Year 2 Monitoring Report for Stream Restoration of Silver Creek and Unnamed Tributaries

Burke County, NC
SCO # D05016-01

Prepared for:
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Raleigh NC 27604

Ecosystem Enhancement PROGRAM

Submitted: December 2008

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I. EXECUTIVE SUMMARY

The Silver Creek stream restoration project is located near Morganton in Burke County, North Carolina. Prior to restoration, channelization and cattle intrusion resulted in vegetative denuding and bank destabilization due to hoof shear. The vertical to undercut unstable streambanks were contributing large volumes of suspended sediment and bedload material to the larger Silver Creek watershed. The project reach includes the restoration of 2,905 linear feet of the Silver Creek mainstem and 1,552 linear feet of an unnamed tributary (UTA); also included is 166 linear feet of preservation along UTB, UTC and UTD. Restoration of the project streams, completed during April 2007, re-established geomorphologic features consistent with natural stream channel characteristics. Elements of the restoration included stable channel pattern, profile and dimension consistent with reference reach conditions quantified within the Silver Creek watershed, upstream from the project on Brindle Creek. In-stream structures were constructed to provide grade control, streambank stabilization and aquatic habitat features. Restoration reconnected project stream channels to functional floodplains with extensive riparian plantings The following report documents the Year 2 Annual Monitoring for this project.

Vegetative monitoring was completed in September 2008 following the Carolina Vegetation Survey methodology. Stem counts completed at ten (10) vegetation plots show an average density of 300 stems per acre for the site. This density falls below the success criteria of 320 stems/acre after three years of monitoring. Six individual plots have stem densities below the minimum; four of these plots were located along the Unnamed Tributary, where seedling survivability ranged from 22% to 60%. The overall Year 2 stem counts represent 69% survival from the initial plantings. It is believed that the presence of large trees and the well-developed existing vegetative cover along the tributary is providing substantial competition for the seedlings. It is recommended that remedial plantings be conducted using larger woody stock, which should be better able to compete for resources in existing vegetative cover.

Visual stream stability assessment, conducted by EMH&T during September 8, 2008 revealed in-stream structures are functioning as designed and built on Silver Creek mainstem and Unnamed Tributary A (UTA). Point bars are well developed along inside meander bends on the mainstem. Cross-vanes, J-hook vanes, log vane – J-Hook – root wad combination structures, rock vanes, dual-winged jetties, rock-toe channel protection, constructed riffles, step pools and rootwad bank stabilization structures are functioning as designed and built. Deep pools with excellent glide features, comprised of well sorted gravels, are present throughout the restored mainstem reach. Constructed riffles remain stable, with median particle distributions ranging from fine to very coarse gravel. The substrate in the pools also remained stable, with median particle distributions ranging from fine sand to fine gravel. Despite extreme drought and low flow conditions during 2008, the active channels are appropriately sized and are entraining their bedload. Based on the crest gage network installed on the project reaches, no bankfull events were recorded since construction was completed during April 2007. Remedial maintenance work on the mainstem is neither warranted nor planned at this time. A few isolated areas on UTA are exhibiting bank scour that will be addressed via live stem plantings during the Year 3 spring planting season.

In addition to the monitoring protocol required by EEP, additional monitoring has been required by the NC DWQ under the Section 401 permit issued for the project on May 25, 2007. Vegetation monitoring found that the average stem density for the combined tributaries exceeds the minimum criteria of 320 stems per acre. Stream monitoring found no stability problems along these tributaries.

II. PROJECT BACKGROUND

A. Location and Setting

The project is located approximately 3,000 feet east of Dysartsville Road and approximately 2,500 feet south of Patton Road, west of the City of Morganton, in Burke County, North Carolina as shown on **Figure 1**. The stream channels included in this project are the Silver Creek mainstem and four unnamed tributary streams designated UTA, UTB, UTC and UTD.

The directions to the project site are as follows:

> From I-40, exit at Exit 94 and travel south along Dysartsville Road and turn left (east) onto Seven Springs Lane. The project spans properties owned separately by Mr. and Mrs. Frank Queen and Mr. and Mrs. Richard Conway (Seven Springs Farms, Inc.).

B. Project Structure, Mitigation Type, Approach and Objectives

Pre-restoration land use surrounding the project streams included active cattle pasture land along the Silver Creek mainstem. The pre-existing riparian corridor along Silver Creek, including UTB, UTC and UTD, varied from wide to denuded within the project area. The wide portion consisted of a mature forested corridor, while narrow and denuded areas were the result of a recent pine beetle infestation. Active pasture is located to the east and west of UTA. A sparsely wooded corridor is present along the reach and has been maintained. Typical species observed along the streams and adjacent forested areas include *Pinus taeda* (loblolly pine), *Platanus occidentalis* (sycamore) and *Ilex opaca* (American holly).

Prior to restoration, agricultural land use and channel incision had altered the Silver Creek mainstem throughout the project reach, resulting in an unstable Rosgen F4 stream type. The incised nature of the channel was attributed to channelization and cattle intrusion, which resulted in vegetative denuding and bank destabilization due to hoof shear. The Silver Creek channel's unstable width to depth ratio, entrenchment ratio, relatively flat average profile slope and poorly defined active streambed resulted in a deeply incised channel disconnected from its floodplain. Mid-channel, lateral, and transverse sand and gravel bar deposits were observed at locations throughout the reach, demonstrating the stream lacked stable pattern, profile and dimension to entrain its bedload. The locations of these depositional features in the near bank region deflected flows from the center of the channel toward the incised vertical to undercut streambanks, accelerating streambank erosion. It is estimated that approximately 5,570 cubic yards per year (or 6,980 tons per year) of sediment was being eroded from the unstable streambanks along the impaired mainstem reach into the Silver Creek watershed prior to restoration.

The UTA channel was a classic Type I valley confined, A1-A2 stream type transitioning to a Type II colluvial valley, B4 stream type in the lower third of the impaired reach. The upper two-thirds of the reach exhibited some bedrock control, in-stream boulders together with flood placed woody debris from leaning or fallen trees along the unstable, steep to undercut streambanks. The impaired riparian vegetative communities were exacerbating streambank erosion rates and down-slope movement of colluvium. Cattle intrusion had adversely impacted the entire tributary as evidenced by vegetative denuding and bank failure attributed to hoof shear. Agricultural land use

(pastureland) adjacent to the stream corridor and uncontrolled cattle access to the stream for watering and shade resulted in unstable, steep to undercut streambanks, and accelerated severe to extreme streambank erosion. The unstable streambanks were contributing large volumes of suspended sediment and bedload material to the larger Silver Creek watershed. It was estimated 290 cubic yards per year (or 375 tons per year) of sediment was being eroded from the unstable streambanks along UTA prior to restoration.

The mitigation goals and objectives for the project streams were met by restoring physical and biological functions of the project reaches beyond pre-existing conditions. Pre-restoration conditions consisted of impaired, channelized, eroding and entrenched stream channels. The mitigation goals and objectives were met by providing the attributes described below.

- Stable stream channels with features inherent of a diverse aquatic and riparian ecosystem
- Restored connections between the bankfull width and floodprone width of the channels by restoring the floodprone area
- Improved physical aquatic habitat features
- Minimization of existing land use impacts on the stream
- Long-term protection of the stream corridors via a perpetual conservation easement conveyed to the State of North Carolina.

Restoration of the project streams re-established geomorphologic features consistent with reference reach conditions. Results achieved are listed below.

- Bankfull channels constructed with the appropriate geometries to convey bankfull flows and transport suspended sediment and bedload materials available to the streams
- Stable channel pattern, profile and dimension consistent with natural streams in the region
- Grade control and bank stabilization in-stream structures, such as cross vanes, J-hook vanes, rock vanes, dual-winged jetties, constructed riffles, step pools, root wad revetment, rock-toe channel protection that enhance environmental attributes of the stream channels though the use of natural materials
- Reconnection of project stream channels to functional floodplains
- Extensive indigenous riparian plantings

The primary, pre-existing land use within the immediate project site was agricultural. Based on photographic interpretation, the site has been historically utilized for agricultural row crop production and hayland. It is likely the project site has been farmed since early colonial times. The site was degraded by past land management practices including mechanical land clearing, straightening and dredging the stream channels. Silver Creek was one of the first streams in North Carolina to be mined for precious metals and gem stones. The project site was most recently utilized to produce hay for livestock feed. The stream banks were denuded and actively eroding, with vertical to undercut streambanks. Vegetative cover was minimal along the stream corridor, resulting in streambank erosion, channel incision leading to entrenchment and over widening. The channels were deeply incised state and laterally confined. Prior to restoration, the floodplain was functioning as an abandoned terrace perched above the bankfull elevation.

The project restoration goal was to restore channel dimension, pattern, and profile to stable and self-maintaining conditions utilizing natural channel design methods and techniques. Physical

restoration and water quality improvements were accomplished by meeting the restoration goals and objectives below:

- Constructed channels with the appropriate cross-sectional dimension, pattern, and longitudinal profile based on reference reach boundary conditions
- Improve and create bedform and aquatic habitat features (riffles, runs, pools, and glides)
- Integrated a Priority Level II restoration approach creating a floodprone area (bankfull bench) connected to the bankfull channel elevation and raised the streambed elevations, reconnecting the bankfull elevation to the existing floodplain elevation
- Restored channel and streambank stability by integrating in-stream grade control structures, root wads, and native revetment while also creating stable and functional aquatic and terrestrial habitat
- Established a native forested plant community within the newly constructed and protected riparian corridor. Eradicate exotic vegetation and protect the riparian corridor with a perpetual conservation easement
- Provide aesthetic and educational opportunities.

Restoration of the streams has met the objective of the project along both the Silver Creek mainstem and UTA, providing the desired habitat and stability features required to improve and enhance the ecologic health of the streams for the long-term. Specifically, the completed restoration project has accomplished the items listed below.

Silver Creek Mainstem:

- Reversed the effects of channel incision and entrenchment using a Priority Level II restoration approach. The restoration has increased the median width/depth ratios from 5.36 to 40.22 after construction completion and 2 years of monitoring.
- Restored natural stream pattern, profile and dimension throughout the 2,959 l.f. mainstem reach, decreasing channel sinuosity from 1.46 to 1.40, while creating a stable relationship between valley, channel, water surface and bankfull slopes.
- Stabilized eroding streambanks by providing an appropriately sized channel with stable streambank slopes using a combination of embedded stone, natural fabrics and aggressive native streamside and riparian revetment. The average Bank Height Ratio has been decreased from 1.95 (deeply incised) to 1.00 (stable) in Year 2.
- Provided a re-connection between the restored stream bankfull elevation and floodprone area (Priority Level II restoration). The completed restoration changed the average entrenchment ratio from <1.4 to 1.8, and restored the pre-existing unstable, incised and entrenched F4 stream channel to a stable B4c stream type (Rosgen, 1994).
- Created instream aquatic habitat features including deep pools, rootwad streamside fish cover and streambank stabilization, constructed riffles, rock cross vanes, J-Hook rock vanes, log vane – J-Hook – root wad combination structures with deep pools and native streamside revetment to enhance outer meander bend stability, shade the pools, provide fish cover and lower water temperature.
- Revegetated the streambanks and riparian corridor with indigenous canopy and mid-story trees, shrubs and herbaceous ground cover.
- Preserved the riparian corridor within a fenced, perpetual conservation easement conveyed to the State of North Carolina.

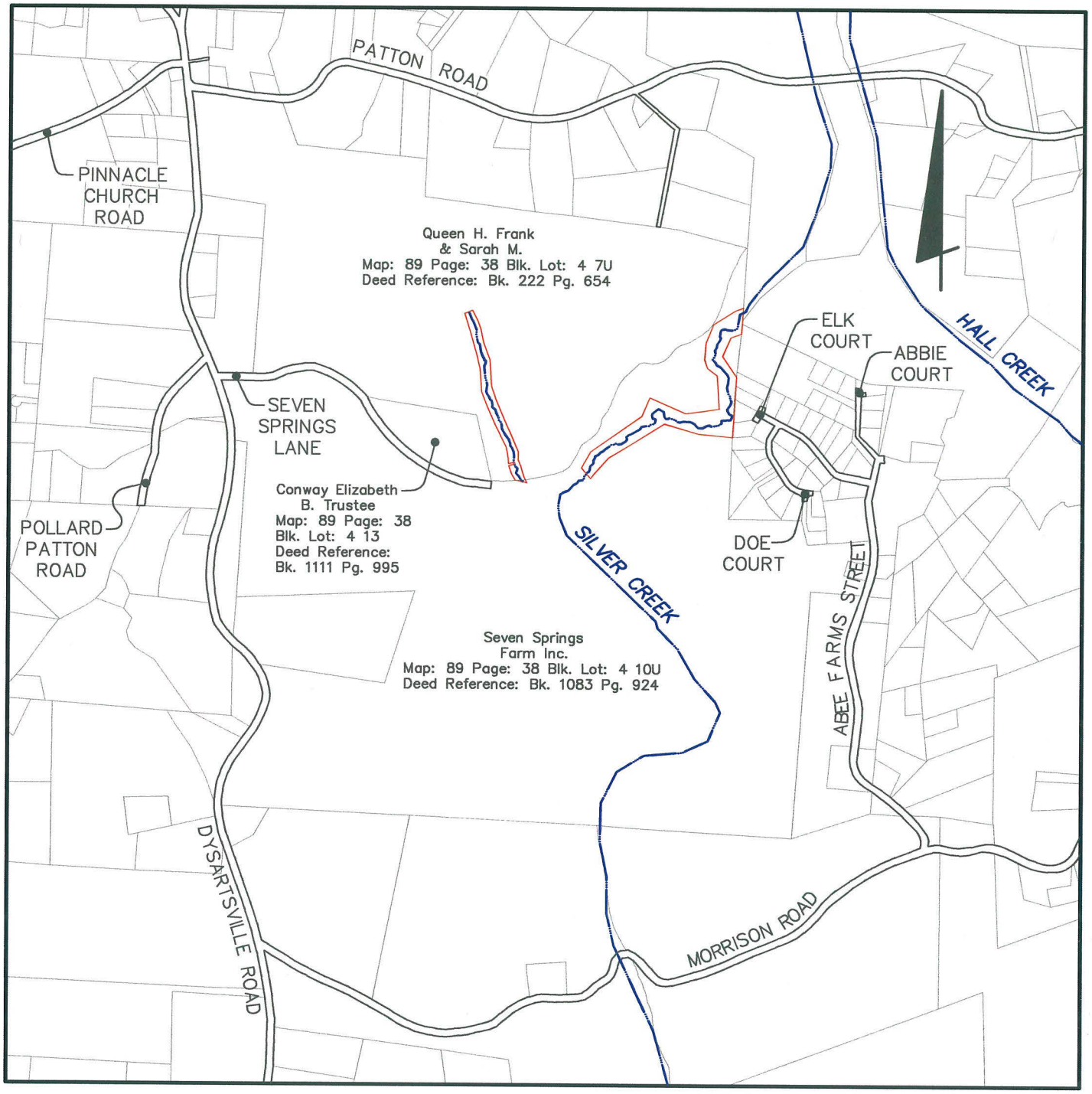
Unnamed Tributary A (UTA):

- Reversed the effects of channelization utilizing Priority Level II natural channel design restoration techniques. The average width/depth ratio of the restored stream channel was increased from < 12 to 17.1.
- Restored natural stream pattern, profile and dimension throughout the 1,552 l.f. stream reach providing a more stable relationship between the Rosgen Type II Valley (Rosgen, 1994) slope and bankfull channel slopes.
- Stabilized vertical to undercut, eroding streambanks by constructing an appropriately sized channel with stable streambank slopes. The average Bank Height Ratio was decreased from 1.91 (deeply incised) to 1.00 (stable).
- Raised the streambed elevation by constructing appropriately spaced step-pools and riffle sequences, decreasing near-bank shear stress from 1.68 to 1.30 lb/sq ft.
- Restoration increased the average entrenchment ratio from < 1.4 to 1.84 restoring the unstable, incised and entrenched A4 stream type to a stable B4a stream type (Rosgen, 1994).
- Created instream aquatic habitat features including step-pools, log sills, streambank slope stabilization, constructed riffles, rock sills and rock toe channel protection.
- Revegetated stabilized streambanks and the riparian corridor with indigenous canopy, mid-story, shrubs and herbaceous plant species, where deficient.
- Preserved the riparian corridor within a fenced, perpetual conservation easement conveyed to the State of North Carolina.

Information on the project structure and objectives is included in Tables I and II.

Table I. Project Structure Table
Silver Creek Stream Restoration / EEP Project No. D05016-01

Project Segment/Reach ID	Linear Footage or Acreage
Silver Creek Mainstem	2,905 ft
Unnamed Tributary A (UTA)	1,552 ft
Unnamed Tributary B (UTB)	66 ft
Unnamed Tributary C (UTC)	48 ft
Unnamed Tributary D (UTD)	52 ft
TOTAL	4,623 ft



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EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists

BURKE COUNTY, NORTH CAROLINA

SILVER CREEK RESTORATION

FIGURE 1: SITE VICINITY MAP

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date: December, 2008

Not To Scale

Ecosystem Enhancement PROGRAM

Table II. Project Mitigation Objectives Table Silver Creek Stream Restoration / EEP Project No. D05016-01					
Project Segment/ Reach ID	**Mitigation Type**	**Linear Footage or Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Comment**
Silver Creek Mainstem	Priority 2 Restoration	2,905 ft	1.0	2,905 ft	Restore dimension, pattern, and profile
UTA	Priority 2 Restoration	1,552 ft	1.0	1,552 ft	Restore dimension, pattern, and profile
UTB	Preservation	66 ft	5.0	13 ft	Preserved within the conservation easement
UTC	Preservation	48 ft	5.0	10 ft	Preserved within the conservation easement
UTD	Preservation	52 ft	5.0	10 ft	Preserved within the conservation easement
TOTAL		4,623 ft		4,490 ft	

C. Project History and Background

Project activity and reporting history are provided in Table III. The project contact information is provided in Table IV. The project background history is provided in Table V.

Table III. Project Activity and Reporting History Silver Creek Stream Restoration / EEP Project No. D05016-01			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration plan	Aug 2005	Feb 2006	May 2006
Final Design - 90%[1]	--	--	--
Construction	Feb 2006	N/A	Apr 2007
Temporary S&E applied to entire project area[2]	Feb 2006	N/A	Apr 2007
Permanent plantings	Apr 2006	N/A	Apr 2007
Mitigation plan/As-built	Jun 2006	May 2007	Sep 2007
Year 1 monitoring	2007	Sep 2007 (vegetation) Nov 2007 (geomorphology)	Jan 2008
Year 2 monitoring	2008	Sep 2008 (vegetation) Dec 2008 (geomorphology)	Dec 2008
Year 3 monitoring	2009		
Year 4 monitoring	2010		
Year 5 monitoring	2011		

[1]Full-delivery project; 90% submittal not provided.
[2]Erosion and sediment control applied incrementally throughout the course of the project.
N/A: Data collection is not an applicable task for these project activities.

Table IV. Project Contact Table Silver Creek Stream Restoration / EEP Project No. D05016-01	
Designer	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
Construction Contractor	South Mountain Forestry 6624 Roper Hollow, Morganton, NC 28655
Monitoring Performers	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
Stream Monitoring POC	Warren E. Knotts, PG, EMH&T
Vegetation Monitoring POC	Holly M. Blunck, Botanist, EMH&T

Table V. Project Background Table Silver Creek Stream Restoration / EEP Project No. D05016-01	
Project County	Burke
Drainage Area[1]	Mainstem-8.26 sq mi UTA-0.075 sq mi
Drainage Impervious Cover Estimate	5.5%
Stream Order[1]	Mainstem-3rd UTA-1st
Physiographic Region	Blue Ridge Mountains/Southern Inner Piedmont
Ecoregion	Eastern Blue Ridge Foothills
Rosgen Classification of As-built[1]	Mainstem-B4c UTA-B4a
Dominant Soil Types	Colvard sandy loam, Rhodhiss sandy loam
Reference Site ID	Brindle Creek
USGS HUC for Project and Reference	03050101
NCDWQ Sub-basin for Project and Reference	03050101050050
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
Reason for 303d listing or stressor	N/A
% of project easement fenced	100%

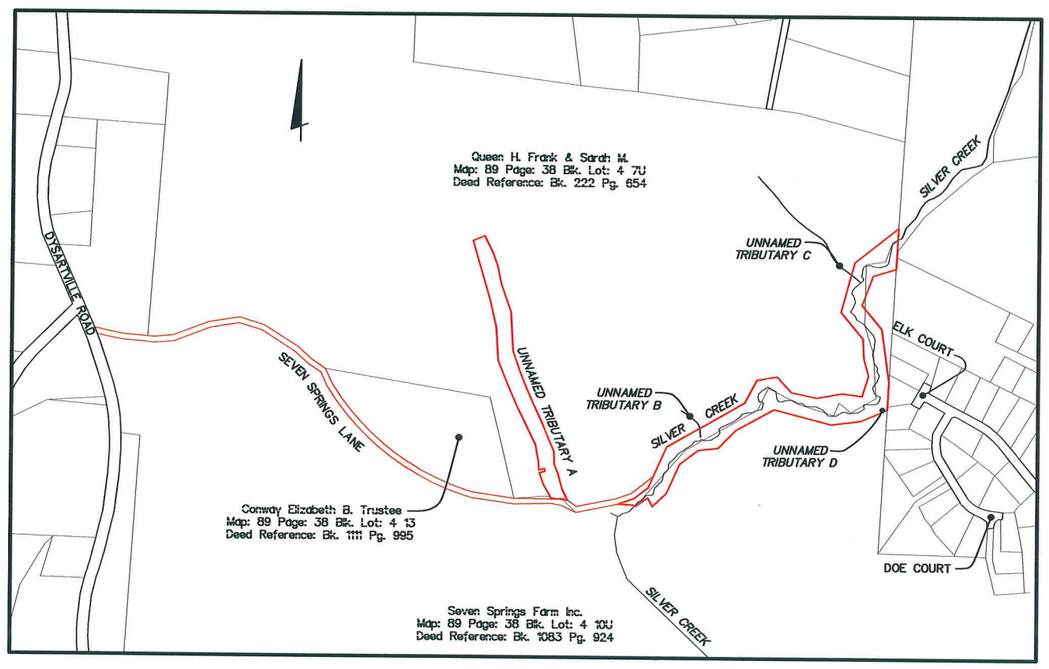
[1]Data for UTB, UTC, and UTD are not reported as they are Preservation reaches.

In addition to the monitoring required by EEP protocol, monitoring has been required by the NC DWQ under the Section 401 permit issued for the project on May 25, 2007. The 401 permit conditions require monitoring data collection related to bank stability and success of vegetative plantings installed along UTB and UTC, which were inadvertently impacted during restoration construction along Silver Creek. The additional monitoring data is summarized under the appropriate sections of this report.

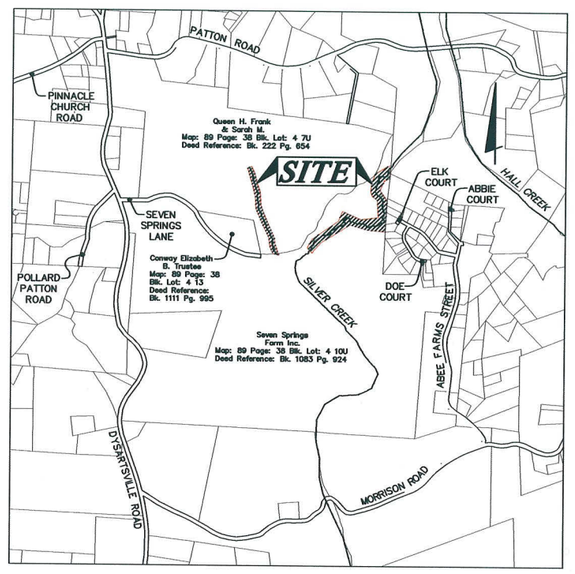
D. Monitoring Plan View

The monitoring plan view is included as Figure 2.

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
SILVER CREEK AND UNNAMED TRIBUTARY
2007



LOCATION MAP
Scale: 1"=400'



VICINITY MAP
Not To Scale

Job No.	2007-1898	Sheet	1/6
Date	January, 2008	Scale	As Noted

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
SILVER CREEK AND UNNAMED TRIBUTARY
SILVER CREEK

Ecosystem Enhancement Program

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614.775.4500 Fax 614.775.4800

EEP Ingress/Egress Easement along Seven Springs Lane

Queen H. Frank & Sarah M.
Map: 89 Page: 38 Blk. Lot: 4 7U
Deed Reference: Bk. 222 Pg. 654

EX. SOIL ROAD (DO NOT DISTURB)

VP-2

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

X-Sec 1
Riffle

X-Sec 2
Pool

BEGIN AS-BUILT
STA. 0+00.00

0+00

1+00

Bankfull
Width(30')

2+00

Prop. Thalweg

3+00

4+00

Ex. Thalweg

Limits of
Beltwidth

5+00

Matchline Sta. 5+00.00 (See This Sheet)

Stream Bank
Reinforcement

BEGIN STREAM WORK
STA. 0+00.00

Ex. Low Water
Crossing

VP-1

Recorded Conservation Easement
NC EPP Project No. D04006-5
Plat Bk. 27, Pgs. 119-120

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

Seven Springs Farm Inc.
Map: 89 Page: 38 Blk. Lot: 4 10U
Deed Reference: Bk. 1083 Pg. 924

Unnamed
Tributary B
(UT-B)

Queen H. Frank & Sarah M.
Map: 89 Page: 38 Blk. Lot: 4 7U
Deed Reference: Bk. 222 Pg. 654

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

Matchline Sta. 5+00.00 (See This Sheet)

Limits of
Beltwidth

6+00

7+00

Prop. Thalweg

Ex. Thalweg

8+00

9+00

Bankfull
Width (30')

Constructed
Point Bar (Typ.)

VP-3

Matchline Sta. 10+00.00 (See Sheet 03)

Prop. Bank Fill (Typ.)

