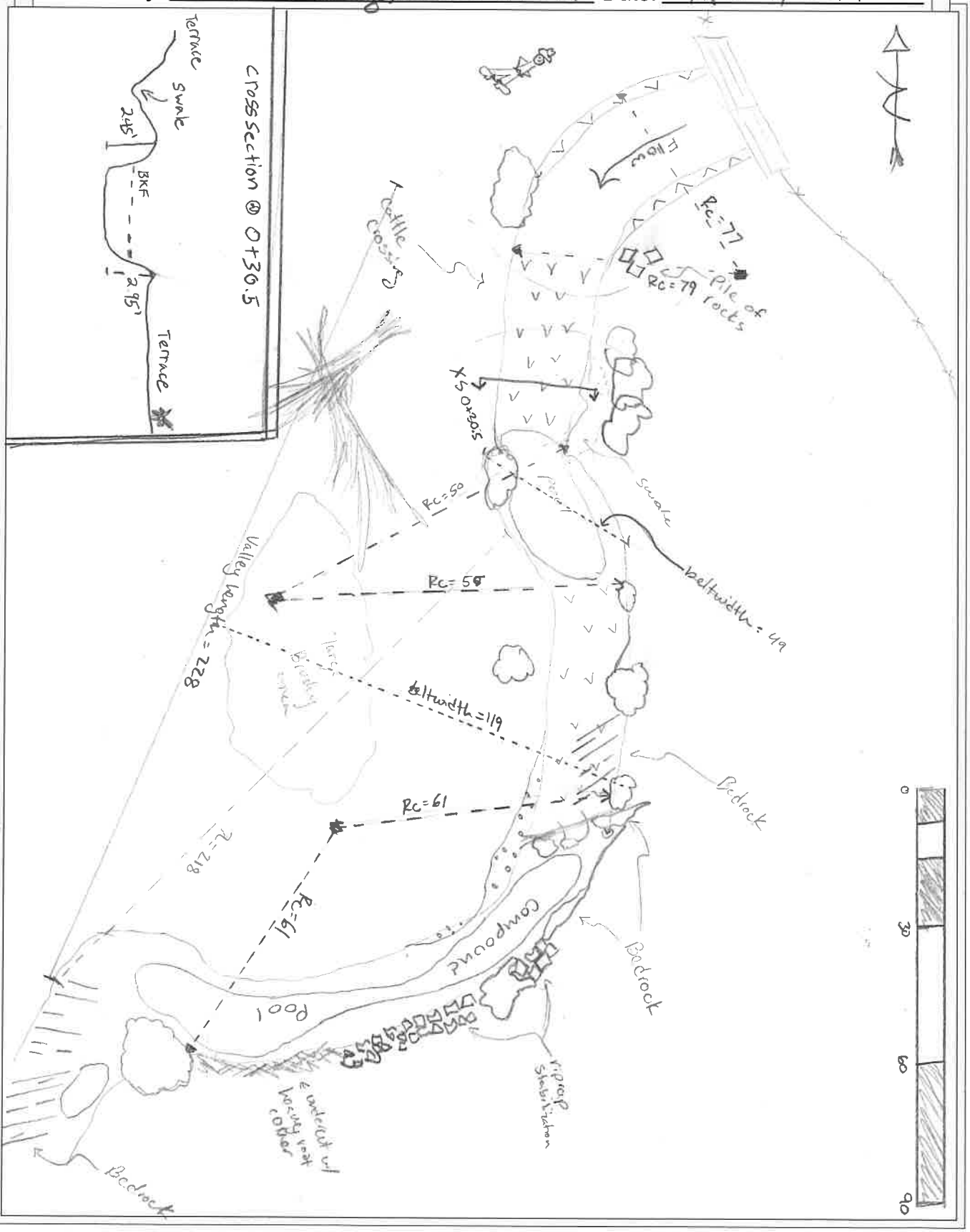
AREA-SITE LOCATION....REACH MAP

Stream: Little Conococheque Reach: 1

Drawn By: Katie Moody, Jason Harmon Date: April 9, 2019



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SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: Date: 4/9/19

Location:

Observers: Group 1 HUC:

Flood Prone width: 133 ft

Height = 4.51 ft

Item	Distance, Point, or STATION ft	Back-Sight B S ft	Height of Instrument H I ft	Fore-Sight F S ft	Elevation ft	REMARKS / COMMENTS / NOTES
1	0	3.88	4.61	-0.73	100 - 0.73 100.73	
2	2	4.13		-0.48	100.48	144 ft
3	4	4.20		-0.41	100.41	2.49 ft
4	6	4.61		0	100	
5	8	5.10		0.49	99.51	
6	10	5.51		0.9	99.1	
7	12	6.06		1.45	98.55	
8	13	6.20		1.59	98.41	
9	14	6.21		1.40	98.6	
10	16	5.89		1.28	98.72	
11	17	5.88		1.27	98.73	
12	18	5.72		1.11	98.89	
13	20	5.42		0.81	99.19	
14	22	5.20		0.59	99.41	
15	24	5.15		0.54	99.46	
16	26	5.39		0.78	99.22	
17	28.1	5.67		1.06	98.94	BKF
18	29.0	7.22		2.61	97.39	WS
19	11	7.51		2.9	97.1	LTOS
20	32	~~7.75~~		3.14	96.86	
21	35	7.75		3.14	96.86	
22	38	7.67		3.06	96.94	
23	41	7.66		3.05	96.95	
24	44	7.69		3.08	96.92	
25	47	7.61		3.0	97.0	
26	49.25	7.37		2.76	97.24	RTOS / EOW
27	50	7.14		2.53	97.47	
28	52	5.99		1.38	98.62	
	56.4	4.69		0.08	99.92	
	61.4	4.85		0.24	99.76	

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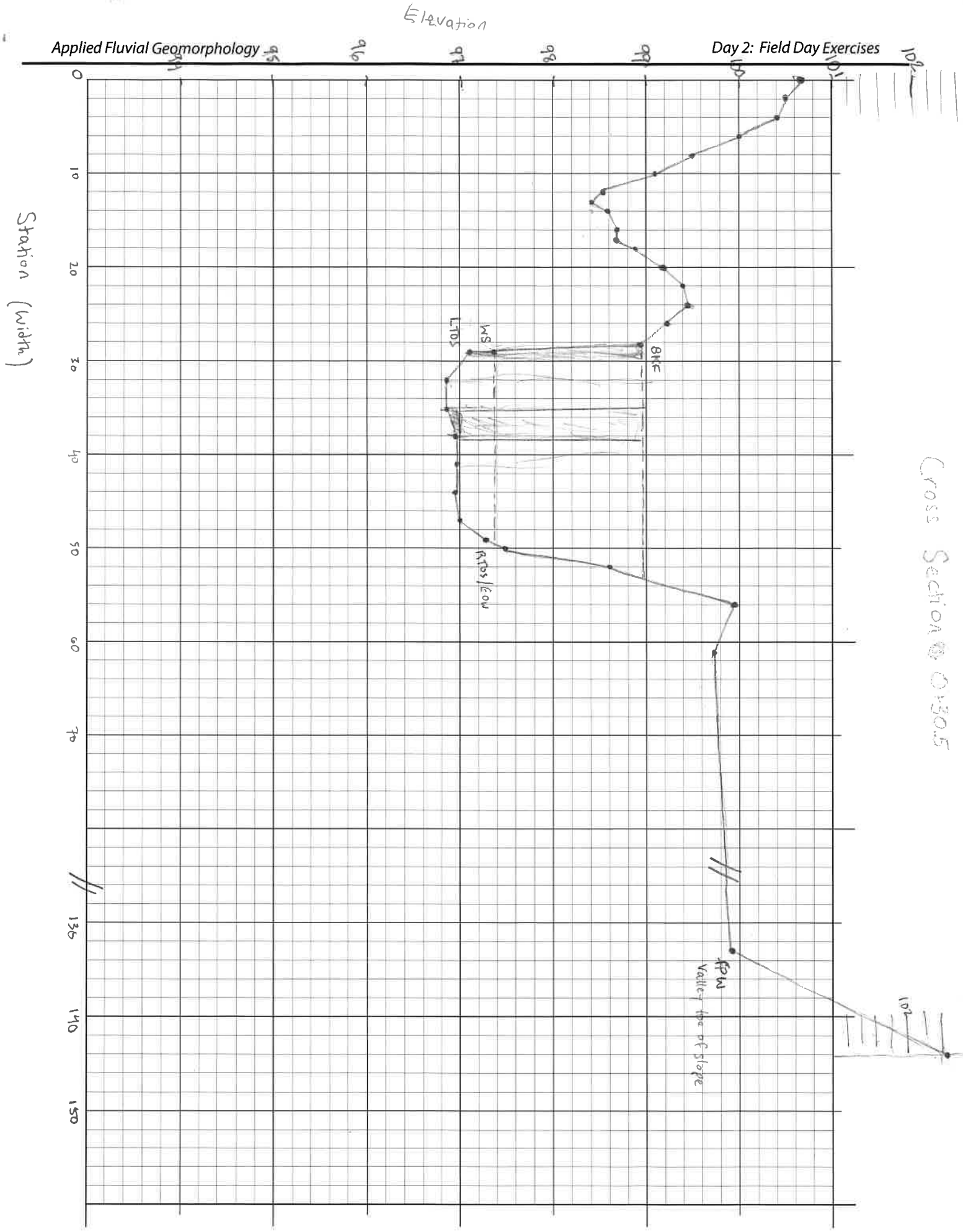

