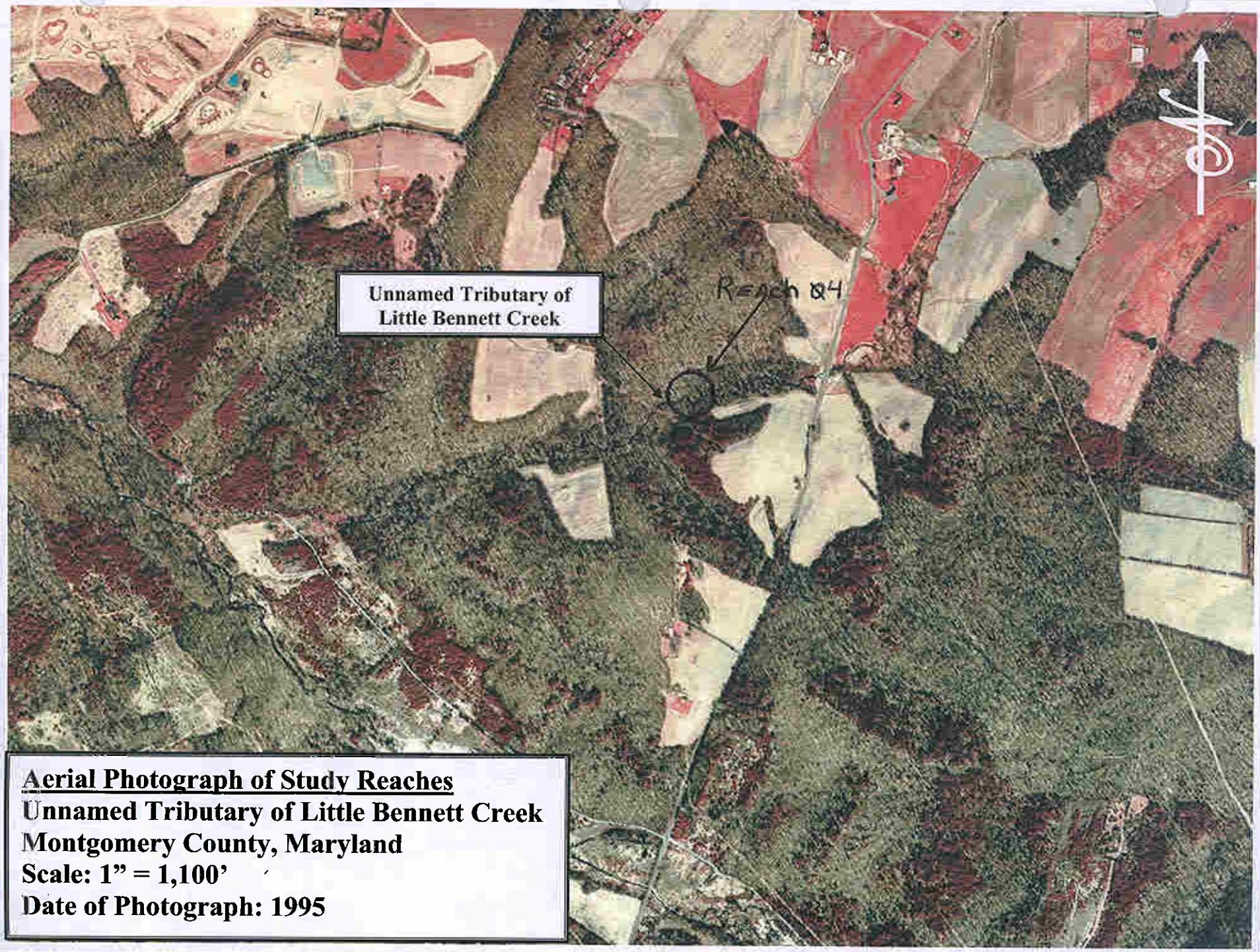
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

Team 4
Day 2
UT Little Bennett
Degraded Reach

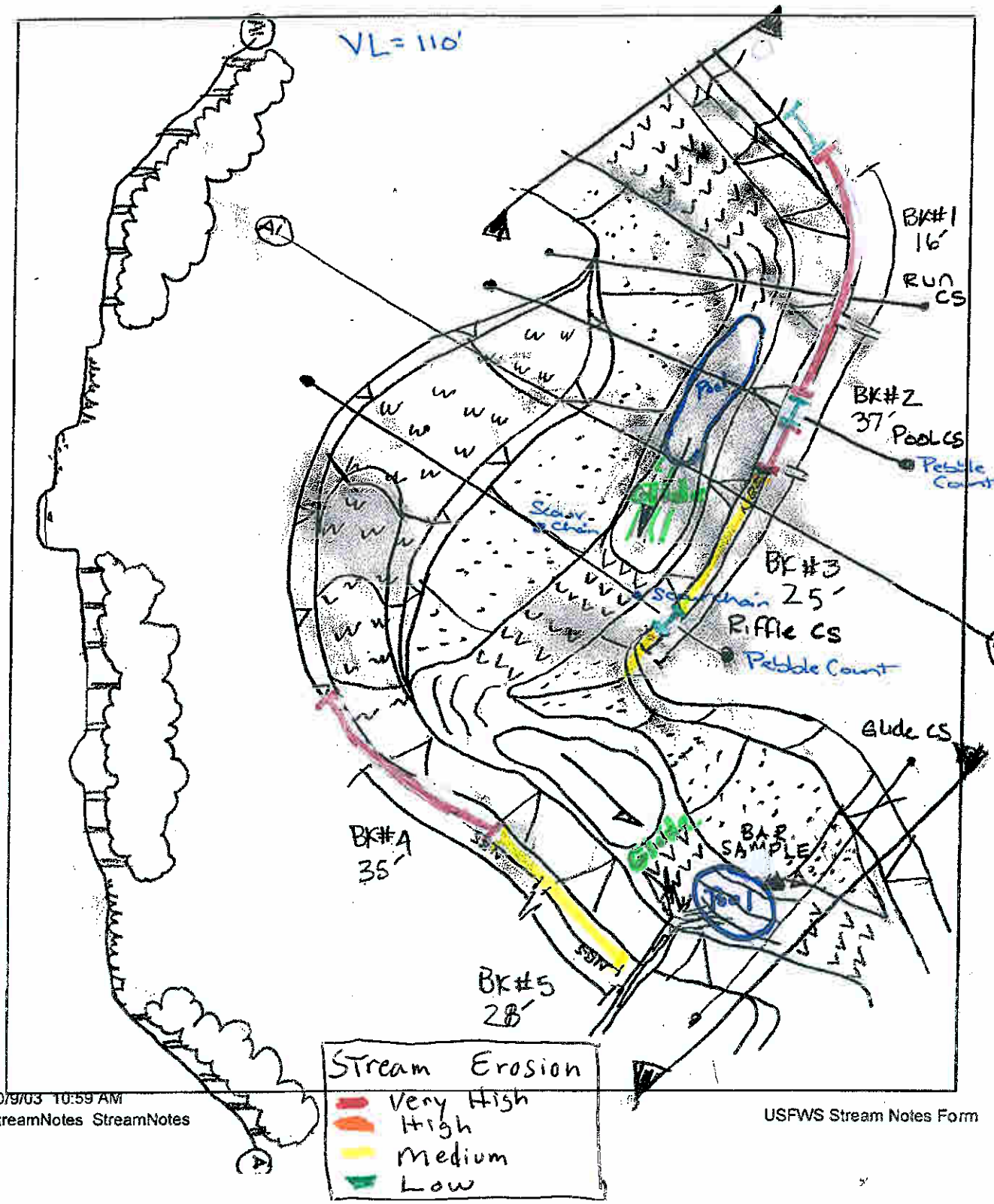


Aerial Photograph of Study Reaches
Unnamed Tributary of Little Bennett Creek
Montgomery County, Maryland
Scale: 1" = 1,100'
Date of Photograph: 1995

FWS-SHARP

Notes

Stream: VT LITTLE BENNETT	Page 1 of 1
Reach 4	Date: 9/21/07
	Crew: RRS

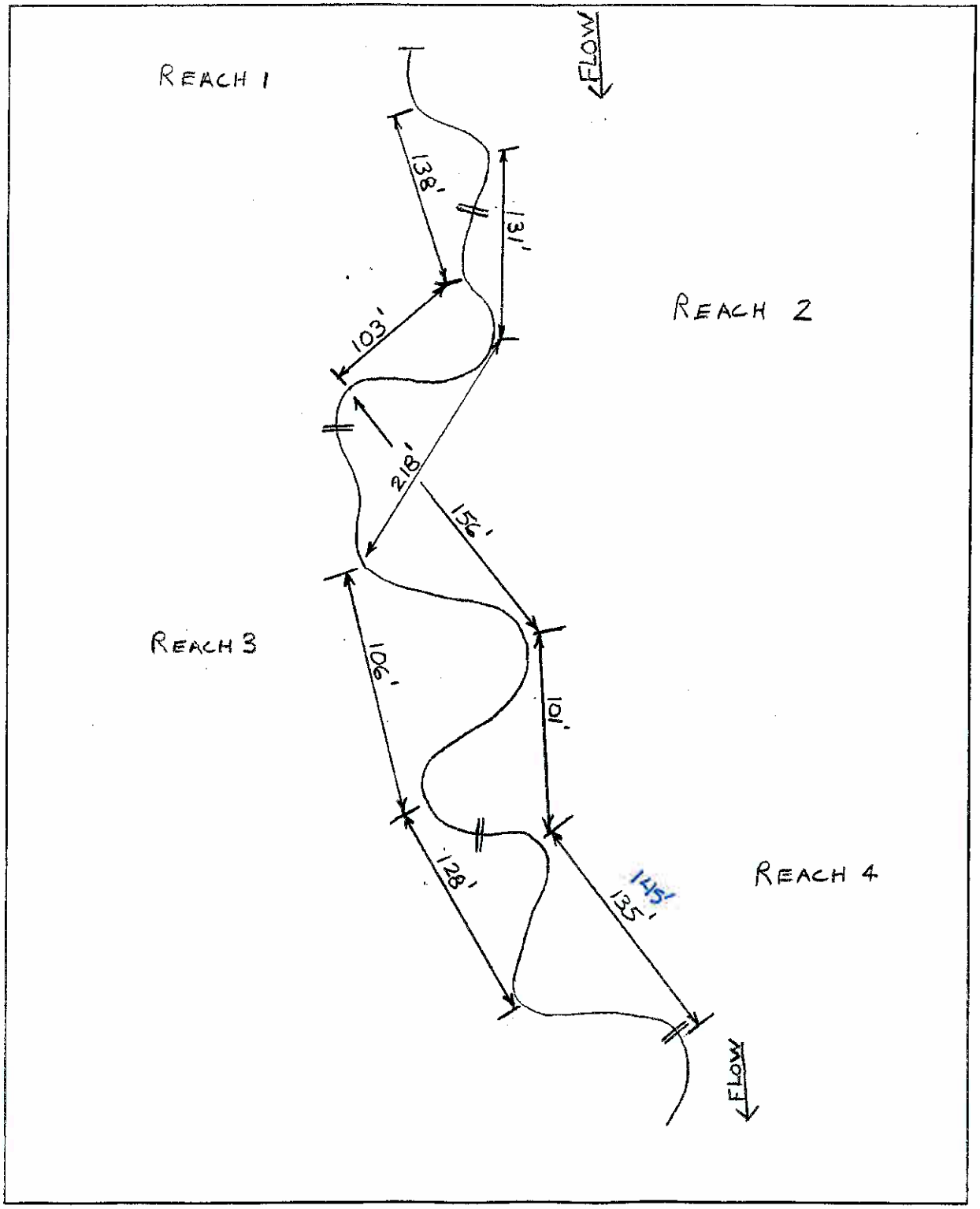


0
38
42
68
74
96
98
123
125
139
144
147
149
160
168

FWS-SHARP

Notes

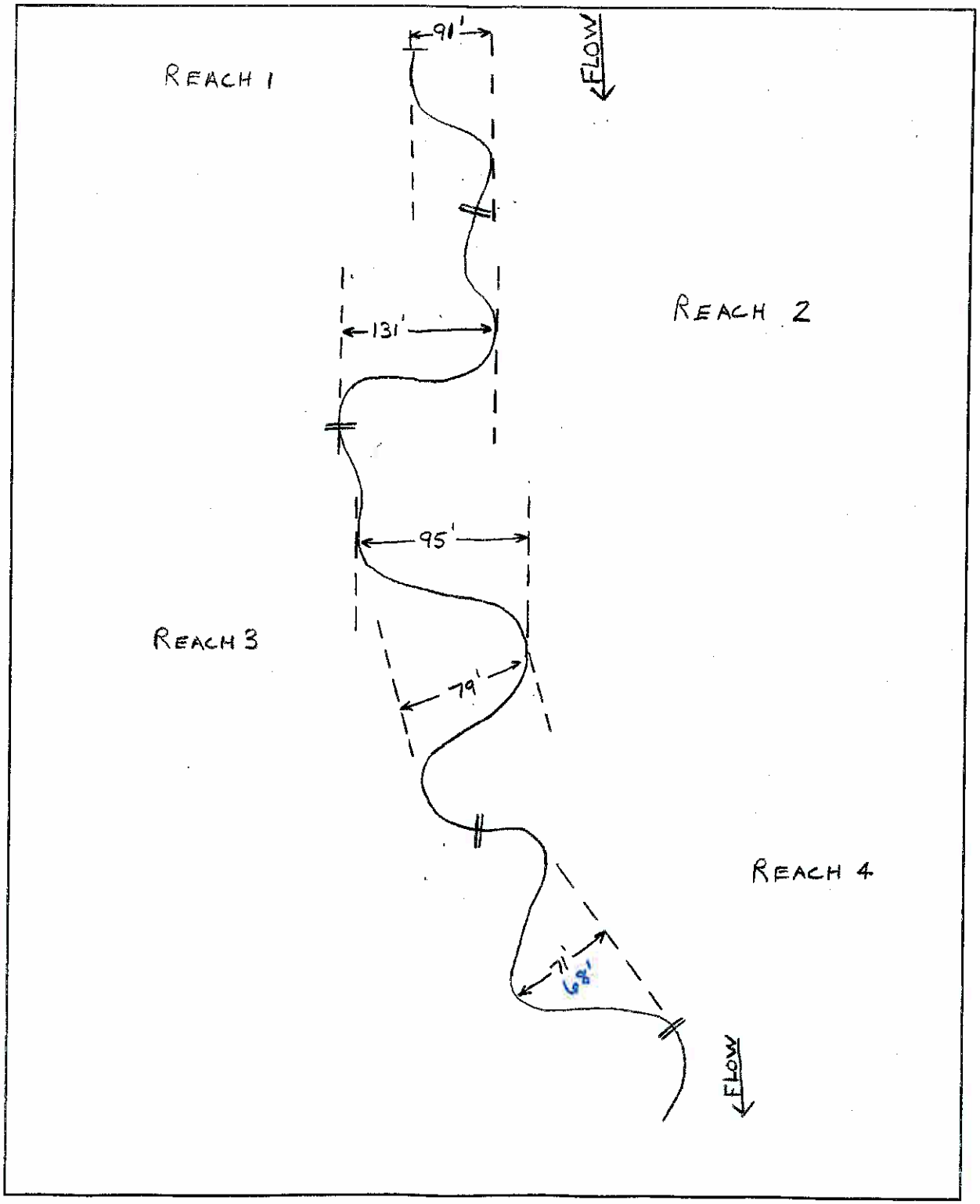
Stream: UT Little Bennett	**Page** 2 **of** 3
Reach: Geometry Map	**Date:** 12/20/06 9/21/07
Meander Wavelength	**Crew:** SHARP Team 4



FWS-SHARP

Notes

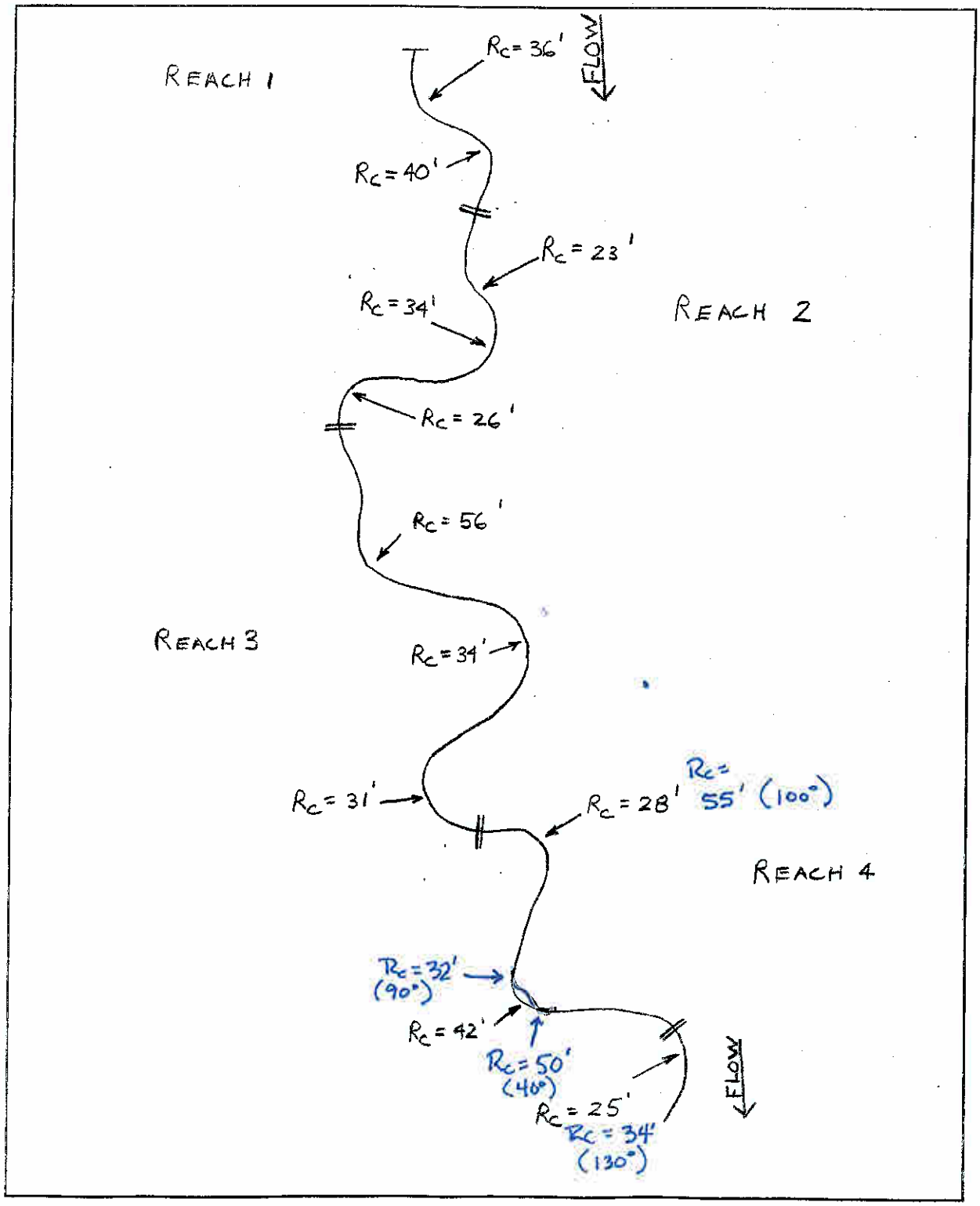
Stream: UT Little Bennett	Page 3 of 3
Reach: Geometry Map	Date: 12/20/06 9/21/07
Belt Width	Crew: SHARP Team 4



FWS-SHARP

Notes

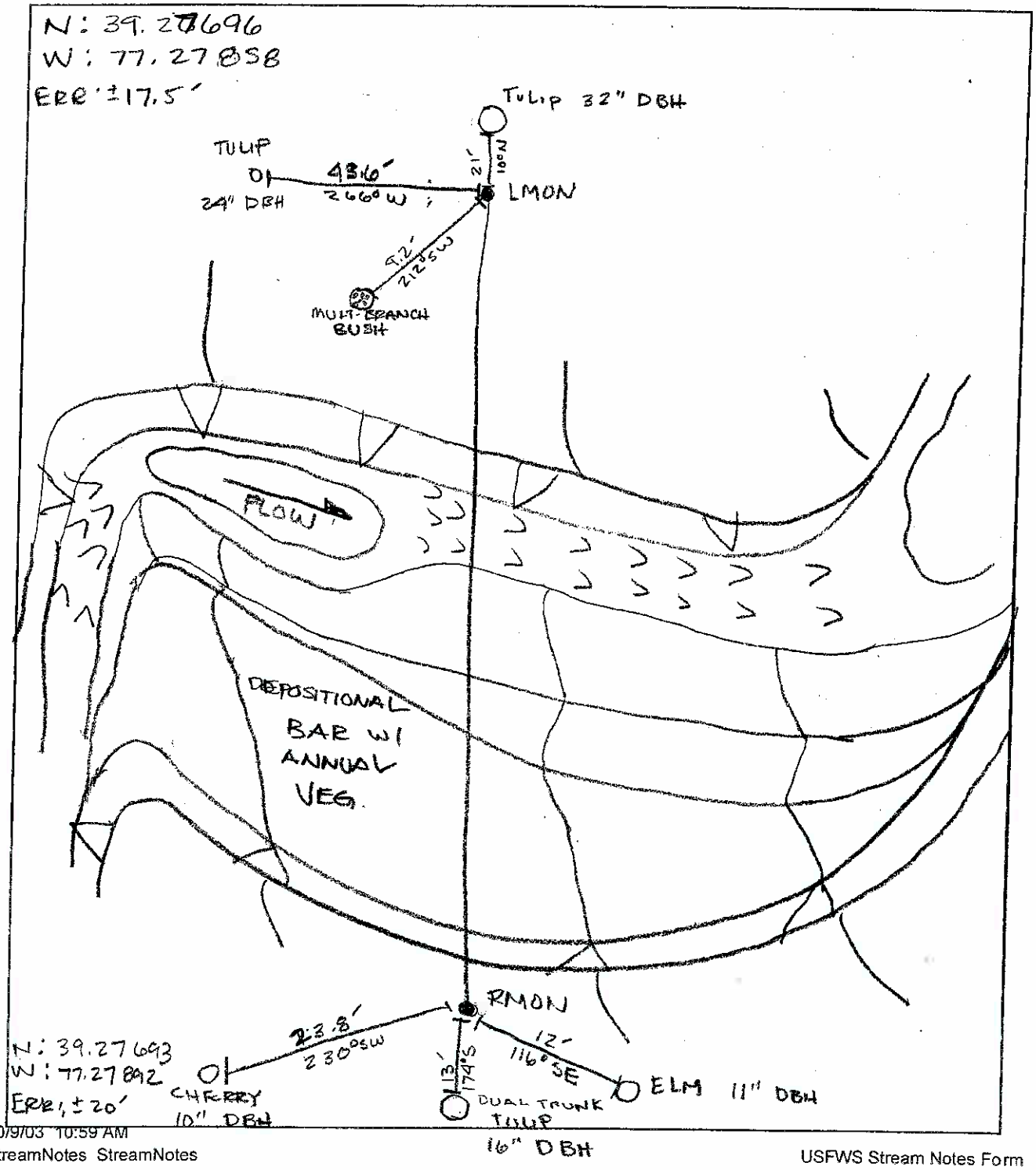
Stream: UT Little Bennett	Page 1 of 3
Reach: Geometry Map	Date: 12/20/06 9/21/07
Radius of Curvature	Crew: SHARP Team4



FWS-SHARP

Notes

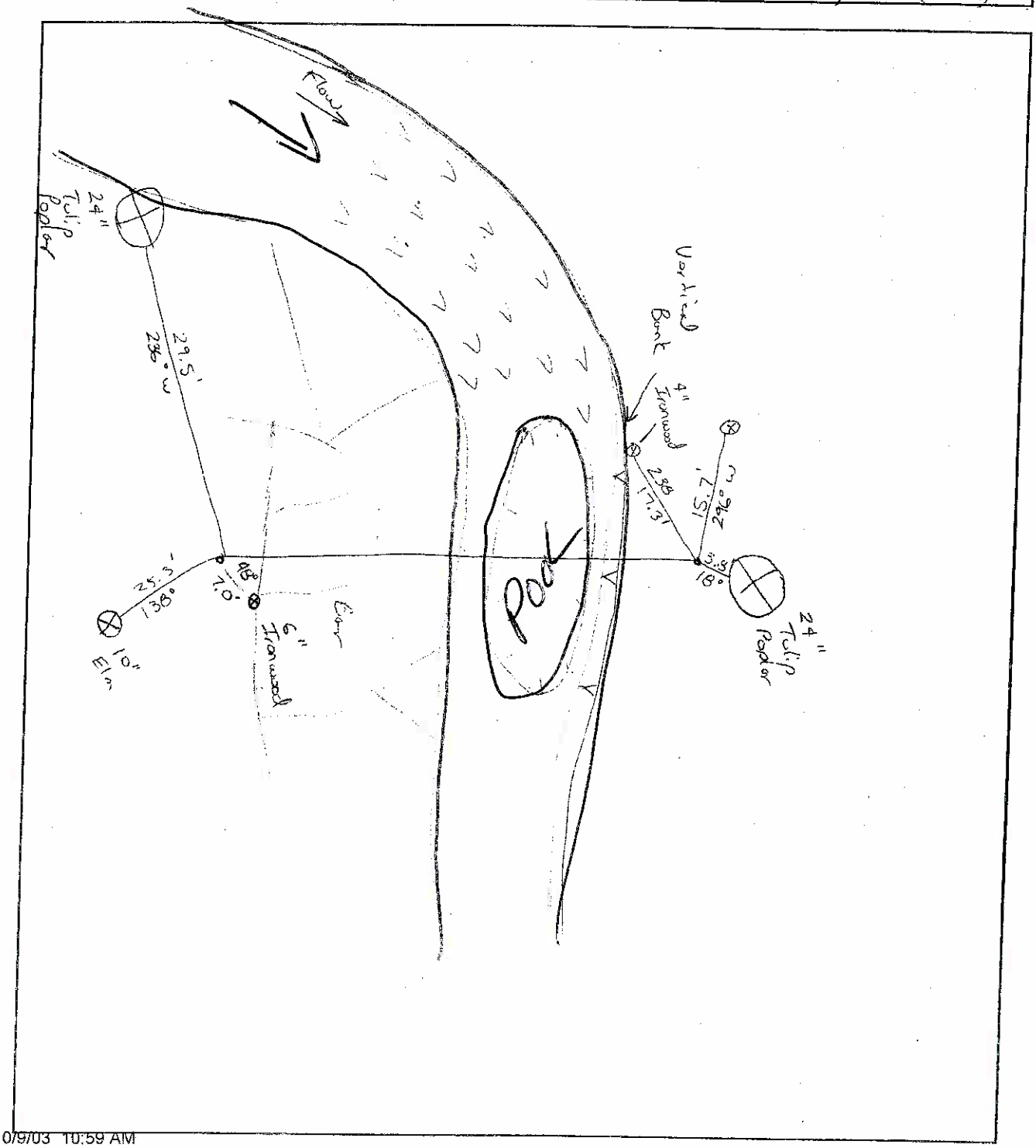
Stream: UT LITTLE BENNETT CREEK	Page of
Reach TEAM 4 Riffle CS	Date: 9/21/07
	Crew: SD RS