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

Seven Springs Farm Inc.
Map: 89 Page: 38 Blk. Lot: 4 10U
Deed Reference: Bk. 1083 Pg. 924

LEGEND

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- P\L Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Channel
- As-Built Structure
- As-Built Bank Stabilization
- As-Built Root Wad
- As-Built Riffle
- Photo Direction and Location

Job No. 2007-1898 | Sheet 2/6
Date January, 2008 | Scale Hor: 1" = 40' Ver: 1" = 4'

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR

SILVER CREEK AND UNNAMED TRIBUTARY

SILVER CREEK
PLAN & PROFILE

Ecosystem Enhancement Program

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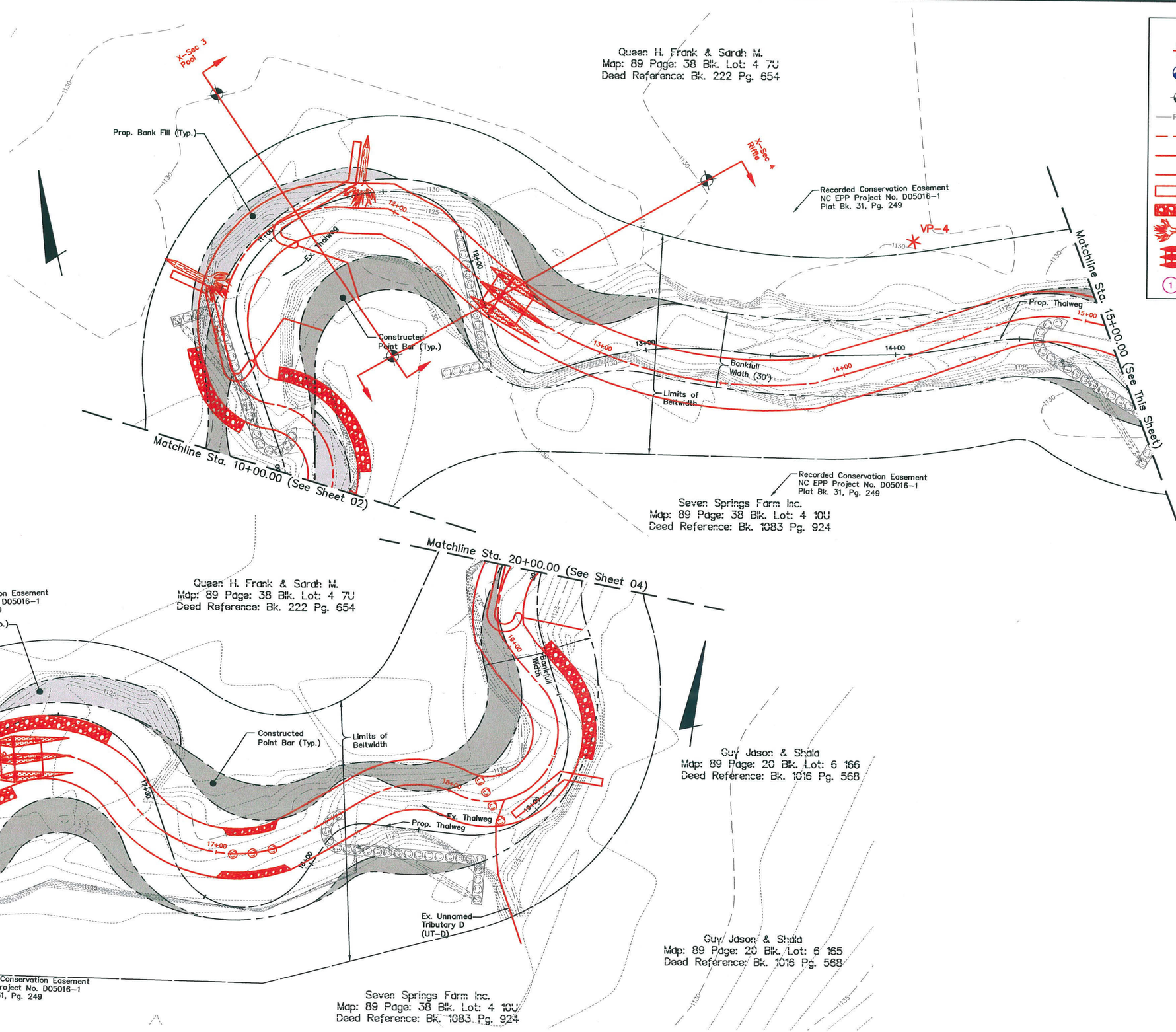

LEGEND

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Channel
- As-Built Structure
- As-Built Bank Stabilization
- As-Built Root Wad
- As-Built Riffle
- Photo Direction and Location

Job No. 2007-1898 | Sheet 3/6

Date January, 2007 | Scale Hor: 1" = 40' Ver: 1" = 4'

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR

SILVER CREEK AND UNNAMED TRIBUTARY

SILVER CREEK
PLAN & PROFILE

Ecosystem Enhancement Program

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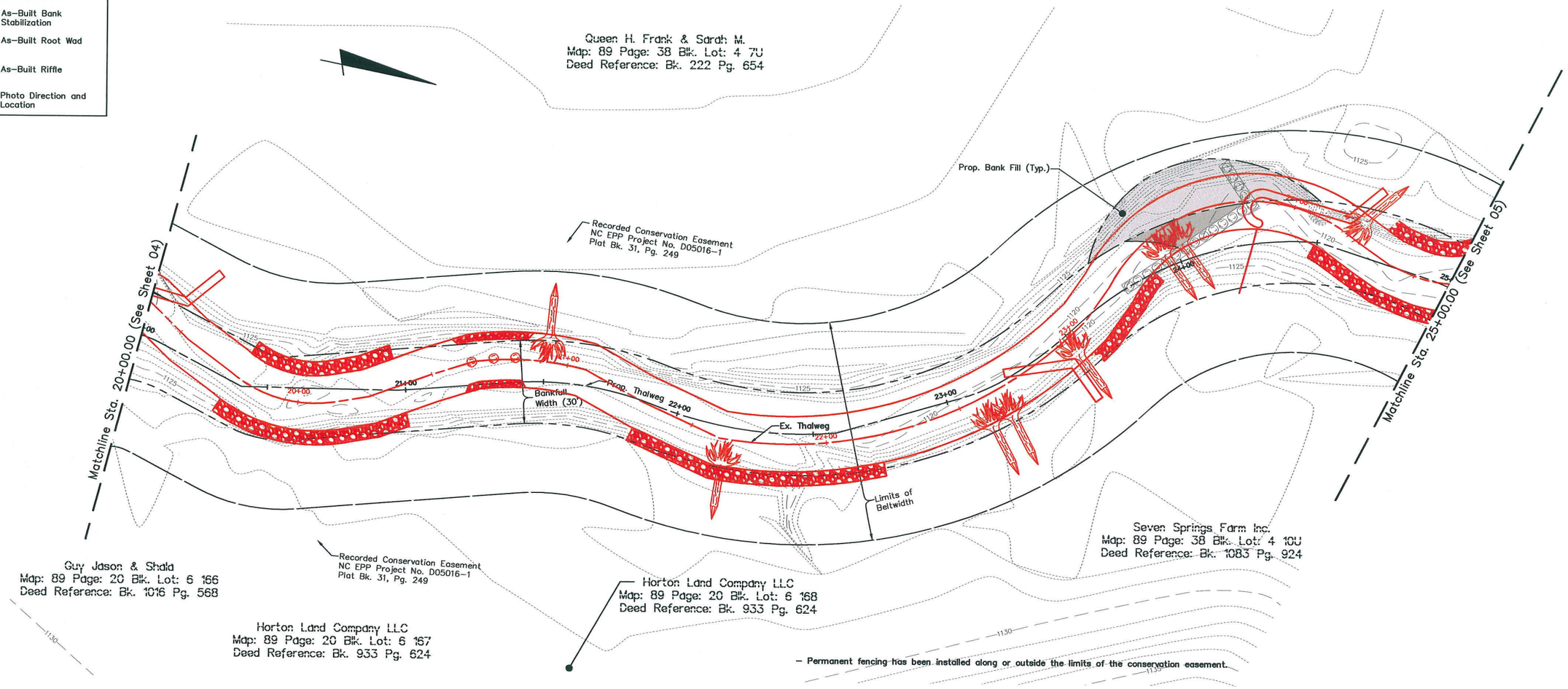
5500 New Albany Road, Columbus, Ohio 43054
Phone: 614.775.4500 Fax: 614.775.4800

LEGEND

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- P\L — Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Channel
- As-Built Structure
- As-Built Bank Stabilization
- As-Built Root Wad
- As-Built Riffle
- 1 → Photo Direction and Location



– Permanent fencing has been installed along or outside the limits of the conservation easement.

Job No.	Sheet
2007-1898	4/6
Date: January, 2008	Scale: Hor: 1" = 40' Ver: 1" = 4'

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR

SILVER CREEK AND UNNAMED TRIBUTARY

SILVER CREEK
PLAN & PROFILE

REVISIONS

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Engineers • Surveyors • Planners • Scientists
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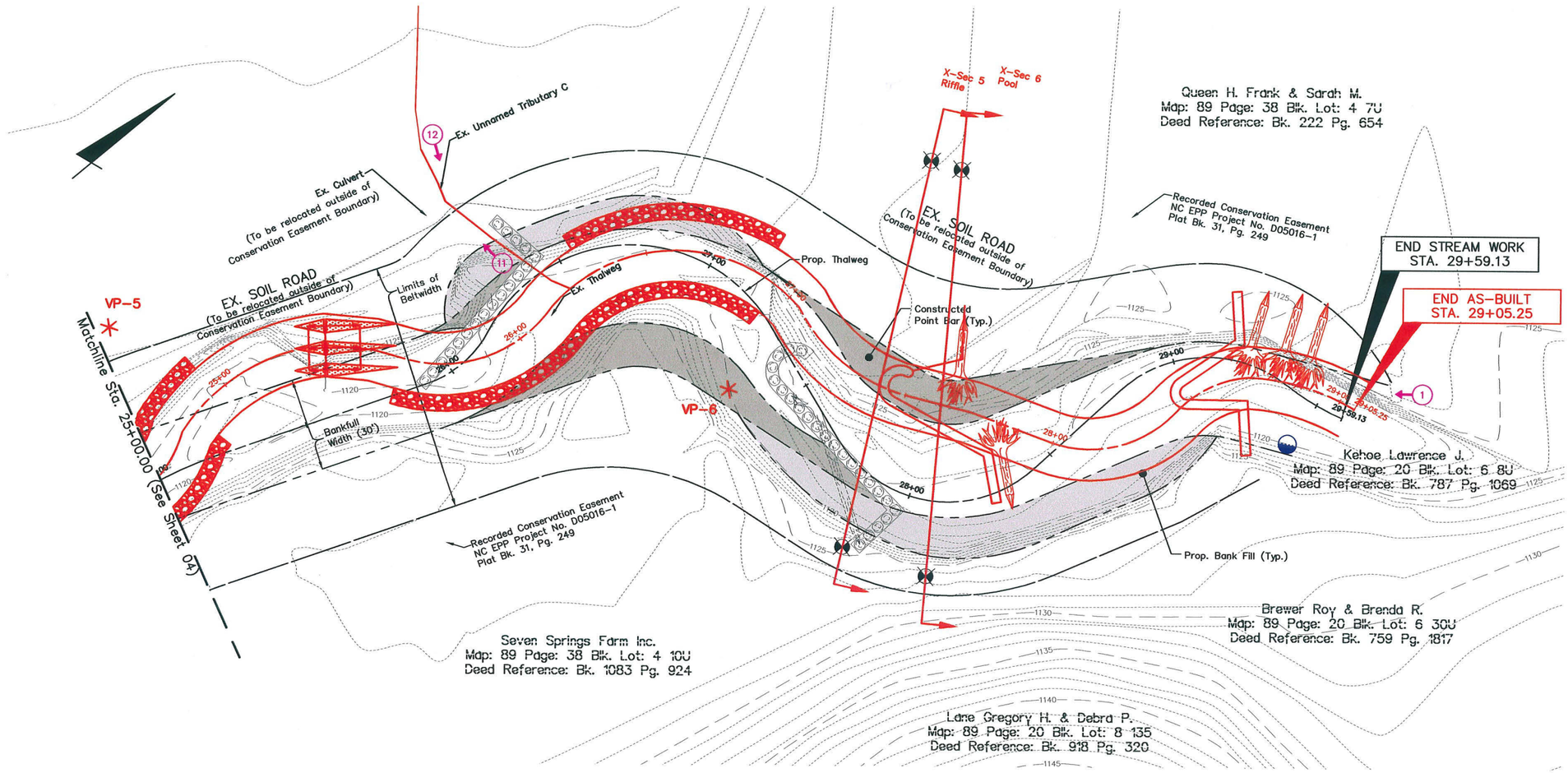
Ecosystem Enhancement Program

LEGEND

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Channel
- As-Built Structure
- As-Built Bank Stabilization
- As-Built Root Wad
- As-Built Riffle
- Photo Direction and Location



Job No. 2007-1898 | Sheet 5/6

Date January, 2008 | Scale Hor: 1" = 40' Ver: 1" = 4'

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
SILVER CREEK AND UNNAMED TRIBUTARY
SILVER CREEK
PLAN & PROFILE

Ecosystem Enhancement Program

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Environmental, Water Resources, Engineering, Planning & Surveying
Evans, Mechwart, Hambleton & Tilton, Inc.
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800

BEGIN AS-BUILT
STA. 0+00.00

BEGIN STREAM WORK
STA. 0+00.00

Queen H. Frank & Sarah M.
Map: 89 Page: 38 Blk. Lot: 4 7U
Deed Reference: Bk. 222 Pg. 654

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

Regrade Channel Banks & Reinforce w/Heavy Fabric and Live Branch Plantings

Unnamed Tributary To Silver Creek

Ex. Thalweg

X-Sec 1 Riffle

Ex. Log Vane (Do Not Disturb)

VP-1

VP-2

Matchline Sta. 5+00.00 (See This Sheet)

Permanent fencing has been installed along or outside the limits of the conservation easement.

Matchline Sta. 5+00.00 (See This Sheet)

Ex. Log Vane (Do Not Disturb)

Step Pools

Unnamed Tributary To Silver Creek

X-Sec 2 Pool

Proposed Bankfull Width (8')

Ex. Thalweg

Prop. Thalweg

Build Bankfull Channel w/Log Vanes

Ex. Overhead Electric

Ex. Log Vane (Do Not Disturb)

Matchline Sta. 10+00.00 (See This Sheet)

Matchline Sta. 10+00.00 (See This Sheet)

Recorded Conservation Easement
NC EPP Project No. D05016-1
Plat Bk. 31, Pg. 249

X-Sec 4 Riffle

X-Sec 3 Pool

VP-3

Unnamed Tributary To Silver Creek

Reinforce Bank w/Heavy Fabric and Live Branch Plantings

Ex. Thalweg

Regrade Channel Banks and Reinforce Bank w/Heavy Fabric and Live Branch Plantings

Proposed Bankfull Width (8')

Excavate Floodprone Bench

VP-4

Prop. Thalweg

Bank Reinforcement w/Point Bar

Riffle

Prop. Thalweg

Ex. Culvert

END AS-BUILT
STA. 15+66.60

END STREAM WORK
STA. 15+32.71

Seven Springs Farm Inc.
Map: 89 Page: 38 Blk. Lot: 4 10U
Deed Reference: Bk. 1083 Pg. 924

EX. SOIL ROAD

Recorded Conservation Easement
NC EEP Project NO. D04006-5
Plat Bk. 27, Pgs. 119-120

EEP Ingress/Egress Easement along Seven Springs Lane

LEGEND

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Channel
- As-Built Structure
- As-Built Bank Stabilization
- As-Built Root Wad
- As-Built Riffle
- Photo Direction and Location

Job No.	2007-1898
Sheet	6/6
Date	January, 2008
Scale	Hor: 1" = 40' Ver: 1" = 4'

BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR

UNNAMED TRIBUTARY TO SILVER CREEK

UT-A

PLAN & PROFILE

Ecosystem Enhancement Program

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800

III. PROJECT CONDITION AND MONITORING RESULTS

A. Vegetation Assessment

1. Soil Data

Soil information was obtained from the NRCS Soil Survey of Burke County, North Carolina (USDA NRCS, January 3, 2006). The soils along the mainstem of Silver Creek include the Colvard Series consisting of loamy sediments ranging from 40 to 60 inches or more in thickness over deposits of sandy, loamy gravelly to cobbly sediments. Rock fragments range from 0 to 15 percent to a depth of 40 inches, and from 0 to 80 percent below 40 inches. Flakes of mica range from a few to common.

The Rhodhiss Series is present along UTA and is residuum from the underlying felsic crystalline bedrock. The Rhodhiss sandy to sandy-clay loam is found on 25 to 40 percent hillside slopes with a depth to bedrock greater than 60 inches. The depth to the top of the argillaceous (clayey) horizon ranges from 2 to 20 inches. The depth to the base of the argillaceous horizon is 20 to 60 inches or more. The pedon contains 0 to 20 percent mica flakes throughout, with mica content ranging up to 35 percent below a depth of 40 inches when the C horizon is present.

Data on the soils series found within and near the project site is summarized in Table VI.

Table VI. Preliminary Soil Data
Silver Creek Stream Restoration / EEP Project No. D05016-01

Series	Max. Depth (in.)	% Clay on Surface	K[1]	T[2]	% Organic Matter
Colvard sandy loam (CvA)	60+	8-18	0.24	5	1-2
Rhodhiss sandy loam (RhD)	60+	5-20	0.24	5	0.5-2

[1]Erosion Factor K indicates the susceptibility of a soil to sheet and rill erosion, ranging from 0.05 to 0.69.
[2]Erosion Factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity, measured in tons per acre per year.

2. Vegetative Problem Areas

Vegetative Problem Areas are defined as areas either lacking vegetation or containing populations of exotic vegetation. There were no problem areas identified along any of the tributaries in Monitoring Year 1 to report in Table VII. There are several locations where the density of planted woody stems is not high enough to meet the required stem counts. Densities of planted woody species are discussed in the Stem Counts section of this report.

Several areas along the Silver Creek Mainstem were noted to have low overall herbaceous cover along the riparian corridor. These areas are small and scattered throughout the corridor, with none of the areas showing banks that are completely bare and none of the areas exhibiting colonization by invasive species. It was also noted that the permanent seeding has begun to grow and is expected to fill in the sparsely covered areas. Due to these reasons, these areas were not mapped and are not considered to be a problem at this time. There is one area along the Unnamed

Tributary in need of revegetation because this area relates to stream stability, it is discussed under the stream problem area section of this report.

3. Vegetation Problem Area Plan View

The location of each vegetation problem area found in future monitoring years will be shown on a vegetative problem area plan view.

4. Stem Counts

A summary of the stem count data for each species arranged by plot is shown in Table VIII. This data was compiled from the information collected on each plot using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0.* Additional data tables generated using the CVS-EEP format are included in Appendix A. All vegetation plots are labeled as VP on Figure 2.

Table VIII. Stem counts for each species arranged by plot.
Silver Creek Stream Restoration / EEP Project No. D05016-01

	Vegetation Plots										Year 0	Year 1	Year 2	
Species	**MS 1**	**MS 2**	**MS 3**	**MS 4**	**MS 5**	**MS 6**	**UTA 1**	**UTA 2**	**UTA 3**	**UTA 4**	**Totals**	**Totals**	**Totals**	**Survival %**
Shrubs														
Alnus serrulata	2			1	1			1	2		5	5	7	100%
Aronia melanocarpa			3			1					8	8	4	50%
Cornus amomum	2	2	5	4	4		1	1	1		31	25	20	65%
Trees														
Acer rubrum							2				2	2	2	100%
Acer saccharum	1			1	10	1					18	18	13	72%
Fraxinus pennsylvanica					1	1			3	4	15	15	9	60%
Liriodendron tulipifera	2				1	1					4	4	4	100%
Platanus occidentalis	2	4								2	16	11	8	50%
Quercus michauxii	1	2									3	3	3	100%
Quercus palustris	1												1	100%
Salix nigra			3								5	5	3	60%
Totals	11	8	11	6	17	4	3	2	6	6	107	96	74	69%
Live Stem Density (stems per acre)	446	324	446	243	689	162	122	81	243	243				
Average Live Stem Density (stems per acre)	300													

The average stem density for the site falls below the minimum criteria of 320 stems per acre after three years. Six individual plots had stem densities below the minimum. The largest deficit occurred along the Unnamed Tributary, where all four plots fell below the three-year threshold. Seedling mortality occurred along the entire length of the unnamed tributary, with the vegetation

plots exhibiting survival rates between 22% and 60%. Plot 4 along the mainstem also exhibited poor survivability, with a survival rate of 50%.

The Year 2 stem counts represent 69% survival from the initial plantings. As mentioned above, the plant mortality is highest along the unnamed tributary. The riparian corridor along the majority of this stream is already forested. While the woody plantings were focused on areas of open canopy in the existing tree cover, the presence of large trees and the well-developed existing vegetative cover shades the smaller seedlings and provides substantial competition for resources.

To address the issue of low plant stem counts, specific areas will be targeted for replanting within the Silver Creek and Unnamed Tributary riparian corridors, which will include the deficient sample plots and surrounding areas within the buffer. All deficient portions of the riparian corridors will be supplemented with additional native tree and shrub plantings. These supplemental plantings will follow the specifications of the project proposed in the project Restoration Plan and Mitigation Plan documents. Consideration will be given to using larger woody stock, such as three-gallon potted material versus bare root specimen in performing the remedial plantings. These larger saplings should have a more developed root system and thus be better able to compete with the existing vegetation. Supplemental replanting will occur during spring 2009. The subsequent Year 3 (2009) monitoring report will contain specific documentation of this remedial planting effort including the specific locations of replanting, and the quantity and species of tree and shrub material installed.

Section 401 Permit Monitoring

In addition to the vegetative monitoring plots on the Silver Creek Mainstem and UTA, one vegetation monitoring plot each has been placed on UTB and UTC, as required by the NC DWQ under the Section 401 permit. Monitoring for these plots includes simple stem counts by species, and does not follow the full methodology of the *CVS-EEP Protocol for Recording Vegetation, Version 4.0*. A summary of the stem count data for these plots is shown in Table VIIIa.

Table VIIIa. Stem counts for the additional plots on UTB and UTC

Species	Plots		Year 1 Totals	Year 2 Totals
	UTB	UTC		
Shrubs				
Aronia melanocarpa		1	0	1
Cephalanthus occidentalis	1	1	0	2
Cornus amomum	6		2	6
Trees				
Acer saccharum	1	7	7	8
Fraxinus pennsylvanica	1		6	1
Liriodendron tulipifera	3	1	2	4
Platanus occidentalis	1		0	1
Quercus alba		3	2	3
Year 1 Totals	13	13	19	26
Live Stem Density	527	527		
Average Live Stem Density	527			

The average stem density for these tributaries well exceeds the minimum criteria of 320 stems per acre after three years. The few supplemental plantings added to the site in the spring of 2008 successfully contributed to the large stem count total, and no further plantings are anticipated for these tributaries.

5. Vegetation Plot Photos

Vegetation plot photos, including photos for the additional plots on UTB and UTC, are provided in Appendix A.

B. Stream Assessment

1. Hydrologic Criteria

Two crest-stage stream gages were installed on the project reaches, one each of the Silver Creek Mainstem and UTA. The locations of the crest-stage stream gages are shown on the monitoring plan view (Figure 2). No bankfull events were documented for this site during the first or second years of monitoring.

2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for Years 1 and 2 is included in Tables IXa and IXb.

Table IXa. Stream Problem Areas – Year 1
Silver Creek Stream Restoration / EEP Project No. D05016-1

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Stressed/failing structure	5+75 UTA	Natural log sill - concern for long-term stability	SPA 1
Other	11+00 - 13+00 UTA	Nearly vertical banks - need to be stabilized with matting and vegetation	SPA 2

Table Xb. Stream Problem Areas – Year 2
Silver Creek Stream Restoration / EEP Project No. D05016-1

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Stressed/failing structure	5+75 UTA	Natural log sill – removed due to concern for long-term stability; channel stabilized	SPA 1
Bank scour	2+50 UTA	Bank scour/ sloughing on left bank	SPA 2
	3+55 UTA	Bank scour/ sloughing on right bank	
	5+60 UTA	Bank scour/ sloughing on left bank	
	10+50 UTA	Bank scour/ sloughing	
Other	11+00 - 13+00 UTA	Nearly vertical banks – have been reshaped, still in need of matting and revetment	SPA 3

Areas of instability were not observed along the Silver Creek Mainstem. On UTA, a natural log sill was preserved during construction. The long-term stability of this feature was a noted concern during the EEP scheduled site visit upon completion of restoration. This structure has been removed, and the channel has been stabilized with appropriately size rock quarried on site. This area remains on the problem area table to ensure it is closely monitored in the following years of monitoring to document the success of the channel stabilization activities. An additional area of concern exists along UTA concerning the steep slopes of the stream banks, also noted by EEP during the construction completion site visit. These banks have been regraded to stable slope conditions and will be revegetated with live stakes to further enhance stability.

Areas of bank scour noted on UTA include a few small areas of minor streambank erosion. Because these areas are small, the use of mechanical means to regrade the banks is not warranted. The areas noted are located in short, narrow channel reaches surrounded by existing forested cover. Any areas deemed to require maintenance to improve stability will be stabilized using vegetative means using live stakes, which provide rapid growth and dense root systems for soil stabilization.

3. Stream Problem Areas Plan View

The locations of problem areas are shown on the stream problem area plan view included in Appendix B. Each problem area is color coded with yellow for areas of low concern (areas to be monitored) or red for high concern (areas where maintenance is warranted).

4. Stream Problem Areas Photos

Photographs of the stream problem areas are included in Appendix B.

5. Fixed Station Photos

Photographs were taken at each established photograph station on September 8, 2008. These photographs are provided in Appendix B. Photographs of UTB and UTC are also provided, as required by the NC DWQ under the Section 401 permit.

6. Stability Assessment Table

The visual stream assessment was performed to determine the percentage of stream features that remain in a state of stability after the second year of monitoring. The visual assessment for each reach is summarized in Table Xa and Table Xb. This summary was compiled from the more comprehensive Table B1, included in Appendix B. Only those structures included in the as-built survey were assessed during monitoring and reported in the tables.

Table Xa. Categorical Stream Feature Visual Stability Assessment Silver Creek Stream Restoration / EEP Project No. D05016-01 Segment/Reach: Mainstem						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	100%	100%			
B. Pools[2]	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc.[3]	100%	100%	100%			
G. Wads and Boulders[4]	N/A	N/A	N/A			

Table Xa. Categorical Stream Feature Visual Stability Assessment Silver Creek Stream Restoration / EEP Project No. D05016-01 Segment/Reach: Tributary A						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	100%	100%			
B. Pools[2]	100%	66%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc.[3]	100%	98%	100%			
G. Wads and Boulders[4]	N/A	N/A	N/A			

[1]Riffles are assessed using the longitudinal profile. A riffle is determined to be stable based on a comparison of location and elevation with respect to the as-built profile.

