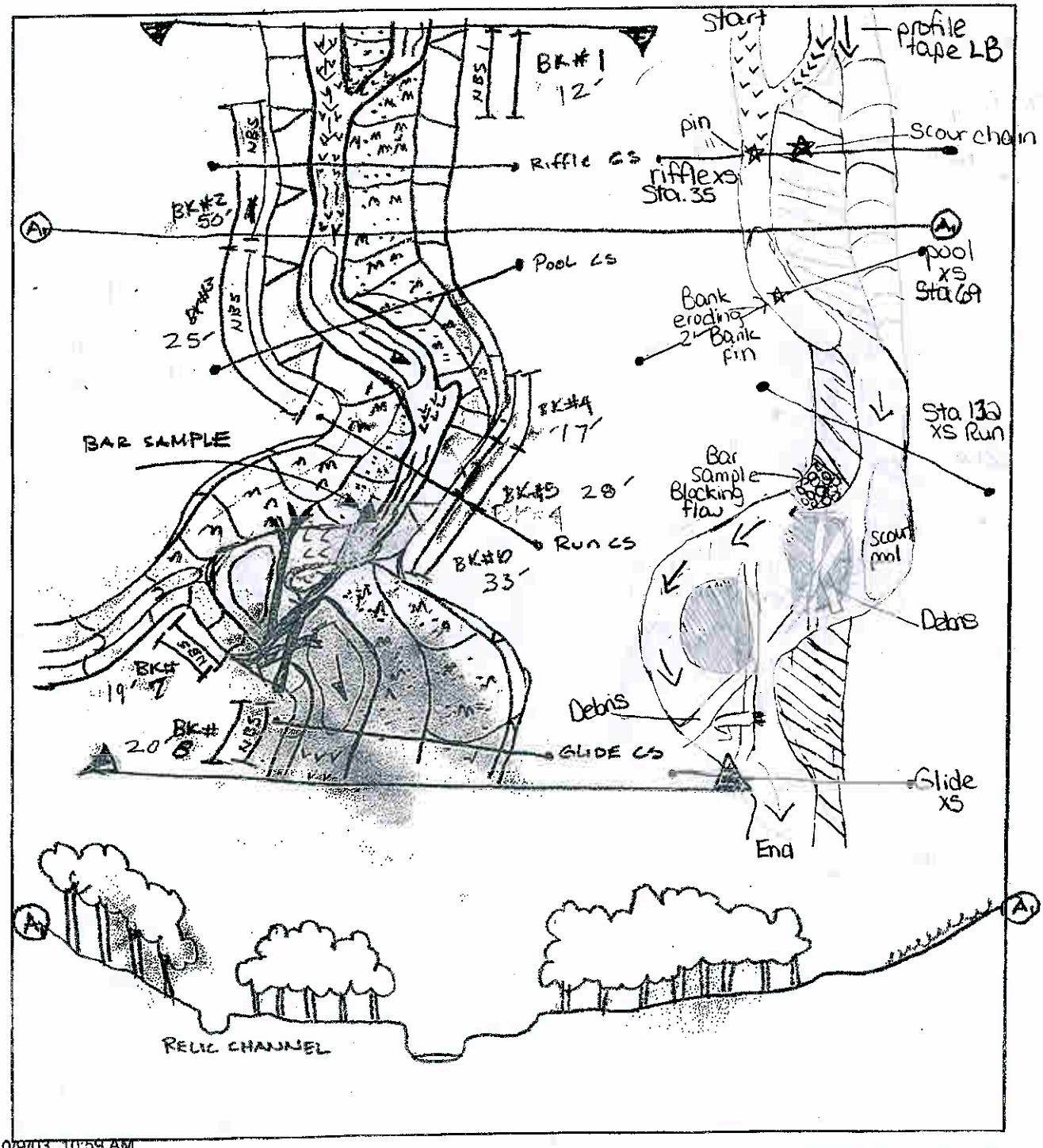
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

Team 2
Day 2
UT Little Bennett
Degraded Reach

FWS-SHARP

Notes

Stream: UT LITTLE BENNETT	Page 1 of 1
Reach 2	Date: 12/12/06 9/21/07
	Crew: RRS



UT Little Bennett Creek Team 2 9/21/2007

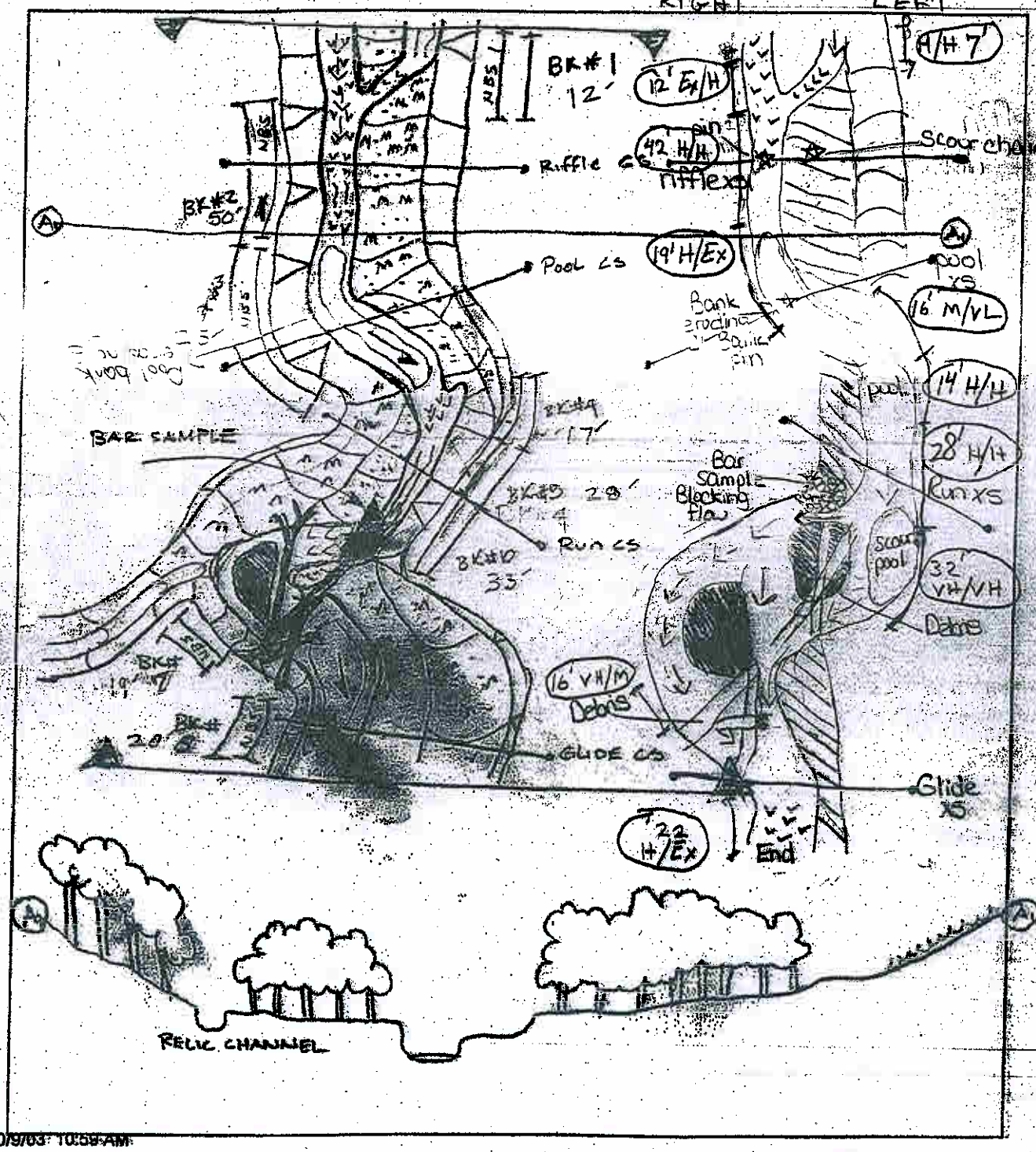
BEHI Locations 2007

FWS-SHARP

Ag-small watershed

Notes

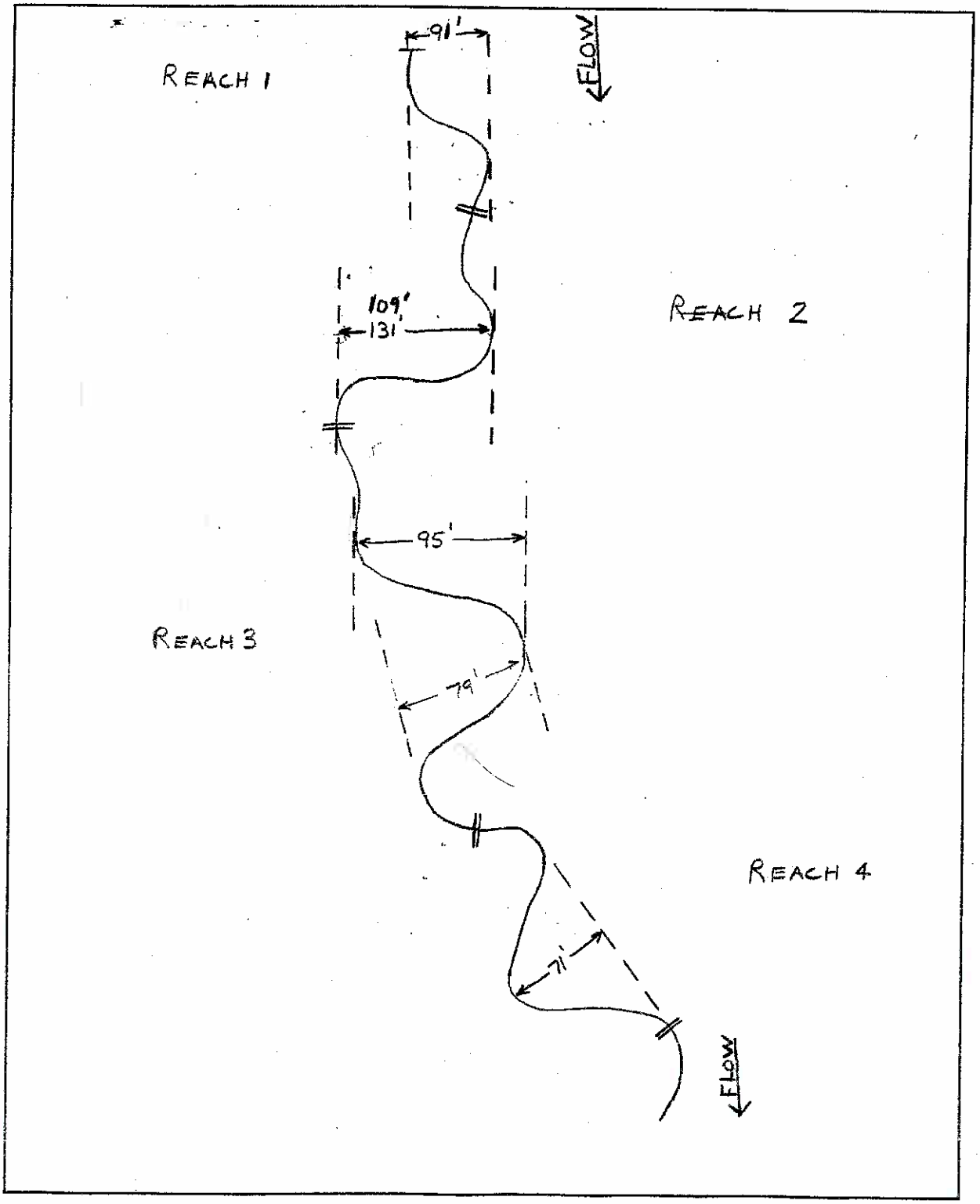
Stream: UT LITTLE BENNETT	Page 1 of 1
Reach 2	Date: 12/12/06
	Crew: RRS



FWS-SHARP

Notes

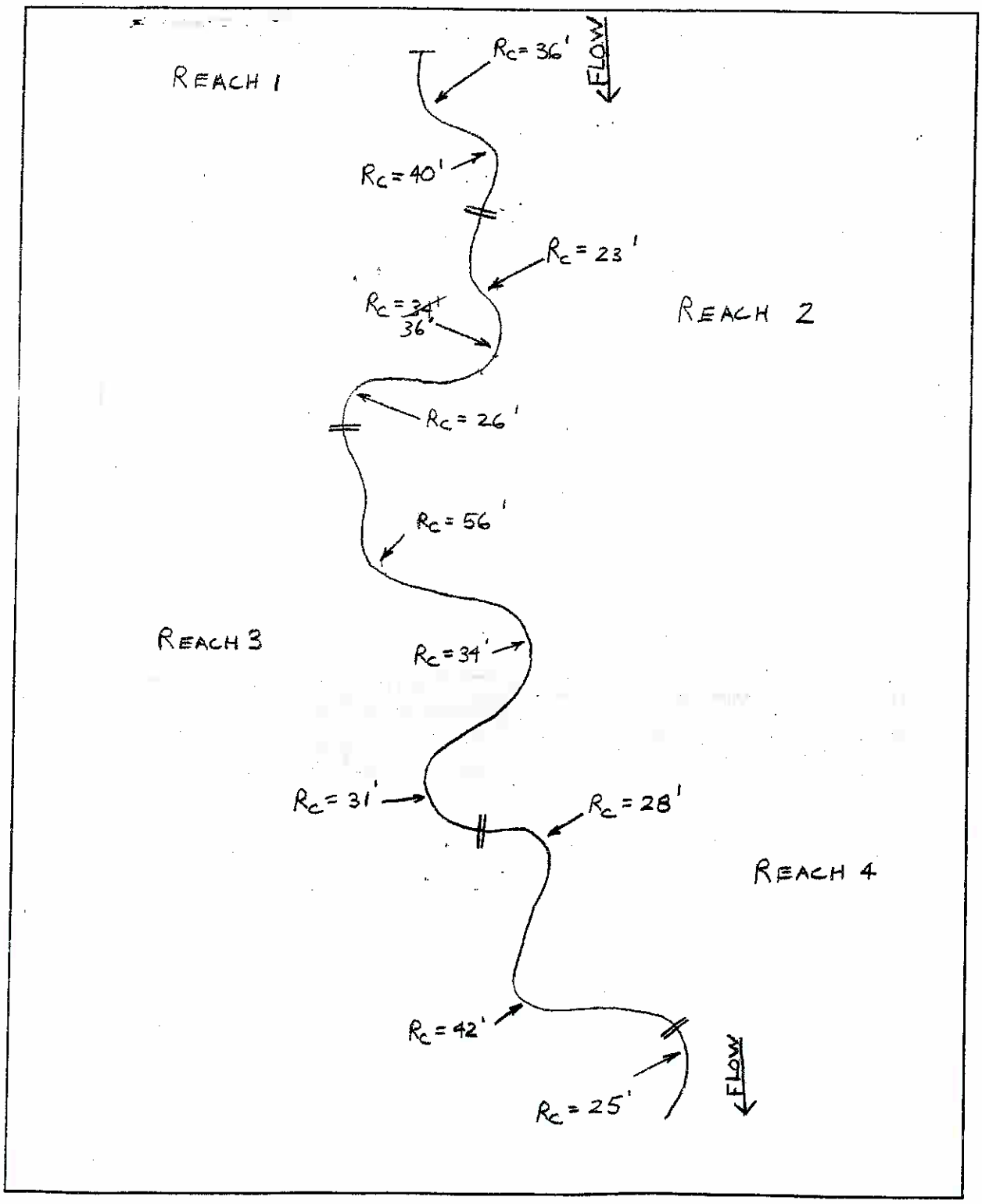
Stream: UT Little Bennett	Page 3 of 3
Reach: Geometry Map	Date: 12/20/06 09/21/07
Belt Width	Crew: SHARP Team 2



FWS-SHARP

Notes

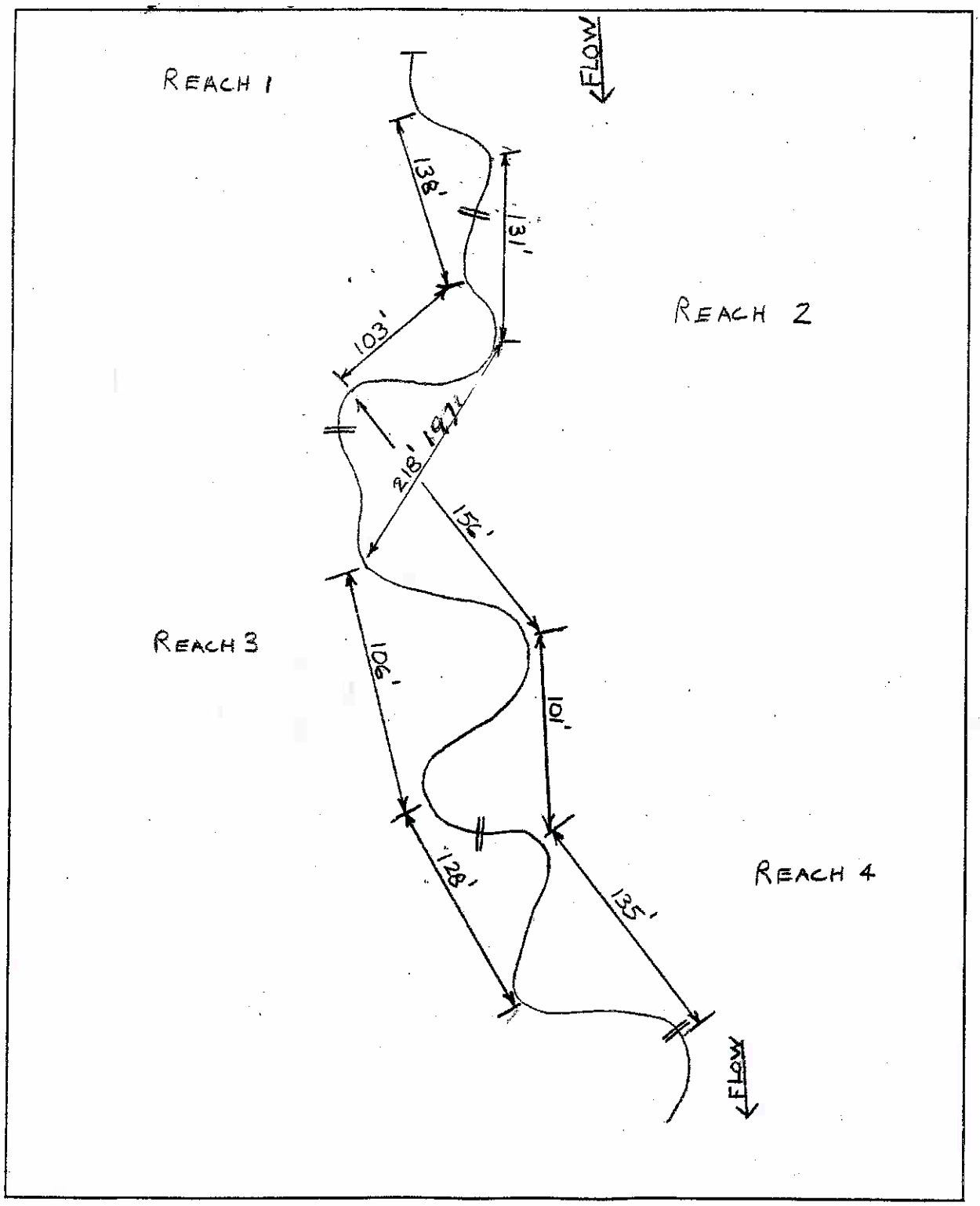
Stream: UT Little Bennett	Page 1 of 3
Reach: Geometry Map	Date: 12/20/06 09/21/07
Radius of Curvature	Crew: SHARP Team 2



