

**Year 2 Monitoring Report for Stream Mitigation of South Muddy Creek
Tributaries
(Queen Property)**

South Muddy Creek Tributaries
McDowell County, NC
SCO # D04006-01



Prepared for:
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Submitted: January 2008

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

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I. EXECUTIVE SUMMARY

The South Muddy Creek Tributaries restoration project is located near Dysartsville in McDowell County, North Carolina. The stream channels included in this project are designated as Tributaries A, A2, B and C. Prior to restoration, Tributaries A and A2 were drainage channels that had experienced modification in the form of ditching and vegetative management. Tributaries B and C were natural channels that were in a degraded condition attributed to head-cutting and streambank erosion exacerbated by cattle intrusion. The project consists of a combination of Priority 1 and Priority 2 Restoration and Enhancement Level 1. The project goal for the restoration plan, completed in 2005, was to re-establish geomorphologic features consistent with natural stream channel characteristics. Elements of the restoration design included grade control and bank stabilization using natural materials and native plantings, reconnection of the channels to functional floodplains, and the incorporation of instream habitat features including riffle/pool complexes to re-establish, sort and transport substrate materials. The following report documents the Year 2 Annual Monitoring for this project.

Vegetative monitoring was completed in September 2007 using the methodology of the Carolina Vegetation Survey. Stem counts completed in 30 vegetation plots showed an average density of 323 stems per acre for the site, which meets the success criteria of 320 stems/acre after three years of monitoring. Fourteen of the thirty vegetation plots fall below this threshold number. These plots are scattered throughout the project area. The stem count for Year 2 represents 83% survival from the previous year, when supplemental trees and shrubs were planted to bring the average live stem density to 390 stems per acre. It is likely that the spread of *Sericea lespedeza* throughout much of the project corridor has hindered the growth and survival of woody vegetation. This species is a common component of pasture mixes, and likely spread into the project area from the surrounding pasture lands. Management is planned for the spring of 2008 to combat this species and will include herbicide treatments, sprayed in a manner to minimize the impact on planted woody vegetation. After management of this species is conducted in the spring of 2008, another round of remedial tree plantings will be conducted. These plantings are intended to bring the site back into compliance with the 320 stems per acre minimum, and to replace any trees inadvertently impacted by the herbicide treatments.

Monitoring of the stream identified some problem areas along the tributaries of South Muddy Creek, including areas of aggradation and bank scour. The problem areas along the streams appear to be limited to isolated areas on each reach. Areas of erosion have resulted in bank scour along meander bends or around riffles and log sills at some locations. A few areas of aggradation have resulted in bar formation in the channel near riffle areas. With the exception noted, the restored stream channels remain stable. In addition, the extensive vegetative development in Year 2 has increased streambank stability.

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 to benthic macro-invertebrate populations to re-emerge. Of interest, is the change (median decrease) in pool to pool spacings between Year 1 and Year 2 on Upper Tributary A and to a lesser degree on the other long-term monitoring profiles. This bedform adjustment may be attributed to extended drought during the summer of 2007 (low flow conditions) and minimal flushing of sand-sized particles through the project reaches. Future monitoring may confirm this hypothesis. Comparison of As-Built, Year 1 and Year 2 long-term stream monitoring show successive increases in channel-floodplain connectivity and increasingly stable channel dimensions, interpreted from width/depth ratios, entrenchment ratios, bank height ratios, etc. as shown on the long-term monitoring cross-sections. Median particle sizes of the stream channels

ranged from fine to coarse gravel in the riffle/run areas, and silt to medium sand in the pool/glide areas. Remedial maintenance work on the restored reaches is not planned at this time.

II. PROJECT BACKGROUND

A. Location and Setting

The project is located in McDowell County, North Carolina, approximately two miles south of Interstate 40, between Marion and Morganton near the community of Dysartsville. The tributaries lie east of Muddy Creek Road, north of Pinnacle Church Road and west of Dysartsville Road, as shown on Figure 1. The stream channels included in the project are designated as Tributaries A, A2, B and C. Tributaries A, B and C confluence directly with South Muddy Creek. Tributary A2 confluences with Tributary A.

Directions to the project site are as follow:

From Marion, follow Interstate 40 east to Dysartsville Road (Exit 94). Turn right onto Dysartsville Road to travel south for approximately 2 miles to Pinnacle Church Road. Follow Pinnacle Church Road to Muddy Creek Road, and turn right. The project site is on the east side of the road. This is private property; access to the stream corridor is limited to the dedicated ingress/egress included as part of the recorded Conservation Easement. Coordination with the property owner is encouraged prior to accessing the property.

B. Project Structure, Mitigation Type, Approach and Objectives

Pre-restoration land use surrounding the project tributaries consisted of agricultural croplands along Tributaries A and A2 and cattle pastureland along Tributaries B and C. The upper reaches of Tributaries A2, B and C were characterized by a mix of pastureland and limited wooded corridor. Tributaries A and A2 were drainage channels that had experienced modification in the form of ditching and vegetative management prior to restoration. Tributaries B and C are natural channels that, prior to restoration, were in a degraded condition attributed to head-cutting and streambank failure and erosion exacerbated by cattle intrusion and associated hoof shear. All of the tributary channels, prior to restoration, had narrow or denuded riparian corridors.

Tributaries A, A2 and B were surrounded by either cropland or pasture with no significant buffer prior to restoration. Tributaries B and C lacked cattle intrusion fencing that adversely impacted streambank stability. Tributary C was less degraded, prior to restoration, in that it had a significant wooded riparian corridor on the south (left) bank with well sorted and well graded bed materials. However, Tributary C was impacted by a significantly degraded riparian corridor on the north (right) bank, with numerous locations of streambank erosion and failure associated with cattle intrusion.

Restoration of the project streams re-established geomorphologic features consistent with natural stream channel characteristics. Results achieved are listed below.

- Bankfull channels constructed with the appropriate geometries to convey bankfull flows and transport suspended and bedload materials available to the streams.
- Stable channel patterns consistent with natural streams in the region.
- Grade control and bank stabilization features that enhance environmental attributes of the stream channels through the use of natural materials and native plantings.
- In-stream habitat features, including riffle/pool complexes to re-establish, sort and transport substrate materials available to the streams.
- Reconnection of project stream channels to functional floodplains.
- Extensive indigenous instream and riparian revegetation.



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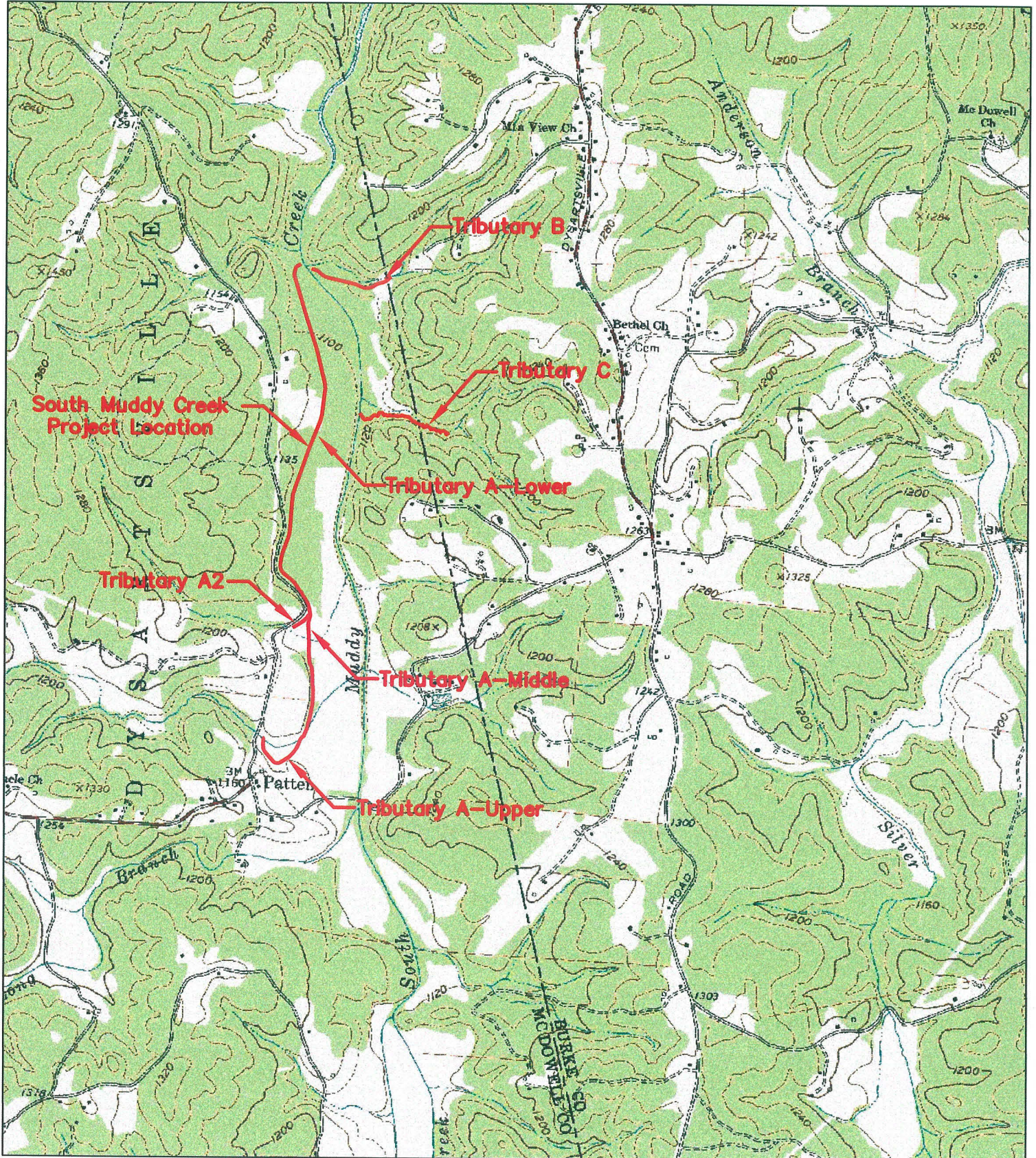
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McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
 FIGURE 1

Date: September, 2007

Job No. 2004-2359

Scale: 1" = 2000'



I:\C:\DATA\1\PUBLICWORKS\PROJECT\2004\2359\DWG\MONITORING_EXHIBITS\FIGURE_1.DWG-SHEET 1 > -- NO XREFS -- LAST SAVED BY JCRAMER [9/13/2007 7:55:21 AM] -- PLOTTED BY JCRAMER [1/24/2008 8:17:08 AM]

Restoration of Tributaries A, A2 and B was accomplished through the modification of the existing pattern, profile and dimension of the tributary channels to a stable condition. The restored channels are on an alignment that is offset from the pre-existing stream channels. Post-construction, the existing tributary channels were abandoned and filled. Restoration along these reaches was either Priority 2, where the elevation of the floodplain was lowered through excavation to re-connect it to the restored stream channel, or a combination of Priority 2 and Priority 1, where the floodplain was lowered and the stream thalweg was raised above the existing channel profile.

The lower reach of Tributary A has a low gradient, which flattens to 0.0012 ft/ft. Due to a relatively flat profile gradient, a series of successive pool and riffle complexes was not proposed. Instead, the restored stream channel has constructed point bars on the inside of meander bends at pool locations and is transporting its bedload through the run/pool complexes as the bed form of the channel naturally evolves. The steeper gradient associated with the restored stream channels along Tributaries A2 and B allowed the construction of a sinuous channel with constructed riffle/pool sequences.

Enhancement Level I was accomplished along one of the reaches on Tributary A by modifying the profile and dimension of the channel. Along this segment, improvements were constructed along the alignment of the existing stream channel. Enhancement Level I on Tributary C provides bank stabilization, through cattle exclusion, with one hard-engineered, fenced and controlled cattle access point for watering, combined with continuous preservation of the riparian buffer. Stabilization was accomplished by re-grading steep, undercut channel banks, and the use of jute matting and live plantings.

An important component of the restoration of Tributaries B and C is cattle exclusion. As mentioned previously, these channels are adjacent to pastureland, where cattle frequented the streams for drinking water. Prior to restoration, the cattle accessed the streams at random locations and, in doing so, denuded and destabilized the pre-existing channel banks. The restoration of Tributary B includes fencing that permanently excludes cattle from the stream corridor. The fencing along Tributary C limits cattle access to a single point along the stream reinforced with stone underlain by non-woven geotextile to prevent degradation that would otherwise occur. All fencing has been placed at the outer edge of the conservation easement.

Information on the project structure and objectives is included in Tables I and II as follows:

Project Segment/Reach ID	Linear Footage or Acreage
A (upper)	1,609 l.f.
A (middle)	1,094 l.f.
A	1,052 l.f.
A (lower)	7,349 l.f.
A2	480 l.f.
B	2,041 l.f.
C	1,601 l.f.
TOTAL	15,226 l.f.

Table II. Project Mitigation Objectives Table
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01

Project Segment/ Reach ID	Mitigation Type	Approach	Linear Footage or Acreage	Comment
A (upper)	Restoration	Priority 1&2	1,609 l.f.	Restore dimension, pattern, and profile
A	Enhancement	Level 1	1,052 l.f.	Restore dimension and profile
A (middle)	Restoration	Priority 1&2	1,094 l.f.	Restore dimension, pattern, and profile
A (lower)	Restoration	Priority 2	7,349 l.f.	Restore dimension, pattern, and profile
A2	Restoration	Priority 2	480 l.f.	Restore dimension, pattern, and profile
B	Restoration	Priority 2	2,041 l.f.	Restore dimension, pattern, and profile
C	Enhancement	Level 1	1,601 l.f.	Restore dimension and pattern
TOTAL			15,226 l.f.	

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
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration plan	Aug 2005	Fall 2004	Mar 2005
Final Design - 90% ¹	N/A	N/A	N/A
Construction	Feb 2006	N/A	Apr 2006
Temporary S&E applied to entire project area ²	Jul 2005	N/A	Jul 2005
Permanent plantings	Apr 2006	N/A	Apr 2006
Mitigation plan/As-built	Jun 2006	Nov 2006	Jan 2007
Year 1 monitoring	2006	Sep 2006 (vegetation) Apr 2007 (geomorphology)	Jun 2007
Year 2 monitoring	2007	Sep 2007 (vegetation) Oct 2007 (geomorphology)	Dec 2007
Year 3 monitoring	2008		
Year 4 monitoring	2009		
Year 5 monitoring	2010		

¹Full-delivery project; 90% submittal not provided.

²Erosion and sediment control applied incrementally throughout the course of the project.

N/A: Data collection is not an applicable task to these project activities.

Table IV. Project Contact Table South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01	
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, P.G., EMH&T
Vegetation Monitoring POC	Holly Blunck, EMH&T

Table V. Project Background Table South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01	
Project County	McDowell
Drainage Area- A (upper & middle)	1.38 sq mi
Drainage Area-A (lower)	2.03 sq mi
Drainage Area-A2	0.27 sq mi
Drainage Area-B	0.44 sq mi
Drainage Area-C	0.37 sq mi
Drainage Impervious Cover Estimate	2%-6%
Stream Order	Tributary A, B, C -2nd Tributaries A2 – 1st
Physiographic Region	Blue Ridge Mountains
Ecoregion	Eastern Blue Ridge Foothills
Rosgen Classification of As-built	C4/C5
Dominant Soil Types	Iotla sandy loam, Dillard loam
Reference Site ID	South Muddy Birchfield, South Muddy "Tributary 4"
USGS HUC for Project and Reference	3050101
NCDWQ Sub-basin for Project and Reference	03-08-30
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	24%

D. Monitoring Plan View

The monitoring plan view is included as Figure 2.

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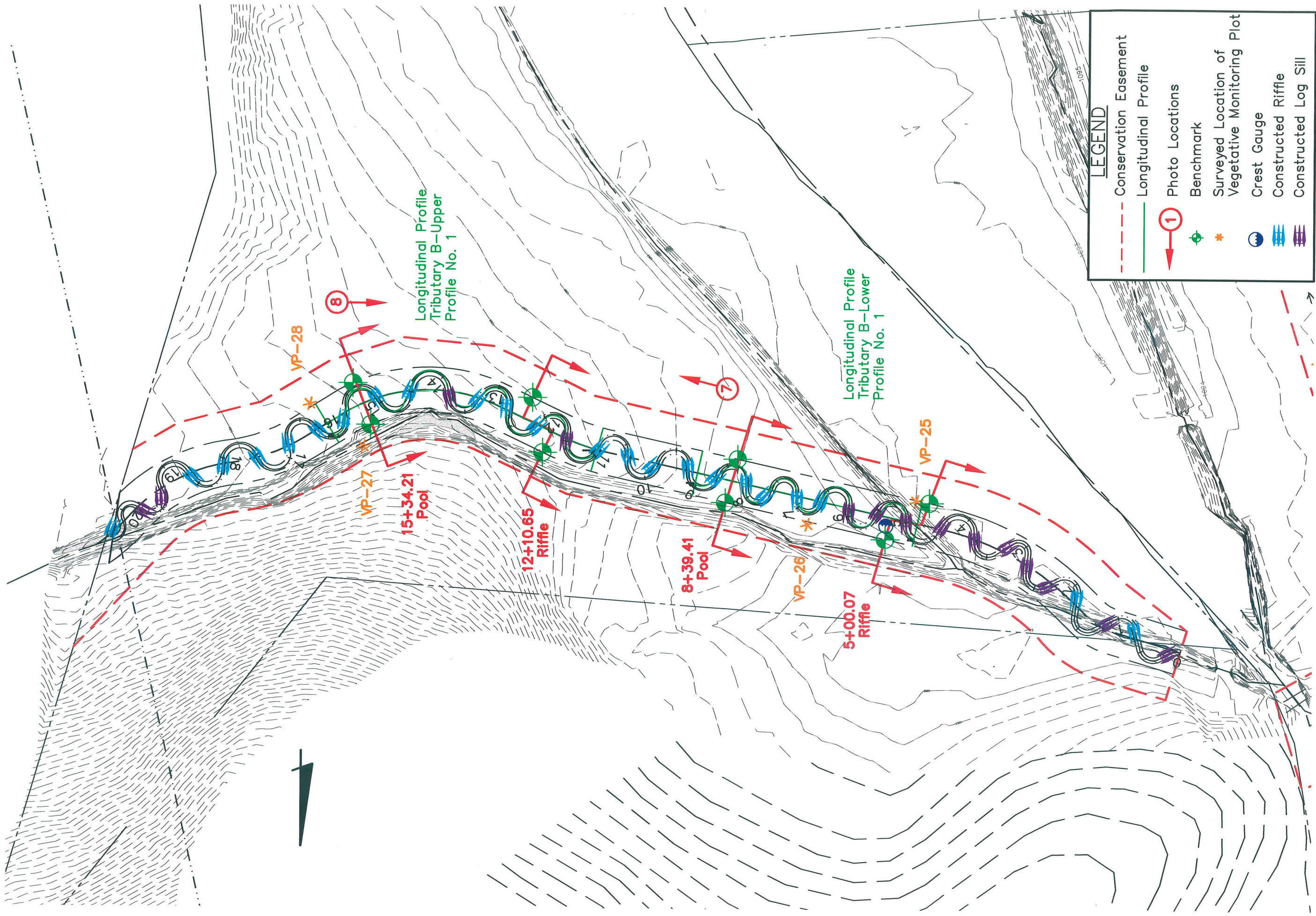
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McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2A
 INDEX MAP

Date: September, 2007

Scale: 1" = 600'

Job No: 2006-1627



LEGEND

- Conservation Easement
- Longitudinal Profile
- ① Photo Locations
- ⊕ Benchmark
- * Surveyed Location of Vegetative Monitoring Plot
- ☉ Crest Gauge
- ▬ Constructed Riffle
- ▬ Constructed Log Sill

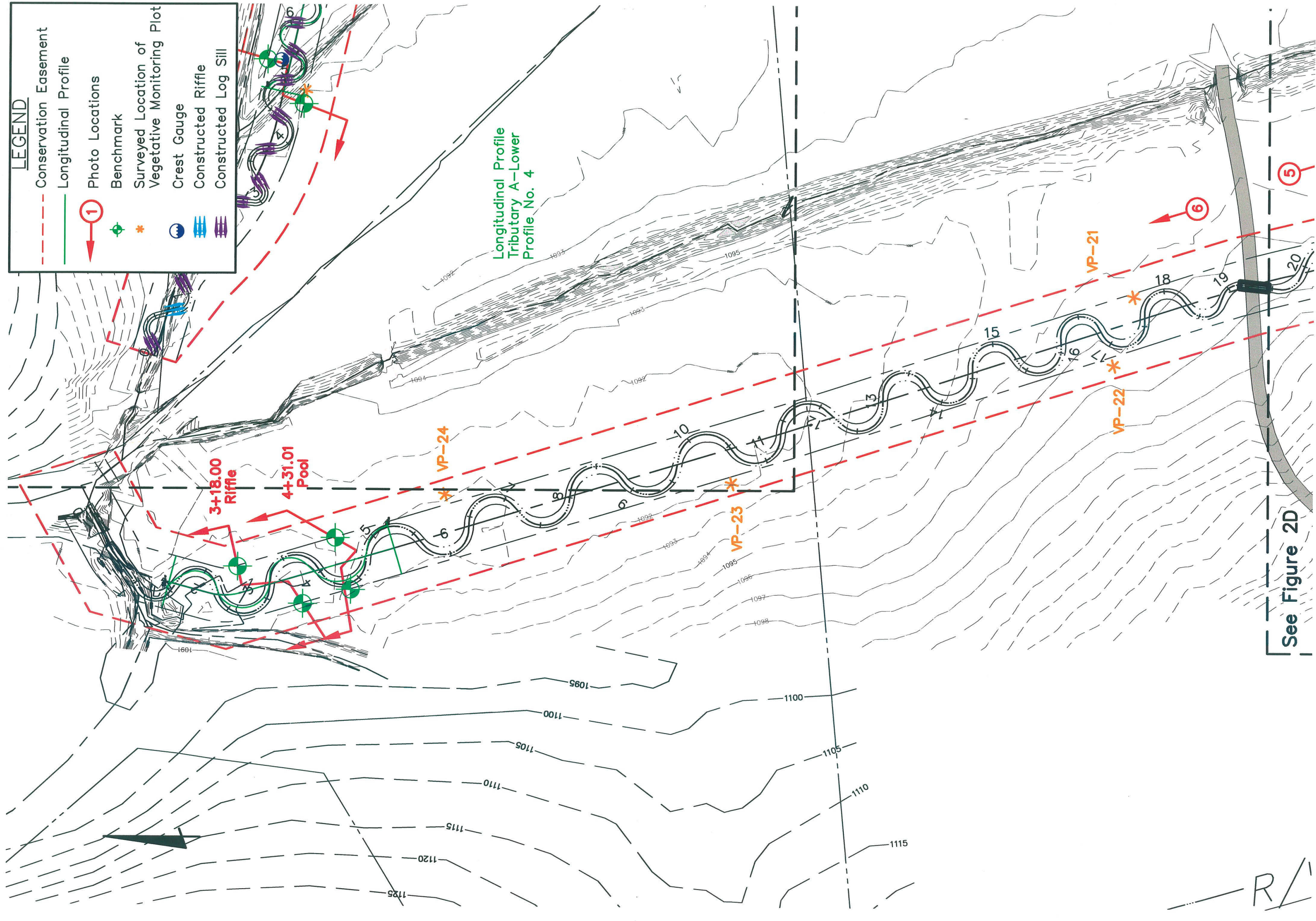
McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2B
 TRIBUTARY B

Date: September, 2007
 Scale: 1" = 600'
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LEGEND

- Conservation Easement
- Longitudinal Profile
- ① Photo Locations
- ⊕ Benchmark
- * Surveyed Location of Vegetative Monitoring Plot
- ☉ Crest Gauge
- ▬ Constructed Riffle
- ▬ Constructed Log Sill

Longitudinal Profile Tributary A-Lower Profile No. 4

See Figure 2D

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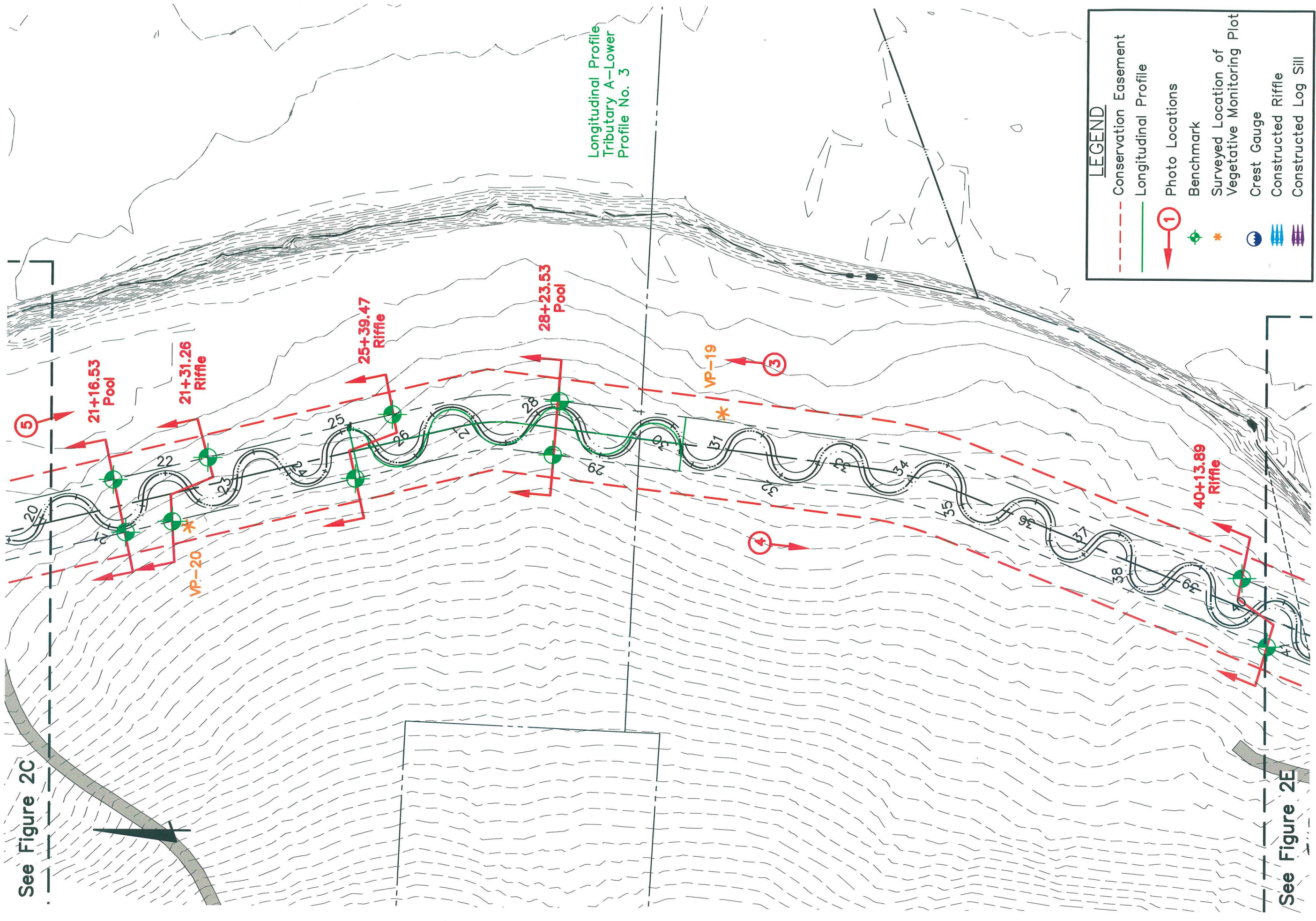
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SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2C
 TRIBUTARY A - LOWER

Date:	September, 2007
Scale:	1" = 100'
Job No:	2006-1627

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See Figure 2C

See Figure 2E

Longitudinal Profile
Tributary A-Lower
Profile No. 3

LEGEND

- Conservation Easement
- Longitudinal Profile
- ① Photo Locations
- ⊕ Benchmark
- * Surveyed Location of Vegetative Monitoring Plot
- ☉ Crest Gauge
- ▬ Constructed Riffle
- ▬ Constructed Log Sill

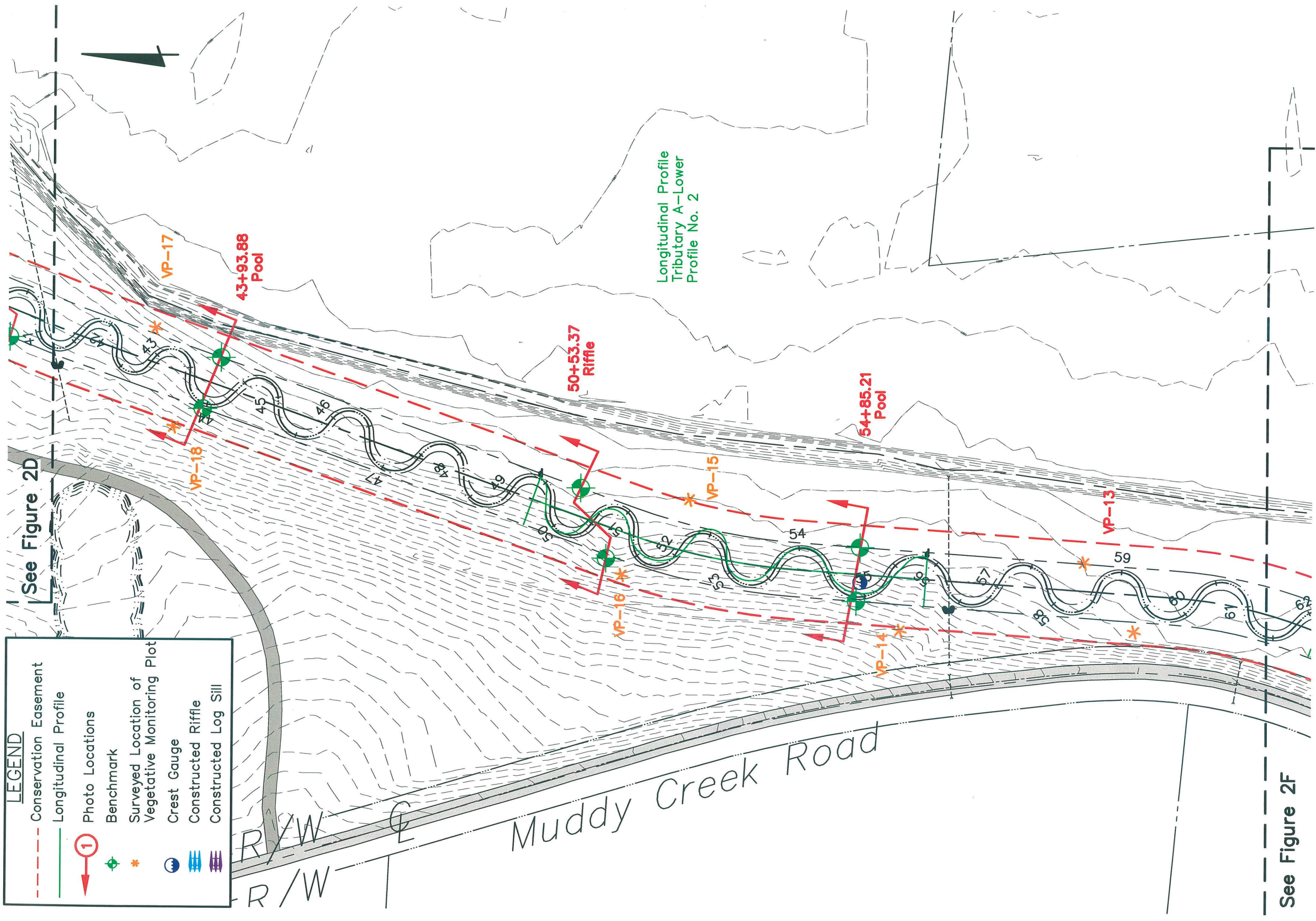
McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2D
 TRIBUTARY A - LOWER

Date:	September, 2007
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See Figure 2D

See Figure 2F

LEGEND

- Conservation Easement
- Longitudinal Profile
- ① Photo Locations
- ⊕ Benchmark
- * Surveied Location of Vegetative Monitoring Plot
- ⊙ Crest Gauge
- ▒ Constructed Riffle
- ▒ Constructed Log Sill

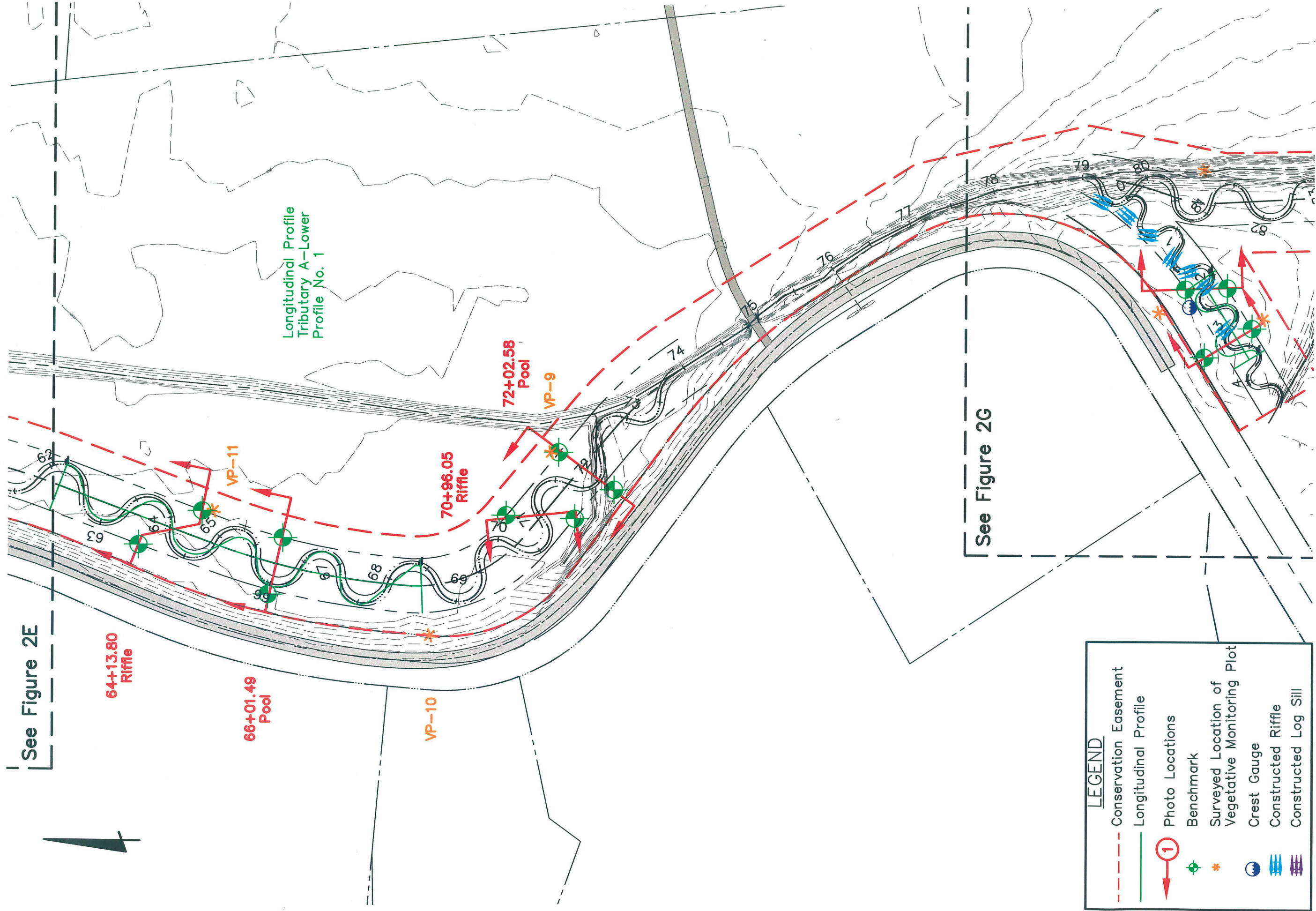
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SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2E
 TRIBUTARY A - LOWER

