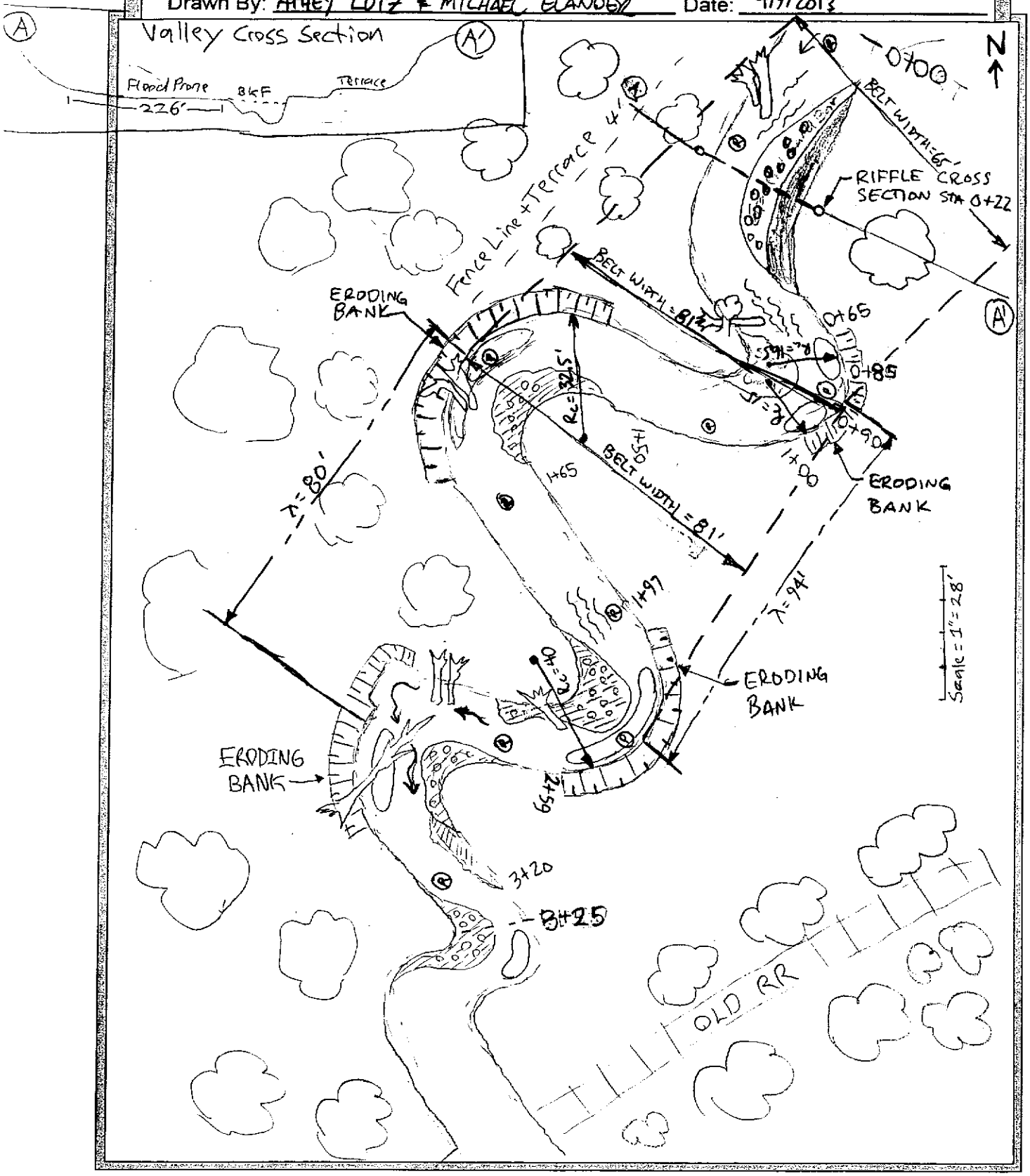
AREA-SITE LOCATION...REACH MAP

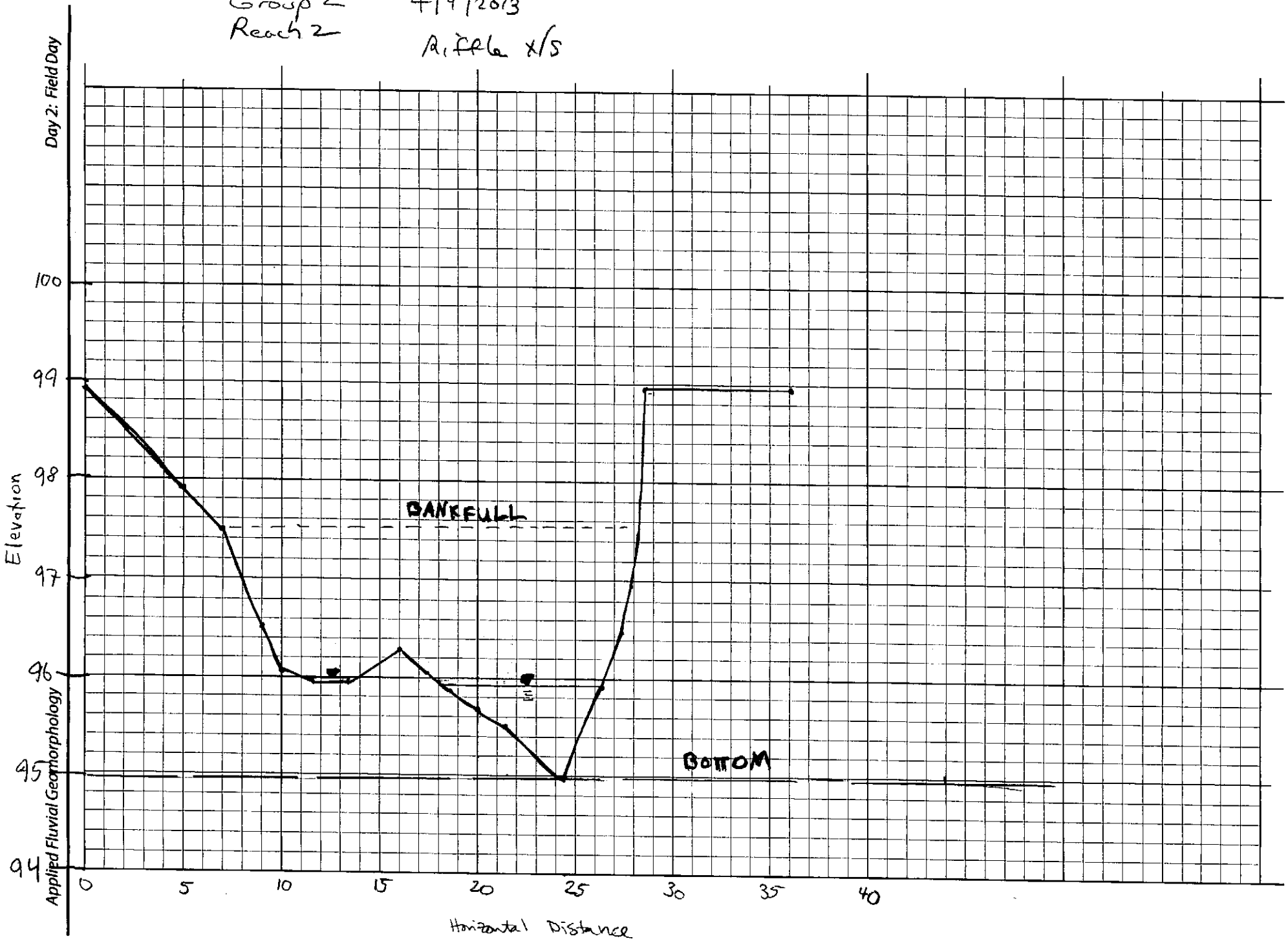
Stream: ISRAEL CREEK Reach: GROUP 2

Drawn By: ATHEY LUTZ & MICHAEL ELANDER Date: 4/9/2013



Group 2
Reach 2

4/9/2013
Riffle x/s



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SURVEY DATA → CROSS - SECTION 2

