East Buffalo Creek Mitigation Plan
Graham County, North Carolina
EEP No. 000615

Prepared For

North Carolina Ecosystem Enhancement Program
2728 Capital Blvd., Suite 1H 103
Raleigh, NC 27604

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East Buffalo Creek Mitigation Plan
Graham County, North Carolina

Report Prepared and Submitted by Michael Baker Engineering, Inc.

NC License #F-1084

Michael Baker Engineering, Inc.
797 Haywood Road
Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Scott Gregory
Project Manager

Micky Clemmons
Office Principal

EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) proposes to restore, enhance, and preserve nearly 11,438 linear feet (LF) of stream along East Buffalo Creek and ten of its tributaries. The work will include 8,475 LF of stream preservation, 1,931 LF of level II stream enhancement, 524 LF of level I stream enhancement, and 508 LF of stream restoration. Streams on the site are located within the headwaters of the East Buffalo Creek watershed which is bordered by Nantahala National Forest across the drainage divide. The project site is located in Graham County, approximately three miles north of Robbinsville. The site lies in the Little Tennessee River Basin within North Carolina Division of Water Quality (NCDWQ) sub-basin 04-04-04 and USGS hydrologic unit 06010204020030. East Buffalo Creek drains into Lake Santeetlah approximately 1.6 miles downstream of the project site.

The goals for the restoration project are as follows:

- To create geomorphically stable conditions on the East Buffalo Creek project site.
- To reduce sediment and nutrient loading through restoration of riparian areas and stream banks.
- To improve and restore hydrologic connections between the creek and floodplain.
- The restoration and preservation of headwater tributaries draining into East Buffalo Creek (and Lake Santeetlah).
- To improve aquatic and terrestrial habitat along the project corridor.

To accomplish these goals, we recommend the following actions:

- Restore the existing incised, eroding, and channelized stream by creating a stable channel which has access to its floodplain.
- Relocate the perched stream channel from the hillside to the low point in the valley to restore natural hydrology and geomorphic form.
- Improve water quality by establishing buffers for nutrient removal from runoff; relocating an eroded, unpaved driveway away from the stream channel and out of the riparian buffer to minimize the sediment supply to the stream; and by stabilizing stream banks to reduce bank erosion.
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools, developing areas that increase oxygenation, providing woody debris for habitat, and reducing bank erosion.
- Improve terrestrial habitat by removing invasive species, planting riparian areas with native vegetation and protecting these areas with a permanent conservation easement so that the riparian area will increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature and improve wildlife habitat.

The total stream length per proposed management recommendation is summarized in Table ES.1 and the project components are mapped in Figure ES.1. This approach should yield 3,324 stream mitigation units (SMUs), which is slightly greater than the contracted amount (3,306 SMUs). The additional credits developed from the site will be available to the NCEEP as part of the proposed project.

Table ES.1 East Buffalo Creek Mitigation Overview
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Project Feature	Existing Condition (Linear Feet)	Design Condition (Linear Feet)	Approach
East Buffalo Creek Reach 1	919	919	Preservation
East Buffalo Creek Reach 2	932	932	Enhancement II
UT2	226	508	Restoration
UT3	1,615	1,615	Preservation
UT4	921	921	Preservation
UT5 Reach 1	809	809	Preservation
UT5 Reach 2	598	598	Enhancement II
UT6 Reach 1	1,145	1,145	Preservation
UT6 Reach 2	401	401	Enhancement II
UT6 Reach 3	524	524	Enhancement I
UT7	940	940	Preservation
UT8	361	361	Preservation
UT9	1,179	1,179	Preservation
UT10	536	536	Preservation
UT11	50	50	Preservation
Total Stream Work	11,156	11,438	Variable

LEGEND:

Project Components
- Preservation
- Enhancement II
- Enhancement I
- Priority I Restoration

- Parcels
- Proposed Easement Boundary
- 40' Powerline Easement
- Powerline
- Power poles

- Streams

0 100 200 400 Feet

Figure ES.1 Proposed Project Components

East Buffalo Creek Restoration Project

Graham County, NC

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1.0 PROJECT SITE IDENTIFICATION AND LOCATION

1.1 Brief Project Description and Directions to Project Site

Baker proposes to restore, enhance, and preserve 11,438 linear feet (LF) of stream along East Buffalo Creek and ten of its tributaries. The work will include 8,475 LF of stream preservation, 1,931 LF of level II stream enhancement, 524 LF of level I stream enhancement, and 508 LF of stream restoration. The area to be protected within a conservation easement totals 17.87 acres. Streams on the site are located within the headwaters of the East Buffalo Creek watershed which is bordered by Nantahala National Forest across the drainage divide. East Buffalo Creek drains into Santeetlah Reservoir approximately 1.6 miles downstream of the project site.

The East Buffalo Creek restoration site is located approximately three miles north of Robbinsville in Graham County, North Carolina, as shown on the Project Location Map in Figure 1.1. From Robbinsville, take U.S. Highway 129 north. Follow U.S. Highway 129 for approximately three miles and turn right on to East Buffalo Circle. Continue on East Buffalo Circle for about a half mile and turn right on East Buffalo Road. East Buffalo Road transitions to a gravel road; the site is accessible from a gated private driveway located on right just past the brick home.

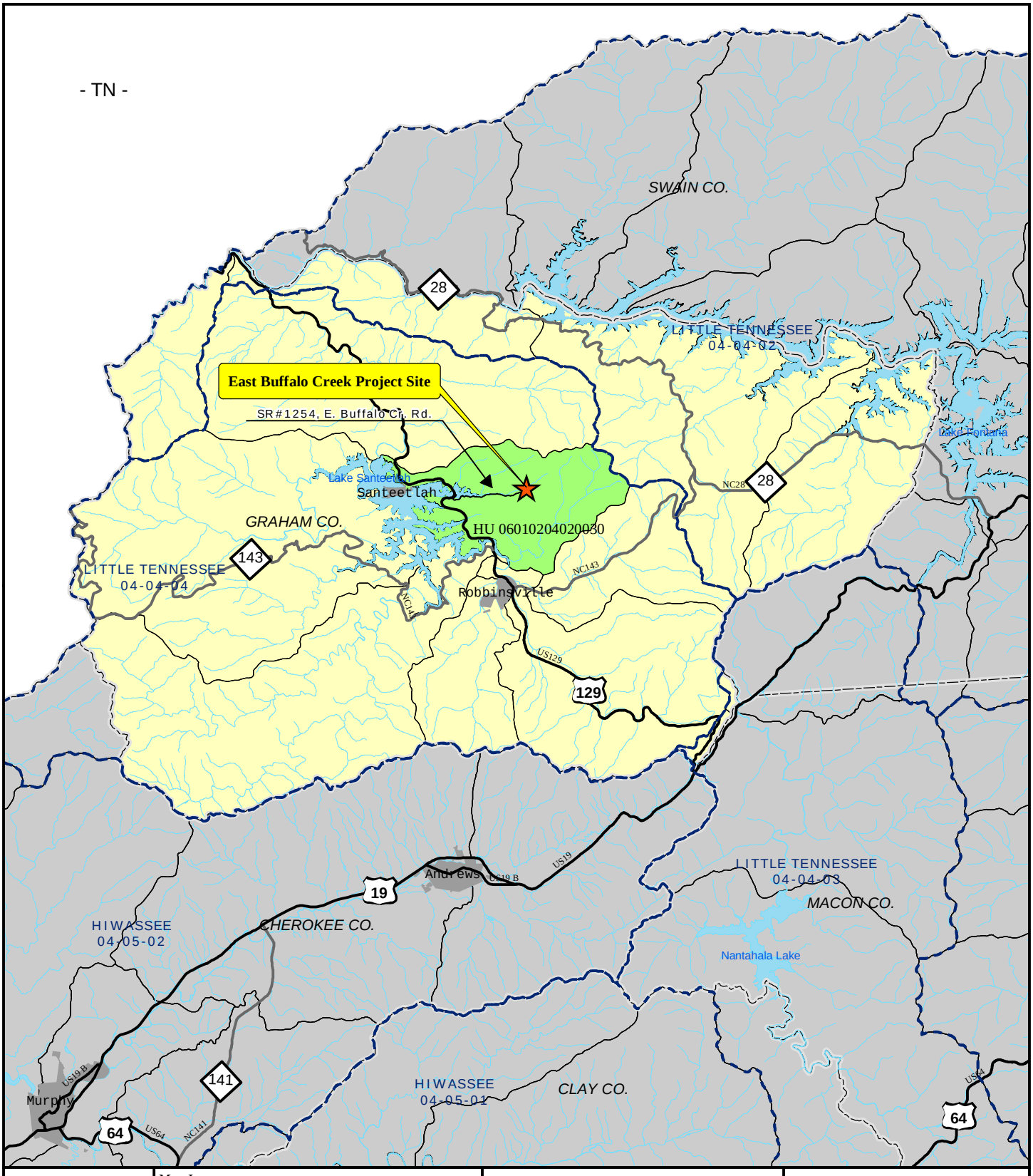
1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The East Buffalo Creek watershed lies in the Little Tennessee River Basin, within North Carolina Division of Water Quality (NCDWQ) sub-basin 04-04-04 and USGS hydrologic unit 06010204020030.

East Buffalo Creek and four of its tributaries included within the project area are identified as “blue-line” streams on the USGS topographic quadrangle (Robbinsville) that includes the site. In order to confirm stream determinations of these “blue-line” streams and all other project reaches included within the East Buffalo watershed, a field evaluation was conducted using the North Carolina Division of Water Quality (NCDWQ) stream assessment protocol. Based on this evaluation, Baker determined that two reaches, UT8 and UT11, were intermittent streams while upstream portions of UT3, UT4, UT5, and UT10 were also intermittent. All other project reaches were confirmed to be perennial streams within the project area based on the assessment protocol. NCDWQ Stream Identification Forms used in stream determinations for all stream channels proposed for restoration, enhancement, or preservation work in the East Buffalo project area are provided in Appendix A. The total current length of stream within the project is 11,156 LF.

1.3 Project Components and Structure

Distinct project reaches are summarized in Table 1.1 below and are depicted in the Project Components figure in the Executive Summary (ES.1). A table (1.2) summarizing project component attributes is also provided.



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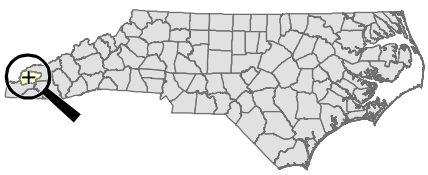


Graham County, NC

LEGEND:

- NCDWQ Sub-basin
- Counties
- USGS Hydrologic Unit
- Project Hydrologic Unit
- Graham County

0 1 2 4 Miles

Figure 1.1 Project Location Map

East Buffalo Restoration Project
Graham County, NC

Ecosystem Enhancement Program

Baker

Table 1.1 Project Restoration Components

East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Project Segment or Reach ID	Existing Feet	Type	Approach	Proposed Restored Footage	Mitigation Ratio	Mitigation Units	Proposed Stationing	Comment
East Buffalo Cr. Reach 1	919	P	-	919	5	184	0+00 to 9+19	No channel alteration (preservation).
East Buffalo Cr. Reach 2	932	EII	-	932	2.5	373	9+19 to 18+51	Improve riparian buffer by removing invasive/exotic vegetation and replanting with native vegetation where applicable.
UT2	226	R	P1	508	1	508	0+00 to 5+08	Restore natural hydrology and geomorphic form by relocating a perched channel to the low point of the valley.
UT3	1,615	P	-	1,615	5	323	0+00 to 16+15	No channel alteration (preservation).
UT4	921	P	-	921	5	184	0+00 to 9+21	No channel alteration (preservation).
UT5 Reach 1	809	P	-	809	5	162	0+00 to 8+09	No channel alteration (preservation).
UT5 Reach 2	598	EII	-	598	2.5	239	8+09 to 14+07	Improve riparian buffer by removing invasive/exotic vegetation and replanting with native vegetation where applicable.
UT6 Reach 1	1,145	P	-	1,145	5	229	0+00 to 11+46	No channel alteration (preservation).
UT6 Reach 2	401	EII	-	401	2.5	160	11+46 to 15+47	Improve riparian buffer by removing invasive/exotic vegetation and replanting with native vegetation where applicable; increase buffer width (filtering capacity) by relocating unpaved road away from the left streambank.
UT6 Reach 3	524	EI	P3	524	1.5	349	15+47 to 20+71	Restore stable channel dimension and profile via bank grading/flood benching along the left bank and installation of grade control. Pattern will be addressed with the relocation of a portion of channel away from the valley wall to minimize further bank erosion. Improve riparian buffer by removing invasive/exotic vegetation and replanting with native vegetation where applicable; increase buffer width (filtering capacity) by relocating unpaved road away from the left streambank.
UT7	940	P	-	940	5	188	0+00 to 9+40	No channel alteration (preservation).
UT8	361	P	-	361	5	72	0+00 to 3+61	No channel alteration (preservation).
UT9	1,179	P	-	1,179	5	236	0+00 to 11+79	No channel alteration (preservation).
UT10	536	P	-	536	5	107	0+00 to 5+36	No channel alteration (preservation).
UT11	50	P	-	50	5	10	0+00 to 0+50	No channel alteration (preservation).

Table 1.1 Project Restoration Components

East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Mitigation Unit Summations				
Stream (LF)	Riparian Wetland (Ac)	Non-Riparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)
3,324	NA	NA	NA	15.27

Table 1.2 Project Attribute Table

East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Project County	Graham						
Physiographic Region	Blue Ridge						
Ecoregion	Blue Ridge Mountains-Southern Metasedimentary Mountains						
Project River Basin	Little Tennessee						
USGS HUC for Project	06010204020030						
NCDWQ Sub-basin for Project	04-04-04						
Planning Area	No local or targeted watershed plans currently available						
WRC Class	Cold						
% of Project Easement Fenced or Demarcated	100 (post-construction)						
Beaver Activity Observed During Design Phase	No						
Restoration Component Attribute Table							
	East Buffalo Cr.		UT2	UT3	UT4	UT5	
	Reach 1	Reach 2				Reach 1	Reach 2
Drainage Area (square miles)	.12	.32	.04	.08	.03	.06	.07
Stream Order	1st to 2nd	2nd to 3rd	1	2	1	1	1
Restored Length (feet)	919	932	508	1,615	921	809	598
Perennial or Intermittent	P	P	P	I/P	I/P	I/P	P
Watershed Type	Rural						
Watershed LULC Distribution (Cumulative acreage)							
Deciduous Forest	.89 (.26%)						
Evergreen Forest	333.4 (99%)						
Grassland/Herbaceous	1.56 (.46%)						
Pasture/Hay	1.11 (.33%)						
Watershed Impervious Cover (%)	<10%						
NCDWQ AU/Index Number	2-190-16						
NCDWQ Classification	C	C	-	-	-	-	-
303d Listed	No	No	No	No	No	No	No

Table 1.2 Project Attribute Table East Buffalo Creek Mitigation Plan-NCEEP Project #000615							
Upstream of 303d Listed Segment	No	No	No	No	No	No	No
Reasons for 303d Listing or Stressor	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Acreage of Easement (Cumulative)	17.87						
Total Vegetated Acreage Within the Easement	1.44	1.09	0.12	2.52	1.44	1.26	0.93
Total Planted Acreage As Part of the Restoration (Cumulative)	2.0						
Rosgen Classification of Pre-existing	A4a+	A4a+	A3a+	A4a+	A4a+	A4a+	A4a+
Rosgen Classification of As-built (Design)	A4a+	A4a+	B3a	A4a+	A4a+	A4a+	A4a+
Valley Type	II	II	II	II	II	II	II
Valley Slope	0.19	0.14	0.2	0.25	0.3	0.23	0.2
Valley Side Slope Range	U	U	U	U	U	U	U
Valley Toe Slope Range	U	U	U	U	U	U	U
Cowardin Classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trout Waters Designation	-	-	-	-	-	-	-
Species of Concern, T&E Species	No	No	No	No	No	No	No
Dominant Soil Series and Characteristics							
Series	Spivey-Whiteoak Complex (SvD)	Spivey-Whiteoak Complex (SvD)	Spivey-Whiteoak Complex (SvD)	Spivey-Whiteoak Complex (SvD)	Spivey-Whiteoak Complex (SvD)	Soco-Stecoah Complex (SdF)	Spivey-Whiteoak Complex (SvD)
Depth	+80”	+80”	+80”	+80”	+80”	+80”	+80”
Clay (%)	5-29	5-29	5-29	5-29	5-29	5-18	5-29
K	.02-.24	.02-.24	.02-.24	.02-.24	.02-.24	.10-.28	.02-.24
T	5	5	5	5	5	2/3	5

Table 1.2 (cont.) Project Attribute Table

East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Project County	Graham
Physiographic Region	Blue Ridge
Ecoregion	Blue Ridge Mountains-Southern Metasedimentary Mountains
Project River Basin	Little Tennessee
USGS HUC for Project	06010204020030
NCDWQ Sub-basin for Project	04-04-04
Planning Area	No local or targeted watershed plans currently available
WRC Class	Cold
% of Project Easement Fenced or Demarcated	100 (post-construction)
Beaver Activity Observed During Design Phase	No

Restoration Component Attribute Table

	UT6			UT7	UT8	UT9	UT10	UT11
	Reach 1	Reach 2	Reach 3					
Drainage Area	.04	.17	0.15	.09	.06	.03	.01	.03
Stream Order	1st	2nd	2nd	2nd	1st	1st	1st	1st
Restored Length (feet)	1,145	401	524	940	361	1,179	536	50
Perennial or Intermittent	P	P	P	P	I	P	I/P	I
Watershed Type	Rural							
Watershed LULC Distribution (Cumulative acreage)								
Deciduous Forest	.89 (.26%)							
Evergreen Forest	333.4 (99%)							
Grassland/Herbaceous	1.56 (.46%)							
Pasture/Hay	1.11 (.33%)							
Watershed Impervious Cover (%)	<10%							
NCDWQ AU/Index Number	2-190-16							
NCDWQ Classification	-	-	-	-	-	-	-	-
303d Listed	No	No	No	No	No	No	No	No
Upstream of 303d Listed Segment	No	No	No	No	No	No	No	No
Reasons for 303d Listing or Stressor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Acreage of Easement (Cumulative)	17.87							
Total Vegetated Acreage	1.79	0.34	0.36	1.47	0.56	1.84	0.84	0.08

Table 1.2 (cont.) Project Attribute Table East Buffalo Creek Mitigation Plan-NCEEP Project #000615								
Within the Easement								
Total Planted Acreage As Part of the Restoration	2.0 (Cumulative)							
Rosgen Classification (Pre-existing	A4a+	A4a+	F4b	B4a	A4a+	F4b	A4a+	B4a
Rosgen Classification (As-built (Design))	A4a+	A4a+	B4a	B4a	A4a+	F4b	A4a+	B4a
Valley Type	II	II	II	II	II	II	II	II
Valley Slope	0.33	0.12	0.16	0.35	0.33	0.22	0.31	0.26
Valley Side Slope Range	U	U	U	U	U	U	U	U
Valley Toe Slope Range	U	U	U	U	U	U	U	U
Cowardin Classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trout Waters Designation	-	-	-	-	-	-	-	-
Species of Concern, T&E Species	No	No	No	No	No	No	No	No
Dominant Soil Series and Characteristics								
Series	Spivey-Santeetlah Complex (SpE)	Spivey-Santeetlah Complex (SpE)	Spivey-Santeetlah Complex (SpE)	Spivey-Santeetlah Complex (SpE)	Spivey-Santeetlah Complex (SpE)	Soco-Stecoah Complex (ScF)	Soco-Stecoah Complex (ScF)	Spivey-White oak Complex (SvD)
Depth	+80”	+80”	+80”	+80”	+80”	+80”	+80”	+80”
Clay %	5-29	5-29	5-29	5-29	5-29	5-18	5-18	5-29
K	.02-.1	.02-.1	.02-.1	.02-.1	.02-.1	.1-.28	.1-.28	.02-.24
T	5	5	5	5	5	2-3	2-3	5

2.0 WATERSHED CHARACTERIZATION

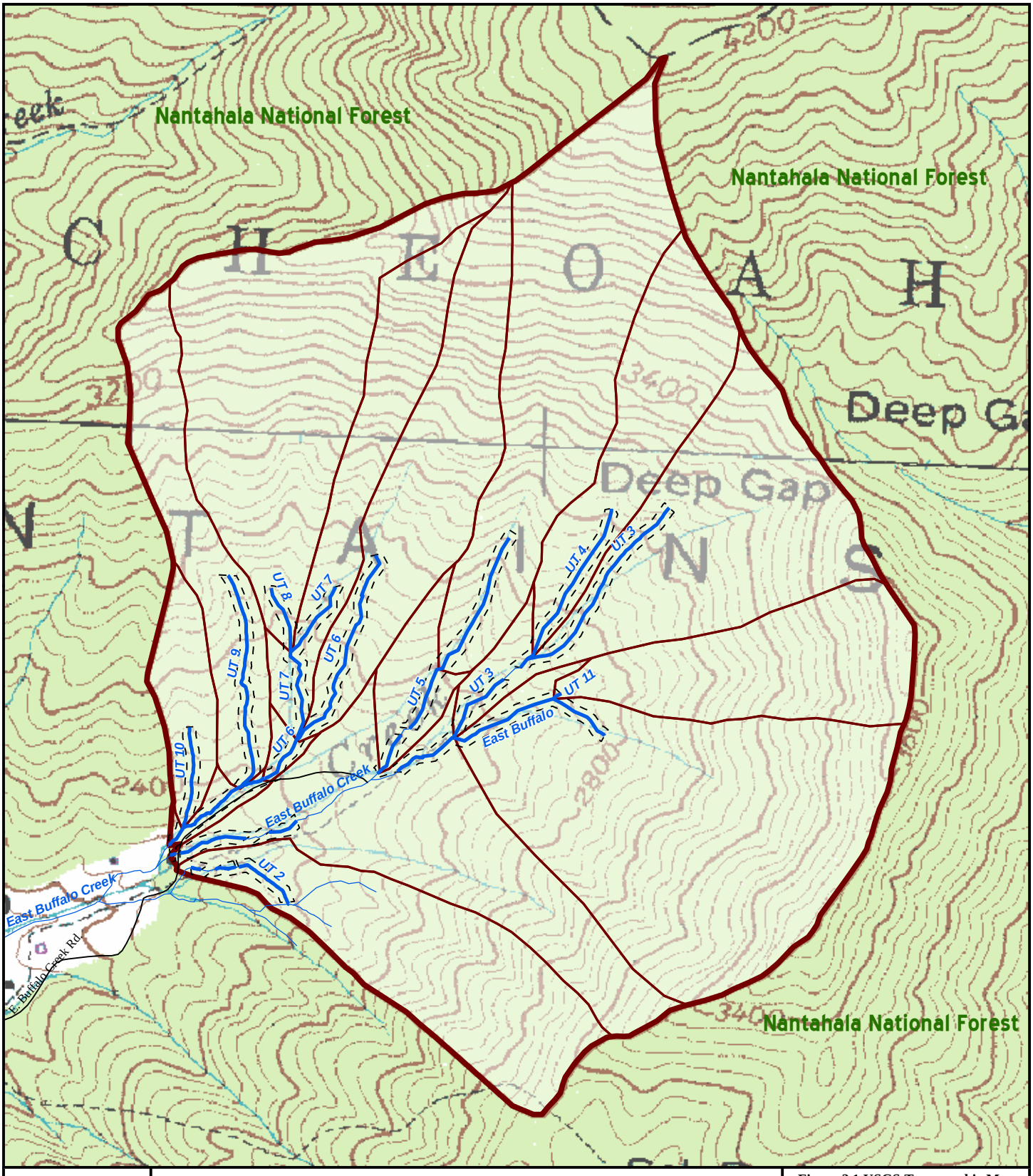
2.1 Watershed Delineation

The East Buffalo Creek site is located in one of the westernmost basins in the state, the Little Tennessee River Basin. Watershed delineations for all the project reaches are illustrated in Figure 2.1. East Buffalo Creek, UT6, and UT2 comprise the three main watersheds within the project area, having a combined total drainage area of 0.53 square miles. East Buffalo Creek and UT6 are the two largest drainages within the project watershed, each draining a number of smaller headwater catchments before converging with each other just downstream of the project limits. East Buffalo Creek has a drainage area of 0.32 square miles and receives flow from the contributing drainage areas of tributaries UT3, UT4, UT5, and UT11. UT6 is the receiving stream for flow from contributing drainage areas of tributaries UT7, UT8, UT9, and UT10, and has a drainage area of 0.17 square miles at the downstream project limits. UT2 has a drainage area of 0.04 square miles within the project limits measured along its natural valley (where the restored channel is proposed to be relocated); the existing channel converges with East Buffalo Creek about 1,000 LF further downstream outside of the project boundary. Watershed areas are provided in Table 2.1 for stream reaches within the project boundaries. The total proposed easement area is 17.87 acres.

Table 2.1 Drainage Areas By Reach
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Reach	Reach Length (LF)	Watershed Size at Downstream End of Reach (square miles)
East Buffalo Creek Reach 1	919	0.12
East Buffalo Creek Reach 2	932	0.32
UT2	226	0.04
UT3	1,615	0.08
UT4	921	0.03
UT5 Reach 1	809	0.06
UT5 Reach 2	598	0.07
UT6 Reach 1	1,145	0.4
UT6 Reach 2	401	0.17*
UT6 Reach 3	524	0.16
UT7	940	0.9
UT8	361	0.06
UT9	1,179	0.03
UT10	536	0.01
UT11	50	0.03
Total Existing Stream Length	11,438	0.53

*Note: Drainage area for UT6 Reach 2 was measured at the downstream segment and therefore has a slightly larger drainage area than UT6 Reach 3.



LEGEND:

- Project Reach
- Proposed Easement Boundary
- Streams
- Watershed Boundary
- Sub-watershed Boundary

0 200 400 800 Feet

Figure 2.1 USGS Topographic Map (Robbinsville/Fontana Dam Quadrangle)

East Buffalo Creek Restoration Project

Graham County, NC

2.2 Surface Water Classification/ Water Quality

The North Carolina Division of Water Quality (NCDWQ) designates surface water classifications for water bodies such as streams, rivers, and lakes. Classifications define the best uses for these waters (e.g., swimming, fishing, and drinking water supply). These classifications are associated with water quality standards that protect their uses. All surface waters in North Carolina must, at minimum, meet the standards for Class C (fishable/swimmable) waters. Other primary classifications provide additional levels of protection for primary water contact recreation (Class B) and drinking water supplies (WS). In addition to these primary classifications, supplemental classifications are sometimes assigned to water bodies to protect special uses or values. East Buffalo Creek [NCDWQ Index No. 2-190-16] is a Class C water and has no current supplemental classifications.

2.3 Physiography, Geology and Soils

The project site lies within the Blue Ridge Belt of the Blue Ridge physiographic province of western North Carolina. According to the 1° x 2° geologic map of the Knoxville Quadrangle prepared by the USGS (Hadley, and Nelson, 1971), the project site is underlain by an undivided, medium to thick bedded, largely feldspathic metasandstone interbedded with quartz-mica schists and gray phyllite common to the Great Smoky Group of the Ocoee Supergroup. The origin of the Ocoee Supergroup is placed in the Late Proterozoic during continental rifting episodes (USGS Bulletin 1979). The metasedimentary rocks of the Great Smoky Group also include local beds of quartz-feldspar pebble conglomerate, graphitic and sulfidic mica schist, and rare thin interbeds of garnet-hornblende-quartz-feldspar granofels.

This rock unit along with other rock types of the geographic area weather to form both fine and coarse grained loams within the Hapludults and Dystrudepts Great Groups. Soils described as the Soco-Stecoah complex are weathered from coarse grained metasandstone, slate and phyllite. Some soils within the Spivey-Whiteoak complex are formed from the weathering of slate, siltstone and phyllite. Additional soil characteristics of the site were determined using the Natural Resources Conservation Service (NRCS) Soil Survey data for Graham County, and site evaluation for hydric soils. A map depicting the boundaries of each soil type is presented in Figure 2.2. There are four general soil types found within the project boundaries. A discussion of each soil type and its locations given by the NRCS is presented in Table 2.2. Table 2.3 identifies characteristics of each soil series located on the project site and will be referenced in conjunction with the soils descriptions to select appropriate seeding mixes and other vegetative cover.

Soils found within drainageways and coves where stream restoration and enhancement activities are proposed are primarily mapped as the Spivey-Whiteoak complex by the NRCS in Graham County. The Spivey-Whiteoak complex is found throughout the drainageways of East Buffalo Creek and its tributaries as well as benches and toe slopes in the lower valley of East Buffalo Creek. The Soco-Stecoah complex extends from ridgelines and side slopes to toe slopes of the project area, and is especially dominant within upper enhancement and preservation reaches of the project. Bedrock was observed in many locations in the unnamed tributaries and in a few isolated locations of the project reach on East Buffalo Creek. Numerous outcroppings are also visible along the valley walls of the tributaries. In areas where shallow bedrock is encountered, the restoration plan will incorporate this bedrock as in-situ grade control.

Table 2.2 Project Soil Types and Descriptions
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

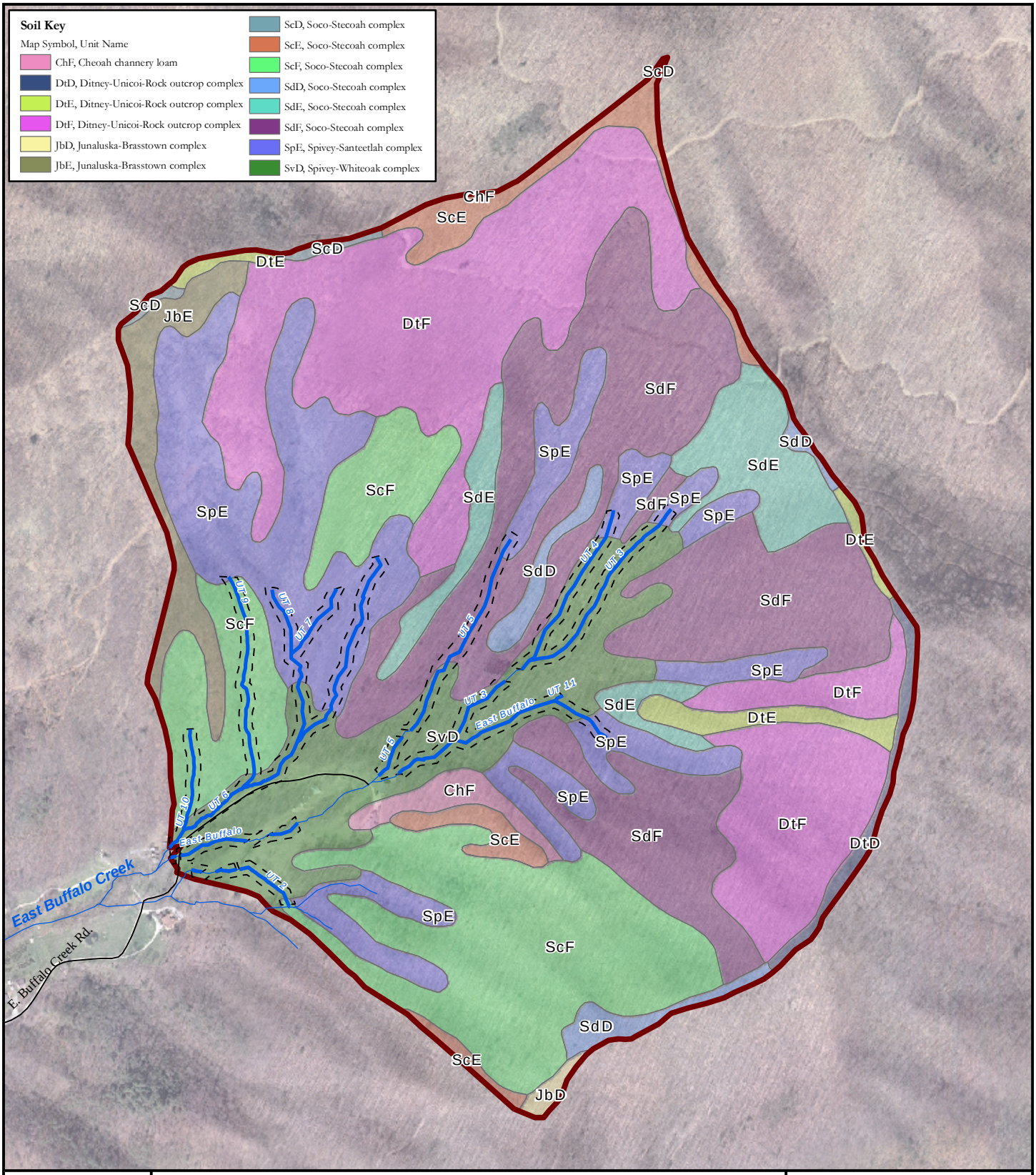
Soil Name	Taxonomic Identification	Location	Description
Spivey-Whiteoak Complex	Loamy-skeletal, isotic, mesic, Humic Dystrudepts / Fine-loamy, isotic, mesic, Typic Dystrudepts	Drainageways, benches, fans and coves / toe slopes, benches, fans	The Spivey-Whiteoak complex consists of well drained, moderately rapid permeable soils on fans, coves and drainageways of mountain slopes in the Great Smoky Mountains. These soils formed in stony colluvium made up of phyllite, slate, metasandstone and/or other metasedimentary rock. Located on slopes ranging from 15 to 30 percent in project area.
Spivey-Whiteoak Complex	Loamy-skeletal, isotic, mesic, Humic Dystrudepts / Fine-loamy, isotic, mesic, Typic Dystrudepts	Drainageways, benches, fans and coves / toe slopes, benches, fans	See above. The Spivey-Whiteoak complex extends to slopes on the project site that range from 30-50%.
Soco-Stecoah Complex	Coarse-loamy, mixed, active, mesic, Typic Dystrudepts	Ridges, side slopes	The Soco-Stecoah complex consists of well drained soils and occurs on steep mountain slopes ranging from 30- 50%. This soil type was formed in residuum, and is affected by soil creep in the upper solum. Parent rock includes weathered metasandstone and thinly bedded phyllite.
Soco-Stecoah Complex	Coarse-loamy, mixed, active, mesic, Typic Dystrudepts	Ridges, side slopes	See above. This category of the Soco-Stecoah complex continues up slopes on the project whose grade is anywhere from 50 to 95%.
Soco-Stecoah Complex, bouldery	Coarse-loamy, mixed, active, mesic, Typic Dystrudepts	Ridges, side slopes	See above. This portion of the Soco-Stecoah complex is also located on slopes from 50 to 95% and is set apart from the previous series by a larger presence of boulders.

Note: USDA, NRCS. Official Soil Series Descriptions. (http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi)

Table 2.3 Project Soil Type Characteristics
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Series	Max Depth (in)	% Clay on Surface	Erosion Factor K	Erosion Factor T	OM %
Spivey-Whiteoak Complex (SvC)	80”	5-20 / 15-24	.02-.10	5	5-15 / 3-10
Spivey-Whiteoak Complex (SvD)	80”	5-20 / 15-24	.05-.15	5	5-18/ 3-10
Soco-Stecoah Complex (SdE)	80”	5-18	.15	3/4	2-6
Soco-Stecoah Complex (SdF)	80”	5-18	.15	3/4	2-6
Soco-Stecoah Complex (SdF) (bouldery)	80”	5-18	.15	3/4	1-8

Source:
USDA, NRCS. Official Soil Series Descriptions (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx)
USDA, NRCS Soil Data Mart Database. (http://soildatamart.nrcs.usda.gov/Default.aspx)



LEGEND:

- Project Reach
- Proposed Easement Boundary
- Streams
- Watershed Boundary

0 200 400 800 Feet

Figure 2.2 Project Soil Types

East Buffalo Creek Restoration Project

Graham County, NC

2.4 Historic Land Use and Development Trends

Except for low density residential development and portions of land in agricultural use, an overwhelming percentage of the East Buffalo Creek project watershed is forested as shown in Table 2.4. The East Buffalo Creek drainage has experienced varying degrees of agricultural and timber harvesting activities over the past 100 years.

Table 2.4 East Buffalo Creek Watershed Land Use/ Land Cover
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Land Use Category*	Area (acres)	Percent Area
Pasture Lands/Hay	1.11	.33%
Grasslands/Herbaceous	1.56	.46%
Evergreen Forest	.89	.26%
Deciduous Forest	333.4	99%

*Note: The above was gathered from 2001 U.S. Geological Survey land cover data.
Source: http://seamless.usgs.gov/

2.4.1 Watershed Trajectory and Stream Design

2.4.1.1 State of Watershed

The majority of the project site consists of forested uplands with a smaller proportion devoted to maintained pasture land in the valley bottom. Although the project watershed has been impacted by past logging activities 60 to 80 years ago and more recently by agricultural practices, the upland areas comprising the larger part of the watershed have returned to a more natural state. Various sections of property within the valley bottom have since been converted for residential and agricultural use. The present landowners currently maintain several acres as pasture land. There are about three single-family residences located in the vicinity of the project streams.

Restoration and enhancement activities are being proposed predominantly along project stream reaches bordering maintained pasture land. These streams are degraded as a result of past channel relocation and buffer impacts from prior logging and agricultural activities, but more recently from the maintenance of pasture land involving the mowing and removal of vegetation within the stream buffer. Such persistent disturbance to the buffer has allowed invasive plant communities to colonize and propagate throughout much of UT2, UT5 Reach 2, UT6 Reaches 2 and 3, and Reach 2 of East Buffalo Creek. UT2 currently flows through a ditch perched along the side of the valley wall beside a fence line located on the southern border of a field just beyond the Gay property boundary. This channel was moved from the center to the edge of the valley in the past to allow for agriculture within the field. Reaches 2 and 3 of UT6 appear to have been relocated to the edge of the valley in the past as well and are bordered by an unpaved gravel driveway that contributes sediment to the channel.

2.4.1.2 Types and Likelihood of Change

Low density residential development and logging of uplands are the potential threats within the East Buffalo project watershed. Even though the project watershed is not located close to any major population centers, land prices in the area have been rising quickly in response to the increased interest in Western North Carolina real estate. The project site is about ten miles away from the town of Robbinsville, one and a half hours from Asheville, and three hours from Atlanta. Protection of these streams via conservation easements will ensure that the headwaters to East Buffalo Creek will be protected from future development. Land use within the watershed is rural in character and is unlikely to change significantly in the near future for a few reasons. The East Buffalo Creek project watershed is nestled within a cove containing steep valley slopes,

and is completely surrounded by the Nantahala National Forest. The small, narrow valley bottoms are unlikely candidates for development or future logging due to the proposed conservation easement restricting the land available for these uses. In addition, the majority of easily developable land is already in residential or agricultural use. Even the lower slopes of the watershed above the residential sites are steep enough so as to discourage intensive development. The landowner is considering constructing a house higher in the watershed that will likely adhere to "low impact" development guidelines.

2.5 Watershed Planning

The East Buffalo Creek project site does not lie within a targeted or local watershed planning area. To promote water quality and habitat protection, the proposed restoration plan includes buffering streams from existing and future land use with a forested riparian zone that will filter pollutants and reduce impacts from overland runoff. A permanent conservation easement will be established which guarantees that approximately 18 acres of stream riparian zones will be protected from encroachment by any future land use practices.

2.6 Endangered/Threatened Species

Some populations of plants and animals are declining as a result of various natural forces including competition with humans for resources. Legal protection for federally listed species, Threatened (T) or Endangered (E) status, is conferred by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1534). This act makes illegal the killing, harming, harassing, or removing of any federally listed animal species from the wild; plants are similarly protected but only on federal lands. Section 7 of this act requires federal agencies to ensure that actions they fund or authorize do not jeopardize any federally listed species.

Organisms that are listed as Endangered (E), Threatened (T), or Special Concern (SC) on the NHP list of Rare Plant and Animal Species are afforded state protection under the State Endangered Species Act and the North Carolina Plant Protection and Conservation Act of 1979.

According to the North Carolina Natural Heritage Program (NHP) and United States Fish and Wildlife Service (USFWS) lists of rare and protected animal and plant species, seven federally protected species are known to exist in Graham County as of January 12, 2009 (USFWS 2008 and NHP 2009).

Species lists that the USFWS and NHP prepared for Graham County were last updated January 31, 2008 and January 9, 2009, respectively. A brief description of the characteristics and habitat requirements of the species under federal protection follows in Table 2.5, along with a conclusion regarding potential project impact. Information on candidate species or species under federal protection through other legislation that occur in Graham County is also provided.

Table 2.5 Species Under Federal Protection in Graham County
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Family	Scientific Name	Common Name	Federal Status	State Status	Habitat Present / Biological Conclusion
Vertebrates					
Accipitridae	*Haliaeetus leucocephalus*	Bald Eagle	BGPA	T	No/No effect
Emydidae	*Clemmys muhlenbergii*	Bog Turtle	T(S/A)	T	No/No effect
Vespertilionidae	*Myotis sodalis*	Indiana Myotis (bat)	E	E	No/No effect
Sciuridae	*Glaucomys sabrinus coloratus*	Carolina Northern Flying Squirrel	E	E	No/No effect

Table 2.5 Species Under Federal Protection in Graham County
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Invertebrates					
Unionidae	*Alasmidonta raveneliana*	Appalachian Elktoe	E	E	No/No effect
Plants					
Rosaceae	*Spiraea virginiana*	Virginia Spiraea	T	E	No/No effect
Lichen					
Cladoniaceae	*Gymnoderma lineare*	Rock Gnome Lichen	E	T	No/No effect

Notes:

BGPA: Bald and Golden Eagle Protection Act. As of August 8, 2007, the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668-668d) is the primary law protecting bald and golden eagles. The Eagle Act prohibits take of bald and golden eagles and provides a statutory definition of "take" that includes "disturb".

C: A candidate species is one under consideration for official listing for which there is sufficient information to support listing. (Formerly "C1" candidate species.)

E: An Endangered species is one whose continued existence as a viable component of the state's flora or fauna is determined to be in jeopardy.