Date:	September, 2007
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See Figure 2E

See Figure 2G

Longitudinal Profile
Tributary A-Lower
Profile No. 1

LEGEND

- Conservation Easement
- Longitudinal Profile
- Photo Locations
- Benchmark
- Surveyed Location of Vegetative Monitoring Plot
- Crest Gauge
- Constructed Riffle
- Constructed Log Sill

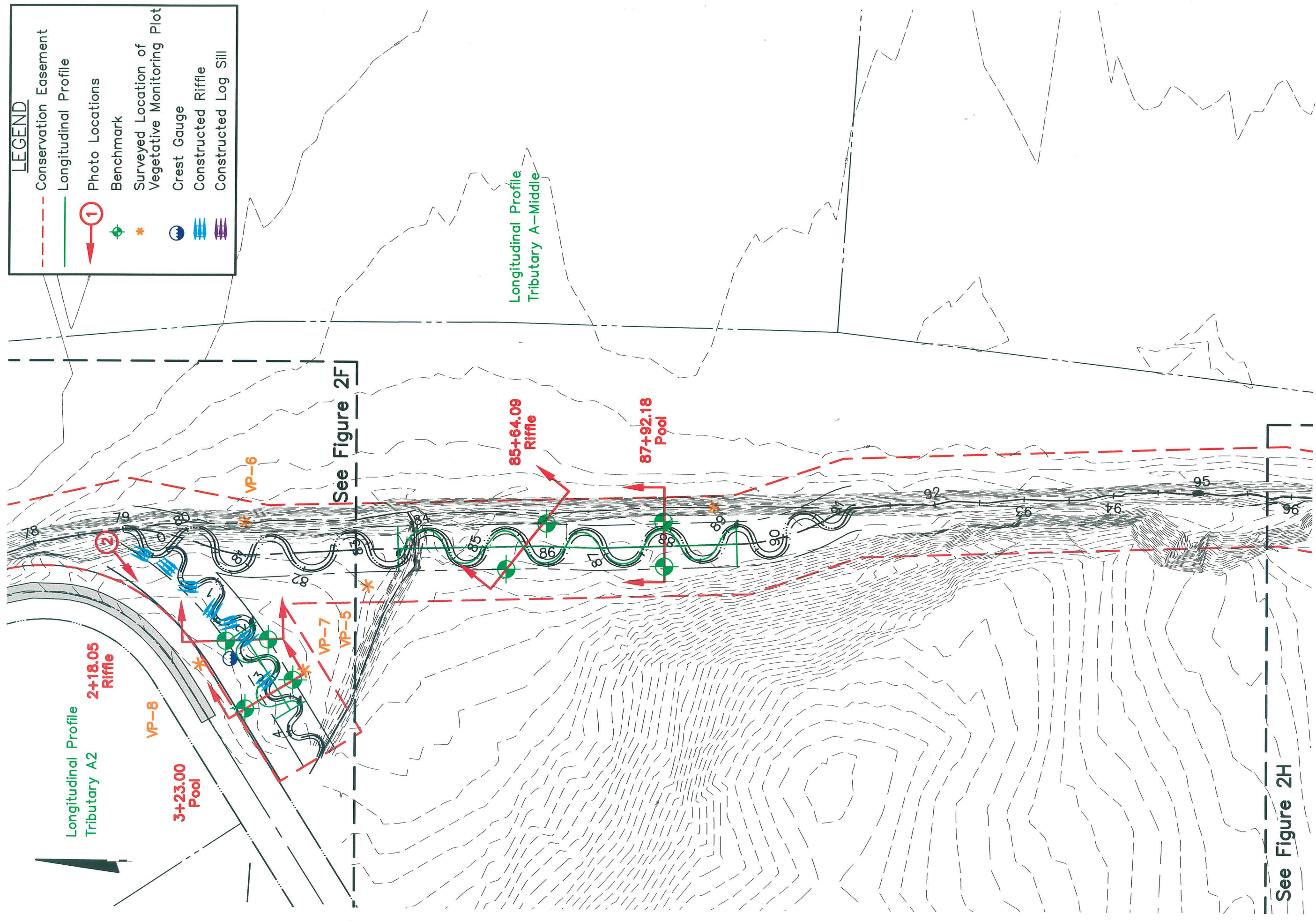
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McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2F
 TRIBUTARY A - LOWER

Date:	September, 2007
Scale:	1" = 100'
Job No:	2006-1627

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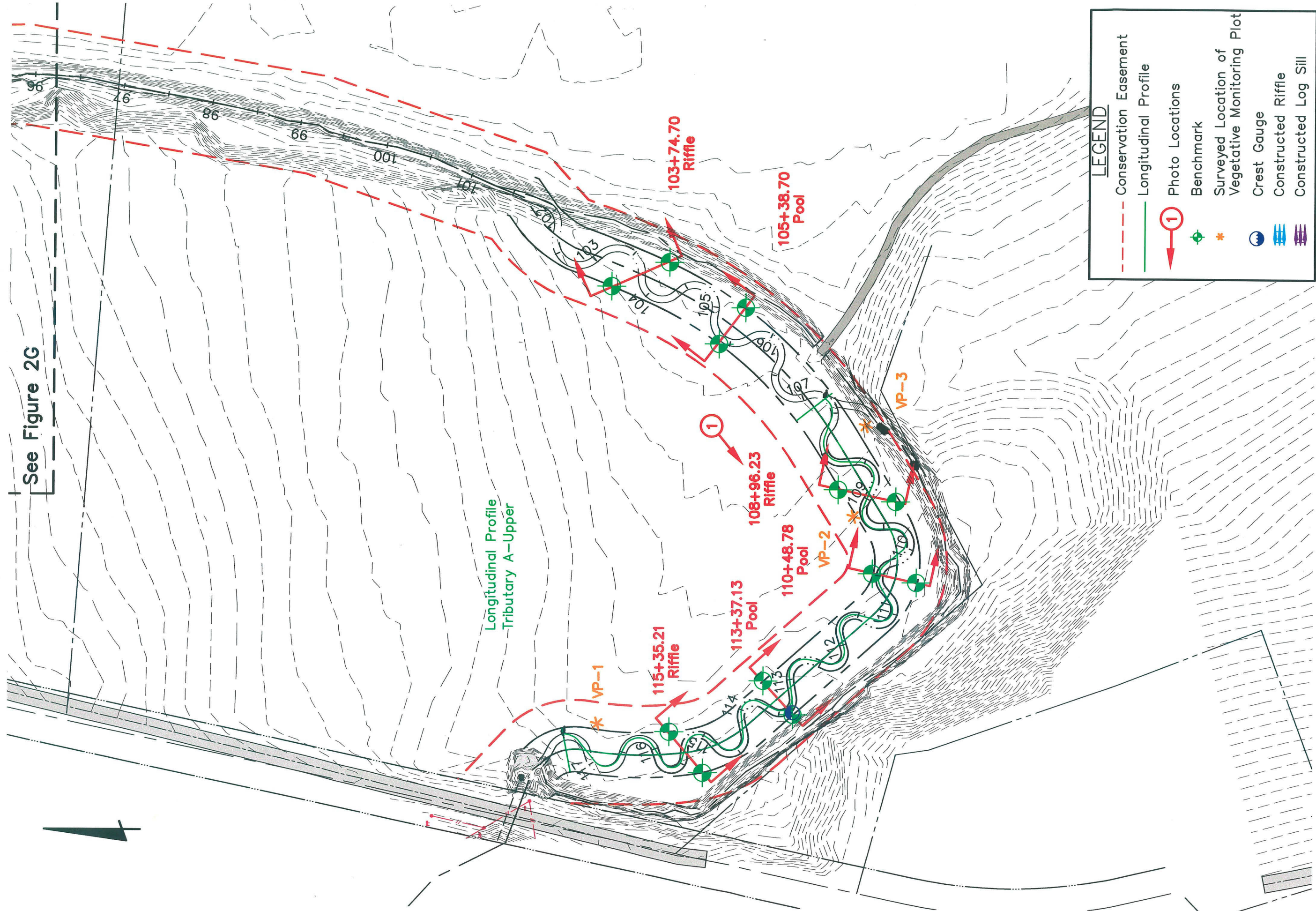
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McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2G
 TRIBUTARY A2 AND TRIBUTARY A - MIDDLE

Date:	September, 2007
Scale:	1" = 100'
Job No:	2006-1627

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See Figure 2G



Longitudinal Profile
Tributary A-Upper

LEGEND

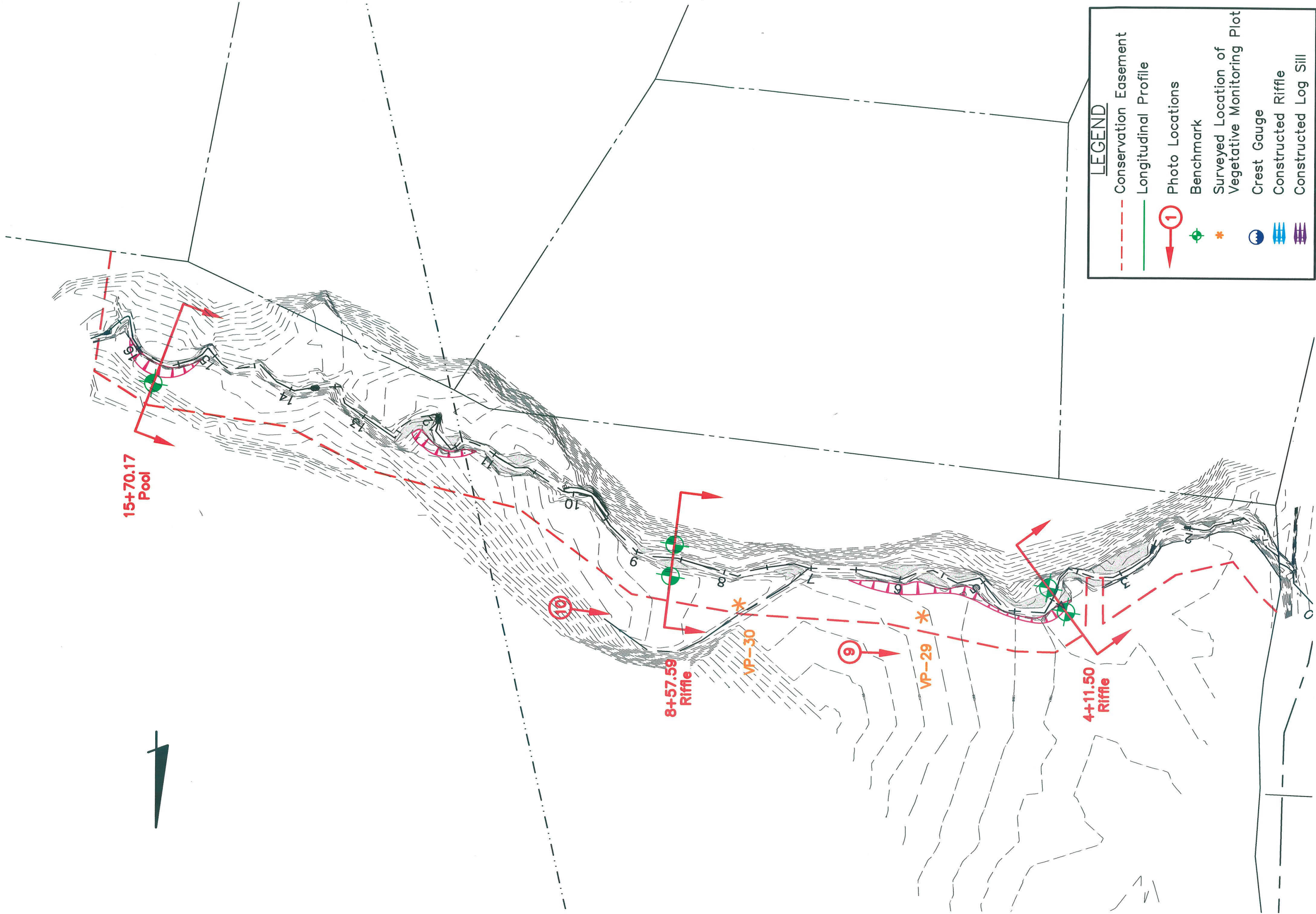
- Conservation Easement
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- ① Photo Locations
- ⊕ Benchmark
- * Surveied Location of Vegetative Monitoring Plot
- ☉ Crest Gauge
- ▬▬▬ Constructed Riffle
- ▬▬▬ Constructed Log Sill

McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2H
 TRIBUTARY A - UPPER

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M C M X X V I



LEGEND

- Conservation Easement
- Longitudinal Profile
- ① Photo Locations
- ⊕ Benchmark
- * Surveied Location of Vegetative Monitoring Plot
- ⊙ Crest Gauge
- ▬ Constructed Riffle
- ▬ Constructed Log Sill

McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES
 MONITORING
FIGURE 2I
 TRIBUTARY C

Date: September, 2007
 Scale: 1" = 100'
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III. PROJECT CONDITION AND MONITORING RESULTS

A. Vegetation Assessment

1. Soil Data

The project area is contained within the Iotla-Braddock-Rosman-Potomac soil association. This soil association typically consists of nearly level to very steep, somewhat poorly drained soils, which have a predominantly loamy, clayey or sandy subsoil formed in alluvium on floodplains and stream terraces (USDA, NRCS 1995).

The majority of Tributary A is mapped within Iotla sandy loam with 0-2% slopes, occasionally flooded. The upstream portion of the tributary flows through additional soil units including Elsinboro loam with 1-4% slopes, rarely flooded, Braddock clay loam with 6-15% slopes, eroded and Hayesville-Evard complex with 15-35% slopes. Tributary A2 is mapped in Iotla sandy loam. The portion of tributary B that is included in the restoration is mapped within Dillard loam, 1-4% slopes, rarely flooded. The portion of Tributary C that is included in the restoration is mapped within the Iotla sandy loam unit.

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

Series	Max. Depth (in.)	% Clay on Surface	K ¹	T ²	% Organic Matter
Braddock clay loam (BrC2)	80+	27-40	0.32	5	0-2
Dillard loam (DdB)	80+	10-15	0.32	5	4-8
Elsinboro loam (EsB)	60+	8-18	0.28	5	1-3
Hayesville-Evard complex (HeD)	60+	7-25	0.24-0.28	5	1-5
Iotla sandy loam (IoA)	60+	12-18	0.2	5	4-8

¹Erosion Factor K indicates the susceptibility of a soil to sheet and rill erosion, ranging from 0.05 to 0.69.

²Erosion 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. All problem areas identified during Monitoring Year 2 are summarized in Table VII. Photographs of the vegetative problem areas are shown in Appendix A. There are also 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.

Feature/Issue	Station # / Range	Probable Cause	Photo #
Invasive Population	Throughout: See VPA Plan View	<i>Sericea lespedeza</i> : encroachment from pasture	VPA 1, VPA 2

The only type of vegetative problem is the spread of an invasive species, *Sericea lespedeza*. This species is a common component of pasture mixes, and as this project is adjacent to pasture lands, it likely spread into the project area from the surrounding landscape. The spread of the species is extensive throughout the project corridor. Management is planned for the spring of 2008 to combat further spread and attempt to eradicate much of this species from areas where it has negatively impacted the survival of planted woody vegetation. This management will include herbicide treatments, sprayed in a manner to minimize the impact on planted woody vegetation. Management of the woody vegetation is discussed in the Stem Counts section of this report. Further spraying will be conducted throughout 2008 if deemed necessary.

3. Vegetation Problem Area Plan View

The location of each vegetation problem area is shown on the vegetative problem area plan view included in Appendix A. 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. 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*.

The average stem density for the entire site just meets the minimum criteria of 320 stems per acre after three years. However, fourteen of the thirty vegetation plots fall below this threshold number. The largest deficit in woody stems is found along Tributary C (Plots 29 and 30). Only one seedling was found in each these two plots. The remainder of the plots with an insufficient number of stems are scattered throughout the project area.

Because the average density of the entire site fell below the 320 stems per acre threshold in Year 1, remedial plantings were conducted in late April, 2007 to supplement the number of trees along the streams. Approximately 2000 trees were planted at this time, including 500 trees along Tributary C, and 1500 trees along the other reaches. These additional trees brought the average live stem density to 390 stems per acre, meeting the three year threshold of 320 stems per acre. These additional plantings are the reason why many of the species exhibit 100% survival, with greater Year 2 totals than the Year 1 totals.

It is clear that the survival of seedlings is being affected on this site, as many of the remedial plantings did not survive through one growing season. It is likely that the spread of *Sericea lespedeza* throughout much of the project corridor has hindered the growth and survival of woody vegetation. Where present, this species is dominant, providing a thick coverage of growth approximately three feet high through which any species must break in order to receive sunlight or rainfall. After management of this species is conducted in the spring of 2008, as discussed previously, another round of remedial tree plantings will be conducted. These plantings are intended to bring the site back into compliance with the 320 stems per acre minimum, and to replace any trees inadvertently impacted by the herbicide treatments. The plantings will be spread throughout the project corridor, with an emphasis on Tributary C, which has the lowest stem counts, and Tributary B, which is most impacted by *Sericea lespedeza*.

5. Vegetation Plot Photos

Vegetation plot photos are provided in Appendix A.

**Table VIII. Stem counts for each species arranged by plot.
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01**

Species	Plots																														Year 1 Totals	Year 2 Totals	Survival %		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
Shrubs																																			
<i>Alnus serrulata</i>	1	2	1	1		1	1		1														1		2		2	3					16	100%	
<i>Cephalanthus occidentalis</i>										1																							1	100%	
<i>Cornus amomum</i>	6	5	6		1	5	2	3	4	3	10	2		1	1	1		3	1	1	3	2	6	1								64	67	100	
<i>Sambucus canadensis</i>										4		1																					5	5	100%
Trees																																			
<i>Fraxinus pennsylvanica</i>	4	2	3	1		5	1	1	4		3	7	2	2	3	2	8	3			1	3	1	4		3	2	1	1	1		29	68	100%	
<i>Platanus occidentalis</i>	1		2	1	5			2					1		2			1	1	1	1			1								19	19	100%	
<i>Quercus alba</i>	1		1	3	1		1	1	3				1	2	4	2			2		8		1	3								34	34	100%	
<i>Quercus phellos</i>		2						2				1	3				1				2	1										10	12	100%	
<i>Quercus pagoda</i>										1			1													2	3	1	3				13	11	85%
<i>Salix nigra</i>						1	5	-																										6	100%
Year 1 Totals	13	11	13	6	7	12	10	9	12	9	13	11	8	5	10	5	9	7	4	4	14	5	9	9	4	6	5	7	1	1		210	239	100%	
Live Stem Density (stems per acre)	527	446	527	243	284	486	405	365	486	365	527	446	324	203	405	203	365	284	162	162	567	203	365	365	162	243	203	284	41	41					
Average Live Stem Density (stems per acre)	323																																		

B. Stream Assessment

1. Hydrologic Criteria

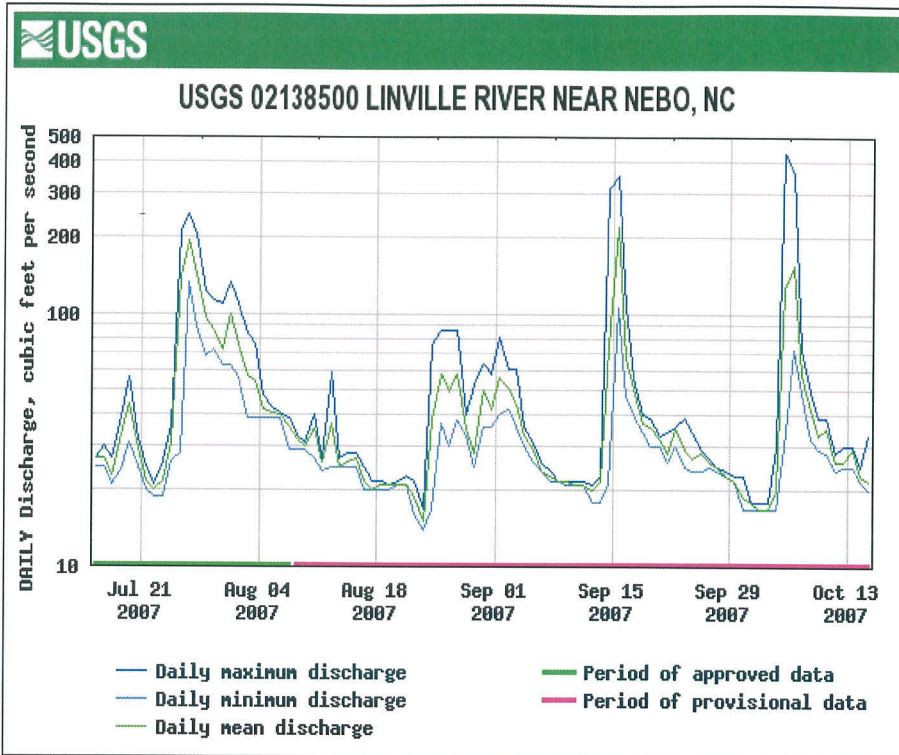
A network of six crest-stage stream gages was installed on each of the project reaches. The locations of the crest-stage stream gages are shown on the monitoring plan view (Figure 2). No bankfull events were documented for this site during the first year of monitoring. Bankfull events were recorded during Year 2, as documented in Table IX.

Date of Data Collection	Date of Occurrence	Method	Photo #
7/18/07	Unknown	Crest gage at Station 5+00 on Tributary B	BF 1
7/18/07	Unknown (3 events)	Crest gage at Station 54+85 on Tributary A (Lower)	BF 2
10/19/07	9/14/07-9/15/07*	Crest gage at Station 113+37 on Tributary A (Upper)	BF 3

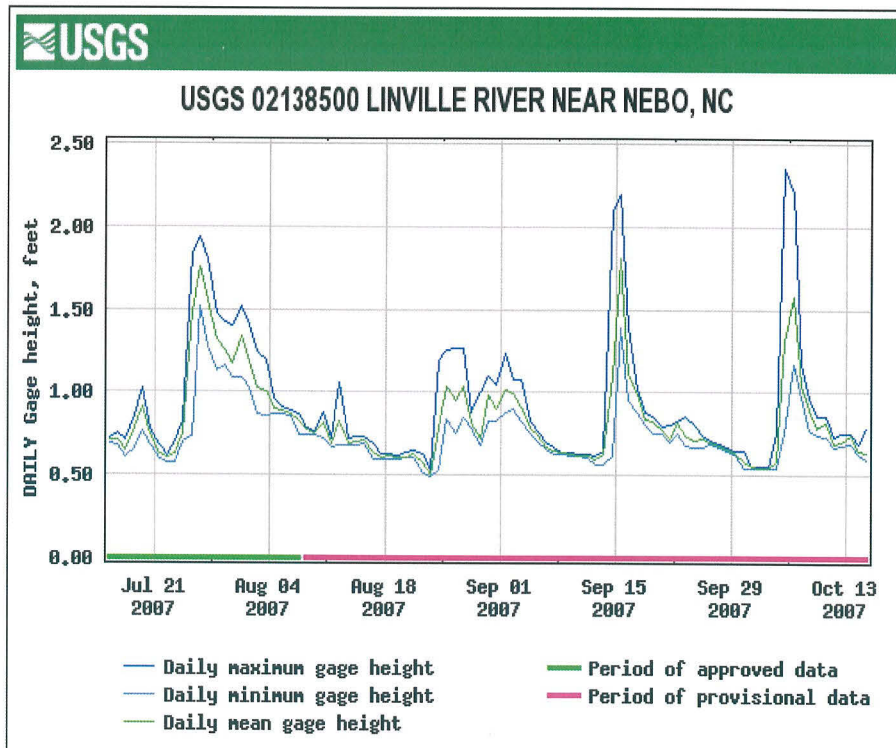
*Date is approximate; based on a review of recorded rainfall data

The height of the bankfull event was not measured for the crest gage on Tributary B. The crest gage on Tributary A (Lower) showed evidence of at least 3 separate events, with levels of 16.75, 24.75, and 33.25 inches above bankfull. In October 2007, the crest gage on Tributary A (Upper) registered a bankfull event at a level of 1.24 feet above bankfull elevation. Photographs of the crest gages are shown in Appendix B.

The most likely date for the bankfull event between the July and October readings was after the September 14, 2007 rain event. On this date, rainfall as recorded in Morganton, NC totaled 1.47 inches. As this was the only precipitation event of significance during the preceding three months, this is likely the bankfull event recorded by the crest gage read on October 19, 2007. This corresponds to a high discharge event on September 15, as recorded at USGS Gage 02138500 at Nebo, NC, which lies approximately 15 miles west of Morganton and 5 miles east of Marion, NC. The discharge and gage height recorded at the Nebo station are shown on the hydrographs below.



USGS Surface-Water Daily Data for North Carolina
<http://waterdata.usgs.gov/nc/nwis/dv?>



USGS Surface-Water Daily Data for North Carolina
<http://waterdata.usgs.gov/nc/nwis/dv?>

2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for each year of monitoring is included in Tables Xa and Xb.

Table Xa. Stream Problem Areas – Year 1 South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01			
Feature Issue	Station Numbers	Suspected Cause	Photo Number
Aggradation	4+50 (A2)	Large bar, 25 feet aggraded	SPA 1 (Year 1 Report)
	3+00 (A2)	Overwidened channel, 40 feet aggraded	
Bank failure	79+50 (A Middle)	Mat failed; scour hole, 5'	SPA 2, SPA 3 (Year 1 Report)
	12+10 (B)	Complete loss of riffle, bank failure.	
Bank scour	103+00 (A Upper)	Large hole, scour (15 feet)	SPA 4, SPA 5, SPA 6 (Year 1 Report)
	83+30 (A Middle)	Sloughing, coir log undercut and fallen into pool (15 feet)	
	82+70 (A Middle)	Sloughing, coir log undercut and fallen into pool (15 feet)	
	3+00 (A Lower)	Sloughing	
	19+70 (B)	Bank scour around log sill	
	18+50 (B)	Scour at outside meander bend; significant aggradation	
	16+00 (B)	Scour, matting loose and failing, bank slough	
	15+70 (C)	Bank scour/ sloughing	
	4+50 (C)	Bank scour/ sloughing	

Table Xb. Stream Problem Areas – Year 2 South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01			
Feature Issue	Station Numbers	Suspected Cause	Photo Number
Bank failure	12+10 (B)	Complete loss of riffle, bank recovering as a result of thick vegetation.	SPA 1
Bank scour	85+64 (A Middle)	Minor bank erosion	SPA 2
	15+70 (C)	Bank scour/ sloughing	
	4+50 (C)	Bank scour/ sloughing; heavily vegetated and stable	

Some unstable areas were found along South Muddy Tributaries in Year 2, including areas of aggradation and bank scour as noted in Table X. Aggradation problem areas noted during Year 1 on Tributary A2 are no longer present. The vegetation along this reach is extremely robust. Lateral bars found during the previous year are no longer present. The Upper and Lower sections of Tributary A had one area of bank scour at approximate profile stations 103+00 and 3+00, respectively. Robust vegetation at both locations is preventing exacerbation as the banks are healing and returning to a stable state. Tributaries B and C and the Middle section of Tributary A each had some areas of bank scour and/or bank erosion. With the exception of minimal bank scour observed during Year 2 at station 85+64 on Tributary Middle A, these areas are now heavily vegetated and stable. Two areas of bank scour along Tributary B and one area of bank failure along the Middle section of Tributary A, were repaired between Year 1 and Year 2. These repairs have been effective, with no anticipated need for further work.

Vegetation along Tributary B is very dense in the downstream reach, covering the stream banks and the streambed itself. The thick vegetation has increased bed roughness, slowing bankfull velocity, and in turn provides optimal conditions for new vegetation to continue to flourish in the channel; however, much of this vegetation is comprised of the invasive *Sericea lespedeza*, discussed under the Vegetation Problem Areas.

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 23, 2007. These photographs are provided in Appendix B.

6. Stability Assessment Table

The visual stream assessment was performed to determine the percentage of stream features that remain in a stable state after the first year of monitoring. A summary of the assessment for each reach is included in Table XIa through Table XIg. 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 XIa. Categorical Stream Feature Visual Stability Assessment South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01 Segment/Reach: A (Upper)						
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles¹	100%	100%	100%			
B. Pools¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	99%*	99%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc.²	N/A	N/A	N/A			
G. Wads and Boulders²	N/A	N/A	N/A			

**Table XIb. Categorical Stream Feature Visual Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: A (Middle)**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles ¹	100%	100%	100%			
B. Pools ¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	96%*	99%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc. ²	N/A	N/A	N/A			
G. Wads and Boulders ²	N/A	N/A	N/A			

**Table XIc. Categorical Stream Feature Visual Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: A (Lower)**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles ¹	100%	100%	100%			
B. Pools ¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	99%*	99%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc. ²	N/A	N/A	N/A			
G. Wads and Boulders ²	N/A	N/A	N/A			

**Table XIId. Categorical Stream Feature Visual Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: Tributary A2**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles ¹	100%	97%*	100%			
B. Pools ¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	93%*	100%			
F. Vanes / J Hooks etc. ²	N/A	N/A	N/A			
G. Wads and Boulders ²	N/A	N/A	N/A			

**Table XIe. Categorical Stream Feature Visual Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: B**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles ¹	100%	99%*	99%			
B. Pools ¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	97%*	98%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc. ²	N/A	N/A	N/A			
G. Wads and Boulders ²	N/A	N/A	N/A			
H. Log Sills	100%	97%*	100%			

**Table XIe. Categorical Stream Feature Visual Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: C**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles ⁴	100%	100%	100%			
B. Pools ¹	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	99%*	98%			
E. Bed General	100%	100%	100%			
F. Vanes / J Hooks etc. ²	N/A	N/A	N/A			
G. Wads and Boulders ²	N/A	N/A	N/A			

* The percentages for Year 1 were updated, using the percentages derived from Table B1 in Appendix B, using the Feature Performance Mean percentages located in the last column of Table B1. The Feature Performance Mean percentages were used for Year 2; therefore, the percentages are now comparable across the years.

¹The tables were completed to include a percentage of stability for pool and riffle features using the definitions provided below for the stream reaches along Tributary A.

Riffle: A portion of the linear stream segment located between two consecutive meander bends.

Pool: A portion of the curvilinear stream segment located in each meander bend.

²Those features not included in the stream restoration were labeled N/A. This includes features such as vanes, J-hooks, rootwads and boulders.

The only category that included unstable features for Tributaries Upper A, Middle A, Lower A and C were meanders, where minor erosion occurred along the outer bends. However, the meanders that had been in a state of degradation have improved during Year 2 due to the increased vegetative cover and associated root mass along the stream corridors. As the vegetation matures, the root mass is expanding both in size, depth and density, enhancing streambank stability. The areas along Tributary A2 with unstable features in Year 1 were locations of aggradation and bar formation in the riffles. These were no longer considered problem areas in Year 2, as the vegetation cover increased along this reach and areas of aggradation noted during Year 1 are no longer evident.

The unstable features on Tributary B were erosion along meander bends and bank scouring around riffles. The overall percentage of stability improved from Year 1 to Year 2, indicating a trend in increased channel stability over time. As discussed previously, the lower reach of Tributary B has become heavily vegetated, increasing bank and streambed stability. Log sills are functioning, maintaining grade control, providing aeration and enhancing aquatic habitat features.

7. Quantitative Measures

Graphic interpretations of cross-sections, profiles and pebble counts are provided in Appendix B. A summary of the baseline morphology for the site is included in Table XII for comparison with the monitoring data shown in the tables in the appendix.

The data provided in Table XII for Year 1 reflects data from only the long-term monitoring reaches assessed along the Year 1 longitudinal profiles, while the As-Built data was collected for the entire reach on each tributary. The stream pattern data provided for Year 1 and Year 2 is the same as the data provided from the As-Built survey, as pattern has not changed based on Year 1 and Year 2 stream surveys and visual field assessment of the each of the reaches in their entirety.