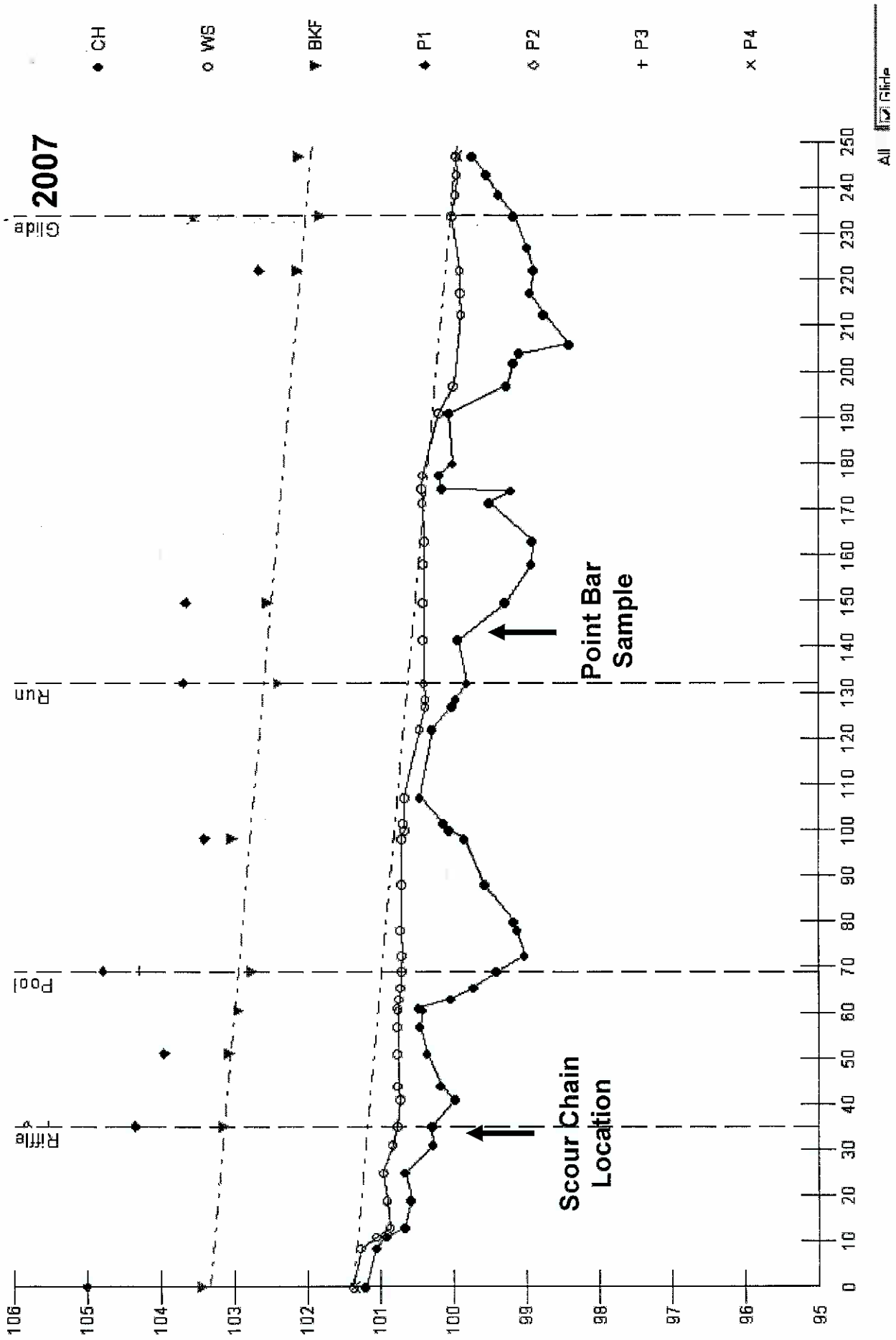
FWS-SHARP

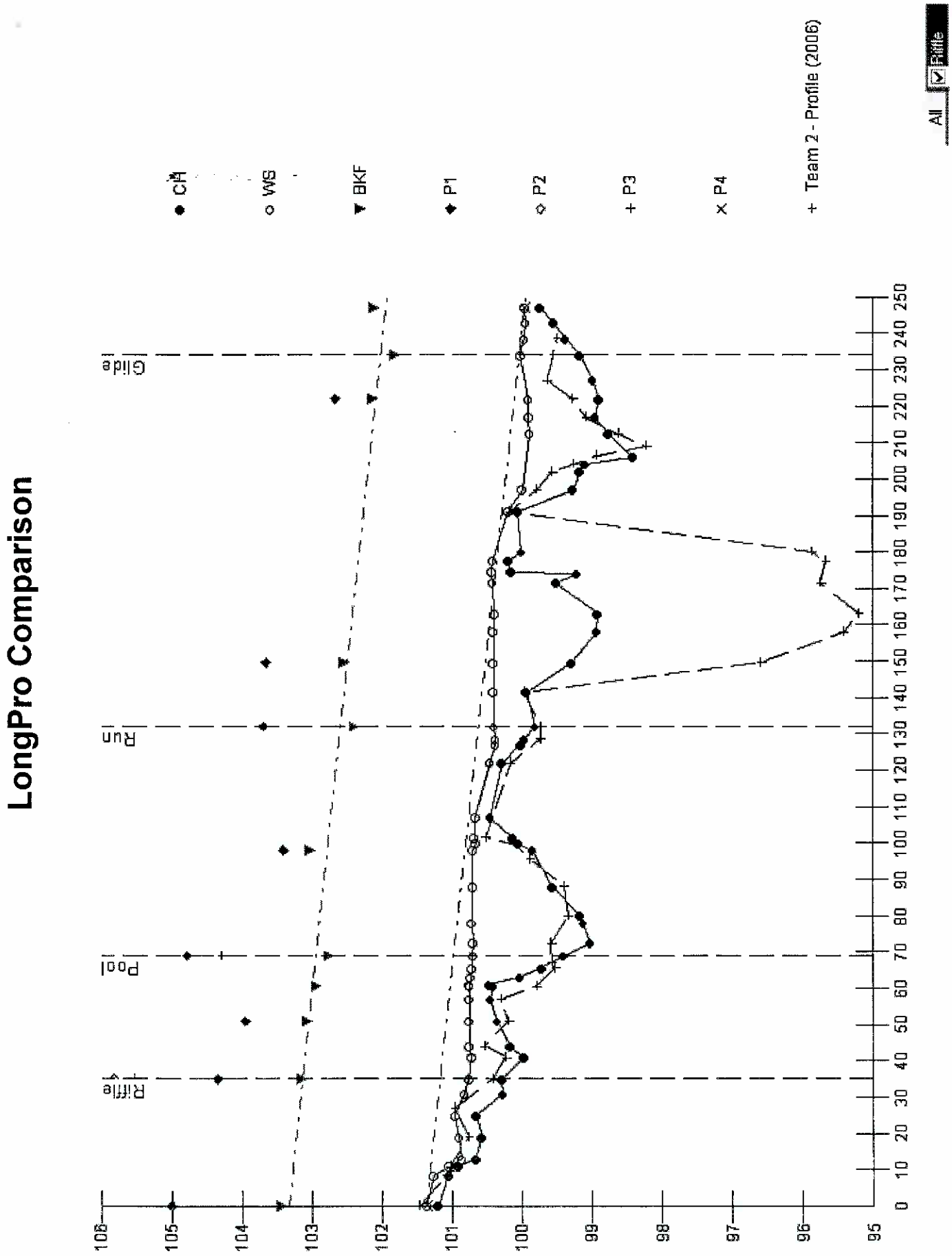
Notes

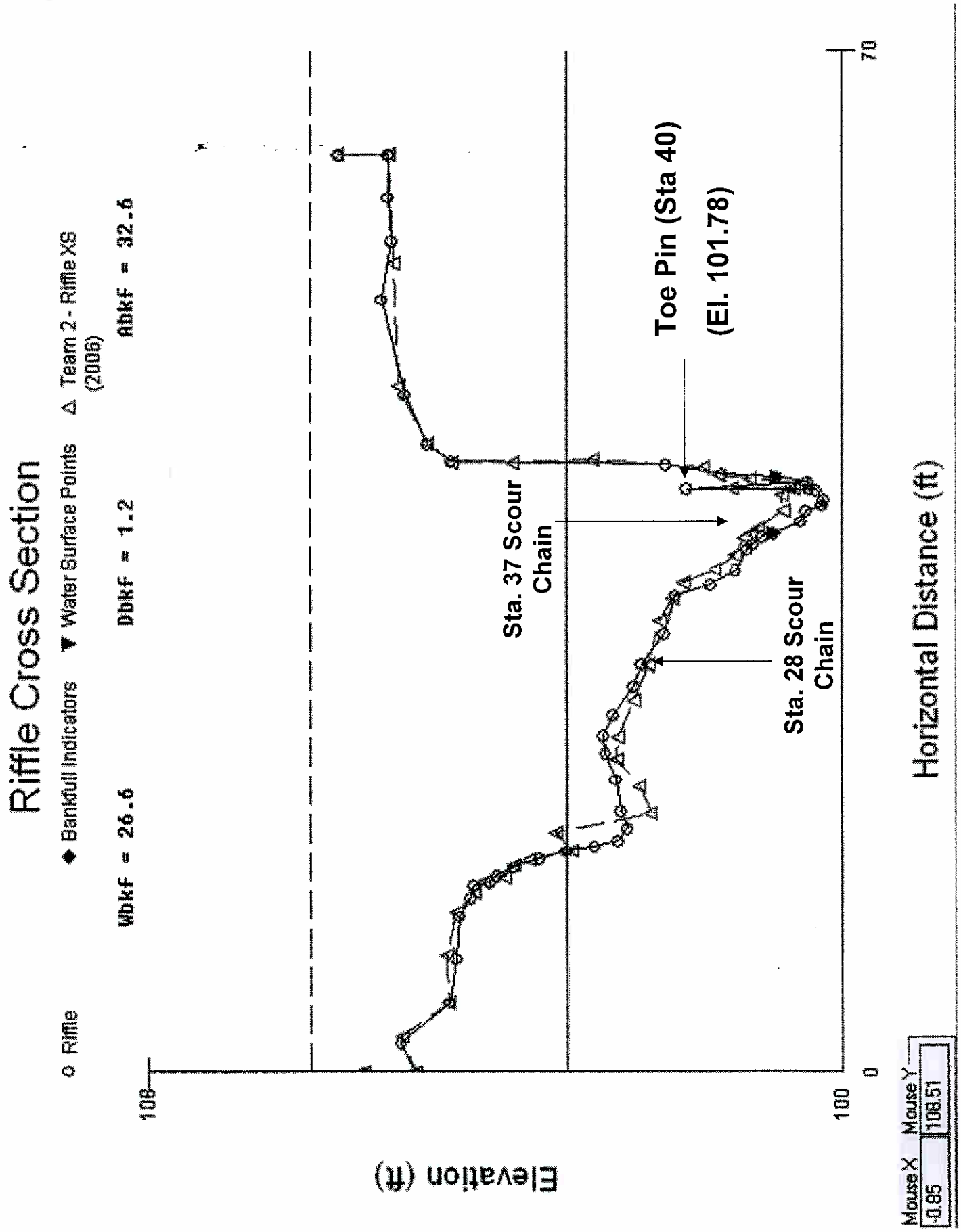
Stream: UT Little Bennett	Page 2 of 3
Reach: Geometry Map	Date: 12/20/06 / 09/21/07
Meander Wavelength	Crew: SHARP Team 2

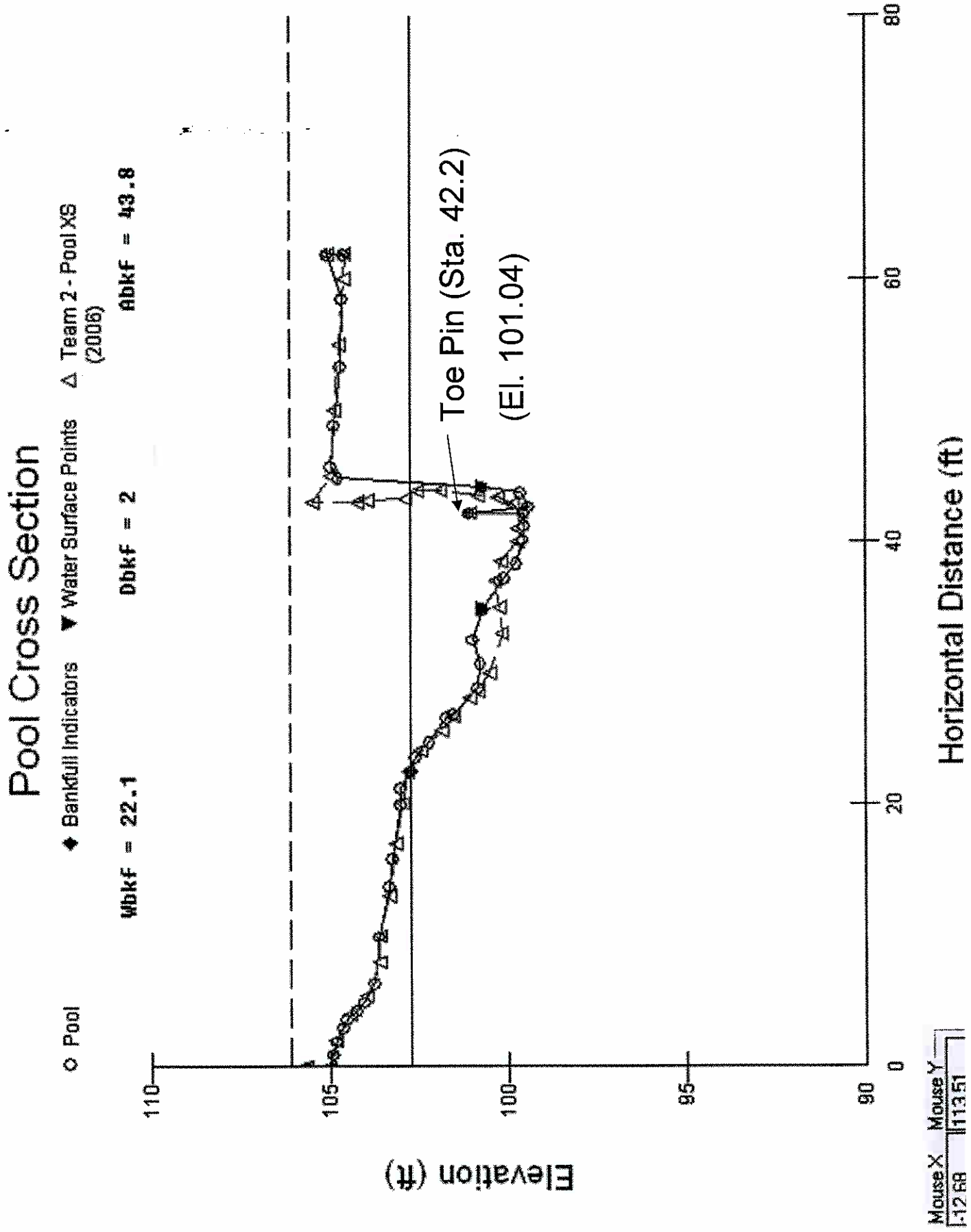


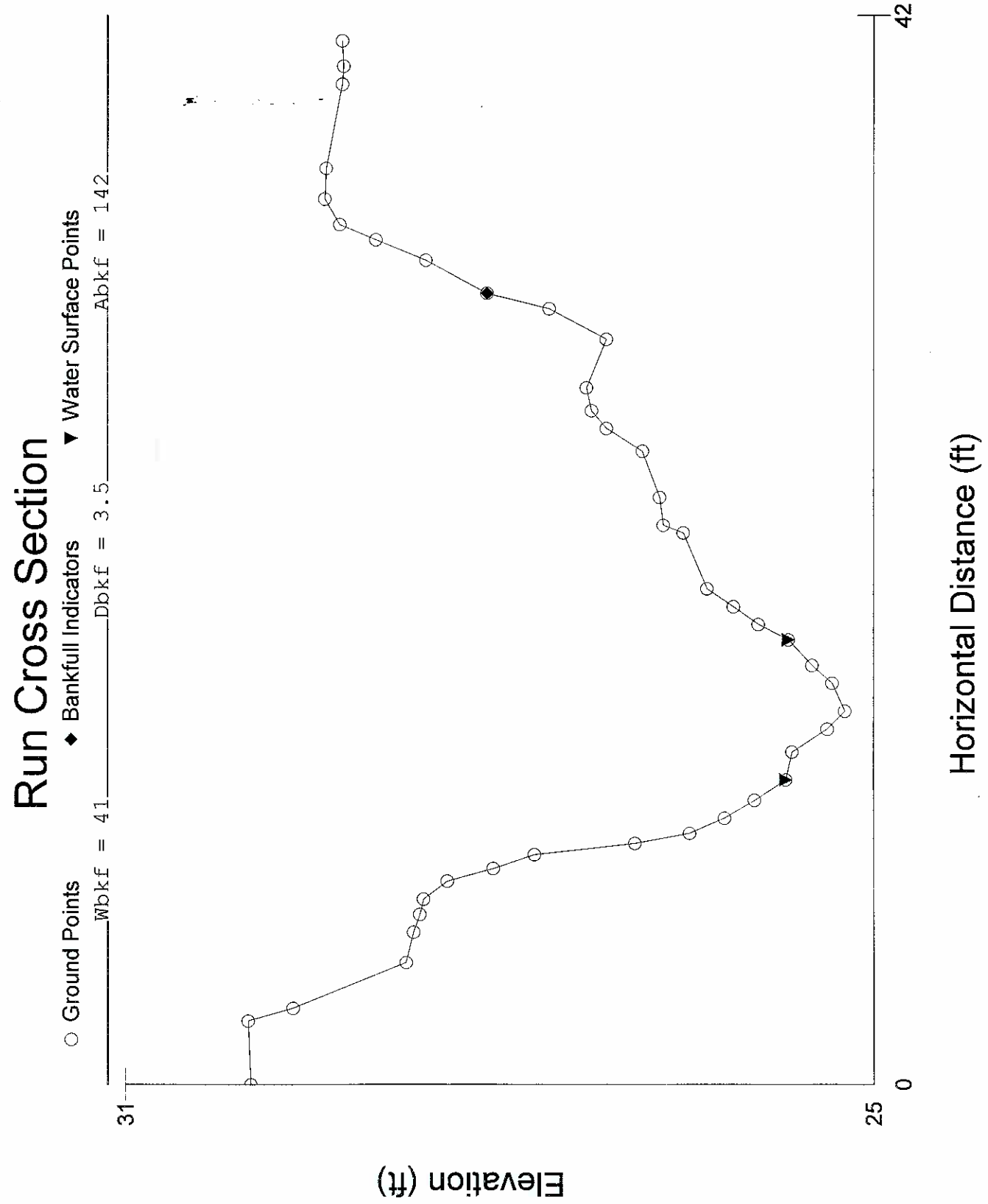
UT Little Bennett Creek Team 2 9/21/2007

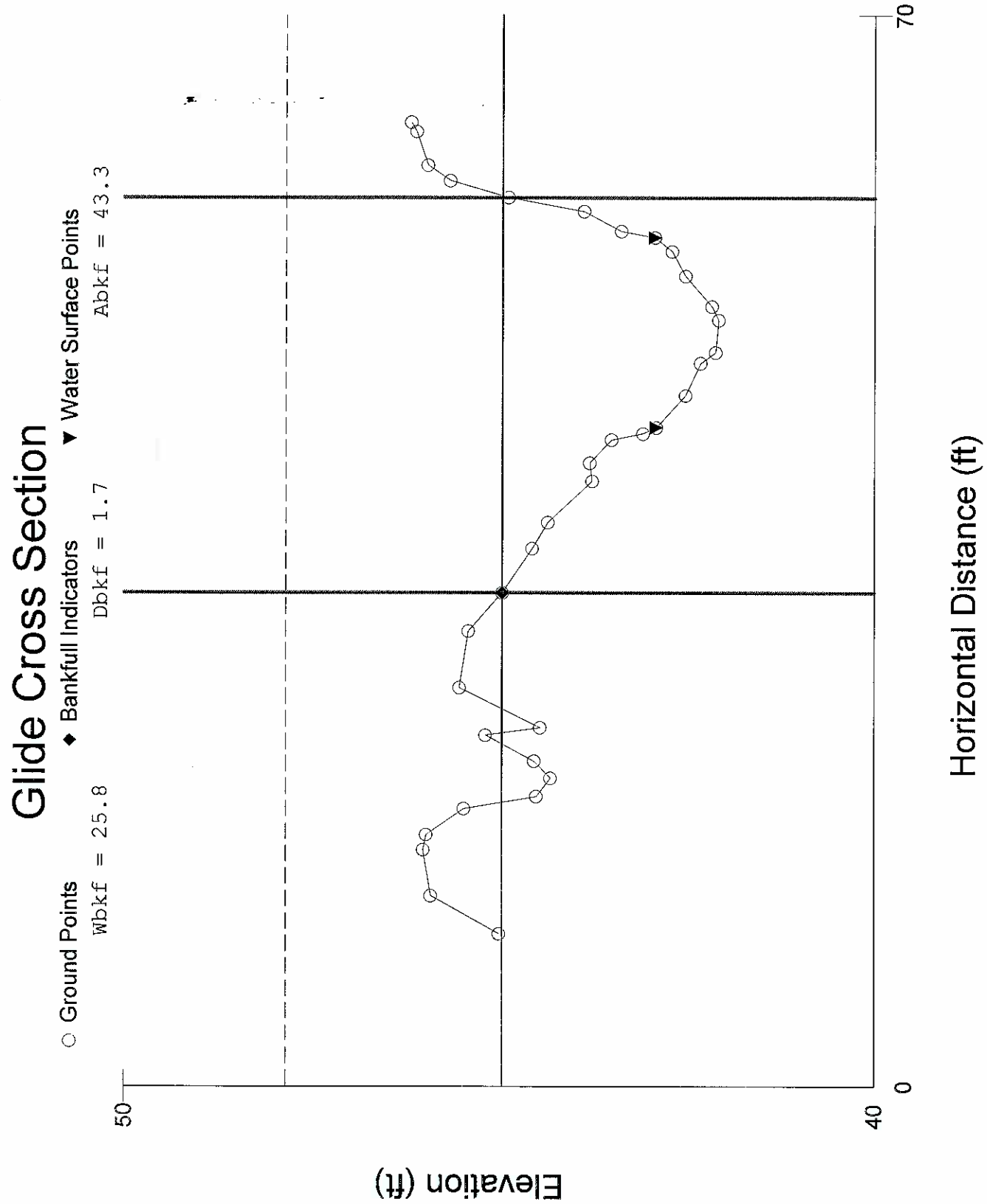


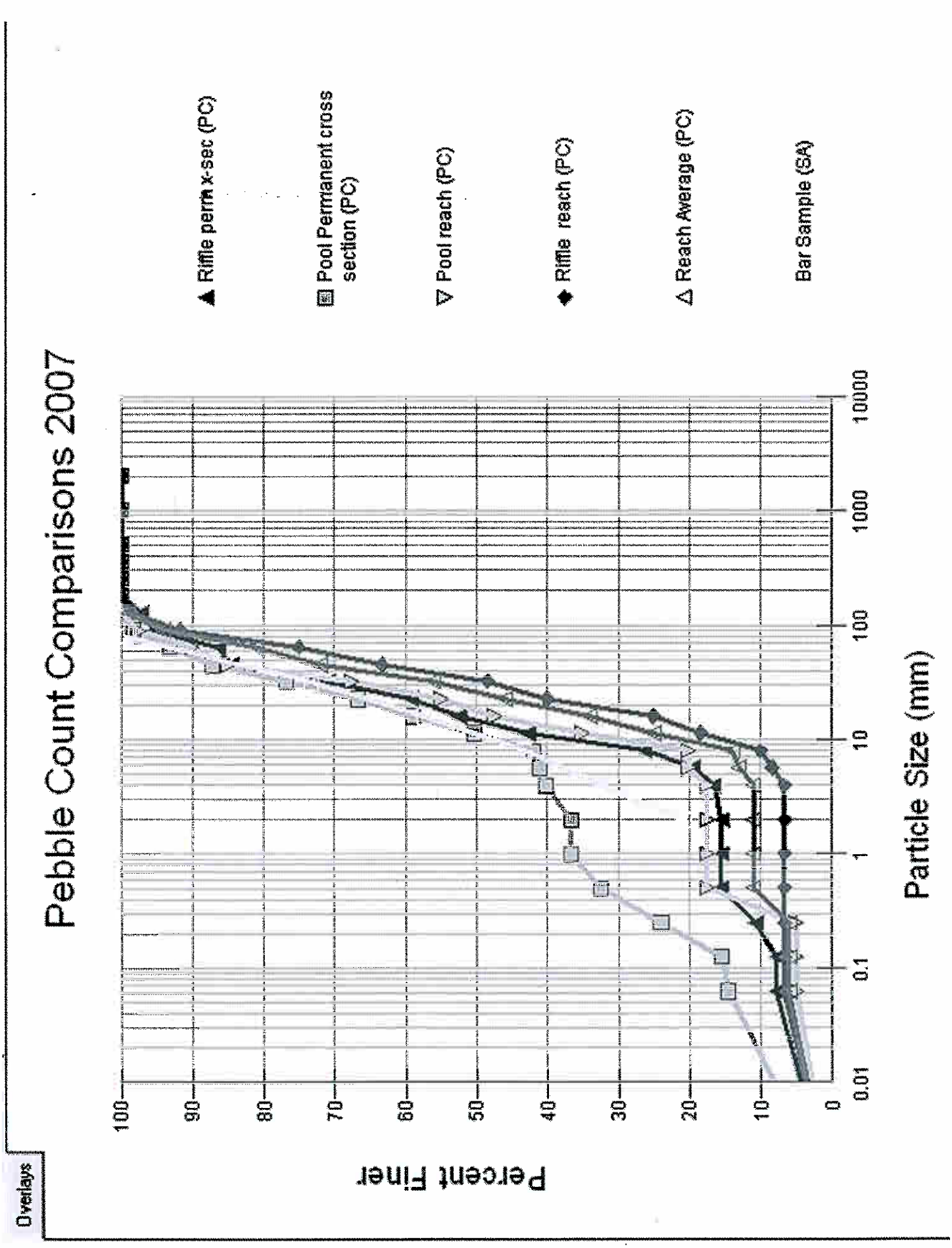

LongPro Comparison
CH
WS
BKF
P1
P2
P3
P4
Team 2 - Profile (2006)
All
Riffle
Riffle
Pool
Run
Glide
106
105
104
103
102
101
100
99
98
97
96
95
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

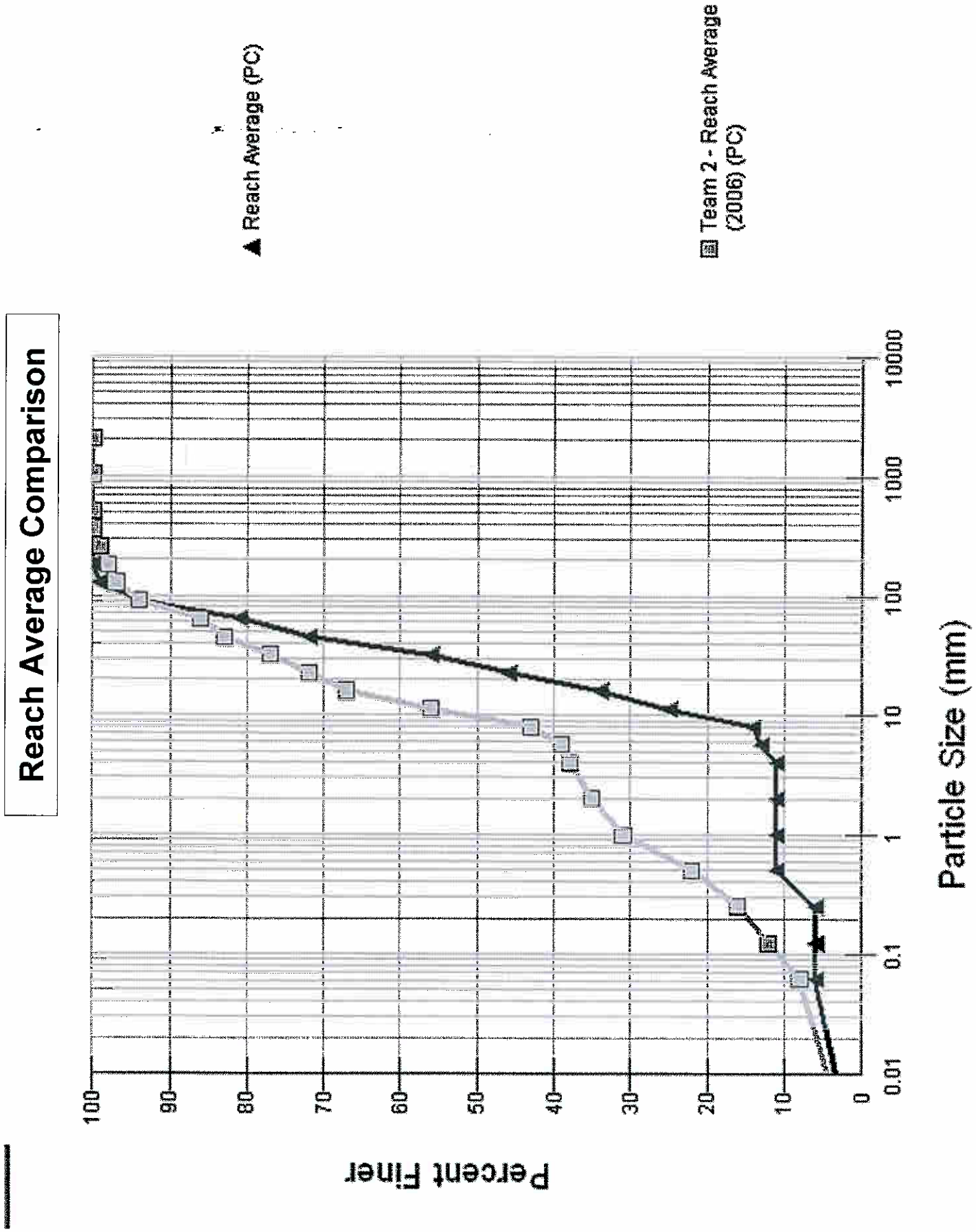

Riffle Cross Section
Riffle
Bankfull Indicators
Water Surface Points
Team 2 - Riffle XS (2006)
Wbkf = 26.6
Dbkf = 1.2
Abkf = 32.6
Toe Pin (Sta 40)
(El. 101.78)
Sta. 37 Scour Chain
Sta. 28 Scour Chain
Elevation (ft)
Horizontal Distance (ft)
108
100
0
70
Mouse X
-0.85
Mouse Y
108.51