SC: A Special Concern species is one that requires monitoring but may be taken or collected and sold under regulations adopted under the provisions of Article 25 of Chapter 113 of the General Statutes (animals) and the Plant Protection and Conservation Act (plants).

T: Threatened

T(S/A): Threatened due to similarity of appearance. A species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

The U.S. Fish and Wildlife Service (USFWS) was most recently contacted March 13, 2008 regarding protected species on the project site. To date, no response has been received from the USFWS regarding potential project impacts to federally listed species located in Graham County. As a precautionary measure, Baker will consider the effects of construction activities on species listed in Table 2.5 and take reasonable measures to avoid direct and indirect impacts during the project. Agency correspondence regarding state and federally protected species is included in Appendix B.

2.6.1 Federally Protected Vertebrates

2.6.1.1 *Haliaeetus leucocephalus* (Bald Eagle)

Bald eagles are large raptors, 32 to 43 inches long, with a white head, white tail, yellow bill, yellow eyes, and yellow feet. The lower section of the leg has no feathers. Wingspread is about seven feet. The characteristic plumage of adults is dark brown to black with young birds completely dark brown. Juveniles have a dark bill, pale markings on the belly, tail, and under the wings and do not develop the white head and tail until five to six years old.

According to the NHP species account, bald eagles in the Southeast frequently build their nests in the transition zone between forest and marsh or open water. Nests are cone-shaped, six to eight feet from top to bottom, and six feet or more in diameter. They are typically constructed of sticks lined with a combination of leaves, grasses, and Spanish moss. Nests are built in dominant live pines or cypress trees that provide a good view and clear flight path, usually less than 0.5 miles from open water. Winter roosts are usually in dominant trees, similar to nesting trees, but may be somewhat farther from water. In North Carolina, nest building takes place in December and January, with egg laying (clutch of one to three eggs) in February and hatching in March. Bald eagles are opportunistic feeders consuming a variety of living prey and carrion. Up to 80 percent of their diet is fish, which is self caught, scavenged, or robbed from osprey. They may also take various small mammals and birds, especially those weakened by injury or disease (Henson 1990, Potter et al. 1980, USFWS 1992a).

Biological Conclusion: No Effect

According to the NCNHP virtual workroom website, the project site is over two miles from a recorded occurrence of bald eagle habitat on Lake Santeetlah. However, the project area consists of headwater streams with small drainage areas. The streams within the project area are not identified as trout supporting streams and are unlikely to hold prey-sized fish to support bald eagle populations.

Improvements made through this project will not adversely impact any bald eagle populations or habitat. Canopy improvements made to the riparian zone within the restoration and enhancement reaches of the project area could actually support bald eagles in the long term should any of the planted trees become dominant canopy trees. Therefore, a determination was made that the proposed project will have no effect on this species.

2.6.1.2 Clemmys muhlenbergii (Bog Turtle)

The Bog Turtle is among the smallest turtles of North America at only 3-4.5 inches in length with an average weight of 4 ounces. Its shell is light brown to ebony in color and it has a notable bright orange, yellow or red blotch on each side of its head. The bog turtle's preferred habitat in the southern Appalachians includes sphagnum bogs, slowly drained swamps, and mucky, slow moving spring-fed streams in meadows and pastures that are typically less than 4 acres in size (USFWS 1997a).

Biological Conclusion: No Effect

East Buffalo Creek does not possess suitable habitat for the bog turtle. Most streams are on moderate to high gradients with numerous waterfalls and rock outcrops. The field that makes up a portion of the lower project area is wet in some areas but was not mucky nor was it found to contain standing water even during field surveys which took place shortly after a series of low to moderate precipitation events. Therefore this project is not expected to effect any populations of bog turtle.

2.6.1.3 *Myotis sodalis* (Indiana Myotis)

The Indiana bat is 3.5 inches long, with mouse-like ears, plain nose, dull, grayish fur on the back, and lighter, cinnamon-brown fur on the belly. Its "wingspread" ranges from 9.5 to 10.5 inches. From early October until late March and April, Indiana bats hibernate in large clusters of hundreds or even thousands in limestone caves and abandoned mines, usually near water. During summer, females establish maternity colonies of two dozen to several hundred under the loose bark of dead and dying trees or shaggy-barked live trees, such as the shagbark hickory. Hollows in live or dead trees are also used. Most roost trees are usually exposed to the sun and are near water. Males and non-reproductive females typically roost singly or in small groups. Roost trees can be found within riparian areas, bottomland hardwoods, and upland hardwoods (Adams 1987, USFWS 1992a).

Biological Conclusion: No Effect

Riparian corridors within the East Buffalo Creek project may provide suitable summer foraging habitat for the Indiana bat; however there are no loose-barked trees within the project area or other habitat suitable for maternity colonies of the bat. There are also no mines or caves within the project area for winter hibernation. In addition, clearing and planting activities slated for riparian areas in project restoration and enhancement reaches will occur outside of the bats' reproduction and roosting cycles and will involve the removal of non-native privet, multiflora rose and Japanese honey-suckle. Therefore a "no effect" determination was made.

2.6.1.4 *Glaucomys sabrinus coloratus* (Carolina Northern Flying Squirrel)

The Carolina northern flying squirrel is a small nocturnal gliding mammal some 260 to 305 millimeters (10 to 12 inches) in total length and 95-140 grams (3-5 ounces) in weight. It possesses a long, broad, flattened tail (80 percent of head and body length), prominent eyes, and dense, silky fur. The broad tail and folds of skin between the wrist and ankle form the aerodynamic surface used for gliding. Adults are gray with a brownish, tan, or reddish wash on the back, and grayish white or buffy white ventrally. Juveniles have uniform dark, slate-gray backs, and off-white undersides. The northern flying squirrel can be distinguished from the southern flying squirrel by its larger size; the gray base of its ventral hairs as opposed to a white base in the southern species; the relatively longer upper tooth row; and the short, stout baculum (penis bone) of the males (Cooper et al. 1977, Murdock pers. comm., Terwilliger et al. 1995, USFWS 1992a, Weigl 1987).

Biological Conclusion: No Effect

The Carolina northern flying squirrel prefers the ecotone between coniferous and mature northern hardwood forests usually above 4,500 feet or narrow, north-facing valleys above 4,000 feet. The project site is located in pastureland and a steep, forested area. Dominant woody vegetation observed onsite during May 2008 site visit consisted of tulip poplar, eastern hemlock, locust, maple, flowering dogwood, birch. The elevation of the site reaches 3,000 feet above sea level (ASL) at the upper terminus of the preservation reaches. The upper limits of enhancement and restoration work planned for East Buffalo Creek and its tributaries end at approximately 2,680 feet ASL, well below what would be considered habitable elevations for this animal. Due to a lack of suitable habitat, there should be no effect on this species.

2.6.2 Federally Protected Invertebrates

2.6.2.1 *Alasmidonta raveneliana* (Appalachian Elktoe)

The Appalachian elktoe has a thin, but not fragile, kidney-shaped shell, reaching up to about 3.2 inches in length, 1.4 inches in height, and one inch in width (Clarke 1981). Like other freshwater mussels, the Appalachian elktoe feeds by filtering food particles from the water column. The specific food habits of the species are unknown, but other freshwater mussels have been documented to feed on detritus, diatoms, phytoplankton, and zooplankton (Churchill and Lewis 1924). The species has been found in relatively shallow, medium-sized creeks and rivers with cool, clean, well-oxygenated, moderate- to fast-flowing water. The species is most often found in riffles, runs, and shallow flowing pools with stable, relatively silt-free, coarse sand and gravel substrate associated with cobble, boulders, and/or bedrock. Stability of the substrate appears to be critical to the Appalachian elktoe, and the species is seldom found in stream reaches with accumulations of silt or shifting sand, gravel, or cobble. Individuals that have been encountered in these areas are believed to have been scoured out of upstream areas during periods of heavy rain, and have not been found on subsequent surveys (USFWS Webpage; C. McGrath, pers. comm. 1996; J.A. Fridell, pers. observation 1995, 1996, 1999).

Biological Conclusion: No Effect

According to the September 27, 2002 Federal Register, 67:61016-61040, critical habitat for the Appalachian elktoe exists in the Cheoah River below the Santeetlah Dam to its confluence with the Little Tennessee River. East Buffalo Creek and the 10 UTs that are included within this project converge before East Buffalo Creek transitions into a normally impounded area of the Santeelah Reservoir. East Buffalo Creek is a tributary to the Santeetlah Reservoir which was created when the Cheoah River was dammed. According to state natural heritage element occurrence data for 2007, the closest recorded occurrence of Appalachian elktoe to the project area is approximately 5.5 miles away, below the Dam. Therefore, any temporary increases in

stream turbidity levels caused by enhancement or restoration activities or other foreseeable impacts will not affect Appalachian elktoe mussel populations downstream of the dam.

The project streams where restoration and enhancement activities are proposed are small with a bankfull width of 10 to 15 feet and have moderately shifting substrate. In late summer or extended dry periods, this section of East Buffalo Creek and its tributaries have low flows. The described habitat does not exist within the project reach and no individual specimens were observed. This project should have no direct impacts to a population or habitat for this species. Project erosion control measures will insure that impacts to downstream habitats are minimized or avoided.

2.6.3 Federally Protected Plants

2.6.3.1 *Spiraea virginiana* (Virginia spiraea)

Preferred habitat of the Virginia spiraea ranges from flood-scoured, high-gradient rocky riverbanks, gorges, and canyons to braided areas of stream reaches. Virginia spiraea have also been observed in disturbed rights-of-way. Virginia spiraea prefer sunlight and moist, acidic soils (primarily sandstones). This plant grows in thickets, and is commonly associated with a variety of grape species (Vitis spp.) and royal fern (Osmunda regalis), though it may still be located in thickets where these other plants are not present. Habitat conditions for the Virginia spiraea must be present in some combination in order for the spiraea to flourish. Due to the specificity of site conditions needed, the Virginia spiraea is limited to a specific ecological niche (Radford et al. 1964, USFWS 1992a.).

Biological Conclusion: No Effect

The project streams are very small with bankfull widths of 10 to 15 feet, and are located on moderate to steep gradients. Some habitat features favored by the Virginia spiraea do exist within the project limits. Favorable habitat features consisted of sections of braided channel, previously disturbed banks and access routes that are highly exposed to sunlight, and minor scour associated with prior channelization of the stream.

Subsequent field surveys have been conducted and potential habitat features were found to be less significant due to a lack of overall habitat suitability. Sections of braided channel were located in moderate to steep relief. Dominant vegetation on steeper slopes consisted of poplar, eastern hemlock, flowering dogwood, beech, and maple. The typical riparian vegetative community on braided channels located on more moderate slopes consisted of multiflora rose, Chinese privet, poplar, dogwood, maple and a variety of ferns and trillium. The enhancement reaches on UT5, UT6 and East Buffalo Creek are located on moderate slopes and are adjacent to some private home sites. Braiding and minor scour were observed along sections of UT5 and UT6 and East Buffalo Creek where the previously channelized tributaries are attempting to revert to pre-disturbance dimension, pattern and profile features. The streams are bordered on the right banks by forested slopes. The left streambanks are bordered by a gravel road or pasture land. Other sections of the enhancement reaches are in moderate to full canopy cover. In the case of UT5, the enhancement reach extends approximately 400 LF into an upland forested area. The proposed location of UT2 places this channel in the low point of the valley which is also pasture land. Although the restoration reach and the majority of the enhancement reaches currently receive ample sunlight, other habitat features required are not present and many areas have been largely overtaken by multiflora rose. Multiflora rose and privet are present at UT2; however the area proposed for stream relocation is primarily vegetated by a variety of grasses. On-site observations made April 30 and May 5-7, 2008 confirm that Virginia spiraea is not present in portions of the project site where land disturbing activity will occur (including staging areas and access

routes). Therefore, this project will have no effect on individuals or populations of this species in Graham County.

East Buffalo Creek and its tributaries are small with bankfull widths ranging between 3 to 11 feet. Although some habitat features were observed during field surveys for the spiraea, no plants were located. Where habitat features were found to exist, other features such as canopy cover and competing vegetation from woody species or exotic invasives diminished habitat suitability for the V. spiraea. This project will not directly impact a population of Virginia spiraea or its habitat.

2.6.4 Federally Protected Lichen

2.6.4.1 *Gymnoderma lineare* (Rock Gnome Lichen)

Rock Gnome Lichen grows in dense colonies of narrow straps (squamules) that appear a bluish-grey on the lichen's upper surface and a shiny white on the lower surface. The squamules are about 1 millimeter across near the tip, tapering to the blackened base, sparingly and subdichotomously branched, and generally about 1 to 2 centimeters (0.39 to 0.79 inches) long, although they can vary somewhat in length, depending upon environmental factors. Flowering occurs July to September; fruiting bodies are located at the tips of the squamules and are also black. The squamules are nearly parallel to the rock surface, with the tips curling away from the rock, in a near perpendicular orientation to the rock surface.

The rock gnome lichen is endemic to the southern Appalachian Mountains of North Carolina and Tennessee, where it is limited to 32 populations. Only seven of the remaining 32 populations cover an area larger than 2 square meters (2.4 square yards). Most populations are 1 meter (3.3 feet) or less in size (USFWS, 1997b).

Rock gnome lichen habitat is located around humid, high elevation rock outcrops or vertical cliff faces or in rock outcrops in humid gorges at lower elevations. Most populations occur above an elevation of (5,000 feet) (USFWS, 1997b).

Biological Conclusion: No Effect

Due to the lack of critical habitat necessary within the restoration and enhancement reaches of the project, it is not likely that the rock gnome lichen is present within this portion of the project area. Although rock outcroppings are present in the mid to upper project reaches where preservation is proposed, the project area does not remain humid enough to support the rock gnome lichen. Project streams are topographically located in coves and the upper valley of the East Buffalo Creek watershed; the site cannot be characterized as containing gorges. No rock gnome lichen has been observed during previous field visits to the project area, nor are there any known populations of the lichen within two miles of the site. Project activities will not adversely impact rock gnome lichen populations or their habitat in Graham County.

2.7 Cultural Resources

A letter was sent to the North Carolina State Historic Preservation Office (SHPO) and Eastern Band of Cherokee Indians' Tribal Historic Preservation Office (THPO), February 8, 2008, requesting a review and comment for the potential of cultural resources in the vicinity of the East Buffalo Creek restoration site. A response was received on February 26, 2008, from the SHPO with a recommendation that a comprehensive survey be conducted due to the project site landscape and its proximity to three previously recorded sites. Subsequently, an archaeological survey was completed by Archaeological Consultants of the Carolinas, Inc. in which no significant archeological or architectural resources were located within the project boundaries. The archaeological survey report was then submitted to the SHPO and THPO for review. On April 17, 2008, Baker received a letter from the SHPO concurring with findings from the archaeological survey that no further archaeological investigation be conducted in connection with this project. To date, the THPO has not

submitted comments on this project. A copy of the SHPO and THPO correspondence is included in Appendix B.

2.8 Potential Constraints

Baker assessed the East Buffalo Creek project site in regards to potential site constraints. No fatal flaws have been identified during project design development.

2.8.1 Property Ownership and Boundary

Baker has obtained a conservation easement purchase option from Barry and Carol Gay for the East Buffalo Creek project area. The easement has been approved by the N. C. State Property Office (SPO) and recorded at the Graham County Courthouse (Deed Book 302, Page Number 60). Final copies of the easement and plat have been provided to the SPO and to EEP. The easement will allow Baker to proceed with the restoration project and restricts the land use in perpetuity. The landowner will retain the right to establish and maintain a road for motorized use that will pass through the easement in a few areas, namely a portion of East Buffalo Creek, UT2, UT3, and UT5. Road and trail bases will be maintained with natural, pervious materials and shall conform to easement guidelines.

2.8.2 Site Access

The site can be accessed for construction and post-restoration monitoring. Construction access and staging areas will be identified during final design.

While the majority of construction to restore UT2 will take place within the Gay property boundary, implementation of the proposed alignment of UT2 will require temporary access within a small portion of the Cushman property (adjacent landowner), within the upstream and downstream project limits, in order to relocate the perched channel to the original low point in the valley (on the Gay property). Baker has received written authorization from Cushman to access the property to conduct the agreed upon stream improvements and monitoring summarized within this restoration plan.

2.8.3 Utilities

A power utility easement, consisting of a single transmission electric line, is present within the proposed conservation easement for UT2 and Reach 2 of UT5 and East Buffalo Creek. The transmission line runs directly down the center of the valley of the project site. Correspondence with Duke Energy revealed an existing right-of-way cited at a width of 20 feet on either side of the transmission line and power poles for a total width of 40 feet. This right-of -way has been excluded from the conservation easement.

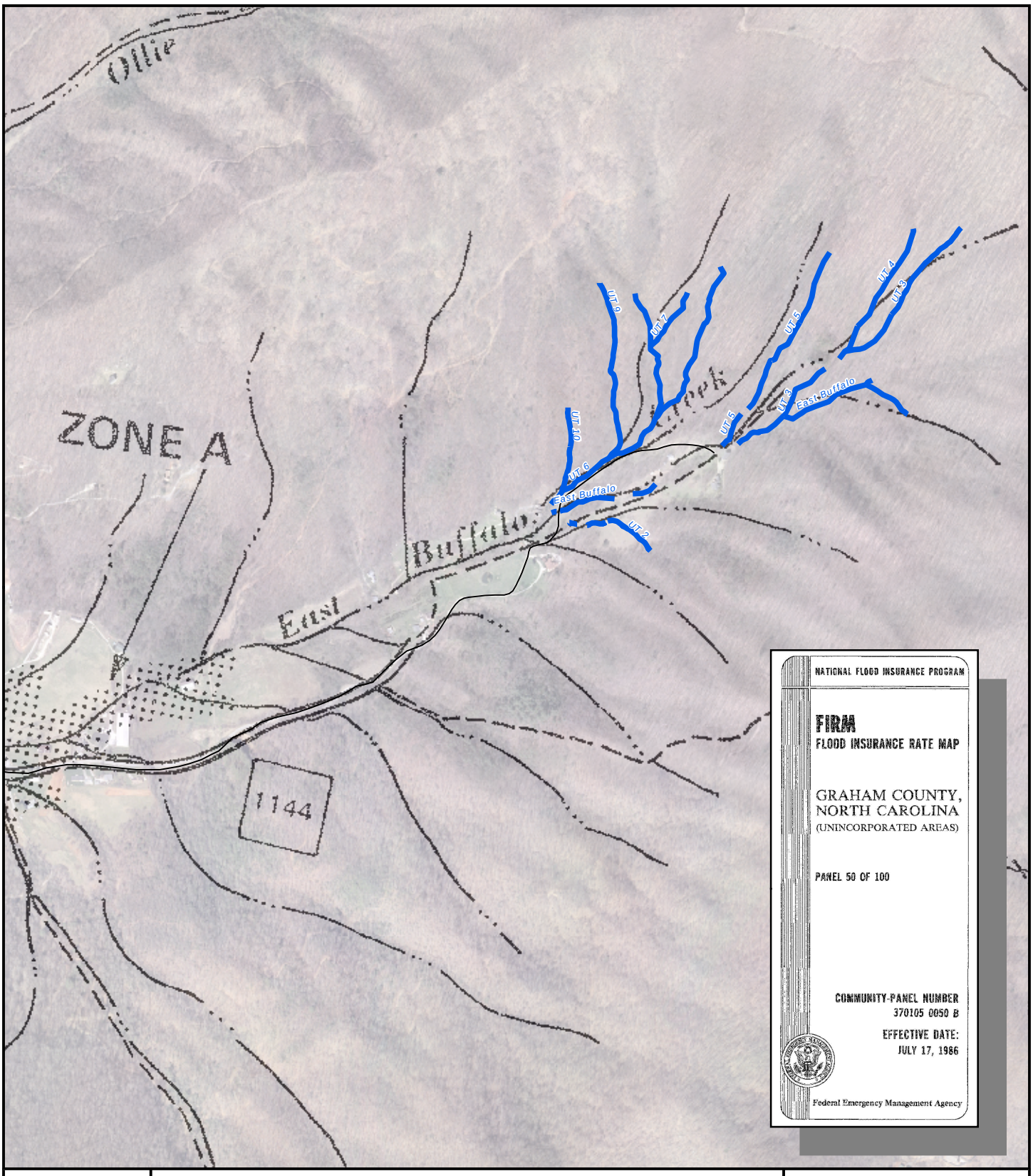
2.8.4 Hydrologic Trespass and Floodplain Characterization

The FEMA Flood Insurance Rate Map (FIRM) for Graham County, NC, (Panel Number 3701050050B) indicates that the project is located within an unregulated Zone X (NCFMP 2009). Figure 2.3 illustrates the FEMA mapping for the site. No flood study is planned as a part of this project. We also do not anticipate any changes to current flood elevations as a result of this project. In addition, Baker will coordinate with the county floodplain manager to ensure local and state floodplain management guidelines have been satisfactorily addressed. The EEP's Floodplain Requirements Checklist for this project is included in Appendix B.

2.9 Potentially Hazardous Environmental Sites

An EDR Transaction Screen Map Report that identifies and maps real or potential hazardous environmental sites within the distance required by the American Society of Testing and Materials (ASTM) Transaction Screen Process (E 1528) was prepared for the site January 4, 2008. A copy of the report with an overview map is included in Appendix C. The overall environmental risk for this site was determined to be low.

Environmental sites including Superfund (National Priorities List, NPL); hazardous waste treatment, storage, or disposal facilities; the Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS); suspect state hazardous waste, solid waste or landfill facilities; or leaking underground storage tanks were not identified by the report in the proposed project area. During field data collection, there was no evidence of these sites in the proposed project vicinity, and conversations with landowners did not reveal any further knowledge of hazardous environmental sites in the area.



LEGEND:

Project Reach

0 200 400 800 Feet

Figure 2.3 FEMA Floodplain Map
Flood Insurance Rate Map
Map Number 370105 0050 B

East Buffalo Restoration Project
Graham County, NC

3.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

3.1 Existing Conditions Survey

Baker collected representative geomorphic survey data of the existing streams within the project area to assess the current condition and overall stability of the channel. Cross sections were collected along each project reach, including the preservation reaches, while longitudinal profiles were only collected along those reaches where restoration or enhancement was proposed. Sufficient profile data was obtained at each preservation reach to calculate a channel slope for channel classification purposes. Channel substrate was sampled at each reach to characterize stream sediments for channel classification. Figure 3.1 illustrates the locations of cross section surveys on the project reaches. All of the surveyed cross sections and profiles are provided in Appendix D. A photo log that depicts the existing conditions at the East Buffalo Creek project site is provided in Appendix E.

Baker assessed the stream and valley types present and considered their evolutionary stage and likely endpoint in order to develop a basis for the proposed restoration plan. The existing conditions of each project reach are described in the following sections with Table 3.1 summarizing the representative geomorphic conditions currently present at the East Buffalo Creek project site.

3.2 Channel Geomorphic Characterization and Classification

Due to the steep gradient, close proximity to the headwaters, and confined valley conditions present, the majority of stream channels at the East Buffalo Creek project site are classified as A-type streams. A-type streams are typically headwater channels that are entrenched with a low sinuosity, a low width/depth ratio, and a steep gradient. Channel slopes among the project reaches are extremely high and range between 12 and 35 percent with 22 percent being the average. This is well within the upper range of slopes observed in A-type streams and thus warrants the Aa+ channel type classification. Project reaches sharing the Aa+ channel classification are typically stable with ample grade control and channel bed armoring from an abundance of large substrate and woody debris, and have stream banks that are firmly planted with mature vegetation.

A few stream reaches are classified as Fb and Ba channel types within the East Buffalo Creek project site. These channel types are entrenched to moderately entrenched, respectively, and both exhibit moderately high width/depth ratios. Cross sections for some reaches sharing the Fb and Ba channel classification, like those for UT7, UT9, and UT11, were most likely captured in a less steep portion of the longitudinal profile containing colluvial deposits, whereby the channel has become overwide from the splaying of sediment and debris fields from upstream. These colluvial deposits help dissipate high energy streamflow throughout the profile and are commonly found in these steep, high gradient, headwater systems. Channels tend to narrow up, both downstream and upstream of these deposits, where flow becomes concentrated again. The Fb channel classification for UT6 Reach 3 is more influenced from instability issues related to past channelization, channel overwidening from bank erosion, and sediment input from the adjacent gravel driveway than the presence of naturally occurring colluvial deposits.

3.3 Valley Classification

In addition to determining stream types present at the East Buffalo Creek project site, valley types were also considered. East Buffalo Creek and its tributaries are high gradient, gravel-cobble bed streams nested within colluvial, Type II valleys. Type II valleys are moderately steep colluvial valleys with gently sloping side slopes (Rosgen 1996). The channel types present in the project are commonly seen in Valley Type II drainages throughout the Blue Ridge Province where channelization, dredging and other practices associated

LEGEND:

Project Reaches
- East Buffalo Reach 1
- East Buffalo Reach 2
- UT 2
- UT 3
- UT 4
- UT 5 Reach 1
- UT 5 Reach 2
- UT 6 Reach 1
- UT 6 Reach 2
- UT 6 Reach 3
- UT 7
- UT 8
- UT 9
- UT10
- UT11

- Cross-sections
- Parcels
- Proposed Easement Boundary
- 40' Powerline Easement
- Powerline
- Power poles
- Existing Gravel Road
- Streams

0 100 200 400 Feet

Figure 3.1 Project Reaches and Surveyed Cross-Section Locations

East Buffalo Creek Restoration Project

Graham County, NC

with agricultural land use has directly impacted the channel and riparian zone, often resulting in an unstable system.

3.4 Project Reach Characterization

The majority of project stream reaches within the East Buffalo Creek watershed are first and second order headwater systems. These reaches generally contain frequent waterfalls and bedrock features, and exhibit cascade-type channel sequences, especially within the higher elevations. With the exception of UT2 and the downstream portions of UT6 and East Buffalo Creek, the project area is overwhelmingly forested. The lower reaches within the East Buffalo Creek project area have been impacted to some degree by past agricultural land management practices involving the relocation of stream channels, channelization, pasture conversion, road access construction, riparian vegetation removal, and the installation of culverts on portions of East Buffalo Creek and its tributaries. The affects of these practices over time has led to channel incision in some areas and to a decreased quality of in-stream habitat from a combination of channel aggradation and embeddedness, reduced baseflow elevation (from disconnected hydrology), proliferation of invasive species within the riparian buffer, and reduced channel shading. Widespread or systemic channel incision has been limited by a combination of grade control structures like exposed bedrock, large cobble and boulder substrate that are frequently found throughout these stream systems. Existing woody vegetation along stream banks have kept portions of the banks from eroding although some channel erosion is present where woody vegetation has been removed.

The following paragraphs describe channel characteristics for project reaches on the mainstem of East Buffalo Creek and tributaries where other restoration or enhancement work is proposed.

3.4.1 East Buffalo Creek Mainstem

East Buffalo Creek extends from its source to approximately 2,600 LF downstream where the project site terminates and is divided into 2 project reaches based primarily on contrasting riparian conditions. In general, the bedform diversity of East Buffalo Creek is characterized by a series of step-pool features. East Buffalo Creek flows through a valley that is somewhat narrow, but is largely unconfined. The stream appears to have been channelized in the past to maximize land available for agricultural use. Land cover around East Buffalo Creek transitions from forested mountain slopes in the upland section to semi-forested cover and open field where enhancement work is proposed. Bedrock, medium to large-sized boulders and cobbles are common substrate features for each of the reaches on the mainstem. Low velocity areas of the channel are primarily composed of large sand particles and medium gravel. Higher velocity pools and runs have some small cobble and gravel. The project reach can be described as a gravel bed stream based on stream bed sampling at East Buffalo Creek.

3.4.1.1 East Buffalo Creek Reach 1

Reach 1 is a preservation reach and extends 919 LF from its source to the confluence of East Buffalo Creek and UT3. This reach of East Buffalo Creek is located in upland forest with a slope of 0.194 which is less steep than that of UT3 and UT4 (0.248 and 0.298 respectively). Old logging trails parallel portions of Reach 1 of East Buffalo Creek, although they have almost completely reverted back to pre-disturbance conditions. With the exception of steeper subreaches, where the channel cascades over bedrock, East Buffalo Creek generally acts as a step-pool channel and, like many streams on-site, is classified as an A4a+-type channel.

3.4.1.2 East Buffalo Creek Reach 2

Reach 2 of East Buffalo Creek begins below the confluence with UT3 and is divided into four non-contiguous subreaches due to easement breaks from utilities, proposed stream crossings, and the encroachment of the channel along the property of a non-participating landowner. This reach

intersects an unpaved road servicing nearby residences twice where flow is conveyed by culverts beneath the road. Within the proposed easement, Reach 2 of East Buffalo Creek flows for a combined total length of approximately 932 LF. Invasive vegetation is particularly common within the upstream reach limits along the left floodplain (which coincides with an abandoned forest road) and surrounding the utility easement corridor which is regularly cleared for overhead electric line maintenance. The step-pool characteristics observed in Reach 1 continue in Reach 2 where pools are spaced fairly evenly and contain a variety of depths. At 0.137, the channel slope becomes less steep than in Reach 1 as the valley opens up where the reach flows past an open field. The buffer along the left bank bordering the field is sparse to absent of vegetation except for some mature trees growing at the top of bank. The width-depth ratio in Reach 2 is low while the channel exhibits moderate entrenchment, with a ratio of 1.5—quite typical for the stable A4a+ type streams observed within the project area. Reach 2 is naturally armored with boulders, large cobble and in some places, bedrock. Streambanks in this reach are also generally armored by woody vegetation.

Table 3.1 Representative Geomorphic Data: Channel Classification Level II
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	Value					Units
	East Buffalo Creek		UT2	UT3	UT4	
	Reach 1 XS1	Reach 2 XS1	XS2	XS1	XS1	
Feature Type	Riffle	Riffle	Riffle	Riffle	Riffle	
Bankfull Width (W_{bkf})	5.2	6.0	4.6	5.6	4.7	Feet
Bankfull Mean Depth (d_{bkf})	0.7	0.7	0.7	0.5	0.5	Feet
Cross sectional Area (A_{bkf})	3.8	4.3	3.0	2.7	2.4	Sq. ft.
Width/Depth Ratio (W/D ratio)	7.0	8.4	7.1	11.7	9.1	
Bankfull Max Depth (d_{mbkf})	1.5	1.1	0.8	0.8	0.7	Feet
Floodprone Area Width (W_{fpa})	16.1	9.0	5.8	6.9	5.4	Feet
Entrenchment Ratio (ER)	3.1	1.5	1.3	1.2	1.2	
Bank Height Ratio (BHR)	1.0	2.3	1.6	3.3	2.0	
Channel Materials (Particle Size Index—d_{50})	Coarse Gravel	Coarse Gravel	Small Cobble	Very Coarse Gravel	Medium Gravel	
d_{16}	0.5	8.5	0.7	7.0	0.1	mm
d_{35}	16.0	12.0	50	25.0	6.2	mm
d_{50}	26.0	22.6	75	49.0	11.0	mm
d_{84}	85.0	82.0	150	128	107.3	mm
d_{95}	110.0	110.0	280	175	151.8	mm
Water Surface Slope (S)	0.19	0.14	0.15	0.23	0.30	Feet per foot
Channel Sinuosity (K)	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	
Rosgen Stream Type	A4a+	A4a+	A3a+	A4a+	A4a+	

3.4.2 Unnamed Tributary 2 (UT2)

UT2 currently flows in a channel perched alongside the valley wall beside a fence line located on the border between property owned by Barry Gay (participating landowner) and Robert Cushman (adjacent landowner). The channel was moved from the center of the valley to a bermed channel that runs along the valley wall and around the cleared field. This was evidently done in the past to allow for agriculture land uses within the field. This reach originates outside the project boundary, on the Cushman property, in a steep, narrow valley surrounded by forest; it flows north before being bermed out of its natural valley at the wood line so that it flows due east along a lower valley slope in a perched channel toward the Cushman residence. The perched channel continues behind the Cushman residence where it flows down a steep man-made cascade before empting into a receiving channel pinched between their residence and a gravel driveway that accesses the Gay property (and the East Buffalo Creek project site). This 'receiving' channel is located at the base of UT2's natural valley and appears to be the relic channel within which UT2 originally drained. Flow has been observed within this channel throughout the majority of field visits despite the lack of a clearly defined channel upstream. Existing flow originates at the base of an old existing rock wall or road crossing coinciding with the Gay/Cushman property line and is fed from seeps, subsurface and macro pore flow from further upstream of the wall.

Baker's proposed channel re-alignment for UT2 involves rerouting 226 LF of perched channel to the low part of valley (within the field on the Gay property) to restore natural hydrology and a stable geomorphic form. The new alignment should capture the subsurface flow and seeps observed in the lower portion of the field that suggests where the channel was originally, before being relocated. Flow from a headwater tributary located downstream and over the ridgeline from UT2 and entirely on the Cushman's property, will continue toward the Cushman residence.

UT2 is classified as an A3a+-type channel and through a step-pool design approach, will remain an A-type channel. Channel slope ranges between 0.1994 and 0.1545 as the existing alignment transitions from its steeper natural valley to its perched location along the hillside. Reference reach data was obtained on an undisturbed subreach of UT2 located upstream of the perched channel and was used in the design process. The reference reach channel bed consists of large, stable boulder/cobble step features with consistent pool to pool spacing compared to the lack of facet slopes and lack of bedform diversity characterizing the perched channel.

3.4.3 Unnamed Tributary 3 (UT3)

UT3, which is 1,615 LF in length, is located north of East Buffalo Creek. Less than half of the upstream portion of this reach is intermittent. This tributary has a moderate width-depth ratio of 11.7 and an entrenchment ratio of 1.2. As with many of the other tributaries that will be preserved, UT3 is characterized by a steep, somewhat narrow valley, and a cascading profile with several small waterfalls interspersed along the length of the channel. Bedform diversity consists of shallow pools (typically with a silty substrate) separated by cascades over bedrock or riffles with a heterogeneous composition of large cobbles and gravel. Exotic, invasive vegetation does not generally appear along UT3 except for sections where the buffer has been cleared in the recent past for road access and where the forest canopy is relatively open.

3.4.4 Unnamed Tributary 4 (UT4)

UT4 is separated from UT3 by a narrow ridgeline and flows for approximately 921 LF before converging with UT3. Like UT3, UT4 is a small, cascading tributary located in the northeastern portion of the project area. The majority of this reach is intermittent. It has a similar width-depth ratio (9.09) and entrenchment ratio (1.2) as UT3 due to the prevailing topography present in the higher elevation streams on-site. The riparian buffer of UT4 is predominantly forested with the occasional rock outcrop present. Exotic, invasive vegetation is not generally present on UT4.

3.4.5 Unnamed Tributary 5 (UT5)

UT5 is located northwest of UT4 and is divided into two reaches based on management approach. Reach 1 is a preservation reach that begins at the origin of UT5 and continues downstream for approximately 809 LF. Reach 2 is a buffer enhancement reach that continues further downstream for approximately 598 LF to the confluence with East Buffalo. UT5 has one of the wider valleys of all the headwater systems in the project area, especially along the downstream half of the tributary along Reach 2 where there is evidence of past development.

3.4.5.1 Unnamed Tributary 5-Reach1

Reach 1 is a headwater stream that originates in a steep, narrow valley surrounded by forest. A little over half of Reach 1 is intermittent. The riparian corridor along this reach is predominantly characterized by a dense upper story canopy consisting of mature hardwoods with a sparse herbaceous understory; the herbaceous understory becomes denser further downstream as the valley broadens. Like many of the headwater streams in the project area, Reach 1 classifies as an A4a+ stream type and exhibits a cascading profile with several small waterfalls interspersed along the length of the channel. Habitat structure is intact and includes an abundance of leaf packs, snags, and woody debris fields within the channel.

3.4.5.2 Unnamed Tributary 5-Reach2

Reach 2 originates where the valley begins to broaden and an herbaceous understory, comprised primarily of invasive species, begins to appear. A forest road intersects Reach 2 mid-reach where stream flow is conveyed through a 12 inch corrugated metal pipe (CMP). While the majority of the project stream reaches in the upland portion of the watershed are in the process of successfully restoring themselves to a more natural condition with native plant species, invasive plant species have proliferated throughout much of the corridor along Reach 2 where past land disturbing activities are evident. The remnants of an old farm site and guy wires from an abandoned power pole were observed upstream of the forest road crossing and happen to coincide with the existing powerline easement alignment from downstream. This suggests that past maintenance of the old power line led to the corridor of invasive species. These invasive species out-compete native vegetation and impair biodiversity. Enhancement efforts on UT5 will consist of extensive removal of exotic, invasive vegetation over an area of approximately 1.7 acres and includes sporadic plantings of native species in open areas where the canopy permits.

Reach 2 is classified as an A4a+ stream channel and exhibits a stable dimension and profile. Pool spacing is fairly consistent and includes a variety of pool sizes and depths. Areas of re-aeration in the form of step-pools, cascades, and riffles are frequent throughout the reach. Gravel and cobble substrate within the channel bed appear to be slightly embedded in some areas. This could be due to a decrease in baseflow conditions from disconnected hydrology in response to past channel manipulation and land disturbance activities along portions of this reach. In-other-words, flow has become less concentrated in some areas from a combination of channel braiding, seeping, and subsurface flow, which has allowed fines to settle out over time instead of flushing downstream on a regular basis.

3.4.6 Unnamed Tributary 6 (UT6)

The next tributary west of UT5, over a broad ridgeline, is UT6. This tributary is broken up into three reaches based on the management approach proposed. The upstream half of UT6, or Reach 1, is proposed for preservation while the downstream half, Reaches 2 and 3, are slated for enhancement II

Table 3.1 (cont.) Representative Geomorphic Data: Channel Classification Level II
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	Value					Units
	UT5		UT6			
	Reach 1 XS1	Reach 2 XS1	Reach 1 XS1	Reach 2 XS1	Reach 3 XS1	
Feature Type	Riffle	Riffle	Riffle	Riffle	Riffle	
Bankfull Width (W_{bkf})	6.1	7.3	5.4	5.5	11.4	Feet
Bankfull Mean Depth (d_{bkf})	0.7	0.4	0.5	1.0	0.6	Feet
Cross sectional Area (A_{bkf})	4.0	2.5	2.8	5.7	6.6	Sq. ft.
Width/Depth Ratio (W/D ratio)	9.1	21.1	10.7	5.3	19.7	
Bankfull Max Depth (d_{mbkf})	1.2	0.7	0.7	1.4	0.9	Feet
Floodprone Area Width (W_{fpa})	9.9	11.2	9.9	10.6	12.6	Feet
Entrenchment Ratio (ER)	1.6	1.5	1.8	1.9	1.1	
Bank Height Ratio (BHR)	2.3	1.0	1.0	1.0	5.7	
Channel Materials (Particle Size Index—d_{50})	Very Coarse Gravel	Coarse Gravel	Medium Gravel	Medium Gravel	Medium Gravel	
d_{16}	8.0	2.8	0.1	5.6	5.6	mm
d_{35}	12.7	10.6	6.9	9.5	9.5	mm
d_{50}	34.8	22.6	14.1	11	11	mm
d_{84}	90.0	84.1	168.1	100	100	mm
d_{95}	165.3	139.4	724.1	200	200	mm
Water Surface Slope (S)	0.23	0.20	0.33	0.12	0.17	Feet per foot
Channel Sinuosity (K)	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	
Rosgen Stream Type	A4a+	A4a+	A4a+	A4a+	F4b	

and enhancement I work, respectively. Reach 3 is nestled between two non-contiguous segments of Reach 2 that are located both, upstream and downstream of Reach 3.

UT6 is the second largest drainage in the project watershed next to East Buffalo Creek and is the receiving stream for UT7, UT8, UT9, UT10. The downstream half of this tributary, comprised of Reaches 2 and 3, appears to have been moved against the valley wall in the past from its original location to facilitate the construction of the unpaved access road on the property. The unpaved road currently parallels a large proportion of Reaches 2 and 3, within 30 feet from the left top of bank, and is eroding, contributing sediment directly to the channel along its length. Remnant water bars and turnouts that served to disperse concentrated storm runoff in intervals, have eroded and become clogged with sediment over time, resulting in rill erosion and gullying from concentrated runoff draining down valley along the driveway. Resurfacing of the road bed with more gravel over time has provided an additional source of fine silt to be transported to the channel via stormwater runoff.

3.4.6.1 Unnamed Tributary 6-Reach 1

UT6 Reach 1 begins at the source of UT6 and continues downstream for 1,145 LF, terminating at the confluence with UT7. Like UT4 and UT5, UT6 Reach 1 has a very steep slope in its higher elevations (0.33) where the channel cascades over rock outcrops and bedrock limits channel incision. An A4a+-type channel, this reach of UT6 is proposed for preservation and has been relatively undisturbed in recent years as evidenced by the surrounding forested landscape.

3.4.6.2 Unnamed Tributary 6- Reach 2

UT6 Reach 2 is proposed for Level II Enhancement in the form of riparian buffer improvements and is comprised of two non-contiguous segments, totaling 401 LF in length, which adjoin the upstream and downstream limits of Reach 3. The upstream segment of Reach 2 originates at the confluence of UT6 and UT7 and continues downstream for 277 LF until the channel flows in close proximity to the road and begins to parallel it. The downstream segment originates at the confluence of UT6 and UT10 (downstream of UT6 Reach 3) and flows for a length of 124 LF before reaching the downstream limits of the East Buffalo Creek project area.

Reach 2 classifies as an A4a+-type channel and exhibits a stable geomorphic form in terms of dimension and profile. Small bankfull flood benches were observed within the upstream segment where cross sections were collected. Channel slope decreases to approximately 0.12, or less than half of that reported upstream for Reach 1. Riffle cascades are longer and more prevalent than in Reach 1 and pool spacing is greater as a result of lower slope and a reduction in stream power. In-stream habitat is intact as evidenced by diverse bedform features, a variety of pool depths, and an abundance of woody debris, snags, and leaf packs within the channel. However, previous land clearing activities in the past along this section of UT6 has aided in the spread of exotic, invasive species, particularly along the left top of bank bordering the unpaved road. Narrow buffer widths limit channel shading and the filtering capacity within the floodplain necessary to remove sediment conveyed from the gravel road to the channel. The relocation of the unpaved road away from the riparian area that is proposed in the design approach for UT6 Reach 3 should also benefit both segments of Reach 2 by providing an ample buffer width to facilitate adequate pollutant and sediment removal of storm runoff before entering the stream.

