SILVER CREEK RESTORATION PROJECT

ANNUAL MONITORING REPORT FOR 2008 (YEAR 3)

Project Number D04006-5

Submitted to:

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1.0 SUMMARY

This Annual Report details the monitoring activities during the 2008 growing season (Monitoring Year 3) on the Silver Creek Stream Restoration Site ("Site"). In accordance with the approved Restoration Plan for this site, this Annual Report presents data on geomorphology data from 3 longitudinal profiles and 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 5,127 linear feet of stream were restored, 1,077 linear feet of stream were preserved and 3,428 linear of stream were enhanced.

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2008 growing season, total rainfall during the monitoring period was above average (approximately 14 inches mores from January 2008 through October 2008). Much of the rain that fell during the 2008 growing season fell during the months of July, August, and September due to tropical systems that moved through the area.

A total of nine vegetation monitoring plots, each 100 square meters (10m x 10m) in size, were used to predict survivability of the woody vegetation planted on-site. The vegetation monitoring documented an average of 547 surviving stems per acre with a range of 160 stems per acre to 680 stems per acre. Other than the data for Plot 6, the density was 480 stem per acre. These data reflect that most of the Site has met the interim success criteria of 320 trees per acre by the end of Year 3 and is on track for meeting the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for the Site.

The entire length of the Site was inspected during Year 3 (2008) to assess stream performance. Measurements of cross-sections documented that UT1, UT2 and M3 are performing well.

The data from the Year 3 longitudinal profiles show that the pools in UT1 have filled slightly, but have remained relatively stable since Year 2. The longitudinal profile data for UT2 show that the pools and riffles have remained stable since Year 2 of monitoring. 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.

The on-site crest gauge documented the occurrence of at least one bankfull flow event during Year 3 of the post-construction monitoring period. The largest on-site stream flow documented by the crest gauges during Year 3 of monitoring was approximately 0.18 feet above the bankfull stage on UT1.

The Year 2 (performed in January 2008) benthic macroinvertebrate sampling results revealed that Site 1 (Silver Creek) exhibited an increase in total and EPT taxa richness. Site 2 (UT1 to Silver Creek) exhibited a decrease in taxa richness and an increase in biotic indices from Year 1 to Year 2 post-construction sampling. It is anticipated that continued improvements in biotic indices and an increase in Dominance in Common (DIC) will be seen in future monitoring reports as communities continue to reestablish.

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

2.0 PROJECT BACKGROUND

The project involved the restoration of 5,127 LF of stream, enhancement of 3,428 LF of stream and the preservation of 1,077 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 is conducted on an annual basis.

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**
M1	EI	PI	1,391 LF
M2	P	PI	1,333 LF
M3	R	PII	2,127 LF
M4	EI	PI	1,825 LF
UT1	R	PII	1,398 LF
UT2	R	PI	1,214 LF
UT3	R	PII	175 LF

* 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	Scheduled Nov-09	Scheduled Nov-09	Scheduled Nov-09
Year 5 Monitoring	Scheduled Nov-10	Scheduled Nov-10	Scheduled Nov-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.	8000 Regency Parkway, Suite 200 Cary, NC 27518
Stream Monitoring Point of Contact:	Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland and Natural Resource Consultants, Inc.	11 South College Ave., Suite 206 Newton, NC 28658
Vegetation Monitoring Point of Contact:	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 3 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.

Some volunteer woody species were observed in many of the vegetation plots, but all were deemed too small to tally. If these trees persist into the next growing season, they will be flagged and added to the overall stems per acre assessment of the site. Red maple (*Acer rubrum*) is the most common volunteer, though the silky dogwood (*Cornus amomum*) and pine (*Pinus spp*.) was 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. The vegetation monitoring documented a range of 160 surviving stems per acre to 680 stems per acre with an overall average density of 547 stems per acre and an overall survival rate of 77 percent. The area around Plot 6 was particularly affected by the last two dry summers, leaving many of the stems dead from lack of moisture. This area will require supplemental planting. Other than the area around Plot 6, the Site meets the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season. Assuming normal precipitation during the next growing season and successful supplemental planting in the area of Plot 6, the final success criteria of 260 trees per acre by the end of year five should be achieved.

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*). Any threatening weedy vegetation found in the future will be documented and discussed in triannual reports.

3.6 Vegetation Photos

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

Table 7. Year 3 Stem Counts for Each Species Arranged by Plot **Silver Creek Restoration Site: EEP Contract No. D04006-3**										Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 3 % Survival
Tree Species	**Plots**													
	1	2	3	4	5	6	7	8	9					
Betula nigra	1	0	0	0	0	0	0	3	0	9	6	4	4	N/A
Fraxinus pennsylvanica	0	0	1	0	1	0	0	0	0	1	5	1	2	N/A
Platanus occidentalis	4	0	3	8	7	2	0	13	6	59	52	47	43	N/A
Quercus phellos	0	0	0	0	0	2	1	1	0	7	7	5	4	N/A
Quercus rubra	2	0	0	0	0	0	0	0	0	0	2	1	2	N/A
Liriodendron tulipiferra	5	10	0	8	0	0	12	0	3	40	37	41	38	N/A
Diospyros virginiana	2	0	5	0	0	0	0	0	0	5	7	6	7	N/A
Unknown	0	0	0	0	0	0	0	0	0	14	0	0	0	N/A
Nyssa sylvatica	3	4	7	0	4	0	0	0	5	24	30	25	23	N/A
Stems per plot	17	14	16	16	12	4	13	17	14	159	146	130	123	77.4
Stems per acre	680	560	640	640	480	160	520	680	560	706	644	578	547	

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 2008 (Year 3) were surveyed in September 2008.

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 September 2008.

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 during Year 3 of the post-construction monitoring period, as shown in Table 8. Inspection of conditions during site visits revealed visual evidence of out-of-bank flow, confirming the crest gauge reading on UT1. There were no crest gauge readings of out-of-bank flow documented by the crest gauge on the mainstem of Silver Creek (M3) during Year 3 of monitoring.

Table 8. Verification of Bankfull Events

Silver Creek Restoration Site: EEP Contract No. D04006-3			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Measurement
1/16/2008	Unknown	Crest Gage UT1	0.18
7/25/2008	Unknown	Crest Gage UT1	0.11
10/28/2008	Unknown	Crest Gage M1	0.10

4.4 Stream Monitoring Data and Photos

Data from each permanent cross-section are included in Appendix B of this report. 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 3 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 3, all structures on UT1, UT2 and UT3, performed well. During Year 2 of monitoring, features on M3 had some minor problems. Some 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 were performing well during the last site visit and will continue to be monitored during Year 4.

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%		
Pools	100%	100%	100%	100%		
Thalweg	100%	100%	100%	100%		
Meanders	100%	100%	95%	100%		
Bed General	100%	100%	100%	100%		
Vanes / J Hooks etc.	100%	100%	95%	100%		

4.6 Stream Stability Baseline

The quantitative pre-construction, reference reach, and design data used to determine mitigation approach and prepare the construction plans for the project, 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 3 longitudinal profile was completed in September 2008 and was compared to the data collected during the as-built condition survey, Year 1 data and Year 2 data. The longitudinal profiles are presented in Appendix B.

During Year 3 monitoring, a total of 3,000 LF of channel was surveyed for UT1, UT2 and M3. The data from the Year 3 longitudinal profiles show that the pools in UT1 have filled slightly, but have remained relatively stable since Year 2. The partial filling of the pools in UT1 is probably due to accumulated sediment and a dense layer of vegetation throughout the channel. The accumulation of sediment has not resulted in instability in this section of channel. It is likely that these sediments are present in the pools due to low flow that is being exerted on the system by the dense vegetation layer in the channel and the low gradient design of UT1. The longitudinal profile data for UT2 show that the pools and riffles have maintained stability since Year 2 of monitoring. The longitudinal profile of M3 shows 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 stream repairs conducted in early 2008 are stable. Areas of noted channel adjustments on UT1 and M3 will be monitored during future site visits.

4.8 Cross-section Monitoring Results

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

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 3. Data from each of these cross-sections are summarized in Appendix D. The cross-sections show that there has been some slight adjustment to stream dimension since construction, but no apparent instability.

Cross-sections 1, 3, 5, 9, 11, 12, 13 and 17 are located across pools found at the apex of meander bends or below cross vanes. Survey data from cross-sections 1, 3, and 5 indicate that these pools have remained stable since Year 2 of monitoring. Cross-section 9 has deepened since Year 2 and the data show that the thalweg is now at the same elevation as it was during Year 1. The data show that the pools in cross-sections 11, 12, 13 and 17 have deepened since Year 2.

Cross-sections 2, 4, 6, 7, 8, 10, 14, 15, 16 and 18 are located in riffles areas. Cross-sections 2, 4, 6, 14, 15, 16 and 18 have remained stable since Year 2 of monitoring. The data from cross-section 7 shows that the channel has experienced deposition that has decreased the channel dimension, but it appears that the dimension has stabilized. The data for cross-sections 8 and 10 show that there has been little change since as-built conditions.

All monitored cross-sections fell within the quantitative parameters defined for “C” or “B” type channels.

In-stream structures installed within the restored streams included constructed riffles, rock cross vanes, rock step-pools, log vanes, rock vanes, log weirs, and root wads. A constructed riffle and a rock step-pool were installed on the lower end of UT1, and a rock cross vane was installed at the lower end of UT2 to step down the elevation of the restored stream bed to match the existing channel invert at the confluences of the restored channels and Silver Creek. Visual observations of these structures throughout the Year 3 growing season have indicated that these structures are functioning as designed and holding their elevation grade. Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Most riffle areas have maintained elevations and have also provided a downstream scour hole as habitat. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms.

Photographs of the channel were taken 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

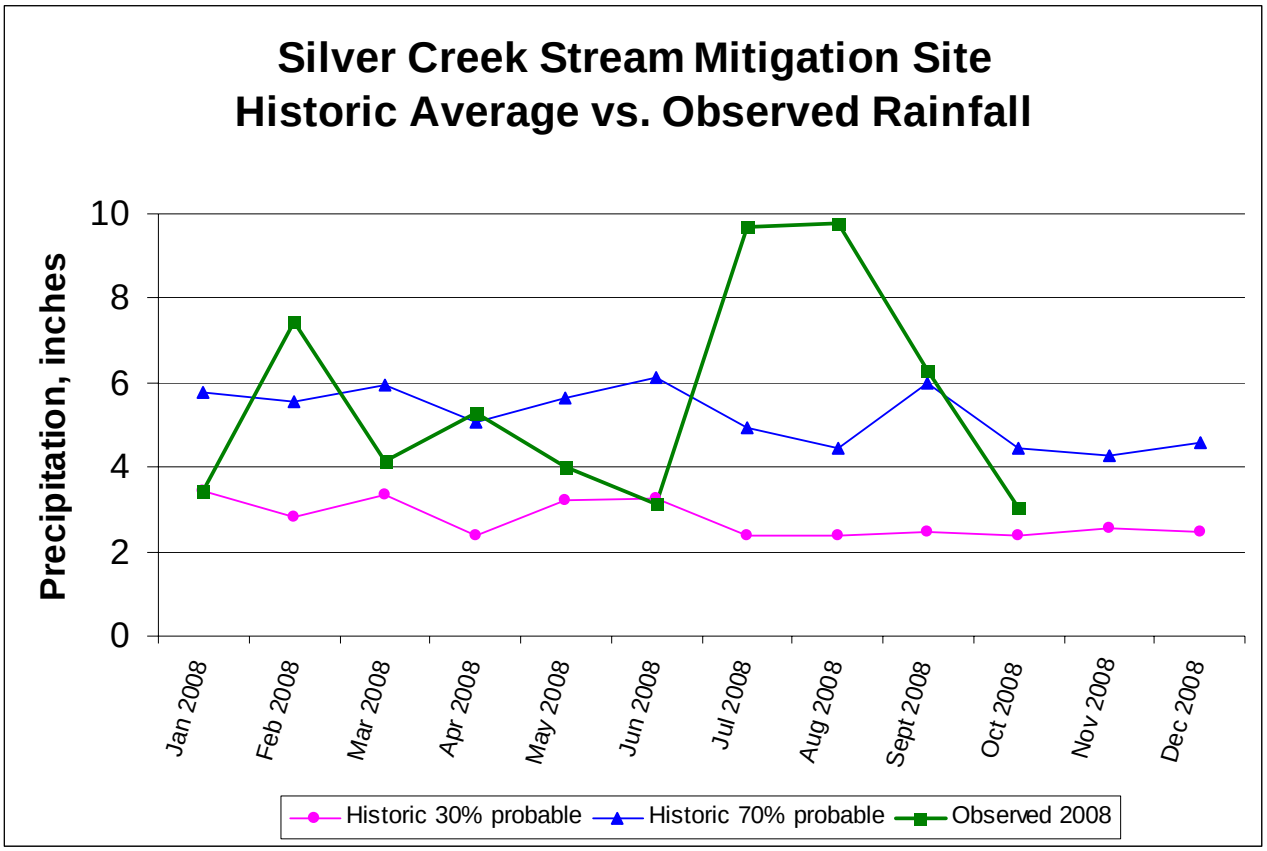
The Restoration Plan for the Site did not included wetland areas, therefore, no hydrology monitoring stations were installed.

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2008 growing season, total rainfall during the monitoring period was above the normal average (approximately 14.2 inches mores from January 2008 through October 2008). Much of the rain that fell during the 2008 growing season fell during the months of July, August, and September when evapotranspiration losses were highest (Table 10 and Figure 3).

Table 10. Comparison of Historic Average Rainfall to Observed Rainfall (Inches)

Month	Average	30%	70%	Observed 2008 Precipitation
January	4.43	3.45	5.79	3.42
February	4.14	2.83	5.53	7.44
March	4.85	3.36	5.94	4.16
April	3.79	2.36	5.06	5.29
May	4.49	3.22	5.62	4.00
June	4.74	3.25	6.12	3.12
July	3.91	2.38	4.95	9.71
August	3.74	2.36	4.45	9.80
September	4.18	2.48	5.98	6.29
October	3.84	2.03	4.76	3.05
November	3.79	2.55	4.27	NA
December	3.72	2.48	4.59	NA
Total:	49.62		Total:	56.28 (through Sept. 08)

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. Benthic sampling for the Site was conducted during January 2008. This report summarizes the benthic samples collected during the second year post-construction monitoring phase.

The sampling methodology followed the Qual 4 method listed in NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006). Field sampling was conducted by Carmen McIntyre and Jake McLean of Baker. Laboratory identification of collected species was conducted by David Lenat, a biologist with Lenat Consulting Services.

Benthic macroinvertebrate samples were collected at two sites on the Silver Creek Project on January 28, 2008 and at one eco-reference site on a Bailey Fork tributary on January 8, 2008. 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; Site 1 lies within the stream restoration portion of the project. Site 2 is located approximately 300 feet upstream of where UT1 flows under Morrison Road. Figure 1 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, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity were recorded at each site. The habitat assessment field data sheets are presented in Appendix E.

6.2 Benthic Macroinvertebrate Sampling Results and Discussion

A comparison between the pre- and post-construction monitoring results is presented in Table 11 with complete results presented in Appendix E.

6.3 Benthic Macroinvertebrate Sampling

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

Metrics	Site 1 Silver Creek			Site 2 UT1 to Silver Creek			Site3 UT1 to Bailey Fork (Reference)		
	Pre 1/3/05	Year 1 1/11/07	Year 2 1/24/08	Pre 1/4/05	Year 1 1/11/07	Year 2 1/24/08	Pre 1/4/05	Year 1 1/17/07	Year 2 1/23/08
Total Taxa Richness	22	36	43	14	39	24	26	34	20
EPT Taxa Richness	14	23	25	3	11	7	16	20	13
Total Biotic Index	3.16	4.40	4.72	7.02	6.86	5.97	4.09	4.30	5.04
EPT Biotic Index	2.59	4.16	4.28	6.1	6.14	4.98	3.41	3.65	4.98
Dominance in Common (%)	29	50	86	12	31	14	n/a	n/a	n/a
Total Shredder/Scraper Index	4/4	5/3	8/4	1/2	3/3	1/3	7/3	5/3	2/5
EPT Shredder/Scraper Index	3/2	2/3	4/4	0/1	0/2	1/1	4/2	2/2	1/3
Habitat Assessment Rating	58	72	74	24	78	77	65	70	72
Water Temperature (˚C)	n/a	7.4	7.6	n/a	3.7	3.8	n/a	8.4	7.9
% Dissolved Oxygen (DO)	n/a	57.7	n/a	n/a	44.0	n/a	n/a	32.1	n/a
DO Concentration (mg/l)	n/a	6.92	11.0	n/a	5.82	6.2	n/a	3.76	11.35
pH	n/a	6.01	7.24	n/a	5.97	7.09	n/a	5.97	7.8
Conductivity (µmhos/cm)	n/a	40	60	n/a	30	30	n/a	50	80

n/a – Data not available

At Site 3, the reference site, the post-construction community structure and ecological habitat appears to be similar to that observed during the pre-construction monitoring period. Site 3 showed a slight decrease in both overall and EPT taxa richness with an increase in total and EPT biotic indices. The higher indices could be attributed to the decrease in overall shredder taxa observed during post-construction monitoring. Many of the shredders present in the pre-construction sample that were not present in the post-construction sample had very low tolerance values. Despite the increase in biotic indices at Site 3, several of the EPT species that were common or abundant in the pre-construction sample, such as *Stenonema pudicum*, *Eccoptera xanthenes*, and *Pycnopsyche spp*. (tolerance values of 2.0, 3.7, and 2.5, respectively) were also common or abundant in the post-construction sample. This suggests that the communities have not been disturbed and that water quality is adequate to support intolerant species. Therefore, Site 3 remains a stable eco-reference site.

