River Morphology and Applications
National Conservation Training Center
Shepherdstown, WV
04/15/2013 - 04/19/2013

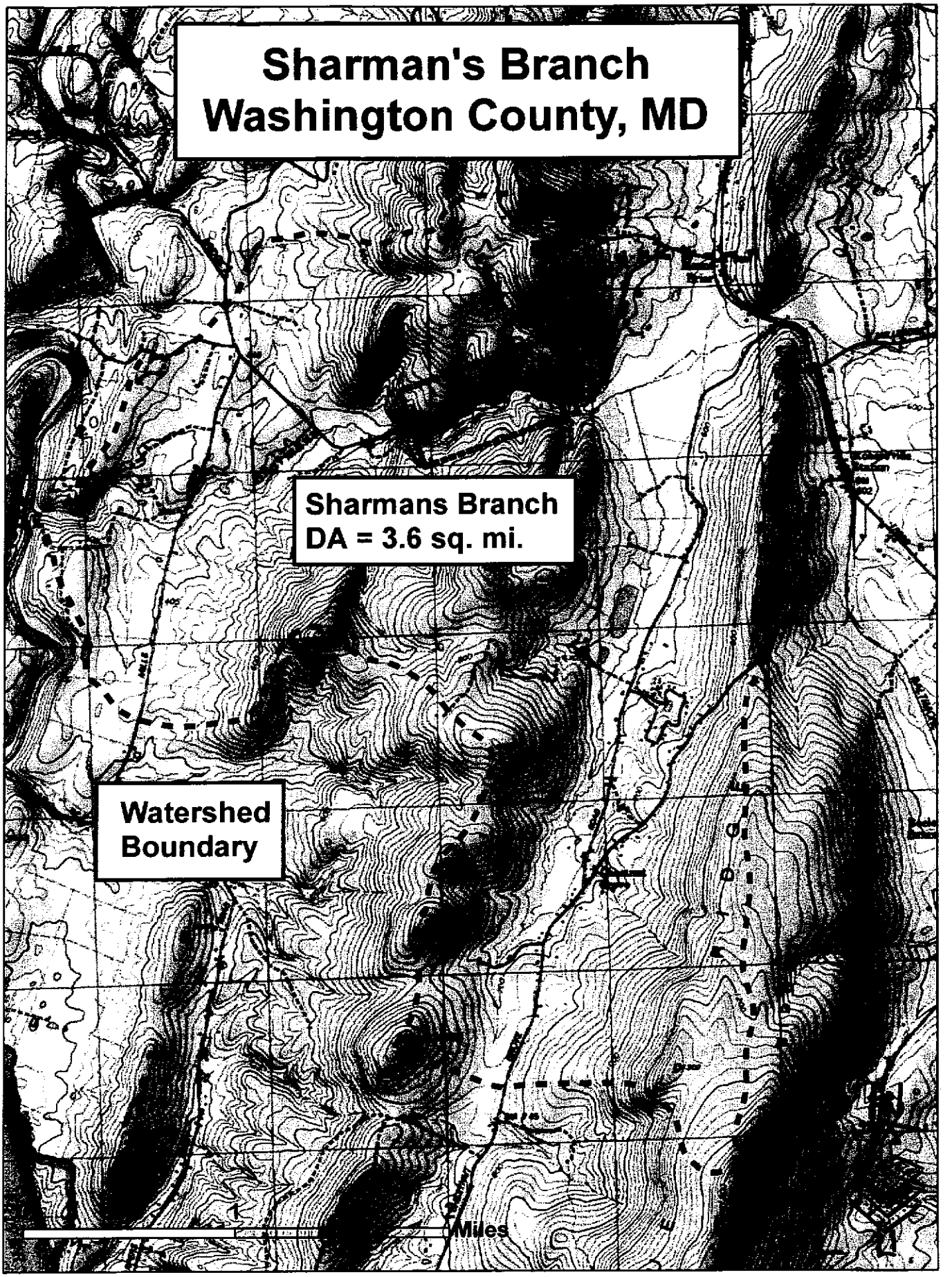
Team 2 Breakout Room 153-IW

John Braico LP
Michael Elander PC
Alana Hartman ~~EP MAP~~ LP
Phillip Herzig ~~EP~~ PC CS
Athey Lutz ~~EP~~ MaP
Michael McGrath MaP
Avi Sareen CS
Jack Vandensype CS
Margaret Wright PC
Leah Szafranski CS

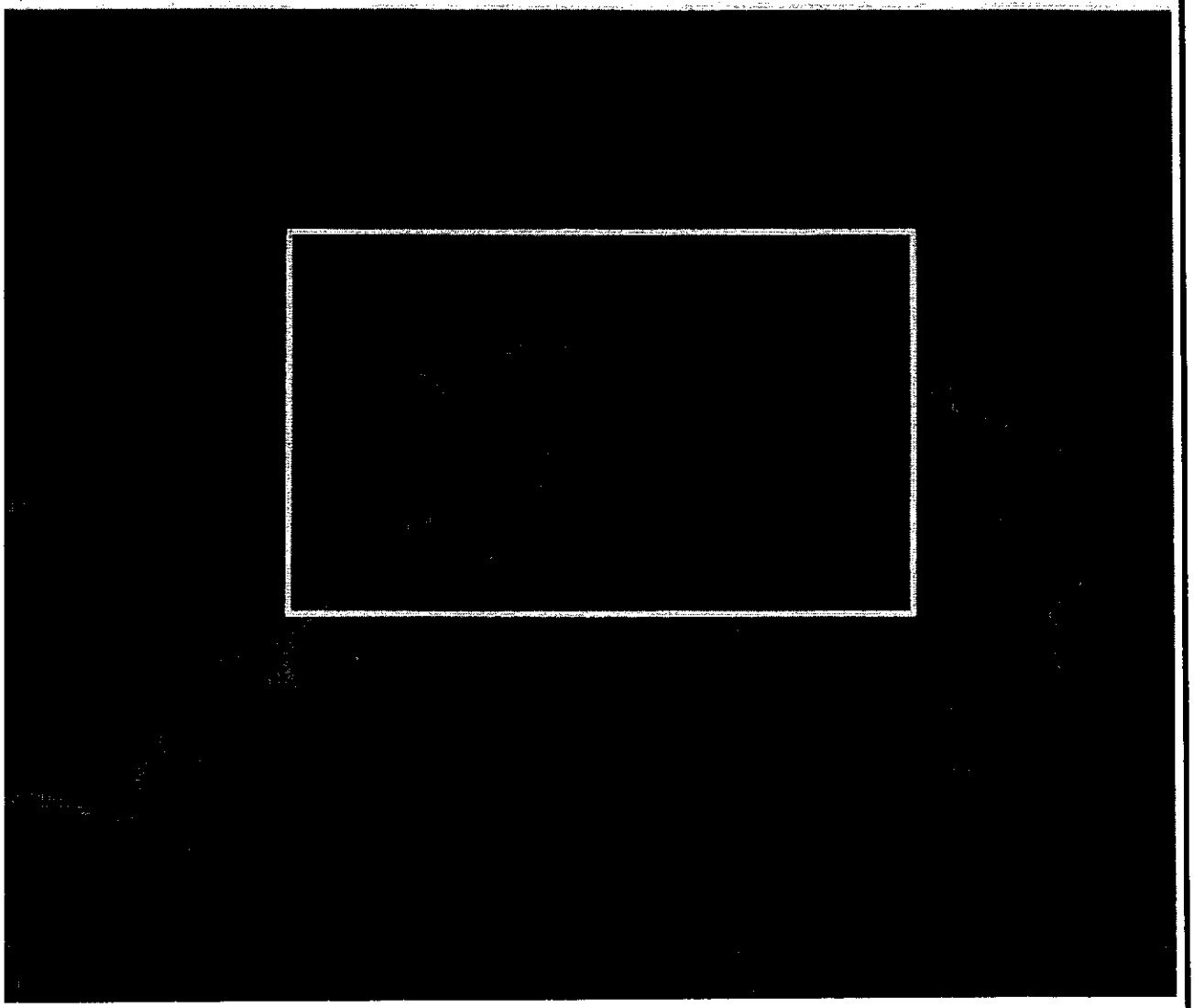
Each team is responsible for identifying a **FOLDER HOLDER** and an **EQUIPMENT PERSON.**

The **FOLDER HOLDER** on each team will be responsible for collecting photo copies of raw data from field books, cross sections, longitudinal profiles, pebble counts, bank profiles and photo copies of all completed forms and finalized plots, making sure they are inserted into the appropriate team field folder, and providing the team folder to the field instructor after they present the data to the class.

The **EQUIPMENT PERSON** will be responsible for ensuring that the team's field equipment is accounted for and back on the bus at the end of each field day. Each team will have an equipment list in their team bag that the EQUIPMENT PERSON can use to inventory the field equipment.


Sharman's Branch
Washington County, MD
Sharmans Branch
DA = 3.6 sq. mi.
Watershed
Boundary
1
2
Miles

Sharman's Branch
Washington County, MD



300 0 300 600 900 Feet

N
W E
S

First Field Exercise: Reference Reach Site

Overview and General Instructions

Objectives

- Reinforce the geomorphic principles discussed in lecture through field application
- Practice applying the Rosgen Stream Classification System in the field
- Practice field determination of bankfull stage

Scope of Exercise

The class will travel to a local stream and collect the basic morphological parameters necessary for stream classification (**Figure B-1**) and stream morphology of a reference reach, including dimensions, pattern, profile and channel materials. The class will be divided into four teams, and each team will be assigned a short stream reach. Your team will be divided into several crews. Each crew will gather a portion of the morphological data and site information required from your reach. By the end of the field session, your team will be able to determine the stream type for your assigned reach. Several forms must be completed using the data you collect in the field. Review the forms before you go to the field so you are familiar with the data requirements (**Worksheet B-1**, **Worksheet B-2** and **Worksheet B-3**). Review the morphological parameters discussed below prior to the exercise.

