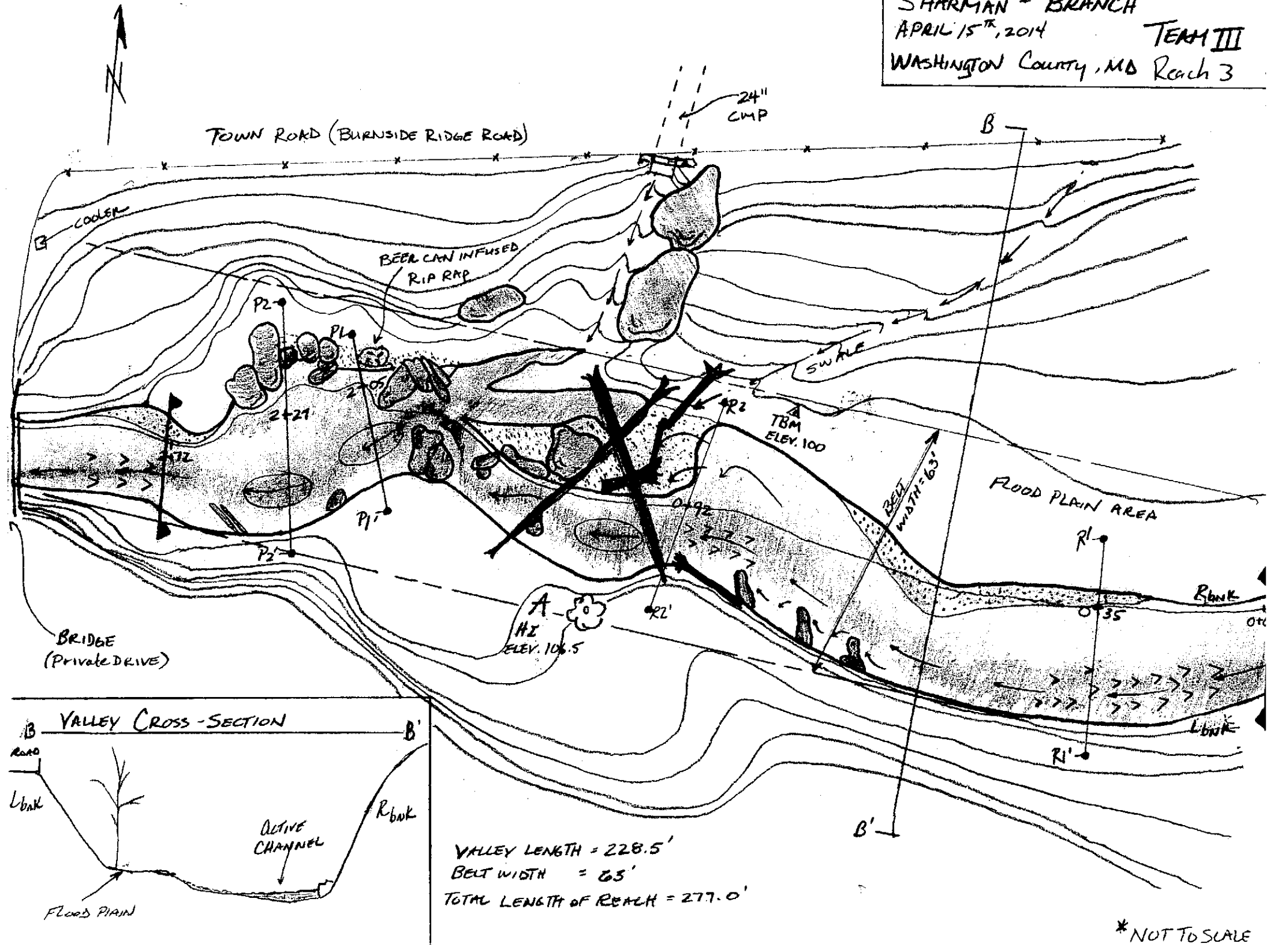
SHARMAN'S BRANCH
APRIL 15TH, 2014
TEAM III
WASHINGTON COUNTY, MD Reach 3



Reference Riffle

Bench = 8.5 = 100

108.5

SURVEY DATA ⟹ **CROSS - SECTION** 1

SITE: SHARMAN'S BRANCH Date: 4/15/14

Location: Riffle

Party / Notes: TEAM 3 Reach 3 HUC:

TAPE # 34.7

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	-1.2	8.8	108.5	5.65	102.85	
2	-.80			6.0	102.5	
3	.5			7.05	101.45	LB EOWL
4	.6			7.46	101.04	
5	1.5			7.58	100.92	
6	2.2			7.66	100.84	
7	2.7			7.26	101.24	rock
8	3.1			7.16	101.34	
9	3.7			7.12	101.38	
10	4.2			7.59	100.91	
11	5.1			7.65	100.85	
12	6.0			7.98	100.52	
13	6.3			8.08	100.42	
14	6.6			8.05	100.45	
15	7.0			8.10	100.4	
16	7.3			8.2	100.3	TW
17	7.7			8.08	100.42	
18	8.2			7.80	100.7	
19	8.6			7.32	101.18	
20	9.3			7.42	101.08	
21	10.3			7.54	100.96	
22	10.9			7.58	100.92	
23	11.3			7.37	101.13	
24	11.6			7.16	101.34	
25	12.1			7.27	101.23	
26	12.7			7.39	101.11	
27	13.2			7.42	101.08	
28	13.6			7.18	101.32	

Copyright © 2014 Wildland Hydrology

14.1	7.14	~~92.86~~	101.36
14.4	7.40	~~92.6~~	101.1
15.3	7.45	~~92.55~~	101.05
16.2	7.40	~~92.6~~	101.1
16.9	7.22	~~92.78~~	101.28
17.8	7.37	~~92.63~~	101.13
18.6	7.1	~~92.9~~	101.4
19.0	7.15	~~92.85~~	101.35
19.8	7.05	FOWR ~~92.95~~	101.45
20.3	6.88	~~93.12~~	101.62
20.8	6.87	~~93.13~~	101.63
21.0	6.78	ROCK ~~93.22~~	101.72
21.4	6.87	~~93.13~~	101.63
21.6	6.97	~~93.53~~	102.03
22.3	7.10	~~92.9~~	101.4
22.9	7.04 ← 4?	~~92.96~~	101.41
23.6	6.97 ← 9?	~~93.03~~	101.53
24.0	6.95 ← 9?	~~93.05~~	101.55
24.4	6.92	~~93.08~~	101.58
4.6	6.86	~~93.14~~	101.64
1.8	6.90 ← 9?	~~93.1~~	101.6

25.0	6.86	~~93.14~~	101.64
25.3	6.69	~~93.31~~	101.81
25.6	6.12	Bank R ~~93.88~~	102.38
26.0	6.0	~~94.0~~	102.5
26.3	5.9	~~94.1~~	102.6
26.6	5.75	~~BF~~ ?	1.3 ~~94.25~~ 102.75
26.9	~~5.52~~	~~Rock~~ ~~94.48~~ ~~102.98~~	5.65 on ground ~~94.35~~ 102.8 BF
27.6	5.55	~~94.45~~	102.95
28.3	5.45	103.05	
29.0	5.30	103.2	
30.0	5.09	103.41	
31.0	5.05	103.45	
32.0	4.98	103.52	
35.0	4.80	103.7	
39.0	4.50	104.0	

(FP Elev = 2.22)

8.20
4.98
4.98 2.22
3

-1.7 5.
-1.2 5.