Site 1, which underwent partial restoration, continued to exhibit an increase in overall and EPT taxa richness, as well as increase in overall and EPT biotic indices in the Year 2 post-construction sample. This suggests that although more species were present (assumedly from increase variety of habitat as 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. Although taxa richness and biotic values between Year 1 and Year 2 are similar, the increased abundance of long-lived intolerant species, especially perlid stoneflies and *Pteronarcys spp*. indicates an improvement in conditions at Site 1. Official bioclassifications cannot be assigned to the sample because Qual 4 sampling methods were used. If standard sampling methods had been used, the increase in EPT taxa would have raised a pre-construction rating of "Fair" to a Year 2 post-construction rating of "Good-Fair". These classifications may be considered the minimum rating for this site until classifications are developed for these smaller samples.

Currently Site 1 has 86 percent Dominance in Common (DIC) compared to the reference site, which indicates that 86 percent of the dominant communities at the reference site are also dominant at Site 1. Site 1 has undisturbed areas located upstream and downstream of the sampling location, and therefore has excellent sources of refugia. The proximity of undisturbed benthic communities may be why the DIC is high at Site 1. It is anticipated that improvements in the biotic indices will be seen in future monitoring reports as communities continue to recolonize.

Site 2, which underwent complete restoration, saw a decrease in taxa richness and an increase in biotic indices from Year 1 to Year 2 post-construction samples. This indicates that fewer species were present and those present were more tolerant species. Site 2 is located along a restored unnamed tributary to Silver Creek that has a smaller drainage area (0.2 square miles) compared to Site 1 (6.6 square miles), which is located along the Silver Creek. Extreme drought conditions that occurred across western North Carolina during late 2007 could also have had greater effects on the smaller drainage area. Site 2 may have experienced low flow conditions that negatively impact taxa richness and biotic indices.

Currently Site 2 has 14 percent DIC with the reference site. The decrease in DIC from Year 1 to Year 2 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 be seen in future monitoring reports if drought conditions ease and communities re-establish.

6.4 Habitat Assessment Results and Discussion

The restoration site habitat scores for Year 2 were similar to those of Year 1 (74 for Site 1 versus 77 for Site 2). Site 1 had a good diversity of substrate sizes but bank erosion was noted directly upstream from the monitoring location. Recent repairs to stabilize the streambank immediately above Site 1 should be reflected in slightly higher future assessment scores. Site 2 had very stable bed and banks but the riffle substrate was fairly homogenous. Neither site had mature riparian buffers. Site 3, the reference site, received a 72 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, dissolved oxygen concentration, pH, and specific conductivity at the restoration sites were all relatively normal for Piedmont streams. The conductivity reading at Site 3 was relatively high (80 µS/cm) compared to the restoration reaches. The macroinvertebrate community at Site 3 appeared stable and therefore external influences are not suspected for the rise in conductivity at this time.

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 from upstream.

6.5 Photograph Log

The photograph log for the benthic macroinvertebrate sampling event is attached as Appendix E. As shown in photos P-1 through P-4, both sites exhibit well defined riffle pool sequences. Both sites lack a forested canopy as the immature riparian vegetation continues to establish. Both sites are stable, however an unstable meander bend is visible in the background of the upstream view of Site 1. P-5 and P-6 are views of the eco-reference site.

7.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Stream Monitoring: The total length of the project is 9,632 LF. This entire length was inspected during Year 3 of the monitoring period to assess stream performance. Measurements of cross-sections documented that UT1, UT2, M1, M3 and M4 are performing well. The M3 reach area was repaired during early 2008, as described in Section 4.5.

The data from the Year 3 longitudinal profiles show that the pools in UT1 have aggraded slightly, but have remained stable since Year 2. The longitudinal profile data for UT2 show that the pools and riffles have remained stable since Year 2 of monitoring. 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.

The on-site crest gauge documented the occurrence of at least one bankfull flow event during Year 2 of the post-construction monitoring period. The largest on-site stream flow documented by the crest gauges during Year 3 of monitoring was approximately 0.18 feet above the bankfull stage on UT.

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

Vegetation Monitoring: The vegetation monitoring documented a range of 160 surviving stems per acre to 680 stems per acre with an overall average of 547 stems per acre, which is a survival rate of 77 percent based on the initial planting count of 706 stems per acre. The area around Plot 6 was particularly affected by the last two dry summers, leaving many of the stems dead from lack of moisture. This area will require supplemental planting during the winter of 2008/2009 to meet the vegetation survival criteria. Other than the area around Plot 6, the Site met the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season.

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

Benthic Macroinvertebrate Monitoring: Year 2 results revealed that Site 1 (Silver Creek) exhibited an increase in total and EPT taxa richness. Site 2 (UT1 to Silver Creek) exhibited a decrease in taxa richness and an increase in biotic indices from Year 1 to Year 2 post-construction sampling. The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at the sampling sites were all relatively normal for Piedmont streams. It is anticipated that continued improvements in biotic indices and an increase in DIC will be seen in Year 3 of monitoring as communities continue to reestablish.

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

North Carolina Division of Water Quality (NCDWQ). 2006. Standard Operating Procedures for Benthic Macroinvertebrates (2006). North Carolina Division of Water Quality, Raleigh, NC.

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

Schafale, M. P., and A. S. Weakley. 1990. *Classification of the Natural Communities of North Carolina, Third Approximation*. North Carolina Natural Heritage Program, Division of Parks and Recreation. NCDEHNR. Raleigh, NC.

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

FIGURES

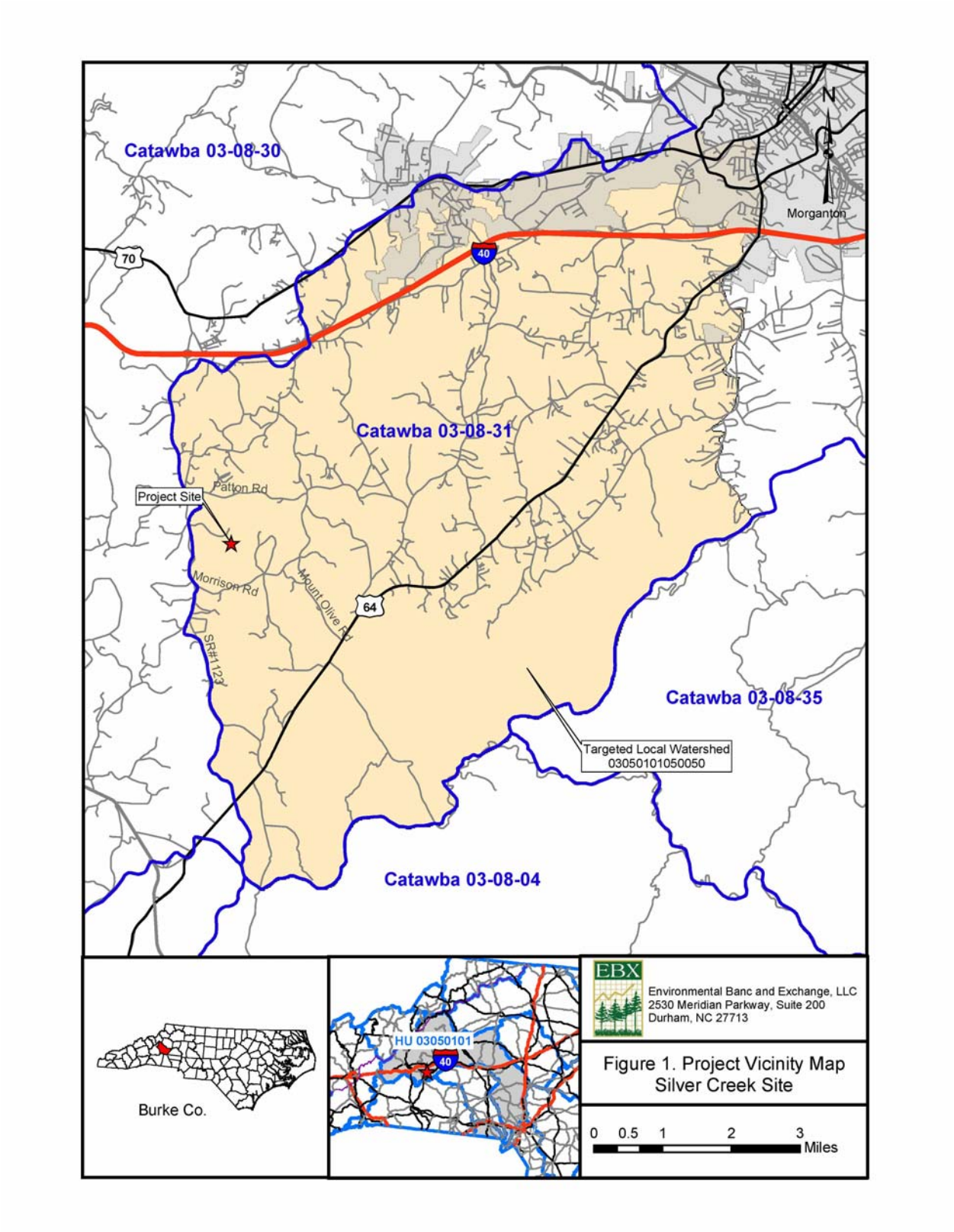


Figure 1. Location of Silver Creek Stream Restoration Site.

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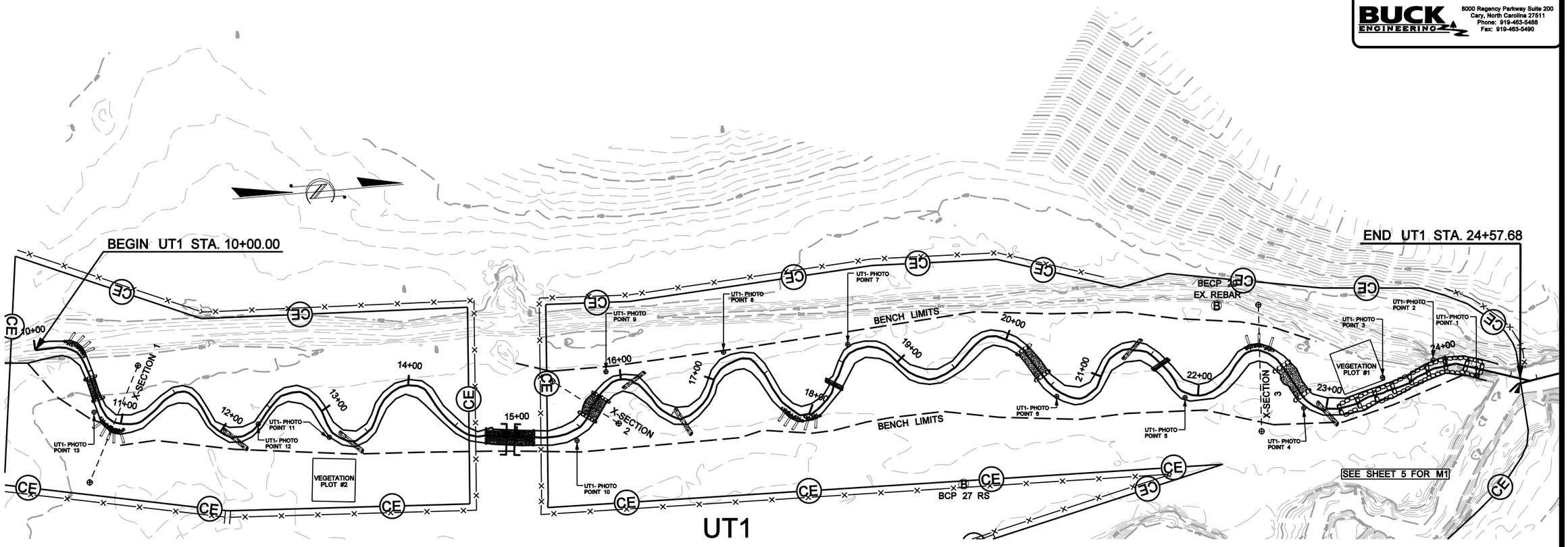

UT1

Figure 2 (a)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

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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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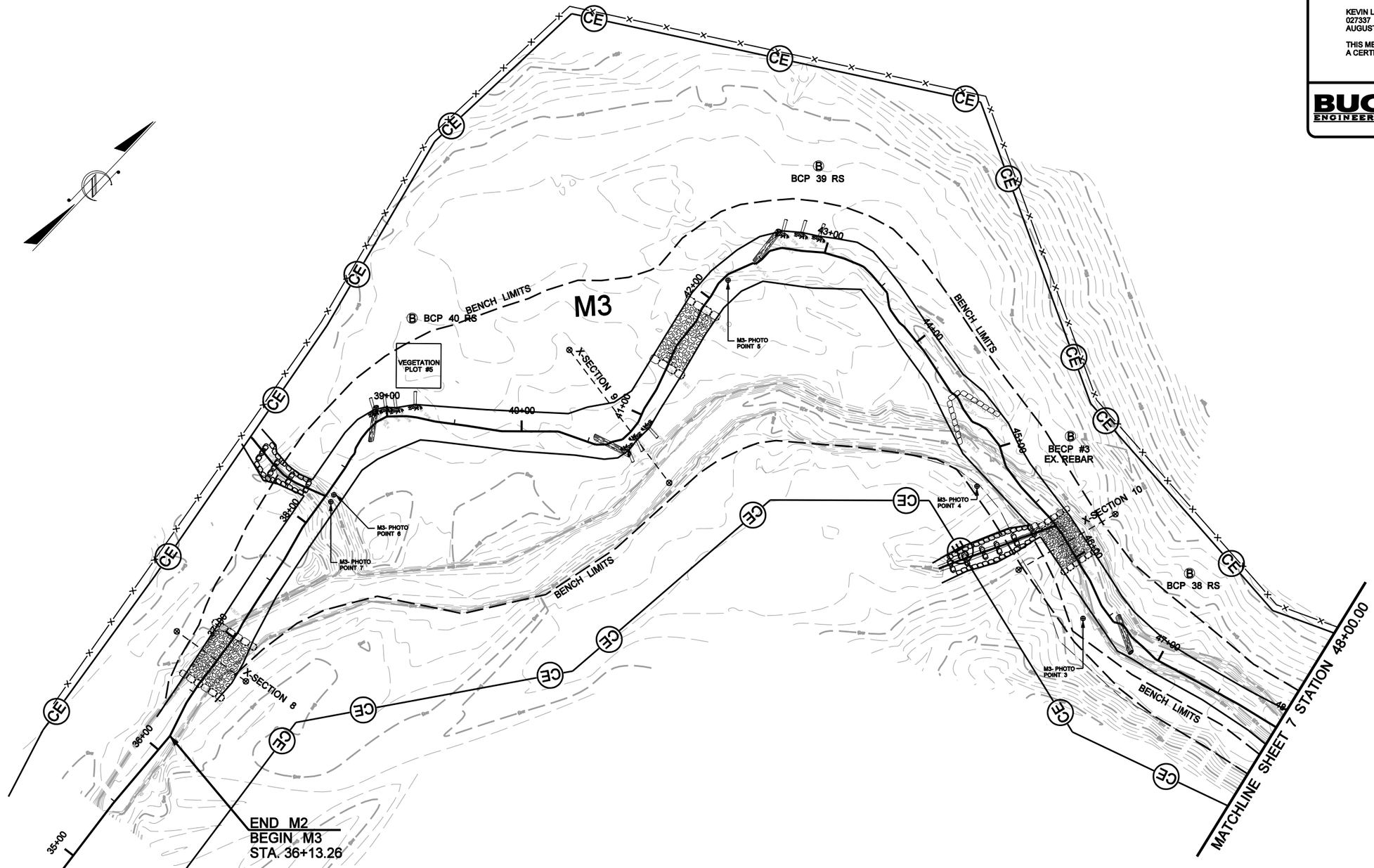

NOTE:
M2 IS A PRESERVATION REACH ONLY.
NO WORK WAS PERFORMED ON THIS REACH.