3.4.6.3 Unnamed Tributary 6- Reach 3

UT6 Reach 3 flows for a length of 524 LF. Like UT6 Reach 2, impacts to the riparian buffer, from past channelization and the encroachment of the unpaved road (within 5 to 30 feet from the left top of bank), threaten the overall stream health of Reach 3. Channel incision and bank erosion are apparent in portions of Reach 3 but are not reach-wide. The presence of grade control, in the form of boulders, tightly packed cobble steps, and hearty rootmass, has prevented systemic channel incision, thus limiting widespread vertical instability. Bank erosion is primarily concentrated to isolated areas along the left bank. The channel is attempting to adjust laterally from being bermed up along the right valley wall by the fill from the road bed of the gravel driveway. Severe bank erosion was observed in one area along the right bank where a sharp meander bend is pinched directly against the valley wall, eroding into the hillside and threatening to undermine a tree; bank slumping is evident within the meander bend from the mass wasting of upland soil layers.

While the majority of Reach 3 is geomorphically stable and affords quality in-stream habitat in terms of bedform diversity, a few incised areas along the reach have become over-widened from bank erosion as a result of unstable bank heights. Sediment, from localized bank erosion and from the gravel road nearby, is aggrading in these areas, flattening facet slopes, and decreasing pool depths and pool to pool spacing. The over-widened channel dimension is reflected in the geomorphic survey collected along this reach which determined a channel classification of a Fb-

type channel for this reach. F type channels are entrenched with moderate to high width/depth ratios. The lack of floodplain access inherent to F-type channels is reflected in the high bank height ratios of 2.2 and 5.7 documented within cross sections collected in the over-widened channel sections. This is significant when compared to bank height ratios ranging between 1.0 and 1.2 documented in stable cross sections further upstream along UT6 Reach 2 where bankfull benches allow flood access, thereby reducing near bank stress and potential bank erosion.

3.4.7 Unnamed Tributary 7 (UT7)

Preservation is proposed along 940 LF of UT7, a major tributary of UT6. Although classified as a B4a-type channel due to its moderately high entrenchment ratio and width-depth ratio, UT7 is the steepest tributary present within the project area with a channel slope of 0.35. As mentioned previously, the cross section used in the determination of channel classification for this reach was most likely conducted within a zone of colluvial deposits where channels tend to be shallow and overwide. The riparian buffer along UT7 consists of a mix of mostly native vegetation and contains geomorphic features typical of a stable headwater tributary within the project watershed.

Table 3.1 (cont.) Representative Geomorphic Data: Channel Classification Level II
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	Value					Units
	UT 7	UT 8	UT 9	UT 10	UT 11	
	XS1	XS1	XS1	XS1	XS1	
Feature Type	Riffle	Riffle	Riffle	Riffle	Riffle	
Bankfull Width (W_{bkf})	7.1	6.0	3.9	6.5	4.0	Feet
Bankfull Mean Depth (d_{bkf})	0.5	0.9	0.3	0.6	0.5	Feet
Cross sectional Area (A_{bkf})	3.2	5.1	1.0	3.9	1.9	Sq. ft.
Width/Depth Ratio (W/D ratio)	15.6	7.0	14.4	11.1	8.3	
Bankfull Max Depth (d_{mbkf})	0.7	1.0	0.4	0.9	1.0	Feet
Floodprone Area Width (W_{fpa})	16.6	8.3	4.4	9.6	11.8	Feet
Entrenchment Ratio (ER)	2.3	1.4	1.1	1.5	3.0	
Bank Height Ratio (BHR)	1.0	1.7	3.8	2.4	1.3	
Channel Materials (Particle Size Index—d_{50})	Very Coarse Gravel	Coarse Gravel	Very Coarse Gravel	Medium Gravel	Coarse Gravel	
d_{16}	0.4	0.1	0.3	0.16	2.8	mm
d_{35}	13.3	6.2	15.0	4.5	15.0	mm
d_{50}	50.6	19.0	49.0	8.5	32.0	mm
d_{84}	180.0	143.4	100.0	83.0	90.0	mm
d_{95}	248.6	304.4	160.0	120.0	304.4	mm
Water Surface Slope (S)	0.35	0.33	0.22	0.31	0.26	Feet per foot
Channel Sinuosity (K)	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	
Rosgen Stream Type	B4a	A4a+	A4a+	A4a+	A4a+	

3.4.8 Unnamed Tributary 8 (UT8)

UT8 is an intermittent channel that flows for 361 LF before converging with UT7 at a large rock outcrop. Like UT7, this tributary will be placed in preservation status under this project. Another A4a+-type stream, UT8 has a slope similar to that of the preservation reach on UT6 (0.33) and is separated from the UT7 drainage by a broad, forested rock outcrop.

3.4.9 Unnamed Tributary 9 (UT9)

UT9, UT10, and UT11 are tributaries that were discovered during field surveys subsequent to the proposal phase. This perennial tributary is located in a small drainage west of UT8 and flows directly into UT6. Preservation is proposed for UT9, an F4b-type channel which has a reach length of 1,179 LF and width-depth ratios similar to that of the Enhancement I reach on UT6. However, unlike UT6, which has been channelized, the Fb-type channel determination for this reach primarily reflects natural, geomorphic processes related to colluvial deposition, localized changes in channel slope and bedrock influences on channel dimension.

3.4.10 Unnamed Tributary 10 (UT10)

UT10 is 536 LF in length and is the last in a series of smaller tributaries that drain to UT6 before it converges with East Buffalo Creek. The western most tributary, UT10 is proposed for preservation due to its stable channel and riparian features. The upstream half of this reach is intermittent.

3.4.11 Unnamed Tributary 11 (UT11)

UT11 is a small, intermittent branch approximately 50 LF in length that drains into East Buffalo Creek near its source. A B4a-type stream situated in a forested upland, it too is proposed for preservation.

3.5 Channel Morphology, Evolution and Stability Assessment

A naturally stable stream must be able to transport the sediment load supplied by its watershed while maintaining dimension, pattern, and profile over time so that it does not degrade or aggrade (Rosgen, 1994). Stable streams migrate across alluvial landscapes slowly, over long periods, while maintaining their form and function. Instability occurs when scouring causes the channel to incise (degrade) or excessive deposition causes the channel bed to rise (aggrade). A generalized relationship of stream stability was proposed by Lane (1955) that states the product of sediment load and sediment size is proportional to the product of stream slope and discharge, or stream power. A change in any one of these variables causes a rapid physical adjustment in the stream channel.

A common sequence of physical adjustments has been observed in many streams following disturbance. This adjustment process is often referred to as channel evolution. Disturbance can result from channelization, increase in runoff due to build-out in the watershed, removal of streamside vegetation, and other changes that negatively affect stream stability. All of these disturbances occur in both urban and rural environments. Several models have been used to describe this process of physical adjustment for a stream. The Simon Channel Evolution Model (1989) characterizes evolution in six steps, including:

1. Sinuous, pre-modified
2. Channelized
3. Degradation
4. Degradation and widening
5. Aggradation and widening
6. Quasi-equilibrium.

The channel evolution process is initiated once a stable, well-vegetated stream that interacts frequently with its floodplain is disturbed. Channelization, dredging, changing land use, removal of streamside vegetation, upstream or downstream channel modifications, and/or change in other hydrologic variables result in

adjustments in channel morphology to compensate for the new condition(s). Disturbance commonly results in an increase in stream power that causes degradation, often referred to as channel incision (Lane, 1955). Incision eventually leads to over-steepening of the banks and, when critical bank heights are exceeded, the banks begin to fail and mass wasting of soil and rock leads to channel widening. Incision and widening continue moving upstream in the form of a head-cut. Eventually the mass wasting slows, and the stream begins to aggrade. A new, low-flow channel begins to form in the sediment deposits. By the end of the evolutionary process, a stable stream with dimension, pattern, and profile similar to those of undisturbed channels forms in the deposited alluvium. The new channel is at a lower elevation than its original form, with a new floodplain constructed of alluvial material (FISRWG, 1998).

The majority of the tributaries within the East Buffalo project watershed have been impacted to some degree from past channelization, timber harvesting, land development or agricultural activities that have negatively affected riparian areas, thus altering catchment hydrology, storm runoff regimes, and channel morphology. All of the reaches proposed for preservation, which are located higher up in the watershed, are fairly stable however (stage I channel evolution), and have nearly recovered from these prior impacts. These resilient channels are primarily controlled by bedrock or colluvial boulders and cobbles, and dissipate energy vertically rather than horizontally like alluvial systems. Their profiles are steep to very steep, tending to erode during low return interval storm events resulting in local changes in bed configuration but not in evolution to a new channel state. The rugged terrain in these headwater corridors has been a limiting factor to more recent land disturbing activities like residential construction and passive agriculture that have been more prominent in proximity to the project reaches at lower elevations in the watershed; having remained undisturbed for a longer period of time has allowed these headwater systems to adjust accordingly and stabilize more quickly. These channels tend to be entrenched to moderately entrenched with low to moderate width/depth ratios as reflected in the A4a+ channel type commonly found throughout the project watershed.

Reach 2 of UT5, UT6, and East Buffalo Creek are generally geomorphically stable overall but have been channelized in the past, thus warranting a stage I/II determination for channel evolution. The degradation of riparian buffers along these reaches via the clearing of streamside vegetation and the proliferation of invasive species threaten bank stability. The lack of rooting depth, density, and mass associated with most invasive species is typically inadequate in maintaining the long term structural integrity of stream banks as is the case along these reaches.

UT2 has been channelized and perched along the hillside and therefore is considered to be at stage II in channel evolution. The channel lacks a diverse bedform but is stable due to the armoring of the bed and banks by large substrate consisting of cobble and boulders, and hearty root mass from a few mature trees. Compared to its reference reach located further upstream, UT2 is entrenched from being bermed up along the hillside. The elevated value of 1.6 for bank height ratio is due more to channel confinement from the constructed berm or levee than to the downcutting of the channel bed; nevertheless, channel dimension, pattern, and profile of UT2 are a-typical for an A3a+ stream in a valley with such a steep slope. Poor bedform habitat and decreased baseflow levels from a disconnected hydrology are also causes for restoring this channel (to the original low point in the valley).

UT6 Reach 3 is considered to be between stages V and VI of channel evolution whereby most of the reach has achieved a stable equilibrium from past channelization while some portions are still aggrading and widening to reduce channel slope and form a stable bankfull channel at a lower elevation. The abundance of grade control has limited channel incision to short sections of this reach longitudinally. Facet slopes within these incised channel sections have flattened from the downcutting of the channel bed and aggradation of eroded stream bank material associated with channel widening (channel evolution stages III-V). The eroding gravel road, adjacent to the reach, is also a sediment source for the aggraded material observed in the over-widened channel. Left unchecked (where stage V is evident), this channel will continue to widen through bank erosion in selected areas until it reaches a stable dimension with a narrower bankfull width and floodplain that can convey the current sediment load. Over-widening of the channel threatens the structural

integrity of grade control in a few areas; flow expansion and erosion around these structures increases the susceptibility to headcutting and undermining of the structure.

Table 3.2 Stability Indicators
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	East Buffalo Creek		UT2	UT3	UT4
	Reach 1 XS1	Reach 2 XS1	XS2	XS1	XS1
Stream Type	A4a+	A4a+	A3a+	A4a+	A4a+
Design Approach	Preservation	Enhancement II	Restoration	Preservation	Preservation
Riparian Vegetation	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide forested buffer within the upstream and downstream reach limits impacted with a dense understory of invasives such as privet and multiflora rose. The buffer is sparse to absent mid-reach due to the encroachment of a powerline cut along the right bank and a manicured field, planted with fescue, bordering the left bank; a thin band of mature trees comprises the buffer along the tops of both banks; multiflora rose and Japanese honeysuckle are prominent mid-reach, propagating from the powerline cut.	Wide forested buffer paralleling the left bank and a 5 to 10 foot buffer bordering the right bank along the berm, consisting of mature trees and sporadic herbaceous vegetation. Beyond the narrow buffer along the right bank is a fallow pasture.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.
Channel Dimension					
Bankfull Area (SF)	3.8	4.3	3.0	2.7	2.4
Width/Depth Ratio	7.0	8.4	7.1	11.7	9.1
Channel Pattern					
Meander	NA	NA	NA	NA	NA

Table 3.2 Stability Indicators
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	East Buffalo Creek		UT2	UT3	UT4
	Reach 1 XS1	Reach 2 XS1	XS2	XS1	XS1
Width Ratio[1]					
Sinuosity	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1
Vertical Stability					
Bank Height Ratio (BHR)	1.0	2.3	1.6	3.3	2.0
Entrenchment Ratio (ER)	3.1	1.5	1.3	1.2	1.2
Evolution Scenario	A→A	A→A	A→A	A→A	A→A
Existing Evolution Stage[2]	I	I / II	II	I	I

Notes:
1. NA: Meander Width Ratio not measured due to channel type.
2. Simon Channel Evolution.

Table 3.2 (cont.) Stability Indicators
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	UT5		UT6		
	Reach 1 XS1	Reach 2 XS1	Reach 1 XS1	Reach 2 XS1	Reach 3 XS1
Stream Type	A4a+	A4a+	A4a+	A4a+	F4b
Design Approach	Preservation	Enhancement II	Preservation	Enhancement II	Enhancement I
Riparian Vegetation	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide forested buffer consisting of scattered mature trees and a fairly dense understory infested by invasive vegetation such as privet, multiflora rose, and Japanese honeysuckle.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide forested buffer exists along the right bank within the upstream segment while the buffer along the left bank becomes narrower within closer proximity to the unpaved road; invasive species such as privet and multiflora rose are present throughout the buffer of the upstream segment and become more	Wide forested buffer exists along the right bank. The buffer along the left bank narrows to within 5 feet of the channel and is absent for much of the reach due to the encroachment of the gravel road. Invasive species such as privet and multiflora rose are present throughout the buffer. Some mature trees

Table 3.2 (cont.) Stability Indicators
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	UT5		UT6		
	Reach 1 XS1	Reach 2 XS1	Reach 1 XS1	Reach 2 XS1	Reach 3 XS1
				prominent near the unpaved road. The downstream segment has a narrow buffer, absent in some areas from the encroachment of the unpaved road corridor and manicured lawn from an adjacent residence; some mature trees situate the top of bank.	situate the tops of both banks.
Channel Dimension					
Bankfull Area (SF)	4.0	2.5	2.8	5.7	6.6
Width/Depth Ratio	9.1	21.1	10.7	5.3	19.7
Channel Pattern					
Meander Width Ratio[1]	NA	NA	NA	NA	NA
Sinuosity	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1
Vertical Stability					
Bank Height Ratio (BHR)	2.3	1.0	1.0	1.0	5.7
Entrenchment Ratio (ER)	1.6	1.5	1.8	1.9	1.1
Evolution Scenario	A→A	A→A	A→A	A→A	A→F
Existing Evolution Stage[2]	I	I / II	I	I / II	V / VI

Notes:
1. NA: Meander Width Ratio not measured due to channel type.
2. Simon Channel Evolution Model.

Table 3.2 (cont.) Stability Indicators
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameter	UT7	UT8	UT9	UT10	UT11
	XS1	XS1	XS1	XS1	XS1
Stream Type	B4a	A4a+	F4b	A4a+	B4a
Design Approach	Preservation	Preservation	Preservation	Preservation	Preservation
Riparian Vegetation	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.	Wide buffer of mature trees scattered within the stand with a dense herbaceous understory including ferns and mosses that line both banks.
Channel Dimension					
Bankfull Area (SF)	3.2	5.1	1.0	3.9	1.9
Width/Depth Ratio	15.6	7.0	14.4	11.1	8.3
Channel Pattern					
Meander Width Ratio[1]	NA	NA	NA	NA	NA
Sinuosity	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1
Vertical Stability					
Bank Height Ratio (BHR)	1.0	1.7	3.8	2.4	1.3
Entrenchment Ratio (ER)	2.3	1.4	1.1	1.5	3.0
Evolution Scenario	B→B	A→A	A→F	A→A	B→B
Existing Evolution Stage[2]	I	I	I	I	I

Notes:
1. NA: Meander Width Ratio not measured due to channel type.
2. Simon Channel Evolution.

3.6 Bankfull Verification

Baker engaged several methods to verify the bankfull stage and discharge of the restoration and enhancement I reaches (UT2 and UT6, respectively) at the East Buffalo Creek project site. Initially, when collecting data points for the topographic survey, physical indicators of bankfull stage were marked and measured. Estimates of discharge flow rates were made by using survey data, mathematical equations, and regional data. Each method reinforces the ultimate conclusion of a bankfull discharge.

Bankfull stage on each reach was identified in the field; indicators included a break in slope, a flat depositional feature, and a consistent scour line. The measured bankfull dimensions were evaluated using the North Carolina Rural Mountain Regional Curve (Harman et al., 2000). Surveyed cross sections with bankfull indicators were plotted; however, the smaller drainage areas associated with this project are not adequately represented on the regional curve since East Buffalo Creek and its tributaries are located in a small headwater system. The East Buffalo restoration site (UT2) is a headwater system with a drainage area of 0.04 square miles while the drainage area of UT6 Reach 3, where channel enhancement is proposed, has a drainage area of 0.16 square miles; drainage areas represented by the regional curve range from 3.44 to 205 square miles.

In an attempt to enhance the validity of the regional curve at lower drainage areas (typical to the project area), reference stream data was obtained from four reaches on site having comparable drainage areas and sharing the same physiographic and geomorphologic character: UT5 Reach 2, UT6 Reach 2, East Buffalo Reach 2, and a geomorphically stable subreach of UT2 located upstream from the perched project reach. While Reach 2 of UT5, UT6, and East Buffalo are proposed for enhancement II work (in the form of buffer improvements), they exhibit stable dimension and profile according to the geomorphic survey data collected. Inclusion of these four additional data points to the NC Rural Mountain Regional Curve resulted in a minor shift in the curve for an improved fit of the data. When plotted, the additional data points from East Buffalo Creek consistently hover close to the supplemented curve, either above or below it. The revised R squared value was 0.97 compared to a value of 0.89 from the NC Rural Mountain Regional Curve suggesting a slightly better correlation for the relationship between drainage area and bankfull cross sectional area for the supplemented regional curve. Therefore, the supplemented regional curve was used to determine bankfull stage due to the validation of its general agreement with available data for smaller drainage areas. Figure 3.2 illustrates the comparison between the NC Rural Mountain and supplemented regional curves including the additional data points (plotted cross sections) from the East Buffalo project site.

3.7 Bankfull Discharge

Manning's equation was used to calculate a bankfull discharge at a representative riffle cross section for UT2. A Manning's roughness coefficient of 0.075 was selected for the reach based on factors including channel bed material, the presence of small shrubs and grasses on the banks, and stream type. Bankfull discharge for UT2 was estimated at 15.5 cubic feet per second (cfs). The estimated bankfull discharge was plotted on the regional curve as shown in Figure 3.3.

For further verification, the NC Rural Mountain Regional Curve and the NC USGS rural regression equation were used to estimate bankfull discharge. These methods, when used in conjunction with Manning's equation, provide a "best estimate" of the channel-forming discharge given the unavailability of gauge or sediment data for the East Buffalo Creek project area. The regional curve was extended (using the existing equation from the power function of the curve) to estimate bankfull discharge of smaller drainages and estimated a discharge of 9 cfs for UT2. The regional curve was also used to estimate a discharge of 24 cfs for UT6 Reach 3 where enhancement I channel improvements are proposed.

The NC USGS rural regression equation was used to estimate the 1.25, 1.5, and 1.75-year discharge for the restoration reach (UT2). The generally accepted recurrence interval of a bankfull event is between 1 and 2 years, and often between approximately 1.25 and 1.5 years. The bankfull discharge of 9 cfs derived from the extended NC Rural Mountain Regional Curve matches that predicted by the NC USGS rural regression for the 1.5 year discharge return interval. Due to the extreme slope of the stream, a much higher flow rate was estimated based on Manning's equation; the bankfull discharge of 15.5 cfs estimated from Manning's equation slightly exceeds the 2 year discharge predicted by the USGS rural regression. Estimates for discharge using the NC USGS rural equation and Manning's equation were not applied to UT6 Reach 3 since channel improvements to dimension and profile are only proposed for specific problem locations along the reach.

Since the bankfull discharge estimate of 9 cfs predicted by the NC Rural Mountain Regional Curve falls within the expected recurrence interval for bankfull events (1.25 to 1.5 years) predicted by the NC USGS rural regression, it was selected as the design discharge for UT2 that best supports the proposed channel geometry. Table 3.4 summarizes the design discharge for UT2 and UT6 Reach 3.

Table 3.3 Bankfull Discharge Determination
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Stream Reach	DA (square miles)	Q, Rural Regional Curve (cfs)	Q, USGS Regression Equation (cfs)			Q, 1-D Manning's Formula (cfs)	Design Q (cfs)
			1.25 year	1.5 year	1.75 year		
UT2	0.04	9	6	9	12	15.5	9
UT6 Reach 3	0.16	24	NA	NA	NA	NA	24

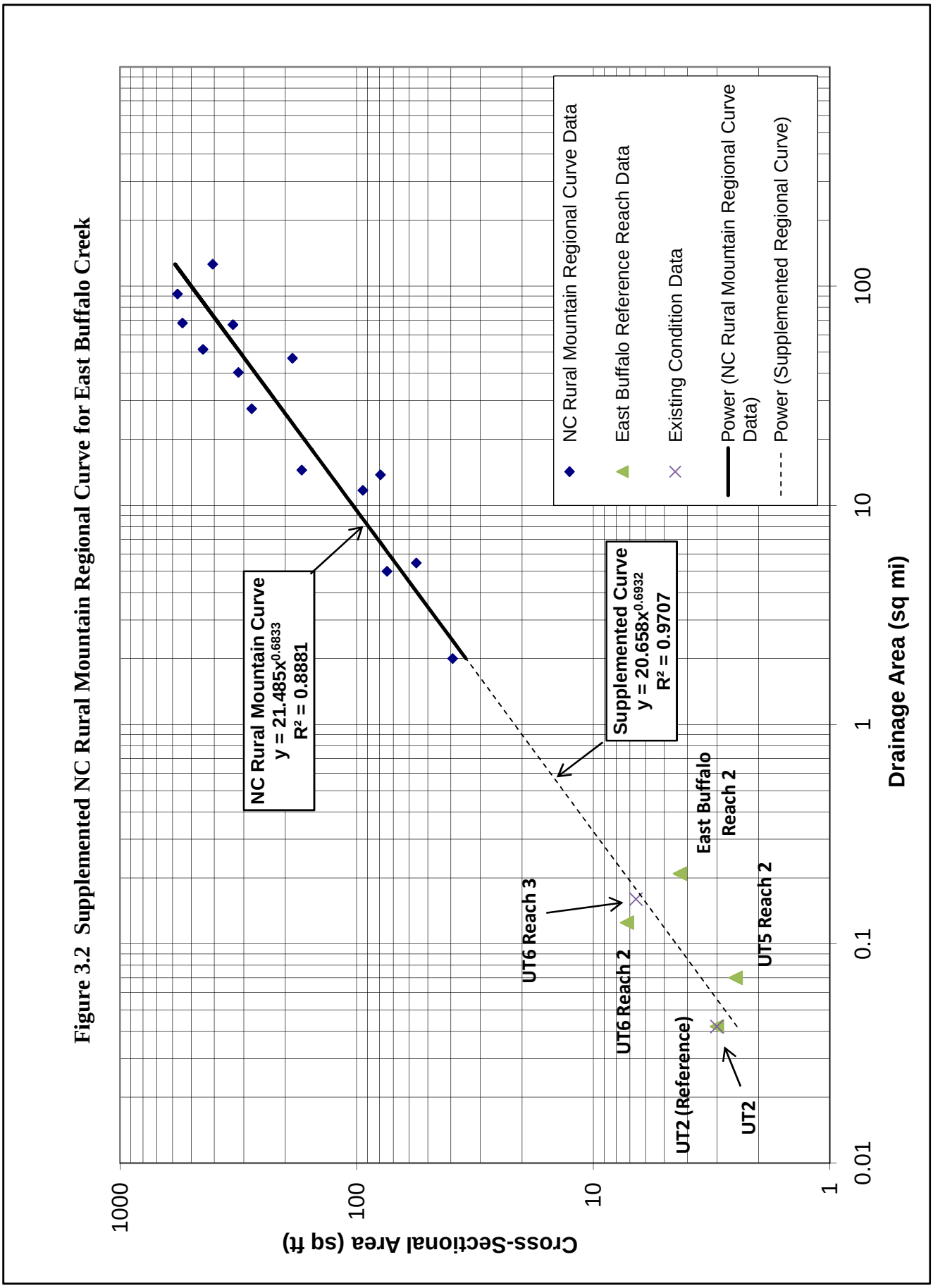


Figure 3.2 Supplemented NC Rural Mountain Regional Curve for East Buffalo Creek

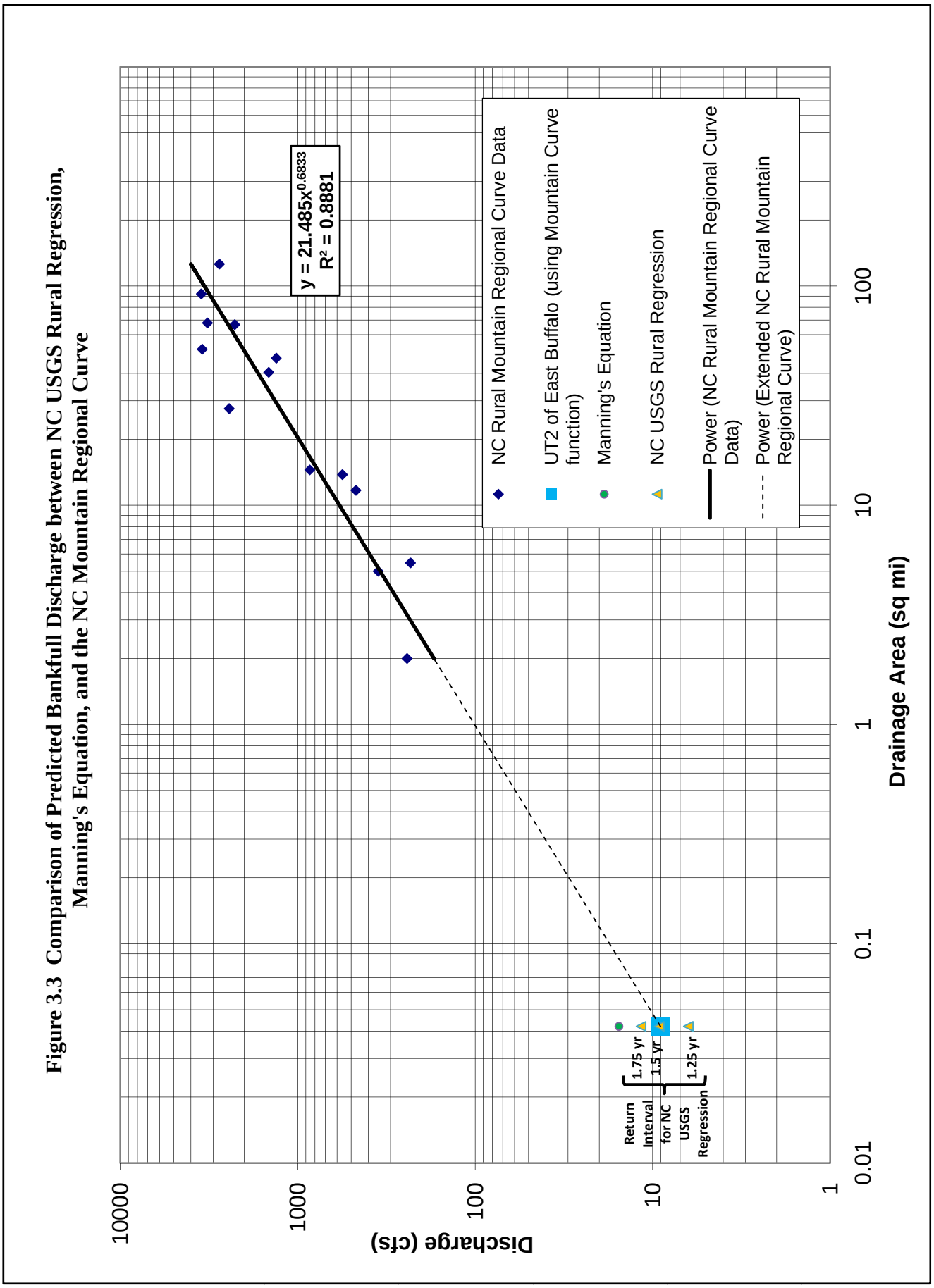


Figure 3.3 Comparison of Predicted Bankfull Discharge between NC USGS Rural Regression, Manning's Equation, and the NC Mountain Regional Curve
y = 21.485x^0.6833
R² = 0.8881
NC Rural Mountain Regional Curve Data
UT2 of East Buffalo (using Mountain Curve function)
Manning's Equation
NC USGS Rural Regression
Power (NC Rural Mountain Regional Curve Data)
Power (Extended NC Rural Mountain Regional Curve)
Return Interval for NC
1.75 yr
1.5 yr
USGS Regression
1.25 yr
Discharge (cfs)
10000
1000
100
10
1
0.01
0.1
1
10
100
Drainage Area (sq mi)

3.8 Vegetation and Habitat Descriptions and Disturbance History

The habitat within and adjacent to the proposed project area consists of a Montane Alluvial Forest and a Montane Oak-Hickory Forest as described by Schafale and Weakley (1990). The riparian areas ranged from relatively disturbed to very disturbed. A general description of each community follows.

3.8.1 Dry Mesic Oak (-Hickory) Forest

This ecological community covers mid slopes and upland forest areas within the preservation reaches. The dominant canopy species of the dry mesic oak forest area includes white oak (*Quercus alba*), northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), mockernut hickory (*Carya alba* (*tomentosa*)), red hickory (*Carya ovalis*), and pignut hickory (*Caryus glabra*). Yellow poplar (*Liriodendron tulipifera*) are also present on-site. Understory species in this forest community typically include red maple (*Acer rubrum*), flowering dogwood (*Cornus florida),* sourwood *(Oxydendrum arborem),* and American holly *(Ilex opaca).* Shrubs include downy arrowwood (*Viburnum rafinesquianum),*deerberry *(Vaccinium stamineum),*Blue Ridge blueberry *(Vaccinium pallidum (vacillans)),* and strawberry bush *(Evonymus americana).* Herbs are fairly sparse, with *Hexastylis spp.,* downy rattlesnake plantain, striped prince's pine *(Chimaphila maculata),* nakedflower ticktrefoil *(Desmodium nudiflorum),* and rattlesnakeweed common.

3.8.2 Dry Mesic Mixed Forest

This ecological community is located on low ridges, upland flats and in transition zones with dry mesic oak-hickory forests within the project area. This community type is similar to the Dry Mesic Oak-Hickory Forest community type with one exception. This forest type is dominated less by white oak and more by northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), and American Beech (*Fagus grandifolia*).

3.8.1 Agricultural/Hay/Pasture Land

East Buffalo Creek and UT2 are both located adjacent to an agricultural area near the bottom of the project area as shown on the cover of this plan. The plant species in the adjacent field are composed primarily of fescue (*Fescue* spp.) and other grasses, golden rod (*Solidago* spp.), jewelweed (*Impatiens capensis*), poison ivy *(Toxicodendron (Rhus) radicans),* Christmas fern (*Polystichum acrostichoides*), woodfern (*Dryopteris* spp.), stinging nettle (*Urtica dioica*), and in a small, depressional area near the woodline near UT2, soft rush (*Juncus effusus*).

4.0 REFERENCE STREAMS

Reference reach surveys are valuable tools to river designers. Reference reaches are stable streams within a specific valley type (Rosgen, 1998). Their dimension, pattern, and profile can be used as a template for design of a stable stream in a similar valley type, with similar bed material and similar hydrological regime. In order to extract the morphological relationships observed in a stable system, dimensionless ratios are developed from the surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type. Appropriate design stream types for the corresponding valley type and sediment regime were assigned to the project streams prior to selecting reference reach streams.

Design ratios for pattern and profile on UT2 and UT6, Reach 3, were based on evaluating dimensionless ratios from reference reaches identified within the East Buffalo Creek project watershed. Reference reaches, for both UT2 and UT6 Reach 3, were identified along geomorphically stable lengths of channel located immediately upstream of each respective project reach. Dimensional data was collected from stable cross sections for each of the reference reaches and plotted on the NC Rural Mountain Regional Curve (supplemented curve) in Figure 3.2. The specific design parameters are described in detail in Section 6. Existing conditions data, reference reach data, and proposed design data for UT2 and UT6 Reach 3 are summarized in Table 4.1. All surveyed cross sections and profile data, including those collected along reference reaches, can be found in Appendix D.

The reference reach selected on-site for UT2 is an undisturbed portion of the reach located upstream from the perched channel, and is situated in the natural low point of its valley. Valley slope for the reference reach is 0.19 and matches that of the valley slope where UT2 is proposed to be relocated flowing downstream through the field (compared to the lower valley slope of the perched channel which is 0.15). The channel bed is primarily composed of a mix of cobble and gravel with some small boulders. Step features within this channel are well defined and regularly spaced, ranging between 11 to 21 feet apart along the surveyed profile. Like many of the preservation reaches within the project area, the riparian buffer consists of a recovering forest with scattered mature trees and an herbaceous understory.

The reference reach for UT6, Reach 3 is the upstream segment of UT6, Reach 2 and is similar in slope and substrate. Reference reach data from UT6, Reach 2 was used to determine a stable dimension and cross sectional area for Reach 3, but profile design ratios were derived from a stable downstream section of Reach 3 that exhibited a diverse bedform and regular pool to pool spacing. Proposed adjustment of channel profile for UT6, Reach 3 is limited to a few areas involving the placement of in-stream structures for additional grade control and to increase the frequency of pool to pool spacing.

Table 4.1 Reference Reach Geomorphic Design Parameters East Buffalo Creek Mitigation Plan-NCEEP Project #000615	**UT2 Design**		**UT2 Existing Conditions**		**Reference Reach: UT2 upstream**	
Parameters	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1. Stream Type	B3a		A3a+		A3a+	
2. Drainage Area – square miles	0.04		0.04		0.04	
3. Bankfull Width (w_{bkf}) – feet	7.7		4.6	4.9	5.6	
4. Bankfull Mean Depth (d_{bkf}) – feet	0.4		0.7		0.5	
5. Width/Depth Ratio (w/d ratio)	20		7.1		10.7	
6. Cross sectional Area (A_{bkf}) – SF	3		3	3.4	3	
7. Bankfull Mean Velocity (v_{bkf}) – fps	3		2.6	3	3	
8. Bankfull Discharge (Q_{bkf}) – cfs	9		9		9	
9. Bankfull Max Depth (d_{mbkf}) – feet	0.5		0.8	1.1	1.1	

Table 4.1 Reference Reach Geomorphic Design Parameters East Buffalo Creek Mitigation Plan-NCEEP Project #000615	**UT2 Design**		**UT2 Existing Conditions**		**Reference Reach: UT2 upstream**	
Parameters	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
10. d_{mbkf} / d_{bkf} ratio	1.2		1.2	1.5	2	
11. Low Bank Height to d_{mbkf} Ratio	1					
12. Bank Height Ratio dlow/dmax	1		1.2	1.6	1	
13. Floodprone Area Width (w_{fpa}) – feet	> 20		5.8	6.2	14.1	
14. Entrenchment Ratio (ER)	> 2		1.3		2.5	
15. Meander length (L_m) – feet						
16. Meander length to bankfull width (L_m/w_{bkf})						
17. Radius of curvature (R_c) – feet						
18. Radius of curvature to bankfull width (R_c / w_{bkf})						
19. Belt width (w_{blt}) – feet						
20. Meander Width Ratio (w_{blt}/W_{bkf})						
21. Sinuosity (K) Stream Length/ Valley Distance	1.1		1		1.1	
22. Valley Slope – feet per foot	0.19		0.15		0.19	
23. Channel Slope ($s_{channel}$) – feet per foot	0.18		-		0.18	
24. Pool Slope (s_{pool}) – feet per foot						
25. Pool Slope to Average Slope (s_{pool} / $s_{channel}$)						
26. Maximum Pool Depth (d_{pool}) – feet	0.8	1.4			1.1	1.4
27. Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	2	3.5			6.1	8
28. Pool Width (w_{pool}) – feet	10.1	13.2			6.9	7.3
29. Pool Width to Bankfull Width (w_{pool} / w_{bkf})	1.3	1.7			1.21	1.28
30. Pool Area (A_{pool}) – square feet						
31. Pool Area to Bankfull Area (A_{pool}/A_{bkf})						
32. Pool-to-Pool Spacing – feet	11.6	23.2			11.1	21
33. Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	1.5	3			2	3.7
34. Riffle Slope [4((s_{riffle}) – feet per foot	0.09	0.24				
35. Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	0.5	1.3				
36. Pool Length, Lp						
37. Pool Length Ratio Lp/Wbkf						
38. Particle Size Distribution of Riffle Material						
Material (d_{50})			Small Cobble		Small Cobble	
d_{16} – mm			0.7		0.7	
d_{35} – mm			50		50	
d_{50} – mm			75		75	
d_{84} – mm			150		150	
d_{95} – mm			280		280	
- : data not available						

Table 4.1 (cont.) Reference Reach Geomorphic Design Parameters East Buffalo Creek Mitigation Plan-NCEEP Project #000615	**UT6 Reach 3 Design**		**UT6 Reach 3 Existing Conditions**		**Reference Reach: UT6 Reach 2**	
Parameters	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1. Stream Type	B4a		Fb		A4a+	
2. Drainage Area – square miles	0.16		0.16		0.13	
3. Bankfull Width (w_{bkf}) – feet	9		9.2	11.4	7.38	8.04
4. Bankfull Mean Depth (d_{bkf}) – feet	0.7		0.6	0.7	0.9	1
5. Width/Depth Ratio (w/d ratio)	12.5		13.3	19.7	7.6	9.2
6. Cross sectional Area (A_{bkf}) – SF	6.5		6.3	6.6	7	7.2
7. Bankfull Mean Velocity (v_{bkf}) – fps	3.7		3.7	3.8		
8. Bankfull Discharge (Q_{bkf}) – cfs	23.8		23	25		
9. Bankfull Max Depth (d_{mbkf}) – feet	0.5		0.9	1.1	1.1	1.4
10. d_{mbkf} / d_{bkf} ratio	1.4		1.5		1.1	1.6
11. Low Bank Height to d_{mbkf} Ratio	1					
12. Bank Height Ratio dlow/dmax	1		2.3	5.7	1.1	1.2
13. Floodprone Area Width (w_{fpa}) – feet	15.5		10.6	12.6	12.2	15.7
14. Entrenchment Ratio (ER)	1.7		1.1	1.2	1.7	2
15. Meander length (L_m) – feet						
16. Meander length to bankfull width (L_m/w_{bkf})						
17. Radius of curvature (R_c) – feet						
18. Radius of curvature to bankfull width (R_c / w_{bkf})						
19. Belt width (w_{blt}) – feet						
20. Meander Width Ratio (w_{blt}/W_{bkf})						
21. Sinuosity (K) Stream Length/ Valley Distance	1.1		1.1		1.1	
22. Valley Slope – feet per foot	0.17		0.17		0.14	
23. Channel Slope ($s_{channel}$) – feet per foot	0.16		0.16		0.12	
24. Pool Slope (s_{pool}) – feet per foot						
25. Pool Slope to Average Slope (s_{pool} / $s_{channel}$)						
26. Maximum Pool Depth (d_{pool}) – feet						
27. Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})						
28. Pool Width (w_{pool}) – feet						
29. Pool Width to Bankfull Width (w_{pool} / w_{bkf})						
30. Pool Area (A_{pool}) – square feet						
31. Pool Area to Bankfull Area (A_{pool}/A_{bkf})						
32. Pool-to-Pool Spacing – feet	7	48	7	48	10	16
33. Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	0.7	5.3	0.7	4.2	1.4	2
34. Riffle Slope [4((s_{riffle}) – feet per foot	0.05	0.83	0.05	0.83	0.07	0.22
35. Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	0.3	5.3	0.3	5.3	0.6	1.8
36. Pool Length, Lp						
37. Pool Length Ratio Lp/Wbkf						
38. Particle Size Distribution of Riffle Material						
Material (d_{50})			Medium Gravel		Medium Gravel	
d_{16} – mm			5.6		5.6	
d_{35} – mm			9.5		9.5	
d_{50} – mm			11		11	
d_{84} – mm			100		100	
d_{95} – mm			200		200	
- : data not available						

5.0 PROJECT SITE WETLANDS

5.1 Jurisdictional Wetlands

The proposed project area was reviewed for the presence of wetlands and waters of the United States in accordance with the provisions on Executive Order 11990, the Clean Water Act, and subsequent federal regulations. Wetlands have been identified by the USACE as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3(b) and 40 CFR 230.3 (t)).

Following an in-office review of the National Wetland Inventory (NWI) map, NRCS soil survey, and USGS quadrangle map, a field survey of the project area was conducted to delineate wetlands and waters of the U. S. The project area was examined utilizing the jurisdictional definition detailed in the *Corps of Engineers Wetlands Delineation Manual* (USACE Environmental Laboratory, 1987). Supplementary information to further support wetland determinations was found in the *National List of Plant Species that Occur in Wetlands: Southeast (Region 2)* (Reed, 1988).

There are no areas located within the project boundary that display true wetland characteristics. Therefore, no wetland restoration or enhancement activities are proposed under the East Buffalo Creek restoration project.

5.2 Reference Wetlands

There are no wetlands located within the project boundaries; therefore, no reference wetlands were selected.

