BAILEY FORK WETLAND AND STREAM RESTORATION PROJECT (DRAFT)

ANNUAL MONITORING REPORT FOR 2007 (YEAR 2)

Project Number D04006-3

Submitted to:

NCDENR - Ecosystem Enhancement Program
2728 Capital Blvd, Suite 1H 103
Raleigh, NC 27604

Prepared for: EBX Neuse-I, LLC

909 Capability Drive
Suite 3100
Raleigh, NC 27606

Prepared by: Baker Engineering NY, Inc.

Baker Engineering NY, Inc.
8000 Regency Parkway
Suite 200
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

December 2007

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1.0 SUMMARY

This Annual Report details the monitoring activities during the 2007 growing season (Monitoring Year 2) on the Bailey Fork Wetland and Stream Restoration Site ("Site"). Construction of the Site, including planting of trees, was completed in April 2006. In order to document project success, 21 vegetation monitoring plots, 13 permanent cross-sections, 3 longitudinal profile surveys, and 8 hydrologic monitoring gauges (4 automated and 4 manual) were installed and/or assessed across the restoration site. The 2007 data represent results from the second year of vegetation and hydrologic monitoring for both wetlands and streams.

The design for the Bailey Fork Site involved the restoration of a "Piedmont/ Low Mountain alluvial forest" and associated riverine wetlands described by Schafale and Weakley (1990). Prior to restoration, wetland, stream, and buffer functions on the Site were impaired as a result of agricultural conversion. Streams flowing through the Site were channelized many years ago to reduce flooding and provide drainage for adjacent farm fields. After construction, it was determined that 12.1 acres of riverine wetlands and 6,097 linear feet (LF) of stream were restored, and 5.3 acres of riverine wetlands and 9,765 LF of stream were enhanced.

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2007 growing season, total rainfall during the monitoring period was well below the normal average (approximately 11.4 inches less from January 2007 through October 2007). Much of the rain that fell during the 2007 growing season fell during the months of June, August, and September when evapotranspiration losses were highest.

A total of 21 monitoring plots, each 100 square meters (m^2) (10m x 10m) in size, were used to document survivability of the woody vegetation planted at the Site. In 2007 the vegetation monitoring documented an average tree density of 537 stems per acre. The data reflects that the majority of the Site is on track to meet the interim success criteria of 320 trees per acre by the end of Year 3 and the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for the Site. To increase the density of successfully established trees in several areas at the Site, supplemental planting of woody vegetation in three isolated zones will occur prior to the start of the 2008 growing season.

Stream cross-sectional data document that there has been some adjustment to stream dimension since construction. The results of the longitudinal profiles document that the pools have aggraded slightly due accumulated sediment. It is likely that these sediments are present in the pools due to the below normal rainfall conditions during 2007. The Site experienced at least two bankfull events during 2007. Overall, monitoring indicates that the site is on track to achieve the stream morphology success criteria specified in the Restoration Plan for the Site.

Six of the eight wells achieved the success criteria of greater than 7% saturation during the growing season. Two wells recorded hydroperiods below the 7% success criteria specified in the Restoration Plan for the Site, but these hydroperiods were greater than those recorded by the monitoring wells at the reference wetland site. The site remains on track to achieve the hydrophytic success criteria specified in the Restoration Plan for the Site.

The Site exhibited excellent riffle pool sequencing, pattern, and habitat diversity for benthic macroinvertebrates. It is anticipated that continued improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities continue to re-establish.

In summary, the Site remains on track to achieve the hydrologic, vegetative and stream success criteria specified in the Site's Restoration Plan.

2.0 PROJECT BACKGROUND

The Site is located in Burke County, North Carolina (Figure 1). The project is within cataloging unit 03050101. The Site has recently been used for pasture and hay production. In the past, the Site was used for row crop agriculture and pasture. Ditches were installed to increase arable land and improve drainage when the land was under agricultural production. The streams on the project Site were channelized and riparian vegetation was cleared in most locations. Wetland and stream functions on the Site had been severely impacted as a result of these land use changes.

The project involved the restoration of 12.1 acres of riverine wetlands, enhancement of 5.3 acres of riverine wetlands, restoration of 6,097 LF of stream, and enhancement of 9,765 LF of stream. Figures 2(a), 2(b), 2(c), and 2(d) summarize the restoration and enhancement zones on the project site. A total of 61 acres of stream, wetland, and riparian buffer are protected through a permanent conservation easement.

2.1 Project Location

The Site is located approximately two miles southwest of the town of Morganton, along Hopewell Road. The Site is divided into two parts by Hopewell Road and I-40. The monitoring entrance for the northern half of the Site is located at a farm gate on the north side of Hopewell Road immediately east of Bailey Fork. The monitoring entrance for the southern half is located at the end of an access road along I-40 that connects to Hopewell Road immediately west of the I-40 overpass.

2.2 Mitigation Goals and Objectives

The specific goals for the Bailey Fork Restoration Project were as follows:

- Restore 6,097 LF of stream channel
- Enhance 9,765 LF of stream channel
- Restore 12.1 acres of riparian wetlands
- Enhance of 5.3 acres of existing, riverine wetlands
- Exclude cattle from stream, wetland and riparian buffer areas
- Develop an ecosystem-based restoration design
- Improve habitat functions
- Realize water quality benefits.

2.3 Project Description and Restoration Approach

For analysis and design purposes, the on-site streams were divided into four reaches. The reaches were numbered sequentially, moving from south to north, with unnamed tributaries carrying a "UT" designation. UT1 is a second order stream that begins offsite, flows into the project area from the southwest, and ends at its confluence with Bailey Fork. UT2 is a first order stream that begins offsite, flows into the project area from the west, and ends at its confluence with UT1. UT3 is a second order stream that begins offsite, flows into the project area from the south, and ends at its confluence with the main stem of Bailey Fork. Bailey Fork flows into the project area from the south and ends at the confluence with Silver Creek. The drainage area of the three tributaries ranges from 0.25 square miles (mi^2) to 0.92 mi^2, while the drainage area at

the downstream end of Bailey Fork is 8.3 mi^2. All four reaches were classified as incised and straightened E5 channels prior to restoration activities. Design information is presented in Table 1.

Table 1. Design Approach for Bailey Fork Restoration Site

Bailey Fork Restoration Site: EEP Contract No. D04006-3			
Project Segment or Reach ID	**Mitigation Type ***	**Approach****	**Linear Footage or Acreage**
Reach UT1	R	P1	1,948 ft
Reach UT2	R	P1	923 ft
Reach UT3	R	P1	3,226 ft
Reach UT3	EII	SS	135 ft
Reach Bailey Fork	EII	SS	9,630 ft
Riverine Wetland	R	-	12.1 ac
Riverine Wetland	E	-	5.3 ac

* R = Restoration; EI = Enhancement I; EII = Enhancement II

** P1 = Priority I; P2 = Priority II; SS = Stabilization

Wetland functions on the Site had been severely impaired by agricultural conversion. Streams flowing through the Site were channelized many years ago to reduce flooding and provide drainage for adjacent farm fields. As a result, nearly all wetland functions were destroyed within the project area.

The design for the restored streams involved the construction of new, meandering channels across the agricultural fields. Reaches UT1, UT2, and UT3 were restored to Rosgen "C5" channels with design dimensions based on nearby reference reaches. The enhancement areas along Bailey Fork and UT3 were accomplished through the use of stabilizing in-stream structures in highly eroded areas and additional buffer planting. Wetland restoration of the prior-converted farm fields on the Site involved grading areas of the farm fields and raising the local water table to restore a natural flooding regime. The streams through the Site were restored to a stable dimension, pattern, and profile, such that riparian wetland functions were restored to the adjacent hydric soil areas. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. Total stream length across the Bailey Fork Restoration Project was increased from approximately 14,076 LF to 15,862 LF.

The designs allow stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing stress on stream banks. In-stream structures were used to control streambed grade, reduce stream bank stress, and promote bedform sequences and habitat diversity. The in-stream structures consisted of root wads, log vanes, log weirs, and rock vanes, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles or rock cross vanes were installed to provide long-term stability. Stream banks were stabilized using a combination of erosion control matting, bare-root planting, and transplants. Transplants provide living root mass to increase stream bank stability and create holding areas for fish and aquatic biota. Native vegetation was planted across the Site, and the entire restoration site is protected through a permanent conservation easement.

2.4 Project History and Background

The chronology of the Bailey Fork Mitigation Project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is presented in Table 4.

Table 2. Project Activity and Reporting History

Bailey Fork Wetland and Stream Restoration Project: EEP Contract No. D04006-3

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan Prepared	N/A	N/A	Apr-05
Restoration Plan Amended	N/A	N/A	Apr-05
Restoration Plan Approved	N/A	N/A	Apr-06
Final Design – (at least 90% complete)	N/A	N/A	N/A
Construction Begins	Oct-05	N/A	Nov-05
Temporary S&E mix applied to entire project area	Mar-06	N/A	Apr-06
Permanent seed mix applied to entire project area	Mar-06	N/A	Apr-06
Planting of live stakes	Mar-06	N/A	Apr-06
Planting of bare root trees	Mar-06	N/A	Apr-06
End of Construction	Mar-06	N/A	Apr-06
Survey of As-built conditions (Year 0 Monitoring-baseline)	Mar-06	Apr-06	Apr-06
Year 1 Monitoring	Dec-06	Nov-06	Dec-06
Year 2 Monitoring	Dec-07	Nov-07	Dec-07
Year 3 Monitoring	Scheduled Oct-08	Scheduled Nov-08	Scheduled Nov-08
Year 4 Monitoring	Scheduled Oct-09	Scheduled Nov-09	Scheduled Nov-09
Year 5 Monitoring	Scheduled Oct-10	Scheduled Nov-10	Scheduled Nov-10

Table 3. Project Contacts

Bailey Fork Restoration Site: EEP Contract No. D04006-3	
Full Service Delivery Contractor	
EBX Neuse-I, LLC	909 Capability Drive, Suite 3100 Raleigh, NC 27606 Contact: Norton Webster, Tel. 919-829-9909
Designer	
Baker Engineering NY, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Eng. Kevin Tweedy, Tel. 919-463-5488
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Planting Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seed Mix Sources	Mellow Marsh Farm, 919-742-1200
Nursery Stock Suppliers	International Paper, 1-888-888-7159
Monitoring Performers	
Baker Engineering NY, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518
Stream Monitoring Point of Contact:	Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland Monitoring Point of Contact:	Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland and Natural Resource Consultants, Inc.	3674 Pine Swamp Rd. Sparta, NC 28675
Vegetation Monitoring Point of Contact:	Chris Huysman, Tel. 336-406-0906

Table 4. Project Background

Bailey Fork Restoration Site: EEP Contract No. D04006-3	
Project County:	Burke County, NC
Drainage Area:	
Reach: Bailey Fork	8.3 mi^2
Reach: UT1	0.81mi^2
Reach: UT2	0.24mi^2
Reach: UT3	0.92 mi^2
Estimated Drainage Percent Impervious Cover:	
Reach: Bailey Fork	> 5%
Reach: UT1	> 5%
Reach: UT2	> 5%
Reach: UT3	> 5%
Stream Order:	
Bailey Fork	2
UT1	1
UT2	1
UT3	1
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-Built	C5
Cowardin Classification	Riverine, Upper Perennial, Unconsolidated Bottom
Dominant Soil Types	Refer to Section 3.1 for Soil Descriptions
Bailey Fork	AaA, CvA
UT1	FaC2, HaA, UnB
UT2	FaC2, HaA, UnB
UT3	FaC2, HaA, UnB
Reference site ID	(Remnant channel - Bailey Fork)
USGS HUC for Project and Reference sites	3050101040020
NCDWQ Sub-basin for Project and Reference	03-08-31
NCDWQ classification for Project and Reference	WS-IV
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor?	N/A
% of project easement fenced	100%

2.5 Project Plan

Plans depicting the as-built conditions of the major project elements, location of permanent monitoring cross-sections, locations of hydrologic monitoring stations, and locations of permanent vegetation monitoring plots are presented in Figure 2(a), 2(b), 2(c) and 2(d) of this report.

3.0 VEGETATION MONITORING

3.1 Soil Data

The soil data for the project site are presented in Table 5.

Table 5. Project Soil Types and Descriptions

Bailey Fork Restoration Site: EEP Contract No. D04006-3

Soil Name	Location	Description
Arkaqua**	Main Channel and Floodplain	Arkaqua series consists of somewhat poorly drained soils that formed in loamy alluvium along nearly level floodplains and creeks. Runoff is slow, and permeability is moderate. Soil texture within the profile ranges from loam to clay loam to sandy loam to sandy clay loam.
Colvard CvA	Main Channel and Floodplain	Colvard series consists of very deep, well drained soils that formed in loamy alluvium on floodplains. These soils are occasionally flooded, well drained, and have slow surface runoff and moderately rapid permeability. The surface layer and subsurface layers are loamy sands in texture.
Fairview FaC2	Floodplain	Fairview soil type occurs on nearly level floodplains along creeks and rivers in pastureland. It has a very deep soil profile and moderate permeability. The surface layer and subsurface layers are clay loams in texture, with an increase in clay content starting at about one foot below the surface.
Hatboro* HaA	Floodplain	Hatboro series consists of a very deep soil profile that is poorly drained with moderate permeability. The series primarily consists of silt loams with underlying layers of sandy clay loam. These soils are generally found on floodplains in pastures and woodlands.
Unison UnB	Floodplain	Unison soil type occurs on mountain foot slopes or stream terraces. It generally has a very deep soil profile, is well drained, and is moderately permeable. Uses include cultivated crops, pasture, orchards, and mixed hardwood forests.

Notes:
Source: From Burke County Soil Survey, USDA-NRCS, http://efotg.nrcs.usda.gov
* Hydric "A" soil type
** Hydric "B" soil type

3.2 Description of Vegetation Monitoring

As a final stage of construction, the stream margins and riparian area of the Bailey Fork stream restoration site were planted with bare root trees, live stakes, and a seed mixture of permanent ground cover herbaceous vegetation. The woody vegetation was planted randomly six to eight feet apart from the top of the stream banks to the outer edge of the project's re-vegetation limits. The tree species planted at the Site are shown in Table 6. The seed mix of herbaceous species applied to the project's riparian area included Soft rush (*Juncus effusus*), Bentgrass (*Agrostis alba),* Virginia wild rye (*Elymus virginicus),* Switch grass (*Panicum virgatum),* Gamagrass, (*Tripsicum dactyloides),* Smartweed (*Polygonum pennsylvanicum),* Little bluestem (*Schizachyrium scoparium),* Devil's beggartick (*Bidens frondosa),* Lanceleaf tickseed (*Coreopsis*

lanceolata), Deertounge (*Panicum clandestinum),* Big bluestem (*Andropogon gerardii),* and Indian grass (*Sorghastrum nutans).*

This seed mixture was broadcast on the Site at a rate of 15 pounds per acre. All planting was completed in April 2006.

Table 6. Tree Species Planted in the Bailey Fork Restoration Area

Bailey Fork Restoration Site: EEP Contract No. D04006-3			
ID	**Scientific Name**	**Common Name**	**FAC Status**
1	*Betula nigra*	River Birch	FACW
2	*Fraxinus pennsylvanica*	Green Ash	FACW
3	*Platanus occidentalis*	Sycamore	FACW-
4	*Quercus phellos*	Willow oak	FACW-
5	*Quercus rubra*	Red oak	FACU
6	*Quercus michauxii*	Swamp chestnut oak	FACW-
7	*Liriodendron tulipifera*	Tulip poplar	FACW
8	*Celtis laevigata*	Sugarberry	FACW
9	*Diospyros virginiana*	Persimmon	FAC
10	*Nyssa sylvatica*	Blackgum	FAC

At the time of planting, vegetation plots labeled 1 through 21 were delineated on-site to monitor survival of the planted woody vegetation. Each vegetation plot is 0.025 acre in size, or 10 meters x 10 meters. All of the planted stems inside the plot were flagged to distinguish them from any colonizing individuals and to facilitate locating them in the future.

3.3 Vegetation Success Criteria

As specified in the approved Restoration Plan for the site, data from vegetation monitoring plots should display a surviving tree density of at least 320 trees per acre at the end of Year 3 of monitoring, and a surviving tree density of at least 260, five-year-old trees per acre at the end of Year 5 of the monitoring period. Although the select native canopy species planted throughout the Site are the target woody vegetation cover, up to 20 percent of the Sites' established woody vegetation at the end of the monitoring period may be comprised of invading species.

3.4 Results of Vegetative Monitoring

Table 7 presents stem counts of surviving individuals found at each of the monitoring stations at the end of Year 2 of the post-construction monitoring period. Trees within each monitoring plot are flagged regularly to prevent planted trees from losing their identifying marks due to flag degradation. It is important for trees within the monitoring plots to remain marked to ensure accurate annual stem counts and calculations of tree survivability. Volunteer individuals found within the plots are also flagged during this process. Flags are used to tag trees because they do not interfere with the growth of the tree.

Volunteer woody species were observed in some of the vegetation plots, but were deemed too small to tally. If these trees persist into the next growing season, they will be flagged and added to the overall stems per acre assessment of the Site. Sweetgum (*Liquidambar styraciflua*) is the most common volunteer, though Red Maple (*Acer rubrum*), River Birch (*Betula nigra*), and Black Walnut (*Juglans nigra*) were also observed.

3.5 Vegetation Observations

After construction of the mitigation project, a permanent ground cover seed mixture of Virginia wild rye (*Elymus virginicus*), switch grass (*Panicum virgatum*), and fox sedge (*Carex vulpinoidea*) was broadcast on the Site at a rate of 15 pounds per acre. These species are present on the restored site. Hydrophytic herbaceous vegetation, including rush (*Juncus effusus*), spike-rush (*Eleocharis obtusa*), Boxseed (*Ludwigia* sp.), and sedge (*Carex* sp.), are observed across the Site, particularly in areas of periodic inundation. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the Site.

There are quite a few weedy species occurring on the Site, though none seem to be posing any problems for the woody or herbaceous hydrophytic vegetation. Other than the thick fescue grasses noted around Plot 9 and the re-occurring grass established in the old pond bottom area, the weedy species are mostly annuals and seem to pose very little threat to survivability on Site. Some Lespedeza is noted to be growing in the vicinity of Plots 2 and 5 and some Kudzu is noted near Plot 10. Other commonly seen weedy vegetation includes various pasture grasses and ragweed (*Ambrosia artemisiifolia*) as well as morning glory (*Ipomoea* spp.).

3.6 Vegetation Photos

Photographs of the Site showing the on-site vegetation are included in Appendix A of this report.

Table 7. Year 2 (2007) Stem Counts for Each Species Arranged by Plot.

Table 7. Year 2 Stem Counts for Each Species Arranged by Plot **Bailey Fork Restoration Site: EEP Contract No. D04006-3**																						Initial Totals	Year 1 Totals	Year 2 Totals	% Survival
	Plots																								
Tree Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21				
Betula nigra	0	0	0	0	0	0	0	0	0	0	0	4	3	1	7	4	5	13	3	6	0	44	50	46	N/A
Fraxinus pennsylvanica	0	0	2	2	0	0	0	0	0	0	0	4	2	6	0	8	4	0	5	8	6	48	56	47	N/A
Platanus occidentalis	0	0	1	9	11	5	8	0	0	9	0	0	1	0	5	0	0	5	2	2	1	54	59	59	N/A
Quercus phellos	0	0	4	0	0	2	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	10	14	11	N/A
Quercus rubra	0	3	4	0	3	1	2	0	0	0	4	0	0	0	0	0	0	0	0	0	1	1	20	18	N/A
Quercus michauxii	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	1	0	0	9	11	8	N/A
Liriodendron tulipiferra	0	4	0	2	0	0	0	1	0	6	8	1	0	0	0	0	0	0	0	0	0	38	35	22	N/A
Celtis laevigata	0	5	0	0	0	0	0	0	2	0	0	0	1	6	3	5	3	0	3	0	5	49	38	33	N/A
Diospyros virginiana	1	0	6	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	N/A
Nyssa sylvatica	4	3	1	0	2	5	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	26	38	23	N/A
Quercus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	N/A
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	0	N/A
Stems/plot	5	15	18	17	18	15	15	12	3	15	15	9	7	13	15	17	12	18	14	16	13	362	328	282	77.9
Stems/acre	200	600	720	680	720	600	600	480	120	600	600	360	280	520	600	680	480	720	560	640	520	537	(Average of all plots)		

4.0 STREAM MONITORING

4.1 Description of Stream Monitoring

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Site:

Bankfull Events: Three crest gauges were installed on the Site to document bankfull events. The gauges are checked each month to record the highest out-of-bank flow event that occurred since the last inspection. Crest gauge 1 is located on UT1 near station 25+00 (Figure 2(c)). Crest gauge 2 is located on UT2 near station 17+00 (Figure 2(c)). Crest gauge 3 is located on UT3 near station 31+00 (Figure 2(d)).