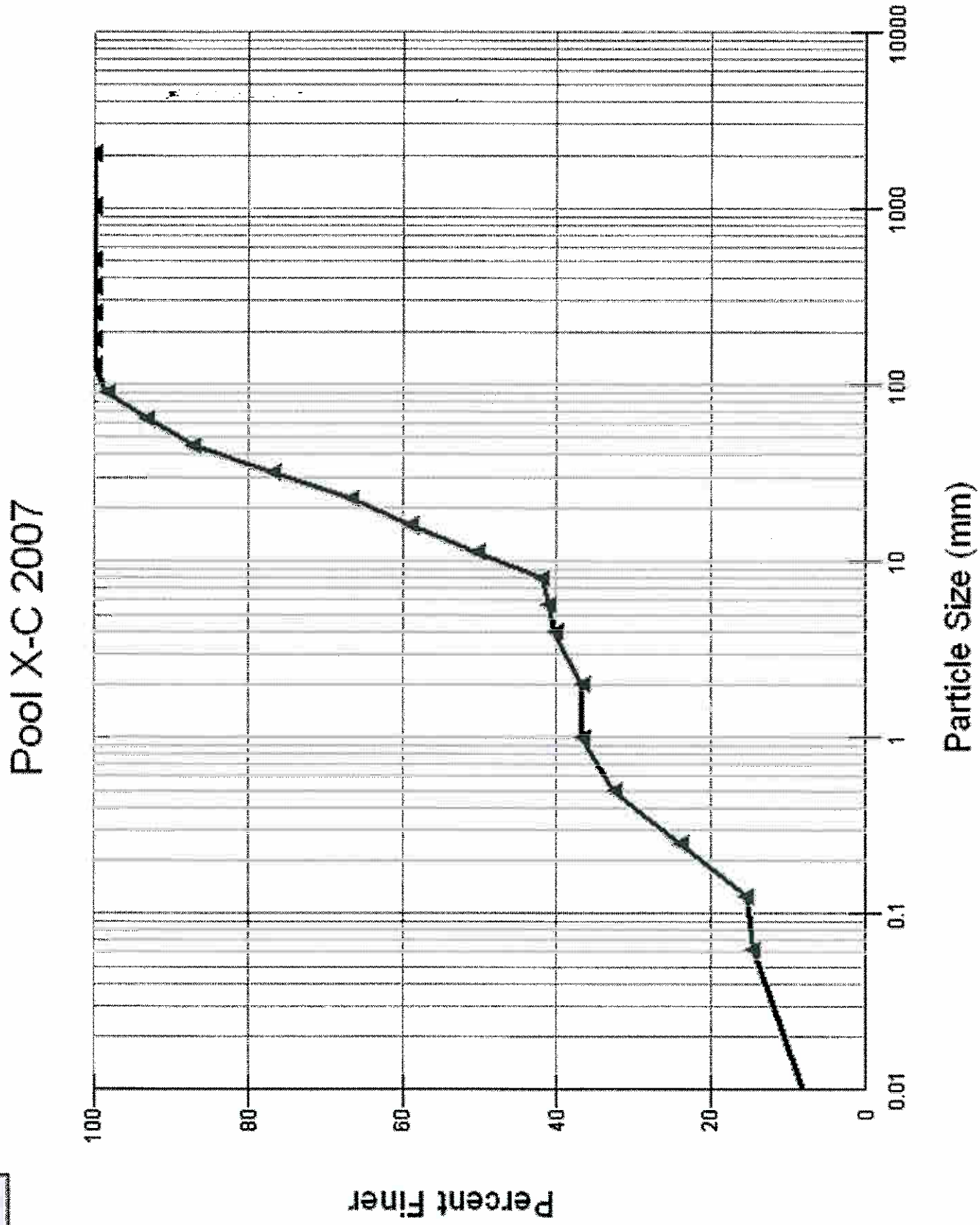

Pool Cross Section
Pool
Bankfull Indicators
Water Surface Points
Team 2 - Pool XS (2006)
WbkF = 22.1
DbkF = 2
AbkF = 43.8
Toe Pin (Sta. 42.2)
(El. 101.04)
Elevation (ft)
110
105
100
95
90
0
20
40
60
80
Horizontal Distance (ft)
Mouse X
Mouse Y
-12.68
113.51


Run Cross Section
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 41
Dbkf = 3.5
Abkf = 142
31
25
0
42
Elevation (ft)
Horizontal Distance (ft)

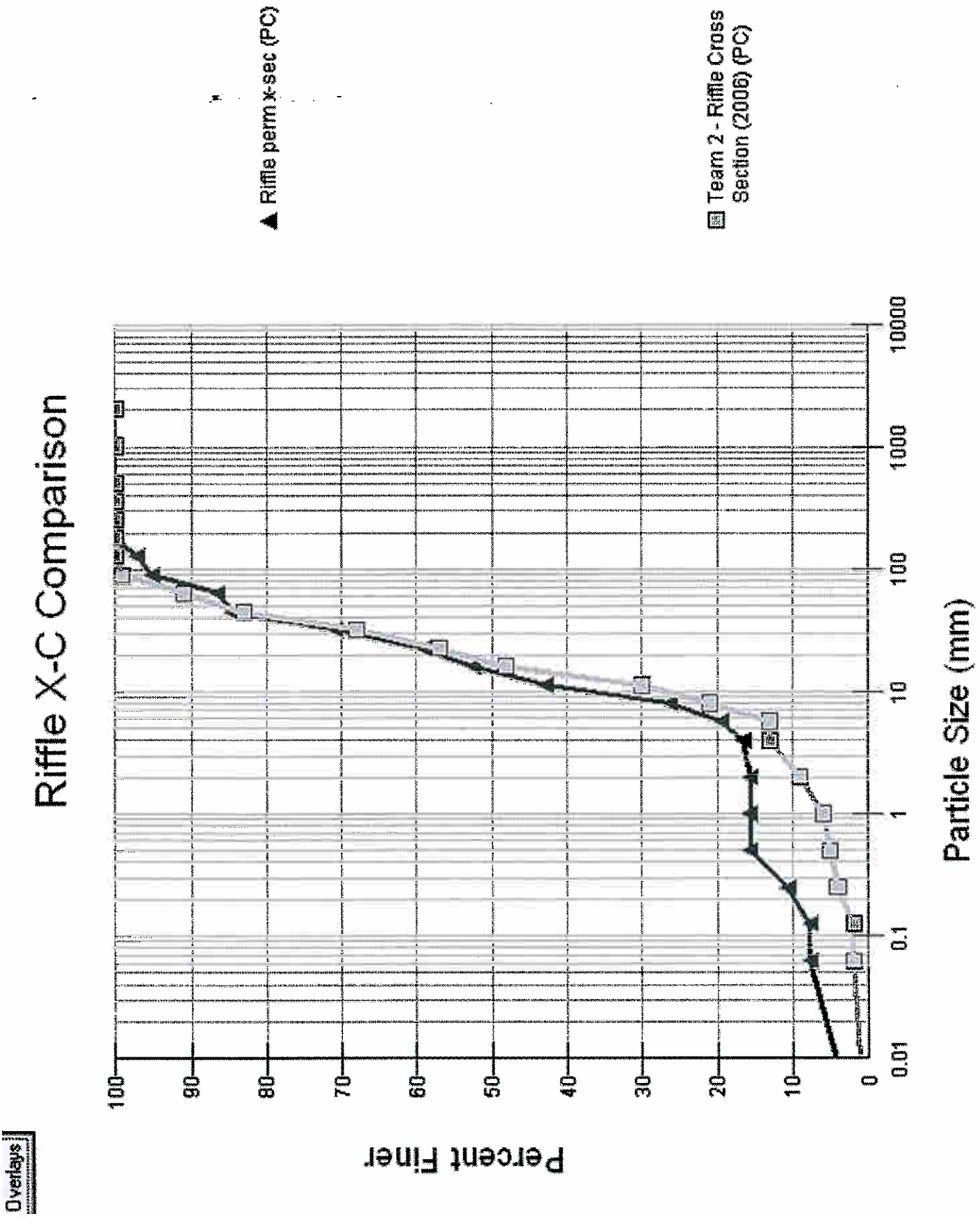

Glide Cross Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.8
Dbkf = 1.7
Abkf = 43.3
50
40
0
70
Elevation (ft)
Horizontal Distance (ft)

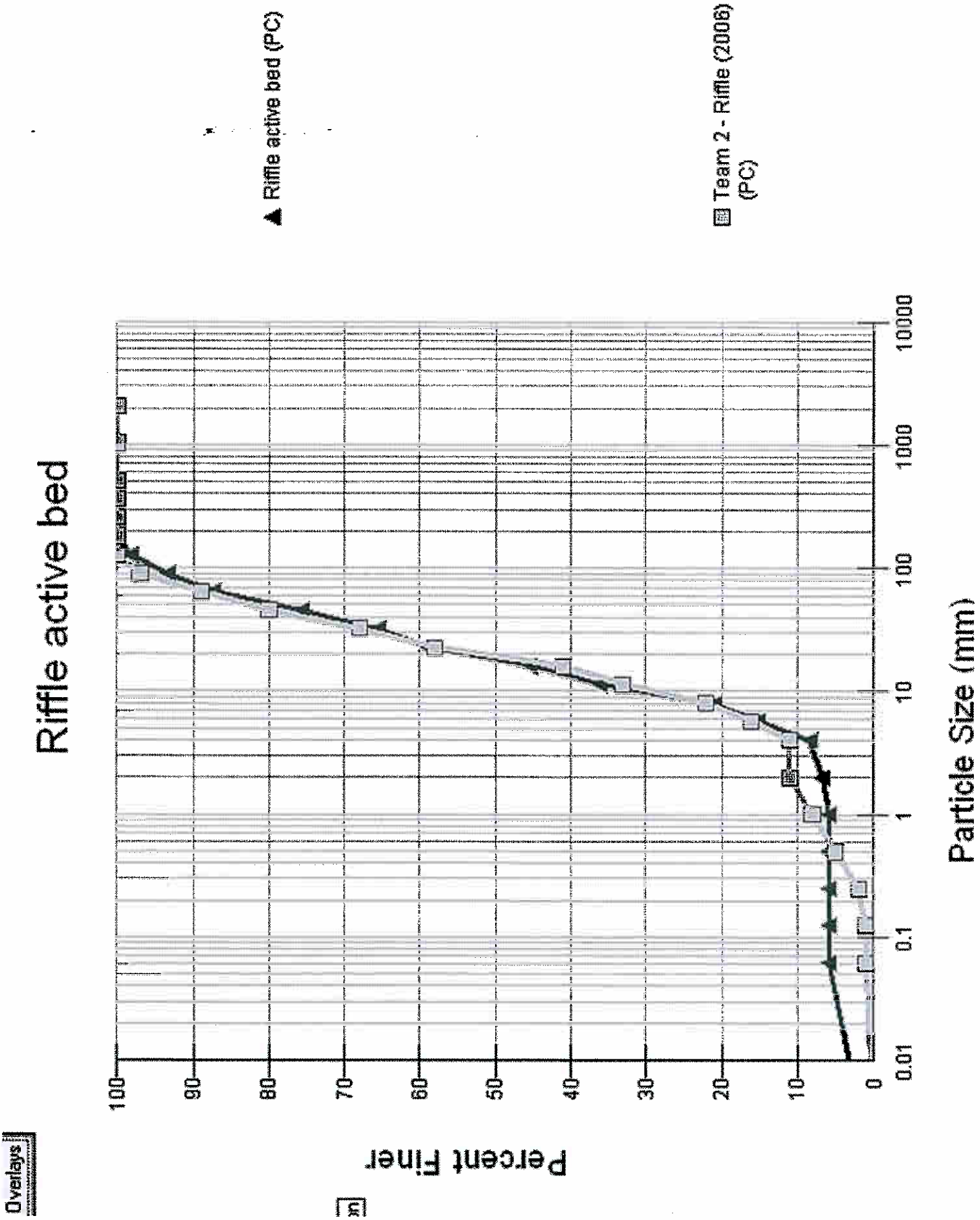

Pebble Count Comparisons 2007
Riffle perm x-sec (PC)
Pool Permanent cross section (PC)
Pool reach (PC)
Riffle reach (PC)
Reach Average (PC)
Bar Sample (SA)
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Overlays

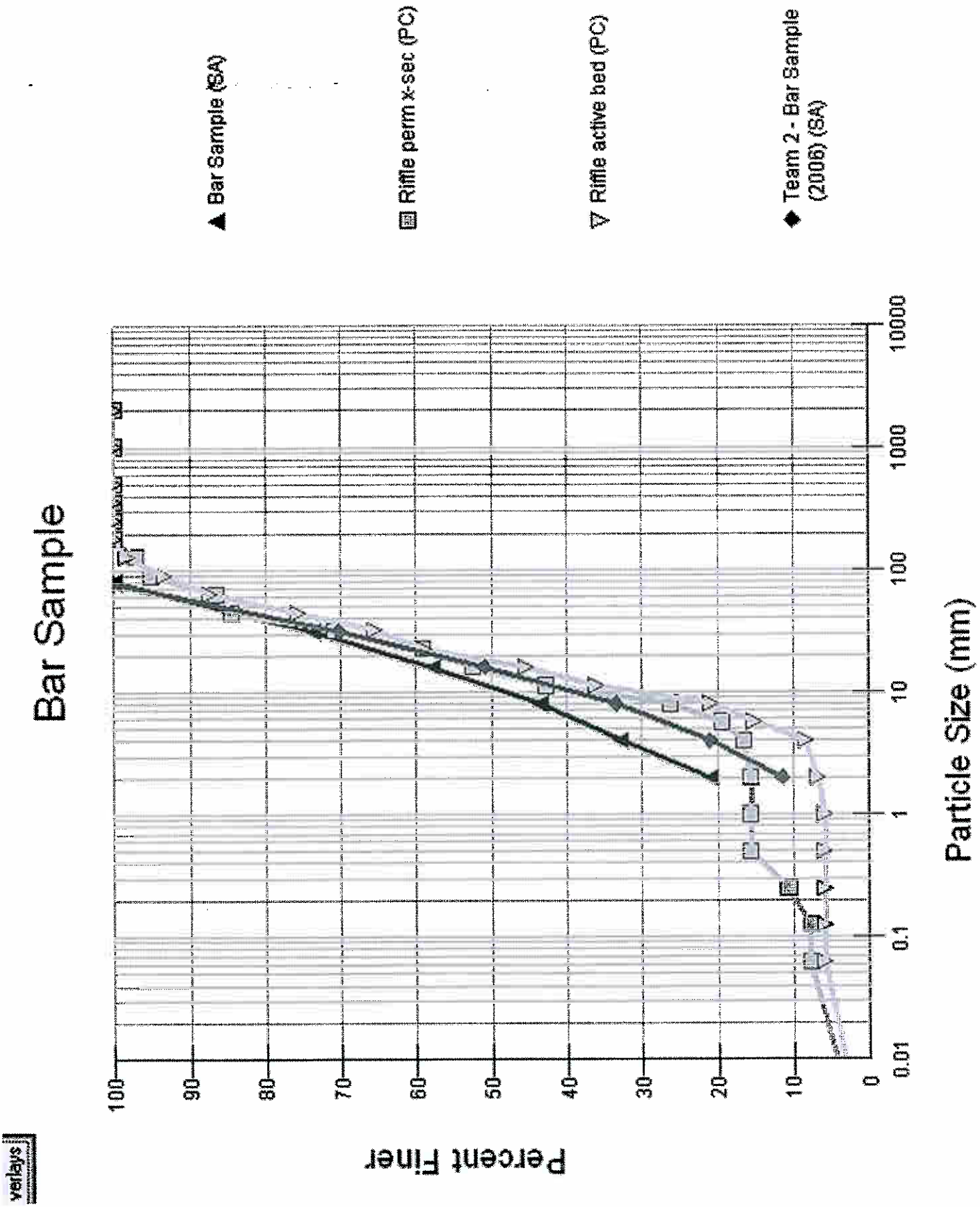

Reach Average Comparison
Reach Average (PC)
Team 2 - Reach Average (2006) (PC)
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)


Pool X-C 2007
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

verlays


Riffle X-C Comparison
Riffle perm x-sec (PC)
Team 2 - Riffle Cross Section (2006) (PC)
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Overlays


Riffle active bed
Riffle active bed (PC)
Team 2 - Riffle (2006) (PC)
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Overlays


Bar Sample
Bar Sample (SA)
Riffle perm x-sec (PC)
Riffle active bed (PC)
Team 2 - Bar Sample (2006) (SA)
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-1. Level II stream classification form.

Stream:	Little Bennet Team 2		
Basin:	Drainage Area:	acres	1.7 mi²
Location:			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date:	9/21/07
Observers:		Valley Type:	VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	26.6	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.2	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	32.6	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	22.2	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.96	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	190	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	7.15	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	26.4	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	.0056	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.4	

Stream Type C4

Reference: *WARSSS*, **Figure 2-14**, page 2-23

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Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2005).

Stream: **2007-09 Little Bennett, Reach - Reach 1** Location: Team 2 9/21/07

Observers: Date: **9/22/2007** Valley Type: **VIII** Stream Type: **C 4**

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.22	ft	Riffle Width (W_{bkf})	26.59	ft	Riffle Area (A_{bkf})	32.57	ft^2
Mean Pool Depth (d_{bkfp})	1.99	ft	Pool Width (W_{bkfp})	22.06	ft	Pool Area (A_{bkfp})	43.85	ft^2
Mean Pool Depth/Mean Riffle Depth	1.63	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.83	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.35	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf}) 2.76	[redacted]	ft	Max Pool Depth (d_{mbkfp}) 3.99	[redacted]	ft	Max Riffle Depth/Mean Riffle Depth	[redacted]	(1.25)
Max Pool Depth/Mean Riffle Depth	[redacted]	1.31				Point Bar Slope	0.69	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				3.68	ft/s	Estimation Method	Stream Type	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				120	cfs	Drainage Area	1.7	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	130	103	156	ft	Meander Length Ratio (Lm/W_{bkf})	4.89	3.87	5.87
Radius of Curvature (Rc)	30	26	34	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.13	0.98	1.28
Belt Width (W_{blt})	94	71	131	ft	Meander Width Ratio (W_{blt}/W_{bkf})	3.54	2.67	4.93
Individual Pool Length	33	30	36.8	ft	Pool Length/Riffle Width	1.24	1.13	1.38
Pool to Pool Spacing	69.5	58.9	80.2	ft	Pool to Pool Spacing/Riffle Width	2.61	2.22	3.01
Riffle Length	12.7	8.61	16.8	ft	Riffle Length/Riffle Width	0.48	0.32	0.63

Channel Profile

Valley Slope (VS)	0.0079	ft/ft	Average Water Surface Slope (S)	0.0056	ft/ft	Sinuosity (VS/S)	1.41	
Stream Length (SL)	247	ft	Valley Length (VL)	176	ft	Sinuosity (SL/VL)	1.4	
Low Bank Height (LBH) start	[redacted]	ft 4.47	Max Riffle Depth start	2.22	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth) start	[redacted]	1.83
Low Bank Height (LBH) end	[redacted]	ft 2.7	Max Riffle Depth end	2.16	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth) end	[redacted]	1.25

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.015	0.013	0.017	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	2.591	2.377	2.984
Run Slope (S_{run})	0.064	0.036	0.091	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S) 11.43	[redacted]	6.463	[redacted] 16.25
Pool Slope (S_p)	0.000	0.000	0.001	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.070	0.000	0.109
Glide Slope (S_g)	0.004	0.001	0.009	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.802	0.146	1.589

Feature Midpoint[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	2.37	2.17	2.96	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.94	1.78	2.43
Run Depth (d_{run})	2.78	2.64	2.95	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	2.28	2.16	2.42
Pool Depth (d_p)	3.73	3.5	3.89	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	3.06	2.87	3.19
Glide Depth (d_g)	2.98	2.88	3.13	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	2.44	2.36	2.57

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	6	7.77	0	D_{16}	8.6	2.97	0	0	mm
% Sand	5	7.76	20.84	D_{35}	16.55	9.76	4.82	0	mm
% Gravel	70	70.88	64.87	D_{50}	26.36	14.82	11.61	0	mm
% Cobble	19	13.59	14.29	D_{84}	70	44.55	58.48	0	mm
% Boulder	0	0	0	D_{95}	97.6	89.55	87	0	mm
% Bedrock	0	0	0	D_{100}	179.99	180	80	0	mm

a Min, max, mean depths are the average mid-point values except pools, which are taken at deepest part of pool.
b Composite sample of riffles and pools within the designated reach.
c Active bed of a riffle.
d Height of roughness feature above bed.

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-3. Bankfull velocity and discharge estimates.

Bankfull VELOCITY / DISCHARGE Estimates

Site		Location	
Date		Stream Type		Valley Type	
Observers		HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	32.6	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.2	D_{bkf} (Ft)
Bankfull WIDTH	26.6	W_{bkf} (Ft)	Wetted PERIMETER – $2 * d_{bkf} + W_{bkf}$	29	W_{Pbkf} (Ft)
D84 @ Riffle	58.5	Dia. (mm)	D84 mm / 304.8 =	.19	D84 (Ft)
Bankfull SLOPE	.0056	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.12	R (Ft)
Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	5.9	
Drainage AREA	1.7	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.45	u^* (Ft / Sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 Log\{ R / D84 \}]u*$	3.23	Ft / Sec	105	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895*R^{2/3}*S^{1/2}/n$ n = .035	3.42	Ft / Sec	111.5	CFS
2. Roughness Coefficient: $u = 1.4895* R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39S^{.38}R^{-.16}$ n = .056 Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.	2.25	Ft / Sec	73	CFS
2. Roughness Coefficient: $u = 1.4895* R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type n = .032 u = 3.757	3.757	Ft / Sec	122.5	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)		Ft / Sec		CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)		Ft / Sec		CFS
4. Continuity Equations: a) Regional Curves u = Q / A Return Period for Bankfull Discharge Q = 120	5.68	Ft / Sec	120	CFS
4. Continuity Equations: b) USGS Gage Data u = Q / A		Ft / Sec		CFS

Options for using the D84 term in the **relative roughness relation** (R/D84), when using estimation method 1.

Option 1. For **sand-bed** channels: measure the "**protrusion height**" (h_{sd}) of sand dunes above channel bed elevations. Substitute an average sand dune protrusion height (h_{sd} in feet) for the D84 term in estimation method 1.

Option 2. For **boulder-dominated** channels: measure several "**protrusion heights**" (h_{bo}) of boulders above channel bed elevations. Substitute an average boulder protrusion height (h_{bo} in feet) for the D84 term in estimation method 1.

Option 3. For **bedrock-dominated** channels: measure several "**protrusion heights**" (h_{br}) of rock separations/steps/joints/ uplifted surfaces above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D84 term in estimation method 1.

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a. Riparian Vegetation

Worksheet B-4. Riparian vegetation composition/density used for channel stability assessment.

Riparian Vegetation

Stream: UT Little Bennett

Location: R2

Observers: GROUP 2

Reference reach ☐

Disturbed (impacted reach) ☑

Date: 9/22/07

Existing species composition: Sycamore, Green Ash, Silver Maple, Boxelder forest association

Potential species composition: SAME

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	60	15	Red Maple	20
				Am. Sycamore	20
				Black Walnut	15
				Elm	15
				Tulip-poplar	15
				Green Ash	15
					100%
2. Understory	Shrub layer		15	Spicebush	40
				Ironwood	40
				Multiflora rose	10
				Am. Sycamore	10
					100%
3. Ground level	Herbaceous		55	Stiltgrass	
				Smartweed	
				Sycamore	
				Red Maple	
					100%
	Leaf or needle litter		10		
	Bare ground		5		
			Column total = 100%		

*Based on crown closure.
**Based on basal area to surface area.

Remarks:

Condition, vigor and/or usage of existing reach: Health is fair. Root mass no longer providing bank protection. LWD recruitment is high. Red Maple/Sycamore are regenerating @ raw surfaces and on bars.

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b. Flow Regime

Worksheet B-5. Flow Regime variables that influence channel characteristics, sediment regime and biological interpretations.

