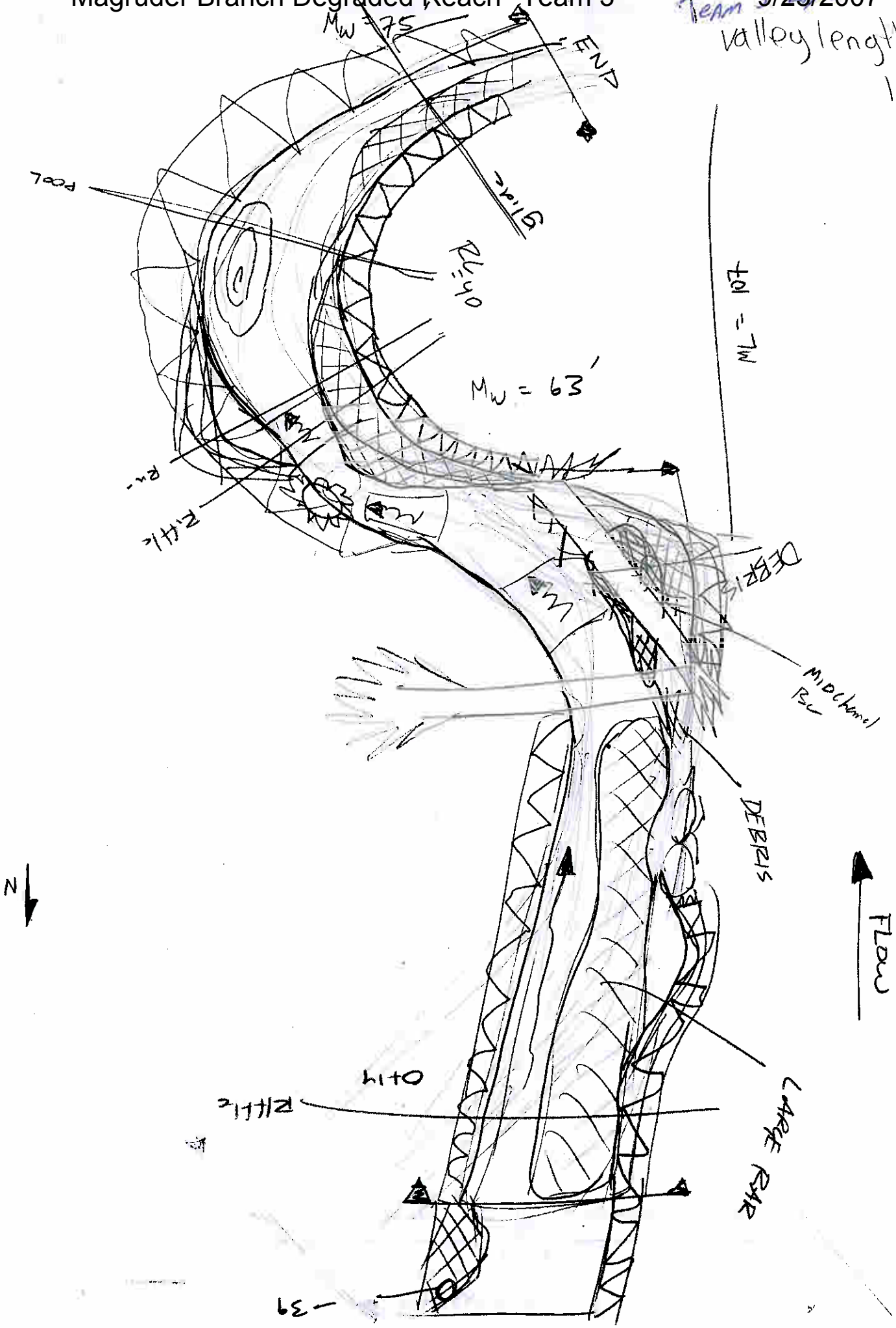
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

Team 3
Day 3
Magruder Branch
Degraded Reach

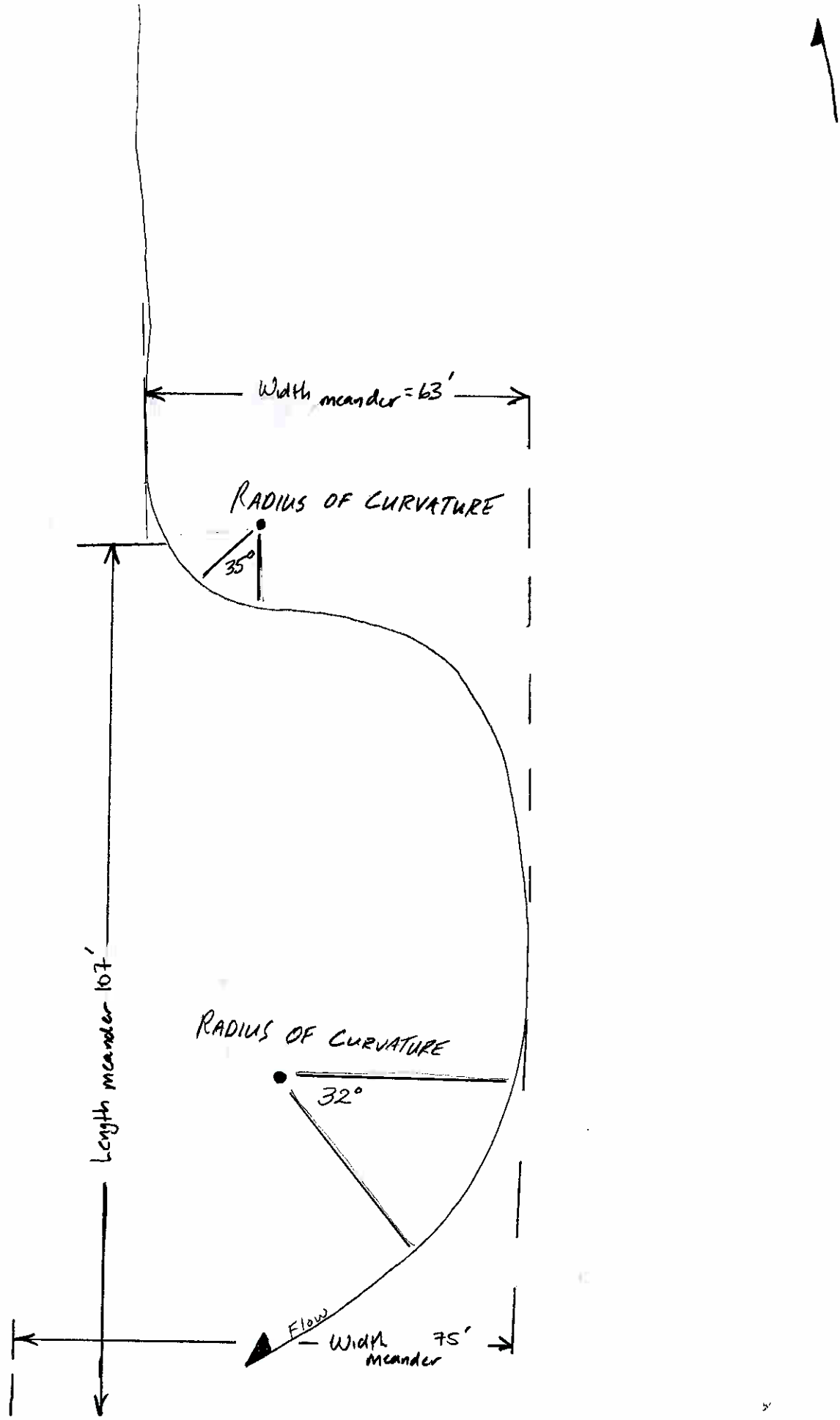
Magruder Branch Degraded Reach Team 3 9/25/2007

Team 3

valley length = 191 ft

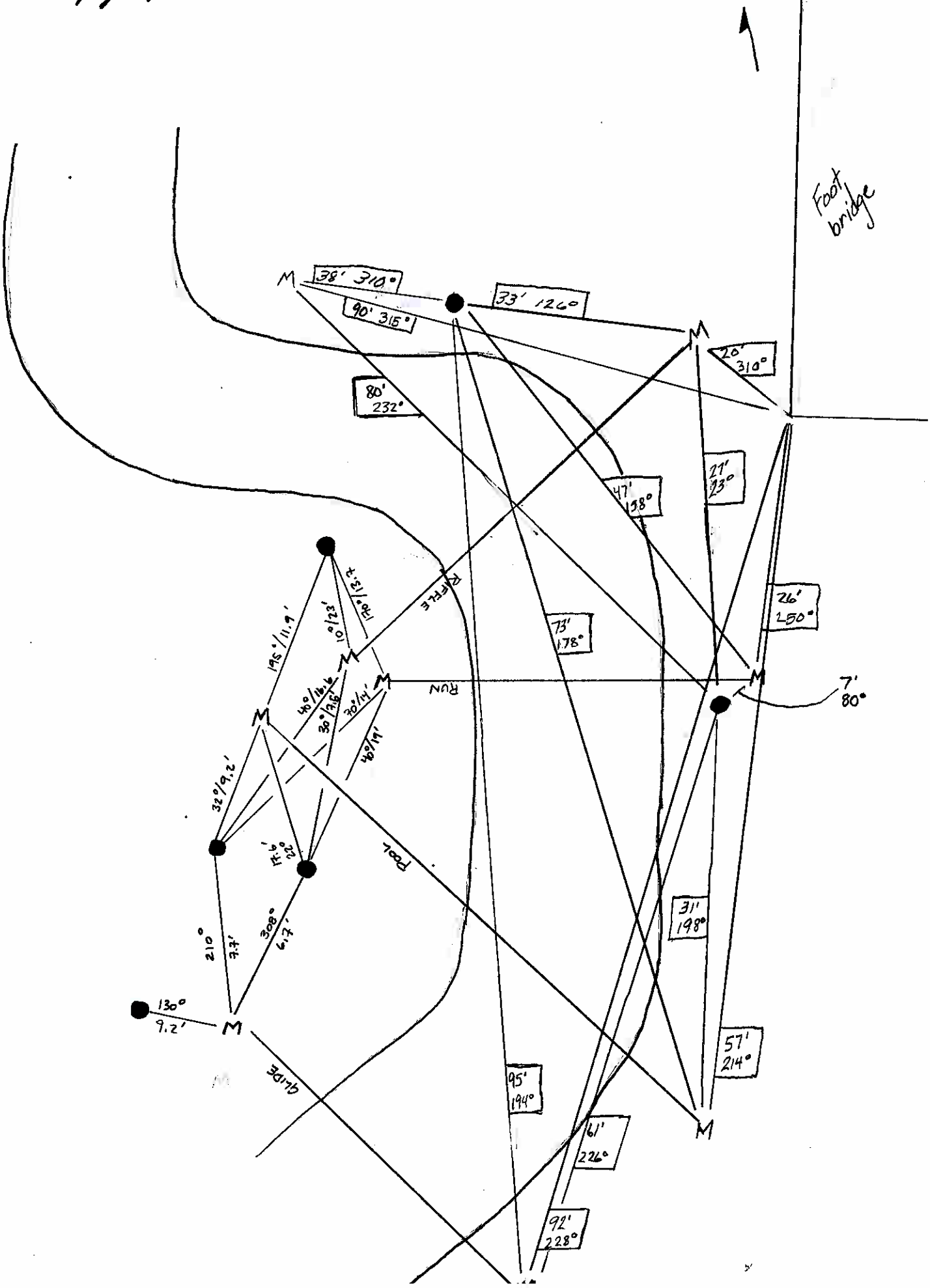


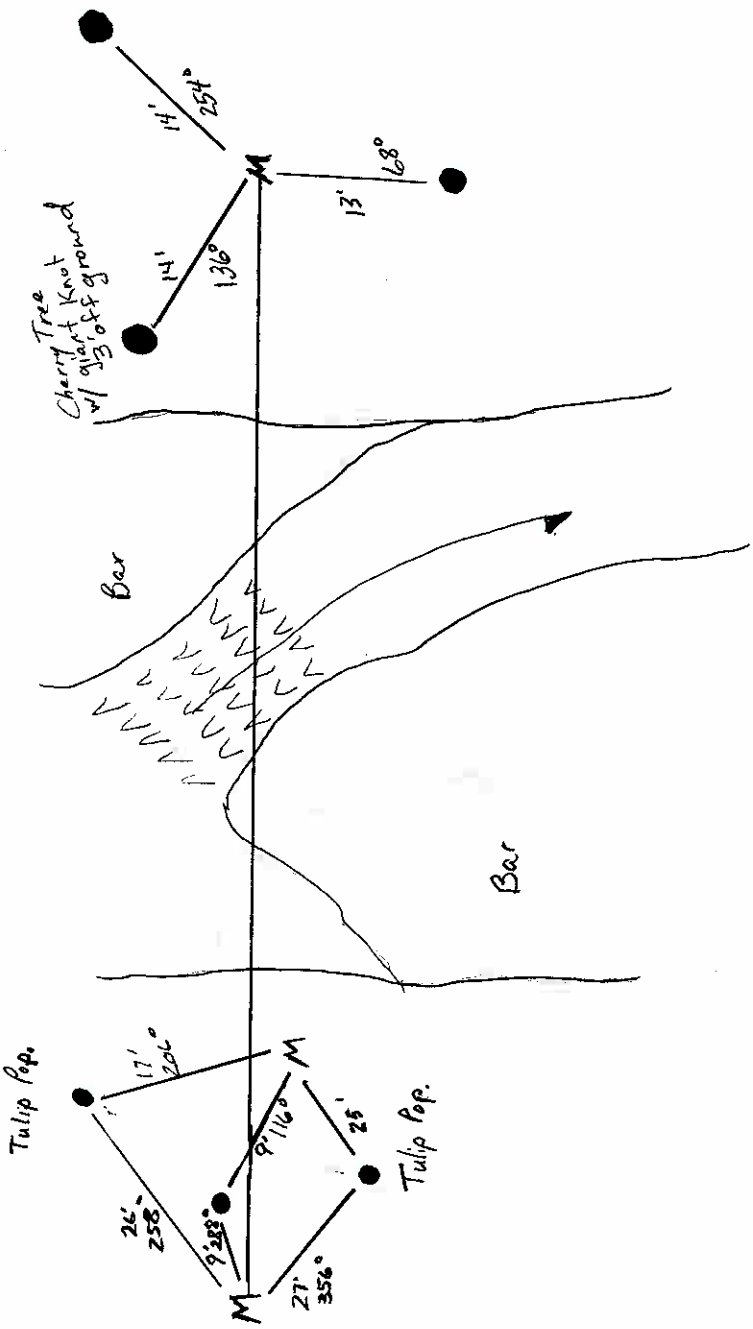
REACH 3
TEAM 3



Team 3 Magruder Branch Degraded Reach Team 3 9/25/2007

Reach 3 1 page of 2





Team 3
Reach 3 2 page of 2
2nd Riffle (upstream)
Station 0+14

Magruder Branch Degraded Reach Team 3 9/25/2007

STA	TW	WS	BKF	WS-BKF	TOB		
TRIFF							
0+5.5	4.04	3.88	2.1 (LB)	1.78			
RIFF							
0+6.5	4.20						
TRUN							
0+23	5.12	4.90					
RIFF 3							
(0+17.3)		4.62			2.12		
RIFF							
0+34	5.17	4.92	2.99	1.93	[illegible]		
RIFF							
0+48	5.18	5.00					
RIFF							
0+62	5.30	5.02			2.75		
TRIFF							
0+76	5.32	5.16					
RIFF							
0+88	5.40	5.29	3.82	1.47			
RIFF							
0+99	5.54	5.38					
TRUN							
1+6.5	5.74	5.64	4.19	1.46			
BRUN							
1+11.5	5.97					TREE	
BRUN	[illegible]	[illegible]	[illegible]	[illegible]			
1+19	7.85	5.97	4.25	1.72			
B GLIDE							
1+16.6	7.40						
		go to Page 44					

Location: Page 50

Party / Notes: Low Flow - Day 3 - Team 3

Item	Distance; Point; or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Height; Depth; or Elevation Ft.	REMARKS / COMMENT / NOTES
1	T Riff	TW	WS	[illegible]	WS-[illegible]	TOB
2	1+24	6.1	5.96	4.37	1.59	3.86
3	Riff					
4	1+34	6.17	5.96	4.50	1.46	TREE CROSSES
5	Riff					
6	1+38.3	6.24	6.03			
7	T Run					
8	1+44.3	6.42	6.28			
9	Run					
10	1+49.5	7.27				
11	Pool					TREE ROOT WAD
12	1+55.2	8.31	6.28			
13	Pool					
14	1+56.8	8.24				
15	Pool					
16	1+60.4	7.91				
17	Glide					
18	1+68.6	6.44	6.31			
19	T Riff					
20	1+70	6.39				
21	Riff					
22	1+74	7.06	6.67	4.75	1.92	
23	Riffle					
24	1+77.5	7.16	6.74	4.97		
25	Riffle					
26	1+82	7.00	6.74	4.4	2.3	
27	T Run					Inner Berm
28	1+85	7.29	6.87	4.36	2.33	6.09 - Narrows
29	E Run					
30	1+86.6	7.63	6.87	[illegible]		
31	Pool					Inner Berm
32	1+91	7.67	6.88	4.88	2.00	6.16
33	Glide					
34	1+95	7.28	6.89			
35						

SURVEY DATA ⟹ **LONGITUDINAL PROFILE** RB looking down Part II

SITE: LONG P/O - DAY 3 - Team 3 Date:

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
36	STA	TW	WS	BKF	WS-BK	TOP
37						
38	2+03.3	7.09				
39						
40	2+06.8	7.05				Toe Pin Riffle X sec
41		4.44				New Laser RB Pin (TOP)
42		3.04				Left Pin (TOP)
43		7.03				Toe Pin
44		TW	WS	BKF	WS-BK	TOP
45	Riff					
46	2+09	7.22	7.07	4.94	2.13	channel NARROWS
47	Riff					
48	2+15	7.44	7.33	5.25	2.08	
49	Run					
50	2+23	7.88	7.45			
51	Pool					
52	2+27.5	8.04	7.46			
53	Pool					
54	2+34	8.74	7.47	5.70	1.77	
55	Pool Toe	Pin				9.41 Toe Pin Pool
56	Pool					
57	2+42	10.00	7.47			
58	Pool					4.56 Pool X sec Pin RB
59	2+45	9.56	7.47	5.76	1.71	4.66 Run X sec Pin RB
60	Glide					
61	2+52.7	8.43	7.47			
62	Glide					
63	2+60	8.22	7.47	5.79	1.72	
64						
65	2+63	8.19	7.47			
66	Glide					
67	2+72	8.08	7.47	5.89	1.58	
68						
69	2+79	7.86	7.47			
70						

Scour Chain Installation - Riffle

~~Chain @ 21~~

~~2 Largest Diameter Particles~~

~~Lost~~

~~Duckbill @ Sta 24~~

Scour Chain @ 24.9

Elevation 7.07

2 largest particles 59mm 49mm

Scour Chain #2 @ 28.0

Elevation 7.01

Pattern 110

4 largest Particles 70 53 124 78

Riffle XSec 3.12 Ag Longpro Stn 208

Stn	FS	Notes
0	3.04	Left Monument Top
0	3.22	Left Monument Bar
1	3.01	
2	3.05	
6	3.52	
8	3.90	
11	3.97	
13	4.16	
15	4.42	
17	4.39	
18	4.36	
19	4.78	
20	5.74	
21	6.82	
21.5	6.92	EOW
23	7.12	TW
23.4	7.06	
23.6	6.94	
24	7.04	
24.6	6.98	
25	6.96	
25.4	6.81	
25.6	6.89	
26	6.91	
27	6.96	
27.5	6.87	
28.0	6.84	
29	6.74	
30.2	6.73	
30.5	6.5[illegible]	
31	6.53	
32	6.41	
33	6.31	
33.7	6.29	
34.2	5.96	
35	4.82	11 + 12.8
36	4.68	
37	4.70	
37.8	4.79	
39	4.87	
39.5	4.82	
39.8	4.77	
42	4.81	
43.8	4.74	

X sec - continued

Stn	FS	Notes
45	4.56	
46	4.62	Monument @ Grade
47	4.39	Top of Monument
22.35	7.00	Toe Pin

Bank Profile

LT FLOODPLAIN

LT MON = 46, 2x BKF (ESTIMATED)

RT FLOODPLAIN

RT MON = 132, 2x BKF (ESTIMATED)

Bank Station <7L Glide

1	TopMon.	0	4.70		26.0	7.
2		0	5.05		27.0	6.
3		1	5.07	BKF	28.0	5.
4		2	5.10		29.0	5.
5		4	5.07		30.0	5.
6		6	5.09		31.0	5.
7		8	5.05		32.0	5.
8		10	5.00		33.0	5.
9		11	5.01		34.0	5
10		12	5.07		35.0	5.
11		12.5	5.12		38.0	5.
12		13.0	7.69	V 2.0 (H .4)	39.0	5.
13	TWG	14.0	8.16	1.5 (.45)	40.0	4.
14		15.0	7.90	1.3 (.52)	41.0	4.
15	Scour Ch.	15.46	8.01	1 (.36)	42.0	4.
16		16.0	7.77	.7 (.35)	42.4	4.
17		17.0	7.70	.5 (.58)	42.4	3.
18		18.0	7.57	.3 (.42)		
19	REW	19.0	7.45			
20		20.0	7.36		12.6	5.
21		21.0	7.37		12.55	6.
22		22.0	7.36		12.48	6
23		23.0	7.43		12.64	6.
24		24.0	7.49		12.65	
25		25.0	7.57		12.42	
					12.58	

Scour Chain

61mm, 79mm } upstrm

66mm, 67mm } Dnstrm

36mm, 43mm } upstrm

29mm, 64mm } Dnstrm

closest to Monument 0

Outside Bend

15.46

Elev. 8.01

Inside Bend

19.18

Elev. 7.59

0+19.0 7.99 Top of Ice Pin

R. 155 LS #2 STA 0+12

Top L Pin 6.40

GD @ Pin 6.31

STA	ELEV				
0	6.54	GD @ L MON.	21.3	9.15	TW
1	6.62		22	9.13	
3	6.62		23	9.09	
5	6.61		23.75	9.02	R-OW
7	6.55		25	8.80	DEPRESS
9	6.51		26	8.76	
10	6.60		28	8.64	
11	6.59		29	8.46	
12	6.66		31	8.34	
13	6.67		32	8.27	
14	6.68	BKF	34	8.08	
15	7.02		35	8.31	
15.6	8.38		37	8.35	
16	8.69		38	8.41	
17	8.73		39	8.36	
18	8.74		39.75	8.43	R-TW
19	8.86		41	7.31	TOPEL
20	9.00	LEDW	43	6.56	
21	8.94		45	6.33	

48 4.86

50 5.60

52 5.16

54 4.25

57.25 3.84 GD @ R MON

57.75 3.65 TOP R MON

PERMANENT MONUMENT

RIGHT BANK STA 0+17

ELEV = 6.28

[illegible] 2, RT FLOODPLAIN

RT MONT ELEV

5/8 0.3

[illegible] 2, LT FLOODPLAIN

-95, 2X BKF (ESTIMATED)

Riffle #2 (u/s RIFFLE)

	Toe Pin	STA	ELEV
(AT TOE OF BAR)	Scour Chain	24.2	9.07
(IN THALWEG)	Scour Chain	21.5	9.22
	(Scour chain approx 1/10' D/S of riffle x/s t-r)		
	Top Toe Pin L/B	16.9	8.70
	Base Toe Pin L/B	16.9	8.77

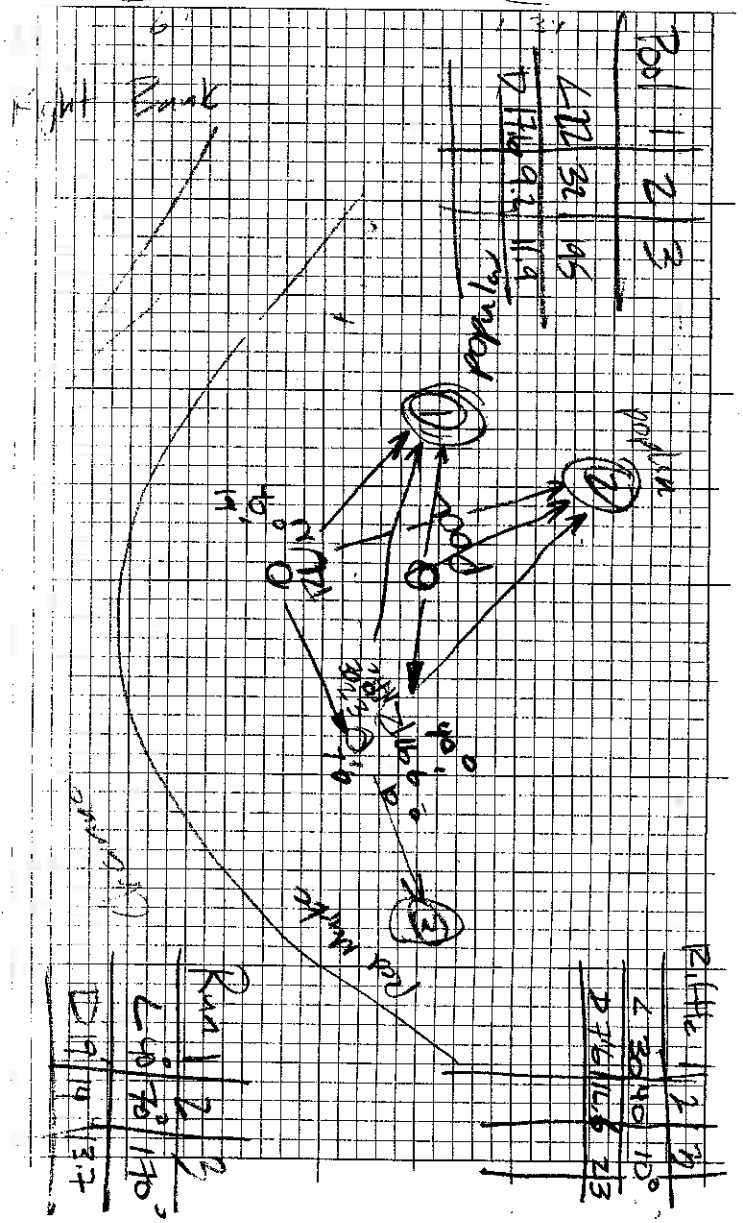
LARGEST PARTICLES ADJACENT TO INSTALLED CHAIN

64 mm, 62 mm, 44 mm

75 mm (measured diagonally), 45 mm, 32 mm, 38 mm

Magruder Branch Degraded Reach Team 3 9/25/2007

1 Pool	XSEC	Station	2140	
2 Station	ELEV.	STA	ELEV	
3 TOP	3.83	24	7.38	
4 0(Grnd)	4.20	24.5	6.93	
5 0+3	4.3	25	6.33	
6 0+7	4.40	25.5	6.14	
7 0+10	4.33	26	6.0	
8 0+11.5	4.40	26.5	5.81	BKT
9 11.8	5.20	27	5.75	
10 12	6.28	27.5	5.68	
11 12.2	6.48	28	5.59	
12 12.5	7.12	30	5.46	
13 12.8	7.36	32	5.38	
14 12.9 (LEW)	9.51	34	5.26	
15 14	9.71	36	5.25	
16 15	9.58	44	5.23	
17 16	9.74	46.7 (LEW)	4.97	
18 17	9.84	TOP	4.57	
19 18	9.35		13.9	9.11
20 19	8.88	TOE PIN @	0+14	9.11
21 20	8.71		0+14.1	9.11
22 21	8.23			
23 22	8.02			
24 23 (REW)	7.48			
25 23.5	7.38			



Magruder Branch Degraded Reach Team 3 9/25/2007

Run XS, station 2 to

sta	elev		
0		LEP	top
0	3.61	LEP	grade
1	3.6		
2	3.61		
4	3.65		
6	3.72		
9	4.03		
11	4.04	top	
11.3	3.4	bank	shot
11.6	4.62	"	"
12	5.11	"	"
12.4	5.66		
13	6.14		
13.5	6.63		
14	7.0		
14.2	7.35	LEW	
15	7.54		
16	7.59		
16.9	7.61	TW	
17.1	7.41	REW	
18.5	7.33		
19	7.19		
20	7.09		

cont'd

21,	6.96	
22,	6.80	
23,	6.57	
23.5	6.45	
24,	6.15	
24.5,	5.62	BKF
25,	5.41	
26,	5.32	
27,	5.18	
28,	5.24	
29,	5.13	
32,	4.83	
35,	5.2	
37.2	5.02	REP grade
38.2		REP top

Right Pin - 4.63

Left Pin - 3.38

Pine Bank Pins

Lower - 6.30

Upper - 5.55

Magruder Branch Degraded Reach Team 3 9/25/2007

RIVERMORPH PARTICLE SUMMARY

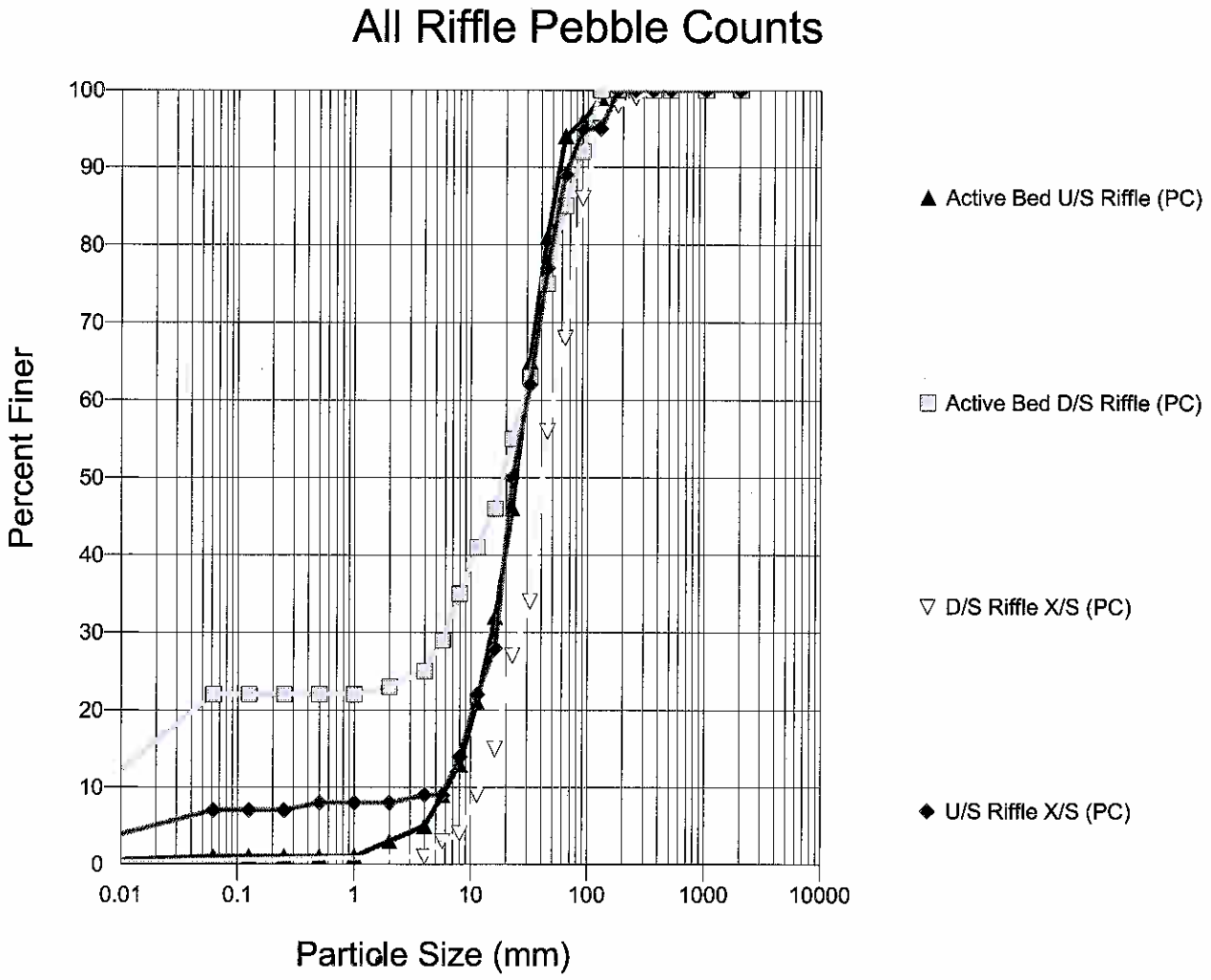
River Name: Macgruder
Reach Name: team 3
Sample Name: Bar Sample
Survey Date: 09/25/2007

