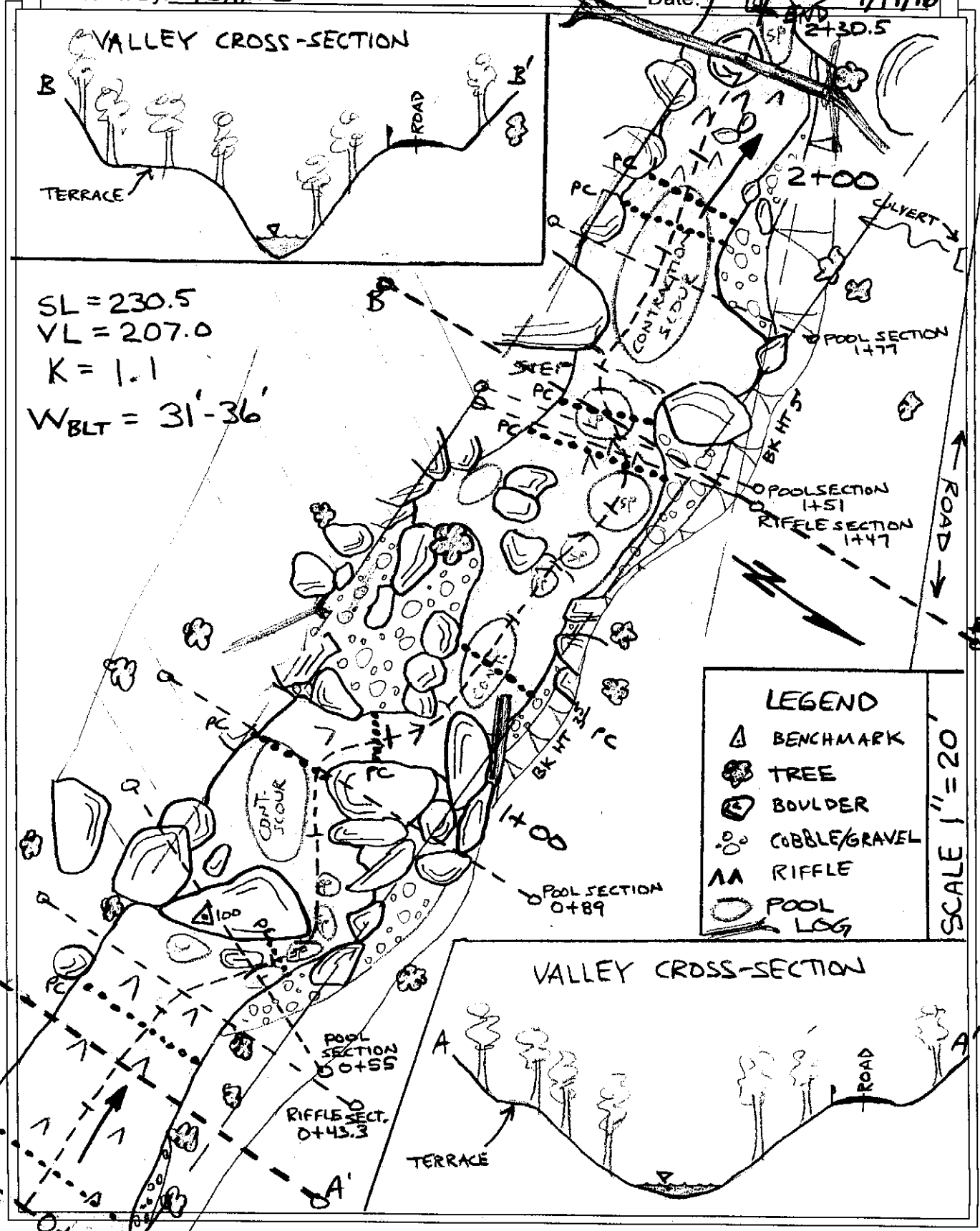
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: SHARMANS BRANCH Site/Reach:

Drawn By: TEAM 2 Date: 4/19/16



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SURVEY DATA ⟹ **CROSS - SECTION** 3

SITE: Team 2 Riffle @ Sta 43.3 **Date:** 4/19/16

@ 43.3

Long pro

Bankfull @

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
1		5.36	105.36			
2	0			2.40	102.96	Left End PIN
3	1.6			3.06	102.30	back Terrace
4	5.0			3.59	101.77	
5	5.9			3.79	101.57	Edge of terrace
6	7.3			4.57	100.79	Bankfull ? RL
7	8.2			5.67	99.69	~~Face of slope~~
8	9.4			6.05	99.31	
9	10.0			6.53	98.83	LWE
10	11.5			6.69	98.67	
11	12.4			6.81	98.55	
12	14.0			6.76	98.60	
13	15.1			6.52	98.84	
14	16.0			6.44	98.92	
15	17.2			6.42	98.94	
16	18.4			6.38	98.98	
17	19.5			6.43	98.93	
18	21.3			6.44	98.92	
19	23.0			6.61	98.75	
20	24.3			6.83	98.53	-thalwg - 0.4 H_2O
21	25.9			6.58	98.78	
22	27.6			6.34	99.02	RWE
23	29.9			6.22	99.14	Bottom Dry
24	31.4			4.67	100.69	-on root-
25	32.4			4.65	100.71	Bankfull RR ?
26	33.0			4.48	100.88	Bankfull RR ? base of tree
27	35.8			4.60	100.76	behind tree
28	37.6			4.69	100.67	
29	39.2			5.12	100.24	
30	42.0			5.14	100.22	
31	46.0			5.31	100.05	back of floodplain

Over

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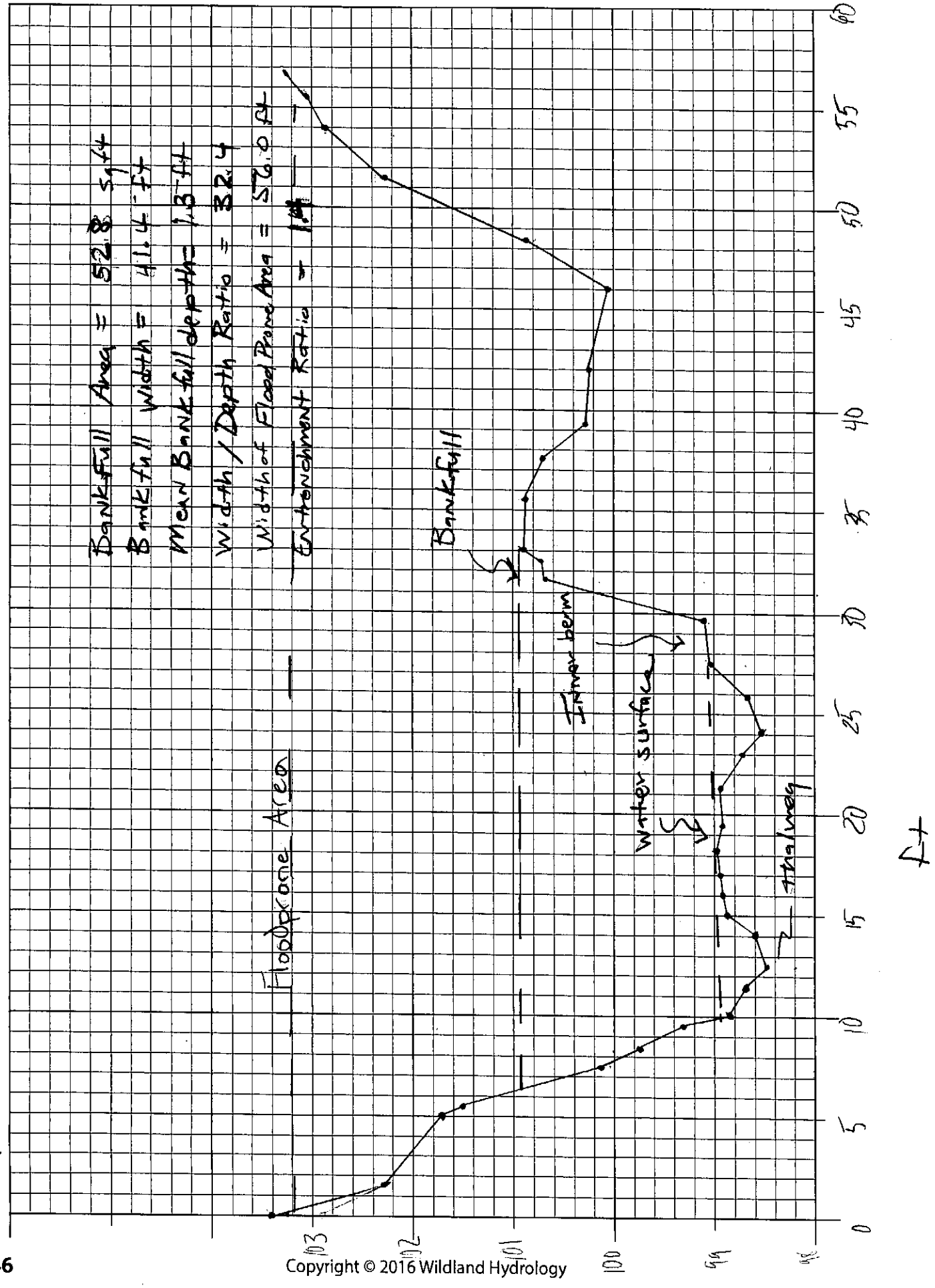
Top of Reach

Riffle @ Sta. 0+43.3

Team 2

4/17/16



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SURVEY DATA ⟹ **CROSS - SECTION** 1

SITE: Team 2 Date: 4/19/16

Location: Riffle @ ~~1+51~~ 1+47

Observers: MP / SH 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		~~5.36~~	~~105.36~~			
2	~~0~~			~~6.90~~		
3	~~4~~			~~9.97~~		~~Base of rock~~
4	~~7~~			~~8.72~~		~~Top of Rock~~
5			2.15	~~10.26~~	102.15	
6	1			4.37	97.78	
7	3			6.00	96.15	bankfull
8	4.5			6.15	96.00	
9	6.0			5.28	96.87	
10	7.8			7.85	94.30	
11	12.6			7.95	94.20	
12	13.0			8.18	93.97	E of W
13	15.8			8.66	93.49	
14	17.4			8.25	93.90	
15	20.9			8.06	94.09	
16	21.5			8.61	93.54	
17	24.0			8.15	94.00	
18	25.6			7.91	94.24	
19	27.7			8.04	94.11	
20	31.0			8.10	94.05	
21	33.0			7.67	94.48	Edge of water
22	39.0			6.00	96.15	bankfull
23	41.0			2.45	99.70	
24						
25						
26						
27						
28						

~~5.36~~

11.77

10.09

2.45

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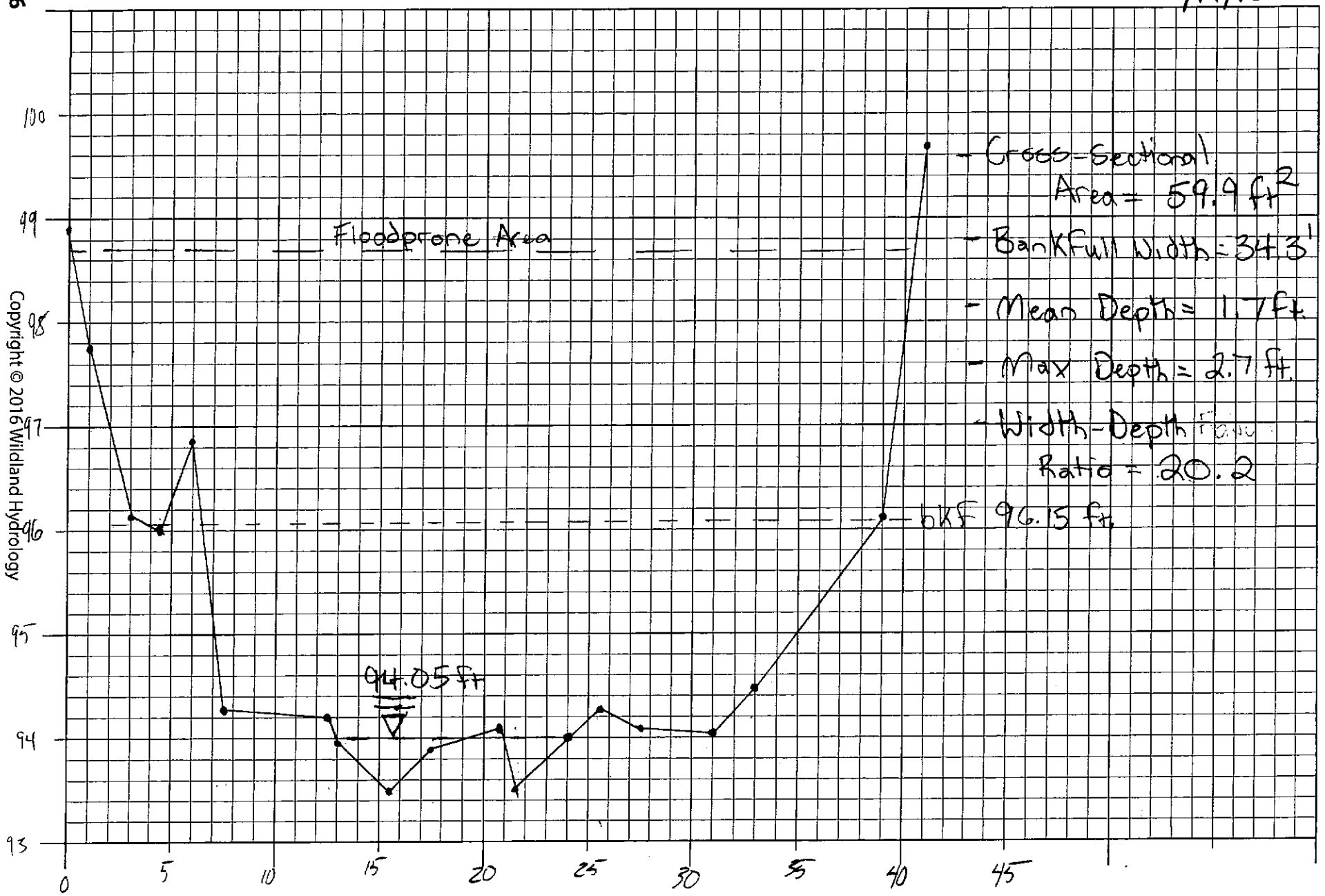
Representative Riffle @ 1+47

Team 2
4/19/16



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SURVEY DATA ⟹ **CROSS - SECTION** 6

SITE: Team 2 Step Pool 1+51 **Date:** 4/19/16

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
1		5.36	105.36			
2	0			8.91	96.45	
3	0.5			10.21	95.15	
4	3.04			10.13	95.23	
5	6.2			11.70	93.66	
6	11.2			11.78	93.58	
7	13.0			11.90	93.46	L edge of water
8	16.0			12.33	93.03	
9	17.4			12.53	92.83	
10	19.7			12.38	92.98	
11	22.7			12.23	93.13	
12	23.7			11.90	93.46	R edge of water
13	25.8			11.38	93.98	
14	30.3			11.07	94.29	
15	36.0			8.60	96.76	
16	37.0			6.24	99.12	
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

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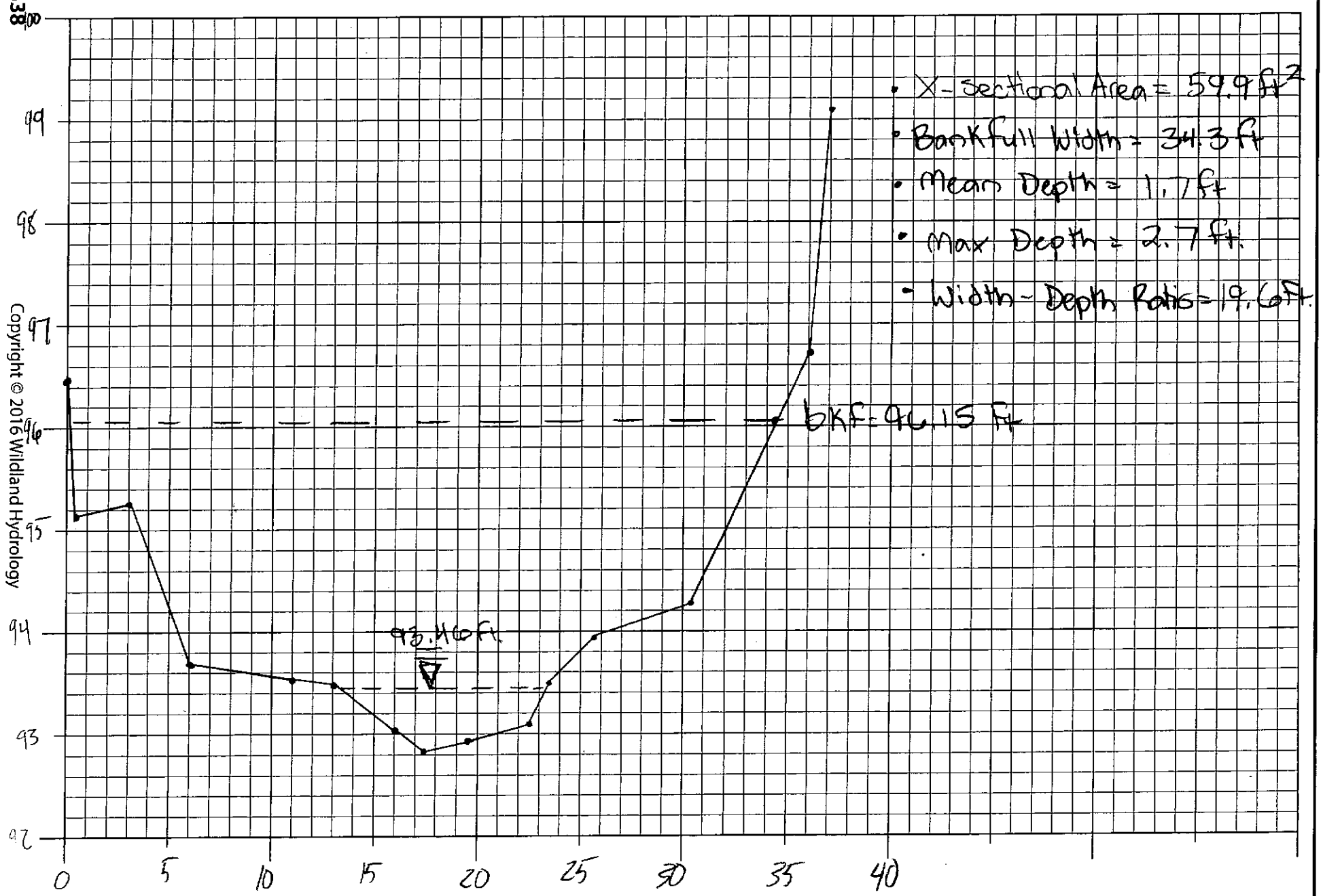
Team 2
4/19/16

Step Pool @ 1+51



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SURVEY DATA ⟹ **CROSS - SECTION** 5

SITE: Team 2 Step Pool @ Sta 0+58&5 (0+55) **Date:** 4/19/16

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
1		4.46	104.46			
2	2.5			3.76	100.70	
3	7.0			6.45	98.01	
4	12.5			6.29	98.17	
5	17.0			2.28	102.18	
6	19.0			2.26	102.20	
7	25			6.61	97.85	
8	28			4.20	100.26	
9	31.8			4.69	99.77	
10	32.6			6.25	98.21	L edge of water
11	33.7			5.94	98.52	
12	35.2			6.33	98.13	~~L edge of water~~
13	36.0			6.96	97.48	
14	37.6			6.74	97.72	
15	39.1			6.62	97.84	
16	40.0			6.33	98.13	R edge of water
17	40.8			5.52	98.94	
18	45.2			5.18	99.28	
19	48.4			4.41	100.05	bankfull
20	58.3			4.42	100.04	
21	65.4			1.56	102.90	
22	78.4			0.86	103.60	
23						
24						
25						
26						
27						
28						
29						
30						
31						

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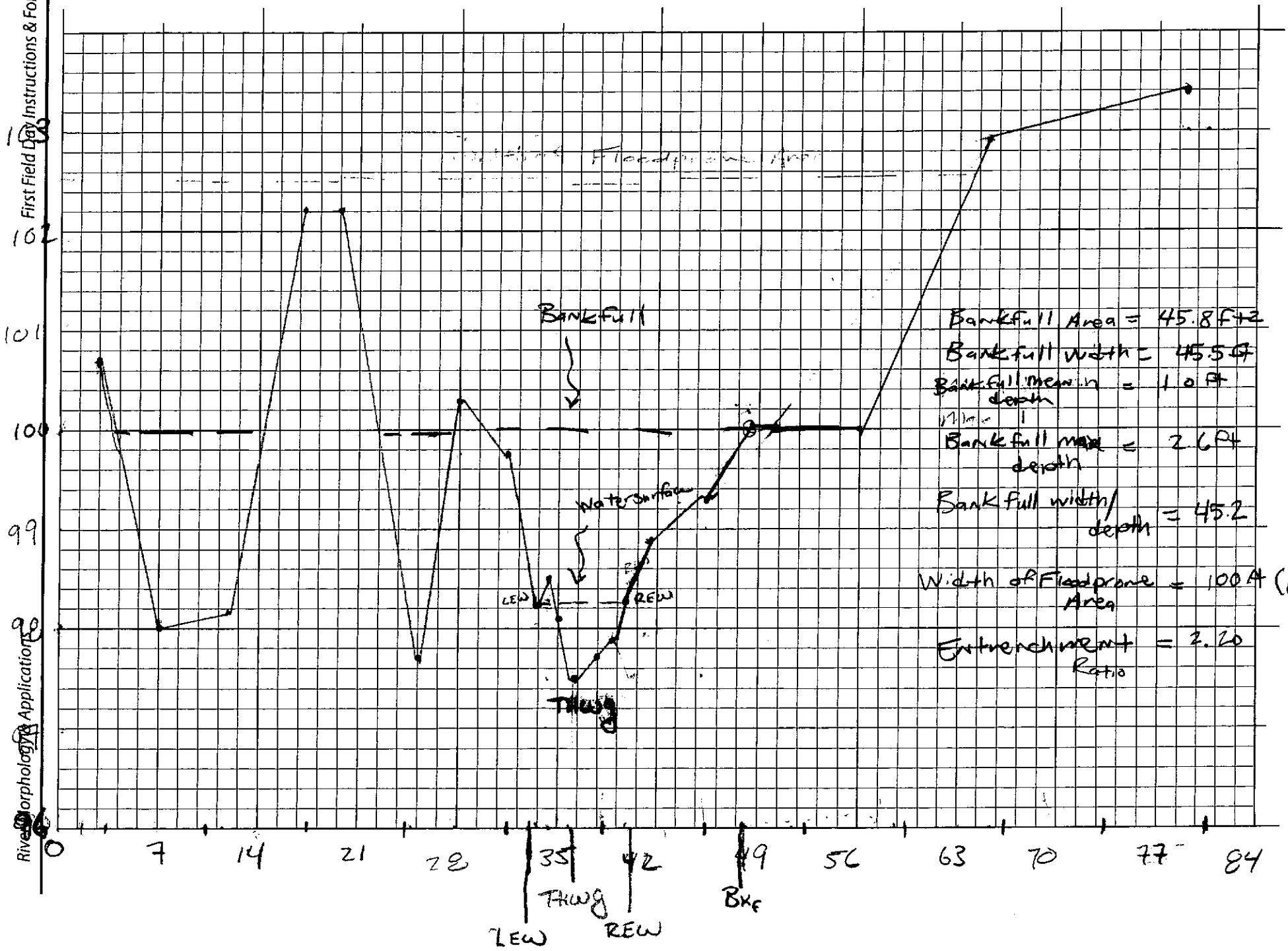
TEAM 2
STEP POOL X-SEC 0+55

4/19/16
Team 2



Bankfull Area = 45.8 ft2
Bankfull width = 45.5 ft
Bankfull mean depth = 1.0 ft
Bankfull max depth = 2.6 ft
Bankfull width/depth = 45.2
Width of Floodprone Area = 100 ft (Est)
Entrenchment Ratio = 2.20

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SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: Team 2 Pool @ 1+77 **Date:** 4/19/16

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
1	~~0~~		~~105.63~~	~~105.36~~		
2	~~0~~			~~9.86~~		
3	~~3~~			~~12.53~~		
4	~~3.5~~			~~11.90~~		1
5	~~4~~			~~11.79~~		
6	~~8.4~~					~~E of W~~
7	~~11.6~~					
8			2.15	102.15		
9	0		~~6.2~~	6.24	96.21	
10	3.0			8.61	93.54	
11	5.0			9.12	93.03	
12	8.0			9.72	92.43	E of W
13	11.0			10.49	91.66	
14	14.0			12.12	90.03	
15	16.6			12.12	90.03	
16	19.0			12.15	90.00	
17	21.4			11.65	90.05	
18	24.4			9.79	92.36	E of W (Better)
19	26.0			9.39	92.76	
20	29.3			10.15	92.00	
21	31.6			9.64	92.51	
22	34.0			8.58	93.57	
23	40.0			4.66	97.49	
24						
25						
26						
27						
28						
29						
30						
31						—

~~11.30 BKF~~

7.57

21.4 24.4 = 3

92.36 - 90.50 = 1.86

0.62%

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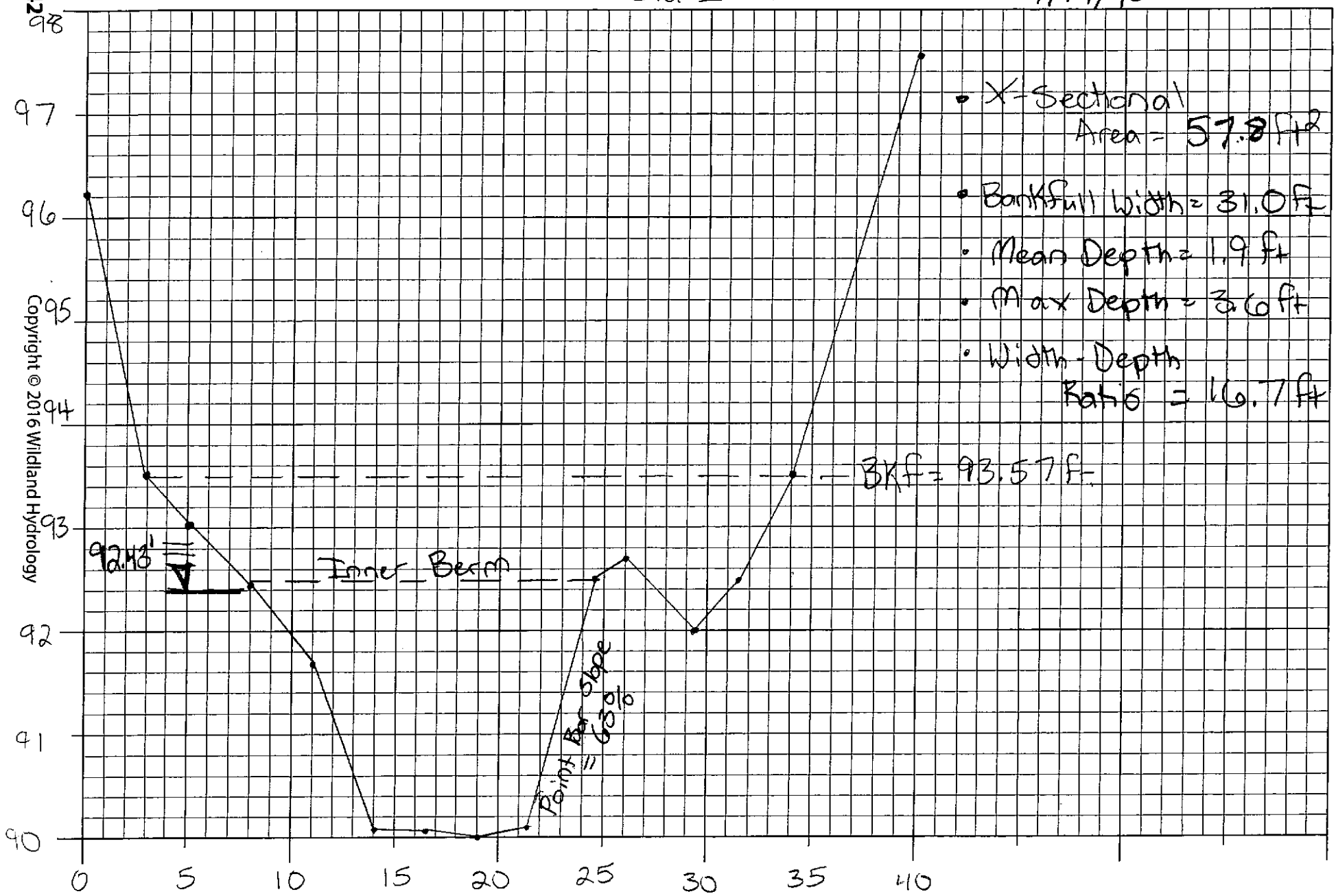
Contraction Pool
Sta. 1+77

Team Z
4/19/16



- X-Sectional Area = 57.8 ft²
- Bankfull Width = 31.0 ft
- Mean Depth = 1.9 ft
- Max Depth = 3.6 ft
- Width-Depth Ratio = 16.7 ft

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SURVEY DATA → **CROSS - SECTION** 4

SITE: Team 2 Pool @ 0+89 Date: 4/19/16

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
1		4.46	104.46			
2	0			4.81	99.65	
3	4.0			5.61	98.85	
4	7.5			6.16	98.30	
5	9.4			7.91	96.55	
6	13.8			8.40	96.06	L edge of water
7	16.0			8.31	96.15	
8	16.4			9.52	94.94	
9	19.6			10.13	94.33	
10	21.7			10.70	93.76	
11	24.5			9.97	94.49	
12	26.6			9.72	94.74	
13	27.0			8.40	96.06	R edge of water
14	28.0			6.59	97.87	boulder
15	35.1			6.58	97.88	boulder
16	37.7			7.19	97.27	boulder
17	44.8			6.47	97.99	boulder - BKF?
18	50.0			7.12	97.34	
19	53.6			5.15	99.31	
20	56.0			2.98	101.48	
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

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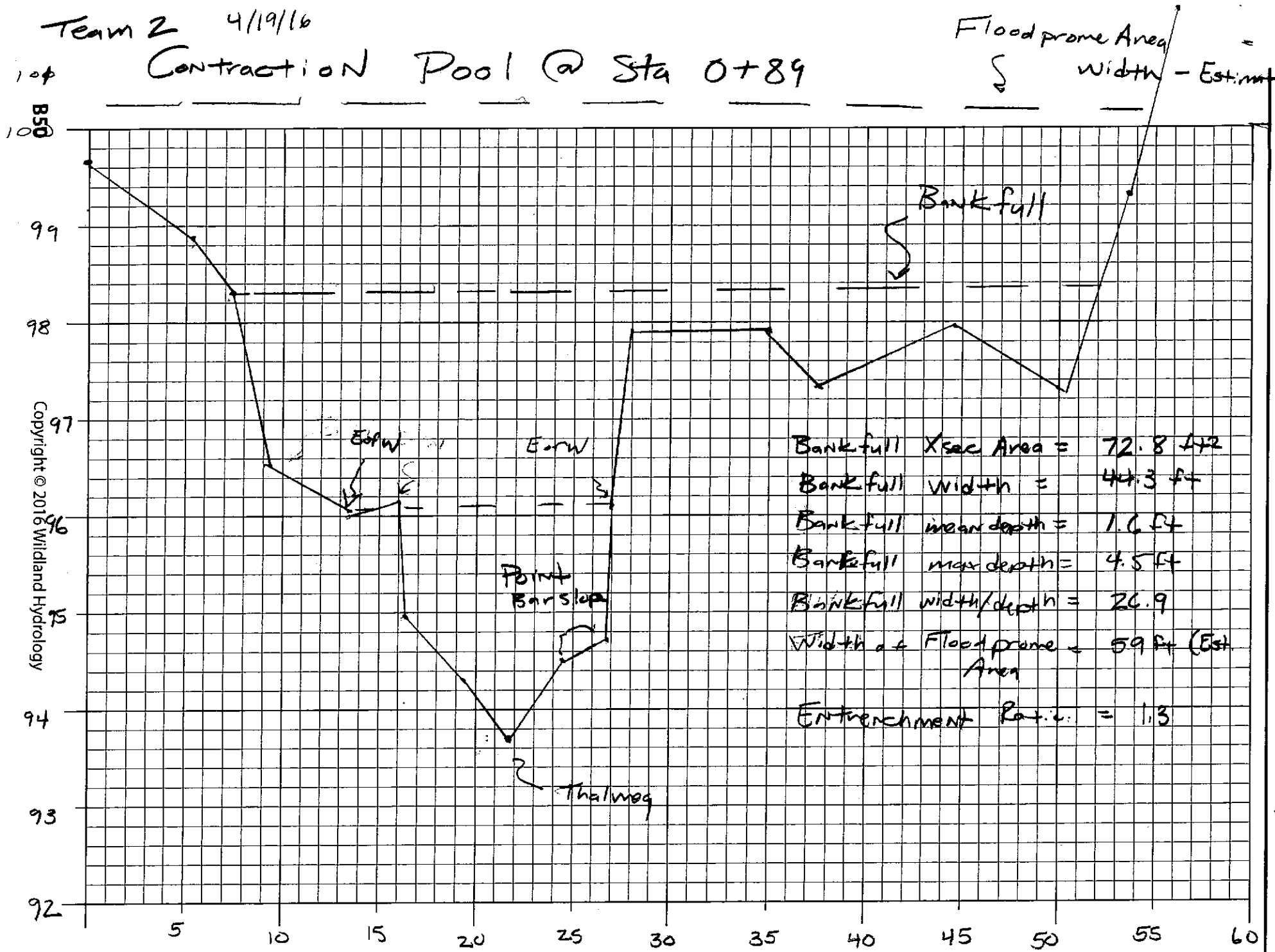
Team 2 4/19/16

Contraction Pool @ Sta 0+89



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SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: SHARMAN'S BRANCH Date: 4/19/2016

Location: WASHINGTON CO, MD

Observers: TEAM 2 HUC:

SL 230.5
VL 207
KC 1.16
Bkf 2.0

	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	5.36	105.36		[illegible]								
2	00		[illegible]	5.63	[illegible]	5.12	100.24						START
3	0+[illegible]			[illegible]	[illegible]	5.17	100.19	3.35	102.01	1.82		BKF	BKF
4	0+13			5.63	99.73	5.20	100.16					Riffle	T RIFFLE
5	0+[illegible]			[illegible]	99.45	[illegible]	100.1					mid	
6	0+31			6.32	99.04	5.99	99.37					Step Pool	T S pool
7	0+31.7			6.46	98.90	6.01	99.35						Pool
8	0+32.5			6.64	[illegible]	6.10	99.26						T Pool
9	0+34			6.62	98.74	6.19	99.17						[illegible]
10	0+37.5			6.64	98.72	6.20	99.16	4.43	100.93	1.77		BKF	BKF / TRIF
11	40.5			6.56	98.80	6.30	99.06						T RIFF RAP
12	47			7.22	98.14	6.77	98.59						MP RAP RF
13	50.5			7.54	97.82	7.02	98.34						FN RAP B POOL SP CONV
14	52.5			7.90	97.46	6.99	98.37						S POOL
15	54.2			7.61	97.20	7.04	98.32						
16	55.2			7.91	97.45	7.20	98.16						ST POOL 1
17	58.4			7.80	97.56	7.33	98.03	5.37	99.99	1.96			ST POOL 2 w/ORF
18	61.5			8.65	96.71	7.53	97.83						ST P 3
19	66			8.31	97.05	7.59	97.77						RAPID T
20	69.8			9.70	95.66	8.46	96.90						S POOL 4
21	70.5			9.80	95.56	8.64	96.72						S POOL
22	71.0			9.19	96.17	8.62	96.74						[illegible]
23	77			9.88	95.48	9.26	95.74						S POOL 5
24	77.6			9.96	95.40	9.26	95.74						WEIR BOT
25	81.4			9.66	95.70	9.21	96.15					Riffle	RIFF/RAPID
26	84.2			9.90	95.46	9.34	96.02						RFP RAPID
27	85.4			9.98	95.38	9.31	96.05					Conv Pool	CONV POOL

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 2**

SITE: SHARMAN'S BRANCH **Date:** 4/19/16

Location:

Observers: TEAM 2 **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			105.36										
29	89			11.59	93.77	9.55	96.01					Converge Pool	CONV POOL
30	92.2			9.95	95.41	9.31	96.05	7.42	97.94	1.89		Glide	B GLIDE
31	96.2			9.81	95.55	9.42	95.94					Riffle	T RIFF
32	103			10.03	95.33	9.70	95.66					mid	MP RIFF
33	107.3			10.40	94.96	9.99	95.37						B RIFF
34	109.6			11.40	93.96	10.36	95.00	[illegible]	[illegible]			Converge Pool	CONV POOL
35	111.3			11.94	93.42	10.36	95.00					Glide	POOL
36	118.4			11.06	94.30	10.40	94.96					Glide	GLIDE
37	120			10.71	94.65	10.40	94.96						SPOOL
38	129.7			11.51	93.85	10.75	94.61						
39	134.7			11.26	94.10	10.97	94.39						WEIR
40	135.3			11.97	93.39	11.07	94.29						SPOOL
41	140			11.58	93.78	11.12	94.24						[illegible]
42	143			11.92	93.44	11.27	94.09						[illegible]
43	143.4			11.69	93.67	11.31	94.05	9.57	95.79	1.74			WEIR
44	150.6			12.32	93.04	11.96	93.40						
45	154.4			12.63	92.73	11.97	93.39						POOL
46	157			12.39	92.97	12.04	93.32						WEIR
47	164.5			15.89	89.47	13.53	91.83						
48	177			15.85	89.51	13.36	92.00						X-SEC
49	189.5			14.09	91.27	13.41	91.95	11.31	94.05	2.1			
50	203.5			13.45	91.51	13.46	91.90						RIFF
51	209.5			[illegible]	91.15	13.52	91.84						
52	215.5			14.21	91.15	13.61	91.75						
53	220.5			15.20	90.16	13.89	91.47						
54	223			14.44	90.96	13.95	91.41						POOL

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 3**

SITE: SHERMAN'S BRANCH Date: 4/19/16

Location:

Observers: TEAM 2 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
55	227		165.36	14.70	90.66	13.86	91.50					Pool
56	230.5			14.25	91.11	13.92	91.44	12.06	93.30	1.86		T RAF BF1
57												
58												
59												
60												
61												
62												
63												
64												
65												
66												
67												
68												
69												
70												
71												
72												
73												
74												
75												
76												
77												
78												
79												
80												
81												

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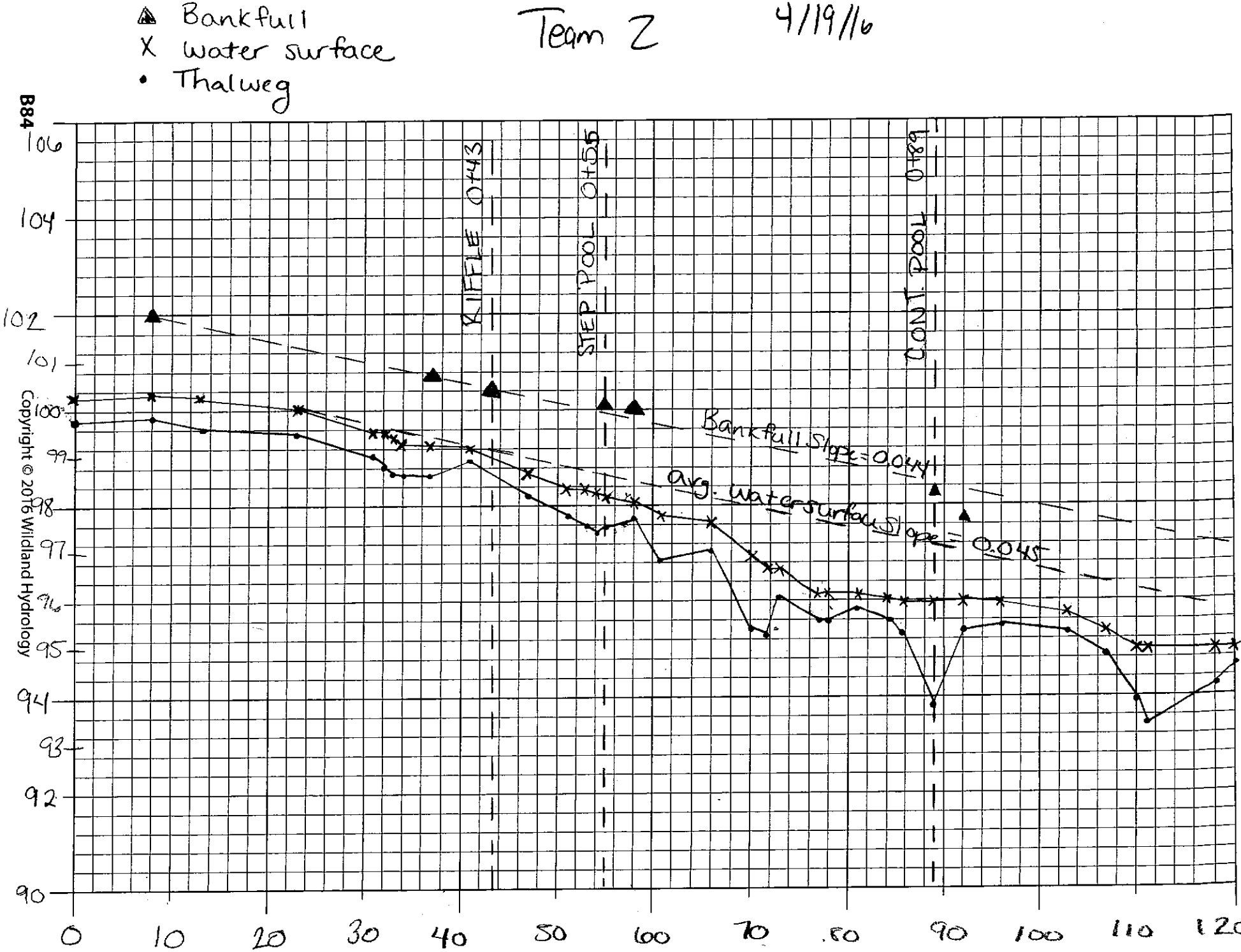

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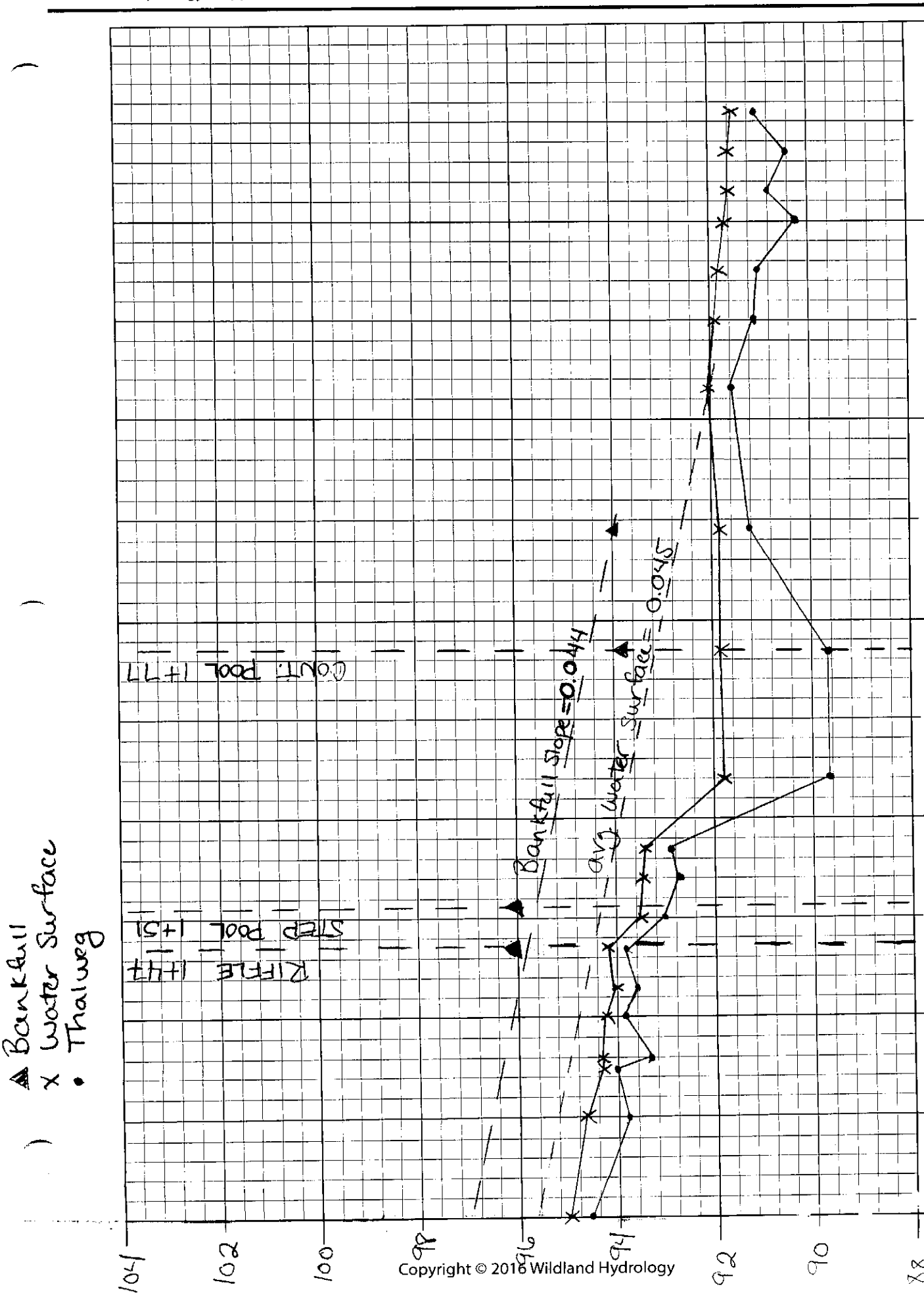

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Team 2

Riffle at sta. 150
(active bed)

PEBBLE COUNT DATA

LOCATION:

Date: 4/19/16

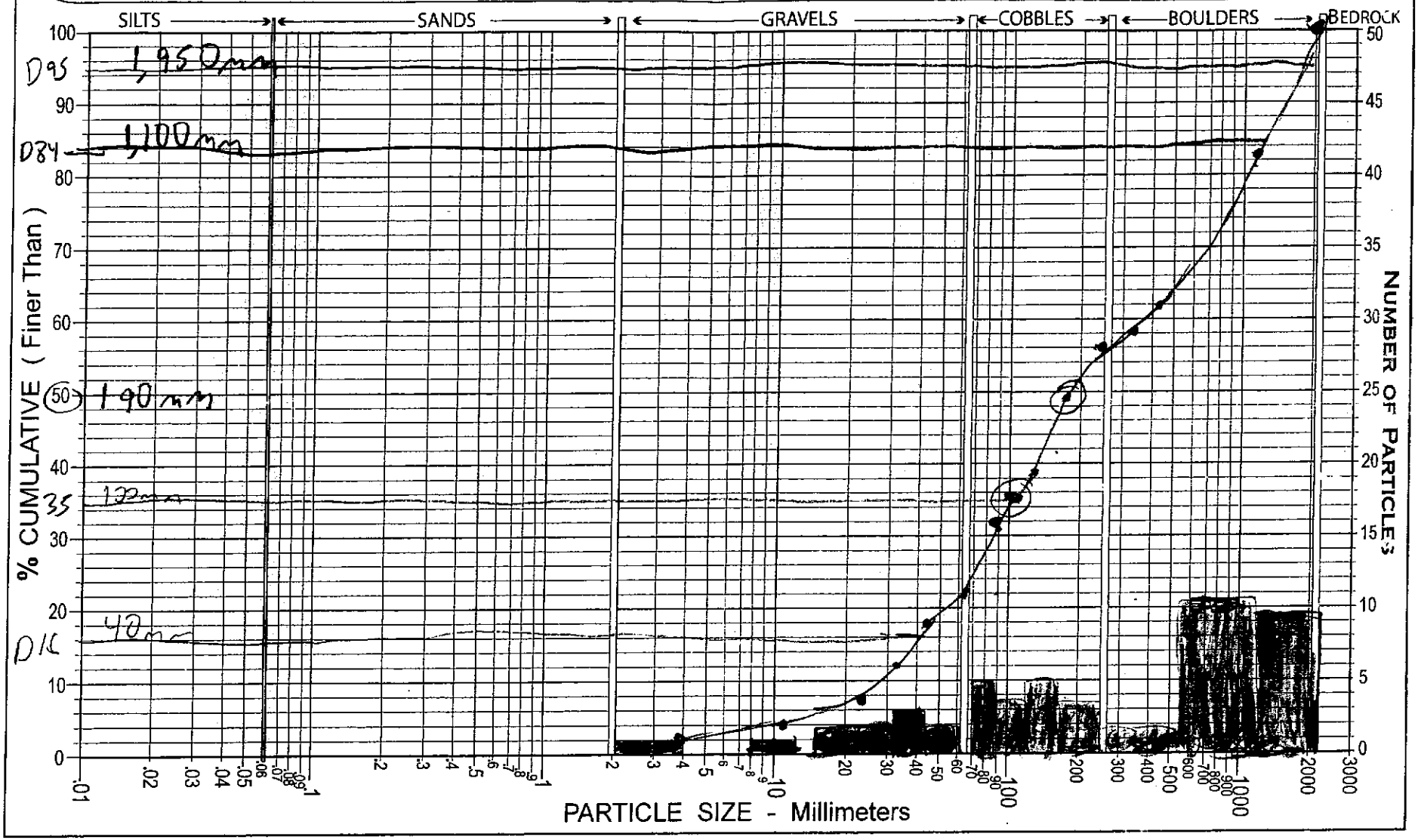
REACH:

Observers:

Stream Type:

Landscape Type:

HUC:



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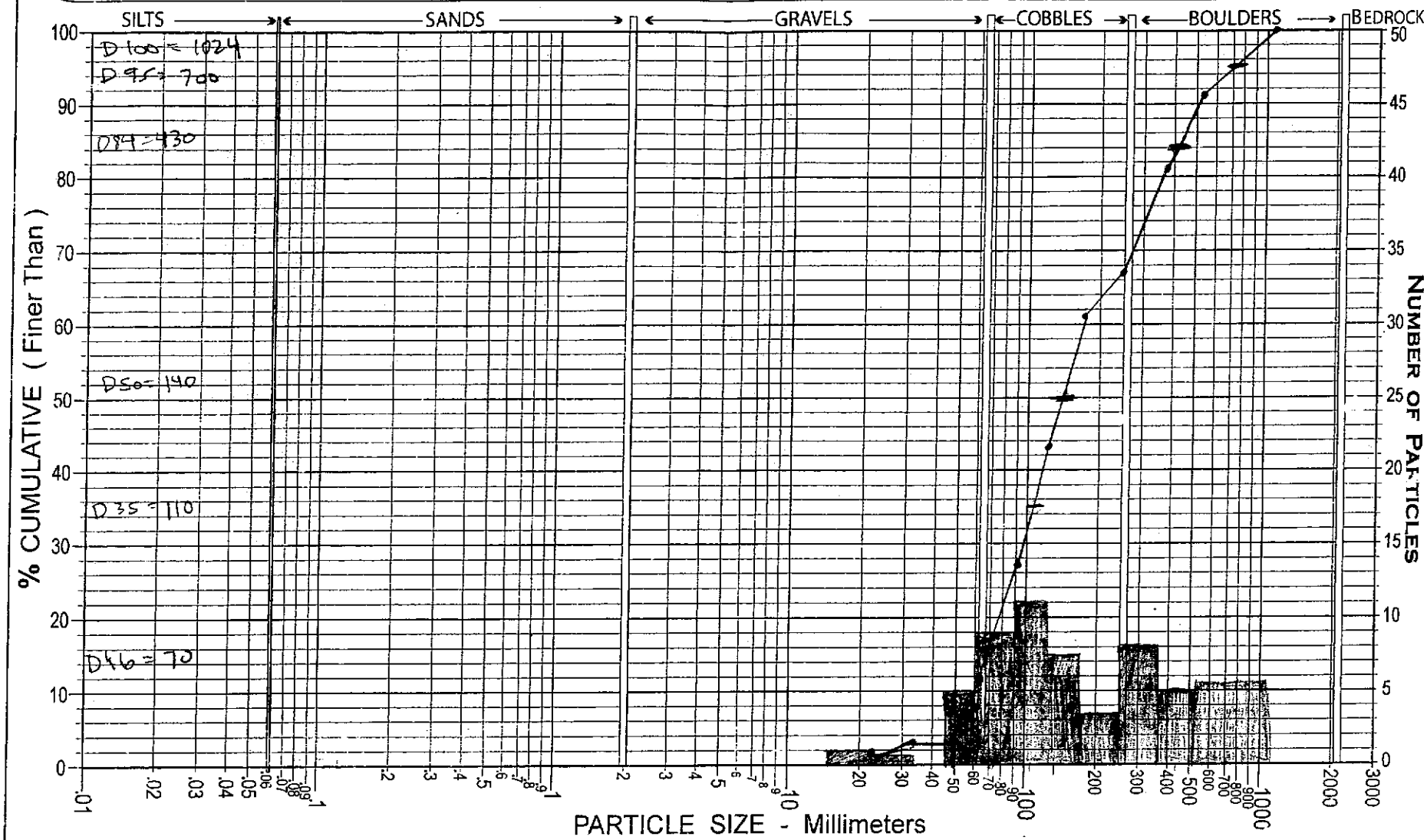
Protrusions for X's @ Sta. 150

PEBBLE COUNT DATA

LOCATION: Sharman's Branch
Date: 4/19/16
REACH:
Observers: Team 2
Stream Type:
Landscape Type:
HUC:



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Reach

PEBBLE COUNT DATA

LOCATION: Sharman's Branch

Date: 4/19/16

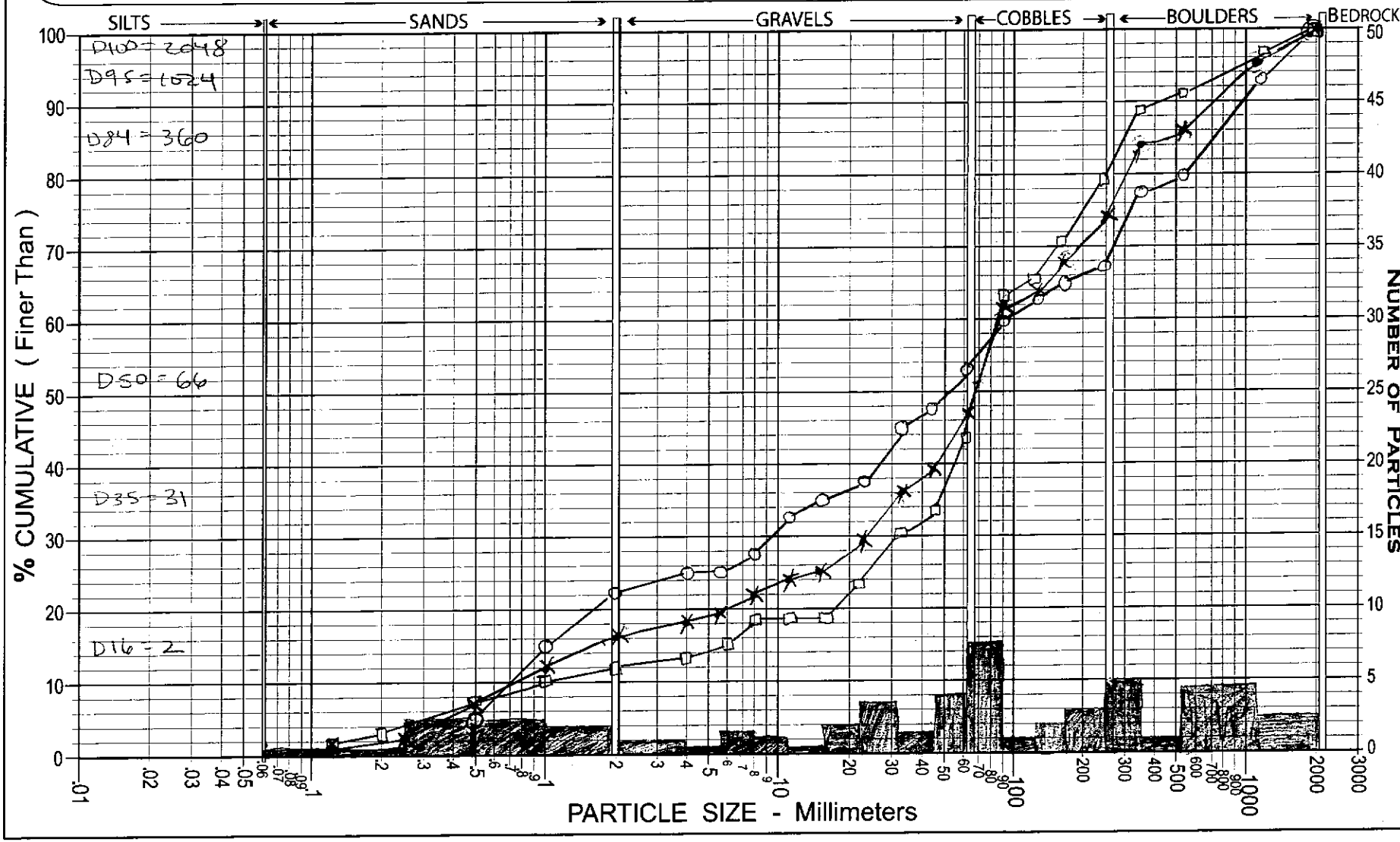
REACH:

Observers: Team 2

Stream Type:

Landscape Type:

HUC:



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Protrusions for XS @ sta. 42.3 (NOT USED)

PEBBLE COUNT DATA

LOCATION: Sharman's Branch

REACH:

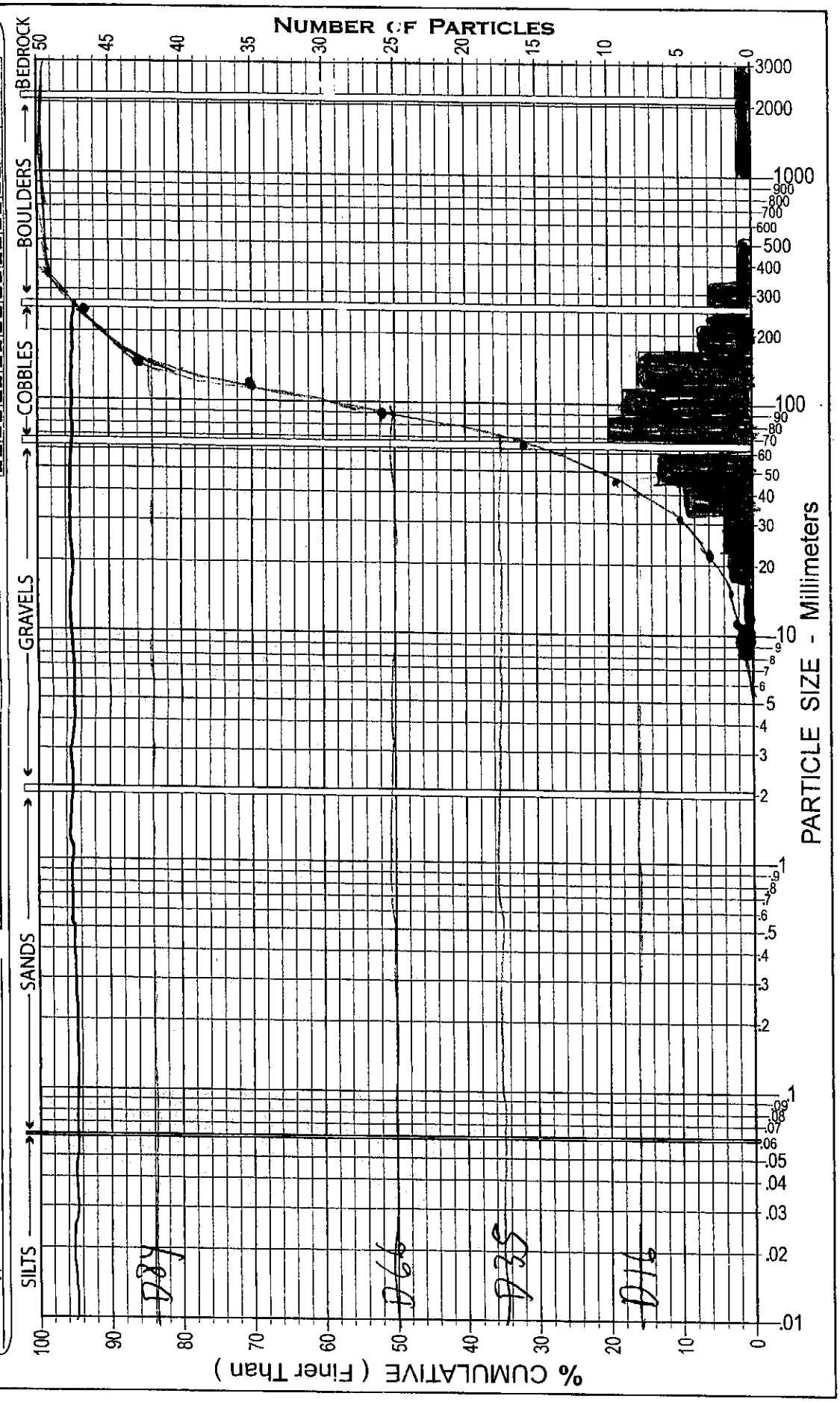
Stream Type:

Date: 4/19/16

Observers: Team 2

Landscape Type:

HUC:



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Riffle @ Sta. 43.3 (active bed)

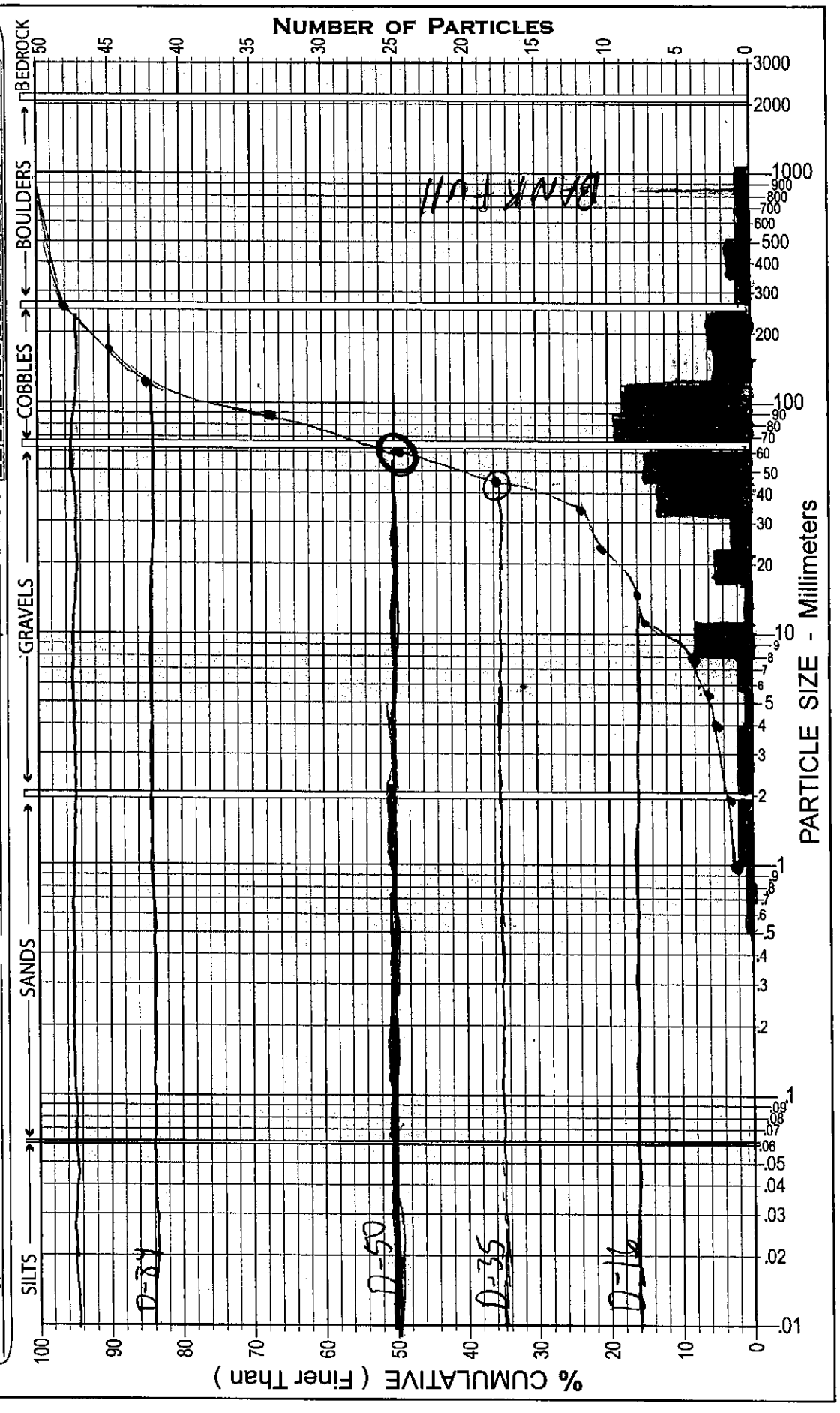
(Not used)

PEBBLE COUNT DATA

LOCATION: Sharman's Branch
REACH:
Stream Type:

Observers: Team 2
Landscape Type: Riffle @ 43.3
HUC:

Date: 4/19/16



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Team 2
4/19/16

Active Riffle Bed Transect @ 150 ft

@ 43.3 — Riffle — Protrusion

Active Riffle Bed sta. @ 150

Site:
Location: HUC:
Observers:

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:														
	Date:														
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0				1	35	1	1						
.04 - .08	Very Coarse	1.0 - 2				2		2	3						
.08 - .16	Very Fine	2 - 4	GRAVEL	2				2	5				2	2	2
.16 - .22	Fine	4 - 5.7				1		1	6						
.22 - .31	Fine	5.7 - 8				2		2	8						
.31 - .44	Medium	8 - 11.3		2	2	8		7	15	2	2	2	2	2	4
.44 - .63	Medium	11.3 - 16			1	1	47	1	16	1	1	3			
.63 - .89	Coarse	16 - 22.6		4	3	5		5	21	3	3	6	4	4	8
.89 - 1.3	Coarse	22.6 - 32		4	4	3		3	24	4	4	10	4	4	12
1.3 - 1.8	Very Coarse	32 - 45		6	9	13		12	36	9	9	19	6	6	18
1.8 - 2.5	Very Coarse	45 - 64		4	13	15		14	50	13	13	32	4	4	22
2.5 - 3.5	Small	64 - 90	COBBLE	11	20	19		18	68	20	20	52	11	10	32
3.5 - 5.0	Small	90 - 128		8	18	18	46	17	85	18	18	70	8	7	39
5.0 - 7.1	Large	128 - 180		11	16	5		5	90	16	16	86	11	10	49
7.1 - 10.1	Large	180 - 256		7	7	6		6	96	7	7	93	7	7	56
10.1 - 14.3	Small	256 - 362	BOULDER	3	6	2		2	98	6	6	99	3	3	59
14.3 - 20	Small	362 - 512		3	1	3	65	3	101	1	1	100	3	3	62
20 - 40	Medium	512 - 1024		22		2		2	103				22	21	83
40 - 80	Large-Vry Large	1024 - 2048		20	2					2	2	102	20	19	102
	Bedrock		BDRK												
Stream Type:		**Landscape Type:**		(107)	(100)	TOTAL →									

8.53

20.5%

34.5%

45%

Protrusion @ Riffle XS @ STA 43.3

active bed pebble count @ STA 43.3 (108)

102 Total

107 @ 107

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4/19/16

Protrusion - XS Riffle Sta. 150

Protrusion @ Riffle XS Sta. 150

Site:

Location: HUC:

Observers: Team 7

Dot Count for RIFFLE 1 | POOL 2 | COMP. 3

Inches	PARTICLE	Millimeters		Prot.	Pool @ 192	Pool @ 185	Riffle @ 146	Riffle @ 154	Pool @ 113	Riffle @ 98	Pool @ 89	Riffle @ 62 (steep)	Riffle @ 36	Riffle @ 7	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																				
	Very Fine	.062 - .125	SAND																		0	0	0
	Fine	.125 - .25	SAND																		0	0	0
	Medium	.25 - .50	SAND																		0	0	0
	Coarse	.50 - 1.0	SAND																		0	0	0
.04 - .08	Very Coarse	1.0 - 2	SAND																		0	0	0
.08 - .16	Very Fine	2 - 4	GRAVEL																		0	0	0
.16 - .22	Fine	4 - 5.7	GRAVEL																		0	0	0
.22 - .31	Fine	5.7 - 8	GRAVEL																		0	0	0
.31 - .44	Medium	8 - 11.3	GRAVEL																		0	0	0
.44 - .63	Medium	11.3 - 16	GRAVEL																		0	0	0
.63 - .89	Coarse	16 - 22.6	GRAVEL		(2)																2	2/112 = 1.8%	1.8%
.89 - 1.3	Coarse	22.6 - 32	GRAVEL		(1)																1	1	2.8
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL																		0	0	2.8
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL		(10)																10	8.9	11.7
2.5 - 3.5	Small	64 - 90	COBBLE		(18)																18	16	27.7
3.5 - 5.0	Small	90 - 128	COBBLE		(22)																22	19.6	47.3
5.0 - 7.1	Large	128 - 180	COBBLE		(15)																15	13.4	60.7
7.1 - 10.1	Large	180 - 256	COBBLE		(7)																7	6.3	67
10.1 - 14.3	Small	256 - 362	BOULDER		(16)																16	14.3	81.3
14.3 - 20	Small	362 - 512	BOULDER		(10)																10	8.9	90.2
20 - 40	Medium	512 - 1024	BOULDER		(11)																11	9.8	100
40 - 80	Large-Vry Large	1024 - 2048	BOULDER																		0	0	100
	Bedrock		BDRK																				
Stream Type:			**Landscape Type:** C-Co-US												TOTAL→							112		

(112)

Rewritten, see other data sheet.

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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:	WASHINGTON CO, MD
Date:	4/19/2016 — Stream Type: F2b/3	Landscape Type:	C - CO - OS
Observers:	TEAM 2	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	59.9	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.7	d_{bkf} (ft)
Bankfull Riffle Width	34.3	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$	37.7	W_p (ft)
D_{84} Particle Size at Riffle PORTRUSION	430	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	1.41	D_{84} (ft)
Bankfull Slope	.044	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.59	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	1.13	R / D_{84} (ft / ft)
Drainage Area	3.6	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	1.50	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	4.69	ft / sec	279	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. B-34, B-35) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .09	4.73	ft / sec	283.4	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. B-36) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .054	7.88	ft / sec	472.3	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 $n =$ .11	3.87	ft / sec	231.8	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: SHARMAN'S BRANCH	
Basin:	Drainage Area: 3[illegible] acres mi² 3.6
Location: WASHINGTON COUNTY, MD	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/19/2016
Observers: TEAM 2	Landscape Type: C-CO-25

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	34.3	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.7	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	59.9	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	20.2	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.	2.7	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.	40.2	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	1.2	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.	66	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.	.045	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).	1.1	ft/ft

Stream Type → F8b/12 ← **See Classification Key (Figure B-2)**

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

Stream: SHARMAN'S BRANCH Location: WASHINGTON CO, MD

Observers: TEAM 2 Date: 4/19/2016 Landscape Type: C-CO-US Stream Type: E3b/2

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios***	Mean	Min.	Max.
Riffle Width (W_{bkf})	37.8	34.2	41.4	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	54	52.9	59.9
Riffle Mean Depth (d_{bkf})	1.52	1.28	1.75	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	25.96	19.57	32.35
Riffle Maximum Depth (d_{max})	2.51	2.35	2.66	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	1.65	1.84	1.84
Width of Flood-Prone Area (W_{fpa})	48.04	40.16	55.6	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.3	1.1	1.5
Riffle Inner Berm Width (W_{ib})	19.52	17.84	21.2	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	.51	.52	.51
Riffle Inner Berm Depth (d_{ib})	.24	.22	.27	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.16	0.17	0.15
Riffle Inner Berm Area (A_{ib})	4.81	3.98	5.63	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.09	0.08	0.09
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})	79.9	→						

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios***	Mean	Min.	Max.
Pool Width (W_{bkfp})	36.1	31.0	41.1	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	0.95	0.8	1.1
Pool Mean Depth (d_{bkfp})	1.6	1.3	1.9	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	1.05	0.88	1.22
Pool Cross-Sectional Area (A_{bkfp})	56.2	54.5	57.8	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	0.99	0.97	1.03
Pool Maximum Depth (d_{maxp})	3.9	3.6	4.1	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	2.53	2.35	2.71
Pool Inner Berm Width (W_{ibp})	16.68	14.06	19.31	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.47	0.32	0.62
Pool Inner Berm Depth (d_{ibp})	1.33	1.33	1.34	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.77	0.71	0.82
Pool Inner Berm Area (A_{ibp})	22.23	18.84	25.61	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.35	0.26	0.44
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	12.53	10.49	14.57

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				

X

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})			

X

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios***	Mean	Min.	Max.
Step Width (W_{bkfs})	38.8	32	45.5	ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})	1.0	0.8	1.2
Step Mean Depth (d_{bkfs})	1.2	1.0	1.4	ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})	0.8	0.7	0.9
Step Cross-Sectional Area (A_{bkfs})	45.8	45.8	45.8	ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})	0.8	0.8	0.8
Step Maximum Depth (d_{maxs})	2.5	2.4	2.6	ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})	1.6	1.6	1.7
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})	33.7	22.4	45.0	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: SHARMANS BRANCH Location: WASHINGTON CO, MD

Observers: TEAM 2 Date: 4/19/2016 Landscape Type: AG CO-US Stream Type: F B/C

Hydraulics

River Reach Summary Data.....2					
Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	3.87	ft/sec	Estimation Method	FF/QR	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	231.8	cfs	Drainage Area	3.6	mi²

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)		N/A		ft	Linear Wavelength to Riffle Width (λ / W_{bkf})		N/A	
Stream Meander Length (L_m)		N/A		ft	Stream Meander Length Ratio (L_m / W_{bkf})		N/A	
Radius of Curvature (R_c)		N/A		ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})		N/A	
Belt Width (W_{blt})	34	31	36	ft	Meander Width Ratio (W_{blt} / W_{bkf})	0.99	0.90	1.05
Arc Length (L_a)		N/A		ft	Arc Length to Riffle Width (L_a / W_{bkf})		N/A	
Riffle Length (L_r)	11.91	9.43	17.57	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.35	0.27	0.51
Individual Pool Length (L_p)	22.51	7.77	46.48	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.66	0.23	1.35
Pool-to-Pool Spacing (P_s)	40.23	22.33	58.08	ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})	1.17	0.65	1.69

Channel Profile

Valley Slope (S_{val})		ft/ft	Average Water Surface Slope (S)	0.045	ft/ft	Sinuosity (S_{val} / S)		
Stream Length (SL)	230.5	ft	Valley Length (VL)	207	ft	Sinuosity (SL / VL)	1.1	
Low Bank Height (LBH)	start	ft	Bankfull Max Depth (d_{max})	start	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start	
	end	ft		end	ft		end	

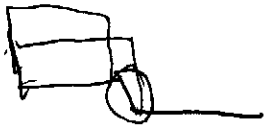
Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})	0.11	0.04	0.21	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	2.4	0.89	4.6
Run Slope (S_{run})		N/A		ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	0.09	0.07	0.11
Pool Slope (S_p)	0.004	0.003	0.005	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)	0.026	0.019	0.032	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.58	0.42	0.71
Step Slope (S_s)	0.057	0.047	0.068	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	1.27	1.04	1.51

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})	2.51	2.35	2.66	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.65	1.52	1.84
Max Run Depth (d_{maxr})		N/A		ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})		N/A	
Max Pool Depth (d_{maxp})	3.9	3.6	4.1	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.53	2.35	2.71
Max Glide Depth (d_{maxg})		N/A		ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})		N/A	
Max Step Depth (d_{maxs})	3.03	2.71	3.62	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	1.9	1.76	2.35

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	0	0		D_{16}	2	40		70	mm
% Sand	169	0		D_{35}	31	100		110	mm
% Gravel	319	20.59		D_{50}	66	190		140	mm
% Cobble	271	34.57		D_{84}	360	1100		430	mm
% Boulder	269	459.0		D_{95}	1024	1950		700	mm
% Bedrock	0	0		D_{100}	2048	2048		1024	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: SHARMAN'S BRANCH Location: WASHINGTON CO, MD

Observers: TEAM 2 Stream Type: F3b/2 Landscape Type: C-CO-US Date: 4/19/2016

		Dimensional Values				Dimensionless Ratios		
Pool Type		Pool Length (L_p)	Pool Max Depth (d_{maxp})	Pool Slope (S_p)		Pool Length to Riffle Width (L_p / W_{bkf})	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	Pool Slope to Average Slope (S_p / S)
X 1. Lateral Scour Pool (LSP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
2. Contraction Scour Pool (CSP)	Mean	22.51	3.9	.004	Mean	.66	2.29	.089
	Min.	7.77	3.6	.003	Min.	.02	2.12	.067
	Max.	46.43	4.1	.005	Max.	1.35	2.41	.111
3. Step/Pool (SP)	Mean	7.74	2.5	.057	Mean	.22	1.78	1.26
	Min.	5.56	2.4	.047	Min.	.16	1.59	1.04
	Max.	10.36	2.6	.068	Max.	.30	2.12	1.51
X 4. Backwater Pool (BWP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 5. Plunge Pool (PP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 6. Pocket Water Pool (PWP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 7. Lateral Protrusion Pool (LPP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 8. Straight Dissipator Pool (SDP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 9. Converging Confluence Pool (CCP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
X 10. Compound Pool (CP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			

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