Cross-sections: Two permanent cross-sections were installed per 1,000 LF of stream restoration work, with one of the locations being a riffle cross-section and one location being a pool cross-section. A total of 13 permanent cross-sections were established across the Site. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross-section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Permanent cross-sections for 2007 (Year 2) were surveyed in November 2007.

Longitudinal Profiles: A complete longitudinal profile was surveyed following construction completion to record as-built conditions. The profile was conducted for the entire length of the restored channels (UT1, UT2, and UT3). Measurements included thalweg, water surface, bankfull, and top of low bank. Each measurement was taken at the head of the feature (e.g., riffle, pool, glide). In addition, maximum pool depths were recorded. All surveys were tied to a single, permanent benchmark. A longitudinal survey of 3,000 LF of restored stream length was completed in November 2007.

Photograph Reference Stations: Photographs are used to visually document restoration success. A total of 52 reference stations were established to document conditions at the constructed grade control structures across the Site, and additional photograph stations were established at each of the 13 permanent cross-sections and hydrologic monitoring stations. The GPS coordinates of each photograph station were noted as additional references to ensure the same photograph location is used throughout the monitoring period. Reference photographs are taken at least once per year.

Each stream bank is photographed at each permanent cross-section photograph station. For each stream bank photo, the photograph view line follows a survey tape placed across the channel, perpendicular to flow (representing the cross-section line). The photograph is framed so that the survey tape is centered in the photograph (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame. A photograph log of the Bailey Fork site is included in Appendix A of this report.

4.2 Stream Restoration Success Criteria

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years.
- *Cross-sections:* There should be little change in as-built cross-sections. If changes to channel cross-sections take place, they should be minor changes representing a move to increasing stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen stream classification method and all monitored cross-sections should fall within the quantitative parameters defined for "C" type channels.
- *Longitudinal Profiles:* The longitudinal profiles should show that the bedform features are remaining stable (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 in "C" type channels.
- *Photograph Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photographs should indicate the absence of developing bars within the channel, no excessive bank erosion or increase in channel depth over time, and maturation of riparian vegetation.

4.3 Bankfull Discharge Monitoring Results

During 2007, the on-site crest gauge documented the occurrence of at least two bankfull flow events during Year 2 of the post-construction monitoring period, as shown in Table 8. Inspection of conditions during a site visit revealed visual evidence of out-of-bank flow, confirming the crest gauge reading. The largest on-site stream flow documented by the crest gauge during Year 2 of monitoring was approximately 3.55 feet (42.6 inches) above the bankfull stage and was the result of overbank flooding of both Bailey Fork and Silver Creek. The crest gauge reading of 3.70 feet is not a valid reading and attributed to the beaver dam downstream of UT3.

Table 8. Verification of Bankfull Events

Bailey Fork Restoration Site: EEP Contract No. D04006-3		
Date of Data Collection	**Method of Data Collection**	**Measurement (Feet)**
1/9/2007	Crest Gauge 1 UT1	0.37
1/9/2007	Crest Gauge 2 UT2	0.35
1/9/2007	Crest Gauge 3 UT3	3.55
3/13/2007	Crest Gauge 1 UT1	0.18
3/13/2007	Crest Gauge 2 UT2	0.20
3/13/2007	Crest Gauge 3 UT3	3.70

4.4 Stream Monitoring Data and Photos

A photograph log of the project showing each of the 52 photograph point locations is included in Appendix A of this report. Data and photographs from each permanent cross-section are included in Appendix B of this report.

4.5 Stream Stability Assessment

Table 9 presents a summary of the results obtained from the visual inspection of in-stream structures performed during Year 2 of post-construction monitoring. The percentages noted are a general overall field evaluation of the how the features were performing at the time of the photograph point survey. According to the visual assessment, all features of UT1 and UT2 were performing as designed. Due to a beaver dam on the lower end of UT3, the riffles and pools exhibited some minor impacts. However, these impacts do not represent a threat to channel stability. This area of UT3 will be observed during monitoring Year 3.

Table 9. Categorical Stream Feature Visual Stability Assessment

Bailey Fork Mitigation Site: EEP Contract No. D04006-3

Feature	Performance Percentage					
	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
Riffles	100%	100%	95%			
Pools	100%	100%	95%			
Thalweg	100%	100%	100%			
Meanders	100%	100%	100%			
Bed General	100%	100%	100%			
Vanes / J Hooks etc.	100%	100%	100%			
Wads and Boulders	100%	100%	100%			

4.6 Stream Stability Baseline

The quantitative pre-construction, reference reach, and design data used to determine mitigation approach and prepare the construction plans for the project are summarized in Table 10. The as-built baseline data that determines stream stability during the project's post construction monitoring period are also summarized in Appendix C.

4.7 Longitudinal Profile Monitoring Results

The Year 3 longitudinal profile was completed in November 2007 and was compared to the data collected during the as-built condition survey and Year 1 data. The longitudinal profile is presented in Appendix B. During Year 2 monitoring, a total of 3000 LF of channel were surveyed. The results of longitudinal profile show that the pools in UT1, UT2 and UT3 have aggraded slightly due accumulated sediment. This accumulation of sediment has not resulted in instability in this section of channel. It is likely that these sediments are present in the pools due to the below normal rainfall conditions during 2007. These areas will be monitored during future site visits. The longitudinal profile also showed that the riffles and in-stream structures are stable.

4.8 Cross-section Monitoring Results

Year 2 cross-section monitoring data for stream stability were collected during November 2007. The data were compared to baseline stream geometry data collected in April 2006 (as-built conditions) and Year 1 monitoring data collected in October 2006.

The 13 permanent cross-sections along the restored channels (7 located across riffles and 6 located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 2. Data from each of these cross-sections are summarized in Appendix D. The cross-sections show that there has been some adjustment to stream dimension since construction.

Cross-sections 2, 10, and 13 are located across pools found at the apex of a meander bend. Survey data from these cross-sections indicate that these pools have aggraded substantially during Year 2. Cross-sections 4, 6 and 8 which are also located in pools aggraded slightly during Year 2. Cross-section 12 which is riffle also aggraded slightly during Year 2 monitoring. The observed collection of finer sediments in these locations is believed to primarily the result of low rainfall and flow conditions for much of the summer of 2007.

A beaver dam that had been constructed downstream of UT3 at the confluence with Silver Creek was off-site and has been removed. This dam had caused water to back up which decreased the stream velocity. The decreased water flows due to the dam and lack of rainfall have allowed some pools to fill in slightly on UT3. The riffles were not significantly affected by the beaver dam.

In-stream structures installed within the restored stream included constructed riffles, rock cross vanes, a rock step-pool, log vanes, log weirs, and root wads. A constructed riffle and a rock step-pool installed on the lower end of UT1, and a constructed riffle installed at the lower end of UT3 step down the elevation of the restored stream bed to match the existing channel invert at the confluences of the restored channels and Bailey Fork. Visual observations of these structures throughout the Year 2 growing season have indicated that all structures are functioning as designed and holding their elevation grade. However, due to the beaver dam on UT3, the banks at the constructed riffle at the lower end of the reach have experienced some collapse.

Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Log weirs placed in riffle areas have maintained riffle elevations and provided a downstream scour hole which provides habitat. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms.

Photographs of the channel were taken throughout the monitoring season to document the evolution of the restored stream geometry (see Appendix A). Herbaceous vegetation is dense along the edges of the restored stream, making it difficult in some areas to photograph the stream channel.

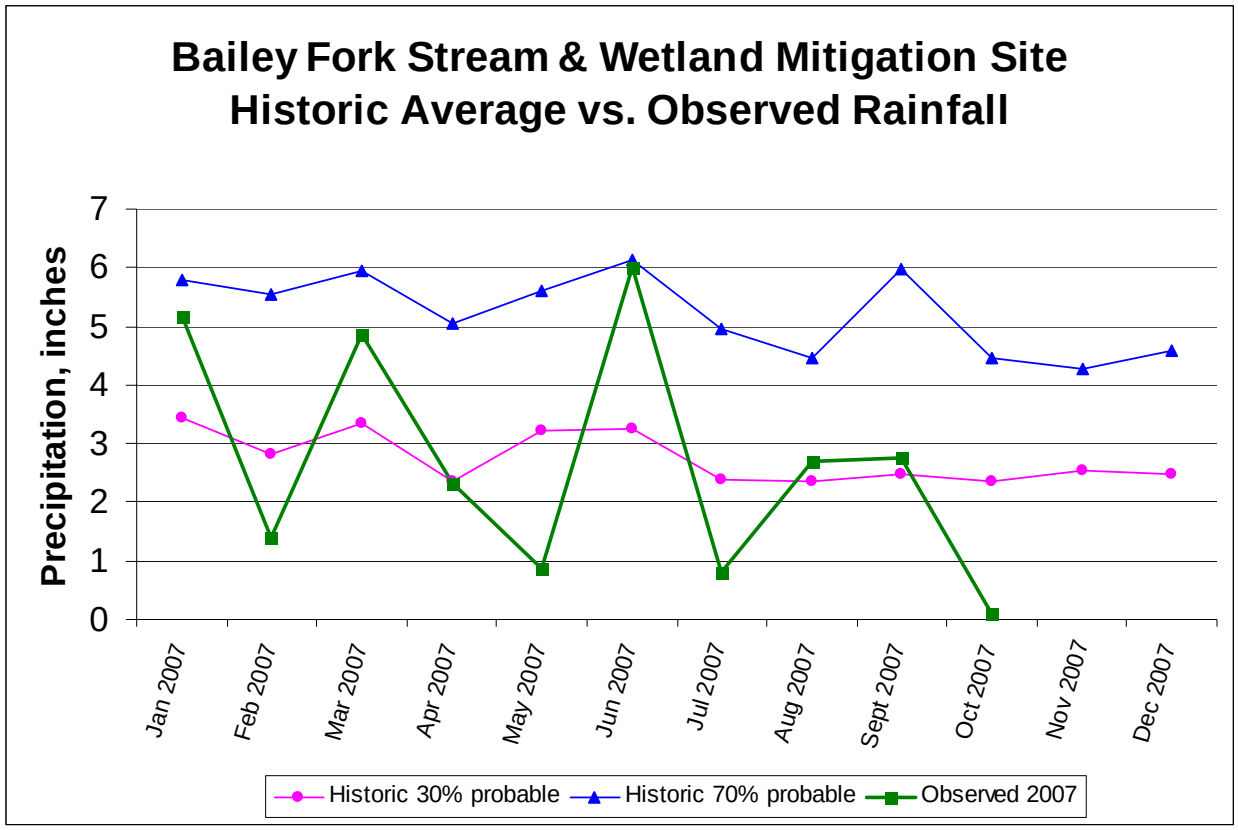
5.0 HYDROLOGY

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2007 growing season, total rainfall during the monitoring period was well below the normal average (approximately 11.4 inches less from January 2007 through October 2007). Much of the rain that fell during the 2007 growing season fell during the months of June, August, and September when evapotranspiration losses were highest (Table 10 and Figure 3).

Table 10. Comparison of Historic Rainfall to Observed Rainfall (inches)
Bailey Fork Mitigation Site: EEP Contract No. D04006-3

Month	Average	30%	70%	Observed 2007 Precipitation
January	4.43	3.45	5.79	5.18
February	4.14	2.83	5.53	1.39
March	4.85	3.36	5.94	4.85
April	3.79	2.36	5.06	2.32
May	4.49	3.22	5.62	0.87
June	4.74	3.25	6.12	6.01
July	3.91	2.38	4.95	0.79
August	3.74	2.36	4.45	2.71
September	4.18	2.48	5.98	2.75
October	3.84	2.03	4.76	0.10
November	3.79	2.55	4.27	NA
December	3.72	2.48	4.59	NA
Total:	49.62	--	--	26.87

Figure 3. Historic Average vs. Observed Rainfall



The Bailey Fork Restoration Plan specified that eight monitoring wells (four automated and four manual) would be established across the restored site. A total of eight wells (four automated and four manual) were installed during early-March 2006 to document water table hydrology in all required monitoring locations. All wells are located in the restored wetland areas adjacent to UT3, and the locations of monitoring wells are shown on the as-built plan sheets. Hydrologic monitoring results are shown in Table 11. A photograph log of the wetland well monitoring stations is included in Appendix A of this report.

In 2007, six of the eight wells achieved the success criteria of greater than 7% saturation during the growing season. AW 3 and MW 3 did not record a hydroperiod of at least 7% during the 2007 growing season, however, these two locations did exceed the hydroperiods recorded by the wells at the reference wetland site and did meet success criteria during the 2006 monitoring season. The performance of these two wells is attributed to the below normal rainfall during the 2007 growing season,. Hydrologic data collected from the reference site, an existing wetland system, indicate that the reference site experienced hydroperiods considerably less than the hydroperiod recorded by all eight wells at the restoration site.

Table 11
Hydrologic Monitoring Results for 2007 (Year 2)

Monitoring Station	Most Consecutive Days Meeting Criteria[1]	Cumulative Days Meeting Criteria[2]	Number of Instances Meeting Criteria[3]
AW1	17 (8.2%)	23 (11.0%)	3
AW2	15 (7.2%)	20 (9.6%)	2
AW3	7 (3.4%)	12 (5.8%)	2
AW4	39 (18.8%)	53 (25.5%)	4
MW1[4]	15 (7.2%)	20 (9.6%)	2
MW2[4]	15 (7.2%)	20 (9.6%)	2
MW3[5]	7 (3.4%)	12 (5.8%)	2
MW4[6]	39 (18.8%)	53 (25.5%)	4
REF1	5 (2.4%)	26 (12.5%)	8
REF2	4 (1.9%)	13 (6.3%)	4

[1] Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches form the soil surface.

[2] Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.

[3] Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.

[4] Groundwater gauge MW1 and MW2 are manual gauges. Hydrologic parameters are estimated based on data from gauge AW2.

[5] Groundwater gauge MW3 is a manual gauge. Hydrologic parameters are estimated based on data from gauge AW3.

[6] Groundwater gauge MW4 is a manual gauge. Hydrologic parameters are estimated based on data from gauge AW4.

6.0 BENTHIC MACROINVERTEBRATE MONITORING

6.1 Description of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring was conducted in accordance with the Bailey Fork Restoration Plan. Because of seasonal fluctuations in populations, macroinvertebrate sampling must be consistently conducted in the same season. Benthic sampling for the Site was conducted during January 2007. This report summarizes the benthic samples collected during the first year post-construction monitoring phase.

The sampling methodology followed the Qual 4 method listed in NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006). Field sampling was conducted by Christine Miller and Anna Cathey of Baker Engineering. Laboratory identification of collected species was conducted by Chris Outlaw and Bobby Louque, biologists with the City of Durham.

Benthic macroinvertebrate samples were collected at two sites on the Bailey Fork Site on January 9 and 10, 2007 and two reference sites located upstream of the sampling sites on January 10 and 17, 2007. Sites 1 and 3 were located within the restoration area on UT1 to Bailey Fork and UT3 to Bailey Fork, respectively. Site 2 was an offsite reference site located upstream of Site 1. Site 4 was an off-site reference site located on UT3 south of Hopewell Road upstream of Site 3. A sampling location map in Appendix E illustrates the sampling site locations.

Benthic macroinvertebrates were collected to assess quantity and quality of life in the creek. In particular, specimens belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) are useful as an index of water quality. These groups are generally the least tolerant to water pollution and therefore are very useful indicators of water quality. Sampling for these three orders is referred to as EPT sampling.

Habitat assessments using NCDWQ's protocols were also conducted at each site. Physical and chemical measurements including water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity were recorded at each site. The habitat assessment field data sheets are presented in Appendix E.

6.2 Benthic Macroinvertebrate Sampling Results and Discussion

A comparison between the pre- and post-construction monitoring results is presented in Table 12 with complete results presented in Appendix E.

6.3 Benthic Macroinvertebrate Sampling

Table 12. Summary of Pre-Restoration vs. Post-Restoration Benthic Macroinvertebrate Sampling Data

Bailey Fork Restoration Site: EEP Contract No. D04006-3								
	Site 1 UT1 to Bailey Fork (Restoration)		**Site 2 UT1 to Bailey Fork (Reference)**		**Site 3 UT3 to Silver Creek (Restoration)**		**Site 4 UT3 to Silver Creek (Reference)**	
	Pre 1/3/05	**Post 1/10/07**	**Pre 1/4/05**	**Post 1/17/07**	**Pre 1/3/05**	**Post 1/9/07**	**Pre 1/5/05**	**Post 1/10/07**
Total Taxa Richness	30	35	26	34	10	26	20	14
EPT Taxa Richness	14	15	16	20	1	4	9	5
Total Biotic Index	4.27	6.33	4.09	4.30	7.8	7.87	4.18	5.75
EPT Biotic Index	3.71	4.95	3.41	3.65	6.2	6.55	2.74	2.81
Dominance in Common (%)	41	40	N/A	N/A	10	50	N/A	N/A
Total Shredder/Scraper Index	6/4	4/3	7/3	5/3	0/1	6/3	3/2	2/2
EPT Shredder/Scraper Index	3/3	1/2	4/2	2/2	0/0	0/1	1/2	0/1
Habitat Assessment Rating	51	82	65	70	37	74	53	52
Water Temperature (˚C)	N/A	8.0	N/A	8.4	N/A	6.7	N/A	6.6
% Dissolved Oxygen (DO)	N/A	42.7	N/A	32.1	N/A	N/A	N/A	51.7
DO Concentration (mg/l)	N/A	5.05	N/A	3.76	N/A	4.70	N/A	6.35
pH	N/A	6.04	N/A	5.97	N/A	5.93	N/A	5.95
Conductivity (µmhos/cm)	N/A	40	N/A	50	N/A	60	N/A	70

At Site 2, the reference site, the post-construction community structure and ecological habitat appears to be similar to that observed during the pre-construction monitoring period. Site 2 showed a slight increase in both overall and EPT taxa richness as well as a slight increase in total and EPT biotic indices. The higher indices could be attributed to the slight decrease in overall shredder taxa observed during the post-construction monitoring. Many of the shredders present in the pre-construction sample that were absent from the post-construction sample had very low tolerance values. Despite the increase in biotic indices at Site 2, several of the EPT species that were common or abundant in the pre-construction sample, such as *Ephemerella* spp., *Stenonema pudicum, Eccoptera xanthenes*, *Diploperla duplicate,* and *Pycnopsyche* spp. (tolerance values of 2.0, 2.0, 3.7, 2.7, and 2.5, respectively) were also common or abundant in the post-construction sample. This suggests that the communities are stable and that water quality is adequate to support intolerant species.

Site 1, which underwent complete restoration, exhibited increased overall and EPT taxa richness, as well as increased overall and EPT biotic indices in the post-construction sample. This suggests

that although more species were present (presumably from increase variety of habitat as provided by designed restoration) these species were slightly more tolerant than previous communities. Post-construction shredder taxa were decreased from the pre-construction sample. These organisms feed on partially decomposed organic matter such as sticks and leaf packs, currently rare at this site (see Habitat Assessments, below). The decrease in sensitive species and lack of shredders are common responses after a major disturbance to habitat such as the in-stream construction implemented at Site 1. It is anticipated that, as the project matures, shredder populations will increase as more habitat in the form of snags, logs, and leaf packs become available.

Currently Site 1 has 40 percent Dominance in Common (DIC) compared to the reference site, which indicates that 40 percent of the dominant communities at the reference site are dominant at Site 1. In pre-construction conditions, Site 1 had a DIC of 41 percent. This indicates that post-construction recolonization from refugia upstream (represented at Site 2) has begun. It is anticipated that improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities begin to recolonize.

Site 4 was the reference reach for Site 3. The post-construction EPT taxa richness decreased from that observed in the pre-construction sample, and the EPT abundance in the pre-construction sample was 42 compared to 7 in the post-construction sample. The decrease in both richness and abundance in the EPT community may indicate a toxic stress on the stream. A sewage smell was observed at this site during monitoring (see Section 6.4 below). The overall biotic index increased and the overall taxa richness decreased, indicating that the diversity in the communities dropped and that only less tolerant species were surviving or colonizing.

The lower end of Site 3 was in backwater conditions during post-construction monitoring. Despite the slow moving water, total and EPT taxa increased and biotic indices stayed relatively the same as in pre-construction conditions. The number of shredder taxa increased, indicating that more organic material is available within the reach. Currently Site 3 has 50 percent DIC with the reference site, up from just 10 percent in pre-construction conditions. It is anticipated that continued improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities begin have time to reestablish as long as conditions at the reference site do not continue to degrade.

