SILVER CREEK RESTORATION PROJECT (FINAL)

ANNUAL MONITORING REPORT FOR 2010 (YEAR 5)

Project Number D04006-5

Submitted to:

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1.0 SUMMARY

This Annual Report details the monitoring activities during the 2010 growing season (Monitoring Year 5) on the Silver Creek Stream Restoration Site ("Site"). In accordance with the approved Restoration Plan for this Site, this Annual Report presents geomorphology data from 3 longitudinal profiles, 18 cross-sections, and stem count data from 9 vegetation monitoring stations.

Prior to restoration, 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 4,914 linear feet (LF) of stream were restored, 1,116 LF of stream were preserved and 3,199 LF of stream were enhanced.

Rainfall data for Years 1 through Year 4 was obtained from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838). During September 2008, the United States Geological Survey (USGS) installed a weather and deep groundwater monitoring station along the northern UT2 conservation easement boundary of the Bailey Fork Restoration site. The USGS weather station includes a rainfall gauge and is identified as Glen Alpine RS well (USGS 354302081433245). According to the Morganton weather station data and the Glen Alpine station data, total rainfall during the Year 5 monitoring period, January through October 2010 was 38.20 inches and 36.61inches, respectively.

During Year 5 monitoring the vegetation monitoring documented a range of 260 stems per acre to 680 stems per acre with an overall average density of 509 stems per acre and an overall survival rate of 72 percent.

The Site has met the success criteria established in the Restoration Plan of the site of 260 stems per acre after Year 5 of monitoring.

The entire length of the Site was inspected during Year 5 to assess stream performance. Two rock cross vanes located on M4 were noted to have stability issues during Year 4 monitoring. Repairs to the cross vane at station 66+75 were completed in September 10, 2010. During an on-site inspection in October 2010, the repaired cross vane was stable and functioning as designed. During the Year 5 monitoring period, the cross vane at station 63+50 on M4 appeared stable and no visible changes had occurred since Year 4 of monitoring.

The cross-sectional survey data documented that UT1, UT2 and M3 are performing well.

The data from the Year 5 longitudinal profiles show that some pools in UT1 have filled slightly, but have remained relatively stable since as-built conditions. The longitudinal profile data for UT2 show that the most pools and riffles have remained stable since as-built conditions. The longitudinal profile of M3 shows that there have been some minor adjustments to bed profile, primarily around structures, but overall bed and feature slopes have remained unchanged. The longitudinal profile of M3 also shows that the channel repairs conducted in early 2008 are stable and functioning as designed.

The on-site crest gauges documented the occurrence of at least one bankfull flow event at each crest gauge during Year 5 of the post-construction monitoring period. The largest on-site stream flows documented by the crest gauges during Year 5 of monitoring was approximately 0.79 feet above the bankfull stage on UT1, 0.50 feet above the bankfull stage on UT2 and 0.15 feet above the bankfull stage on M3.

The bankfull measurements collected during monitoring Years 1 through 5, documents that all three restored reaches have met the success criteria for bankfull events for the project. For UT1, the two highest bankfull measurements recorded were during Years 2 and 5, the readings were 0.34 and 0.79 feet above bankfull stage, respectively. For UT2, the two highest bankfull measurements recorded were during Years 2 and 5, the readings were 0.28 and 0.5 feet above bankfull stage, respectively. For M3, the two highest bankfull measurements recorded was during Year 2 and Year 4, the readings were 1.43 and 0.59 feet above bankfull stage, respectively.

The Site has met the final stream morphology success criteria specified in the Restoration Plan for the Site.

In accordance with the Restoration Plan for the Site, benthic macroinvertebrate monitoring was last conducted during Year 3 of the monitoring period. Year 3 benthic macroinvertebrate results revealed that Site 1 (Silver Creek) exhibited total and EPT biotic indices similar to Year 2 values, which remain above the pre-construction indices. This suggests that although more species were present during Year 3 these species were slightly more tolerant than previous communities. This is a typical response after a major disturbance to habitat such as in-stream construction techniques. It is anticipated that Site 1 will continue to improve as the project matures. The results for Site 2 (UT1 to Silver Creek) exhibited a decrease in taxa richness and an increase in biotic indices from Year 1 to Year 3 post-construction sampling. This indicates that fewer species were present and those present were more tolerant species. After Year 3, Site 2 had 0 percent DIC with the reference site. The decrease in DIC from Year 2 to Year 3 may indicate a stress on the stream during low flow conditions experienced in 2008. It is anticipated that improvements in biotic indices and an increase in DIC will occur as communities re-establish.

In summary, the Site has met all of the vegetative and stream success criteria specified in the Restoration Plan.

2.0 PROJECT BACKGROUND

The project involved the restoration of 4,914 LF of stream, enhancement of 3,199 LF of stream and the preservation of 1,116 LF of stream. Figures 2(a), 2(b), 2(c), 2(d), 2(e) and 2(f) summarize the restoration and enhancement zones on the project site. A total of 9,632 LF of stream and riparian buffer are protected through a conservation easement.

2.1 Project Location

The Site is located approximately nine miles southwest of the town of Morganton in Burke County, North Carolina (Figure 1). The Site lies in US Geological Survey (USGS) Cataloging Unit 03050101 and North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-31 of the Catawba River Basin. The existing stream channels were re-designed and constructed as shown in Figures 2(a) through 2(f), to enhance the water quality and wildlife habitat.

2.2 Mitigation Goals and Objectives

The specific goals for the Silver Creek Restoration Project were as follows:

- Restore 5,127 LF of stream channel
- Enhance 3,428 LF of stream channel
- Preserve 1,077 LF of stream channel
- Exclude cattle from stream and riparian buffer areas
- Develop an ecosystem-based restoration design
- Improve habitat functions
- Realize significant water quality benefits.

2.3 Project Description and Restoration Approach

The Site had a recent history of pasture, hay production and general agricultural usage. The streams on the project site were channelized, riparian vegetation had been cleared in most locations, and cattle were allowed to graze on the banks and access the channels. Stream functions on the Site had been severely impacted as a result of these land use changes.

The restoration project provides compensatory mitigation for stream impacts associated with construction disturbance in the resident cataloging unit. The design approaches for the project are summarized and presented in Table 1.

Monitoring of the Site is required to demonstrate successful stream mitigation based on the criteria found in the approved Restoration Plan for this Site. Monitoring of stream performance was conducted annually for five years.

Construction at the Site was completed in April 2006 with all vegetation was also planted by April 2006.

Table 1. Design Approach for Silver Creek Restoration Site

Silver Creek Restoration Site: EEP Contract No. D04006-5				
Project Segment or Reach ID	**Mitigation Type ***	**Approach****	**Linear Footage or Acreage**	**Stream Mitigation Units**
M1	EI	P1	1,323 LF	882
M2	P	P1	1,116 LF	223
M3	R	P2	2,127 LF	2,127
M4	EI	P1	1,876 LF	1,251
UT1	R	P2	1,398 LF	1,398
UT2	R	P1	1,214 LF	1,214
UT3	R	P2	175 LF	175
Total			**9,229 LF**	**7,271**

* R = Restoration
P = Preservation
EI = Enhancement I

** P1 = Priority I
P2 = Priority II

2.4 Project History and Background

The chronology of the Silver Creek Restoration 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.

2.5 Project Plan

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

Table 2. Project Activity and Reporting History			
Silver Creek Mitigation Site: Project No. D04006-5			
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	Jun-05
Final Design – (at least 90% complete)	N/A	N/A	Aug-05
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	Nov-06	Nov-06	Dec-06
Year 2 Monitoring	Nov-07	Nov-07	Dec-07
Year 3 Monitoring	Nov-08	Nov-08	Dec-08
Year 4 Monitoring	Nov-09	Nov-09	Dec-09
Year 5 Monitoring	Nov-10	Oct-10	Dec-10

Table 3. Project Contacts

Silver Creek Restoration Site: EEP Contract No. D04006-5	
Full Service Delivery Contractor	
EBX Neuse-I, LLC	909 Capability Drive, Suite 3100 Raleigh, NC 27606 Contact: Norton Webster, Tel. 919-829-9909
Designer	
Michael Baker Engineering, 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	
Michael Baker Engineering, Inc. Stream Monitoring Point of Contact:	8000 Regency Parkway, Suite 200 Cary, NC 27518 Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland and Natural Resource Consultants, Inc. Vegetation Monitoring Point of Contact:	11 South College Ave., Suite 206 Newton, NC 28658 Chris Huysman, Tel. 828-465-3035

Table 4. Project Background	
Silver Creek Restoration Site: Project No. D04006-5	
Project County:	Burke County, NC
Drainage Area:	
Reach: M1	6.6 mi²
Reach: M2	6.9 mi²
Reach: M3	7.2 mi²
Reach: M4	7.6 mi²
Reach: UT1	0.20 mi²
Reach: UT2	0.25 mi²
Reach: UT3	0.07 mi²
Estimated Drainage % Impervious Cover:	
Reach: Silver Creek	< 5%
Reach: UT1	< 5%
Reach: UT2	< 5%
Reach: UT3	< 5%
Stream Order:	
Silver Creek	3
UT1	1
UT2	1
UT3	1
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	C
Cowardin Classification	Riverine, Upper Perennial, Unconsolidated Bottom, Cobble-Gravel
Dominant Soil Types	
Silver Creek	CvA,FaD2, AaA, BvB
UT1	CvA,FaD2, AaA, BvB
UT2	CvA,FaD2, AaA, BvB
UT3	CvA,FaD2, AaA, BvB
Reference site ID	(Tributary to Bailey Fork)
USGS HUC for Project and Reference sites	03050101040020
NCDWQ Sub-basin for Project and Reference	03-08-31
NCDWQ classification for Project and Reference	C
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	75%

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

Silver Creek Restoration Site: EEP Contract No. D04006-5		
Soil Name	**Location**	**Description**
Colvard (CvA)	Flood plains in the southern Appalachian Mountains	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 composed of loamy sands.
Fairview (FaD2)	Piedmont upland	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, with an increase in clay content from about one foot below the surface.
Arkaqua (AaA)	Nearly level flood plains	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.
Brevard (BvB)	High-stream terraces, foot slopes, benches, fans, and coves	Brevard series consists of a very deep soil profile that is well drained with moderate permeability. The series primarily consists of colluvium and alluvium. These soils are generally found in footslopes and toeslopes.
Notes: Source: From Burke County Soil Survey, USDA-NRCS, http://efotg.nrcs.usda.gov		

3.2 Description of Vegetation Monitoring

As a final stage of construction, the stream margins and riparian area of the Site were planted with bare root trees, live stakes, and 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 Site's re-vegetation limits. Bare-root vegetation was planted at a target density of 680 stems per acre, in an 8-foot by 8-foot grid pattern. The tree species planted at the Site are shown in Table 6. The seed mix of herbaceous species applied to the Site's riparian area included soft rush (*Juncus effuses*), bentgrass (*Agrostis alba),* Virginia wild rye (*Elymus virginicus),* switchgrass (*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 10 pounds per acre. All planting was completed in April 2006.

Table 6. Tree Species Planted in the Silver Creek Restoration Area

Silver Creek Restoration Site: EEP Contract No. D04006-5			
ID	**Scientific Name**	**Common Name**	**FAC Status**
1	*Platanus occidentalis*	Sycamore	FACW-
2	*Quercus phellos*	Willow Oak	FACW-
3	*Quercus rubra*	Northern Red Oak	FACU
4	*Nyssa sylvatica*	Black Gum	FAC
5	*Diospyros virginiana*	Persimmon	FAC
6	*Fraxinus pennsylvanica*	Green Ash	FACW
7	*Liriodendron tulipifera*	Tulip Poplar	FAC

At the time of planting, nine vegetation plots – labeled 1 through 9 - 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

To define vegetation success criteria objectively, specific goals for woody vegetation density have been defined. Data from vegetation monitoring plots should display a surviving tree density of at least 320 trees per acre at the end of Year 3 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.

Up to 20 percent of the site's species composition may be comprised of invaders. Remedial action may be required should these (i.e. Loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), Sweet gum (*Liquidambar styraciflua*), etc.) present a problem and exceed 20 percent composition.

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 5 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 they are all accounted for during the annual stem counts and calculation of tree survivability. Permanent aluminum tags are used on surviving stems to aid in relocation during future counts. Flags are also used to mark trees because they do not interfere with the growth of the tree.

Few volunteer woody species were observed in any of the vegetation plots. Red maple (*Acer rubrum*) is the most common volunteer, though the silky dogwood (*Cornus amomum*) and pine (*Pinus spp.*) were also observed in some of the plots.

The Site was planted in bottomland hardwood forest species in April 2006. There were nine vegetation-monitoring plots established throughout the planting areas. During Year 5 monitoring the vegetation monitoring documented a range of 260 surviving stems per acre to 680 stems per acre with an overall average density of 509 stems per acre. An overall survival rate greater than

72 percent based on the initial planting of 706 stems per acre was observed during Year 5 monitoring.

Supplemental planting of four-year-old stems was conducted in early 2010 around Plot 6 due to mortality from previous drought conditions. The low end survival rate found around Plot 6 was particularly affected by the last two dry summers leaving many stems dead from lack of moisture. Plot 6 yielded 200 stems per acre at the end of Year 5, which is below the minimum success criteria of 260 stems per acre stated in the Restoration Plan

In fall of 2010, the area around Plot 6 was evaluated to determine overall success and to determine the likely causes for low survival. Two test plots, each 10 meters x 10 meters square, were established immediately north and south of the existing Plot 6 to validate observations. Both plots yielded 280 stems per acre. The average of the three square plots, including Plot 6, is 260 stems per acre. Achievement of the success criteria was further validated by establishing two, 0.25 acre circular plots in the vicinity of Plot 6. One plot yielded 360 stems per acre and the other 320 stems per acre. It was determined that Plot 6 is an anomaly based on the four additional plots and lack of discernable differences with other parts of the mitigation area.

3.5 Vegetation Observations

After construction of the mitigation site, 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 10 pounds per acre. These species are present on the site. Hydrophytic herbaceous vegetation, including rush (*Juncus effusus*), spike-rush (*Eleocharis obtusa*), boxseed (*Ludwigia spp.*), and sedge (*Carex spp.*), were 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. Commonly seen weedy vegetation includes fescue (*Festuca spp.*), goldenrod (*Solidago spp.*), pokeweed (*Phytolacca americana),* honeysuckle (*Lonicera spp.*), ragweed (*Ambrosia artemisiifolia*) and wild dill (*Foeniculum vulgare*).

3.6 Vegetation Photos

Photos of the project showing the on-site vegetation are included in Appendix A of this report.

Table 7. Year 5 (2010) Stem Counts for Each Species Arranged by Plot **Silver Creek Restoration Site: EEP Contract No. D04006-5**										Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	Year 5 % Survival
Tree Species	**Plots**															
	1	2	3	4	5	6	7	8	9							
Betula nigra	1							3		9	6	4	17	4	4	
Fraxinus pennsylvanica			1		1	3				1	5	1	14	2	5	
Platanus occidentalis	4		1	8	7			13	6	59	52	47	16	39	39	
Quercus phellos						2	1	1		7	7	5	16	4	4	
Quercus rubra	2									0	2	1	12	2	2	72%
Liriodendron tulipiferra	5	6		8			12		3	40	37	41	4	34	34	
Diospyros virginiana	2		4							5	7	6	13	6	6	
Nyssa sylvatica	3	4	7		3				2	24	30	25	17	20	19	
Unknown										14	0	0	14	0	0	
Stems per plot	17	10	13	16	11	5	13	17	11	145	146	130	123	111	113	
Stems per acre	680	400	520	640	440	200*	520	680	440	706	644	578	547	493	509	

*Details of vegetation plot 6 success are summarized in Section 3.4

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 record the highest out-of-bank flow event that occurs between site visits. The gauges are checked each month during site visits. Locations of the gauges are on UT1, UT2, and M3. See Figures 2(a), 2(d) and 2(f) respectively.

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 18 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 2010 (Year 5) were surveyed in October 2010.

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, UT3 and M3). Measurements included thalweg, water surface, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool, glide). In addition, maximum pool depth was recorded. All surveys were tied to a single, permanent benchmark. A longitudinal survey of 3,000 LF of stream channel that included UT1, UT2, and M3 was conducted in November 2010.

Photo Reference Stations: Photographs are used to visually document restoration success. A total of 29 reference stations were established to document conditions at the constructed grade control structures across the Site, and additional photo stations were established at each of the 18 permanent cross-sections and hydrologic monitoring stations. The Global Positioning System (GPS) coordinates of each grade control structure photo station have been noted as additional reference to ensure the same photo location is used throughout the monitoring period. Reference photos are taken at least once per year. A photo log of the Site is included in Appendix A of this report.

Stream banks are photographed at each permanent cross-section photo station. For each stream bank photo, the photo 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 photo (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.

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 an increase in 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" and "B" 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" and "B" type channels.
- *Photo 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. Photos 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

The on-site crest gauge documented the occurrence of at least one bankfull flow event at each crest gauge during Year 5 of the post-construction monitoring period, as shown in Table 8. The values presented are the highest recorded readings on each reach during Year 5. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows, confirming the crest gauge readings on UT1, UT2 and M3.

Table 8. Verification of Bankfull Events

Silver Creek Restoration Site: EEP Contract No. D04006-5 (Highest reading by reach)			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Measurement (feet)
6/28/2010	6/1/2010	Crest Gauge UT1	0.79
9/30/2010	9/29/2010	Crest Gauge UT2	0.50
9/30/2010	9/29/2010	Crest Gauge M3	0.15

4.4 Stream Monitoring Data and Photos

Data from each permanent cross-section are included in Appendix B. A photo log showing each of the 18 permanent cross-section locations is also 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 5 of post-construction monitoring. The percentages noted are a general overall field evaluation of the how the structures were performing at the time of the latest photo point survey. Based on visual assessments during Year 5, all structures on UT1, UT2 and UT3 performed well.

During Year 2 monitoring, features on M3 had experienced minor problems. Two meanders had stability issues, one cross vane showed lack of a scour pool and one riffle had a stability issue at the tail of riffle. Minor repair work was completed in early 2008 to address these areas. Disturbed bank and buffer areas were replanted after repairs were completed. The repaired areas on M3 have maintained stability and have performed well throughout the five-year monitoring period. There are currently no issues associated with this section of stream.

During Year 4 monitoring, two rock cross vanes located on M4 were noted to have stability issues. The first cross vane is located approximately at station 66+75 on M4. The problem noted was that the right arm of the cross vane appeared to have subsided slightly and low to moderate stream levels were flowing over the arm. To re-center the thalweg with the invert of the structure, repairs to this cross vane were completed on September 10, 2010. During an on-site inspection in October 2010, the repaired cross vane was stable and functioning as designed.

The second cross vane is located approximately at station 63+50 on M4. The problem noted was that one or two boulders appeared to have fallen off of the right arm of the cross vane into the pool. The arm is missing these boulders but appears to be stable. Photos of these two cross vane problem areas are provided in the stream photo log in Appendix A.

Table 9. Categorical Stream Features Stability Assessment

Silver Creek Restoration Site: Project No. D04006-5						
	Performance Percentage					
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
Riffles	100%	100%	95%	100%	100%	100%
Pools	100%	100%	100%	100%	100%	100%
Thalweg	100%	100%	100%	100%	100%	100%
Meanders	100%	100%	95%	100%	100%	100%
Bed General	100%	100%	100%	100%	100%	100%
Vanes / J Hooks etc.	100%	100%	95%	100%	95%	98%

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, as well as the as-built baseline data to determine stream stability during the project's post construction monitoring period are summarized in Appendix C.

4.7 Longitudinal Profile Monitoring Results

A Year 5 longitudinal profile was completed in October 2010 and was compared to the data collected during the as-built condition survey, Year 2, Year 3 and Year 4 of monitoring. The longitudinal profiles are presented in Appendix B. During Year 5 monitoring, a total of approximately 3,000 LF of channel was surveyed for UT1, UT2 and M3.

The data from the Year 5 longitudinal profiles show that the pools in UT1 have filled slightly and have adjusted since as-built conditions. The partial filling of the pools in UT1 is attributed to a dense layer of vegetation throughout the channel which has likely caused accumulation of sediment. It is likely that these sediments are present in the pools due to the reduced velocities that are being exerted on the system by the dense vegetation layer in the channel and the low gradient design of UT1. The reduced velocities have therefore limited scouring in the pools on UT1; however, the pools are maintaining depths significantly deeper than the riffles. The Year 5 survey data show that the riffles throughout UT1 have maintained elevations at or above as-built conditions. During Year 5 monitoring, the UT1 riffles appear to be stable and are performing as designed.

The longitudinal profile data for UT2 show that the pools and riffles between stations 12+55 and 15+00 have adjusted slightly since as-built conditions. According to the Year 5 survey data, the riffles in this area have been stable since Year 3 and the pools have deepened since as-built conditions. The Year 5 survey data show that UT2 appears to be stable and performing as designed. The longitudinal profile data for UT2 show that the pools and riffles at stations 15+00 through 22+45 have maintained stability since as-built conditions.

The Year 5 longitudinal profile of M3 shows some minor fluctuations and adjustments to the bed profile, primarily around structures, but overall bed and feature slopes have remained relatively unchanged. The changes observed are typical for a larger creek with predominantly sand sized bed load. The longitudinal profile of M3 shows that the in-stream repairs conducted in early 2008 are stable and functioning as designed.

4.8 Cross-section Monitoring Results

Year 5 cross-section monitoring data for stream stability were collected during October 2010. The Year 5 cross-section data were compared to baseline stream geometry data collected in April 2006 (as-built conditions), Year 1 data collected in October 2006, Year 2 data collected in November 2007, Year 3 data collected in October 2008 and Year 4 data collected in October 2009.

The 18 permanent cross-sections along the restored channels (10 located across riffles and 8 located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 5. Data from each of these cross-sections are summarized in Appendix B and Appendix D. The cross-sections show that there has been some slight adjustment to stream dimension since construction, but there is no apparent instability.

The 8 pool cross-sections are located on all restored reaches on the Site, except UT3. Pool cross-sections 1 and 3 are located on UT1, cross-section 5 is located on UT2, cross-sections 9 and 11 are located on M3, cross-sections 12 and 13 are on located on M4 and cross-section 17 is located on M1. The pool cross-sections are located across pools found at the apex of meander bends or

below cross vanes. The Year 5 data from the pool cross-sections indicated that some pools have adjusted slightly since as-built conditions. Overall, the Year 5 survey data show that the all of the pool cross-sections have remained relatively stable since as-built conditions.

The 10 riffle cross-sections are located in riffle areas on all restored reaches on the Site. Cross-section 2 is located UT1, cross-sections 4 and 6 are located on UT2, cross-section 7 is located on UT3, cross-sections 8 and 10 are located on M3, cross-sections 14 and 15 are located on M4 and cross-sections 16 and 18 are located within M1 riffles areas. Cross-sections 4, 6, 8, and 10 have remained very stable since Year 2 monitoring. Cross-sections 2, 7, 14, 15, 16 and 18 have adjusted slightly since as-built conditions but the riffles appear to be stable. Overall the survey data show that the riffle cross-sections are remaining relatively stable.

