Year 1 Monitoring Report for Stream Restoration of Silver Creek and Unnamed Tributaries

Burke County, NC
SCO # D05016-01

Prepared for:
NCDENR – EEP
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Raleigh NC 27604

Ecosystem Enhancement PROGRAM

Submitted: January 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 (UT-A); also included is 166 linear feet of preservation along UT-B, UT-C and UT-D. 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 1 Annual Monitoring for this project.

Vegetative monitoring was completed in September 2007 following the Carolina Vegetation Survey methodology. Stem counts completed at ten (10) vegetation plots show an average density of 389 stems per acre for the site. This density exceeds the success criteria of 320 stems/acre after three years of monitoring. Two individual plots have stem densities below the minimum. These plots were located in areas where the existing vegetation was not disturbed during construction. The Year 1 stem counts represent 95% survival from the initial plantings. While several of the living stems appeared stressed from lack of water due to the severe 2007 drought, the low seedling mortality is not seen as a problem at this time.

Visual stream stability assessment, conducted by EMH&T during October 19-20, 2007 revealed in-stream structures are functioning as designed and built on Silver Creek mainstem and Unnamed Tributary A (UT-A). Point bars are beginning to form along the inside meander bends on the mainstem. Cross-vanes, J-hook vanes, rock vanes, dual-winged jetties, rock-toe channel protection and constructed riffles, step pools, root wad bank stabilization 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 2007, the active channels are appropriately sized to entrain their bedload. Minor aggradation was noted at a few isolated locations. It is anticipated this sediment will move through the system when precipitation, runoff and discharge from the 8.26-square mile contribution watershed returns to normal conditions. 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 not warranted nor planned at this time. A portion of UT-A is exhibiting bank instability that will be addressed prior to the Year 2 monitoring activities.

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; however, the plot on UT-B had stem densities below the minimum. A few supplemental plantings will be added to the site in the spring of 2008 to bring all vegetation plots back into compliance. 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 in Figure 1. The stream channels included in this project are the Silver Creek mainstem and four unnamed tributary streams designated UT-A, UT-B, UT-C and UT-D.

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 UT-B, UT-C and UT-D, 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 UT-A. 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 UT-A channel was a classic Type I valley confined, A1-A2 stream type transitioning to a Type II colluvial valley, B4-B5 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 (pasture land) adjacent to the stream corridor and uncontrolled cattle access to the stream for drinking water 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 UT-A 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 indicative of a biologically diverse environment.
- 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 to the stream.
- Long-term protection of the stream corridors.

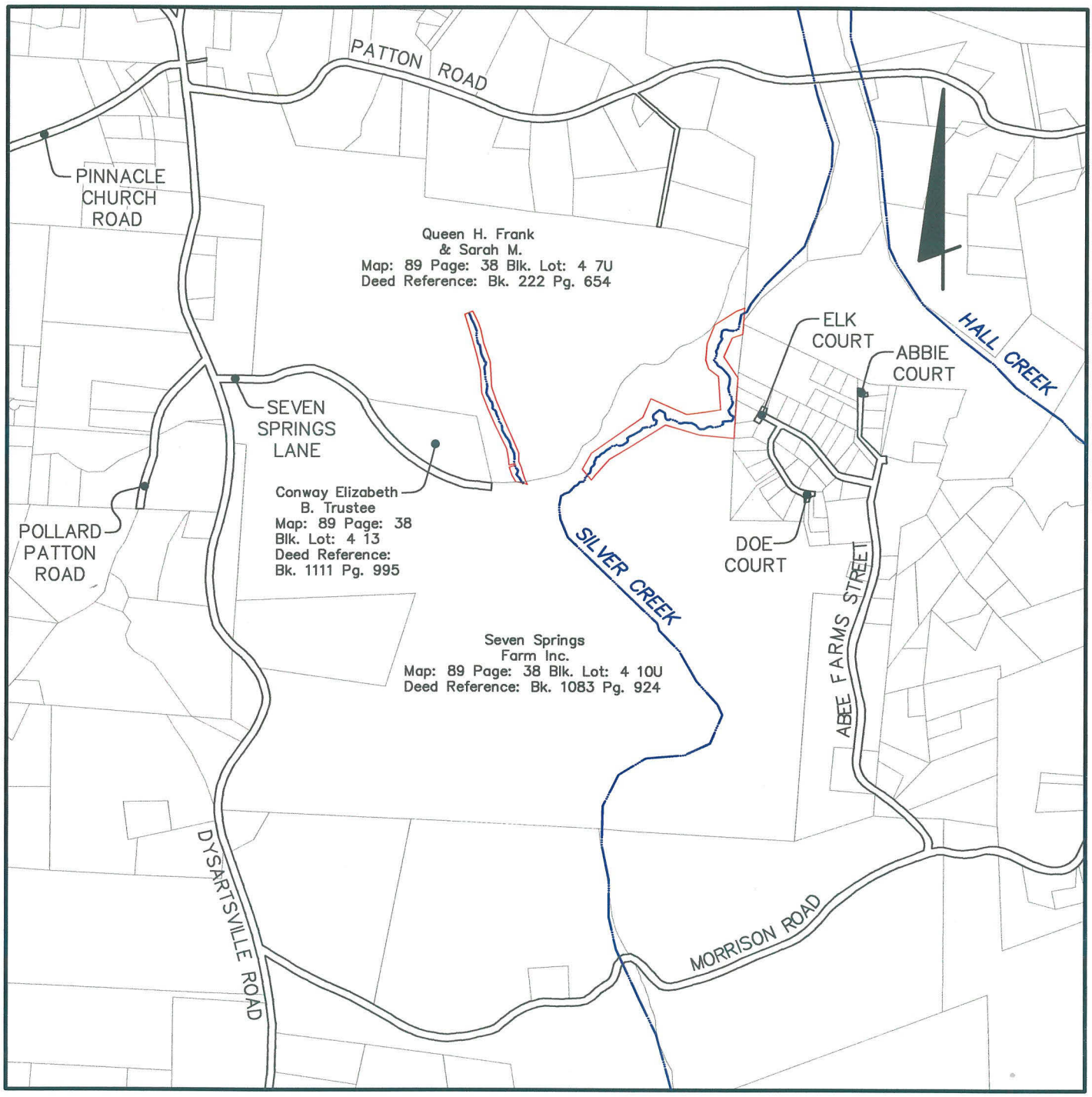
Restoration of the project streams re-established geomorphologic features consistent with reference reach conditions. Results achieved are listed below.

- 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.

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 (UT-A)	1,552 ft
Unnamed Tributary B (UT-B)	66 ft
Unnamed Tributary C (UT-C)	48 ft
Unnamed Tributary D (UT-D)	52 ft
TOTAL	4,623 ft



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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: January, 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
UT-A	Priority 2 Restoration	1,552 ft	1.0	1,552 ft	Restore dimension, pattern, and profile
UT-B	Preservation	66 ft	5.0	13 ft	Preserved within the conservation easement
UT-C	Preservation	48 ft	5.0	10 ft	Preserved within the conservation easement
UT-D	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		
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 Blunck, 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 UT-A-0.075 sq mi
Drainage Impervious Cover Estimate	5.5%
Stream Order[1]	Mainstem-3rd UT-A-1st
Physiographic Region	Blue Ridge Mountains/Southern Inner Piedmont
Ecoregion	Eastern Blue Ridge Foothills
Rosgen Classification of As-built[1]	Mainstem-B4c UT-A-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%

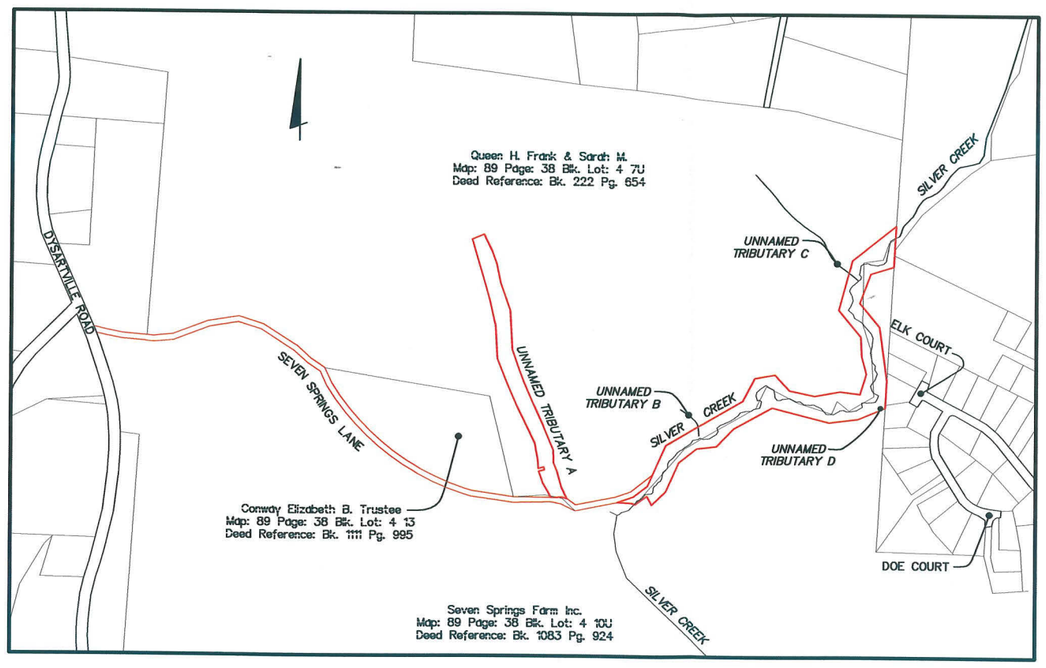
[1]Data for UTB, UTC, and UTD are not reported as they are Preservation reaches.

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 UT-B and UT-C, which were incidentally 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
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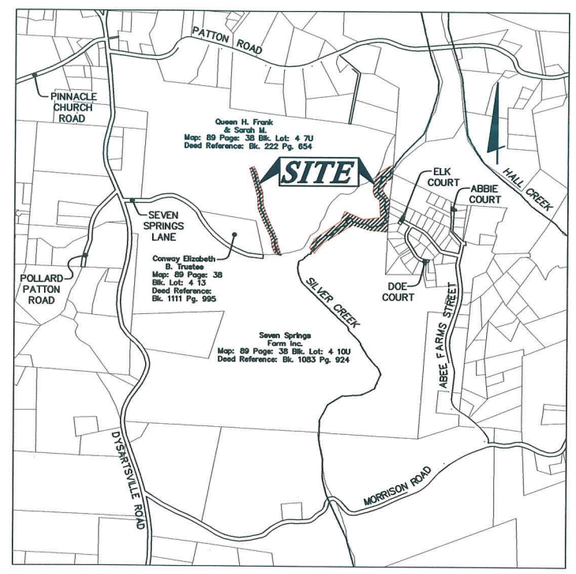

VICINITY MAP
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Job No.	Sheet
2007-1898	1/6
Date: January, 2008	Scale: As Noted

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

Ecosystem Enhancement Program

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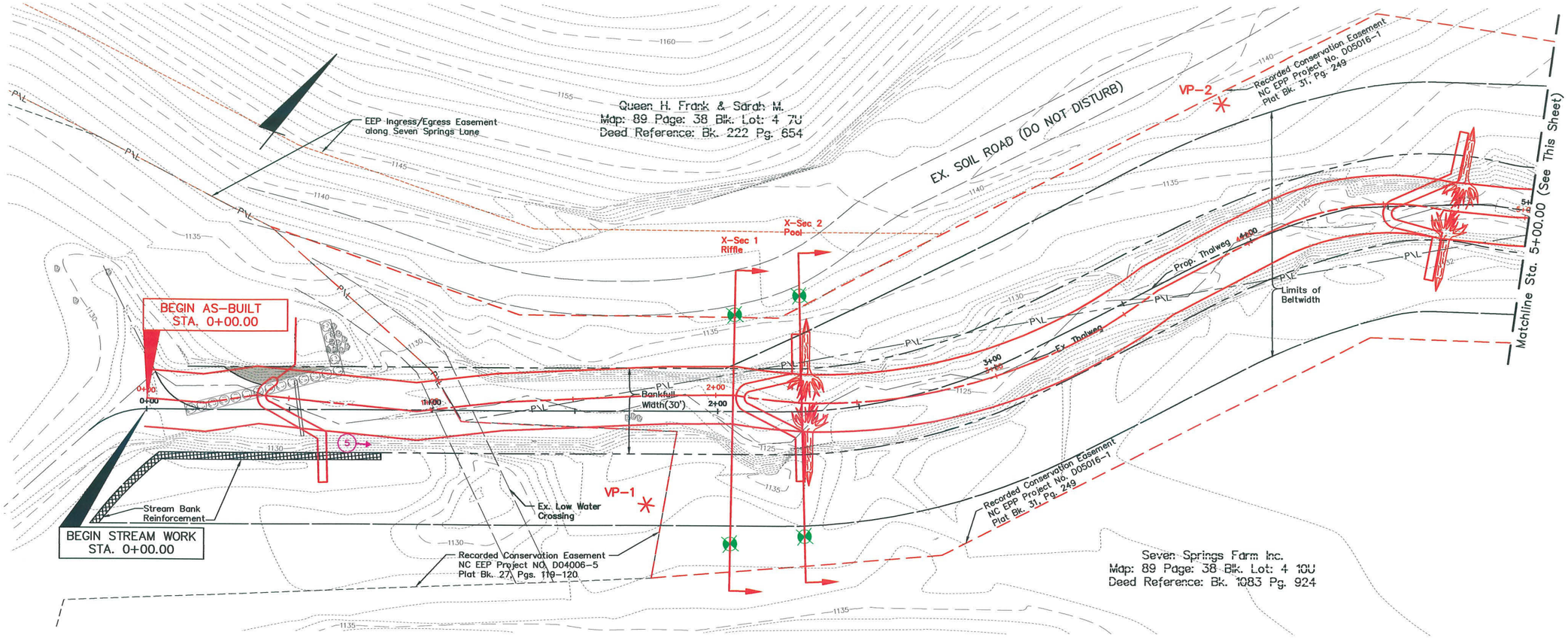