6.4 Habitat Assessment Results and Discussion

Site 1 received an 82 on the Habitat Assessment Field Data Sheet. The site exhibited excellent riffle pool sequencing, pattern, and habitat diversity. Riffles were mostly gravel and cobbles, moderately embedded with sand, and the pool bottoms were sandy. The Site 1 riparian buffer could be classified as fallow field with immature hardwood seedlings scattered throughout. Because there was no woody vegetation directly adjacent to the channel, organic habitats such as sticks and leaf packs were rare throughout Site 1. The lack of organic habitats is likely the cause for the decreased shredder communities from pre-construction monitoring to post-construction monitoring. It is anticipated that as the riparian buffer matures, the shredders from the upstream reference site (Site 2) will begin to colonize the restoration reach.

Site 2, the reference reach for Site 1, received a habitat assessment score of 70. The reach exhibited riffle pool sequencing with moderate bank erosion on alternating banks. The riparian buffer was mature and intact along most of the reach. Rocks, sticks, leaf packs, snags and undercut banks were all present along this reach; however large substrate in riffles was often embedded by sand. Bottoms of pools were sandy and filling in. As stated above, the ecological habitat observed during this monitoring cycle appears to be very similar to the pre-construction conditions.

Site 3 received a habitat assessment score of 74 during the post-construction monitoring period. This site exhibited excellent riffle pool sequencing, pattern and habitat diversity, however the water level in the channel was high during the monitoring session. The high water surface was likely caused by recent storm events and was a backwater effect caused by increased water elevations in Bailey Fork. A beaver dam was also observed near the junction of Bailey Fork and UT3. Rocks, sticks, and leaf packs, and root mats from the root wads were found in the sampling area, however the riffle substrate was covered with fine sediments. The leaf packs found were fresh and probably originated from the minimal canopy directly adjacent to the right bank at the meander bend.

Site 4, the reference reach for Site 3, received a habitat assessment score of 52. The riparian zone was mature forest and intact. Rocks, sticks, leaf packs, logs, and undercut banks were present throughout the reach, however, riffle substrate was embedded with sand. Pool bottoms were sandy. The reach had severe bank erosion, was incised, and smelled like sewage. A quick upstream search was performed in attempt to locate the source of the smell to no avail. The conductivity reading was higher than was anticipated in a "normal" stream with an intact buffer (70 µS/cm). This reach scored a 53 in the pre-construction monitoring report, so it appears that the habitat is similar to pre-construction conditions. Despite the low habitat assessment score and sewage odor, this reach continues to have a very low EPT biotic index, indicating that the water quality is sufficient to support fairly intolerant species.

The restoration of pattern and dimension as well as the addition of several root wads, vanes, and armored riffles has enhanced the overall in-stream habitat throughout the restoration sites, while the reference reaches appeared ecologically stable. Newly planted riparian vegetation has had minimal effect on in-stream habitat at Sites 1 and 3, however future contributions from planted riparian vegetation will be evident as the woody plant species mature. These contributions will include in-stream structures such as sticks and leaf packs.

The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at all sites were relatively normal for Piedmont streams with the above noted exceptions.

6.5 Photograph Log

The photograph log is attached as Appendix E. Photographs P-1 and P-2 show the stable, well defined riffle pool sequence at Site 1. Due to recent project construction, Site 1 lack a mature forested canopy, however, young woody vegetation is present along the banks. Photographs P-3 and P-4 show the mature canopy with breaks for light penetration. The embeddedness of the substrate at this site is visible in P-4. Site 3 is shown in P-5 and P-6. These photographs show

the backwater condition affecting the area during monitoring. The stable banks of Site 3 and the minimal mature forested canopy present are visible in P-5. P-7 and P-8 are upstream and downstream views of Site 4. These photographs show the extreme bank erosion affecting the right bank of the stream. Despite the erosion, the varied habitat types are visible, including rocks, logs, undercut banks, and leafpacks.

7.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Vegetation Monitoring. For the 21 monitoring plots, survivability ranged from 120 stems per acre to 720 stems per acre with an overall average of 537 stems per acre. The data reflects that the majority of the Site is on track to meet the minimum success interim criteria of 320 trees per acre by the end of Year 3 and the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for the Site. The exception to this overall trend is the area surrounding Plot 1, located in an old pond bottom, and the zone around Plot 9, located in a thick fescue area and under mature black walnut (*Juglans nigra*) trees, both of which are known to suppress the development of young trees. The area surrounding the restored channel at the north end of UT3 was inundated with water trapped by a beaver dam, and some damage occurred to the young stems in Plots 12 and 13. These three isolated zones may not meet the interim minimum success criteria without supplemental planting.

To increase the density of successfully established trees at the site, supplemental planting of woody vegetation will occur prior to the start of the 2008 growing season.

Overall, the Site is on track to achieve the vegetative success criteria specified in the Restoration Plan for the Site.

Stream Monitoring. This entire length of the restored stream channel was inspected during Year 2 of the monitoring period to assess stream performance. The cross-sections documented that there has been some adjustment to stream dimension since construction. The results of longitudinal profile documented that some pools have aggraded slightly due accumulated sediment. This accumulation of sediment has not resulted in instability in these sections of channel. It is likely that these sediments are present in the pools due to the below normal rainfall and flow conditions during 2007.

These areas will be monitored during future site visits. The longitudinal profile documented that the riffles and in-stream structures are stable. The on-site crest gauge documented the occurrence of at least two bankfull flow events during Year 2 of the post-construction monitoring period.

Overall, the site is on track to achieve the stream morphology success criteria specified in the Restoration Plan for the Site.

Hydrologic Monitoring. Six of the eight wells achieved the success criteria of greater than 7% saturation during the growing season as specified in the Restoration Plan for the Site. The two wells recording less than the specified success criteria did record hydroperiods greater than the hydroperiod documented at the reference wetland site and did achieve the success criteria for Year 1.

Overall, the Site is on track to achieve the hydrologic success criteria specified in the Restoration Plan for the Site.

Benthic Monitoring. The Site exhibited excellent riffle pool sequencing, pattern, and habitat diversity. The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at all sites were relatively normal for Piedmont streams. It is anticipated that continued

improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities continue to reestablish.

In summary, the Site remains on track to achieve the hydrologic, vegetative and stream success criteria specified in the Restoration Plan for the Site and monitoring will continue in 2008.

8.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Bailey Fork Site. During certain times of the year, frogs, turtles, fish, and also wild turkeys, have been observed.

9.0 REFERENCES

NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006)

Rosgen, D.L. 1994. *A Classification of Natural R ivers*. Catena 22: 169-199.

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.

USDA, NC Agricultural Experiment Station, *Soil Survey of Burke County, North Carolina*, 2006.

FIGURES

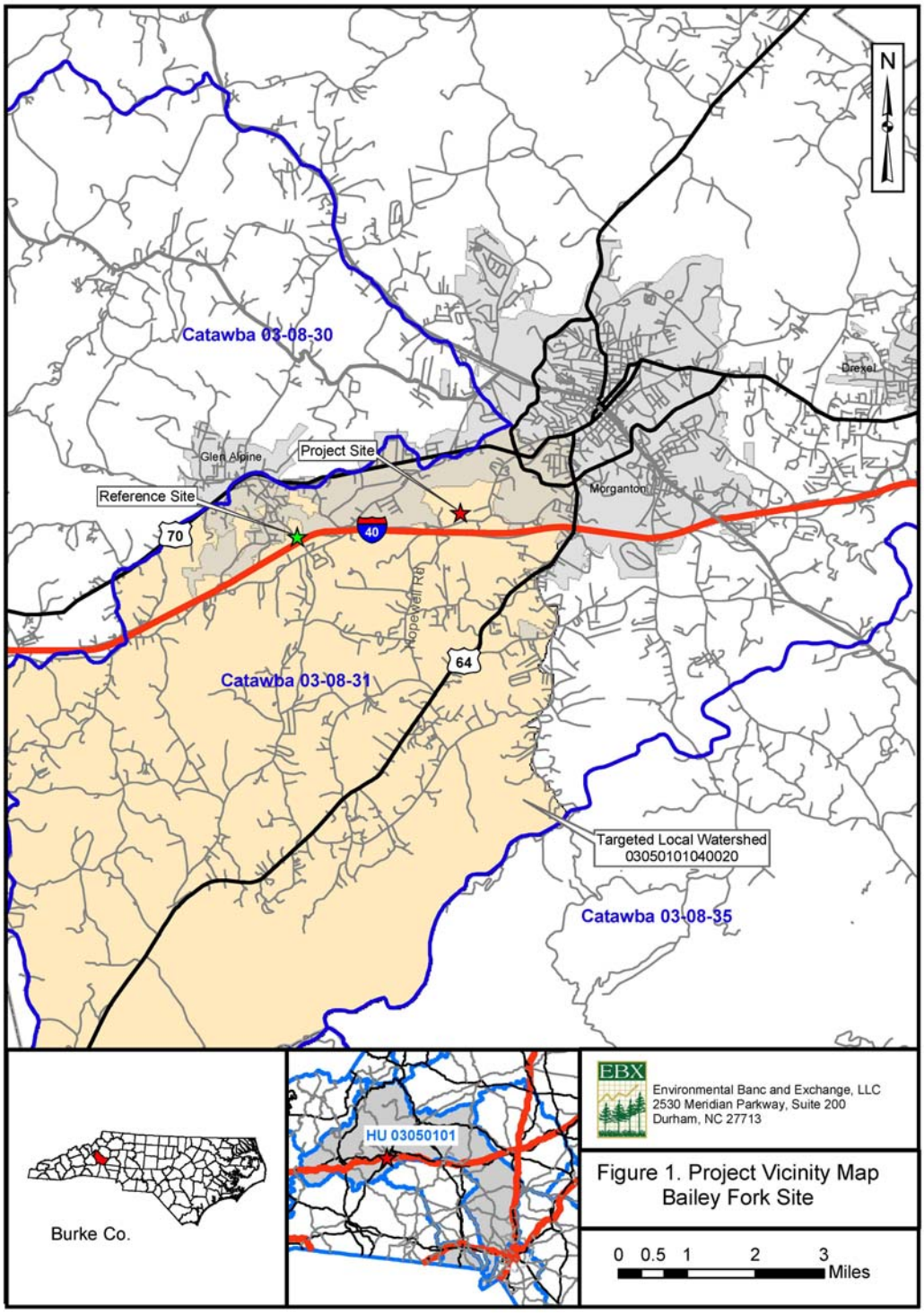


Figure 1. Location of Bailey Fork Stream Mitigation Site.

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0221R	13

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
JULY 31, 2008

THIS MEDIA SHALL NOT BE CONSIDERED
A CERTIFIED DOCUMENT

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

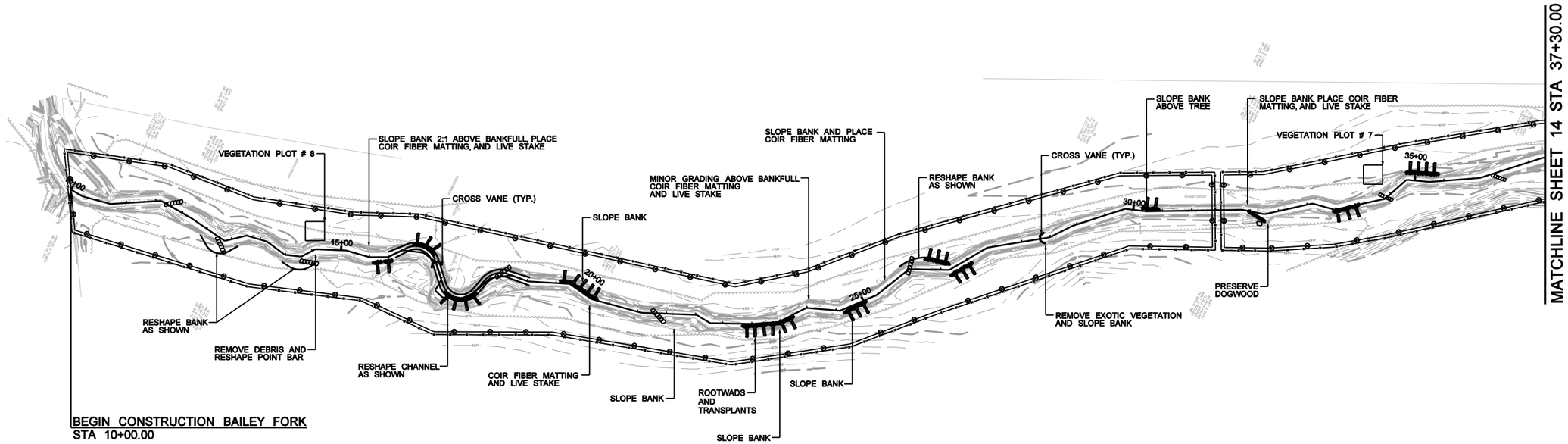


FIGURE: 2A

PLAN VIEW

100 50 0 100 200
SCALE (FT)

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0221R	14

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
JULY 31, 2006

THIS MEDIA SHALL NOT BE CONSIDERED
A CERTIFIED DOCUMENT

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

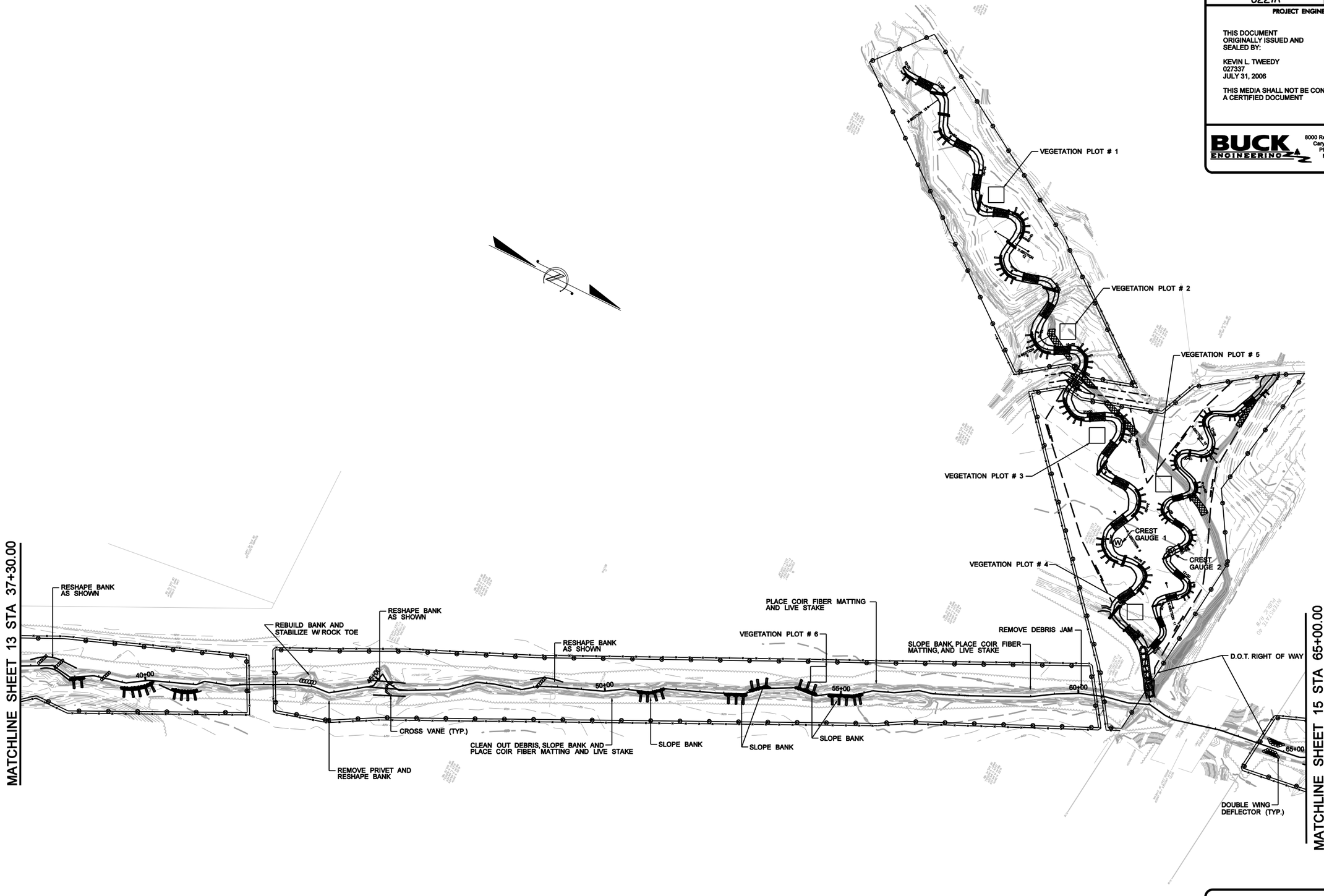


FIGURE: 2B
CROSS SECTION NUMBERING CHANGED 11-20-07

PLAN VIEW

100 50 0 100 200
SCALE (FT)

K:\26_2007\0221R\Design\As-built\0221R_AB_EBX_psh_14.dgn

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0221R	15

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
JULY 31, 2006

THIS MEDIA SHALL NOT BE CONSIDERED
A CERTIFIED DOCUMENT

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

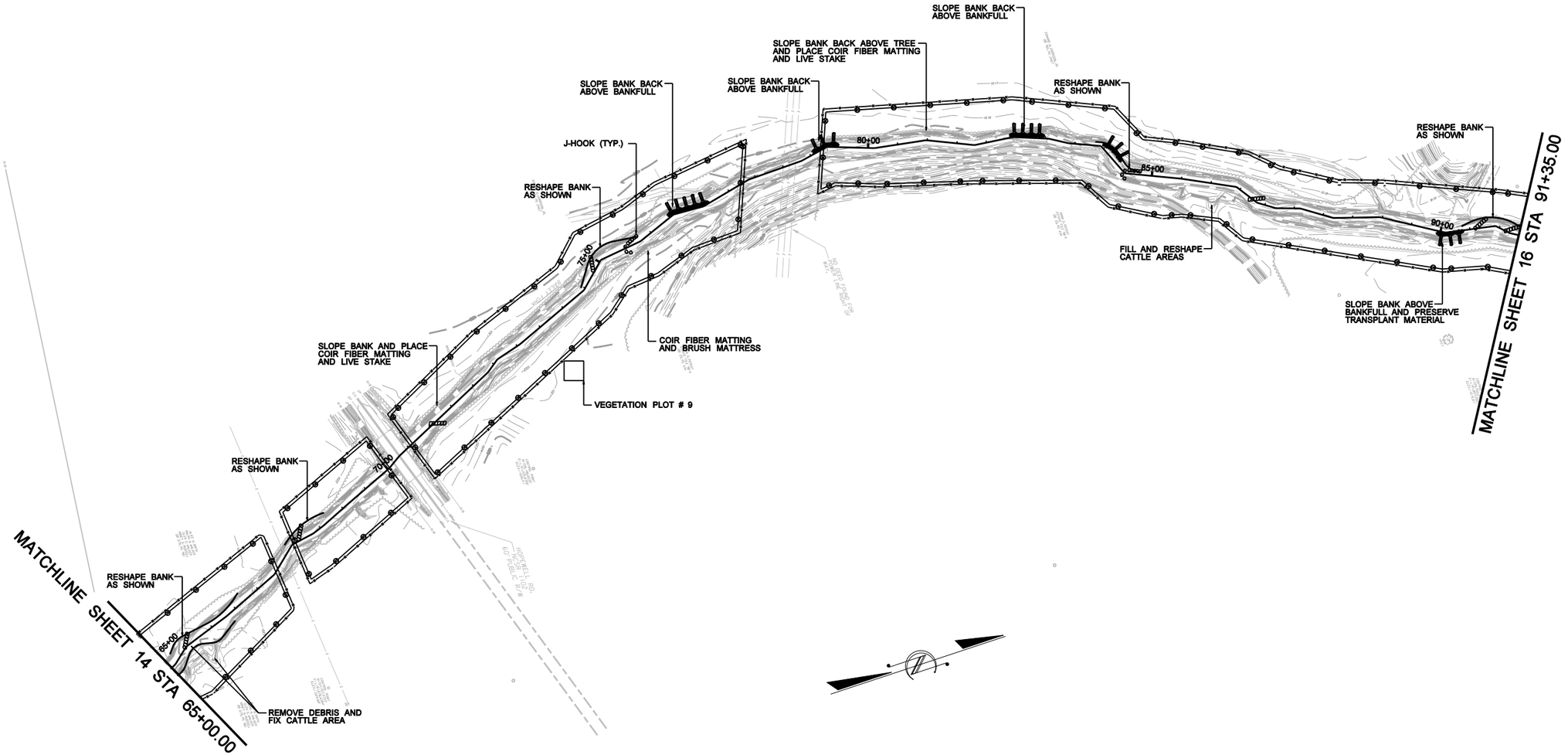


FIGURE: 2C

PLAN VIEW

100 50 0 100 200
SCALE (FT)