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 glide features, providing spawning habitat for native fishes and riffle substrates conducive to benthic macro-invertebrate populations to re-emerge. Of interest, is the change (median decrease) in pool to pool spacings between Year 1 and Year 2 on Upper Tributary A and to a lesser degree on the other long-term monitoring profiles. This bedform adjustment may be attributed to extended drought during the summer of 2007 (low flow conditions) and minimal flushing of sand-sized particles through the project reaches. Future monitoring may confirm this hypothesis. Comparison of As-Built, Year 1 and Year 2 long-term stream monitoring show successive increases in channel-floodplain connectivity and increasingly stable channel dimensions, interpreted from width/depth ratios, entrenchment ratios, bank height ratios, etc. as shown on the long-term monitoring cross-sections. Median particle sizes of the stream channels ranged from fine to coarse gravel in the riffle/run areas, and silt to medium sand in the pool/glide areas. Remedial maintenance work on the restored reaches is not planned at this time.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Upper Tributary A {Long-Term Monitoring Profile Station 0+00 to 9+26.47 (926.47 feet)}

Parameter	Reference Reach Data ¹						XS 114+61.61, -35.13						Monitoring			Monitoring					
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			1.38			1.38			1.38			1.38			1.38
Bankfull Width (Wbkf) - ft.			10.8			7.35			6.55			7.60	11.00	14.00	12.50	12.42	20.22	16.32	12.21	20.20	16.21
Flood Prone Width (Wfpa) - ft.			100			43			9.12			50.00			50	38.82	65.6	52.21	39.19	51.52	45.36
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			5.91			10.44	8.86	12.24	10.55	11.69	18.64	15.17	11.19	17.78	14.49
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.90			1.80	0.63	1.11	0.87	0.92	0.94	0.93	0.88	0.91	0.90
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.78				1.28	1.66	1.47	1.52	2.3	1.91	1.52	2.23	1.88
Width/Depth Ratio			5.6			6.1			7.28			4.22	9.91	22.22	16.07	13.21	21.98	17.60	13.45	22.95	18.20
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.39			6.58	3.57	4.55	4.06	3.13	3.25	3.19	3.20	3.20	3.20
Bank Height Ratio			1.0			1.8			3.59			1.00			1.11	1.11	1.11	1.11	0.78	1.00	0.89
Wetted Perimeter - ft.			14.6			9.95			8.35			9.09	12.00	14.38	13.19	13.15	20.95	17.05	12.85	20.90	16.88
Hydraulic radius - ft.			1.42			0.91			0.71			1.15	0.62	1.02	0.82	0.89	0.89	0.89	0.85	0.87	0.86
Pattern																					
Belt Width (Wblt) - ft.						50				46.38	64.9		50	50	50	50	50	50	50	50	50
Radius of Curvature (Rc) - ft.						10						19.00	10.67	24.71	16.26	10.67	24.71	16.26	10.67	24.71	16.26
Meander Length (Lm) - ft.						50				76	106.4		60	107	78.5	60	107	78.5	60	107	78.5
Meander Width Ratio (Wblt/Wbkf)						6.8						6.58	3.57	4.55	4.00	2.47	4.03	3.25	2.48	4.10	3.29
Profile																					
Riffle Length (Lrif) - ft.			16			10							23.8	130.3	53.3	10.6	92.4	31.6	8.03	52.4	23.19
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032							0.0026	0.0069	0.0048	0.0014	0.0078	0.0038	0.0054	0.0112	0.0078
Pool Length (Lpool) - ft.			9			24							26.8	96.8	46.8	42.6	99.6	73.7	30.14	64.32	49.74
Pool-Pool Spacing (p-p) - ft.			40			27							85.3	159.9	128.7	88.8	142.2	104.5	49.78	111.68	69.1
Substrate																					
d ₅₀ (mm)			20			26						20			3.4			3.4			7.0
d ₈₄ (mm)			38			76						38			12.5			12.5			16.3
Additional Reach Parameters																					
Valley Length (ft)						295			2520			1049			1097			660.04			660.04
Channel Length (ft)			236			479			2644			1539			1609			926.47			926.47
Sinuosity						1.6			1.05			1.47			1.47			1.40			1.40
Water Surface Slope (S _{ave})			0.006			0.022			0.0035			0.0030			0.0023			0.0025			0.0031
Bankfull Slope (S _{bkf})			NA			0.025						0.0044			0.0033			0.0029			0.0026
Rosgen Classification			E4			E4			F/G			E4			C4			C4			C4
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.77			1.98			1.98			1.98			2.32
Bankfull Discharge (Q _{bkf})			98			60			26.00			20.7			20.7			20.7			18.65

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

⁴ Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Middle Tributary A {Long-Term Monitoring Profile Station 0+00 to 5+17.09 (517.09 feet)}

Parameter	Reference Reach Data ¹						XS 114+61.61, -35.13						Monitoring			Monitoring					
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			1.38			1.38			1.38			1.38			1.38
Bankfull Width (Wbkf) - ft.			10.8			7.35			6.55			8.00			15.00			14.63			14.68
Flood Prone Width (Wfpa) - ft.			100			43			9.12			50.00			60.00			67.33			61.33
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			5.91			12.00			12.61			16.62			15.35
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.90			2.00			0.84			1.14			1.05
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.78						1.50			2.38			2.11
Width/Depth Ratio			5.6			6.1			7.28			4.00			17.86			12.83			13.98
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.39			6.25			4.00			4.60			4.18
Bank Height Ratio			1.0			1.8			3.59			1.00			1.11			1.11			0.72
Wetted Perimeter - ft.			14.6			9.95			8.35			9.66			15.49			15.54			15.41
Hydraulic radius - ft.			1.42			0.91			0.71			1.24			0.81			1.07			1.00
Pattern																					
Belt Width (Wblt) - ft.						50				48.80	68.32				60.00			60.00			60.00
Radius of Curvature (Rc) - ft.						10						20.00	15.04	41.80	20.62	15.04	41.80	20.62	15.04	41.80	20.62
Meander Length (Lm) - ft.						50				80.00	112.00		75.00	91.00	85.00	75.00	91.00	85.00	75.00	91.00	85.00
Meander Width Ratio (Wblt/Wbkf)						6.8						6.25			4.00			4.10			4.09
Profile																					
Riffle Length (Lrif) - ft.			16			10							36.5	72.5	52.3	28.2	70.8	46.5	5.8	17.8	11.9
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032							0.0012	0.0032	0.0026	0.0020	0.0053	0.0033	0.0092	0.0139	0.0109
Pool Length (L _{pool}) - ft.			9			24							18.4	42.5	34.1	14.7	57.2	29.5	26.4	40.8	33.2
Pool-Pool Spacing (p-p) - ft.			40			27							49.8	83.6	66.5	64.5	87.6	78.3	42.5	133.0	78.9
Substrate																					
d ₅₀ (mm)			20			26						20			0.23			0.23			<0.062
d ₈₄ (mm)			38			76						38			0.41			0.41			<0.062
Additional Reach Parameters																					
Valley Length (ft)						295			816			816			816			375.94			375.94
Channel Length (ft)			236			479			824			1203			1094			517.09			517.09
Sinuosity						1.6			1.01			1.47			1.34			1.38			1.38
Water Surface Slope (S _w)			0.006			0.022			0.0035			0.002			0.0017			0.0017			0.0018
Bankfull Slope (S _{val})			NA			0.025						0.003			0.0020			0.0011			0.0016
Rosgen Classification			E4			E4			F/G			E			C5			C5			C6
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.77			1.71			1.98			1.98			1.75
Bankfull Discharge (Q _{bkf})			98			60			26.00			20.5			20.7			20.7			26.9

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Lower Tributary A {Long-Term Monitoring Profile No. 1 Station 0+00 to 5+88.16 (588.16 feet)}

Parameter	Reference Reach Data ¹						XS 1+66.16, -4.60			Design			As-Built ³			Monitoring Year 1 ⁴			Monitoring Year 2 ⁴		
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			2.03			2.03			2.03			2.03			2.03
Bankfull Width (Wbkf) - ft.			10.8			7.35			6.59			10.00	13.00	23.00	16.00			19.78			18.87
Flood Prone Width (Wfpa) - ft.			100			43			10.41			60.00			60.00			71.26			49.74
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.89			20.16	7.10	19.87	13.29			19.46			17.12
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.74			2.80	0.55	1.16	0.83			0.98			0.91
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.39				1.00	2.09	1.62			2.02			1.91
Width/Depth Ratio			5.6			6.1			8.91			4.00	14.79	31.08	19.28			20.18			20.74
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.58			6.00	2.61	7.98	16.76			3.60			2.64
Bank Height Ratio			1.0			1.8			5.85			1.00			1.28			1.28			0.72
Wetted Perimeter - ft.			14.6			9.95			7.34			12.32	13.28	23.59	16.76			20.21			19.29
Hydraulic radius - ft.			1.42			0.91			0.67			1.64	0.53	1.12	0.81			0.96			0.89
Pattern																					
Belt Width (Wblt) - ft.						50						61.00	85.40		60.00			60.00			60.00
Radius of Curvature (Rc) - ft.						10						25.00	15.22	39.94	24.86	16.70	26.55	21.70	16.70	26.55	21.70
Meander Length (Lm) - ft.						50						100.00	140.00		90.00	145.00	107.00	90.00	145.00	107.00	90.00
Meander Width Ratio (Wblt/Wbkf)						6.8						6.00	2.37	4.62	3.75			3.03			3.18
Profile																					
Riffle Length (Lrif) - ft.			16			10										27.90	41.90	32.20	10.30	34.35	22.45
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032										0.0020	0.0072	0.0048	0.0035	0.0096	0.0057
Pool Length (L _{pool}) - ft.			9			24										48.60	62.90	52.20	19.61	62.34	41.63
Pool-Pool Spacing (p-p) - ft.			40			27										51.50	88.70	72.30	59.63	87.76	73.55
Substrate																					
d ₅₀ (mm)			20			26									0.13			0.13			0.21
d ₈₄ (mm)			38			76									0.29			0.29			0.25
Additional Reach Parameters																					
Valley Length (ft)						295			5710			5164			5178			419.5			419.5
Channel Length (ft)			236			479			5948			7391			7349			588.16			588.16
Sinuosity						1.6			1.04			1.43			1.42			1.4			1.4
Water Surface Slope (S _{ave})			0.006			0.022			0.0019			0.0014	0.0012	0.0012	0.0012			0.0010			0.0015
Bankfull Slope (S _{val})			NA			0.025						0.0020	0.0007	0.00099	0.00084			0.0012			0.0016
Rosgen Classification			E4			E4			F/G			E			C5			C5			C5
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.47			1.65			1.65			1.65			1.65
Bankfull Discharge (Q _{bkf})			98			60			40.7			20.70			20.70			20.7			20.7

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Lower Tributary A (Long-Term Monitoring Profile No. 2 Station 0+00 to 6+23.77 (623.77 feet))

Parameter	Reference Reach Data ¹						XS 1+66.16, -4.60			Design			As-Built ³			Monitoring			Monitoring		
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			2.03			2.03			2.03			2.03			2.03
Bankfull Width (Wbkf) - ft			10.8			7.35			6.59			10.00	13.00	23.00	16.00			17.21			20.89
Flood Prone Width (Wfpa) - ft			100			43			10.41			60.00			60			31.25			38.54
Bankfull Cross-Section Area (Abkf) - ft ²			20.7			9.1			4.89			20.16	7.10	19.87	13.29			8.87			15.80
Bankfull Mean Depth (Dbkf) - ft			1.9			1.3			0.74			2.80	0.55	1.16	0.83			0.52			0.76
Bankfull Max Depth (Dmax) - ft			2.5			1.8			1.39				1.00	2.09	1.62			1.17			1.34
Width/Depth Ratio			5.6			6.1			8.91			4.00	14.79	31.08	19.28			33.10			27.49
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.58			6.00	2.61	7.98	5.30			1.82			1.84
Bank Height Ratio			1.0			1.8			5.85			1.00			1.28			1.28			0.80
Wetted Perimeter - ft			14.6			9.95			7.34			12.32	13.28	23.59	16.76			17.46			21.12
Hydraulic radius - ft			1.42			0.91			0.67			1.64	0.53	1.12	0.81			0.51			0.75
Pattern																					
Belt Width (Wblt) - ft						50				61.00	85.40				60			60			60
Radius of Curvature (Rc) - ft						10						25.00	15.22	39.94	24.86	15.22	39.94	23.19	15.22	39.94	23.19
Meander Length (Lm) - ft						50				100.00	140.00		90	145	107	90	145	107	90	145	107
Meander Width Ratio (Wblt/Wbkf)						6.8						6.00	2.37	4.62	3.75			3.49			2.87
Profile ³																					
Riffle Length (Lrif) - ft			16			10										7.70	25.20	17.60	6.18	31.37	17.04
Riffle Slope (Srif) - ft/ft			0.026			0.032										0.0056	0.0148	0.0098	0.0035	0.0194	0.0100
Pool Length (Lpool) - ft			9			24										39.90	86.90	60.30	27.07	37.05	33.37
Pool-Pool Spacing (p-p) - ft			40			27										50.70	95.20	74.50	64.70	109.76	89.03
Substrate ³																					
d ₅₀ (mm)			20			26									0.13			0.13			0.21
d ₈₄ (mm)			38			76									0.29			0.29			0.25
Additional Reach Parameters ³																					
Valley Length (ft)						295			5710			5164			5178			449.17			449.17
Channel Length (ft)			236			479			5948			7391			7349			623.77			623.77
Sinuosity						1.6			1.04			1.43			1.42			1.39			1.39
Water Surface Slope (S _{ave})			0.006			0.022			0.0019			0.0014	0.0012	0.0012	0.0012			0.0014			0.0015
Bankfull Slope (S _{val})			NA			0.025						0.0020	0.0007	0.0010	0.0008			0.0022			0.0017
Rosgen Classification			E4			E4			F/G			E			C5			B5			B5
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.47			1.65			1.65			1.65			1.65
Bankfull Discharge (Q _{bkf})			98			60			40.7			20.70			20.70			20.70			20.70

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

⁴ Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value; where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Lower Tributary A {Long-Term Monitoring Profile No. 3 Station 0+00 to 5+18.94 (518.94 feet)}

Parameter	Reference Reach Data ¹						XS 1+66.16, -4.60			Design			As-Built ³			Monitoring Year 1 ⁴			Monitoring Year 2 ⁴		
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Monitoring Year 1 ⁴			Monitoring Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			2.03			2.03			2.03			2.03			2.03
Bankfull Width (Wbkf) - ft.			10.8			7.35			6.59			10.00	13.00	23.00	16.00			15.83			14.57
Flood Prone Width (Wfpa) - ft.			100			43			10.41			60.00			60.00			36.07			32.57
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.89			20.16	7.10	19.87	13.29			8.72			6.68
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.74			2.80	0.55	1.16	0.83			0.55			0.46
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.39				1.00	2.09	1.62			1.23			1.13
Width/Depth Ratio			5.6			6.1			8.91			4.00	14.79	31.08	19.28			28.78			31.67
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.58			6.00	2.61	7.98	16.76			2.28			2.24
Bank Height Ratio			1.0			1.8			5.85			1.00			1.28			1.28			1.00
Wetted Perimeter - ft.			14.6			9.95			7.34			12.32	13.28	23.59	16.76			16.07			14.80
Hydraulic radius - ft.			1.42			0.91			0.67			1.64	0.53	1.12	0.81			0.54			0.45
Pattern																					
Belt Width (Wbtl) - ft.						50				61.00	85.40				60			60.00			60.00
Radius of Curvature (Rc) - ft.						10						25.00	15.22	39.94	24.86	19.56	32.82	29.53	19.56	32.82	29.53
Meander Length (Lm) - ft.						50				100.00	140.00		90	145	107	90	145	107	90	145	107
Meander Width Ratio (Wbtl/Wbkf)						6.8						6.00	2.37	4.62	3.75			3.79			4.12
Profile³																					
Riffle Length (Lrif) - ft.			16			10										13.70	46.80	28.00	13.75	22.00	16.69
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032										0.0016	0.0151	0.0064	0.0031	0.0055	0.0044
Pool Length (L _{pool}) - ft.			9			24										20.90	55.90	38.20	14.80	46.90	29.02
Pool-Pool Spacing (p-p) - ft.			40			27										42.10	76.20	63.30	28.88	86.12	48.93
Substrate³																					
d ₅₀ (mm)			20			26									0.13			0.13			0.21
d ₈₄ (mm)			38			76									0.29			0.29			0.25
Additional Reach Parameters³																					
Valley Length (ft)						295			5710			5164			5178			369.80			369.80
Channel Length (ft)			236			479			5948			7391			7349			518.94			518.94
Sinuosity						1.6			1.04			1.43			1.42			1.40			1.40
Water Surface Slope (S _{ave})			0.006			0.022			0.0019			0.0014	0.0012	0.0012	0.0012			0.0010			0.0007
Bankfull Slope (S _{val})			NA			0.025						0.0020	0.0007	0.0010	0.0008			0.0022			0.0016
Rosgen Classification			E4			E4			F/G			E			C5			C5			C5
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.47			1.65			1.65			1.65			1.65
Bankfull Discharge (Q _{bkf})			98			60			40.7			20.70			20.70			20.70			20.70

¹Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

²S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³As-Built dimension data includes each riffle cross-sections in a described reach.

⁴Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Lower Tributary A {Long-Term Monitoring Profile No. 4 Station 0+00 to 3+46.16 (346.16 feet)}

Parameter	Reference Reach Data ¹						XS 1+66.16, -4.60						Monitoring			Monitoring					
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																					
Drainage Area - mi. ²			1.3			0.14			2.03			2.03			2.03			2.03			2.03
Bankfull Width (Wbkf) - ft.			10.8			7.35			6.59			10.00	13.00	23.00	16.00			14.52			14.48
Flood Prone Width (Wfpa) - ft.			100			43			10.41			60.00			60.00			49.36			69.16
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.89			20.16	7.10	19.87	13.29			10.09			10.89
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.74			2.80	0.55	1.16	0.83			0.70			0.75
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.39				1.00	2.09	1.62			1.55			1.57
Width/Depth Ratio			5.6			6.1			8.91			4.00	14.79	31.08	19.28			20.74			19.31
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.58			6.00	2.61	7.98	16.76			3.40			4.78
Bank Height Ratio			1.0			1.8			5.85			1.00			1.28			1.28			1.00
Wetted Perimeter - ft.			14.6			9.95			7.34			12.32	13.28	23.59	16.76			14.89			14.96
Hydraulic radius - ft.			1.42			0.91			0.67			1.64	0.53	1.12	0.81			0.68			0.73
Pattern																					
Belt Width (Wblt) - ft.						50				61.00	85.40				60			60			60
Radius of Curvature (Rc) - ft.						10						25.00	15.22	39.94	24.86	24.54	33.26	30.15	24.54	33.26	30.15
Meander Length (Lm) - ft.						50				100.00	140.00		90	145	107	90	145	107	90	145	107
Meander Width Ratio (Wblt/Wbkf)						6.8						6.00	2.37	4.62	3.75			4.13			4.14
Profile																					
Riffle Length (Lrif) - ft.			16			10										14.40	20.70	17.50	5.74	24.74	14.11
Riffle Slope (Srif) - ft./ft.			0.026			0.032										0.0044	0.0070	0.0057	0.0031	0.0075	0.0051
Pool Length (Lpool) - ft.			9			24										38.70	80.30	58.50	27.75	48.75	40.43
Pool-Pool Spacing (p-p) - ft.			40			27										52.00	88.60	62.90	30.00	58.88	44.63
Substrate																					
d ₅₀ (mm)			20			26									0.04			0.04			0.21
d ₈₄ (mm)			38			76									0.07			0.07			0.25
Additional Reach Parameters																					
Valley Length (ft)						295			5710			5164			5178			259.00			259.00
Channel Length (ft)			236			479			5948			7391			7349			346.16			346.16
Sinuosity						1.6			1.04			1.43			1.42			1.34			1.34
Water Surface Slope (S _{ave})			0.006			0.022			0.0019			0.0014	0.0012	0.0012	0.0012			0.0009			0.0015
Bankfull Slope (S _{val})			NA			0.025						0.0020	0.0007	0.0010	0.0008			0.0004			0.0012
Rosgen Classification			E4			E4			F/G			E			C5			C5			C5
Bankfull mean velocity (V _{bkf})			4.7			6.9			2.47			1.65			1.65			1.65			1.65
Bankfull Discharge (Q _{bkf})			98			60			40.7			20.70			20.70			20.70			20.70

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Tributary A2 {Long-Term Monitoring Profile Station 0+00 to 1+96.06 (196.06 feet)}

Parameter	Reference Reach Data ¹						XS 3+61.77, -216.17			Design			As-Built ³			Monitoring Year 1 ⁴			Monitoring Year 2 ⁴		
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Monitoring Year 1 ⁴			Monitoring Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			0.27			0.27			0.27			0.27			0.27
Bankfull Width (Wbkf) - ft.			10.8			7.35			7.09			5.00			11.65			21.43			21.74
Flood Prone Width (Wfpa) - ft.			100			43			11.19			30.00			30			46.81			44.56
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.29			2.40			7.63			17.52			17.47
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.60			2.80			0.66			0.82			0.80
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.12						1.41			1.55			1.52
Width/Depth Ratio			5.6			6.1			11.82			3.85			17.65			26.13			27.17
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.58			6.00			9.44			2.18			2.05
Bank Height Ratio			1.0			1.8			5.85			1.00			1.26			1.26			1.00
Wetted Perimeter - ft.			14.6			9.95			7.52			6.08			12.04			21.73			21.98
Hydraulic radius - ft.			1.42			0.91			0.57			0.79			0.63			0.81			0.79
Pattern																					
Belt Width (Wblt) - ft.						50				30.5	42.7				40.00			40.00			40.00
Radius of Curvature (Rc) - ft.						10						12.5	8.19	14.26	12.00	8.19	14.26	12.00	8.19	14.26	12.00
Meander Length (Lm) - ft.						50				50	70		47.00	57.00	51.00	47.00	57.00	51.00	47.00	57.00	51.00
Meander Width Ratio (Wblt/Wbkf)						6.8						6.00			3.43			1.87			1.84
Profile																					
Riffle Length (Lrif) - ft.			16			10							8.30	11.20	9.80	2.56	24.20	14.60	16.80	47.82	29.75
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032							0.0534	0.0718	0.0626	0.0255	0.1033	0.0523	0.0155	0.0328	0.0242
Pool Length (Lpool) - ft.			9			24							31.90	47.10	39.50	12.60	30.30	24.30	20.72	26.29	23.75
Pool-Pool Spacing (p-p) - ft.			40			27							55.50	79.40	67.60	26.10	48.60	34.80	18.78	37.08	27.50
Substrate																					
d ₅₀ (mm)			20			26						26									
d ₈₄ (mm)			38			76						76									
Additional Reach Parameters																					
Valley Length (ft)						295			310			334			334			136.15			136.15
Channel Length (ft)			236			479			325			462			480			196.06			196.06
Sinuosity						1.6			1.05			1.38			1.44			1.44			1.44
Water Surface Slope (S _{ave})			0.006			0.022			0.0156			0.0206			0.01025			0.0095			0.0069
Bankfull Slope (S _{val})			NA			0.025						0.0284			0.01035			0.0080			0.0063
Rosgen Classification			E4			E4			F/G			E4			C4			C4			C4
Bankfull mean velocity (V _{bkf})			4.7			6.9			4.46			3.87			3.87			3.87			3.87
Bankfull Discharge (Q _{bkf})			98			60			18.4			18.4			18.4			18.4			18.4

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Tributary B {Upper Tributary B Long-Term Monitoring Profile Station 0+00 to 4+75.72 (475.72 feet)}

Parameter	Reference Reach Data ¹						XS 12+28.00, -35.88						Monitoring			Monitoring					
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area - mi. ²			1.3			0.14			0.44			0.44			0.44			0.44			0.44
Bankfull Width (Wbkf) - ft.			10.8			7.35			7.83			6.20	5.11	10.98				12.11			11.94
Flood Prone Width (Wfpa) - ft.			100			43			11.86			45.38			50.00			47.40			46.71
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.86			7.36	6.06	7.56				8.37			7.33
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.62			1.60	0.58	0.69				0.69			0.61
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.22				1.17	1.84				1.46			1.45
Width/Depth Ratio			5.6			6.1			12.63			3.88	8.81	15.91	12.36			17.55			19.57
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.51			7.32	10.02	21.51				3.92			3.91
Bank Height Ratio			1.0			1.8			4.40			1.00	1.00	1.18				1.00			1.00
Wetted Perimeter - ft.			14.6			9.95			8.22			7.53	5.68	11.84				13.15			12.75
Hydraulic radius - ft.			1.42			0.91			0.59			0.98	0.53	0.64				0.64			0.58
Pattern																					
Belt Width (Wblt) - ft.						50				45.38	52.95				50.00			50.00			50.00
Radius of Curvature (Rc) - ft.						10						15.50	10.20	19.38	14.05	12.95	19.38	16.79	12.95	19.38	16.79
Meander Length (Lm) - ft.						50				62.00	86.80				60.00	80.00	70.00	60.00	80.00	70.00	60.00
Meander Width Ratio (Wblt/Wbkf)						6.8						7.32	3.14	5.68	4.05			4.13			4.19
Profile																					
Riffle Length (Lrif) - ft.			16			10										13.10	15.60	14.40	13.06	18.82	15.31
Riffle Slope (Srif) - ft./ft.			0.026			0.032										0.0216	0.0754	0.0501	0.0160	0.0497	0.0396
Pool Length (Lpool) - ft.			9			24										13.60	67.40	28.60	14.66	67.75	30.56
Pool-Pool Spacing (p-p) - ft.			40			27										56.80	128.20	79.70	27.81	86.46	58.15
Substrate																					
d ₅₀ (mm)			20			26									55.06			55.1			0.19
d ₈₄ (mm)			38			76									83.88			83.9			0.23
Additional Reach Parameters																					
Valley Length (ft)						295			1360			1302			1312			320.61			320.61
Channel Length (ft)			236			479			1455			2052			2041			475.72			475.72
Sinuosity						1.6			1.07			1.58			1.56			1.48			1.48
Water Surface Slope (S _{ave})			0.006			0.022			0.0124			0.0123	0.0091	0.0099				0.0093			0.0090
Bankfull Slope (S _{val})			NA			0.025						0.0078	0.0089	0.0097				0.0093			0.0100
Rosgen Classification			E4			E4			B			E	E4	C4	C4			E4			C5
Bankfull mean velocity (V _{bkf})			4.7			6.9			4.18			2.83			2.83			2.83			2.83
Bankfull Discharge (Q _{bkf})			98			60			20.4			20.4			20.4			20.4			20.4

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

Note: Where only two measurements were taken, they are listed as 'Min' and 'Max' values with no 'Med' value;

where only one measurement was taken, that is listed as a 'Med' value.

Blank fields indicate either no measurement was taken or data were not available at the time of this report.

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
South Muddy Creek Tributaries Stream Restoration / EEP Project No. D04006-01
Station/Reach: Tributary B {Lower Tributary B Long-Term Monitoring Profile Station 0+00 to 4+ 4.08 (404.08 feet)}

Parameter	Reference Reach Data ¹						XS 12+28.00, -35.88						Monitoring			Monitoring							
	S. Muddy Birchfield ²			S. Muddy Trib 4 ²			Pre-Existing			Design			As-Built ³			Year 1 ⁴			Year 2 ⁴				
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med		
Drainage Area - mi. ²			1.3			0.14			0.44			0.44			0.44			0.44			0.44		
Bankfull Width (Wbkf) - ft.			10.8			7.35			7.83			6.20	5.11	10.98				18.34			18.63		
Flood Prone Width (Wfpa) - ft.			100			43			11.86			45.38			50.00			58.32			58.37		
Bankfull Cross-Section Area (Abkf) - ft. ²			20.7			9.1			4.86			7.36	6.06	7.56				11.12			10.34		
Bankfull Mean Depth (Dbkf) - ft.			1.9			1.3			0.62			1.60	0.58	0.69				0.61			0.56		
Bankfull Max Depth (Dmax) - ft.			2.5			1.8			1.22				1.17	1.84				1.3			1.29		
Width/Depth Ratio			5.6			6.1			12.63			3.88	8.81	15.91	12.36			30.07			33.27		
Entrenchment Ratio (Wfpa/Wbkf)			9.3			3			1.51			7.32	10.02	21.51				3.18			3.13		
Bank Height Ratio			1.0			1.8			4.40			1.00	1	1.18				1.18			1		
Wetted Perimeter - ft.			14.6			9.95			8.22			7.53	5.68	11.84				18.79			19.09		
Hydraulic radius - ft.			1.42			0.91			0.59			0.98	0.53	0.64				0.59			0.54		
Pattern																							
Belt Width (Wblt) - ft.						50						45.38	52.95					50.00			50.00		
Radius of Curvature (Rc) - ft.						10								15.5	10.20	19.38	14.05	10.20	15.54	13.34	10.20	15.54	13.34
Meander Length (Lm) - ft.						50						62	86.8		60.00	80.00	70.00	60.00	80.00	70.00	60.00	80.00	70.00
Meander Width Ratio (Wblt/Wbkf)						6.8						7.32	3.14	5.68	4.05			2.73					2.68
Profile																							
Riffle Length (Lrif) - ft.			16			10												1.30	12.30	6.50	9.00	12.39	10.17
Riffle Slope (S _{rif}) - ft./ft.			0.026			0.032												0.0171	0.0934	0.0469	0.0275	0.0778	0.0444
Pool Length (L _{pool}) - ft.			9			24												17.80	37.20	26.70	25.79	42.57	36.22
Pool-Pool Spacing (p-p) - ft.			40			27												41.60	60.80	47.70	20.06	47.07	34.09
Substrate																							
d ₅₀ (mm)			20			26									55.06			55.06					0.19
d ₈₄ (mm)			38			76									83.88			83.88					0.23
Additional Reach Parameters																							
Valley Length (ft)						295			1360			1302			1312						404.08		404.08
Channel Length (ft)			236			479			1455			2052			2041						251.58		251.58
Sinuosity						1.6			1.07			1.58			1.56						1.61		1.61
Water Surface Slope (S _{ave})			0.006			0.022			0.0124			0.0123	0.0091	0.0099							0.0073		0.0067
Bankfull Slope (S _{val})			NA			0.025						0.0078	0.0089	0.0097							0.0069		0.0070
Rosgen Classification			E4			E4			B			E	E4	C4	C4						C4		C5
Bankfull mean velocity (V _{bkf})			4.7			6.9			4.18			2.83			2.83						2.83		2.83
Bankfull Discharge (Q _{bkf})			98			60			20.4			20.4			20.4						20.4		20.4

¹ Data provided by Natural Systems Engineering (NSE) and used in the Restoration Plan for S. Muddy Tributaries

² S Muddy Birchfield Ref for Trib A; S. Muddy Trib 4 Ref for Tribs B & C

³ As-Built dimension data includes each riffle cross-sections in a described reach.

Monitoring Year 1 thru 5 data is derived by EMH&T from the long-term profile reach only

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Blank fields indicate either no measurement was taken or data were not available at the time of this report.

IV. METHODOLOGY

Year 1 vegetation monitoring was conducted in September 2006 using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, R.K., Roberts, S.R., Wentworth, T.R. 2006). Year 2 vegetation monitoring was conducted in September 2007 using the same protocol. Year 1 stream monitoring was conducted in April 2007 to provide adequate time between the as-built survey (accepted in January 2007) and the Year 1 monitoring survey. Stream monitoring for Year 2 occurred in October 2007, to provide six months between the Year 1 and Year 2 surveys. Subsequent stream monitoring will occur in the fall of Years 3, 4 and 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.

APPENDIX A

Vegetation Raw Data

1. Vegetation Problem Area Photos
2. Vegetation Problem Area Plan View
3. Vegetation Monitoring Plot Photos
4. Vegetation Data Tables



VPA 1

Overview of the spread of *Sericea lespedeza* in the stream valley along Tributary A (lower), looking downstream from station 19+00.
(EMH&T, Inc. 10/23/07)



VPA 2

View of *Sericea lespedeza* growing along bank of Tributary A (middle) near station 85+64.
(EMH&T, Inc. 10/23/07)



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SOUTH MUDDY CREEK TRIBUTARIES

MONITORING YEAR 2

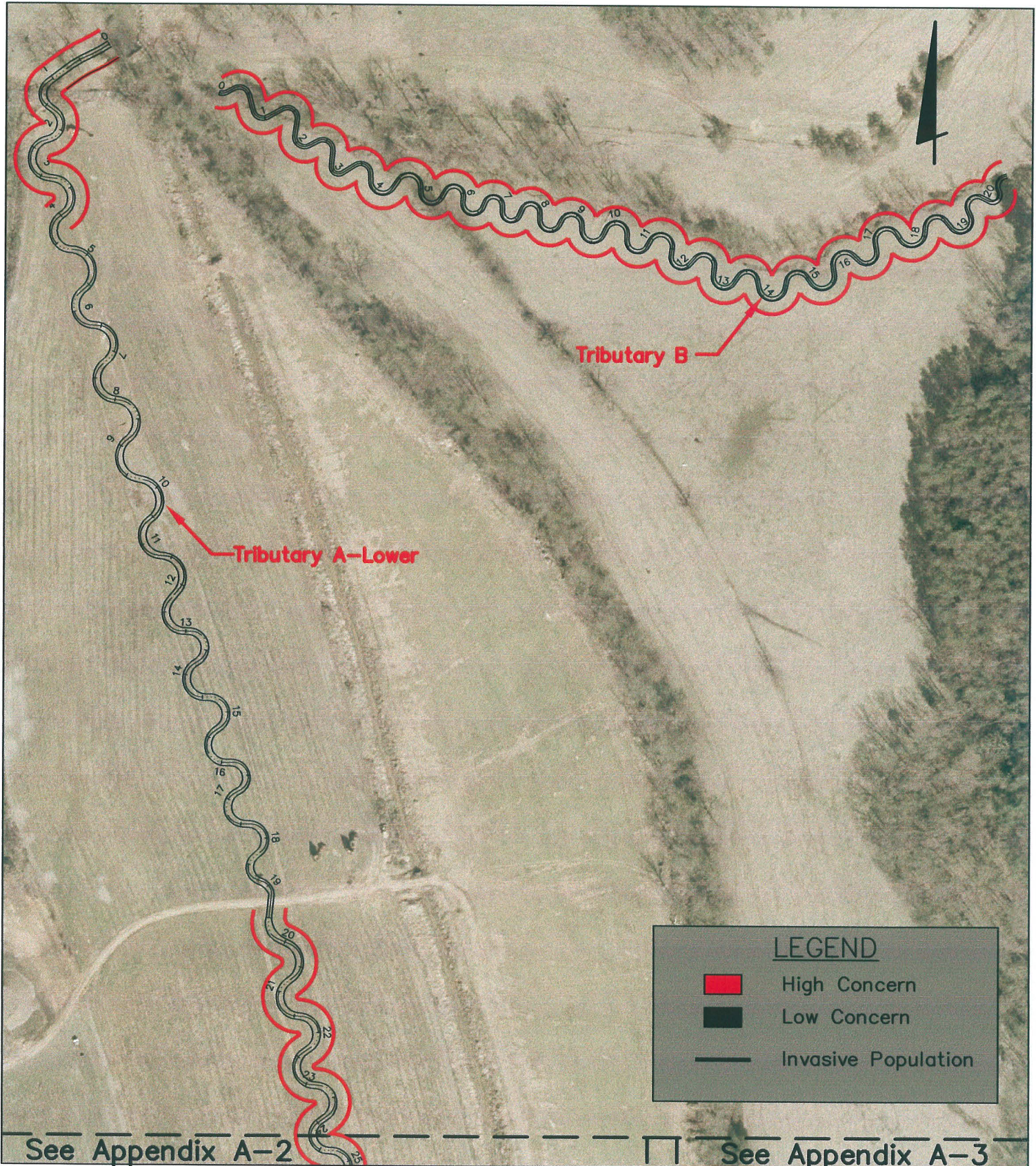
APPENDIX A-1

TRIBUTARY A - LOWER AND TRIBUTARY B

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'



