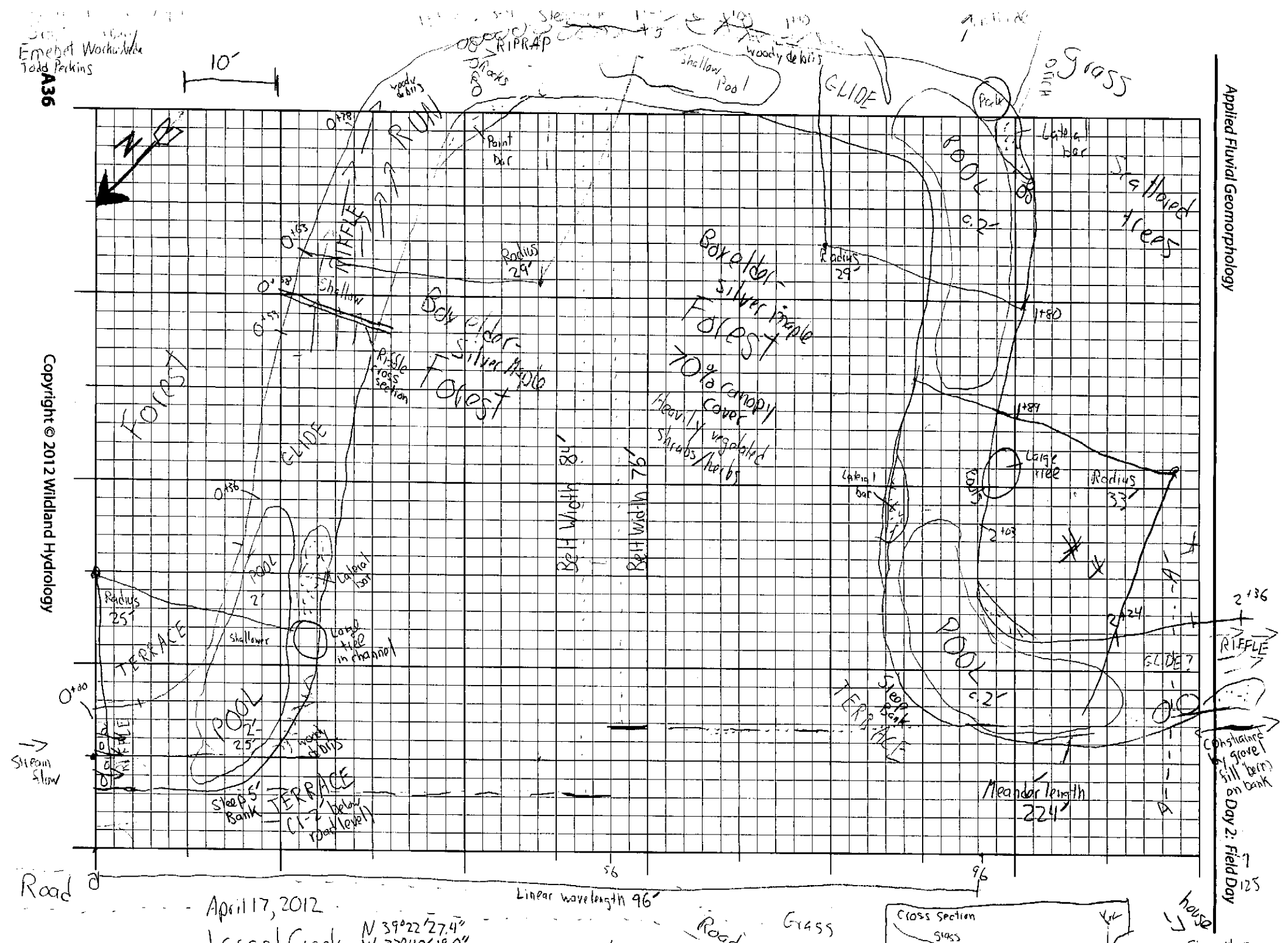
Emerald Workshop
Todd Perkins



April 17, 2012

Israel Creek
Washington Co, MD

N 39°22'27.4"
W 77°40'19.0"
Route 67 is 1000' to SE

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SURVEY DATA → **CROSS - SECTION 1**

