Big Cedar Creek Stream Restoration Plan
Stanly County, North Carolina

EEP Project Number D06054-D

Prepared For

NCDENR-EEP
1652 Mail Service Center
Raleigh, North Carolina 27699-1652
Phone: 919-715-0476
Fax: 919-715-2219

October, 2007

Final Plans

Big Cedar Creek Restoration Plan
Stanly County, North Carolina

Report Prepared and Submitted by:

Baker Engineering NY, Inc.
1447 South Tryon Street
Suite 200
Charlotte, NC 28203
Phone: 704.334.4454
Fax: 704.334.4492

Christine D. Miller
Project Manager

William A. Harman, PG
Principal in Charge

EXECUTIVE SUMMARY

Baker Engineering NY, Inc. (Baker) proposes to restore 10,686 linear feet (LF) of perennial channel along Big Cedar Creek and two unnamed tributaries (UT1 and UT2) in Stanly County, NC. Additionally, this plan proposes 1,094 LF of enhancement along Big Cedar Creek and UT1 and 597 LF of preservation along Big Cedar Creek and the northern most unnamed tributary (UT2). Big Cedar Creek flows directly into Rocky River approximately 500 feet below the site. The Big Cedar Creek site is approximately 10 miles south of Albemarle (Figure 1.1). The site lies in the Yadkin River Basin within North Carolina Division of Water Quality (NCDWQ) sub-basin 03-07-14 and United States Geological Survey (USGS) hydrologic unit 03040105060080.

The goals for the restoration project are as follows:

- Create geomorphically stable conditions on the Big Cedar Creek project site.
- Improve and restore hydrologic connections between the streams and their floodplains.
- Improve the water quality in the Big Cedar Creek and Rocky River watersheds.
- Improve aquatic and terrestrial habitat along the project corridor.

To accomplish these goals, we recommend the following:

- Restore the existing incised, eroding and channelized stream by creating a stable channel with access to the floodplain.
- Improve water quality by establishing buffers for nutrient removal from runoff and by stabilizing stream banks to reduce bank erosion and sediment contribution to creek flows.
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools and areas of water re-aeration, providing woody debris for habitat and reducing bank erosion.
- Improve terrestrial habitat by planting riparian areas.
- Establish native stream bank and floodplain vegetation in a permanent conservation easement to increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature and provide cover and improve wildlife habitat.
- Improve channel stability and protect riparian buffer by excluding livestock through fencing streams and riparian buffer limits.

Table ES.1 Restoration Plan Overview
Big Cedar Creek Restoration Plan

Project Feature	Existing Condition (LF)	Design Condition (LF)	Approach	Compensatory Mitigation Ratio	SMU
Big Cedar Creek	5,826	4,987	Restoration	1:1	4,989
		969	Enhancement II	1:2.5	388
		435	Preservation	1:5	87
UT1	5,210	5,094	Restoration	1:1	5,094
		125	Enhancement II	1:2.5	50
UT2	625	605	Restoration	1:1	605
		162	Preservation	1:5	32
Total Stream Work	11,661	**12,377**	**----**		**11,245**

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION AND BACKGROUND

1.1 Brief Project Description and Location

Baker proposes to restore 10,686 linear feet (LF) of perennial stream channel along Big Cedar Creek and two unnamed tributaries (UT1 and UT2) in Stanly County, NC. Additionally, this plan proposes 1,094 LF of Enhancement II along Big Cedar Creek and UT1 and 597 LF of preservation along Big Cedar Creek and UT2.

The Big Cedar Creek restoration site is located approximately ten miles south of the City of Albemarle in Stanly County, North Carolina, as shown in the Vicinity Map, Figure 1.1. The project site lies in the Yadkin River Basin within NCDWQ sub-basin 03-07-14 and USGS hydrologic unit 03040105060080 (NCDENR, 2003). Figure 1.1 depicts the basin boundaries and USGS hydrologic unit code (HUC) for the project reach.

The area has a history of general agricultural usage including cattle, cotton and corn production. The streams on the project site have been channelized and riparian vegetation on the majority of the site has been removed. The riparian vegetation that is found on much of the site consists of successional and invasive species such as Chinese privet (*Ligustrum sinense)* and Japanese honeysuckle (*Lonicera japonica*).

Big Cedar Creek, UT1, and UT2 are "blue-line" streams, as shown on the USGS topographic quadrangle for the site (Figure 1.3). Big Cedar Creek, UT1, and UT2 were determined to be perennial based on the NCDWQ Stream Identification Forms (Appendix E). The total current length of stream on the project site is 11,661 LF.

1.2 Directions to the Project Site

The latitude and longitude at the center of the Big Cedar Creek project site is 80° 07' 37.72" W, 35° 11' 53.94" N.

Driving directions to the project site are as follows.

- From Highway 52, turn west onto Mount Zion Church Road (1.25 miles south of the Town of Norwood.
- Continue approximately 0.5 mile west to the intersection of Mount Zion Road and Big Cedar Creek. This is the southern project boundary as shown on Figure 1.2.
    - UT1, UT2, and the upstream reaches of Big Cedar Creek can be accessed from the farm road on the north side of Mount Zion Church Road, approximately 0.25 miles east of the intersection of the railroad and Mount Zion Church road.
    - Reach 5 and 6 of Big Cedar Creek can be accessed from a farm field approximately 0.1 mile west of the intersection of the railroad and Mount Zion Church road.

2.0 WATERSHED CHARACTERIZATION

2.1 Watershed Delineation

The Big Cedar Creek Restoration project is located in Stanly County in the Yadkin River Basin. Within the project boundary, the streams were divided into reaches based on changes in channel and valley geomorphology. Watershed areas provided in Table 2.1 were calculated at the upstream and downstream ends of each stream reach within the project boundaries. Figure 1.3 depicts the drainage areas for Big Cedar Creek, UT1, and UT2.

Table 2.1 Drainage Areas By Reach
Big Cedar Creek Restoration Plan

Reach	Existing Conditions Reach Length (LF)	Watershed Size at Upstream End of Reach (square miles)	Watershed Size at Downstream End of Reach (square miles)
Big Cedar Creek – Reach 1	350	2.29	2.85
Big Cedar Creek – Reach 2	1,016	2.85	2.91
Big Cedar Creek – Reach 3	2,046	2.91	3.30
Big Cedar Creek – Reach 4	976	3.30	3.35
Big Cedar Creek – Reach 5	534	3.35	4.67
Big Cedar Creek – Reach 6	904	4.67	4.71
UT1 – Reach 1	1,998	0.70	0.93
UT1 – Reach 2	759	0.93	0.98
UT1 – Reach 3	1,518	0.98	1.18
UT1 – Reach 4	935	1.18	1.21
UT2	625	0.54	0.55
Total Existing Stream Length	11,661		

2.2 Surface Water Classification/ Water Quality

NCDWQ designates surface water classifications for water bodies such as streams, rivers, and lakes which define the best uses to be protected within these waters (e.g., swimming, fishing, and drinking water supply). These classifications are associated with water quality standards that govern those uses. All surface waters in North Carolina must meet the minimum standards for fishable/swimmable waters (Class C). The other classifications provide additional levels of protection for primary water contact recreation (Class B) and drinking water supplies (WS). Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses. Classifications and their associated protection standards may also be designated to protect the free-flowing nature of a stream or other special characteristics (NC DENR, 2007).

Big Cedar Creek is classified by the NCDWQ as Class C waters (DWQ Index No. 13-17-44). Based on North Carolina's tributary rule, its tributaries would also be considered Class "C" waters (NCDENR, 2005). Big Cedar Creek's water quality is not specifically monitored as a part of a basinwide plan (NCDENR, 2003).

2.3 Physiography, Geology and Soils

The Big Cedar Creek site lies within the Piedmont physiographic province. Medina and others describe the Piedmont as, "… consist(ing) of generally rolling, well-rounded hills and ridges with a few hundred feet of

elevation difference between the hills and valleys. Elevations in the Piedmont range from 300 to 600 feet above sea level near its border with the Coastal Plain to 1,500 feet at the foot of the Blue Ridge" (Medina, 2004).

The project site is located within the Carolina Slate Belt lithotectonic province of central North Carolina, and its geology is comprised of Proterozoic and Cambrian age siltstone, mudstone, and mafic hypabyssal intrusive rocks according to the 1 degree by 2 degree geologic map of the Charlotte Quadrangle prepared by the USGS (Goldsmith et al., 1988). The siltstone and mudstone rock units are part of the Tillery and Cid Formations. The Tillery Formation contains millimeter-scale laminated siltstone and mudstone layers, is gray to locally green in color, and contains minor tuff beds. The Cid Formation (Mudstone Member) commonly has graded 10-40 cm thick beds consisting of a lower, ripple-marked, cross-bedded, stratified siltstone and an upper, laminated siltstone-mudstone unit. The Cid Formation is gray in color but typically weathers to a tan. The mafic hypabyssal intrusive rock unit is a greenstone compromised largely of actinolitic amphibole, albite, epidote, and chlorite, with quartz and leucoxene.

Soil types at the site were researched using Natural Resources Conservation Service (NRCS) soil survey data for Stanly County, along with on-site evaluations to determine any hydric soil areas. A map depicting the boundaries of each soil type is presented in Figure 2.1. There are four primary soils found within the project boundary: Oakboro, Congaree, Goldston, and Badin. A discussion of each soil type is presented in Tables 2.2 and 2.3.

Table 2.2 Project Soil Types and Descriptions
Big Cedar Creek Restoration Plan

Soil Name	Location	Description
Oakboro	Floodplain	The Oakboro series consists of deep, moderately well drained and somewhat poorly drained soils that formed in loamy alluvium from slates, siltstones, sandstones, and tuffs in the Carolina Slate Belt of the Piedmont. Slopes range from 0 to 2 percent.
Congaree	Floodplain	The Congaree series consists of deep, well to moderately well drained, moderately permeable loamy soils that formed in fluvial sediments. Slopes range from 0 to 4 percent.
Goldston	Adjacent to floodplain	The Goldston series consists of shallow, well drained to excessively drained, moderately rapidly permeable soils that formed in residuum weathered from fine-grained metavolcanic rocks in the Carolina Slate Belt. Slopes range from 2 to 60 percent.
Badin	Adjacent to floodplain	The Badin series consists of moderately deep, well drained, moderately permeable soils that formed in residuum weathered from fine-grained metavolcanic rocks of the Carolina Slate Belt. These soils are on gently sloping to steep uplands in the Piedmont. Slopes range from 2 to 55 percent.

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

The predominant soil series within the floodplain area of the site is mapped as Oakboro silt loam series. This soil type is considered a hydric soil type in Stanly County, indicating that in some areas of mapped Oakboro soils, inclusions of hydric soils can compose up to 3% of the mapped areas.

Table 2.3 Project Soil Type Characteristics
Big Cedar Creek Restoration Plan

Series	Max Depth (in)	% Clay on Surface	Erosion Factor K	Erosion Factor T	OM %
Oakboro silt loam (Oa)	10	27	0.28	3	1-4
Congaree fine sandy loam (Co)	10	15	.24	5	1-3
Goldston very channery silt loam (GoF)	7	15	.05	2	0.5-2
Badin channery silt loam (BaF)	6	27	0.15	3	1-3

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

2.4 Land Use and Development Trends

The Big Cedar Creek restoration project area drains predominately forested and agricultural lands, as well as a portion of the residential and commercial district of the town of Norwood. The Winston-Salem Southbound Railroad line parallels Big Cedar to the east, then turns to cross Big Cedar and UT1 upstream of their confluence. Table 2.4 presents a summary of land uses found within the Big Cedar Creek watershed. This land use composition was derived from a 2001 National Land Cover Database (Vogelmann et al., 2001) published by United States Geological Survey (USGS).

Over half of the Big Cedar Creek watershed, or approximately 56.1 percent, is occupied by forested land and represents the largest land use classification within the watershed. The majority of forested land is situated within the central and western third of the watershed. The second largest land use category is agricultural lands, represented by Pasture/Hay and Cultivated Crops classifications in Table 2.4. Together these two land uses comprise approximately 27.9 percent of the watershed and are located around the outer periphery of the watershed. A larger proportion of agricultural lands are concentrated in the south and southeastern portion of the watershed, within the restoration project area and in proximity to the watershed outlet. Developed Open Space and Grassland/Herbaceous land uses are mostly found within the north and northeast portions of the watershed surrounding Low-Medium Intensity Development of the neighboring town of Norwood. These three land uses comprise approximately 7.5, 6.5, and 1.3 percent of the watershed, respectively.

Table 2.4 Watershed Land Use
Big Cedar Creek Restoration Plan

Land Use Category	Area (acres)	Percent Area
Forested	1720.0	56.1
Pasture/Hay	808.4	26.4
Developed Open Space	228.9	7.5
Grassland/Herbaceous	198.8	6.5
Cultivated Crops	47.4	1.5
Developed Low-Medium Intensity	38.5	1.3
Woody Wetlands	7.1	0.2
Shrub/Scrub	6.8	0.2
Barren Land (Rock/Sand/Clay)	3.3	0.1
Open Water	3.3	0.1

There is only one community within the Big Cedar Creek watershed, the Town of Norwood, where the estimated population was 2,216 in 2000 (US Census Bureau, 2000). The population declined to 2,160 according to the 2005 US Census Bureau's population estimate. Based on that trend, it is estimated that the municipality in the project area will undergo only minimal growth in population and land area over the next 25 years.

It is also reasonable to anticipate that only minimal changes in land use will take place over the next 25 years. Land use change will probably be concentrated in areas where infrastructure improvements take place. Current data shows that these areas may be concentrated in the northeastern section of the watershed near the Town of Norwood. However, given the lack of growth forecasted for the area, land uses are estimated to be insignificant.

2.5 Endangered/Threatened Species

Some populations of plants and animals are declining because of either natural forces or their inability to compete for resources with the encroachment of humans. The North Carolina Natural Heritage Program (NHP) and United States Fish and Wildlife Service (USFWS) composed a list of rare and protected animal and plant species that contains two federally listed species known to exist in Stanly County (USFWS, 2007 and NCNHP, 2006).

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.

Species that the NHP lists under federal protection in Stanly County as of August 8, 2006, are listed in Table 2.5. A brief description of the characteristics and habitat requirements of the federally protected species is included in the following section, along with a conclusion regarding potential project impacts.

Table 2.5 Species of Federal and State Status in Stanly County
Big Cedar Creek Restoration Plan

Family	Scientific Name	Common Name	Federal Status	State Status	Habitat Present / Biological Conclusion
Vertebrate					
Accipitridae	*Haliaeetus leucocephalus*	Bald Eagle	T	T	No/No Effect
Vascular Plant					
Asteraceae	*Helianthus schweinitzii*	Schweinitz's Sunflower	E	E	Yes/No Effect

Notes:
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.
T Threatened

A pedestrian survey of the project area was conducted on September 14, 2006, for species listed in Table 2.5. No federal protected species were observed in or adjacent to the project area during the field survey. A September 12, 2006, search of the NHP database indicated there are no known populations of these species within five miles of the study area.

The North Carolina Wildlife Resources Commission (WRC) has been contacted and has not expressed concerns regarding protected species on the project site. Big Cedar Creek is not a Designated Public Trout Water, so trout buffer restrictions do not apply to this site. A copy of the WRC letter is included in Appendix A.

The USFWS was notified of the project on September 15, 2006. Baker did not receive any comments from the USFWS. All correspondence on this issue is included in Appendix A.

2.5.1 Federally Listed Endangered Species

2.5.1.1 Vertebrates

***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 (NHP, 2001).

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 (NHP, 2001).

The study site does not possess favorable habitat for the bald eagle since the site is more than 2 miles from open water. A search of the NHP database on September 12, 2006, found no known populations within five miles of the immediate project area. A determination was made that the proposed project will have "no effect" for this species.

2.5.1.2 Vascular Plants

***Helianthus schweinitzii* (Schweinitz's Sunflower)**

Schweinitz's sunflower, usually three to six feet tall, is a perennial herb with one to several fuzzy purple stems growing from a cluster of carrot-like tuberous roots. Leaves are two to seven inches long, 0.4 to 0.8 inch wide, lance shaped, and usually opposite, with upper leaves alternate. Flowers are yellow and generally smaller than other sunflowers in North America. Flowering and fruiting occurs from mid-September to frost. The Schweinitz's sunflower grows in clearings and along edges of upland woods, thickets, and pastures. It is also found along roadsides, power line clearings, and woodland openings. It prefers full sunlight or partial shade and is tolerant of full shade (NHP, 2001).

According to the NHP database, no known Schweinitz's sunflower populations have been identified within 5 miles of the proposed project area. Habitat exists for Schweinitz's sunflower in woodland openings and pastures within the proposed project. A survey was conducted on September 14, 2006, for potential individuals throughout the project area and none were identified. Livestock have exclusive access to the mainstem of Big Cedar Creek and UT2; as a result, potential individuals may have been grazed or trampled. Therefore, a "no effect" determination was made for Schweinitz's sunflower.

2.6 Cultural Resources

A letter was sent to the North Carolina State Historic Preservation Office (SHPO) on August 29, 2006, requesting a review and comment for the potential of cultural resources in the vicinity of the Big Cedar Creek restoration site. A response was received on September 15, 2006, indicating that the SHPO had reviewed the proposed project and was not aware of any historic resources that would be affected by the project. No formal surveys have been performed at the site previously. A copy of the SHPO correspondence is included in Appendix A.

2.7 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 on August 15, 2006. A copy of the report with an overview map is included in Appendix B. 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.

2.8 Potential Constraints

Baker assessed the Big Cedar Creek project site in regards to potential fatal flaws and 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 from the current landowners for the Big Cedar Creek project area. The easement is held by the State of North Carolina and has been recorded at the Stanly County Courthouse (Deed Book 1165, Page Number 865(18)). The easement allows Baker to proceed with the restoration project and restricts the land use in perpetuity.

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

2.8.2 Utilities

No utility easements are present within the conservation easement. The Winston-Salem Southbound Railroad crosses Big Cedar Creek and UT1 just upstream of their confluence and maintains a 100 foot right-of-way. The right-of-way is excluded from the conservation easement.

2.8.3 Hydrologic Trespass and Floodplain Characterization

The FEMA Flood Insurance Rate Map (FIRM) for Stanly County, NC, (Map Numbers 37167C0250D and 37167C0275D) indicates that the project is located within a regulatory Zone A floodplain where no base flood information is available. Figure 2.2 illustrates the FEMA mapping near the site.

The topography of the site and the restoration techniques employed at the upstream extents of the project will limit the potential to create a hydrologic trespass issue related to the site restoration. Results from the HEC-RAS analysis are provided in Appendix F.

3.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

3.1 Existing Channel Geomorphic Characterization and Classification

Baker performed representative longitudinal and cross section surveys of the existing stream reaches to assess the current condition, stability and overall function of the channels. Baker also collected substrate samples to characterize stream sediments. Figure 3.1 illustrates the locations of cross section surveys on the project reaches. The following sections of this report summarize the survey results for the mainstem reaches. Surveyed cross sections, profiles, and site photos are included in Appendix C.

3.1.1 Big Cedar Creek Mainstem & UT2

The existing mainstem channel of Big Cedar Creek and UT2 are depicted in Figure 3.1. Table 3.1 summarizes the geomorphic parameters of both channels. Both Big Cedar Creek and UT2 were historically straightened for agricultural purposes and are currently under pressure from livestock encroachment In general, the bedform diversity of Big Cedar Creek is poor with long stagnant, backwater pools formed by natural grade control features, such as riffles. Bedform features formed by hydraulic processes are absent from this reach. Existing conditions reach breakpoints are defined by a change in geomorphic characteristics found in the stream bed as well as moderate changes in valley slope.

Big Cedar Creek flows through a broad, alluvial floodplain. The overall valley slope is 0.007 ft/ft. Within the project limits, Big Cedar Creek is in various stages of stability. From upstream to downstream, Big Cedar Creek changes from an incised E type channel, to a Bc, to a straightened C, to a Bc and to an F. These various channel types are commonly seen in alluvial valleys throughout the Piedmont where agricultural activities have directly impacted the channel and riparian zone, resulting in an unstable system. Overall, Big Cedar Creek is incised and is disconnected from the historic floodplain at bankfull stage. Incision is indicated by bank height ratios in the 1.5 to 2.2 range. Although portions of the channel are moving towards quasi-equilibrium, the channel continues to lack bedform diversity as well as the sinuosity expected given the valley type and slope. The channel will continue to erode its streambanks to increase belt width until a higher sinuosity is achieved.

UT2 flows from the northwest property corner through an alluvial, forested floodplain, then through an alluvial cattle pasture and converges with Big Cedar Creek. The valley slope of the lower floodplain is 0.024 ft/ft. UT2 is classified as a G.

Table 3.1 Representative Geomorphic Data for Big Cedar Creek and UT2– Rosgen Stream Channel Classification
Big Cedar Creek Restoration Plan

Parameter	Big Cedar Creek						UT2	Units
	Reach 1 X1	Reach 2 X4	Reach 3 X6	Reach 4 X7	Reach 5 X9	Reach 6 X10	Reach 1 X1	
Feature Type	Riffle	Riffle	Riffle	Riffle	Riffle	Riffle	Riffle	
Bankfull Width (W_{bkf})	16.3	22.0	19.5	29.6	26.3	25.6	9.2	Feet
Bankfull Mean Depth (d_{bkf})	2.3	1.8	1.7	1.6	1.6	2.4	1.2	Feet
Cross-Sectional Area (A_{bkf})	36.7	39.7	32.8	47.1	41.5	60.9	10.8	Square feet
Width/Depth Ratio (W/D ratio)	7.1	12.2	11.5	18.5	16.4	10.7	7.7	
Bankfull Max Depth (d_{mbkf})	2.8	2.6	2.7	2.3	2.3	3.1	1.6	Feet
Floodprone Area Width (W_{fpa})	>126.6	33.0	>111.4	>109.7	>52.9	30.4	>142.2	Feet
Entrenchment Ratio (ER)	>7.8	1.5	>5.7	>3.7	>2.0	1.2	>15.5	
Bank Height Ratio (BHR)	1.8	1.9	1.6	1.6	1.5	2.2	1.3	
Channel Materials (Particle Size Index – d_{50})	Medium Gravel, Bedrock Influenced	Coarse Gravel, Bedrock Influenced	Coarse Gravel, Bedrock Influenced	Coarse Gravel, Bedrock Influenced	Small Cobble, Bedrock Influenced	Small Cobble, Bedrock Influenced	Medium Gravel	
d_{16}	<0.06	<0.06	<0.06	<0.06	0.3	<0.06	<0.06	mm
d_{35}	6	8	8	5	40	15	8	mm
d_{50}	14	17	17	17	90	34	15	mm
d_{84}	100	85	85	120	>2048	130	64	mm
d_{95}	300	350	350	>2048	>2048	>2048	90	mm
Water Surface Slope (S)	0.0080	0.0077	0.0045	0.0088	0.0126	0.0033	0.0215	Feet per foot
Channel Sinuosity (K)	1.0	1.0	1.1	1.1	1.1	1.2	1.1	
Rosgen Stream Type[1]	E4/1	B4/1c	C4/1	C4/1	B3/1c	F3/1	G4	

Notes:
1. See Figure 3.2 for additional information.
2. Values in this chart are rounded and therefore may differ slightly from actual values.
3. All values reported in this chart are based off one data point.

3.1.1.1 Big Cedar Creek Reach 1

The head of Reach 1 is defined by a wood line and marks the upstream extent of the project area. Reach 1 ends approximately 60 LF below the confluence of Big Cedar Creek and UT2. Reach 1 is horizontally confined, and its bank height ratio of 1.8 indicates that the reach does not have access to a floodplain at the bankfull stage. Existing conditions sediment competence analyses confirmed high shear stresses. Further detail on these analyses is given in Section 6.4. The reach has a low width to depth ratio of 7.1 and an overall channel slope of 0.008 ft/ft. As a result of the low width to depth ratio, no depositional areas, such as point bars, lateral bars, or side bars are present throughout this reach.

The floodprone width for Reach 1 is greater than 126 ft, giving the cross section an entrenchment ratio typical of an E stream type. Although the floodprone area is wide, it rises only 0.2 ft above the top of the low bank. Thus, the majority of storm flows are contained within the banks and the channel does not experience floodplain relief during storm flows. This reach, although classified as an E stream type, functions as a Gc stream. If left alone, this reach would vertically incise (where feasible) and laterally erode until quasi-equilibrium was reached. For more information on the evolutionary stage of this channel, please refer to section 3.2.

Bedform diversity ranges from sorted gravels and cobbles in riffles to finer particles in pools. Bedrock was most frequently observed in the pools and controls the maximum pool depth. The reach is classified as an E4/1 to indicate that while the d50 particle size corresponds to the gravel classification (4), the reach exhibits bedrock control (1).

3.1.1.2 Big Cedar Creek Reach 2

Reach 2 extends 1,016 LF downstream from Reach 1 and is defined by an increase in width to depth ratio. Reach 2 has a similar channel slope to Reach 1 of 0.0077 ft/ft but has a width to depth ratio of 12.2. The channel is incised as evidenced by bank height ratios of 1.9 and is horizontally constrained. Depositional bars, including lateral bars, are common throughout this reach due to the increase in width to depth ratio. Long, stagnant, backwater pools followed by riffle/run sequences are typical of this reach. This reach has dimensions of an F stream type; however the entrenchment ratio classifies this channel as a Bc stream type. This suggests that this channel was recently an F and is in the process of widening its floodplain through erosion. Mass erosion will continue until the stream reaches quasi-equilibrium. For more information on channel evolution, please see section 3.2.

Bedform diversity ranges from well sorted gravels and cobbles in riffles to finer particles in pools. Bedrock was observed in pools and controls the maximum pool depth. The reach is classified as a Rosgen B4/1c channel due to the presence of both gravel and bedrock.

3.1.1.3 Big Cedar Creek Reach 3

Reach 3 extends 2,046 LF downstream of Reach 2 and is defined by a decrease in channel slope. The overall channel slope for this reach is 0.0045 ft/ft. The channel has an entrenchment ratio of >5.7 and a width to depth ratio of 11.5. However, the reach is moderately incised as indicated by a bank height ratio of 1.6. Reach 3 exhibits well sorted gravel and cobble riffles. Point bars and lateral bars are observed throughout this reach. A bedrock riffle 100 LF in length is located at the base of Reach 3. This feature acts as grade control for the entire reach. This reach is classified as a C4/1, although sinuosity is much lower than expected for a C channel due to past channelization. If left alone, this channel would continue to laterally erode to increase sinuosity. A small ephemeral tributary joins Big Cedar on the left bank approximately two thirds of the way down the reach. This area

is heavily traversed by cattle and contributes fine sediment through bank erosion to the system.

3.1.1.4 Big Cedar Creek Reach 4

Reach 4 extends 976 LF from the bedrock riffle at the base of Reach 3 to the railroad culvert. The stream was channelized along the right valley wall. There are several bedrock riffles throughout this reach that function as grade control. The channel dimension is typical of a C4/1; however, the stream lacks sinuosity. The entrenchment ratio and the width to depth ratio are high which would indicate a stable cross-section; however, the bank height ratio is 1.6. This indicates that the channel is incised and unable to access its floodplain to dissipate excess energy. If left alone, this channel would continue to laterally erode to increase sinuosity.

3.1.1.5 Big Cedar Creek Reach 5

Reach 5 extends 534 LF from the railroad culvert to the confluence with UT1. This reach has a mature forested buffer on both banks. The channel runs along the left valley wall and is confined by the railroad embankment on the right. Due to this horizontal confinement, Reach 5 lacks sinuosity and is the steepest section of Big Cedar Creek throughout the project area. The channel slope is 0.0126 ft/ft. Because the channel cannot dissipate energy through lateral meanders, the channel dissipates energy vertically through steep riffles and step-pools, many of which have formed in bedrock. Reach 5 classifies as a stable B3/1c stream.

3.1.1.6 Big Cedar Creek Reach 6

Reach 6 extends from below the confluence of Big Cedar Creek mainstem and UT1 to the Mount Zion Church Road culvert. Mount Zion Church Road marks the southern project boundary. The left bank of this reach is the forested valley wall, while the right bank is adjacent to a cattle pasture with approximately 20 to 35 feet of mature forested buffer. This reach has a low entrenchment ratio and is disconnected from the floodplain as evidenced by bank height ratios of 2.2. Deep-rooted woody vegetation is holding the banks in place at the riffle cross section, giving a low width to depth ratio of 10.7; however, the majority of the channel is without mature vegetation and has consistently high width to depth ratios. Reach 6 classifies as an F3/1 stream. Lateral and point bars are prevalent throughout this reach, indicating that the channel is actively developing a new floodplain at a lower elevation. If left alone, this channel would continue to reform the floodplain through lateral erosion and deposition, and eventually would evolve into a C channel type.

3.1.2 UT2

UT2 extends from the northwestern property boundary 625 LF downstream to the confluence with Big Cedar Creek. The stream has a mature forested buffer and stable dimension and pattern for the first 162 LF. Downstream of the forested buffer, the stream flows through a heavily utilized alluvial pasture. Sporadic riparian vegetation exists directly adjacent to the channel and primarily consists of invasive, early successional species. The substrate is sorted gravels in the riffles and fine sediments, presumably generated from livestock disturbance of the banks. UT2 was historically straightened and is now incised and disconnected from the floodplain. The riffle cross section X1 was taken at an old cattle crossing and the entrenchment ratio measured does not accurately represent the entire reach. This reach is classified as a G4 stream and has an overall channel slope of 0.0215 ft/ft. Sediment transport calculations performed on the existing conditions also indicate a degrading channel with high shear stress on the bed and banks. If left alone, this channel would continue to incise and then laterally erode to develop a floodplain. For more information on channel evolution, please refer to Section 3.2.

3.1.3 UT1

UT1 to Big Cedar Creek is depicted in Figure 3.1. UT1 flows through an alluvial floodplain with shallow bedrock. In the 1960's, a trapezoidal ditch was excavated at the edge of the field and the stream was routed into the ditch. Since that time, the stream has formed benches within the excavated channel. The channel is located at the low point on the valley, and the land slopes gently up and away from the top of banks. The overall valley slope is 0.014 ft/ft. Like Big Cedar Creek, UT1 exhibits characteristics commonly seen throughout the Piedmont where historic agricultural manipulation of the floodplain in the form of filling, grading, and plowing have directly impacted the channel and riparian zone, resulting in an unstable system. Bank height ratios range from 1.4 to 2.1. Because the channel is incised, it lacks hydraulic functions such as floodplain connectivity. Additionally, although shallow bedrock has prevented further vertical incision, development of bed features through hydraulic processes has also been halted. The channel is vertically stable, however, bedform diversity is poor and the channel continues to function as more of a ditch than a stream.

Table 3.2 summarizes the geomorphic parameters of UT1. Existing condition reach breakpoints were defined by a change in geomorphic characteristics found in the stream bed, significant drainage area changes, and moderate changes in valley type and slope.

Table 3.2 Representative Geomorphic Data for UT1– Rosgen Stream Channel Classification
Big Cedar Creek Restoration Plan

Parameter	UT1				Units
	Reach 1 X3	Reach 2 X6	Reach 3 X7	Reach 4 X13	
Feature Type	Riffle	Riffle	Riffle	Riffle	
Bankfull Width (W_{bkf})	18.9	13.1	17.6	23.1	Feet
Bankfull Mean Depth (d_{bkf})	0.8	1.4	1.2	1.0	Feet
Cross-Sectional Area (A_{bkf})	14.4	18.5	20.9	22.6	Square feet
Width/Depth Ratio (W/D ratio)	23.6	9.4	14.7	23.1	
Bankfull Max Depth (d_{mbkf})	1.8	2.2	2.4	1.8	Feet
Floodprone Area Width (W_{fpa})	>135.3	48.8	>115.2	69.2	Feet
Entrenchment Ratio (ER)	>7.2	3.7	>6.5	3.0	
Bank Height Ratio (BH)	1.6	2.1	1.4	1.8	
Channel Materials (Particle Size Index – d_{50})	Coarse gravel	Very Coarse gravel	Medium to Coarse gravel	Coarse to Very Coarse gravel	
d_{16}	<.06	<.06	<.06	<.06	mm
d_{35}	7	11	8	11	mm
d_{50}	18	40	16	32	mm
d_{84}	149	>2048	110	100	mm
d_{95}	>2048	>2048	1024	180	mm
Water Surface Slope (S)	0.0116	0.0140	0.0134	0.0145	Feet per foot
Channel Sinuosity (K)	1.1	1.0	1.0	1.1	
Rosgen Stream Type[2]	C4/1	E4/1	C4/1	C4/1	

Notes:
1. See Figure 3.2 for additional information
2. Values in this chart are rounded and therefore may differ slightly from actual values.
3. All values represented are based on one data point.

3.1.3.1 UT1 Reach 1

Reach 1 begins just downstream of a gravel road crossing and extends approximately 1,998 LF downstream. In an effort to maximize the area available for agricultural production, this reach and adjacent ephemeral/intermittent tributaries were historically straightened to improve drainage. The channel is wide and shallow throughout Reach 1 and has a width to depth ratio of 23.6. Although the channel dimensions classify the stream as a C type channel, the stream is incised as evidenced by a bank height ratio of 1.6. Reach 1 also does not exhibit a defined riffle pool sequence typical of a C channel. The lack of a defined

riffle pool sequence is the result of channelization and bedrock. Bedrock nickpoints have provided vertical stability and have limited channel incision. Maximum pool depth for this reach is limited by bedrock outcroppings and is not a function of scour.

The banks throughout Reach 1 are moderately stable due to established woody vegetation and extensive bedrock formations. Bed substrate material ranges from well sorted gravels and cobbles in riffles to finer particles in pools. Point bars are absent from this reach, indicating that a new floodplain at a lower elevation has not started to form. Reach 1 is classified as a Rosgen C4/1 channel to indicate that while the reach wide d50 particle size corresponds to a gravel particle (4), the reach exhibits bedrock control (1).

3.1.3.2 UT1 Reach 2

Reach 2 is an approximately 759 LF straightened reach that has medium to dense brush and trees along the left top of bank and floodplain. This reach break was defined by a decrease in width to depth ratio to 9.4. This channel is incised as indicated by a bank height ratio of 2.1. Reach 2's channel dimensions are typical of an incised E type channel.

Bed substrate material ranges in size from bedrock to silt and clay found in the pools. Maximum pool depths for this reach are a function of the bedrock outcrops. These outcrops provide vertical stability and prevent channel incision. Reach 2 is classified as a Rosgen E4/1 channel.

3.1.3.3 UT1 Reach 3

Reach 3 extends 1,518 LF downstream from Reach 2 and is defined by a wider and shallower typical cross section than Reach 2. The downstream limits of Reach 3 are defined by a gravel stream crossing. The width to depth ratio throughout this reach averages around 14.7; however, it increases to 45.5 near the gravel stream crossing where bed and bank definition is lost. Channel dimension throughout Reach 3 is typical of a C type channel; however, this reach is incised and disconnected from the floodplain as evidenced by a bank height ratio of 1.4. If left alone, portions of this reach that are overly wide would aggrade, however the channel overall would continue to function as a channelized ditch. Functions such as diversified bedform and floodplain connectivity cannot be restored.

Bed substrate material ranges in size from bedrock to silt and clay found in the pools. Maximum pool depths for this reach are a function of the bedrock outcrops. These outcrops provide vertical stability and prevent channel incision. Reach 3 is classified as a Rosgen C4/1 channel.

3.1.3.4 UT1 Reach 4

Reach 4 extends approximately 935 feet from the gravel stream crossing at the downstream end of Reach 3 through the railroad culvert to the confluence with Big Cedar Creek. This reach runs along the right valley wall and may have been relocated and straightened to maximize available cropland. This reach has a high width to depth ratio of 23.1 and is horizontally confined within the banks. The channel dimension is typical of a Rosgen C type channel; however, this reach is incised and disconnected from the floodplain as evidenced by a bank height ratio of 1.8.

Bed substrate material ranges in size from bedrock to silt and clay found in the pools. Maximum pool depths for this reach are a function of the bedrock outcrops. These outcrops provide vertical stability and prevent channel incision. Reach 4 is classified as a Rosgen C4/1 channel.

3.2 Channel 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.

3.2.1 Channel Evolution Process

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 (1989) Channel Evolution Model 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.

Figure 3.3 illustrates the six steps of the Simon Channel Evolution Model.

The channel evolution process is initiated once a stable, well-vegetated stream that interacts frequently with its floodplain is disturbed. 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 mainstem channel within the project area is a perennial, channelized stream with a flow regime dominated by storm water runoff from a watershed that is approximately 45% forested, 50% agricultural and 5% developed. The mainstem channel is incised as evidenced by bank height ratios in the 1.5 to 2.2 range. UT2 within the project area is a perennial, channelized stream. Its watershed is predominately forested, with agricultural areas on the ridges of the watershed and within the project limits. UT2 is incised as evidenced by bank height ratios of 1.3 and exhibits shear banks with minimal riparian vegetation. UT1 flows through predominately forested floodplain outside the project limits. Within the project limits, UT1 becomes incised and disconnected from the floodplain, as evidenced by bank height ratios in the 1.6 to 2.1 range.

Table 3.3 summarizes the geomorphic parameters related to channel stability for Big Cedar Creek, UT1 and UT2.

Table 3.3 Stability Indicators – Big Cedar Creek and UT2
Big Cedar Creek Restoration Plan

Parameter	Big Cedar Creek						UT2
	Reach 1 X1	Reach 2 X4	Reach 3 X6	Reach 4 X7	Reach 5 X9	Reach 6 X10	Reach 1 X1
Stream Type	E4/1	B4/1c	C4/1	C4/1	B3/1c	F3/1	G4
Riparian Vegetation	Narrow mature woody buffer ranging from 3 to 5 feet wide. Pasture grasses extend beyond woody buffer.	Narrow mature woody buffer ranging from 3 to 5 feet wide. Pasture grasses extend beyond woody buffer.	Narrow mature woody buffer ranging from 3 to 5 feet wide. Pasture grasses extend beyond woody buffer. Sporadic wetland pockets present within pasture.	Narrow mature woody buffer ranging from 3 to 5 feet wide followed by a wide buffer of pasture on the left bank. Forested right bank for first 900 LF, then wide buffer of pasture for last 200 LF on right bank.	Wide, mature forested buffer. Cleared railroad easement 100 to 300 feet from right bank.	Wide, mature forested buffer on left bank. Mature forested buffer ranging from 25 to 30 feet on right bank. Pasture grasses extend beyond forested buffer.	Narrow early successional woody buffer ranging from 3 to 5 feet wide. Pasture grasses extend beyond woody buffer.
Channel Dimension							
Bankfull Area (SF)	36.7	39.7	32.8	47.1	41.5	60.9	10.8
Width/Depth Ratio	7.1	12.2	11.5	18.5	16.4	10.7	7.7
Channel Pattern							
Meander Width Ratio[1]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sinuosity	1.0	1.0	1.1	1.1	1.1	1.2	1.1
Vertical Stability							
Bank Height Ratio (BHR)	1.8	1.9	1.6	1.6	1.5	2.2	1.3
Entrenchment Ratio (ER)	>7.8	1.5	>5.7	>3.7	>2.0	1.2	>15.5
Evolution Scenario	E-G-F-Bc-C-E	E-G-F-Bc-C-E	E-G-F-Bc-C-E	E-G-F-Bc-C-E	E-G-F-Bc-C-E	E-G-F-Bc-C-E	E-G-F-Bc-C-E
Simon Evolution Stage[2]	III	IV-V	IV-V	V	VI	IV	III

Notes:
1. N/A: Meander Width Ratio not measured because channel has been straightened.
2. Simon Channel Evolution see Figure 3.3.
3. Values in this chart are rounded and therefore may differ slightly from actual values.
4. All values represented are based on one data point.

Table 3.4 Stability Indicators – UT1
Big Cedar Creek Restoration Plan

Parameter	UT1			
	Reach 1 X3	**Reach 2 X6**	**Reach 3 X7**	**Reach 4 X13**
Stream Type	C4/1	E4/1	C4/1	C4/1
Riparian Vegetation	Woody buffer ranging from 3 to 5 feet on both the left and right floodplains. Crop land extends beyond narrow woody buffer.	Mature forest on the left top of bank and floodplain. Crop land on the right top of bank and floodplain.	Woody buffer ranging from 3 to 5 feet on both the left and right floodplains. Crop land extends beyond narrow woody buffer.	Mature forest along the right top of bank and floodplain. Up to 3 feet of woody buffer on the left top of bank and floodplain. Crop land extends beyond narrow woody buffer on left floodplain.
Channel Dimension				
Bankfull Area (SF)	14.4	18.5	20.9	22.6
Width/Depth Ratio	23.6	9.4	14.7	23.1
Channel Pattern				
Meander Width Ratio[1]	N/A	N/A	N/A	N/A
Sinuosity	1.1	1.0	1.0	1.1
Vertical Stability				
Bank Height Ratio (BHR)	1.6	2.1	1.4	1.8
Entrenchment Ratio (ER)	>7.2	3.7	>6.5	3.0
Evolution Scenario	E-G-F-C-E	E-G-F-C-E	E-G-F-C-E	E-G-F-C-E
Simon Evolution Stage[2]	IV - V	VI	IV - V	IV - V

Notes:
1. N/A: Meander Width Ratio and Sinuosity not measured because channel has been straightened.
2. Simon Channel Evolution see Figure 3.3.
3. Values in this chart are rounded and therefore may differ slightly from actual values.
4. All values represented are based on one data point.

3.2.2 Bank Erodibility Hazard Index and Near Bank Stress Measurements

Sediment loading was estimated for all eleven project reaches comprising Big Cedar Creek, UT1 and UT2 using BEHI and Near Bank Stress index (NBS) measurements. Results from this analysis are summarized in Table 3.5, and field sheets containing the raw data can be found in Appendix C.

Baker Engineering estimates that Big Cedar Creek, UT1, and UT2 are contributing 220 tons/year, 51 tons/year, and 31 tons/year of sediment from bank erosion, respectively. On a reach-wide scale, UT2 and Reaches 2 and 3 of Big Cedar Creek reported the highest potential loading of sediment from bank erosion with 31 tons/year, 74 tons/year, and 83 tons/year, respectively. UT2 and Reach 2 of Big

Cedar also reported the highest sediment loading when erosion rates were standardized by stream length, resulting in a more valid comparison of erosion rates per linear foot of stream channel per reach; UT2 reported 1.96 ft^3/LF of sediment loading from bank erosion and Reach 2 of Big Cedar Creek reported 1.48 ft^3/LF. Reaches 1, 3, 5, and 6 of Big Cedar Creek and Reach 4 of UT1 reported moderate to moderate high sediment loading with values of 0.91 ft^3/LF, 0.84 ft^3/LF, 0.88 ft^3/LF, 0.85 ft^3/LF, and 0.74 ft^3/LF, respectively. Bank erosion on many of these reaches are a result of minimal floodplain access from channel incision, limited bank vegetation, trampled banks from frequent cattle access, and/or high bank stress from riffles located within tight meander bends.