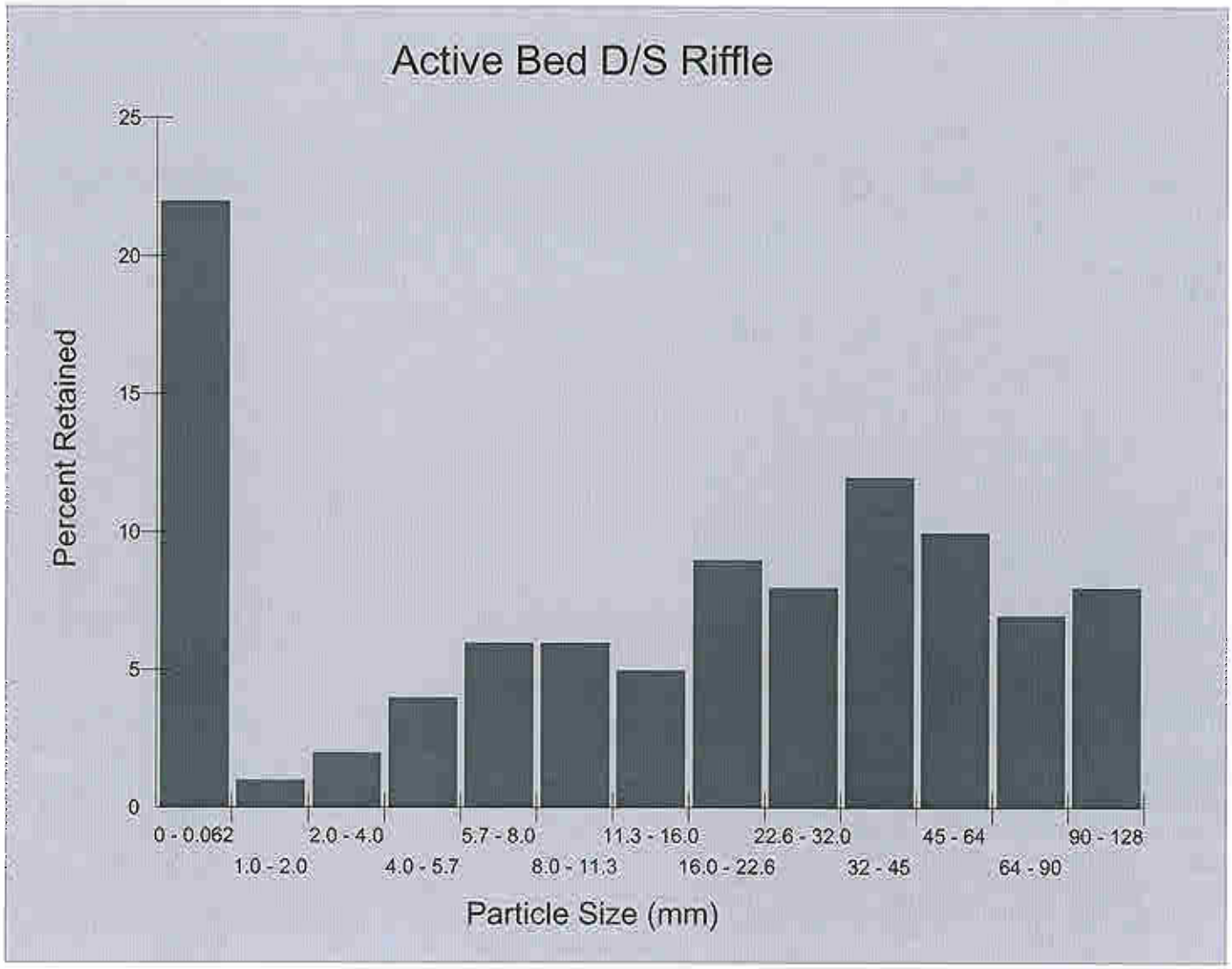
SIEVE (mm)	NET WT
63	11.5
31.5	10.625
16	11.875
8	10.375
4	9.75
2	9.25
PAN	12

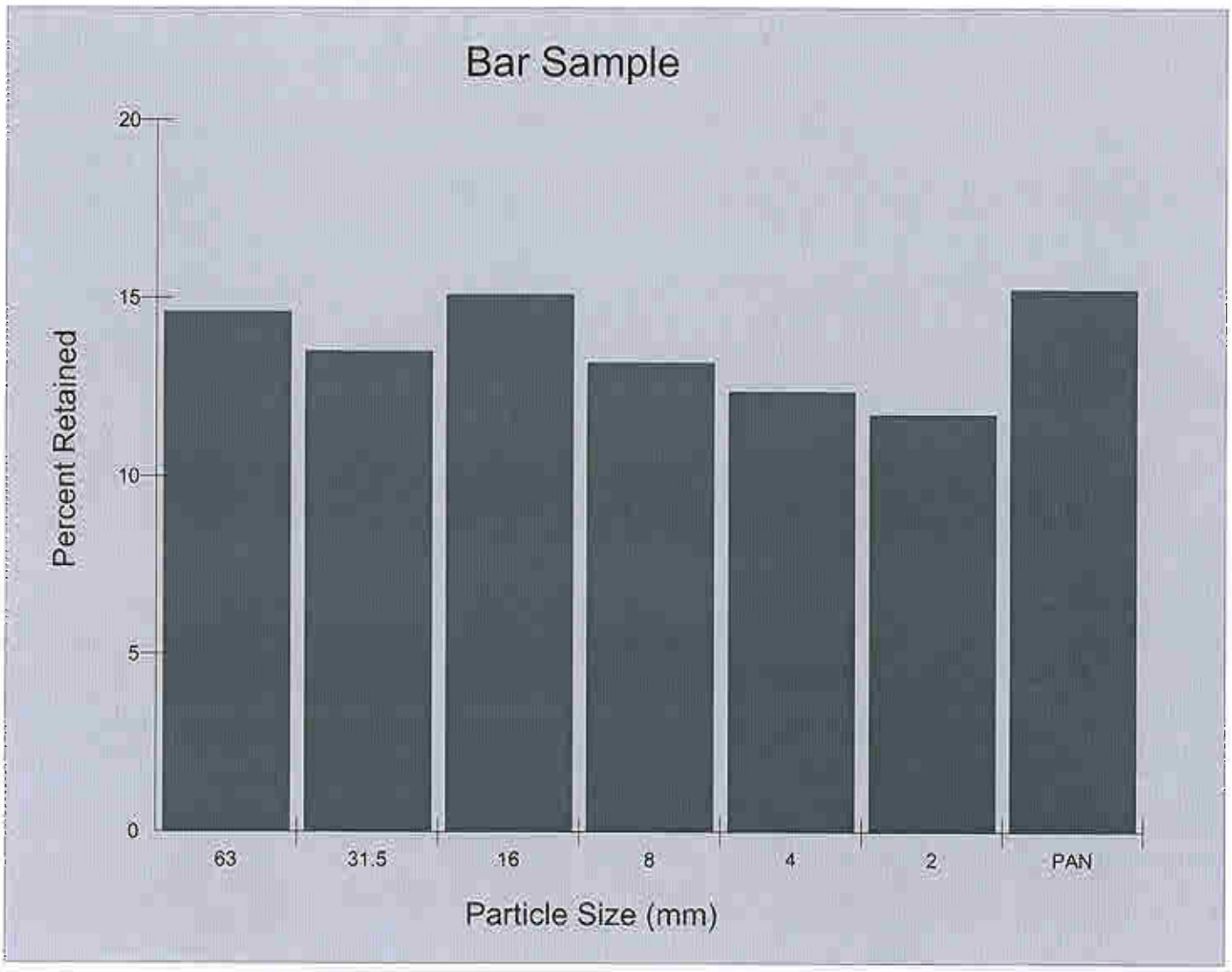
D16 (mm)	2.13
D35 (mm)	6.57
D50 (mm)	14.41
D84 (mm)	67.71
D95 (mm)	86.47
D100 (mm)	95
Silt/Clay (%)	0
Sand (%)	15.26
Gravel (%)	66.7
Cobble (%)	18.04
Boulder (%)	0
Bedrock (%)	0

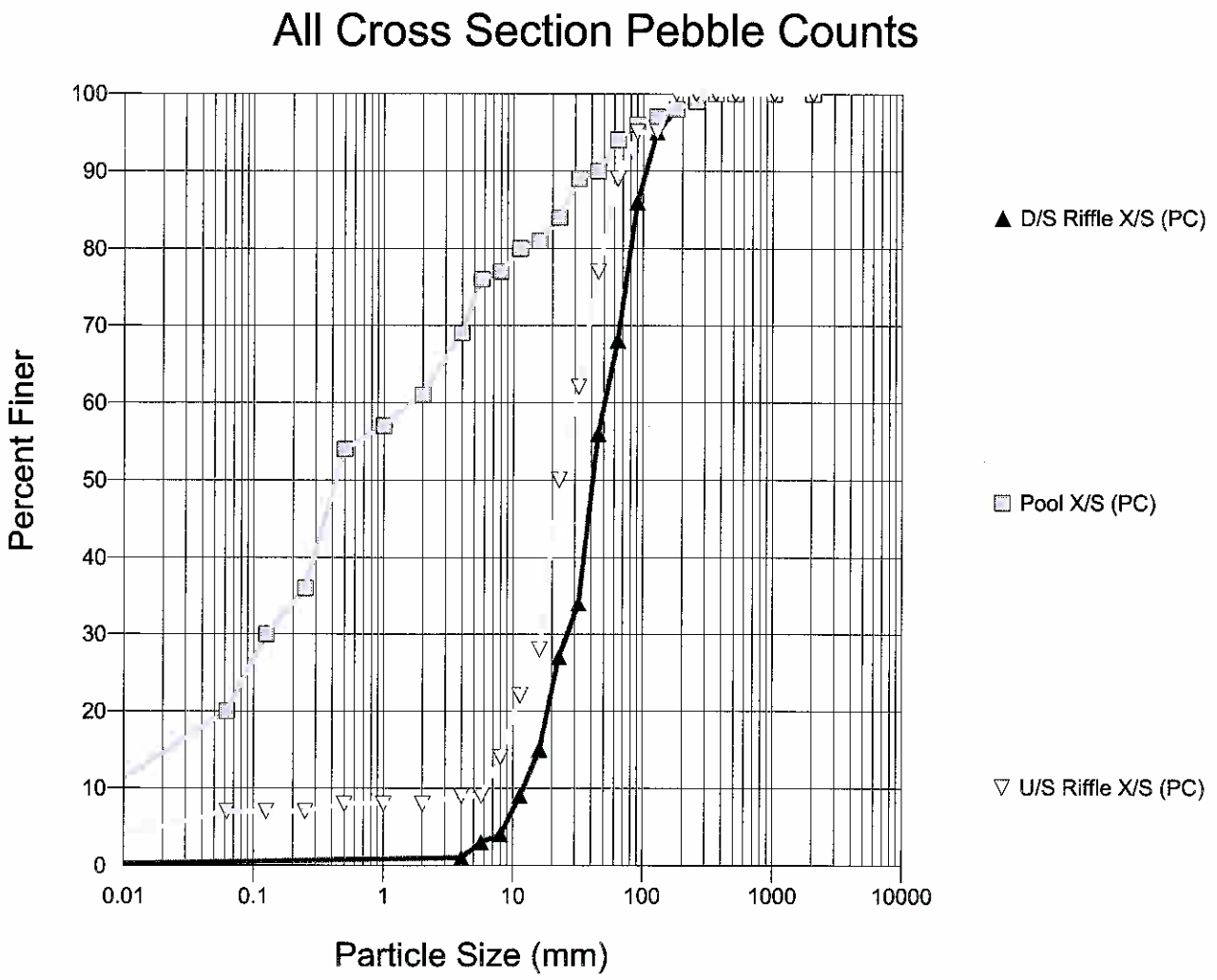
Total Weight = 78.6250.

SAND — 2 mm
GRAVEL
COBBLE — 64 mm
BOULDER — 256 mm

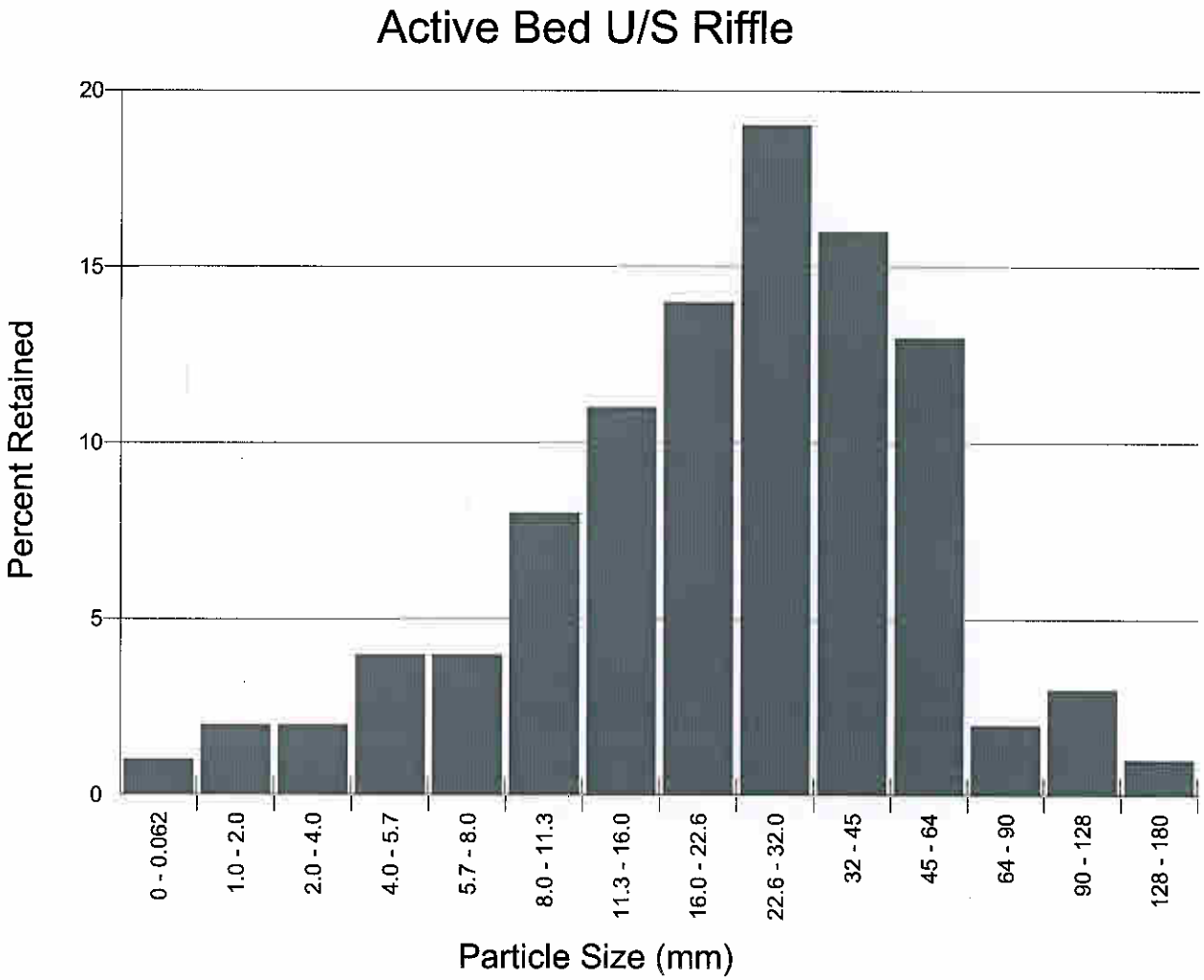

All Riffle Pebble Counts
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Active Bed U/S Riffle (PC)
Active Bed D/S Riffle (PC)
D/S Riffle X/S (PC)
U/S Riffle X/S (PC)


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

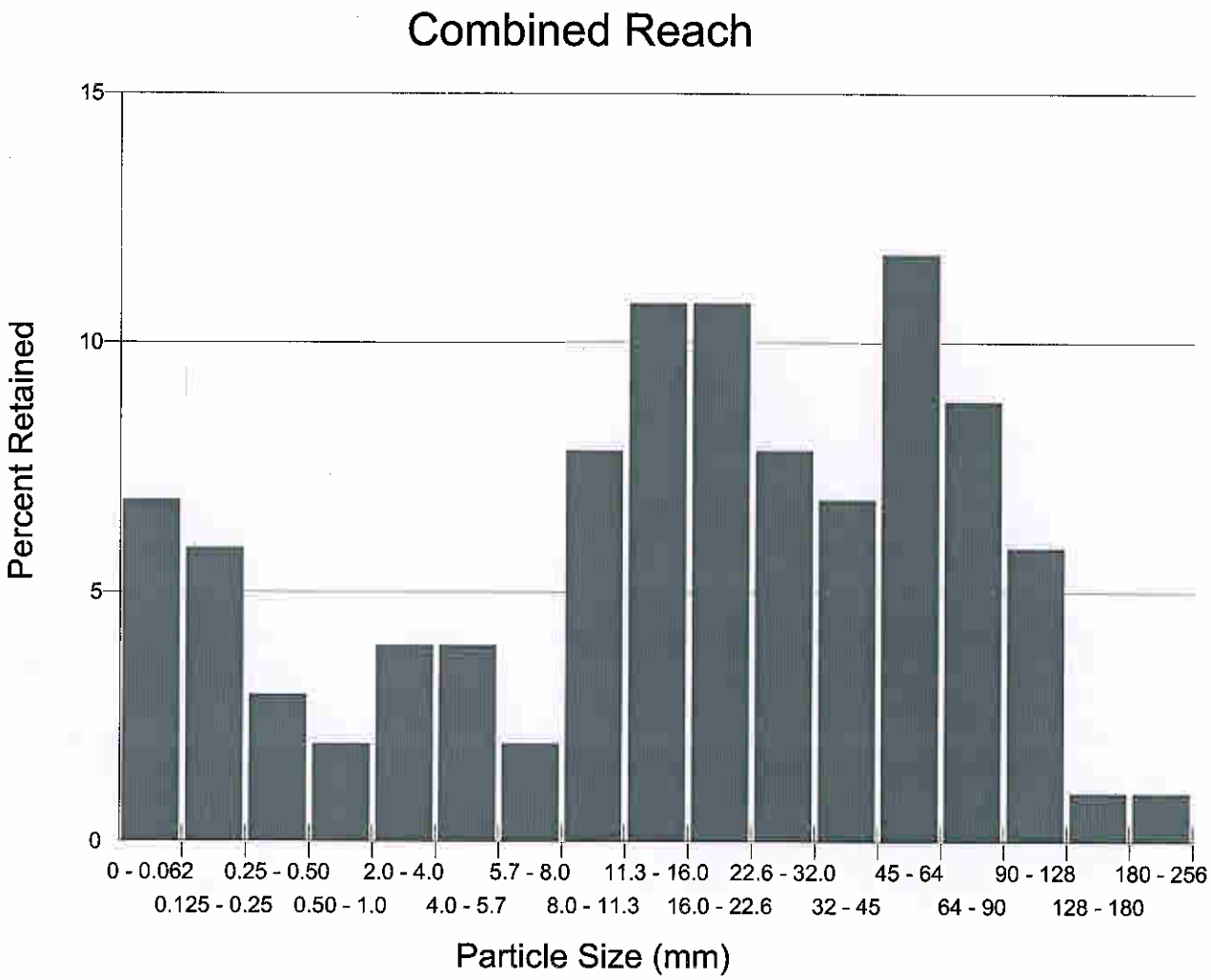

Bar Sample
Percent Retained
20
15
10
5
0
63
31.5
16
8
4
2
PAN
Particle Size (mm)


All Cross Section Pebble Counts
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
D/S Riffle X/S (PC)
Pool X/S (PC)
U/S Riffle X/S (PC)

Magruder Branch Degraded Reach Team 3 9/25/2007



D_{50} = 24.6 mm
Coarse gravel



D_{50} = 18.4 mm
Coarse gravel

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-3. Bankfull velocity and discharge estimates. STA 0+14

Bankfull VELOCITY / DISCHARGE Estimates

Site	MAGRUDER/RIFFLE #2			Location	REACH 3
Date	9/25/07	Stream Type	C4	Valley Type	VIII
Observers	TEAM 3			HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	30.84	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.19	D_{bkf} (Ft)
Bankfull WIDTH	25.85	W_{bkf} (Ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	27.23	W_{Pbkf} (Ft)
D84 @ Riffle	49.4	Dia. (mm)	D84 mm / 304.8 =	0.162	D84 (Ft)
Bankfull SLOPE	0.0114	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.13	R (Ft)
Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	6.98	
Drainage AREA	1.1	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.644	u* (Ft / Sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 \mathrm{Log}\{ R / D84 \}]u*$	4.90	Ft / Sec	151.12	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895*R^{2/3}*S^{1/2}/n$ n = 0.03	5.75	Ft / Sec	177.37	CFS
2. Roughness Coefficient: $u = 1.4895* R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39S^{.38}R^{-.16}$ n = Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.		Ft / Sec		CFS
2. Roughness Coefficient: $u = 1.4895* R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type n = 0.04	4.31	Ft / Sec	133.02	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy	4.95	Ft / Sec	152.58	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)		Ft / Sec		CFS
4. Continuity Equations: a) Regional Curves u = Q / A Return Period for Bankfull Discharge Q = 91	2.95	Ft / Sec	91	CFS
4. Continuity Equations: b) USGS Gage Data u = Q / A		Ft / Sec		CFS

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

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

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

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-3. Bankfull velocity and discharge estimates. STA 2+08

Bankfull VELOCITY / DISCHARGE Estimates

Site	MAGRUDER / RIFFLE #4			Location	REACH 3
Date	9/25/07	Stream Type	C4	Valley Type	VIII
Observers	TEAM 3			HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	27.9	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.62	D_{bkf} (Ft)
Bankfull WIDTH	17.2	W_{bkf} (Ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	18.94	W_{Pbkf} (Ft)
D84 @ Riffle	87.1	Dia. (mm)	D84 mm / 304.8 =	0.286	D84 (Ft)
Bankfull SLOPE	0.0114	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.47	R (Ft)
Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	5.14	
Drainage AREA	1.1	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.73	u* (Ft / Sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 \mathrm{Log}\{ R / D84 \}]u^*$	5.00	Ft / Sec	139.60	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895 * R^{2/3} * S^{1/2} / n$ n =		Ft / Sec		CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ b) Manning's 'n' from Jarrett (~~USGS~~): ~~$n = 0.39 S^{.38} R^{-.16}$~~ n = Note: This equation is for applications involving ~~steep, step-pool~~, high boundary roughness, cobble-boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.		Ft / Sec		CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type n = 0.04	5.14	Ft / Sec	143.41	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) DARCY	5.52	Ft / Sec	153.56	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)		Ft / Sec		CFS
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = 91	3.26	Ft / Sec	91	CFS
4. Continuity Equations: b) USGS Gage Data $u = Q / A$		Ft / Sec		CFS

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

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

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

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

a. Riparian Vegetation

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

Riparian Vegetation

Stream: Magruder Branch
Location: Reach 3
Observers: Team 3
Reference reach [ ]
Disturbed (impacted reach) [✓]
Date: 9/25/07
Existing species composition: Mid Sucessional Tulip Poplar Dominated
Potential species composition: Oak overstory more diverse shrub layer - alder, arrow-wood, winterberry, spicebush mix, eradicate microstegium

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	70%	15	Red Maple	10
				Tulip	80
				Black Walnut	2.5
				Amer. Sycamore	5
				Mixed Oak - white NRO	2.5
					100%
2. Understory	Shrub layer		30	Spice bush	85
				Red Maple	5
				Flowering Dogwood	5
				Rubis sp.	2.5
				M.F. rose	2.5
					100%
3. Ground level	Herbaceous		40	Microstegium	80
				Clearweed	5
				White smartweed	5
				X-mas fern	2.5
				V.A. creeper	5
				Fern sp	2.5
					100%
	Leaf or needle litter		10		
	Bare ground		5		
			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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b. Flow Regime

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

FLOW REGIME

Stream: Magruder	Location: Reach 3							
Observers: TEAM 3						Date: 9/25/07		
List ALL COMBINATIONS that APPLY.....	P	2						

General Category

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

Specific Category

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

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c. Stream Size and Order

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

Stream Size and Order			
Stream: Maggruder			
Location: R3			
Observers: T3			
Date: 9/25/07			
Stream Size Category and Order ☞			
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).			