SURVEY DATA ⟹ **CROSS - SECTION** 4

SITE: # 2 Reach 3 **Date:** 4/15/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0	6.40	106.4	3.97	110.37	102.43
30	1			4.40	110.8	102.00
31	1.5			4.62	111.02	101.78
32	2.5			5.81	112.21	100.58
33	3.1			6.14	112.54	100.25 EOW L
34	3.7			6.85	113.25	99.55
35	4.6			—	—	tree
36	6.3			6.61	113.01	99.79
37	7.5			6.83	113.23	99.57
38	8.6			6.73	113.13	99.67
39	9.7			6.77	113.17	99.63
40	10.0			6.62	113.02	99.78
41	10.5			6.81	113.21	99.59
42	~~11.4~~			—	—	tree
43	13.4			6.77	113.17	99.68
44	14.5			6.83	113.23	99.57
45	15.0			6.78	113.18	99.62
46	16.0			6.89	113.29	99.51
47	16.7			6.92	113.32	99.48 VV
48	17.2			6.62	113.02	99.78
49	18.0			6.67	113.07	99.73
50	19.0			6.74	113.14	99.66
51	19.9			6.74	113.14	99.66
52	20.6			6.64	113.04	99.76
53	21.2			6.51	112.91	99.89
54	21.4			6.27	112.67	100.13
55	22			6.27	112.67	100.13
56	23.1			6.19	112.59	100.25 EOW R
57	23.7			5.91	112.31	100.49
58	24.3			5.8	112.20	100.6
59	25			5.87	112.27	100.53

Copyright © 2014 Wildland Hydrology

Reference Pool #6

SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: Pool XS1 laser Reach 3 Date:

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29		~~6.5~~ 6.4				BM1 = 6.50
30	~~6.27~~			6.27	100.13	0+00
31	6+00			7.30	99.1	Top Bench
32	9+00			9.12	97.28	Bottom Bench
33	11+80			9.50	96.9	BF
34	14+30			9.88	96.52	
35	16+50			10.65	95.75	
36	20+90			11.13	95.27	waters edge (L)
37	22+60			11.72	94.68	
38	23+20			10.60	95.80	Rock
39	25+00			11.10	95.30	waters edge
40	28+00			11.79	94.61	pool Rock
41	31+00			12.62	93.78	pool Rock
42	33+10			13.17	93.23	Bottom Rock
43	34+10			13.03	93.37	Pool
44	36+00			12.65	93.75	Pool
45	39+00			12.11	94.29	Pool
46	40+80			11.78	94.62	
47	42+40			10.99	95.41	waters edge (R)
48	45+00			10.27	96.13	ground
49	46+00			10.25	96.15	ground
50	48+00			10.48	95.92	ground
51	51+00			9.44	96.96	slope up
52	53.3			7.59	98.81	slope up
53	55+00			6.13	100.27	END
54						
55						
56						
57						
58						
59						

11.15
10.20
1.88

Copyright © 2014 Wildland Hydrology

SURVEY DATA ⟹ **CROSS - SECTION 3**

SITE: Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
		6.40				
29	0	8.1		8.2		Bench
30	5.30			9.64	98.96	BF
31	7.40			10.35	97.75	
32	8.80			10.79	97.31	
33	11.00			10.9	97.2	
34	11.40			11.21	96.89	water edge (L)
35	13.00			12.65	95.45	
36	14.00			12.85	95.25	
37	16.00			12.97	95.13	Thalweg
38	19.00			13.17	94.93	
39	22.00			13.19	94.91	
40	25.00			13.25	94.85	
41	28.00			12.77	95.33	
42	30.00			12.85	95.25	
43	31.00			13.15	94.95	
44	32.00			13.07	95.03	
45	33.00			12.80	95.3	
46	34.00			12.82	95.28	
47	34.40			10.42	97.68	Rock
48	37.00			9.65	98.45	
49	38.00			9.10	99.00	
50	38.60			9.25	98.85	
51	39.00			8.30	99.80	
52	42.00			7.49	100.61	
53	44.00			7.12	100.98	
54	45.40			6.82	101.28	
55	34.30			11.22	96.88	Water edge (R)
56					wrong	
57						
58						
59						

Copyright © 2014 Wildland Hydrology

TEAM 3 - Pool CROSS SECTION @ 2+27.7 POLE #2

SURVEY DATA ⟶ **CROSS - SECTION 8**

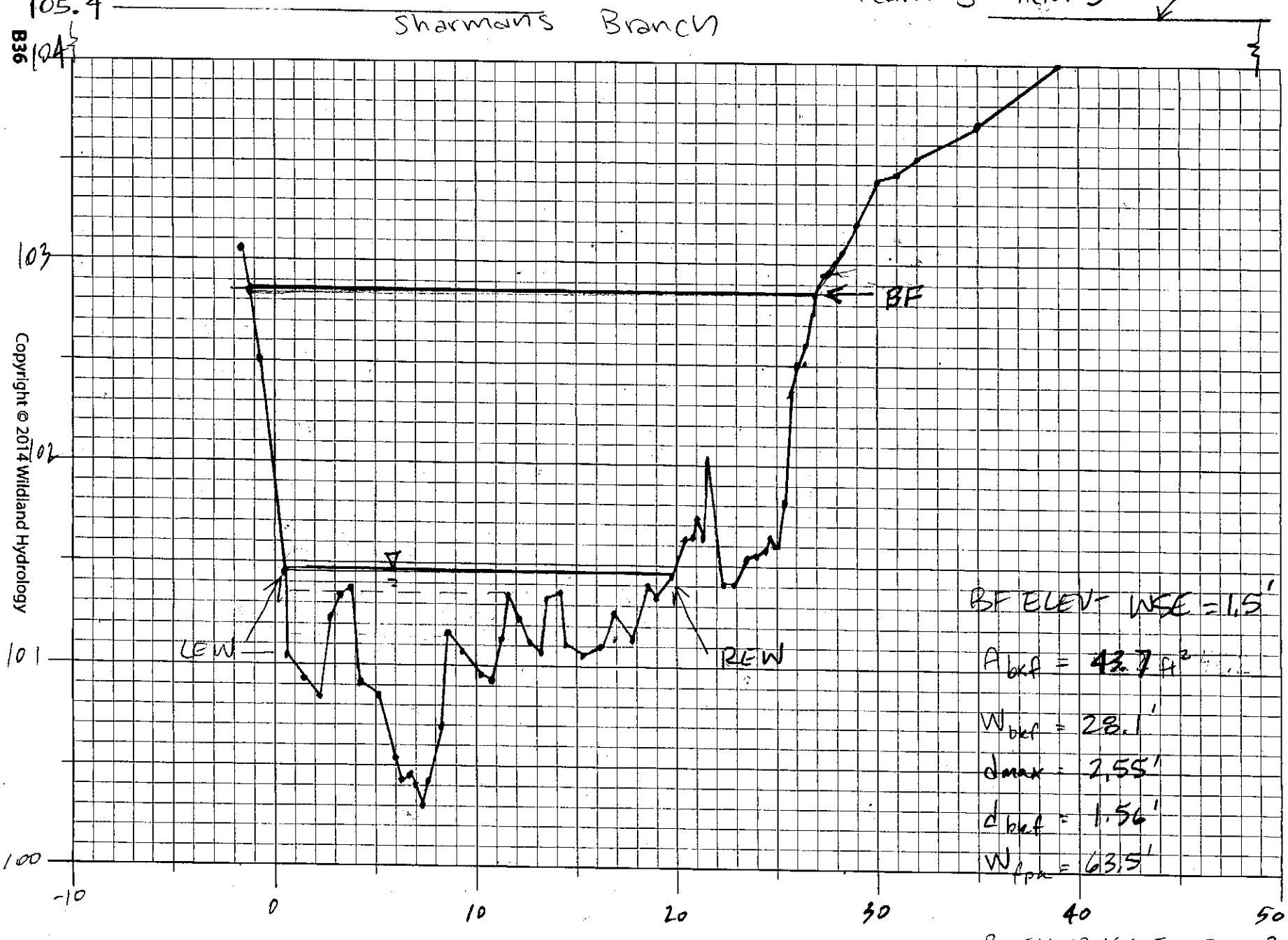
SITE: SHERMANS BRIDGE Reach 3 Date: 4/15/14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	0			8.2	98.2	
30	5.3			9.64	96.76	
31	7.4			10.35	96.05	
32	8.80			10.79	95.61	
33	11.00			10.9	95.5	
34	11.40			11.21	95.19	WS
35	13.00			12.65	93.75	
36	14.00			12.85	93.55	
37	16.00			12.97	93.43	
38	19.00			13.17	93.23	
39	22.00			13.19	93.21	
40	25.00			13.25	93.15	
41	28.00			12.77	93.63	
42	30.00			12.85	93.55	
43	31.00			13.15	93.25	
44	32.00			13.07	93.33	
45	33.00			12.8	93.6	
46	34.00			12.82	93.58	
47	34.40			11.22	95.18	
48	37.00			10.42	95.98	
49	38.00			9.65	96.75	BKF
50	38.60			9.1	97.3	
51	39.00			9.25	97.15	
52	42.00			8.3	98.1	
53	44.00			7.49	98.91	
54	45.40			7.12	99.28	
55	34.30			6.82	99.58	
56						
57						
58						
59						

