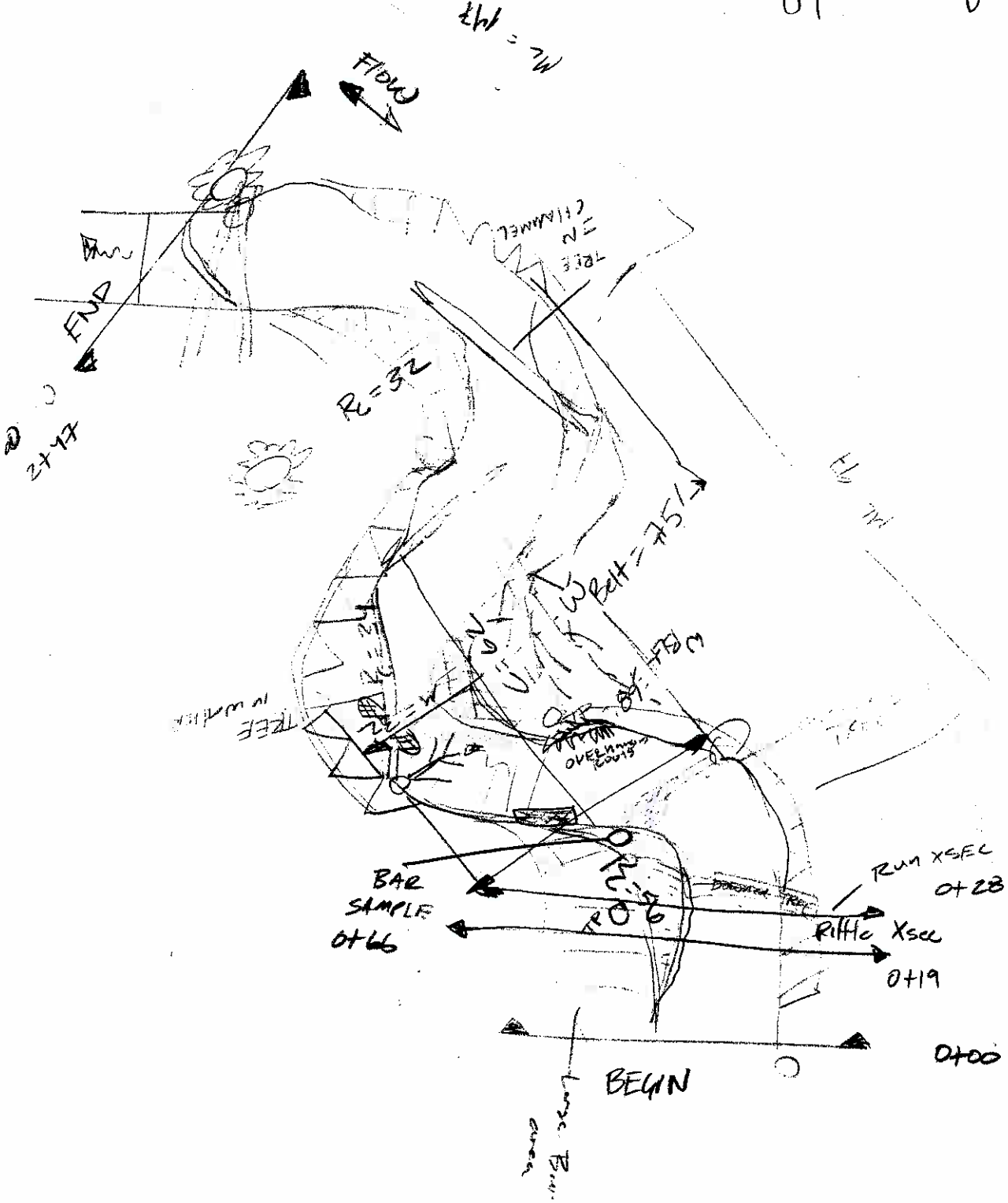
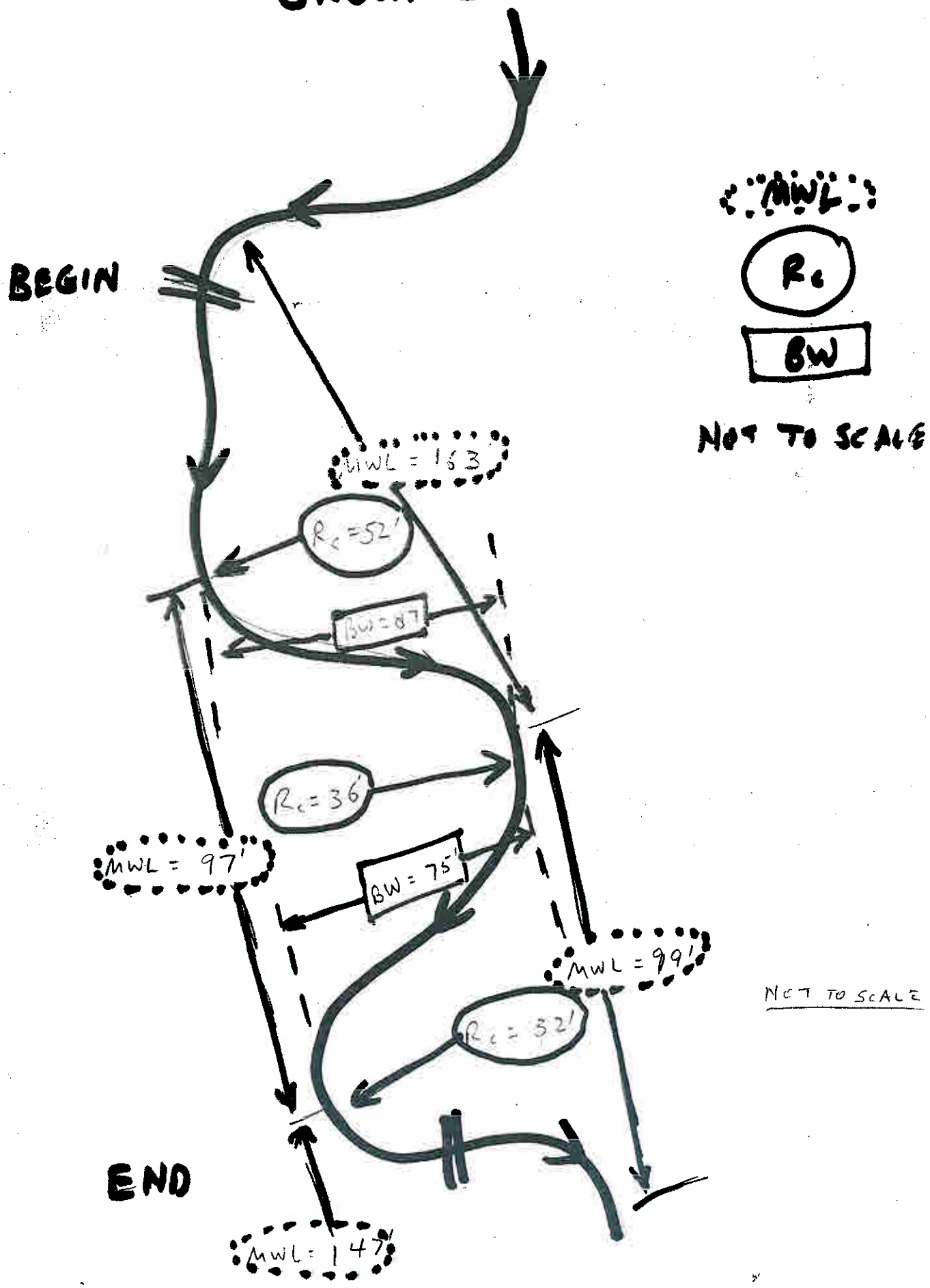
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

Team 3
Day 2
UT Little Bennett
Degraded Reach

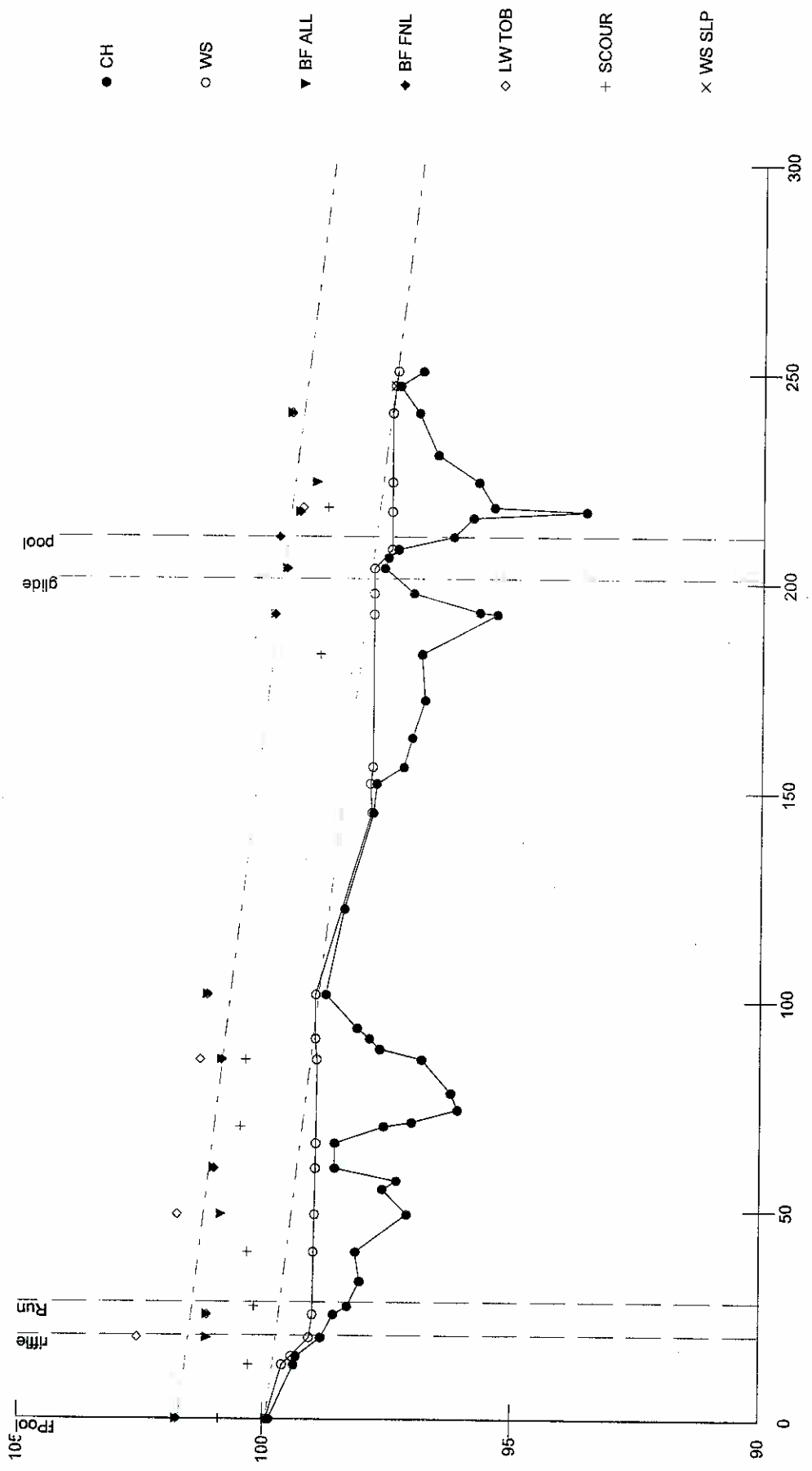
Team 3
Field Day 2
UT



L. BENNETT CREEK
GROUP 3



UT Little Bennett Creek Team 3 9/21/2007



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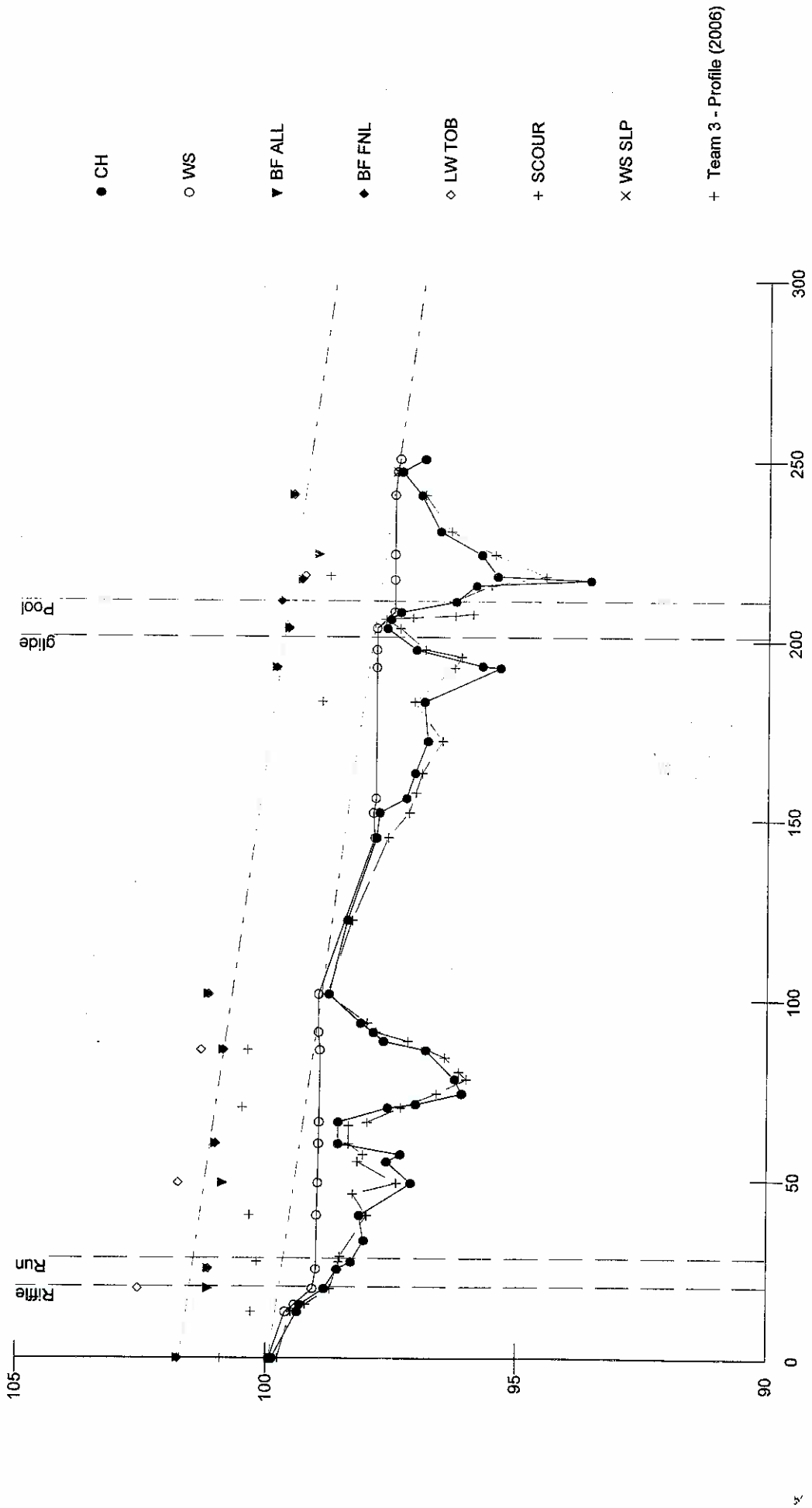
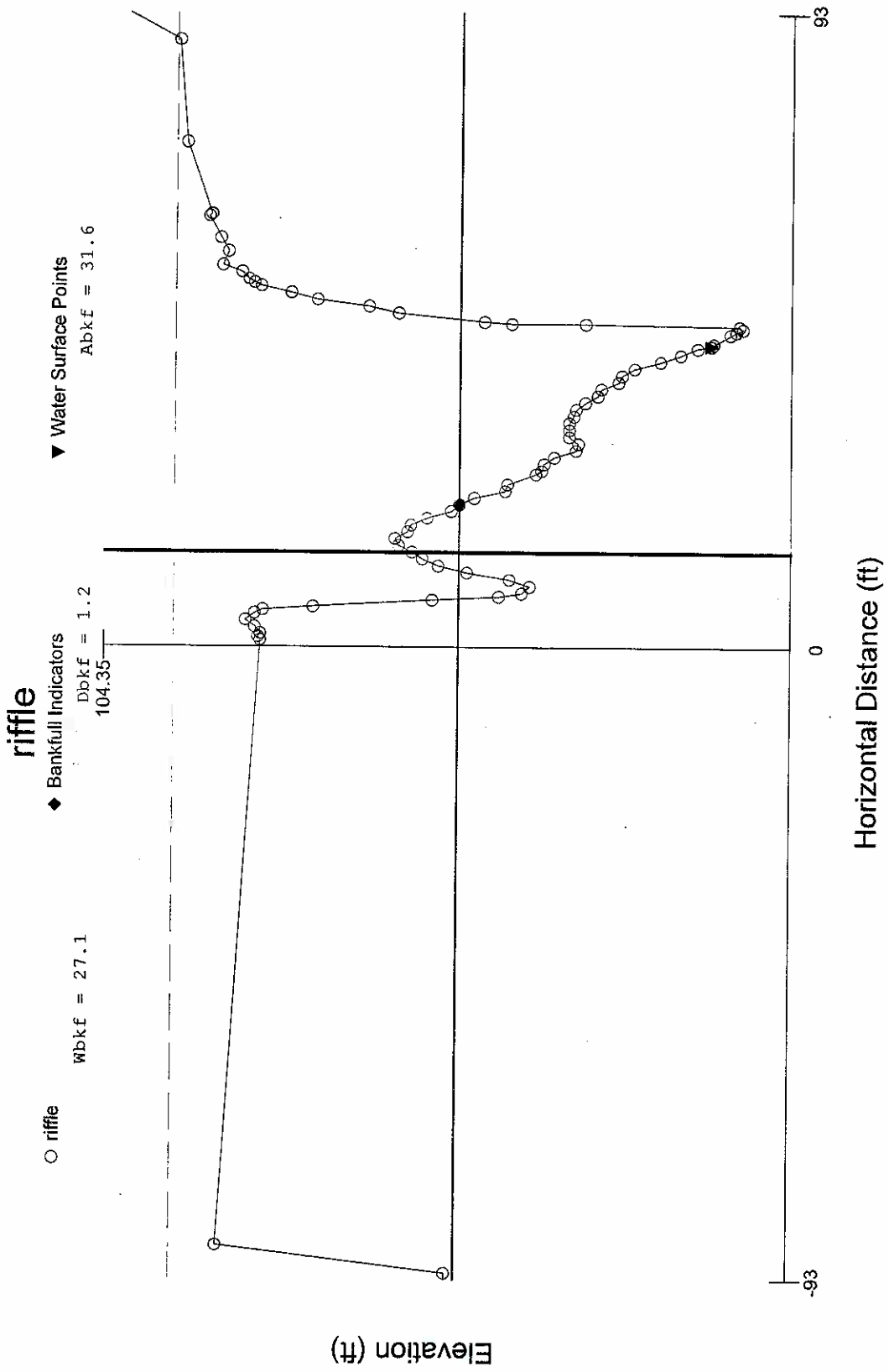
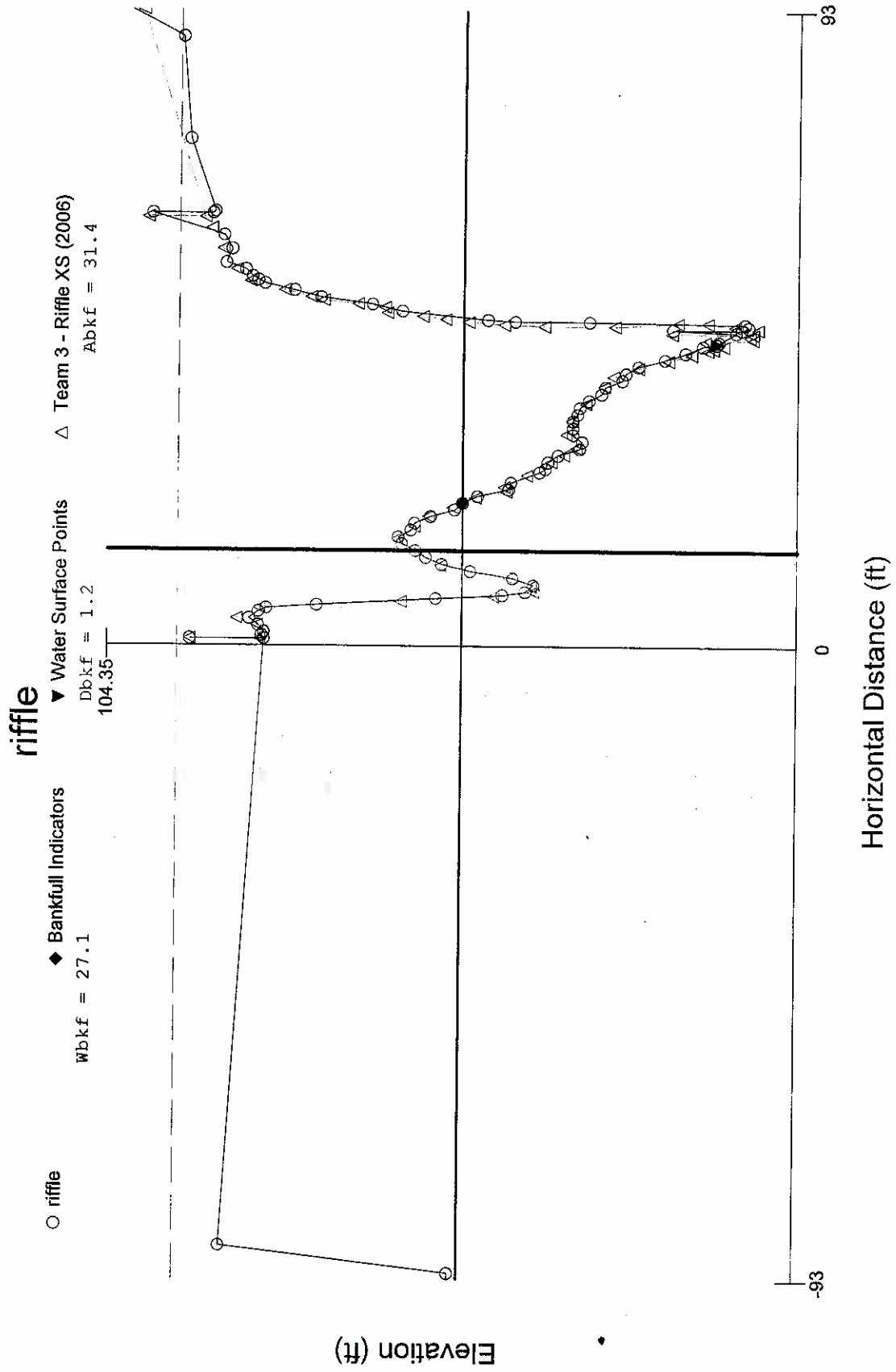
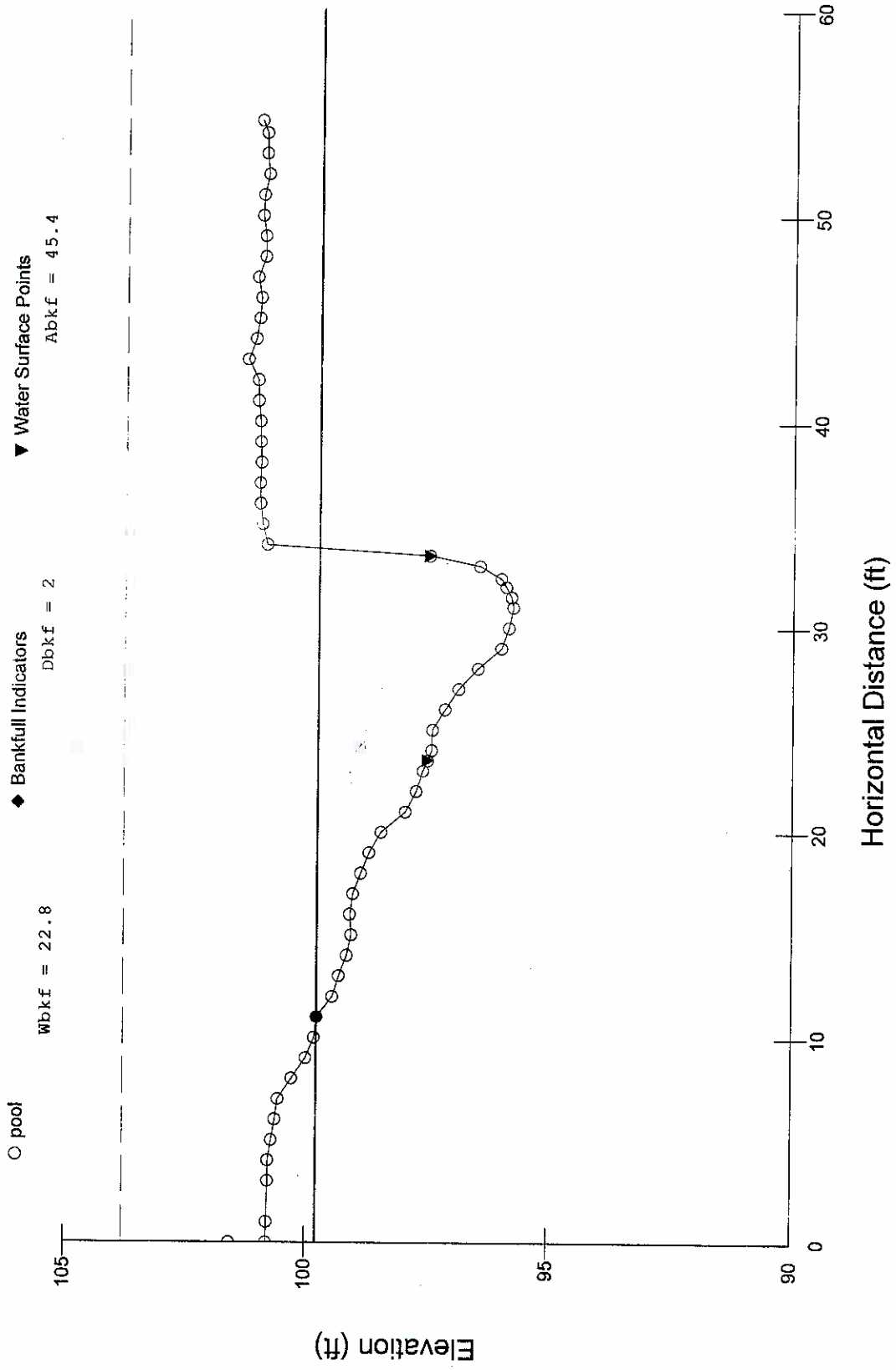
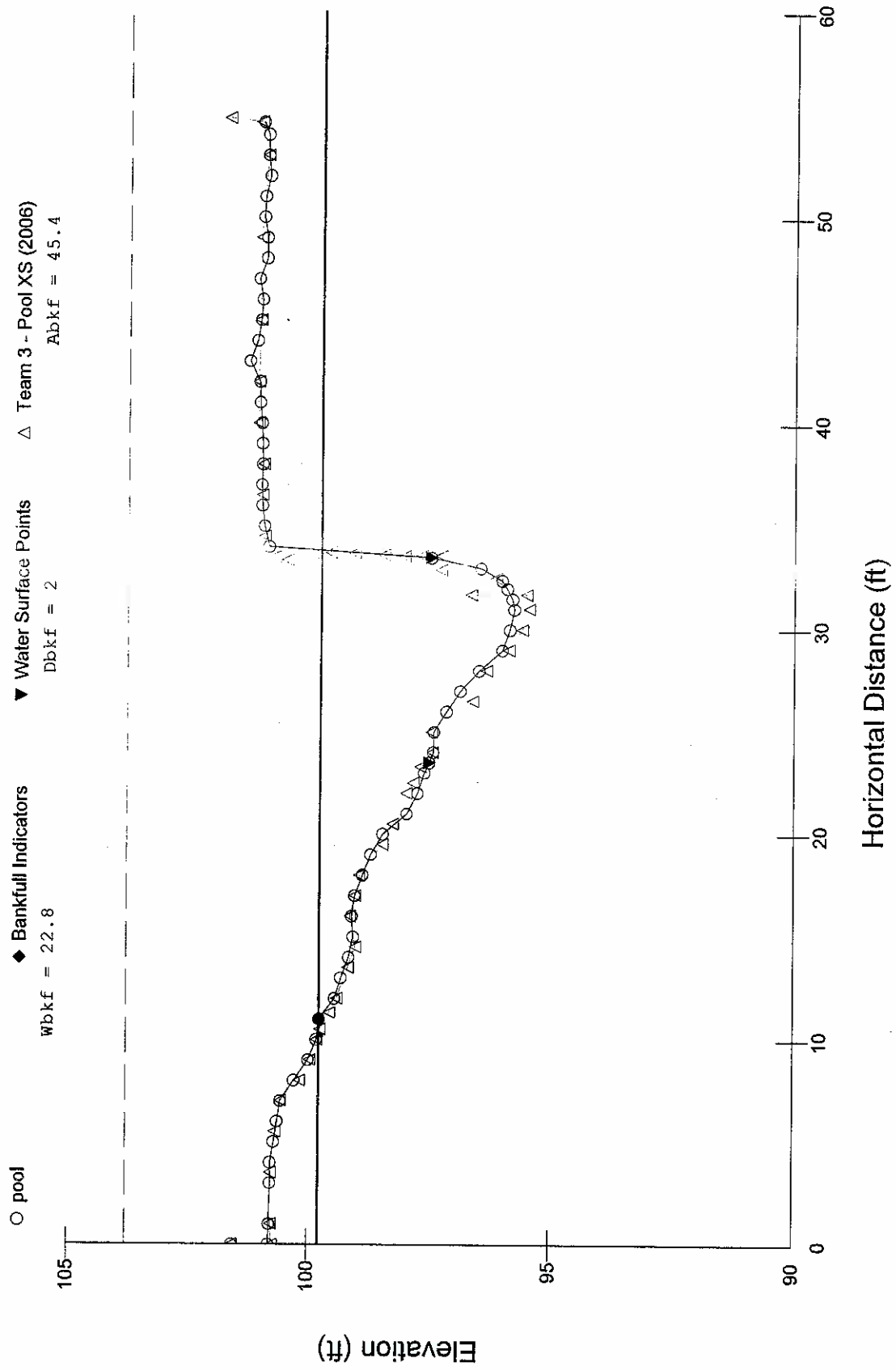
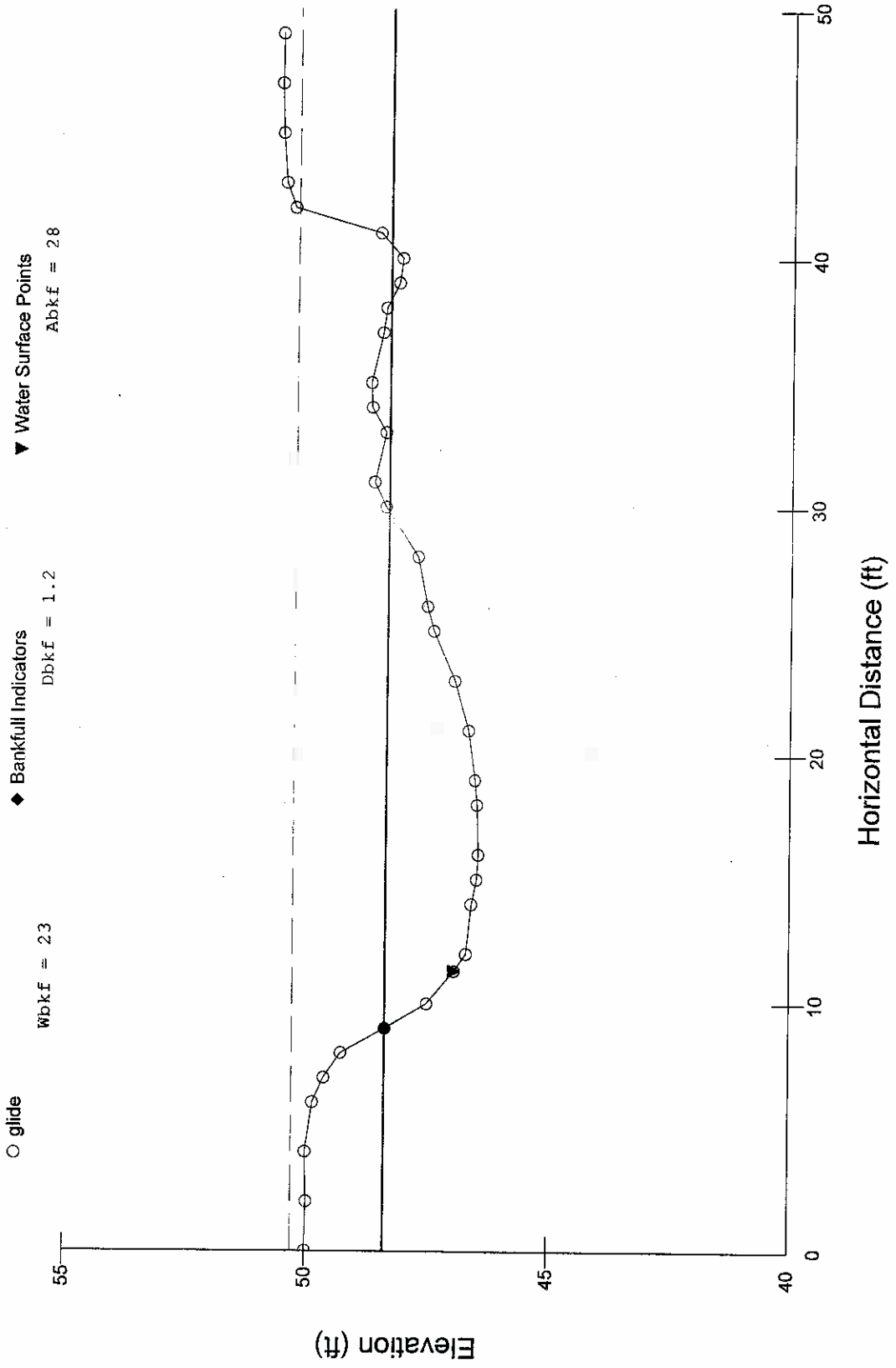