FLOW REGIME

Stream: LITTLE BENNET CREK.	Location: MONTG. CO. MD REACH 2							
Observers: TEAM 2	Date: 9/21/07							
List ALL COMBINATIONS that APPLY.....	P2							

General Category

E	Ephemeral stream channels: flows only in response to precipitation. Often used in conjunction with intermittent.
S	Subterranean stream channel: flows parallel to and near the surface for various seasons - a sub-surface flow that follows the stream bed.
I	Intermittent stream channel: one that flows only seasonally or sporadically. Surface sources involve springs, snowmelt, artificial controls, etc. Often this term is associated with flows that reappear along various locations of a reach then run subterranean.
P	Perennial stream channels: surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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c. Stream Size and Order

Worksheet B-6. Stream size/order categories for stratification by stream type.

Stream Size and Order			
Stream: LITTLE BENNETT CREK			
Location: MONTG. CO., MD REACH 2			
Observers: TEAM 2			
Date: 9/21/07			
Stream Size Category and Order ☞			S-4(2)
Category	**STREAM SIZE: Bankfull width**		**Check (✓) appropriate category**
	meters	**feet**	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9	15 – 30	✓
S-5	9 – 15	30 – 50	☐
S-6	15 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46	100 – 150	☐
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐
Stream Order			
Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).			

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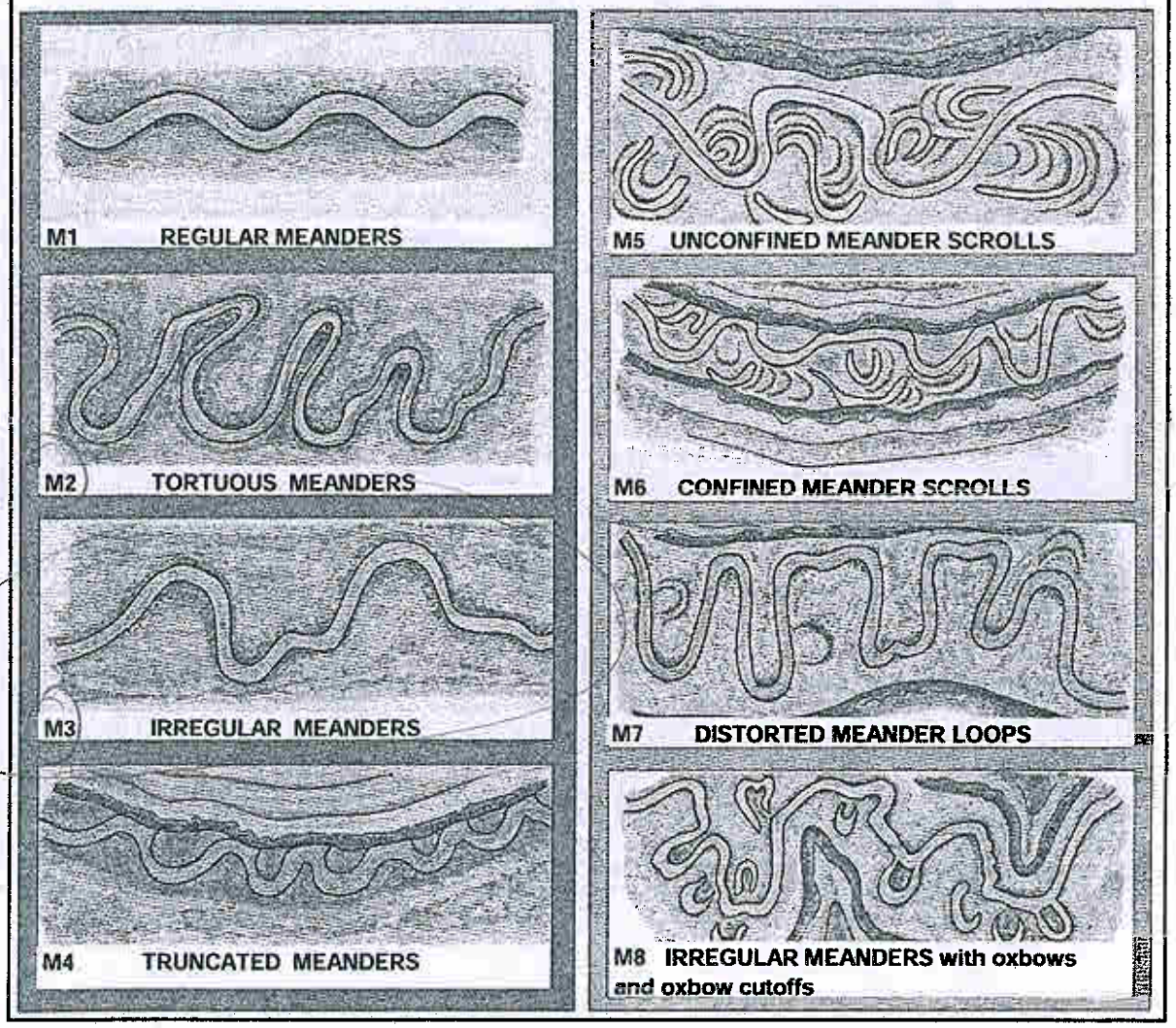
d. Meander Patterns

Worksheet B-7. Meander pattern relations used for interpretations for river stability.

Meander Patterns					
Stream: LITTLE BENNETT CREEK		Reach: 2 MONTG. CO., MD			
Observers: TEAM 2		Date: 9/21/07			
List ALL CATEGORIES that APPLY	M3	M2			

Various Meander Pattern variables modified from Galay et al. (1973)



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e. Depositional Patterns

Worksheet B-8. Depositional patterns used for stability assessment interpretations.

Depositional Patterns					
Stream: LITTLE BENNETT CREEK		Reach: 2, MONTG. CO., MD			
Observers: TEAM 2		Date: 9/21/07			
List ALL CATEGORIES that APPLY ☞	B2				

Various Depositional Features modified from Galay et al. (1973)

B1 POINT BARS

B2 POINT BARS with Few MID-CHANNEL BARS

B3 NUMEROUS MID-CHANNEL BARS

B4 SIDE BARS

B5 DIAGONAL BARS

B6 Main Channel Branching with Numerous MID-CHANNEL BARS and Islands

B7 SIDE BARS AND MID-CHANNEL BARS with Length Exceeding 2 to 3 Channel Widths

B8 DELTA BARS

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f. Channel Blockages

Worksheet B-9. Various categories of in-channel debris, dams and/or channel blockages used to evaluate channel stability.

Channel Blockages			
Stream: LITTLE BENNETT CRK		Location: MONTGOMERY CO., MD	
Observers: TEAM 2		Date: 9/21/07	
Description/extent		**Materials, which upon placement into the active channel or flood-prone area, may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	✓
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	✓
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	✓
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.	✓
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.	✓
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.	☐
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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g. Degree of Channel Incision (Bank-Height Ratio)

LITTLE BENNETT CREEK, MONTG. CO. MD. REACH 2

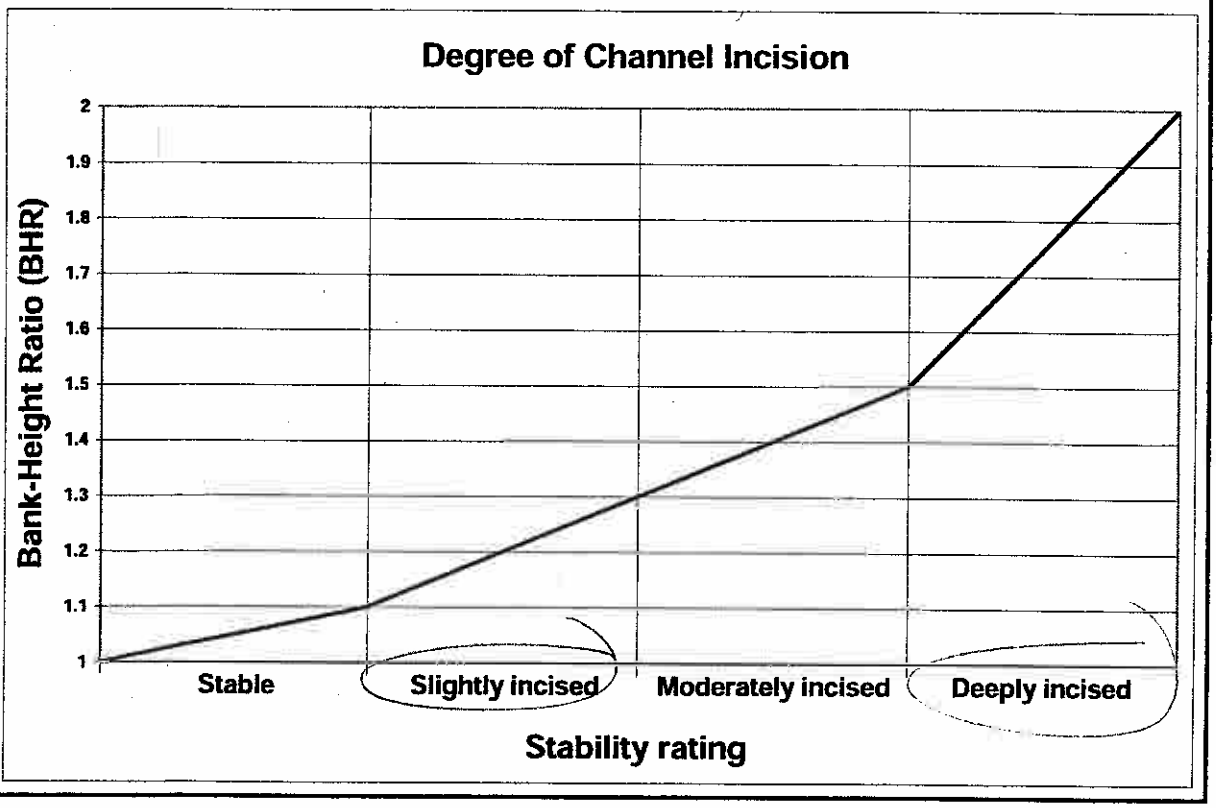
Worksheet B-10. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings to determine degree of channel incision.

Degree of Channel Incision

Low Bank Height:	4.07 / 2.70
Max Bankfull Depth:	2.22 / 2.16

Bank-Height Ratio:	1.83 / 1.25

Degree of Channel Incision Stability Rating G



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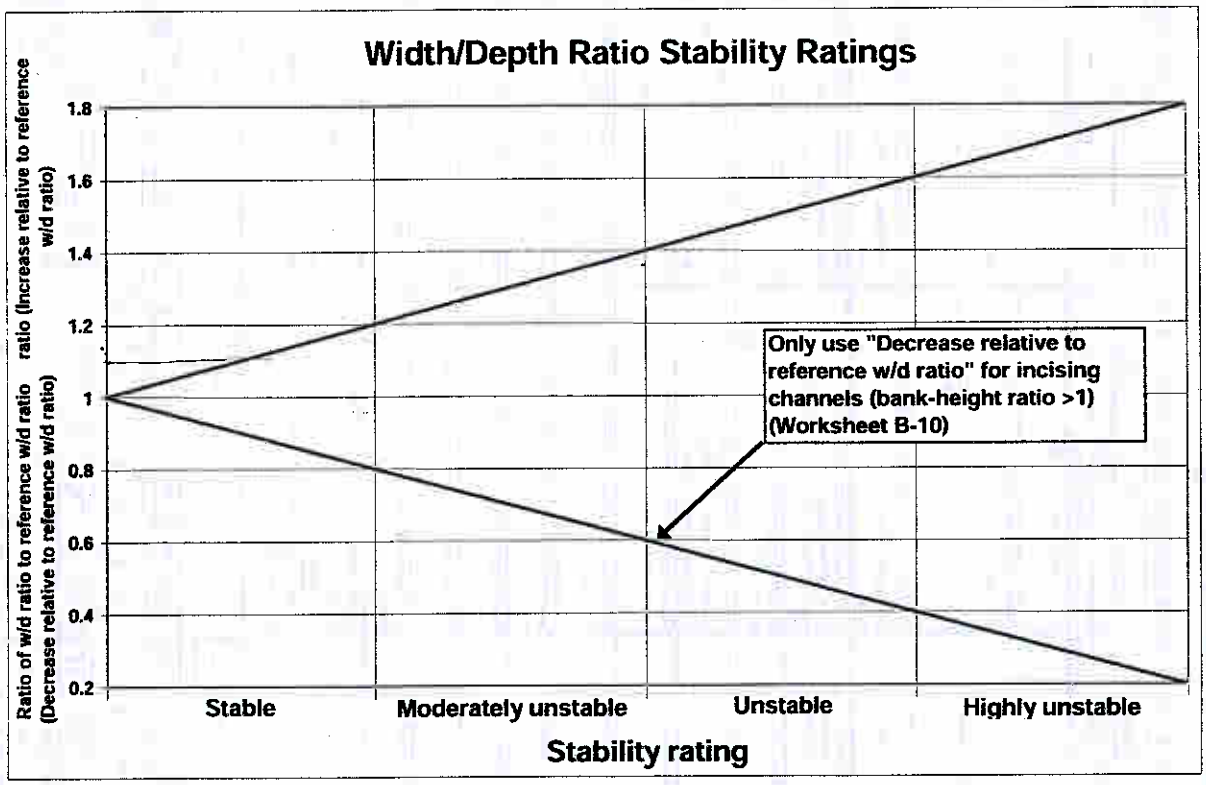
i. Width/Depth Ratio State

LITTLE BENNETT CRK, MONTG. CO. MD REACH 2 9/21/07

Worksheet B-12. Width/depth ratio state stability rating.

Width/Depth Ratio State			
Existing Width/Depth Ratio:	22	Ratio of existing w/d to reference w/d:	1.6
Reference Width/Depth Ratio:	12.2		
Width/Depth Ratio State Stability Rating			MODERATELY UNSTABLE



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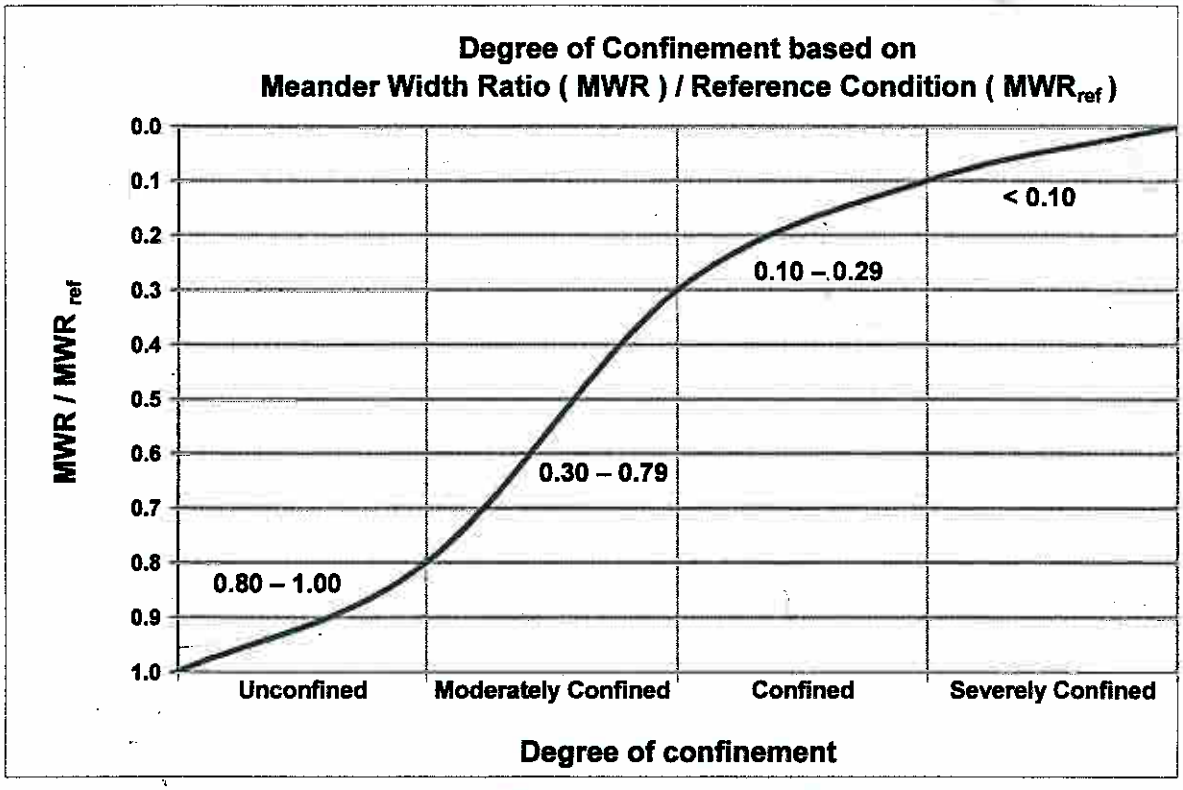
j. Degree of Channel Confinement (Meander Width Ratio (MWR))

Worksheet B-13. Degree of confinement stability ratings based on meander width ratio divided by reference meander width ratio.

Degree of Confinement			
BFW/WDBKF = 71/26.59			
Existing Meander Width Ratio (MWR):	2.67	Ratio of MWR to MWRref:	0.96
Reference Meander Width Ratio (MWR_{ref}):	2.78		
Degree of Confinement Stability Rating ☞	Unconfined		



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Worksheet 5-10. Summary form of annual streambank erosion estimates for various study reaches.

Stream:	little bennett creek, Reach - Reach 2			Location:			
Graph Used:		Total Bank Length (ft): 243				Date: 12/30/1999	
Observers:			Valley Type:			Stream Type:	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	BEHI rating (Worksheet 5-8) (adjective)	NBS rating (Worksheet 5-9) (adjective)	Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)	Length of bank (ft)	Study bank height (ft)	Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)	Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}
1. STA 000-007 LB	High	High	0.99831933	7	3.4	23.76	0.16
2. STA 008-200 RB	Extreme	High	2.25	12	4.4	118.8	0.48
3. STA 020-062 RB	Very High	High	1.00068929	41	4.6	188.73	0.22
4. STA 040 Riffle XS	Very High	High	0.99782609	1	4.6	4.59	0.22
5. STA 062-081 RB	Very High	Extreme	2.25	18	4.8	194.4	0.52
6. STA 070 Pool XS	Very High	High	1.026	1	5	5.13	0.25
7. STA 087-103 LB	Moderate	Very Low	0.3	16	2.7	12.96	0.04
8. STA 105-119 LB	High	High	1.00191638	14	4.1	57.51	0.20
9. STA 119-147 LB	High	High	1.29910714	28	3.6	130.95	0.23
10. STA 147-179 LB	Very High	Very High	1.299375	32	5	207.9	0.31
11. STA 195-211 RB	Very High	Moderate	0.59960106	16	4.7	45.09	0.14
12. STA 211-223 RB	High	Extreme	2.24897727	22	4	197.91	0.43
13.							
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					Total erosion (ft^3/yr)	1187.73	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					Total erosion (yds^3/yr)	43.99	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					Total erosion (tons/yr)	57.19	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					Total erosion (tons/yr/ft)	0.2353	

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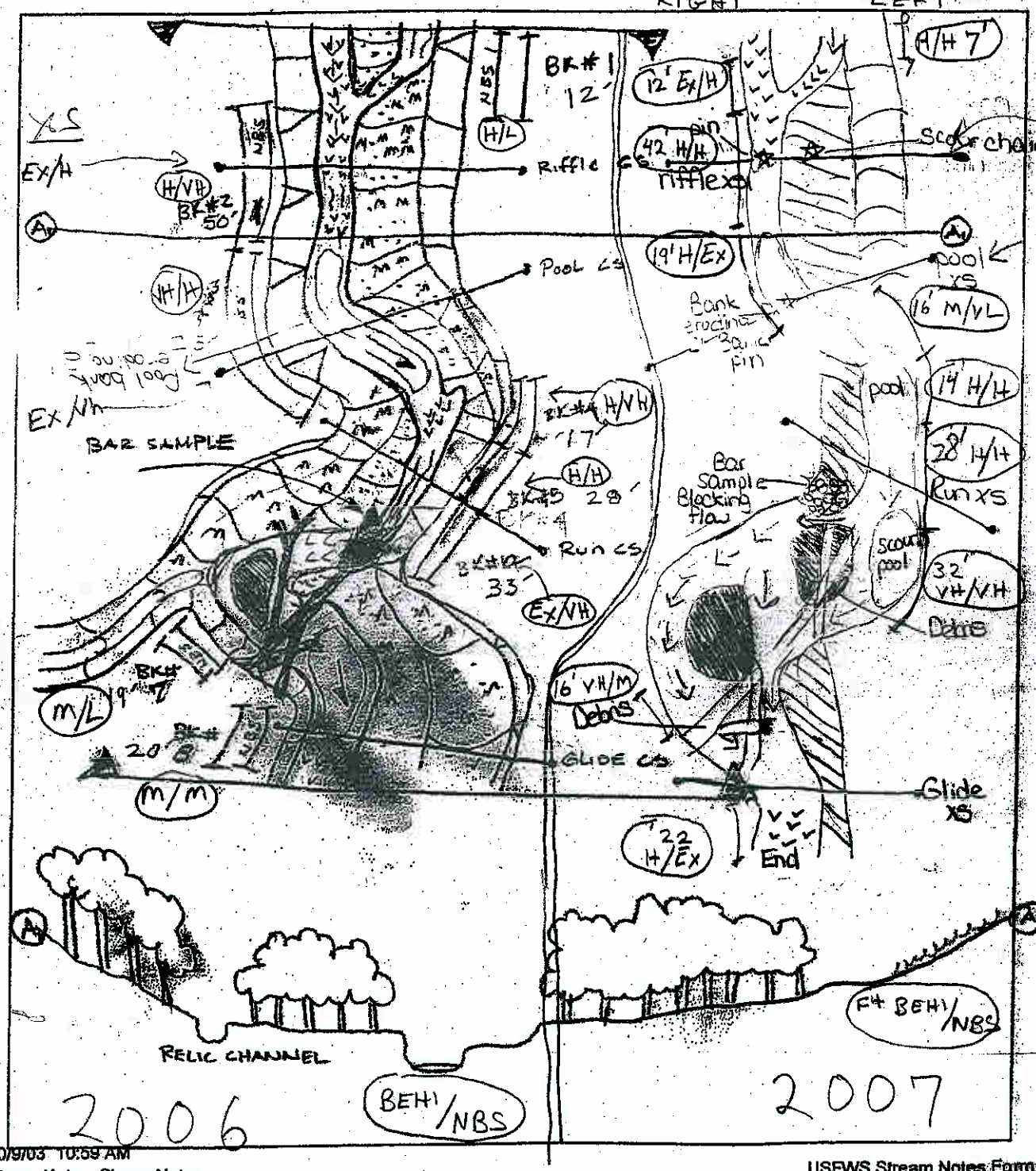
FWS-SHARP

Notes

Ag-small watershed

Stream: UT LITTLE BENNETT	Page 1 of 1
Reach 2	Date: 12/12/06
	Crew: RRS



REACH 2, UT LITTLE BENNETT CREEK, BEHI COMPARISON BETWEEN 2006 AND 2007

	2006 STA	2006 BEHI	2007 BEHI	2006 to 2007 change
	0-7L	37	32	
	8-20R	44	51	added 5 pt stratification/material adjustment
	20-62R	44	44	
RIFF XS	40R	49	43	no 10 pt stratification/material adjustment
	62-81R	41	45	
POOL XS	70R	47	45	
	87-103L		25	
	105-119L	39	37	
	119-147L	35	38	
	147-179L	50	44	no 10 pt. stratification/material adjustment
	195-211R	30	41	42 to 110 degree bank angle change
	211-223R	27	39	85 to 3% surface protection change; 34 to 95 degree bank angle change

factors affecting 2006-2007 changes:
a) stratification (observer subjectivity)
b) site length and boundary (observer subjectivity)
c) bank angle (measured)
d) surface protection (observer subjectivity)

River Assessment and Monitoring: Impaired Reach 3rd Field Day

h. Modified Pfankuch Channel Stability Rating

Worksheet C-11. Modified Pfankuch channel stability rating procedure as modified by Rosgen.

Stream: Location: Valley Type: Observers: Date:

Location	Key	Category	Excellent Description	Rating	Good Description	Rating	Fair Description	Rating	Poor Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4 5	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species & less vigor indicating poor, discontinuous and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3 *	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	10 12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8 10	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4 5	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	16 18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water, too.	1	Common. Algae forms in low velocity and pool areas. Moss here, too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent total =		Good total = 34		Fair total = 44		Poor total = 50	

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA1	DA2	DA3	DA4	DA5	DA6	E1	E2	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107				
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120				
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+				

*Rating should be adjusted to potential stream type, not existing.

Grand total =	111
Existing stream type =	G4
*Potential stream type =	G4 *
Modified channel stability rating =	Poor

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* EXISTING W/D: REF W/D = 1.47, BHR = 1.22

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-18. Sediment competence calculation form to assess bed stability.