Copyright © 2014 Wildland Hydrology

REFERENCE Riffle XS - 0+35 4/15/14

Sharmans Branch Team 3 Reach 3



BF ELEV - WSE = 1.5'

A_{bkf} = 43.7 ft²

W_{bkf} = 28.1'

d_{max} = 2.55'

d_{bkf} = 1.56'

W_{fpk} = 63.5'

RIFFLE 1B X-SECT = 5.3 ft²

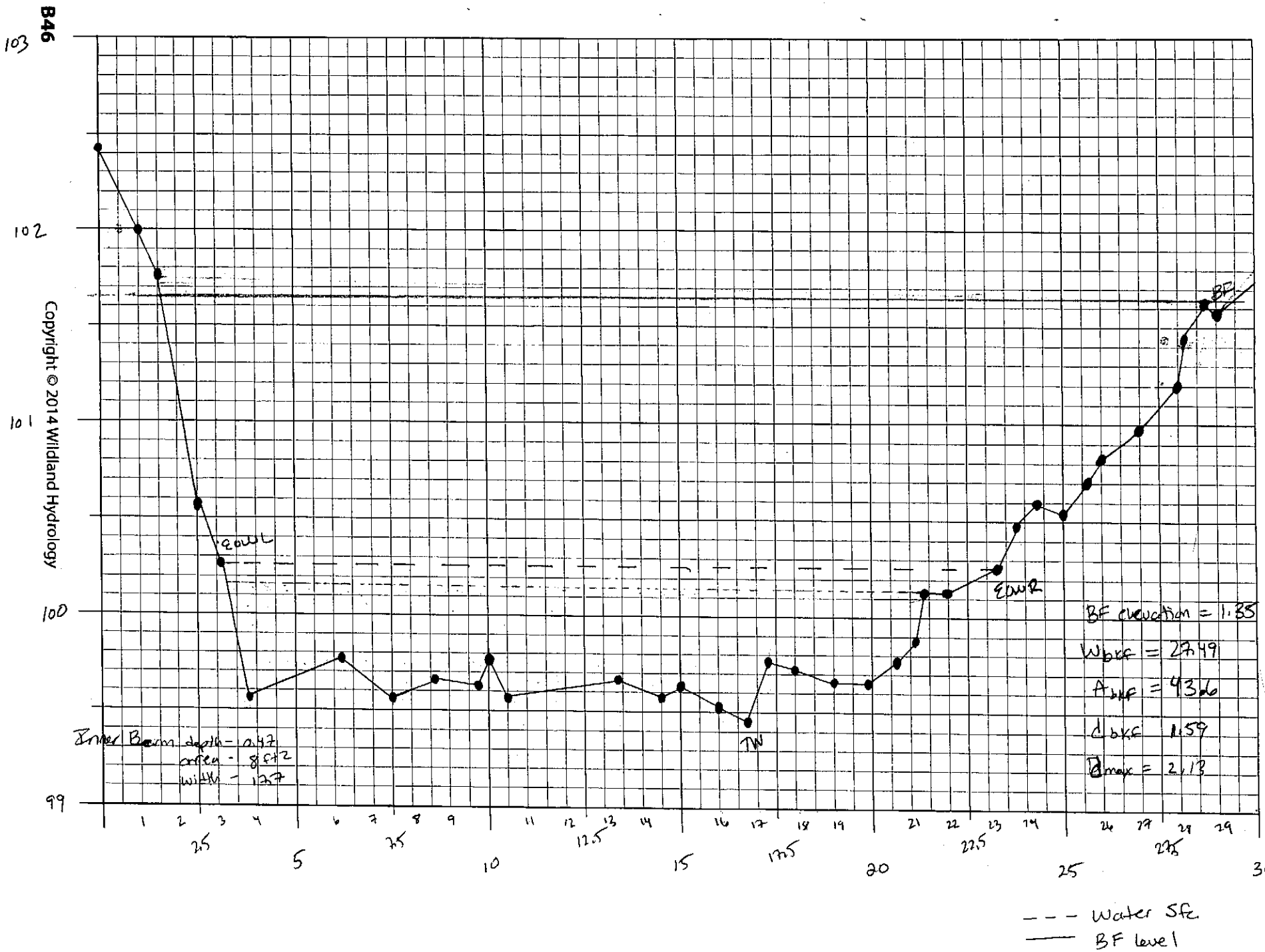
WIDTH = 11.0'