Minimal bank erosion and sediment loading was observed at Reach 4 of Big Cedar Creek and Reaches 1, 2, and 3 of UT1 due to ample floodplain access and surface protection along the bank in the form of bedrock, boulders and dense root mass.

Table 3.5 Sediment Loading Estimate from BEHI
Big Cedar Creek Restoration Plan

Reach	ft^3/LF	Tons/year
Big Cedar Creek Reach 1	0.91	15
Big Cedar Creek Reach 2	1.48	74
Big Cedar Creek Reach 3	0.84	83
Big Cedar Creek Reach 4	0.28	7
Big Cedar Creek Reach 5	0.88	21
Big Cedar Creek Reach 6	0.85	20
	Total	***220***
Reach	**ft^3/LF**	**Tons/year**
UT1 Reach 1	0.15	13
UT1 Reach 2	0.12	4
UT1 Reach 3	0.17	9
UT1 Reach 4	0.74	25
	Total	***51***
Reach	**ft^3/LF**	**Tons/year**
UT2	1.96	31
	Total	***31***

3.3 Bankfull Verification

Baker Engineering engaged several methods to verify the bankfull stage and discharge of the restoration reach of Big Cedar Creek. 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. Surveyed cross sections with bankfull indicators were plotted on the North Carolina Regional Curve (Harman et al., 1999) as shown in Figure 3.4. The bankfull cross sectional areas consistently plotted slightly below the regional curve; however, all were within the 95% confidence interval. This indicates that the bankfull stages selected in the field were comparable with that of other Piedmont streams of similar drainage area. The discrepancies between the regional curve and the field bankfull calls were largest in reaches with smaller drainage areas and smaller in reaches with larger drainage areas. This could be because the regional curve is based primarily on data from higher order streams. It is also important to note that variations in channel geometry, or stream types, are not accounted for in the regional curve. For example, the regional curves only include stable stream types. Channel slope, valley type, channel type, and sediment supply, as well as information gained from the regression and Manning's equations were all considered during office verification of the field data.

3.4 Bankfull Discharge

Manning's equation was used to calculate a bankfull discharge at representative riffle cross sections for each reach. The Manning's roughness coefficient was individually selected for each reach based on factors including channel bed material, the presence of small shrubs and grasses on the banks, and stream type. Bankfull discharge ranged from 119 cfs to 249 cfs on the mainstem and 48 to 65 cfs on UT2, with variations attributable to the drainage area and variations in the estimate bankfull stage. Bankfull flow estimates for UT1 ranged from 61 cfs to 107 cfs. The estimated bankfull discharges were plotted on the regional curve as shown in Figure 3.4.

For further verification of these discharges, the NC USGS rural regression equation was used to estimate the 1.25, 1.5, and 2-year discharge. A USGS gage station with adequate peak flow data was not available for analysis near this site. 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 discharges calculated using Manning's equation typically fall in the 1.25 to 1.5-year discharges predicted by the regression equation. These results indicate that the estimated bankfull discharge range falls within the expected recurrence interval for bankfull events.

Table 3.6 summarizes the design discharge by reach.

Table 3.6 Bankfull Discharge Determination
Big Cedar Creek Restoration Plan

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		
Big Cedar Creek	1	2.30	162	141	179	212	204	150
	2	3.10	201	177	223	262	199	185
	3	3.32	211	186	235	275	119	195
	4	3.35	213	188	236	277	239	199
	5	4.67	270	241	301	351	249	255
	6	4.71	272	242	303	353	237	260
UT1	1	0.93	85	71	93	111	61	69
	2	0.98	88	74	96	115	89	76
	3	1.20	101	86	111	133	102	95
	4	1.21	102	87	113	134	107	100
UT2	1	0.55	58	48	63	76	65	56

3.5 Vegetation and Habitat Descriptions

The habitat within and adjacent to the proposed project area, primarily consists of agricultural areas, Piedmont/Mountain Bottomland Forest (mixed riparian community) and Dry-Mesic Oak-Hickory Forest as described by Schafale and Weakely (1990). The riparian areas ranged from relatively disturbed to very disturbed. Examples of major disturbance include active livestock grazing and crop rotation. A general description of each community follows.

3.5.1 Piedmont/Mountain Bottomland Forest

This ecological community is located on large floodplains on the mainstem of Big Cedar Creek, UT1, and UT2 within the project area. The riparian buffer varied from narrow corridors of 5 to 15 feet in width to broad corridors exceeding 50 feet in width. The dominant canopy species of the piedmont/mountain bottomland forest area included yellow poplar (*Liriodendron tulipifera*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), black willow (*Salix nigra*), pecan (*Carya illinoensis*), hackberry (*Celtis occidentalis*), American elm (*Ulmus americana*), and black walnut (*Juglans nigra*). Understory species included box elder (*Acer negundo*), yellow poplar, sweetgum, red maple, flowering dogwood (*Cornus florida*), ironwood (*Carpinus caroliniana*), red mulberry (*Morus rubra*), black cherry (*Prunus serotina*), alder (*Alnus serrulata*), black willow, elderberry (*Sambucus canadensis*), red bud (*Cercis canadensis*), winged elm (*Ulmus alata*), persimmon (*Diospyros virginiana*), and winged sumac (*Rhus copallinum*). Woody vine and herbaceous species consisted of poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), trumpet creeper (*Campsis radicans*), grape (*Vitis* spp.), morning glory (*Ipomoea purpurea*), blackberry (*Rubus* spp.), passionflower (*Passiflora incarnate*), false nettle (*Boehmeria cylindrica*), Virginia dayflower (*Commelina virginica*), wingstem (*Actinomeris alternifolia*), Indian strawberry (*Duchesnea indica*), asters (*Aster* spp.), golden rod (*Solidago* spp.),

red clover (*Trifolium pretense*), pokeweed (*Phytolacca americana*), dog fennel (*Eupatorium capillifolium*), New York ironweed (*Vernonia noveboracensis*), cardinal flower (*Lobelia cardinalis*), partridge pea (*Cassia fasciculate*), arrow-leaf sida (*Sida rhombifolia*), jewelweed (*Impatiens* spp.), lizard's tail (*Saururus cernuus*), beggars-ticks (*Bidens* spp.), water hemlock (*Cicuta maculata*), tearthumb (*Polygonum sagittatum*), swamp smartweed (*Polygonum hydropiperoi*des), lady's thumb (*Polygonum persicaria*), hop sedge (*Carex lupulina*), shallow sedge (*Carex lurida*), flat sedge (*Cyperus strigosus*), fescue (*fescue* spp.), and little bluestem (*Schizachyrium scoparium*). Many places are heavy with exotic invasive species that include Japanese honeysuckle (*Lonicera japonica*), Nepal grass (*Microstegium vimineum*), Johnson grass (*Sorghum halepense*), and Chinese privet (*Ligustrum sinense*), which are having an adverse affect on native vegetation.

3.5.2 Dry-Mesic Oak-Hickory Forest

This ecological community is located on the hillsides of the project area and is an upland transition from the Piedmont/Mountain Bottomland Forest. The dominant overstory species of this upslope area include sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), loblolly pine (*Pinus taeda*), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), shag-bark hickory (*Carya ovata*), mockernut hickory (*Carya tomentosa*), green ash (*Fraxinus pennsylvanica*), and hackberry (*Celtis occidentalis*). Mid-canopy species include red bud (*Cercis canadensis*), red mulberry (*Morus rubra*), green ash, sourwood (*Oxydendrum arboretum*), red cedar (*Juniperus virginiana*), service berry (*Amelanchier arborea*), and buckeye (*Aesculus sylvatica*). Herbaceous and vine species consisted of poison ivy (*Toxicodendron radicans*), grape (*Vitis* spp.), Virginia creeper (*Parthenocissus quinquefolia*), trumpet creeper (*Campsis radicans*), Christmas fern (*Polystichum acrostichoides*), yellow root (*Xanthorhiza simplicissima*), Nepal grass (*Microstegium vimineum*), and Japanese honeysuckle (*Lonicera japonica*).

3.5.3 Agricultural Areas

Agricultural areas are adjacent to the existing stream buffer throughout the project site. Pastureland is adjacent to the mainstem of Big Cedar Creek and UT2. The pastureland appears to be heavily grazed with live stock granted unrestricted access to the creek. The plant species in the adjacent pastureland are composed primarily of herbaceous species that included fescue (*Fescue* spp.), golden rod (*Solidago* spp.), pokeweed (*Phytolacca americana*), dog fennel (*Eupatorium capillifolium*), New York ironweed (*Vernonia noveboracensis*), partridge pea (*Cassia fasciculate*), arrow-leaf sida (*Sida rhombifolia*), false nettle (*Boehmeria cylindrica*), horse nettle (*Solanum carolinense*), and soft rush (*Juncus effusus*). Corn and cotton fields are adjacent to the degraded stream buffer on UT1.

4.0 REFERENCE STREAMS

Reference reach surveys are valuable tools to river designers. Reference reaches are stable rivers 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. 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 conceptually assigned to the project streams prior to selecting reference reach streams (see Section 6.0 for detail).

An undisturbed reference reach could not be found within the adjacent reaches or the same watershed as the project site, so reference reaches in adjacent watersheds as well as those within a common physiographic province were identified and reconnaissance performed. Among all of the systems considered, only UT to Rocky Creek was determined to be adequately stable and undisturbed to be considered a reference reach.

The UT to Rocky Creek reach is a small gravel bed stream within the Uwharrie National Forest. Baker conducted a survey of approximately 300 LF, encompassing a pool and a riffle cross section. Surveyed cross sections, profile data, and photos are included in Appendix D. The bankfull discharge of the stream was estimated to be 85 cfs. Additionally, the NCDOT database was reviewed for applicable reference reach streams. Four additional sites with similar slope and substrate were chosen as appropriate reference reaches for the Big Cedar Creek restoration project including: Richland Creek, Morgan Creek and Spencer Creek. The locations of all the reference reaches are shown in Figure 4.1.

While reference reaches can be used as an aid in designing channel dimension, pattern, and profile, there are limitations. The pattern for most reference reach quality streams is controlled by large trees and other woody vegetation. Therefore, the pattern is not "free to form" based on fluvial processes, but instead is controlled by vegetation. Parameters such as radius of curvature are especially affected by vegetation control, often resulting in very tight bends. Therefore, pattern ratios observed in reference reaches are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction, before the permanent vegetation is established.

A summary of the reference data is provided in Table 4.1

Table 4.1 Reference Reach Geomorphic Parameters
Big Cedar Creek Restoration Plan

	UT to Rocky Creek			Spencer Creek Upstream			Richland Creek			Morgan Creek		
	Min	**Max**	**n***	**Min**	**Max**	**n***	**Min**	**Max**	**n***	**Min**	**Max**	**n***
1. Stream Type	E4b		N/A	E4/C4		N/A	C4		N/A	C4		N/A
2. Drainage Area – square miles	1.05		N/A	0.50		N/A	1.00		N/A	8.35		N/A
3. Bankfull Width (w_{bkf}) – feet	12.2		1	8.7		1	16.2	16.7	2	33.2		2
4. Bankfull Mean Depth (d_{bkf}) – feet	1.3		1	1.2		1	0.9	0.9	2	2.3		2
5. Width/Depth Ratio (w/d ratio)	**9.1**		**1**	**7.3**		**1**	**18.0**	**18.6**	**2**	**14.1**		**2**
6. Cross sectional Area (A_{bkf}) – SF	16.3		1	10.6		1	15.0	15.5	2	75.1		2
7. Bankfull Mean Velocity (v_{bkf}) - fps	5.5		N/A	N/P		N/A	N/P		N/A	6.6		N/A
8. Bankfull Discharge (Q_{bkf}) – cfs	85		N/A	N/P		N/A	N/P		N/A	524.0		N/A
9. Bankfull Max Depth (d_{mbkf}) - feet	1.8		1	1.9		1	1.4	1.5	2	2.8		2
10. d_{mbkf} / d_{bkf} ratio	**1.3**		**1**	**1.6**		**1**	**1.6**	**1.7**	**2**	**1.2**		**2**
11. Low Bank Height to d_{mbkf} Ratio	**1.0**		**1**	**1.0**		**1**	**1.0**		**2**	**1.0**		**2**
12. Floodprone Area Width (w_{fpa}) – feet	72.4		1	228.5		1	50	53	2	77.5		2
13. Entrenchment Ratio (ER)	**6.0**		**1**	**26.3**		**1**	**3.0**	**3.3**	**2**	**2.3**		**2**
14. Meander length (L_m) – feet	N/A		N/A	54.0	196.0	2	90	94	2	N/P		N/P
15. Ratio of meander length to bankfull width (L_m/w_{bkf})	**N/A**		**N/A**	**6.2**	**22.5**	**2**	**5.5**	**5.7**	**2**	**N/P**		**N/P**
16. Radius of curvature (R_c) – feet	N/A		N/A	5.4	22.1	5	14.3	26.1	3	N/P		N/P
17. Ratio of radius of curvature to bankfull width (R_c / w_{bkf})	**N/A**		**N/A**	**0.6**	**2.5**	**5**	**0.9**	**1.6**	**3**	**N/P**		**N/P**
18. Belt width (w_{blt}) – feet	N/A		N/A	24.0	52.0	2	25	40	3	N/P		N/P
19. Meander Width Ratio (w_{blt}/W_{bkf})	**N/A**		**N/A**	**2.8**	**6.0**	**2**	**1.5**	**2.4**	**3**	**N/P**		**N/P**
20. Sinuosity (K) Stream Length/ Valley Distance	1.1		N/A	1.1		N/A	1.2		N/A	N/P		N/A
21. Valley Slope – feet per foot	0.0261		N/A	0.0139		N/A	0.0136		N/A	N/P		N/A
22. Channel Slope ($s_{channel}$) – feet per foot	0.0235		N/A	0.0132		N/A	0.0133		N/A	0.0070		N/A
23. Pool Slope (s_{pool}) – feet per foot	0.0	0.0037	1	0.0001		2	0.00	0.0014	4	0.0001		1
24. Ratio of Pool Slope to Average Slope (s_{pool} / $s_{channel}$)	**0.0**	**0.15**	**1**	**0.01**		**2**	**0.00**	**0.11**	**4**	**0.01**		**1**
25. Maximum Pool Depth (d_{pool}) – feet	2.2		1	2.5		1	2.5		1	4.1		1
26. Ratio of Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	**1.6**		**1**	**2.1**		**1**	**2.8**		**1**	**1.8**		**1**
27. Pool Width (w_{pool}) – feet	10.9		1	8.4		1	11.1		1	25.9		1
28. Ratio of Pool Width to Bankfull Width (w_{pool} / w_{bkf})	**0.9**		**1**	**1.0**		**1**	**0.7**		**1**	**0.8**		**1**
29. Pool Area (A_{pool}) – square feet	19.3		1	12.8		1	20.1		1	88.9		1
30. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	**1.2**		**1**	**1.2**		**1**	**1.3**		**1**	**1.2**		**1**

Table 4.1 Reference Reach Geomorphic Parameters
Big Cedar Creek Restoration Plan

	UT to Rocky Creek			Spencer Creek Upstream			Richland Creek			Morgan Creek		
31. Pool-to-Pool Spacing – feet	26.3	81.3	4	13.0	46.5	5	37.3	95.8	3	146.0	277.0	2
32. Ratio of Pool-to-Pool Spacing to Bankfull Width ($p\text{-}p/w_{bkf}$)	**2.2**	**6.7**	**4**	**1.5**	**5.3**	**5**	**2.3**	**5.8**	**3**	**4.4**	**8.3**	**2**
33. Riffle Slope (s_{riffle}) – feet per foot	0.0606	0.0892	1	0.010	0.067	2	0.0138	0.0413	5	0.014	0.024	2
34. Ratio of Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	**2.6**	**3.8**	**1**	**0.8**	**5.1**	**2**	**1.0**	**3.1**	**5**	**2.0**	**3.4**	**2**
Particle Size Distribution of Riffle Material												
Material (d_{50})	Coarse Gravel			Medium Gravel			Very Coarse Gravel			Very Fine Gravel		
d_{16} – mm	<0.063			0.06			6.0			N/P		
d_{35} – mm	2.4			3			N/P			1.2		
d_{50} – mm	22.6			8.6			45.0			3		
d_{84} – mm	120			77			125.0			77		
d_{95} – mm	256			180			N/P			800		

Notes:
NC Department of Transportation, Reference Reach Database
N/A: Channel was straight - no pattern
N/P: Data was not provided in the NCDOT reference reach database
Values in this chart are rounded and therefore may differ slightly from actual values.
n* – This column represents the number of data points used where a range or mean is specified.

5.0 PROJECT SITE WETLANDS (EXISTING CONDITIONS)

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, 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 et. al., 1988).

A comprehensive field survey throughout the project area was conducted on August 14, 2006, to assess vegetation, soils, and hydrology for determination of the presence of jurisdictional wetlands. There were no areas within the project boundary that displayed true wetland characteristics. There is one emergent wetland adjacent to the project area that will not be impacted. Therefore, no wetland monitoring is required.

6.0 PROJECT SITE RESTORATION PLAN

This section discusses the design criteria selected for stream restoration on the Big Cedar Creek project site.

6.1 Restoration Project Goals and Objectives

The specific goals for the restoration project are as follows:

- Create geomorphically stable conditions on the Big Cedar Creek project site.
- Improve and restore hydrologic connections between the streams and their floodplains.
- Improve the water quality in the Big Cedar Creek and Rocky River watersheds.
- Improve aquatic and terrestrial habitat along the project corridor.

The primary objective of the Big Cedar Restoration project is to accelerate the channel evolutionary process by constructing channels with stable cross sections, increased sinuosity, and access to the floodplain at bankfull stage. Flood attenuation, increased groundwater infiltration, and alleviation of bank stress will result from providing floodplain access. The removal of cattle from direct access with the restored reaches will also be accomplished. Invasive vegetative species removal efforts and reforestation of the riparian buffer with native species will complement the restoration of Big Cedar Creek, UT1, and UT2. Existing native trees will be preserved onsite wherever feasible.

6.2 Design Criteria Selection for Stream Restoration

Selection of natural channel design criteria is based on a combination of approaches including review of reference reach databases, regime equations, and evaluation of results from past projects. In the case of Big Cedar Creek, old meander scars were prevalent and allowed for a more historical replication of alignment.

Selection of a general restoration approach, or a Rosgen Priority level, was the first step in selecting design criteria at the Big Cedar Creek site. The approach was based on the reach's potential for restoration as determined during the site assessment. Design criteria for the proposed stream concept were selected based on the range of the reference data and the desired performance of the proposed channel. The developed design criteria were then compared to past projects built with similar conditions. Ultimately, these sites provide the best pattern and dimension ratios because they reflect site conditions after construction. While most reference reaches are in mature forests, restoration sites are in floodplains with little or no mature woody vegetation. This lack of mature woody vegetation severely alters floodplain processes and stream bank conditions. If past ratios did not provide adequate stability or bedform diversity, they are not used. Conversely, if past project ratios created stable channels with optimal bedform diversity, they will be incorporated into the design.

Following the initial application of design criteria, detailed refinements were made to accommodate the existing valley morphology and to promote natural channel adjustment following construction. The design philosophy employed at the Big Cedar Creek site was to use conservative design parameter values based on reference reach data and lessons learned from past projects. This allows the project to evolve in a positive direction as the permanent vegetation becomes established. The proposed stream types for the project are summarized in Table 6.1.

Table 6.1 Project Design Stream Types
Big Cedar Creek Restoration Plan

Stream	Reach	Proposed Stream Type	Rationale
Big Cedar Creek Mainstem	1	E/C4	Priority 2 restoration will be used to raise the bed elevation and allow reconnection of the channel and floodplain downstream. A floodplain bench will be excavated adjacent to the channel to dissipate flood water energy and a new channel will be excavated in connection with this new floodplain. This technique will increase sinuosity, pool development, and reestablish connection with a floodplain. Native revegetation will improve habitat and stabilize the banks.
	2	E/C4	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the historic floodplain. Native revegetation will improve habitat and stabilize the banks.
	3	E/C4	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the historic floodplain. Native revegetation will improve habitat and stabilize the banks.
	4	E/C4	Priority 2 restoration will facilitate the transition between the constructed channel and the existing downstream channel (at the culvert elevation under the railway). The channel will meander, dropping grade to disconnect it from the historic floodplain gradually in order to meet the existing channel elevation. A floodplain bench will be excavated adjacent to the channel to dissipate flood water energy.
	5	B3/1c	Preservation will protect the existing mature forested buffer and stable stream channel from any potential future impacts.
	6	F3/1	Enhancement level II including installation of structures and stabilization of stream banks will halt erosion and help improve channel dimension. Native revegetation of the floodplain will improve habitat and stabilize the banks.
UT1	1	C4	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the floodplain. Native revegetation will improve habitat and stabilize the banks.
	2	B4c	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the floodplain. Native revegetation will improve habitat and stabilize the banks. Rosgen Priority 1 A B stream type would be a priority 3.
	3	C4	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the floodplain. Native revegetation will improve habitat and stabilize the banks. Rosgen Priority 1
	4	B4c	Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the floodplain. Native revegetation will improve habitat and stabilize the banks. Rosgen Priority 1
UT2	1	E/C4	Priority 2 restoration will be used to raise the bed elevation and allow reconnection of the channel and floodplain downstream for the first 152 LF. A floodplain bench will be excavated adjacent to the channel to dissipate flood water energy. For the remained of the reach the channel will meander out into the historic floodplain. Priority 1 restoration will increase sinuosity, pool development, and reestablish connection with the floodplain. Native revegetation will improve habitat and stabilize the banks. Priority 2 restoration will facilitate the transition between the constructed tributary and the relocated Big Cedar Creek.

6.3 Design Parameters

The primary objective of the stream restoration effort is to design and construct a stream with stable dimension, pattern, and profile that has access to its floodplain at bankfull flows. The proposed design for Big Cedar Creek Reaches 1 through 4; UT1 Reaches 1 through 4; and, UT2, is shown in Figure 6.1. Please note that proposed reach breaks vary slightly from existing reach breaks. While existing reach breaks were made based on changes in existing channel geometry and morphology, proposed reach breaks were made based on changes in proposed restoration techniques.

The design rationale and design parameters for all of the design reaches are presented below.

Dimension

Riffle cross sections were designed to carry the bankfull flow and to transport sediment delivered by the watershed. All flows greater than bankfull are transported on the adjacent floodplain. The low range of width to depth ratios was chosen for C-type channels and a higher range of width to depth ratio was chosen for the E-type channels. Side slopes for all constructed channels range from 2:1 to 3:1 to lower the risk of erosion and to aid in the establishment of vegetation. Using conservative channel dimension values allows the constructed channel to narrow over time.

Typical cross sections for each reach are shown on the plan sheets.

Pattern

The proposed channel alignment will result in an overall increase sinuosity on Big Cedar Creek, UT1 and UT2.

Meander width ratios for the project range from 2.1 to 6.6 times the bankfull width. Higher meander width ratios were incorporated into the design to lessen slope and decrease shear stress. In areas where the valley is narrow, the meander width ratio and sinuosity necessarily decreases. In these areas energy is dissipated through vertical drops and the associated pools. Plan views of the main channel and unnamed tributaries are shown on the attached plan sheets.

Radii of curvature have been designed throughout the project to fall into the range of approximately 2 to 3.5 times the channel's proposed bankfull width. Radius of curvature ratios in this range were chosen based on past project performance to minimize the risk of meander bend failure prior to vegetative root mass establishment while promoting the maintenance of preferred pool depth.

Profile/Bedform

Bedform will be diversified throughout the project through facet development (riffle, run, pool, glide, and step-pool) mimicking those characteristic of the reference reaches. Reach slopes were designed to be appropriate for the channel type and to provide adequate sediment transport capacity and competency.

Riffles throughout the design reaches are typically between 1.2 and 3.0 times the average slope of the channel. The maximum pool depth will be constructed from the meander curve apex to a point one-third of the distance along the profile from the apex to the head of the next downstream riffle, or two-thirds of the distance along the profile from the tail of riffle to the downstream head of riffle (Copeland et al, 2001). All elevation change will occur over the riffles and step structures; pools were designed with 0% slope to ensure constructability. Additionally, the longitudinal profile was optimized in conjunction with structure placement for aquatic habitat.

6.3.1 Design Reaches

A stable cross section will be achieved by widening the channel and increasing the width/depth ratio. C/E type channels and Bc channels will be implemented throughout the Priority 1and Priority 2 restoration reaches; the sinuosity will be increased through the C/E sections by adding meanders and length to the channel. Grade control at the bed will be provided by in-stream structures such as

constructed riffles, cross-vanes, and log step structures. These structures will improve habitat and enhance bedform diversity. Bioengineering and in-stream structures will be used at the outside of meander bends (including root wads, brush mattressing, vanes and cover logs) to promote additional bank stability and improve habitat. Tables 6.2 and 6.3 present the proposed stream restoration design criteria applied throughout the project area.

6.3.1.1 Big Cedar Creek Reach 1

This reach was designed as a Rosgen E/C4. This reach is a transition zone; the primary design objective of this reach was to bring the channel up onto the historic floodplain as quickly as possible. The lower end of C width/depth ratios was utilized and channel slope was minimized to fulfill that goal. Sediment transport calculations required a channel slope of 0.003 ft/ft in order to prevent degradation (see Section 6.4.2 for further detail). The valley slope of 0.0039 ft/ft along this reach required a sinuosity of 1.3 in order to achieve the required channel slope. A floodplain bench is proposed at bankfull elevations consistently throughout the reach. A variety of in-stream structures will be installed in this reach including log cross vanes, constructed riffles and log drops that will serve to provide vertical grade control and improve habitat quality. Reach 1 terminates at Station 15+73 when the design is fully reconnected with the historic floodplain.

6.3.1.2 Big Cedar Creek Reach 2

Reach 2 is a Rosgen Priority 1 design. Channel dimensions were designed to E/C4 standards. The new channel alignment crosses back and forth across the existing channel, utilizing the wide, flat floodplain on both the east and west overbank. Sediment transport calculations required a channel slope of 0.0049 ft/ft in order to prevent degradation (see Section 6.4.2 for further detail). The valley slope of 0.0061 ft/ft along this reach required a sinuosity of 1.3 in order to achieve the 0.0048 ft/ft channel slope and prevent degradation.

6.3.1.3 Big Cedar Creek Reach 3

Reach 3 continues the full Priority 1 design. Channel dimensions were designed to E/C4 standards. The new channel alignment utilizes the west bank for the first half of the stream and then crosses over the old channel to use the floodplain on the east overbank. The lower section of this reach is designed to flow through a remnant channel (visible from the aerial photograph). An ephemeral tributary is tied into the channel at Station 48+00.

6.3.1.4 Big Cedar Creek Reach 4

The final section of full restoration on Big Cedar Creek, Reach 4, marks the transition from Priority 1 restoration to Priority 2 restoration. Channel dimensions were designed to E/C4 standards. The proposed alignment meanders and uses log vane structures and construction riffles near the reach terminus to lower the channel bed elevation to the box culvert elevation under the railroad.

6.3.1.5 Big Cedar Creek Reach 5

This reach is approximately 435 LF and is to be preserved.

6.3.1.6 Big Cedar Creek Reach 6

This reach is approximately 969 LF and is an Enhancement level II design. Banks will be sloped to 2:1 slopes, where feasible, and rock vanes will be installed to divert erosive forces from newly stabilized slopes. Existing riffles will be enhanced through addition of large rock, and single and double vane deflectors will be installed to narrow the channel in overly wide sections. Upstream of where Big Cedar Creek crosses under Mount Zion Road, a

rock cross vane will be installed to center the thalweg as the stream enters the culvert. Rock toe protection will be applied to the right bank.

6.3.1.7 UT2

UT2 is design as an E/C4 channel. The first 162 LF of UT2 consist of a forested floodplain and will not be disturbed. Below the wood line, the design channel slope was minimized to tie the designed floodplain bench into the existing floodplain as quickly as possible. The proposed realignment meanders down the floodplain and joins Big Cedar Creek at the head of a pool (Big Cedar Creek Station 16+25). Sediment transport calculations determined that a design channel slope of 0.0071 ft/ft is necessary in order to prevent degradation (see Section 6.4.2). The valley slope through this reach is 0.0183 ft/ft, and decreasing the channel slope to 0.0071 ft/ft would create a channel with a sinuosity of 2.6. UT2's valley is somewhat narrow and designing a channel with a meander width ratio higher than 4.2 was not feasible. The design meanders the channel to the extent feasible, decreasing channel slope as much as possible and producing a sinuosity of 1.2. Because the bankfull channel width is only 13.0 feet, only constructed riffles and structures such as brush mattresses will be installed along this reach to function as degradational control.

6.3.1.8 UT1 Reach 1

Reach 1 begins at the upstream extent of the project and meanders down valley. The reach was designed as an E/C4 channel with moderate sinuosity and low slope, 0.0078 ft/ft. The low slope was designed to minimize earthwork and tie the proposed bankfull elevations into the adjacent floodplain in the shortest stream length. Sediment transport calculations determined that a design channel slope of 0.0038 ft/ft is necessary in order to prevent degradation (see Section 6.4.2). The valley slope through this reach is 0.01 ft/ft, and decreasing the channel slope to 0.0038 ft/ft would create a channel with a sinuosity of 2.6. The design meanders the channel to the extent feasible given the fall and shape of the valley, decreasing channel slope as much as possible and producing a sinuosity of 1.2. Structures will be installed to establish grade control, brush mattresses and root wads will be installed to protect the outside of meander bends. An existing intermittent tributary will be tied in at proposed station 22+00. A proposed stream crossing defines the downstream reach break for Reach 1.

6.3.1.9 UT1 Reach 2

The valley narrows in Reach 2 and the slope increases to accommodate the decrease in floodplain area. For this reason, a B4c channel was designed with less sinuosity and higher slope. This section does still have a moderate entrenchment ratio. The proposed stream ties into the existing stream at proposed station 26+00 and meanders in the existing channel to proposed station 31+00. The downstream reach break is defined by a change in valley geomorphology.

6.3.1.10 UT1 Reach 3

Reach 3 meanders down valley and is the longest reach on UT1. The valley begins to widen at the upstream extent of this reach and provides the opportunity to increase sinuosity as well as the entrenchment ratio. This reach was designed as a C4 channel. Sediment transport calculations determined that a design channel slope of 0.0091 ft/ft is necessary in order to prevent degradation (see Section 6.4.2). The valley slope through this reach is 0.014 ft/ft, and decreasing the channel slope to 0.0091 ft/ft would create a channel with a sinuosity of 1.5. The design meanders the channel to the extent feasible, decreasing channel slope as much as possible and producing a sinuosity of 1.2. A majority of this reach will be excavated in the existing floodplain and offline of the existing stream. Reach

3 ties into the existing stream at station 44+50 and continues to meander in and out of the existing stream to the end of Reach 3. A roadway drainage swale, an intermittent tributary and an ephemeral channel were tied into Reach 3, at stations 40+00, 46+60, and 49+30, respectively. The downstream reach break is defined by a change in valley slope.

6.3.1.11 UT1 Reach 4

Reach 4 is approximately 1,501 LF in total length, although only 993 LF of the channel is within the conservation easement. Upstream of the railroad culvert, this channel was designed as a high slope B4c channel with low sinuosity. This reach was designed to transition from the original floodplain elevation to a new floodplain elevation. This section does still have a moderate entrenchment ratio. An ephemeral channel was tied into the reach at station 55+80. The existing stream crossing will be enhanced and preserved to maintain access to adjacent farm fields.

Table 6.2 Geomorphic Characteristics of the Proposed Big Cedar Creek and UT2 Reaches

Big Cedar Creek Restoration Plan

	Big Cedar Creek Mainstem												UT2		
	Reach 1			Reach 2			Reach 3			Reach 4			Reach 1		
	10+00 to 15+73			15+73 to 38+13			38+13 to 56+22			56+22 to 60+22			10+00 to16+05		
	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*
1. Stream Type	E/C4		N/A	E/C4		N/A	E/C4		N/A	E/C4		N/A	E/C4		N/A
2. Drainage Area – mi^2	2.3	2.3	N/A	2.3	3.1	N/A	3.1	3.3	N/A	3.3	3.35	N/A	0.54	0.55	N/A
3. Bankfull Width (w_{bkf}) – ft	20.0		1	23.0		1	24.4		1	26.0		1	13.0		1
4. Bankfull Mean Depth (d_{bkf}) – ft	2.0		1	2.3		1	2.1		1	2.2		1	1.1		1
5. Width/Depth Ratio (w/d ratio)	10.0		1	10.0		1	11.6		1	11.8		1	11.8		1
6. Cross sectional Area (A_{bkf}) – ft^2	39.0		1	52.7		1	52.1		1	57.2		1	14.3		1
7. Bankfull Mean Velocity (v_{bkf}) - ft/sec	3.8		N/A	3.5		N/A	3.7		N/A	3.5		N/A	3.9		N/A
8. Bankfull Discharge (Q_{bkf}) – ft^3/sec	150		N/A	185		N/A	195		N/A	199		N/A	56		N/A
9. Bankfull Max Depth (d_{mbkf}) - ft	2.8		1	3.3		1	3.0		1	3.0		1	1.4		1
10. d_{mbkf} / d_{bkf} ratio	1.4		1	1.4		1	1.4		1	1.4		1	1.3		1
11. Low Bank Height to d_{mbkf} ratio	1.0		1	1.0		1	1.0		1	1.0		1	1.0		1
12. Floodprone Area Width (w_{fpa}) – feet	87		1	100+		1	100+		1	94+		1	74+		1
13. Entrenchment Ratio (ER)	4.4		1	4.3+		1	4.1+		1	3.6+		1	5.7+		1
14. Meander length (L_m) – ft	281	285	2	197	312	13	187	313	11	207	247	2	98	142	6
15. Ratio of meander length to bankfull width (L_m/w_{bkf})	14.1	14.3	2	8.6	13.6	13	7.7	12.8	11	8.0	9.5	2	7.5	10.9	6
16. Radius of curvature (R_c) – ft	50	70	3	44	77	15	44	83	13	52	53	3	23	37	7
17. Ratio of radius of curvature to bankfull width (R_c / w_{bkf})	2.5	3.5	3	1.9	3.3	15	1.8	3.4	13	2.0	2.0	3	1.8	2.8	7
18. Belt width (w_{blt}) – ft	103	132	3	73	144	14	52	114	12	58	91	3	46	55	7
19. Meander Width Ratio (w_{blt}/W_{bkf})	5.2	6.6	3	3.2	6.3	14	2.1	4.7	12	2.2	3.5	3	3.5	4.2	7
20. Sinuosity (K) stream length / valley length	1.3		N/A	1.3		N/A	1.1		N/A	1.1		N/A	1.2		N/A
21. Valley Slope – feet per foot	0.0039		N/A	0.0061		N/A	0.0077		N/A	0.0109		N/A	0.0183		N/A
22. Average Channel Slope (S_{bkf}) – feet per foot	0.0030		N/A	0.0048		N/A	0.0068		N/A	0.0098		N/A	0.0150		N/A

Table 6.2 Geomorphic Characteristics of the Proposed Big Cedar Creek and UT2 Reaches

Big Cedar Creek Restoration Plan

	Big Cedar Creek Mainstem												UT2		
	Reach 1			Reach 2			Reach 3			Reach 4			Reach 1		
	10+00 to 15+73			15+73 to 38+13			38+13 to 56+22			56+22 to 60+22			10+00 to16+05		
	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*
23. Pool Slope (s_{pool}) – feet per foot	0.0		4	0.0		15	0.0		13	0.0		4	0.0		8
24. Ratio of Pool Slope to Average Slope (S_{pool} / S_{bkf})	0.0		4	0.0		15	0.0		13	0.0		4	0.0		8
125. Maximum Pool Depth (d_{pool}) – ft	6.5		1	5.2		1	5.5		1	5.0		1	3.6		1
26. Ratio of Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	3.3		1	2.3		1	2.6		1	2.3		1	3.3		1
27. Pool Width (w_{pool}) – ft	25.0		1	33.6		1	35.5		1	40.0		1	20.1		1
28. Ratio of Pool Width to Bankfull Width (w_{pool} / w_{bkf})	1.3		1	1.5		1	1.5		1	1.5		1	1.5		1
29. Pool Area (A_{pool}) – ft^2	56.8		1	86.8		1	97.0		1	102.5		1	36.2		1
30. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	1.5		1	1.6		1	1.9		1	1.8		1	2.5		1
31. Pool-to-Pool Spacing (p-p) – ft	150	205	4	110	223	15	83	185	13	105	112	2	62	99	7
32. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	7.5	10.3	4	4.8	9.7	15	3.4	7.6	13	4.0	4.3	2	4.8	7.6	7
33. Riffle Slope (s_{riffle}) – feet per foot	0.0073	0.0079	4	0.0092	0.0144	15	0.0080	0.0169	13	0.0119	0.0237	4	0.0230	0.0504	8
34. Ratio of Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	2.4	2.6	4	1.9	3.0	15	1.2	2.5	13	1.2	2.4	4	1.5	3.4	8

n* – This column represents the number of data points used where a range or mean is specified.

Table 6.3 Geomorphic Characteristics of the Proposed UT1 Reaches
Big Cedar Creek Restoration Plan

	UT1											
	Reach 1			Reach 2			Reach 3			Reach 4		
	10+00 to 22+76			22+76 to 33+01			33+01 to 52+55			52+55 to 67+56		
	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*
1. Stream Type	E/C4		N/A	B4c		N/A	C4		N/A	B4c		N/A
2. Drainage Area – mi^2	0.70	0.83	N/A	0.83	0.93	N/A	0.93	1.13	N/A	1.13	1.20	N/A
3. Bankfull Width (w_{bkf}) – ft	13.0		1	15.0		1	15.0		1	16.0		1
4. Bankfull Mean Depth (d_{bkf}) – ft	1.2		1	1.1		1	1.2		1	1.3		1
5. Width/Depth Ratio (w/d ratio)	10.8		1	13.6		1	12.5		1	12.3		1
6. Cross sectional Area (A_{bkf}) – ft^2	15.3		1	16.8		1	17.3		1	20.0		1
7. Bankfull Mean Velocity (v_{bkf}) - ft/sec	4.5		N/A	4.5		N/A	5.5		N/A	5.0		N/A
8. Bankfull Discharge (Q_{bkf}) – ft^3/sec	69.0		N/A	76.0		N/A	95.0		N/A	100.0		N/A
9. Bankfull Max Depth (d_{mbkf}) - ft	1.7		1	1.5		1	1.5		1	1.7		1
10. d_{mbkf} / d_{bkf} ratio	1.4		1	1.4		1	1.3		1	1.3		1
11. Low Bank Height to d_{mbkf} ratio	1.0		1	1.0		1	1.0		1	1.0		1
12. Floodprone Area Width (w_{fpa}) – feet	73.8		1	85.5		1	85.2		1	87.0		1
13. Entrenchment Ratio (ER)	5.7		1	5.7		1	5.7		1	5.4		1
14. Meander length (L_m) – ft	140	157	12	134	199	9	127	198	17	133	168	5
15. Ratio of meander length to bankfull width (L_m/w_{bkf})	10.8	12.1	12	8.9	13.3	9	8.5	13.2	17	8.3	10.5	5
16. Radius of curvature (R_c) – ft	28	40	14	30	48	11	30	50	19	32	50	9
17. Ratio of radius of curvature to bankfull width (R_c / w_{bkf})	2.2	3.1	14	2.0	3.2	11	2.0	3.3	19	2.0	3.1	9
18. Belt width (w_{blt}) – ft	29	64	13	30	45	10	22	65	18	31	47	7
19. Meander Width Ratio (w_{blt}/W_{bkf})	2.2	4.9	13	2.0	3.0	10	1.5	4.3	18	1.9	2.9	7
20. Sinuosity (K) stream length / valley length	1.3		N/A	1.0		N/A	1.2		N/A	1.0		N/A
21. Valley Slope – feet per foot	0.01		N/A	0.0131		N/A	0.014		N/A	0.0167		N/A
22. Average Channel Slope (S_{bkf}) – feet per foot	0.0078		N/A	0.0128		N/A	0.0118		N/A	0.0161		N/A
23. Pool Slope (s_{pool}) – feet per foot	0.0		14	0.0		11	0.0		19	0.0		10
24. Ratio of Pool Slope to Average Slope (S_{pool} / S_{bkf})	0.0		14	0.0		11	0.0		19	0.0		10
25. Maximum Pool Depth (d_{pool}) – ft	3.0		1	3.5		1	3.3		1	4.0		1
26. Ratio of Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	2.5		1	3.2		1	2.8		1	3.1		1
27. Pool Width (w_{pool}) – ft	19.0		1	21.0		1	22.0		1	23.0		1

Table 6.3 Geomorphic Characteristics of the Proposed UT1 Reaches
Big Cedar Creek Restoration Plan

	UT1											
	Reach 1			Reach 2			Reach 3			Reach 4		
	10+00 to 22+76			22+76 to 33+01			33+01 to 52+55			52+55 to 67+56		
	Min	Max	n*	Min	Max	n*	Min	Max	n*	Min	Max	n*
28. Ratio of Pool Width to Bankfull Width (w_{pool} / w_{bkf})	1.5		1	1.4		1	1.5		1	1.4		1
29. Pool Area (A_{pool}) – ft^2	31.1		1	39.3		1	37.4		1	50.3		1
30. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	2.0		1	2.3		1	2.2		1	2.5		1
31. Pool-to-Pool Spacing (p-p) – ft	63	115	13	62	140	11	61	137	19	64	105	9
32. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	4.8	8.8	13	4.1	9.3	11	4.1	9.1	19	4.0	6.6	9
33. Riffle Slope (s_{riffle}) – feet per foot	0.0115	0.023	14	0.0192	0.028	11	0.0175	0.0354	19	0.0222	0.0301	12
34. Ratio of Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	1.5	2.9	14	1.5	2.1	11	1.5	3.0	19	1.4	1.9	12

6.4 Sediment Transport

6.4.1 Methodology

The purpose of sediment transport analysis is to ensure that the stream restoration design creates a stable channel that does not aggrade or degrade over time, but adjusts within its stable limits. The overriding assumption is that the project reach should be transporting all the sediment delivered from upstream sources, thereby being a "transport" reach and classified as a Rosgen "C" or "E" type channel.

Sediment transport is typically assessed by computing channel competency, capacity, or both. Sediment transport competency is a measure of force (lbs/ft^2) that refers to the stream's ability to move a given grain size. Quantitative assessments include shear stress, tractive force, and critical dimensionless shear stress. Since these assessments help determine a size class that is mobile under certain flow conditions, they are most important in gravel bed studies in which the bed material ranges in size from sand to cobble (of which only a fraction are mobile during bankfull conditions).

Project reaches were separated for sediment transport analyses based on median particle size and channel slope and dimension. Because the riffle materials were coarse for each of the project reaches, it was determined that these larger particles were controlling sediment transport in the system, and so sediment transport competency was analyzed.