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

Figure 2 (c)

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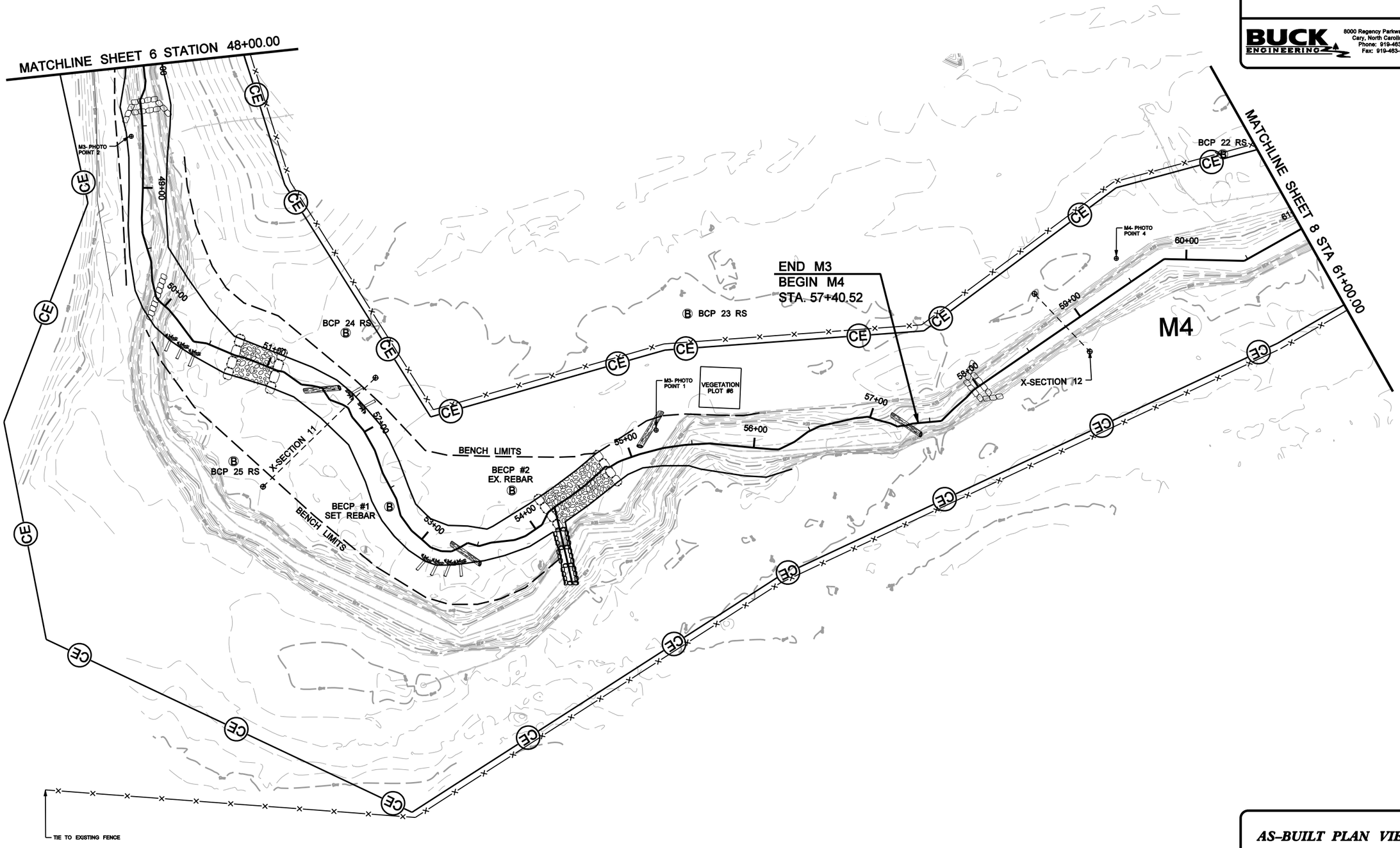

FIGURE: 2(d)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

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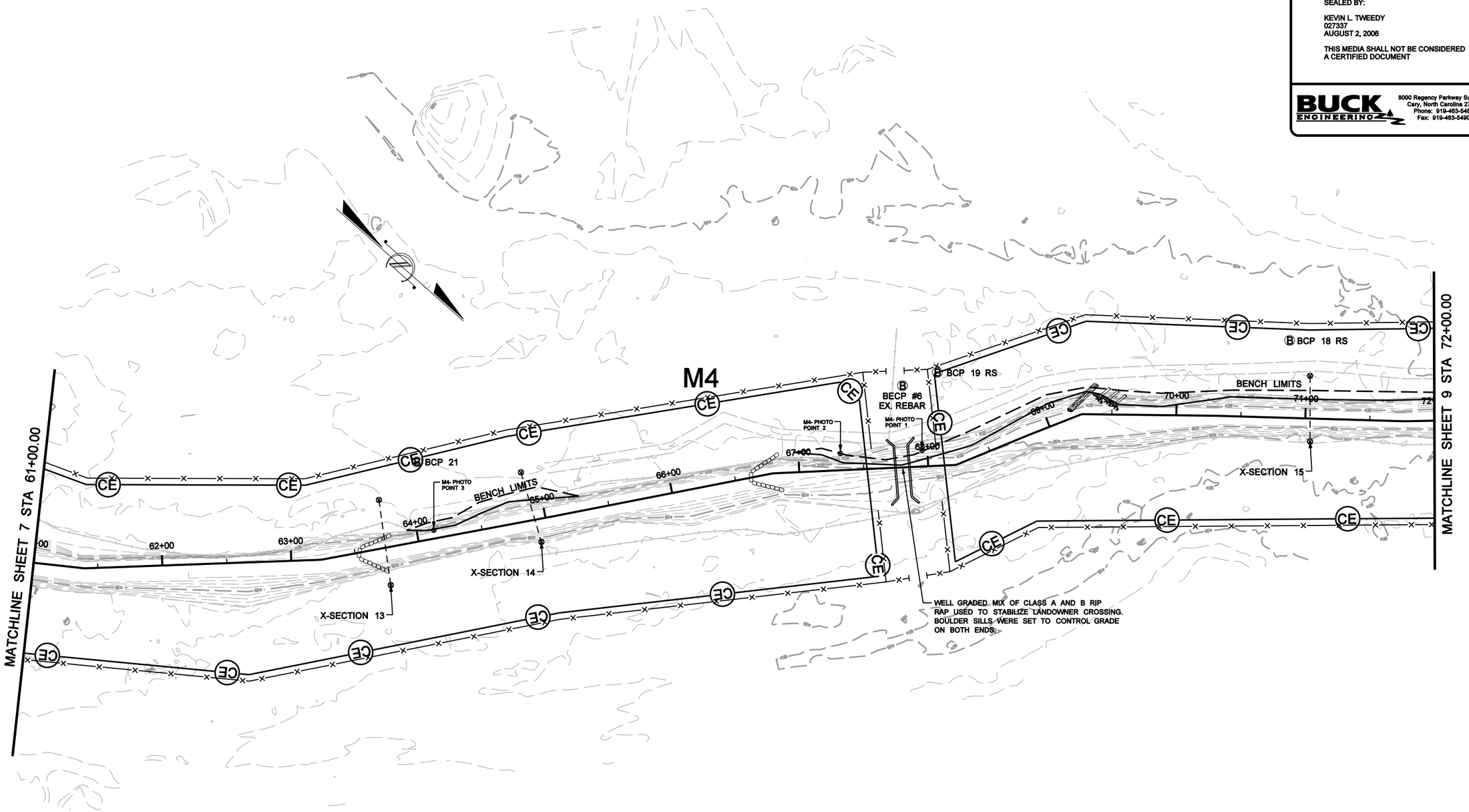

FIGURE: 2(e)

AS-BUILT PLAN VIEW

40 20 0 40 80
SCALE (FT)

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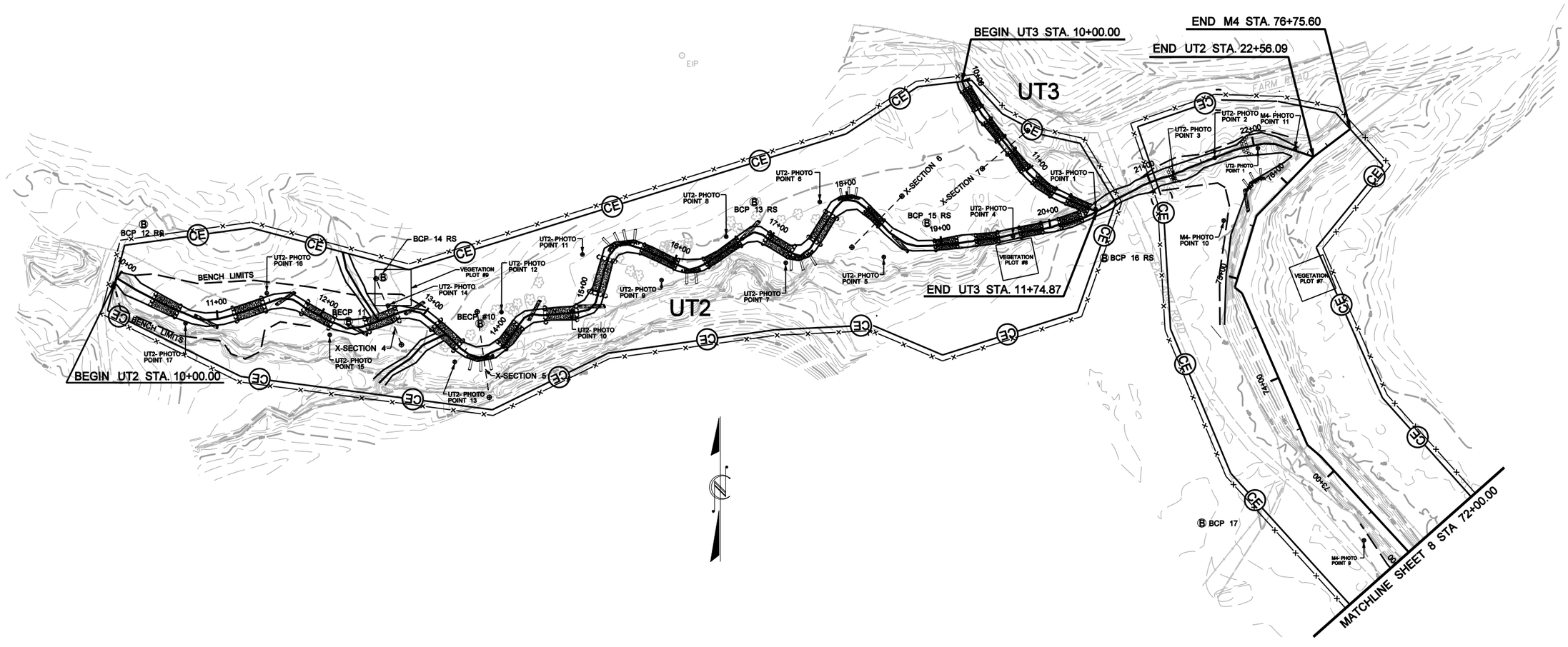


Figure 2 (f)

AS-BUILT PLAN VIEW

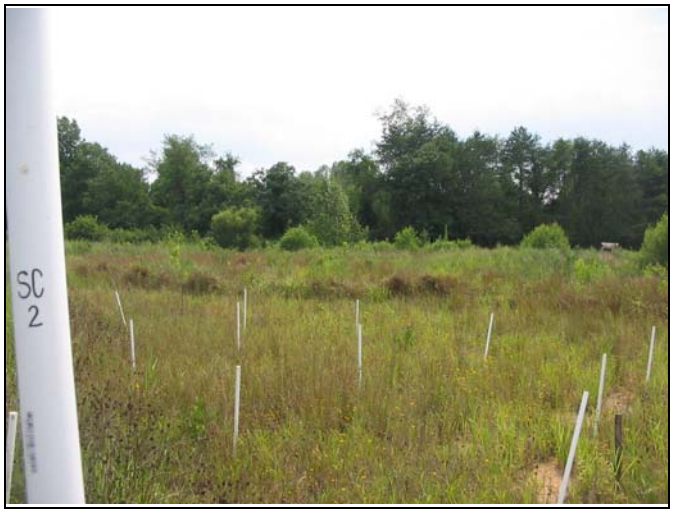
40 20 0 40 80
SCALE (FT)