Copyright © 2014 Wildland Hydrology

Team 3
4/15/14

Sharman's Branch Riffle #2 Cross Section

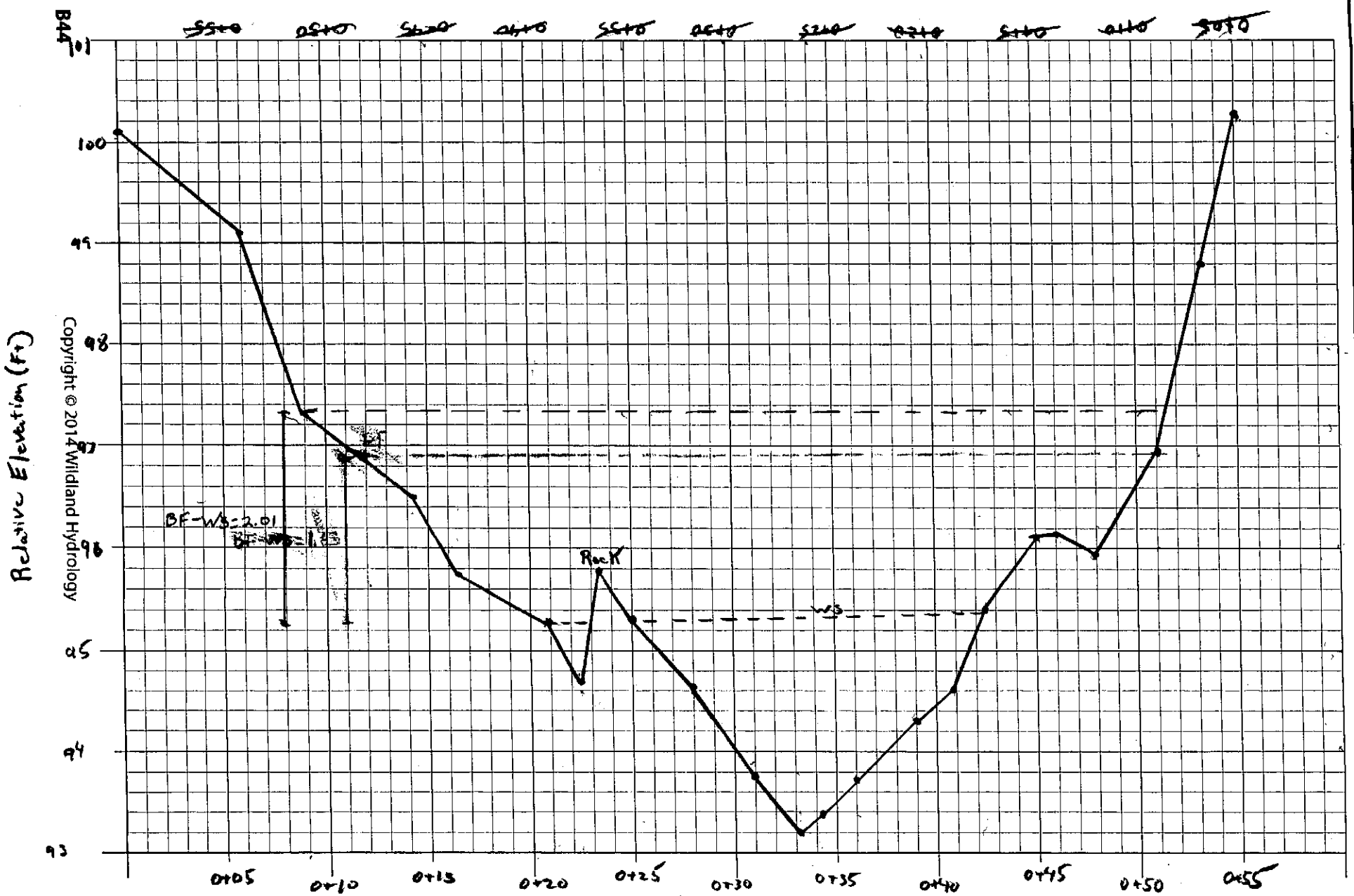
Reach 3 0+92



Copyright © 2014 Wildland Hydrology

Team 3 - Pool Cross Section @ 24.05 Ft - Sharman's Bridge 4/15/2014

Reach 3

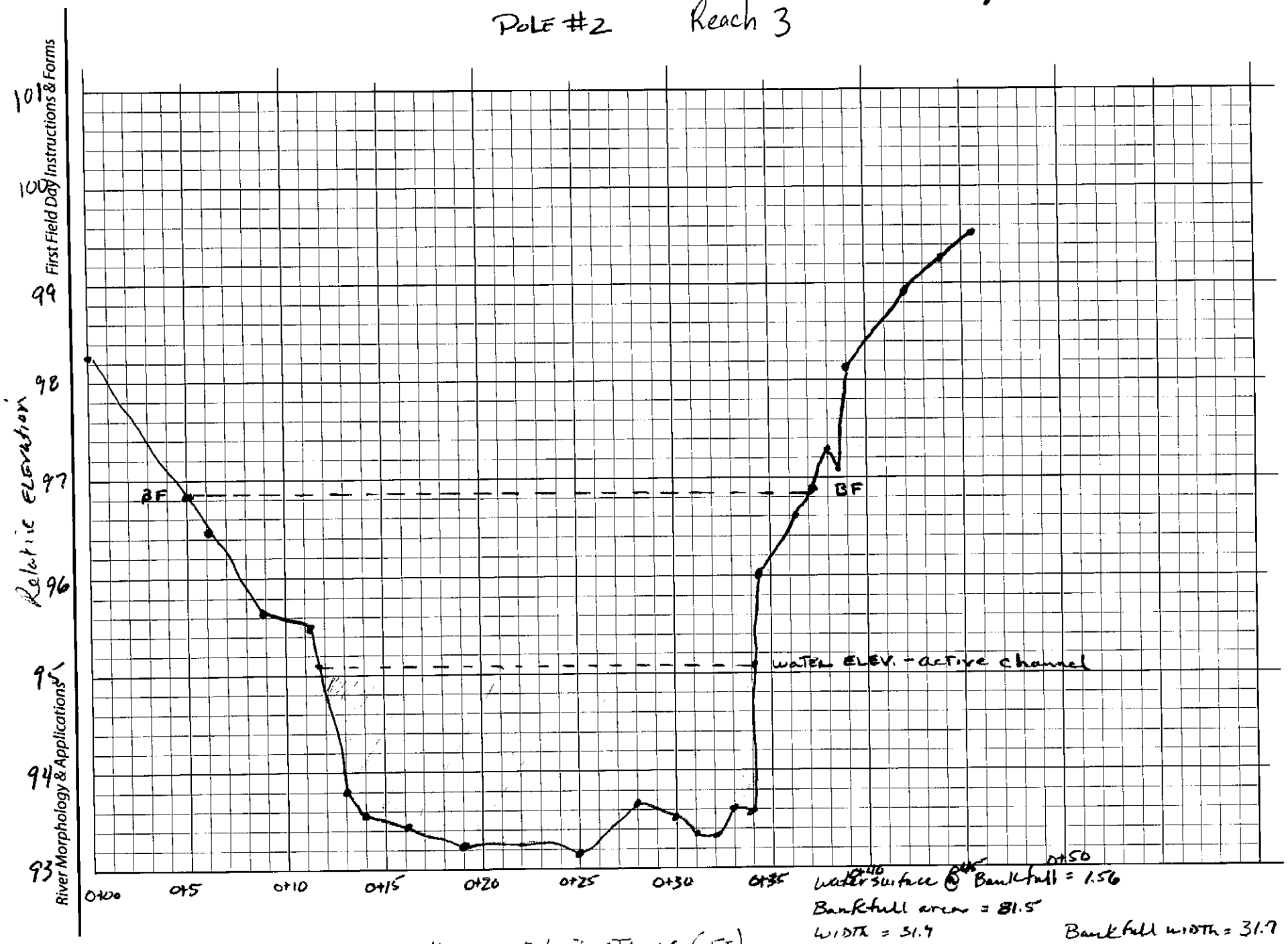


max depth: 4.05
mean depth: 1.86
BF width: 24.41
BF Area: 45.3

Copyright © 2014 Wildland Hydrology

TEAM 3 - Pool Cross Section @ 2+27.7 Sherman's Bridge 4/15/14 TEAM III

Pole #2 Reach 3



Water surface @ Bankfull = 1.56

Bankfull area = 81.5

Width = 31.4

Max Depth = 3.60

Mean Depth = 2.57

Bankfull width = 31.7

First Field Day Instructions & Forms
River Morphology & Applications
Copyright © 2014 Wildland Hydrology