SITE: Isreal Creek Date: 4-17-12

Location:

Party / Notes: Team 4 XS FD/KV/JM 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	BM	3.50	103.50		100.0	
2	0+00			4.20	99.3	Top of Bank LT
3	0+2.0			4.34	99.16	1
4	0+6.5			7.75	95.75	L W/S
5	0+8.0			7.84	95.66	
6	0+9.6			7.99	95.51	TWG
7	0+12.3			7.87	95.63	RB
8	0+17.5			7.76	95.74	RB
9	0+19.5			8.04	95.46	
10	0+20.4			7.64	95.86	E/ WATER RIGHT
11	0+20.5			8.09	95.41	RB
12	0+21.5			7.64	95.86	TRUE EDGE H2O
13	0+20.92			7.23	96.27	MID UNDERCUT
14	0+20.5			6.91	96.59	TBK RT
15	0+23.6			5.29	98.21	@BKFL
16	0+27.8			4.52	99.98	
17	0+4.2			5.29	98.21	19.4 BKF WD
18			~~5.2~~	5.29	98.21	BNFL +/- Rt Bank 2.46
19						
20					100.91 ✓	CALC 2D MAX 2.7 x 2 = 5.4
21						TREE UPSTREAM - ROUGHNESS!
22						
23	X SEC	AREA	.2 MD	x 15 WD	3 x	50/34 1.47 = 4.4 CFS
24						
25						
26						
27						
28						

CFS. ? 10-

.2x

WIDTH @ BLK 20' x 7.9

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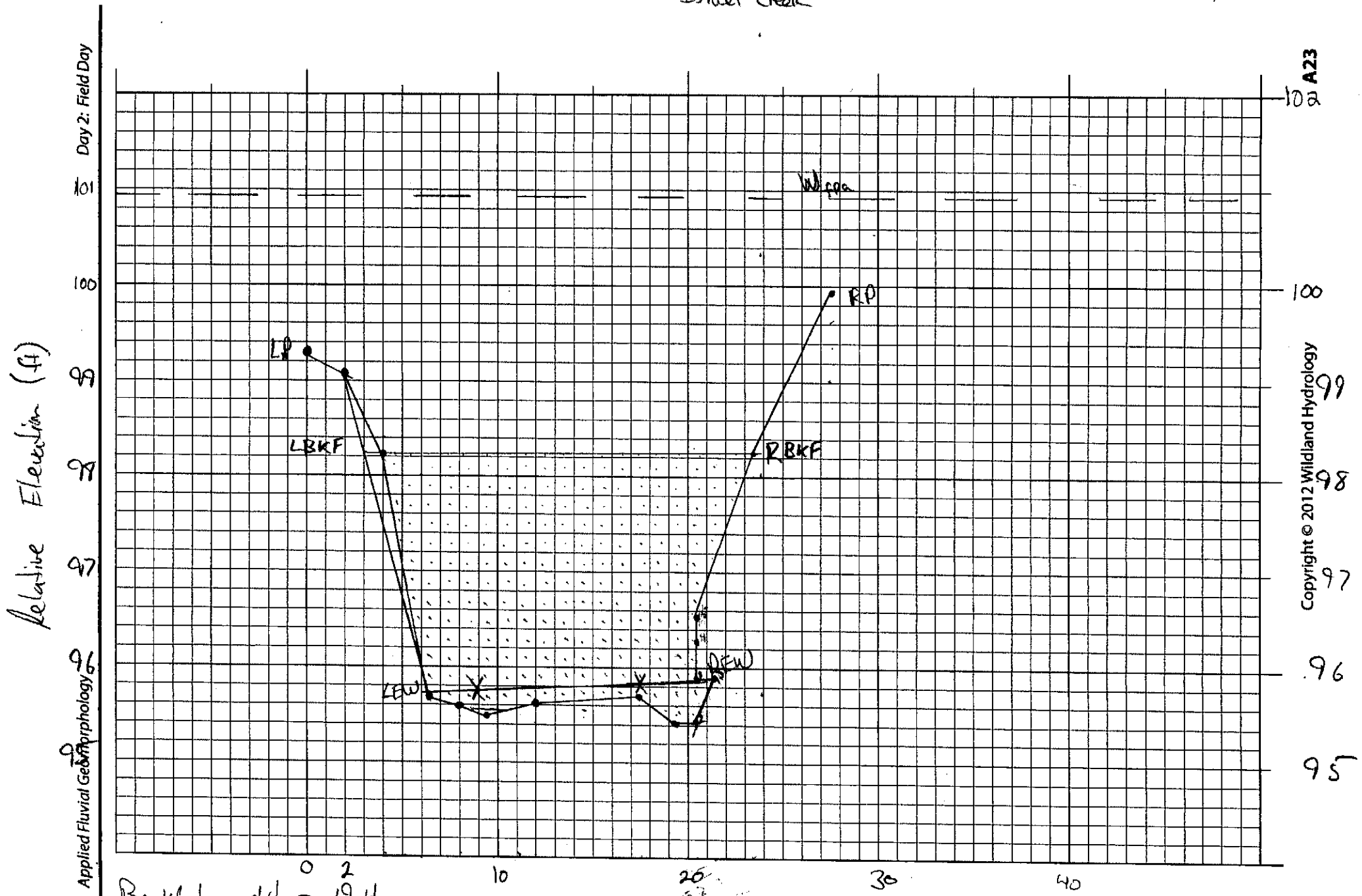
F.P. 58 x 3 = 174"