SITE: Isreal Creek Date: 4/9/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	BM	3.29	103.29		100	Benchmark
30	0			4.45	98.84	
31	5			5.31	97.98	
32	7			5.84	97.45	LBF
33	9			6.77	96.52	
34	10			7.25	96.04	left ~~channel berm~~ bottom
35	11.7			7.34	95.95	
36	13.4			7.32	95.97	left channel berm
37	16			7.01	96.28	top channel berm
38	17.5			7.16	96.13	
39	18.75			7.43	95.86	right channel berm
40	20			7.6	95.69	
41	21.3			7.75	95.54	
42	24.6			8.3	94.99	thalweg
43	26.3			7.38	95.91	right water edge
44	27.3			6.81	96.48	right bank - low
45	27.9			6.32	96.97	right bank - mid
46	28.08				97.45	interpolated value
47	28.65			4.3	98.99	
48	36			4.38	98.91	
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

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Cell #	Station (ft)	Elevation (ft)	Depth (ft)	Cell Width (ft)	Average Cell Depth (ft)	Incremental Area (ft^2)
1	0.0	98.84				
2	5.0	97.98				
3	7.0	97.45				
4	9.0	96.52	.93	2	(0+.93)/2=.465	2 x .465=.93
5	10.0	96.04	1.41	1	(1.41+.93)/2=1.17	1 x1.17=1.17
6	11.7	95.95	1.50	1.7	(1.5+1.41)/2=1.455	1.7x1.455=2.474
7	13.4	95.97	1.48	1.7	(1.48+1.5)/2=1.49	1.7x1.49=2.533
8	16.0	96.28	1.17	2.6	(1.17+1.48)/2=1.325	2.6x1.325=3.445
9	17.5	96.13	1.32	1.5	(1.32+1.17)/2=1.245	1.5x1.245=1.868
10	18.75	95.86	1.59	1.25	(1.59+1.32)/2=1.455	1.25x1.455=1.819
11	20.0	95.69	1.76	1.25	(1.76+1.59)/2=1.675	1.25x1.675=2.094
12	21.3	95.54	1.91	1.3	(1.91+1.76)/2=1.835	1.3x1.835=2.386
13	24.6	94.99	2.46	3.3	(2.46+1.91)/2=2.185	3.3x2.185=7.211
14	26.3	95.91	1.54	1.7	(1.54+2.46)/2=2	1.7x2=3.4
15	27.3	96.48	.97	1	(.97+1.54)/2=1.255	1x1.255=1.255
16	27.9	96.97	.48	.6	(.48+.97)/2=.725	.6x.725=.435
17	28.03	97.45		.18	(0+.48)/2=.24	.18x.24=.0432
18	28.65	98.99				
19	30.0	98.91				
					Total Area (ft^2)	31.063

4/9/13
Team 2 Reach 2
Riffle x/s calcs

Israel Crk

SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: group 2 Reach 2 Date: 4-9-13