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SURVEY DATA ⟹ **LONGITUDINAL PROFILE 1**

SITE: Date: 4-9-19

Location: Team 1 Station

Observers: Sophie, Drew, Danielle 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	BM1	2.06	102.06									assumed 100' el.
2	0.0			7.35	94.71	6.54	95.52			5.65	96.41	top of riffle
3	30.5				94.33	7.50	94.56	5.65	96.41			cross section intersection possible bankfull
4	67.8			7.96	94.10	7.32	94.74	6.40	95.66	5.94	96.12	bottom of riffle
5	76.0			11.62	90.44	7.44	94.62	5.95	96.11			pool
6	90			9.89	92.17	7.80	94.26*	6.20	95.86			end of pool
7	129			9.04	93.02	7.45	94.61	6.14	95.92	6.35	95.71	glide
TP * 8	127	5.77	100.55	7.28								TP
102.06 9	188			6.74	93.81	6.06	94.49			4.00	96.55	riffle
-1.51 10	202			6.75	93.8	6.09	94.46			4.97	95.58	end of riffle
11	212			12.38	88.17	6.71	93.84			4.33	96.22	pool
12	220			8.00	92.55	6.73	93.82			4.61	95.94	end of pool
13	233			8.88	91.67	6.84	93.71			4.61	95.94	start of pool
14	264			10.01	90.54	6.81	93.74	5.33	95.22	5.33	95.22	pool
15	272			9.10	91.45	6.81	93.74			5.63	94.92	end of pool
16	305			7.42	93.13	6.81	93.74			5.07	95.48	start of riffle - end of recon
17												
18												
19												
20												
21	*taken w/ different method											
22												
23												
24												
25												
26												
27												