SURVEY DATA ⟶ LONGITUDINAL PROFILE 1

SITE: Sharmans Branch **Date:** 4/15/14

Location: Wash. Co. MD Reach 3

Party / Notes: Team 3 **HUC:**

elev readings smaller to higher

WS should be close in pool, diff in riffle

	Distance, Point, or STATION (ft)	Back-Sight BS (ft)	Height of Instrument HI (ft)	Thalweg Fore-Sight FS (ft)	Thalweg Elevation Elev. (ft)	Water Surface Fore-Sight FS (ft)	Water Surface Elevation Elev. (ft)	Bankfull Fore-Sight FS (ft)	Bankfull Elevation Elev. (ft)	Low Bank HI Fore-Sight FS (ft)	Low Bank HI Elevation Elev. (ft)	NOTES e.g. Riffle Run Pool Glide	
1	BM	6.40	106.4										
BF-WS 1.46 2	0+00			5.06	100.8	4.16	102.24	2.70?				Top of Rif	
3	0+15			5.26	101.14	4.36	102.04					Rif	
4	0+24			5.56	100.84	4.55	101.85			2.32	104.08	Rif	
B.T. 1.43 5	0+35			6.03	100.37	4.84	101.56	3.41	103.26	2.66	103.74	Rif	X Sec
1.79 6	0+65			6.94	99.46	5.76	100.64	3.97	102.43	3.97		Rif	★
1.42 7	0+80			7.10	99.30	5.91	100.49	4.49	101.91			Rif	- Polish
1.28 8	0+87			6.75	99.65	6.02	100.38	4.74	101.66			Rif End	Top of Step
1.57 9	0+98			7.05	99.35	6.42	99.98	4.85	101.55			Step	
10	1+08			7.90	98.50	6.92	99.48					Step	
11	1+20			9.35	97.07	7.26	99.14					End step Top pool	
12	1+24			9.53	96.87	7.76	98.64					Pool	
13	1+37			9.43	96.97	7.92	98.48					Pool END Start Rapid	
14	1+44			9.37	97.07	8.41	97.99					END Rapid Start Step	
15	1+55			9.93	96.47	8.84	97.56					~~END~~ Step ~~Start~~	
16	1+77			11.51	94.89	9.97	96.43	~~9.36?~~	- Pipe & Rock			END Step/Start/Pool	
17	1+88			13.15	93.25	10.86	95.54					END Step/Pool start	
1.34 18	2+05			12.80	93.60	10.86	95.54	9.52	96.88			Pool	X Sec
19	2+16			12.57	93.83	11.11	95.29			END Pool/Small step			
1.61 20	2+27			12.87	93.53	11.11	95.29	9.50	96.90	8.31	98.09	Pool	X Sec
21	2+45			12.35	94.05	11.18	95.29					Pool end/Glide	
22	2+55			12.20	94.20	11.16	95.24					Glide	start
23	2+72			11.87	94.53	11.24	95.16			Glide end/Riffle		start	
24	2+77			12.17	94.23	11.38	95.02					Riffle	
25	[illegible]												X-S riffle
1.47 26	0+92			6.71	99.69	6.27	100.13	4.80	101.60				
27													