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See Appendix A-2

See Appendix A-3



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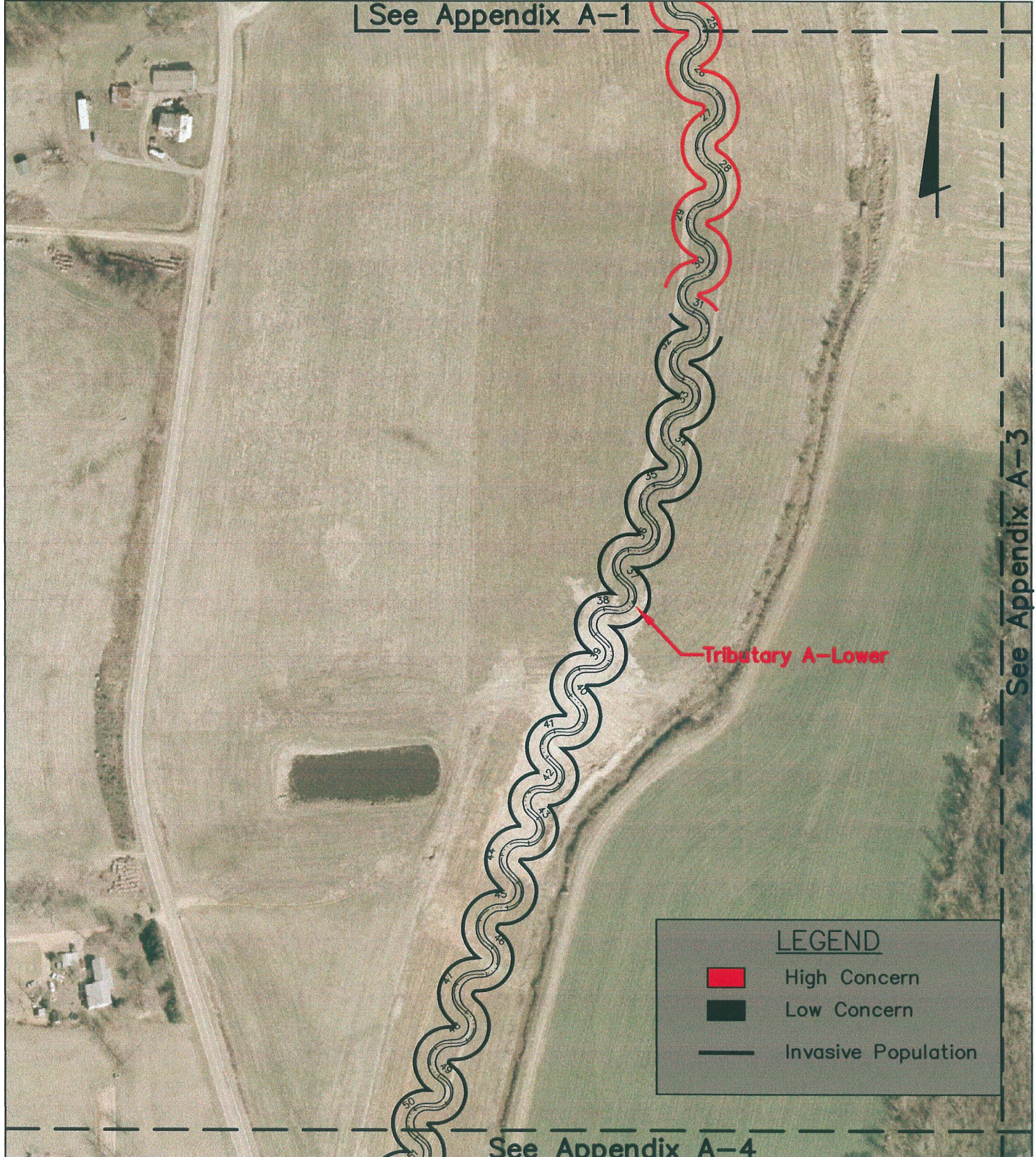
MONITORING APPENDIX A-2 TRIBUTARY A-LOWER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix A-1



LEGEND

- High Concern
- Low Concern
- Invasive Population

See Appendix A-4

See Appendix A-3

\\CMHDATA1\PUBLICWORKS\PROJECT\2004\359\DWG\MONITORING_EXHIBITS\YEAR 2 APPENDIX A1-5.DWG-APPENDIX A-2> - NO XREFS - LAST SAVED BY JCRAMER [11/19/2007 2:13:14 PM] - PLOTTED BY JCRAMER [11/19/2007 2:16:39 PM]



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SOUTH MUDDY CREEK TRIBUTARIES

MONITORING APPENDIX A-3 TRIBUTARY C

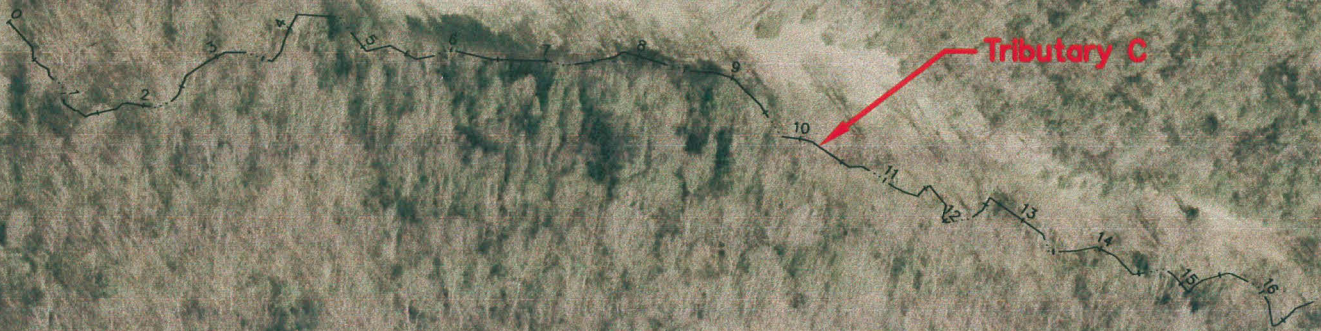
Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix A-1

See Appendix A-2



LEGEND

- High Concern
- Low Concern
- Invasive Population

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MONITORING

APPENDIX A-4 TRIBUTARY A-LOWER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

\\C:\DATA1\PUBLIC\WORKS\PROJECT\20042359\DWG\MONITORING\EXHIBITS\YEAR 2\APPENDIX A1-5.DWG-APPENDIX A-4-4 - NO XREFS - LAST SAVED BY JCRAMER [11/19/2007 2:13:14 PM] - PLOTTED BY JCRAMER [11/19/2007 2:16:50 PM]

See Appendix A-2

Tributary A-Lower

LEGEND

- High Concern
- Low Concern
- Invasive Population

See Appendix A-5



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SOUTH MUDDY CREEK TRIBUTARIES

MONITORING

APPENDIX A-5

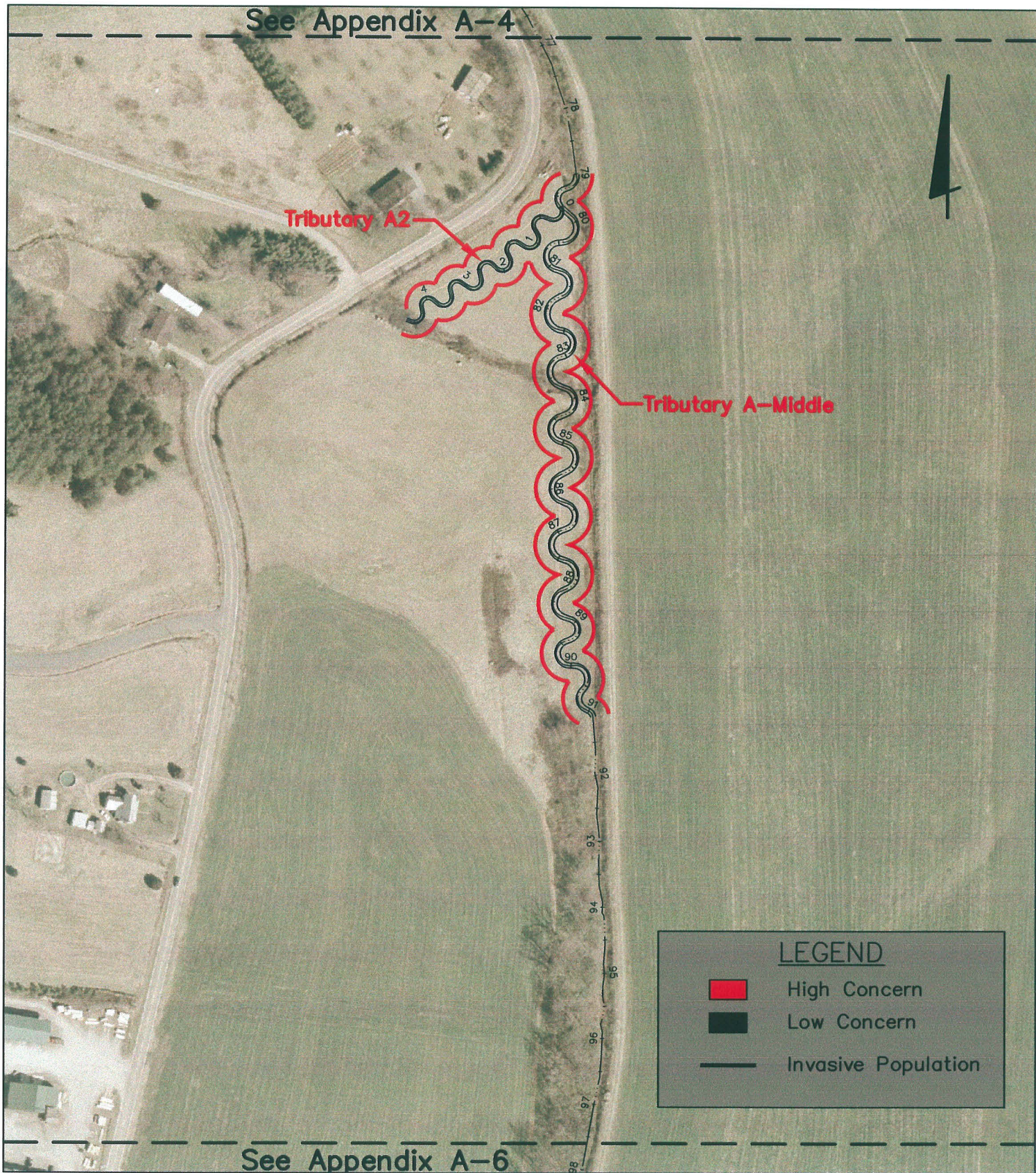
TRIBUTARY A-MIDDLE AND TRIBUTARY A2

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix A-4



LEGEND

- High Concern
- Low Concern
- Invasive Population

See Appendix A-6

\\CMHDATA1\PUBLICWORKS\PROJECT\2004\355\DWG\MONITORING_EXHIBITS\YEAR 2 APPENDIX A1-5.DWG-APPENDIX A-5> - NO XREFS - LAST SAVED BY JCRAMER [11/19/2007 2:13:14 PM] - PLOTTED BY JCRAMER [11/19/2007 2:16:55 PM]



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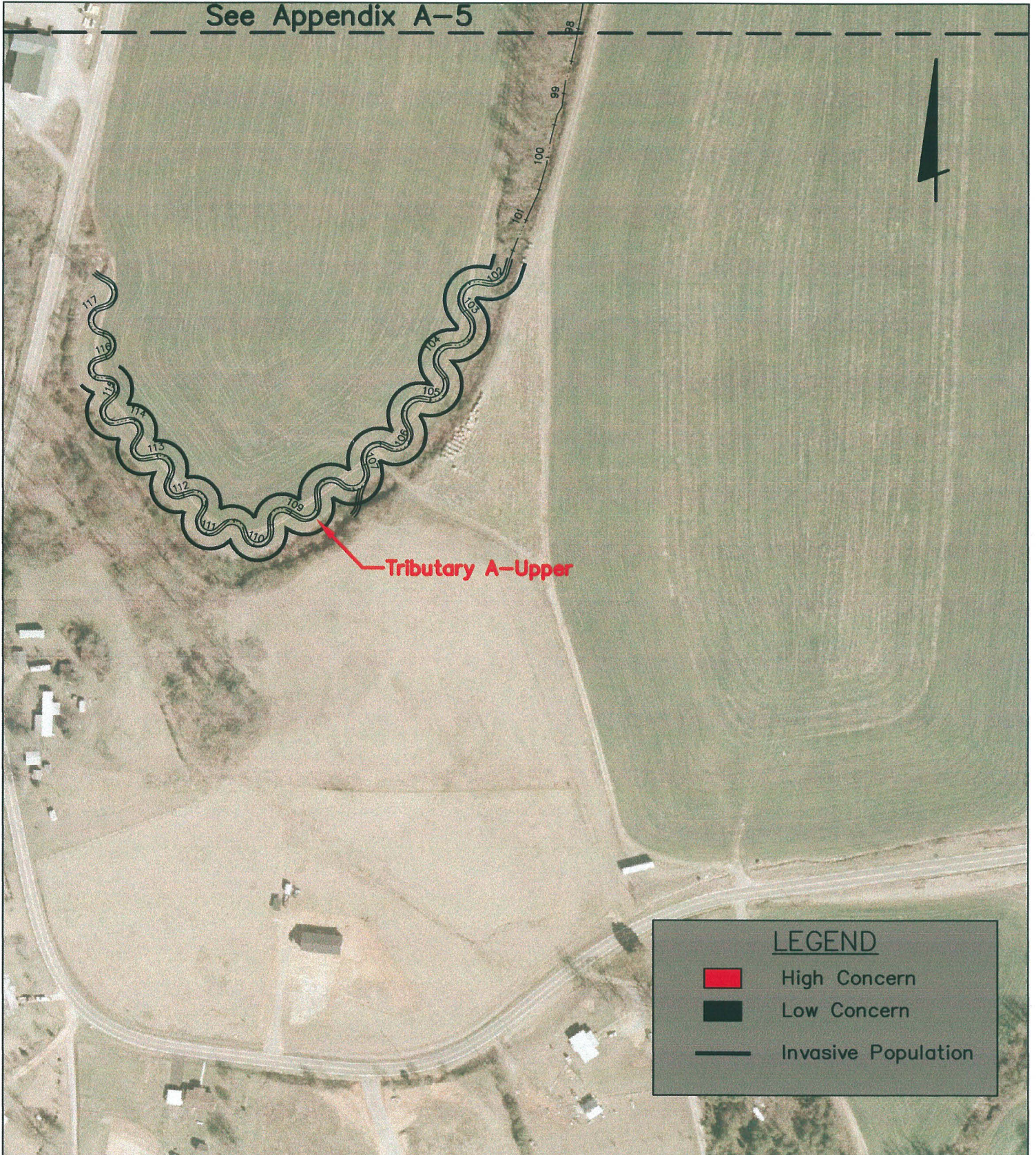
MONITORING
APPENDIX A-6
TRIBUTARY A-UPPER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix A-5



LEGEND

- High Concern
- Low Concern
- Invasive Population

\\CMHDATA1\PUBLICWORKS\PROJECT\2004\2359\DWG\MONITORING EXHIBITS\YEAR 2 APPENDIX A1--S.DWG-APPENDIX A-6-- NO XREFS -- LAST SAVED BY JCRAMER [11/19/2007 2:13:14 PM] -- PLOTTED BY JCRAMER [11/19/2007 2:17:00 PM]



Vegetation Plot 1
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 2
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 3
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 4
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 5
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 6
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 7
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 8
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 9
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 10
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 11
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 12
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 13
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 14
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 15
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 16
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 17
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 18
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 19
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 20
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



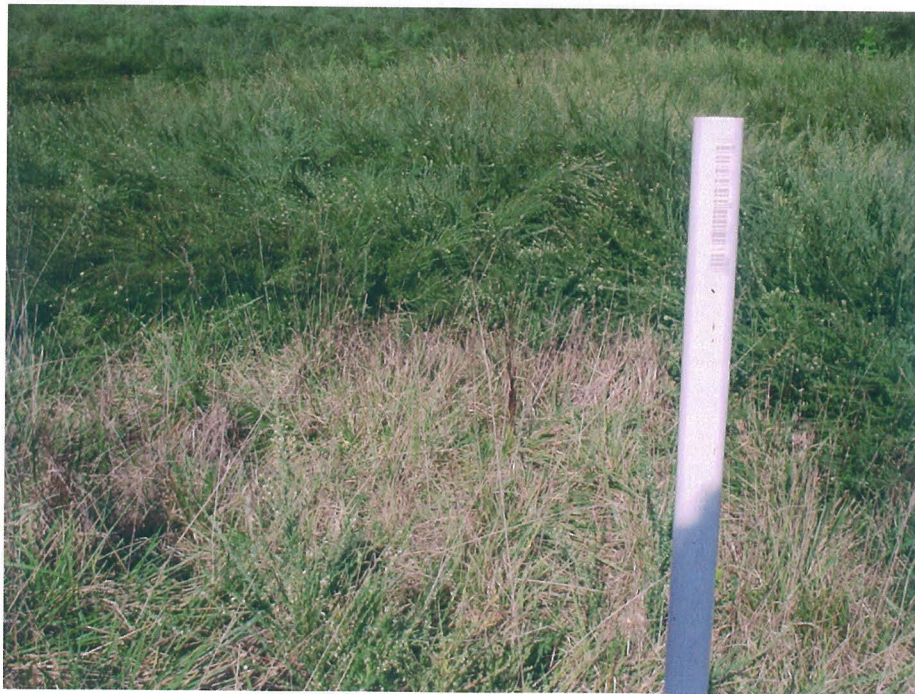
Vegetation Plot 21
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 22
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 23
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 24
Monitoring Year 2
(EMH&T, Inc. 9/17/07)



Vegetation Plot 25
Monitoring Year 2
(EMH&T, Inc. 9/19/07)



Vegetation Plot 26
Monitoring Year 2
(EMH&T, Inc. 9/19/07)



Vegetation Plot 27
Monitoring Year 2
(EMH&T, Inc. 9/19/07)



Vegetation Plot 28
Monitoring Year 2
(EMH&T, Inc. 9/19/07)



Vegetation Plot 29
Monitoring Year 2
(EMH&T, Inc. 9/19/07)



Vegetation Plot 30
Monitoring Year 2
(EMH&T, Inc. 9/19/07)

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	D0400601
project Name	South Muddy Creek
Description	Restoration of tributaries A, A2, B and C of South Muddy Creek
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	30

Table 2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	
	Alnus serrulata	13	3				14	
	Cephalanthus occidentalis	5						
	Cornus amomum	54	11	2			3	
	Fraxinus pennsylvanica	54	11	3	1		1	
	Platanus occidentalis	10	7	3			4	
	Quercus alba	26	6	2			5	
	Quercus pagoda	8	3				4	
	Quercus phellos	10	1	1			2	
	Salix nigra	6						
	Sambucus canadensis	1						
TOT:		10	191	45	13	2	0	33

|

Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Dry	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)	
	<i>Alnus serrulata</i>	16	16										
	<i>Cephalanthus occidentalis</i>	5	5										
	<i>Cornus amomum</i>	67	63	3				1					
	<i>Fraxinus pennsylvanica</i>	69	62	1				4			2		
	<i>Platanus occidentalis</i>	18	16	2									
	<i>Quercus alba</i>	34	32	2									
	<i>Quercus pagoda</i>	11	11										
	<i>Quercus phellos</i>	12	12										
	<i>Salix nigra</i>	6	6										
	<i>Sambucus canadensis</i>	1	1										
TOT:		10	239	224	8	0	0	0	5	0	0	2	0

Table 4. Vegetation Damage by Plot

plot	All Damage Categories		_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)	
	(no damage)											
D0400601-01-0001 (year 2)	13	12					1					
D0400601-01-0002 (year 2)	11	9					2					
D0400601-01-0003 (year 2)	16	15					1					
D0400601-01-0005 (year 2)	10	10										
D0400601-01-0006 (year 2)	12	11								1		
D0400601-01-0007 (year 2)	10	6						4				
D0400601-01-0008 (year 2)	9	5						4				
D0400601-01-0009 (year 2)	13	13										
D0400601-01-0010 (year 2)	9	9										
D0400601-01-0011 (year 2)	14	14										
D0400601-01-0012 (year 2)	11	11										
D0400601-01-0013 (year 2)	10	10										
D0400601-01-0014 (year 2)	5	5										
D0400601-01-0015 (year 2)	10	9					1					
D0400601-01-0016 (year 2)	5	5										
D0400601-01-0017 (year 2)	10	10										
D0400601-01-0018 (year 2)	7	7										
D0400601-01-0019 (year 2)	4	4										
D0400601-01-0020 (year 2)	5	4								1		
D0400601-01-0021 (year 2)	14	14										
D0400601-01-0022 (year 2)	5	5										
D0400601-01-0023 (year 2)	9	9										
D0400601-01-0024 (year 2)	9	7					1			1		
D0400601-01-0025 (year 2)	9	9										
D0400601-01-0026 (year 2)	14	14										
D0400601-01-0027 (year 2)	8	8										
D0400601-01-0028 (year 2)	12	12										
D0400601-01-0029 (year 2)	1	1										
D0400601-01-0030 (year 2)	1	1										
TOT:	30	266	249	0	0	0	0	6	0	8	3	0

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
 8. Bankfull Event Photos



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McDOWELL COUNTY, NORTH CAROLINA
SOUTH MUDDY CREEK TRIBUTARIES

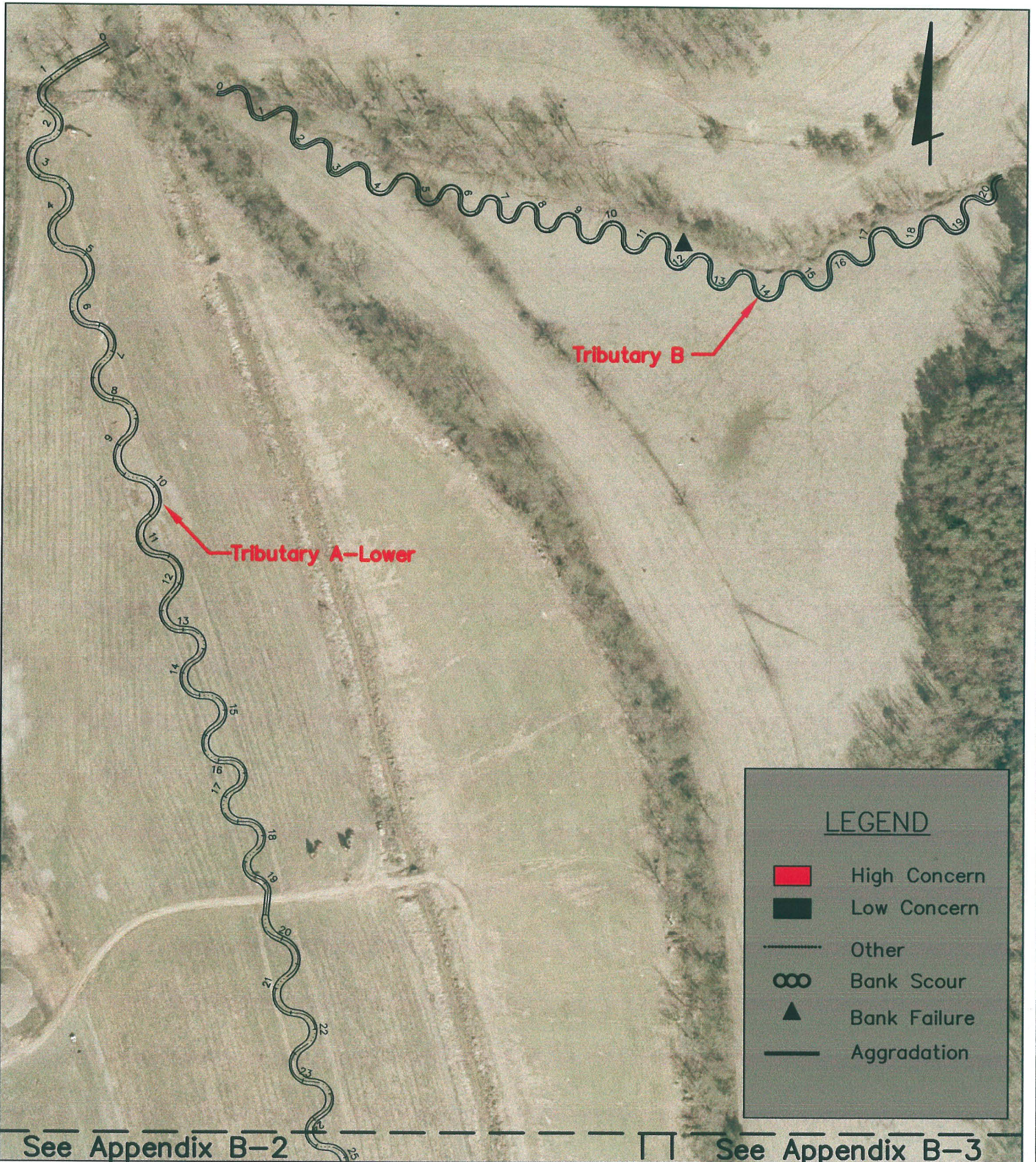
YEAR 2 MONITORING

APPENDIX B-1
TRIBUTARY A - LOWER AND TRIBUTARY B

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'



See Appendix B-2

See Appendix B-3

\\CHADATA1\PUBLICWORKS\PROJECT\20042359\DWG\MONITORING_EXHIBITS\YEAR 2 APPENDIX B1-5.DWG-APPENDIX B-1-5 - NO XREFS - LAST SAVED BY JCRAMER [12/18/2007 4:07:08 PM] - PLOTTED BY JCRAMER [1/24/2008 1:06:41 PM]



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SOUTH MUDDY CREEK TRIBUTARIES

YEAR 2 MONITORING

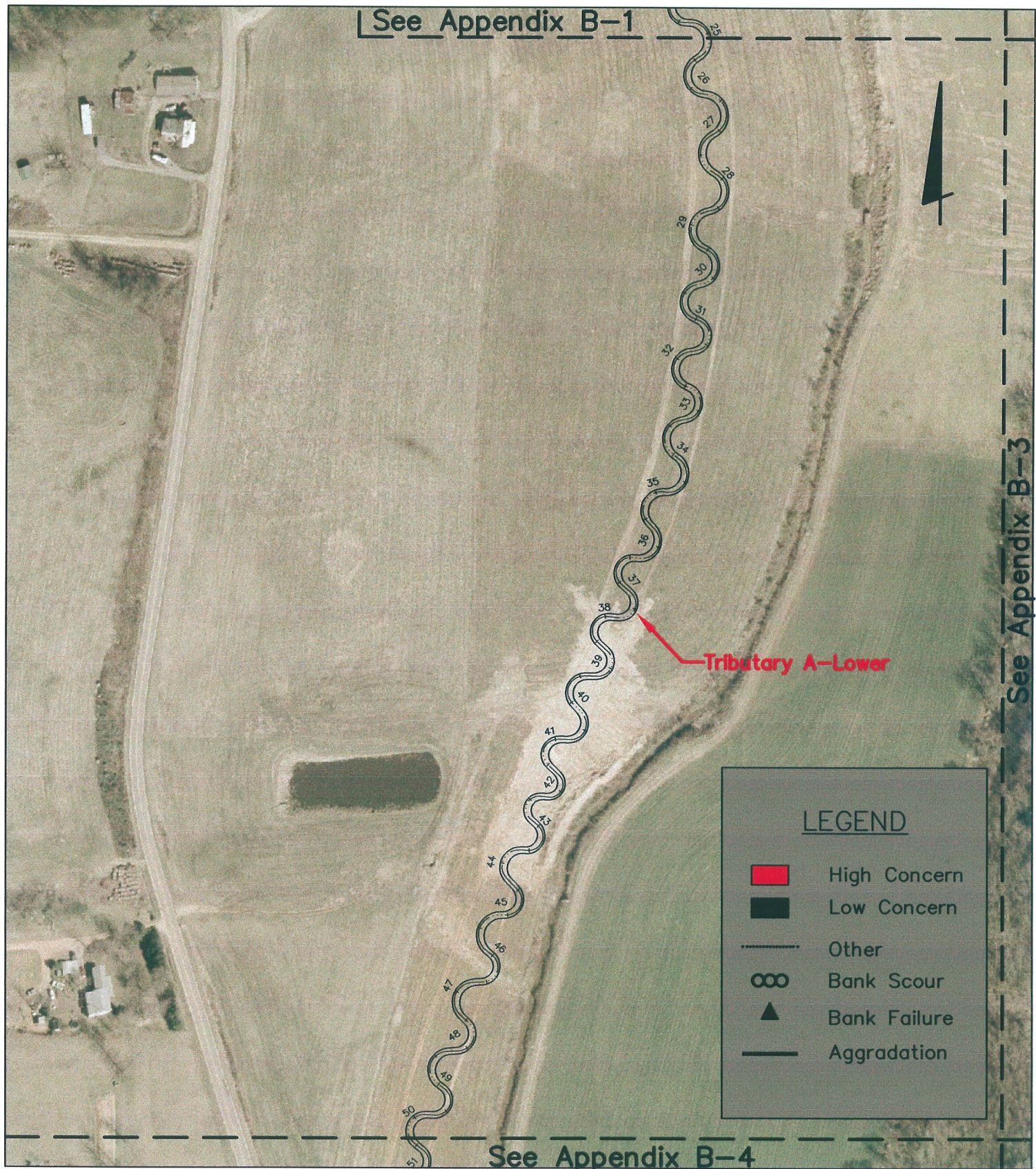
APPENDIX B-2 TRIBUTARY A-LOWER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix B-1



See Appendix B-3

See Appendix B-4

LEGEND

- High Concern
- Low Concern
- Other
- Bank Scour
- Bank Failure
- Aggradation

\\C:\HW\DATA1\PUBLIC\WORKS\PROJECT\2004\2359\DWG\MONITORING\EXHIBITS\YEAR 2\APPENDIX B1-5.DWG-APPENDIX B-2> - NO XREFS - LAST SAVED BY JCRAMER [12/18/2007 3:07:11 PM] - PLOTTED BY JCRAMER [12/18/2007 3:59:34 PM]



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SOUTH MUDDY CREEK TRIBUTARIES

YEAR 2 MONITORING

**APPENDIX B-3
 TRIBUTARY C**

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix B-1

See Appendix B-2



LEGEND

- High Concern
- Low Concern
- Other
- Bank Scour
- Bank Failure
- Aggradation

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SOUTH MUDDY CREEK TRIBUTARIES

YEAR 2 MONITORING

APPENDIX B-4

TRIBUTARY A-LOWER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

\\CMHDATA\PUBLICWORKS\PROJECT\20042359\DWG\MONITORING_EXHIBITS\YEAR_2_APPENDIX_B1-5.DWG<APPENDIX B-4> - NO XREFS - LAST SAVED BY JCRAMER [11/19/2007 2:16:16 PM] - PLOTTED BY JCRAMER [11/19/2007 2:20:21 PM]





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SOUTH MUDDY CREEK TRIBUTARIES

YEAR 2 MONITORING

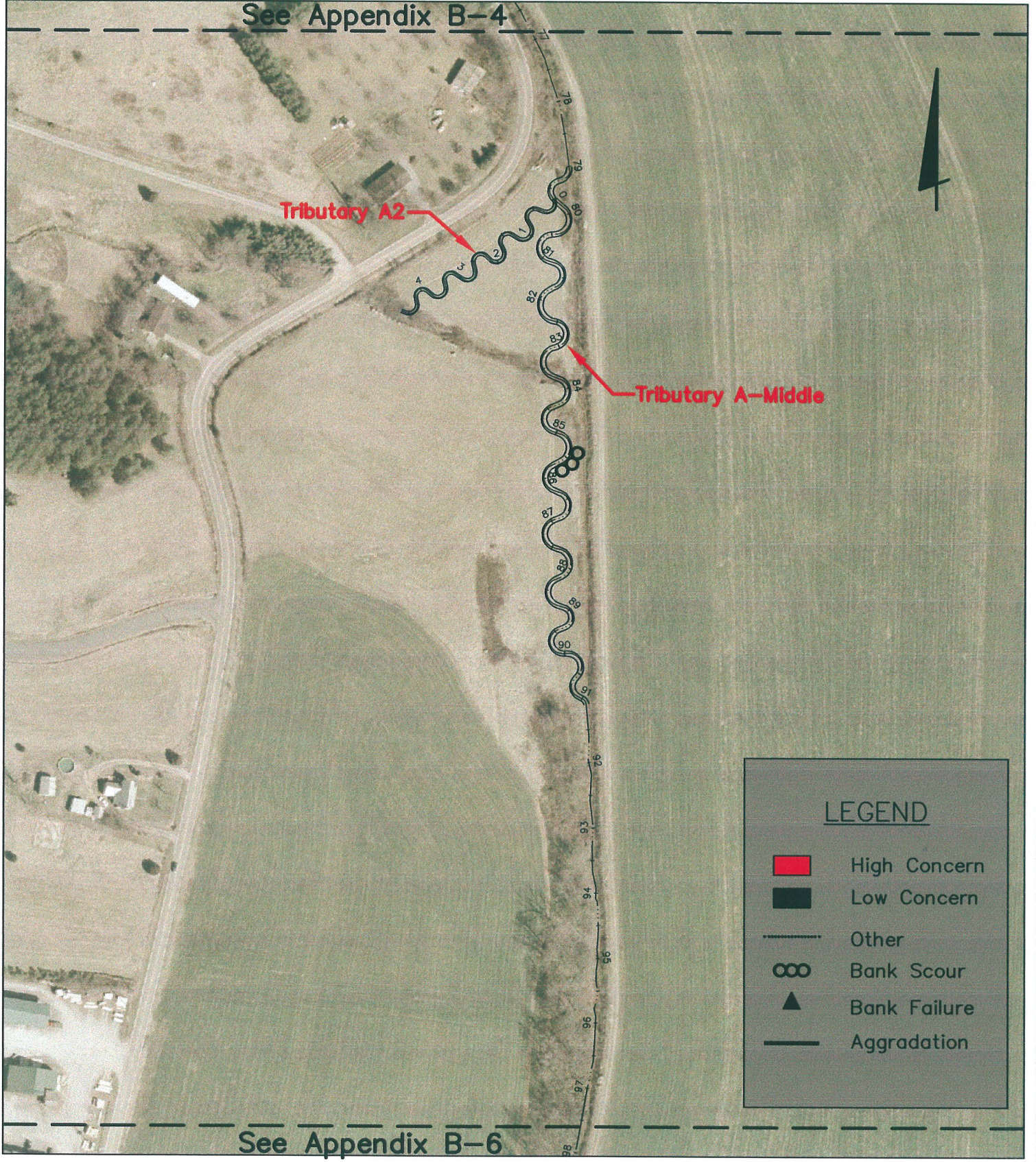
APPENDIX B-5
TRIBUTARY A-MIDDLE AND TRIBUTARY A2

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix B-4



LEGEND

- High Concern
- Low Concern
- Other
- + Bank Scour
- Bank Failure
- Aggradation

See Appendix B-6

\\C:\DATA\1\PROJECTS\2004\2359\DWG\MONITORING EXHIBITS\YEAR 2 APPENDIX B1-5.DWG-APPENDIX B-5- - NO XREFS - LAST SAVED BY JORAMER [11/19/2007 4:48:21 PM] - PLOTTED BY JORAMER [12/19/2007 2:26:44 PM]



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SOUTH MUDDY CREEK TRIBUTARIES

YEAR 2 MONITORING

APPENDIX B-6 TRIBUTARY A-UPPER

Date: December, 2007

Job No. 2006-1627

Scale: 1" = 500'

See Appendix B-5



\\CHW\DATA1\PUBLIC\WORKS\PROJECT\20042359\DWG\MONITORING EXHIBITS\YEAR 2 APPENDIX B1-5.DWG-APPENDIX B-6 - NO XREFS - LAST SAVED BY JCRAMER [11/19/2007 2:16:16 PM] - PLOTTED BY JCRAMER [11/19/2007 2:20:29 PM]