6.4.2 Sediment Transport Analysis & Discussion

Sediment transport competency is measured in terms of the relationship between critical and actual depth at a given slope, and occurs when the critical depth produces enough shear stress to move the largest (d_{100}) subpavement particle. The boundary shear stress curve used is shown in Figure 6.2.

Table 6.4 Existing Boundary Shear Stresses and Stream Power – Big Cedar Creek and UT2
Big Cedar Creek Restoration Plan

Parameter	Big Cedar Creek Mainstem				UT2
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 1
Bankfull Discharge, Q (cfs)	150	185	195	199	56
Bankfull Area (square feet)	36.7	39.7	32.3	47.1	10.8
Mean Bankfull Velocity (cfs)	4.1	4.7	5.9	4.2	5.2
Bankfull Width, W (feet)	16.3	22.0	19.5	29.6	9.2
Bankfull Mean Depth, D (feet)	**2.3**	**1.8**	**1.7**	**1.6**	**1.2**
Width to Depth Ratio, w/d (feet/ foot)	7.1	12.2	11.5	18.5	7.7
Wetted Perimeter (feet)	20.9	25.6	22.9	32.8	11.6
Hydraulic Radius, R (feet)	1.8	1.5	1.4	1.4	0.9
Channel Slope (feet/ foot)	**0.0080**	**0.0077**	**0.0045**	**0.0088**	**0.0215**
Boundary Shear Stress, τ (lbs/ft^2)	0.88	0.72	0.40	0.79	1.25
Subpavement D_{100} (mm)	64	67	45	70	64
Largest Moveable Particle (mm) per Shield's Curve (Rosgen Curve)	70(250)	55(190)	30(100)	65(200)	100(300)
Critical Depth (feet)	**0.8**	**1.4**	**1.5**	**1.2**	**0.4**
Critical Slope (feet/ foot)	**0.0028**	**0.0062**	**0.0038**	**0.0066**	**0.0065**

Table 6.4 summarizes the existing sediment competence calculations for Big Cedar Creek and UT2. Reach 1 of Big Cedar has an existing depth of 2.3 ft and an existing slope of 0.008 ft/ft. The existing conditions are in excess of the depth and slope required to move the D100, 0.8 ft and 0.0028 ft/ft, respectively. Reach 1 is therefore capable of moving a much larger particle size than the D100 and is degradational. This is reflected in the channel dimension and classification; Reach 1 is classified as a E4/1. The channel is vertically stable due to bedrock, however, it is laterally unstable and eroding. Reach 2, and B4/1c-type channel, also has an existing depth and slope in excess of that required to move the D100, however, the difference between existing and critical is not as great as seen in Reach 1. Lateral bars were observed throughout Reach 2 which suggests that although the channel has the competence to move the material through the reach, the channel lacks capacity and is unable to transport sediment efficiently through a cross section. Reaches 3 and 4, both classified as C4/1-type channels, have existing depths and slopes similar to that required to move the D100. These two reaches are adequately transporting the sediment supplied to them. UT2 is deeper and has a steeper slope than is required to move the D100. This is reflected in the degradational state of the channel. UT2 is classified as a G4 and is vertically unstable.

Table 6.5 Proposed Boundary Shear Stresses and Stream Power – Big Cedar Creek and UT2
Big Cedar Creek Restoration Plan

Parameter	Big Cedar Creek Mainstem				UT2
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 1
Bankfull Discharge, Q (cfs)	150.0	185	195	199	56.0
Bankfull Area (square feet)	39.0	52.7	52.1	57.2	14.3
Mean Bankfull Velocity (cfs)	3.8	3.5	3.7	3.5	3.9
Bankfull Width, W (feet)	20.0	23.0	24.4	26.0	13.0
Bankfull Mean Depth, D (feet)	**2.0**	**2.3**	**2.1**	**2.2**	**1.1**

Table 6.5 Proposed Boundary Shear Stresses and Stream Power – Big Cedar Creek and UT2
Big Cedar Creek Restoration Plan

Parameter	Big Cedar Creek Mainstem				UT2
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 1
Width to Depth Ratio, w/d (feet/ foot)	10.0	10.0	11.6	11.8	11.8
Wetted Perimeter (feet)	24.0	27.6	28.7	30.4	15.2
Hydraulic Radius, R (feet)	1.7	1.9	1.8	1.9	0.9
Channel Slope (feet/ foot)	**0.0030**	**0.0048**	**0.0068**	**0.0098**	**0.0150**
Boundary Shear Stress, τ (lbs/ft^2)	0.31	0.57	0.77	1.15	0.88
Subpavement D_{100} (mm)	64.0	67.0	45.0	70.0	64
Largest Moveable Particle (mm) per Shield's Curve (Rosgen Curve)	22.0 (80.0)	45.0 (100.0)	55.0 (150.0)	85.0 (275.0)	70.0 (220.0)
Critical Depth (feet)	**2.1**	**2.3**	**1.0**	**1.0**	**0.5**
Critical Slope (feet/ foot)	**0.0032**	**0.0049**	**0.0031**	**0.0045**	**0.0071**

Table 6.5 summarizes the proposed channel dimensions and critical depths and slopes given the proposed conditions. Reach 1 and 2 both have depths and slopes similar to the critical values and are competent to move the supplied sediment load without aggrading or degrading. Reach 3 is deeper and steeper than the critical depths and slopes required to move the D100, and therefore, it is expected to be degradational. Channel slope is set by decreased meander width ratios in this section of the project and cannot be decreased. The width to depth ratio of the riffle cross sections were optimized for channel constructability and therefore the depth was not changed. Degradational forces will be addressed through structure placement and installation of constructed riffles. These features will control vertical and horizontal stability so that the channel will not degrade down to bedrock as observed currently in several sections of the channel. Reach 4 also has greater slope and depth than required to transport supplied sediment. This reach is dedicated to dropping the proposed channel to meet the existing channel elevation prior to going through the railroad culvert. Because of the vertical and horizontal stability provided by log vanes and constructed riffles, degradation is not a concern.

Table 6.6 Existing Boundary Shear Stresses and Stream Power – UT1
Big Cedar Creek Restoration Plan

Parameter	UT1			
	Reach 1	Reach 2	Reach 3	Reach 4
Bankfull Discharge, Q (cfs)	69.0	76.0	95.0	100.0
Bankfull Area (square feet)	14.4	18.5	20.9	22.6
Mean Bankfull Velocity (cfs)	4.8	4.1	4.5	4.4
Bankfull Width, W (feet)	18.9	13.1	17.6	23.1
Bankfull Mean Depth, D (feet)	**0.8**	**1.4**	**1.2**	**1.0**
Width to Depth Ratio, w/d (feet/ foot)	23.6	9.4	14.7	23.1
Wetted Perimeter (feet)	20.5	15.9	20.0	25.1
Hydraulic Radius, R (feet)	0.7	1.2	1.0	0.9
Channel Slope (feet/ foot)	**0.0116**	**0.014**	**0.0134**	**0.0145**

Table 6.6 Existing Boundary Shear Stresses and Stream Power – UT1 Big Cedar Creek Restoration Plan				
Parameter	**UT1**			
	Reach 1	**Reach 2**	**Reach 3**	**Reach 4**
Boundary Shear Stress, τ (lbs/ft^2)	0.51	1.01	0.87	0.81
Subpavement D_{100} (mm)	45.0	64.0	64.0	64.0
Largest Moveable Particle (mm) per Shield's Curve (Rosgen Curve)	35 (125)	80 (250)	70 (225)	70 (200)
Critical Depth (feet)	**0.4**	**0.4**	**0.8**	**0.5**
Critical Slope (feet/ foot)	**0.0057**	**0.0042**	**0.0091**	**0.0078**

Table 6.6 summarizes the existing boundary conditions for UT1. All reaches on UT1 are degradational and have slopes and mean depths greater than what is required to move the D100. Most areas throughout UT1 are vertically stable due to a large amount of bedrock in the channel.

Table 6.7 Proposed Boundary Shear Stresses and Stream Power – UT1 Big Cedar Creek Restoration Plan				
Parameter	**UT1**			
	Reach 1	**Reach 2**	**Reach 3**	**Reach 4**
Bankfull Discharge, Q (cfs)	69.0	76.0	95.0	100.0
Bankfull Area (square feet)	15.3	16.8	17.3	20.0
Mean Bankfull Velocity (cfs)	4.5	4.5	5.5	5.0
Bankfull Width, W (feet)	13.0	15.0	15.0	16.0
Bankfull Mean Depth, D (feet)	1.2	1.1	1.2	1.3
Width to Depth Ratio, w/d (feet/ foot)	10.8	13.6	12.5	12.3
Wetted Perimeter (feet)	15.4	17.2	17.4	18.6
Hydraulic Radius, R (feet)	1.0	1.0	1.0	1.1
Channel Slope (feet/ foot)	0.0078	0.0128	0.0118	0.0161
Boundary Shear Stress, τ (lbs/ft^2)	0.48	0.78	0.73	1.07
Subpavement D_{100} (mm)	45	64	64	64
Largest Moveable Particle (mm) per Shield's Curve (Rosgen Curve)	35 (125)	60 (200)	55 (190)	80 (250)
Critical Depth (feet)	0.6	0.5	0.9	0.5
Critical Slope (feet/ foot)	0.0038	0.0054	0.0091	0.006

As shown in Table 6.7, the critical depth for the proposed cross section in each Reach of UT1 is less than the design depth. This data indicates the proposed channel is adequately sized to carry the supplied sediment load, but it will require grade control to protect the channel from degradation. As a second check of sediment transport competency, boundary shear stress was compared to Shield's curve – Figure 6.2 - to estimate the largest moveable particle. The Shield's curve predicts the mobility of particles larger than the d_{100} observed in the subpavement. Both of these sediment transport competency analyses confirm the ability of the design channel to transport the coarse sediment load.

6.5 In-Stream Structures

A variety of in-stream structures are proposed for the Big Cedar Creek site. Structures such as root wads, constructed riffles, log vanes, and j-hooks will be used to stabilize the newly-restored stream. Wood structures will be alternated with boulder structures on this site because of the material observed in the existing system. A certain amount of wood will be generated through the construction of this project and will be available for use. Table 6.8 summarizes the use of in-stream structures at the site.

Table 6.8 Proposed In-Stream Structure Types and Locations
Big Cedar Creek Restoration Plan

Structure Type	Location
Root Wad	Outside bank of smaller radius meander bends.
Brush Mattress	Outside bank of shorter arcs and larger radius meander bends.
Rock Cross Vane	Reach 6 of Big Cedar to align stream velocity vectors with existing culvert and step down bed elevation in a stable manner.
Constructed Riffle	Through straight, steeper sections to provide grade control.
Rock or Log Vane	In meander bends to turn water.
Cover Log	In pools to provide habitat features.
Boulder or Log Sill	For grade control and pool habitat.
Boulder Cluster	For energy dissipation and habitat in long straight riffles.

Root Wad

Root wads are placed at the toe of the stream bank in the outside of meander bends for the creation of habitat and for stream bank protection. Root wads include the root mass or root ball of a tree plus a portion of the trunk. They are used to armor a stream bank by deflecting stream flows away from the bank. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. They also serve as a food source for aquatic insects. Root wads will be placed throughout the Big Cedar Creek project.

Brush Mattress

Brush mattresses are placed on bank slopes on the outside of meander bends for stream bank protection. Layers of live, woody cuttings are wired together and staked into the bank. Brush mattresses help to establish vegetation on the bank to secure the soil. Once the vegetation is established, the cover also provides habitat for wildlife.

Cross Vane

Cross vanes are used to provide grade control, keep the thalweg in the center of the channel, and protect the stream bank. A cross vane consists of two rock or log vanes joined by a center structure installed perpendicular to the direction of flow. This centering structure sets the invert elevation of the stream bed. These structures will be placed in Big Cedar Creek in Reach 6 to align the velocity vectors with the existing culvert.

Constructed Riffle

A constructed riffle consists of the placement of coarse bed material in the stream at specific riffle locations along the profile. A buried log or rock boulders at the upstream and downstream end of riffles may be used to control the slope through the riffle in steeper sections. The purpose of this structure is to provide grade control and establish riffle habitat. Constructed riffles will be placed throughout all reaches. In the higher

slope reaches, the constructed riffles and cross vanes will be intermixed to provide diversity of structure and in-stream habitat.

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 are located either upstream or downstream along a meander bend and function to initiate or complete the redirecting of flow energies resulting in reduced near bank shear stress and alignment maintenance. Vanes are located just downstream of the point where the stream flow intercepts the bank at acute angles. In an effort to promote structural diversity, the proposed restoration indicates a mixed use of rock and logs to construct vanes.

Cover Log

A cover log is placed in the outside of a meander bend to provide habitat in the pool area. The log is buried into the outside bank of the meander bend; the opposite end extends through the deepest part of the pool and may be buried in the inside of the meander bend, in the bottom of the point bar. The placement of the cover log near the bottom of the bank slope on the outside of the bend encourages scour in the pool. This increased scour provides a deeper pool for bedform variability. Cover logs will be used on all reaches.

Boulder or Log Sill

Boulder and log sills consist of either header stones and footer stones or header log and a footer log placed in the bed of the stream channel, perpendicular to stream flow. The rocks or logs extend into the stream banks on both sides of the structure to prevent erosion and bypassing of the structure. The rocks or logs are installed flush with the channel bottom upstream of the rock or log. The footer rock or log is placed to the depth of scour expected, to prevent the structure from being undermined. Rock and log weirs provide bedform diversity, maintain channel profile, and provide pool and cover habitat.

Boulder Cluster Placement

Boulder cluster placement is proposed in areas between short riffles. While the short riffles act as grade control, the boulder placement produces lateral and vertical flow diversity at low flows. At bankfull flows, the boulders serve as energy dissipation features, adding to the overall bed roughness and providing local downstream eddy microhabitat.

6.6 Soil Restoration

Soil composition is vitally important to the success of newly planted riparian vegetation. Technical specifications will require the contractor to perform pre-construction soil tests to determine the existing soil composition. Soil amendments necessary to support the growth of proposed herbaceous and woody riparian species shall be added prior to planting.

6.7 Natural Plant Community Restoration

Native riparian vegetation will be established in the restored stream buffer. Also, any areas of invasive vegetation such as Chinese privet (*Ligustrum sinense*) and Japanese honeysuckle (*Lonicera japonica*) will be managed so as not to threaten the newly-established native plants within the conservation easement.

6.7.1 Stream Buffer Vegetation

Bare-root trees, live stakes, and permanent seeding will be planted within designated areas of the conservation easement. A preferred 50-foot buffer measured from the top of banks (sometimes slightly less and quite often, substantially more) will be established along the restored stream reaches. In many areas, the combined buffer width for left and right banks will be in excess of 100 feet. Bare-root vegetation will be planted at a target density of 680 stems per acre, or an 8-foot by 8-foot grid. The proposed species to be planted are listed in Table 6.9. 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 be generally 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 (USACE, 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 between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing.

Permanent seed mixtures will be applied to all disturbed areas of the project site. Table 6.9 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 or browntop millet). 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 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 of the site that are susceptible to erosion. These areas include constructed streambanks, 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 6.9 Proposed Bare-Root and Live Stake Species
Big Cedar Creek Restoration Plan

Common Name	Scientific Name	Percent Planted by Species	Planting Density
Floodplain Planting Zone			
Persimmon	*Diospyros virginiana*	5%	34 stems per acre
Tulip poplar	*Liriodendron tulipifera*	10%	68 stems per acre
Green ash	*Fraxinus pennsylvanica*	20%	136 stems per acre
Black walnut	*Juglans nigra*	10%	68 stems per acre
Sycamore	*Platanus occidentalis*	15%	102 stems per acre
Willow oak	*Quercus phellos*	7%	48 stems per acre
Swamp chestnut oak	*Quercus michauxii*	15%	102 stems per acre
Blackgum	*Nyssa salvatica*	8%	54 stems per acre
Paw paw	*Asimina triloba*	10%	68 stems per acre
Alternate Species			
River birch	*Betula nigra*		
Sugarberry	*Celtis laevigata*		

Table 6.9 Proposed Bare-Root and Live Stake Species
Big Cedar Creek Restoration Plan

Common Name	Scientific Name	Percent Planted by Species	Planting Density
Upland Planting Zone			
Persimmon	*Diospyros virginiana*	5%	34 stems per acre
Tulip poplar	*Liriodendron tulipifera*	15%	102 stems per acre
Green ash	*Fraxinus pennsylvanica*	20%	136 stems per acre
Black walnut	*Juglans nigra*	5%	34 stems per acre
Sugarberry	*Celtis laevigata*	15%	102 stems per acre
Willow oak	*Quercus phellos*	10%	68 stems per acre
Blackgum	*Nyssa salvatica*	15%	102 stems per acre
Southern red oak	*Quercus falcata*	10%	68 stems per acre
Flowering dogwood	*Cornus florida*	5%	34 stems per acre
Alternate Species			
Sycamore	*Platanus occidentalis*		
Black haw viburnum	*Viburnum prunifolium*		
Redbud	*Cercis canadensis*		
Live Stakes			
Silky dogwood	*Cornus amomum*	35%	56 to 126 stems per 1,000 SF
Silky willow	*Salix sericea*	35%	56 to 126 stems per 1,000 SF
Elderberry	*Sambucus canadensis*	20%	32 to 72 stems per 1,000 SF
Black willow	*Salix nigra*	10%	16 to 36 stems per 1,000 SF
Brush Mattresses			
Silky dogwood	*Cornus amomum*	40%	
Silky willow	*Salix sericea*	30%	
Elderberry	*Sambucus canadensis*	30%	

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

Table 6.10 Proposed Permanent Seed Mixture
Big Cedar Creek Restoration Plan

Common Name	Scientific Name	Percent of Mixture	Seeding Density (lbs/acre)
Floodplain and Upland Areas			
Virginia wild rye	*Elymus virginicus*	20%	3
Switchgrass	*Panicum virgatum*	10%	1.5
River oats	*Chasmanthum latifolium*	5%	0.75
Soft rush	*Juncus effusus*	15%	2.25
Fox sedge	*Carex vulpinoidea*	10%	1.5
Deertongue	*Dichathelium Clandestinum*	15%	2.25
Common smartweed	*Persicaria pennsylvanica*	10%	1.5
Beggar's ticks	*Bidens fondosum*	15%	2.25

Table 6.10 Proposed Permanent Seed Mixture
Big Cedar Creek Restoration Plan

Common Name	Scientific Name	Percent of Mixture	Seeding Density (lbs/acre)
Note: Species selection may change due to availability at the time of planting.			

6.7.2 On-site Invasive Species Management

The site has some infestation of Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), and Japanese honeysuckle (*Lonicera japonica*) in the floodplains of the riverine system. These areas will be treated and monitored so that the invasive species do not threaten the newly-planted riparian vegetation.

7.0 PERFORMANCE CRITERIA

The Baker team has been involved in obtaining recent approvals from the regulatory agencies for a series of mitigation and restoration plans for wetland and stream 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 numerous NCEEP full delivery projects, as well as the Stream Mitigation Guidelines issued jointly by the USACE, NCDWQ, WRC, and the Environmental Protection Agency (EPA) in April 2003. 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 document project success.

Geomorphic monitoring of restored stream reaches will be conducted for five years 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 any 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 gage and photographs. The crest gage will be installed on the floodplain within 10 feet of the restored channel. The crest gage will record the highest watermark between site visits, and the gage 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 five-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. 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 in 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). 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 annually for the duration of the five-year monitoring period. The as-built survey will be used for year one monitoring. Representative 3,000 LF segments of the restored Big Cedar Creek and UT1 will be surveyed. The entire project length of UT2 will be surveyed. 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 on Big Cedar Creek and UT1, and on at least two permanent cross sections on UT2 (100-counts per cross section). Pebble counts will be conducted immediately after construction and at a two-year interval thereafter at the time the longitudinal surveys are performed (years three and five) throughout the five year monitoring period. Pebble count data will be plotted on semi-log paper and compared with data from previous years. Data should indicate a relative coarsening of the riffles (or maintenance of a coarse bed in constructed riffles) and a relative fining in the pools.

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 at representative grade control structures along the restored stream, limited to cross-vanes and weir structures. Photographers should 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 quadrats will be installed across the restoration site. The number of quadrats required will be based on the species/area curve method, with a minimum of three quadrats. The size of individual quadrats 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 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 (USACE, 1997) 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.

7.3 Benthic Monitoring

If required by NCDWQ as part of the permitting requirements of the project, benthic macroinvertebrate sampling will be conducted on the restored site after one year of construction and every two years thereafter (years three and five) through the five year monitoring period. Appropriate sampling methodologies will be based on current sampling protocols approved by the NCDWQ.

7.4 Maintenance Issues

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.
- 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 the as-built and monitoring reports. The conditions listed above, and any other factors that may have necessitated maintenance, will be discussed.

7.5 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 success criteria are met.

8.0 REFERENCES

Copeland, R.R, D.N. McComas, C.R. Thorne, P.J. Soar, M.M. Jones, and J.B. Fripp. 2001. United States Army Corps of Engineers (USACOE). Hydraulic Design of Stream Restoration Projects. Washington, DC.

Federal Interagency Stream Restoration Working Group (FISRWG). 1998. Stream corridor restoration: Principles, processes and practices. National Technical Information Service. Springfield, VA.

Goldsmith, R., Milton, D.J., and Horton, J.W. 1988. Geologic Map of the Charlotte 1° x 2° Quadrangle, North Carolina and South Carolina. USGS Map I-1251-E, 3p.

Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology.* AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Lane, E. W. 1955. Design of stable channels. Transactions of the American Society of Civil Engineers. Paper No. 2776: 1234-1279.

Medina, M.A., Reid, J.C., Carpenter, R.H. 2004. Physiography of North Carolina Map. North Carolina Geologic Survey. Raleigh, NC.

North Carolina Department of Transportation (NCDOT). Reference Reach Database.

North Carolina Department of Earth and Natural Resources (NCDENR), Division of Water Quality (DWQ). 2003. Yadkin-Pee Dee River Basinwide Water Quality Plan. Raleigh, NC. http://h2o.enr.state.nc.us/basinwide/yadkin/YadkinPD_wq_dt_management_plan0103.htm

NCDENR, DWQ. 2005. Basinwide Information Management System. http://h2o.enr.state.nc.us/bims/reports/basinsandwaterbodies/Stanly.pdf

NCDENR, DWQ. 2007. CSU: Surface Water Classification. Raleigh, NC. http://h2o.enr.state.nc.us/csu/swc.html

North Carolina Natural Heritage Program (NHP). 2001. Guide to Federally Listed Endangered and Threatened Species of North Carolina. NCDENR. Raleigh, North Carolina, USA, pp 21 and 103. http://www.ncnhp.org/Pages/guide.htm

North Carolina Natural Heritage Program (NHP). 2006. 2006 Natural Heritage Program List of the Rare Plant Species of North Carolina. NCDENR. Raleigh, North Carolina. http://www.ncnhp.org/Images/2006RareAnimalList.pdf

NHP. 2006. 2006 Natural Heritage Program List of the Rare Animal Species of North Carolina. NCDENR. Raleigh, North Carolina. http://www.ncnhp.org/Images/2006RarePlantList.pdf

Reed, Jr., and Porter B. 1988. National List of Plant Species That Occur in Wetlands: National Summary. US Fish & Wildlife Service. Biol. Rep. 88(24). 244 pp.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDEHNR. Raleigh, NC.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14(1):11-26.

United States Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

USACE. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-rs-4.1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

United States Census Bureau (USCB), 2000. US Census Bureau, Census 2000. http://factfinder.census.gov

USCB, 2005. US Census Bureau, 2005 Population Estimates. http://factfinder.census.gov

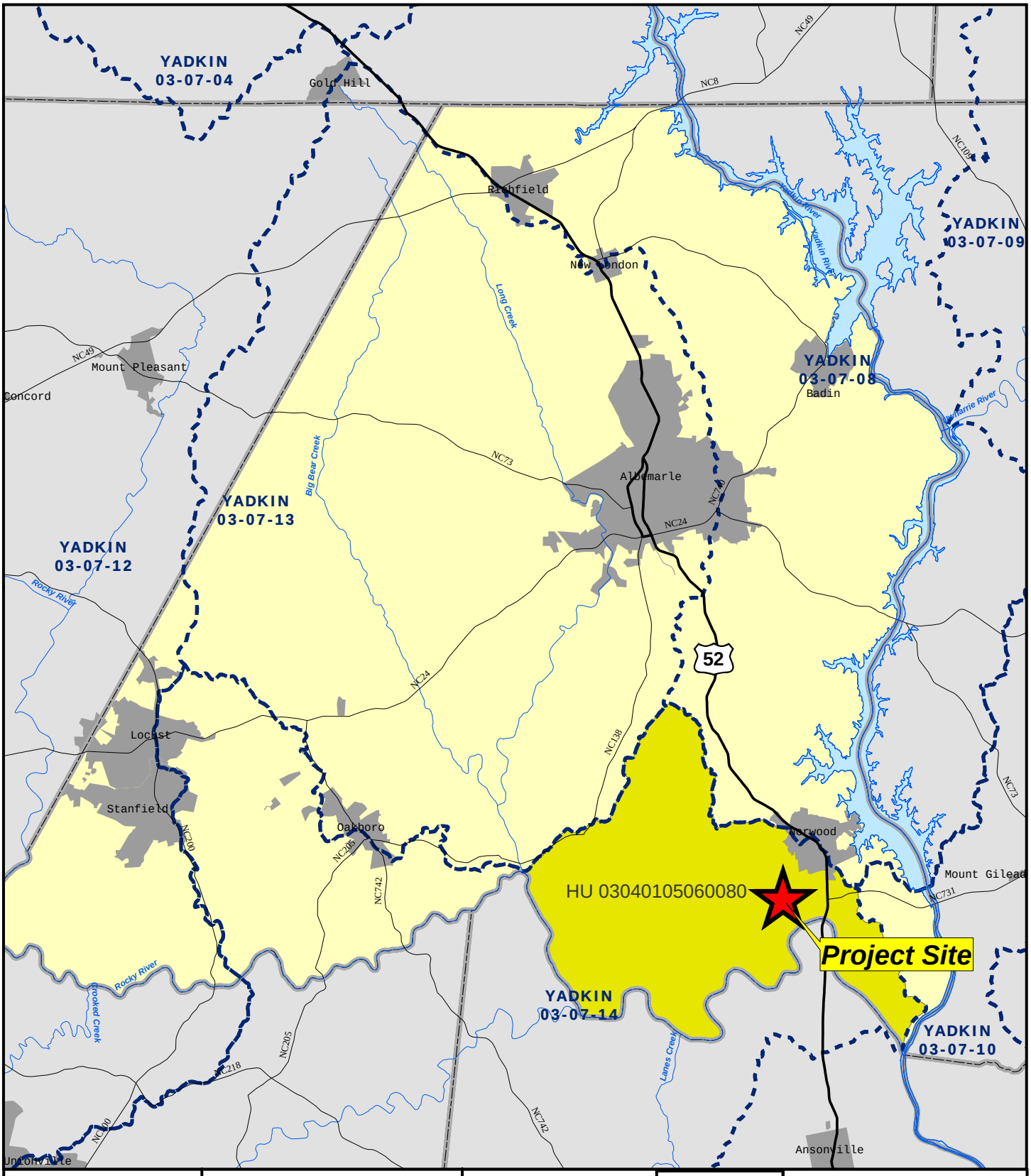
United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). Official Soil Series Descriptions. http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi

USDA, NRCS. Web Soil Survey of Stanly County, North Carolina. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

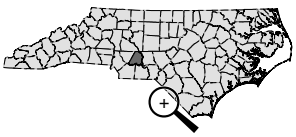
United States Department of the Interior (USDOI), Fish and Wildlife Service (USFWS). 1973. The Endangered Species Act of 1973. Amended through the 108th Congress. http://www.fws.gov/endangered/esaall.pdf

USDOI, USFWS. 2007. Endangered Species, Threatened Species, Federal Species of Concern, and Candidate Species, Stanly County, North Carolina. **http://www.fws.gov/nc%2Des/es/cntylist/stanly.html**

Vogelmann, J.E., S.M. Howard, L. Yang, C. R. Larson, B. K. Wylie, and J. N. Van Driel, 2001, Completion of the 1990's National Land Cover Data Set for the conterminous United States, Photogrammetric Engineering and Remote Sensing 67:650-662.



Map Inset



Stanly County, NC

EEP Project No.: D06054-D

September 2007

LEGEND

- USGS Hydrologic Unit
- NCDWQ Sub-basin
- Counties

0 2 4 Miles

Figure 1.1 Vicinity Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

LEGEND

Project Area

Town of Norwood

Streams

Parcels

0 0.25 0.5 Miles

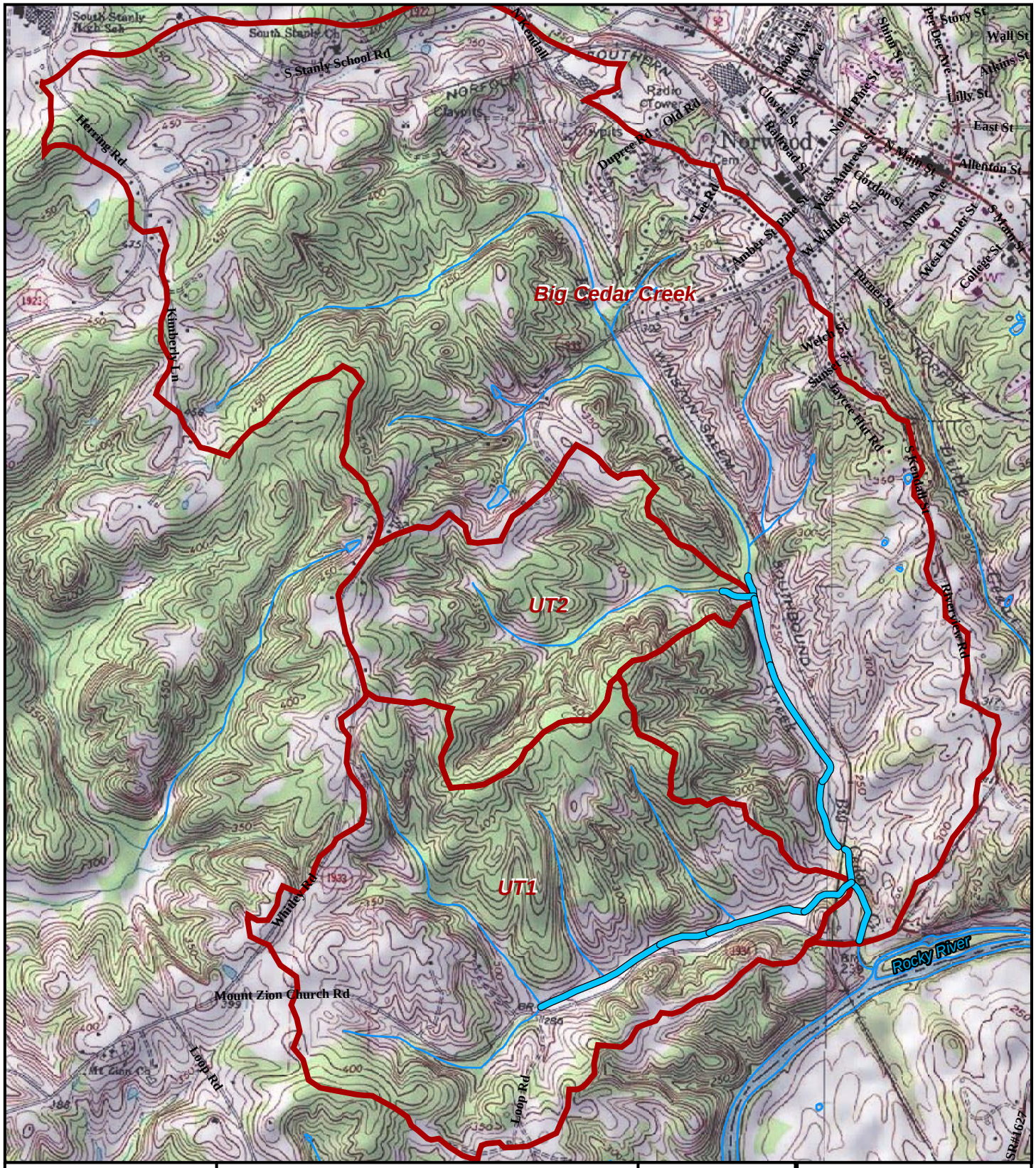
September 2007

Figure 1.2: Site Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

EEP Project No.: D06054-D

Ecosystem Enhancement Program

Baker



September 2007

Figure 1.3: Watershed Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

LEGEND

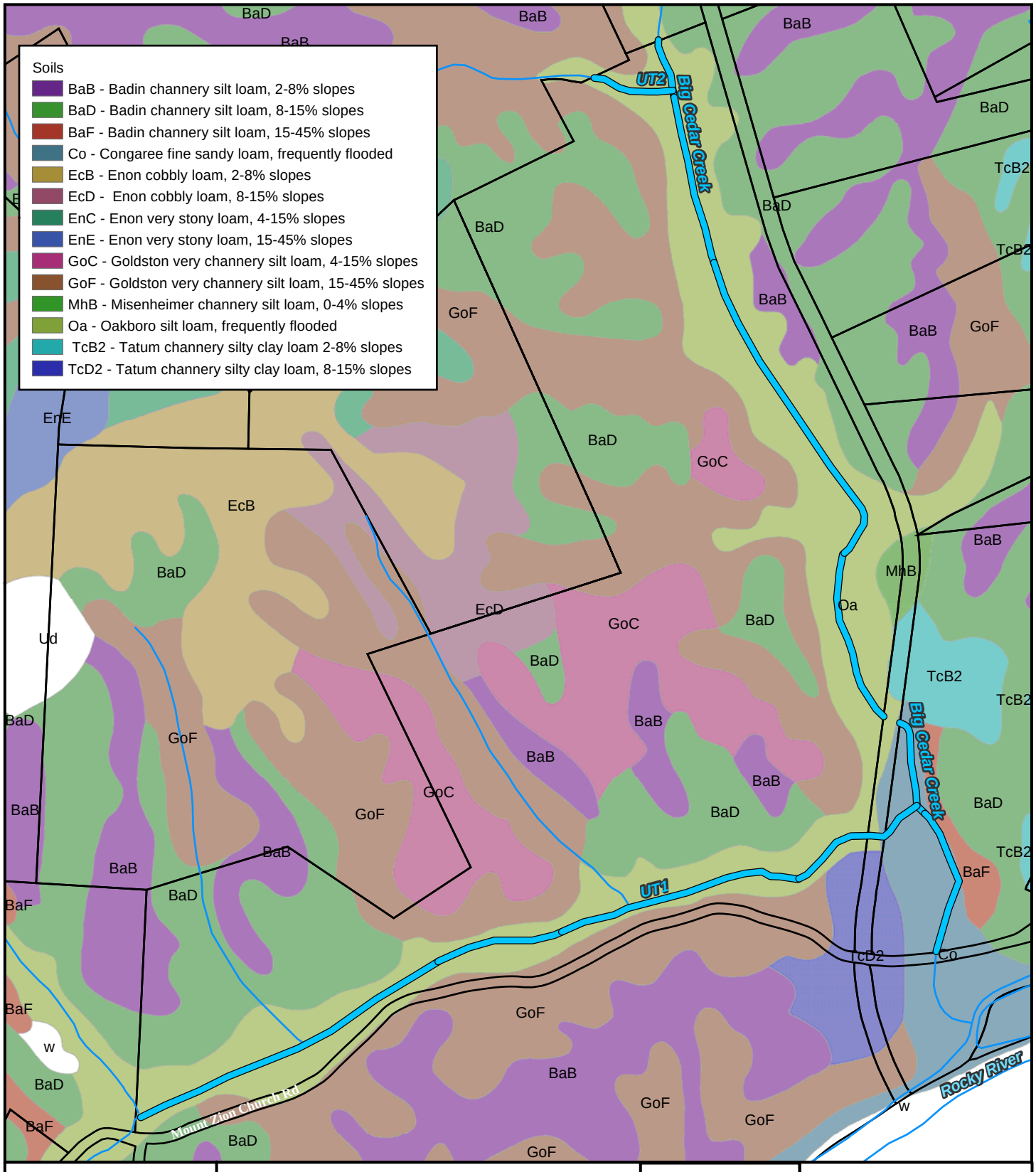
Watershed Boundary | Project Reaches | Streams

EEP Project No.: D06054-D

0 0.25 0.5 Miles

Ecosystem Enhancement PROGRAM

Baker



Ecosystem Enhancement Program

LEGEND

Project Reaches — Streams — Parcels

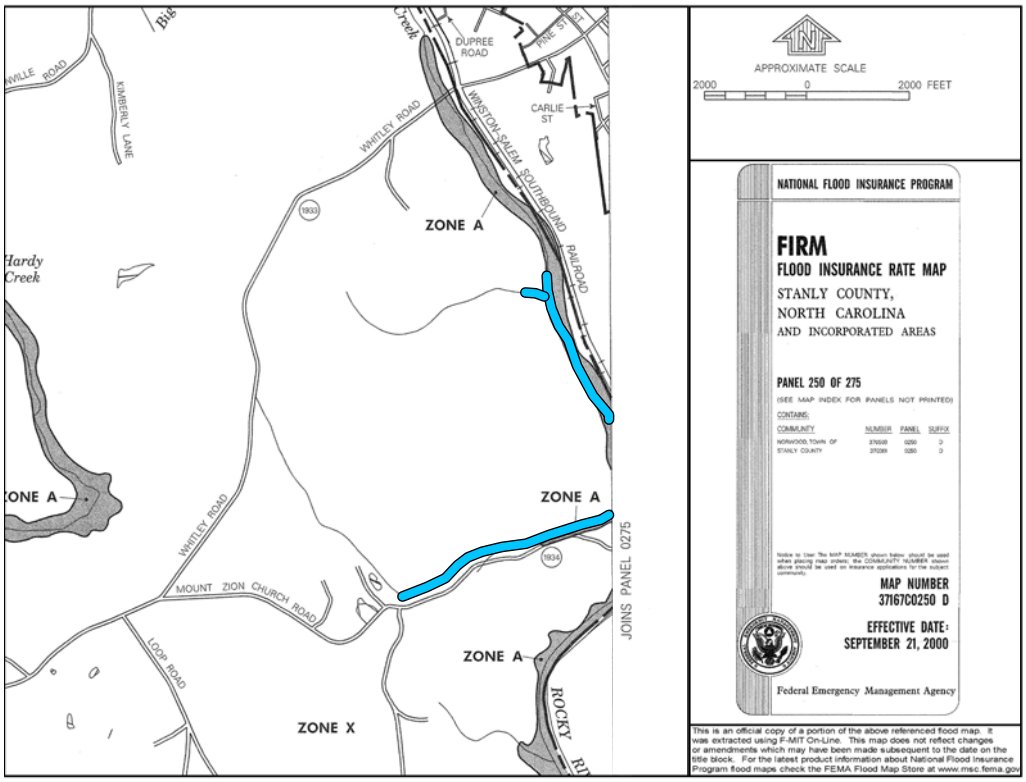
September 2007

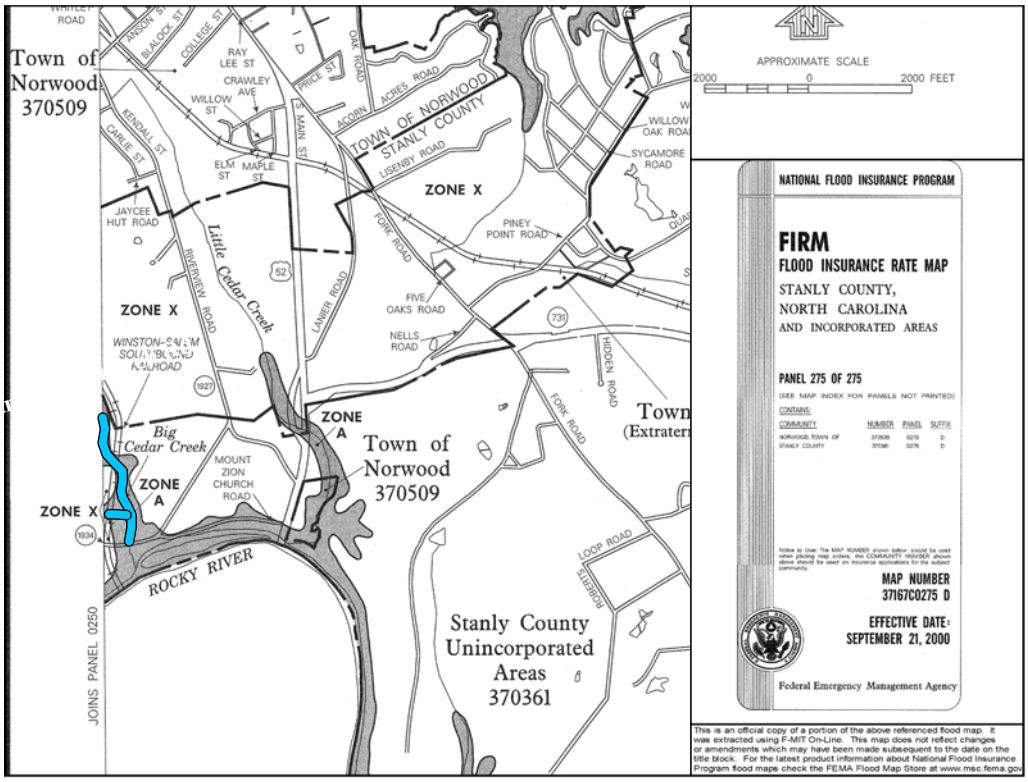
Figure 2.1: Soils Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