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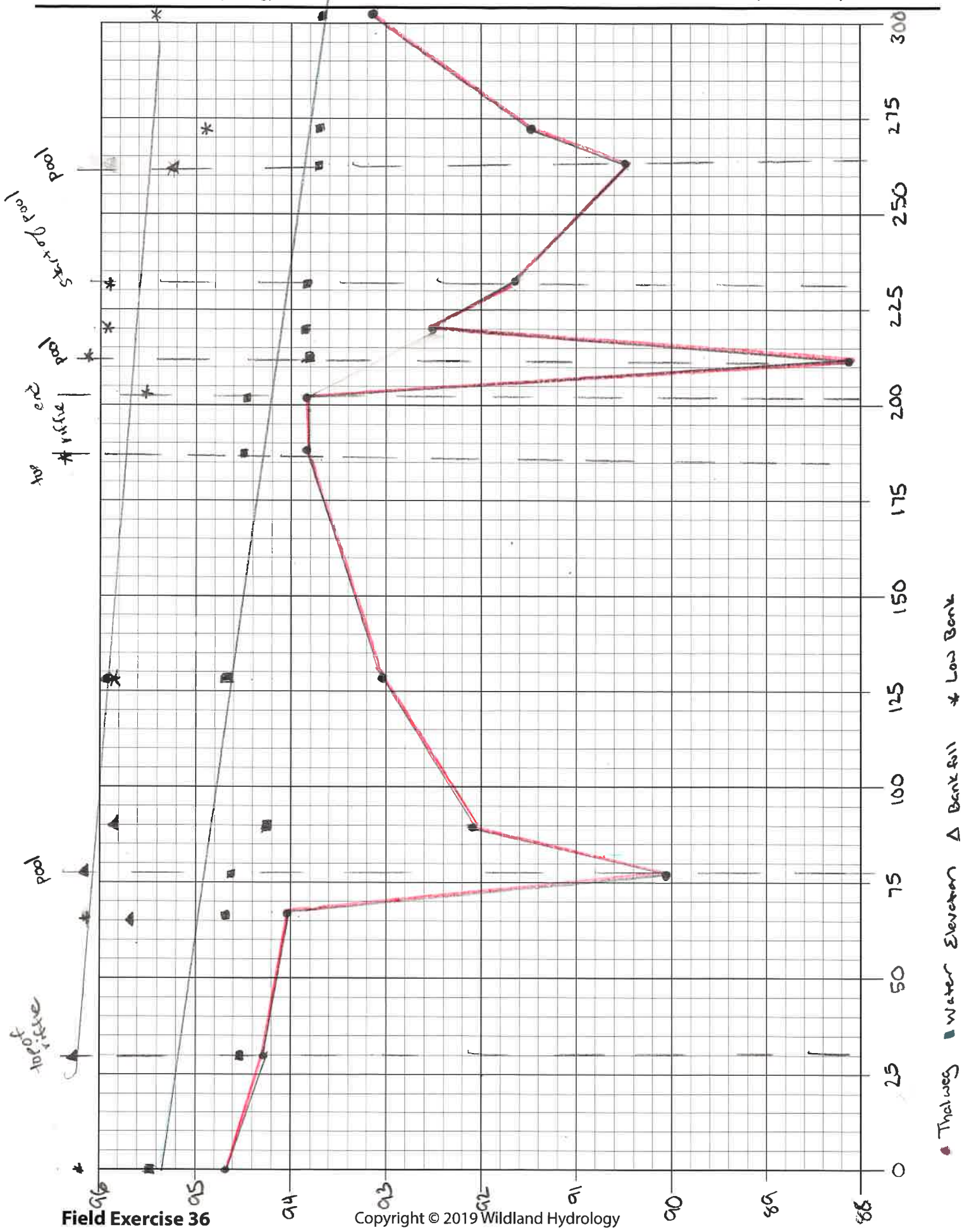

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4/9/19 Representative Pebble Count

Site: Site #1

Location: Fieldtrip #1 HUC:

Observers: JP, JK, BF

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	Dot Count for POOL 2	Dot Count for COMP. 3	RIFFLE (1) Reach: 1 Date: TOT #	RIFFLE ITEM %	RIFFLE % CUM	POOL (2) Reach: 1 Date: TOT #	POOL ITEM %	POOL % CUM	COMPOSITE (3) Reach: 1 Date: TOT #	COMPOSITE ITEM %	COMPOSITE % CUM	% cum
	Silt / Clay	< .062	S/C				1	2.4	2.4	1	1.5	1.5		2	1.9	1.9
	Very Fine	.062 - .125	SAND													
	Fine	.125 - .25	SAND							1	1.5	3.0		1	.9	2.8
	Medium	.25 - .50	SAND							2	3.0	6.0		2	1.9	4.7
	Coarse	.50 - 1.0	SAND													
.04 - .08	Very Coarse	1.0 - 2	SAND							1	1.5	7.5		1	.9	5.6
.08 - .16	Very Fine	2 - 4	GRAVEL				1	2.4	4.8	2	3.0	10.5		3	2.8	8.4
.16 - .22	Fine	4 - 5.7	GRAVEL							1	1.5	9.0	12	1	.9	9.3
.22 - .31	Fine	5.7 - 8	GRAVEL							1	1.5	10.5	13.5	1	.9	10.2
.31 - .44	Medium	8 - 11.3	GRAVEL				1	2.4	7.2	3	4.5	15	18	4	3.7	13.9
.44 - .63	Medium	11.3 - 16	GRAVEL				2	4.9	12.1	4	6.1	21.1	24.1	6	5.6	19.5
.63 - .89	Coarse	16 - 22.6	GRAVEL				4	9.8	21.9	4	6.1	27.2	30.2	8	7.5	27.0
.89 - 1.3	Coarse	22.6 - 32	GRAVEL				2	4.9	26.8	12	18.2	45.4	48.4	14	13.1	40.1
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL				5	12.2	39	7	10.6	56	59	12	11.2	51.3
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL				12	29.3	68.3	14	21.2	77.2	80.2	26	24.3	75.6
2.5 - 3.5	Small	64 - 90	COBBLE				13	31.7	100	7	10.6	87.8	90.8	20	18.7	94.3
3.5 - 5.0	Small	90 - 128	COBBLE							4	6.1	93.9	96.9	4	3.7	98.0
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							2	3.0		~~99.9~~	2	1.9	99.9
Stream Type:			Landscape Type:			TOTAL→	41		100	66		99.9		107		

