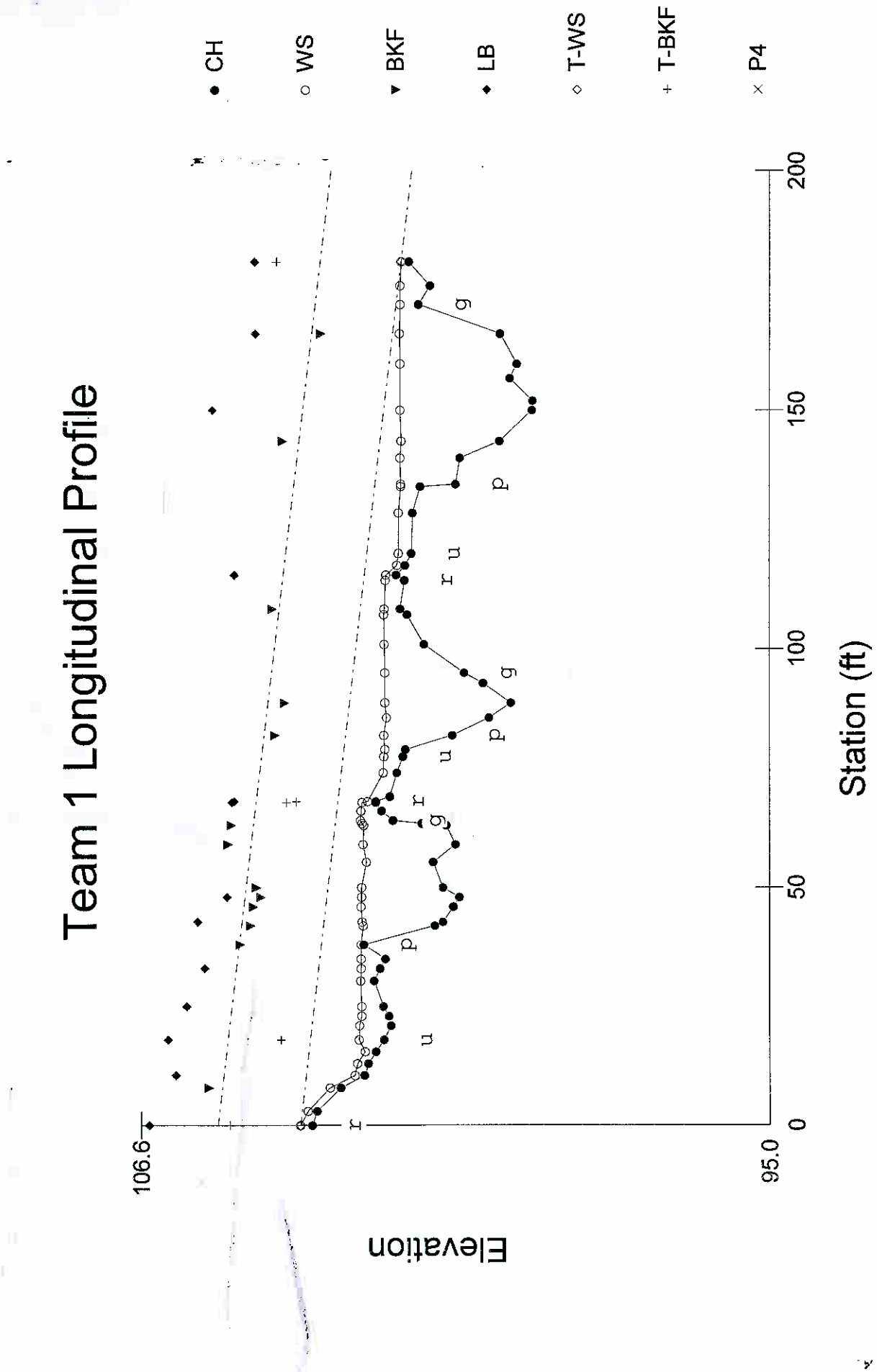
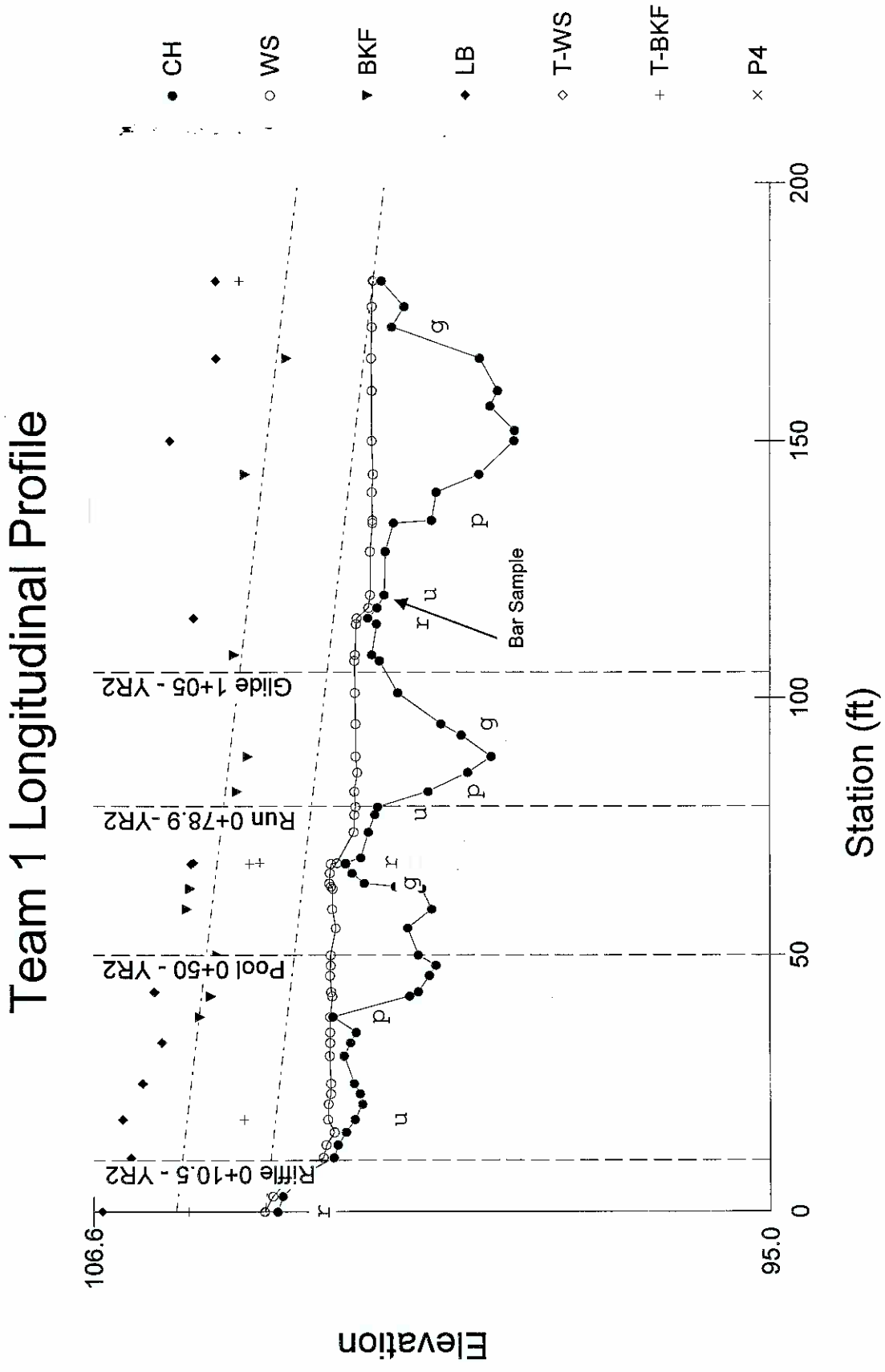
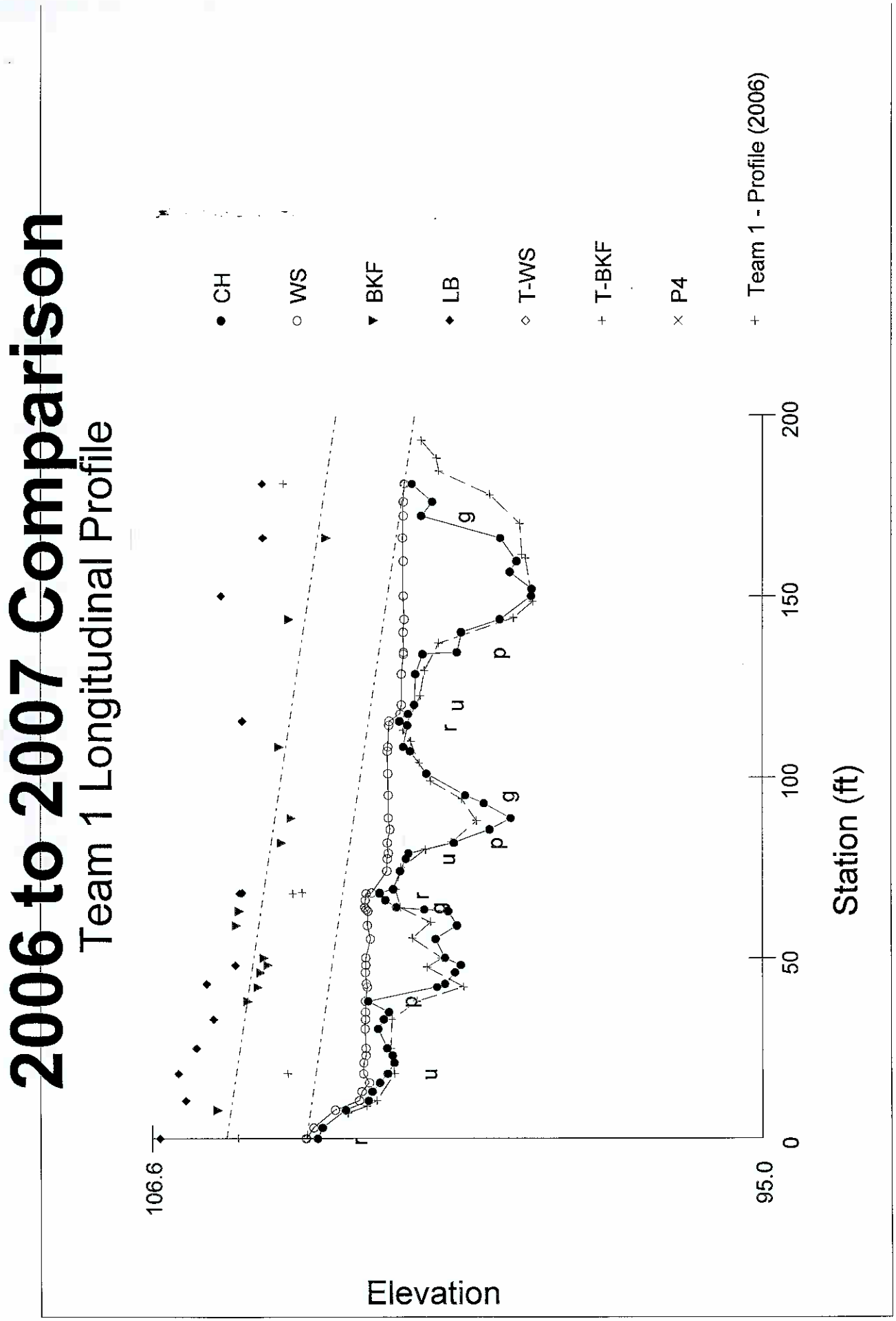
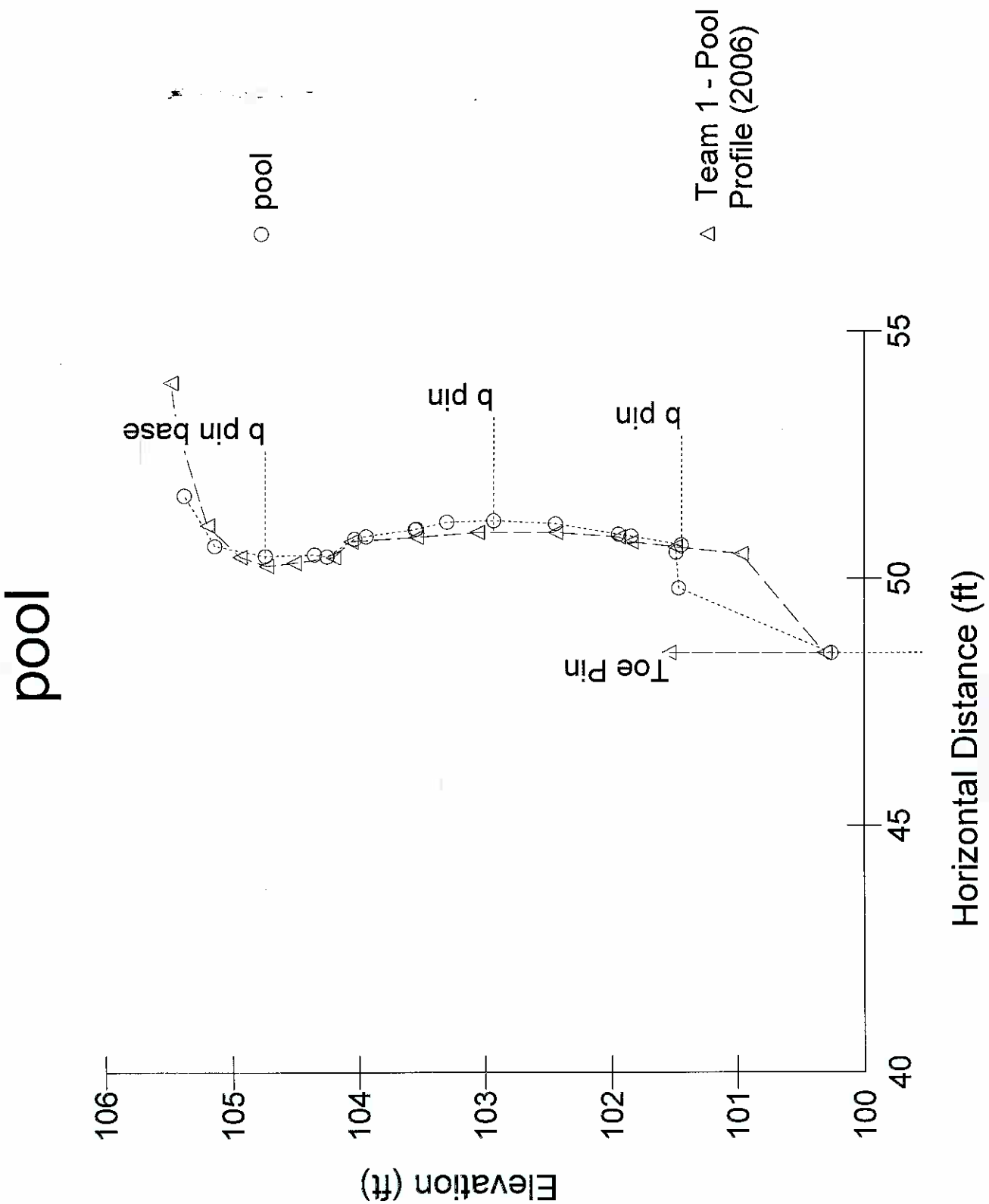
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