6.0 PROJECT SITE RESTORATION PLAN

This section discusses the design objectives selected for the stream restoration, enhancement, and preservation of 11 tributaries encompassed within the East Buffalo Creek project area. Preservation is proposed on UT3, UT4, UT7, UT8, UT9, UT10, UT11, and Reach 1 of UT5, UT6, and East Buffalo Creek. Need, costs and risk benefits were weighed qualitatively in determining which reaches to preserve and which to enhance or restore. Despite prior impacts, the preservation areas have largely recovered. The remaining evidence for local instability is not of system-wide concern and mostly reflects local perturbations that are consistent with natural impacts found in reference streams. Any minor improvements that could be made to them would not be justified given the level of disturbance that would be required to access these steep and densely wooded areas.

The other reaches will be treated with the appropriate level of site work to generate a sustainable functional lift for the functions that have been compromised. Enhancement Level II measures are proposed for UT5 Reach 2, UT6 Reach 2, and Reach 2 of East Buffalo Creek. The design will focus on removing invasive species and establishing native riparian buffers in open areas where the existing upper canopy permits. UT6 Reach 2 will also benefit from the reduction in sediment input from the unpaved road by the relocation proposed in the UT6 Reach 3 management recommendation.

An Enhancement I approach is proposed for Reach 3 of UT6. The proposed approach will restore a stable channel dimension and profile through floodplain benching along the left bank and installation of grade control. Pattern will be addressed with the relocation of a portion of the channel away from the valley wall to minimize further bank erosion. Buffer improvements will involve the relocation of an eroded, unpaved driveway away from the channel to re-establish a wider, diversely vegetated buffer in order to minimize sediment loading. Nonnative vegetation will be eliminated and will be replaced with native buffer plantings that will provide bank stabilization, channel shading, and vegetative diversity.

UT2 will be restored. The Priority 1 approach for UT2 involves the reconstruction of a channel along the location of the previously abandoned historical stream channel within the low point of the valley.

Priority 1 restoration efforts on UT2 are justifiable for the following reasons:

1. The stream would benefit significantly by being returned to its original location, and pattern; and creating better riffle and step/pool sequences;
2. Moving the stream away from the valley wall will reduce erosion, improve floodplain connectivity, and improve floodplain hydrology;
3. The recommended Priority 1 restoration efforts are likely to raise the water table in the valley and result in improved hydrology.

The restored and enhanced stream channels will be Rosgen B type streams with design dimensions based on reference reaches, sediment transport modeling and successful application in past projects. Where abandoned, the old stream channel will be backfilled using berm material that presently exists along the channel. Any excess fill material that is generated during construction will be disposed of on-site in designated disposal areas at least 50 feet from any water course.

The proposed restoration and enhancement channel improvements will allow stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing the stress on streambanks. In-stream structures will be used to control streambed grade, reduce stresses on streambanks, and promote bedform sequences and habitat diversity for UT2 and UT6, Reach 3. In-stream structures may consist of root wads, constructed riffle/cascades, rock/log vanes, and boulder steps. Reach-wide grade control will be provided by the aforementioned in-stream structures. Where possible, both wood and rock will be

incorporated into the structures to promote a diversity of habitat features. Streambanks will be stabilized with a combination of bioengineering measures, erosion control matting, bare-root plantings, and live staking.

6.1 Restoration Project Goals and Objectives

The design objectives for East Buffalo Creek and its tributaries are based on the following goals:

- ✓ Create geomorphically stable conditions;
- ✓ Reduce sediment and nutrient loading by restoring riparian corridors;
- ✓ Restore or enhance hydrologic connectivity between streams and floodplain;
- ✓ Restore and preserve headwater tributaries to East Buffalo Creek (and Santeetlah Reservoir); and
- ✓ Improve aquatic and terrestrial habitat along the project corridor.

Design objectives are a set of guidelines used to accomplish these goals in an effective and efficient manner. The following objectives guided the design of the streams on this site:

1. Make important design decisions based on geomorphic and substrate analyses.
2. Use constructability as a guiding consideration in order to produce a realistic design that is possible to build given field constraints and construction tolerances. Design ideas are discussed with knowledgeable construction personnel to determine the constructability, likely footprint, and severity of impacts to on-site resources.
3. Minimize disturbance to ecologically functional and physically stable areas; mimic the character of these areas and borrow materials from them where appropriate to create a more natural design.
4. Structures and over-all design will attempt to use native materials and minimize materials brought on-site in order to produce habitat favoring native flora and fauna, reduce compaction and site disturbance from material transport, and produce an aesthetically pleasing result with minimal evidence of site disturbance.

UT2 and UT6, Reach 3 are appropriate candidates for restoration as these channels have been straightened in the past, and moved, or perched, to one side of the valley, and locked in these locations by manmade berms (or road embankments). These stream reaches have not been able to reach a stable state. Habitat and hydrologic function of UT2 will remain compromised from decreased baseflow conditions (disconnected hydrology) and limited bedform diversity until this channel is returned to the low point in the valley. A lack of a riparian buffer, and sediment input from localized bank erosion and the adjacent gravel driveway, continue to threaten the overall habitat function and stability of UT6, Reach 3. Restoration and enhancement measures will create a stable stream that will diminish bank erosion and improve habitat value.

The accompanying plans depict the proposed restoration measures. The application of these measures is described below for the project restoration reaches:

<u>UT2</u>

Priority I restoration of UT2 will address prior manipulation and relocation of the reach by recreating a channel with step-pool morphology in the low point of the valley. The reconstruction of the stream will facilitate the elimination of existing problems which include limited bedform or pool habitat, aggradation of fines, lack of riparian vegetation, and a disconnected hydrology that has decreased baseflow conditions, negatively affecting in-stream habitat. The new channel will be connected to the floodplain in the appropriate hydrologic location in the valley. Vertical and lateral stability will be achieved with riffle-pool sequences constructed with a series of small grade drops. Grade control structures will aid in dissipating streamflow energy, decrease pool-to-pool spacing and improve the quality of pool habitat present. A vegetated riparian buffer will also be restored. These efforts will restore grade control, lateral stability, and habitat features to the reach, thereby improving its health and function, as well as that of receiving waters.

<u>UT6 Reach 3</u>

Enhancement Level I work is proposed for Reach 3 of UT6 in an effort to improve in-stream habitat by minimizing sediment input to the stream from bank erosion and the adjacent unpaved road. Channel improvements related to this management recommendation will involve the manipulation of dimension and pattern to improve lateral channel stability and reduce bank erosion through a combination of floodplain benching and the relocation of a 53 foot length of channel away from the valley wall (along the right bank). Grade control structures will be strategically placed in selected areas to better distribute channel slope throughout the reach and improve pool habitat and bedform diversity (increasing pool to pool spacing) while reinforcing vertical stability in the channel profile.

Another significant component of this approach involves the re-establishment of a wide, vegetated buffer along the left floodplain by relocating approximately 832 LF of an eroding, unpaved driveway to the terrace. Sediment loading to the stream from the unpaved driveway is expected to be minimized given the proposed increase in buffer width and native buffer plantings which will help to improve floodplain sediment filtering capacity and also provide channel shading, bank stability, and vegetative diversity. Gravel road BMPs, such as water bars and ditch turnouts, are proposed for the newly constructed gravel driveway to diffuse concentrated storm flow, limit erosion and gullying, and to help maintain the integrity of the driveway for the land owner. Vegetated roadside swales and culverts will be installed at specific locations to direct runoff away from UT6 and toward an existing natural drainage possessing mature vegetation for filtering.

6.2 Design Criteria Selection for Stream Restoration

A number of analyses and data were incorporated in the development of the site-specific natural channel design approach for restoration efforts on UT2 and UT6, Reach 3. Among these are sediment analyses, existing site conditions data collection, incorporation of reference reaches, regime equations, and evaluation of results from past projects.

Design criteria are dependent on the general restoration approach determined to be a best fit for the East Buffalo Creek restoration site (Table 6.1). The approach was based on the reach's potential for restoration, as determined during the site assessment. After selection of the general restoration approach, specific design criteria were developed so that the plan view layout, cross section dimensions, and profile could be described for each reach, for the purpose of developing construction documents. The design philosophy at the East Buffalo Creek site is to use average values for the selected stream type when designing dimension and profile and to work within the ranges expected for the selected stream type with regards to pattern and in-stream structures used. This approach should allow for maximum diversity of pattern and habitat while maintaining step pools and riffles. Some variation in form will develop over long periods of time under the processes of flooding, re-colonization of vegetation, and geologic influences.

After examining the existing conditions, recognizing the potential for restoration, and reviewing reference reach data, specific design criteria were developed. Assigning an appropriate stream type for the corresponding valley that will accommodate the existing and future hydrologic and sediment contributions was considered conceptually prior to selecting reference reach streams. Design criteria for the proposed stream were selected based on the range of the reference data and the desired performance of the proposed channel.

Following initial application of the design criteria, detail refinements were made to accommodate the existing valley morphology, to avoid encroachment on property boundaries and the valley wall, to minimize unnecessary disturbance of the existing large trees, and to promote natural channel adjustment following construction. The proposed design rationale for the project is summarized in Table 6.1.

Table 6.1 Project Design Stream Types and Rationale
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Stream/Reach	Proposed Stream Type	Rationale
UT2	B3a	A Restoration approach will be used to establish a stable, step/pool channel with greater pool habitat and connectivity to the floodplain. Natural hydrology is expected to be restored by relocating the perched channel to the original low point in the valley. Bank stability will be improved by eliminating nonnative vegetation and planting diverse tree, shrub and herbaceous species.
East Buffalo Reach 2	NA	An Enhancement II approach will be used to improve the riparian buffer by eliminating nonnative vegetation and planting diverse trees where applicable. Native buffer plantings will provide bank stabilization, shading and vegetative diversity.
UT5 Reach 2	NA	An Enhancement II approach will be used to improve the riparian buffer by eliminating nonnative vegetation and planting diverse trees where applicable. Native buffer plantings will provide bank stabilization, shading and vegetative diversity.
UT6 Reach 2	NA	An Enhancement II approach will be used to improve the riparian buffer along this reach. Buffer improvements include the relocation of an eroded, unpaved driveway away from the channel to re-establish a wider, diversely vegetated buffer to more effectively minimize sediment loading. Nonnative vegetation will be eliminated and will be replaced with native buffer plantings where applicable, which will provide bank stabilization, channel shading, and vegetative diversity.
UT6 Reach 3	B4a	An Enhancement I approach will be used to restore a stable channel dimension and profile via floodplain benching along the left bank and installation of grade control, respectively. Pattern will be addressed with the relocation of a portion of channel away from the valley wall to minimize further bank erosion. Buffer improvements will involve the relocation of an eroded, unpaved driveway away from the channel to re-establish a wider, diversely vegetated buffer to more effectively minimize sediment loading. Nonnative vegetation will be eliminated and will be replaced with native buffer plantings where applicable, which will provide bank stabilization, channel shading, and vegetative diversity.

6.3 Stream Project Design & Justification

The primary objective of the restoration design is to construct a stream with a stable dimension, pattern, and profile that has access to its floodplain at bankfull flows while enhancing riparian and aquatic habitat. The philosophy applied by Baker through the restoration reach of UT2 and enhancement reach of UT6, Reach 3 consisted of creating a high width-depth ratio B type channel with the expectation that it may naturally narrow over time to an A-type morphology as the riparian buffers become more established.

Data for design guidance was developed using a survey of the existing conditions both upstream and within the design reach, selecting applicable reference reach data to survey and use in the development of dimensionless geomorphic design ratios, selecting data to enhance and extend the data range of published regional curves, and based on a consideration of constructability and equipment limitations. Lines of converging evidence provided confidence in the approach and design targets. The proposed design parameters for the restoration of UT2 and UT6 Reach 3 in the East Buffalo Creek project area are detailed in Table 6.2. The design rationale and design parameters are presented below.

Dimension

Through the proposed design, the cross section dimensions were adjusted to reduce velocities and near-bank shear stress during storm flows. Channel width was designed to maintain velocities that could

move small grain particles through the reach and avoid aggradation. A low bank height ratio (BHR) of 1.0 was designed so the channel has access to the floodplain during events having flows in excess of bankfull. Typical cross sections are shown on the attached plan sheets.

Pattern

The proposed channel alignment on UT2 will return the channel to the original location at the lowest point of the valley. Pattern will be addressed on UT6, Reach 3 by relocating a 53 LF section of channel, located downstream of the UT9 confluence, away from the right valley wall (or right bank). Baseflow within a few areas of UT6, Reach 3 has become diffuse, or braided, from sediment splays where the channel has become overwide, forming small islands as a result. Flow in these areas will be concentrated through the use of in-stream structures that will divert flow to the primary, stable channel, thus creating a single threaded channel. Plan views of the channel are shown on the attached plan sheets.

The pattern for the proposed step-pool channel is based on typical natural sinuosity for steep headwater streams in natural settings. A sinuosity of approximately 1.0 to 1.1 is typical of these streams and is appropriate for the new design channel. These channels do not dissipate energy in meanders but rather through vertical drops. The pattern has been laid out so as not to create high shear stresses with sharp bends that would be atypical to this type of stream system. The overall length of restored channel for UT2 will increase by about 282 LF, from 226 LF to 508 LF, or greater than twice the length of the existing condition channel for UT2. However, the existing channel is the bermed side slope channel that was routed along the valley wall and into the next drainage, and the length does not reflect a pre-impact condition. Plan views of the main channel are shown on the plan sheets.

Profile/Bedform

Although moderately functional and somewhat stable, the channel profile for UT2 and portions of the profile for UT6, Reach 3 are lacking sufficient overall bedform diversity. During construction of the proposed channel, cross section dimensions will be achieved first, followed by structure placement and facet development to mimic characteristics of the reference conditions. The profile along the proposed restoration channel alignment for UT2 calls for alternating steps, pools, and steep riffles (or cascades) while the proposed profile for UT6, Reach 3 calls for the sporadic, but strategic placement of alternating steps and pools. This step-pool morphology is typical of steep headwater mountain streams which are both hydraulically diverse and stable. With valley slopes ranging between approximately 17% and 19% for UT6, Reach 3 and UT2 respectively, the steps, pools, and cascades will provide adequate energy dissipation and prohibit bed degradation and excessive material transport. Riffle slopes and the magnitude of drops are limited to sustainable values observed to be stable from prior project experience. The average channel slope for the proposed UT2 restoration reach is 18.5% which is an increase of approximately 3% from the existing reach-wide slope for the perched channel. Riffles or cascades throughout the proposed UT2 design profile are between 0.5 and 1.3 times the average slope of the channel. Change in overall channel slope for UT6, Reach 3 is expected to be minimal since the work is limited to placement of a few in-stream structures throughout the reach. Structural modifications to the existing profile will be done primarily with rock structures on both stream reaches.

A stable cross section will be achieved by widening the channel and increasing the width/depth ratio. Stability will be enhanced by achieving a cross section with banks that are gently sloping up to the bankfull height while generally maintaining channel bottom widths observed on respective reference reaches. Grade control of the bed is a major concern at this site due to the steep slope of the valley. A variety of in-stream structures will be used to enhance stability and improve habitat. These structures include boulder steps, log J-hook structures and embedded logs. Bioengineering and in-stream structures will be used (including root wads, vegetated geo-lifts and log vanes) to promote additional bank stability and improve habitat.

UT2, a 508-LF reach, is designed as a Rosgen B stream type, having a steep slope and minimal meandering. A variety of in-stream structures will be installed in this reach that will serve to provide grade control, center the thalweg, and improve habitat quality. The downstream tie-in point for the proposed alignment of UT2 will be at the base of the rock wall or old road crossing, or the origin of the relic channel for UT2. The rock wall or old road crossing is composed of boulders and large cobble that will be strategically dismantled when excavating the proposed alignment and profile. The foundation stones will be left in place to provide ample grade control for the downstream limit of the proposed design. Excess rock removed from the wall will be incorporated into structures elsewhere or bed armoring as needed.

Table 6.2 Design Parameters and Proposed Geomorphic Characteristics
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Parameters	UT2		UT6	
	Min	Max	Min	Max
1. Stream Type	B3a		B4a	
2. Drainage Area – square miles	0.04		0.16	
3. Bankfull Width (w_{bkf}) – feet	7.7		9	
4. Bankfull Mean Depth (d_{bkf}) – feet	0.4		0.7	
5. Width/Depth Ratio (w/d ratio)	20		12.5	
6. Cross sectional Area (A_{bkf}) – SF	3		6.5	
7. Bankfull Mean Velocity (v_{bkf}) - fps	3		3.7	
8. Bankfull Discharge (Q_{bkf}) – cfs	9		23.8	
9. Bankfull Max Depth (d_{mbkf}) - feet	0.5		0.5	
10. d_{mbkf} / d_{bkf} ratio	1.2		1.4	
11. Low Bank Height to d_{mbkf} Ratio	1		1	
12. Floodprone Area Width (w_{fpa}) – feet	> 20		15.5	
13. Entrenchment Ratio (ER)	> 2		1.7	
14. Meander length (L_m) – feet	NA		NA	
15. Ratio of meander length to bankfull width (L_m/w_{bkf})				
16. Radius of curvature (R_c) – feet				
17. Ratio of radius of curvature to bankfull width (R_c / w_{bkf})				
18. Belt width (w_{blt}) – feet				
19. Meander Width Ratio (w_{blt}/W_{bkf})				
20. Sinuosity (K) Stream Length/ Valley Distance	1.1		1.1	
21. Valley Slope – feet per foot	0.19		0.17	
22. Channel Slope ($s_{channel}$) – feet per foot	0.18		0.16	
23. Pool Slope (s_{pool}) – feet per foot	0			
24. Maximum Pool Depth (d_{pool}) – feet	0.8	1.4		
25. Ratio of Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	2	3.5		
26. Pool Width (w_{pool}) – feet				
27. Ratio of Pool Width to Bankfull Width (w_{pool} / w_{bkf})				
28. Pool Area (A_{pool}) – square feet				
29. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})				
30. Pool-to-Pool Spacing – feet	11.6	23.2	7	48
31. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	1.5	3	0.7	5.3
32. Riffle Slope [4((s_{riffle}) – feet per foot	0.09	0.24	0.05	0.83
33. Ratio of Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	0.5	1.3	0.3	5.3

6.3.1 Sediment Transport Analysis

The purpose of a sediment transport analysis is typically to ensure that the stream restoration design creates a stable channel that does not aggrade or degrade over time. Being naturally degradational, steep

headwater streams should primarily be designed to have limited particle mobility so that the design particle size emulates or mimics the colluvial material that supports grade control in these systems. This is accomplished through a sediment competency analysis. It is typically a flow much greater than the bankfull flow that moves the larger particles present in these systems.

Sediment transport competency is a measure of force over an area (lbs/ft^2) that refers to the stream's ability to move a given particle size. Quantitative assessment undertaken for the design of this project includes shear stress and dimensionless shear stress analyses. Comparing the design critical shear stress values for a project reach to those of the existing conditions in a system allows a quantitative determination of reduction in erosive forces. The existing shear stresses are also valuable for interpretation of sediment sample data obtained from the existing channel.

Sediment samples were taken from a mix of preservation, enhancement and restoration reaches within the project area. The type of sample was either a bulk sample or a pebble count. Bulk samples are here defined as a sample of the bed, typically divided into pavement and subpavement components. The pavement is taken from the surface layer and, when compared to the subpavement (or subsurface layer), depicts the coarsening effect of winnowing to create an "armored" surface layer. The results and discussion of these samples are provided below. In addition, a summary of the pebble count samples are provided in Table 6.3.

6.3.1.1 Methodology and Discussion

The methods, results, and discussion of the sampling and calculation are discussed in this section. Finally, recommendations used for design based on these analyses and results are provided.

As previously mentioned, pavement, subpavement, and pebble count sediment samples were taken. While only one bulk sample (pavement/subpavement) was taken in the project area, pebble count samples were taken in each project reach. All sediment samples were weighed to generate cumulative frequency plots. From these plots, the D16, 35, 50, 84, 95, and 100 particle sizes were noted; results are provided in Table 6.3 below. The D50, a common means of comparison, is the particle size in millimeters for which 50% of the sample (by weight) is smaller. The particle size in millimeters is used to classify the particle as a sand, gravel, cobble, etc. For pebble counts, the D50 of East Buffalo Creek and its tributaries ranged from 11 to 50.6 mm (or medium to very coarse gravel). Also of interest, the D100 ranged from 128 to greater than 2048 mm (small cobble to very large boulder). For comparison, the subpavement taken from UT2 has a D50 of 43 mm and D100 of 108 mm. It does not have as coarse a particle size for the D100. In most of the recommended restoration reaches, sand and smaller particles account for more than 16% of the pebble count samples. UT5, Reach 1, which is proposed for preservation, demonstrates the reference condition that should be sought—the D16 particle is a medium gravel. The restoration of streambanks and the designation of a conservation easement to protect the riparian buffer should help the other reaches achieve a long term equilibrium in which the combined percentage of fines is very small, thus improving the stream habitat for macroinvertebrates and other species that are smothered by excessive sedimentation.

Table 6.3. Cumulative Sediment Distribution for East Buffalo and Tributaries
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Particle Size (mm)	UT8	UT7	UT6 Reach 1	UT5 Reach 1	UT5 Reach 2	UT4	East Buffalo Creek*	UT11
D_{16}	0.1	0.4	0.1	8.0	2.8	0.1	0.5	2.8
D_{35}	6.2	13.3	6.9	12.7	10.6	6.2	15.6	15.0
D_{50}	19.0	50.6	14.1	34.8	22.6	11.0	25.1	32.0
D_{84}	143.4	180.0	168.1	90.0	84.1	107.3	77.7	90.0

Table 6.3. Cumulative Sediment Distribution for East Buffalo and Tributaries
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Particle Size (mm)	UT8	UT7	UT6 Reach 1	UT5 Reach 1	UT5 Reach 2	UT4	East Buffalo Creek*	UT11
D_{95}	304.4	248.6	724.1	165.3	139.4	151.8	114.8	304.4
D_{100}	>2048	512 - 1024	> 2048	362 - 512	> 2048	180 - 256	128 – 180	512 - 1024

*Note: Reaches 1 and 2 of East Buffalo Creek combined.

Multiple methods were used to collect converging lines of evidence for recommending construction materials (stone) that will have limited or no mobility and will be appropriate for the headwater setting of the project. These methods are all published ways of estimating the critical particle size based on shear stress or velocity. Critical shear stress is calculated based on the typical riffle and pool; but the riffle is used as the predominant design calculation since it is the grade control for the project. The other grade control features (structures), will have a large factor of safety when selecting the appropriate size. This is intended to mimic boulders and bedrock outcroppings that are immobile or only mobile under event-of-record size events in headwater systems.

The energy grade line slope used in the analysis was 18 percent which is typical of East Buffalo Creek and its tributaries. Based on the proposed typical cross section for UT2, which has a cross sectional area of 3.0 square feet, a width to depth ratio of 20, and a wetted perimeter of approximately 7.9, the shear stress for a channel filling discharge was calculated to be 4.3 lb/ft^2. Based on this value, multiple methods were used to assess the maximum competent particle. Among the methods used were Lane's diagram (1953) as described in *Hydraulics of Sediment Transport* (Graf, 1971), the method "Shields Diagram for Direct Determination of Critical Shear" as described in *Open Channel Hydraulics* (Sturm 2001), a critical shear stress versus subpavement graph provided in Rosgen's training documents, and Figure 10.3 from Raudkivi's (1967) *Loose Boundary Hydraulics*. In addition, the riprap sizing plots referencing the Isbesh curve (based on velocity rather than shear stress) were consulted. The results were varied by about an order of magnitude, with good agreement between Lane, Shields, and Raudkivi. These methods yielded a maximum mobile particle size of 200-300 mm for bankfull flows in the typical riffle section. The Isbesh curve suggested that a smaller particle would be immobile (29 mm) and the Rosgen curve suggested that the mobile particle size would be considerably larger (~1000 mm). Based on the limitations of the methods, it is sufficient for this analysis to assume that particles below 200 mm have a much higher likelihood of movement under the right conditions at bankfull flow and that particles above 300 mm may be mobile under higher than bankfull flow conditions. The analysis suggests that particles on the order of 1000 mm should be immobile during almost all flow conditions.

DISCUSSION OF RESULTS AND CONCLUSIONS

Based on the existing conditions samples and the calculations based on the design cross section of UT2, there is a strong agreement in the particle sizes that will be resistant to motion under most or all flow conditions. For pebble count sampling, the largest particles were 128 mm to greater than 2048 mm. In all but two tributaries and in East Buffalo Creek, the maximum particle was between 128 and 1024 mm. This indicates that this particle size is rarely or never moved in these channels. The calculations indicated that particle sizes greater than 200-300 mm would be strongly resistant to motion. Under average velocity conditions (unaffected by variable flow conditions), perhaps the largest mobile particle would be much lower still. However, for design purposes, the sampling and calculations point to a coincident result that riffles and cascades should have a high percentage of particles greater than 200 mm in order to hold grade and that for grade control structures subject to a strong vertical forces, a minimum size of 500 mm and a typical size of >1000 mm is prudent.

Non-mobile riffle/cascade features for UT2 and UT6, Reach 3 should be conducted of Class 1 and 2 stone with a midrange particle size of 10-14" (255-355 mm); this would include riffle keys that extend far below the channel bed to serve as grade control protection. The existing bed material is very comparable to Class A stone. A mix of Class A and B stone may be incorporated into riffles at a percentage of up to 75 percent of the mix along with 25 percent larger Class 1 and 2 particles. Structures should be between 500-2000 mm based on the analysis in the previous paragraph; this corresponds with boulders of 2' X 1.5' X 1' up to 4' X 3' X 2'.

6.3.2 Hydrologic Trespass

UT2 is a low order tributary to East Buffalo Creek. It is not necessary to conduct a flood study based on the following information: according to the FEMA Flood Insurance Rate Map (FIRM) for Graham County, NC, (Map Number 3701050050B) the entire project area is in an unregulated area mapped Zone X (Figure 2.3). Flood modeling is not required for non-regulatory floodplains. Furthermore, any change in the 100-year water surface is expected to be minimal and to be contained within the conservation easement.

The County does not have a Local Floodplain Administrator so Baker will be consulting with the state to ensure that there are no other requirements. The FEMA floodplain checklist has been completed and is in Appendix B.

6.4 Site Construction

6.4.1 Site Grading, Structure Installation, and Other Project Related Construction

6.4.1.1 (Narrative)

A construction sequence for stream channel improvements is provided below and can be found within the accompanying restoration plan set for the East Buffalo Creek project.

Stream Channel Improvements:

1. Equipment and materials shall be mobilized to the site.
2. The contractor shall have all underground utilities within the project limits located and marked prior to beginning construction.
3. Access to the site shall be from the existing gated private drive on East Buffalo Road; any impact to these roads or associated erosion control practices shall be addressed immediately. All damage or impacts from use of existing access roads will be repaired immediately if it poses a risk to water quality or prior to demobilization or at the request of the project engineer.
4. The construction entrance shall be maintained to the specifications of the detail. Excessively muddy stone shall be replaced. All public roads shall be kept free of mud and debris.
5. Temporary and permanent stream crossings and temporary check dams shall be installed as shown in the plan set. Temporary check dams shall be removed when grading work upstream has been completed.
6. Construction shall proceed upstream to downstream. Grading of bankfull benches within a work area shall be done before new channels are graded and on UT6, after the newly relocated gravel driveway grading is completed.
7. Temporary sand bag coffer dams shall be installed upstream of each work area and water flow in the work reach shall be diverted by pumping around the work area. The length of each diversion shall be approximately 300 to 500 linear feet. Pumping will be done whenever work is required in a channel where the stream is flowing.

8. The limited clearing and grubbing required within the grading limits shall be performed so as to limit sediment migration off-site. Logs and root wads from trees larger than 10 inches in diameter shall be stockpiled for use as in-stream structures. Salvageable native vegetation (doghobble, yellowroot, etc.) shall be harvested for transplanting or for cutting and live-staking.
9. The new channel sections shall be stabilized with in-stream structures, erosion control matting, seed, and transplants before turning water into these sections. Compacted soil channel plugs shall be installed in areas where the new channel diverges from the original channel, and the original, abandoned channel sections will be backfilled.
10. Dewatering of off-line sections shall be diverted through a sediment filter before being discharged into the downstream reach.
11. Earthwork shall be staged such that no more channel will be disturbed than can be stabilized by the end of the work day or before flow is diverted into a new channel segment.
12. Excess soil materials shall be stockpiled in designated staging and stockpile areas, with silt fence installed on the stream side(s) of the base of the stockpiles and maintained when sediment has accumulated above one third of the height of the silt fence and/or the silt fence has failed. Excess soil shall be hauled outside the conservation easement before demobilization.
13. The flow diversions and temporary stream crossings shall be removed when no longer needed and the banks in these areas stabilized with seeding and matting.
14. Bank and floodplain vegetation, including brush materials and live stakes, are preferably installed during the dormant season, November to April.
15. Construction entrances, staging and stockpile areas, and silt fences shall be removed and the ground shall be repaired to its original conditions once planting is complete or once they are no longer needed.

Guidance for Gravel Road Construction:

1. Prior to construction, the new road alignment will be staked and reviewed by the Owner, Engineer, and Contractor. The layout stakes will be field adjusted by the Engineer to minimize impacts to mature trees while maintaining a constructible road with adequate geometry for the anticipated level of usage. The stream buffers will also be staked to ensure that no field changes encroach on the conservation easements.
2. The cross section of the 10-foot wide gravel road with a 2-inch crown is shown in the plan set. The grade of the centerline of the new road will follow the existing ground as much as possible with a maximum grade of 25% on the tangents and 20% on the curves. The roadway cross-section will be created by borrowing at a 1.5:1 slope on the uphill side to fill on a 2:1 slope on the downhill side. The contractor will balance the earthwork by borrowing additional fill from the enhancement earthwork along UT 6 – Reach 3.
3. Vegetated roadside swales are to be constructed on the uphill side of the new road. The road construction should incorporate cross pipes, where necessary and/or indicated, to reduce the flow in the ditches and direct the runoff toward stable vegetated natural drainage routes. Where possible, at 50-foot intervals, water bars should be constructed and the ditches turned out. At a minimum, the ditches should be turned out at every curve.

4. The surface of the existing roadbed to be abandoned will be scarified and filled over with additional soil, topsoil, and soil amendments as described for the planting plan and then planted as part of the conservation easement and buffer.

6.4.1.2 In-stream Structures

A variety of in-stream structures are proposed for the East Buffalo Creek site. Structures such as root wads, boulder steps, embedded logs and log vanes will be used to stabilize the newly-restored stream. This project will primarily utilize those structures which provide grade control and enhance pool habitat as "A" and "B" type streams make up the project site. Wood structures will be incorporated into the site because of the observed role of this material in the existing system. Table 6.3 summarizes the use of in-stream structures at the site.

Table 6.4 Proposed In-Stream Structure Types and Locations
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Structure Type	Location
Root Wad	Outside bank of bends for stability and habitat.
Boulder Steps	Straight sections to provide grade control, center thalweg, and improve habitat.
Embedded Logs	Primarily located in riffles to improve habitat diversity and below crossings to provide grade control.
Log Vane	Riffles to turn water off of the stream bank and provide convergence for habitat improvement.

Root Wad

Root wads are large in-tact root masses placed at the toe of the stream bank in high stress areas to absorb energy, increase flow roughness and provide a physical barrier to the erosion of vulnerable stream banks. In the process, they can help induce scour-pool formation and serve as habitat for organisms favoring wood or cover. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. They also increase substrate surface area for aquatic insects and other benthic organisms. Root wads include the root mass or root ball of a tree plus a portion of the trunk which is driven or buried into the bank. Root wads will be used in the restoration reach.

Boulder Step Structure

Boulder step structures consist of boulders placed in the channel in a U-shape constructed similarly to a cross-vane. These structures provide grade control in steep channels, direct high velocity flows to the center of the channel, and promote diverse habitat through the creation of plunge pools immediately downstream of the structure. These structures will be used extensively on the restoration reach.

Embedded Logs

Embedded logs consist of a series of logs placed in a series of opposing angles and slopes or in a perpendicular fashion to the channel banks. These structures are used to create micro-pool habitat that is common to mountain streams. Embedded logs can also function as grade control and are particularly useful below stream crossings.

Rock or Log Vane

A rock or log vane is used to protect the stream bank. The length of a single-vane structure can span one-half to two-thirds the bankfull channel width. Vanes in this project typically are intended to function as flow directional devices reducing near bank shear stress and alignment maintenance and secondarily as grade control features. Logs and/or boulders may be used to construct vanes.

Typically, cross vane applications in the project reach will be replaced with boulder steps due to the low width of the proposed cross section. In either case, the purpose is to keep the thalweg in the center of the channel, promote channel narrowing and protect the stream bank. Any cross vanes built for this project will come to more of a point due to the requirement that the vane allow for a triangular flow "ramp" on either margin of the channel.

6.4.2 Native Plant Community Restoration

Native riparian vegetation will be established in the restored stream buffer. Also, any areas of invasive vegetation such as multiflora rose and Japanese honeysuckle will be removed so as not to threaten the newly-established native plants within the conservation easement.

6.4.2.1 Soil Preparation and Amendments

Soil amendments will be prepared according to the dominant soil types present within the floodplains for East Buffalo Creek and its tributaries and subsequent analysis of the soils by the NRCS. Application of soil amendments will occur as temporary site stabilization measures are implemented, during construction and during installation of permanent bank and riparian vegetation. The use of soil amendments will be minimized to the extent possible to prevent the accelerated growth of weed species as the native riparian seed mix becomes established.

6.4.2.2 Riparian Community Plant Restoration

Bare-root trees, live stakes, and permanent seeding will be planted within designated areas of the conservation easement. A 30-foot buffer measured from the top of banks will be established along all jurisdictional stream reaches. Bare-root vegetation will be planted at a target density of 680 stems per acre. The proposed species to be planted are listed in Table 6.4. Planting of bare-root trees and live stakes will be conducted during the first dormant season following construction. If construction activities are completed in summer/fall of a given year, all vegetation will be installed prior to the start of the growing season of the following calendar year.

Species selection for re-vegetation of the site will generally follow those suggested by Schafale and Weakley (1990) and tolerances cited in the USACE Wetland Research Program (WRP) Technical Note VN-RS-4.1 (1997). Tree species selected for stream restoration areas will generally be weakly tolerant to tolerant of flooding. Weakly tolerant species are able to survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species are able to survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species are able to survive on sites in which the soil is saturated or flooded for extended periods during the growing season (WRP, 1997).

Observations will be made during construction regarding the relative wetness of areas to be planted. Planting zones will be determined based on these observations, and planted species will be matched according to their wetness tolerance and the anticipated wetness of the planting area.

Live stakes will be installed two to three feet apart using triangular spacing or at a density of 160 to 360 stakes per 1,000 square feet along the stream banks just above and just below the bankfull elevation. Site variations may require slightly different spacing.

Permanent seed mixtures of native species will be applied to all disturbed areas of the project site. Table 6.5 lists the species, mixtures, and application rates that will be used. A mixture is provided for floodplain wetland and floodplain non-wetland areas. Mixtures will also include temporary seeding (rye grain during cold season or browntop millet during warm season). The permanent seed mixture specified for floodplain areas will be applied to all disturbed areas outside the banks of the restored stream channel and is intended to provide rapid growth of herbaceous ground cover and improvements to biological habitat value. The species provided are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability.

Temporary seeding will be applied to all disturbed areas. These areas include constructed stream banks, access roads, side slopes, and spoil piles. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 45 pounds per acre.

Table 6.5 Proposed Bare-Root and Live Stake Species (may also include seed or container species)
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Common Name	Scientific Name	% Planted by Species	Wetness Tolerance
Riparian Buffer Plantings			
Trees Overstory			
Sycamore	*Platanus occidentalis*	8	FACW-
River Birch	*Betula nigra*	7	FACW
White Oak	*Quercus alba*	5	FACU
Red Maple	*Acer rubrum*	5	FAC
Tulip Poplar	*Liriodendron tulipifera*	5	FAC
Yellow Birch	*Betula alleghaniensis (lutea)*	5	FACU+
Black (Sweet) Birch	*Betula lenta*	5	FACU
Northern Red Oak	*Quercus rubra*	5	FACU
Yellow Buckeye	*Aesculus octandra*	5	N/A
Mockernut Hickory	*Carya alba (tomentosa)*	3	N/A
Scarlet Oak	*Quercus coccinea*	2	N/A
Trees Understory			
Highland Doghobble	*Leucothoe fontanesiana (axilarris var. editorum)*	5	N/A
Mountain Laurel	*Kalmia latifolia*	5	FACU
Flame Azalea	*Rhododendron calendulaceum*	5	N/A
Black Willow	*Salix nigra*	2	OBL
Ironwood	*Carpinus caroliniana*	3	FAC
Witch Hazel	*Hamamelis virginiana*	2	FACU
Sourwood	*Oxydendrum arboreum*	5	FACU
Flowering Dogwood	*Cornus florida*	5	FACU

Table 6.5 Proposed Bare-Root and Live Stake Species (may also include seed or container species)
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Common Name	Scientific Name	% Planted by Species	Wetness Tolerance
Rhododendron	*Rhododendron maximum*	3	FAC-
Tag Alder	*Alnus serrulata*	5	FACW+ or OBL
Redbud	*Cercis canadensis*	5	FACU
Shrubs			
Rivercane (giant cane)	*Arundinaria gigantea*	15	FACW
Spicebush	*Lindera benzoin*	15	FACW
Deerberry	*Vaccinium stamineum*	15	FACU
Eastern Sweetshrub, Sweetshrub	*Calycanthus floridus, Calycanthus spp.*	10	FACU
Sweetpepperbush	*Clethra spp.*	15	N/A
Winterberry	*Ilex verticillata*	10	FACW
Virginia Sweetspire	*Itea virginica*	15	FACW+
Chokeberry	*Photinia*	5	N/A
Alternate Species			
Blight-resistant American Chestnut	*Castanea dentata*	N/A	N/A
American Hazelnut	*Corylus americana*	N/A	FACU
Blue Ridge Blueberry	*Vaccinium pallidum*	N/A	N/A
Riparian Livestake Plantings			
Ninebark	*Physocarpus opulifolius*	15	FAC-
Elderberry	*Sambucus canadensis*	20	FACW-
Buttonbush	*Cephalanthus occidentalis*	15	OBL
Silky Willow	*Salix sericea*	25	OBL
Silky Dogwood	*Cornus amomum*	25	FACW+

Note: Species selection may change due to refinement or availability at the time of planting.

Table 6.6 Proposed Permanent Seed Mixture Species
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Common Name	Scientific Name	% Planted by Species	Density (lbs/ac)	Wetness Tolerance
Creeping Bentgrass	*Agrostis stolonifera*	10%	1.5	FACW
Big Bluestem	*Andropogon gerardii*	2%	0.3	N/A
Devil's Beggartick	*Bidens frondosa (or aristosa)*	3%	0.45	FACW
Northern Long Sedge	*Carex folliculata*	2%	0.3	N/A
Nodding Sedge	*Carex gynandra*	5%	0.75	N/A
Upright Sedge	*Carex stricta*	2%	0.3	OBL
Lance-leaved Tick Seed	*Coreopsis lanceolata*	3%	0.45	N/A
Virginia Wildrye	*Elymus virginicus*	15%	2.25	FAC

Table 6.6 Proposed Permanent Seed Mixture Species
East Buffalo Creek Mitigation Plan-NCEEP Project #000615

Common Name	Scientific Name	% Planted by Species	Density (lbs/ac)	Wetness Tolerance
Soft Rush	*Juncus effusus*	2%	0.3	FACW+
Tioga Deer Tongue	*Panicum clandestinum*	10%	1.5	FACW
Switch Grass	*Panicum virgatum*	15%	2.25	FAC+
Pennsylvania Smartweed	*Polygonum pensylvanicum*	5%	0.75	FACW
Broadleaf Arrowhead	*Sagittaria latifolia var. pubescens*	1%	0.15	OBL
Little Bluestem	*Schizachyrium scoparium*	5%	0.75	FACU
Roundleaf Goldenrod	*Solidago patula*	3%	0.45	OBL
Indian Grass	*Sorghastrum nutans*	10%	1.5	FACU
Eastern Gamma Grass	*Tripsacum dactyloides*	5%	0.75	FAC+
Joe Pye Weed	*Eupatorium fistulosum*	2%	0.3	N/A
	Total	100	15	

Note: Species selection may change due to refinement or availability at the time of planting.

6.4.2.3 Invasives Species Management/Other Vegetation Management

The East Buffalo Creek project site has stands of multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), and privet (*Ligustrum sinense*) on the floodplains of the enhancement and restoration reaches: UT5, Reach 2 , UT6 Reaches 2 and 3, Reach 2 of East Buffalo Creek, and within the downstream limits of where UT2 is proposed to be rerouted. These stands will be mechanically removed during construction and destroyed. These populations will be monitored to evaluate if they begin to reestablish. If these species persist after removal, individual plants will be treated with a direct application of herbicide and monitored to insure they are completely eradicated. Areas of infestation by these invasive species will be monitored to insure they do not threaten the newly-planted riparian vegetation by becoming reestablished.

7.0 PERFORMANCE CRITERIA

Baker has been involved in obtaining recent approvals from the regulatory agencies for a series of mitigation and restoration plans for NCEEP full-delivery projects. The stream restoration success criteria for the project site will follow accepted and approved success criteria presented in recent restoration and mitigation plans developed for these full delivery projects. These plans were based on the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWQ. Specific success criteria components are presented below.

7.1 Stream Monitoring

Channel stability and vegetation survival will be monitored on the project site. Post-restoration monitoring will be conducted for five years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream parameters include stream dimension (cross sections), pattern (longitudinal survey), profile (profile survey), and photographic documentation. The methods used and related success criteria are described below for each parameter.

7.1.1 Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. The crest gauge will be installed on the floodplain within 10 feet of the restored channel. The crest gauge will record the highest watermark between site visits, and the gauge will be checked each time there is a 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 monitoring site visits.