EEP Project No.: D06054-D

0 400 800 Feet

Baker





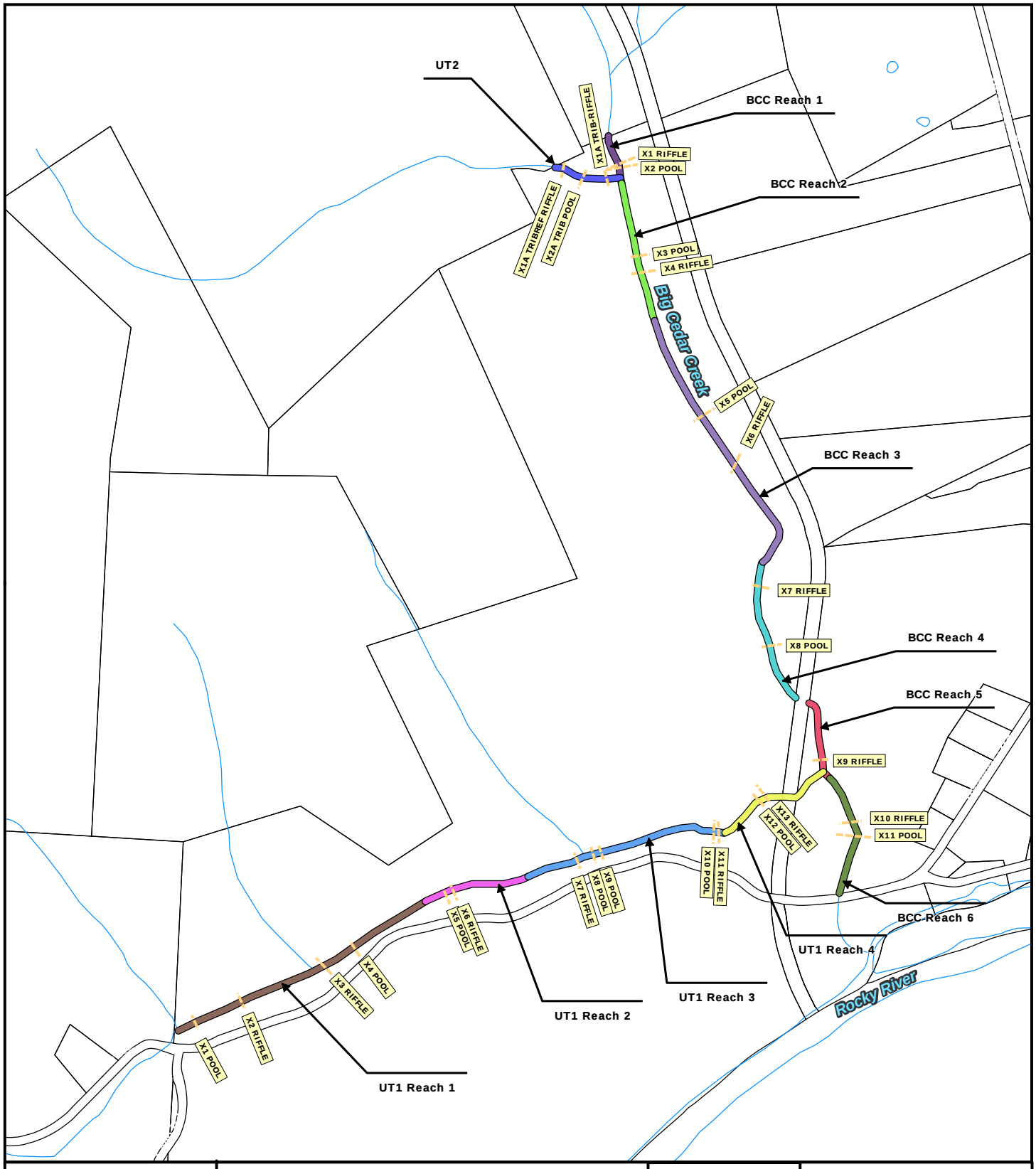
LEGEND

Project Reaches

September 2007

Figure 2.2: FEMA Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

EEP Project No.: D06054-D



LEGEND

Project Reaches

- BCC Reach 1
- BCC Reach 2
- BCC Reach 3
- BCC Reach 4
- BCC Reach 5
- BCC Reach 6
- UT1 Reach 1
- UT1 Reach 2
- UT1 Reach 3
- UT1 Reach 4
- UT2

Streams

Parcels

0 400 800 Feet

EEP Project No.: D06054-D

September 2007

Figure 3.1: Existing Conditions Project Reaches and Surveyed Cross-Section Locations Big Cedar Creek Stream Restoration Project Stanly County, NC

Ecosystem Enhancement Program

Baker

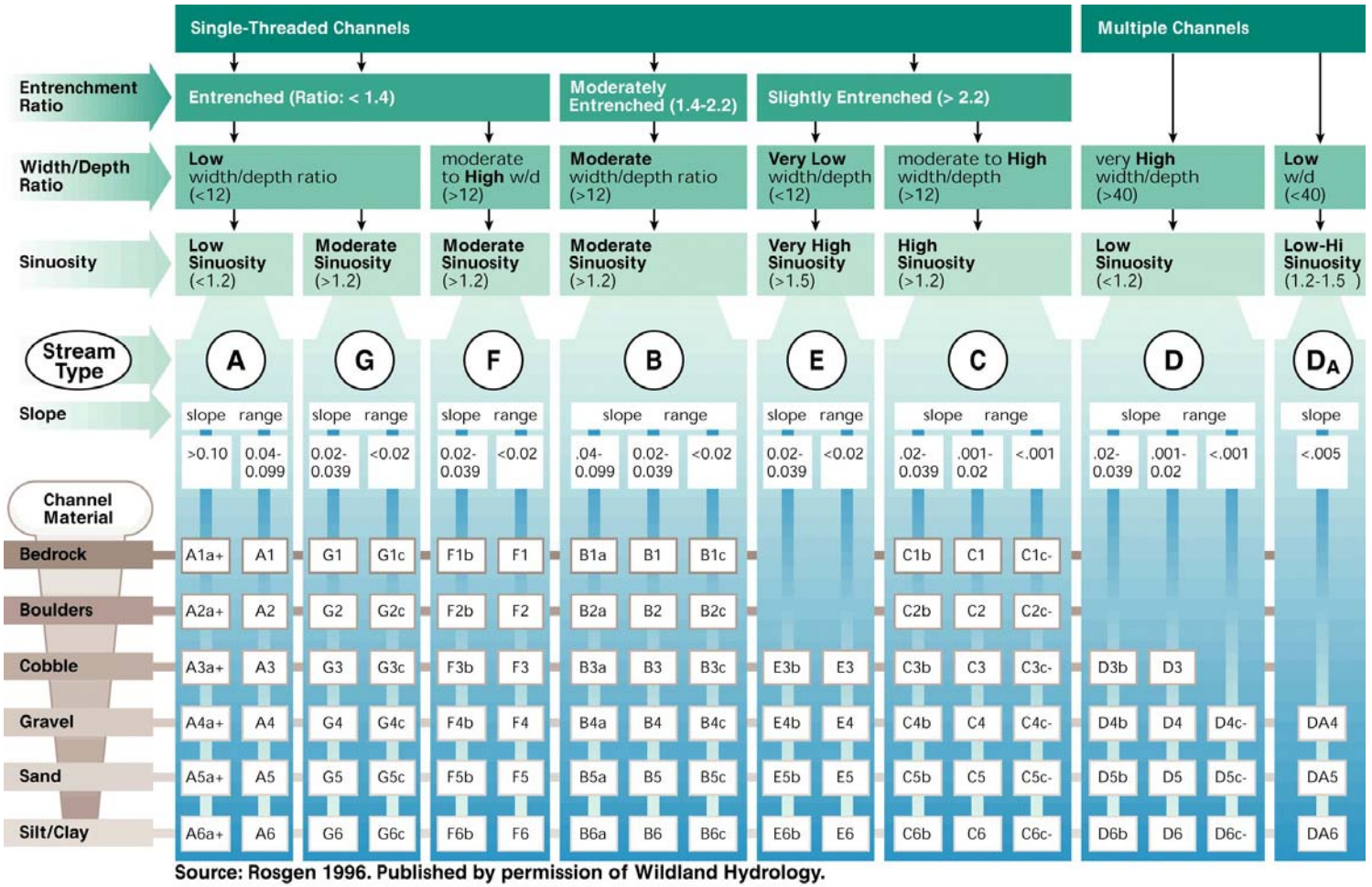
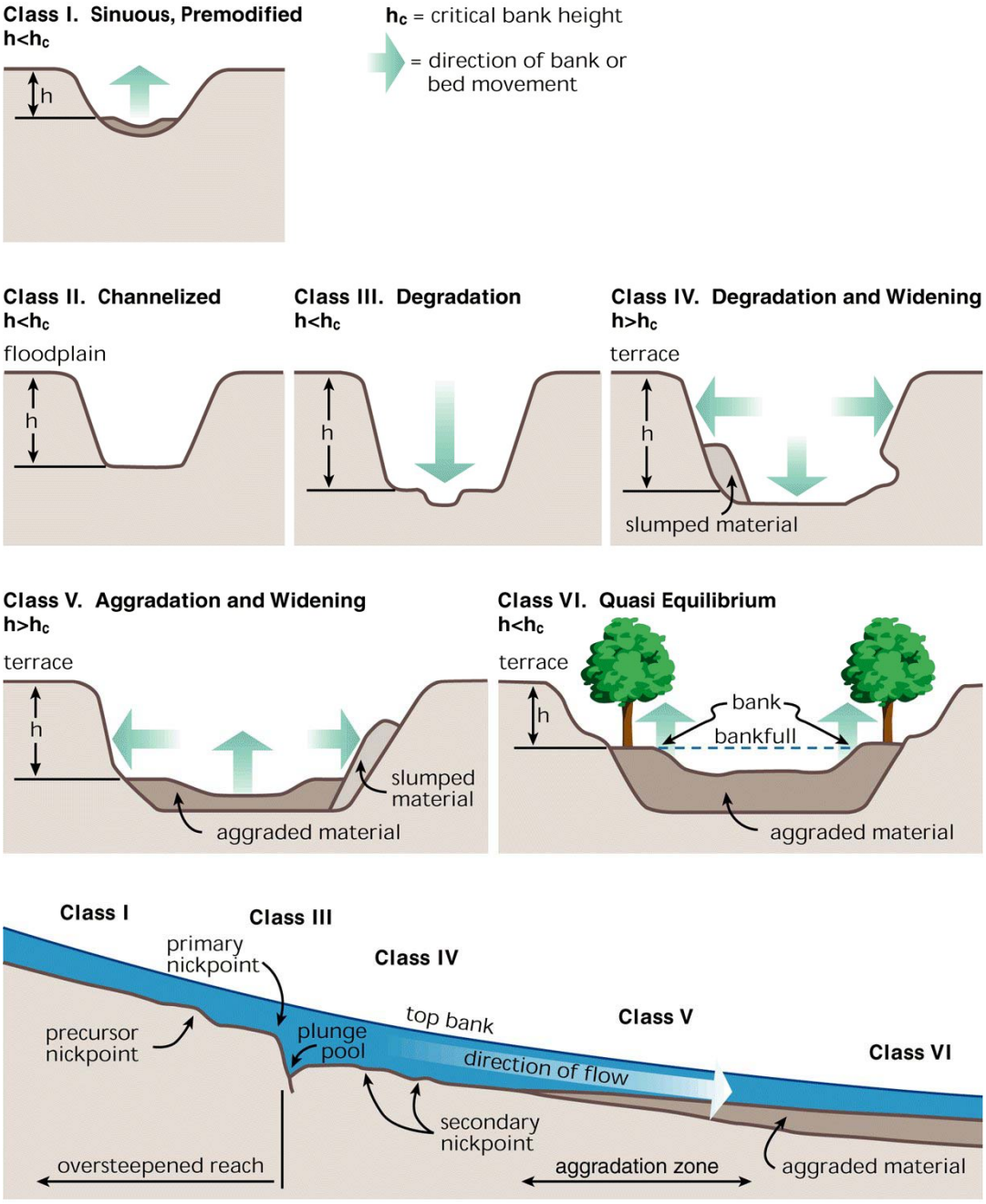


Fig. 7.12 -- Rosgen's stream classification system (Level II).
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

Figure 3.2 Rosgen Stream Classification
Big Cedar Creek
Stream Restoration Project
Stanly County, NC
September 2007
EEP Project # D06054-D

Source: Rosgen, David L., *Applied River Morphology*, Wildland Hydrology, 1996



Source: Simon, 1989; US Army Corps of Engineers, 1990.
Fig. 7.14 -- Channel evolution model..
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

Figure 3.3 Simon Channel Evolution Model
Big Cedar Creek Stream Restoration Project
Stanly County
September 2007
EEP Project # D06054-D

Source: Simon, 1989

Figure 3.4 North Carolina Piedmont Regional Curve
Big Cedar Creek, UT1 & UT2 - Existing Conditions Riffle Areas

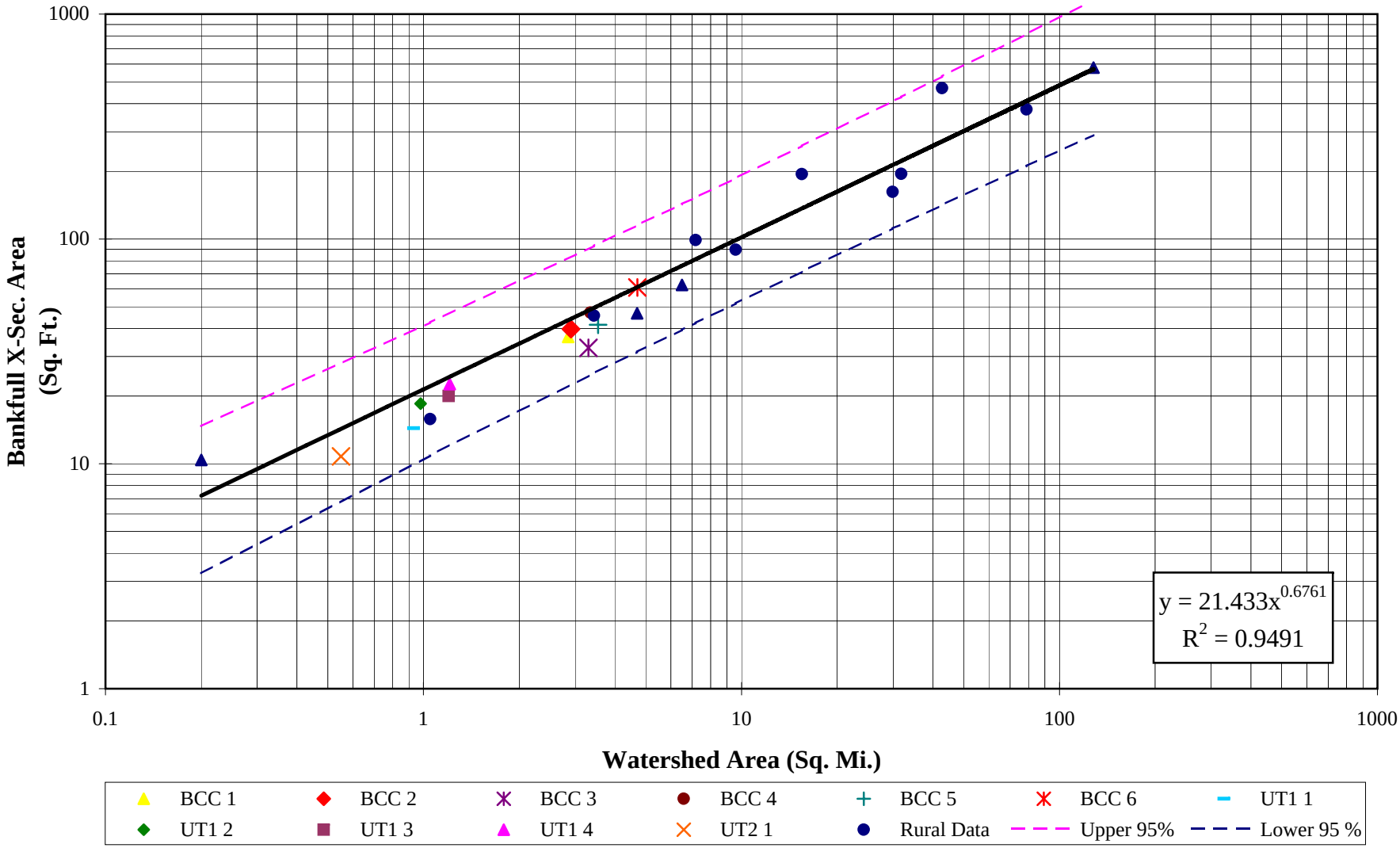
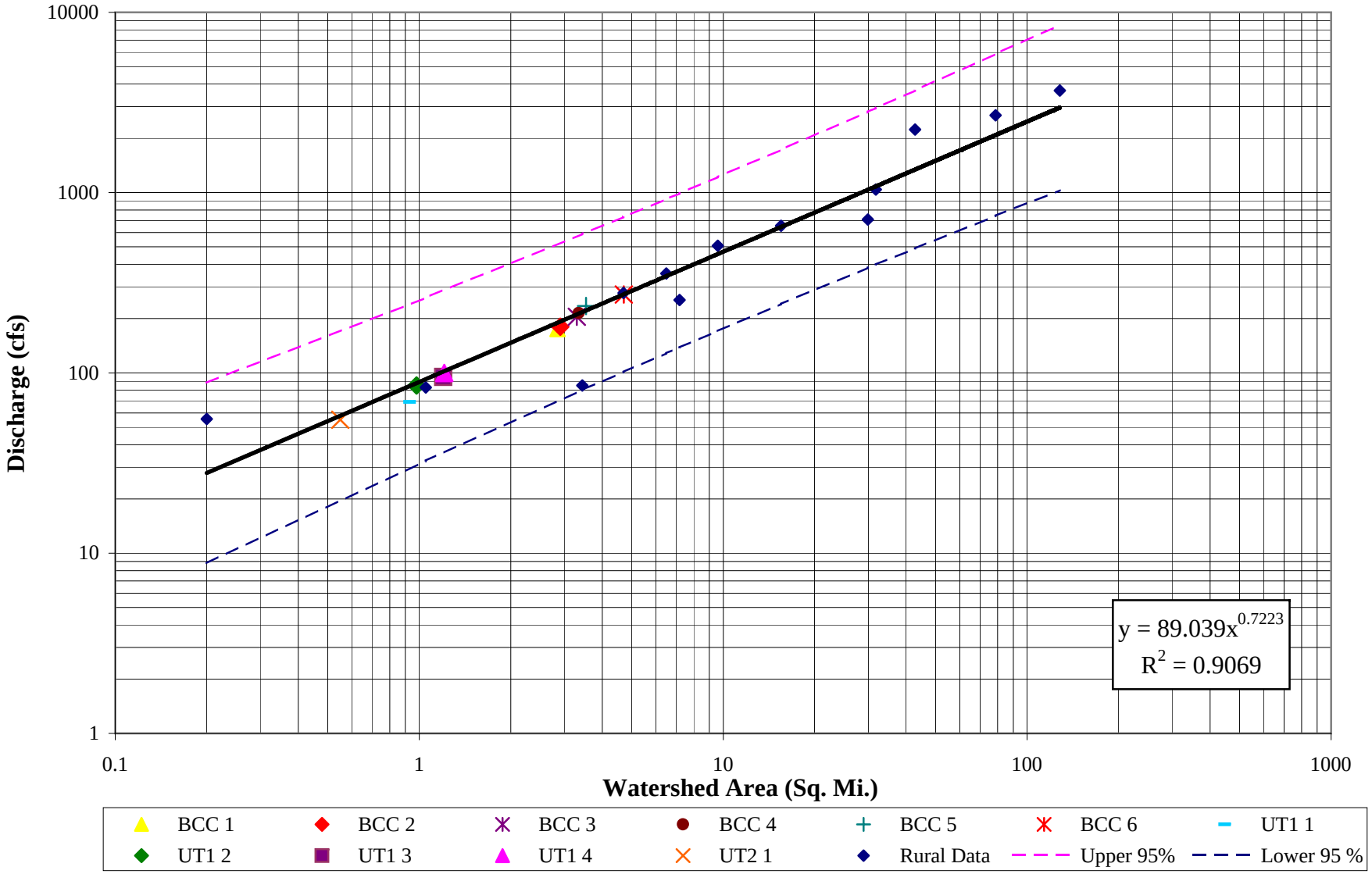
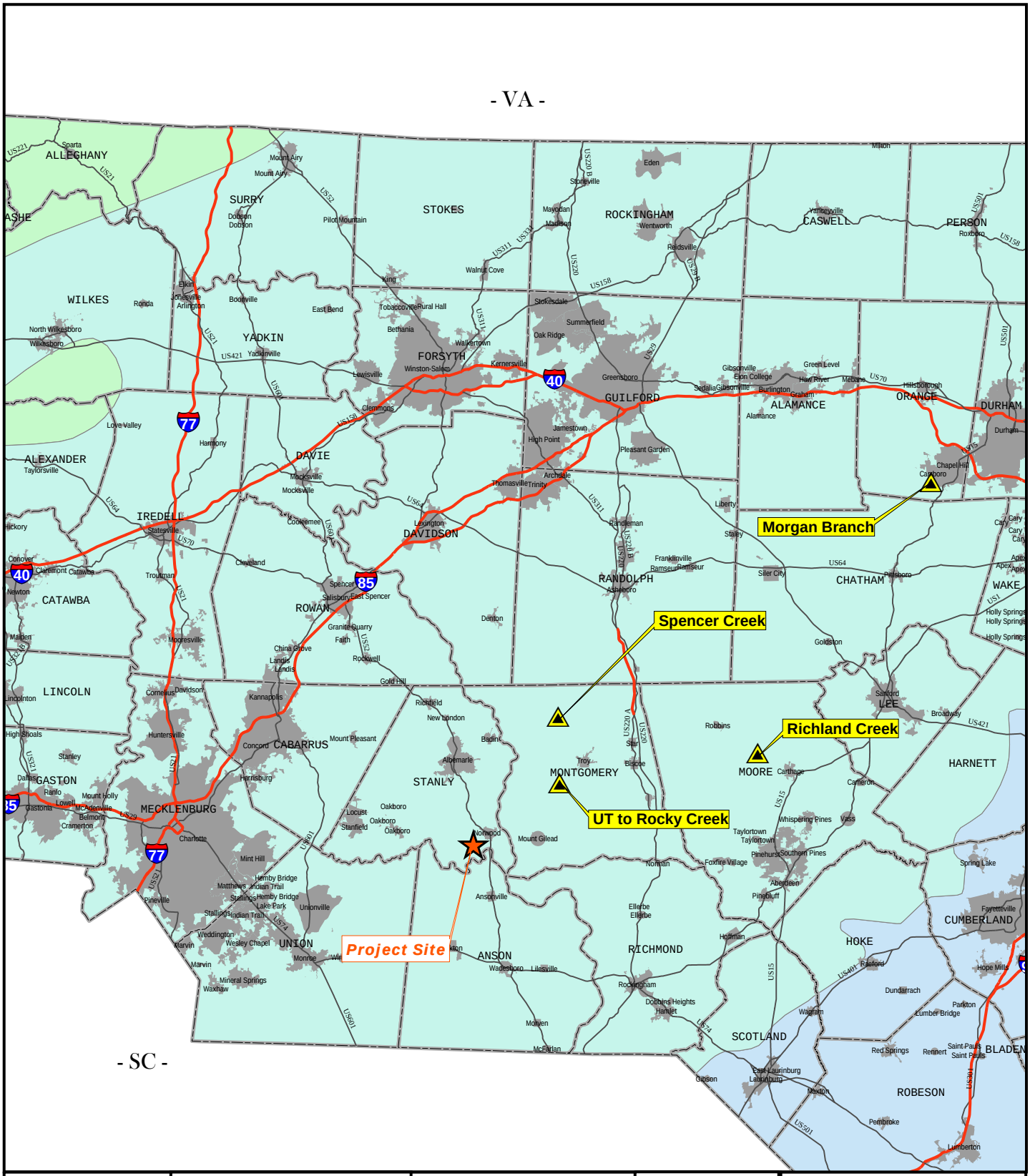


Figure 3.5 North Carolina Piedmont Regional Curve
Big Cedar Creek, UT1 & UT2 - Discharge





Map Inset

North Carolina

EEP Project No.: D06054-D

LEGEND

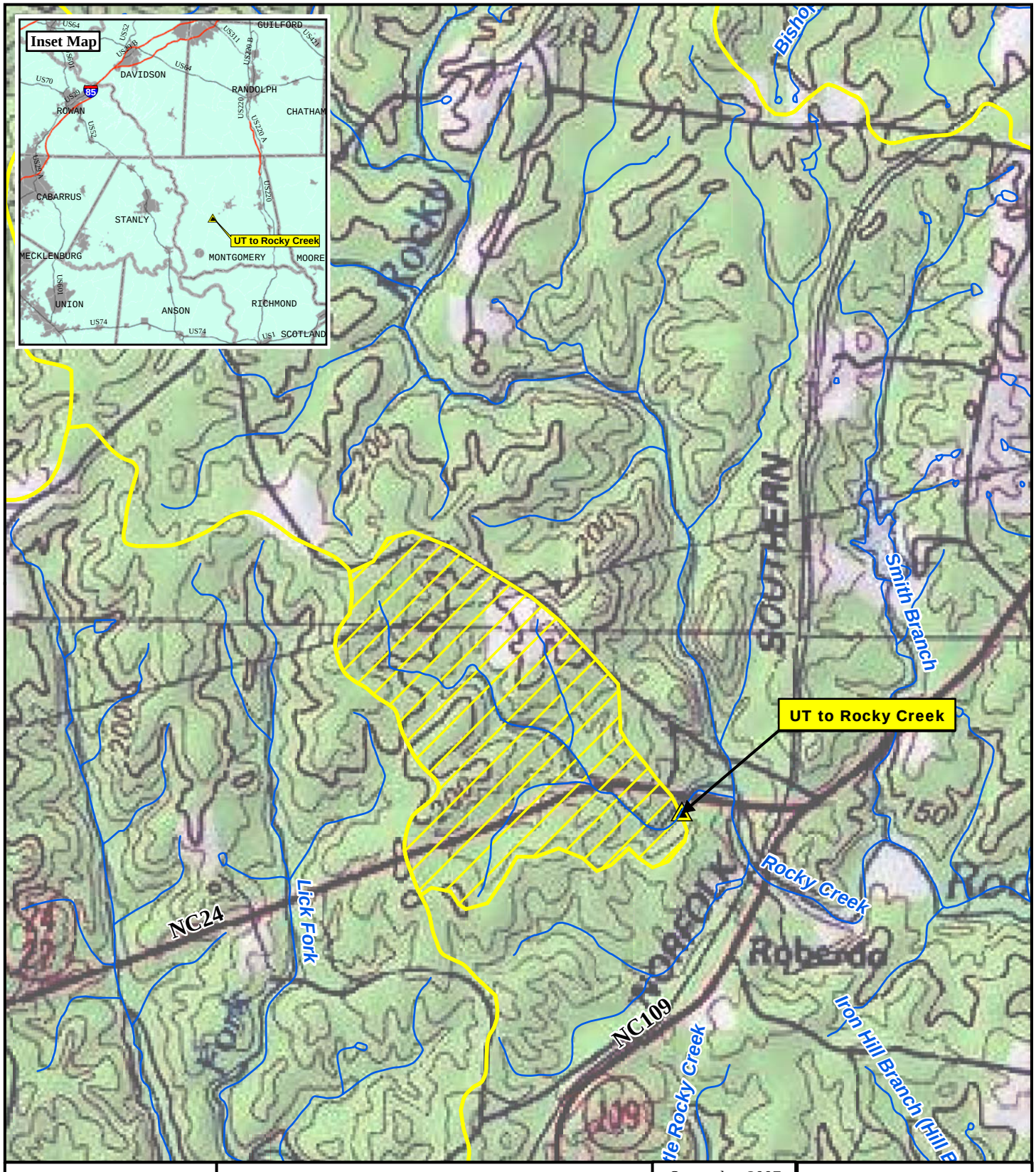
- Reference Reach Sites
- Counties

Physiographic Province
- Mountain
- Piedmont
- Coastal Plain

10 5 0 10 Miles

September 2007

Figure 4.1: Reference Reach Locations
Big Cedar Creek
Stream Restoration Project
Stanly County, NC



LEGEND

Reference Reach Watershed

HUC Watersheds

Streams

0 0.25 0.5 Miles

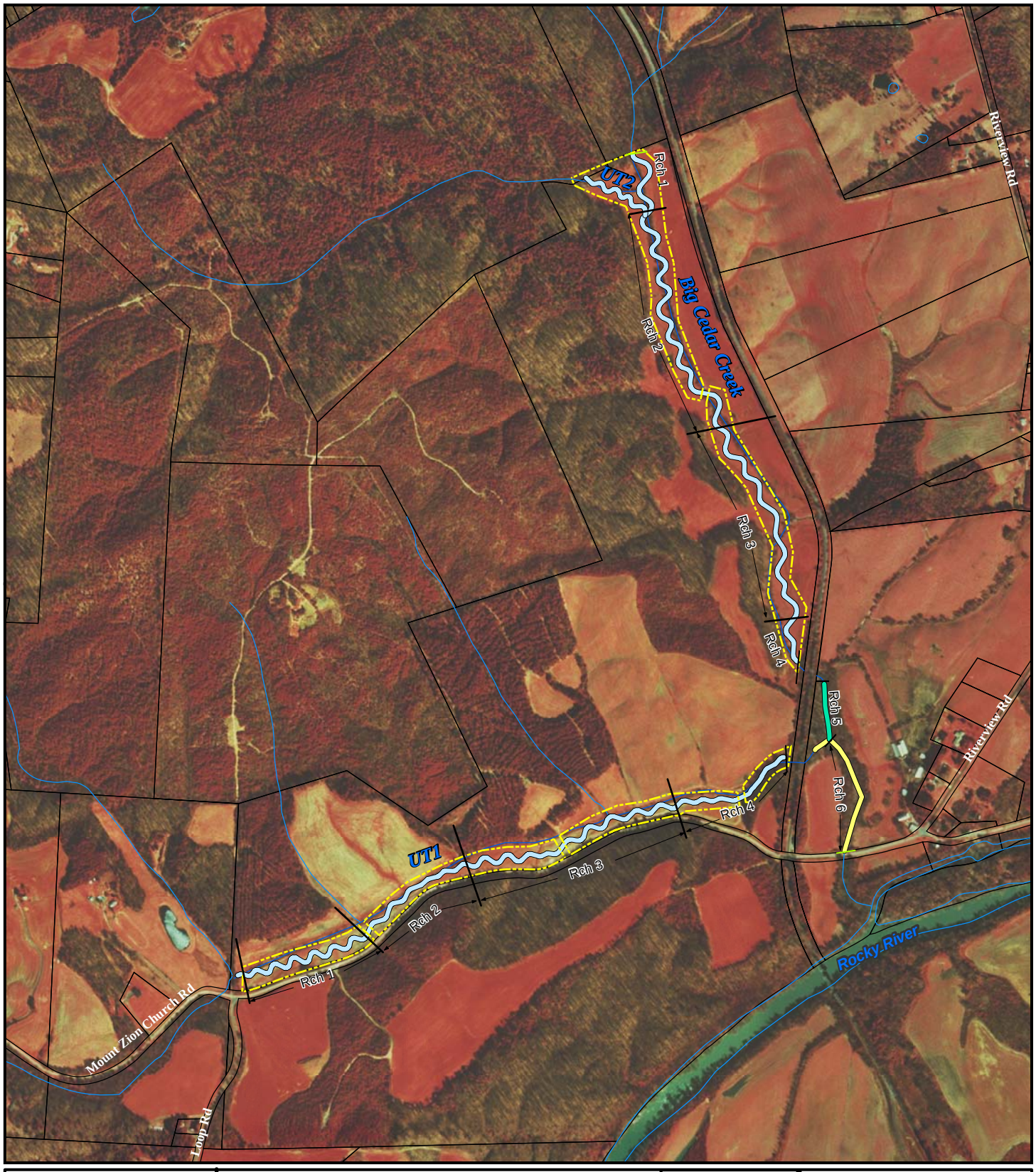
September 2007

Figure 4.2: Reference Site Watershed Map
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

Ecosystem Enhancement Program

Baker

EEP Project No.: D06054-D



Ecosystem Enhancement PROGRAM

September 2007

LEGEND

- Preservation
- Enhancement
- Restoration
- Existing Stream Alignment
- Streams
- Parcels
- Conservation Easement
- Reach Breaks

0 400 800 Feet

EEP Project No. : D06054-D

Figure 6.1: Proposed Stream Restoration Design
Big Cedar Creek
Stream Restoration Project
Stanly County, NC

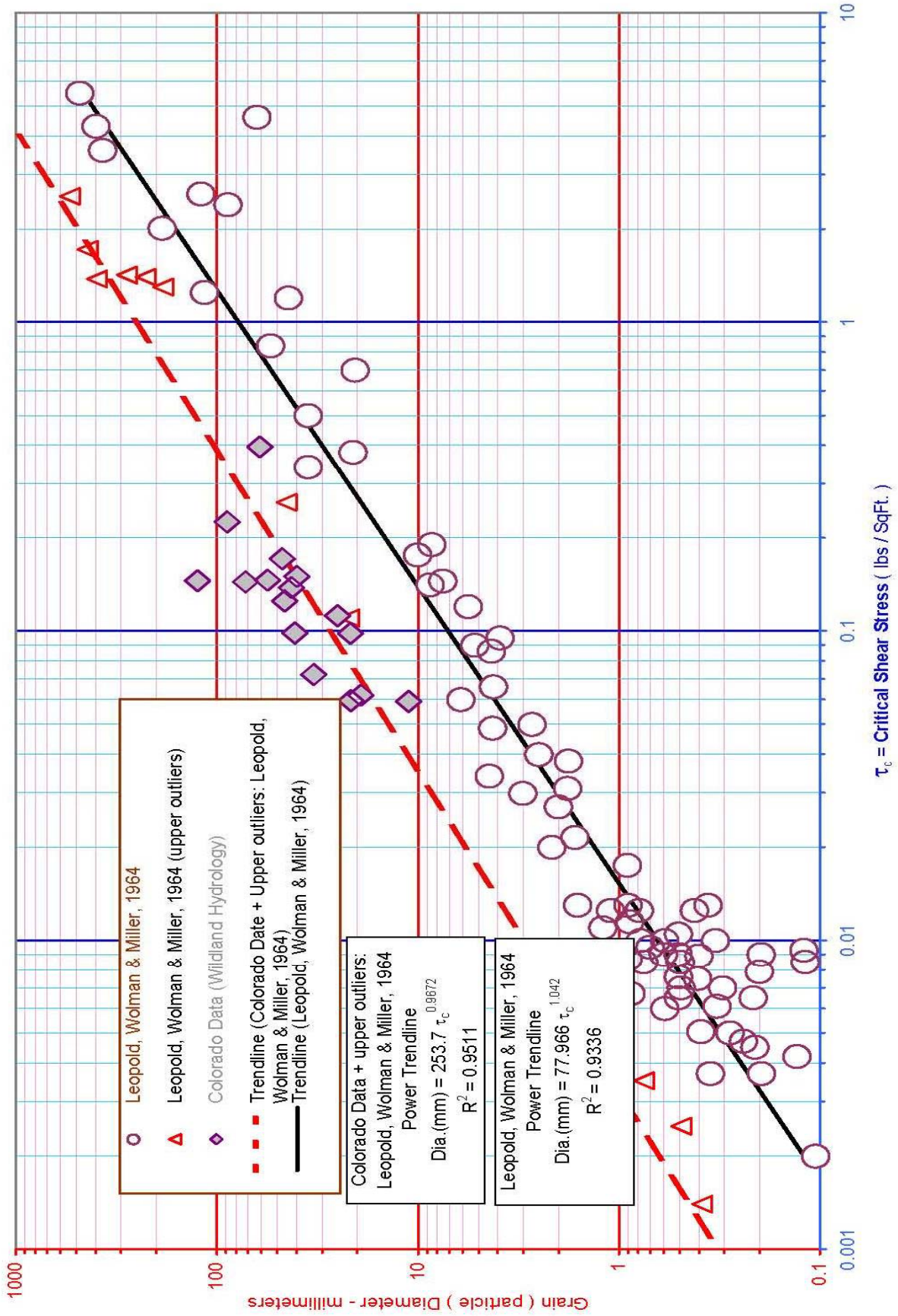


Figure 6.2
Shield's Curve Modified with Colorado Data
Big Cedar Creek Stream Restoration Plan
EEP Project D06054-D
September, 2007
Stanly County, NC

Appendix A
Regulatory Agency Correspondence

Baker

Buck Engineering
A Unit of Michael Baker

1447 S. Tryon St.
Charlotte, NC 28203

704-334-4454
FAX 704-334-4492

August 29, 2006

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

Subject: North Carolina Ecosystem Enhancement Program,
Big Cedar Creek Stream Restoration Project,
Stanly County, NC

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 on the attached site (a vicinity map, a USGS map of potential ground disturbance areas, and a soils map are enclosed).

The Big Cedar Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. The project will include one reach of Big Cedar Creek and two unnamed tributaries, UT1 and UT2, all of which have sections of channel that are identified as significantly degraded. No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. In addition, the majority of the site has historically been disturbed due to agricultural purposes such as straightening, tilling, and cattle grazing.

We ask that you review this site based on the attached information to determine the presence of historic properties. 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 the site disturbance associated with this project.

Sincerely,

Andrea Spangler
Buck Engineering
A Unit of Michael Baker
aspangler@mbakercorp.com
704-319-7884

Buck Engineering
A Unit of Michael Baker

1447 S. Tryon St.
Charlotte, NC 28203

704-334-4454
FAX 704-334-4492

September 15, 2006

Marella Buncick
US Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Street
Asheville, NC 28801

Subject: North Carolina Ecosystem Enhancement Program (NCEEP),
Big Cedar Creek Stream Restoration Project,
Stanly County, NC

Dear Ms. Buncick:

The purpose of this letter is to provide additional information to your office on the potential effects to threatened and endangered species from the NCEEP Big Cedar Creek Stream Restoration Project in Stanly County for your review and comment.

We have obtained an updated species list for Stanly County from your web site (http://nc-es.fws.gov/es/countyfr.html). The threatened and endangered species listed for Stanly County are: the Bald eagle (*Haliaeetus leucocephalus*) and Schweinitz's sunflower (*Helianthus schweinitzii*).

Since the project involves primarily degraded streams and wooded areas, federally protected species are not expected to be impacted by the proposed project. Suitable habitat does not exist for the bald eagle since the project site is more than 0.5 miles from open water, the preferred nesting distance of the bald eagle. Suitable habitat does exist for Schweinitz's sunflower in woodland openings and adjacent agricultural land. A pedestrian survey of the project area was conducted on September 14, 2006 during blooming season. Schweinitz's sunflower was not observed in or adjacent to the project area during the field survey; therefore, it is anticipated that project construction will have "no effect" on these two species.

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 stream restoration project on the subject property. A vicinity map showing the project location 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 biological conclusions are 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.

Your correspondence will be forwarded to NCEEP for consideration. 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 this stream restoration project.

Sincerely,

Eric Mularski
Buck Engineering
A Unit of Michael Baker

Baker

Buck Engineering
A Unit of Michael Baker

1447 S. Tryon St.
Charlotte, NC 28203

704-334-4454
FAX 704-334-4492

August 29, 2006

Ms. Renessa Brown
District Conservationist
26032-C Newt Road
Albemarle, NC 28001

Subject: North Carolina Ecosystem Enhancement Program,
Big Cedar Creek Stream Restoration Project,
Stanly County, NC

Dear Ms. Brown:

The purposed 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, vicinity map, USGS topographic map, and soils map of the project site. For this stream restoration project, ground disturbing activities are indicated by the areas bounded in red on the enclosed maps. These areas include 22.3 acres of Oakboro silt loam, 0.9 acres of Congaree fine sandy loam, and 0.1 acre of Badin channery silt loam with 15-45% slopes. Based on our evaluation, we estimate that 23.2 acres of Prime Farmland will be converted to nonagricultural use by this action.

We know that you have more familiarity with the region 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 remainder of the form. Our Fax number is (704) 334-4492.

If you have any questions, please feel free to contact me at (704) 319-7884 or aspangler@mbakercorp.com. Thank you for your assistance in this matter.

Sincerely,

Andrea Spangler
Buck Engineering
A Unit of Michael Baker

Baker

Buck Engineering
A Unit of Michael Baker

1447 S. Tryon St.
Charlotte, NC 28203

704-334-4454
FAX 704-334-4492

September 7, 2006

Mr. Alan Walters
District Conservationist
530 West Innes Street
Salisbury, NC 28144

Subject: Prime and Important Farmlands
North Carolina Ecosystem Enhancement Program,
Big Cedar Creek Stream Restoration Project,
Stanly County, NC

Dear Mr. Walters:

Thank you for your assistance in completing a Farmland Conversion Impact Rating form for the subject site. Enclosed please find a copy of the completed form.

We know that you have more familiarity with the site, so we will be happy to make any changes to the form that you deem appropriate. Please return the form to us if changes are needed. Our Fax number is (704) 334-4492. Otherwise we will send a copy of the completed form to NCEEP as part of the categorical exclusion document.

If you have any questions, please feel free to contact me at (704) 319-7884 or aspangler@mbakercorp.com. Thank you for your assistance in this matter.

Sincerely,

Andrea Spangler
Buck Engineering
A Unit of Michael Baker

RECEIVED SEP - 8 2006

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/29/06
Name Of Project Big Cedar Creek	Federal Agency Involved FHWA/EEP
Proposed Land Use Stream Restoration	County And State Stanly County, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 9/5/2006

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 [X] No [ ]

Acres Irrigate: 0 | Average Farm Size: 150.7 acres

Major Crop(s): CORN | Farmable Land In Govt. Jurisdiction Acres: 198232 % 76.5 | Amount Of Farmland As Defined in FPPA Acres: 162996 % 55.0

Name Of Land Evaluation System Used: STANLY CO LE | Name Of Local Site Assessment System: NONE | Date Land Evaluation Returned By NRCS: 9/7/2006

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	23.3			
B. Total Acres To Be Converted Indirectly	0.0			
C. Total Acres In Site	23.3	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	23.2			
B. Total Acres Statewide And Local Important Farmland	0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.014			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	62.9			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	67	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		15			
2. Perimeter In Nonurban Use		10			
3. Percent Of Site Being Farmed		7			
4. Protection Provided By State And Local Government		20			
5. Distance From Urban Builtup Area		15			
6. Distance To Urban Support Services		10			
7. Size Of Present Farm Unit Compared To Average		6			
8. Creation Of Nonfarmable Farmland		0			
9. Availability Of Farm Support Services		3			
10. On-Farm Investments		0			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		0			
TOTAL SITE ASSESSMENT POINTS	160	70	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	67	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	70	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	137	0	0	0

Site Selected: | Date Of Selection 9/7/06 | Was A Local Site Assessment Used? Yes [ ] No [X]

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

Buck Engineering
A Unit of Michael Baker

1447 S. Tryon St.
Charlotte, NC 28203

704-334-4454
FAX 704-334-4492

September 15, 2006

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

Subject: North Carolina Ecosystem Enhancement Program (NCEEP)
Big Cedar Creek Stream Restoration Project
Stanly 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 the fish and wildlife associated with the Big Cedar Creek Stream Restoration Project, located in Stanly County (a USGS site map with approximate areas of potential ground disturbance is enclosed).

The Big Cedar Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of the channel have been identified as significantly degraded. This stream restoration site was selected based on its probability to restore high quality stream habitat where it has ceased to exist. The conceptual plan for this project calls for the restoration of these channels to a stable condition. This process will involve the restoration of natural channel dimension, pattern and profile and the reestablishment of forested riparian buffers within the project area.