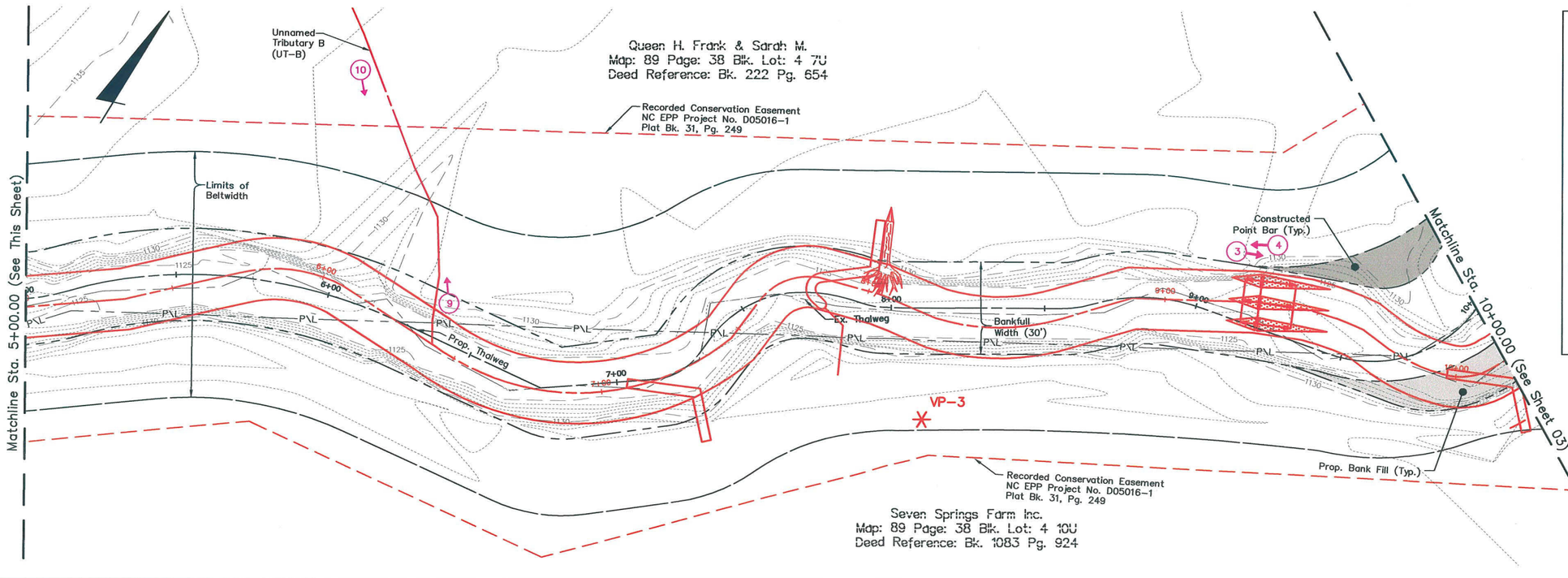

Job No. 20071898
Sheet 2/6
Date January, 2008
Scale Hor: 1" = 40'
Ver: 1" = 4'

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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5500 New Albany Road, Columbus, OH 43054
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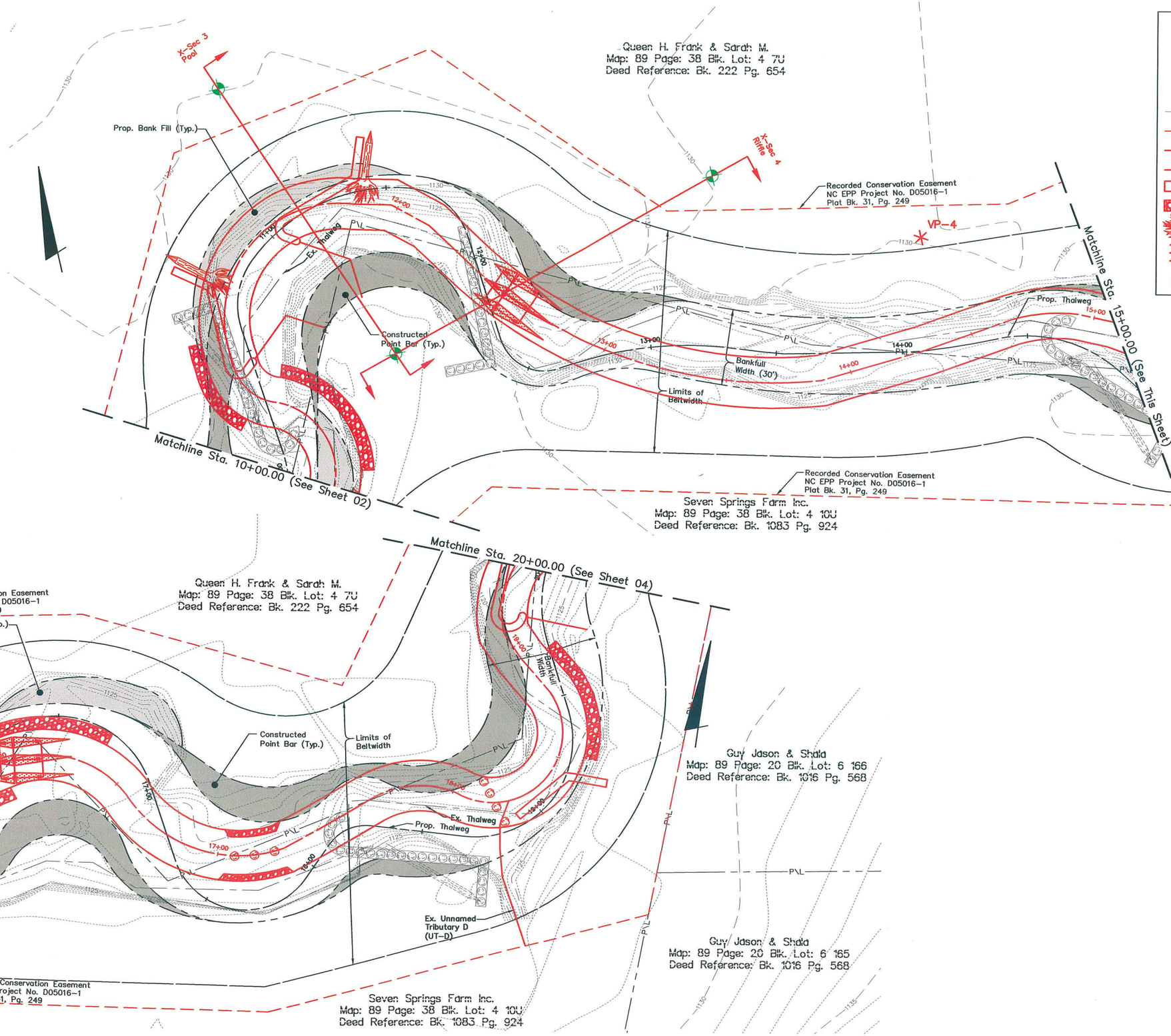

LEGEND

- 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.	Sheet
2007-1898	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

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LEGEND

- Vegetation Plot (VP)
- Crest Gauge
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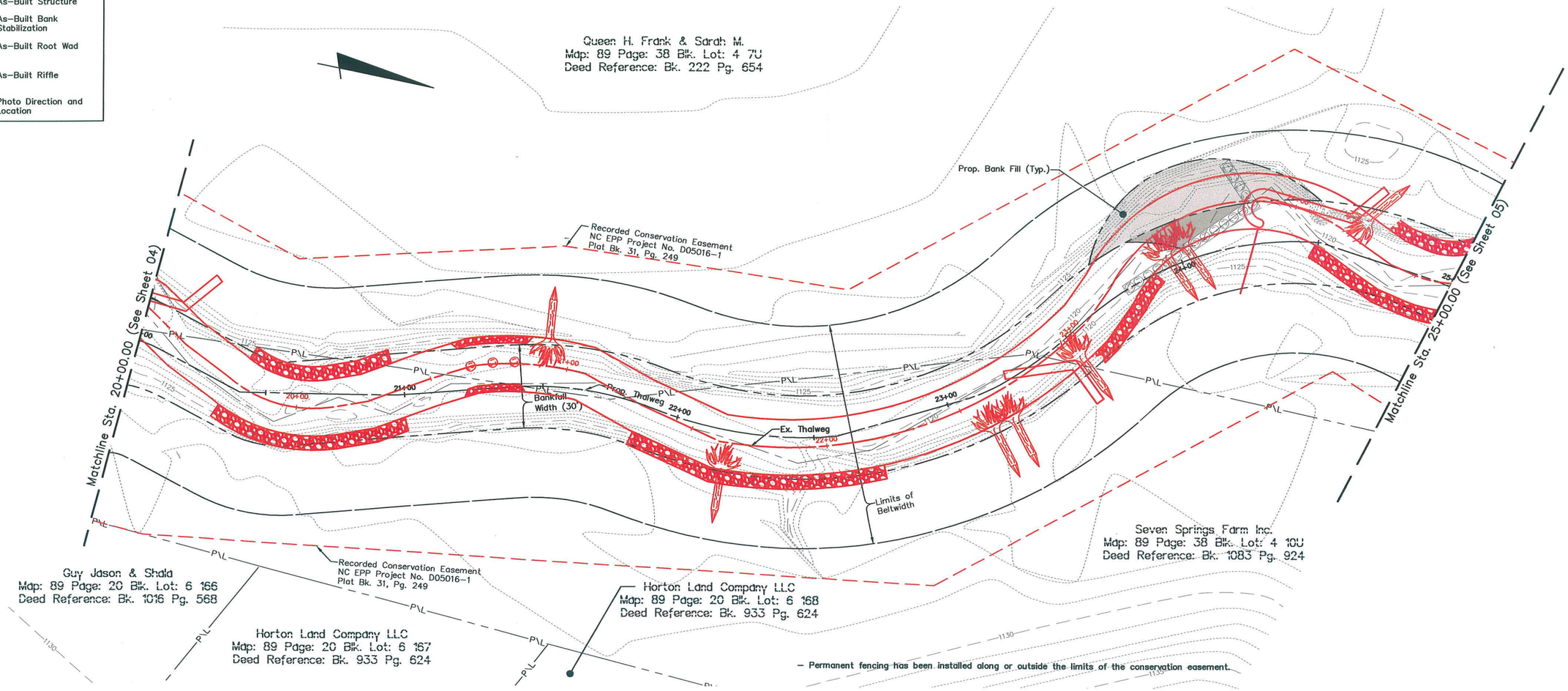
- Photo Direction and Location



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2007-1898	4/6
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January, 2008	
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BURKE COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR

SILVER CREEK AND UNNAMED TRIBUTARY

SILVER CREEK
PLAN & PROFILE

REVISIONS

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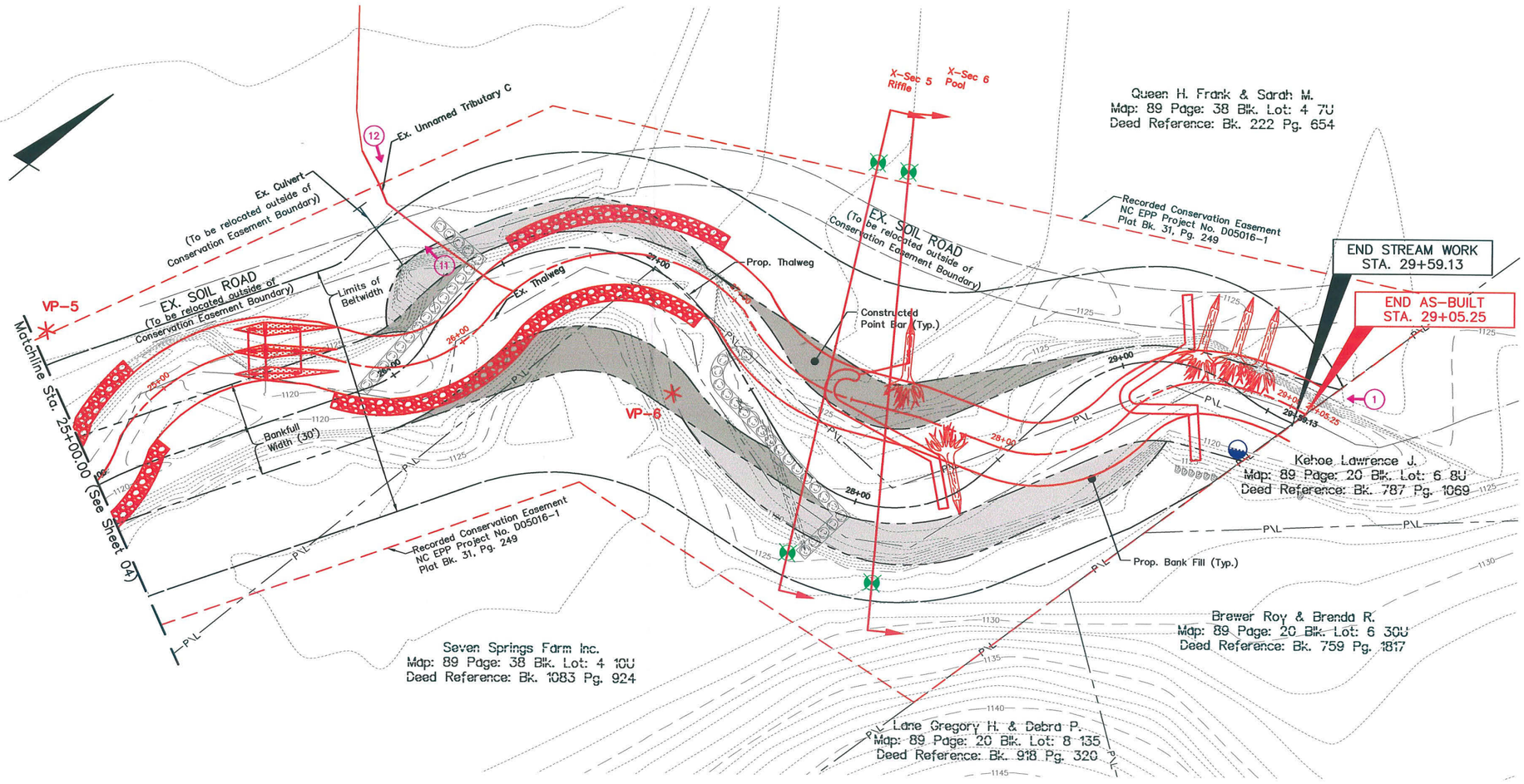
N. C M X X V I

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

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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

Proposed Bankfull Width (8')

X-Sec 2 Pool

Ex. Overhead Electric

Prop. Thalweg

Build Bankfull Channel w/Log Vanes

Matchline Sta. 10+00.00 (See This Sheet)

Matchline Sta. 10+00.00 (See This Sheet)

X-Sec 4 Riffle

X-Sec 3 Pool

Reinforce Bank w/Heavy Fabric and Live Branch Plantings

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

VP-3

VP-4

Excavate Floodprone Bench

Bank Reinforcement w/Point Bar

Riffle

Ex. Culvert

Ex. Soil Road

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

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

UT4
PLAN & PROFILE

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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 UT-A 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 a few 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.