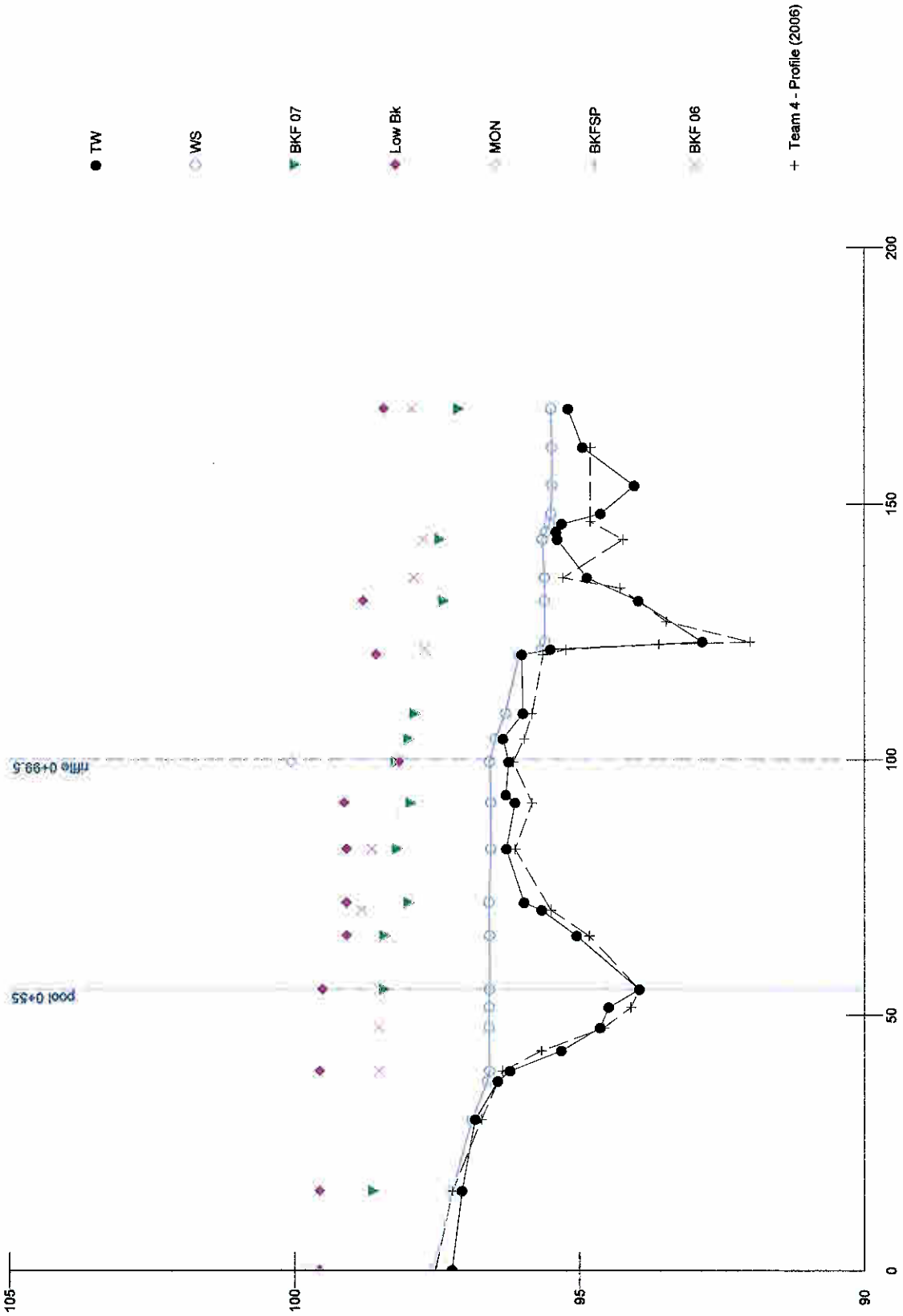
FWS-SHARP

Notes

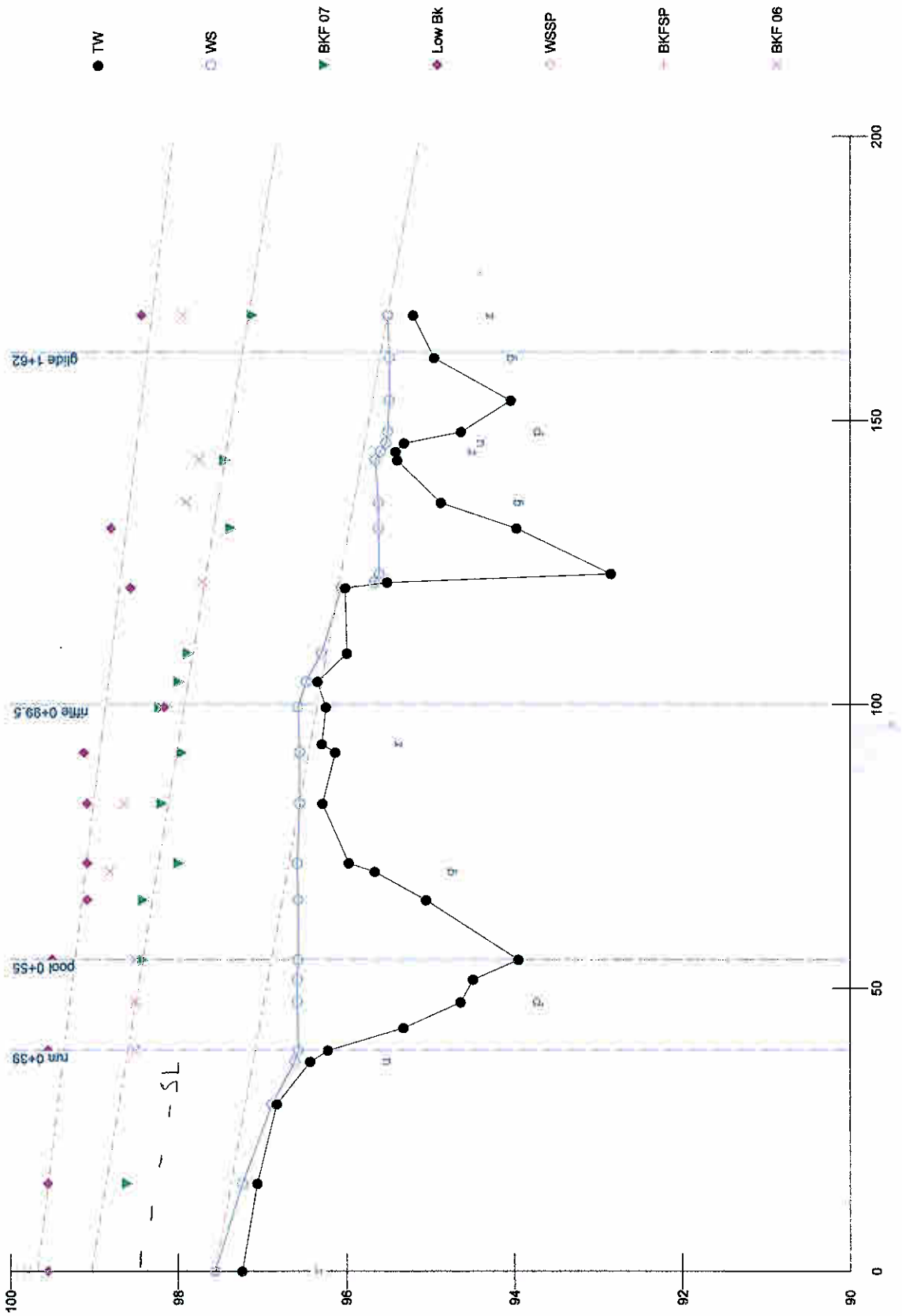
Stream: UT Little Bennett - Level III	**Page** 1 **of** 1
Reach Reach 4 Pool XS	**Date:** ~~[illegible]~~ 9/21/07
	Crew: MAB, DL (NCR)

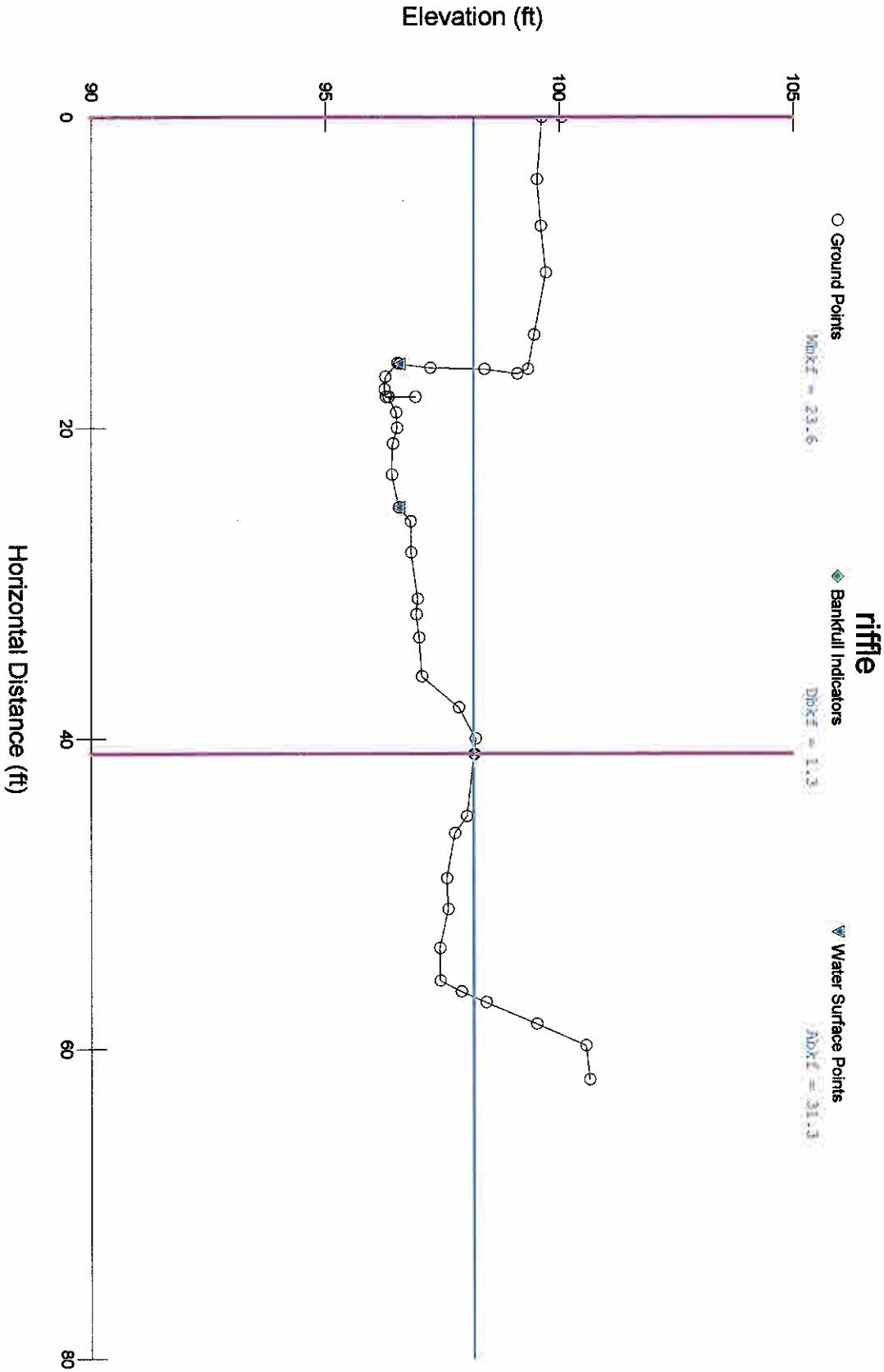


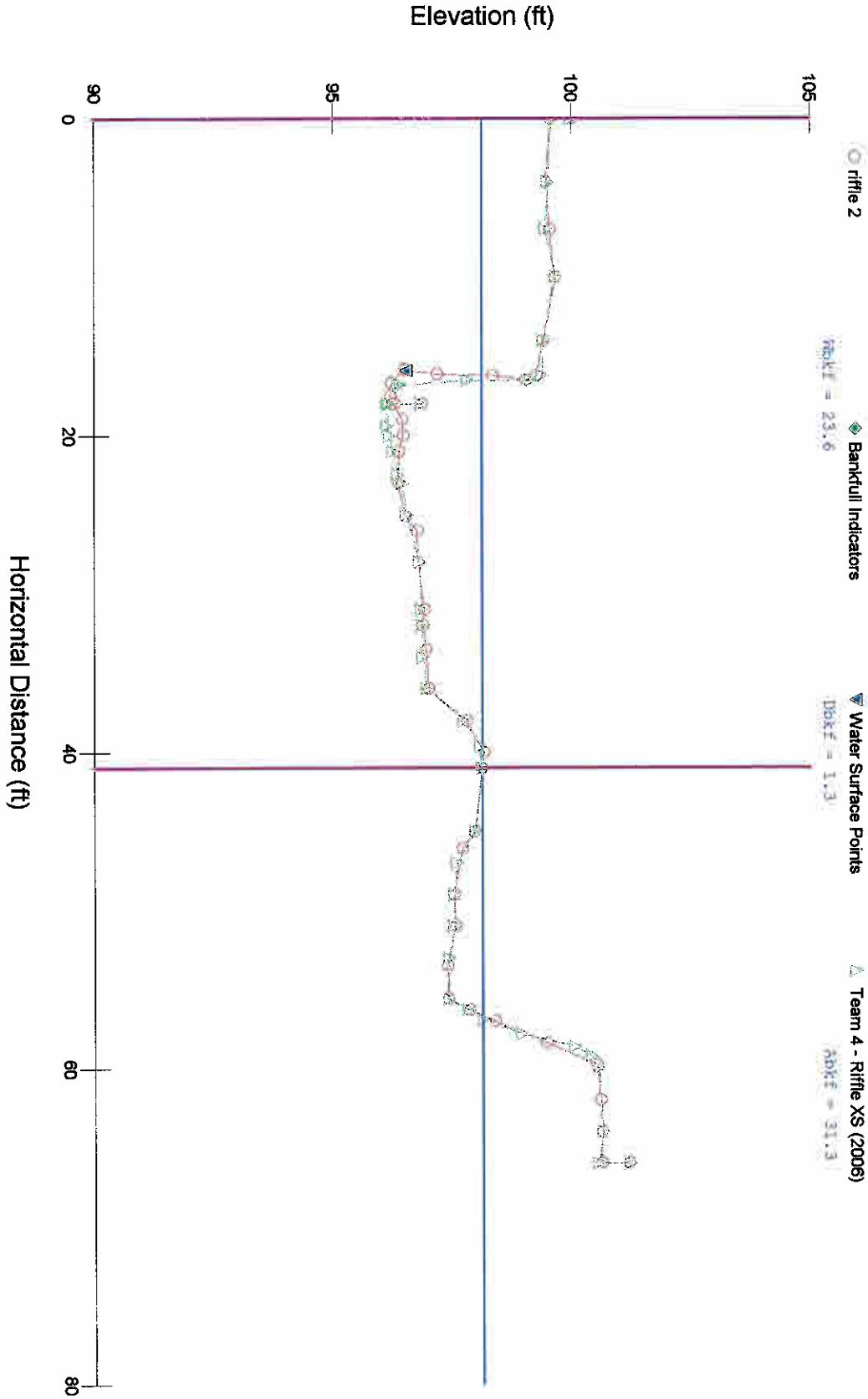
UT Little Bennett Creek Team 4 9/21/2007

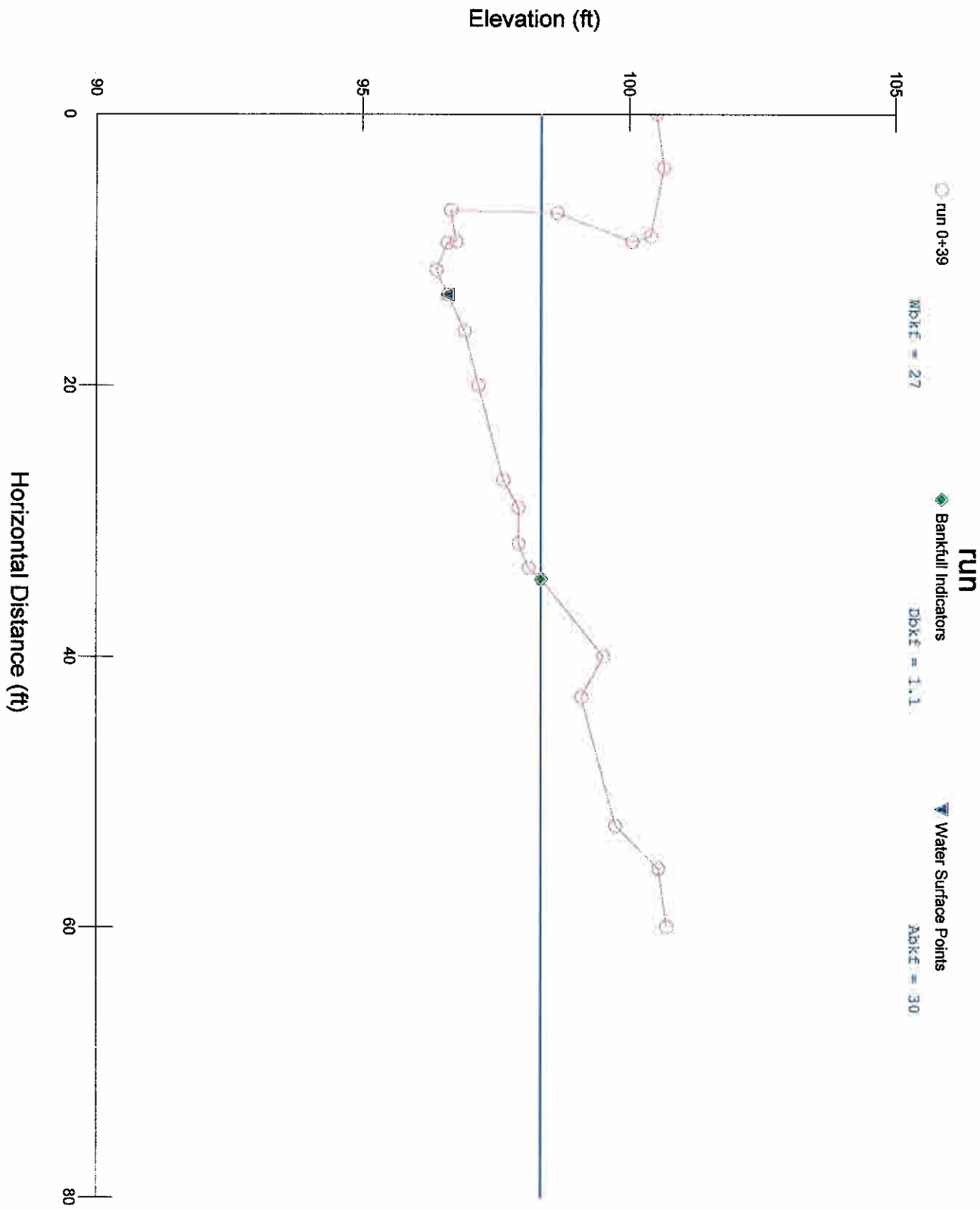


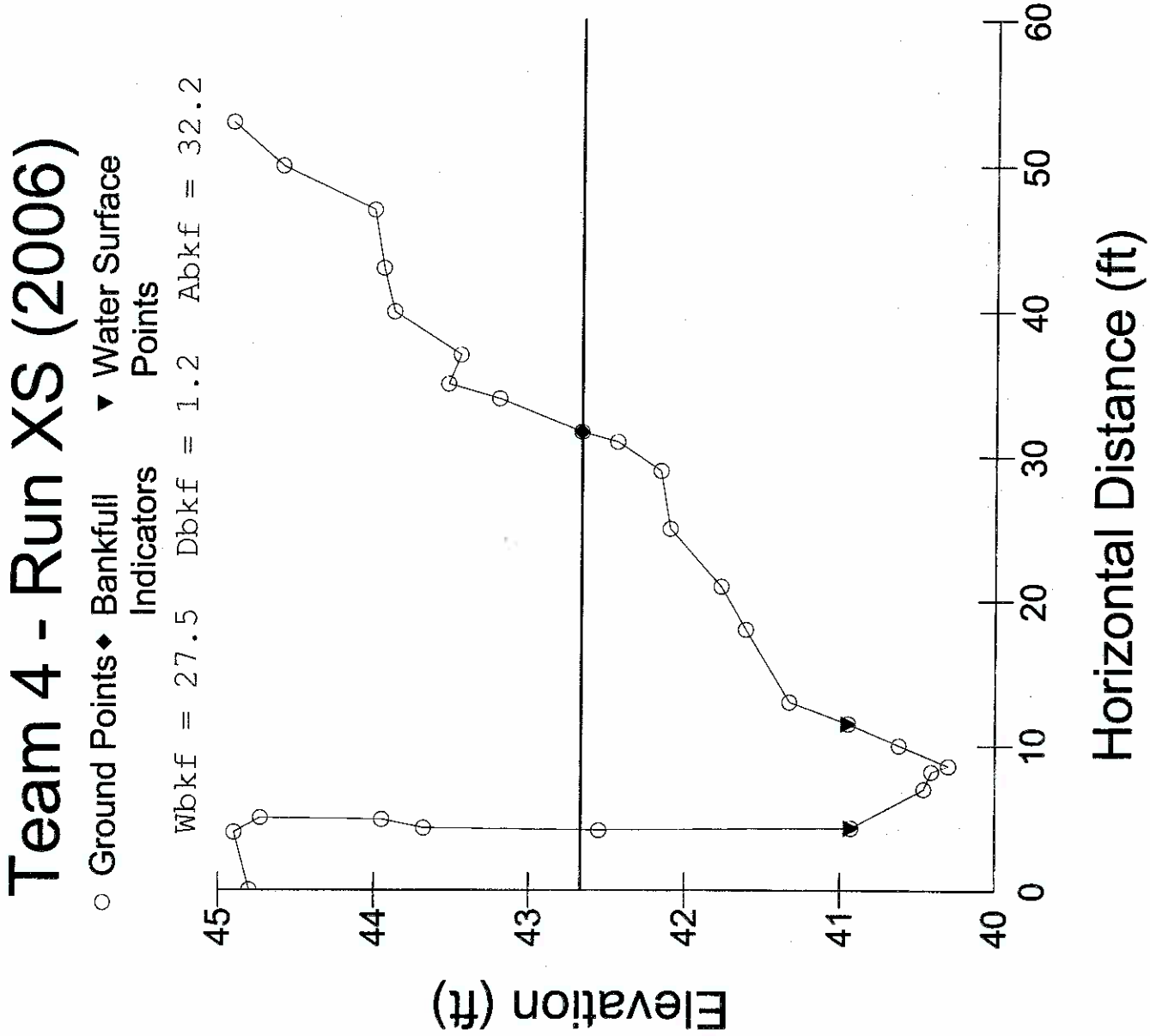
UT Little Bennett Creek Team 4 9/21/2007



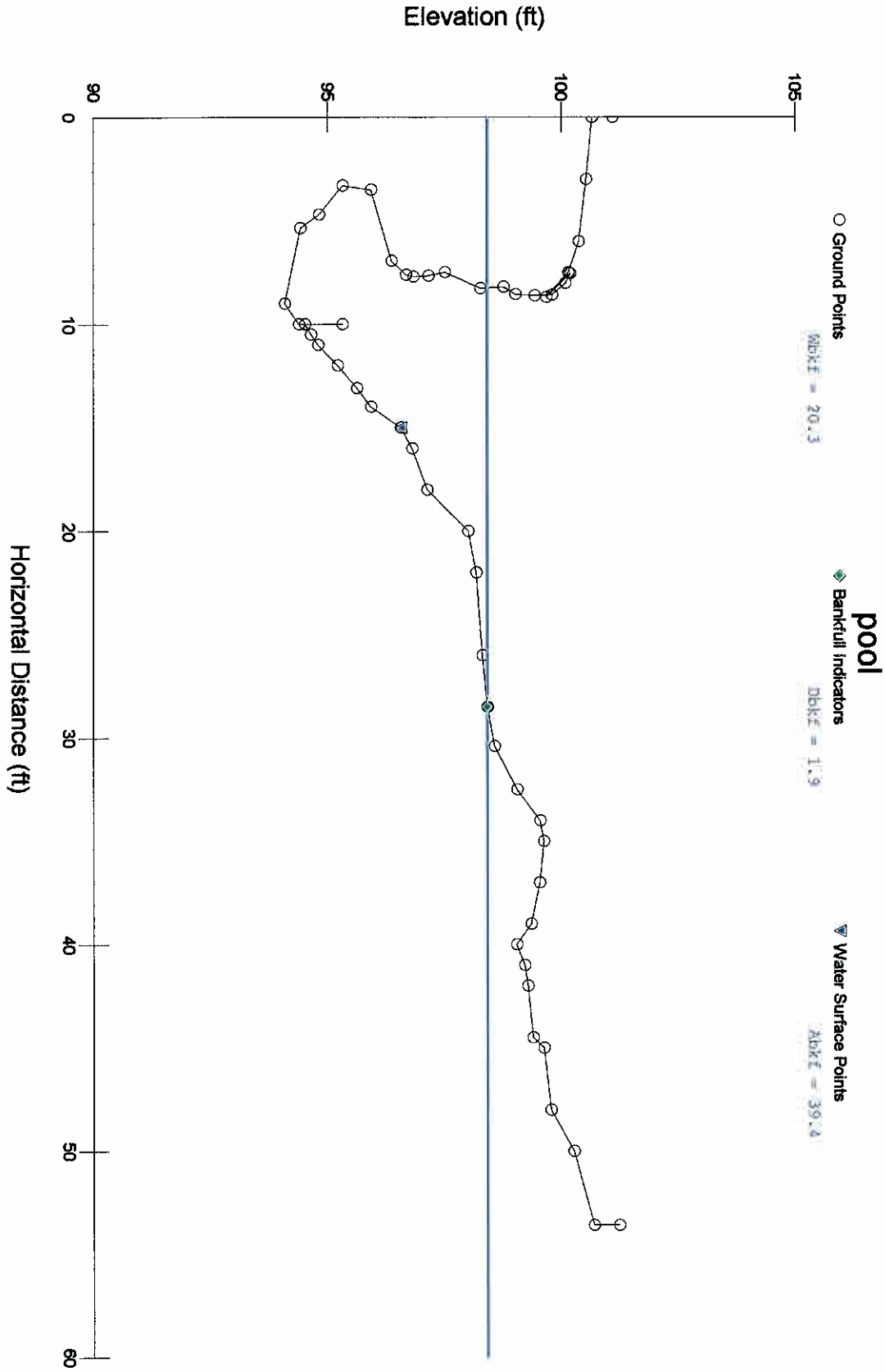

riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 23.6
Dbkf = 1.3
Abkf = 31.3
Elevation (ft)
105
100
95
90
0
20
40
60
80
Horizontal Distance (ft)


riffle
riffle 2
Bankfull Indicators
Water Surface Points
Team 4 - Riffle XS (2006)
Wbkf = 23.6
Dbkf = 1.3
Abkf = 31.3
Elevation (ft)
105
100
95
90
0
20
40
60
80
Horizontal Distance (ft)

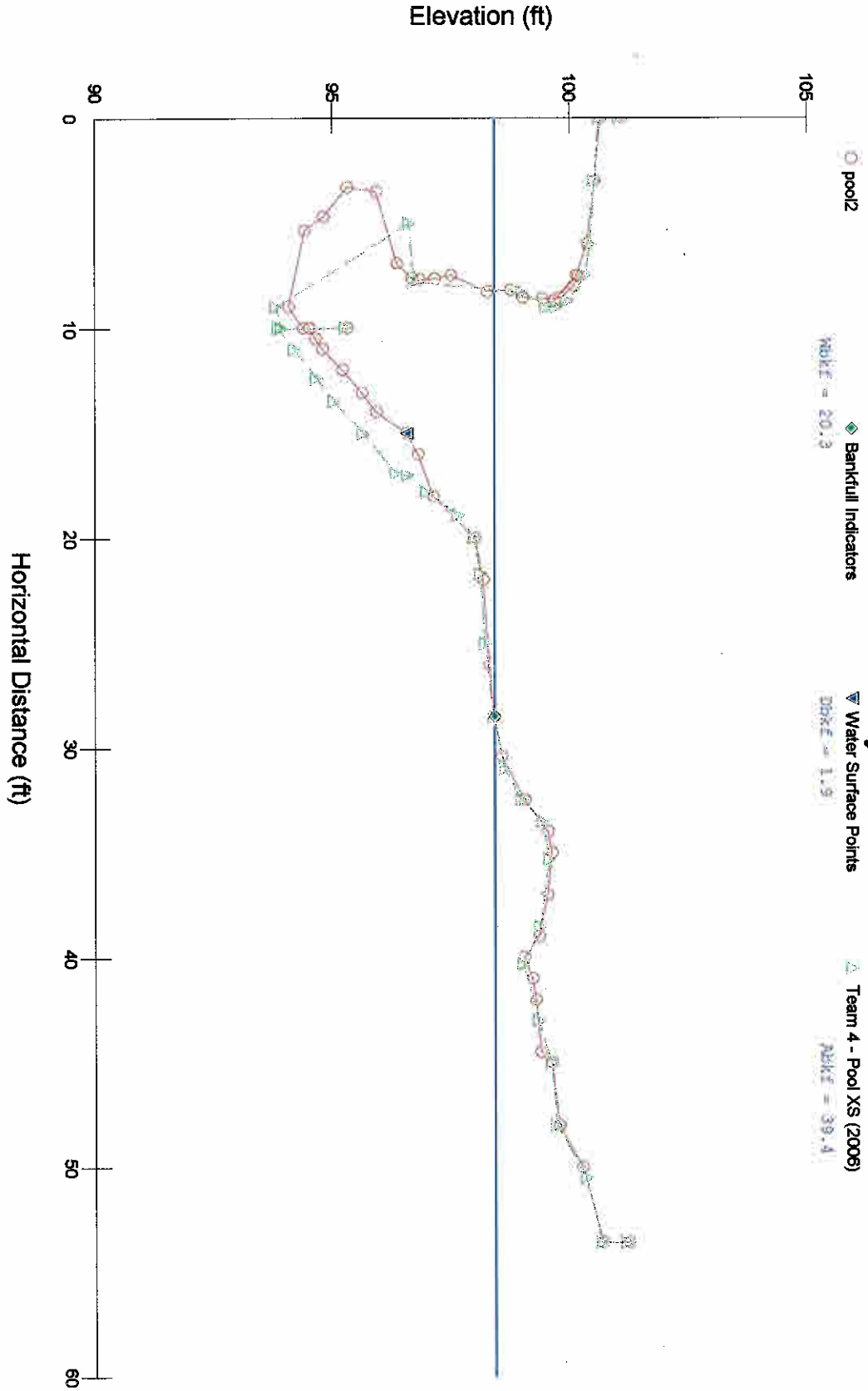

run
run 0+39
Bankfull Indicators
Water Surface Points
WBkf = 27
DBkf = 1.1
ABkf = 30
Elevation (ft)
105
100
95
90
0
20
40
60
80
Horizontal Distance (ft)

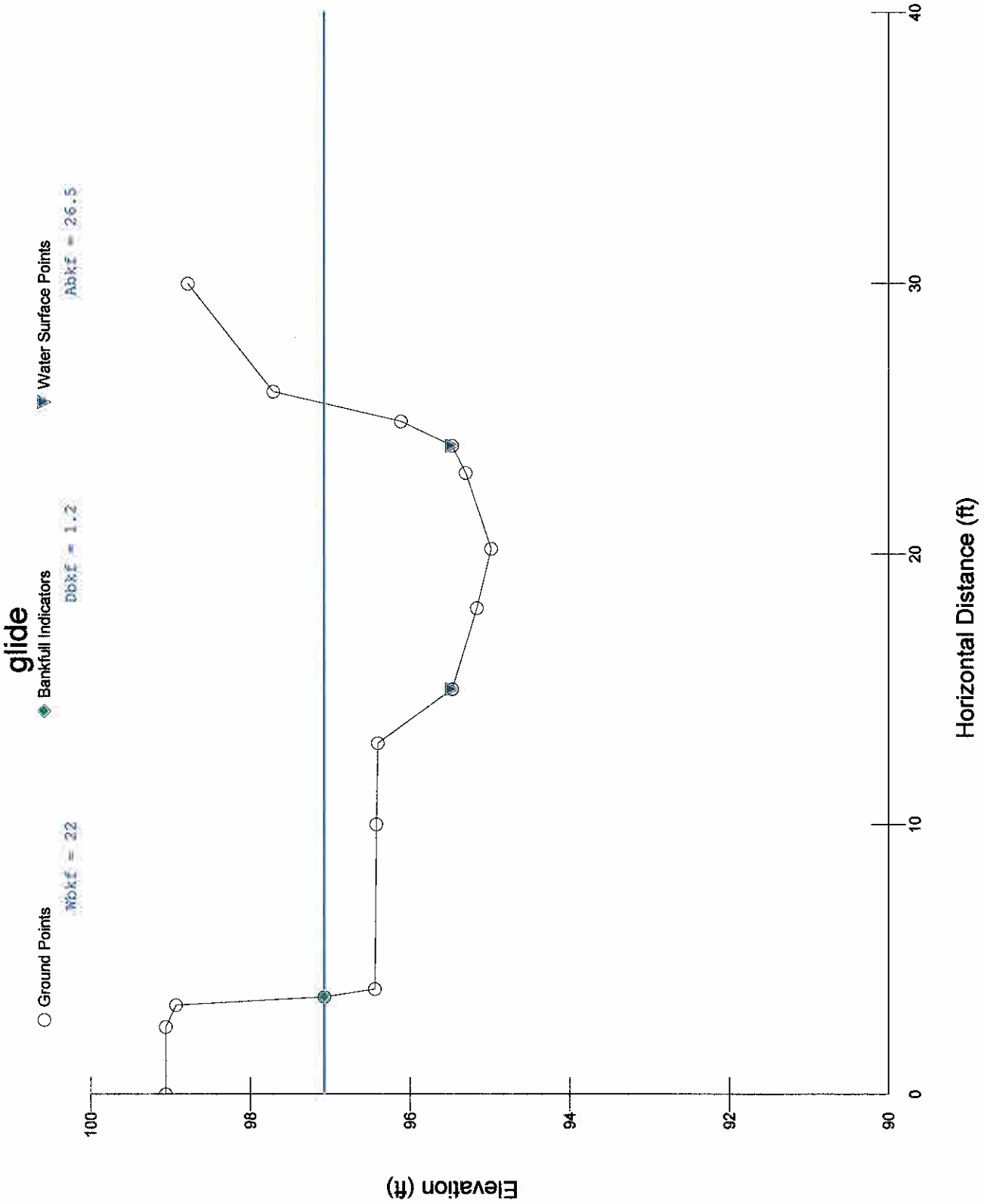

Team 4 - Run XS (2006)
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 27.5 Dbkf = 1.2 Abkf = 32.2
Elevation (ft)
45
44
43
42
41
40
0
10
20
30
40
50
60
Horizontal Distance (ft)