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Enter required information					
18.3	D_{50}	Riffle bed material D_{50} (mm)			
11.6	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.26	D_{max}	Largest particle from bar sample (ft)	80	(mm)	304.8 mm/ft
.0056	S	Existing bankfull water surface slope (ft/ft)			
1.2	d	Existing bankfull mean depth (ft)			
1.65	γ_s	Submerged specific weight of sediment			
Select the appropriate equation and calculate critical dimensionless shear stress					
1.58	$D_{50}/\hat{D}_{50}$	Range: [illegible]	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
4.37	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
.056	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:		
Calculate bankfull mean depth required for entrainment of largest particle in bar sample					
~~0.35~~	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}}{S}$		
~~0.8~~	Check: ☐ Stable ☒ Aggrading ☐ Degrading				
Calculate bankfull water surface slope required for entrainment of largest particle in bar sample					
	S	Required bankfull water surface slope (ft/ft) .02	$S = \frac{\tau^* \gamma_s D_{max}}{d}$		
	Check: ☐ Stable ☒ Aggrading ☐ Degrading				
Sediment competence using dimensional shear stress					
0.39	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) R=1.12 62.4				
80 mm	Moveable particle size (mm) at bankfull shear stress **(Figure B-4)**				
0.39	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure B-4)**				
1.116 ~~0.8~~	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$				
.0078	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$				

$\frac{.39}{(62.4)(.8)}$

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Worksheet B-19. Stability ratings for corresponding successional stage shifts of stream types. Check (✓) the appropriate stability rating.

Stream: LITTLE BENNETT CRK	Stream Type: C4
Location: MONTG. CO, MD	Valley Type: 8
Observers: REACH 2 TEAM 2	Date: 9/21/07

Stream type changes due to successional stage shifts (Figure B-5)	Stability rating (check appropriate rating)
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☐ Stable
(E→C) widen C4	☑ Moderately unstable
(G→F), (F→D), (C→F)	☐ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

? STAY C4 AND WIDEN

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Worksheet B-20. Lateral stability prediction summary.

Stream: LITTLE BENNETT CREEK			Stream Type: C4		
Location: MONTG. Co. MD REACH 2			Valley Type: 8		
Observers: TEAM 2			Date: 9/21/07		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral stability categories**				**Selected points (from each row)**
	Stable	**Moderately unstable**	**Unstable**	**Highly unstable**	
1 **W/d ratio state (Worksheet B-12)**	< 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	> 1.6 (8)	8
2 **Depositional pattern (Worksheet B-8)**	B1, B2 (1)	B4, B8 (2)	B3 (3)	B5, B6, B7 (4)	4
3 **Meander pattern (Worksheet B-7)**	M1, M3, M4 (1)		M2, M5, M6, M7, M8 (3)		3
4 **Dominant BEHI / NBS (Worksheet B-16)**	L/VL, L/L, L/M, L/H, L/VH, M/VL (2)	M/L, M/M, M/H, L/Ex, H/L (4)	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL (6)	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex (8)	8
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet B-13)**	0.8 – 1.0 (1)	0.3 – 0.79 (2)	0.1 – 0.29 (3)	< 0.1 (4)	4
				Total points	27
	Lateral stability category point range				
Overall lateral stability category (use total points and check stability rating)	**Stable 7 – 9** ☐	**Moderately unstable 10 – 12** ☐	**Unstable 13 – 21** ☑	**Highly unstable > 21** ☑	

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-21. Vertical stability prediction for excess deposition/aggradation.

Stream: LITTLE BENNETT CRK			Stream Type: C4		
Location: MONTG. CO. MD REACH 2			Valley Type: B		
Observers: TEAM 2			Date: 9/21/07		
Vertical stability criteria (choose one stability category for each criterion 1–6)	**Vertical stability categories for excess deposition / aggradation**				**Selected points (from each row)**
	No deposition	**Moderate deposition**	**Excess deposition**	**Aggradation**	
1 **Sediment competence (Worksheet B-18)**	Sufficient depth and/or slope to transport largest size available (2)	Trend toward insufficient depth and/or slope-slightly incompetent (4)	Cannot move D_{35} of bed material and/or D_{100} of bar material (6)	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size (8)	4
2 **Sediment capacity (POWERSED)**	Sufficient capacity to transport annual load (2)	Trend toward insufficient sediment capacity (4)	Reduction up to 25% of annual sediment yield of bedload and/or suspended (6)	Reduction over 25% of annual sediment yield for bedload and/or suspended (8)	7
3 **W/d ratio state (Worksheet B-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	6
4 **Stream succession states (Worksheet B-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	6
5 **Depositional patterns (Worksheet B-8)**	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	2
6 **Debris / blockages (Worksheet B-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	1
				Total points	26
	Vertical stability category point range for excess deposition / aggradation				
Vertical stability for excess deposition / aggradation (use total points and check stability rating)	**No deposition 10 – 14** ☐	**Moderate deposition 15 – 20** ☐	**Excess deposition 21 – 30** ☑	**Aggradation > 30** ☐	

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-22. Vertical stability prediction for channel incision/degradation.

Stream: LITTLE BENNETT CREEK		Stream Type: C4	
Location: MONTG. CO. MD REACH 2		Valley Type: B	
Observers: TEAM 2		Date: 9/21/07	

Vertical stability criteria (choose one stability category for each criterion 1–5)	Vertical stability categories for channel incision / degradation				Selected points (from each row)
	Not incised	Slightly incised	Moderately incised	Degradation	
1 Sediment competence (Worksheet B-18)	Does not indicate excess competence (2)	Trend to move larger sizes than D_{100} of bar or > D_{84} of bed (4)	D_{100} of bed moved (6)	Particles much larger than D_{100} of bed moved (8)	3
2 Sediment capacity (POWERSED)	Does not indicate excess capacity (2)	Slight excess energy: up to 10% increase above reference (4)	Excess energy sufficient to increase load up to 50% of annual load (6)	Excess energy transporting more than 50% of annual load (8)	2
3 Degree of channel incision (BHR) (Worksheet B-10)	1.00 – 1.10 (2)	1.11 – 1.30 (4)	1.31 – 1.50 (6)	> 1.50 (8)	6
4 Stream succession states (Worksheets B-19 and B-10)	Does not indicate incision or degradation (2)	If BHR > 1.1 and stream type has w/d between 5–10 (4)	If BHR > 1.1 and stream type has w/d less than 5 (6)	(B→G), (C→G), (E→G), (D→G) (8)	3
5 Confinement (MWR / MWR_{ref}) (Worksheet B-13)	0.80 – 1.00 (1)	0.30 – 0.79 (2)	0.10 – 0.29 (3)	< 0.10 (4)	2
				Total points	16

Vertical stability for channel incision/ degradation (use total points and check stability rating)	Vertical stability category point range for channel incision / degradation			
	Not incised 9 – 11 ☐	Slightly incised 12 – 18 ☑	Moderately incised 19 – 27 ☐	Degradation > 27 ☐

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Worksheet B-23. Channel enlargement prediction summary.

Stream: LITTLE BENNETT CRK.		Stream Type: C4	
Location: MONTG. CO., MD REACH 2		Valley Type: B	
Observers: TEAM 2		Date: 9/21/07	

Channel enlargement prediction criteria (choose one stability category for each criterion 1–4)	Channel enlargement prediction categories				Selected points (from each row)
	No increase	Slight increase	Moderate increase	Extensive	
1 Successional stage shift (Worksheet B-19)	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C) (2)	(E→C) (4)	(G→F), (F→D) C→WIDER C (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	7
2 Lateral stability (Worksheet B-20)	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	8
3 Vertical stability excess deposition/ aggradation (Worksheet B-21)	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	6
4 Vertical stability incision/ degradation (Worksheet B-22)	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	4
				Total points	23

	Category point range				
Channel enlargement prediction (use total points and check stability rating)	No increase 8 – 10 ☐	Slight increase 11 – 16 ☐	Moderate increase 17 – 24 ☑	Extensive > 24 ☑	

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-25. Summary of stability condition categories.

Stream: LITTLE BENNETT CRK					Location: MONTG. CO. MD, REACH 2			
Observers: TEAM 2		Date: 9/21/07			Stream Type: C4		Valley Type: B	
Channel Dimension	Mean bankfull depth (ft): 1.2	Mean bankfull width (ft): 26.6	Cross-section area (ft²): 32.6	Width of flood-prone area (ft): 190	Entrenchment ratio: 7.15			
Channel Pattern	Mean (range)	MWR: 2.67	Lm/W$_{bkf}$: 4.89	3.87-5.87	Rc/W$_{bkf}$: 1.13	0.98-1.28	Sinuosity: 1.41	
River Profile and Bed Features	Circle: Riffle/pool Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed							
	Max bankfull depth (ft):	Riffle 2.96	Pool 3.36	Depth ratio (max/mean):	Riffle 2.43	Pool 1.69	Pool to pool spacing:	Ratio 69.5
	Slope	Valley: .0079	Average bankfull: 0.0056					
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: AS/GA/SM/BE →	Potential composition/density:	Remarks: Condition, vigor and/or usage of exiting reach: FAIR/NO BANK PROTECTION				
	Flow regime: P2	Stream size and order: S-4 (2)	Meander pattern(s): m3/m2	Depositional pattern(s): B2	Debris/channel blockage(s): D1, D2, D3, D4, D5			
	Degree of incision (Bank-Height Ratio): 1.25-1.83	Degree of incision stability rating: SLIGHTLY-DEEPLY	Modified Pfankuch stability rating (numeric and adjective rating): 111 Poor					
	Width/depth ratio (W/D): 22.2	Reference W/D ratio (W/D$_{ref}$): 12.2	Width/depth ratio state (W/D) / (W/D$_{ref}$): 1.6	W/D ratio state stability rating: Highly Unstable				
	Meander Width Ratio (MWR): 2.67	Reference MWR$_{ref}$: 2.78	Degree of confinement (MWR / MWR$_{ref}$): 0.96	MWR / MWR$_{ref}$ stability rating: Unconfined				
Bank Erosion Summary	Length of reach studied (ft): 243	Annual streambank erosion rate: 49.73 (tons/yr)	0.2 (tons/yr/ft)	Curve used: DC	Remarks:			
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks: Sufficient Competence but Aggrade ~70 tons/yr.					
Entrainment/ Competence	Largest particle from bar sample (mm):	τ = 0.39	τ* =	Existing depth$_{bkf}$: 1.2	Required depth$_{bkf}$: 1.1	Existing slope$_{bkf}$: .0056	Required slope$_{bkf}$: .0078	
Successional Stage Shift	C → wider C4 → → → →				Existing stream state (type): C4	Potential stream state (type): C4 WIDER		
Lateral Stability	Circle: Stable	Moderately unstable	Unstable	Highly unstable	Remarks/causes:			
Vertical Stability (aggradation)	Circle: No deposition	Moderate deposition	Excess deposition	Aggradation	Remarks/causes: HIGH SUPPLY			
Vertical Stability (degradation)	Circle: Not incised	Slightly incised	Moderately incised	Degradation	Remarks/causes:			
Channel Enlargement	Circle: No increase	Slight increase	Moderate increase	Extensive	Remarks/causes:			
Sediment Supply (Channel Source)	Circle: Low	Moderate	High	Very high	Remarks/causes: HIGH BEHI/NBS			

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-RELIC CHANNEL ~3-4' @ LB/DS MEANDER MIGRATION

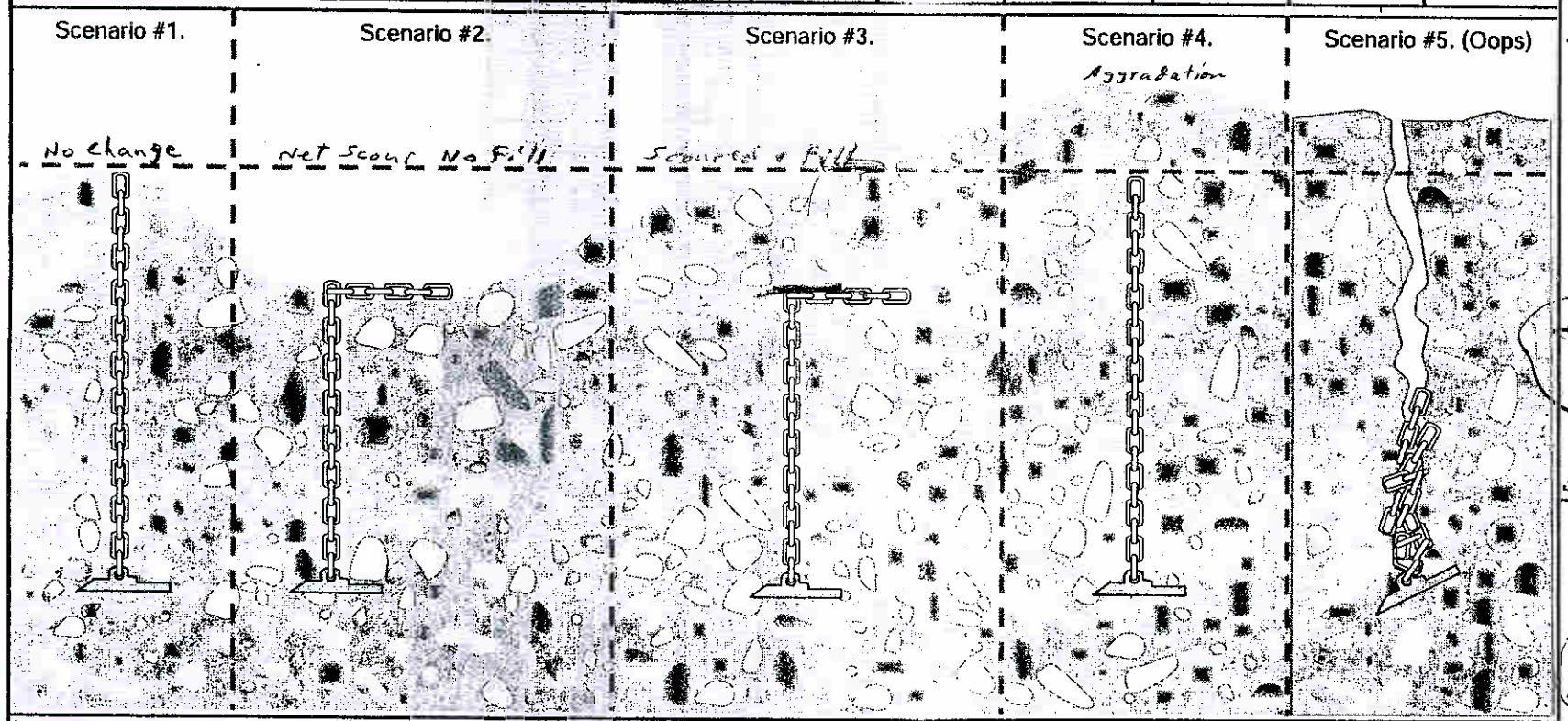
2nd Field Day

Worksheet B-26. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name: [redacted] Little Bennett Location: Maryland

Observers: Rice / Powers Stream Type: C Valley Type: Date: 9-21-07

		Installation Data (1st Year)				Recovery Data (2nd Year)					
		From cross-section		Particles near chain		Chain recovery				Particles near chain	
		Station (ft)	Elevation (ft)	Largest (mm)	2nd Largest (mm)	Scenario # (1–5)	Scour depth[a] (ft)	Elevation[b] (ft)	Net change[c] (ft)	Largest (mm)	2nd Largest (mm)
Riffle	Chain #1	28	102.22	47	40	4	0	4.60	0.08	52	40
Riffle	Chain #2	37	101.03	53	46	3	3.0"	6.13	0.26	95	59
Glide	Chain #3										
Glide	Chain #4										



[a] Scenario 2 or 3. Scenario 2: Enter length of chain exposed. Scenario 3: Enter length of chain exposed then subsequently buried.

[b] Scenario 3 or 4. Scenario 3: Enter elevation of bed at same station @ 2nd year. Scenario 4: Enter depth of material over chain.

[c] Scenario 3: Subtract 1st and 2nd year elevations to calculate net change in bed.

UT Little Bennett Creek Team 2 9/21/2007

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

3. Channel Change

Worksheet B-28. Summary of annual data comparisons.

Data Comparison Form

Stream: Little Bennett — Team 2 Reach: Reach 2

Observers: Team 2 Date - Year 1: 8/10/07 Date - Year 2: 9/21/07

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	25.31	26.6	20.91	22.06	26.3	44.96
	Mean $depth_{bkf}$	1.18	1.2	2.17	1.99	1.7	2.89
	Width/depth ratio	21.45	22.2	9.64	11.1	15.47	15.36
	Cross-sectional $Area_{bkf}$	29.97	22.2	45.28	43.85	43.9	43.3
	Max $depth_{bkf}$	2.83	32.6	7.49	3.89	2.86	3.13
Pebble count	D_{35} (mm)	12.48	11.05	0.75	0.8		
	D_{50} (mm)	19.49	18.27	6.0	11.13		
	D_{84} (mm)	53.44	58.52	30.0	40.97		
Bank Erosion	BEHI rating	Extreme	Very High	Extreme	Very High	mod	High
	NBS rating	High	High	Very High	Extreme	mod	Extreme
	Predicted erosion (ft/yr)	2.374	0.9978	6.014	1.02		
	Measured erosion (ft/yr)	—	0.9	—	1.03		

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	94		Bar Sample	D_{35} (mm)	8.73	4.82
Bank-Height Ratio start: / end:	1.70 / 1.00	1.83 / 1.25		D_{50} (mm)	15.59	11.61
Point Bar slope	0.22	0.69		D_{84} (mm)	53.02	50.41
Riffle Length/Riffle Width	1.09	0.48		D_{100} (mm)	78	80
Pool Length/Riffle Width	1.39	1.24				
Dimensionless Slope Ratios: S_{rif}/S	4.41	2.6	Dimensionless Depth Ratios	d_{rif}/d_{bkf}	2.36	1.84
S_{run}/S	0.876	11.43		d_{run}/d_{bkf}	2.5	2.28
S_p/S	0.106	0.07		d_p/d_{bkf}	4.3	3.06
S_g/S	0.703	0.802		d_g/d_{bkf}	2.38	2.44

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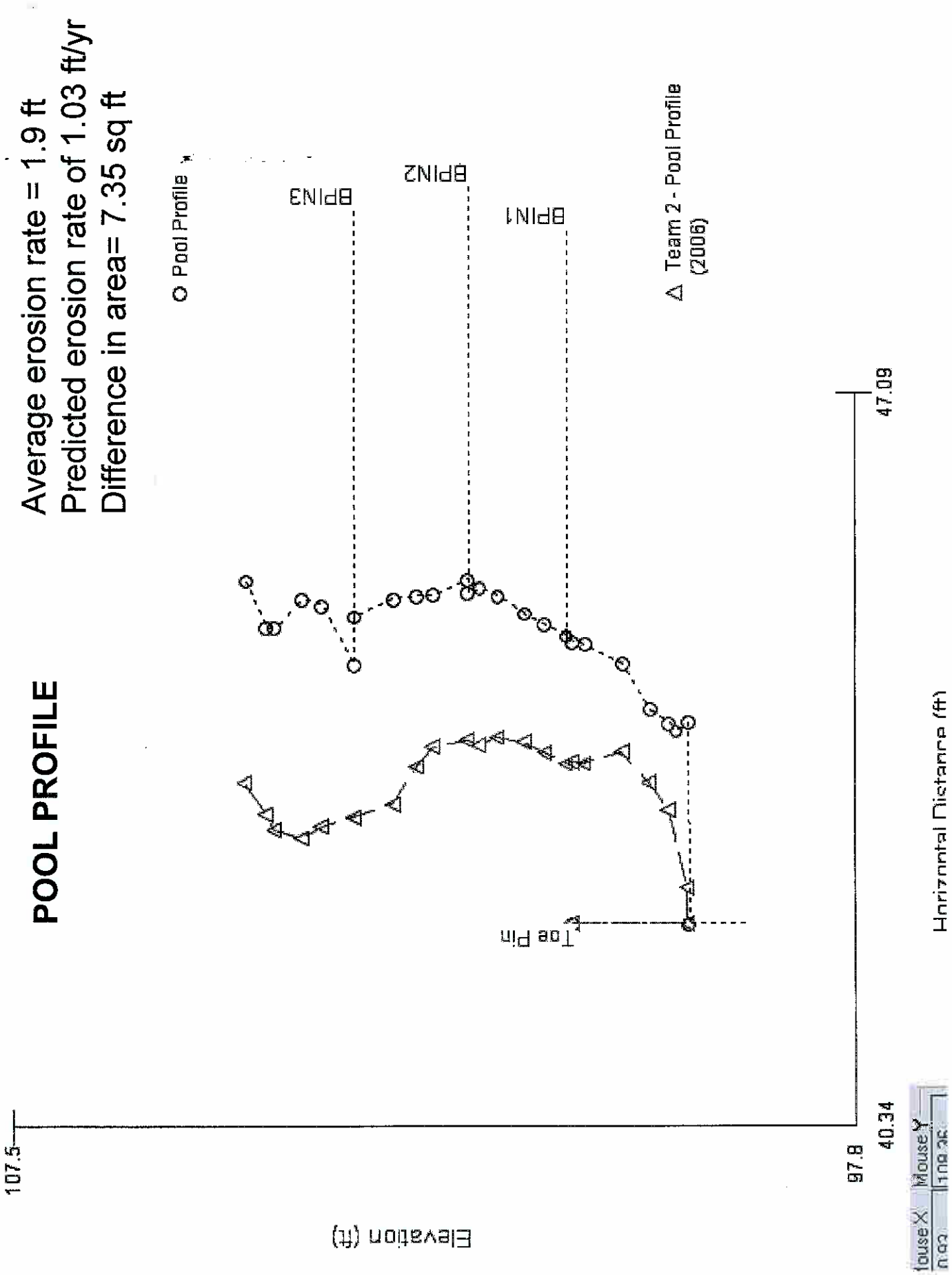
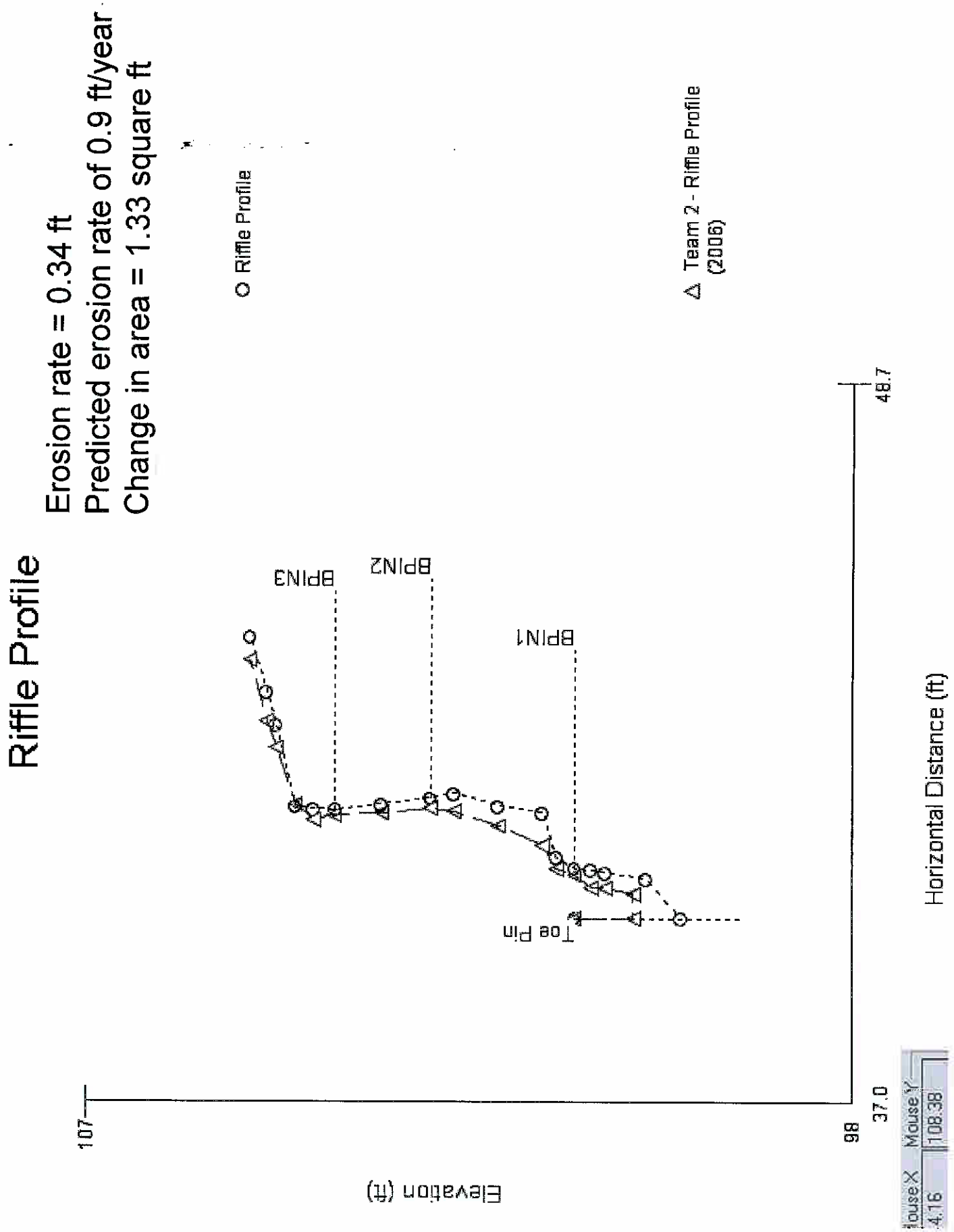