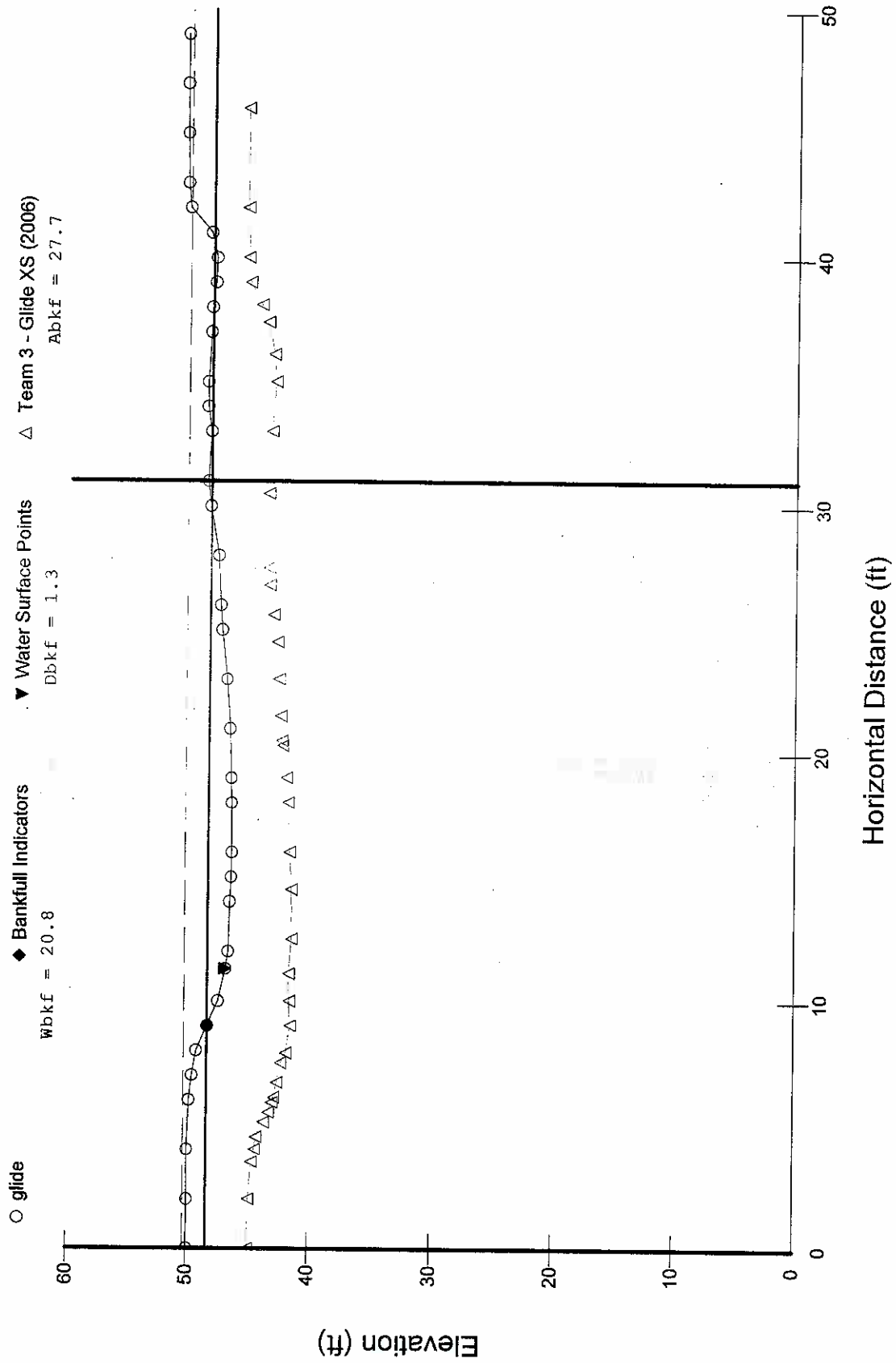

riffle
▼ Water Surface Points
Abkf = 31.6
◆ Bankfull Indicators
Dbkf = 1.2
104.35
Wbkf = 27.1
○ riffle
93
0
-93
Horizontal Distance (ft)
Elevation (ft)

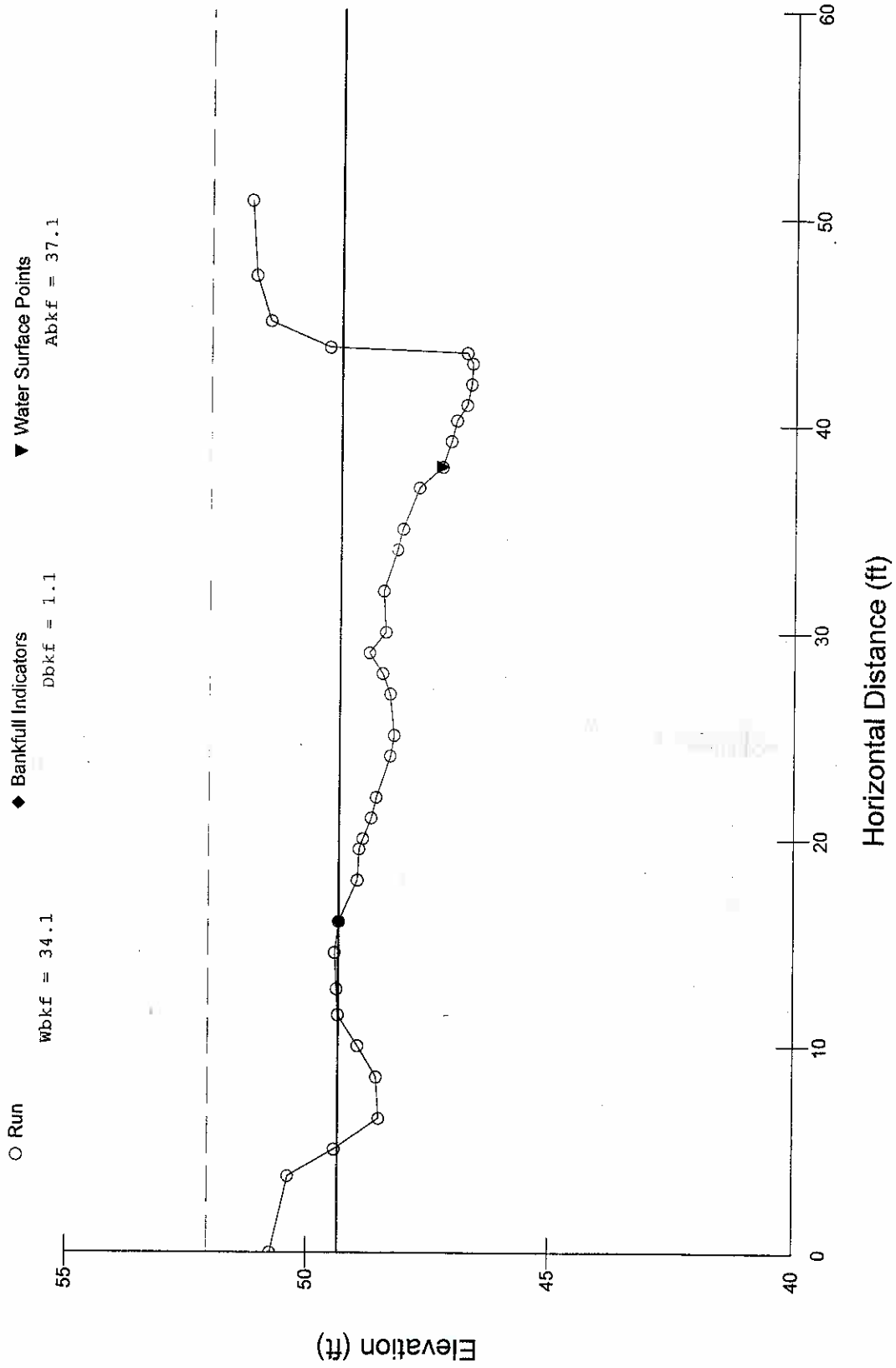

riffle
△ Team 3 - Riffle XS (2006)
Abkf = 31.4
▼ Water Surface Points
Dbkf = 1.2
104.35
◆ Bankfull Indicators
Wbkf = 27.1
○ riffle
93
0
-93
Horizontal Distance (ft)
Elevation (ft)

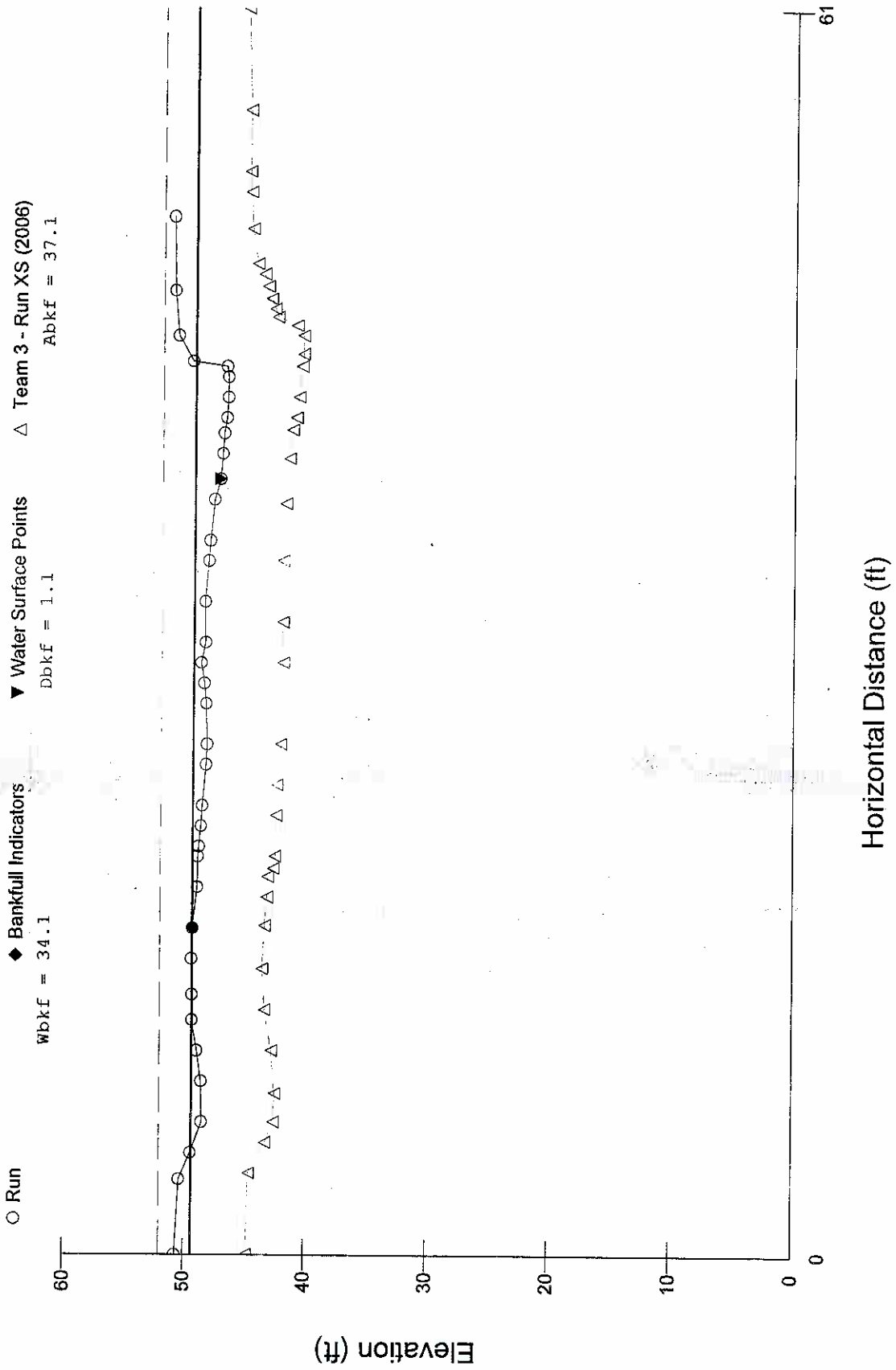

O pool
◆ Bankfull Indicators
Wbkf = 22.8
Dbkf = 2
▼ Water Surface Points
Abkf = 45.4
Elevation (ft)
105
100
95
90
0
10
20
30
40
50
60
Horizontal Distance (ft)

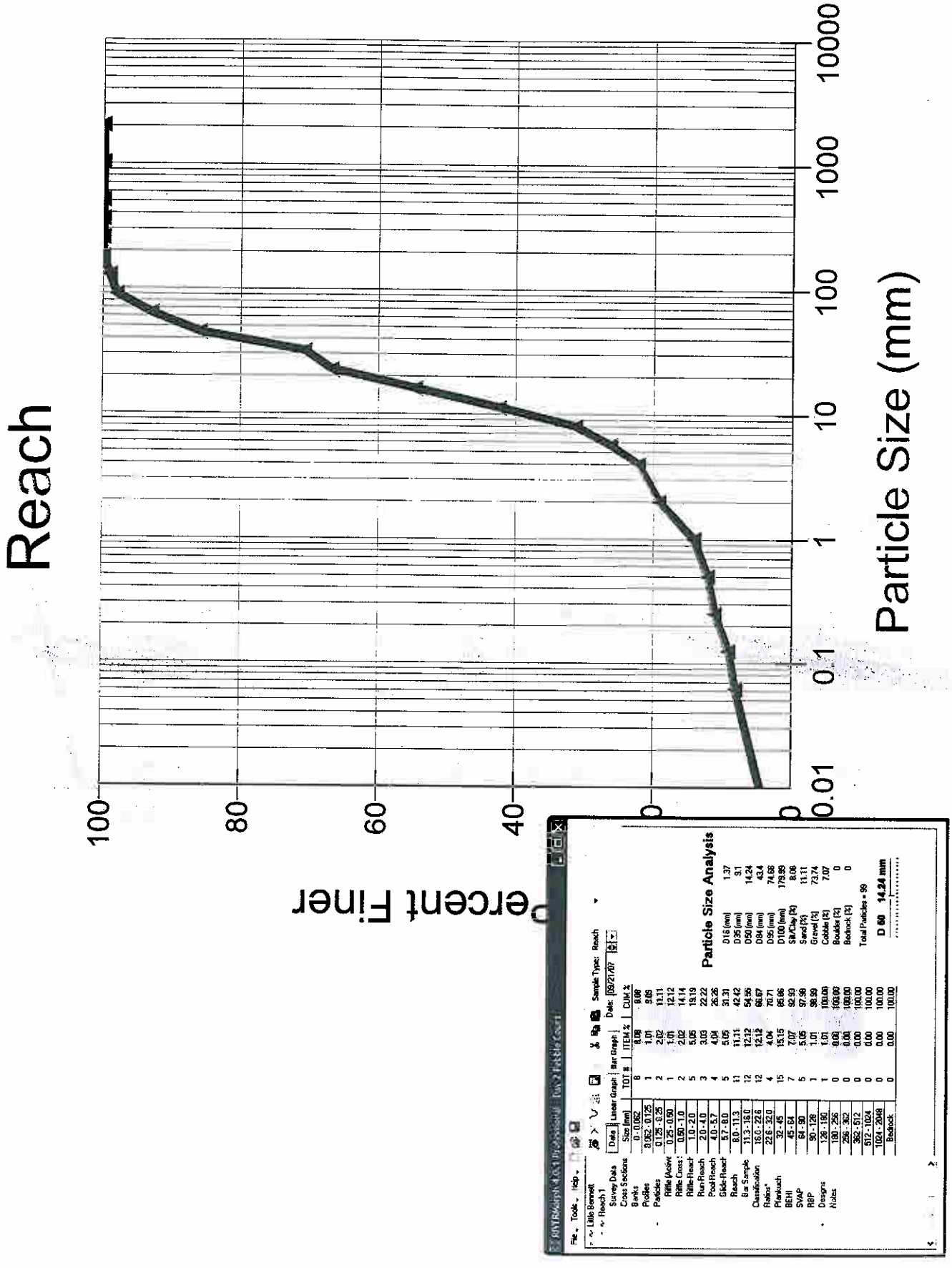

○ pool
◆ Bankfull Indicators
Wbkf = 22.8
▼ Water Surface Points
Dbkf = 2
△ Team 3 - Pool XS (2006)
Abkf = 45.4
105
100
95
90
0
10
20
30
40
50
60
Elevation (ft)
Horizontal Distance (ft)

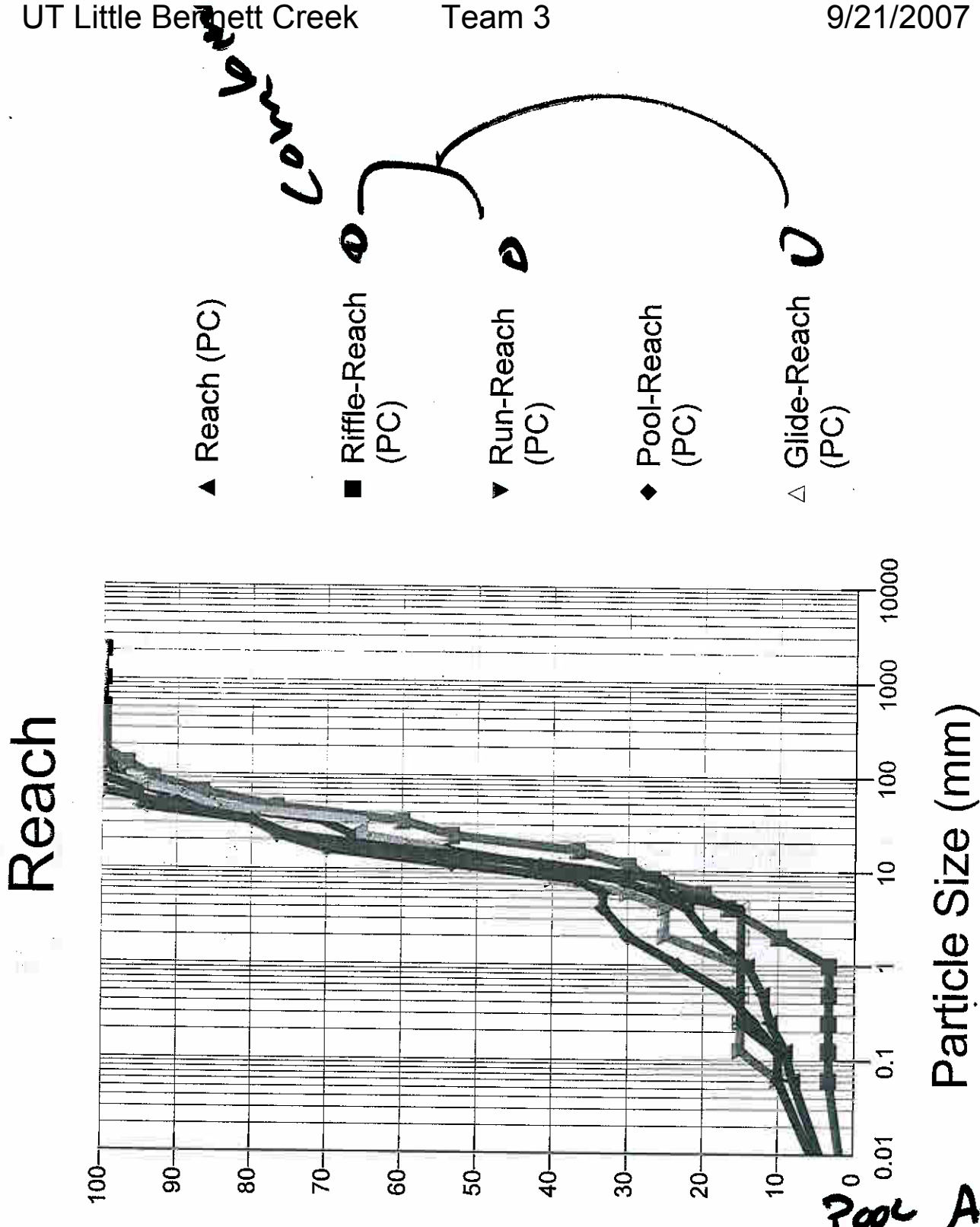

○ glide
Wbkf = 23
◆ Bankfull Indicators
Dbkf = 1.2
▼ Water Surface Points
Abkf = 28
Elevation (ft)
55
50
45
40
0
10
20
30
40
50
Horizontal Distance (ft)