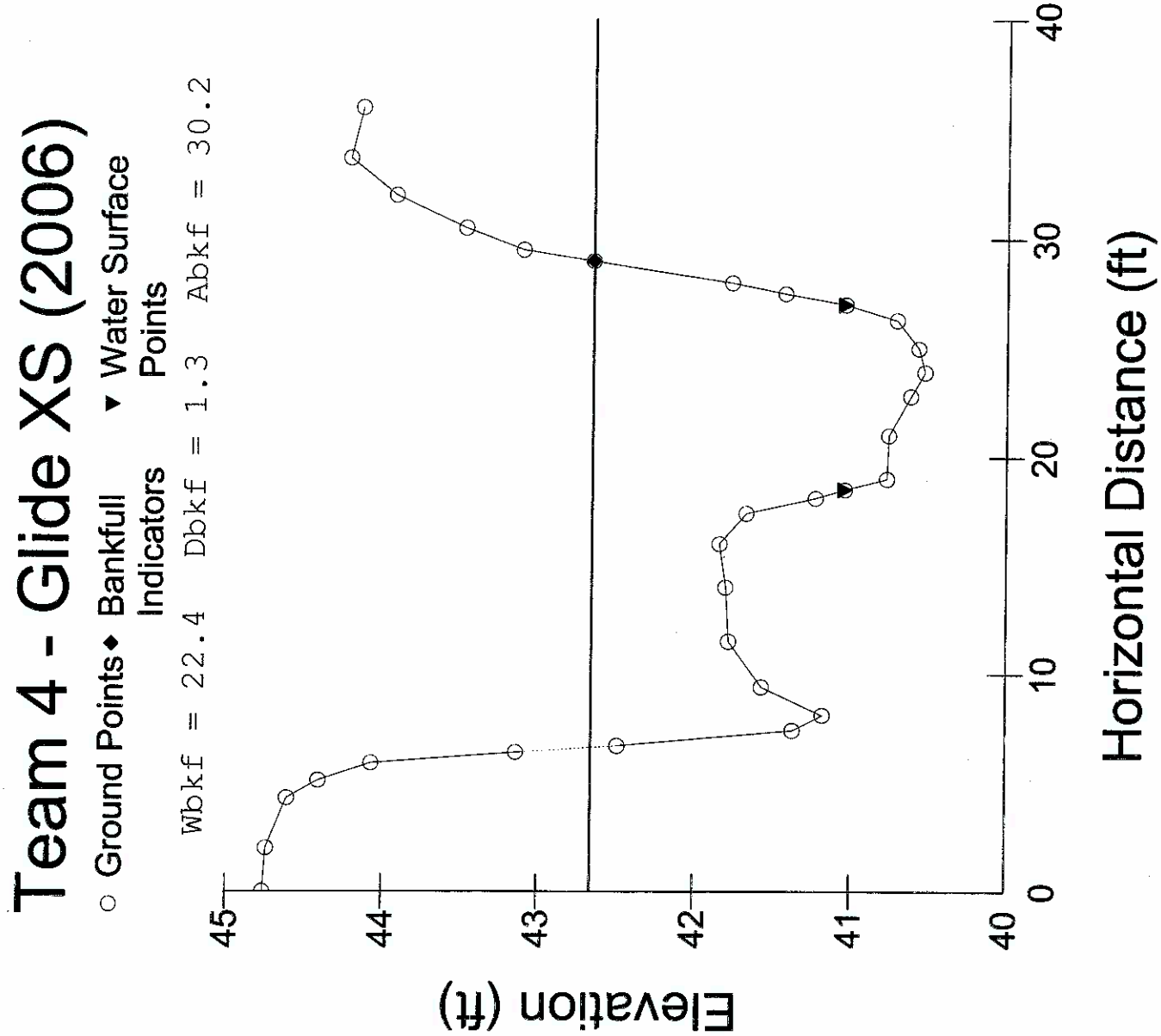
UT Little Bennett Creek Team 4 9/21/2007



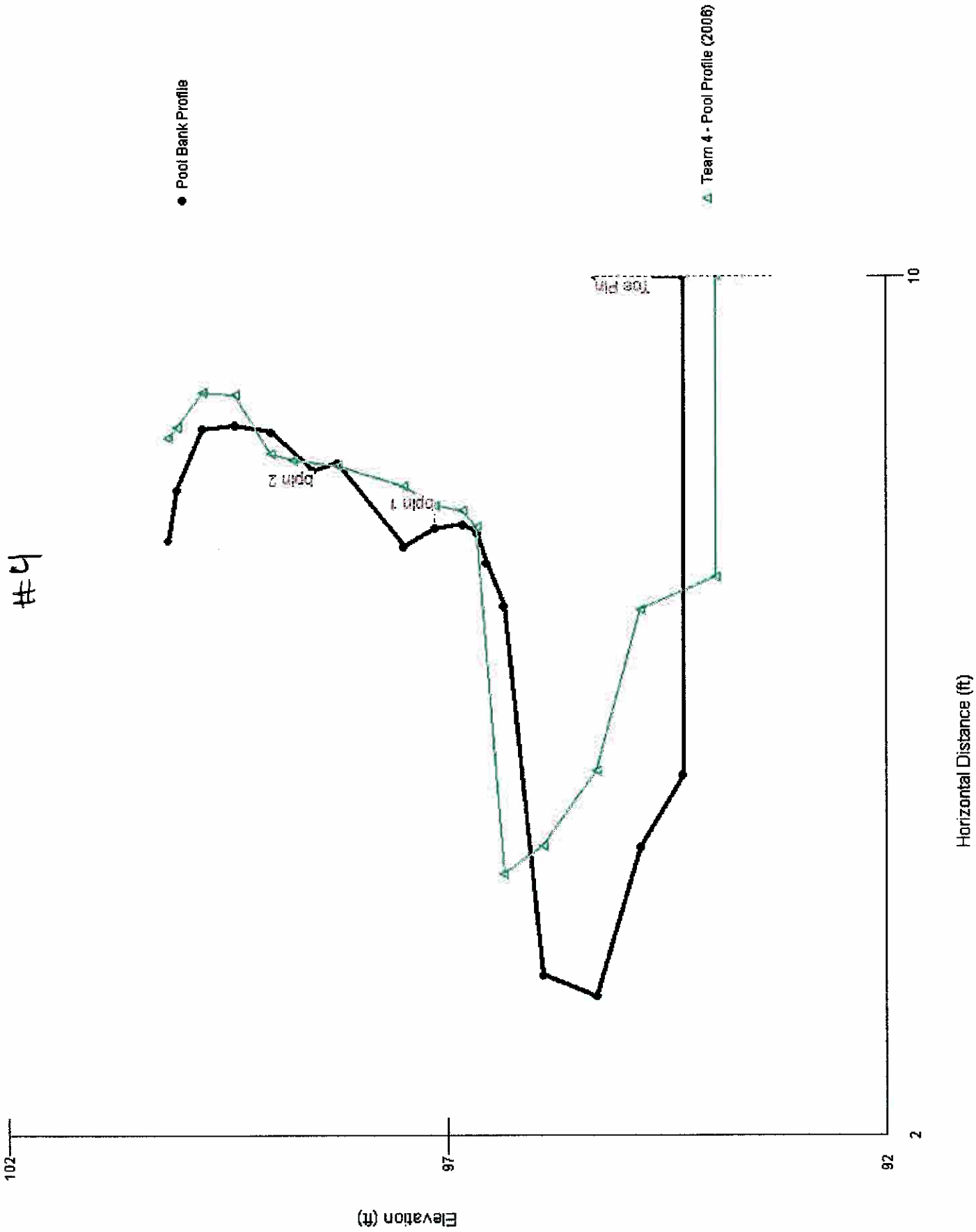
UT Little Bennett Creek Team 4 9/21/2007




glide
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22
Dbkf = 1.2
Abkf = 26.5
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)


Team 4 - Glide XS (2006)
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22.4 Dbkf = 1.3 Abkf = 30.2
Elevation (ft)
45
44
43
42
41
40
0
10
20
30
40
Horizontal Distance (ft)

Pool Bank Profile
#4



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:
Location:	Date:
Cross-section:	BEHI adjective:
Bank: Pool X-S	NBS adjective:
Toe pin station (ft):	Predicted erosion (ft):
Toe pin elevation (ft):	Measured erosion (ft):

Overlay #2
Area = 17.03
Height = 4.87
Angle = 21.14
ΔArea = 1.98
Erosion = .4066 ft

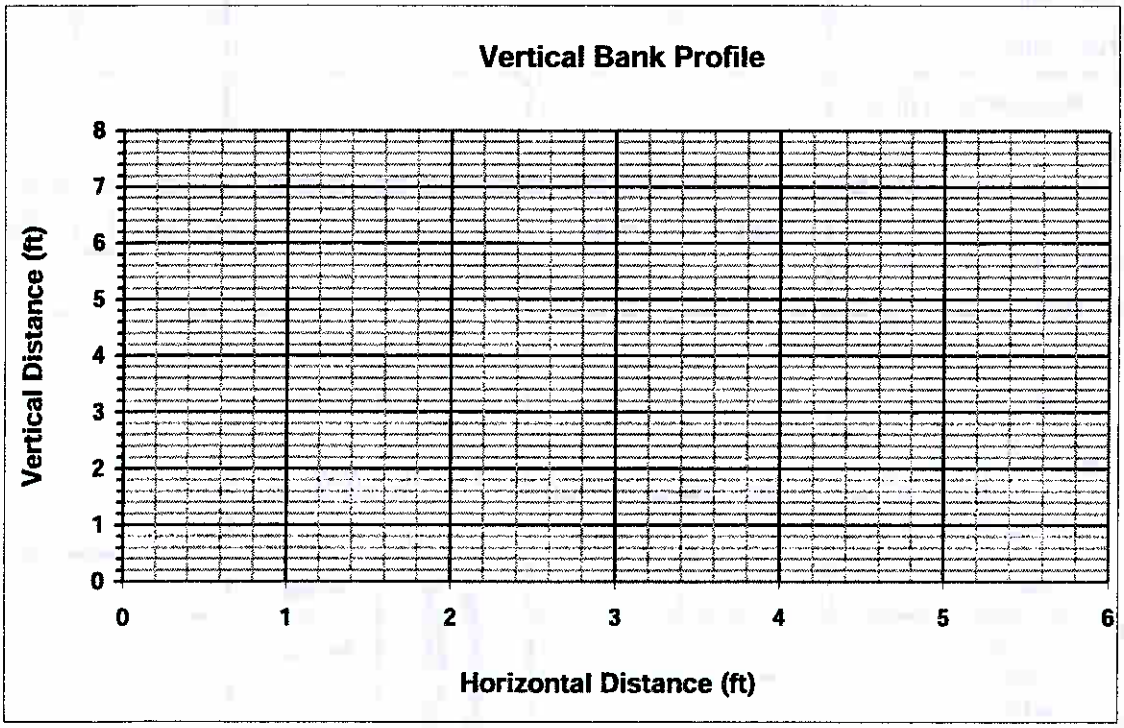
Date:

Horizontal	Vertical	Notes
0	0	
0	-0.98	GTpin
4.64	-0.98	
5.31	-0.5	undercut
6.7	0	
6.5	0.61	
3.06	1.05	
2.38	1.36	
2.30	1.52	BKF
2.34	1.84	BPIN 1
2.51	2.19	
1.73	2.95	
1.8	3.45	BPIN 2*
1.44	3.7	
1.38	4.11	

Date:

Horizontal	Vertical	Notes
1.41	4.48	
1.98	4.77	TOB
2.45	4.87	GS

Location
*BPIN2 3.22



WS V 1.25 H 2.66

EXPOSED
BPIN1 0.32
BPIN2 0.01

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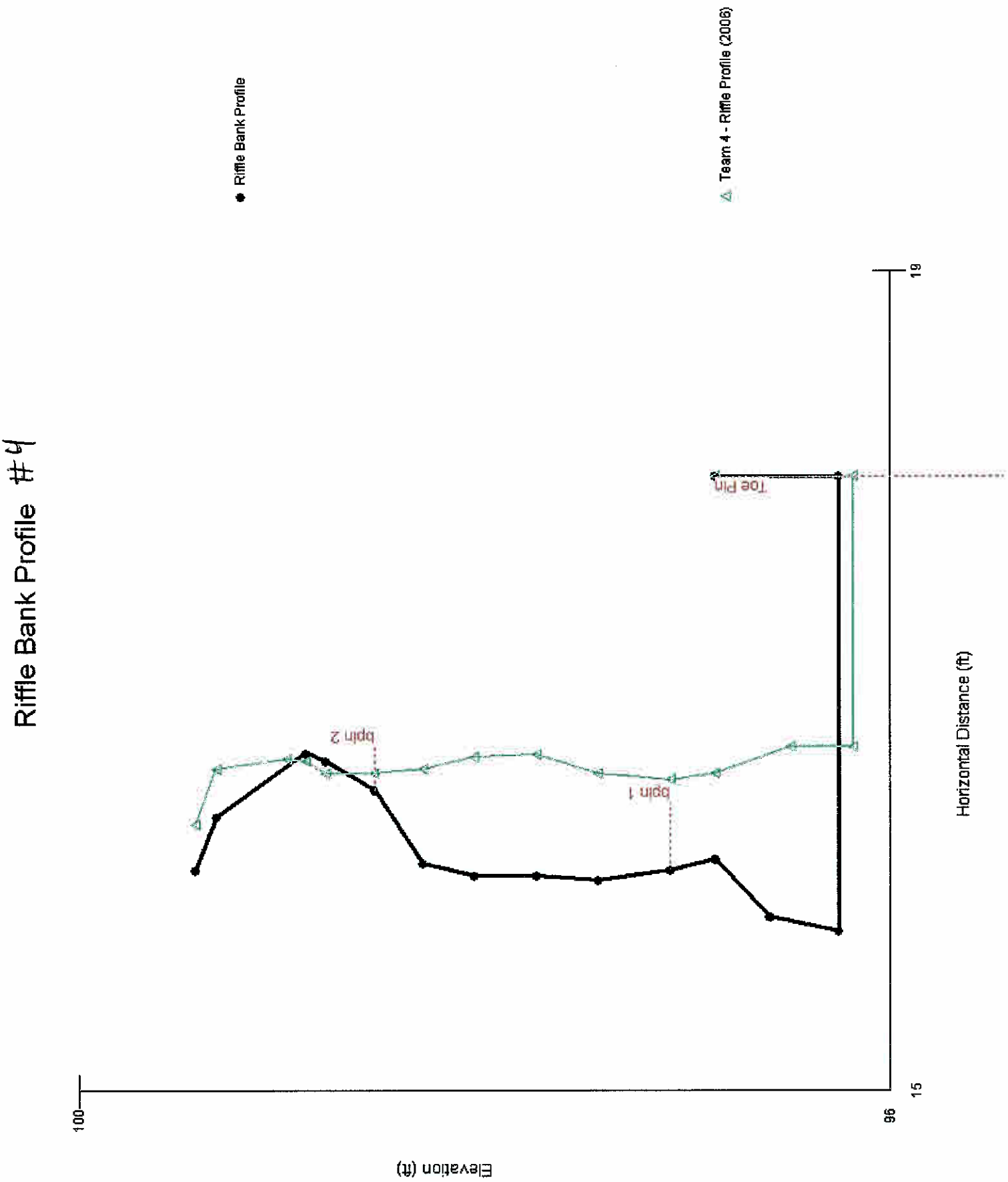
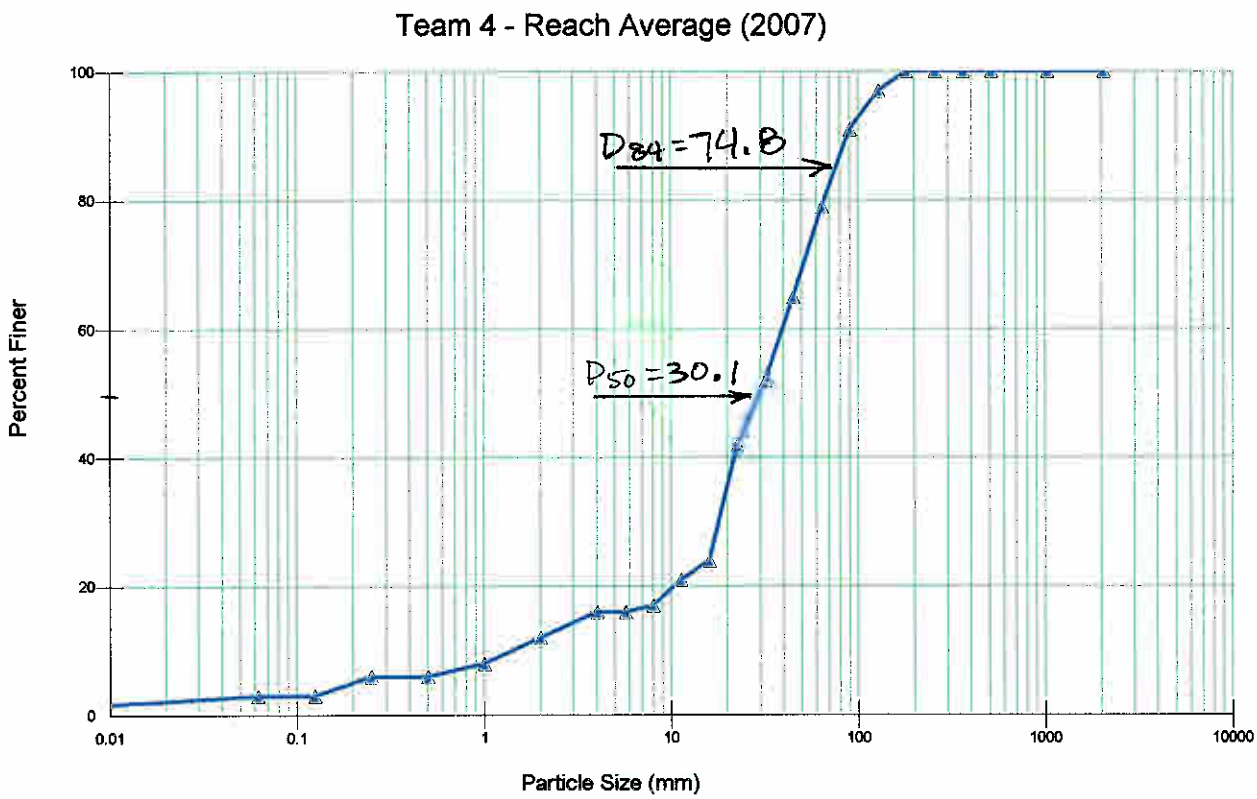
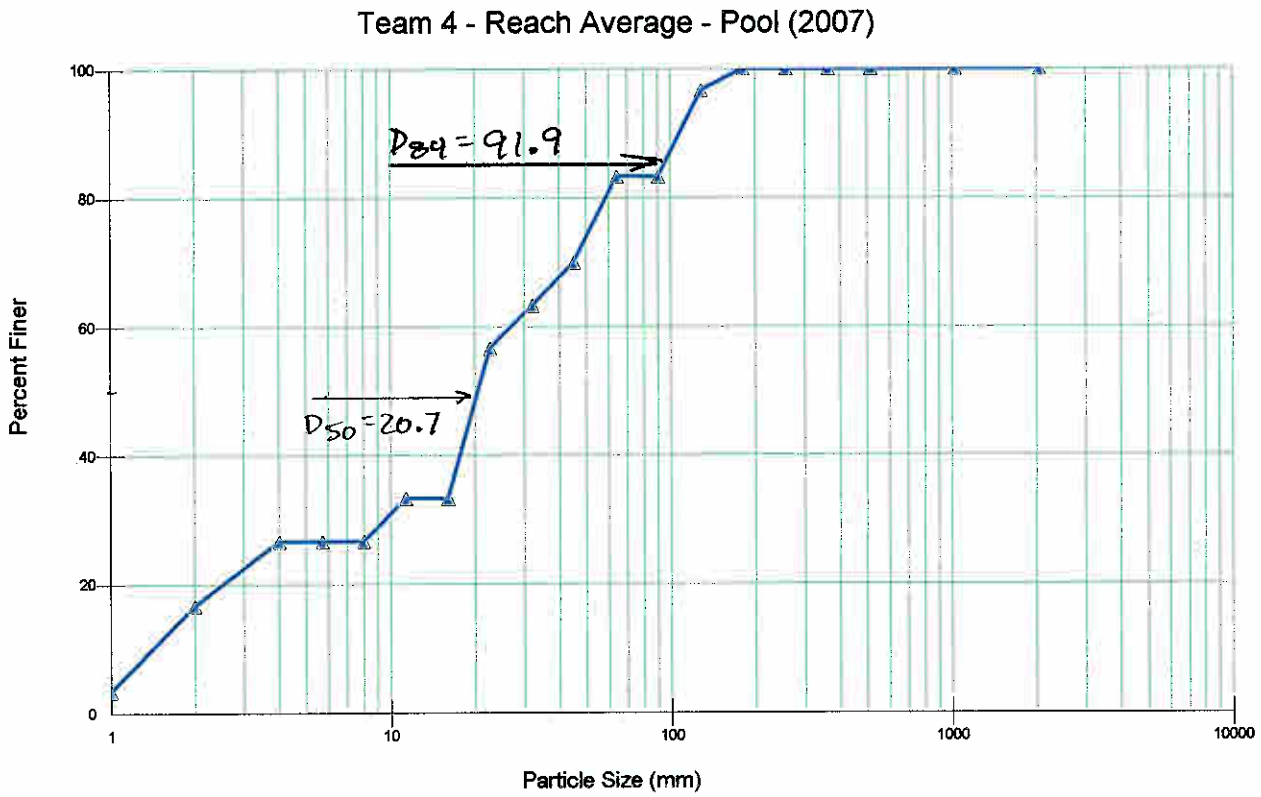
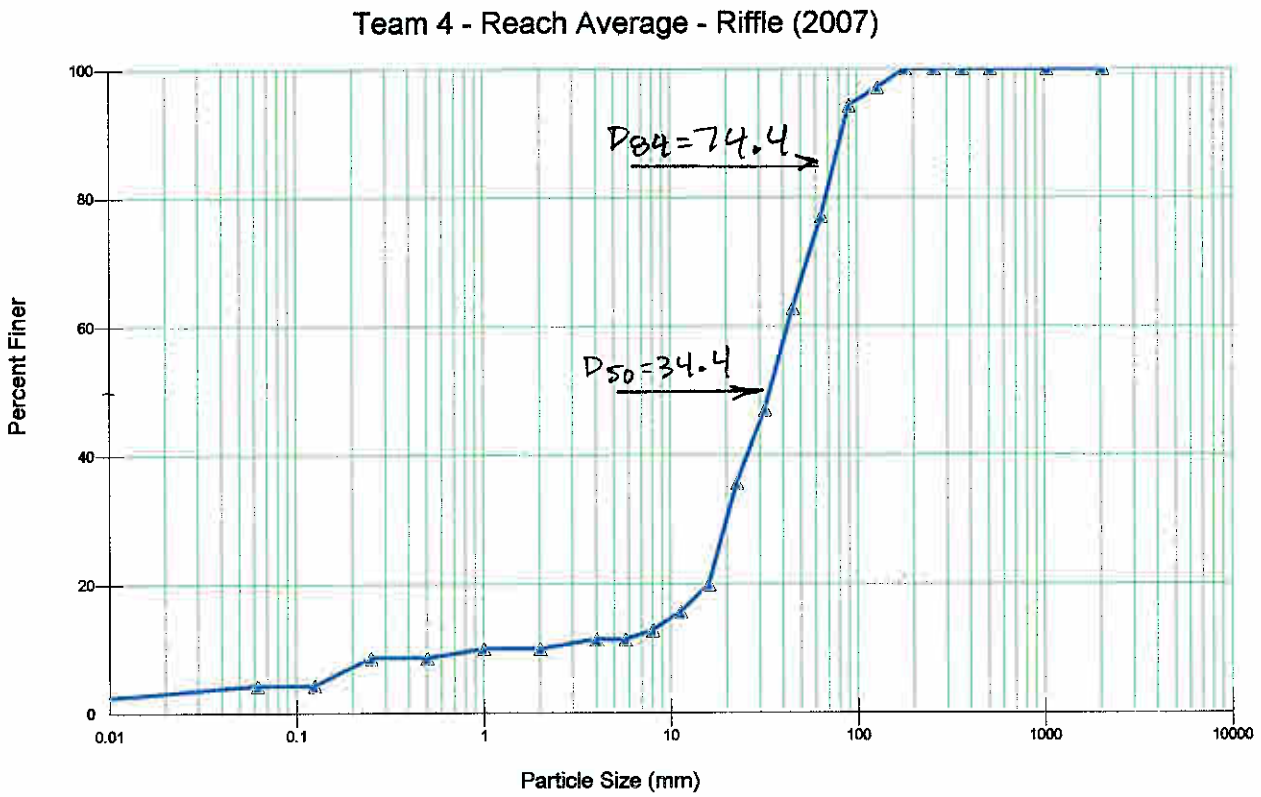
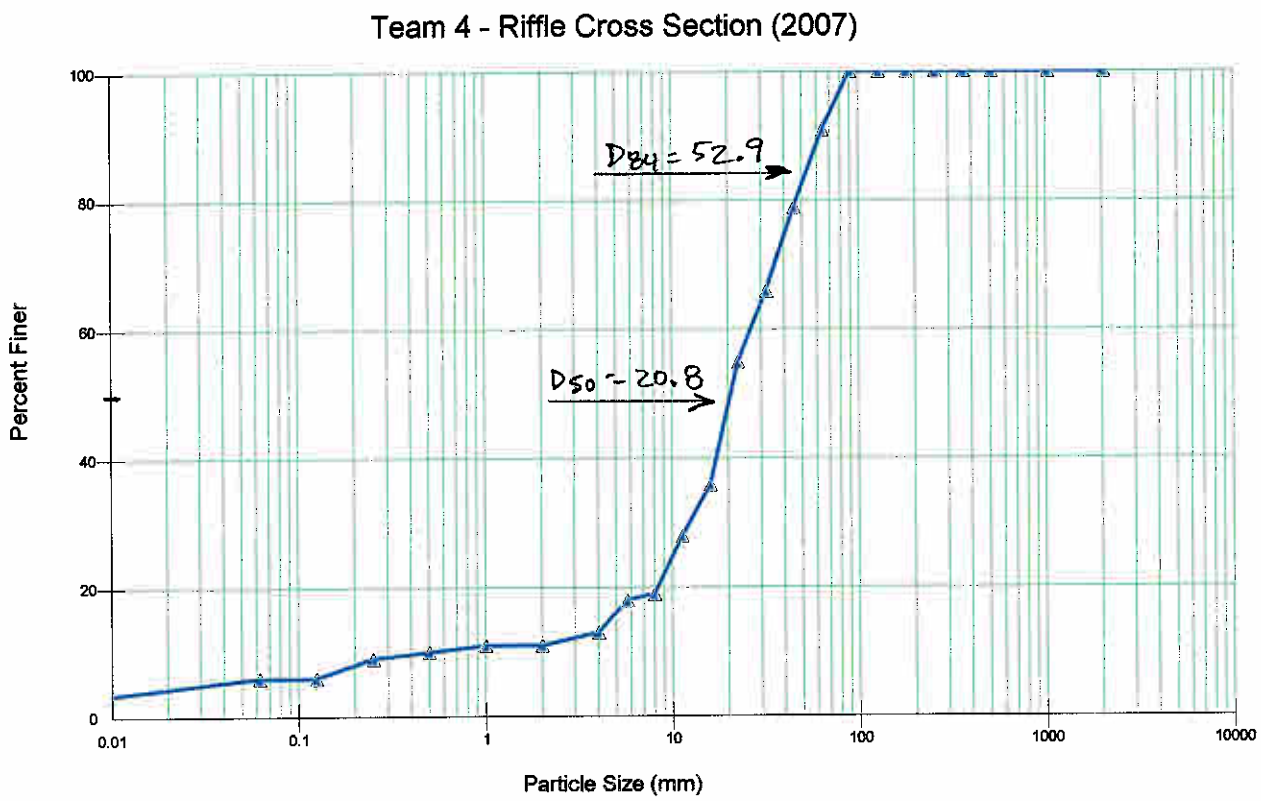
UT Little Bennett Creek Team 4 9/21/2007