S4(2)

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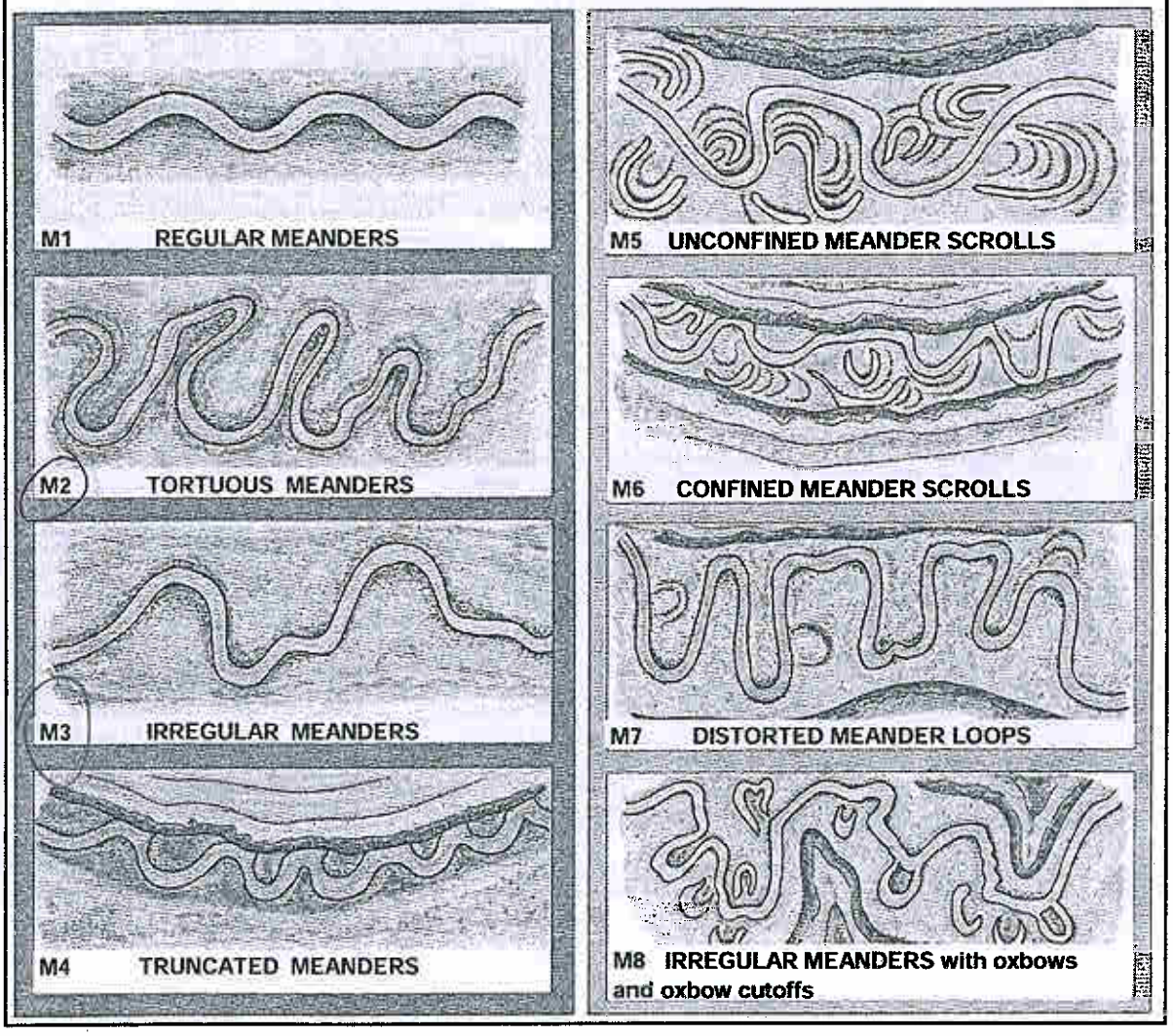
d. Meander Patterns

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

Meander Patterns					
Stream: Magruder		Reach: F3			
Observers: T3		Date: 9/25/07			
List ALL CATEGORIES that APPLY ☞	M3	M2			

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



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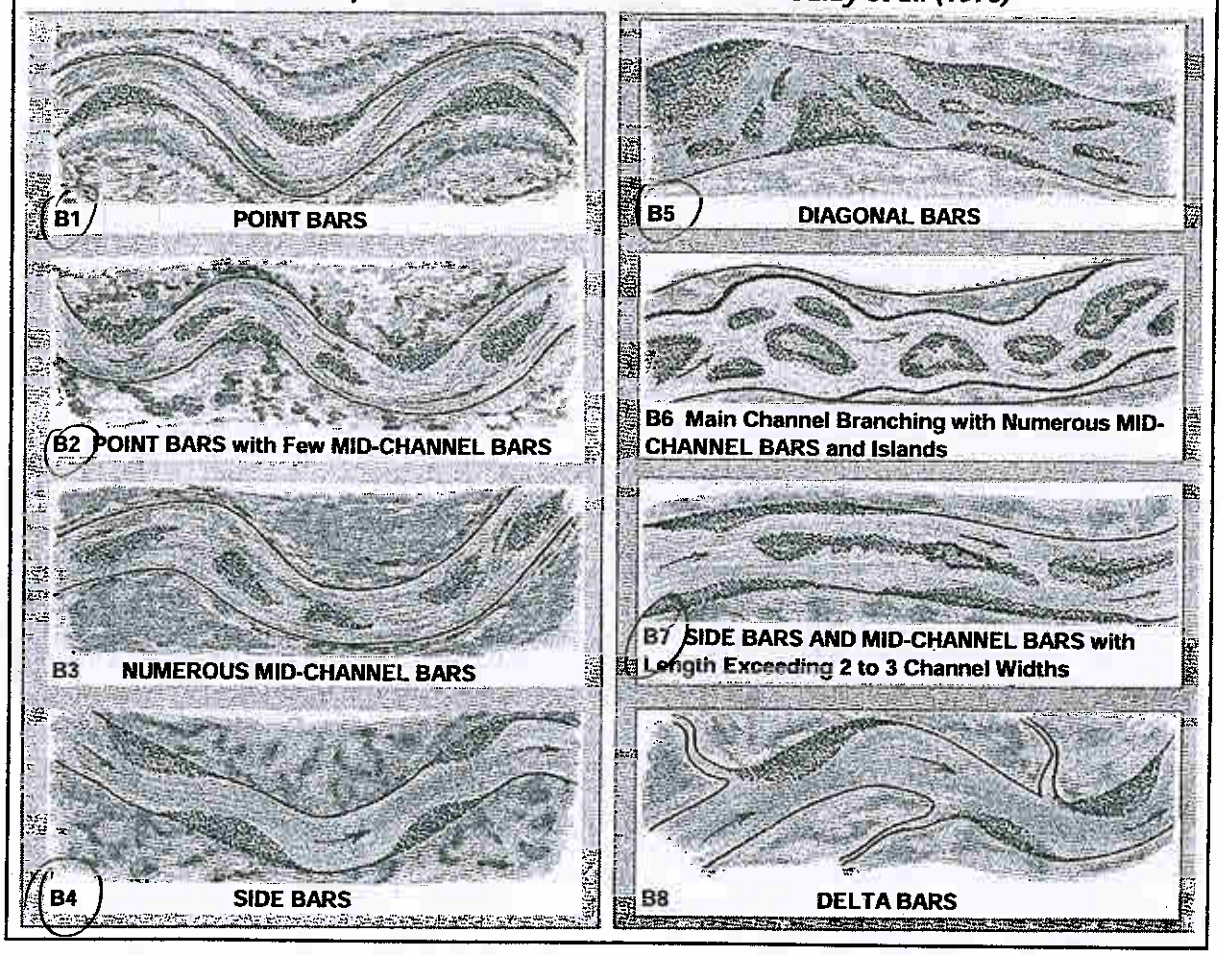
e. Depositional Patterns

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

Depositional Patterns					
Stream: MAGRUDER		Reach: 3			
Observers: TEAM 3		Date: 9/25/07			
List ALL CATEGORIES that APPLY ☞	B1	B2	B4	B5	B7

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



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f. Channel Blockages

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

Channel Blockages			
Stream: Magruder		Location: R3	
Observers: T3		Date: 9/25/07	
Description/extent		**Materials, which upon placement into the active channel or flood-prone area, may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	☑
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	☑
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	☑
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.	☑
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.	☐
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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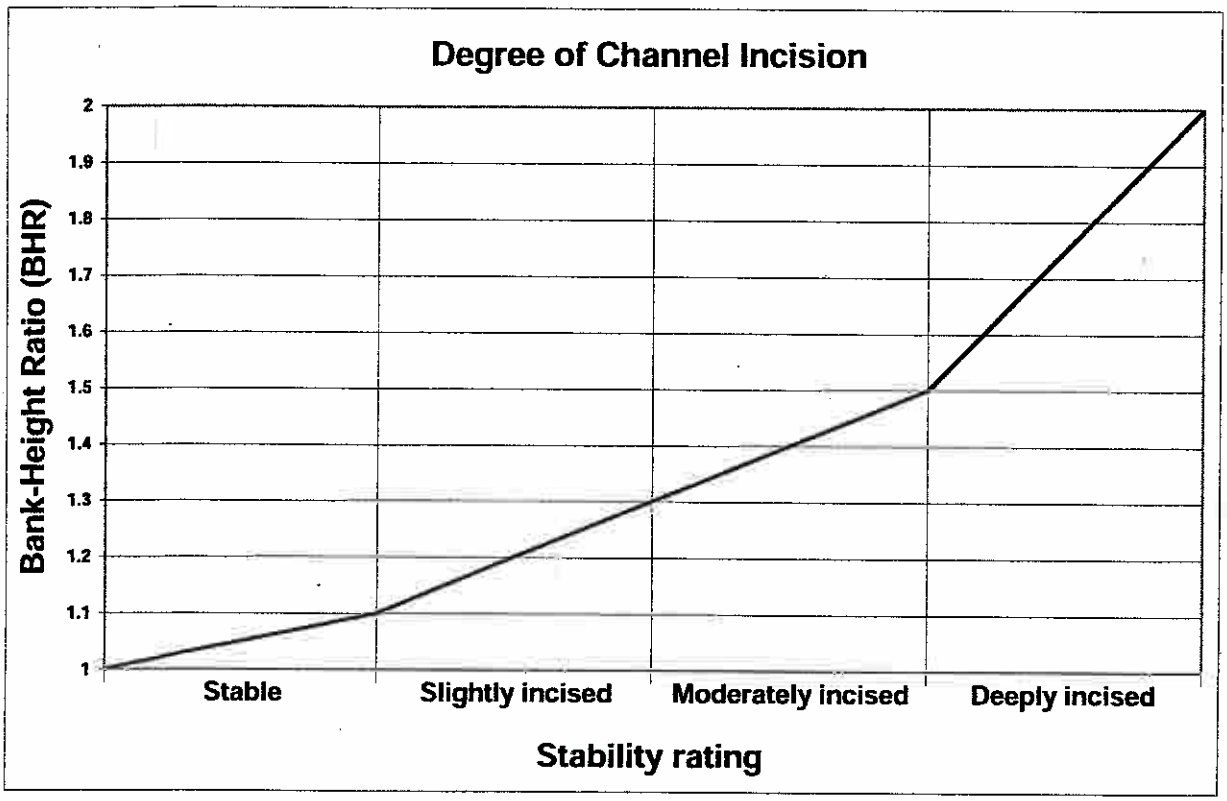
g. Degree of Channel Incision (Bank-Height Ratio)

Worksheet C-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:	2.13	Bank-Height Ratio:	1.20
Max Bankfull Depth:	1.78		
Degree of Channel Incision Stability Rating	SLIGHTLY INCISED		



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River Assessment and Monitoring: Impaired Reach

3rd Field Day

h. Modified Pfankuch Channel Stability Rating

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

Stream: MAGRUDER Location: REACH 5 Valley Type: VIII Observers: TEAM 3 Date: 9/25/07

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.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water, too.	1	Common. Algae forms in low velocity and pool areas. Moss here, too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4

Excellent total = 2 Good total = 24 Fair total = 12 Poor total = 76 80

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 = 114 118

Existing stream type = C4

*Potential stream type = C4

Modified channel stability rating = POOR

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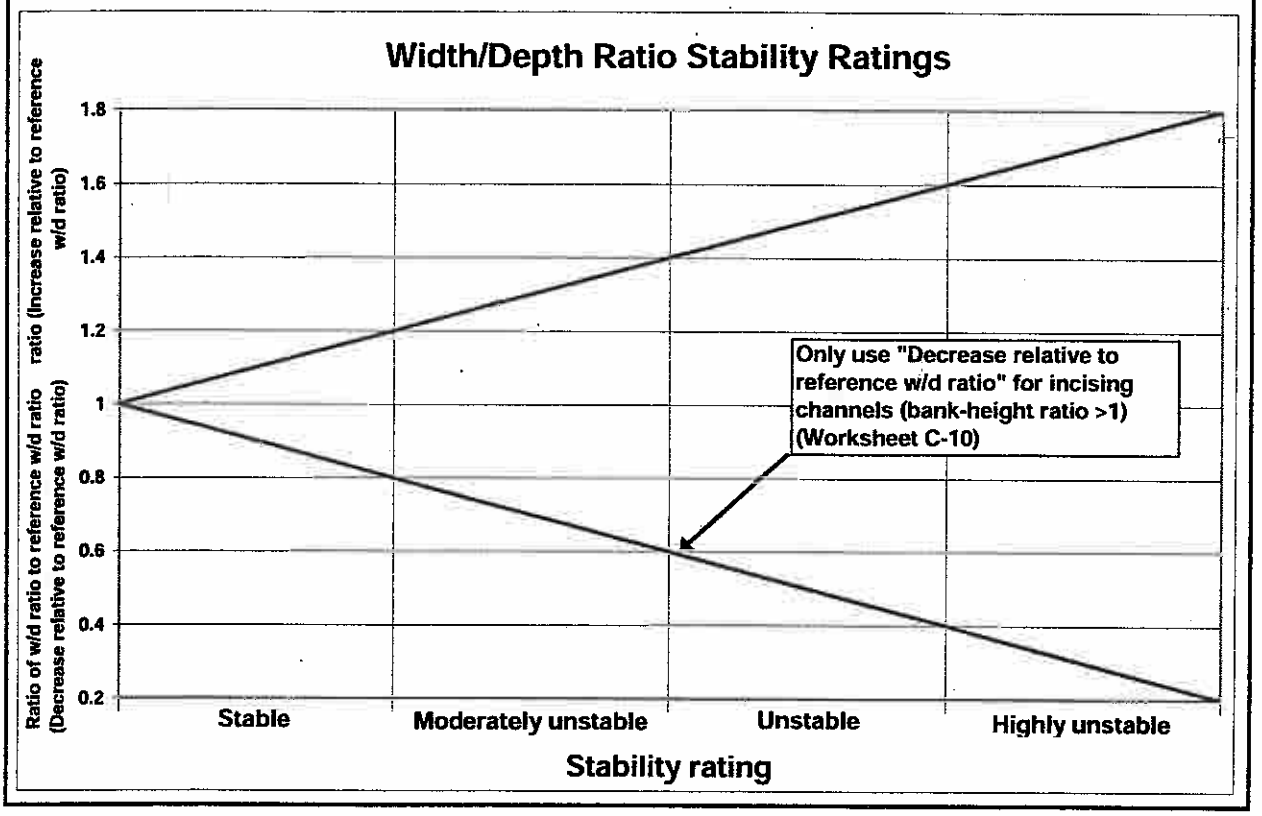
i. Width/Depth Ratio State

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

Width/Depth Ratio State			
Existing Width/Depth Ratio:	21.7	Ratio of existing w/d to reference w/d:	1.9
Reference Width/Depth Ratio:	11.4		
Width/Depth Ratio State Stability Rating			Highly Emotionally Unstable



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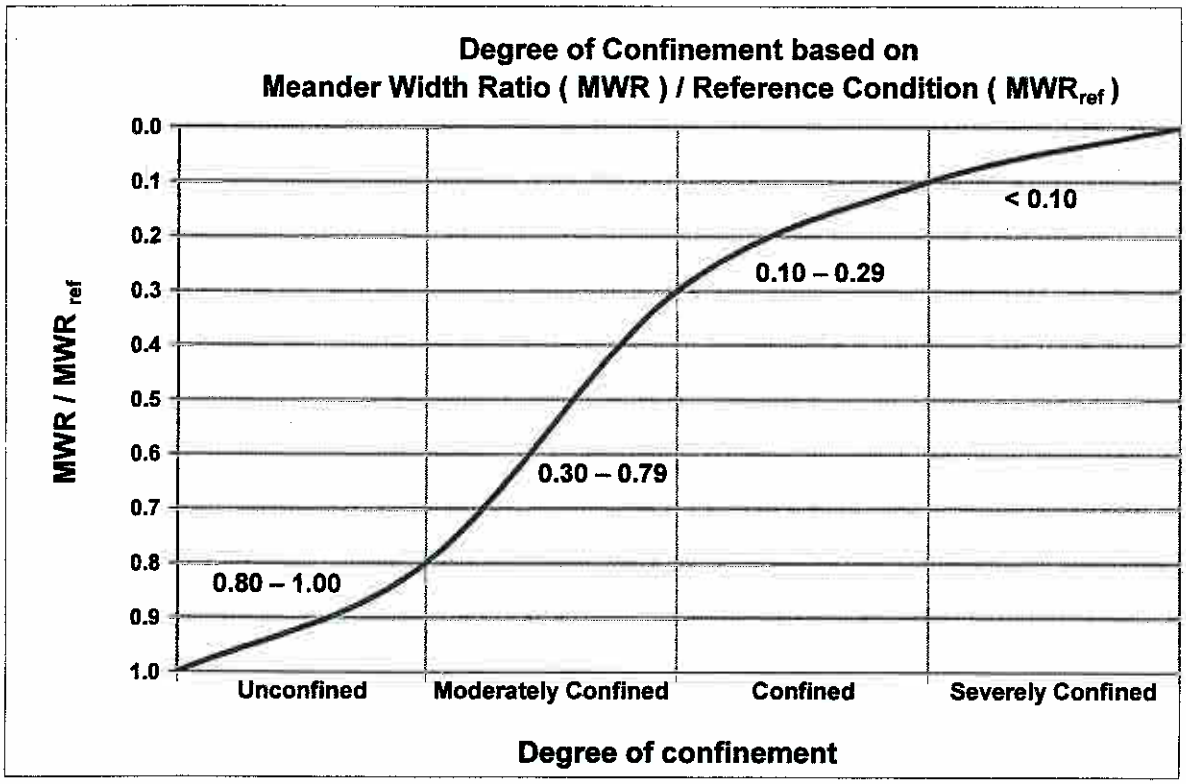
j. Degree of Channel Confinement (Meander Width Ratio (MWR))

Worksheet C-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):	2.44	Ratio of MWR to MWRref:	1.06
Reference Meander Width Ratio (MWR_{ref}):	2.30		
Degree of Confinement Stability Rating	UNCONFINED		



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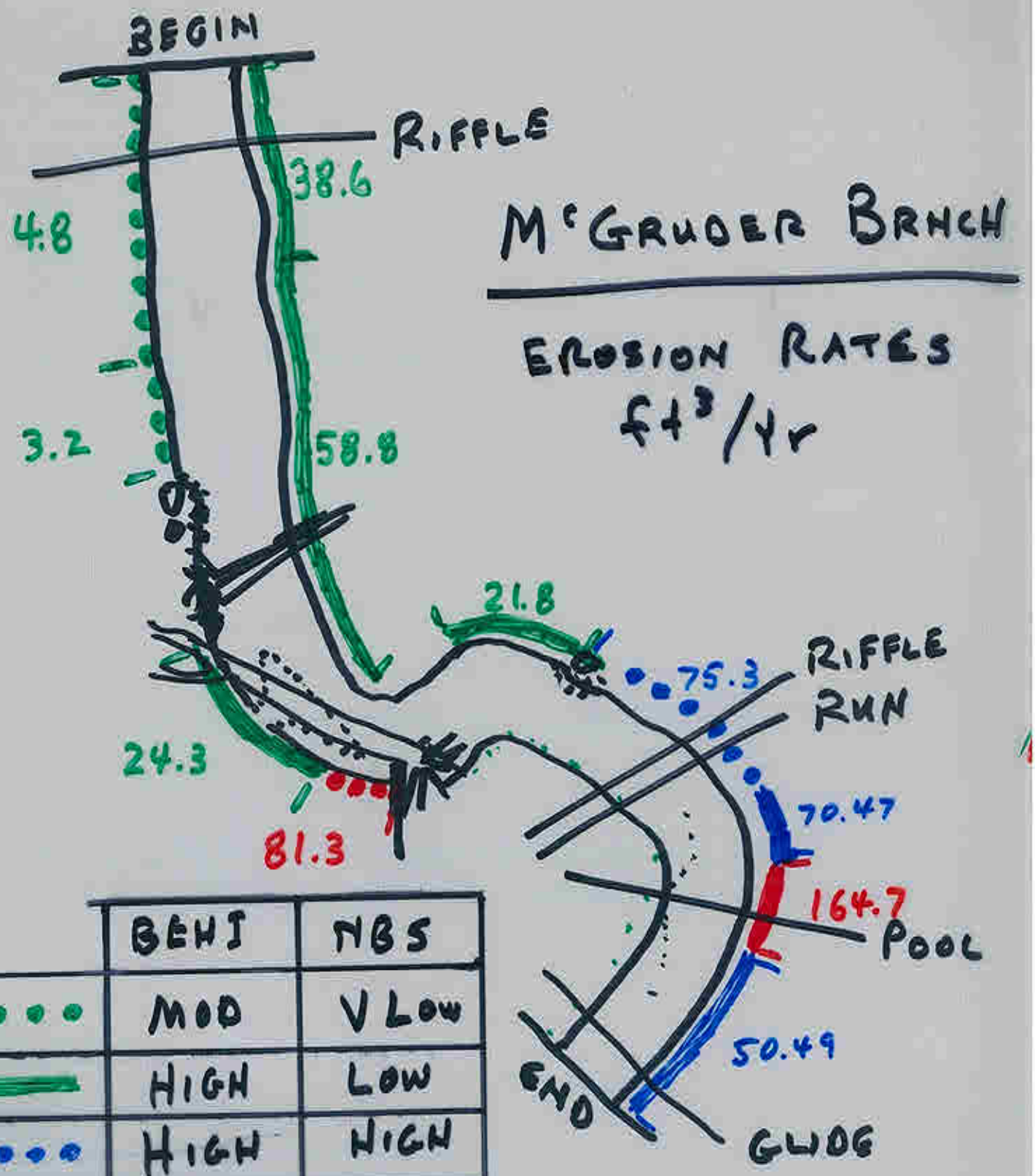

	BEHI	NBS
	MOD	V LOW
	HIGH	LOW
	HIGH	HIGH
	V HIGH	MOD
	V HIGH	HIGH
	EXTR	MOD

Magruder Branch Degraded Reach Team 3 9/25/2007

POOL

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: POOL L 234-251 Stream Type: Valley Type:

Observers: Date:

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

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)	32	15	2.13	MODERATE

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

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)	0.00067	0.038	.0176	VERY LOW

Dominant Near-Bank Stress

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	3.8	2.4	1.6	MODERATE

	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)
(6)								

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating MODERATE

Logically?

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UP RIFFLE

River Assessment and Monitoring: Impaired Reach 3rd Field Day

ii. Near-Bank Stress

Worksheet C-15. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:		Location:	
Station:		Stream Type:	Valley Type:
Observers:			Date:

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

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.05	1.2	1.55	MOD

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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Magruder Branch Degraded Reach Team 3 9/25/2007

4 RIFFLE MODERATE

NOT

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream: Magruder Location:

Station: upstream [illegible] S1,14 Observers: Heather

Date: Stream Type: Valley Type:

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.95 (A)	Bankfull Height (ft) =	1.95 (B)	(A) / (B) =	1 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.3 (D)	Study Bank Height (ft) =	1.95 (A)	(D) / (A) =	0.15 (E)	8
Weighted Root Density (G)						
Root Density as % =	5 (F)			(F) x (E) =	.77 (G)	0
Bank Angle (H)						
Bank Angle as *Degrees* =	90 (H)					8
Surface Protection (I)						
Surface Protection as % =	2 (I)					10

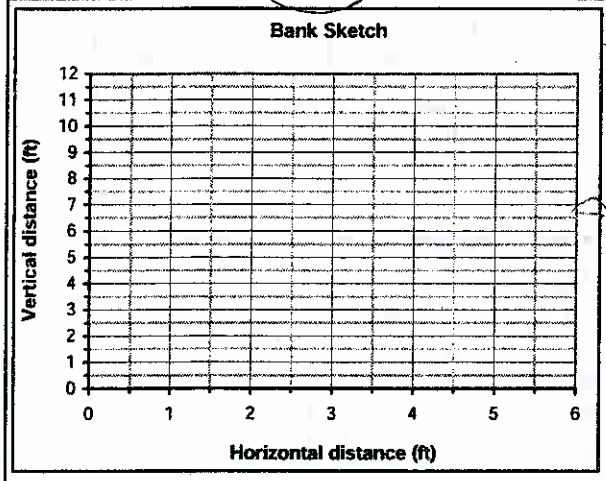
Bank Material Adjustment:

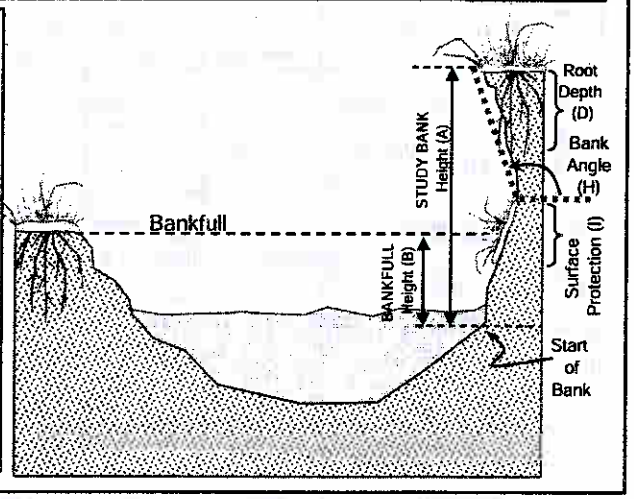
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment 0

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

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	MODERATE 26





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RIFFLE UP NBS

River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.85	1.2	1.55	MODERATE

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating MODERATE

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Magruder Branch Degraded Reach Team 3 9/25/2007

BEHI RIFFLE UP HIGH

River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: Location: --

Station: RiffleXS (u/s) Observers:

Date: 9/25/07 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.1 (A)	Bankfull Height (ft) =	1.7 (B)	(A) / (B) =	1.24 (C)	5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.1 (D)	Study Bank Height (ft) =	2.1 (A)	(D) / (A) =	0.52 (E)	4
Weighted Root Density (G)						
		Root Density as % =	20 (F)	(F) x (E) =	10.4 (G)	7.1
Bank Angle (H)						
				Bank Angle as Degrees =	90 (H)	8.2
Surface Protection (I)						
				Surface Protection as % =	10 (I)	9

3.2

Bank Material Adjustment:

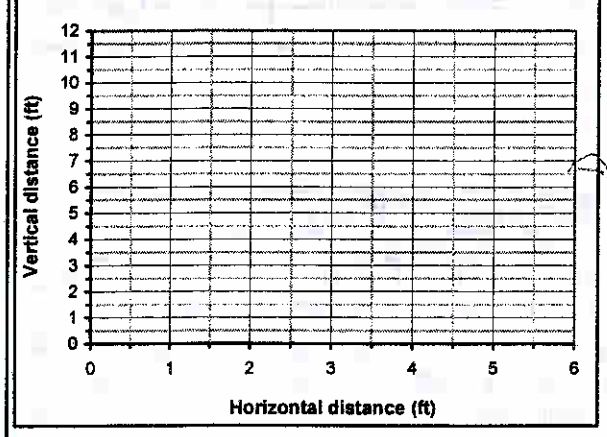
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

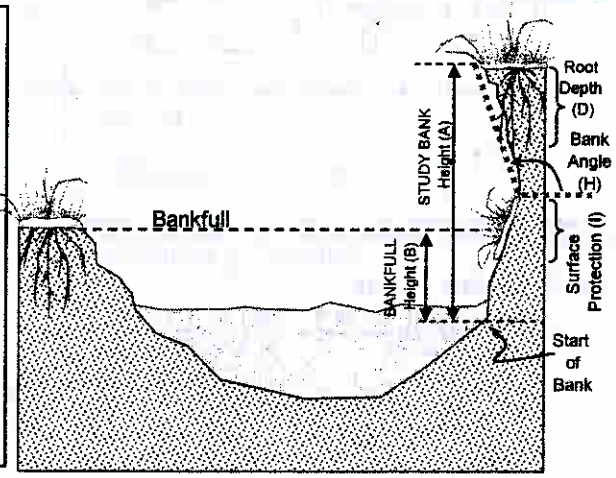
Bank Material Adjustment 0

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
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	HIGH 33.3

Bank Sketch





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Magruder Branch Degraded Reach Team 3 9/25/2007

RIFFLE DOWN NB)

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: RIFFLE N207 Stream Type: Valley Type:

Observers: Date:

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

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.3	1.62	1.42	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

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Magruder Branch Degraded Reach Team 3 9/25/2007

BEHI RIFFLE DOWN VERY HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station:	RIFFLE ~207	Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.8 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.5 (C)	5.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.5 (D)	Study Bank Height (ft) =	2.8 (A)	(D) / (A) =	.18 (E)	7.5
Weighted Root Density (G)						
Root Density as % =	2 (F)			(F) x (E) =	.36 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	50 (H)					10
Surface Protection (I)						
Surface Protection as % =	1 (I)					10

Bank Material Adjustment:

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

Bank Material Adjustment 0

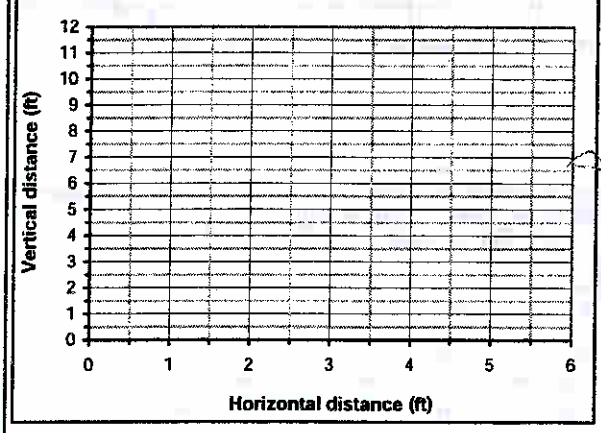
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

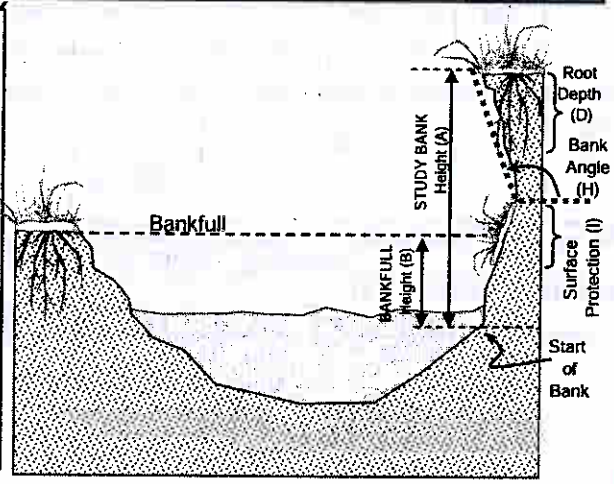
Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating VH

and Total Score 43

Bank Sketch





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Magruder Branch Degraded Reach Team 3 9/25/2007

RUN

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: RUN Stream Type: Valley Type:

Observers: Date:

Methods for estimating Near-Bank Stress (NBS)

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

Level I

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

Level II

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

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

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

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.1	1.4	1.5	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)
2.09	1.45						

Level IV

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

Dominant Near-Bank Stress: MOD

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

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

Overall Near-Bank Stress (NBS) rating

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Run

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station:	Run	Observers:	
Date:	Stream Type:	Valley Type:	

							BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	3.8 (A)	Bankfull Height (ft) =	1.7 (B)	(A) / (B) =	2.23 (C)		8.5
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	.4 (D)	Study Bank Height (ft) =	3.8 (A)	(D) / (A) =	0.10 (E)		8.5
Weighted Root Density (G)							
		Root Density as % =	1 (F)	(F) x (E) =	.1 (G)		10
Bank Angle (H)							
				Bank Angle as *Degrees* =	50 (H)		3.5
Surface Protection (I)							
				Surface Protection as % =	0 (I)		10

Bank Material Adjustment:

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

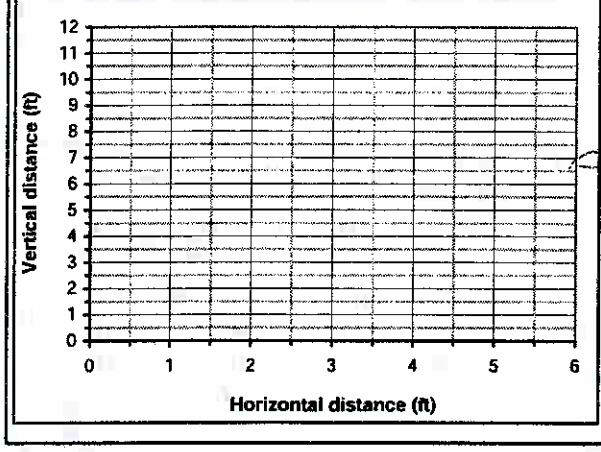
Bank Material Adjustment 0

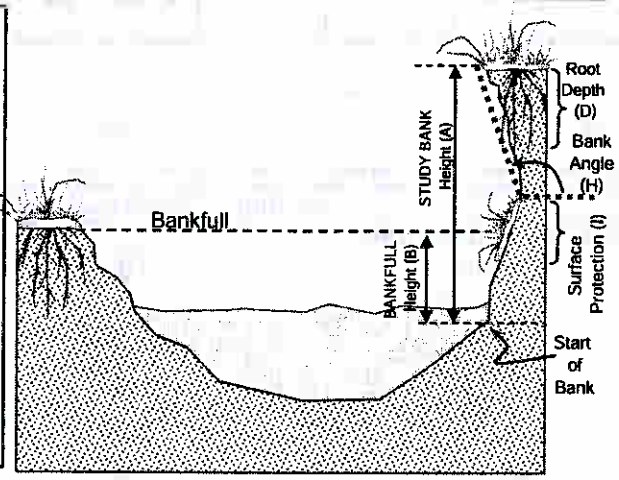
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

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** VH 40.5

Bank Sketch





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GLIDE

River Assessment and Monitoring: Impaired Reach

3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream:		Location:	
Station:	GLIDE	Stream Type:	Valley Type:
Observers:			Date:

Methods for estimating Near-Bank Stress (NBS)

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

Level I

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

Level II

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

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

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

Dominant Near-Bank Stress: MODERATE

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.3	1.5	1.5	MOD

(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)

4 sec 2.36 1.48

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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GLIDE