○ glide
◆ Bankfull Indicators
Wbkf = 20.8
▼ Water Surface Points
Dbkf = 1.3
△ Team 3 - Glide XS (2006)
Abkf = 27.7
Elevation (ft)
60
50
40
30
20
10
0
0
10
20
30
40
50
Horizontal Distance (ft)


○ Run
Wbkf = 34.1
◆ Bankfull Indicators
Dbkf = 1.1
▼ Water Surface Points
Abkf = 37.1
Elevation (ft)
55
50
45
40
0
10
20
30
40
50
60
Horizontal Distance (ft)


○ Run
◆ Bankfull Indicators
Wbkf = 34.1
▼ Water Surface Points
Dbkf = 1.1
△ Team 3 - Run XS (2006)
Abkf = 37.1
Elevation (ft)
60
50
40
30
20
10
0
0
61
Horizontal Distance (ft)


Reach
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size Analysis
D16 (mm) 1.37
D35 (mm) 31
D50 (mm) 14.24
D84 (mm) 43.4
D95 (mm) 74.88
D100 (mm) 179.99
Sil/Clay (%) 8.08
Sand (%) 11.11
Gravel (%) 73.74
Cobble (%) 7.07
Boulder (%) 0
Bedrock (%) 0
Total Particles = 99
D 50 14.24 mm



R. Rfl

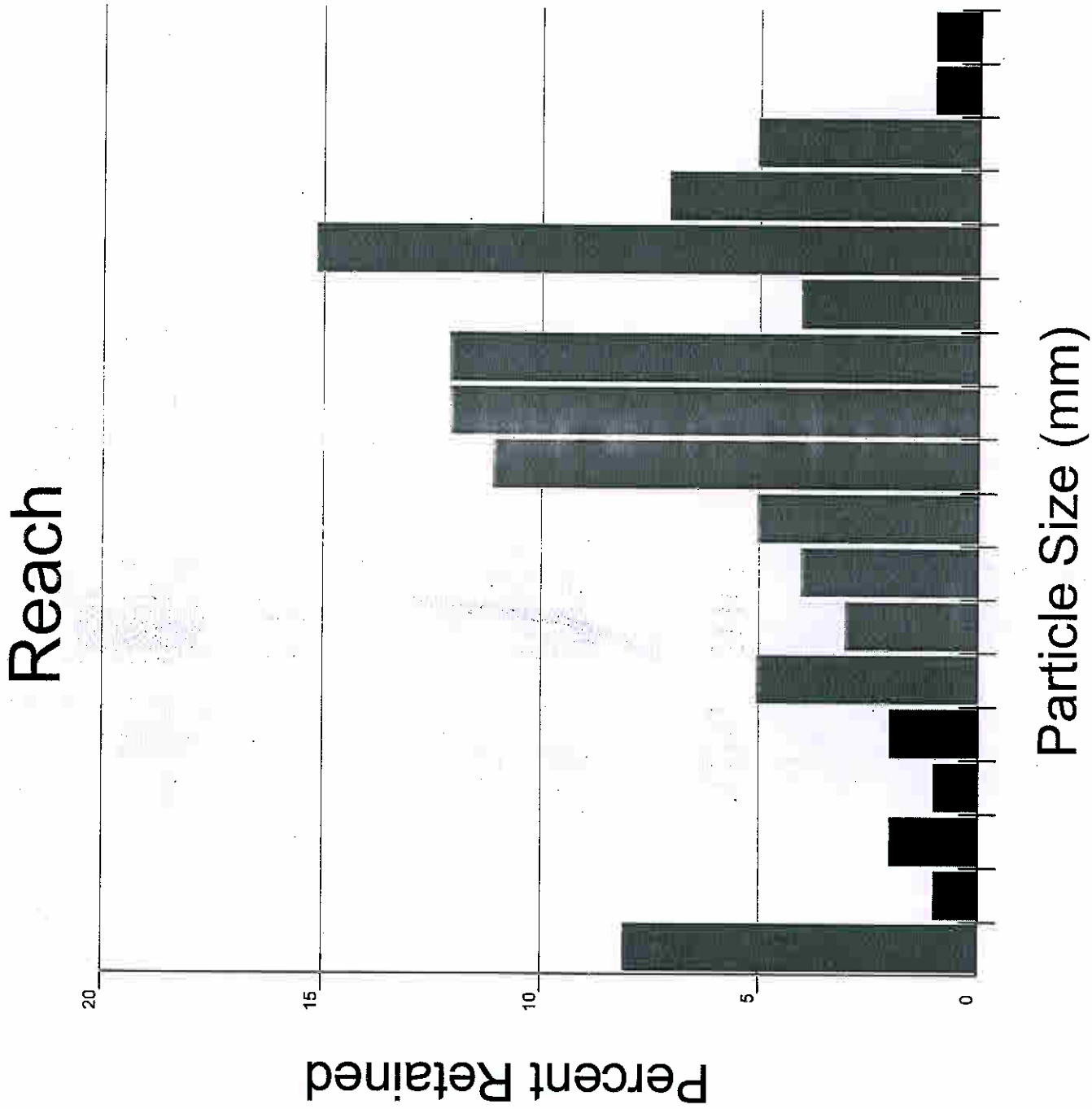
2007
50 = 26.78
84 = 83.13
100 = 180

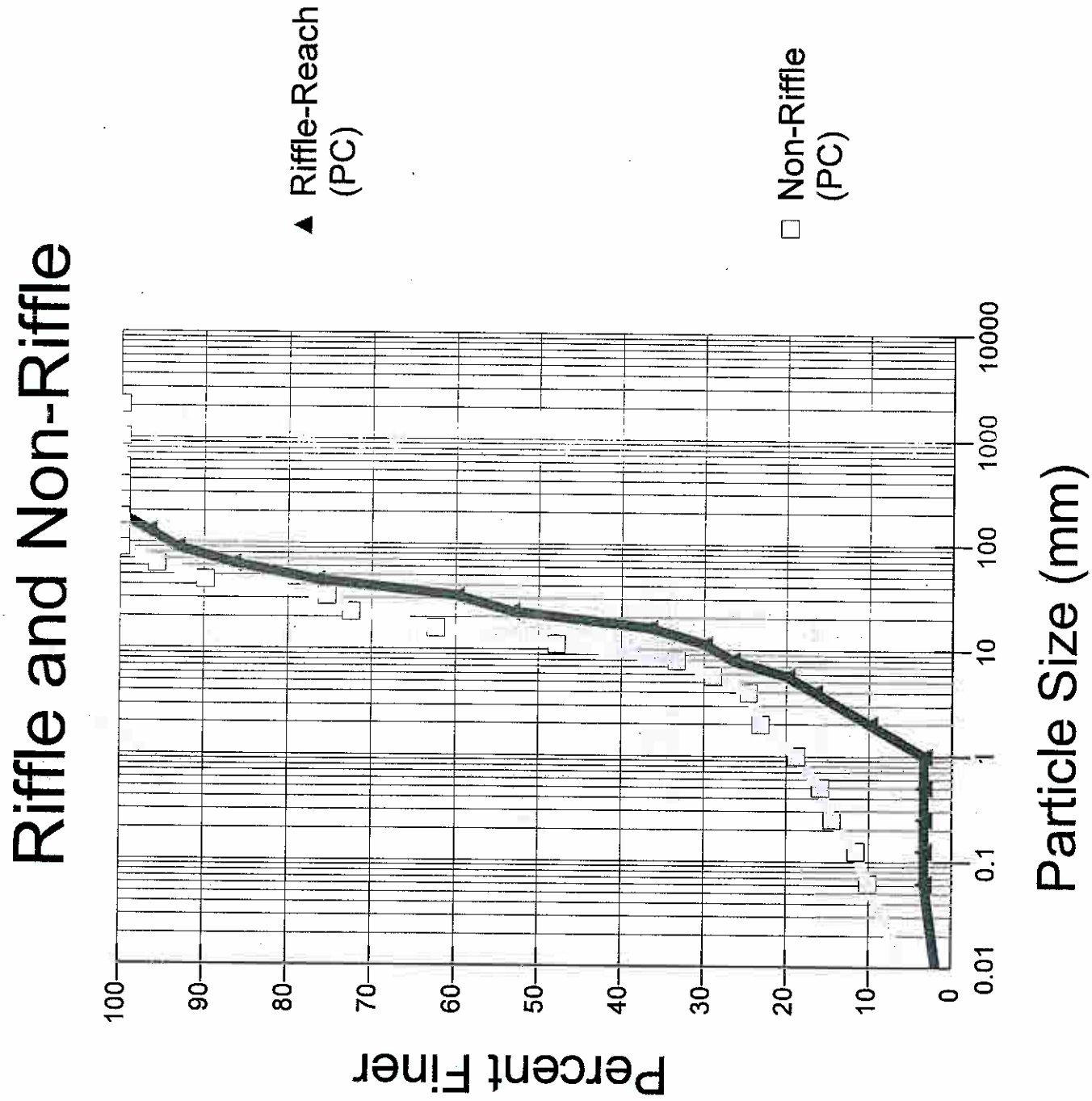
2006 50 = 37.35
84 = 77
100 = 180

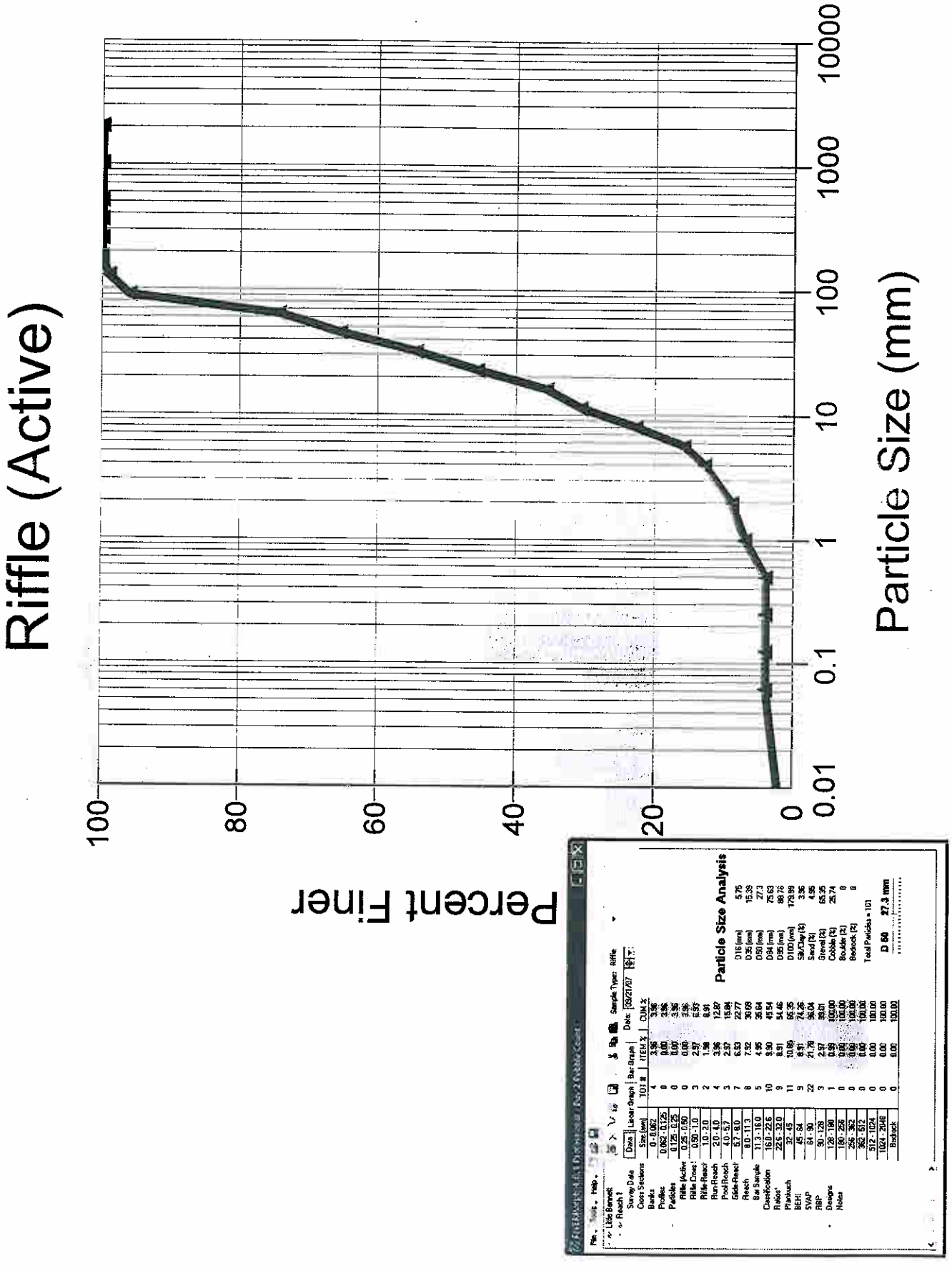
Pool Ave

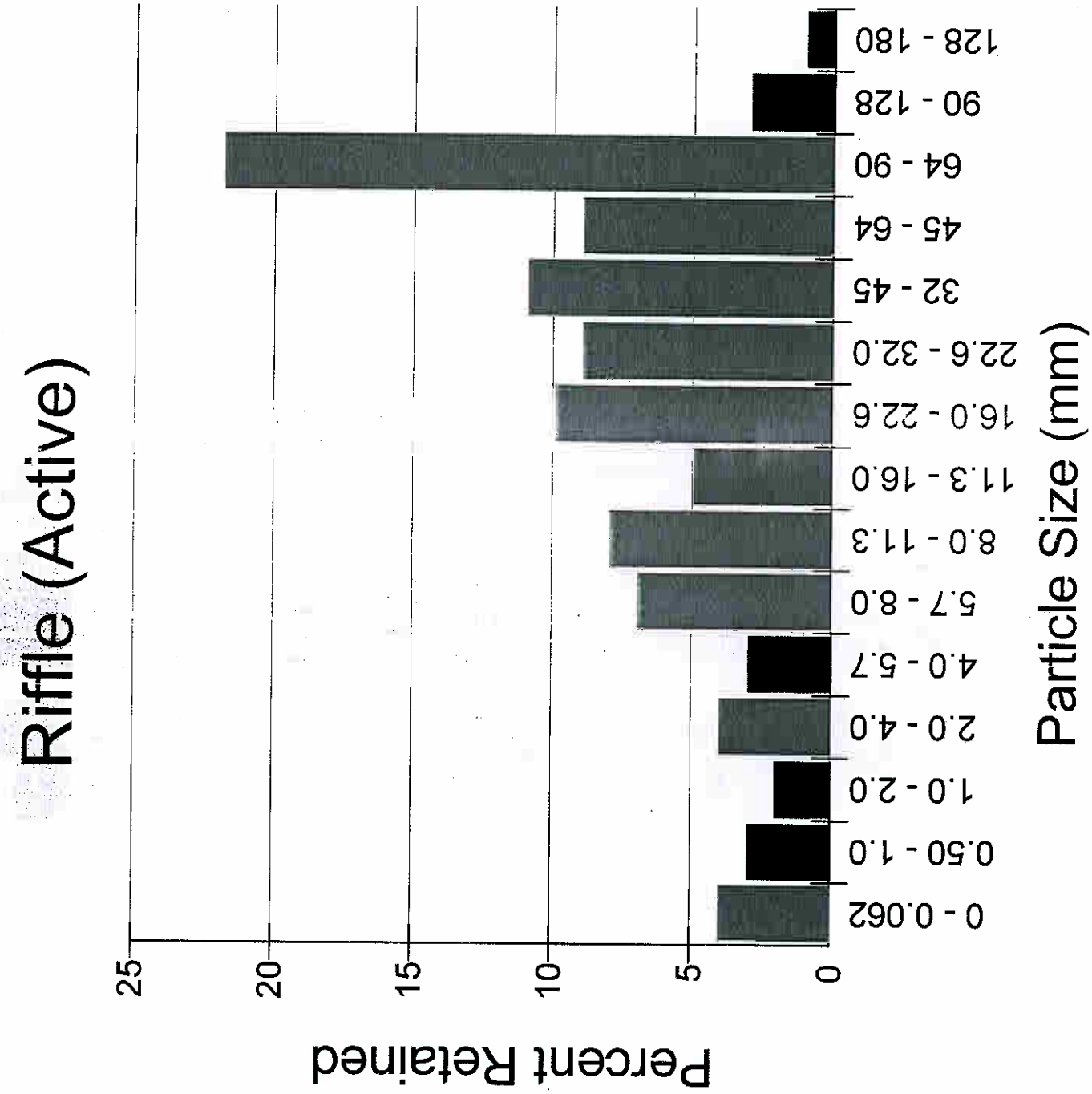
2007 d50 = 10.64mm
d 84 = 37.2
d 100 = 64

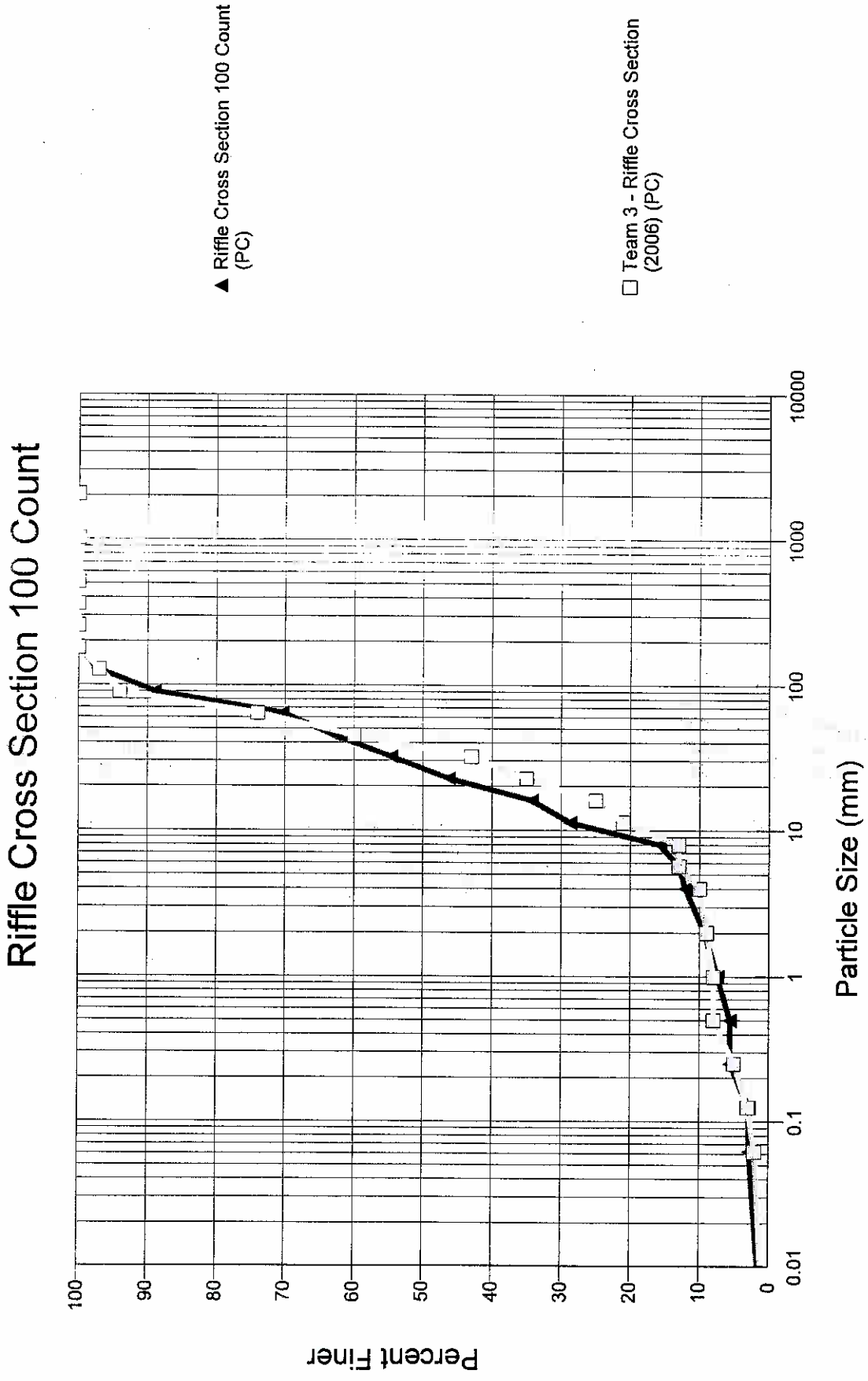
2006 50 = 8
84 = 32
100 = BEDROCK

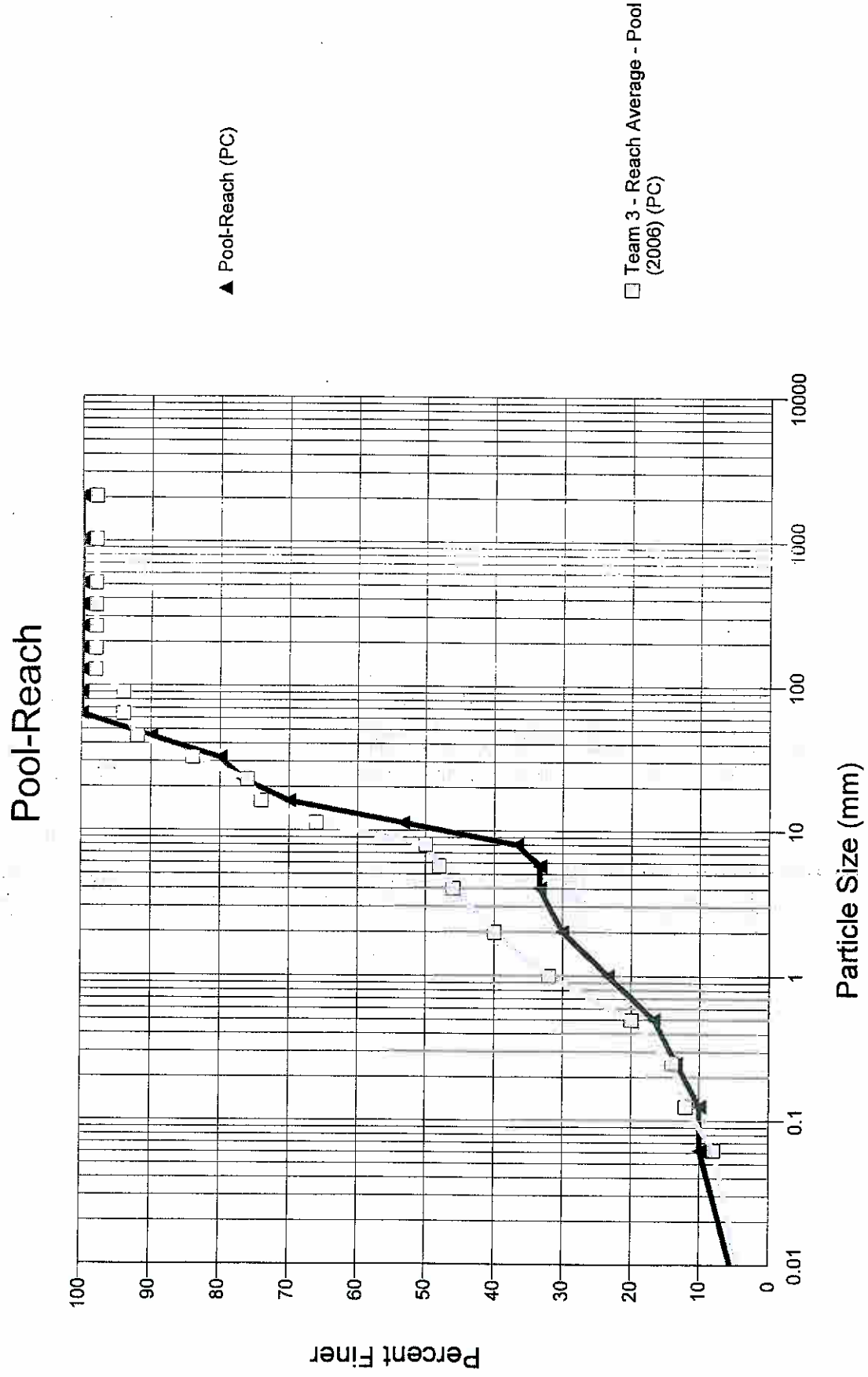

Reach
Percent Retained
Particle Size (mm)
20
15
10
5
0


Riffle and Non-Riffle
Riffle-Reach (PC)
Non-Riffle (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)

