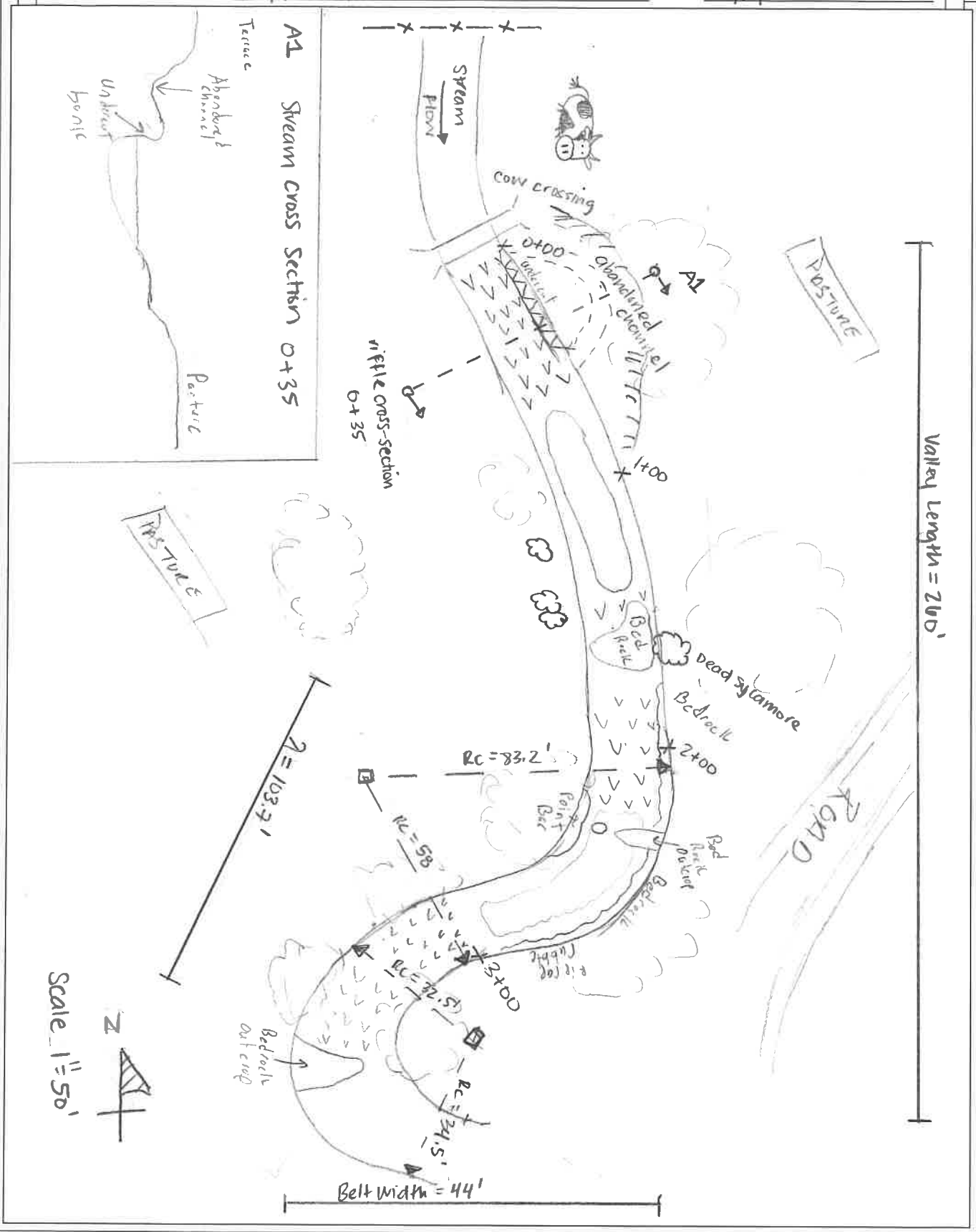
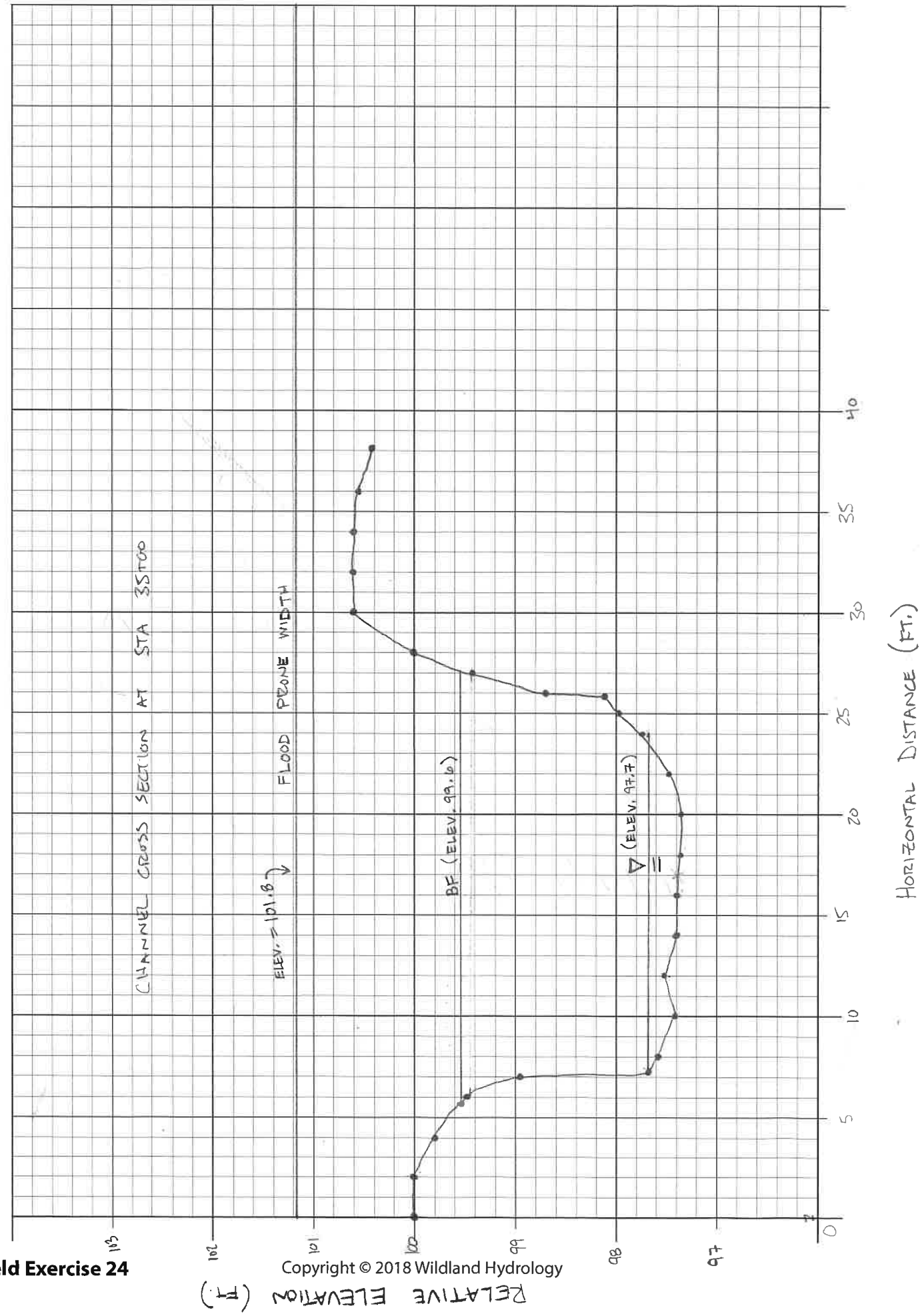
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Little Conococheague Creek Site/Reach: 1