All monitored cross-sections fell within the quantitative parameters defined for "C", "B" or "E" type channels.

Photographs of the channel were taken at the end of 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

The Restoration Plan for the Site did not included wetland areas. Therefore, no hydrology monitoring stations were installed.

Rainfall data for Years 1 through Year 4 were obtained from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838). The data were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts.

During September 2008, the United States Geological Survey (USGS) installed a weather and deep groundwater monitoring station at the Bailey Fork Restoration Site within the conservation easement boundary. This USGS weather station includes a rainfall gauge and is identified as Glen Alpine RS well (USGS 354302081433245). The data from the Glen Alpine gauge was used in conjunction with the Morganton gauge to document rainfall data for this report.

Table 10. Comparison of Historic Rainfall to Observed Rainfall (inches)
Silver Creek Mitigation Site: EEP Contract No. D04006-5

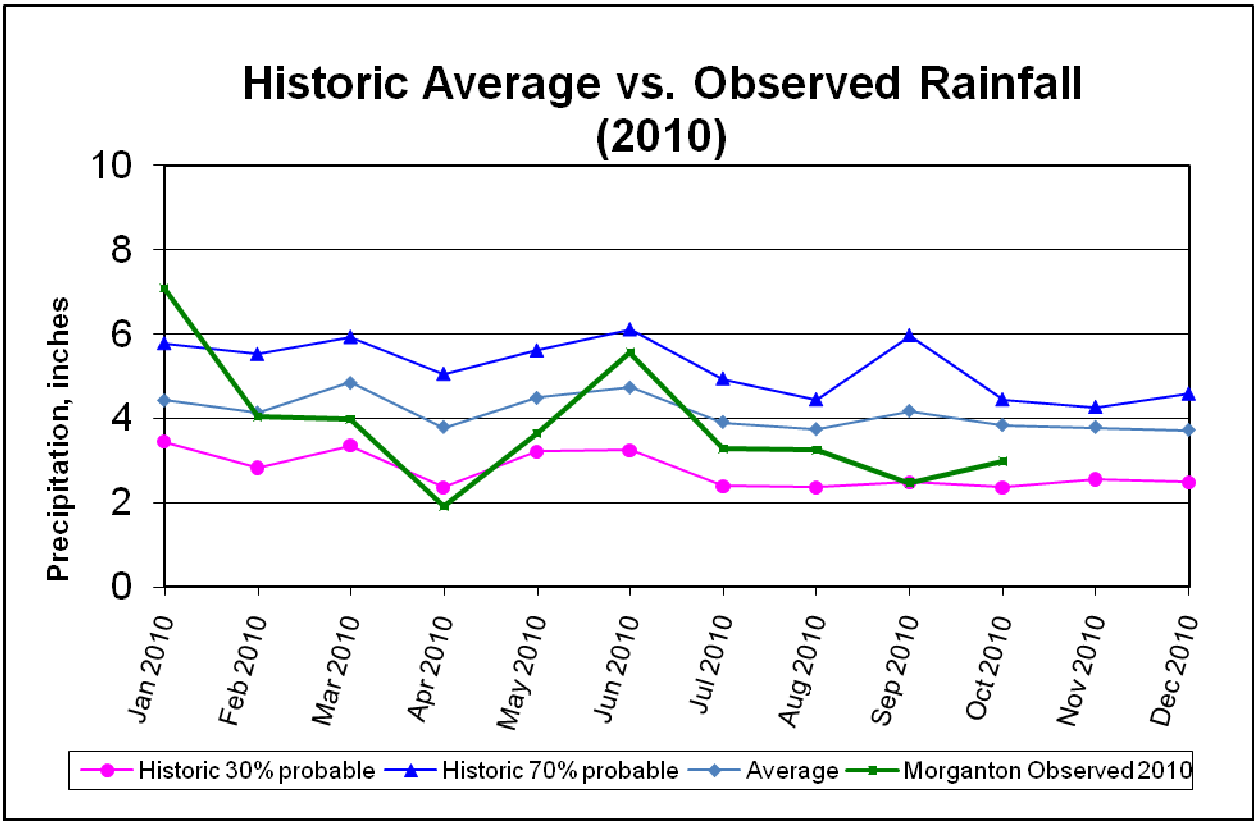
Month	Average	30%	70%	Morganton Station Observed 2010 Precipitation
January	4.43	3.45	5.79	7.09
February	4.14	2.83	5.53	4.04
March	4.85	3.36	5.94	3.98
April	3.79	2.36	5.06	1.91
May	4.49	3.22	5.62	3.64
June	4.74	3.25	6.12	5.57
July	3.91	2.38	4.95	3.27
August	3.74	2.36	4.45	3.25
September	4.18	2.48	5.98	2.47
October	3.84	2.03	4.76	2.98
November	3.79	2.55	4.27	NA
December	3.72	2.48	4.59	NA
Total:	49.62	--	--	38.20 (through October 2010)

An on-site manual gauge is used to validate observations made at the automated stations. During Year 5 monitoring, the manual gauge experienced several problems throughout the year. Therefore, data from the manual gauge during Year 5 is substituted with rainfall data from the Glen Alpine station. In place of the manual gauge, data from the Glen Alpine station was compared with the Morganton gauge for this report.

According to the Morganton weather station data and the Glen Alpine weather station data, total rainfall during the Year 5 monitoring period was shown to be below the normal average from January through October 2010. For this period, the Morganton station measured rainfall to be 3.91 inches below the historic average. For the same period, Glen Alpine weather station also measured total rainfall to be below the normal average. The Glen Alpine station measured rainfall to be 5.50 inches below the historic average from January to October 2010.

Above average to average rainfall occurred during the months of January, February and June. Below average rainfall during 2010 occurred during March, April, May, July, August, September and October. (see Table 10 and Figure 3

Figure 3. Historic Average vs. Observed Rainfall



6.0 BENTHIC MACROINVERTEBRATE MONITORING

6.1 Description of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring was conducted in conjunction with the Silver Creek Restoration Project. Because of seasonal fluctuations in populations, macroinvertebrate sampling must be consistently conducted in the same season. This section summarizes the benthic macroinvertebrate samples collected during pre-construction and for Years 1, 2, and 3 of the five-year monitoring period.

The sampling methodology followed the Qual 4 method listed in NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006). Field sampling was conducted by Carmen McIntyre and Jake McLean of Baker. Laboratory identification of collected species was conducted by Pennington & Associates, Inc.

For the final Year 3 monitoring event, benthic macroinvertebrate samples were collected at two sites on the Silver Creek Project on February 2, 2009 and one eco-reference site a tributary to Bailey Fork on March 19, 2009. Sites 1 and 2 were located within the restoration area on Silver Creek and UT1 to Silver Creek, respectively. The majority of the restoration activities on Silver Creek were enhancement and preservation. Sampling Site 1 lies within the stream restoration portion of the project. Sampling Site 2 is located approximately 300 feet upstream of where UT1 flows under Morrison Road. Figure 4 illustrates the sampling site locations.

Benthic macroinvertebrates were collected to assess quantity and quality of life in the stream. In particular, specimens belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (EPT species) 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, dissolved oxygen concentration, pH, and specific conductivity were recorded at each site. The habitat assessment field data sheets are presented in each monitoring report for the respective year of monitoring.

6.2 Benthic Macroinvertebrate Sampling Results

Pre-restoration field samples for benthic macroinvertebrates were collected in January 2005 before construction commenced. The three remaining sampling events took place each January during monitoring years 1, 2 and 3. A comparison between the pre- and post-construction monitoring results is presented in Table 11.

6.3 Benthic Macroinvertebrate Sampling Discussion

Site 3, the reference site, exhibited an abundance of taxa during Year 3 monitoring. Overall taxa richness was more than double that observed during pre-construction monitoring. EPT richness decreased slightly. Although EPT richness dropped when compared to pre-construction values, the EPT biotic index was lower than that recorded during pre-construction monitoring. The total biotic index for Site 3 remained slightly above the pre-construction value. The higher total index could be attributed to the decrease in overall shredder taxa observed during the recent post-construction monitoring. Despite the increase in the total biotic index at Site 2, the decrease in

EPT biotic index suggests that the communities are stable and that water quality is adequate to support intolerant species. Site 3 is therefore remains a stable eco-reference site.

Site 1, which underwent partial restoration, had a decrease in overall and EPT taxa richness from Year 2 to Year 3 post construction; however, Year 3 richness values were still above pre-construction numbers. Year 3 total and EPT biotic indices were similar to Year 2 values, which remain above the pre-construction indices. This suggests that although more species were present (presumably due to the increase variety of habitat post-provided by designed restoration); these species were slightly more tolerant than previous communities. This is a typical response after a major disturbance to habitat such as the in-stream construction techniques implemented on Site 1. It is anticipated that Site 1 will continue to improve as the project matures.

Currently, Site 1 has 13 percent Dominance in Common (DIC) compared to the reference site. In Year 2 post-construction conditions, Site 1 had a DIC of 86 percent. The DIC has decreased but that doesn't necessarily indicate that conditions at Site 1 have degraded. Several low tolerance EPT species such as *Acroneuria*, *Isoperla sp*., and *Pteronarcys sp*., (tolerance values of 1.0, 2.0, and 1.7, respectively) are still present.

Site 2, which underwent complete restoration, saw a decrease in taxa richness and an increase in biotic indices from Year 2 to Year 3 post-construction samples. This indicates that fewer species were present and those present were more tolerant species. Although the biotic indices have increased from Year 2 to Year 3 they remained slightly lower than pre-construction values. This indicates that overall the site is able to support less tolerant species post construction. Site 2 is located along a restored tributary to Silver Creek that has a smaller drainage area than Site 1, which is located along the larger Silver Creek. During the extreme drought conditions that occurred across western North Carolina during late 2007, Site 2 likely experienced low flow conditions that negatively impacted taxa richness and biotic indices. According to Year 3 sampling data, it appears the Site has not rebounded from drought conditions.

Currently Site 2 has 0 percent DIC with the reference site. The decrease in DIC from Year 2 to Year 3 may indicate a stress on the stream such as the low flow conditions previously discussed. It is anticipated that improvements in biotic indices and an increase in DIC will occur as communities re-establish.

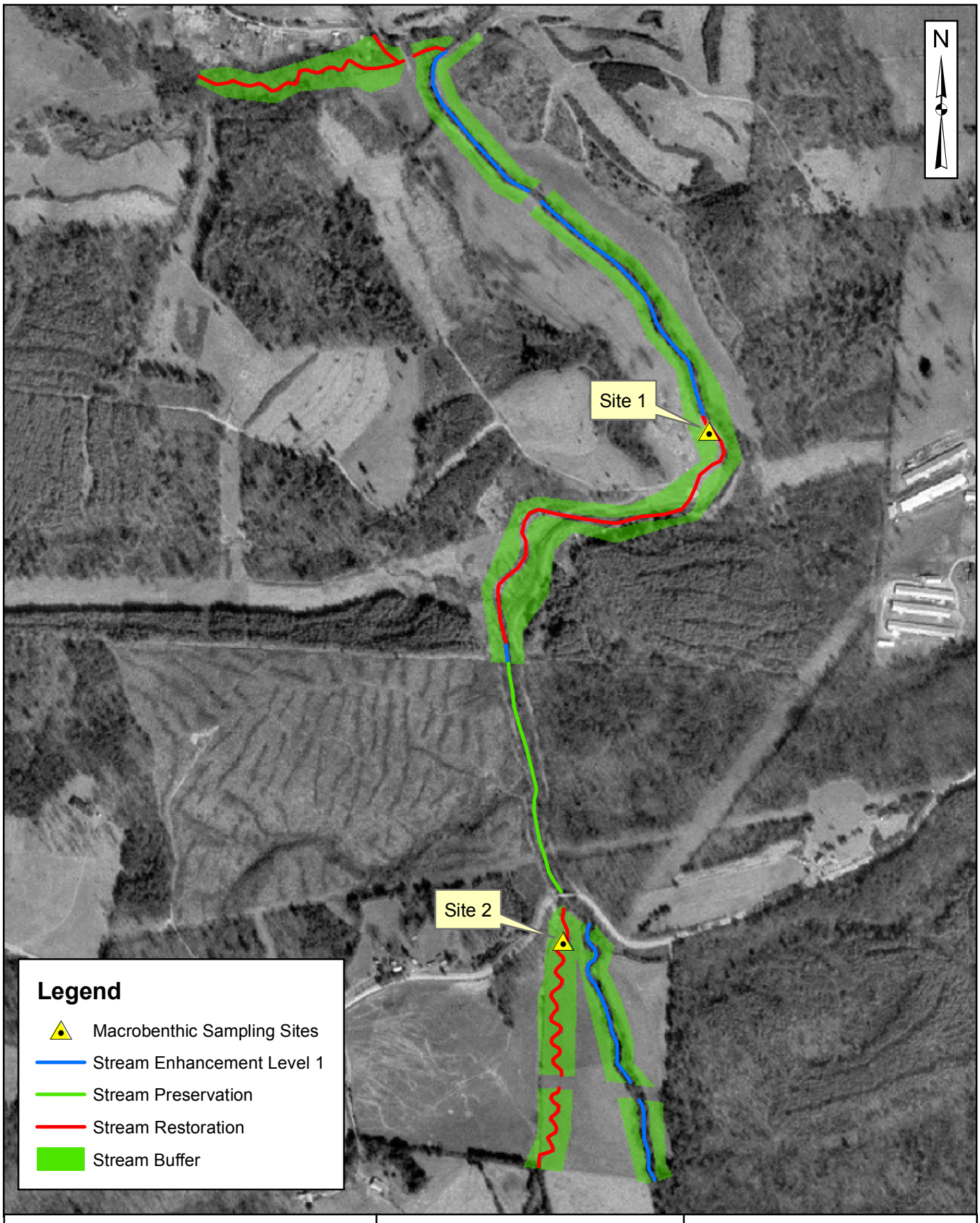
6.4 Habitat Assessment Results and Discussion

The restoration site habitat scores slightly increased from Year 2 to Year 3 (74 to 78 for Site 1 and 77 to 81 for Site 2). The increase in score for Site 1 reflects minor streambank repair work completed directly upstream from the monitoring location. The banks were stabilized and young vegetation is starting to establish. Site 2 had very stable bed and banks but the riffle substrate was fairly homogenous. Riparian buffers on both sites have yet to mature. Site 3, the reference site, received a 75 on the habitat assessment despite having a mature forested buffer; the banks of the channel were eroded and the substrate was embedded.

The physical and chemical measurements of water temperature, pH, and specific conductivity at the restoration sites were all relatively normal for Piedmont streams.

The restoration of pattern and dimension as well as the installation of several root wads, vanes, and armored riffles has enhanced the overall in-stream habitat throughout the project area. The immature riparian vegetation has had minimal effect on in-stream habitat at Sites 1 and 2 however future contributions from planted riparian vegetation will be evident as the woody plant

species mature. Contributions will include in-stream structures such as sticks and leaf packs. Since no woody riparian buffer currently exists at either Site 1 or 2, it can be concluded that the existing in-stream structures that include stick and leaf packs have originated upstream.



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

0 500 1,000 Feet

Figure 4.
Benthic Macroinvertebrate
Sampling Sites
Silver Creek Site

Table 11.
Summary of Pre-Restoration vs. Post-Restoration Benthic Macroinvertebrate Sampling Data

Metrics	Site 1 Silver Creek				Site 2 UT1 to Silver Creek				Site 3 UT1 to Bailey Fork (Reference)			
	Pre	Year 1	Year 2	Year 3	Pre	Year 1	Year 2	Year 3	Pre	Year 1	Year 2	Year 3
	1/3/2005	1/11/2007	1/24/2008	2/2/2009	1/4/2005	1/11/2007	1/24/2008	2/2/2009	1/4/2005	1/17/2007	1/23/2008	3/19/2009
Total Taxa Richness	22	36	43	35	14	39	24	15	26	34	20	43
EPT Taxa Richness	14	23	25	15	3	11	7	4	16	20	13	9
Total Biotic Index	3.16	4.4	4.72	4.79	7.02	6.86	5.97	7.01	4.09	4.3	5.04	4.83
EPT Biotic Index	2.59	4.16	4.28	4.11	6.1	6.14	4.98	5.67	3.41	3.65	4.98	2.57
Dominance in Common (%)	29	50	86	19	12	31	14	0	n/a	n/a	n/a	n/a
Total Shredder/Scraper Index	4/4	5/3	8/4	6/8	1/2	3/3	1/3	0/3	7/3	5/3	2/5	5/6
EPT Shredder/Scraper Index	3/2	2/3	4/4	3/5	0/1	0/2	1/1	0/2	4/2	2/2	1/3	1/3
Habitat Assessment Rating	58	72	74	78	24	78	77	81	65	70	72	75
Water Temperature (˚C)	n/a	7.4	7.6	6.4	n/a	3.7	3.8	5.1	n/a	8.4	7.9	14.6
% Dissolved Oxygen (DO)	n/a	57.7	n/a	n/a	n/a	44	n/a	n/a	n/a	32.1	n/a	n/a
DO Concentration (mg/l)	n/a	6.92	n/a	n/a	n/a	5.82	6.2	n/a	n/a	3.76	11.35	n/a
pH	n/a	6.01	7.24	7.08	n/a	5.97	7.09	6.94	n/a	5.97	7.8	6.93
Conductivity (µmhos/cm)	n/a	40	60	60	n/a	30	30	20	n/a	50	80	40

7.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Stream Monitoring: The total length of the project is 9,229 LF. This entire length was inspected during Year 5 of the monitoring period to assess stream performance. Measurements of cross-sections documented that UT1, UT2, M1, M3 and M4 are performing well. Two rock cross vanes located on M4 were noted to have stability issues during Year 4 monitoring. Repairs to the cross vane at station 66+75 were completed in September 10, 2010. During an on-site inspection in October 2010, the repaired cross vane was stable and functioning as designed. During the Year 5 monitoring period, the cross vane at station 63+50 on M4 appeared stable and no visible changes had occurred since Year 4 of monitoring.

The data from the Year 5 longitudinal profiles show that some pools in UT1 have filled slightly, but have remained stable since as-built conditions. The longitudinal profile data for UT2 show that the pools and riffles have remained stable since as-built conditions. The longitudinal profile of M3 shows that there have been some minor adjustments to the bed profile, primarily around structures, but overall bed and feature slopes have remained unchanged. The longitudinal profile of M3 shows that the repairs conducted in early 2008 are stable and functioning as designed.

All three on-site crest gauges documented the occurrence of at least one bankfull flow event during Year 5 of the post-construction monitoring period. The largest on-site stream flows documented by the crest gauges during Year 5 of monitoring was approximately 0.79 feet above the bankfull stage on UT1, 0.50 feet above the bankfull stage on UT2 and 0.15 feet above the bankfull stage on M3.

The bankfull measurements collected during monitoring Years 1 through 5, documents that all three restored reaches have met the success criteria for bankfull events for the project. For UT1, the two highest bankfull measurements recorded were during Years 2 and 5, the readings were 0.34 and 0.79 feet above bankfull stage, respectively. For UT2, the two highest bankfull measurements recorded were during Years 2 and 5, the readings were 0.28 and 0.5 feet above bankfull stage, respectively. For M3, the two highest bankfull measurements recorded was during Year 2 and Year 4, the readings were 1.43 and 0.59 feet above bankfull stage, respectively.

The Site has met the final stream morphology success criteria specified in the Restoration Plan for the Site.

Vegetation Monitoring: During Year 5 monitoring the vegetation monitoring documented a range of 260 surviving stems per acre to 680 stems per acre with an overall average density of 509 stems per acre and an overall survival rate of 72 percent.

The area around Plot 6 was supplemental planted with 4-year old stems in early 2010 due to mortality from the drought conditions in 2007. Plot 6 yielded 200 stems per acre at the end of Year 5, which is below the minimum success criteria of 260 stems per acre stated in the Restoration Plan. In fall of 2010, this area was evaluated to determine overall success and to determine the likely causes for low survival. Two test plots each 10 meters x 10 meters square were established immediately north and south of the existing Plot 6 to validate observations. Both plots yielded 280 stems per acre. The average of the three square plots, including Plot 6, is 260 stems per acre. The achievement of the success criteria was further validated by establishing by two 0.25 acre circular plots in the vicinity of Plot 6. One plot yielded 360 stems per acre and the other 320 stems per acre. It was determined that Plot 6 is an anomaly based on the four

additional plots and lack of discernable differences with other parts of the mitigation area. The area defined by Plot 6 has therefore been determined to have met success criteria.

The Site has met the vegetative success criteria specified in the Restoration Plan for the Site.

Benthic Macroinvertebrate Monitoring: Year 3 results revealed that Site 1 (Silver Creek) exhibited total and EPT biotic indices similar to Year 2 values, which remain above the pre-construction indices. This suggests that although more species were present during Year 3 these species were slightly more tolerant than previous communities. This is a typical response after a major disturbance to habitat such as the in-stream construction techniques. It is anticipated that Site 1 will continue to improve as the project matures.

Site 2 (UT1 to Silver Creek) exhibited a decrease in taxa richness and an increase in biotic indices from Year 1 to Year 3 post-construction sampling. This indicates that fewer species were present and those present were more tolerant species. Currently Site 2 has 0 percent DIC with the reference site. The decrease in DIC from Year 2 to Year 3 may indicate a stress on the stream such as low flow conditions. It is anticipated that improvements in biotic indices and an increase in DIC will occur as communities re-establish.

In summary, the Site has met all of the vegetative and stream success criteria specified in the Restoration Plan.

8.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Site. During the past year, frogs, turtles and fish have been observed at the Site.

9.0 REFERENCES

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

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US Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2006. *Soil Survey of Burke County, North Carolina*, NC Agricultural Experiment Station.