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

Species	Vegetation Plots										Year 0 Totals	Year 1 Totals	Survival %
	MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	UTA 1	UTA 2	UTA 3	UTA 4			
Shrubs													
Alnus serrulata					1		1	1	2		5	5	100
Aronia melanocarpa			3			1		2	1	1	8	8	100
Cornus amomum	2	2	5	5	4		1	4	2		31	25	81
Trees													
Acer rubrum							2				2	2	100
Acer saccharum	2			4	10	2					18	18	100
Fraxinus pennsylvanica					3	1	1	2	4	4	15	15	100
Liriodendron tulipifera	2				1	1					4	4	100
Platanus occidentalis	1	4							3	3	16	11	69
Quercus michauxii	1	2									3	3	100
Salix nigra		1	3							1	5	5	100
Totals	8	9	11	9	19	5	5	9	12	9	107	96	95
Live Stem Density (stems per acre)	324	365	446	365	770	203	203	365	486	365			
Average Live Stem Density (stems per acre)	389												

The average stem density for the site exceeds the minimum criteria of 320 stems per acre after three years. Two individual plots had stem densities below the minimum. These two plots were located in areas where the existing vegetation was not disturbed during construction, and plantings were placed into openings in the existing vegetation.

The Year 1 stem counts represent 95% survival from the initial plantings. Several of the living stems appeared stressed due to lack of water, and it is assumed that any seedling death was caused by dryness. The low seedling mortality is not seen as a problem at this time. If future monitoring shows that seedling mortality from dry site conditions is causing stem densities to fall below the threshold, supplemental plantings will be recommended.

Section 401 Permit Monitoring

In addition to the vegetative monitoring plots on the Silver Creek Mainstem and UT-A, one vegetation monitoring plot each has been placed on UT-B and UT-C, 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 UT-B and UT-C			
Species	Plots		Year 1 Totals
	UT-B	UT-C	
Shrubs			
Cornus amomum	1	1	2
Trees			
Acer saccharum		7	7
Fraxinus pennsylvanica	6		6
Liriodendron tulipifera		2	2
Quercus alba		2	2
Year 1 Totals	7	12	19
Live Stem Density (stems per acre)	284	486	
Average Live Stem Density (stems per acre)	385		

The average stem density for these tributaries combined exceeds the minimum criteria of 320 stems per acre after three years. However, the plot on UT-B had stem densities below the minimum. A few supplemental plantings will be added to the site in the spring of 2008, which will bring the stem counts on this plot, and Plots MS6 and UTA1, back into compliance.

5. Vegetation Plot Photos

Vegetation plot photos, including photos for the additional plots on UT-B and UT-C, 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 UT-A. 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 year of monitoring.

2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for the first year of monitoring is included in Tables IX.

Table IX. Stream Problem Areas Silver Creek Stream Restoration / EEP Project No. D05016-1			
Feature Issue	**Station Numbers**	**Suspected Cause**	**Photo Number**
Stressed/failing structure	5+75 UT-A	Natural log sill - concern for long-term stability	SPA 1
Other	11+00 - 13+00 UT-A	Nearly vertical banks - need to be stabilized with matting and vegetation	SPA 2

Areas of instability were not observed along the Silver Creek Mainstem. On UT-A, a natural log sill was preserved during construction; the long-term stability of this feature was a noted concern during a site visit with the EEP. This structure will be monitered to further assess stream stability in this area. An additional area of concern exists along UT-A concerning the steep slopes of the stream banks. These banks are in need of reshaping to decrease the slopes and need revegetating to further enhance stability, as requested by EEP. Erosion control matting should be applied to protect the stream banks along this stream segment while vegetation is reestablished.

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 watched) 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 October 19, 2007. These photographs are provided in Appendix B. Photographs of UT-B and UT-C 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 first year of monitoring. A summary of the visual assessment for each reach is included 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%				
B. Pools[2]	100%	100%				
C. Thalweg	100%	100%				
D. Meanders	100%	100%				
E. Bed General	100%	100%				
F. Vanes / J Hooks etc. [3]	100%	100%				
G. Wads and Boulders[4]	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%				
B. Pools[2]	100%	66%				
C. Thalweg	100%	100%				
D. Meanders	100%	100%				
E. Bed General	100%	100%				
F. Vanes / J Hooks etc. [3]	100%	98%				
G. Wads and Boulders[4]	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 during October 19-20, 2007 revealed in-stream structures are functioning as intended on the Silver Creek mainstem and UT-A. Point bars are beginning to form 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 constructed. One natural log sill has been noted as an area of concern and 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. Some aggradation is shown on the long-term monitoring profile and cross-section plots for UT-A. Aggradation is primarily observed at pool locations. This is attributed to extended drought during the summer of 2007 and minimal flushing of sand-sized particles through the project reach. It is anticipated this sediment will move through the system when precipitation, runoff and discharge return to normal conditions. 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 2007, the active channels are appropriately sized to entrain their bedload. Repairs requested by EEP, as documented in the Stream Problem Areas, will be addressed during Year 2 maintenance of project reaches.

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 UT-A. Both UT-B and UT-C 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 and Year 1 is the same as the data provided from the As-Built survey, as pattern has not changed based on the Year 1 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 reference reach conditions, adjusted for drainage area and bankfull width. The pools have developed excellent glide features, providing spawning habitat for native fishes and riffle substrates conducive for benthic macro-invertebrate populations to re-emerge. Comparison of As-Built and Year 1 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 1 substrate analysis.

IV. METHODOLOGY

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). 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. Subsequent stream monitoring will occur in the fall of Years 2 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.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary

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

Station/Reach: Mainstem {Long-Term Monitoring Profile Station 0+00 to 18+71.14 (1871.14 feet)}

Parameter	Reference Reach			Pre-Existing Condition			Design			As-Built			Year 1 Sta. 0+00 - 18+71		
Dimension	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
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
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
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
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
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
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
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
Bank Height Ratio			1.00	3.89	4.07	3.98			1.00	0.93	1.02	0.97	0.30	0.50	0.40
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
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
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
*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
*Meander Wavelength (ft)	88.23	115.70	104.80						191.8	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
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
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
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
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
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
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
Additional Reach Parameters															
Valley Length (ft)			294.00			2077			2077			2077			2077
Channel Length (ft)			353.00			3040			2959			2905			2905
Sinuosity			1.2			1.46			1.43			1.40			1.40
Water Surface Slope (ft/ft)			0.0106	0.00218	0.00299	0.00259			0.0025			0.0026			0.0028
BF Slope (ft/ft)			0.0115			**			0.0026			0.0027			0.0028
Rosgen Classification			C4			F4	B4c	C4	C4			B4c			B4c
*Habitat Index															

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 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 provided, only one value was measured or computed and is presented as the mean value.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary

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

Station/Reach: Tributary A {Long-Term Monitoring Profile Station 0+00 to 11+42.65 (1142.65 feet)}

Parameter	Reference Reach			Pre-Existing Condition			Design			As-Built			Year 1 Sta 0+00 - 11+43		
Dimension	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
BF Width (ft)			24.02			13.72			8.00	6.81	8.11	7.46	6.78	7.32	7.05
Floodprone Width (ft)			232.00	Confined	15.00	15.00	Confined	15.00	15.00	13.28	14.57	13.93	10.45	13.35	11.90
BF Cross Sectional Area (ft^2)			30.77			3.54			3.50	3.51	3.59	3.55	3.52	3.57	3.55
BF Mean Depth (ft)			1.28			0.26			0.50	0.43	0.53	0.48	0.48	0.53	0.51
BF Max Depth (ft)			1.72			0.90			1.00	0.81	1.01	0.91	0.63	1.01	0.82
Width/Depth (ft)			18.77			52.77			16.00	12.85	18.86	15.86	12.79	15.25	14.02
Entrenchment Ratio			9.66			1.09			1.88	1.80	1.95	1.88	1.43	1.97	1.70
Bank Height Ratio			1.00			1.91			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
Hydraulic Radius (ft)			1.16			0.25			0.39	0.42	0.50	0.46	0.47	0.50	0.49
Pattern															
*Channel Beltwidth (ft)	44.17	46.50	45.22							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
*Meander Wavelength (ft)	88.23	115.70	104.80							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
Profile															
Riffle Length (ft)	19.0	31.0	25.7							1.34	47.90	15.30	2.35	49.50	12.84
Riffle Slope (ft/ft)	0.0125	0.0362	0.0211							0.0344	0.6094	0.1389	0.0401	0.4593	0.1278
Pool Length (ft)	11.0	31.6	17.4							6.07	22.79	12.43	6.59	24.21	13.81
Pool Spacing (ft)	67.6	77.5	71.4							10.19	143.20	55.63	10.92	150.25	38.78
Substrate															
d50 (mm)			38.5							6.9	15.8	11.4	2.4	8.2	5.3
d84 (mm)			60.2							20.2	42.4	31.3	9.2	14.3	11.8
Additional Reach Parameters															
Valley Length (ft)			294.00			1426			1426			1426			1426
Channel Length (ft)			353.00			1508			1533			1552			1552
Sinuosity			1.2			1.06			1.07			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			0.03850
BF Slope (ft/ft)			0.0115			**	0.0375	0.0535	0.0455			0.0469			0.03670
Rosgen Classification			C4			A-->B	A1/A2 --> B4a					B4a			B4a
*Habitat Index															

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 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 2 on Mainstem
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 3 on Mainstem
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 4 on Mainstem
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 5 on Mainstem
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 6 on Mainstem
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 1 on Tributary A
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 2 on Tributary A
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 3 on Tributary A
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot 4 on Tributary A
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot on Tributary B
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Vegetation Plot on Tributary C
Monitoring Year 1
(EMH&T, Inc. 9/18/07)

Table 1. Vegetation Metadata	
Report Prepared By	Holly Blunck
Date Prepared	11/14/2007 8:16
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 saccharum	2	7	8	1		
	Alnus serrulata	5					
	Aronia melanocarpa		2	6			
	Cornus amomum	13	8	4		6	
	Fraxinus pennsylvanica	9	4		2		
	Quercus michauxii	2		1			
	Salix nigra	4	1				
	Liriodendron tulipifera	1	3				
	Platanus occidentalis	8	1		2	5	
	Acer rubrum			2			
TOT:	**10**	**44**	**26**	**21**	**5**	**11**	**0**

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	18	17					1				
	Alnus serrulata	5	5									
	Aronia melanocarpa	8	5					2		1		
	Cornus amomum	31	30							1		
	Fraxinus pennsylvanica	15	13							2		
	Liriodendron tulipifera	4	4									
	Platanus occidentalis	16	16									
	Quercus michauxii	3	3									
	Salix nigra	5	5									
TOT:	**10**	**107**	**100**	**0**	**0**	**0**	**0**	**3**	**0**	**4**	**0**	**0**

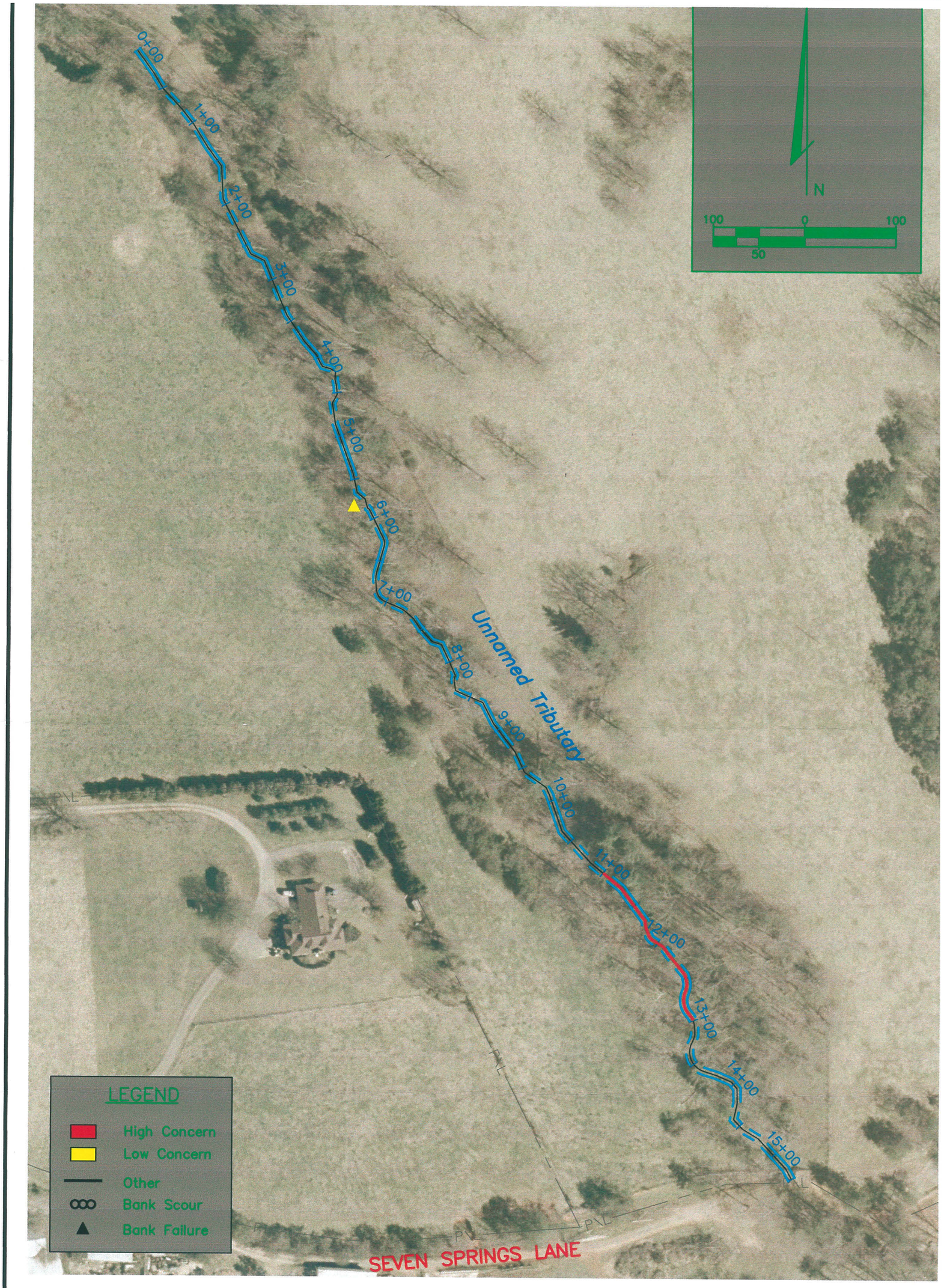
Table 4. Vegetation Damage by Plot												
	plot	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)
	D0501601-01-0001	11	11									
	D0501601-01-0002	10	10									
	D0501601-01-0003	12	11					1				
	D0501601-01-0004	11	11									
	D0501601-01-0005	20	19					1				
	D0501601-01-0006	6	6									
	D0501601-01-0007	5	5									
	D0501601-01-0008	9	8							1		
	D0501601-01-0009	13	9					1		3		
	D0501601-01-0010	16	16									
TOT:	**10**	**113**	**106**	**0**	**0**	**0**	**0**	**3**	**0**	**4**	**0**	**0**