ENTRT. 8.70

4/17/12
Israel Creek

Team 4: Jason, Frank, Kevin



Bankful width = 19.4
Bankful XS area = 42.4
Mean depth = 2.19
Max depth = 2.8
Width/Depth = 8.86
Floodprone width = 174'
Entrenchment ratio = 8.97

Slope - .0034

SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Israel Creek **Date:** 4/17/12

Location: Site 4

Party / Notes: Mike, Tom, Callie **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	0		103.5	7.72	95.78	7.30	96.20				99.9	Top of Riffle Placed
2	0+05			8.72	94.78	7.58	95.92			3.60	LTB	Bottom Riffle
3	0+11			8.90	94.60	7.68	95.82					Middle Run
4	0+13			9.27	94.23	7.70	95.80					Start Pool
5	0+14			9.23	94.27	7.70	95.80					~~Mid Pool~~ Pool
6	0+15			9.33	94.17	7.70	95.80					Mid Pool
7	0+21			9.78	93.72	7.98	95.79					Mid Pool
8	0+36			9.25	94.25	7.64	95.86	~~5.50~~ 5.70	97.8	~~5.50~~	L	End of Pool
9	0+48			8.12	95.38	7.61	95.89	5.30	98.2		L	Mid Glide
10	0+58			7.83	95.67	7.61	95.89					Start Riffle
11	0+58			8.05	95.45							XSection Riffle
12	0+65			8.10	95.40	7.78	95.72					Mid Riffle
13	0+78			8.69	94.81	7.84	95.66					End Riffle
14	0+63							5.25	98.25			
15	0+110			8.88	94.62	8.00	95.50					Mid Run
16	0+122					8.03	95.47	5.35	98.15	~~5.85~~		RTB
17	0+132			8.82	94.68							
18	0+143			8.57	94.93	8.05	95.45					
19	0+157			8.59	94.91							Start Pool
20	0+172			9.10	94.40							Mid Pool?
21	0+180			9.10	94.40	8.05	95.45					Pool
22	0+98			8.92	94.58							End Pool
23	2+03			9.36	94.14	8.06	95.44	~~5.85~~ 5.5	98.00		(Start pool)	thalweg (BF=LLBH)
24	2+10			9.41	94.09							Mid Pool
25	2+23			9.41	94.09	8.10	95.40					End Pool
26	2+35			9.11	94.39	8.11	95.39					Start Riffle (end profile)
27												