FIGURES

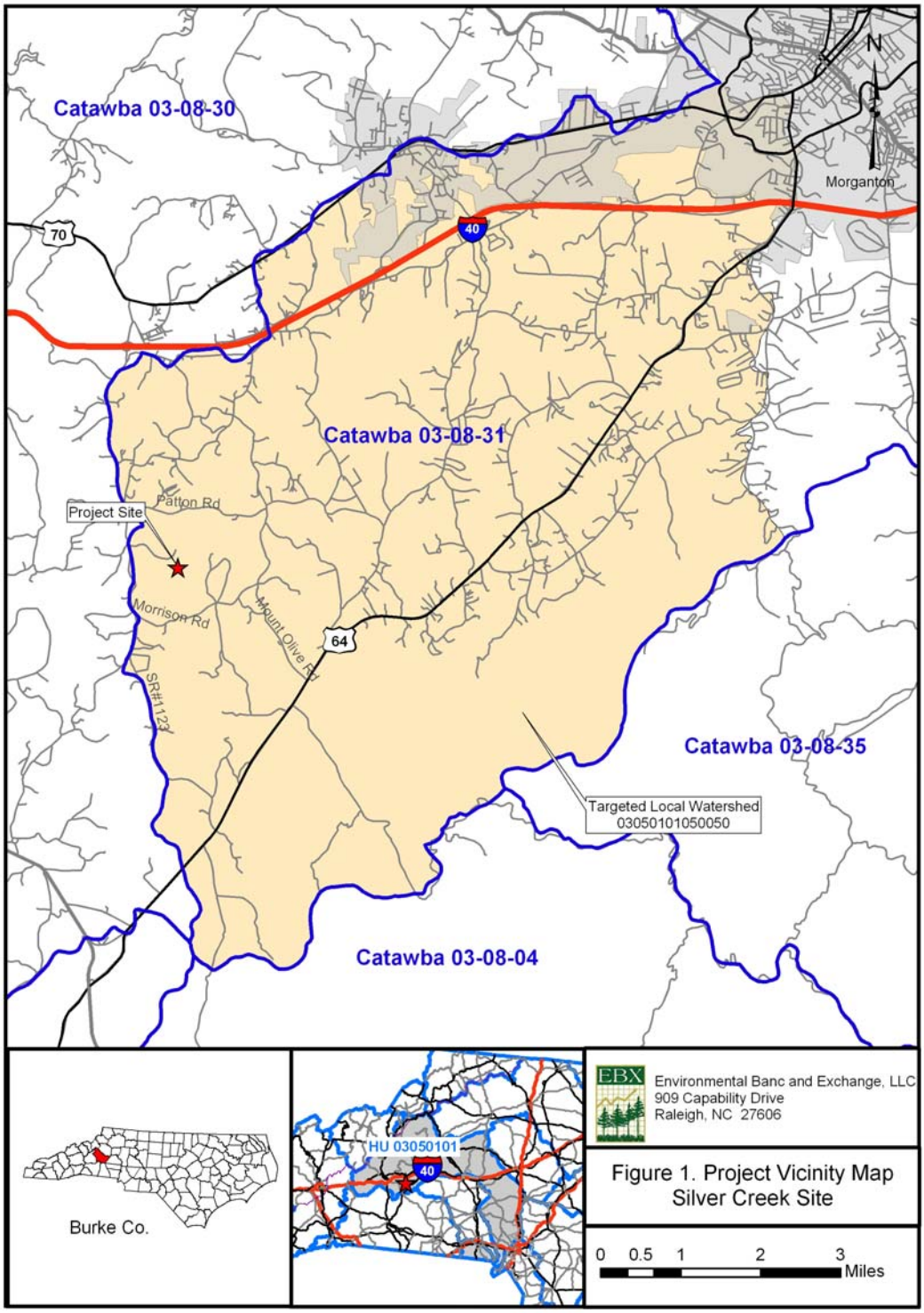

Figure 1. Location of Silver Creek Stream Restoration Site.

2/26/03

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0222R	4

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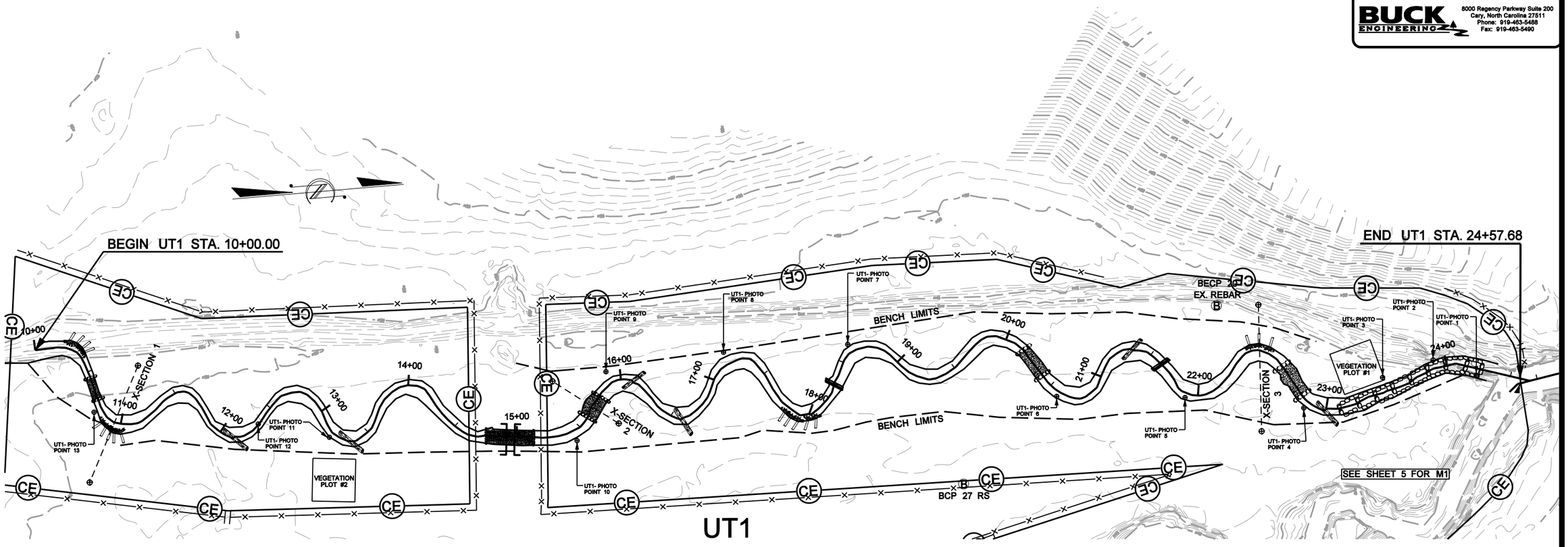

UT1

Figure 2 (a)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

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2/14/2006

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2/26/03

Ⓑ BCP 29 RS

10+00

M1- PHOTO POINT 1

11+00

BECP #3
EX. REBAR
Ⓑ

BENCH LIMITS

12+00

13+00

BEGIN M1 STA. 10+46.47

BCP 31 NS
Ⓑ

M1- PHOTO POINT 2

14+00

Ⓑ
BCP 28 RS

15+00

BCP 32 NS
Ⓑ

16+00

M1

BENCH LIMITS

17+80

VEGETATION PLOT #3

WELL GRADED MIX OF CLASS A AND B RIP RAP USED TO STABILIZE LANDOWNER CROSSING. BOULDER SILLS WERE SET TO CONTROL GRADE ON BOTH ENDS.

BENCH LIMITS

X-SECTION 16

18+00

19+00

VEGETATION PLOT #4
Ⓑ

BCP 33 NS

20+00

BCP 34 NS
Ⓑ

SEE SHEET 4 FOR UT1

21+00

Ⓑ
BCP 42 NS

22+00

Ⓑ
BCP 35 NS

BCP 36 NS
Ⓑ

24+00

23+00

END M1 STA. 24+37.07
BEGIN M2 STA. 24+09.25

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

FIGURE: 2(b)

12/02/2007
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2/26/03

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0222R	6

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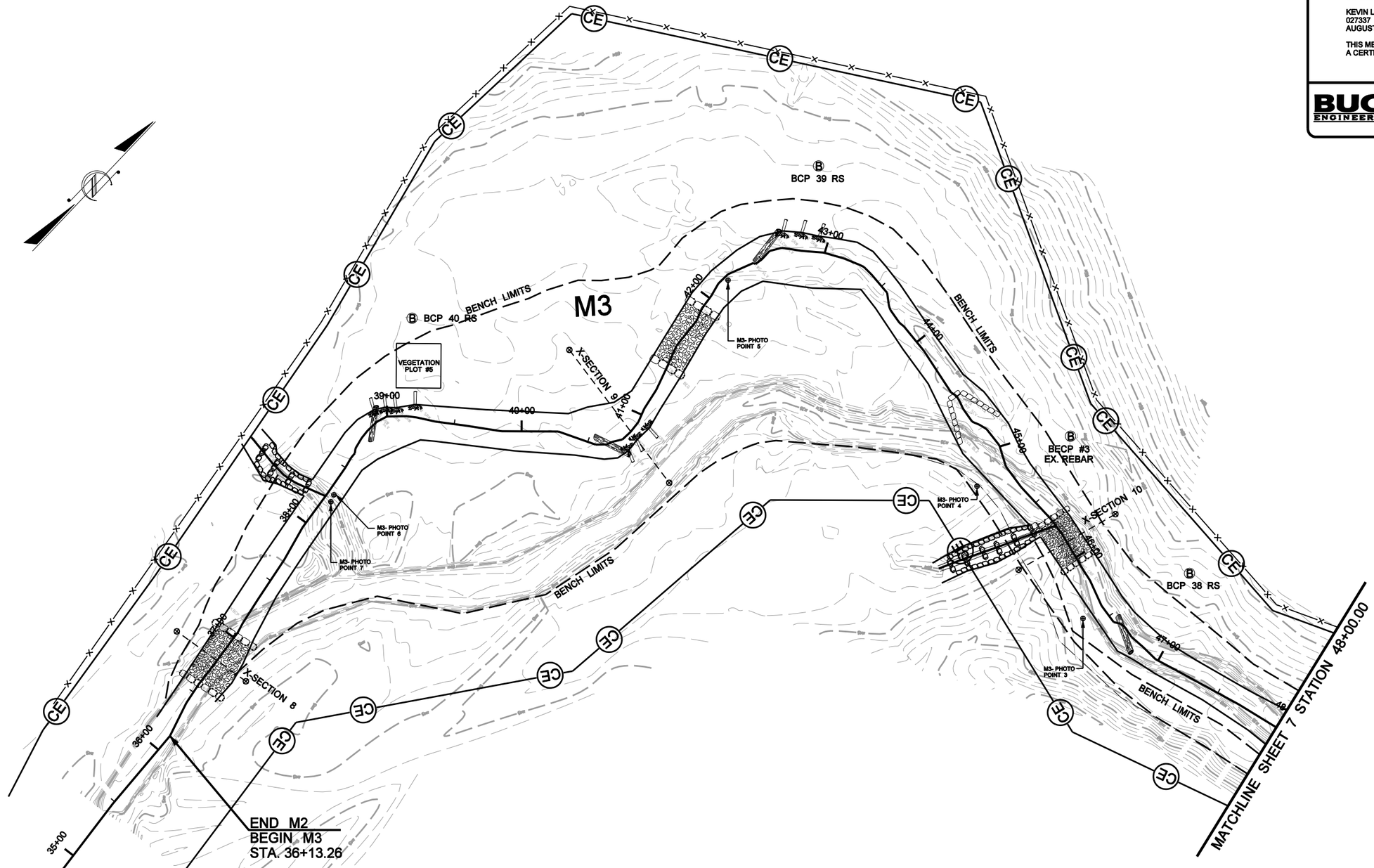

NOTE:
M2 IS A PRESERVATION REACH ONLY.
NO WORK WAS PERFORMED ON THIS REACH.

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

Figure 2 (c)

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R:\Projects\0222R\Design\As-Built\R0222_AB_EBX_PSH_06.dgn

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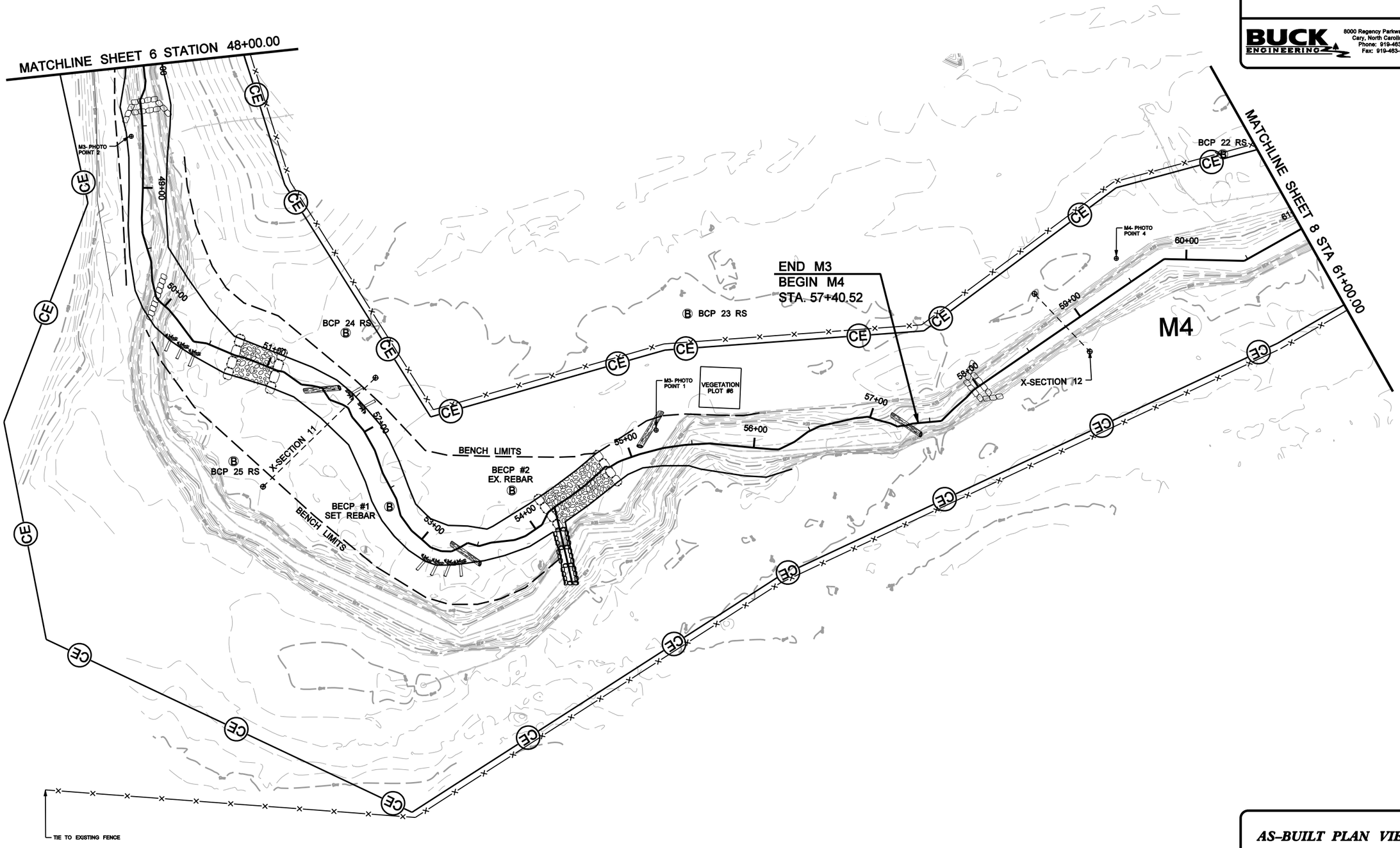

FIGURE: 2(d)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

12/10/2007
I:\0222R\Design\As-Built\R0222_AB_EBX_PSH_07.dgn

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0222R	8

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
AUGUST 2, 2006

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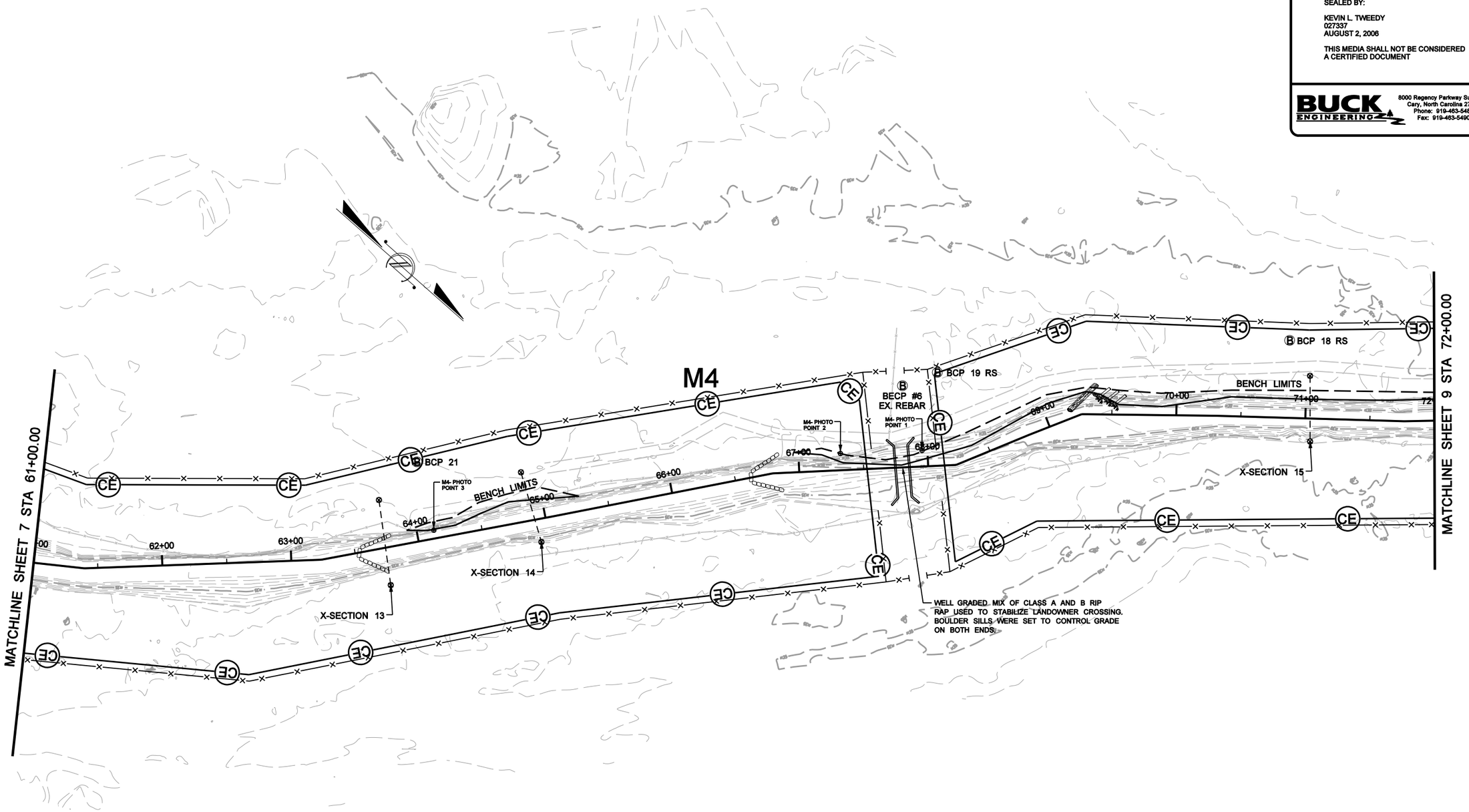

FIGURE: 2(e)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

12/19/2007
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2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0222R	9

PROJECT ENGINEER

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KEVIN L. TWEEDY
027337
AUGUST 2, 2006

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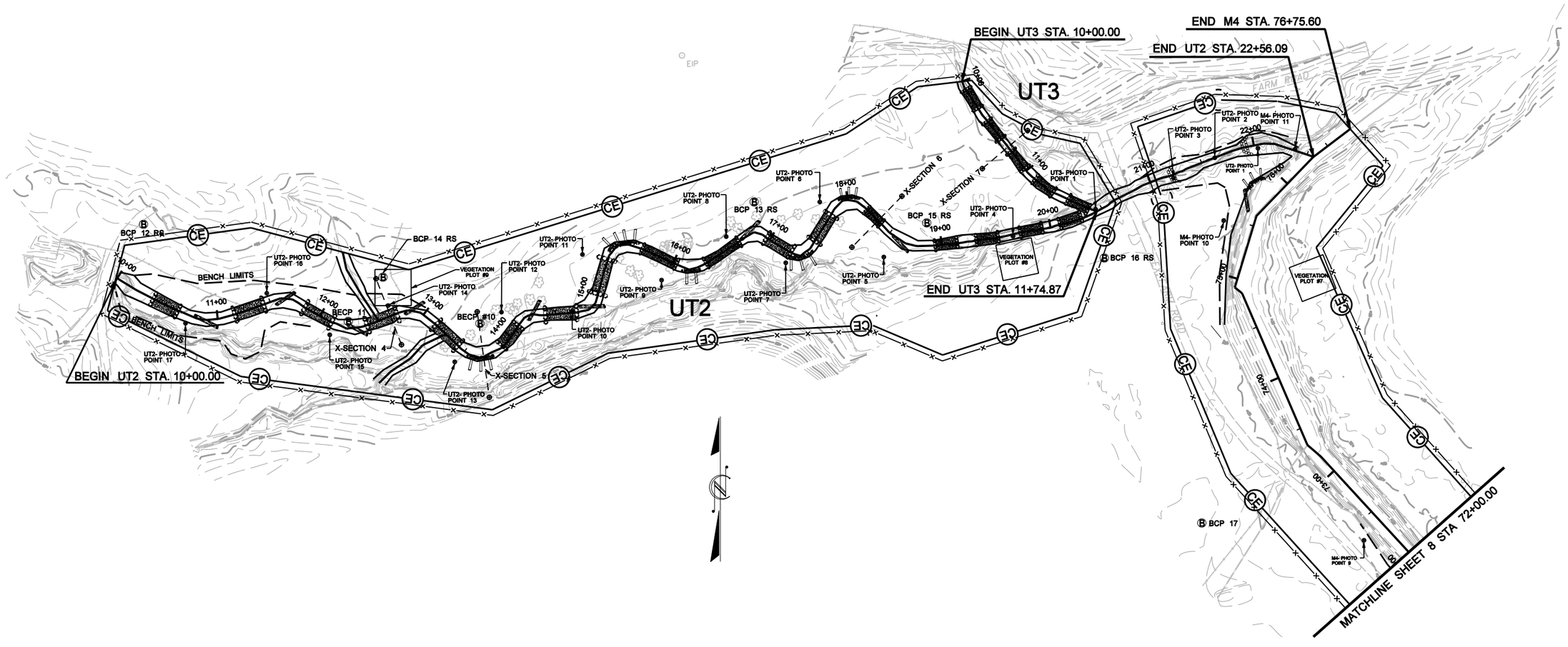


Figure 2 (f)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

APPENDIX A

PROJECT PHOTO LOG

VEGETATION PHOTOS

Silver Creek Vegetation Plot Photos

Silver Creek Vegetation Monitoring Plot #1

Silver Creek Vegetation Monitoring Plot #2

Silver Creek Vegetation Monitoring Plot #3

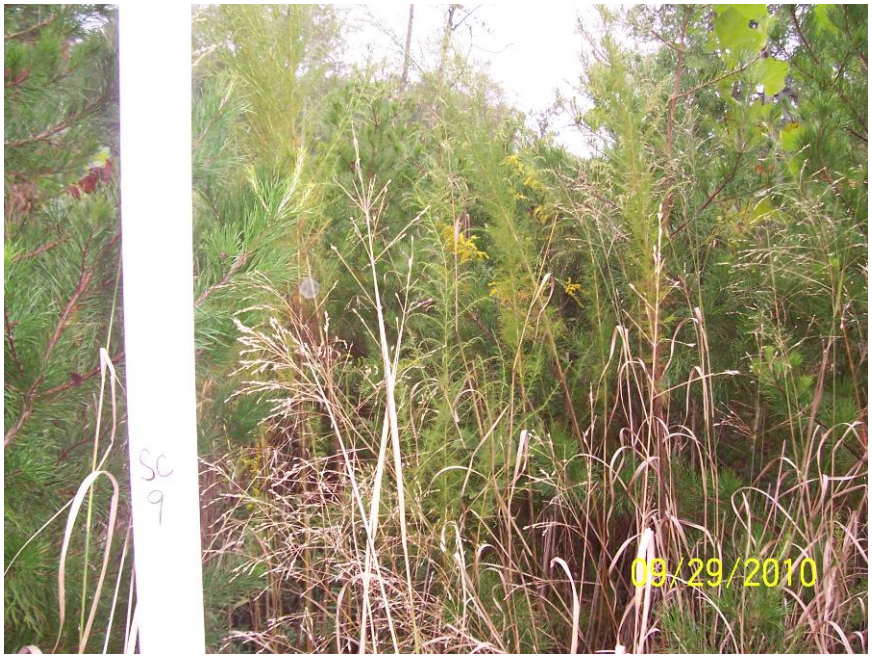
Silver Creek Vegetation Monitoring Plot #4