Table 5. Stem Count by Plot and Species														
	Species	Total Stems	# plots	avg# stems	plot D0501601-01-0001	plot D0501601-01-0002	plot D0501601-01-0003	plot D0501601-01-0004	plot D0501601-01-0005	plot D0501601-01-0006	plot D0501601-01-0007	plot D0501601-01-0008	plot D0501601-01-0009	plot D0501601-01-0010
	Acer rubrum	2	1	2							2			
	Acer saccharum	18	4	4.5	2			4	10	2				
	Alnus serrulata	5	4	1.25					1		1	1	2	
	Aronia melanocarpa	8	5	1.6			3			1		2	1	1
	Cornus amomum	25	8	3.13	2	2	5	5	4		1	4	2	
	Fraxinus pennsylvanica	15	6	2.5					3	1	1	2	4	4
	Liriodendron tulipifera	4	3	1.33	2				1	1				
	Platanus occidentalis	11	4	2.75	1	4							3	3
	Quercus michauxii	3	2	1.5	1	2								
	Salix nigra	5	3	1.67		1	3							1
TOT:	**16**	**96**	**16**		**8**	**9**	**11**	**9**	**19**	**5**	**5**	**9**	**12**	**9**

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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M C M X X V I

BURKE COUNTY, NORTH CAROLINA

SILVER CREEK AND UNNAMED TRIBUTARY

MONITORING

APPENDIX B

STREAM PROBLEM AREA PLAN VIEW

Date:	January, 2008
Scale:	1" = 100'
Job No:	2007-1898

SPA 1
Natural log sill along Unnamed Tributary A near station 5+75.
(EMH&T, Inc. 10/22/07)

SPA 2
Steep banks in need of stabilization along Unnamed Tributary A near station 13+00.
(EMH&T, Inc. 10/22/07)

Fixed Station 1
Overview of the Silver Creek Mainstem, facing downstream from the downstream project terminus.
(EMH&T, Inc. 10/22/07)

Fixed Station 2
Overview of the Silver Creek Mainstem at Riffle #3, facing downstream.
(EMH&T, Inc. 10/22/07)

Fixed Station 3
Overview of the Silver Creek Mainstem at Riffle #1, facing downstream.
(EMH&T, Inc. 10/22/07)

Fixed Station 4
Overview of the Silver Creek Mainstem at Riffle #1, facing upstream.
(EMH&T, Inc. 10/22/07)

Fixed Station 5
Overview of the Silver Creek Mainstem, facing downstream near station 2+60.
(EMH&T, Inc. 10/22/07)

Fixed Station 6
Overview of UT-A, facing upstream near station 0+50.
(EMH&T, Inc. 10/22/07)

Fixed Station 7
Overview of UT-A, facing upstream near station 8+00.
(EMH&T, Inc. 10/22/07)

Fixed Station 8
Overview of UT-A, facing upstream near station 11+00.
(EMH&T, Inc. 10/22/07)

Fixed Station 9
Overview of UT-B, facing upstream from the confluence of UT-B with Silver Creek.
(EMH&T, Inc. 10/22/07)

Fixed Station 10
Overview of UT-B, facing downstream towards the confluence of UT-B with Silver Creek.
(EMH&T, Inc. 10/22/07)

Fixed Station 11
Overview of UT-C, facing upstream from the confluence of UT-C with Silver Creek.
(EMH&T, Inc. 10/22/07)

Fixed Station 12
Overview of UT-C, facing downstream towards the confluence of UT-C with Silver Creek.
(EMH&T, Inc. 10/22/07)

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

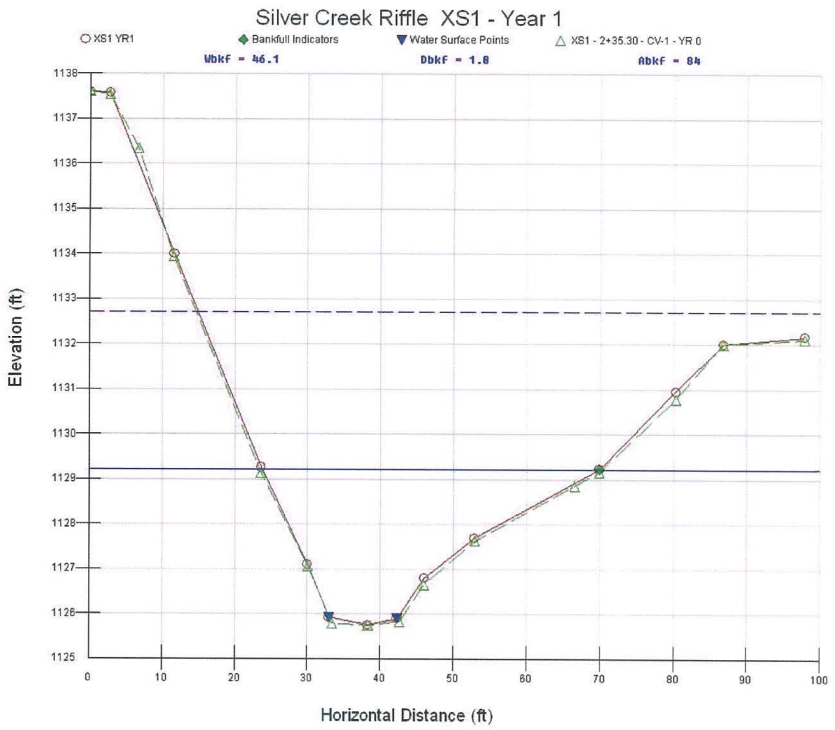
Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	25	25	0	100	
	2. Armor stable (e.g. no displacement)?	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.?)	11	15	4	73	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	8	15	7	53	
	3. Length appropriate?	11	15	4	73	**66%**
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	1	94	
	3. Angle and geometry appear appropriate?	17	17	0	100	
	4. Free of piping or other structural failures?	17	17	0	100	**98%**
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
All dimensions in feet.

Bankfull Area	83.97
Bankfull Width	46.14
Mean Depth	1.82
Maximum Depth	3.48
Width/Depth Ratio	25.35
Entrenchment Ratio	1.8
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	1
FEATURE:	Riffle at Cross Vane # 1

Cross-section photo – looking downstream

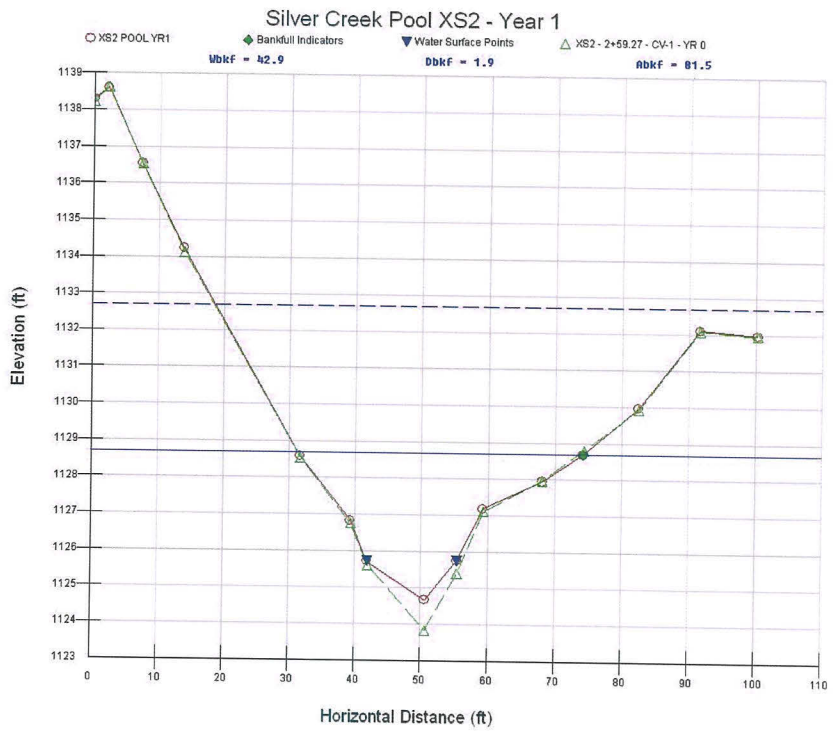


Summary Data
All dimensions in feet.

Bankfull Area	81.53
Bankfull Width	42.89
Mean Depth	1.9
Maximum Depth	4.02
Width/Depth Ratio	22.57
Entrenchment Ratio	1.9
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	2
FEATURE:	Pool at Cross Vane # 1

Cross-section photo – looking downstream

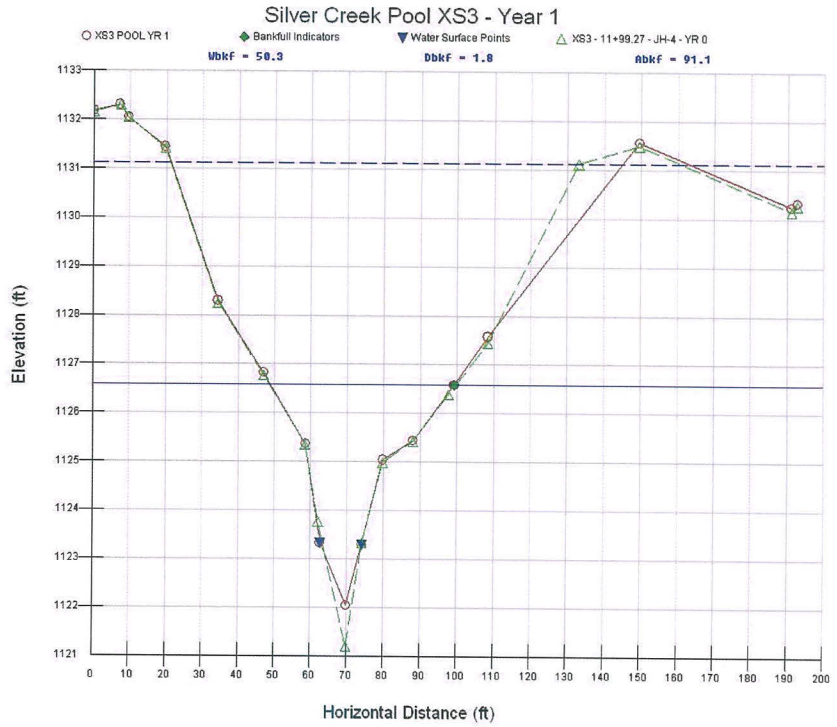


Summary Data
All dimensions in feet.