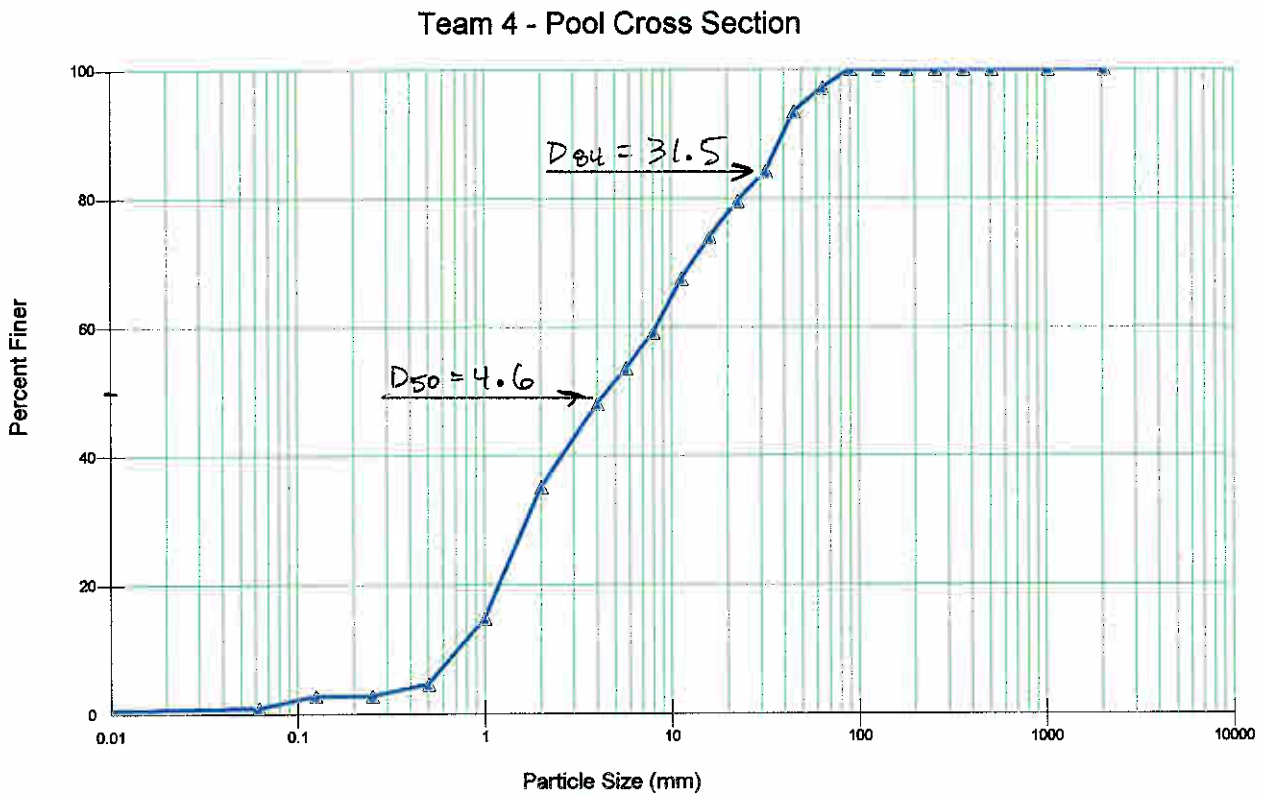


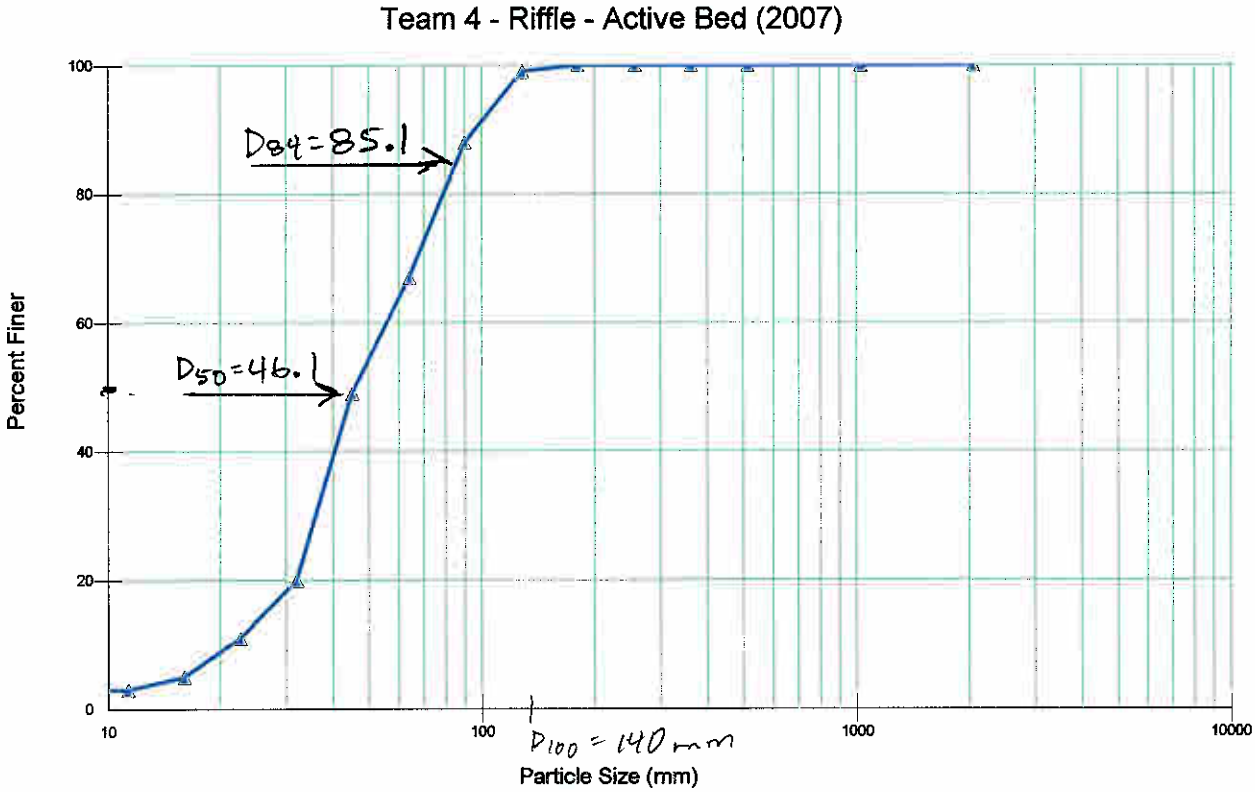

Team 4 - Reach Average (2007)
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
D84 = 74.8
D50 = 30.1

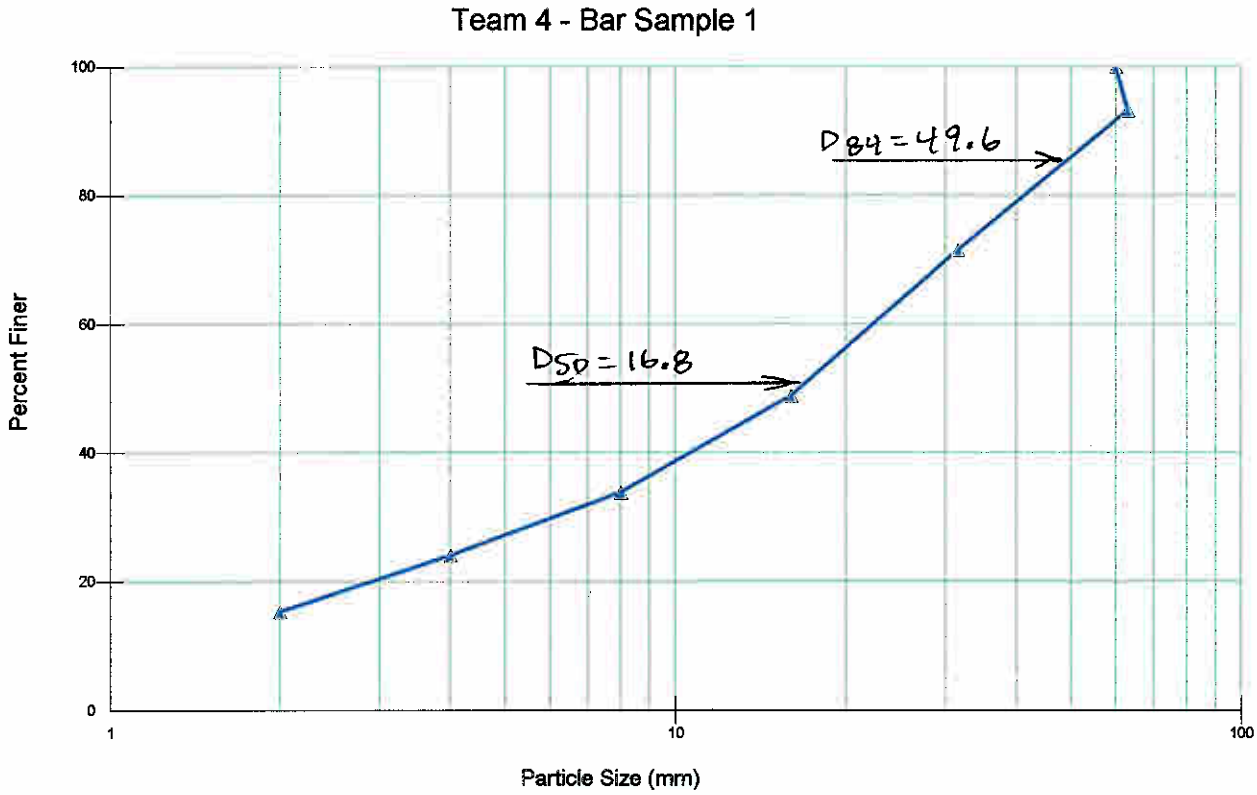

Team 4 - Reach Average - Pool (2007)
Percent Finer
Particle Size (mm)
0
20
40
60
80
100
1
10
100
1000
10000
D84 = 91.9
D50 = 20.7


Team 4 - Reach Average - Riffle (2007)
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
D84=74.4
D50=34.4

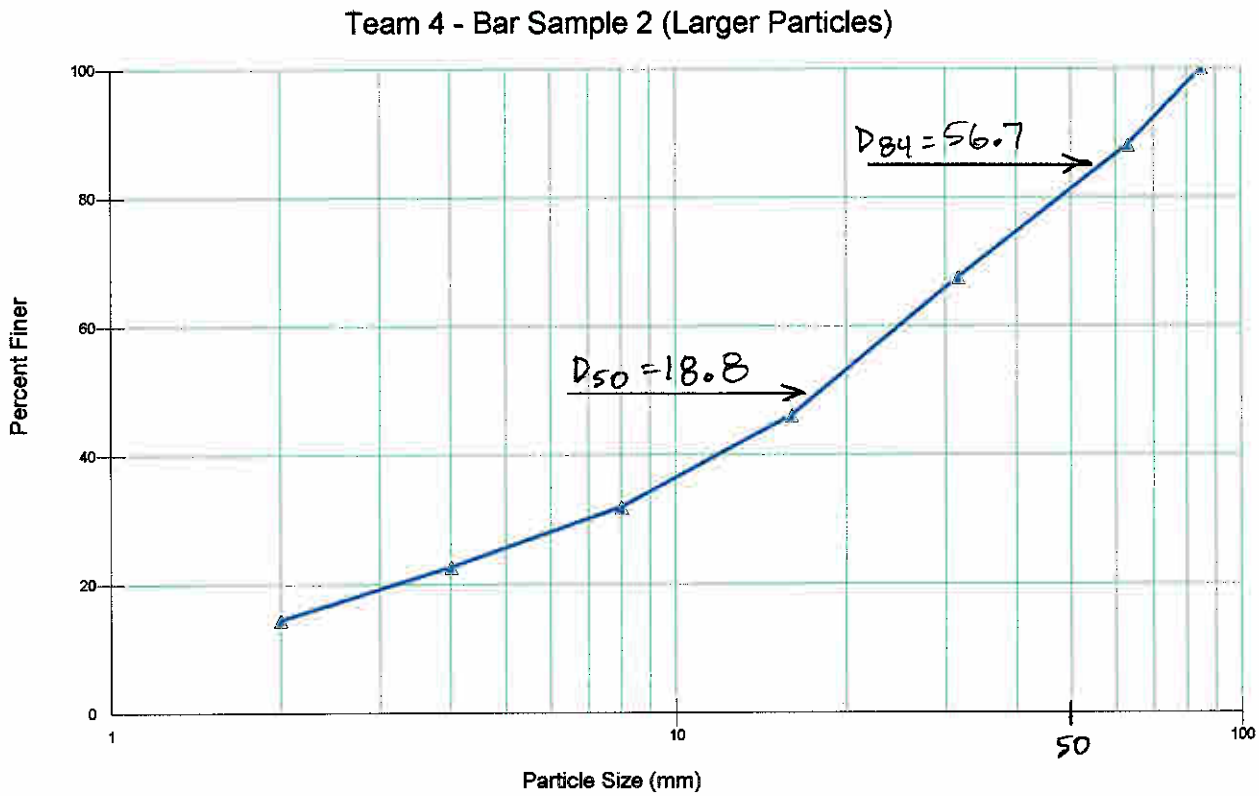

Team 4 - Riffle Cross Section (2007)
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
D84 = 52.9
D50 ~ 20.8


Team 4 - Pool Cross Section
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
D84 = 31.5
D50 = 4.6


Team 4 - Riffle - Active Bed (2007)
Percent Finer
Particle Size (mm)
100
80
60
40
20
0
10
100
1000
10000
D84=85.1
D50=46.1
D100 = 140 mm

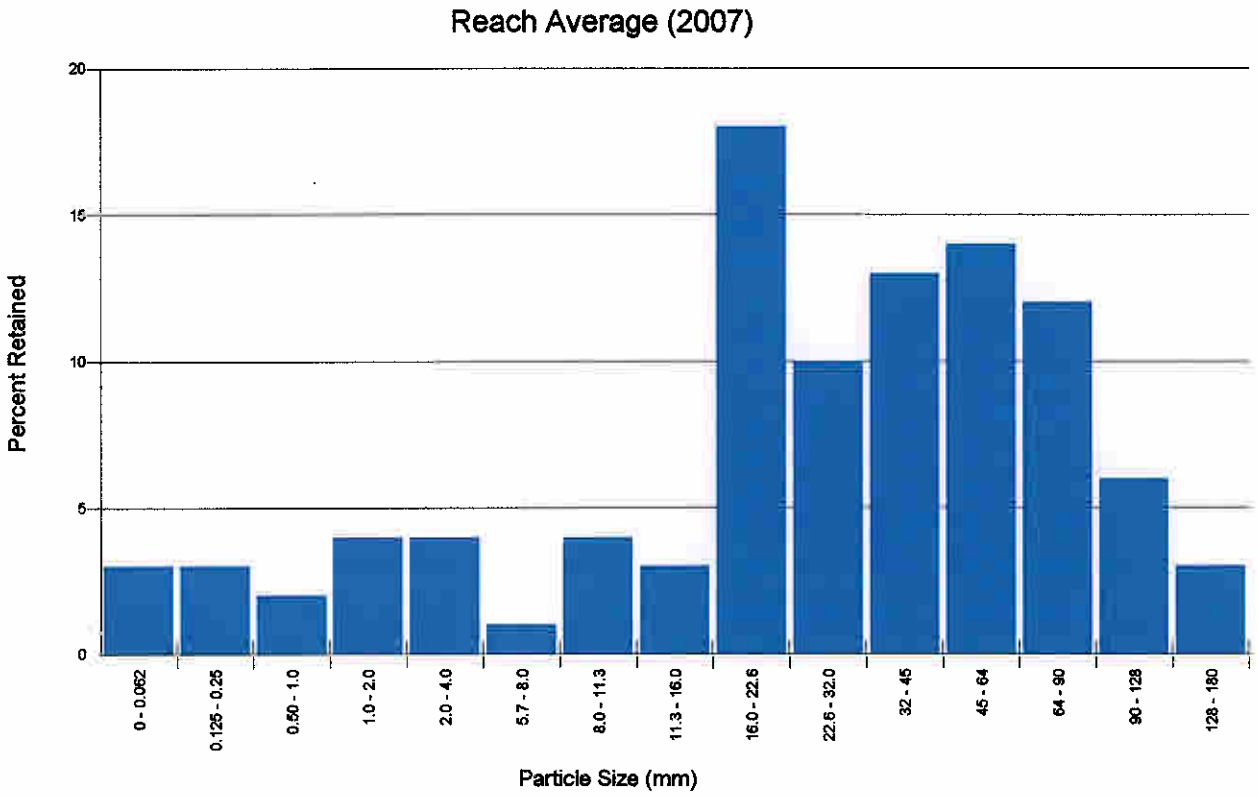


D_{100} = Largest Particle = 60 mm



D_{100} = Largest Particle = 95 mm

UT Little Bennett Creek Team 4 9/21/2007



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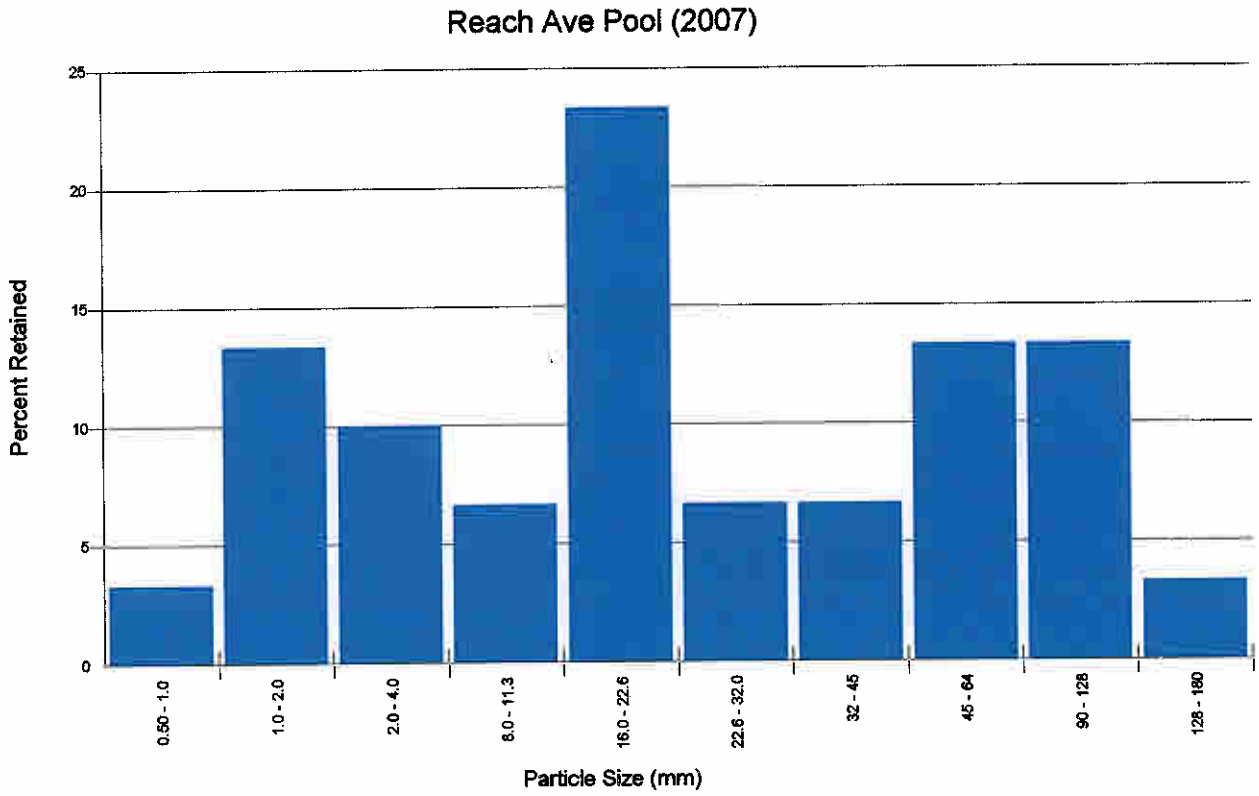
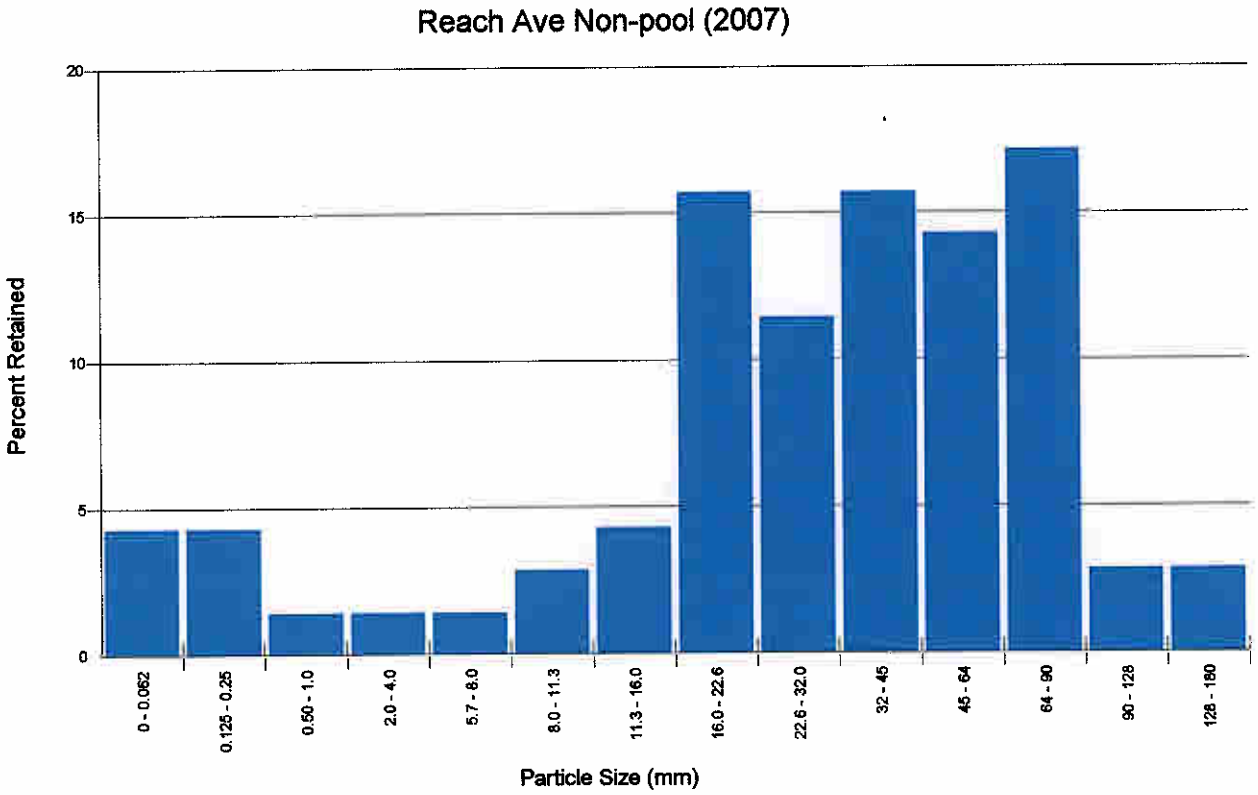
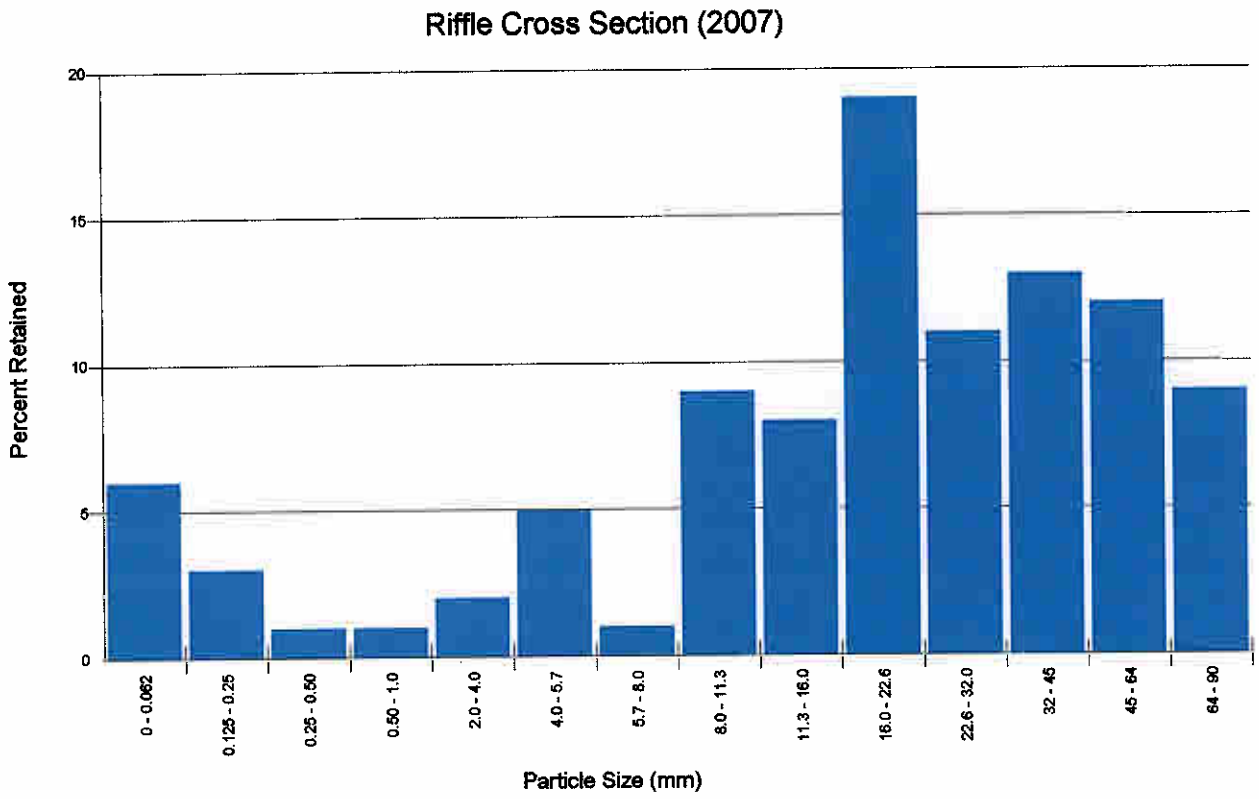


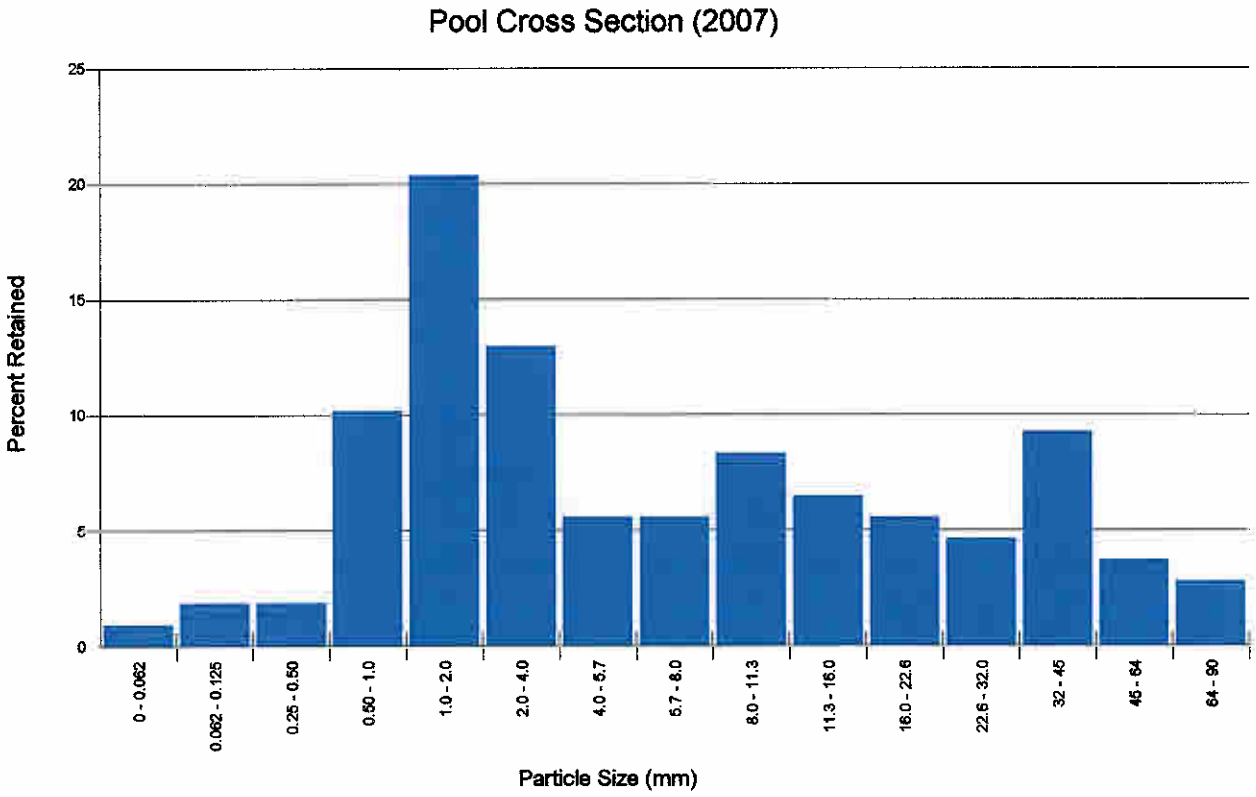
UT Little Bennett Creek Team 4 9/21/2007



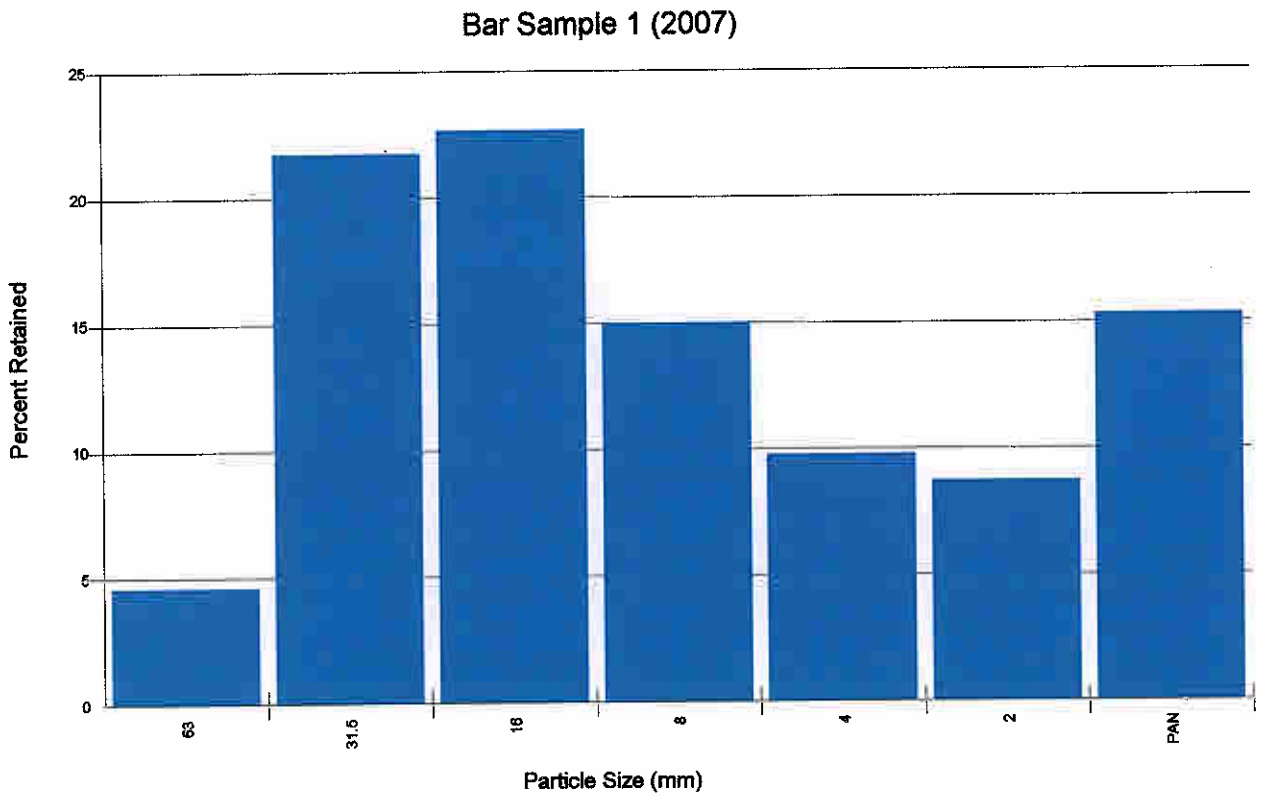
UT Little Bennett Creek Team 4 9/21/2007