Silver Creek Vegetation Monitoring Plot #5

Silver Creek Vegetation Monitoring Plot #6

Silver Creek Vegetation Monitoring Plot #7

Silver Creek Vegetation Monitoring Plot #8



Silver Creek Vegetation Monitoring Plot #9

STREAM PHOTOS

UT1 Photo Point 1

UT1 Photo Point 2

UT1 Photo Point 6

UT1 Photo Point 10

Silver Creek Stream Crossing M1

Silver Creek Cross Vane M1

UT2 Photo Point 1

UT2 Photo Point 2

UT2 Photo Point 3

UT2 Photo Point 5

UT2 Photo Point 6

UT2 Photo Point 7

UT2 Photo Point 8

UT2 Photo Point 9

UT2 Photo Point 10

UT2 Photo Point 11

UT2 Photo Point 14

UT2 Photo Point 15

UT2 Photo Point 16

UT2 Photo Point 17

UT3 Photo Point 1

M3 Photo Point 1

M3 Photo Point 2

M3 Photo Point 3

M3 Photo Point 4

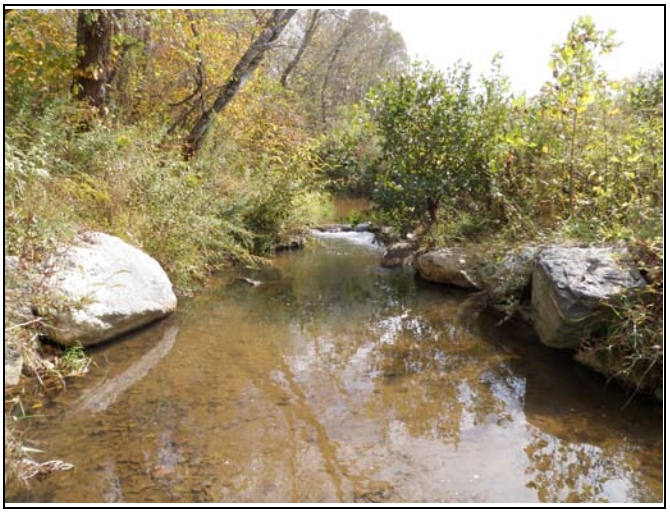
M3 Photo Point 5

M3 Photo Point 6

M3 Photo Point 7

M4 Photo Point 1

M4 Photo Point 2 – Problem cross-vane at station 66+75



M4 Photo Point 3 – Problem cross-vane at station 63+50

M4 Photo Point 4

M4 Photo Point 9

M4 Photo Point 10

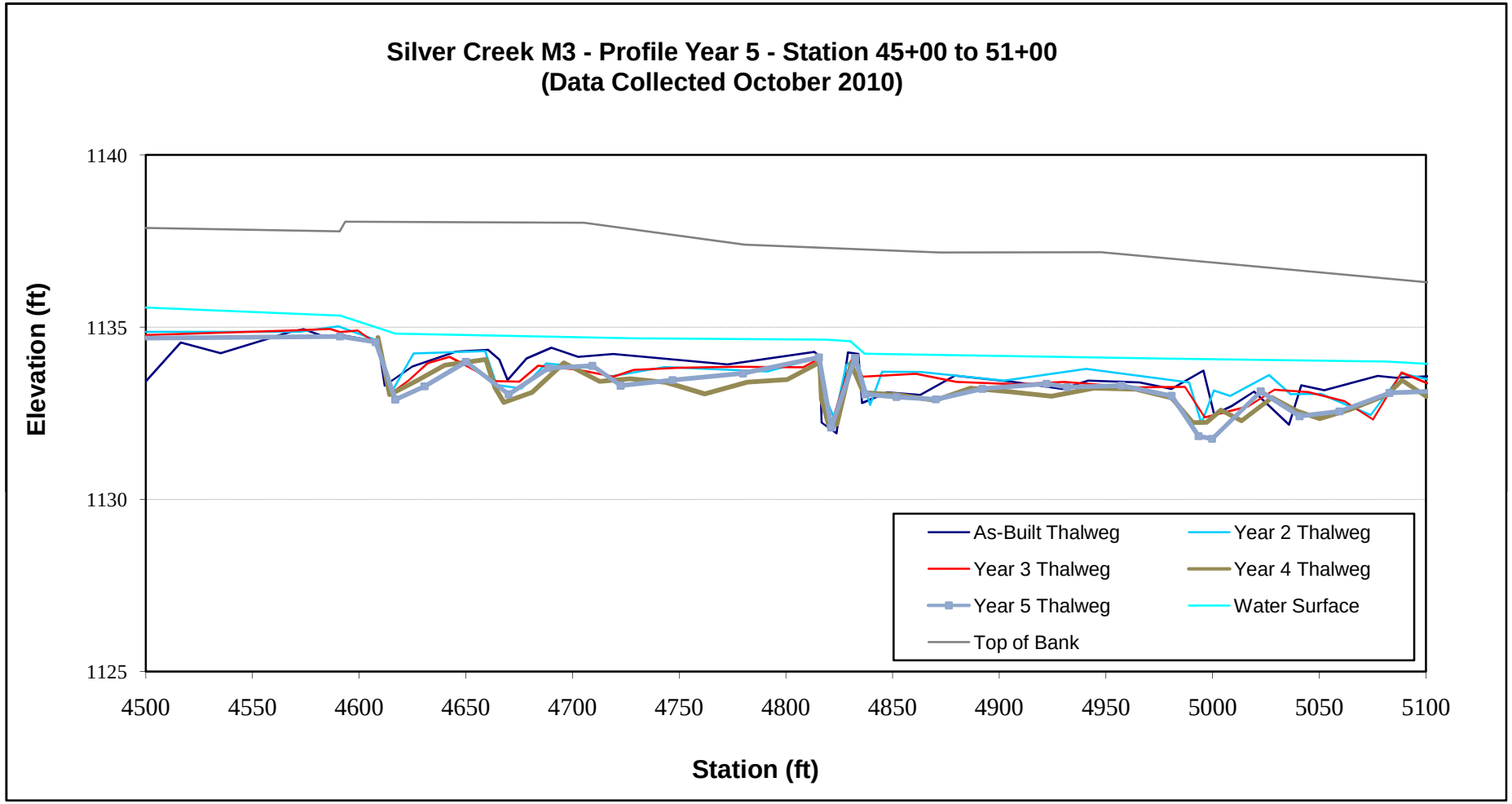
UT1 Crest Gauge - 0.79, June 28, 2010

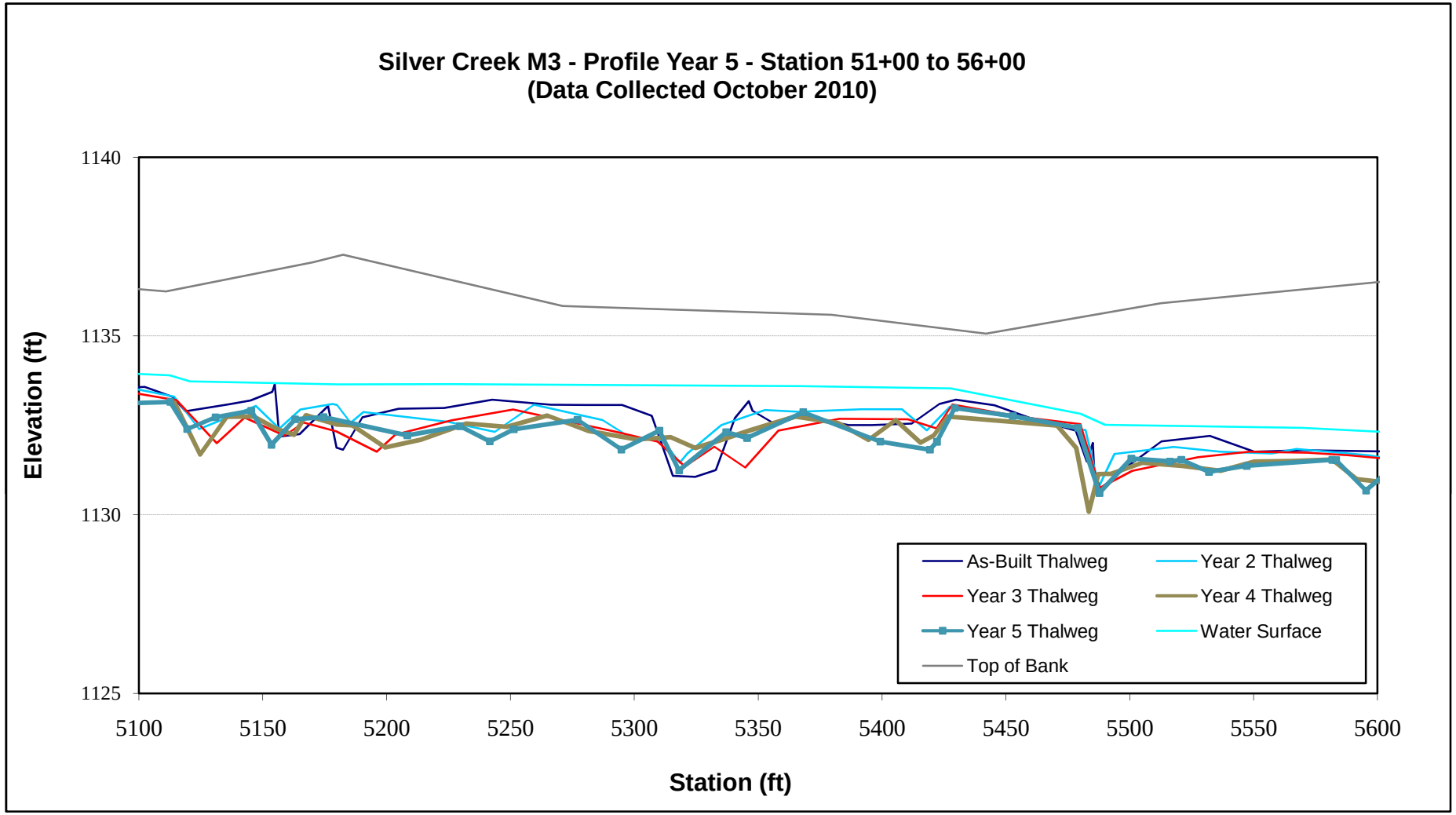
UT2 Crest Gauge - 0.17, June 28, 2010

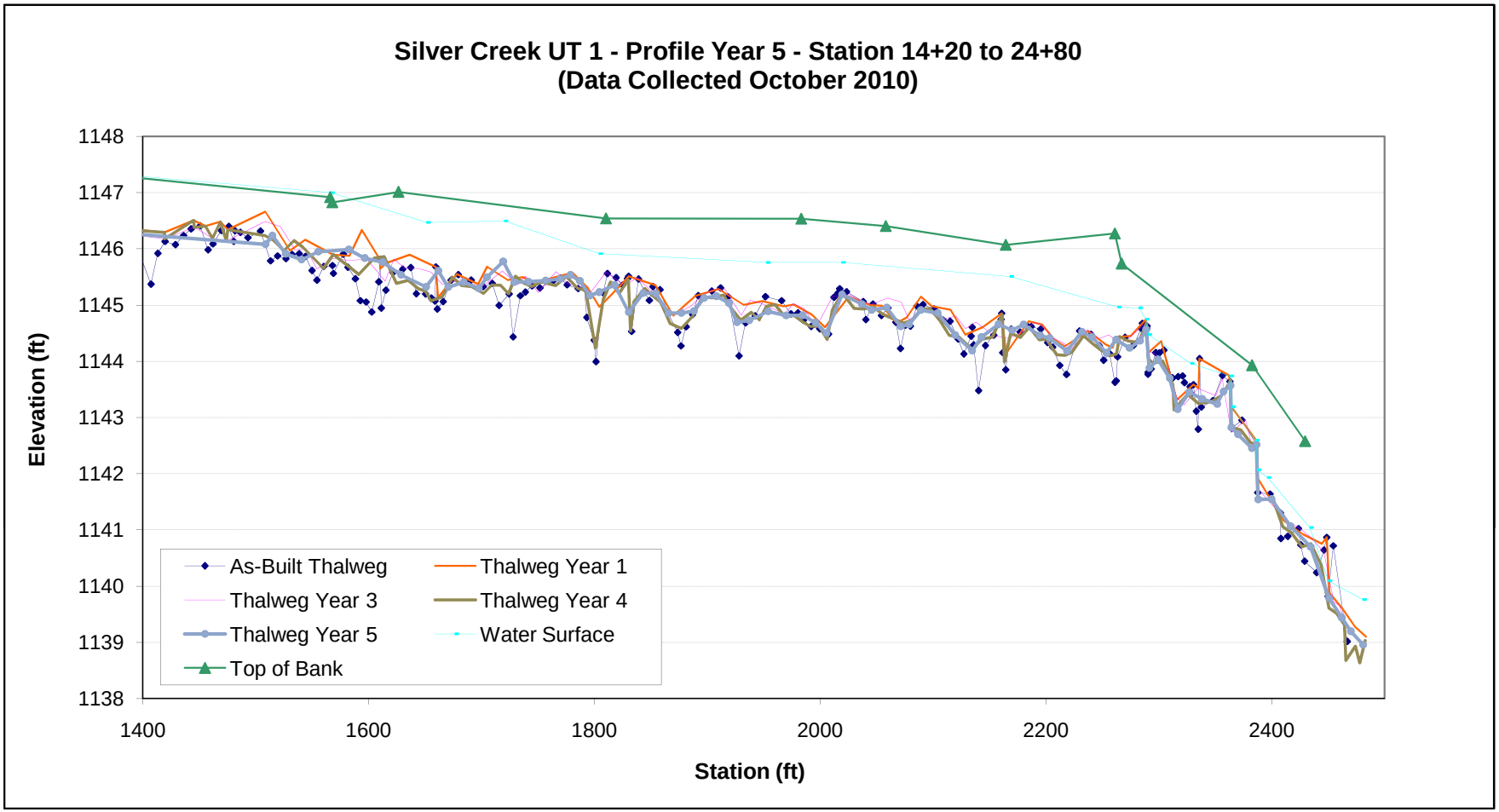
M3 Crest Gauge - 0.13, June 28, 2010

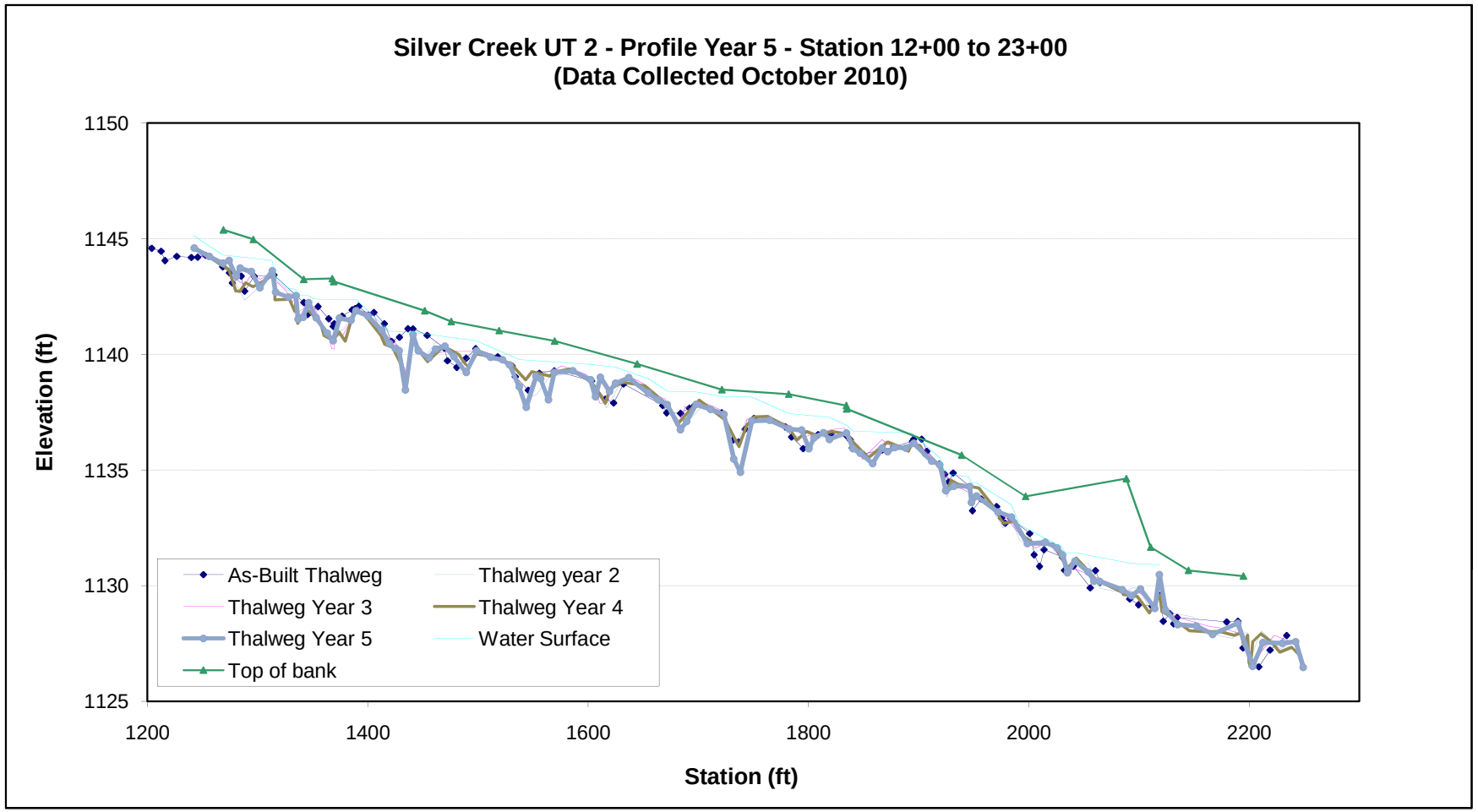
APPENDIX B

STREAM MONITORING DATA


Silver Creek M3 - Profile Year 5 - Station 45+00 to 51+00
(Data Collected October 2010)
Elevation (ft)
1140
1135
1130
1125
4500
4550
4600
4650
4700
4750
4800
4850
4900
4950
5000
5050
5100
Station (ft)
As-Built Thalweg
Year 2 Thalweg
Year 3 Thalweg
Year 4 Thalweg
Year 5 Thalweg
Water Surface
Top of Bank


Silver Creek M3 - Profile Year 5 - Station 51+00 to 56+00
(Data Collected October 2010)
Elevation (ft)
1140
1135
1130
1125
5100
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
Station (ft)
As-Built Thalweg
Year 2 Thalweg
Year 3 Thalweg
Year 4 Thalweg
Year 5 Thalweg
Water Surface
Top of Bank


Silver Creek UT 1 - Profile Year 5 - Station 14+20 to 24+80
(Data Collected October 2010)
Elevation (ft)
1148
1147
1146
1145
1144
1143
1142
1141
1140
1139
1138
1400
1600
1800
2000
2200
2400
Station (ft)
As-Built Thalweg
Thalweg Year 1
Thalweg Year 3
Thalweg Year 4
Thalweg Year 5
Water Surface
Top of Bank


Silver Creek UT 2 - Profile Year 5 - Station 12+00 to 23+00
(Data Collected October 2010)
Elevation (ft)
1150
1145
1140
1135
1130
1125
1200
1400
1600
1800
2000
2200
Station (ft)
As-Built Thalweg
Thalweg year 2
Thalweg Year 3
Thalweg Year 4
Thalweg Year 5
Water Surface
Top of bank

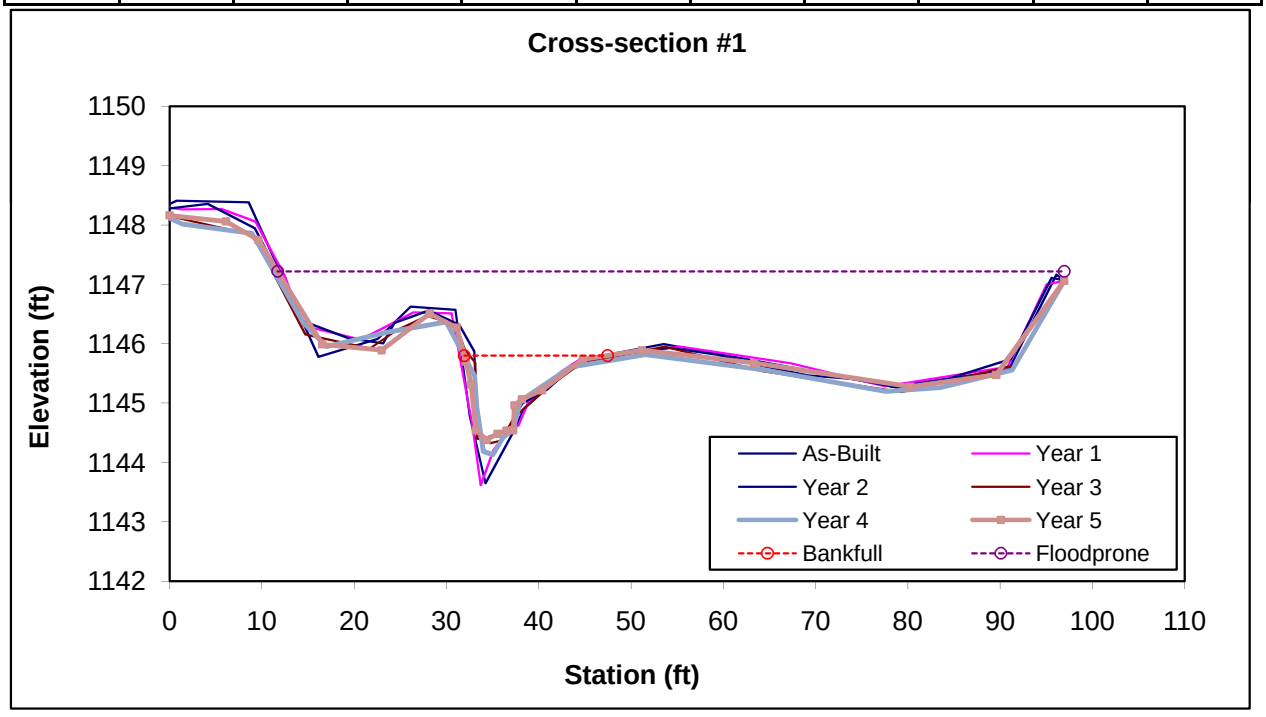
Permanent Cross-section #1 UT1

(Year 5 Data - Collected October 2010)