POOL PROFILE
Average erosion rate = 1.9 ft
Predicted erosion rate of 1.03 ft/yr
Difference in area= 7.35 sq ft
Pool Profile
Team 2 - Pool Profile (2006)
BPIN1
BPIN2
BPIN3
Toe Pin
107.5
97.8
40.34
47.09
Elevation (ft)
Horizontal Distance (ft)


Riffle Profile
Erosion rate = 0.34 ft
Predicted erosion rate of 0.9 ft/year
Change in area = 1.33 square ft
Riffle Profile
Team 2 - Riffle Profile (2006)
BPIN1
BPIN2
BPIN3
Toe Pin
107
98
Elevation (ft)
37.0
48.7
Horizontal Distance (ft)
Mouse X
4.16
Mouse Y
108.38

Close

```
Reach 1: Stable or Reference Cross Section: Macgruder Branch, Reach 3,
Bankfull Discharge (cfs): 137.41 - calculated value
Measured Bankfull Bedload (lb/s): 0.255
Measured Bankfull Suspended Sediment (mg/l): 37
Use Hydraulic Geometry from the Entire Cross Section

Reach 2: Altered or Unstable Cross Section: Little Bennett, Reach 1, Ri
Bankfull Discharge (cfs): 133.47 - calculated value
Use Hydraulic Geometry from the Entire Cross Section

Selected Flow Duration Curve:

Gage Name: Patuxent River Near Unity, MD Bankfull Discharge (cfs): 225

Selected Sediment Rating Curves:

Reach 1
Dimensionless Bedload Rating Curve
Name: Pagosa Springs Reference Curve; Stability Rating: Good/Fair
 y = -0.0113 + 1.0139 x ^ 2.1929

Dimensionless Suspended Sediment Rating Curve
Name: Pagosa Springs Reference Curve; Stability Rating: Good/Fair
 y = 0.0636 + 0.9326 x ^ 2.4085


Dimensionless Conversion (FLOWSED)
```

X	Y	Q	Qbed	Qsand
0.1	0.07	13.741	0.000	2.488
0.2	0.08	27.482	0.005	3.068
0.3	0.11	41.224	0.016	4.252
0.4	0.17	54.965	0.032	6.150
0.5	0.24	68.706	0.054	8.852
0.6	0.34	82.447	0.081	12.436
0.7	0.46	96.189	0.115	16.969
0.8	0.61	109.930	0.156	22.513
0.9	0.79	123.671	0.202	29.126
1.0	1.00	137.412	0.256	36.859
1.1	1.24	151.153	0.316	45.763
1.2	1.51	164.895	0.383	55.884

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Worksheet 5-12a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream: Macgruder Branch, Reach 3, Reference Riffle, (Ri Location: Reach 3 Date: 09/18/07

Observers: Team 3 Stream Type: C4 Valley Type: VII Gage Station # 01591000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)x(14)]	Time adjusted suspended sand transport [(13)x(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.14										0%						
90.0%	5.50	2.82	2.43	9.74	0.25	1.16	0.009	0.14	1.58	0.16	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.97	6.74	4.64	13.32	0.35	1.45	0.009	0.19	3.79	0.28	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.76	8.87	5.69	14.71	0.39	1.55	0.009	0.22	4.98	0.34	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	12.23	11.00	6.66	15.77	0.42	1.64	0.009	0.24	6.18	0.39	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.94	14.09	7.91	16.85	0.47	1.78	0.009	0.26	7.91	0.48	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	19.51	17.73	9.12	16.83	0.54	1.94	0.009	0.30	9.86	0.59	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	24.46	21.99	10.43	16.89	0.61	2.10	0.009	0.34	12.35	0.73	10%	36.50	0.00	0.20	0.00	0.02	0.02
20.0%	31.74	28.10	12.17	17.19	0.71	2.30	0.009	0.39	15.78	0.92	10%	36.50	0.40	0.20	0.04	0.02	0.06
10.0%	43.97	37.85	14.71	17.48	0.84	2.57	0.009	0.46	21.26	1.22	10%	36.50	0.40	0.40	0.04	0.04	0.08
5.0%	61.70	52.84	16.19	17.88	1.02	2.90	0.009	0.55	29.57	1.66	5%	18.25	1.30	0.80	0.07	0.04	0.11
4.0%	68.98	65.34	20.84	18.17	1.15	3.13	0.009	0.62	36.59	2.02	1%	3.65	2.20	1.4	0.02	0.01	0.03
3.0%	79.97	74.47	22.68	18.38	1.23	3.28	0.009	0.66	41.82	2.28	1%	3.65	3.00	2.10	0.03	0.02	0.05
2.0%	103.20	91.58	25.95	18.79	1.38	3.53	0.01	0.74	51.44	2.75	1%	3.65	4.30	3.80	0.04	0.04	0.08
1.5%	123.95	113.58	29.88	19.14	1.56	3.80	0.009	0.83	63.79	3.33	1%	1.83	7.30	7.50	0.04	0.04	0.08
1.0%	156.38	140.17	43.72	36.80	1.19	3.20	0.01	0.64	78.72	2.14	1%	1.83	11.70	14.70	0.06	0.07	0.13
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					124.1	124.1	248.2

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Worksheet 5-12b. Bedload and suspended sand and bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: Little Bennett, Reach 1, Riffle, (Riffle) Location: Reach 3 Date: 09/18/07

Observers: Team 3 Stream Type: C4 Valley Type: VIII Gage Station #: 01591000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(15)x(14)]	Time adjusted suspended sand transport [(16)x(14)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft²)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft²)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.13										0%						
90.0%	5.34	2.74	1.45	3.62	0.41	1.89	0.005	0.13	1.20	0.33	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.74	6.54	3.12	6.14	0.51	2.10	0.005	0.17	2.66	0.47	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.48	8.61	3.81	6.66	0.57	2.26	0.005	0.18	3.76	0.56	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	11.88	10.68	4.46	7.07	0.63	2.39	0.005	0.20	4.67	0.66	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.46	13.68	5.35	7.62	0.70	2.55	0.005	0.22	5.98	0.78	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	18.85	17.22	6.30	8.04	0.78	2.73	0.005	0.25	7.52	0.94	10%	36.50	0.40	0.10	0.04	0.01	0.05
30.0%	23.76	21.36	7.34	8.46	0.87	2.91	0.005	0.27	9.33	1.10	10%	36.50	0.40	0.20	0.04	0.02	0.06
20.0%	30.83	27.30	8.85	9.91	0.90	3.05	0.005	0.29	11.92	1.20	10%	36.50	0.40	0.30	0.04	0.03	0.07
10.0%	42.71	36.77	11.51	12.78	0.91	3.16	0.005	0.31	16.06	1.26	10%	36.50	0.40	0.40	0.04	0.04	0.08
5.0%	59.83	51.32	15.38	16.24	0.95	3.34	0.006	0.33	22.42	1.36	5%	18.25	0.30	0.60	0.05	0.03	0.08
4.0%	67.00	63.47	19.62	23.51	0.84	3.20	0.006	0.31	27.72	1.18	1%	3.65	0.40	0.7	0.00	0.01	0.01
3.0%	77.66	72.34	22.07	25.46	0.87	3.27	0.006	0.32	31.60	1.24	1%	3.65	0.40	0.80	0.00	0.01	0.01
2.0%	100.24	88.96	25.31	26.31	0.96	3.51	0.01	0.35	38.86	1.46	1%	3.65	0.90	1.20	0.01	0.01	0.02
1.5%	120.39	110.32	28.92	26.45	1.09	3.81	0.006	0.40	48.13	1.82	1%	1.83	1.70	2.00	0.01	0.01	0.02
1.0%	151.68	136.14	32.97	26.63	1.24	4.13	0.01	0.46	59.47	2.23	1%	1.83	3.00	3.60	0.02	0.02	0.04

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	31.3	80.3	171.6
Upstream total annual sediment supply (tons/yr) (Worksheet 5-12a):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-92.8	-43.7	-76.5
Stability evaluation: Aggradation, Degradation or Stable:			

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Worksheet 5-12a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream: Macgruder Branch, Reach 3, Reference Riffle, (Ri Location: Reach 3 Date: 09/18/07

Observers: Team 3 Stream Type: C4 Valley Type: VII Gage Station # 01591000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(kns/day)	(kns/day)	(kns)	(kns)	(kns)
100.0%	0.14										0%						
90.0%	5.50	2.82	2.48	9.74	0.25	1.16	0.009	0.14	1.58	0.16	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.97	6.74	4.64	13.32	0.35	1.45	0.009	0.19	3.79	0.28	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.76	8.87	5.69	14.71	0.39	1.55	0.009	0.22	4.98	0.34	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	12.23	11.00	6.66	15.77	0.42	1.64	0.009	0.24	6.18	0.39	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.94	14.09	7.91	16.85	0.47	1.78	0.009	0.26	7.91	0.48	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	19.51	17.73	9.12	16.88	0.54	1.94	0.009	0.30	9.96	0.59	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	24.46	21.99	10.43	16.99	0.61	2.10	0.009	0.34	12.35	0.73	10%	36.50	0.00	0.20	0.00	0.02	0.02
20.0%	31.74	28.10	12.17	17.19	0.71	2.30	0.009	0.39	15.78	0.92	10%	36.50	0.40	0.20	0.04	0.02	0.06
10.0%	43.97	37.85	14.71	17.48	0.84	2.57	0.009	0.46	21.26	1.22	10%	36.50	0.40	0.40	0.04	0.04	0.08
5.0%	61.70	52.84	18.19	17.88	1.02	2.90	0.009	0.55	29.67	1.66	5%	18.25	1.30	0.80	0.07	0.04	0.11
4.0%	68.98	65.34	20.84	18.17	1.15	3.13	0.009	0.62	36.69	2.02	1%	3.65	2.20	1.4	0.02	0.01	0.03
3.0%	79.97	74.47	22.68	18.38	1.23	3.28	0.009	0.66	41.82	2.28	1%	3.65	3.00	2.10	0.03	0.02	0.05
2.0%	103.20	91.59	25.95	18.73	1.39	3.53	0.01	0.74	51.44	2.75	1%	3.65	4.30	3.80	0.04	0.04	0.08
1.5%	123.95	113.58	29.88	19.14	1.56	3.80	0.009	0.83	63.79	3.33	1%	1.83	7.30	7.50	0.04	0.04	0.08
1.0%	156.38	140.17	43.72	36.80	1.19	3.20	0.01	0.64	78.72	2.14	1%	1.83	11.70	14.70	0.06	0.07	0.13
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr)					124.1	124.1	248.2

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Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: Little Bennett, Reach 1, Riffle, (Riffle) Location: Reach 3 Date: 09/18/07

Observers: Team 3 Stream Type: C4 Valley Type: VIII Gage Station #: 01581000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [13]×[14]	Time adjusted suspended sand transport [12]×[15]	Time adjusted total transport [16]+[17]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.13										0%						
90.0%	5.34	2.74	1.49	3.62	0.41	1.83	0.005	0.13	1.20	0.33	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.74	6.54	3.12	6.14	0.51	2.10	0.005	0.17	2.86	0.47	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.48	8.61	3.81	6.66	0.57	2.26	0.005	0.18	3.76	0.56	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	11.88	10.68	4.46	7.07	0.63	2.39	0.005	0.20	4.67	0.66	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.48	13.68	5.35	7.62	0.70	2.55	0.005	0.22	5.98	0.78	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	18.35	17.22	6.30	8.04	0.78	2.73	0.005	0.25	7.52	0.94	10%	36.50	0.40	0.10	0.04	0.01	0.05
30.0%	23.76	21.36	7.34	8.46	0.87	2.91	0.005	0.27	9.33	1.10	10%	36.50	0.40	0.20	0.04	0.02	0.06
20.0%	30.63	27.30	8.35	9.91	0.90	3.05	0.005	0.28	11.32	1.20	10%	36.50	0.40	0.30	0.04	0.03	0.07
10.0%	42.71	36.77	11.61	12.78	0.91	3.16	0.005	0.31	16.06	1.26	10%	36.50	0.40	0.40	0.04	0.04	0.08
5.0%	59.33	51.32	15.38	16.24	0.95	3.34	0.006	0.33	22.42	1.38	5%	18.25	0.90	0.60	0.05	0.03	0.08
4.0%	67.00	63.47	19.82	23.51	0.84	3.20	0.006	0.31	27.72	1.18	1%	3.65	0.40	0.7	0.00	0.01	0.01
3.0%	77.68	72.34	22.07	25.48	0.87	3.27	0.006	0.32	31.60	1.24	1%	3.65	0.40	0.80	0.00	0.01	0.01
2.0%	100.24	88.96	25.31	26.31	0.96	3.51	0.01	0.36	38.86	1.48	1%	3.65	0.90	1.20	0.01	0.01	0.02
1.5%	120.33	110.32	28.32	26.45	1.09	3.81	0.006	0.40	48.13	1.82	1%	1.83	1.70	2.00	0.01	0.01	0.02
1.0%	151.33	136.14	32.37	26.63	1.24	4.13	0.01	0.46	59.47	2.23	1%	1.83	3.00	3.60	0.02	0.02	0.04

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	91.3	80.3	171.6
Upstream total annual sediment supply (tons/yr) (Worksheet 6-12a):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-32.8	-43.7	-76.5
Stability evaluation: Aggradation, Degradation or Stable:			

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```
Reach 1: Stable or Reference Cross Section: Macgruder Branch, Reach 3,
Bankfull Discharge (cfs): 137.41 - calculated value
Measured Bankfull Bedload (lb/s): 0.255
Measured Bankfull Suspended Sediment (mg/l): 37
Use Hydraulic Geometry from the Entire Cross Section

Reach 2: Altered or Unstable Cross Section: Little Bennett, Reach 1, Ri
Bankfull Discharge (cfs): 133.47 - calculated value
Use Hydraulic Geometry from the Entire Cross Section

Selected Flow Duration Curve:

Gage Name: Patuxent River Near Unity, MD Bankfull Discharge (cfs): 225

Selected Sediment Rating Curves:

Reach 1
Dimensionless Bedload Rating Curve
Name: Pagosa Springs Reference Curve; Stability Rating: Good/Fair
 y = -0.0113 + 1.0139 x ^ 2.1929

Dimensionless Suspended Sediment Rating Curve
Name: Pagosa Springs Reference Curve; Stability Rating: Good/Fair
 y = 0.0636 + 0.9326 x ^ 2.4085