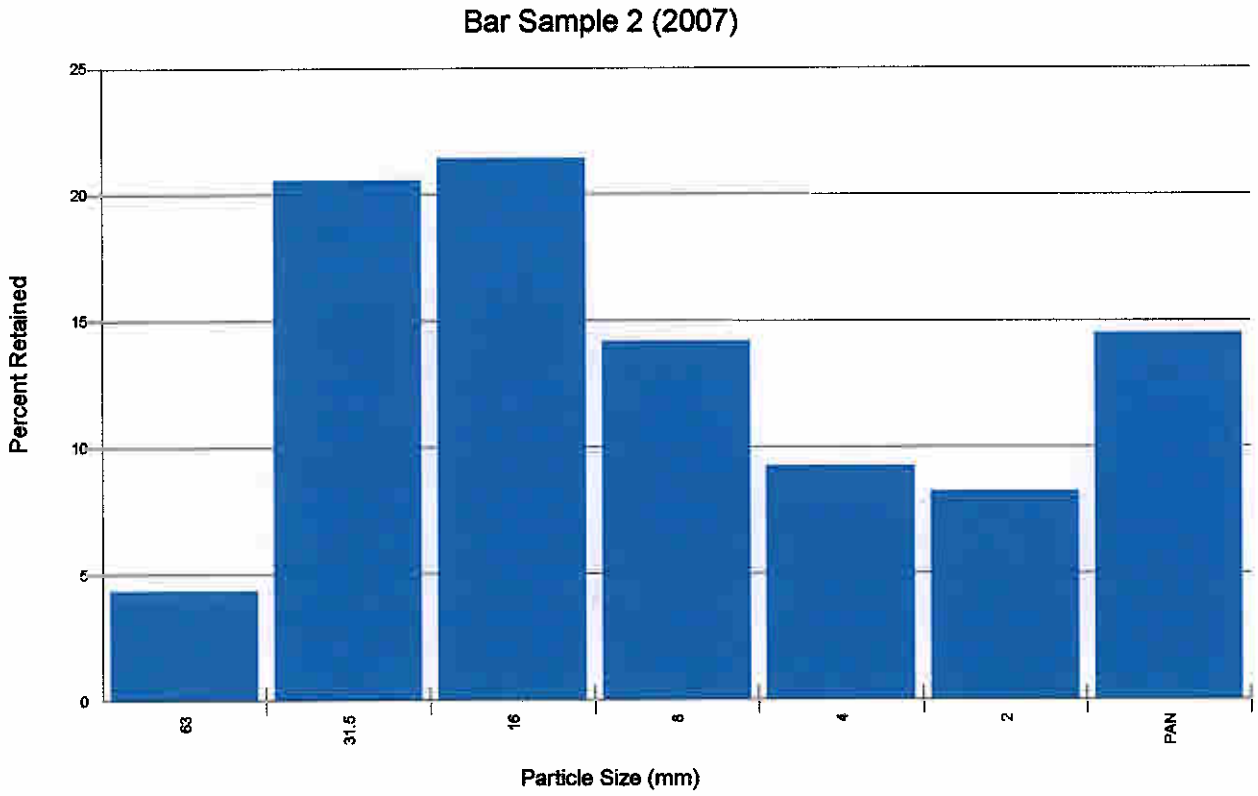
UT Little Bennett Creek Team 4 9/21/2007



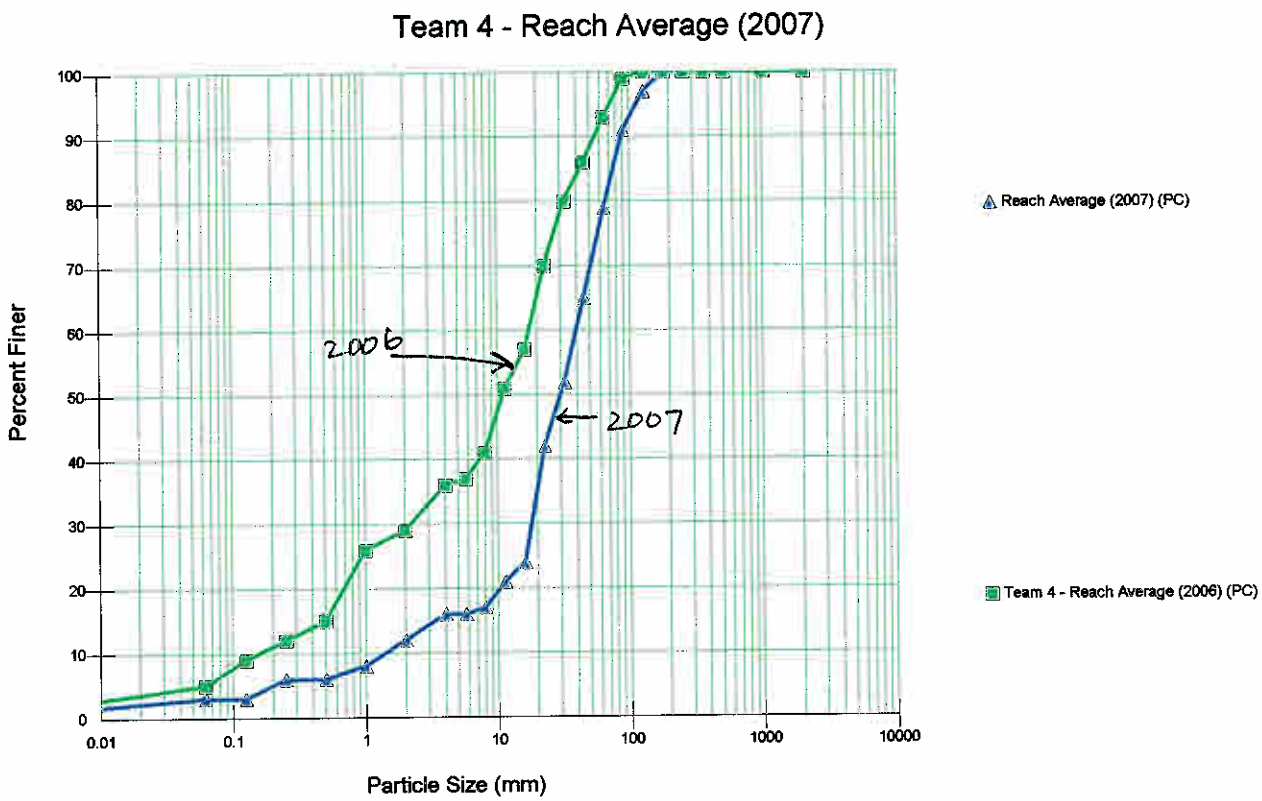
UT Little Bennett Creek Team 4 9/21/2007



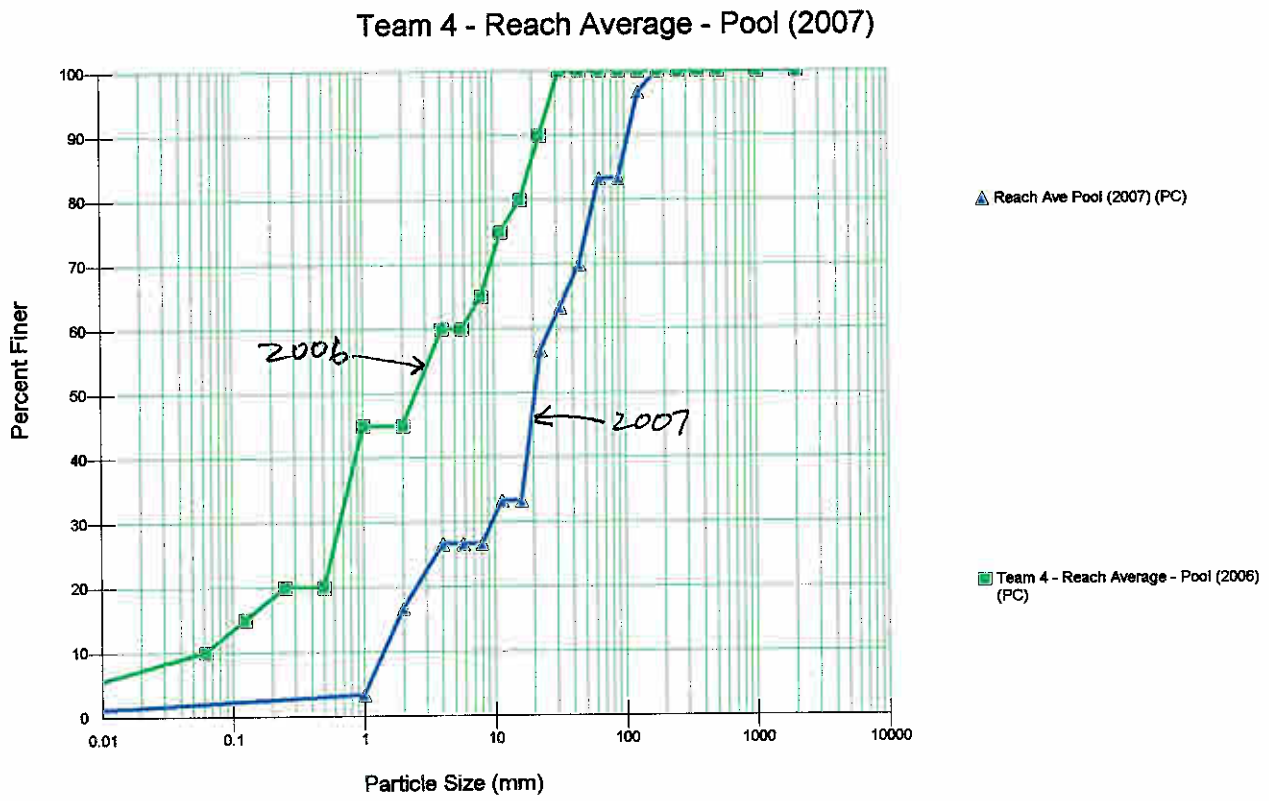
UT Little Bennett Creek Team 4 9/21/2007



UT Little Bennett Creek Team 4 9/21/2007

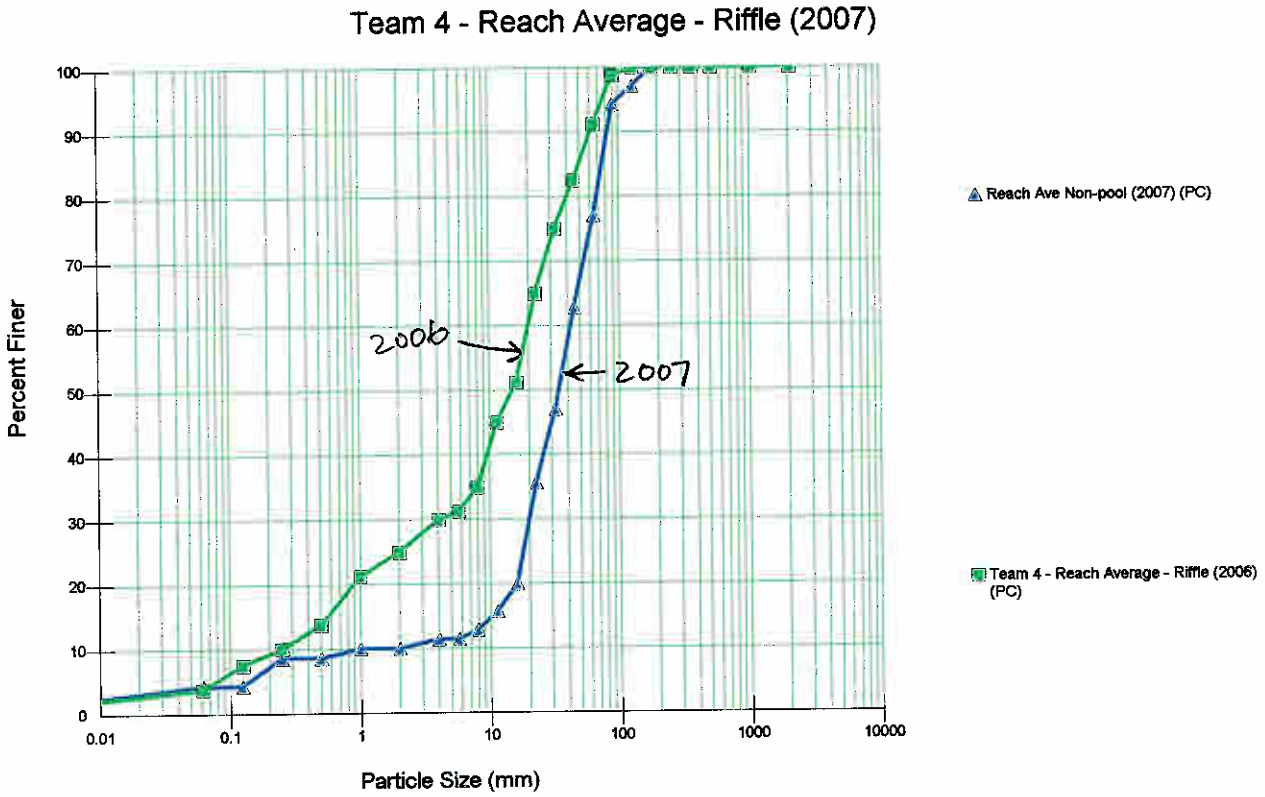


	2006	2007
D_{50}	11.0	34.4
D_{84}	40.7	74.4



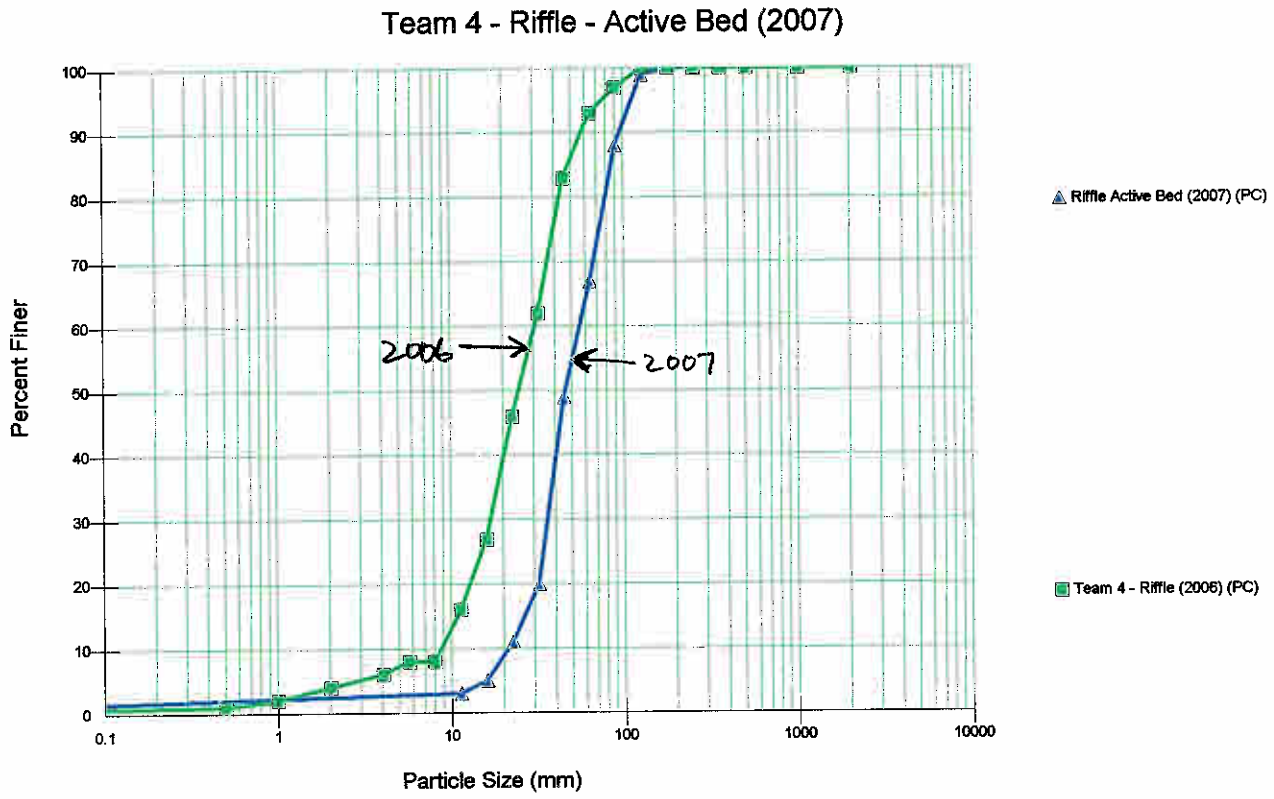
	2006	2007
D_{50}	2.7	20.7
D_{84}	18.6	91.9

UT Little Bennett Creek Team 4 9/21/2007



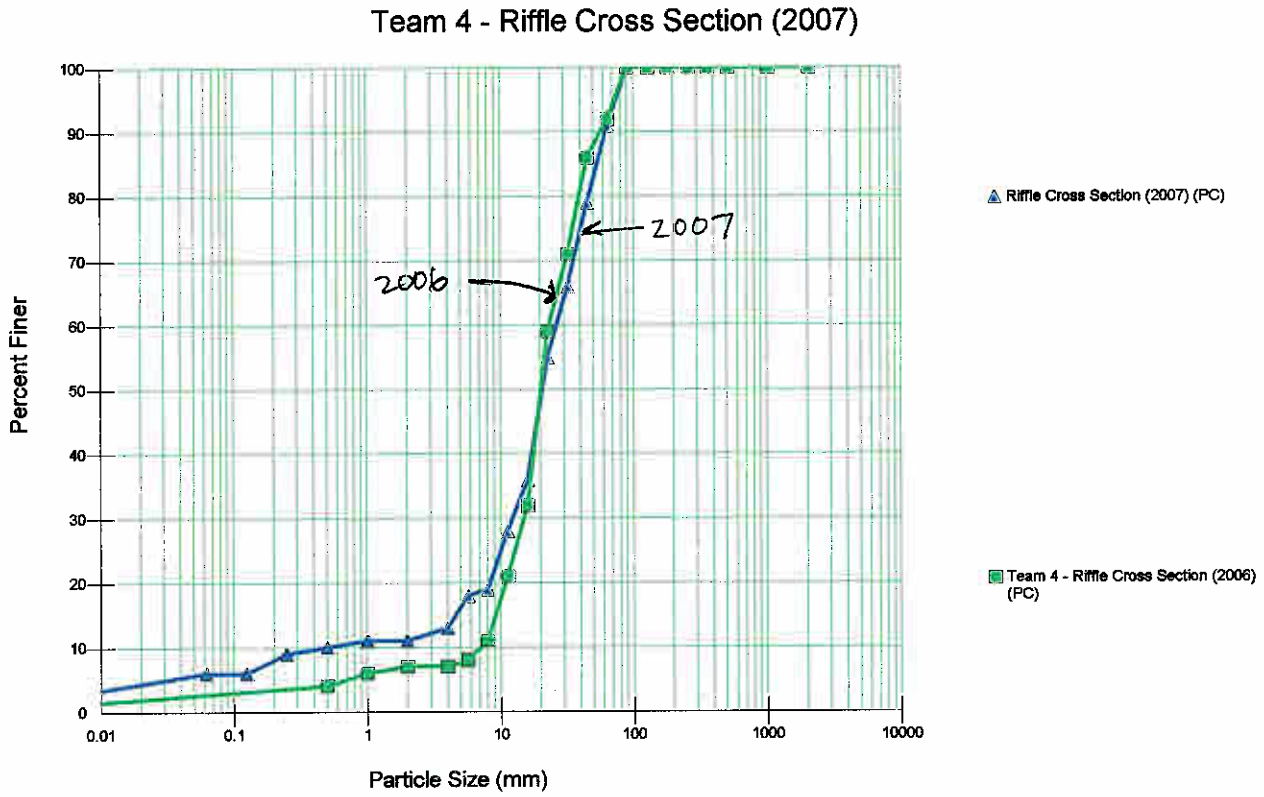
	2006	2007
D_{50}	15.1	34.4
D_{84}	48.3	74.4

UT Little Bennett Creek Team 4 9/21/2007



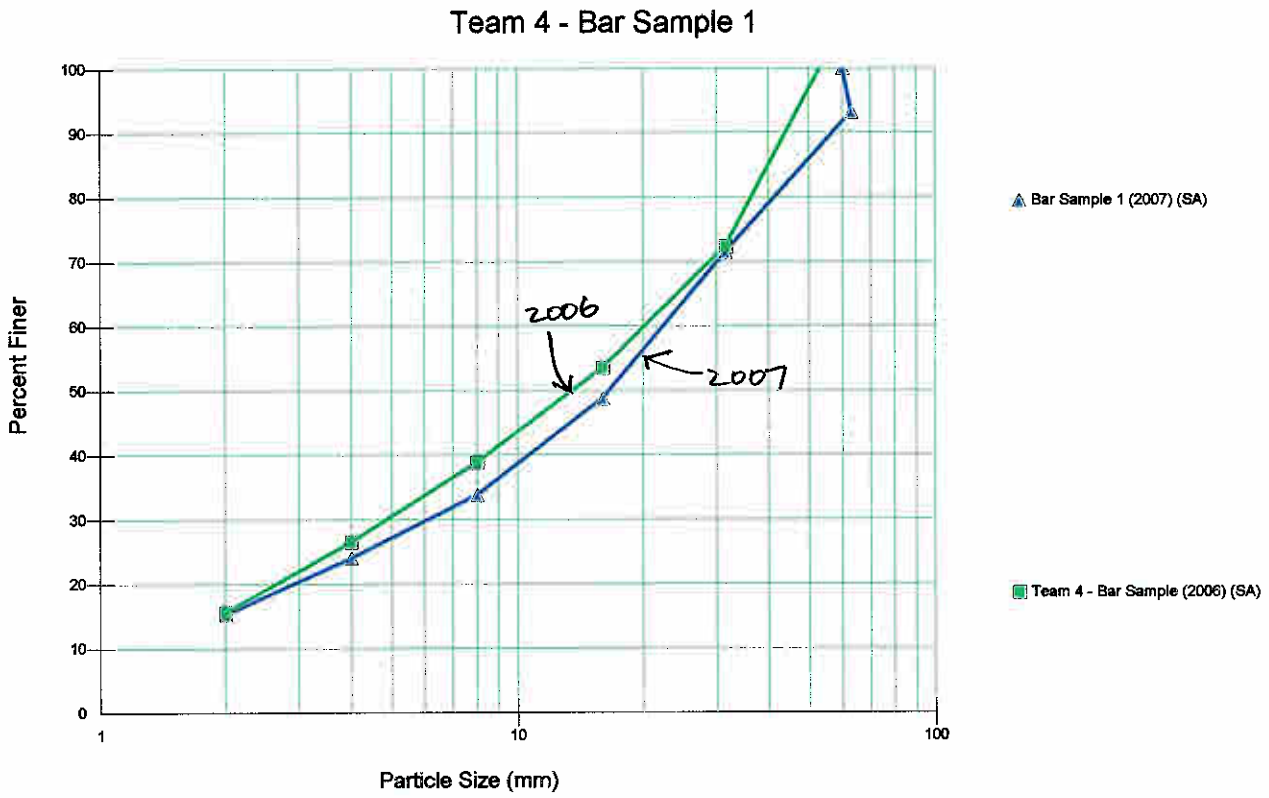
	2006	2007
D_{50}	25.0	46.1
D_{84}	46.9	85.1

UT Little Bennett Creek Team 4 9/21/2007



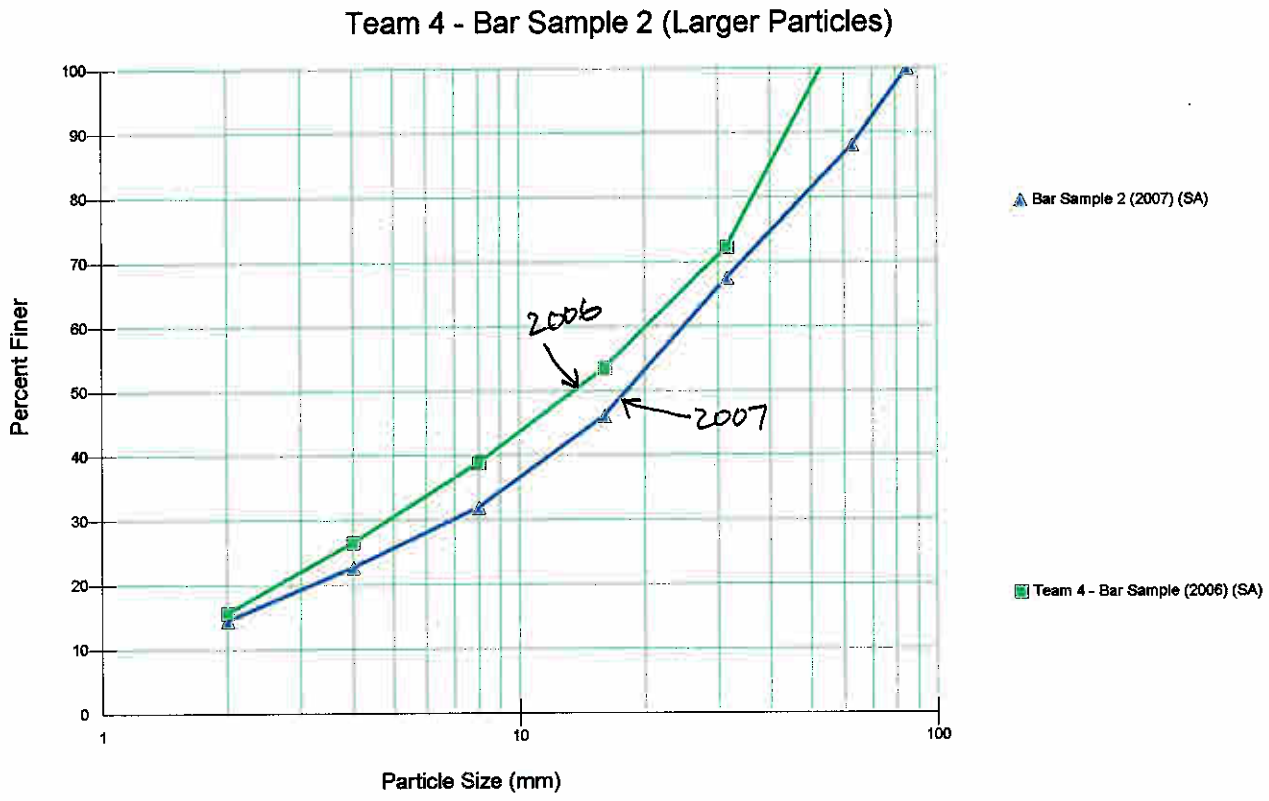
	2006	2007
D_{50}	20.4	20.8
D_{84}	43.3	52.9

UT Little Bennett Creek Team 4 9/21/2007



	2006	2007
D_{50}	14.6	16.8
D_{84}	42.1	49.6
D_{100}	55	60

UT Little Bennett Creek Team 4 9/21/2007



	2006	2007
D_{50}	14.6	18.8
D_{84}	42.1	56.7
D_{100}	55	95

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 - Reach 4**	Location:	
Station:	**0+28 to 0+38 LB**	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) =	1.7 (B)	(A) / (B) =	2.52941 (C)	8.61
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.3 (D)	Study Bank Height (ft) =	4.3 (A)	(D) / (A) =	0.06977 (E)	8.78
Weighted Root Density (G)						
		Root Density as % =	5 (F)	(F) × (E) =	0.34884 (G)	10
Bank Angle (H)						
				Bank Angle as *Degrees* =	35 (H)	2.68
Surface Protection (I)						
				Surface Protection as % =	30 (I)	5.9

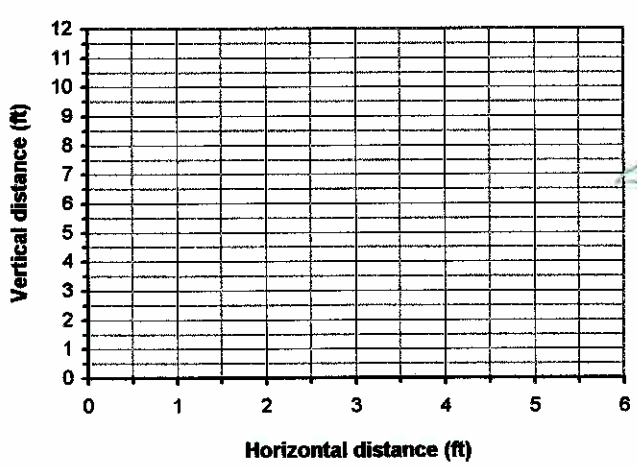
Bank Material Adjustment:

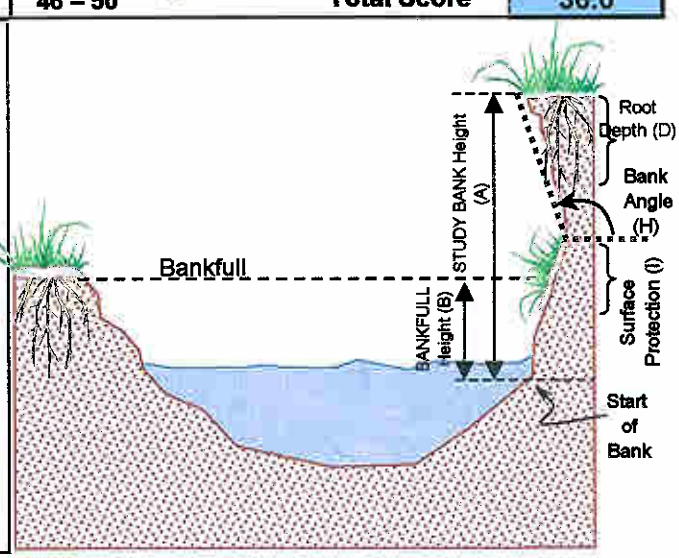
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

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

Very Low	Low	Moderate	High	Very High	Extreme		
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	**Adjective Rating** and **Total Score**	High / 36.0