Drawn By: Vivian, Marc, Erin Date: 4/10/18





Copyright © 2018 Wildland Hydrology

SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: Date:

Location:

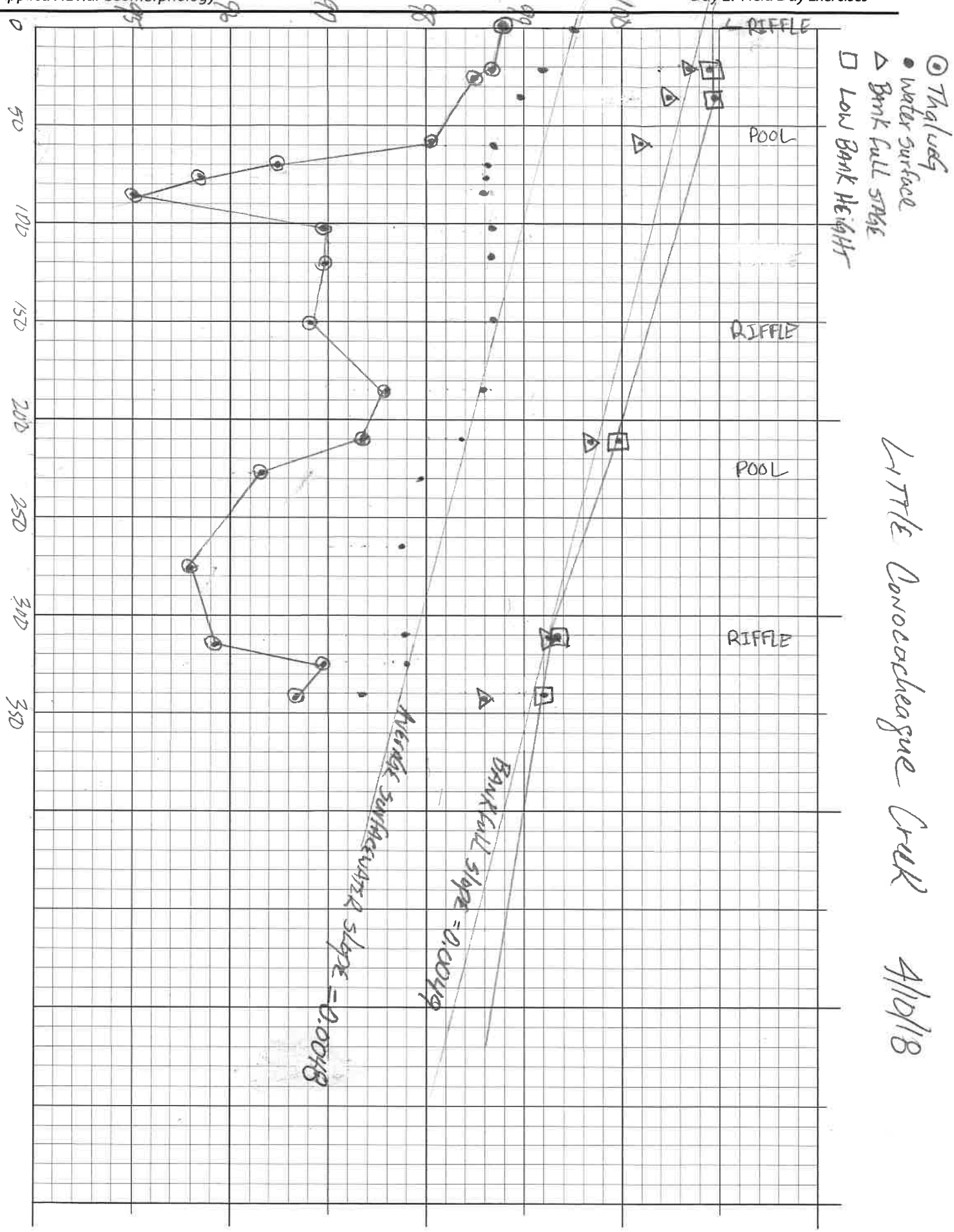
Observers: HUC:

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
1	Ø		105.85			
2	2		LPIN Top of Bank	5.84	LPIN 100.01	
3	4			6.04	99.81	
4	5.7		LBF	6.27	99.58	
5	6			6.32	99.53	
6	7			6.90	98.95	
7	7.2 7.166		BOB LEW	8.18	97.67	
8	8			8.26	97.59	
9	10			8.39	97.46	
10	12			8.33	97.52	
11	14			8.45	97.40	
12	16			8.44	97.41	
13	18			8.49	97.36	
14	20			8.48	97.37	
15	22			8.38	97.47	
16	24			8.11	97.74	
17	25		REW	7.91	97.94	
18	25.7		RBOB	7.75	98.10	
19	26			7.17	98.68	
20	27		RBF	6.40	99.45	
21	28			5.84	100.01	
22	30		R Top of Bank	5.22	100.63	
23	32			5.24	100.61	
24	34			5.25	100.60	
25	36			5.29	100.56	
26	37.1		RPIN	5.38	100.47	
27						
28						