Field Instructions

1. Perform a toothpick survey with your entire team. Walk your designated reach and look for consistent bankfull indicators and a representative riffle for your stream classification cross-section (see **Figure B-5** for guidelines on selecting a cross-section and **Page B20** for a discussion on identifying bankfull). Estimate the variables in **Table B-1**.
2. As a group, select representative riffle, pool, run and glide cross-sections to survey and select the bankfull elevation at each cross-section. The stream must be free to adjust its boundaries at the riffle cross-sections. More than one cross-section for each bed feature must be measured to obtain a range of values. Note that run and glide bed features may not be present in certain stream types (confirm with Dave the number of cross-sections you need to survey).
3. Divide your team into four crews:
   - Cross-Section Crew (**Page B25**)
   - Longitudinal Profile Crew (**Page B65**)
   - Pebble Count Crew (**Page B91**)
   - Geometry & Sketch Map Crew (**Page B107**)
4. Turn to the appropriate page in *Section A* for instructions for your crew's task.
5. Complete the *Checklist for First Field Day Tasks* (**Page B2**).
6. Combine all team folder items and give folder to Dave.

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Checklist for *First Field Day* Tasks

- ☐ Sketch Map (be sure to include items listed in **Table B-14**, including cross-section locations, meander geometry, stationing and valley cross-section) (**Page B109**)
- ☐ Riffle Cross-Sections: Select (2) *representative* riffles & survey (**Page B25**)
  - ☐ Plot each cross-section and determine bankfull width, bankfull cross-sectional area, bankfull mean depth and bankfull maximum depth (**Page B32**)
  - ☐ Entrenchment ratio: Measure flood-prone area width (**Page B29**)
- ☐ Pool Cross-Sections: Select (2) *representative* pools & survey (**Page B25**)
  - ☐ Measure point bar slope (**Page B30**)
- ☐ Run Cross-Sections: Select (2) *representative* runs & survey (if in a Riffle-Pool system)
- ☐ Glide Cross-Sections: Select (2) *representative* glides & survey (if in a Riffle-Pool system)
- ☐ Longitudinal Profile (through your entire reach) (**Page B65**)
  - ☐ Measure thalweg, water surface, bankfull and lowest bank height (if higher than bankfull)
  - ☐ Note type of feature at each survey point (start riffle, pool, glide, run, etc.)
  - ☐ Tie profile to cross-section in elevation and note the location and the bankfull elevation of the cross-section on the profile
  - ☐ Measure water surface facet slopes and max depth measurements from plotted longitudinal profile
- ☐ Representative Pebble Count for Stream Classification (**Page B93**)
- ☐ Active Bed Riffle Pebble Count for Hydraulic Computations (**Page B93**)
- ☐ Sinuosity (k) (**Page B113**)
- ☐ Linear Wavelength (λ), Stream Meander Length (L_m), Belt Width (W_{blt}), Radius of Curvature (R_c), and Arc Length (L_a): Obtain min., max. and mean values (**Page B113**)
- ☐ Riffle Length (L_r), Pool Length (L_p), and Pool-to-Pool Spacing (P_s) measured from plotted longitudinal profile: Obtain min., max. and mean values (**Page B117**)

Worksheets

- ☐ Stream Classification Form: (**Worksheet B-1, Page B12**)
- ☐ Velocity Computation Form: (**Worksheet B-2, Page B13**)
- ☐ Morphological Relations & Dimensionless Ratios Form (**Worksheet B-3, Pages B14–B15**)

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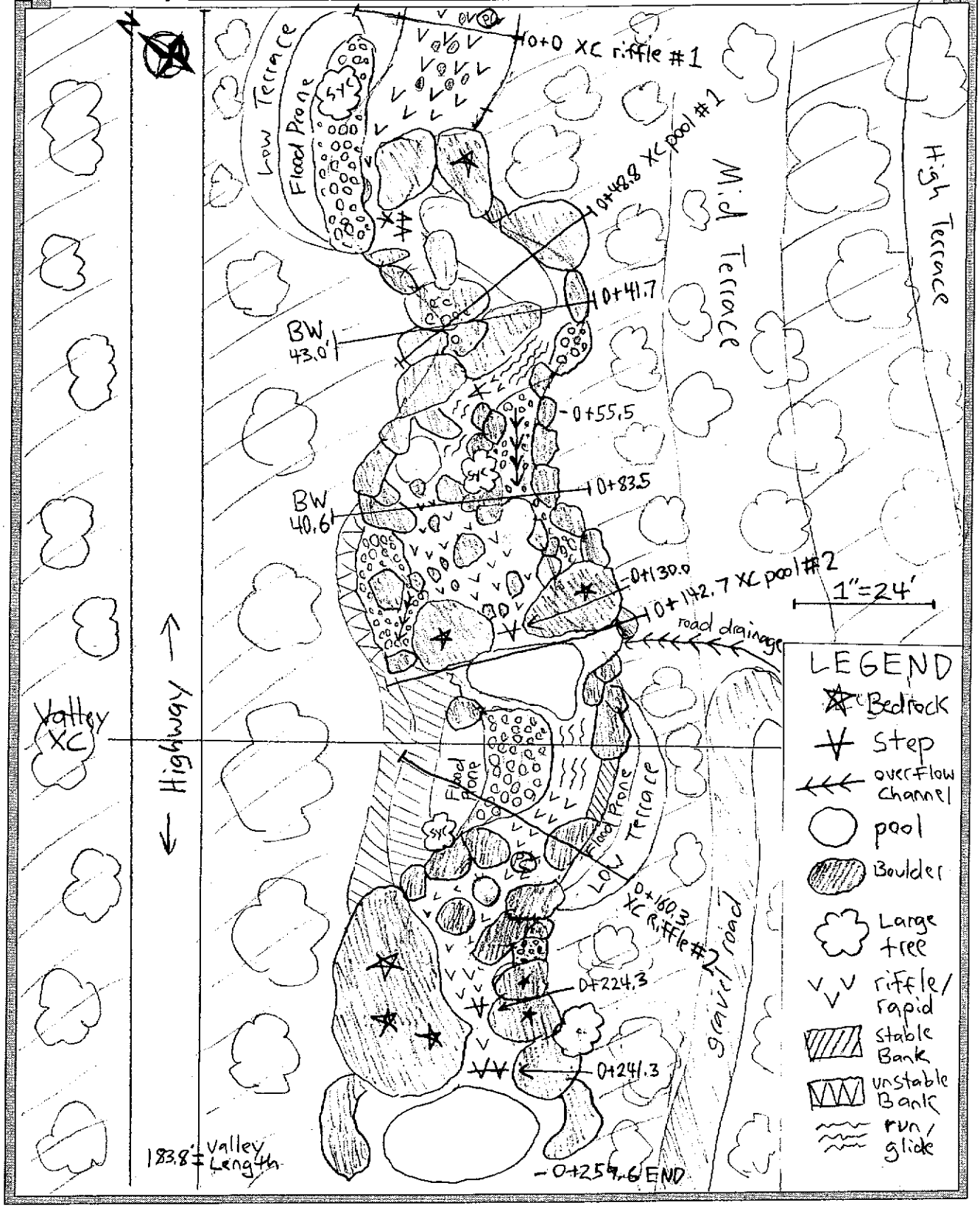
AREA-SITE LOCATION....REACH MAP