water surf to Bankfull

tree @ 23

1.9

2.33

2.53

2.68

2.54

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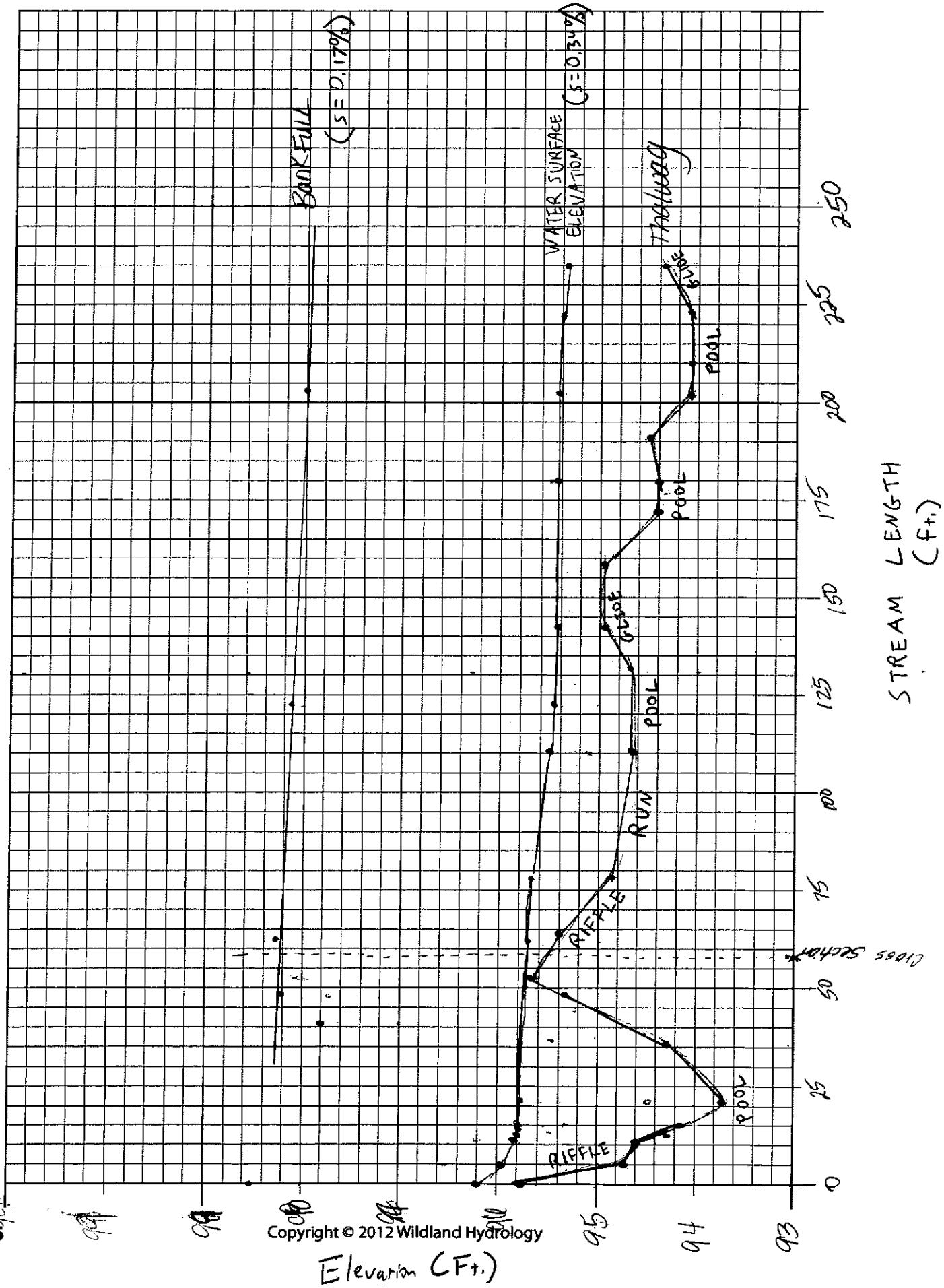
Team 4

4/17/12
Israel Creek



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80% pool
20% riffle/run/glide