A threatened and endangered species survey was conducted on September 14, 2006 for the two federally protected species listed for Stanly County: bald eagle (*Haliaeetus leucocephalus*) and Schweinitz's sunflower (*Helianthus schweinitzii*). Suitable habitat does not exist for the bald eagle since the project site is more than 0.5 miles from open water, the preferred nesting distance of the bald eagle. Suitable habitat does exist for Schweinitz's sunflower but no species were observed in or adjacent to the project area during the field survey; therefore, it is anticipated that these species will not be impacted by the proposed project.

We have enclosed a copy of the vicinity map and USGS topographic map that includes the proposed stream restoration project site. We ask that you review this information to determine the presence of any constraints concerning protected species. Your correspondence will be forwarded to the North Carolina Ecosystem Enhancement Program for consideration.

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 this stream restoration project (704-319-7889).

Sincerely,

Eric Mularski
Buck Engineering
A Unit of Michael Baker

North Carolina Wildlife Resources Commission

Richard B. Hamilton, Executive Director

2 October 2006

Mr. Eric Mularski
Buck Engineering – A Unit of Michael Baker
1447 S. Tryon Street
Charlotte, NC 28203

Subject: Big Cedar Creek Stream Restoration Project, Stanly County, North Carolina.

Dear Mr. Mularski:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject document. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and North Carolina General Statutes (G.S. 113-131 et seq.).

The North Carolina Ecosystem Enhancement Program has identified a stream restoration site along Big Cedar Creek in the Yadkin-Pee Dee River basin. Several sections of channel have been identified as significantly degraded. The stream will be restored to natural channel dimension, pattern and profile and forested riparian buffers will be re-established.

There are records for the state threatened Roanoke slabshell (*Elliptio roanokensis*) downstream in Rocky River. We recommend you consult with the U.S. Fish and Wildlife Service regarding potential impacts to Schweinitz's sunflower (*Helianthus schweinitzii*).

Stream and wetland restoration projects often improve water quality and aquatic habitat. Provided measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this project. If you require further assistance, please contact our office at (336) 449-7625.

Sincerely,

Shari L. Bryant

Shari L. Bryant
Piedmont 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

Appendix B
EDR Transaction Screen Map Report

The EDR Radius Map
with GeoCheck®

Big Cedar Creek Stream Restoration
Stanley County
Norwood, NC 28128

Inquiry Number: 01735681.1r

August 15, 2006

The Standard in Environmental Risk Management 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

TABLE OF CONTENTS

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

STANLEY COUNTY
NORWOOD, NC 28128

COORDINATES

Latitude (North):	35.198900 - 35° 11' 56.0''
Longitude (West):	80.130300 - 80° 7' 49.1''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	579171.9
UTM Y (Meters):	3895249.0
Elevation:	334 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	35080-B2 AQUADALE, NC
Most Recent Revision:	2002
East Map:	35080-B1 MOUNT GILEAD WEST, NC
Most Recent Revision:	2002

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 RECOVERY ---------- Federal Superfund Liens
CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

EXECUTIVE SUMMARY

CORRACTS Corrective Action Report
RCRA-TSDF Resource Conservation and Recovery Act Information
RCRA-LQG Resource Conservation and Recovery Act Information
RCRA-SQG Resource Conservation and Recovery Act Information
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
ICIS Integrated Compliance Information System
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
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
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
EDR Historical Auto Stations EDR Proprietary Historic Gas Stations
EDR Historical Cleaners EDR Proprietary Historic Dry Cleaners

EXECUTIVE SUMMARY

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

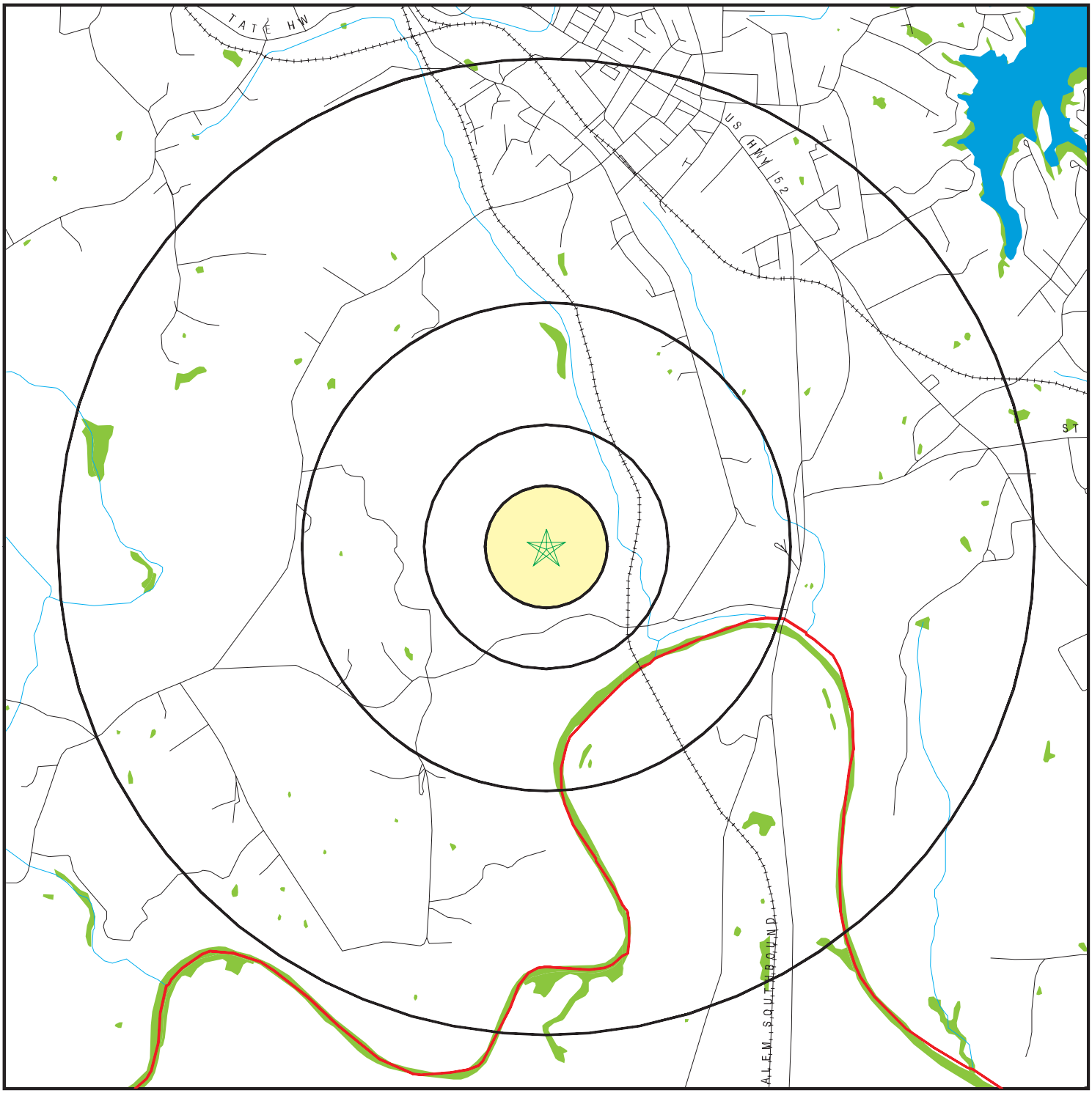
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

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

Site Name	Database(s)
ANSON COUNTY SCHOOL DISTRICT	FTTS
CAROLINA SOLITE CORP/AQUADALE	CERC-NFRAP
MCCOY OIL COMPANY	LUST, LUST TRUST, IMD
CORNER STORE #3 (WILDERS C-STO	LUST, IMD
CORNER STORE #3 (WILDERS C-STORE)	LUST TRUST
AEROQUIP-NORWOOD PLANT	UST
REMBERT HARGROVE BLALOCK	UST
KAISER AGRICULTURAL CHEMICAL	UST
STANLY FIXTURES CO.. INC.	UST
FAST SHOP OF BURNSVILLE	UST
POOLES GROCERY	UST
JC'S KWIK STOP	UST
R.P. ALLEN STORE	UST
RAYFIELD MEAT CENTER	UST
RED STAR SERVICE STATION	UST
JACKSON'S GROCERY	UST
MARTIN BROTHERS CO.	UST
SAMUEL DURHAM SESSIONS	UST
COMMUNITY GROCERY	UST
ALLTEL CAROLINA-(SERVICE CENT	UST
JIMMYS SUPERETTE	UST
HORNWOOD INC. (KENVILLE PLANT)	AST
NORWOOD DUMP	OLI
WADESBORO LANDFILL	OLI
NORWOOD WWTP	NPDES

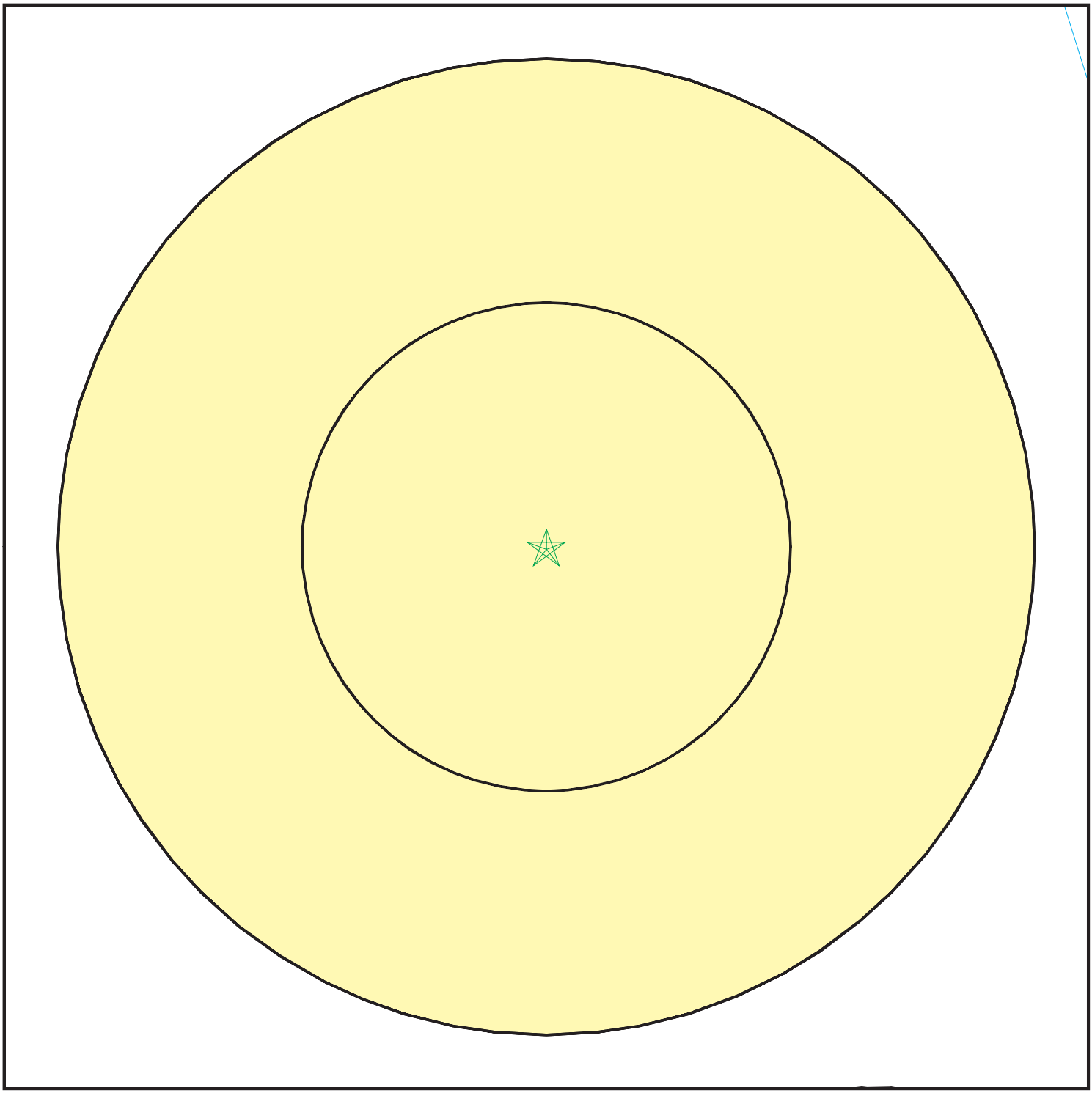
OVERVIEW MAP - 01735681.1r



- 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
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

SITE NAME: Big Cedar Creek Stream Restoration	CLIENT: Buck Engineering
ADDRESS: Stanley County Norwood NC 28128	CONTACT: Andrea Spangler
LAT/LONG: 35.1989 / 80.1303	INQUIRY #: 01735681.1r DATE: August 15, 2006

DETAIL MAP - 01735681.1r



- 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
- Landfill 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: Big Cedar Creek Stream Restoration	CLIENT: Buck Engineering
ADDRESS: Stanley County Norwood NC 28128	CONTACT: Andrea Spangler
LAT/LONG: 35.1989 / 80.1303	INQUIRY #: 01735681.1r DATE: August 15, 2006

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		1.750	0	0	0	0	0	0
Proposed NPL		1.750	0	0	0	0	0	0
Delisted NPL		1.750	0	0	0	0	0	0
NPL RECOVERY		0.750	0	0	0	0	NR	0
CERCLIS		1.250	0	0	0	0	0	0
CERC-NFRAP		1.250	0	0	0	0	0	0
CORRACTS		1.750	0	0	0	0	0	0
RCRA TSD		1.250	0	0	0	0	0	0
RCRA Lg. Quan. Gen.		1.000	0	0	0	0	NR	0
RCRA Sm. Quan. Gen.		1.000	0	0	0	0	NR	0
ERNS		0.750	0	0	0	0	NR	0
HMIRS		0.750	0	0	0	0	NR	0
US ENG CONTROLS		1.250	0	0	0	0	0	0
US INST CONTROL		1.250	0	0	0	0	0	0
DOD		1.750	0	0	0	0	0	0
FUDS		1.750	0	0	0	0	0	0
US BROWNFIELDS		1.250	0	0	0	0	0	0
CONSENT		1.750	0	0	0	0	0	0
ROD		1.750	0	0	0	0	0	0
UMTRA		1.250	0	0	0	0	0	0
ODI		1.250	0	0	0	0	0	0
TRIS		0.750	0	0	0	0	NR	0
TSCA		0.750	0	0	0	0	NR	0
FTTS		0.750	0	0	0	0	NR	0
SSTS		0.750	0	0	0	0	NR	0
ICIS		0.750	0	0	0	0	NR	0
PADS		0.750	0	0	0	0	NR	0
MLTS		0.750	0	0	0	0	NR	0
MINES		1.000	0	0	0	0	NR	0
FINDS		0.750	0	0	0	0	NR	0
RAATS		0.750	0	0	0	0	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.750	0	0	0	0	0	0
NC HSDS		1.750	0	0	0	0	0	0
IMD		1.250	0	0	0	0	0	0
State Landfill		1.250	0	0	0	0	0	0
OLI		1.250	0	0	0	0	0	0
LUST		1.250	0	0	0	0	0	0
LUST TRUST		1.250	0	0	0	0	0	0
UST		1.000	0	0	0	0	NR	0
AST		1.000	0	0	0	0	NR	0
INST CONTROL		1.250	0	0	0	0	0	0
VCP		1.250	0	0	0	0	0	0
DRYCLEANERS		1.000	0	0	0	0	NR	0
BROWNFIELDS		1.250	0	0	0	0	0	0
NPDES		0.750	0	0	0	0	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
TRIBAL RECORDS								
INDIAN RESERV		1.750	0	0	0	0	0	0
INDIAN LUST		1.250	0	0	0	0	0	0
INDIAN UST		1.000	0	0	0	0	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.750	0	0	0	0	0	0
EDR Historical Auto Stations		1.000	0	0	0	0	NR	0
EDR Historical Cleaners		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		

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
NORWOOD	U001206927	AEROQUIP-NORWOOD PLANT	HWY #52 SOUTH	28128	UST
NORWOOD	U003143678	REMBERT HARGROVE BLALOCK	ROUTE 1	28128	UST
NORWOOD	S101523265	MCCOY OIL COMPANY	HWY 138	28128	LUST, LUST TRUST, IMD
NORWOOD	1003868329	CAROLINA SOLITE CORP/AQUADALE	RTE 2	28128	CERC-NFRAP
NORWOOD	U001191609	KAISER AGRICULTURAL CHEMICAL	ROUTE 2, BOX 227	28128	UST
NORWOOD	S105486000	NORWOOD DUMP	HWY 52, 2 MI S OF TOWN		OLI
NORWOOD	S105764473	CORNER STORE #3 (WILDERS C-STO	HIGHWAY 52/718 N. MAIN ST		LUST, IMD
NORWOOD	S107525969	CORNER STORE #3 (WILDERS C-STORE)	HWY 52/718 N MAIN ST		LUST TRUST
NORWOOD	U001191554	STANLY FIXTURES CO.. INC.	P.O. BOX 616 - HIGHWAY 138	28128	UST
NORWOOD	S107780455	NORWOOD WWTP	6896 US HWY 52	28128	NPDES
POLKTON	U003147373	FAST SHOP OF BURNSVILLE	HWY 742	28170	UST
TROY	U001205477	POOLES GROCERY	HWY 109	28170	UST
WADAESBORO	U003369590	JC'S KWIK STOP	1100 US OLD 74 HWY WEST	28170	UST
WADESBORO	U001200731	R.P. ALLEN STORE	HIGHWAY 109 NORTH	28170	UST
WADESBORO	U003562972	RAYFIELD MEAT CENTER	4450 HWY 109 S	28170	UST
WADESBORO	U001201347	RED STAR SERVICE STATION	ROUTE 2, BOX 21-A	28170	UST
WADESBORO	U003145808	JACKSON'S GROCERY	HIGHWAY 218 NORTH	28170	UST
WADESBORO	S105485443	WADESBORO LANDFILL	HWY 52 1/2 MI N OF TOWN	28170	OLI
WADESBORO	U001200892	MARTIN BROTHERS CO.	HIGHWAY 52 SOUTH	28170	UST
WADESBORO	U001201763	SAMUEL DURHAM SESSIONS	HIGHWAY 52 NORTH	28170	UST
WADESBORO	U001205470	COMMUNITY GROCERY	HWY 52N	28170	UST
WADESBORO	U001200783	ALLTEL CAROLINA-(SERVICE CENT	HIGHWAY 742	28170	UST
WADESBORO	U003138285	JIMMYS SUPERETTE	HWY 742 SOUTH & SR 1003	28170	UST
WADESBORO	A100186558	HORNWOOD INC. (KENVILLE PLANT)	PO BOX 799 US HWY. 52 S.	28170	AST
WADESBORO	1008174788	ANSON COUNTY SCHOOL DISTRICT	SOUTH GREEN STREET, HIGHWAY 10	28170	FTTS

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

FEDERAL RECORDS

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 04/19/2006
Date Data Arrived at EDR: 05/05/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 17

Source: EPA
Telephone: N/A
Last EDR Contact: 08/02/2006
Next Scheduled EDR Contact: 10/30/2006
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

Date of Government Version: 04/19/2006
Date Data Arrived at EDR: 05/05/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 17

Source: EPA
Telephone: N/A
Last EDR Contact: 08/02/2006
Next Scheduled EDR Contact: 10/30/2006
Data Release Frequency: Quarterly

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 04/19/2006
Date Data Arrived at EDR: 05/05/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 17

Source: EPA
Telephone: N/A
Last EDR Contact: 08/02/2006
Next Scheduled EDR Contact: 10/30/2006
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

NPL RECOVERY: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 05/23/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: No Update Planned

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/01/2006
Date Data Arrived at EDR: 03/21/2006
Date Made Active in Reports: 04/13/2006
Number of Days to Update: 23

Source: EPA
Telephone: 703-413-0223
Last EDR Contact: 06/22/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Quarterly

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 02/01/2006
Date Data Arrived at EDR: 03/21/2006
Date Made Active in Reports: 04/13/2006
Number of Days to Update: 23

Source: EPA
Telephone: 703-413-0223
Last EDR Contact: 06/23/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Quarterly

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 03/15/2006
Date Data Arrived at EDR: 03/17/2006
Date Made Active in Reports: 04/13/2006
Number of Days to Update: 27

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 08/03/2006
Next Scheduled EDR Contact: 09/04/2006
Data Release Frequency: Quarterly

RCRA: Resource Conservation and Recovery Act Information

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS). The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month. Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month. Transporters are individuals or entities that move hazardous waste from the generator off-site to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 03/09/2006
Date Data Arrived at EDR: 04/27/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 33

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 06/28/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 01/12/2006
Date Made Active in Reports: 02/21/2006
Number of Days to Update: 40

Source: National Response Center, United States Coast Guard
Telephone: 202-260-2342
Last EDR Contact: 07/25/2006
Next Scheduled EDR Contact: 10/23/2006
Data Release Frequency: Annually

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 04/14/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 46

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 07/19/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Annually

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 03/21/2006
Date Data Arrived at EDR: 03/27/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 56

Source: Environmental Protection Agency
Telephone: 703-603-8905
Last EDR Contact: 07/03/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 03/21/2006
Date Data Arrived at EDR: 03/27/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 56

Source: Environmental Protection Agency
Telephone: 703-603-8905
Last EDR Contact: 07/03/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2004
Date Data Arrived at EDR: 02/08/2005
Date Made Active in Reports: 08/04/2005
Number of Days to Update: 177

Source: USGS
Telephone: 703-692-8801
Last EDR Contact: 08/11/2006
Next Scheduled EDR Contact: 11/06/2006
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/05/2005
Date Data Arrived at EDR: 01/19/2006
Date Made Active in Reports: 02/21/2006
Number of Days to Update: 33

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 07/17/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Varies

US BROWNFIELDS: A Listing of Brownfields Sites

Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: 04/26/2006
Date Data Arrived at EDR: 04/27/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 33

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 06/12/2006
Next Scheduled EDR Contact: 09/11/2006
Data Release Frequency: Semi-Annually

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 12/14/2004
Date Data Arrived at EDR: 02/15/2005
Date Made Active in Reports: 04/25/2005
Number of Days to Update: 69

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 07/24/2006
Next Scheduled EDR Contact: 10/23/2006
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 04/13/2006
Date Data Arrived at EDR: 04/28/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 32

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 07/06/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 11/04/2005
Date Data Arrived at EDR: 11/28/2005
Date Made Active in Reports: 01/30/2006
Number of Days to Update: 63

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 06/21/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Varies

ODI: Open Dump Inventory

An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

PRP: Potentially Responsible Parties

A listing of verified Potentially Responsible Parties

Date of Government Version: 03/09/2006
Date Data Arrived at EDR: 04/13/2006
Date Made Active in Reports: 05/19/2006
Number of Days to Update: 36

Source: EPA
Telephone: 202-564-6064
Last EDR Contact: 07/06/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Quarterly

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2003
Date Data Arrived at EDR: 07/13/2005
Date Made Active in Reports: 08/17/2005
Number of Days to Update: 35

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 06/22/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2002
Date Data Arrived at EDR: 04/14/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 46

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 07/17/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 03/29/2006
Date Data Arrived at EDR: 04/26/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 34

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 06/19/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

Date of Government Version: 03/31/2006
Date Data Arrived at EDR: 04/26/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 34

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 06/19/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Quarterly

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2004
Date Data Arrived at EDR: 05/11/2006
Date Made Active in Reports: 05/22/2006
Number of Days to Update: 11

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 07/17/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 02/13/2006
Date Data Arrived at EDR: 04/21/2006
Date Made Active in Reports: 05/11/2006
Number of Days to Update: 20

Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 07/17/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 12/27/2005
Date Data Arrived at EDR: 02/08/2006
Date Made Active in Reports: 02/27/2006
Number of Days to Update: 19

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 08/09/2006
Next Scheduled EDR Contact: 11/06/2006
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/12/2006
Date Data Arrived at EDR: 04/26/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 34

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 07/03/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Quarterly

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 02/09/2006
Date Data Arrived at EDR: 03/29/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 62

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 06/28/2006
Next Scheduled EDR Contact: 09/25/2006
Data Release Frequency: Semi-Annually

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 04/27/2006
Date Data Arrived at EDR: 05/02/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 28

Source: EPA
Telephone: N/A
Last EDR Contact: 04/03/2006
Next Scheduled EDR Contact: 07/03/2006
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/05/2006
Next Scheduled EDR Contact: 09/04/2006
Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2003
Date Data Arrived at EDR: 06/17/2005
Date Made Active in Reports: 08/04/2005
Number of Days to Update: 48

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 07/21/2006
Next Scheduled EDR Contact: 09/11/2006
Data Release Frequency: Biennially

STATE AND LOCAL RECORDS

SHWS: Inactive Hazardous Sites Inventory

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 04/11/2006
Date Data Arrived at EDR: 04/12/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 42

Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801
Last EDR Contact: 07/10/2006
Next Scheduled EDR Contact: 10/09/2006
Data Release Frequency: Quarterly

HSDS: Hazardous Substance Disposal Site

Locations of uncontrolled and unregulated hazardous waste sites. The file includes sites on the National Priority List as well as those on the state priority list.

Date of Government Version: 06/21/1995
Date Data Arrived at EDR: 03/10/1997
Date Made Active in Reports: 05/02/1997
Number of Days to Update: 53

Source: North Carolina Center for Geographic Information and Analysis
Telephone: 919-733-2090
Last EDR Contact: 05/31/2006
Next Scheduled EDR Contact: 08/28/2006
Data Release Frequency: Biennially

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

IMD: Incident Management Database
Groundwater and/or soil contamination incidents

Date of Government Version: 04/01/2006
Date Data Arrived at EDR: 04/27/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 27

Source: Department of Environment and Natural Resources
Telephone: 919-733-3221
Last EDR Contact: 08/01/2006
Next Scheduled EDR Contact: 10/23/2006
Data Release Frequency: Quarterly

SWF/LF: List of Solid Waste Facilities
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 04/27/2006
Date Data Arrived at EDR: 04/27/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 27

Source: Department of Environment and Natural Resources
Telephone: 919-733-0692
Last EDR Contact: 08/07/2006
Next Scheduled EDR Contact: 10/23/2006
Data Release Frequency: Semi-Annually

OLI: Old Landfill Inventory
Old landfill inventory location information. (Does not include no further action sites and other agency lead sites).

Date of Government Version: 04/03/2006
Date Data Arrived at EDR: 05/09/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 15

Source: Department of Environment & Natural Resources
Telephone: 919-733-4996
Last EDR Contact: 07/27/2006
Next Scheduled EDR Contact: 10/23/2006
Data Release Frequency: Varies

LUST: Regional UST Database
This database contains information obtained from the Regional Offices. It provides a more detailed explanation of current and historic activity for individual sites, as well as what was previously found in the Incident Management Database. Sites in this database with Incident Numbers are considered LUSTs.

Date of Government Version: 06/02/2006
Date Data Arrived at EDR: 06/07/2006
Date Made Active in Reports: 07/06/2006
Number of Days to Update: 29

Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
Last EDR Contact: 06/07/2006
Next Scheduled EDR Contact: 09/04/2006
Data Release Frequency: Quarterly

LUST TRUST: State Trust Fund Database
This database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating Leaking USTs.

Date of Government Version: 05/04/2006
Date Data Arrived at EDR: 05/09/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 15

Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
Last EDR Contact: 08/09/2006
Next Scheduled EDR Contact: 11/06/2006
Data Release Frequency: Semi-Annually

UST: Petroleum Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 05/12/2006
Date Data Arrived at EDR: 06/07/2006
Date Made Active in Reports: 06/30/2006
Number of Days to Update: 23

Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
Last EDR Contact: 06/07/2006
Next Scheduled EDR Contact: 09/04/2006
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

AST: AST Database
Facilities with aboveground storage tanks that have a capacity greater than 21,000 gallons.

Date of Government Version: 04/12/2006
Date Data Arrived at EDR: 04/13/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 41

Source: Department of Environment and Natural Resources
Telephone: 919-715-6183
Last EDR Contact: 07/17/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Semi-Annually

INST CONTROL: No Further Action Sites With Land Use Restrictions Monitoring

Date of Government Version: 04/11/2006
Date Data Arrived at EDR: 04/12/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 42

Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801
Last EDR Contact: 07/10/2006
Next Scheduled EDR Contact: 10/09/2006
Data Release Frequency: Quarterly

VCP: Responsible Party Voluntary Action Sites

Date of Government Version: 04/11/2006
Date Data Arrived at EDR: 04/12/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 42

Source: Department of Environment and Natural Resources
Telephone: 919-733-4996
Last EDR Contact: 07/10/2006
Next Scheduled EDR Contact: 10/09/2006
Data Release Frequency: Semi-Annually

DRYCLEANERS: Drycleaning Sites
Potential and known drycleaning sites, active and abandoned, that the Drycleaning Solvent Cleanup Program has knowledge of and entered into this database.

Date of Government Version: 04/04/2006
Date Data Arrived at EDR: 04/14/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 40

Source: Department of Environment & Natural Resources
Telephone: 919-508-8400
Last EDR Contact: 07/19/2006
Next Scheduled EDR Contact: 10/16/2006
Data Release Frequency: Varies

BROWNFIELDS: Brownfields Projects Inventory
A brownfield site is an abandoned, idled, or underused property where the threat of environmental contamination has hindered its redevelopment. All of the sites in the inventory are working toward a brownfield agreement for cleanup and liabitliy control.

Date of Government Version: 09/30/2005
Date Data Arrived at EDR: 02/14/2006
Date Made Active in Reports: 03/08/2006
Number of Days to Update: 22

Source: Department of Environment and Natural Resources
Telephone: 919-733-4996
Last EDR Contact: 08/04/2006
Next Scheduled EDR Contact: 10/30/2006
Data Release Frequency: Varies

NPDES: NPDES Facility Location Listing
General information regarding NPDES(National Pollutant Discharge Elimination System) permits.

Date of Government Version: 05/22/2006
Date Data Arrived at EDR: 06/02/2006
Date Made Active in Reports: 07/06/2006
Number of Days to Update: 34

Source: Department of Environment & Natural Resources
Telephone: 919-733-7015
Last EDR Contact: 05/19/2006
Next Scheduled EDR Contact: 08/28/2006
Data Release Frequency: Varies

TRIBAL RECORDS

INDIAN RESERV: Indian Reservations
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2004
Date Data Arrived at EDR: 02/08/2005
Date Made Active in Reports: 08/04/2005
Number of Days to Update: 177

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 08/11/2006
Next Scheduled EDR Contact: 11/06/2006
Data Release Frequency: Semi-Annually

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 01/04/2005
Date Data Arrived at EDR: 01/21/2005
Date Made Active in Reports: 02/28/2005
Number of Days to Update: 38

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 06/08/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 07/28/2006
Number of Days to Update: 49

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 06/01/2006
Date Data Arrived at EDR: 06/23/2006
Date Made Active in Reports: 08/02/2006
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 06/06/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 07/28/2006
Number of Days to Update: 49

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 06/08/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 06/28/2006
Number of Days to Update: 19

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land

Date of Government Version: 06/06/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 07/28/2006
Number of Days to Update: 49

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

INDIAN UST R5: Underground Storage Tanks on Indian Land

Date of Government Version: 12/02/2004
Date Data Arrived at EDR: 12/29/2004
Date Made Active in Reports: 02/04/2005
Number of Days to Update: 37

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

Date of Government Version: 06/08/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 07/28/2006
Number of Days to Update: 49

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

INDIAN UST R1: Underground Storage Tanks on Indian Land

A listing of underground storage tank locations on Indian Land.

Date of Government Version: 06/08/2006
Date Data Arrived at EDR: 06/09/2006
Date Made Active in Reports: 06/30/2006
Number of Days to Update: 21

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Varies

INDIAN UST R9: Underground Storage Tanks on Indian Land

Date of Government Version: 06/01/2006
Date Data Arrived at EDR: 06/23/2006
Date Made Active in Reports: 08/02/2006
Number of Days to Update: 40

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 05/24/2006
Next Scheduled EDR Contact: 08/21/2006
Data Release Frequency: Quarterly

EDR PROPRIETARY RECORDS

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Historical Auto Stations: EDR Proprietary Historic Gas Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Historical Cleaners: EDR Proprietary Historic Dry Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 12/31/2004
Date Data Arrived at EDR: 02/17/2006
Date Made Active in Reports: 04/07/2006
Number of Days to Update: 49

Source: Department of Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 06/14/2006
Next Scheduled EDR Contact: 09/11/2006
Data Release Frequency: Annually

NJ MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 06/01/2006
Date Data Arrived at EDR: 07/06/2006
Date Made Active in Reports: 08/01/2006
Number of Days to Update: 26

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 07/05/2006
Next Scheduled EDR Contact: 10/02/2006
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 05/02/2006
Date Data Arrived at EDR: 05/31/2006
Date Made Active in Reports: 06/27/2006
Number of Days to Update: 27

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 05/31/2006
Next Scheduled EDR Contact: 08/28/2006
Data Release Frequency: Annually

PA MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 05/04/2006
Date Made Active in Reports: 06/06/2006
Number of Days to Update: 33

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 06/12/2006
Next Scheduled EDR Contact: 09/11/2006
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 09/30/2005
Date Data Arrived at EDR: 05/09/2006
Date Made Active in Reports: 05/24/2006
Number of Days to Update: 15

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 06/19/2006
Next Scheduled EDR Contact: 09/18/2006
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 03/17/2006
Date Made Active in Reports: 05/02/2006
Number of Days to Update: 46

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 07/25/2006
Next Scheduled EDR Contact: 10/09/2006
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: PennWell Corporation
Telephone: (800) 823-6277
This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Facility List
Source: Department of Health & Human Services
Telephone: 919-662-4499

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory
Source: Department of Environment & Natural Resources
Telephone: 919-733-2090

STREET AND ADDRESS INFORMATION

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

BIG CEDAR CREEK STREAM RESTORATION
STANLEY COUNTY
NORWOOD, NC 28128

TARGET PROPERTY COORDINATES

Latitude (North):	35.19890 - 35° 11' 56.0''
Longitude (West):	80.1303 - 80° 7' 49.1''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	579171.9
UTM Y (Meters):	3895249.0
Elevation:	334 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	35080-B2 AQUADALE, NC
Most Recent Revision:	2002
East Map:	35080-B1 MOUNT GILEAD WEST, NC
Most Recent Revision:	2002

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

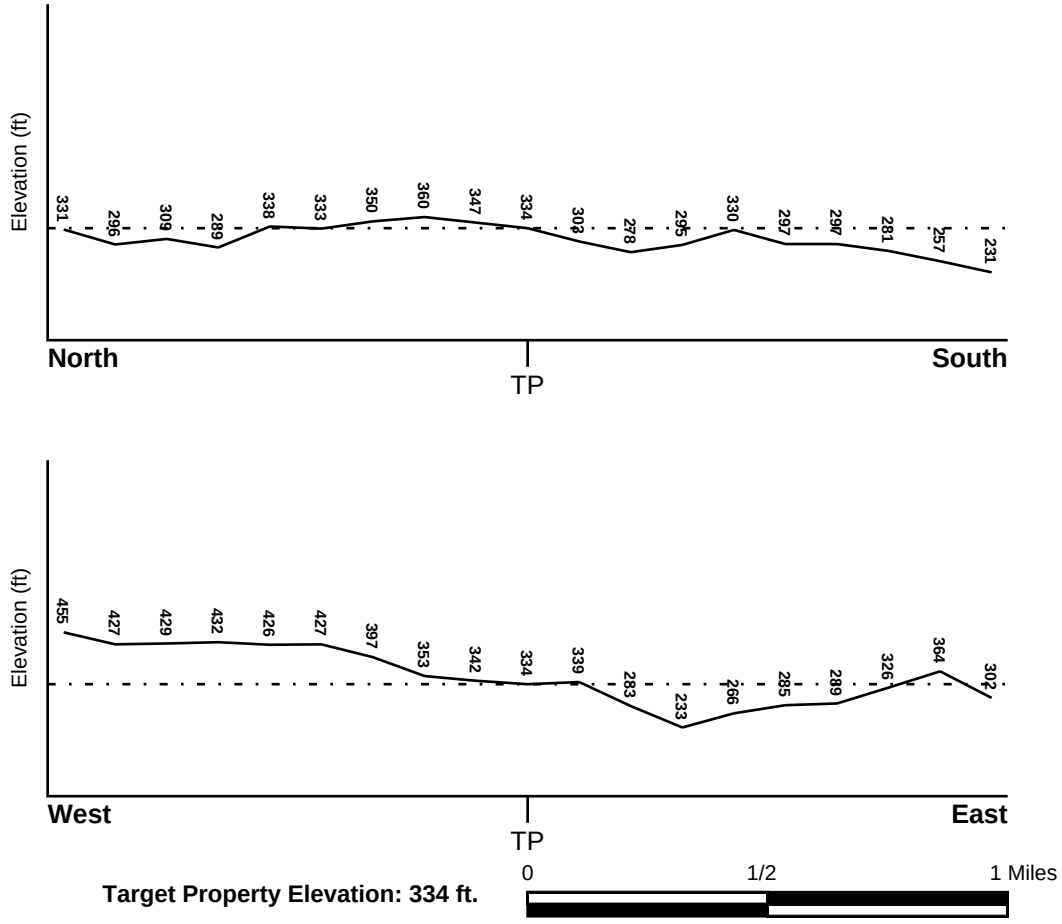
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General SE

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
STANLY, NC	Not Available

Flood Plain Panel at Target Property: Not Reported

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
AQUADALE	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Paleozoic
System:	Cambrian
Series:	Cambrian
Code:	Ce *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Eugeosynclinal Deposits

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	TATUM
Soil Surface Texture:	silt loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel: HIGH

Depth to Bedrock Min: > 40 inches

Depth to Bedrock Max: > 60 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	6 inches	silt loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 2.00 Min: 0.60	Max: 5.50 Min: 4.50
2	6 inches	42 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit 50% or more), Elastic silt.	Max: 2.00 Min: 0.60	Max: 5.50 Min: 4.50
3	42 inches	46 inches	weathered bedrock	Not reported	Not reported	Max: 0.06 Min: 0.00	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: clay loam
loam
fine sandy loam
channery - silt loam

Surficial Soil Types: clay loam
loam
fine sandy loam
channery - silt loam

Shallow Soil Types: clay loam
very channery - silt loam
silt loam
sandy clay loam

Deeper Soil Types: silty clay loam
sandy loam
silt loam
unweathered bedrock

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
1	USGS2260378	1/2 - 1 Mile WNW

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

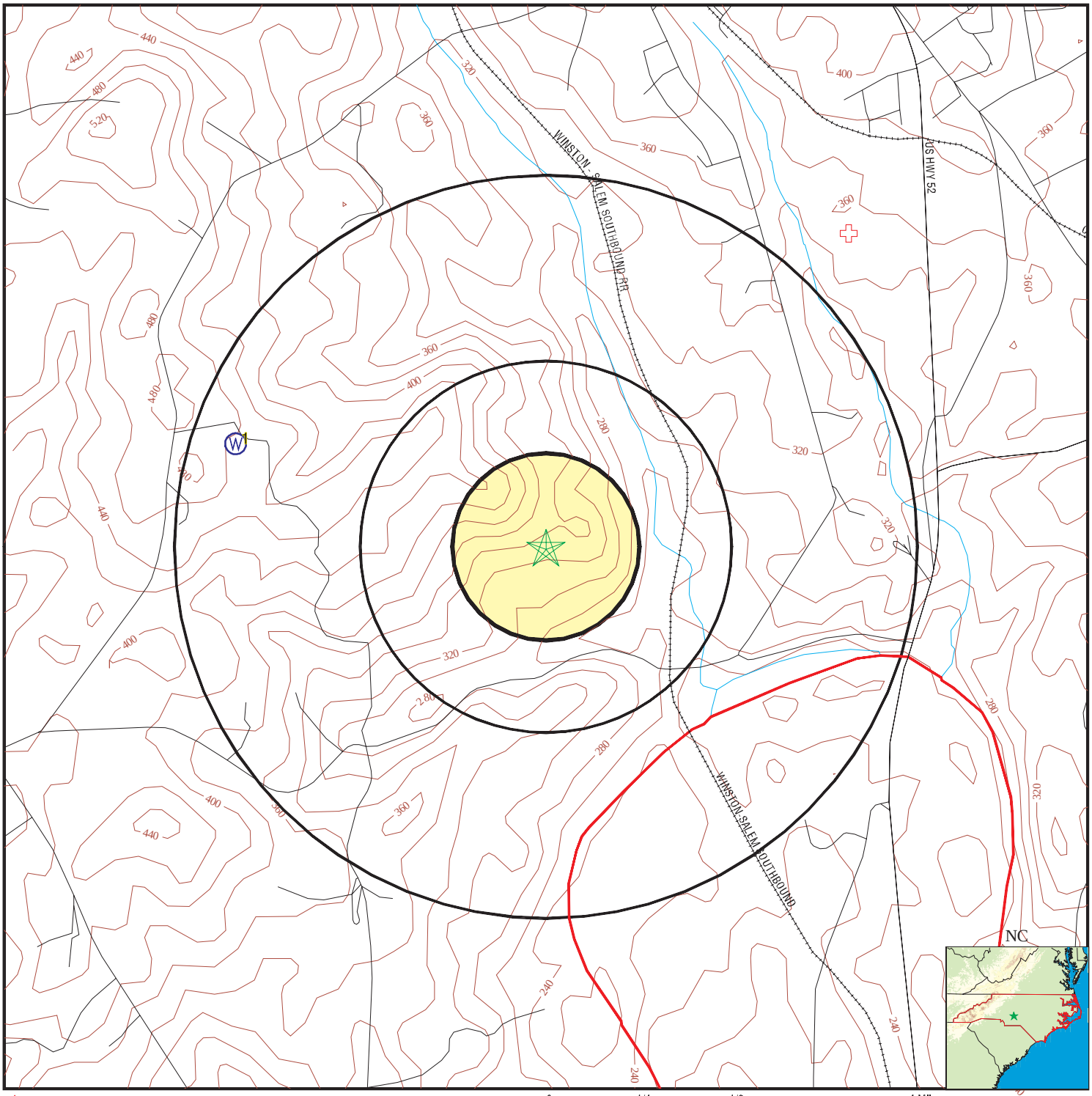
MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

OTHER STATE DATABASE INFORMATION

NORTH CAROLINA NATURAL HERITAGE ELEMENT OCCURRENCES

ID	Class
NC50003393	Animal

PHYSICAL SETTING SOURCE MAP - 01735681.1r



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:	Big Cedar Creek Stream Restoration	CLIENT:	Buck Engineering
ADDRESS:	Stanley County Norwood NC 28128	CONTACT:	Andrea Spangler
LAT/LONG:	35.1989 / 80.1303	INQUIRY #:	01735681.1r
		DATE:	August 15, 2006

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation | Database | EDR ID Number

1
WNW
1/2 - 1 Mile
Higher | **FED USGS** | **USGS2260378**

Agency cd:	USGS	Site no:	351210080084301
Site name:	ST-213		
Latitude:	351210		
Longitude:	0800843	Dec lat:	35.20292395
Dec lon:	-80.14505943	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	167
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hilltop		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y		
Type of ground water site:	Single well, other than collector or Ranney type		
Aquifer Type:	Not Reported		
Aquifer:	ARGILLITE		
Well depth:	101.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1965-00-00	Ground water data end date:	1965-00-00
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1965	40	

Direction Distance		Database	EDR ID Number
		NC_NHEO	**NC50003393**
GIS ID:	141811		
Classification by Type:	Animal		
Occurrence Status:	Extant		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: NC Radon

Radon Test Results

County	Result Type	Total Sites	Avg pCi/L	Range pCi/L
STANLY	Statistical	5	0.86	0.30-2.00
STANLY	Non-Statistical	37	2.56	0.00-12.30

Federal EPA Radon Zone for STANLY County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for STANLY COUNTY, NC

Number of sites tested: 3

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.400 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	1.167 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)

Source: United States Geologic Survey

EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory

Source: Department of Environment & Natural Resources

Telephone: 919-733-2090

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System

Source: EDR proprietary database of groundwater flow information

EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit

Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database

Source: Department of Agriculture, Natural Resources Conservation Services

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database

Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)

Telephone: 800-672-5559

SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

North Carolina Public Water Supply Wells
Source: Department of Environmental Health
Telephone: 919-715-3243

OTHER STATE DATABASE INFORMATION

NC Natural Areas: Significant Natural Heritage Areas
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A polygon converage identifying sites (terrestrial or aquatic that have particular biodiversity significance. A site's significance may be due to the presenceof rare species, rare or hight quality natural communities, or other important ecological features.