[2]Pools are assessed using the longitudinal profile. A pool is determined to be stable based on a comparison of location and elevation with respect to the as-built profile and a consideration of appropriate depth.

[3]Physical structures such as vanes, J-hooks, and root wads are assessed using the as-built plan sheets to define the location of such features. A structure is considered stable if the feature remains functional in the same location as shown in the as-built plan.

[4]Those features not included in the stream restoration were labeled N/A. This includes structures such as rootwads and boulders.

Visual stream stability assessment, conducted by EMH&T on September 8, 2008 revealed in-stream structures are functioning as designed and built on the Silver Creek mainstem and UTA. Point bars have formed along the inside meander bends on the mainstem. Cross-vanes, J-hook vanes, rock vanes, dual-winged jetties, rock-toe channel protection, root wad bank stabilization, step pools and constructed riffles are functioning as designed and intended. One natural log sill noted as an area of concern by EEP during As-Built site visit in April 2007 was removed during Year 2 and the channel and streambanks stabilized and regraded using native stone quarried on site. Live branch and bare root seedlings will be planted during the Spring 2008 planting season. This location will continue to be monitored for long-term stability on Tributary A. Deep pools with excellent glide features, comprised of well sorted gravels, are present throughout the restored mainstem reach. Pool depths on the mainstem have noticeably increased to As-Built depths. Constructed riffles remain stable, with median particle distributions ranging from fine to very

coarse gravel. The substrate in the pools has remained stable as well, with median particle distributions ranging from fine sand to fine gravel. Despite extreme drought and low flow conditions during 2008, the stream channels are appropriately sized and are entraining their bedload without aggrading or degrading.

Section 401 Permit Monitoring

Monitoring is required by the NC DWQ under the Section 401 permit to ensure that stability is achieved along the restored portions of Unnamed Tributaries B and C. These streams were visually assessed for stability at the same time that the visual stream stability assessment was performed for the Silver Creek Mainstem and UTA. Both UTB and UTC appeared to be stable during this assessment. Photographic documentation of the stability of the preserved portions of Tributaries B and C is included with the Fixed Station Photographs in Appendix B.

7. Quantitative Measures

Graphic interpretations of cross-sections, profiles and substrate particle distributions are presented in Appendix B. A summary of the baseline morphology for the site is included in Table XI for comparison with the monitoring data shown in the tables in the appendix.

The stream pattern data provided for As-Built, Year 1 and Year 2 is the same as the data provided from the As-Built survey, as pattern has not changed based on the Year 2 stream surveys and visual field assessment.

Bedform features continue to evolve along the restored reaches as shown on the long-term longitudinal profiles. Riffle lengths and slopes are stable. Pool to pool spacings are representative of As-Built conditions. The deep pools have developed excellent glide features, providing spawning habitat for native fishes; riffle substrates are conducive for benthic macro-invertebrate populations to re-emerge. Comparison of As-Built, Year 1 and Year 2 long-term stream monitoring data show stability with minimal change from as-built conditions.

The constructed riffles remain stable, with a median particle distributions ranging from fine to very coarse gravel. The pool substrate remains stable as well, with median particle sizes ranging from fine sand to fine gravel based on Year 2 substrate analysis.

IV. METHODOLOGY

Year 1 vegetation monitoring was conducted in September 2007 using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, RK., Roberts, S.R., Wentworth, T.R. 2006). Year 2 vegetation monitoring was conducted in September 2008 using the same protocol. Year 1 stream monitoring was conducted in November 2007 to provide adequate time between the as-built survey (completed in May 2007) and the Year 1 monitoring survey. Stream monitoring for Year 2 occurred in the fall of 2008, providing a full year between the Year 1 and Year 2 surveys. Subsequent stream monitoring will occur in the fall of Years 3 through 5 to provide a full year between surveys. Vegetation monitoring will continue to be conducted in the fall of each subsequent year of monitoring, providing a full year between vegetative surveys.

Table XI. Baseline Geomorphic and Hydraulic Summary

Silver Creek Stream Restoration / EEP Project No. D05016-01

Station/Reach: Mainstem {Long-Term Monitoring Profile Station 0+00 to 20+71.94 (2071.94 linear feet)}

Parameter	Reference Reach			Pre-Existing Condition			Design			As-Built			Year 1 Sta. 0+00 - 18+71			Year 2 Sta. 0+00 - 20+72		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			1.16			8.26			8.26			8.26			8.26			8.26
BF Width (ft)			24.02	29.22	122.47	60.86			30.00	46.18	69.81	58.00	46.14	68.80	57.47	43.86	68.44	58.73
Floodprone Width (ft)			232.00	37.00	84.00	60.00	54.0	145.0	99.5	82.81	114.45	98.63	82.93	114.25	98.59	81.98	114.11	101.89
BF Cross Sectional Area (ft^2)			30.77	139.70	230.44	176.46			90.00	83.59	103.55	93.57	83.97	100.15	92.06	73.69	95.39	89.90
BF Mean Depth (ft)			1.28	1.88	5.45	3.95			1.59	1.29	1.81	1.55	1.46	1.82	1.64	1.39	1.68	1.49
BF Max Depth (ft)			1.72	6.57	7.62	7.04			3.00	2.80	3.75	3.28	2.81	3.48	3.15	3.08	4.15	3.35
Width/Depth (ft)			18.77	5.36	65.14	25.78			18.87	25.51	52.16	38.84	25.35	47.12	36.24	26.11	49.24	40.22
Entrenchment Ratio			9.66	0.69	1.91	1.29	1.80	4.83	3.32	1.59	1.79	1.69	1.66	1.80	1.73	1.60	1.87	1.79
Bank Height Ratio			1.00	3.89	4.07	3.98			1.00	1.00	1.02	1.01	1.00	1.00	1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			26.58	35.78	152.95	75.32			33.18	46.98	70.20	58.59	46.96	69.18	58.07	44.62	69.80	59.58
Hydraulic Radius (ft)			1.16	1.51	4.28	3.23			2.71	1.27	1.78	1.53	1.45	1.79	1.62	1.37	1.65	1.47
Pattern																		
*Channel Beltwidth (ft)	44.17	46.50	45.22	37	84	60	54.0	145.0	93.9	82.81	181.94	109.79	82.93	114.25	102.73	82.93	114.25	102.73
*Radius of Curvature (ft)	12.97	24.44	17.67				45.0	75.0	60.0	46.07	185.40	68.70	46.07	185.40	68.70	46.07	185.40	68.70
*Meander Wavelength (ft)	88.23	115.70	104.80				60.0	191.8	125.9	73.79	191.70	124.86	73.79	191.70	124.86	73.79	191.70	124.86
*Meander Width Ratio	1.84	1.94	1.88	0.61	1.38	0.99	1.80	4.83	3.13	1.79	2.61	1.89	1.66	1.80	1.79	1.57	1.89	1.75
Profile																		
Riffle Length (ft)	19.0	31.0	25.7	6.5	10.5	12.5			32.9	9.4	47.7	28.4	7.3	47.3	27.8	7.5	68.6	29.6
Riffle Slope (ft/ft)	0.0125	0.0362	0.0211	0.0045	0.0096	0.0069			0.0056	0.0039	0.1787	0.0242	0.0084	0.0318	0.0165	0.0080	0.0218	0.0131
Pool Length (ft)	11.0	31.6	17.4	20.1	36.1	26.3			65.7	17.1	56.9	35.7	28.1	70.7	51.3	17.8	89.9	47.4
Pool Spacing (ft)	67.6	77.5	71.4	101.1	149.0	129.1			131.4	36.4	388.3	145.5	61.5	257.3	161.2	49.1	245.9	114.9
Substrate																		
d50 (mm)			38.5	12.9	38.5	26.6	12.9	38.5	25.7	15.5	26.9	21.2	7.7	16.5	12.1	9.8	21.4	18.9
d84 (mm)			60.2	20.6	60.2	52.3	20.6	60.2	40.4	21.2	30.4	25.8	10.9	21.3	16.1	15.3	29.8	27.6
Additional Reach Parameters																		
Valley Length (ft)			294.00			2077			2077			2077			1336			1480
Channel Length (ft)			353.00			3040			2959			2905			1871			2072
Sinuosity			1.2			1.46			1.43			1.40			1.40			1.40
Water Surface Slope (ft/ft)			0.0106	0.0022	0.0030	0.0026			0.0025			0.0026			0.0028			0.0027
BF Slope (ft/ft)			0.0115			**			0.0026			0.0027			0.0028			0.0027
Rosgen Classification			C4			F4	B4c	C4	C4			B4c			B4c			B4c
*Habitat Index																		
*Macrobenthos																		

Notes: * Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

**Insufficient field indicators to estimate bankfull slope under impaired F4 channel conditions.

Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

Where no min/max values are provided, only one value was measured or computed and is presented as the median value.

Table XI. Baseline Geomorphic and Hydraulic Summary

Silver Creek Stream Restoration / EEP Project No. D05016-01

Station/Reach: Tributary A {Long-Term Monitoring Profile Station 0+00 to 10+49.79 (1049.79 feet)}

Parameter	Reference Reach			Pre-Existing Condition			Design			As-Built			Year 1 Sta 0+00 - 10+43			Year 2 Sta 0+00 - 10+50		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			1.16			0.08			0.08			0.08			0.08			0.08
BF Width (ft)			24.02			13.72			8.00	6.81	8.11	7.46	6.78	7.32	7.05	6.62	7.20	6.91
Floodprone Width (ft)			232.00	10.00	15.00	12.50	10.00	15.00	12.50	13.28	14.57	13.93	10.45	13.35	11.90	12.15	17.83	14.71
BF Cross Sectional Area (ft^2)			30.77			3.54			3.50	3.51	3.59	3.55	3.52	3.57	3.55	3.29	4.08	3.69
BF Mean Depth (ft)			1.28			0.26			0.50	0.43	0.53	0.48	0.48	0.53	0.51	0.50	0.57	0.54
BF Max Depth (ft)			1.72			0.90			1.00	0.81	1.01	0.91	0.63	1.01	0.82	1.00	1.02	1.01
Width/Depth (ft)			18.77			52.77			16.00	12.85	18.86	15.86	12.79	15.25	14.02	12.63	17.13	14.71
Entrenchment Ratio			9.66			0.91			1.56	1.80	1.95	1.88	1.43	1.97	1.70	1.84	2.48	2.13
Bank Height Ratio			1.00			1.91			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			26.58			13.97			9.00	6.97	8.28	7.63	7.08	7.56	7.32	6.97	7.50	7.24
Hydraulic Radius (ft)			1.16			0.25			0.39	0.42	0.50	0.46	0.47	0.50	0.49	0.47	0.54	0.51
Pattern																		
*Channel Beltwidth (ft)	44.17	46.50	45.22							10.80	14.57	12.95	10.80	14.57	12.95	10.80	14.57	12.95
*Radius of Curvature (ft)	12.97	24.44	17.67							9.32	124.90	23.59	9.32	124.90	23.59	9.32	124.90	23.59
*Meander Wavelength (ft)	88.23	115.70	104.80							58.82	106.30	73.72	58.82	106.30	73.72	58.82	106.30	73.72
*Meander Width Ratio	1.84	1.94	1.88							1.45	1.95	1.74	1.59	1.99	1.84	1.82	1.84	1.83
Profile																		
Riffle Length (ft)	19.0	31.0	25.7							1.34	47.90	15.30	2.35	49.50	12.84	1.85	48.70	14.07
Riffle Slope (ft/ft)	0.0125	0.0362	0.0211							0.0344	0.6094	0.1389	0.0401	0.4593	0.1278	0.0373	0.5344	0.1334
Pool Length (ft)	11.0	31.6	17.4							6.07	22.79	12.43	6.59	24.21	13.81	6.30	23.50	13.10
Pool Spacing (ft)	67.6	77.5	71.4							10.19	143.20	55.63	10.92	150.25	38.78	10.60	146.70	47.20
Substrate																		
d50 (mm)			38.5							6.9	15.8	11.4	2.4	8.2	5.3	2.4	11.8	7.1
d84 (mm)			60.2							20.2	42.4	31.3	9.2	14.3	11.8	1.6	17.9	10.7
Additional Reach Parameters																		
Valley Length (ft)			294.00			1426			1426			1426			1137			1145
Channel Length (ft)			353.00			1508			1533			1552			1043			1050
Sinuosity			1.2			1.06			1.07			1.09			1.09			1.09
Water Surface Slope (ft/ft)			0.0106	0.0350	0.0500	0.0425	0.0350	0.0500	0.0425			0.0427			0.0385			0.0386
BF Slope (ft/ft)			0.0115			**	0.0375	0.0535	0.0455			0.0469			0.0367			0.0386
Rosgen Classification			C4			A→B	A1/A2 → B4a					B4a			B4			B4
*Habitat Index																		
*Macrobenthos																		

Notes: * Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

**Insufficient field indicators to estimate bankfull slope under altered A → B channel conditions.

Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

Where no min/max values provided, only one value was measured or computed and is presented as the mean value.

APPENDIX A

Vegetation Raw Data

1. Vegetation Monitoring Plot Photos
2. Vegetation Data Tables

Vegetation Plot 1 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 2 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 3 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 4 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 5 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 6 on Mainstem
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 1 on Tributary A
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 2 on Tributary A
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 3 on Tributary A
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot 4 on Tributary A
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot on Tributary B
Monitoring Year 2
(EMH&T, September 8, 2008)

Vegetation Plot on Tributary C
Monitoring Year 2
(EMH&T, September 8, 2008)

Table 1. Vegetation Metadata	
Report Prepared By	Holly Blunck
Date Prepared	9/30/2008 9:58
database name	CVS_EEP_DataEntry_v202.mdb
database location	Q:\ENVIRONMENTAL\Monitoring\EEP Vegetation Database
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	D0501601
project Name	Silver Creek
Description	Restoration of Silver Creek Mainstem and Unnamed Tributary A.
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	10

Table 2. Vegetation Vigor by Species							
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**
	Acer rubrum		2				
	Acer saccharum		4	9		2	3
	Alnus serrulata	6		1			1
	Aronia melanocarpa		2	2			4
	Cornus amomum	2	14	4		3	8
	Fraxinus pennsylvanica	5	2	2			6
	Liriodendron tulipifera	1	2	1			
	Platanus occidentalis	5	2	1		1	8
	Quercus michauxii	1	2				1
	Quercus palustris		1				
	Salix nigra	3					2
TOT:	**10**	**23**	**31**	**20**	**0**	**6**	**33**

Table 3. Vegetation Damage by Species													
	Species	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)
	Acer rubrum	2	2									
	Acer saccharum	13	10								3	
	Alnus serrulata	7	6								1	
	Aronia melanocarpa	4	4									
	Cornus amomum	20	16		3						1	
	Fraxinus pennsylvanica	9	7		1						1	
	Liriodendron tulipifera	4	3		1							
	Platanus occidentalis	8	8									
	Quercus michauxii	3	3									
	Quercus palustris	1	1									
	Salix nigra	3	3									
TOT:	**11**	**74**	**63**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**6**	**0**

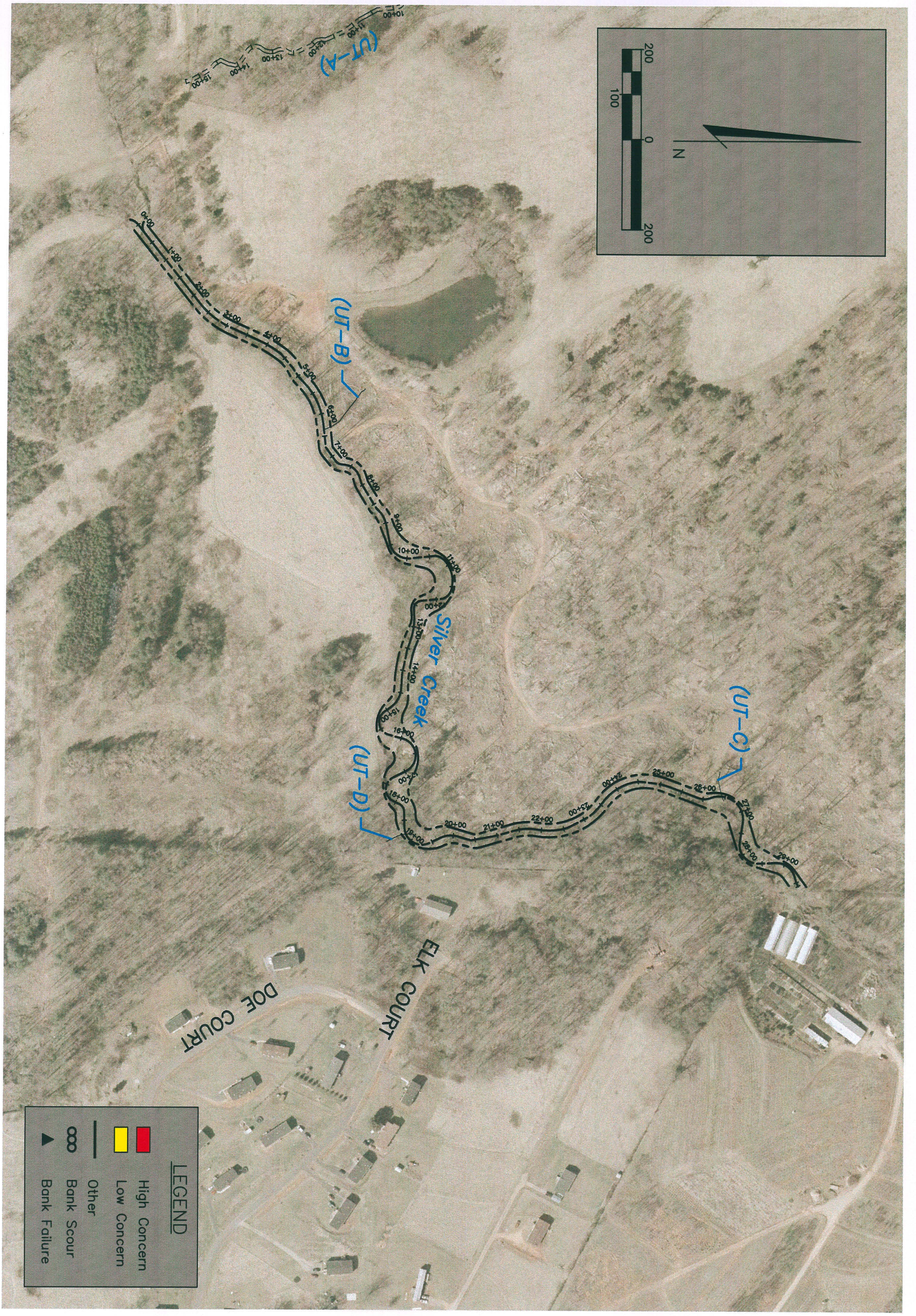
Table 4. Vegetation Damage by Plot												
	plot	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)
	D0501601-01-0001 (year 2)	11	9		2							
	D0501601-01-0002 (year 2)	8	8									
	D0501601-01-0003 (year 2)	11	9		2							
	D0501601-01-0004 (year 2)	6	5								1	
	D0501601-01-0005 (year 2)	17	15								2	
	D0501601-01-0006 (year 2)	4	4									
	D0501601-01-0007 (year 2)	3	2								1	
	D0501601-01-0008 (year 2)	2	2									
	D0501601-01-0009 (year 2)	6	4								2	
	D0501601-01-0010 (year 2)	6	5		1							
TOT:	**10**	**74**	**63**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**6**	**0**

Table 5. Stem Count by Plot and Species															
	Species	Total Stems	# plots	avg# stems	plot D0501601-01-0001 (year 2)	plot D0501601-01-0002 (year 2)	plot D0501601-01-0003 (year 2)	plot D0501601-01-0004 (year 2)	plot D0501601-01-0005 (year 2)	plot D0501601-01-0006 (year 2)	plot D0501601-01-0007 (year 2)	plot D0501601-01-0008 (year 2)	plot D0501601-01-0009 (year 2)	plot D0501601-01-0010 (year 2)
	Acer rubrum	2	1	2							2			
	Acer saccharum	13	4	3.25	1			1	10	1				
	Alnus serrulata	7	5	1.4	2			1	1			1	2	
	Aronia melanocarpa	4	2	2			3			1				
	Cornus amomum	20	8	2.5	2	2	5	4	4		1	1	1	
	Fraxinus pennsylvanica	9	4	2.25					1	1			3	4
	Liriodendron tulipifera	4	3	1.33	2				1	1				
	Platanus occidentalis	8	3	2.67	2	4								2
	Quercus michauxii	3	2	1.5	1	2								
	Quercus palustris	1	1	1	1									
	Salix nigra	3	1	3			3							
TOT:	**11**	**74**	**11**		**11**	**8**	**11**	**6**	**17**	**4**	**3**	**2**	**6**	**6**

APPENDIX B

Geomorphologic Raw Data

1. Stream Problem Areas Plan View
2. Stream Problem Area Photos
3. Fixed Station Photos
4. Table B1. Qualitative Visual Stability Assessment
5. Cross Section Plots
6. Longitudinal Plots
7. Pebble Count Plots



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BURKE COUNTY, NORTH CAROLINA

SILVER CREEK AND UNNAMED TRIBUTARY

MONITORING

APPENDIX B

STREAM PROBLEM AREA PLAN VIEW

Date:	December, 2008
Scale:	1" = 200'
Job No:	2007-1898
Sheet:	1/2

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APPENDIX B

STREAM PROBLEM AREA PLAN VIEW

Date:	December, 2008
Scale:	1" = 200'
Job No:	2007-1898
Sheet:	2/2

SPA 1
Natural log sill on Unnamed Tributary A near station 5+75. Log sill was removed and channel stabilized with rock.
(EMH&T, September 8, 2008)

SPA 2
Right streambank scour on Unnamed Tributary A near station 3+55.
(EMH&T, September 8, 2008)

SPA 3
Close-up of right streambank scour on Unnamed Tributary A near station 3+55.
(EMH&T, September 8, 2008)

SPA 4
Steep streambanks on Unnamed Tributary A, looking downstream near station 12+00. The streambanks have been mechanically reshaped; the remaining stabilization will occur using vegetative means.
(EMH&T, September 8, 2008)

Fixed Station 1
Overview of the Silver Creek Mainstem, facing upstream near the bottom of the mainstem restored reach.
(EMH&T, September 8, 2008)

Fixed Station 2
Overview of the Silver Creek Mainstem at Riffle #3, facing downstream.
(EMH&T, September 8, 2008)

Fixed Station 3
Overview of the Silver Creek Mainstem at Riffle #1, facing downstream.
(EMH&T, September 8, 2008)

Fixed Station 4
Overview of the Silver Creek Mainstem at Riffle #1, facing upstream.
(EMH&T, September 8, 2008)

Fixed Station 5
Overview of the Silver Creek Mainstem, facing downstream near station 2+60.
(EMH&T, September 8, 2008)

Fixed Station 6
Overview of UT-A, facing upstream near station 0+50.
(EMH&T, September 8, 2008)

Fixed Station 7
Overview of UT-A, facing upstream near station 8+00.
(EMH&T, September 8, 2008)

Fixed Station 8
Overview of UT-A, facing upstream near station 11+00.
(EMH&T, September 8, 2008)

Fixed Station 9
Overview of UT-B, facing upstream from the confluence of UT-B with Silver Creek.
(EMH&T, September 8, 2008)

Fixed Station 10
Overview of UT-B, facing downstream towards the confluence of UT-B with Silver Creek.
(EMH&T, September 8, 2008)

Fixed Station 11
Overview of UT-C, facing upstream from the confluence of UT-C with Silver Creek.
(EMH&T, September 8, 2008)

Fixed Station 12
Overview of UT-C, facing downstream towards the confluence of UT-C with Silver Creek.
(EMH&T, September 8, 2008)

Table B1. Visual Morphological Stability Assessment
Silver Creek Stream Restoration / EEP Project No. D05016-1
Segment/Reach: Mainstem

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number/ feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	25	25	0	100	
	2. Armor stable (e.g. no displacement)?	25	25	0	100	
	3. Facet grade appears stable?	25	25	0	100	
	4. Minimal evidence of embedding/fining?	25	25	0	100	
	5. Length appropriate?	25	25	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	24	24	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	24	24	0	100	
	3. Length appropriate?	24	24	0	100	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	25	25	0	100	
	2. Downstream of meander (glide/inflection) centering?	25	25	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	25	25	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	25	25	0	100	
	3. Apparent Rc within spec?	25	25	0	100	
	4. Sufficient floodplain access and relief?	25	25	0	100	**100%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	0/ 0 feet	100	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**100%**
F. Vanes	1. Free of back or arm scour?	15	15	0	100	
	2. Height appropriate?	15	15	0	100	
	3. Angle and geometry appear appropriate?	15	15	0	100	
	4. Free of piping or other structural failures?	15	15	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	N/A

Table B1. Visual Morphological Stability Assessment
Silver Creek Stream Restoration / EEP Project No. D05016-1
Segment/Reach: Tributary A

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	25	25	0	100	
	2. Armor stable (e.g. no displacement)?	25	25	0	100	
	3. Facet grade appears stable?	25	25	0	100	
	4. Minimal evidence of embedding/fining?	25	25	0	100	
	5. Length appropriate?	25	25	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	15	15	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	15	15	0	100	
	3. Length appropriate?	15	15	0	100	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	12	12	0	100	
	2. Downstream of meander (glide/inflection) centering?	12	12	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	12	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	12	12	0	100	
	3. Apparent Rc within spec?	12	12	0	100	
	4. Sufficient floodplain access and relief?	12	12	0	100	**100%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	0/ 0 feet	100	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**100%**
F. Vanes	1. Free of back or arm scour?	17	17	0	100	
	2. Height appropriate?	16	17	0	100	
	3. Angle and geometry appear appropriate?	17	17	0	100	
	4. Free of piping or other structural failures?	17	17	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	N/A