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station:	GLIDE	Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.9 (A)	Bankfull Height (ft) =	1.7 (B)	(A) / (B) =	1.7 (C)	6.8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	2.9 (A)	(D) / (A) =	0.34 (E)	5.5
Weighted Root Density (G)						
		Root Density as % =	10 (F)	(F) x (E) =	3.45 (G)	9
Bank Angle (H)						
				Bank Angle as *Degrees* =	95 (H)	8.5
Surface Protection (I)						
				Surface Protection as % =	5 (I)	10

Bank Material Adjustment:

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

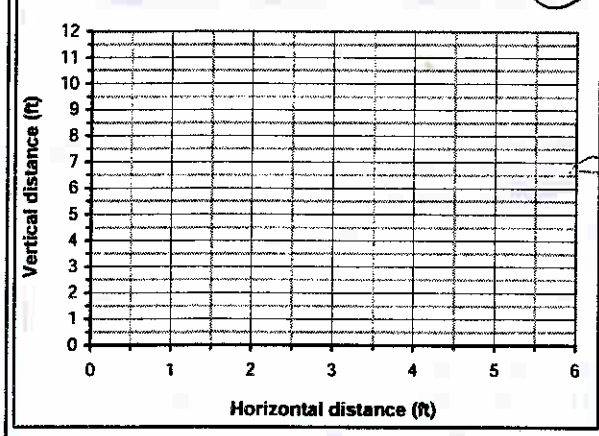
Bank Material Adjustment 0

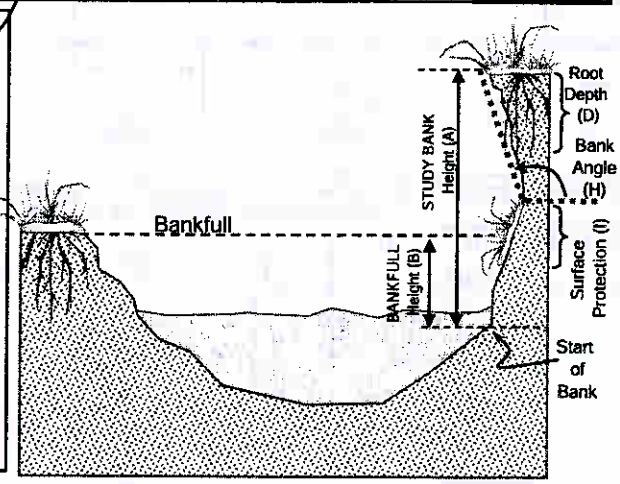
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 5

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score VH > E 44.8

Bank Sketch





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Magruder Branch Degraded Reach Team 3 9/25/2007

BEHI VERY HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station: L207-234 / L251-280		Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.9 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.5 (C)	6
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.7 (D)	Study Bank Height (ft) =	2.9 (A)	(D) / (A) =	0.24 (E)	6.5
Weighted Root Density (G)						
Root Density as % =	3 (F)			(F) × (E) =	.72 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	80 (H)					6
Surface Protection (I)						
Surface Protection as % =	0 (I)					10

Bank Material Adjustment:

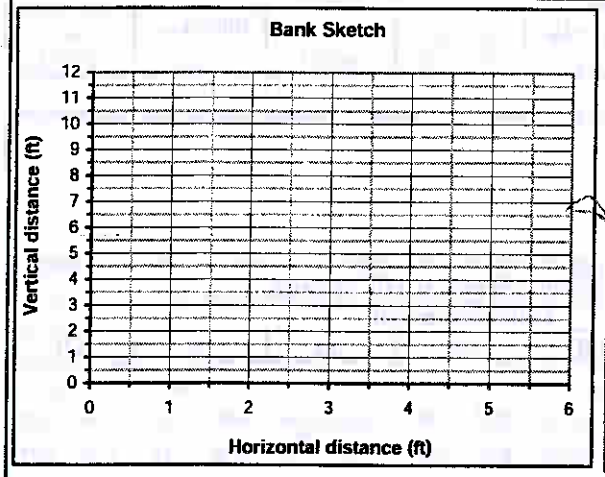
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

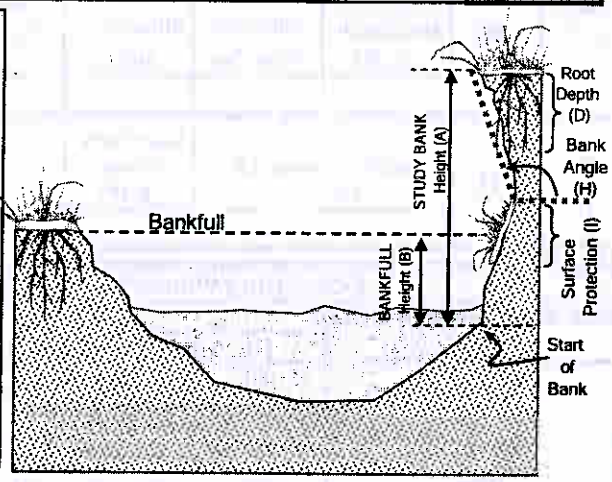
Bank Material Adjustment

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

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score: V. HIGH 43.5





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NB S MOD

River Assessment and Monitoring: Impaired Reach

3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: MCGRUDER ✓ Location:

Station: L 207-234 / L251-280 Stream Type: C 4 Valley Type: 8

Observers: TEAM 3 Date: 9/23

Methods for estimating Near-Bank Stress (NBS)

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

Level I

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

Level II

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

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

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

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.4	1.4	1.71	

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

Level IV

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

Dominant Near-Bank Stress: MODERATE

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

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

Overall Near-Bank Stress (NBS) rating

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Magruder Branch Degraded Reach Team 3 9/25/2007

HBS VERY LOW

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: R: 167 - 203 → 290 Date:

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

Level III

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

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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Magruder Branch Degraded Reach Team 3 9/25/2007

B2H1 MODERATE

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station: R-167-2003 → 280		Observers:	
Date:	Stream Type:	Valley Type:	

							BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	1 (A)	Bankfull Height (ft) =	1 (B)	(A) / (B) =	1 (C)		1
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	.5 (D)	Study Bank Height (ft) =	1 (A)	(D) / (A) =	.5 (E)		4
Weighted Root Density (G)							
Root Density as % =	5 (F)			(F) x (E) =	2.5 (G)		9
Bank Angle (H)							
Bank Angle as *Degrees* =	35 (H)						3
Surface Protection (I)							
Surface Protection as % =	40 (I)						5

GUESTIMATE

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)

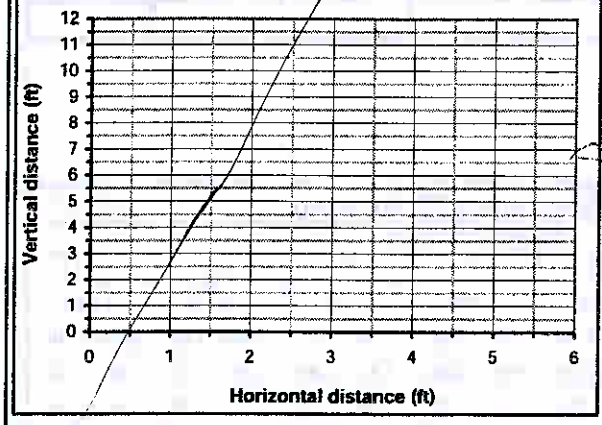
Bank Material Adjustment 0

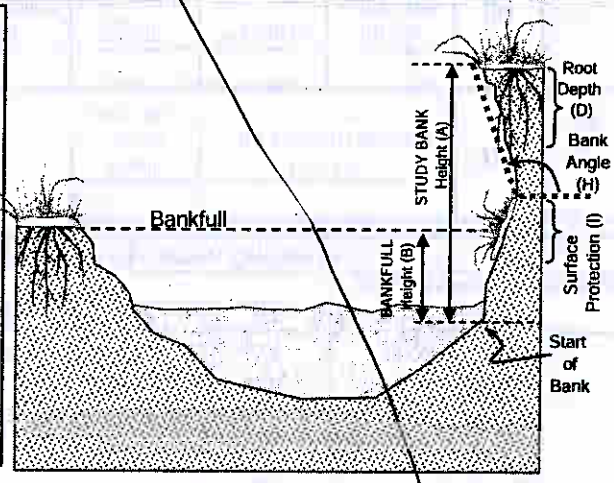
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

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 MOD
and
Total Score 22

Bank Sketch





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BEHI VERY HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station: R 139-152		Observers:	
Date:	Stream Type:	Valley Type:	

							BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	2.9 (A)	Bankfull Height (ft) =	1.5 (B)	(A) / (B) =	1.93 (C)		7.5
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	.5 (D)	Study Bank Height (ft) =	2.9 (A)	(D) / (A) =	0.17 (E)		7.2
Weighted Root Density (G)							
Root Density as % =	5% (F)			(F) x (E) =	.85 (G)		10
Bank Angle (H)							
Bank Angle as *Degrees* =	80 (H)						6
Surface Protection (I)							
Surface Protection as % =	1 (I)						10

Bank Material Adjustment:

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

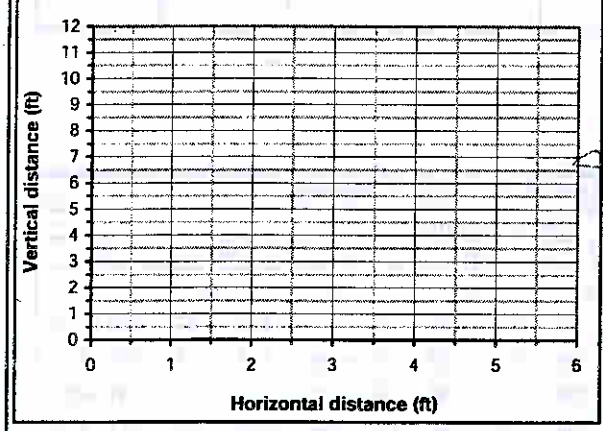
Bank Material Adjustment 0

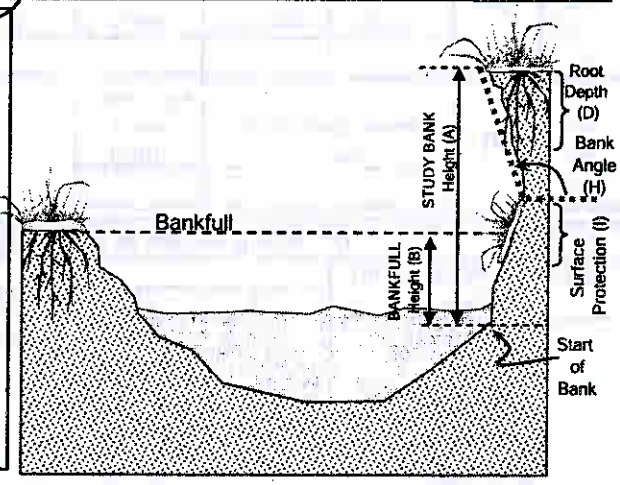
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

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 40.7

Bank Sketch





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HBS HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: ✓ Location:

Station: R138 -152 Stream Type: Valley Type:

Observers: Date:

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

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)	35	18	1.94	

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

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

Dominant Near-Bank Stress

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5) X	2.4	1.8	1.33	

	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)
(6)								

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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River Assessment and Monitoring: Impaired Reach

3rd Field Day

Additional BEHI and NBS worksheets

Stream:	Location:
Station: R 167 - 138	Observers: SAM, Geo
Date: Stream Type:	Valley Type:

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.0 (A)	Bankfull Height (ft) =	2.4 (B)	(A) / (B) =	1.25 (C)	5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.8 (D)	Study Bank Height (ft) =	3.0 (A)	(D) / (A) =	0.27 (E)	5.5
Weighted Root Density (G)						
Root Density as % =	7 (F)			(F) x (E) =	1.89 (G)	9.5
Bank Angle (H)						
Bank Angle as *Degrees* =	60 (H)					4
Surface Protection (I)						
Surface Protection as % =	10 (I)					8

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)

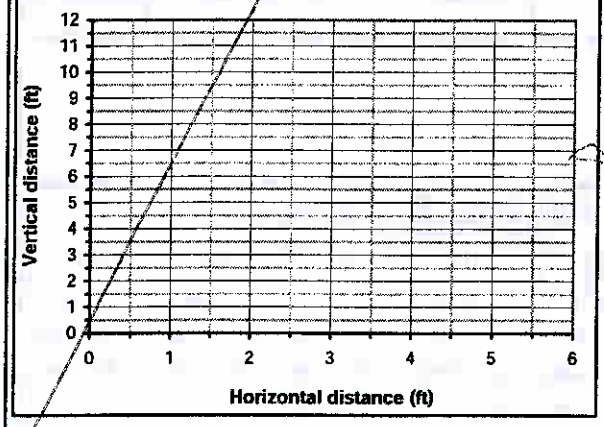
Bank Material Adjustment 0

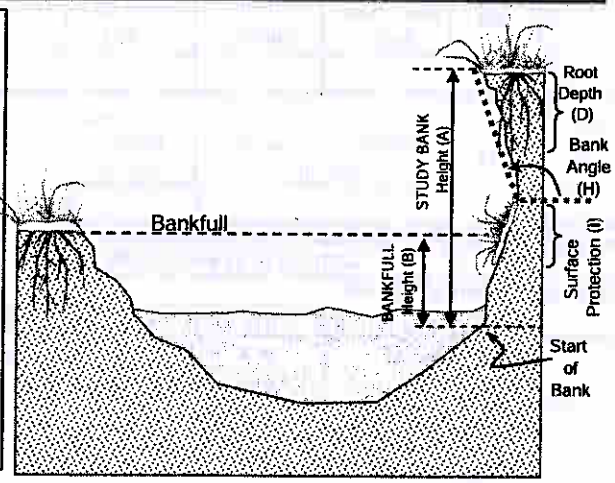
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

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 32

Bank Sketch





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Magruder Branch Degraded Reach Team 3 9/25/2007

NBS High

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: L 106-135 Stream Type: Valley Type:

Observers: Date:

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

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	3.0	1.5	2	

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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BEHI HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station: L42-134		Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.6 (A)	Bankfull Height (ft) =	1.7 (B)	(A) / (B) =	0.94 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.8 (D)	Study Bank Height (ft) =	1.6 (A)	(D) / (A) =	0.5 (E)	4
Weighted Root Density (G)						
Root Density as % =	4 (F)			(F) × (E) =	2 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	80 (H)					6
Surface Protection (I)						
Surface Protection as % =	2 (I)					10

Bank Material Adjustment:

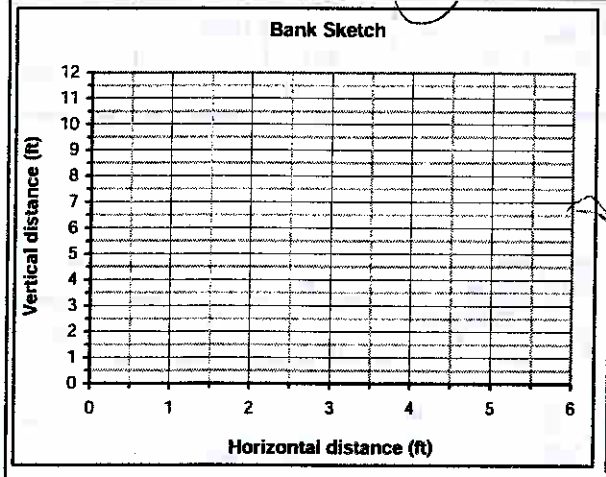
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

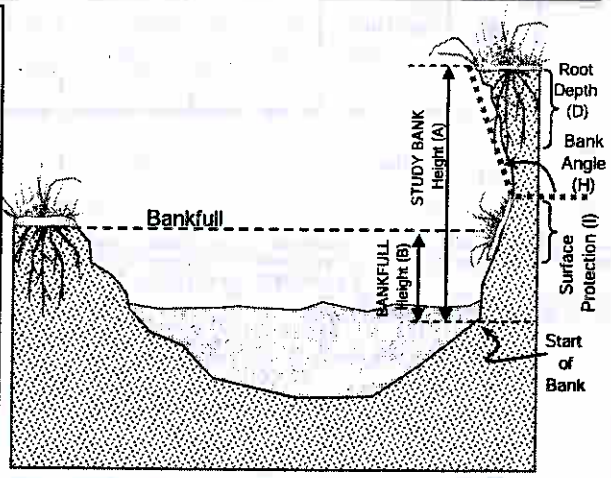
Bank Material Adjustment 0

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

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 26





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BEHI

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:	Location:
Station: L158-178	Observers:
Date: Stream Type:	Valley Type:

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.2 (A)	Bankfull Height (ft) =	2.1 (B)	(A) / (B) =	(C)	
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	2.2 (A)	(D) / (A) =	(E)	
Weighted Root Density (G)						
Root Density as % =	7 (F)	(F) × (E) =	(G)			
Bank Angle (H)						
Bank Angle as *Degrees* =	90 (H)					
Surface Protection (I)						
Surface Protection as % =	5 (I)					

Bank Material Adjustment:

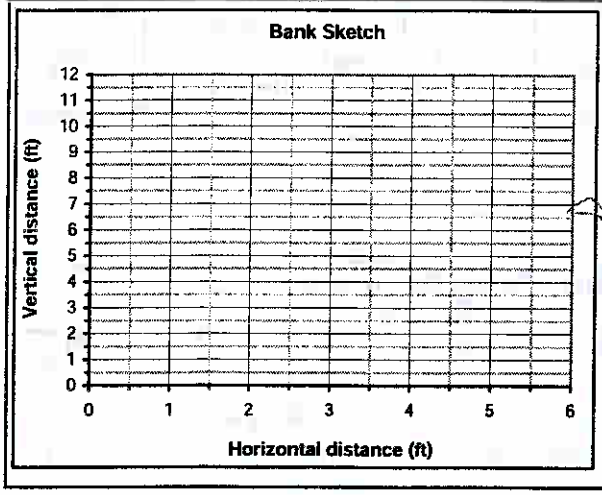
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

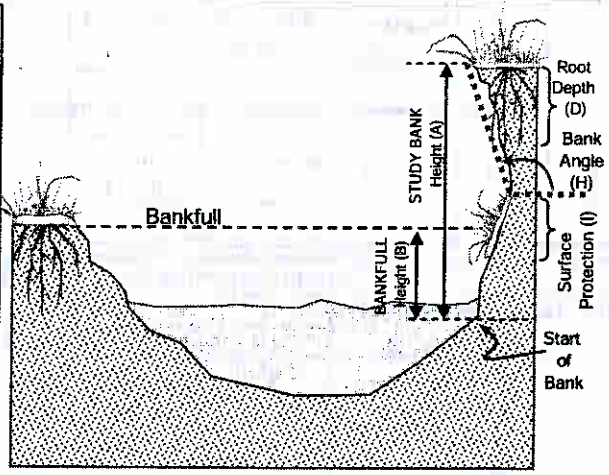
Bank Material Adjustment

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

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: 36.8





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Magruder Branch Degraded Reach Team 3 9/25/2007

NBS Low

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: L 150 - 170 Stream Type: Valley Type:

Observers: Date:

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

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.1	1.5	1.4	

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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B2H1

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station: L 178 - 207		Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.6 (A)	Bankfull Height (ft) =	2.1 (B)	(A) / (B) =	(C)	
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	2.0 (D)	Study Bank Height (ft) =	2.6 (A)	(D) / (A) =	(E)	
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) × (E) =	(G)	
Bank Angle (H)						
Bank Angle as *Degrees* =	110 (H)					
Surface Protection (I)						
Surface Protection as % =	12 (I)					

Bank Material Adjustment:

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

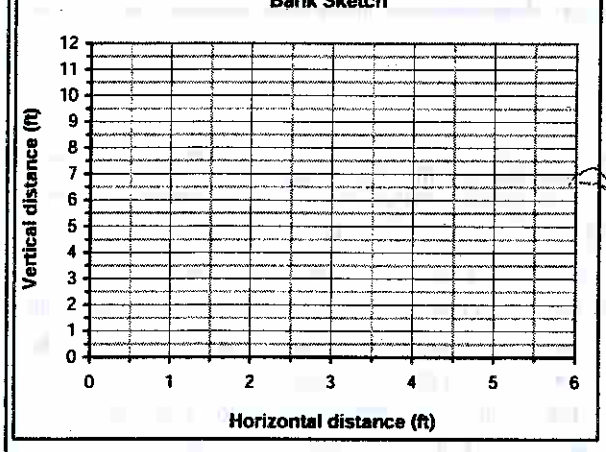
→ **Bank Material Adjustment**

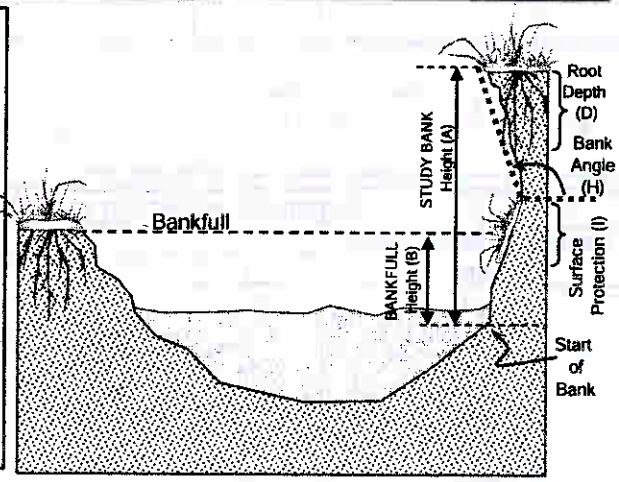
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

→ **Adjective Rating and Total Score**: 31.7

Bank Sketch





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NBS HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: L 178 - 207 Stream Type: Valley Type:

Observers: Date:

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

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

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

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

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	3.2	1.4	2.3	

	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)
(6)								

Level IV

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

Dominant Near-Bank Stress

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

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

Overall Near-Bank Stress (NBS) rating

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BEHI MODERATE

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station:	R 0-59	Observers:	
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.1 (A)	Bankfull Height (ft) =	1.5 (B)	(A) / (B) =	1.3 (C)	5-2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	2.1 (A)	(D) / (A) =	0.71 (E)	2.8
Weighted Root Density (G)						
Root Density as % =	18 (F)			(F) x (E) =	8.5 (G)	7.4
Bank Angle (H)						
Bank Angle as *Degrees* =	60 (H)					4
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)

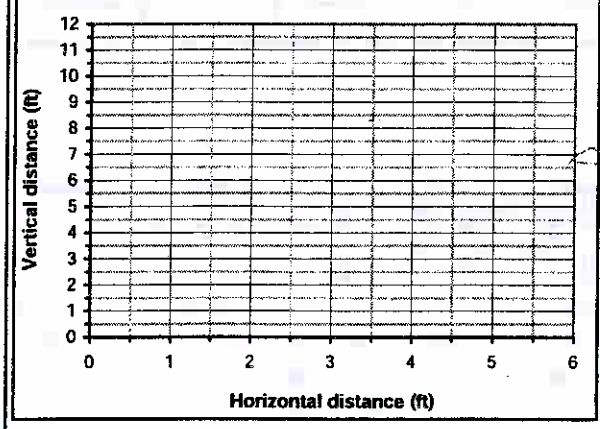
Bank Material Adjustment 0

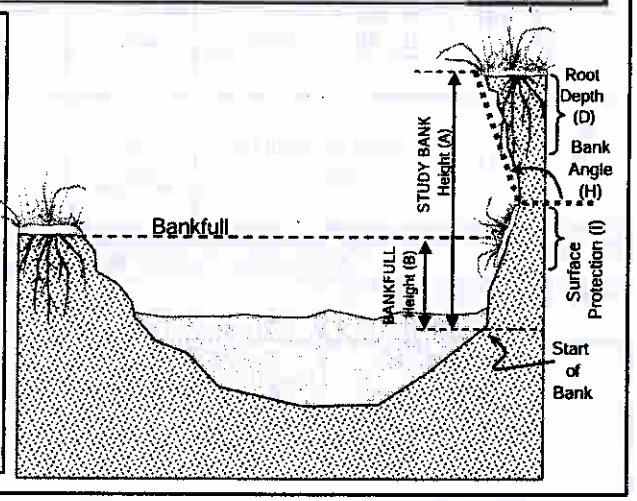
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 28.4

Bank Sketch





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Magruder Branch Degraded Reach Team 3 9/25/2007

NBS VERY LOW

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: R0-77 Stream Type: C4 Valley Type:

Observers: Date:

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 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)
1.4	2.1	0.67	VL

MOD @ DAP RIFFLE

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

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating

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BEHI High

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream:		Location:	
Station R59-85		Observers:	
Date:	Stream Type:	Valley Type:	

Yellow Poplar covers most of Bank

							BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	3.1 (A)	Bankfull Height (ft) =	1.7 (B)	(A) / (B) =	1.8 (C)		7.6
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	2.5 (D)	Study Bank Height (ft) =	3.1 (A)	(D) / (A) =	0.8 (E)		2.5
Weighted Root Density (G)							
Root Density as % =	40 (F)			(F) x (E) =	32 (G)		5.5
Bank Angle (H)							
Bank Angle as *Degrees* =	175 (H)						9.0
Surface Protection (I)							
Surface Protection as % =	40 (I)						5.0

Bank Material Adjustment:

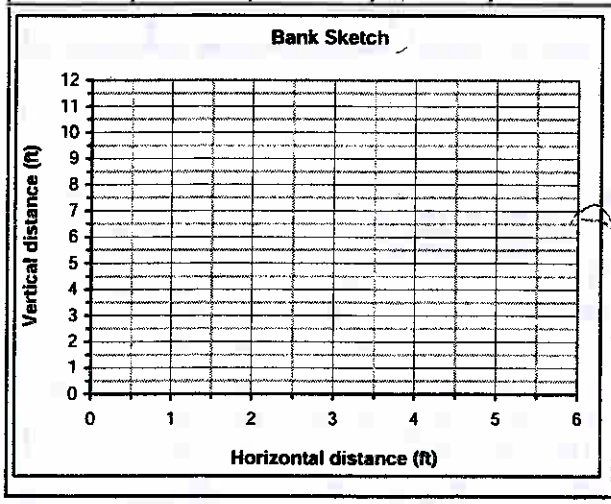
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

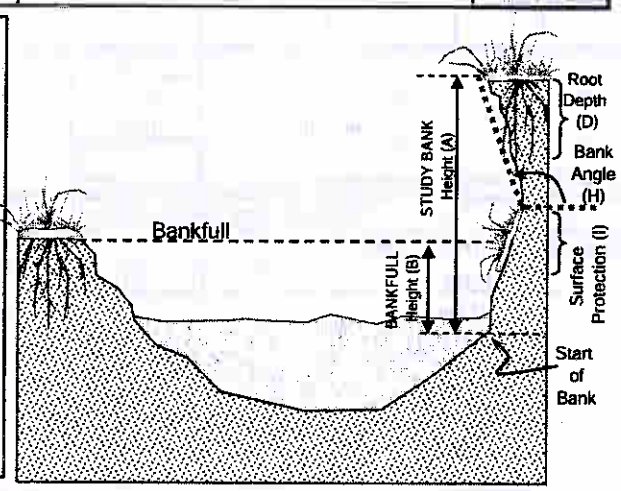
Bank Material Adjustment 0

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 29.6





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NBS HIGH

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: F77-107 Stream Type: Valley Type:

Observers: Date:

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

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

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

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

Dominant Near-Bank Stress

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	2.6	1.4	1.86	

	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)
(6)								

Level IV

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

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

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

Overall Near-Bank Stress (NBS) rating HIGH

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BEHI HIGH

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Additional BEHI and NBS worksheets

Stream: 3		Location:	
Station: L 0-42 / R 112-138		Observers: SWB	
Date:	Stream Type: C4	Valley Type: 8	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.3 (A)	Bankfull Height (ft) =	1.63 (B)	(A) / (B) =	1.4 (C)	4.3
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	2.2 (A)	(D) / (A) =	0.65 (E)	3.2
Weighted Root Density (G)						
Root Density as % =	25 (F)			(F) x (E) =	16.25 (G)	7.6
Bank Angle (H)						
Bank Angle as *Degrees* =	110 (H)					8.7
Surface Protection (I)						
Surface Protection as % =	10 (I)					8.0

Bank Material Adjustment:

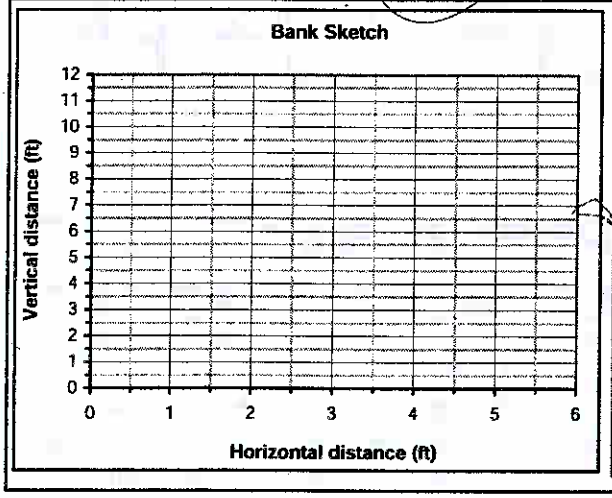
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

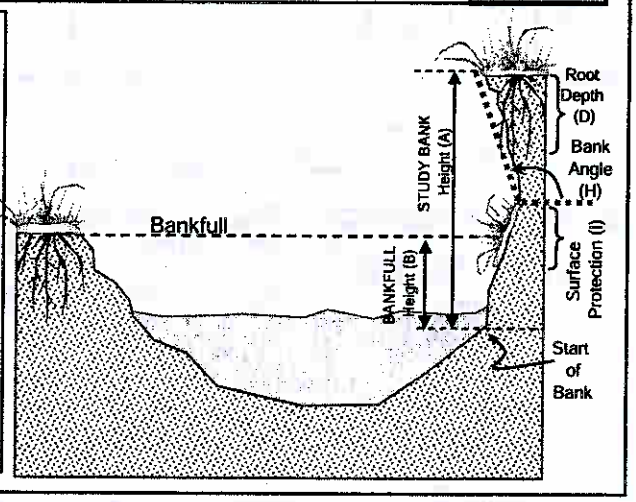
Bank Material Adjustment 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 1

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 32.8





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Magruder Branch Degraded Reach Team 3 9/25/2007

NBS Low

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: LD-106 (138?) Stream Type: Valley Type:

Observers: SWB Date:

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

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2-1	2-1	1	

(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:	**Macgruder , Reach - team 3**			Location:			
Graph Used:		Total Bank Length (ft): **280**				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. **000 - 042 L**	**High**	**Low**	**0.39968944**	**42**	**2.3**	**38.61**	**0.04**
2. **000 - 059 R**	**Moderate**	**Very Low**	**0.03922518**	**59**	**2.1**	**4.86**	**0.00**
3. **042 - 134 L**	**High**	**Low**	**0.39986413**	**92**	**1.6**	**58.86**	**0.03**
4. **059 - 085 R**	**Moderate**	**Very Low**	**0.04019851**	**26**	**3.1**	**3.24**	**0.01**
5. **110 - 138 R**	**High**	**Low**	**0.40183946**	**26**	**2.3**	**24.03**	**0.04**
6. **138 - 152 R**	**Very High**	**High**	**2.00172414**	**14**	**2.9**	**81.27**	**0.28**
7. **158 - 178 L**	**High**	**Low**	**0.49704545**	**20**	**2.2**	**21.87**	**0.05**
8. **178 - 207 L**	**High**	**High**	**0.99907162**	**29**	**2.6**	**75.33**	**0.13**
9. **207 - 234 L**	**Very High**	**Moderate**	**0.6 ~~0.5~~**	**27**	**2.9**	**46.98 ~~70.47~~**	**~~0.15~~ 0.08**
10. **234 - 251 L**	**Extreme**	**Moderate**	**1.89965398**	**17**	**5.1**	**164.7**	**0.47**
11. **251 -280 L**	**Very High**	**Moderate**	**0.60035672**	**29**	**2.9**	**50.49**	**0.08**
12. **glide**	**Very High**	**Moderate**	**0.55862069**	**1**	**2.9**	**1.62**	**0.08**
13. **pool**	**Extreme**	**Moderate**	**1.90588235**	**1**	**5.1**	**9.72**	**0.47**
14. **Run**	**High**	**Low**	**0.42631579**	**1**	**3.8**	**1.62**	**0.08**
15. **us riffle**	**High**	**Moderate**	**0.69230769**	**1**	**1.95**	**1.35**	**0.07**
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total erosion (ft^3/yr)**	587.55 **~~808.04~~**	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					**Total erosion (yds^3/yr)**	21.65 **~~22.52~~**	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					**Total erosion (tons/yr)**	28.15 **~~29.28~~**	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					**Total erosion (tons/yr/ft)**	0.101 **~~0.1046~~**	

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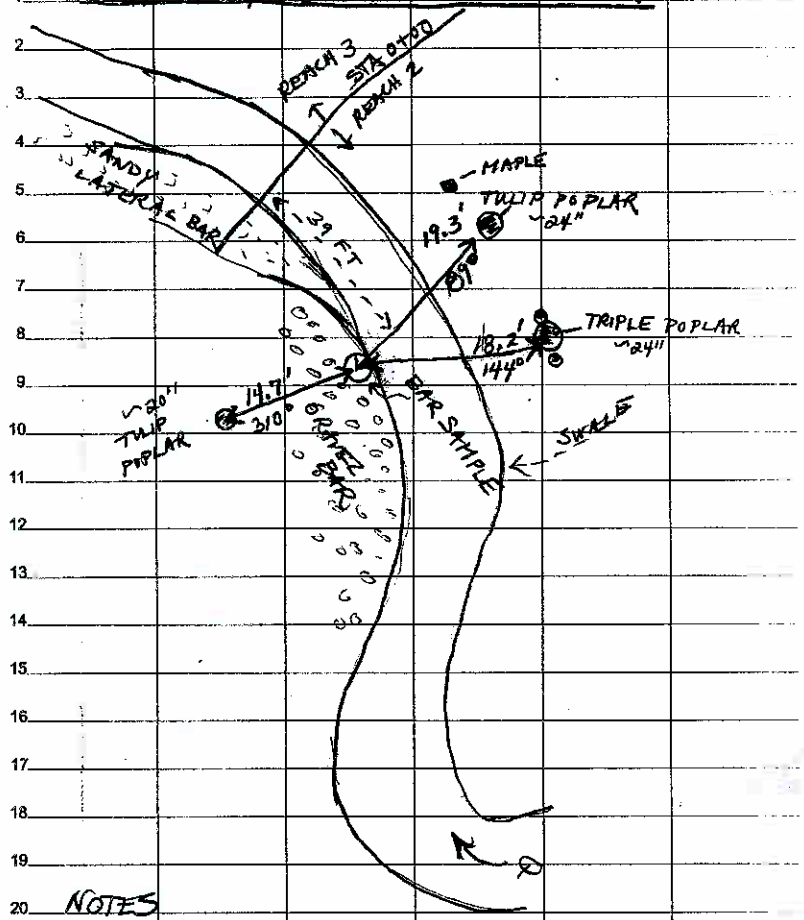
TEAM 3

MAP OF BAR SAMPLE LOCATION



NOTES

- TAKEN AT EDGE OF WATER SURFACE/BAR TOE
- BASED ON MAGNETIC NORTH, NOT ADJUSTED FOR DECLINATION
- BAR SAMPLE LOCATED 39' U/S OF REACH 3'S STA 0+00 (WITHIN REACH 2)

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

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

Observers: E. McClure / H. Martinez

Stream: Macgruder Branch

Location: Station −0+39 Team 3 OR Station 2+21 Team 2

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 2.25		Tare weight 2.125		Tare weight 2.375		Tare weight 2.375		Tare weight 2.56		Tare weight 2.625		Tare weight 2.375		Tare weight		Tare weight		
	Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		
	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	
1	14.25	12.0	6.375	4.25	6.125	3.75	7.0	4.625	10.875	8.315	9.0	6.375	13.875	11.5					
2			5.0	2.875	5.875	3.5	5.25	2.875	6.125	3.565	6.875	4.25							
3			4.25	2.125	4.875	2.5	5.25	2.875											
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Net wt. total	12.0		9.25		9.75		10.375		11.88		10.625		11.5						78.625
% Grand total	15.3%		11.8		12.4		13.2		15.1		13.5		14.6						
Accum. % =<	15.3		27.1		39.5		52.7		67.8		81.3		95.9						

SURFACE MATERIALS DATA (Two largest particles)

No.	Dia.	WT.
1	95	5.25
2	64	3.0

Bucket + materials weight	8.25
Bucket tare weight	2.5 (x2)
Materials weight	3.25 = 4.1%
Materials less than:	mm

Be sure to add separate material weights to grand total

GRAND TOTAL SAMPLE WEIGHT

Sample location notes

This sample was located just u/s of Team 3's reach (w/in Team 2's reach). The location is STA −39' for team 3's long pro and STA 2+21 for Team 2's long pro. Taken along baseflow edge along D/s 1/3 of bar.

Sample location sketch

(see triangulation map)

	TEAM 3 (mm)	TEAM 2 (comparison)
D_{16}	2.13	
D_{35}	6.57	
D_{50}	14.41	18.
D_{84}	67.71	65
D_{100}	95	85

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THIS COLUMN ↓

EXPERIMENT: RERUN W/ GROUP 2 SLOPE

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

Stream: Macgruder Branch			Stream Type: C4		
Location: Reach 3 Upstream Riffle			Valley Type: VIII		
Observers: H. Martinez / E. McClure			Date:		
Enter required information					
24.6	D_{50}	Riffle bed material D_{50} (mm) W/S RIFFLE ACTIVE BED			
14.4	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.31	D_{max}	Largest particle from bar sample (ft)	95	(mm)	304.8 mm/ft
0.0112 (0.0078)	S	Existing bankfull water surface slope (ft/ft)			
1.2	d	Existing bankfull mean depth (ft)			
	γ_s	Submerged specific weight of sediment			
Select the appropriate equation and calculate critical dimensionless shear stress					
1.7	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
3.86	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					
0.58	0.83	Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d)			
101.8	132.6	Moveable particle size (mm) at bankfull shear stress **(Figure C-4)**			
	0.54	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure C-4)** 95 mm			
1.11	0.77	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$ (τ predicted, S measured from x/s)			
0.0072	0.0072	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$ (τ predicted, d measured from x/s)			

mean depth: 1.19 u/s, 1.62 d/s

(62.4)(1.19')(.0112)

∴ Bankfull τ competent to mobilize largest particle measured in bar sample. To move largest particle size of bar sample, stream can have gradient as low as 0.0072 ft/ft or mean depth can be as low as 0.77 ft.

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

THIS COLUMN ↓ EXPERIMENT: RERUN w/ GROUP 2 SLOPE

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

Stream: Macgruder			Stream Type: C4		
Location: Downstream Riffle Active Bed			Valley Type: 8		
Observers: H & Ellen			Date:		
Enter required information					
18.9	D_{50}	Riffle bed material D_{50} (mm)			
14.4	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.3	D_{max}	Largest particle from bar sample (ft)	95	(mm)	304.8 mm/ft
0.0078 .0112	S	Existing bankfull water surface slope (ft/ft)			
1.62	d	Existing bankfull mean depth (ft)			
	γ_s	Submerged specific weight of sediment			
Select the appropriate equation and calculate critical dimensionless shear stress					
1.3	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
~~0.45~~ 5.0	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					
0.78	1.13	Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) (depth)			
126.6	166.3	Moveable particle size (mm) at bankfull shear stress **(Figure C-4)**			
	0.54	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure C-4)**			
1.11	0.77	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$ (slope)			
0.0072	0.057	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$			

62.4 = γ

1486

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

Stream: Macgruder	Stream Type:
Location: Team 3	Valley Type:
Observers:	Date:
Stream type changes due to successional stage shifts (Figure C-5)	**Stability rating (check appropriate rating)**
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☐ Stable
(E→C) C – wider w/D 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 C-20. Lateral stability prediction summary.

Stream: Magruder			Stream Type:		
Location: Team 3			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 C-12)**	< 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	> 1.6 (8)	8
2 **Depositional pattern (Worksheet C-8)**	B1, B2 (1)	B4, B8 (2)	B3 (3)	B5, B6, B7 (4)	4
3 **Meander pattern (Worksheet C-7)**	M1, M3, M4 (1)		M2, M5, M6, M7, M8 (3)		3
4 **Dominant BEHI / NBS (Worksheet C-16)**	L/VL, L/L, L/M, L/H, L/VH, M/VL (2)	M/L, M/M, M/H, L/Ex, H/L (4)	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL (6)	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex (8)	6
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet C-13)** 1.65	0.8 – 1.0 (1)	0.3 – 0.79 (2)	0.1 – 0.29 (3)	< 0.1 (4)	1
				Total points	~~20~~ 22
	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** ☐	unstable

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

Stream: Magruder			Stream Type:		
Location: Team 3			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 C-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)	2
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)	6
3 **W/d ratio state (Worksheet C-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	8
4 **Stream succession states (Worksheet C-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	6
5 **Depositional patterns (Worksheet C-8)**	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	3 4
6 **Debris / blockages (Worksheet C-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	2
				Total points	
	Vertical stability category point range for excess deposition / aggradation				
Vertical stability for excess deposition / aggradation (use total points and check stability rating)	**No deposition 10 – 14** ☐	**Moderate deposition 15 – 20** ☐	**Excess deposition 21 – 30** ✓	**Aggradation > 30** ☐	28

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

Stream: Magruder			Stream Type:		
Location: Team 3			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 C-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 C-10)** 1.20	1.00 – 1.10 (2)	1.11 – 1.30 (4) 3	1.31 – 1.50 (6)	> 1.50 (8)	3
4 **Stream succession states (Worksheets C-19 and C-10)**	Does not indicate incision or degradation (2)	If BHR > 1.1 and stream type has w/d between 5–10 (4)	If BHR > 1.1 and stream type has w/d less than 5 (6)	(B→G), (C→G), (E→G), (D→G) (8)	2
5 **Confinement (MWR / MWR_{ref})** ~~2.4~~ 2.3 **(Worksheet C-13)**	0.80 – 1.00 (1)	0.30 – 0.79 (2)	0.10 – 0.29 (3)	< 0.10 (4)	1
				Total points	11
	Vertical stability category point range for channel incision / degradation				
Vertical stability for channel incision/ degradation (use total points and check stability rating)	**Not incised 9 – 11** ☑	**Slightly incised 12 – 18** ☐	**Moderately incised 19 – 27** ☐	**Degradation > 27** ☐	

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Worksheet C-23. Channel enlargement prediction summary.

Stream: Magruder			Stream Type:		
Location: Team3			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 C-19)**	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C) (2)	(E→C) C → High WYD C (5) (4)	(G→F), (F→D) (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	5
2 **Lateral stability (Worksheet C-20)**	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	~~6~~ 8
3 **Vertical stability excess deposition/ aggradation (Worksheet C-21)**	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	~~6~~ 7
4 **Vertical stability incision/ degradation (Worksheet C-22)**	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	2
				Total points	19
	Category point range				
Channel enlargement prediction (use total points and check stability rating)	**No increase 8 – 10** ☐	**Slight increase 11 – 16** ☐	**Moderate increase 17 – 24** ☑	**Extensive > 24** ☐	22

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Worksheet C-24. Overall sediment supply rating determined from individual stability rating categories.

Stream: Magruder		Stream Type:	
Location: Team 3		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 C-20)	Stable	1	4
	Mod. unstable	2	
	Unstable	3	
	Highly unstable	4	
2 Vertical stability excess deposition/ aggradation (Worksheet C-21)	No deposition	1	3
	Mod. deposition	2	
	Excess deposition	3	
	Aggradation	4	
3 Vertical stability channel incision/ degradation (Worksheet C-22)	Not incised	1	1
	Slightly incised	2	
	Mod. incised	3	
	Degradation	4	
4 Channel enlargement prediction (Worksheet C-23)	No increase	1	3
	Slight increase	2	
	Mod. increase	3	
	Extensive	4	
5 Pfankuch channel stability (Worksheet C-11)	Good: stable	1	4
	Fair: mod unstable	2	
	Poor: unstable	4	
		Total Points	~~14~~ 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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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-25. Summary of stability condition categories.

Stream: Magruder				Location: Team 3 Day 3		
Observers:		Date:		Stream Type:	Valley Type:	
Channel Dimension	Mean bankfull depth (ft): 1.19	Mean bankfull width (ft): 25.85	Cross-section area (ft^2): 30.8	Width of flood-prone area (ft): 88.5	Entrenchment ratio: 3.4	
Channel Pattern	Mean (range)	MWR: 2.44	Lm/W_{bkf}: 4.14	Rc/W_{bkf}: 1.3	Sinuosity: 1.47	
River Profile and Bed Features	Circle: Riffle/pool Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed					
	Max bankfull depth (ft): Riffle 1.76 Pool 4.4	Depth ratio (max/mean): Riffle 1.39 Pool 3.27	Pool to pool spacing: Ratio 2.5	Slope: Valley: 0.0163 Average bankfull: 0.0112		
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: mid sw. tulip pop dominated	Potential composition/density: late sw. oak dom.	Remarks: Condition, vigor and/or usage of exiting reach:		
	Flow regime: P2	Stream size and order: S4 (2)	Meander pattern(s): M3	Depositional pattern(s): 1, 2 4, 5	Debris/channel blockage(s): D1 - D-4	
	Degree of incision (Bank-Height Ratio): 1.2	Degree of incision stability rating: Slightly incised	Modified Pfankuch stability rating (numeric and adjective rating): Poor ~~114~~ 118			
	Width/depth ratio (W/D): 21.7	Reference W/D ratio (W/D_{ref}): 11.4	Width/depth ratio state (W/D) / (W/D_{ref}): 1.9	W/D ratio state stability rating: highly unstable		
	Meander Width Ratio (MWR): 2.44	Reference MWR_{ref}: 2.3	Degree of confinement (MWR / MWR_{ref}): 1.06	MWR / MWR_{ref} stability rating: unconfined		
Bank Erosion Summary	Length of reach studied (ft): 280	Annual streambank erosion rate: 29.28 (tons/yr) 0.105 (tons/yr/ft)	Curve used: DC curve	Remarks:		
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks:			
Entrainment/ Competence	Largest particle from bar sample (mm): 95	$\tau = 0.83$	$\tau^* =$	Existing $depth_{bkf}$: 1.2	Required $depth_{bkf}$: 0.77	Existing $slope_{bkf}$: 0.0112 Required $slope_{bkf}$: 0.0072
Successional Stage Shift	C → High W/D C → → → →			Existing stream state (type): C4	Potential stream state (type): C4	
Lateral Stability	Circle: Stable	Moderately unstable	Unstable	Highly unstable	Remarks/causes:	
Vertical Stability (Aggradation)	Circle: No deposition	Moderate deposition	Excess deposition	Aggradation	Remarks/causes:	
Vertical Stability (Degradation)	Circle: Not incised	Slightly incised	Moderately incised	Degradation	Remarks/causes:	
Channel Enlargement	Circle: No increase	Slight increase	Moderate increase	Extensive	Remarks/causes:	
Sediment Supply (Channel Source)	Circle: Low Moderate	High	Very high	Remarks/causes:		

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3rd Field Day

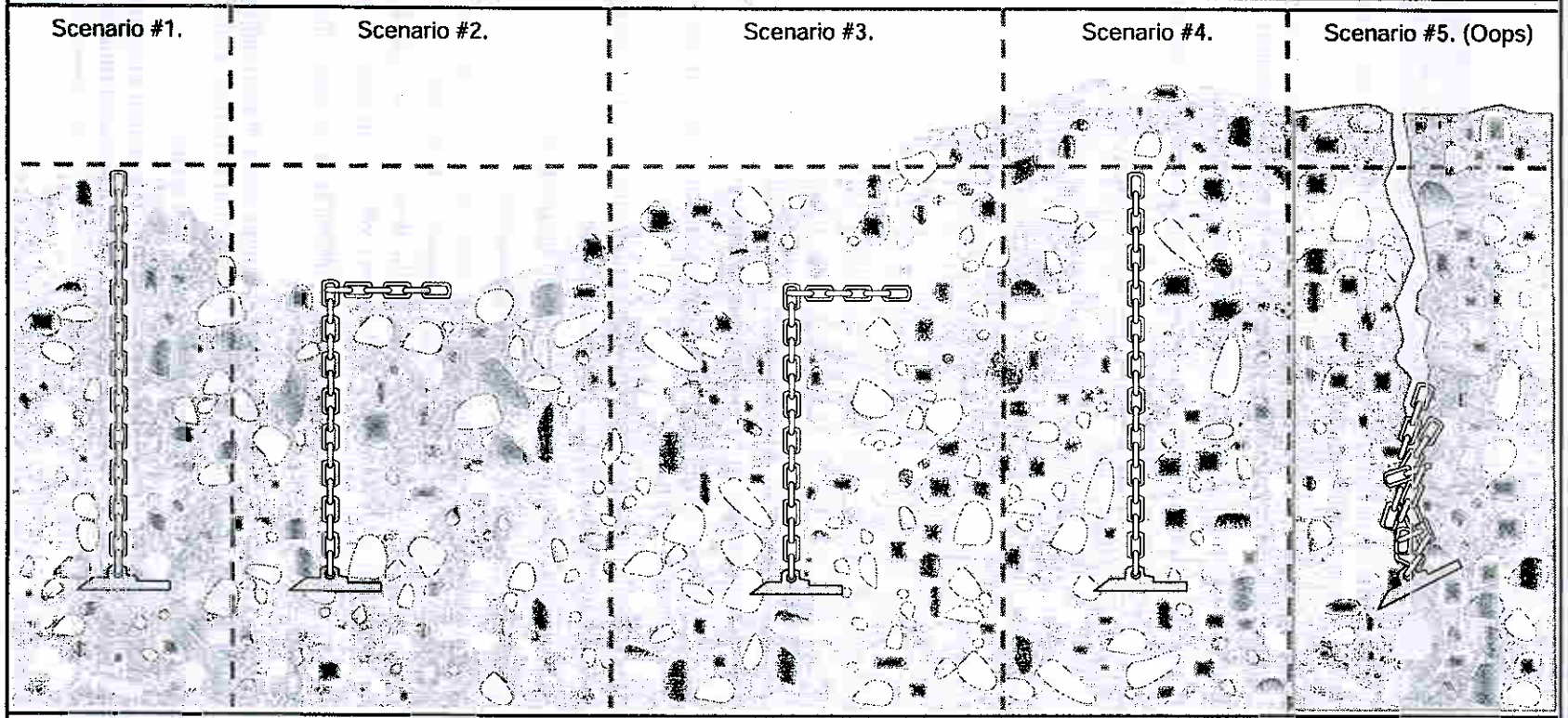
Worksheet C-26. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name: Macgruder Creek Location: Reach 3

Observers: Team 3 Stream Type: C4 Valley Type: VIII Date: 9/25/07

Bank Station 2+08

		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	24.9	7.07	52	49						
Riffle	Chain #2	28.0	7.01	124	78						
~~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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River Assessment and Monitoring: Impaired Reach 3rd Field Day

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

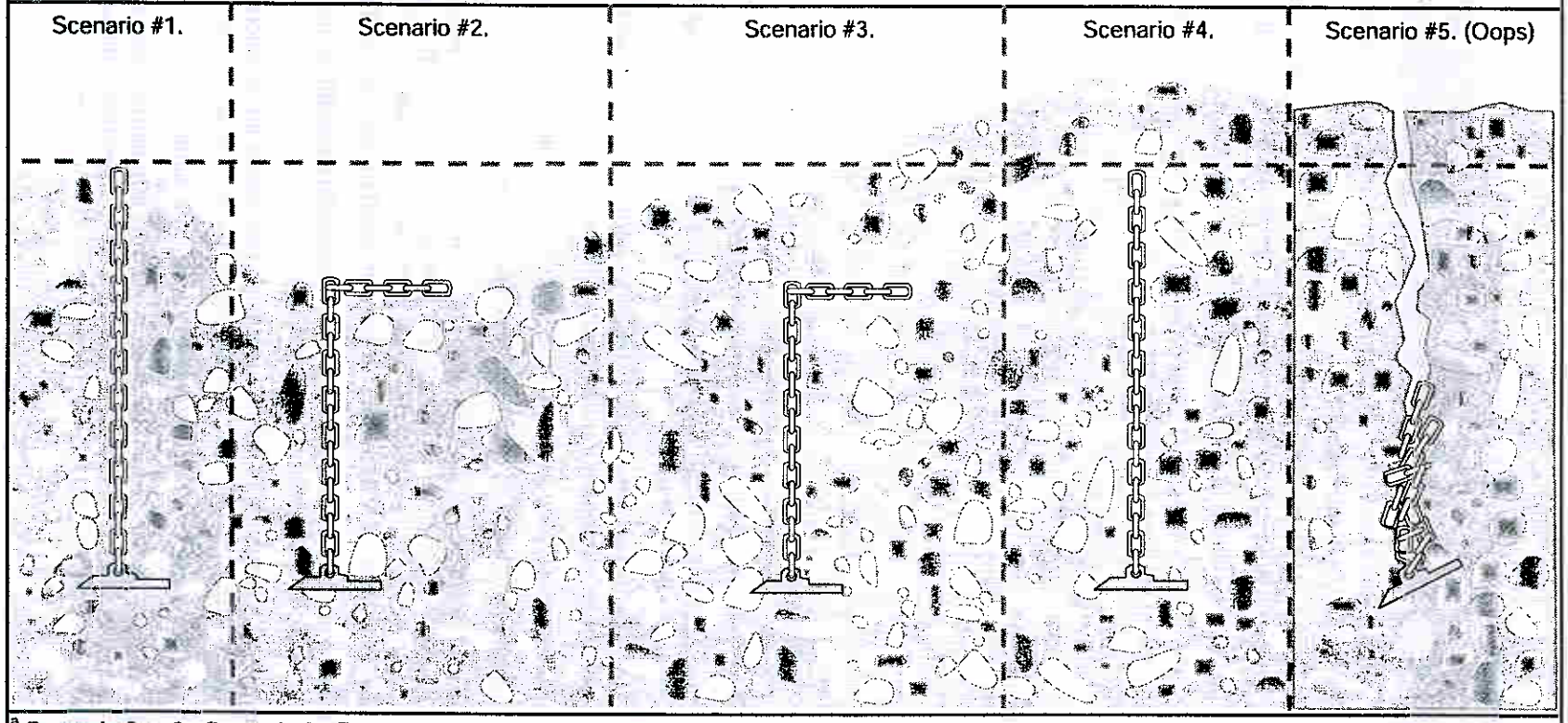
Stream name: Macgruder Creek Location: Reach 3

Observers: Team3 Stream Type: C4 Valley Type: VIII Date: 9/25/07

Bank Station 0+14

2+72

		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	21.5	9.22	95	45						
Riffle	Chain #2	24.2	9.07	64	62						
Glide	Chain #3	15.46	8.01	79	66						
Glide	Chain #4	19.18	7.59	64	43						



[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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River Assessment and Monitoring: Impaired Reach 3rd Field Day

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

BANK PROFILE WORKSHEET

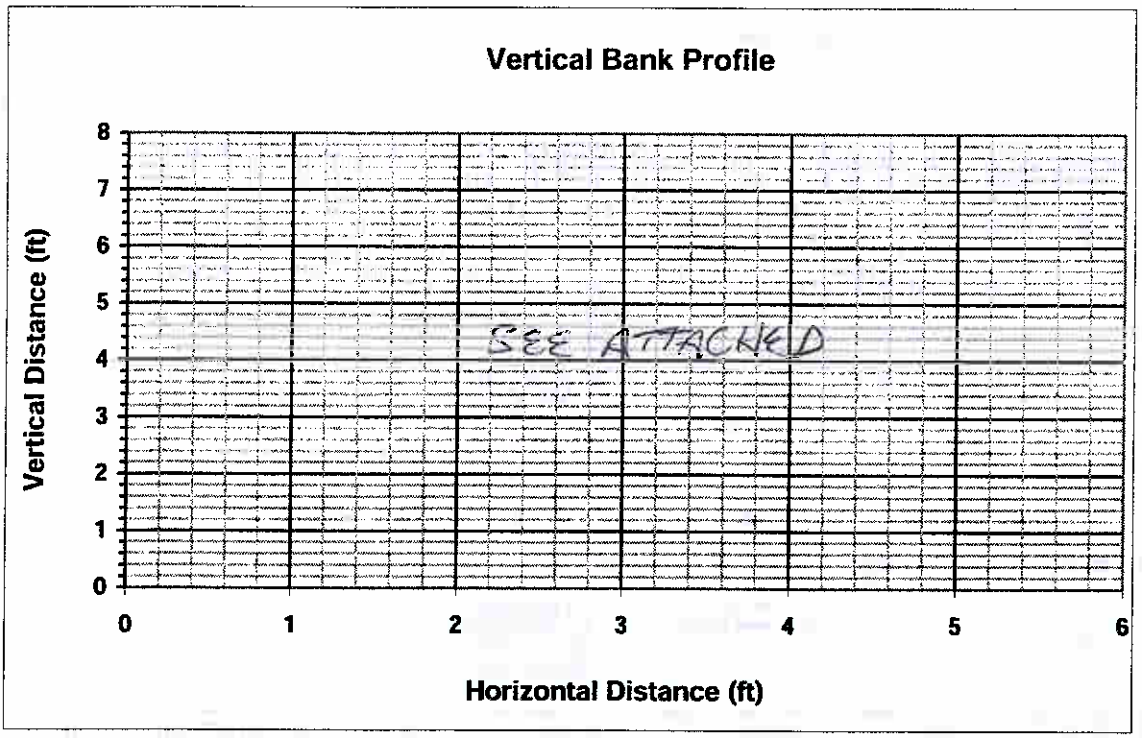
Stream: MAGRUDER	Observers: TEAM 3
Location: REACH 3	Date: 9/25/07
Cross-section: STA 14 (RIFFLE)	BEHI adjective: HIGH
Bank: LT	NBS adjective: MOD.
Toe pin station (ft): 0+14	Predicted erosion (ft): 0.69
Toe pin elevation (ft):	Measured erosion (ft): N/A

Date:

Horizontal	Vertical	Notes
0	0	Top of Pin (toe)
0	-0.08	Btm of Pin (toe)
1.1	0.11	Toe of Bank
1.2	0.33	Slope Break
1.34	0.47	Bank Pin
1.47	0.68	Undercut
1.42	0.93	Slope Break
1.35	1.26	Bank Pin
1.5	1.57	Inflection Pt
2.22	1.97	BKF

Date:

Horizontal	Vertical	Notes



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River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

BANK PROFILE WORKSHEET

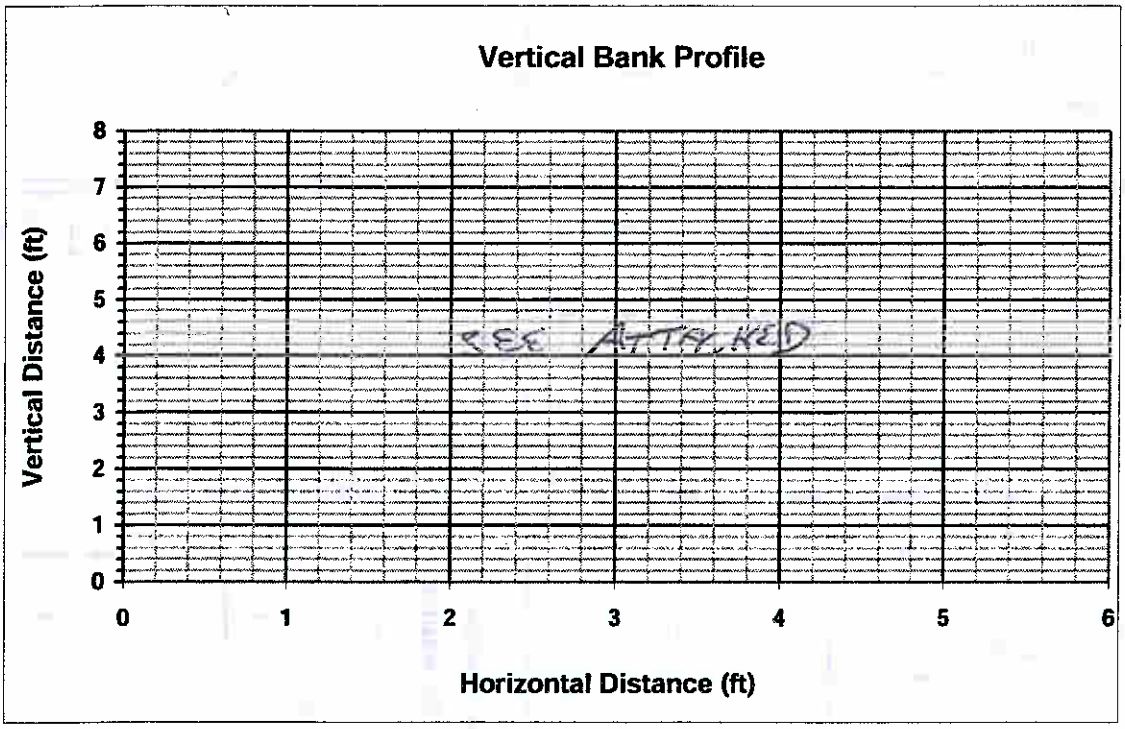
Stream: MAGRUDER	Observers: TEAM 3
Location: REACH 3	Date: 9/25/07
Cross-section: Riffle 2+08	BEHI adjective: V. HIGH
Bank: LT	NBS adjective: MOD
Toe pin station (ft): 2+08	Predicted erosion (ft): 0.005
Toe pin elevation (ft):	Measured erosion (ft):