SPA 1

Bank failure along Tributary B at station 12+10. Buffer vegetation is obscuring the erosion.
(EMH&T, Inc. 10/23/07)



SPA 2

Bank scour along Tributary C at station 15+70.
(EMH&T, Inc. 10/23/07)



Fixed Station 1
Overview of Tributary A (upper), facing upstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 2
Overview of valley along confluence of Tributary A2 with Tributary A, facing upstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 3

Overview of valley along Tributary A (lower) near station 31+50, facing downstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 4

Overview of valley along Tributary A (lower) near station 31+50, facing upstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 5
Overview of valley on Tributary A (lower) at large culvert, facing upstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 6
Overview of valley on Tributary A (lower) at large culvert, facing downstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 7
Overview of valley along Tributary B, facing upstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 8
Overview of valley along Tributary B, facing downstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 9
Overview of valley along Tributary C near station 6+50, facing downstream.
(EMH&T, Inc. 10/23/07)



Fixed Station 10
Overview of valley along Tributary C near station 8+60, facing downstream.
(EMH&T, Inc. 10/23/07)

Table B1. Visual Morphological Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: A (upper)

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?	24	24	N/A	100	
	2. Armor stable (e.g. no displacement)?	24	24	N/A	100	
	3. Facet grade appears stable?	24	24	N/A	100	
	4. Minimal evidence of embedding/fining?	24	24	N/A	100	
	5. Length appropriate?	24	24	N/A	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	25	25	N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	25	25	N/A	100	
	3. Length appropriate?	25	25	N/A	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?	24	25	1	96	
	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	99%
E. Bed General	1. General 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?	N/A	N/A	0	N/A	
	2. Height appropriate?	N/A	N/A	0	N/A	
	3. Angle and geometry appear appropriate?	N/A	N/A	0	N/A	
	4. Free of piping or other structural failures?	N/A	N/A	0	N/A	N/A
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	0	N/A	
	2. Footing stable?	N/A	N/A	0	N/A	N/A

Table B1. Visual Morphological Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: A (middle)

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?	18	18	N/A	100	
	2. Armor stable (e.g. no displacement)?	18	18	N/A	100	
	3. Facet grade appears stable?	18	18	N/A	100	
	4. Minimal evidence of embedding/fining?	18	18	N/A	100	
	5. Length appropriate?	18	18	N/A	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	19	19	N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	19	19	N/A	100	
	3. Length appropriate?	19	19	N/A	100	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	19	19	0	100	
	2. Downstream of meander (glide/inflection) centering?	19	19	0	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	18	19	1	95	
	2. Of those eroding, # w/concomitant point bar formation?	19	19	0	100	
	3. Apparent Rc within spec?	19	19	0	100	
	4. Sufficient floodplain access and relief?	19	19	0	100	99%
E. Bed General	1. General 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?	N/A	0	N/A	N/A	
	2. Height appropriate?	N/A	0	N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	0	N/A	N/A	
	4. Free of piping or other structural failures?	N/A	0	N/A	N/A	N/A
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
 South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
 Segment/Reach: A (lower)

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?	93	93	N/A	100	
	2. Armor stable (e.g. no displacement)?	93	93	N/A	100	
	3. Facet grade appears stable?	93	93	N/A	100	
	4. Minimal evidence of embedding/fining?	93	93	N/A	100	
	5. Length appropriate?	93	93	N/A	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	95	95	N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bkt>1.6?)	95	95	N/A	100	
	3. Length appropriate?	95	95	N/A	100	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	95	95	0	100	
	2. Downstream of meander (glide/inflection) centering?	95	95	0	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	94	95	1	98	
	2. Of those eroding, # w/concomitant point bar formation?	95	95	0	100	
	3. Apparent Rc within spec?	95	95	0	100	
	4. Sufficient floodplain access and relief?	95	95	0	100	99%
E. Bed General	1. General channel bed aggradation areas (bar formation) or headcutting?	N/A	N/A	0/ 0 feet	100	
	2. Channel bed degradation - areas of increasing downcutting?	N/A	N/A	0/ 0 feet	100	100%
F. Vanes	1. Free of back or arm scour?	N/A	0	N/A	N/A	
	2. Height appropriate?	N/A	0	N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	0	N/A	N/A	
G. Wads/ Boulders	4. Free of piping or other structural failures?	N/A	0	N/A	N/A	N/A
	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
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: A2

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?	7	7	0	100	
	2. Armor stable (e.g. no displacement)?	7	7	0	100	
	3. Facet grade appears stable?	7	7	0	100	
	4. Minimal evidence of embedding/fining?	7	7	0	100	
	5. Length appropriate?	7	7	0	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	7	7	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	7	7	0	100	
	3. Length appropriate?	7	7	0	100	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	11	11	0	100	
	2. Downstream of meander (glide/inflection) centering?	11	11	0	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	11	11	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	11	11	0	100	
	3. Apparent Rc within spec?	11	11	0	100	
	4. Sufficient floodplain access and relief?	11	11	0	100	100%
E. Bed General	1. General 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?	N/A	N/A	0 N/A	N/A	
	2. Height appropriate?	N/A	N/A	0 N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	N/A	0 N/A	N/A	
	4. Free of piping or other structural failures?	N/A	N/A	0 N/A	N/A	N/A
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	0 N/A	N/A	
	2. Footing stable?	N/A	N/A	0 N/A	N/A	N/A

Table B1. Visual Morphological Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: B

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?	22	23	1	96	
	2. Armor stable (e.g. no displacement)?	23	23	0	100	
	3. Facet grade appears stable?	23	23	0	100	
	4. Minimal evidence of embedding/fining?	23	23	0	100	
	5. Length appropriate?	23	23	0	100	99%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	23	23	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkt>1.6?)	23	23	0	100	
	3. Length appropriate?	23	23	0	100	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	36	36	0	100	
	2. Downstream of meander (glide/inflection) centering?	36	36	0	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	34	36	2	94	
	2. Of those eroding, # w/concomitant point bar formation?	36	36	0	100	
	3. Apparent Rc within spec?	36	36	0	100	
	4. Sufficient floodplain access and relief?	35	36	1	97	98%
E. Bed General	1. General 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?	N/A	0	N/A	N/A	
	2. Height appropriate?	N/A	0	N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	0	N/A	N/A	
	4. Free of piping or other structural failures?	N/A	0	N/A	N/A	N/A
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
H. Log Sills	1. Maintaining grade control?	14	14	0	100	
	2. Minimal evidence of sedimentation in adjacent pool?	14	14	0	100	100%

Table B1. Visual Morphological Stability Assessment
South Muddy Creek Tributaries Restoration / EEP Project No. D04006-01
Segment/Reach: C

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?	33	33	33 N/A	100	
	2. Armor stable (e.g. no displacement)?	33	33	33 N/A	100	
	3. Facet grade appears stable?	33	33	33 N/A	100	
	4. Minimal evidence of embedding/fining?	33	33	33 N/A	100	
	5. Length appropriate?	33	33	33 N/A	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	34	34	34 N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bk<1.6?)	34	34	34 N/A	100	
	3. Length appropriate?	34	34	34 N/A	100	100%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	19	19	19	0	
	2. Downstream of meander (glide/inflection) centering?	19	19	19	0	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	32	34	34	2	94
	2. Of those eroding, # w/concomitant point bar formation?	34	34	34	0	100
	3. Apparent Rc within spec?	34	34	34	0	100
	4. Sufficient floodplain access and relief?	33	34	34	1	97
E. Bed General	1. General 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?	N/A	N/A	0 N/A	N/A	
	2. Height appropriate?	N/A	N/A	0 N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	N/A	0 N/A	N/A	
	4. Free of piping or other structural failures?	N/A	N/A	0 N/A	N/A	N/A
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	0 N/A	N/A	
	2. Footing stable?	N/A	N/A	0 N/A	N/A	N/A

Summary Data

Bankfull Area 11.19 ft²
 Bankfull Width 12.24 ft
 Mean Depth 0.91 ft
 Maximum Depth 1.52 ft
 Width/Depth Ratio 13.45
 Entrenchment Ratio 3.2
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

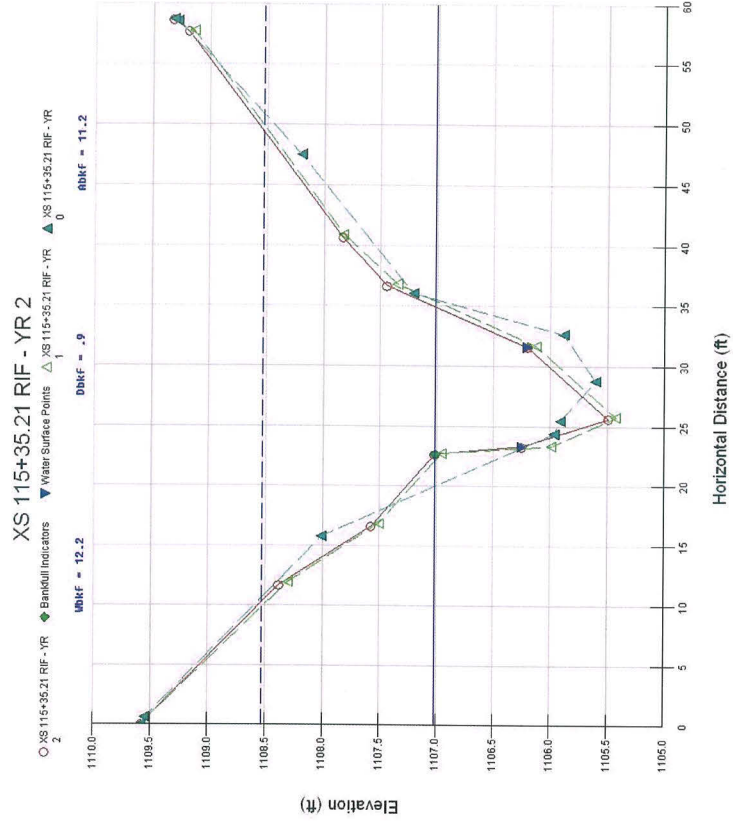
TASK Cross-Section
REACH A Upper
DATE 10/23/07



CROSS SECTION: 115+35
FEATURE: Riffle



Cross-section photo – looking downstream



Summary Data

Bankfull Area 10.89 ft²
 Bankfull Width 11.55 ft
 Mean Depth 0.94 ft
 Maximum Depth 1.84 ft
 Width/Depth Ratio 12.29
 Entrenchment Ratio 4.93
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

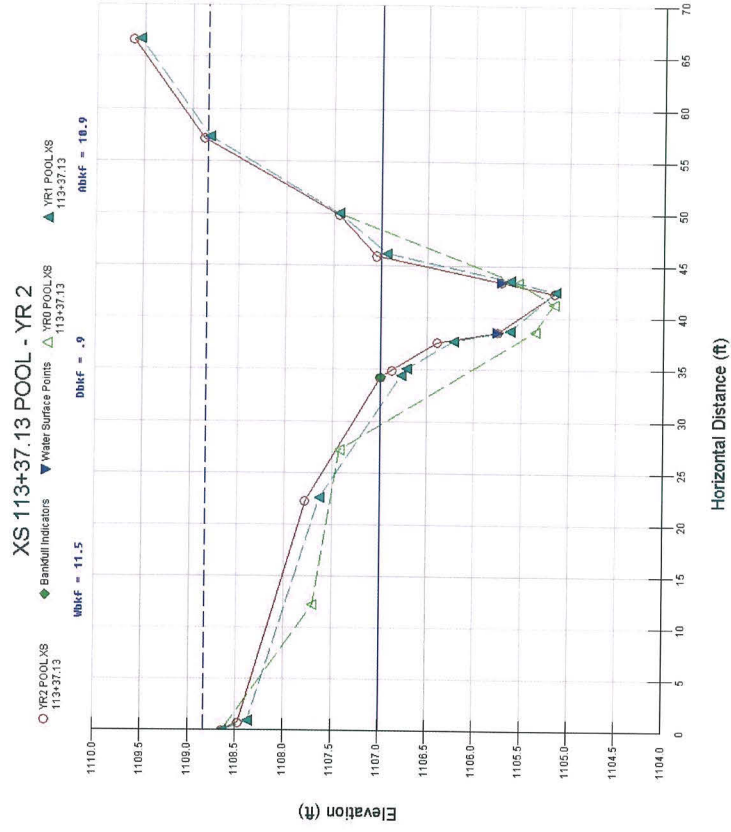
TASK Cross-Section
REACH A Upper
DATE 10/23/07



CROSS SECTION: 113+37
FEATURE: Pool



Cross-section photo – looking downstream



Summary Data

Bankfull Area 3.64 ft²
 Bankfull Width 5.58 ft
 Mean Depth 0.65 ft
 Maximum Depth 1.37 ft
 Width/Depth Ratio 8.58
 Entrenchment Ratio 4.79
 Classification E

PROJECT South Muddy

D04006-1

2-YEAR

TASK Cross-Section

REACH A Upper

DATE 10/23/07

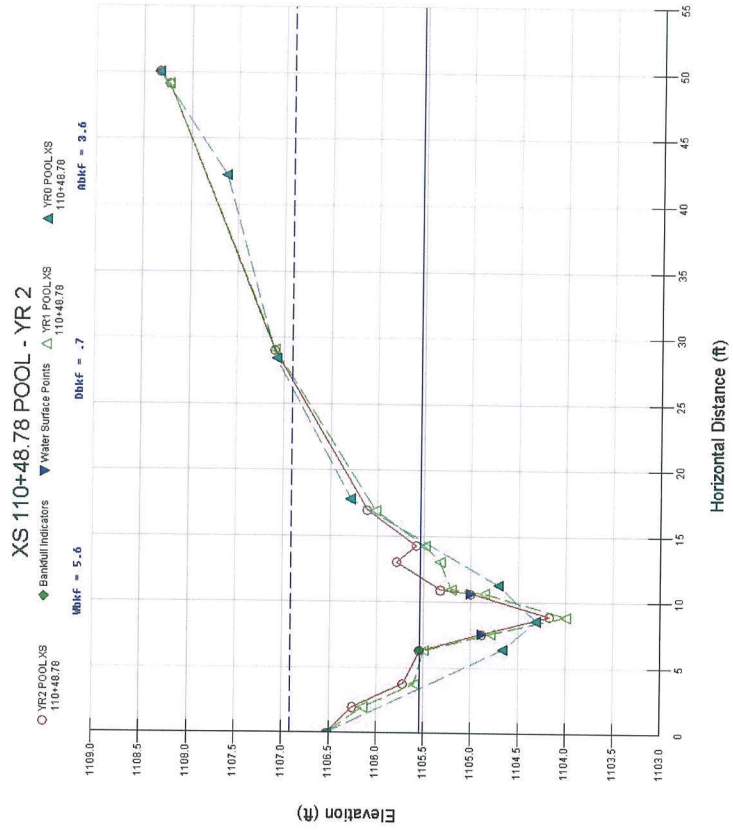


CROSS SECTION: 110+48

FEATURE: Pool



Cross-section photo – looking downstream



Summary Data

Bankfull Area 17.78 ft²
 Bankfull Width 20.2 ft
 Mean Depth 0.88 ft
 Maximum Depth 2.23 ft
 Width/Depth Ratio 22.95
 Entrenchment Ratio 3.2
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

TASK Cross-Section
REACH A Upper
DATE 10/23/07

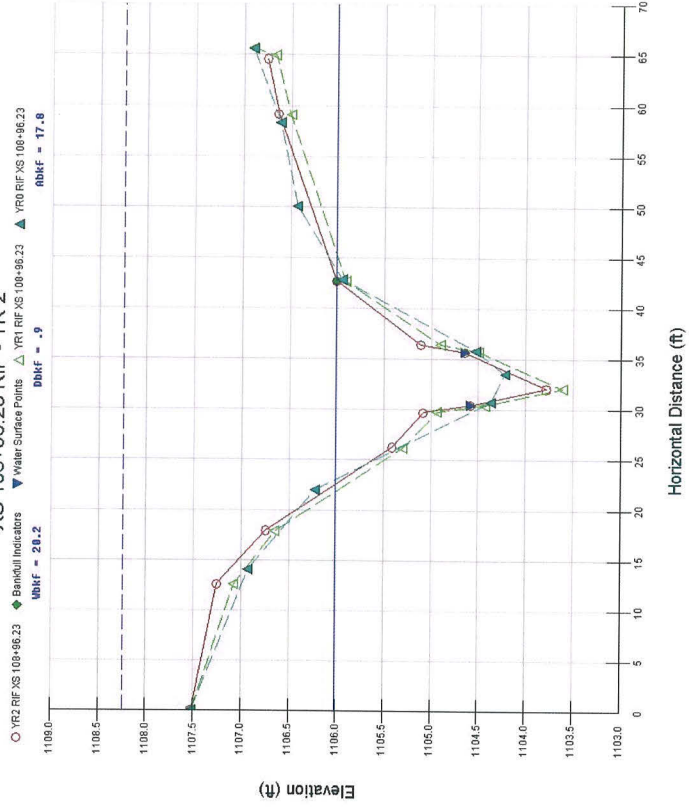


CROSS SECTION: 108+96
FEATURE: Riffle



Cross-section photo – looking downstream

XS 108+96.23 RIF - YR 2



Summary Data

Bankfull Area 7.55 ft²
 Bankfull Width 10.94 ft
 Mean Depth 0.69 ft
 Maximum Depth 1.47 ft
 Width/Depth Ratio 15.86
 Entrenchment Ratio 4.58
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

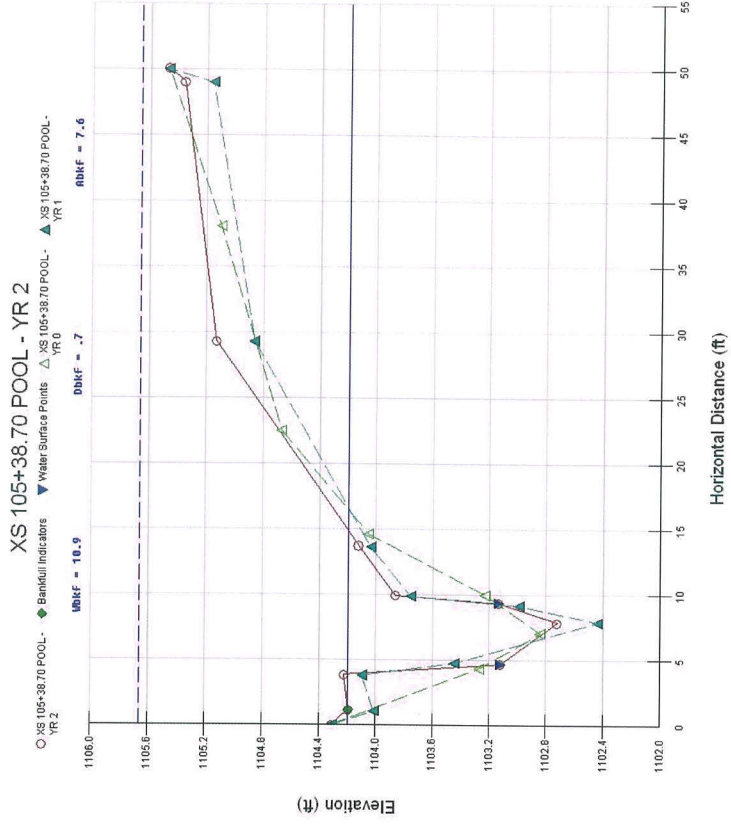
TASK Cross-Section
REACH A Upper
DATE 10/23/07



CROSS SECTION: 105+38
FEATURE: Pool



**Cross-section photo – looking downstream
 Channel is obscured by vegetation.**



Summary Data

Bankfull Area 9.08 ft²
 Bankfull Width 10.73 ft
 Mean Depth 0.85 ft
 Maximum Depth 1.56 ft
 Width/Depth Ratio 12.62
 Entrenchment Ratio 4.8
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

Cross-Section

REACH

A Upper

DATE

10/23/07



CROSS SECTION:

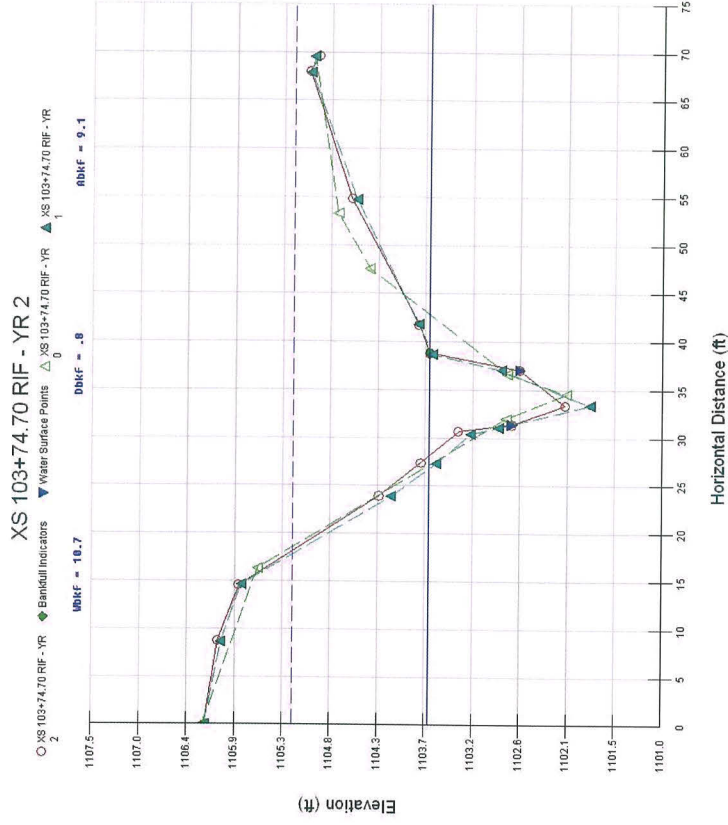
103+74

FEATURE:

Riffle



Cross-section photo – looking downstream



Summary Data

Bankfull Area 16.33 ft²
 Bankfull Width 16.36 ft
 Mean Depth 1 ft
 Maximum Depth 1.88 ft
 Width/Depth Ratio 16.36
 Entrenchment Ratio 3.51
 Classification C

PROJECT South Muddy

D04006-1

2-YEAR

TASK Cross-Section

REACH A Middle

DATE 10/23/07

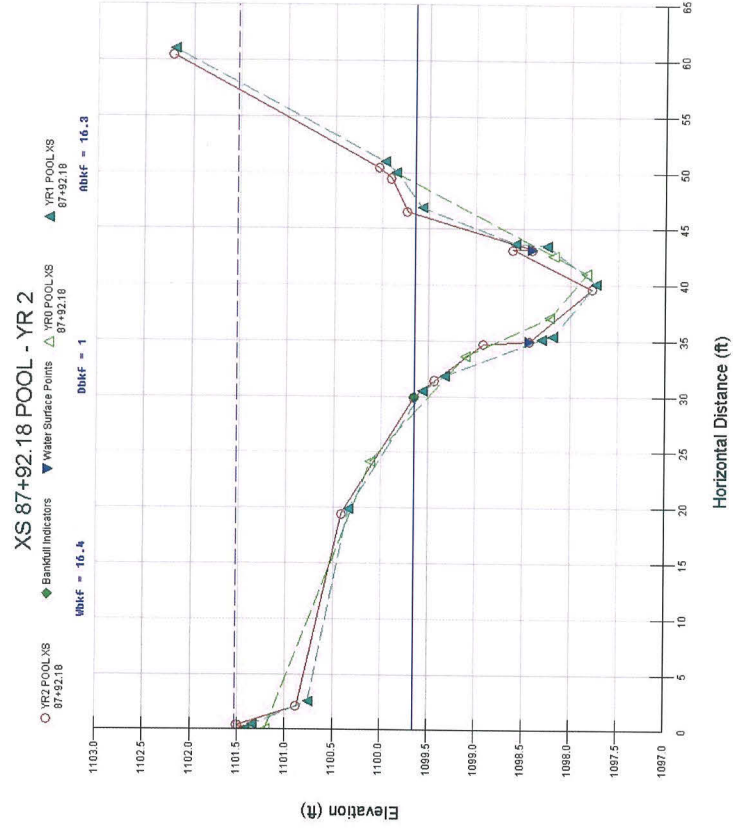


CROSS SECTION: 87+92

FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 15.35 ft²
 Bankfull Width 14.68 ft
 Mean Depth 1.05 ft
 Maximum Depth 2.11 ft
 Width/Depth Ratio 13.98
 Entrenchment Ratio 4.18
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

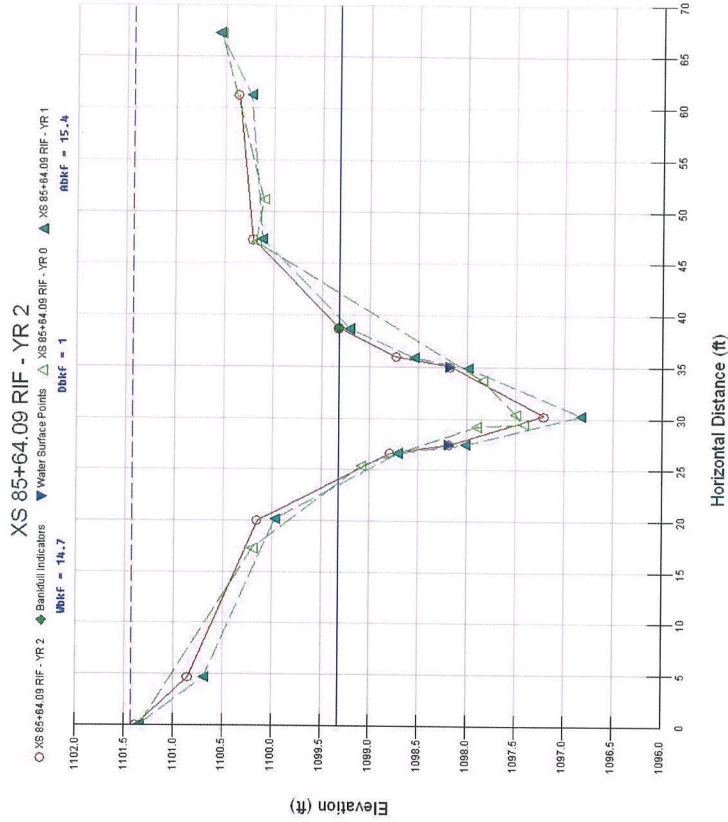
TASK Cross-Section
REACH A Middle
DATE 10/23/07



CROSS SECTION: 85+64
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 8.11 ft²
 Bankfull Width 9.97 ft
 Mean Depth 0.81 ft
 Maximum Depth 1.78 ft
 Width/Depth Ratio 12.31
 Entrenchment Ratio 5.7
 Classification C

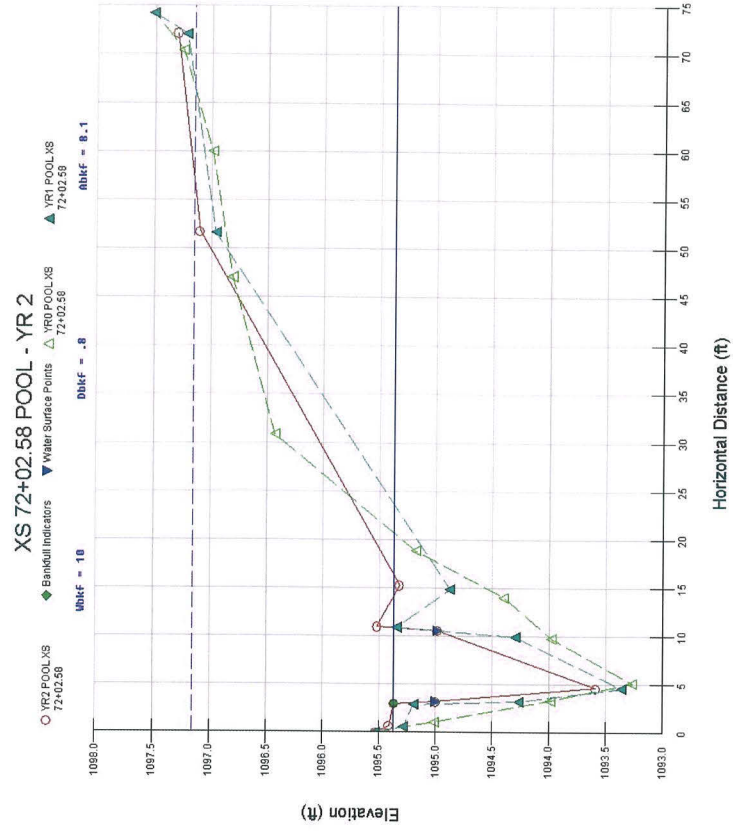
PROJECT South Muddy
 D04006-1
 2-YEAR

TASK Cross-Section
REACH A Lower
DATE 10/23/07

CROSS SECTION: 72+02
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 12.24 ft²
 Bankfull Width 15.22 ft
 Mean Depth 0.8 ft
 Maximum Depth 1.79 ft
 Width/Depth Ratio 19.02
 Entrenchment Ratio 3.39
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

Cross-Section

REACH

A Lower

DATE

10/23/07



CROSS SECTION:

70+96

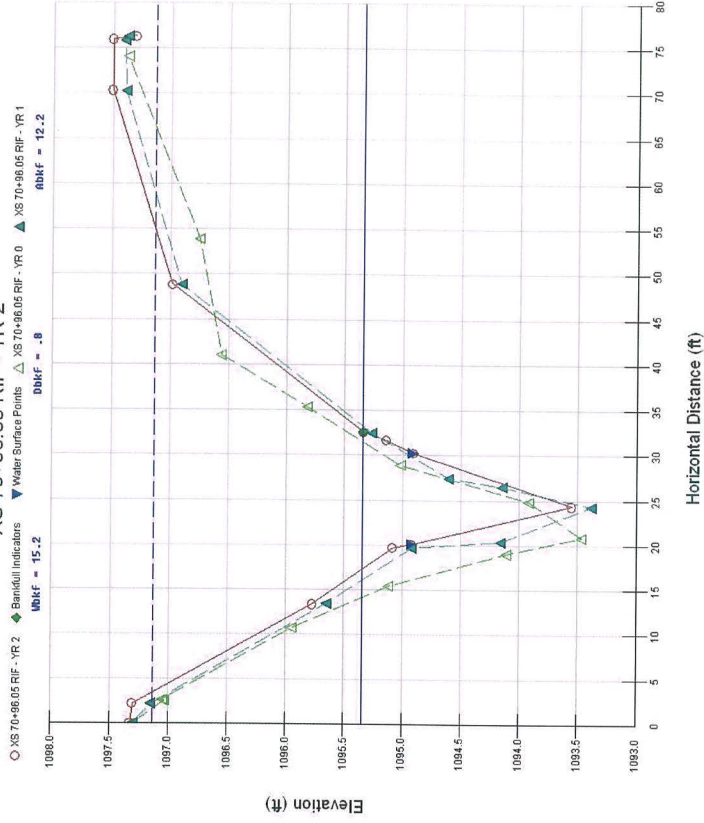
FEATURE:

Riffle



Cross section photo – looking downstream
 Channel is obscured by vegetation.