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		9.7	15.53	0.63	1.42	24.8	1.1	5.5	1145.8	1145.89



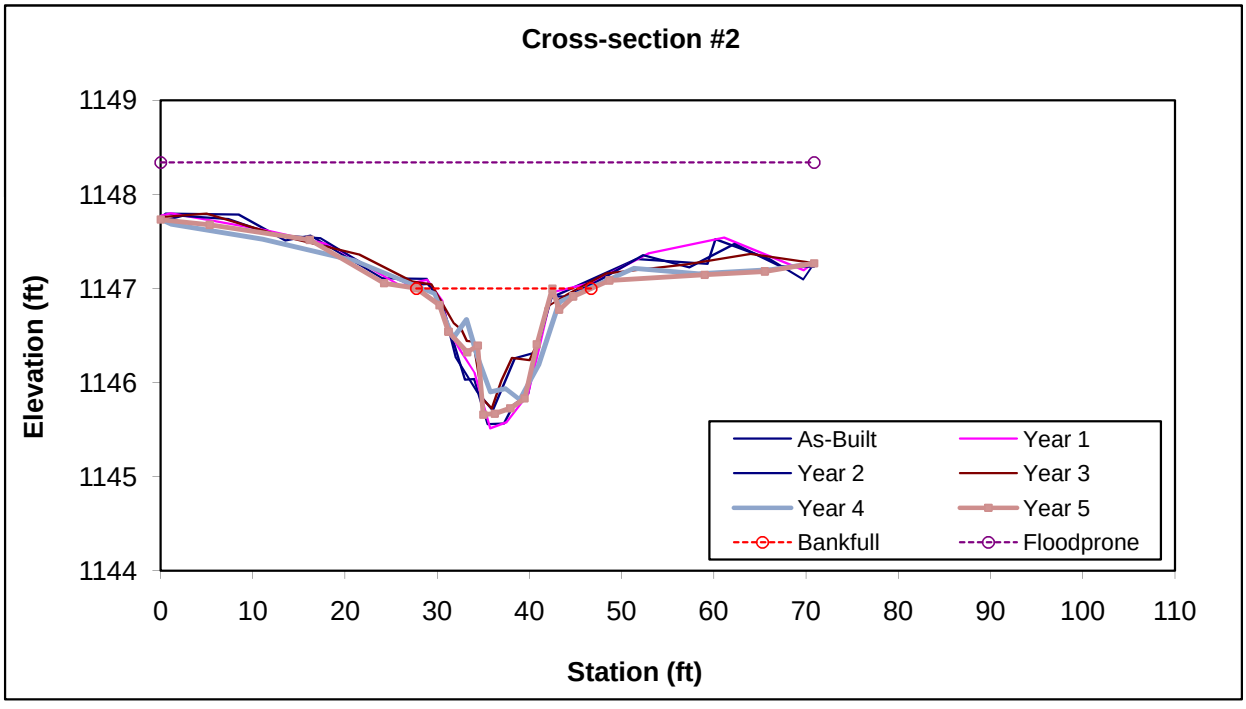
Permanent Cross-section #2 UT1

(Year 5 Data - Collected October 2010)

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	10.8	18.97	0.57	1.34	33.24	1	3.7	1147	1147



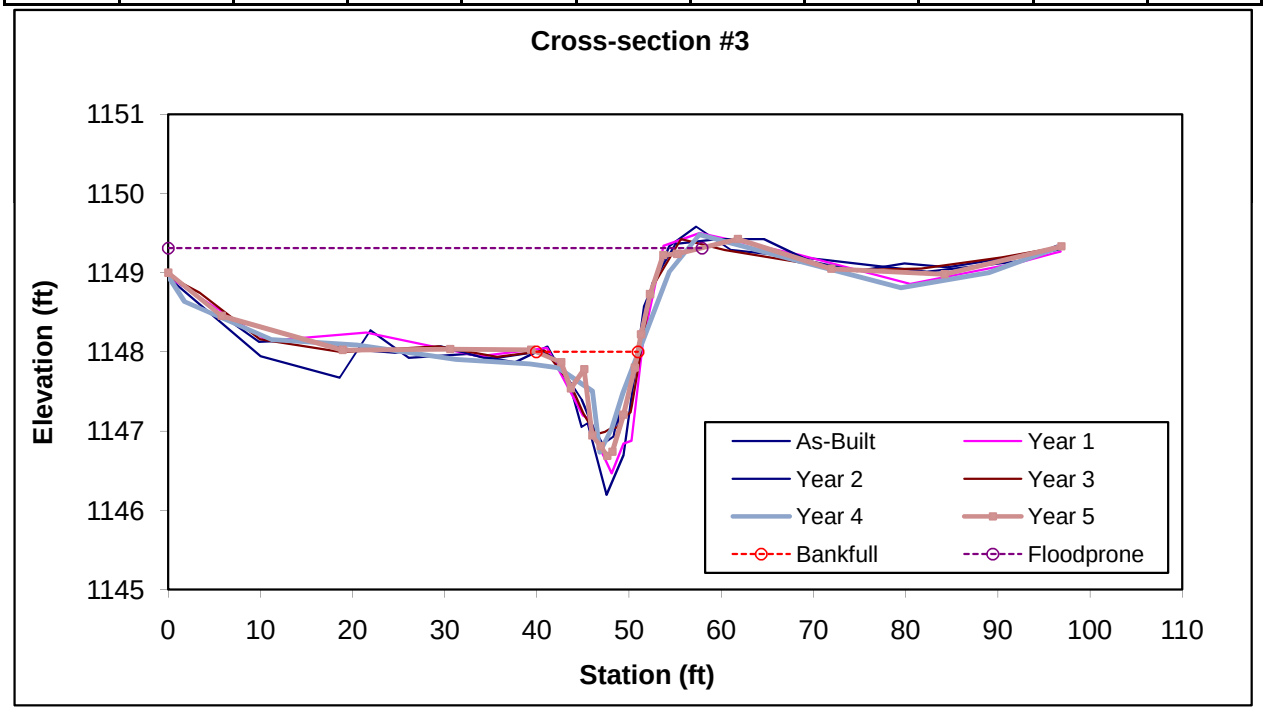
Permanent Cross-section #3 UT1

(Year 5 Data - Collected October 2010)

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		6.1	11.01	0.55	1.31	20.01	1	5.3	1148	1148.03



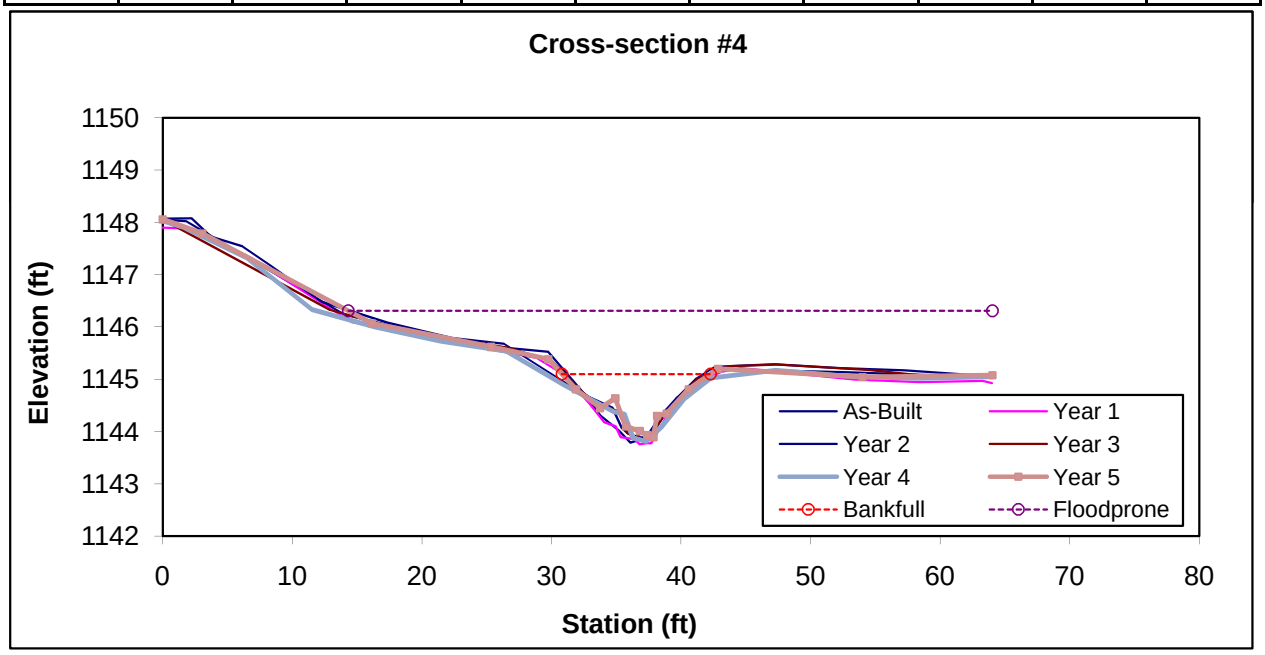
Permanent Cross-section #4 UT2

(Year 5 Data - Collected October 2010)

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	6.6	11.46	0.58	1.21	19.91	1.1	4.3	1145.1	1145.2



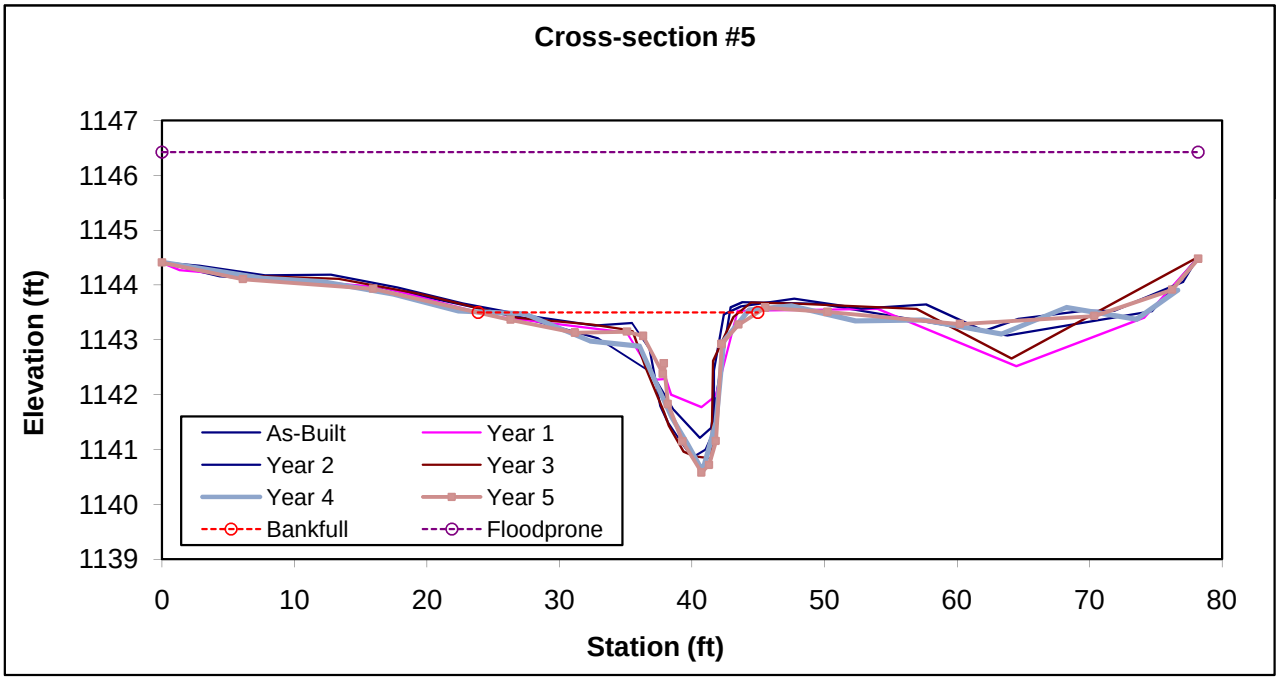
Permanent Cross-section #5 UT2

(Year 5 Data - Collected October 2010)

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		15.2	21.13	0.72	2.92	29.38	0.9	3.7	1143.5	1143.15

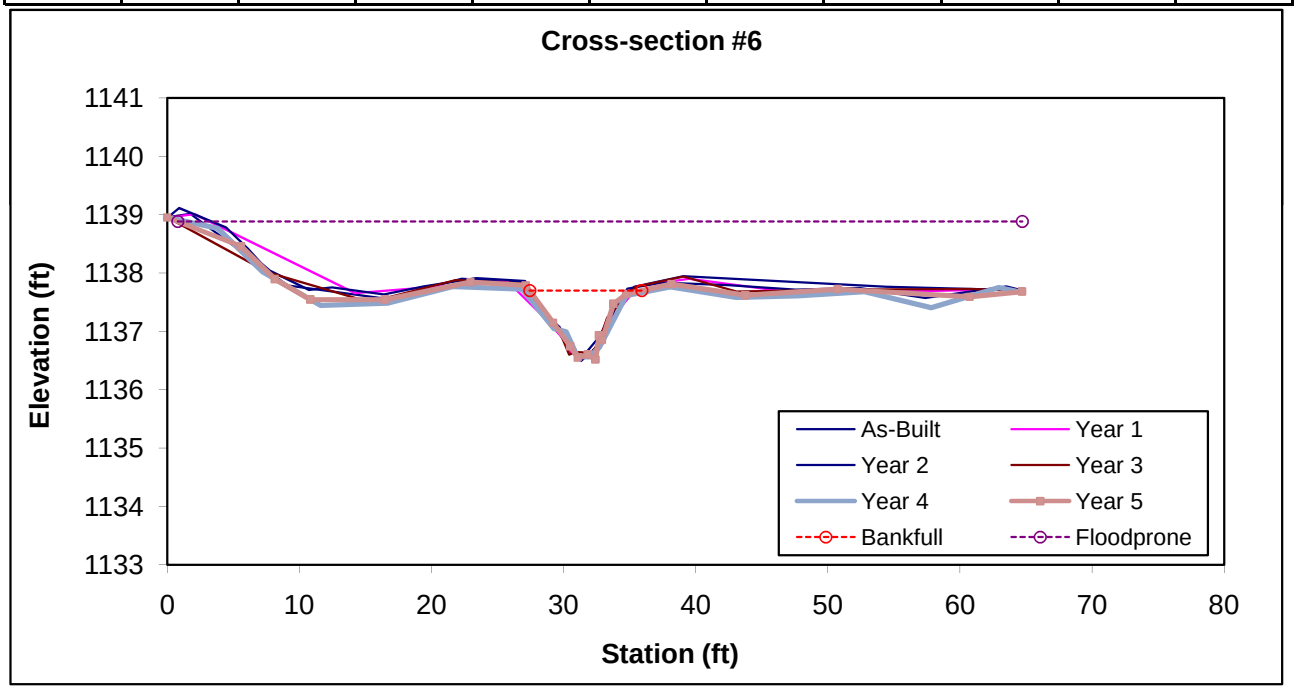


Permanent Cross-section #6 UT2
(Year 5 Data - Collected October 2010)

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	4.7	8.49	0.55	1.18	15.48	1.1	7.5	1137.7	1137.79



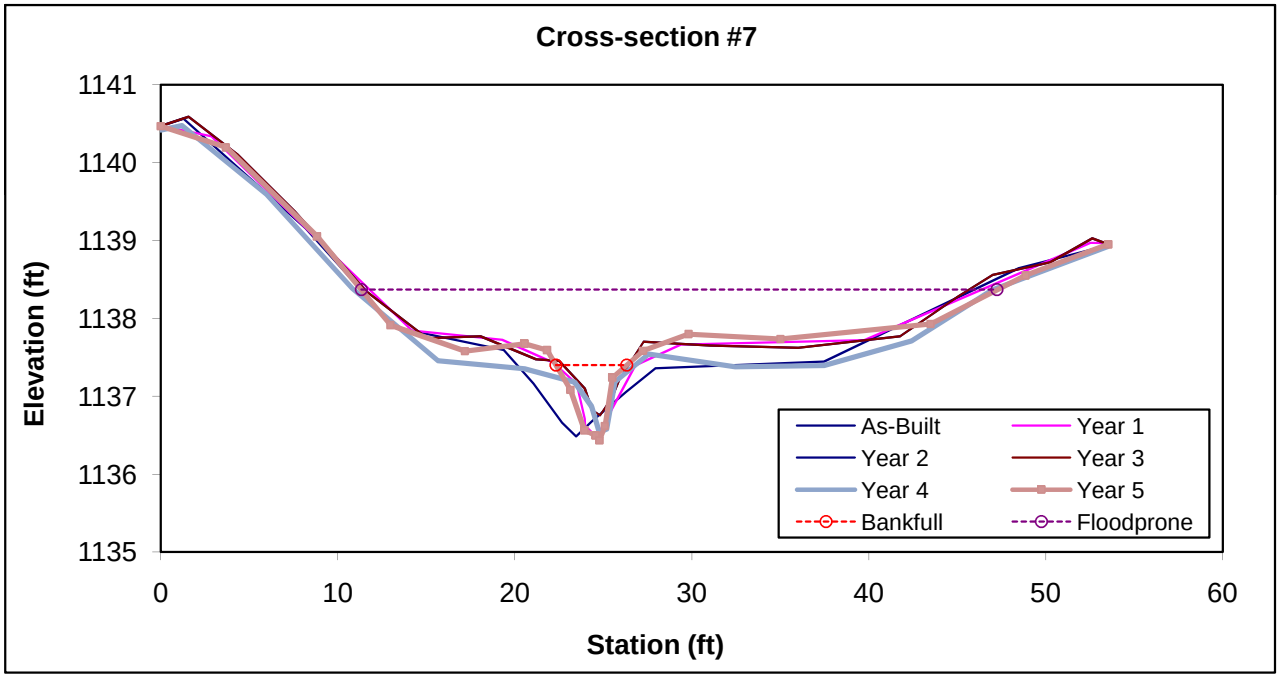
Permanent Cross-section #7 UT3

(Year 5 Data - Collected October 2010)

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	E	1.9	3.99	0.47	0.97	8.52	1.2	9	1137.4	1137.58



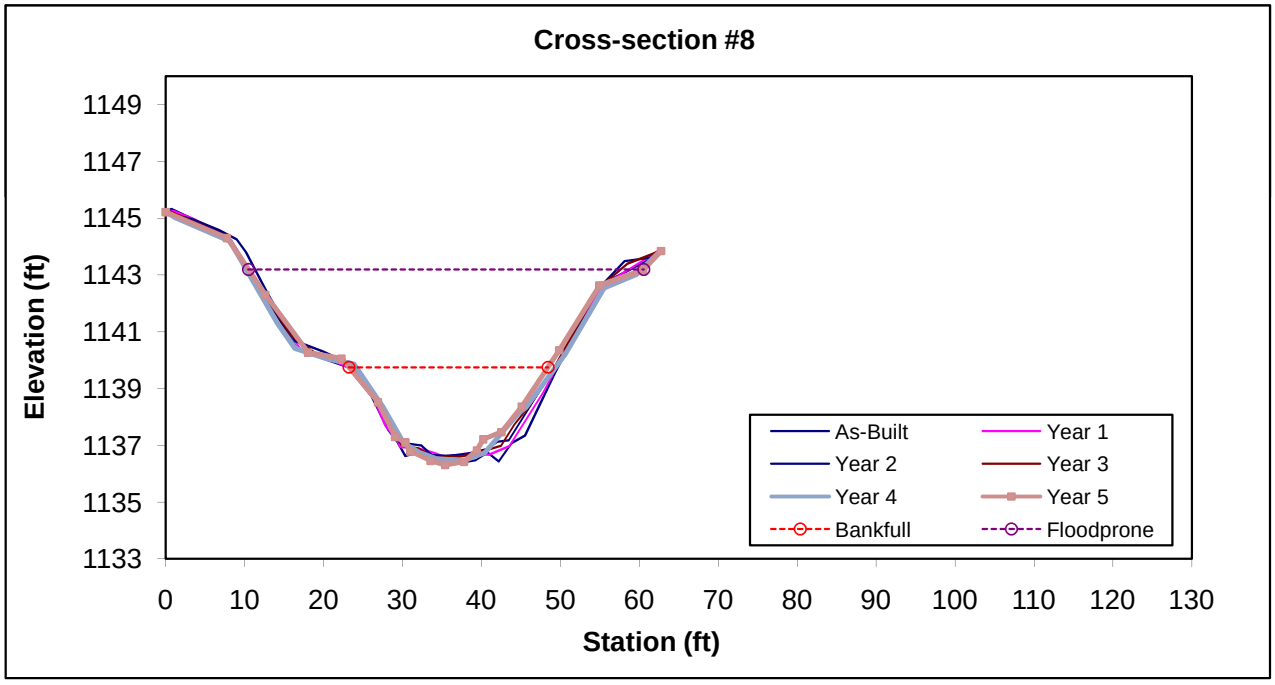
Permanent Cross-section #8 M3

(Year 5 Data - Collected November 2010)

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	Bc	53.5	25.23	2.12	3.44	11.9	1.1	2	1139.75	1140.05



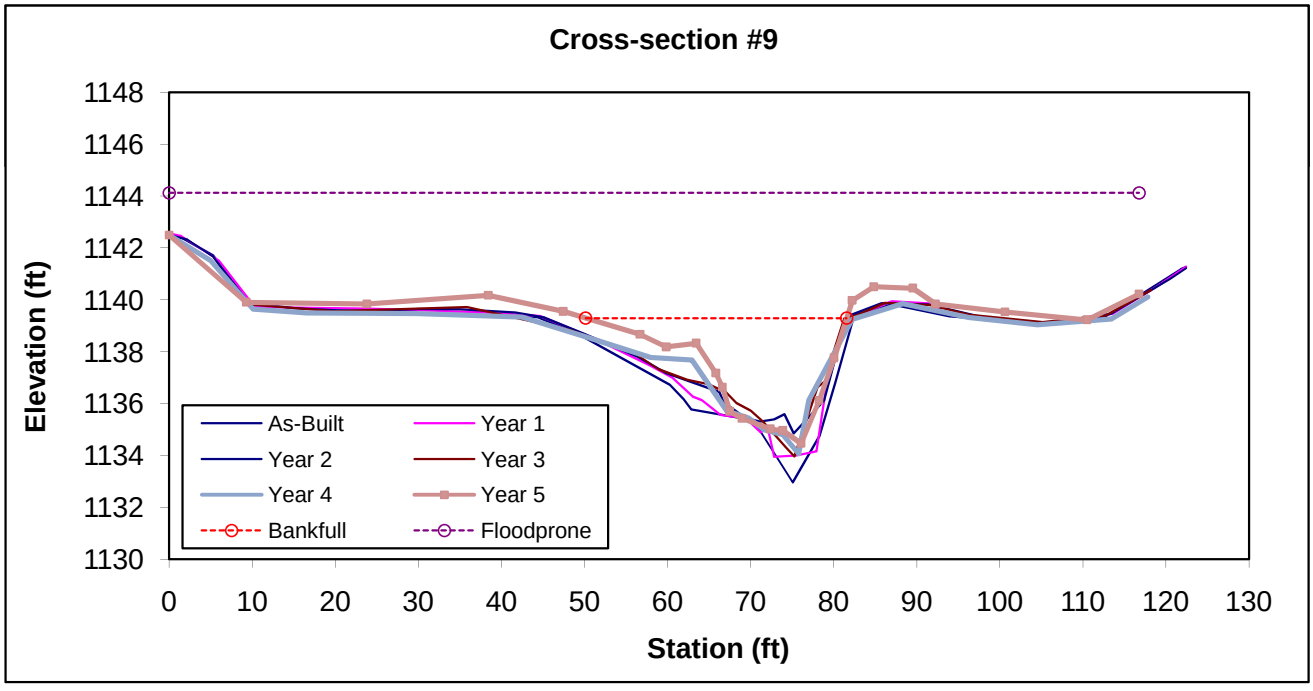
Permanent Cross-section #9 M3

(Year 5 Data - Collected October 2010)