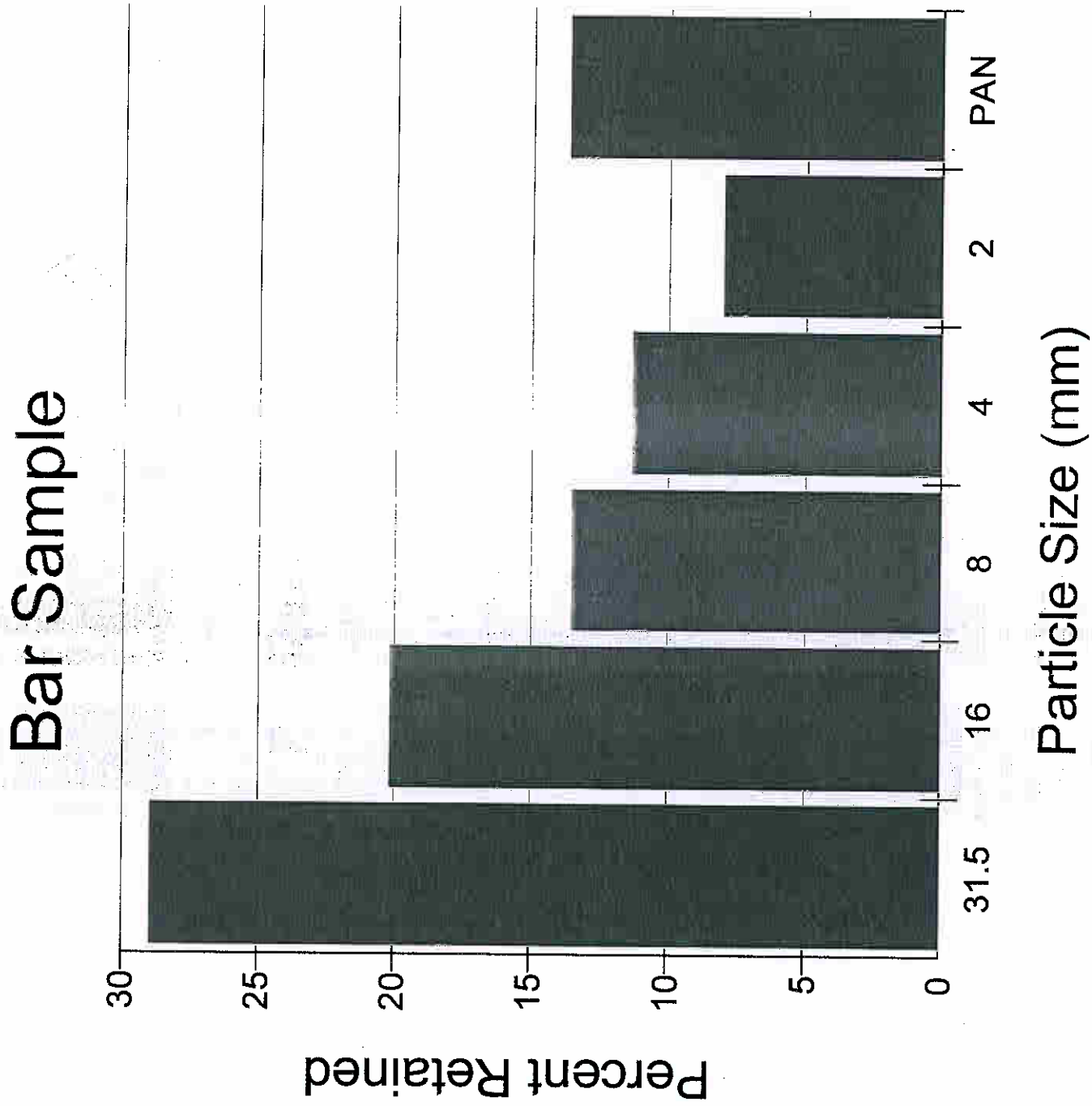

Riffle (Active)
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size Analysis
D16 (mm) 5.75
D35 (mm) 15.39
D50 (mm) 27.3
D84 (mm) 75.63
D95 (mm) 98.76
D100 (mm) 179.99
Silt/Clay (%) 3.96
Sand (%) 4.95
Gravel (%) 65.35
Cobble (%) 25.74
Boulder (%) 0
Bedrock (%) 0
Total Particles = 101
D 50 27.3 mm


Riffle (Active)
Percent Retained
0
5
10
15
20
25
Particle Size (mm)
0 - 0.062
0.50 - 1.0
1.0 - 2.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180


Riffle Cross Section 100 Count
▲ Riffle Cross Section 100 Count (PC)
☐ Team 3 - Riffle Cross Section (2006) (PC)
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
Particle Size (mm)
10000
1000
100
10
1
0.1
0.01


Pool-Reach
▲ Pool-Reach (PC)
□ Team 3 - Reach Average - Pool (2006) (PC)
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
Particle Size (mm)
0.01
0.1
1
10
100
1000
10000

Bar Sample
Percent Finer
Particle Size (mm)
100
10
1
0
20
40
Sample Type: Bar
Date: 09/21/07
Largest Surface Particles
Particle 1:
Particle 2:
Note: The size of the largest particle must be entered to obtain valid sieve analysis results
Particle Size Analysis
D16 (mm) 2.59
D35 (mm) 9.2
D50 (mm) 18.7
D84 (mm) 65.07
D95 (mm) 86.34
D100 (mm) 96
Silt/Clay (%) 0
Sand (%) 13.65
Gravel (%) 74.21
Cobble (%) 12.14
Boulder (%) 0
Bedrock (%) 0
Total Weight = 45.3400
D 50 18.7 mm
Survey Data
Cross Sections
Banks
Profiles
Particles
Riffle (Active
Riffle Cross
Riffle Reach
Run Reach
Pool Reach
Glide Reach
Reach
Bar Sample
Classification
Ratios
Pfankuch
BEHI
SVAP
RBP
Designs
Notes
SIEVE (mm)
NET WT
31.5
13.13
16
9.13
8
6.13
4
5.13
2
3.63
PAN
6.19


Bar Sample
Percent Retained
0
5
10
15
20
25
30
31.5
16
8
4
2
PAN
Particle Size (mm)

Worksheet 3.3: Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Little Bennett, Reach - Reach 3**			
Basin:	Drainage Area:	**1088** acres	**1.7**	mi^2
Location:				
Twp.&Rge: ;	Sec.&Qtr.: ;			
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**		Date: **9/21/2007**	
Observers:			Valley Type: **VIII**	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**27.1**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.16**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**31.56**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**23.36**	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.	**2.49**	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.	**204.4**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**7.54**	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.	**14.24**	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.	**0.01003**	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).	**1.41**	

Stream Type **C 4** (See **Figure 2-14**)

UT Little Bennett Creek Team 3 9/21/2007

2003).

Bankfull VELOCITY / DISCHARGE Estimates

Site	Little Bennett	Location	Reach 3
Date		Stream Type		Valley Type	
Observers	Team 3	HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	31.4	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.16	D_{bkf} (Ft)
Bankfull WIDTH	27.3	W_{bkf} (Ft)	Wetted PERIMETER $2 * d_{bkf} + W_{bkf}$	29.62	W_{Pbkf} (Ft)
D84 @ Riffle	76	Dia. (mm)	D84 mm / 304.8 =	0.25	D84 (Ft)
Bankfull SLOPE	0.01003	S (Ft/Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.06	R (Ft)
Gravitational Acceleration	32.2	g ($Ft\ Sec^2$)	Relative Roughness R (ft) / D84 (ft)	4.24	
Drainage AREA	1.7	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.59	u* (Ft Sec)

ESTIMATION METHODS

	Bankfull VELOCITY		Bankfull DISCHARGE		
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 \mathrm{Log}\{ R / D84 \}\ ] u^*$	3.76	Ft / Sec	118	CFS	Abkf=37 139
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. (Figs. 5-6, 5-7) $u = 1.4895 * R^{2/3} * S^{1/2} / n$ $n =$ 0.05	3.1	Ft / Sec	97	CFS	
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ $n =$		Ft / Sec		CFS	
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 F3					
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type $n =$ 0.04	3.88	Ft / Sec	122	CFS	144
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach	3.76	Ft / Sec	118	CFS	139
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Limerinos	3.96	Ft / Sec	125	CFS	147
4. Continuity Equations: a) USGS Gage: $u = Q / A$ Return Period for Bankfull Discharge (Yr.) Q =		Ft / Sec		CFS	
4. Continuity Equations: b) Regional Curves $u = Q / A$		Ft / Sec	127	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_{sb}) of boulders above channel bed elevations. Substitute an average boulder protrusion height (h_{sb} in feet) for the D84 term in estimation method 1.

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

Stream: **Little Bennett, Reach - Reach 3** Location:

Observers: Date: **9/21/2007** Valley Type: **VIII** Stream Type: **C 4**

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.16	ft	Riffle Width (W_{bkf})	27.1	ft	Riffle Area (A_{bkf})	31.56	ft^2
Mean Pool Depth (d_{bkfp})	1.99	ft	Pool Width (W_{bkfp})	22.84	ft	Pool Area (A_{bkfp})	45.36	ft^2
Mean Pool Depth/Mean Riffle Depth	1.72	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.84	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.44	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	2.09	ft	Max Pool Depth (d_{mbkfp})	5.1	ft	Max Riffle Depth/Mean Riffle Depth	1.80	
Max Pool Depth/Mean Riffle Depth	4.397					Point Bar Slope	0.51	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	3.98	ft/s				Estimation Method	Manning's n	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	125	cfs				Drainage Area	1.7	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	122	97	147	ft	Meander Length Ratio (L_m/W_{bkf})	4.50	3.58	5.42
Radius of Curvature (Rc)	50	32	62	ft	Radius of Curvature/Riffle Width (R_c/W_{bkf})	1.85	1.18	2.29
Belt Width (W_{blt})	82	75	89	ft	Meander Width Ratio (W_{blt}/W_{bkf})	3.03	2.77	3.28
Individual Pool Length	45.4	28.9	66.2	ft	Pool Length/Riffle Width	1.67	1.07	2.44
Pool to Pool Spacing	94.7	59.9	130	ft	Pool to Pool Spacing/Riffle Width	3.49	2.21	4.78
Riffle Length	22.7	4.77	43.7	ft	Riffle Length/Riffle Width	0.84	0.18	1.61

Channel Profile

Valley Slope (VS)	0.0112	ft/ft	Average Water Surface Slope (S)	0.01003	ft/ft	Sinuosity (VS/S)	1.41	
Stream Length (SL)	247	ft	Valley Length (VL)	175	ft	Sinuosity (SL/VL)	1.41	

Low Bank Height (LBH)	start	1.75	ft	Max Riffle Depth	start	1.94	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start	0.9
	end	2.93	ft		end	2.45	ft		end	1.2

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.049	0.025	0.078	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	4.910	2.515	7.794
Run Slope (S_{run})	0.012	0.011	0.013	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	1.151	1.063	1.252
Pool Slope (S_p)	0.000	0.000	0.001	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.033	0.000	0.076
Glide Slope (S_g)	0.001	0.000	0.006	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.110	0.000	0.598

Feature Midpoint [a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	2.09	2.05	2.16	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.8	1.77	1.86
Run Depth (d_{run})	2.93	2.48	3.52	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	2.53	2.14	3.03
Pool Depth (d_p)	5.1	4.46	5.98	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	4.4	3.84	5.16
Glide Depth (d_g)	2.46	2.13	2.93	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	2.12	1.84	2.53

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	8.08	3.96	0	D_{16}	1.37	5.75	2.59	0	mm
% Sand	11.11	4.95	13.65	D_{35}	9.1	15.39	9.2	0	mm
% Gravel	73.74	65.35	82.1	D_{50}	14.24	27.3	18.7	0	mm
% Cobble	7.07	25.74	4.25	D_{84}	43.4	75.63	50.39	0	mm
% Boulder	0	0	0	D_{95}	74.66	88.76	62.36	0	mm
% Bedrock	0	0	0	D_{100}	179.99	179.99	96	0	mm

a Min, max, mean depths are the average mid-point values except pools, which are taken at deepest part of pool.

UT Little Bennett Creek Team 3 9/21/2007

Worksheet 5-6. Riparian vegetation composition/density used for channel stability assessment.

Stream: **Little Bennett**			Location: **Reach 3**		
Observers: **Team 3**	Reference reach		Disturbed (impacted reach)	X	Date: **9-21-07**
Existing species composition: **Soft Hardwood (Mature-Popular)**			Potential species composition: **Mixed Mesophytic Including Oak/Walnut/Beech**		

Riparian cover categories		Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	80%	25%	Poplar	82%
				Black Walnut	1%
				Sycamore	1%
				Elm	5%
				Ironwood	10%
				Dogwood/Beech	1%
					100%
2. Understory	Shrub layer		10%	Spicebush	30%
				Multiflora Rose	25%
				Ironwood	20%
				Barberry	25%
					100%
3. Ground level	Herbaceous		60%	Microstegiam	75%
				Tear thumb	20%
				Polygonum sp.	1%
				Panicum	3%
				Nettle/Basil	1%
					100%
	Leaf or needle litter		2%	Remarks: Condition, vigor and/or usage of existing reach: **Robust vegetation except at bar alluvium where vegetation is sparse**	
	Bare ground		3%		
*Based on crown closure. **Based on basal area to surface area.			Column total = 100%		

UT Little Bennett Creek Team 3 9/21/2007

b. Flow Regime

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

FLOW REGIME

Stream: DAY 2	Location: Reach 3							
Observers: TEAM 3					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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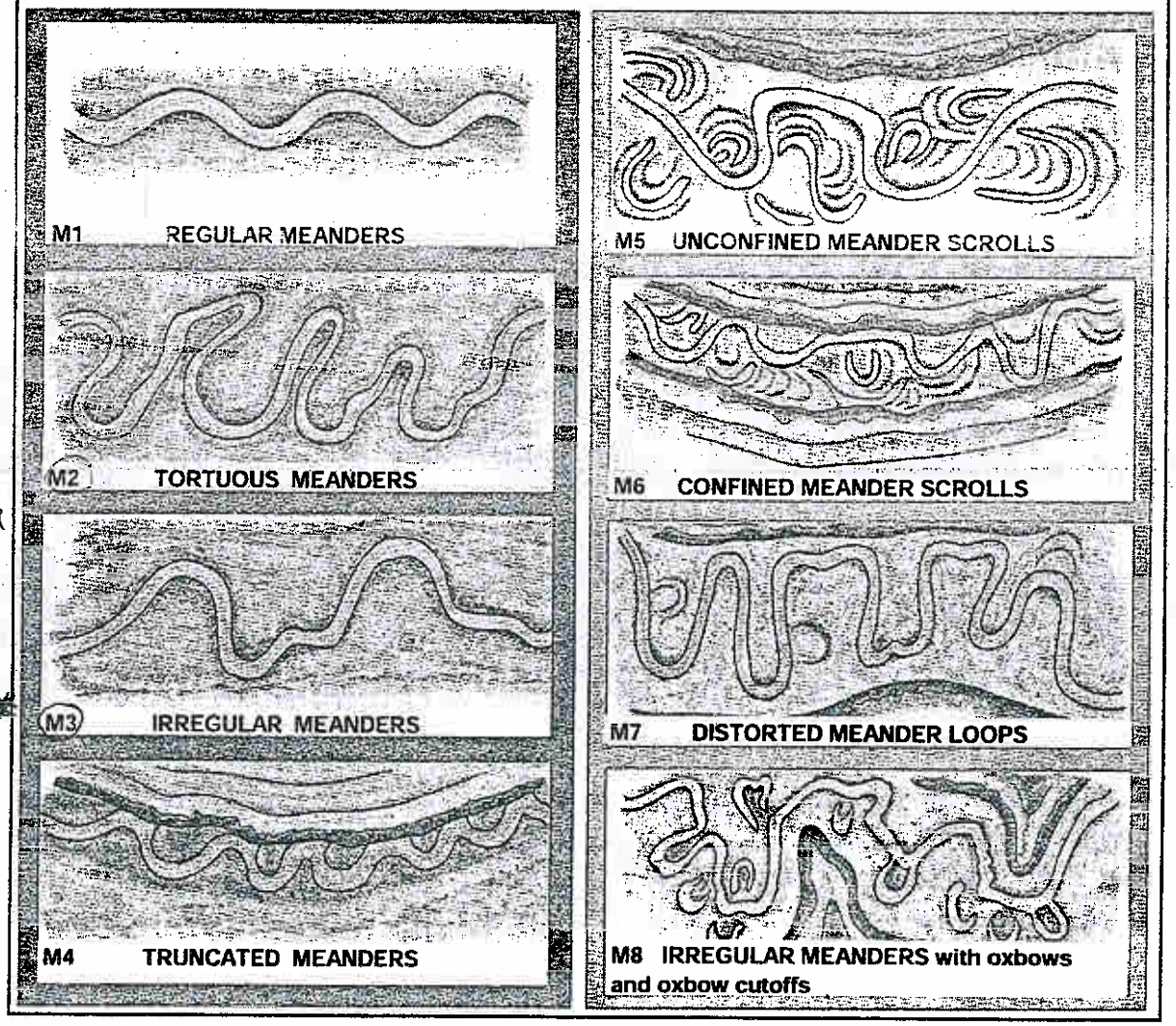
d. Meander Patterns

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

Meander Patterns					
Stream: DAY 2			Reach: REACH 3		
Observers: TEAM 2			Date:		
List ALL CATEGORIES that APPLY	M2	M3			

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



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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: UT Little Bennett		Location: Reach 3	
Observers: Team 3		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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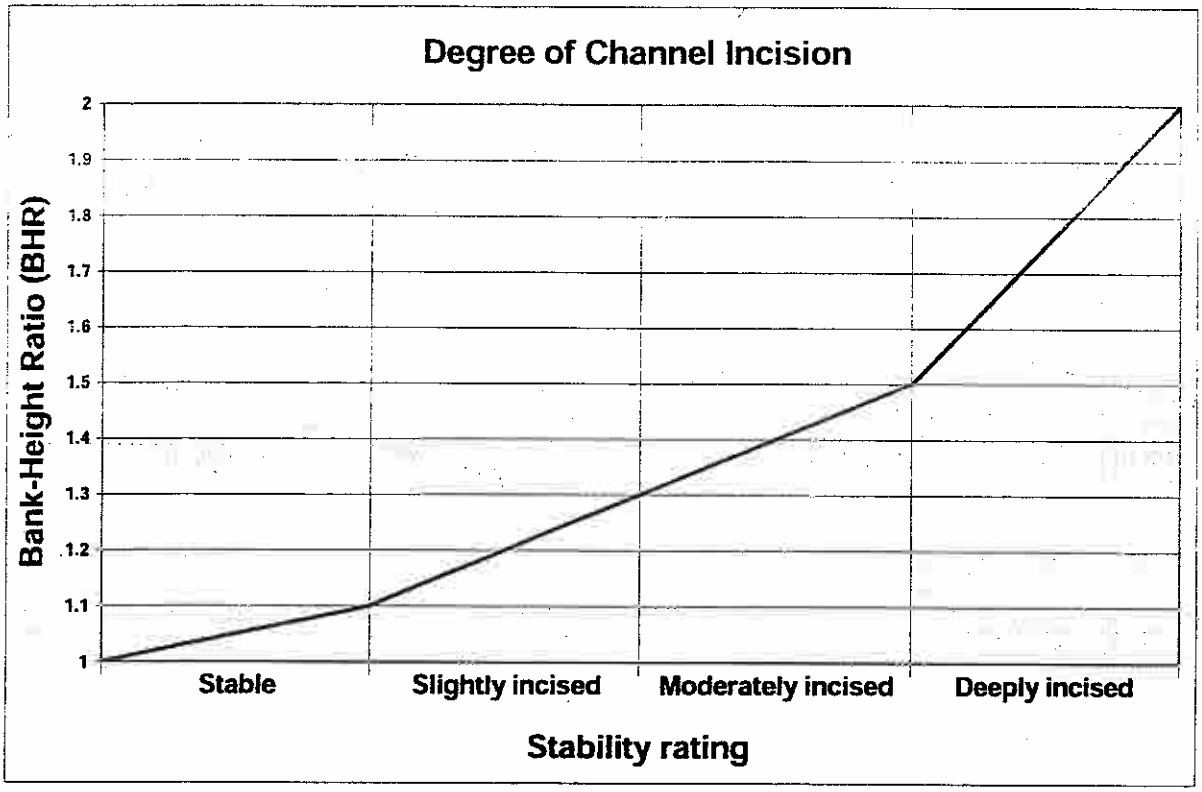
g. Degree of Channel Incision (Bank-Height Ratio)

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:	2.41	Bank-Height Ratio:	1
Max Bankfull Depth:	2.41		
Degree of Channel Incision Stability Rating ☞	STABLE		



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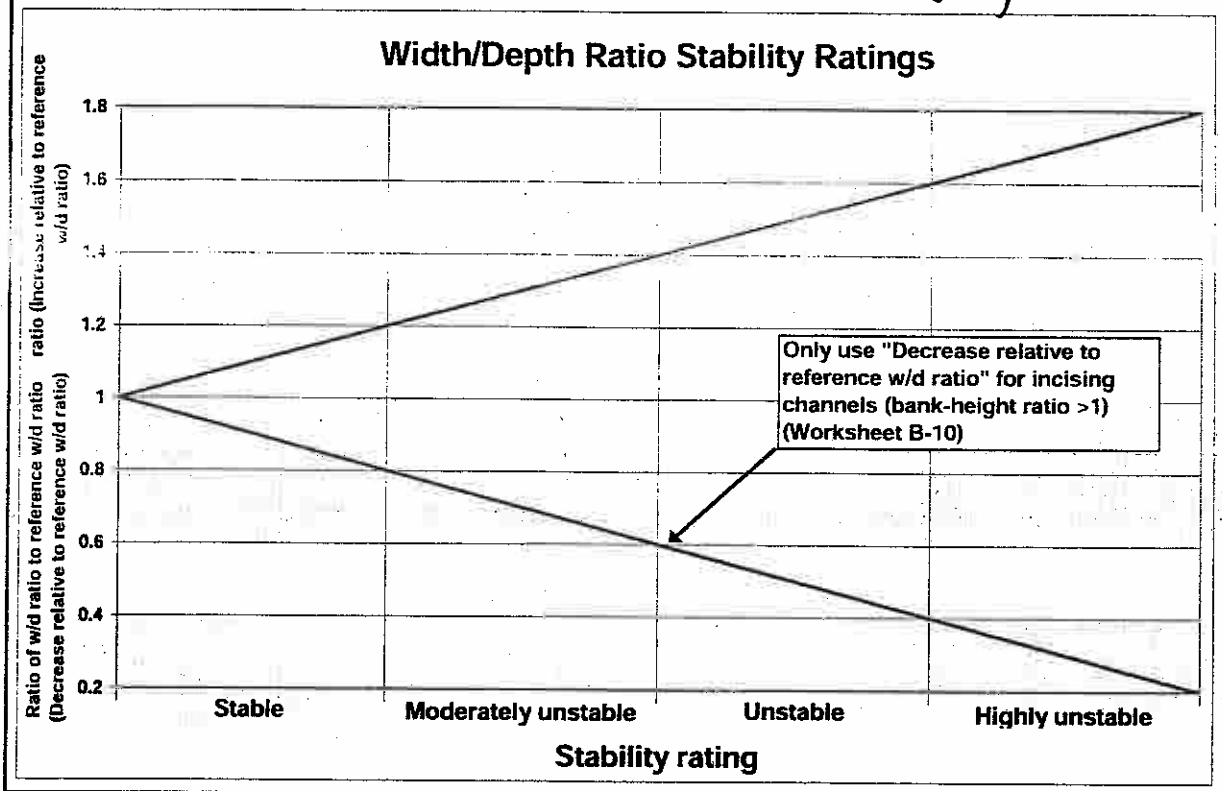
i. Width/Depth Ratio State

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

Width/Depth Ratio State			
Existing Width/Depth Ratio:	23.4	Ratio of existing w/d to reference w/d:	2.05
Reference Width/Depth Ratio:	11.4		
Width/Depth Ratio State Stability Rating ☞	Highly unstable		



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UT Little Bennett Creek Team 3 9/21/2007

Worksheet 5-7. Pfankuch (1975) stream channel stability rating procedure, as modified by Rosgen (1996, 2001b).

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	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 turbulent 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.	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	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	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.	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 =	8	**Good total =**	12	**Fair total =**	44	**Poor total =**	40

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	DA3	DA4	DA5	DA6	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	65-85	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 =	104
Existing stream type =	C4
*Potential stream type =	C4
Modified channel stability rating =	Fair

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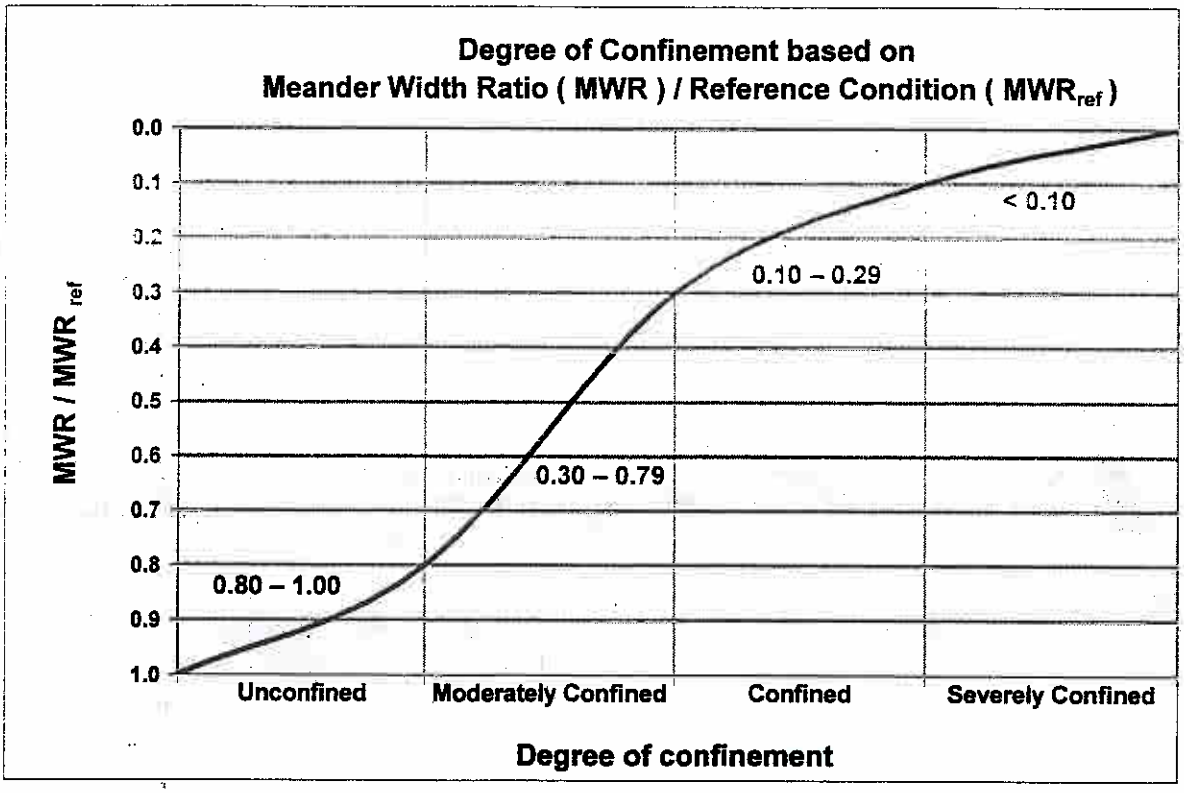
j. Degree of Channel Confinement (Meander Width Ratio (MWR))

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

Degree of Confinement			
Existing Meander Width Ratio (MWR):	3.03	Ratio of MWR to MWRref:	1.3
Reference Meander Width Ratio (MWR_{ref}):	2.3		
Degree of Confinement Stability Rating	☞	Unconfined	