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 - Reach 4**	Location:	
Station:	**0+76 to 1+08 LB**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.58 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.88421 (C)	7.33
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	3.58 (A)	(D) / (A) =	0.41899 (E)	4.7
Weighted Root Density (G)						
Root Density as % =	15 (F)			(F) × (E) =	6.28492 (G)	8.86
Bank Angle (H)						
Bank Angle as *Degrees* =	88 (H)					7.48
Surface Protection (I)						
Surface Protection as % =	10 (I)					9

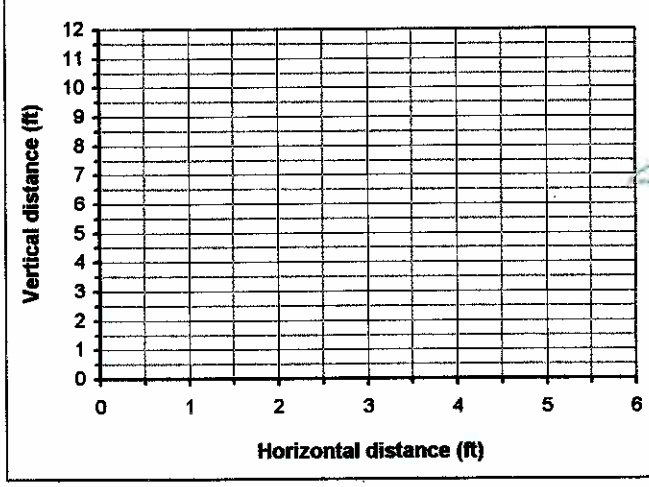
Bank Material Adjustment:

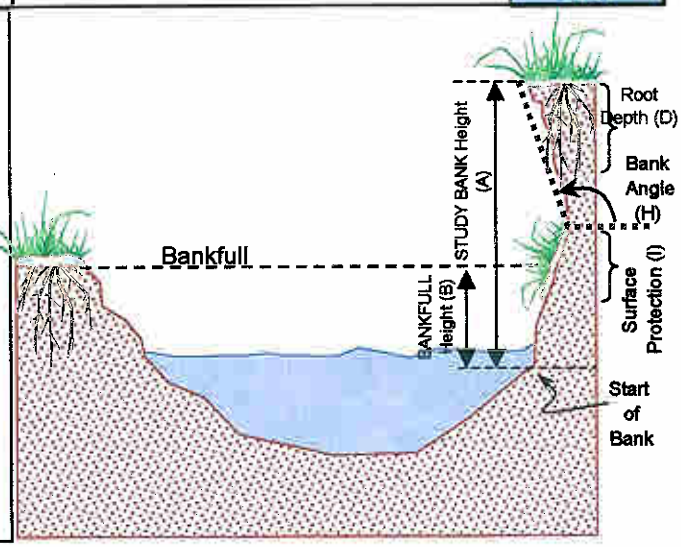
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

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

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		37.4

Bank Sketch





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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 - Reach 4** Location:

Station: **0+76 to 1+08 LB** 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: Low

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.9	1.3	1.46	Low

(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: Low

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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 - Reach 4** Location:

Station: **0+28 to 0+38 LB** 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
Low

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.7	1.3	1.31	Low

(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 Low

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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 - Reach 1**	Location:	
Station:	**Pool XS STA 0+55 LB**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.7 (A)	Bankfull Height (ft) =	3.8 (B)	(A) / (B) =	1.5 (C)	5.9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	3 (D)	Study Bank Height (ft) =	5.7 (A)	(D) / (A) =	0.52632 (E)	3.75
Weighted Root Density (G)						
		Root Density as % =	40 (F)	(F) × (E) =	21.0526 (G)	7.08
Bank Angle (H)						
				Bank Angle as *Degrees* =	140 (H)	10
Surface Protection (I)						
				Surface Protection as % =	45 (I)	4.71

Bank Material Adjustment:

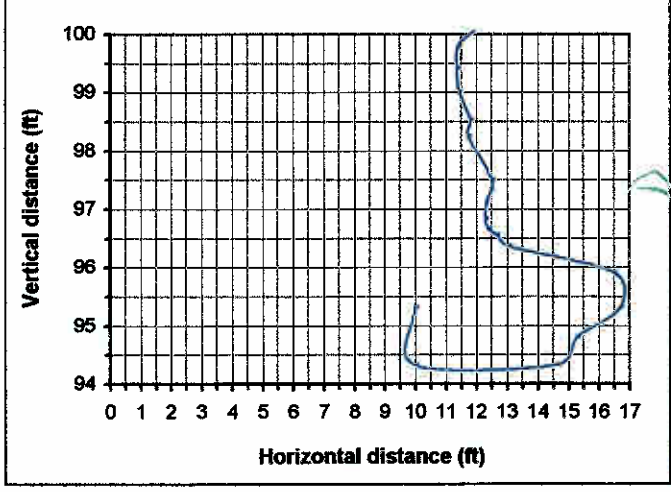
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

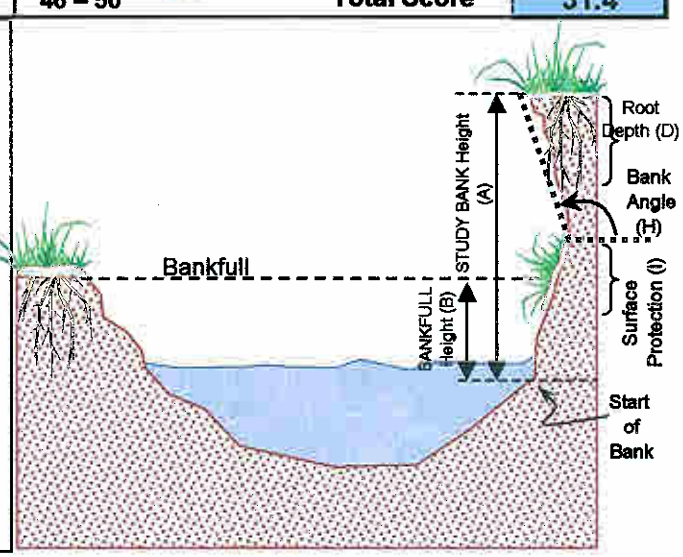
Bank Material Adjustment 0

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	High
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50		31.4

Bank Sketch





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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 - Reach 1** Location:

Station: **Pool XS STA 0+55 LB** 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)
	3.8	1.3	2.92	Very 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: Very High

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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 - Reach 1**	Location:	
Station:	**Riffle XS STA 0+99 LB**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

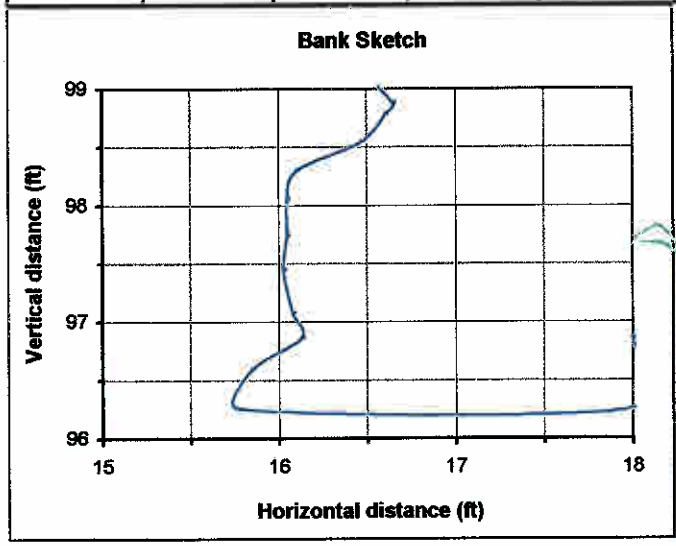
						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.2 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.68421 (C)	6.38
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.5 (D)	Study Bank Height (ft) =	3.2 (A)	(D) / (A) =	0.15625 (E)	7.76
Weighted Root Density (G)						
		Root Density as % =	20 (F)	(F) × (E) =	3.125 (G)	10
Bank Angle (H)						
				Bank Angle as *Degrees* =	133 (H)	10
Surface Protection (I)						
				Surface Protection as % =	10 (I)	9

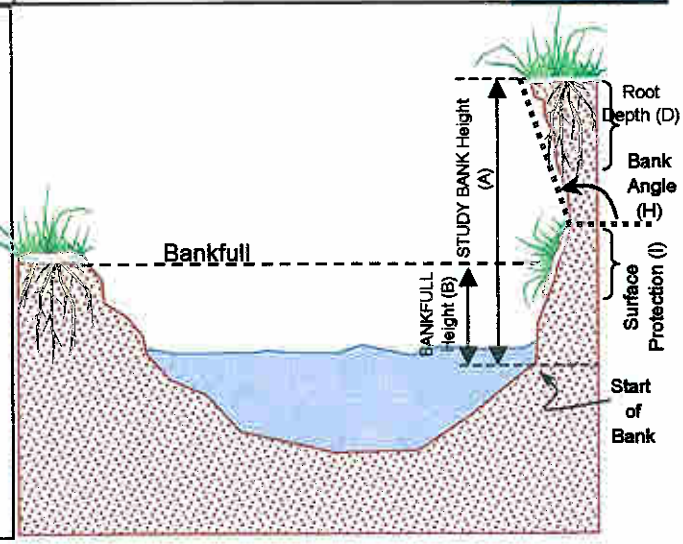
Bank Material Adjustment:

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	0

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		43.1





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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 - Reach 1** Location:

Station: **Riffle XS STA 0+99 LB** 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)
	1.9	1.3	1.46	Low

(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
Low

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 Low

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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 - Reach 4**	Location:	
Station:	**0+38-0 to 0+76 LB**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.7 (A)	Bankfull Height (ft) =	3.8 (B)	(A) / (B) =	1.5 (C)	5.9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	3 (D)	Study Bank Height (ft) =	5.7 (A)	(D) / (A) =	0.52632 (E)	3.75
Weighted Root Density (G)						
Root Density as % =	40 (F)			(F) × (E) =	21.0526 (G)	7.08
Bank Angle (H)						
Bank Angle as *Degrees* =	165 (H)					10
Surface Protection (I)						
Surface Protection as % =	45 (I)					4.71

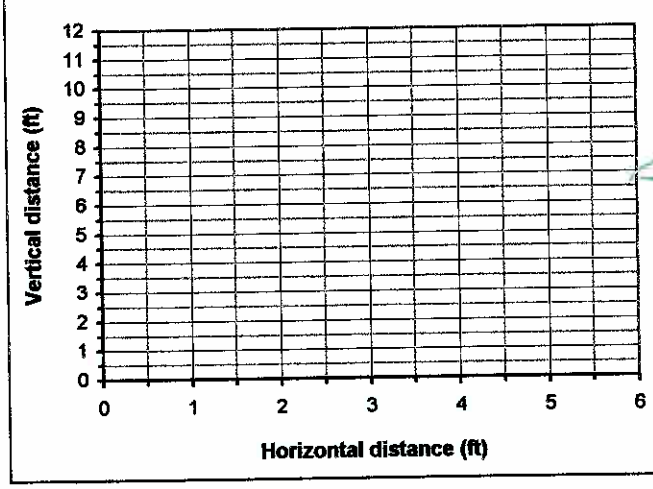
Bank Material Adjustment:

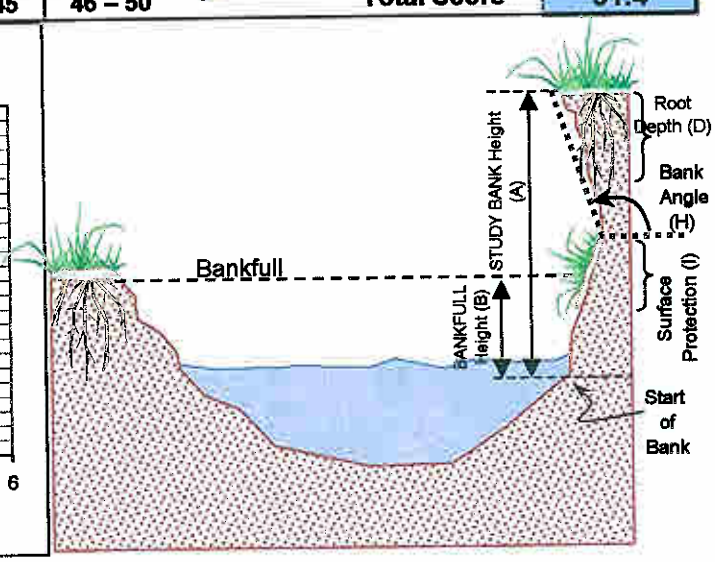
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

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		
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	**Adjective Rating and Total Score**	High / 31.4

Bank Sketch





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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 - Reach 4** Location:

Station: **0+38-0 to 0+76 LB** 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)
	3.8	1.3	2.92	Very 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: Very High

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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 - Reach 4**	Location:	
Station:	**1+21 to 1+31 RB**	Observers:	
Date:	**12/30/99**	Stream Type:	Valley Type:

						BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	6.8 (A)	Bankfull Height (ft) =	4.3 (B)	(A) / (B) =	1.5814 (C)	5.91
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.5 (D)	Study Bank Height (ft) =	6.8 (A)	(D) / (A) =	0.07353 (E)	8.78
Weighted Root Density (G)						
		Root Density as % =	12 (F)	(F) × (E) =	0.88235 (G)	10
Bank Angle (H)						
				Bank Angle as *Degrees* =	130 (H)	10
Surface Protection (I)						
				Surface Protection as % =	30 (I)	5.9

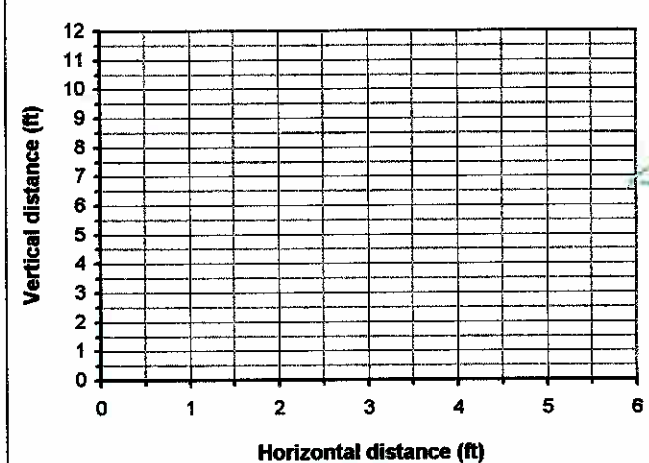
Bank Material Adjustment:

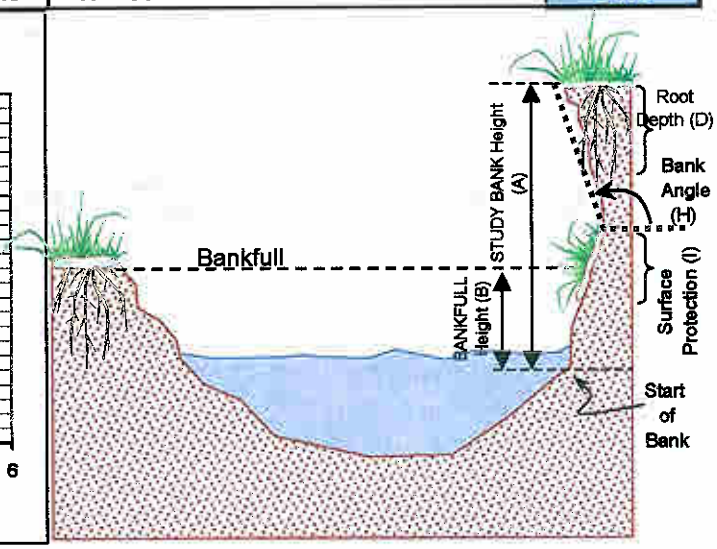
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment	0
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage	6

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		46.6

Bank Sketch





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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 - Reach 4** Location:

Station: **1+31 to 1+52 RB** 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: Low

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.7	1.3	1.31	Low

(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: Low

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

Stream:	**Little Bennett, Reach - Reach 4**			Location:			
Graph Used:		Total Bank Length (ft): **168**				Date: **12/30/1999**	
Observers:			Valley Type:			Stream Type:	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 5-8) (adjective)**	**NBS rating (Worksheet 5-9) (adjective)**	**Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}**
1. **0+28 to 0+38 LB**	High	Low	0.4018605	10	4.3	17.28	0.08
2. **0+38-0 to 0+76 LB**	High	Very High	1.999446	38	5.7	433.08	0.55
3. **0+76 to 1+08 LB**	High	Low	0.4006634	32	3.58	45.9	0.07
4. **1+21 to 1+31 RB**	Extreme	Extreme	4.9998065	22.8	6.8	775.17	1.64
5. **1+31 to 1+52 RB**	High	Low	0.3991486	38	3.4	51.57	0.07
6. **Pool XS STA 0+55 LB**	High	Very High	1.7052632	1	5.7	9.72	0.47
7. **Riffle XS STA 0+99**	Very High	Low	0.421875	1	3.2	1.35	0.07
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total erosion (ft^3/yr)**	1334.07	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					**Total erosion (yds^3/yr)**	49.41	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					**Total erosion (tons/yr)**	64.23	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					**Total erosion (tons/yr/ft)**	0.3823	

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

Stream:	**UT Little Bennett Creek, Reach - Team 4**	Location:	**Montgomery County, Maryland**
Graph Used:	Total Bank Length (ft): **168.5**		Date: **8/15/2007**
Observers:	**SHARP**	Valley Type: **VIII**	Stream Type: **C 4**

(1) Station (ft)	(2) BEHI rating (Worksheet 5-8) (adjective)	(3) NBS rating (Worksheet 5-9) (adjective)	(4) Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)	(5) Length of bank (ft)	(6) Study bank height (ft)	(7) Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)	(8) Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}
1. Pool BEHI (2006)	High	High	0.5085616	1	5.84	2.97	0.14
2. Reach BEHI BK1 (2006)	Very High	Very High	0.7995536	16	4.2	53.73	0.16
3. Reach BEHI BK2 (2006)	High	High	0.4998649	37	6	110.97	0.14
4. Reach BEHI BK3 (2006)	Extreme	Moderate	1.0989	25	4	109.89	0.21
5. Reach BEHI BK4 (2006)	Extreme	Extreme	29.99967	35	7.8	8189.91	11.27
6. Reach BEHI BK5 (2006)	Very High	Moderate	0.2994361	28	3.8	31.86	0.05
7. Riffle BEHI (2006)	Very High	Moderate	0.2579618	1	3.14	0.81	0.04
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

Sum erosion subtotals in Column (7) for each BEHI/NBS combination	Total erosion (ft^3/yr)	8500.14
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}	Total erosion (yds^3/yr)	314.82
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}	Total erosion (tons/yr)	409.27
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}	Total erosion (tons/yr/ft)	2.4289

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

Stream: **UT Little Bennett**		Location: **Montgomery County, Maryland**	
Observers: **Team 4**	Reference reach [ ]	Disturbed (impacted reach) [X]	Date: **9-21-07**
Existing species composition: **Late to mid succesional hardwood**		Potential species composition: **Late succesional hardwood**	

Riparian cover categories		Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	30%	15%	Tulip Poplar	30%
				Green Ash	30%
				Black Walnut	30%
				Sycamore	10%
					100%
2. Understory	Shrub layer		15%	Green Ash	30%
				Spice Bush	30%
				Sycamore	20%
				Multiflora Rose	10%
				Ironwood	5%
				Alder	5%
					100%
3. Ground level	Herbaceous		69%	Smart Weed	40%
				Microstegium	35%
				Tearthumb	10%
				Jewel Weed	5%
				Thistle	5%
				Sycamore	5%
					100%
	Leaf or needle litter				
	Bare ground		1%		
			Column total = 100%		

Remarks:
Condition, vigor and/or usage of existing reach:

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

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Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**UT Little Bennett River 2007, Reach - Reach 1**				
Basin:		Drainage Area:	**1088** acres	**1.7**	mi^2
Location:					
Twp.&Rge: ;		Sec.&Qtr.: ;			
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**			Date: **9/22/2007**	
Observers:				Valley Type: VIII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	23.6	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.33	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	31.3	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	17.74	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.	1.92	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.	150	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	6.36	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.	30.1	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.	0.0123	ft/ft 0.013
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).	1.53	

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

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

Stream: **Charles Little Bennett, Reach - Reach 1** Location:

Observers: Date: **8/22/2007** Valley Type: **VIII** Stream Type: **C 4**

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.32	ft	Riffle Width (W_{bkf})	23.64	ft	Riffle Area (A_{bkf})	31.29	ft^2
Mean Pool Depth (d_{bkfp})	1.95	ft	Pool Width (W_{bkfp})	20.25	ft	Pool Area (A_{bkfp})	39.41	ft^2
Mean Pool Depth/Mean Riffle Depth	1.48	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.86	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.26	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	1.82	ft	Max Pool Depth (d_{mbkfp})	4.16	ft	Max Riffle Depth/Mean Riffle Depth	1.38	
Max Pool Depth/Mean Riffle Depth	3.152					Point Bar Slope	0.3	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	~~4.45~~ 4.23	ft/s				Estimation Method	Leopold 1994	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	~~430~~ 132.4	cfs				Drainage Area	1.7	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	145	145	145	ft	Meander Length Ratio (Lm/W_{bkf})	6.13	6.13	6.13
Radius of Curvature (Rc)	43	32	55	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.82	1.35	2.33
Belt Width (W_{blt})	68	68	68	ft	Meander Width Ratio (W_{blt}/W_{bkf})	2.88	2.88	2.88
Individual Pool Length	16.8	13.2	23.1	ft	Pool Length/Riffle Width	0.71	0.56	0.98
Pool to Pool Spacing	50.4	27.3	73.5	ft	Pool to Pool Spacing/Riffle Width	2.13	1.16	3.11
Riffle Length	22	1.42	35.7	ft	Riffle Length/Riffle Width	0.93	0.06	1.51

Channel Profile

Valley Slope (VS)	0.0123	ft/ft	Average Water Surface Slope (S)	0.0113	ft/ft	Sinuosity (VS/S)	1.53
Stream Length (SL)	168	ft	Valley Length (VL)	110	ft	Sinuosity (SL/VL)	1.527

Low Bank Height (LBH)	start	2.33	ft	Max Riffle Depth	start	1.69	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth) start 1.379
	end	3.23	ft		end	1.97	ft	end 1.64

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.030	0.017	0.047	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	2.627	1.468	4.158
Run Slope (S_{run})	0.118	0.037	0.276	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	10.463	3.241	24.443
Pool Slope (S_p)	0.000	0.000	0.001	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.027	0.000	0.083
Glide Slope (S_g)	0.002	0.000	0.005	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.191	0.000	0.404

Feature Midpoint [a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	1.82	1.68	1.97	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.379	1.27	1.492
Run Depth (d_{run})	2.47	1.97	3.06	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	1.871	1.49	2.318
Pool Depth (d_p)	4.16	3.26	4.78	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	3.152	2.47	3.621
Glide Depth (d_g)	2.16	2.08	2.3	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	1.636	1.58	1.742

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	3	0	0	D_{16}	4	27.82	2.37	0	mm
% Sand	9	0	14.47	D_{35}	20.03	38.72	9.71	0	mm
% Gravel	67	67	74.28	D_{50}	30.12	46.06	18.78	0	mm
% Cobble	21	33	11.25	D_{84}	74.83	85.05	56.68	0	mm
% Boulder	0	0	0	D_{95}	115.33	114.18	75.74	0	mm
% Bedrock	0	0	0	D_{100}	180	179.99	95	0	mm

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

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UT Little Bennett Creek Team 4 9/21/2007

STREAM NAME - REACH IDENTIFICATION

VELOCITY CALCULATION FORM

Stream:	Bennett UNT
Reach:	4.00
Location:	
Date:	
Observer(s):	
Comments:	

Existing Conditions					
31.30	A_{BKF}	Bankfull Cross-Sectional Area (ft^2)	0.17	D_{84}	Riffle D_{84} (ft)
23.60	W_{BKF}	Bankfull Width (ft)	0.0113	S	Water Surface Slope
1.33	D_{BKF}	Bankfull Mean Depth (ft)	~~7.00~~ 4.27	R/D_{84}	R/D_{84} (ft/ft)
26.25	WP	Wetted Perimeter (ft)	32.20	g	Gravitational Acceleration (ft/s^2)
1.19	R	Hydraulic Radius (ft)	1.70	DA	Drainage Area (mi^2)
85.10 ~~52.90~~	D_{84}	Riffle D_{84} (mm)			

R/D84, u/u*, Mannings "n" Relative Roughness vs. Resistance Relationship Graphs		
u/u* (using R/D_{84}: see Reference Reach Field Book (p.188), River Field Book (p.233))	~~7.62~~ 6.44	ft/s/ ft/s
Manning's "n" (see Reference Reach Field Book (p.189), River Field Book (p.236)	0.04	
Velocity (using Manning's equation: $u=1.49R^{(2/3)}S^{(1/2)}/n$)	4.45	ft/s
Discharge (using $Q=A_{BKF}u$)	139.36	cfs

Resistance as a function of Relative Roughness (Leopold 1994) $u/u^* = 2.83+5.7\log(R/D84)$		
u*: (using $u^*=(gRS)^{0.5}$)	0.66	ft/s
Velocity (using $u=u^*(2.83+5.7\log(R/D_{84}))$)	~~5.04~~ 4.23	ft/s
Discharge (using $Q=A_{BKF}u$)	~~157.65~~ 132.4	cfs

Manning's "n" by Stream Type		
Stream Type	C4	
Manning's "n" (see Reference Reach Field Book (p.187), River Field Book (p.237)	0.04	
Velocity (using Manning's equation: $u=1.49R^{(2/3)}S^{(1/2)}/n$)	4.45	ft/s
Discharge (using $Q=A_{BKF}u$)	139.36	cfs

Limerinos Equation (1970)		
Manning's "n" (using $"n"=(R^{(1/6)}0.0926)/(1.16+2\log(R/D84))$)	0.03	
Velocity (using Manning's equation: $u=1.49R^{(2/3)}S^{(1/2)}/n$)	5.32	ft/s
Discharge (using $Q=A_{BKF}u$)	166.62	cfs

Jarretts Equation for Estimating Manning's n		
$n = 0.39\ S^{0.38}\ R^{-0.16}$	0.07	
Velocity (using Manning's equation: $u=1.49R^{(2/3)}S^{(1/2)}/n$)	2.58	ft/s
Discharge (using $Q=A_{BKF}u$)	80.76	cfs

Continuity Equation

MD Piedmont Curve 126.56
MD Ridge & Valley curve 56.02

River Name: UT Little Bennett River 2007
Reach Name: Reach 1
Survey Date: 09/21/2007

Upper Bank

Landform Slope:	2
Mass Wasting:	3
Debris Jam Potential:	4
Vegetative Protection:	9

Lower Bank

Channel Capacity:	2
Bank Rock Content:	6
Obstructions to Flow:	3
Cutting:	16
Deposition:	10

Channel Bottom

Rock Angularity:	2
Brightness:	3
Consolidation of Particles:	5
Bottom Size Distribution:	8
Scouring and Deposition:	12
Aquatic Vegetation:	4

Channel Stability Evaluation

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

Rating - 89
Condition - Good

River Assessment and Monitoring: Impaired Reach 2nd Field Day

h. Modified Pfankuch Channel Stability Rating

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

Stream: **Location:** **Valley Type:** **Observers:** **Date:**

Location	Key	Category	Excellent Description	Excellent Rating	Good Description	Good Rating	Fair Description	Fair Rating	Poor Description	Poor 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.	6
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm. 3	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. 10	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. 5	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 =	5	**Good total =**	31	**Fair total =**	~~27~~ 33	**Poor total =**	20

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	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

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

Grand total =	89
Existing stream type =	C4
*Potential stream type =	
Modified channel stability rating =	Good

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b. Flow Regime

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

FLOW REGIME

Stream: UT Little Bennett Cr Location: Montgomery Co., MD

Observers: Team 4 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.