XS 70+96.05 RIF - YR 2



Summary Data

Bankfull Area 6.92 ft²
 Bankfull Width 12.84 ft
 Mean Depth 0.54 ft
 Maximum Depth 1.23 ft
 Width/Depth Ratio 23.78
 Entrenchment Ratio 2.75
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

REACH A Lower
 DATE 10/23/07

Cross-Section

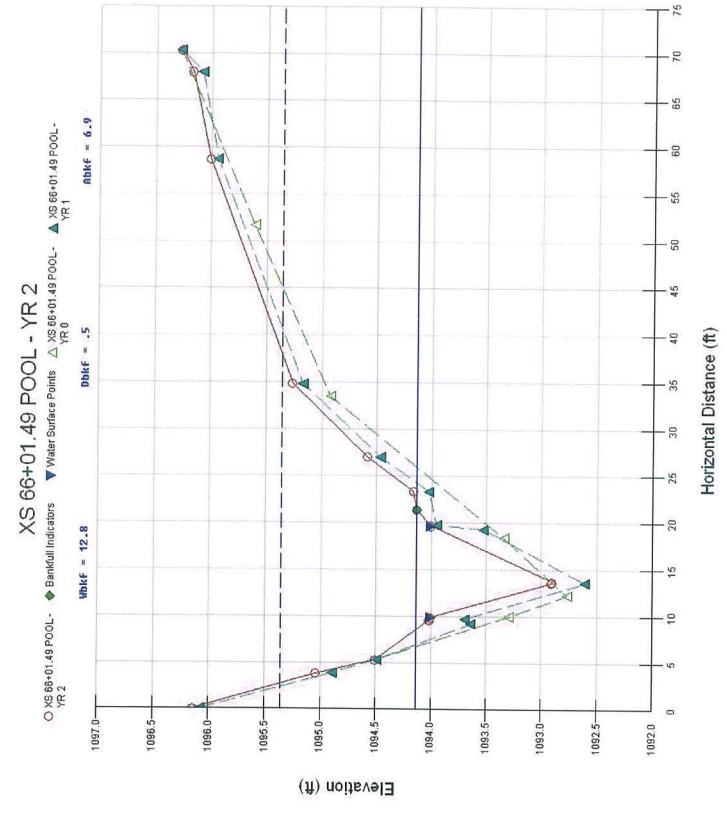
66+01



CROSS SECTION: 66+01
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 17.12 ft²
 Bankfull Width 18.87 ft
 Mean Depth 0.91 ft
 Maximum Depth 1.91 ft
 Width/Depth Ratio 20.74
 Entrenchment Ratio 2.64
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

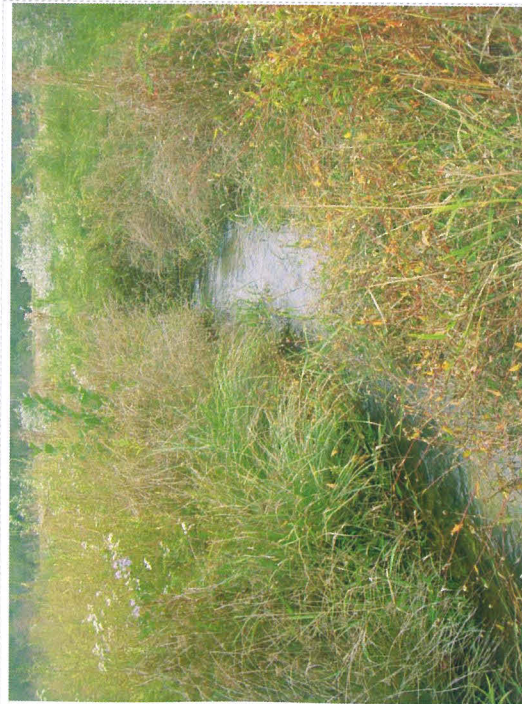
TASK

REACH A Lower
 DATE 10/23/07

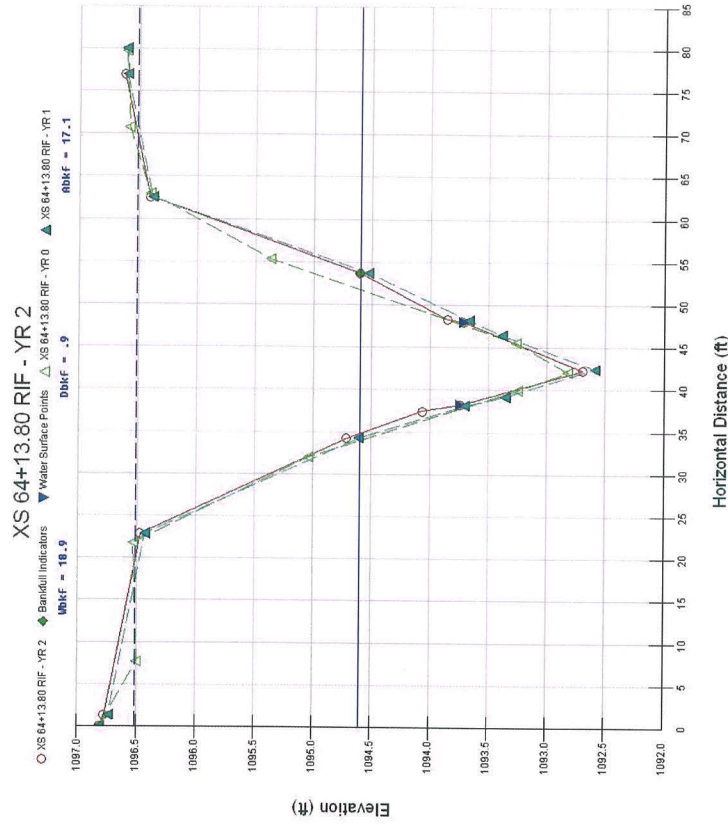
Cross-Section



CROSS SECTION: 64+13
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 9.67 ft²
 Bankfull Width 13.93 ft
 Mean Depth 0.69 ft
 Maximum Depth 1.92 ft
 Width/Depth Ratio 20.19
 Entrenchment Ratio 2.39
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

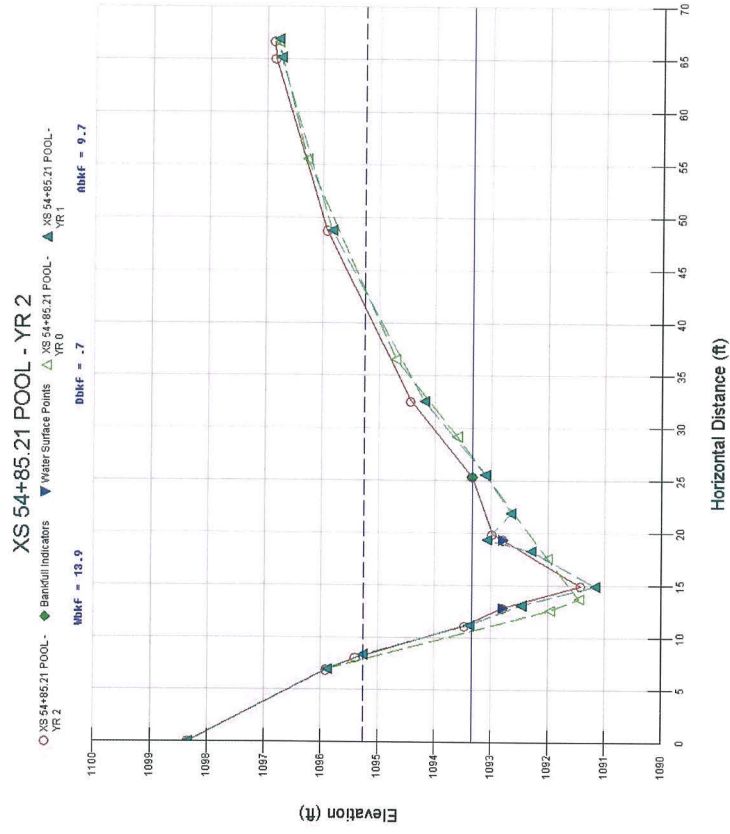
Cross-Section
 A Lower
 10/23/07



CROSS SECTION: 54+85
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 15.8 ft²
 Bankfull Width 20.89 ft
 Mean Depth 0.76 ft
 Maximum Depth 1.34 ft
 Width/Depth Ratio 27.49
 Entrenchment Ratio 1.84
 Classification B

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

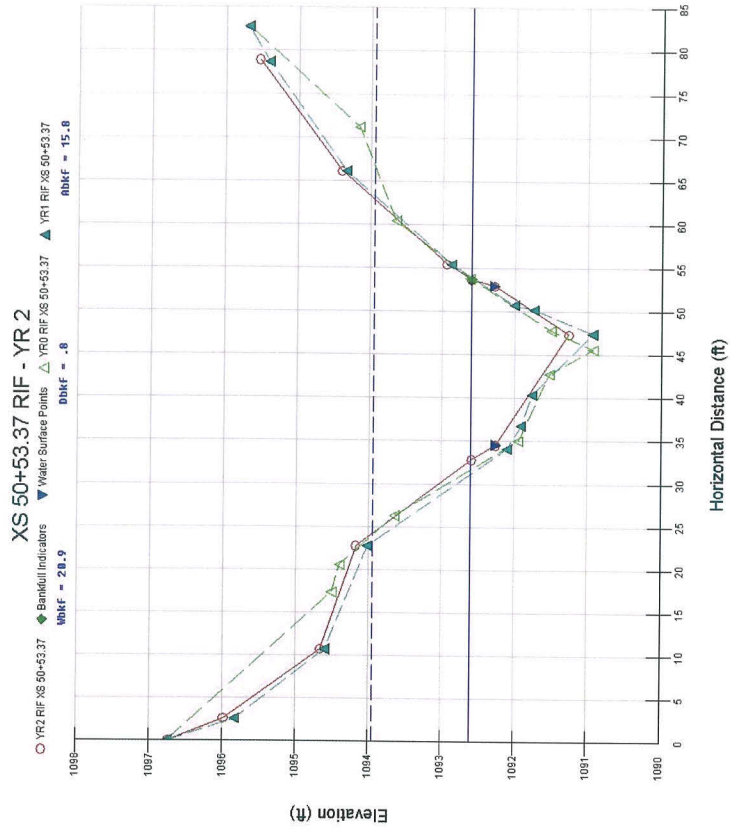
REACH A Lower
 DATE 10/23/07

Cross-Section

50+53
 CROSS SECTION: 50+53
 FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 16.56 ft²
 Bankfull Width 14.99 ft
 Mean Depth 1.1 ft
 Maximum Depth 2.87 ft
 Width/Depth Ratio 13.63
 Entrenchment Ratio 4.32
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

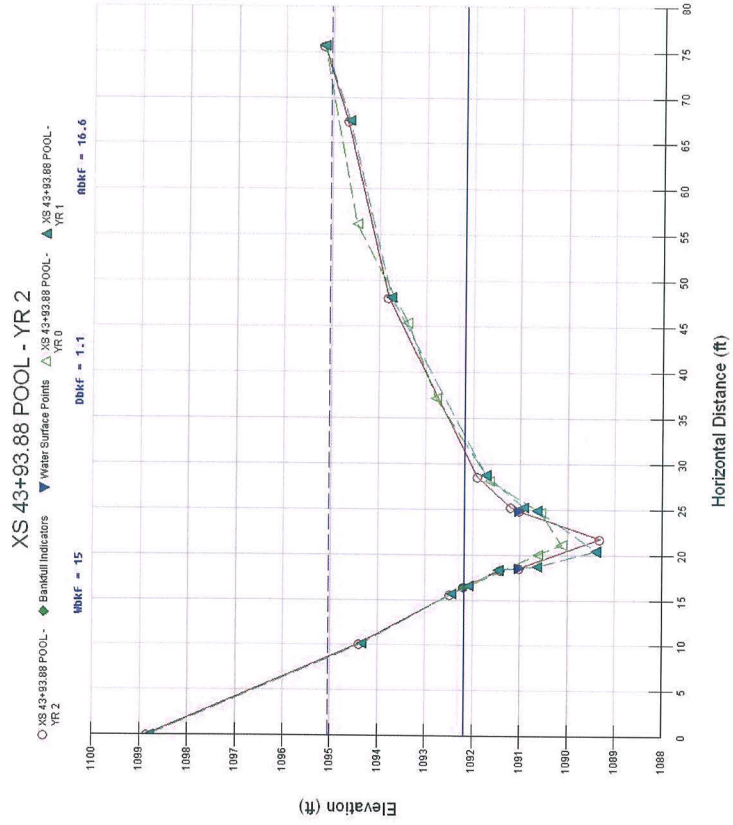
Cross-Section
 A Lower
 10/23/07



CROSS SECTION: 43+93
FEATURE: Pool



Cross section photo – looking downstream
Channel is obscured by vegetation.



Summary Data

Bankfull Area 20.36 ft²
 Bankfull Width 20.44 ft
 Mean Depth 1 ft
 Maximum Depth 2.12 ft
 Width/Depth Ratio 20.44
 Entrenchment Ratio 2.53
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

REACH
 DATE

Cross-Section

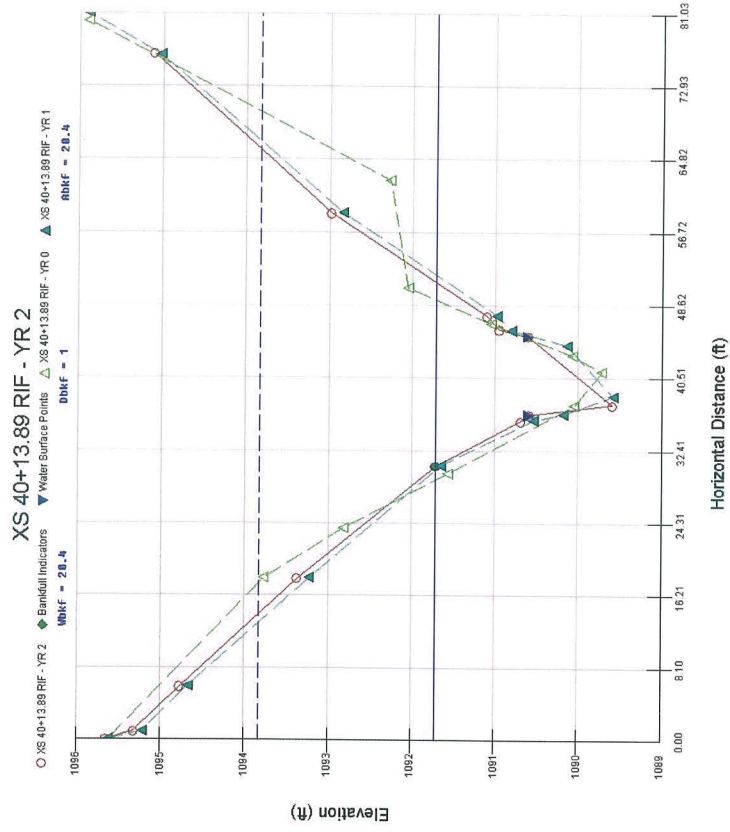
A Lower
 10/23/07



CROSS SECTION: 40+13
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

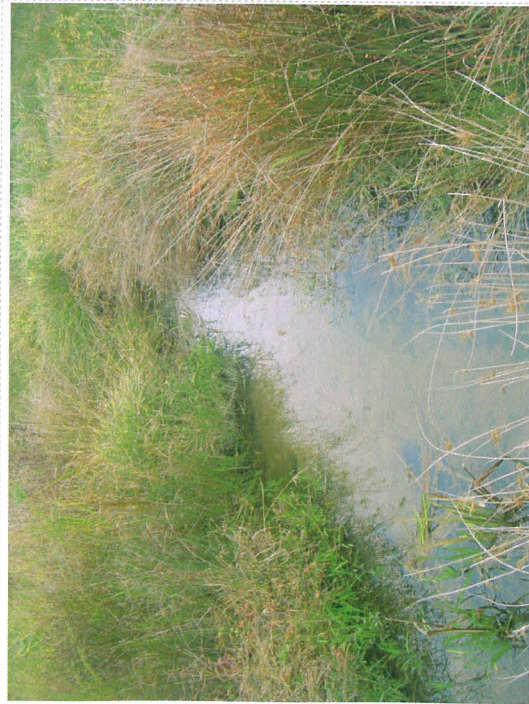
Bankfull Area 12.72 ft²
 Bankfull Width 15.79 ft
 Mean Depth 0.81 ft
 Maximum Depth 1.93 ft
 Width/Depth Ratio 19.49
 Entrenchment Ratio 3.44
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

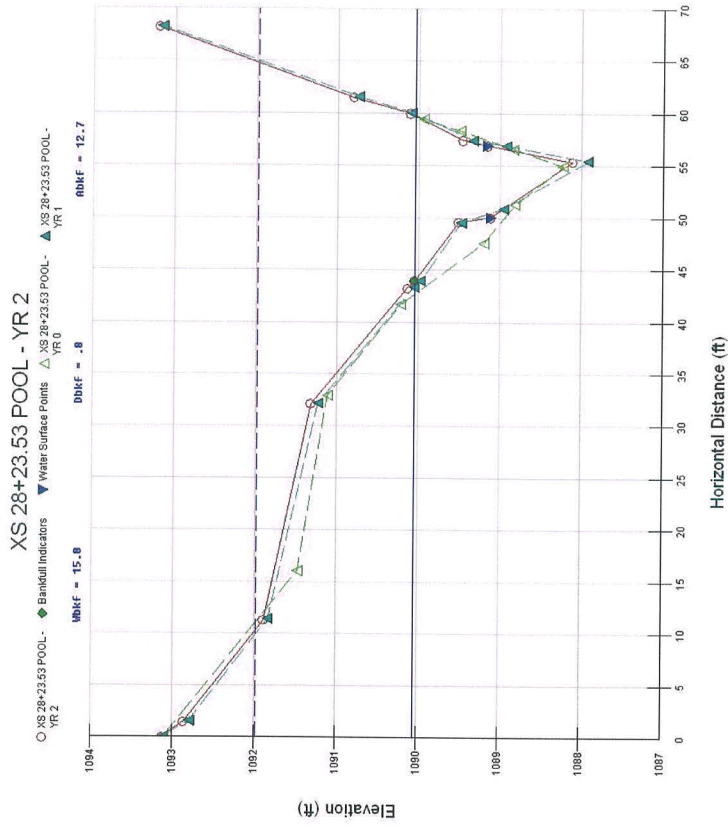
TASK Cross-Section
REACH A Lower
DATE 10/23/07



CROSS SECTION: 28+23
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 6.68 ft²
 Bankfull Width 14.57 ft
 Mean Depth 0.46 ft
 Maximum Depth 1.13 ft
 Width/Depth Ratio 31.67
 Entrenchment Ratio 2.24
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

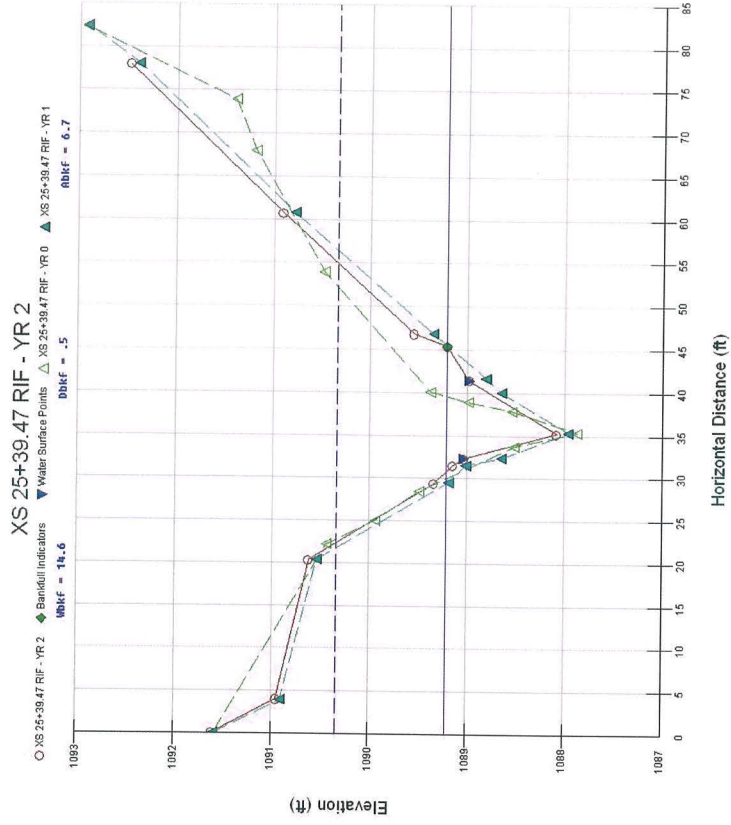
TASK Cross-Section
REACH A Lower
DATE 10/23/07



CROSS SECTION: 25+39
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 5.34 ft²
 Bankfull Width 12.2 ft
 Mean Depth 0.44 ft
 Maximum Depth 1.11 ft
 Width/Depth Ratio 27.73
 Entrenchment Ratio 2.29
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

REACH A Lower
 DATE 10/23/07

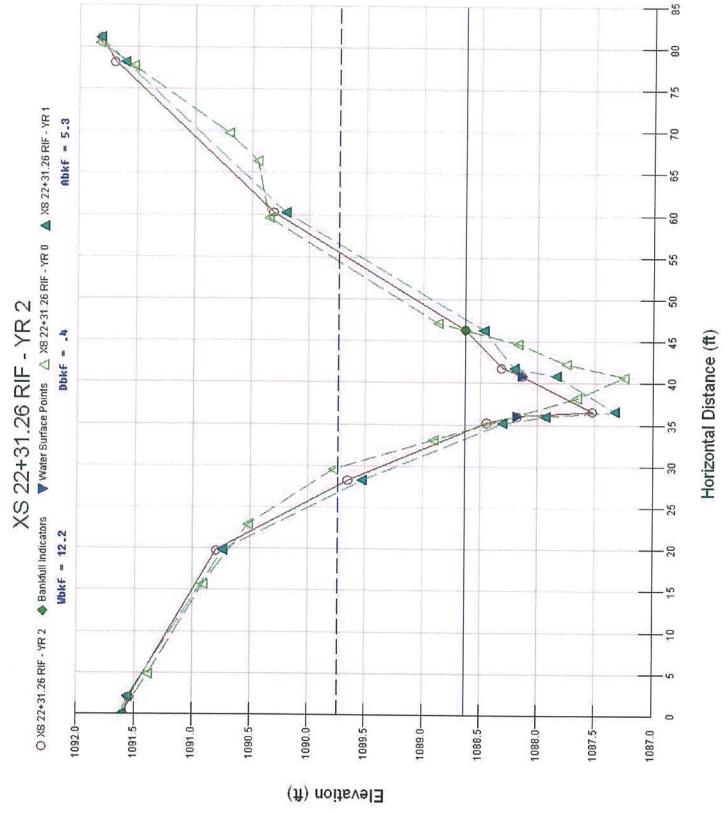
Cross-Section



CROSS SECTION: 22+31
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 16.59 ft²
 Bankfull Width 14.95 ft
 Mean Depth 1.11 ft
 Maximum Depth 2.62 ft
 Width/Depth Ratio 13.47
 Entrenchment Ratio 4.51
 Classification C

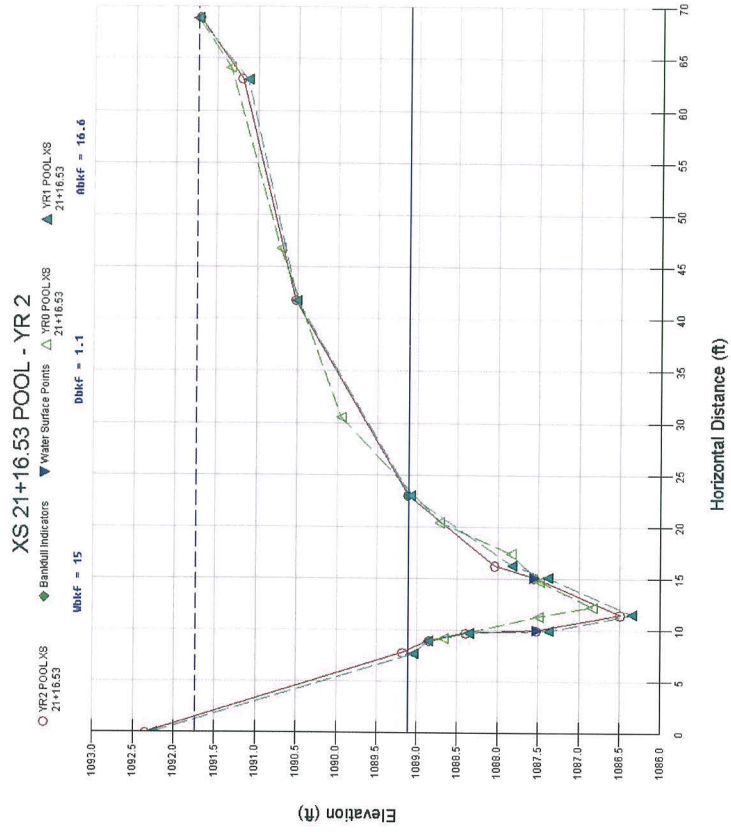
PROJECT South Muddy
 D04006-1
 2-YEAR

TASK Cross-Section
REACH A Lower
DATE 10/23/07

CROSS SECTION: 21+16
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 45.57 ft²
 Bankfull Width 25.5 ft
 Mean Depth 1.79 ft
 Maximum Depth 3.6 ft
 Width/Depth Ratio 14.25
 Entrenchment Ratio 2.65
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

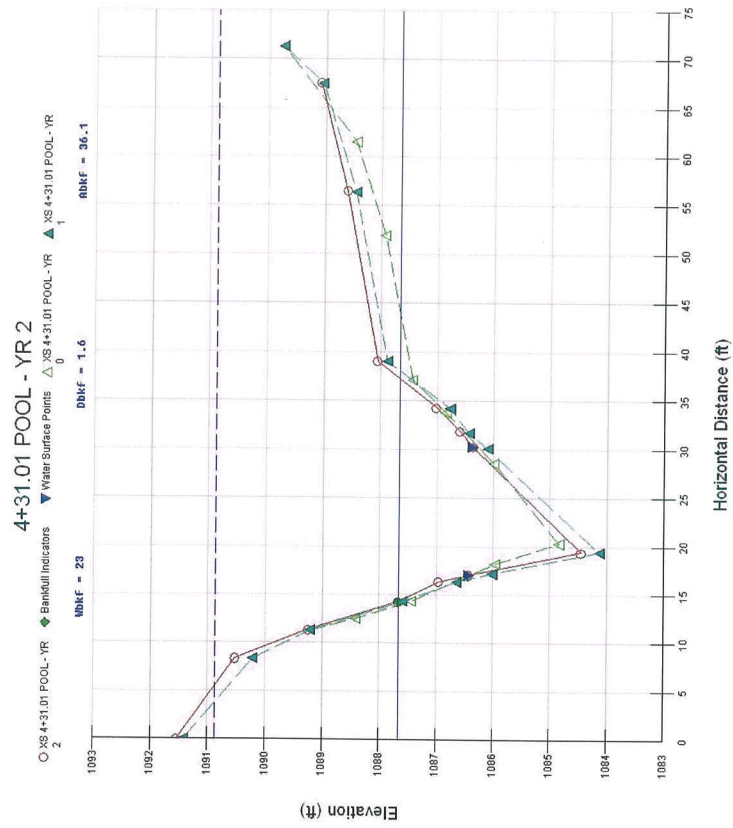
TASK Cross-Section
REACH A Lower
DATE 10/23/07



CROSS SECTION: 4+31
FEATURE: Pool



Cross section photo – looking downstream



Summary Data

Bankfull Area 10.89 ft²
 Bankfull Width 14.48 ft
 Mean Depth 0.75 ft
 Maximum Depth 1.57 ft
 Width/Depth Ratio 19.31
 Entrenchment Ratio 4.78
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

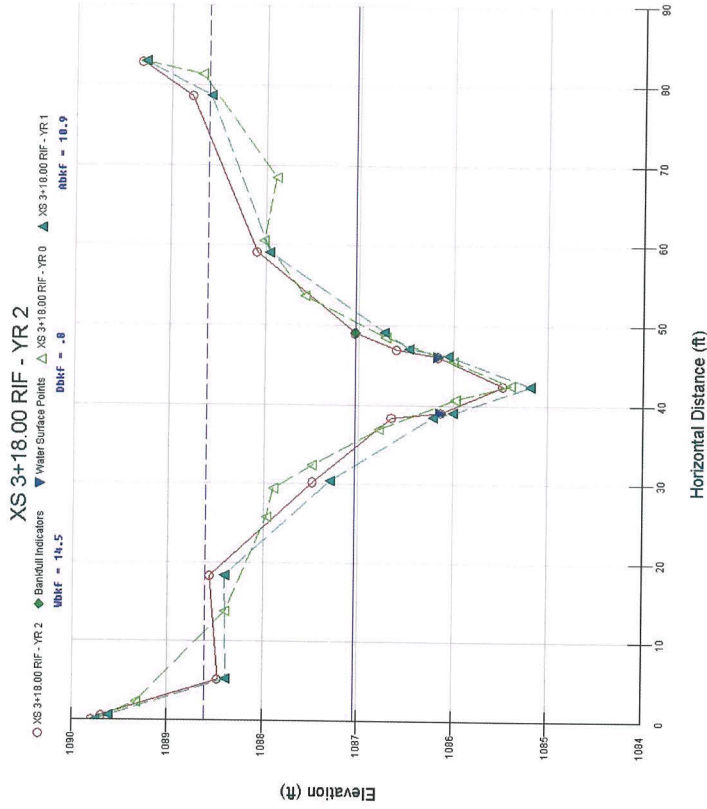
TASK Cross-Section
REACH A Lower
DATE 10/23/07



CROSS SECTION: 3+18
FEATURE: Riffle



Cross section photo – looking downstream



Summary Data

Bankfull Area 5.16 ft²
 Bankfull Width 8.5 ft
 Mean Depth 0.61 ft
 Maximum Depth 1.17ft
 Width/Depth Ratio 13.93
 Entrenchment Ratio 3.55
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

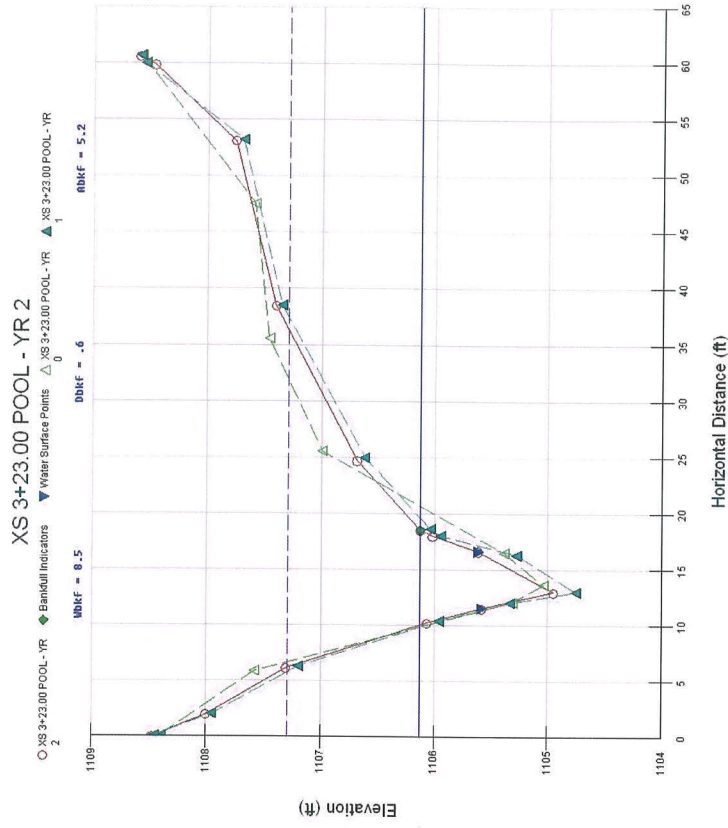
TASK Cross-Section
REACH A2
DATE 10/23/07



CROSS SECTION: 3+23
FEATURE: Pool



Cross-section photo – looking downstream



Summary Data

Bankfull Area 17.47 ft²
 Bankfull Width 21.74 ft
 Mean Depth 0.8 ft
 Maximum Depth 1.52 ft
 Width/Depth Ratio 27.17
 Entrenchment Ratio 2.05
 Classification B

PROJECT South Muddy
 D04006-1
 2-YEAR

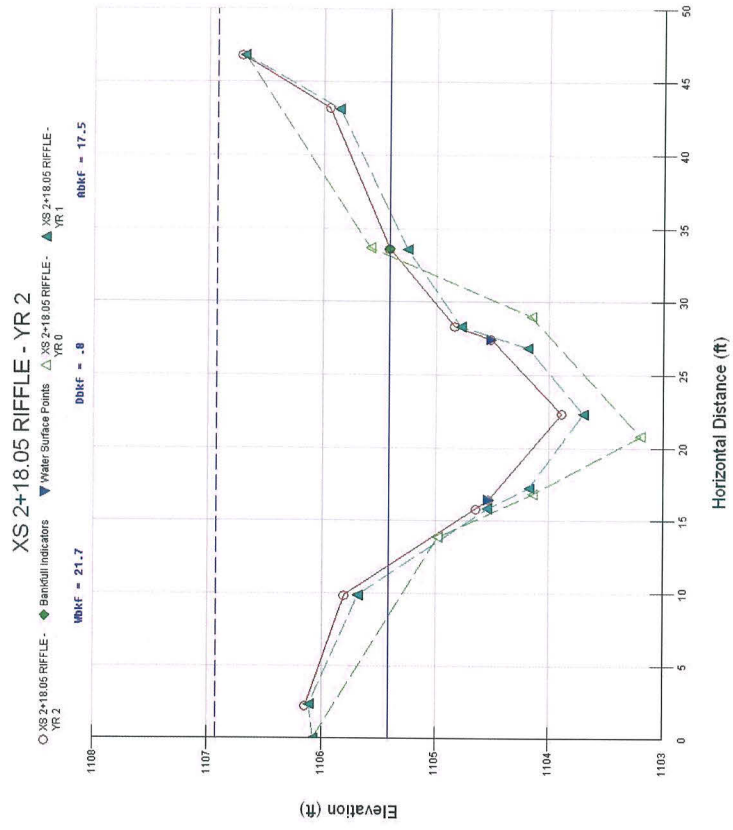
TASK Cross-Section
REACH A2
DATE 10/23/07



CROSS SECTION: 2+18
FEATURE: Riffle



Cross-section photo – looking downstream



Summary Data

Bankfull Area 9.64 ft²
 Bankfull Width 10.11 ft
 Mean Depth 0.95 ft
 Maximum Depth 2.24 ft
 Width/Depth Ratio 10.64
 Entrenchment Ratio 5.48
 Classification E

PROJECT

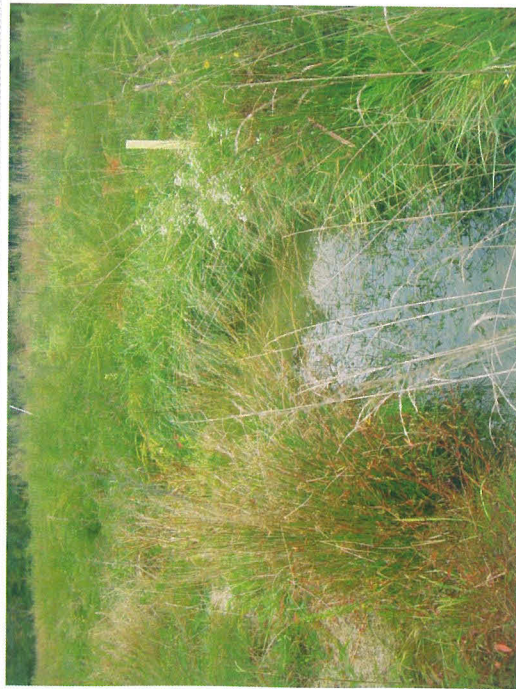
South Muddy
 D04006-1
 2-YEAR

TASK

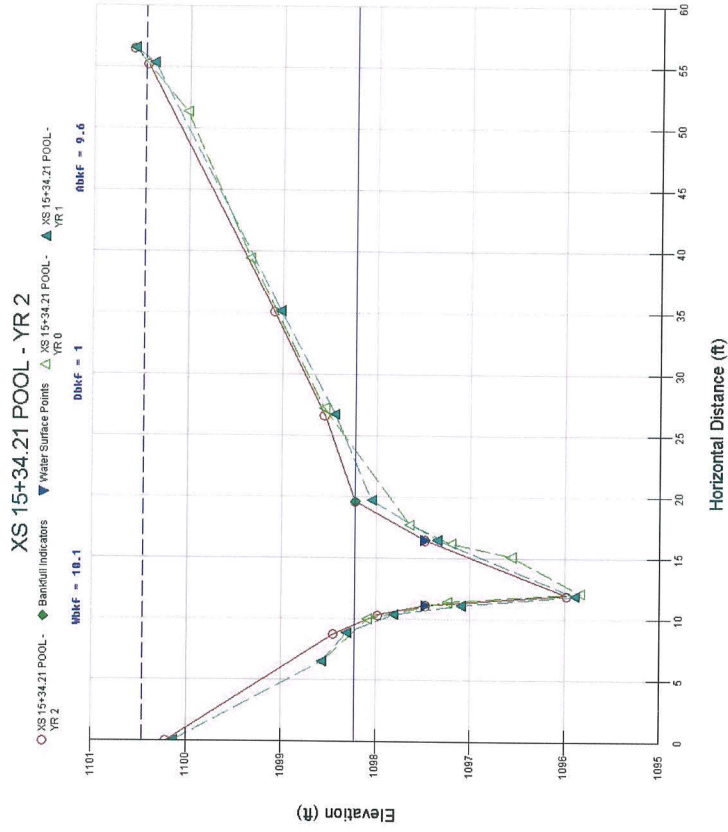
Cross-Section
 REACH B
 DATE 10/23/07



CROSS SECTION: 15+34
FEATURE: Pool



Cross-section photo – looking downstream



Summary Data

Bankfull Area 7.33 ft²
 Bankfull Width 11.94 ft
 Mean Depth 0.61 ft
 Maximum Depth 1.45 ft
 Width/Depth Ratio 19.57
 Entrenchment Ratio 3.91
 Classification C