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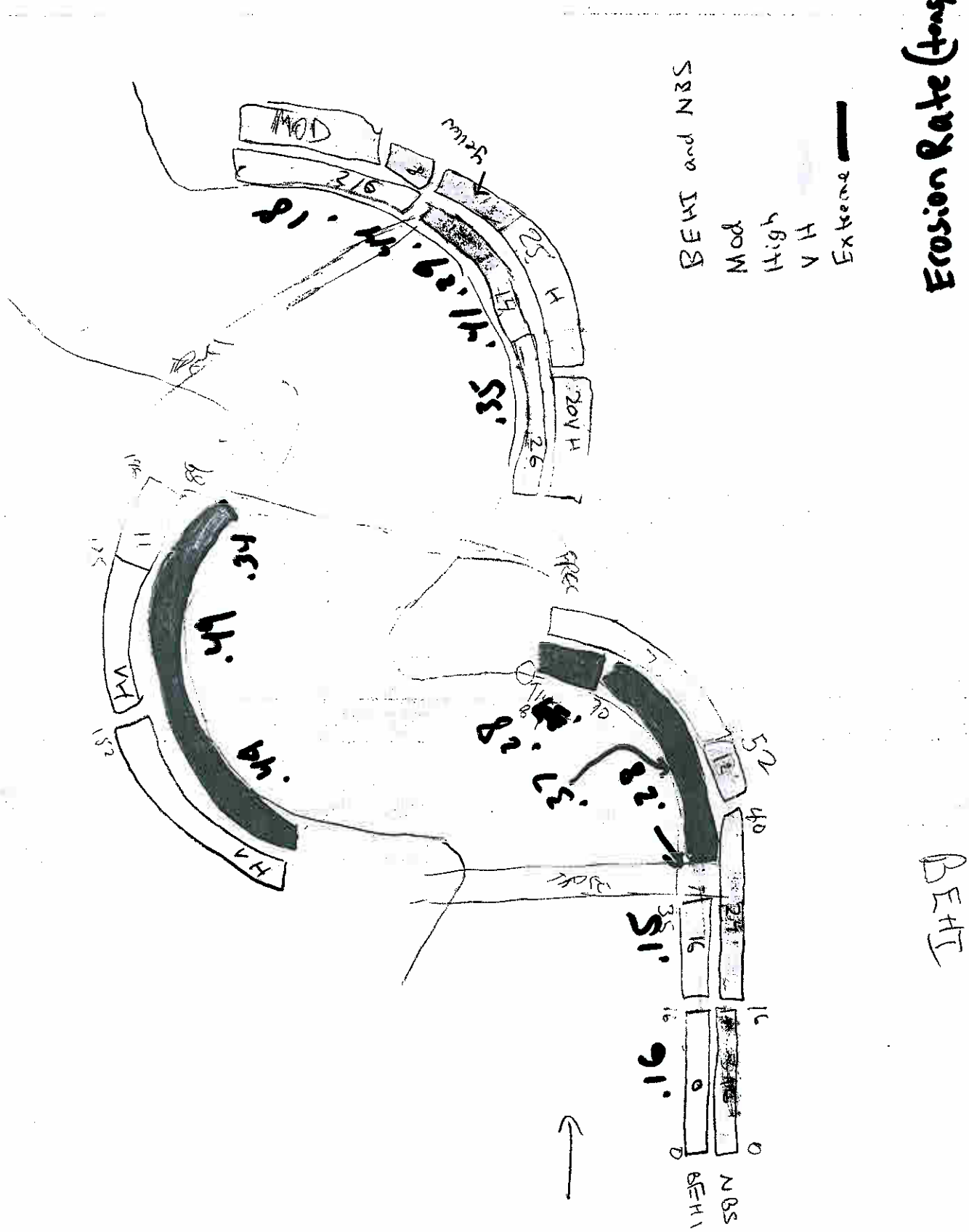
Erosion Rate (tons/yr/ft)
BEHI and NBS
Mod
High
VH
Extreme
MOD
BEHI
NBS
BEHI
VH
H
H
VH
H
H
.18
.29
.41
.35
.34
.44
.44
.82
.82
.27
.51
.91
52
40
16
0
0
16
16
35
152
26
25
20
19
18

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

Stream:	Little Bennett, Reach - Reach 3			Location:			
Graph Used:		Total Bank Length (ft): 247				Date: 9/21/2007	
Observers:		Valley Type: VIII				Stream Type: C 4	
(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. 1 L	Very High	Moderate	0.59960106	16	4.7	45.09	0.14
2. 10 L	Very High	Very High	1.701	6	5	51.03	0.41
3. 11 L	Very High	High	0.999	14	5	69.93	0.24
4. 12 L	High	Very High	1.7	8	5.4	73.44	0.44
5. 13 L	High	Moderate	0.6	17	5.4	55.08	0.16
6. 2 L	Very High	Moderate	0.6007177	19	4.4	50.22	0.13
7. 3 L	Extreme	Moderate	1.8984375	8	4.8	72.9	0.44
8. 4 L	Extreme	High	2.4984375	12	4.8	143.91	0.58
9. 5 L	Extreme	Moderate	1.90125	15	4.8	136.89	0.44
10. 6 R	Extreme	Very High	3.24927938	41	4.4	586.17	0.69
11. 7 R	Extreme	Very High	3.25041322	33	4.4	471.96	0.69
12. 8 R	Extreme	High	2.49917355	11	4.4	120.96	0.53
13. 9 L	Very High	Very High	1.69848837	20	4.3	146.07	0.35
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total erosion (ft^3/yr)**	2023.65	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					**Total erosion (yds^3/yr)**	74.95	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					**Total erosion (tons/yr)**	97.44	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					**Total erosion (tons/yr/ft)**	0.3945	

2006 0.2 289

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TON/FT/YR

Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**1 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

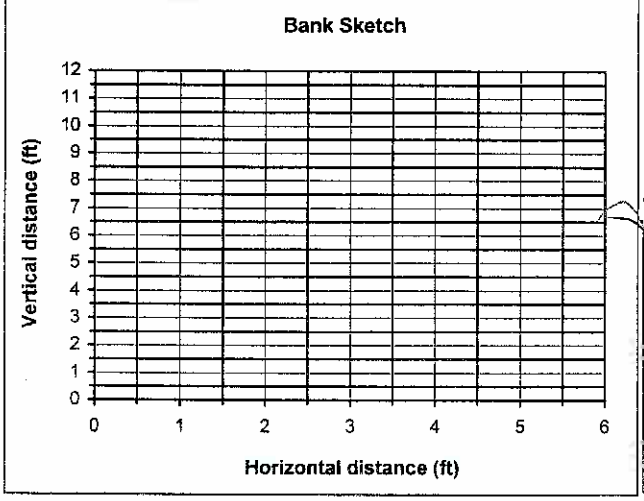
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.7 (A)	Bankfull Height (ft) =	2.1 (B)	(A) / (B) =	2.2381 (C)	8.2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.4 (D)	Study Bank Height (ft) =	4.7 (A)	(D) / (A) =	0.08511 (E)	8.56
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	0.85106 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	122 (H)					10
Surface Protection (I)						
Surface Protection as % =	40 (I)					5.11

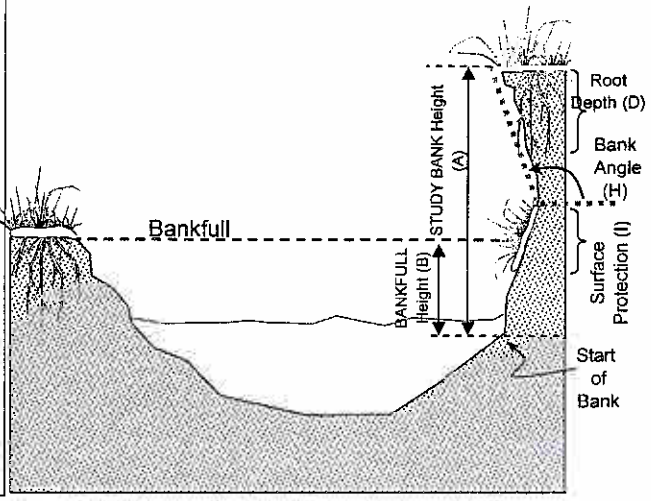
Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	0

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High 41.9
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		





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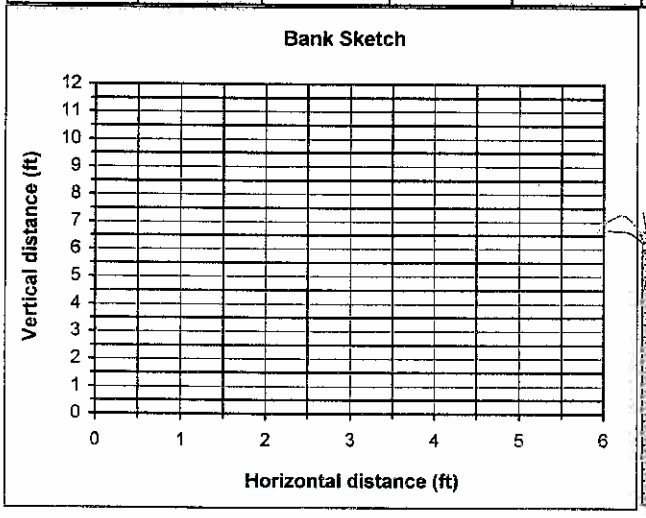
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

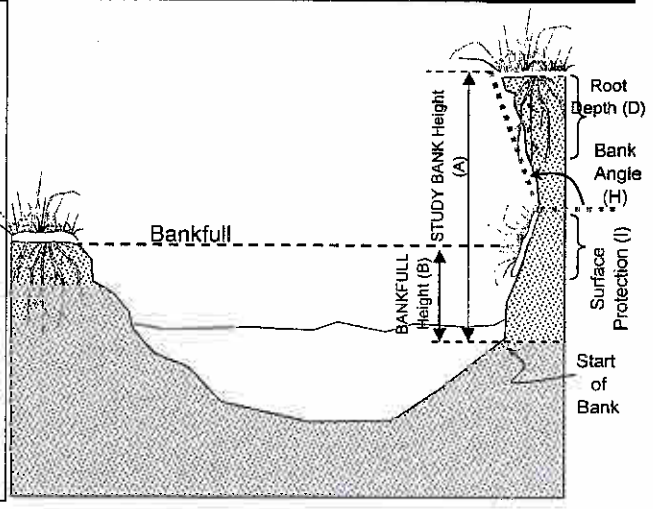
Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**2 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.4 (A)	Bankfull Height (ft) =	3.1 (B)	(A) / (B) =	1.41935 (C)	5.39
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.6 (D)	Study Bank Height (ft) =	4.4 (A)	(D) / (A) =	0.13636 (E)	8
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	1.36364 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	95 (H)					8.14
Surface Protection (I)						
Surface Protection as % =	20 (I)					7.22

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	7

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High 45.8
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		





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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

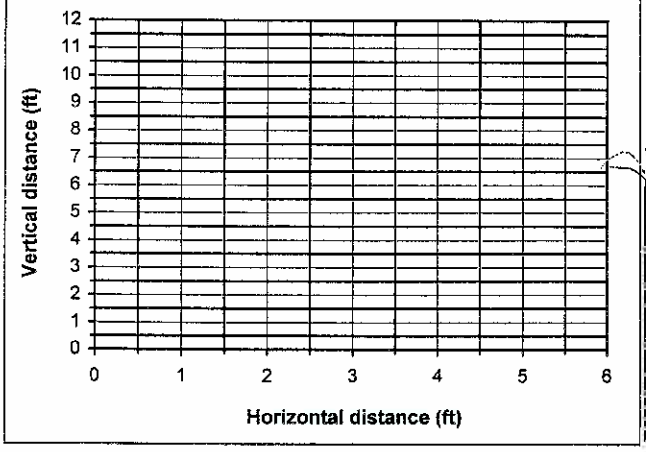
Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**3 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

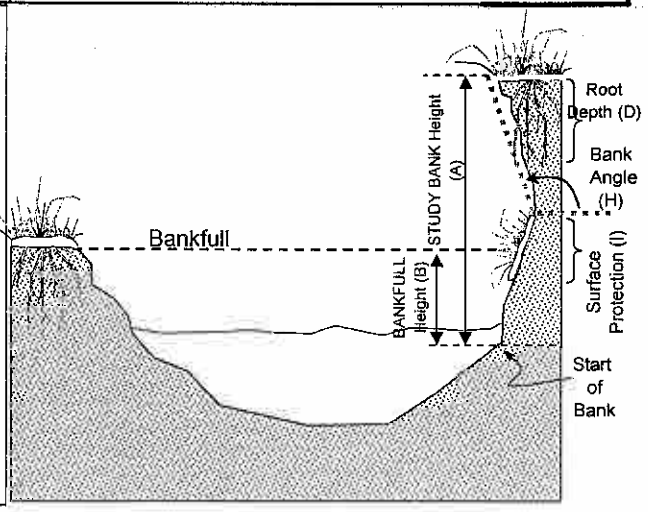
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.8 (A)	Bankfull Height (ft) =	3.7 (B)	(A) / (B) =	1.2973 (C)	4.63
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	4.8 (A)	(D) / (A) =	0.20833 (E)	7.09
Weighted Root Density (G)						
Root Density as % =	20 (F)			(F) x (E) =	4.16667 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	135 (H)					10
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		46.7

Bank Sketch





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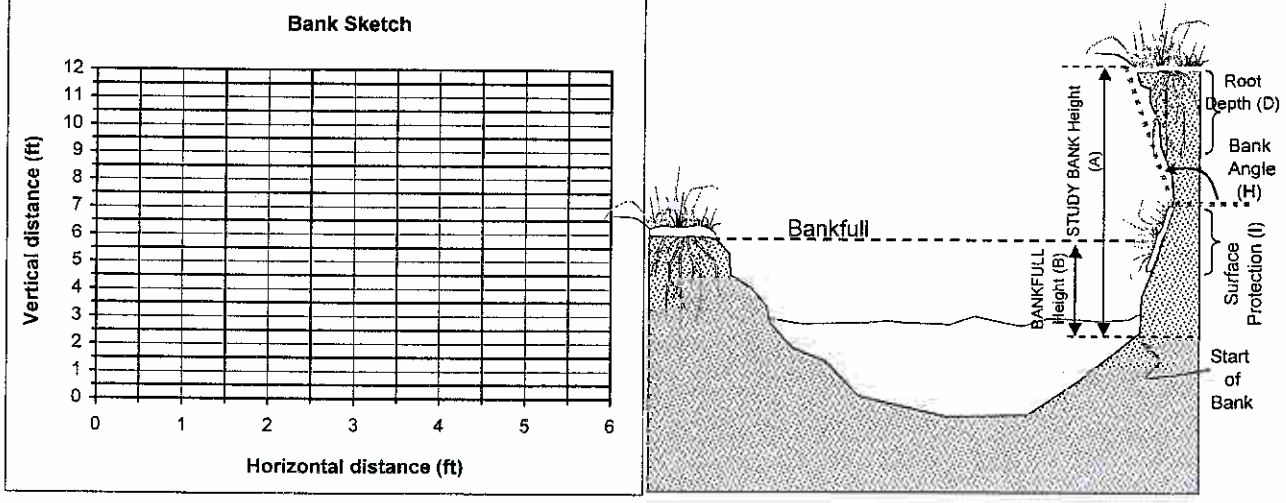
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**4 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.8 (A)	Bankfull Height (ft) =	3.7 (B)	(A) / (B) =	1.2973 (C)	4.63
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	4.8 (A)	(D) / (A) =	0.20833 (E)	7.09
Weighted Root Density (G)						
Root Density as % =	20 (F)			(F) x (E) =	4.16667 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	135 (H)					10
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	Bank Material Adjustment	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		46.7



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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**5 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

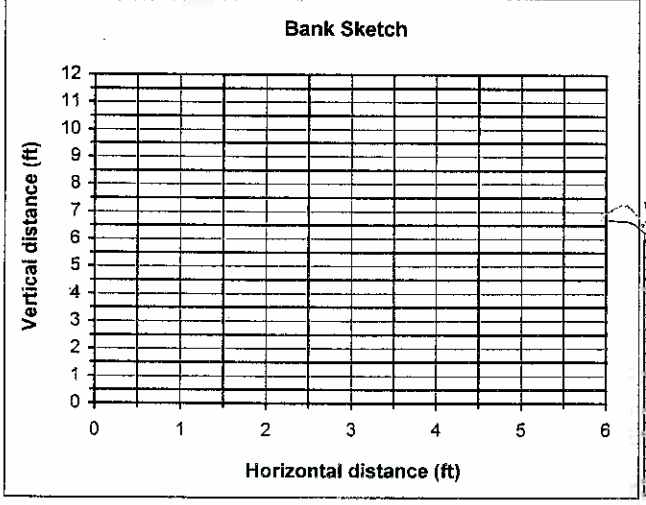
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.8 (A)	Bankfull Height (ft) =	3.7 (B)	(A) / (B) =	1.2973 (C)	4.63
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	4.8 (A)	(D) / (A) =	0.20833 (E)	7.09
Weighted Root Density (G)						
Root Density as % =	20 (F)			(F) x (E) =	4.16667 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	135 (H)					10
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

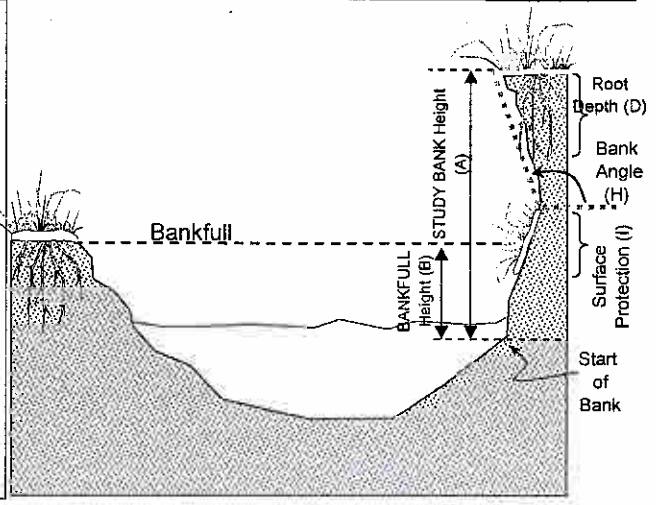
Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		46.7





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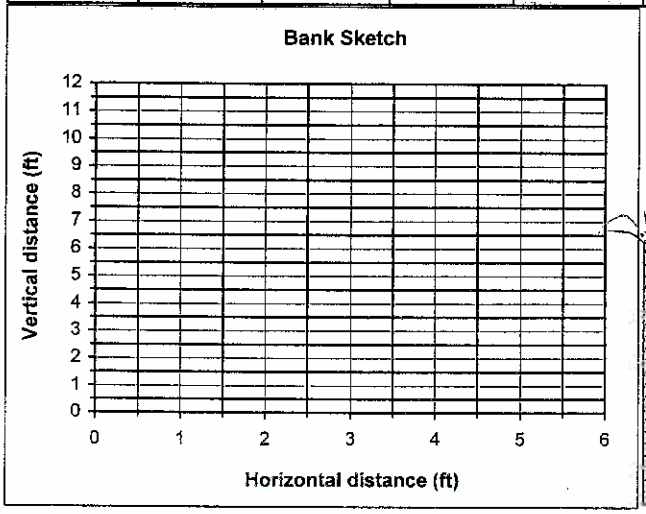
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

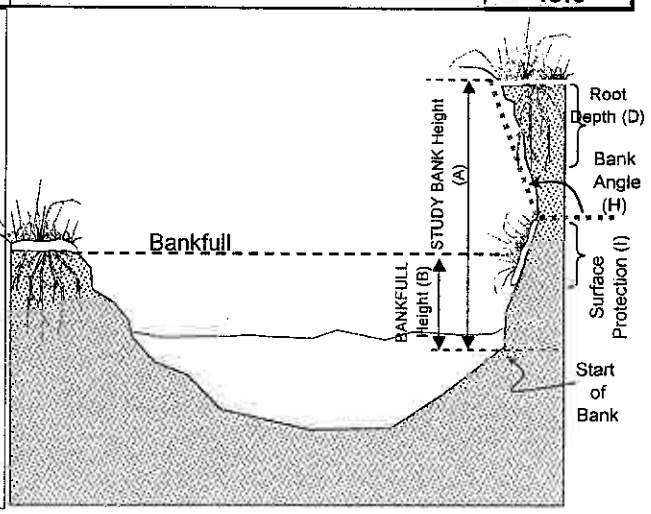
Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**6 R**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.4 (A)	Bankfull Height (ft) =	2.4 (B)	(A) / (B) =	1.83333 (C)	7.09
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.9 (D)	Study Bank Height (ft) =	4.4 (A)	(D) / (A) =	0.20455 (E)	7.22
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	2.04545 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	120 (H)					10
Surface Protection (I)						
Surface Protection as % =	2 (I)					10

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		49.3





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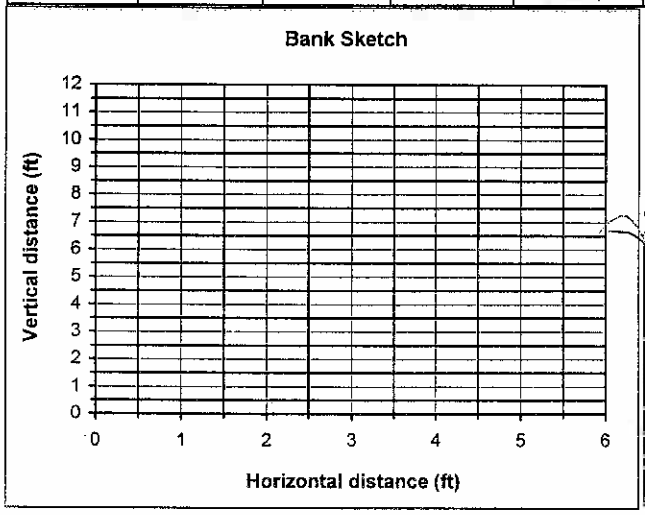
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

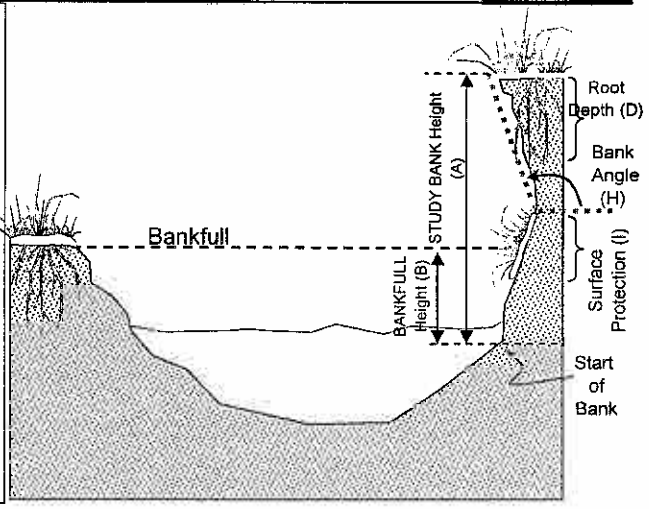
Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**7 R**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.4 (A)	Bankfull Height (ft) =	2.4 (B)	(A) / (B) =	1.83333 (C)	7.09
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.9 (D)	Study Bank Height (ft) =	4.4 (A)	(D) / (A) =	0.20455 (E)	7.22
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	2.04545 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	120 (H)					10
Surface Protection (I)						
Surface Protection as % =	2 (I)					10

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		49.3





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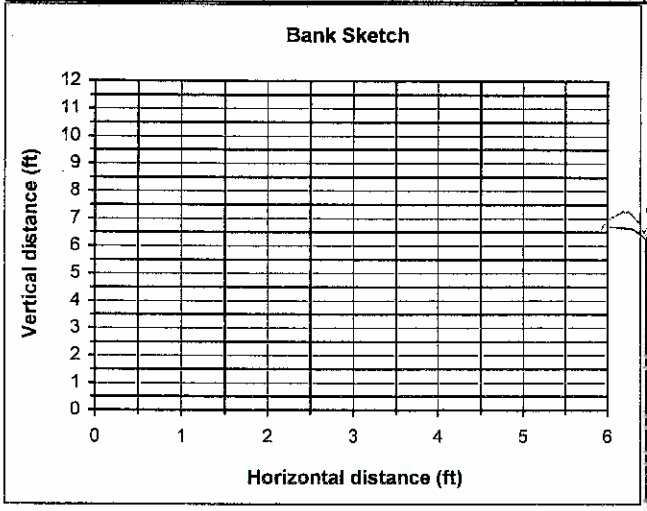
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

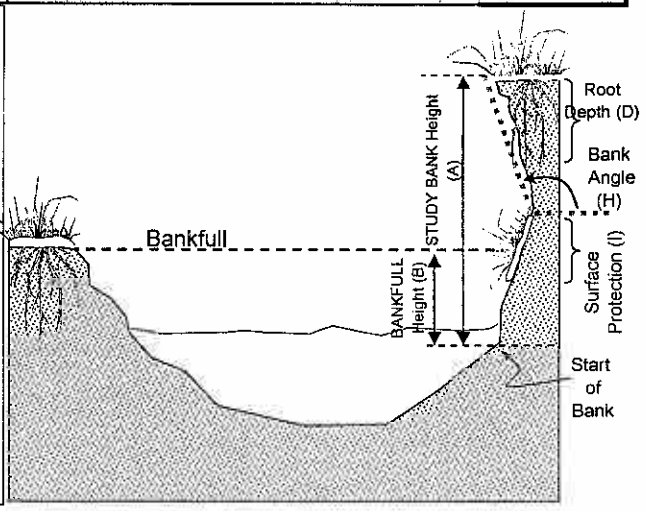
Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**8 R**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.4 (A)	Bankfull Height (ft) =	2.4 (B)	(A) / (B) =	1.83333 (C)	7.09
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.9 (D)	Study Bank Height (ft) =	4.4 (A)	(D) / (A) =	0.20455 (E)	7.22
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	2.04545 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	120 (H)					10
Surface Protection (I)						
Surface Protection as % =	2 (I)					10