WS

Slope = 0.026

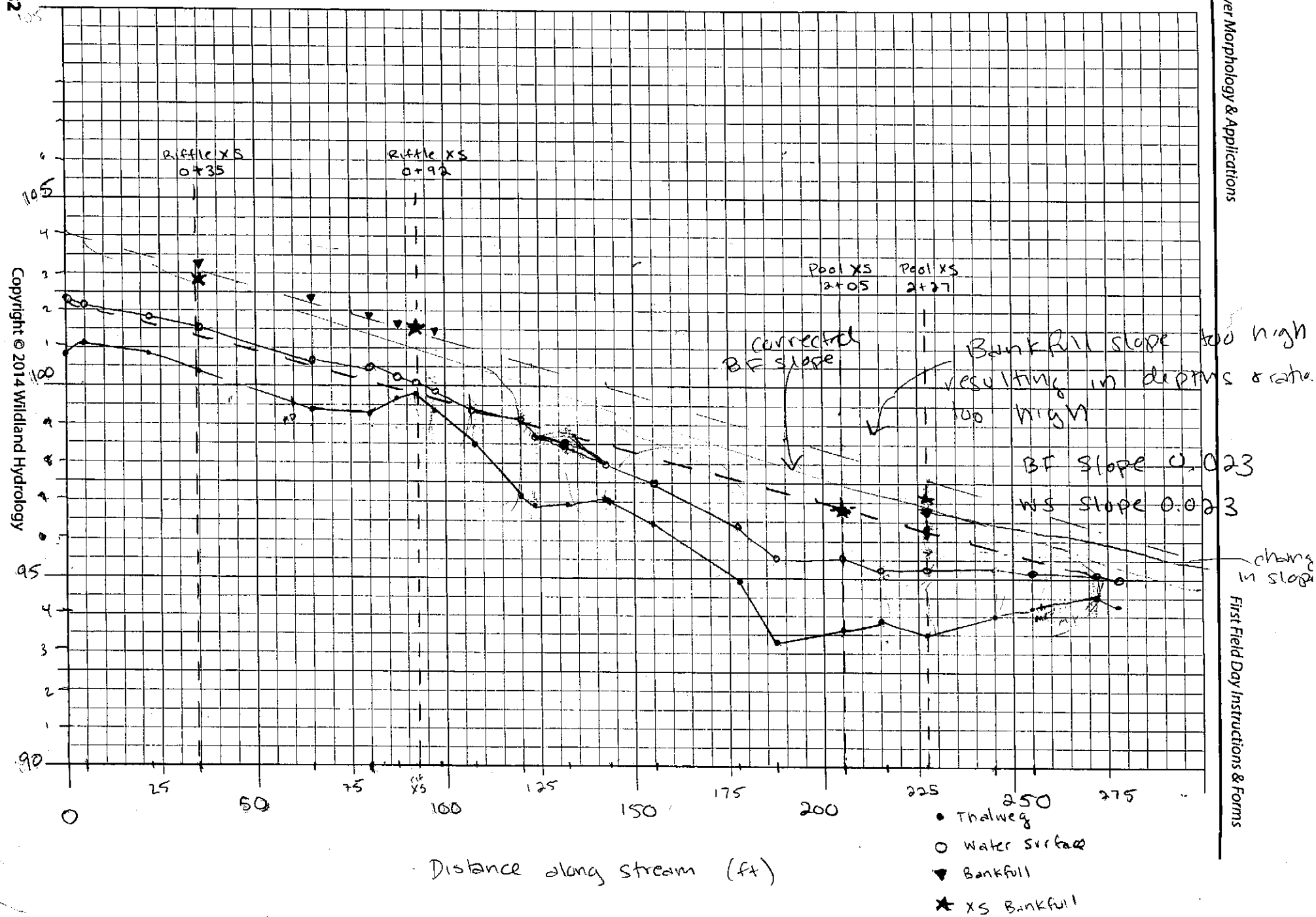
Copyright © 2014 Wildland Hydrology

Copyright © 2014 Wildland Hydrology

4/15/14

Team 3

Sharmans Branch Longitudinal Profile
Reach 3



Reach 3

Site: Pebble Count Classification Date: 4-15-14
Location: Sharman HUC:
Party: #3

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: 0+00 - 2+79 Date: 4-15-14 TOT #	ITEM %	% CUM	POOL (2) Reach: 0+00 - 2+79 Date: 4-15-14 TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: 0+00 - 2+79 Date: 4-15-14 TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C				0	0	0	0	0	0	0	0	0
	Very Fine	.062 - .125	SAND				0	0	0	0	0	0	0	0	0
	Fine	.125 - .25	SAND				0	0	0	2	6.7	6.7	2	2	2
	Medium	.25 - .50	SAND				0	0	0	0	0	6.7	0	0	2
	Coarse	.50 - 1.0	SAND				0	0	0	0	0	6.7	0	0	2
.04 - .08	Very Coarse	1.0 - 2	SAND				0	0	0	0	0	6.7	0	0	2
.08 - .16	Very Fine	2 - 4	GRAVEL				0	0	0	0	0	6.7	0	0	2
.16 - .22	Fine	4 - 5.7	GRAVEL				1	1.4	1.4	0	0	6.7	1	1	3
.22 - .31	Fine	5.7 - 8	GRAVEL				0	0	1.4	0	0	6.7	0	0	3
.31 - .44	Medium	8 - 11.3	GRAVEL				0	0	1.4	0	0	6.7	0	0	3
.44 - .63	Medium	11.3 - 16	GRAVEL				3	4.3	5.7	0	0	6.7	3	3	6
.63 - .89	Coarse	16 - 22.6	GRAVEL				6	8.6	14.3	2	6.7	13.4	8	8	14
.89 - 1.3	Coarse	22.6 - 32	GRAVEL				5	7.1	21.4	6	20	33.4	11	11	25
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL				5	7.1	28.5	3	10	43.4	8	8	33
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL				9	12.9	41.4	2	6.7	50.1	11	11	44
2.5 - 3.5	Small	64 - 90	COBBLE				0	0	41.4	4	13.3	63.4	4	4	48
3.5 - 5.0	Small	90 - 128	COBBLE				3	4.3	45.7	3	10	73.4	6	6	54
5.0 - 7.1	Large	128 - 180	COBBLE				9	12.9	58.6	2	6.7	80.1	11	11	65
7.1 - 10.1	Large	180 - 256	COBBLE				10	14.3	72.9	1	3.3	83.4	11	11	76
10.1 - 14.3	Small	256 - 362	BOULDER				5	7.1	80	1	3.3	86.7	6	6	82
14.3 - 20	Small	362 - 512	BOULDER				3	4.3	84.3	0	0	86.7	3	3	85
20 - 40	Medium	512 - 1024	BOULDER				9	12.7	97.2	0	0	86.7	9	9	94
40 - 80	Large-Vry Large	1024 - 2048	BOULDER				2	2.8	100	0	0	86.7	2	2	96
	Bedrock		BDRK				0	0	100	4	13.3	100	4	4	100
Stream Type: B3			Valley Type: C-BR-BC			TOTAL→	70			30			100		

Riffles
B 0+00
0+27
B 0+54 2+75B
1+76
2+27

Copyright © 2014 Wildland Hydrology

Site: ACTIVE BED Pebble Count Date: 4-15-14

Location: Reach 3 Sherman HUC:

Party: Reach 3

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	ITEM %	% CUM	POOL (2) TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
							Reach: 0+00 - 0+60			Reach:			Reach:		
							Date: 4-15-14			Date:			Date:		
	Silt / Clay	< .062	S/C				1	1	1						
	Very Fine	.062 - .125	SAND				1	1	2						
	Fine	.125 - .25													
	Medium	.25 - .50					1	1	3						
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7					1	1	4						
.22 - .31	Fine	5.7 - 8													
.31 - .44	Medium	8 - 11.3					3	3	7						
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6					7	7	14						
.89 - 1.3	Coarse	22.6 - 32					7	7	21						
1.3 - 1.8	Very Coarse	32 - 45					6	6	27						
1.8 - 2.5	Very Coarse	45 - 64					11	11	38						
2.5 - 3.5	Small	64 - 90	COBBLE				18	18	56						
3.5 - 5.0	Small	90 - 128					12	12	68						
5.0 - 7.1	Large	128 - 180					11	11	79						
7.1 - 10.1	Large	180 - 256					7	7	86						
10.1 - 14.3	Small	256 - 362	BOULDER				13	13	99						
14.3 - 20	Small	362 - 512					1	1	100						
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK				2								
Stream Type: B3			Valley Type: C-BR-BC			TOTAL→									