Bankfull Area	95.81
Bankfull Width	50.34
Mean Depth	1.81
Maximum Depth	4.54
Width/Depth Ratio	27.81
Entrenchment Ratio	3.04
Classification	C

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	3
FEATURE:	Pool at J-Hook # 4

Cross-section photo – looking downstream



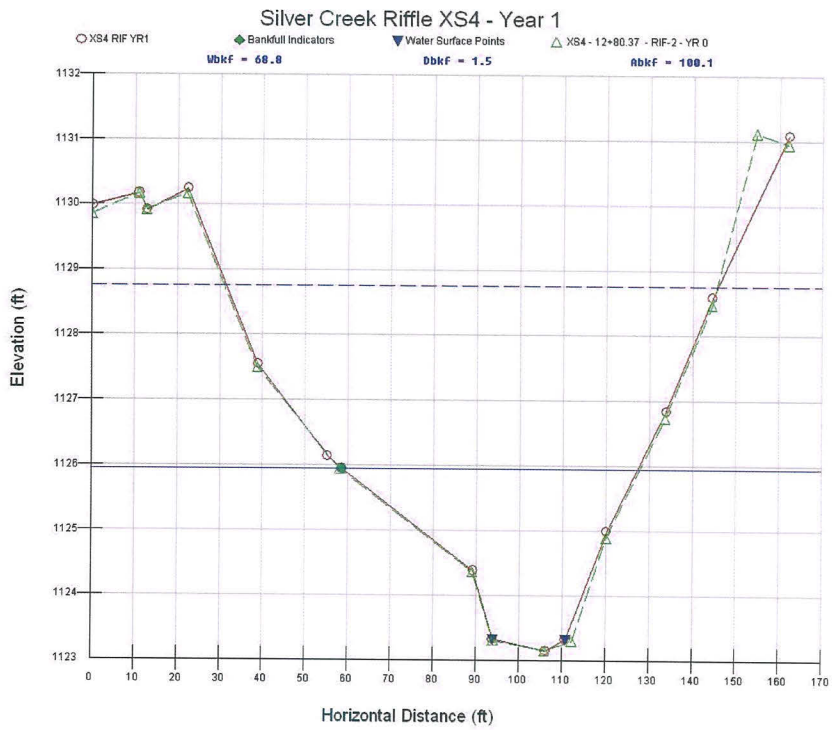
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	100.15
Bankfull Width	68.8
Mean Depth	1.46
Maximum Depth	2.81
Width/Depth Ratio	47.12
Entrenchment Ratio	1.66
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	4
FEATURE:	Riffle

Cross-section photo – looking downstream

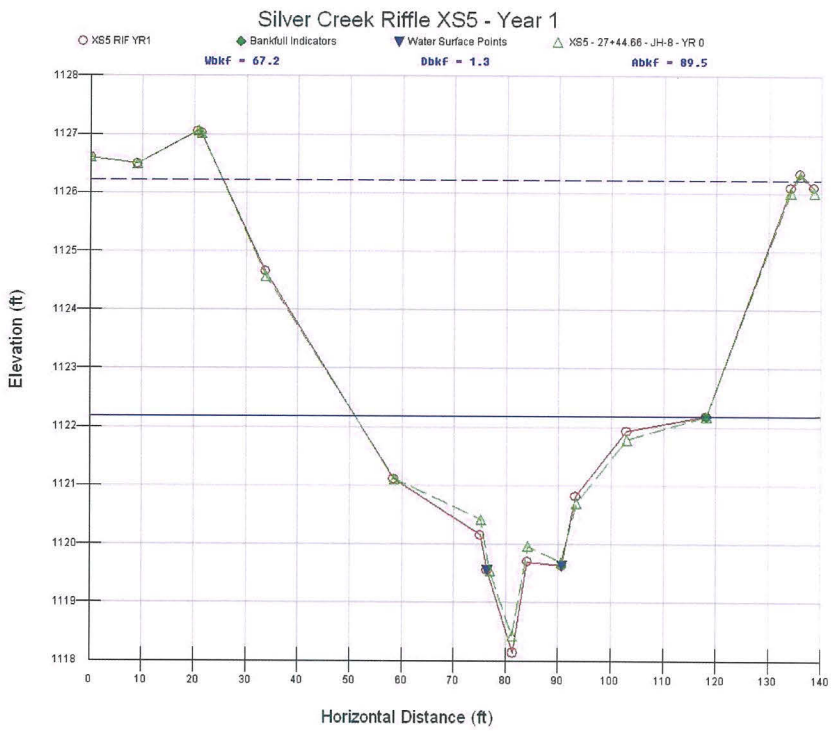


Summary Data
All dimensions in feet.

Bankfull Area	89.46
Bankfull Width	67.15
Mean Depth	1.33
Maximum Depth	4.04
Width/Depth Ratio	50.49
Entrenchment Ratio	1.65
Classification	B4c

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	5
FEATURE:	Riffle at J-Hook # 8

Cross-section photo – left to right bank

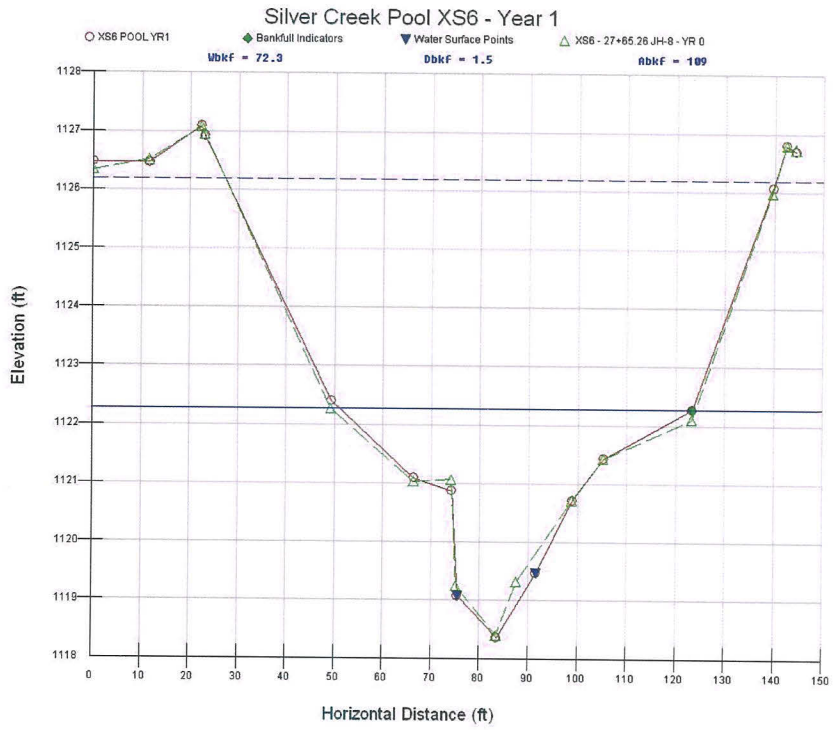


Summary Data
All dimensions in feet.

Bankfull Area	109.03
Bankfull Width	72.28
Mean Depth	1.51
Maximum Depth	3.91
Width/Depth Ratio	47.87
Entrenchment Ratio	1.56
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	12/10/07
CROSS SECTION:	6
FEATURE:	Pool at J-Hook # 8

Cross-section photo – looking downstream

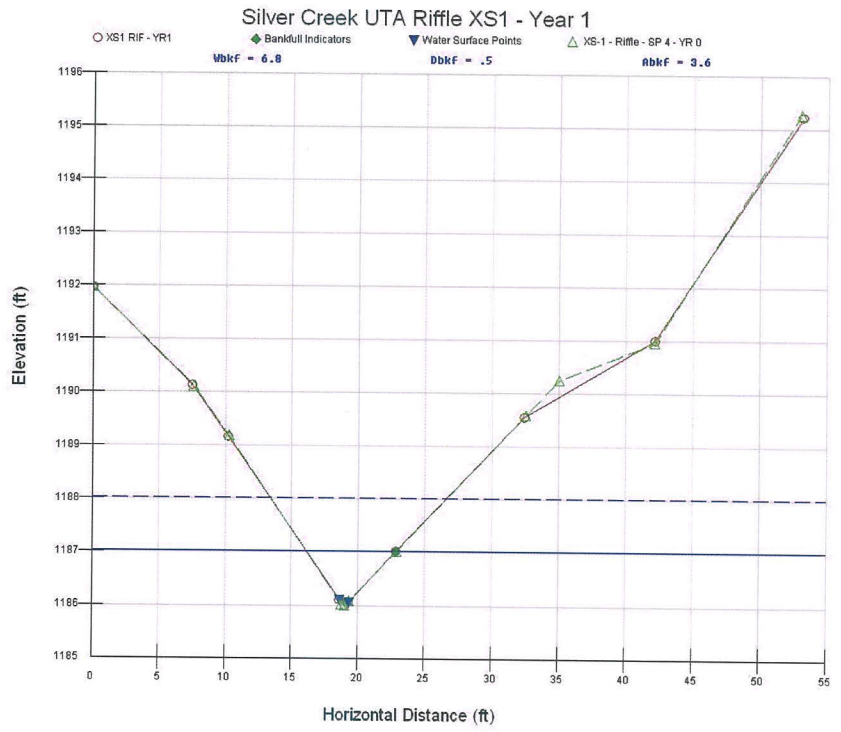


Summary Data
All dimensions in feet.

Bankfull Area	3.57
Bankfull Width	6.78
Mean Depth	0.53
Maximum Depth	1.01
Width/Depth Ratio	12.79
Entrenchment Ratio	1.97
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/10/07
CROSS SECTION:	1
FEATURE:	Riffle

Cross-section photo – looking upstream

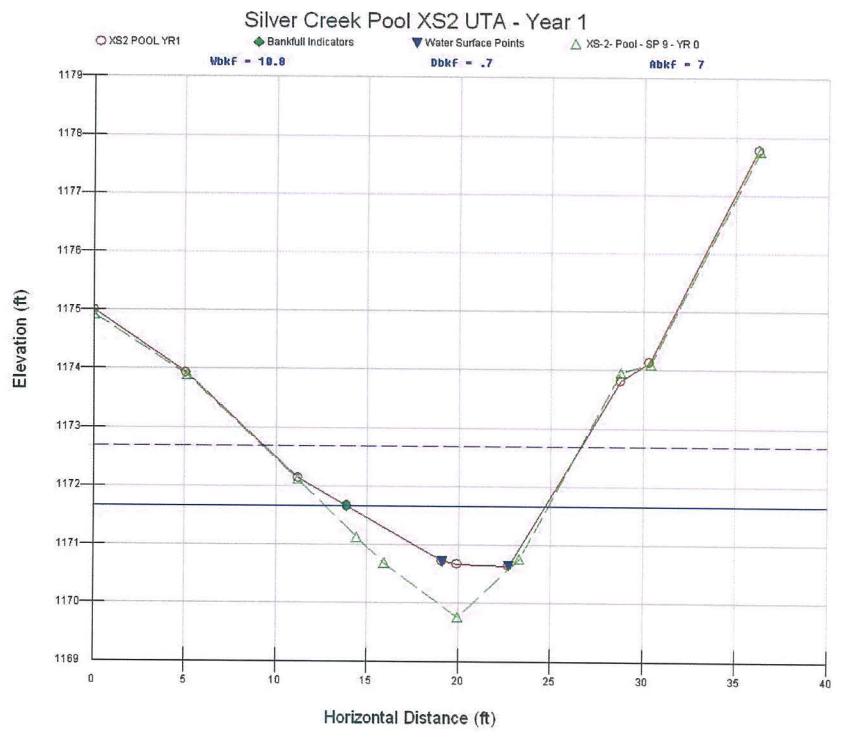


Summary Data
All dimensions in feet.

Bankfull Area	7.05
Bankfull Width	10.79
Mean Depth	0.65
Maximum Depth	1.02
Width/Depth Ratio	16.6
Entrenchment Ratio	1.6
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/10/07
CROSS SECTION:	2
FEATURE:	Pool

Cross-section photo – looking upstream

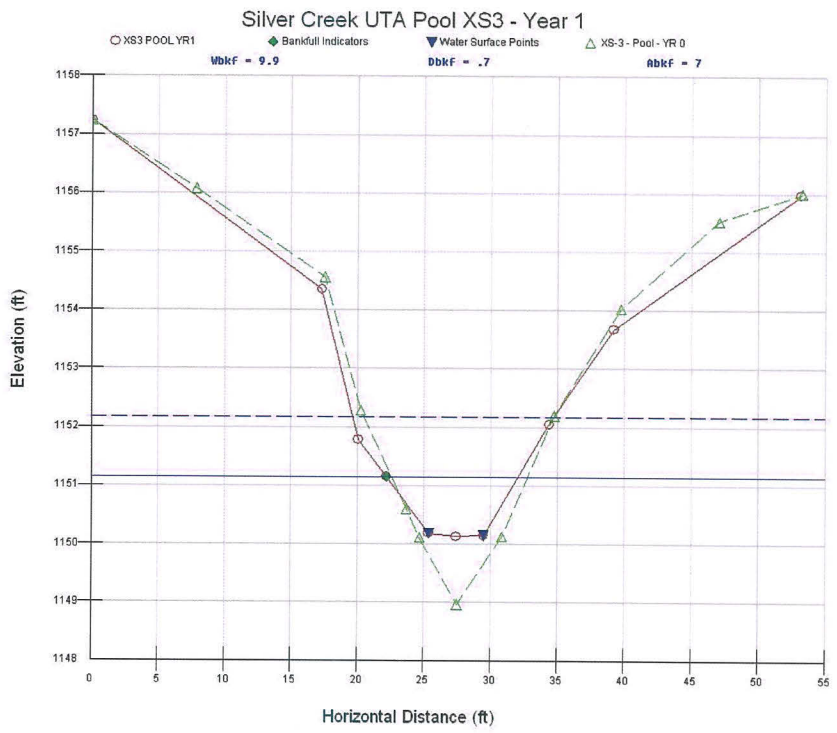


Summary Data
All dimensions in feet.

Bankfull Area	6.95
Bankfull Width	9.86
Mean Depth	0.71
Maximum Depth	1.02
Width/Depth Ratio	13.89
Entrenchment Ratio	1.53
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/10/07
CROSS SECTION:	3
FEATURE:	Pool

Cross-section photo – looking downstream



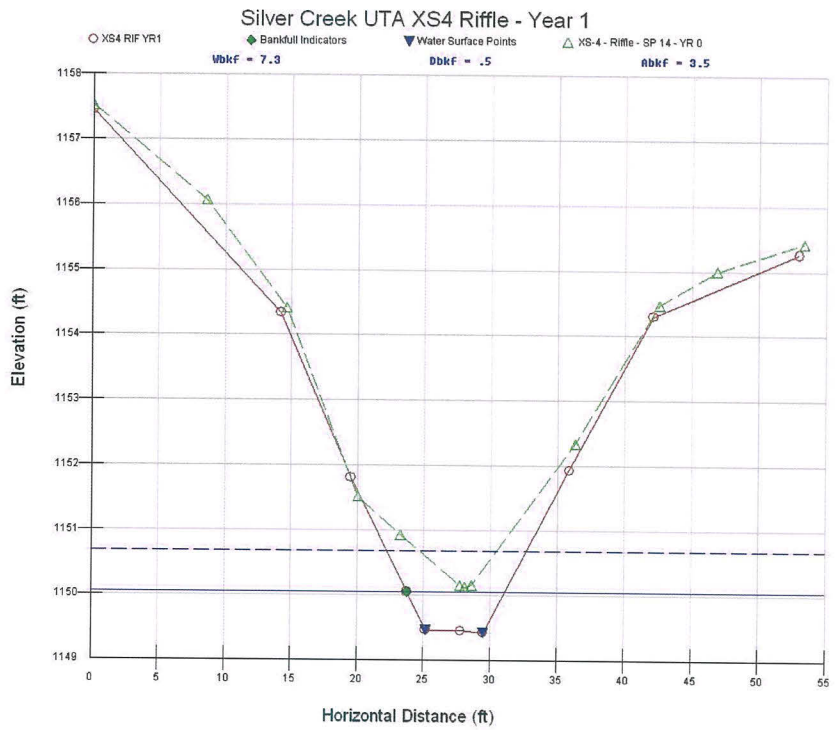
EMH&T

Summary Data
All dimensions in feet.