PROJECT

South Muddy
 D04006-1
 2-YEAR

TASK

REACH B
 DATE 10/23/07

Cross-Section

12+10



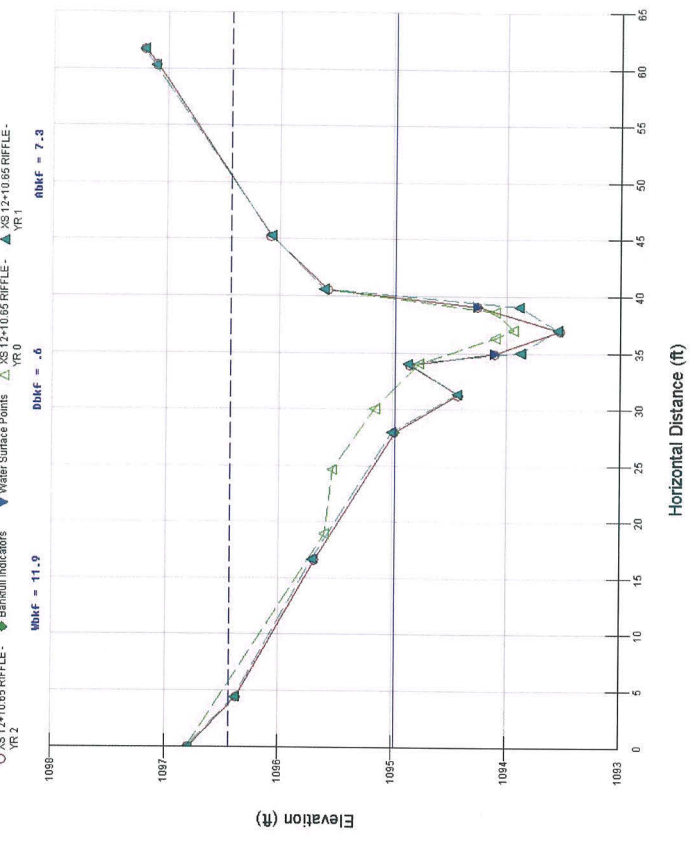
CROSS SECTION:

12+10
 Riffle



Cross-section photo – looking downstream

XS 12+10.65 RIFFLE - YR 2



Summary Data

Bankfull Area 5.2 ft²
 Bankfull Width 9.78 ft
 Mean Depth 0.53 ft
 Maximum Depth 1.39 ft
 Width/Depth Ratio 18.45
 Entrenchment Ratio 4.3
 Classification C

PROJECT South Muddy

D04006-1

2-YEAR

TASK Cross-Section

REACH B

DATE 10/23/07

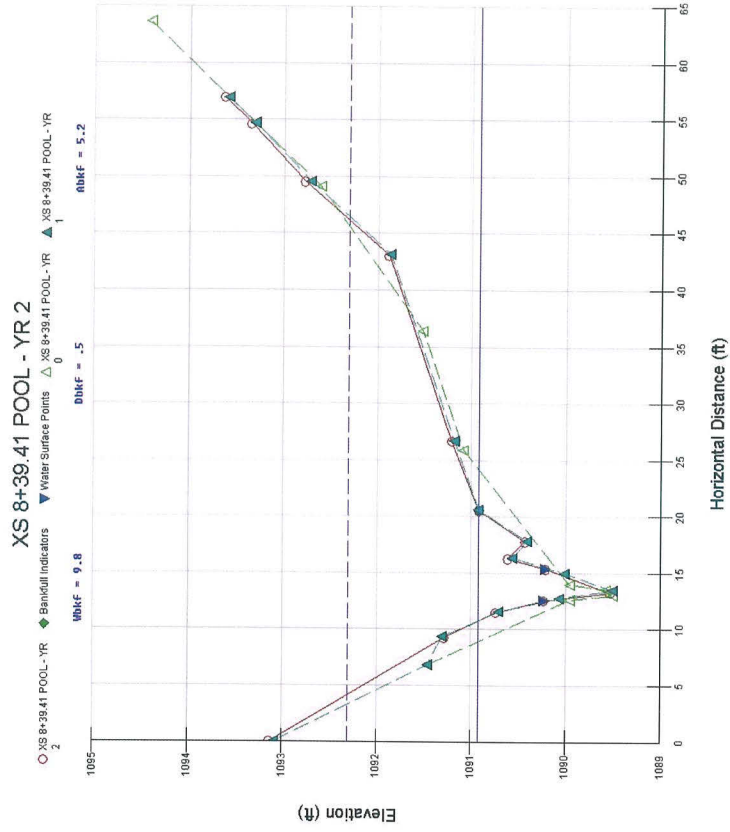


CROSS SECTION: 8+39

FEATURE: Pool



**Cross-section photo – looking across stream.
 Channel is obscured by vegetation.**



Summary Data

Bankfull Area 10.34 ft²
 Bankfull Width 18.63 ft
 Mean Depth 0.56 ft
 Maximum Depth 1.29 ft
 Width/Depth Ratio 33.27
 Entrenchment Ratio 3.13
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

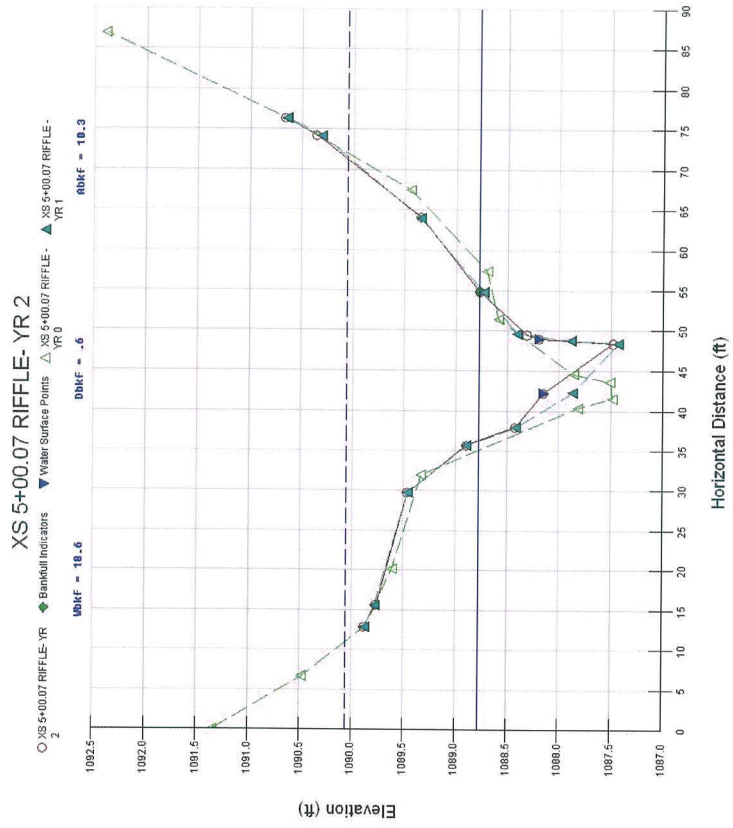
TASK Cross-Section
REACH B
DATE 10/23/07



CROSS SECTION: 5+00
FEATURE: Riffle



Cross-section photo – looking downstream
 Channel obscured by vegetation.



Summary Data

Bankfull Area 6.76 ft²
 Bankfull Width 7.4 ft
 Mean Depth 0.91 ft
 Maximum Depth 1.24 ft
 Width/Depth Ratio 8.13
 Entrenchment Ratio 5.08
 Classification E

PROJECT South Muddy

D04006-1

2-YEAR

TASK Cross-Section

REACH C

DATE 10/23/07



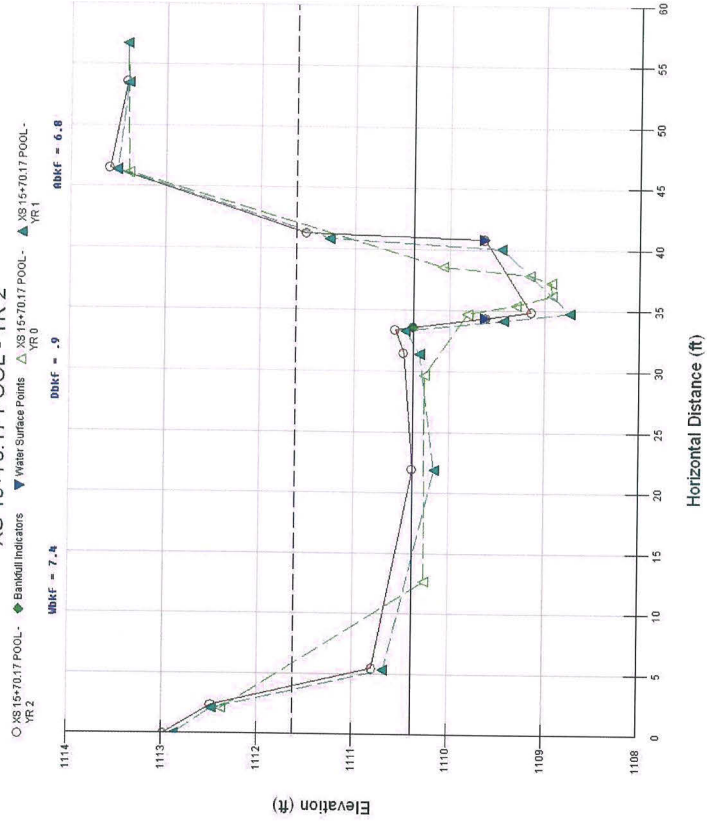
CROSS SECTION: 15+70

FEATURE: Pool



Cross-section photo – looking downstream

XS 15+70.17 POOL - YR 2



Summary Data

Bankfull Area 3.8 ft²
 Bankfull Width 11.24 ft
 Mean Depth 0.34 ft
 Maximum Depth 0.61 ft
 Width/Depth Ratio 33.06
 Entrenchment Ratio 1.35
 Classification F

PROJECT South Muddy

D04006-1

2-YEAR

TASK Cross-Section

REACH C

DATE 10/23/07

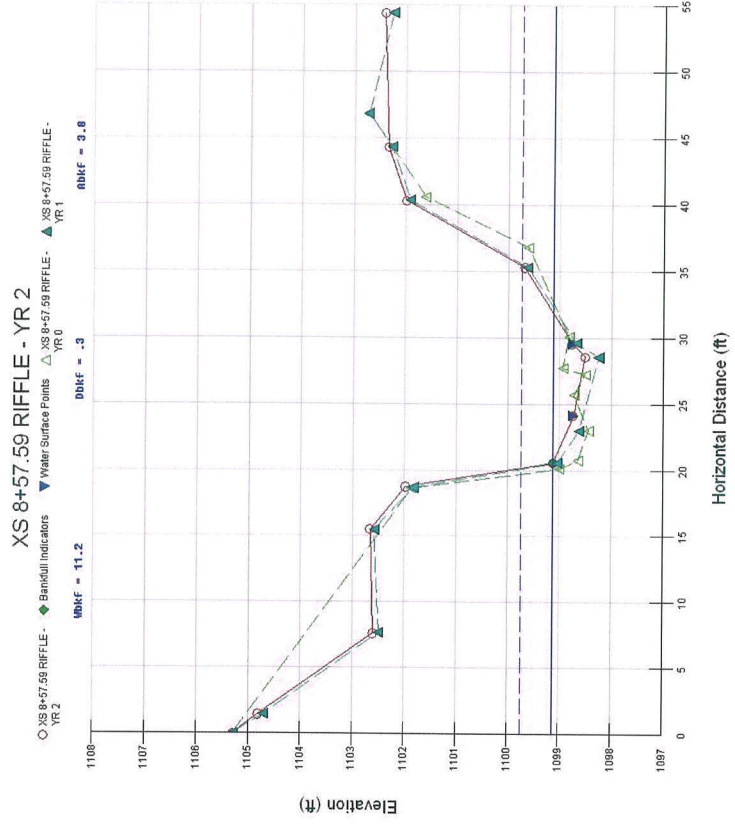


CROSS SECTION: 8+57

FEATURE: Riffle



**Cross-section photo – looking upstream
 Downstream photos were blurry and obscured.**



Summary Data

Bankfull Area 3.66 ft²
 Bankfull Width 6.67 ft
 Mean Depth 0.55 ft
 Maximum Depth 1.04 ft
 Width/Depth Ratio 12.13
 Entrenchment Ratio 3.94
 Classification C

PROJECT South Muddy
 D04006-1
 2-YEAR

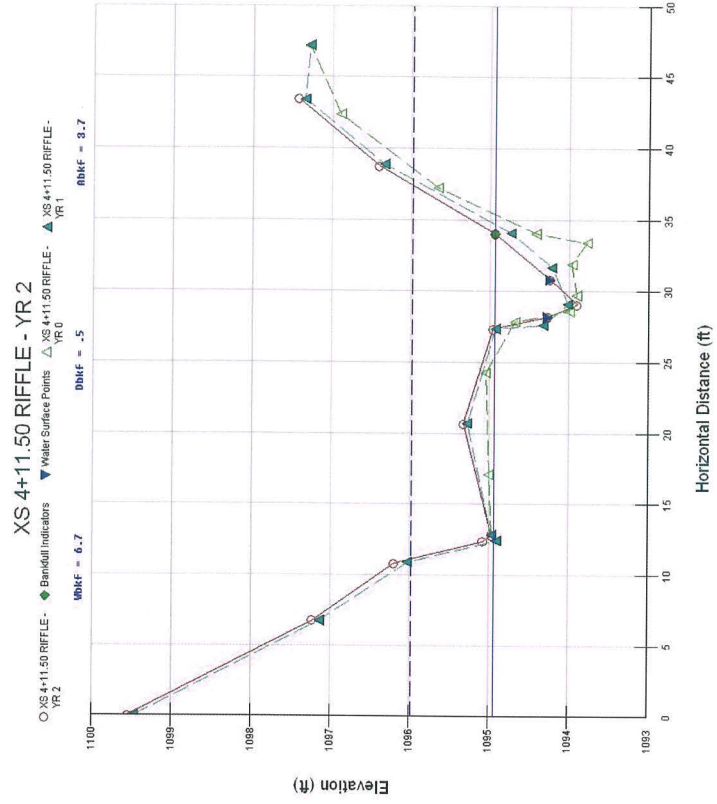
TASK Cross-Section
REACH C
DATE 10/23/07



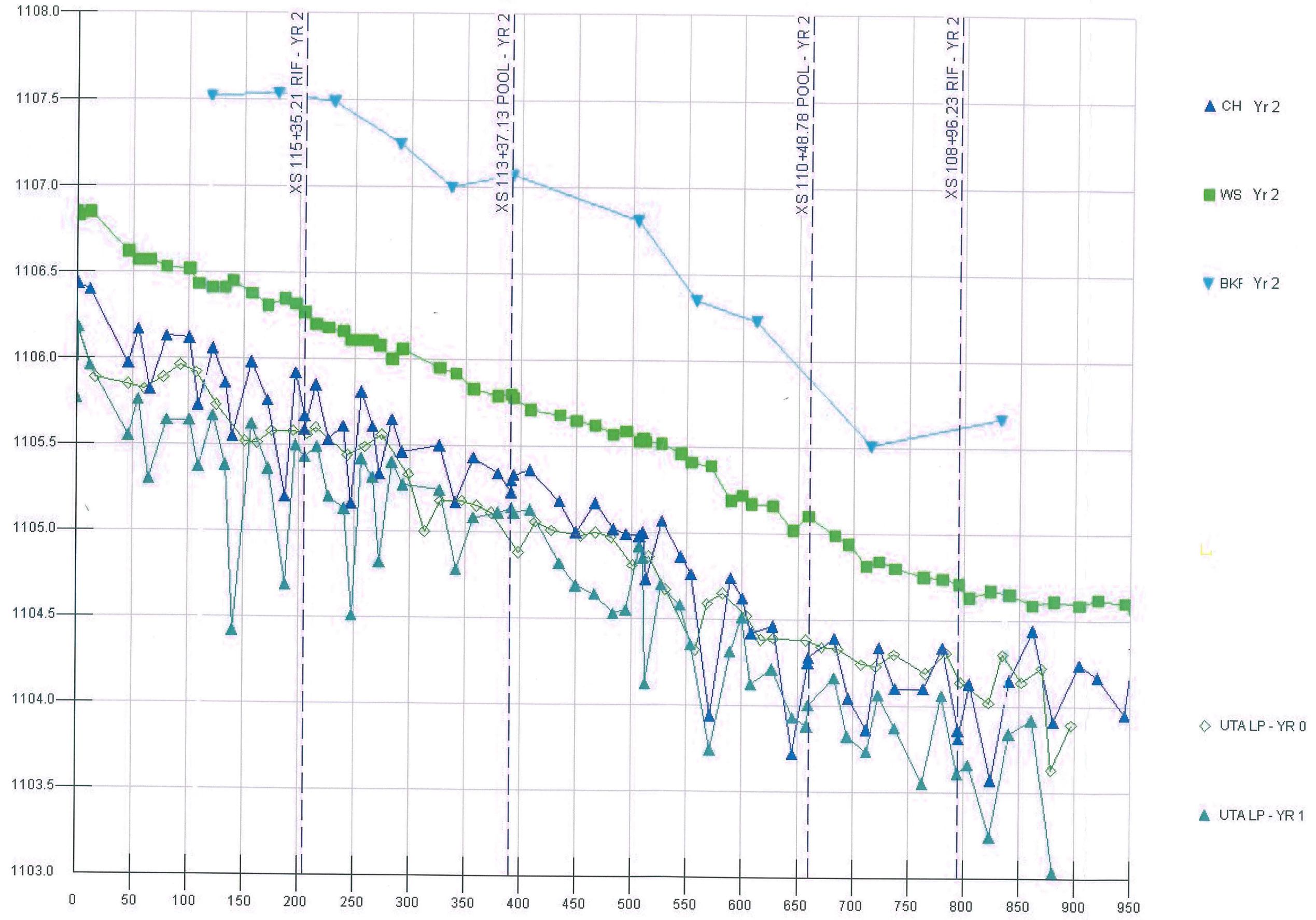
CROSS SECTION: 4+11
FEATURE: Riffle



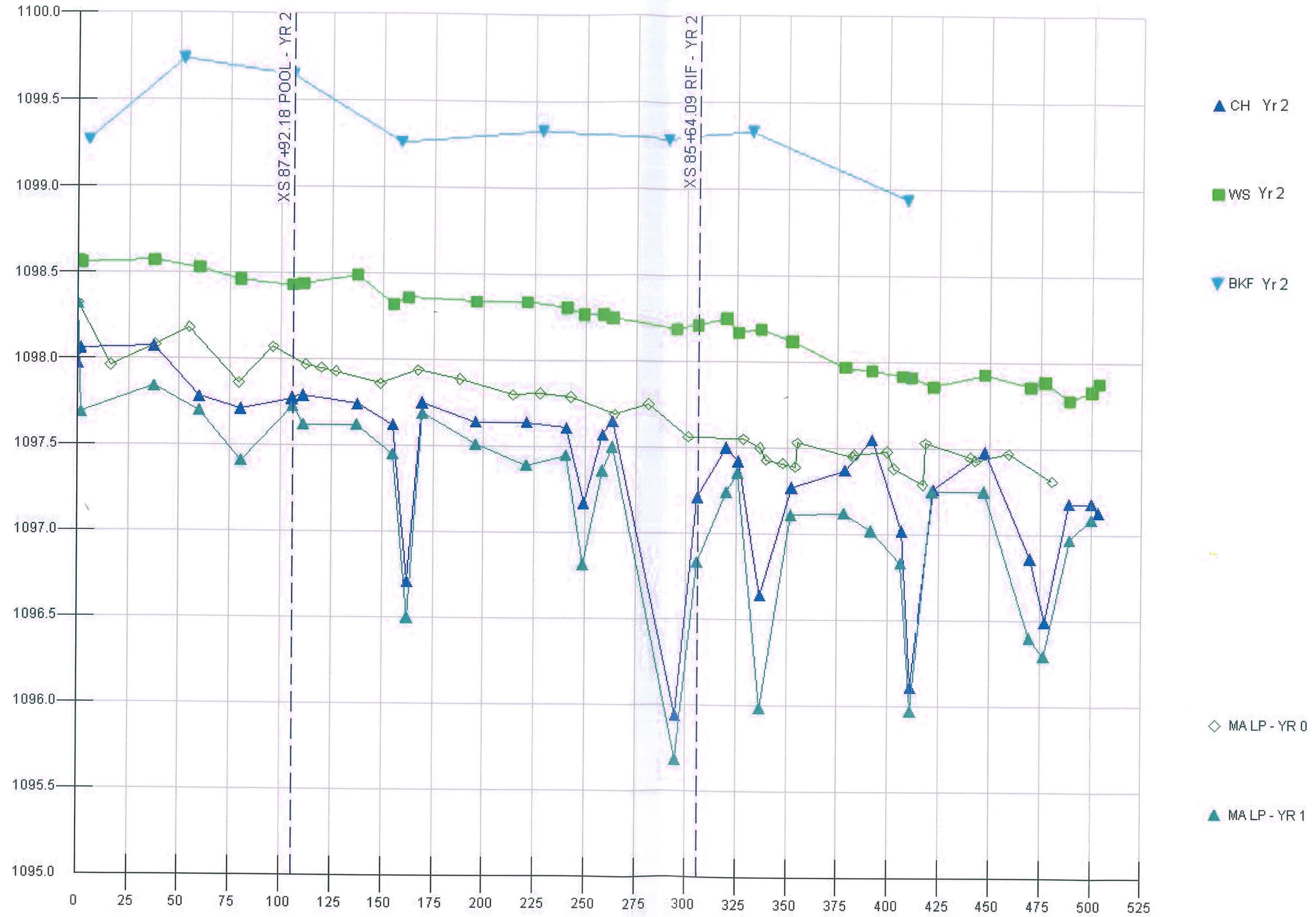
Cross-section photo – looking downstream



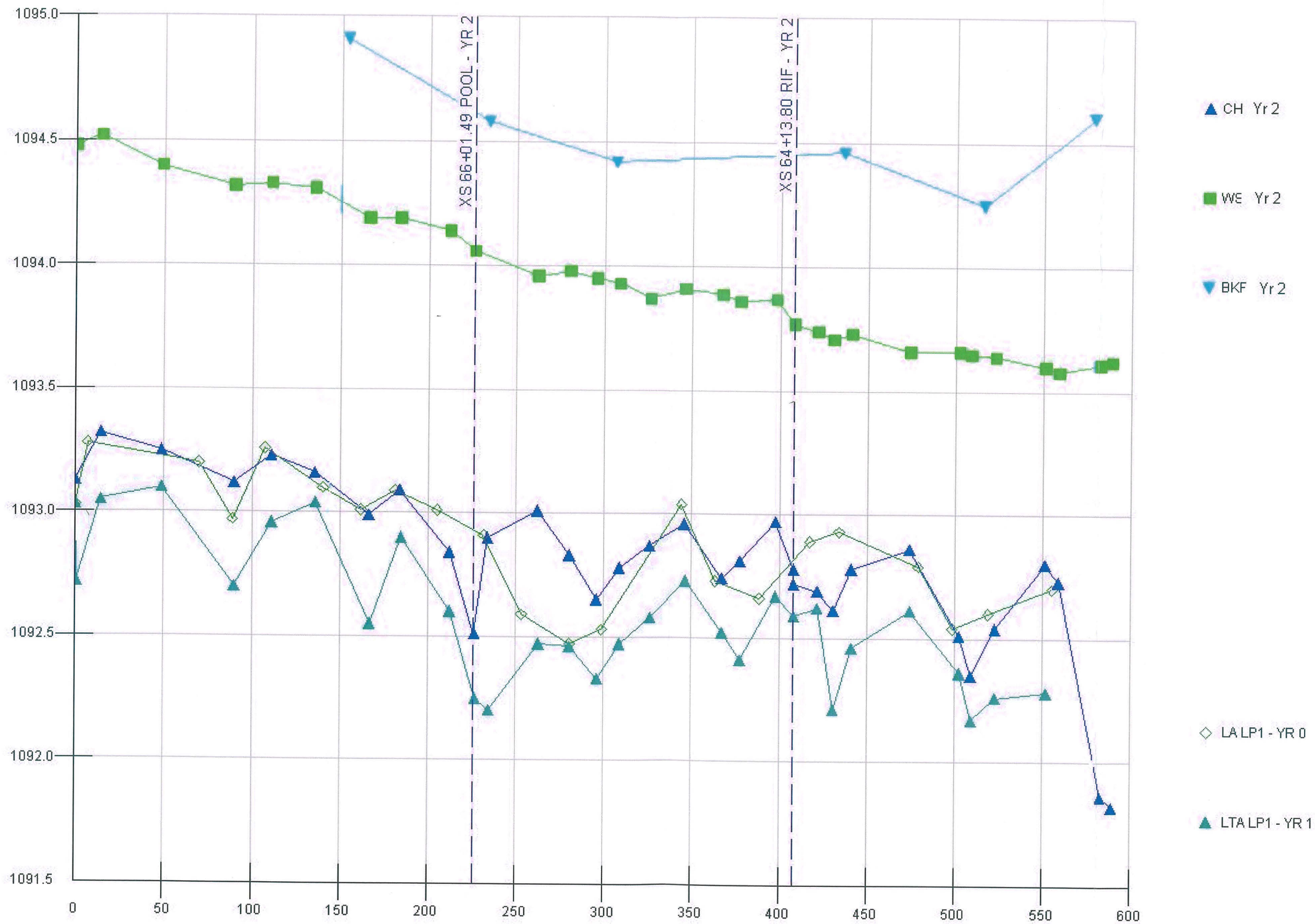
Upper Trib A - Longitudinal Profile - Year 2



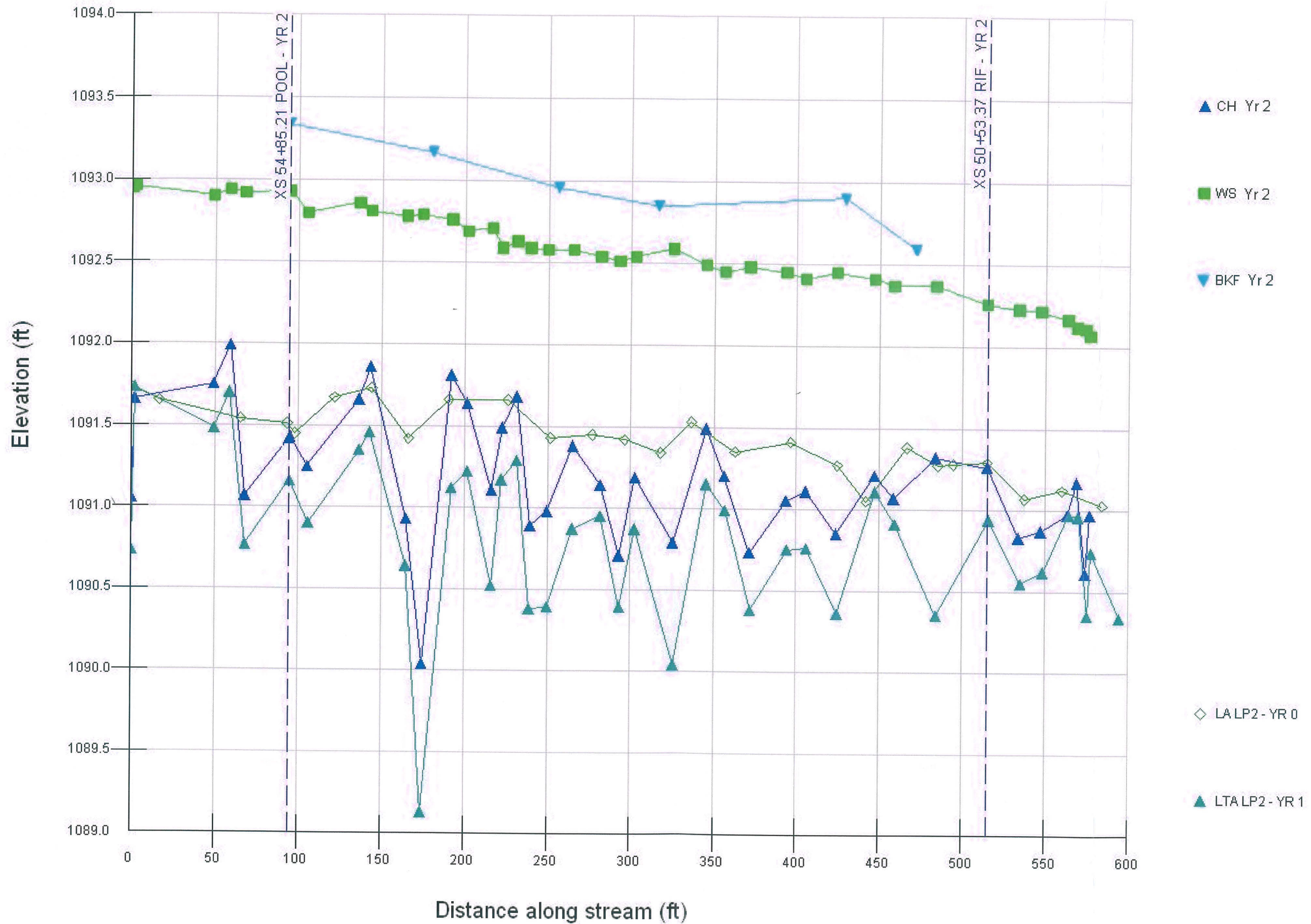
Middle Tributary A - Longitudinal Profile - Year 2



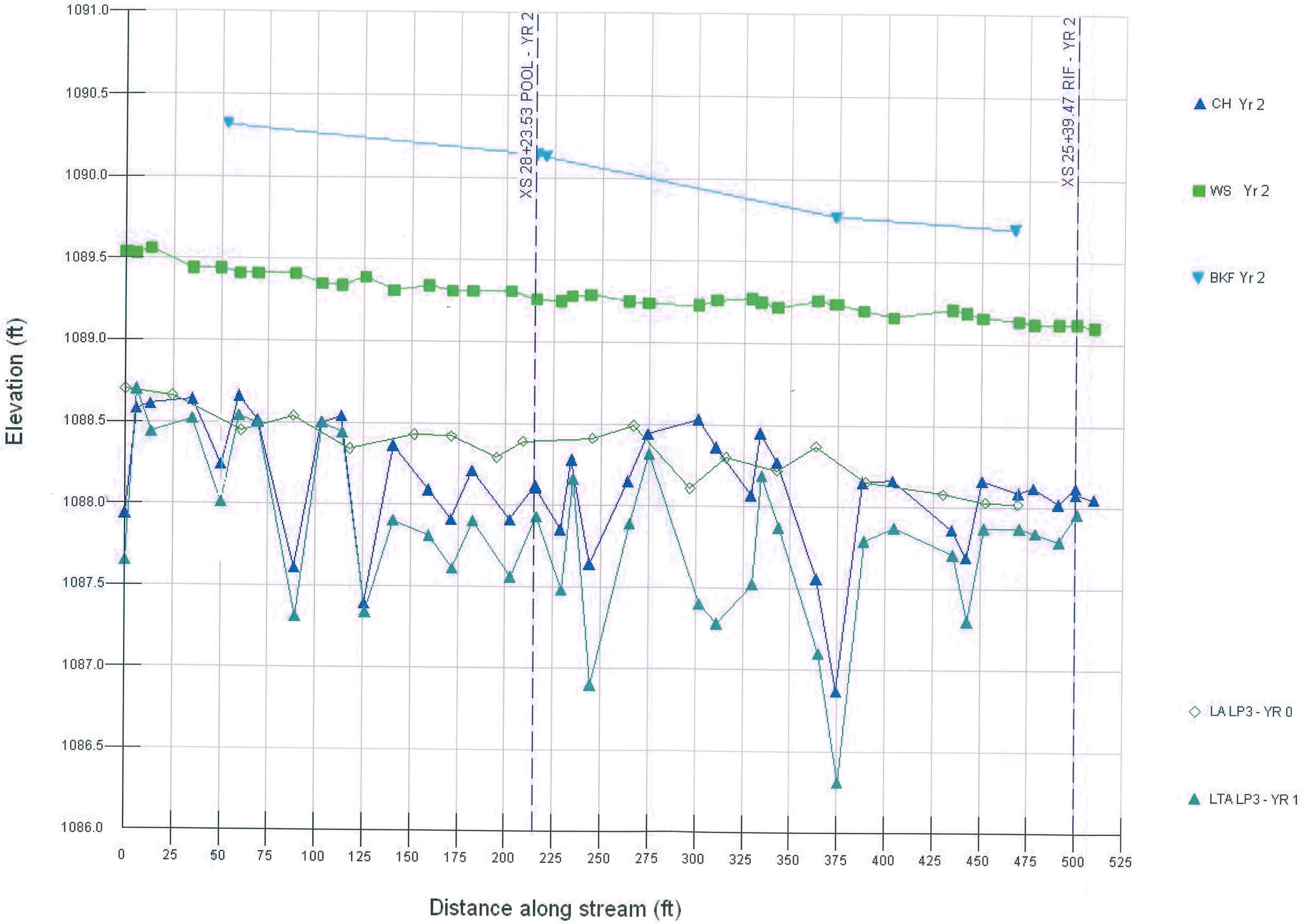
Lower Tributary A - Longitudinal Profile No. 1 - Year 2



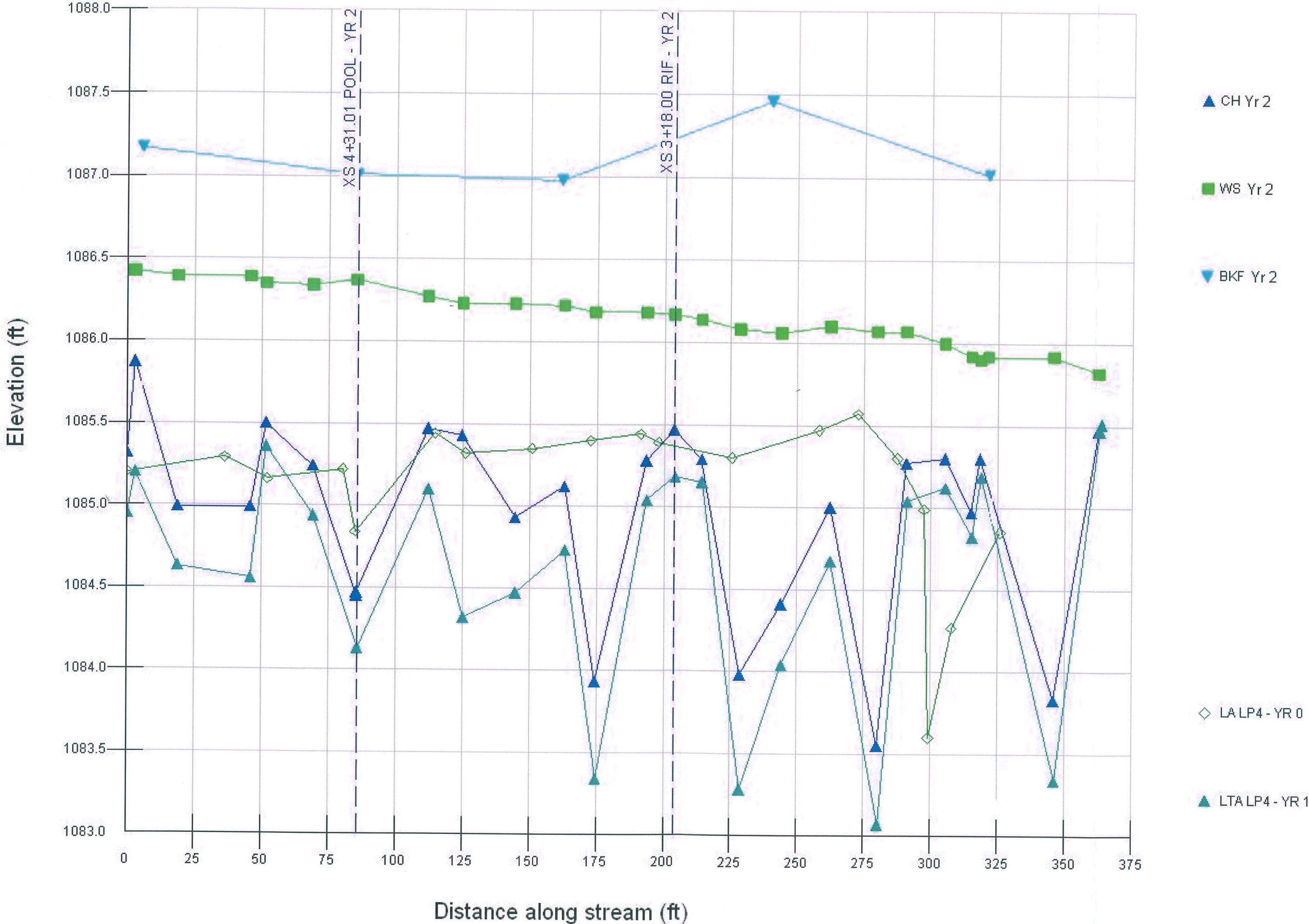
Lower Tributary A - Longitudinal Profile No. 2 - Year 2