* Large amount of bedrock

40 60

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4/9/19 Active Riffle Pebble Count Team 1

Site: Site #1

Location: Field trip #1 HUC:

Observers: JP, JK, BF

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: 1			Reach:			Reach:		
							Date: 4/9/19			Date:			Date:		
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND	⁝			2	1.9	1.9						
	Medium	.25 - .50	SAND	⁝			1	0.9	2.8						
	Coarse	.50 - 1.0	SAND	•			1	0.9	3.7						
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL												
.31 - .44	Medium	8 - 11.3	GRAVEL	⊡			7	6.5	10.2						
.44 - .63	Medium	11.3 - 16	GRAVEL	⊠ •			11	10.3	20.5						
.63 - .89	Coarse	16 - 22.6	GRAVEL	⊡			8	7.5	28						
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	⊠ ⊠			20	18.7	46.7						
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	⊠ ⊠ ⁝			23	21.5	68.2						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	⊠ ⊠ ⁝			22	20.6	88.8						
2.5 - 3.5	Small	64 - 90	COBBLE	⊠			10	9.3	98.1						
3.5 - 5.0	Small	90 - 128	COBBLE	• •			2	1.9	100						
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												
						TOTAL→	107								

Stream Type: **Landscape Type:**

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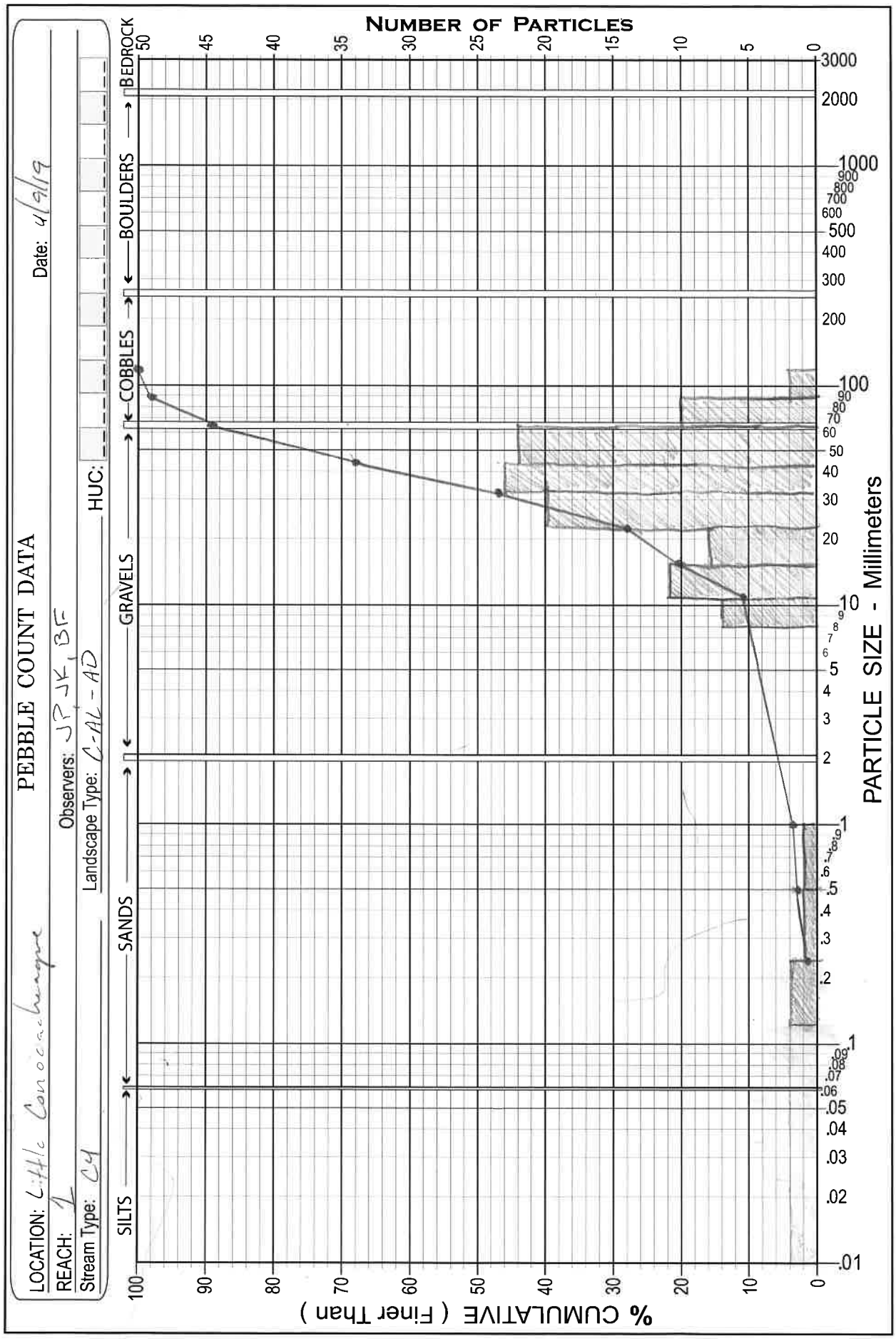

Riffle

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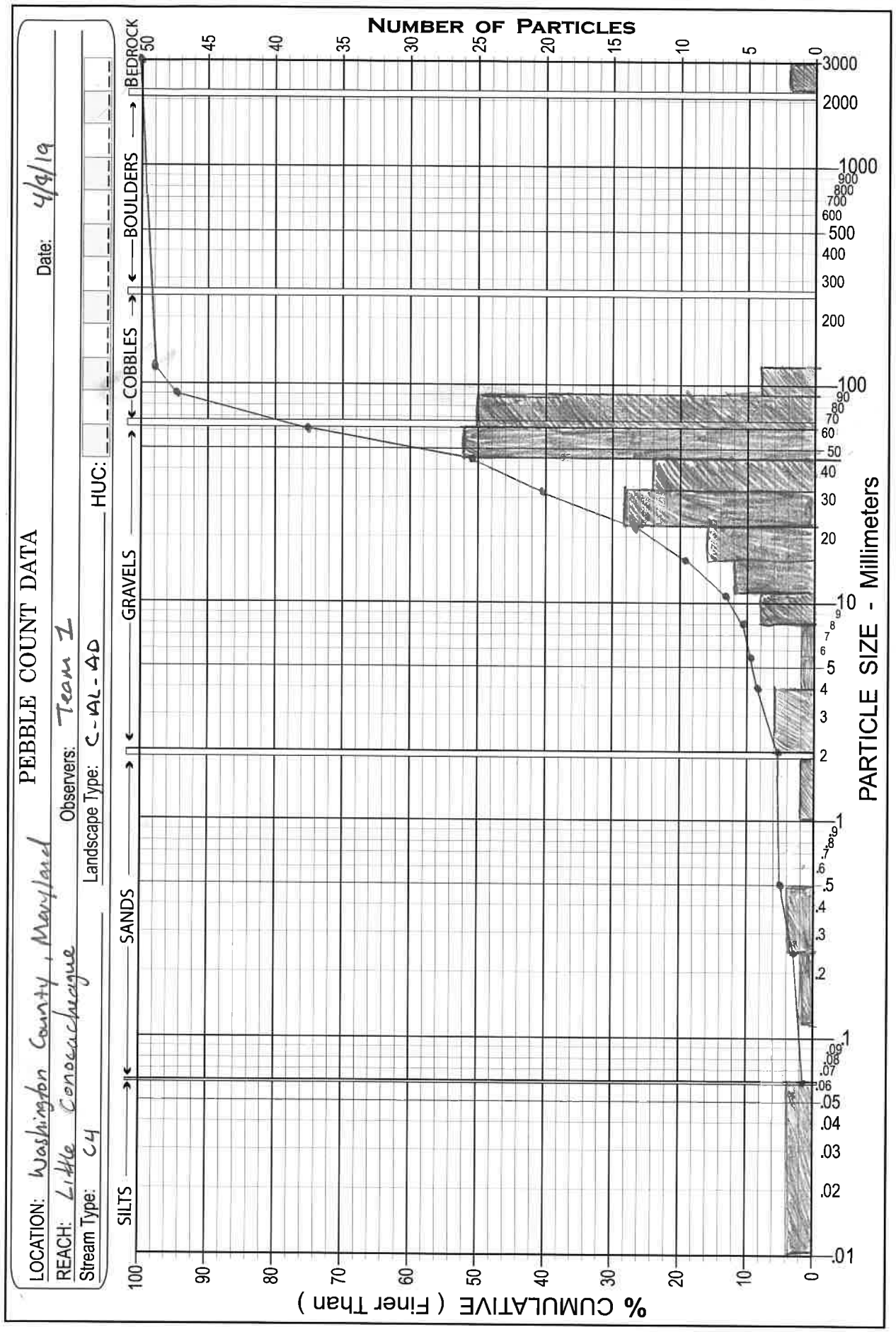