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0221R	16

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
JULY 31, 2006

THIS MEDIA SHALL NOT BE CONSIDERED
A CERTIFIED DOCUMENT

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

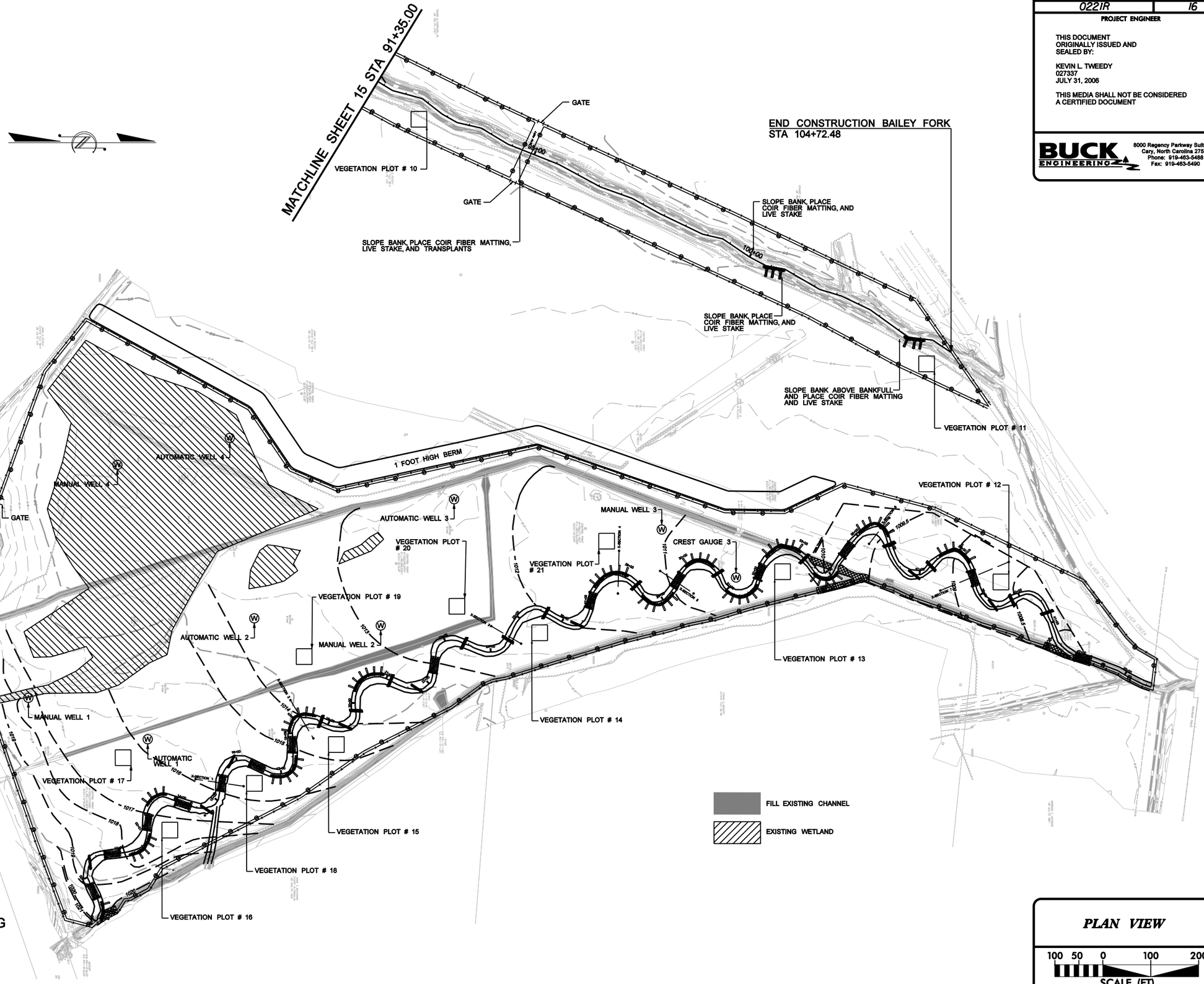


FIGURE: 2D
CROSS SECTION NUMBERING
CHANGED 11-20-07

PLAN VIEW

100 50 0 100 200
SCALE (FT)

IK/26/2007
R:\0221R\Design\As-built\0221R_AB_EBX_psh_16.dgn

APPENDIX A

PHOTO LOG

VEGETATION PHOTOS

Bailey Fork Vegetation Plot 1

Bailey Fork Vegetation Plot 2

Bailey Fork Vegetation Plot 3

Bailey Fork Vegetation Plot 4

Bailey Fork Vegetation Plot 5

Bailey Fork Vegetation Plot 6

Bailey Fork Vegetation Plot 7

Bailey Fork Vegetation Plot 8

Bailey Fork Vegetation Plot 9

Bailey Fork Vegetation Plot 10

Bailey Fork Vegetation Plot 11

Bailey Fork Vegetation Plot 12

Bailey Fork Vegetation Plot 13

Bailey Fork Vegetation Plot 14

Bailey Fork Vegetation Plot 15

Bailey Fork Vegetation Plot 16

Bailey Fork Plot Vegetation 17

Bailey Fork Vegetation Plot 18

Bailey Fork Vegetation Plot 19

Bailey Fork Vegetation Plot 20

Bailey Fork Vegetation Plot 21

STREAM PHOTOS AND WETLAND PHOTOS

UT1 Step Pool Lower

UT1 Step Pool Middle

UT1 Constructed Riffle 1/Head of Step Pool

UT1 Constructed Riffle 2

UT1 Constructed Riffle 3

UT1 Constructed Riffle 4

UT1 Constructed Riffle 5

UT1 Constructed Riffle 6

UT1 Constructed Riffle 7

UT1 Constructed Riffle 8

UT1 Constructed Riffle 9

UT1 Constructed Riffle 10

UT1 Constructed Riffle 11

UT1 Log Weir 1

UT1 Log Weir 2

UT2 Constructed Riffle 1

UT2 Constructed Riffle 2

UT2 Constructed Riffle 3

UT2 Constructed Riffle 4

UT2 Constructed Riffle 5

UT2 Constructed Riffle 6

UT2 Constructed Riffle 7

UT2 Log Weir 1

UT2 Log Weir 2

UT3 Constructed Riffle 1

UT3 Constructed Riffle 1

UT3 Constructed Riffle 3

UT3 Constructed Riffle 4

UT3 Constructed Riffle 5

UT3 Constructed Riffle 6

UT3 Constructed Riffle 7

UT3 Constructed Riffle 8

UT3 Constructed Riffle 9

UT3 Constructed Riffle 10

UT3 Constructed Riffle 11

UT3 Constructed Riffle 12

UT3 Constructed Riffle 13

UT3 Log Weir 1

UT3 Log Weir 2

UT3 Log Weir 3

UT3 Log Weir 4

UT3 Log Weir 5

UT3 Log Weir 6

UT3 Log Weir 7

UT3 Log Weir 8

UT3 Log Weir 9

UT3 Log Weir 10

UT3 Log Weir 11

UT3 Log Weir 12

UT3 Log Weir 13

Bailey Fork Cross Vane 1

Bailey Fork Cross Vane 2

Auto Well 1 - East

Auto Well 1 - North

Auto Well 1 – South

Auto Well 1 - West

Auto Well 2 - East

Auto Well 2 - North

Auto Well 2 - South

Auto Well 2 - West

Auto Well 3 - East

Auto Well 3 - North

Auto Well 3 - South

Auto Well 3 - West

Auto Well 4 - East

Auto Well 4 - North

Auto Well 4 - South

Auto Well 4 - West

Manual Well 1 - East

Manual Well 1 - North

Manual Well 1 - South

Manual Well 1 - West

Manual Well 2 - East

Manual Well 2 - North

Manual Well 2 - South

Manual Well 2 - West

Manual Well 3 - East

Manual Well 3 - North

Manual Well 3 - South

Manual Well 3 - West

Manual Well 4 - East

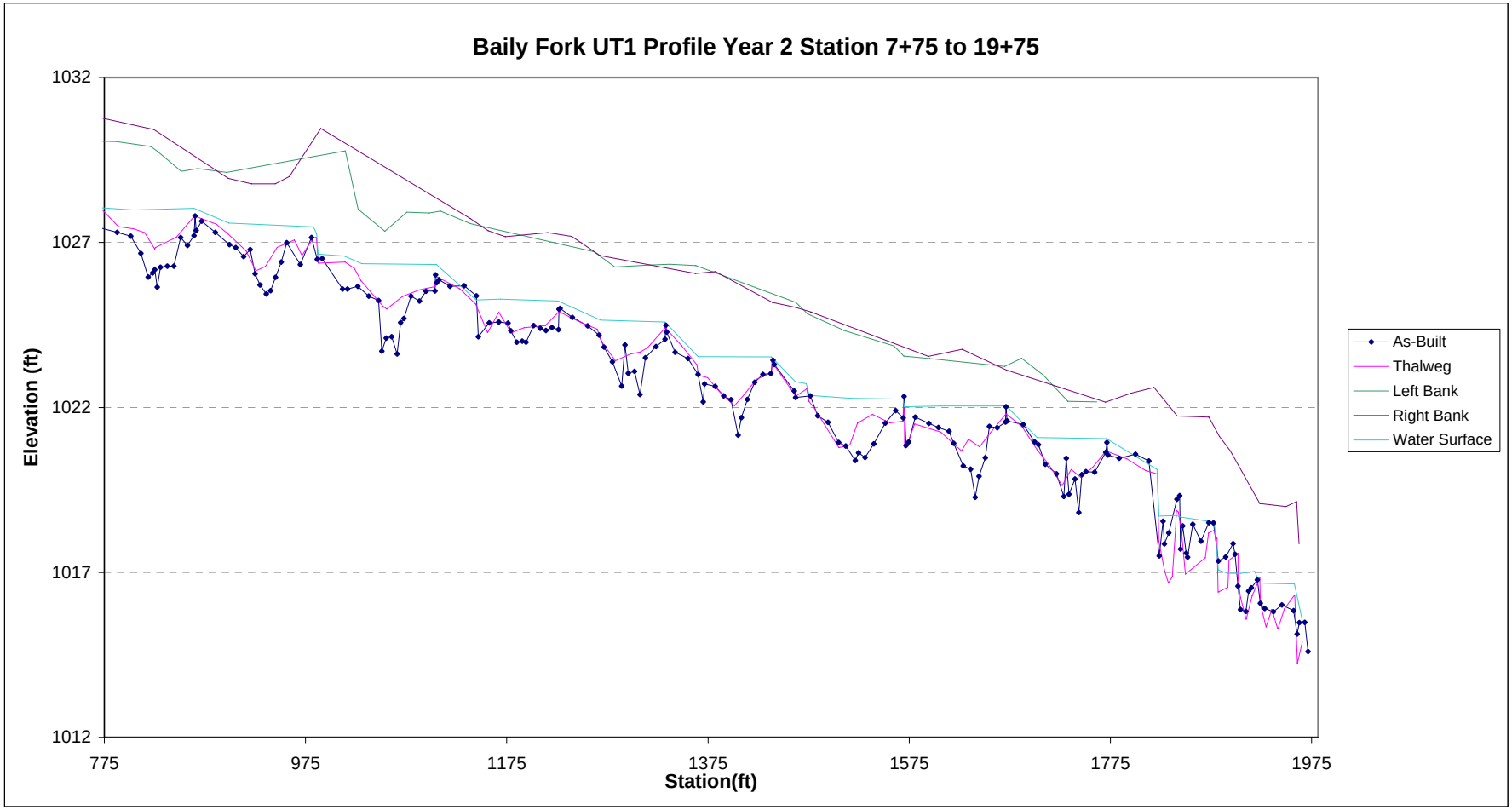
Manual Well 4 - North

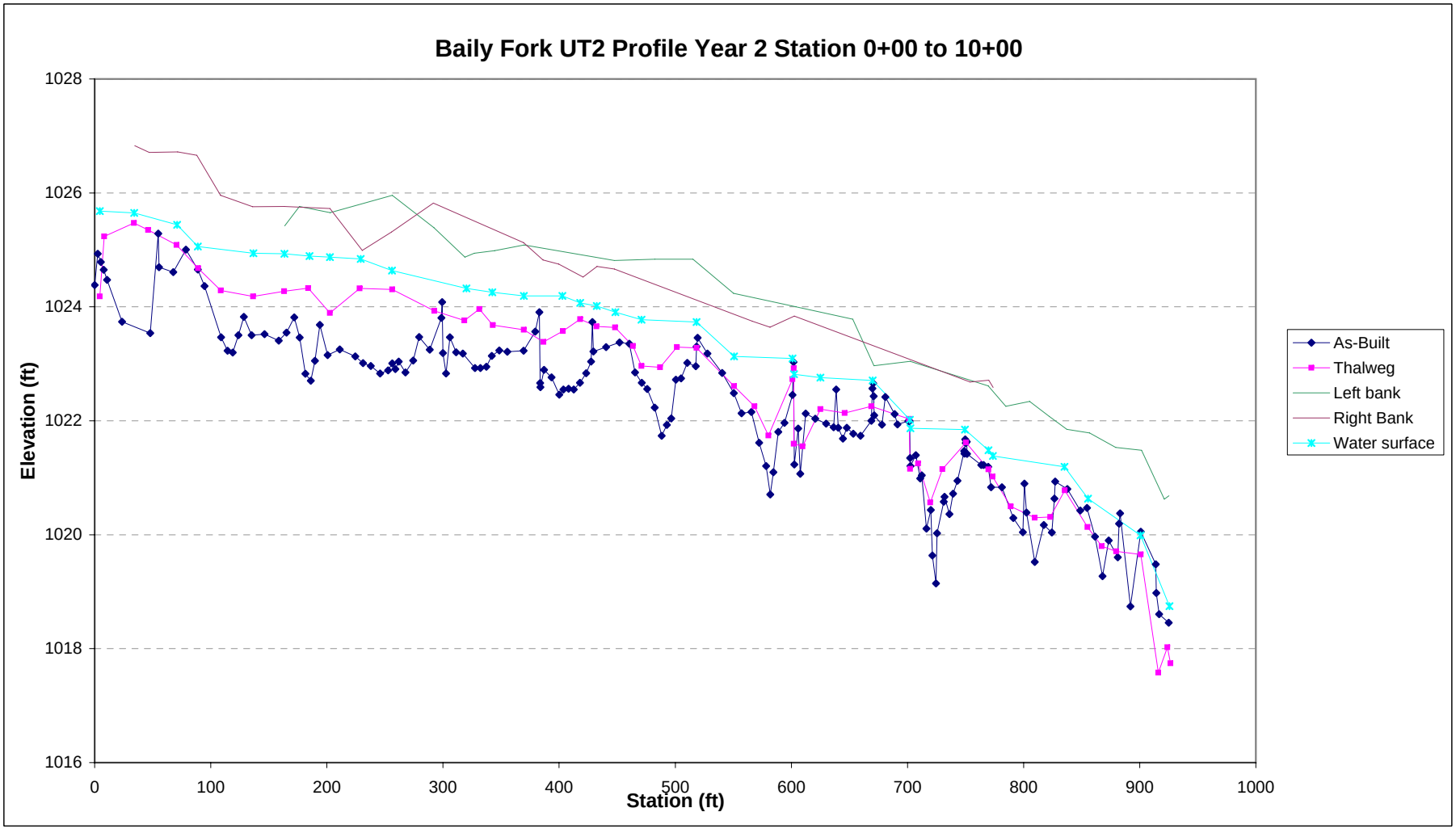
Manual Well 4 – South

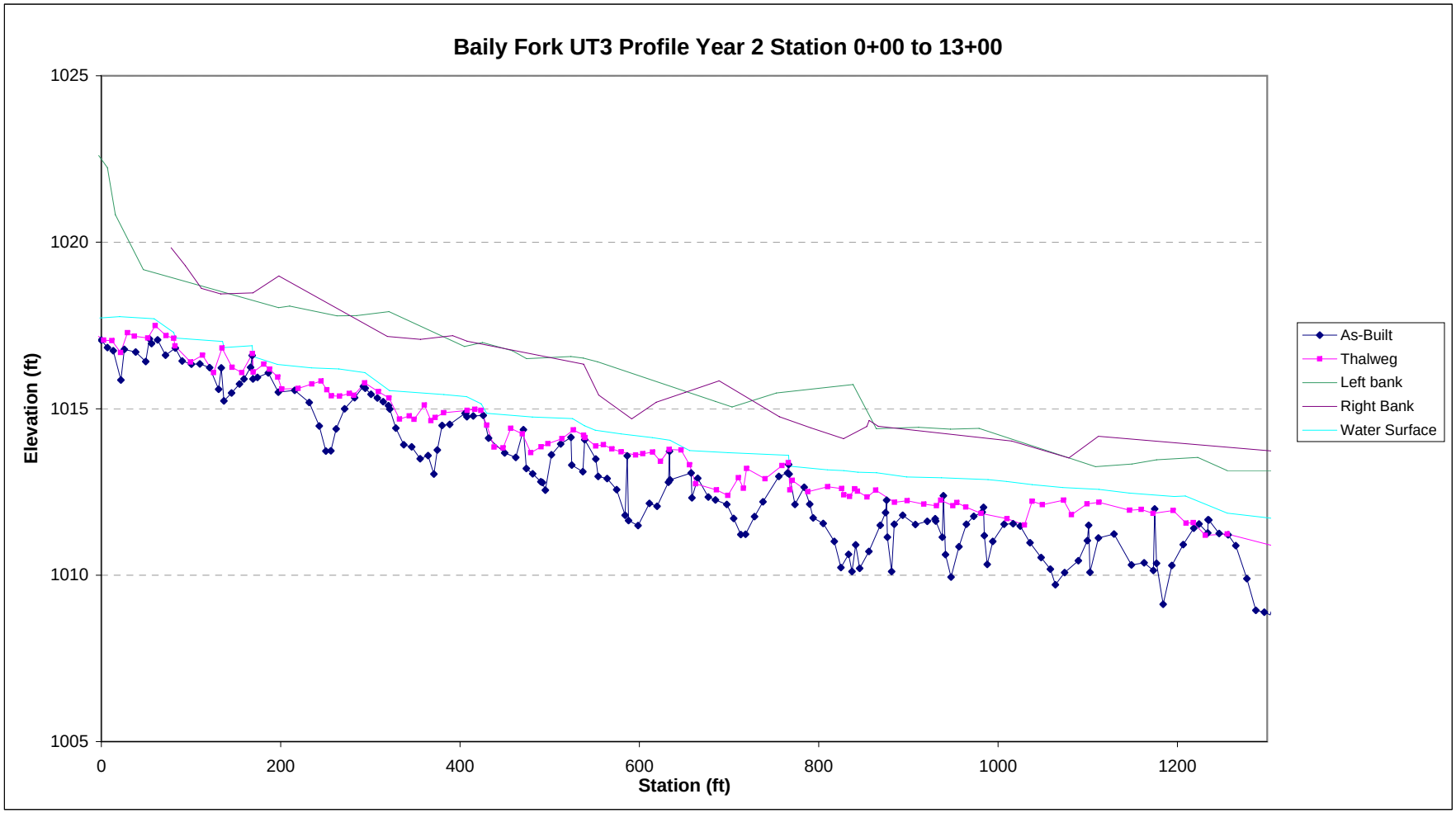
Manual Well 4 - West

APPENDIX B

STREAM MONITORING DATA

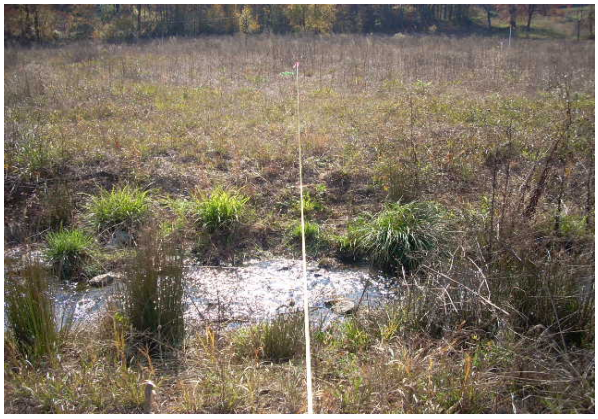

Baily Fork UT1 Profile Year 2 Station 7+75 to 19+75
1032
1027
1022
1017
1012
Elevation (ft)
775
975
1175
1375
1575
1775
1975
Station(ft)
As-Built
Thalweg
Left Bank
Right Bank
Water Surface


Baily Fork UT2 Profile Year 2 Station 0+00 to 10+00
Elevation (ft)
1028
1026
1024
1022
1020
1018
1016
0
100
200
300
400
500
600
700
800
900
1000
Station (ft)
As-Built
Thalweg
Left bank
Right Bank
Water surface