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

7.1.2 Cross Sections

Two permanent cross sections will be installed per 1,000 linear feet of stream restoration work, with one located at a riffle cross section and one located at a pool cross section. Although it is only 524 LF in length, two permanent cross sections will be established on the Level I Enhancement reach, UT6 Reach 3. No cross sections are proposed for Level II Enhancement reaches as these reaches are limited to vegetation enhancement work only. Each cross section will be marked on both banks with permanent pins to establish the exact transect used. A common benchmark will be used for cross sections and consistently used to facilitate easy comparison of year-to-year data. The annual cross section survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross sections will be classified using the Rosgen Stream Classification System.

There should be little change from the as-built cross sections. If changes do take place, they should 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). Cross sections will be classified using the Rosgen Stream Classification System, and all monitored cross sections should fall within the quantitative parameters defined for channels of the design stream type.

7.1.3 Longitudinal Profile

A longitudinal profile will be surveyed immediately after construction and once every year thereafter for the duration of the five-year monitoring period. The as-built survey will be used as the baseline for

year one monitoring. Per the monitoring report guidelines, the longitudinal profile will extend the entire length of restoration on UT2 and the length of Level I Enhancement improvements implemented along UT6 Reach 3. Measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The survey will be tied to a permanent benchmark.

The longitudinal profiles should show that the bedform features are remaining stable; i.e., they 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. Bedforms observed should be consistent with those observed for channels of the design stream type.

7.1.4 Bed Material Analyses

Pebble counts will be conducted for at least six permanent cross sections (100-counts per cross section) across the East Buffalo Creek project site. Pebble counts will be conducted immediately after construction and annually thereafter at the time the cross section and longitudinal surveys are performed during the five year monitoring period. Pebble count data will be plotted on semi-log paper and compared with data from previous years.

7.1.5 Photo Reference Sites

Photographs will be used to visually document restoration success. Reference stations will be photographed before construction and continued annually for at least five years following construction. Photographs will be taken from a height of approximately five to six feet. Permanent markers will be established to ensure that the same locations (and view directions) on the site are monitored in each monitoring period.

Lateral reference photos. Reference photo transects will be taken at each permanent cross section. Photographs will be taken of both banks at each cross section. The survey tape will be centered in the photographs of the bank. The water line will be located in the lower edge of the frame, and as much of the bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

Structure photos. Photographs will be taken of grade control structures along the restored stream, and will be limited to boulder and log steps. Photographers will make every effort to consistently maintain the same area in each photo over time.

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

7.2 Vegetation Monitoring

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, vegetation monitoring quadrants will be installed across the restoration site. The NCEEP's methodology for determining the number of vegetation plots required per mitigation site will be used to figure the number of quadrants needed for the East Buffalo Creek project. The size of individual quadrants will vary from 100 square meters for tree species to 1 square meter for herbaceous vegetation. Vegetation monitoring will occur in spring, after leaf-out has occurred. Individual quadrant data will be provided and will include diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual seedlings will be marked to ensure that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first growing season, species composition, density, and survival will be evaluated. For each subsequent year, until the final success criteria are achieved, the restored site will be evaluated between July and November.

Specific and measurable success criteria for plant density on the project site will be based on the recommendations found in the WRP Technical Note and past project experience.

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. While measuring species density is the current accepted methodology for evaluating vegetation success on restoration projects, species density alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices to assess overall vegetative success.

7.3 Schedule/Reporting

Annual monitoring reports containing the information defined herein will be submitted to NCEEP by December 31 of the year during which the monitoring was conducted. Project success criteria must be met by the fifth monitoring year, or monitoring will continue until all success criteria are met

8.0 PRELIMINARY MONITORING

Once construction is complete, geomorphic data collected during the design phase will be compared to post-construction survey data to evaluate the success of restoration measures implemented. Post-construction data will be summarized in a mitigation plan which will also include Baker's monitoring approach for evaluating the success of the East Buffalo Creek and its tributaries within the project area for five years following the collection of As-built data. Preliminary monitoring of the site included the collection of longitudinal profile data as well as cross sectional data to assess existing channel dimension and hydraulic function. Other data collected during the preliminary monitoring phase included sediment transport data and vegetative data including an evaluation of invasive vegetation present.

9.0 SITE PROTECTION AND ADAPTIVE MANAGEMENT STRATEGY

East Buffalo Creek and its tributaries included within the restoration plan will be protected by a permanent conservation easement that will be held by the State. Baker will monitor the project site for a minimum of five years following construction. Post-construction monitoring activities will be conducted to evaluate site performance, to identify maintenance and/or repair concerns, and to maintain the integrity of the project boundaries. If during the post-construction monitoring period it is determined project compliance is jeopardized, Baker shall take the necessary action to resolve the project concerns and bring the project back into compliance. If maintenance or site repairs become necessary, Baker will evaluate the level of response required, secure a contractor to make the repairs and monitor the work performed by the construction contractor.

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- ✓ Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- ✓ Projects with sandy, non-cohesive soils are more prone to short-term bank erosion than cohesive soils or soils with high gravel and cobble content.
- ✓ Alluvial valley channels with wide floodplains are less vulnerable than confined channels.
- ✓ Wet weather during construction can make accurate channel and floodplain excavations difficult.
- ✓ Extreme and/or frequent flooding can cause floodplain and channel erosion.
- ✓ Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- ✓ The presence and aggressiveness of invasive species can affect the extent to which a native buffer can be established.

Maintenance issues and recommended remediation measures will be detailed and documented in post-construction monitoring reports as necessary. The conditions listed above and any other factors that may have necessitated maintenance will be discussed. If more substantial repair work is required Baker will coordinate with the NCEEP and regulatory agencies to determine whether work performed merits an extended monitoring period. At the conclusion of the post-construction monitoring period the project shall be transferred to the NCDENR Division of Natural Resource Planning and Conservation Stewardship Program for long-term management and stewardship.

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APPENDIX A. NCDWQ Stream Identification Forms

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.6.07	**Project:** E. Buffalo	**Latitude:**
Evaluator: MC + AMC	**Site:** E Buffalo	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if > 30* 32.5	**County:** Graham	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 16)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	(0.5)	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?		(No = 0)	Yes = 1.5	

C. Biology (Subtotal = 7.5)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5	1	(1.5)
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Sketch:

Notes: (use back side of this form for additional notes.)

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 4/2/07	Project: E. Buffalo	Latitude: 35°22'16"N
Evaluator: AB	Site: UT2	Longitude: 83°47'29"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 37.5	County: ~~Mitchell~~ Graham	Other *e.g. Quad Name:* Robbinsville

A. Geomorphology (Subtotal = 26)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	0	(1)	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 3.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	0.5	1	1.5
23. Bivalves	0	1	2	3
24. Fish	0	0.5	1	1.5
25. Amphibians - Salamanders	0	0.5	1	(1.5)
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2·6·07	Project: E. Buffalo	Latitude:
Evaluator: AMC + MC	Site: UT 3 (downstream)	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30.5	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoxymorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 3)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.6.07	**Project:** E. Buffalo	**Latitude:**
Evaluator: MC + AMC	**Site:** UT 3 (upstream)	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 22.5	**County:** Graham	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 16.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	0.5	(0)
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 0)				
20[b]. Fibrous roots in channel	3	2	1	(0)
21[b]. Rooted plants in channel	3	2	1	(0)
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.6.07	Project: E. Buffalo	Latitude:
Evaluator: MC + AMC	Site: UT 4 (downstream)	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 33	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2·6·07	Project: E. Buffalo	Latitude:
Evaluator: AMC + MC	Site: UT 4 (upstream)	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 23.5	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 15)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	(0)	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?		(No = 0)	Yes = 1.5	

C. Biology (Subtotal = 2)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2·6·07	**Project:** E. Buffalo	**Latitude:**
Evaluator: AMC + MC	**Site:** UT 5 (downstream)	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 31.5	**County:** Graham	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 21)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	0	1	2	(3)
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 4)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2·6·07	Project: E. Buffalo	Latitude:
Evaluator: AMC + MC	Site: UT 5 (upstream)	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 23.5	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 4)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.22.07	Project: E. Buffalo	Latitude:
Evaluator: AMC	Site: UT6	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30.5	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	2	(3)
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoxiomorphic features) present?		(No = 0)	Yes = 1.5	

C. Biology (Subtotal = 3)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.22.07	Project: E. Buffalo	Latitude:
Evaluator: AMC	Site: UT7	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 35	County: Orange	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 23.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	0	(1)	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	(0)
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?		(No = 0)	Yes = 1.5	

C. Biology (Subtotal = 4)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2.22.07	Project: E. Buffalo	Latitude:
Evaluator: AMC	Site: UT8	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 28.5	County: Graham	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 18)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	(0)	1	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	1	2	(3)
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 2)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality Stream Identification Form. Version 3.1

Date: 5/26/09	Project: East Buffalo	Latitude:
Evaluator: CHM / CM	Site: UT9	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 33	County:	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	1	2	(3)
8. Recent alluvial deposits	0	1	(2)	3
9[a]. Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a]Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaf litter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 6)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	(FAC=0.5) FACW=0.75 OBL=1.5 SAV= 2.0 Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.

shaded

ferns

Notes: (use back of form for additional notes)

Sinuosity low due to steepness of channel

Headcuts boulders

1693 LF

P/E Break

1492 LF - possible I/P Break

(Log Skin)

Sketch:

North Carolina Division of Water Quality Stream Identification Form. Version 3.1

Date: 5/26/09	**Project:** EAST BUFFALO	**Latitude:**
Evaluator: CMM / CM	**Site:** UT 10 P/I	**Longitude:**
Total Points: 31.25 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**County:** (BREAK Downstream)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 16)	**Absent**	**Weak**	**Moderate**	**Strong**
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1) →	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a]. Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

[a]Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaf litter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 6.75)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5	1	(1.5)
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC=0.5 FACW=(0.75) OBL=1.5 SAV= 2.0 Other = 0			
[b] Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.				

Notes: (use back of form for additional notes)

SINUOSITY NEAR - STEEP CHANNEL & SURROUNDING TOPOGRAPHY

SOME FERNS ON FRINGE OF CHANNEL

RAINED PREVIOUS DAY

STEP-POOL & CASCADE CHANNEL STRUCTURE FOR MUCH OF CHANNEL

Sketch:

North Carolina Division of Water Quality Stream Identification Form. Version 3.1

Date: 5/26/09	**Project:** EAST BUFFALO	**Latitude:**
Evaluator: CMM / CM	**Site:** UT 10 I/E	**Longitude:**
Total Points: 25 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**County:** BREAK (upstream)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14)	**Absent**	**Weak**	**Moderate**	**Strong**
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	(0)	1	2	3
9[a]. Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

[a]Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	(2)	3
16. Leaf litter	1.5	1	(0.5)	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

RAINED PREVIOUSDAY

C. Biology (Subtotal = 6)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC=(0.5) FACW=0.75 OBL=1.5 SAV= 2.0 Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back of form for additional notes)

SINUOSITY WEAK DUE TO STEEPNESS OF CHANNEL / SURROUNDING TOPOGRAPHY

STEP-POOL - CASCADE CHANNEL STRUCTURE

SOME WETLAND VEG (FERNS) ON FRINGE ON CHANNEL

SOME MIDGES + CRANEFLY LARVAE NOTED

Sketch:

North Carolina Division of Water Quality Stream Identification Form. Version 3.1

Date: 5/27/09	**Project:**	**Latitude:**
Evaluator: Carmen Horne-McIntyre	**Site:** East Buffalo Creek - UT11	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 23.5	**County:**	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 17)	**Absent**	**Weak**	**Moderate**	**Strong**
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a]. Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a]Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 2)				
14. Groundwater flow/discharge	* (0)	1	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	(0)	1	2	3
16. Leaf litter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 4.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5 **	(1)	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	(FAC=0.5) FACW=0.75 OBL=1.5 SAV= 2.0 Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants. Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back of form for additional notes)

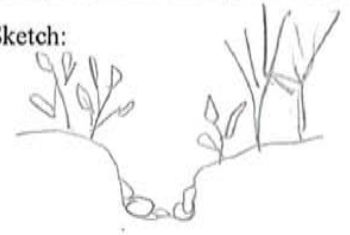
* FLOW IN CHANNEL OBSERVED PREVIOUS WEEK

** SALAMANDER OBSERVED

Possible wetland vegetation banks, Not in bed of stream

WEAK SINUOSITY DUE TO STEEPNESS OF CHANNEL / TOPOGRAPHY

Sketch:



APPENDIX B. Regulatory Agency Correspondence

June 2, 2008

Mr. Micky Clemmons
Michael Baker of NY, Inc.
797 Haywood Road, Suite 201
Asheville, North Carolina 28806

Subject: Categorical Exclusion Form for
East Buffalo Creek Stream Restoration & Enhancement Project
Little Tennessee River Basin – CU# 06010204
Graham County, North Carolina
Contract No. 000615

Dear Mr. Clemmons:

Attached please find the approved Categorical Exclusion Form for the subject full delivery project. Please include a copy of the form in your Restoration Plan. I will approve the invoice for completion of Task 1upon receipt.

If you have any questions, or wish to discuss this matter further, please contact me at any time. I can be reached at (919) 715-1656, or email me at guy.pearce@ncmail.net.

Sincerely,

Guy C. Pearce
EEP Full Delivery Program Supervisor

cc: file

Categorical Exclusion Form for Ecosystem Enhancement Program Projects

Part 1: General Project Information	
Project Name:	East Buffalo Creek Restoration & Enhancement Project
County Name:	Graham County
EEP Number:	000615
Project Sponsor:	Baker Engineering NY, Inc.
Project Contact Name:	Micky Clemmons
Project Contact Address:	797 Haywood Rd., Suite 201 Asheville, NC 28806
Project Contact E-mail:	mclemmons@mbakercorp.com
EEP Project Manager:	Guy Pearce

Project Description

Baker Engineering NY, Inc., proposes to conduct stream restoration and enhancement activities in Graham County, four miles northeast of Robbinsville. East Buffalo Creek is a Class C water within cataloging unit 06010204 and DENR sub-basin 04-04-04 of the Little Tennessee River Basin. Project goals include the restoration, enhancement, or preservation of approximately 9,920 linear feet of stream for the purpose of obtaining stream mitigation credit in the Little Tennessee River Basin.

For Official Use Only

Reviewed By:

Date — **EEP Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

☐ **Check this box if there are outstanding issues**

Final Approval By:

5-30-08

Date — **For Division Administrator FHWA**

7

RECEIVED
MAY 27 2008
NC ECOSYSTEM
ENHANCEMENT PROGRAM

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☒ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☒ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☒ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☒ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☒ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☒ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☒ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☒ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☒ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☒ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☒ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☒ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☒ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☒ Yes ☐ No
2. Does the project require the acquisition of real estate?	☒ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☒ Yes ☐ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☒ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☒ Yes ☐ No
2. Is the site of religious importance to American Indians?	☐ Yes ☒ No ☐ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☒ No ☐ N/A
4. Have the effects of the project on this site been considered?	☒ Yes ☐ No ☐ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☒ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☒ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☒ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☒ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☒ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☒ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☒ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☒ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☒ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☐ Yes ☒ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☒ No ☐ N/A
4. Is the project "likely to adversely affect" the specie and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☒ No ☐ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☒ Yes ☐ No ☐ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☒ No ☐ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☒ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☒ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☒ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☒ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or local important farmland?	☐ Yes ☒ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☒ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☒ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☒ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☒ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☒ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☒ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☒ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☒ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☒ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☒ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☒ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☒ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☒ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☒ N/A

Categorical Exclusion – Summary

Project Background
The East Buffalo Tributaries Enhancement Project involves the restoration, enhancement or preservation of approximately 9,920 linear feet of stream in Graham County for the purpose of obtaining stream mitigation credit for the NC Ecosystem Enhancement Program (NCEEP). Land cover on the property is predominantly forested with the exception of pasture land and residential development in the lower reaches of the project area. Un-named Tributaries (UT) 1 and 2 are located in pastureland while the lower reaches of UT6 and East Buffalo Creek run adjacent to a gravel road past several residences.

The National Environmental Policy Act of 1969 (NEPA) requires agencies to use an interdisciplinary approach in planning and decision-making for actions that will have an impact on the environment. The Federal Highway Administration (FHWA) and NC Department of Transportation (NCDOT) have determined that NCEEP projects will not involve significant impacts and therefore a Categorical Exclusion (CE) is the appropriate type of environmental document for this project. FHWA has also determined that stream restoration projects are considered land disturbing activities, so Parts 2 and 3 of the NCEEP checklist and the following environmental laws are applicable to this project (supporting information is located in the Appendix):

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
Environmental Data Resources, Inc (EDR) prepared a Radius Map Report with GeoCheck on January 3, 2008. Based on the EDR report, there are no known or potential hazardous waste sites within or adjacent to the project area. The Executive Summary of the EDR report is included in the Appendix.

National Historic Preservation Act (Section 106)
Baker Engineering requested review and comment from the North Carolina State Historic Preservation Office (SHPO) on any possible issues that might emerge with respect to architectural or archaeological resources from the restoration project on February 8, 2008. Baker also requested review and comment from the Tribal Historic Preservation Office of the Eastern Band of Cherokee Indians on February 8, 2008. The SHPO responded on February 26, 2008, and requested that a Phase I Survey be completed. Although there were no known recorded sites or resources within the project area, three previously recorded sites are located less than one mile from the project area. Baker contracted with Archaeological Consultants of the Carolinas, Inc. to perform the survey which was completed in March 2008. The archaeological consulting group was unable to locate any sites within the project area and issued a report recommending no further archaeological investigations be conducted for the purposes of this project. On April 17, 2008, the SHPO submitted correspondence to Baker agreeing with the findings of the Archaeological Consultants of the Carolinas. As of March 31, 2008, the Tribal Historic Preservation Office has not provided comment. All correspondence on this issue is included in the Appendix.

Uniform Relocation Assistance and Real Property Act
Land owners participating in the stream restoration project were notified of the fair market value their land coincident with the project and that Baker Engineering did not have condemnation authority prior to signing the Option Agreement for the Conservation Easement.

American Indian Religious Freedom Act (AIRFA)
Baker Engineering requested review and comment from the Eastern Band of Cherokee Indians' Tribal Historic Preservation Office (THPO) on any possible issues that might emerge with respect to any architectural or archaeological resources from the restoration project on February 8, 2008. At this time, THPO has not commented on the project. Baker Engineering will continue working with THPO to ensure they do not have any concerns regarding the project. All correspondence on this issue is included in the Appendix.

Endangered Species Act (ESA)
Baker Engineering reviewed both the NC Natural Heritage Program (NCNHP) and the US Fish and Wildlife Service (USFWS) lists of rare and protected animal and plant species and found that six federally listed species are known to occur in Graham County: Bog Turtle (*Clemmys muhlenbergii)*, Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus)*, Indiana Bat (*Myotis sodalis*), Appalachian Elktoe (*Alasmidonta raveneliana*), Virginia Spiraea (*Spiraea virginiana*), and the Rock Gnome Lichen (*Gymnoderma lineare*).

It was determined that no suitable habitat existed for five of the six species listed for Graham County. Therefore, a "no effect" determination has been made for these five species. Some habitat features favored by the *Spiraea viginiana* were noted during preliminary field observations and are discussed below. Disturbed, open areas and sections of scoured streambank were present within the project site and access routes, but were devoid of the suitable habitat conditions required by the *S. virginiana* upon further investigation. Furthermore, no individual plants or plant populations of the *S. virginiana* were located during preliminary field surveys or surveys most recently conducted on April 30 and May 5-7, 2008. As a result, a "no effect" determination was also made for the Virginia spiraea.

Access to restoration and enhancement reach sites will be achieved by utilizing previously established access routes on-site. Preservation and vegetation enhancement within the stream riparian corridor will serve to protect and promote habitat for these species. More detail on each species and their habitat is listed in the following paragraphs.

Bald Eagle (Federally Protected): Bald eagles have been sighted in Graham County given the large open waters of Santeetlah Lake. According to the NC Natural Heritage Program website, bald eagle habitat in the southeast typically consists of "dominant live pines or cypress trees that provide a clear flight path and are located within 0.5 miles of open water. Winter roosting usually occurs farther inland, within dominant tree types that are also used for nesting in warmer seasons. According to information posted on the NC Natural Heritage Program website, there are no occurrences of the bald eagle that have been recorded within 2 miles of the project area. However, the project area consists of headwater streams with small drainage areas. The streams within the project area are not identified as trout supporting streams and are unlikely to hold prey-sized fish to support bald eagle populations.

This project primarily involves riparian enhancement and bank stabilization with limited in-stream channel restoration work. Restoration activities will consist of relocating two tributaries and re-establishing channel dimension, pattern, and profile of approximately 980 LF of stream. The streams to be restored, UT1 and UT2, have been moved in the past from the low point of the valley to the toe of slope abutting the valley wall in order to allow for agricultural practices. Improvements made through this project will not adversely impact any bald eagle populations or habitat. Canopy improvements made to the riparian zone within the restoration and enhancement reaches of the project area could actually support bald eagles in the long term should any of the planted trees become dominant canopy trees. Stream enhancement activities will also result in improved channel stability and water quality through a reduction in sediment loading.

Biological Conclusion: No effect

Bog turtle, (Threatened): NCNHP lists the preferred habitat as "*shallow, spring-fed fens, sphagnaceous bogs, marshy meadows and pasture, with thick, grassy cover and crossed by slow, muddy bottomed streams, and swamps with aquatic and semiaquatic plants. The best habitats in NC are open and sunny.*" The East Buffalo Creek project site is predominantly forested. Shallow spring-fed fens, sphagnaceous bogs and marshy meadows are not present in the pasture land that comprises part of the site. Streams

on-site are fairly fast flowing, steep, and have a bed of gravel and cobble with minimal areas of mud or silt. There should be no effects from construction of this project because the project will have no direct impacts to a population or to habitat for this species.

Biological Conclusion: No effect

Carolina northern flying squirrel, (Endangered): The Carolina northern flying squirrel prefers the ecotone between coniferous and mature northern hardwoods usually above 4,500 feet above sea level (ASL) or narrow, north-facing valleys above 4,000 feet ASL. There is no habitat of this kind at the project site. Preservation reaches within the project area reach a maximum of 3,000 feet ASL or lower. Enhancement and restoration reaches where land disturbing activities will occur are located at 2,680 feet ASL and lower, as the reaches level off into the valley floor. These elevations are well below what would be the expected habitable range for this animal. There will be no effect on this species or habitat for this species.

Biological Conclusion: No effect

Indiana Bat, (Endangered): NCNHP lists the preferred summer habitat as "*females and young (maternity colonies) roost under loose bark and in tree hollows of shagbark hickory (Carya ovata) and oak near small-to medium-sized streams.*" Riparian corridors within the East Buffalo Creek project may provide suitable summer foraging habitat for the Indiana bat; however there are no loose-barked trees within the project area or other habitat suitable for maternity colonies of the bat. There are also no mines or caves within the project area for winter hibernation. Clearing within the enhancement reaches of the project area will be limited to the removal of exotic, invasive vegetation such as multiflora rose and privet. Incidental removal of smaller, understory trees while removing exotic vegetation will be minimized to the extent possible. Because no potential habitat will be impacted by this project there should be no effect on this species. Therefore a "no effect" determination was made.

Biological Conclusion: No effect

Appalachian elktoe, (Endangered): The N.C. Natural Heritage Program lists the preferred habitat as "*relatively shallow, medium-sized creeks and rivers with cool, well-oxygenated, moderate- to fast-flowing water. Observed in gravelly substrates often mixed with cobble and boulders, in cracks in bedrock, and sometimes in relatively silt-free, coarse, sandy substrates.*" The project streams where restoration and enhancement activities are proposed are small with a bankfull width of 10 to 15 feet. The USFWS has designated a portion of the Cheoah River system within Graham County as critical habitat for the Appalachian elktoe. According to the September 27, 2002 Federal Register, 67:61016-61040, critical habitat for the Appalachian elktoe exists in the Cheoah River below the Santeetlah Dam to its confluence with the Little Tennessee River. However, the project site is not located in the critical habitat area for the Appalachian elktoe. The described habitat does not exist within the project reach and no individual animals were observed. East Buffalo Creek and the 8 UTs that are included within this project converge before East Buffalo Creek transitions into a normally impounded area of the Santeelah Reservoir. East Buffalo Creek is a tributary to the Santeetlah Reservoir which was created when the Cheoah River was dammed. According to state natural heritage element occurrence data for 2007, the closest recorded occurrence of Appalachian elktoe to the project area is approximately 5.5 miles away, below the Dam. Therefore, any temporary increases in stream turbidity levels caused by enhancement or restoration activities or other foreseeable impacts will not affect Appalachian elktoe mussel populations downstream of the dam. Project erosion

control measures will further ensure that impacts to any potential habitat downstream of the project area are minimized or avoided.

Biological Conclusion: No effect

Virginia spiraea, (Threatened): NCNHP lists the preferred habitat as "*Flood-scoured, high-gradient rocky riverbanks; braided areas of lower stream reaches, gorges, and canyons; as well as disturbed rights-of-way. Grows in thickets, in association with a variety of grape species (Vitis spp.) and royal fern (Osmunda regalis), among other plant associations. Occurs in sunny areas on moist, acid soils, primarily over sandstone. Habitat is critical and restricts the species to a narrow ecological niche.*" The project streams are very small with bankfull widths of 10 to 15 feet, and are located on moderate to steep gradients. Some habitat features favored by the Virginia spiraea do exist within the project limits for Virginia spiraea. Favorable habitat features consisted of sections of braided channel, previously disturbed banks and access routes that are highly exposed to sunlight, and minor scour associated with prior channelization of the stream.

Subsequent field surveys have been conducted and potential habitat features were found to be less significant due to a lack of overall habitat suitability. Sections of braided channel were located in moderate to steep relief. Dominant vegetation on steeper slopes consisted of poplar, eastern hemlock, flowering dogwood, beech, and maple. Riparian features of braided channels located on more moderate slopes consisted of multiflora rose, chinese privet, poplar, dogwood, maple and a variety of ferns and trillium. The enhancement reaches on UT5, UT6 and East Buffalo Creek are located on moderate slopes and are adjacent to residential development. Braiding and minor scour were observed along sections of UT5 and UT6 and East Buffalo Creek where the previously channelized tributaries are attempting to revert to pre-disturbance dimension, pattern and profile features. The streams are bordered on the right banks by forested slope. The left streambanks are bordered by a gravel road or pasture land. Other sections of the enhancement reaches are in moderate to full canopy cover. In the case of UT5, the enhancement reach extends approximately 400 LF into an upland forested area. The proposed location of UT1 and UT2 places these channels in the low point of the valley which is also pasture land. Although the restoration reaches and the majority of the enhancement reaches currently receive ample sunlight, other habitat features required are not present and many areas have been largely overtaken by multiflora rose. Multiflora rose and privet are present at UT1 and UT2; however the area proposed for stream relocation is primarily vegetated by a variety of grasses. Recent on-site observations made April 30 and May 5-7, 2008 confirm that Virginia spiraea is not present in portions of the project site where land disturbing activity will occur (including staging areas and access routes). Therefore, this project will have no effect on individuals or populations of this species in Graham County.

Biological Conclusion: No effect

Rock gnome lichen, (Endangered): The rock gnome lichen is endemic to the southern Appalachian Mountains of North Carolina and Tennessee, where it is limited to 32 populations. Rock gnome lichen habitat is located around humid, high elevation rock outcrops or vertical cliff faces or in rock outcrops in humid gorges at lower elevations. According to the USFWS and NCNHP, most populations occur on rocky outcrops or cliffs above 5,000 feet around spruce-fir forests.

No critical habitat necessary for the rock gnome lichen was identified within the project site. Although rock outcroppings are present in the mid to upper project reaches, the project area does not remain humid enough to support the rock gnome lichen. Project streams are topographically located in coves and the upper valley of East Buffalo Creek; therefore, the

site cannot be characterized as containing gorges. No rock gnome lichen have been observed during previous field visits to the project area, nor are there any known populations of the lichen within two miles of the site. Project activities will not effect rock gnome lichen populations or their habitat in Graham County.

Biological Conclusion: No effect

The USFWS was notified of the project on January 15, 2008 and again on March 13, 2008. At this time, Baker Engineering has not received any comments from the USFWS. Correspondence on this issue is included in the Appendix.

Farmland Protection Policy Act (FPPA)
On January 30, 2008, Baker Engineering submitted the AD-1006 form for the East Buffalo Creek project site to the Graham County Natural Resources Conservation Service (NRCS) office. The NRCS responded on March 28, 2008, with the determination that implementation of this restoration project would not result in the conversion of any acreage of prime farmland soils. The completed AD-1006 form and other correspondence on this issue is included in the Appendix.

Fish and Wildlife Coordination Act (FWCA)
A letter was sent by Baker Engineering to the NC Wildlife Resources Commission (NCWRC) on January 15, 2008, requesting their comment and review on the East Buffalo Creek Restoration and Enhancement Project. NCWRC responded on January 29, 2008, and expressed no concerns regarding anticipated impacts to NCNHP or federally listed species for the county. Correspondence pertaining to project permitting and design plans will be submitted to the NCWRC at a later time. Correspondence on this issue is included in the Appendix.

Baker Engineering sent a letter to the USFWS on January 15, 2008 and again on March 13, 2008, requesting their comment and review on the East Buffalo Creek Project. At this time, Baker Engineering has not received any comments from the USFWS. All correspondence on this issue is included in the Appendix.

Migratory Bird Treaty Act (MBTA)
A letter was sent by Baker Engineering to the USFWS on January 15, 2008 and again on March 13, 2008, requesting their comment and review on the East Buffalo Creek Restoration and Enhancement Project in relation to migratory birds. At this time, Baker Engineering has not received any comments from the USFWS. All correspondence on this issue is included in the Appendix.

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	East Buffalo Creek Restoration Project
Name of stream or feature:	East Buffalo Creek, unnamed tributaries that feed into East Buffalo Creek
County:	Graham
Name of river basin:	Little Tennessee River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Graham County
DFIRM panel number for entire site:	5662, 5672
Consultant name:	Michael Baker Engineering, Inc. Jacob McLean
Phone number:	828.350.1408 ext. 2007
Address:	797 Haywood Rd., Suite 201 Asheville, NC 28806

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500'.

The Mainstem of East Buffalo Creek and most of the Unnamed Tribs are conservation or Enhancement II reaches with no floodplain development activities. UT2 and UT6 (Reach 3) are Restoration and Enhancement I reaches, respectively.

UT2 will be restored to the low point in the valley and will consist of a step-pool, priority 1 design approach. UT6 will have intermittent modifications to the existing pattern, profile and dimension. Pattern modifications will be minor. Changes on UT6 also involve a step pool design approach that would be referred to as a combination of priority 2 and 3 work. These streams are in the Little Tennessee Basin.

Summarize stream reaches or wetland areas according to their restoration priority.

Reach	Length	Priority
UT2	***524***	***One (Restoration)***
UT6, Reach 3	***508***	***Two/Three (Enhancement I)***

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

☐ Yes ☒ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: **Zone X (Unmapped)**

Check if applies:

☐ AE Zone

- ☐ Floodway
- ☐ Non-Encroachment
- ☒ None

☐ A Zone

- ☐ Local Setbacks Required
- ☐ No Local Setbacks Required

If local setbacks are required, list how many feet: **Not Applicable**

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? **Not Applicable**

○ Yes ◉ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

◉ Yes ○ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)

Name of Local Floodplain Administrator: **None (per conversation with county planning department 5-27-2009)**

Phone Number:

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☑ No Action

☐ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☐ Other Requirements

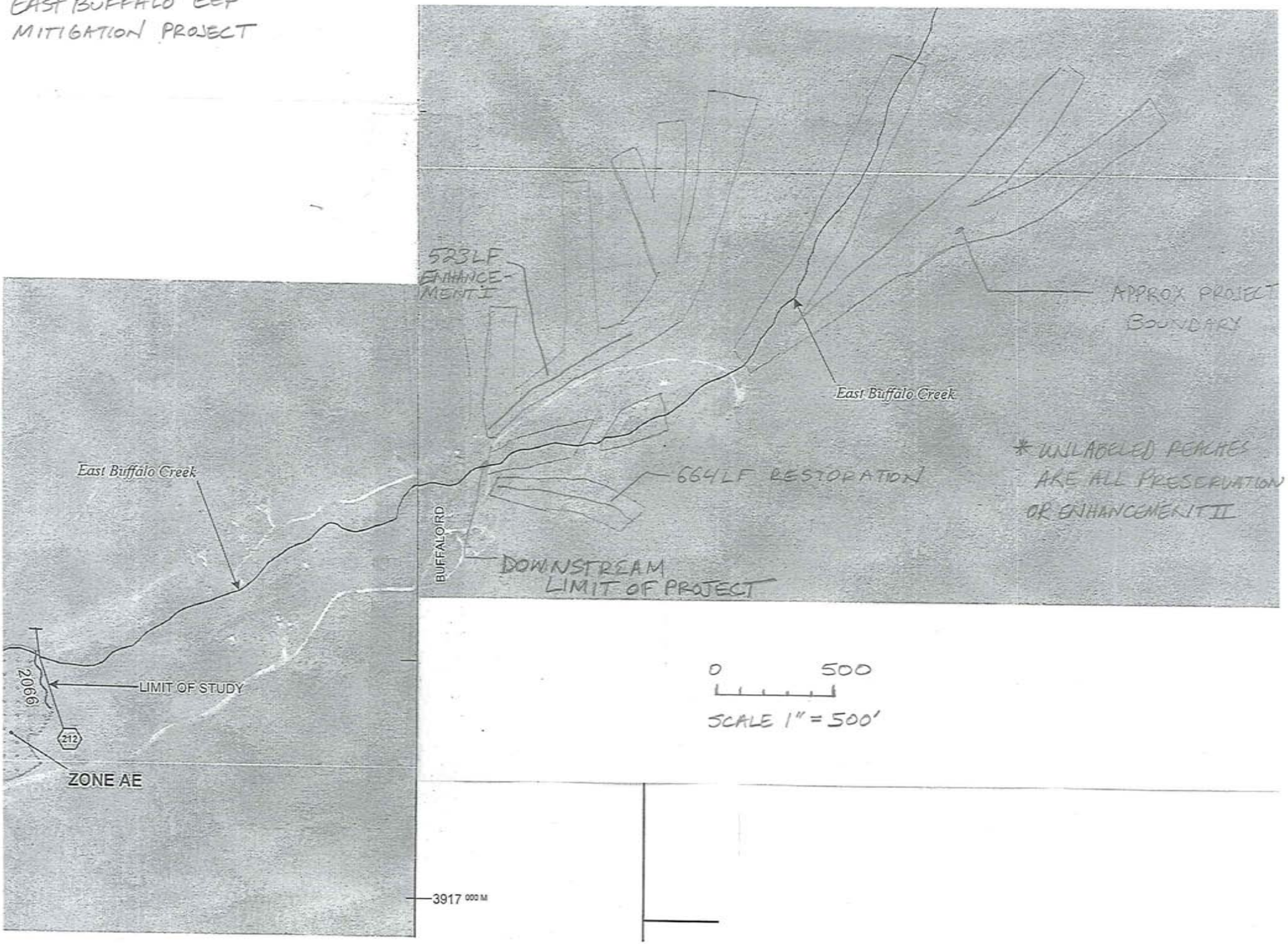
List other requirements:
Not Applicable

Comments:
The stream is an unmapped Zone X. It does not involve disturbance to more than 5 acres of land. No FEMA requirements apply.

Name: Jacob P. McLean Signature: Jacob P McLean

Title: PE, CFM Date: 4/9/10

EAST BUFFALO EEP
MITIGATION PROJECT



Baker

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

828-350-1408
FAX 828-350-1409

February 8, 2008

Ms. Renee Gledhill-Earley
State Historic Preservation Office
Raleigh, NC 27699-4617
4617 Mail Service Center

Subject: NC-EEP stream mitigation project in Graham County.

Dear Ms. Gledhill-Earley,

The North Carolina Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream restoration project area identified on the maps attached (a vicinity map, and USGS site map with areas of potential ground disturbance are enclosed).

The streams identified on the attached maps are tributaries to East Buffalo Creek and have been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts in the Little Tennessee River Basin. The project will involve enhancement of a section of East Buffalo Creek as well as the restoration, enhancement or preservation of eight tributaries to East Buffalo Creek in the Little Tennessee River Basin. Project goals include the restoration or enhancement of approximately 3,670 linear feet of stream and the preservation of an additional 6,250 linear feet of stream under this project.

No architectural structures or archaeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. The project area consists of floodplain and forested slopes with maximum elevations of approximately 3,000' ASL. Approximately 65% of the project area is in forested cover, 30% is in agricultural use and consists of mowed fields, and the remaining 5% consists of residential development. Headwaters identified within the project boundary are in a forested area that borders U.S. Forest Service land. Agricultural and residential land use is located in the lower section of the project area. During previous site visits in February 2007, it was noted that two streams had been moved from the center to the edge of the valley on the southern edge of the project area in association with the conversion of the land to agricultural use.

Mapped soils within the project area include the Spivey-Whiteoak complex (15 to 30% slopes, bouldery), Spivey-Santeetlah complex (30 to 50%, very bouldery), and a mix of Soco-Stecoah complexes which occur on 30 to 95% slopes and are also bouldery. The Spivey-Whiteoak and Spivey-Santeetlah complexes are dominant in areas adjacent to the streams. These soils are located on moderate to steep mountain slopes and coves, are well drained and lie above the seasonal high water table. Soils data presented in this letter were assembled from the initial dataset of soil mapping updates by the Natural Resources Conservation Service in 2007 for

Graham County and from the USDA-NRCS Soil Data Mart website (http://soildatamart.nrcs.usda.gov/Default.aspx).

Minimal ground disturbing activities are proposed for enhancement reaches within the project site. Ground disturbing activities will consist of the planting of additional trees and other vegetation, and the removal of exotic, invasive vegetative species. Streambank stabilization will also be performed where it is necessary within the enhancement reaches. Restoration activities on UT1 and UT2 will involve re-establishing the streams back to the center of their valley. The Proposed Restoration Plan figure illustrates what UT1 and UT2 would look like after restoration occurs. Preservation reaches are located in the upper limits of the project area where the streams are in a natural state and invasives are generally not present. Riparian corridors identified for preservation purposes will not be disturbed. As the enclosed aerial photograph shows, the majority of the area within the construction limits of the site consists of floodplain, a straightened and relocated channel, land in agricultural use and upland forested area.

We ask that you review this site based on the attached information to determine the presence of any historic properties or other objects of cultural significance. Thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Carmen Horne-McIntyre

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806
Phone: 828.350.1408, Email: cmcintyre@mbakercorp.com

Cc:
Mr. Guy Pearce
NC Ecosystem Enhancement Program (EEP)
1652 Mail Service Center
Raleigh, NC 27699

Mr. Tyler Howe
Tribal Historic Preservation Office
P.O. Box 455
Cherokee, NC 28719

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

February 26, 2008

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Road, Suite 201
Asheville, NC 28806

Re: EEP Stream Mitigation, Tributaries to East Buffalo Creek, Graham County, ER 08-0548

Dear Ms. Horne-McIntyre:

Thank you for your letter of February 8, 2008, concerning the above project.

There are no known recorded archaeological sites within the project boundaries. There are three previously recorded sites within one mile of the project area. However, the project area has never been systematically surveyed to determine the location or significance of archaeological resources. Based on the topographic and hydrological situation, there is a high probability for the presence of prehistoric or historic archaeological sites.

We recommend that a comprehensive survey be conducted by an experienced archaeologist to identify and evaluate the significance of archaeological remains that may be damaged or destroyed by the proposed project. The survey should be conducted in that portion of the project area where ground disturbance is planned. Potential effects on unknown resources must be assessed prior to the initiation of construction activities.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Harley, environmental review coordinator, at 919/807-6579. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

April 17, 2008

Michael O'Neal
Archaeological Consultants of the Carolinas, Inc.
121 East First Street
Clayton, NC 27520

Re: EEP Stream Mitigation, Tributaries to East Buffalo Creek, Graham County, ER 08-0548

Dear Mr. O'Neal:

Thank you for your letter of March 31, 2008, transmitting the archaeological survey report for the above project.

During the course of the survey, no sites were located within the project area. The report author has recommended that no further archaeological investigation be conducted in connection with this project. We concur with this recommendation since the project will not involve significant archaeological resources.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/807-6579. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

cc: Baker Engineering NY, Inc.

Baker

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

828-350-1408
FAX 828-350-1409

February 8, 2008

Mr. Tyler Howe
Tribal Historic Preservation Office
P.O. Box 455
Cherokee, NC 28719

Subject: NC-EEP stream mitigation project in Graham County.

Dear Mr. Howe,

The North Carolina Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream restoration project area identified on the maps attached (a vicinity map, and USGS site map with areas of potential ground disturbance are enclosed).

The streams identified on the attached maps are tributaries to East Buffalo Creek and have been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts in the Little Tennessee River Basin. The project will involve enhancement of a section of East Buffalo Creek as well as the restoration, enhancement or preservation of eight tributaries to East Buffalo Creek in the Little Tennessee River Basin. Project goals include the restoration or enhancement of approximately 3,670 linear feet of stream and the preservation of an additional 6,250 linear feet of stream under this project.

No architectural structures or archaeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. The project area consists of floodplain and forested slopes with maximum elevations of approximately 3,000' ASL. Approximately 65% of the project area is in forested cover, 30% is in agricultural use and consists of mowed fields, and the remaining 5% consists of residential development. Headwaters identified within the project boundary are in a forested area that borders U.S. Forest Service land. Agricultural and residential land use is located in the lower section of the project area. During previous site visits in February 2007, it was noted that two streams had been moved from the center to the edge of the valley on the southern edge of the project area in association with the conversion of the land to agricultural use.

Mapped soils within the project area include the Spivey-Whiteoak complex (15 to 30% slopes, bouldery), Spivey-Santeetlah complex (30 to 50%, very bouldery), and a mix of Soco-Stecoah complexes which occur on 30 to 95% slopes and are also bouldery. The Spivey-Whiteoak and Spivey-Santeetlah complexes are dominant in areas adjacent to the streams. These soils are located on moderate to steep mountain slopes and coves, are well drained and lie above the seasonal high water table. Soils data presented in this letter were assembled from the initial dataset of soil mapping updates by the Natural Resources Conservation Service in 2007 for

Graham County and from the USDA-NRCS Soil Data Mart website (http://soildatamart.nrcs.usda.gov/Default.aspx).