Location: Israel Creek MD

Party / Notes: 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	BM	3.35	103.35		100								WS-T
2	∅			7.02	95.73	7.26	96.09	5.35	98	4.77	98.58	top riffle	7.26 5.35 1.91*
3	42.5			8.45	94.9	7.70	95.65	5.87	97.48	5.60	97.75	bottom riffle	7.70 5.87 1.83*
4	62			8.70	94.65	7.90	95.45	5.97	97.38	5.20	98.15	top pool	7.97 5.97 2.00
5	81			8.77	94.58	7.87	95.48					shallow	
6	108			9.50	93.85	7.94	95.41						9.50 7.94
7	675			9.84	93.51							deep pool	
8	145			8.99	94.36	7.98	95.37	6.26	97.09	5.83	97.52	pool	7.98 6.26 1.72*
9	160			10.96	92.39	7.95	95.4	6.10	97.25	5.77	97.58	pool	1.85*
10	200			8.41	94.94	7.98	95.37	5.84	97.51	5.51	97.84	top of riffle	2.14
11	208			8.86	94.49	8.05	95.3					bottom of riffle	
12	239			10.36	92.99	8.18	95.17						
13	270			9.91	93.44	8.05	95.3	6.67	96.68	6.15	97.2		2.10
14	288			8.6	94.75	8.15	95.2						
15	290			8.81	94.54	8.16	95.19						
16	304			9.31	94.04	8.18	95.17	6.21	97.41	6.21	97.14		1.97
17	332			8.58	94.77	8.24	95.11	6.66	96.69				1.58
18													
19						slope		slope					
20						96.09		98					
21						91.11		96.69					
22						0.98		1.31					
23						0.98		1.31					
24						332		332					
25						0.0025		0.0039					
26													
27													

poor? bankfull

poor sample

(not in order)

poor

poor point

riffle 0.0036

riffle 0.002

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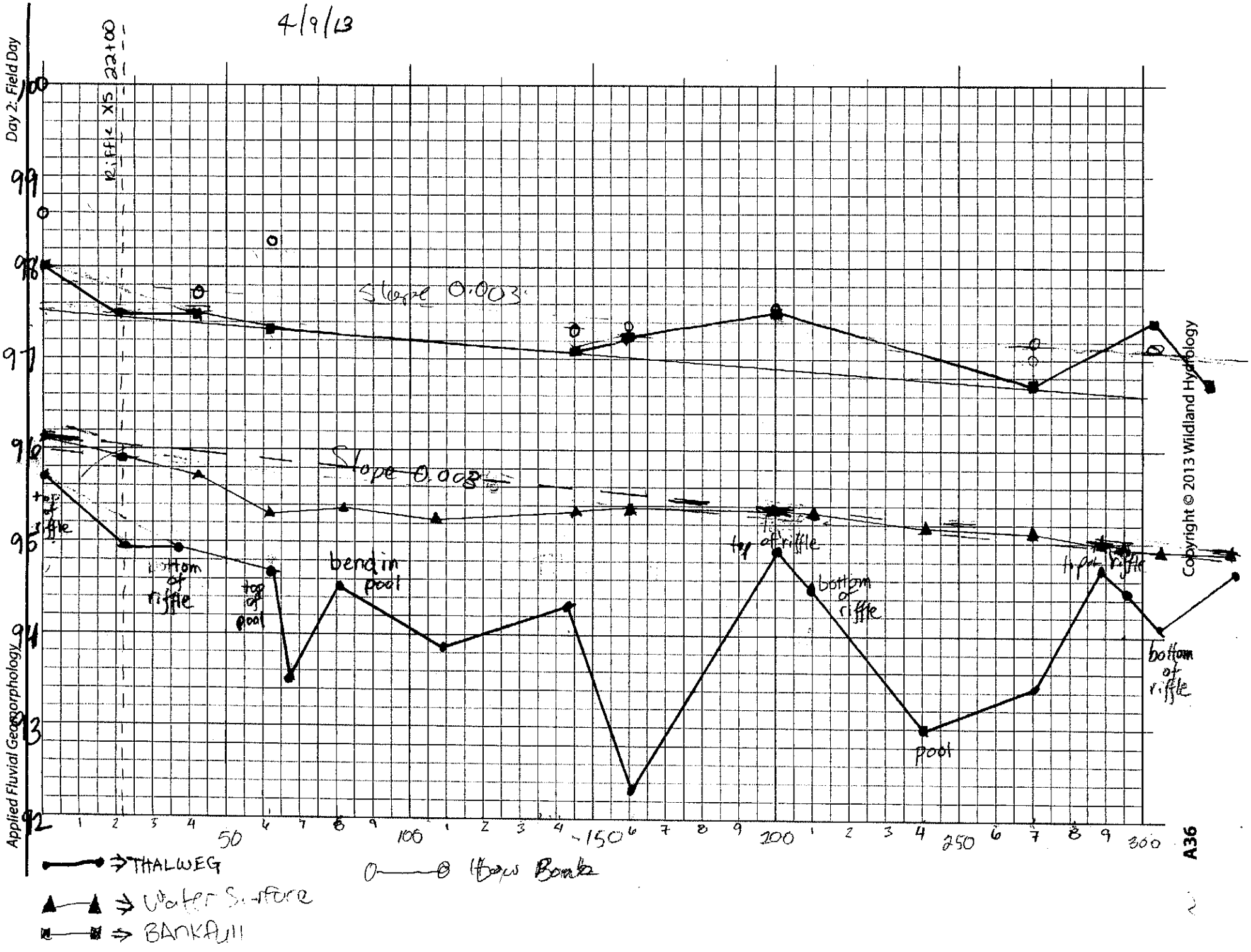
Group 2, Reach 2
Israel Creek
4/9/13