Baily Fork UT3 Profile Year 2 Station 0+00 to 13+00
Elevation (ft)
1025
1020
1015
1010
1005
0
200
400
600
800
1000
1200
Station (ft)
As-Built
Thalweg
Left bank
Right Bank
Water Surface

Permanent Cross-section #1

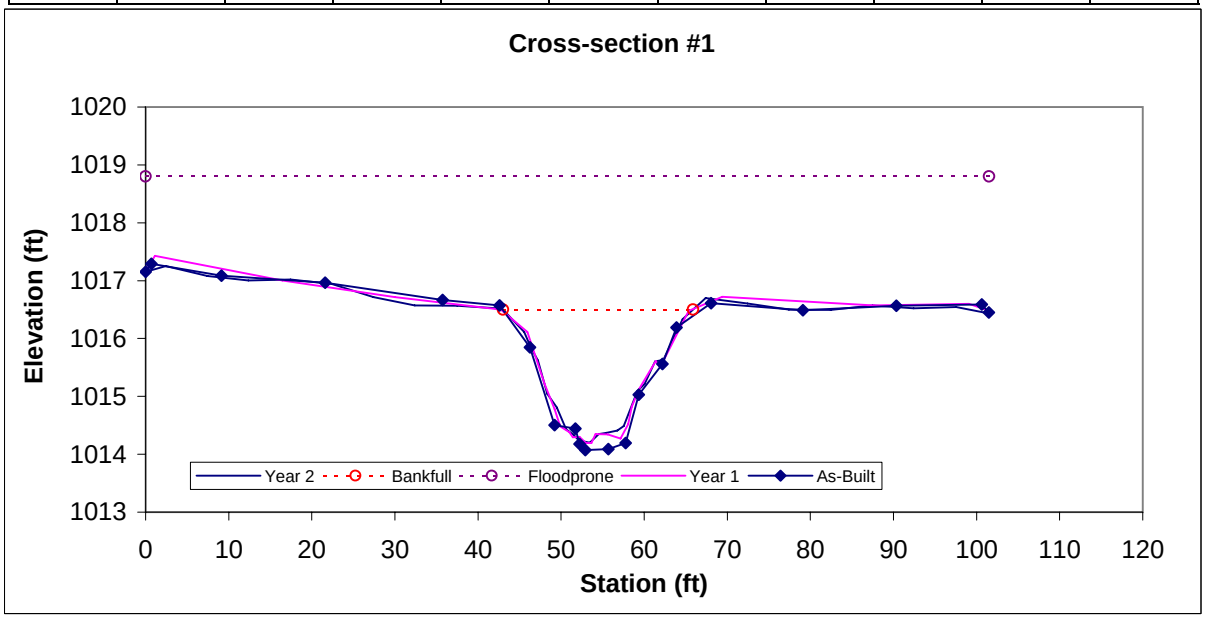
(Year 2 Data - Collected Nov. 2007)



Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	29.3	22.89	1.28	2.3	17.86	1	4.4	1016.5	1016.52



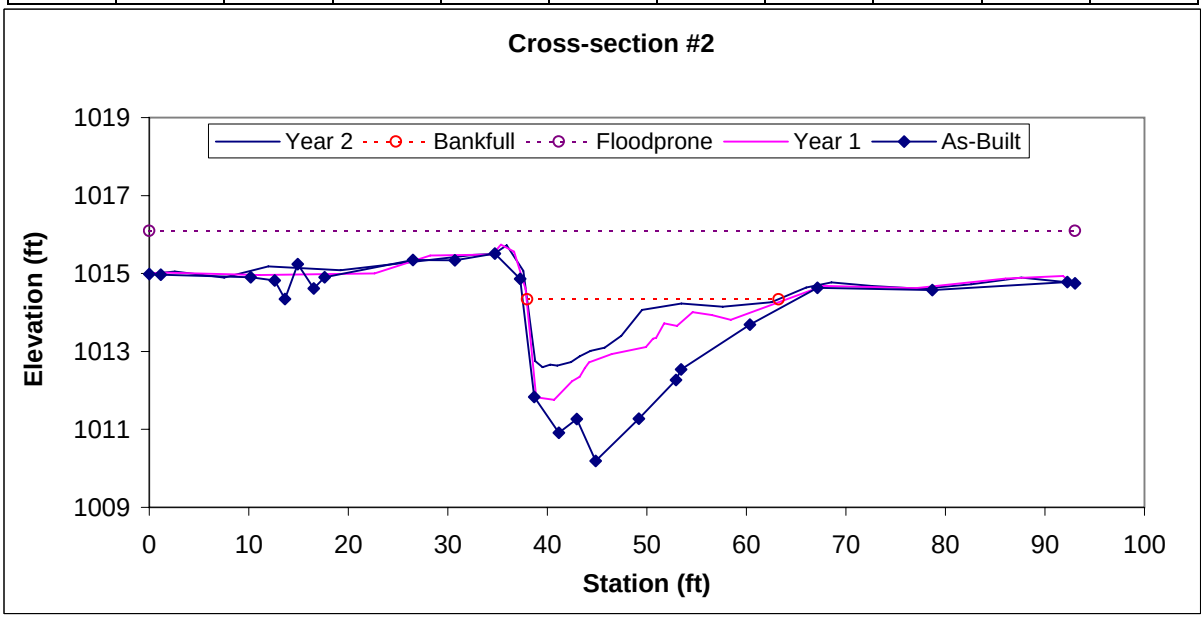
Permanent Cross-section #2

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16.5	25.27	0.65	1.75	38.62	1.2	3.7	1014.34	1014.64



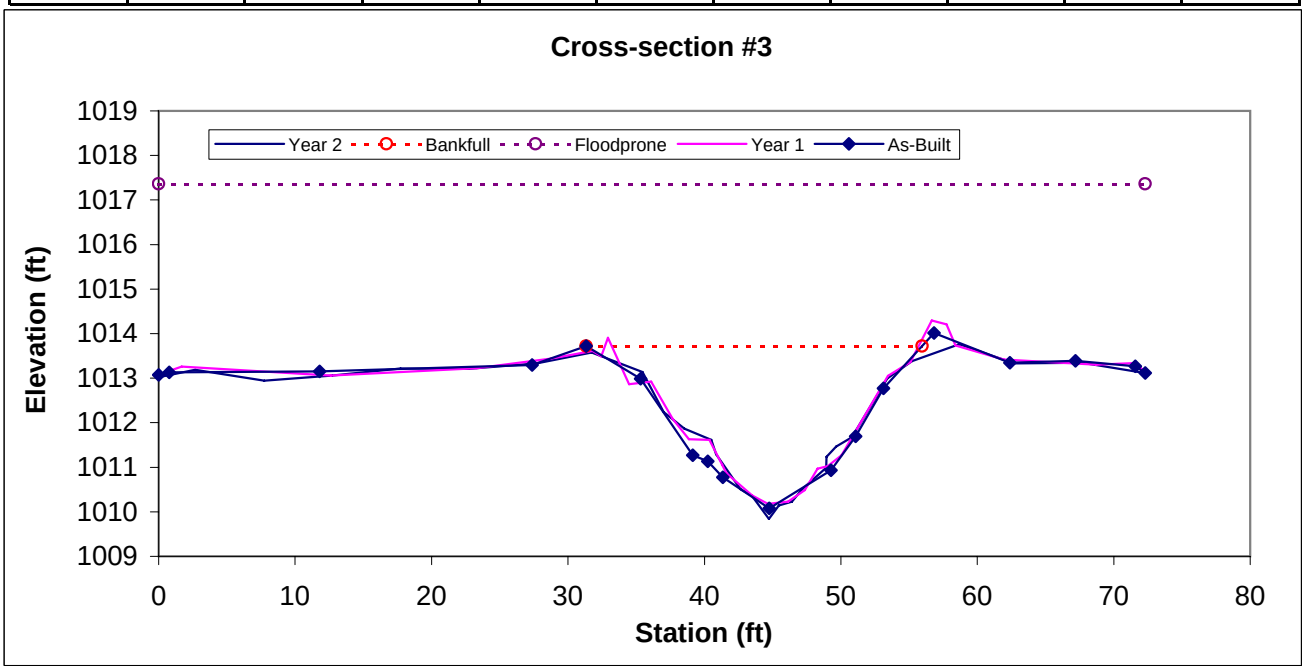
Permanent Cross-section #3

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	40.1	23.88	1.68	3.66	14.24	0.9	3	1013.5	1013.14



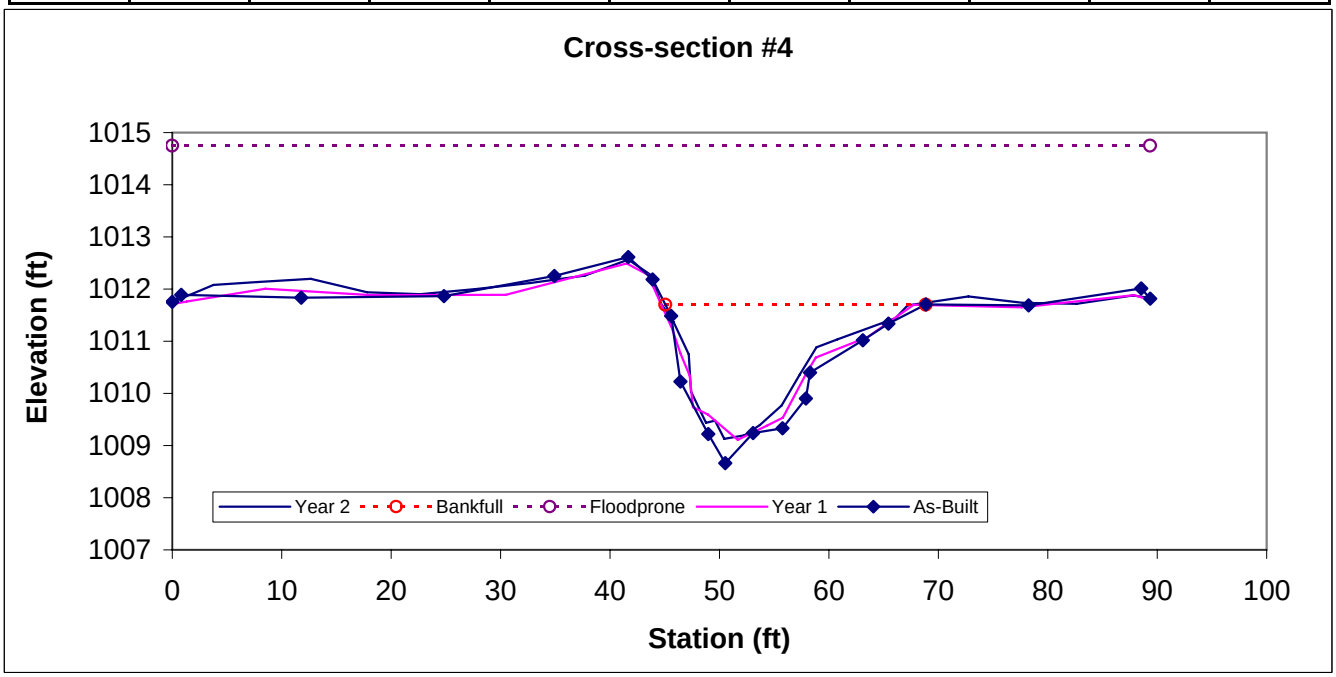
Permanent Cross-section #4

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		28.5	22.84	1.25	2.57	18.27	1	3.9	1011.7	1011.69



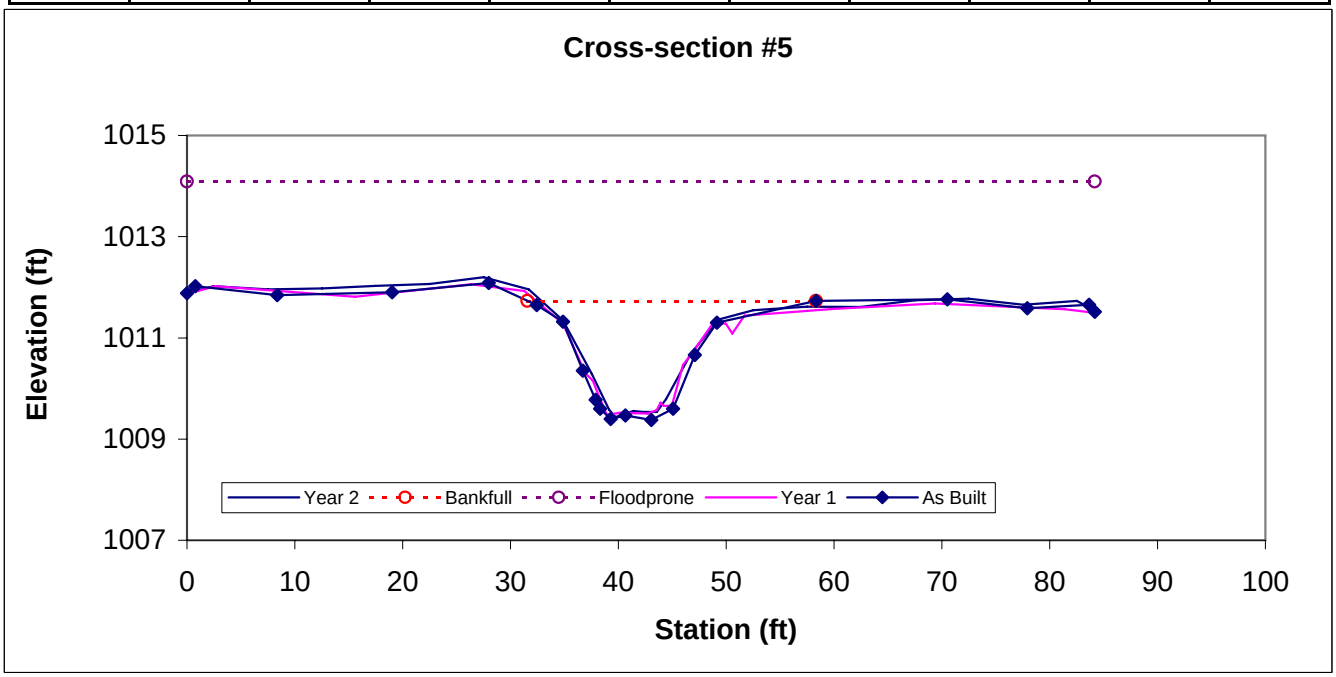
Permanent Cross-section #5

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	19	17.59	1.08	2.07	16.28	1	4.8	1011.5	1011.55



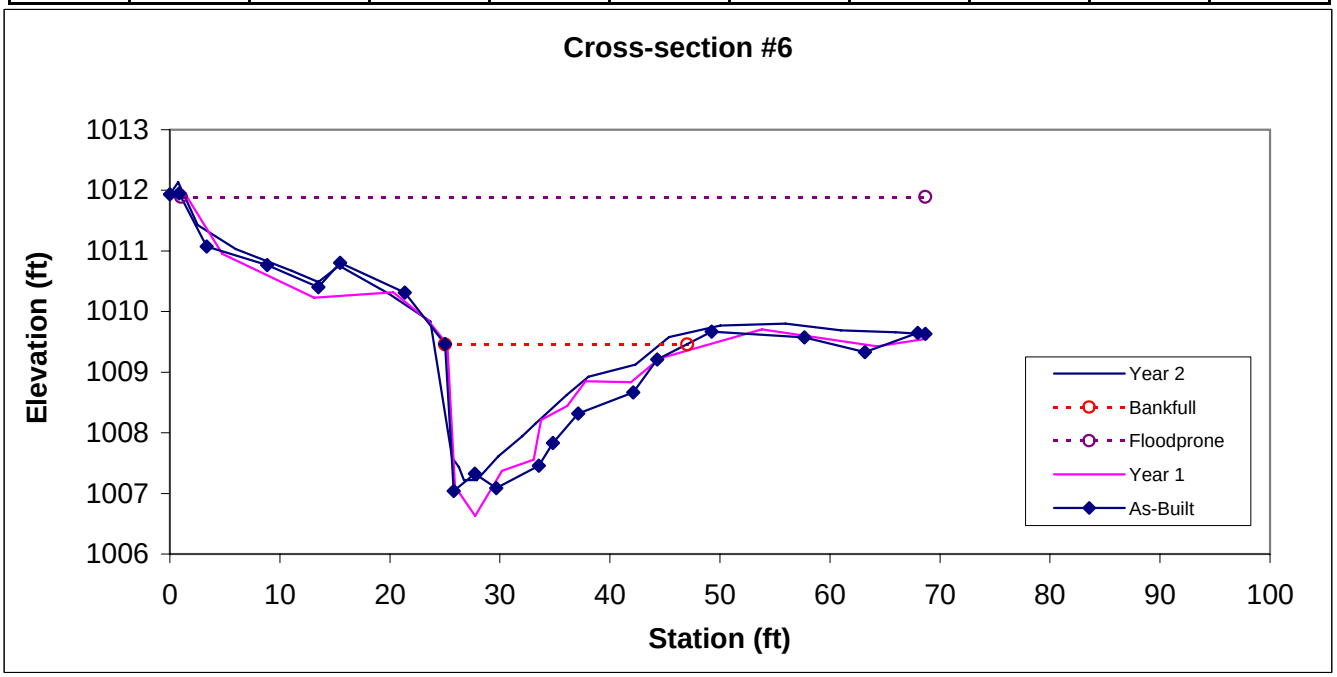
Permanent Cross-section #6

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		22.3	20.57	1.09	2.24	18.95	1.1	3.2	1009.46	1009.58



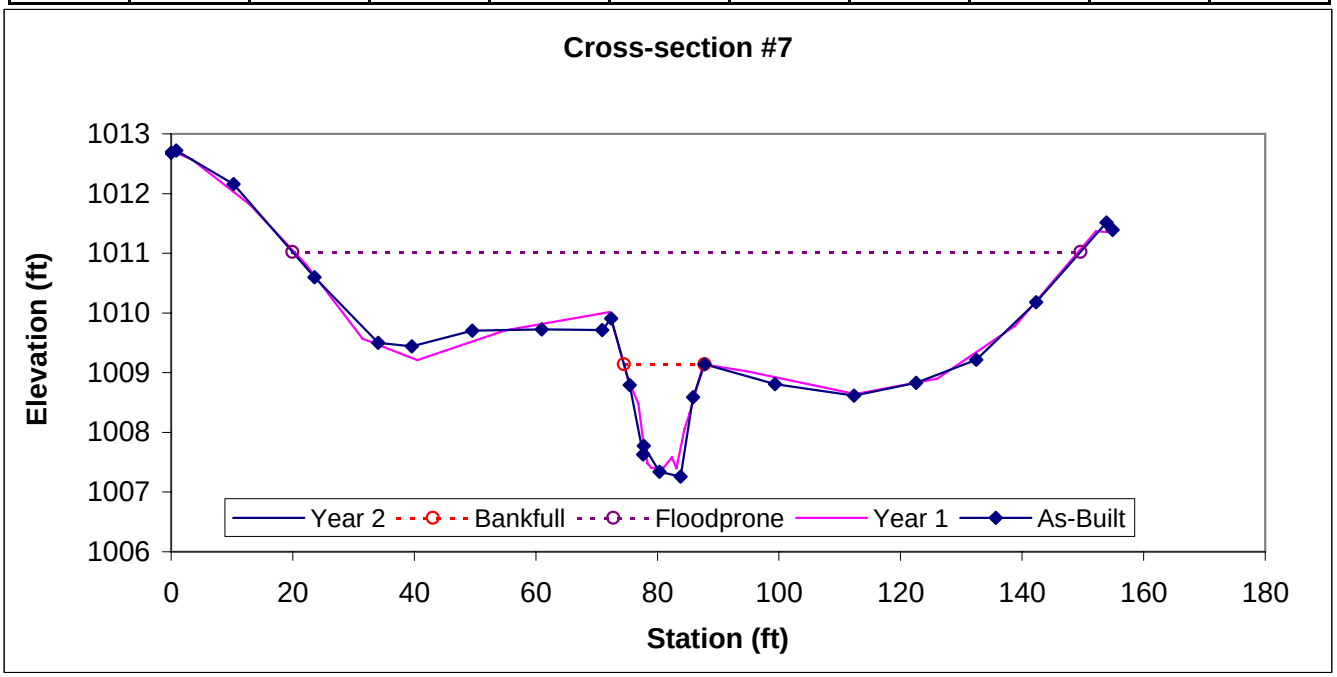
Permanent Cross-section #7

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	13	11.25	1.16	1.73	9.72	1.1	11	1009.14	1009.3