APPENDIX A

PROJECT PHOTO LOG

VEGETATION PHOTOS

Vegetation Plot 1



Vegetation Plot 2

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plot 7

Vegetation Plot 8

Vegetation Plot 9

STREAM PHOTOS

UT1 Photo Point 1

UT1 Photo Point 4

UT1 Photo Point 6

UT1 Photo Point 13

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

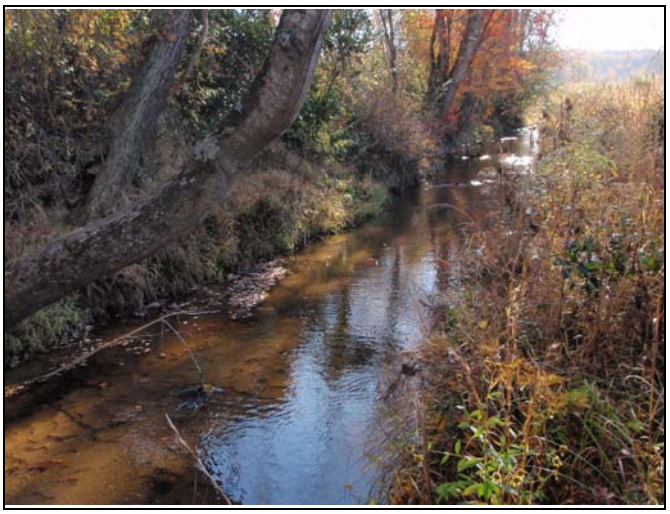
M3 Photo Point 7

M4 Photo Point 1

M4 Photo Point 2

M4 Photo Point 3

M4 Photo Point 4



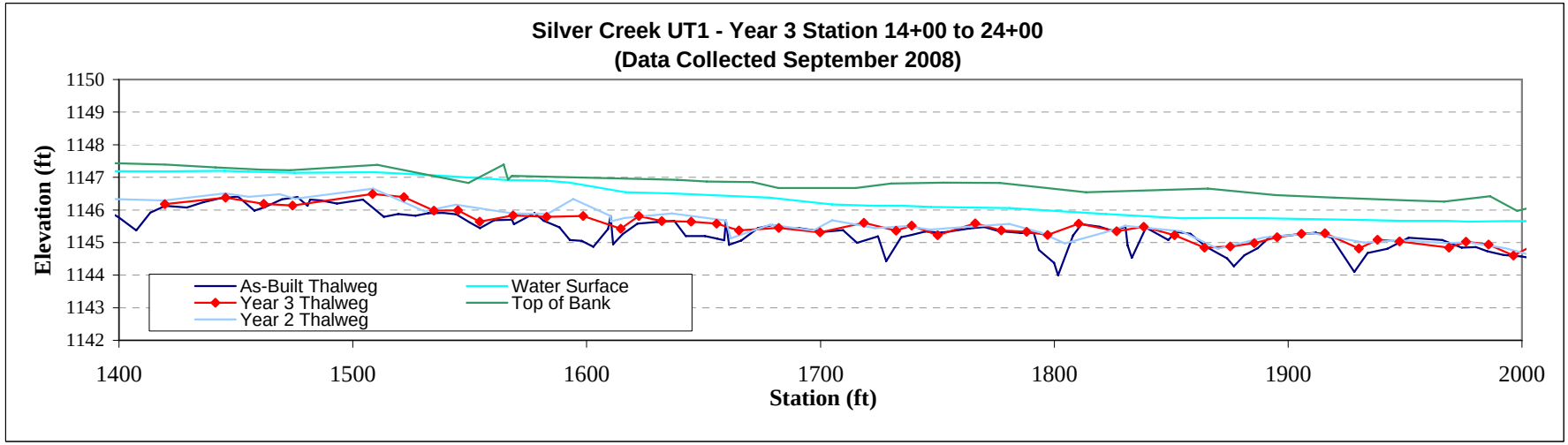
M4 Photo Point 9

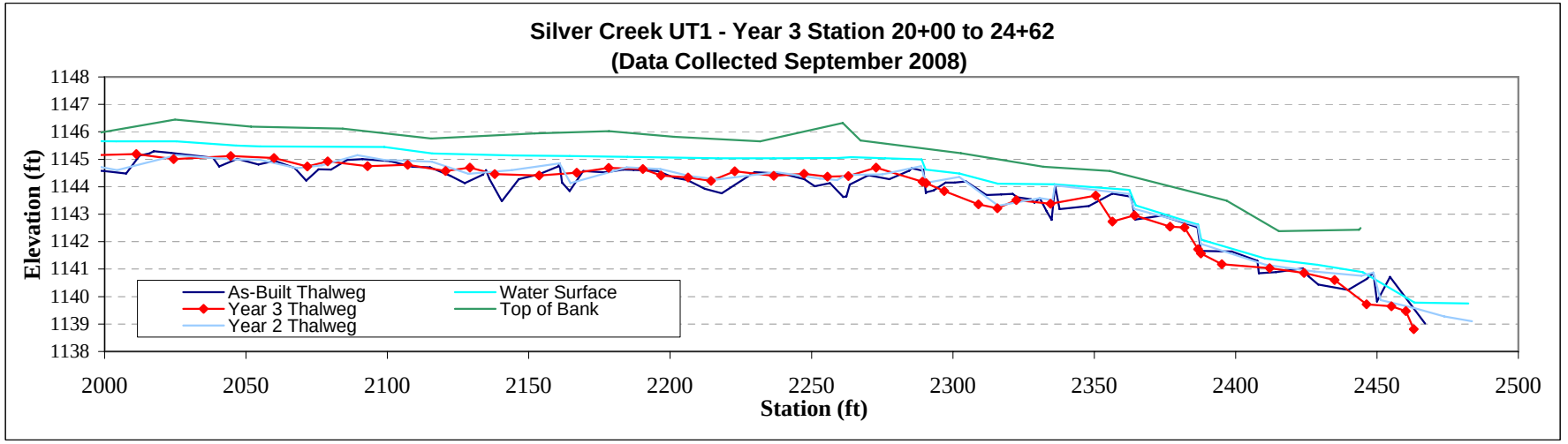
M4 Photo Point 10

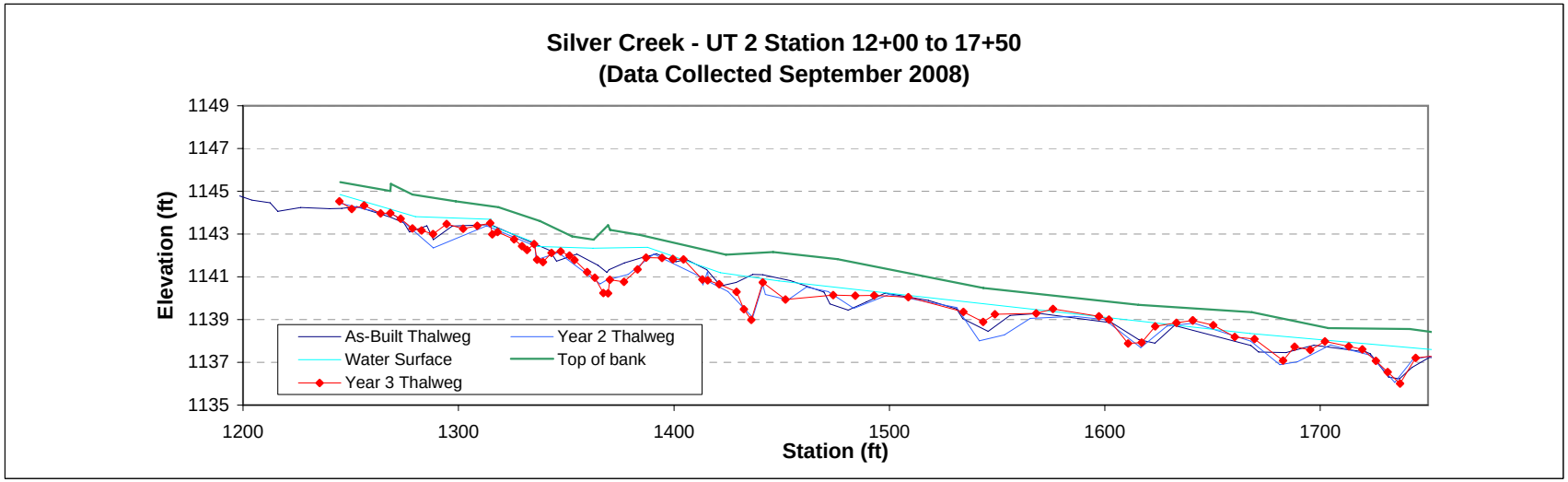
M4 Photo Point 1

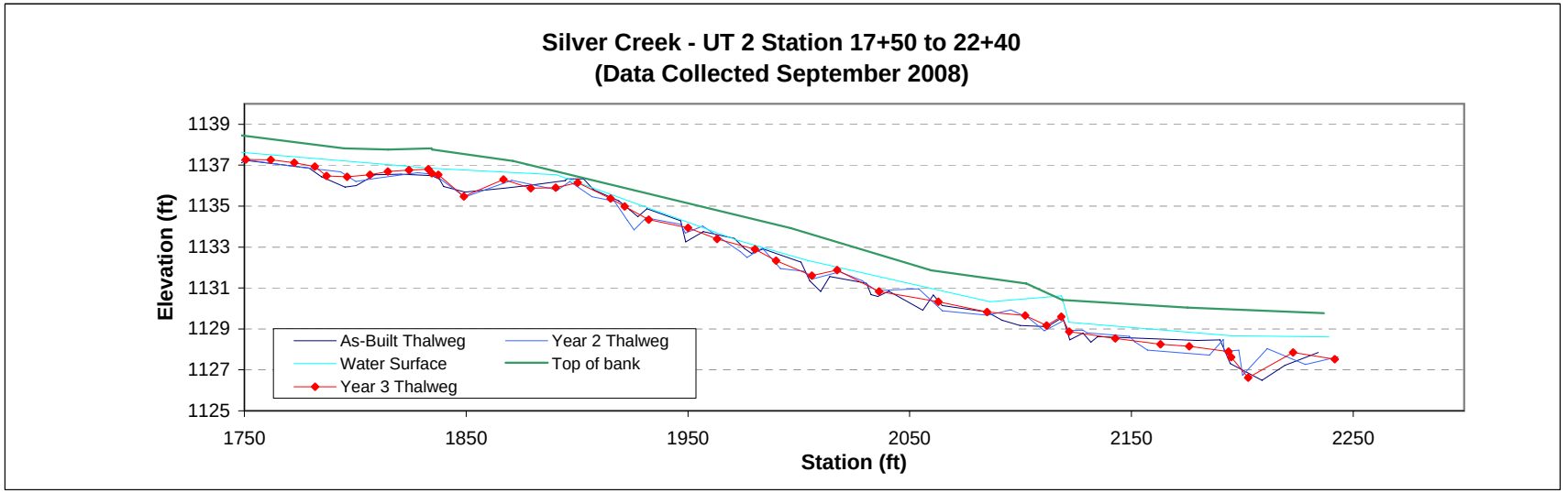
APPENDIX B

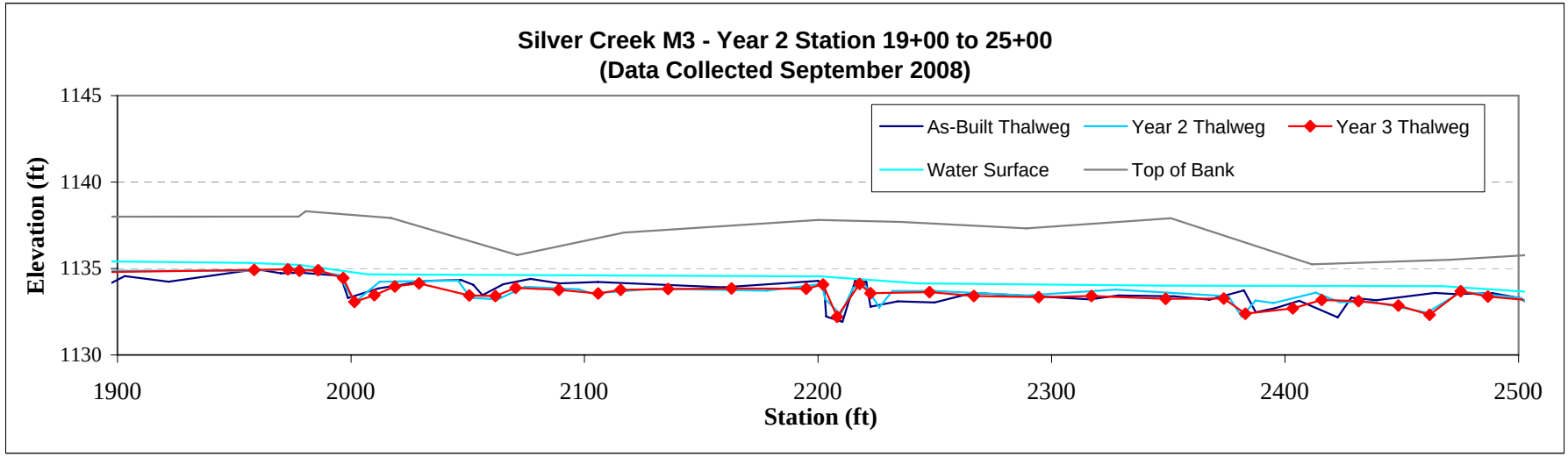
STREAM MONITORING DATA

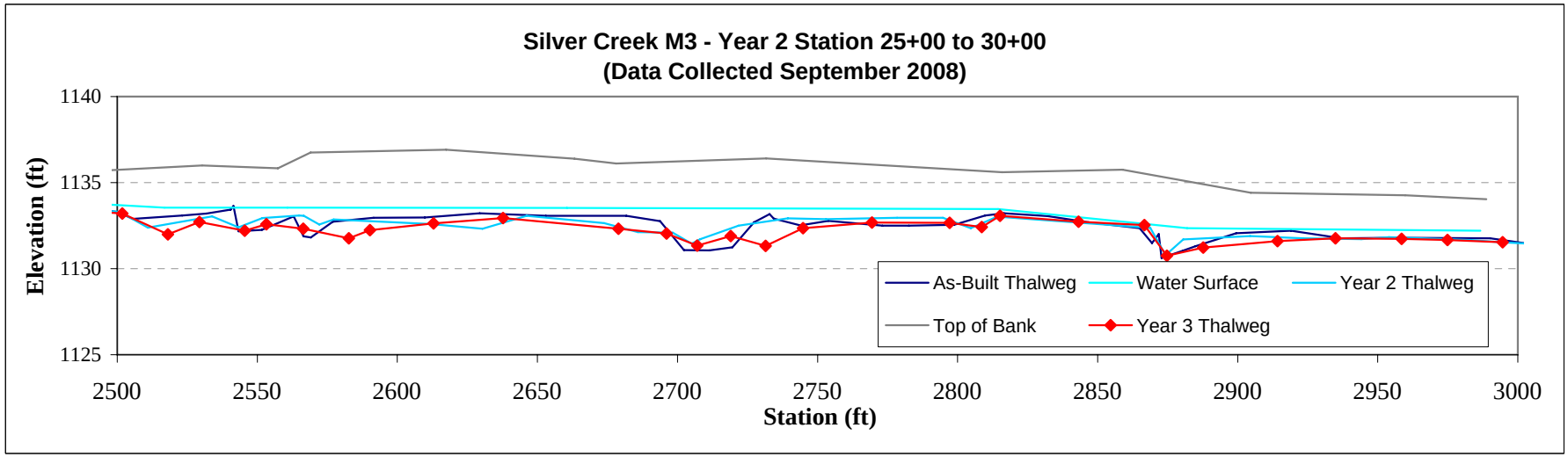

Silver Creek UT1 - Year 3 Station 14+00 to 24+00
(Data Collected September 2008)
Elevation (ft)
1150
1149
1148
1147
1146
1145
1144
1143
1142
1400
1500
1600
1700
1800
1900
2000
Station (ft)
As-Built Thalweg
Year 3 Thalweg
Year 2 Thalweg
Water Surface
Top of Bank


Silver Creek UT1 - Year 3 Station 20+00 to 24+62
(Data Collected September 2008)
Elevation (ft)
1148
1147
1146
1145
1144
1143
1142
1141
1140
1139
1138
2000
2050
2100
2150
2200
2250
2300
2350
2400
2450
2500
Station (ft)
As-Built Thalweg
Year 3 Thalweg
Year 2 Thalweg
Water Surface
Top of Bank


Silver Creek - UT 2 Station 12+00 to 17+50
(Data Collected September 2008)
Elevation (ft)
1149
1147
1145
1143
1141
1139
1137
1135
1200
1300
1400
1500
1600
1700
Station (ft)
As-Built Thalweg
Year 2 Thalweg
Water Surface
Top of bank
Year 3 Thalweg


Silver Creek - UT 2 Station 17+50 to 22+40
(Data Collected September 2008)
Elevation (ft)
1139
1137
1135
1133
1131
1129
1127
1125
1750
1850
1950
2050
2150
2250
Station (ft)
As-Built Thalweg
Year 2 Thalweg
Water Surface
Top of bank
Year 3 Thalweg


Silver Creek M3 - Year 2 Station 19+00 to 25+00
(Data Collected September 2008)
Elevation (ft)
1145
1140
1135
1130
1900
2000
2100
2200
2300
2400
2500
Station (ft)
As-Built Thalweg
Year 2 Thalweg
Year 3 Thalweg
Water Surface
Top of Bank


Silver Creek M3 - Year 2 Station 25+00 to 30+00
(Data Collected September 2008)
Elevation (ft)
1140
1135
1130
1125
2500
2550
2600
2650
2700
2750
2800
2850
2900
2950
3000
Station (ft)
As-Built Thalweg
Water Surface
Year 2 Thalweg
Top of Bank
Year 3 Thalweg

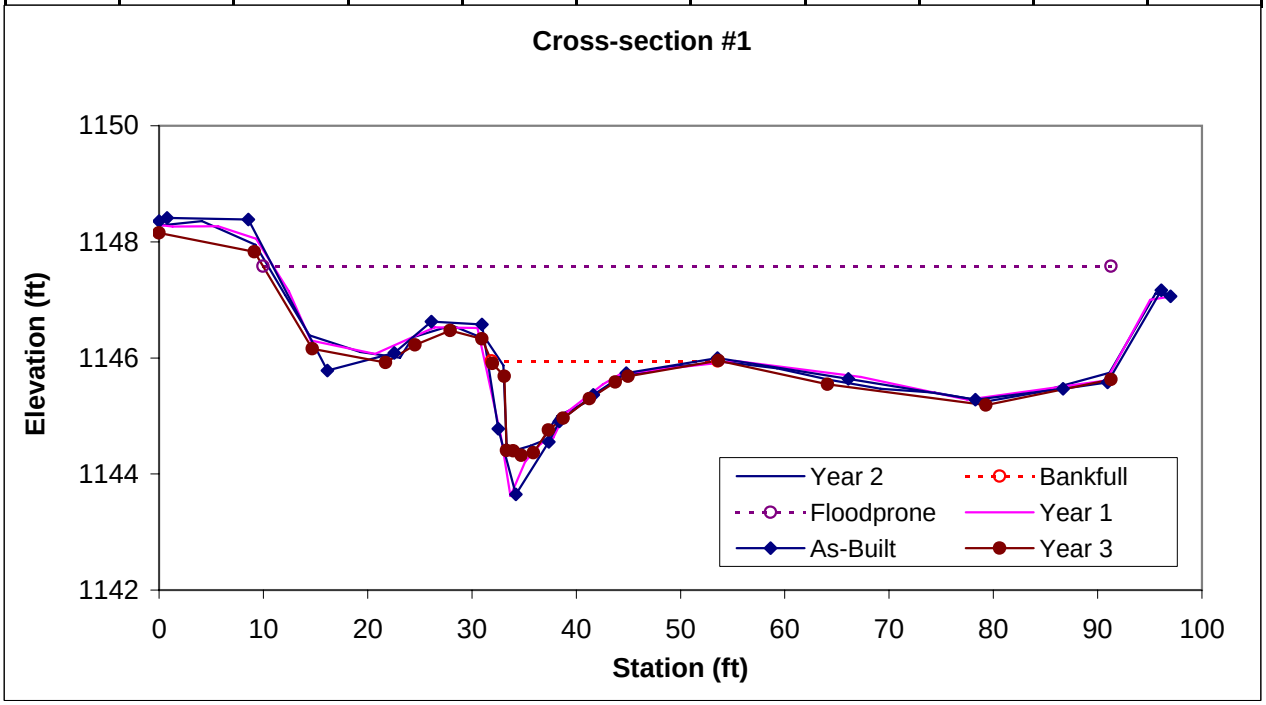
Permanent Cross-section #1 UT1

(Year 3 Data - Collected September 2008)

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		12.9	21.71	0.59	1.63	36.6	1	3.7	1145.95	1145.95



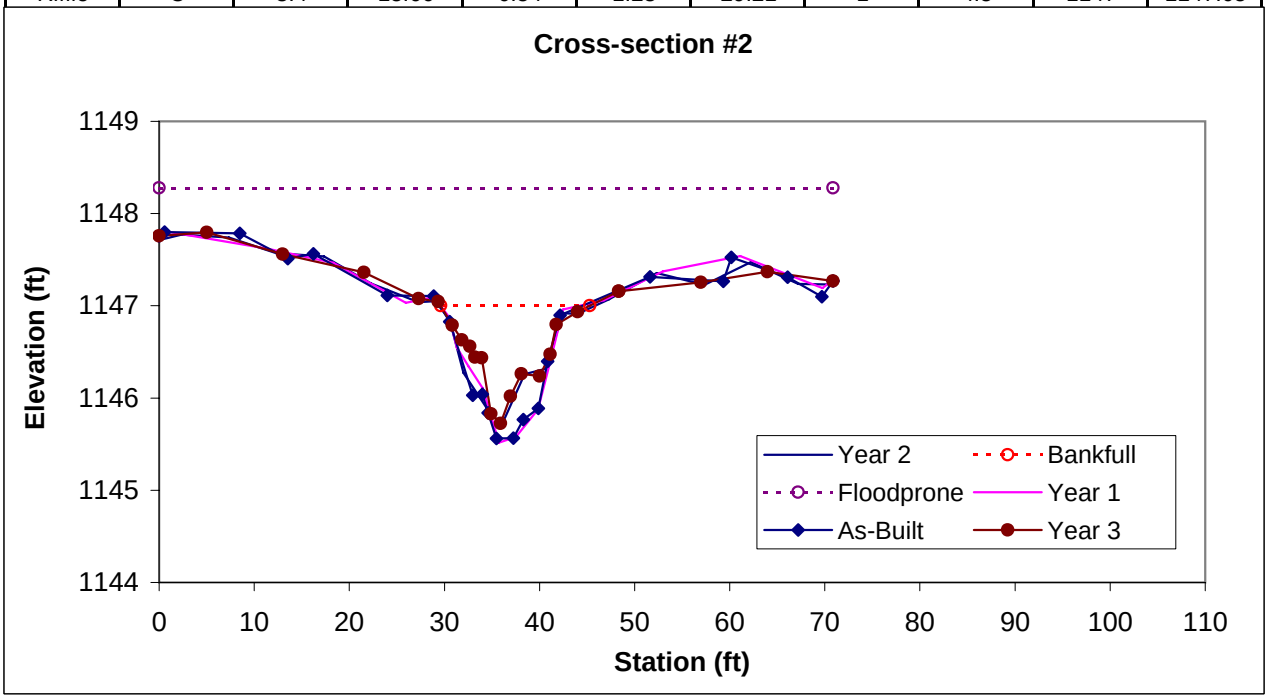
Permanent Cross-section #2 UT1

(Year 3 Data - Collected September 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	8.4	15.66	0.54	1.28	29.21	1	4.5	1147	1147.05



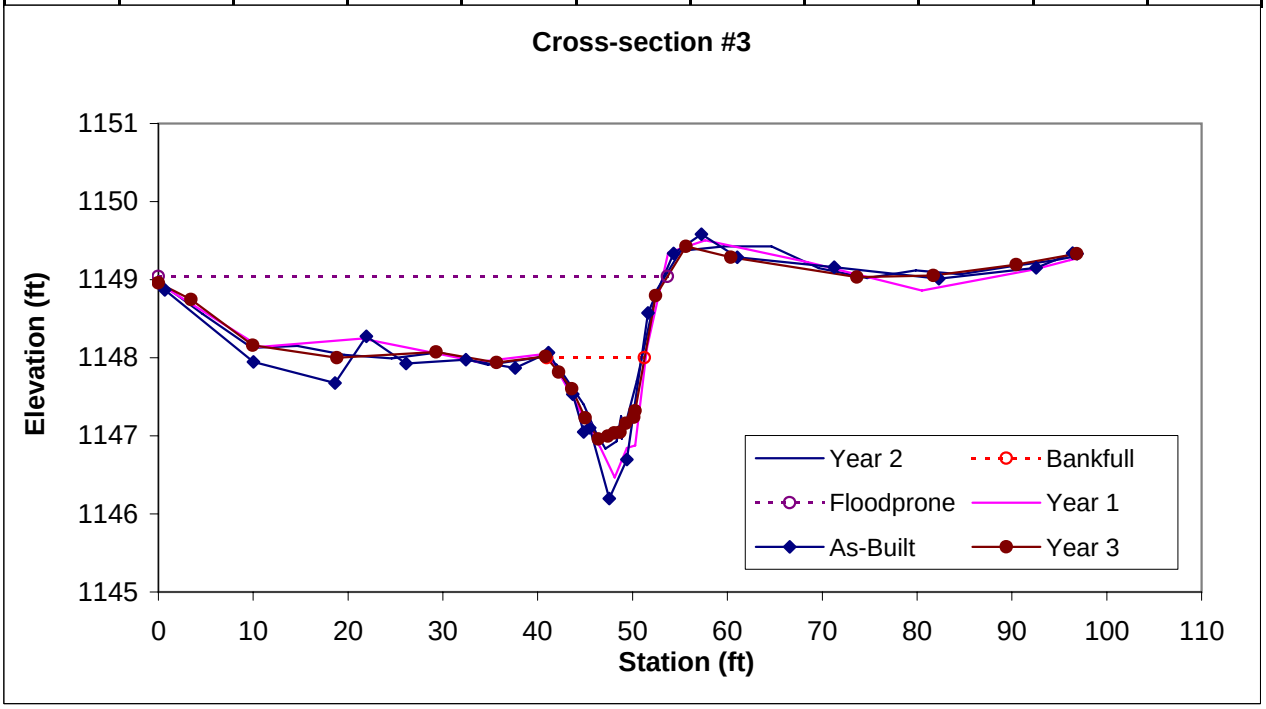
Permanent Cross-section #3 UT1

(Year 3 Data - Collected September 2008)