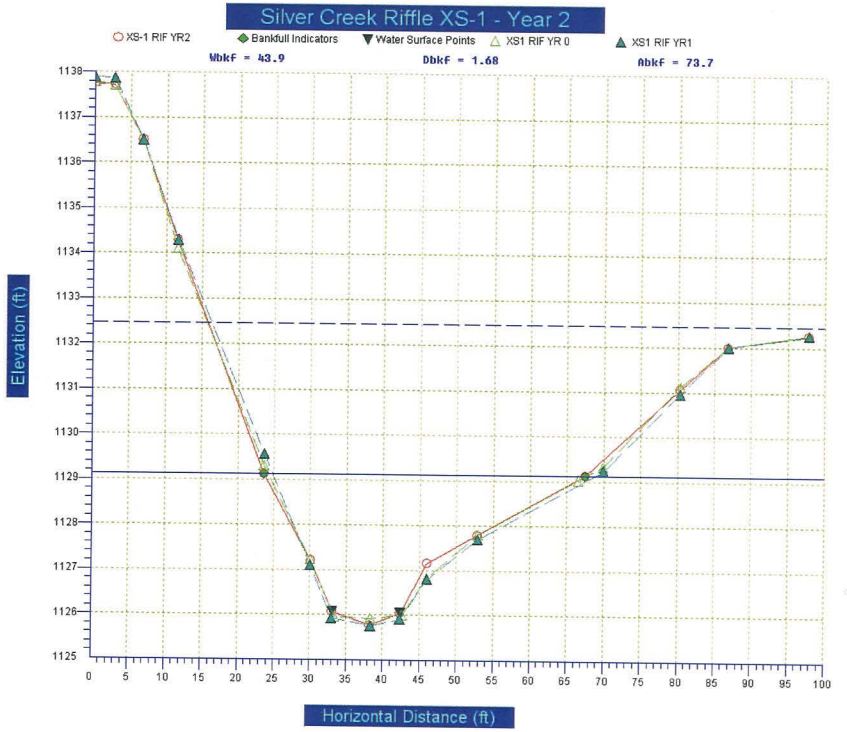
Summary Data

Bankfull Area (sq ft)	73.69
Bankfull Width (ft)	43.86
Mean Depth (ft)	1.68
Maximum Depth (ft)	3.35
Width/Depth Ratio	26.11
Entrenchment Ratio	1.87
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/2008
CROSS SECTION:	1
FEATURE:	Riffle at Cross Vane # 1

Ecosystem Enhancement

Riffle Cross-Section 1, looking right to left (September 8, 2008)



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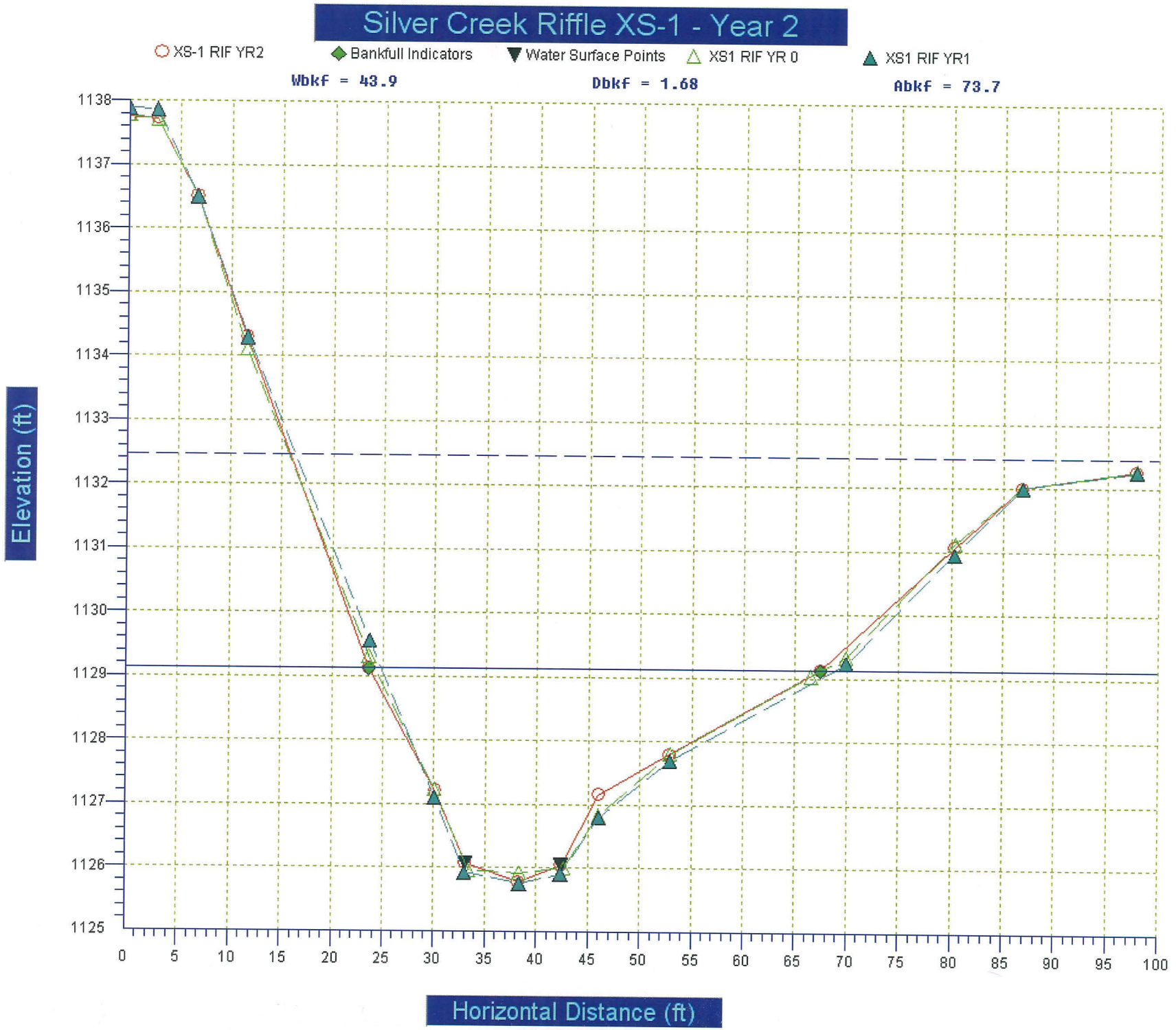

Silver Creek Riffle XS-1 - Year 2
XS-1 RIF YR2
Bankfull Indicators
Water Surface Points
XS1 RIF YR 0
XS1 RIF YR1
Wbkf = 43.9
Dbkf = 1.68
Abkf = 73.7
Elevation (ft)
1138
1137
1136
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Horizontal Distance (ft)

XS1 RIF YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS-1 RIF YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1137.75	HT
2.77	0	1137.73	HT
6.73	0	1136.5	bm
11.62	0	1134.29	fp
23.61	0	1129.12	BKF
30.1	0	1127.2	
33.1	0	1126.06	lew 0.0
38.27	0	1125.77	cv 0.2
42.41	0	1126.04	rew 0.0
46.03	0	1127.15	
52.84	0	1127.79	fp
67.47	0	1129.12	BKF
80.34	0	1131.06	fp
86.81	0	1132	bm
97.82	0	1132.26	lt

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1132.47	1132.47	1132.47
Bankfull Elevation (ft)	1129.12	1129.12	1129.12
Floodprone Width (ft)	81.98	-----	-----
Bankfull Width (ft)	43.86	14.6	29.26
Entrenchment Ratio	1.87	-----	-----
Mean Depth (ft)	1.68	2.06	1.49
Maximum Depth (ft)	3.35	3.35	3.35
Width/Depth Ratio	26.11	7.09	19.64
Bankfull Area (sq ft)	73.69	30.07	43.62
Wetted Perimeter (ft)	44.62	18.44	32.87

Hydraulic Radius (ft)	1.65	1.63	1.33
Begin BKF Station	23.61	23.61	38.21
End BKF Station	67.47	38.21	67.47

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

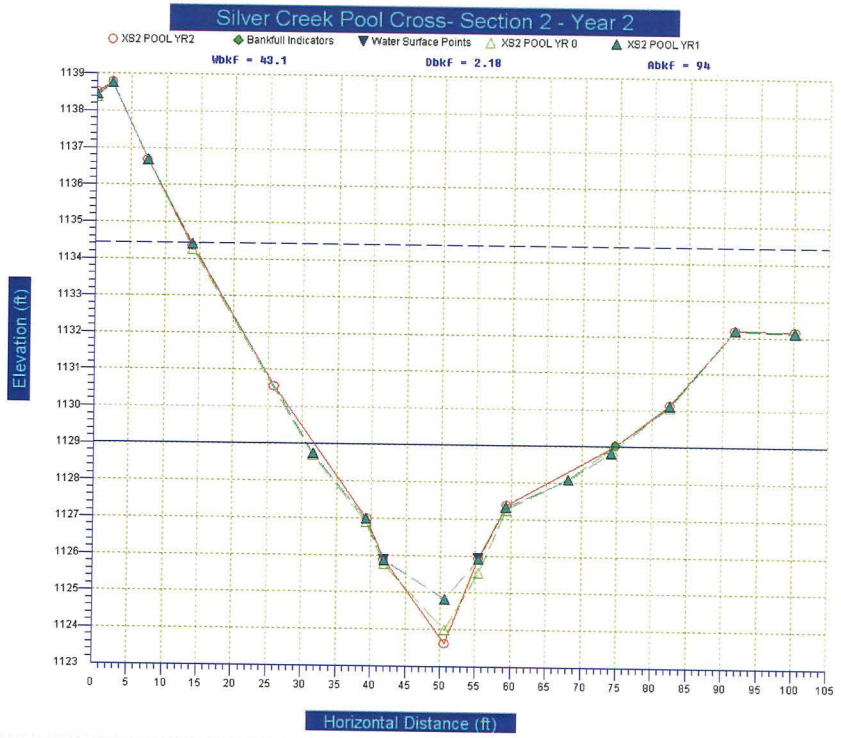
	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.28		
Movable Particle (mm)	59.3		

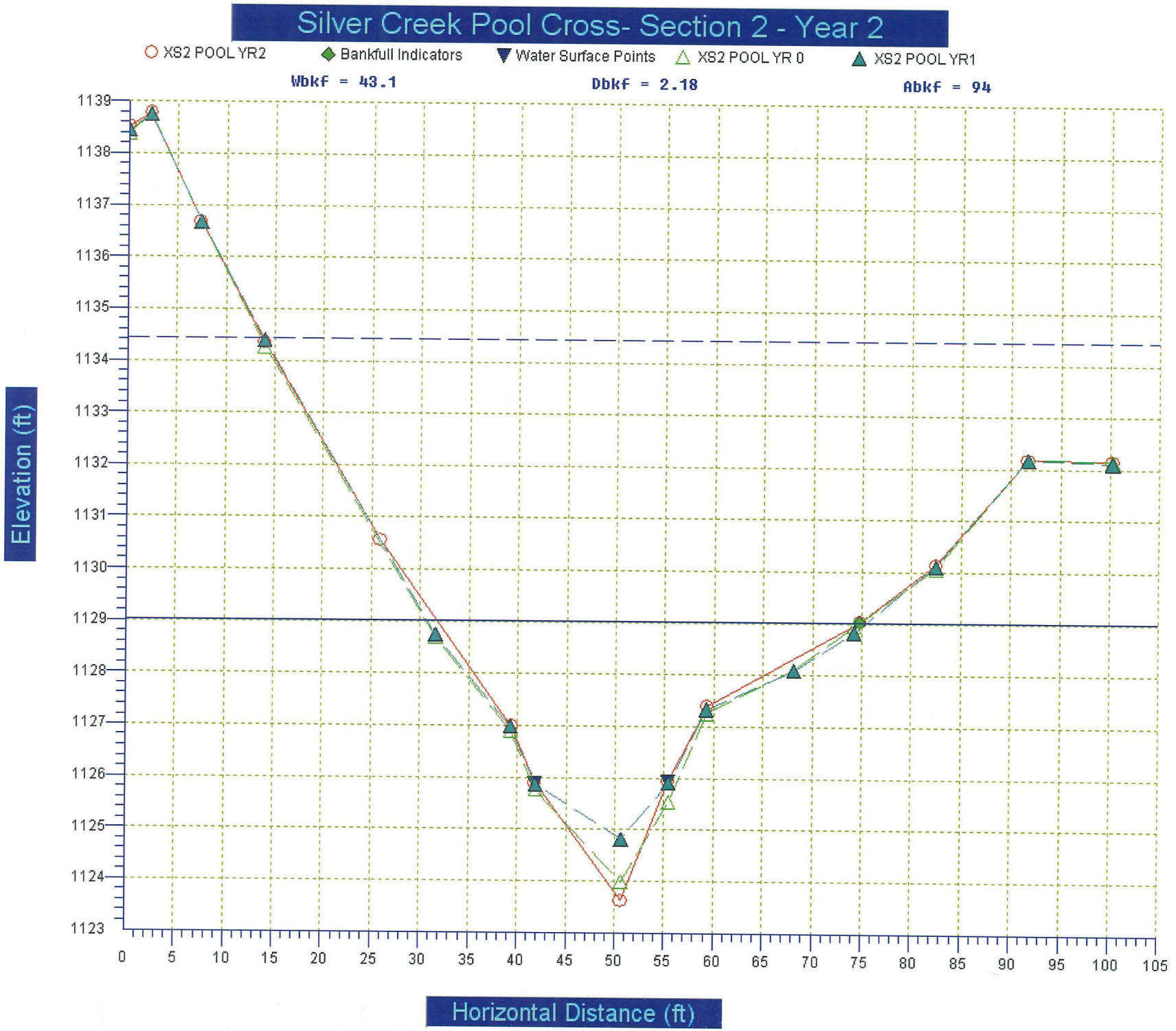
Summary Data

Bankfull Area (sq ft)	93.99
Bankfull Width (ft)	43.13
Mean Depth (ft)	2.18
Maximum Depth (ft)	5.41
Width/Depth Ratio	19.78
Entrenchment Ratio	2.01
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/2008
CROSS SECTION:	2
FEATURE:	Pool at Cross Vane # 1

Pool Cross-Section 2, looking upstream (September 8, 2008)




Silver Creek Pool Cross- Section 2 - Year 2
XS2 POOL YR2
Bankfull Indicators
Water Surface Points
XS2 POOL YR 0
XS2 POOL YR1
Wbkf = 43.1
Dbkf = 2.18
Abkf = 94
Elevation (ft)
1139
1138
1137
1136
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
Horizontal Distance (ft)

XS2 POOL YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS2 POOL YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1138.52	fp
2.27	0	1138.77	bw/ht
7.42	0	1136.68	bm
13.93	0	1134.35	fp
25.89	0	1130.56	
39.4	0	1126.98	
41.79	0	1125.89	lew 0.0
50.62	0	1123.61	p 1.55
55.37	0	1125.93	rew 0.0
59.39	0	1127.39	
74.83	0	1129.02	BKF
82.46	0	1130.13	fp
91.71	0	1132.17	bm
100.25	0	1132.15	fp/lt

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1134.43	1134.43	1134.43
Bankfull Elevation (ft)	1129.02	1129.02	1129.02
Floodprone Width (ft)	86.54	-----	-----
Bankfull Width (ft)	43.13	16.97	26.16
Entrenchment Ratio	2.01	-----	-----
Mean Depth (ft)	2.18	2.46	2
Maximum Depth (ft)	5.41	4.91	5.41
Width/Depth Ratio	19.78	6.9	13.08
Bankfull Area (sq ft)	93.99	41.68	52.32
Wetted Perimeter (ft)	44.8	22.6	32.01
Hydraulic Radius (ft)	2.1	1.84	1.63

Begin BKF Station	31.7	31.7	48.67
End BKF Station	74.83	48.67	74.83

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

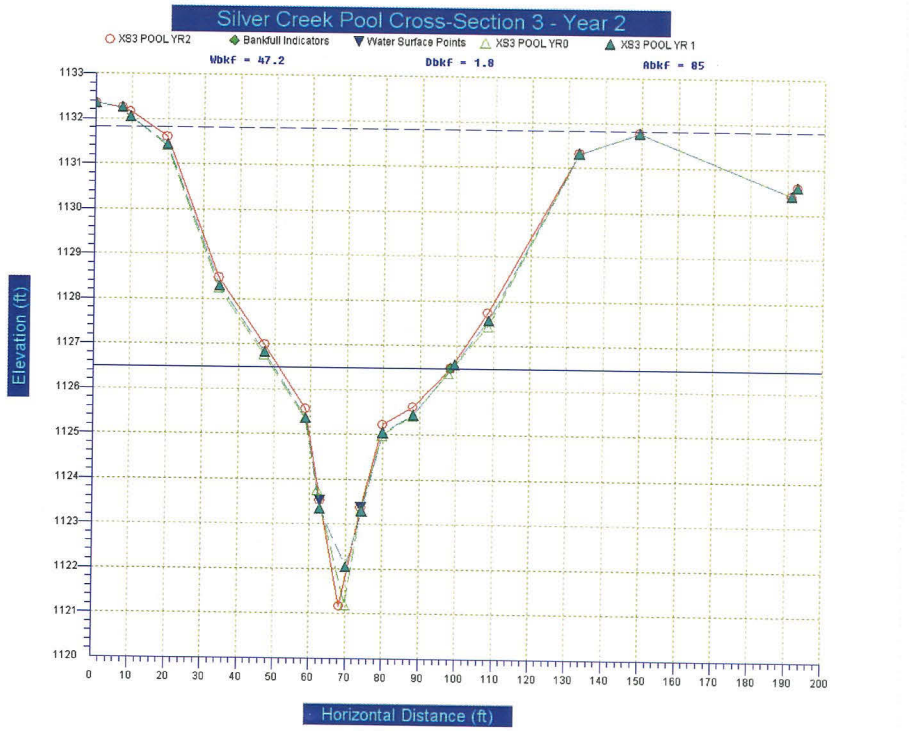
	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.35		
Movable Particle (mm)	70.8		

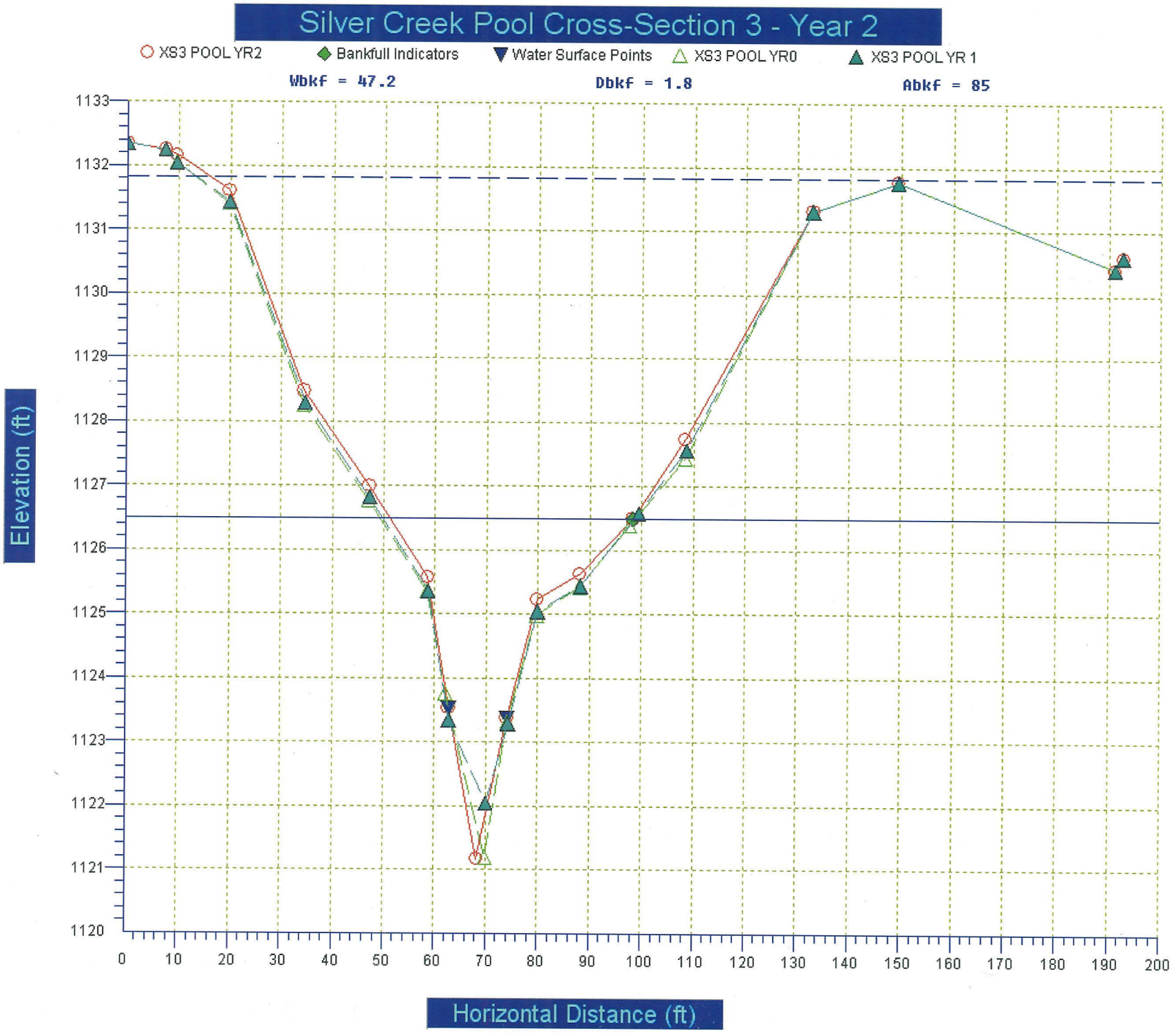
Summary Data

Bankfull Area (sq ft)	84.95
Bankfull Width (ft)	47.20
Mean Depth (ft)	1.8
Maximum Depth (ft)	5.33
Width/Depth Ratio	26.22
Entrenchment Ratio	3.75
Classification	C4

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/08
CROSS SECTION:	3
FEATURE:	Pool at J-Hook # 4

Pool Cross-Section 3 at J-Hook, Log Vane, Rootwad Combination Structure (September 8, 2008)




Silver Creek Pool Cross-Section 3 - Year 2
XS3 POOL YR2
Bankfull Indicators
Water Surface Points
XS3 POOL YR0
XS3 POOL YR 1
Wbkf = 47.2
Dbkf = 1.8
Abkf = 85
Elevation (ft)
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Horizontal Distance (ft)

XS3 POOL YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS3 POOL YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1132.35	fp
7.4	0	1132.25	bm
9.56	0	1132.16	lt
19.8	0	1131.61	bw
34.46	0	1128.47	fp
47.14	0	1126.99	fp
58.5	0	1125.57	
62.7	0	1123.53	lew
68.26	0	1121.16	tw2.3 p
74.09	0	1123.38	rew
79.9	0	1125.23	
88.07	0	1125.63	fp
98.34	0	1126.49	BKF
108.4	0	1127.74	fp
133	0	1131.31	bm
149.4	0	1131.77	fp
191.11	0	1130.41	bw
192.68	0	1130.6	ht

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1131.82	1131.82	1131.82
Bankfull Elevation (ft)	1126.49	1126.49	1126.49
Floodprone Width (ft)	176.79	-----	-----
Bankfull Width (ft)	47.2	19.93	27.27
Entrenchment Ratio	3.75	-----	-----
Mean Depth (ft)	1.8	2.41	1.35
Maximum Depth (ft)	5.33	5.33	4.26

Width/Depth Ratio	26.22	8.27	20.2
Bankfull Area (sq ft)	84.95	48.05	36.9
Wetted Perimeter (ft)	48.95	25.4	32.07
Hydraulic Radius (ft)	1.74	1.89	1.15
Begin BKF Station	51.14	51.14	71.07
End BKF Station	98.34	71.07	98.34

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

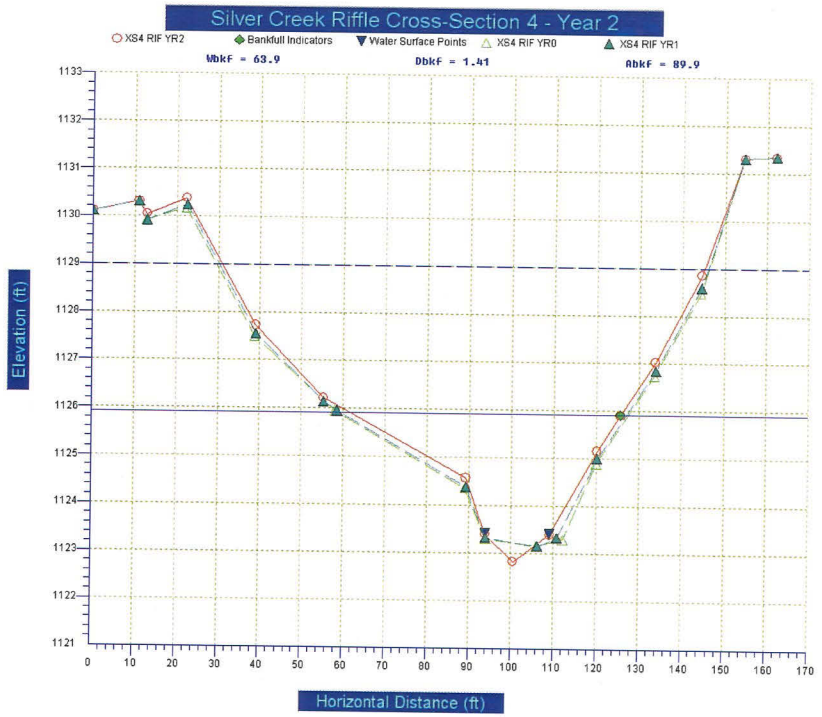
	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.29		
Movable Particle (mm)	61.7		