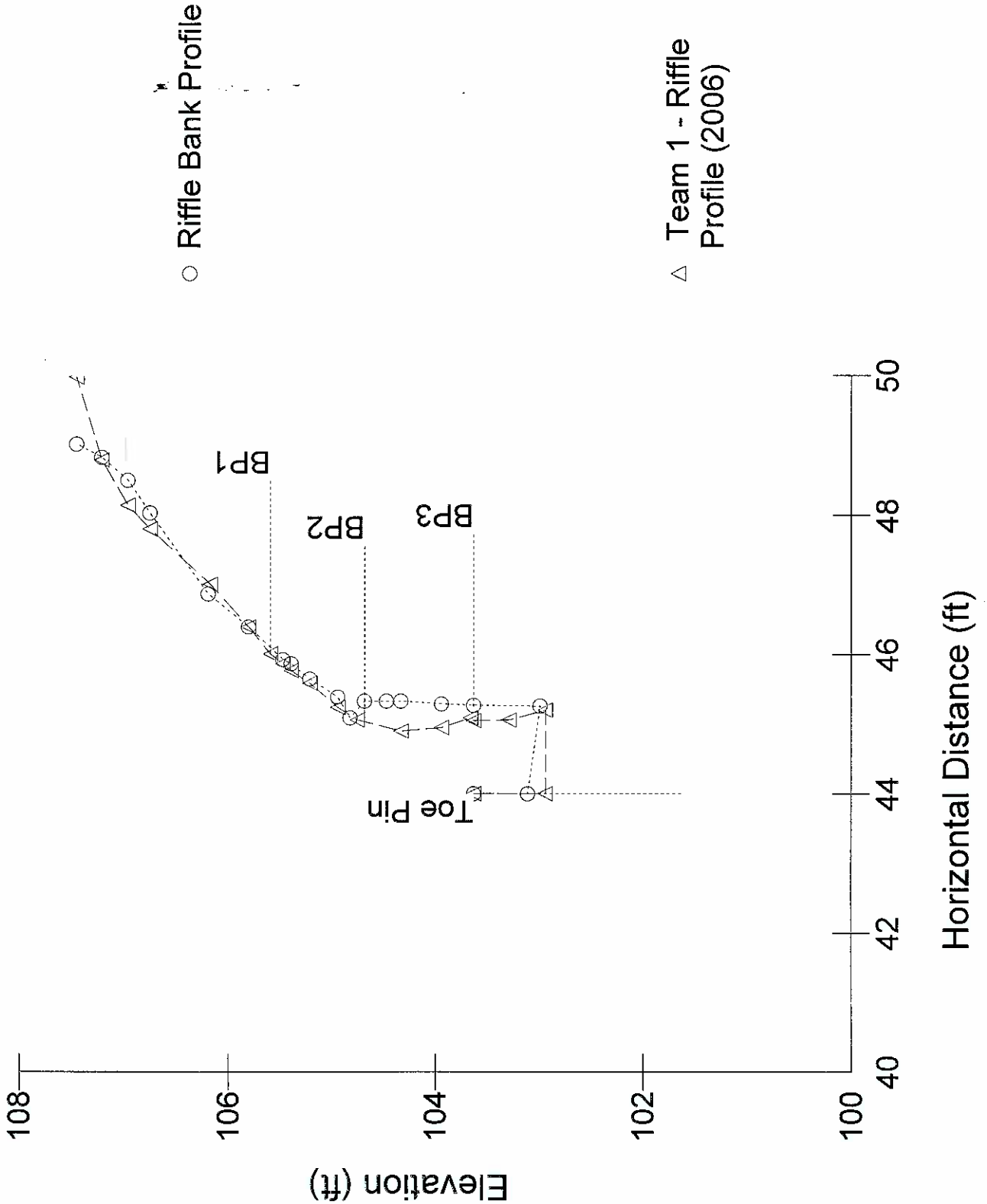
Team 1
Day 2
UT Little Bennett
Degraded Reach

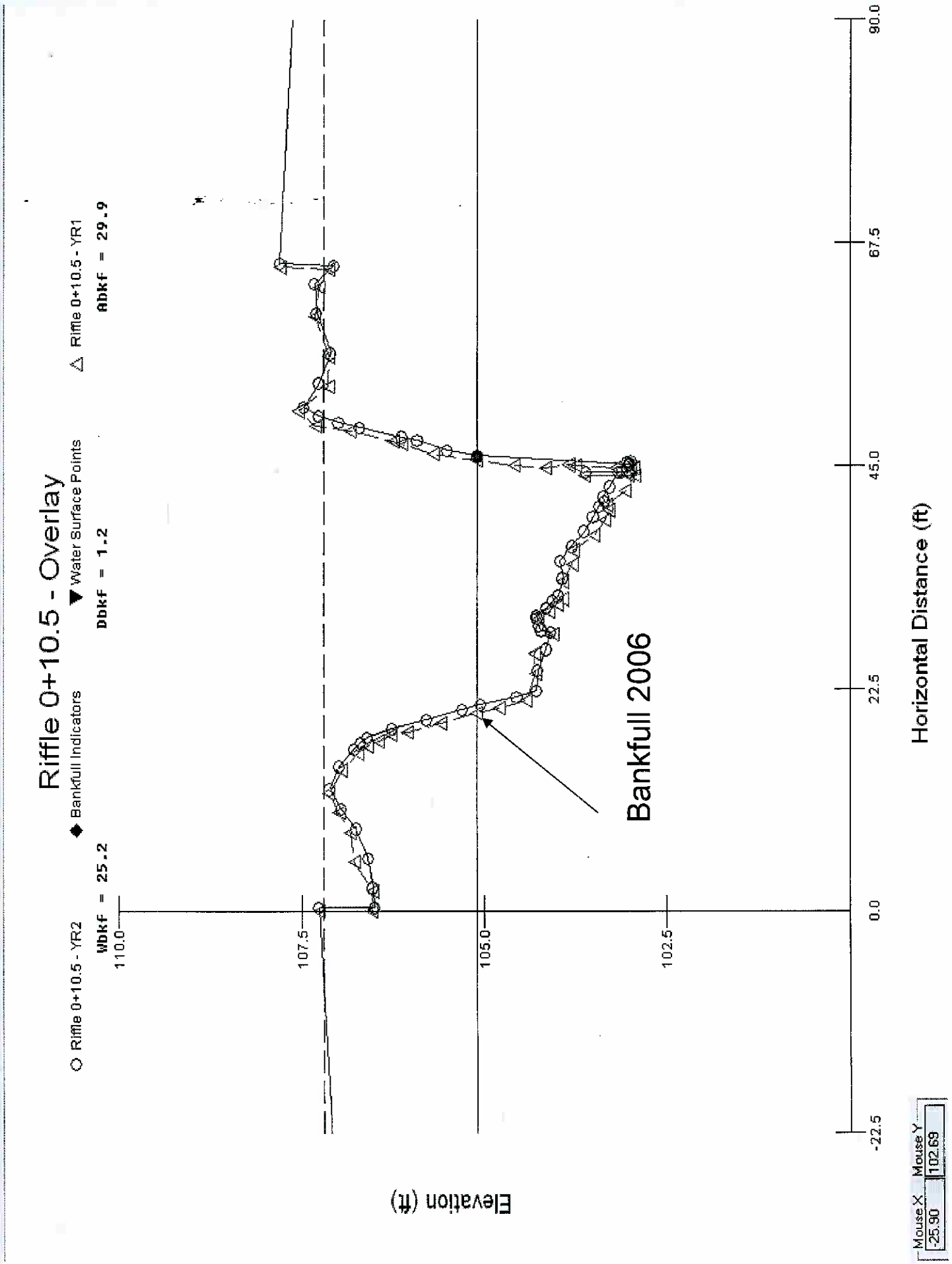

Team 1 Longitudinal Profile
CH
WS
BKF
LB
T-WS
T-BKF
P4
Elevation
106.6
95.0
0
50
100
150
200
Station (ft)

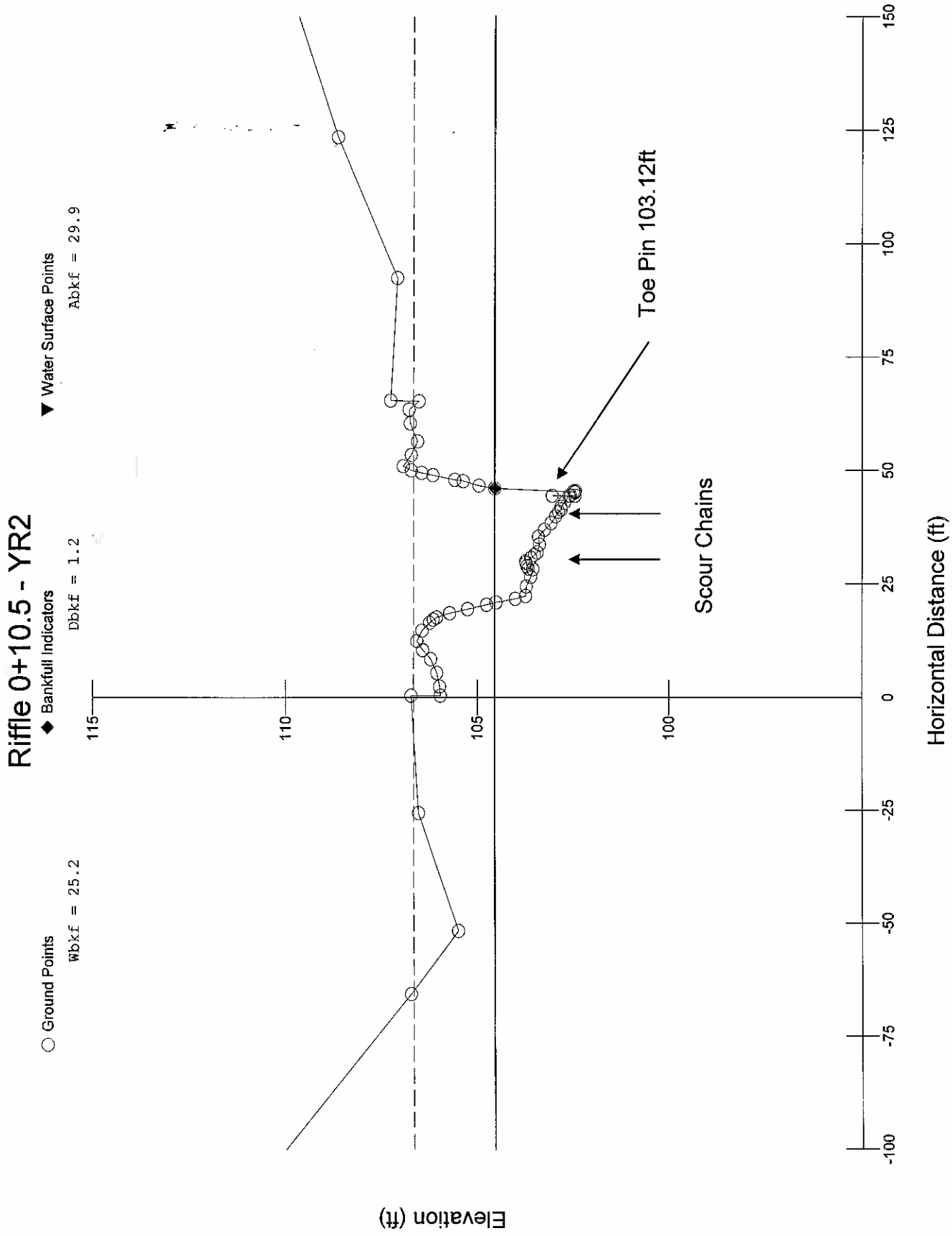

Team 1 Longitudinal Profile
CH
WS
BKF
LB
T-WS
T-BKF
P4
Riffle 0+10.5 - YR2
Pool 0+50 - YR2
Run 0+78.9 -YR2
Glide 1+05 - YR2
Bar Sample
106.6
95.0
0
50
100
150
200
Elevation
Station (ft)

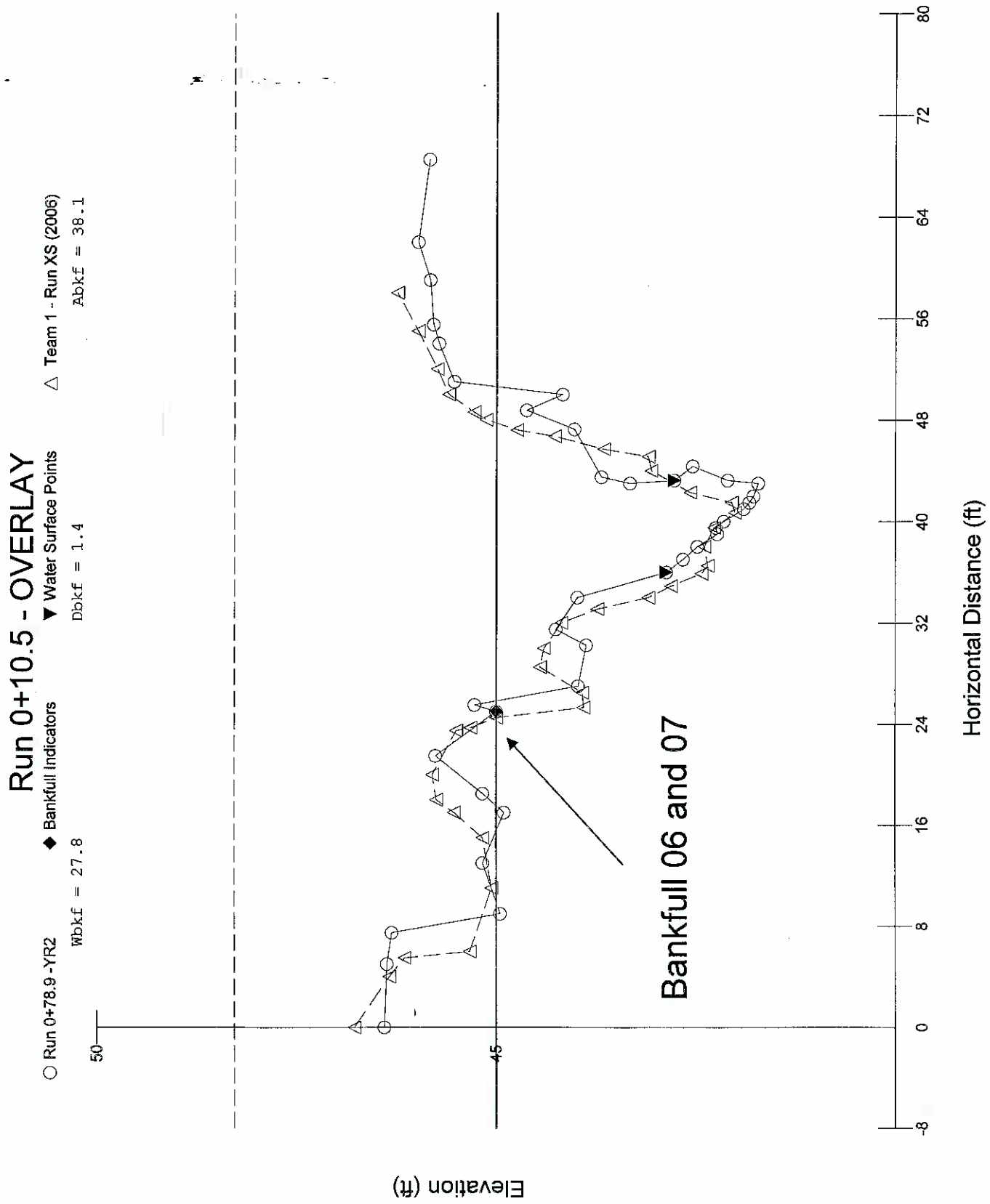

2006 to 2007 Comparison
Team 1 Longitudinal Profile
CH
WS
BKF
LB
T-WS
T-BKF
P4
Team 1 - Profile (2006)
106.6
95.0
0
50
100
150
200
Station (ft)
Elevation