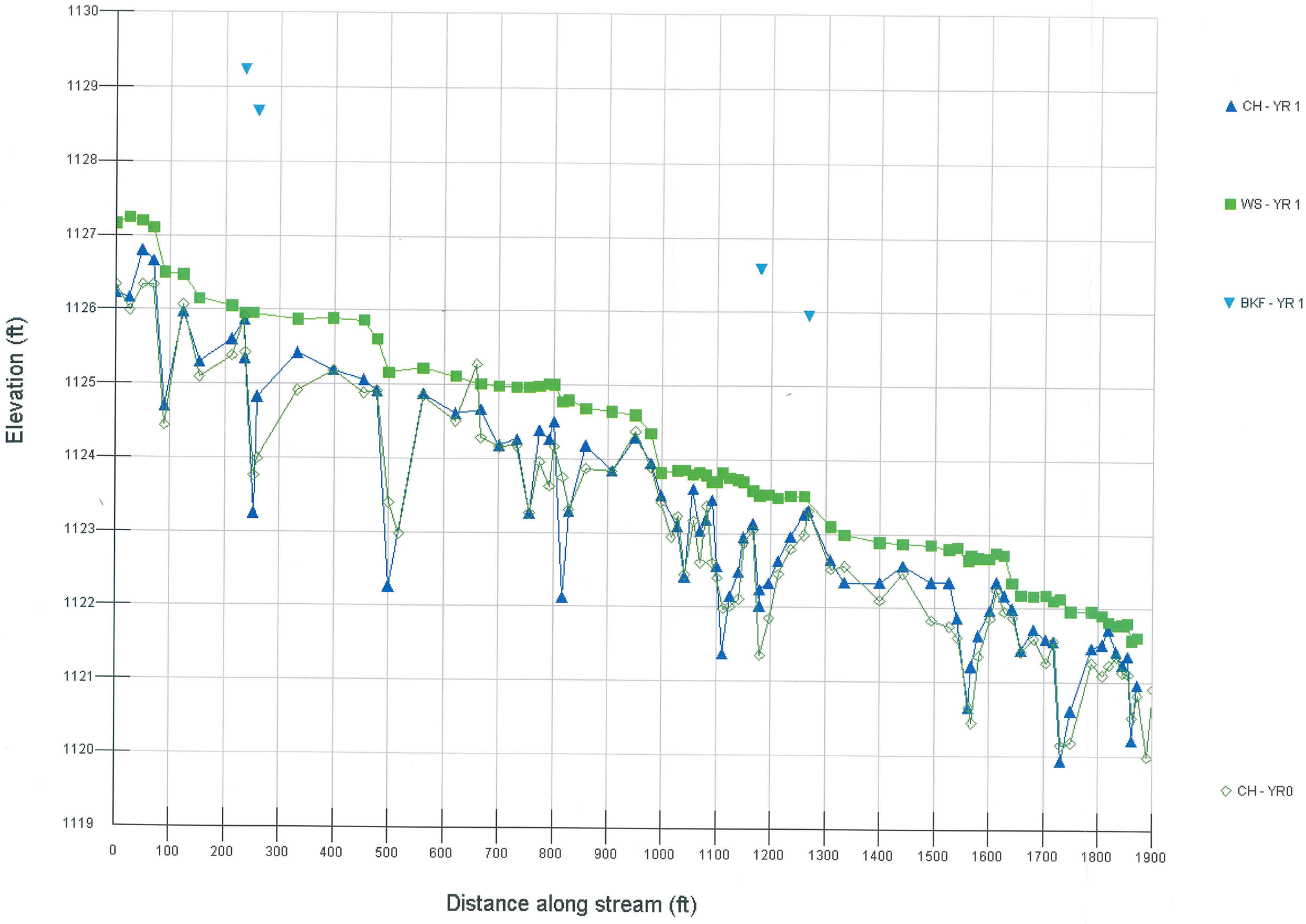
Bankfull Area	3.52
Bankfull Width	7.32
Mean Depth	0.48
Maximum Depth	0.63
Width/Depth Ratio	15.25
Entrenchment Ratio	1.43
Classification	B

PROJECT	Silver Creek
	D05016-1
	1-YEAR
TASK	Cross-Section
REACH	UT-A
DATE	12/10/07
CROSS SECTION:	4
FEATURE:	Riffle

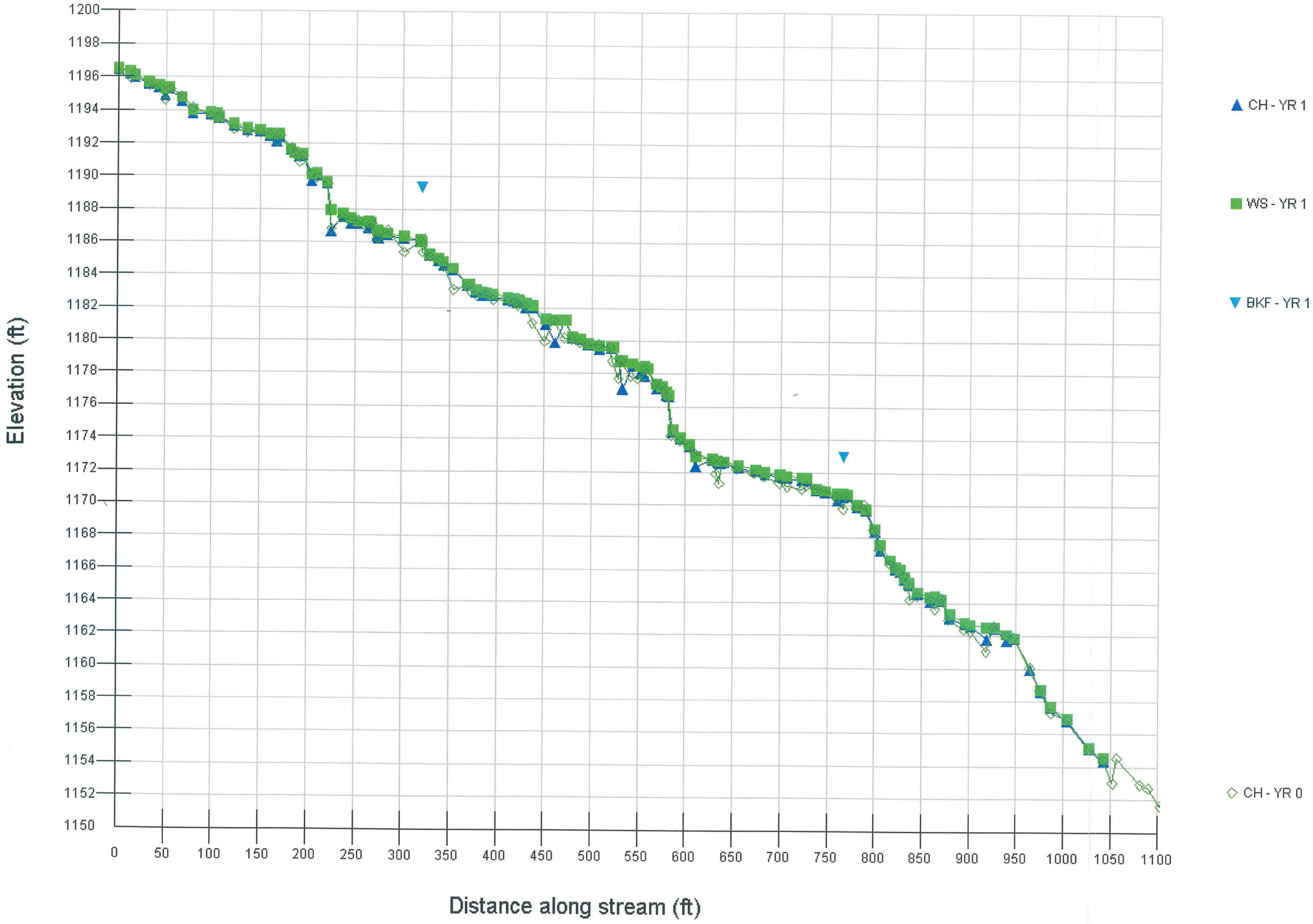
Cross-section photo – looking downstream



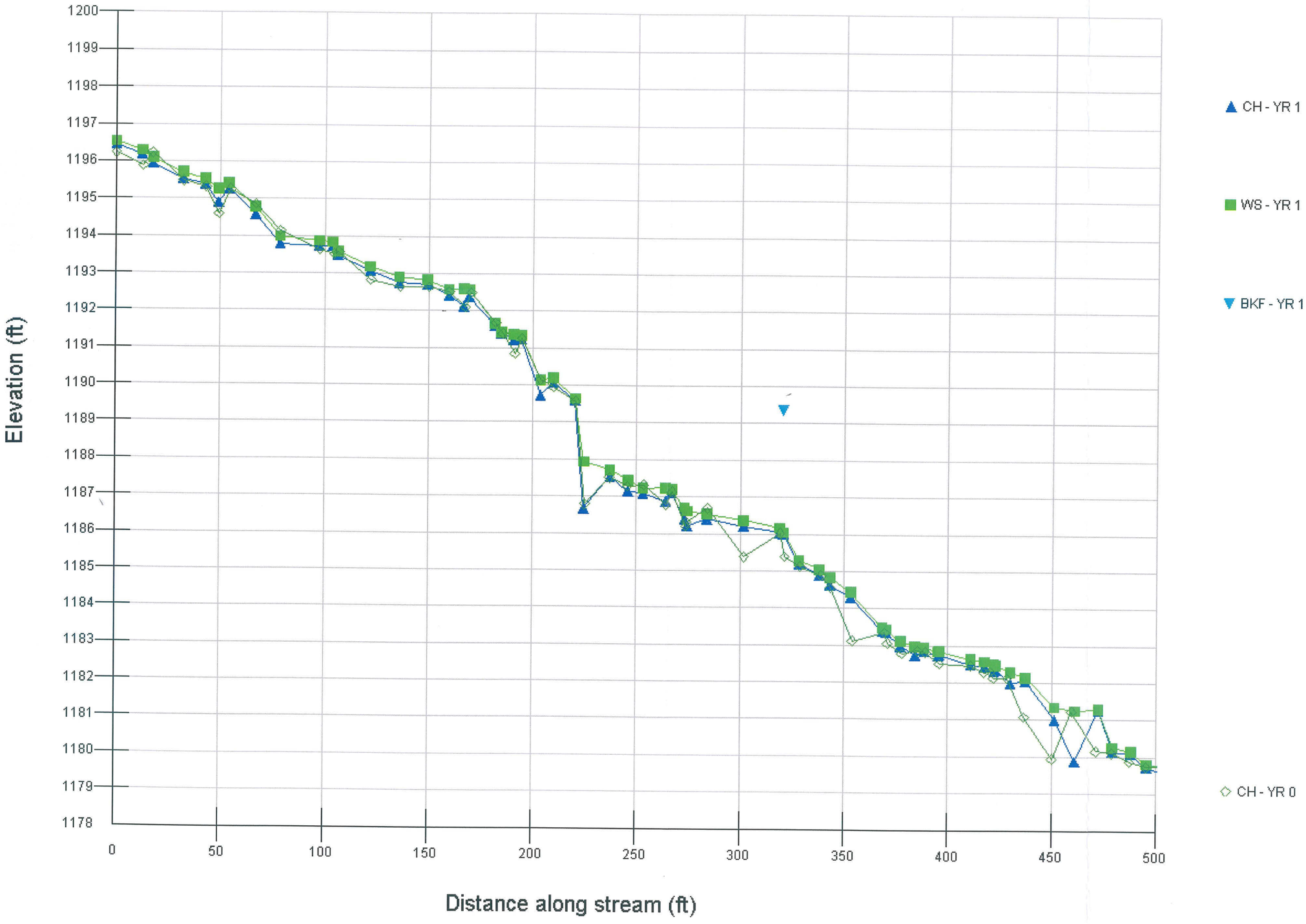
Silver Creek Mainstem Longitudinal Profile - Year 1



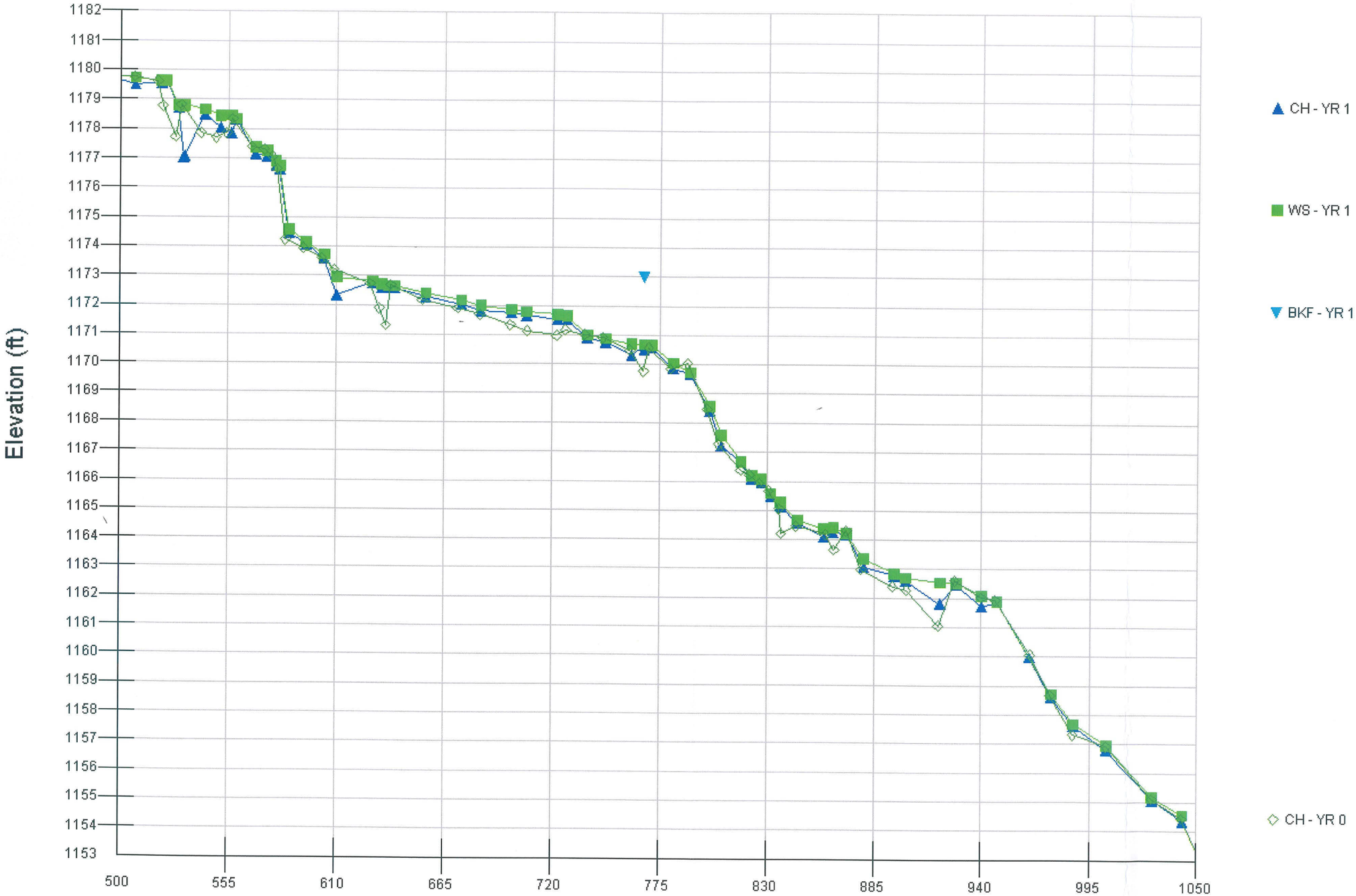
Silver Creek UT-A Longitudinal Profile - Year 1