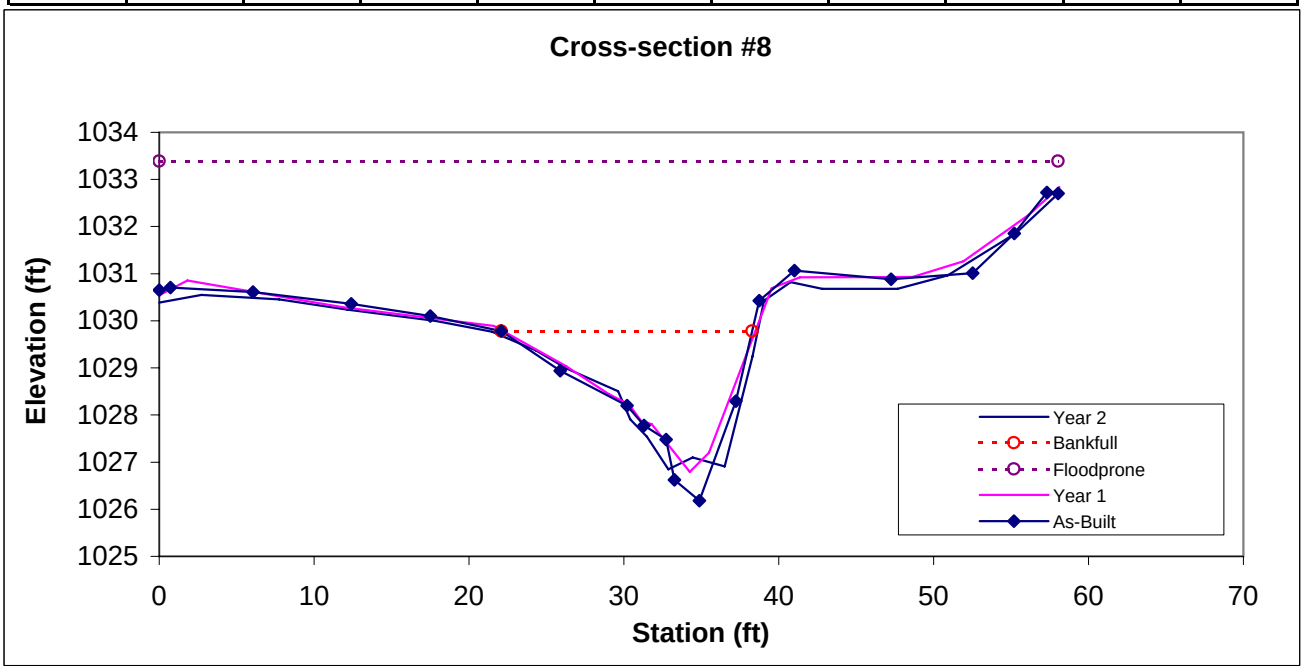
Permanent Cross-section #8

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		25.7	17.55	1.47	2.94	11.97	1	3.3	1029.79	1029.77



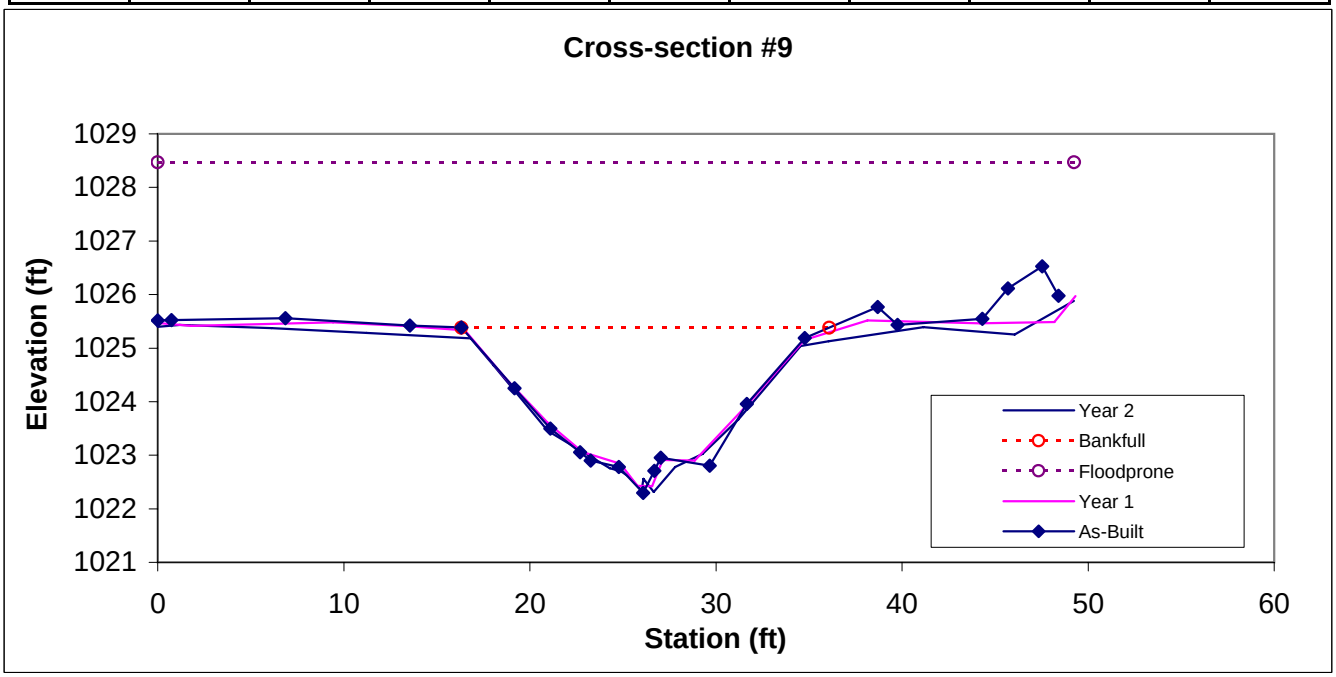
Permanent Cross-section #9

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	29.5	20.2	1.46	2.87	13.83	1	2.4	1025.18	1025.04



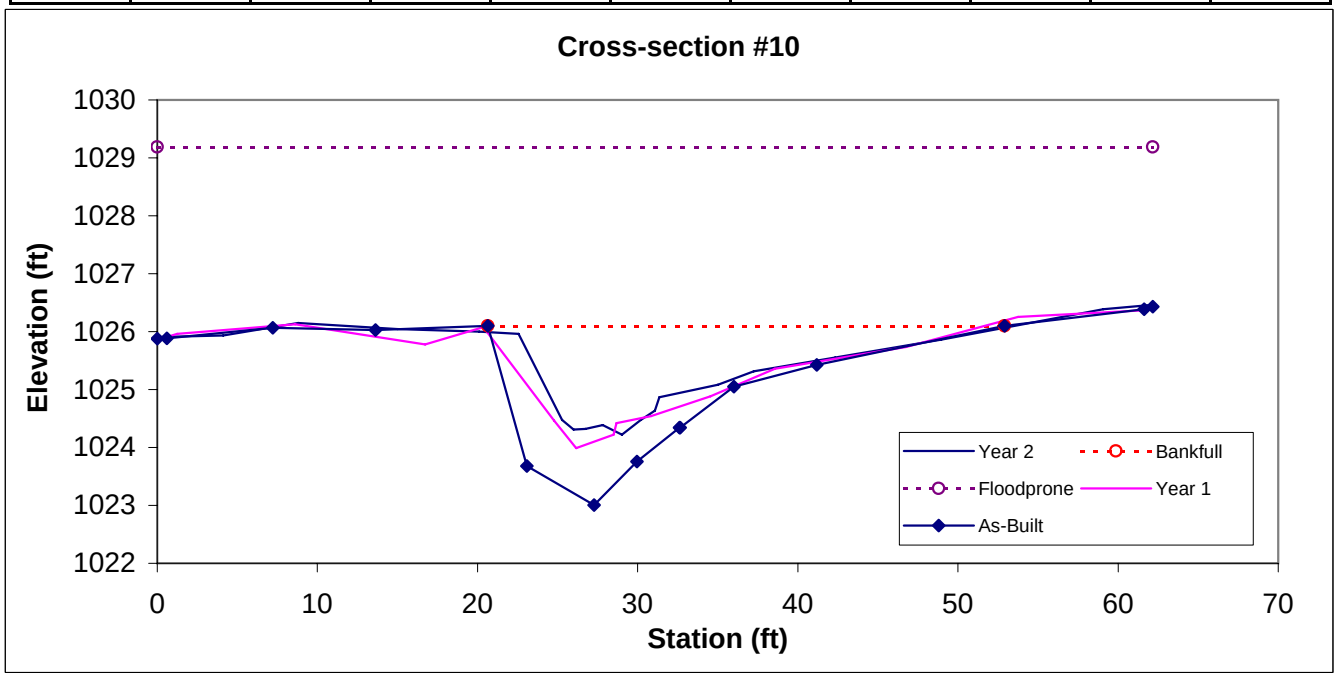
Permanent Cross-section #10

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		21.3	28.26	0.75	1.74	37.57	0.9	2.2	1025.96	1025.86



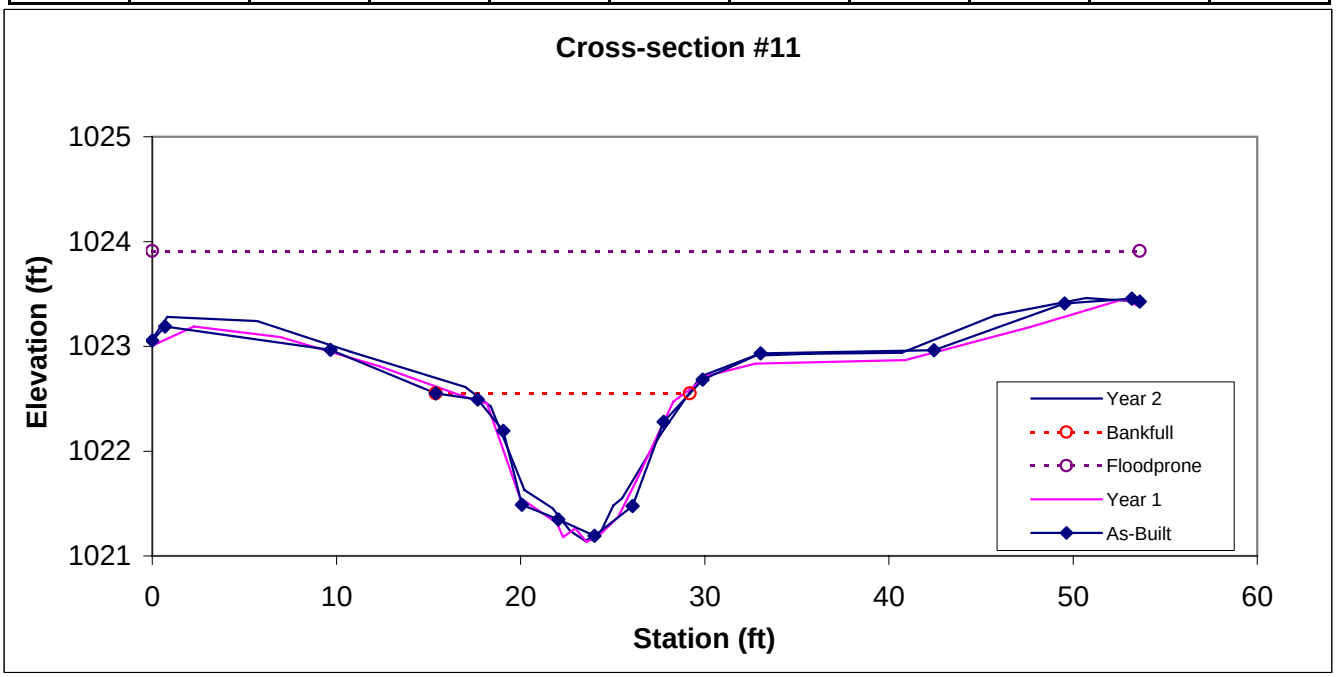
Permanent Cross-section #11

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	9.00	11.69	0.77	1.4	15.13	1	4.6	1022.55	1022.61



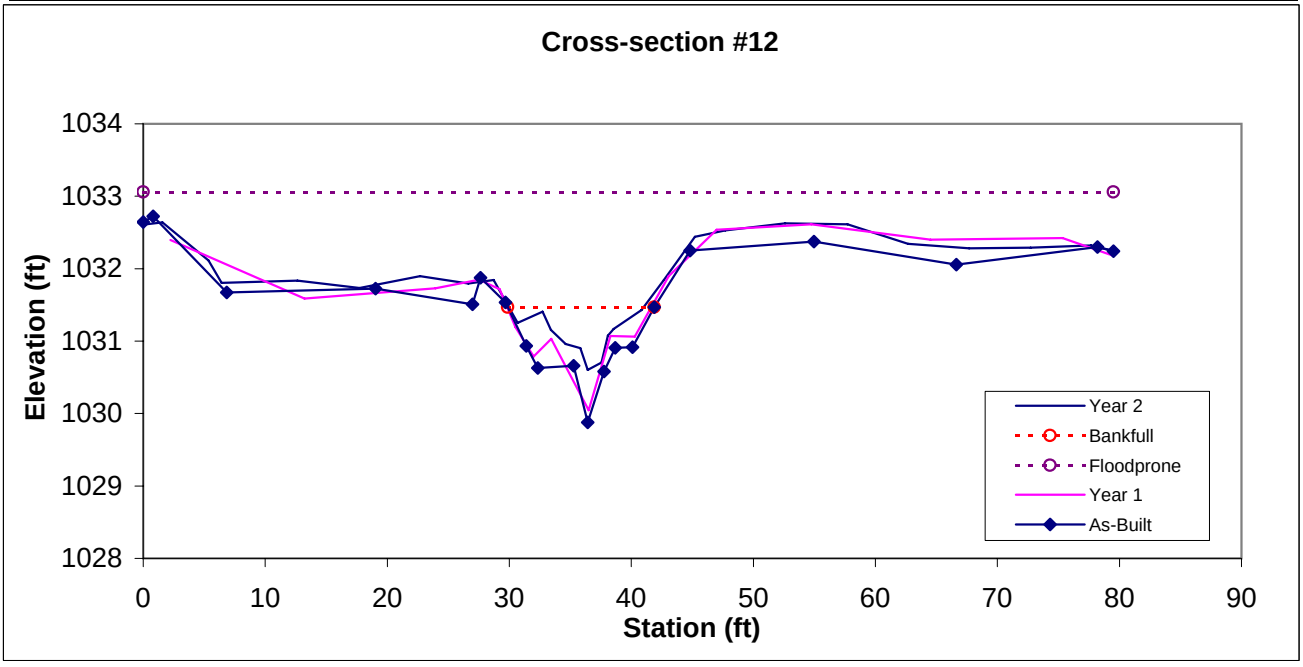
Permanent Cross-section #12

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	8.5	13.9	0.61	1.24	22.81	1	5.7	1031.84	1031.84



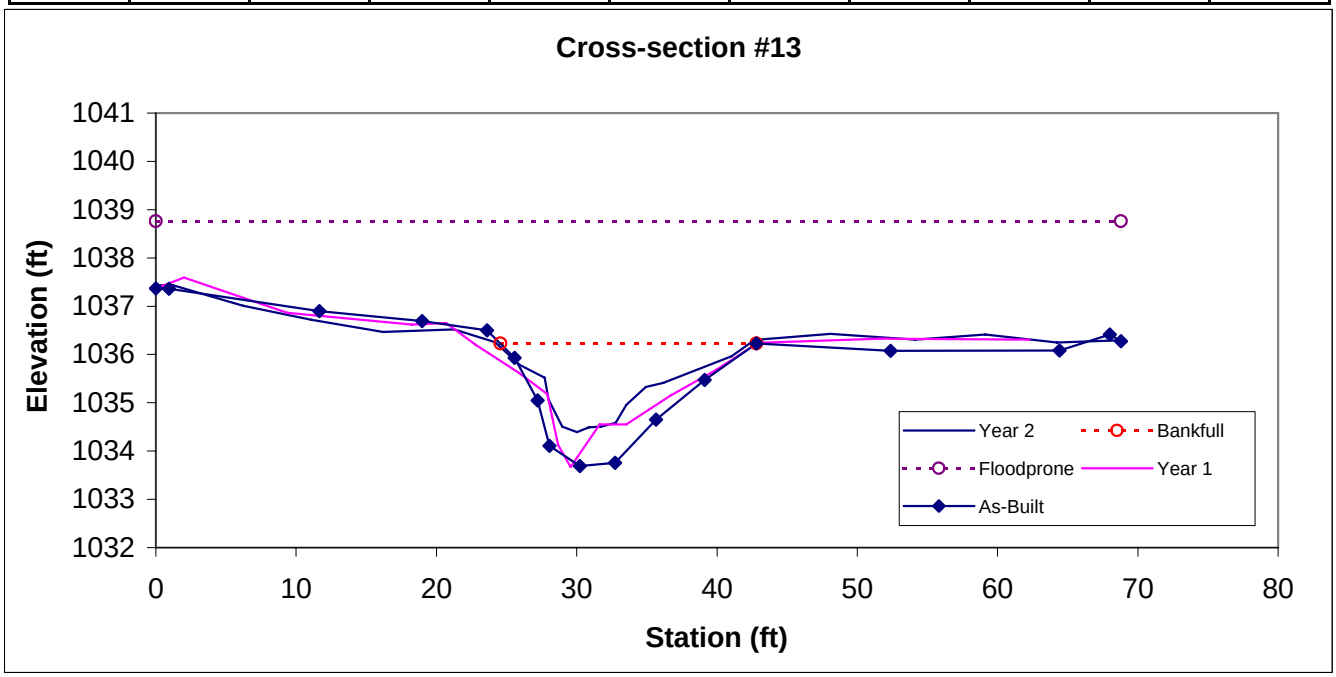
Permanent Cross-section #13

(Year 2 Data - Collected Nov. 2007)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16.2	18.07	0.9	1.84	20.15	1	3.8	1036.23	1036.26



APPENDIX C

BASELINE STREAM SUMMARY FOR RESTORATION REACHES

Baseline Stream Summary for Restoration Reaches

Bailey Fork Creek Mitigation Site: EEP Contract No. D04006-3																	
Reach UT1																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-Built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32	6.7	25	10.9	9.2	10.0	10.9	-----	-----	-----	-----	14.9	-----	15.7	17.7	19.8
Floodprone Width (ft)	96.3	-----	-----	-----	-----	12.9	35.9	58.9	-----	-----	-----	130.0	185.0	240.0	80.0	105.4	130.7
Bankfull Mean Depth (ft)	4.7	3.1	0.9	2.4	1.4	1.2	1.6	2.0	-----	-----	-----	-----	1.2	-----	0.9	1.3	1.7
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	2.0	2.4	2.9	-----	-----	-----	-----	1.8	-----	2.0	2.5	3.1
Bankfull Cross-sectional Area (ft2)	290	99	9	37	18.6	10.9	16.3	21.6	-----	-----	-----	-----	18.5	-----	14.0	23.3	32.7
Width/Depth Ratio	13	10.3	-----	-----	-----	5.5	6.6	7.8	5.1	7.1	9.1	-----	12.0	-----	17.0	17.4	17.7
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.4	3.4	5.4	-----	23.5	-----	8.7	12.4	16.1	5.1	5.9	6.6
Bank Height Ratio	1.3	-----	-----	-----	-----	1.0	1.5	2.0	-----	1.2	-----	-----	1.0	-----	1.0	1.1	1.3
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	4.8	-----	-----	5.8	-----	-----	3.9	-----	-----	3.9	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52	85.5	119	51	67	84
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	37.5	45	28	32	37
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	104	134	164	130	150	162
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	2.9	3.8	4.7
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	18	45	59	10	45	60
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.016	0.0235	0.031	0.016	0.0235	0.031
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	19	50.8	69.7	19	40	63
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52	67	82	65	75	80
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.25 / 0.46 / 0.86 / 9.05 / 14.98			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.98	-----	-----	-----	-----	-----	0.66	-----	-----	0.64	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	93.5	-----	-----	-----	-----	-----	43.7	-----	-----	39.6	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	1,638	-----	-----	-----	-----	-----	1,920	-----	-----	1,948	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.8	-----	0.39	0.945	1.5	-----	0.8	-----	-----	0.8	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5/G5	-----	E5	-----	E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	18	220	76.47	-----	72	-----	-----	119	-----	-----	72	-----	-----	72	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.1	-----	1.24	1.52	1.8	-----	1.3	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.013	-----	-----	-----	-----	-----	0.010	-----	-----	0.010	-----