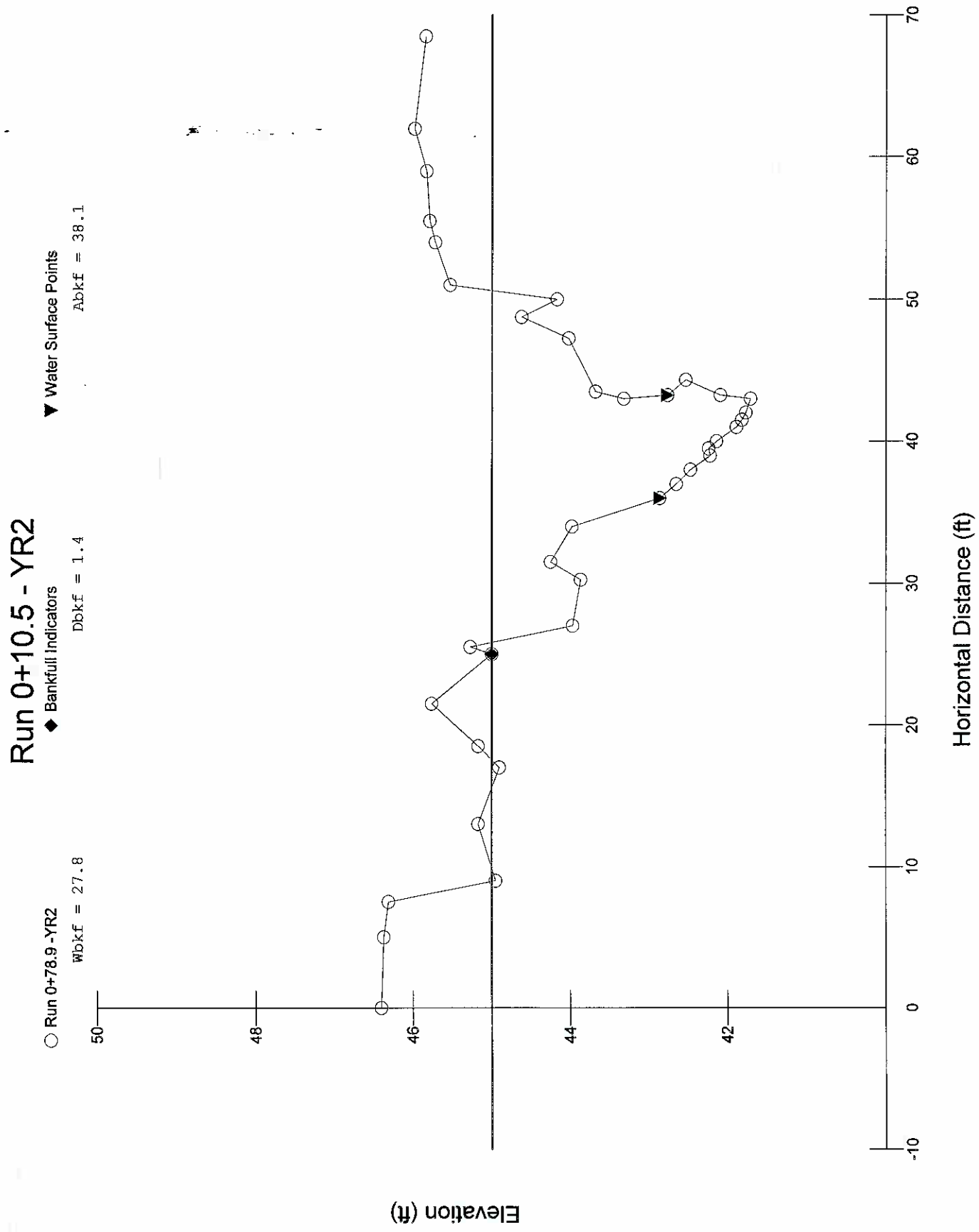

pool
Team 1 - Pool Profile (2006)
pool
b pin base
b pin
b pin
Toe Pin
Elevation (ft)
106
105
104
103
102
101
100
40
45
50
55
Horizontal Distance (ft)

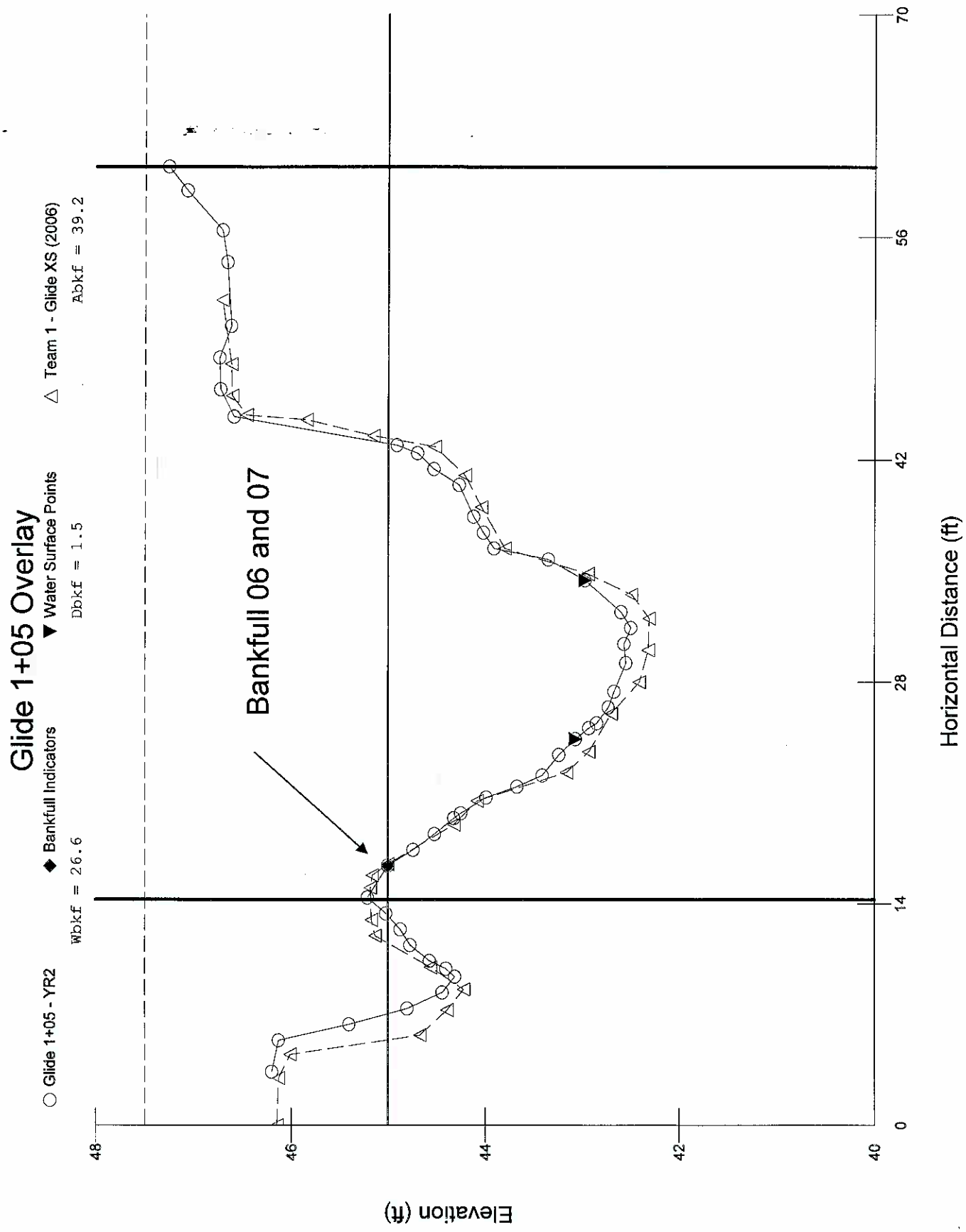

Riffle Bank Profile
Team 1 - Riffle Profile (2006)
BP1
BP2
BP3
Toe Pin
Elevation (ft)
108
106
104
102
100
Horizontal Distance (ft)
40
42
44
46
48
50

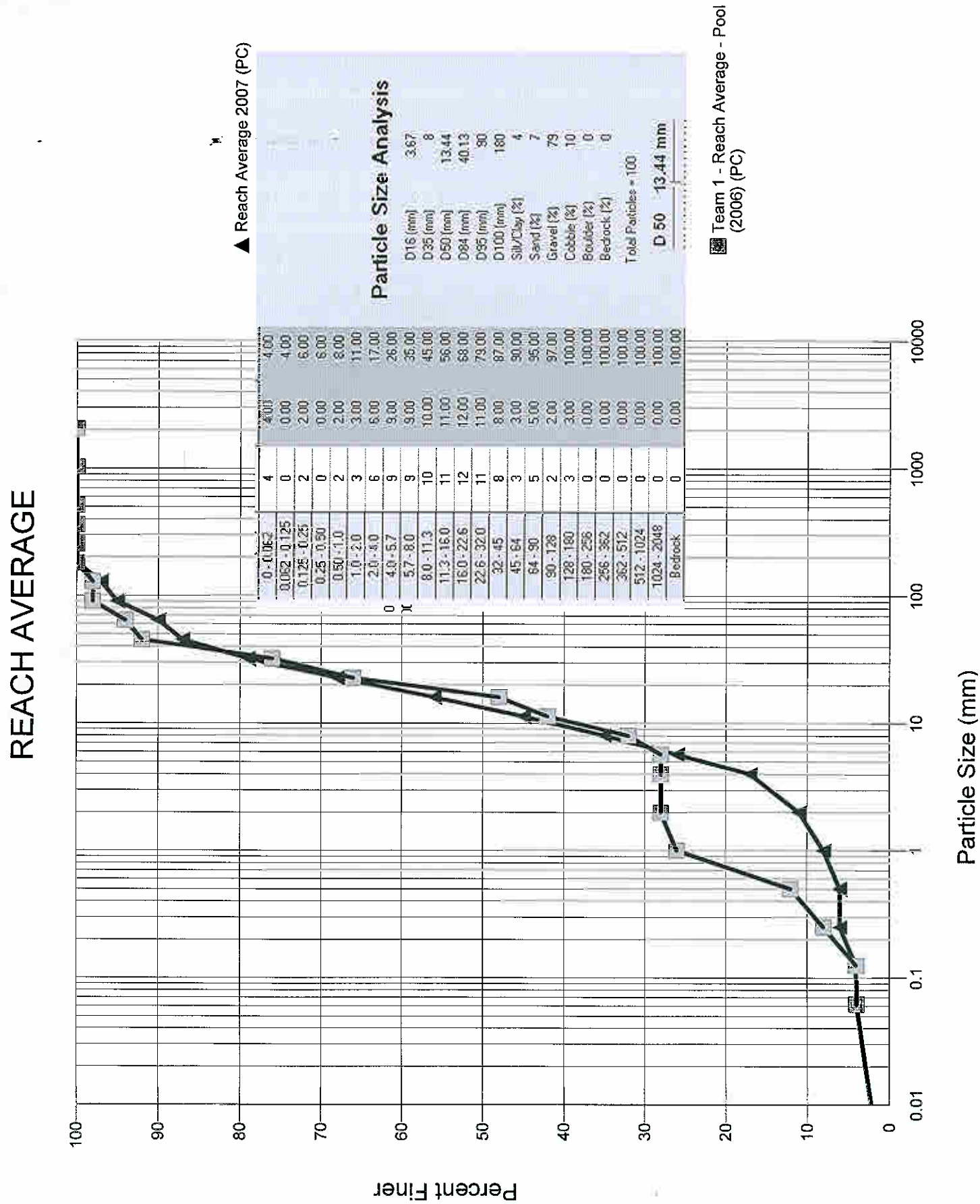

Riffle 0+10.5 - Overlay
Rifle 0+10.5 - YR2
Bankfull Indicators
Water Surface Points
Riffle 0+10.5 - YR1
Wbkf = 25.2
Dbkf = 1.2
Abkf = 29.9
Bankfull 2006
Elevation (ft)
Horizontal Distance (ft)
110.0
107.5
105.0
102.5
-22.5
0.0
22.5
45.0
67.5
90.0
Mouse X
-25.90
Mouse Y
102.69

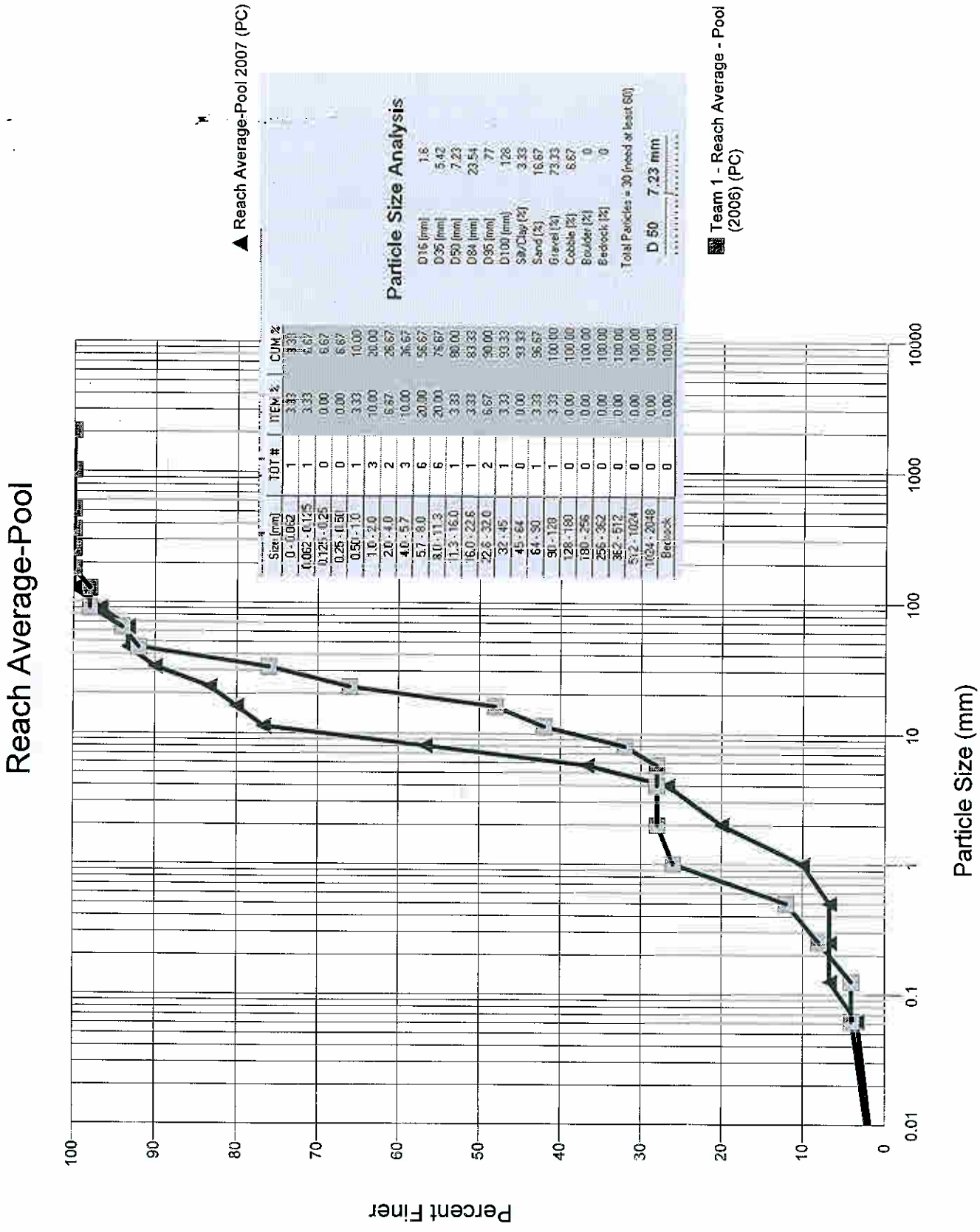

Riffle 0+10.5 - YR2
Water Surface Points
Abkf = 29.9
Bankfull Indicators
Dbkf = 1.2
Ground Points
Wbkf = 25.2
Toe Pin 103.12ft
Scour Chains
Elevation (ft)
Horizontal Distance (ft)
115
110
105
100
150
125
100
75
50
25
0
-25
-50
-75
-100


Run 0+10.5 - OVERLAY
○ Run 0+78.9 -YR2
◆ Bankfull Indicators
▼ Water Surface Points
△ Team 1 - Run XS (2006)
Wbkf = 27.8
Dbkf = 1.4
Abkf = 38.1
Bankfull 06 and 07
Elevation (ft)
Horizontal Distance (ft)
50
45
0
8
16
24
32
40
48
56
64
72
80
-8