Dimensionless Conversion (FLOWSED)
```

X	Y	Q	Qbed	Qsand
0.1	0.07	13.741	0.000	2.488
0.2	0.08	27.482	0.005	3.068
0.3	0.11	41.224	0.016	4.252
0.4	0.17	54.965	0.032	6.150
0.5	0.24	68.706	0.054	8.852
0.6	0.34	82.447	0.081	12.436
0.7	0.46	96.189	0.115	16.969
0.8	0.61	109.930	0.156	22.513
0.9	0.79	123.671	0.202	29.126
1.0	1.00	137.412	0.256	36.859
1.1	1.24	151.153	0.316	45.763
1.2	1.51	164.895	0.383	55.884

UT Little Bennett Creek Team 2 9/21/2007

RIVERMORPH BANK PROFILE REPORT

River Name: Little Bennett
Reach Name: Reach 1
Bank Name : Riffle Profile

Toe Pin Setup Data:
Station: 40 Elevation: 101.26 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: 0 Backsight: 0

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	
0	-1.26	assumed bed elevation
0.65	-0.84	toe
0.75	-0.36	
0.79	-0.2	
0.82	0	BPIN1
1.01	0.22	
1.72	0.38	
1.82	0.9	
2.03	1.42	
1.96	1.7	BPIN2
1.85	2.28	
1.76	2.82	BPIN3
1.77	3.07	
1.82	3.29	TOB
3.15	3.52	
3.69	3.63	
4.58	3.83	

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN1	0.82	0	4	
BPIN2	1.96	1.7	4	
BPIN3	1.76	2.82	4	

Summary:

Toe Pin Area: 8.35 square feet (used for erosion monitoring)
Bank Height: 3.83 feet
Avg. Bank Angle: 50.34 degrees

BEHI Pool XS
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: Pool XS Bank Pin
Survey Date: 09/22/2007

Bankfull Height: 3.35 ft
Bank Height: 5 ft
Root Depth: 1.7 ft
Root Density: 10 %
Bank Angle: 105 Degrees
Surface Protection: 3 %

Bank Material Adjustment: Gravel 3

Bank Stratification Adjustment: Yes 2

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 3.5 ft Mean Depth: 1.7 ft
Ratio: 2.06

BEHI Numerical Rating: 44.8
BEHI Adjective Rating: Very High
NBS Numerical Rating: 2.06
NBS Adjective Rating: High
Total Bank Length: 1 ft
Estimated Sediment Loss: 0.19 Cu Yds per Year
Estimated Sediment Loss: 0.25 Tons per Year

UT Little Bennett Creek Team 2 9/21/2007

RIVERMORPH BANK PROFILE REPORT

River Name: Little Bennett
Reach Name: Reach 1
Bank Name : Pool Profile

Toe Pin Setup Data:
Station: 42.2 Elevation: 101.04 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: 0 Backsight: 0

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	
0	-1.35	
1.86	-1.34	
1.78	-1.2	
1.85	-1.12	
1.98	-0.9	
2.4	-0.58	toe
2.58	-0.14	
2.6	0	TTPIN
2.65	0.07	BPIN1
2.66	0.07	Bank at pin
2.76	0.32	
2.86	0.56	
3.02	0.87	
3.09	1.08	
3.05	1.22	BPIN2
3.17	1.22	bank at pin
3.03	1.62	
3.02	1.81	
2.99	2.08	
2.83	2.54	BPIN3
2.39	2.54	bank at pin
2.93	2.91	
2.99	3.14	
2.73	3.46	
2.73	3.56	Right top of bank
3.16	3.8	

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN1	2.65	0.07	4	
BPIN2	3.05	1.22	4	
BPIN3	2.83	2.54	4	

Summary:

Toe Pin Area:	14.03 square feet (used for erosion monitoring)
Bank Height:	3.80 feet
Avg. Bank Angle:	48.44 degrees

Bar Sample Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Bar Sample
Survey Date: 09/22/2007

SIEVE (mm)	NET WT
31.5	5.1
16	6.8
8	6.1
4	4.6
2	5.1
PAN	8.9

D16 (mm)	0
D35 (mm)	4.82
D50 (mm)	11.61
D84 (mm)	50.41
D95 (mm)	70.75
D100 (mm)	80
Silt/Clay (%)	0
Sand (%)	20.84
Gravel (%)	72.88
Cobble (%)	6.28
Boulder (%)	0
Bedrock (%)	0

Total Weight = 42.7000.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	80	3.1
Particle 2:	75	3

BEHI Riffle XS
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: Riffle XS Bank Pin
Survey Date: 09/22/2007

Bankfull Height: 2.7 ft
Bank Height: 4.6 ft
Root Depth: 0.6 ft
Root Density: 4 %
Bank Angle: 100 Degrees
Surface Protection: 3 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 2.6 ft Mean Depth: 1.2 ft
Ratio: 2.17

BEHI Numerical Rating: 42.9
BEHI Adjective Rating: Very High
NBS Numerical Rating: 2.17
NBS Adjective Rating: High
Total Bank Length: 1 ft
Estimated Sediment Loss: 0.17 Cu Yds per Year
Estimated Sediment Loss: 0.22 Tons per Year

BEHI STA 0-7 LB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 0-7 LB
Survey Date: 09/21/2007

Bankfull Height: 2.6 ft
Bank Height: 3.4 ft
Root Depth: 0.25 ft
Root Density: 5 %
Bank Angle: 54 Degrees
Surface Protection: 25 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #1: Channel Pattern and/or Depositional Features for Adjustments in Near-Bank Stress
Rating: High

BEHI Numerical Rating: 33.6
BEHI Adjective Rating: High
NBS Numerical Rating:
NBS Adjective Rating: High
Total Bank Length: 7 ft
Estimated Sediment Loss: 0.88 Cu Yds per Year
Estimated Sediment Loss: 1.14 Tons per Year

BEHI STA 8-20 RB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 8-20 RB
Survey Date: 09/21/2007

Bankfull Height: 2.45 ft
Bank Height: 4.4 ft
Root Depth: 0.3 ft
Root Density: 5 %
Bank Angle: 120 Degrees
Surface Protection: 10 %

Bank Material Adjustment: Gravel 5

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 2.65 ft Mean Depth: 1.2 ft
Ratio: 2.21

BEHI Numerical Rating: 49.7
BEHI Adjective Rating: Extreme
NBS Numerical Rating: 2.21
NBS Adjective Rating: High
Total Bank Length: 12 ft
Estimated Sediment Loss: 4.4 Cu Yds per Year
Estimated Sediment Loss: 5.72 Tons per Year

BEHI STA 20-62 RB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 20-62 RB
Survey Date: 09/21/2007

Bankfull Height: 4.6 ft
Bank Height: 2.5 ft
Root Depth: 0.5 ft
Root Density: 6 %
Bank Angle: 90 Degrees
Surface Protection: 5 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 2.6 ft Mean Depth: 1.2 ft
Ratio: 2.17

BEHI Numerical Rating: 38.3
BEHI Adjective Rating: High
NBS Numerical Rating: 2.17
NBS Adjective Rating: High
Total Bank Length: 41 ft
Estimated Sediment Loss: 3.8 Cu Yds per Year
Estimated Sediment Loss: 4.94 Tons per Year

BEHI STA 62-81 RB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 62-81 RB
Survey Date: 09/21/2007

Bankfull Height: 4.8 ft
Bank Height: 3.1 ft
Root Depth: 1.6 ft
Root Density: 10 %
Bank Angle: 110 Degrees
Surface Protection: 5 %

Bank Material Adjustment: Gravel 5

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #2: Ratio of Radius of Curvature to Bankfull Width

Radius of Curvature: 23 ft Bankfull Width: 35 ft
Ratio: 0.66 psf

BEHI Numerical Rating: 38.6
BEHI Adjective Rating: High
NBS Numerical Rating: 0.66
NBS Adjective Rating: Extreme
Total Bank Length: 18 ft
Estimated Sediment Loss: 4.65 Cu Yds per Year
Estimated Sediment Loss: 6.05 Tons per Year

BEHI STA 87-103 LB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 87-103 LB
Survey Date: 09/21/2007

Bankfull Height: 2.4 ft
Bank Height: 2.7 ft
Root Depth: 0.25 ft
Root Density: 5 %
Bank Angle: 20 Degrees
Surface Protection: 80 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 0.9 ft Mean Depth: 2 ft
Ratio: 0.45

BEHI Numerical Rating: 24.8
BEHI Adjective Rating: Moderate
NBS Numerical Rating: 0.45
NBS Adjective Rating: Very Low
Total Bank Length: 16 ft
Estimated Sediment Loss: 0.48 Cu Yds per Year
Estimated Sediment Loss: 0.62 Tons per Year

BEHI STA 105-119 LB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 105-119 LB
Survey Date: 09/21/2007

Bankfull Height: 2.5 ft
Bank Height: 4.1 ft
Root Depth: 2 ft
Root Density: 12 %
Bank Angle: 115 Degrees
Surface Protection: 10 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #1: Channel Pattern and/or Depositional Features for Adjustments in Near-Bank Stress
Rating: High

BEHI Numerical Rating: 37.0
BEHI Adjective Rating: High
NBS Numerical Rating:
NBS Adjective Rating: High
Total Bank Length: 14 ft
Estimated Sediment Loss: 2.13 Cu Yds per Year
Estimated Sediment Loss: 2.77 Tons per Year

BEHI STA 119-147 LB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 119-147 LB
Survey Date: 09/21/2007

Bankfull Height: 2.6 ft
Bank Height: 3.6 ft
Root Depth: 0.3 ft
Root Density: 5 %
Bank Angle: 60 Degrees
Surface Protection: 7 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 2.8 ft Mean Depth: 1.4 ft
Ratio: 2.00

BEHI Numerical Rating: 37.7
BEHI Adjective Rating: High
NBS Numerical Rating: 2.00
NBS Adjective Rating: High
Total Bank Length: 28 ft
Estimated Sediment Loss: 4.85 Cu Yds per Year
Estimated Sediment Loss: 6.31 Tons per Year

BEHI STA 147-179 LB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 147-179 LB
Survey Date: 09/21/2007

Bankfull Height: 3.3 ft
Bank Height: 5 ft
Root Depth: 2 ft
Root Density: 3 %
Bank Angle: 105 Degrees
Surface Protection: 2 %

Bank Material Adjustment: Gravel 5

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 3.7 ft Mean Depth: 1.4 ft
Ratio: 2.64

BEHI Numerical Rating: 44.0
BEHI Adjective Rating: Very High
NBS Numerical Rating: 2.64
NBS Adjective Rating: Very High
Total Bank Length: 32 ft
Estimated Sediment Loss: 7.7 Cu Yds per Year
Estimated Sediment Loss: 10.01 Tons per Year

BEHI STA 195-211 RB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 195-211 RB
Survey Date: 09/21/2007

Bankfull Height: 2.8 ft
Bank Height: 4.7 ft
Root Depth: 0.5 ft
Root Density: 6 %
Bank Angle: 110 Degrees
Surface Protection: 70 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: Yes 5

Erosion Loss Curve: Yellowstone

NBS Method #5: Ratio of Near-Bank Maximum Bankfull Depth to Mean Bankfull Depth

NB Max Depth: 3 ft Mean Depth: 1.7 ft
Ratio: 1.76

BEHI Numerical Rating: 41.1
BEHI Adjective Rating: Very High
NBS Numerical Rating: 1.76
NBS Adjective Rating: Moderate
Total Bank Length: 16 ft
Estimated Sediment Loss: 1.67 Cu Yds per Year
Estimated Sediment Loss: 2.17 Tons per Year

BEHI STA 211-223 RB
RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
BEHI Name: STA 211-223 RB
Survey Date: 09/21/2007

Bankfull Height: 2.3 ft
Bank Height: 4 ft
Root Depth: 0.5 ft
Root Density: 10 %
Bank Angle: 95 Degrees
Surface Protection: 30 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #2: Ratio of Radius of Curvature to Bankfull Width

Radius of Curvature: 26 ft Bankfull Width: 35 ft
Ratio: 0.74 psf

BEHI Numerical Rating: 38.8
BEHI Adjective Rating: High
NBS Numerical Rating: 0.74
NBS Adjective Rating: Extreme
Total Bank Length: 22 ft
Estimated Sediment Loss: 7.33 Cu Yds per Year
Estimated Sediment Loss: 9.53 Tons per Year

Classification
RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: 2007-09 Little Bennett
Reach Name: Reach 1 <-- This is not a Reference Reach
Drainage Area: 1.7 sq mi
State:
County:
Latitude: 0
Longitude: 0
Survey Date: 09/22/2007

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0079	ft/ft
Number of Channels:	Single	
Width:	26.59	ft
Mean Depth:	1.22	ft
Flood-Prone Width:	190	ft
Channel Materials D50:	14.82	mm
Water Surface Slope:	0.0056	ft/ft
Sinuosity:	1.41	
Discharge:	122.5	cfs
Velocity:	3.76	fps
Cross Sectional Area:	32.57	sq ft
Entrenchment Ratio:	7.15	
Width to Depth Ratio:	21.8	
Rosgen Stream Classification:	C 4	

Glide
RIVERMORPH CROSS SECTION SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Cross Section Name: Glide
Survey Date: 09/21/2007

Cross Section Data Entry

BM Elevation: 45 ft
Backsight Rod Reading: 4.33 ft

TAPE	FS	ELEV	NOTE
10	4.33	45	
12.5	3.42	45.91	
15.5	3.32	46.01	
16.5	3.36	45.97	
18.2	3.86	45.47	
19	4.83	44.5	
20.2	5.02	44.31	
21.3	4.8	44.53	
23	4.15	45.18	
23.5	4.88	44.45	
26.1	3.8	45.53	
29.8	3.92	45.41	
32.3	4.37	44.96	BKF
35.2	4.77	44.56	
36.9	4.98	44.35	
39.6	5.57	43.76	
40.8	5.54	43.79	
42.3	5.83	43.5	
42.7	6.25	43.08	
43.1	6.43	42.9	LEW
45.2	6.82	42.51	
47.3	7.02	42.31	
48	7.22	42.11	
50.1	7.26	42.07	TW
51	7.17	42.16	
53	6.82	42.51	
54.6	6.64	42.69	
55.5	6.41	42.92	REW
55.9	5.96	43.37	
57.2	5.46	43.87	
58.1	4.45	44.88	
59.2	3.67	45.66	
60.2	3.37	45.96	
62.4	3.22	46.11	
63	3.15	46.18	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	47.85	47.85	47.85
Bankfull Elevation (ft)	44.96	44.96	44.96
Floodprone Width (ft)	190	-----	-----
Bankfull Width (ft)	25.8	1.97	23.83

		Glide	
Entrenchment Ratio	7.36	-----	-----
Mean Depth (ft)	1.68	0.14	1.81
Maximum Depth (ft)	2.89	0.27	2.89
Width/Depth Ratio	15.36	14.07	13.17
Bankfull Area (sq ft)	43.3	0.27	43.03
Wetted Perimeter (ft)	27.13	2.26	25.41
Hydraulic Radius (ft)	1.6	0.12	1.69
Begin BKF Station	32.3	32.3	34.27
End BKF Station	58.1	34.27	58.1

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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

Long Pro
RIVERMORPH PROFILE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Profile Name: Team 2 Long Pro
Survey Date: 07/21/2007

Survey Data

DIST	CH	WS	BKF	P1	P2	P3	P4
0	6.9	6.74	4.67	3.1			6.74
8.5	7.05	6.84					
11	7.19	7.06					
13	7.44	7.24					
19	7.53	7.2					
25	7.45	7.15					
31	7.83	7.28					
35	7.81	7.34	4.96	3.76	2.28	2.58	
41	8.13	7.38					
44	7.94	7.35					
51	7.75	7.35	5.03	4.15			
57	7.65	7.35					
60.5	7.69	7.36	5.16				
61	7.63	7.35					
63	8.07	7.37					
65.5	8.38	7.39					
69	8.7	7.4	5.35	3.32		3.82	
72.5	9.08	7.41					
78	8.98	7.39					
80	8.94						
88	8.54	7.4					
98	8.26	7.4	5.07	4.7			
99.9	8.05	7.45					
101.5	7.97	7.43					
107	7.65	7.44					
122	7.82	7.65					
127	8.09	7.73					
128.5	8.14	7.73					
132	8.3	7.71	5.71	4.41			
141.5	8.68	8.21					
149.5	9.33	8.21	6.08	4.96			
158	9.69	8.21					
163	9.7	8.23					
171.5	9.11	8.2					
174	9.41						
174.5	8.46	8.19					
177.5	8.42	8.2					
180	8.61						
191	8.56	8.42					
197	9.35	8.63					
202	9.45						
204	9.53						
206	10.21						
212.5	9.86	8.73					
217	9.67	8.72					
222	9.72	8.71	6.48	5.95			
227	9.63						

Long Pro

234	9.45	8.6	6.8	
238.5	9.24	8.65		
243	9.07	8.67		
247	8.88	8.66	6.5	8.66

Cross Section / Bank Profile Locations

Name	Type	Profile Station
Pool	Pool XS	69
Riffle	Riffle XS	35
Glide	Glide XS	234
Run	Run XS	132

Measurements from Graph

Bankfull Slope: 0.0056

Variable	Min	Avg	Max
S riffle	0.01197	0.01656	0.02341
S pool	0	0.00039	0.00061
S run	0.03619	0.06365	0.09111
S glide	0.00082	0.00449	0.0089
P - P	58.91	69.53	80.15
Pool length	29.99	33.02	36.77
Riffle length	8.24	12.25	14.99
Dmax riffle	2.24	2.31	2.38
Dmax pool	3.52	3.71	3.87
Dmax run	2.64	2.78	2.95
Dmax glide	2.88	2.98	3.13
Low bank ht	2.7	3.25	4.07

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

Notes

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Profile Name: Team 2 Long Pro
Survey Date: 07/21/2007

DIST	Note
0	Riffle
35	riffle cross section
57	glide
63	begin pool
69	Pool cross section
88	end pool
98	glide
107	riffle
127	end riffle
132	run cross section
141.5	pool
163	end pool
171.5	glide
177.5	riffle
191	run

		Long Pro
197	pool	
234	glide cross section	
247	begin riffle	

Pfankuch
RIVERMORPH PFANKUCH SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Survey Date: 09/22/2007

Upper Bank

Landform Slope:	8
Mass Wasting:	9
Debris Jam Potential:	5
Vegetative Protection:	12

Lower Bank

Channel Capacity:	3
Bank Rock Content:	6
Obstructions to Flow:	4
Cutting:	10
Deposition:	10

Channel Bottom

Rock Angularity:	1
Brightness:	2
Consolidation of Particles:	5
Bottom Size Distribution:	8
Scouring and Deposition:	16
Aquatic Vegetation:	4

Channel Stability Evaluation

Sediment Supply:	High
Stream Bed Stability:	Aggrading
W/D Condition:	Very High
Stream Type:	C4

Rating - 103
Condition - Fair

Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Cross Section Name: Pool
Survey Date: 09/21/2007

Cross Section Data Entry

BM Elevation: 105.7 ft
Backsight Rod Reading: 1.18 ft

TAPE	FS	ELEV	NOTE
0	1.18	105.7	TLMON
0	1.88	105	GLMON
1	1.98	104.9	
2	2.09	104.79	
3.1	2.26	104.62	
3.7	2.36	104.52	
4.3	2.62	104.26	
5	2.87	104.01	
6.4	3.13	103.75	
10	3.26	103.62	
13.8	3.57	103.31	
15.9	3.64	103.24	
20	3.89	102.99	
21.3	3.89	102.99	
22.5	4.14	102.74	BKF
23.7	4.29	102.59	
24.8	4.69	102.19	
26.7	5.16	101.72	
26.9	5.37	101.51	
28.9	6.07	100.81	
30.8	6.12	100.76	
32.6	5.92	100.96	
34.9	6.21	100.67	LEW
37.3	6.79	100.09	
38.4	7.14	99.74	
40.2	7.33	99.55	
41.3	7.35	99.53	
42.2	7.34	99.54	GTPIN
42.2	5.84	101.04	TTPIN
42.7	7.5	99.38	
43.8	7.25	99.63	
44.2	6.2	100.68	REW
44.9	2.14	104.74	
45.8	1.95	104.93	
48.9	2.04	104.84	
53.4	2.2	104.68	
58.5	2.26	104.62	
61.9	1.85	105.03	TRMON
61.9	2.29	104.59	

Cross Sectional Geometry

Channel Left Right

		Pool	
Floodprone Elevation (ft)	106.1	106.1	106.1
Bankfull Elevation (ft)	102.74	102.74	102.74
Floodprone Width (ft)	190	-----	-----
Bankfull Width (ft)	22.06	11.03	11.03
Entrenchment Ratio	8.61	-----	-----
Mean Depth (ft)	1.99	1.28	2.69
Maximum Depth (ft)	3.36	1.98	3.36
Width/Depth Ratio	11.09	8.62	4.1
Bankfull Area (sq ft)	43.85	14.16	29.69
Wetted Perimeter (ft)	27.79	13.29	18.29
Hydraulic Radius (ft)	1.58	1.07	1.62
Begin BKF Station	22.5	22.5	33.53
End BKF Station	44.56	33.53	44.56

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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

Pool Perm X-Sec Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Pool Permanent cross section
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	17	14.53	14.53
0.062 - 0.125	1	0.85	15.38
0.125 - 0.25	10	8.55	23.93
0.25 - 0.50	10	8.55	32.48
0.50 - 1.0	5	4.27	36.75
1.0 - 2.0	0	0.00	36.75
2.0 - 4.0	4	3.42	40.17
4.0 - 5.7	1	0.85	41.03
5.7 - 8.0	1	0.85	41.88
8.0 - 11.3	10	8.55	50.43
11.3 - 16.0	10	8.55	58.97
16.0 - 22.6	9	7.69	66.67
22.6 - 32.0	12	10.26	76.92
32 - 45	12	10.26	87.18
45 - 64	7	5.98	93.16
64 - 90	6	5.13	98.29
90 - 128	2	1.71	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.13
D35 (mm)	0.8
D50 (mm)	11.13
D84 (mm)	40.97
D95 (mm)	73.33
D100 (mm)	128
Silt/Clay (%)	14.53
Sand (%)	22.22
Gravel (%)	56.41
Cobble (%)	6.84
Boulder (%)	0
Bedrock (%)	0

Total Particles = 117.

Reach - Pool Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Pool reach
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	2	5.00	5.00
0.062 - 0.125	0	0.00	5.00
0.125 - 0.25	0	0.00	5.00
0.25 - 0.50	5	12.50	17.50
0.50 - 1.0	0	0.00	17.50
1.0 - 2.0	0	0.00	17.50
2.0 - 4.0	0	0.00	17.50
4.0 - 5.7	1	2.50	20.00
5.7 - 8.0	0	0.00	20.00
8.0 - 11.3	6	15.00	35.00
11.3 - 16.0	5	12.50	47.50
16.0 - 22.6	3	7.50	55.00
22.6 - 32.0	5	12.50	67.50
32 - 45	7	17.50	85.00
45 - 64	2	5.00	90.00
64 - 90	3	7.50	97.50
90 - 128	1	2.50	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.47
D35 (mm)	11.3
D50 (mm)	18.2
D84 (mm)	44.26
D95 (mm)	81.33
D100 (mm)	128
Silt/Clay (%)	5
Sand (%)	12.5
Gravel (%)	72.5
Cobble (%)	10
Boulder (%)	0
Bedrock (%)	0

Total Particles = 40 (need at least 60).

Reach - Riffle Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Riffle reach
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	6.67	6.67
0.062 - 0.125	0	0.00	6.67
0.125 - 0.25	0	0.00	6.67
0.25 - 0.50	0	0.00	6.67
0.50 - 1.0	0	0.00	6.67
1.0 - 2.0	0	0.00	6.67
2.0 - 4.0	0	0.00	6.67
4.0 - 5.7	1	1.67	8.33
5.7 - 8.0	1	1.67	10.00
8.0 - 11.3	5	8.33	18.33
11.3 - 16.0	4	6.67	25.00
16.0 - 22.6	9	15.00	40.00
22.6 - 32.0	5	8.33	48.33
32 - 45	9	15.00	63.33
45 - 64	7	11.67	75.00
64 - 90	10	16.67	91.67
90 - 128	4	6.67	98.33
128 - 180	1	1.67	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	10.38
D35 (mm)	20.4
D50 (mm)	33.45
D84 (mm)	78.04
D95 (mm)	109
D100 (mm)	180
Silt/Clay (%)	6.67
Sand (%)	0
Gravel (%)	68.33
Cobble (%)	25
Boulder (%)	0
Bedrock (%)	0

Total Particles = 60.

Reach Average Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Reach Average
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	6	6.00	6.00
0.062 - 0.125	0	0.00	6.00
0.125 - 0.25	0	0.00	6.00
0.25 - 0.50	5	5.00	11.00
0.50 - 1.0	0	0.00	11.00
1.0 - 2.0	0	0.00	11.00
2.0 - 4.0	0	0.00	11.00
4.0 - 5.7	2	2.00	13.00
5.7 - 8.0	1	1.00	14.00
8.0 - 11.3	11	11.00	25.00
11.3 - 16.0	9	9.00	34.00
16.0 - 22.6	12	12.00	46.00
22.6 - 32.0	10	10.00	56.00
32 - 45	16	16.00	72.00
45 - 64	9	9.00	81.00
64 - 90	13	13.00	94.00
90 - 128	5	5.00	99.00
128 - 180	1	1.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	8.6
D35 (mm)	16.55
D50 (mm)	26.36
D84 (mm)	70
D95 (mm)	97.6
D100 (mm)	179.99
Silt/Clay (%)	6
Sand (%)	5
Gravel (%)	70
Cobble (%)	19
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Reach BEHI Summary
RIVERMORPH BEHI SUMMARY REPORT

River Name: 2007-09 Little Bennett
Reach Name: Reach 1

Table 1. Bank Identification Summary

Bank	Name
1	STA 0-7 LB
2	STA 8-20 RB
3	STA 20-62 RB
4	STA 62-81 RB
5	STA 87-103 LB
6	STA 105-119 LB
7	STA 119-147 LB
8	STA 147-179 LB
9	STA 195-211 RB
10	STA 211-223 RB
11	Riffle XS Bank Pin
12	Pool XS Bank Pin

Table 2. Predicted Annual Bank Erosion Rates

Bank	BEHI Numeric Rating	BEHI Adjective Rating	NBS Adjective Rating	Length ft	Loss cu yds/yr	Loss tons/yr
1	33.6	High	High	7	0.88	1.14
2	49.7	Extreme	High	12	4.4	5.72
3	38.3	High	High	41	3.8	4.94
4	38.6	High	Extreme	18	4.65	6.05
5	24.8	Moderate	Very Low	16	0.48	0.62
6	37	High	High	14	2.13	2.77
7	37.7	High	High	28	4.85	6.31
8	44	Very High	Very High	32	7.7	10.01
9	41.1	Very High	Moderate	16	1.67	2.17
10	38.8	High	Extreme	22	7.33	9.53
11	42.9	Very High	High	1	0.17	0.22
12	44.8	Very High	High	1	0.19	0.25
Totals				208	38.25	49.73

Total Reach Ln: 243 Total Loss (tons/yr) per ft of Reach: 0.2047

Reach Dimensions Summary
RIVERMORPH REACH SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1

Stream Type	Valley Type	D50(mm)	Val Slope	BKF Q(cfs)	DA(sq mi)
C 4	VIII	14.82	0.0079	122.5	1.7

Dimension Summary

Database based on the following Cross Sections:

Variable	Min	Avg	Max
Floodprone Width (ft)	190	190	190
Riffle Area (Sq ft)	32.57	32.57	32.57