Summary Data

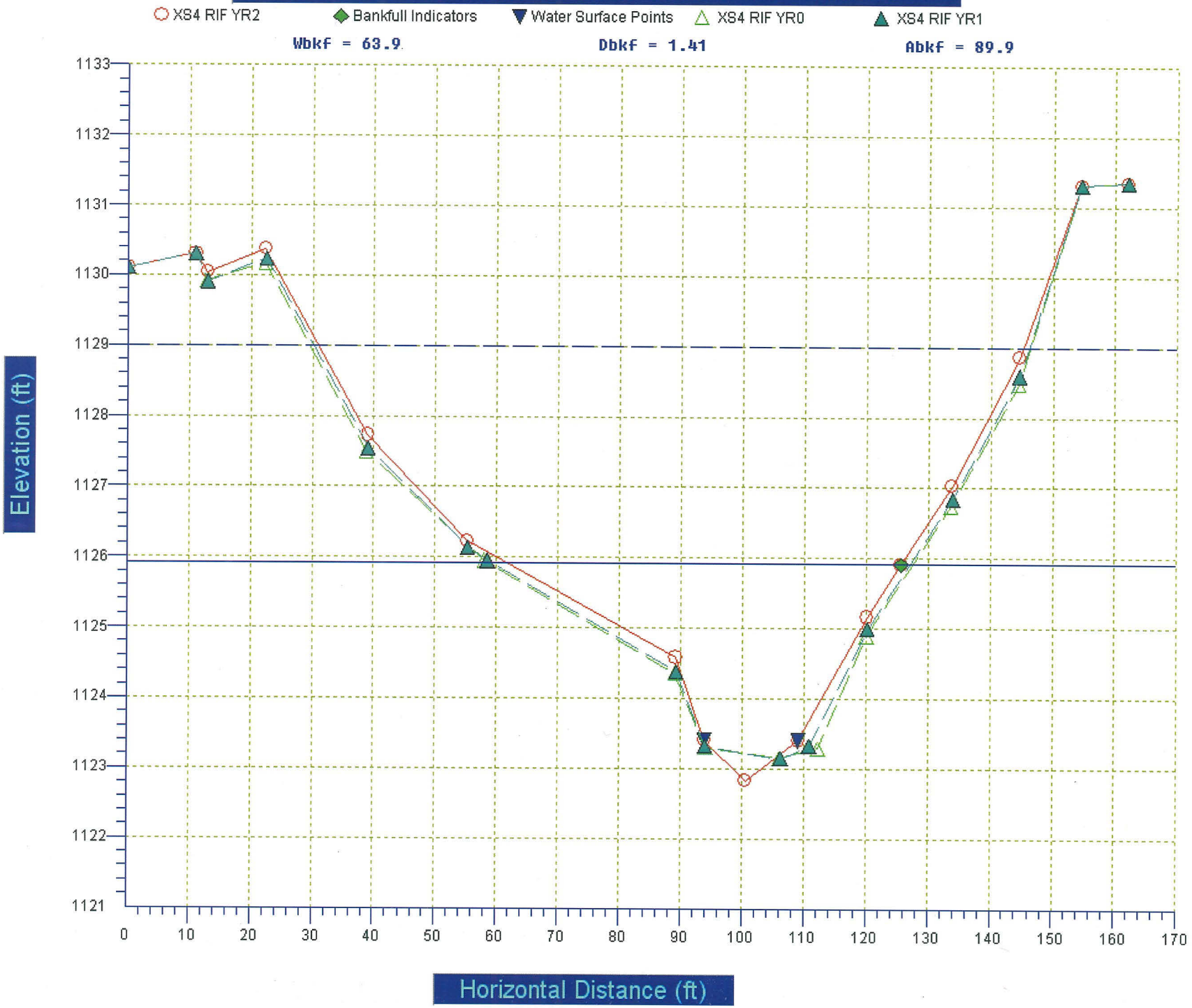
Bankfull Area (sq ft)	89.90
Bankfull Width (ft)	63.90
Mean Depth (ft)	1.41
Maximum Depth (ft)	3.08
Width/Depth Ratio	45.32
Entrenchment Ratio	1.79
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/2008
CROSS SECTION:	4
FEATURE:	Riffle

Riffle Cross-Section 4, looking downstream (September 8, 2008)



Silver Creek Riffle Cross-Section 4 - Year 2



XS4 RIF YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS4 RIF YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1130.11	fp
11.06	0	1130.31	bm
12.93	0	1130.04	lt
22.37	0	1130.37	bw
38.96	0	1127.73	fp
55.15	0	1126.23	FP
89.19	0	1124.58	
93.83	0	1123.41	lew
100.57	0	1122.83	tw0.65 r
109.11	0	1123.4	rew
120.18	0	1125.16	
125.65	0	1125.91	BKF
133.83	0	1127.03	fp
144.62	0	1128.86	fp
154.57	0	1131.31	bm
162.06	0	1131.35	fp/ht

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1128.99	1128.99	1128.99
Bankfull Elevation (ft)	1125.91	1125.91	1125.91
Floodprone Width (ft)	114.11	-----	-----
Bankfull Width (ft)	63.9	39.15	24.75
Entrenchment Ratio	1.79	-----	-----
Mean Depth (ft)	1.41	1.2	1.74
Maximum Depth (ft)	3.08	3.08	3.06
Width/Depth Ratio	45.32	32.63	14.22
Bankfull Area (sq ft)	89.9	46.95	42.95

Wetted Perimeter (ft)	64.31	42.41	28.02
Hydraulic Radius (ft)	1.4	1.11	1.53
Begin BKF Station	61.75	61.75	100.9
End BKF Station	125.65	100.9	125.65

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.24		
Movable Particle (mm)	52.5		

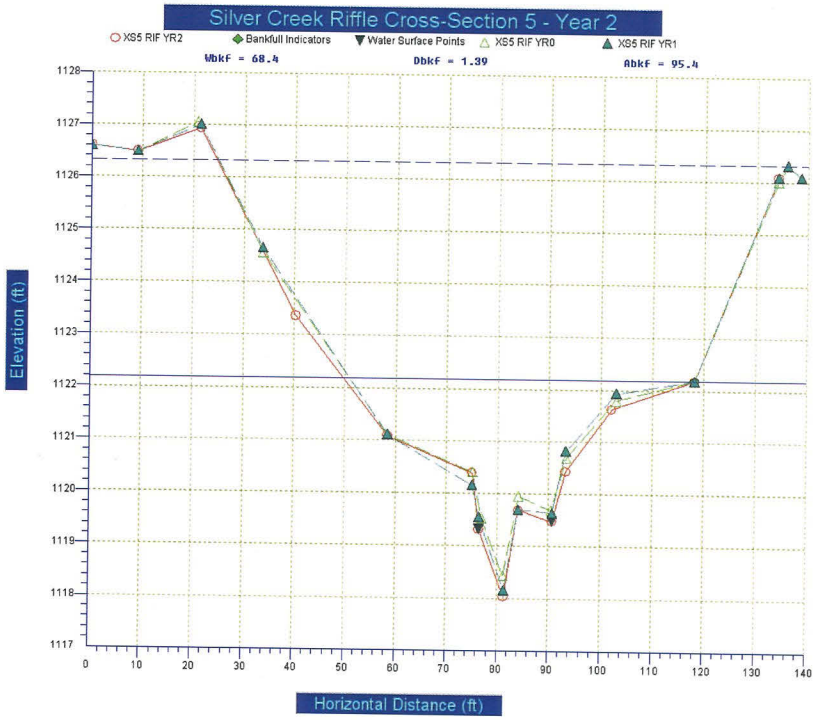
Summary Data

Bankfull Area (sq ft)	95.39
Bankfull Width (ft)	68.44
Mean Depth (ft)	1.39
Maximum Depth (ft)	4.15
Width/Depth Ratio	49.24
Entrenchment Ratio	1.60
Classification	B4c

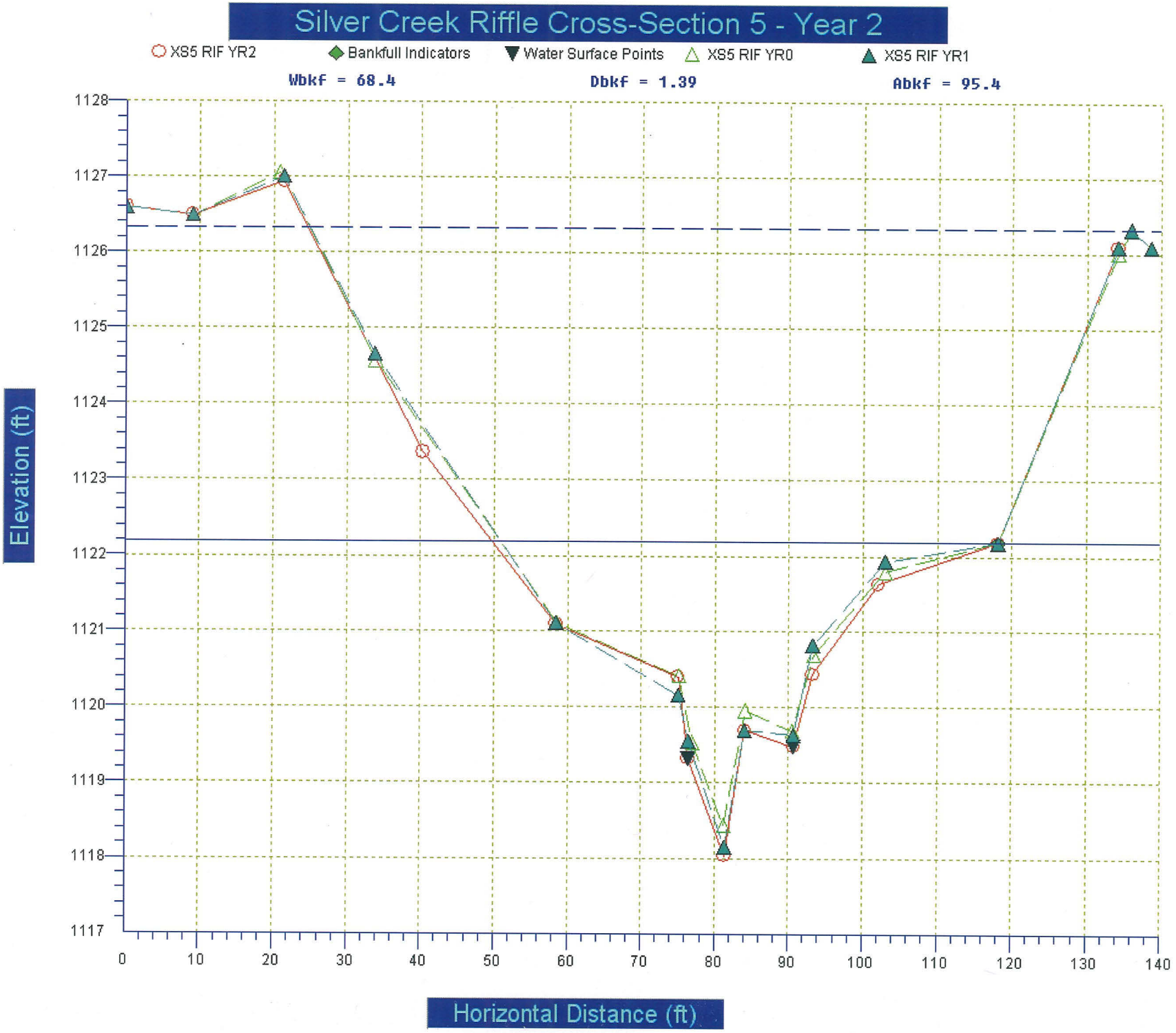
PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/2008
CROSS SECTION:	5
FEATURE:	Riffle at J-Hook # 8

Ecosystem Enhancement

Riffle Cross-Section 5, looking from right to left across channel (September 8, 2008)



EMH&T


Silver Creek Riffle Cross-Section 5 - Year 2
XS5 RIF YR2
Bankfull Indicators
Water Surface Points
XS5 RIF YR0
XS5 RIF YR1
Wbkf = 68.4
Dbkf = 1.39
Abkf = 95.4
Elevation (ft)
1128
1127
1126
1125
1124
1123
1122
1121
1120
1119
1118
1117
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Horizontal Distance (ft)

XS5 RIF YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS5 RIF YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1126.6	FP
9.04	0	1126.49	BM
21.36	0	1126.94	FP
40.27	0	1123.36	FP
58.45	0	1121.09	FP
75.08	0	1120.4	LB
76.42	0	1119.32	LEW
81.34	0	1118.03	TW1.25 R
84.07	0	1119.7	JH
90.64	0	1119.48	REW
93.25	0	1120.44	RB
102.1	0	1121.63	FP
118.16	0	1122.18	BKF
134.15	0	1126.09	BW

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1126.33	1126.33	1126.33
Bankfull Elevation (ft)	1122.18	1122.18	1122.18
Floodprone Width (ft)	109.57	-----	-----
Bankfull Width (ft)	68.44	5.14	63.3
Entrenchment Ratio	1.6	-----	-----
Mean Depth (ft)	1.39	0.32	1.48
Maximum Depth (ft)	4.15	0.64	4.15
Width/Depth Ratio	49.24	16.06	42.77
Bankfull Area (sq ft)	95.39	1.65	93.74
Wetted Perimeter (ft)	69.8	5.82	65.27
Hydraulic Radius (ft)	1.37	0.28	1.44

Begin BKF Station	49.72	49.72	54.86
End BKF Station	118.16	54.86	118.16

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

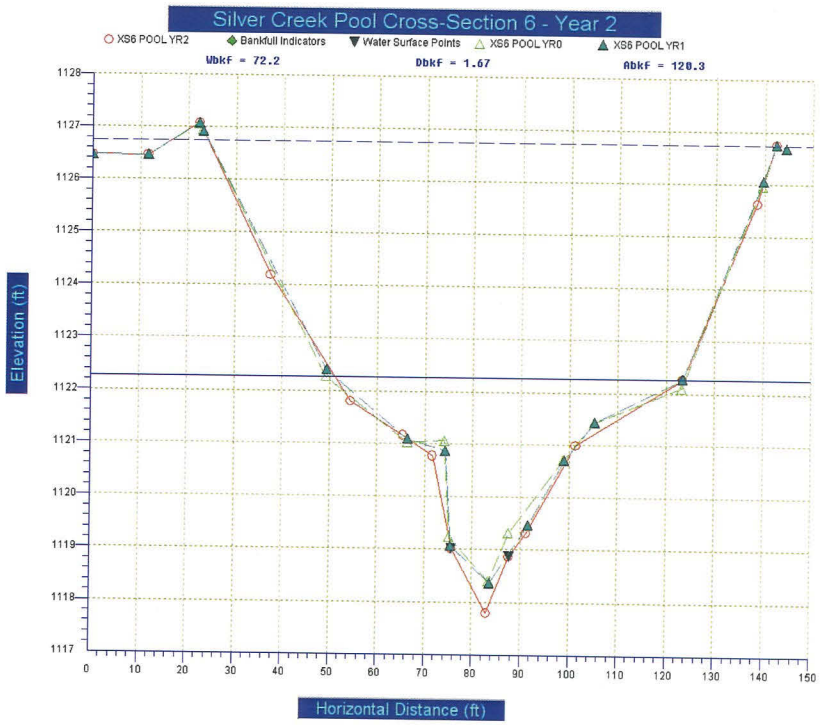
	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.23		
Movable Particle (mm)	51.7		

Summary Data

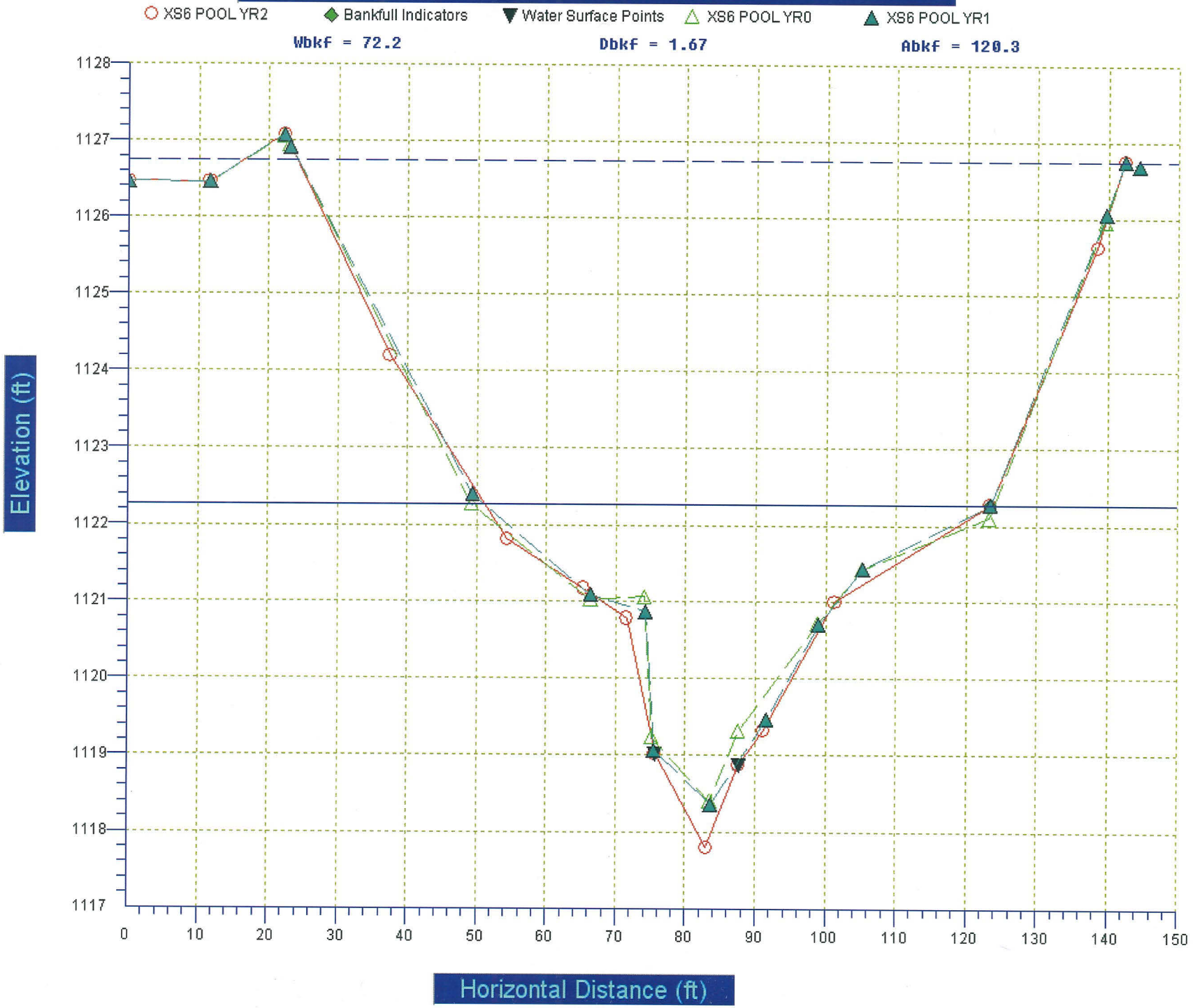
Bankfull Area (sq ft)	120.32
Bankfull Width (ft)	72.24
Mean Depth (ft)	1.67
Maximum Depth (ft)	4.48
Width/Depth Ratio	43.26
Entrenchment Ratio	1.87
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/02/2008
CROSS SECTION:	6
FEATURE:	Pool at J-Hook # 8

Pool Cross-Section 6, from right to left across channel (September 8, 2008)



Silver Creek Pool Cross-Section 6 - Year 2



XS6 POOL YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: Mainstem
Cross Section Name: XS6 POOL YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1126.47	HT
11.7	0	1126.46	BM
22.37	0	1127.08	HT
37.52	0	1124.19	FP
54.38	0	1121.81	FP
65.29	0	1121.17	FP
71.56	0	1120.78	LB
75.64	0	1119.02	LEW
83	0	1117.79	TW1.05 P
87.61	0	1118.87	REW
91.11	0	1119.32	FP
101.33	0	1121	RB
123.36	0	1122.27	BKF
138.51	0	1125.63	FP
142.41	0	1126.76	BM

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1126.75	1126.75	1126.75
Bankfull Elevation (ft)	1122.27	1122.27	1122.27
Floodprone Width (ft)	134.97	-----	-----
Bankfull Width (ft)	72.24	36.12	36.12
Entrenchment Ratio	1.87	-----	-----
Mean Depth (ft)	1.67	2	1.33
Maximum Depth (ft)	4.48	4.48	3.49
Width/Depth Ratio	43.26	18.06	27.16
Bankfull Area (sq ft)	120.32	72.38	47.94
Wetted Perimeter (ft)	73.09	40.25	39.82

Hydraulic Radius (ft)	1.65	1.8	1.2
Begin BKF Station	51.12	51.12	87.24
End BKF Station	123.36	87.24	123.36

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

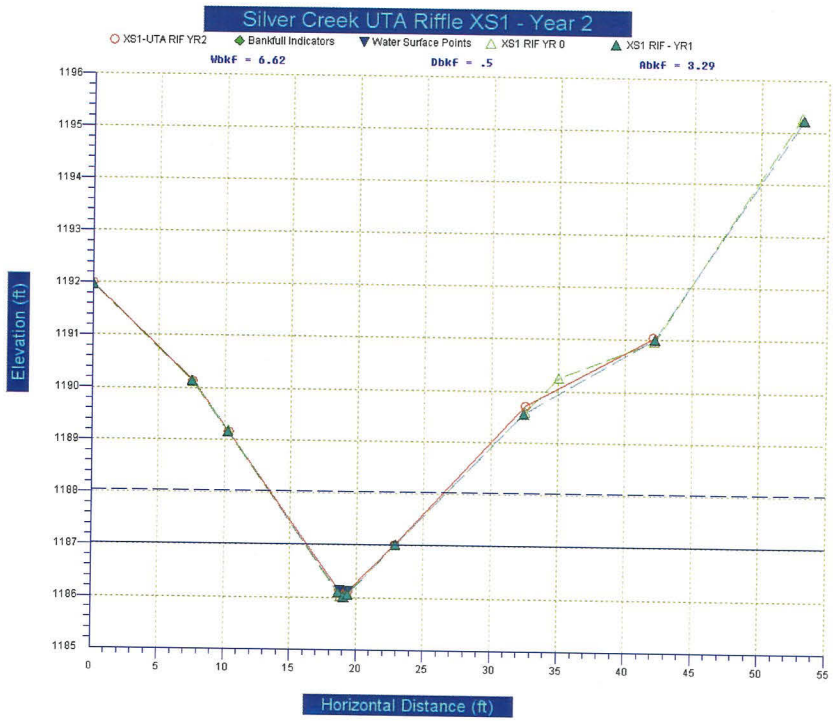
	Channel	Left Side	Right Side
Slope	0.0027	0	0
Shear Stress (lb/sq ft)	0.28		
Movable Particle (mm)	59.3		

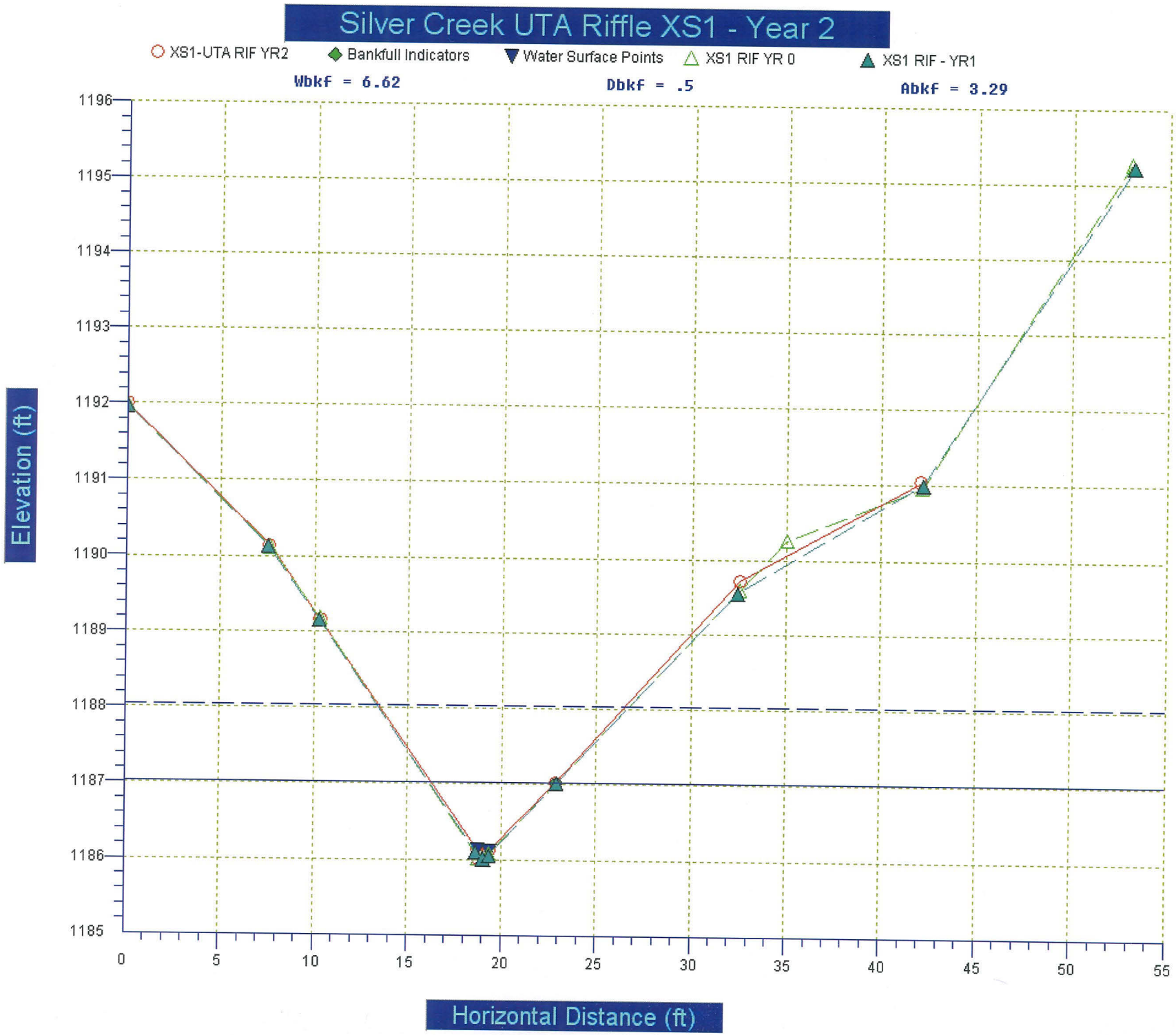
Summary Data

Bankfull Area (sq ft)	3.29
Bankfull Width (ft)	6.62
Mean Depth (ft)	0.50
Maximum Depth (ft)	1.02
Width/Depth Ratio	13.24
Entrenchment Ratio	1.98
Classification	B4

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/02/2008
CROSS SECTION:	1
FEATURE:	Riffle

UTA Cross-Section 1, looking upstream (September 8, 2008)




Silver Creek UTA Riffle XS1 - Year 2
XS1-UTA RIF YR2
Bankfull Indicators
Water Surface Points
XS1 RIF YR 0
XS1 RIF - YR1
Wbkf = 6.62
Dbkf = .5
Abkf = 3.29
Elevation (ft)
1196
1195
1194
1193
1192
1191
1190
1189
1188
1187
1186
1185
0
5
10
15
20
25
30
35
40
45
50
55
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: UTA
Cross Section Name: XS1-UTA RIF YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1191.99	fp
7.59	0	1190.13	bm
10.33	0	1189.16	
18.75	0	1186.13	lew
18.85	0	1186	TW0.0 r
19.38	0	1186.12	rew no water
22.9	0	1187.02	BKF
32.56	0	1189.71	
42.09	0	1191.04	fp