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		6.6	10.31	0.64	1.04	16.24	1	5.2	1148	1148.02



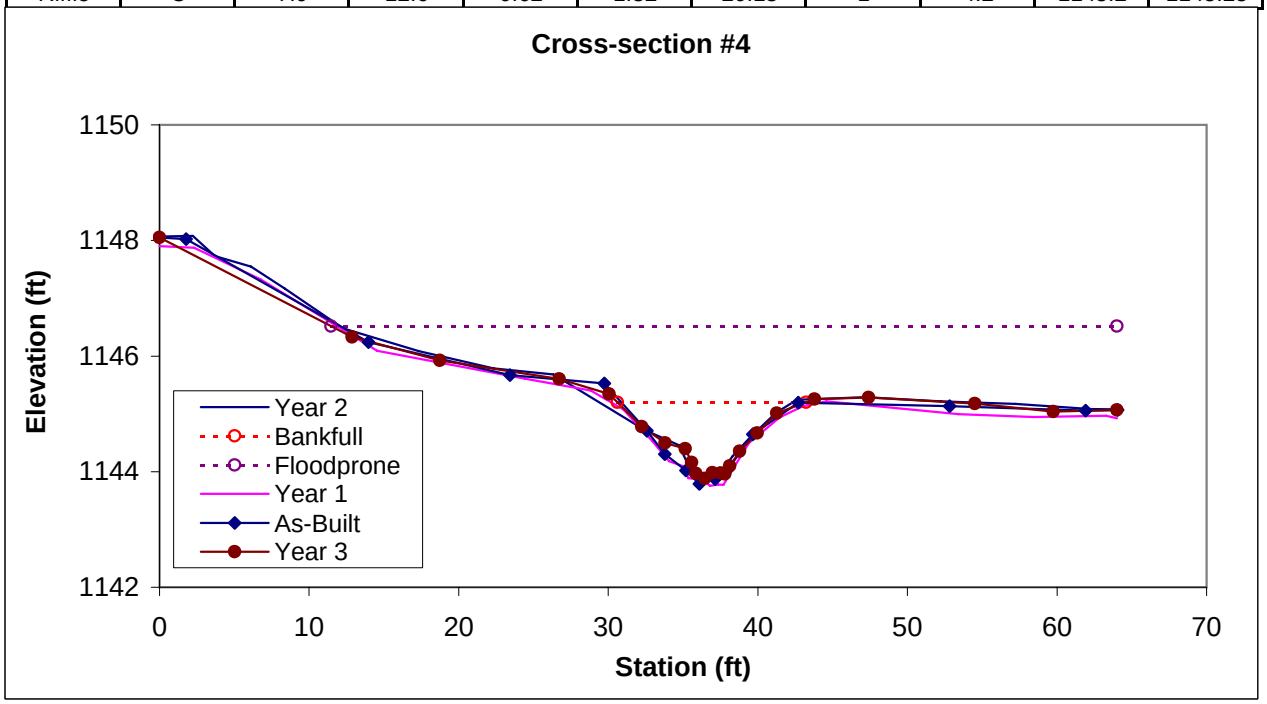
Permanent Cross-section #4 UT2

(Year 3 Data - Collected September 2008)

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	7.9	12.6	0.62	1.32	20.18	1	4.2	1145.2	1145.25



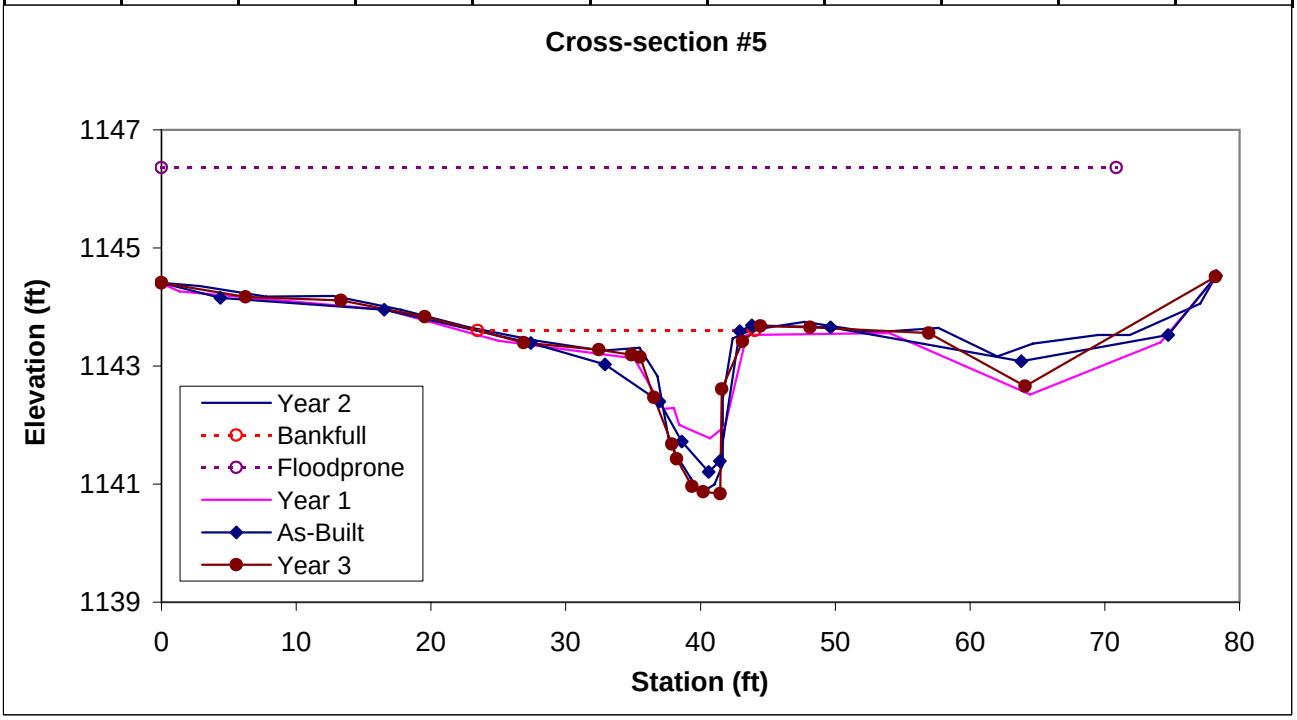
Permanent Cross-section #5 UT2

(Year 3 Data - Collected Sepember 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16.2	20.6	0.79	2.76	26.18	0.9	3.4	1143.6	1143.4



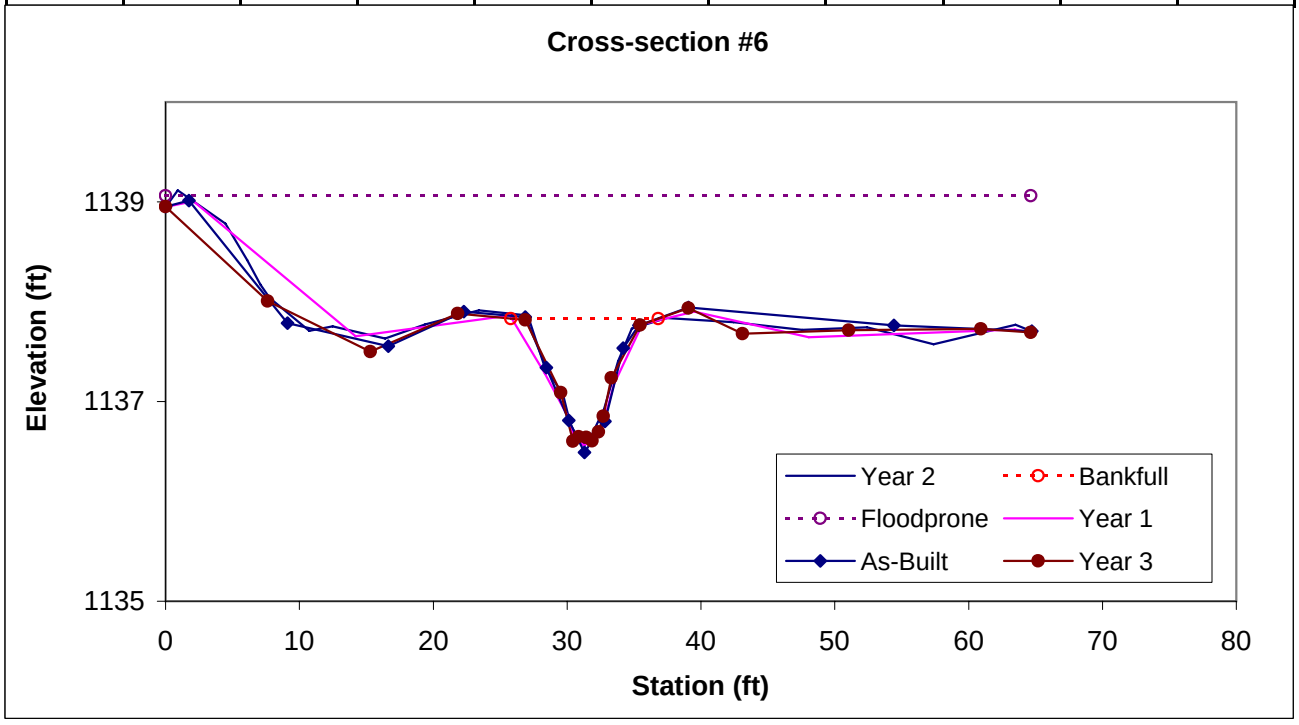
Permanent Cross-section #6 UT2

(Year 3 Data - Collected September 2008)

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	5.8	11.02	0.53	1.23	21	0.9	5.9	1137.83	1137.77



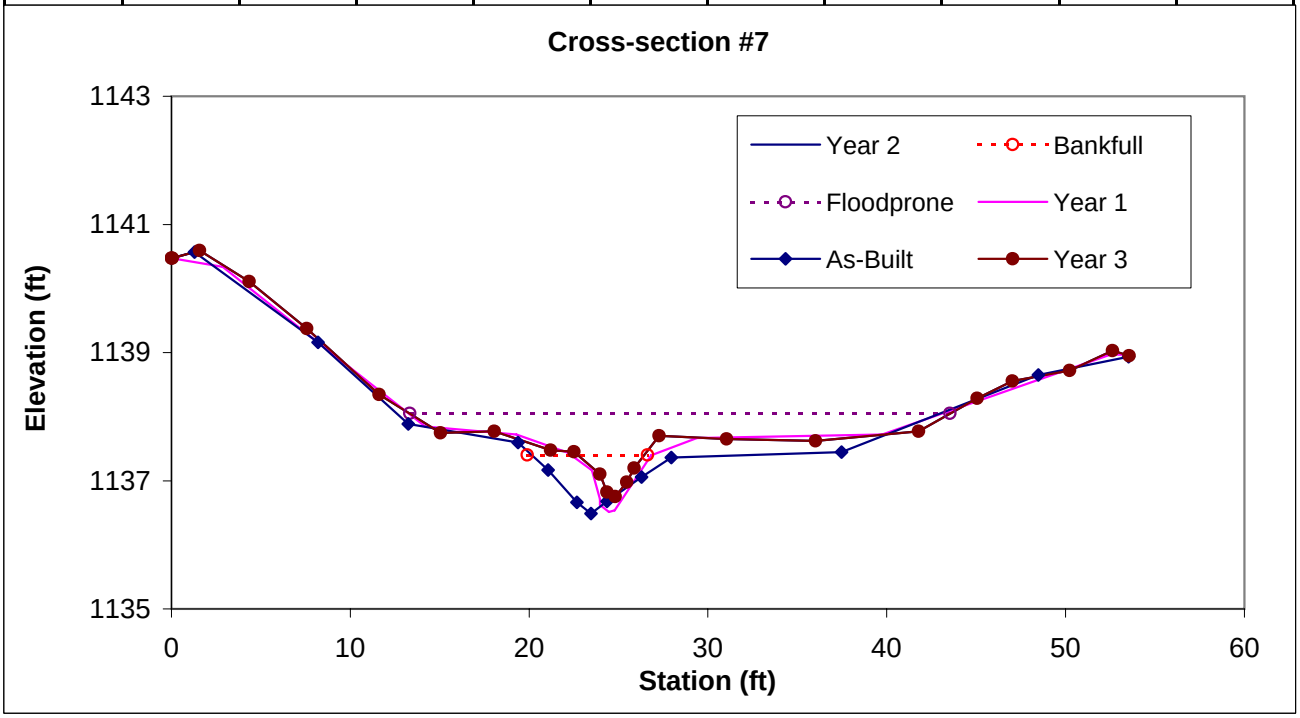
Permanent Cross-section #7 UT3

(Year 3 Data - Collected September 2008)

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	1.7	6.73	0.25	0.68	26.46	0.9	4.5	1137.4	1137.31



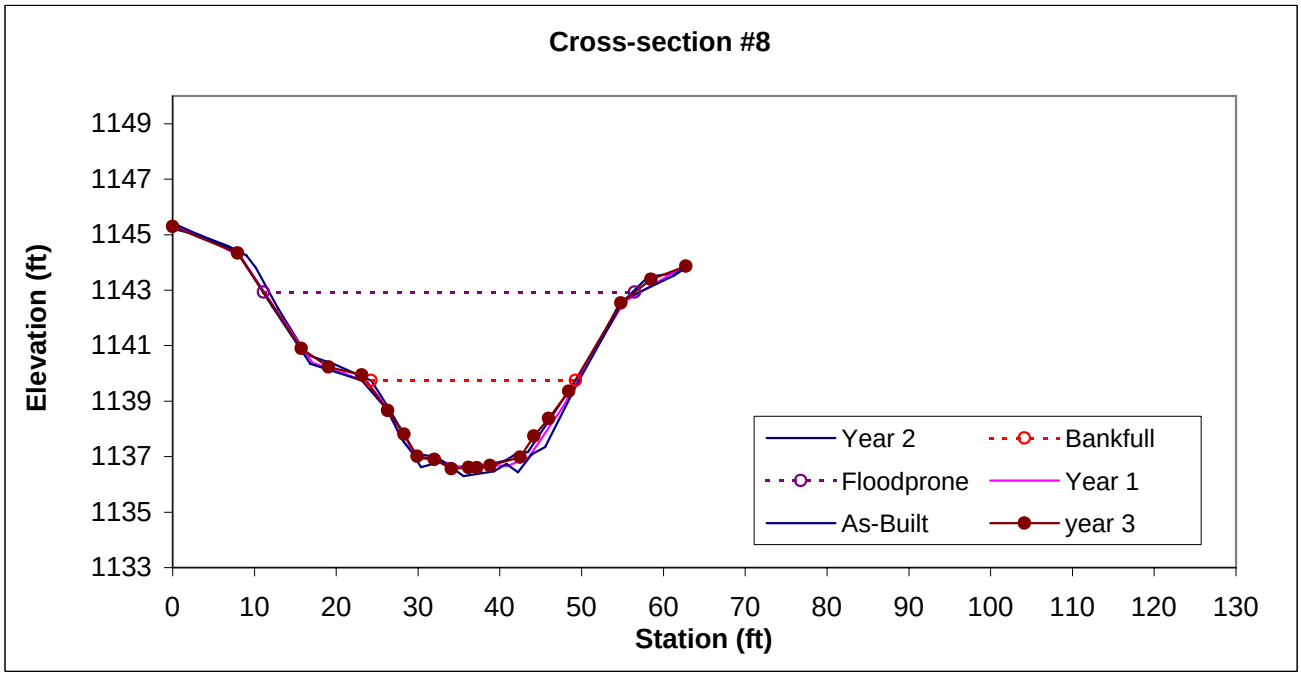
Permanent Cross-section #8 M3

(Year 3 Data - Collected September 2008)

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	55.4	25.63	2.16	3.18	11.85	1.1	1.8	1139.75	1139.94