@ 0+10

@ 0+35

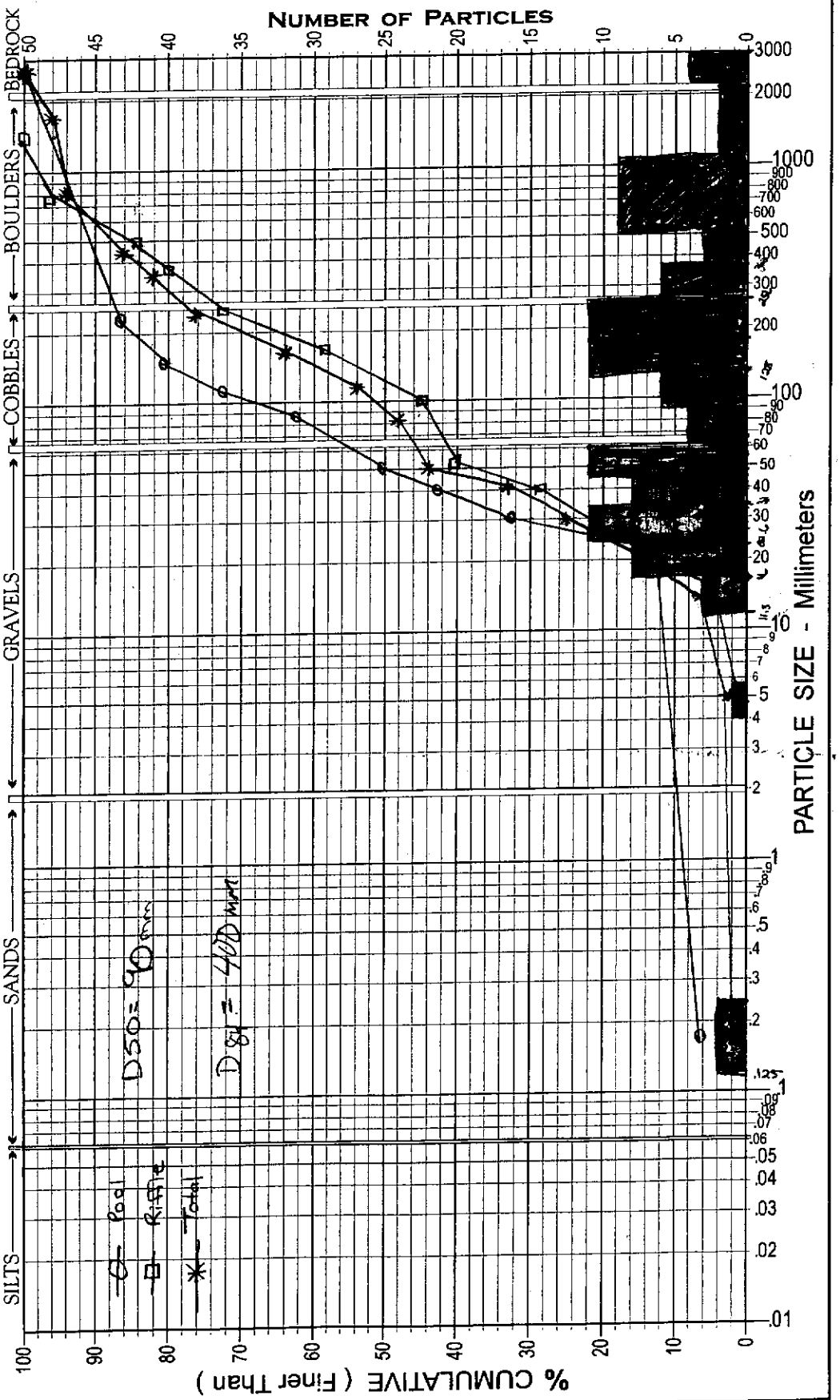
85

Copyright © 2014 Wildland Hydrology

Representative Pebble Count
Reach 3

PEBBLE COUNT DATA

LOCATION: Sharman's Branch
REACH: #3 Sharman
Stream Type: B3
PARTY: Team 3
Valley Type: C-BR-BC
HUC:
Date: 4-15-14

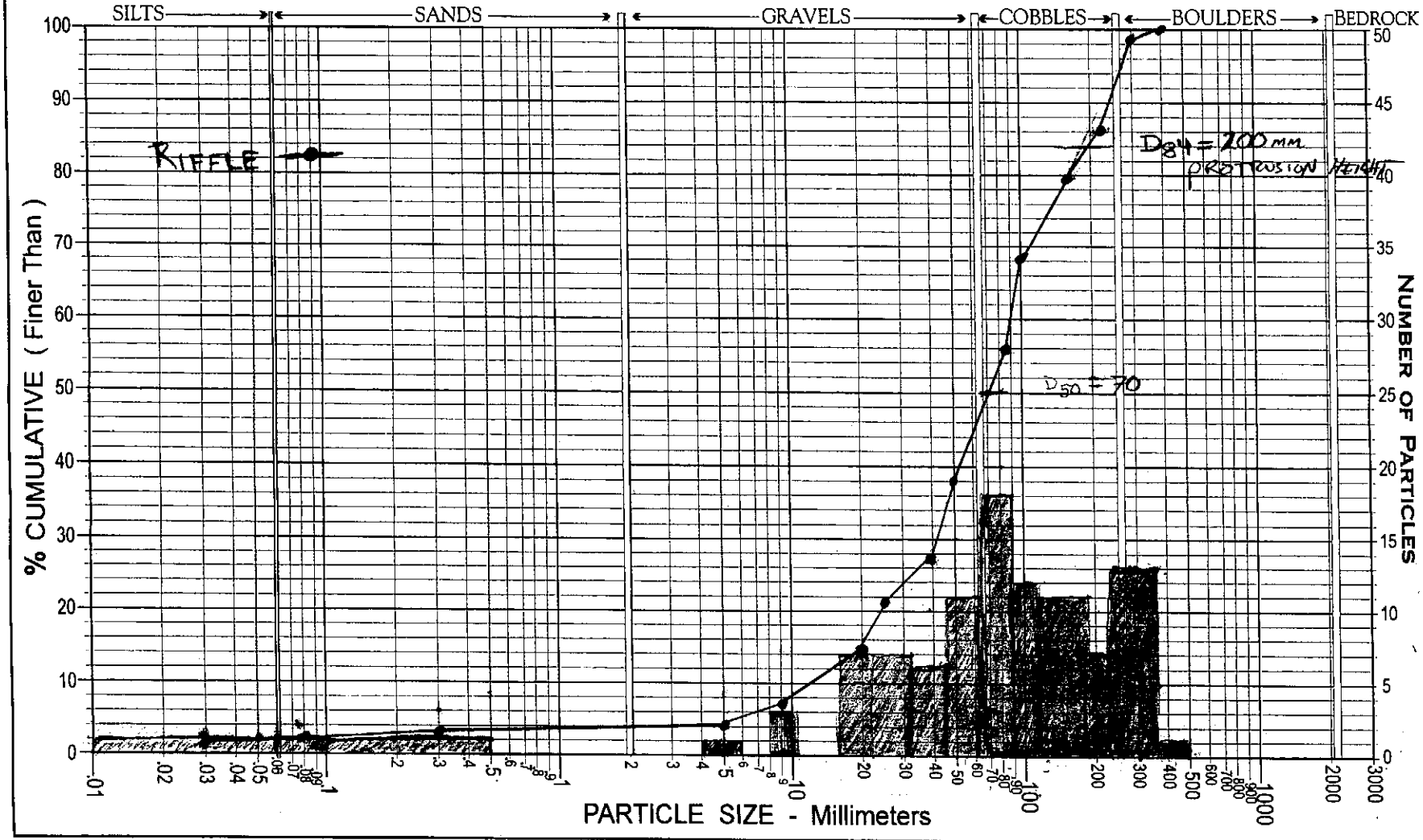


Copyright © 2014 Wildland Hydrology

Active Bed Riffle Pebble Count
Reach 3

PEBBLE COUNT DATA

LOCATION: Sharman's Branch
Date: 4-15-14
REACH: #3 Sharman
PARTY: Team3
Stream Type: B3
Valley Type: C-BR-BC
HUC:



Copyright © 2014 Wildland Hydrology

TEAM III SHARMAN'S [redacted] 4/15/2014

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

Stream: Sharmans Branch	
Basin:	Drainage Area: acres mi^2
Location: Washington County, MD	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/15/14
Observers: Team 3 Reach 3	Valley Type: C-BR-BC

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	28.1	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.56	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	43.7	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	18.0	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.	2.55	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.	63.5	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	2.26	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.	90	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.	0.023	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (S_{val} / S).	1.2	

Stream Type B3/2/1 **See Classification Key (Figure B-2)**

Copyright © 2014 Wildland Hydrology

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Sharmans Branch	Location:	Wash. County, MD
Date:	4/15/14	Stream Type:	
Valley Type:	C-BR-BC		
Observers:	Team 3 Reach 3	HUC:	-- -- -- -- -- -- -- -- -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	43.7	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.52	d_{bkf} (ft)
Bankfull Riffle WIDTH	28.1	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	31.22	W_p (ft)
D_{84} at Riffle	200	Dia. (mm)	D_{84} (mm) / 304.8	0.656	D_{84} (ft)
Bankfull SLOPE	0.023	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.40	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	2.13	R / D_{84}
Drainage Area	3.6	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	1.02	u* (ft/sec)

could have explored different values for D84

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	4.78	ft / sec	209	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. B-34, B-35) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.055	5.09	ft / sec	222	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. B-36) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.075	3.7	ft / sec	162	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 $n =$ 0.12	2.3	ft / sec	101	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 $\bar{u} = Q / A$	2.28	ft / sec	100	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.

Copyright © 2014 Wildland Hydrology

TEAM III SHARMANS BRANCH 4/15/2014

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

Stream: Sharmans Branch Location: Wash Co. MD

Observers: Team 3 Date: 4/15/14 Valley Type: C-BR-BC Stream Type:

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	27.8	27.4	28.1	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	43.65	43.6	43.7
Riffle Mean Depth (d_{bkf})	1.58	1.56	1.59	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	17.65	17.3	18
Riffle Maximum Depth (d_{max})	2.34	2.13	2.55	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	1.48	1.33	1.63
Width of Flood-Prone Area (W_{fpa})	63.5	63.5	63.5	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	2.26		
Riffle Inner Berm Width (W_{ib})	14.35	11	17.7	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.52	0.39	0.64
Riffle Inner Berm Depth (d_{ib})	0.52	0.47	0.57	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.34	0.3	0.37
Riffle Inner Berm Area (A_{ib})	6.65	5.3	8	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.15	0.12	0.18
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	28.9	19.3	38.5					

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	28.06	24.41	31.7	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	1.0	0.88	1.13
Pool Mean Depth (d_{bkfp})	2.22	1.86	2.57	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	1.41	1.19	1.62
Pool Cross-Sectional Area (A_{bkfp})	63.4	45.3	81.5	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.45	1.04	1.86
Pool Maximum Depth (d_{maxp})	3.83	3.6	4.05	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	2.42	2.31	2.55
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

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*	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**	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.

Copyright © 2014 Wildland Hydrology

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

Stream: Sharmans Branch Location: Wash. Co. MD

Observers: Team 3 Date: 4/15/14 Valley Type: C-BR-BC Stream Type:

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	2.3	ft/sec	Estimation Method	Jarrettts
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	101	cfs	Drainage Area	3.6 mi²

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})	63			ft	Meander Width Ratio (W_{blt} / W_{bkf})	2.24		
Arc Length (L_a)				ft	Arc Length to Riffle Width (L_a / W_{bkf})			
Riffle Length (L_r)	120			ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)	27	9	29	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.78	0.32	1.03
Pool to Pool Spacing (P_s)	52.5	42	63	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	1.87	1.49	2.24

Channel Profile

Valley Slope (S_{val})		ft/ft	Average Water Surface Slope (S)		ft/ft	Sinuosity (S_{val} / S)	
Stream Length (SL)	277	ft	Valley Length (VL)	228.5	ft	Sinuosity (SL / VL)	1.2
Low Bank Height (LBH) start		ft	Max Depth (d_{max}) start		ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start	
end		ft	end		ft	end	

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.026			ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	1.13		
~~Run Slope (S_{run})~~				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)	0.006	0.001	0.017	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.35	0.04	0.74
Glide Slope (S_g)	0.005			ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.22		
Step Slope (S_s)	0.06	0.05	0.06	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	2.61	2.17	2.61

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	2.9			ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.86		
~~Max Run Depth (d_{maxrun})~~				ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})			
Max Pool Depth (d_{maxp})	4.38	3.63	5.45	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.81	2.32	3.49
Max Glide Depth (d_{maxg})	1.87			ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.19		
Max Step Depth (d_{maxs})	3.7	3.3	4.1	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	2.37	2.12	2.6

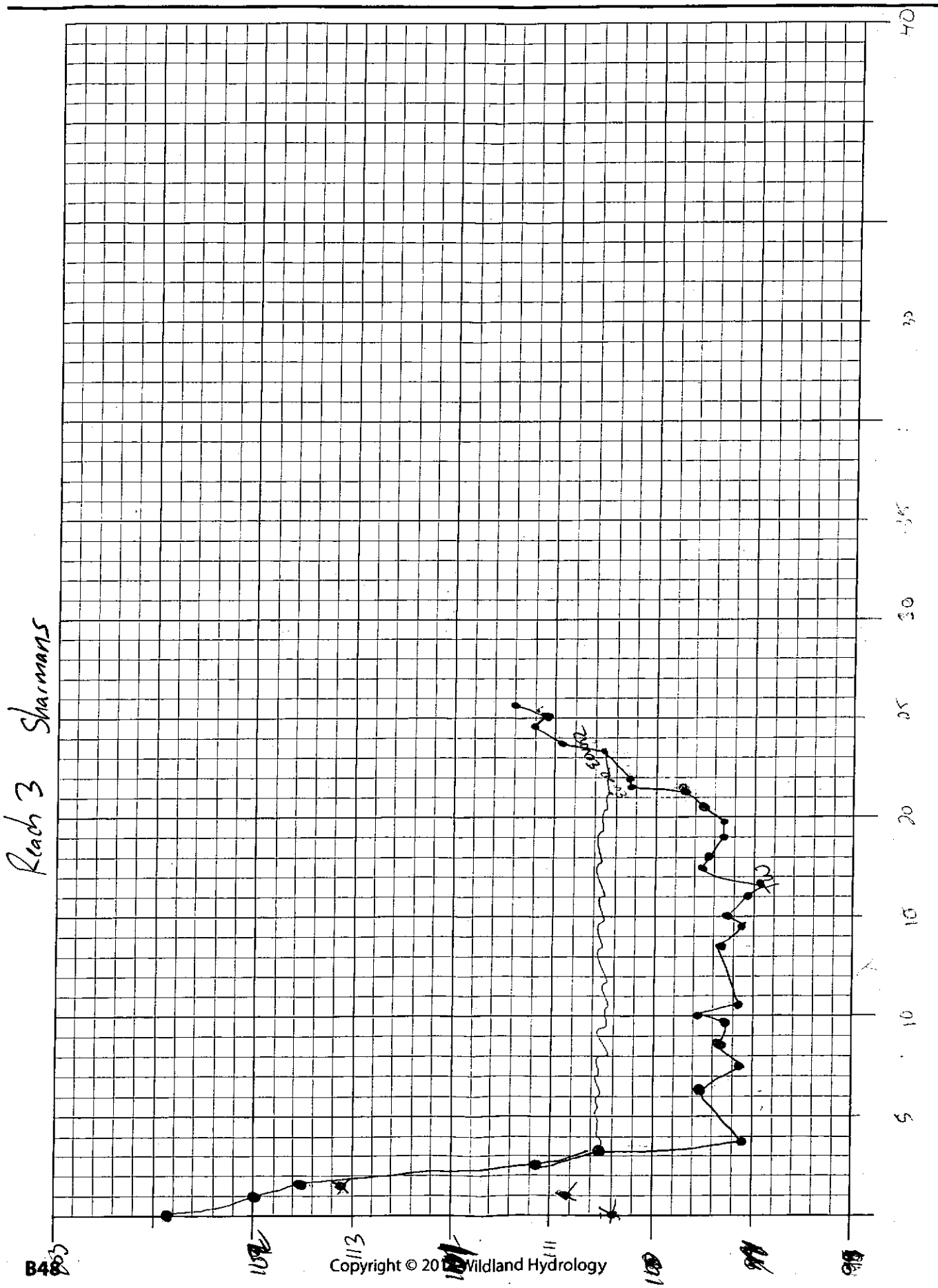
- could have included more riffle values

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	0	1	N/A	D_{16}	23	NA	NA	21	mm
% Sand	2	2	N/A	D_{35}	42	NA	NA	48	mm
% Gravel	42	35	N/A	D_{50}	90	NA	NA	70	mm
% Cobble	32	48	N/A	D_{84}	400	NA	NA	200	mm
% Boulder	20	14	N/A	D_{95}	1200	NA	NA	280	mm
% Bedrock	4	0	N/A	D_{100}	2700	NA	NA	500	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.

Copyright © 2014 Wildland Hydrology



Copyright © 2010 Wildland Hydrology