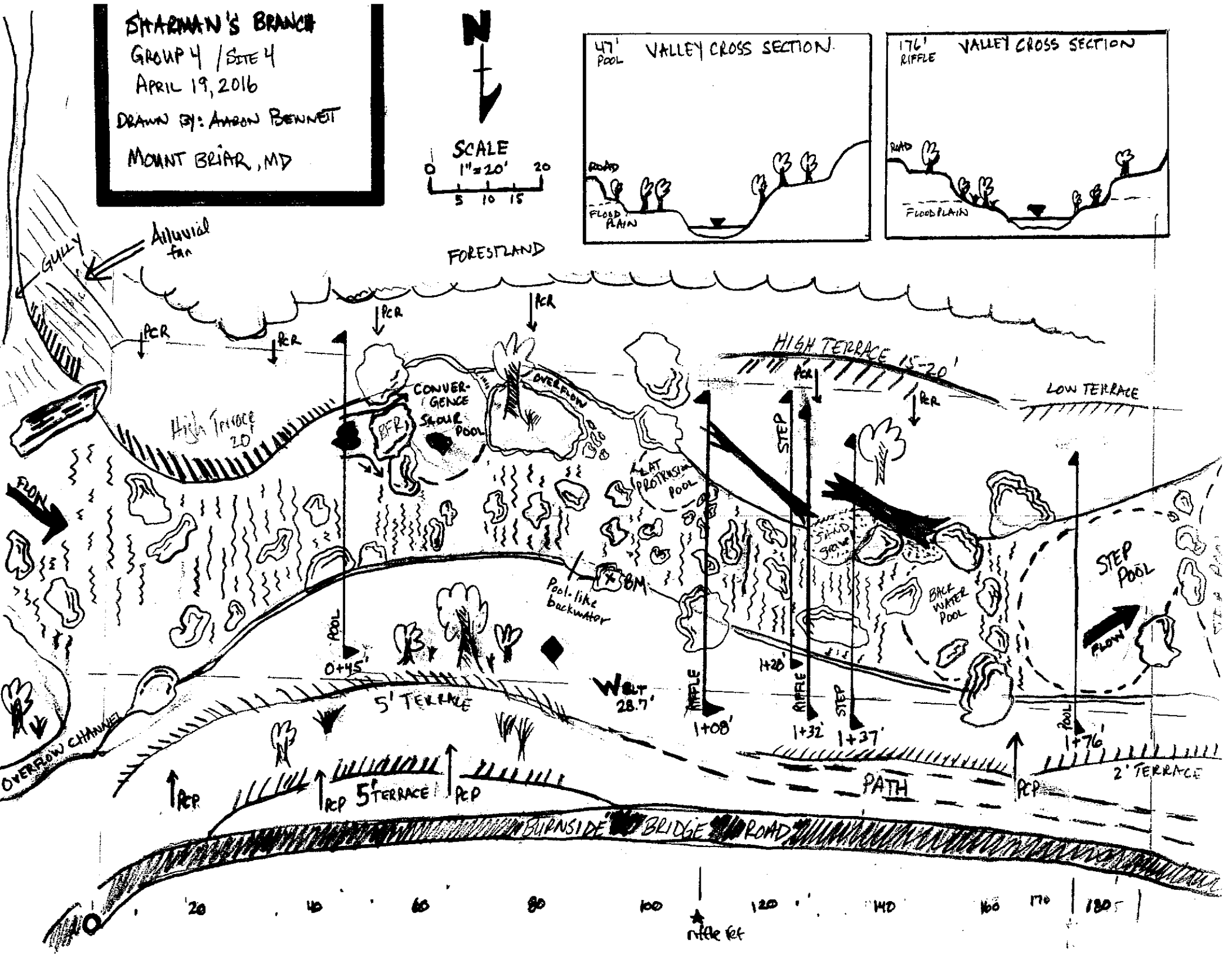
SHARMAN'S BRANCH
GROUP 4 / SITE 4
APRIL 19, 2016
DRAWN BY: AARON BENNETT
MOUNT BRIAR, MD
N
SCALE
0 1"=20' 20
5 10 15
47' POOL VALLEY CROSS SECTION
ROAD
FLOOD PLAIN
176' RIFFLE VALLEY CROSS SECTION
ROAD
FLOODPLAIN
GULLY
Alluvial fan
FORESTLAND
PCR
HIGH TERRACE 15-20'
LOW TERRACE
CONVERGENCE SCOUR POOL
OVERFLOW
High Terrace 20'
BFR
LAT PROTRUSION POOL
STEP
SAND GROVE
BACK WATER POOL
STEP POOL
FLOW
Pool-like backwater
BM
POOL
0+45'
5' TERRACE
WBLT 28.7'
RIFFLE
1+08'
1+20'
1+32'
1+37'
1+76'
2' TERRACE
PATH
OVERFLOW CHANNEL
PCP
5' TERRACE
BURNSIDE BRIDGE ROAD
0
20
40
60
80
100
120
140
160
170
180
riffle ret

1 Flood prone width at X-Section 108 ft (sta.) = 53 ft

D = 1.6
W = 28
A = 39 ft²

SURVEY DATA ⟹ **CROSS - SECTION** 1

SITE: Sherman's Branch – Team 4 Date: 4/20/16

Location: Reference riffle 1+08

Observers: Team 4 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		6.02	106.02			Benchmark	Entrench =
2	Ø			6.0	100.02	Low Bank @ pin	
3	2.3			7.15	98.87	Ground shot	
4	4.0			7.72	98.3	IB – Ground shot	LB
5	6.0			8.11	97.91	Ground Shot	
6	9.0			8.54	97.48	Ground Shot	
7	12.2			8.71	97.31	Ground/Water surface	
8	13.0			8.73	97.29	LEW / water surface	
9	13.0			8.80	97.22	Stream bottom	
10	15.0			9.0	97.02	" "	
11	17.0			9.09	96.93	" "	
12	18.2			9.19	96.83	" "	
13	20.0			9.22	96.80	" "	
14	21.5			9.04	96.98	Top boulder	
15	22.5			7.96	98.06	Top boulder	
16	24.0			9.10	96.92	Edge of boulder	
17	24.5			8.60	97.42	Stream bottom	
18	25.0			9.20	96.82	" "	
19	26.0			8.90	97.12	REW	
20	~~29.0~~ 26.0			8.81	97.21	Water surface – REW	
21	29.0			7.37	98.65	Ground / Slope	
22	31.0			7.20	98.82	Ground	
23	35.0			6.41	99.61	Ground	RB
24	37.0			6.13	99.89	Right pin	
25							
26	1.5		1.5	6.86		Bm	
27	1.75		2.0	7.05		Bankfull check – LB Bkf 7.05	
28	2.0		1.75	6.92			

31.3

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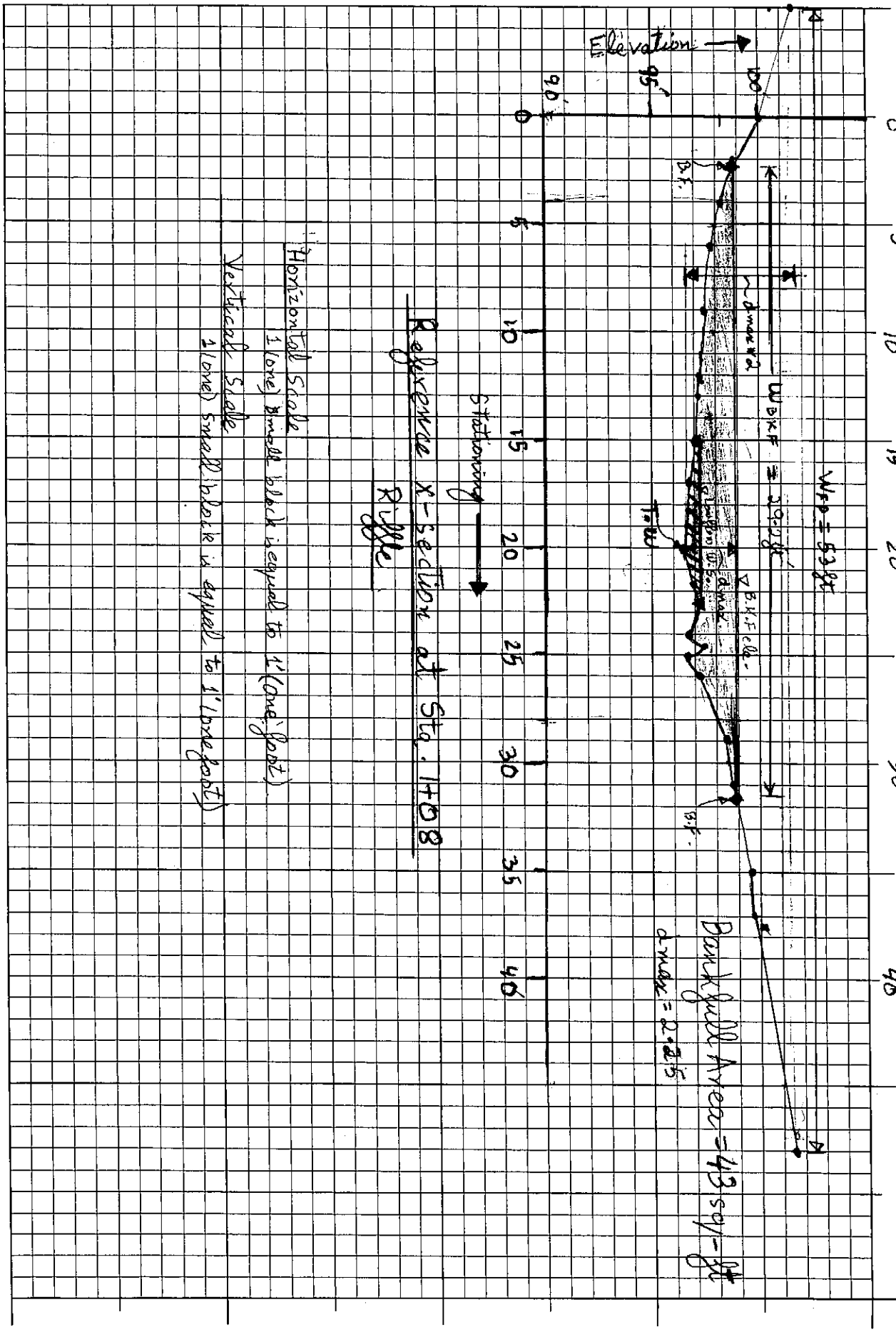
7.05 RB Bankful



Sharman's Branch
4/19/2016
Team 4

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Sharman's Branch
Team 4

cross section at 45 ft

SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: pool #2 uppermost Pool **Date:** 4/20/16

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
1	BM	8.95	108.95			
2	0.00			7.15	101.8	LB slope start
3	3.8			8.75	100.2	slope
4	8.6			9.58	99.37	
5	10.4			9.42	99.53	top of rock
6	11.7			9.68	99.27	dip of rock
7	12.2			9.77	99.18	LEW
8	13.4			9.64	99.31	bed
9	14.6			10.22	98.73	bed
10	16.9			10.25	98.7	bed
11	18.2			10.43	98.52	
12	19.5			10.0	98.95	rock
13	20.8			10.57	98.38	Thalweg
14	21.7			10.45	98.50	bed
15	22.2			9.68	99.27	Rock
16	22.9			10.56	98.39	slope break
17	24.5			10.24	98.71	" break
18	26.3			10.23	98.72	" break
19	27.6			9.90	99.05	REW
20	29.0			7.50	101.45	slope
21	33.9			6.78	102.17	slope
22	41.3			5.90	103.5	flat
23	45.5			5.41	103.54	
24						
25						
26						
27						
28						
29						
30						
31						

Questionable pool

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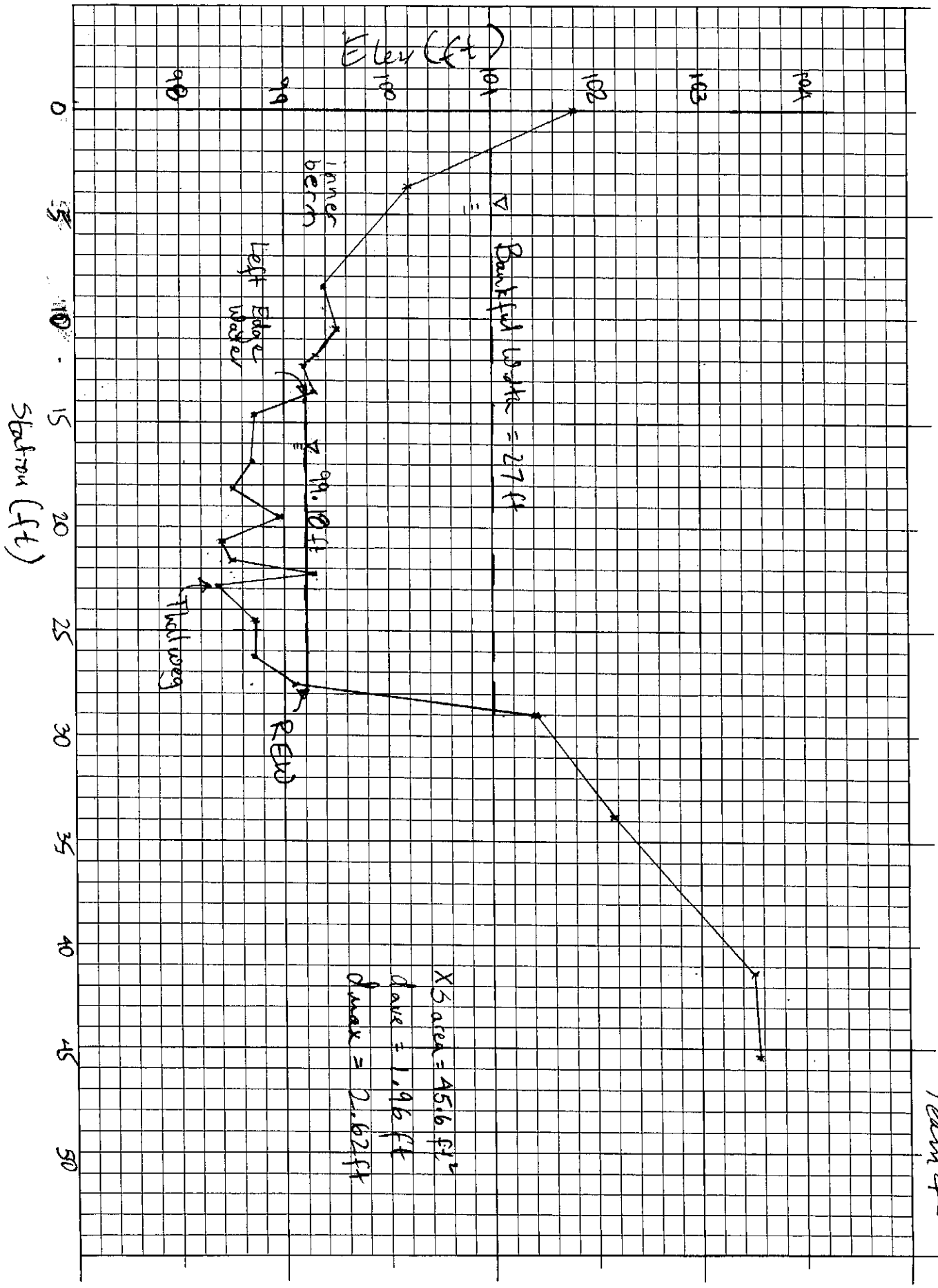

Cross Section 0+45 ft Pool

XS area = 45.6 ft²
dave = 1.96 ft
dmax = 2.62 ft

Sharmans Branch
4/19/2016
Team 4

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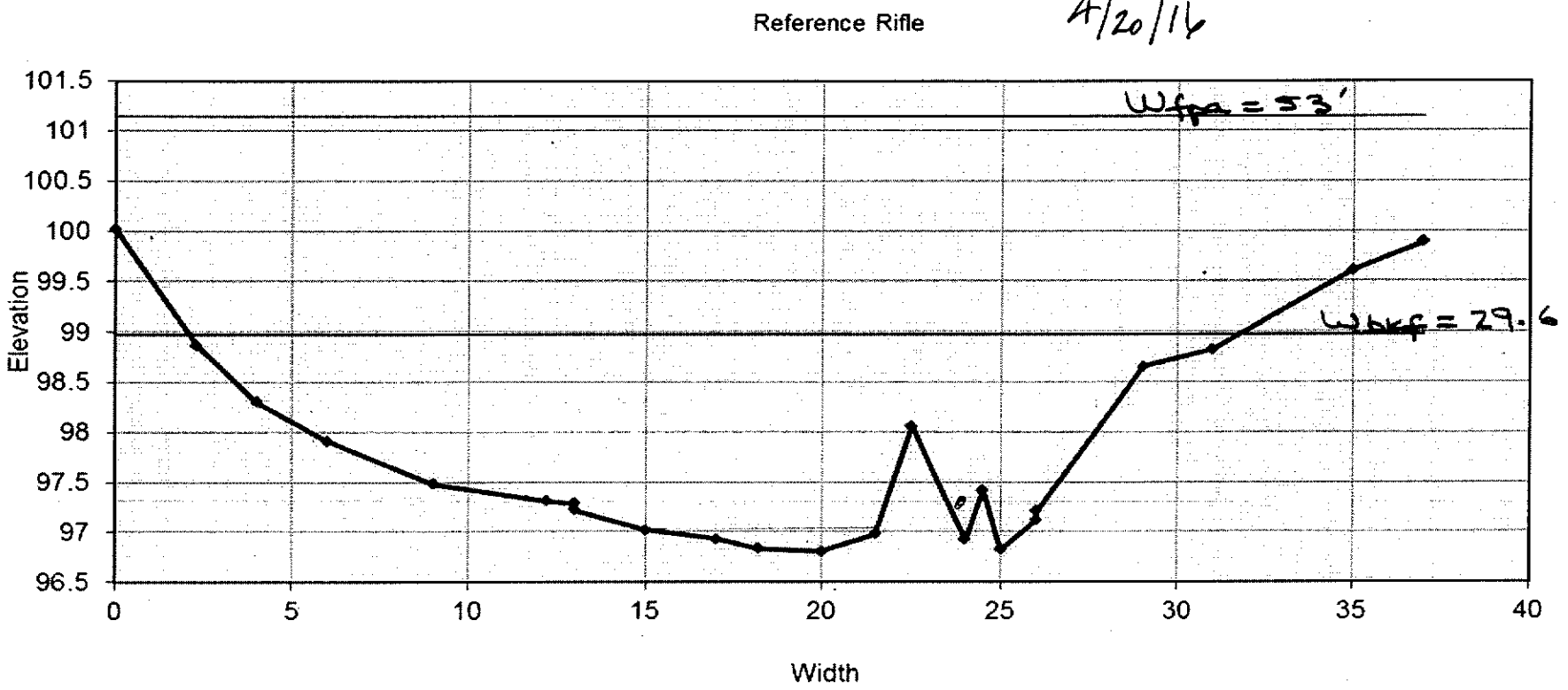
Sharman's Branch
Team 4
4/20/16



SURVEY DATA ⟹ **CROSS - SECTION** 6

SITE: Step / 1+28' Date: 4/20/16

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
1	0.0	6.02	106.02	6.97	99.1	LB start
2	2.0			8.04	98.0	slope
3	4.0			8.41	97.6	boulder - Top bank
4	7.0			8.34	97.7	Stream bank - on boulder
5	10.0			10.15	95.9	LEW
6	12.3			10.41	95.6	stream bottom
7	14.5			10.52	95.5	Thalweg
8	16.7			10.24	95.8	streambed
9	18.7			9.88	96.1	cobble
10	21.5			9.56	96.5	REW → go with
11	24.2			9.49	96.5	bank flat
12	27.0			8.28	97.7	slope RB
13	30.0			7.58	98.4	Top bank
14	30.9			7.49	98.5	RB break
15	34.8			6.87	99.2	slope break
16	37.5			6.26	99.8	slope
17	40.0			5.74	100.3	slope end
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

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Sherman's Branch

186 X .2 sq ft = 37.2 ft² XAREA Date: 4/20/2016

Dmax = 2.4 ft

DMEAN = 1.32 ft

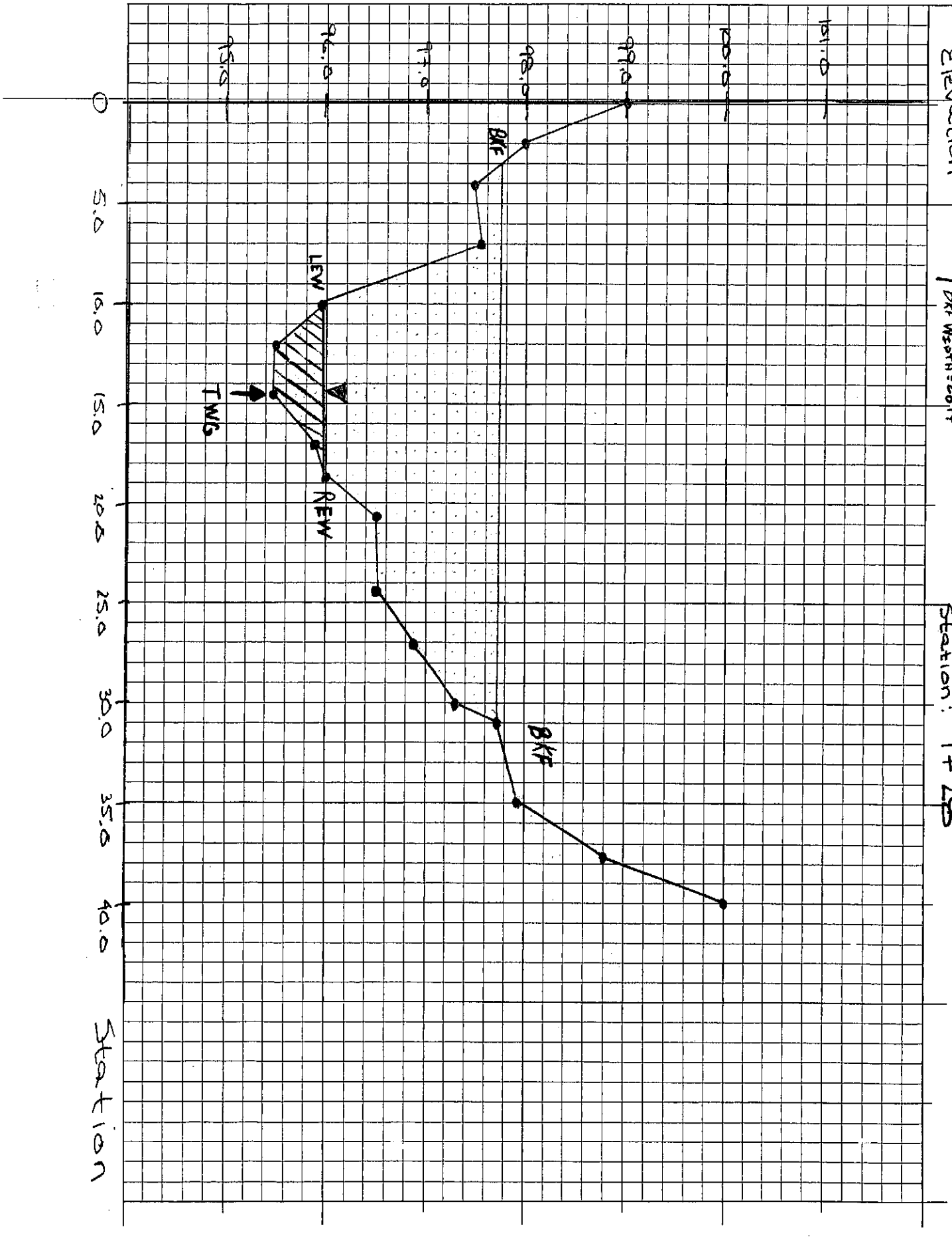
BKF WIDTH = 28 ft

Stream: Sharman's Branch

Feature: Step

Station: 1+28

Team 4



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Shaumans Branch Team 4 6x/21.5 = 2.46 2.54

SURVEY DATA ⟹ **CROSS - SECTION 3**

SITE: Riffle sta. 132+00 Date: 04/19/2016

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
1		8.46	108.46	~~8.46~~	108.46	
2	0			7.85	100.6	Bank shot.
3	2			10.35	98.1	Bank shot
4	6			10.55	97.9	B.K.F.
5	7.5			12.12	96.3	Ban
6	9			12.82	95.6	stream bed. Left edge water
7	13			12.6	95.9	stream bed.
8	15			13.05	95.4	Talwag
9	18			12.75	95.7	stream Bed
10	20			12.5	96.0	Right edge of water surface ele.
11	23			12.2	96.3	stream Bed.
12	26			11.1	97.4	slope break.
13	27.5			10.5	98.0	B.K.F
14	33.5			9.55	98.9	Bank shot
15	48			6.58	101.9	Last pt. Bank shot.
16	56			4.15	104.3	R.B Entrachment
17	-5			5.45	103.0	L.B Entrachment
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						98.9

13.05 10.5 2.55 ~~13.5~~ ~~10.5~~ ~~3.5~~ 7.

5.1 5.4.

~~4.15~~

6

33.5 6

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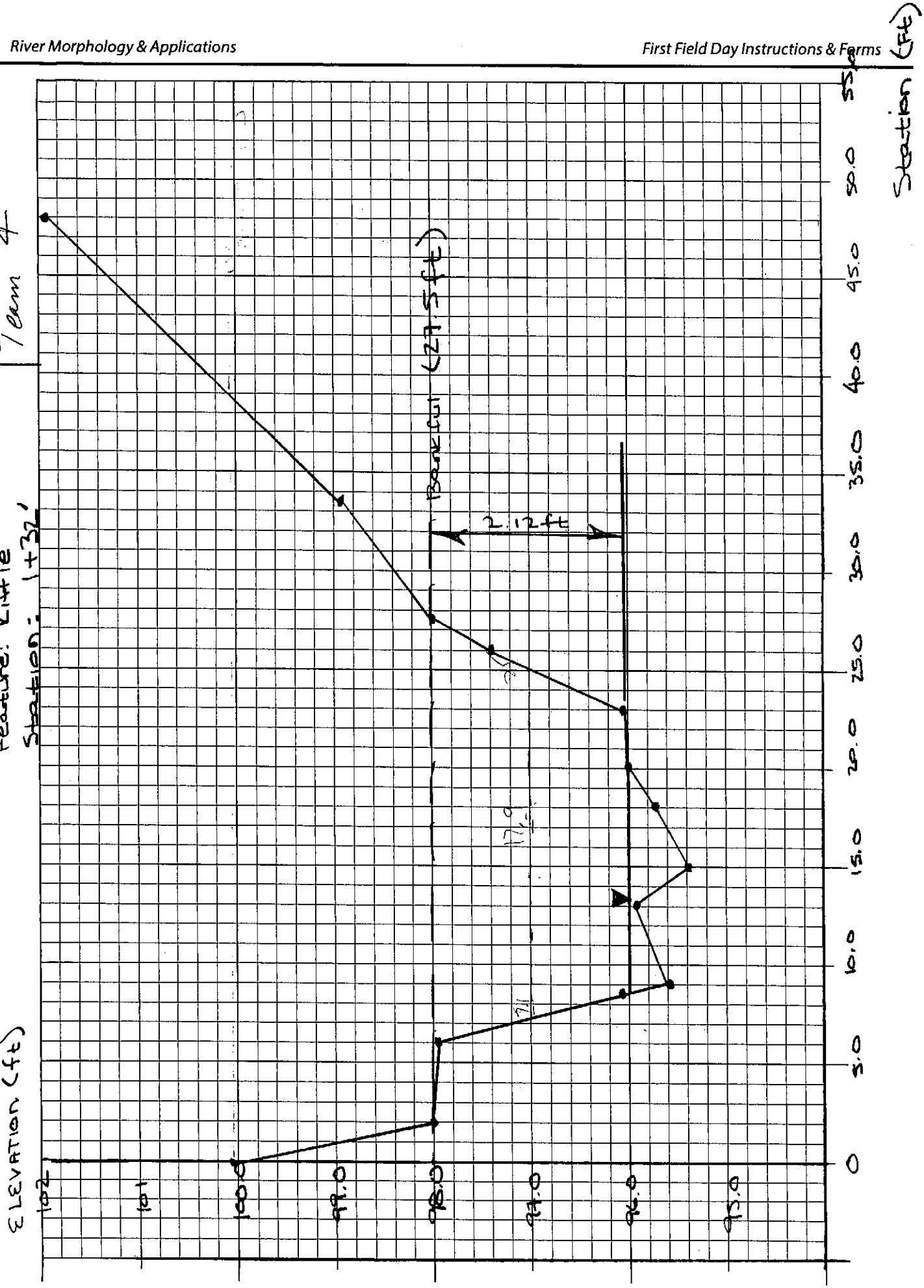
Date: 4/20/16
Stream: Sharman's Branch
Feature: Riffle
Station: 1+32'

Area = 32.4 ft²
dmax = 2.5 ft
Team 4



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SURVEY DATA ⟹ **CROSS - SECTION** 7

SITE: Step 2 It 37 Date: 4/20/2016

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
1	0.2	6.02	106.02	7.91	98.11	LB
2	1.4			7.71	98.32	Divit before top boulder
3	2.9			9.06	96.96	Edge of boulder
4	4.8			9.28	96.74	shelf between boulder
5	5.6			8.98	97.04	tree root
6	6.8			9.79	96.23	off tree root towards edge
7	8.3			10.01	96.01	LEW
8	8.5			10.10	95.92	
9	9.2			9.86	96.16	Rock edge
10	10.0			10.64	95.38	stream bed
11	11.2			10.26	95.76	boulder
12	12.4			10.78	95.24	Thalweg
13	13.2			10.13	95.89	boulder
14	15.2			10.36	95.66	bed - between boulders
15	16.0			10.10	95.92	boulder
16	16.8			10.33	95.69	off boulder
17	17.5			10.21	95.81	REW
18	18.1			9.71	96.31	boulder
19	18.7			10.04	95.98	off boulder
20	21.3			9.66	96.36	slope break
21	23.0			8.52	97.48	slope break
22	26.5			7.86	98.16	slope break
23	31.0			7.05	98.97	slope break
24						
25						
26						
27						
28						
29						
30						
31						

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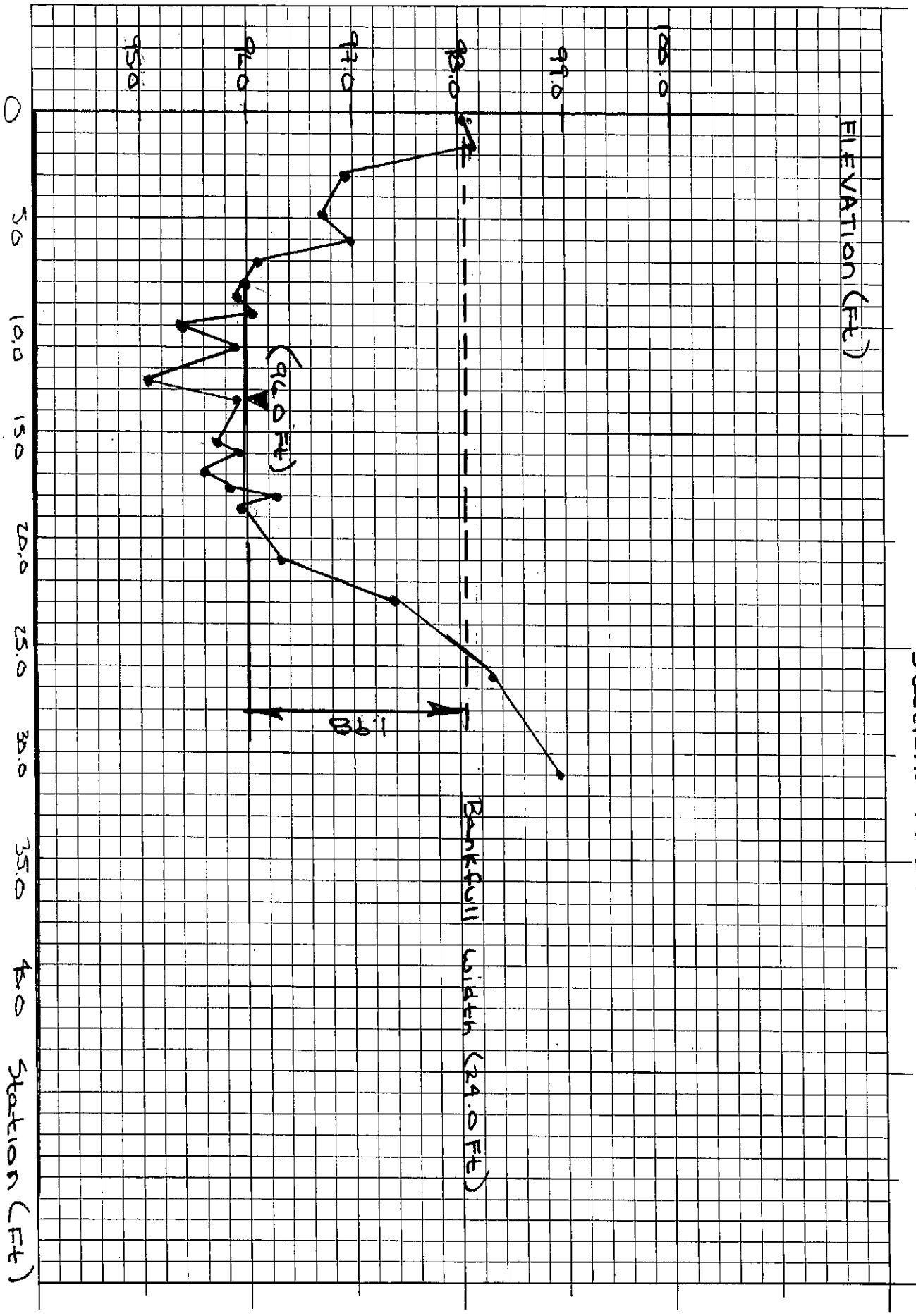
Team 4

Date: 4/20/2016
Stream: Sharman's Branch
Feature: Step
Station: 1+37'

Area = 38 ft²
d_{max} = 2.87 ft
d_{mean} = 1.94 ft



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SURVEY DATA ⟹ **CROSS - SECTION** 8

SITE: (Reference Pool) / 1+76' Date: 4/19/2012

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
1		6.02	106.02			Pool
2	1.0			11.29	94.73	Ground Shot
3	2.5			11.84	94.18	" " Slope
4	4.0			10.62	95.4	" " "
5	5.5			10.99	95.03	Ground shot
6	8.5			11.5	94.52	LEW - water surface
7	10.7			11.65	94.37	Channel bed
8	12.5			12.12	93.90	" "
9	15.0			11.69	94.33	" "
10	17.0			12.10	93.92	" "
11	19.0			11.98	94.04	" "
12	21.0			11.82	94.20	Channel bed
13	23.0			11.7	94.32	Channel bed
14	26.0			11.42	94.60	" " "
15	29.0			11.05	94.97	REW / water surface
16	30.0			10.88	95.14	Break in slope
17	31.0			9.94	96.08	Top of Bank
18	36.0			9.6 9.2	96.37 96.82	RB pin
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

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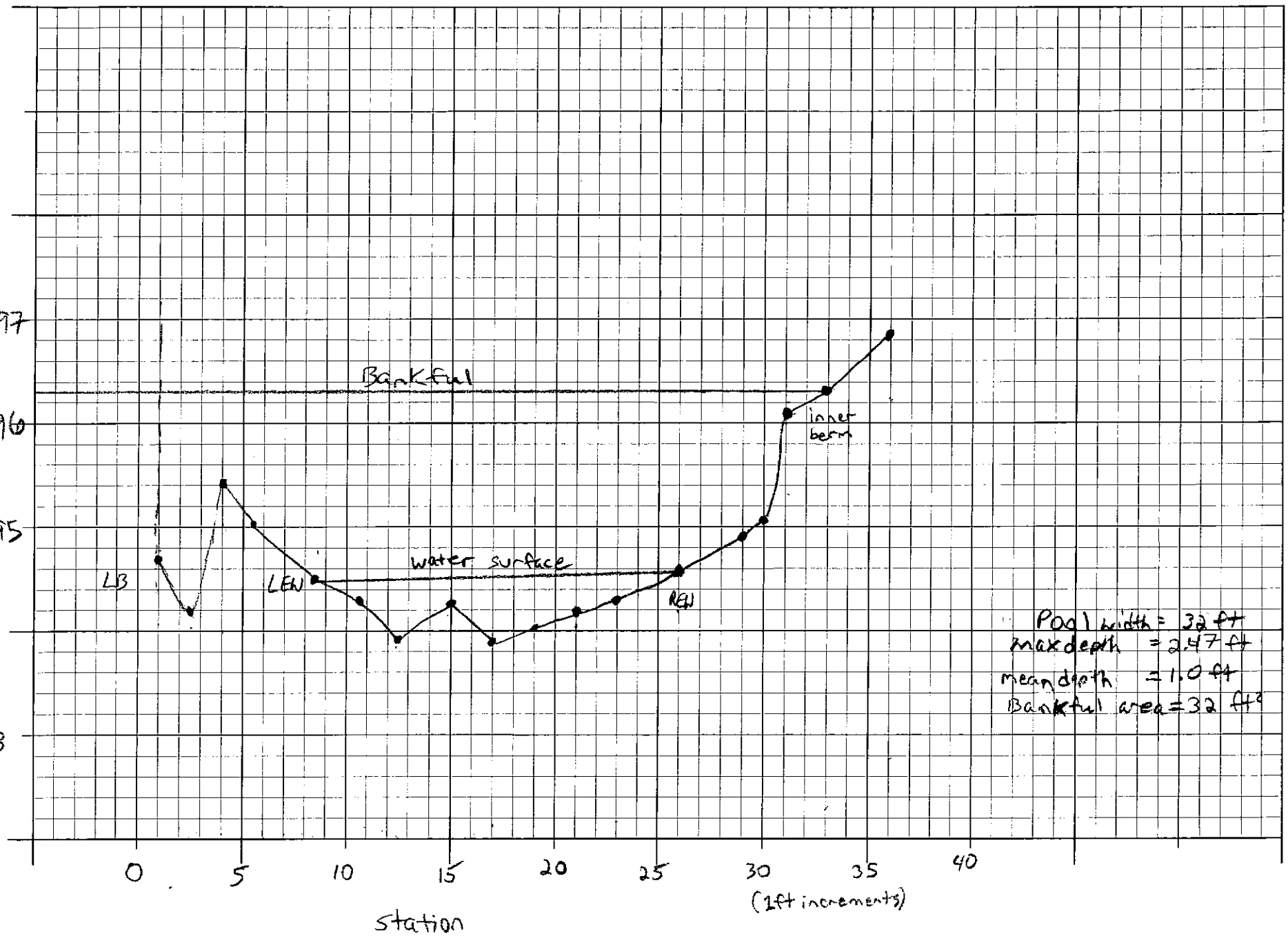
Station 176

Team 4 Sharman's Branch
Washington County, MD
4/19/2016

Pool



Pool width = 32 ft
max depth = 2.47 ft
mean depth = 1.0 ft
Bankful area = 32 ft²

(1ft increments)

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SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Sharman's Branch Team 4 **Date:** 4/19/2016

Location: Team 4

Observers: Mat, Neftalem, Tim **HUC:**

	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 Hl Fore-Sight FS (ft)	Low Bank Hl Elevation Elev. (ft)	NOTES e.g. Riffle Run Pool Glide
1	BM	8.47	108.47									
* 2	0+00			8.12	100.35	7.39	101.08	5.29	2.1 103.18			Riffle
3	+13			8.65	99.82	7.97	100.5					End Riffle Start Run
4	+21	CCP		8.71	99.76	8.13	100.34					End Run Start Pool
5	23.5	SP		8.96	99.51							Pool max
6	28.4			8.83	99.64	8.27	100.2					End Pool Begin step
7	28					8.49	99.98	6.72	101.75	1.77 ft		Bankfull * step
8	33.5			9.34	99.13	8.59	99.88					middle step
9	36			9.05	99.42							end of step
10	37.2	SP		10.14	98.33	9.24	99.23					Begin Pool Step Pool
11	51			10.09	98.38	9.38	99.09	7.77	100.7	1.8		End of Pool begin step
12	52.8			10.10	98.37	9.57	98.90	8.27	100.2	1.83 ft		XS step
13	62.7	SP		11.95	96.52	10.37	98.1					Pool max Step pool
14	74			10.92	97.55	10.36	98.11					End pool top Riffle
15	81			11.14	97.33	10.64	97.83					Riffle
16	85			11.32	97.15	10.60	97.87					End Riffle Pool
17	88.4			11.53	96.94	10.59	97.88					max pool depth Tiny pool
18	95.0			11.21	97.26							Top Riffle
19	108			11.77	96.7	11.23	97.24	9.20	2.03 99.27	OK		Riffle XS ref riff
20	123			12.35	96.12	12.07	96.4					Riffle
* 21	133			12.95	95.52	12.45	96.02	10.52 10.99	1.46 ft 97.48	1.93 97.95		Riffle
22	143.3			13.55	94.92	12.83	95.64					Run
23	154.5	Backwater pool		13.67	94.8	12.91	95.56					Top of End Run Pool
24	163			13.82	94.65	12.89	95.58					Pool max
25	169			13.27	95.2	13.13	95.34			1.64 ft		Top Step
26	173	SP		14.45	94.02	13.55	94.92	12.1	1.45 96.37	96.56		Bottom Step Top pool
27	176			14.66	93.81							XS pool Max d pool

Water 3.8% SFC

11.91

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SURVEY DATA → LONGITUDINAL PROFILE 2

SITE: Sharman's Branch Team 4 Date: 4/20/16

Location:

Observers: HUC:

	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
28	185			14.2	94.27	13.51	94.96					End of Pool E of Reach
29	BM	8.47	108.47									
30												
31	128			12.83	95.64	12.03	96.44	10.0	2.03 98.47			Dave Step XS #1
32	137			13.35	95.12	12.73	95.74					Dave Step XS #2
33												
34	99.4			11.61	96.86	11.17	97.3					Top of pool
35	107.3			11.76	96.71	11.16	97.31					max depth
36	133			13.05	95.42	12.45	96.02	10.33	2.12 98.14			
37	45			13.86	94.61	9.33	99.14					Pool max
38	88			11.53	96.94							Top
39	93			12.18	96.29							max dep
40	102			11.21	97.26							
41	54			11.58	96.89							
42	58			11.86	96.61							max dep
43	69.5			10.6	97.87							
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												

Cut Part

non long pro pools

45 - Conv

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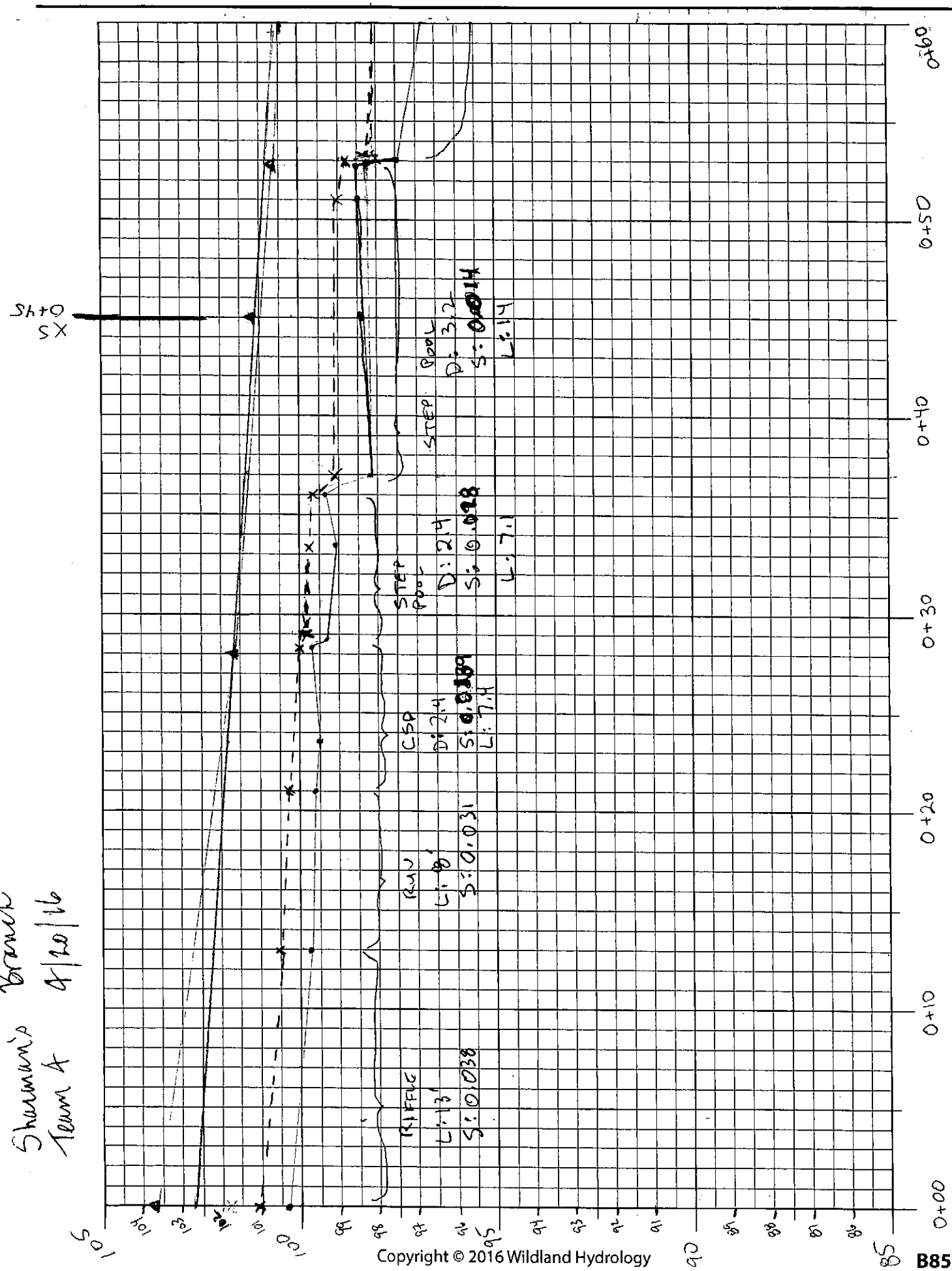

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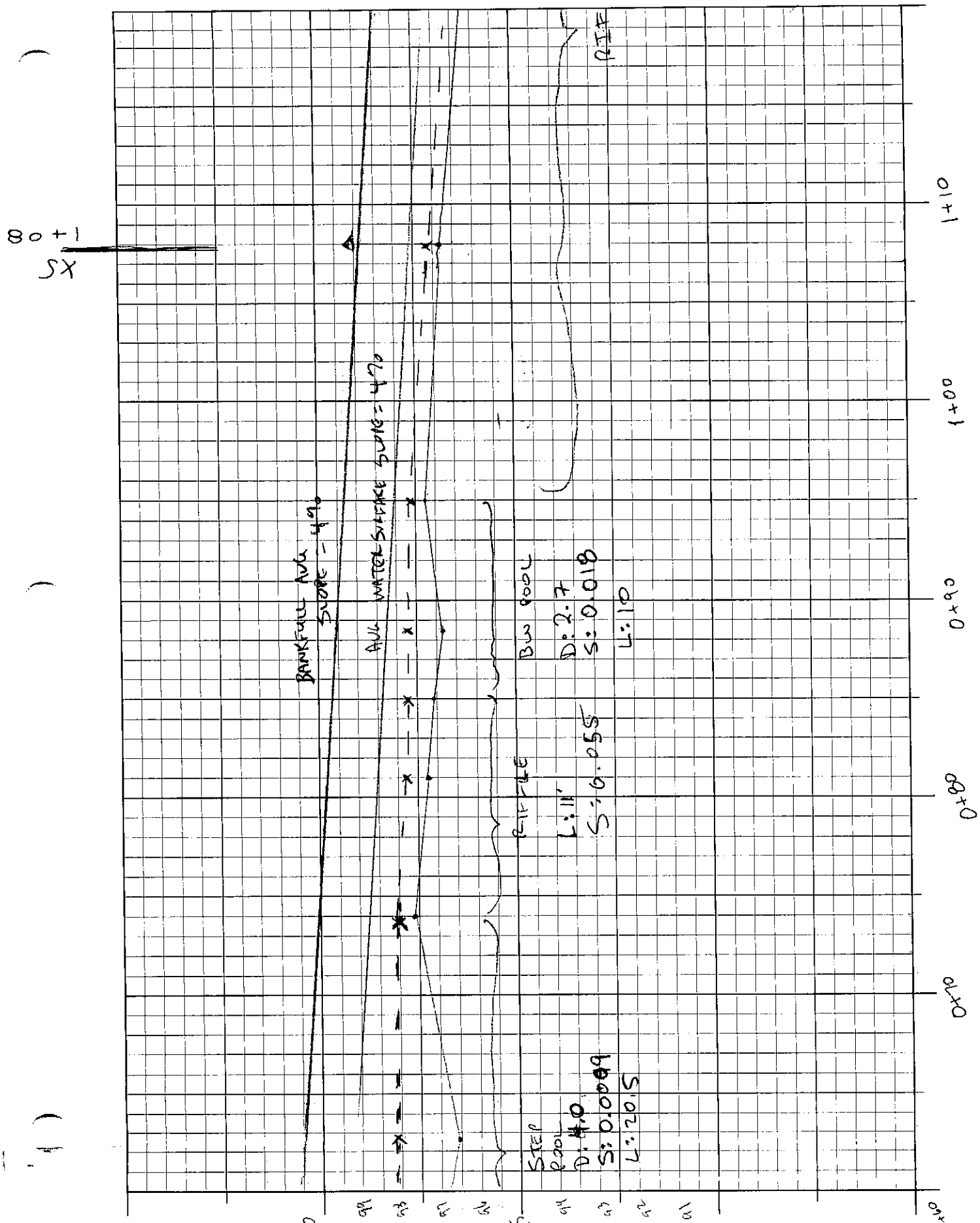

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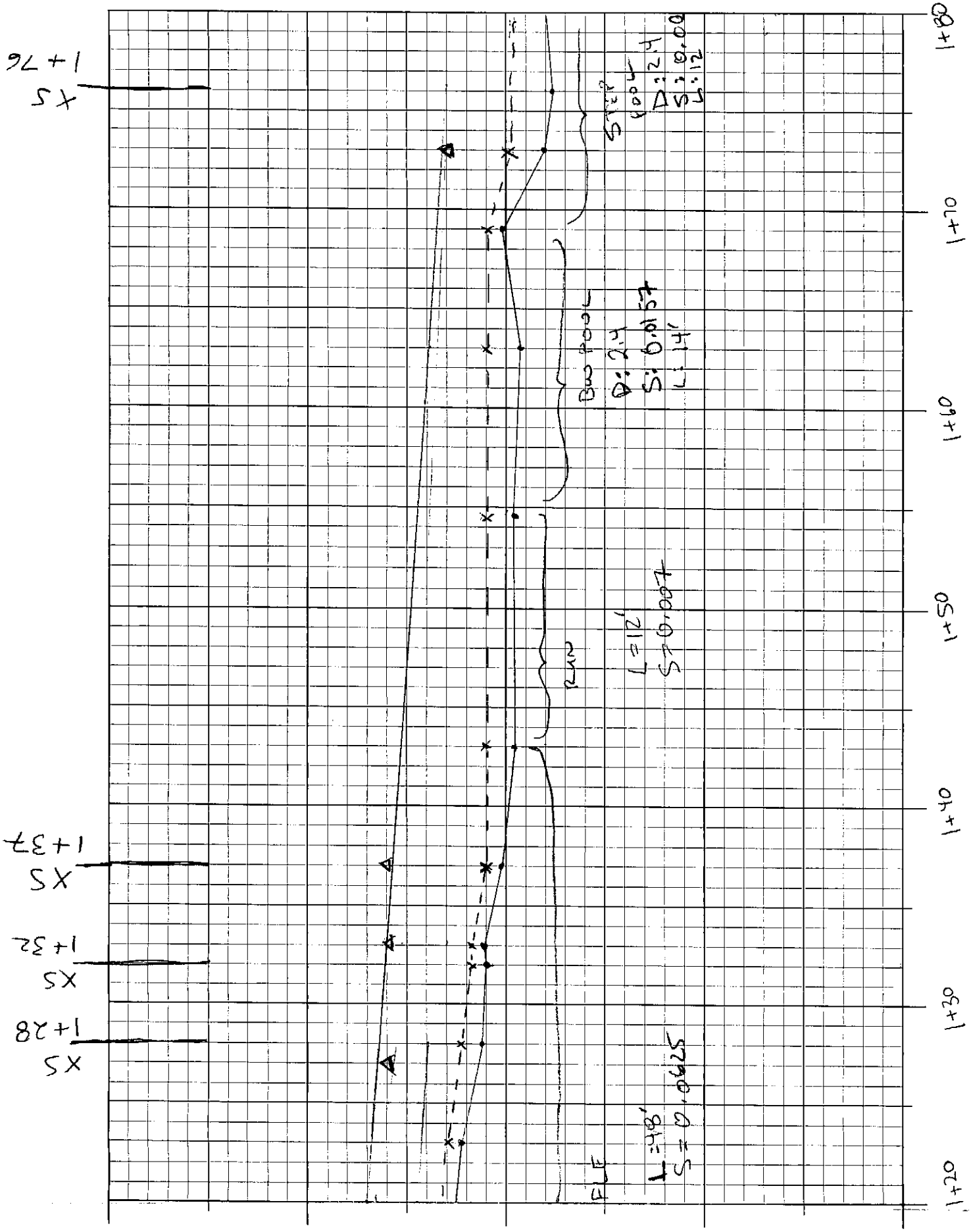

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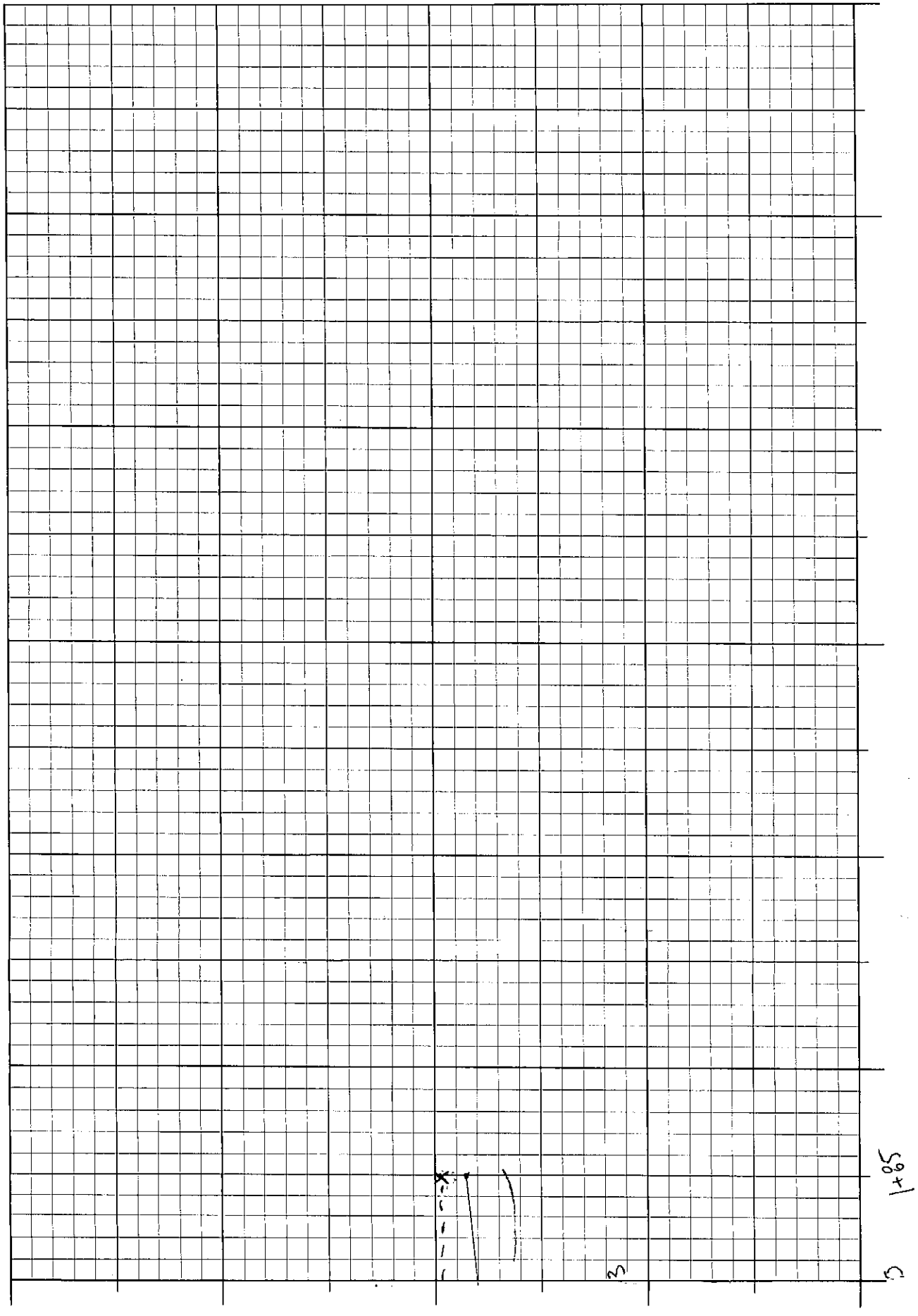

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Representative

riffle riffle riffle Pool Riffle riffle riffle pool Pool Pool
13, 32, 50, 64, 80, 137, 145, 162, 41, 17

Team 4
4/20/16

Site: Sharman's Branch near Sharpsburg, MD
Location: Reach 4 HUC:
Observers: B. Bendik, N. Bush

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 60 1	POOL 40 2	COMP. 3	RIFFLE (1) TOT #	ITEM %	% CUM	POOL (2) TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C		III					3	7.5	7.5	3	3	3
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND		I					1	2.5	10	1	1	4
	Medium	.25 - .50	SAND	I			1	1.7	3.7				1	1	5
	Coarse	.50 - 1.0	SAND	I	II		1	1.7	3.4	2	5.0	15	3	3	8
.04 - .08	Very Coarse	1.0 - 2	SAND												
.08 - .16	Very Fine	2 - 4	GRAVEL		I					1	2.5	17.5	1	1	9
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL	III			3	5.0	8.4				3	3	12
.31 - .44	Medium	8 - 11.3	GRAVEL	II			2	3.3	11.7				2	2	14
.44 - .63	Medium	11.3 - 16	GRAVEL	I	I		1	1.7	13.4	1	2.5	20	2	2	16
.63 - .89	Coarse	16 - 22.6	GRAVEL	I			1	1.7	15.1				1	1	17
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	II	III		1	1.7	16.8	3	7.5	27.5	4	4	21
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	IIII	III		4	6.7	23.5	3	7.5	35	7	7	28
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	~~IIII~~ II	IIII		7	11.7	35.2	4	10	45	11	11	39
2.5 - 3.5	Small	64 - 90	COBBLE	~~IIII~~ I	III		6	10	45.2	3	7.5	52.5	9	9	48
3.5 - 5.0	Small	90 - 128	COBBLE	~~IIII~~ I	~~IIII~~ II		6	10	55.2	7	17.5	70	13	13	61
5.0 - 7.1	Large	128 - 180	COBBLE	~~IIII~~ III	IIII		8	13.3	68.5	4	10	80	12	12	73
7.1 - 10.1	Large	180 - 256	COBBLE	~~IIII~~ I	IIII		6	10	78.5	4	10	90	10	10	83
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER	IIII			4	6.7	85.2				4	4	87
20 - 40	Medium	512 - 1024	BOULDER	~~IIII~~ II	IIII		7	11.7	96.9	4	10	100	11	11	98
40 - 80	Large-Vry Large	1024 - 2048	BOULDER	II			2	3.3	100.2				2	2	100
	Bedrock		BDRK												
						TOTAL→	60			40			100		

Stream Type: B 3/2 **Landscape Type:** C-AL-AD

Protrusion 6" in riffle

Protrusion 3" in pool

D50 = small cobble 90mm

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Protrusion
at active Riffle cross section 108

Team 4
4/20/16

Site:	Sharman's Branch near Sharpsburg, MD						RIFFLE (1)			POOL (2)			COMPOSITE (3)		
Location:	Reach 4	HUC:					Reach:			Reach:			Reach:		
Observers:	B. Bendik, N. Bush			Dot Count for			Date:			Date:			Date:		
Inches	PARTICLE	Millimeters		RIFFLE 1	POOL 2	COMP. 3	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8													
.31 - .44	Medium	8 - 11.3													
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6													
.89 - 1.3	Coarse	22.6 - 32													
1.3 - 1.8	Very Coarse	32 - 45													
1.8 - 2.5	Very Coarse	45 - 64													
2.5 - 3.5	Small	64 - 90	COBBLE	III			3	23.1	23.1						
3.5 - 5.0	Small	90 - 128													
5.0 - 7.1	Large	128 - 180		II			2	15.4	38.5						
7.1 - 10.1	Large	180 - 256		~~IIII~~ I			6	46.2	84.7						
10.1 - 14.3	Small	256 - 362	BOULDER	I			1	7.7	92.4						
14.3 - 20	Small	362 - 512		I			1	7.7	100.1						
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type: B 3/2			**Landscape Type:** C-AL-AD			TOTAL→	13								

Protrusion
8", 9", 11", 8", 7.5", 15", 9", 6", 3", 7", 8.5", 3", 3"

D84 = 256 mm

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Active BED cross section
Riffle 108

Team 4
4/20/16

Site:	Sherman's Branch near Sharpsburg, MD						RIFFLE (1)			POOL (2)			COMPOSITE (3)		
Location:	Reach 4	HUC:					Reach:			Reach:			Reach:		
Observers:	B. Bendik, N. Bush			Dot Count for			Date:			Date:			Date:		
Inches	PARTICLE	Millimeters		RIFFLE 1	POOL 2	COMP. 3	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C	卌 |			6	6.9	6.9						
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25		|			|	1.1	8.0						
	Medium	.25 - .50													
	Coarse	.50 - 1.0		|			|	1.1	9.1						
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL	|			|	1.1	10.2						
.16 - .22	Fine	4 - 5.7		|			|	1.1	11.3						
.22 - .31	Fine	5.7 - 8		|			|	1.1	12.4						
.31 - .44	Medium	8 - 11.3		||			2	2.3	14.7						
.44 - .63	Medium	11.3 - 16		|||			3	3.4	18.1						
.63 - .89	Coarse	16 - 22.6		卌			5	5.7	23.8						
.89 - 1.3	Coarse	22.6 - 32		||||			4	4.6	28.4						
1.3 - 1.8	Very Coarse	32 - 45		卌 |||			8	9.2	37.6						
1.8 - 2.5	Very Coarse	45 - 64		卌 |||			8	9.2	46.8					
2.5 - 3.5	Small	64 - 90	COBBLE	卌 卌			10	11.5	58.3						
3.5 - 5.0	Small	90 - 128		卌 |||			8	9.2	67.5					
5.0 - 7.1	Large	128 - 180		卌 |||			9	10.3	77.8					
7.1 - 10.1	Large	180 - 256		卌			5	5.7	83.5						
10.1 - 14.3	Small	256 - 362	BOULDER	卌 |			6	6.9	90.4						
14.3 - 20	Small	362 - 512		卌			5	5.7	96.1						
20 - 40	Medium	512 - 1024		|||			3	3.4	99.5					
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type: B 3/2			**Landscape Type:** C-AL-AD			TOTAL→	87								

D 84 = 256 mm

D84 ft = 256 mm / 304.8 = 0.84 ft

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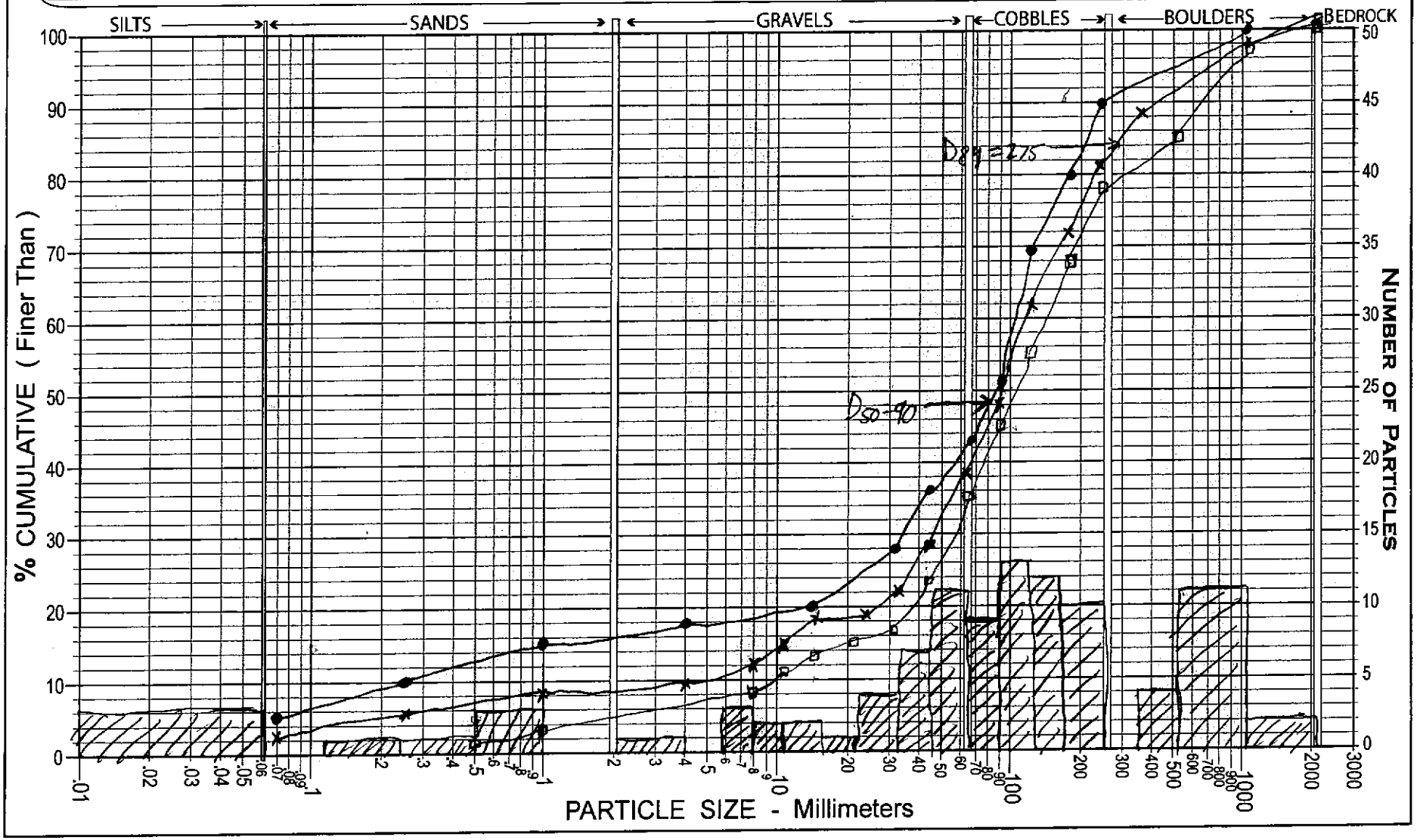
Representative Team 4

PEBBLE COUNT DATA

LOCATION: Sharman's Branch
Date: 4/19/2016
REACH: 4
Observers: Beth Bendik, Nick Bush
Stream Type: B3/2
Landscape Type: C-AL-AD
HUC:



Pool
Riffle
Total

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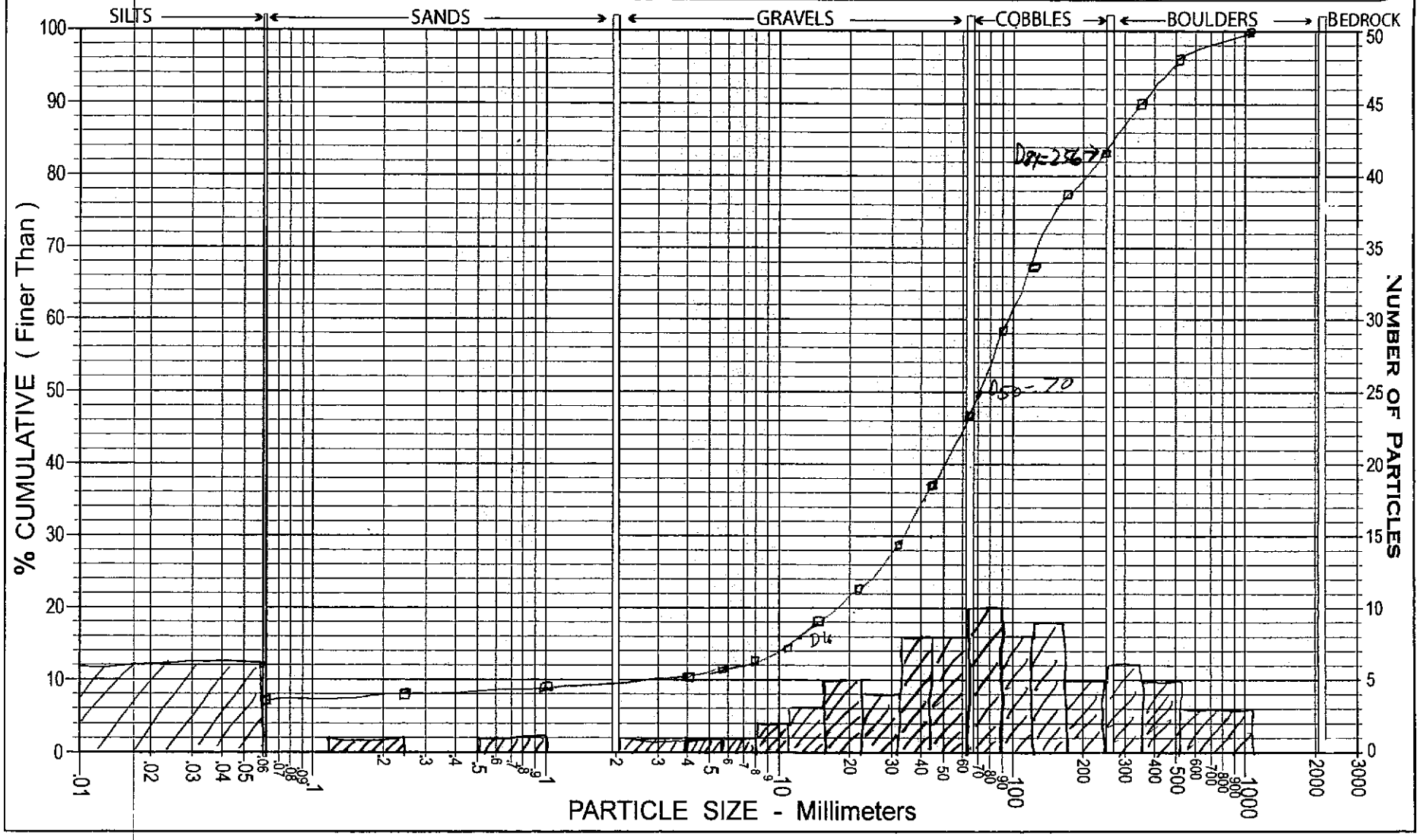
Active Cross Section
Riffle 108

Team 4

PEBBLE COUNT DATA

LOCATION: Sharman's Branch near Sharpsburg, MD
Date: 4/19/2016
REACH: 4
Observers: B. Bendik, N. Bush
Stream Type: B3/2
Landscape Type: C-AL-AD
HUC:



Riffle

$D_{84} = 256_{mm}$

$D_{50} = 70_{mm}$

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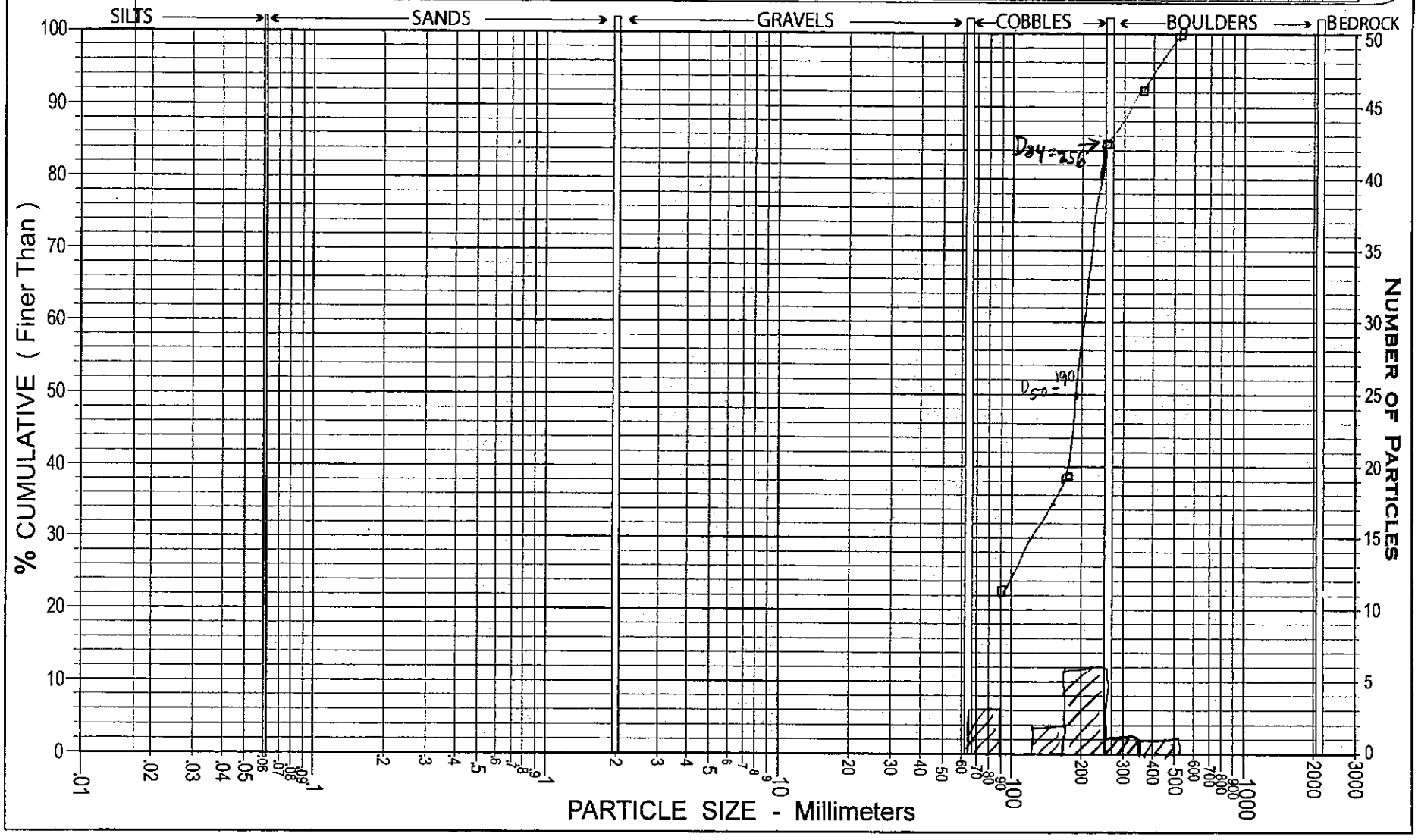
Protrusion
at active riffle cross section 108
Team 4

PEBBLE COUNT DATA

LOCATION: Sherman's Branch near Sharpsburg, MD
Date: 4/19/2016
REACH: 4
Observers: B. Bendix, N. Bush
Stream Type: B 3/2
Landscape Type: C-AL-AD
HUC:



D84 = 256mm
D50 = 190mm

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Sherman's Branch	Location:	confined colluvial
Date: 4/19/16	Stream Type: B3/2	Landscape Type:	~~G-AL-AD~~ C-CO-US
Observers:	TEAM 4	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	43	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.47	d_{bkf} (ft)
Bankfull Riffle Width	29.2	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$	32.14	W_p (ft)
D_{84} Particle Size at Riffle	256	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	0.84	D_{84} (ft)
Bankfull Slope	.04	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.34	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	1.60	R / D_{84} (ft / ft)
Drainage Area	3.6	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	~~1.60~~	u^* (ft / sec)

1.31

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE		
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	5.21	ft / sec	224.0	cfs	
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. B-34, B-35) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .07 (.05)	6.24 (5.17)	ft / sec	222.3	cfs	268.3
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. B-36) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .058	6.24	ft / sec	2.68	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 $n =$ .109	3.31	ft / sec	142	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 Q: Q = ____ year		ft / sec		cfs	
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$		ft / sec		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-1. Field Form for Level II Stream Classification (*First Field Day*).

Stream: Sherman's Branch			
Basin:	Drainage Area:	acres	3.6 mi²
Location:			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: 4/19/16	
Observers: Team 4		Landscape Type: C-AL-AS	

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	29.2	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.47	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	43	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	19.9	ft/ft
Bankfull 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.	2.25	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	53	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	1.82	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
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	.004	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	1.09	ft/ft

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

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

Stream: Sherman's Branch Location: C-CO-US

Observers: Team 4 Date: 4 19 2016 Landscape Type: C-ALAP Stream Type: B3/2

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios***	Mean	Min.	Max.
Riffle Width (W_{bkf})	29.2	27.5	29.2	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	43	38.4	43
Riffle Mean Depth (d_{bkf})	1.47	1.47	2.12	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	29.2	27.5	29.2
Riffle Maximum Depth (d_{max})	2.25	2.12	2.25	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	1.53	1.41	1.06
Width of Flood-Prone Area (W_{fpa})	53	53	61	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.82	1.93	2.10
Riffle Inner Berm Width (W_{ib})	21.8	17.9	21.8	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	.75	.65	.75
Riffle Inner Berm Depth (d_{ib})	1	1	1	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	.68	.68	.47
Riffle Inner Berm Area (A_{ib})	15	15	21	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	.35	.39	.49
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})	21.8	17.9	21.8					

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios***	Mean	Min.	Max.
Pool Width (W_{bkfp})	33.5	31	35	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	1.06	.92	1.2
Pool Mean Depth (d_{bkfp})	1.48	1.0	1.96	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	1.28	1.22	1.33
Pool Cross-Sectional Area (A_{bkfp})	38.9	32.2	45.6	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	.91	.75	1.06
Pool Maximum Depth (d_{maxp})	2.55	2.47	2.62	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	1.06	.96	1.16
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})		–	–

NA

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				

NA

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 Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios***	Mean	Min.	Max.
Step Width (W_{bkfs})	26	24.0	28.0	ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})	.89	.82	.96
Step Mean Depth (d_{bkfs})	1.63	1.32	1.94	ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})	1.11	.90	1.32
Step Cross-Sectional Area (A_{bkfs})	37.6	37.2	38	ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})	.875	.87	.88
Step Maximum Depth (d_{maxs})	2.64	2.4	2.87	ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})	1.19	1.1	1.28
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})	16.31	14.43	18.18	ft/ft				

*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: SHACKMAN'S BRANCH Location: REACH 4

Observers: Team 4 Date: 4/19/16 Landscape Type: C-CO-VS Stream Type: B3/2

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	3.31	ft/sec	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	142	cfs	Drainage Area		mi^2

Channel Pattern

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})	28.7	28	29.3	ft	Meander Width Ratio (W_{blt} / W_{bkf})	1.00	[illegible]	1.00
Arc Length (L_a)				ft	Arc Length to Riffle Width (L_a / W_{bkf})			
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	0.044	ft/ft	Average Water Surface Slope (S)	0.04	ft/ft	Sinuosity (S_{val} / S)	—	
Stream Length (SL)	185	ft	Valley Length (VL)	170	ft	Sinuosity (SL / VL)	1.09	
Low Bank Height (LBH) start	2.1	ft	Bankfull Max Depth (d_{max}) start	2.1	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start	1	
Low Bank Height (LBH) end	2.1	ft	Bankfull Max Depth (d_{max}) end	2.1	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) end	1	

Riffle Slope (S_{rif})	0.052	0.04	0.06	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	1.3	[illegible]	1.5
Run Slope (S_{run})	0.013	0.007	0.02	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	0.33	0.18	0.5
Pool Slope (S_p)	0.014	0.001	0.018	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.35	0.03	0.45
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)	0.66	0.2	1	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	16.5	5	25
Max Riffle Depth (d_{max})	2.3	2	2.5	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.56	1.36	1.7
Max Run Depth (d_{maxr})	2.5	2.5	2.5	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.7	1.7	1.7
Max Pool Depth (d_{maxp})	2.79	2.4	4.0	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.9	1.63	2.72
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})	3.0	2.5	3.5	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	2.04	1.7	2.38

Channel Materials

% Silt/Clay	3	6.9		D_{16}	16	13		40	mm
% Sand	5	2.2		D_{35}	55	42		160	mm
% Gravel	31	37.7		D_{50}	90	70		190	mm
% Cobble	44	36.7		D_{84}	275	256		256	mm
% Boulder	17	16		D_{95}	700	495		400	mm
% Bedrock	0	0		D_{100}	2048	1024		512	mm

[a] *Mean*, *Min*., and *Max*. depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and 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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Worksheet B-4. Dimensionless ratios of the ten pool types (*First Field Day*).

Stream: Sherman's Branch Location: Confined-colluvial-U-shaped

Observers: Team 4 Stream Type: B3/2 Landscape Type: CALAD Date: 4/19/2016

Pool Type		Dimensional Values: Pool Length (L_p)	Pool Max Depth (d_{maxp})	Pool Slope (S_p)	Dimensionless Ratios: Pool Length to Riffle Width (L_p/W_{bk})	Pool Max Depth to Riffle Mean Depth (d_{maxp}/d_{bk})	Pool Slope to Average Slope (S_p/S)
1. Lateral Scour Pool (LSP)	Mean						
	Min.						
	Max.						
2. Contraction Scour Pool (CSP)	Mean	11.2	2.45	0.014	0.38	1.25	0.35
	Min.	7.4	2.4	0.01	0.25	1.22	0.25
	Max.	15	2.5	0.0189	0.51	1.27	0.47
3. Step/Pool (SP)	Mean	13.4	3	0.01	0.46	1.53	0.25
	Min.	7.1	2.4	0.004	0.24	1.22	0.1
	Max.	20.5	4	0.014	0.70	2.04	0.35
4. Backwater Pool (BWP)	Mean	12	2.55	0.017	0.41	1.30	0.425
	Min.	10	2.4	0.016	0.34	1.22	0.4
	Max.	14	2.7	0.018	0.48	1.38	0.45
5. Plunge Pool (PP)	Mean						
	Min.						
	Max.						
6. Pocket Water Pool (PWP)	Mean						
	Min.						
	Max.						
7. Lateral Protrusion Pool (LPP)	Mean	7.9	2.5	0.001	0.27	1.28	0.025
	Min.	7.9	2.5	0.001	0.27	1.28	0.025
	Max.	7.9	2.5	0.001	0.27	1.28	0.025
8. Straight Dissipator Pool (SDP)	Mean						
	Min.						
	Max.						
9. Converging Confluence Pool (CCP)	Mean						
	Min.						
	Max.						
10. Compound Pool (CP)	Mean						
	Min.						
	Max.						

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Team 4 Sharman's Branch
4/20/16

Table B-1. List of morphological relations and variables to estimate for the ***First Field Day***.

Estimate the Following Morphological Relations and Variables			
1. Bankfull Riffle Width (W_{bkf}) (ft)	29.2	2. Bankfull Riffle Mean Depth (d_{bkf})	1.47
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	19.9	4. Bankfull Riffle Cross-Sectional Area (A_{bkf})	43
5. Width of Flood-Prone Area (W_{fpa})	53	6. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	1.82
7. Sinuosity (k)	1.09	8. Average Water Surface Slope (S)	.004
9. D_{50} Particle Size for Reach	90	10. Bankfull Discharge (Q_{bkf})	142
11. Landscape Type	C-CO-US ~~C-AL-AD~~	12. Stream Type	B3/2

Table B-2. List of morphological relations and variables to estimate for the ***Second Field Day***.

Estimate the Following Morphological Relations and Variables			
1. Bankfull Riffle Width (W_{bkf}) (ft)		2. Bankfull Riffle Mean Depth (d_{bkf})	
3. Width/Depth Ratio (W_{bkf} / d_{bkf})		4. Bankfull Riffle Cross-Sectional Area (A_{bkf})	
5. Width of Flood-Prone Area (W_{fpa})		6. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	
7. Sinuosity (k)		8. Average Water Surface Slope (S)	
9. D_{50} Particle Size for Reach		10. Bankfull Discharge (Q_{bkf})	
11. Landscape Type		12. Stream Type	

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