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1188.04	1188.04	1188.04
Bankfull Elevation (ft)	1187.02	1187.02	1187.02
Floodprone Width (ft)	13.12	-----	-----
Bankfull Width (ft)	6.62	4.27	2.35
Entrenchment Ratio	1.98	-----	-----
Mean Depth (ft)	0.5	0.6	0.3
Maximum Depth (ft)	1.02	1.02	0.6
Width/Depth Ratio	13.24	7.12	7.83
Bankfull Area (sq ft)	3.29	2.58	0.71
Wetted Perimeter (ft)	6.97	5.14	3.03
Hydraulic Radius (ft)	0.47	0.5	0.23
Begin BKF Station	16.28	16.28	20.55
End BKF Station	22.9	20.55	22.9

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0.03856	0	0
Shear Stress (lb/sq ft)	1.13		
Movable Particle (mm)	166.4		

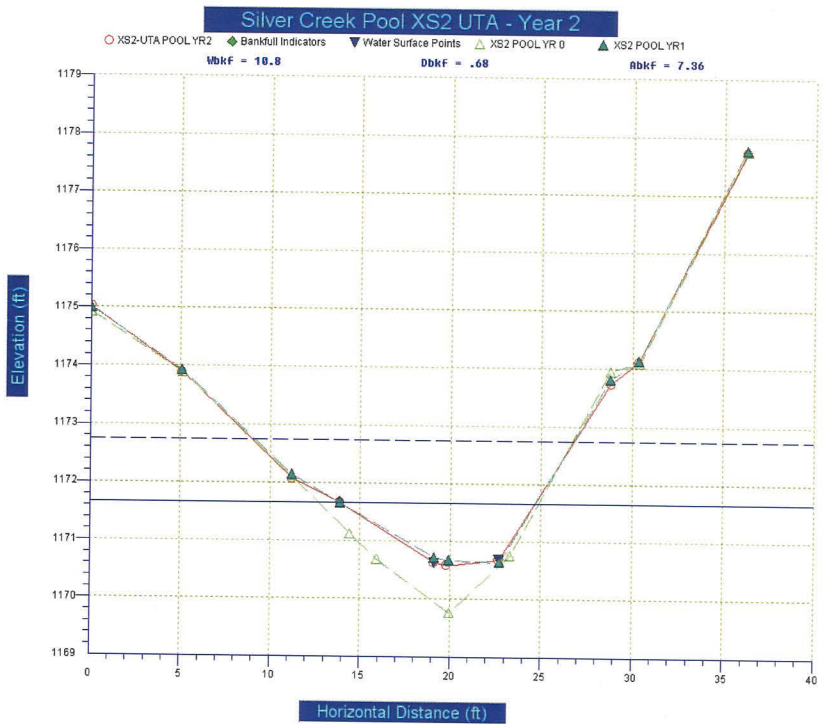
Summary Data

Bankfull Area (sq ft)	7.36
Bankfull Width (ft)	10.77
Mean Depth (ft)	0.68
Maximum Depth (ft)	1.08
Width/Depth Ratio	15.84
Entrenchment Ratio	1.66
Classification	B4

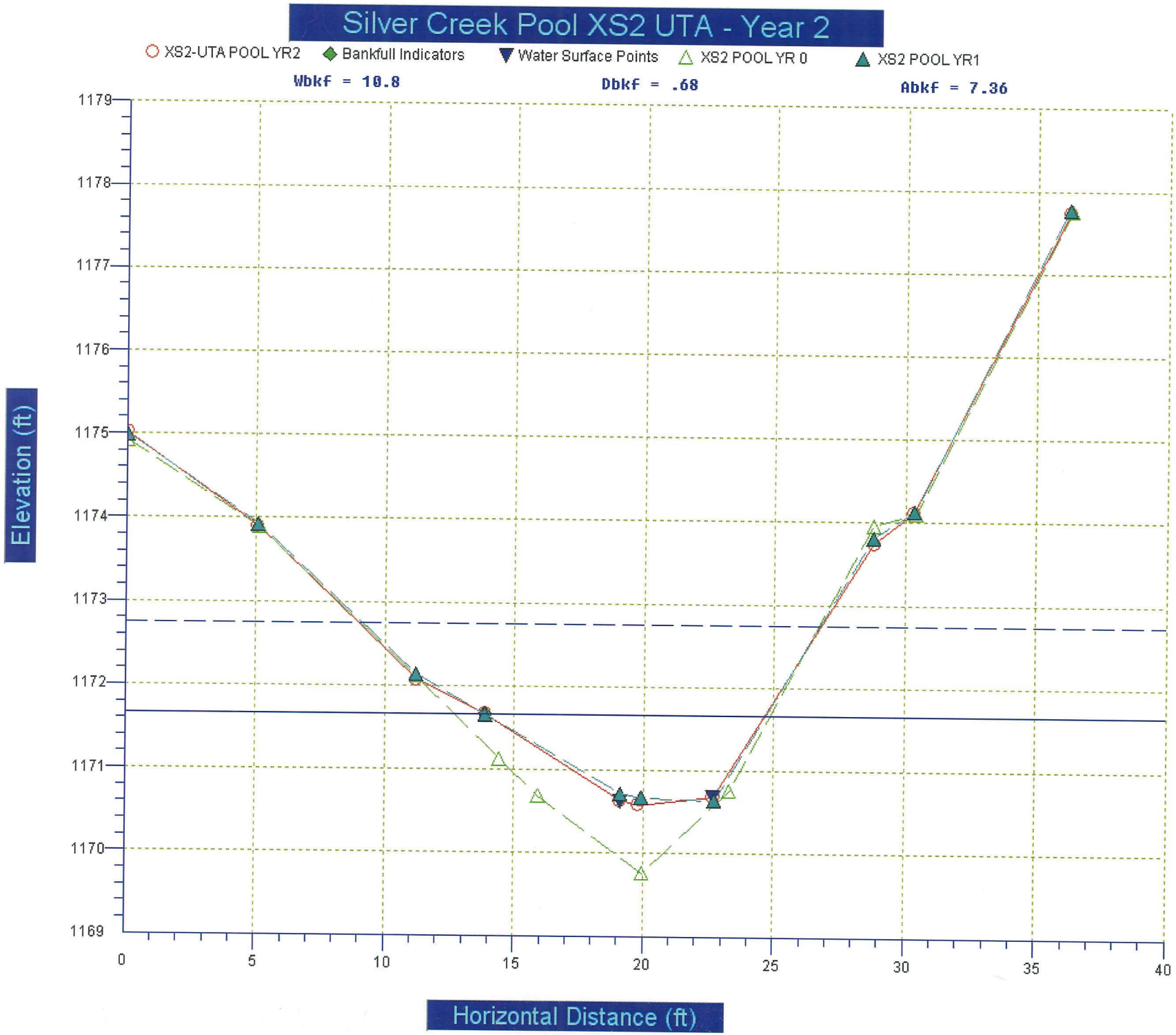
PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/02/2008
CROSS SECTION:	2
FEATURE:	Pool

Ecosystem Enhancement

UTA Pool Cross-Section 2, looking upstream (September 8, 2008)



EMH&T


Silver Creek Pool XS2 UTA - Year 2
XS2-UTA POOL YR2
Bankfull Indicators
Water Surface Points
XS2 POOL YR 0
XS2 POOL YR1
Wbkf = 10.8
Dbkf = .68
Abkf = 7.36
Elevation (ft)
1179
1178
1177
1176
1175
1174
1173
1172
1171
1170
1169
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: UTA
Cross Section Name: XS2-UTA POOL YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1175.02	fp
5.07	0	1173.9	bm
11.22	0	1172.07	
13.87	0	1171.66	BKF
19.1	0	1170.63	lew no water
19.8	0	1170.58	p TW0.0
22.68	0	1170.68	rew no water
28.8	0	1173.74	
30.31	0	1174.11	bm
36.24	0	1177.74	fp

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1172.74	1172.74	1172.74
Bankfull Elevation (ft)	1171.66	1171.66	1171.66
Floodprone Width (ft)	17.83	-----	-----
Bankfull Width (ft)	10.77	3.91	6.86
Entrenchment Ratio	1.66	-----	-----
Mean Depth (ft)	0.68	0.39	0.85
Maximum Depth (ft)	1.08	0.77	1.08
Width/Depth Ratio	15.84	10.03	8.07
Bankfull Area (sq ft)	7.36	1.51	5.85
Wetted Perimeter (ft)	11.11	4.76	7.89
Hydraulic Radius (ft)	0.66	0.32	0.74
Begin BKF Station	13.87	13.87	17.78
End BKF Station	24.64	17.78	24.64

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

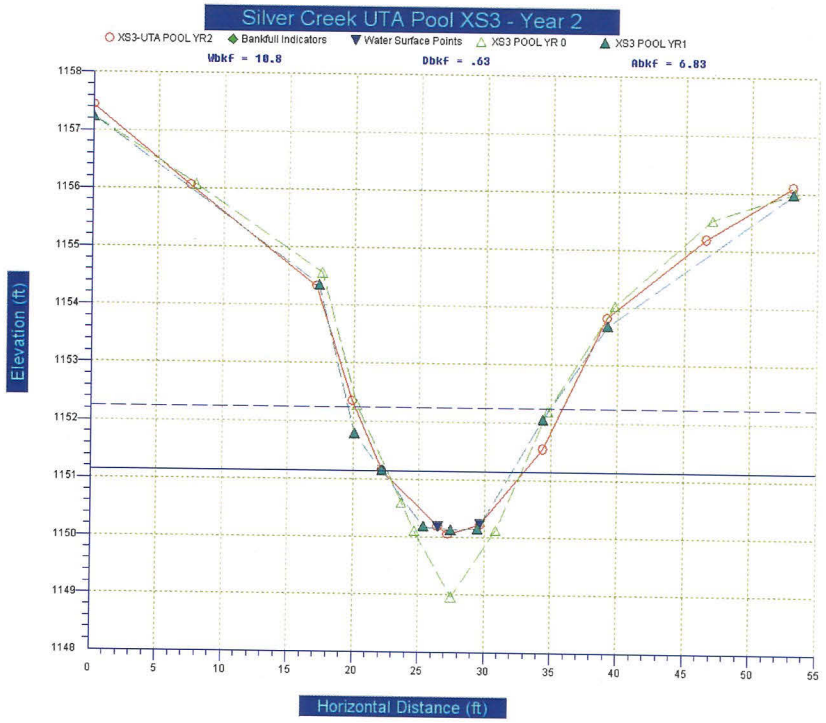
	Channel	Left Side	Right Side
Slope	0.03856	0	0
Shear Stress (lb/sq ft)	1.59		
Movable Particle (mm)	213.6		

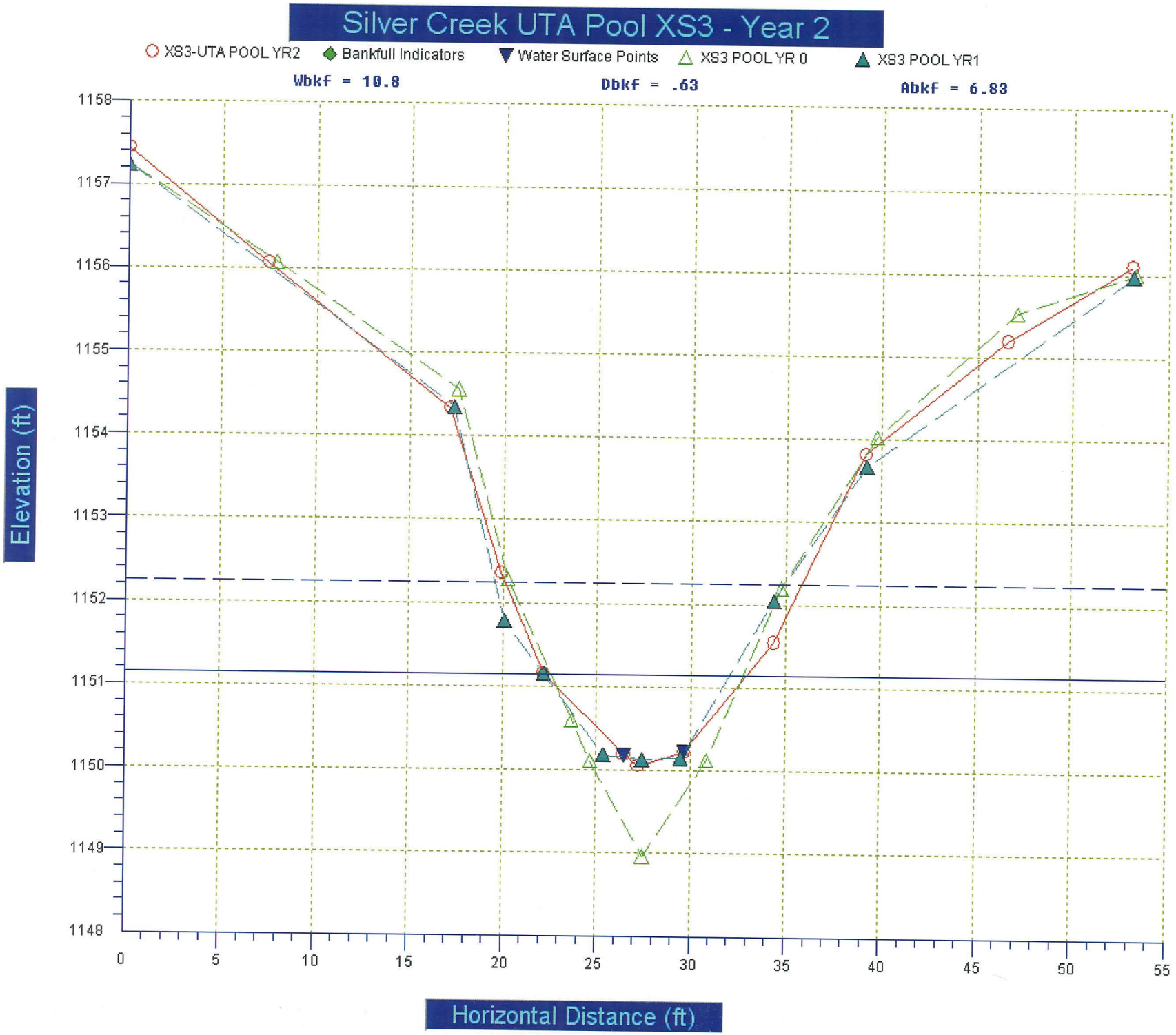
Summary Data

Bankfull Area (sq ft)	6.83
Bankfull Width (ft)	10.79
Mean Depth (ft)	0.63
Maximum Depth (ft)	1.10
Width/Depth Ratio	17.13
Entrenchment Ratio	1.46
Classification	B4

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/02/2008
CROSS SECTION:	3
FEATURE:	Pool

UTA Pool Cross-Section 3, looking from right to left across channel (September 8, 2008)




Silver Creek UTA Pool XS3 - Year 2
XS3-UTA POOL YR2
Bankfull Indicators
Water Surface Points
XS3 POOL YR 0
XS3 POOL YR1
Wbkf = 10.8
Dbkf = .63
Abkf = 6.83
Elevation (ft)
1158
1157
1156
1155
1154
1153
1152
1151
1150
1149
1148
0
5
10
15
20
25
30
35
40
45
50
55
Horizontal Distance (ft)

XS3-UTA POOL YR2.txt
RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: UTA
Cross Section Name: XS3-UTA POOL YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1157.44	fp
7.46	0	1156.06	bm
17.13	0	1154.33	
19.91	0	1152.36	fp
22.2	0	1151.15	BKF
26.49	0	1150.19	lew
27.25	0	1150.05	p TW0.11
29.65	0	1150.22	rew
34.39	0	1151.54	fp
39.15	0	1153.82	
46.58	0	1155.19	bm
53.09	0	1156.1	fp

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1152.25	1152.25	1152.25
Bankfull Elevation (ft)	1151.15	1151.15	1151.15
Floodprone Width (ft)	15.75	-----	-----
Bankfull Width (ft)	10.79	6.8	3.99
Entrenchment Ratio	1.46	-----	-----
Mean Depth (ft)	0.63	0.69	0.54
Maximum Depth (ft)	1.1	1.1	0.98
Width/Depth Ratio	17.13	9.86	7.39
Bankfull Area (sq ft)	6.83	4.66	2.17
Wetted Perimeter (ft)	11.04	7.9	5.09
Hydraulic Radius (ft)	0.62	0.59	0.43
Begin BKF Station	22.2	22.2	29
End BKF Station	32.99	29	32.99

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

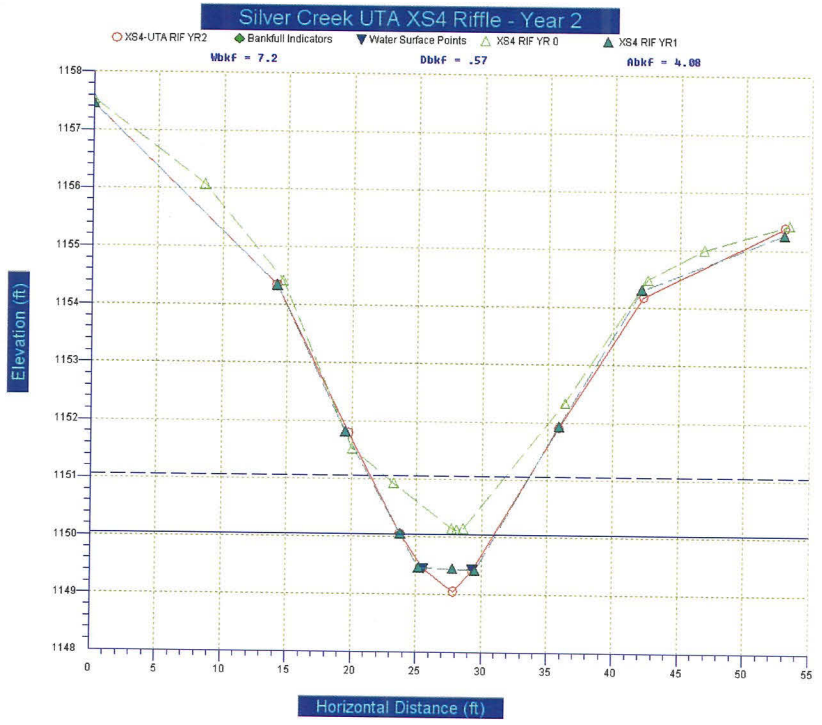
	Channel	Left Side	Right Side
Slope	0.03856	0	0
Shear Stress (lb/sq ft)	1.49		
Movable Particle (mm)	204.0		

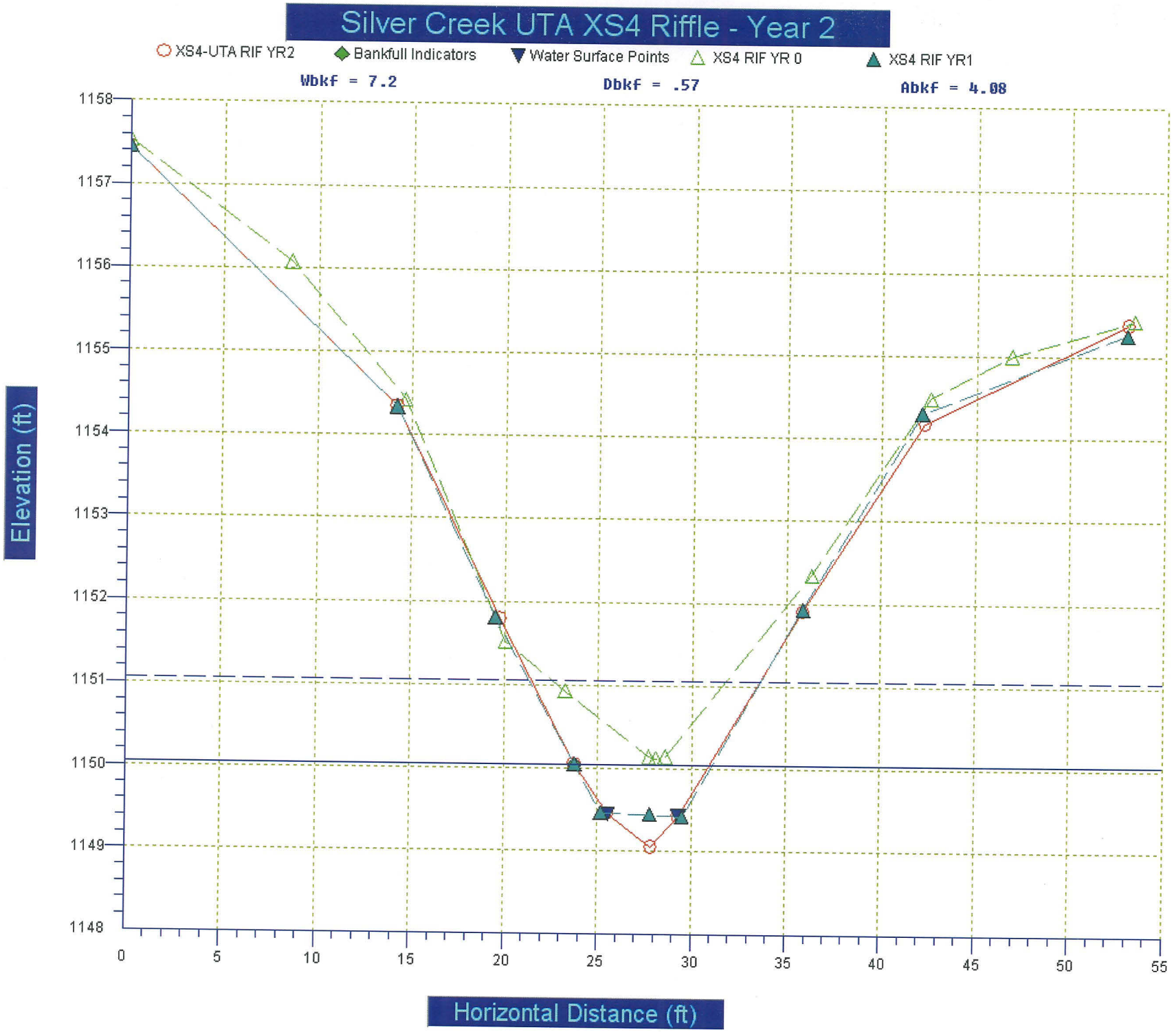
Summary Data

Bankfull Area (sq ft)	4.08
Bankfull Width (ft)	7.02
Mean Depth (ft)	0.57
Maximum Depth (ft)	1.00
Width/Depth Ratio	12.63
Entrenchment Ratio	1.69
Classification	B4

PROJECT	Silver Creek
	D05016-1
	2-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/02/2008
CROSS SECTION:	4
FEATURE:	Riffle

UTA Riffle Cross-Section 4, looking right to left across channel (September 8, 2008)




Silver Creek UTA XS4 Riffle - Year 2
XS4-UTA RIF YR2
Bankfull Indicators
Water Surface Points
XS4 RIF YR 0
XS4 RIF YR1
Wbkf = 7.2
Dbkf = .57
Abkf = 4.08
Elevation (ft)
1158
1157
1156
1155
1154
1153
1152
1151
1150
1149
1148
0
5
10
15
20
25
30
35
40
45
50
55
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Silver Creek & Trib Restoration
Reach Name: UTA
Cross Section Name: XS4-UTA RIF YR2
Survey Date: 12/02/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	1157.45	FP
14.21	0	1154.34	LB
19.76	0	1151.79	fp
23.76	0	1150.05	BKF
25.55	0	1149.45	lew
27.87	0	1149.05	p TW0.5
29.32	0	1149.43	rew
35.87	0	1151.9	fp
42.26	0	1154.18	
53.03	0	1155.38	fp

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	1151.05	1151.05	1151.05
Bankfull Elevation (ft)	1150.05	1150.05	1150.05
Floodprone Width (ft)	12.15	-----	-----
Bankfull Width (ft)	7.2	6.61	0.59
Entrenchment Ratio	1.69	-----	-----
Mean Depth (ft)	0.57	0.61	0.11
Maximum Depth (ft)	1	1	0.22
Width/Depth Ratio	12.63	10.84	5.36
Bankfull Area (sq ft)	4.08	4.01	0.07
Wetted Perimeter (ft)	7.5	7.09	0.86
Hydraulic Radius (ft)	0.54	0.57	0.08
Begin BKF Station	23.76	23.76	30.37
End BKF Station	30.96	30.37	30.96

Entrainment Calculations

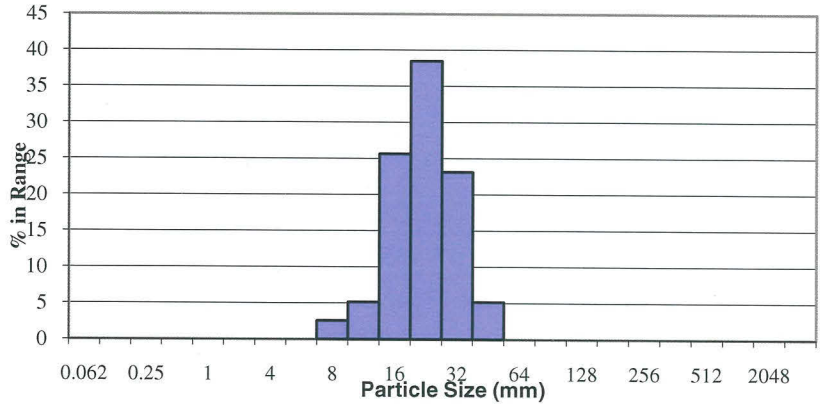
Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0.03856	0	0
Shear Stress (lb/sq ft)	1.30		
Movable Particle (mm)	184.3		