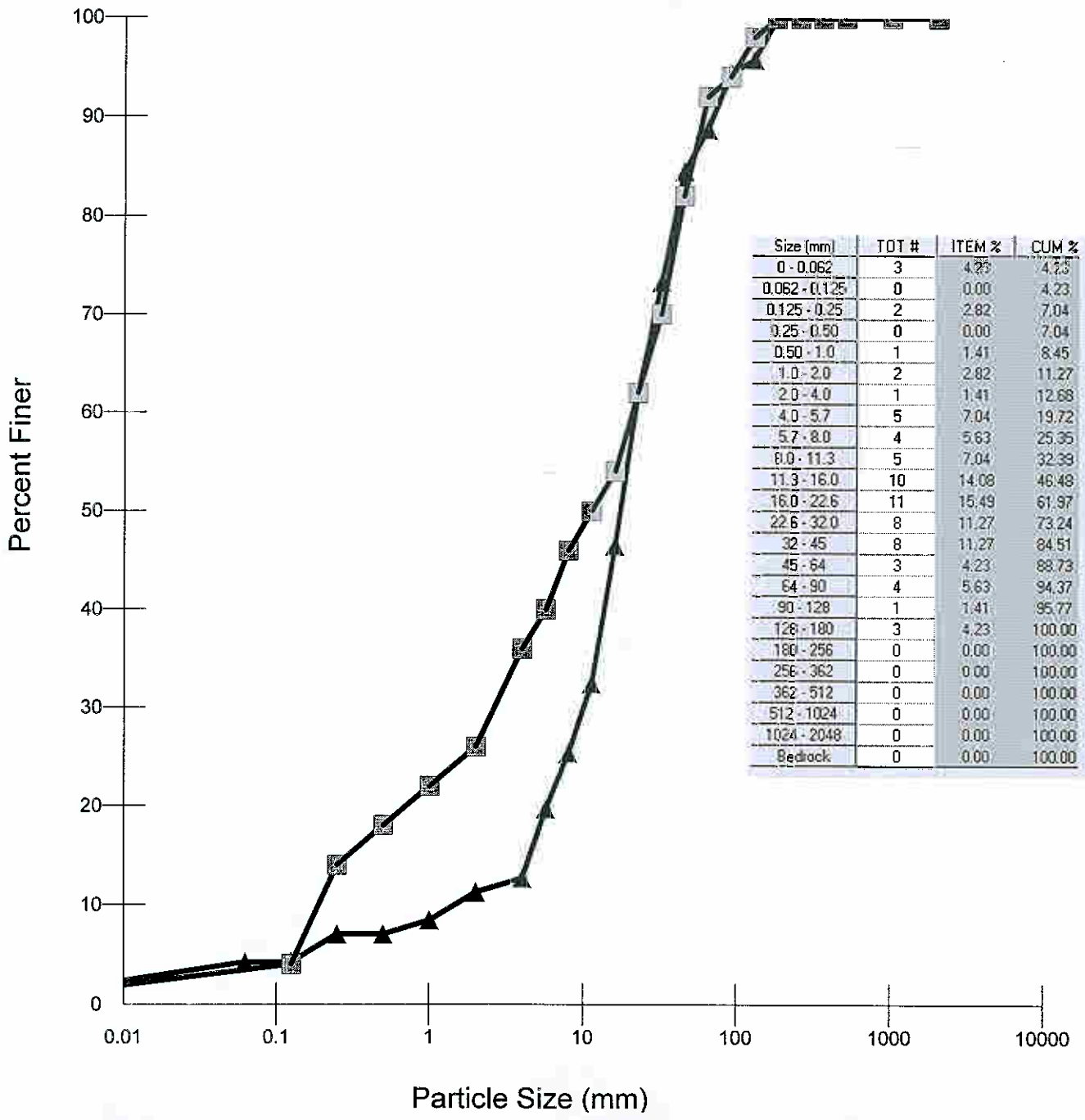

Run 0+10.5 - YR2
◆ Bankfull Indicators
Dbkf = 1.4
▼ Water Surface Points
Abkf = 38.1
○ Run 0+78.9 -YR2
Wbkf = 27.8
Elevation (ft)
50
48
46
44
42
-10
0
10
20
30
40
50
60
70
Horizontal Distance (ft)


Glide 1+05 Overlay
○ Glide 1+05 - YR2
◆ Bankfull Indicators
▼ Water Surface Points
△ Team 1 - Glide XS (2006)
Wbkf = 26.6
Dbkf = 1.5
Abkf = 39.2
Bankfull 06 and 07
Elevation (ft)
Horizontal Distance (ft)
48
46
44
42
40
0
14
28
42
56
70


REACH AVERAGE
Reach Average 2007 (PC)
Particle Size Analysis
D16 (mm) 3.67
D35 (mm) 8
D50 (mm) 13.44
D84 (mm) 40.13
D95 (mm) 90
D100 (mm) 180
Silt/Clay (%) 4
Sand (%) 7
Gravel (%) 79
Cobble (%) 10
Boulder (%) 0
Bedrock (%) 0
Total Particles = 100
D 50 13.44 mm
Team 1 - Reach Average - Pool (2006) (PC)
Percent Finer
Particle Size (mm)


Reach Average-Pool
Reach Average-Pool 2007 (PC)
Team 1 - Reach Average - Pool (2006) (PC)
Particle Size Analysis
D16 [mm] 1.8
D35 [mm] 5.42
D50 [mm] 7.23
D84 [mm] 23.54
D95 [mm] 77
D100 [mm] 128
Silt/Clay (%) 3.33
Sand (%) 16.67
Gravel (%) 73.33
Cobble (%) 6.67
Boulder (%) 0
Bedrock (%) 0
Total Particles = 30 (need at least 60)
D 50 7.23 mm
Size [mm] | TOT # | ITEM % | CUM %
0 - 0.062 | 1 | 3.33 | 3.33
0.062 - 0.125 | 1 | 3.33 | 6.67
0.125 - 0.25 | 0 | 0.00 | 6.67
0.25 - 0.50 | 0 | 0.00 | 6.67
0.50 - 1.0 | 1 | 3.33 | 10.00
1.0 - 2.0 | 3 | 10.00 | 20.00
2.0 - 4.0 | 2 | 6.67 | 26.67
4.0 - 5.7 | 3 | 10.00 | 36.67
5.7 - 8.0 | 6 | 20.00 | 56.67
8.0 - 11.3 | 6 | 20.00 | 76.67
11.3 - 16.0 | 1 | 3.33 | 80.00
16.0 - 22.6 | 1 | 3.33 | 83.33
22.6 - 32.0 | 2 | 6.67 | 90.00
32 - 45 | 1 | 3.33 | 93.33
45 - 64 | 0 | 0.00 | 93.33
64 - 90 | 1 | 3.33 | 96.67
90 - 128 | 1 | 3.33 | 100.00
128 - 180 | 0 | 0.00 | 100.00
180 - 256 | 0 | 0.00 | 100.00
256 - 362 | 0 | 0.00 | 100.00
362 - 512 | 0 | 0.00 | 100.00
512 - 1024 | 0 | 0.00 | 100.00
1024 - 2048 | 0 | 0.00 | 100.00
Bedrock | 0 | 0.00 | 100.00
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000

Reach Average Riffle



▲ Reach Average-Riffle 2007 (PC)

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	4.23	4.23
0.062 - 0.125	0	0.00	4.23
0.125 - 0.25	2	2.82	7.04
0.25 - 0.50	0	0.00	7.04
0.50 - 1.0	1	1.41	8.45
1.0 - 2.0	2	2.82	11.27
2.0 - 4.0	1	1.41	12.68
4.0 - 5.7	5	7.04	19.72
5.7 - 8.0	4	5.63	25.35
8.0 - 11.3	5	7.04	32.39
11.3 - 16.0	10	14.08	46.48
16.0 - 22.6	11	15.49	61.97
22.6 - 32.0	8	11.27	73.24
32 - 45	8	11.27	84.51
45 - 64	3	4.23	88.73
64 - 90	4	5.63	94.37
90 - 128	1	1.41	95.77
128 - 180	3	4.23	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

Particle Size Analysis

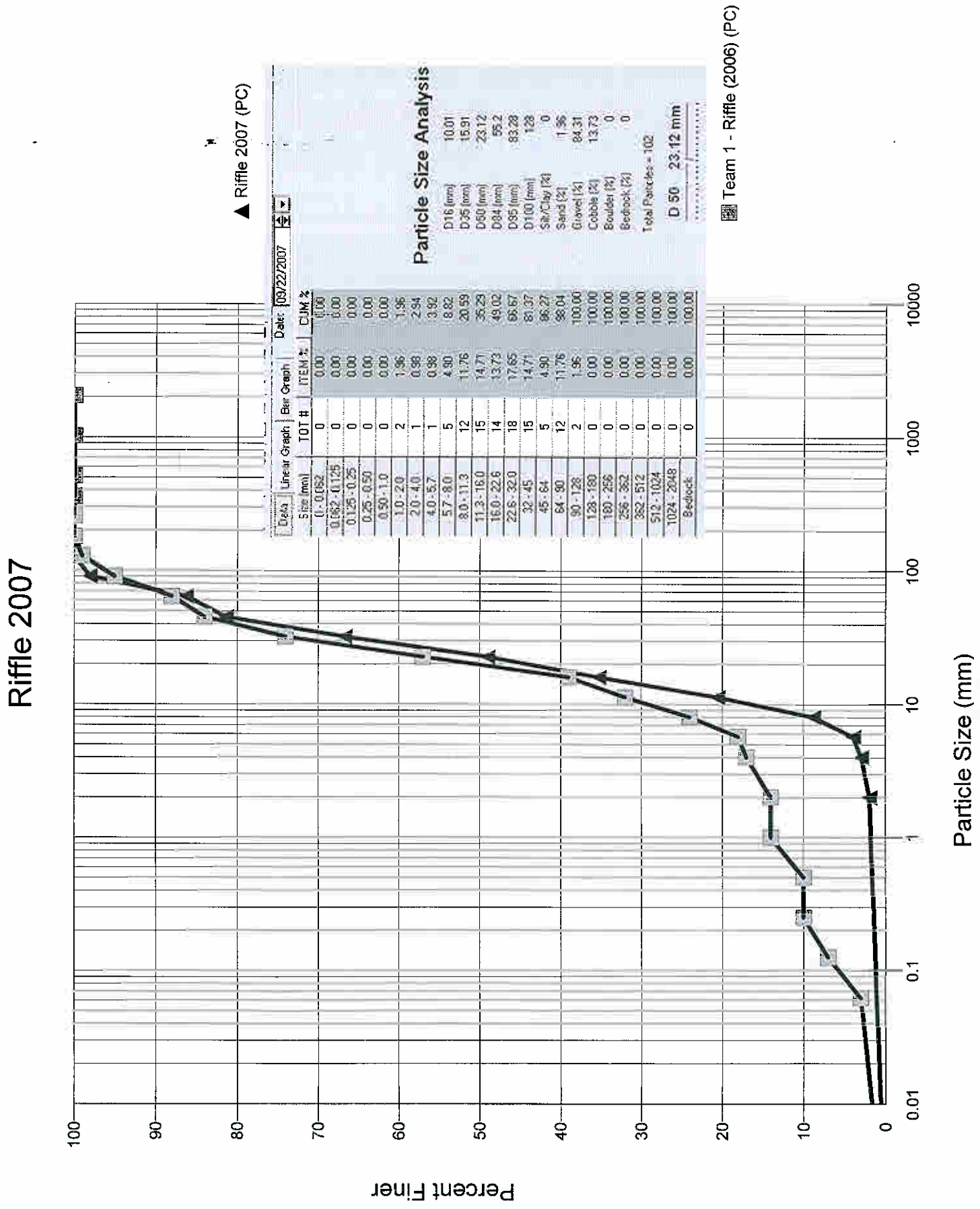
D16 (mm)	4.8
D35 (mm)	12.17
D50 (mm)	17.5
D84 (mm)	44.41
D95 (mm)	107.1
D100 (mm)	180
Silt/Clay (%)	4.23
Sand (%)	7.04
Gravel (%)	77.46
Cobble (%)	11.27
Boulder (%)	0
Bedrock (%)	0

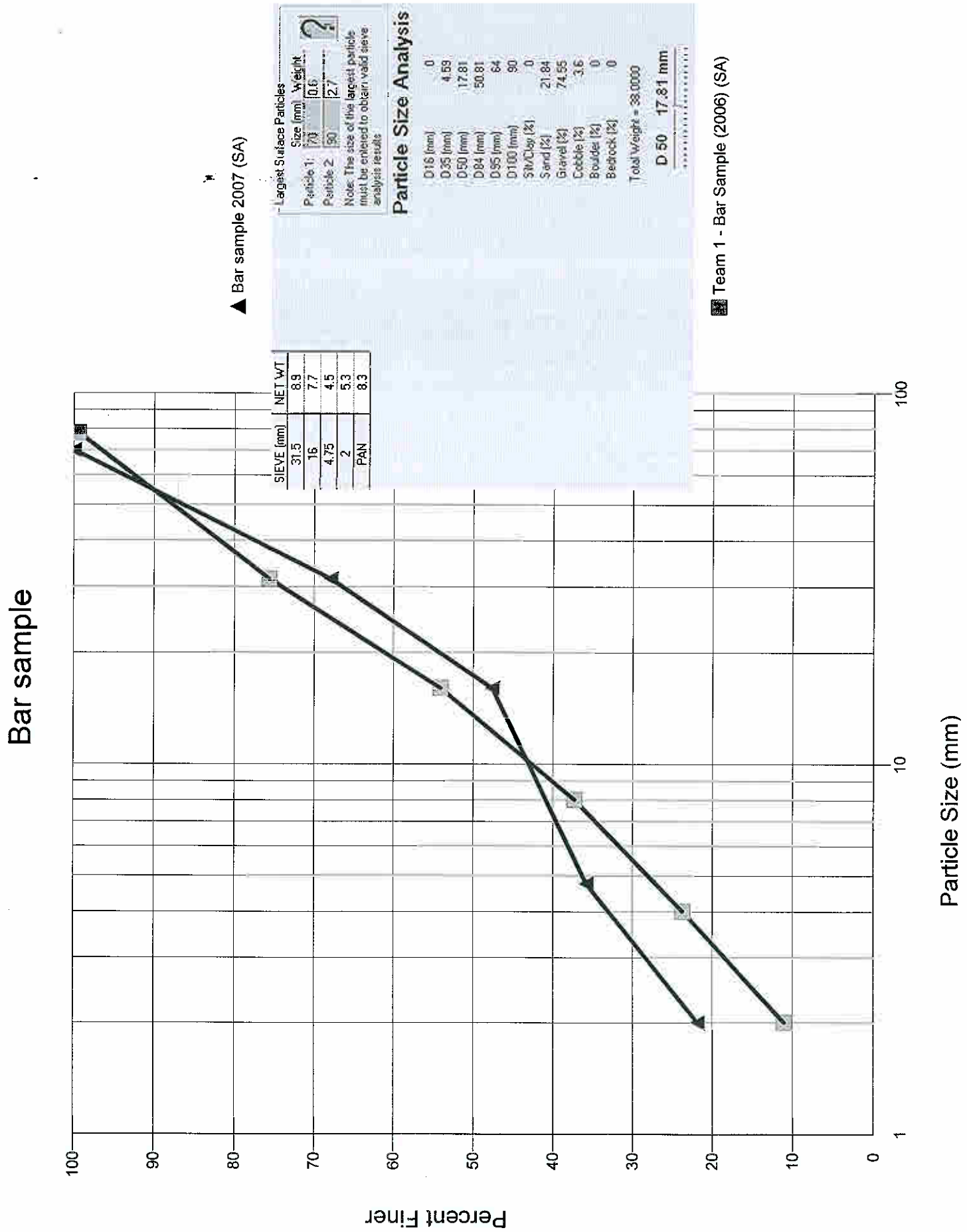
Total Particles = 71

D 50 17.5 mm

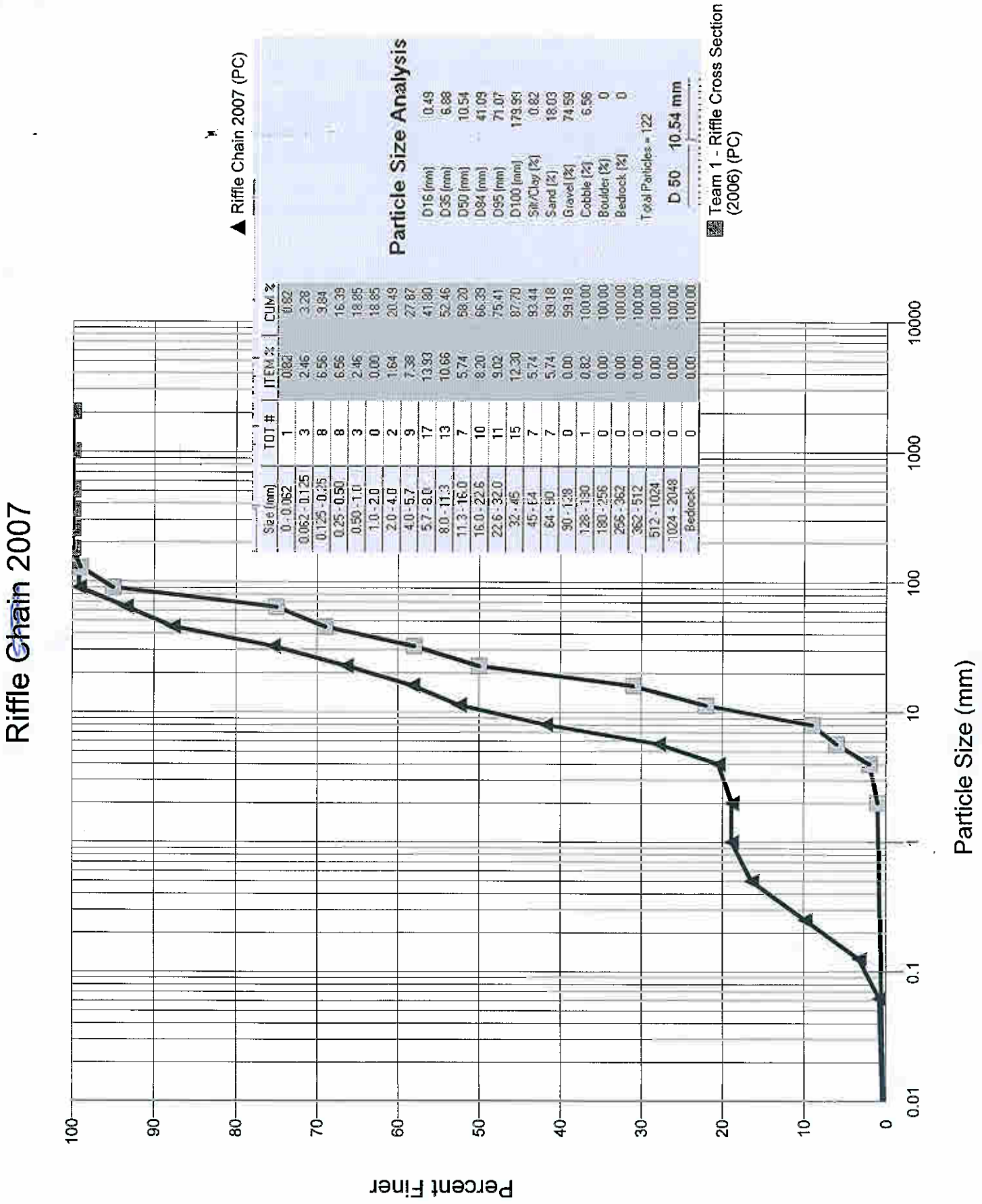
▩ Team 1 - Reach Average - Riffle (2006) (PC)