NC Game Lands: Wildlife Resources Commission Game Lands
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
All publicly owned game lands managed by the North Carolina Wildlife Resources Commission and as listed in Hunting and Fishing Maps.

NC Natural Heritage Sites: Natural Heritage Element Occurrence Sites
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A point coverage identifying locations of rare and endangered species, occurrences of exemplary or unique natural ecosystems (terrestrial or aquatic), and special animal habitats (e.g., colonial waterbird nesting sites).

RADON

State Database: NC Radon
Source: Department of Environment & Natural Resources
Telephone: 919-733-4984
Radon Statistical and Non Statiscal Data

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

STREET AND ADDRESS INFORMATION

Appendix C
Existing Conditions Data

Big Cedar Creek – near top of project. High shear stress forces cause bank instability, resulting in loss of bank vegetation.

Big Cedar Creek – near center of project. High erodibility and lack of surface protection results in shear, unstable banks.

Big Cedar Creek – cattle access point. Continuous bed and bank disturbance causes fine sediments to enter the channel. Note invasive vegetation on right bank.

Big Cedar Creek – near center of project. High near bank stress results in shear, unstable left bank.

Big Cedar Creek - typical. Long, straight, shallow pool with vegetation dominated by invasive species.

Big Cedar Creek – near Mount Zion Road culvert. Mass aggradation in overly wide channel.

UT1. High shear stress forces cause bank instability, resulting in loss of bank vegetation.

UT1 - typical. Historic agricultural manipulation resulted in a straight channel lacking bedform diversity. Agricultural activities today come within feet of the channel.

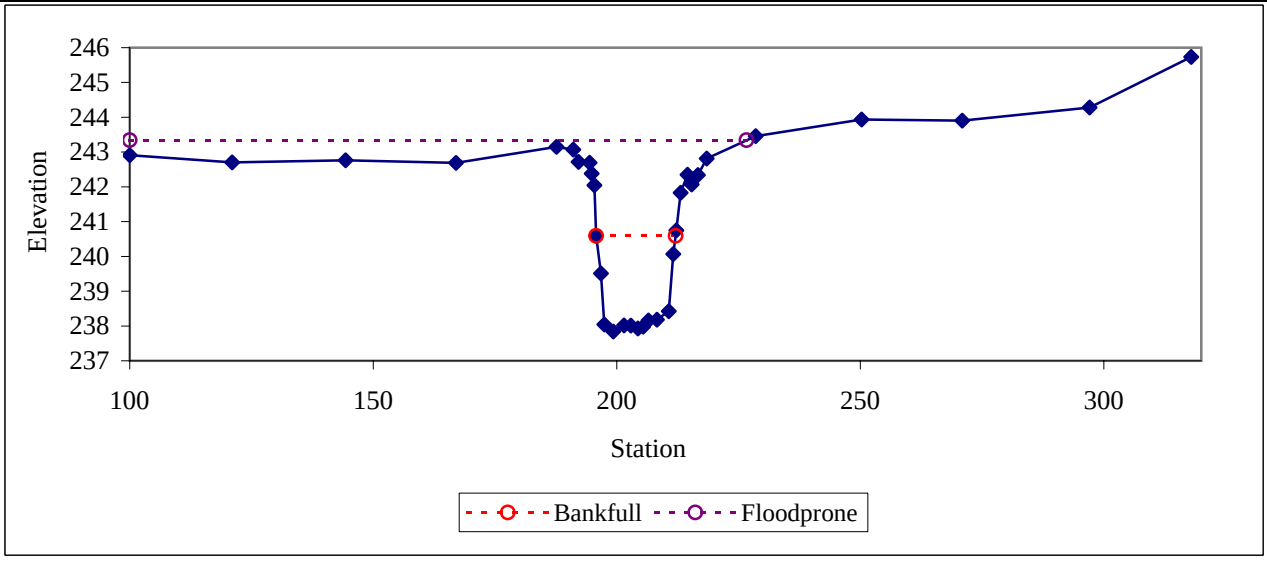
UT1 – typical. Max depth in pools is controlled by bedrock, resulting in wide, shallow pools.

UT1 – below agricultural crossing. Continuous bed and bank disturbance resulted in a lack of bed definition.

UT2 – agricultural crossing and shear, unstable banks below.

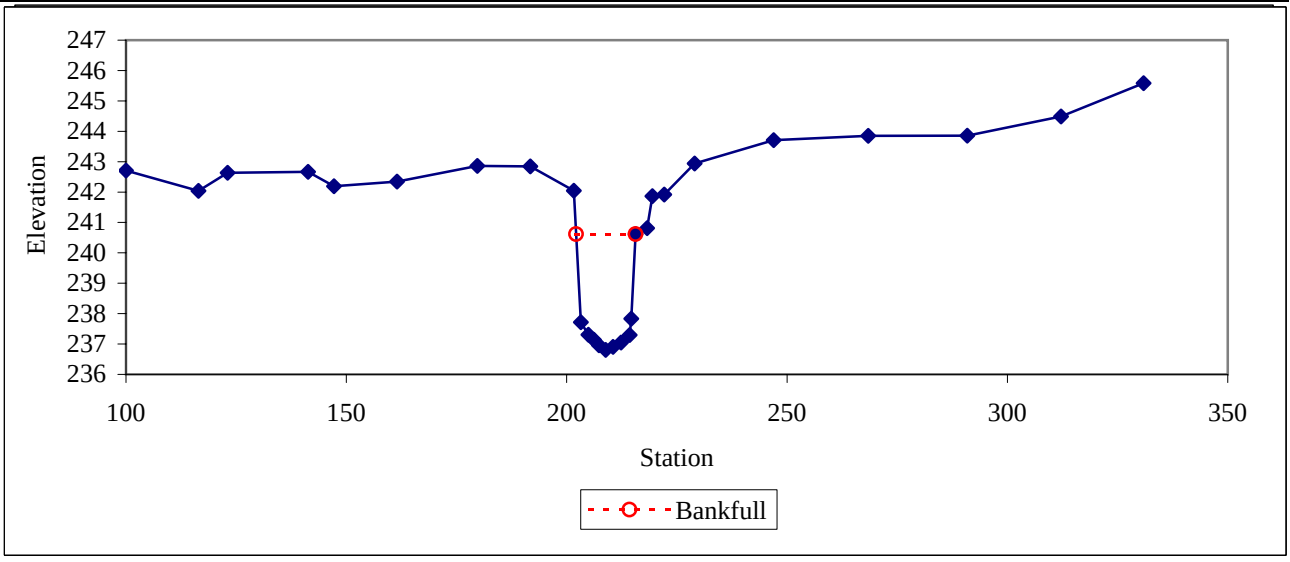
Cross-section Data: BCC Reach 1 X1

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E4/1	36.7	16.3	2.3	2.8	7.1	1.8	>7.8	240.6	242.7



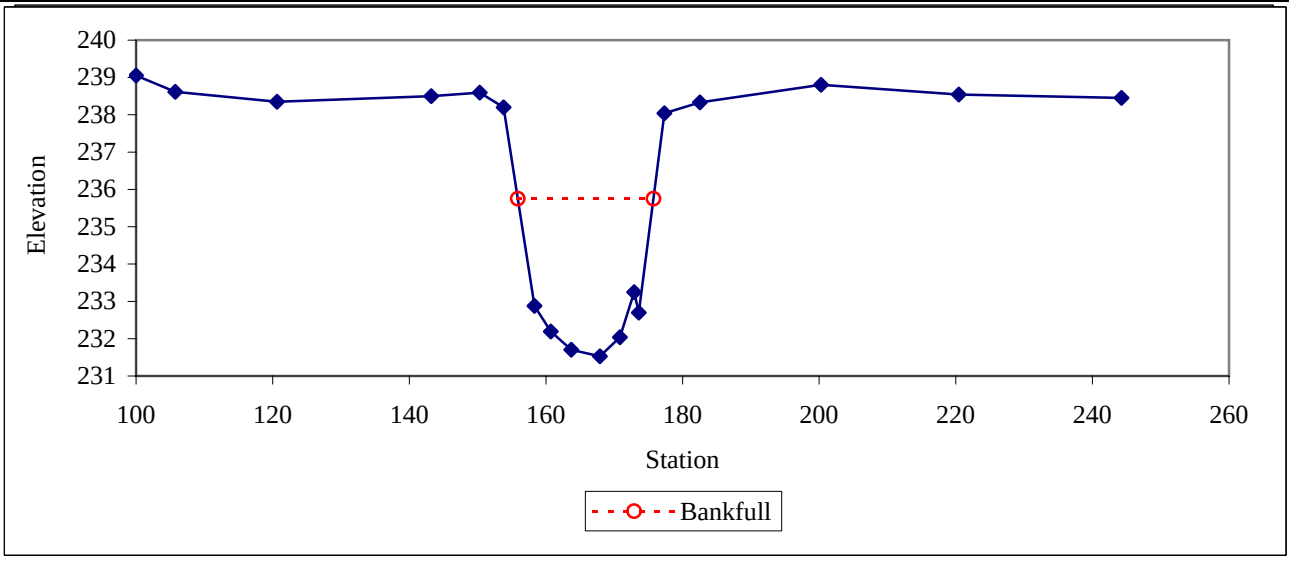
Cross-section Data: BCC Reach 1 X2

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		43.0	13.5	3.2	3.8	4.2	1.3		240.6	241.9



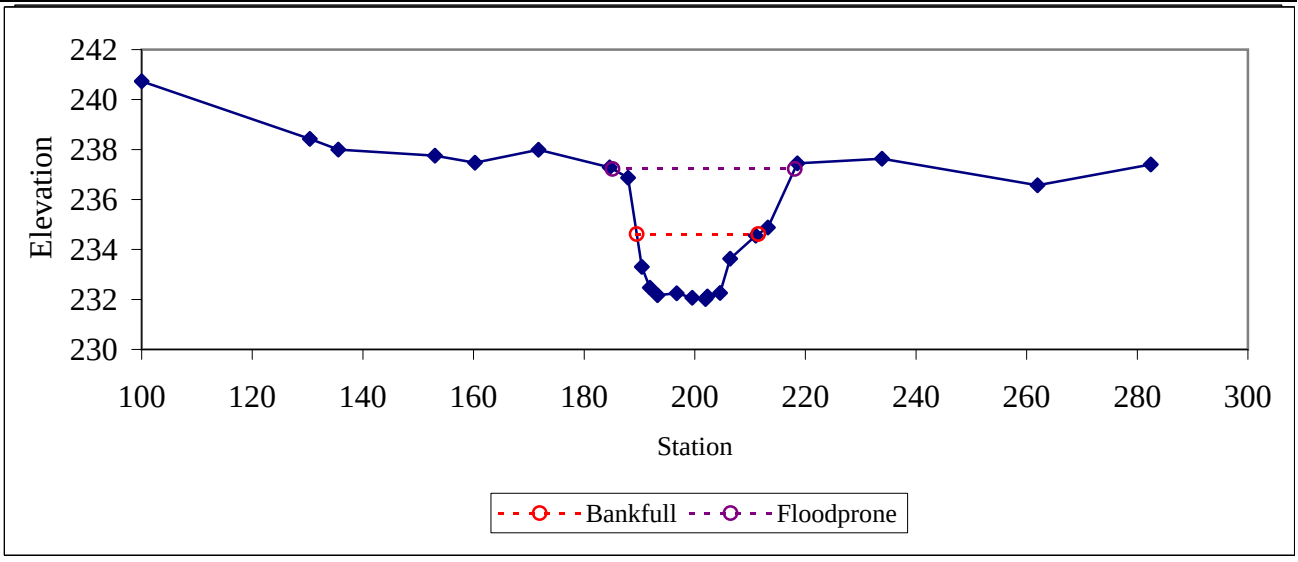
Cross-section Data: BCC Reach 2 X3

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		63.2	19.9	3.2	4.2	6.2	1.5		235.8	238.0



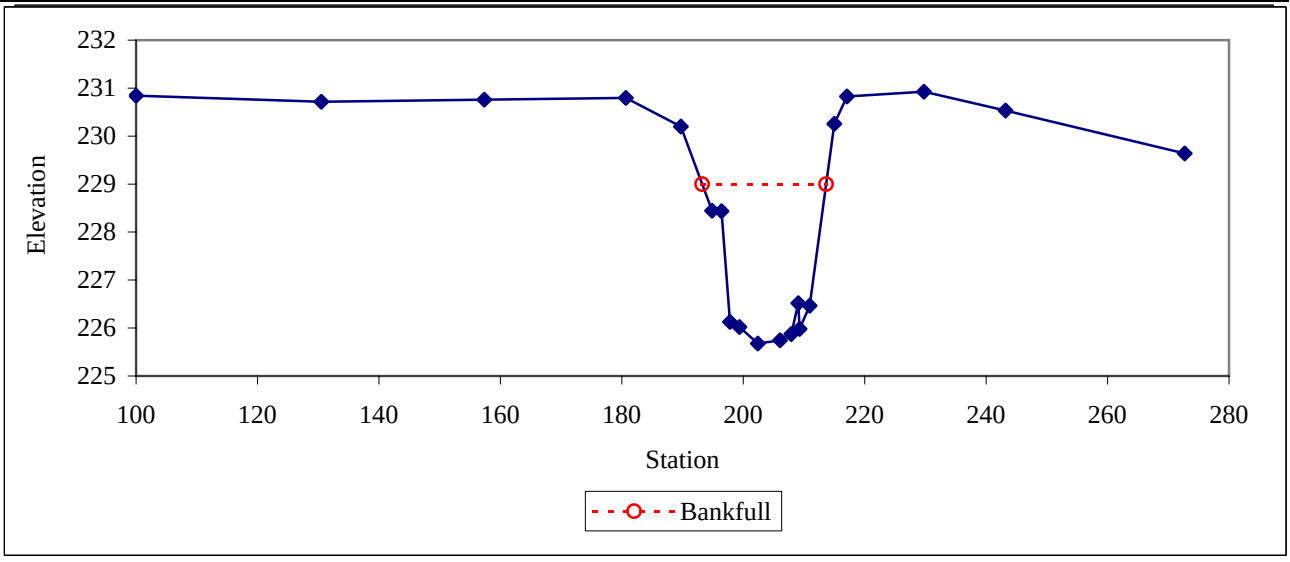
Cross-section Data: BCC Reach 2 X4

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B4/1c	39.7	22.0	1.8	2.6	12.2	1.9	1.5	234.6	236.9



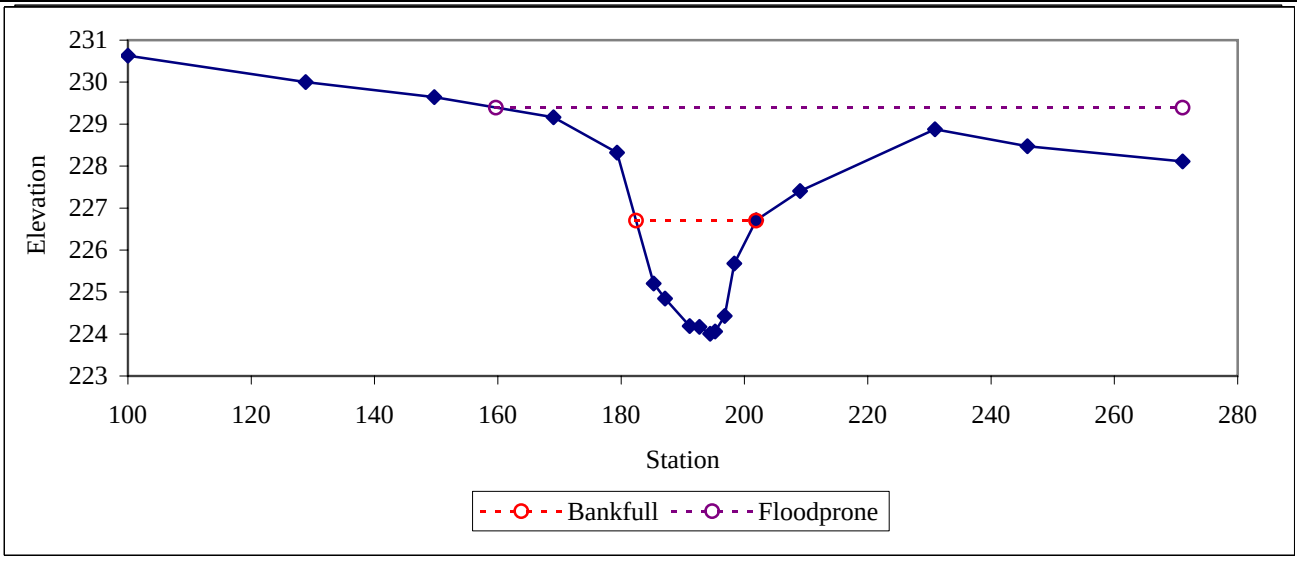
Cross-section Data: BCC Reach 3 X5

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		47.6	20.4	2.3	3.3	8.9	1.4		229.0	230.2



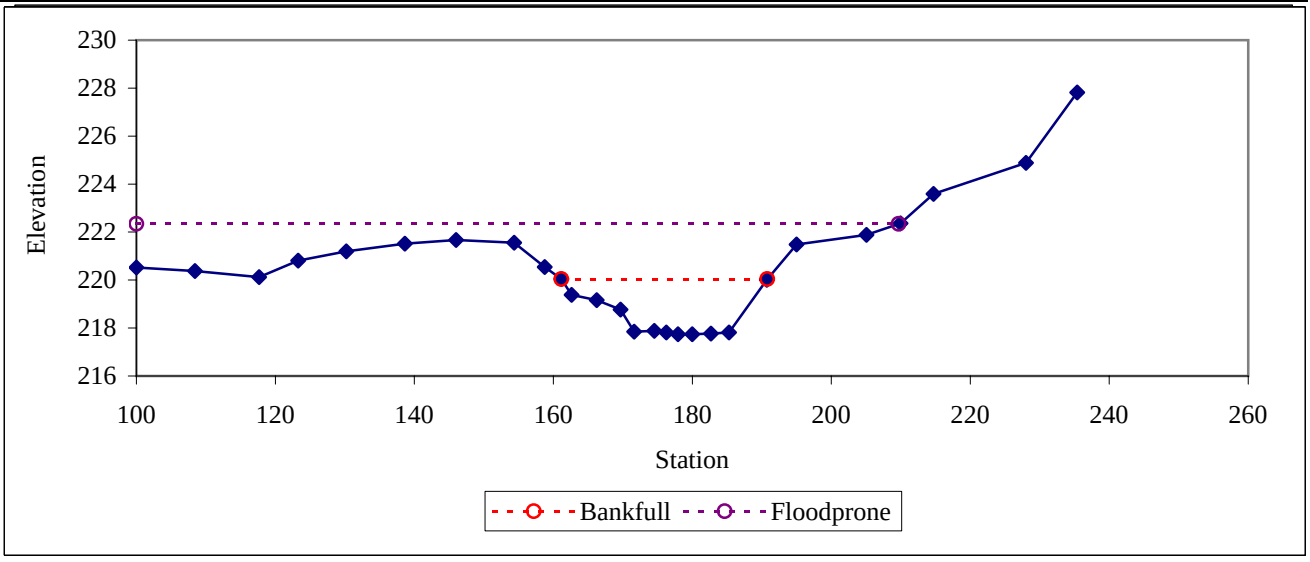
Cross-section Data: BCC Reach 3 X6

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4/1	32.8	19.5	1.7	2.7	11.5	1.6	>5.7	226.7	228.3



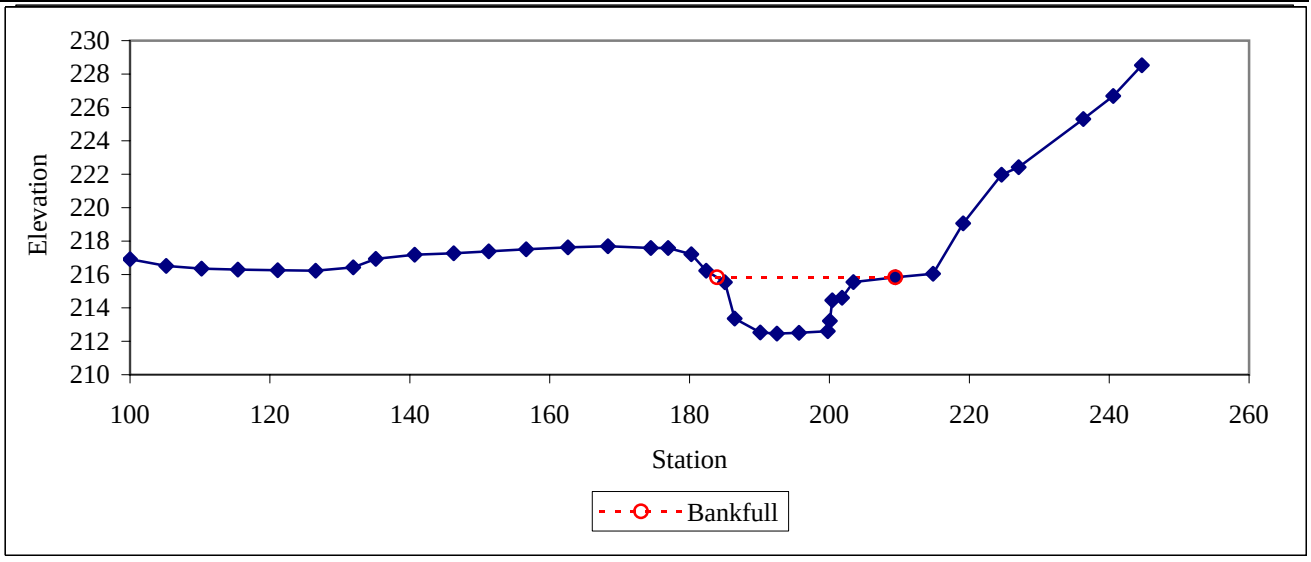
Cross-section Data: BCC Reach 4 X7

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4/1	47.1	29.6	1.6	2.3	18.5	1.6	>3.7	220.0	221.5



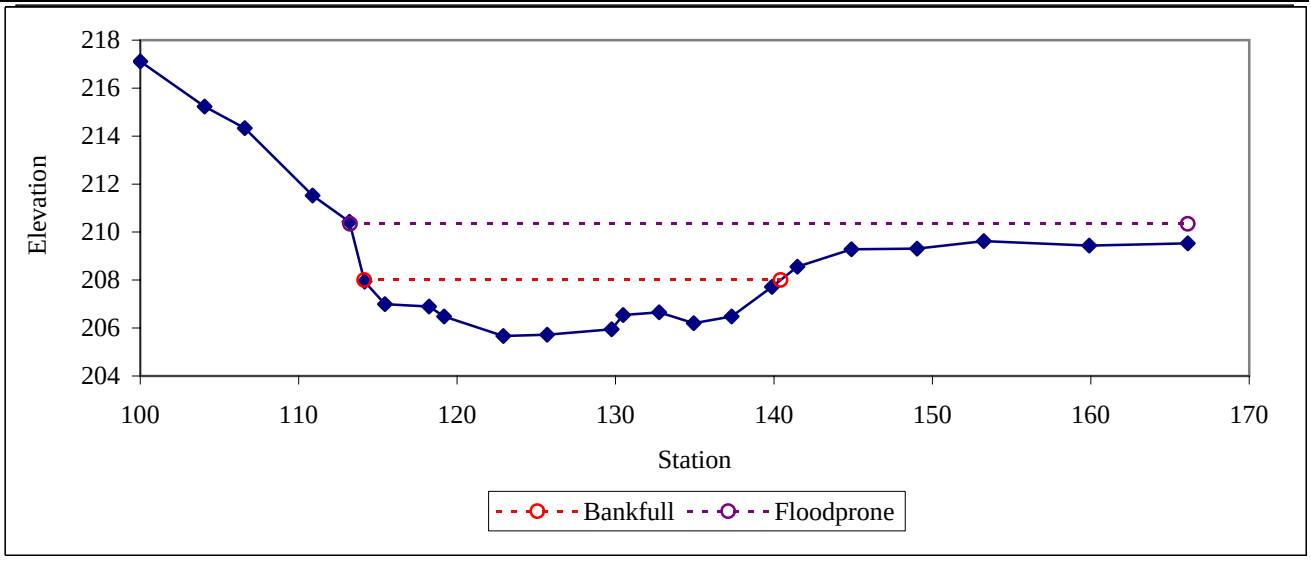
Cross-section Data: BCC Reach 4 X8

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		50.1	25.5	2.0	3.4	12.8	1.4		215.8	217.2



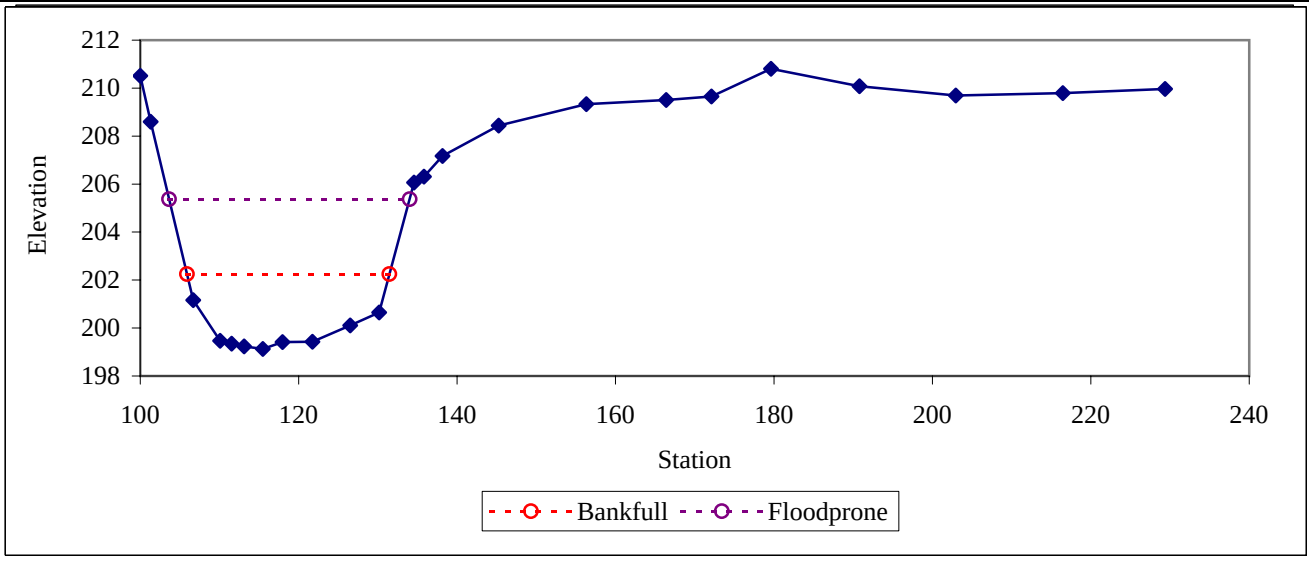
Cross-section Data: BCC Reach 5 X9

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B3/1c	41.5	26.3	1.6	2.3	16.4	1.5	>2.0	208.0	209.3



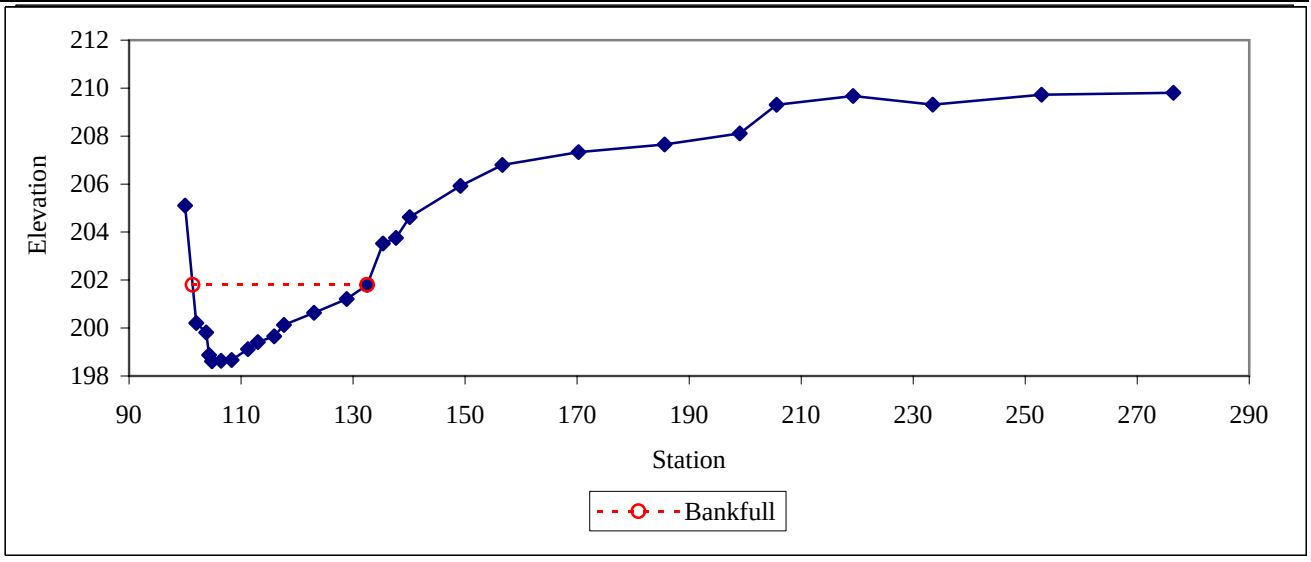
Cross-section Data: BCC Reach 6 X10

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F3/1	60.9	25.6	2.4	3.1	10.7	2.2	1.2	202.3	206.1



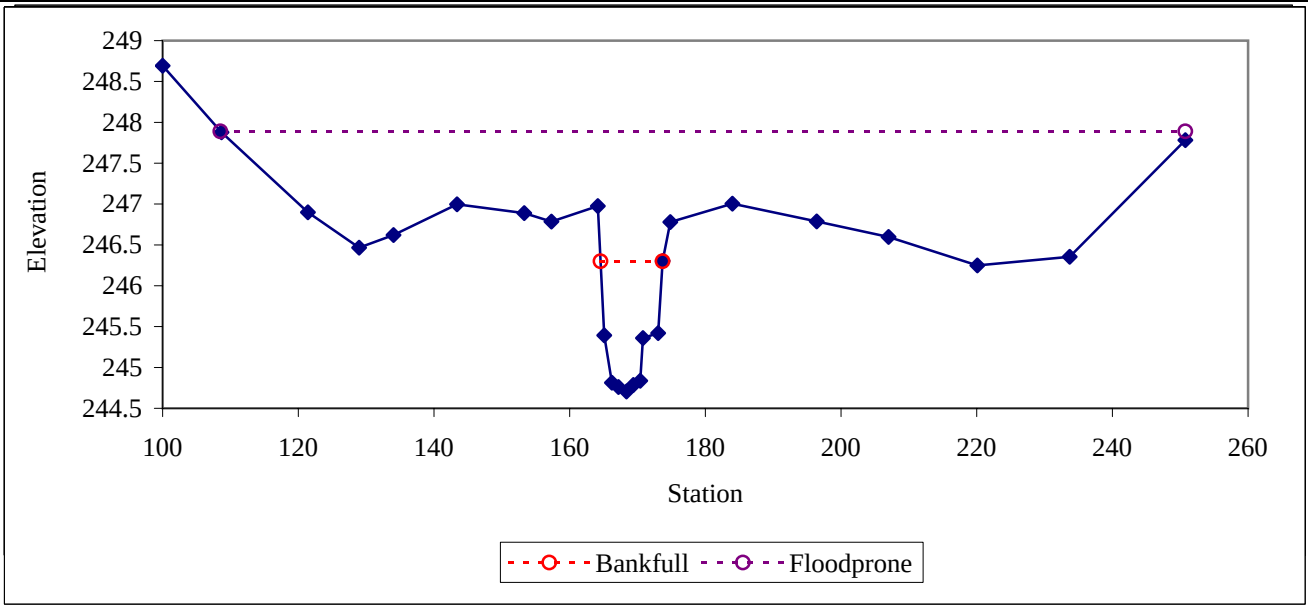
Cross-section Data: BCC Reach 6 X11

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		54.3	31.2	1.7	3.2	18.4	1.9		201.8	204.6



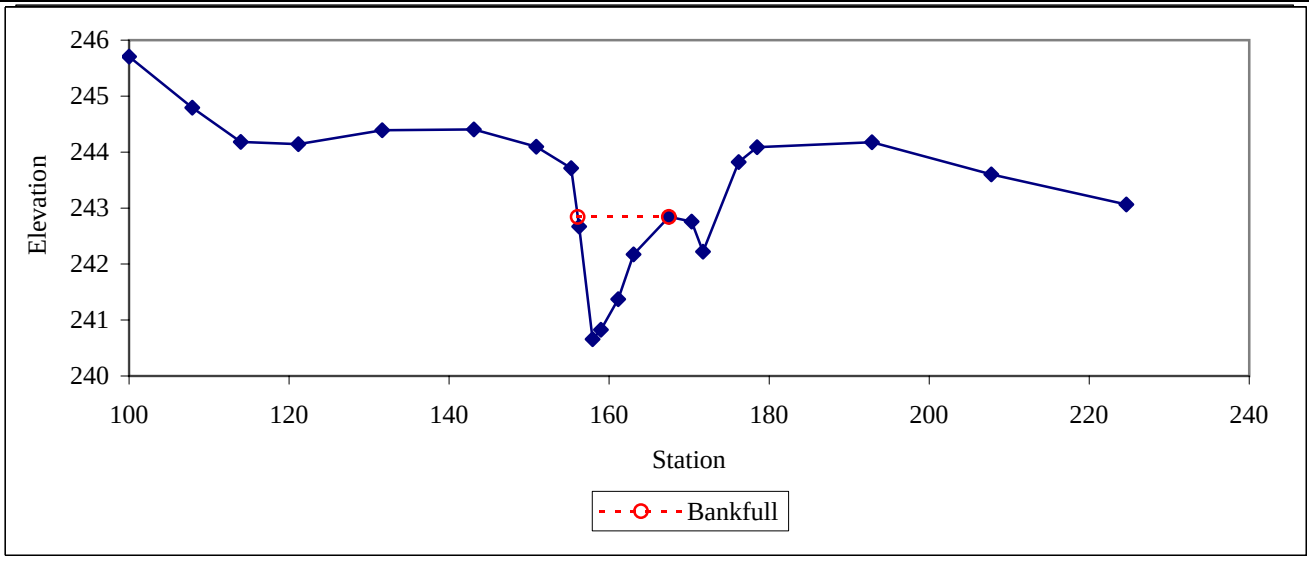
Cross-section Data: UT2 Reach 1 X1

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G4	10.8	9.2	1.2	1.6	7.7	1.3	>15.5	246.3	246.8



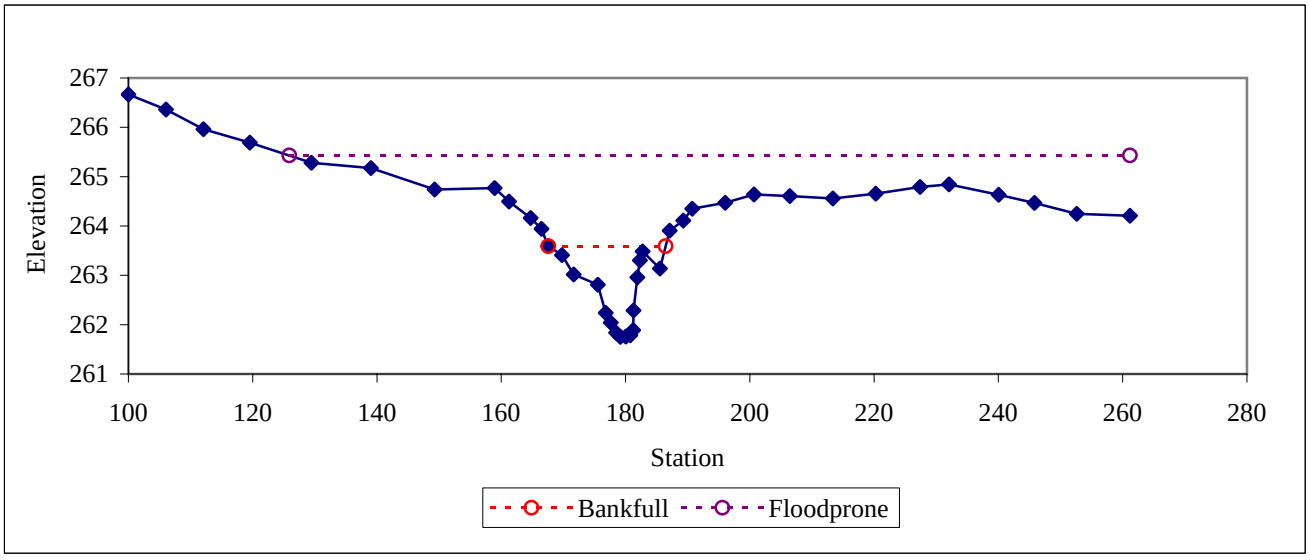
Cross-section Data: UT2 Reach 1 X2

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		11.5	11.4	1.0	2.2	11.4	1.4		242.8	243.7



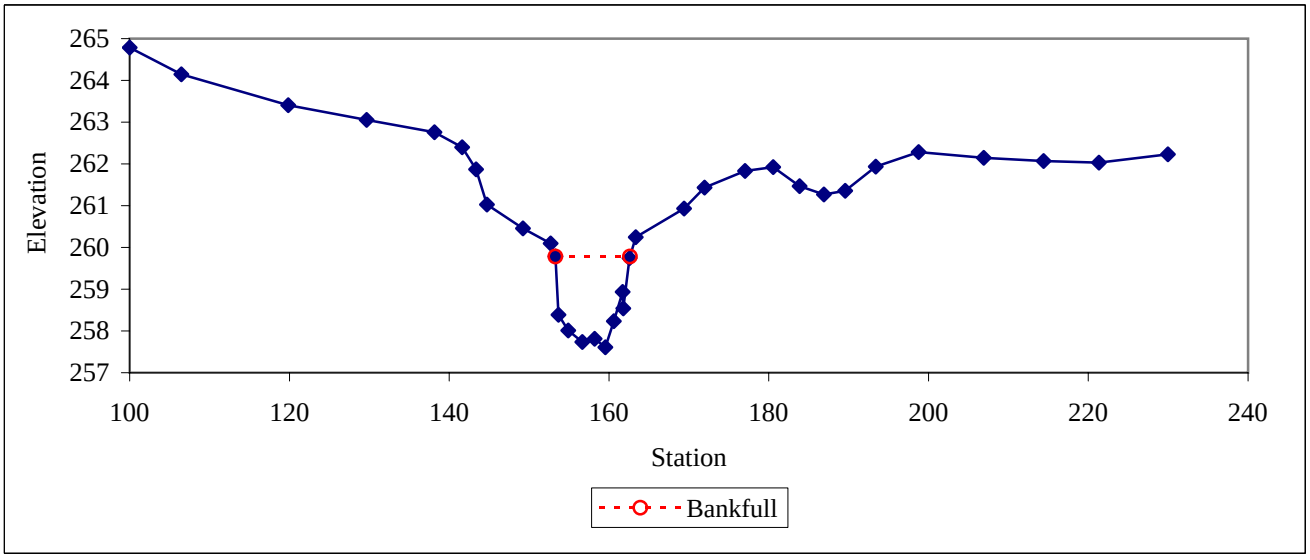
Cross-section Data: UT1 Reach 1 X3

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4/1	14.4	18.9	0.8	1.8	23.6	1.6	>7.2	263.6	264.64



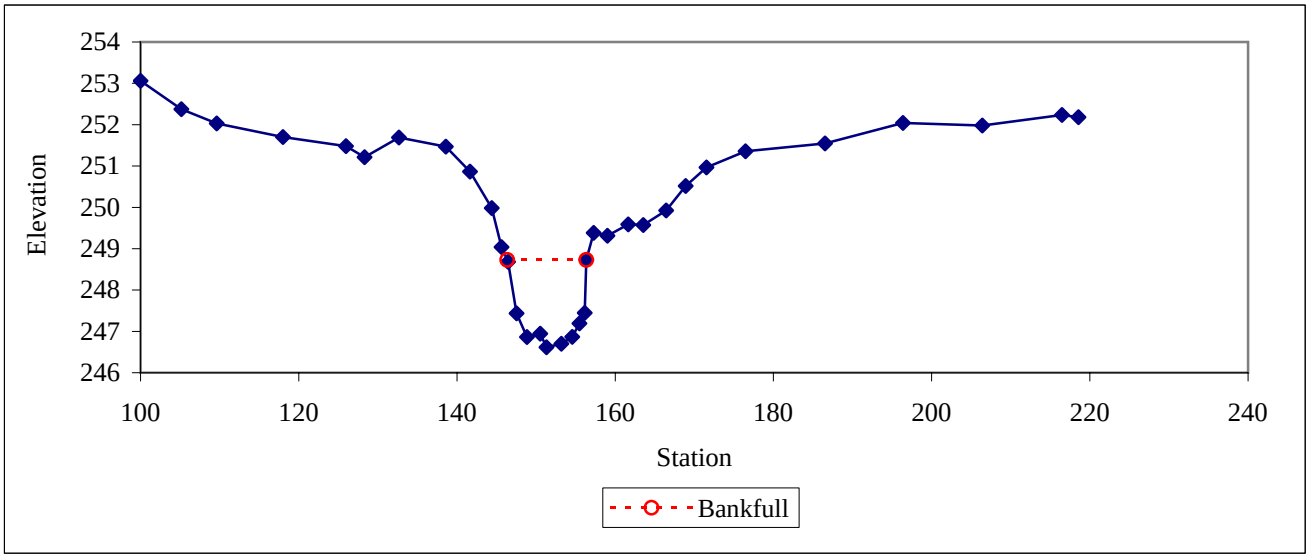
Cross-section Data: UT1 Reach 1 X4

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4/1	15.3	9.3	1.6	2.2	5.8	2.2		259.8	262.28