Reach UT2																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	4.0	17.0	6.4	-----	5.1	-----	-----	-----	-----	-----	9.9	-----	-----	13.8	-----
Floodprone Width (ft)	96.3	-----	-----	-----	-----	-----	10.0	-----	-----	-----	-----	60.0	140.0	220.0	-----	53.6	-----
Bankfull Mean Depth (ft)	4.7	3.1	0.5	1.7	1.0	-----	1.6	-----	-----	-----	-----	-----	0.8	-----	-----	0.7	-----
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	-----	1.9	-----	-----	-----	-----	-----	1.2	-----	-----	1.4	-----
Bankfull Cross-sectional Area (ft2)	290.0	99.0	3.8	17.0	8.2	-----	8.0	-----	-----	-----	-----	-----	8.2	-----	-----	9.7	-----
Width/Depth Ratio	13.0	10.3	-----	-----	-----	-----	3.3	-----	5.1	7.1	9.1	-----	12.0	-----	-----	19.7	-----
Entrenchment Ratio	1.6	-----	-----	-----	-----	-----	2.0	-----	-----	23.5	-----	6.1	14.2	22.2	-----	3.9	-----
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	2.5	-----	-----	1.2	-----	-----	1.0	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	2.2	-----	-----	5.8	-----	-----	2.2	-----	-----	1.9	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	35	57	79	54	64	72
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	25	30	19	21	24
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	69	89	109	83	99	111
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	3.9	4.6	5.2
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22	27	36	22	27	32
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.003	0.013	0.022	0.003	0.013	0.022
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	21	44	58	21	47	64
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	35	45	55	41.6	49.285	55.73
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.23 / 0.39 / 0.61 / 2.67 / 5.90			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.32	-----	-----	-----	-----	-----	0.25	-----	-----	0.21	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	19.3	-----	-----	-----	-----	-----	9.6	-----	-----	6.6	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	270	-----	-----	-----	-----	-----	870	-----	-----	923	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.24	-----	0.39	0.945	1.5	-----	0.24	-----	-----	0.24	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5	-----	E5		E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	10	100	32	-----	18	-----		119		-----	18	-----	-----	18	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.0	-----	1.2	1.5	1.8	-----	1.4	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.005	-----	-----	-----	-----	-----	0.006	-----	-----	0.005	-----

Reach UT3																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	6.8	26.0	11.5	9.2	10.0	10.8	-----	-----	-----	-----	16.7	-----	13.3	24.4	26.8
Floodprone Width (ft)	96.3	-----	-----	-----	-----	40.0	60.0	80.0	-----	-----	-----	80.0	280.0	480.0	72.3	96.9	129.7
Bankfull Mean Depth (ft)	4.7	3.1	0.9	2.5	1.5	1.9	2.1	2.2	-----	-----	-----	-----	1.2	-----	1.0	1.2	1.4
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	2.9	3.0	3.1	-----	-----	-----	-----	1.7	-----	1.9	2.2	2.5
Bankfull Cross-sectional Area (ft2)	290.0	99.0	10.0	40.0	20.3	19.8	20.3	20.7	-----	-----	-----	-----	20.0	-----	15.9	24.5	34.1
Width/Depth Ratio	13.0	10.3	-----	-----	-----	4.3	5.0	5.6	5.1	7.1	9.1	-----	14.0	-----	11.1	17.2	26.6
Entrenchment Ratio	1.6	-----	-----	-----	-----	3.4	5.1	6.8	-----	23.5	-----	4.8	16.8	28.7	3.2	6.5	9.8
Bank Height Ratio	1.3	-----	-----	-----	-----	1.3	1.6	1.9	-----	1.2	-----	-----	1.0	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	2.7	2.7	2.6	-----	5.8	-----	-----	2.7	-----	3.4	2.2	1.6
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	59	96.5	134	85	91	120
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	33	41.5	50	27	37	43
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	117	150.5	184	172	179	200
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	3.5	3.7	4.9
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	26	75	91	26	50	63
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.004	-----	-----	0.004	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	26	49	69	26	75	98
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	59	75.5	92	86	90	100
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.24 / 0.34 / 0.44 / 1.38 / 3.40			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	0.3	-----	-----	0.3	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	25.0	-----	-----	-----	-----	-----	14.7	-----	-----	9.5	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	2,513	-----	-----	-----	-----	-----	3,227	-----	-----	3,226	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.92	-----	0.39	0.945	1.5	-----	0.92	-----	-----	0.92	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5	-----	E5	-----	E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	29	250	83.83	-----	54	-----	-----	119	-----	-----	54	-----	-----	54	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.1	-----	1.24	1.52	1.8	-----	1.4	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.002	-----	-----	-----	-----	-----	0.004	-----	-----	0.004	-----

APPENDIX D

MORPHOLOGY AND HYDRAULIC MONITORING SUMMARY - YEAR 2 MONITORING

Morphology and Hydraulic Monitoring Summary - Year 1 Monitoring

Bailey Fork Restoration Site: EEP Contract No. D04006-3

Reach: UT1

I. Cross-Section Parameters	Cross-section 8 Riffle					Cross-section 9 Pool					Cross-section 12 Riffle					Cross-section 13 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	16.29	17.55				22.25	20.2				15.25	13.9				20.19	18.07			
Floodprone Width (ft)	5.98	-				5.92	-				3.58	-				5.12	-			
BF Cross-sectional Area (ft2)	22.4	25.7				32	29.5				12.0	8.5				21.3	16.2			
BF Mean Depth (ft)	1.37	1.47				1.44	1.46				.79	0.61				1.06	0.9			
BF Max Depth (ft)	2.99	2.94				2.96	2.87				1.79	1.24				2.56	1.84			
Width/Depth Ratio	11.87	11.97				15.48	13.83				19.32	22.81				19.1	20.15			
Entrenchment Ratio	3.6	3.3				2.2	2.4				5.2	5.7				3.4	3.8			
Wetted Perimeter (ft)	-	-				-	-				-					-				
Hydraulic Radius (ft)	-	-				-	-				-					-				
Substrate																				
d50 (mm)																				
d84 (mm)																				

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	52	85	-									
Radius of Curvature (ft)			-	33	41	-									
Meander Wavelength (ft)			-	130	136	-									
Meander Width Ratio			-	7.40	9.78	-									
Profile															
Riffle Length (ft)			-			-									
Riffle Slope (ft/ft)			-			-									
Pool Length (ft)			-			-									
Pool Spacing (ft)			-			-									
Additional Reach Parameters															
Valley Length (ft)			-												
Channel Length (ft)			1,948			1,948									
Sinuosity			1.4			1.4									
Water Surface Slope (ft/ft)			-			-									
BF Slope (ft/ft)			0.0142			0.0142									
Rosgen Classification			C5			C5									

Reach: UT2															
I. Cross-Section Parameters	Cross-section 10 Pool					Cross-section 11 Riffle									
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5					
Dimension															
BF Width (ft)	29.75	28.26				12.41	11.69								
Floodprone Width (ft)	4.02	-				2.84	-								
BF Cross-sectional Area (ft2)	26.2	21.3				9.6	9.0								
BF Mean Depth (ft)	0.88	0.75				0.78	.77								
BF Max Depth (ft)	2.01	1.74				1.42	1.4								
Width/Depth Ratio	33.81	37.57				15.98	15.13								
Entrenchment Ratio	2.1	2.2				4.3	4.6								
Wetted Perimeter (ft)	-					-									
Hydraulic Radius (ft)	-					-									
Substrate															
d50 (mm)															
d84 (mm)															

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	50	55	-									
Radius of Curvature (ft)			-	22	26	-									
Meander Wavelength (ft)			-	90	100	-									
Meander Width Ratio			-	7.69	8.55	-									
Profile															
Riffle length (ft)			-			-									
Riffle Slope (ft/ft)			-			-									
Pool Length (ft)			-			-									
Pool Spacing (ft)			-			-									
Additional Reach Parameters															
Valley Length (ft)			-			-									
Channel Length (ft)			923			923									
Sinuosity			1.4			1.4									
Water Surface Slope (ft/ft)			-			-									
BF Slope (ft/ft)			0.005			0.005									
Rosgen Classification			C5			C5									

Reach: UT3				
I. Cross-Section Parameters	Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4

	Riffle					Pool					Riffle					Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	22.4	22.89				26.14	25.27				22.48	23.88				22.62	22.84			
Floodprone Width (ft)	4.58	-				5.16	-				-	-				-	-			
BF Cross-sectional Area (ft2)	29.40	29.3				27.7	16.5				45.1	40.1				30	28.5			
BF Mean Depth (ft)	1.31	1.28				1.06	0.65				2.01	1.68				1.32	1.25			
BF Max Depth (ft)	2.29	2.3				2.58	1.75				3.54	3.66				2.54	2.57			
Width/Depth Ratio	17.1	17.2				24.65	38.62				11.21	14.24				17.08	18.27			
Entrenchment Ratio	>4.5	>4.4				>3.6	>3.7				>3.2	>3.0				3.9	3.9			
Wetted Perimeter (ft)	-	-				-					-					-				
Hydraulic Radius (ft)	-	-				-					-					-				
Substrate																				
d50 (mm)																				
d84 (mm)																				

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	70	90	-									
Radius of Curvature (ft)			-	28	45	-									
Meander Wavelength (ft)			-	160	180	-									
Meander Width Ratio			-	6.70	16	-									
Profile															
Riffle length (ft)			-			-									
Riffle Slope (ft/ft)			-			-									
Pool Length (ft)			-			-									
Pool Spacing (ft)			-			-									
Additional Reach Parameters															
Valley Length (ft)			-			-									
Channel Length (ft)			3226			3226									
Sinuosity			1.4			1.4									
Water Surface Slope (ft/ft)			-			-									
BF Slope (ft/ft)			0.0049			0.0049									
Rosgen Classification			C5			C5									

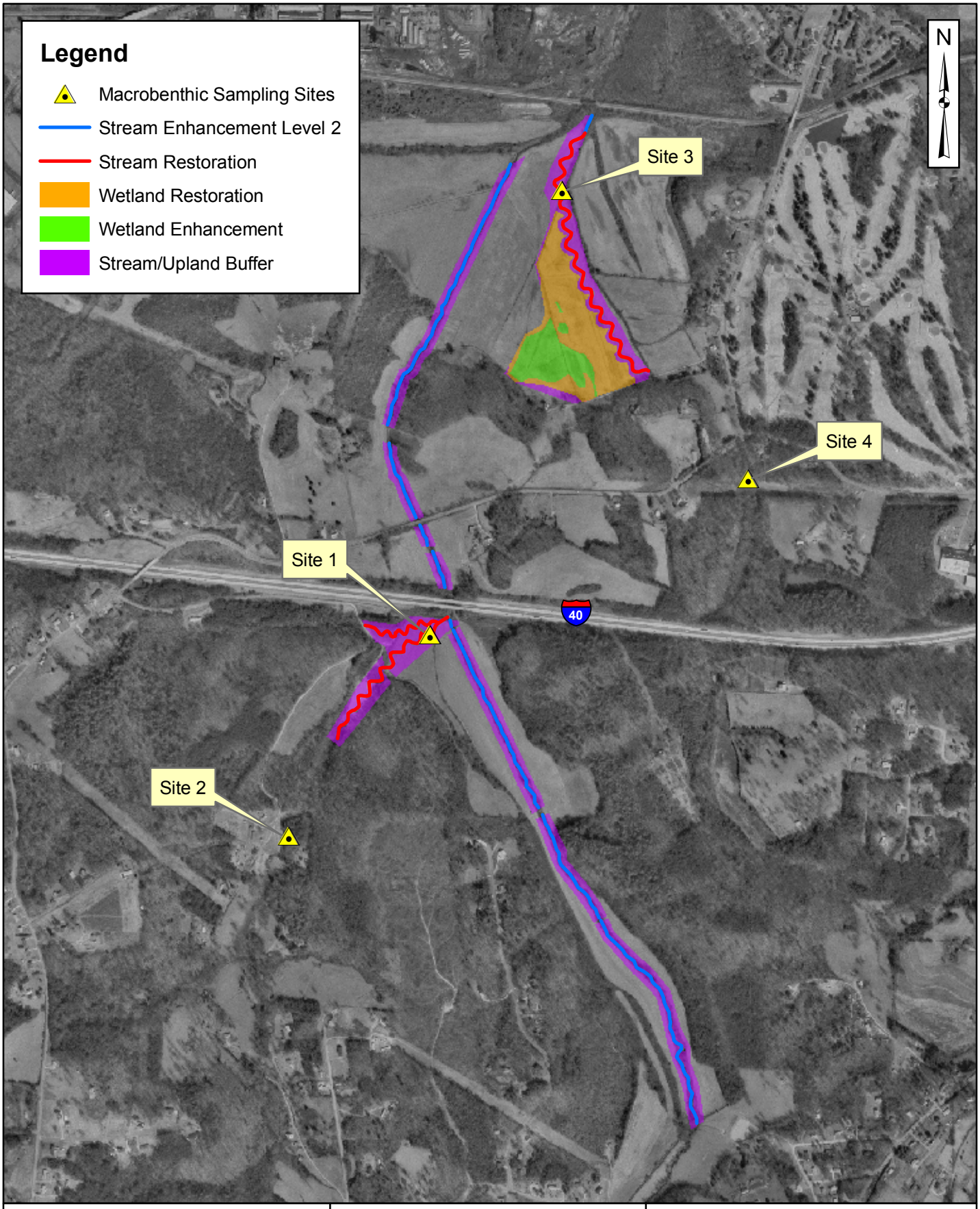
Reach: UT3 Continued

I. Cross-Section Parameters	Cross-section 5 Riffle					Cross-section 6 Pool					Cross-section 7 Riffle					
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	

Dimension									
BF Width (ft)	33.77	17.59		23.85	20.57		13.09	11.25	
Floodprone Width (ft)	4.34	-		5.66	-		3.48	-	
BF Cross-sectional Area (ft2)	24.6	19		26.6	22.3		14.3	13.0	
BF Mean Depth (ft)	0.73	1.08		1.12	1.09		1.09	1.16	
BD Max Depth (ft)	2.17	2.07		2.83	2.24		1.74	1.73	
Width/Depth Ratio	46.36	16.28		21.36	18.95		12	9.72	
Entrenchment Ratio	2.5	4.8		2.9	3.2		9.7	11	
Wetted Perimeter (ft)	-			-			-		
Hydraulic Radius (ft)	-			-			-		
Substrate									
d50 (mm)									
d84 (mm)									

APPENDIX E

BENTHIC MACROINVERTEBRATE MONITORING DATA



EBX
Environmental Banc and Exchange, LLC
2530 Meridian Parkway, Suite 200
Durham, NC 27713

0 500 1,000 2,000 Feet

Benthic Macroinvertebrate Sampling Sites
Bailey Fork Site

P-1

Site 1 – looking upstream

P-2

Site 1 – looking downstream

P-3

Site 2 – looking upstream

P-4

Site 2 – looking downstream

P-5

Site 3 – looking upstream

P-6

Site 3 – looking downstream

P-7

Site 4 – looking upstream

P-8

Site 4 – looking downstream

Appendix A. Benthos Data for Bailey Fork Project Collected on January 9-17, 2007

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/10/07	Site 2 UT1 to Bailey Fork Reference 1/17/06	Site 3 UT3 to Silver Creek 1/9/07	Site 4 UT3 to Silver Creek Reference 1/10/07
ANNELIDA						
Oligchaeta						
Lumbriculidae	**7.0**	**GC**	**R**			
Megadrile						
Megadrile oligochaeta	**9.0**					**R**
Tubificidae	**7.1**	**GC**	**R**			
ARTHROPODA						
Crustacea						
Talitridae	**5.5**					
Hyallela azteca	**7.8**	**GC**	**R**		**R**	
Insecta						
Coleoptera						
Elmidae						
Stenelmis spp.	**5.1**	**SC**		**R**		
Hydrophilidae						
Tropisternus spp.	**9.7**	**PR**	**C**			
Noteridae						
Hydrocanthus spp.	**7.1**	**OM**	**R**		**R**	
Ptilodactylidae						
Anchytarsus bicolor	**3.6**	**SH**		**A**		
Hemiptera						
Corixidae	**9.0**	**PR**			**R**	
Diptera						
Chironomidae						
Ablabesmysia mallochi	**7.2**	**OM**			**R**	
Brillia spp.	**5.2**	**SH**			**C**	
Chironomus spp.	**9.6**	**GC**			**A**	
Clinotanypus pinguis	**8.7**	**PR**	**R**			
Conchapelopia grp	**8.4**	**PR**	**A**	**R**	**A**	
Cricotopus bicinctus	**8.5**	**SH**	**R**	**C**	**R**	
Microtendipes spp.	**5.5**	**FC**		**R**	**R**	
Orthocladius obumbratus c/o 10	**8.5**	**GC**	**R**			
Parakiefferiella spp.	**5.4**	**GC**	**R**			
Parametriocnemus lundbecki	**3.7**	**GC**	**R**	**C**	**C**	**C**
Paratanytarsus spp.	**8.5**	**GC**			**C**	
Phaeopsectra spp.	**6.5**				**R**	
Polypedilum fallax grp	**6.4**	**SH**	**R**		**R**	
Polypedilum halterale grp	**7.3**	**SH**			**R**	
Rheocricotopus spp.	**7.3**	**GC**	**C**	**R**		**R**
Stenochironomus spp.	**6.5**	**SH**			**R**	
Stictochironomus spp.	**6.1**	**OM**	**C**		**R**	

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/10/07	Site 2 UT1 to Bailey Fork Reference 1/17/06	Site 3 UT3 to Silver Creek 1/9/07	Site 4 UT3 to Silver Creek Reference 1/10/07
Tanytarsus spp.	**6.8**	**FC**		**R**		
Zavrelimyia spp.	**9.1**	**PR**			**C**	**C**
Dixidae						
Dixa spp.	**2.6**	**GC**		**C**		
Simulidae						
Simulium spp.	**6.0**	**FC**	**C**	**A**		**A**
Tipulidae						
Erioptera spp.	**4.6**	**GC**		**R**		
Hexatoma spp.	**4.3**	**PR**				**C**
Tipula spp.	**7.3**	**SH**	**C**	**C**	**C**	**A**
Ephemeroptera						
Baetidae						
Acentrella spp.	**4.0**	**GC**	**R**			
Acerpenna pygmaea	**3.9**	**OM**		**R**		
Baetis pluto	**4.3**			**R**		
Centroptilum spp.	**6.6**	**GC**	**R**			
Caenidae						
Caenis spp.	**7.4**	**GC**	**C**		**R**	
Ephemerellidae						
Ephemerella spp.	**2.0**	**GC**	**A**	**A**		
Eurylophella funeralis	**2.1**	**GC**	**R**	**C**		
Serratella deficiens	**2.8**	**GC**	**C**	**C**		
Ephemera spp.	**2.0**	**GC**		**R**		
Heptageniidae						
Stenonema modestum	**5.5**	**SC**	**A**	**A**	**R**	**R**
Stenonema pudicum	**2.0**	**SC**	**C**	**C**		
Stenonema ithaca	**3.6**	**OM**	**R**			
LeptophlebiIdae						
Leptophlebia spp.	**6.2**	**GC**	**C**	**R**		
Megaloptera						
Corydalidae						
Nigronia serricornus	**5.0**	**PR**	**R**			
Sialidae						
Sialis spp.	**7.2**	**PR**				**R**
Odonata						
Aeshnidae						
Boyeria vinosa	**5.9**	**PR**		**R**		
Calopterygidae						
Calopteryx spp.	**7.8**	**PR**	**C**		**R**	
Coenagrionidae						
Argia spp.	**8.2**	**PR**	**R**			
Ischnura spp	**9.5**	**PR**			**R**	
Cordulegastridae						
Cordulegaster spp.	**5.7**	**PR**		**R**		

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/10/07	Site 2 UT1 to Bailey Fork Reference 1/17/06	Site 3 UT3 to Silver Creek 1/9/07	Site 4 UT3 to Silver Creek Reference 1/10/07
Plecoptera						
Perlidae						
Acroneuria abnormis	**2.1**	**PR**		**R**		**R**
Eccoptura xanthenes	**3.7**			**C**		
Perlodidae						
Diploperla duplicata	**2.7**	**??**		**C**		**R**
Isoperla bilineata	**5.4**	**??**	**R**	**A**		
Taeniopterygidae						
Strophopteryx spp.	**2.7**	**??**	**R**	**R**		
Trichoptera						
Hydropsychidae						
Cheumatopsyche spp.	**6.2**	**FC**	**A**	**R**	**C**	
Diplectrona modesta	**2.2**	**FC**		**C**		**C**
Hydropsyche betteni	**7.8**	**FC**	**A**	**R**	**R**	
Lepidostomatidae						
Lepidostoma spp.	**0.9**	**SH**		**R**		
Limnephilidae						
Pycnopsyche spp.	**2.5**	**SH**	**C**	**C**		
Philopotamidae						
Chimarra spp.	**2.8**	**FC**				**R**
Polycentropodidae						
Polycentropus spp.	**3.5**	**PR**		**R**		
MOLLUSCA						
Gastropoda						
Lymnaeidae						
Pseudosuccinea columella	**7.7**	**SC**			**C**	
Physidae						
Physella spp.	**8.8**	**SC**	**A**		**A**	
Pleuroceridae						
Elimia spp.	**2.5**	**SC**				**R**
Total Taxa Richness			**35**	**34**	**26**	**14**
EPT Taxa Richness			**15**	**20**	**4**	**5**
Total Biotic Index			**6.33**	**4.30**	**7.87**	**5.75**
EPT Biotic Index			**4.95**	**3.65**	**6.55**	**2.81**
Dominant in Common Taxa (%)			**40**	**N/A**	**50**	**N/A**

Notes: Tolerance Values: ranges from 0 (least tolerant to pollution) to 10 (most tolerant to pollution).
Functional Feeding Group: CG = Collector-Gatherer, FC = Filterer-Collector, OM = Omnivore, PR = Predator, SC = Scraper, SH = Shredder.
Abundance: R = Rare (1-2 individuals); C = Common (3-9 individuals); A = Abundant (10 or more individuals).