Minimal ground disturbing activities are proposed for enhancement reaches within the project site. Ground disturbing activities will consist of the planting of additional trees and other vegetation, and the removal of exotic, invasive vegetative species. Streambank stabilization will also be performed where it is necessary within the enhancement reaches. Restoration activities on UT1 and UT2 will involve re-establishing the streams back to the center of their valley. The Proposed Restoration Plan figure illustrates what UT1 and UT2 would look like after restoration occurs. Preservation reaches are located in the upper limits of the project area where the streams are in a natural state and invasives are generally not present. Riparian corridors identified for preservation purposes will not be disturbed. As the enclosed aerial photograph shows, the majority of the area within the construction limits of the site consists of floodplain, a straightened and relocated channel, land in agricultural use and upland forested area.

We ask that you review this site based on the attached information to determine the presence of any historic properties or other objects of cultural significance. Thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Carmen Horne-McIntyre

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806
Phone: 828.350.1408, Email: cmcintyre@mbakercorp.com

Cc:
Mr. Guy Pearce
NC Ecosystem Enhancement Program (EEP)
1652 Mail Service Center
Raleigh, NC 27699

Ms. Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

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

828-350-1408
FAX 828-350-1409

March 31, 2008

Eastern Band of Cherokee Indians (EBCI)
Mr. Tyler Howe
Tribal Historic Preservation Office
PO Box 455
Cherokee, NC 28719

RE: Phase I Archaeological Survey Report (ER 08-0014) for stream restoration site on East Buffalo Creek in Graham County, North Carolina.

This letter and the enclosed report are provided to your office at the State Historic Preservation Office's request that Baker Engineering NY, Inc. conduct a comprehensive survey of areas to be impacted during a stream restoration project on East Buffalo Creek.

The enclosed report details the approach that Archaeological Consultants of the Carolinas, Inc. (ACC) used for this survey, as well as research conducted and findings from their field survey. A copy of this report is also being submitted to the State Historic Preservation Office for their review as well.

Based on our understanding of this report, no significant archaeological remains were found within our project area. Two archaeological sites (31GH198 and 31GH199) have been previously identified within 1.6 km of the project area; however neither archaeological site will be impacted by the stream restoration work proposed. We are submitting this information for your review and comment as to the potential for impacting cultural resources.

Additionally, we have received comment back from the State Historic Preservation Office regarding enhancement of tributaries to Snowbird Creek, also located in Graham County, NC. The State Historic Preservation Office has concluded that the project, as proposed, will not result in any potential historic resources being affected. I am enclosing a copy of the previous letter submitted to the THPO which summarizes the extent of work being performed on the Snowbird tributaries within the proposed project area.

Please provide us your comments as soon as possible regarding the projects above so that we can either address further needs or communicate a finding of no significant impact for these projects to the NC Ecosystem Enhancement Program. I can be reached via email at cmcintyre@mbakercorp.com or by phone (828.350.1408 x.2010). Thank-you for your assistance in this matter.

Sincerely,
Carmen Horne-McIntyre
Carmen Horne-McIntyre
Environmental Scientist

Enclosure: Archaeological Survey Report for East Buffalo Creek, Snowbird Tributaries Project Letter

Baker

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

828-350-1408
FAX 828-350-1409

January 15, 2008

U.S. Fish and Wildlife Service
Ms. Marella Buncick
Asheville Field Office
160 Zillicoa St.
Asheville, NC 28801

Subject: NC-EEP East Buffalo Creek Project in Graham County

Dear Ms. Buncick,

The Ecosystem Enhancement Program (EEP), requests review and comment on any possible issues that might emerge with respect to endangered species as a stream enhancement project is conducted. A vicinity map and a topographic map showing the approximate areas of potential ground disturbance by enhancement activities are enclosed.

The East Buffalo Creek project site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts in the Little Tennessee River Basin. A section of East Buffalo Creek and portions of eight tributaries to East Buffalo Creek have been identified as being degraded. Approximately 65% of the project area is in forested cover, 30% is in agricultural use and consists of mowed fields, and the remaining 5% consists of residential development. The headwaters identified within the project area are in a forested area that borders U.S. Forest Service land. Agricultural and residential land use is located in the lower section of the project area. During previous site visits in February 2007, it was noted that two streams had been moved from the center to the edge of the valley on the southern edge of the project area in association with the conversion of the land to agricultural use.

We have already obtained a current species list for Graham County from your website (http://nc-es.fws.gov/es/countyfr.html). The threatened or endangered species for this county as identified on the website are: the Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus*), Bog Turtle (*Clemmys muhlenbergii*), Indiana Bat (*Myotis sodalis*), Appalachian Elktoe (*Alasmidonta raveneliana*), Virginia Spiraea (*Spiraea virginiana*), and the Rock Gnome Lichen (*Gymnoderma lineare*).

With the exception of the Virginia spiraea, no suitable habitat was located within the limits of disturbance for the property. Potential habitat does exist within the project limits for Virginia spiraea. Its habitat is described as "flood-scoured, high-gradient, rocky riverbanks, braided areas of lower stream reaches, gorges, and canyons, as well as disturbed rights-of-way." Limited debris removal and buffer planting on the enhancement reaches where exotic, invasive vegetation is being removed is not expected to disturb potential habitat and may actually serve to increase habitat. The project in the upper reaches consists solely of preservation. Therefore, no impacts to the species are anticipated.

The Carolina northern flying squirrel prefers the ecotone between coniferous and mature northern hardwoods usually above 4,500' above sea level (ASL). The project area consists of floodplain and forested slopes with maximum elevations at approximately 3,000' ASL. Therefore, a "no effect" determination was made for the Carolina northern flying squirrel due to lack of suitable habitat.

No foraging or nesting habitat was found for the Indiana bat in the lower project reaches due to the level of disturbance to the riparian area. As stated earlier, riparian areas in the headwaters of the project area will not be disturbed. Any potential habitat that may exist in the upper reaches will be left in its current condition; therefore no adverse impacts to the Indiana bat are expected to occur from this project.

Based on the degraded conditions found within the proposed enhancement reaches, a "no effect," determination was made regarding the Appalachian elktoe. The Appalachian elktoe prefers morphologically stable stream segments in silt accumulation or heavily shifting substrate, which does not currently exist on the site as the proposed project is to perform enhancement activities on each tributary so that they become more morphologically stable. Additionally, the project is not located within the area designated as critical habitat for the Appalachian elktoe in Graham County.

The project area lacks habitat characteristics favored by the rock gnome lichen which include humid, high elevation rock outcrops, vertical cliff faces or in rock outcrops in humid gorges at lower elevations. Enhancement activities which are located in lower altitude and less steep portions of the project area also make it unlikely that any habitat exists for the rock gnome lichen as most populations occur above an elevation of (5,000 feet). Because this project involves degraded streams and lacks other habitat criteria necessary, this project is not likely to affect the rock gnome lichen.

We are requesting that you please provide any known information for each species in the county. The USFWS will be contacted if suitable habitat for any listed species may be encroached upon or if we determine that the project may affect one or more federally listed species or designated critical habitat area.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of a wetland and/or stream restoration project on the subject property. A vicinity map and a USGS map showing the approximate areas of potential ground disturbance are enclosed.

If we have not heard from you in 30 days we will assume that our species list is correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

We thank you in advance for your timely response and cooperation. Please feel free to contact me at cmcintyre@mbakercorp.com or by phone at 828.350.1408 ext. 2007 with any questions you may have concerning the extent of site disturbance associated with this project.

Sincerely,

CARMEN HORNE-MCINTYRE

Carmen Horne-McIntyre
Environmental Scientist
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806

Cc:
Mr. Guy Pearce
NC Ecosystem Enhancement Program (EEP)
1652 Mail Service Center
Raleigh, NC 27699

East Buffalo Creek and Snowbird Tributaries Restoration Projects (NCEEP)
From: Carmen McIntyre
To: Marella_Buncick@fws.gov
Date: 3/13/2008 8:47 AM
Subject: East Buffalo Creek and Snowbird Tributaries Restoration Projects (NCEEP)
Attachments: East Buffalo.pdf; USFWS Letter.pdf; figure_disturbance_limits.pdf; Location Map.pdf; Topo Map.pdf; Snowbird Figures.pdf

Hi Ms. Buncick,
Our office is in the process of finalizing an environmental review for the two projects listed above. We plan to submit our findings to the NCDENR Ecosystem Enhancement Program (NCEEP) by April 4th. Before we finalize the environmental review document, I wanted ensure any concerns held by USFWS about the two projects had been met. If there are any concerns, please contact me at your earliest convenience at 828.350.1408 x. 2010 or Micky Clemmons at 828.350.1408 x. 2002. If we do not hear from you by March 31st, we will assume the USFWS has no concerns regarding federally listed species within the project area. Please see the documents attached which describe the scope of the projects as well as their locations.

Thank-you for your assistance,

Carmen Horne-McIntyre

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806
P: 828.350.1408 x. 2010
F: 828.350.1409

Baker

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

828-350-1408
FAX 828-350-1409

January 15, 2008

Ms. Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: NC-Ecosystem Enhancement Program: Stream mitigation project in Graham County, NC.

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential stream restoration project area identified on the maps attached (vicinity map and USGS site map with approximate areas of potential ground disturbance are enclosed).

The East Buffalo Creek project site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. The project will involve the restoration, enhancement and preservation of East Buffalo Creek and a portion of its tributaries. Project goals include the restoration or enhancement of approximately 3,670 linear feet of stream for the purpose of obtaining stream mitigation credit in the Little Tennessee River Basin. An additional 6,250 linear feet of stream will be preserved under this project.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

CARMEN HORNE-MCINTYRE

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806
Phone: 828.350.1408, Email: cmcintyre@mbakercorp.com

Cc:
Mr. Guy Pearce
NC Ecosystem Enhancement Program (EEP)
1652 Mail Service Center
Raleigh, NC 27699

North Carolina Wildlife Resources Commission

January 29, 2008

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806

SUBJECT: EEP Stream Mitigation Project in Graham County, East Buffalo Creek

Dear Ms. Horne-McIntyre:

Biologists with the North Carolina Wildlife Resources Commission (Commission) received your letter dated January 15, 2008 regarding the Ecosystem Enhancement Program project on East Buffalo Creek in Graham County. Comments from the Commission are provided under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Graham County is a "trout county" per an agreement between the U.S. Army Corps of Engineers (ACOE) and the Commission. As such, Commission biologists review all Nationwide Permit applications here and make recommendations to minimize the adverse resource effects of some activities, including restoration work. Once a permit application is prepared for this project, a copy must be sent to me in order to solicit Commission concurrence and recommendations for consideration by the ACOE.

The Commission does not anticipate any major resource concerns with this project provided sedimentation from construction is **minimized**. Existing mature vegetation should be preserved as much as possible because it promotes the stability of channel work and provides seed sources for natural regeneration, organic material to the streams, and riparian habitat complexity until planted vegetation matures. The use of balled or container grown trees is recommended in the outside of channel bends to expedite long-term bank stability. Also, any stream channel modifications should create dimensions, patterns, and profiles that mimic stable, reference conditions. Overly and unnaturally sinuous stream channels should be avoided.

Thank you for the opportunity to review and comment on this project. If there are any questions regarding these comments, please contact me at (828) 452-2546 ext. 24.

Sincerely,

Dave McHenry
Mountain Region Coordinator
Habitat Conservation Program

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Baker

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

828-350-1408
FAX 828-350-1409

January 23, 2008

Mr. Glenn Carson
USDA-NRCS District Conservationist
Graham County
P.O. Box 286
480 Village Shopping Center
Robbinsville, NC 28771

Subject: Prime and Important Farmland Soils RE: NCEEP Full Delivery Project, East Buffalo Creek Project Site, Graham County, NC

Dear Mr. Carson,

The purpose of this letter is to request your assistance in completing a Farmland Conversion Impact Rating form for the subject site. Enclosed please find a copy of the form, site and location mapping for the East Buffalo Creek project site. Mapped soils within the project area include the Spivey-Whiteoak complex (15 to 30% slopes, bouldery), Spivey-Santeetlah complex (30 to 50%, very bouldery), and a mix of Soco-Stecoah complexes which occur on 30 to 95% slopes and are also bouldery. The Spivey-Whiteoak and Spivey-Santeetlah complexes are dominant in areas adjacent to the streams. These soils are characterized as steep and well drained and lie above the seasonal high water table. Soils data presented in this letter were assembled from the initial dataset of soil mapping updates by the Natural Resources Conservation Service in 2007 for Graham County and from the USDA-NRCS Soil Data Mart website (http://soildatamart.nrcs.usda.gov/Default.aspx).

For this stream restoration and enhancement project, areas where ground disturbing activities are expected to take place are noted on the restoration figure enclosed. The total area of the site is approximately 13.55 acres. A review of the soil types for the project area indicate there are no soils within or adjacent to the project site that are associated with areas of prime farmland or farmland of statewide importance.

We ask that you review this site based on the attached information to determine if you know of any other existing resources that we need to know about. We know that you have greater familiarity with farmland issues in this area than we do, and we will be happy to make any changes to the form that you deem appropriate. Please return the form to us with your determinations and we will fill out the rest of the form if needed. In addition, please let us know the level of involvement you may require (if needed), as it is anticipated this project will be implemented in the Fall of 2008 or Spring of 2009. If we have not received a response from you within 30 days, we will assume that you have no comment regarding the project. This letter is intended to satisfy any requirements of the Farmland Protection Policy Act.

If you have any questions, please feel free to contact me at cmcintyre@mbakercorp.com or by phone at 828.350.1408 ext. 2010. Our fax number is 828.350.1409.
Thank-you for your assistance in this matter.

Sincerely,

CARMEN HORNE-MCINTYRE

Carmen Horne-McIntyre
Environmental Scientist
Baker Engineering NY, Inc.
797 Haywood Rd., Suite 201
Asheville, NC 28806

Cc:
Mr. Guy Pearce
NC Ecosystem Enhancement Program (EEP)
1652 Mail Service Center
Raleigh, NC 27699

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
589 Raccoon Road, Suite 246
Waynesville, NC 28786
Phone 828 456-6341 ext. 5 FAX 828 452-7031

March 27, 2008

Carmen Horne-McIntyre
Baker Engineering NY, Inc.
797 Haywood Road, Suite 201
Asheville, NC 28806

Re: USDA Farmland Conversion Impact Rating Form (AD-1006)
East Buffalo Creek Restoration and Enhancement – Graham County, NC

Ms. Horne-McIntyre

Attached you will find two copies of the completed AD-1006. Based on the maps that you provided, and on a soil survey map of the area, it appears that no important farmlands (prime, state-wide important, or locally important) will be impacted by the proposed project.

If I can be of further assistance, please feel free to contact me.

M. Kent Clary
Area Resource Soil Scientist
USDA-NRCS

cc: Glenn Carson, District Conservationist, USDA-NRCS, Murphy, NC

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*		Date Of Land Evaluation Request 1/31/08	
Name Of Project East Buffalo Creek Restoration and Enhancement		Federal Agency Involved FHWA	
Proposed Land Use Stream restoration and enhancement		County And State Graham, NC	
PART II *(To be completed by NRCS)*		Date Request Received By NRCS	
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☐ No ☑	Acres Irrigated	Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %	Amount Of Farmland As Defined in FPPA Acres: %	
Name Of Land Evaluation System Used	Name Of Local Site Assessment System	Date Land Evaluation Returned By NRCS 3/27/08	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	~~0.0~~ 13.55			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	~~0.0~~ 13.55	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (10-83)

This form was electronically produced by National Production Services Staff

APPENDIX C. EDR Transaction Screen Map Report

The EDR Radius Map
with GeoCheck®

East Buffalo Creek Project
E Buffalo Rd (SR 1254)/Unpaved Driveway
Robbinsville, NC 28771

Inquiry Number: 2112222.1s

January 03, 2008

The Standard in Environmental Risk Information

440 Wheelers Farms Road
Milford, Connecticut 06461

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

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GEOCHECK ADDENDUM

Physical Setting Source Addendum	A-1
Physical Setting Source Summary	A-2
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Physical Setting Source Records Searched	A-13

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

E BUFFALO RD (SR 1254)/UNPAVED DRIVEWAY
ROBBINSVILLE, NC 28771

COORDINATES

Latitude (North):	35.368610 - 35° 22' 7.0''
Longitude (West):	83.798330 - 83° 47' 54.0''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	245758.6
UTM Y (Meters):	3917318.5
Elevation:	2256 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	35083-C7 ROBBINSVILLE, NC
Most Recent Revision:	2001
North Map:	35083-D7 FONTANA DAM, NC
Most Recent Revision:	2001

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL National Priority List
Proposed NPL Proposed National Priority List Sites
Delisted NPL National Priority List Deletions
NPL LIENS Federal Superfund Liens
CERCLIS Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP CERCLIS No Further Remedial Action Planned
CORRACTS Corrective Action Report

EXECUTIVE SUMMARY

ERNS Emergency Response Notification System
HMIRS Hazardous Materials Information Reporting System
US ENG CONTROLS Engineering Controls Sites List
US INST CONTROL Sites with Institutional Controls
DOD Department of Defense Sites
FUDS Formerly Used Defense Sites
US BROWNFIELDS A Listing of Brownfields Sites
CONSENT Superfund (CERCLA) Consent Decrees
ROD Records Of Decision
UMTRA Uranium Mill Tailings Sites
ODI Open Dump Inventory
TRIS Toxic Chemical Release Inventory System
TSCA Toxic Substances Control Act
FTTS FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
SSTS Section 7 Tracking Systems
LUCIS Land Use Control Information System
DOT OPS Incident and Accident Data
ICIS Integrated Compliance Information System
RCRA-CESQG RCRA - Conditionally Exempt Small Quantity Generator
RCRA-NonGen RCRA - Non Generators
DEBRIS REGION 9 Torres Martinez Reservation Illegal Dump Site Locations
HIST FTTS FIFRA/TSCA Tracking System Administrative Case Listing
US CDL Clandestine Drug Labs
RADINFO Radiation Information Database
LIENS 2 CERCLA Lien Information
RCRA-TSDF RCRA - Transporters, Storage and Disposal
RCRA-SQG RCRA - Small Quantity Generators
RCRA-LQG RCRA - Large Quantity Generators
PADS PCB Activity Database System
MLTS Material Licensing Tracking System
MINES Mines Master Index File
FINDS Facility Index System/Facility Registry System
RAATS RCRA Administrative Action Tracking System

STATE AND LOCAL RECORDS

SHWS Inactive Hazardous Sites Inventory
NC HSDS Hazardous Substance Disposal Site
IMD Incident Management Database
SWF/LF List of Solid Waste Facilities
OLI Old Landfill Inventory
HIST LF Solid Waste Facility Listing
LUST Regional UST Database
LUST TRUST State Trust Fund Database
UST Petroleum Underground Storage Tank Database
AST AST Database
INST CONTROL No Further Action Sites With Land Use Restrictions Monitoring
VCP Responsible Party Voluntary Action Sites
DRYCLEANERS Drycleaning Sites
BROWNFIELDS Brownfields Projects Inventory
NPDES NPDES Facility Location Listing

TRIBAL RECORDS

INDIAN RESERV Indian Reservations

EXECUTIVE SUMMARY

INDIAN LUST Leaking Underground Storage Tanks on Indian Land
INDIAN UST Underground Storage Tanks on Indian Land

EDR PROPRIETARY RECORDS

Manufactured Gas Plants EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

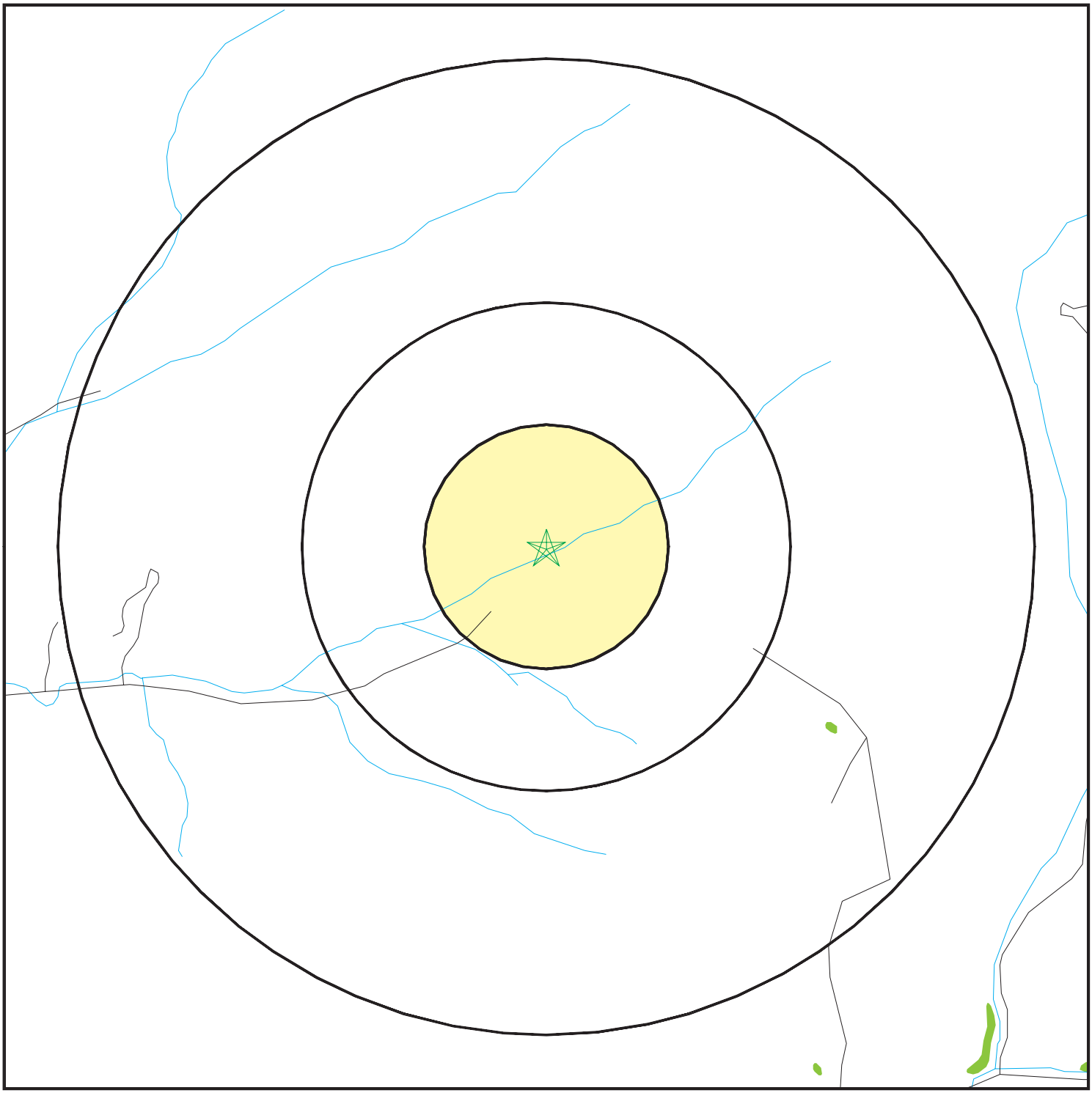
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
GRAHAM COUNTY LANDFILL	SWF/LF, HIST LF
GRAHAM COUNTY TEMPORARY TRANSFER STATION	HIST LF
BURLINGTON FURNITURE	SHWS
GRAHAM COUNTY MUNICIPAL LANDFILL	SHWS
HACKNEY FOOD SHOP #3	LUST, IMD
BEN CRISP CITGO	FINDS, LUST
DOT FACILITY-ROBBINSVILLE	LUST, IMD
CROSSROADS OF TIME	LUST, IMD
HACKNEY FOOD SHOP #3	LUST TRUST
TED NORCROSS RESIDENCE	LUST TRUST
KAY'S FASION & CONVIENIENCE S	UST
ATOAH GROCERY	UST
ROBINSON'S GROC	UST
EVERETT WILLIAMS GROCERY	UST
JOANNA'S GROCERY	UST
JOHNNY'S CARB & TUNE & AMOCO	UST
CHESTER CRISP	UST
BEN CRISP CITGO	UST, IMD
STECOAH SCHOOL	UST
WOLFECREEK GROCERY	UST
STEWARTS GROC.	UST
SANTEETLAH BOAT DOCK	UST
TALLAUFF SERVICE STATION	UST
CHEOAH DAM	UST
CHEOAH HYDROELECTRIC PROJECT	UST
WOLF CREEK GROC.	FINDS
BIG D #27 AST SPILL(RVIL BLK)	IMD

OVERVIEW MAP - 2112222.1s



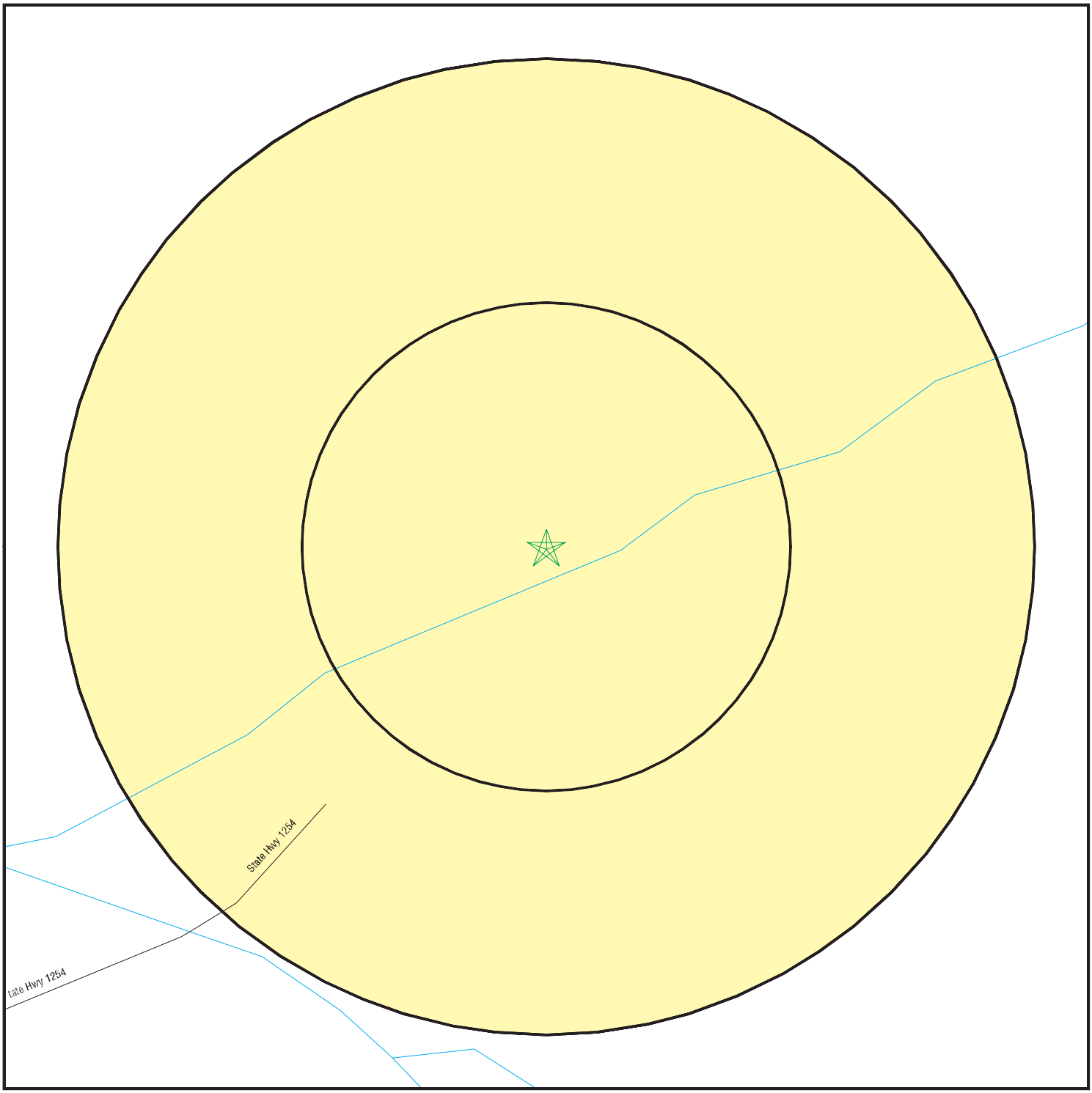
- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

0 1/4 1/2 1 Miles

N

SITE NAME:	East Buffalo Creek Project	CLIENT:	Baker Engineering
ADDRESS:	E Buffalo Rd (SR 1254)/Unpaved Driveway Robbinsville NC 28771	CONTACT:	Carmen Horne-McIntyre
LAT/LONG:	35.3686 / 83.7983	INQUIRY #:	2112222.1s
		DATE:	January 03, 2008 4:38 pm

DETAIL MAP - 2112222.1s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- Hazardous Substance Disposal Sites

0 1/16 1/8 1/4 Miles

N

SITE NAME:	East Buffalo Creek Project	CLIENT:	Baker Engineering
ADDRESS:	E Buffalo Rd (SR 1254)/Unpaved Driveway Robbinsville NC 28771	CONTACT:	Carmen Horne-McIntyre
LAT/LONG:	35.3686 / 83.7983	INQUIRY #:	2112222.1s
		DATE:	January 03, 2008 4:38 pm

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
NPL LIENS		TP	NR	NR	NR	NR	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
LUCIS		0.500	0	0	0	NR	NR	0
DOT OPS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
RCRA-CESQG		0.250	0	0	NR	NR	NR	0
RCRA-NonGen		0.250	0	0	NR	NR	NR	0
DEBRIS REGION 9		0.500	0	0	0	NR	NR	0
HIST FTTS		TP	NR	NR	NR	NR	NR	0
CDL		TP	NR	NR	NR	NR	NR	0
RADINFO		TP	NR	NR	NR	NR	NR	0
LIENS 2		TP	NR	NR	NR	NR	NR	0
RCRA-TSDF		0.500	0	0	0	NR	NR	0
RCRA-SQG		0.250	0	0	NR	NR	NR	0
RCRA-LQG		0.250	0	0	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.000	0	0	0	0	NR	0
NC HSDS		1.000	0	0	0	0	NR	0
IMD		0.500	0	0	0	NR	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
HIST LF		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
BROWNFIELDS		0.500	0	0	0	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0
TRIBAL RECORDS								
INDIAN RESERV		1.000	0	0	0	0	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0

NOTES:

TP = Target Property

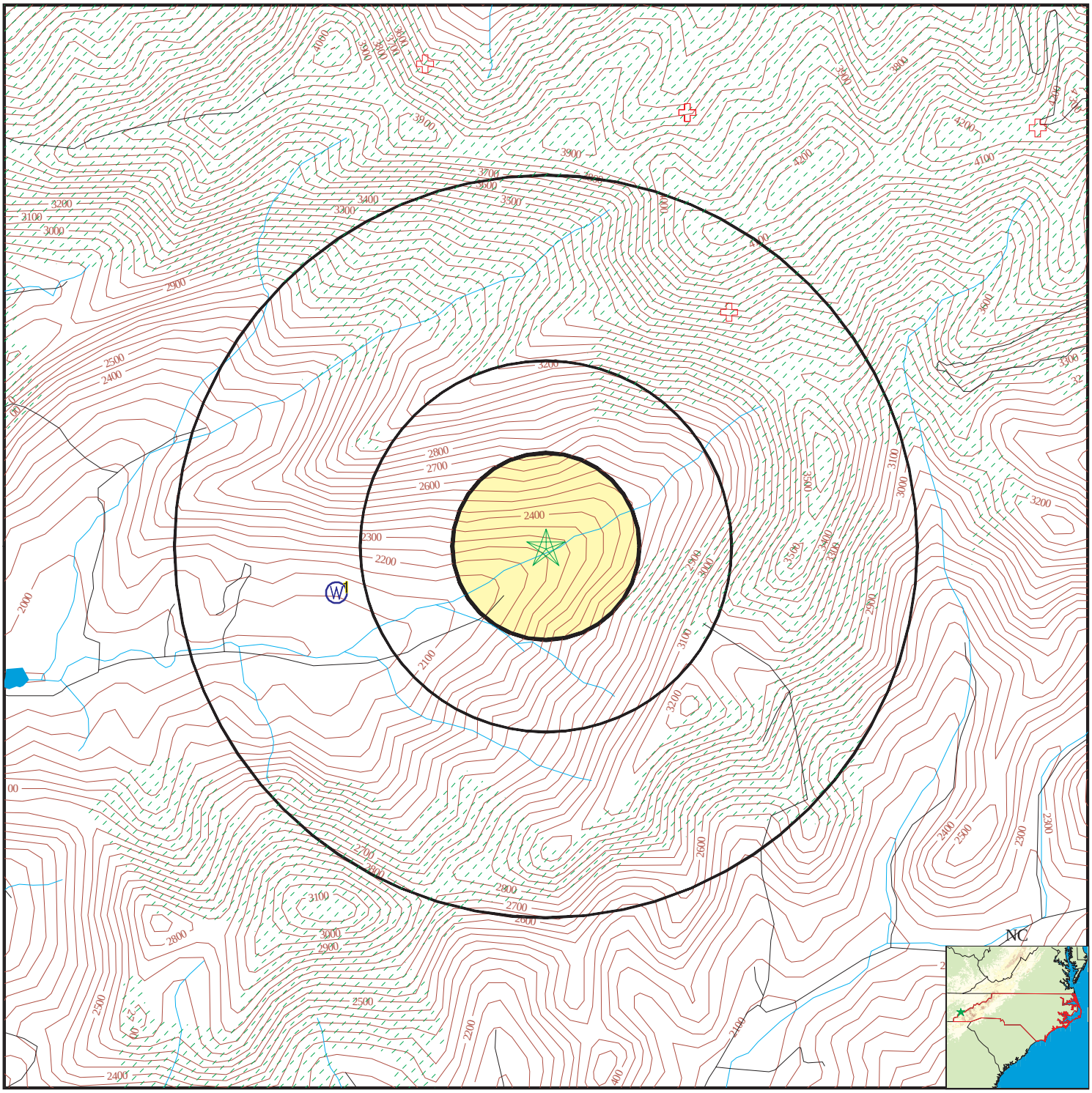
NR = Not Requested at this Search Distance

Sites may be listed in more than one database

MAP FINDINGS

Map ID Direction Distance Distance (ft.) Elevation	Site	Database(s)	EDR ID Number EPA ID Number
	NO SITES FOUND		

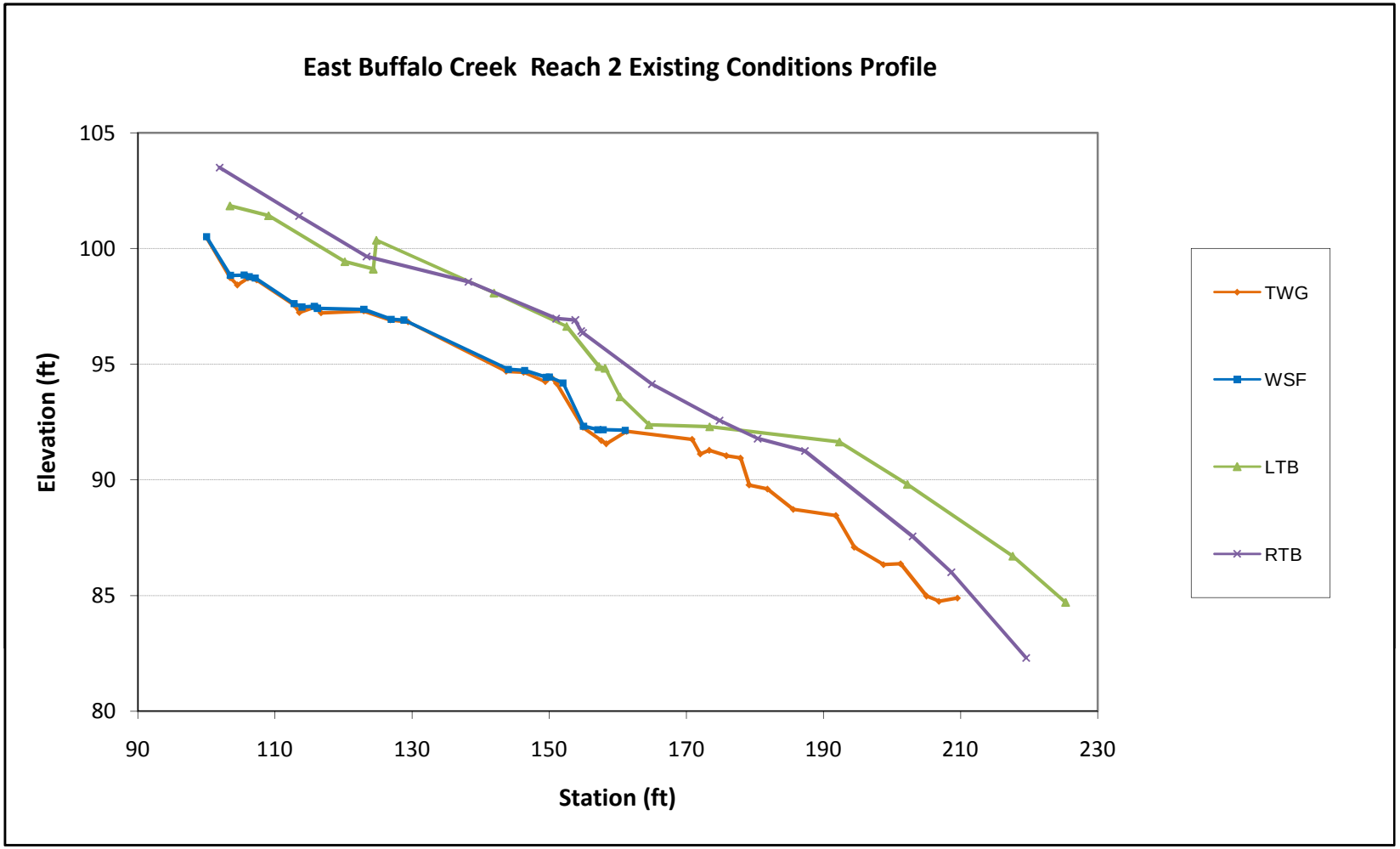
PHYSICAL SETTING SOURCE MAP - 2112222.1s