Site: Downstream Tran 4 - Representative Date:
Location: HUC:
Party: Tran 4

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	1	IIII	9	1	5	5	8	10	10	9	9	9
	Very Fine	.062 - .125	SAND		II	2	–	–	5	2	2.5	12.5	2	2	11
	Fine	.125 - .25		1	IIII	9	1	5	10	8	10	22.5	9	9	20
	Medium	.25 - .50			IIII	5	–	–	10	5	6.2	28.7	5	5	25
	Coarse	.50 - 1.0			IIII	9	–	–	10	9	11.25	40.0	9	9	34
.04 - .08	Very Coarse	1.0 - 2			III	4	–	–	10	4	5	45.0	4	4	38
.08 - .16	Very Fine	2 - 4	GRAVEL		II	1	–	–	10	1	1.3	46.3	1	1	39
.16 - .22	Fine	4 - 5.7			III	4	–	–	2.10	4	5	51.3	4	4	43
.22 - .31	Fine	5.7 - 8		1	IIII	9	1	5	75	8	10	61.3	9	9	52
.31 - .44	Medium	8 - 11.3		IIII	II	7	5	25	40	2	2.5	63.8	7	7	59
.44 - .63	Medium	11.3 - 16		II	IIII	10	2	10	50	8	10	73.8	10	10	69
.63 - .89	Coarse	16 - 22.6		IIII	IIIII	14	5	25	75	9	11.25	85.1	14	14	83
.89 - 1.3	Coarse	22.6 - 32		II	III	5	2	10	85	3	3.7	88.8	5	5	88
1.3 - 1.8	Very Coarse	32 - 45		1		1	1	5	90	–	–	88.8	1	1	89
1.8 - 2.5	Very Coarse	45 - 64			II	2	–	–	90	2	2.5	91.3	2	2	91
2.5 - 3.5	Small	64 - 90	COBBLE			–	–	–	90	–	–	91.3	–	–	91
3.5 - 5.0	Small	90 - 128		II	III	4	1	5	95	3	3.7	95.0	4	4	95
5.0 - 7.1	Large	128 - 180				–	–	–	95	–	–	95.0	–	–	95
7.1 - 10.1	Large	180 - 256		1	III	4	1	5	100	3	3.7	98.7	4	4	99
10.1 - 14.3	Small	256 - 362	BOULDER		I	1	–	–	100	1	1.3	100.0	1	1	100
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→	20		100	80		100			