Representative

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

Bankfull Velocity and Discharge Estimates

Stream: Little Conococheague	Stream Type: C4
Location: Washington County, Maryland	Landscape Type: C-AL-AD
Observers: Team 1	Date: 4/9/19

Input Variables			Output Variables		
Bankfull Riffle Cross-Sectional Area	44.21	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.78	d_{bkf} (ft)
Bankfull Riffle Width	24.9	W_{bkf} (ft)	Wetted Perimeter: $\approx (2 \cdot d_{bkf}) + W_{bkf}$	28.46	W_p (ft)
D_{84} Particle Size at Riffle	60	Dia. (mm)	D_{84} at Riffle (mm to ft): D_{84} (mm) / 304.8	0.20	D_{84} (ft)
Bankfull Slope	0.005	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)	7.75	R / D_{84}
Drainage Area	12	DA (mi^2)	Shear Velocity: $u^* = (gRS)^{1/2}$	0.50	u^* (ft/sec)

Estimation Methods	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 \cdot \text{Log}\,(R / D_{84})\,]\,u^*$	3.93	ft / sec	173.75	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figures 28–29) $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n =$ 0.036	3.92	ft / sec	173.30	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Figure 30) $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n =$ 0.032	4.41	ft / sec	194.97	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n = 0.39 \cdot S^{0.38} \cdot R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for $n =$ 0.049	2.88	ft / sec	127.32	cfs
3. Other Methods (e.g., Hey, Darcy-Weisbach, or Chezy C)		ft / sec		cfs
3. Other Methods (e.g., Hey, Darcy-Weisbach, or Chezy C)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Discharge $Q_{bkf} =$ ____ year	N/A	ft / sec	N/A	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	3.90	ft / sec	172.42	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 3. Summary of Morphological Variables.

Stream:	Little Conocacheague	Location:	Washington County, Maryland
Team:	Team 1	Date:	4/9/19

Riffle Channel Dimensions

1. Bankfull Width	(W_{bkf}) (ft)	24.9	2. Bankfull Mean Depth	(d_{bkf}) (ft)	1.78
3. Width/Depth Ratio	(W_{bkf}/d_{bkf})	13.99	4. Bankfull Cross-Sectional Area	(A_{bkf}) (ft^2)	44.21
5. Bankfull Maximum Depth	(d_{max}) (ft)	2.08	6. Width of Flood-Prone Area	(W_{fpa}) (ft)	144
7. Entrenchment Ratio	(W_{fpa}/W_{bkf})	5.78			