Stream: Charmins Branch Reach: Team #2

Drawn By: Team #2, AL Date: 4/16/2013



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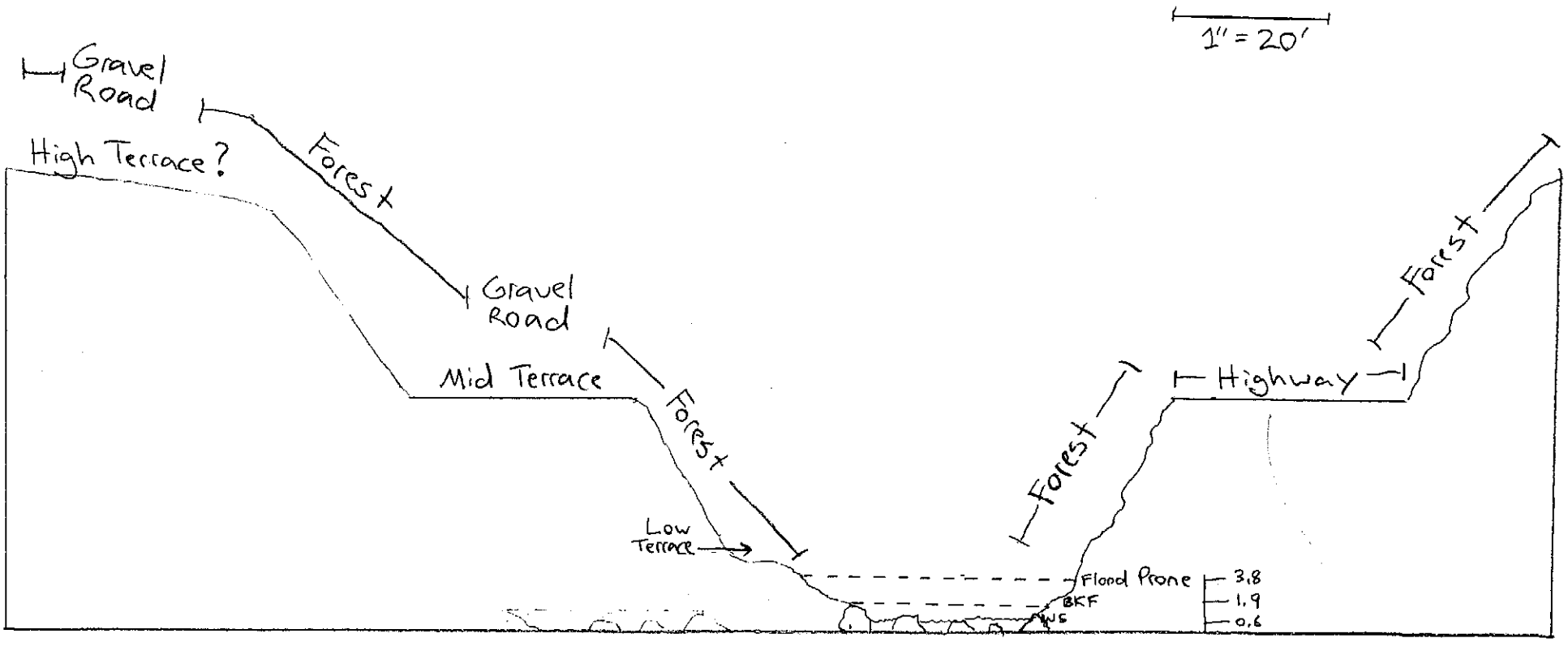
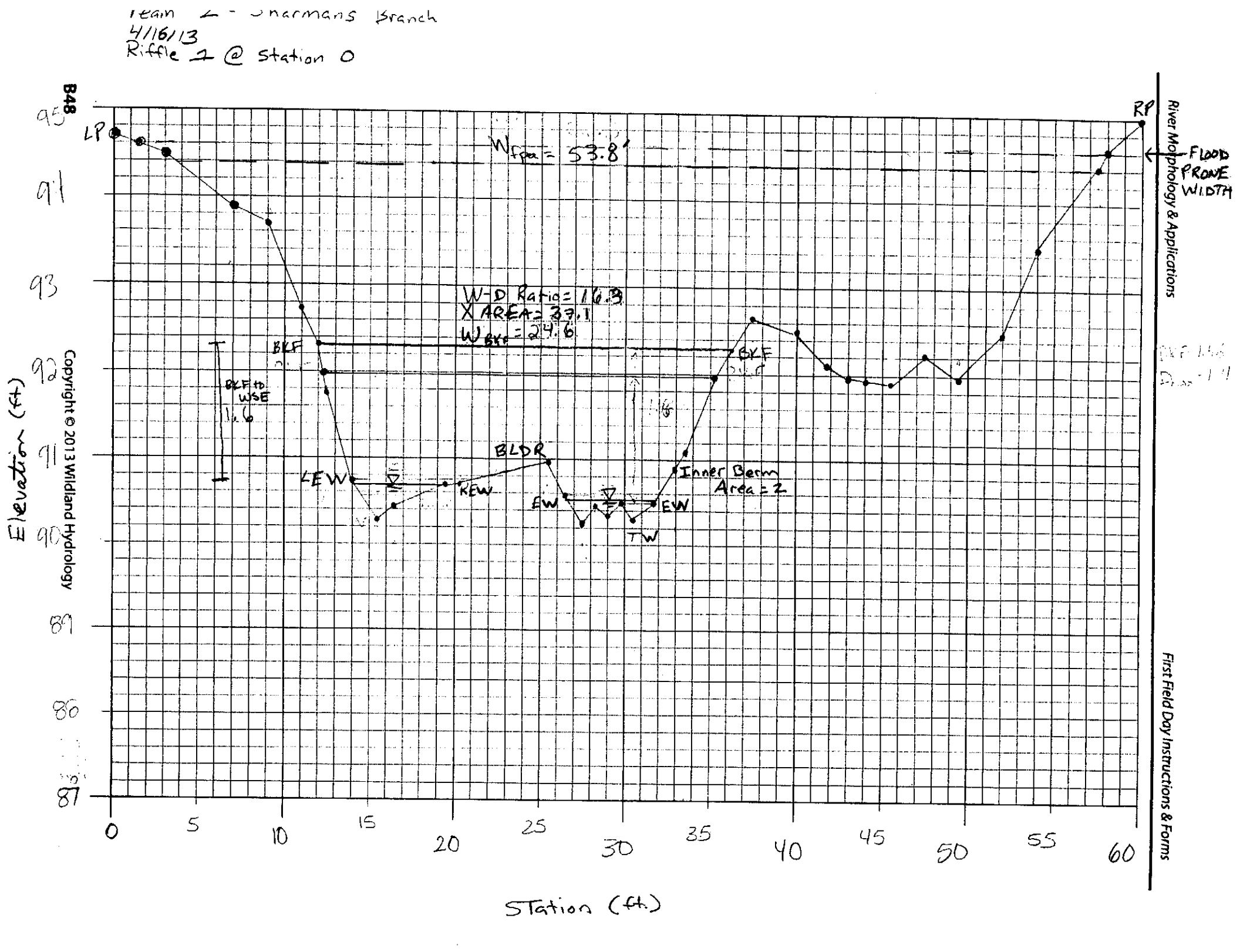
Charmins Branch Valley XC, Team 2

11/16/2013



Team 2 - Sharmans Branch
4/16/13
Riffle 1 @ Station 0



SURVEY DATA → CROSS-SECTION 8

SITE: Sharman's Branch Riffle Cross Section STA 0+00 Date: 4/16/13

Item	STATION ft	STATION ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
1	29 G.S.	0.0	5.31		94.69	
2	30 GS	0+03	5.52		94.48	
3	31 GS	0+07	6.14		93.86	
4	32 SB	0+09	6.31		93.69	Edge of slope
5	33 GS	0+11	7.25		92.75	Slope
6	~~34 S~~	~~0+12.5~~	~~8.33~~		~~91.77~~	~~BANKFULL~~
7	35 LEOW	0+14	9.27		90.73	Edge of water
8	36 BPF	0+15.5	9.72		90.28	Pool feature (Bottom)
9	37 TPF	0+16.5	9.55		~~90.45~~	Top of Pool feature
10	38 S	0+12	7.65		92.35	BANKFULL
11	39 CREOW	0+19.5	9.28		90.72	Break in Stream Gravel
12	40 TOBAR	0+20.3	9.28		90.72	Gravel Bar
13	41 TOBAR	0+25.5	9.06		90.94	Gravel Bar
14	42 CLEOW	0+26.6	9.42		90.58	Center Left EOW
15	43 BC	0+27.5	9.74		90.26	Bottom of Channel TW
16	44 TBFR	0+28.3	9.53		90.47	Top of Rock
17	45 TBFR	0+29	9.64		90.36	Top of Rock
18	46 EBFR	0+29.8	9.52		90.48	Edge of Rock
19	47 BOTC	0+30.4	9.68		90.32	Bottom of Channel
20	48 REOW	+31.8	9.49		90.51	Right Edge of Water
21	49	+32.9	9.11		90.89	Middle of depositional feature
22	50	+33.6	8.89		91.11	Back of depositional feature
23	51 RBF	+35.3	~~7.87~~	8.03	91.97	~~Bankfull~~
24	52	+37.7	~~7.51~~	7.36	92.64	Top of slope
25	53	+40.2	~~7.53~~	7.52	92.48	Back of slope
26	54	+46.8	~~7.~~	7.89	92.11	Break in slope
27	55	+...	~~7.~~			Run slope
28	56	+43.0	~~8.~~	8.03	91.97	edge of flood chute
29	57	+44.0	~~8.~~	8.05	91.95	Bottom of flood chute
30	58	+45.5	~~8.~~	8.12	91.88	Bottom of flood channel
31	59	+47.5	~~7.~~	7.72	92.28	Top of FC bar

1.16 = diff. in crosshairs

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SURVEY DATA → CROSS-SECTION 6

SITE: Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29		+49.6	~~5.12~~	8.01	91.99	edge of terrace
30		+52.0	~~7.50~~	7.52	92.48	1/3 way up slope
31		+55.0	~~6.55~~	6.55	93.45	1/2 way up slope
32		+58.0	~~5.52~~	5.40	94.60	Top of slope
33		+59.6	~~5.15~~	5.00	95.00	Top of Terrace
34		+62.0	~~5.14~~	5.04	94.96	Top of Terrace
~~35~~		+57.6		5.56		FLOOD PRONE ELEVATION
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48				3-0		
49				94.48-94.69	= 14.29	
50						
51				3-X		
52				94.48-94.44		
53				104		
54						
55						
56						
57						
58						
59						

1.45
1.62

1.96

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-20.8 102.4 TW
102.9 WS 104.36 BKF, 104.94 LBH