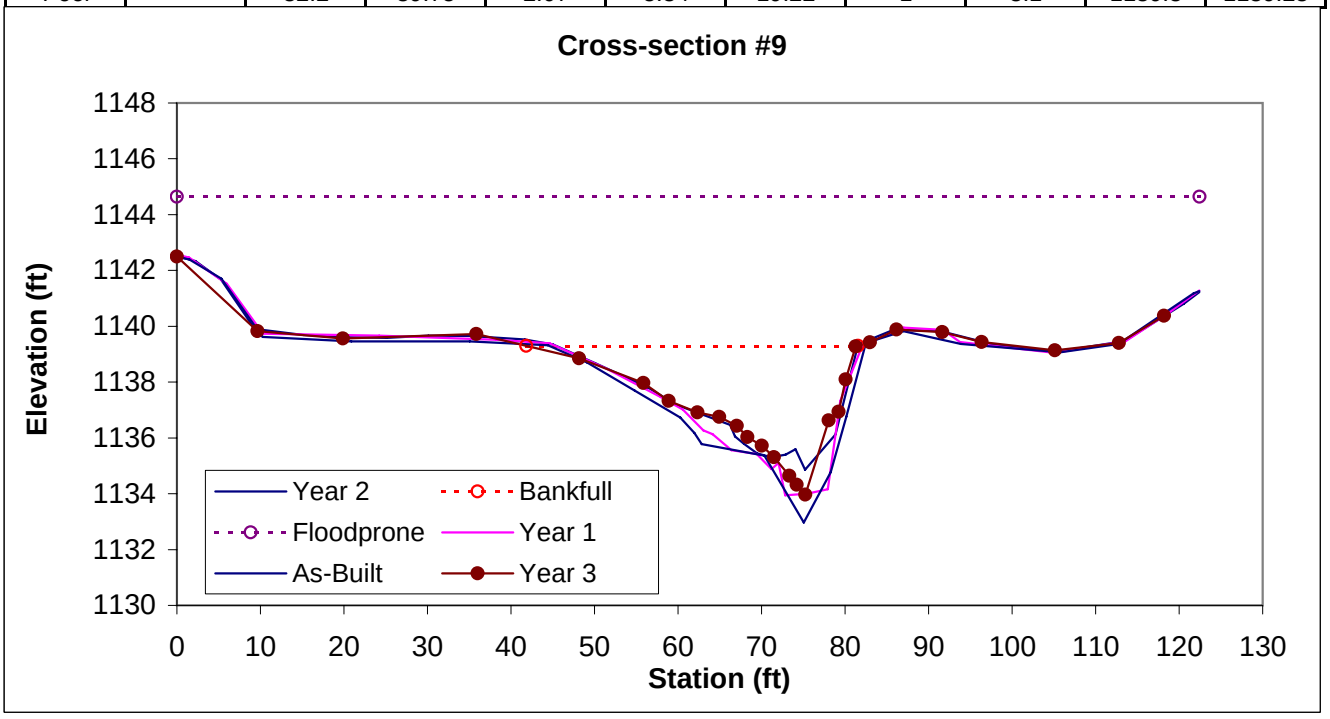
Permanent Cross-section #9 M3

(Year 3 Data - Collected September 2008)

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		82.2	39.75	2.07	5.34	19.22	1	3.1	1139.3	1139.28



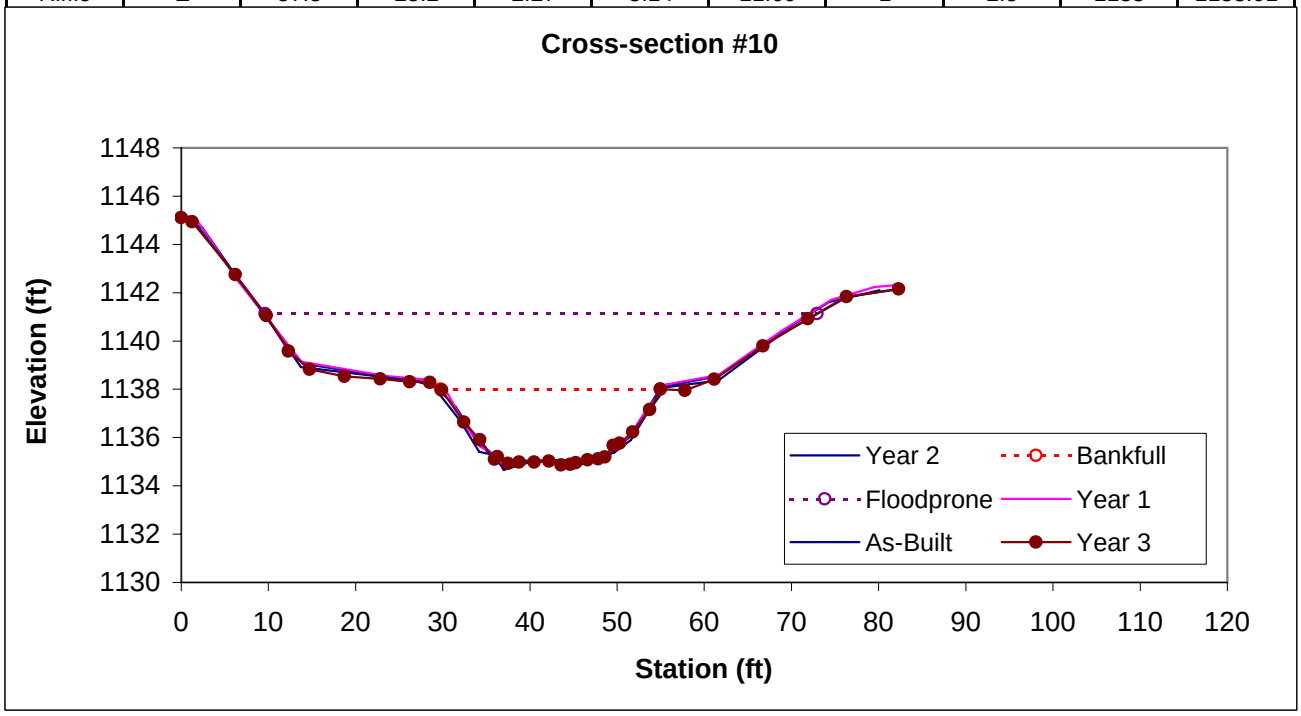
Permanent Cross-section #10 M3

(Year 3 Data - Collected September 2008)

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	57.3	25.2	2.27	3.14	11.09	1	2.5	1138	1138.01



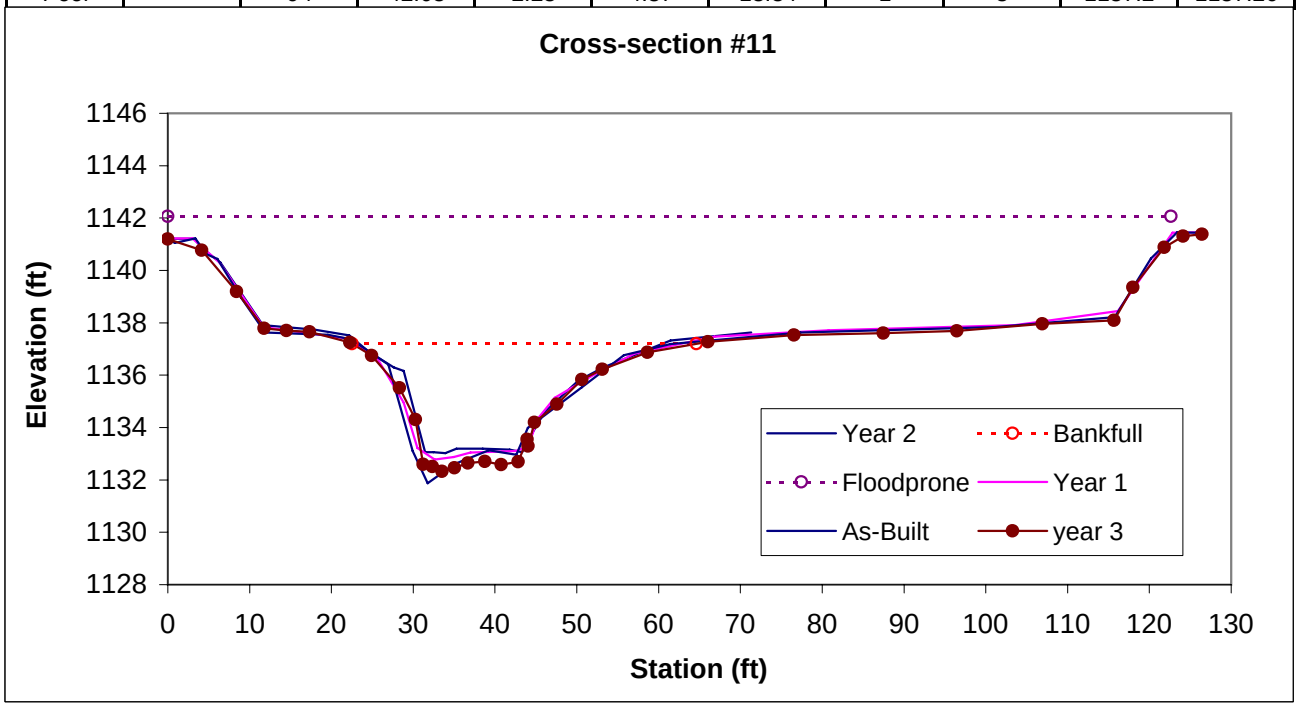
Permanent Cross-section #11 M3

(Year 3 Data - Collected September 2008)

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		94	42.08	2.23	4.87	18.84	1	3	1137.2	1137.26



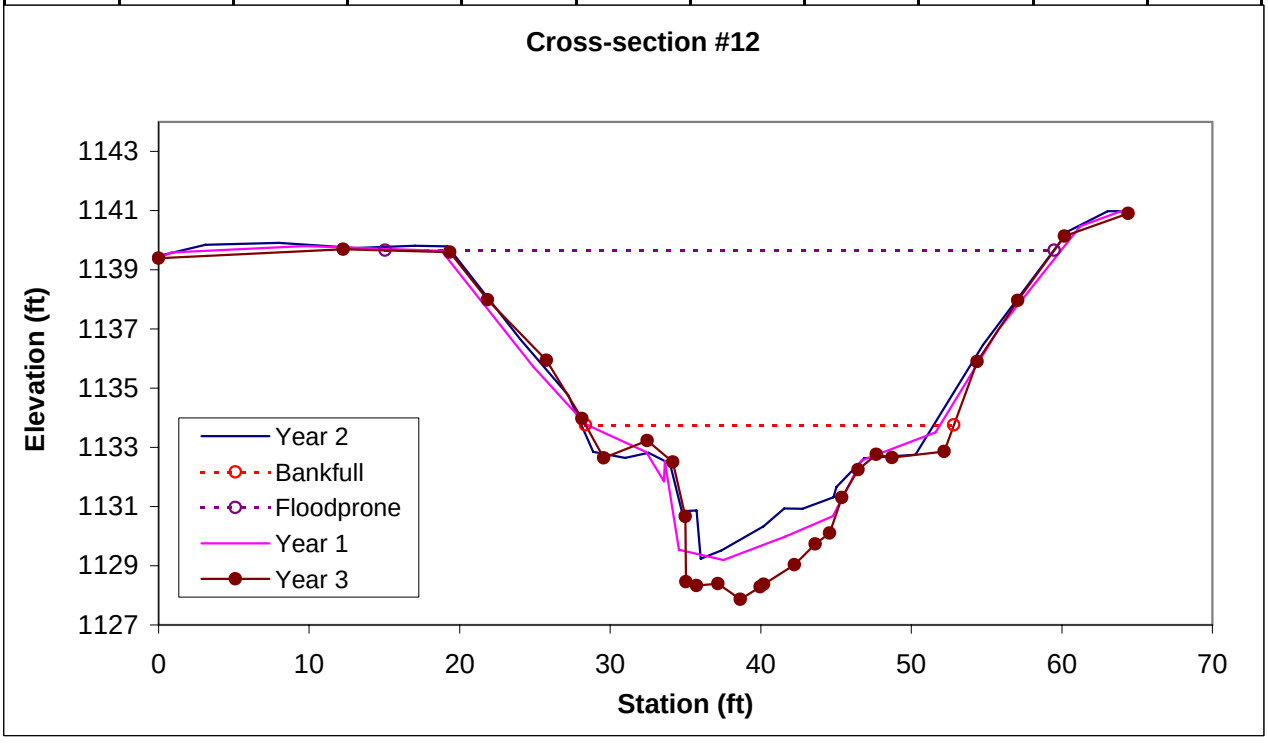
Permanent Cross-section #12 M4

(Year 3 Data - Collected September 2008)

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		66.2	24.47	2.7	5.9	9.05	2	1.8	1133.76	1139.6



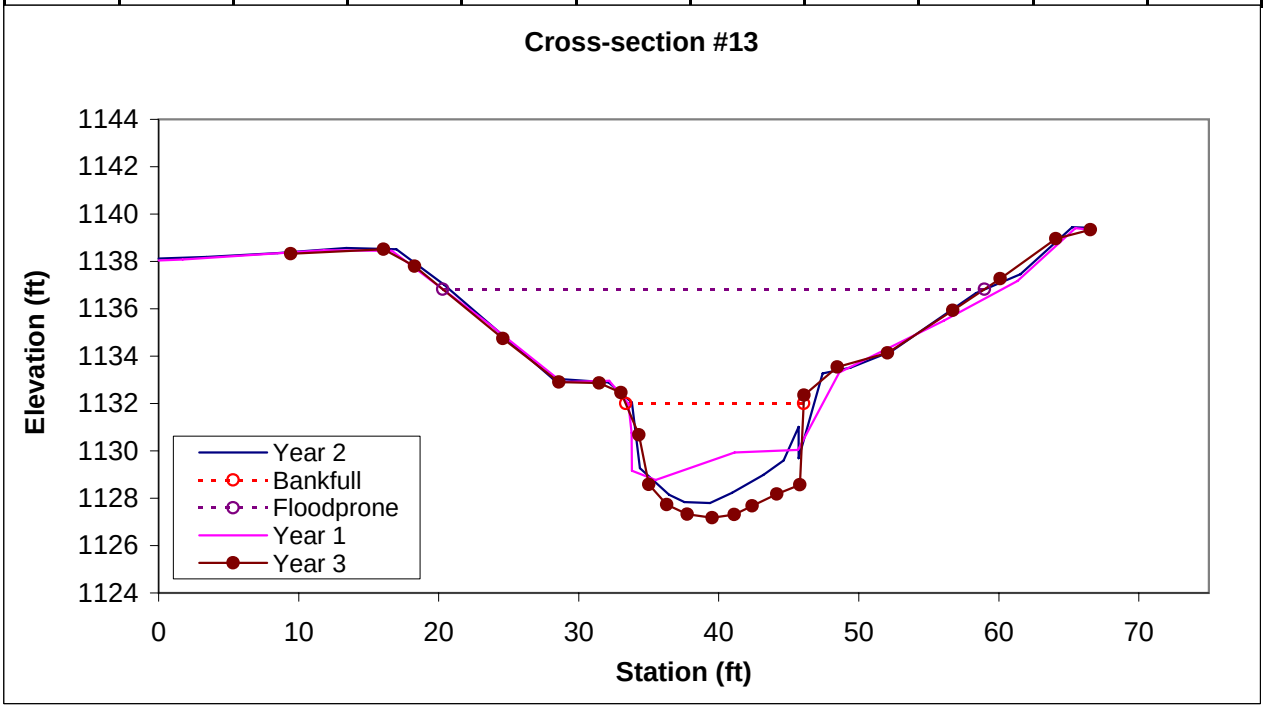
Permanent Cross-section #13 M4

(Year 3 Data - Collected September 2008)

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		49.1	12.72	3.86	4.82	3.29	2.1	3	1132	1137.27



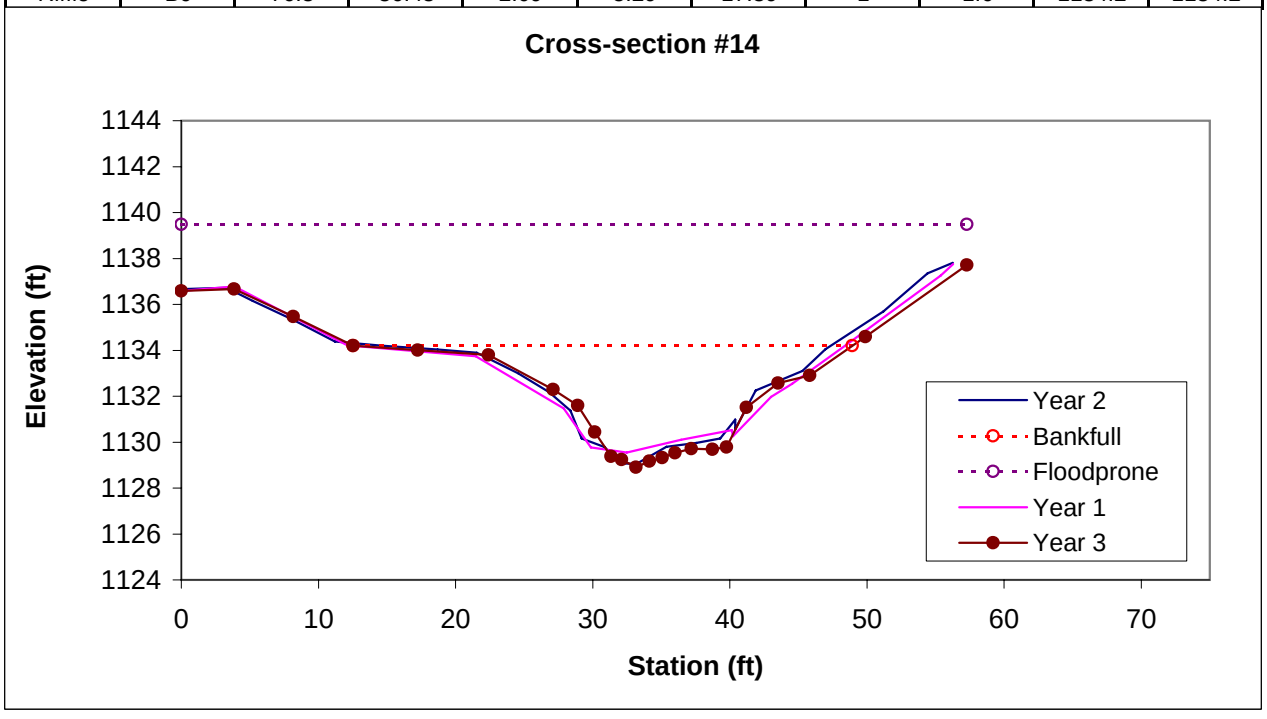
Permanent Cross-section #14 M4

(Year 3 Data - Collected September 2008)

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	76.3	36.43	2.09	5.29	17.39	1	1.6	1134.2	1134.2