Max Riffle Depth (ft)	2.24	2.31	2.38
Mean Riffle Depth (ft)	1.22	1.22	1.22
Riffle Width (ft)	26.59	26.59	26.59
Pool Area (Sq ft)	43.85	43.85	43.85
Max Pool Depth (ft)	3.52	3.71	3.87
Mean Pool Depth (ft)	1.99	1.99	1.99
Pool Width (ft)	22.06	22.06	22.06
Run Area (Sq ft)	37.06	37.06	37.06
Max Run Depth (ft)	2.64	2.78	2.95
Mean Run Depth (ft)	1.64	1.64	1.64
Run Width (ft)	22.67	22.67	22.67
Glide Area (Sq ft)	43.3	43.3	43.3
Max Glide Depth (ft)	2.88	2.98	3.13
Mean Glide Depth (ft)	1.68	1.68	1.68
Glide Width (ft)	25.8	25.8	25.8

Pattern Summary

Variable	Min	Avg	Max
Sinuosity		1.41	
Meander Wavelength (ft)	103	130	156
Radius of Curvature (ft)	26	30	34
Belt Width (ft)	218	218	218

Profile Summary

Data Based on the following:

Variable	Min	Avg	Max
S riffle (ft/ft)	0.01197	0.01656	0.02341
S pool (ft/ft)	0	0.00039	0.00061
S run (ft/ft)	0.03619	0.06365	0.09111
S glide (ft/ft)	0.00082	0.00449	0.0089
P - P (ft)	58.91	69.53	80.15
Pool length (ft)	29.99	33.02	36.77
Riffle length (ft)	8.24	12.25	14.99
Dmax riffle (ft)	2.24	2.96	2.38
Dmax pool (ft)	3.52	3.71	3.87
Dmax run (ft)	2.64	2.78	2.95
Dmax glide (ft)	2.88	2.98	3.13
Low bank ht (ft)	2.7	3.25	4.07

Reach Dimensions Summary

Bankfull slope (ft/ft) 0.0056

Hydraulic Summary

Variable	Min	Avg	Max
Discharge (cfs)		122.5	
Velocity (fps)		3.76	
Hyd Radius (ft)	1.03	1.03	1.03

Reach Dimensions Summary
RIVERMORPH REACH SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1

Stream Type	Valley Type	D50(mm)	Val Slope	BKF Q(cfs)	DA(sq mi)
C 4	VIII	14.82	0.0079	122.5	1.7

Dimension Summary

Database based on the following Cross Sections:

Variable	Min	Avg	Max
Floodprone Width (ft)	190	190	190
Riffle Area (Sq ft)	32.57	32.57	32.57
Max Riffle Depth (ft)	2.24	2.31	2.38
Mean Riffle Depth (ft)	1.22	1.22	1.22
Riffle Width (ft)	26.59	26.59	26.59
Pool Area (Sq ft)	43.85	43.85	43.85
Max Pool Depth (ft)	3.52	3.71	3.87
Mean Pool Depth (ft)	1.99	1.99	1.99
Pool Width (ft)	22.06	22.06	22.06
Run Area (Sq ft)	37.06	37.06	37.06
Max Run Depth (ft)	2.64	2.78	2.95
Mean Run Depth (ft)	1.64	1.64	1.64
Run Width (ft)	22.67	22.67	22.67
Glide Area (Sq ft)	43.3	43.3	43.3
Max Glide Depth (ft)	2.88	2.98	3.13
Mean Glide Depth (ft)	1.68	1.68	1.68
Glide Width (ft)	25.8	25.8	25.8

Pattern Summary

Variable	Min	Avg	Max
Sinuosity		1.41	
Meander Wavelength (ft)	103	130	156
Radius of Curvature (ft)	26	30	34
Belt Width (ft)	218	218	218

Profile Summary

Data Based on the following:

Variable	Min	Avg	Max
S riffle (ft/ft)	0.01197	0.01656	0.02341
S pool (ft/ft)	0	0.00039	0.00061
S run (ft/ft)	0.03619	0.06365	0.09111
S glide (ft/ft)	0.00082	0.00449	0.0089
P - P (ft)	58.91	69.53	80.15
Pool length (ft)	29.99	33.02	36.77
Riffle length (ft)	8.24	12.25	14.99
Dmax riffle (ft)	2.24	2.96	2.38
Dmax pool (ft)	3.52	3.71	3.87
Dmax run (ft)	2.64	2.78	2.95
Dmax glide (ft)	2.88	2.98	3.13
Low bank ht (ft)	2.7	3.25	4.07

Reach Dimensions Summary

Bankfull slope (ft/ft) 0.0056

Hydraulic Summary

Variable	Min	Avg	Max
Discharge (cfs)		122.5	
Velocity (fps)		3.76	
Hyd Radius (ft)	1.03	1.03	1.03

Reach Summary
RIVERMORPH REACH SUMMARY

River Name: Macgruder
Reach Name: Final Reach

Stream Type	Valley Type	D50(mm)	Val Slope	BKF Q(cfs)	DA(sq mi)
C 4	VIII	17.89	0.0122	115	1.3

Dimension Summary

Database based on the following Cross Sections:

Variable	Min	Avg	Max
Floodprone Width (ft)	149.94	150	150
Riffle Area (Sq ft)	31	31	31
Max Riffle Depth (ft)	1.61	1.98	2.6
Mean Riffle Depth (ft)	1.27	1.27	1.27
Riffle Width (ft)	24.46	24.46	24.46
Pool Area (Sq ft)	27.59	27.59	27.59
Max Pool Depth (ft)	3.16	4.02	4.69
Mean Pool Depth (ft)	2.38	2.38	2.38
Pool Width (ft)	11.57	11.57	11.57
Run Area (Sq ft)	45.19	45.19	45.19
Max Run Depth (ft)	1.77	2.28	2.8
Mean Run Depth (ft)	1.79	1.79	1.79
Run Width (ft)	25.27	25.27	25.27
Glide Area (Sq ft)	41.99	41.99	41.99
Max Glide Depth (ft)	1.29	2.26	2.91
Mean Glide Depth (ft)	1.73	1.73	1.73
Glide Width (ft)	24.2	24.2	24.2

Pattern Summary

Variable	Min	Avg	Max
Sinuosity		1.4	
Meander Wavelength (ft)	0	0	0
Radius of Curvature (ft)	29	36	45
Belt Width (ft)	0	68	0

Profile Summary

Data Based on the following:

Variable	Min	Avg	Max
S riffle (ft/ft)	0.03665	0.05142	0.06384
S pool (ft/ft)	0.00038	0.00058	0.00085
S run (ft/ft)	0.02705	0.12034	0.24659
S glide (ft/ft)	0.00185	0.00285	0.0035
P - P (ft)	54.28	64.88	75.48
Pool length (ft)	32.97	47.84	75.97
Riffle length (ft)	2.75	5.81	8.68
Dmax riffle (ft)	1.63	1.78	1.86
Dmax pool (ft)	3.16	4.02	4.69
Dmax run (ft)	1.77	2.28	2.8
Dmax glide (ft)	1.29	2.26	2.91
Low bank ht (ft)	1.19	1.46	1.72

Reach Summary

Bankfull slope (ft/ft) 0.00874

Hydraulic Summary

Variable	Min	Avg	Max
Discharge (cfs)		115	
Velocity (fps)		3.71	
Hyd Radius (ft)	1.21	1.21	1.21

Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Cross Section Name: Riffle
Survey Date: 09/21/2007

Cross Section Data Entry

BM Elevation: 105.52 ft
Backsight Rod Reading: 1.38 ft

TAPE	FS	ELEV	NOTE
0	1.38	105.52	TLMON
0	1.97	104.93	GMON
2	1.82	105.08	SLP BRK
4.8	2.38	104.52	SLP BRK
7.8	2.46	104.44	SLP BRK
10.7	2.5	104.4	SLP BRK
12	2.62	104.28	SLP BRK
12.8	2.66	104.24	SLP BRK
13.1	2.85	104.05	SLP BRK
13.5	2.93	103.97	SLP BRK
14.1	3.12	103.78	SLP BRK
14.7	3.42	103.48	
15.2	3.74	103.16	BKF
15.5	4.06	102.84	BAR
15.9	4.33	102.57	BAR
16.8	4.44	102.46	BAR
18	4.37	102.53	BAR
20.1	4.31	102.59	BAR
21.9	4.19	102.71	BAR
23.1	4.17	102.73	BAR
24.5	4.28	102.62	BAR
26.5	4.52	102.38	BAR
28	4.6	102.3	BAR/SCOUR CHAIN
30.1	4.87	102.03	BAR
32.7	4.99	101.91	BAR
33.5	5.4	101.5	BAR
34.5	5.69	101.21	BAR
35.9	5.83	101.07	BAR
36.2	5.88	101.02	BAR
36.8	6	100.9	BAR
37	6.13	100.77	LEW
37.8	6.44	100.46	CS
38.5	6.5	100.4	CS
38.9	6.68	100.22	CS
39.3	6.7	100.2	TW
39.9	6.61	100.29	GTPIN
40	6.53	100.37	CS
40	5.12	101.78	TTPIN
40.5	6.52	100.38	CS
40.8	6.16	100.74	REW
41	5.53	101.37	SLP BRK
41.7	4.89	102.01	SLP BRK
41.9	2.41	104.49	RTOB
43.1	2.12	104.78	SLP BRK
46.5	1.87	105.03	SLP BRK
53	1.61	105.29	GS

			Riffle
57	1.72	105.18	GS
60	1.68	105.22	GS
62.9	1.68	105.22	GRMON
62.9	1.1	105.8	TRMON

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	106.12	106.12	106.12
Bankfull Elevation (ft)	103.16	103.16	103.16
Floodprone Width (ft)	190	-----	-----
Bankfull Width (ft)	26.59	13.3	13.29
Entrenchment Ratio	7.14	-----	-----
Mean Depth (ft)	1.22	0.6	1.85
Maximum Depth (ft)	2.96	0.92	2.96
Width/Depth Ratio	21.8	22.17	7.18
Bankfull Area (sq ft)	32.57	7.99	24.58
Wetted Perimeter (ft)	31.54	14.48	18.9
Hydraulic Radius (ft)	1.03	0.55	1.3
Begin BKF Station	15.2	15.2	28.5
End BKF Station	41.79	28.5	41.79

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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

Riffle Active Bed Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Riffle active bed
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	7	5.88	5.88
0.062 - 0.125	0	0.00	5.88
0.125 - 0.25	0	0.00	5.88
0.25 - 0.50	0	0.00	5.88
0.50 - 1.0	0	0.00	5.88
1.0 - 2.0	1	0.84	6.72
2.0 - 4.0	2	1.68	8.40
4.0 - 5.7	8	6.72	15.13
5.7 - 8.0	7	5.88	21.01
8.0 - 11.3	18	15.13	36.13
11.3 - 16.0	11	9.24	45.38
16.0 - 22.6	16	13.45	58.82
22.6 - 32.0	8	6.72	65.55
32 - 45	12	10.08	75.63
45 - 64	14	11.76	87.39
64 - 90	7	5.88	93.28
90 - 128	6	5.04	98.32
128 - 180	2	1.68	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	6.04
D35 (mm)	11.05
D50 (mm)	18.27
D84 (mm)	58.52
D95 (mm)	102.97
D100 (mm)	180
Silt/Clay (%)	5.88
Sand (%)	0.84
Gravel (%)	80.67
Cobble (%)	12.61
Boulder (%)	0
Bedrock (%)	0

Total Particles = 119.

Riffle Perm X-Sec Pebble
RIVERMORPH PARTICLE SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Sample Name: Riffle perm x-sec
Survey Date: 09/22/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	8	7.77	7.77
0.062 - 0.125	0	0.00	7.77
0.125 - 0.25	3	2.91	10.68
0.25 - 0.50	5	4.85	15.53
0.50 - 1.0	0	0.00	15.53
1.0 - 2.0	0	0.00	15.53
2.0 - 4.0	1	0.97	16.50
4.0 - 5.7	3	2.91	19.42
5.7 - 8.0	7	6.80	26.21
8.0 - 11.3	17	16.50	42.72
11.3 - 16.0	10	9.71	52.43
16.0 - 22.6	7	6.80	59.22
22.6 - 32.0	12	11.65	70.87
32 - 45	14	13.59	84.47
45 - 64	2	1.94	86.41
64 - 90	9	8.74	95.15
90 - 128	2	1.94	97.09
128 - 180	3	2.91	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	2.97
D35 (mm)	9.76
D50 (mm)	14.82
D84 (mm)	44.55
D95 (mm)	89.55
D100 (mm)	180
Silt/Clay (%)	7.77
Sand (%)	7.76
Gravel (%)	70.88
Cobble (%)	13.59
Boulder (%)	0
Bedrock (%)	0

Total Particles = 103.

Run
RIVERMORPH CROSS SECTION SUMMARY

River Name: 2007-09 Little Bennett
Reach Name: Reach 1
Cross Section Name: Run
Survey Date: 09/21/2007

Cross Section Data Entry

BM Elevation: 30 ft
Backsight Rod Reading: 1.69 ft

TAPE	FS	ELEV	NOTE
0	1.69	30	
2.5	1.67	30.02	
3	2.03	29.66	
4.8	2.94	28.75	
6	3	28.69	
6.7	3.05	28.64	
7.3	3.08	28.61	
8	3.27	28.42	
8.5	3.64	28.05	
9.05	3.97	27.72	
9.5	4.78	26.91	
9.9	5.22	26.47	
10.5	5.5	26.19	
11.2	5.74	25.95	
12	5.99	25.7	LEW
13.1	6.04	25.65	
14	6.32	25.37	
14.7	6.46	25.23	TW
15.8	6.36	25.33	
16.5	6.2	25.49	
17.5	6.01	25.68	REW
18.1	5.77	25.92	
18.8	5.57	26.12	
19.5	5.36	26.33	
21.7	5.17	26.52	
22	5.01	26.68	
23.1	4.98	26.71	
24.9	4.84	26.85	
25.8	4.55	27.14	
26.5	4.43	27.26	
27.4	4.39	27.3	
29.3	4.55	27.14	
30.5	4.09	27.6	
31.1	3.59	28.1	BKF
32.4	3.1	28.59	
33.2	2.7	28.99	
33.8	2.41	29.28	
34.8	2.29	29.4	
36	2.3	29.39	
39.3	2.43	29.26	
40	2.44	29.25	
41	2.43	29.26	

Cross Sectional Geometry

Run

	Channel	Left	Right
Floodprone Elevation (ft)	30.97	30.97	30.97
Bankfull Elevation (ft)	28.1	28.1	28.1
Floodprone Width (ft)	190	-----	-----
Bankfull Width (ft)	22.67	11.34	11.33
Entrenchment Ratio	8.38	-----	-----
Mean Depth (ft)	1.64	2.15	1.12
Maximum Depth (ft)	2.87	2.87	1.75
Width/Depth Ratio	13.82	5.27	10.12
Bankfull Area (sq ft)	37.06	24.42	12.64
Wetted Perimeter (ft)	24.17	14.21	13.46
Hydraulic Radius (ft)	1.53	1.72	0.94
Begin BKF Station	8.43	8.43	19.77
End BKF Station	31.1	19.77	31.1

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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

riffle bank profile
RIVERMORPH BANK PROFILE REPORT

River Name: Little Bennett
Reach Name: Reach 1
Bank Name : Riffle Profile

Toe Pin Setup Data:
Station: 40 Elevation: 101.26 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	
0	-1.26	assumed bed elevation
0.65	-0.84	toe
0.75	-0.36	
0.79	-0.2	
0.82	0	BPIN1
1.01	0.22	
1.72	0.38	
1.82	0.9	
2.03	1.42	
1.96	1.7	BPIN2
1.85	2.28	
1.76	2.82	BPIN3
1.77	3.07	
1.82	3.29	TOB
3.15	3.52	
3.69	3.63	
4.58	3.83	

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN1	0.82	0	4	
BPIN2	1.96	1.7	4	
BPIN3	1.76	2.82	4	

Summary:

Toe Pin Area: 8.35 square feet (used for erosion monitoring)
Bank Height: 3.83 feet

riffle bank profile

Avg. Bank Angle: 50.34 degrees

pool profile
RIVERMORPH BANK PROFILE REPORT

River Name: Little Bennett
Reach Name: Reach 1
Bank Name : Pool Profile

Toe Pin Setup Data:
Station: 42.2 Elevation: 101.04 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	
0	-1.35	
1.86	-1.34	
1.78	-1.2	
1.85	-1.12	
1.98	-0.9	
2.4	-0.58	toe
2.58	-0.14	
2.6	0	TTPIN
2.65	0.07	BPIN1
2.66	0.07	Bank at pin
2.76	0.32	
2.86	0.56	
3.02	0.87	
3.09	1.08	
3.05	1.22	BPIN2
3.17	1.22	bank at pin
3.03	1.62	
3.02	1.81	
2.99	2.08	
2.83	2.54	BPIN3
2.39	2.54	bank at pin
2.93	2.91	
2.99	3.14	
2.73	3.46	
2.73	3.56	Right top of bank
3.16	3.8	

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN1	2.65	0.07	4	
BPIN2	3.05	1.22	4	

pool profile

BPIN3 2.83 2.54 4

Summary:

Toe Pin Area: 14.03 square feet (used for erosion monitoring)
Bank Height: 3.80 feet
Avg. Bank Angle: 48.44 degrees

UT Little Bennett Creek Team 2 9/21/2007

STREAM SURVEY

CROSS SECTION The Long Protapes (Offsets are at 26.8)

STREAM UT LITTLE BENNETT	DATE 9/21/07 0
REACH 2	CREW (3) SLN, LM, RMC
XS RIFFLE / STATION	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV./DEPTH	NOTE	DIST.	ELEV./DEPTH
T L MON	0	1.38	R TO B	41.9	2.41
G L MON	0	1.97	SLP BRK	43.1	2.12
SLP BRK	2.0	1.82	SLP BRK	46.5	1.87
SLP BRK	4.8	2.38	GS	53.0	1.61
SLP BRK	7.8	2.46	GS	57.0	1.72
SLP BRK	10.7	2.50	GS	60.0	1.68
SLP BRK	12.0	2.62	GR MON	62.9	1.68
SLP BRK	12.8	2.66	TR MON	62.9	1.10
SLP BRK	13.1	2.85			
SLP BRK	13.5	2.93			
SLP BRK	14.1	3.12			
SLP BRK	14.7	3.42			
BKF	15.2	3.74			
Bar	15.5	4.06			
Bar	15.9	4.33			
Bar	16.5	4.44			
Bar	18.0	4.37			
Bar	20.1	4.31			
Bar	21.9	4.19			
Bar	23.1	4.17			
Bar	24.5	4.28			
Bar	26.5	4.52			
Scour chain	26.0	4.68			
Bar	30.1	4.87			
Bar	32.7	4.99			
Bar	33.5	5.40			
Bar	34.5	5.69			
Bar	35.9	5.83			
Bar	36.2	5.88			
Bar	36.8	6.00			
Scour chain	37.0	6.13			
WS	37.0	6.13			
CS	37.8	6.44			
CS	38.5	6.50			
CS	39.9	6.58			
(Thalweg) CS	39.3	6.70			
GT Pin (Left)	39.9	6.61			
Downstream GT Pin	40	6.53			
TT Pin	40	5.12			
CS	40.5	6.52			
WS/BKB	40.8	6.16			
SLP BRK	41.0	5.53			
SLP BRK	41.7	4.09			

NOTATIONS	
NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL
Right edge of Bank	REB
Left edge of Bank	LEB
ENTRENCHMENT	
FLOODPRONE ELEVATION	
FLOODPRONE WIDTH	
BANKFULL WIDTH	
ENTRENCHMENT	

5.62

(edge of upper bank overhang)

USFWS-CBFO
9/20/2007 2:31 PM

Cross Section XSForm

STREAM SURVEY

CROSS SECTION

STREAM	UT LITTLE BENNETT	DATE	9/21/07
REACH	2	CREW	(3) JLW, CM & RMC
XS	POOL	STATION	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV./DEPTH	NOTE	DIST.	ELEV./DEPTH
TL MON	0	1.18			
BL MON	0	1.88			
	1	1.95			
	2	2.09			
	3.1	2.26			
	3.7	2.36			
	4.3	2.62			
	5.0	2.87			
	6.4	3.13			
	10.0	3.26			
	13.8	3.57			
	15.9	3.64			
	20.0	3.89			
	21.3	3.89			
BKF	22.3	4.14			
	23.7	4.29			
	24.8	4.69			
	25.7	5.16			
	26.9	5.37			
	28.9	6.07			
	30.8	6.12			
	32.6	5.92			
LBW	34.9	6.21			
	37.3	6.79			
	38.4	7.14			
	40.2	7.33			
	41.3	7.35			
GT PIN	42.2	7.34			
TT PIN	42.2	7.84			
	42.7	7.80			
	43.8	7.25			
RBW	44.2	7.01			
	44.9	2.14			
	45.8	1.95			
	48.9	2.09			
	53.4	2.20			
	58.5	2.26			
TR MON	61.9	1.85			
BR MON	61.9	2.29			

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT

FLOODPRONE ELEVATION	
FLOODPRONE WIDTH	190
BANKFULL WIDTH	
ENTRENCHMENT	

7.50
4.14
2.36
3
5.72

UT Little Bennett Creek Team 2 9/21/2007

145
50 195 FPA - NOTE old new channel on left Bank crosses long pro @ 138.7

STREAM SURVEY
CROSS SECTION

STREAM UT Little Bennett	DATE 9/21/07
REACH 2	CREW (3) JLN, LM, RMC
XS Run / STATION	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV./DEPTH	NOTE	DIST.	ELEV./DEPTH
SLP BRK	0	1.69			
SLP BRK	2.5	1.67			
SLP BRK	3.0	2.03			
SLP BRK	4.8	2.94			
SLP BRK	6.0	3.00			
SLP BRK	6.7	3.05			
SLP BRK	7.3	3.08			
L TOB	8.0	3.27			
SLP BRK	8.5	3.64			
SLP BRK	9.05	3.97			
SLP BRK	9.5	4.78			
SLP BRK	9.9	5.22			
SLP BRK	10.5	5.50			
SLP BRK	11.2	5.74			
EW / WS	12.0	5.99			
CS	13.1	6.04			
CS	14.0	6.32			
TW	14.7	6.46			
CS	15.8	6.36			
CS	16.5	6.20			
EW / WS	17.5	6.01			
SLP BRK	18.1	5.77			
SLP BRK	18.8	5.57			
SLP BRK	19.5	5.36			
SLP BRK	21.7	5.17			
SLP BRK	22.0	5.01			
SLP BRK	23.1	4.94			
SLP BRK	24.9	4.94			
SLP BRK	25.8	4.55			
SLP BRK	26.5	4.43			
SLP BRK	27.4	4.39			
SLP BRK	29.3	4.55			
SLP BRK	30.5	4.09			
SLP BRK	32.4	3.10			
R TOB	33.8	2.41			
SLP BRK	34.8	2.29			
SLP BRK	36.0	2.30			
SLP BRK	39.3	2.43			
SLP BRK	40.0	2.44			
SLP BRK	41.0	2.43			
BKF	32.2	2.70			

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT

FLOODPRONE ELEVATION	
FLOODPRONE WIDTH	
BANKFULL WIDTH	
ENTRENCHMENT	

NOTE	Distance	ELEV
BKF?	9.5	4.78
BKF?	31.1	3.59

2.70
2.70
5.40

TW 6.46
4.0

TW 6.46 5.74
2.87

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Cross Section XSForm

RIFFLE PEBBLE COUNT

Point Bar Slope: Lill Lib

STREAM: UT Little Bennet Creek

DATE: 9/21/07

REACH: 2

CREW: Rice / Pautzke

XS No.:

Riffle Location (also mark on reach sketch) Reach Average

ft	PARTICLE	mm		Riffle X 1	Active Bar Riffle 2	3	Pool Cross 4	Particle Count 5	6	Pool Cx Vol. 7	8	Riffle Cx Vol. 9	10	TOTALS Tot #	% Cum
	Silt/Clay	< .062	S/C	8		7		17		2		4		6	
	Very Fine	.062 - .125	S					1		5					
	Fine	.125 - .25	A	3				10							
	Medium	.25 - .50	N	5				10		5				5	
	Coarse	.50 - 1.0	D					5							
	Vry Coarse	1.0 - 2	S			1									
	Very Fine	2 - 4		1		2		4							
	Fine	4 - 6	G	3		8		1		1		1		2	
	Fine	6 - 8	R	7		7		1				1		1	
	Medium	8 - 12	A	17		18		10		3		5		11	
	Medium	12 - 16	V	14		11		10		5		4		9	
	Coarse	16 - 24	E	7		16		9		3		9		12	
	Coarse	24 - 32	L	12		8		12		5		5		10	
	Vry Coarse	32 - 48	S	14		12		12		7		9		16	
	Vry Coarse	48 - 64		2		14		2		2		7		9	
0.21-0.31	Small	64 - 96	C	9		7		6		2		10		13	
0.31-0.42	Small	96 - 128	O	2		6		2		1		4		5	
0.42-0.63	Large	128 - 192	B	3		2						1		1	
0.63-0.84	Large	192 - 256	L												
0.84-1.26	Small	256 - 384	B												
1.26-1.68	Small	384 - 512	L												
1.68-3.36	Medium	512 - 1024	D												
3.36-6.72	Lrg	1024 - 2048	R												
6.72-13.43	Vry Lrg	2048-4096													
	Bedrock	>4096	BDRK	Riff-XC	Active		Pool X-C		40% Pool 15						

LARGEST PARTICLES ON BAR

Bar Location (also mark on reach sketch):

		Length	%	units	Sampled
Bar Length:				4	6 - 1R, 4 Riffles
Bar Width (Thalweg - BF):	Non Pool	151	62%		
Sketch bar profile (Thalweg - BF)	Pool	92	38%	3	4 - Pools

Part. #	mm	Part. #	mm	Part. #	mm
1		6		11	
2		7		12	
3		8		13	
4		9		14	
5		10		15	

Riffle Cross-Section is now a bit backwatered.

USFWS-Stream Habitat Assessment and Restoration Program
Modified 04/22/04, TLM

Riffle_PC_Form2

UT Little Bennett Creek Team 2 9/21/2007

UT Little Bennett Creek Team 2 9/21/2007

long pro tape @ 40 on ovrs + 232.6 on long pro

STREAM SURVEY

CROSS SECTION

STREAM: UT Little Bennett	DATE: 9/21/07
REACH: 2	CREW: (3) JRN, LM, LMC
XS: BLDE	STATION:

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV./DEPTH	NOTE	DIST.	ELEV./DEPTH
SLP BRK	10	4.33			
SLP BRK	12.5	3.42			
SLP BRK	15.5	3.32			
SLP BRK	16.5	3.36			
SLP BRK	18.2	3.86			
SLP BRK	19.0	4.83			
SLP BRK	20.2	5.02			
SLP BRK	21.3	4.80			
SLP BRK	23.0	4.15			
SLP BRK	23.5	4.88			
SLP BRK	26.1	3.80			
SLP BRK	29.8	3.92			
SLP BRK	32.3	4.37	BKF		
SLP BRK	35.2	4.77			
SLP BRK	36.9	4.98			
SLP BRK	39.6	5.57			
SLP BRK	40.8	5.54			
SLP BRK	42.3	5.83			
SLP BRK	42.7	6.25			
EW/WS	43.1	6.43			
CS	45.2	6.82			
CS	47.3	7.02			
CS	48.0	7.22			
TW	50.1	7.26			
CS	51.0	7.17			
CS	53.0	6.82			
CS	54.6	6.64			
REW	55.5	6.41			
top of long pr	55.9	5.68			
SLP BRK	57.2	5.46			
SLP BRK	58.1	4.45			
SLP BRK	59.2	3.67			
RTOB	60.2	3.37			
SLP BRK	62.4	3.22			
SLP BRK	63.0	3.15			

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT	
FLOODPRONE ELEVATION	
FLOODPRONE WIDTH	
BANKFULL WIDTH	
ENTRENCHMENT	

7.26 − 3.92 = 3.37

7.26 − 2.80 = 4.46

UT Little Bennett Creek Team 2 9/21/2007

Bedload at Bkfl for Flowsld

STREAM SURVEY

LONGITUDINAL PROFILE

1.3 higher

STREAM LITTLE BENNETT	DATE 9-21-07
REACH Reach 2	CREW April, Phillip, David
	★ Best Bkfl indicators

Difference 2.3' WS to BKFL at Riffle

(all measurements are in feet unless otherwise noted) WS-Bk-Dif

STATION	TW	WS	BKF	WS/BF	TOB	Other	Other	COMMENT
1.35	0.52				0.52	R-mon		2.58-Rif
-10.4		6.29				BRIF		
★ 0	6.90	6.74	4.67/4.36		3.10LB	RIF	2.07/2.38	slight break
8.5	7.05	6.84				Rif		
11	7.19	7.06				Rif		
13	7.44	7.24				ERif		
19	7.53	7.20						
25	7.45	7.15				BRif		
31	7.83	7.28				Erif		
35	7.81	7.34	4.96		3.76LB		2.38	R-XS
35						L-mon		2.28-Rif
41	8.10	7.38				CS		
44	7.94	7.35				CS		
51	7.75	7.38	4.61X	5.39/5.03	4.15LB		2.35	
57	7.65	7.35						
60.5	7.69	7.36	4.88X	5.16			2.2	
61	7.63	7.35						
65	8.01	7.37				BPO		
65.5	8.38	7.39						
69	8.70	7.40	5.35		3.32LB	PO XS	2.05	
69						R-mon		(3.02)
72.5	9.08	7.41				PO		
78	8.98	7.39				PO		
80	8.94							
88	8.54	7.40				EPO		
98	8.20	7.40	5.07		4.70LB		2.33	
99.5	8.05	7.45						
101.5	7.97	7.43						
107	7.65	7.44				BRif		
122	7.82	7.65				Rif		
127	8.09	7.73				ERif		
135	8.14	7.73						
139	7.49	7.71	5.71		4.41LB		scour line	
141.5	8.68	8.21				Run ↗		
						TPoint		(9.23)
149.5	9.33	8.21	6.08		4.96LB	BPO		slight break
158	9.69	8.21						
163	9.70	8.23				EPO		
171.5	9.11	8.20						
174	8.90	8.20						
174.5	8.90	8.19						
177.5	8.42	8.20						
180	8.61							

NOTATIONS	
NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Veg Line	VL

138.8-Run

5.65 7.71 8.21 8.21 8.21

5.65 6.08 6.08

2.56 3 2.13

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Long Prof XSForm

UT Little Bennett Creek Team 2 9/21/2007

(no BKF indicators)

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM	DATE
REACH	CREW

(all measurements are in feet unless otherwise noted)

STATION	TW	WS	BKF	WS/BF	TOB	Other	Other	COMMENT
191	8.56	8.42	no indicators					
197	9.35	8.63						
202	9.45							
204	9.53							
206	10.21							
no 209	8.61							
212.5	9.86	8.73						
217	9.67	8.72						
222	9.72	8.71	6.48		5.95 LB		2.23	
227	9.63							
234	9.45	8.100	6.80					
238.5	9.24	8.65						
243	9.07	8.67						
247	8.88	8.66	6.50	Break		BRK		
					⊗	4.94	L Mon riff xs Team 3	

NOTATIONS	
NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Veg Line	VL

1.81

7.35
RB 6.27

7.35
RB: 5.66
1.69

7.35
5.91 LB
1.44

8.41
6.48
2.23

8.66
7.23
1.43

8.66
6.50
2.16

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9/20/2007 2:30 PM

Long Prof XSForm