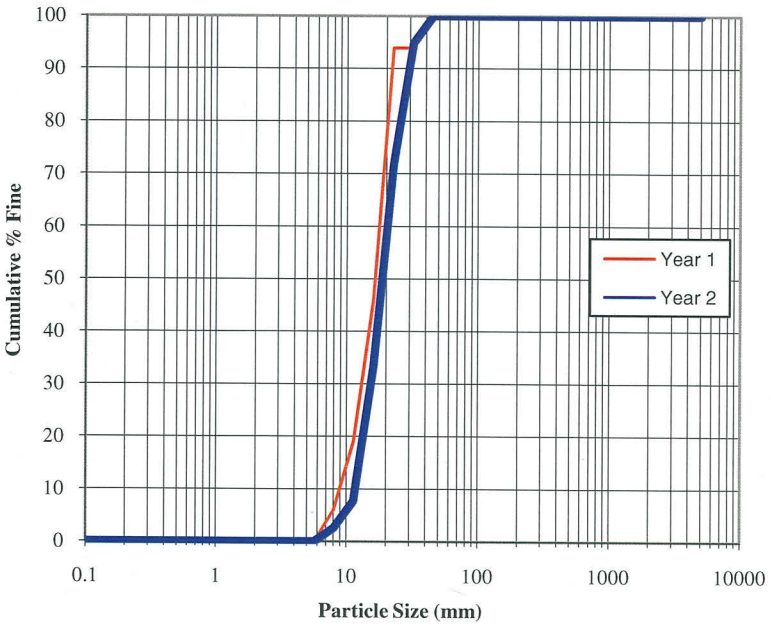
Pebble Count – Riffle XS-1 (D50 = 18.9 mm; D84 = 27.6 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	0	0	0
Fine Gravel	5.7-8.0	2	3	3
Medium Gravel	8.0-11.3	4	5	8
Medium Gravel	11.3-16.0	20	26	33
Coarse Gravel	16.0-22.6	30	38	72
Coarse Gravel	22.6-32	18	23	95
Very Coarse Gravel	32-45	4	5	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		78	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	1
Date	9/8/08	**Sta No.**	2+05

Histogram

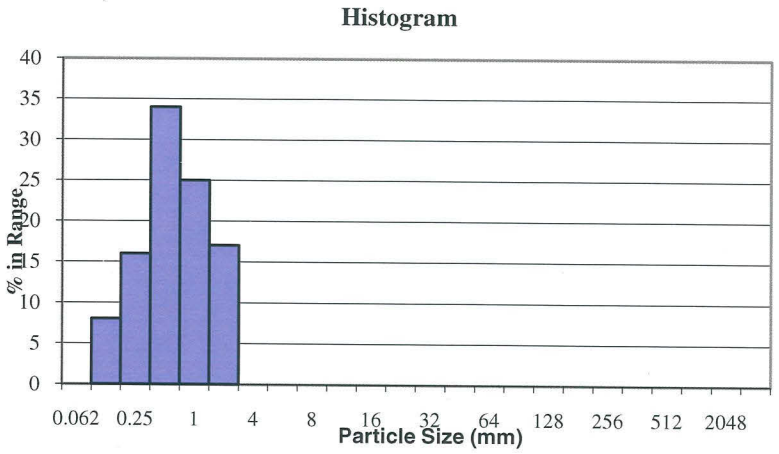


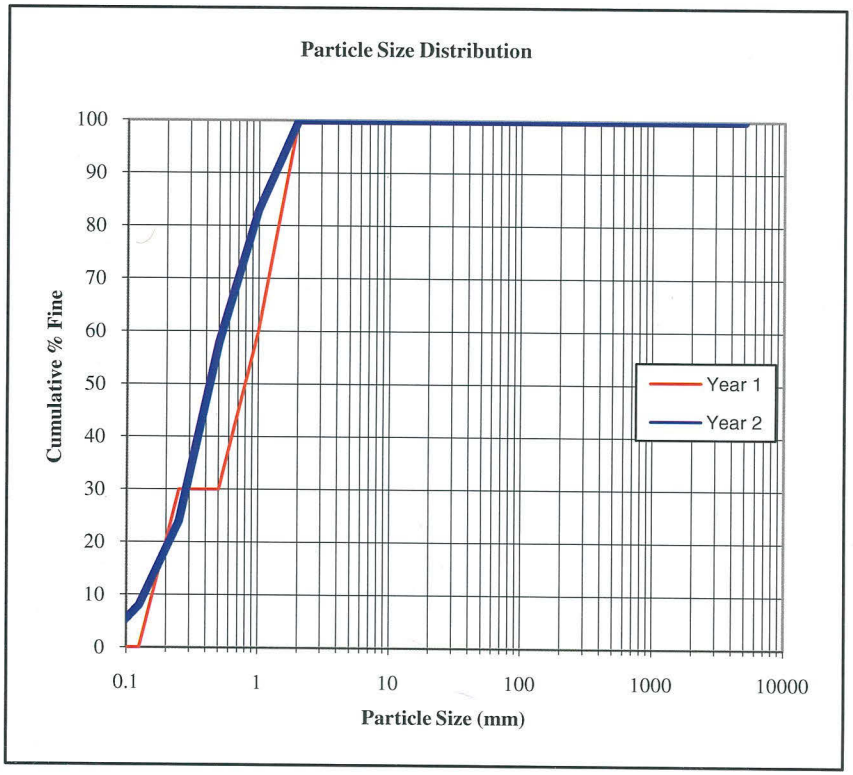
Particle Size Distribution



Pebble Count – Pool XS-2 (D50 = 0.4 mm; D84= 1.1 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	8	8	8
Fine Sand	0.125-0.25	16	16	24
Medium Sand	0.25-0.5	34	34	58
Coarse Sand	0.5-1.0	25	25	83
Very Coarse Sand	1.0-2.0	17	17	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine Gravel	4.0-5.7	0	0	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	2
Date	9/8/08	**Sta No.**	2+30

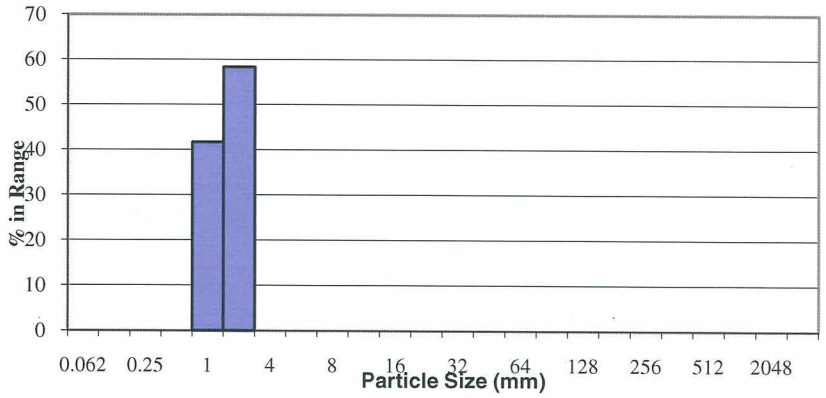


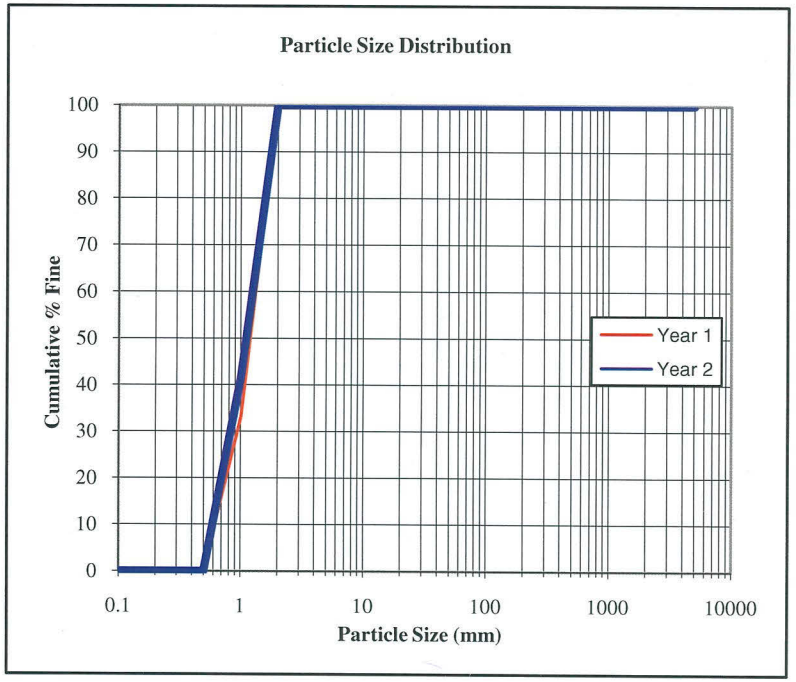


Pebble Count – Pool XS-3 (D50 = 1.1 mm; D84 = 1.7 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	25	42	42
Very Coarse Sand	1.0-2.0	35	58	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine Gravel	4.0-5.7	0	0	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	3
Date	9/8/08	**Sta No.**	11+18

Histogram

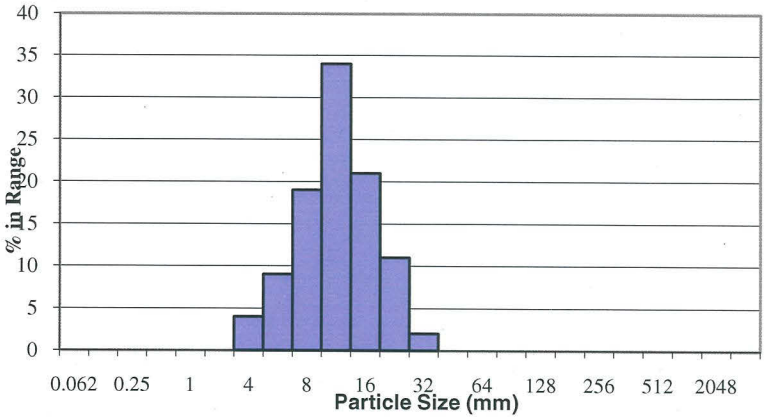


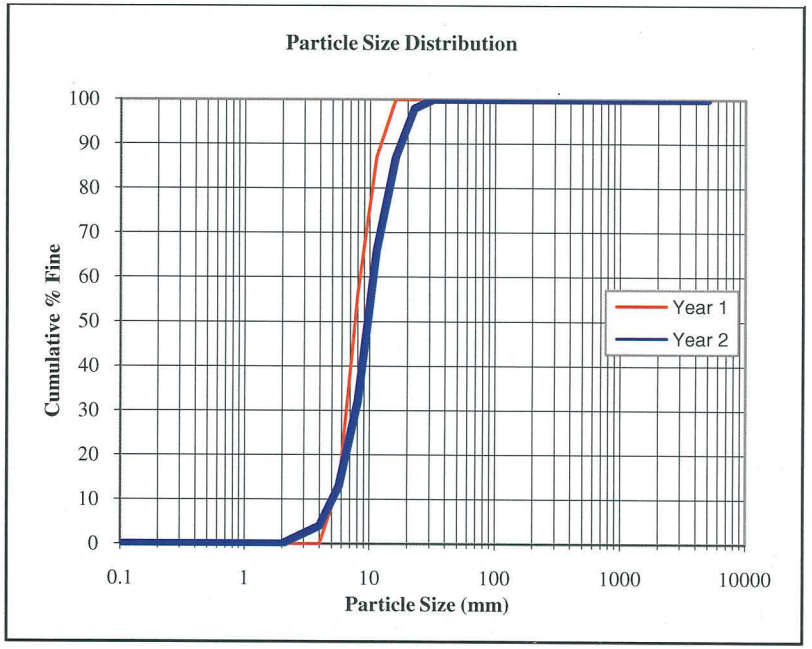


Pebble Count – Riffle XS-4 (D50 = 9.8 mm; D84 = 15.3 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	4	4	4
Fine Gravel	4.0-5.7	9	9	13
Fine Gravel	5.7-8.0	19	19	32
Medium Gravel	8.0-11.3	34	34	66
Medium Gravel	11.3-16.0	21	21	87
Coarse Gravel	16.0-22.6	11	11	98
Coarse Gravel	22.6-32	2	2	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	4
Date	9/8/08	**Sta No.**	12+25

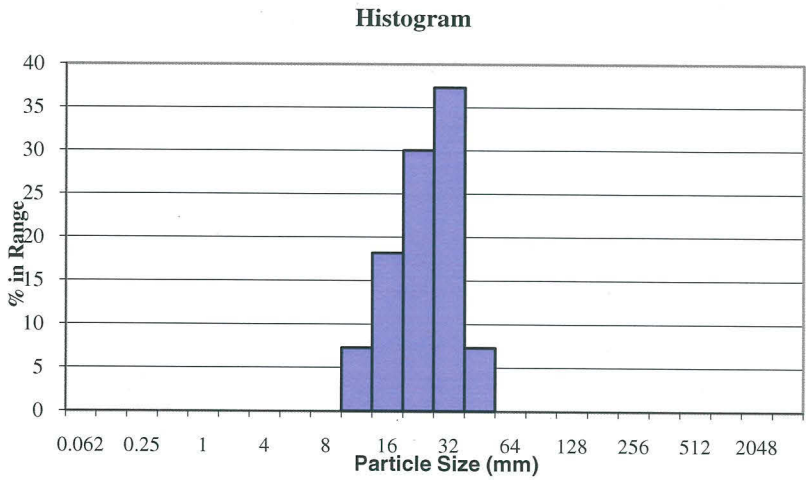
Histogram

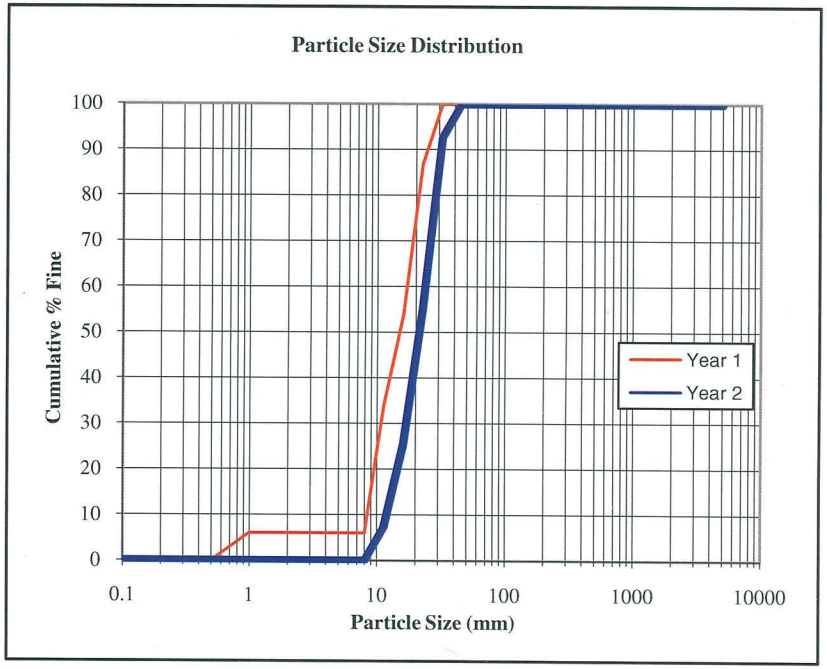




Pebble Count – Riffle XS-5 (D50 = 21.4 mm; D84 = 29.8 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	0	0	0
Fine Gravel	5.7-8.0	0	0	0
Medium Gravel	8.0-11.3	8	7	7
Medium Gravel	11.3-16.0	20	18	25
Coarse Gravel	16.0-22.6	33	30	55
Coarse Gravel	22.6-32	41	37	93
Very Coarse Gravel	32-45	8	7	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		110	100	

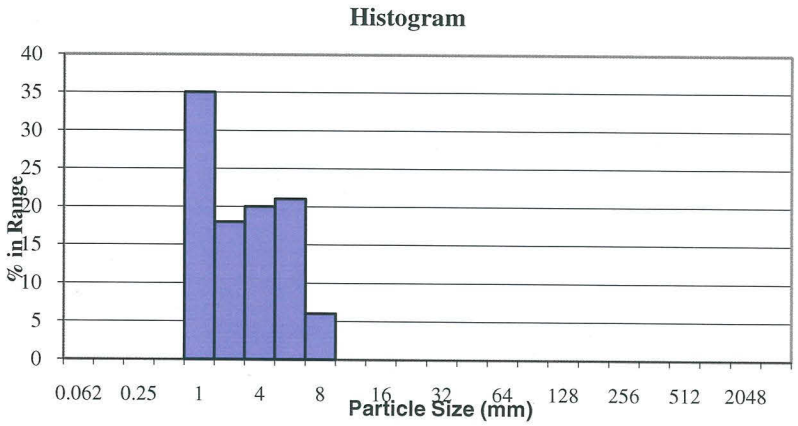
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	5
Date	9/8/08	**Sta No.**	27+62

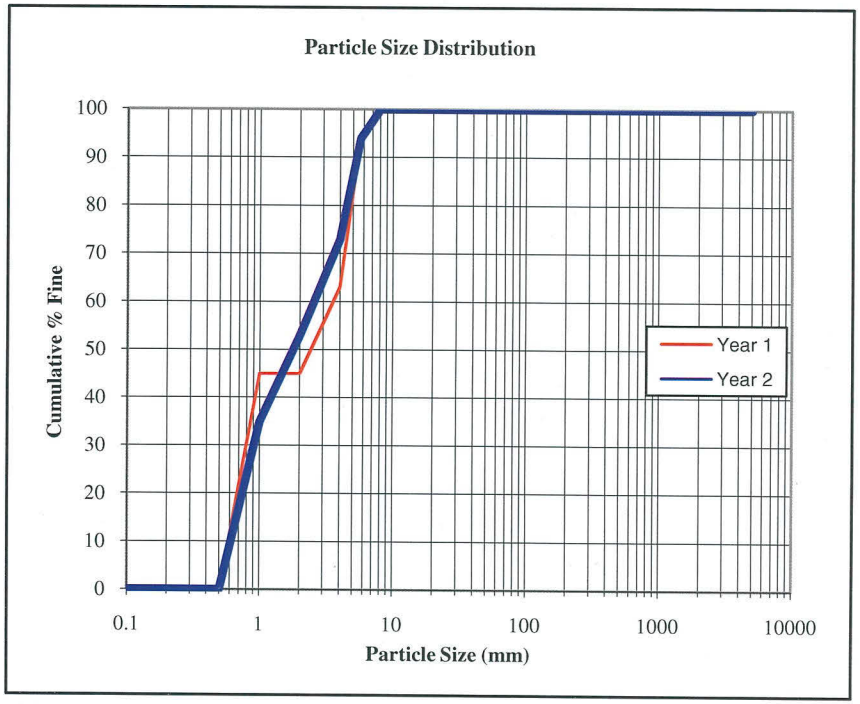




Pebble Count – Pool XS-6 (D50 = 1.8 mm; D84 = 4.9 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	35	35	35
Very Coarse Sand	1.0-2.0	18	18	53
Very Fine Gravel	2.0-4.0	20	20	73
Fine Gravel	4.0-5.7	21	21	94
Fine Gravel	5.7-8.0	6	6	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	6
Date	9/8/08	**Sta No.**	27+75

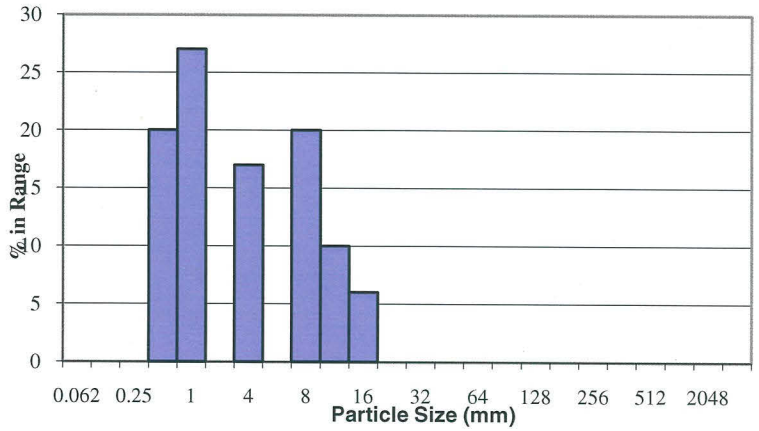




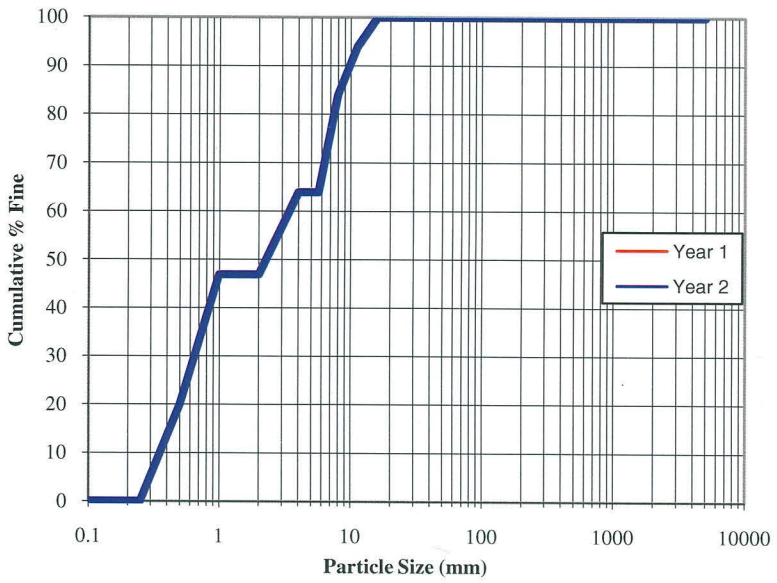
Pebble Count – Riffle XS1-UTA (D50 = 2.4 mm; D84 = 8.0 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	20	20	20
Coarse Sand	0.5-1.0	27	27	47
Very Coarse Sand	1.0-2.0	0	0	47
Very Fine Gravel	2.0-4.0	17	17	64
Fine Gravel	4.0-5.7	0	0	64
Fine Gravel	5.7-8.0	20	20	84
Medium Gravel	8.0-11.3	10	10	94
Medium Gravel	11.3-16.0	6	6	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	DS of 1
Date	9/8/08	**Sta No.**	3+45

Histogram



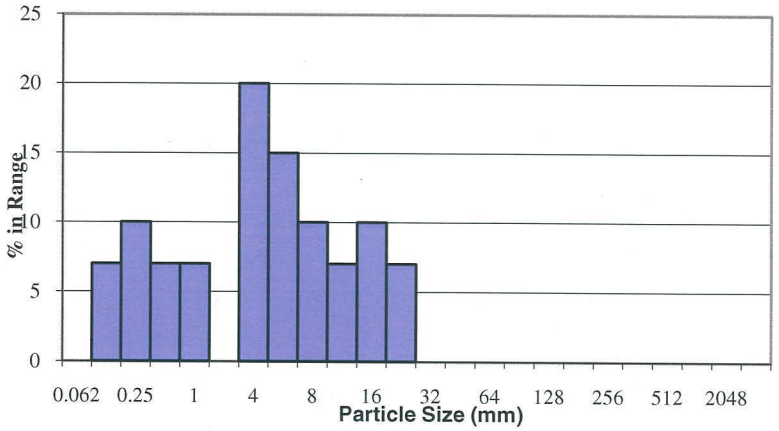
Particle Size Distribution



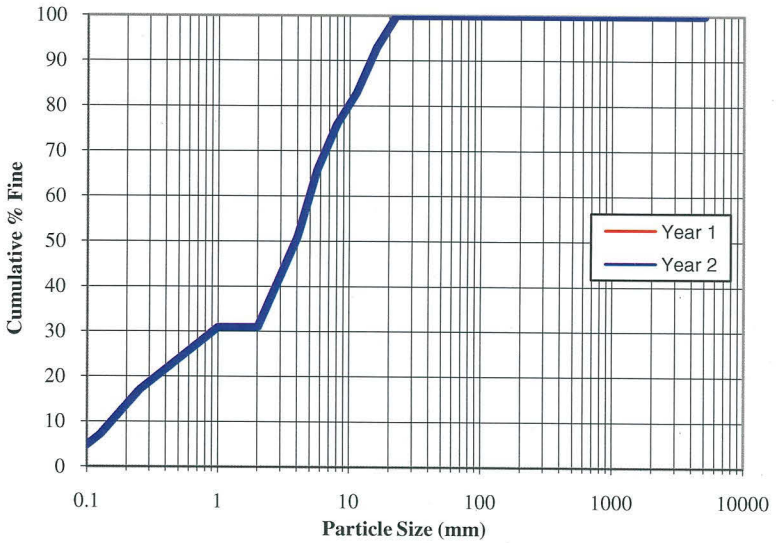
Pebble Count – Pool XS2-UTA (D50 = 11.8 mm; D84 = 17.9 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	7	7	7
Fine Sand	0.125-0.25	10	10	17
Medium Sand	0.25-0.5	7	7	24
Coarse Sand	0.5-1.0	7	7	31
Very Coarse Sand	1.0-2.0	0	0	31
Very Fine Gravel	2.0-4.0	20	20	51
Fine Gravel	4.0-5.7	15	15	66
Fine Gravel	5.7-8.0	10	10	76
Medium Gravel	8.0-11.3	7	7	83
Medium Gravel	11.3-16.0	10	10	93
Coarse Gravel	16.0-22.6	7	7	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	2
Date	9/8/08	**Sta No.**	7+80

Histogram

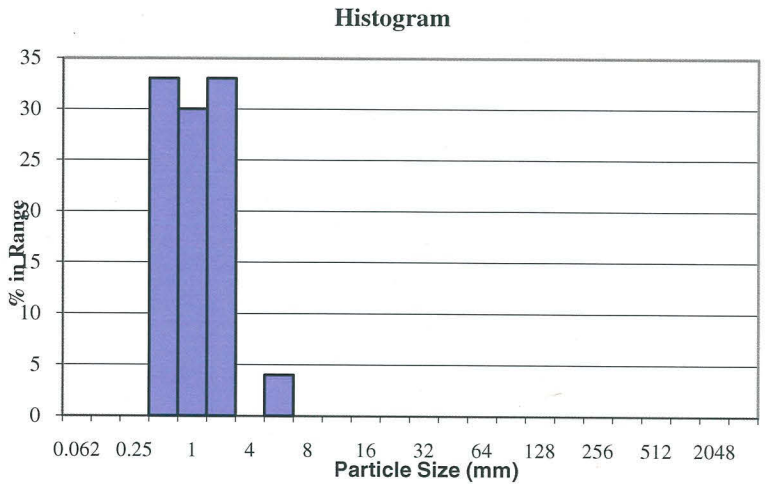


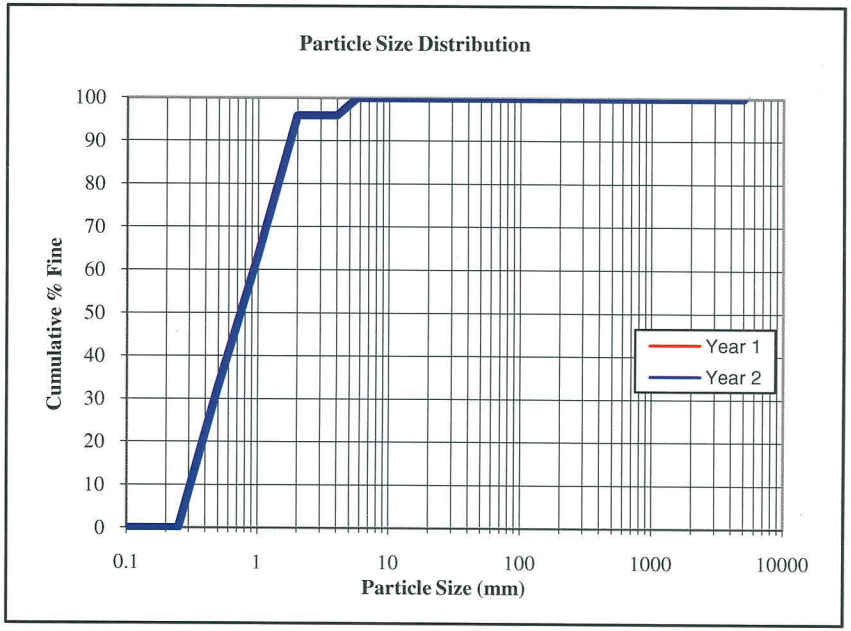
Particle Size Distribution



Pebble Count – Pool XS3-UTA (D50 = 0.8 mm; D84 = 1.6 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	33	33	33
Coarse Sand	0.5-1.0	30	30	63
Very Coarse Sand	1.0-2.0	33	33	96
Very Fine Gravel	2.0-4.0	0	0	96
Fine Gravel	4.0-5.7	4	4	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