UT Little Bennett Creek Team 1 9/21/2007


Riffle 2007
Riffle 2007 (PC)
Team 1 - Riffle (2006) (PC)
Percent Finer
Particle Size (mm)
Data
Linear Graph
Bar Graph
Date: 09/22/2007
Particle Size Analysis
D16 (mm) 10.01
D35 (mm) 15.91
D50 (mm) 23.12
D84 (mm) 55.2
D95 (mm) 83.28
D100 (mm) 128
Silt/Clay (%) 0
Sand (%) 1.96
Gravel (%) 84.31
Cobble (%) 13.73
Boulder (%) 0
Bedrock (%) 0
Total Particles = 102
D 50 23.12 mm
Size (mm) TOT # ITEM % CUM %
0 - 0.062 0 0.00 0.00
0.062 - 0.125 0 0.00 0.00
0.125 - 0.25 0 0.00 0.00
0.25 - 0.50 0 0.00 0.00
0.50 - 1.0 0 0.00 0.00
1.0 - 2.0 2 1.96 1.96
2.0 - 4.0 1 0.98 2.94
4.0 - 5.7 1 0.98 3.92
5.7 - 8.0 5 4.90 8.82
8.0 - 11.3 12 11.76 20.59
11.3 - 16.0 15 14.71 35.29
16.0 - 22.6 14 13.73 49.02
22.6 - 32.0 18 17.65 66.67
32 - 45 15 14.71 81.37
45 - 64 5 4.90 86.27
64 - 90 12 11.76 98.04
90 - 128 2 1.96 100.00
128 - 180 0 0.00 100.00
180 - 256 0 0.00 100.00
256 - 362 0 0.00 100.00
362 - 512 0 0.00 100.00
512 - 1024 0 0.00 100.00
1024 - 2048 0 0.00 100.00
Bedrock 0 0.00 100.00
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000


Bar sample
Bar sample 2007 (SA)
Team 1 - Bar Sample (2006) (SA)
Particle Size Analysis
D16 (mm) 0
D35 (mm) 4.59
D50 (mm) 17.81
D84 (mm) 50.81
D95 (mm) 64
D100 (mm) 90
Silt/Clay (%) 0
Sand (%) 21.84
Gravel (%) 74.55
Cobble (%) 3.6
Boulder (%) 0
Bedrock (%) 0
Total Weight = 38.0000
D 50 17.81 mm
Largest Surface Particles
Size (mm) Weight
Particle 1: 76 0.6
Particle 2 90 2.7
Note: The size of the largest particle must be entered to obtain valid sieve analysis results
SIEVE (mm) NET WT
31.5 8.9
16 7.7
4.75 4.5
2 5.3
PAN 8.3
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
1
10
100

Xsec


Riffle Chain 2007
Riffle Chain 2007 (PC)
Team 1 - Riffle Cross Section (2006) (PC)
Particle Size Analysis
D16 (mm) 0.49
D35 (mm) 6.88
D50 (mm) 10.54
D84 (mm) 41.09
D95 (mm) 71.07
D100 (mm) 179.99
Silt/Clay (%) 0.82
Sand (%) 18.03
Gravel (%) 74.59
Cobble (%) 6.56
Boulder (%) 0
Bedrock (%) 0
Total Particles = 122
D 50 10.54 mm
Size (mm) | TOT # | ITEM % | CUM %
0 - 0.062 | 1 | 0.82 | 0.82
0.062 - 0.125 | 3 | 2.46 | 3.28
0.125 - 0.25 | 8 | 6.56 | 9.84
0.25 - 0.50 | 8 | 6.56 | 16.39
0.50 - 1.0 | 3 | 2.46 | 18.85
1.0 - 2.0 | 0 | 0.00 | 18.85
2.0 - 4.0 | 2 | 1.64 | 20.49
4.0 - 5.7 | 9 | 7.38 | 27.87
5.7 - 8.0 | 17 | 13.93 | 41.80
8.0 - 11.3 | 13 | 10.66 | 52.46
11.3 - 16.0 | 7 | 5.74 | 58.20
16.0 - 22.6 | 10 | 8.20 | 66.39
22.6 - 32.0 | 11 | 9.02 | 75.41
32 - 45 | 15 | 12.30 | 87.70
45 - 64 | 7 | 5.74 | 93.44
64 - 90 | 7 | 5.74 | 99.18
90 - 128 | 0 | 0.00 | 99.18
128 - 180 | 1 | 0.82 | 100.00
180 - 256 | 0 | 0.00 | 100.00
256 - 362 | 0 | 0.00 | 100.00
362 - 512 | 0 | 0.00 | 100.00
512 - 1024 | 0 | 0.00 | 100.00
1024 - 2048 | 0 | 0.00 | 100.00
Bedrock | 0 | 0.00 | 100.00
Percent Finer
Particle Size (mm)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000

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

Stream:	UT Little Bennett River 2007, Reach - Reach 1		
Basin:	Drainage Area: 1088 acres	1.7	mi²
Location:			
Twp.&Rge: ;	Sec./Qtr.: ;		
Cross-Section Monument (Lat/Long):	0 Lat / 0 Long	Date: 9/22/2007	
Observers:		Valley Type: VII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section	25.18	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.	29.92	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	21.16	ft/ft
Maximum DEPTH ($d_{bkf max}$) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.11	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x $d_{bkf max}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	111.45	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) in riffle sections.	4.43	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.	13.44	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.	0.01	ft/ft
Channel SINUOSITY (k) Crudely characterizes channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or as created from a ratio of valley slope divided by channel slope (VS / S).	1.5	

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

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UT Little Bennett Creek Team 1 9/21/2007

b. Flow Regime

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

FLOW REGIME

Stream: UT to Little Bennett Cr. Location: REACH 1								
Observers: Date: 9.21.07								
List ALL COMBINATIONS that APPLY.....	P2							

General Category

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

Specific Category

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

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c. Stream Size and Order

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

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

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d. Meander Patterns

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

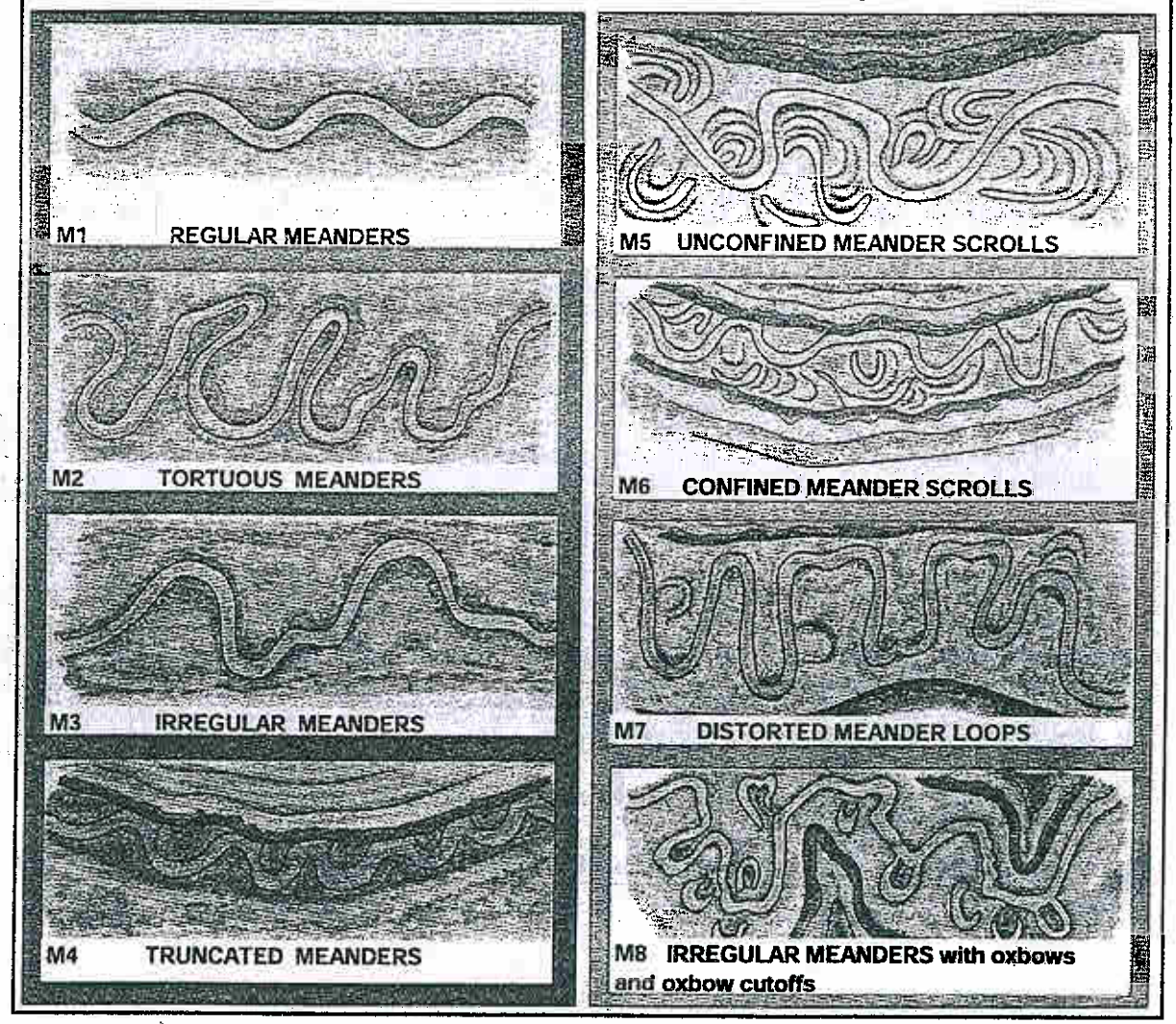
Meander Patterns

Stream: UT TO LITTLE BENNETT Reach: 1

Observers: Date: 9/21/07

List ALL CATEGORIES that APPLY	M3	M2			

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



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e. Depositional Patterns

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

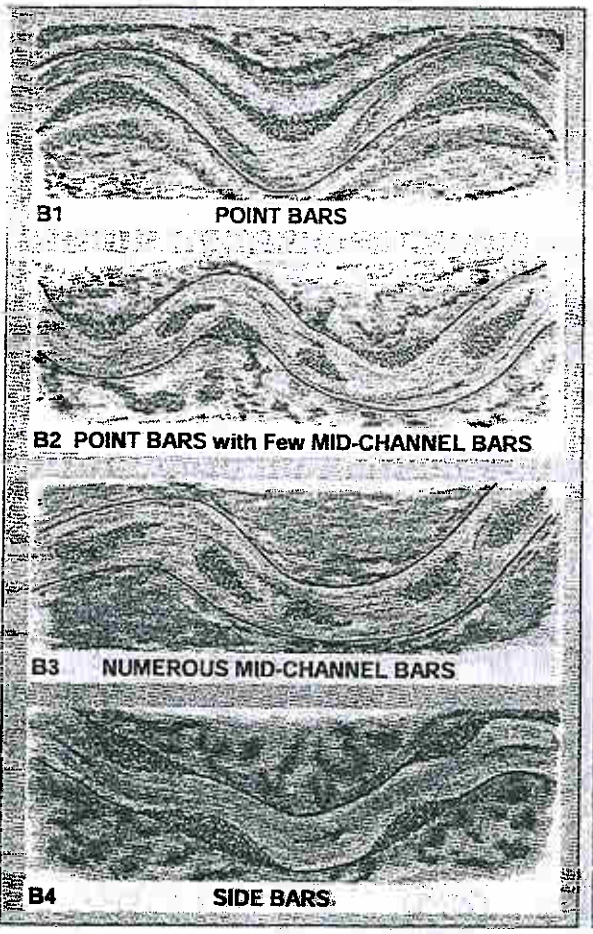
Depositional Patterns

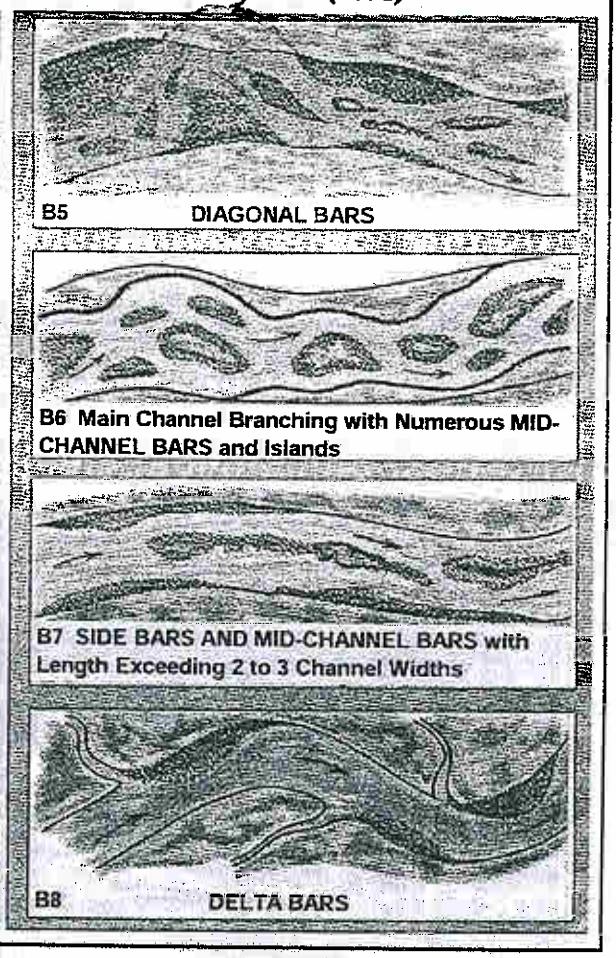
Stream: UT TO LITTLE BENNETT Reach: 1

Observers: Date: 9/21/07

List ALL CATEGORIES that APPLY ☞ B1 | B5 | B7

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





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f. Channel Blockages

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

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

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f. Channel Blockages

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

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

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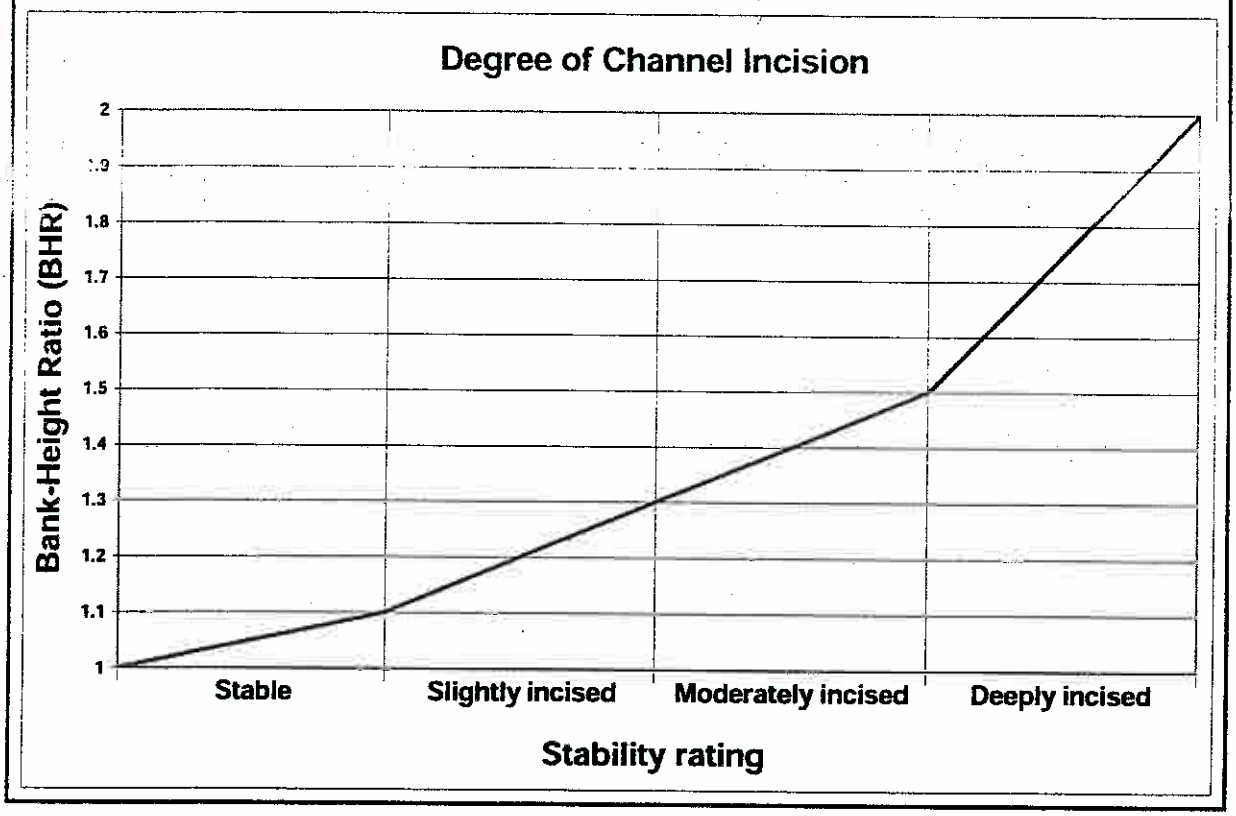
g. Degree of Channel Incision (Bank-Height Ratio)