Silver Creek UT-A Longitudinal Profile (Station 0+00 to 5+00) - Year 1

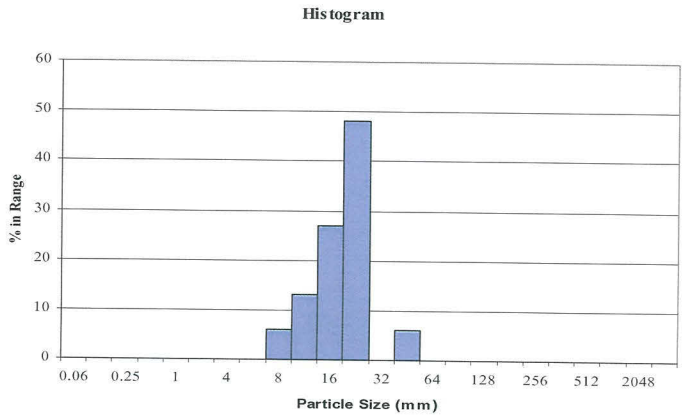


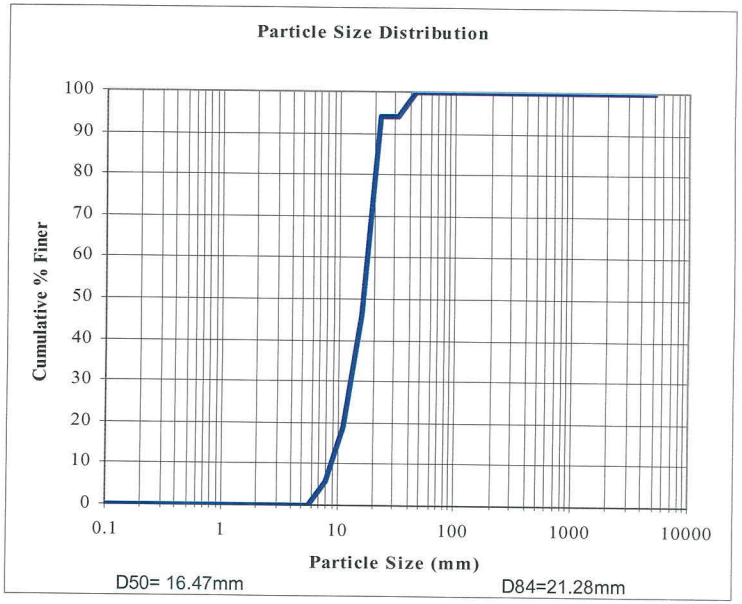
Silver Creek UT-A Longitudinal Profile (Station 5+00 to 10+50) - Year 1



Pebble Count - Riffle				
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	4	6	6
Medium Gravel	8.0-11.3	8	13	19
Medium Gravel	11.3-16.0	16	27	46
Coarse Gravel	16.0-22.6	28	48	94
Coarse Gravel	22.6-32	0	0	94
Very Coarse Gravel	32-45	4	6	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	

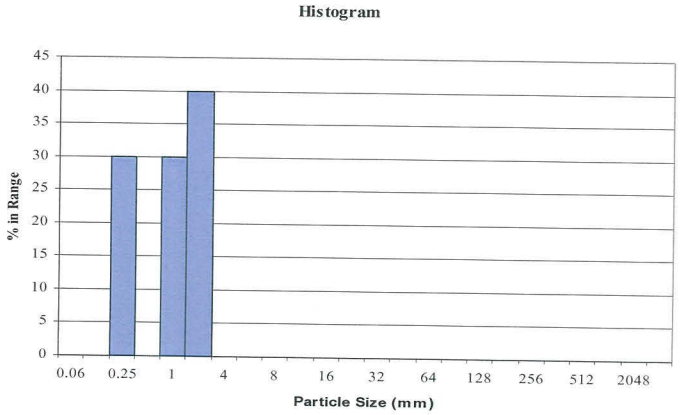
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	1
Date	10/18/07	**Sta No.**	2+05

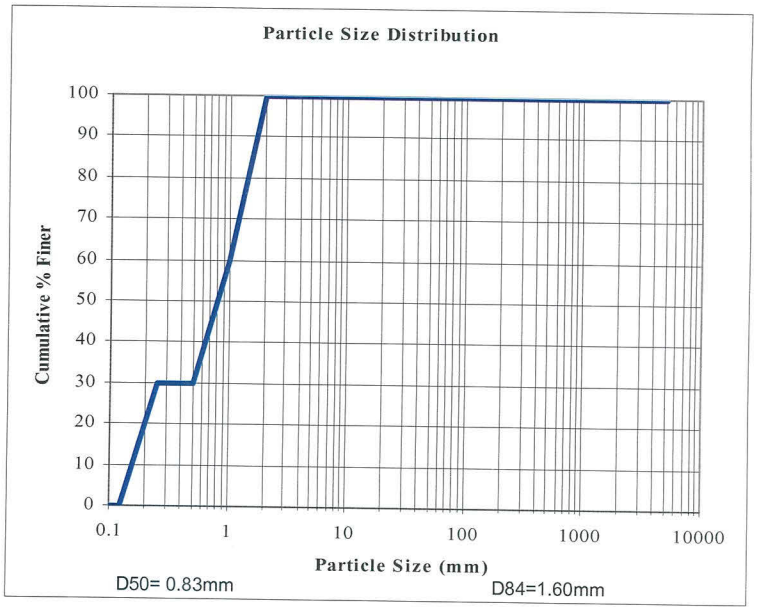




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	30	30	30
Medium Sand	0.25-0.5	0	0	30
Coarse Sand	0.5-1.0	30	30	60
Very Coarse Sand	1.0-2.0	40	40	100
Very Fine Gravel	2.0-4.0	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	

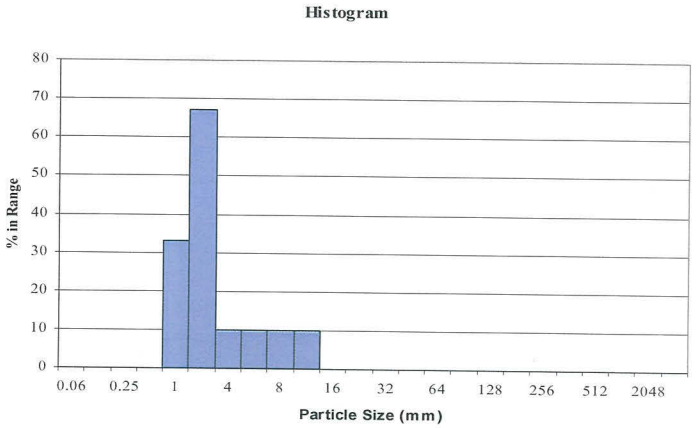
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	2
Date	10/18/07	**Sta No.**	2+30

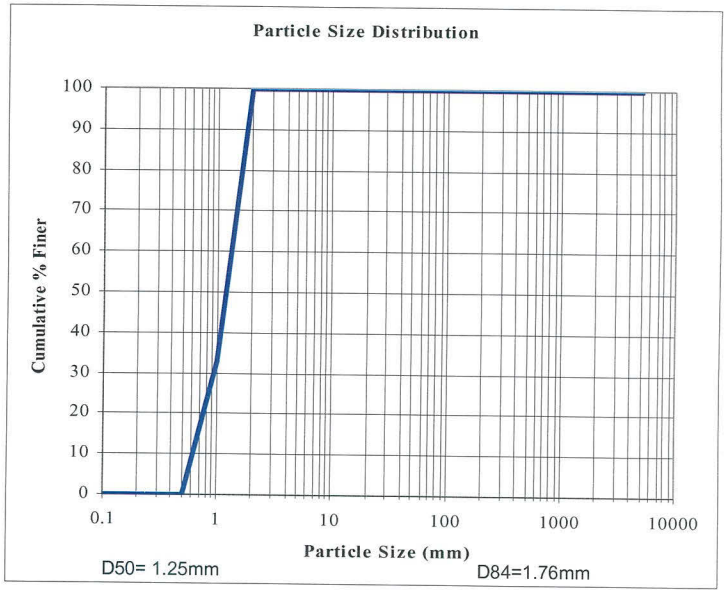




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	20	33	33
Very Coarse Sand	1.0-2.0	40	67	100
Very Fine Gravel	2.0-4.0	0	10	100
Fine Gravel	4.0-5.7	0	10	100
Fine Gravel	5.7-8.0	0	10	100
Medium Gravel	8.0-11.3	0	10	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	140	

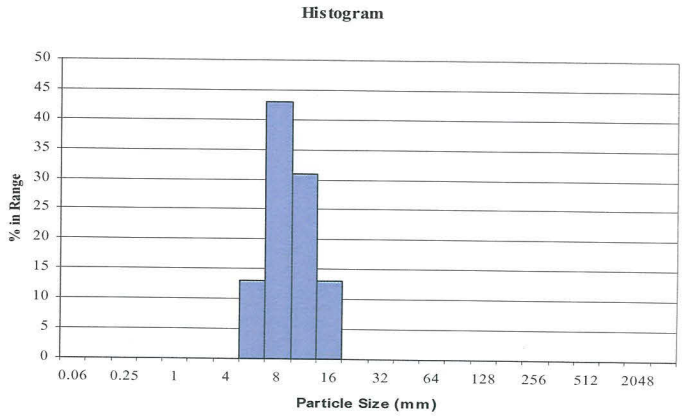
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	3
Date	10/18/07	**Sta No.**	11+18

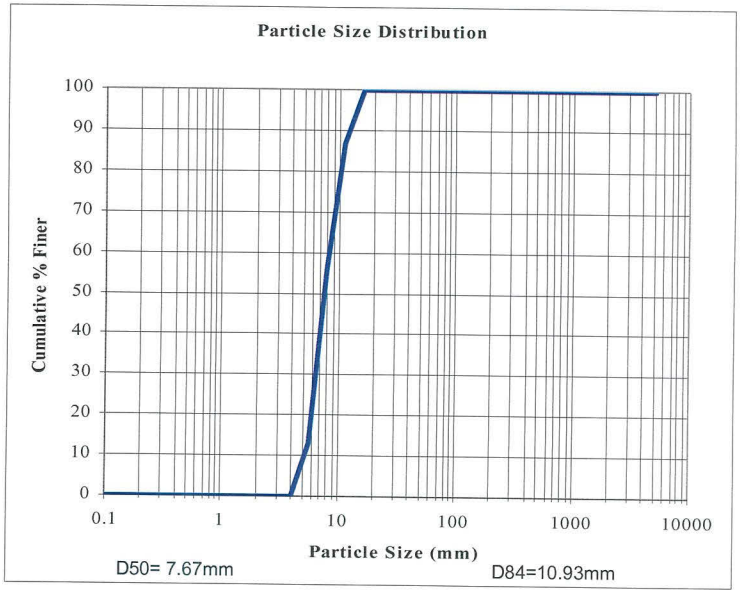




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	8	13	13
Fine Gravel	5.7-8.0	28	43	56
Medium Gravel	8.0-11.3	20	31	87
Medium Gravel	11.3-16.0	8	13	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		64	100	

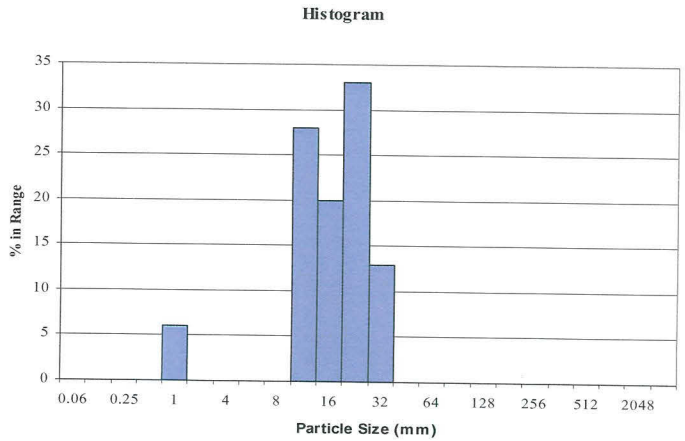
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	4
Date	10/18/07	**Sta No.**	12+25