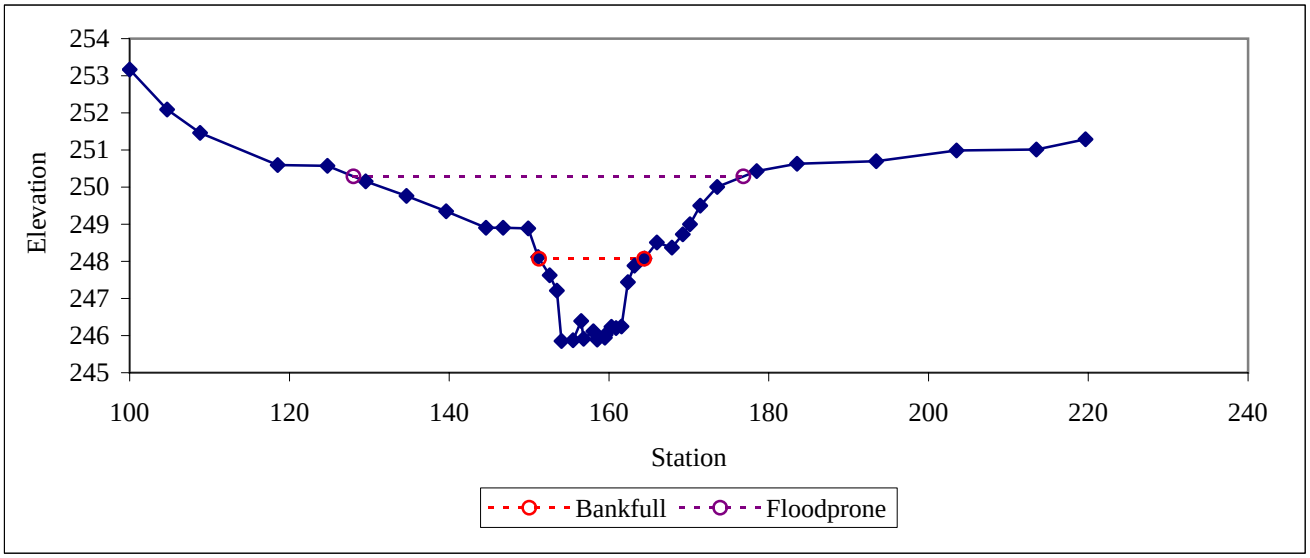
Cross-section Data: UT1 Reach 2 X5

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E4/1	16.6	10	1.7	2.1	6.0	2.2		248.7	251.36



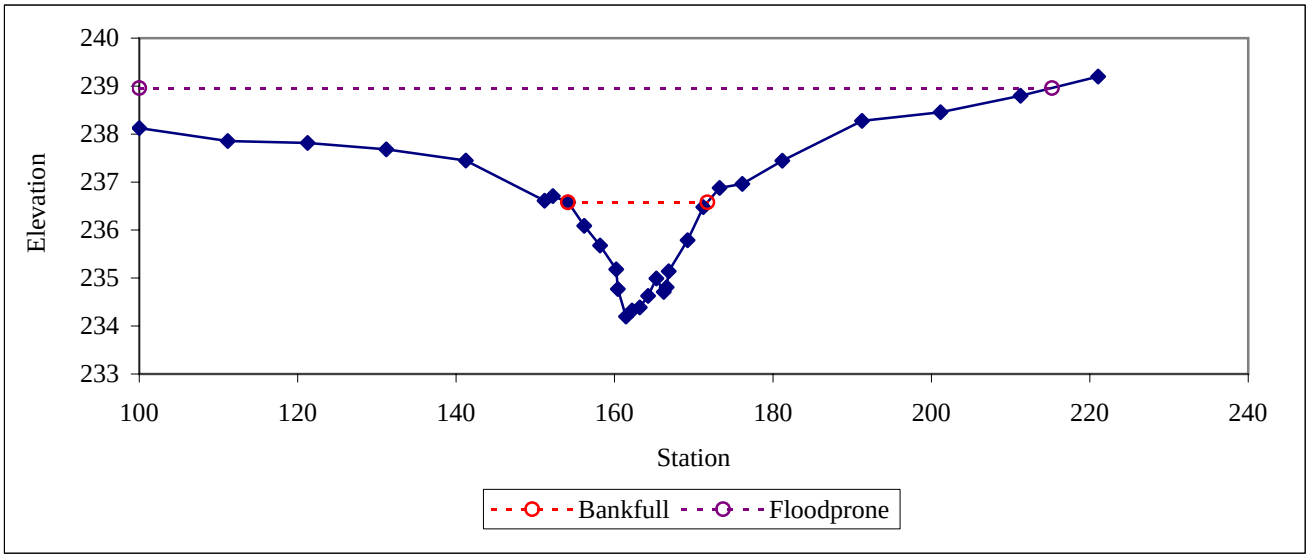
Cross-section Data: UT1 Reach 2 X6

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E4/1	18.5	13.1	1.4	2.2	9.4	2.1	3.7	248.1	250.57



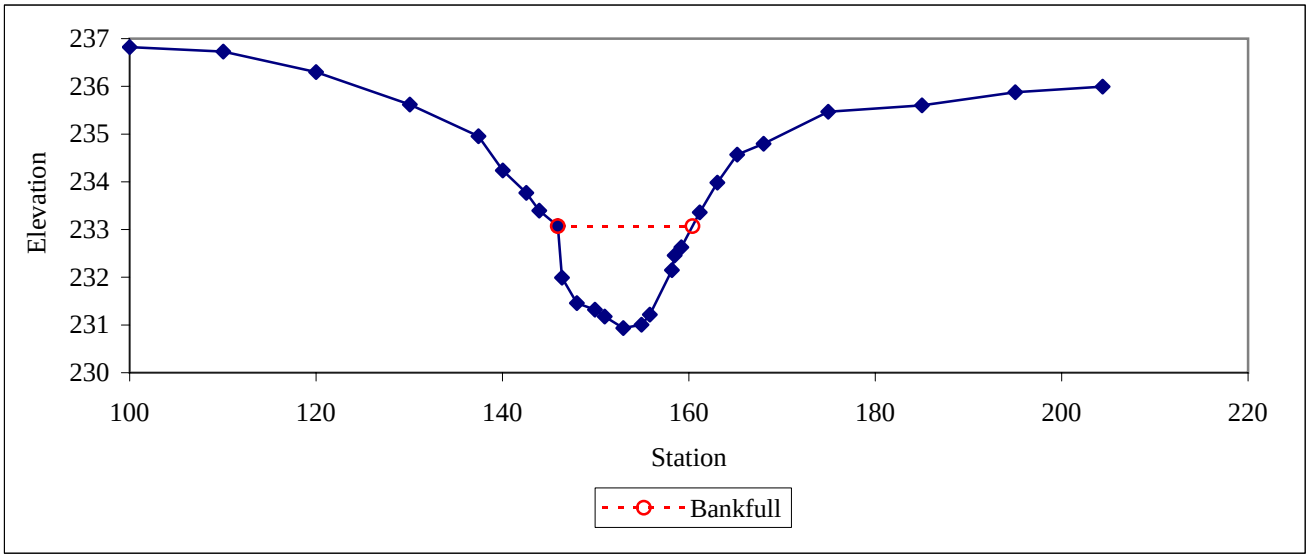
Cross-section Data: UT1 Reach 3 X7

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4/1	20.9	17.6	1.2	2.4	14.7	1.4	>6.5	236.6	237.45



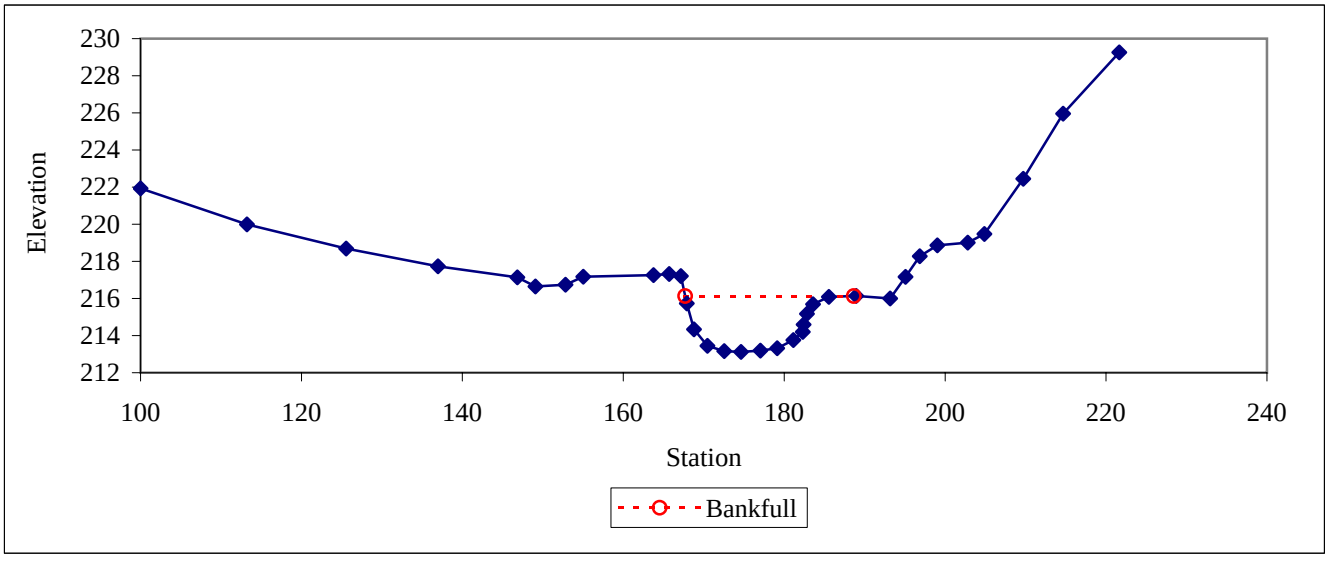
Cross-section Data: UT1 Reach 3 X9

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4/1	21.6	14.5	1.5	2.1	9.7	1.9		233	234.95



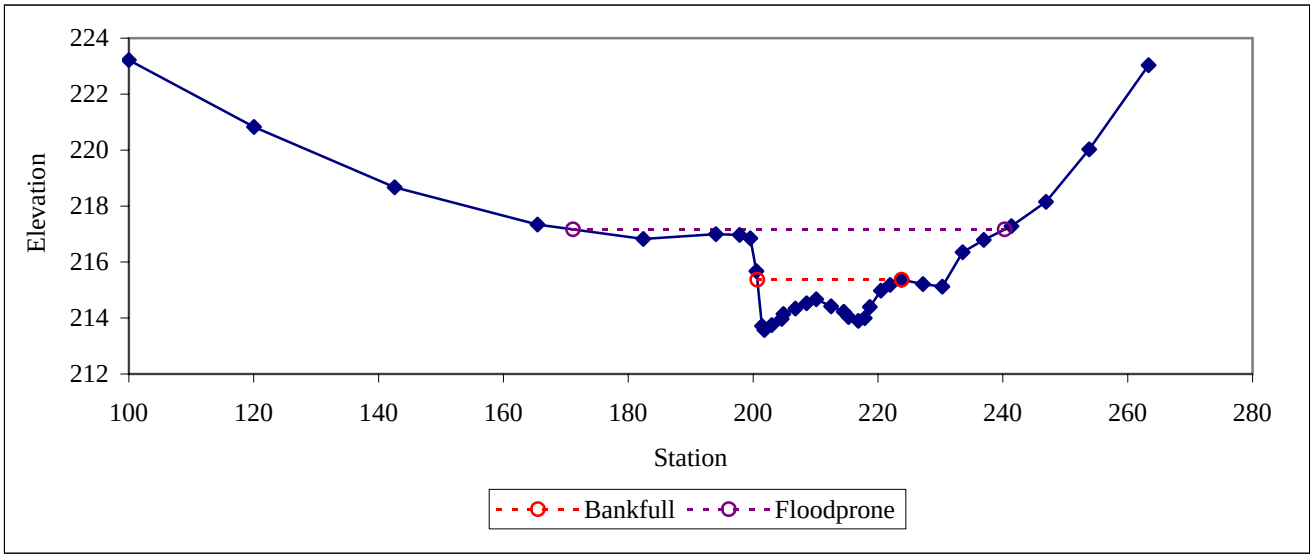
Cross-section Data: UT1 Reach 4 X12

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4/1	39.5	21.0	1.9	3.0	11.1	1.4	3.9	216.1	217.21

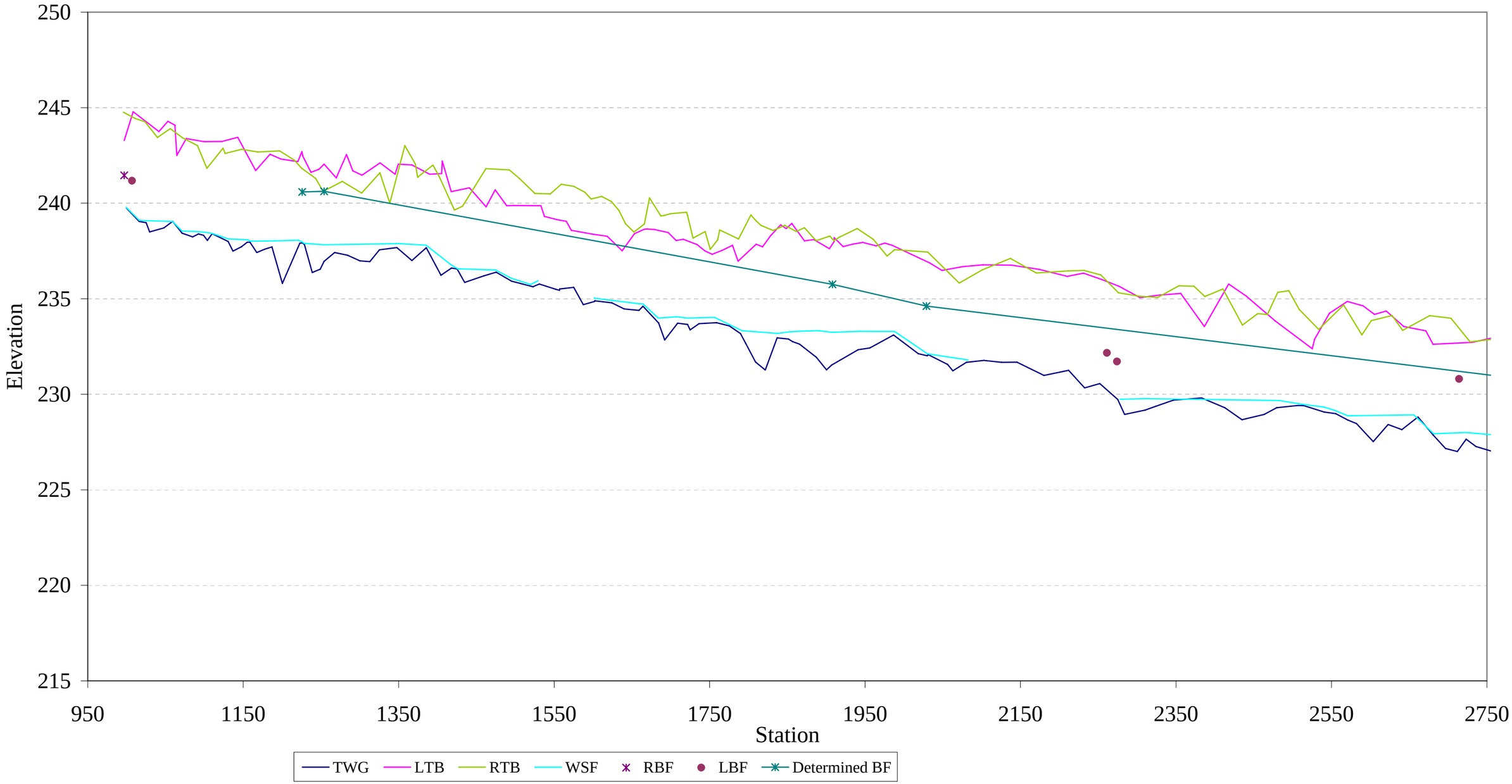


Cross-section Data: UT1 Reach 4 X13

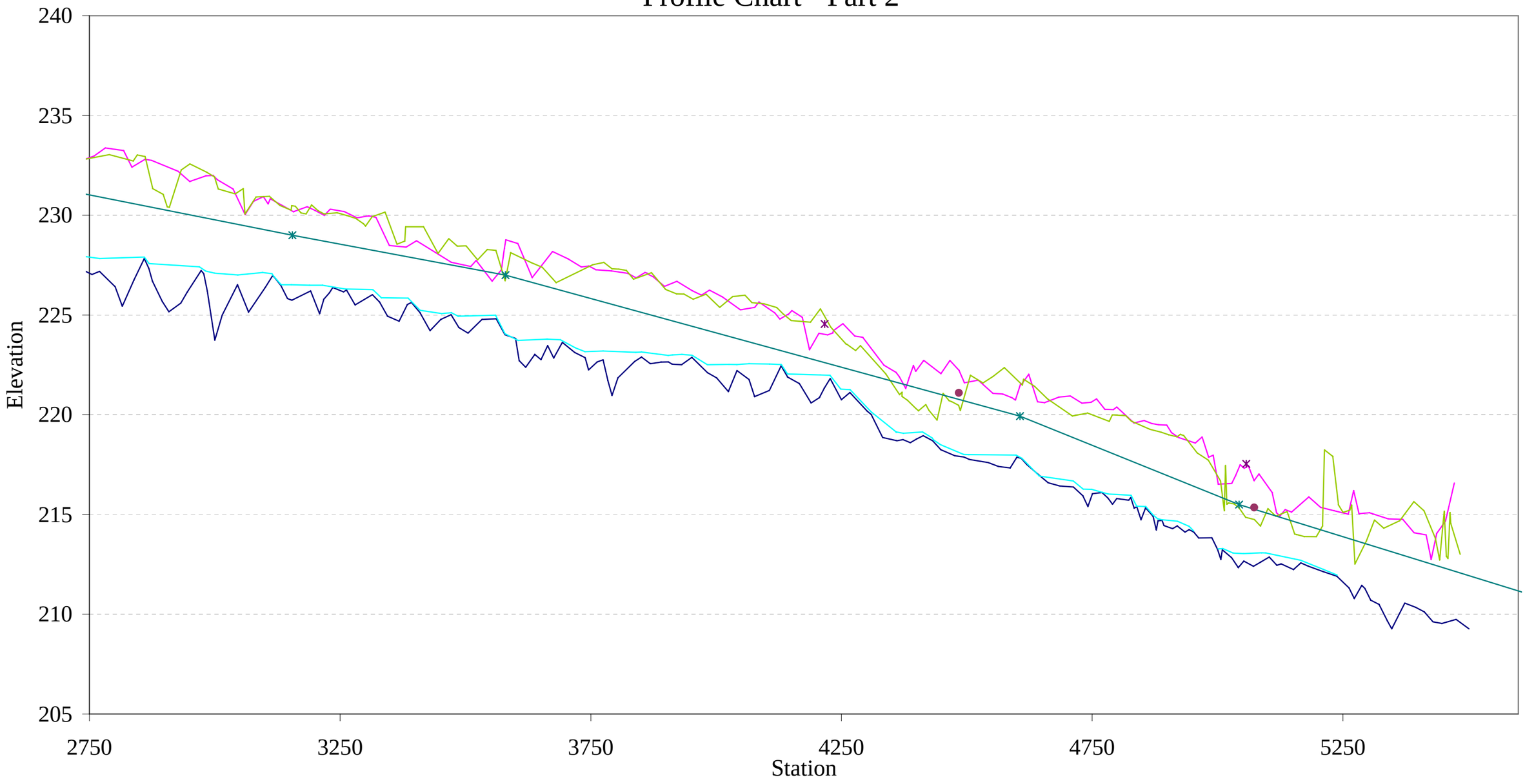
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4/1	22.6	23.1	1.0	1.8	23.1	1.8	3.0	215.4	216.85



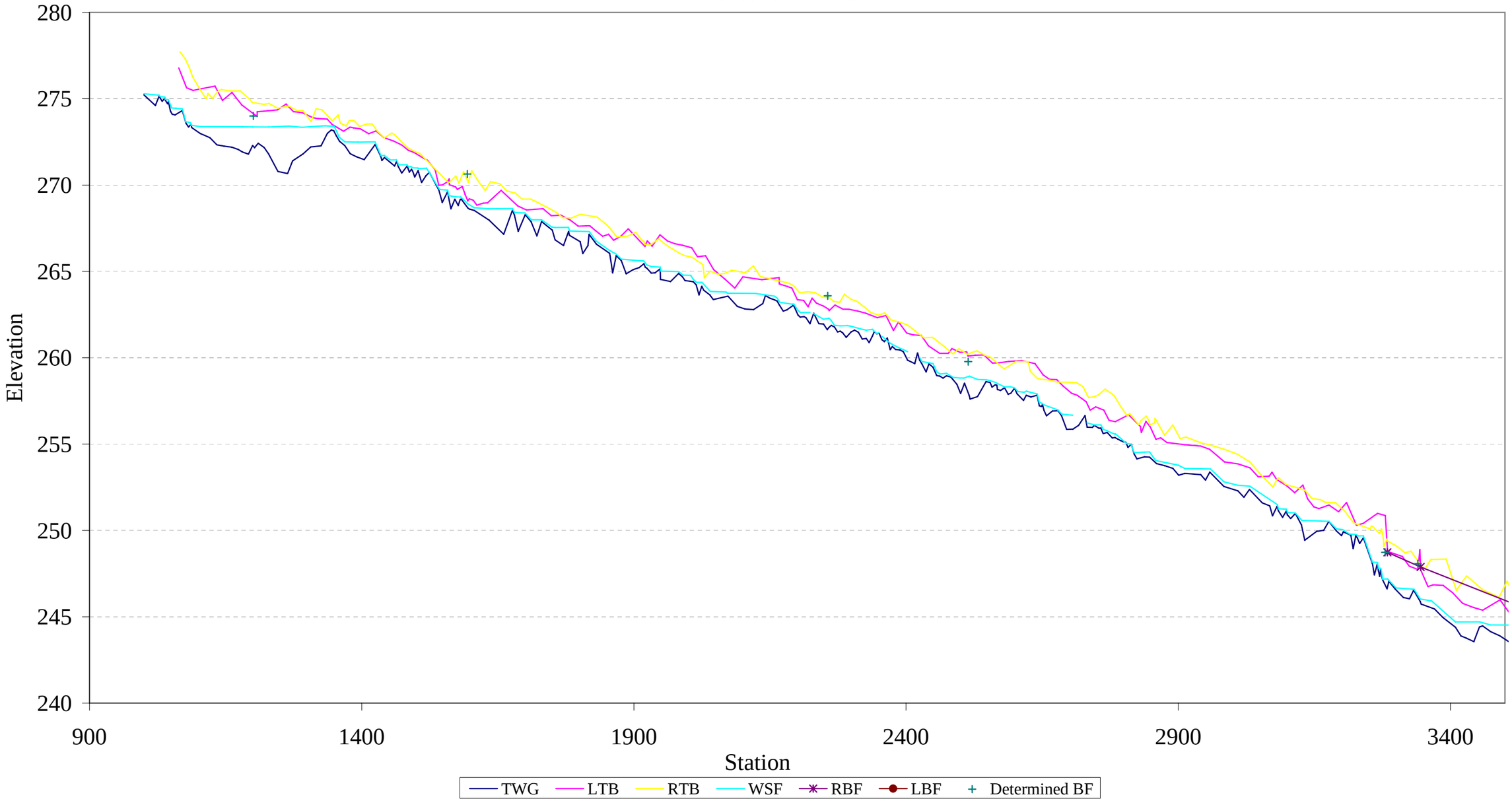
Big Cedar Creek Longitudinal Profile Chart -Part 1



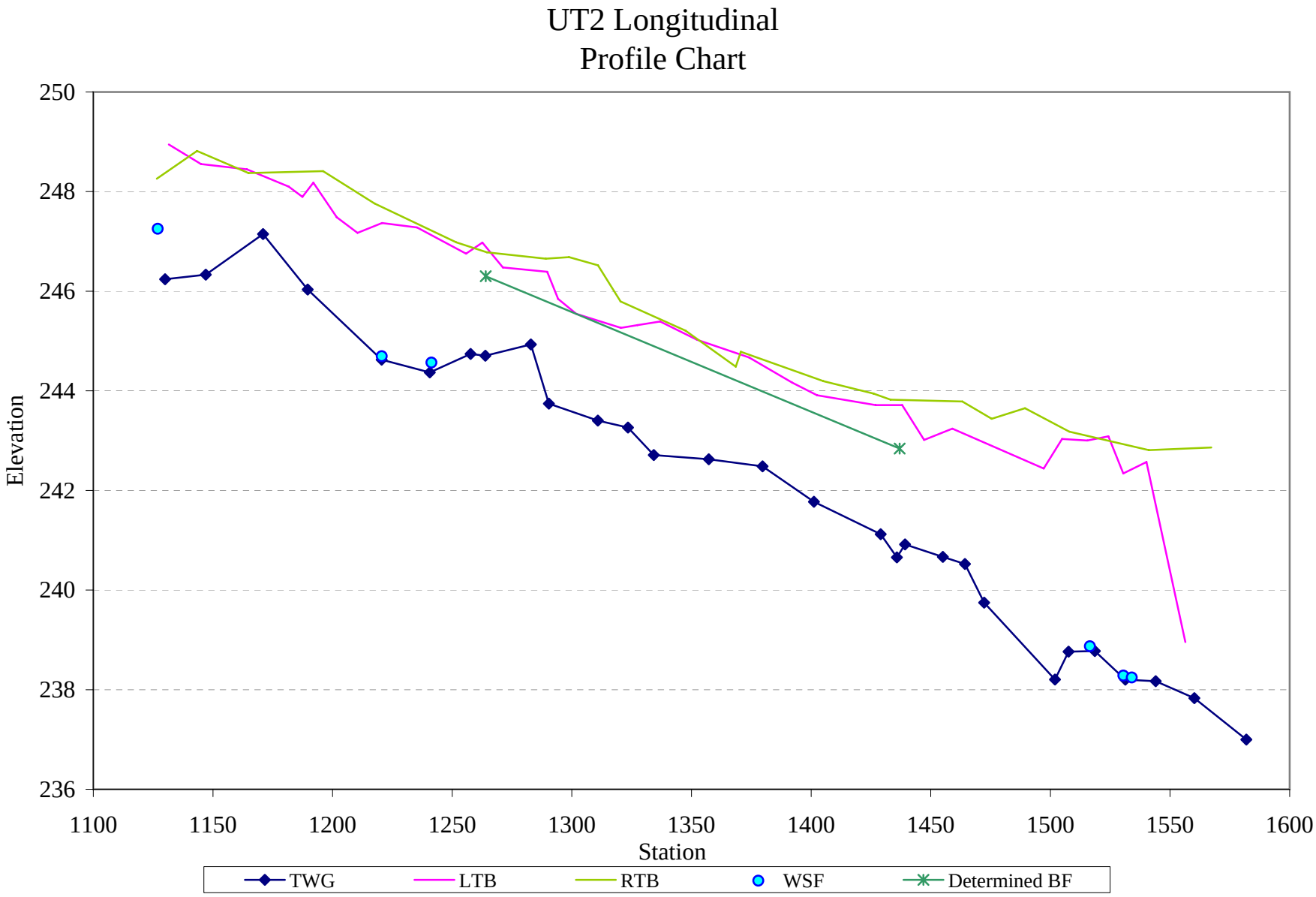
Big Cedar Creek Longitudinal Profile Chart - Part 2



UT1 Longitudinal Profile Chart - Part 1



UT1 Longitudinal Profile Chart - Part 2


UT2 Longitudinal
Profile Chart
Elevation
250
248
246
244
242
240
238
236
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
Station
TWG
LTB
RTB
WSF
Determined BF

Location: Big Cedar Creek Reach 1

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
D	D		0	23	0.0
Mod	Mod-High	3.50	0.27	22	20.8
Mod	Low	4.75	0.09	15	6.4
Mod	Low	4.50	0.09	28	11.3
Mod	Low	4.50	0.09	11	4.5
Rootwad	Rootwad		0	11	0.0
Mod	Low	4.50	0.09	18	7.3
Rootmass	Rootmass		0	10	0.0
Mod	Mod	5.75	0.18	10	10.4
High	V. High	4.50	0.8	18	64.8
Mod	Low	4.50	0.09	11	4.5
Mod	Low-Mod	5.00	0.135	20	13.5
Mod	Low	4.50	0.09	12	4.9
Mod	Mod	4.00	0.18	30	21.6
High	Mod	4.00	0.3	35	42.0
V. Low	V. Low	3.00	0.015	18	0.8
D	D		0	23	0.0
Mod	Mod	4.00	0.18	21	15.1
				TOTAL FT³/YR	227.8
Divide FT³/yr by 27				TOTAL YD³/YR	8.4
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	11.0

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Mod-High	4.25	0.27	23	26.4
V. Low	Low	3.75	0.02	22	1.7
Mod	Mod	3.75	0.18	15	10.1
Low	Low-Mod	4.50	0.051	28	6.4
Low	Low	4.50	0.034	11	1.7
Rootmass	Rootmass		0	11	0.0
Mod	Low	4.50	0.09	18	7.3
Rootmass	Rootmass		0	10	0.0
Low-Mod	Low	5.75	0.055	10	3.2
Low	V. Low	4.50	0.02	18	1.6
Mod	Mod	4.25	0.18	11	8.4
V. Low	V. Low	3.75	0.015	20	1.1
Low-Mod	Low	3.25	0.055	12	2.1
Low	Low	3.00	0.034	30	3.1
V. Low	Low	3.00	0.02	35	2.1
Low	Low	4.50	0.034	18	2.8
D	D		0	23	0.0
V. Low	V. Low	1.50	0.015	21	0.5
				TOTAL FT³/YR	78.4
				TOTAL YD³/YR	2.9
				TOTAL TONS/YR	3.8

Location: Big Cedar Creek Reach 2

Field Crew: SEG

Date: 3/28/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	Low	4.00	0.034	21	2.9
Low	Low	2.75	0.034	15	1.4
Low	Low	3.25	0.034	13	1.4
Mod	Mod	4.00	0.18	17	12.2
Mod	High	3.75	0.38	16	22.8
V. Low	Low	3.25	0.02	28	1.8
Low	Low	3.50	0.034	16	1.9
Low	Mod	3.75	0.068	19	4.9
V. Low	Low-Mod	2.50	0.023	17	1.0
Mod	Mod	4.00	0.18	19	13.7
Rootmass	Rootmass		0	9	0.0
Rootmass	Rootmass		0	7	0.0
Low-Mod	Low	3.75	0.055	14	2.9
Mod	Mod-High	4.00	0.27	20	21.6
Low	Low	3.75	0.034	17	2.2
Mod	High	3.75	0.38	15	21.4
Mod	Low	5.75	0.09	24	12.4
Mod	Mod	5.00	0.18	30	27.0
Low	Low	5.00	0.034	13	2.2
Low	Low	5.50	0.034	26	4.9
Mod	Mod	4.25	0.18	47	36.0
Mod	Mod	4.25	0.18	23	17.6
Mod	Low	4.50	0.09	18	7.3
High	High	3.75	0.5	23	43.1

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Mod	3.00	0.18	21	11.3
Low	Mod	2.50	0.068	15	2.6
V. Low	Low-Mod	1.75	0.023	13	0.5
Mod	Low	5.50	0.09	17	8.4
V. Low	V. Low	5.00	0.015	16	1.2
Mod	Mod	5.00	0.18	28	25.2
Mod	High	5.00	0.38	16	30.4
Low	Low	5.00	0.034	19	3.2
Low	Low-Mod	4.25	0.051	17	3.7
Low	Low	4.50	0.034	19	2.9
Low-Mod	Mod	4.75	0.1	9	4.3
Rootmass	Rootmass		0	7	0.0
Mod	Low	5.50	0.09	14	6.9
Low	Low-Mod	5.00	0.051	20	5.1
V. Low	V. Low	4.00	0.015	17	1.0
Low-Mod	V. Low	4.00	0.04	15	2.4
Mod	High	5.75	0.38	24	52.4
Mod	Low	5.00	0.09	30	13.5
Mod	Mod	5.00	0.18	13	11.7
Mod-High	Mod	5.75	0.25	26	37.4
High	Low-Mod	5.00	0.24	47	56.4
Mod	Mod	4.00	0.18	23	16.6
Rootmass	Rootmass		0	18	0.0
D	D		0	23	0.0

Location: Big Cedar Creek Reach 2

LEFT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Low	4.00	0.09	18	6.5
Mod	Low	4.50	0.09	25	10.1
High	Mod-High	5.25	0.4	10	21.0
Low	V. Low	4.25	0.02	22	1.9
Low-Mod	Low	4.50	0.055	15	3.7
Mod	Mod	4.50	0.18	33	26.7
Low	Mod	5.00	0.068	28	9.5
Mod	Mod	5.75	0.18	11	11.4
Low	Low-Mod	5.75	0.051	18	5.3
Mod	Low	6.00	0.09	24	13.0
Mod	Mod	6.25	0.18	31	34.9
Mod	Low	6.00	0.09	42	22.7
Low-Mod	Low	5.25	0.055	22	6.4
Mod	Mod-High	6.00	0.27	37	59.9
Mod	Mod	5.75	0.18	47	48.6
D	D		0	56	0.0
High	V. High	5.50	0.8	39	171.6
High	High	5.50	0.5	24	66.0
Mod	Low	4.75	0.09	29	12.4
Mod	Low	4.00	0.09	28	10.1
V. Low	Low	3.75	0.02	13	1.0
				TOTAL FT³/YR	805.1
Divide FT³/yr by 27				TOTAL YD³/YR	29.8
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	38.8

RIGHT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Mod	5.00	0.18	18	16.2
Mod	Low	4.00	0.09	25	9.0
Mod	Low	4.25	0.09	10	3.8
Mod	Low-Mod	5.00	0.135	22	14.9
High	Low-Mod	5.75	0.24	15	20.7
Mod	Low	5.75	0.09	33	17.1
Mod	Low-Mod	5.00	0.135	28	18.9
Mod	Mod	6.00	0.18	11	11.9
High	Low-Mod	5.75	0.24	18	24.8
Mod	Mod-High	5.75	0.27	24	37.3
Mod	Mod	6.25	0.18	31	34.9
Mod	Low	6.25	0.09	42	23.6
Low	Mod	5.00	0.068	22	7.5
Mod	Low	5.75	0.09	37	19.1
Low-Mod	Low	5.00	0.055	47	12.9
Mod	High	5.75	0.38	56	122.4
Mod	Low	5.00	0.09	39	17.6
Mod	Low	5.25	0.09	24	11.3
Mod	V. Low	4.75	0.04	29	5.5
Mod	Low	4.00	0.09	28	10.1
Rootmass	Rootmass		0	13	0.0
				TOTAL FT³/YR	736.6
				TOTAL YD³/YR	27.3
				TOTAL TONS/YR	35.5

Location: Big Cedar Creek Reach 3

Field Crew SEG

Date: 3/28/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Mod	3.50	0.18	38	23.9
Mod	Mod	4.25	0.18	41	31.4
Mod	Mod	5.50	0.18	35	34.7
Low	Mod	6.00	0.068	25	10.2
Mod	Low	6.00	0.09	12	6.5
Low	Low	3.75	0.034	13	1.7
High	High	6.00	0.5	35	105.0
Mod	High	6.00	0.38	25	57.0
High	Low	6.25	0.18	37	41.6
Mod-High	Low	4.25	0.15	30	19.1
V. High	High	5.00	0.5	18	45.0
Mod	Low	6.00	0.09	15	8.1
Rootmass	Rootmass		0	19	0.0
Mod	Low	3.75	0.09	22	7.4
Mod	Mod-High	3.75	0.27	16	16.2
Low-Mod	Mod	4.00	0.1	25	10.0
V. Low	V. Low	2.75	0.015	18	0.7
Low	Low	3.50	0.034	25	3.0
Mod	Mod	3.75	0.18	27	18.2
Rootmass	Rootmass		0	15	0.0
Mod	Low	4.50	0.09	20	8.1
D	D		0	26	0.0
Mod	V. Low	3.75	0.04	32	4.8
Low	Low	3.50	0.034	18	2.1
Rootmass	Rootmass		0	16	0.0
Low	Mod	3.00	0.068	-44	-9.0
Low	Mod-High	3.75	0.1	92	34.5

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	Mod-High	3.75	0.27	38	38.5
Mod	Low	4.50	0.09	41	16.6
Mod	Mod	4.50	0.18	35	28.4
Mod	Mod	6.00	0.18	25	27.0
Mod	Low	6.00	0.09	12	6.5
Low	Low	3.75	0.034	13	1.7
Mod	High	4.75	0.38	35	63.2
Mod	High	4.00	0.38	25	38.0
Mod	Low	4.75	0.09	37	15.8
Mod	Mod	4.25	0.18	30	23.0
D	D		0	18	0.0
Low-Mod	Low-Mod	5.50	0.078	15	6.4
Mod-High	Mod	5.50	0.25	19	26.1
High	Mod	4.25	0.3	22	28.1
V. Low	V. Low	4.25	0.015	16	1.0
D	D		0	25	0.0
V. Low	V. Low	2.75	0.015	18	0.7
Mod	Mod-High	4.25	0.27	25	28.7
Low	Low	4.00	0.034	27	3.7
Rootmass	Rootmass		0	15	0.0
D	D		0	20	0.0
Mod	Mod	3.75	0.18	26	17.6
Low	Low	3.50	0.034	32	3.8
Low-Mod	Low	3.50	0.055	18	3.5
Low	Mod	4.00	0.068	16	4.4
Low	Low	4.25	0.034	-44	-6.4
D	D		0	92	0.0

Location: Big Cedar Creek Reach 3

LEFT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
V. Low	Mod	3.75	0.025	13	1.2
Low	Low	3.75	0.034	25	3.2
Mod	Low-Mod	3.75	0.135	13	6.6
Low	V. Low	2.50	0.02	19	1.0
Mod	Mod	2.50	0.18	26	11.7
Low	Mod	3.75	0.068	42	10.7
V. Low	Low	3.00	0.02	20	1.2
V. Low	Low	2.75	0.02	17	0.9
Mod	Low	4.25	0.09	15	5.7
High	V. High	4.00	0.8	13	41.6
Mod	High	4.00	0.38	15	22.8
Low	Low	3.75	0.034	16	2.0
V. Low	V. Low	1.75	0.015	8	0.2
Mod	Mod	3.50	0.18	27	17.0
High	Mod-High	3.75	0.4	20	30.0
Mod-High	High	3.50	0.4	30	42.0
D	D		0	11	0.0
D	D		0	53	0.0
High	High	4.25	0.5	21	44.6
High	Mod-High	4.25	0.4	30	51.0
High	Mod-High	3.25	0.4	27	35.1
Mod	Mod	3.50	0.18	26	16.4
Low	Low	3.00	0.034	28	2.9
Mod	Low	4.25	0.09	37	14.2
Low	V. Low	2.00	0.02	15	0.6
D	D		0	29	0.0
Rootmass	Rootmass		0	25	0.0
Mod	Mod	3.00	0.18	26	14.0

RIGHT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	Mod	3.75	0.068	13	3.3
Low	Low	3.75	0.034	25	3.2
Low	Low	4.00	0.034	13	1.8
Low	Mod	3.50	0.068	19	4.5
Mod	V. Low	3.50	0.04	26	3.6
Rootmass	Rootmass		0	42	0.0
Mod-High	Low	3.75	0.15	20	11.3
D	D		0	17	0.0
D	D		0	15	0.0
D	D		0	13	0.0
Mod	Mod-High	4.75	0.27	15	19.2
Mod	Mod-High	4.50	0.27	16	19.4
Rootmass	Rootmass		0	8	0.0
Mod	Low	3.00	0.09	27	7.3
Mod	Mod-High	3.75	0.27	20	20.3
Mod	Low	3.75	0.09	30	10.1
Mod	Mod	3.25	0.18	11	6.4
V. High	V. High	5.00	0.8	53	212.0
D	D		0	21	0.0
Mod	Low	4.25	0.09	30	11.5
D	D		0	27	0.0
Low	Low	3.25	0.034	26	2.9
Low	Mod	3.50	0.068	28	6.7
Low-Mod	Mod-High	3.50	0.15	37	19.4
Mod	Mod	4.00	0.18	15	10.8
Mod	Mod	3.00	0.18	29	15.7
D	D		0	25	0.0
Mod	Low	3.50	0.09	26	8.2

Location: Big Cedar Creek Reach 3

LEFT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low-Mod	Mod-High	3.00	0.15	51	23.0
D	D		0	37	0.0
Low	High	3.00	0.14	27	11.3
Bedrock	Bedrock		0	15	0.0
D	D		0	17	0.0
Bedrock	Rootmass		0	53	0.0
Low	Mod	2.25	0.068	30	4.6
Mod	Low	2.75	0.09	13	3.2
D	D		0	32	0.0
D	D		0	61	0.0
V. Low	V. Low	3.00	0.015	62	2.8
D	D		0	23	0.0
D	D		0	33	0.0
Mod	V. Low	3.50	0.04	16	2.2
Rootmass	Boulder		0	77	0.0
V. Low	V. Low	3.00	0.015	32	1.4
Mod	Low	3.00	0.09	15	4.1
Low	V. Low	2.50	0.02	15	0.8
V. Low	V. Low	2.50	0.015	17	0.6
Rootmass	Rootmass		0	26	0.0
Low-Mod	Mod	3.00	0.1	27	8.1
Rootmass	Boulder		0	80	0.0
				TOTAL FT³/YR	919.0
Divide FT³/yr by 27				TOTAL YD³/YR	34.0
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	44.2

RIGHT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
D	D		0	51	0.0
Mod	Mod-High	3.00	0.27	37	30.0
D	D		0	27	0.0
D	D		0	15	0.0
Bedrock	Rootmass		0	17	0.0
Bedrock	Rootmass		0	53	0.0
D	D		0	30	0.0
Low	V. Low	1.00	0.02	13	0.3
V. Low	V. Low	1.00	0.015	32	0.5
V. Low	V. Low	2.00	0.015	61	1.8
V. Low	V. Low	2.25	0.015	62	2.1
D	D		0	23	0.0
V. Low	V. Low	2.75	0.015	33	1.4
V. Low	V. Low	2.75	0.015	16	0.7
Rootmass	Boulder		0	77	0.0
V. Low	V. Low	1.75	0.015	32	0.8
V. Low	Low	2.00	0.02	15	0.6
No erosion	No erosion		0	15	0.0
V. Low	V. Low	2.25	0.015	17	0.6
Rootmass	Rootmass		0	26	0.0
Rootmass	Rootmass		0	27	0.0
Rootmass	Rootmass		0	80	0.0
				TOTAL FT³/YR	812.3
				TOTAL YD³/YR	30.1
				TOTAL TONS/YR	39.1