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		49.3





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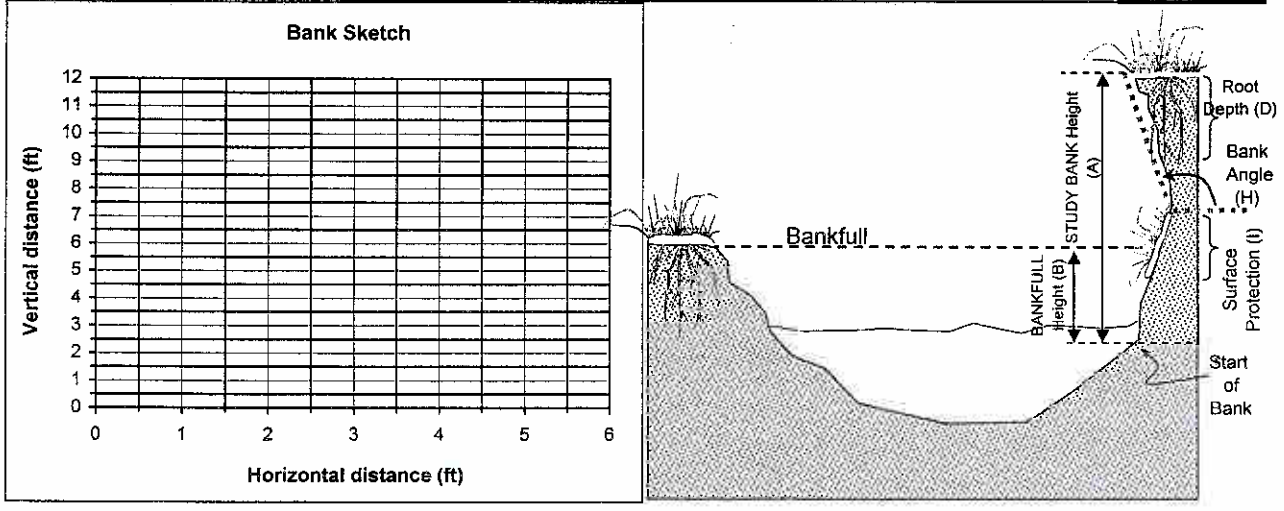
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**9 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.3 (A)	Bankfull Height (ft) =	2.7 (B)	(A) / (B) =	1.59259 (C)	5.95
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.9 (D)	Study Bank Height (ft) =	4.3 (A)	(D) / (A) =	0.2093 (E)	7.09
Weighted Root Density (G)						
Root Density as % =	60 (F)			(F) x (E) =	12.5581 (G)	8.16
Bank Angle (H)						
Bank Angle as *Degrees* =	170 (H)					10
Surface Protection (I)						
Surface Protection as % =	10 (I)					9

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	Bank Material Adjustment	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		45.2



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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**10 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5 (A)	Bankfull Height (ft) =	4.2 (B)	(A) / (B) =	1.19048 (C)	3.9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	5 (A)	(D) / (A) =	0.2 (E)	7.22
Weighted Root Density (G)						
Root Density as % =	40 (F)			(F) x (E) =	8 (G)	8.67
Bank Angle (H)						
Bank Angle as *Degrees* =	100 (H)					8.32
Surface Protection (I)						
Surface Protection as % =	10 (I)					9

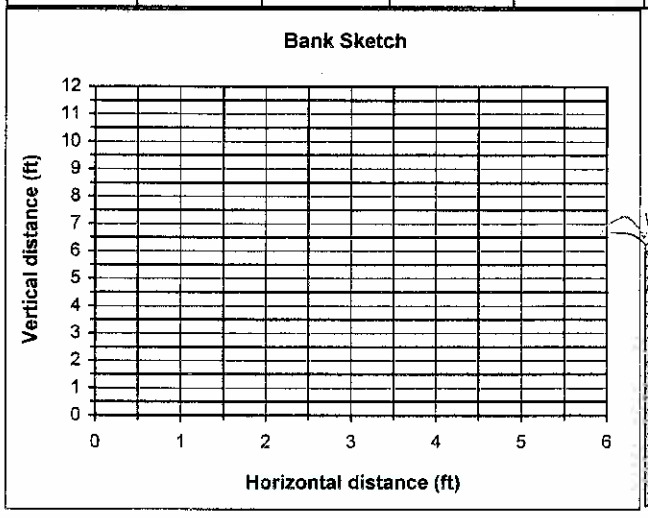
Bank Material Adjustment:

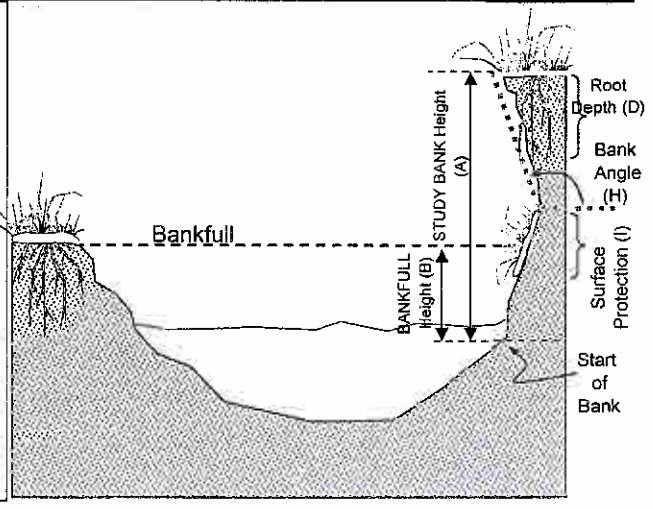
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	Very High 42.1





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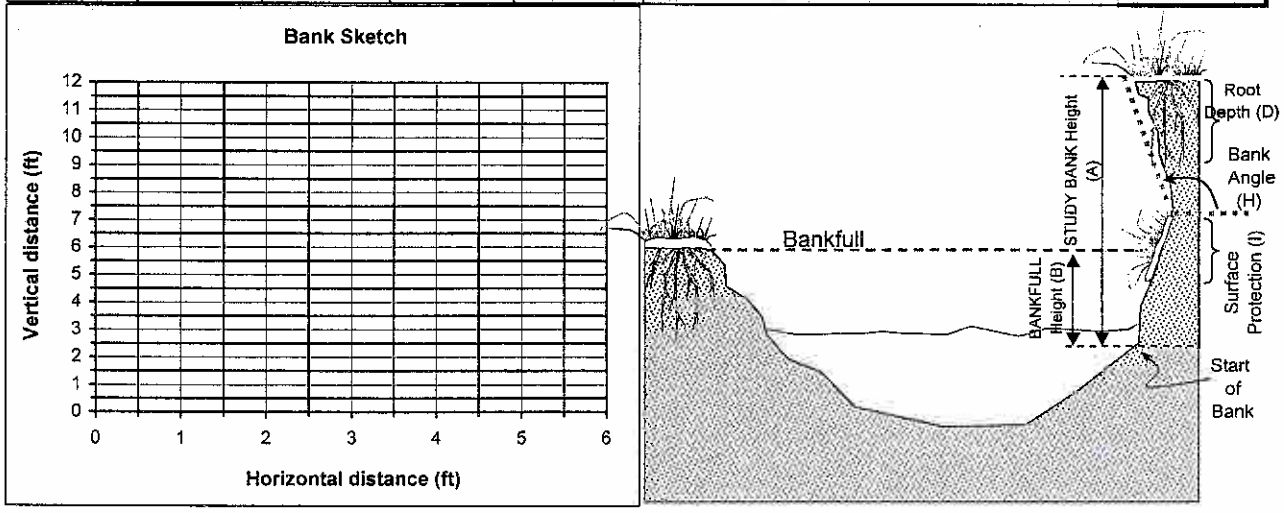
Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**11 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5 (A)	Bankfull Height (ft) =	4.2 (B)	(A) / (B) =	1.19048 (C)	3.9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	5 (A)	(D) / (A) =	0.2 (E)	7.22
Weighted Root Density (G)						
Root Density as % =	40 (F)			(F) x (E) =	8 (G)	8.67
Bank Angle (H)						
Bank Angle as *Degrees* =	100 (H)					8.32
Surface Protection (I)						
Surface Protection as % =	10 (I)					9

Bank Material Adjustment:		
Bedrock (Overall Very Low BEHI) **Boulders** (Overall Low BEHI) **Cobble** (Subtract 10 points if uniform medium to large cobble) **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand) **Sand** (Add 10 points) **Silt/Clay** (no adjustment)	**Bank Material Adjustment**	0
	Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	Very High
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		42.1



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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**12 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

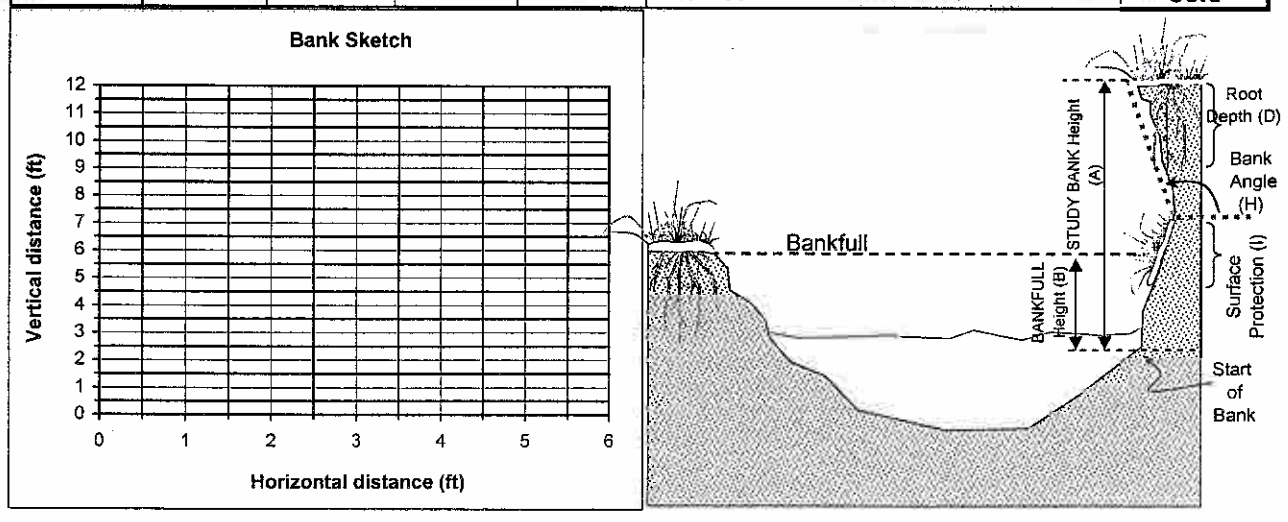
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.4 (A)	Bankfull Height (ft) =	4 (B)	(A) / (B) =	1.35 (C)	4.95
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	3.1 (D)	Study Bank Height (ft) =	5.4 (A)	(D) / (A) =	0.57407 (E)	3.56
Weighted Root Density (G)						
Root Density as % =	65 (F)			(F) x (E) =	37.3148 (G)	5.32
Bank Angle (H)						
Bank Angle as *Degrees* =	115 (H)					8.86
Surface Protection (I)						
Surface Protection as % =	30 (I)					5.9

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	High / 33.6
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		



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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Little Bennett, Reach - Little Bennet**	Location:	
Station:	**13 L**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

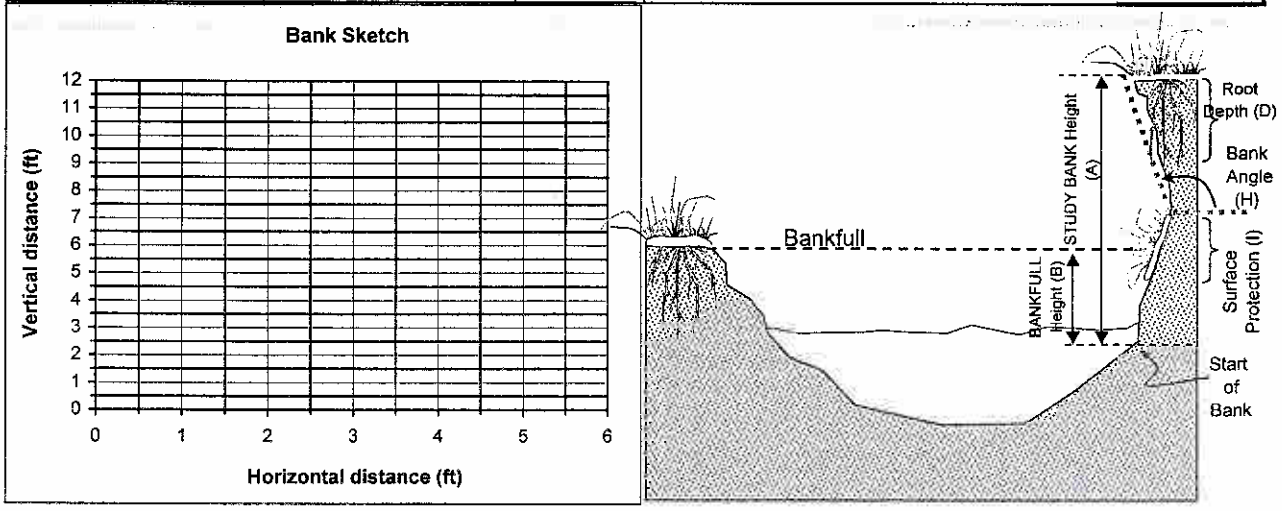
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.4 (A)	Bankfull Height (ft) =	4 (B)	(A) / (B) =	1.35 (C)	4.95
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	3.1 (D)	Study Bank Height (ft) =	5.4 (A)	(D) / (A) =	0.57407 (E)	3.56
Weighted Root Density (G)						
Root Density as % =	65 (F)			(F) x (E) =	37.3148 (G)	5.32
Bank Angle (H)						
Bank Angle as *Degrees* =	115 (H)					8.86
Surface Protection (I)						
Surface Protection as % =	30 (I)					5.9

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score	High
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		33.6



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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **1 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.1	**1.2**	**1.75**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Moderate

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **4 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2) Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3) Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4) Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
High

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
4	**1.6**	**2.5**	**High**

(6) Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7) Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **5 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
5	**2.8**	**1.79**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV (7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Moderate

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **6 R** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Very High

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **7 R** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High

Extensive deposition (continuous, cross-channel).....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Very High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV (7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **8 R** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
High

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **9 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II **(2)**

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III **(5)**

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV **(7)**

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress: Very High

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Very High

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **10 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Very High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N/A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N/A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N/A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **11 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High

Extensive deposition (continuous, cross-channel).....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
High

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV **(7)**

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating	**High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **12 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Very High

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

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Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Little Bennett, Reach - Little Bennet** Location:

Station: **13 L** Stream Type: Valley Type:

Observers: Date: **12/30/99**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress
Moderate

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

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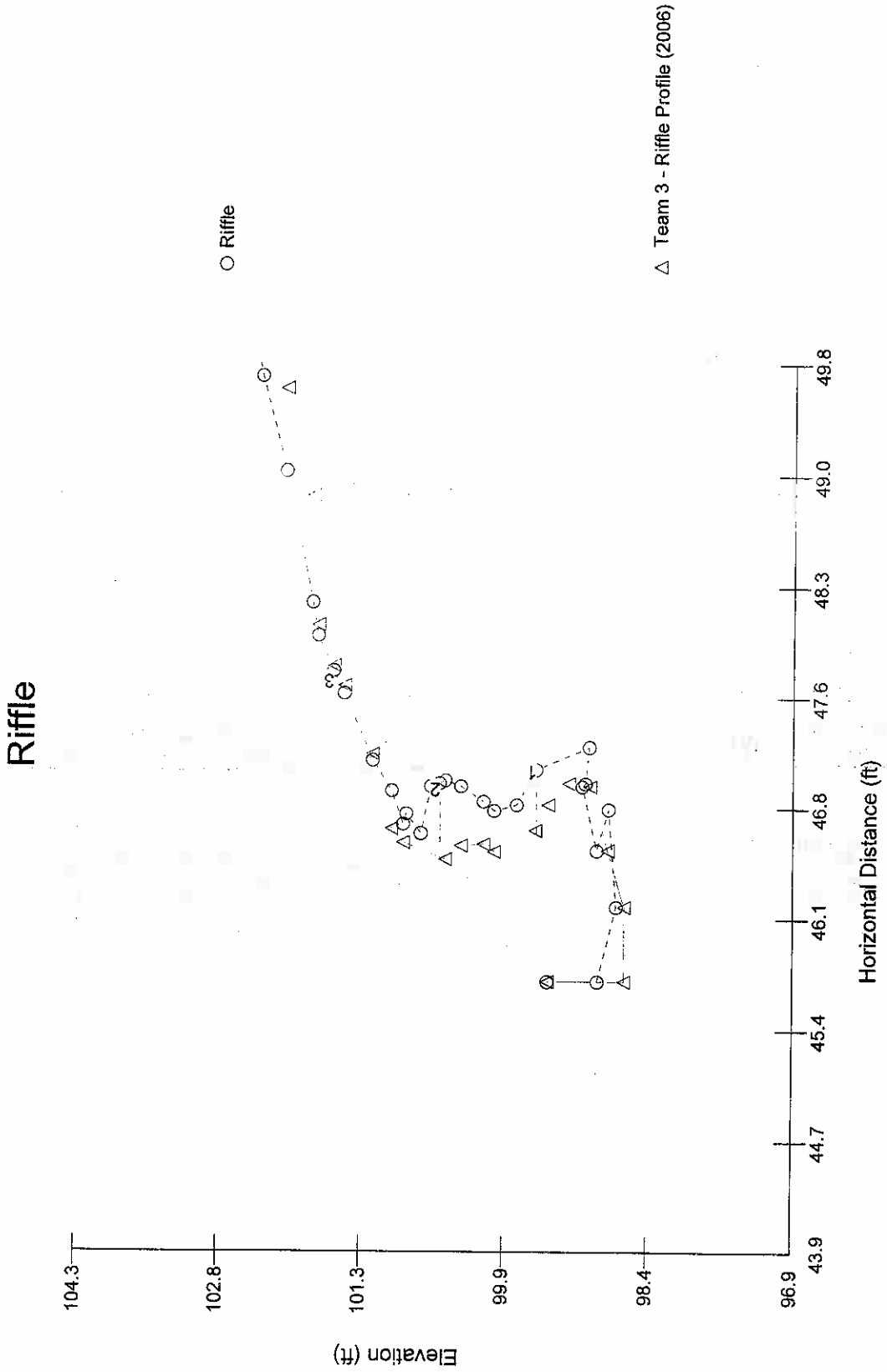
Riffle
○ Riffle
△ Team 3 - Riffle Profile (2006)
Elevation (ft)
104.3
102.8
101.3
99.9
98.4
96.9
Horizontal Distance (ft)
43.9
44.7
45.4
46.1
46.8
47.6
48.3
49.0
49.8

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Estimating Near-Bank Stress (NBS)

Stream: UT Bennet Creek Location: Montgomery Co., MD

Station: 0+19.5 Stream Type: C4 Valley Type: VIII

Observers: Team 3 Date: 9/21/07

Methods for estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High

Extensive deposition (continuous, cross-channel).....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress: High

Riffle Bank Pins

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.49	1.16	2.15	High

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N/A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N/A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N/A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating

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Additional BEHI and NBS worksheets

Stream: UT Bennet Creek Location: Montgomery Co., MD
Station: 0+19.5 Observers: Team 3
Date: 9/21/07 Stream Type: C4 Valley Type: VIII

						BEHI Score (Fig. B-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.1 (A)	Bankfull Height (ft) =	2.6 (B)	(A) / (B) =	1.19 (C)	2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.4 (D)	Study Bank Height (ft) =	3.1 (A)	(D) / (A) =	.12 (E)	8
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	.93 (G)	10
Bank Angle (H)						
Bank Angle as Degrees =	(H)					10
Surface Protection as % =	(I)					-

Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	45

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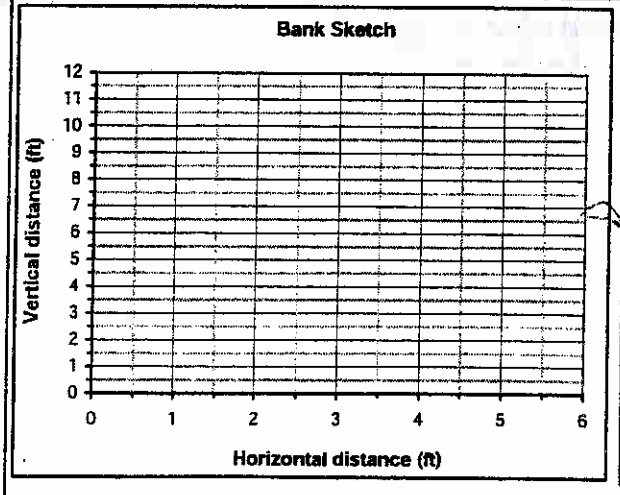
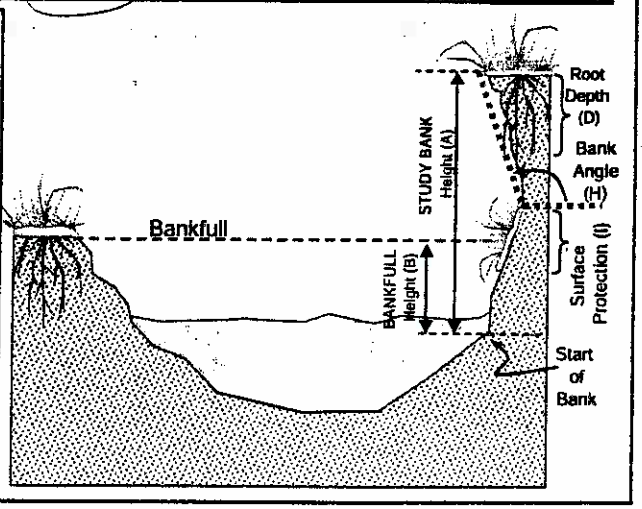
Bank Sketch





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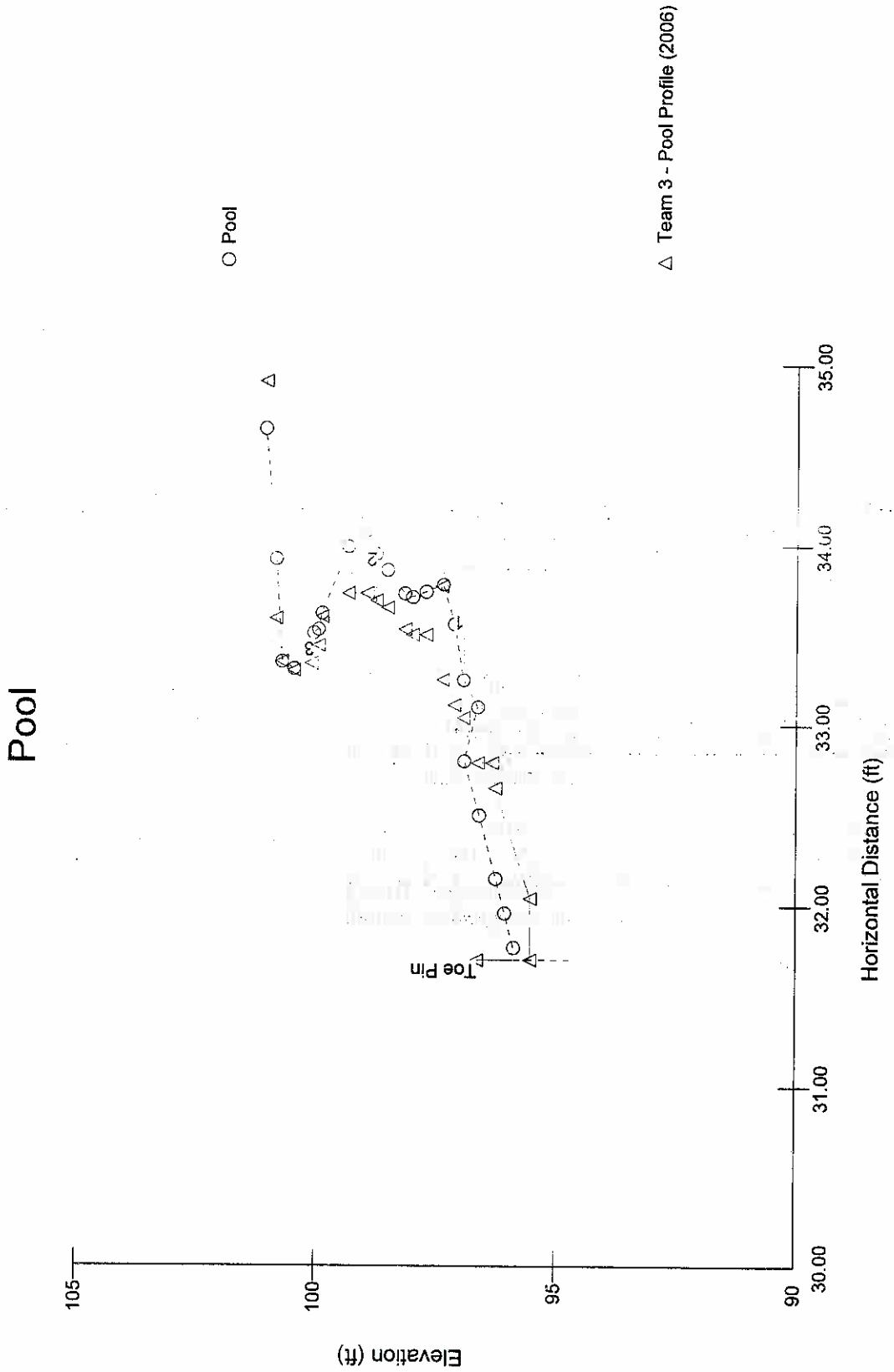
Pool
Pool
Team 3 - Pool Profile (2006)
Toe Pin
Elevation (ft)
105
100
95
90
30.00
31.00
32.00
33.00
34.00
35.00
Horizontal Distance (ft)

Estimating Near-Bank Stress (NBS)

Stream: UT Bennett Creek Location: Montgomery Co., MD
Station: 2+11 Stream Type: C4 Valley Type: VIII
Observers: Team 3 Date: 9/21/07

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I (1)
Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

Dominant Near-Bank Stress: High

(4)

Pool Slope S_o	Riffle Slope S_{rif}	*Ratio* S_o / S_{rif}	Near-Bank Stress (NBS)

Pool Bank Pins

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
4.01	1.99	2.02	High

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV (7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N/A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N/A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N/A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Additional BEHI and NBS worksheets

Stream: UT Bennet Creek Location: Montgomery Co., MD

Station: 2+11 Observers: Team 3

Date: 9/21/07 Stream Type: C4 Valley Type: VIII

Study Bank Height / Bankfull Height (C)

Study Bank Height (ft) =	4.7 (A)	Bankfull Height (ft) =	3.4 (B)	(A) / (B) =	1.38 (C)	BEHI Score (Fig. B-1) 5

Root Depth / Study Bank Height (E)

Root Depth (ft) =	2 (D)	Study Bank Height (ft) =	4.7 (A)	(D) / (A) =	.43 (E)	4

Weighted Root Density (G)

Root Density as % =	10 (F)	(F) x (E) =	4.3 (G)	10

Pool Bank Pins

Bank Angle (H)

Bank Angle as *Degrees* =	80 (H)	5

Surface Protection (I)