Date:

Horizontal	Vertical	Notes
0	0	toe pin top
0.1	0	
1.08	0.1	
1.28	0.2	
1.45	0.21	
1.66	0.46	
1.78	0.71	
2.08	0.94	
2.34	1.26	
2.6	1.52	
2.62	1.55	
2.74	1.6	
3	1.82	
3.26	1.96	
3.64	2.26	

Date:

Horizontal	Vertical	Notes
3.94	2.48	
4.18	2.58	Top of Bank
		Bank Pins
1.78	0.71	L
2.62	1.55	U



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River Assessment and Monitoring: Impaired Reach 3rd Field Day

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

BANK PROFILE WORKSHEET

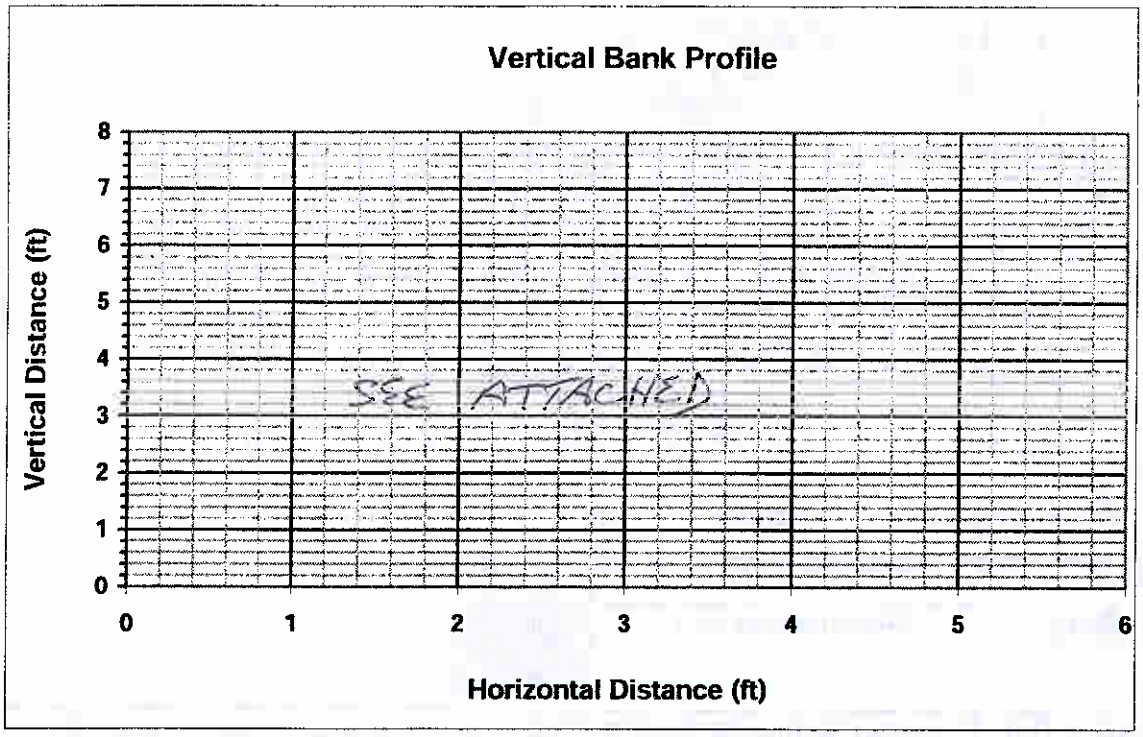
Stream: MAGRUDER	Observers: TEAM 3
Location: REACH 3	Date: 9/25/07
Cross-section: Pool (2+40.6)	BEHI adjective: ~~HIGH~~ EXTREME
Bank: LT	NBS adjective: MOD.
Toe pin station (ft): 2+40.6	Predicted erosion (ft): 1.91
Toe pin elevation (ft):	Measured erosion (ft): N/A

Date:

Horizontal	Vertical	Notes
2.51	5.02	
2.41	4.9	
2.33	4.1	
2.25	3.68	
1.89	3.06	
1.66	2.69	
1.33	2.48	
1.26	2.16	
1.55	1.99	
1.74	1.8	
1.79	1.7	
2.29	1.53	
2.71	1.29	
3.03	0.68	
2.96	0	

Date:

Horizontal	Vertical	Notes
2.93	-0.28	
1.35	-0.35	
1.2	-0.35	
1	-0.35	
0.85	-0.32	
0.75	-0.33	
0.6	-0.25	
0.3	-0.27	
0.1	-0.2	
0	0.28	
		Bank Pin
2.3	1.1	L (0.48 exposed)
1.89	3.08	M
2.33	4.1	U



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0.48

River Assessment and Monitoring: Impaired Reach 3rd Field Day

3. Channel Change

Worksheet C-28. Summary of annual data comparisons.

Data Comparison Form

Stream: MAGRUDER Reach: REACH 3

Observers: TEAM 3 Date - Year 1: 9/25/07 Date - Year 2:

		Riffle XS: UPSTREAM		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	25.85		14.7		17.41	
	Mean $depth_{bkf}$	1.19		2.44		1.48	
	Width/depth ratio	21.72		6.02		11.76	
	Cross-sectional $Area_{bkf}$	30.84		35.88		25.7	
	Max $depth_{bkf}$	1.85		4.03		2.36	
Pebble count	D_{35} (mm)	18.1		0.23			
	D_{50} (mm)	22.6		0.44			
	D_{84} (mm)	56.1		22.6			
Bank Erosion	BEHI rating	HIGH		EXTREME		V. HIGH	
	NBS rating	MOD.		MOD.		MOD.	
	Predicted erosion (ft/yr)	0.7		1.9		0.6	
	Measured erosion (ft/yr)	N/A		N/A		N/A	

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	114		Bar Sample	D_{35} (mm)	6.6	
Bank-Height Ratio start: / end:	1.2/1			D_{50} (mm)	14.4	
Point Bar slope	0.44 (0.3-0.7)			D_{84} (mm)	67.7	
(MEAN) Riffle Length/Riffle Width	0.94			D_{100} (mm)	95.0	
(MEAN) Pool Length/Riffle Width	0.94				1.38	
(MEAN) Dimensionless Slope Ratios: S_{rif}/S	3.40		Dimensionless Depth Ratios (MEAN): d_{rif}/d_{bkf}		~~0.39~~	
(MEAN) S_{run}/S	1.31		d_{run}/d_{bkf}		1.08 ~~1.24~~	
(MEAN) S_p/S	0.09		d_p/d_{bkf}		3.26 ~~2.10~~	
(MEAN) S_g/S	0.24		d_g/d_{bkf}		1.93 ~~1.24~~	

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

3. Channel Change

Worksheet C-28. Summary of annual data comparisons.

Data Comparison Form

Stream: MAGRUDER Reach: 3

Observers: TEAM 3 Date - Year 1: 9/25/07 Date - Year 2:

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	17.2					
	Mean $depth_{bkf}$	1.62					
	Width/depth ratio	10.86					
	Cross-sectional $Area_{bkf}$	27.9					
	Max $depth_{bkf}$	2.3					
Pebble count	D_{35} (mm)	32.6					
	D_{50} (mm)	41.5					
	D_{84} (mm)	87.1					
Bank Erosion	BEHI rating	HIGH					
	NBS rating	LOW					
	Predicted erosion (ft/yr)	0.4					
	Measured erosion (ft/yr)	N/A					

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	114		Bar Sample	D_{35} (mm)	6.6	
Bank-Height Ratio start: end:	1.2/1			D_{50} (mm)	14.4	
Point Bar slope	0.44 (0.3-0.7)			D_{84} (mm)	67.7	
Riffle Length/Riffle Width	1.41			D_{100} (mm)	95.0	
Pool Length/Riffle Width	1.41					
Dimensionless Slope Ratios: S_{rif}/S	3.40		Dimensionless Depth Ratios	d_{rif}/d_{bkf}	1.42 ~~0.60~~	
S_{run}/S	1.31			d_{run}/d_{bkf}	1.38 ~~0.94~~	
S_p/S	0.09			d_p/d_{bkf}	2.40 ~~1.09~~	
S_g/S	0.24			d_g/d_{bkf}	1.42 ~~1.03~~	

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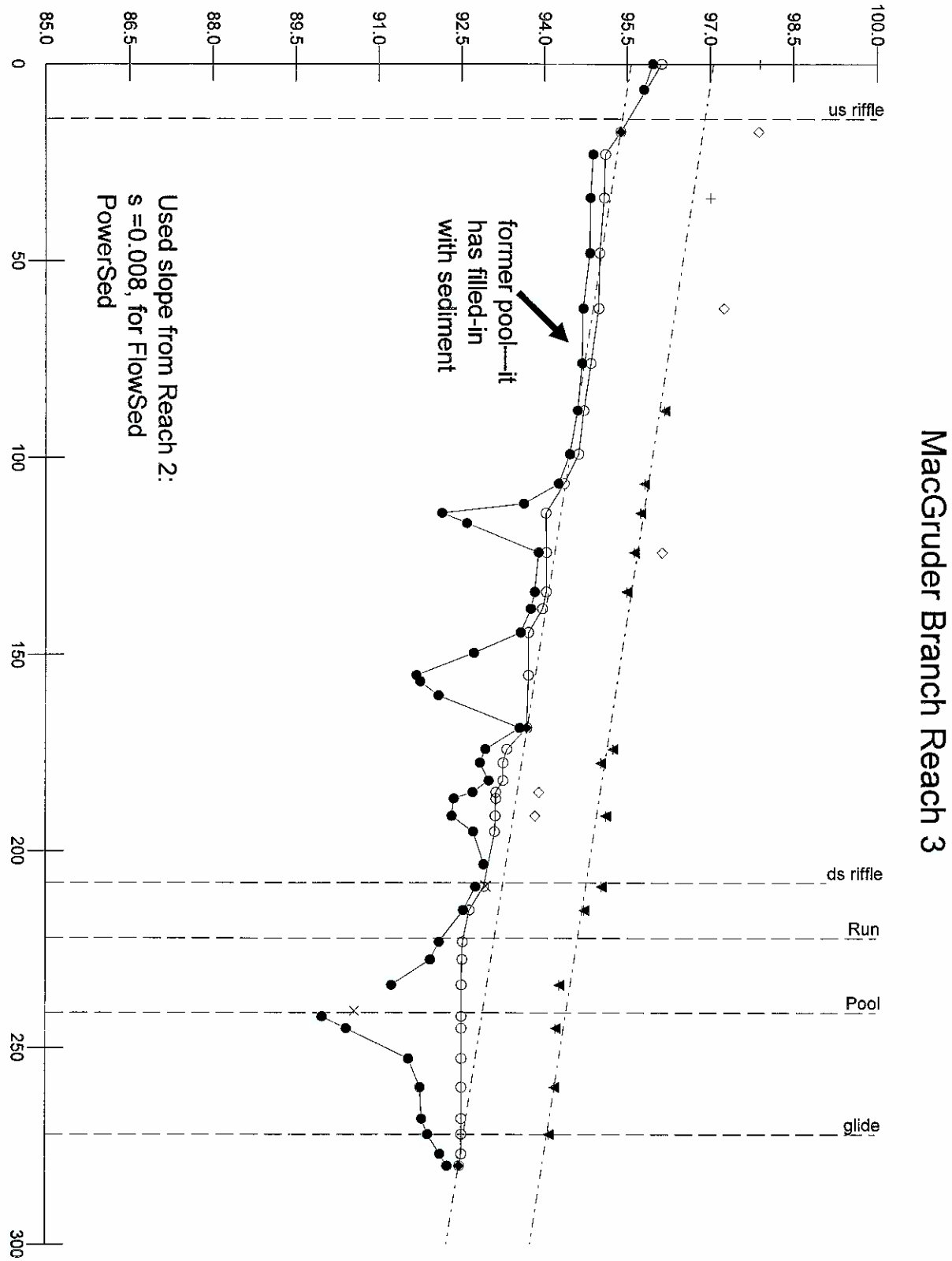
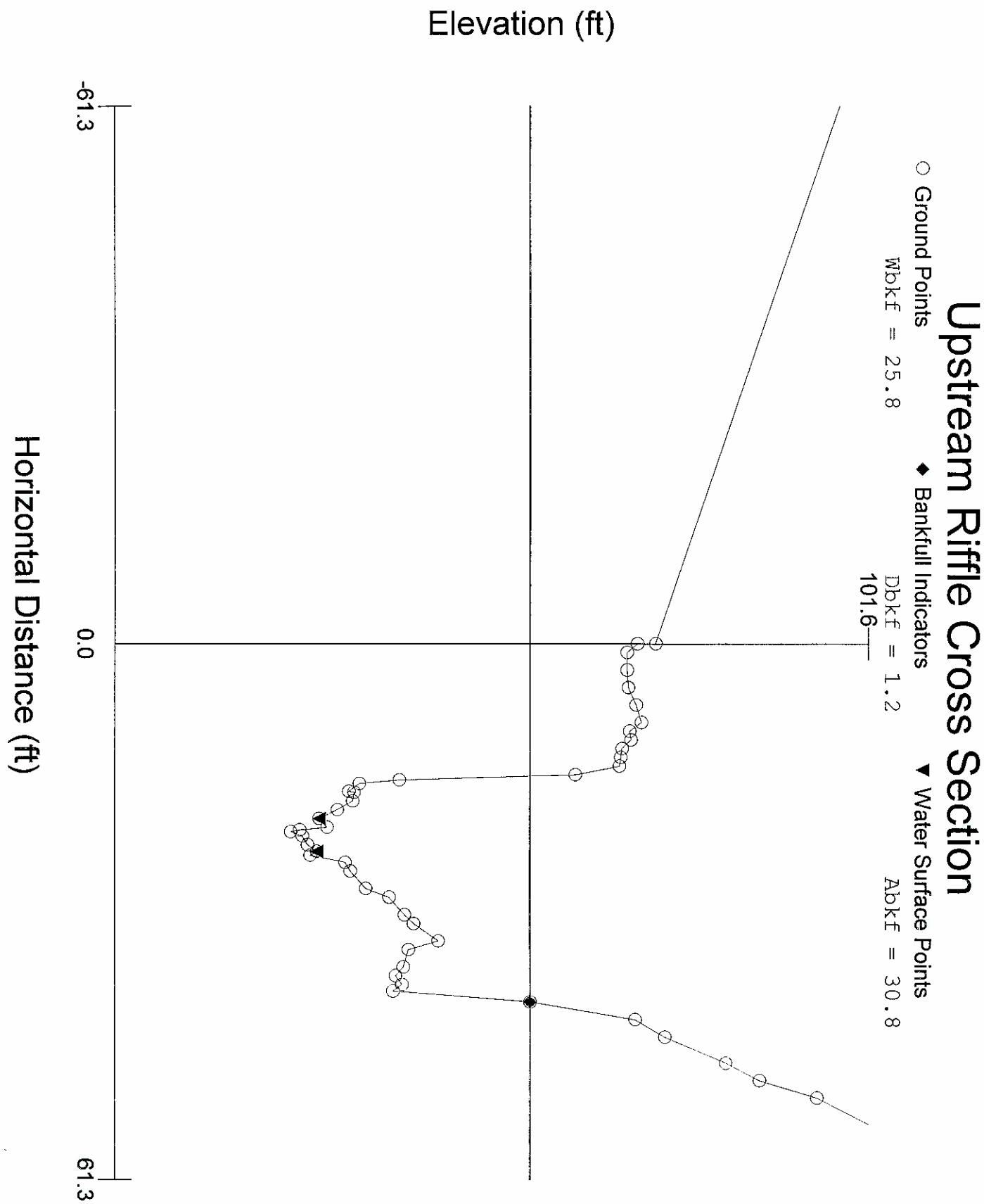
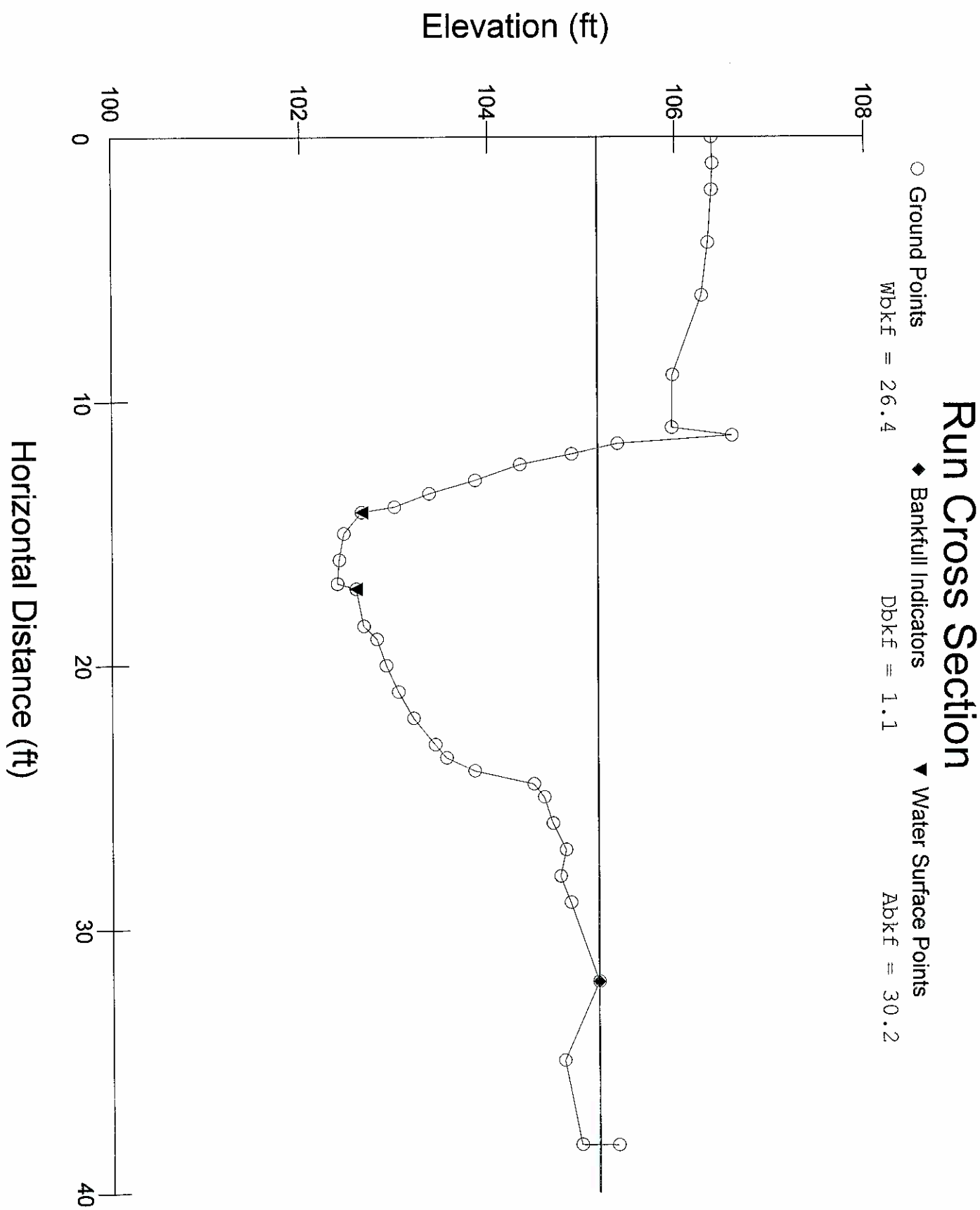
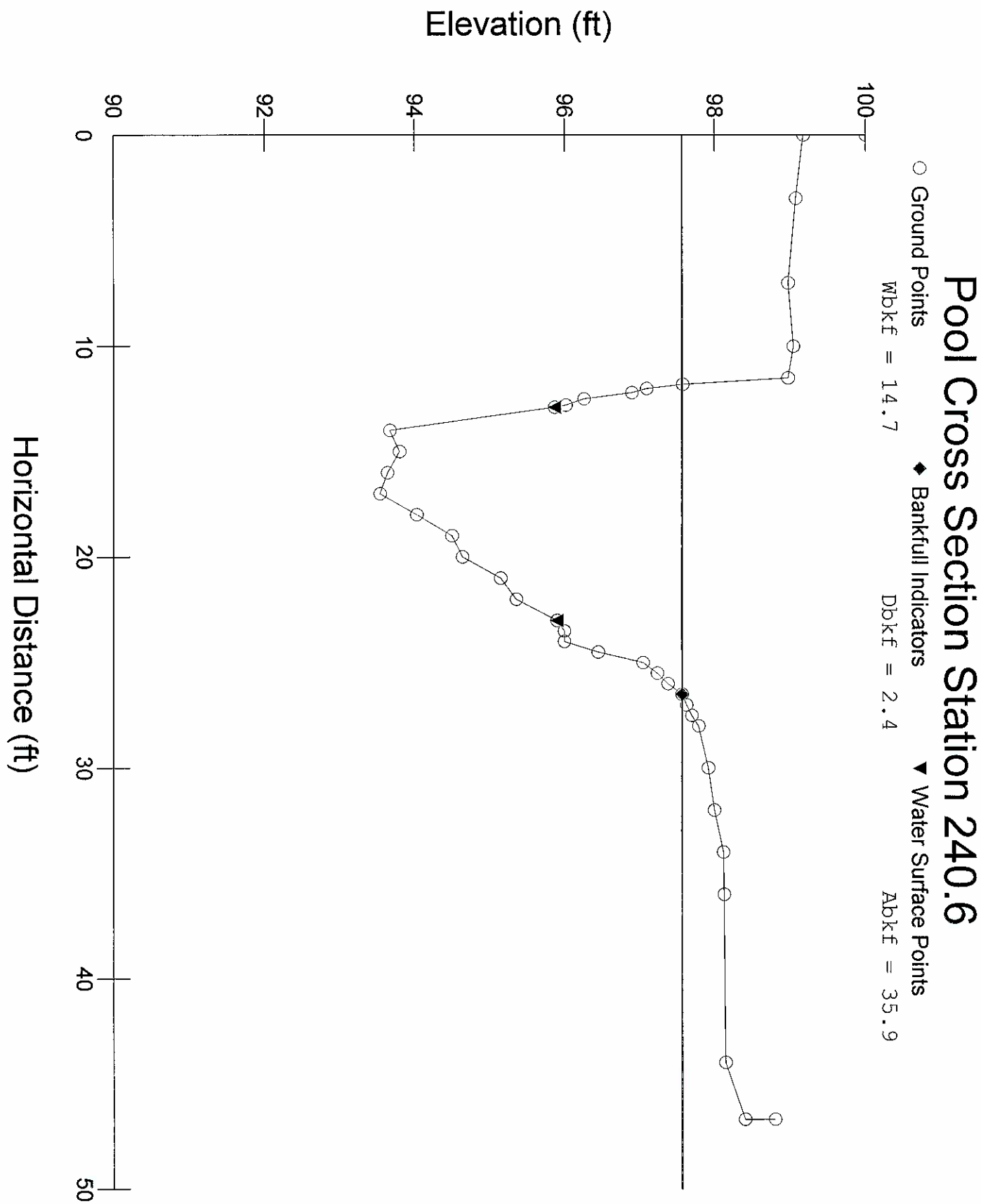
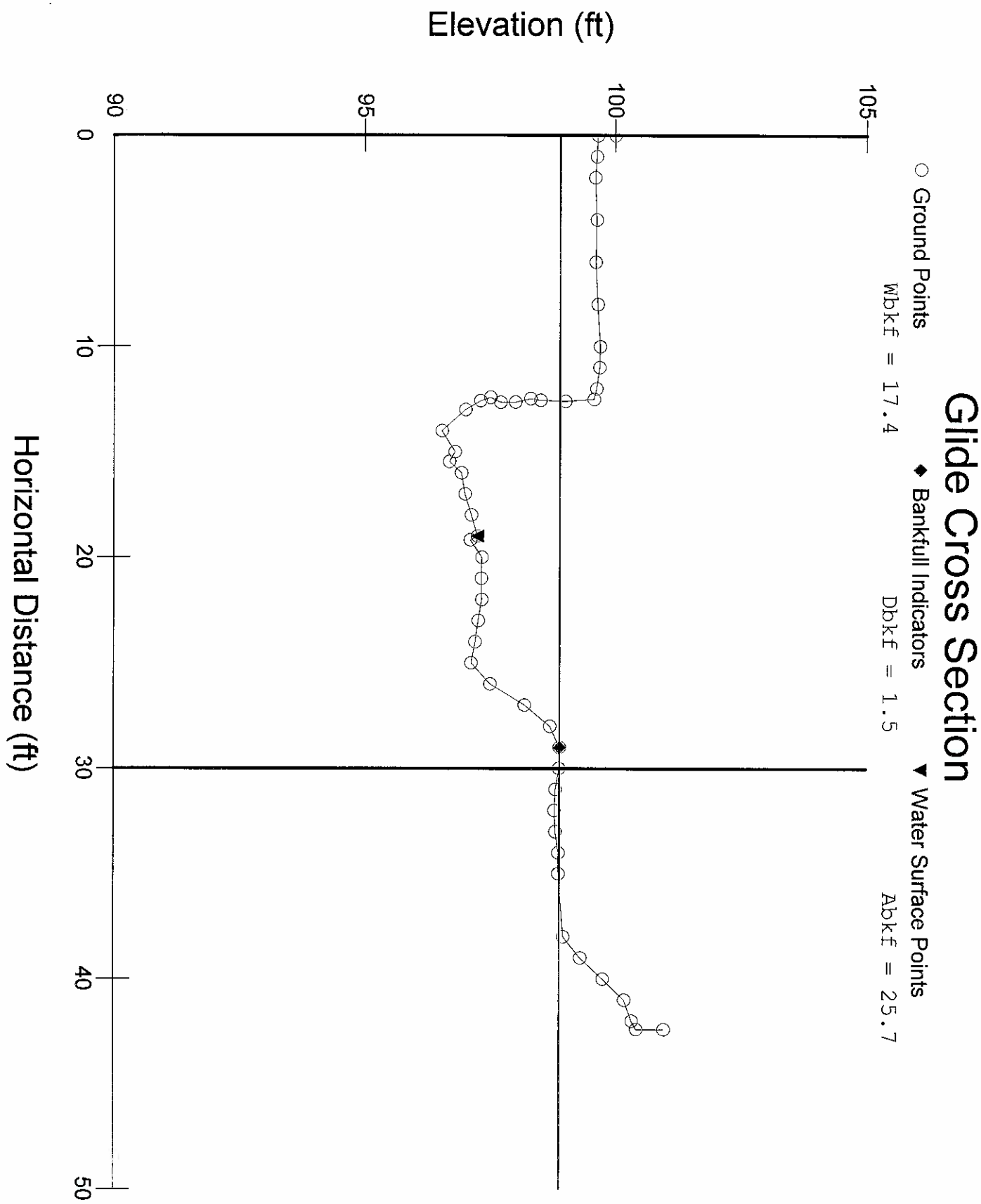
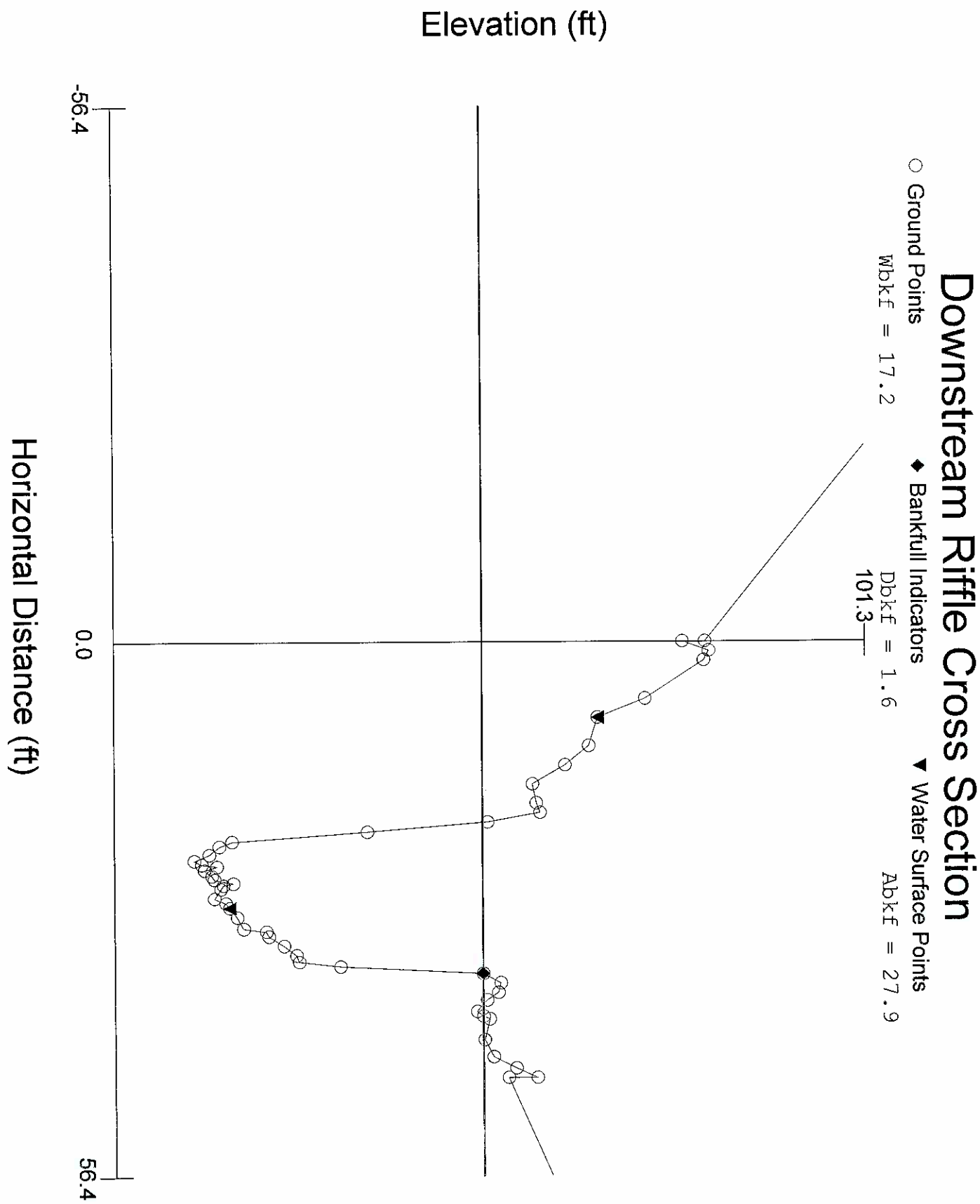