Location: Big Cedar Creek Reach 4

Field Crew: SEG

Date: 3/28/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT^3/yr =(C×D×E)
Mod	Mod	3.75	0.18	32	21.6
Mod	Low-Mod	3.00	0.135	39	15.8
Mod	Mod-High	3.25	0.27	34	29.8
V. Low	V. Low	2.50	0.015	42	1.6
Low	V. Low	2.25	0.02	74	3.3
Rootmass	Boulder		0	28	0.0
D	D		0	29	0.0
V. Low	V. Low	2.25	0.015	32	1.1
V. Low	V. Low	2.25	0.015	40	1.4
Mod	Low	4.50	0.09	40	16.2
Rootmass	Rootmass		0	21	0.0
D	D		0	25	0.0
D	D		0	34	0.0
Wingwall	Wingwall		0	21	0.0
				TOTAL FT^3/YR	90.8
Divide FT^3/yr by 27				TOTAL YD^3/YR	3.4
Multiply YD^3/yr by 1.3				**TOTAL TONS/YR**	4.4

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT^3/yr =(C×D×E)
Low	Mod	3.00	0.068	32	6.5
Bedrock	Bedrock		0	39	0.0
V. Low	Low	1.25	0.02	34	0.9
V. Low	Low	1.75	0.02	42	1.5
No erosion	No erosion		0	74	0.0
Low-Mod	Mod	4.75	0.1	28	13.3
Low	Mod	3.00	0.068	29	5.9
D	D		0	32	0.0
V. Low	V. Low	2.25	0.015	40	1.4
Low	Low	5.00	0.034	40	6.8
Low	Low	4.50	0.034	21	3.2
Mod	Low	3.75	0.09	25	8.4
V. Low	V. Low	2.00	0.015	34	1.0
Wingwall	Wingwall		0	21	0.0
				TOTAL FT^3/YR	48.9
				TOTAL YD^3/YR	1.8
				TOTAL TONS/YR	2.4

Location: Big Cedar Creek Reach 5

Field Crew SEG

Date: 3/28/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
No erosion	No erosion		0	31	0.0
Mod	V. Low	2.5	0.04	68	6.8
No erosion	No erosion		0	154	0.0
Mod	High	2.5	0.38	69	65.6
Mod	High	3.5	0.38	27	35.9
High	Mod-High	4.8	0.4	24	45.6
Bedrock	Boulder		0	29	0.0
Bedrock	Boulder		0	26	0.0
Bedrock	Boulder		0	53	0.0
No erosion	No erosion		0	24	0.0
				TOTAL FT³/YR	153.9
Divide FT³/yr by 27				TOTAL YD³/YR	5.7
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	7.4

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Wingwall	Wingwall		0	31	0.0
D	D		0	68	0.0
No erosion	No erosion		0	154	0.0
No erosion	No erosion		0	69	0.0
No erosion	No erosion		0	27	0.0
V. Low	V. Low	4.0	0.015	24	1.4
Low	V. High	4.5	0.28	29	36.5
High	V. High	4.0	0.8	26	83.2
V. High	V. High	4.0	0.8	53	169.6
No erosion	No erosion		0	24	0.0
				TOTAL FT³/YR	290.8
				TOTAL YD³/YR	10.8
				TOTAL TONS/YR	14.0

Location: Big Cedar Creek Reach 6

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
D	D		0	38	0.0
Low-Mod	Low	7.00	0.055	43	16.6
Low	V. High	7.50	0.28	15	31.5
Bedrock	Bedrock		0	12	0.0
Low-Mod	Low	7.50	0.055	17	7.0
Rootmass	Bedrock		0	14	0.0
Rootmass	Bedrock		0	33	0.0
Low	Low	3.00	0.034	19	1.9
D	D		0	19	0.0
Low-Mod	V. Low	3.25	0.04	19	2.5
Low	Low-Mod	4.75	0.051	12	2.9
V. Low	Mod-High	7.50	0.04	24	7.2
Low-Mod	Mod	5.00	0.1	12	6.0
Mod-High	Low-Mod	4.25	0.2	7	6.0
Mod	High	6.00	0.38	17	38.8
Bedrock	Bedrock		0	9	0.0
Bedrock	Bedrock		0	21	0.0
Mod	Low-Mod	5.00	0.135	17	11.5
D	D		0	51	0.0
Low-Mod	Low	4.75	0.055	20	5.2
Rootmass	Rootmass		0	17	0.0
D	D		0	18	0.0
Low-Mod	Low	4.00	0.055	29	6.4
				TOTAL FT³/YR	143.4
Divide FT³/yr by 27				TOTAL YD³/YR	5.3
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	6.9

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Rootmass	Rootmass		0	38	0.0
Mod-High	V. Low	3.75	0.1	43	16.1
Mod	V. Low	3.75	0.04	15	2.3
D	D		0	12	0.0
Mod	Low-Mod	4.00	0.135	17	9.2
Mod	Low-Mod	5.75	0.135	14	10.9
V. Low	V. Low	6.75	0.015	33	3.3
High	Mod-High	8.00	0.4	19	60.8
Mod	Mod	7.00	0.18	19	23.9
High	Mod-High	6.00	0.4	19	45.6
High	Low	5.75	0.18	12	12.4
High	V. Low	5.75	0.1	24	13.8
Low	V. Low	5.00	0.02	12	1.2
Mod	V. Low	4.25	0.04	7	1.2
D	D		0	17	0.0
D	D		0	9	0.0
V. Low	V. Low	4.00	0.015	21	1.3
Mod	Mod-High	3.25	0.27	17	14.9
Low	Mod-High	3.25	0.1	51	16.6
Mod	Low-Mod	5.00	0.135	20	13.5
Wall	Wall		0	17	0.0
Mod	Low	5.00	0.09	18	8.1
Mod	Low	4.25	0.09	29	11.1
				TOTAL FT³/YR	266.2
				TOTAL YD³/YR	9.9
				TOTAL TONS/YR	12.8

Location: UT1 Reach 1

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Mod	V. Low	2.50	0.04	30	3.0
V. Low	V. Low	2.50	0.015	20	0.8
Low	Mod	3.25	0.068	28	6.2
Mod	Low	3.25	0.09	29	8.5
V. Low	V. Low	1.50	0.015	27	0.6
V. Low	Low	1.00	0.02	26	0.5
Low	Low	2.00	0.034	60	4.1
D	D		0	37	0.0
V. Low	V. Low	1.00	0.015	19	0.3
V. Low	Low	1.25	0.02	17	0.4
V. Low	V. Low	1.00	0.015	52	0.8
Low	Low	1.75	0.034	34	2.0
Low	Mod	1.75	0.068	24	2.9
D	D		0	26	0.0
D	D		0	14	0.0
D	D		0	24	0.0
D	D		0	36	0.0
D	D		0	22	0.0
Low	Low	2.25	0.034	23	1.8
V. Low	Low-Mod	1.50	0.023	42	1.4
V. Low	V. Low	1.25	0.015	28	0.5
Low	Low	1.00	0.034	12	0.4
D	D		0	69	0.0
D	D		0	11	0.0
D	D		0	14	0.0
D	D		0	12	0.0
Low	Mod	2.00	0.068	13	1.8

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	Mod-High	2.50	0.1	30	7.5
Mod	Low-Mod	3.00	0.135	20	8.1
Mod	Low	3.25	0.09	28	8.2
Low-Mod	Low	3.25	0.055	29	5.2
High	Low	2.50	0.18	27	12.2
Low-Mod	Low	2.00	0.055	26	2.9
Low	Low	2.00	0.034	60	4.1
D	D		0	37	0.0
V. Low	Low-Mod	1.00	0.023	19	0.4
V. Low	Low	1.25	0.02	17	0.4
V. Low	V. Low	1.25	0.015	52	1.0
Low	Low	1.75	0.034	34	2.0
V. Low	V. Low	1.75	0.015	24	0.6
D	D		0	26	0.0
Low-Mod	Mod	2.25	0.1	14	3.2
D	D		0	24	0.0
High	High	2.50	0.5	36	45.0
Mod	Low-Mod	2.50	0.135	22	7.4
Mod	Low	2.50	0.09	23	5.2
Low	Low	1.75	0.034	42	2.5
Mod	Low-Mod	1.75	0.135	28	6.6
V. Low	V. Low	1.25	0.015	12	0.2
D	D		0	69	0.0
V. Low	V. Low	1.25	0.015	11	0.2
V. Low	Low	2.00	0.02	14	0.6
D	D		0	12	0.0
Mod	High	2.00	0.38	13	9.9

Location: UT1 Reach 1

LEFT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	V. Low	1.50	0.02	16	0.5
Low	Mod-High	2.00	0.1	17	3.4
Low-Mod	Low	2.25	0.055	10	1.2
Mod	Mod	2.50	0.18	28	12.6
D	D		0	10	0.0
Mod	Low-Mod	3.00	0.135	25	10.1
Low	Mod-High	3.00	0.1	11	3.3
D	D		0	16	0.0
D	D		0	15	0.0
D	D		0	38	0.0
V. Low	Low	1.50	0.02	15	0.5
D	D		0	24	0.0
D	D		0	38	0.0
D	D		0	38	0.0
D	D		0	20	0.0
D	D		0	19	0.0
V. Low	V. Low	1.50	0.015	37	0.8
V. Low	V. Low	1.50	0.015	20	0.5
Boulder	Boulder		0	30	0.0
V. Low	V. Low	1.25	0.015	18	0.3
V. Low	V. Low	1.25	0.015	35	0.7
V. Low	Low-Mod	1.25	0.023	20	0.6
V. Low	Low-Mod	2.25	0.023	28	1.4
Low	Low	2.25	0.034	20	1.5
Low	Low	2.25	0.034	28	2.1
V. Low	Low	1.50	0.02	41	1.2
Low	Low-Mod	2.00	0.051	10	1.0
V. Low	Low	1.00	0.02	13	0.3
D	D		0	17	0.0

RIGHT BANK					
A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	Mod	1.50	0.068	16	1.6
D	D		0	17	0.0
Low	Low-Mod	2.25	0.051	10	1.1
V. Low	V. Low	1.75	0.015	28	0.7
V. Low	V. Low	1.50	0.015	10	0.2
V. Low	V. Low	1.25	0.015	25	0.5
D	D		0	11	0.0
V. Low	Mod	2.00	0.025	16	0.8
V. Low	V. Low	1.00	0.015	15	0.2
Low	V. Low	2.00	0.02	38	1.5
V. Low	Low	1.50	0.02	15	0.5
D	D		0	24	0.0
V. Low	V. Low	1.00	0.015	38	0.6
D	D		0	38	0.0
V. Low	V. Low	1.00	0.015	20	0.3
D	D		0	19	0.0
Low	V. Low	1.75	0.02	37	1.3
V. Low	V. Low	1.50	0.015	20	0.5
Boulder	Boulder		0	30	0.0
V. Low	Low-Mod	2.00	0.023	18	0.8
Low	Low	2.00	0.034	35	2.4
Low	V. Low	2.00	0.02	20	0.8
D	D		0	28	0.0
Low	Low-Mod	2.25	0.051	20	2.3
Low	Low	2.00	0.034	28	1.9
Low	Low	2.00	0.034	41	2.8
Low	Low	2.00	0.034	10	0.7
Low	Low	2.00	0.034	13	0.9
Woody Debris	Woody Debris		0	17	0.0

Location: UT1 Reach 1

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
V. Low	Low	2.00	0.02	49	2.0
Low	V. Low	2.00	0.02	16	0.6
Low	Low	1.50	0.034	30	1.5
V. Low	Low	1.50	0.02	32	1.0
V. Low	V. Low	1.50	0.015	11	0.2
V. Low	Mod	2.00	0.025	11	0.6
D	D		0	11	0.0
Rootwad	Rootwad		0	13	0.0
Low	Low-Mod	2.00	0.051	11	1.1
D	D		0	9	0.0
V. Low	Low-Mod	1.75	0.023	10	0.4
D	D		0	17	0.0
Low	Mod	2.75	0.068	10	1.9
Low	Low	2.00	0.034	6	0.4
Low	Low-Mod	1.50	0.051	10	0.8
Low	V. Low	1.75	0.02	23	0.8
D	D		0	23	0.0
V. Low	Low	1.50	0.02	14	0.4
Low	V. Low	1.25	0.02	11	0.3
Low	Mod	1.50	0.068	14	1.4
Rootmass	Rootmass		0	30	0.0
Low-Mod	V. Low	2.25	0.04	27	2.4
Low	V. Low	1.75	0.02	23	0.8
				TOTAL FT³/YR	94.6
Divide FT³/yr by 27				TOTAL YD³/YR	3.5
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	4.6

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
V. Low	Low	2.00	0.02	49	2.0
V. Low	V. Low	2.25	0.015	16	0.5
Low	Low	2.25	0.034	30	2.3
Low-Mod	Low	2.25	0.055	32	4.0
Low	Mod	1.75	0.068	11	1.3
Boulder	Boulder		0	11	0.0
Boulder	Boulder		0	11	0.0
Low	Mod	2.25	0.068	13	2.0
Rootwad	Rootwad		0	11	0.0
D	D		0	9	0.0
D	D		0	10	0.0
Mod	Low	2.75	0.09	17	4.2
Low	Mod	2.75	0.068	10	1.9
Low	Mod-High	3.00	0.1	6	1.8
Woody Debris	Woody Debris		0	10	0.0
Low	V. Low	1.75	0.02	23	0.8
Boulder	Boulder		0	23	0.0
Low	V. Low	2.00	0.02	14	0.6
V. Low	V. Low	2.00	0.015	11	0.3
Low	V. Low	2.00	0.02	14	0.6
D	D		0	30	0.0
V. Low	Mod	1.75	0.025	27	1.2
Low	Mod	1.50	0.068	23	2.3
				TOTAL FT³/YR	181.4
				TOTAL YD³/YR	6.7
				TOTAL TONS/YR	8.7

Location: UT1 Reach 2

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Bedrock	Bedrock		0	18	0.0
Low	Low	1.25	0.034	34	1.4
V. Low	Mod	0.50	0.025	13	0.2
D	D		0	11	0.0
V. Low	Low	1.50	0.02	24	0.7
D	D		0	23	0.0
D	D		0	7	0.0
Rootmass	Bedrock		0	10	0.0
Rootmass	Bedrock		0	12	0.0
Rootmass	Bedrock		0	27	0.0
Rootmass	Bedrock		0	10	0.0
Rootmass	Bedrock		0	16	0.0
D	D		0	29	0.0
D	D		0	18	0.0
Rootmass	Boulder		0	11	0.0
Rootmass	Boulder		0	22	0.0
D	D		0	30	0.0
Rootmass	Boulder		0	26	0.0
V. Low	V. Low	1.50	0.015	29	0.7
D	D		0	56	0.0
D	D		0	24	0.0
Rootmass	Rootmass		0	55	0.0
No erosion	No erosion		0	40	0.0
D	D		0	19	0.0
D	D		0	27	0.0
D	D		0	20	0.0
				TOTAL FT³/YR	3.0
Divide FT³/yr by 27				TOTAL YD³/YR	0.1
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	0.1

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	Low	1.75	0.034	18	1.1
Low	Low	1.25	0.034	34	1.4
Boulder	Boulder		0	13	0.0
V. Low	V. Low	0.75	0.015	11	0.1
V. Low	Low	0.75	0.02	24	0.4
D	D		0	23	0.0
Low	Mod	2.00	0.068	7	1.0
Rootmass	Bedrock		0	10	0.0
Mod	Low-Mod	2.25	0.135	12	3.6
Bedrock	Bedrock		0	27	0.0
Low-Mod	Low	2.00	0.055	10	1.1
V. Low	Low-Mod	2.00	0.023	16	0.7
Mod	Mod-High	3.25	0.27	29	25.4
Bedrock	Boulder		0	18	0.0
V. Low	V. Low	3.25	0.015	11	0.5
Mod-High	High	4.00	0.4	22	35.2
V. Low	Low	2.50	0.02	30	1.5
V. Low	V. Low	2.50	0.015	26	1.0
V. Low	V. Low	2.50	0.015	29	1.1
D	D		0	56	0.0
Low	Low	2.00	0.034	24	1.6
Bedrock	Bedrock		0	55	0.0
No erosion	No erosion		0	40	0.0
Low	V. Low	1.25	0.02	19	0.5
Low	Mod	2.00	0.068	27	3.7
Low-Mod	Low	2.00	0.055	20	2.2
				TOTAL FT³/YR	82.2
				TOTAL YD³/YR	3.0
				TOTAL TONS/YR	4.0

Location: UT1 Reach 3

Field Crew: SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
D	D		0	9	0.0
D	D		0	15	0.0
No erosion	No erosion		0	43	0.0
D	D		0	16	0.0
No erosion	No erosion		0	13	0.0
Low	Low-Mod	2.00	0.051	15	1.5
D	D		0	19	0.0
Low	High	2.25	0.14	11	3.5
D	D		0	14	0.0
D	D		0	20	0.0
V. Low	V. Low	2.00	0.015	19	0.6
D	D		0	11	0.0
D	D		0	13	0.0
D	D		0	32	0.0
Boulder	Bedrock		0	103	0.0
Low	Mod	3.50	0.068	20	4.8
V. Low	Low-Mod	2.00	0.023	21	1.0
V. Low	V. Low	2.00	0.015	55	1.7
V. Low	V. Low	2.00	0.015	24	0.7
No erosion	No erosion		0	11	0.0
Low	V. Low	2.25	0.02	25	1.1
Rootwad	Rootwad		0	15	0.0
Rootwad	Rootwad		0	23	0.0
No erosion	No erosion		0	20	0.0

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
V. Low	V. Low	2.25	0.015	9	0.3
Low	V. Low	2.25	0.02	15	0.7
No erosion	No erosion		0	43	0.0
V. Low	Low-Mod	1.50	0.023	16	0.6
D	D		0	13	0.0
V. Low	V. Low	1.50	0.015	15	0.3
D	D		0	19	0.0
D	D		0	11	0.0
Low	Mod	1.75	0.068	14	1.7
Low	V. Low	2.00	0.02	20	0.8
Low	V. Low	2.00	0.02	19	0.8
D	D		0	11	0.0
V. Low	Low	1.25	0.02	13	0.3
V. Low	Low	1.00	0.02	32	0.6
Boulder	Bedrock		0	103	0.0
Boulder	Bedrock		0	20	0.0
V. Low	V. Low	2.00	0.015	21	0.6
V. Low	V. Low	2.00	0.015	55	1.7
No erosion	No erosion		0	24	0.0
No erosion	No erosion		0	11	0.0
No erosion	No erosion		0	25	0.0
D	D		0	15	0.0
Low	Low-Mod	2.25	0.051	23	2.6
V. Low	Mod-High	1.00	0.04	20	0.8

Location: UT1 Reach 3

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT^3/yr =(C×D×E)
Low	Low	2.00	0.034	31	2.1
No erosion	No erosion		0	165	0.0
No erosion	No erosion		0	23	0.0
No erosion	No erosion		0	48	0.0
Low	V. Low	2.50	0.02	36	1.8
V. Low	V. Low	2.25	0.015	59	2.0
Low	Mod	3.00	0.068	25	5.1
Mod-High	V. High	3.00	0.8	11	26.4
V. High	V. High	4.00	0.8	4	12.8
High	Mod-High	4.00	0.4	20	32.0
V. Low	Mod	2.00	0.025	23	1.2
No erosion	No erosion		0	20	0.0
D	D		0	53	0.0
D	D		0	22	0.0
V. Low	Mod-High	2.50	0.04	17	1.7
V. Low	Mod	1.75	0.025	13	0.6
V. Low	Low	1.75	0.02	13	0.5
Xing	Xing		0	7	0.0
				TOTAL FT^3/YR	100.9
Divide FT^3/yr by 27				TOTAL YD^3/YR	3.7
Multiply YD^3/yr by 1.3				**TOTAL TONS/YR**	4.9

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT^3/yr =(C×D×E)
V. Low	Low	1.00	0.02	31	0.6
No erosion	No erosion		0	165	0.0
V. Low	Low-Mod	1.00	0.023	23	0.5
No erosion	No erosion		0	48	0.0
V. Low	V. Low	1.00	0.015	36	0.5
D	D		0	59	0.0
D	D		0	25	0.0
D	D		0	11	0.0
V. Low	Mod	1.75	0.025	4	0.2
Low	Mod-High	3.00	0.1	20	6.0
No erosion	No erosion		0	23	0.0
No erosion	No erosion		0	20	0.0
Low	Mod-High	2.25	0.1	53	11.9
Low	High	2.00	0.14	22	6.2
Mod-High	V. High	2.25	0.8	17	30.6
Mod-High	Mod	2.75	0.25	13	8.9
Low-Mod	V. High	3.00	0.4	13	15.6
Xing	Xing		0	7	0.0
				TOTAL FT^3/YR	92.9
				TOTAL YD^3/YR	3.4
				TOTAL TONS/YR	4.5

Location: UT1 Reach 4

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
D	D		0	20	0.0
D	D		0	22	0.0
Low-Mod	Low	3.25	0.055	32	5.7
Rootwad	Rootwad		0	60	0.0
V. Low	V. Low	3.25	0.015	11	0.5
Low	V. Low	3.25	0.02	21	1.4
V. Low	V. Low	3.25	0.015	12	0.6
Mod-High	Mod	3.50	0.25	25	21.9
Mod	Mod-High	3.50	0.27	32	30.2
Mod	Low-Mod	3.25	0.135	58	25.4
High	High	3.75	0.5	77	144.4
Mod	Mod-High	3.75	0.27	28	28.4
High	Mod-High	4.50	0.4	11	19.8
Culvert	Culvert		0	66	0.0
D	D		0	22	0.0
Bedrock	Bedrock		0	19	0.0
Low	Low-Mod	2.00	0.051	58	5.9
Mod	High	2.50	0.38	26	24.7
Mod	V. High	2.50	0.78	30	58.5
Mod	High	2.00	0.38	20	15.2
D	D		0	15	0.0
D	D		0	23	0.0
				TOTAL FT³/YR	382.6
Divide FT³/yr by 27				TOTAL YD³/YR	14.2
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	18.4

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
No erosion	No erosion		0	20	0.0
V. Low	V. High	4.50	0.08	22	7.9
D	D		0	32	0.0
D	D		0	60	0.0
V. Low	Mod	2.25	0.025	11	0.6
V. Low	V. Low	2.25	0.015	21	0.7
V. Low	V. Low	2.50	0.015	12	0.5
D	D		0	25	0.0
D	D		0	32	0.0
No erosion	No erosion		0	58	0.0
D	D		0	77	0.0
D	D		0	28	0.0
D	D		0	11	0.0
Culvert	Culvert		0	66	0.0
Mod	V. High	5.00	0.78	22	85.8
D	D		0	19	0.0
Low	Mod	3.25	0.068	58	12.8
D	D		0	26	0.0
D	D		0	30	0.0
D	D		0	20	0.0
D	D		0	15	0.0
Low-Mod	High	3.00	0.25	23	17.3
				TOTAL FT³/YR	125.6
				TOTAL YD³/YR	4.7
				TOTAL TONS/YR	6.0

Location: UT2

Field Crew SEG

Date: 3/23/2007

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	V. Low	1.00	0.02	39	0.8
Low-Mod	Low	2.25	0.055	9	1.1
High	V. High	3.00	0.8	13	31.2
Mod	Mod	2.00	0.18	10	3.6
D	D		0	11	0.0
High	High	3.25	0.5	14	22.8
Low-Mod	Low	2.75	0.055	18	2.7
D	D		0	9	0.0
D	D		0	2	0.0
Mod	Mod	2.25	0.18	13	5.3
D	D		0	11	0.0
Mod	High	3.00	0.38	11	12.5
Low	Low	2.50	0.034	20	1.7
Low	V. Low	2.25	0.02	45	2.0
Low	Low	2.25	0.034	8	0.6
High	Mod-High	3.00	0.4	17	20.4
Low-Mod	High	2.00	0.25	8	4.0
D	D		0	9	0.0
D	D		0	16	0.0
High	High	4.25	0.5	17	36.1
Mod	Mod	4.00	0.18	21	15.1
Mod	Mod	2.50	0.18	9	4.1
				TOTAL FT³/YR	164.0
Divide FT³/yr by 27				TOTAL YD³/YR	6.1
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	7.9

RIGHT BANK

A	B	C	D	E	F
BEHI	NBS	BK HEIGHT	FEET/YR (from curve)	DISTANCE(note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)
Low	V. Low	1.00	0.02	39	0.8
V. Low	Mod-High	1.50	0.04	9	0.5
D	D		0	13	0.0
D	D		0	10	0.0
High	High	3.50	0.5	11	19.3
V. Low	V. Low	2.75	0.015	14	0.6
V. Low	V. Low	2.00	0.015	18	0.5
Low-Mod	Mod	2.50	0.1	9	2.3
High	V. High	3.00	0.8	2	4.8
V. High	High	3.00	0.5	13	19.5
High	High	3.00	0.5	11	16.5
D	D		0	11	0.0
Low	Low	2.50	0.034	20	1.7
V. Low	Low	2.25	0.02	45	2.0
D	D		0	8	0.0
D	D		0	17	0.0
D	D		0	8	0.0
Mod	Mod-High	3.00	0.27	9	7.3
Extreme	V. High	4.00	6	16	384.0
D	D		0	17	0.0
Mod-High	Low	4.25	0.15	21	13.4
High	Low	5.00	0.18	9	8.1
				TOTAL FT³/YR	481.2
				TOTAL YD³/YR	17.8
				TOTAL TONS/YR	23.2

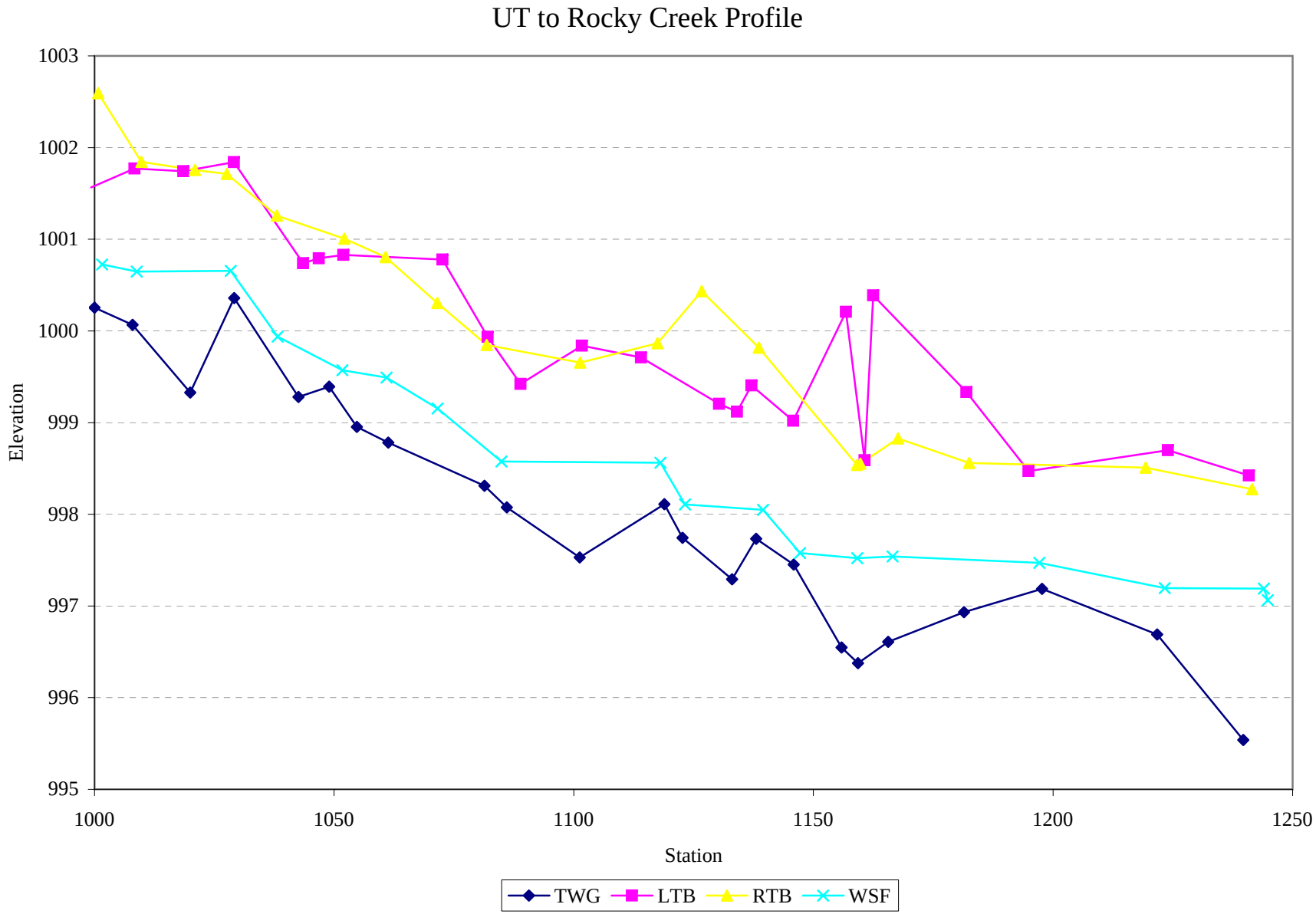
Appendix D
Reference Reach Survey Data and Photographs

UT to Rocky Creek – surveyed riffle cross section. This channel is completely connected to its floodplain.

UT to Rocky Creek – surveyed pool cross section. This is a stable scour pool in a meander bend.

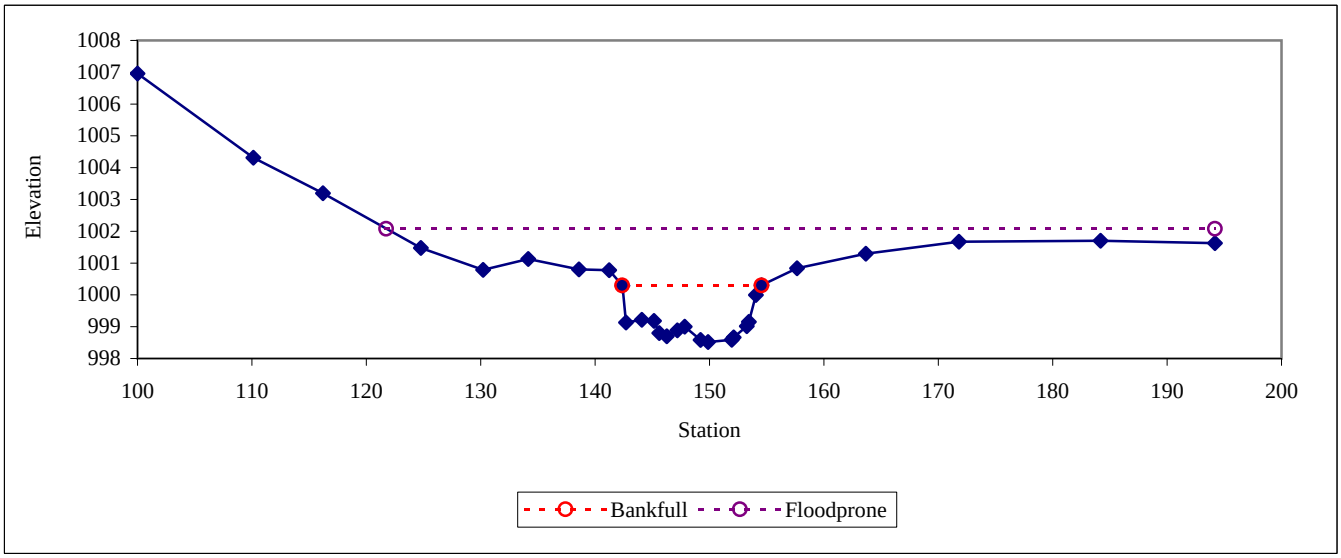
UT to Rocky Creek – riffle and pool sequence.

UT to Rocky Creek – looking upstream.


UT to Rocky Creek Profile
Elevation
1003
1002
1001
1000
999
998
997
996
995
1000
1050
1100
1150
1200
1250
Station
TWG
LTB
RTB
WSF

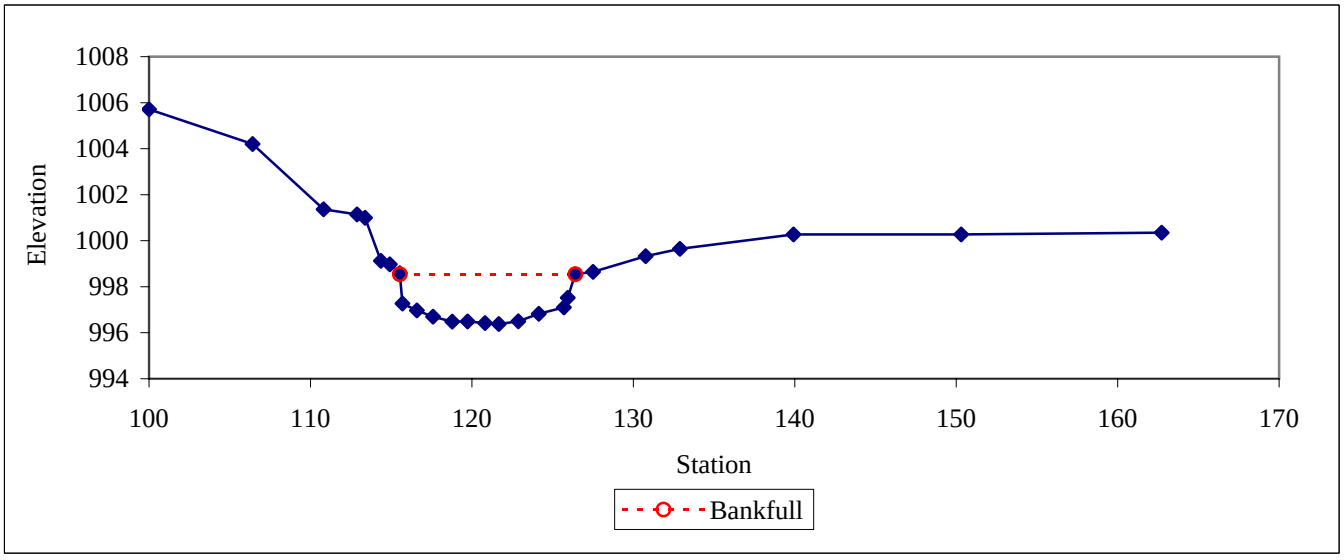
Cross-section Data: UT to Rocky Creek - Riffle

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E4b	16.3	12.2	1.3	1.8	9.1	1.0	5.9	1000.3	1000.3



Cross-section Data: UT to Rocky Creek - Pool

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		19.3	10.9	1.8	2.2	6.1	1.0		998.5	998.5



Appendix E
Stream Identification Forms

Ecosystem Enhancement Program

LEGEND

Town of Norwood

Streams

Parcels

Project Area

0 400 800 Feet

EEP Project No.: D06054-D

September 2007

Stream IDs - Intermittent/ Perennial Stream Calls
Big Cedar Creek Restoration Project
Stanly County, NC

Baker

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

Date: 3/7/06	Project: THOMPSON	Latitude:
Evaluator: EAM	Site: BIG CEDAR CREEK (MAIN STEM)	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 45	County: STANLY	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 22.0)	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 = 9.0)				
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 = 14)				
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.)

SOME MATURE TREES IN RIPARIAN BUFFER
GOOD SUBSTRATE

Sketch:

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

Date: 3/7/06 (UT1)	**Project:** THOMPSON FARM	**Latitude:**	
Evaluator: SAM	**Site:** (UT1)	**Longitude:**	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 34.0	**County:** STANLY	**Other** *e.g. Quad Name:*	

A. Geomorphology (Subtotal = 17.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity ~ CHANNELIZED (MG)	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 BEDROCK KNICK PTS	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) (4)		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 = 10.0)				
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: 3/7/06	Project: THOMPSON FARM	Latitude:
Evaluator: FAM	Site: UT 2	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 32.5	County: STANLEY	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 = 7.0)				
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 = 9.0)				
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: 5-18-07	**Project:** Big Cedar Creek	**Latitude:**
Evaluator: D. Huneycutt	**Site:** A	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 14.0	**County:** Stanly	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 6.5)	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 = 1.5)				
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 = 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 side of this form for additional notes.)

Sketch:

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

Date: 5-18-07	**Project:** Big Cedar Creek	**Latitude:**	
Evaluator: P. Hunegnet	**Site:** B	**Longitude:**	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 15.5	**County:** Stanly	**Other** *e.g. Quad Name:*	

A. Geomorphology (Subtotal = 9.5)	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 = 1.5)				
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 = 4.5)				
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: 5-18-07	**Project:** Big Cedar	**Latitude:**	
Evaluator: D. Honeycutt	**Site:** B(2)	**Longitude:**	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 22	**County:** Stanly	**Other** *e.g. Quad Name:*	

A. Geomorphology (Subtotal = 12)	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 = 4.5)				
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 = 5.5)				
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.)

B(2) - water below headcut or what could be a spring (not flowing

Sketch:

- lots of crayfish, amphipods, midge, alderfly (very small)

ONLY

A section is ~ 20-25' from confluence and below headcut or spring

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

Date: 5-18-07	**Project:** Big Cedar	**Latitude:**
Evaluator: P Honeycutt	**Site:** C	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 25.25	**County:** Stanly	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	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 = 5.5)				
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 = 6.25)				
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.)

Midges

Form Done ~ 75-100' upstream from confluence

Sketch:

Appendix F
HEC-RAS Analysis

BIG CEDAR CREEK

	Reach	River Sta	Profile	Existing Cond W.S. Elev (ft)	Proposed Cond W.S. Elev (ft)	Rise in WSEL (ft)
	REACH 1	48	100 YR	249.27	249.27	0
	REACH 1	47	100 YR	248.78	248.78	0
	REACH 1	46	100 YR	247.54	247.54	0
Project Start	REACH 1	45	100 YR	246.31	246.04	-0.27
	REACH 1	44	100 YR	243.59	243.3	-0.29
	REACH 1	43	100 YR	243.3	242.61	-0.69
	REACH 1.5	43	100 YR	243.2	242.48	-0.72
	REACH 1.5	42	100 YR	242.44	242.38	-0.06
	REACH 1.5	41	100 YR	241.41	241.53	0.12
	REACH 1.5	40	100 YR	240	240.99	0.99
	REACH 1.5	39	100 YR	238.79	239.79	1
	REACH 1.5	38	100 YR	238.68	239.18	0.5
	REACH 1.5	37	100 YR	237.88	238.65	0.77
	REACH 1.5	36	100 YR	237.21	238.15	0.94
	REACH 1.5	35	100 YR	237.03	237.47	0.44
	REACH 1.5	34	100 YR	236	236.24	0.24
	REACH 1.5	33	100 YR	234.45	235.57	1.12
	REACH 1.5	32	100 YR	234.14	234.83	0.69
	REACH 1.5	31	100 YR	232.73	233.31	0.58
	REACH 1.5	30	100 YR	232.18	232.39	0.21
	REACH 1.5	29	100 YR	231.15	231.38	0.23
	REACH 1.5	28	100 YR	230.98	230.92	-0.06
	REACH 1.5	27	100 YR	229.85	230.09	0.24
	REACH 1.5	26	100 YR	229.56	229.47	-0.09
	REACH 1.5	25	100 YR	229.34	229.35	0.01
	REACH 1.5	24	100 YR	229.25	229.31	0.06
	REACH 1.5	23	100 YR	229.12	229.14	0.02
	REACH 1.5	22	100 YR	229.11	229.12	0.01
	REACH 1.5	21	100 YR	229.1	229.11	0.01
	REACH 1.5	20	100 YR	229.1	229.11	0.01
	REACH 1.5	19	100 YR	229.1	229.1	0
	REACH 1.5	18	100 YR	229.1	229.1	0
	REACH 1.5	17	100 YR	229.1	229.1	0
	REACH 1.5	16	100 YR	229.09	229.09	0
	REACH 1.5	15	100 YR	229.09	229.09	0
	REACH 1.5	14	100 YR	229.09	229.09	0
	REACH 1.5	13.5				0
	REACH 1.5	13	100 YR	229.01	229.01	0
	REACH 1.5	12	100 YR	229.01	229.01	0
	REACH 1.5	11	100 YR	229.01	229.01	0
	REACH 1.5	10	100 YR	229	229	0
	REACH 1.5	9	100 YR	229	229	0
	REACH 1.5	8	100 YR	229.01	229.01	0
	REACH2	8	100 YR	229.01	229.01	0
	REACH2	7	100 YR	229	229	0
	REACH2	6	100 YR	229	229	0
	REACH2	5	100 YR	229	229	0
	REACH2	4	100 YR	229	229	0
	REACH2	3	100 YR	229	229	0
Project End	REACH2	2	100 YR	229	229	0
	REACH2	1	100 YR	229	229	0

UT1

	Reach	River Sta	Profile	Existing Cond W.S. Elev (ft)	Proposed Cond W.S. Elev (ft)	Rise in WSEL (ft)
	REACH 1	15	100 YR	281.33	281.33	0
Project Start	REACH 1	14	100 YR	280.46	280.46	0
	REACH 1	13	100 YR	279.32	277.22	-2.1
	REACH 1	12	100 YR	275.82	276.17	0.35
	REACH 1	11	100 YR	273.46	274.45	0.99
	REACH 1	10	100 YR	270.92	272.18	1.26
	REACH 1	9	100 YR	267.07	267.73	0.66
	REACH 1	8	100 YR	261.84	261.12	-0.72
	REACH 1	7	100 YR	252.47	252.68	0.21
	REACH 1	6	100 YR	242.79	242.74	-0.05
	REACH 1	5	100 YR	231.48	231.11	-0.37
	REACH 1	4	100 YR	229.03	229.03	0
	REACH 1	3	100 YR	229	229	0
Project End	REACH 1	2	100 YR	229.01	229.01	0
	REACH 1	1	100 YR	229.01	229.01	0

UT2

	Reach	River Sta	Profile	Existing Cond W.S. Elev (ft)	Proposed Cond W.S. Elev (ft)	Rise in WSEL (ft)
	REACH 1	6	100 YR	254.72	254.72	0
Project Start	REACH 1	5	100 YR	251.76	251.76	0
	REACH 1	4	100 YR	250.21	250.23	0.02
	REACH 1	3	100 YR	248.2	248.17	-0.03
	REACH 1	2	100 YR	246.52	246.6	0.08
Project End	REACH 1	1	100 YR	244.48	244.66	0.18