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		66.9	31.42	2.13	4.83	14.76	1.1	3.7	1139.3	1139.56



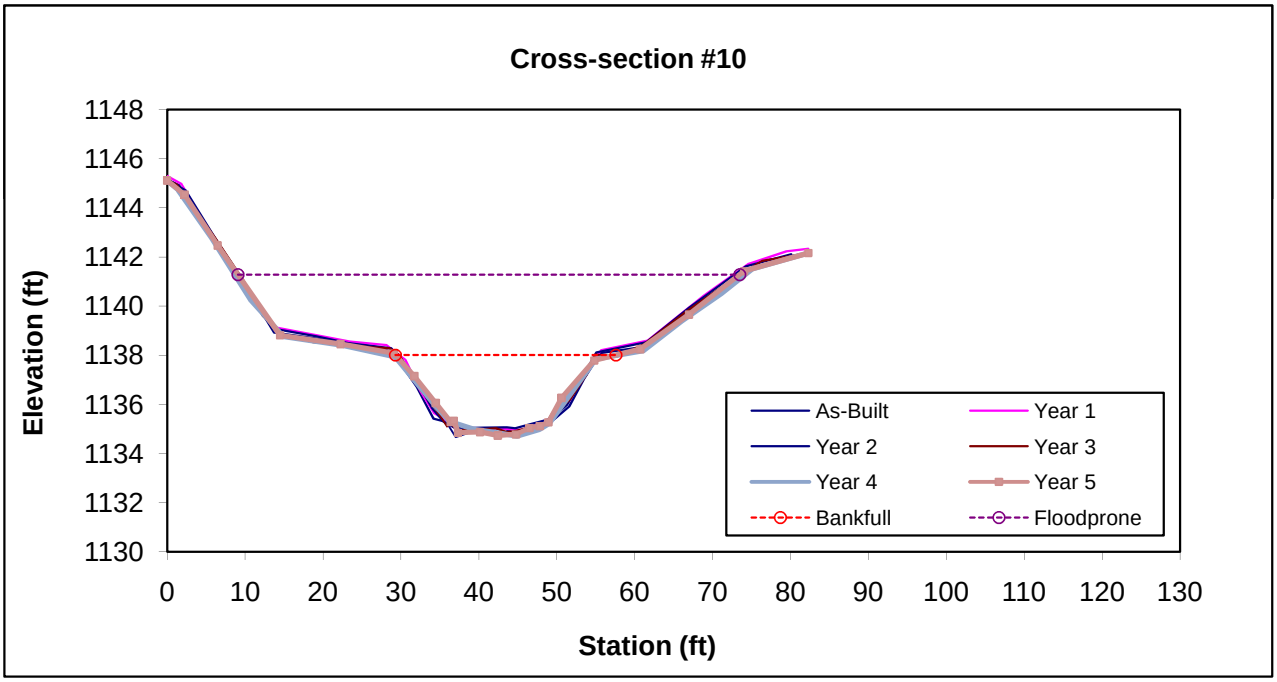
Permanent Cross-section #10 M3

(Year 5 Data - Collected October 2010)

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	56.3	28.3	1.99	3.27	14.23	0.9	2.3	1138	1137.78



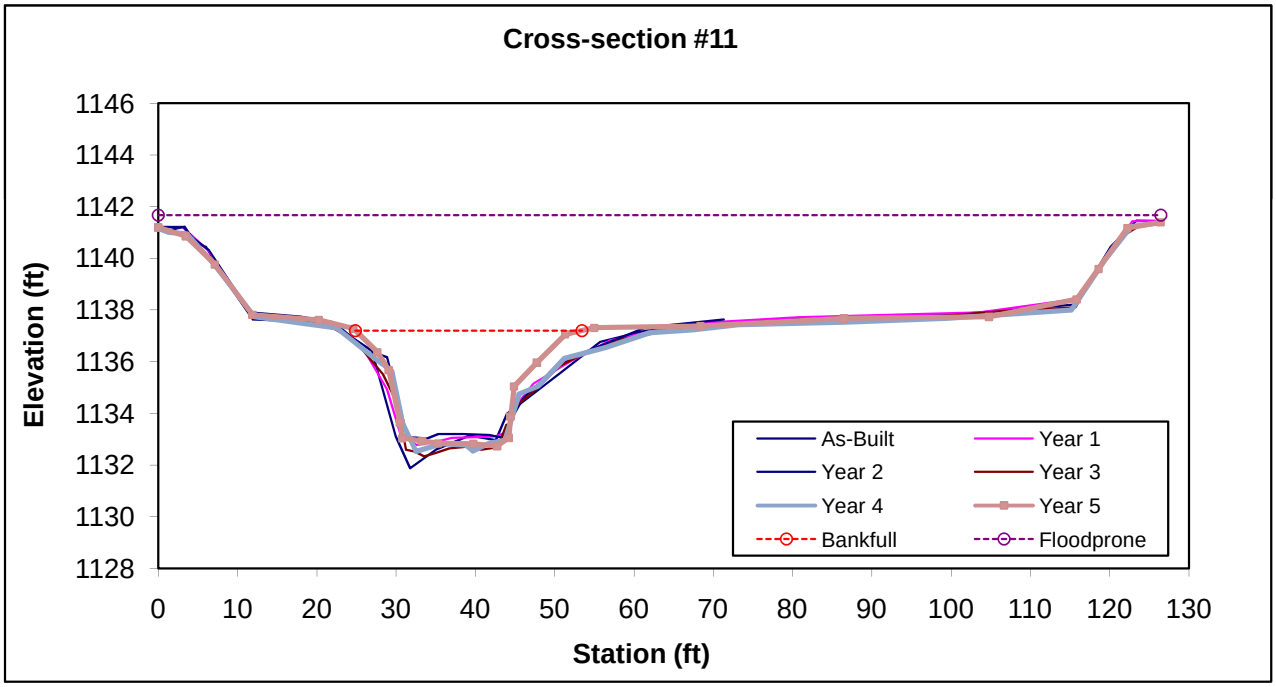
Permanent Cross-section #11 M3

(Year 5 Data - Collected October 2010)

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		75.5	28.56	2.64	4.47	10.81	1	4.4	1137.2	1137.06



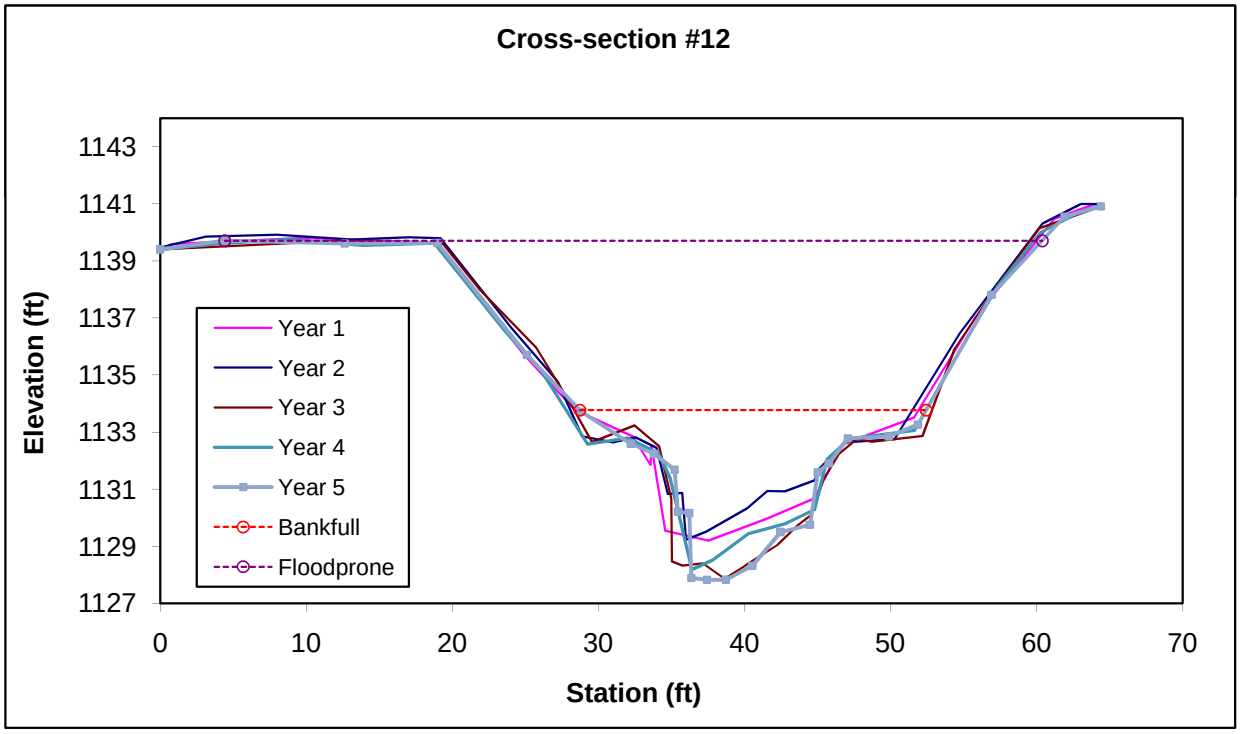
Permanent Cross-section #12 M4

(Year 5 Data - Collected October 2010)

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		62.1	23.7	2.62	5.94	9.04	2	2.4	1133.77	1139.62



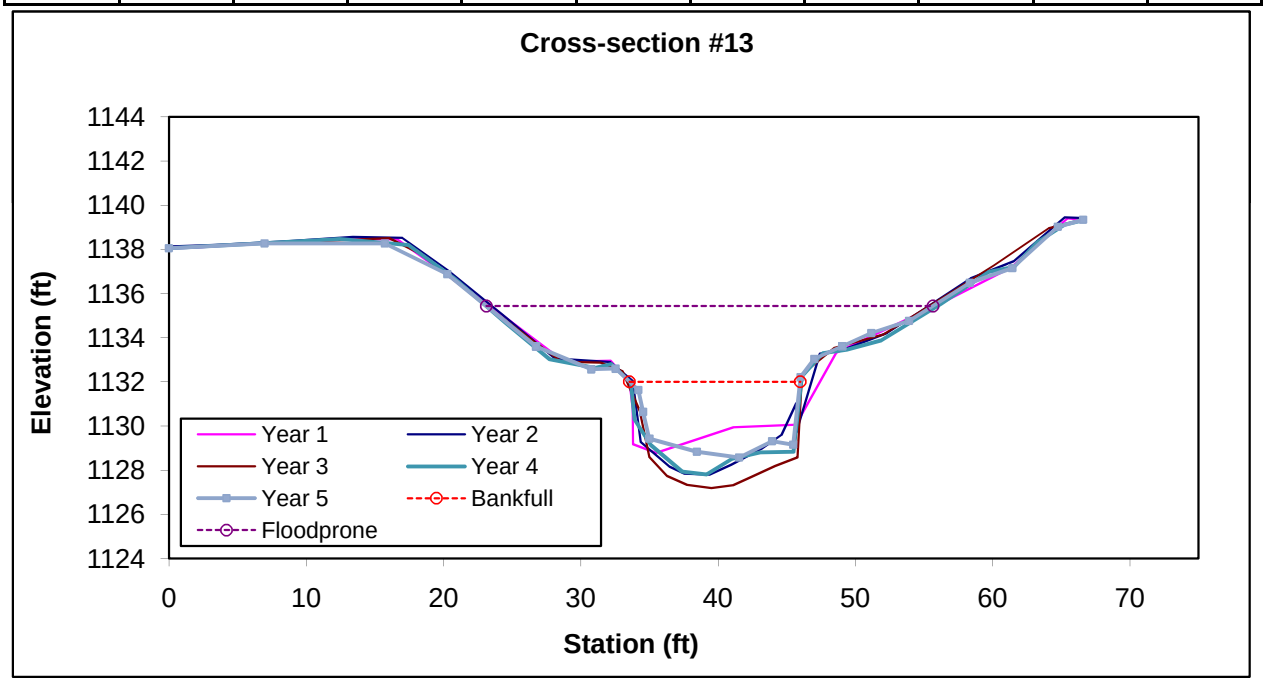
Permanent Cross-section #13 M4

(Year 5 Data - Collected October 2010)

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		33.7	12.43	2.71	3.43	4.58	2.5	2.6	1132	1137.14



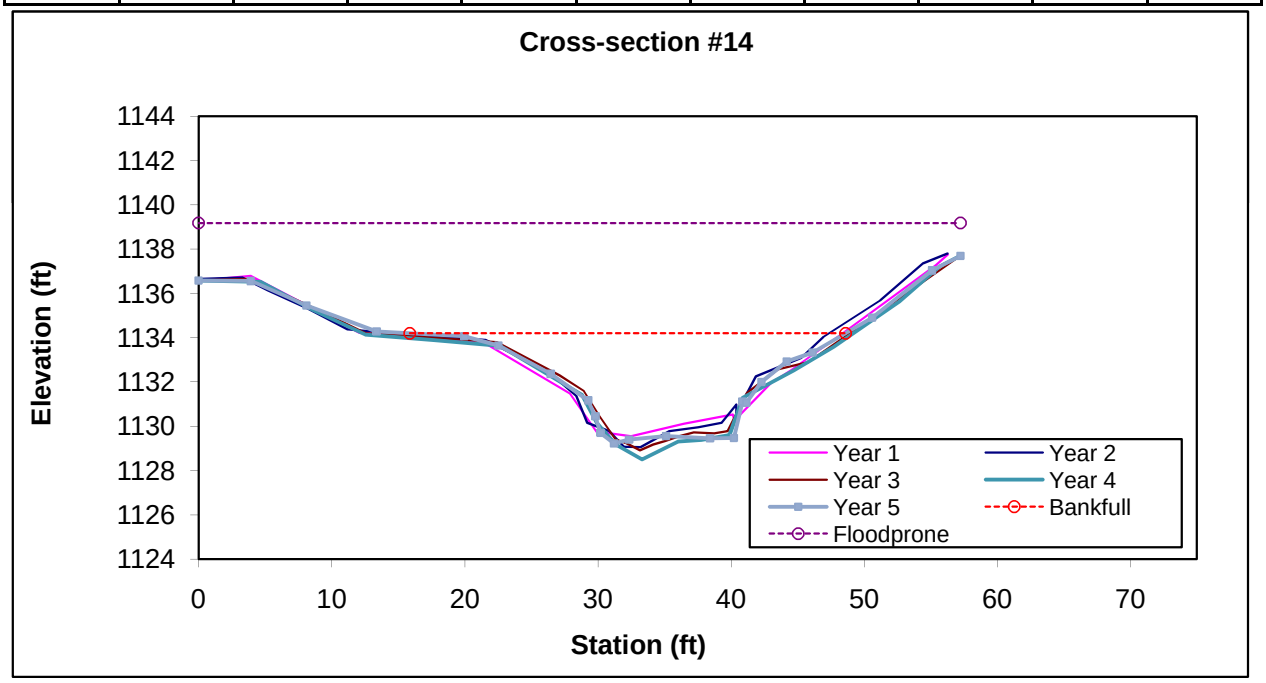
Permanent Cross-section #14 M4

(Year 5 Data - Collected October 2010)

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	Cc	76.5	32.74	2.34	4.98	14.01	1	1.7	1134.2	1134.07



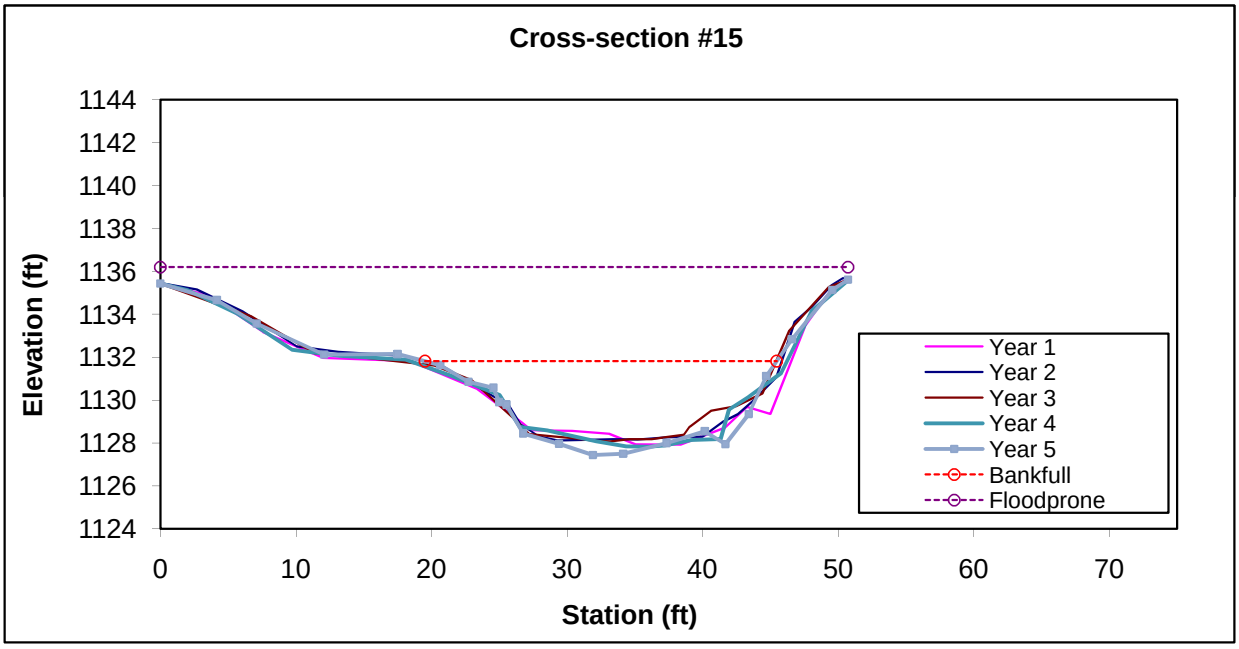
Permanent Cross-section #15 M4

(Year 5 Data - Collected October 2010)

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	Bc	74.2	25.94	2.86	4.38	9.07	1.8	2	1131.82	1135.14

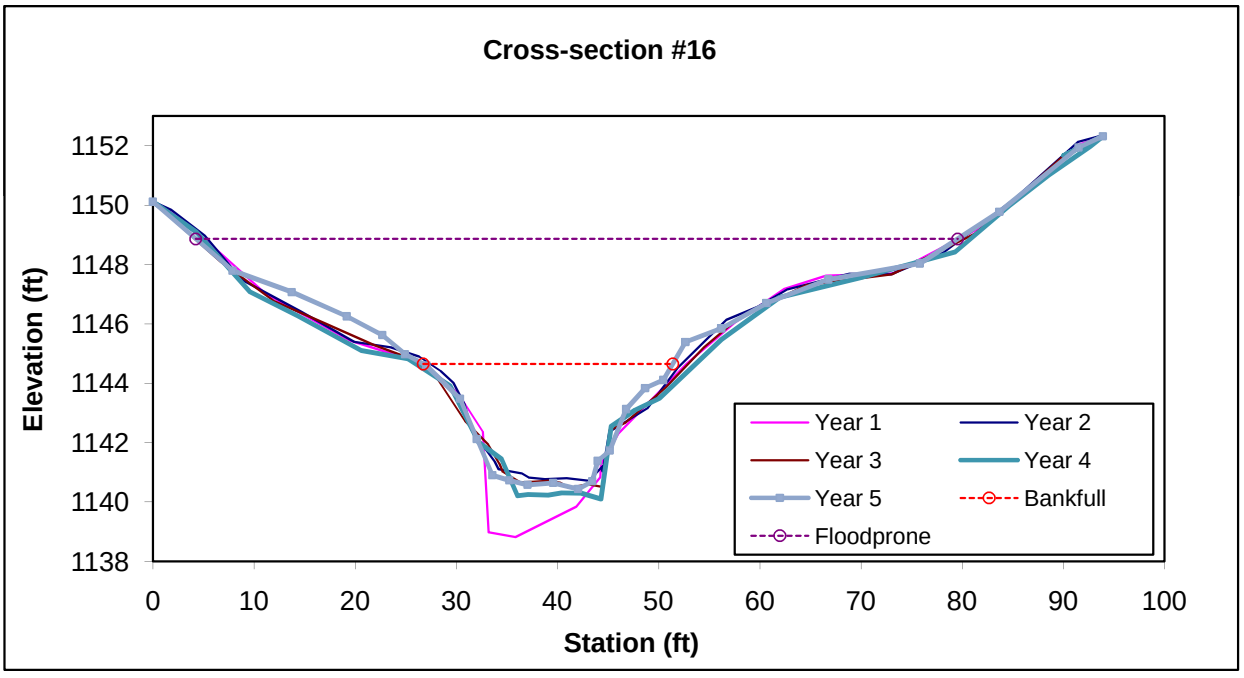


Permanent Cross-section #16 M1
(Year 5 Data - Collected October 2010)

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	E	62.5	24.64	2.54	4.21	9.71	1.1	3.1	1144.65	1144.98