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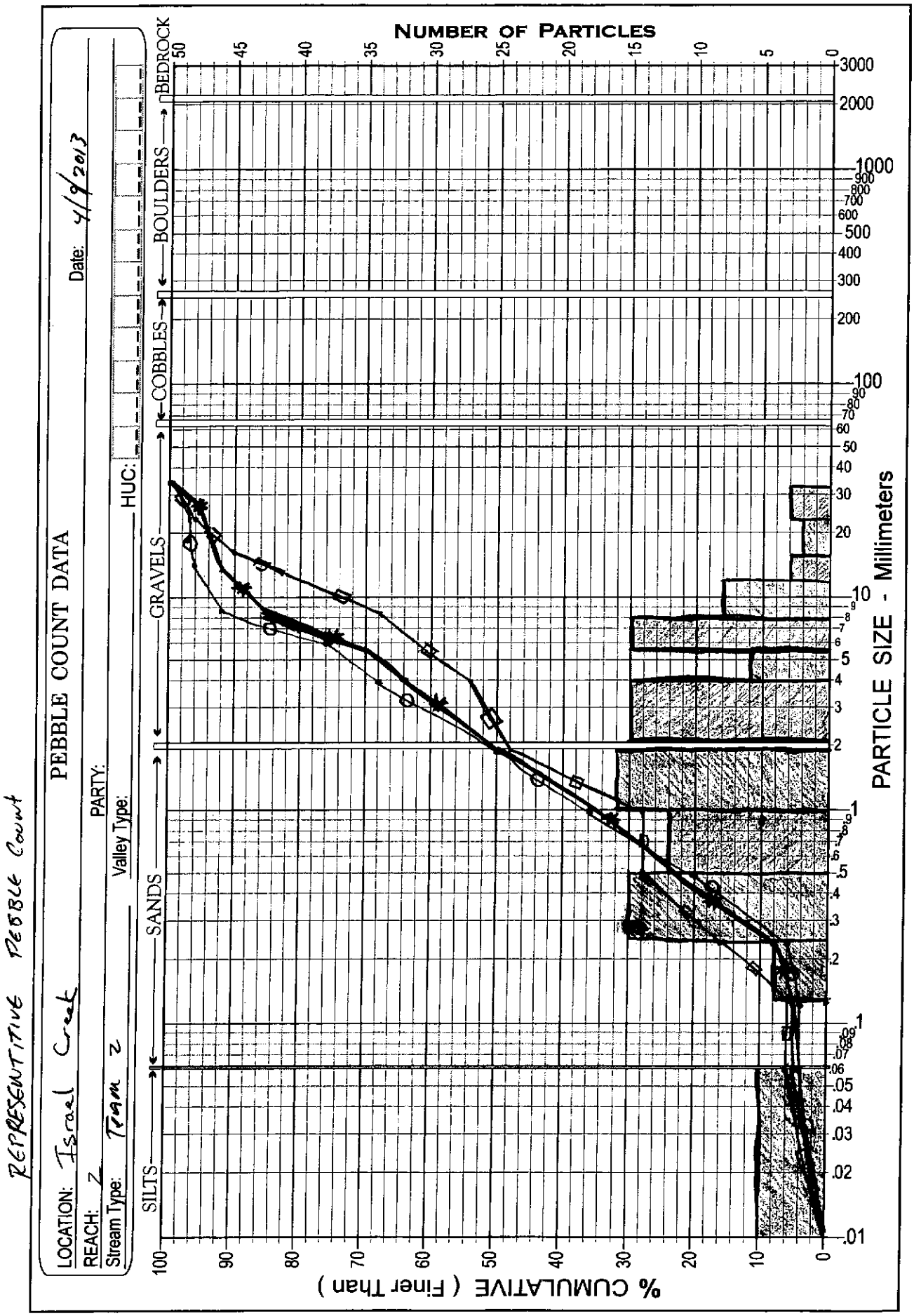