Surface Protection as % =	5 (I)	10

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

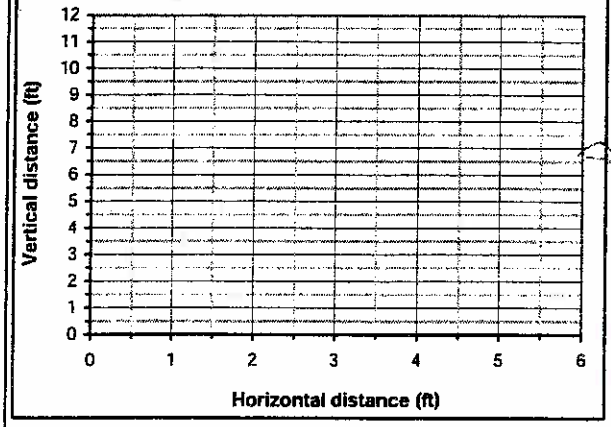
Bank Material Adjustment: 0

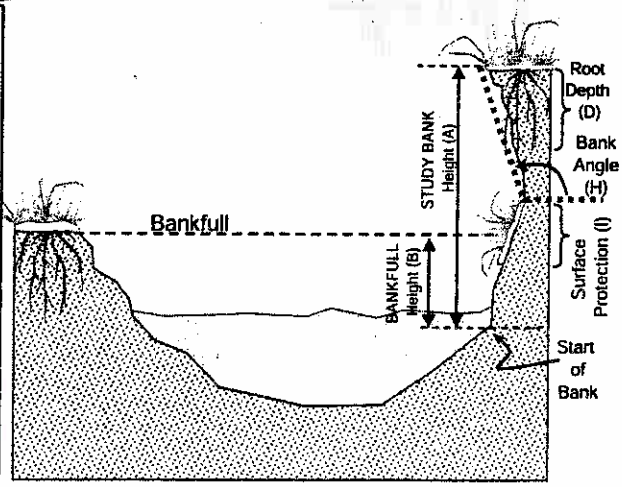
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	39

40.6

Bank Sketch





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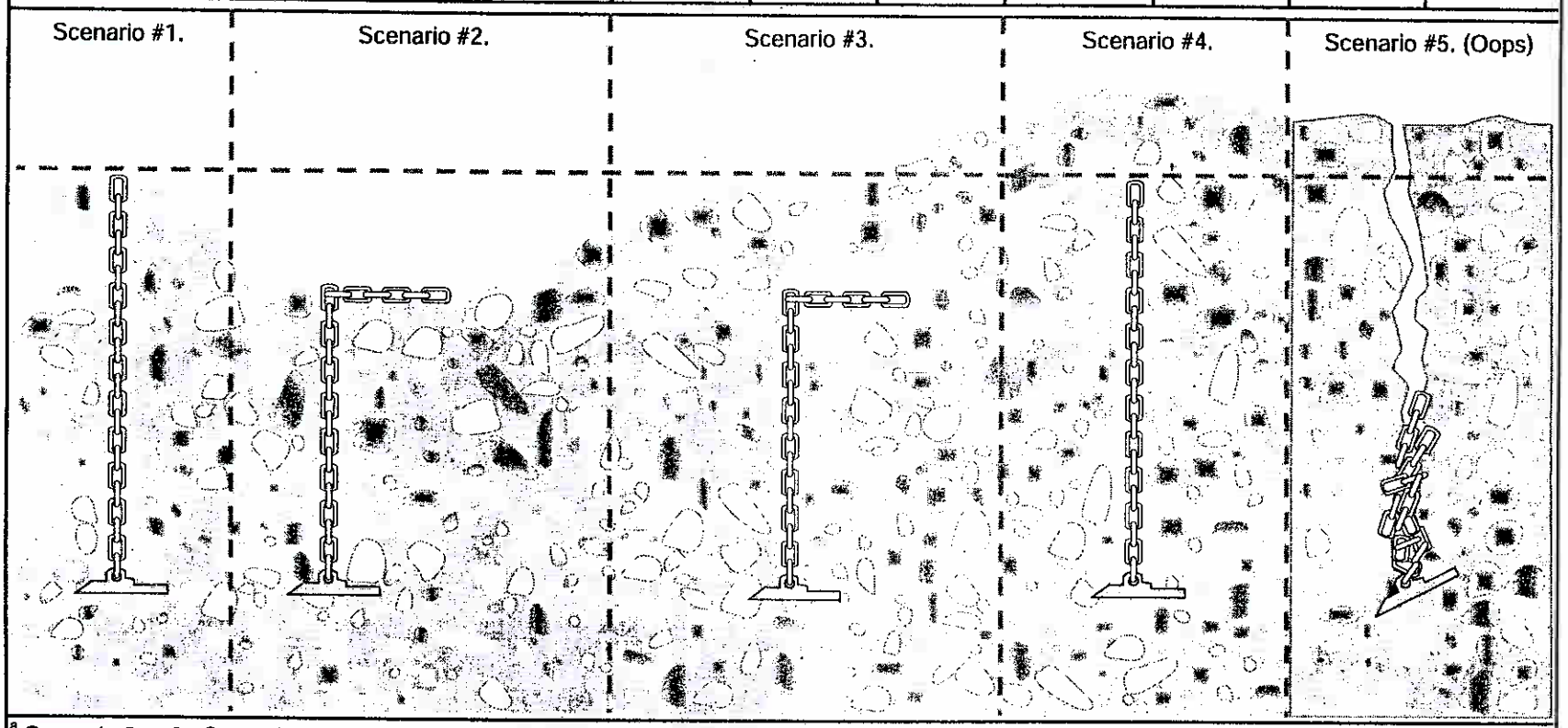
Worksheet B-26. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name: LITTLE BENNETT Location: REACH 3

Observers: TEAM 3 Stream Type: C Valley Type: ALL Date: 9/20/07

		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				1				68	65
Riffle	Chain #2	45				4/1				110	67
Glide	Chain #3										
Glide	Chain #4										

← ON TOP OF CHAIN



[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.

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UT Little Bennett Creek Team 3 9/21/2007

Worksheet 5-16. Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream: **Little Bennet**	Stream Type: **C4**
Location: **Reach 3**	Valley Type:
Observers: **Team 3**	Date:
Stream type changes due to successional stage shifts (Figure 5-55)	**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) C -> Higher W/D C	☐ Moderately unstable
(G→F), (F→D)	☐ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

Worksheet B-20. Lateral stability prediction summary.

Stream: Little Bennett Stream Type: C4

Location: R-3 Valley Type: VIII

Observers: Team 3 Date: 9/21/07

Lateral stability criteria (choose one stability category for each criterion 1–5)	Lateral stability categories: Stable	Moderately unstable	Unstable	Highly unstable	Selected points (from each row)
1 W/d ratio state (Worksheet B-12)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	8
	(2)	(4)	(6)	(8)	
2 Depositional pattern (Worksheet B-8)	B1, B2	B4, B8	B3	B5, B6, B7	4 → 2
	(1)	(2)	(3)	(4)	
3 Meander pattern (Worksheet B-7)	M1, M3, M4		M2, M5, M6, M7, M8		2
	(1)		(3)		
4 Dominant BEHI / NBS (Worksheet B-16)	L/VL, L/L, L/M, L/H, L/VH, M/VL	M/L, M/M, M/H, L/Ex, H/L	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex	8
	(2)	(4)	(6)	(8)	
5 Degree of confinement (MWR / MWR_{rel}) (Worksheet B-13)	0.8 – 1.0	0.3 – 0.79	0.1 – 0.29	< 0.1	1
	(1)	(2)	(3)	(4)	
				Total points	21 → 23

Overall lateral stability category (use total points and check stability rating)	Lateral stability category point range: Stable 7 – 9	Moderately unstable 10 – 12	Unstable 13 – 21	Highly unstable > 21
	☐	☐	☑	☑

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

Stream: Little Bennett			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
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	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	2
	(2)	(4)	(6)	(8)	
2 **Sediment capacity (POWERSED)**	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended	Reduction over 25% of annual sediment yield for bedload and/or suspended	8
	(2)	(4)	(6)	(8)	
3 **W/d ratio state (Worksheet B-12)**	1.0 – 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	8
	(2)	(4)	(6)	(8)	
4 **Stream succession states (Worksheet B-19)**	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(C→High w/d C), (B→High w/d B), (C→F)	(C→D), (F→D)	6
	(2)	(4)	(6)	(8)	
5 **Depositional patterns (Worksheet B-8)**	B1	B2, B4	B3, B5	B6, B7, B8	3 2
	(1)	(2)	(3)	(4)	
6 **Debris / blockages (Worksheet B-9)**	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	2
	(1)	(2)	(3)	(4)	
				Total points	29 28
	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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Worksheet B-22. Vertical stability prediction for channel incision/degradation.

Stream: LITTLE BENNETT Stream Type: C4
Location: REACH 3 Valley Type: VIII
Observers: TEAM 3 Date: 9/21/07

Vertical stability criteria (choose one stability category for each criterion 1–5)	Vertical stability categories for channel incision / degradation: Not incised	Slightly incised	Moderately incised	Degradation	Selected points (from each row)
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)	4
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) (Workshet B-10)	1.00 – 1.10 (2)	1.11 – 1.30 (4)	1.31 – 1.50 (6)	> 1.50 (8)	2
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)	2
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)	1
				Total points	11

OK

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:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
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)	(E→C) C→wider C	(G→F), (F→D)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F)	5
	(2)	(4)	(6)	(8)	
2 **Lateral stability (Worksheet B-20)**	Stable	Moderately unstable	Unstable	Highly unstable	6
	(2)	(4)	(6)	(8)	
3 **Vertical stability excess deposition/ aggradation (Worksheet B-21)**	No deposition	Moderate deposition	Excess deposition	Aggradation	6
	(2)	(4)	(6)	(8)	
4 **Vertical stability incision/ degradation (Worksheet B-22)**	Not incised	Slightly incised	Moderately incised	Degradation	2
	(2)	(4)	(6)	(8)	
				Total points	19 ok
	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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Worksheet B-24. Overall sediment supply rating determined from individual stability rating categories.

Stream: LITTLE BENNETT			Stream Type: C4
Location: REACH 3			Valley Type: VIII
Observers: TEAM 3			Date: 9/21/07
Overall sediment supply prediction criteria (choose corresponding points for each criterion 1–5)	**Stability rating**	**Points**	**Selected points**
1 **Lateral stability (Worksheet B-20)**	**Stable**	**1**	3 4
	Mod. unstable	**2**	
	Unstable	**3**	
	Highly unstable	**4**	
2 Vertical stability excess deposition/ aggradation (Worksheet B-21)	No deposition	1	3
	Mod. deposition	2	
	Excess deposition	3	
	Aggradation	4	
3 **Vertical stability channel incision/ degradation (Worksheet B-22)**	**Not incised**	**1**	1
	Slightly incised	**2**	
	Mod. incised	**3**	
	Degradation	**4**	
4 **Channel enlargement prediction (Worksheet B-23)**	**No increase**	**1**	3
	Slight increase	**2**	
	Mod. increase	**3**	
	Extensive	**4**	
5 **Pfankuch channel stability (Worksheet B-11)**	**Good: stable**	**1**	2
	Fair: mod unstable	**2**	
	Poor: unstable	**4**	
		Total Points	~~12~~ 13

	Category point range			
Overall sediment supply rating (use total points and check stability rating)	**Low** 5 ☐	**Moderate** 6 – 10 ☐	**High** 11 – 15 ☑	**Very High** 16 – 20 ☐

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Worksheet B-25. Summary of stability condition categories.

Stream: Little Bennett Location: Reach 3
Observers: Team 3 Date: 9/21/07 Stream Type: C4 Valley Type: VIII (8)

Channel Dimension	Mean bankfull depth (ft): 1.16	Mean bankfull width (ft): 27.1	Cross-section area (ft^2): 31.56	Width of flood-prone area (ft): 204.4	Entrenchment ratio: 7.54							
Channel Pattern	Mean (range)	MWR: 3.03	Lm/W_{bkf}: 4.50	Rc/W_{bkf}: 1.85	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: 2.09	Pool: 5.1	Depth ratio (max/mean):	Riffle: 1.8	Pool: 4.397	Pool to pool spacing:	Ratio: 3.49	Slope Valley: 0.0112	Slope Average bankfull: 0.01003		
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: Maturing Forest	Potential composition/density: Mature Forest →	Remarks: Condition, vigor and/or usage of exiting reach: oak dominated stand								
	Flow regime: P2	Stream size and order: S-4 (2)	Meander pattern(s): M2, M3	Depositional pattern(s): B1, B2, B4	Debris/channel blockage(s): DH							
	Degree of incision (Bank-Height Ratio): 1.0	Degree of incision stability rating:	Modified Pfankuch stability rating (numeric and adjective rating): 96, Fair									
	Width/depth ratio (W/D): 23.36	Reference W/D ratio (W/D_{ref}): 11.43	Width/depth ratio state $(W/D)/(W/D_{ref})$: 2.04	W/D ratio state stability rating: Highly Unstable								
	Meander Width Ratio (MWR): 3.03	Reference MWR_{ref}: 2.3	Degree of confinement (MWR/MWR_{ref}): 1.3	MWR/MWR_{ref} stability rating: Unconfined								
Bank Erosion Summary	Length of reach studied (ft): 247	Annual streambank erosion rate: 97.44 (tons/yr)	0.3945 (tons/yr/ft)	Curve used: DC Curve	Remarks:							
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks:									
Entrainment/ Competence	Largest particle from bar sample (mm): 96	τ = ~~0.190~~ 0.73	τ^*=N/A	Existing $depth_{bkf}$: 1.01	Required $depth_{bkf}$: N/A	Existing $slope_{bkf}$: 0.0104	Required $slope_{bkf}$: N/A					
Successional Stage Shift	C → C wider → → →	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:							
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:							

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3. Channel Change

Worksheet B-28. Summary of annual data comparisons.

Data Comparison Form

Stream: Reach:

Observers: Date - Year 1: Date - Year 2:

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	26.2	27.1	23.16	22.89	—	
	Mean $depth_{bkf}$	1.13	1.16	1.98	1.99	—	
	Width/depth ratio	23.18	23.36	11.69	11.48	—	
	Cross-sectional $Area_{bkf}$	29.7	31.56	45.9	45.4	—	
	Max $depth_{bkf}$	illegible	illegible	4.31	illegible	—	
Pebble count	D_{35} (mm)	25.60	illegible	—	illegible	—	
	D_{50} (mm)	37.35	36.78	—	10.69	—	
	D_{84} (mm)	77.06	83.13	—	37.20	—	
Bank Erosion	BEHI rating	(39.1) HIGH	(46) EXTREME	44.3 VERY HIGH	(40.0) VERY HIGH	—	
	NBS rating	(2.30) HIGH	3.74 HIGH	(1.71) MODERATE	(2.02) HIGH	—	
	Predicted erosion (ft/yr)	1.00	2.5	0.06	1.0	—	
	Measured erosion (ft/yr)	—	0.30	—	0.27	—	

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	96	96	Bar Sample	D_{35} (mm)	7.09	9.2
Bank-Height Ratio start: / end:	~~1.4~~	~~1.0~~		D_{50} (mm)	14.36	18.70
Point Bar slope	16.5%	~~27%~~ 50%		D_{84} (mm)	48.16	65.07
Riffle Length/Riffle Width	1.04	0.84		D_{100} (mm)	57.00	96.00
Pool Length/Riffle Width	1.51	1.67				
Dimensionless Slope Ratios: S_{riff}/S	3.260	4.910	Dimensionless Depth Ratios	d_{riff}/d_{bkf}	1.67	2.15
S_{run}/S	0.905	1.151		d_{run}/d_{bkf}	2.29	2.33
S_p/S	0.090	0.033		d_p/d_{bkf}	3.54	3.46
S_g/S	0.347	0.632		d_g/d_{bkf}	1.83	1.65

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Worksheet 5-15. Sediment competence calculation form to assess bed stability.

Stream: Little Bennett			Stream Type: C4		
Location: Reach 3			Valley Type: VIII		
Observers: Team 3			Date: 9-21-07		
Enter required information					
27.3	D_{50}	Riffle bed material D_{50} (mm)			
18.7	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.31	D_{max}	Largest particle from bar sample (ft)	96	(mm)	304.8 mm/ft
0.0104	S	Existing bankfull water surface slope (ft/ft)			
1.01	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					
1.46	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834 (D_{50}/\hat{D}_{50})^{-0.872}$		
3.5	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384 (D_{max}/D_{50})^{-0.887}$		
N/A	τ^*	Bankfull Dimensionless Shear Stress		EQUATION USED:	N/A
Calculate bankfull mean depth required for entrainment of largest particle in bar sample					
N/A	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}}{S}$		
Check: ☐ Stable ☐ Aggrading ☐ Degrading					
Calculate bankfull water surface slope required for entrainment of largest particle in bar sample					
N/A	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}}{d}$		
Check: ☐ Stable ☐ Aggrading ☐ Degrading					
Sediment competence using dimensional shear stress					
~~0.66~~ 0.73		Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d)			
~~110~~ 120		Moveable particle size (mm) at bankfull shear stress (Figure 5-54)			
0.53		Predicted shear stress required to initiate movement of D_{max} (mm) (Figure 5-54)			
~~0.82~~ 0.85		Predicted mean depth required to initiate movement of D_{max} (mm)	$d = \frac{\tau}{\gamma S}$		
~~0.0084~~ 0.0093		Predicted slope required to initiate movement of D_{max} (mm)	$S = \frac{\tau}{\gamma d}$		

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Worksheet 5-16. Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream: **Little Bennet**	Stream Type: **C4**
Location: **Reach 3**	Valley Type:
Observers: **Team 3**	Date:
Stream type changes due to successional stage shifts (Figure 5-55)	**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) C -> Higher W/D C	◯ Moderately unstable
(G→F), (F→D)	☐ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

Worksheet 5-17. Lateral stability prediction summary.

Stream: **Little Bennett**			Stream Type: **C4**		
Location: **Reach 3**			Valley Type: **VIII**		
Observers: **Team 3**			Date:		
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 5-5)**	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	8
	(2)	(4)	(6)	(8)	
2 **Depositional pattern (Worksheet 5-5)**	B1, B2	B4, B8	B3	B5, B6, B7	14
	(1)	(2)	(3)	(4)	
3 **Meander pattern (Worksheet 5-5)**	M1, M3, M4		M2, M5, M6, M7, M8		2
	(1)		(3)		
4 **Dominant BEHI / NBS (Worksheet 5-10)**	L/VL, L/L, L/M, L/H, L/VH, M/VL	M/L, M/M, M/H, L/Ex, H/L	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex	8
	(2)	(4)	(6)	(8)	
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet 5-5)**	0.8 – 1.0	0.3 – 0.79	0.1 – 0.29	< 0.1	1
	(1)	(2)	(3)	(4)	
				Total points	21 23
	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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Worksheet 5-18. Vertical stability prediction for excess deposition/aggradation.

Stream: **Little Bennet**			Stream Type: **C4`**		
Location: **Reach 3**			Valley Type: **VIII**		
Observers: **Team 3**			Date:		
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 5-15)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope- slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	2
	(2)	(4)	(6)	(8)	
2 Sediment capacity (POWERSED) (Worksheet 5-12)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended	Reduction over 25% of annual sediment yield for bedload and/or suspended	8
	(2)	(4)	(6)	(8)	
3 W/d ratio state (Worksheet 5-5)	1.0 – 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	8
	(2)	(4)	(6)	(8)	
4 Stream sucession states (Worksheet 5-16)	Current stream type at potential	(E→C)	(C→High w/d C), (B→High w/d B)	(C→D), (F→D)	6
	(2)	(4)	(6)	(8)	
5 Depositional patterns (Worksheet 5-5)	B1	B2, B4	B3, B5	B6, B7, B8	3
	(1)	(2)	(3)	(4)	
6 Debris / blockages (Worksheet 5-5)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	2
	(1)	(2)	(3)	(4)	
				Total points	27 2
	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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Worksheet 5-19. Vertical stability prediction for channel incision/degradation.

Stream: **Little Bennet**			Stream Type: **C4**		
Location: **Reach 3**			Valley Type: **VIII**		
Observers: **Team 3**			Date:		
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 5-15)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or > D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**4**
	(2)	(4)	(6)	(8)	
2 Sediment capacity (POWERSED) (Worksheet 5-12)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**2**
	(2)	(4)	(6)	(8)	
3 Degree of channel incision (BHR) (Workshet 5-5)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**2**
	(2)	(4)	(6)	(8)	
4 Stream sucession states (Worksheets 5-5 and 5-16)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has w/d between 5–10	If BHR > 1.1 and stream type has w/d less than 5	(B→G), (C→G), (E→G), (D→G)	**2**
	(2)	(4)	(6)	(8)	
5 Confinement (MWR / MWR_{ref}) (Worksheet 5-5)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**1**
	(1)	(2)	(3)	(4)	
				Total points	**11**
	Vertical stability category point range for channel incision / degradation				
Vertical stability for channel incision/ degradation (use total points and check stability rating)	**Not incised** 9 – 11 ☐	**Slightly incised** 12 – 18 ☐	**Moderately incised** 19 – 27 ☐	**Degradation** > 27 ☐	

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Worksheet 5-20. Channel enlargement prediction summary.

Stream: **Little Bennet**			Stream Type: **C4**		
Location: **Reach 3**			Valley Type: **VIII**		
Observers: **Team 3**			Date:		
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 5-16)	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(E→C)	(G→C), (F→D)	(C→D), (B→G), (D→G), (C→G), (E→G)	**5**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral stability (Worksheet 5-17)	Stable	Moderately unstable	Unstable	Highly unstable	**6**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical stability excess deposition/ aggradation (Worksheet 5-18)	No deposition	Moderate deposition	Excess deposition	Aggradation	**6**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical stability incision/ degradation (Worksheet 5-19)	Not incised	Slightly incised	Moderately incised	Degradation	**2**
	(2)	**(4)**	**(6)**	**(8)**	
				Total points	**19**
	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** ☐	

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

Stream: **Macgruder Branch, Reach 3, Reference 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 [(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)	(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	16.65	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	9.96	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	2.60	3.50	0.01	0.02	0.03

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	105.9	105.9	211.7
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-18.2	-18.2	-36.3
Stability evaluation: Aggradation, Degradation or Stable:			

UT Little Bennett Creek Team 3 9/21/2007

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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 3, 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 [(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)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.14										0%						
90.0%	5.49	2.82	2.09	5.19	0.40	1.35	0.009	0.23	1.76	0.34	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.95	6.72	4.02	7.14	0.56	1.67	0.009	0.31	4.19	0.59	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.74	8.85	5.15	8.87	0.58	1.72	0.009	0.33	5.52	0.62	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	12.21	10.98	6.20	10.28	0.60	1.77	0.009	0.34	6.85	0.67	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.91	14.06	7.55	11.61	0.65	1.86	0.009	0.37	8.77	0.76	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	19.47	17.69	10.32	18.48	0.56	1.71	0.009	0.32	11.04	0.60	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	24.41	21.94	12.04	19.72	0.61	1.82	0.009	0.35	13.69	0.69	10%	36.50	0.00	0.20	0.00	0.02	0.02
20.0%	31.68	28.05	14.48	21.60	0.67	1.94	0.009	0.39	17.50	0.84	10%	36.50	0.00	0.20	0.00	0.02	0.02
10.0%	43.89	37.78	18.04	23.94	0.75	2.09	0.009	0.44	23.57	0.98	10%	36.50	0.40	0.30	0.04	0.03	0.07
5.0%	61.58	52.74	23.30	27.58	0.84	2.26	0.009	0.49	32.91	1.19	5%	18.25	0.40	0.50	0.02	0.03	0.05
4.0%	68.84	65.21	26.91	28.69	0.94	2.42	0.009	0.54	40.69	1.42	1%	3.65	0.90	0.8	0.01	0.01	0.02
3.0%	79.82	74.33	29.48	29.57	1.00	2.52	0.009	0.58	46.38	1.57	1%	3.65	1.30	1.10	0.01	0.01	0.02
2.0%	102.99	91.41	34.77	32.83	1.06	2.63	0.01	0.61	57.04	1.74	1%	3.65	1.30	1.60	0.01	0.02	0.03
1.5%	123.70	113.35	41.67	37.47	1.11	2.72	0.009	0.65	70.73	1.89	1%	1.83	1.70	2.20	0.01	0.01	0.02
1.0%	156.07	139.89	49.53	42.17	1.17	2.82	0.01	0.68	87.29	2.07	1%	1.83	2.20	3.20	0.01	0.02	0.03

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	40.2	76.7	116.8
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-83.9	-47.4	-131.2
Stability evaluation: Aggradation, Degradation or Stable:			

UT Little Bennett Creek Team 3 9/21/2007

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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	Stream Type: C4
Location: Reach 3	Valley Type: VIII
Observers: Team 3	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) C → wider C	☑ Moderately unstable
(G→F), (F→D), (C→F)	☐ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

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ROSGEN REPRESENTATIVE REACH PEBBLE COUNT

STREAM:	**DATE:** 9/21/07
REACH: 3	**CREW:**

PARTICLE TALLY COUNTS BY TRANSECT PG3 PG4 PG5 ~~PG6~~ need to add

ft	PARTICLE	mm		1	2	3	4	5	6	7	8	9	10	Tot Pool	Tot Riff	Comb Tot	%CUM
	Silt/Clay	< .062	S/C					2			3		2	2 3	2 1	8	7
	Very Fine	.062 - .125	S					1			0		0	1 0	0 0	1	1
	Fine	.125 - .25	A					0			1		1	0 1	1 0	2	2
	Medium	.25 - .50	N					0			1		0	0 1	0 0	1	1
	Coarse	.50 - 1.0	D					0			2		0	0 2	0 0	2	2
	Vry Coarse	1.0 - 2	S					2			2		0	2 1	0 2	5	3
	Very Fine	2 - 4						0			1		0	0 1	0 2	3	1
	Fine	4 - 6	G					1			0		2	1 0	2 1	4	3
	Fine	6 - 8	R					2			1		0	2 1	0 2	5	3
	Medium	8 - 12	A					2			5		3	2 5	3 1	11	10
	Medium	12 - 16	V					1			5		4	1 5	4 2	12	10
	Coarse	16 - 24	E					2			2		3	2 2	3 5	12	7
	Coarse	24 - 32	L					0			1		1	0 1	1 2	4	2
	Vry Coarse	32 - 48	S					4			3		3	4 3	3 5	15	10
	Vry Coarse	48 - 64						1			3		0	1 3	0 3	7	4
0.21-0.31	Small	64 - 96	C					2					1	2 0	1 2	5	3
0.31-0.42	Small	96 - 128	O											0 0	0 1	1	0
0.42-0.63	Large	128 - 192	B											0 0	0 1	1	0
0.63-0.84	Large	192 - 256	L											0 0	0 0	0	0
0.84-1.26	Small	256 - 384	B											0 0	0 0	0	0
1.26-1.68	Small	384 - 512	L											0 0	0 0	0	0
1.68-3.36	Medium	512 - 1024	D											0 0	0 0	0	0
3.36-6.72	Lrg	1024 - 2048	R											0 0	0 0	0	0
6.72-13.43	Vry Lrg	2048-4096												0 0	0 0		0
	Bedrock	>4096	BDRK											0 0	0 0		0
		FEATURE SAMPLED															

	Length	Proportion	No. Units	Sampled
REACH			10	10
POOL			3	3
RIFFLE			3	3
RUN			2	2
GLIDE			2	2

@ protusion height

Transect	Feature	Length	Width
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

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PC 2

RIFFLE PEBBLE COUNT

9/21/2007 Team 3 UT Little Bennett Creek

STREAM: DAY 2 TEAM 3 **DATE:** 9/21/07

REACH: REACH 3 **CREW:** TEAM 3

XS No.: Riffle X SEC 100cnt **Riffle Location (also mark on reach sketch):**

ft	PARTICLE	mm		Particle Count 1	2	3	4	5	6	7	8	9	10	TOTALS Tot #	% Cum
	Silt/Clay	< .062	S/C												
	Very Fine	.062 - .125	S												
	Fine	.125 - .25	A												
	Medium	.25 - .50	N												
	Coarse	.50 - 1.0	D												
	Vry Coarse	1.0 - 2	S												
	Very Fine	2 - 4													
	Fine	4 - 6	G												
	Fine	6 - 8	R												
	Medium	8 - 12	A												
	Medium	12 - 16	V												
	Coarse	16 - 24	E												
	Coarse	24 - 32	L												
	Vry Coarse	32 - 48	S												
	Vry Coarse	48 - 64													
0.21-0.31	Small	64 - 96	C												
0.31-0.42	Small	96 - 128	O												
0.42-0.63	Large	128 - 192	B												
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												

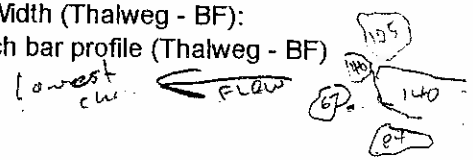
LARGEST PARTICLES ON BAR

Bar Location (also mark on reach sketch):

Bar Length:

Bar Width (Thalweg - BF):

Sketch bar profile (Thalweg - BF)



Part. #	mm	Part. #	mm	Part. #	mm
1	65	6		11	
2	68	7		12	
3		8		13	
4		9		14	
5		10		15	

LBS/02

Worksheet B-17. Bar sample data collection and sieve analysis form.