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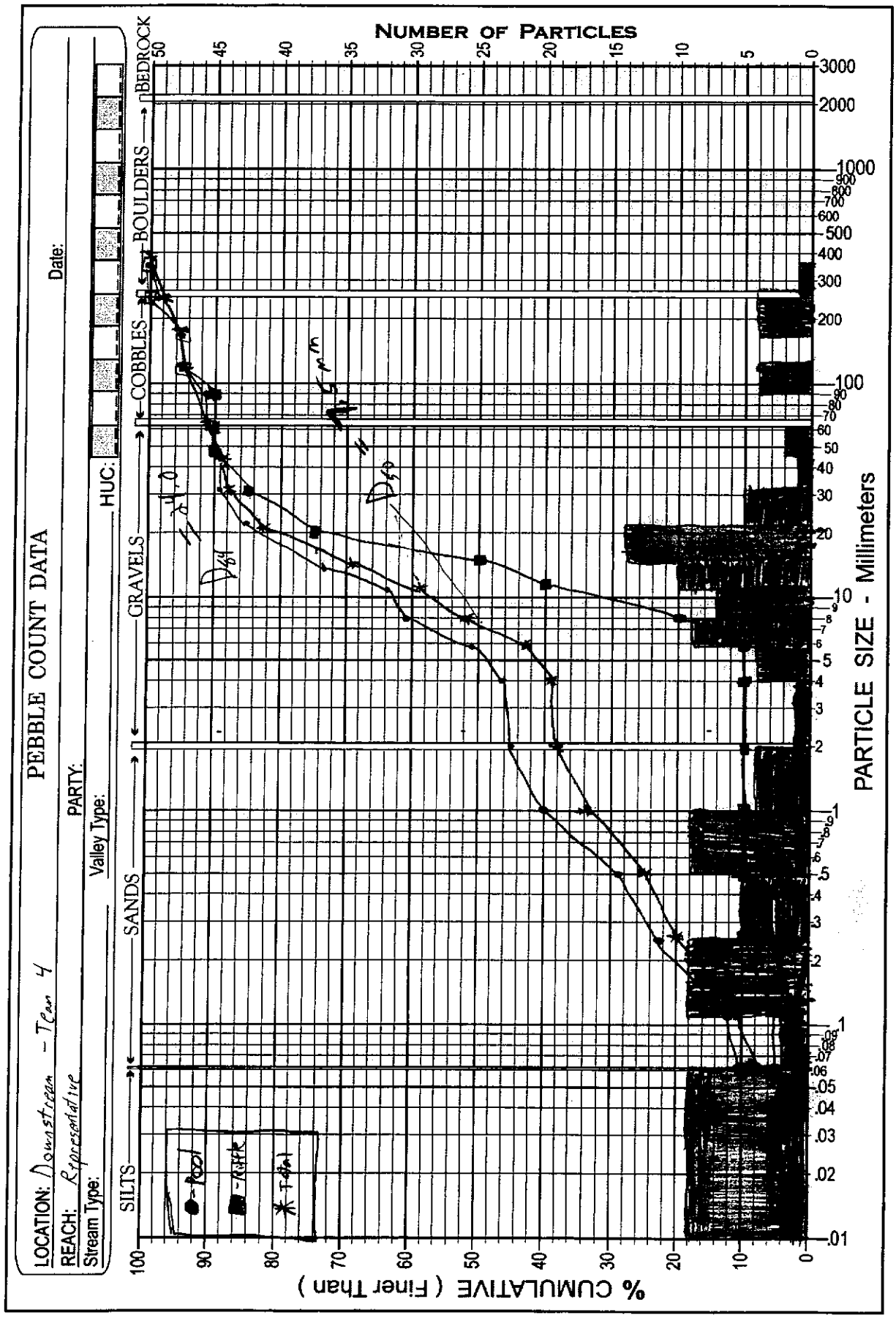
PEBBLE COUNT DATA
LOCATION: Downstream - Team 4
REACH: Representative
Stream Type:
Date:
PARTY:
Valley Type:
HUC:
SILTS
SANDS
GRAVELS
COBBLES
BOULDERS
BEDROCK
NUMBER OF PARTICLES
% CUMULATIVE (Finer Than)
PARTICLE SIZE - Millimeters
Pool
Riffle
Total

$D_{50} = 7.5$

Active Pebble Count

Site: Team 4 Downstream Reach Date:

Location: HUC:

Party:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	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
							Reach:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C	III		3	3	2.7	3						
	Very Fine	.062 - .125	SAND				—	—	3						
	Fine	.125 - .25	SAND	II		2	2	1.8	5						
	Medium	.25 - .50	SAND	II		2	2	1.8	7						
	Coarse	.50 - 1.0	SAND				—	—	7						
.04 - .08	Very Coarse	1.0 - 2	SAND				—	—	7						
.08 - .16	Very Fine	2 - 4	GRAVEL	II		2	2	1.8	9						
.16 - .22	Fine	4 - 5.7	GRAVEL	IIII		4	4	3.6	13						
.22 - .31	Fine	5.7 - 8	GRAVEL	~~IIII IIII~~		16	16	14.5	27						
.31 - .44	Medium	8 - 11.3	GRAVEL	~~IIII IIII IIII IIII IIII~~		34	34	30.9	58						
.44 - .63	Medium	11.3 - 16	GRAVEL	~~IIII IIII IIII~~		18	18	16.3	74						
.63 - .89	Coarse	16 - 22.6	GRAVEL	~~IIII IIII~~		11	11	10.0	84						
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	~~IIII IIII~~		12	12	10.9	95						
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	IIII		4	4	3.6	98						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	I		1	1	0.9	99						
2.5 - 3.5	Small	64 - 90	COBBLE	I		1	1	0.9	100						
3.5 - 5.0	Small	90 - 128	COBBLE												
5.0 - 7.1	Large	128 - 180	COBBLE												
7.1 - 10.1	Large	180 - 256	COBBLE												
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→									