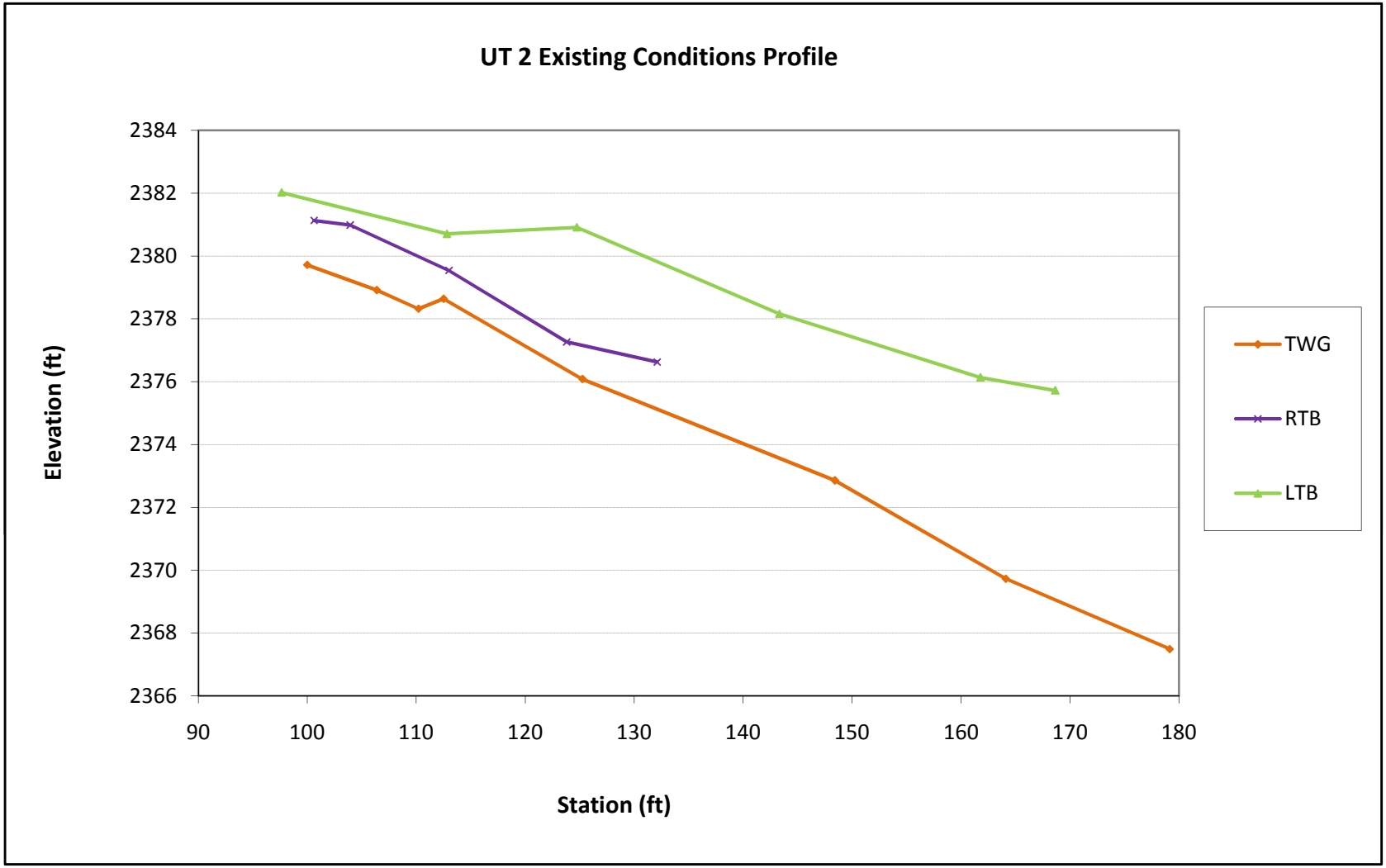


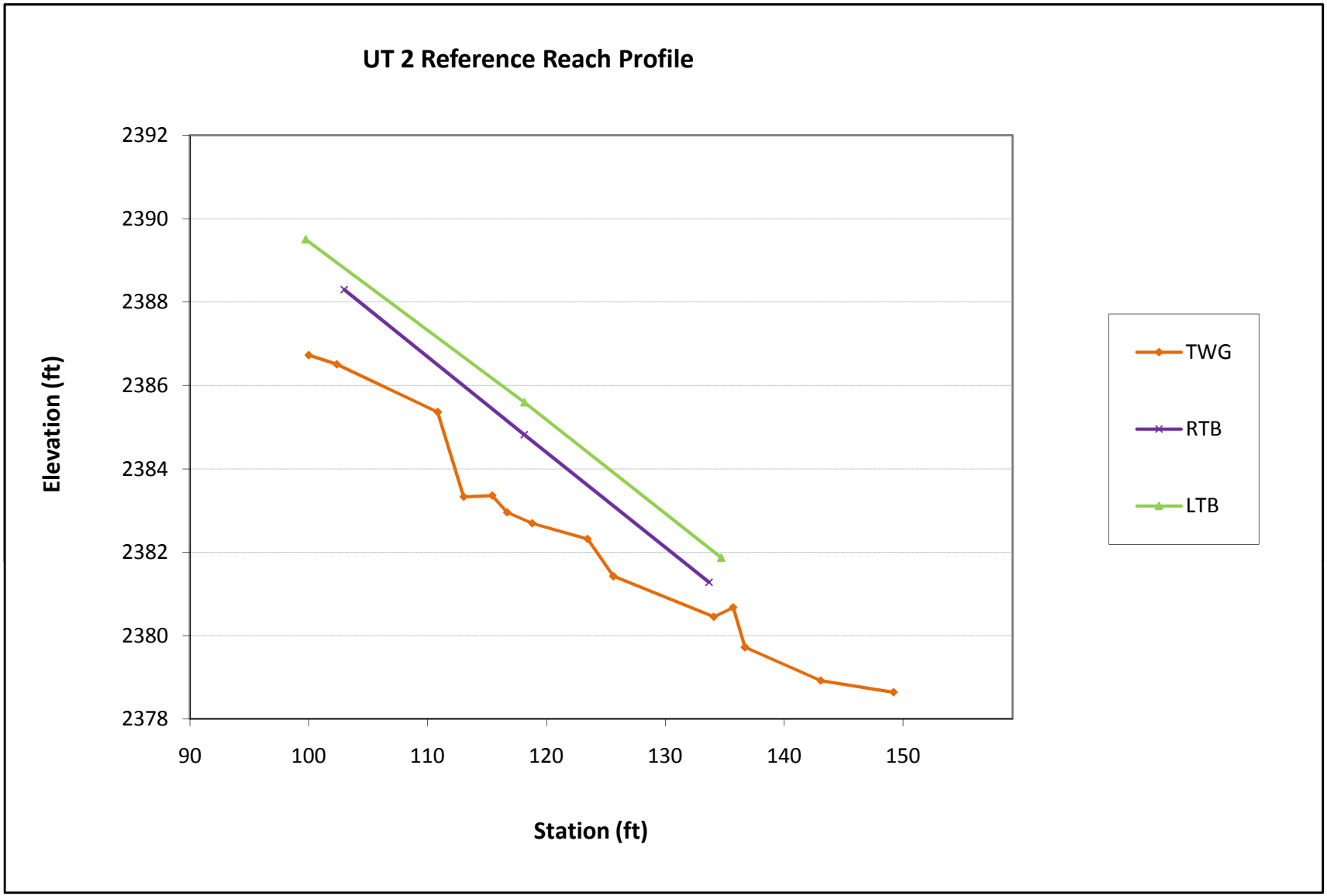
- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location
- Wildlife Areas
- Natural Areas
- Rare & Endangered Species

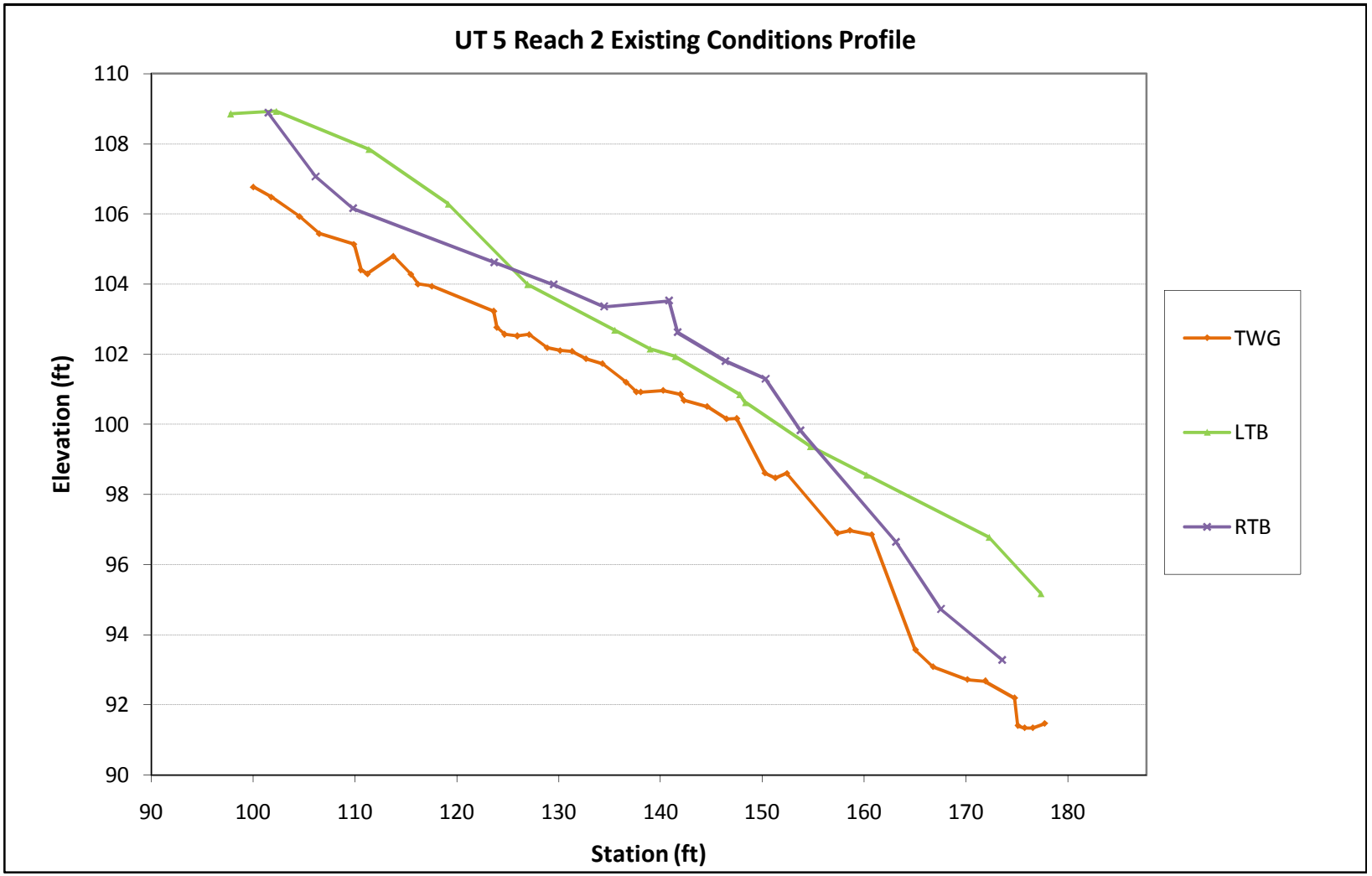
SITE NAME: East Buffalo Creek Project	CLIENT: Baker Engineering
ADDRESS: E Buffalo Rd (SR 1254)/Unpaved Driveway Robbinsville NC 28771	CONTACT: Carmen Horne-McIntyre INQUIRY #: 2112222.1s
LAT/LONG: 35.3686 / 83.7983	DATE: January 03, 2008 4:38 pm

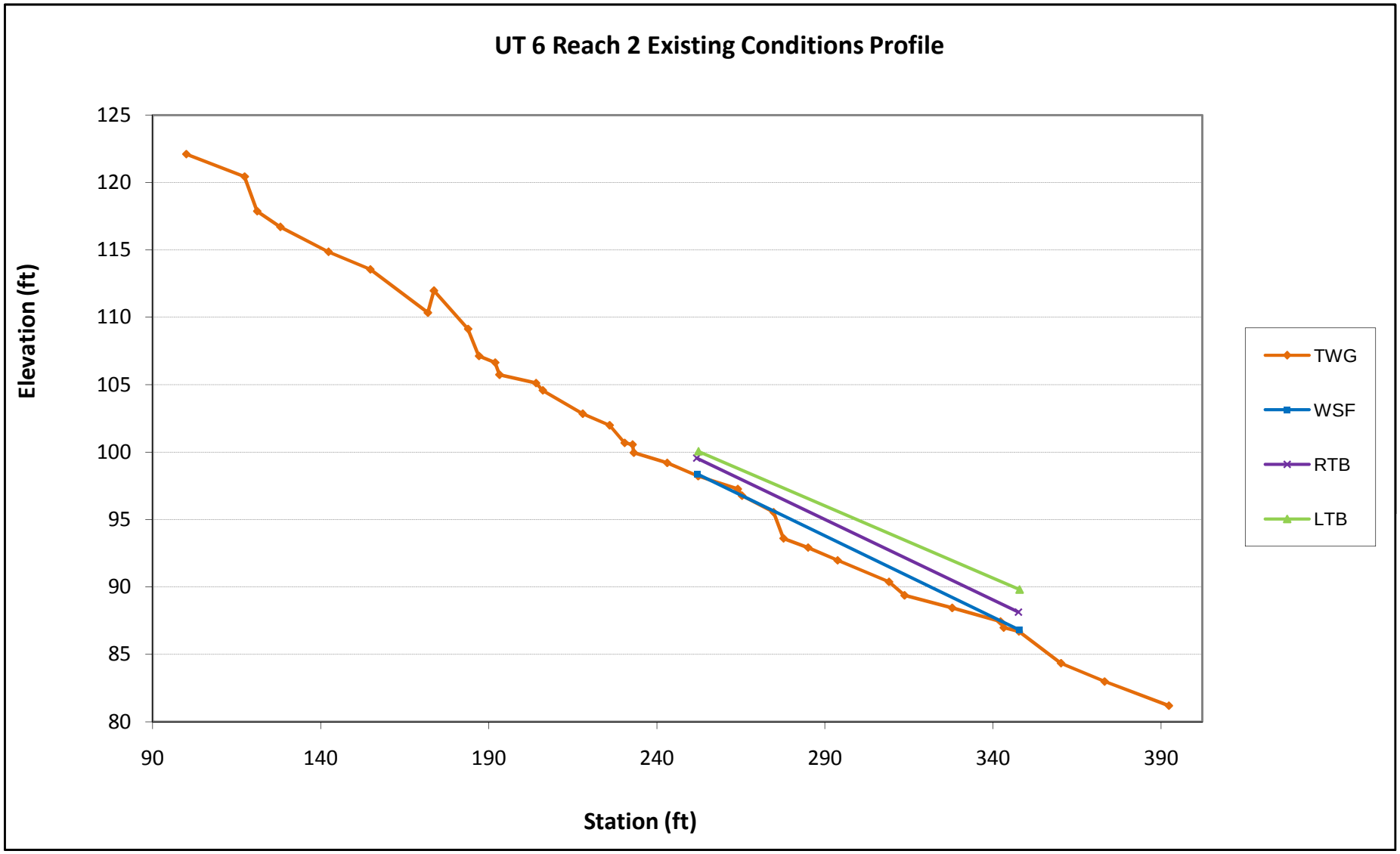
APPENDIX D. Existing Conditions Geomorphic Data

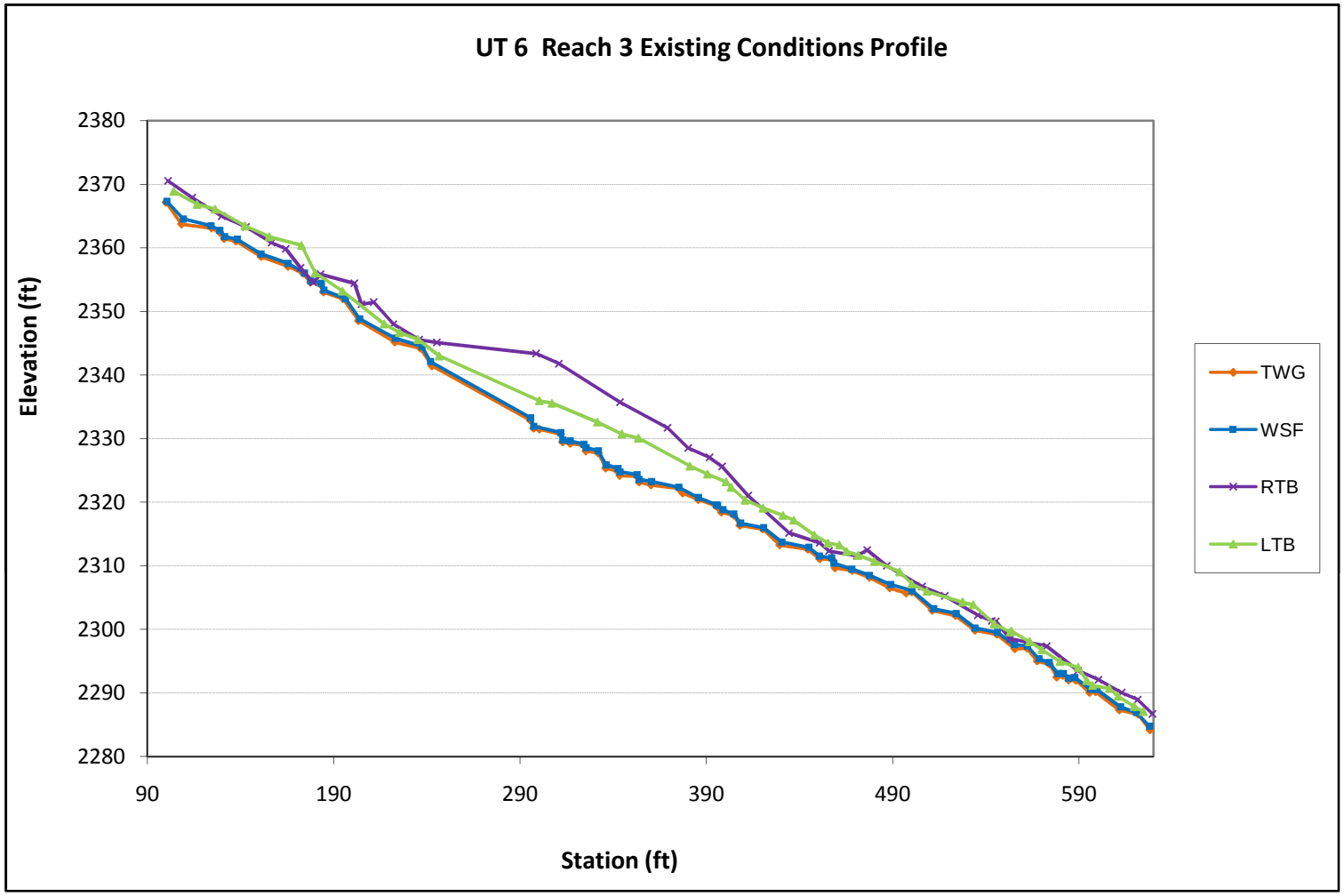

East Buffalo Creek Reach 2 Existing Conditions Profile
Elevation (ft)
105
100
95
90
85
80
90
110
130
150
170
190
210
230
Station (ft)
TWG
WSF
LTB
RTB


UT 2 Existing Conditions Profile
Elevation (ft)
2384
2382
2380
2378
2376
2374
2372
2370
2368
2366
90
100
110
120
130
140
150
160
170
180
Station (ft)
TWG
RTB
LTB

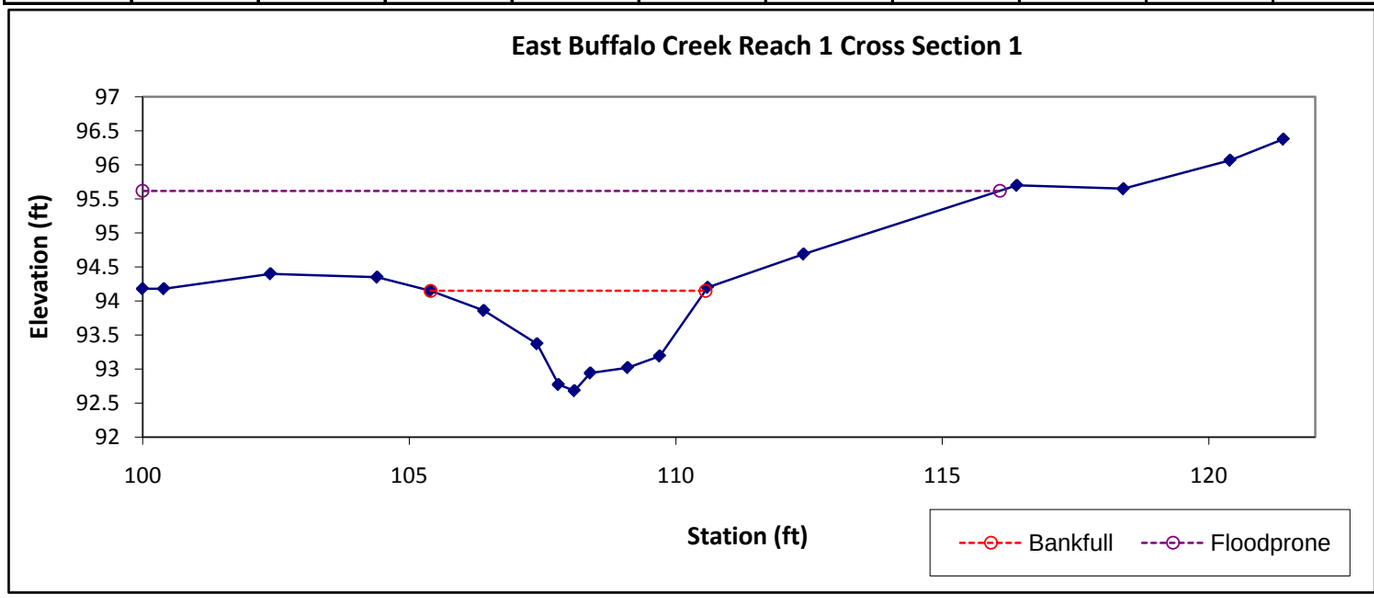

UT 2 Reference Reach Profile
Elevation (ft)
2392
2390
2388
2386
2384
2382
2380
2378
90
100
110
120
130
140
150
Station (ft)
TWG
RTB
LTB


UT 5 Reach 2 Existing Conditions Profile
Elevation (ft)
110
108
106
104
102
100
98
96
94
92
90
90
100
110
120
130
140
150
160
170
180
Station (ft)
TWG
LTB
RTB

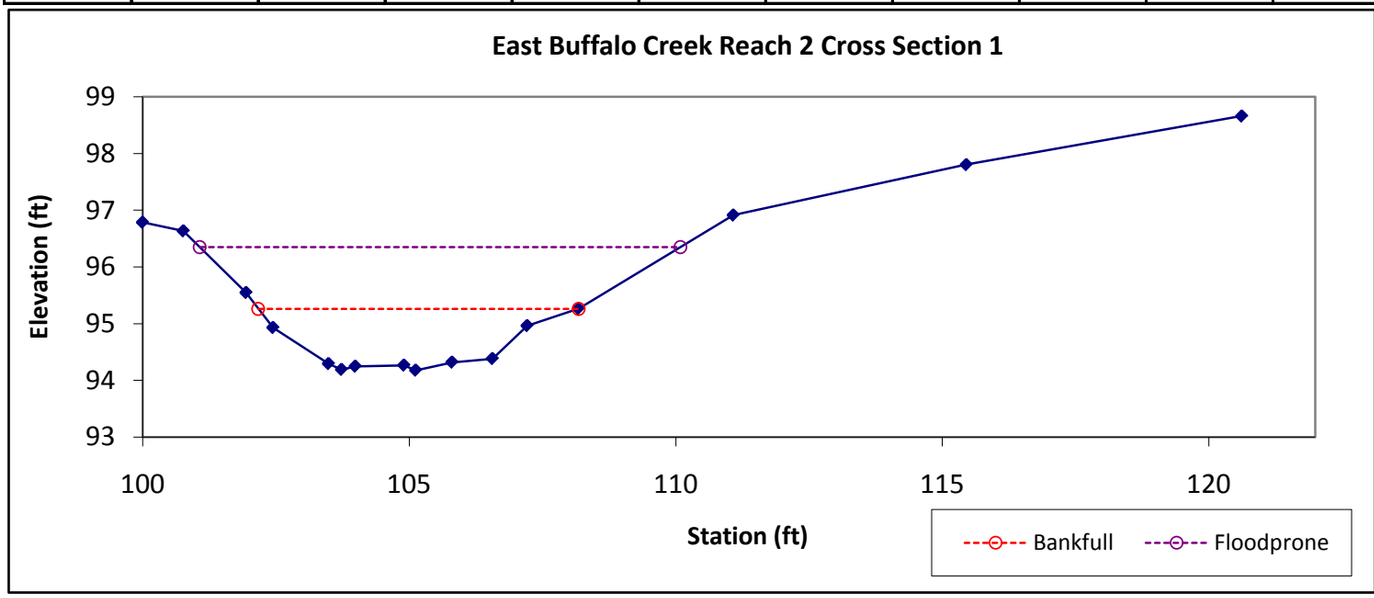

UT 6 Reach 2 Existing Conditions Profile
Elevation (ft)
125
120
115
110
105
100
95
90
85
80
90
140
190
240
290
340
390
Station (ft)
TWG
WSF
RTB
LTB


UT 6 Reach 3 Existing Conditions Profile
Elevation (ft)
2380
2370
2360
2350
2340
2330
2320
2310
2300
2290
2280
90
190
290
390
490
590
Station (ft)
TWG
WSF
RTB
LTB

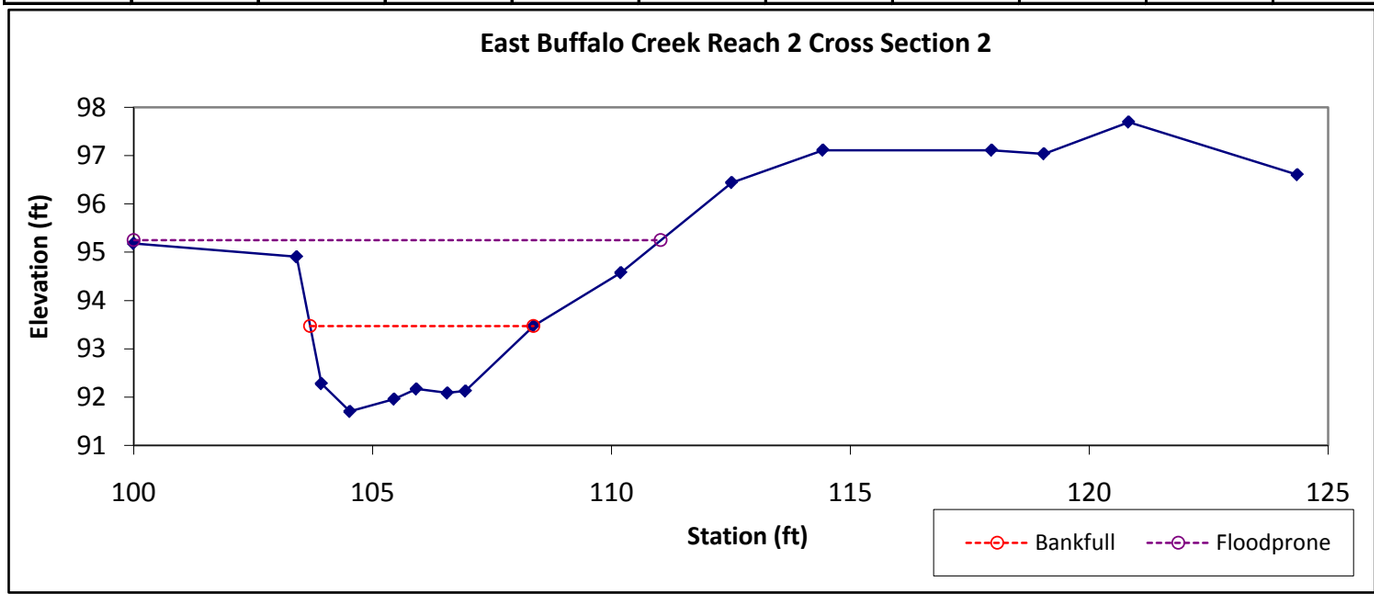
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	3.8	5.16	0.74	1.47	7	1	3.1	94.15	94.15



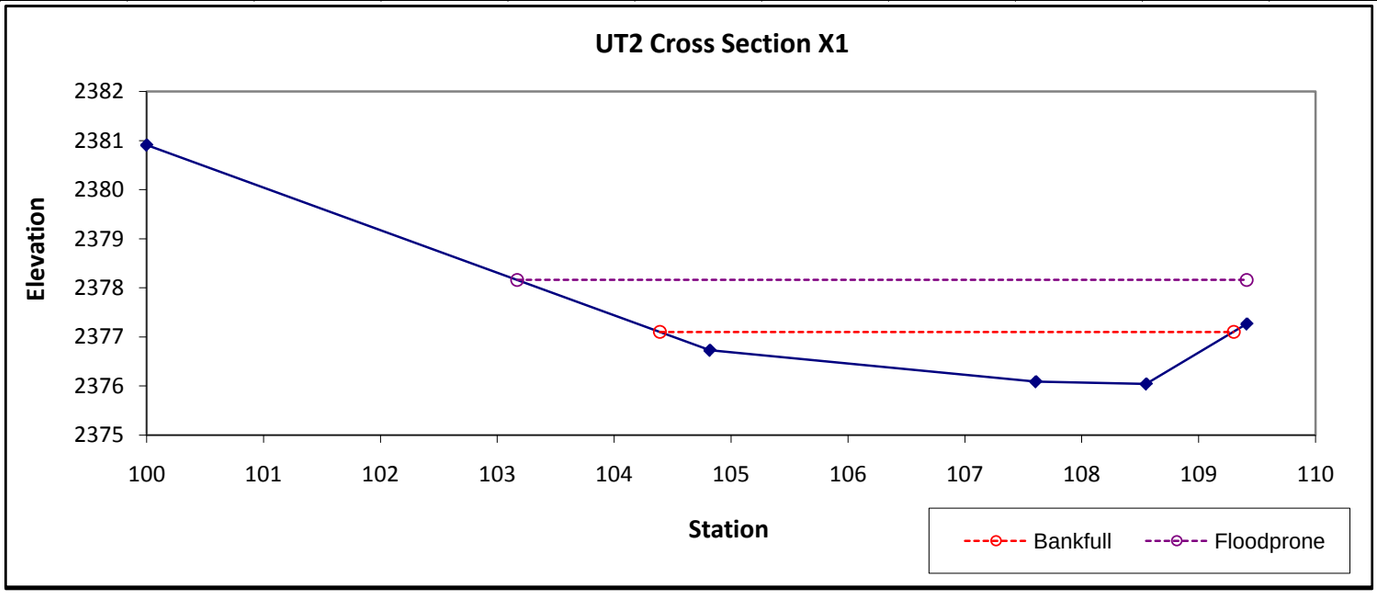
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	4.3	6	0.72	1.09	8.37	2.3	1.5	95.26	96.64



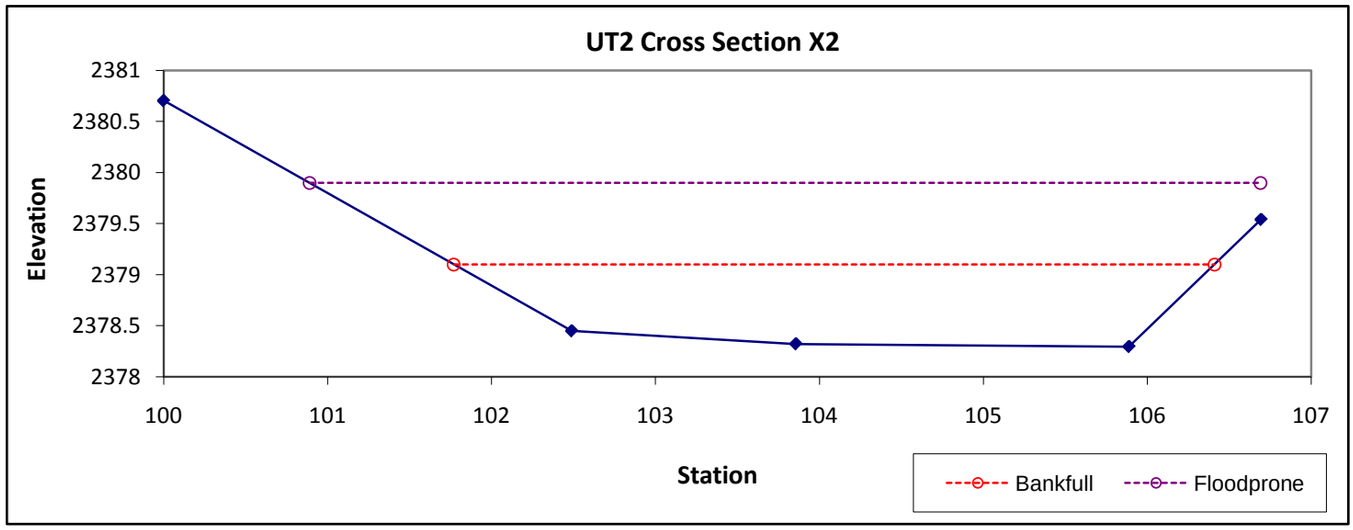
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	A4a+	5.6	4.68	1.19	1.77	3.94	1.8	2.4	93.47	94.9



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A3a+	3.4	4.91	0.69	1.06	7.12	1.2	1.3	2377.1	2377.26

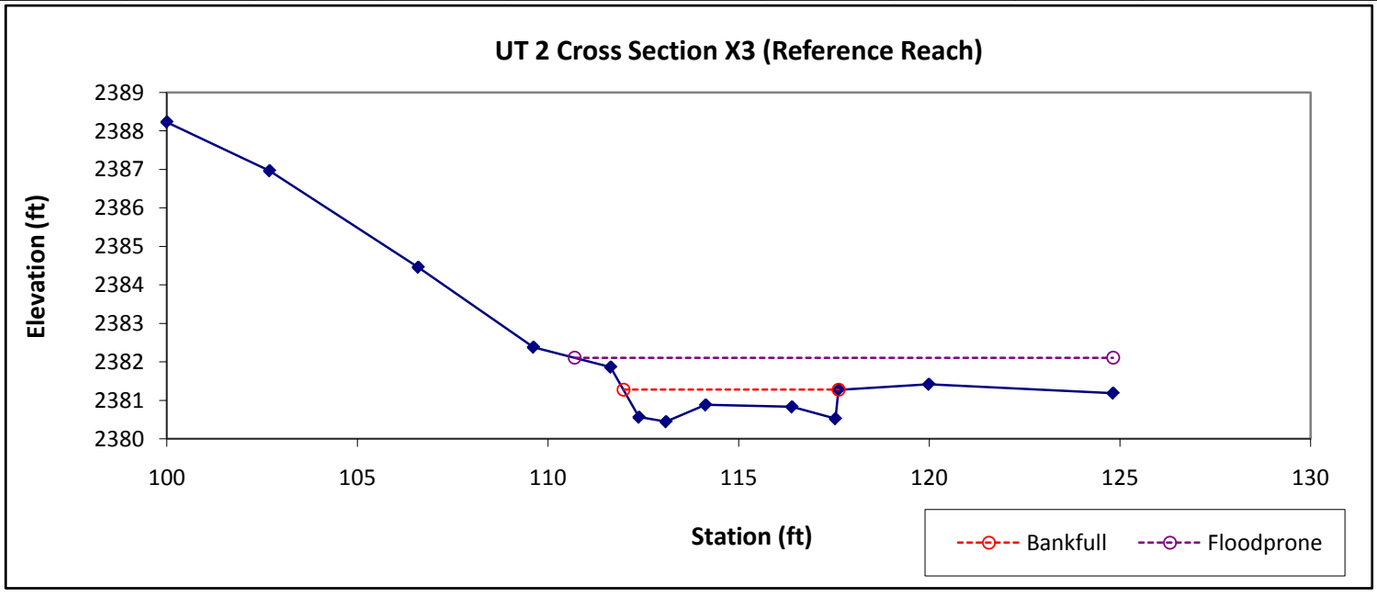


Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A3a+	3	4.64	0.65	0.8	7.11	1.6	1.3	2379.1	2379.54



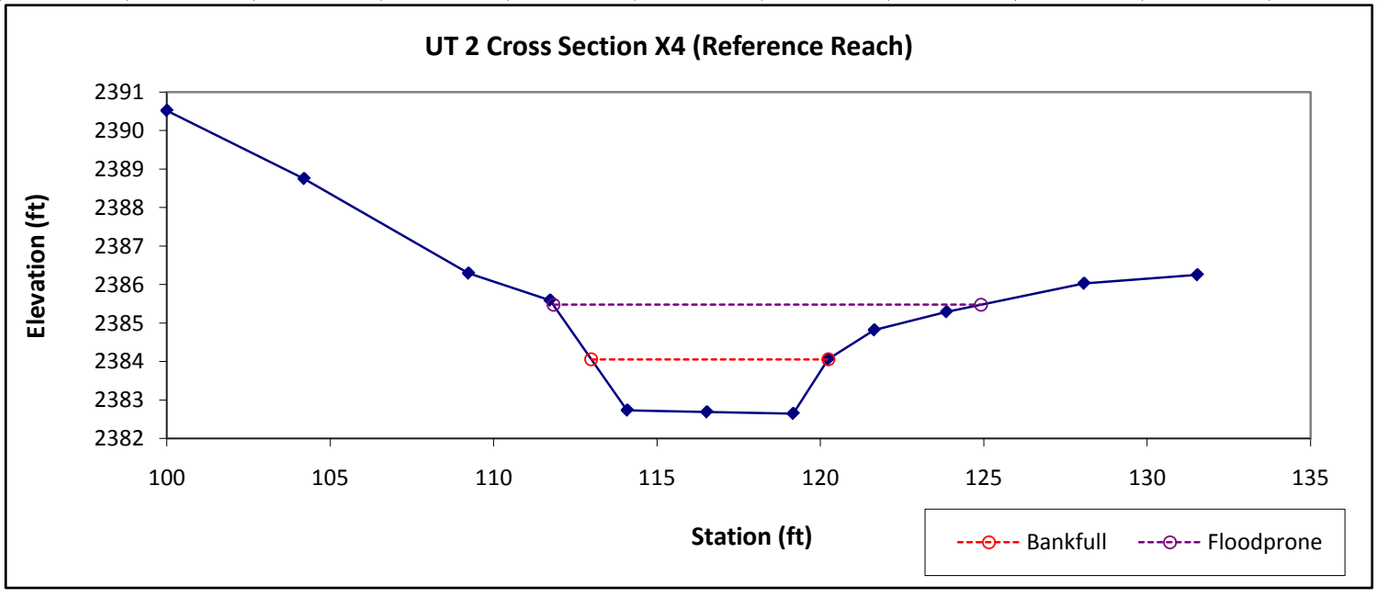
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Step (Riffle)	A3a+	3	5.64	0.53	0.83	10.65	1	2.5	2381.28	2381.28



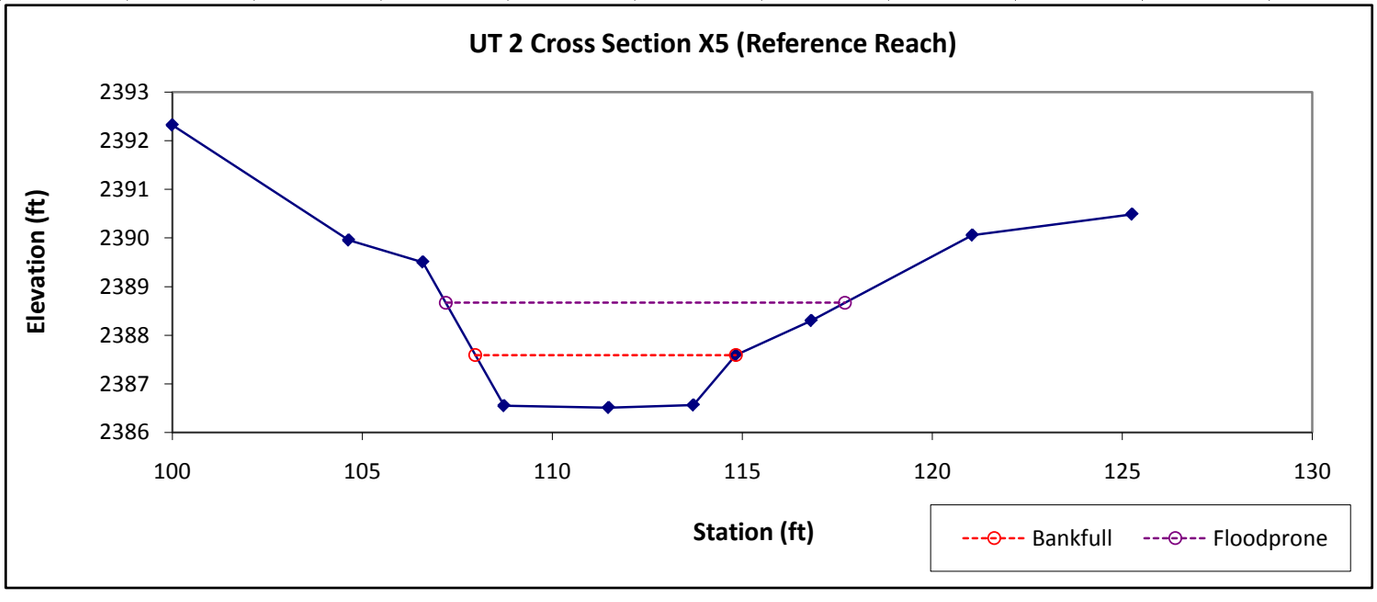
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	A3a+	8.5	7.25	1.17	1.41	6.22	1.5	1.8	2384.06	2384.82



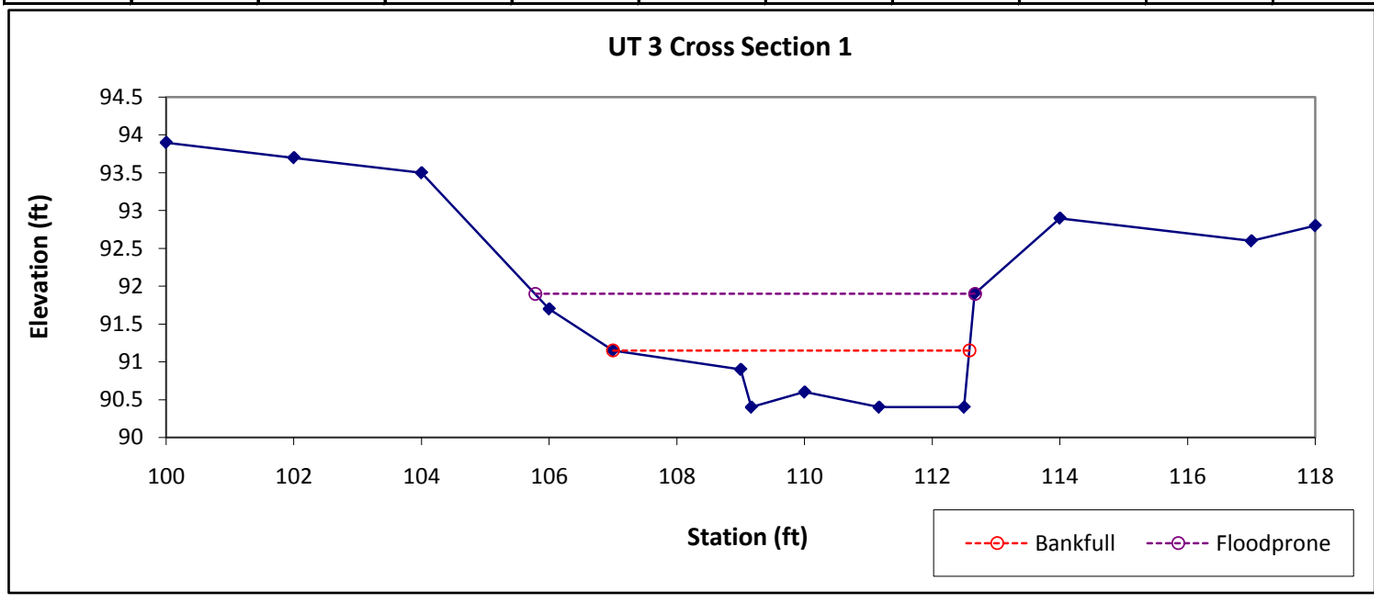
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	A3a+	6.2	6.85	0.91	1.08	7.53	1.7	1.5	2387.59	2388.3