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Site: Israel Creek Date:

Location: Reach 2 HUC:

Party: Team 2

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:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C				5	2/31	6%	3/73	4%		5	5/104	5%
	Very Fine	.062 - .125	SAND					2/31	6%	3/73	4%		~~5~~	5/104	5%
	Fine	.125 - .25					4	5/31	16%	4/73	5%		4	9/104	9%
	Medium	.25 - .50					15	9/31	29%	15/73	20%		15	24/104	23%
	Coarse	.50 - 1.0					12	9/31	29%	27/73	36%		12	36/104	35%
.04 - .08	Very Coarse	1.0 - 2					16	15/31	48%	37/73	50%		16	52/104	50%
.08 - .16	Very Fine	2 - 4	GRAVEL				15	17/31	54%	50/73	68%		15	67/104	64%
.16 - .22	Fine	4 - 5.7					6	19/31	61%	54/73	74%		6	73/104	70%
.22 - .31	Fine	5.7 - 8					15	21/31	67%	67/73	92%		15	88/104	85%
.31 - .44	Medium	8 - 11.3					8	26/31	83.8%	70/73	96%		8	96/104	92%
.44 - .63	Medium	11.3 - 16					3	28/31	90%	71/73	97%		3	99/104	95%
.63 - .89	Coarse	16 - 22.6					2	30/31	96%	71/73	97%		2	101/104	97%
.89 - 1.3	Coarse	22.6 - 32					3	31/31	100%	73/73	100%		3	104/104	100%
1.3 - 1.8	Very Coarse	32 - 45													
1.8 - 2.5	Very Coarse	45 - 64													
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												
						TOTAL→	31			73			104		