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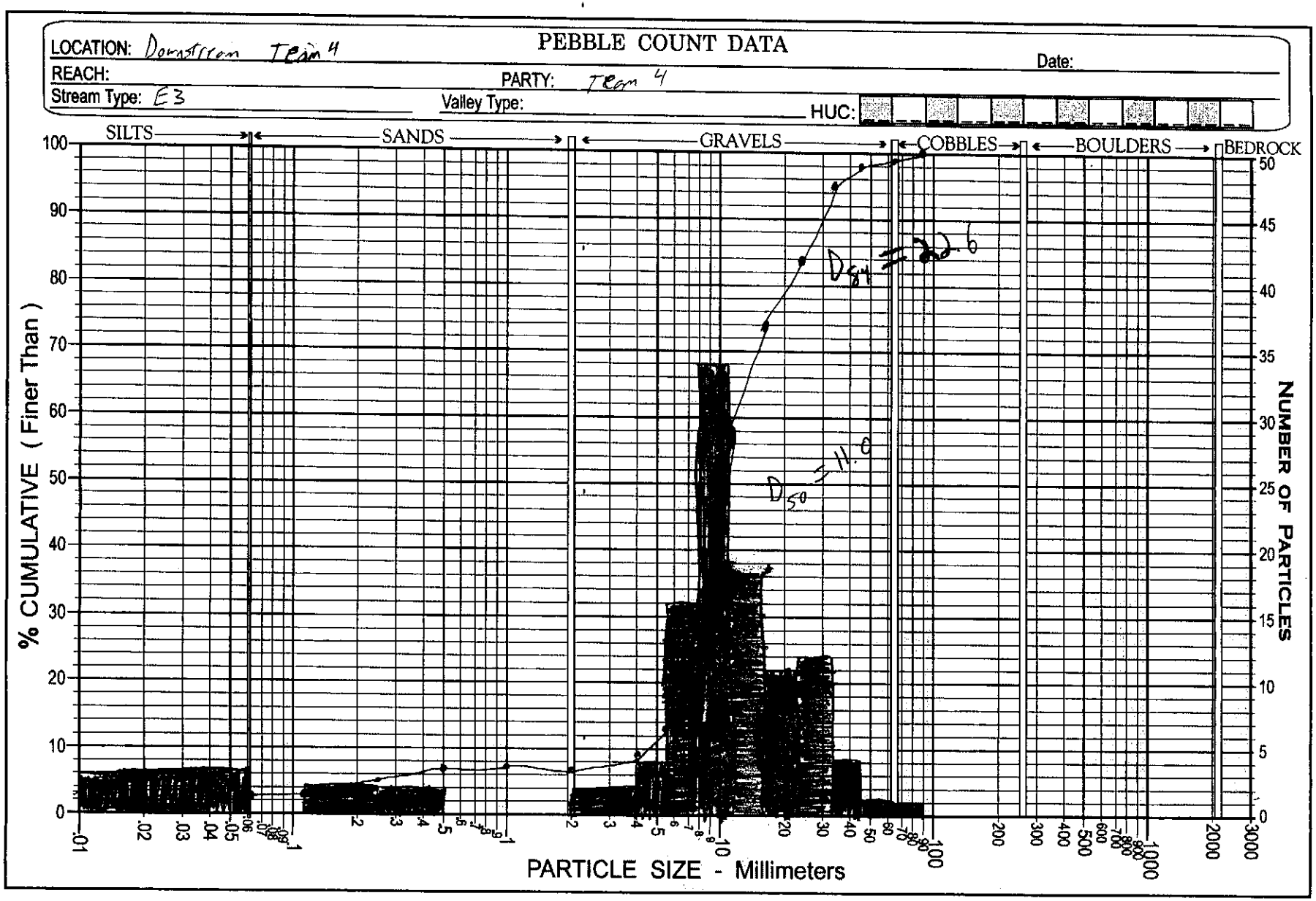
Active Pebble Count



$D_{84} = 22.6$ mm

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

Bankfull VELOCITY & DISCHARGE Calculations

Stream:	Israel Creek			Location:	
Date:	4/17/12	Stream Type:	E4	Valley Type:	9C
Observers:	Team 4			HUC:	-- -- -- -- -- -- -- -- -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	42.4	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	2.19	d_{bkf} (ft)
Bankfull Riffle WIDTH	19.4	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	23.78	W_p (ft)
D_{84} at Riffle	22.6	Dia. (mm)	D_{84} (mm) / 304.8	.0741	D_{84} (ft)
Bankfull SLOPE	0.17%	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.78	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	~~24.02~~	R / D_{84}
Drainage Area	5	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	.441	u^* (ft/sec)