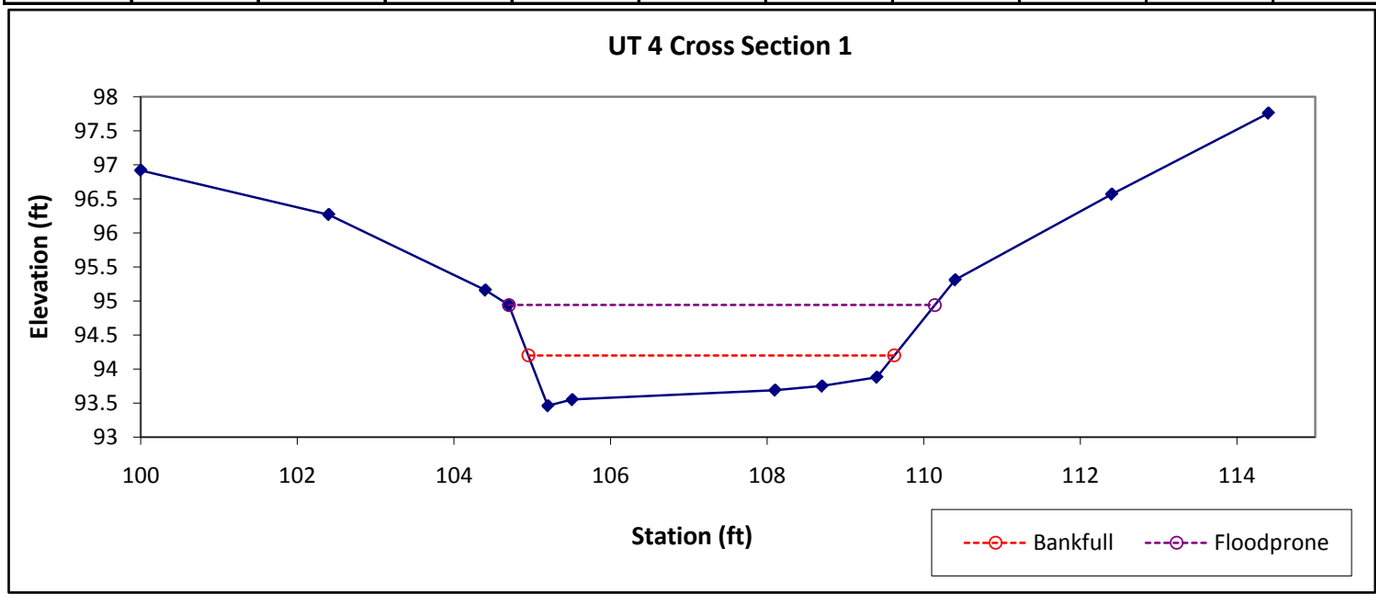
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	2.7	5.58	0.48	0.75	11.7	3.3	1.2	91.15	92.9



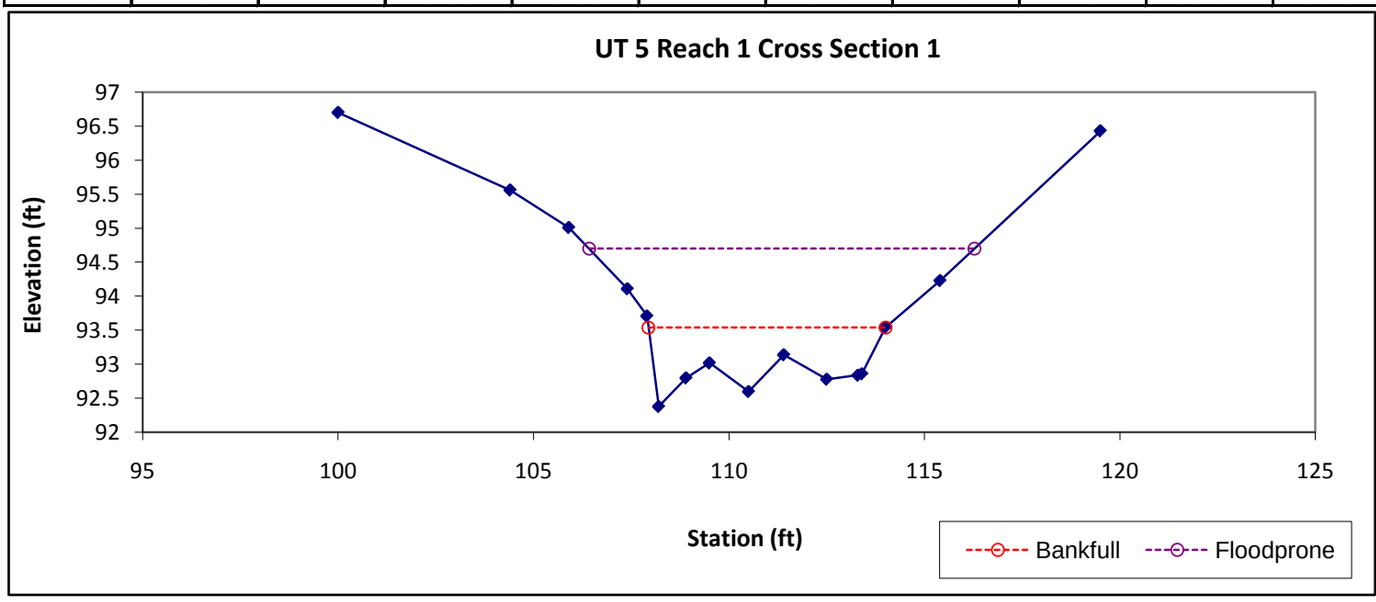
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	2.4	4.67	0.51	0.74	9.09	2	1.2	94.2	94.94

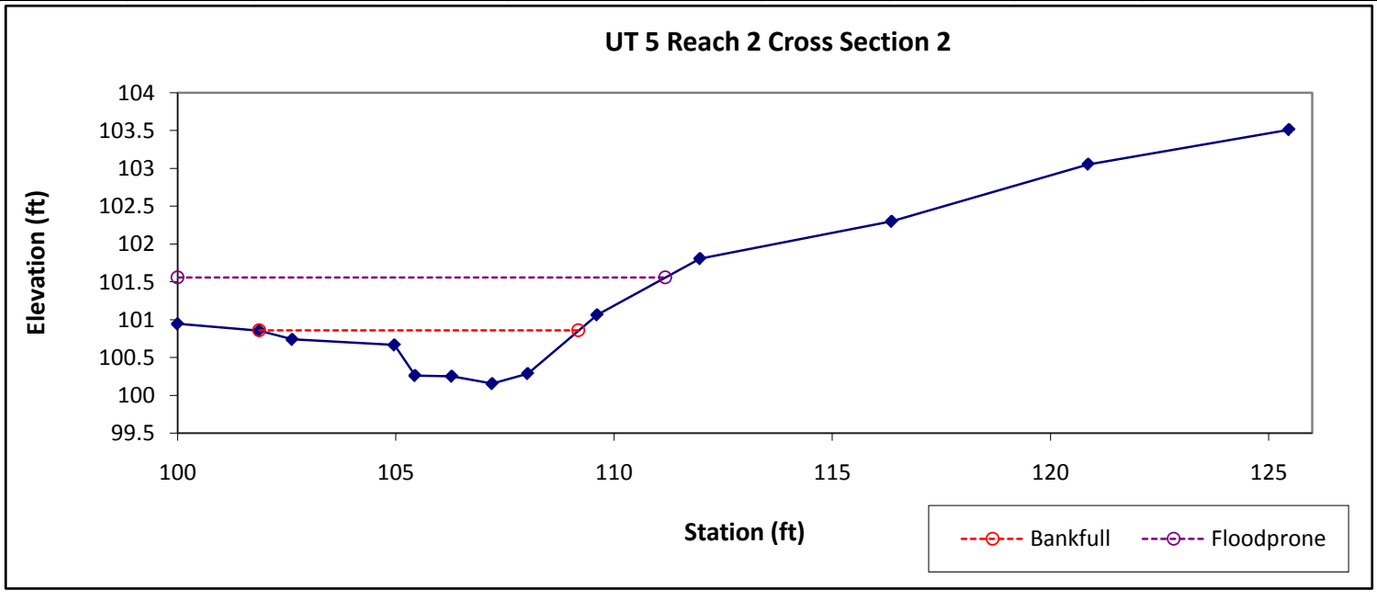


Note: Photo looking upstream

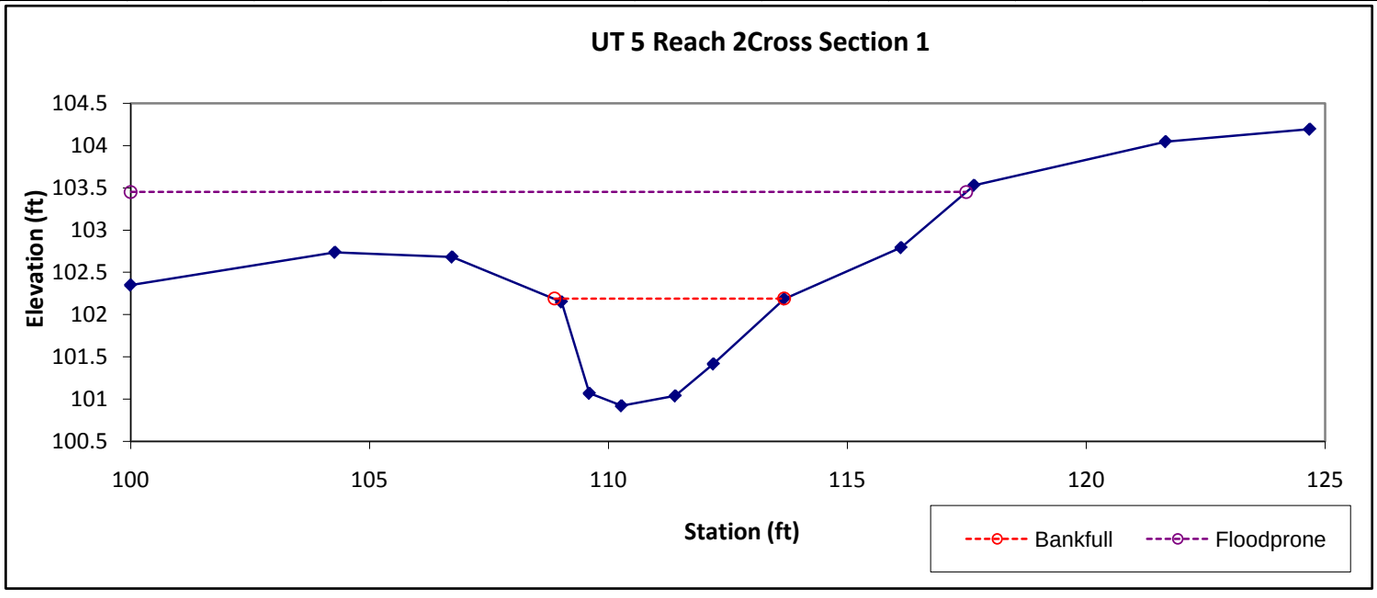
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	4	6.06	0.66	1.16	9.13	2.3	1.6	93.54	95.01



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	2.5	7.32	0.35	0.7	21.07	1	1.5	100.86	100.86

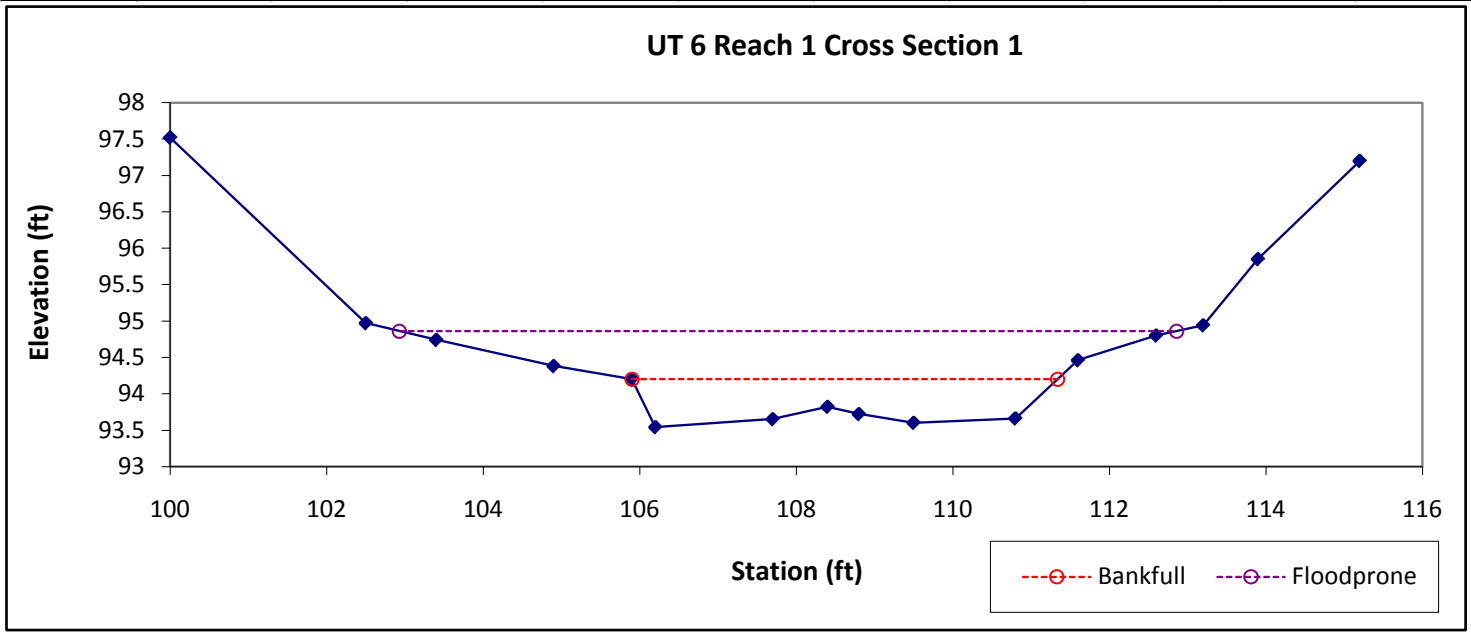


Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	A4a+	3.8	4.81	0.8	1.26	6.03	1	3.6	102.19	102.15

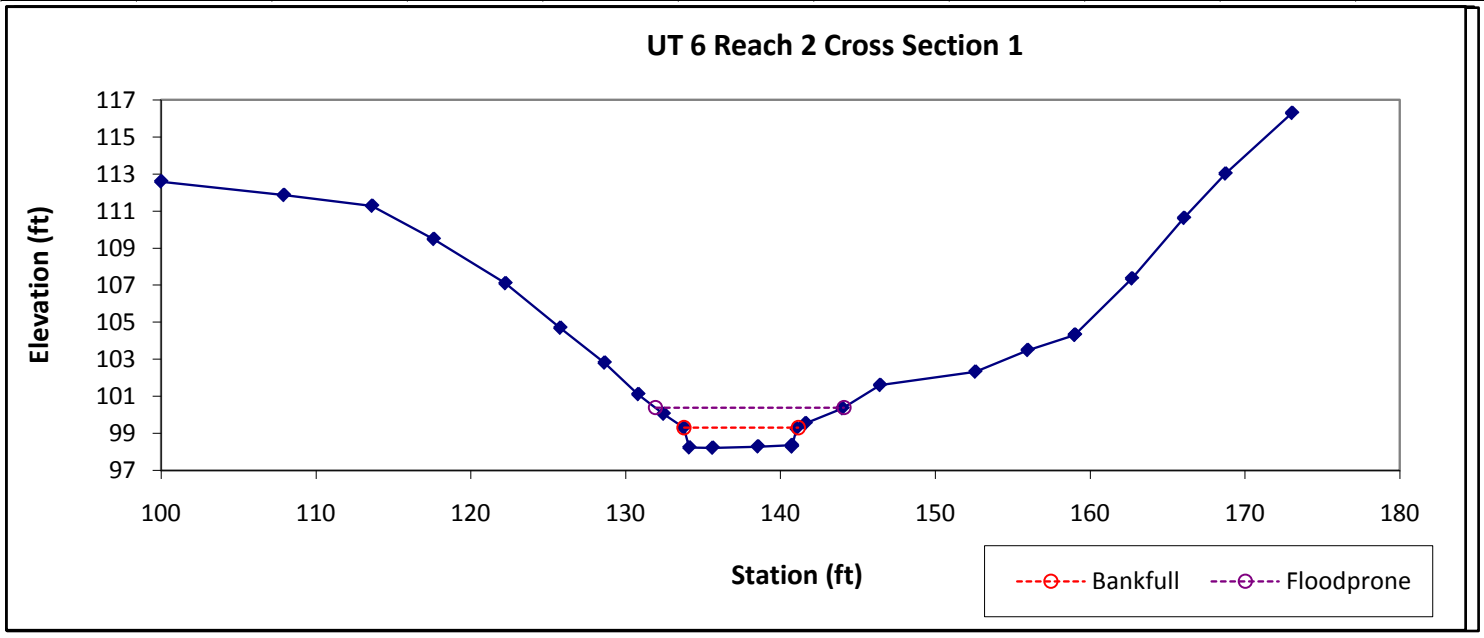


Note: Photo looking upstream

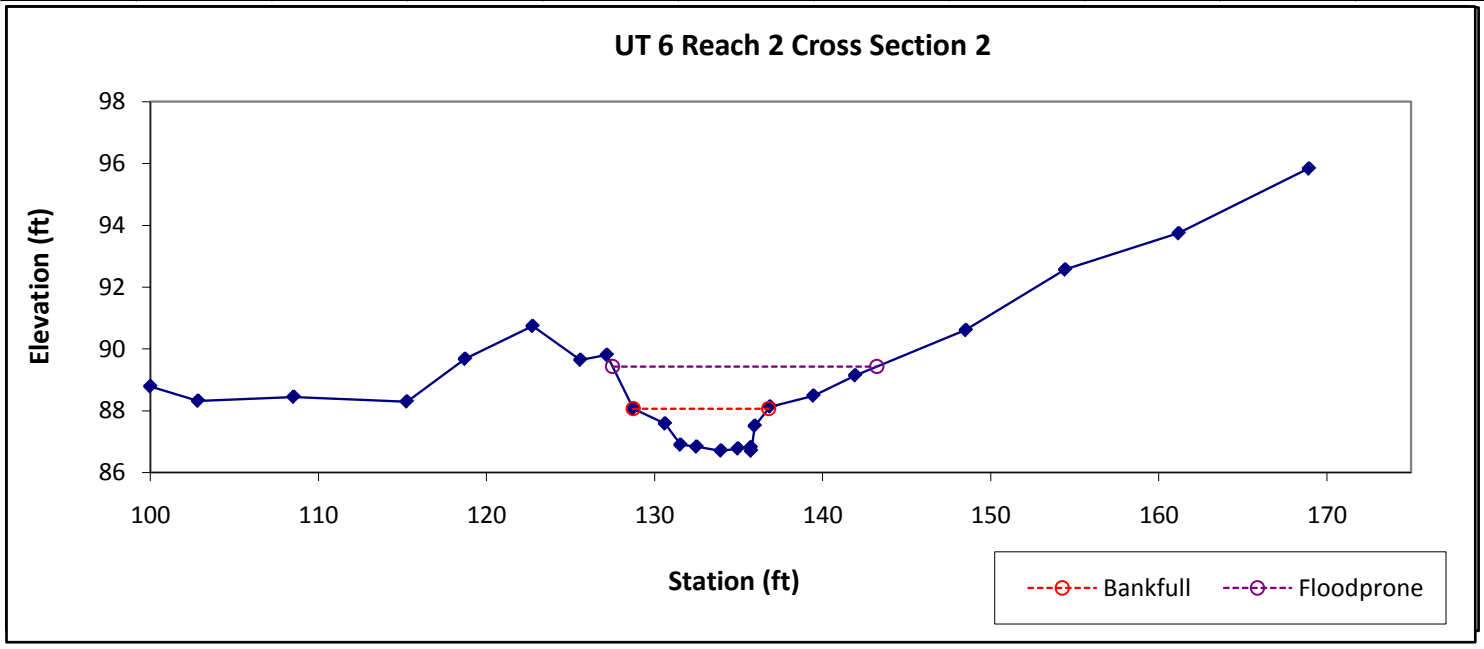
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	2.8	5.44	0.51	0.66	10.69	1	1.8	94.2	94.2



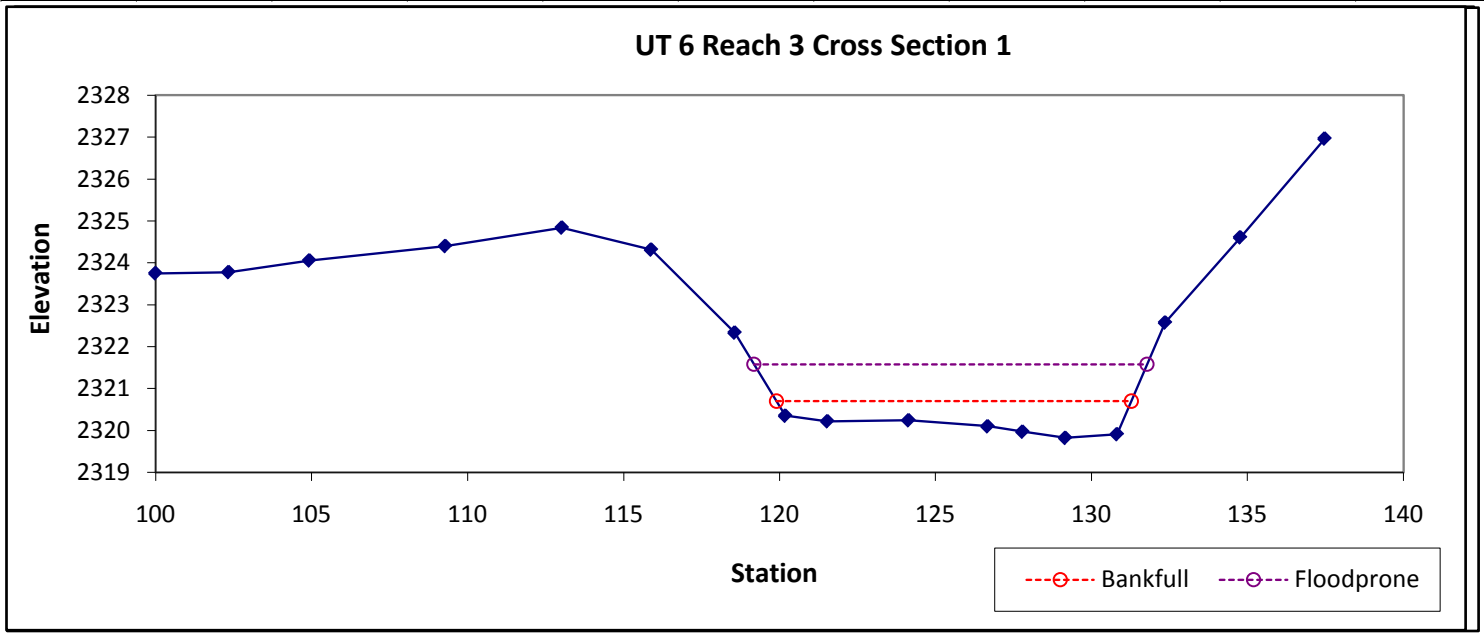
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	7.2	7.38	0.98	1.09	7.57	1.2	1.6	99.31	99.55



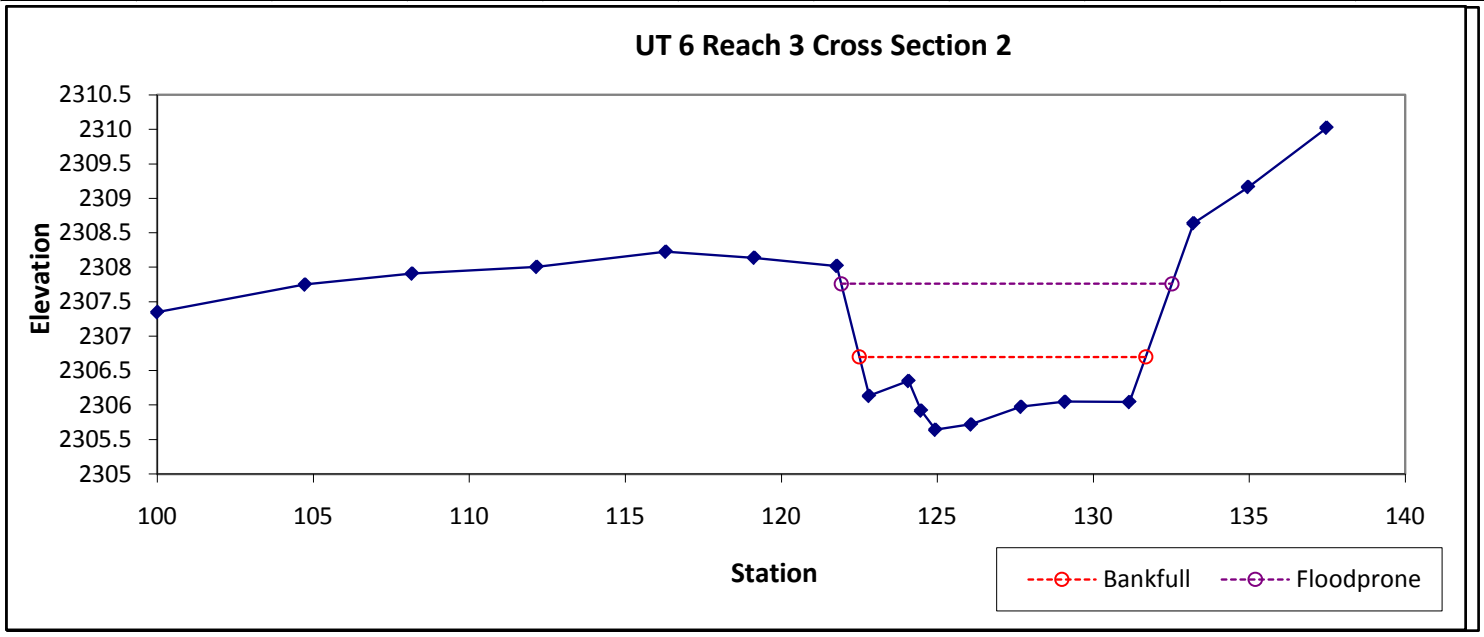
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	7	8.04	0.87	1.36	9.22	1	2	88.07	88.14



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F4b	6.6	11.37	0.58	0.88	19.7	5.7	1.1	2320.7	2324.84

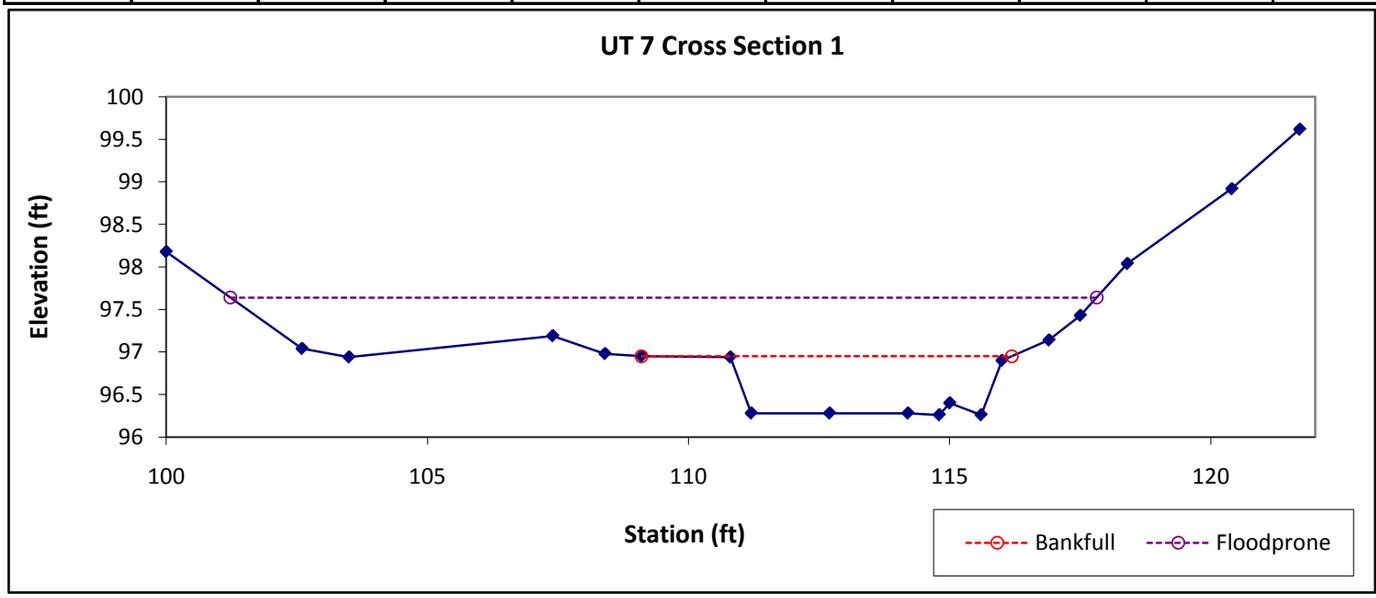


Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F4b	6.3	9.18	0.69	1.06	13.28	2.2	1.2	2306.7	2308.02

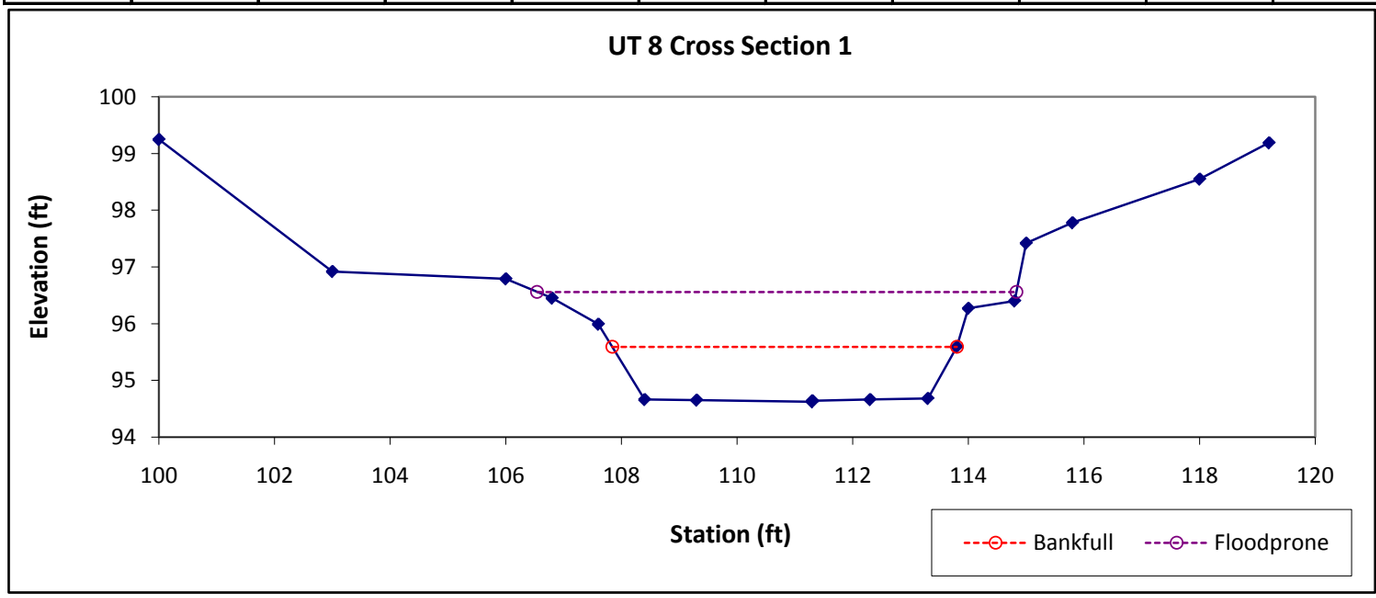


Note: Photo looking upstream

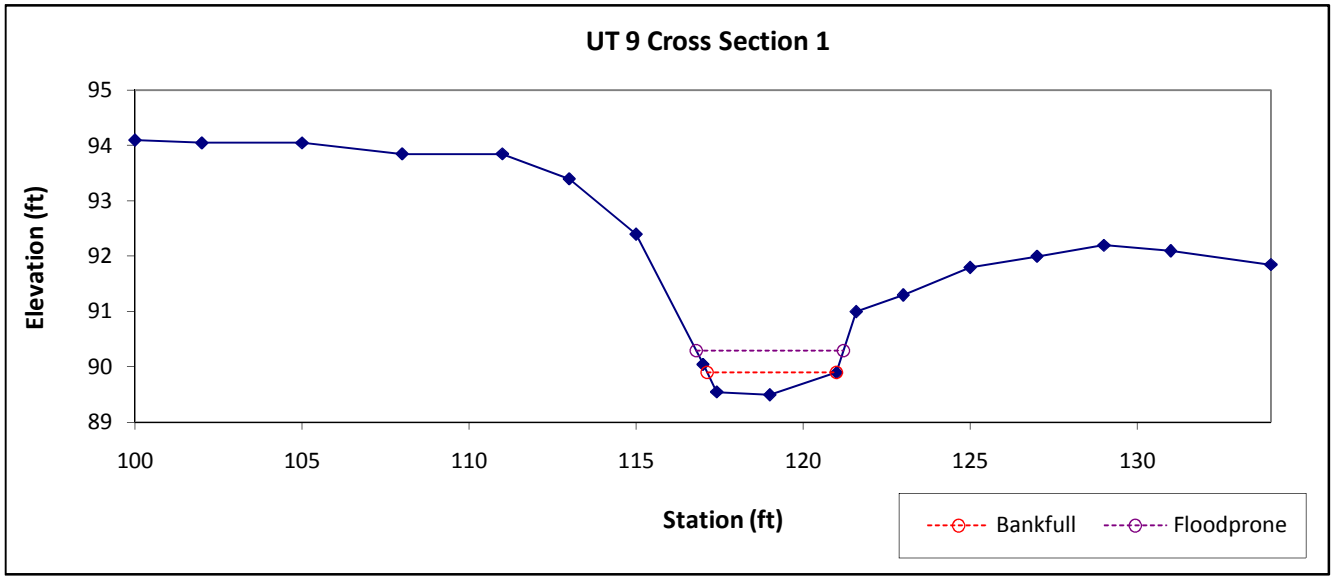
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B4a	3.2	7.09	0.45	0.69	15.64	1	2.3	96.95	96.98



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	5.1	5.96	0.86	0.97	6.96	1.7	1.4	95.59	96.27

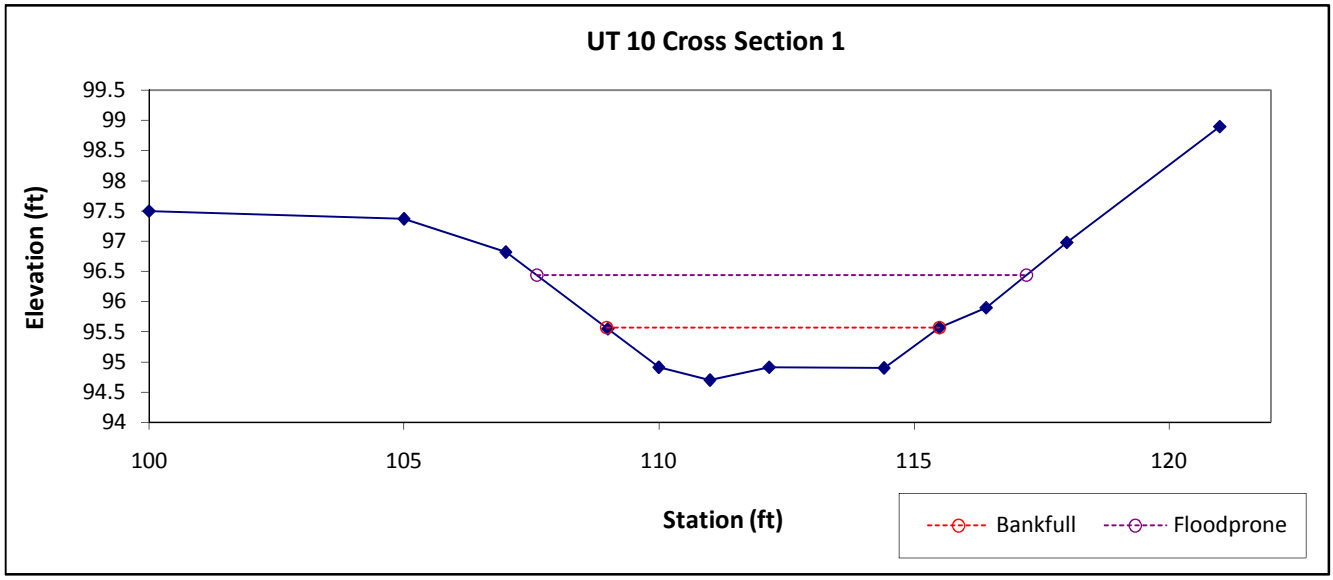


Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F4b	1	3.87	0.27	0.4	14.37	3.7	1.1	89.9	91



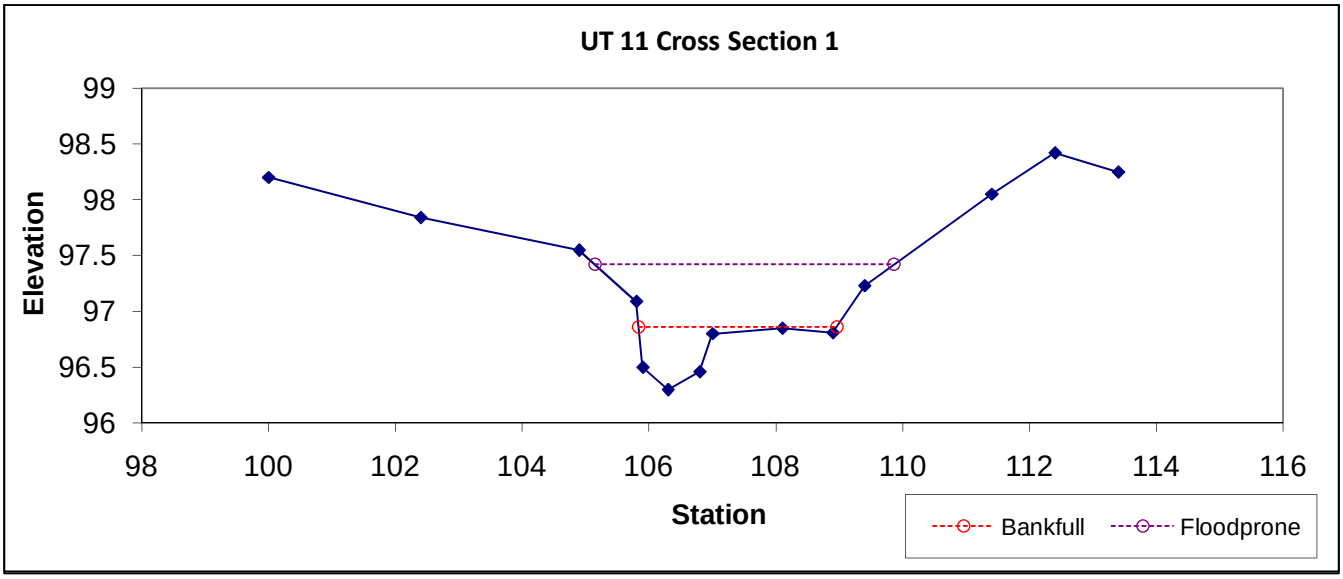
Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	A4a+	3.9	6.53	0.59	0.87	11.06	2.4	1.5	95.57	96.82



Note: Photo looking upstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B4a	0.5	3.12	0.17	0.56	17.87	2.2	1.5	96.86	97.55



Reach 2, East Buffalo Creek (enhancement) – Invasive vegetation thriving within the upstream reach limits.

Reach 2, East Buffalo Creek (enhancement) – Invasive vegetation located mid-reach, upstream of the power line easement.

Reach 2, East Buffalo Creek (enhancement) – Invasive vegetation flourishing within the power line easement mid-reach.

Reach 2, East Buffalo Creek (enhancement) – Invasive vegetation located within the downstream reach limits below the power line easement.

UT2 – Reference reach section located upstream from the perched channel transition.

UT2 – Stable step-pool sequence within the reference reach section.

UT2 - Channel perched along the hillside with a berm along the right bank.

UT2 – Upstream limits of proposed offline channel alignment (by breaching the right bank).

UT2 – Berm along right bank proposed for breaching to re-align channel down valley.

UT2 – Looking down valley where the restored channel will be relocated to the natural low point.

UT2 – Looking up valley where the restored channel will be relocated. Note the seeps on the right where the proposed channel will be routed.

UT2 – 'Relic' channel within which UT2 drained before channelization and where flow from the proposed alignment will be re-routed (looking down valley).

UT5 Reach 2 (enhancement) – Invasive vegetation choking out native species within the downstream reach limits.

UT5 Reach 2 (enhancement) – Confluence of UT5 Reach 2 and East Buffalo looking upstream.

UT5 Reach 2 (enhancement) – Old forest road intersecting channel mid-reach where flow is routed through a culvert beneath the road

UT6 Reach 2 (enhancement) – Upstream subreach with invasive species situating the left floodplain in proximity to the clearing along the gravel road nearby.

UT6 Reach 2 (enhancement) – Downstream subreach looking up valley at the gravel road realignment origin.

UT6 Reaches 2 & 3 (enhancement) – Looking down valley along proposed corridor for the relocated road.

UT6 Reach 2 (enhancement) – Proposed tie-in location for the relocated road up valley (looking down valley).

UT6 Reach 3 (enhancement) – Hillside erosion and bank slumping in sharp meander bend where channel is proposed for relocation away from valley wall.

UT6 Reach 3 (enhancement) – Overwidened channel at eroded meander bend where the channel will be relocated.

UT6 Reach 3 (enhancement) – Looking upstream at where channel will be relocated. Overwidened channel has eroded around existing grade control (boulder).

UT6 Reach 3 (enhancement) – Overwidened, entrenched channel with no buffer pinched between valley wall and eroding road embankment.

UT6 Reach 3 (enhancement) – Stable step-pool profile and diverse bedform features within downstream reach limits.

Reach 1, East Buffalo Creek (preservation)

Reach 1, East Buffalo Creek (preservation)

Preservation Reach UT3

Preservation Reach UT3

Preservation Reach UT4

Preservation Reach UT5

Preservation Reach UT5

Preservation Reach UT6

Preservation Reach UT7

Confluence of Preservation Reaches UT7 and UT8

Preservation Reach UT8

Preservation Reach UT9

Preservation Reach UT9

Preservation Reach UT10

Preservation Reach

Preservation Reach

Preservation Reach

Preservation Reach