Channel Pattern / Pattern Ratios

8. Belt Width	(W_{blt}) (ft)	Avg:	84	9. Meander Width Ratio (MWR)	(W_{blt}/W_{bkf})	Avg:	3.37
		LL:	49			LL:	1.96
		UL:	119			UL:	4.78
10. Stream Meander Length	(L_m) (ft)	Avg:	244	11. Meander Length Ratio (MLR)	(L_m/W_{bkf})	Avg:	9.79
		LL:				LL:	
		UL:				UL:	
12. Linear Wavelength	(λ) (ft)	Avg:	218	13. Linear Wavelength to Bankfull Width	(λ / W_{bkf})	Avg:	8.75
		LL:	218			LL:	8.75
		UL:	218			UL:	8.75
14. Radius of Curvature	(R_c) (ft)	Avg:	63.83	15. Radius of Curvature to Bankfull Width	(R_c/W_{bkf})	Avg:	2.56
		LL:	78			LL:	2.11
		UL:	52.5			UL:	3.13

Channel Particles

Representative Pebble Count					
16. D_{16} (mm)	14	17. D_{35} (mm)	28	18. D_{50} (mm)	45
19. D_{84} (mm)	73	20. D_{95} (mm)	90	21. D_{100} (mm)	3,000
Active Bed Riffle Pebble Count					
22. D_{16} (mm)	14	23. D_{35} (mm)	25	24. D_{50} (mm)	32
25. D_{84} (mm)	60	26. D_{95} (mm)	80	27. D_{100} (mm)	128

Channel Sinuosity & Slope

28. Sinuosity	(k)	1.34	29. Average Water Surface Slope	(S)	0.006

Classification

30. Stream Type	C4	31. Landscape Type	C-AL-AD

Velocity & Discharge

32. Friction Factor	($\bar{u} / u^*$)	7.8	33. Relative Roughness	(R/D_{84})	7.75
34. Manning's 'n' from R / D_{84}	(n)	0.036	35. Manning's 'n' from Stream Type	(n)	0.032
36. Estimated Bankfull Mean Velocity	($\bar{u}_{bkf}$) (ft/sec)	4.41	37. Estimated Bankfull Discharge	(Q) (cfs)	194.97
38. Estimation Method Selected for Velocity & Discharge		Stream Type			

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Worksheet 1. Field Form for Level II Stream Classification.

Stream: Little Conocacheague	
Location: Washington County, Maryland	Landscape Type: C-AL-AD
Observers: Team 1	Riffle Cross-Section: 1
Date: 4/9/19	Drainage Area: 12 mi^2

Bankfull Riffle Width (W_{bkf}) The surface width of the stream at the bankfull stage elevation.	24.9	ft
Bankfull Riffle Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section at the bankfull stage elevation ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.78	ft
Bankfull Riffle Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section at the bankfull stage elevation ($A_{bkf} = W_{bkf} \bullet d_{bkf}$).	44.21	ft^2
Bankfull Riffle Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Riffle Width* divided by *Bankfull Riffle Mean Depth* that describes the channel shape (large number = wide and shallow channel; small number = narrow and deep channel).	13.99	ft/ft
Bankfull Riffle Maximum Depth (d_{max}) The distance measured between the bankfull stage elevation and the channel Thalweg.	2.08	ft
Flood-Prone Area Width (W_{fpa}) Width at an elevation that is twice the *Bankfull Riffle Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	144	ft
Entrenchment Ratio (ER) The vertical containment of a river calculated as *Flood-Prone Area Width* divided by *Bankfull Riffle Width* (W_{fpa} / W_{bkf}).	5.78	ft/ft
Channel Materials (Particle Size Index D_{50}) The median diameter of channel materials within the bankfull channel sampled proportionately through a reach.	45	mm
Average Water Surface Slope (S) Elevation difference of water surface between two similar bed features (e.g., start of riffle to start of last riffe) over the stream length for several riffle–pool or step–pool sequences, representing channel gradient.	0.006	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (L_{st} / L_{val}), or from valley slope divided by average water surface slope (S_{val} / S).	1.34	ft/ft

Stream Type C4 **See Classification Key (Figure 2)**

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