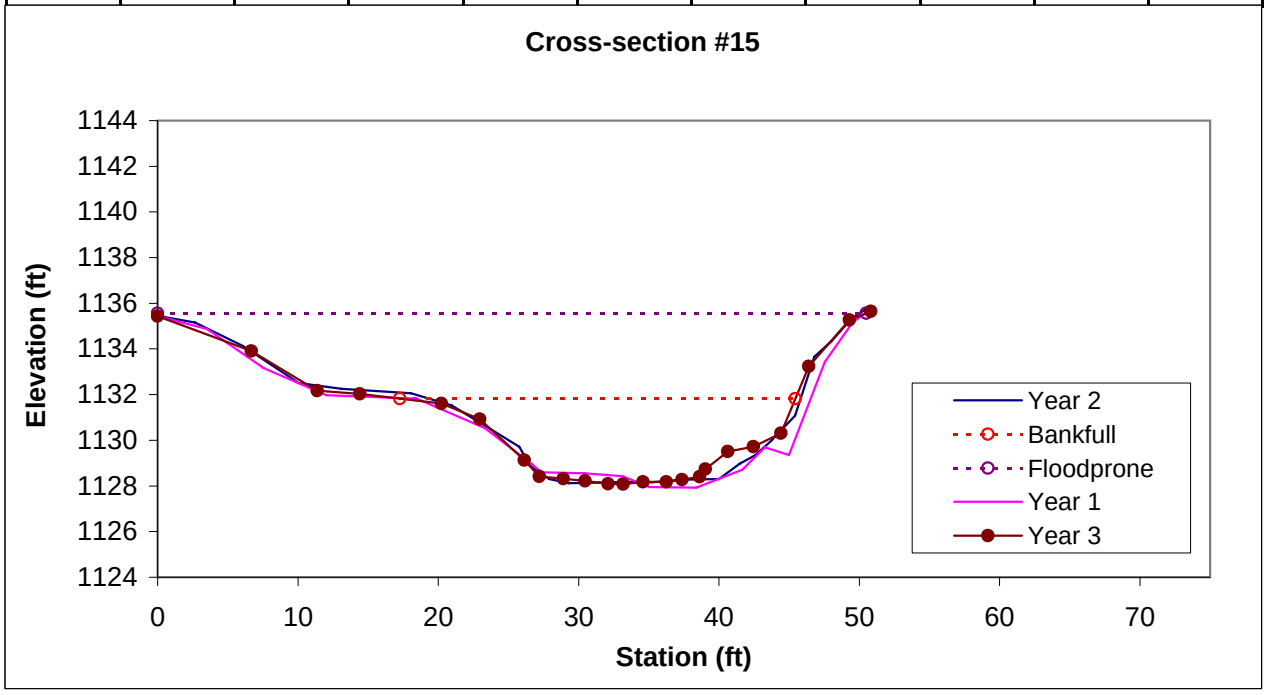
Permanent Cross-section #15 M4

(Year 3 Data - Collected September 2008)

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		65.8	28.18	2.33	3.74	12.07	2	1.8	1131.82	1135.44



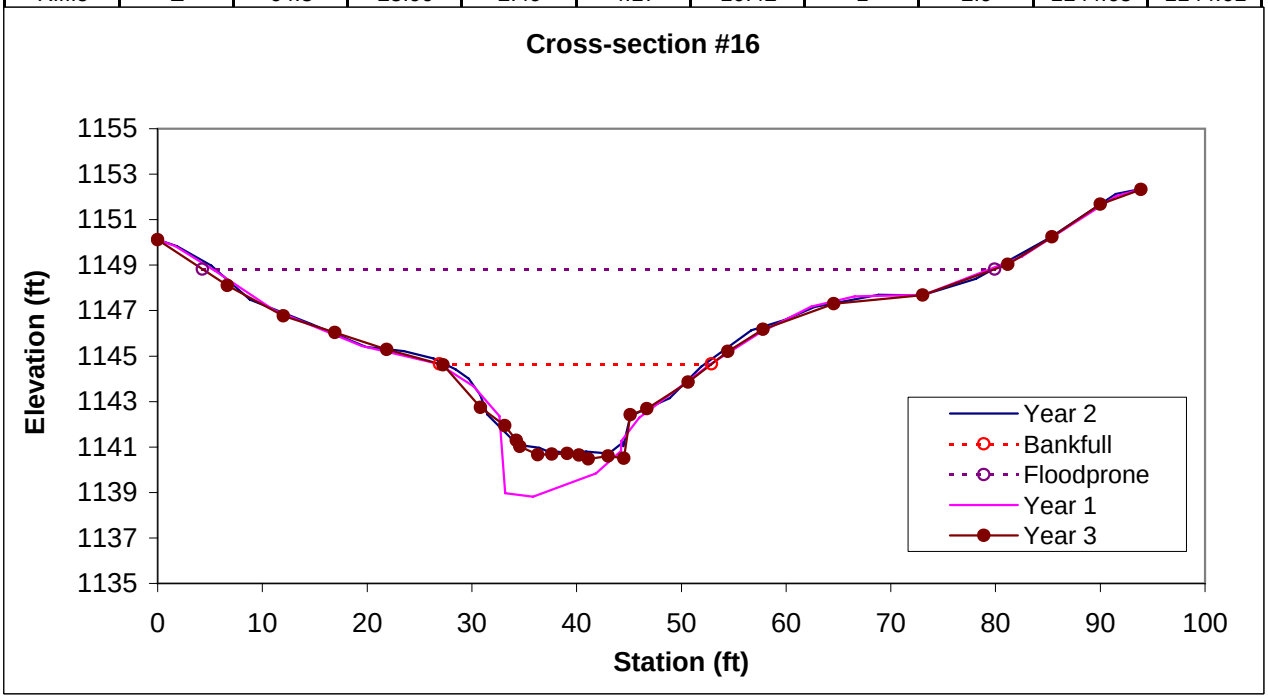
Permanent Cross-section #16 M1

(Year 3 Data - Collected September 2008)

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	64.8	25.99	2.49	4.17	10.42	1	2.9	1144.65	1144.61



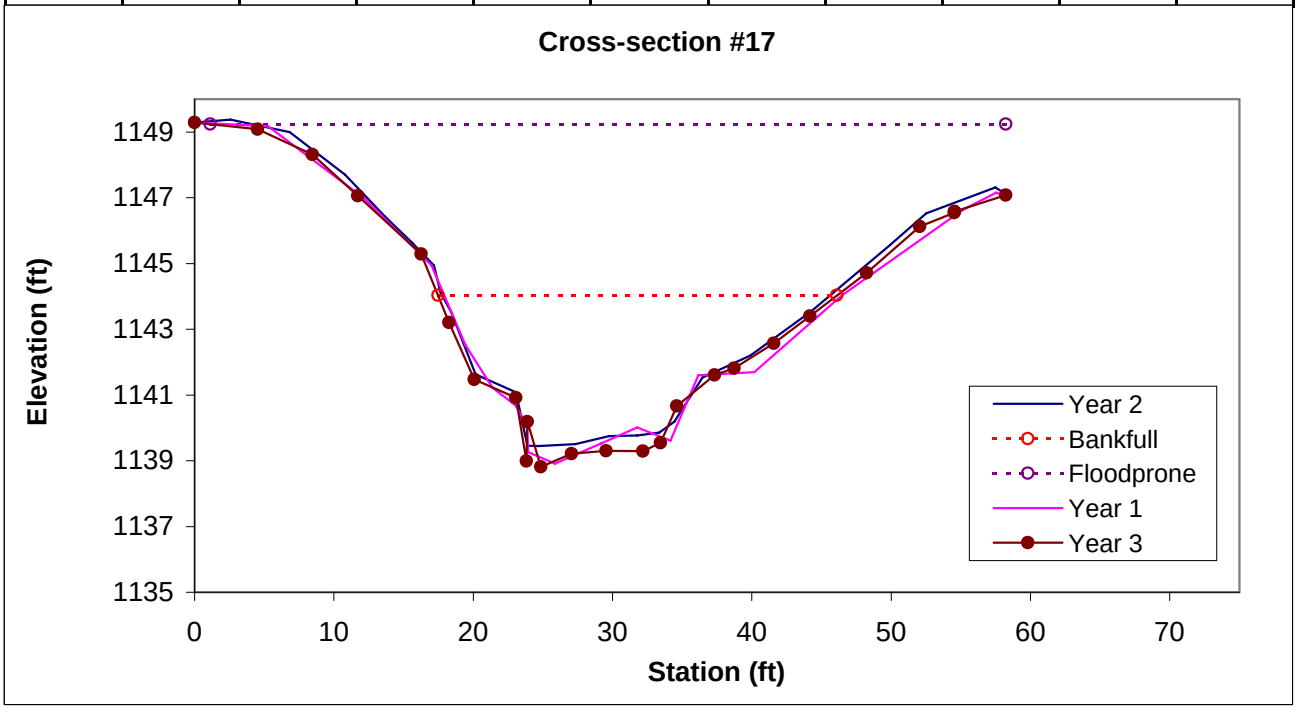
Permanent Cross-section M1 #17

(Year 3 Data - Collected September 2008)

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		85	28.64	2.97	5.21	9.65	1.6	2	1144.03	1147.08



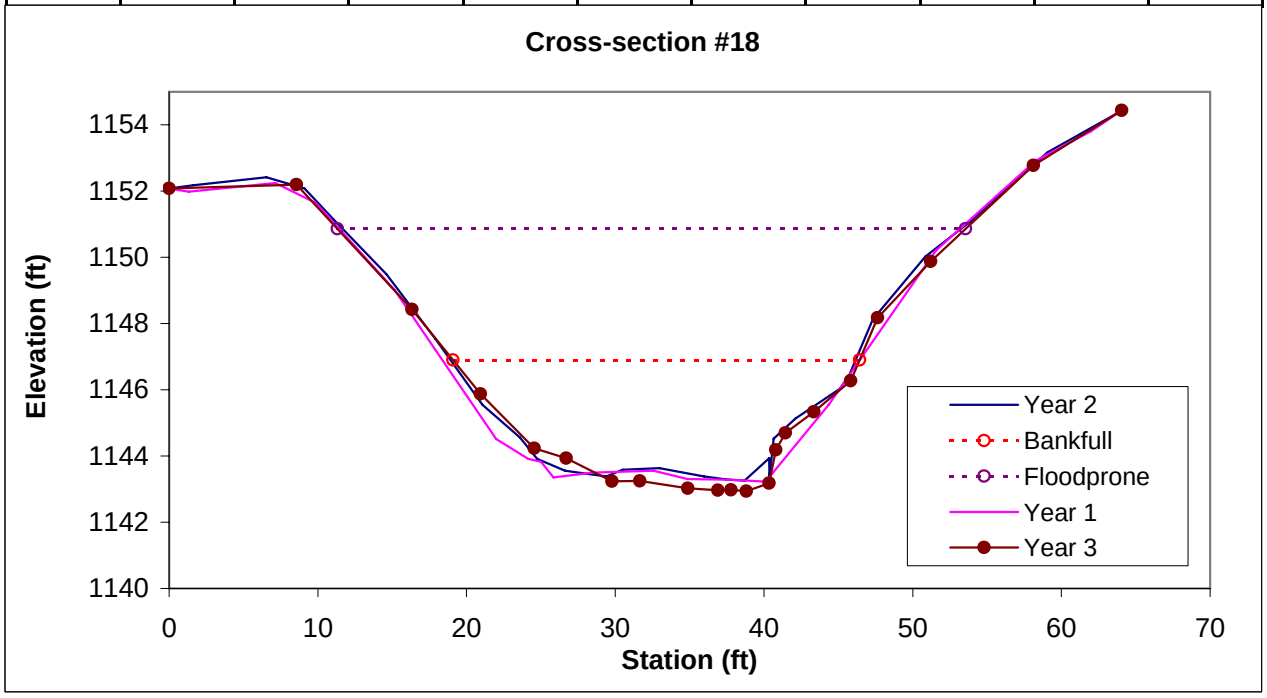
Permanent Cross-section #18 M1

(Year 3 Data - Collected September 2008)

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	73.7	27.35	2.7	3.96	10.15	2.3	1.5	1146.9	1152.2



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 - YEAR 2 MONITORING

Morphology and Hydraulic Monitoring Summary - Year 3 Monitoring

Silver Creek Restoration Site: Project No. D04006-5

Reach: Unnamed Tributary 1 (UT1)

Parameter	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			11.99	16.46	15.66			10.27	10.24	10.31		
Bankfull Mean Depth (ft)	0.62	0.56	0.59			0.83	0.6	0.54			0.85	0.59	0.64		
Width/Depth Ratio	38.7	37.02	36.6			14.4	27.62	29.21			12.0	17.35	16.24		
Bankfull Area (sq ft)	14.99	11.52	12.9			9.99	9.81	8.4			8.77	6.04	6.6		
Bankfull Max Depth (ft)	2.33	1.57	1.63			1.38	1.3	1.28			1.57	1.16	1.04		
Width of Floodprone Area (ft)	96.46	86.2	-			70.82	70.87	-			96.81	96.89	-		
Entrenchment Ratio	4.01	4.17	3.7			5.91	4.31	4.5			9.43	9.47	5.2		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-		
Substrate															
d50 (mm)															
d84 (mm)															

Parameter	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									
Channel Length (ft)			1467			1467									
Sinuosity			1.32			1.32									

Water Surface Slope (ft/ft)			0.0054			0.0072									
BF Slope (ft/ft)			0.0071			0.0054									
Rosgen Classification			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			53.60	24.29	20.6			11.42	10.14	11.02		
Bankfull Mean Depth (ft)	0.68	0.61	0.62			0.55	0.69	0.79			0.58	0.55	0.53		
Width/Depth Ratio	20.9	21.1	20.18			97.0	35.21	26.18			19.8	18.5	21		
Bankfull Area (sq ft)	9.53	7.96	7.9			29.62	16.76	16.2			6.60	5.56	5.8		
Bankfull Max Depth (ft)	1.44	1.31	1.32			1.88	2.85	2.76			1.27	1.27	1.23		
Width of Floodprone Area (ft)	52.94	51.95	-			78.21	78.27	-			64.70	63.65	-		
Entrenchment Ratio	3.75	4.01	4.2			1.46	3.22	3.4			5.67	6.27	5.9		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-		
Substrate															
d50 (mm)															
d84 (mm)															

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-												
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									
Channel Length (ft)			1234.2			1234.2									
Sinuosity			1.15			1.15									

Water Surface Slope (ft/ft)			0.0151			0.0191							
BF Slope (ft/ft)			0.0174			0.0165							
Rosgen Classification			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		
Bankfull Mean Depth (ft)	0.39	0.32	0.25		
Width/Depth Ratio	15.9	11.71	26.46		
Bankfull Area (sq ft)	2.45	1.2	1.7		
Bankfull Max Depth (ft)	0.98	0.64	0.68		
Width of Floodprone Area (ft)	36.28	45	-		
Entrenchment Ratio	5.81	8.1	4.5		
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)			154.1			154.1									
Channel Length (ft)			157.79			157.79									
Sinuosity			1.02			1.02									

Water Surface Slope (ft/ft)			0.0536												
BF Slope (ft/ft)			0.0545												
Rosgen Classification			-												
Reach: Silver Creek M1															
Parameter	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			28.54	27.84	28.64			28.08	27.23	27.35		
Floodprone Width (ft)	86.30	-	-			52.78	50.16	-			40.47	-	-		
BF Cross Sectional Area (ft2)	78.6	61.1	64.8			84.1	78.75	85.0			77.5	70.4	73.7		
BF Mean Depth (ft)	3.03	2.46	2.49			2.95	2.83	2.97			2.76	2.58	27.35		
BF Max Depth (ft)	5.84	3.93	4.17			5.11	4.58	5.21			3.68	3.64	3.96		
Width/Depth Ratio	8.57	10.12	10.42			9.69	9.84	9.65			10.17	10.54	10.15		
Entrenchment Ratio	3.30	2.93	2.9			1.80	1.8	2.0			1.40	1.47	1.5		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-		
Substrate															
d50 (mm)															
d84 (mm)															

Parameter	MY-1 (2005)			MY-2 (2006)			MY-3 (2007)			MY-4 (2008)			MY-5 (2009)		
	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																	
Reach: Silver Creek M3																				
Parameter	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			36.81	36.15	39.75			26.10	25.86	25.2			39.85	37.09	42.08		
Floodprone Width (ft)	45.80	-	-			122.40	-	-			63.31	-	-			126.40	-	-		
BF Cross Sectional Area (ft2)	58.20	54.46	55.4			95.40	82.05	82.2			59.40	58.7	57.3			88.90	82.43	94		
BF Mean Depth (ft)	2.20	2.18	2.16			2.59	2.27	2.07			2.27	2.27	2.27			2.23	2.22	2.23		
BD Max Depth (ft)	3.16	3.12	3.18			5.35	4.44	5.34			3.14	3.08	3.14			4.43	4.18	4.87		
Width/Depth Ratio	12.0	11.5	11.85			14.2	15.93	19.22			11.5	11.39	11.09			17.9	16.69	18.84		
Entrenchment Ratio	1.70	1.76	1.8			3.30	3.39	3.1			2.40	2.43	2.5			3.20	3.31	3		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Substrate																				
d50 (mm)																				
d84 (mm)																				