SHARMON BRANCH

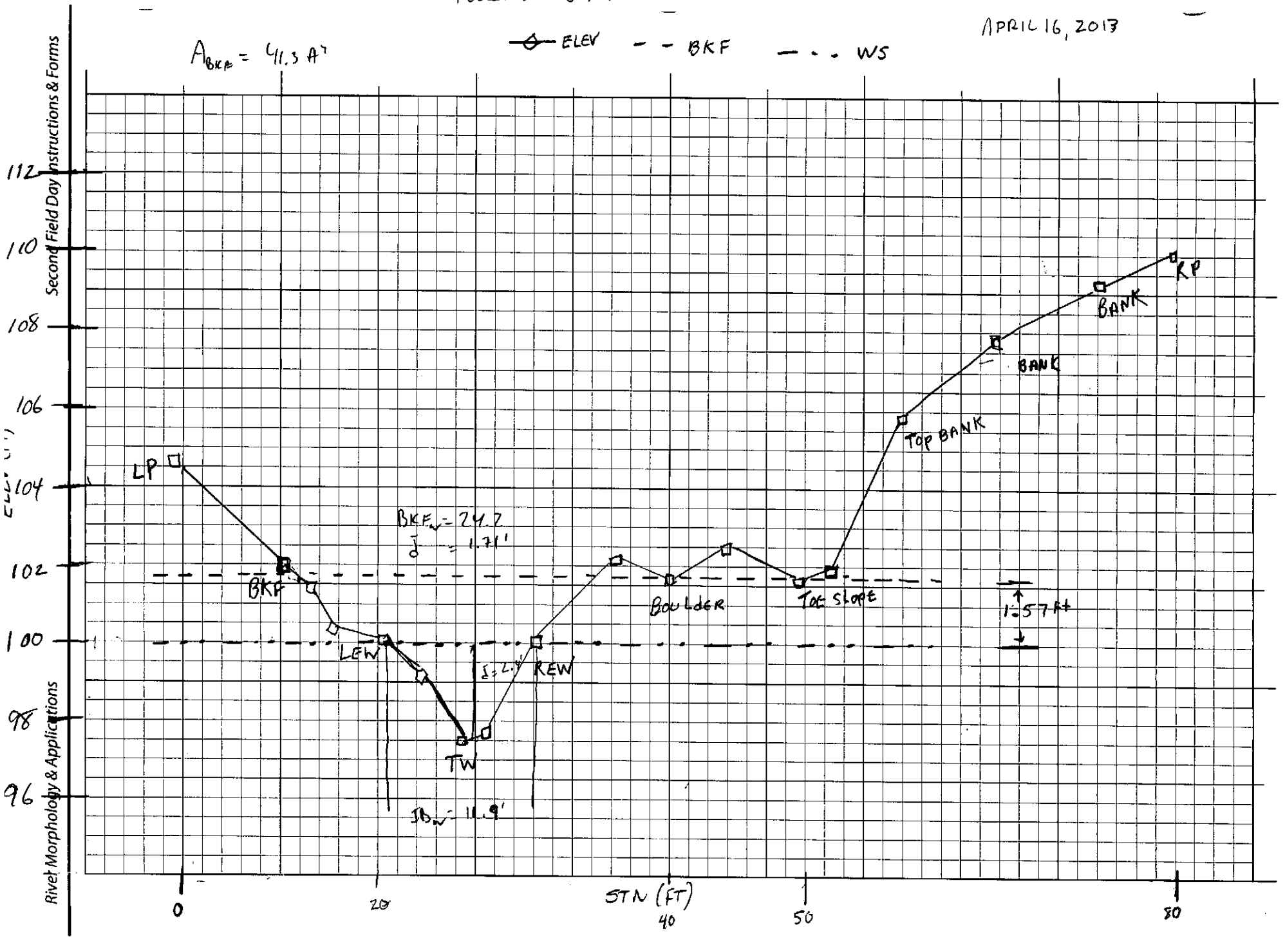
POOL 1 - LP STA: 42.8

TEAM 2

APRIL 16, 2013

A_{BKF} = 41.3 ft²

ELEV — — BKF — · — WS



Second Field Day Instructions & Forms

Rivet Morphology & Applications

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SURVEY DATA → **CROSS-SECTION 1**

SITE: Loop 2 Date: 4/16/2013

Location: Pool LP Stn = 22 Bm = top of Rock = 100

Party / Notes: JACK V. / PHIL HUC: _____

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	REMARKS / COMMENTS / NOTES
1	0	12.29	112.29	[redacted]	104.54	LP (7.75)
2	[redacted]			[redacted]	101.48	BKF (10.81)
3	5			11.86	100.43	Bottom BKF = Bench
4	[redacted]			12.10	100.19	LEW
5	[redacted]			12.91	99.38	CB
6	[redacted]			[redacted]	97.75	CB (14.54)
7	[redacted]			14.33	97.96	TW
8	[redacted]			[redacted]	[redacted]	[redacted]
9	[redacted]			10.13	102.16	Rock / Boulder
10	39.6			10.68	101.68	Boulder
11	44.2			9.79	102.5	Boulder
12	50.			10.71	101.58	Boulder Stn = 50
13	[redacted]			10.35	101.94	Toe of Slope Stn = 52.7
14	Stn 58.2	10.28	110.28	4.65	105.63	Top of Bank Stn 58.2 = New HI
15	65.6			2.85	107.43	Bank
16	74.1			1.43	108.85	Bank
17	79.5			0.73	109.55	RP
18	26.7			10.15	100.13	REW
19						
20	9.8			8.52	101.76	BKF 101.76 - 101.19 = 1.57
21				[redacted]	[redacted]	[redacted]
22						
23						
24						
25						
26						
27						
28						

11
12.8
16.8
19.9
23
25
28.7
35.4

1.3 = BKF - WS

10.15

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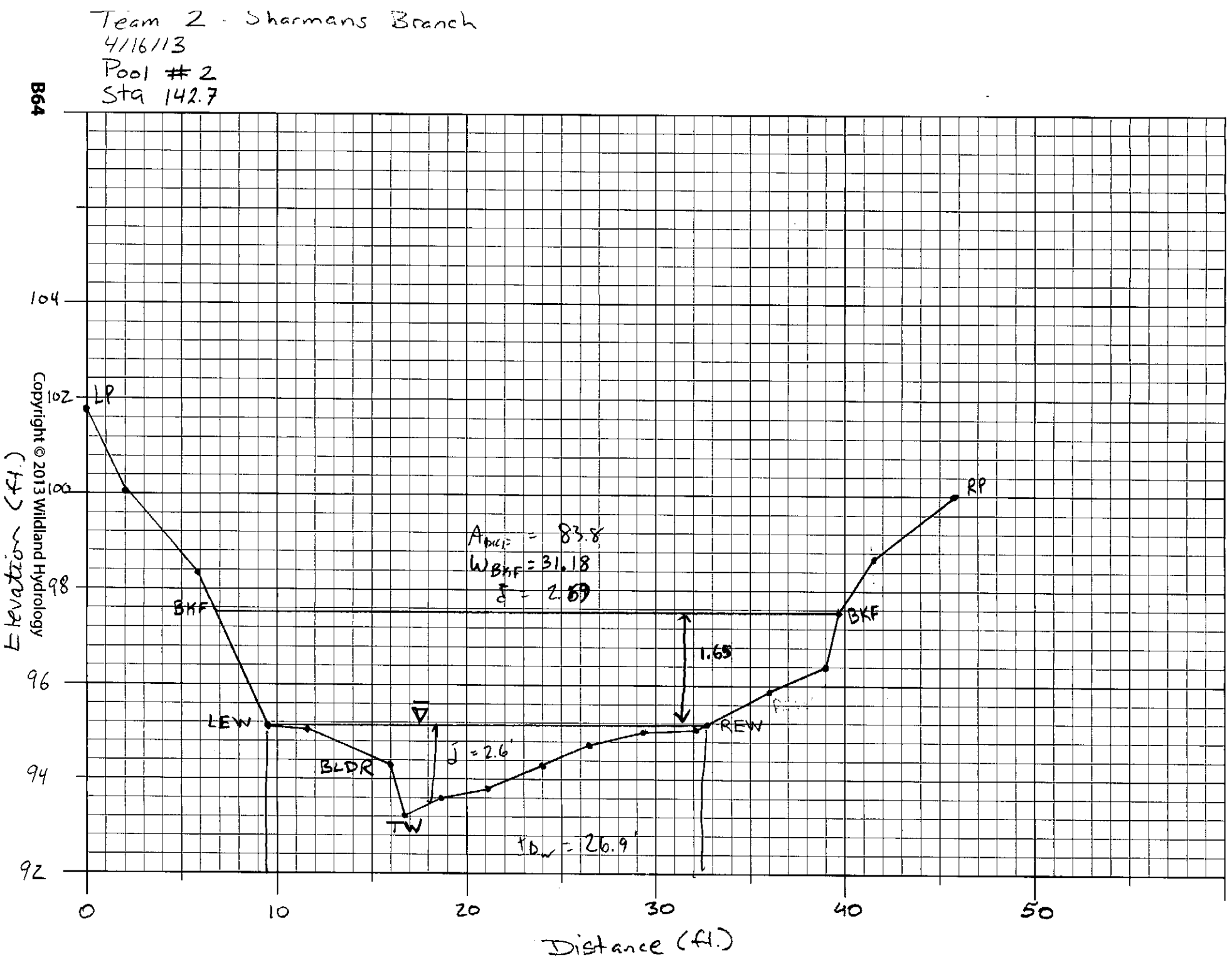
Team 2 - Sharmans Branch
4/16/13
Pool #2
Sta 142.7



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SURVEY DATA → CROSS - SECTION 2

SITE: Pool LP Stn = 142 **Date:** 4/16/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	45.8	4.04	104.09	0.31	103.73	RP
30	41.6			5.31	98.73	Bankl Slope
31	39.8			6.57	97.47	BKF
32	39			7.66	96.38	Bankl
33	36.1			8.22	95.82	REW
34	32.2			9.01	95.03	CB
35	29.3			9.10	94.94	CB
36	26.4			9.30	94.74	CB
37	24.0			9.81	94.23	CB
38	21.2			10.35	93.69	CB
39	18.8			10.64	93.4	CB
40	16.7			10.84	93.2	CB TW
41	16.0			9.68	94.36	CB
42	11.8			8.73	95.31	CB
43	9.2			8.60	95.44	LEW Backwater behind large rock
44	5.8			5.75	98.29	mid slope
45	1.9			3.93	100.11	mid slope
46	0			2.26	101.78	left Pin LP
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