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis | Observers: TEAM 3

Stream: | Location: REACH 3 | Date: 9/21/07

Subsamples	0 Catch Pan or BUCKET		2 Sieve SIZE 2 mm		4 Sieve SIZE 4 mm		8 Sieve SIZE 8 mm		16 Sieve SIZE 16 mm		32 Sieve SIZE 32 mm		64 Sieve SIZE 64 mm		128 Sieve SIZE 128 mm		256 Sieve SIZE 256 mm	
	Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight	
	2/2		2/2		2/6		2/6		1/9		2/10		2/6					
	Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights	
	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net
1	[illegible]	4/4	[illegible]	1/8	[illegible]	1/3	[illegible]	[illegible]	[illegible]	[illegible]	7/11	5/1	6/5	3/15	—	—	—	—
2	4/1	1/15	4/0	2/2	5/11	3/5	5/10	[illegible]	[illegible]	2/12	10/11	8/1	—	—	—	—	—	—
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
Net wt. total	6/3		[illegible]		5/2		6/[illegible]		9/2		[illegible]		3/15					
% Grand total																		
Accum. % =<																		
	6.19		3.63		5.13		6.1[illegible]		9.15		[illegible]3.13		3.94					

SURFACE MATERIALS DATA (Two largest particles)

No.	Dia.	WT.
1	96	1/7
2	60	0/9

1.44
0.56

Bucket + materials weight	
Bucket tare weight	
Materials weight	
Materials less than:	mm

Be sure to add separate material weights to grand total

GRAND TOTAL SAMPLE WEIGHT

Sample location notes	Sample location sketch

9/21/2007 Team 3 UT Little Bennett Creek

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River Name: UT Little Bennett Creek
Reach Name: Team 3
Bank Name : Team 3 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 45.7 Elevation: 99.43 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	TTPIN
0	-0.78	GTPIN
0.49	-0.78	TOE
0.86	-0.61	CS
1.28	-0.43	UNDERCUT
1.3	-0.21	UNDERCUT
1.16	0	UNDERCUT
0.99	0.13	BPIN 1
0.85	0.55	SLP BRK
0.9	0.66	SLP BRK
0.89	0.89	SLP BRK
0.8	1.05	BPIN 2
0.91	1.48	SLP BRK
1	1.6	SLP BRK
1.49	1.8	SLP BRK
1.94	2.09	BKF
2.07	2.2	BPIN 3
2.34	2.36	RTOB
3.19	2.42	SLP BRK
3.89	2.7	SLP BRK
4.1	2.95	SLP BRK
4.86	3.28	SLP BRK
6.05	3.55	SLP BRK
6.77	3.74	SLP BRK

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	0.99	0.13	3	
BPIN 2	0.8	1.05	3	
BPIN 3	2.07	2.2	3	

UT Little Bennett Creek Team 3 9/21/2007

River Name: UT Little Bennett Creek
Reach Name: Team 3
Bank Name : Team 3 - Pool Profile (2006) Team 3 1.55 - .37

Toe Pin Setup Data:
Station: 31.7 Elevation: 96.66 Northing: 0 Easting: 0

9/21/07

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override: Bank Pins (length exposed) rock on lowest pin
Towest 0.38'
mid 0.3'
highest 0.14'

Linked Cross Section: --none--

0.82 TP above bed
0.84 TP to WS

Vertical Bank Profile Data:

Horizontal	Vertical	Note	Horizontal	Verticle
0	0	TTPIN		
0	-1.11	GTPIN		
0.34	-1.11	TOE		
0.95	-0.37	CS		
1.09	-0.3	CS		
1.09	0	CS		
1.34	0.3	BPIN 1	tp 1.40' / 1.17 / 1.55	0.0 / 0.3
1.41	0.5	CS	[illegible]	[illegible]
1.55	0.74	UNDERCUT	2.08	0.74
2.07	0.78	UNDERCUT	2.08	0.74
1.8	1.1	SLP BRK	2.04	1.1
1.8	1.38	SLP BRK	2.01	1.38
1.83	1.54	SLP BRK	2.03	1.54
1.95	1.9	UNDERCUT	2.16	1.9
1.99	2.14	BPIN 2	1.98 / 2.25	2.14
2.03	2.34	UNDERCUT	2.38	2.34
2.03	2.72	BKF	2.29	2.72
1.9	3.26	UNDERCUT	1.92	3.26
1.74	3.33	UNDERCUT	1.83	3.33
1.64	3.48	BPIN 3	1.64 / 1.81	3.43
1.6	3.84	SLP BRK	1.61	3.84
1.65	4.09	RTOB	1.65	4.09
1.89	4.22	GS	2.22	4.22
3.2	4.45	GS	2.94	4.45
			2.33	2.70'

Scour line

Bank Pin Information:

WS = 0.84' 2.03'

Name	Horiz	Vert	Length	Note	H from Bank	V
BPIN 1	1.34	0.3	3		(.28) 1.1	1.42
BPIN 2	1.99	2.14	3		(.04) 0.8	1.19
BPIN 3	1.64	3.48	3		(-.39) 0.45	0.7
					0.26	0.34
					0.07	0.22

a. Riparian Vegetation

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

Riparian Vegetation

Stream: LITTLE BENNETT DAY 2 Location: REACH 3

Observers: TEAM 3 Reference reach [ ] Disturbed (impacted reach) [X] Date: 9/21/07

Existing species composition: SOFT HARDWOOD (MATURE) Potential species composition: MIXED MESOPHYTIC INCL. OAK/WALNUT/BEECH

Riparian cover categories		Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	30	5	YELLOW POPLAR	80
				[illegible]	
				[illegible]	5
				DOGWOOD/BEECH	15
					100%
2. Understory	Shrub layer		10	SPICEBUSH	30
				MULTIFLORA ROSE	25
				[illegible]	20
				RASPBERRY	25
					100%
3. Ground level	Herbaceous		60	MICROSTEGIUM	75
				Halberd Leaf Hawthorn	20
				Polygonum sp.	1
				PANICUM	3
				NETTLE/BASIL	1
					100%
	Leaf or needle litter		2		
	Bare ground		3		

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

Column total = 100%

Remarks:

Condition, vigor and/or usage of existing reach: ROBUST VEGETATION EXCEPT AT BAR ALLUVIUM WHERE VEG. IS SPARSE

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SURVEY DATA ⟹ CROSS - SECTION 1

SITE: LT Little Bennett RP Date: 9/21/07

Location: Ram Cross Section Riffle

Party / Notes: MARK / Logs Team 3

Item	Distance, Point, or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Elevation Ft.	COMMENT / REMARKS
1	0+00				3.7	Tape Ref
2	0+00				4.35	Ground @ 1'
3	0+0.5				4.33	GS
4	0+01				4.35	GS
5	0+02				4.30	GS
6	0+03				4.22	GS
7	0+04				4.30	GS
8	0+04.5				4.37	TOS TLB
9	0+05				4.81	OS Slope
10	0+06				5.85	ON Slope
11	0+06.5				6.43	OS
12	0+07				6.63	Toe Slope
13	0+08				6.70	Toe BAR
14	0+09				6.52	BAR
15	0+10				6.15	BAR
16	0+11				5.90	BAR
17	0+12				5.76	BAR
18	0+13				5.67	Top Bar
19	0+14				5.55	Top Bar
20	0+15				5.52	Top Bar
21	0+16				5.63	Top of Bar
22	0+17				5.66	BAR
23	0+18				5.8	Bar
24	0+19				6.01	Bar
25	0+20				6.08	BKF
26	0+21				6.21	Slope
27	0+22				6.48	Slope
28	0+23				6.5	Slope

SURVEY DATA ⟹ CROSS - SECTION 2

SITE: Riffle Date:

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
29	0+24.5				6.75	Slope
30	0+25				6.80	Slope
31	0+26				6.82	Slope
32	0+27				6.91	Slope
33	0+28				7.10	Scour Chan
34	0+29				7.12	GS
35	0+30				7.04	GS
36	0+31				7.04	GS
37	0+32				7.04	GS
38	0+33				7.08	GS
39	0+34				7.10	GS
40	0+35				7.18	GS
41	0+36				7.29	GS
42	0+37				7.32	GS
43	0+38				7.47	GS
44	0+39				7.50	GS
45	0+40				7.61	GS
46	0+41				7.84	GS
47	0+42				8.02	GS
48	0+43				8.17	GS
49	0+43.3				8.29	LEOW
50	0+43.6				8.31	scour chan
51	0+45				8.46	GS
52	0+45.1				7.91	Toe Rt
53	0+45.1				8.51	GS
54	0+45.8				8.57	THW
55	0+46.2				8.54	GS
56	0+46.5				7.18	1.3 Above Wedge
57	0+46.7				6.53	scour line
58	0+47.1				6.29	GS BKF

UT Little Bennett Creek Team 3 9/21/2007

SURVEY DATA ⟹ LONGITUDINAL PROFILE

SITE: Cross section Page 3 Date:

Location: Riffle

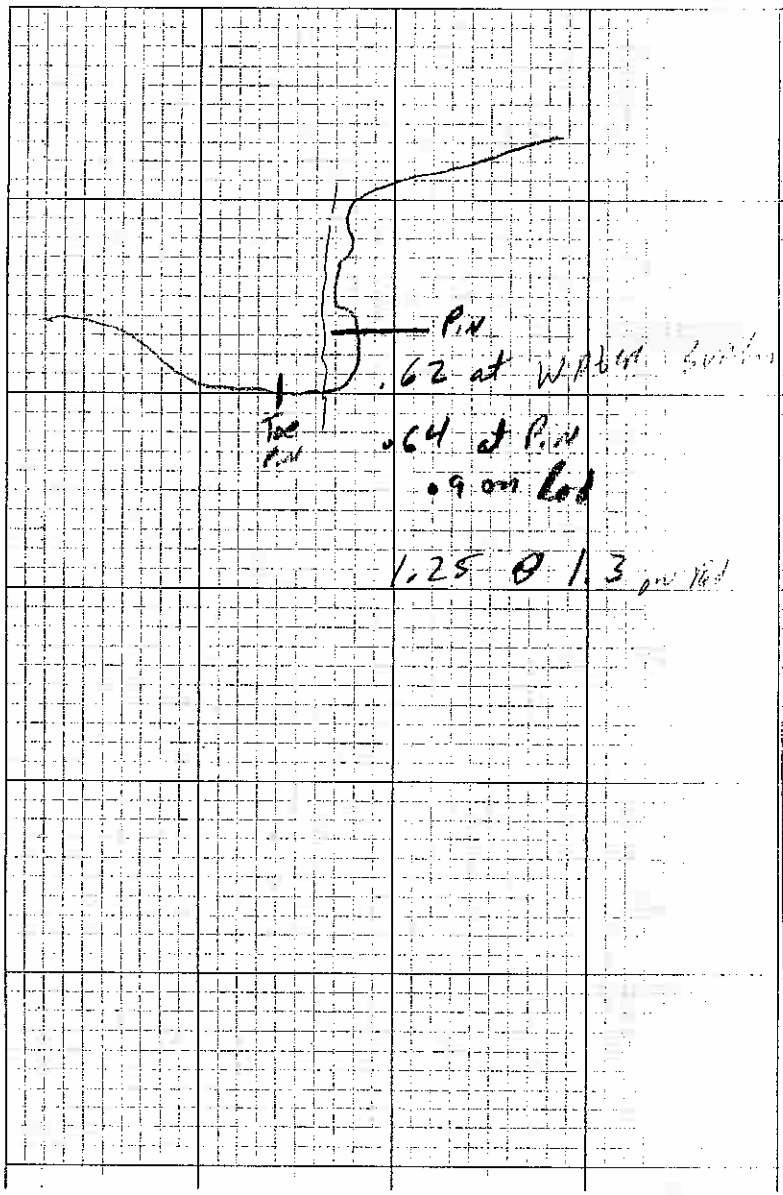
Party / Notes:

Item	Distance, Point, or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
1	0+48				5.54	Slope Start
2	0+49				5.28	Slope
3	0+50				4.83	Slope
4	0+51				4.60	Slope
5	0+52				4.34	Slope
6	0+52.5				4.28	Slope
7	0+53				4.23	Terrace
8	0+54				4.17	
9	0+55				4.0	
10						
11	TURN				1st	Laser
12	0+00				3.75	Top of left
13						
14	0+00				4.99	2nd [illegible] TLP
15						
16	Toe Pin	1st Laser			7.92	Bank toe [illegible]
17		2nd Laser			9.19	[illegible]
18						
19	0+52				5.65	Slope 4.38
20	0+53				5.56	Slope 4.29
21	0+55				5.41	" 4.14
22	0+57				5.32	4.05
23	0+59				5.25	3.98
24	0+62.2				4.62	Top of P. BR 3.31
25	0+62.2				5.15	3.88
26						
27						
28						

SURVEY DATA ⟹ LONGITUDINAL PROFILE 2

SITE: Date:

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
29	103			4.61		LMON
30		Estimated		Flood Prone		Diff .67
31			Area			27°
32	0	62.5			4.19	3.88 -.31
33	11	73			3.99	3.68
34	26	88			3.92	3.61
35	46	108			1.70	1.39
36						
37						
38						
39						
40						
41						
42		89				
43						
44	1					
45						
46				156'		
47	-89				4.0	
48	-93				6.0	
49	-95				6.0	
50	-97				4	
51	-156				2	
52						
53						
54						
55						
56						
57						
58						



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SURVEY DATA ⟹ CROSS - SECTION 1

SITE: POOL 1C Date:

Location:

Party / Notes:

Item	Distance, Point, or STATION Ft	Back-Sight BS Ft	Height of Instrument HI Ft	Fore-Sight FS Ft	Elevation Ft	NOTES / COMMENT / REMARKS
1	0+00			5.80		Top of Pin, Left
2	0+00			6.57		Ground @ Pin
3	0+01			6.58		
4	0+03			6.60		
5	0+04			6.60		
6	0+05			6.67		Top of Lower Point
7	0+06			6.74		
8	0+07			6.80		
9	0+08			7.08		
10	0+09			7.37		
11	0+10			7.54		
12	0+11			7.59		BKF
13	0+12			7.91		
14	0+13			8.04		
15	0+14			8.20		
16	0+15			8.29		
17	0+16			8.26		
18	0+17			8.32		
19	0+18			8.48		
20	0+19			8.65		Top of interbern
21	0+20			8.90		↳
22	0+21			9.40		L Bank Scarline
23	0+22			9.62		
24	0+23			9.76		
25	0+23.5			9.86		LEOW
26	0+24			9.94		
27	0+25			9.95		Log Retaining Structure
28	0+26			10.21		

SURVEY DATA ⟹ CROSS - SECTION 2

SITE: Date:

Item	STATION Ft	BS Ft	HI Ft	FS Ft	Elevation Ft	NOTES / COMMENT / REMARKS
29	0+27			10.19		
30	0+28			[illegible]		
31	0+29			[illegible]		
32	0+30			[illegible]		
33	0+31			11.50		TW
34	0+32			[illegible]		
35	0+31.5			10.12		Toe Pin - Top
36	0+31.5			11.56		Toe Pin - Ground
37						Turning Point
38						
39			8.16	Rec. Lazer		Toe Pin - Top
40			3.24	Rec. Lazer		Top of Pin Left Bank
41	0+32			4.89	11.45	
42	0+32.4			5.01	11.35	Dif Level 2.56
43	0+33			2.35	10.91	
44	0+33.5			3.32	9.88	EOW - Rt
45	0+34			3.14	6.5	Top of Bank
46	0+35			3.84	6.4	
47	0+36			3.19	6.35	
48	0+37			3.18	6.34	
49	0+38			3.80	6.36	
50	0+39			3.19	6.35	
51	0+40			3.78	6.34	
52	0+41			3.14	6.3	
53	0+42			3.73	6.29	
54	0+43			3.52	6.08	
55	0+44			3.68	6.24	
56	0+45			3.15	6.31	
57	0+46			3.18	6.34	
58	0+47			3.71	6.27	

UT Little Bennett Creek Team 3 9/21/2007

Pool #C Continued

Sn	FS	Notes
0+48	3.86	6.42
0+49	3.86	6.42
0+50	3.80	6.36
0+51	3.82	6.38
0+52	3.90	6.48
0+53	3.88	6.44
0+54	3.84	6.44 6.34
0+51.6	3.76	GS Bolt Pin
0+51.6	3.80	Top of RebarPin 5.62

UT Little Bennett Creek Team 3 9/21/2007

SURVEY DATA ⟹ LONGITUDINAL PROFILE 1

SITE: [illegible] Date:

Location: Glide 2nd Field [illegible]

Party / Notes: 201 2+01 on Long Pro

Item	Distance, Point, or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
1	0+00				5.31	
2	0+02				5.33	
3	0+04				5.30	
4	0+06				5.44	
5	0+07				5.67	
6	0+08				6.02	
7	0+09				6.92	BKF
8	0+10				7.79	
9	0+11.3				8.35	EOW
10	0+12				8.59	
11	0+14				8.69	
12	0+15				8.80	
13	0+16				8.93	THW
14	0+18				8.80	
15	0+19				8.75	
16	0+21				8.61	
17	0+23				8.32	
18	0+25				7.88	
19	0+26				7.74	
20	0+28				7.53	Toe slope
21	0+30				6.85	
22	0+31				6.61	
23	0+33				6.84	
24	0+34				6.55	
25	0+35				6.53	
26	0+37				6.76	
27	0+38				6.83	
28	0+39				7.09	

SURVEY DATA ⟹ LONGITUDINAL PROFILE 2

SITE: Date:

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
29	0+40				7.15	
30	0+41				6.70	
31	0+42				4.93	TLB
32	0+43				4.74	
33	0+45				4.67	
34	0+47				4.64	
35	0+49				4.65	
36						
37						
38						
39						
40	Water Depth from Long Pro					
41	203.5				.21	
42	197.5				.8	
43						
44	201				.46	
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						

UT Little Bennett Creek Team 3 9/21/2007

1.3↑W

• note: at STA 0+00 ... on left side ... no collar ...

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM Little Bennett Creek | DATE 9/21/2007

REACH 3 | CREW DREAM TEAM REACH 3

Molly, George, Sc...

(all measurements are in feet unless otherwise noted) *=flagged about ... Scour

STATION	TW	WS	#1 BKF	ΔWS/BF	LOW/TOB	Other	Other	COMMENT
0.0	7.51	7.45	6.14 (5.62)	1.31 1.83	5.62 5.26	6.48		R, start
13.0	7.21	7.55				7.09		MOR
15.0	7.26	7.95						MOR
17.5	7.55	8.31	6.97 (6.23)	2.22 (2.08)	4.62		LEFT 3.76 7.3	X/S R bottom run
11			6.50	1.81				
25.0	6.81	7.38	6.53 (6.23)		6.23			P, start
27.0	7.09					7.22		MOP
32.0	7.34							MOP (deepest)
40.0	7.25	7.[illegible]				7.05		MOP compound
47.0	[illegible]	7.41	6.05 (6.51)	2.26 (2.[illegible])	5.62			P max
55	7.[illegible]	7.[illegible]						MOP [illegible]
	10.[illegible]							
71.0	10.35					-0.		
72.0	11.29							MOP
73.0	11.15							P max
79.0	10.57	7.[illegible]	2.5	1.93	6.07	7.0*		MOP
83.5	9.72							MOP
91.0	9.5	7.41?						Glide, start
93.5	9.[illegible]							
101.5	8.62	7.41	6.81 / 6.21	1.60 / 2.0	6.21			R, start
122.0	8.99							MOR
145.0	9.50	9.52						U, start
152.0	9.62	9.49?		irregular	inner bar			
156.0	10.16	9.54	7.28 / 8.03	2.26 / 1.5				P, start
163.0	10.33							MOP
172.0	10.58							MOP
183.0	10.51					8.45		MOP
192.5	12.03	9.57	7.53		7.53			P max
193.0	11.67							MOP
197.5	10.34	9.54	HIGH BANK	LOW BANK				G, start
203.5	9.75	9.54	6.68 (7.76)	1.79				R, start
206.0	9.82							MOR
206.0	8.78	8.65						U, start bottom riffle
211.0	9.90						5.82	X/S P bottom RUN
								FS = 5.82 X/S P
								BS = 4.58 X/S P
215.5	10.69							MOP
217.0	10.53	7.[illegible]	6.34 / 6.78	2.27 / 1.93				MOP [illegible]
218.0	10.72				6.84	7.35		MOP
224.0	10.40	8.78	7.[illegible]					MOP

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
T[illegible] Bank	[illegible]
Slope Break	[illegible] BF
Scour Line	SL
Inflection Point	IP
Veg Line	VL
[illegible]	[illegible]
[illegible]	[illegible]

D= [illegible]

R = [illegible]

Dar Sample ... Dup ...

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM	DATE
REACH	CREW

(all measurements are in feet unless otherwise noted)

STATION	TW	WS	BKF	WS/BF	LOW TOB	Other	Other	COMMENT
230.5	9.57							
240.5	9.19	8.65	6.61 *		6.61			G, START
247.0	8.80	8.70						R, START
250.5	9.26	8.75						

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

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-27. Bank profile and bank erosion summary data form.

BANK PROFILE WORKSHEET

Stream:	Observers: Team #3
Location:	Date: 9/21/07
Cross-section: Riffle	BEHI adjective:
Bank: RB	NBS adjective:
Toe pin station (ft):	Predicted erosion (ft):
Toe pin elevation (ft):	Measured erosion (ft):

Date: 0

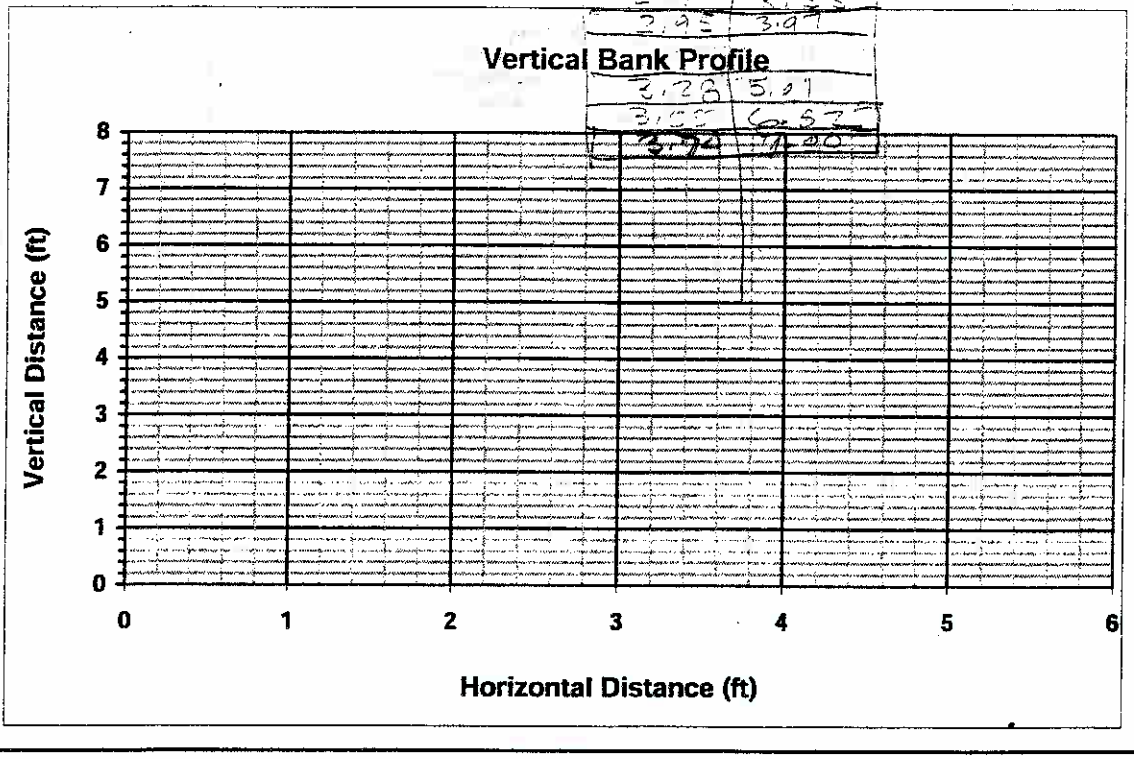
Horizontal	Vertical	Notes
0.48		Pin #1 (lowest)
0.42		Pin #2
0.0		Pin #3
0.0	0.0	TP
0.0	-0.51	bed
0.49	-0.7	[illegible]
1.13	-0.62	[illegible]
[illegible]	-0.5	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	Pin # [illegible]
1.39	0.12	PIN #1 @ Bank
1.16	0.32	
1.12	0.55	

exposed pin

Date:

Horizontal	Vertical	Notes
1.18	0.66	
1.28	0.89	
1.32	1.05	
0.91	1.11	Pin #2 Tip
1.3	1.11	bankPIN
[illegible]	[illegible]	scour line
[illegible]	1.3	
[illegible]	1.45	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
2.09	1.89	BKF
2.2	2.04	Pin #3
2.36	2.27	TOB (OLD)
[illegible]	2.49	NEW TOB
[illegible]	[illegible]	
2.95	3.97	
3.28	5.01	
[illegible]	6.52	
3.94	7.00	

45.7
99.43



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