B 25 →

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c. Stream Size and Order

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

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

→ B-25

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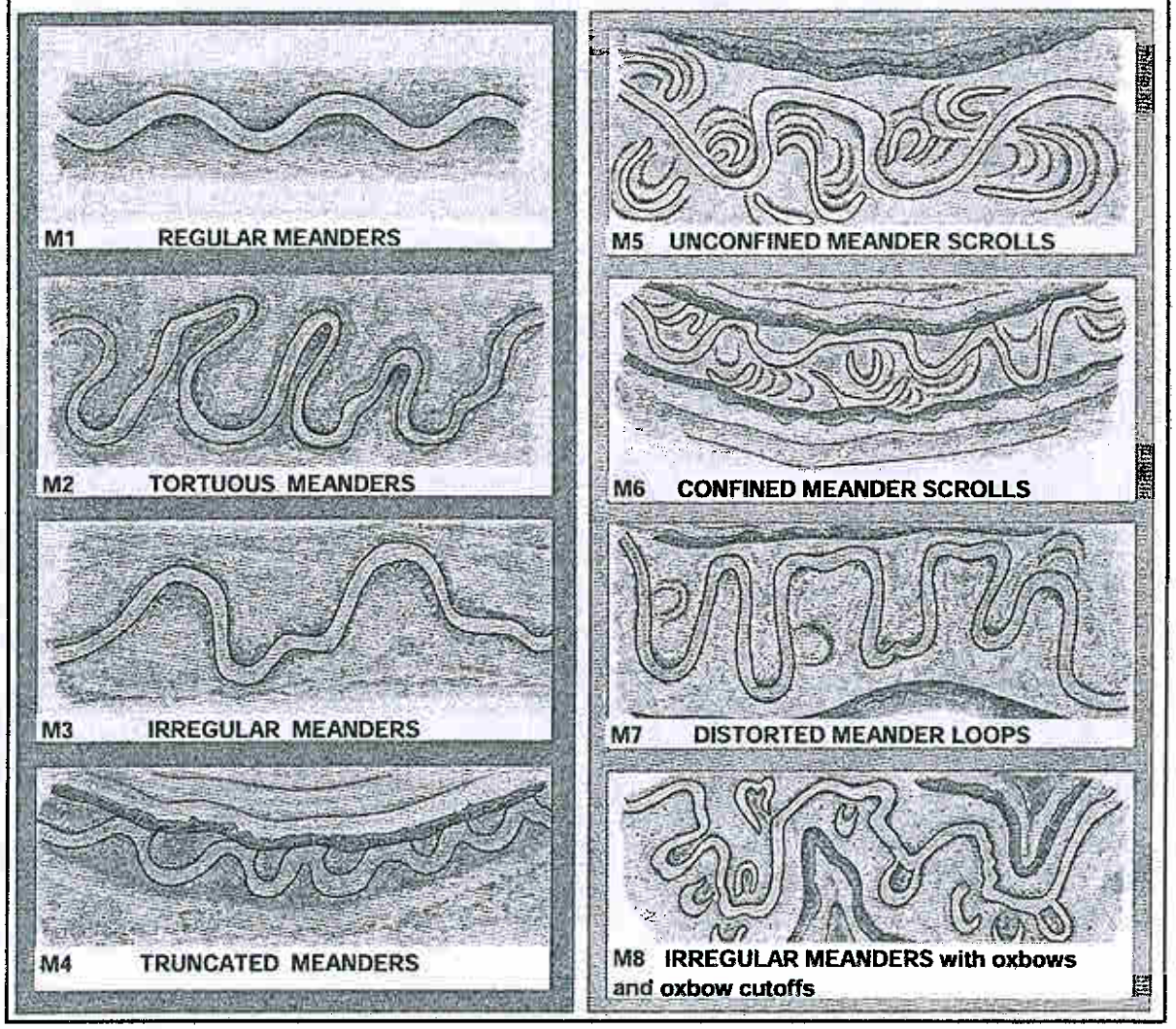
d. Meander Patterns

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

Meander Patterns					
Stream: UT Little Bennett Cr.		Reach: 4			
Observers: Team 4		Date: 9/21/07			
List ALL CATEGORIES that APPLY ☞	M3				

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



→B-20

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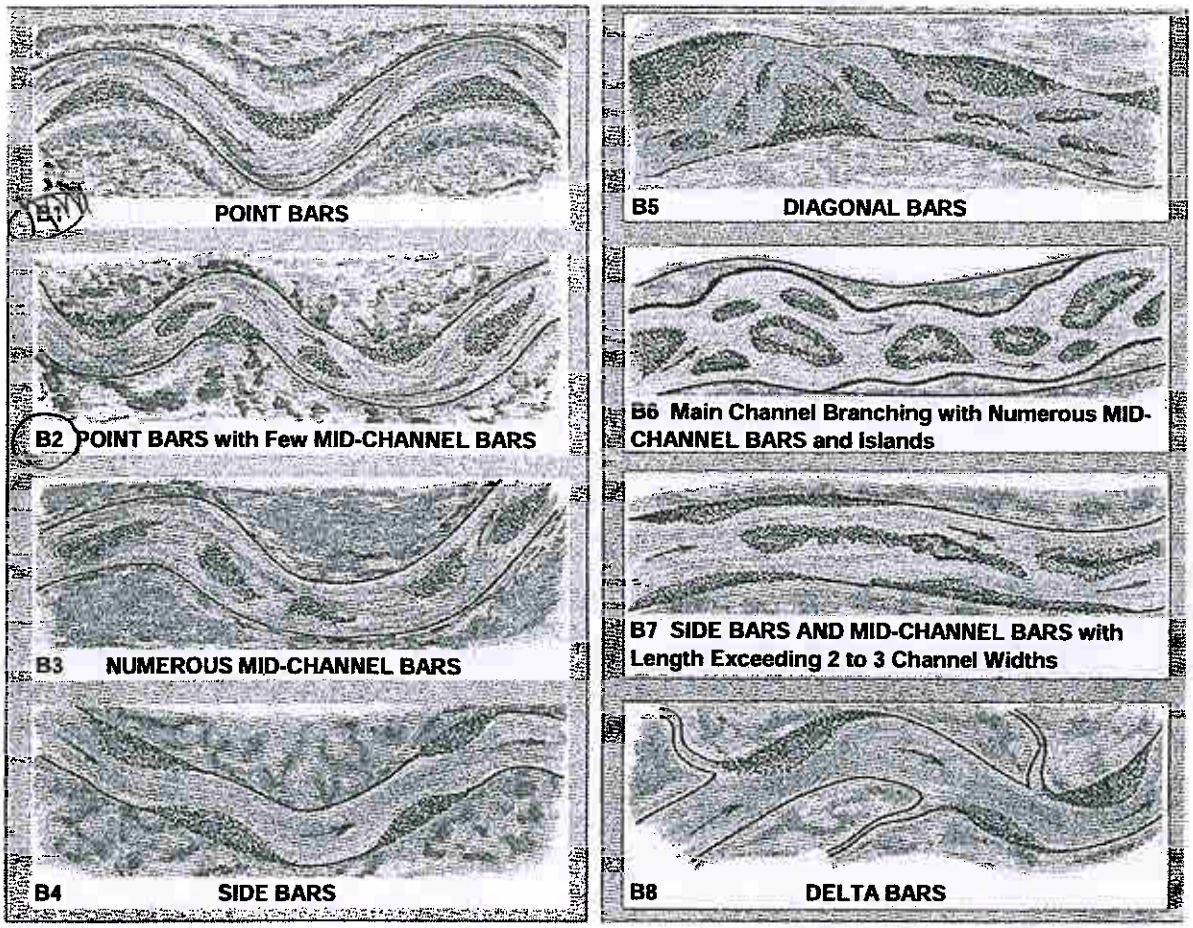
e. Depositional Patterns

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

Depositional Patterns					
Stream: UT Little Bennett Cr		Reach: 4			
Observers: Team 4		Date: 9/21/07			
List ALL CATEGORIES that APPLY ☞	B2				

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



→ B20, B21

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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 Cr		Location: Montgomery Co. MD	
Observers: Team 4		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.	☐

→ B21

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

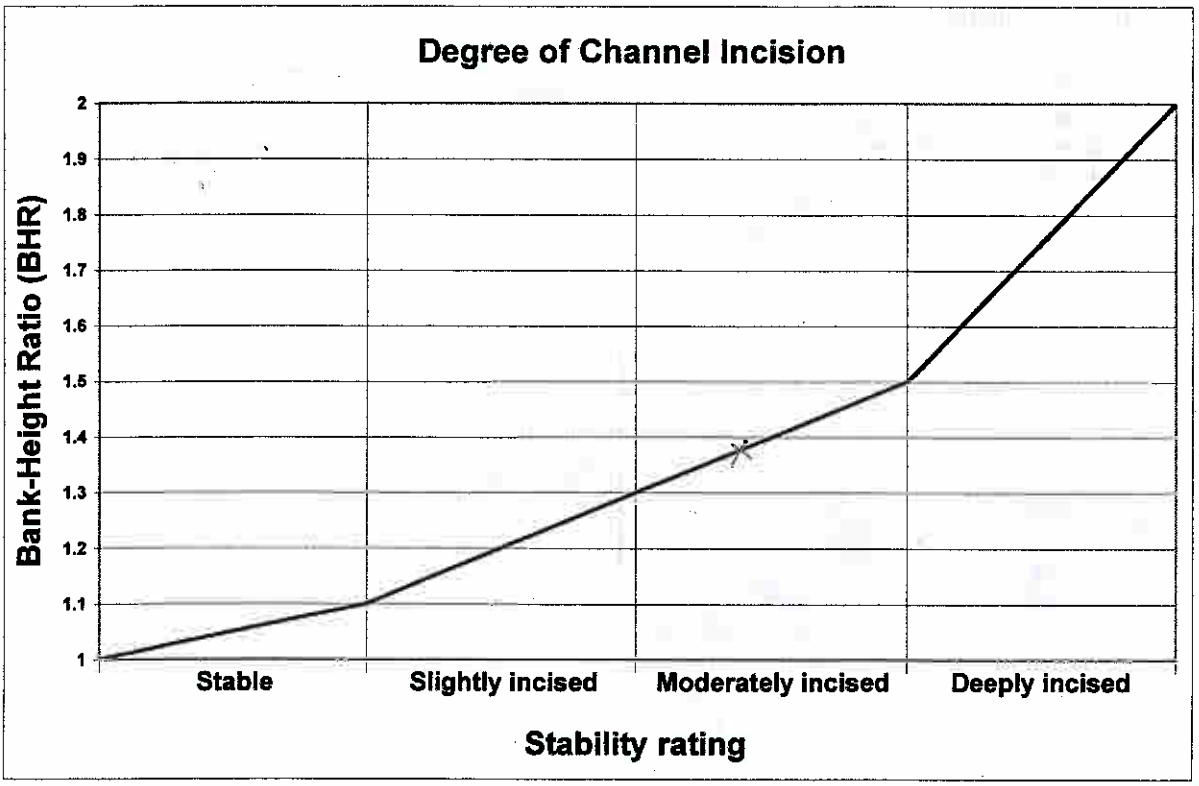
Worksheet A-10. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings to determine degree of channel incision.

Degree of Channel Incision

Low Bank Height:	2.36
Max Bankfull Depth:	1.73

Bank-Height Ratio:	1.36

Degree of Channel Incision Stability Rating ☞ Moderately Incised



Done at one site that is representative of the reach

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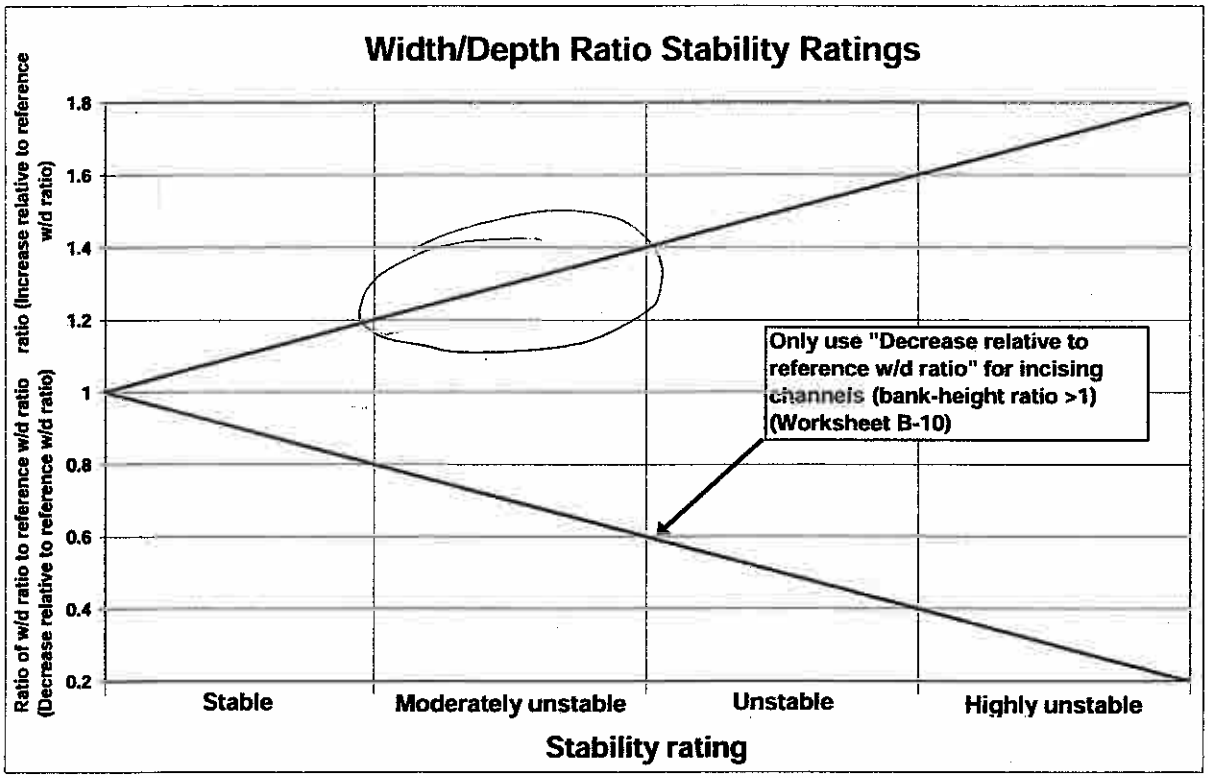
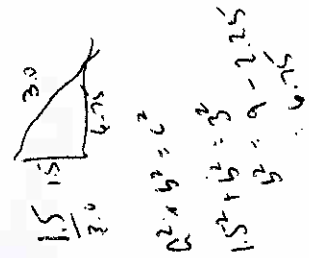
i. Width/Depth Ratio State

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

Width/Depth Ratio State			
Existing Width/Depth Ratio:	17.7	Ratio of existing w/d to reference w/d:	1.36
Reference Width/Depth Ratio:	13.0		
Width/Depth Ratio State Stability Rating ☞	moderately unstable		



B20, B21



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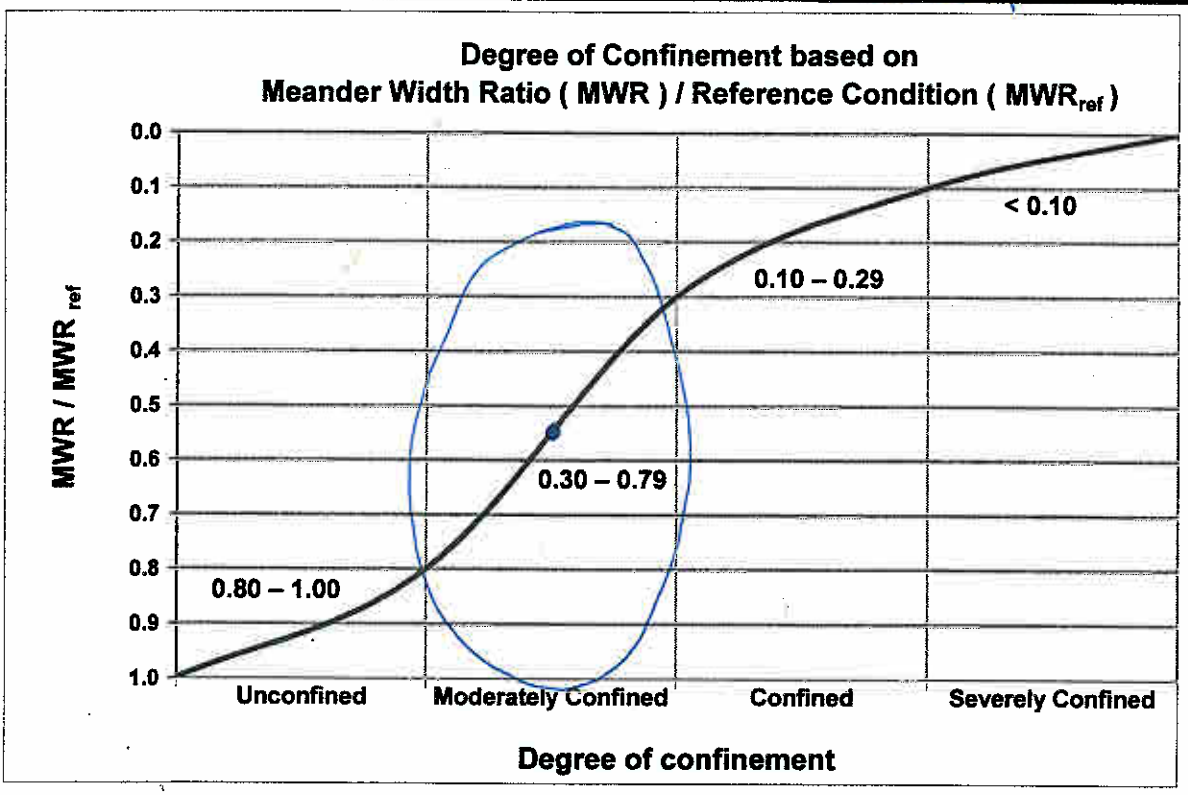
j. Degree of Channel Confinement (Meander Width Ratio (MWR))

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): $\frac{W_{ALT}}{W_{REF}}$	2.88	Ratio of MWR to MWRref:	0.63
Reference Meander Width Ratio (MWR_{ref}):	4.59	C4 = 4-10	
Degree of Confinement Stability Rating	Moderately Confined		



D22

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream: Little Bennett		Stream Type: C4	
Location:		Valley Type: 8	
Observers: Team 4		Date: 9/22/2007	

Enter required information

46.1	D_{50}	Riffle bed material D_{50} (mm) – active			
16.8	$\hat{D}_{50}$	Bar sample D_{50} (mm) 1			
0.197	D_{max}	Largest particle from bar sample (ft)	60	(mm)	304.8 mm/ft
0.0113	S_{bkf}	Existing bankfull water surface slope (ft/ft)			
1.33	d	Existing bankfull mean depth (ft)			
1.65	γ_s	Submerged specific weight of sediment			

0.009

Select the appropriate equation and calculate critical dimensionless shear stress

2.74	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
1.30	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
0.030	τ^*	Bankfull Dimensionless Shear Stress		EQUATION USED:	2

$\frac{46.1}{16.8} =$ $\frac{60}{46.1} =$

Calculate bankfull mean depth required for entrainment of largest particle in bar sample

0.87	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}}{S} = \frac{0.030(1.65)(0.197)}{0.0113}$

1.083

Check: ☐ Stable ☐ Aggrading ☑ Degrading

Calculate bankfull water surface slope required for entrainment of largest particle in bar sample

0.007	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}}{d} = \frac{0.030(1.65)(0.197)}{1.33}$

Check: ☐ Stable ☐ Aggrading ☑ Degrading

Sediment competence using dimensional shear stress A = 31.3 ft² W = 26.25 ft

0.84	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) R = 1.19
133	Moveable particle size (mm) at bankfull shear stress (Figure B-4) D = 152.02 τc 0.7355 – Active Riffle Bed D84 = 85 mm D90 = 140 mm
0.28	Predicted shear stress required to initiate movement of D_{max} ~~(mm)~~ (Figure B-4) 60
0.40	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S} = \frac{0.28}{62.4(0.0113)}$
0.0034	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d} = \frac{0.28}{62.4(1.33)}$

400/

62.4(1.33)(0.0113)

existing slope

existing depth

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream: Little Bennett		Stream Type: C4	
Location:		Valley Type: 8	
Observers: Team 4		Date: 9/22/2007	

Enter required information

46.1	D_{50}	Riffle bed material D_{50} (mm)			
18.8	$\hat{D}_{50}$	Bar sample D_{50} (mm) 2			
0.31	D_{max}	Largest particle from bar sample (ft)	95	(mm)	304.8 mm/ft
0.0113	S_{bkf}	Existing bankfull water surface slope (ft/ft)			
1.33	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

2.45	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
2.06	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
0.020	τ^*	Bankfull Dimensionless Shear Stress		EQUATION USED:	2

$\frac{46.1}{18.8}$ $\frac{95}{46.1}$ = 0.030

Calculate bankfull mean depth required for entrainment of largest particle in bar sample

~~0.91~~ 1.4'	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}}{S} = \frac{0.020(1.65)(0.31')}{0.0113}$

Check: ☐ Stable ☐ Aggrading ☑ Degrading

Calculate bankfull water surface slope required for entrainment of largest particle in bar sample

0.0077	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}}{d} = \frac{0.020(1.65)(0.31')}{1.33}$

Check: ☐ Stable ☐ Aggrading ☑ Degrading

Sediment competence using dimensional shear stress A = 31.3 ft² W = 26.25 ft R = 1.19

0.84	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) (62.4)(1.33)(0.0113)
133	Moveable particle size (mm) at bankfull shear stress **(Figure B-4)** D_{84} - active riffle bed = 85mm
0.50	Predicted shear stress required to initiate movement of D_{max} (95 mm) **(Figure B-4)**
0.70	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S} = \frac{0.50}{62.4(0.0113)}$ Existing slope
0.006	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d} = \frac{0.50}{62.4(1.33)}$ Existing Depth

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream: Little Bennett			Stream Type: C4		
Location: Reach 4			Valley Type: 8		
Observers: Team 4			Date: 9-21-07		
Enter required information					
46.1	D_{50}	Riffle bed material D_{50} (mm)			
16.8	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.197	D_{max}	Largest particle from bar sample (ft)	60	(mm)	304.8 mm/ft
0.009	S	Existing bankfull water surface slope (ft/ft)			
1.33	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					
2.74	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
1.30	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
0.030	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:		
Calculate bankfull mean depth required for entrainment of largest particle in bar sample					
1.083	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					
0.007	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					
0.67		Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d)			
Shield 40	CO 105	Moveable particle size (mm) at bankfull shear stress **(Figure B-4)**			
0.9	0.3	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure B-4)**			
1.6	0.5	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$			
1.9	.0036	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$			

R = 1.19

$\gamma = 62.4$ = Specific Gravity of water

Shields = Aggrading

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SCOUR LINE

River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Enter required information					
	D_{50}	Riffle bed material D_{50} (mm)			
	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
	D_{max}	Largest particle from bar sample (ft)		(mm)	304.8 mm/ft
0.0113	S	Existing bankfull water surface slope (ft/ft)			
0.95	~~d~~ R	Existing bankfull mean depth (ft) $R = \frac{A}{WP} = \frac{22.5 ft^2}{23.7 ft} = 0.95 ft$			
1.65	γ_s	Submerged specific weight of sediment			
Select the appropriate equation and calculate critical dimensionless shear stress					
	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:		
Calculate bankfull mean depth required for entrainment of largest particle in bar sample					
	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					
	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 $\gamma = 62.4\ lb/ft^3$					
0.67	Bankfull shear stress $\tau = \gamma dS$ ($= \gamma RS$) (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) ($R = 0.95$)				$= 62.4(0.95)(0.0113)$
113	Moveable particle size (mm) at bankfull shear stress **(Figure B-4)** $D = 152.02\,\tau_c^{0.7355}$				
	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure B-4)**				
	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$				
	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$				

scour line →

Dmax Bar Sample = 95 mm

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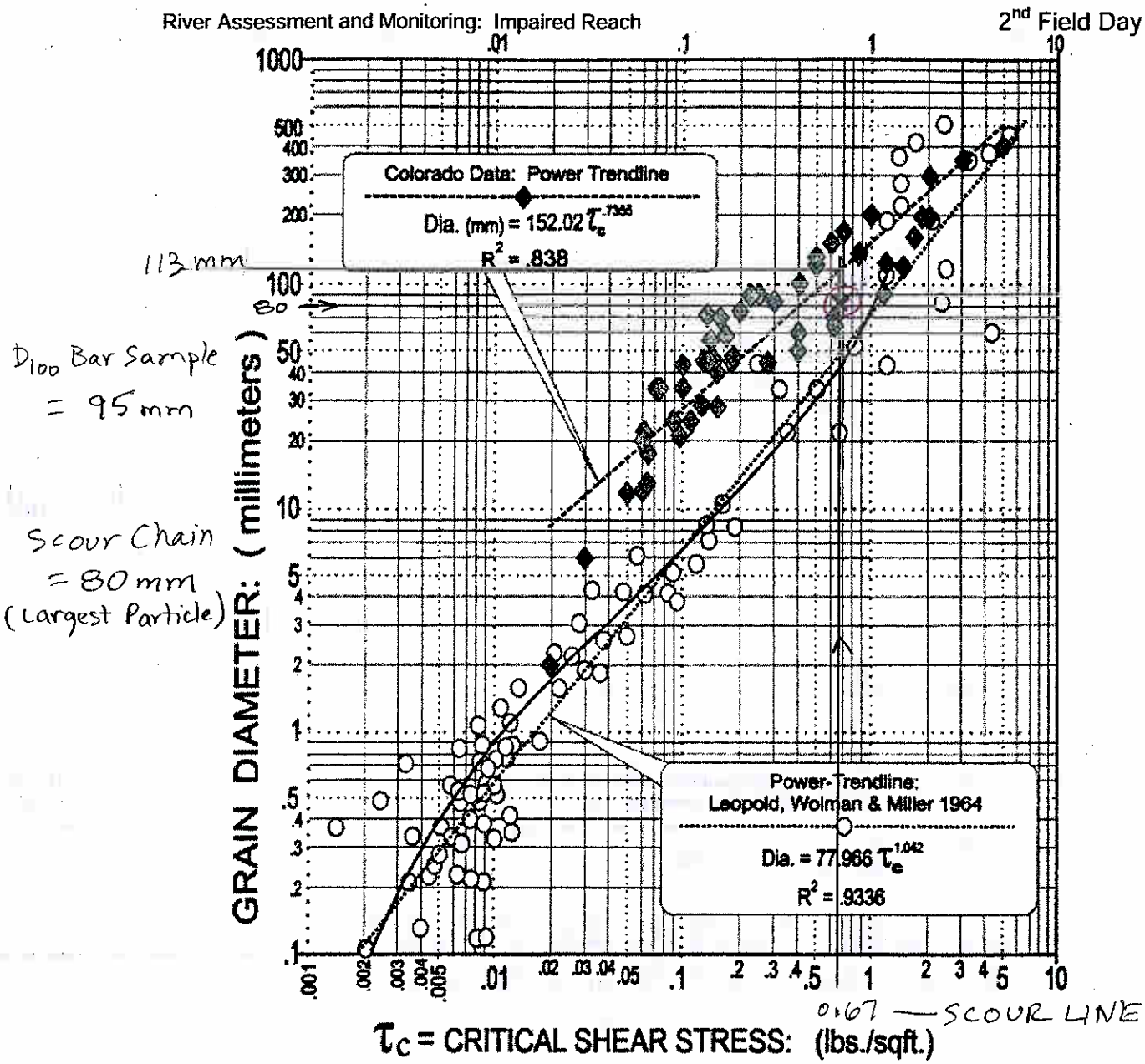

Laboratory and field data on critical shear stress required to initiate movement of grains (Leopold, Wolman, & Miller 1964). The solid line is the Shields curve of *the threshold of motion*, transposed from the Θ versus R_g form into the present form, in which critical shear stress is plotted as a function of grain diameter.

○ Leopold, Wolman & Miller: 1964
◆ Colorado Data (Wildland Hydrology)

Figure B-4. Critical shear stress required to initiate movement of bed-material grains following the Shields relation (Leopold et. Al, 1964), as modified by field data from Colorado (Rosgen, 2005).

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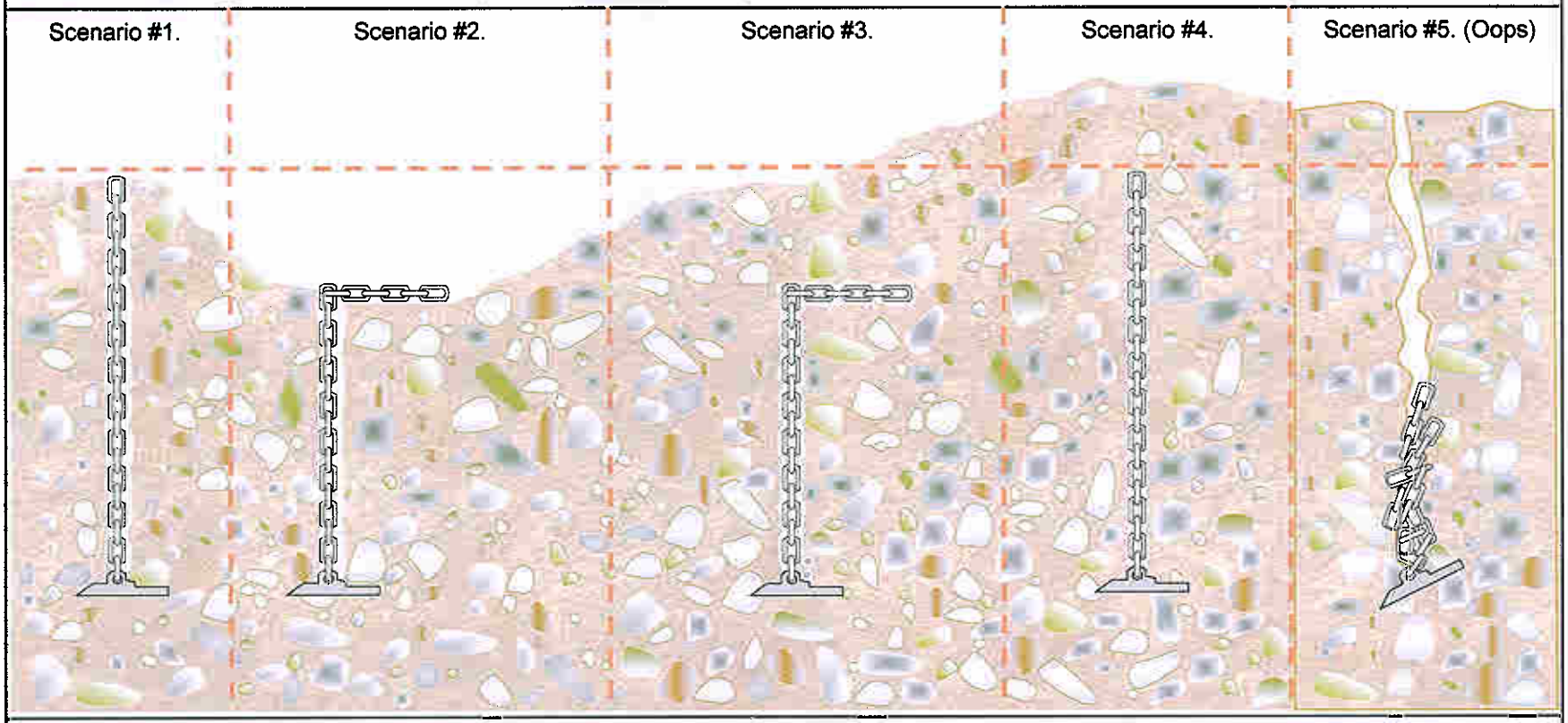
UT Little Bennett Creek Team 4 9/21/2007

Worksheet 6-1. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name:	**UT Little Bennett Creek**					Location:					
Observers:						Stream Type: **c4**		Valley Type: **VIII**		Date:	
		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	20	96.20	69	47	**3**	**- 0.19**	96.35	+0.15	**80**	**47**
Riffle	Chain #2	32	96.88	41	27	**1**		96.88	—	**34**	**20**
Glide	Chain #3										
Glide	Chain #4										



[a] Scenario 2 or 3. Scenario 2: Enter length of chain exposed. Scenario 3: Enter length of chain exposed then subsequently buried.
[b] Scenario 3 or 4. Scenario 3: Enter elevation of bed at same station @ 2nd year. Scenario 4: Enter depth of material over chain.
[c] Scenario 3: Subtract 1st and 2nd year elevations to calculate net change in bed.