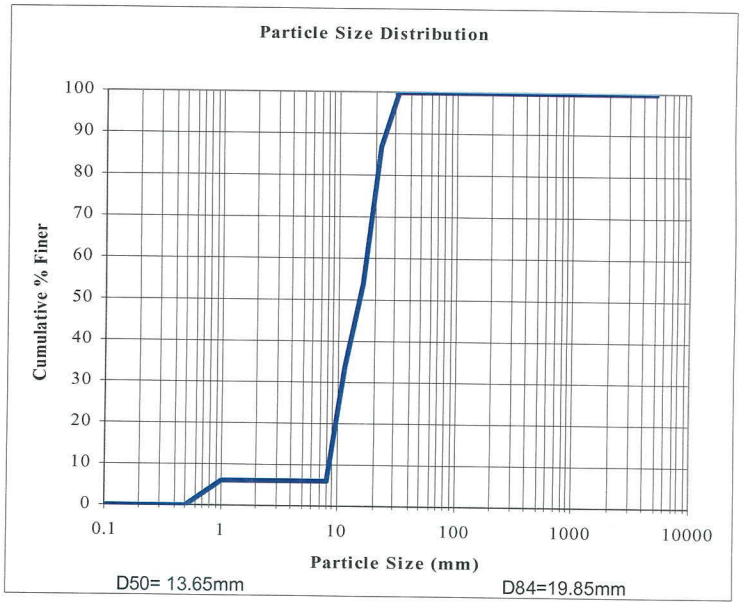




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	4	6	6
Very Coarse Sand	1.0-2.0	0	0	6
Very Fine Gravel	2.0-4.0	0	0	6
Fine Gravel	4.0-5.7	0	0	6
Fine Gravel	5.7-8.0	0	0	6
Medium Gravel	8.0-11.3	16	28	34
Medium Gravel	11.3-16.0	12	20	54
Coarse Gravel	16.0-22.6	20	33	87
Coarse Gravel	22.6-32	8	13	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	

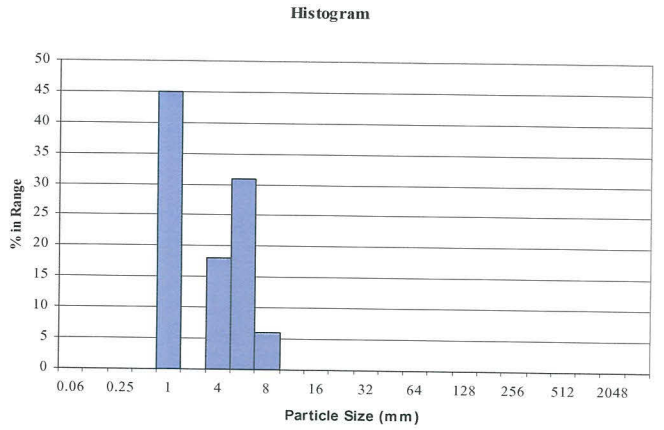
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	5
Date	10/18/07	**Sta No.**	27+62

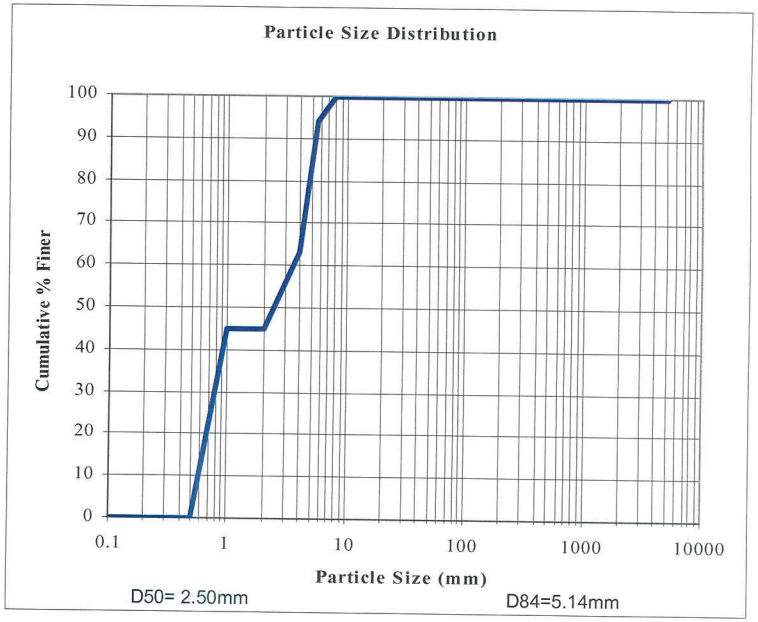




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	30	45	45
Very Coarse Sand	1.0-2.0	0	0	45
Very Fine Gravel	2.0-4.0	12	18	63
Fine Gravel	4.0-5.7	20	31	94
Fine Gravel	5.7-8.0	4	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		66	100	

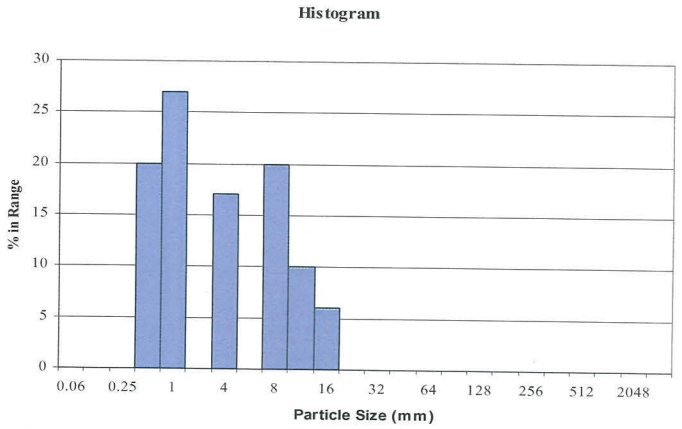
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	Mainstem	**X Sec**	6
Date	10/18/07	**Sta No.**	27+75

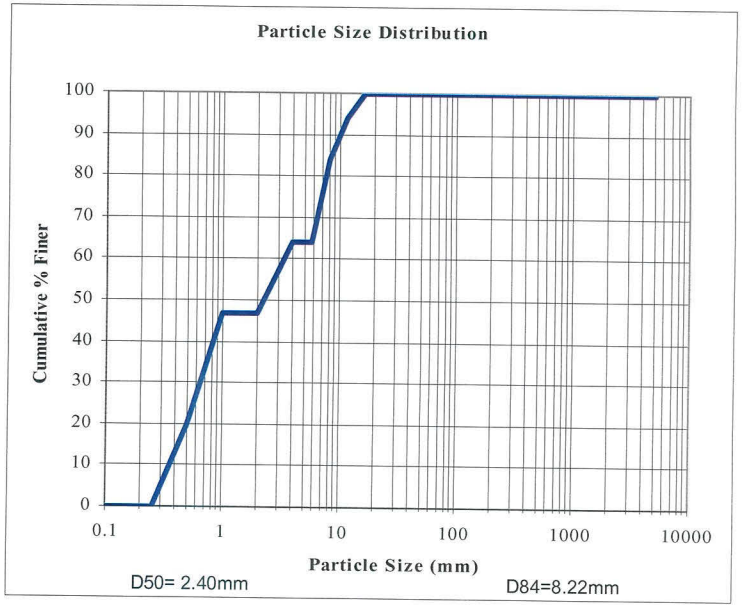




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	12	20	20
Coarse Sand	0.5-1.0	16	27	47
Very Coarse Sand	1.0-2.0	0	0	47
Very Fine Gravel	2.0-4.0	10	17	64
Fine Gravel	4.0-5.7	0	0	64
Fine Gravel	5.7-8.0	12	20	84
Medium Gravel	8.0-11.3	6	10	94
Medium Gravel	11.3-16.0	4	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		60	100	

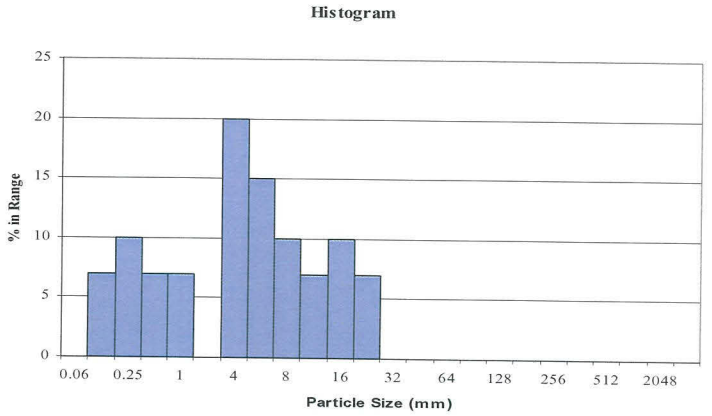
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	DS of 1
Date	10/18/07	**Sta No.**	3+45

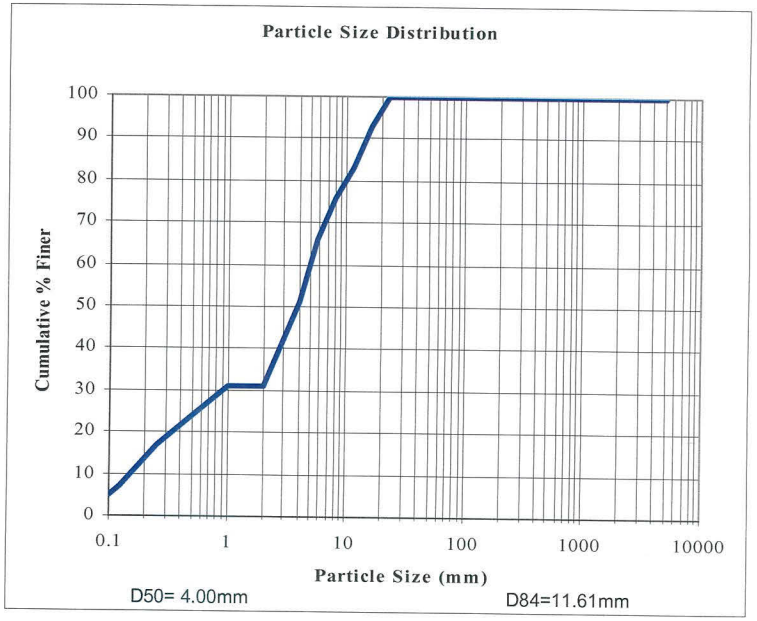




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	4	7	7
Fine Sand	0.125-0.25	6	10	17
Medium Sand	0.25-0.5	4	7	24
Coarse Sand	0.5-1.0	4	7	31
Very Coarse Sand	1.0-2.0	0	0	31
Very Fine Gravel	2.0-4.0	12	20	51
Fine Gravel	4.0-5.7	10	15	66
Fine Gravel	5.7-8.0	6	10	76
Medium Gravel	8.0-11.3	4	7	83
Medium Gravel	11.3-16.0	6	10	93
Coarse Gravel	16.0-22.6	4	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		60	100	

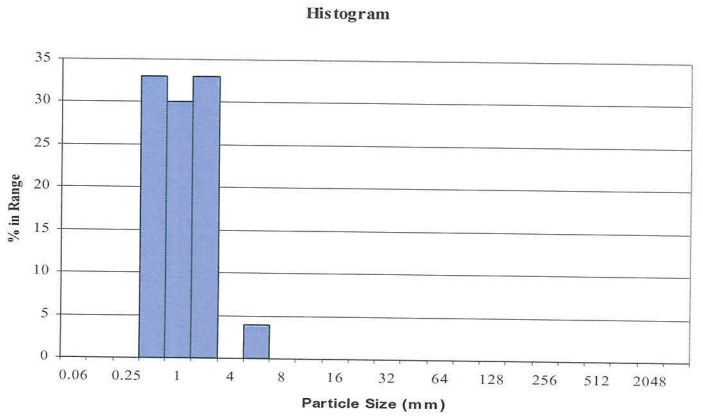
Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	2
Date	10/18/07	**Sta No.**	7+80

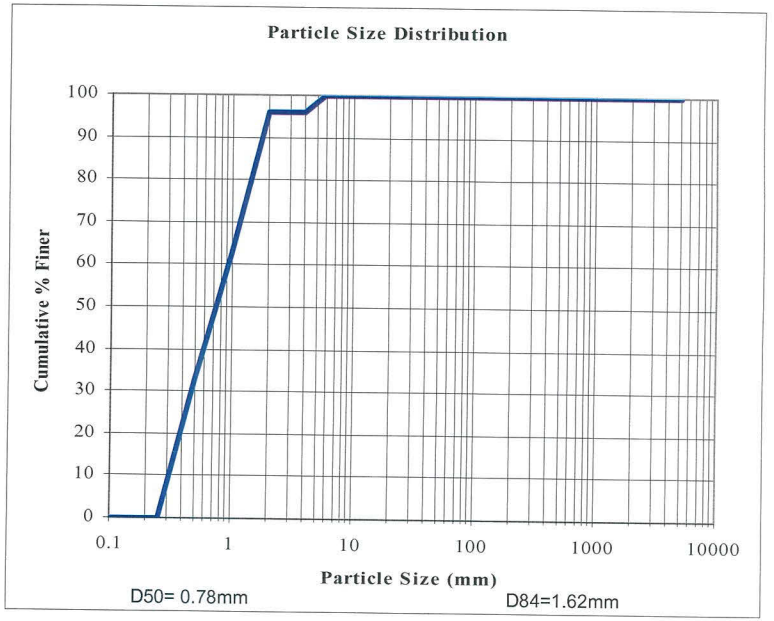




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	20	33	33
Coarse Sand	0.5-1.0	18	30	63
Very Coarse Sand	1.0-2.0	20	33	96
Very Fine Gravel	2.0-4.0	0	0	96
Fine Gravel	4.0-5.7	2	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		60	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	3
Date	10/18/07	**Sta No.**	11+80





Pebble Count - Riffle				
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	15	17	17
Very Fine Gravel	2.0-4.0	3	4	21
Fine Gravel	4.0-5.7	3	4	25
Fine Gravel	5.7-8.0	12	14	39
Medium Gravel	8.0-11.3	24	29	68
Medium Gravel	11.3-16.0	21	25	93
Coarse Gravel	16.0-22.6	6	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		84	100	

Silver Creek Stream Restoration EEP Project No. D05016-1			
Reach	UTA	**X Sec**	DS of 4
Date	10/18/07	**Sta No.**	12+00