Stream Type: c4 **Valley Type:** 31

BANKFULL .5
CLAY (2)
Fine SAND
.25

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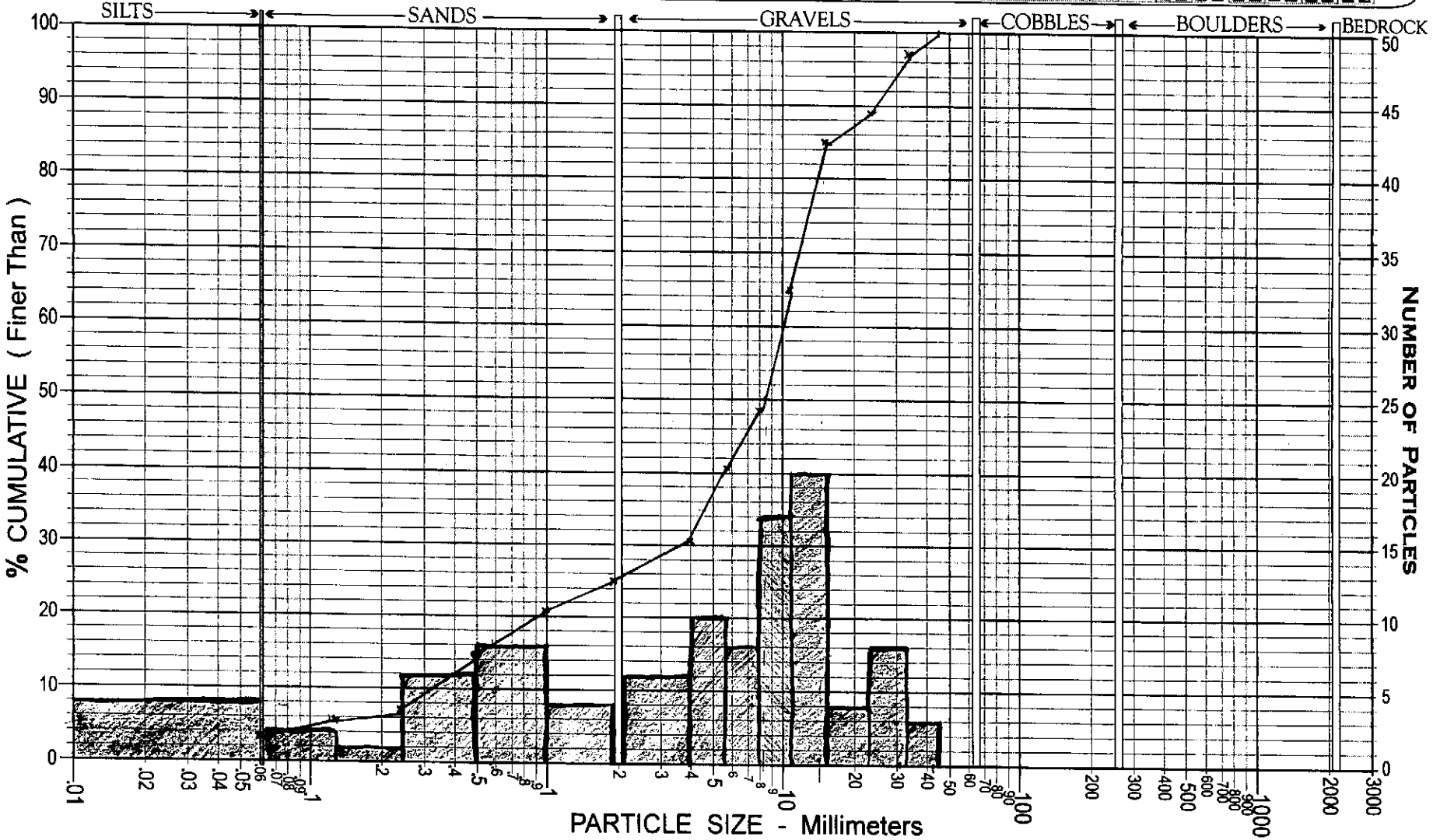
Active Bed Riffle Pebble Count

PEBBLE COUNT DATA

LOCATION: Group 2 / Israel Creek
Date: 4/9/13
REACH: 2
PARTY: Group 2
Stream Type: C4/5
Valley Type: VIII c
HUC:



$D_{16} = \sim 0.58$ mm $D_{35} = \sim 4.4$ mm $D_{65} \approx 31$ mm

$D_{84} = \sim 15$ mm $D_{50} = \sim 8.2$ mm $D_{100} \approx 45$ mm

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Active Bed Riffle Count

Active Count (A)

Site: 2 Israel Creek Date: 4/9/13

Location: Israel Creek 2 HUC:

Party: 2

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				4	3.9	3.9						
	Very Fine	.062 - .125	SAND				2	2.0	5.9						
	Fine	.125 - .25					1	1.0	6.9						
	Medium	.25 - .50					6	5.9	12.8						
	Coarse	.50 - 1.0					8	7.9	20.7						
.04 - .08	Very Coarse	1.0 - 2					4	4.0	24.7						
.08 - .16	Very Fine	2 - 4	GRAVEL				6	5.9	30.6						
.16 - .22	Fine	4 - 5.7					10	9.9	40.5						
.22 - .31	Fine	5.7 - 8					8	7.9	48.4						
.31 - .44	Medium	8 - 11.3					17	16.8	65.2						
.44 - .63	Medium	11.3 - 16					20	19.8	85.0						
.63 - .89	Coarse	16 - 22.6					4	4.0	89.0						
.89 - 1.3	Coarse	22.6 - 32					8	7.9	96.9						
1.3 - 1.8	Very Coarse	32 - 45					3	3.0	99.9						
1.8 - 2.5	Very Coarse	45 - 64													
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												
						TOTAL→	101								