MacGruder Branch Reach 3
100.0
98.5
97.0
95.5
94.0
92.5
91.0
89.5
88.0
86.5
85.0
0
50
100
150
200
250
300
us riffle
ds riffle
Run
Pool
glide
former pool---it
has filled-in
with sediment
Used slope from Reach 2:
s =0.008, for FlowSed
PowerSed
CH
WS
BKF
WTRSLP
InBerm
BKFPTS
Pins


Upstream Riffle Cross Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.8
Dbkf = 1.2
Abkf = 30.8
101.6
Elevation (ft)
-61.3
0.0
61.3
Horizontal Distance (ft)


Run Cross Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 26.4
Dbkf = 1.1
Abkf = 30.2
Elevation (ft)
108
106
104
102
100
0
10
20
30
40
Horizontal Distance (ft)


Pool Cross Section Station 240.6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 14.7
Dbkf = 2.4
Abkf = 35.9
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
Horizontal Distance (ft)


Glide Cross Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.4
Dbkf = 1.5
Abkf = 25.7
Elevation (ft)
105
100
95
90
0
10
20
30
40
50
Horizontal Distance (ft)


Downstream Riffle Cross Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.2
Dbkf = 1.6
Abkf = 27.9
101.3
Elevation (ft)
-56.4
0.0
56.4
Horizontal Distance (ft)

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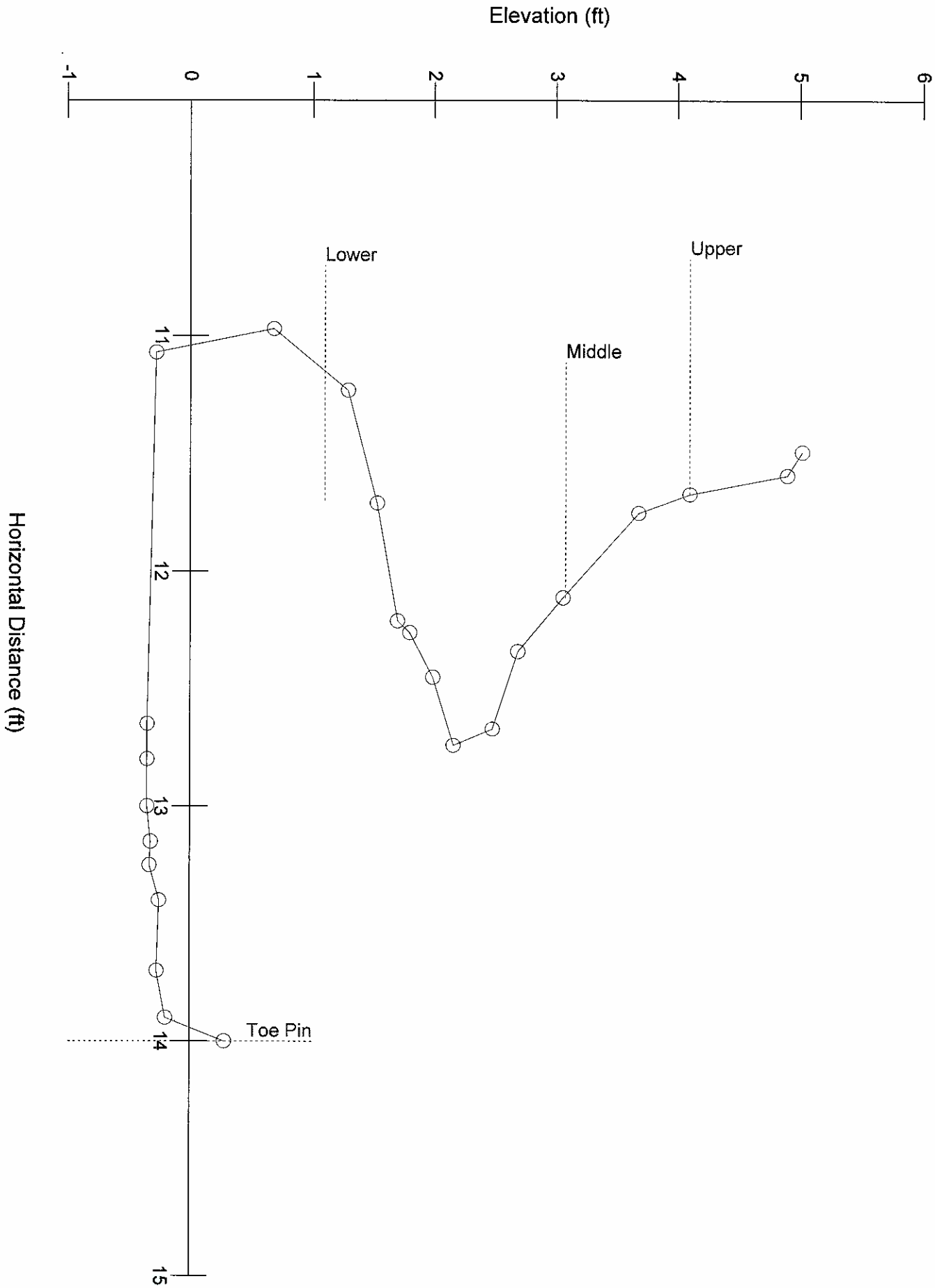

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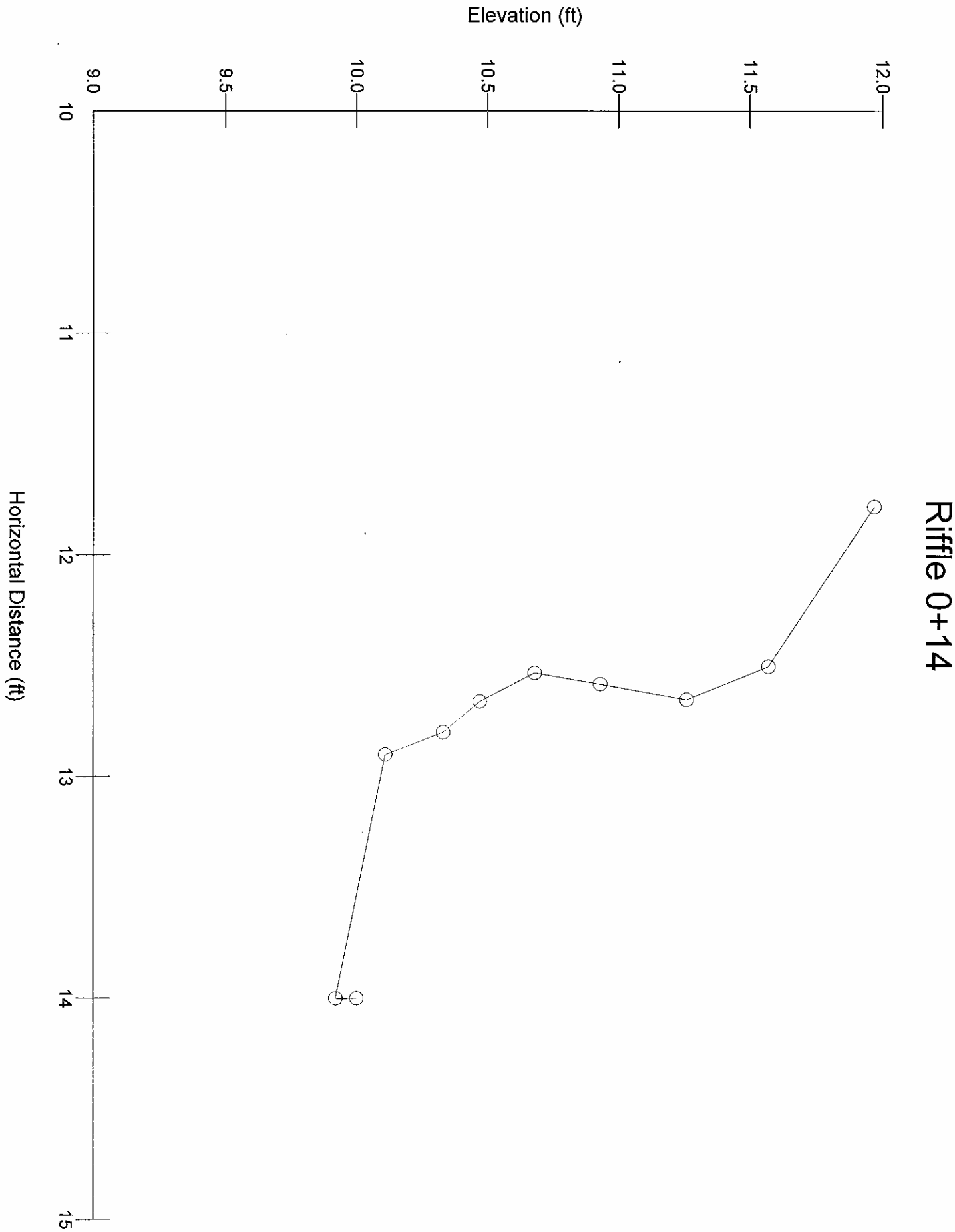
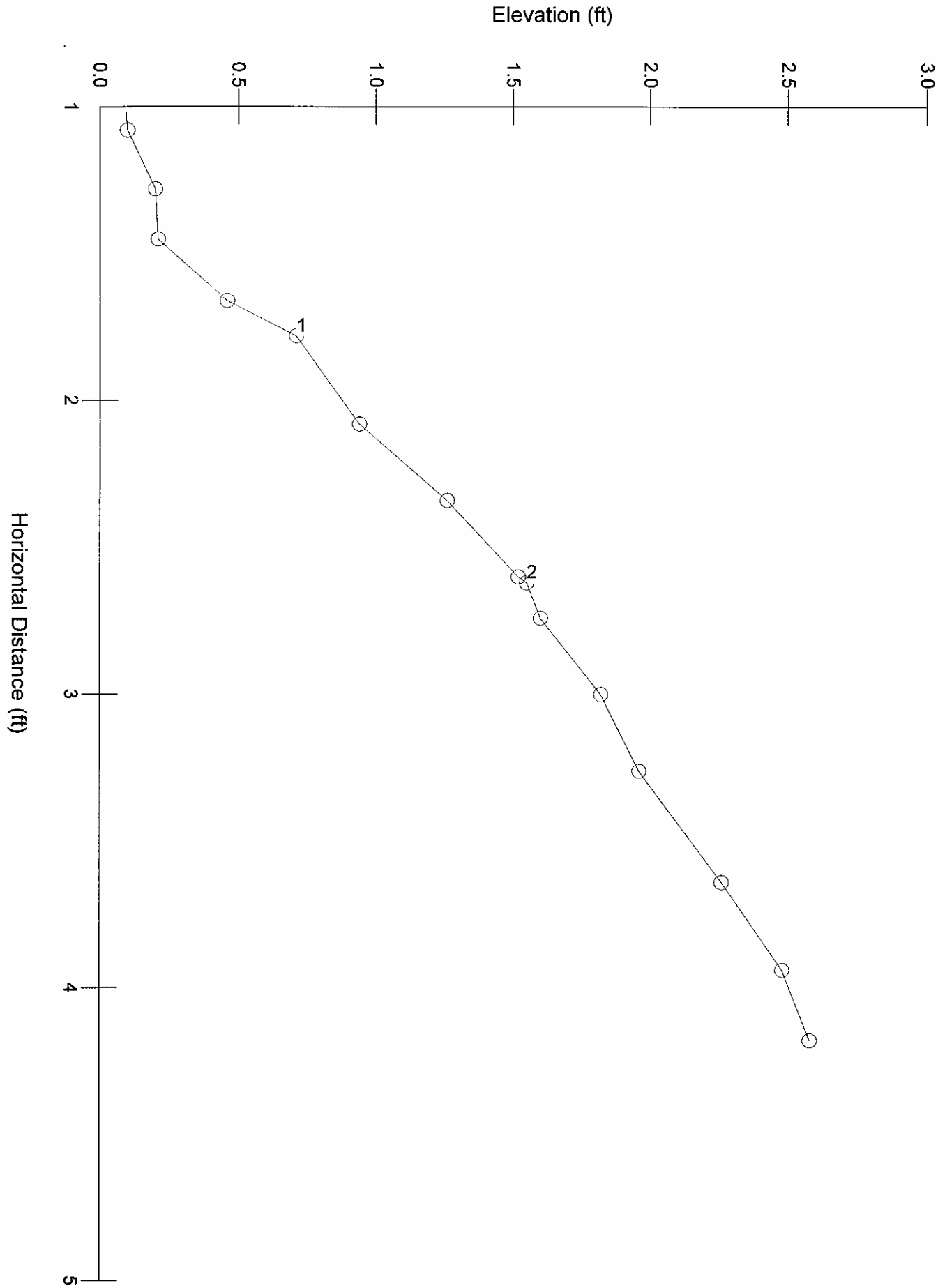
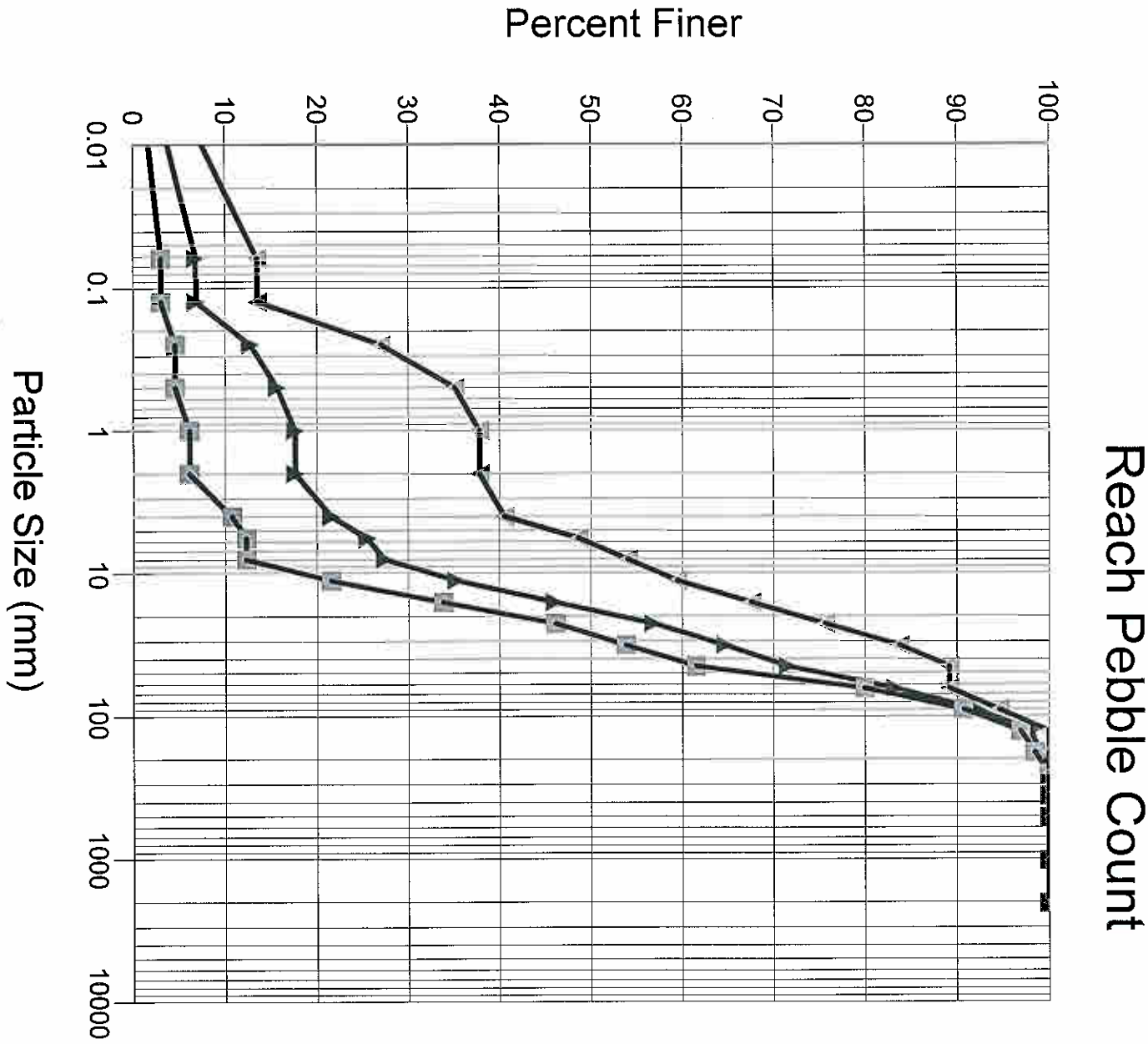
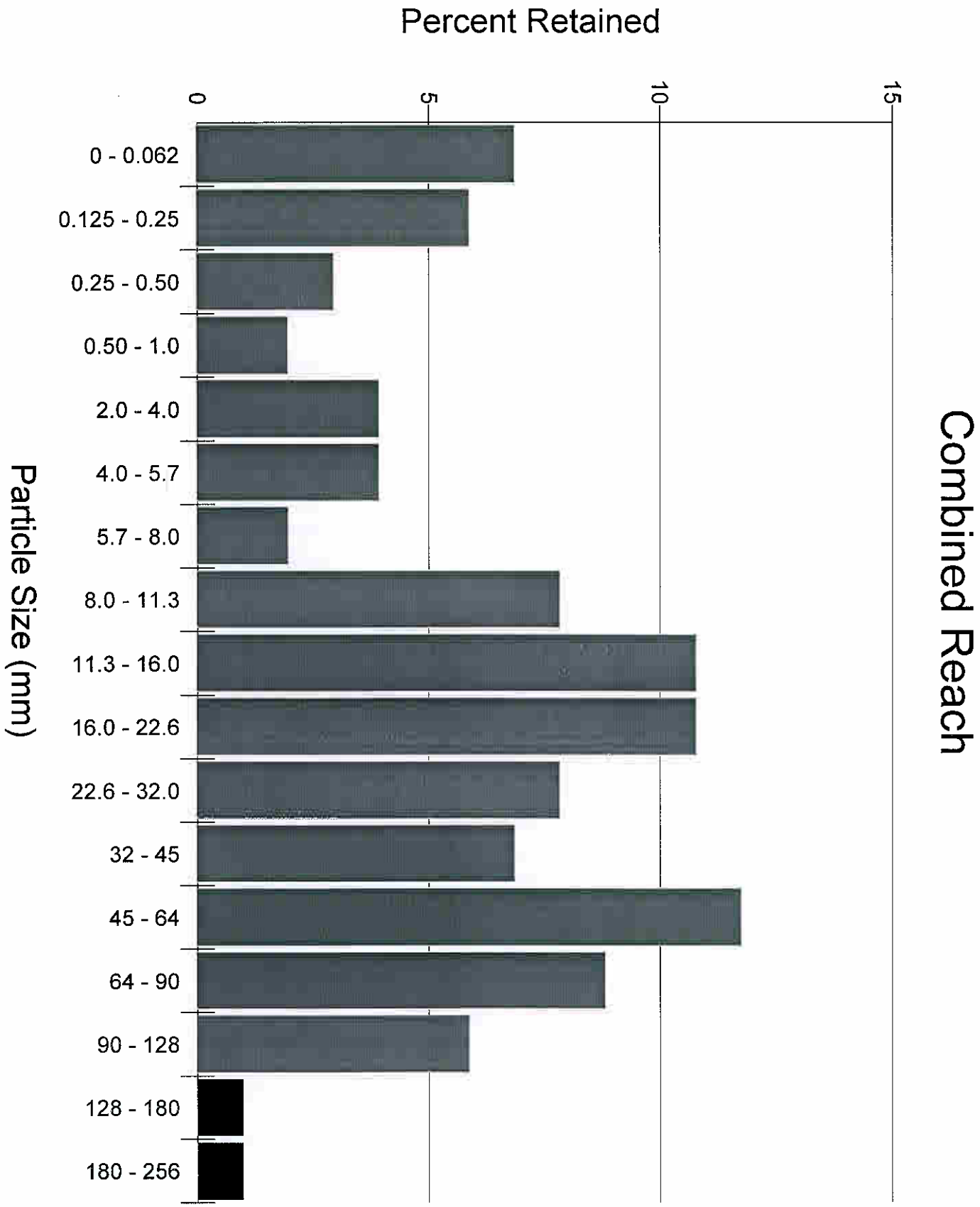
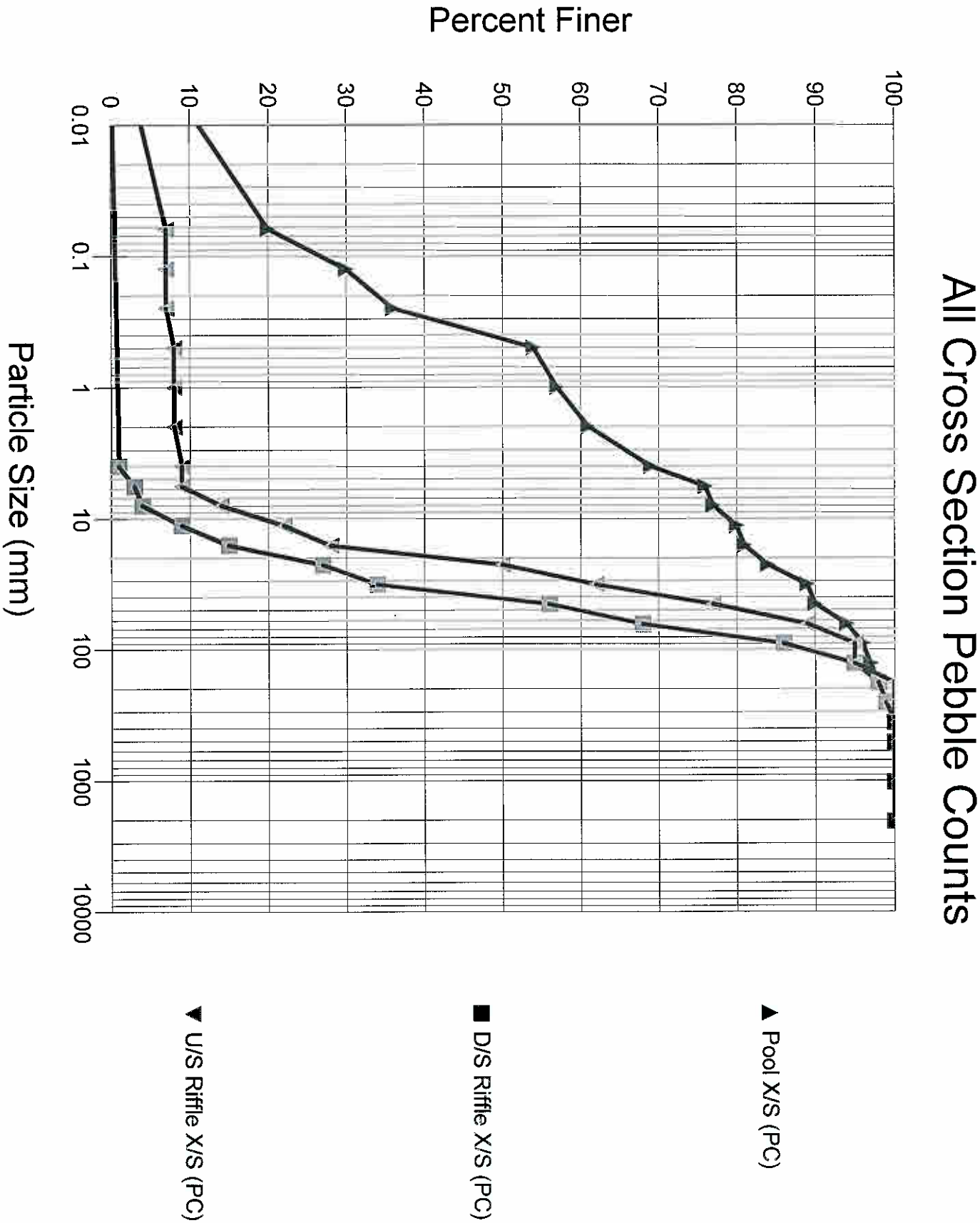


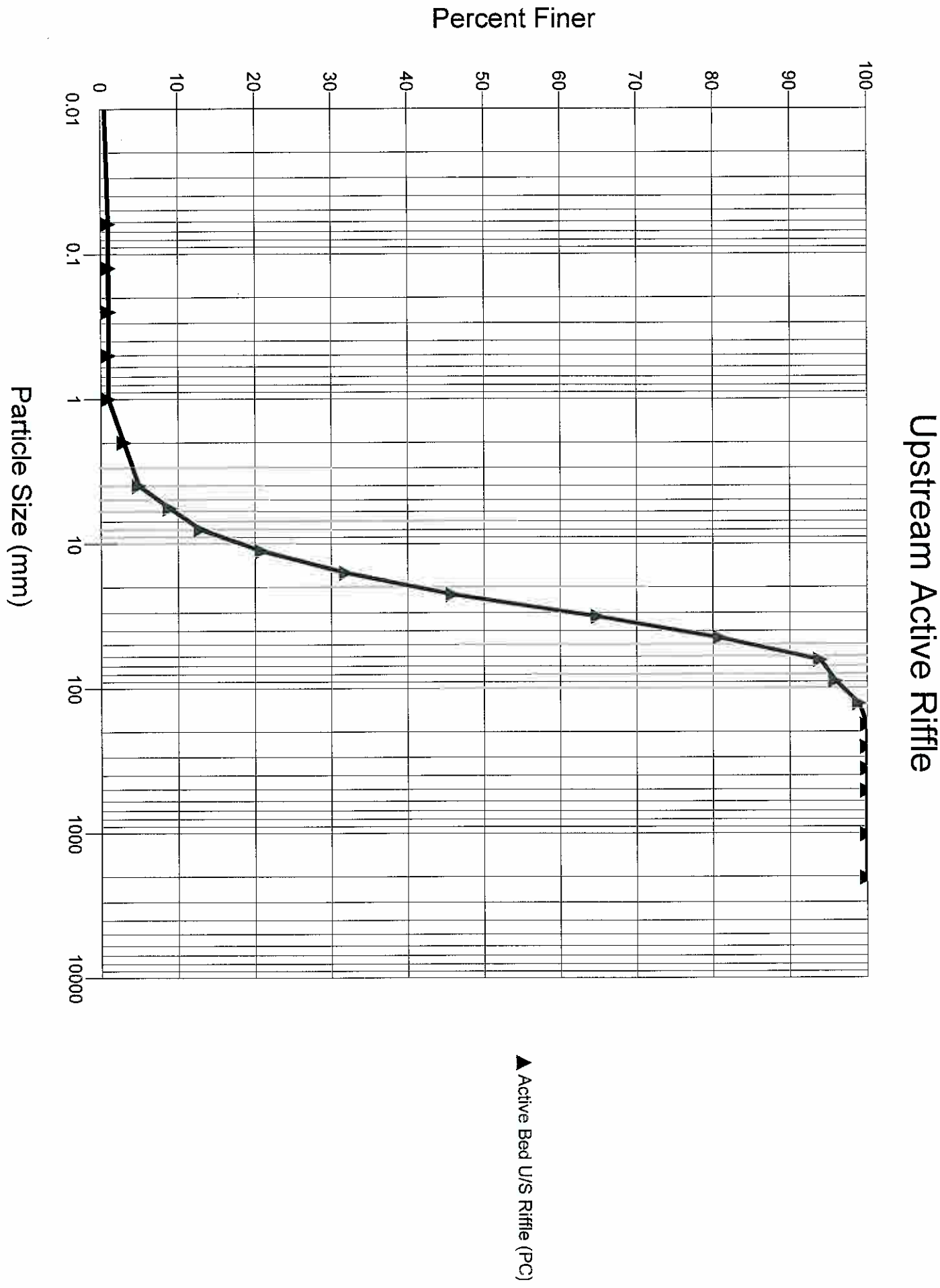
Magruder Branch Degraded Reach Team 3 9/25/2007