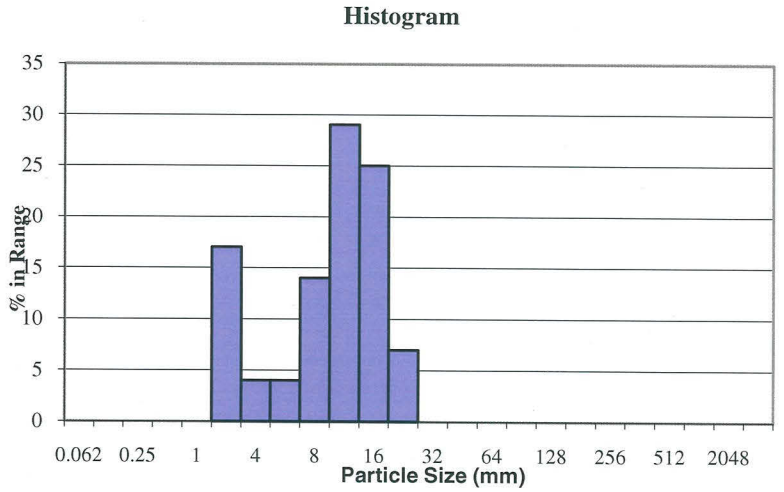
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	3
Date	9/8/08	**Sta No.**	11+80

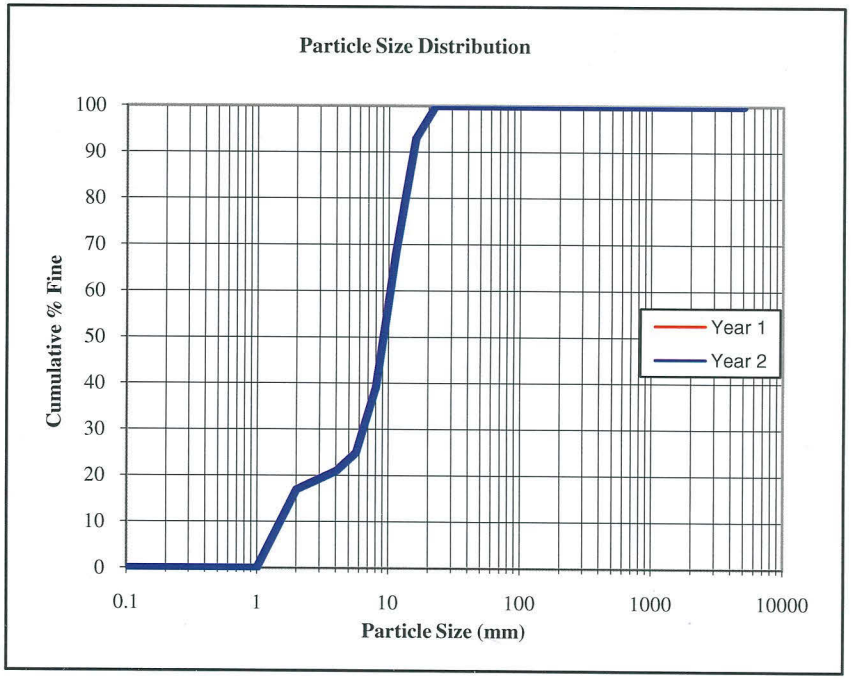




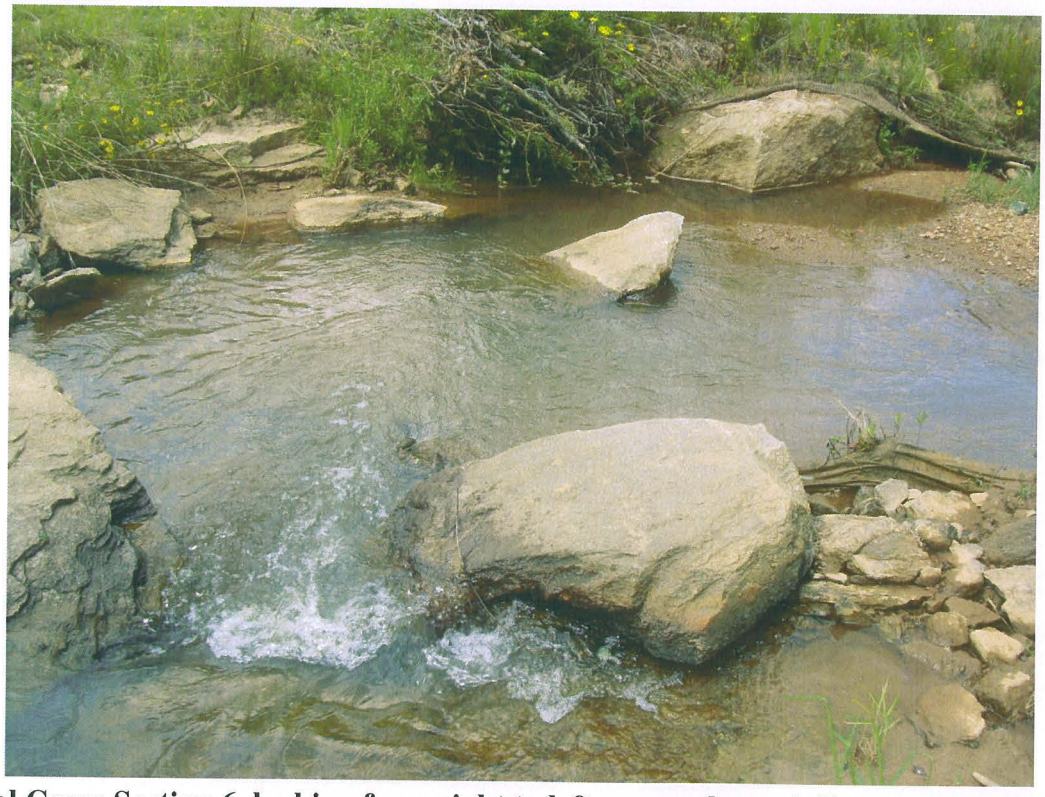
Pebble Count – Riffle XS4-UTA (D50 = 9.3 mm; D84 = 14.3 mm)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	17	17	17
Very Fine Gravel	2.0-4.0	4	4	21
Fine Gravel	4.0-5.7	4	4	25
Fine Gravel	5.7-8.0	14	14	39
Medium Gravel	8.0-11.3	29	29	68
Medium Gravel	11.3-16.0	25	25	93
Coarse Gravel	16.0-22.6	7	7	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	DS of 4
Date	9/8/08	**Sta No.**	12+00





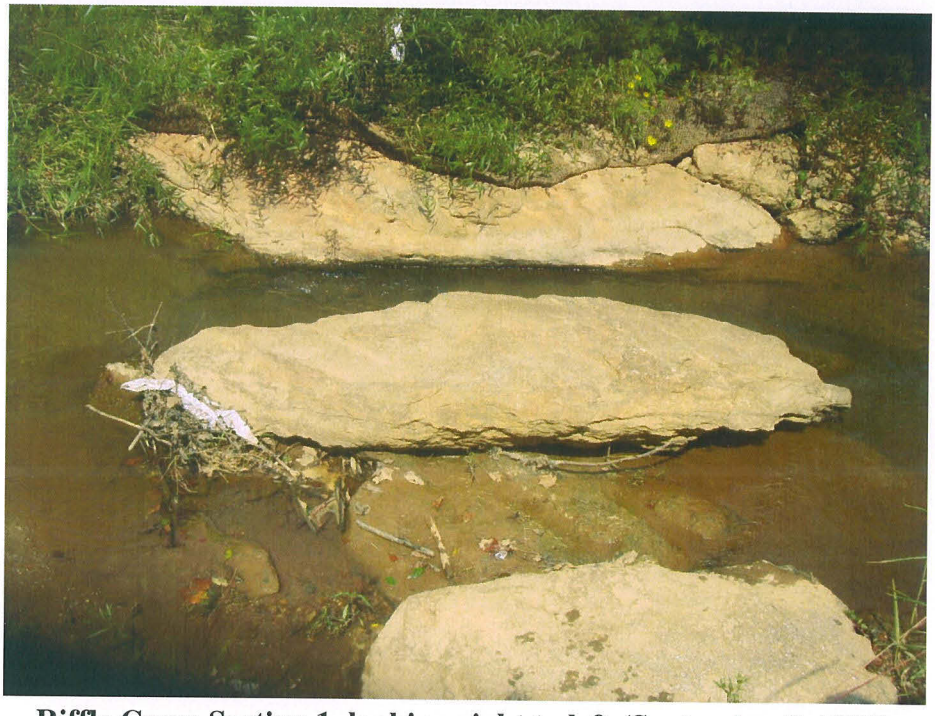
Riffle Cross-Section 5, looking from right to left across channel (September 8, 2008)



Pool Cross-Section 6, looking from right to left across channel (September 8, 2008)

Silver Creek Mainstem, Monitoring Year 2
Monumented Cross-Section Photographs

Riffle Cross-Section 1, looking downstream (September 8, 2008)



Riffle Cross-Section 1, looking right to left (September 8, 2008)

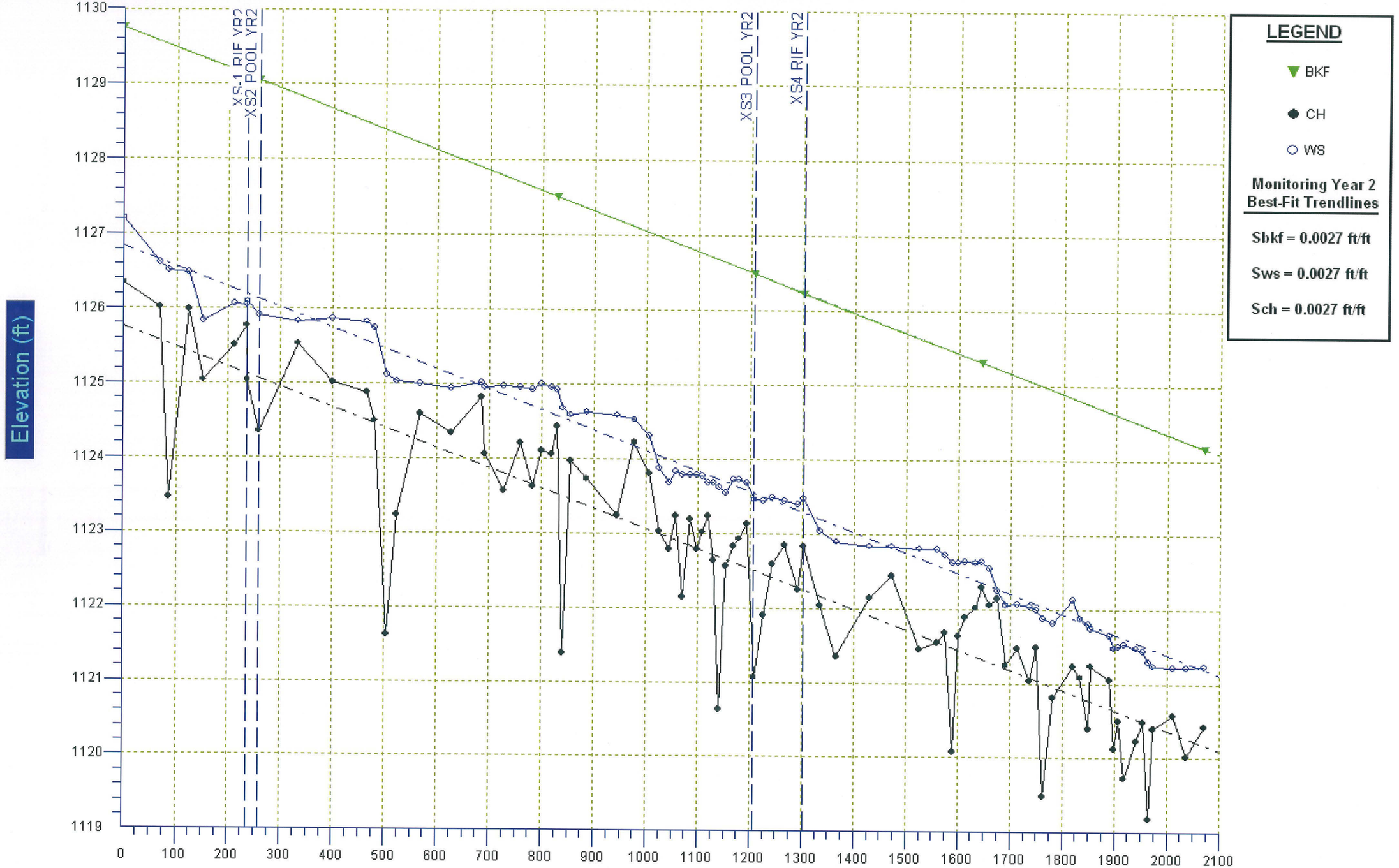
Pool Cross-Section 2, looking upstream (September 8, 2008)

Pool Cross-Section 3 at J-Hook, Log Vane, Rootwad Combination Structure (September 8, 2008)

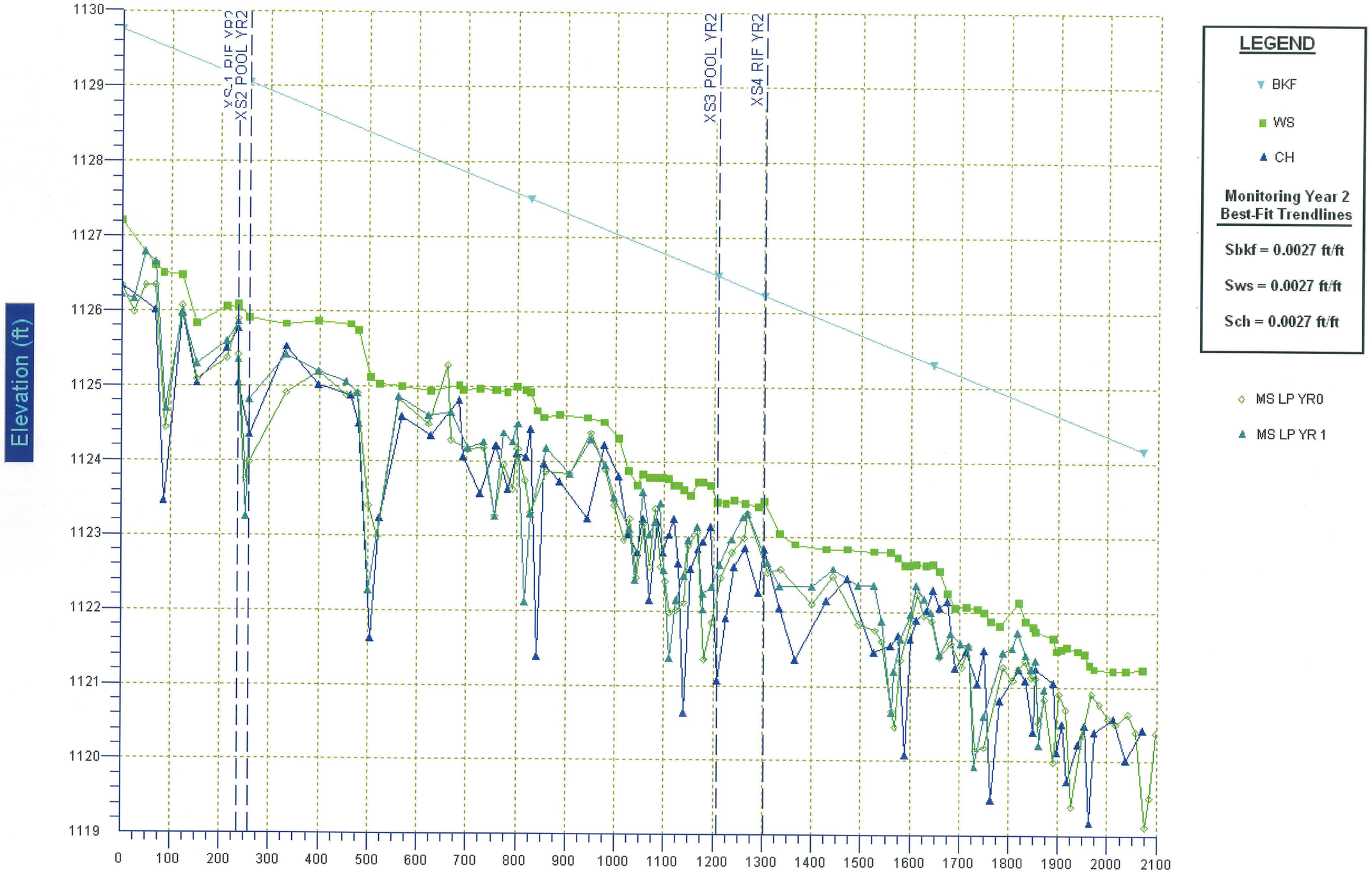
Riffle Cross-Section 4, looking downstream (September 8, 2008)

Riffle Cross-Section 4, looking upstream, from top to bottom: Riffle, run, pool sequence with sand and gravel point bar formation (September 8, 2008)

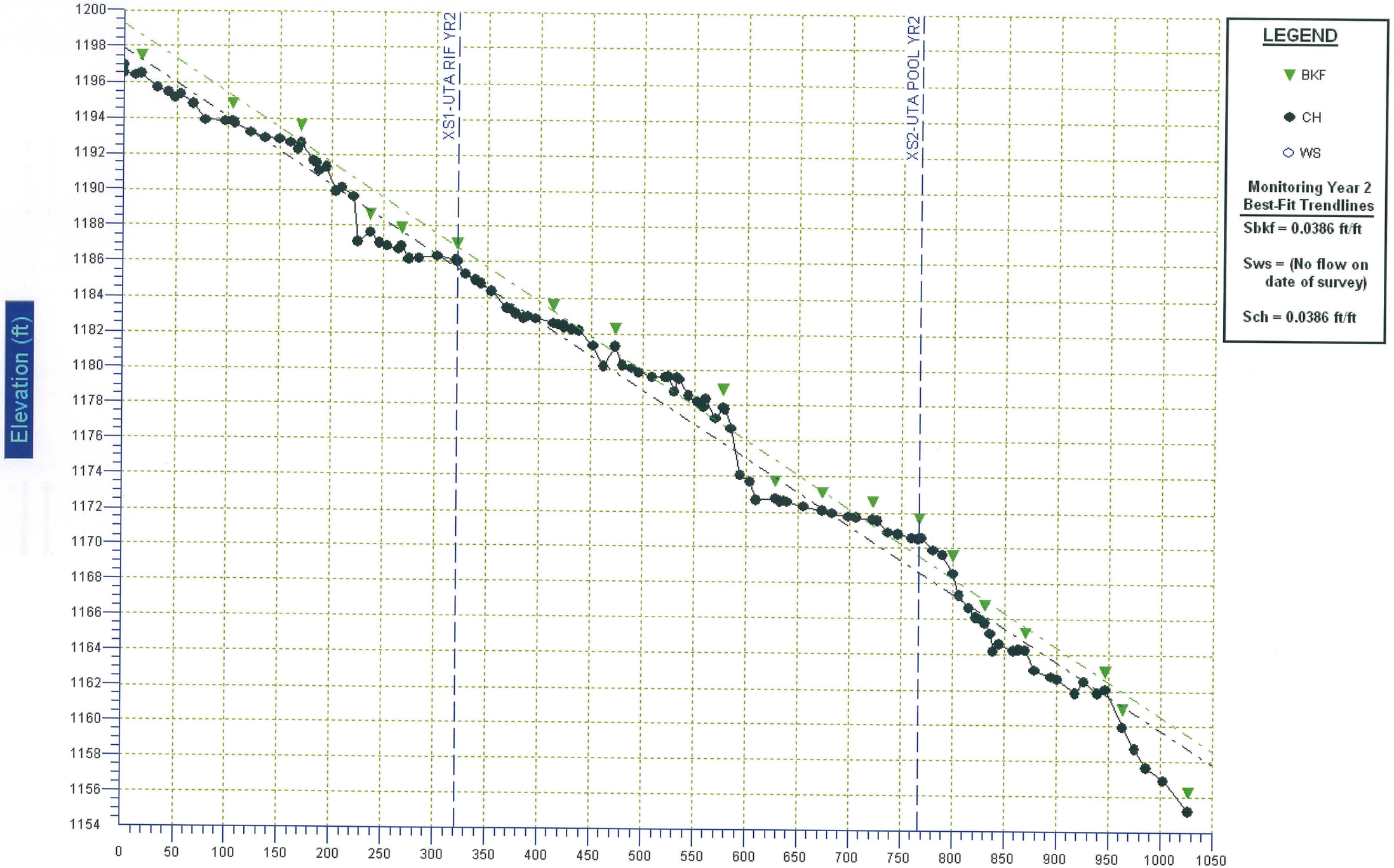
Silver Creek Mainstem - Year 2 Long-Term Monitoring Profile - 12/02/2008



Silver Creek Mainstem - Year 2 Long-Term Monitoring Profile - 12/02/2008



Silver Creek UTA - Long-Term Monitoring Profile - Year 2



LEGEND

- BKF
- CH
- WS

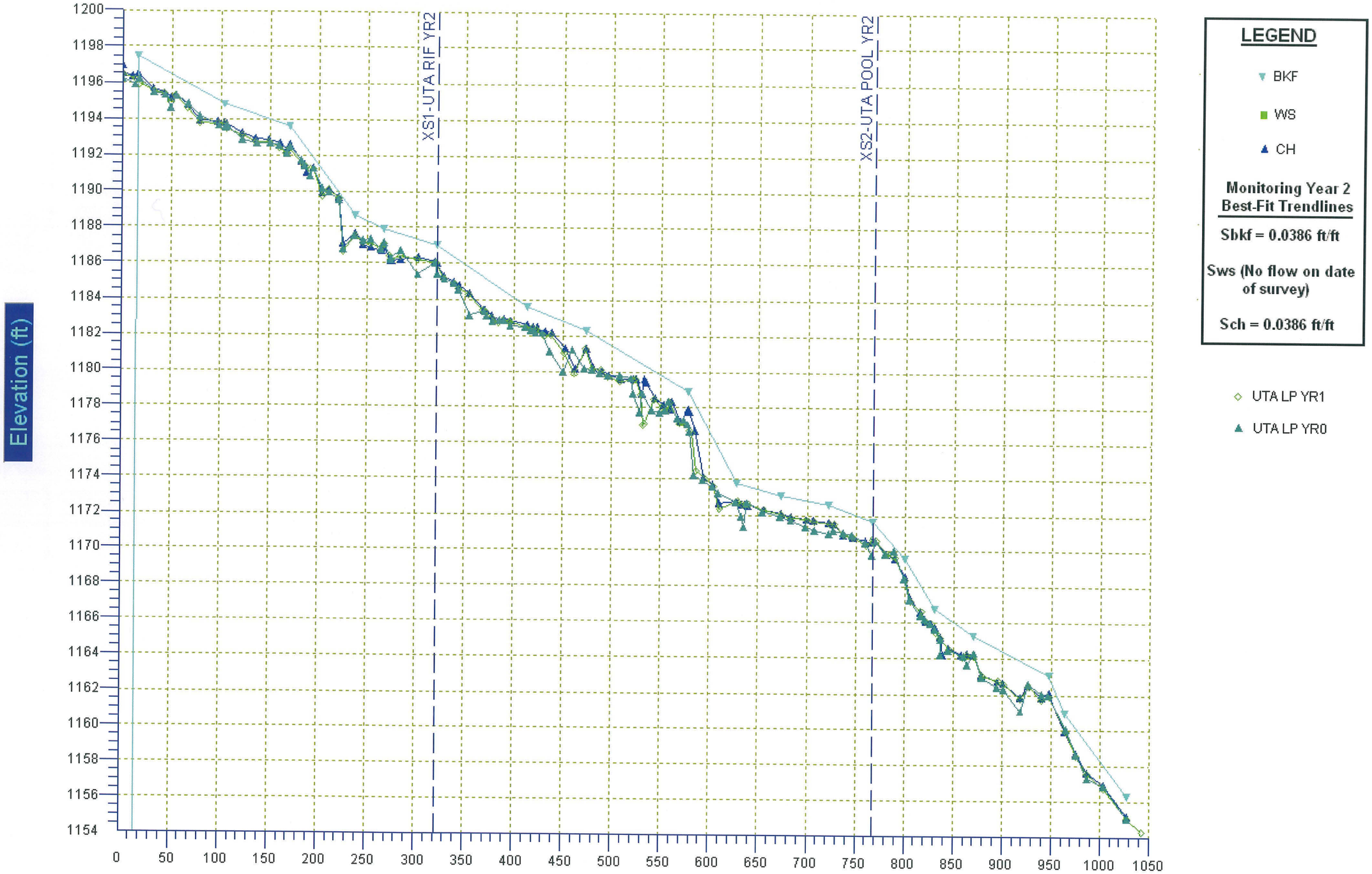
Monitoring Year 2 Best-Fit Trendlines

Sbkf = 0.0386 ft/ft

Sws = (No flow on date of survey)

Sch = 0.0386 ft/ft

Silver Creek UTA - Long-Term Monitoring Profile - Year 2



LEGEND

- BKF
- WS
- CH

Monitoring Year 2 Best-Fit Trendlines

Sbkf = 0.0386 ft/ft

Sws (No flow on date of survey)

Sch = 0.0386 ft/ft

- UTA LP YR1
- UTA LP YR0