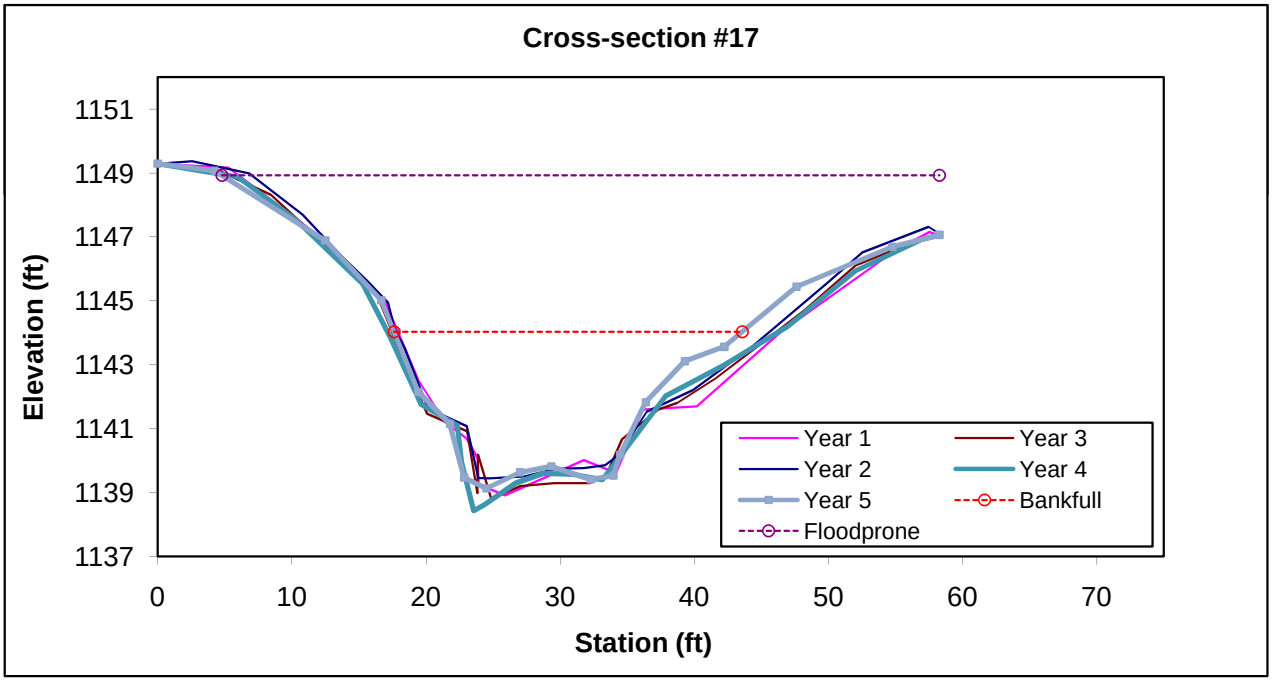
Permanent Cross-section M1 #17

(Year 5 Data - Collected October 2010)

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		76.2	25.95	2.94	4.9	8.84	1.5	2.1	1144.03	1146.69



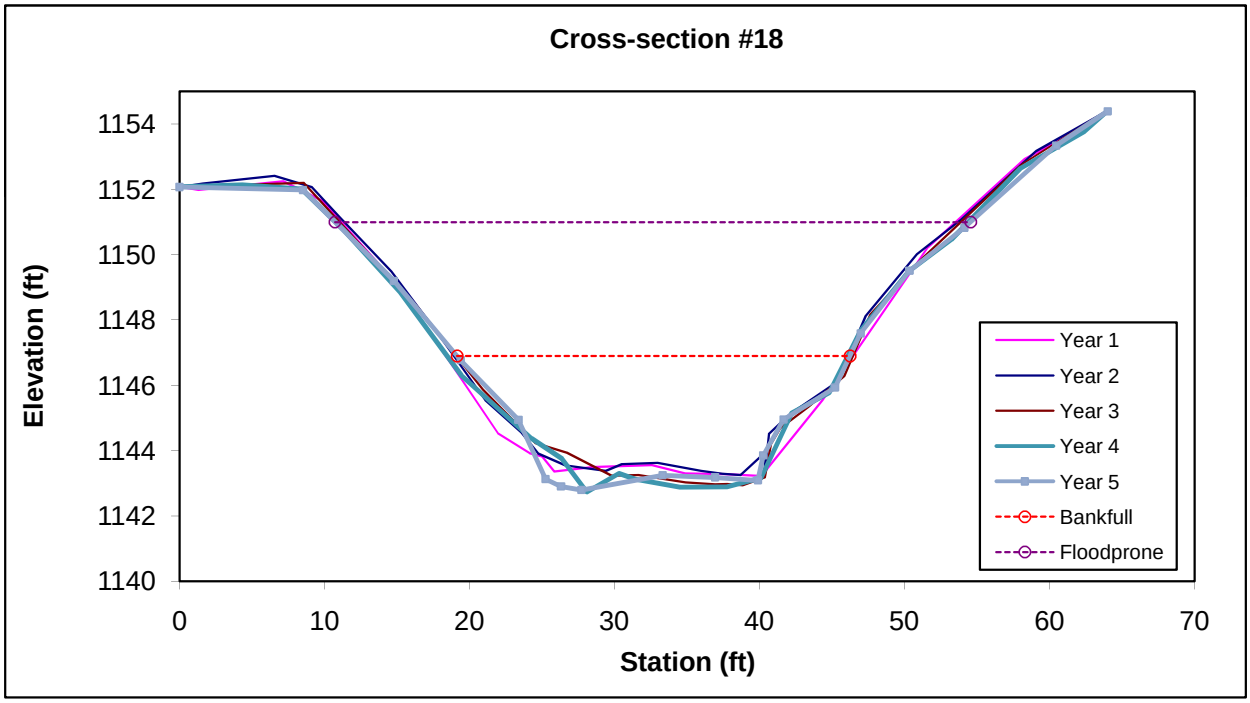
Permanent Cross-section #18 M1

(Year 5 Data - Collected November 2010)

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	Bc	75.9	27.08	2.8	4.1	9.66	2.3	1.6	1146.9	1152.08



APPENDIX C

BASELINE STREAM SUMMARY FOR RESTORATION REACHES

Baseline Stream Summary for Restoration Reaches

Baseline Stream Summary
Silver Creek Site - 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	3.3	14.7	6.8	7.5	7.7	7.8	54.2	79.1	104	-----	9.2	-----	18.0	18.0	22.1
Floodprone Width (ft)	96.3	-----	-----	-----	-----	13.0	16.0	19.0	-----	-----	-----	90.0	100.0	110.0	70.9	70.9	88.3
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	-----	0.65	-----	-----	4.7	-----	-----	0.76	-----	0.73	0.73	0.74
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	1.32	1.36	1.40	-----	5.8	-----	1.5	1.9	2.3	1.5	1.5	2.3
Bankfull Cross-sectional Area (ft2)	290	99	-----	-----	-----	-----	5.0	-----	261.1	290.3	307.8	-----	7.0	-----	13.2	13.2	13.2
Width/Depth Ratio	13	10.3	-----	-----	-----	11.4	11.9	12.3	11.3	13.0	14.2	-----	12.0	-----	24.6	30.0	24.6
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.7	2.1	2.5	1.2	1.6	2.1	9.8	10.9	12.0	3.9	3.9	4.0
Bank Height Ratio	1.3	-----	-----	-----	-----	2.4	2.7	3.0	1.0	1.3	1.8	-----	1.0	-----	0.9	0.9	0.9
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	1.6	-----	-----	5.7	-----	-----	3.4	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	32	52.5	73	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	23	27.5	32	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	64	87	110	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0062	0.00825	0.0103	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	45.8	55	64.2	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.1 / 0.2 / 0.4 / 6.4 / 21.2			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			0.1 / 0.2 / 0.4 / 6.4 / 21.2			-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.069	-----	-----	-----	-----	-----	0.069	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	1,171	-----	-----	-----	-----	-----	1,579	-----	-----	1,467	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.2	-----	-----	25.7	-----	-----	0.2	-----	-----	0.2	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	F5/E5	-----	-----	E/C4	-----	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	8.1	-----	0.92	1655.46	3310	-----	24	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.02	-----	-----	1.06	-----	-----	1.34	-----	-----	1.3	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.008	-----	-----	-----	-----	-----	0.0017	-----	-----	0.007	-----

Silver Creek Site - 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	5.2	14.4	9.8	4.4	6.6	8.8	54.2	79.1	104	-----	10.5	-----	10.26	11.03	11.81
Floodprone Width (ft)	96.3	-----	-----	-----	-----	11.0	14.5	18.0	-----	-----	-----	80.0	115.0	150.0	52.5	64.7	58.6
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	0.7	1.4	2.1	-----	4.7	-----	-----	0.9	-----	0.60	0.73	0.66
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	1.4	2.0	2.6	-----	5.8	-----	1.9	2.4	2.9	1.36	1.38	1.40
Bankfull Cross-sectional Area (ft2)	290.0	99.0	-----	-----	-----	6.2	7.7	9.1	261.1	290.3	307.8	-----	9.5	-----	6.2	7.4	8.6
Width/Depth Ratio	13.0	10.3	-----	-----	-----	2.1	7.3	12.4	11.3	13.0	14.2	-----	10.0	-----	16.2	16.7	17.1
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.4	2.8	4.1	1.2	1.6	2.1	8.2	11.8	15.4	4.4	5.4	6.3
Bank Height Ratio	1.3	-----	-----	-----	-----	2.2	2.4	2.5	1.0	1.3	1.8	-----	1.0	-----	1.0	1.0	1.0
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	-----	5.7	-----	-----	4.1	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	34	51	68	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	24	29	34	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	68	92.5	117	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	5.25	7	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0184	0.02455	0.0307	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	49	58	68	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.2 / 0.8 / 3.7 / 28.3 / 43.2			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			0.2 / 0.8 / 3.7 / 28.3 / 43.2			-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.87	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	1250	-----	-----	-----	-----	-----	1256	-----	-----	1234	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.25	-----	-----	25.7	-----	-----	0.25	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E4 / C4 / G4	-----	-----	E/C4	-----	-----	C4	-----	-----	-----	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	-----	-----	0.92	1655.46	3310	-----	39	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.07	-----	-----	1.06	-----	-----	1.14	-----	-----	1.15	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.016	-----	-----	-----	-----	-----	0.018	-----	-----	0.015	-----

Silver Creek Site - 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	-----	-----	-----	-----	4.6	-----	54.2	79.1	104	-----	6.5	-----	7.66	7.66	7.66
Floodprone Width (ft)	96.3	-----	-----	-----	-----	-----	15.0	-----	-----	-----	-----	15.0	22.5	30.0	32.9	32.9	32.9
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	-----	0.44	-----	-----	4.7	-----	-----	0.54	-----	0.4	0.4	0.4
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	-----	0.95	-----	-----	5.8	-----	1.6	1.9	2.2	0.9	0.9	0.9
Bankfull Cross-sectional Area (ft2)	290.0	99.0	-----	-----	-----	-----	2.0	-----	261.1	290.3	307.8	-----	3.5	-----	3.3	3.3	3.3
Width/Depth Ratio	13.0	10.3	-----	-----	-----	-----	10.4	-----	11.3	13.0	14.2	-----	12.0	-----	17.7	17.7	17.7
Entrenchment Ratio	1.6	-----	-----	-----	-----	-----	2.3	-----	1.2	1.6	2.1	2.3	3.5	4.6	4.3	4.3	4.3
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	3.3	-----	1.0	1.3	1.8	-----	1.0	-----		1.0	
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	3.5	-----	-----	5.7	-----	-----	2.0	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0558	0.07445	0.0931	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	16.2	19.45	22.7	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.2 / 0.5 / 0.9 / 8.0 / 20.4			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			0.2 / 0.5 / 0.9 / 8.0 / 20.4			-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.231	-----	-----	-----	-----	-----	0.231	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	7.8	-----	-----	-----	-----	-----	7.8	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	191	-----	-----	-----	-----	-----	157	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.07	-----	-----	25.7	-----	-----	0.07	-----	-----	0.92	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5b	-----	-----	E/C4	-----	-----	B4	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	7.0	-----	0.92	1655.46	3310	-----	7.0	-----	-----	54	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.18	-----	-----	1.06	-----	-----	1.01	-----	-----	1.0	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.047	-----	-----	-----	-----	-----	0.008	-----	-----	0.054	-----

Silver Creek Site - Reach M1																	
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	-----	-----	-----	20.3	23.9	27.5	54.2	79.1	104	-----	30.0	-----	-----	-----	-----
Floodprone Width (ft)	96.3	-----	-----	-----	-----	30.0	57.5	85.0	-----	-----	-----	35.0	57.5	80.0	-----	-----	-----
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	2.7	3.4	4.1	-----	4.7	-----	-----	2.5	-----	-----	-----	-----
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	4.2	5.2	6.1	-----	5.8	-----	3	5.3	7.5	-----	-----	-----
Bankfull Cross-sectional Area (ft2)	290.0	99.0	-----	-----	-----	69.8	76.9	83.9	261.1	290.3	307.8	-----	75.0	-----	-----	-----	-----
Width/Depth Ratio	13.0	10.3	-----	-----	-----	7.5	8.7	9.8	11.3	13.0	14.2	-----	12.0	-----	-----	-----	-----
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.3	2.6	3.8	1.2	1.6	2.1	1.2	2.0	2.7	-----	-----	-----
Bank Height Ratio	1.3	-----	-----	-----	-----	1.6	2.1	2.5	1.0	1.3	1.8	-----	1.0	-----	-----	-----	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	-----	5.7	-----	-----	4.7	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	105	142.5	180	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	75	90	105	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	210	285	360	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	4.75	6	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0034	0.0045	0.0056	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	150	180	210	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.19 / 1.23 / 4.20 / 14.57 / 24.65			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			0.2 / 1.2 / 4.2 / 14.6 / 24.7			-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	25.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	1,392	-----	-----	-----	-----	-----	1,392	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	6.6	-----	-----	25.7	-----	-----	6.6	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E/G4	-----	-----	E/C4	-----	-----	C4	-----	-----	-----	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	-----	-----	0.92	1655.46	3310	-----	350	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.04	-----	-----	1.06	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.002	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Silver Creek Site - Reach M2																	
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	-----	-----	-----	-----	-----	-----	54.2	79.1	104	-----	-----	-----	-----	-----	-----
Floodprone Width (ft)	96.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	-----	-----	-----	-----	4.7	-----	-----	-----	-----	-----	-----	-----
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	-----	-----	-----	-----	5.8	-----	-----	-----	-----	-----	-----	-----
Bankfull Cross-sectional Area (ft2)	290.0	99.0	-----	-----	-----	-----	-----	-----	261.1	290.3	307.8	-----	-----	-----	-----	-----	-----
Width/Depth Ratio	13.0	10.3	-----	-----	-----	-----	-----	-----	11.3	13.0	14.2	-----	-----	-----	-----	-----	-----
Entrenchment Ratio	1.6	-----	-----	-----	-----	-----	-----	-----	1.2	1.6	2.1	-----	-----	-----	-----	-----	-----
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	-----	-----	1.0	1.3	1.8	-----	-----	-----	-----	-----	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	-----	5.7	-----	-----	-----	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	0.2 / 6.79 / 19.02 / 88.89 / 2749.59			-----	-----	-----	-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	-----	-----	-----	25.7	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	-----	-----	-----	E/C4	-----	-----	-----	-----	-----	-----	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	-----	-----	0.92	1655.46	3310	-----	-----	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	-----	-----	-----	1.06	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Silver Creek Site - Reach M3																	
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	-----	-----	-----	20.3	23.9	27.5	54.2	79.1	104	-----	31.0	-----	26.6	27.0	38.2
Floodprone Width (ft)	96.3	-----	-----	-----	-----	30.0	57.5	85.0	-----	-----	-----	100.0	250.0	400.0	48.5	57.5	126.5
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	2.7	3.4	4.1	-----	4.7	-----	-----	2.58	-----	2.3	2.3	2.5
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	4.2	5.2	6.1	-----	5.8	-----	3.1	5.40	7.7	3.4	3.5	5.3
Bankfull Cross Sectional Area (ft2)	290.0	99.0	-----	-----	-----	69.8	76.9	83.9	261.1	290.3	307.8	-----	80.0	-----	62.6	63.2	93.7
Width/Depth Ratio	13.0	10.3	-----	-----	-----	4.9	7.3	9.7	11.3	13.0	14.2	-----	12.0	-----	11.3	11.6	15.6
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.3	2.6	3.8	1.2	1.6	2.1	3.2	8.1	12.9	1.8	2.1	3.3
Bank Height Ratio	1.3	-----	-----	-----	-----	1.2	1.5	1.7	1.0	1.3	1.8	-----	1.0	-----		1.0	
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	3.2	2.9	2.7	-----	5.7	-----	-----	4.8	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	108	147	186	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	77	92.5	108	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	217	294.5	372	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	4.75	6	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0019	0.00255	0.0032	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	154.9	185.9	216.9	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.3 / 0.55 / 0.85 / 3.63 / 8.73			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			0.3 / 0.6 / 0.8 / 3.6 / 8.7			-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.276	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	13.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	2,100	-----	-----	-----	-----	-----	2,100	-----	-----	2,193	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	7.2	-----	-----	25.7	-----	-----	7.2	-----	-----	7.2	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5	-----	-----	E/C4	-----	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	226	-----	0.92	1655.46	3310	-----	385	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.4	-----	-----	1.06	-----	-----	1.4	-----	-----	1.480	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.002	-----	-----	-----	-----	-----	0.0016	-----	-----	0.002	-----

Silver Creek Site - Reach M4																	
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	-----	-----	-----	20.3	23.9	27.5	54.2	79.1	104	-----	-----	-----	-----	-----	-----
Floodprone Width (ft)	96.3	-----	-----	-----	-----	30.0	57.5	85.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Mean Depth (ft)	4.7	3.1	-----	-----	-----	2.7	3.4	4.1	-----	4.7	-----	-----	-----	-----	-----	-----	-----
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	4.2	5.2	6.1	-----	5.8	-----	-----	-----	-----	-----	-----	-----
Bankfull Cross-sectional Area (ft2)	290.0	99.0	-----	-----	-----	69.8	76.9	83.9	261.1	290.3	307.8	-----	-----	-----	-----	-----	-----
Width/Depth Ratio	13.0	10.3	-----	-----	-----	4.9	7.3	9.7	11.3	13.0	14.2	-----	-----	-----	-----	-----	-----
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.3	2.6	3.8	1.2	1.6	2.1	-----	-----	-----	-----	-----	-----
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	1.2	-----	1.0	1.3	1.8	-----	-----	-----	-----	-----	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	-----	5.7	-----	-----	-----	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.71 / 2.77 / 10.91 / 29.87 / 39.50			0.2 / 6.79 / 19.02 / 88.89 / 2749.59			-----	-----	-----	-----	-----	-----
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	2,036	-----	-----	-----	-----	-----	2,036	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	7.6	-----	-----	25.7	-----	-----	7.6	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E4	-----	-----	E/C4	-----	-----	-----	-----	-----	-----	-----
Bankfull Discharge (cfs)	1140	254	-----	-----	-----	-----	-----	-----	0.92	1655.46	3310	-----	-----	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.07	-----	-----	1.06	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.002	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

APPENDIX D

MORPHOLOGY AND HYDRAULIC MONITORING SUMMARY

Morphology and Hydraulic Monitoring Summary - Year 5 Monitoring

Silver Creek Restoration Site: Project No. D04006-5

Reach: Unnamed Tributary 1 (UT1)

I. Cross-section Parameters	Cross-section 1 Pool					Cross-section 2 Riffle					Cross-section 3 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
Bankfull Width (ft)	24.08	20.65	21.71	19.05	15.53	11.99	16.46	15.66	18.06	18.97	10.27	10.24	10.31	25.51	11.01
Bankfull Mean Depth (ft)	0.62	0.56	0.59	0.53	0.63	0.83	0.6	0.54	0.56	0.57	0.85	0.59	0.64	0.26	0.55
Width/Depth Ratio	38.7	37.02	36.6	35.65	24.8	14.4	27.62	29.21	32.66	33.24	12.0	17.35	16.24	98.22	20.01
BF Cross-sectional Area (sq ft)	14.99	11.52	12.9	10.2	9.7	9.99	9.81	8.4	10	10.8	8.77	6.04	6.6	6.63	6.1
Bankfull Max Depth (ft)	2.33	1.57	1.63	1.67	1.42	1.38	1.3	1.28	1.18	1.34	1.57	1.16	1.04	1.27	1.31
Width of Floodprone Area (ft)	96.92	96.94	91.30	96.91	96.43	70.82	70.87	70.87	70.83	70.88	53.67	53.67	53.67	56.13	57.9
Entrenchment Ratio	4.01	4.17	3.7	4.5	5.5	5.91	4.31	4.5	3.9	3.7	9.43	9.47	5.2	2.2	5.3
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			1108.53			1108.53			1108.53			1108.53			1108.53
Channel Length (ft)			1467			1467			1467			1467			1467
Sinuosity			1.32			1.32			1.32			1.32			1.32
Water Surface Slope (ft/ft)			0.0054			0.0054			0.0055			0.0057			0.0058
BF Slope (ft/ft)			0.0071			0.0071			0.0071			0.0075			0.0076
Rosgen Classification			C			C			C			C			C

Reach: Unnamed Tributary 2 (UT2)															
I. Cross-section Parameters	Cross-section 4 Riffle					Cross-section 5 Pool					Cross-section 6 Riffle				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	14.11	12.96	12.6	15.33	11.46	19.91	24.29	20.6	19.87	21.13	11.42	10.14	11.02	9.80	8.49
Bankfull Mean Depth (ft)	0.68	0.61	0.62	0.51	0.58	0.63	0.69	0.79	0.80	0.72	0.58	0.55	0.53	0.53	0.55
Width/Depth Ratio	20.9	21.1	20.18	29.99	19.91	31.58	35.21	26.18	24.78	29.38	19.8	18.5	21	18.52	15.48
BF Cross-sectional Area (sq ft)	9.53	7.96	7.9	7.8	6.6	12.56	16.76	16.2	15.9	15.2	6.60	5.56	5.8	5.2	4.7
Bankfull Max Depth (ft)	1.44	1.31	1.32	1.29	1.21	1.75	2.85	2.76	2.9	2.92	1.27	1.27	1.23	1.14	1.18
Width of Floodprone Area (ft)	64.0	64.06	64.02	64.0	64.04	78.21	78.27	70.85	78.18	78.20	64.72	64.74	64.65	64.66	64.71
Entrenchment Ratio	3.75	4.01	4.2	3.4	4.3	3.93	3.22	3.4	3.9	3.7	5.67	6.27	5.9	6.4	7.5
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			1068.85			1068.85			1068.85			1068.85			1068.85
Channel Length (ft)			1234.2			1234.2			1234.2			1234.2			1234.2
Sinuosity			1.15			1.15			1.15			1.15			1.15
Water Surface Slope (ft/ft)			0.0151			0.0165			0.0163			0.0167			0.0175
BF Slope (ft/ft)			0.0174			0.0191			0.0195			0.0195			0.0207
Rosgen Classification			C			C			C			C			C

Reach: Unnamed Tributary (UT3)																
I. Cross-section Parameters	Cross-section 7 Riffle															
	MY1	MY2	MY3	MY4	MY5											
Dimension																
BF Width (ft)	6.24	3.7	6.73	8.6	3.99											
Bankfull Mean Depth (ft)	0.39	0.32	0.25	0.21	0.47											
Width/Depth Ratio	15.9	11.71	26.46	40.4	8.52											
BF Cross-sectional Area (sq ft)	2.45	1.2	1.7	1.8	1.9											
Bankfull Max Depth (ft)	0.98	0.64	0.68	0.87	0.97											
Width of Floodprone Area (ft)	47.55	43.53	43.23	46.28	47.25											
Entrenchment Ratio	5.81	8.1	4.5	4.1	9.0											
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			154.1			-			-			-			-
Channel Length (ft)			157.79			-			-			-			-
Sinuosity			1.02			-			-			-			-
Water Surface Slope (ft/ft)			0.0536			-			-			-			-
BF Slope (ft/ft)			0.0545			-			-			-			-
Rosgen Classification			Ba												