Stream Type: Valley Type:

4
2
1
6
8
4
6
0
3
7
0
1
8
3

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

Stream: ISRAEL CREEK			
Basin: REACH 2	Drainage Area:	acres 4.20	mi^2
Location: REACH 2			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: 4/9/2013	
Observers: TEAM 2		Valley Type: VIII c	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	21.08	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.47	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	31.06	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.	2.46	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.	226	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	10.7	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface, between the bankfull stage and Thalweg elevations.	2	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.	0.003	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).	1.26	

Stream Type C4/5 **See Classification Key (Figure A-2)**

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Worksheet A-3. Summary of Morphological Variables.

Stream: ISRAEL CREEK		Location: REACH 2	
Team: 2	Date: 4/9/13	Drainage Area: 4.20 sq. mi.	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	21.08	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.47
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	14.3	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	31.06
5. Bankfull Maximum Depth (d_{max}) (ft)	2.46	6. Width of Flood-Prone Area (W_{fpa}) (ft)	226
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	10.7		

Channel Pattern			***Dimensionless Ratios***		
8. Belt Width (W_{blt}) (ft)	Mean	75.5	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	3.58
	Min	65		Min	3.08
	Max	81		Max	3.84
10. Stream Meander Length (L_m) (ft)	Mean	145.5	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	6.9
	Min	132		Min	6.3
	Max	159		Max	7.5
12. Linear Wavelength (λ) (ft)	Mean	87	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	4.1
	Min	80		Min	3.8
	Max	94		Max	4.5
14. Radius of Curvature (R_c) (ft)	Mean	26	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.2
	Min	15		Min	0.17
	Max	40		Max	1.9

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	35	17. D_{35} (mm)	1	18. D_{50} (mm)	2
19. D_{84} (mm)	8	20. D_{95} (mm)	21	21. D_{100} (mm)	32

Active Bed Riffle Pebble Count

22. D_{16} (mm)	0.58	23. D_{35} (mm)	4.4	24. D_{50} (mm)	8.2
25. D_{84} (mm)	15	26. D_{95} (mm)	31	27. D_{100} (mm)	45

Classification

28. Sinuosity (k)	1.26	29. Average Water Surface Slope (S)	0.003
30. Stream Type	C4/5	31. Valley Type	VIII C

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u^*)	10.8	33. Relative Roughness (R / D_{84})	25.8
34. Manning's 'n' from Friction Factor / Relative Roughness	0.029	35. Manning's 'n' from Stream Type	0.031
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	4.4	37. Estimated Bankfull Discharge (cfs)	137
38. Estimation Method Selected for Velocity & Discharge	FRICTION FACTOR/RELATIVE ROUGHNESS		

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	ISRAEL CREEK			Location:	REACH 2
Date:	4/9/13	Stream Type:	C4/5	Valley Type:	VIII C
Observers:	TEAM 2			HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	31.06	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.47	d_{bkf} (ft)
Bankfull Riffle WIDTH	21.08	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	24	W_p (ft)
D_{84} at Riffle	15	Dia. (mm)	D_{84} (mm) / 304.8	0.049	D_{84} (ft)
Bankfull SLOPE	0.003	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.29	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	25.8	R / D_{84}
Drainage Area	4.20	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.41	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	4.4	ft / sec	137	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.029	3.3	ft / sec	102	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.031	3.1	ft / sec	96	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 $n =$	N/A	ft / sec	N/A	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 $\bar{u} = Q / A$	4.2	ft / sec	132	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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