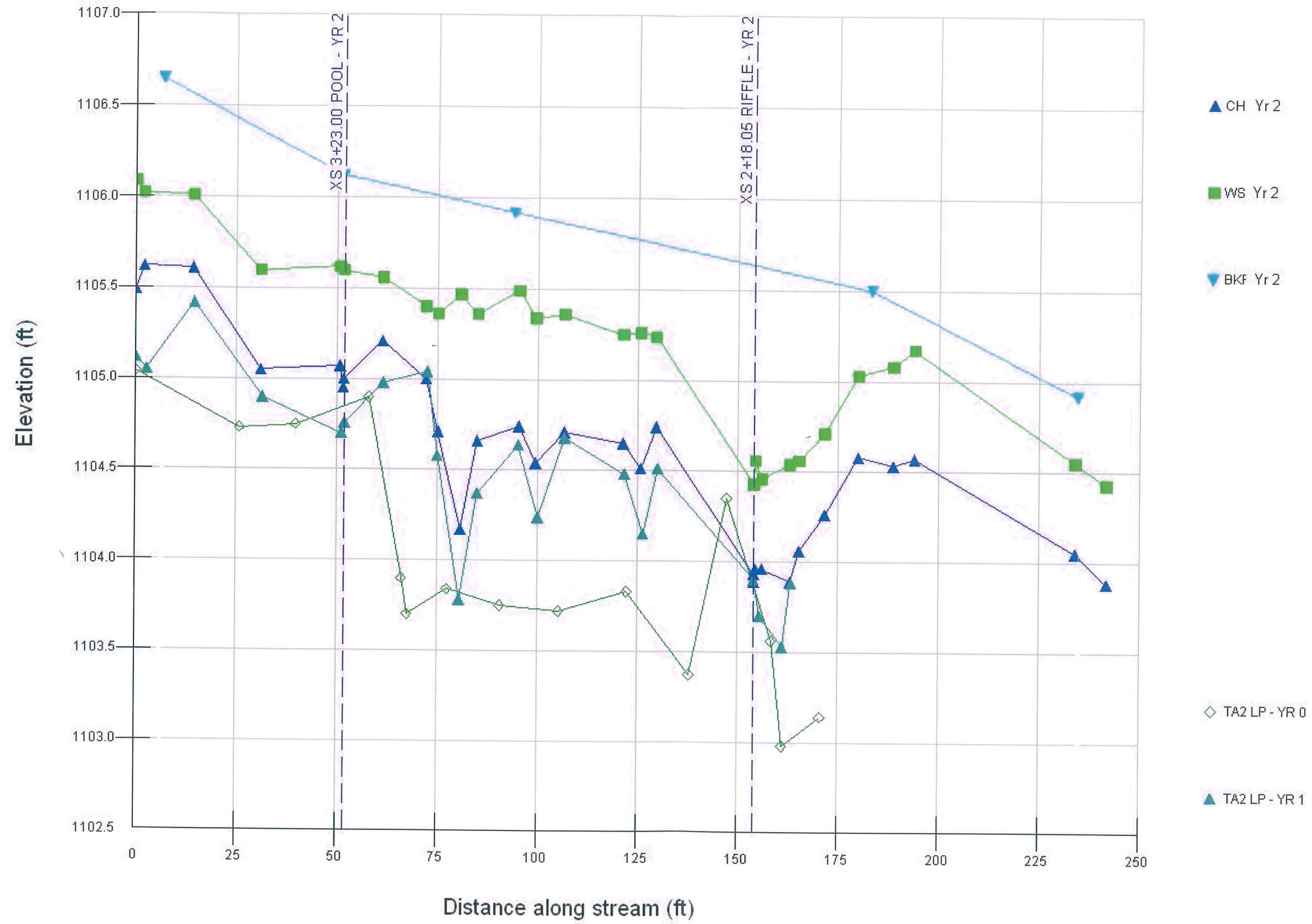
Lower Tributary A - Longitudinal Profile No. 3 - Year 2



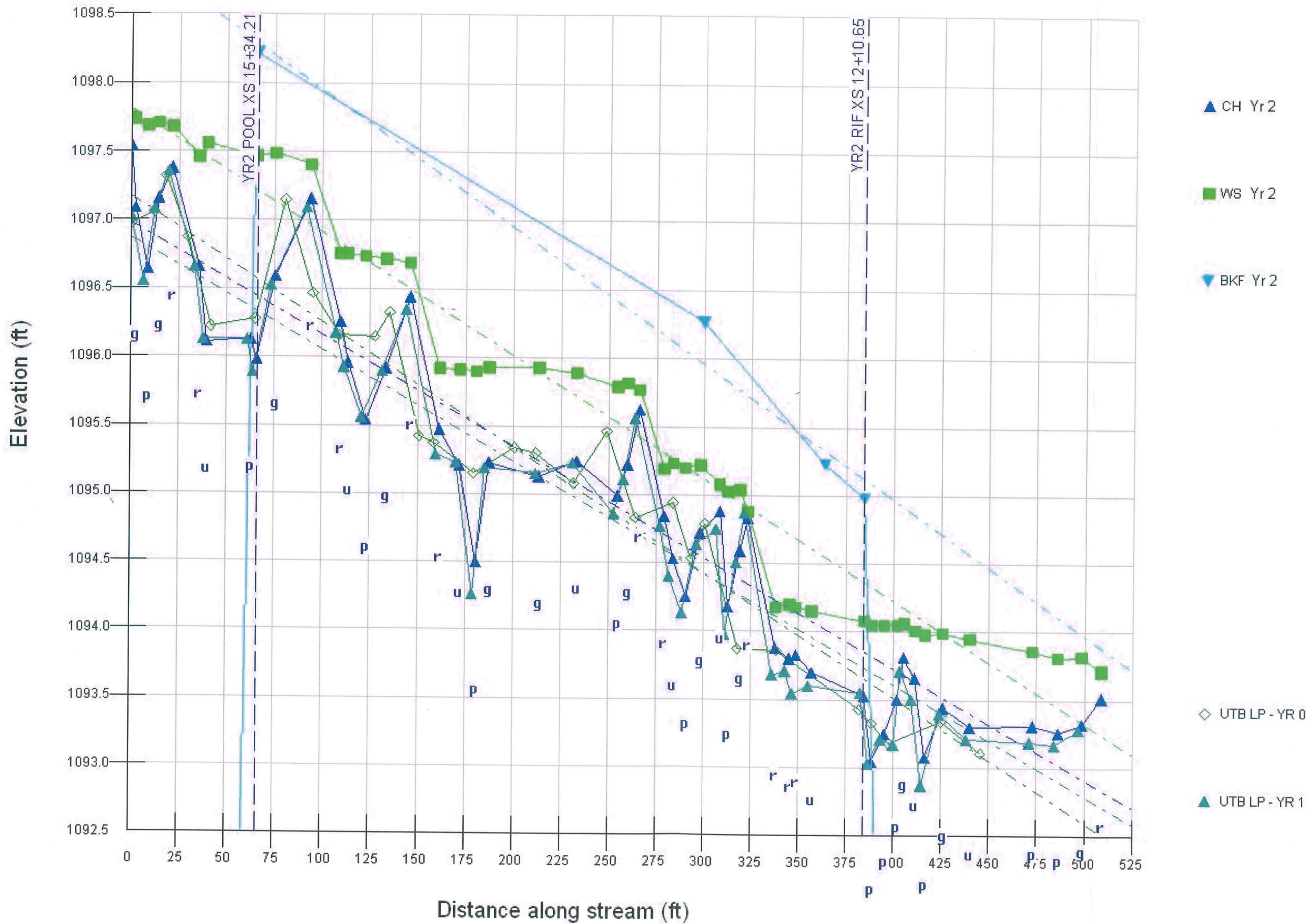
Lower Tributary A - Longitudinal Profile No. 4 - Year 2



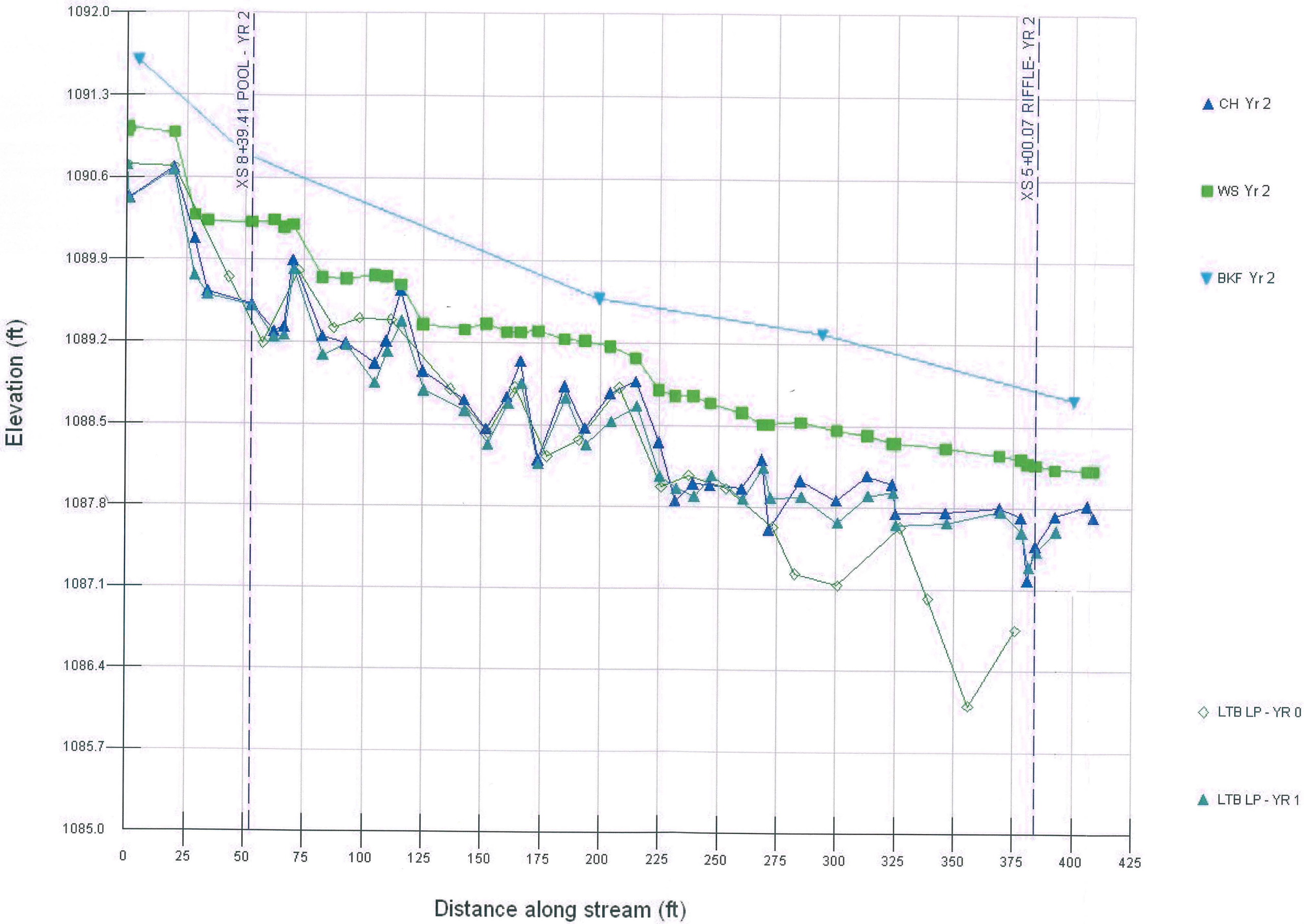
Tributary A2 Longitudinal Profile - Year 2



Upper Tributary B - Longitudinal Profile - Year 2



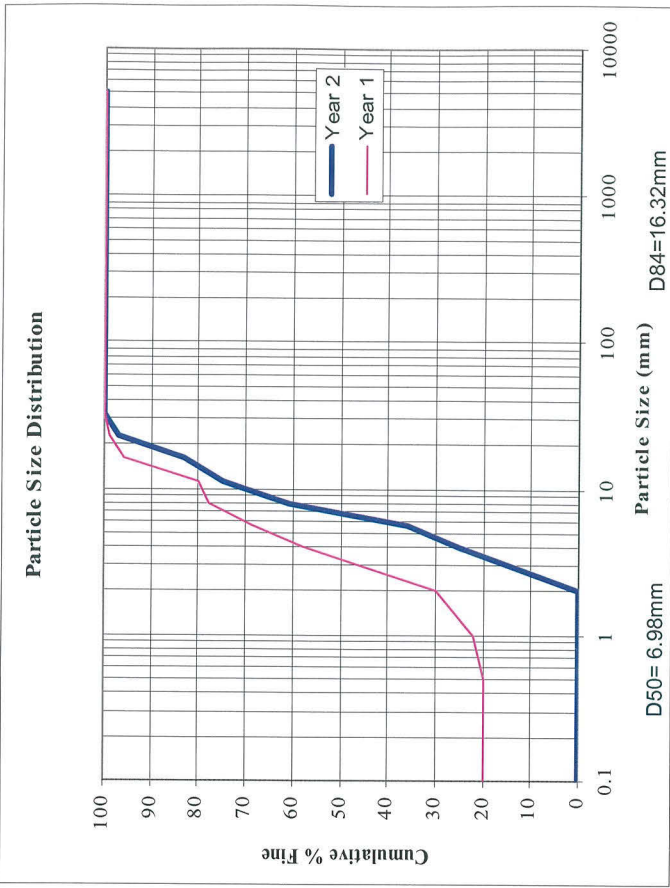
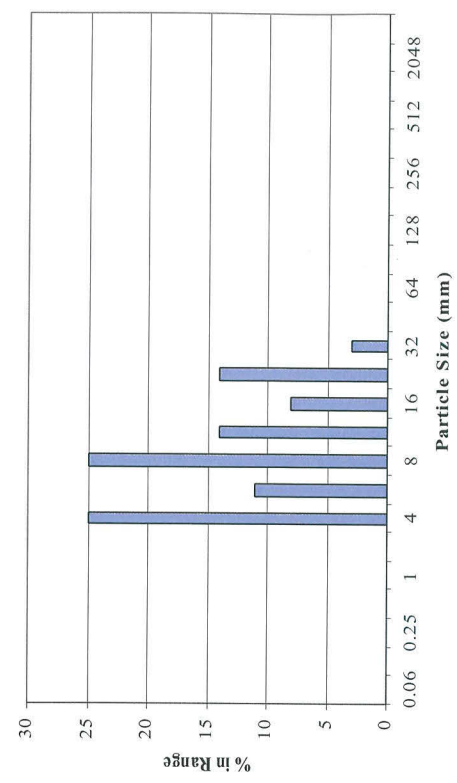
Lower Tributary B - Longitudinal Profile - Year 2



Pebble Count - Riffle					
Material	Particle Size (mm)	Count	% in Range	% Cumulative	
Silt/Clay	<0.062	0	0	0	0
Very Fine Sand	0.062-0.125	0	0	0	0
Fine Sand	0.125-0.25	0	0	0	0
Medium Sand	0.25-0.5	0	0	0	0
Coarse Sand	0.5-1.0	0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0	0
Very Fine Gravel	2.0-4.0	18	25	25	25
Fine Gravel	4.0-5.7	8	11	36	36
Fine Gravel	5.7-8.0	18	25	61	61
Medium Gravel	8.0-11.3	10	14	75	75
Medium Gravel	11.3-16.0	6	8	83	83
Coarse Gravel	16.0-22.6	10	14	97	97
Coarse Gravel	22.6-32	2	3	100	100
Very Coarse Gravel	32-45	0	0	100	100
Very Coarse Gravel	45-64	0	0	100	100
Small Cobble	64-90	0	0	100	100
Small Cobble	90-128	0	0	100	100
Large Cobble	128-180	0	0	100	100
Large Cobble	180-256	0	0	100	100
Small Boulder	256-362	0	0	100	100
Small Boulder	362-512	0	0	100	100
Medium Boulder	512-1024	0	0	100	100
Large Boulder	1024-2048	0	0	100	100
Bedrock	<2048	0	0	100	100
Totals		72	100		

South Muddy Creek Tributaries Restoration EEP Project No. D04006-01			
Reach	A (upper)	X Sec	N/A
Date	10/18/2007	Sta No.	108+96

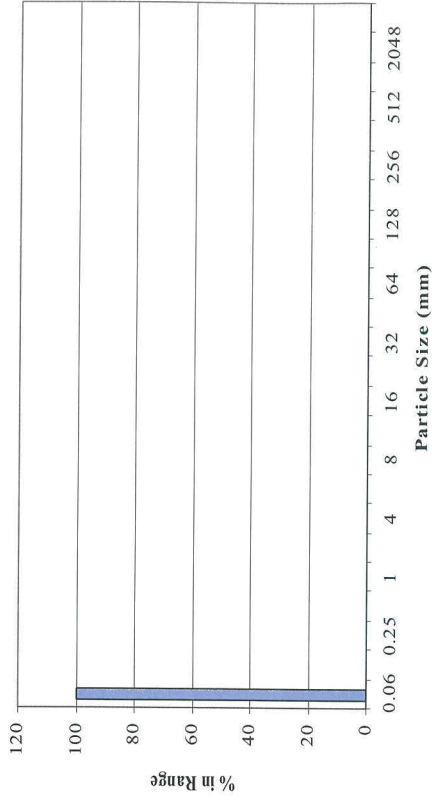
Histogram



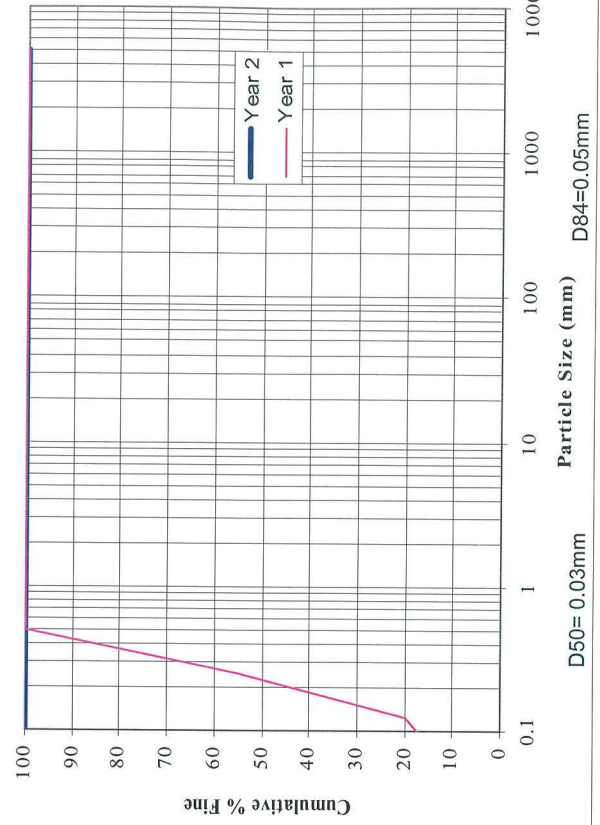
South Muddy Creek Tributaries Restoration EEP Project No. D04006-01

Reach	A (middle)	X Sec	N/A
Date	10/18/2007	Sta No.	87+92

Histogram



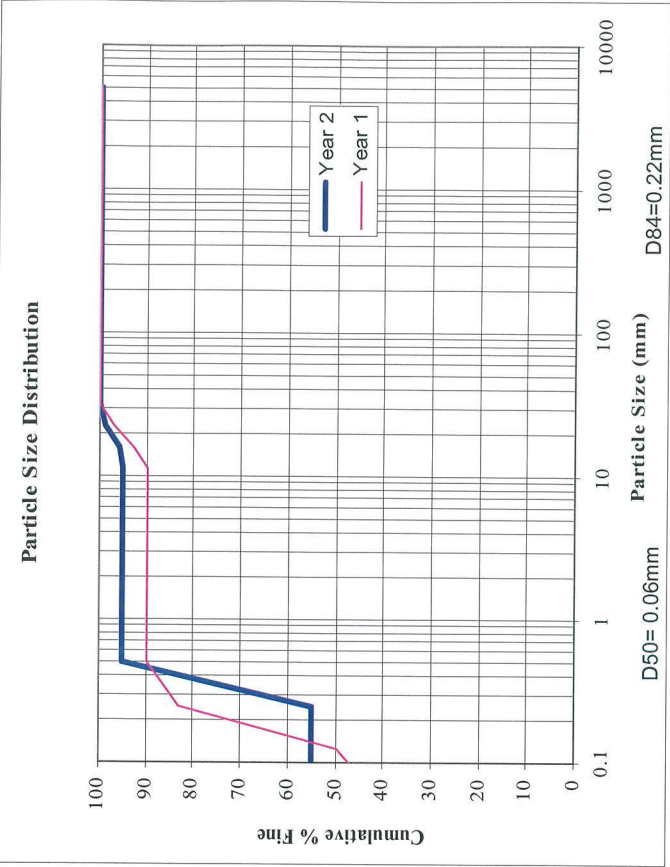
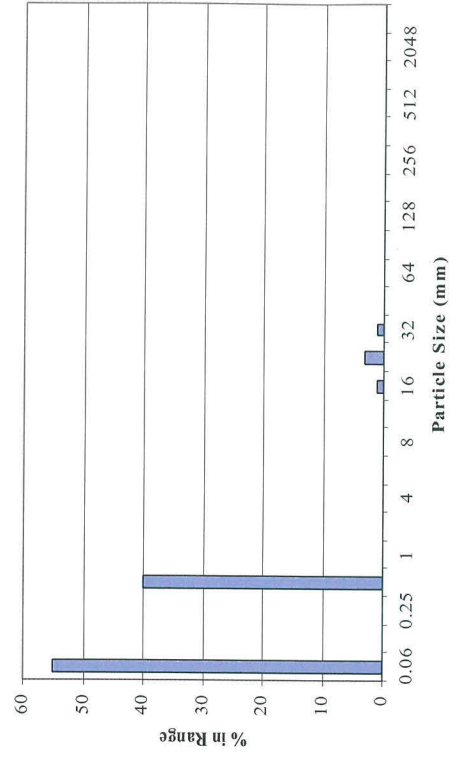
Particle Size Distribution



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

South Muddy Creek Tributaries Restoration EEP Project No. D04006-01			
Reach	A (lower)	X Sec	N/A
Date	10/18/2007	Sta No.	40+13

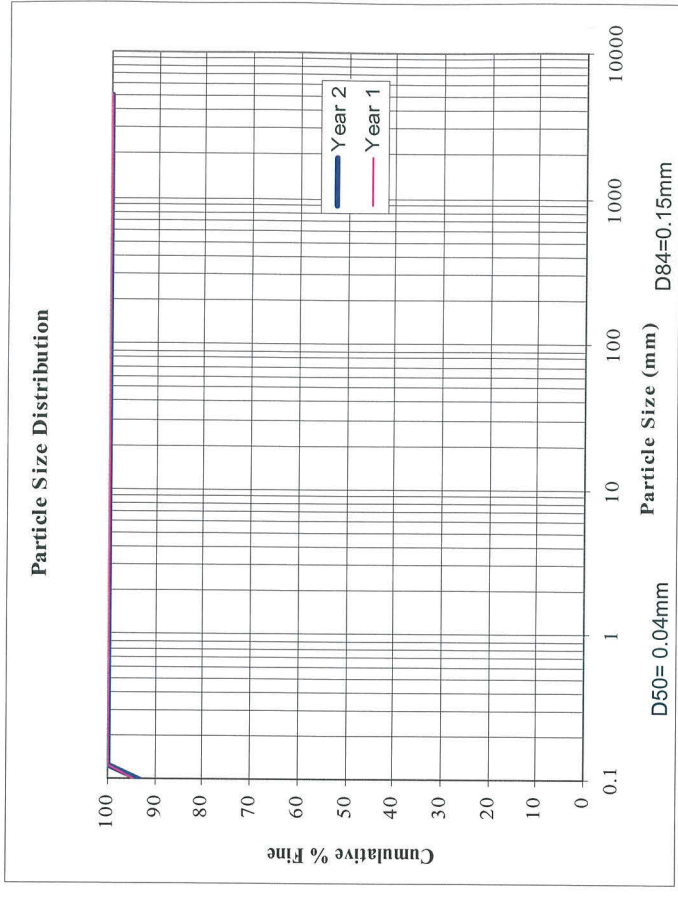
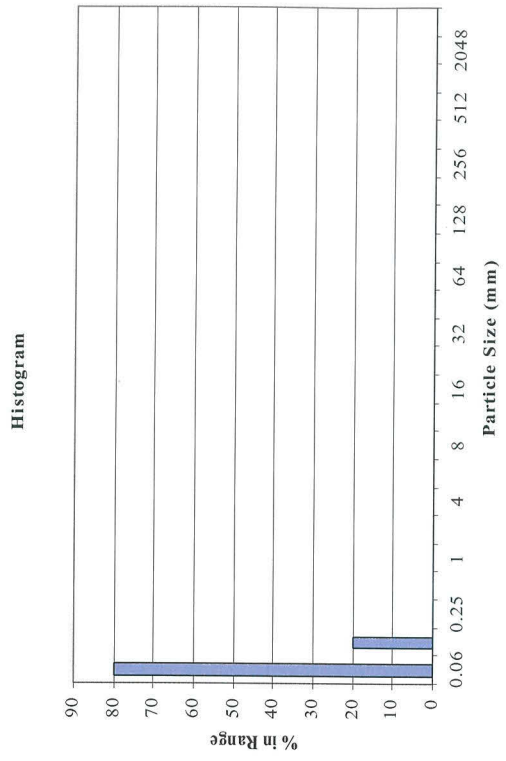
Histogram



Pebble Count - Riffle					
Material	Particle Size (mm)	Count	% in Range	% Cumulative	
Silt/Clay	<0.062	55	55	55	
Very Fine Sand	0.062-0.125	0	0	55	
Fine Sand	0.125-0.25	0	0	55	
Medium Sand	0.25-0.5	40	40	95	
Coarse Sand	0.5-1.0	0	0	95	
Very Coarse Sand	1.0-2.0	0	0	95	
Very Fine Gravel	2.0-4.0	0	0	95	
Fine Gravel	4.0-5.7	0	0	95	
Fine Gravel	5.7-8.0	0	0	95	
Medium Gravel	8.0-11.3	0	0	95	
Medium Gravel	11.3-16.0	1	1	96	
Coarse Gravel	16.0-22.6	3	3	99	
Coarse Gravel	22.6-32	1	1	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		

Pebble Count - Pool				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	80	80	80
Very Fine Sand	0.062-0.125	20	20	100
Fine Sand	0.125-0.25	0	0	100
Medium Sand	0.25-0.5	0	0	100
Coarse Sand	0.5-1.0	0	0	100
Very Coarse Sand	1.0-2.0	0	0	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	

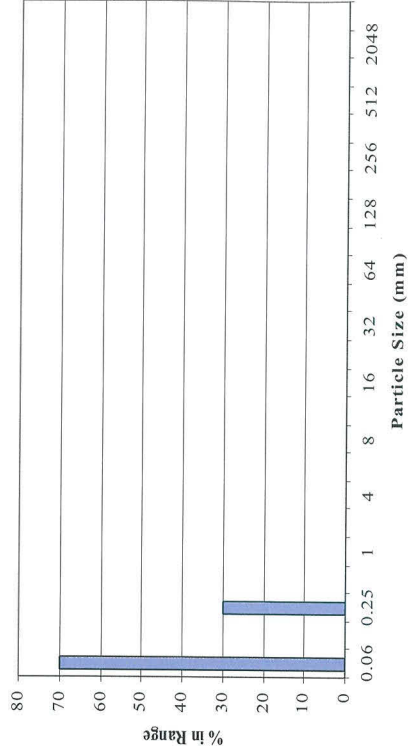
South Muddy Creek Tributaries Restoration EEP Project No. D04006-01			
Reach	A (lower)	X Sec	N/A
Date	10/18/2007	Sta No.	4+31



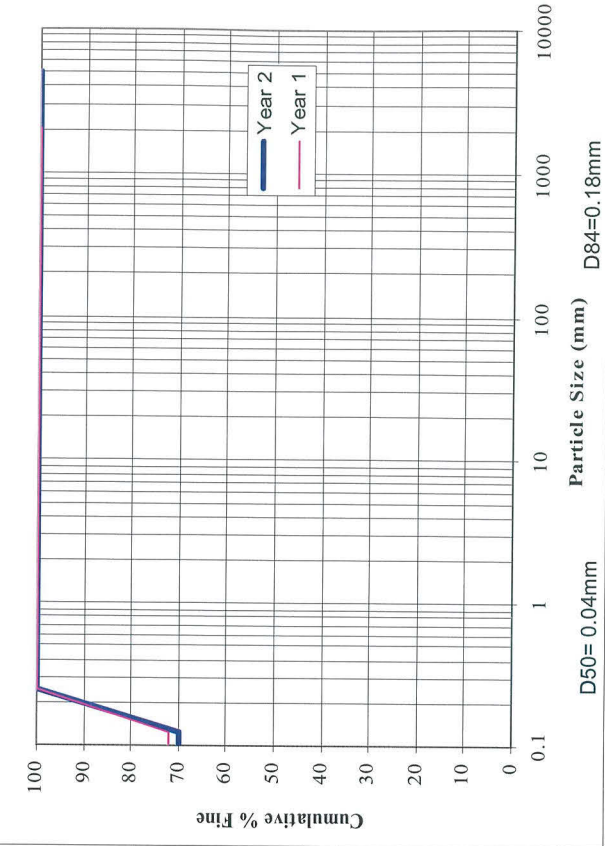
Pebble Count - Pool				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	70	70	70
Very Fine Sand	0.062-0.125	0	0	70
Fine Sand	0.125-0.25	30	30	100
Medium Sand	0.25-0.5	0	0	100
Coarse Sand	0.5-1.0	0	0	100
Very Coarse Sand	1.0-2.0	0	0	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine 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	

South Muddy Creek Tributaries Restoration EEP Project No. D04006-01			
Reach	B	X Sec	N/A
Date	10/18/2007	Sta No.	15+34

Histogram

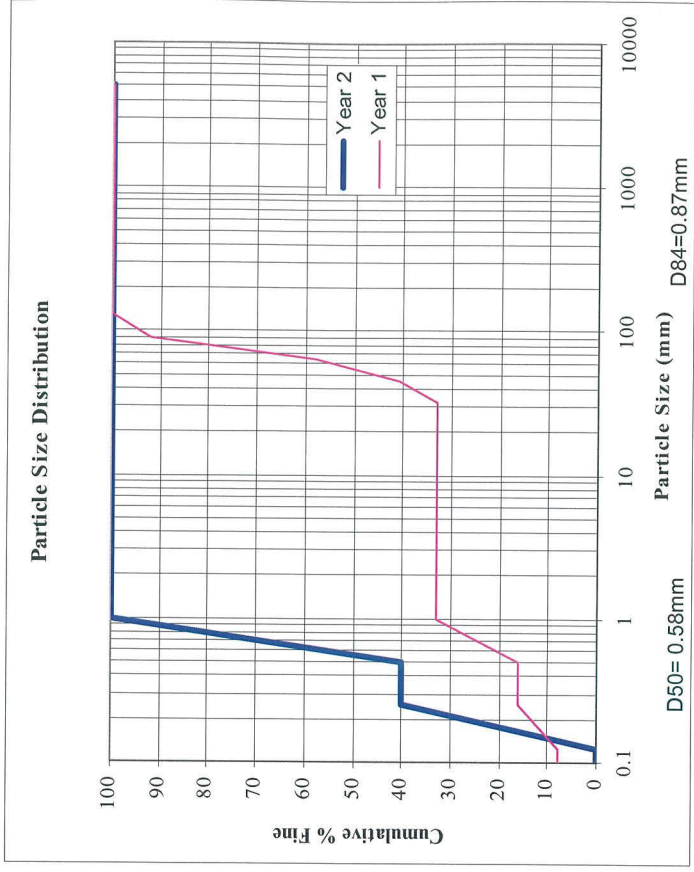
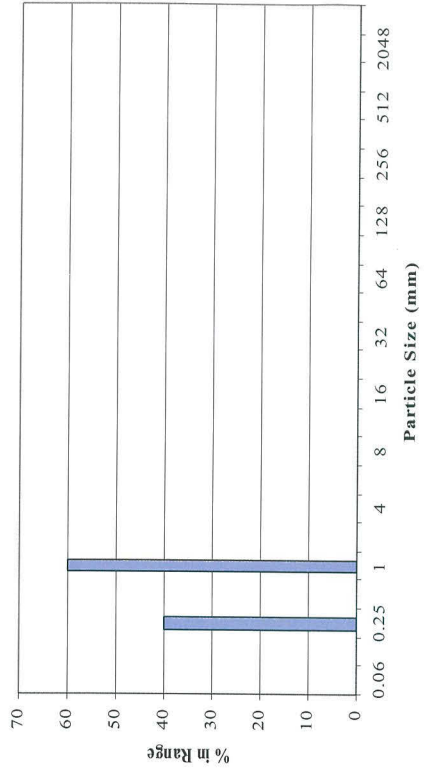


Particle Size Distribution



South Muddy Creek Tributaries Restoration EEP Project No. D04006-01			
Reach	B	X Sec	N/A
Date	10/18/2007	Sta No.	2+25

Histogram



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	40	40	40	
Medium Sand	0.25-0.5	0	0	40	
Coarse Sand	0.5-1.0	60	60	100	
Very Coarse Sand	1.0-2.0	0	0	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		

D50= 0.58mm

D84=0.87mm



BF 1
Crest Gage at station 5+00 on Tributary B.
(EMH&T, Inc. 7/18/07)



BF 2
Crest Gage at station 54+85 on Tributary A (lower).
(EMH&T, Inc. 7/18/07)



BF 3
Crest Gage at station 113+37 on Tributary A (upper).
(EMH&T, Inc. 10/19/07)