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

82

Biological Assessment Unit, DWQ **TOTAL SCORE** 77

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Bailey's Fork UT to Site 1 **Location/road:** Hopewell & I-40 (Road Name Hopewell) **County** Burke

Date 1/10/07 **CC#** _____ **Basin** Catawba **Subbasin** 11-34-3-(3)

Observer(s) CDM AMC **Type of Study:** ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Northing ~~Latitude~~ 726970.6 Easting ~~Longitude~~ 1191435.9 **Ecoregion:** ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 5.05 °C DO 42.7% → 8.0° C mg/l Conductivity (corr.) 40 µS/cm pH 6.04

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 15 %Forest _____ %Residential _____ %Active Pasture _____ % Active Crops
80 %Fallow Fields _____ % Commercial _____ %Industrial 5 %Other - Describe: Pasture

Watershed land use : ☐Forest ☒Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream 1.5m Channel (at top of bank) 4m **Stream Depth:** (m) Avg 1ft Max ____
☒ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 2 ft

Bank Angle: 20 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐Deeply incised-steep, straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐ Recent overbank deposits ☒Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☐N ☒Y: ☐Rip-rap, cement, gabions ☒ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☐Normal ☐Low natural channel design restoration
Turbidity: ☐Clear ☒ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☒ **YES** ☐**NO Details** wetlands in floodplain

Channel Flow Status
Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☐
C. Water fills 25-75% of available channel, many logs/snags exposed	☒
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: Sunny cold **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: _____

I. Channel Modification

	Score
A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks_____ Subtotal 5

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

A X **Rocks** C X **Macrophytes** C/R X **Sticks and leafpacks** R **Snags and logs** C **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	(16)	12	8
3 types present	19	15	11	7
2 types present	18	14	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks leaf packs minimal Subtotal 16

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	(11)
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks_____ Subtotal 11

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☒ Silt bottom ☐ Some pools over wader depth

Remarks_____

Page Total 42

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☒ Typical for area ☐ Steep=fast flow ☐ Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	(7)	(7)
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 14

Remarks some matting w/o veg, but very stable

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	(0)

Remarks young woody veg

Subtotal 0

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☐ Trees ☐ Shrubs ☒ Grasses ☒ Weeds/old field ☐ Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	(0)	(0)

Remarks field conditions → wide protected buffer

Total 10

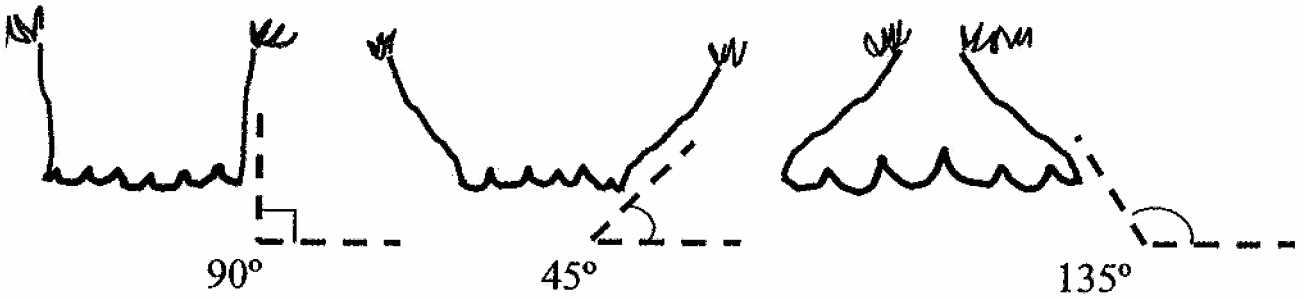
Page Total ~~30~~ 40

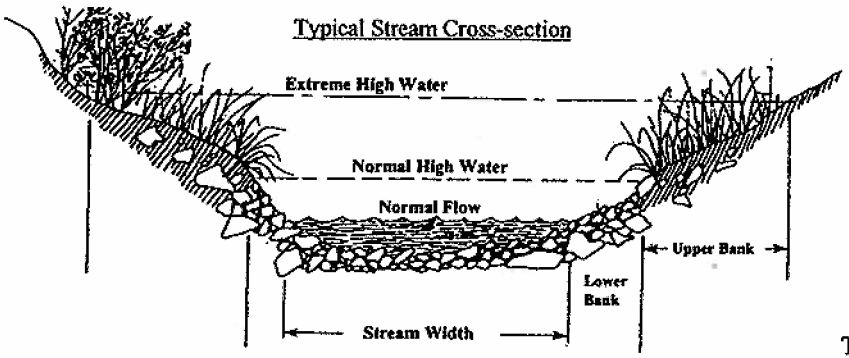
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE ~~78~~ 82

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments: _____

_____

_____

_____

_____

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 70

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Baileys Fork Location/road: Site 2 (Road Name Hopewell) County Burke

Date 1/17/07 **CC#** _____ Basin Catawba Subbasin 11-34-8-(3)

Observer(s) CDM AMC Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Northing ~~Latitude~~ 7752314 Easting ~~Longitude~~ 1192166 Ecoregion: ☐ MT ☐ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 8.4 °C DO 32.1% 3.76 mg/l Conductivity (corr.) 50 µS/cm pH 5.97

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 75 %Forest 25 %Residential _____%Active Pasture _____% Active Crops
_____%Fallow Fields _____% Commercial _____%Industrial _____%Other - Describe: _____

Watershed land use : ☒Forest ☒Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream 2m Channel (at top of bank) 4.5 **Stream Depth:** (m) Avg 6 in Max 24
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m)_____

Bank Angle: 60 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☒Deeply incised-steep, straight banks ☒Both banks undercut at bend ☒Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☒N ☐Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☒Normal ☐Low
Turbidity: ☐Clear ☒ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☐ **YES** ☐**NO Details** when walked in

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☒
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☐
C. Water fills 25-75% of available channel, many logs/snags exposed	☐
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: SUNNY cold **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: _____

I. Channel Modification

	Score
A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks _____ Subtotal 5

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C X **Rocks** R **Macrophytes** C X **Sticks and leafpacks** C X **Snags and logs** A **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score		20-40% Score	<20% Score
4 or 5 types present	20	16	(14)	12	8
3 types present	19	15		11	7
2 types present	18	14		10	6
1 type present	17	13		9	5
No types present	0				

☐ No woody vegetation in riparian zone Remarks minimal large substrate riffles Subtotal 14

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	(4)
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks Many sand riffles Subtotal 4

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	10
b. pools about the same size (indicates pools filling in)	(8)
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 8

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks lots of silt/sand in pools

Page Total 31

3/18/05

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	(14)	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal 14

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	(6)	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	(5)
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 11

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	(7)
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 7

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☒ Trees ☒ Shrubs ☒ Grasses ☐ Weeds/old field ☐Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	(2)
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

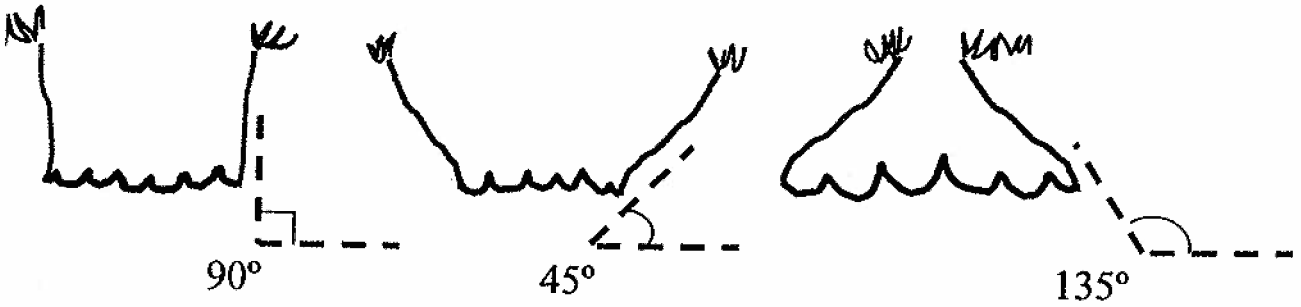
Remarks _____ Total 7

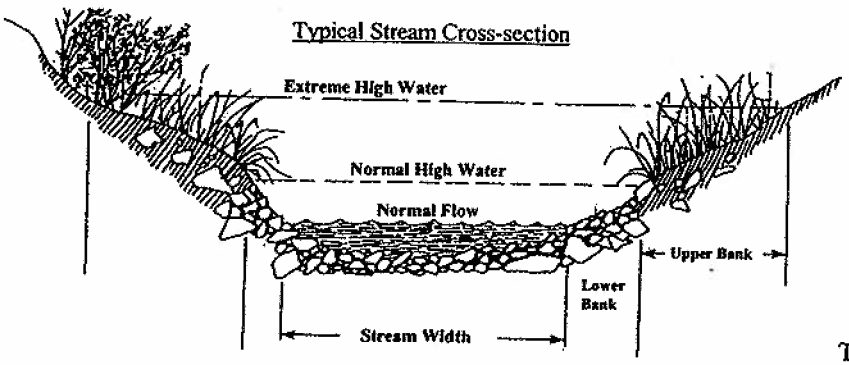
Page Total 39

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 70

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments:_____

_____

_____

_____

_____

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

(60) 74

Biological Assessment Unit, DWQ **TOTAL SCORE**

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream UT3 - Bailey Fork **Location/road:** SR 3 **(Road Name** Hopewell **)County** Burke

Date 12/9/07 **CC#** _____ **Basin** Catawba **Subbasin** 11-34-8-(3)

Observer(s) CDM / AMC Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Northing Latitude 7308080 Easting Longitude 1192576.6 (0.9 Do meter) Ecoregion: ☒ MT ☐ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 6.7 °C DO 4.70 mg/l Conductivity (corr.) 60 µS/cm pH 5.93

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: _____%Forest _____%Residential 25 %Active Pasture _____% Active Crops
75 ~~40~~ %Fallow Fields _____% Commercial _____%Industrial _____%Other - Describe:_____

Watershed land use : ☐Forest ☒Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream 9ft Channel (at top of bank) 15ft **Stream Depth:** (m) Avg 3ft Max 4-5ft
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 3.5ft

Bank Angle: 20 ~~30~~ ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐Deeply incised-steep, straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☐N ☐Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☒High ☐Normal ☐Low
Turbidity: ☐Clear ☐ Slightly Turbid ☒Turbid ☐Tannic ☐Milky ☐Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☒ **YES** ☐**NO Details** wetland creation in floodplain,

Channel Flow Status
Useful especially under abnormal or low flow conditions.
A. Water reaches base of both lower banks, minimal channel substrate exposed ..... ☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed..... ☒
C. Water fills 25-75% of available channel, many logs/snags exposed..... ☐
D. Root mats out of water..... ☐
E. Very little water in channel, mostly present as standing pools..... ☐

Weather Conditions: sunny cold **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: high flows - stagnant - beaver dam at base out UT3 & trib

I. Channel Modification

	Score
A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks Restored stream Subtotal 5

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

A X **Rocks** R **Macrophytes** A X **Sticks and leafpacks** R **Snags and logs** A X **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	(11)	7
2 types present	18	14	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks leaf packs fresh → not good cover Subtotal 11

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	(6)
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks lots of sediment → watercress, riffle sediment Subtotal 6

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☐ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk X Silt bottom ☐ Some pools over wader depth

Remarks

Page Total 32

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☒Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation designed

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	(7)	(7)
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 14

Remarks Matting in place – veg has not grown up yet

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	(2)
E. **No canopy** and no shading.....	0

Remarks <10%

Subtotal 2

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☒Trees ☐Shrubs ☒Grasses ☒Weeds/old field ☐Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	(2)
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	(0)	0

Total ~~8~~ 10

Remarks just one tree width → otherwise grass on River Right

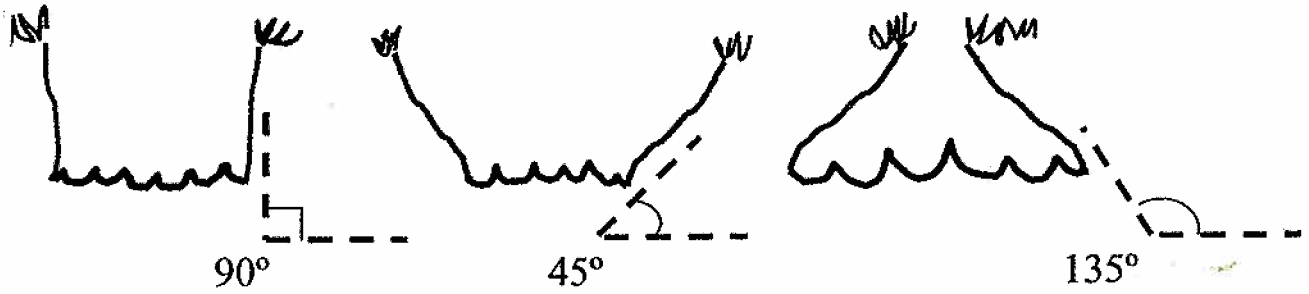
Page Total ~~8~~ 12

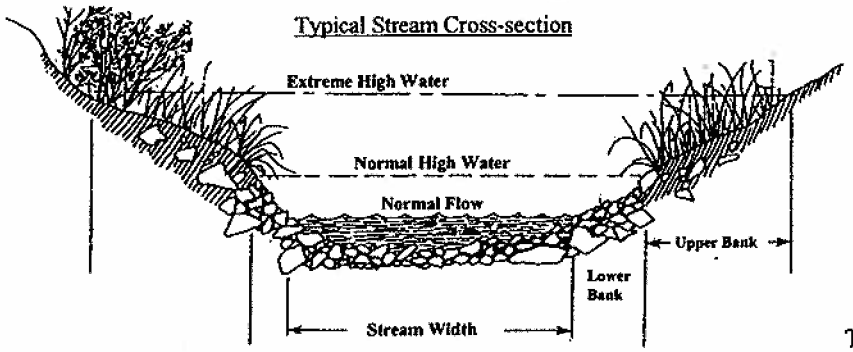
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE ~~84~~ 74

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments:_____

_____

_____

_____

_____

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ

TOTAL SCORE 52

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Bailey Fork UT3 site 4 **Location/road:** Hopewell Golf Club **(Road Name** Hopewell **)County** Burke Co

Date 1 10 07 **CC#** _____ **Basin** Catawba _____ **Subbasin** 11-34-8-(3)

Observer(s) CBM AMC Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Northing ~~Latitude~~ 729313.9 Easting ~~Longitude~~ 1194186.3 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

51.7%

Water Quality: Temperature 6.6 °C DO 6.35 mg/l Conductivity (corr.) 70 µS/cm pH 5.95

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 80 %Forest 20 %Residential _____%Active Pasture _____% Active Crops
_____%Fallow Fields _____% Commercial _____%Industrial _____%Other - Describe:_____

Watershed land use : ☐Forest ☐Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream 1.5 Channel (at top of bank) 4.5 **Stream Depth:** (m) Avg .25 Max ~~2.5~~ 1
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1.75

Bank Angle: 75° ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☒Deeply incised-steep, straight banks ☒Both banks undercut at bend ☒Channel filled in with sediment
☐ Recent overbank deposits ☒Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☒Sewage smell
Manmade Stabilization: ☐N ☐Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☒Normal ☐Low
Turbidity: ☐Clear ☐ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☐ **YES** ☒ **NO Details** _____

Channel Flow Status
Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
(B) Water fills >75% of available channel, or <25% of channel substrate is exposed	☒
C. Water fills 25-75% of available channel, many logs/snags exposed	☐
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: Sunny 45° **Photos:** ☐N ☐Y ☐ Digital ☐35mm

Remarks: _____

I. Channel Modification

	Score
A. channel natural, frequent bends	5
B. channel natural, infrequent bends (channelization could be old)	(4)
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks_____ Subtotal 4

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

X **Rocks** ____ **Macrophytes** X **Sticks and leafpacks** X **Snags and logs** X **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	(12)	8
3 types present	19	15	~~11~~	7
2 types present	18	14	10	6
1 type present	17	13	9	5
No types present	0			

12

☐ No woody vegetation in riparian zone Remarks_____ Subtotal ~~12~~

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	~~12~~
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	(10) ✓
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks_____ Subtotal 6

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	10
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	(6)
b. pools about the same size	4
B. Pools absent	0

6

Subtotal____

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks_____

Page Total 28

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	(7)
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☒ Typical for area ☐ Steep=fast flow ☐ Low=like a coastal stream

Subtotal ~~27~~

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	(0)	(0)

Total 0

Remarks_____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	(7)
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks_____ Subtotal 7

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☒ Trees ☐ Shrubs ☐ Grasses ☐ Weeds/old field ☐ Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

Total 10

Remarks_____

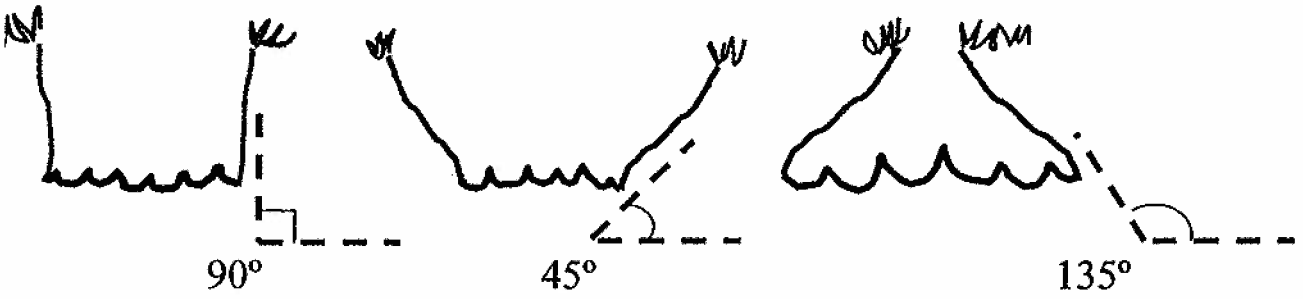
Page Total ~~24~~

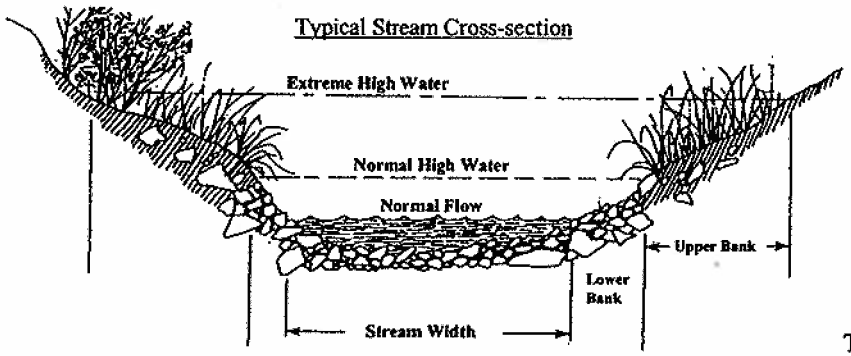
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 51

Supplement for Habitat Assessment Field Data Sheet

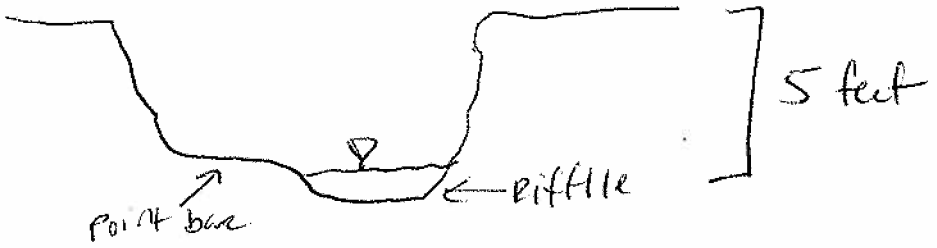
Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:



Other comments: