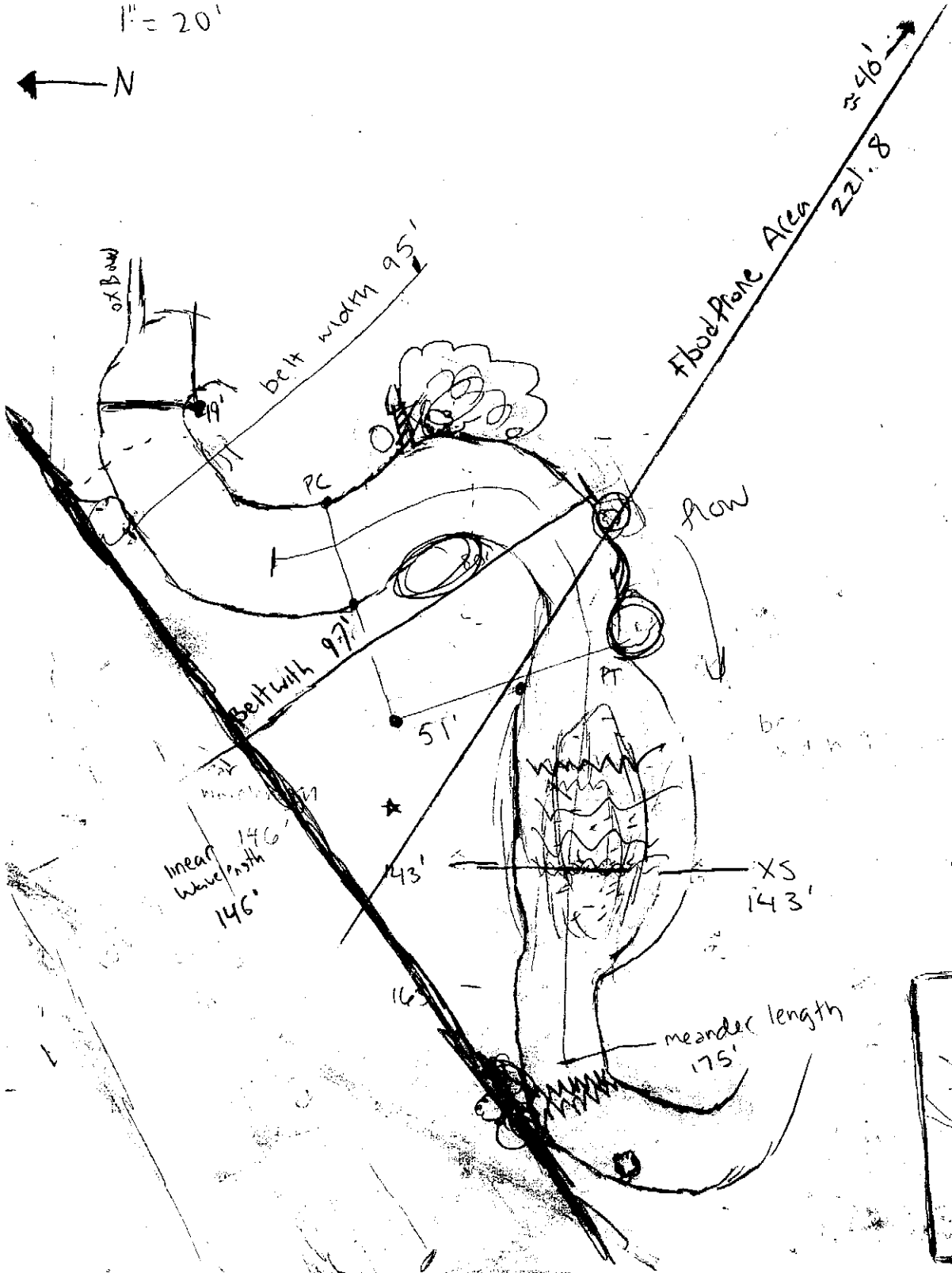
1" = 20'

N

Israel Creek 4/8/14

Washington County, MD

Reach # 3



tree

brush

riffle

road

bar

radius of curvature

centroid

benchmark

drainage seep

sinuosity = 1.2'

W_{fpa} = 221.8'

Valley Cross Section

SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: ISRAEL CREEK vicinity of Brownsville Md Date: 4/8/14

Location: Israel Creek

Party / Notes: #3 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	TBM	4.18	104.18		100	Anchor wire Buckle
2						
3	0+00			4.81	99.37	TOB Left
4						
5	0+01			7.73	96.45	Edge of water Left
6						
7	0+02			8.67	95.51	Deep part of Stream
8						
9	0+11.8			7.66	96.52	Gravel bar
10						
11	0+24.2			9.18	95.00	Thalweg
12						
13	0+25			7.74	96.44	edge of water Right
14						
15	0+26.4			5.1	99.08	TOB Right
16						
17	Bankfull			6.46	97.72	
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						

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Riffle X-S

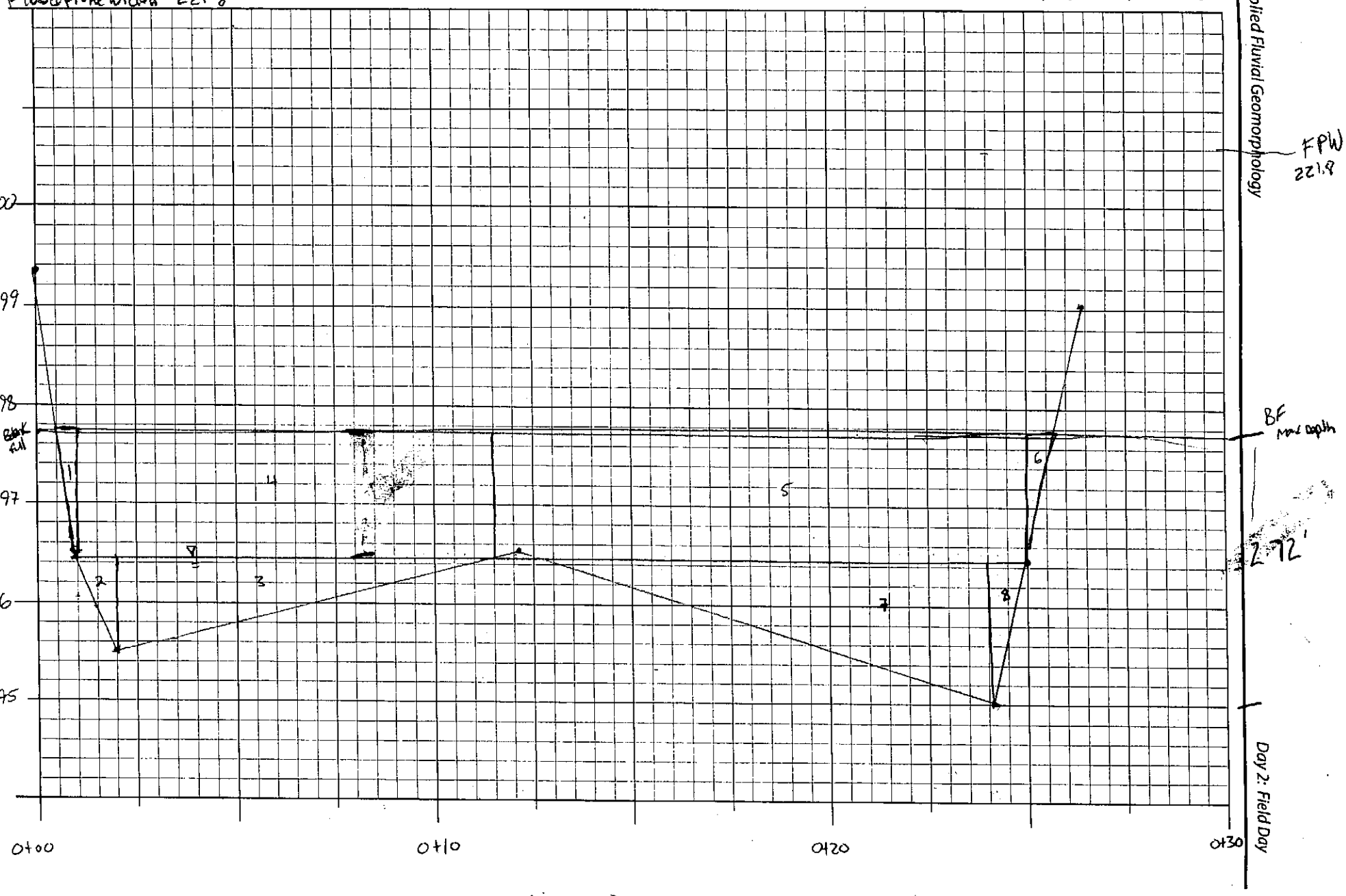
Bankful width 25.2'
Bankful max depth 2.72
BF XS area 44.4 ft²
Floodprone width 221.8'

1 = (1.32 x .5).5
2 = (0.92 x 1).5
3 = (9.5 x .94).5
4 = (9.5 x 1.32)
5 = (13.5 x 1.32)
6 = (1.16 x 0.75).5
7 = (11 x 1.4).5
8 = (1.44 x 0.9).5

$A_x = 44.4\ ft^2$

Reach #3
4/8/14

Israel Creek



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SURVEY DATA ⟹ **LONGITUDINAL PROFILE 1**

SITE: Israel Creek Date: 4/8/14

Location: Reach 3

Party / Notes: Team # 3 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
1	TBM	4.19	104.19									
2	0			9.28	94.91	7.43	96.76	5.75	98.44			
3	15			8.38	95.81	7.56	96.63	5.88	98.31			
4	46			8.87	95.32	7.63	96.56	6.06	98.13			
5	56			9.64	94.55	7.51	96.68	6.15	98.04			Pool Thlwg
6	86			8.95	95.24	7.56	96.63					
7	106			9.91	94.28	7.63	96.56	5.47	98.72			st. of glide
8	129			8.73	95.46	7.63	96.56					st. of riffle
9	142			9.05	95.14	7.64	96.55	6.36	97.83			X-section 1.28
10	188			9.16	95.03	7.73	96.46	6.24	97.95			End riffle
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												

Top of gutter wire

C.B.

Top Riffle

End

Meander length
190
15
175

wave length
1
146

0.18% ~ 2/10 %

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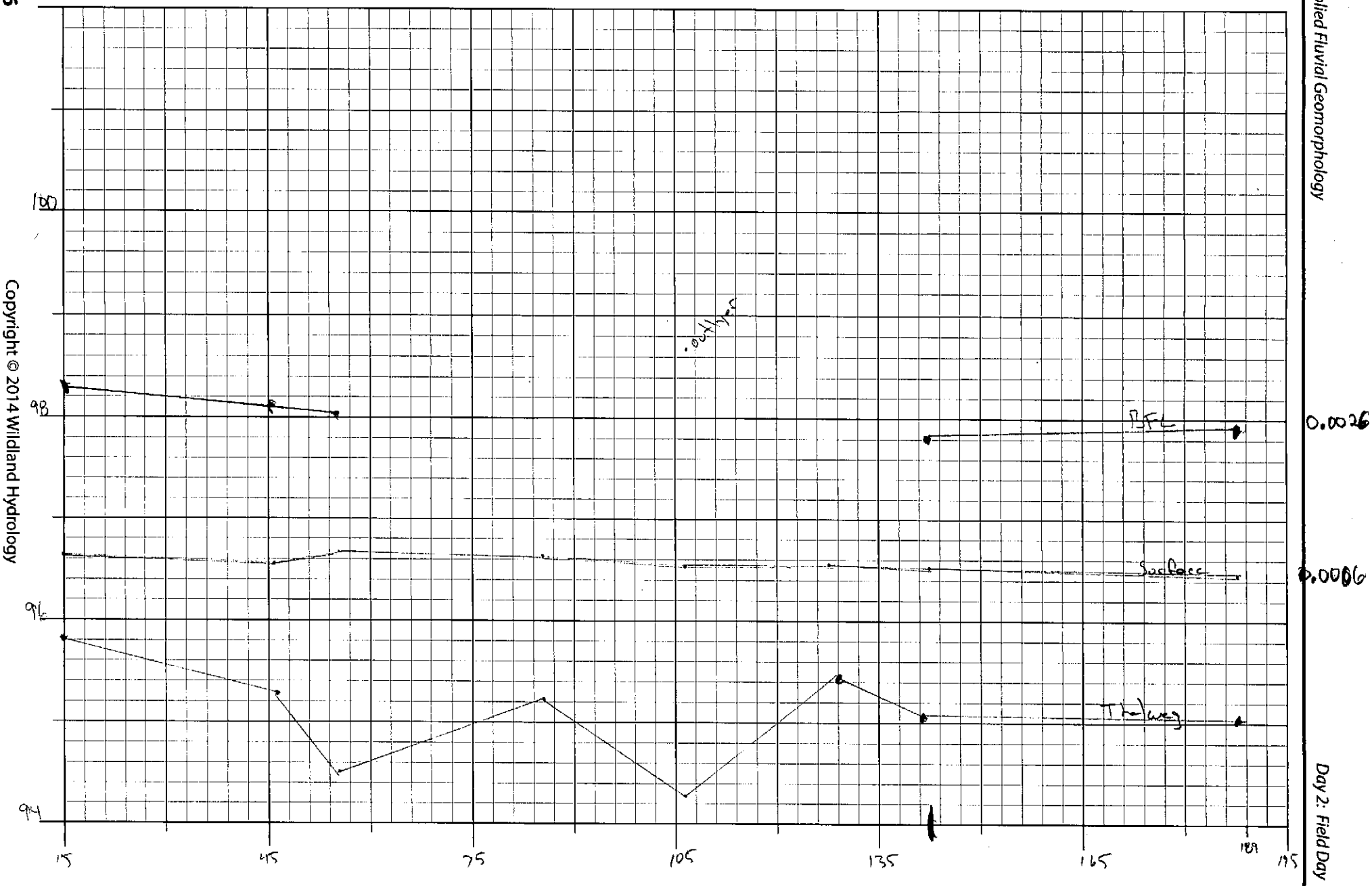
Belt width 97'

radius = 51

Floodpione width = 221.8

Long Pro Team 3 Israel Creek 4/8/14



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Pebble Counts

Pebble Count Overview.....A39

Representative Pebble Count Instructions.....A41

Active Bed Riffle Pebble Count Instructions.....A41

Pebble Count Forms..... A44

$$\bar{v} = \frac{1.49\, R^{2/3} \sqrt{S}}{n}$$

$$n = \frac{1.49\, R^{2/3} \sqrt{S}}{\bar{v}}$$

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~~Representative~~ Riffle

Team #3
4/8/14
Isreal Creek

Site:
Date:
Location:
HUC:
Party:

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
	Silt / Clay	< .062	S/C	IIII			4	3.8	3.8						
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25		IIII			4	3.8	7.6						
	Medium	.25 - .50		III			3	2.8	10.4						
	Coarse	.50 - 1.0		~~IIII~~ ~~IIII~~ IIII			14	13.2	23.6						
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7		IIII			4	3.8	27.4						
.22 - .31	Fine	5.7 - 8		~~IIII~~ ~~IIII~~ III			13	12.2	39.6						
.31 - .44	Medium	8 - 11.3		~~IIII~~ ~~IIII~~ ~~IIII~~ III			17	16.0	55.6						
.44 - .63	Medium	11.3 - 16		~~IIII~~ ~~IIII~~ ~~IIII~~ III			18	17.0	72.6						
.63 - .89	Coarse	16 - 22.6		~~IIII~~ ~~IIII~~ II			12	11.3	83.9						
.89 - 1.3	Coarse	22.6 - 32		~~IIII~~ III			8	7.5	91.4						
1.3 - 1.8	Very Coarse	32 - 45		~~IIII~~ III			8	7.5	98.9						
1.8 - 2.5	Very Coarse	45 - 64		I			1	1.1	100						
2.5 - 3.5	Small	64 - 90	COBBLE												
3.5 - 5.0	Small	90 - 128													
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			**Valley Type:**			TOTAL→	106								

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Reach wide

Israel Creek
Team #3
4/8/14

Site: Date:
Location: HUC:
Party:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: Date: TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C	𝍸 IIII	II		9	11.11	11.11	2	6.06	6.06	11 ✓	9.65	9.65
	Very Fine	.062 - .125	SAND	II			2	2.47	13.58				2 ✓	1.75	11.4
	Fine	.125 - .25	SAND	𝍸 𝍸	𝍸 I		10	12.34	25.92	6	18.18	24.24	16 ✓	14.04	25.44
	Medium	.25 - .50	SAND	𝍸 𝍸 II	II		12	14.81	40.73	2	6.06	30.3	14 ✓	12.28	37.72
	Coarse	.50 - 1.0	SAND	III	𝍸 III		3	3.70	44.43	8	24.24	54.54	11 ✓	9.65	47.37
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7	GRAVEL	I			1	1.23	45.66				1 ✓	0.88	48.25
.22 - .31	Fine	5.7 - 8	GRAVEL	𝍸 IIII	III		9	11.11	56.77	3	9.09	63.63	12 ✓	10.53	58.78
.31 - .44	Medium	8 - 11.3	GRAVEL	𝍸 𝍸 𝍸	III		15	18.52	75.29	3	9.09	72.72	18 ✓	15.79	74.57
.44 - .63	Medium	11.3 - 16	GRAVEL	𝍸 𝍸 I	II		11	13.58	88.87	2	6.06	78.78	13 ✓	11.40	85.97
.63 - .89	Coarse	16 - 22.6	GRAVEL	𝍸	I		4	4.94	93.81	1	3.03	81.81	5 ✓	4.39	90.36
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	III	I		3	3.70	97.51	1	3.03	84.84	4 ✓	3.51	93.87
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	𝍸 I	III		1	1.23	98.74	3	9.09	93.93	4 ✓	3.51	97.38
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL		I					1	3.03	96.96	1 ✓	0.88	98.26
2.5 - 3.5	Small	64 - 90	COBBLE												
3.5 - 5.0	Small	90 - 128	COBBLE												
5.0 - 7.1	Large	128 - 180	COBBLE		I					1	3.03	100	1 ✓	0.88	99.14
7.1 - 10.1	Large	180 - 256	COBBLE	I			1	1.23	100				1 ✓	0.88	100
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK												
Stream Type:			**Valley Type:**			TOTAL→»	81			33			114		

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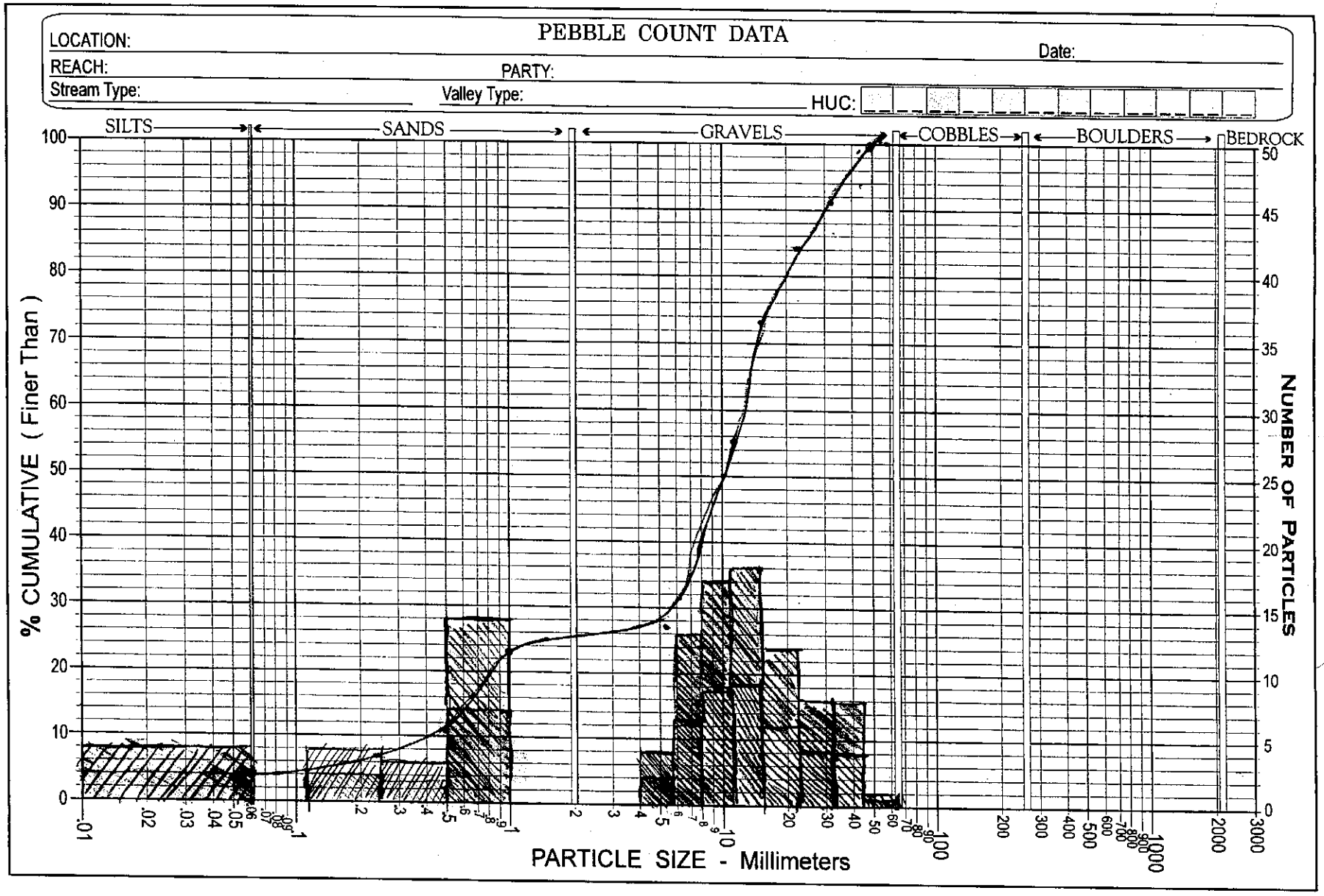
Israel Creek Reach #3
4/8/14
Riffle Pebble Count



D_{50} : 10mm
D_{84} : 23mm

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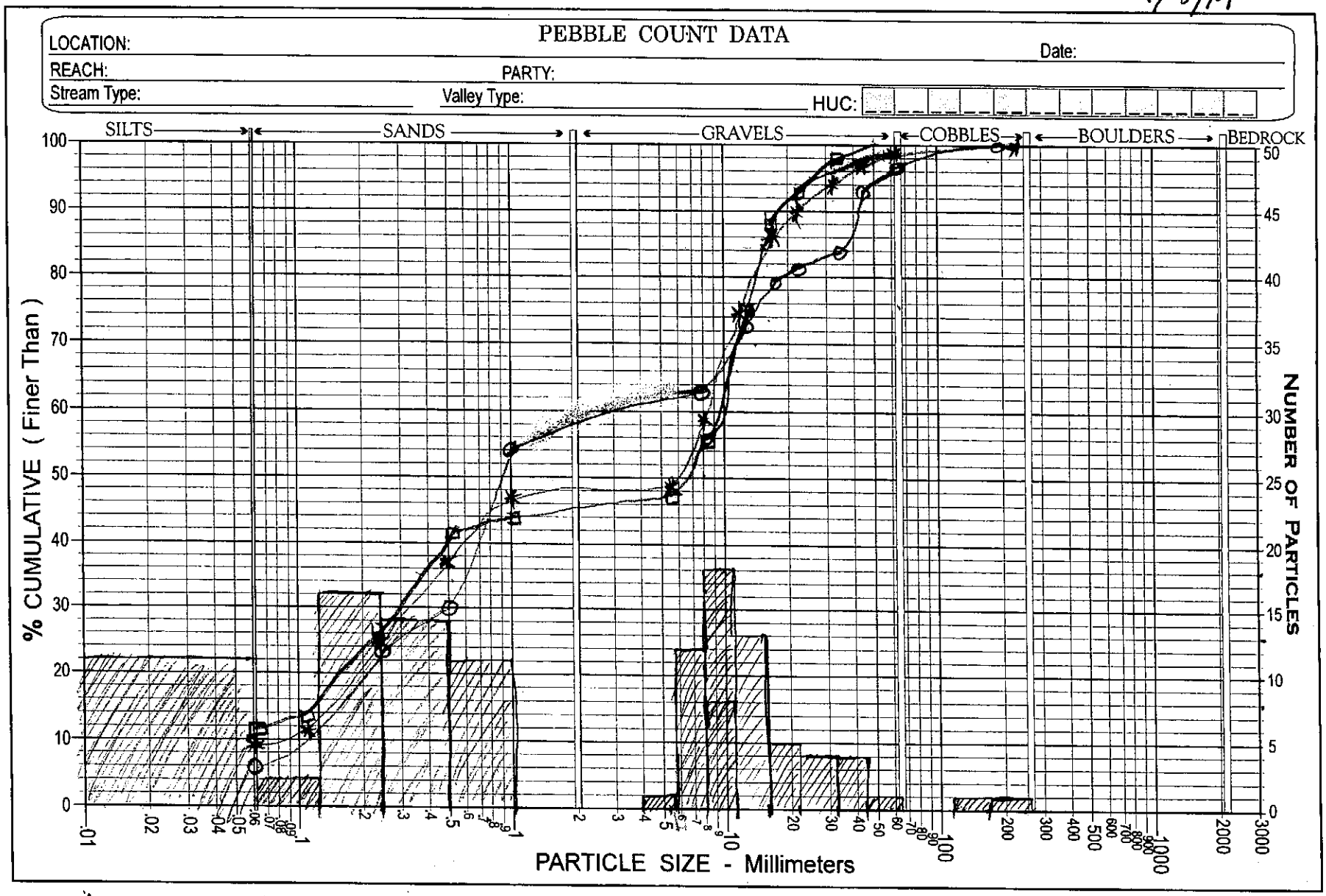
(Israel Creek) Reach # 3
Reach wide (Representative Pebble Count)
4/8/14



* → Total
O → Pool
□ → Riffle

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Reach #3
4/8/14

Worksheet A-1. Field Form for Level II Stream Classification.

Stream: Israel Creek	
Basin:	Drainage Area: acres 5.40 mi^2
Location: Washington County, MD	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/8/14
Observers: Team 3	Valley Type: U-AL-FD

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	25.2	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.76	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	44.4	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	14.3	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.	2.72	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.	221.8	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	8.8	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.	610	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.	0.001	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 C 4-5 **See Classification Key (Figure A-2)**

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Worksheet A-2. Computations of velocity and discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Israel Creek	Location:	Wash. Co, MD
Date: 4/8/14	Stream Type: C4-5	Valley Type:	U-AL-FD
Observers:	Team 3	HUC:	-- -- -- -- -- -- -- -- -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	44.4	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.76	d_{bkf} (ft)
Bankfull Riffle WIDTH	25.2	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	28.72	W_p (ft)
D_{84} at Riffle	23	Dia. (mm)	D_{84} (mm) / 304.8	0.075	D_{84} (ft)
Bankfull SLOPE	0.0026	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.55	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	20.6	R / D_{84}
Drainage Area	5.4	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.36	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	3.7	ft / sec	164.3	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.030	3.4	ft / sec	150.6	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.032	3.2	ft / sec	141.2	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 $n =$ 0.038	2.68	ft / sec	118.9	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 $\bar{u} = Q / A$	4.05	ft / sec	180	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 A-3. Summary of Morphological Variables.

Stream: Israel Creek		**Location:** Washington County	
Team: 3	**Date:** 4/8/14	**Drainage Area:** 5.40	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	25.2	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.76
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	14.3	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	44.4
5. Bankfull Maximum Depth (d_{max}) (ft)	2.72	6. Width of Flood-Prone Area (W_{fpa}) (ft)	221.8
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	8.8		

Channel Pattern / *Dimensionless Ratios*

8. Belt Width (W_{blt}) (ft)	Mean	96'	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	3.8
	Min	95'		Min	3.7
	Max	97'		Max	3.9
10. Stream Meander Length (L_m) (ft)	Mean	175'	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	6.94
	Min			Min	
	Max			Max	
12. Linear Wavelength (λ) (ft)	Mean	146'	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	5.8
	Min			Min	
	Max			Max	
14. Radius of Curvature (R_c) (ft)	Mean	35'	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.4
	Min	19'		Min	0.8
	Max	51'		Max	2.0

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	0.13	17. D_{35} (mm)	0.37	18. D_{50} (mm)	0.90
19. D_{84} (mm)	16	20. D_{95} (mm)	25	21. D_{100} (mm)	180

Active Bed Riffle Pebble Count

22. D_{16} (mm)	0.65	23. D_{35} (mm)	5.8	24. D_{50} (mm)	10
25. D_{84} (mm)	23	26. D_{95} (mm)	38	27. D_{100} (mm)	50

Classification

28. Sinuosity (k)	1.2	29. Average Water Surface Slope (S)	0.0006
30. Stream Type	C4-5	31. Valley Type	U-AL-FD

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u*)	10.2	33. Relative Roughness (R / D_{84})	20.6
34. Manning's 'n' from Friction Factor / Relative Roughness	0.030	35. Manning's 'n' from Stream Type	0.032
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	3.4	37. Estimated Bankfull Discharge (cfs)	150.6
38. Estimation Method Selected for Velocity & Discharge	Mannings 'n' from friction factor / relative roughness		

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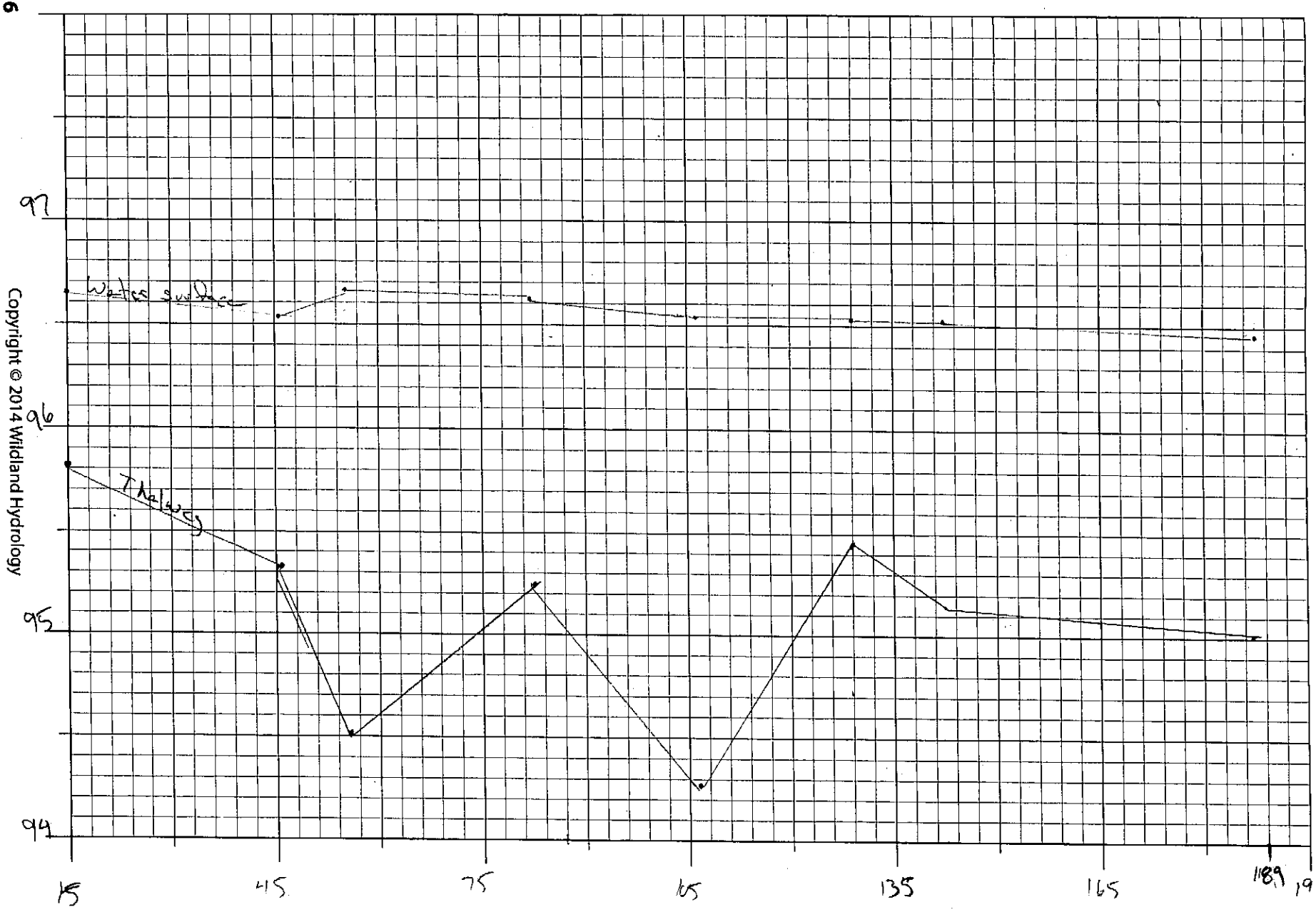

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