S=.0034

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log(R/D_{84})] u^*$ (1.78)	4.69	ft / sec	198.9	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. A-~~27~~ 28, A-~~28~~ 29) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .028	4.56	ft / sec	193.3	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. A-~~29~~ 30) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .048	2.66	ft / sec	112.8	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $u = 1.49*R^{2/3}*S^{1/2}/n$ $n = 0.39*S^{0.38}*R^{-0.16}$ 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 $n =$ —	—	ft / sec	—	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 $u = Q / A$ Return Period for Bankfull Discharge Q = 1.2 year	4.—	ft / sec	190	cfs
4. Continuity Equations: b) Regional Curves $u = Q / A$	4.48	ft / sec	190	cfs

$\frac{U}{u^*} = 10.4$

n=.28

Roughness Coefficient Option 1 for Use in Determining Relative Roughness (Friction Factor) 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-1. Field Form for Level II Stream Classification.

Stream: Israel Ck			
Basin:	Drainage Area:	acres	5.7 mi²
Location: Team 4			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: 4/17/12	
Observers: Team 4		Valley Type: 8C	[Terraced Alluvial Valley]

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	19.4	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	2.19	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	42.4	ft²
* **Width/Depth Ratio (W_{bkf} / d_{bkf})** Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.86	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.	2.8	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.	174'	ft Cannot show
* **Entrenchment Ratio (ER)** The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	8.97	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.	0.5	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).	1.88	

Stream Type [redacted] **See Classification Key (Figure A-2)**

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Worksheet A-3. Summary of Morphological Variables.

Stream: Israel Creek		**Location:**	
Team: #4	**Date:** 4/17/12	**Drainage Area:** 5.4 mi²	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	19.4	2. Bankfull Mean Depth (d_{bkf}) (ft)	2.19
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	8.86	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	42.4
5. Bankfull Maximum Depth (d_{max}) (ft)	2.80	6. Width of Flood-Prone Area (W_{fpa}) (ft)	174
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	8.97		

Channel Pattern / Dimensionless Ratios

8. Belt Width (W_{blt}) (ft)	Mean	80	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	4.12
	Min	76'		Min	3.92
	Max	84'		Max	4.33
10. Stream Meander Length (L_m) (ft)	Mean	224'	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	11.55
	Min	224'		Min	
	Max			Max	
12. Linear Wavelength (λ) (ft)	Mean	96.5'	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	4.97
	Min	—		Min	—
	Max	—		Max	—
14. Radius of Curvature (R_c) (ft) 25', 34', 29', 29'	Mean	29.25	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.51
	Min	25'		Min	1.29
	Max	34		Max	1.75

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	0.19	17. D_{35} (mm)	1.5	18. D_{50} (mm)	9.5
19. D_{84} (mm)	24.0	20. D_{95} (mm)	128.0	21. D_{100} (mm)	362.0

Active Bed Riffle Pebble Count

22. D_{16} (mm)	6.2	23. D_{35} (mm)	9.0	24. D_{50} (mm)	10.5
25. D_{84} (mm)	22.4	26. D_{95} (mm)	32.0	27. D_{100} (mm)	90.0

Classification

28. Sinuosity (k)	1.88	29. Average Water Surface Slope (S)	0.34%
30. Stream Type	E4	31. Valley Type	8(c)

Velocity & Discharge

32. Friction Factor (u / u*)	10.6	33. Relative Roughness (R / D_{84})	24.02
34. Manning's "n" from Friction Factor / Relative Roughness	.028	35. Manning's "n" from Stream Type	.048
36. Estimated Mean Velocity (u_{bkf}) (ft/sec)	4.56	37. Estimated Bankfull Discharge (cfs)	193.3
38. Estimation Method Selected for Velocity & Discharge	Figure A-28, A-29 Friction Factor vs. Manning's Coefficient		

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