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

Degree of Channel Incision			
Low Bank Height:	2.63	Bank-Height Ratio:	1.25
Max Bankfull Depth:	2.1		
Degree of Channel Incision Stability Rating		SLIGHTLY INCISED.	



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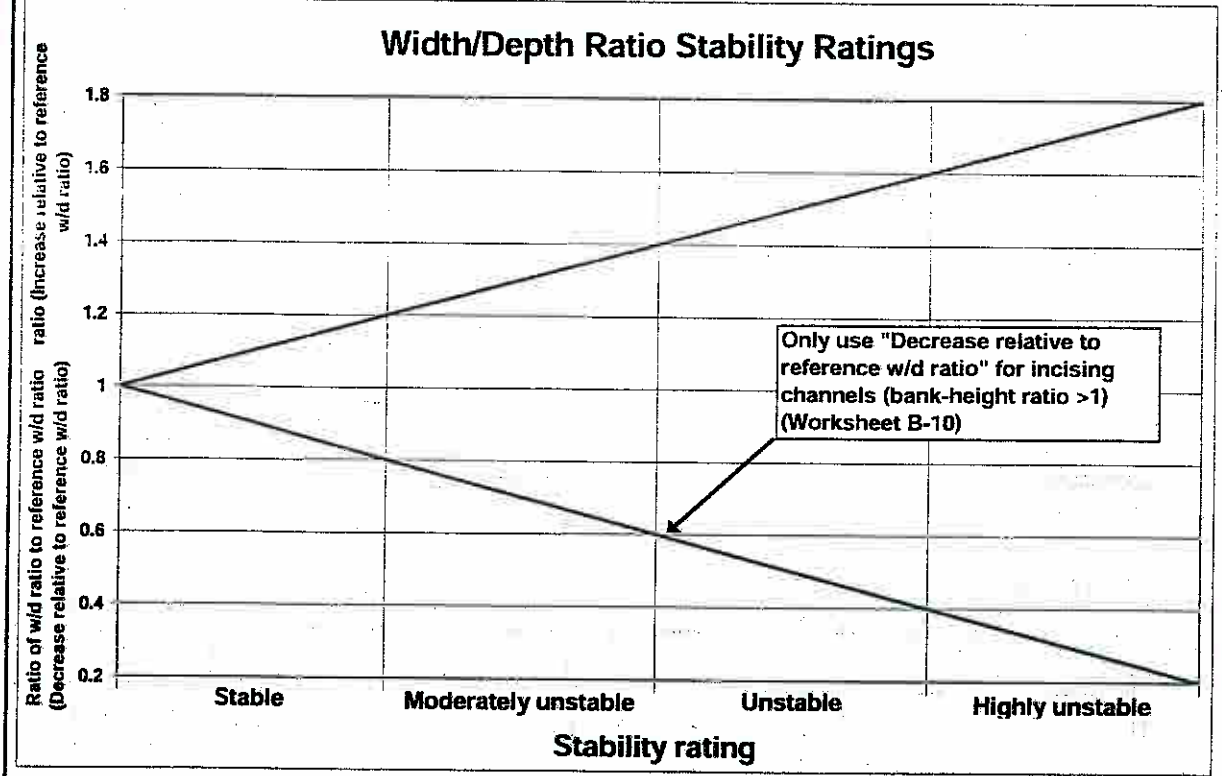
i. Width/Depth Ratio State

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

Width/Depth Ratio State			
Existing Width/Depth Ratio:	21	Ratio of existing w/d to reference w/d:	1.84
Reference Width/Depth Ratio:	11.43		
Width/Depth Ratio State Stability Rating ☞	HIGHLY UNSTABLE		



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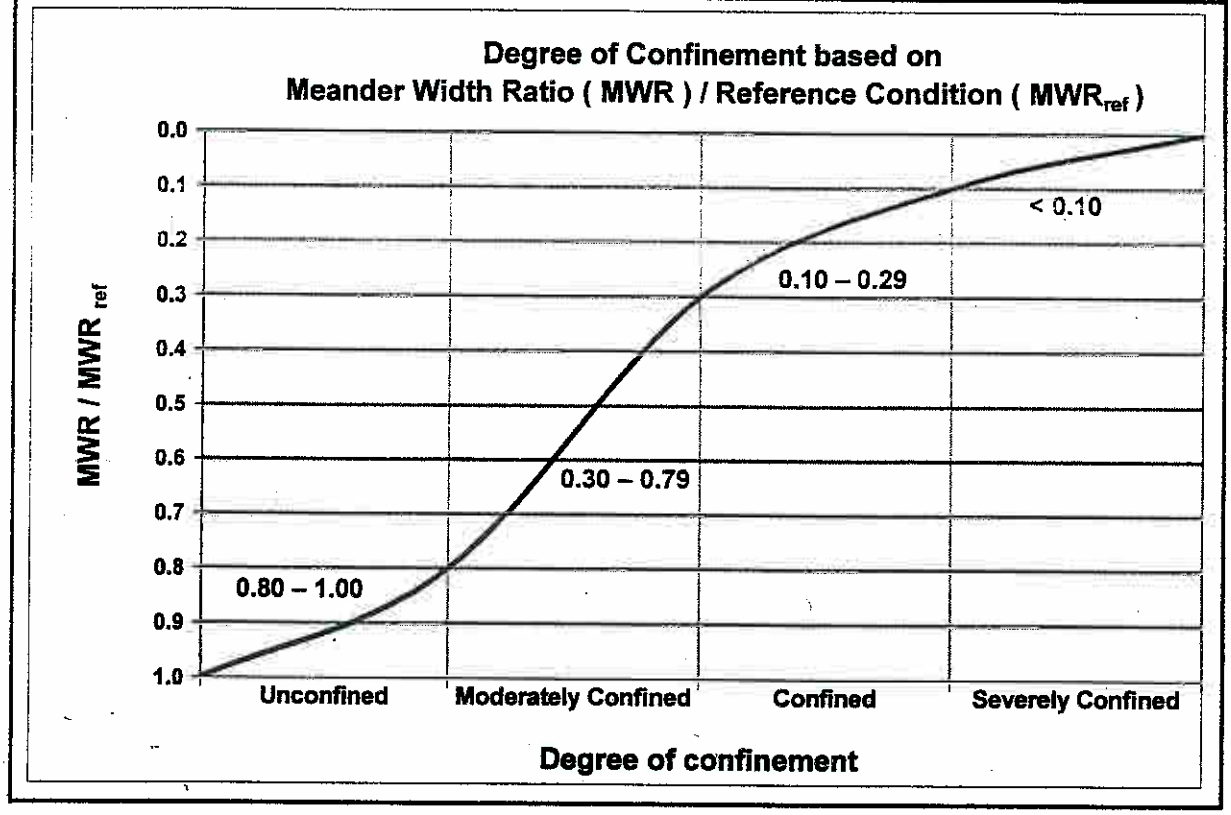
j. Degree of Channel Confinement (Meander Width Ratio (MWR))

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

Degree of Confinement			
Existing Meander Width Ratio (MWR):	2.98	Ratio of MWR to MWRref:	1.30* (0.24)
Reference Meander Width Ratio (MWR_{ref}):	2.3 (12.5)		
Degree of Confinement Stability Rating	Severely Confined* (CONFINED)		



* REFERENCE REACH IS CONFINED. MEANDER WIDTH RATIO SHOULD BE LARGER FOR A REFERENCE REACH.

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

Stream: **UT Little Bennett River 2007, Reach - Reacl** Location:

Observers: Date: **9/22/2007** 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})	25.18	ft	Riffle Area (A_{bkf})	29.92	ft^2
Mean Pool Depth (d_{bkfp})	1.94	ft	Pool Width (W_{bkfp})	22.87	ft	Pool Area (A_{bkfp})	44.45	ft^2
Mean Pool Depth/Mean Riffle Depth	1.63	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.91	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.49	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	2.3	ft	Max Pool Depth (d_{mbkfp})	4.19	ft	Max Riffle Depth/Mean Riffle Depth	1.93	
Max Pool Depth/Mean Riffle Depth	3.521					Point Bar Slope	18	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				4.39	ft/s	Estimation Method	Mannings	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				131.35	cfs	Drainage Area	1.7	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	144	140	149	ft	Meander Length Ratio (Lm/W_{bkf})	5.73	5.54	5.92
Radius of Curvature (Rc)	38.5	34	43	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.53	1.35	1.71
Belt Width (W_{blt})	75	75	75	ft	Meander Width Ratio (W_{blt}/W_{bkf})	2.98	2.98	2.98
Individual Pool Length	25.3	13.1	37.7	ft	Pool Length/Riffle Width	1.00	0.52	1.50
Pool to Pool Spacing	50.1	36.8	63.4	ft	Pool to Pool Spacing/Riffle Width	1.99	1.46	2.52
Riffle Length	9.81	4.53	15.4	ft	Riffle Length/Riffle Width	0.39	0.18	0.61

Channel Profile

Valley Slope (VS)	0.0150447	ft/ft	Average Water Surface Slope (S)	0.01	ft/ft	Sinuosity (VS/S)	1.5	
Stream Length (SL)	193	ft	Valley Length (VL)	130	ft	Sinuosity (SL/VL)	1.48	
Low Bank Height (LBH)	start 2.63 / end 3	ft	Max Riffle Depth	start 1.73 / end 2.64	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start 1.52 / end 1.14	

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.053	0.031	0.078	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	5.339	3.131	7.837
Run Slope (S_{run})	0.002	0.000	0.003	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	0.174	0.000	0.284
Pool Slope (S_p)	0.001	0.000	0.002	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.108	0.033	0.189
Glide Slope (S_g)	0.003	0.001	0.004	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.265	0.097	0.403

Feature Midpoint[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	2.3	2.17	2.53	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.93	1.82	2.13
Run Depth (d_{run})	2.82	2.27	3.34	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	2.37	1.91	2.81
Pool Depth (d_p)	4.19	3.9	4.48	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	3.52	3.28	3.76
Glide Depth (d_g)	2.71	2.42	3.17	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	2.28	2.03	2.66

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	4	0	0	D_{16}	3.67	0	0	0	mm
% Sand	7	2	21.84	D_{35}	8	0	4.59	0	mm
% Gravel	79	5	74.55	D_{50}	13.44	0	17.81	0	mm
% Cobble	10	0	3.6	D_{84}	40.13	0	50.81	0	mm
% Boulder	0	0	0	D_{95}	90	0	64	0	mm
% Bedrock	0	93	0	D_{100}	180	0	90	0	mm

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

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

a. Riparian Vegetation

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

Riparian Vegetation

Stream: UT of Little Bennet | Location: Reach 1

Observers: Team 1 | Reference reach [ ] | Disturbed (impacted reach) [X] | Date: 9/20/07

Existing species composition: Mixed lowland Riparian Hardwoods | Potential species composition: Same, with better understory diversity

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	50%	20	Black Walnut	60
				Tulip Poplar	25
				Ailanthus	2
				Elm	#6
				Ash	#7
					100%
2. Understory	Shrub layer		15	Spice Bush	100
					100%
3. Ground level	Herbaceous		63	Dog. stHgrass	90
				multiflora Rose	4
				Smartweed	1
				Clearweed	1
				misc. mints	#2
				Impatiens	2
					100%
	Leaf or needle litter		1	**Remarks:** Condition, vigor and/or usage of existing reach:	
	Bare ground		1		
*Based on crown closure. **Based on basal area to surface area.			Column total = 100%		

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-3. Bankfull velocity and discharge estimates.

Bankfull VELOCITY / DISCHARGE Estimates

Site	UT LITTLE BENNETT		Location	MD	
Date	9.21.07	Stream Type	C4	Valley Type	VIII
Observers	TEAM 1		HUC		

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	29.9	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.2	D_{bkf} (Ft)
Bankfull WIDTH	25.2	W_{bkf} (Ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	28.68	W_{Pbkf} (Ft)
D84 @ Riffle	55.2	Dia. (mm)	D84 mm / 304.8 =	0.18	D84 (Ft)
Bankfull SLOPE	0.0107	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.04	R (Ft)
Gravitational Acceleration	32.2	g (Ft/Sec^2)	Relative Roughness R (ft) / D84 (ft)	5.7	
Drainage AREA	1.7	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.59	u^* Ft / Sec