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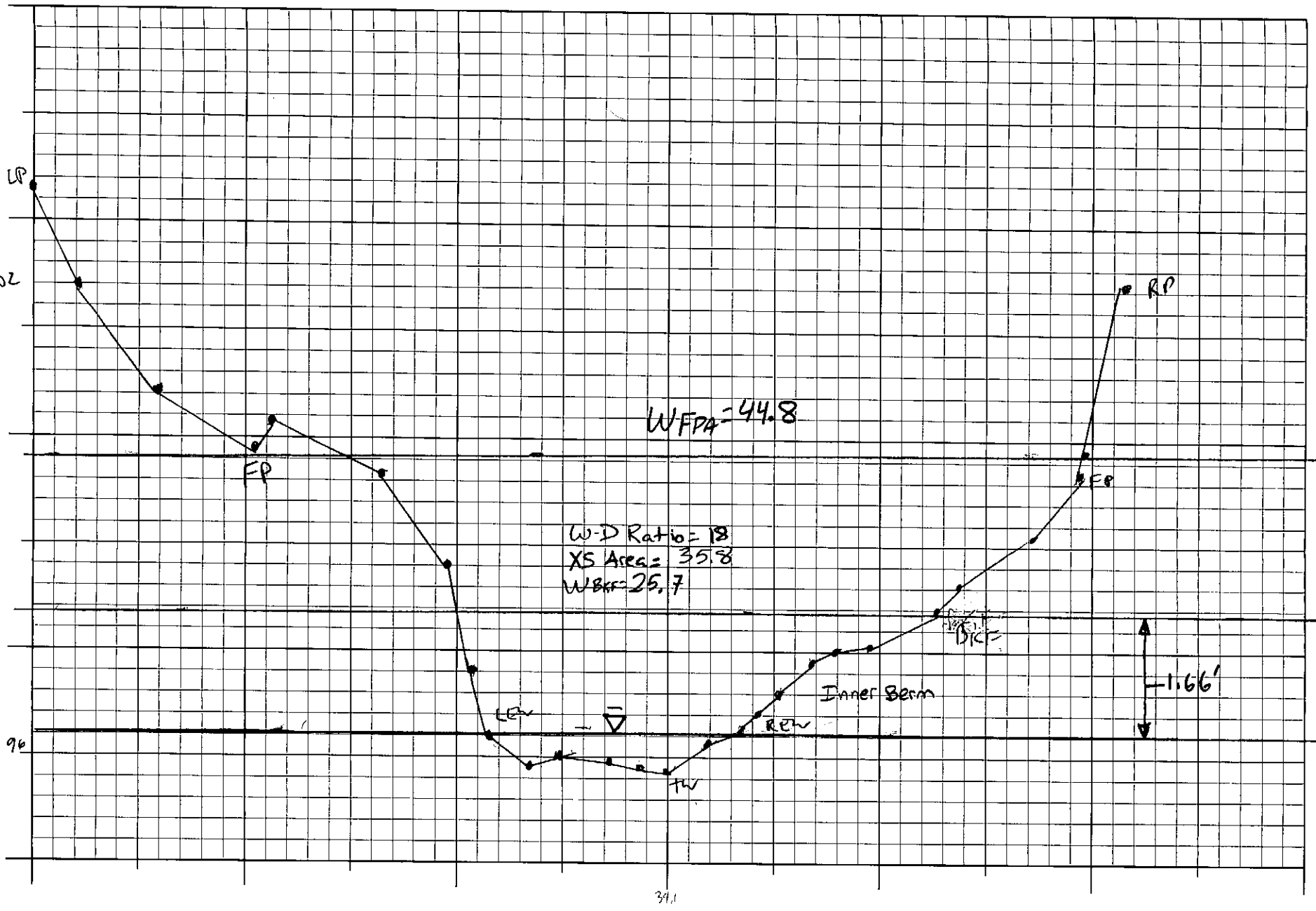
Team 2
Sharman's Branch
4/16/13

Riffle - CP Stn: 162



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SURVEY DATA → **CROSS-SECTION 4**

SITE: Riffle (Representative) LP Stn = 162 **Date:** 4/16/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
~~29~~	58.9	3.80	103.8	1.71	102.09	RP
30	56.4			4.35	99.45	Toe of Slope
31	53.8			5.25	98.55	Bank
32	49.9			5.96	97.84	"High" BKF Δ = 1.99
33	48.7			6.29	97.51	"Low" BKF (Δ = 1.66)
34	45			6.79	97.01	Inner Berm
35	43.3			6.86	96.94	Inner Berm (Top)
36	42			7.01	96.79	" (Top)
37	40.3			7.44	96.36	" (Mid)
38	39.1			7.73	96.07	"
39	38.2			7.95	95.85	REW
40	36.4			8.16	95.64	CB
41	34.1			8.50	95.30	~~CB~~ (TW)
42	32.6			8.47	95.33	CB
43	31			8.42	95.38	CB
44	28.5			8.33	95.47	CB
45	26.7			8.46	95.34	CB
46	24.8			8.08	95.74	LEW
47	23.9			7.13	96.67	Boulder
48	22.6			5.66	98.14	Top of Bank
49	18.9			4.35	99.45	Bank
50	13			3.69	100.11	Bank
51	7.1			3.24	100.56	Bank
52	2.7	↓	↓	1.83	101.97	Bank
53	0	4.04	104.04	0.69	103.35	LP New HI
54						
55	12.3		104.04	4.32	99.72	
56	57.1		↓	4.32	99.72	FP_W = 44.8
57						
58						
59						

1.63

0.33

0.11

FP_W = 2 × (BKF − TW) = 4.42

LEL = 99.72

104.04 − 99.72 = R.E.: 4.32

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SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Sharman's Branch, Group#2 Date: 4/16/13

Location:

Party / Notes: John Braico, mike mcGrath, Alana Hartman HUC:

	Distance, Point, or	Back-Sight	Height of Instrument	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	e.g. Riffle Run Pool Glide
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
1	BM	9.56	109.56									
2	0		109.56	7.18	102.38	6.66	102.9	5.20	104.36	4.62	104.94	rapid XS
3	20.8		109.56	8.45	101.11	7.62	101.94	5.99	5.2	5.65	4.62	step
4	44		109.56	9.83	99.73	9.36	100.2					pool
5	49.1		109.56	11.70	97.86	9.46	100.1	7.89	101.67	6.69	102.87	pool XS (42.8")
6	49.7		109.56	10.78	98.78	9.46	100.1					glide
7	52.8		109.56	9.81	99.75	9.51	100.05					rapid
8	60.3		109.56	10.69	98.87	10.23	99.33					pool
9	75.8		109.56	11.82	97.74	10.31	99.25	9.31	100.25			
10	80.8		109.56	11.19	98.37	10.35	99.21					glide
11	93.8		109.56	10.66	98.9	10.38	99.18					rapid
12	114.3		109.56	11.60	97.96	11.37	98.19					
13	123.3		109.56	11.92	97.64	11.72	97.84	10.48	99.08	6.89	102.67	
14	129.8		109.56	12.42	97.14	12.04	97.52					step
15	131.8		109.56	14.94	94.62	13.41	96.15					pool
16	135.8		109.56	16.21	93.35	13.38	96.18					
17	149.3		109.56	15.44	94.12	13.44	96.12					glide ← XS pool "142.8"
18	158.6		109.56	13.72	95.84	13.45	96.11					rapid
19	160.6		109.56	14.07	95.49	13.45	96.11	11.82	97.74			XS "162.8"
20	187.6		109.56	14.32	95.24	13.75	95.81	11.87	97.69	11.09	98.47	
21	203.6		109.56	14.88	94.68	13.96	95.6					
22	209.6		109.56	14.45	95.11	13.94	95.62	12.38	97.18	12.01	97.55	
23	220.6		109.56	14.60	94.96	14.65	95.46					step
24	221.6		109.56	15.71	93.85	15.11	94.45					bottom of step
25	231.6		109.56	15.73	93.83	15.26	94.3					
26	240.6		109.56	18.19	91.37	15.73	93.83					pool
27	243.6		109.56	18.4	91.16	15.7	93.86					

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SURVEY DATA → LONGITUDINAL PROFILE-2

SITE: Sharman's Branch, Group #2 Date: 4/16/13

Location:

Party / Notes: John Braico, Mike McGrath, Alana Hartman HUC: _ _ _ _ _ _ _ _ _ _ _ _