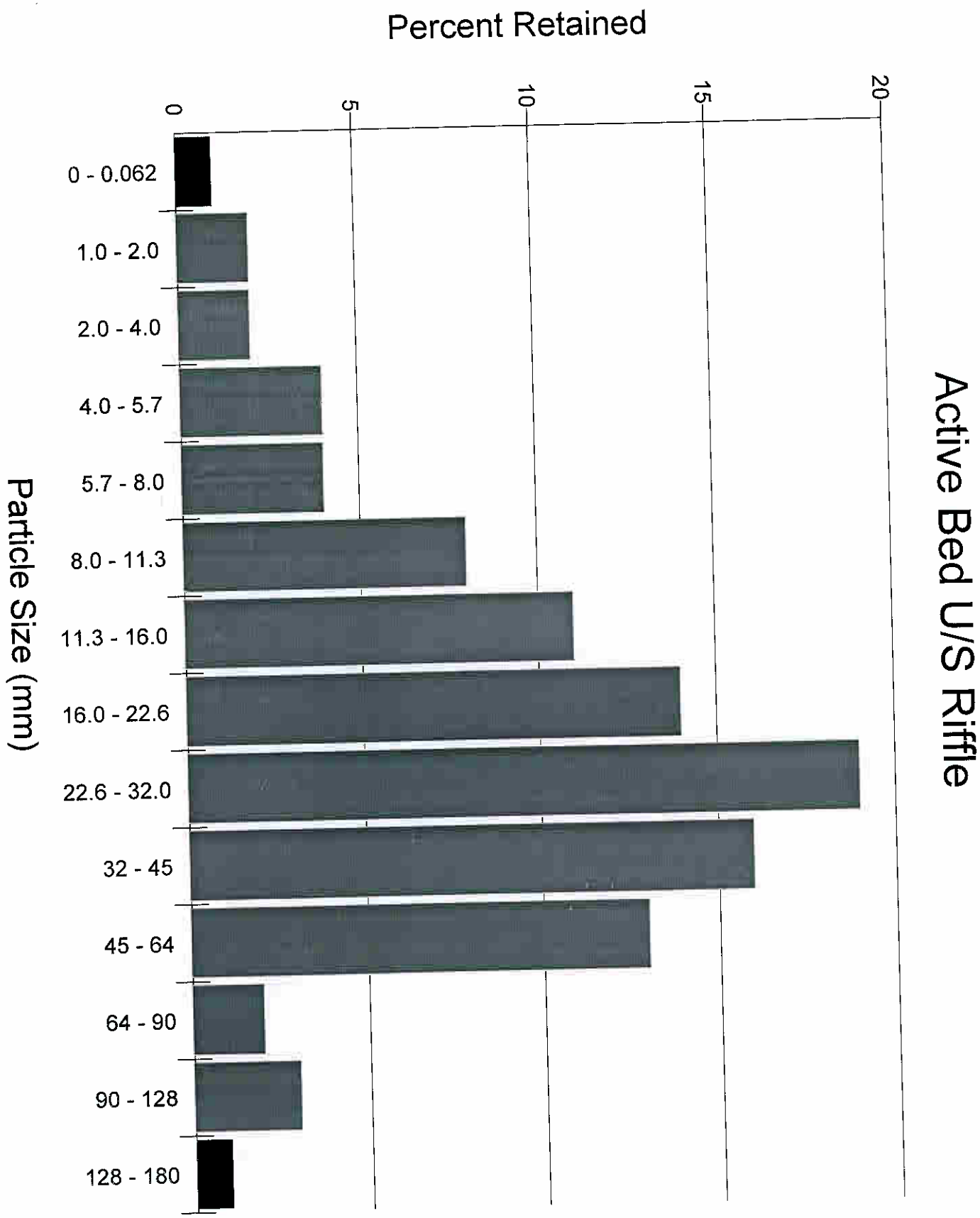


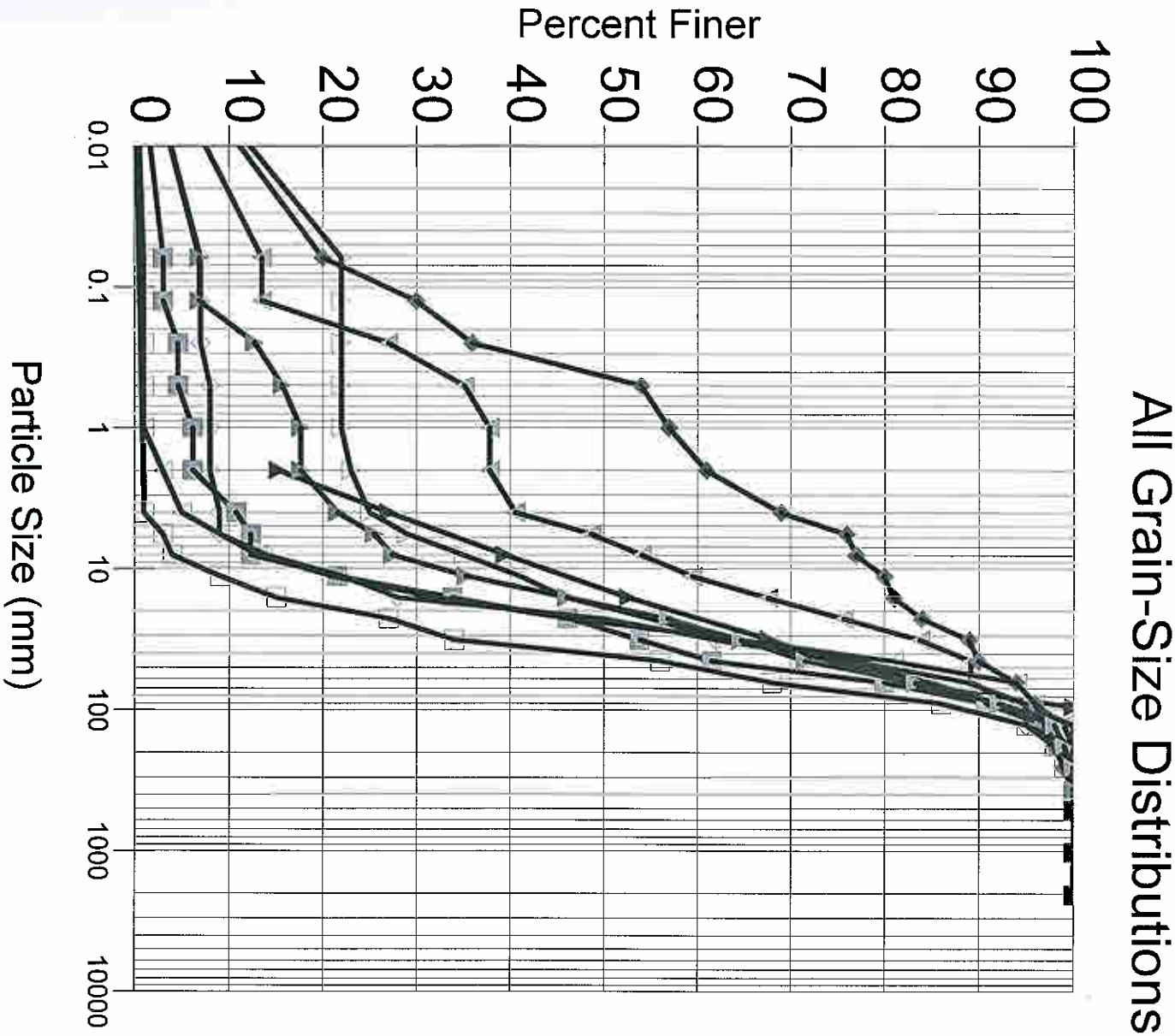

Reach Pebble Count
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Combined Reach (PC)
Reach, Riffle Only (PC)
Reach, Pool Only (PC)


Combined Reach
15
10
5
0
Percent Retained
0 - 0.062
0.125 - 0.25
0.25 - 0.50
0.50 - 1.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
Particle Size (mm)

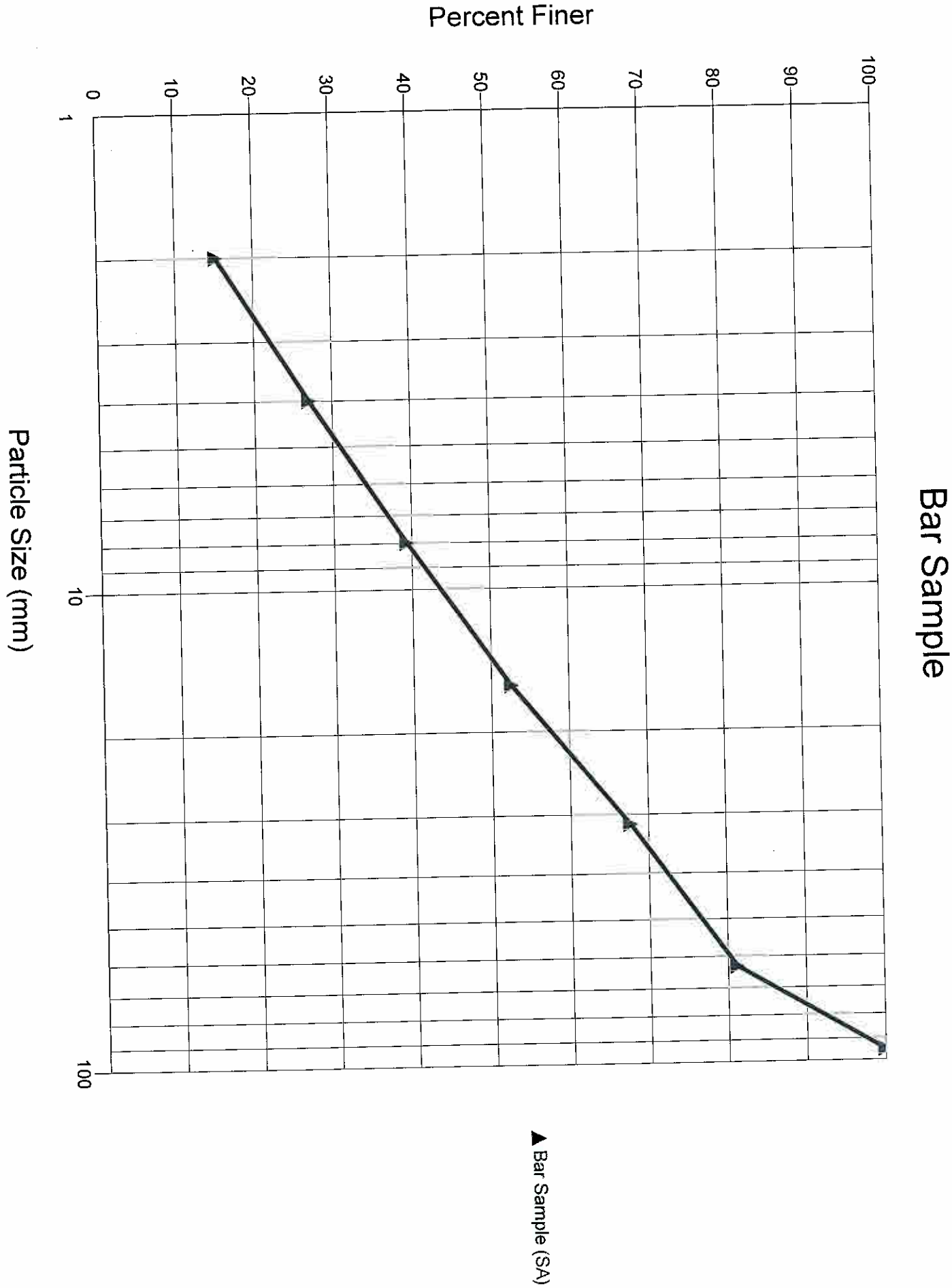

All Cross Section Pebble Counts
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Pool X/S (PC)
D/S Riffle X/S (PC)
U/S Riffle X/S (PC)


Upstream Active Riffle
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Active Bed U/S Riffle (PC)

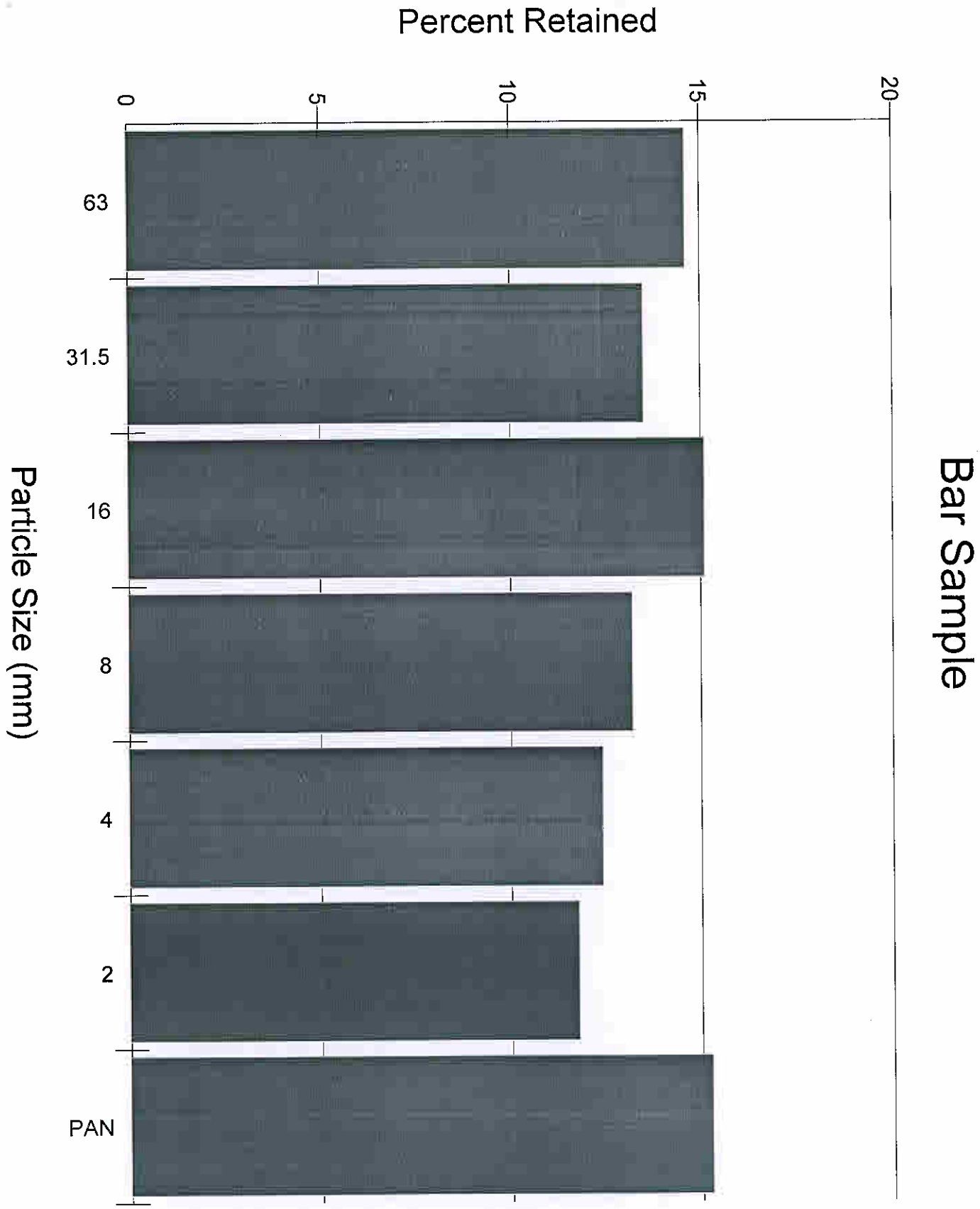

Active Bed U/S Riffle
Percent Retained
0
5
10
15
20
Particle Size (mm)
0 - 0.062
1.0 - 2.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180


All Grain-Size Distributions
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
▲ Bar Sample (SA)
■ Reach, Riffle Only (PC)
▼ Reach, Pool Only (PC)
◆ Pool X/S (PC)
△ Active Bed D/S Riffle (PC)
□ D/S Riffle X/S (PC)
▽ Active Bed U/S Riffle (PC)
◇ U/S Riffle X/S (PC)
▲ Combined Reach (PC)

Magruder Branch Degraded Reach Team 3 9/25/2007



Magruder Branch Degraded Reach Team 3 9/25/2007



Magruder Branch Degraded Reach Team 3 9/25/2007

Observers: Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	25.85	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.19	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	30.84	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	21.72	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.	1.85	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.	88.54	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	3.43	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.	18.4	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.01112	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.47	

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

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Magruder Branch Degraded Reach Team 3 9/25/2007

Stream: Magruder, Reach - Reach 3 final Location:

Observers: Date: 9/25/2007 Valley Type: VIII Stream Type: C 4

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.19	ft	Riffle Width (W_{bkf})	25.85	ft	Riffle Area (A_{bkf})	30.84	ft^2
Mean Pool Depth (d_{bkfp})	2.44	ft	Pool Width (W_{bkfp})	14.7	ft	Pool Area (A_{bkfp})	35.88	ft^2
Mean Pool Depth/Mean Riffle Depth	2.05	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.57	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.16	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	1.65	ft	Max Pool Depth (d_{mbkfp})	3.89	ft	Max Riffle Depth/Mean Riffle Depth	1.39	
Max Pool Depth/Mean Riffle Depth	3.269					Point Bar Slope	0.44	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				4.31	ft/s	Estimation Method	anning's by Strear	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				132.9	cfs	Drainage Area	1.1	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	107	0	0	ft	Meander Length Ratio (Lm/W_{bkf})	4.14	0.00	0.00
Radius of Curvature (Rc)	33.5	32	35	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.30	1.24	1.35
Belt Width (W_{blt})	69	63	75	ft	Meander Width Ratio (W_{blt}/W_{bkf})	2.67	2.44	2.90
Individual Pool Length	24.3	10.1	38.2	ft	Pool Length/Riffle Width	0.94	0.39	1.48
Pool to Pool Spacing	64.7	38.8	90.6	ft	Pool to Pool Spacing/Riffle Width	2.50	1.50	3.50
Riffle Length	24.2	5.38	76.5	ft	Riffle Length/Riffle Width	0.94	0.21	2.96

Channel Profile

Valley Slope (VS)	0.0163	ft/ft	Average Water Surface Slope (S)	0.01112	ft/ft	Sinuosity (VS/S)	1.47	
Stream Length (SL)	280	ft	Valley Length (VL)	191	ft	Sinuosity (SL/VL)	1.47	
Low Bank Height (LBH)	start 1.62 ft, end 2.15 ft		Max Riffle Depth	start 1.24 ft, end 1.72 ft		Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start 1.31, end 1.25	

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.038	0.006	0.069	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	3.422	0.580	6.181
Run Slope (S_{run})	0.015	0.000	0.044	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	1.317	0.000	3.948
Pool Slope (S_p)	0.001	0.000	0.002	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.087	0.015	0.175
Glide Slope (S_g)	0.003	0.001	0.004	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.240	0.122	0.349

Feature Midpoint[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	1.65	1.53	1.76	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.39	1.29	1.48
Run Depth (d_{run})	2.23	1.89	2.55	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	1.87	1.59	2.14
Pool Depth (d_p)	3.89	3.62	4.4	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	3.27	3.04	3.7
Glide Depth (d_g)	2.3	1.99	2.55	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	1.93	1.67	2.14

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[c]	
% Silt/Clay	6.86	1	0	D_{16}	0.58	9.24	2.13	0	mm
% Sand	10.79	2	15.26	D_{35}	11.18	17.41	6.57	0	mm
% Gravel	65.68	91	65.7	D_{50}	18.4	24.58	14.41	0	mm
% Cobble	16.67	6	18.04	D_{84}	65.97	49.38	67.71	0	mm
% Boulder	0	0	0	D_{95}	108.35	77	86.47	0	mm
% Bedrock	0	0	0	D_{100}	255.99	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.

Magruder Branch Degraded Reach Team 3 9/25/2007

Stream: **magruder, Reach - Reach 3 final** Location:

Graph Used: Total Bank Length (ft): **280** Date: **9/25/2007**

Observers: 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. 000 - 042 L	High	Low	0.39968944	42	2.3	38.61	0.04
2. 000 - 059 R	Moderate	Very Low	0.03922518	59	2.1	4.86	0.00
3. 042 - 134 L	High	Low	0.39986413	92	1.6	58.86	0.03
4. 059 - 085 R	Moderate	Very Low	0.04019851	26	3.1	3.24	0.01
5. 112 - 138 R	High	Low	0.40183946	26	2.3	24.03	0.04
6. 138 - 152 R	Very High	High	2.00172414	14	2.9	81.27	0.28
7. 158 - 178 L	High	Low	0.49704545	20	2.2	21.87	0.05
8. 178 - 207 L	High	High	0.99907162	29	2.6	75.33	0.13
9. 207 - 234 L	Very High	Moderate	0.6	27	2.9	46.98	0.08
10. 234 - 251 L	Extreme	Moderate	1.89965398	17	5.1	164.7	0.47
11. 251 -280 L	Very High	Moderate	0.60035672	29	2.9	50.49	0.08
12.							
13.							
14.							
15.							

Sum erosion subtotals in Column (7) for each BEHI/NBS combination	Total erosion (ft^3/yr)	570.24
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}	Total erosion (yds^3/yr)	21.12
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}	Total erosion (tons/yr)	27.46
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}	Total erosion (tons/yr/ft)	0.0981

Magruder Branch Degraded Reach Team 3 9/25/2007

Stream: magruder, Reach - Cross Section BEHI Location:

Graph Used: Total Bank Length (ft): 280 Date: 12/30/1999

Observers: Valley Type: Stream Type:

(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. ds riffle	High	Low	0.38571429	1	2.8	1.08	0.05
2. glide	Very High	Moderate	0.55862069	1	2.9	1.62	0.08
3. pool	Extreme	Moderate	1.90588235	1	5.1	9.72	0.47
4. Run	High	Low	0.42631579	1	3.8	1.62	0.08
5. us riffle	High	Moderate	0.69230769	1	1.95	1.35	0.07
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

Sum erosion subtotals in Column (7) for each BEHI/NBS combination	Total erosion (ft^3/yr)	15.39
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}	Total erosion (yds^3/yr)	0.57
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}	Total erosion (tons/yr)	0.74
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}	Total erosion (tons/yr/ft)	0.0026

Magruder Branch Degraded Reach Team 3 9/25/2007

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

Stream: **magruder, Reach 3 final, us riffle, (Riffle)** Location: **Reach 3** Date: **09/18/07**

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

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.13										0%						
90.0%	5.27	2.70	2.05	10.37	0.20	1.32	0.011	0.14	1.89	0.18	10%	36.50	0.90	0.00	0.09	0.00	0.09
80.0%	7.64	6.46	3.70	12.49	0.30	1.72	0.011	0.20	4.51	0.36	10%	36.50	0.90	0.10	0.09	0.01	0.10
70.0%	9.36	8.50	4.45	12.91	0.34	1.91	0.011	0.24	5.94	0.46	10%	36.50	0.90	0.10	0.09	0.01	0.10
60.0%	11.73	10.55	5.16	13.58	0.38	2.03	0.011	0.26	7.37	0.54	10%	36.50	0.90	0.10	0.09	0.01	0.10
50.0%	15.29	13.51	6.54	16.89	0.39	2.07	0.011	0.27	9.44	0.56	10%	36.50	0.90	0.10	0.09	0.01	0.10
40.0%	18.71	17.00	8.16	20.85	0.39	2.07	0.011	0.27	11.88	0.57	10%	36.50	0.90	0.20	0.09	0.02	0.11
30.0%	23.46	21.09	9.58	22.36	0.43	2.20	0.011	0.29	14.74	0.66	10%	36.50	0.90	0.20	0.09	0.02	0.11
20.0%	30.44	26.95	11.34	23.62	0.48	2.37	0.011	0.33	18.83	0.80	10%	36.50	0.90	0.30	0.09	0.03	0.12
10.0%	42.17	36.31	13.80	24.61	0.56	2.62	0.011	0.38	25.38	1.03	10%	36.50	0.90	0.40	0.09	0.04	0.13
5.0%	59.17	50.67	17.00	24.96	0.68	2.98	0.011	0.46	35.41	1.42	5%	18.25	1.70	0.60	0.09	0.03	0.12
4.0%	66.16	62.67	19.40	25.12	0.77	3.23	0.011	0.52	43.80	1.74	1%	3.65	2.20	0.8	0.02	0.01	0.03
3.0%	76.70	71.43	21.02	25.22	0.83	3.39	0.011	0.56	49.92	1.98	1%	3.65	2.60	1.10	0.03	0.01	0.04
2.0%	98.97	87.84	23.91	25.41	0.94	3.67	0.01	0.63	61.39	2.42	1%	3.65	3.90	2.00	0.04	0.02	0.06
1.5%	118.87	108.92	27.36	25.63	1.07	3.98	0.011	0.71	76.12	2.97	1%	1.83	6.50	4.40	0.03	0.02	0.05
1.0%	149.97	134.42	31.23	25.91	1.21	4.30	0.01	0.80	93.94	3.63	1%	1.83	5.60	9.30	0.03	0.05	0.08

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	383.3	105.9	489.1
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	430.0	127.0	557.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-46.8	-21.2	-67.9
Stability evaluation: Aggradation, Degradation or Stable:			

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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: **magruder, Reach 3 final, ds riffle, (Riffle)** Location: **Reach 3** Date: **09/18/07**

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

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.14										0%						
90.0%	5.69	2.92	2.04	9.38	0.22	1.39	0.011	0.15	2.04	0.22	10%	36.50	0.90	0.00	0.09	0.00	0.09
80.0%	8.25	6.97	3.62	10.31	0.35	1.92	0.011	0.24	4.87	0.47	10%	36.50	0.90	0.10	0.09	0.01	0.10
70.0%	10.09	9.17	4.37	10.95	0.40	2.08	0.011	0.27	6.41	0.59	10%	36.50	0.90	0.10	0.09	0.01	0.10
60.0%	12.65	11.37	5.10	11.58	0.44	2.22	0.011	0.30	7.95	0.69	10%	36.50	0.90	0.10	0.09	0.01	0.10
50.0%	16.49	14.57	6.10	12.47	0.49	2.39	0.011	0.33	10.18	0.82	10%	36.50	0.90	0.10	0.09	0.01	0.10
40.0%	20.19	18.34	7.19	13.31	0.54	2.55	0.011	0.36	12.82	0.96	10%	36.50	0.90	0.20	0.09	0.02	0.11
30.0%	25.31	22.75	8.24	13.54	0.61	2.75	0.011	0.41	15.90	1.17	10%	36.50	1.30	0.20	0.13	0.02	0.15
20.0%	32.84	29.08	9.64	13.79	0.70	3.01	0.011	0.47	20.32	1.47	10%	36.50	1.70	0.30	0.17	0.03	0.20
10.0%	45.49	39.17	11.67	14.09	0.83	3.35	0.011	0.55	27.38	1.94	10%	36.50	2.60	0.60	0.26	0.06	0.32
5.0%	63.83	54.66	14.45	14.42	1.00	3.78	0.011	0.66	38.20	2.65	5%	18.25	4.80	1.60	0.24	0.08	0.32
4.0%	71.37	67.60	16.58	14.67	1.13	4.07	0.010	0.74	47.24	3.22	1%	3.65	7.80	3.5	0.08	0.04	0.12
3.0%	82.74	77.06	18.06	14.85	1.22	4.26	0.010	0.79	53.86	3.63	1%	3.65	5.60	5.30	0.06	0.05	0.11
2.0%	106.77	94.76	20.68	15.15	1.36	4.58	0.01	0.88	66.23	4.37	1%	3.65	6.50	9.60	0.07	0.10	0.17
1.5%	128.23	117.50	23.84	15.51	1.54	4.93	0.010	0.98	82.12	5.29	1%	1.83	7.30	16.60	0.04	0.08	0.12
1.0%	161.79	145.01	33.71	27.61	1.22	4.30	0.01	0.80	101.34	3.67	1%	1.83	5.60	10.30	0.03	0.05	0.08

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	591.3	208.1	799.4
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	430.0	127.0	557.0
Difference in sediment transport capacity (tons/yr) (+ or -):	161.3	81.1	242.4
Stability evaluation: Aggradation, Degradation or Stable:			

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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: **Macgruder Day 3, Reach 3 final, us riffle, (Riffle)** Location: **Reach 3** Date: **09/18/07**

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

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.11										0%						
90.0%	4.46	2.29	2.05	10.37	0.20	1.11	0.008	0.10	1.14	0.11	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	6.46	5.46	3.70	12.49	0.30	1.45	0.008	0.15	2.73	0.22	10%	36.50	0.90	0.10	0.09	0.01	0.10
70.0%	7.91	7.19	4.45	12.91	0.34	1.61	0.008	0.17	3.59	0.28	10%	36.50	0.90	0.10	0.09	0.01	0.10
60.0%	9.91	8.91	5.16	13.57	0.38	1.72	0.008	0.19	4.45	0.33	10%	36.50	0.90	0.10	0.09	0.01	0.10
50.0%	12.92	11.42	6.54	16.89	0.39	1.75	0.008	0.19	5.70	0.34	10%	36.50	0.90	0.10	0.09	0.01	0.10
40.0%	15.82	14.37	8.16	20.85	0.39	1.75	0.008	0.19	7.17	0.34	10%	36.50	0.90	0.10	0.09	0.01	0.10
30.0%	19.83	17.83	9.58	22.36	0.43	1.86	0.008	0.21	8.90	0.40	10%	36.50	0.90	0.20	0.09	0.02	0.11
20.0%	25.73	22.78	11.34	23.62	0.48	2.00	0.008	0.23	11.37	0.48	10%	36.50	0.90	0.20	0.09	0.02	0.11
10.0%	35.64	30.69	13.80	24.61	0.56	2.22	0.008	0.27	15.32	0.62	10%	36.50	0.90	0.30	0.09	0.03	0.12
5.0%	50.01	42.83	17.00	24.96	0.68	2.52	0.008	0.33	21.38	0.86	5%	18.25	0.90	0.40	0.05	0.02	0.07
4.0%	55.91	52.96	19.39	25.12	0.77	2.73	0.008	0.37	26.44	1.05	1%	3.65	0.90	0.6	0.01	0.01	0.02
3.0%	64.82	60.36	21.01	25.22	0.83	2.87	0.008	0.40	30.13	1.19	1%	3.65	1.30	0.60	0.01	0.01	0.02
2.0%	83.65	74.24	23.91	25.41	0.94	3.10	0.01	0.45	37.06	1.46	1%	3.65	1.70	0.90	0.02	0.01	0.03
1.5%	100.46	92.06	27.36	25.63	1.07	3.36	0.008	0.51	45.96	1.79	1%	1.83	2.20	1.30	0.01	0.01	0.02
1.0%	126.75	113.60	31.23	25.91	1.21	3.63	0.01	0.57	56.71	2.19	1%	1.83	3.00	2.10	0.02	0.01	0.03

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	306.6	69.4	376.0
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	430.0	127.0	557.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-123.4	-57.7	-181.1
Stability evaluation: Aggradation, Degradation or Stable:			

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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: **Macgruder Day 3, Reach 3 final, ds riffle, (Riffle)** Location: **Reach 3** Date: **09/18/07**

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

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.12										0%						
90.0%	4.81	2.47	2.04	9.38	0.22	1.18	0.008	0.11	1.23	0.13	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	6.97	5.89	3.62	10.31	0.35	1.62	0.008	0.17	2.94	0.29	10%	36.50	0.90	0.10	0.09	0.01	0.10
70.0%	8.53	7.75	4.37	10.95	0.40	1.76	0.008	0.19	3.87	0.35	10%	36.50	0.90	0.10	0.09	0.01	0.10
60.0%	10.69	9.61	5.10	11.58	0.44	1.88	0.008	0.21	4.80	0.41	10%	36.50	0.90	0.10	0.09	0.01	0.10
50.0%	13.94	12.32	6.10	12.47	0.49	2.02	0.008	0.24	6.15	0.49	10%	36.50	0.90	0.10	0.09	0.01	0.10
40.0%	17.06	15.50	7.19	13.31	0.54	2.15	0.008	0.26	7.74	0.58	10%	36.50	0.90	0.20	0.09	0.02	0.11
30.0%	21.39	19.23	8.24	13.54	0.61	2.33	0.008	0.29	9.60	0.71	10%	36.50	0.90	0.20	0.09	0.02	0.11
20.0%	27.76	24.58	9.64	13.79	0.70	2.54	0.008	0.33	12.27	0.89	10%	36.50	0.90	0.20	0.09	0.02	0.11
10.0%	38.45	33.11	11.67	14.09	0.83	2.83	0.008	0.39	16.53	1.17	10%	36.50	1.30	0.40	0.13	0.04	0.17
5.0%	53.95	46.20	14.45	14.42	1.00	3.19	0.008	0.47	23.06	1.60	5%	18.25	2.20	0.60	0.11	0.03	0.14
4.0%	60.32	57.14	16.58	14.67	1.13	3.44	0.008	0.53	28.52	1.94	1%	3.65	2.60	0.9	0.03	0.01	0.04
3.0%	69.93	65.13	18.06	14.85	1.22	3.60	0.007	0.56	32.51	2.19	1%	3.65	3.00	1.20	0.03	0.01	0.04
2.0%	90.23	80.08	20.68	15.15	1.36	3.87	0.01	0.63	39.98	2.64	1%	3.65	4.80	2.30	0.05	0.02	0.07
1.5%	108.38	99.31	23.84	15.51	1.54	4.16	0.007	0.70	49.58	3.20	1%	1.83	7.30	5.00	0.04	0.03	0.07
1.0%	136.73	122.56	33.71	27.62	1.22	3.64	0.01	0.57	61.18	2.22	1%	1.83	3.50	2.30	0.02	0.01	0.03

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	379.6	91.3	470.9
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	430.0	127.0	557.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-50.4	-35.8	-86.2
Stability evaluation: Aggradation, Degradation or Stable:			

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