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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: **UT Little Bennett (2007), Reach 1, riffle 0+99.5, (Rifl** 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%	5.55	2.85	2.11	9.44	0.22	1.35	0.008	0.11	1.60	0.17	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	8.05	6.80	3.91	12.14	0.32	1.74	0.008	0.16	3.82	0.31	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.85	8.95	4.94	14.64	0.34	1.81	0.008	0.17	5.03	0.34	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	12.35	11.10	5.93	16.94	0.35	1.87	0.008	0.18	6.23	0.37	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	16.10	14.23	7.32	19.94	0.37	1.94	0.008	0.19	7.99	0.40	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	19.71	17.91	8.41	20.06	0.42	2.11	0.008	0.21	10.06	0.50	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	24.71	22.21	9.63	20.19	0.48	2.30	0.008	0.24	12.47	0.62	10%	36.50	0.00	0.20	0.00	0.02	0.02
20.0%	32.06	28.39	11.23	20.37	0.55	2.53	0.008	0.28	15.94	0.78	10%	36.50	0.00	0.20	0.00	0.02	0.02
10.0%	44.41	38.24	13.53	20.64	0.66	2.82	0.008	0.33	21.48	1.04	10%	36.50	0.40	0.40	0.04	0.04	0.08
5.0%	62.32	53.36	16.67	21.01	0.79	3.19	0.008	0.40	29.97	1.43	5%	18.25	0.90	0.70	0.05	0.03	0.08
4.0%	69.67	66.00	19.08	21.29	0.90	3.45	0.008	0.45	37.07	1.74	1%	3.65	1.30	1.1	0.01	0.01	0.02
3.0%	80.78	75.22	20.74	21.48	0.97	3.62	0.008	0.48	42.24	1.97	1%	3.65	2.20	1.60	0.02	0.02	0.04
2.0%	104.23	92.51	23.69	21.85	1.08	3.90	0.01	0.54	51.95	2.38	1%	3.65	3.50	2.80	0.04	0.03	0.07
1.5%	125.19	114.71	27.41	22.73	1.21	4.18	0.008	0.59	64.42	2.83	1%	1.83	4.80	5.20	0.02	0.03	0.05
1.0%	157.95	141.57	31.64	23.63	1.34	4.47	0.01	0.66	79.51	3.36	1%	1.83	9.50	9.50	0.05	0.05	0.10

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr)	84.0	105.9	189.8
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-40.1	-18.2	-58.2
Stability evaluation: Aggradation, Degradation or Stable:			

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

Stream: **Macgruder Branch, Reach 3, Reference Riffle, (Riff** 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	11.70	14.70	0.06	0.07	0.13
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr)					124.1	124.1	248.2

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

Stream:	Stream Type:
Location:	Valley Type:
Observers:	Date:
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 - $C^{w/o}$ - 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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Worksheet B-20. Lateral stability prediction summary.

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			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 B-12)**	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	4
	(2)	(4)	(6)	(8)	
2 **Depositional pattern (Worksheet B-8)**	B1, B2	B4, B8	B3	B5, B6, B7	4
	(1)	(2)	(3)	(4)	
3 **Meander pattern (Worksheet B-7)**	M1, M3, M4		M2, M5, M6, M7, M8		1
	(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	6
	(2)	(4)	(6)	(8)	
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet B-13)**	0.8 – 1.0	0.3 – 0.79	0.1 – 0.29	< 0.1	2
	(1)	(2)	(3)	(4)	
				Total points	~~14~~ 17
	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** ☐	

+5

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

Stream:	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 (2)	Trend toward insufficient depth and/or slope-slightly incompetent (4)	Cannot move D_{35} of bed material and/or D_{100} of bar material (6)	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size (8)	4
2 **Sediment capacity (POWERSED)**	Sufficient capacity to transport annual load (2)	Trend toward insufficient sediment capacity (4)	Reduction up to 25% of annual sediment yield of bedload and/or suspended (6)	Reduction over 25% of annual sediment yield for bedload and/or suspended (8)	8
3 **W/d ratio state (Worksheet B-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	4
4 **Stream succession states (Worksheet B-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	~~4~~ 6
5 **Depositional patterns (Worksheet B-8)**	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	~~2~~ 3
6 **Debris / blockages (Worksheet B-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	1
				Total points	~~23~~ 26

Vertical stability for excess deposition / aggradation (use total points and check stability rating)	Vertical stability category point range for excess deposition / aggradation			
	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:			Stream Type:		
Location:			Valley Type:		
Observers:			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 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)	2
2 **Sediment capacity (POWERSED)**	Does not indicate excess capacity (2)	Slight excess energy: up to 10% increase above reference (4)	Excess energy sufficient to increase load up to 50% of annual load (6)	Excess energy transporting more than 50% of annual load (8)	2
3 **Degree of channel incision (BHR) (Worksheet B-10)**	1.00 – 1.10 (2)	1.11 – 1.30 (4)	1.31 – 1.50 (6)	> 1.50 (8)	~~6~~ 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)	~~3~~ 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)	2
				Total points	~~15~~ 10
	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 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) (2)	(E→C) C-E^w-C (4)	(G→F), (F→D) (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	4
2 **Lateral stability (Worksheet B-20)**	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	6
3 **Vertical stability excess deposition/ aggradation (Worksheet B-21)**	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	6
4 **Vertical stability incision/ degradation (Worksheet B-22)**	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	4
				Total points	20
	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:	Stream Type:
Location:	Valley Type:
Observers:	Date:

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
	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	2
	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	4
	Fair: mod unstable	2	
	Poor: unstable	4	
		Total Points	~~12~~ 15

	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:			Location:		
Observers:		Date:	Stream Type:	Valley Type:	
Channel Dimension	Mean bankfull depth (ft): 1.33	Mean bankfull width (ft): 23.6	Cross-section area (ft^2): 31.3	Width of flood-prone area (ft): 150	Entrenchment ratio: 6.36
Channel Pattern	Mean (range)	MWR: 2.88	Lm/W_{bkf}: 6.13	Rc/W_{bkf}: 1.82	Sinuosity: 1.53
River Profile and Bed Features	Circle: Riffle/pool Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed				
	Max bankfull depth (ft): Riffle 1.92, Pool 4.16	Depth ratio (max/mean): Riffle 1.38, Pool 3.15	Pool to pool spacing: Ratio 50.4	Slope: Valley: 0.0123 VIII	Average bankfull: 0.0113
Level III Stream Stability Indices	Riparian vegetation	Current composition/density:	Potential composition/density:	Remarks: Condition, vigor and/or usage of exiting reach:	
	Flow regime: P2	Stream size and order: S-4(3)	Meander pattern(s): M3	Depositional pattern(s): ~~D1, D2~~ B2	Debris/channel blockage(s): D1, D2
	Degree of incision (Bank-Height Ratio): 1.36	Degree of incision stability rating: MOD. INCISED	Modified Pfankuch stability rating (numeric and adjective rating): ~~89 (GOOD)~~		
	Width/depth ratio (W/D): ~~1.36~~ 11.1	Reference W/D ratio (W/D_{ref}): ~~11.6~~ 13.0	Width/depth ratio state (W/D) / (W/D_{ref}): 1.36	W/D ratio state stability rating: MODERATELY UNSTABLE	
	Meander Width Ratio (MWR): 2.88	Reference MWR_{ref}: 4.59	Degree of confinement (MWR / MWR_{ref}): 0.63	MWR / MWR_{ref} stability rating: MODERATELY CONFINED	
Bank Erosion Summary	Length of reach studied (ft): 168	Annual streambank erosion rate: 64.23 (tons/yr)	0.38 (tons/yr/ft)	Curve used: MARYLAND/DC	Remarks: NONE AT THIS TIME
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks: CELL 1 USE ONLY		
Entrainment/ Competence	Largest particle from bar sample (mm): 95 mm	$\tau = 0.84$	$\tau^* = 0.020$	Existing $depth_{bkf}$: 1.33	Required $depth_{bkf}$: 0.70
	Existing $slope_{bkf}$: 0.0113	Required $slope_{bkf}$: 0.006			
Successional Stage Shift	C → ~~E~~ → ~~F~~ → WIDE C → → → →	Existing stream state (type): C4	Potential stream state (type): C4		
Lateral Stability	Circle: Stable Moderately unstable Unstable Highly unstable	Remarks/causes: SCOUR IN POOLS			
Vertical Stability (aggradation)	Circle: No deposition Moderate deposition Excess deposition Aggradation	Remarks/causes: SOME DEGRADATION IN RIFFLES			
Vertical Stability (degradation)	Circle: Not incised ~~Slightly incised~~ Moderately incised Degradation	Remarks/causes: PREVIOUS BUNOUT INCISED			
Channel Enlargement	Circle: No increase Slight increase Moderate increase Extensive	Remarks/causes: HIGH W/D RATIO			
Sediment Supply (Channel Source)	Circle: Low Moderate High Very high	Remarks/causes:			

REMARK: IF YOU DONT KNOW BANKFULL, YOU DONT KNOW SHIT!!

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9/21/2007 Team 4 UT Little Bennett Creek

River Assessment and Monitoring: Impaired Reach 2nd Field Day

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	$Width_{BKF}$	24.5	23.6	20.33	20.25		
	Mean $depth_{bkf}$	1.28	1.33	1.96	1.95		
	Width/depth ratio	19.14	17.74	10.37	10.37		
	Cross-sectional $Area_{bkf}$	31.34	31.3	39.94	39.41		
	Max $depth_{bkf}$	1.98	1.92	5.42	4.16		
Pebble count	D_{35} (mm)	18.78	38.72	≈0.6	≈0.75		
	D_{50} (mm)	24.95	46.06	≈2.9	20.7		
	D_{84} (mm)	46.9	85.05	≈18.6	91.9		
Bank Erosion	BEHI rating	VH41.4	VH43.1	H32.5	H 31.4		
	NBS rating	MOD	LOW	High	VH		
	Predicted erosion (ft/yr)	0.26	0.42	0.51	1.71		
	Measured erosion (ft/yr)	—	.4844	—	.4066		

		Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating		96	90	Bar Sample	D_{35} (mm)	6.97	9.71
Bank-Height Ratio	start:	1.58	1.38		D_{50} (mm)	14.6	18.78
	end:	1.25	1.64		D_{84} (mm)	42.08	56.68
Point Bar slope		14%	30%		D_{100} (mm)	55	95
Riffle Length/Riffle Width		1.6	0.93				
Pool Length/Riffle Width		1.25	0.71				
Dimensionless Slope Ratios	S_{rif}/S	1.967	2.63	Dimensionless Depth Ratios	d_{rif}/d_{bkf}	1.71	1.379
	S_{run}/S	4.9	10.46		d_{run}/d_{bkf}	2.14	1.87
	S_p/S	0.050	0.027		d_p/d_{bkf}	4.23	3.15
	S_g/S	0.163	0.191		d_g/d_{bkf}	2.06	1.64

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STREAM SURVEY

CROSS SECTION

STREAM	Bennett	DATE	9/21/07
REACH	04	CREW	TOM/GREG
XS	RiFFle	STATION	8+995

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

NOTE	Station DIST.	ELEV./ DEPTH	NOTE	DIST.	ELEV./ DEPTH
T/ MON	0	4.61			
GL MON	0	5.03			
GS	4	5.13			
GS	7	5.05			
GS	10	4.94			
GS	14	5.19			
LTOB	16.2	5.32			
SLB BRK	16.5	5.55			
Tape at Bottom	16.7	8.37	0.32 WSEL		
	16.21	6.25			
	16.13	7.41			
LEW Station	15.88	8.07	water surface *		
	15.82	8.11			
(end of top Bank area)	16.7	8.37	(-0.30 ft elev depth off Rod)		
CS/TW	17.5	8.39			
LGPIN	18	8.36			
TPIN	18	7.73			
RGPIN	18	8.30			
CS	19	8.14			
Scour Pin	20	8.12			
CS	21	8.21			
CS	23.0	8.23			
REW	25.1	8.08			
CS	26.0	7.83			
CS	28.0	7.82			
CS	31.0	7.68			
Scour chain	32.0	7.71			
CS	33.5	7.65			
Toe	36.0	7.59	GS	64.0	3.98
SL BRK	38.0	6.80	GR MON	66.0	3.99
TOB (inside bank)	40	6.44	TP MON	66.0	3.41
BKF	41	6.47			
SL BRK	45	6.63			
SL BRK	46.1	6.89			
SL BRK	49.0	7.06			
SL BRK	51.0	7.03			
SL BRK	53.5	7.21			
Toe of Slope	55.6	7.20			
SL BRK	56.3	6.75			
SL BRK	57.0	6.22			
SL BRK	58.4	5.14			
RTOB	59.8	4.09			
GS	62	4.01			

NOTATIONS

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

ENTRENCHMENT			
FLOODPRONE ELEVATION			
FLOODPRONE WIDTH			
BANKFULL WIDTH			
ENTRENCHMENT			
Pebbles	ST.	UP(2)	DS(2)
Scour chain	+20	22MM	80MM
		45MM	47MM
Scour chain	+32	34MM	8MM
		9MM	20MM

Double check BANK EROSION MEASURES

4.61
3.41
1.20

8.07
6.45
1.62

Water level @ gage .5 ft.
water depth @ gage 1.74

River Assessment and Monitoring: Impaired Reach

2nd Field Day

UT Little Bennett Creek Team 4 9/21/2007

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

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis

Observers: Adam / Scott / Sandy

Stream:

Location:

Date:

Subsamples	0	2	4	8	16	32	64	128	256	512
	Catch Pan or BUCKET	Sieve SIZE 2 mm	Sieve SIZE 4 mm	Sieve SIZE 8 mm	Sieve SIZE 16 mm	Sieve SIZE 32 mm	Sieve SIZE 64 mm	Sieve SIZE 128 mm	Sieve SIZE 256 mm	
Tare weight	2 lb	2lb 2oz	2lb 6oz	2lb 6oz	2lb 9oz	2lb 10oz	2lb 6oz			
Sample weights Total	8/14	4/0	4/8	5/10	7/10	8/4	4/4			
Sample weights Net	6/4	1/14	2/2	3/4	5/1	5/10	1/14			
1		3/13	4/4	5/4	6/12	5/14				
2		1/11	1/14	2/14	4/3	3/4				
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
Net wt. total	6/4	3/9	4/10	6/2	9/4	8/14	1/14			
% Grand total										
Accum. % =<	6.25	3.56	4.0	6.13	9.25	8.88	1.88			

SURFACE MATERIALS DATA (Two largest particles)

No.	Dia.	WT.
1	60	10 oz
2	60	4 oz

Rosgen Rocks

Bucket + materials weight	43.25
Bucket tare weight	2 lb
Materials weight	41.25
Materials less than:	mm

Be sure to add separate material weights to grand total

39/15

GRAND TOTAL SAMPLE WEIGHT

Sample location notes

Rosgen Rocks
95 .75 lb
85 2.5 lb

Sample location sketch

1.1
39

Point bar shape

.75
3.3

Station 158 ft. on Long Pro

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Bankfull to Bankfull - 5% of pebble from bank - Rich 5PC

RIFFLE PEBBLE COUNT - 100 under tape (Riffle X-sec)

STREAM:	**DATE:**
REACH:	**CREW:** PM Romely
XS No.:	**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											6	6
	Very Fine	.062 - .125	S												
	Fine	.125 - .25	A											3	9
	Medium	.25 - .50	N											1	10
	Coarse	.50 - 1.0	D											1	11
	Vry Coarse	1.0 - 2	S 12												
	Very Fine	2 - 4												2	13
	Fine	4 - 6	G											5	18
	Fine	6 - 8	R											1	19
	Medium	8 - 12	A 29											9	28
	Medium	12 - 16	V 37											8	36
	Coarse	16 - 24	E 56											19	55
	Coarse	24 - 32	L 67											11	66
	Vry Coarse	32 - 48	S 80											13	79
	Vry Coarse	48 - 64	92											12	91
0.21-0.31	Small	64 - 96	C 100											9	100
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		6		11	
2		7		12	
3		8		13	
4		9		14	
5		10		15	

UT Little Bennett Creek Team 4 9/21/2007

① Put pabble back in place
② Bank included ?

4.PC

RIFFLE PEBBLE COUNT – Active Bed @ Riffle X-sec.

STREAM:	**DATE:**
REACH:	**CREW:** Randy PM
XS No.:	**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											3	
	Medium	12 - 16	V											2	
	Coarse	16 - 24	E											6	
	Coarse	24 - 32	L											9	
	Vry Coarse	32 - 48	S											29	
	Vry Coarse	48 - 64												18	
0.21-0.31	Small	64 - 96	C											21	
0.31-0.42	Small	96 - 128	O											11	
0.42-0.63	Large	128 - 192	B											1	
0.63-0.84	Large	192 - 256	L												
0.84-1.26	Small	256 - 384	B												
1.26-1.68	Small	384 - 512	L												
1.68-3.36	Medium	512 - 1024	D												
3.36-6.72	Lrg	1024 - 2048	R												
6.72-13.43	Vry Lrg	2048-4096													
	Bedrock	>4096	BDRK												

LARGEST PARTICLES ON BAR

115mm

Dmax = 140mm

100

Bar Location (also mark on reach sketch):

Riffle length = 2.6 ft. 23'

Bar Length:
Bar Width (Thalweg - BF):
Sketch bar profile (Thalweg - BF)

Bar Sample
Dmax = 105mm
(active bar slope)

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

UT Little Bennett Creek Team 4 9/21/2007

$P_1 = 20$ $P_2 = 10$, Randy

ROSGEN REPRESENTATIVE REACH PEBBLE COUNT

STREAM:	DATE:
REACH:	CREW:

LB — R PARTICLE ~~TALLY COUNTS BY~~ TRANSECT — 1PC 2PC 3PC

ft	PARTICLE	mm		Ri 113	RU 230	P1 350	P1 470	G 564	Rif 606	Rum 722	P3 827	G 1439	R 1659	Tot Pool	Tot Riff	Comb Tot	%CUM
	Silt/Clay	< .062	S/C					●●		●					3	3	
	Very Fine	.062 - .125	S														
	Fine	.125 - .25	A	●								●●			3	3	
	Medium	.25 - .50	N														
	Coarse	.50 - 1.0	D				●						●	1	1	2	
	Vry Coarse	1.0 - 2	S			●●								4		4	
	Very Fine	2 - 4						●			●●●			3	1	4	
	Fine	4 - 6	G														
	Fine	6 - 8	R						●						1	1	
	Medium	8 - 12	A				●	●●			●			2	2	4	
	Medium	12 - 16	V		●			●		●					3	3	
	Coarse	16 - 24	E	●●	●●	●●	●●	●●	●●		●●	●	●	7	11	18	
	Coarse	24 - 32	L		●●		●●	●	●●	●●		●		2	8	10	
	Vry Coarse	32 - 48	S	●●			●	●	●●	●●	●	●●	●	2	11	13	
	Vry Coarse	48 - 64		●●	●●	●	●	●	●	●●	●●	●●	●	4	10	14	
0.21-0.31	Small	64 - 96	C	●●	●●					●		●●	●●		12	12	
0.31-0.42	Small	96 - 128	O			●●	●			●	●		●	4	2	6	
0.42-0.63	Large	128 - 192	B			●							●●	1	2	3	
0.63-0.84	Large	192 - 256	L														
0.84-1.26	Small	256 - 384	B													100	
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														
			FEATURE SAMPLED														

	Length	Proportion	No. Units	Sampled
REACH				
POOL				
RIFFLE				
RUN				

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

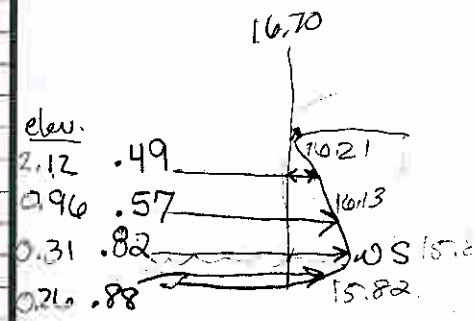
UT Little Bennett Creek Team 4 9/21/2007

UT to Little Bennett Creek
Reach 4 - Riffle Cross Section

STATION	ELEVATON	NOTE
0	100	TLMON
0	99.59	GLMON
4	99.52	GS
7	99.47	GS
10	99.69	GS
14	99.43	GS
16.2	99.4	LTOB
16.5	99.16	SLP BRK
16.5	97.84	SLP BRK
16.8	96.43	LEW
16.8	96.38	CS
18	96.2	GTPIN
18	96.86	TTPIN
18	96.15	GTPIN
19.4	96.16	TW
20	96.2	SCOUR CHAIN
21	96.27	CS
22.5	96.38	CS
23	96.47	REW
25	96.55	CS
28	96.82	CS
31	96.87	CS
32	96.88	SCOUR CHAIN
34	96.89	TOE
36	96.98	SLP BRK
38	97.75	SLP BRK
39.6	98.1	SLP BRK
41	98.13	BKF
45	97.98	SLP BRK
47	97.6	SLP BRK
49	97.55	SLP BRK
51	97.54	SLP BRK
53	97.43	SLP BRK
55.6	97.43	SLP BRK
56.3	97.85	SL SLP BRK
56.9	98.17	SL SLP BRK
57.8	98.96	SLP BRK
58.6	100.06	SLP BRK
59.2	100.42	RTOB
60	100.57	GS
64	100.65	GS
66	100.57	GRMON
66	101.22	TRMON

Survey Toe Pin

1.3ft Above WS Scour



16.7	8.37
-.49	-2.12
16.21	6.25
16.13	7.41
15.88	8.06
15.82	8.11

STREAM SURVEY

CROSS SECTION

STREAM	Bennett	DATE	9/21/07
REACH	04	CREW	TOM / GREG
XS	RUN	STATION	04 35 ups

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

NOTE	DIST.	ELEV. / DEPTH	NOTE	DIST.	ELEV. / DEPTH
GS	0	4.14			
GS	4.0	4.00			
LTOB	9.00	4.25			
CS	9.4	8.01			
LEW	9.5	8.06			
TW	11.5	8.27			
REW	13.3	8.06			
CS	16.0	7.74			
CS	20.0	7.48			
SLBRK	27.0	7.01			
SLBRK	29.0	6.72			
SLBRK	34.5	6.53	BKF	31.7	6.72
TOBRK/ROB	40.0	5.13			
SLBRK	43.0	5.54			
SLBRK	52.5	4.90			
SLBRK	55.7	4.09			
SLBRK	60.0	3.94			

NOTATIONS

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

ENTRENCHMENT

FLOODPRONE ELEVATION

FLOODPRONE WIDTH

BANKFULL WIDTH

ENTRENCHMENT

Long Pro. Station 37.00

1.2

~~HI - 7.78~~

STREAM SURVEY

CROSS SECTION

STREAM Bennett		DATE 9/21/07	
REACH Ø4		CREW TOM / GREG	
XS Glide	STATION Long. pro. 162.0		

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

NOTE	DIST.	ELEV. / DEPTH	NOTE	DIST.	ELEV. / DEPTH
GS	2.5	5.6			
TOB	3.0	5.73			
SLBRK	3.9	8.22			
SLBRK	10.0	8.24			
LTOB	13.0	8.26			
LEW WS	15.0	9.19			
CS	18.0	9.50			
TW CS	20.2	9.68			
CS	23.0	9.36			
REW WS	24.0	9.19			
SLBRK	26.0	6.95	Possible BKF	24.9	8.55
SLBRK	30.0	5.88			
~~SLBRK~~		Flat			

NOTATIONS

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

ENTRENCHMENT
FLOODPRONE ELEVATION
FLOODPRONE WIDTH
BANKFULL WIDTH
ENTRENCHMENT

~~HE~~ 7.78

STREAM SURVEY
CROSS SECTION

STREAM	Bennett	DATE	9/21/07
REACH	04	CREW	TOM / GREG
XS	Pool	STATION	55

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

NOTE	DIST.	ELEV. / DEPTH	100 NOTE	DIST.	ELEV. / DEPTH
TLMON	0	3.56			
GLMON	0	4.00			
GS	3	4.12			
GS	10	4.28			
GS	7.5	4.50			
LTOB	8.7	4.97			
W edge of cut CS	9.0	10.56	WS	9.0	8.08
U undercut LEW elev.	-1.41		*		
LGTPIN	10.0	10.26			
TTPIN	10.0	9.33			
RGTPIN	10.0	10.13			
CS	10.5	10.0			
CS	11.0	9.85			
CS	12.0	9.43			
CS	13.1	9.02			
CS	14.0	8.72			
REW	15.0	8.08			
SL BRK	16.0	7.84			
SL BRK	18.0	7.52			
SL BRK TB	20.0	6.64			
Flat	22.0	6.47			
Flat	26.0	6.34			
BKF	28.5	6.23			
Possible new BKF	30.4	6.08			
SL BRK	32.5	5.60			
SL BRK	34.0	5.11			
RTOB	35.0	5.03			
GS	37.0	5.12			
GS	39.0	5.30			
GS	40.0	5.61			
GS	41.0	5.44			
GS	42.0	5.37			
GS	44.5	5.26			
GS SLBRK	45	5.03			
GS SLBRK	48.0	4.88			
GS SLBRK	50.0	4.39			
GRMON	53.6	3.96			
GRMON	53.6	3.42			

NOTATIONS

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

ENTRENCHMENT
FLOODPRONE ELEVATION
FLOODPRONE WIDTH
BANKFULL WIDTH
ENTRENCHMENT

Include undercut measures into profile from bank erosion measure *

3.56
3.42
.14

UT Little Bennett Creek Team 4 9/21/2007

8.11
6.71
1.40

8.11
6.47
1.64

8.25
2.05
6.20

WS - BF = 1.6

Slower - WS = 1.3

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM Bennett | DATE 9-21-07

REACH 4 | CREW 96.88 el + 7.78 = 104.66 HI | Frank, Charles, Scott

(all measurements are in feet unless otherwise noted) BS FS

STATION	TW	WS	BKF	WS/BF	TOB	[redacted]	Other	COMMENT
3m Rif Top Pin						7.78	96.88	Back Sight bm
0	7.41	7.10			5.11			
15.5	7.60	7.43	6.03*	1.38	5.11	6.26 SL		CS, Slower
29.5	7.83	7.78				6.41 SL		CS
37.0	8.23	8.05						Top Run
39.0	8.44	8.09			5.11	6.46	6.31	TR Pool
43.0	9.34							
47.5	10.02	8.08				6.96 SL		T Pool
51.5	10.17	8.08						
55.0	10.71	8.09	6.24*	1.85	5.16			Pool Pin
65.5	9.61	8.09	6.25*	1.84	5.58			
70.5	9.00							T Glide
72.0	8.69	8.08	6.67*	1.41	5.58			
82.5	8.38	8.11	6.47*	1.64	5.58			T Riff
91.5	8.53	8.11	6.71*	1.4	5.54			CS
79.0						6.20 SL	?	?Slower Shot
93	8.37							CS
99.5	8.42	8.09	6.45*	1.64		6.50 OH	BKF	Riff XS } BKF =
104.0	8.32	8.19	6.67*	1.59				}
109	8.67	8.37	6.78*	1.59				
120.5	8.65	8.7	7.40	1.30	6.10			Shitty BKF
121.5	9.15	9.06	7.43	1.63				T Pool
	10.36							CS
123	11.81	9.06				8.06 SL		CS
131	10.69	9.05	7.29	1.76	5.87			CS
135.5	9.79	9.05						T Glide
143.0	9.27	9.01	7.22	1.80				CS
144.5	9.25	9.07						T Riffle
146	9.35	9.14						T Run
148	10.07	9.16						T Pool
153.5	10.62	9.18						CS Pool
161	9.71	9.18						T Glide
168.5	9.46	9.16	7.81	1.35	6.23			T Riff
			7.25 7.35	→ 23 shots				
								158 = Pebbles
					TW	WS		

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

Good Slope break

Bad sharp corner

10 ft from 120.5

Shitty BKF Backwash

Backwash may effect BKF

New Riffle Shoot

Root Wad

Slope on [illegible]

168.5 = gage, Water level = 0.46, 9.30 | 8.12 HI = 104.66

* = Our BKF

River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream name: Bennett Creek Location: Reach 4

Observers: Stream Type: Valley Type: Date: 9/21/07

		Installation Data (1st Year)				Recovery Data (2nd Year)					
		From cross-section		Particles near chain		Chain recovery				Particles near chain	
		Station (ft)	Elevation (ft)	Largest (mm)	2nd Largest (mm)	Scenario # (1–5)	Scour depth[a] (ft)	Elevation[b] (ft)	Net change[c] (ft)	Largest (mm)	2nd Largest (mm)
Riffle	Chain #1					3	.19			80mm	47mm
Riffle	Chain #2					1				34mm	20mm
Glide	Chain #3										
Glide	Chain #4										

toward left bank

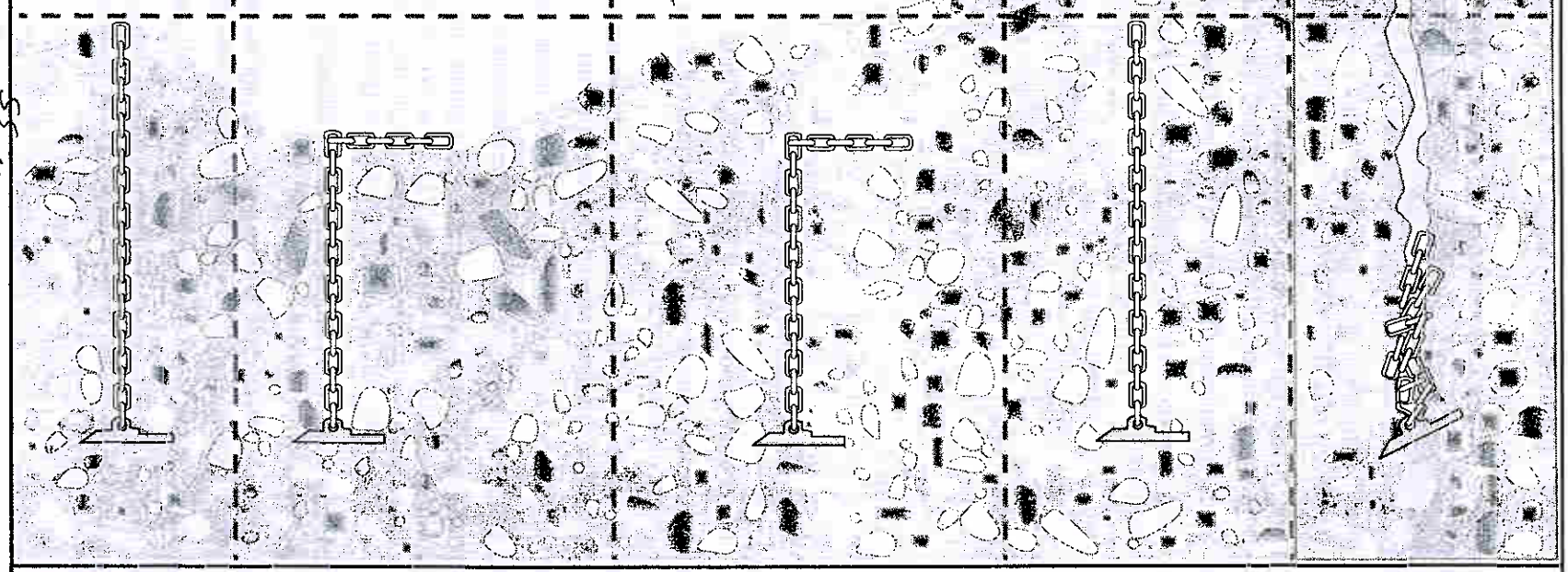
toward right bank

Scenario #1. Scenario #2. Scenario #3. Scenario #4. Scenario #5. (Oops)

2.25 in

FS for exposed chain 8.31

HI 104.66 - 8.31 = 96.35



[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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