	Distance, Point, or	Back-Sight	Height of Instru-ment	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	e.g. Riffle Run Pool Glide
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
28	259.6		109.56	16.14	93.42	15.77	93.79	14.28	95.28			
29												
30												
31												
32												
33												
34												
35												
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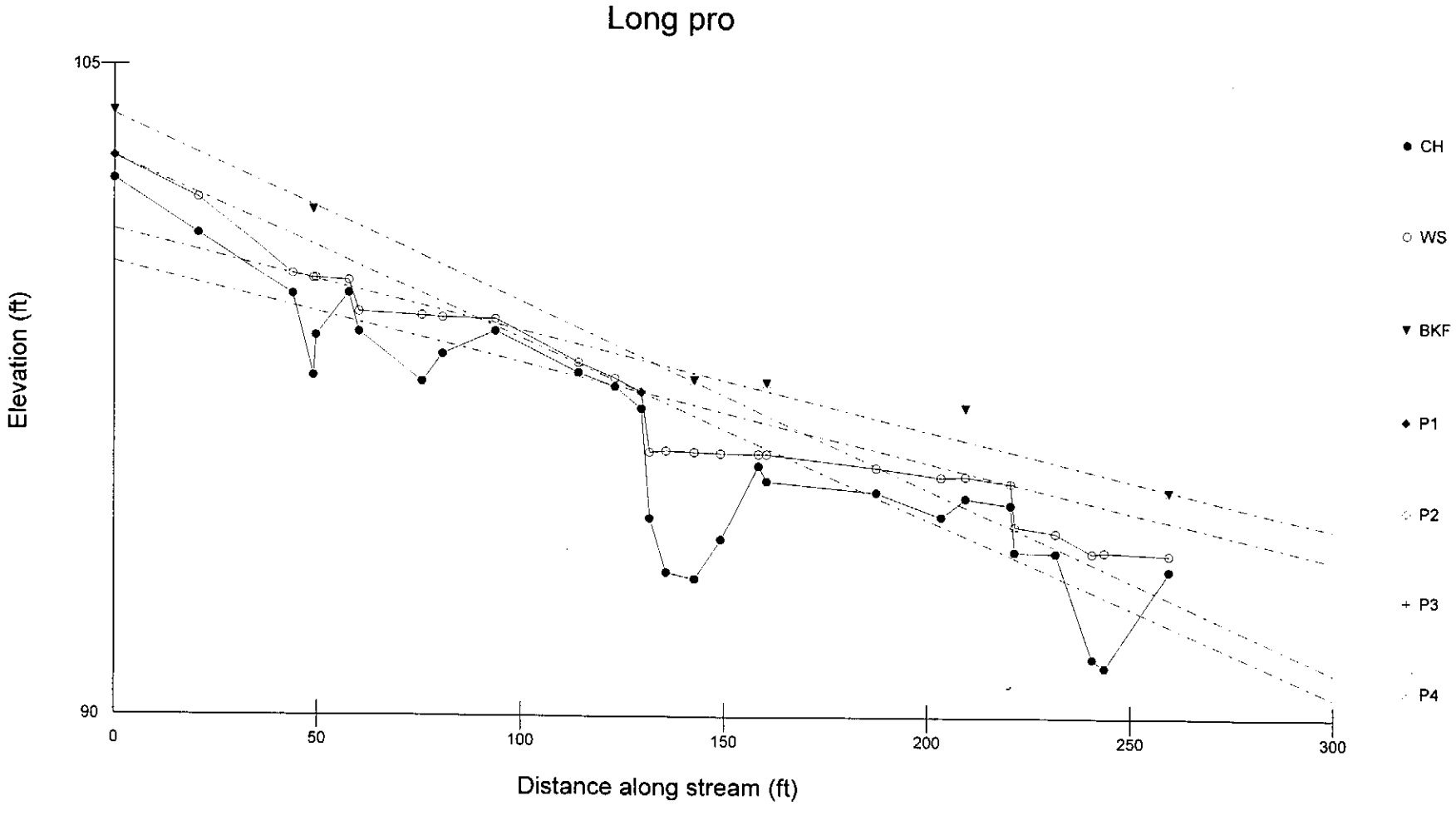
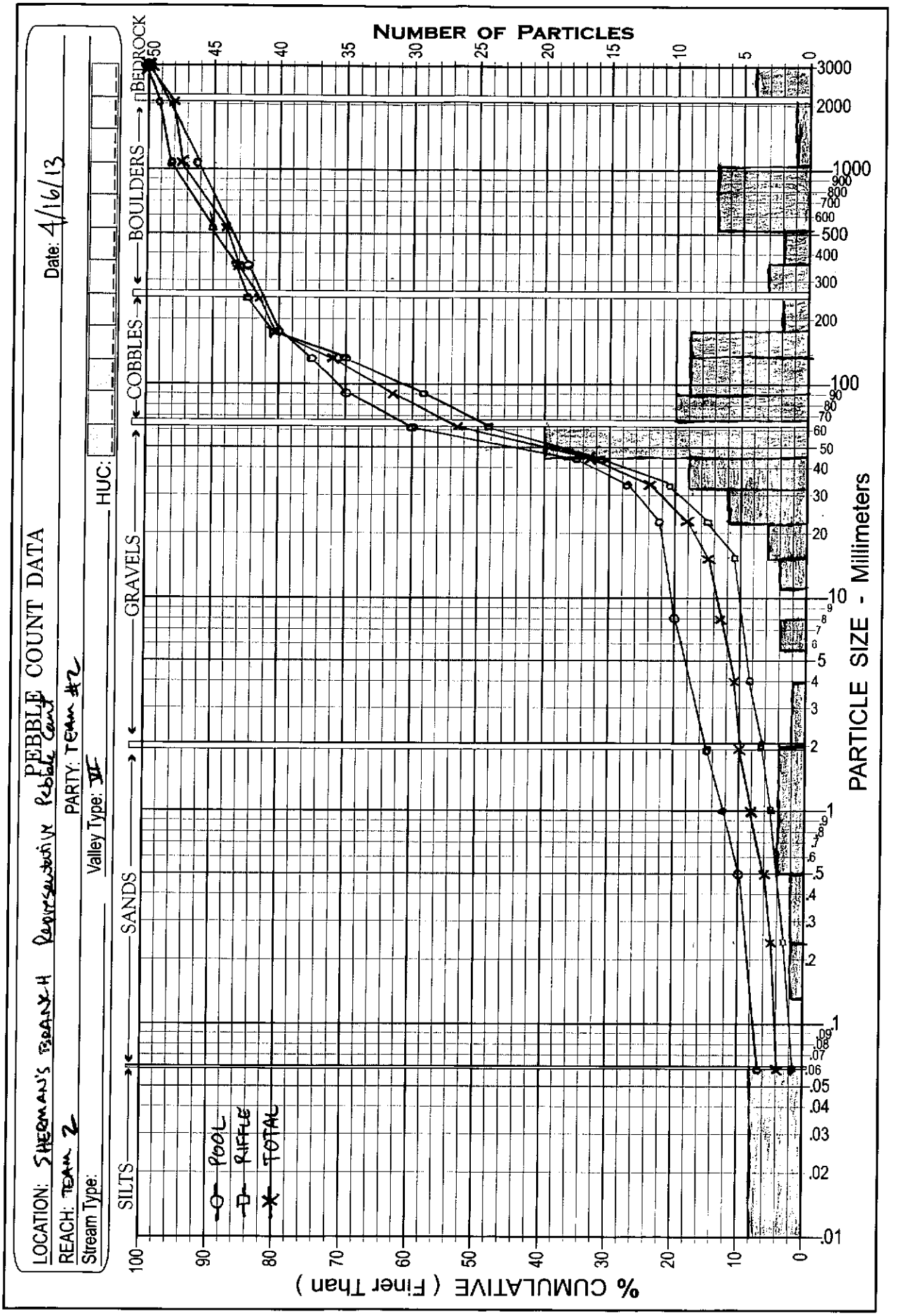
Sharman's Branch
Reach 2
04/16/13





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Representative Pebble Count

Site: Sherman's Branch Date:

Location: HUC:

Party: Team #2

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	RIFFLE (1) ITEM %	RIFFLE (1) % CUM	POOL (2) TOT #	POOL (2) ITEM %	POOL (2) % CUM	COMPOSITE (3) TOT #	COMPOSITE (3) ITEM %	COMPOSITE (3) % CUM
							Reach:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C				1	1.67	1.67	3	7.50	7.50	4	4	4
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25					1	1.67	3.34				1	1	5
	Medium	.25 - .50								1	2.50	10.00	1	1	6
	Coarse	.50 - 1.0					1	1.67	5.01	1	2.50	12.50	2	2	8
.04 - .08	Very Coarse	1.0 - 2					1	1.67	6.68	1	2.50	15.00	2	2	10
.08 - .16	Very Fine	2 - 4	GRAVEL				1	1.67	8.35				1	1	11
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8								2	5.00	20.00	2	2	13
.31 - .44	Medium	8 - 11.3													
.44 - .63	Medium	11.3 - 16					2	3.33	11.68				2	2	15
.63 - .89	Coarse	16 - 22.6					2	3.33	15.01	1	2.50	22.50	3	3	18
.89 - 1.3	Coarse	22.6 - 32					4	6.67	21.68	2	5.00	27.50	6	6	24
1.3 - 1.8	Very Coarse	32 - 45					6	10.00	31.68	3	7.50	35.00	9	9	33
1.8 - 2.5	Very Coarse	45 - 64					10	16.67	48.35	10	25.00	60.00	20	20	53
2.5 - 3.5	Small	64 - 90	COBBLE				6	10.00	58.35	4	10.00	70.00	10	10	63
3.5 - 5.0	Small	90 - 128					7	11.67	70.02	2	5.00	75.00	9	9	72
5.0 - 7.1	Large	128 - 180					7	11.67	81.69	2	5.00	80.00	9	9	81
7.1 - 10.1	Large	180 - 256					2	3.33	85.02				2	2	83
10.1 - 14.3	Small	256 - 362	BOULDER				1	1.67	86.69	2	5.00	85.00	3	3	86
14.3 - 20	Small	362 - 512					2	3.33	90.02				2	2	88
20 - 40	Medium	512 - 1024					4	6.67	96.69	3	7.50	92.50	7	7	95
40 - 80	Large-Vry Large	1024 - 2048					1	1.67	98.36				1	1	96
	Bedrock		BDRK				1	1.67	100.03	3	7.50	100	4	4	100
Stream Type:			**Valley Type:**			TOTAL→	60	100.03	100.03	40	100	100	100	100	100