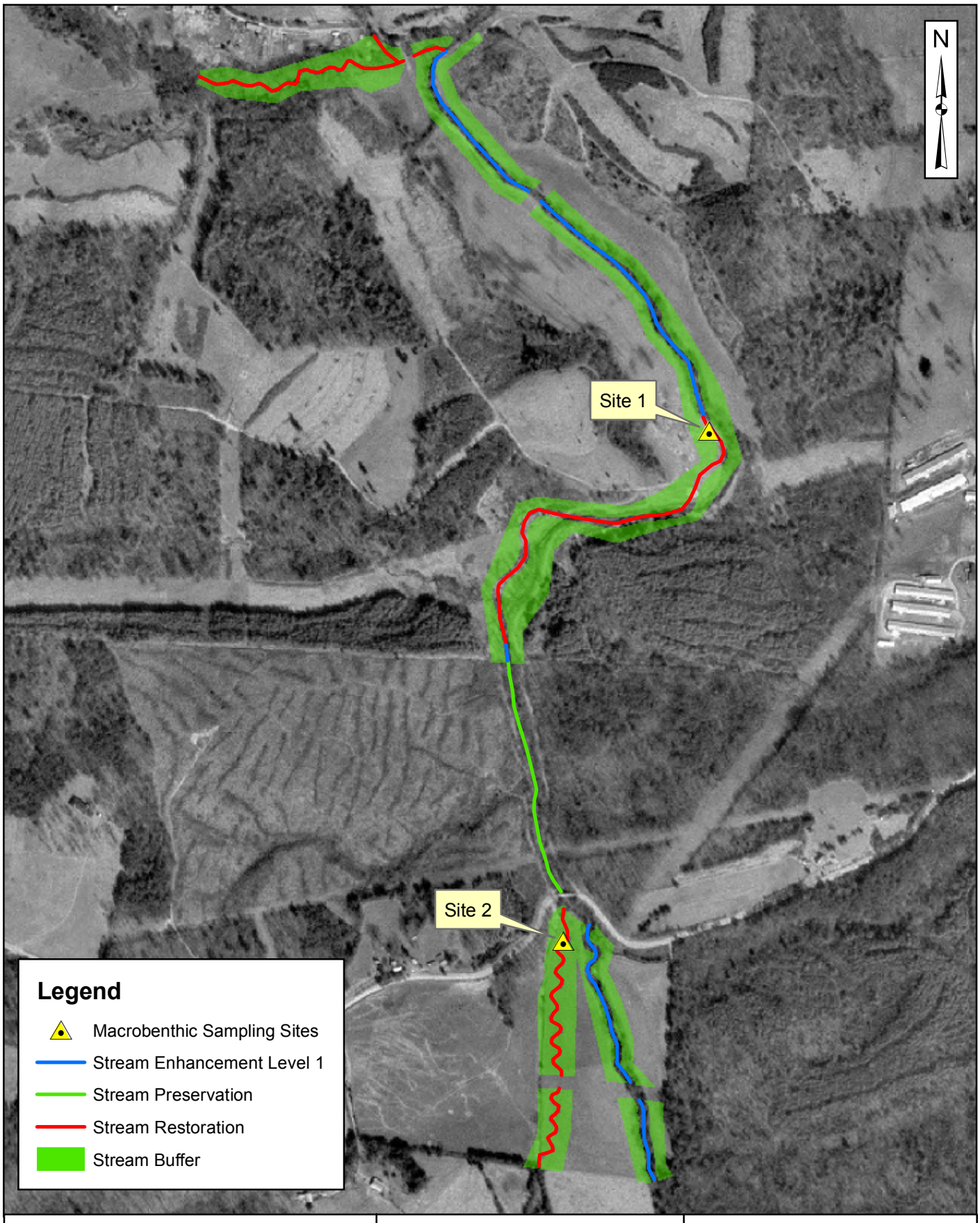
Parameter	MY-1 (2005)			MY-2 (2006)			MY-3 (2007)			MY-4 (2008)			MY-5 (2009)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-												
Radius of Curvature (ft)			-												
Meander Wavelength (ft)			-												
Meander Width Ratio			-												
Profile															
Riffle length (ft)			-												
Riffle Slope (ft/ft)			-												
Pool Length (ft)			-												
Pool Spacing (ft)			-												
Additional Reach Parameters															
Valley Length (ft)			1481.1			1481.1									
Channel Length (ft)			2192.57			2192.57									
Sinuosity			1.48			1.48									
Water Surface Slope (ft/ft)			0.0022			0.0023									
BF Slope (ft/ft)			0.0032			0.0036									

Rosgen Classification			C				C													
Reach: Silver Creek M4																				
Parameter	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			19.74	17.92	12.72			36.07	32.68	36.43			28.08	26.49	28.18		
Floodprone Width (ft)	37.13	-	-			42.06	-	-			56.29	-	-			50.83	2.59	-		
BF Cross Sectional Area (ft2)	55.20	49.27	66.2			46.40	54.86	49.1			78.00	73.54	76.3			72.70	68.6	65.8		
BF Mean Depth (ft)	2.34	2.1	2.7			2.35	3.06	3.86			2.16	2.25	2.09			2.59	2.59	2.33		
BD Max Depth (ft)	4.58	4.55	5.9			4.23	5.21	4.82			4.65	5.13	5.29			3.90	3.7	3.74		
Width/Depth Ratio	10.1	11.16	9.05			8.4	5.85	3.29			16.7	14.52	17.39			10.9	10.23	12.07		
Entrenchment Ratio	1.60	1.54	1.8			2.10	2.53	3.0			1.60	1.75	1.6			1.80	1.89	1.8		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Substrate																				
d50 (mm)																				
d84 (mm)																				

Parameter	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												

APPENDIX E

BENTHIC MACROINVERTEBRATE MONITORING DATA



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

0 500 1,000 Feet

Figure 1.
Benthic Macroinvertebrate
Sampling Sites
Silver Creek Site

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

Appendix A. Benthos Data for Silver Creek Project Collected on January 8 & 28, 2008

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek 1/28/08	Site 2 UT1 to Silver Creek 1/28/08	Site 3 UT to Bailey Fork Reference 1/8/08
ANNELIDA					
Oligchaeta					
Enchytraeidae	**9.8**	**GC**		**R**	
ARTHROPODA					
Insecta					
Coleoptera					
Dryopidae					
Helichus spp.	**4.6**	**SH**	**C**		
Elmidae					
Oulimnius latiusculus	**1.8**	**N/A**	**R**		
Stenelmis spp.	**5.1**	**SC**		**R**	
Hydrophilidae					
Berosus spp.	**8.4**	**PR**		**R**	
Diptera					
Chironomidae					
Brillia spp.	**5.2**	**SH**			**R**
Conchapelopia grp	**8.4**	**PR**			**R**
Corynoneura spp.	**6.0**	**GC**		**R**	
Cricotopus bicinctus	**8.5**	**SH**	**R**		
Diplocladius cultriger	**7.4**	**GC**	**R**	**C**	
Micropsectra spp.	**1.5**	**GC**		**C**	
Microtendipes spp.	**5.5**	**FC**	**R**		**R**
Orthocladius obumbratus	**8.5**	**GC**		**A**	
Parametriocnemus lundbecki	**3.7**	**GC**	**C**	**C**	**R**
Paraphaenocladius spp.	**N/A**	**N/A**		**A**	**R**
Polypedilum fallax grp	**6.4**	**SH**	**R**		
Rheotanytarsus spp.	**5.9**	**FC**		**C**	
Tvetenia bavarica	**3.7**	**GC**	**C**	**C**	
Empididae					
Empididae	**7.6**	**PR**	**R**		
Simulidae					
Cnephia mutata	**N/A**	**N/A**		**A**	
Prosimulium spp.	**6.0**	**FC**	**C**		
Tipulidae					
Antocha spp	**4.3**	**GC**	**A**		
Hexatoma spp.	**4.3**	**PR**	**R**		
Tipula spp.	**7.3**	**SH**	**A**		
Ephemeroptera					
Baetidae					
Acentrella ampla	**3.6**	**GC**	**A**		
Baetiscidae					
Baetisca carolina	**3.5**	**OM**	**C**		

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek 1/28/08	Site 2 UT1 to Silver Creek 1/28/08	Site 2 UT to Bailey Fork Reference 1/8/08
Ephemerellidae					
Ephemerella catawba	**4.4**	**N/A**	**C**		
Ephemerella dorothea	**6.0**	**GC**	**A**		**C**
Ephemerella invaria	**2.4**	**N/A**	**C**		
Eurylophella spp.	**4.3**	**SC**		**R**	
Eurylophella funeralis	**2.1**	**GC**	**C**		**R**
Ephemeridae					
Ephemera spp.	**2.0**	**GC**			**R**
Heptageniidae					
Stenonema modestum	**5.5**	**SC**	**C**		**C**
Stenonema pudicum	**2.0**	**SC**	**R**		**C**
Leptophlebiidae					
Leptophlebia spp.	**6.2**	**GC**		**A**	
Megaloptera					
Corydalidae					
Corydalus cornutus	**5.2**	**PR**	**C**		
Nigronia serricornis	**5.0**	**PR**	**C**		
Odonata					
Calopterygidae					
Calopteryx spp.	**7.8?**	**PR**			**R**
Coenagrionidae					
Argia spp.	**8.2**	**PR**		**C**	
Gomphidae					
Ophiogomphus spp	**5.5**	**PR**	**A**		
Progomphus obscurus	**8.2**	**PR**	**R**		
Libellulidae					
Libellula spp.	**9.6**	**PR**		**R**	
Pachydiplax longipennis	**9.9**	**PR**		**R**	
Plecoptera					
Capniidae					
Allocapnia spp.	**2.5**	**SH**			**R**
Leuctridae					
Leuctra spp.	**2.5**	**SH**	**R**		
Nemouridae					
Prostoia spp.	**5.8**	**SH**	**C**		
Perlidae					
Acroneuria abnormis	**2.1**	**PR**	**C**		
Eccoptura xanthenes	**3.7**	**N/A**	**C**		**C**
Perlodidae					
Clioperla clio	**4.7**	**N/A**	**C**		
Diploperla duplicata	**2.7**	**N/A**			**R**
Isoperla namata grp	**2.0**	**N/A**	**A**	**C**	
Isoperla spp.	**N/A**	**N/A**	**C**		
Pteronarcyidae					
Pteronarcys spp.	**1.7**	**SH**	**C**		

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek 1/28/08	Site 2 UT1 to Silver Creek 1/28/08	Site 2 UT to Bailey Fork Reference 1/8/08
Taeniopterygidae					
Strophopteryx spp.	**2.7**	**N/A**		**R**	
Trichoptera					
Brachycentridae					
Brachycentrus nigrisoma	**2.3**	**FC**	**R**		
Hydropsychidae					
Cheumatopsyche spp.	**6.2**	**FC**	**A**	**C**	**C**
Diplectrona modesta	**2.2**	**FC**		**C**	**R**
Hydropsyche betteni	**7.8**	**FC**	**A**		**A**
Hydroptilidae					
Hydroptila spp.	**6.2**	**SC**	**R**		
Limnephilidae					
Pycnopsyche spp.	**2.5**	**SH**	**C**		**C**
Pycnopsyche lepida grp.	**2.7**	**N/A**	**R**		
Philopotamidae					
Chimarra spp.	**2.2**	**FC**	**R**		
Dolophilodes spp.	**2.8**	**GC**	**R**		
Phryganeidae					
Ptilostomis spp.	**6.4**	**SH**		**C**	
Uenoidae					
Neophylax oligius	**2.2**	**SC**	**C**		**R**
MOLLUSCA					
Gastropoda					
Lymnaeidae					
Pseudosuccinea columella	**7.7**	**SC**		**R**	
Physidae					
Physella spp.	**8.8**	**SC**			**R**
Pleurocerbidae					
Elimia spp.	**2.5**	**SC**			**R**

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Silver Creek 1/28/08	Site 2 UT1 to Silver Creek 1/28/08	Site 2 UT to Bailey Fork Reference 1/8/08
Total Taxa Richness			**43**	**24**	**20**
EPT Taxa Richness			**25**	**7**	**13**
Total Biotic Index			**4.7**	**5.9**	**5.1**
EPT Biotic Index			**4.3**	**4.9**	**4.6**
Dominant in Common Taxa (%)			**86**	**14**	**N/A**

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

SILVER CREEK SITE 1

7/00 Revision 5

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** of stream, preferably in an **upstream** direction starting above bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a prop 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 habit score is determined by adding the results from the different metrics.

Stream SILVER CREEK Location/road: SITE 1 (Road Name POWERLINE OFF SEVEN SPRINGS) **County** BURKE

Date 1/28/08 **CC#** _____ **Basin** CATAWBA **Subbasin** 11-34-0.5

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

NORTHING EASTING
~~Latitude~~ 702587.2 ~~Longitude~~ 1160599 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 7.6 °C DO 11.0 mg/l Conductivity (corr.) 60 µmhos/cm pH 7.24

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what y 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 (est): _____ %Forest _____ %Agriculture _____ %Urban ☐ Animal operations upstream

Width: (meters) Stream 5 Channel (at top of bank) 7 **Stream Depth:** (m) Avg 1 Max 3.5
☐ Width variable

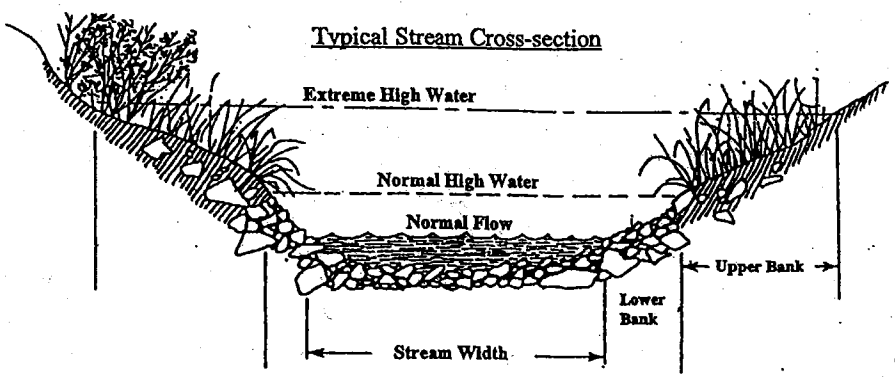
Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) 4-5

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

☐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)

Weather Conditions: SUNNY 43° **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: _____



This side is 45° bank angle.

SILVER CREEK SITE 1

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

Subtotal 5

Remarks_____

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** C **Macrophytes** A **Sticks and leafpacks** R **Snags and logs** R **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 riffl for embeddedness.

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

Remarks_____ Subtotal 12

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.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes	(10)
b. pools same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes	6
b. pools 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 43

SILVER CREEK SITE 1

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. no 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. no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 5

Remarks EROSION PRESENT ON LEFT BANK, BUFFER STILL IMMATURE, MATTING & STAKES, + GRASSES OTHERWISE STABLE

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block o sunlight when the sun is directly overhead).

	Score
A. Stream with **good** shading with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** shading - sunlight and shading are essentially equa.....	7
D. Stream with **minimal** shading - full sun in all but a few areas.....	2
E. **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 br the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths dc stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM	Lft. Bank Score	Rt. Bank Score
Dominant vegetation: ☐ Trees ☐ Shrubs ☐ Grasses ☐ Weeds/old field ☐Exotics (kudzu,etc)		
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(8)	(6)
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 10

Page Total 31

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

TOTAL SCORE 74

SILVER CREEK SITE 1

VIII. Channel Flow Status

Useful especially under abnormal or low flow conditions.

	Score
A. Water reaches base of both lower banks, minimal channel substrate exposed	10
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	(7)
C. Water fills 25-75% of available channel, many logs/snags exposed	4
D. Very little water in channel, mostly present as standing pools	0
	Subtotal 7

Remarks

Page Total 7

TOTAL SCORE 81

SILVER CREEK

7/00 Revision 5

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE 84**

Directions for use: The observer is to survey a **minimum of 100 meters** of stream, preferably in an **upstream** direction starting above bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a prop 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 habit score is determined by adding the results from the different metrics.

Stream SILVER CREEK **Location/road:** SITE 2 **(Road Name** MORRISON RD. **)County** BURKE

Date 1/24/08 **CC#** _____ **Basin** CATAWBA **Subbasin** 11-34-0.5

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

~~Latitude~~ NORTHING 700355.1 ~~Longitude~~ EASTING 1159960 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 3.8 °C DO 6.2 mg/l Conductivity (corr.) 30 µmhos/cm pH 7.09

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

Visible Land Use: 50 %Forest ____ %Residential 10 %Active Pasture ____ % Active Crops
35 %Fallow Fields ____ % Commercial ____ %Industrial 5 %Other - Describe: HWY/ROAD

Watershed land use (est): 50 %Forest 40 %Agriculture 10 RESIDENTIAL %Urban ☐ Animal operations upstream

Width: (meters) Stream 1 Channel (at top of bank) 2.75 **Stream Depth:** (m) Avg .15 Max .5
☐ Width variable

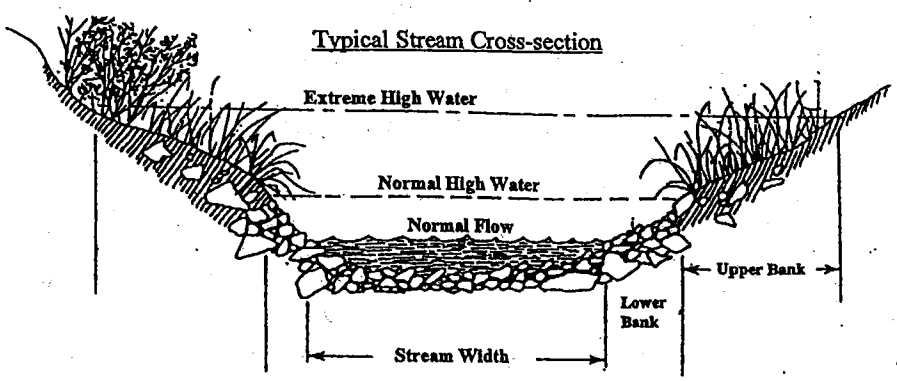
Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) .7

Bank Angle: 15 ° 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.)

☐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)

Weather Conditions: Sunny 43° **Photos:** ☐N ☒Y ☒Digital ☐35mm

Remarks: _____



This side is 45° bank angle.

SILVER CR. 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

Subtotal 5

Remarks

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** A **Macrophytes** R **Sticks and leafpacks** R **Snags and logs** R **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 14

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at riffl for embeddedness.

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

Subtotal 8

Remarks

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.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes	(10)
b. pools same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes	6
b. pools 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 37

SILVER CREEK. 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. no 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. no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 14

Remarks NO EROSION AREAS PRESENT.

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block o sunlight when the sun is directly overhead).

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

Remarks RIPARIAN VEG AREAS HEALTHY, BUT IS NOT YET MATURE Subtotal 6

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 br the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths dc 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	8
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** 77

SILVER CREEK SITE 2

VIII. Channel Flow Status

Useful especially under abnormal or low flow conditions.

	Score
A. Water reaches base of both lower banks, minimal channel substrate exposed	10
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	CP
C. Water fills 25-75% of available channel, many logs/snags exposed	4
D. Very little water in channel, mostly present as standing pools	0
	Subtotal 7

Remarks

Page Total 7

TOTAL SCORE 84