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 \text{Log}\{ R / D84 \}\ ]u^*$	4.19	Ft / Sec	1254	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895 * R^{2/3} * S^{1/2} / n$ n =	4.13	Ft / Sec	123.5	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 = 0.07 Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder-dominated stream systems: i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.	2.26	Ft / Sec	67.6	CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type n = 0.04	3.95	Ft / Sec	118.2	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) DARCY-WEISBACH	4.3	Ft / Sec	128.6	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 =	3.2	Ft / Sec	95	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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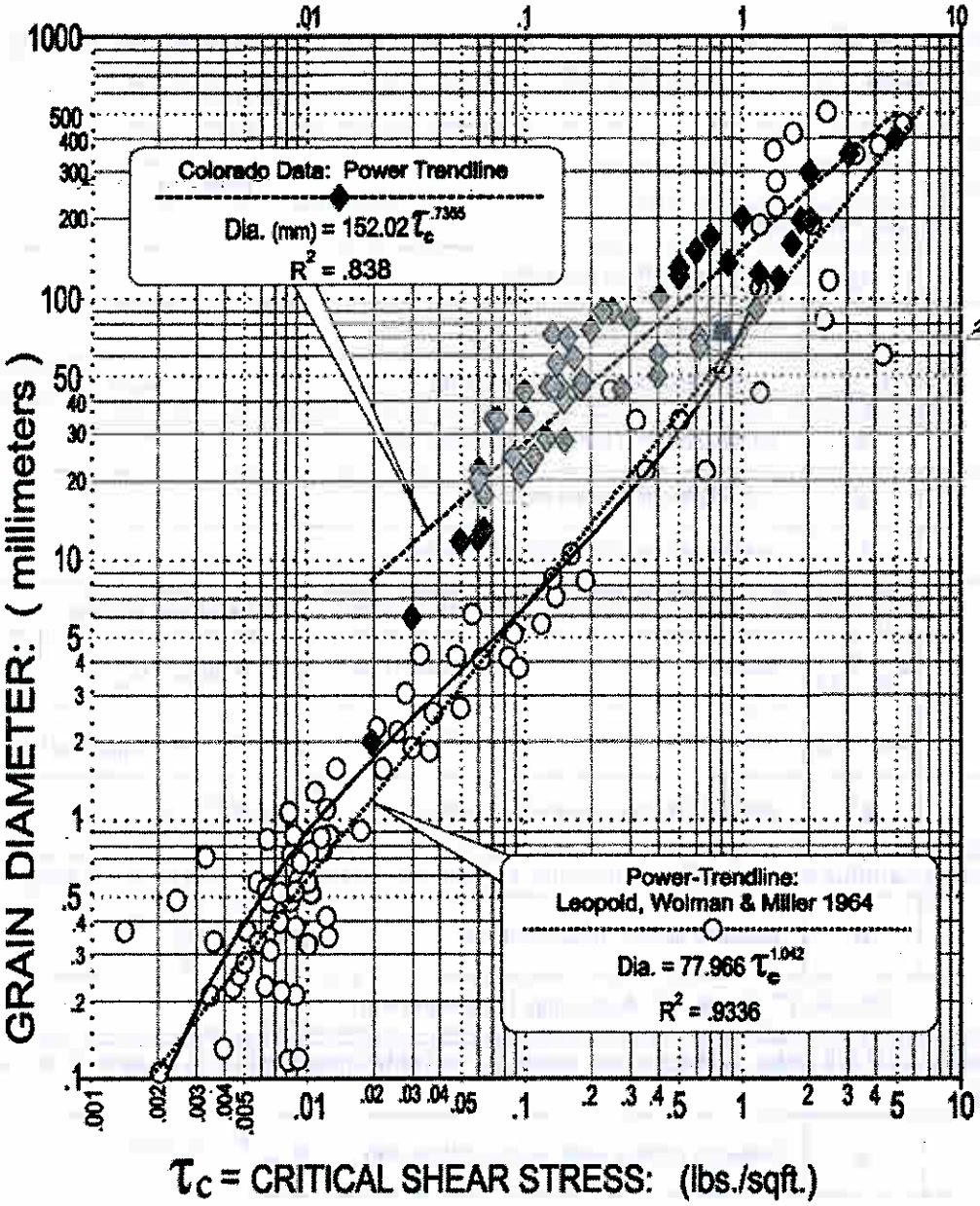

Laboratory and field data on critical shear stress required to initiate movement of grains (Leopold, Wolman, & Miller 1964). The solid line is the Shields curve of *the threshold of motion*, transposed from the Θ versus R_g form into the present form, in which critical shear stress is plotted as a function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

heterogenous mixture

Figure A-28. Critical shear stress required to initiate movement of bed-material grains following the Shields relation (Leopold et. Al, 1964), as modified by field data from Colorado (Rosgen, 2005).

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h. Modified Pfankuch Channel Stability Rating

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

Stream: Location: Valley Type: Observers: Date:

Location	Key	Category	Excellent Description	Rating	Good Description	Rating	Fair Description	Rating	Poor Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	(2)	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	(6)	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	(6)	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicating poor, discontinuous and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	(2)	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	(8)
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and 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 =	16	Fair total =	24	Poor total =	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 =	122
Existing stream type =	C4
*Potential stream type =	C4
Modified channel stability rating =	Poor

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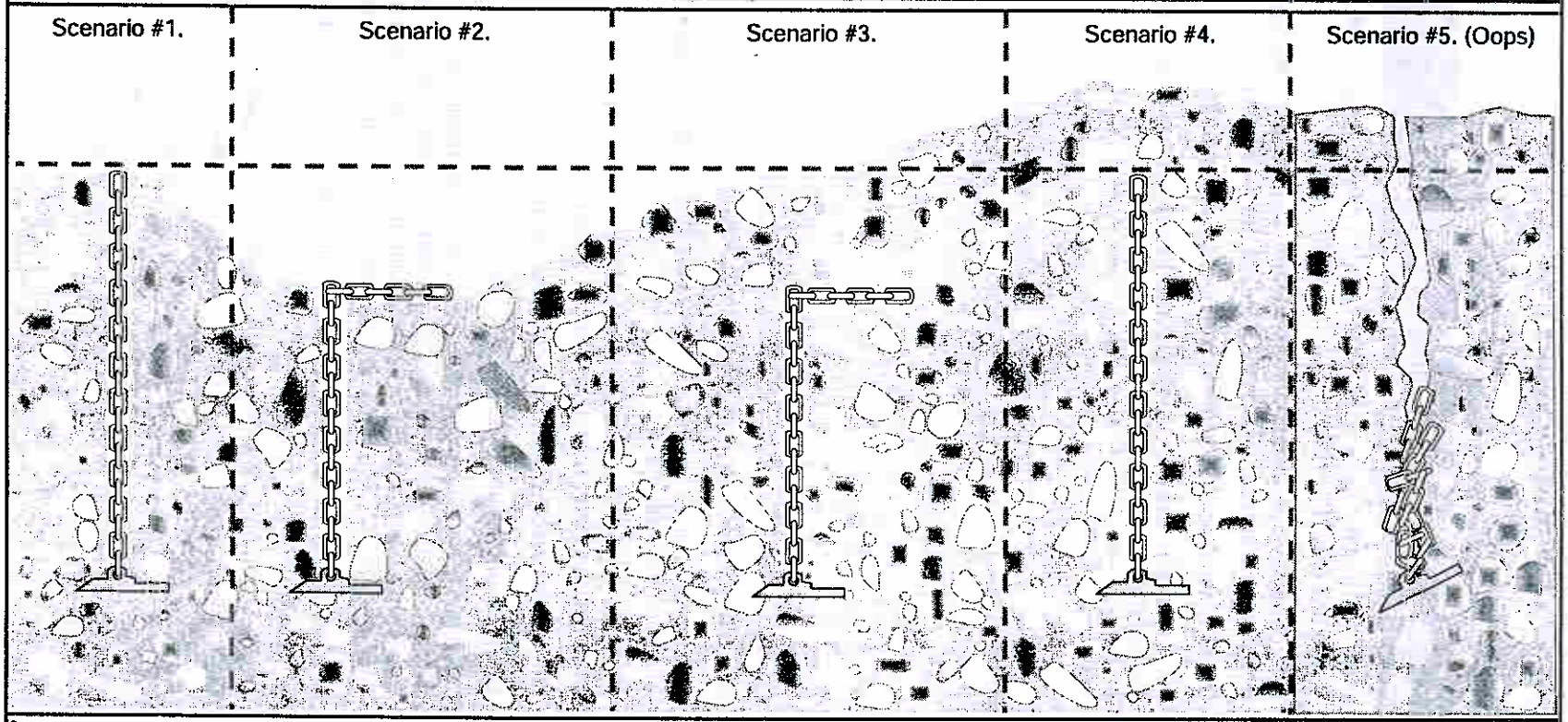
9/21/2007 Team 1 UT Little Bennett Creek

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

Stream name: Location:

Observers: Stream Type: Valley Type: Date:

		Installation Data (1st Year)				Recovery Data (2nd Year)					
		From cross-section		Particles near chain		Chain recovery				Particles near chain	
		Station (ft)	Elevation (ft)	Largest (mm)	2nd Largest (mm)	Scenario # (1–5)	Scour depth[a] (ft)	Elevation[b] (ft)	Net change[c] (ft)	Largest (mm)	2nd Largest (mm)
Riffle	Chain #1	31	104,01	64	42	1	0	104,06	.05	75	55
Riffle	Chain #2	41	103,33	31	61	4	.065	103.36	.03	52	47
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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9/21/2007 Team 1 UT Little Bennett Creek

River Assessment and Monitoring: Impaired Reach 2nd Field Day

3. Channel Change

Worksheet B-28. Summary of annual data comparisons.

Data Comparison Form

Stream: UT LITTLE BENNETT Reach: 1

Observers: TEAM 1 Date - Year 1: 2006 Date - Year 2: 9/20/2007

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	25.6	25.2	22.1	22.8	26.8	28.8
	Mean $depth_{bkf}$	1.2	1.2	1.9	1.9	1.6	1.6
	Width/depth ratio	21	21	11.6	12	16.7	18
	Cross-sectional $Area_{bkf}$	31.4	29.9	41	44.4	43.2	45
	Max $depth_{bkf}$	2.15	2.1	3.5	3.5	2.6	2.7
Pebble count	D_{35} (mm)	13.3	15.9	—	—	—	—
	D_{50} (mm)	20.0	23.1	—	—	—	—
	D_{84} (mm)	45	55.2	—	—	—	—
Bank Erosion	BEHI rating	VERY HIGH	HIGH	HIGH	HIGH	—	—
	NBS rating	MODERATE	EXTREEM	MODERATE	HIGH	—	—
	Predicted erosion (ft/yr)	0.03 0.06		0.05	0.07	—	—
	Measured erosion (ft/yr)	—	0, 0.26, .10 0.12	—	0.07, 0.10, .16 0.11	—	—

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	94	107	Bar Sample	D_{35} (mm)	7.3	4.6
Bank-Height Ratio start:	1.75	1.52		D_{50} (mm)	13.9	17.8
Bank-Height Ratio end:	1.65	1.14		D_{84} (mm)	46.9	50.8
Point Bar slope	15	18		D_{100} (mm)	78	90
Riffle Length/Riffle Width	0.44	0.39				
Pool Length/Riffle Width	1.5	1.0				
Dimensionless Slope Ratios: S_{rif}/S	4.9	5.3	Dimensionless Depth Ratios	d_{rif}/d_{bkf}	1.87	1.77
S_{run}/S	1.9	0.17		d_{run}/d_{bkf}	2.24	2.55
S_p/S	0.02	0.11		d_p/d_{bkf}	3.42	3.02
S_g/S	0.27	0.26		d_g/d_{bkf}	2.12	2.28

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

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

Stream: UT TO LITTLE BENNETT CRK.			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Enter required information					
17.5	D_{50}	Riffle bed material D_{50} (mm)			
11.81	$D^{\wedge}_{50}$	Bar sample D_{50} (mm)			
0.3	D_{max}	Largest particle from bar sample (ft)	90	(mm)	304.8 mm/ft
0.0166	S	Existing bankfull water surface slope (ft/ft)			
1.2	d	Existing bankfull mean depth (ft)			
1.7	γ_s	Submerged specific weight of sediment			

Select the appropriate equation and calculate critical dimensionless shear stress				
6.98	$D_{50}/D^{\wedge}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\ (D_{50}/D^{\wedge}_{50})^{-0.872}$	
5.05	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				
0.79	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d)			
130	Moveable particle size (mm) at bankfull shear stress (Figure B-4)			
0.49	Predicted shear stress required to initiate movement of D_{max} (mm) (Figure B-4)			
6.74	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$			
0.0065	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$			

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

Stream: UT TO LITTLE BENNETT CRK	Stream Type: C4
Location: REACH 1	Valley Type: VIII
Observers:	Date: 9/21/07

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

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Worksheet B-20. Lateral stability prediction summary.

Stream: UT TO LITTLE BENNETT CRK. Stream Type: C4

Location: REACH 1 Valley Type: VIII

Observers: Date: 9/21/07

Lateral stability criteria (choose one stability category for each criterion 1–5)	Lateral stability categories: Stable	Moderately unstable	Unstable	Highly unstable	Selected points (from each row)
1 **W/d ratio state (Worksheet B-12)**	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	8
	(2)	(4)	(6)	1.84 (8)	
2 **Depositional pattern (Worksheet B-8)**	~~B1, B2~~	B4, B8	B3	B5, B6, B7	4
	(1)	(2)	(3)	(4)	
3 **Meander pattern (Worksheet B-7)**	M1, M3, M4 M3		M2, M5, M6, M7, M8		+2
	(1)		(3)		
4 **Dominant BEHI / NBS (Worksheet B-16)**	L/VL, L/L, L/M, L/H, L/VH, M/VL	M/L, M/M, M/H, L/Ex, H/L	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex	7
	(2)	(4)	(6)	(8)	
5 **Degree of confinement (MWR / MWR_{valley}) (Worksheet B-13)**	0.8 – 1.0	0.3 – 0.79	0.1 – 0.29	< 0.1	4
	(1)	(2)	(3)	(4)	
				Total points	22 23

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

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

Stream:	UT TO LITTLE BENNETT CRK		Stream Type:	C4	
Location:	REACH 1		Valley Type:	VIII	
Observers:			Date:	9/21/07	

Vertical stability criteria (choose one stability category for each criterion 1–6)	Vertical stability categories for excess deposition / aggradation				Selected points (from each row)
	No deposition	Moderate deposition	Excess deposition	Aggradation	
1 Sediment competence (Worksheet B-18)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	4
	(2)	(4)	(6)	(8)	
2 Sediment capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended	Reduction over 25% of annual sediment yield for bedload and/or suspended	8
	(2)	(4)	(6)	(8)	
3 W/d ratio state (Worksheet B-12)	1.0 – 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	8
	(2)	(4)	(6)	(8)	
4 Stream succession states (Worksheet B-19)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(C→High w/d C), (B→High w/d B), (C→F)	(C→D), (F→D)	6
	(2)	(4)	(6)	(8)	
5 Depositional patterns (Worksheet B-8)	B1	B2, B4	B3, B5	B6, B7, B8	3
	(1)	(2)	(3)	(4)	
6 Debris / blockages (Worksheet B-9)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	2
	(1)	(2)	(3)	(4)	
				Total points	31

Vertical stability for excess deposition / aggradation (use total points and check stability rating)	Vertical stability category point range for excess deposition / aggradation				
	No deposition 10 – 14	Moderate deposition 15 – 20	Excess deposition 21 – 30	Aggradation > 30	
	☐	☐	☐	☒	AGGRADATION

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

Stream: UT TO LITTLE BENNETT CRK. Stream Type: C4

Location: REACH 1 Valley Type: VIII

Observers: Date: 9/21/07

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

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

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Worksheet B-23. Channel enlargement prediction summary.

Stream:	UT TO LITTLE BENNETT CRK.		Stream Type:	C4	
Location:	REACH 1		Valley Type:	VIII	
Observers:			Date:	9/21/07	

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

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

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

Stream:			Stream Type:	
Location:			Valley Type:	
Observers:			Date:	
Overall sediment supply prediction criteria (choose corresponding points for each criterion 1–5)		**Stability rating**	**Points**	**Selected points**
1	**Lateral stability (Worksheet B-20)**	**Stable**	**1**	4
		Mod. unstable	**2**	
		Unstable	**3**	
		Highly unstable	**4**	
2	Vertical stability excess deposition/ aggradation (Worksheet B-21)	No deposition	1	4
		Mod. deposition	2	
		Excess deposition	3	
		Aggradation	4	
3	**Vertical stability channel incision/ degradation (Worksheet B-22)**	**Not incised**	**1**	3
		Slightly incised	**2**	
		Mod. incised	**3**	
		Degradation	**4**	
4	**Channel enlargement prediction (Worksheet B-23)**	**No increase**	**1**	3
		Slight increase	**2**	
		Mod. increase	**3**	
		Extensive	**4**	
5	**Pfankuch channel stability (Worksheet B-11)**	**Good: stable**	**1**	4
		Fair: mod unstable	**2**	
		Poor: unstable	**4**	
			Total Points	18

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

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Worksheet B-25. Summary of stability condition categories.