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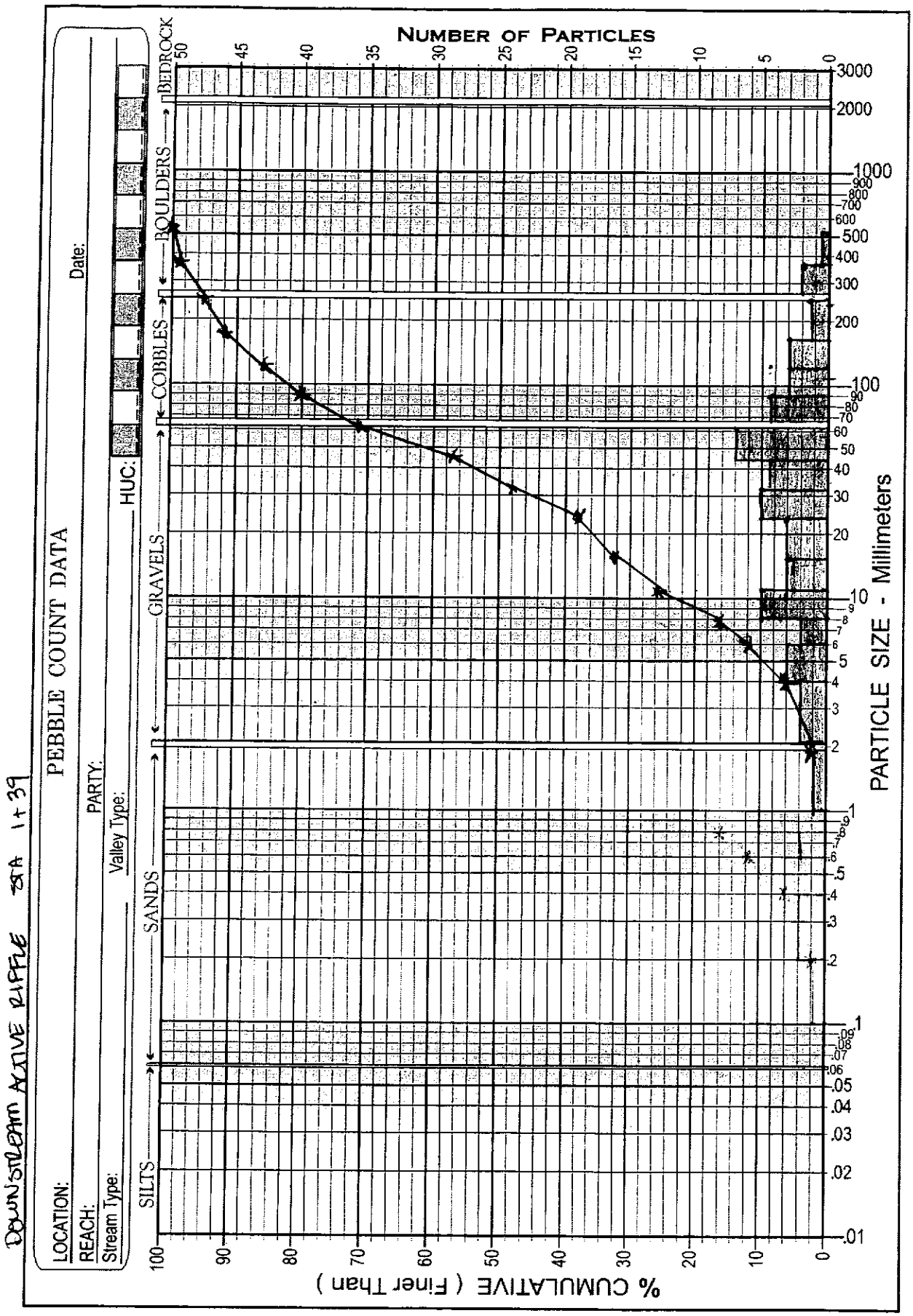
PEBBLE COUNT DATA
LOCATION:
REACH:
Stream Type:
Date:
PARTY:
Valley Type:
HUC:
NUMBER OF PARTICLES
BEDROCK
BOULDERS
COBBLES
GRAVELS
SANDS
SILTS
PARTICLE SIZE - Millimeters
% CUMULATIVE (Finer Than)

D.S. ACTIVE RIFFLE STA 1+38

Site: Sharman's Branch Date: 4/16/13

Location: HUC:

Party: Team #2

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: Date: TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND												
	Medium	.25 - .50	SAND												
	Coarse	.50 - 1.0	SAND												
.04 - .08	Very Coarse	1.0 - 2	SAND	2			2	2							
.08 - .16	Very Fine	2 - 4	GRAVEL	4			4	4	6						
.16 - .22	Fine	4 - 5.7	GRAVEL	6			6	6	12						
.22 - .31	Fine	5.7 - 8	GRAVEL	4			4	4	16						
.31 - .44	Medium	8 - 11.3	GRAVEL	10			10	10	26						
.44 - .63	Medium	11.3 - 16	GRAVEL	6			6	6	32						
.63 - .89	Coarse	16 - 22.6	GRAVEL	6			6	6	38						
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	10			10	10	48						
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	9			9	9	57						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	14			14	14	71						
2.5 - 3.5	Small	64 - 90	COBBLE	9			9	9	80						
3.5 - 5.0	Small	90 - 128	COBBLE	6			6	6	86						
5.0 - 7.1	Large	128 - 180	COBBLE	6			6	6	92						
7.1 - 10.1	Large	180 - 256	COBBLE	3			3	3	95						
10.1 - 14.3	Small	256 - 362	BOULDER	4			4	4	99						
14.3 - 20	Small	362 - 512	BOULDER	1			1	1	100						
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK												
Stream Type:				**Valley Type:**			TOTAL →								

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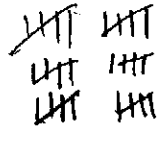

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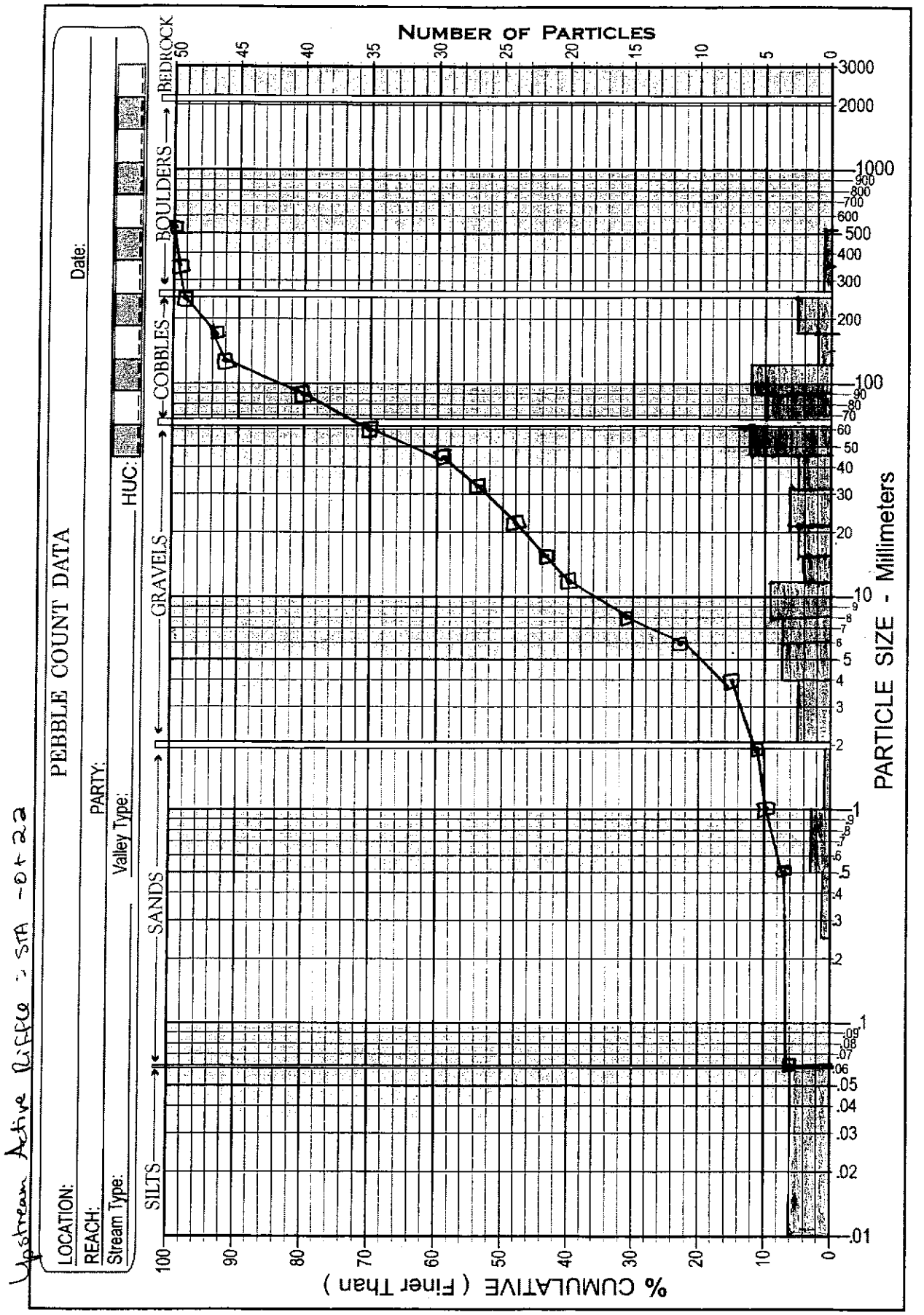

Upstream Active Riffle - STA -0+22

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Upstream Active Riffle STA -0+22

Site: Sharman's Branch Date:

Location: HUC:

Party: Team #2

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	RIFFLE (1) ITEM %	RIFFLE (1) % CUM	POOL (2) TOT #	POOL (2) ITEM %	POOL (2) % CUM	COMPOSITE (3) TOT #	COMPOSITE (3) ITEM %	COMPOSITE (3) % CUM
	Silt / Clay	< .062	S/C				6	5.77							
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50					1	0.96	6.73						
	Coarse	.50 - 1.0					3	2.88	9.61						
.04 - .08	Very Coarse	1.0 - 2					1	0.96	10.57						
.08 - .16	Very Fine	2 - 4	GRAVEL				5	4.81	15.38						
.16 - .22	Fine	4 - 5.7					8	7.69	23.07						
.22 - .31	Fine	5.7 - 8					8	7.69	30.76						
.31 - .44	Medium	8 - 11.3					9	8.65	39.41						
.44 - .63	Medium	11.3 - 16					4	3.85	43.26						
.63 - .89	Coarse	16 - 22.6					5	4.81	48.07						
.89 - 1.3	Coarse	22.6 - 32					6	5.77	53.84						
1.3 - 1.8	Very Coarse	32 - 45					5	4.81	58.65						
1.8 - 2.5	Very Coarse	45 - 64					12	11.54	70.19						
2.5 - 3.5	Small	64 - 90	COBBLE				10	9.62	79.81						
3.5 - 5.0	Small	90 - 128					12	11.54	91.35						
5.0 - 7.1	Large	128 - 180					2	1.92	93.27						
7.1 - 10.1	Large	180 - 256					5	4.81	98.08						
10.1 - 14.3	Small	256 - 362	BOULDER				1	0.96	99.04						
14.3 - 20	Small	362 - 512					1	0.96	100						
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			**Valley Type:**			TOTAL→	104	100	100						

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Worksheet B-1. Field Form for Level II Stream Classification (*First Field Day*).

Stream: SHARMAN'S BRANCH	
Basin:	Drainage Area: 2304 acres 3.6 mi^2
Location:	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/16/13
Observers: TEAM #2	Valley Type: VI

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	25.7	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.4	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	35.8	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	18	ft/ft
Maximum DEPTH (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.2	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.	44.8	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	1.7	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface, between the bankfull stage and Thalweg elevations.	59	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.	.035	ft/ft → INTEGRATED BETWEEN VARIABLE SLOPES.
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 (S_{val} / S).	1.3	

Stream Type [redacted] **See Classification Key (Figure B-2)**

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Worksheet B-2. Computations of velocity and discharge using various methods (*First Field Day*).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	SHARMAN'S BRANCH	Location:	
Date:	9/16/13	Stream Type:	B4a/2/1
Observers:	TEAM #2	Valley Type:	VI
		HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	35.8	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.4	d_{bkf} (ft)
Bankfull Riffle WIDTH	25.7	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	28.5	W_p (ft)
D_{84} at Riffle	110	Dia. (mm)	D_{84} (mm) / 304.8	0.36	D_{84} (ft)
Bankfull SLOPE	0.035	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.2	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	3.3	R / D_{84}
Drainage Area	3.6	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	1.2	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	6.9	ft / sec	247	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. B-34, B-35) $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.05	6.3	ft / sec	226	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. B-36) $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.058	5.4	ft / sec	193	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n = 0.39 * S^{0.38} * R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ 0.106	3.0	ft / sec	107	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	—	ft / sec	—	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	—	ft / sec	—	cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Discharge Q = ____ year	—	ft / sec	—	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	3.2	ft / sec	113	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure **"protrusion heights"** proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet B-3a. Morphological relations, including dimensionless ratios (*First Field Day*).

Stream: SHARMAN'S BRANCH | Location:

Observers: TEAM #2 | Date: 4/16/13 | Valley Type: VI | Stream Type: B4a/2/1

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios***	Mean	Min	Max
Riffle Width (W_{bkf})	—	25.7	25.7	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	—	35.8	35.8
Riffle Mean Depth (d_{bkf})	—	1.4	1.4	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	—	18	18
Riffle Maximum Depth (d_{max})	—	2.2	2.2	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	—	1.6	1.6
Width of Flood-Prone Area (W_{fpa})	—	44.8	44.8	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	—	1.7	1.7
Riffle Inner Berm Width (W_{ib})	—	13.4	13.4	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	—	0.52	0.52
Riffle Inner Berm Depth (d_{ib})	—	0.4	0.4	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	—	0.29	0.29
Riffle Inner Berm Area (A_{ib})	—	5.1	5.1	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	—	0.14	0.14
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	—	33.5	33.5					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios***	Mean	Min	Max
Pool Width (W_{bkfp})	—	31.2	31.2	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	—	1.21	1.21
Pool Mean Depth (d_{bkfp})	—	2.69	2.69	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	—	1.84	1.84
Pool Cross-Sectional Area (A_{bkfp})	—	83.8	83.8	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	—	2.34	2.34
Pool Maximum Depth (d_{maxp})	—	4.27	4.27	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	—	3.05	3.05
Pool Inner Berm Width (W_{ibp})	—	26.9	26.9	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	—	0.86	0.86
Pool Inner Berm Depth (d_{ibp})	—	2.62	2.62	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	—	0.97	0.97
Pool Inner Berm Area (A_{ibp})	—	32.2	32.2	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	—	0.38	0.38
Point Bar Slope (S_{pb})	—	—	—	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	—	10.3	10.3

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios***	Mean	Min	Max
Run Width (W_{bkfr})	—	—	—	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	—	—	—
Run Mean Depth (d_{bkfr})	—	—	—	ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})	—	—	—
Run Cross-Sectional Area (A_{bkfr})	—	—	—	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	—	—	—
Run Maximum Depth (d_{maxr})	—	—	—	ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})	—	—	—
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	—	—	—	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	—	—	—	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	—	—	—
Glide Mean Depth (d_{bkfg})	—	—	—	ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})	—	—	—
Glide Cross-Sectional Area (A_{bkfg})	—	—	—	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	—	—	—
Glide Maximum Depth (d_{maxg})	—	—	—	ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})	—	—	—
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	—	—	—	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	—	—	—
Glide Inner Berm Width (W_{ibg})	—	—	—	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	—	—	—
Glide Inner Berm Depth (d_{ibg})	—	—	—	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	—	—	—
Glide Inner Berm Area (A_{ibg})	—	—	—	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	—	—	—

Step**

Step Dimensions**	Mean	Min	Max		Step Dimensionless Ratios***	Mean	Min	Max
Step Width (W_{bkfs})	—	—	—	ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})	—	—	—
Step Mean Depth (d_{bkfs})	—	—	—	ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})	—	—	—
Step Cross-Sectional Area (A_{bkfs})	—	—	—	ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})	—	—	—
Step Maximum Depth (d_{maxs})	—	—	—	ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})	—	—	—
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})	—	—	—					

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet B-3b. Morphological relations, including dimensionless ratios (*First Field Day*).

Stream: SHARMANS BRANCH Location:

Observers: TEAM #2 Date: 4/16/13 Valley Type: VI Stream Type: B4a/2/1

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	3.0	ft/sec	Estimation Method	JARRETT	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	107	cfs	Drainage Area	3.6	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	—	—	—	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	—	—	—
Stream Meander Length (L_m)	—	—	—	ft	Stream Meander Length Ratio (L_m / W_{bkf})	—	—	—
Radius of Curvature (R_c)	—	—	—	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	—	—	—
Belt Width (W_{blt})	91.8	40.6	430	ft	Meander Width Ratio (W_{blt} / W_{bkf})	1.66	1.65	1.67
Arc Length (L_a)	—	—	—	ft	Arc Length to Riffle Width (L_a / W_{bkf})	—	—	—
Riffle Length (L_r)	—	61.4	61.4	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	—	2.5	2.5
Individual Pool Length (L_p)	22.9	19	26.8	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.93	0.77	1.09
Pool to Pool Spacing (P_s)	—	107.5	102.5	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	—	4.37	4.37

Channel Profile

Valley Slope (S_{val})	0.044	ft/ft	Average Water Surface Slope (S)	0.035	ft/ft	Sinuosity (S_{val} / S)		1.3
Stream Length (SL)	238.8	ft	Valley Length (VL)	183.8	ft	Sinuosity (SL / VL)		1.3
Low Bank Height (LBH)	start — / end —	ft	Max Depth (d_{max})	start — / end —	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start — / end —	

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.055	0.05	0.06	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	1.57	1.43	1.71
Run Slope (S_{run})	—	—	—	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	—	—	—
Pool Slope (S_p)	0.002	0.002	0.002	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	—	0.06	0.06
Glide Slope (S_g)	—	—	—	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	—	—	—
Step Slope (S_s)	—	—	—	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	—	—	—

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	—	2.21	2.21	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	—	1.58	1.58
Max Run Depth (d_{maxrun})	—	—	—	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	—	—	—
Max Pool Depth (d_{maxp})	—	4.27	4.27	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	—	3.05	3.05
Max Glide Depth (d_{maxg})	—	—	—	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	—	—	—
Max Step Depth (d_{maxs})	—	—	—	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	—	—	—

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	4	0	—	D_{16}	18	8	—	—	mm
% Sand	6	2	—	D_{35}	46	20	—	—	mm
% Gravel	43	69	—	D_{50}	59	33	—	—	mm
% Cobble	30	24	—	D_{84}	260	110	—	—	mm
% Boulder	13	5	—	D_{95}	2048	240	—	—	mm
% Bedrock	4	0	—	D_{100}	BEDROCK	518	—	—	mm

[a] Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs & steps, the deepest part of pools, & at the tail-out of glides.

[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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