Reach: Silver Creek M1															
I. Cross-section Parameters	Cross-section 16 Riffle					Cross-section 17 Pool					Cross-section 18 Riffle				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	25.96	24.86	25.99	27.63	24.64	28.54	27.84	28.64	29.17	25.95	28.08	27.23	27.35	27.63	27.08
Floodprone Width (ft)	86.30	78.84	79.94	81.98	79.55	58.15	58.16	58.23	58.13	58.27	52.47	52.34	53.56	54.52	54.56
BF Cross-sectional Area (ft2)	78.6	61.1	64.8	68	62.5	84.1	78.75	85.0	85.1	76.2	77.5	70.4	73.7	77.0	75.9
BF Mean Depth (ft)	3.03	2.46	2.49	2.46	2.54	2.95	2.83	2.97	2.92	2.94	2.76	2.58	27.35	2.79	2.8
BF Max Depth (ft)	5.84	3.93	4.17	4.56	4.21	5.11	4.58	5.21	5.6	4.9	3.68	3.64	3.96	4.16	4.1
Width/Depth Ratio	8.57	10.12	10.42	11.23	9.71	9.69	9.84	9.65	10	8.84	10.17	10.54	10.15	9.91	9.66
Entrenchment Ratio	3.30	2.93	2.9	2.8	3.1	1.80	1.8	2.0	2	2.1	1.40	1.47	1.5	1.6	1.6
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			-			-			-			-			-
Channel Length (ft)			-			-			-			-			-
Sinuosity			-			-			-			-			-
Water Surface Slope (ft/ft)			-			-			-			-			-
BF Slope (ft/ft)			-			-			-			-			-
Rosgen Classification			C			C			C			C			C

Reach: Silver Creek M3																				
I. Cross-section Parameters	Cross-section 8 Riffle					Cross-section 9 Pool					Cross-section 10 Riffle					Cross-section 11 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)	26.43	25.03	25.63	25.3	25.23	36.81	36.15	39.75	39.8	31.42	26.10	25.86	25.2	29.82	28.3	39.85	37.09	42.08	43.09	28.56
Floodprone Width (ft)	57.05	56.01	56.51	59.62	60.55	122.40	122.43	122.44	117.8	116.76	72.52	72.37	72.94	74.28	73.49	126.40	122.63	126.43	126.39	126.44
BF Cross-sectional Area (ft2)	58.20	54.46	55.4	53.8	53.5	95.40	82.05	82.2	80.2	66.9	59.40	58.7	57.3	58.2	56.3	88.90	82.43	94	89.3	75.5
BF Mean Depth (ft)	2.20	2.18	2.16	2.13	2.12	2.59	2.27	2.07	2.02	2.13	2.27	2.27	2.27	1.95	1.99	2.23	2.22	2.23	2.07	2.64
BD Max Depth (ft)	3.16	3.12	3.18	3.28	3.44	5.35	4.44	5.34	5.24	4.83	3.14	3.08	3.14	3.3	3.27	4.43	4.18	4.87	4.68	4.47
Width/Depth Ratio	12.0	11.5	11.85	11.9	11.9	14.2	15.93	19.22	19.75	14.76	11.5	11.39	11.09	15.28	14.23	17.9	16.69	18.84	20.78	10.81
Entrenchment Ratio	1.70	1.76	1.8	1.9	2	3.30	3.39	3.1	3.0	3.7	2.40	2.43	2.5	2.2	2.3	3.20	3.31	3	2.9	4.4
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			1481.1			1481.1			1481.1			1481.1			1481.1
Channel Length (ft)			2192.57			2192.57			2192.57			2192.57			2192.57
Sinuosity			1.48			1.48			1.48			1.48			1.48
Water Surface Slope (ft/ft)			0.0022			0.0023			0.0025			0.0023			0.0025
BF Slope (ft/ft)			0.0032			0.0036			0.0036			0.0036			0.0036
Rosgen Classification			C			C			C			C			C

Reach: Silver Creek M4																				
I. Cross-section Parameters	Cross-section 12 Riffle					Cross-section 13 Riffle					Cross-section 14 Riffle					Cross-section 15 Riffle				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	23.56	23.45	24.47	24.63	23.7	19.74	17.92	12.72	12.45	12.43	36.07	32.68	36.43	36.86	32.74	28.08	26.49	28.18	27.8	25.94
Floodprone Width (ft)	57.93	57.49	59.50	59.25	60.38	61.44	62.94	58.97	57.85	55.65	56.29	57.27	57.28	57.28	57.23	50.83	49.94	50.52	50.74	50.72
BF Cross-sectional Area (ft2)	55.20	49.27	66.2	59.6	62.1	46.40	54.86	49.1	40.8	33.7	78.00	73.54	76.3	83.4	76.5	72.70	68.6	65.8	70.2	74.2
BF Mean Depth (ft)	2.34	2.1	2.7	2.42	2.62	2.35	3.06	3.86	3.27	2.71	2.16	2.25	2.09	2.26	2.34	2.59	2.59	2.33	2.52	2.86
BD Max Depth (ft)	4.58	4.55	5.9	5.58	5.94	4.23	5.21	4.82	4.2	3.43	4.65	5.13	5.29	5.68	4.98	3.90	3.7	3.74	3.99	4.38
Width/Depth Ratio	10.7	11.16	9.05	10.18	9.04	8.4	5.85	3.29	3.8	4.58	16.7	14.52	17.39	16.29	14.01	10.9	10.23	12.07	11.01	9.07
Entrenchment Ratio	1.60	1.54	1.8	1.6	2.4	2.10	2.53	3.0	2.9	2.6	1.60	1.75	1.6	1.6	1.7	1.80	1.89	1.8	1.8	1.8
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)			-			-			-			-			-
Radius of Curvature (ft)			-			-			-			-			-
Meander Wavelength (ft)			-			-			-			-			-
Meander Width Ratio			-			-			-			-			-
Profile															
Riffle length (ft)			-			-			-			-			-
Riffle Slope (ft/ft)			-			-			-			-			-
Pool Length (ft)			-			-			-			-			-
Pool Spacing (ft)			-			-			-			-			-
Additional Reach Parameters															
Valley Length (ft)			-			-			-			-			-
Channel Length (ft)			-			-			-			-			-
Sinuosity			-			-			-			-			-
Water Surface Slope (ft/ft)			-			-			-			-			-
BF Slope (ft/ft)			-			-			-			-			-
Rosgen Classification			C4			C4			C4			C4			C4

APPENDIX E

BENTHIC MACROINVERTEBRATE MONITORING DATA

P1 Site 1 – Facing Upstream

P2 Site 1 – Facing Downstream

P3 Site 2 – Facing Upstream

P4 Site 2 – Facing Downstream

P5 Site 3 – Facing Upstream

P6 Site 3 – Facing Downstream

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek	Site 2 UT1 to Silver Creek	Site 3 UT to Bailey Fork Reference
			2/2/2009	2/2/2009	3/19/2009
PLATYHELMINTHES					
Turbellaria					R
MOLLUSCA					
Gastropoda					
Mesogastropoda					
Pleuroceridae					
Elimia sp.	**2.5**	**SC**	C		A
ANNELIDA					
Oligochaeta					
Tubificida					
Enchytraeidae	**9.8**	**CG**		R	
Lumbricidae					
Naididae	**8**	**CG**			C
Nais sp.	**8.9**	**CG**			A
Nais behningi	**8.9**	**CG**			R
Slavina appendiculata	**7.1**	**CG**			R
Tubificidae w.h.c.	**7.1**	**CG**			R
Limnodrilus hoffmeisteri	**9.5**	**CG**	R		
Lumbriculida					
Lumbriculidae	**7**	**CG**	R	R	R
ARTHROPODA					
Arachnoidea					
Acariformes	**5.5**				
Lebertiidae	**5.5**				
Lebertia sp.	**5.5**		A		
Crustacea					
Cyclopoida				C	
Insecta					
Collembola				R	
Ephemeroptera					
Baetidae					
Heterocloeon sp.	**3.5**	**SC**	A		
Baetiscidae					
Baetisca carolina	**3.5**		R		
Ephemerellidae					
Ephemerella sp.	**2**	**SC**		R	A
Eurylophella sp.	**4.3**	**SC**	A		C
Ephemeridae		**CG**			
Ephemera sp.	**2**	**CG**			R
Heptageniidae					
Maccaffertium (Stenonema) sp.	**4**	**SC**	C	R	
Maccaffertium (Stenonema) modestum	**5.5**	**SC**	C		
Leptophlebiidae		**CG**		R	
Leptophlebia sp.	**6.2**	**CG**		A	R
Odonata					
Aeshnidae		**P**			
Boyeria vinosa	**5.9**	**P**			R
Calopterygidae		**P**			
Calopteryx maculata	**7.8**	**P**			C
Cordulegastridae		**P**			
Cordulegaster sp.	**5.7**	**P**			C

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek	Site 2 UT1 to Silver Creek	Site 3 UT to Bailey Fork Reference
			2/2/2009	2/2/2009	3/19/2009
Gomphidae					
Gomphus sp.	**5.8**	**P**			R
Ophiogomphus sp.	**5.5**	**P**	C		R
Stylogomphus albistylus	**4.7**	**P**			R
Plecoptera					
Nemouridae					
Prostoia sp.	**5.8**		A		
Perlidae					
Acroneuria sp.	**1**	**P**	R		
Eccoptura xanthenes	**3.7**	**P**			C
Perlodidae					
Isoperla sp.	**2**	**P**	A		
Pteronarcidae	**1.6**	**SH**			
Pteronarcys (Allonarcys) sp.	**1.7**	**SH**	R		
Pteronarcys sp.	**1.7**	**SH**	R		
Hemiptera					
Veliidae		**P**			
Microvelia sp.		**P**			R
Megaloptera					
Corydalidae					
Nigronia serricornis	**5**	**P**	R		
Trichoptera					
Calamoceratidae		**SH**			
Heteroplectron americanum	**3.2**	**-**	R		
Hydropsychidae					
Cheumatopsyche sp.	**6.2**	**FC**	C		
Diplectrona modesta	**2.2**	**FC**			A
Hydropsyche betteni gp.	**7.8**	**FC**	C		
Lepidostomatidae		**SH**			
Lepidostoma sp.	**0.9**	**FC**			R
Limnephilidae					
Pycnopsyche sp.	**2.5**	**SH**	R		C
Uenoidae					
Neophylax sp.	**2.2**	**SC**	R		R
Coleoptera					
Dryopidae					
Helichus sp.	**4.6**	**SC**	R		R
Elmidae					
Optioservus sp.	**2.4**	**SC**	C		
Oulimnius latiusculus	**1.8**	**CG**			C
Stenelmis sp.	**5.1**	**SC**			R
Ptilodactylidae		**SH**			
Anchytarsus bicolor	**3.6**	**SH**	R		A
Diptera					
Ceratopogonidae		**P**			R
Chironomidae					
Conchapelopia sp.	**8.4**	**P**			R
Corynoneura sp.	**6**	**CG**			R
Cricotopus sp.	**7**	**CG**		A	R
Diplocladius cultriger	**7.4**	**CG**		C	
Eukiefferiella claripennis gp.	**5.6**	**CG**	R	R	

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek	Site 2 UT1 to Silver Creek	Site 3 UT to Bailey Fork Reference
			2/2/2009	2/2/2009	3/19/2009
Hydrobaenus sp.	**9.5**	**SC**		A	
Orthocladius sp.	**6**	**CG**	R	R	R
Parametriocnemus sp.	**3.7**	**CG**	C		
Polypedilum fallax	**6.4**	**SH**			R
Polypedilum illinoense	**9**	**SH**			C
Pseudorthocladius sp.	**1.5**	**CG**			R
Rheocricotopus glabricollis				R	
Stenochironomus sp.	**6.5**	**SH**	R		
Tribelos jucundum	**6.3**		R		
Tvetenia paucunca	**3.7**	**CG**	C		
Dixidae		**CG**			
Dixa sp.	**2.6**	**CG**			C
Empididae	**7.6**	**P**			
Hemerodromia sp.	**6**	**P**	R		
Simuliidae					
Simulium sp.	**6**	**FC**	C	A	R
Prosimulium sp.	**6**	**FC**	A		
Tabanidae		**PI**			
Chrysops sp.	**6.7**	**PI**			R
Tipulidae					
Antocha sp.	**4.3**	**CG**	C		
Hexatoma sp.	**4.3**	**P**			R
Pseudolimnophila sp.	**7.2**	**P**			C
Ptychoptera sp.					R
Tipula sp.	**7.3**	**SH**	A		A

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 78

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 Silver Creek Location/road: Site 1 (Road Name _____) County Burke

Date 2/2/09 **CC#** _____ Basin Catawba Subbasin 11-34-0.5

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

Latitude _____ Longitude _____ Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 6.4 °C DO 98.7 % 12.07 mg/l Conductivity (corr.) 60 µS/cm pH 7.08

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: 25 %Forest _____ %Residential 50 %Active Pasture _____ % Active Crops
25 %Fallow Fields _____ % Commercial _____ %Industrial _____ %Other - Describe: _____

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

Width: (~~meters~~ feet) Stream 10-15' Channel (at top of bank) 3-7' **Stream Depth:** (~~m~~) Avg 1' Max 3.5'
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 4-5'

Bank Angle: 30-60° 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** Restored stream project

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: Partly Cloudy **Photos:** ☐ N ☒ Y ☒ Digital ☐ 35mm

Remarks: During Year 2 areas of erosion were repaired immediately upstream of sampling site. Mid-channel bar has developed immediately upstream. Bar may be result of repair work. Monitor in future visits.

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 sit 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 **Rocks** R **Macrophytes** R-C **Sticks and leafpacks** R **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)	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 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.

A. substrate with good mix of gravel, cobble and boulders	**Score**
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.

A. Pools present	Score
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 10

Remarks Previous bank erosion has been repaired but vegetation hasn't established in these areas 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 Young floodplain veg doesn't provide shade to channel 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
		Total 10

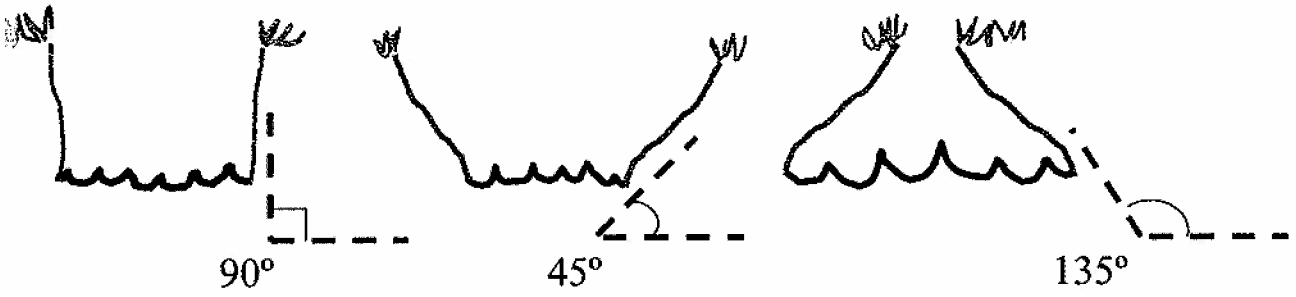
Remarks _____

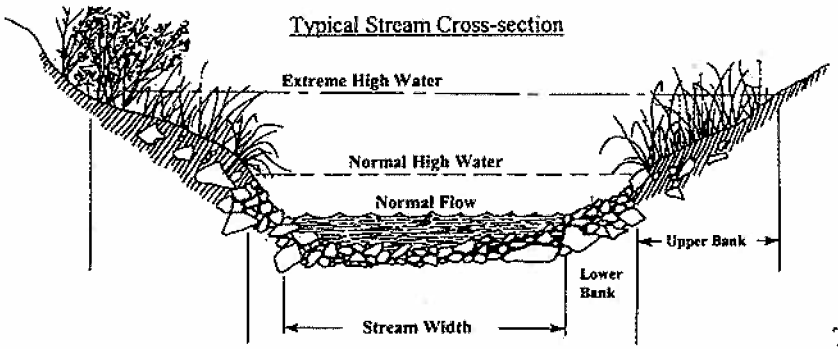
Page Total 36

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 78

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** 81

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 UT1 to Silver Creek Location/road: Site 2 (Road Name Morrison Rd) County Burke

Date 2-2-09 **CC#** _____ Basin Catawba Subbasin 11-34-0.5

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

Latitude _____ Longitude _____ Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 5.1 °C DO 14.02 (*110.4%) mg/l Conductivity (corr.) 20 µS/cm pH 6.94

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: 40 %Forest ____ %Residential 30 %Active Pasture ____ % Active Crops
30 %Fallow Fields ____ % Commercial ____ %Industrial ____ %Other - Describe: _____

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

Width: (~~meters~~ feet) Stream 1-2' Channel (at top of bank) 3-5' **Stream Depth:** (~~m~~) Avg 0.25 Max 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'

Bank Angle: 30-60 ° 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 Already restored
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: Overcast, windy, 50's **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: Stream bank vegetation has flourished and grasses overhang and even enclose portions of the reach

*DO meter reading suspect

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.

C **Rocks** C **Macrophytes** R **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 Subtotal 15

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.

A. substrate with good mix of gravel, cobble and boulders	**Score**
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.

A. Pools present	Score
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 41

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 well established stream bank vegetation

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 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
		Total 10

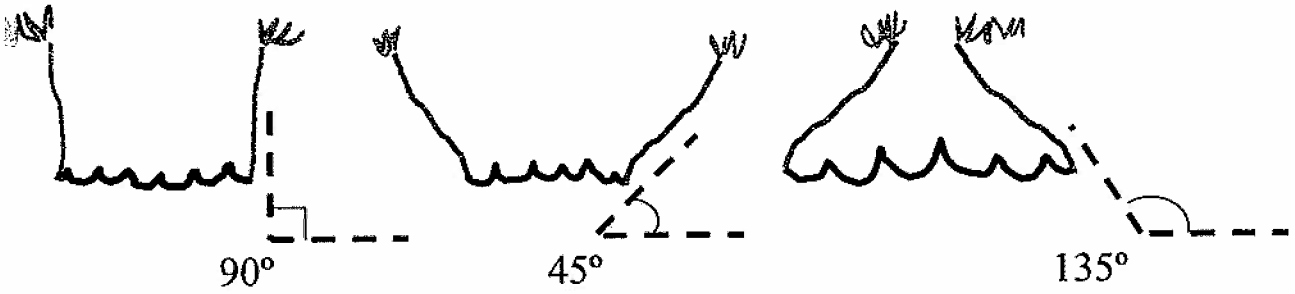
Remarks _____

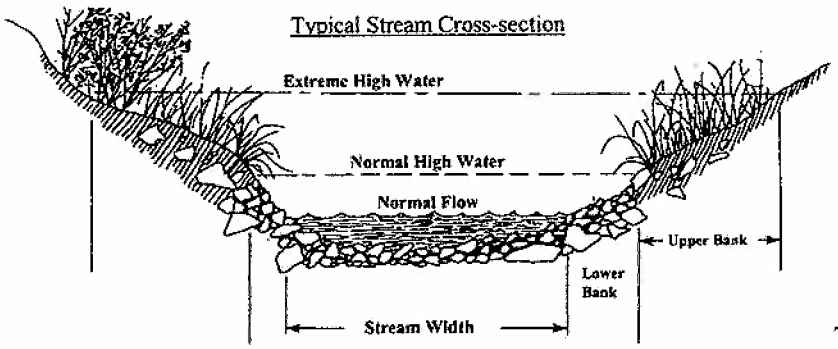
Page Total 40

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

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments:_____

_____

_____

_____

_____

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 75

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 Location/road: Site 2 (Road Name Flint Rd) County Burke

Date 3-19-09 **CC#** _____ Basin Catawba Subbasin 11-34-8-3

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

Latitude _____ Longitude _____ Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 14.6 °C DO 9.36 (91%) mg/l Conductivity (corr.) 40 µS/cm pH 6.93

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: 50 %Forest 25 %Residential _____ %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial 25 %Other - Describe: Recently cut forest

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

Width: (meters) Stream 2 Channel (at top of bank) 4 **Stream Depth**: (m) Avg 0.3 Max 0.75
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1.5

Bank Angle: 30-70 ° 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: Party Cloudy, 70° **Photos:** ☐ N ☑ Y ☐ Digital ☑ 35mm

Remarks: Eco-reference site for Bailey Fork & Silver Creek Sites

Site 2

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 **Rocks** R **Macrophytes** C **Sticks and leafpacks** R-C **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	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 _____ Subtotal 15

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.

A. substrate with good mix of gravel, cobble and boulders	Score
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 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.

A. Pools present	Score
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 _____

Page Total 34

Site 2

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 10

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 10

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
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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 5

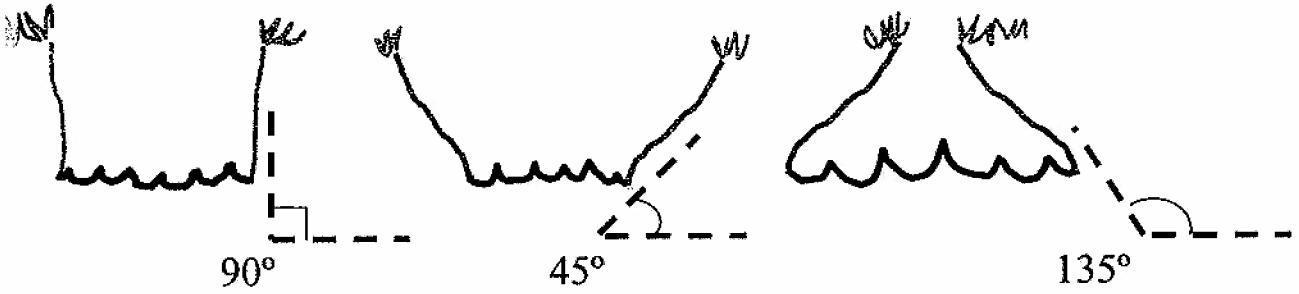
Page Total 41

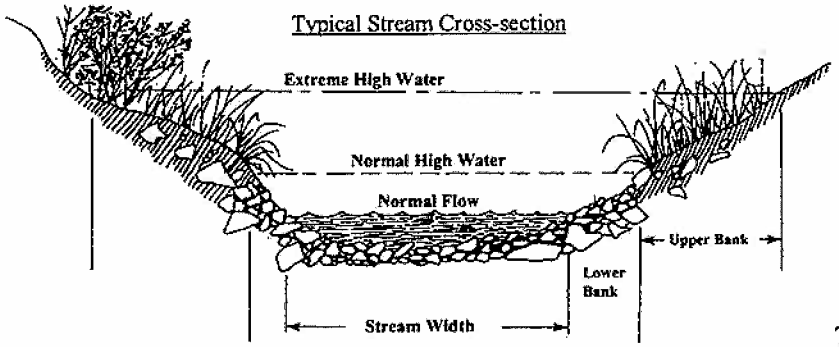
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE**_____

Site 2

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments: _____