Stream: UT TO LITTLE BENNETT CRK. Location: REACH 1

Observers: TEAM 1 Date: 9.21.07 Stream Type: C4 Valley Type: VIII

Channel Dimension	Mean bankfull depth (ft): 1.2	Mean bankfull width (ft): 25.2	Cross-section area (ft²):	Width of flood-prone area (ft): 112	Entrenchment ratio: 4.4	
Channel Pattern	Mean (range)	MWR: 2.98	Lm/W_{bkf}: 5.71	Rc/W_{bkf}: 1.53	Sinuosity: 1.5	
River Profile and Bed Features	Circle: (Riffle/pool) Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed					
	Max bankfull depth (ft): Riffle 2.11 Pool 3.59	Depth ratio (max/mean): Riffle 1.77 Pool	Pool to pool spacing: 56.1	Ratio	Slope: Valley: 0.0150 Average bankfull: 0.0103	
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: WALNUT GROVE / DENSE	Potential composition/density: BOTTOMLAND H.	Remarks: Condition, vigor and/or usage of existing reach: BLACK WALNUTS KEEP OTHER VEGETATION OUT		
	Flow regime: P2	Stream size and order: S-4(2)	Meander pattern(s): M3	Depositional pattern(s): B1, B2, B3	Debris/channel blockage(s): D3, D4	
	Degree of incision (Bank-Height Ratio): 1.09	Degree of incision stability rating: STABLE	Modified Pfankuch stability rating (numeric and adjective rating): 110, FAIR			
	Width/depth ratio (W/D): 21	Reference W/D ratio (W/D_{ref}): 11.43	Width/depth ratio state (W/D) / (W/D_{ref}): 1.84	W/D ratio state stability rating: HIGHLY UNSTABLE		
	Meander Width Ratio (MWR): 2.98	Reference MWR_{ref}: 2.3	Degree of confinement (MWR / MWR_{ref}): 1.30	MWR / MWR_{ref} stability rating: SEVERELY CONFINED		
Bank Erosion Summary	Length of reach studied (ft): 193	Annual streambank erosion rate: 33.25 (tons/yr) 0.17 (tons/yr/ft)	Curve used: COLORADO	Remarks:		
Sediment Capacity (POWERSED)	Sufficent capacity (Insufficient capacity)	Remarks: AGGRADING				
Entrainment/ Competence	Largest particle from bar sample (mm): 90	$\tau = 0.99$	$\tau^* =$ —	Existing $depth_{bkf}$: 1.2	Required $depth_{bkf}$: —	Existing $slope_{bkf}$: 0.0106 Required $slope_{bkf}$: —
Successional Stage Shift	C → (LARGER W/D) C → → → →			Existing stream state (type): C4	Potential stream state (type): WIDER W/D 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:	

- REFERENCE REACH IS SEVERELY CONFINED

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Worksheet B-23. Channel enlargement prediction summary.

Stream: UT TO LITTLE BENNETT CRK.			Stream Type: C4		
Location: Reach 1			Valley Type: VIII		
Observers:			Date: 9/21/07		
Channel enlargement prediction criteria (choose one stability category for each criterion 1–4)	Channel enlargement prediction categories				Selected points (from each row)
	No increase	Slight increase	Moderate increase	Extensive	
1 Successional stage shift (Worksheet B-19)	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(E→C) C→CANCER w/a C	(G→F), (F→D)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F)	4
	(2)	(4)	(6)	(8)	
2 Lateral stability (Worksheet B-20)	Stable	Moderately unstable	Unstable	Highly unstable	8
	(2)	(4)	(6)	(8)	
3 Vertical stability excess deposition/ aggradation (Worksheet B-21)	No deposition	Moderate deposition	Excess deposition	Aggradation	6
	(2)	(4)	(6)	(8)	
4 Vertical stability incision/ degradation (Worksheet B-22)	Not incised	Slightly incised	Moderately incised	Degradation	5
	(2)	(4)	(6)	(8)	
				Total points	23
	Category point range				
Channel enlargement prediction (use total points and check stability rating)	No increase 8 – 10 ☐	Slight increase 11 – 16 ☐	Moderate increase 17 – 24 ☒	Extensive > 24 ☐	MODERATE INCREASE

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

Stream:	UT TO LITTLE BENNETT CK.			Stream Type:	C4
Location:	REACH 1			Valley Type:	VIII
Observers:				Date:	9/21/07

Vertical stability criteria (choose one stability category for each criterion 1–6)	Vertical stability categories for excess deposition / aggradation				Selected points (from each row)
	No deposition	Moderate deposition	Excess deposition	Aggradation	
1 **Sediment competence (Worksheet B-18)**	Sufficient depth and/or slope to transport largest size available (2)	Trend toward insufficient depth and/or slope-slightly incompetent (4)	Cannot move D_{35} of bed material and/or D_{100} of bar material (6)	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size (8)	4
2 **Sediment capacity** POWERSED	Sufficient capacity to transport annual load (2)	Trend toward insufficient sediment capacity (4)	Reduction up to 25% of annual sediment yield of bedload and/or suspended (3)	Reduction over 25% of annual sediment yield for bedload and/or suspended (3)	8
3 **W/d ratio state (Worksheet B-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	8
4 **Stream succession states (Worksheet B-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) C→larger W/D C (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	4
5 **Depositional patterns (Worksheet B-8)**	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	2
6 **Debris / blockages (Worksheet B-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	2
				Total points	28

Vertical stability for excess deposition / aggradation (use total points and check stability rating)	Vertical stability category point range for excess deposition / aggradation				
	No deposition 10 – 14	Moderate deposition 15 – 20	Excess deposition 21 – 30	Aggradation >30	EXCESS DEPOSITION
	☐	☐	☒	☐	

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

Stream: UT TO LITTLE BENNETT CRK	Stream Type: C-4
Location: REACH 1	Valley Type: VIII
Observers:	Date: 9/21/07
Stream type changes due to successional stage shifts (Figure B-5)	**Stability rating (check appropriate rating)**
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☐ Stable
(E→C) (C → LARGER W/DC)	☒ 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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RIVERMORPH BANK PROFILE REPORT

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
1.75	3.19	SLP BRK
1.93	3.4	RTOB/BPIN 3
2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
1.75	3.19	SLP BRK
1.93	3.4	RTOB/BPIN 3
2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
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Bank Pin Information:

Name	Horiz	Vert	Length	Note
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Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
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Bank Pin Information:

Name	Horiz	Vert	Length	Note
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Toe Pin Area: 9.81 square feet (used for erosion monitoring)

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
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2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
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2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

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Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

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Toe Pin Area: 11.10 square feet (used for erosion monitoring)
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River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

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Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
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River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
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2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

RIVERMORPH BANK PROFILE REPORT

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
1.75	3.19	SLP BRK
1.93	3.4	RTOB/BPIN 3
2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

7.01 6.50 7.09 6.31 104.2

STREAM SURVEY
LONGITUDINAL PROFILE

Page 2

STREAM	UT Bennett CK	DATE	9-21-07
REACH	#1	CREW	

(all measurements are in feet unless otherwise noted) LBH

STATION	TW	WS	BKF	WS/BF	TOB	Other	Other	COMMENT
101.0	9.11	8.38						Glide
107.2	8.80	8.37						Glide
108.4	8.67	8.38	6.31					Glide
114.4	8.75	8.40						Glide-END?
115.5	8.60	8.41					5.61	Riffle TOP
117.5	8.76	8.61						Riffle
120.0	8.88	8.64						RUN?
128.5	8.90	8.64						RUN
134.0	9.04	8.68						RUN-Clay lense
134.5	9.69	8.68						Pool-TOP
140.0	9.77	8.67						Pool
143.5	10.50	8.69	6.50					Pool
150.0	11.10	8.68					5.21	Pool
152.0	11.11							Pool - Root WAD
156.7	10.69							Pool Root WAD
159.7	10.82	8.67						US Tree
166.0	10.51	8.66	7.21				6.00	POOL-DS TREE
172.0	9.09	8.67						Glide-Tail
176.0	9.22	8.67						Glide
181.0	8.83	8.69	6.39?	103.14			5.99	Transverse BAR (R)
29 181.0	Better	BKF	(7.54)					
183.0							5.86	Right
90.6						10.24		High H2O Debris (RB)
55.0		8.04				6.19		AB3-High Water Scour (Diff is 1.85ft)

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

6.93 Best 104.62 − 101.65 = 2.97

102.94 BKF
101.65

UT Little Bennett Creek Team 1 9/21/2007

TW - WD - WSE

5.72 5.21 6.57 103.91 Riffle XS TL MON 106.72

6.05 7.04 5.60

STREAM SURVEY

LONGITUDINAL PROFILE

4.52 3.76 .76

STREAM UT Little Bennett CK	DATE 9/21/07
REACH #1	CREW 21.7 BKF Elev (WD) (LBH)

(all measurements are in feet unless otherwise noted)

STATION	TW	WS	BKF	~~WS/BF~~	TOB	Other	Other	COMMENT
								BM 3.76
							Surrounding Ground	HI 4.52
						103.66		HI: 110.48
0	7.04	103.66	5.52	elev 104.96		0.22	4.05	T-Riffle
3.0	7.13	103.52				0.17		Riffle
7.9	7.57	103.11	5.14	105.34		0.20		Riffle
10.5	8.01	102.65				0.18	4.54	XS-Riffle
13.0	8.08	102.60				0.20		Riffle
7.0	No WAY!							No Way!
15.5	8.22	102.46				0.20	Head of Run	Riffle-END
18.0	8.37	102.57	6.47	105.01		0.46	4.40	RUN-TOP
21.0	8.50	102.56				0.58		US-Down Tree
23.0	8.46	102.52				0.50		Deep-RUN
25.0	8.36					0.40	4.74	RUN
30.4	8.19					0.25		RUN
35.0	8.40					0.45		RUN
33.0	8.30					0.35	5.07	RUN
38.0	8.80	102.52	5.72	elev 104.76		0.84		Pool-TOP
42.0	9.31	102.49	5.91	elev 104.57		1.32		Pool
42.8	9.46					1.49	4.94	Pool
46.0	9.65		5.96			1.70		US Tree-Pool
48.0	9.76		6.10			1.80	5.48	Pool
50.0	9.46		6.02			1.50		POOL-XS
55.3	9.28					1.23		Pool
59.0	9.69		5.50			1.70		Pool-US-Tree
63.0	9.52		5.56			1.52		Pool-DS-Tree
63.4	9.07					1.10		Glide-Begin
64.0	8.54	102.54	7.25	103.23		0.60		Glide
66.0	8.33					0.38		Gli
67.8	8.22	102.51	6.57	elev 103.91		0.25	5.57	Riffle-TOA
68.0	8.22	8.07	6.75				5.61	Riffle
69.0	8.48							Riffle
74.0	8.61	8.36						Riffle
77.4	8.72	8.37						RUN Top
78.9	8.77	8.39						RUN
80.5	TREE	Block				0.88		RUN END
81.9	9.63	8.37	6.36	104.12				Pool
85.6	10.31	8.42						Pool
88.7	10.71	8.39	6.54					Pool DMAX
92.8	10.20							Pool
95.0	9.85	8.39						Glide

NOTATIONS

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

Begin measure WSE

103.91 BKF 102.01 WSE Hang

5.56

105.01 BKF 104.12 102.11

103.94 100.63

USFWS-CBFO
9/20/2007 2:30 PM

Long Prof XSForm

UT Little Bennett Creek Team 1 9/21/2007

HI: ~~114.47~~ 110.54 TP 7.79 RM 3.86

6 7.79 3.86 3.93

UT to Little Bennett Creek
Reach 1 - Pool Cross Section

STATION	ELEVATON	NOTE		
0	106.68	TLMON		4.39
0	105.96	GLMON		5.09
4	105.31	SLP BRK		5.73
7	105.13	SLP BRK		5.92
10	105.05	SLP BRK		5.99
13	105.17	SLP BRK		5.91
15	105.47	SLP BRK		5.55
18	105.27	SLP BRK	5.69	
22	105.51	SLP BRK	5.58	
23	105.51	LTOB	5.54	
25	105.15	SLP BRK	5.83	
25.8	105.03	SLP BRK	5.99	
28	104.43	BKF	6.50	
31	104.1	SLP BRK	6.92	
34	103.73	SLP BRK	7.65	
35.6	103.41	SLP BRK	7.85	
37	102.81	SLP BRK	8.15	
37.3	102.45	LEW	8.22	
38.6	102.01	CS	8.49	
41	101.91	CS	9.01	
43	101.65	CS	9.22	
45	101.33	CS	9.95	
46.4	101.12	TW		
47.5	101.34	CS		
48.5	101.32	GTPIN	9.72	
48.5	101.54	TTPIN	8.30	
48.5	101.32	GTPIN	9.36	
49.8	102.06	CS		
49.8	102.45	REW		
50.1	103.06	SLP BRK		
50.2	104.05	SLP BRK		
50	105.38	SLP BRK		
48	105.88	SLP BRK		
47	106	SLP BRK		
50	106.22	SLP BRK		
50.5	106.41	RTOB		
52	106.53	SLP BRK		
55	106.54	SLP BRK	4.56	
60	106.24	SLP BRK	4.84	
65	105.91	SLP BRK +.46	4.45	corrected 4.91
67.55	105.8	GRMON	4.64	5.12
67.55	106.41	TRMON	4.13	4.59
67.55	105.8	GRMON	4.76	5.22
92	107.77	GS	4.36	4.92

26

~~5.25~~ 5.71

102.75

Rock 102.77 1.23

Riffle undercut

45.1	8.60
45.4	8.20
45.6	7.2
45.6	7.0

TP pt

5.09 − 4.39 = .70

Ours: 7.12 10 8.30 4.39 3.91

Theirs: 106.68 101.54 5.14

5.14 3.91 1.23

LEW

33	7.25
39	8.53
40	8.79
42	9.29
44	9.75
46	10.09
47	9.99
~~48~~	~~9.72~~
~~48.5~~	~~8.30~~
49	9.22
50.3	8.91
50.3	8.57
50.6	7.87
51	5.57
50.9	6.37
50.65	5.47

TW

undercut

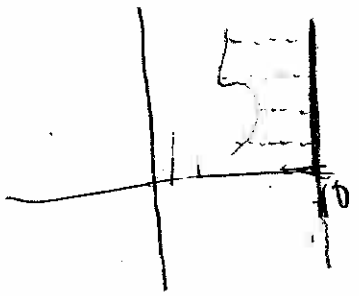
RTOB 52.75 4.90

TP old 4.39 for new 4.85

65 4.45

Pool X sec

Note	Hor Station	Elevation
T PIN	0	0
G PIN	0	-1.28
Ch ↓ toe	1.31	-.078
Toe	2.03	-.058
B PIN (exposed .08)	2.18	-0.1
	2.36	0.3
	2.40	0.4
	2.61	0.9
B PIN Base (exposed 0.2)	2.67	1.39
	2.64	1.76
	2.50	2.0
	2.49	2.01
	2.35	2.4
	2.30	2.49
	1.94	2.71
	1.98	2.81
B PIN Base exposed 0.16	1.95	3.2
	2.15	3.6
	3.17	3.84



RIVERMORPH BANK PROFILE REPORT

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

RIVERMORPH BANK PROFILE REPORT

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
1.75	3.19	SLP BRK
1.93	3.4	RTOB/BPIN 3
2.57	3.66	GS
4.58	3.9	GS
5.45	3.95	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Riffle Profile (2006)

Toe Pin Setup Data:
Station: 44 Elevation: 103.63 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-0.69	GTPIN
1.2	-0.69	TOE
1.06	-0.34	UNDERCUT
1.05	0	UNDERCUT
1.09	0.03	BPIN 1
0.95	0.31	UNDERCUT
0.9	0.7	SLP BR
1.06	1.12	BPIN 2
1.24	1.31	SLP BRK
1.59	1.58	BKF
1.77	1.76	SLP BRK
1.87	1.84	SLP BRK
2.01	1.96	BPIN 3
2.4	2.17	SLP BRK
3.01	2.54	SLP BRK
3.8	3.12	RTOB
4.14	3.33	GS
4.79	3.58	GS
5.98	3.82	GS

Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	1.09	0.03	3	
BPIN 2	1.06	1.12	3	
BPIN 3	2.01	1.96	3	

Summary:

Toe Pin Area: 9.81 square feet (used for erosion monitoring)

River Name: UT Little Bennett Creek
Reach Name: Team 1
Bank Name : Team 1 - Pool Profile (2006)

Toe Pin Setup Data:
Station: 805 Elevation: 101.54 Northing: 0 Easting: 0

Benchmark Setup Data:
Elevation: Backsight:

Bankfull Elevation Override:

Linked Cross Section: --none--

Vertical Bank Profile Data:

Horizontal	Vertical	Note
0	0	TTPIN
0	-1.23	GTPIN
2	-0.57	TOE
2.14	-0.05	BPIN 1
2.24	0.3	UNDERCUT
2.34	0.4	UNDERCUT
2.43	0.9	UNDERCUT
2.43	1.52	BPIN 2
2.33	2	UNDERCUT
2.24	2.52	UNDERCUT
1.92	2.66	SLP BRK
1.81	2.97	BKF
1.75	3.19	SLP BRK
1.93	3.4	RTOB/BPIN 3
2.57	3.66	GS
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Bank Pin Information:

Name	Horiz	Vert	Length	Note
BPIN 1	2.14	-0.05	3	
BPIN 2	2.43	1.52	3	
BPIN 3	1.75	3.19	3	

Summary:

Toe Pin Area: 11.10 square feet (used for erosion monitoring)
Bank Height: 3.95 feet
Avg. Bank Angle: 39.10 degrees