FPW
L: 22 ft.
R: 152 ft.
TOT: 174 ft

AVG. BKFL DEPTH
XSA = 38.8 ft²
W = 21.3 ft
D_{AVG} = 1.82 ft

Copyright © 2018 Wildland Hydrology



Copyright © 2018 Wildland Hydrology

12 sq mi

SURVEY DATA ⟶ **LONGITUDINAL PROFILE 1**

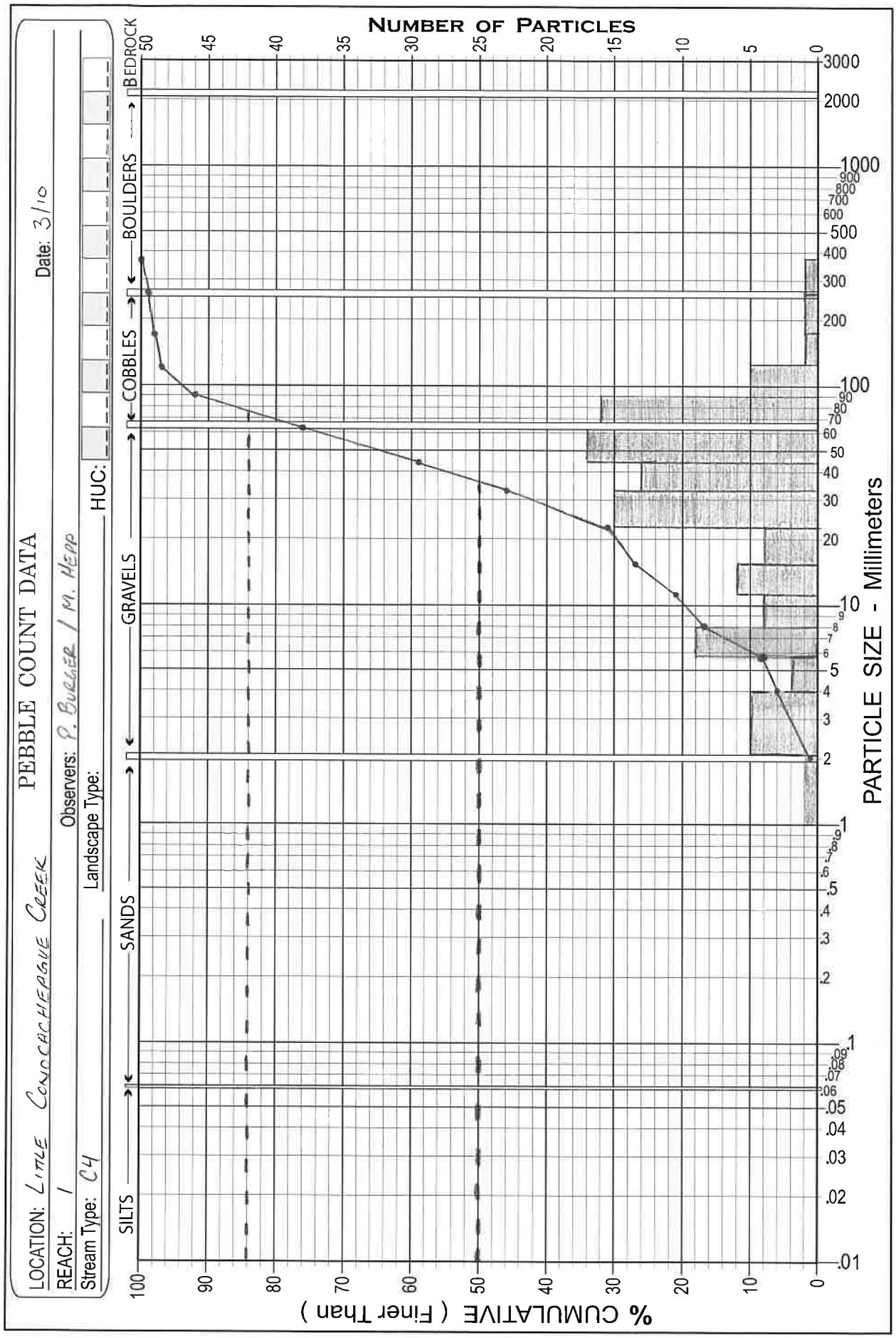
SITE: Little Conococheague Creek Date: 4/10/18

Location:

Observers: Hal, Marc, Daniel 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	6.25	106.25									
2	0			7.45	98.80	6.80	99.45					Riffle
3	21			7.48	98.77	7.05	99.20	5.55	100.70	5.85	100.95	CS1 mid-riffle
4	*59			8.10	98.15	7.55	98.70	6.15	100.10			Pool (run)
5	70			9.80	96.45	7.58	98.67					↓
6	75			10.50	95.75	7.58	98.67					
7	84			11.15	95.10	7.59	98.66					Bottom pool
8	102			8.86	97.39	7.60	98.65			6.40	99.85	End pool (Glide)
9	120			8.85	97.40	7.60	98.65					Riffle
10	149			9.45	96.80	7.60	98.65					mid-riffle
11	184			8.64	97.61	7.67	98.58					riffle
12	210			8.87	97.38	8.08	98.17	6.56	99.69	6.27	99.98	end of riffle (rock abundant)
13	228			9.93	96.32	8.33	97.92					Pool (b/w rock)
14	267			10.65	95.60	8.40	97.85					Pool
15	313			10.42	95.83	8.44	97.81	7.00	99.25			Pool (Glide) Gravel
16	326			9.29	96.96	8.45	97.80					Riffle above rock
17	341			10.53	95.72	9.13	97.12	7.68	98.57	7.44	99.20	run (Pool) below rock
18												
19												
20	*35			7.75	98.5	7.27	98.98	5.70	100.55	5.20	101.05	CS1 revisited
21												
22												
23												
24												
25												
26												
27												

 1.45/292 Copyright © 2018 Wildland Hydrology 2.33/3.41 1.4-1.51 1.65/3.41 = 0.78



Copyright © 2018 Wildland Hydrology

Site: LITTLE CONOCACHEAGUE CREEK
Location: REACH 1 HUC:
Observers: P. BURGER / M. HEPP

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: 1 Date: 3/10/18 TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2		•			1	1	1						
.08 - .16	Very Fine	2 - 4	GRAVEL	⁝			5	5	6						
.16 - .22	Fine	4 - 5.7		•			2	2	8						
.22 - .31	Fine	5.7 - 8		⊠			9	9	17						
.31 - .44	Medium	8 - 11.3		⁝			4	4	21						
.44 - .63	Medium	11.3 - 16		⁝			6	6	27						
.63 - .89	Coarse	16 - 22.6		⁝			4	4	31						
.89 - 1.3	Coarse	22.6 - 32		⊠⁝			15	15	46						
1.3 - 1.8	Very Coarse	32 - 45		⊠⁝			13	13	59						
1.8 - 2.5	Very Coarse	45 - 64		⊠⁝			17	17	76						
2.5 - 3.5	Small	64 - 90	COBBLE	⊠⁝			16	16	92						
3.5 - 5.0	Small	90 - 128		⁝			5	5	97						
5.0 - 7.1	Large	128 - 180		•			1	1	98						
7.1 - 10.1	Large	180 - 256		•			1	1	99						
10.1 - 14.3	Small	256 - 362	BOULDER	•			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: C4		Landscape Type:				TOTAL→	100								

Copyright © 2018 Wildland Hydrology

Riffle 0 - 64

Site: Little Conocacheague Creek (12 mi²)

Location: Reach 1 HUC:

Observers: Michael Hepp / Paul Burger

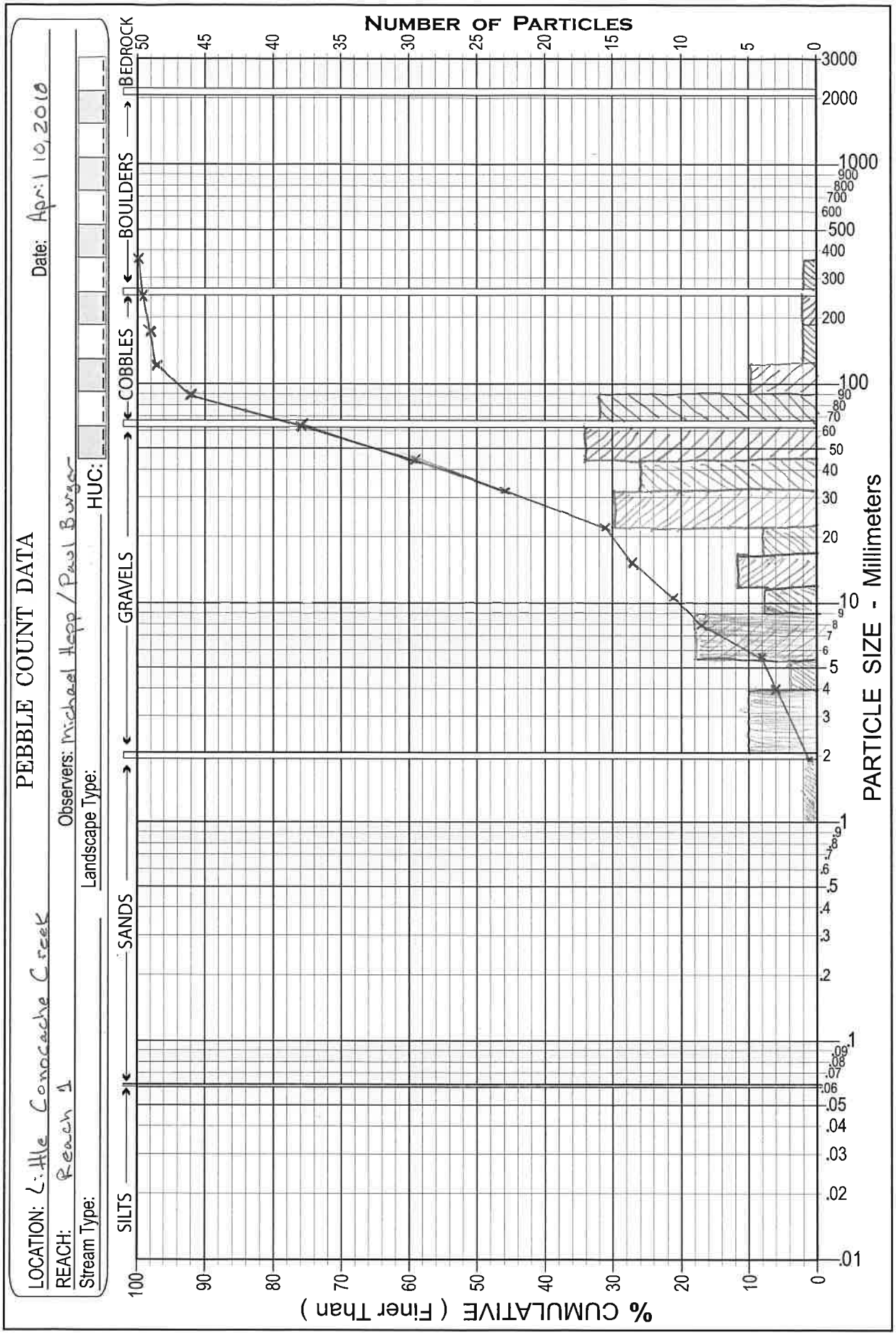
Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	ITEM %	% CUM	POOL (2) TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
							Reach:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2		I			1		1						
.08 - .16	Very Fine	2 - 4	GRAVEL	𝍸			5		6						
.16 - .22	Fine	4 - 5.7		II			2		8						
.22 - .31	Fine	5.7 - 8		𝍸 IIII			9		17						
.31 - .44	Medium	8 - 11.3		IIII			4		21						
.44 - .63	Medium	11.3 - 16		𝍸 I			6		27						
.63 - .89	Coarse	16 - 22.6		IIII			4		31						
.89 - 1.3	Coarse	22.6 - 32		𝍸 𝍸 𝍸			15		46						
1.3 - 1.8	Very Coarse	32 - 45		𝍸 𝍸 III			13		59						
1.8 - 2.5	Very Coarse	45 - 64		𝍸 𝍸 𝍸 II			17		76						
2.5 - 3.5	Small	64 - 90	COBBLE	𝍸 𝍸 𝍸 IIII			16		92						
3.5 - 5.0	Small	90 - 128		𝍸			5		97						
5.0 - 7.1	Large	128 - 180		I			1		98						
7.1 - 10.1	Large	180 - 256		I			1		99						
10.1 - 14.3	Small	256 - 362	BOULDER	I			1		100						
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type: ~~E~~ C4			**Landscape Type:**			TOTAL→	100								

Riffle 0 - 64
Pool 64 - 184 (120)
Riffle 184 - 213 (29)
Pool 213 - 324 (Step) III

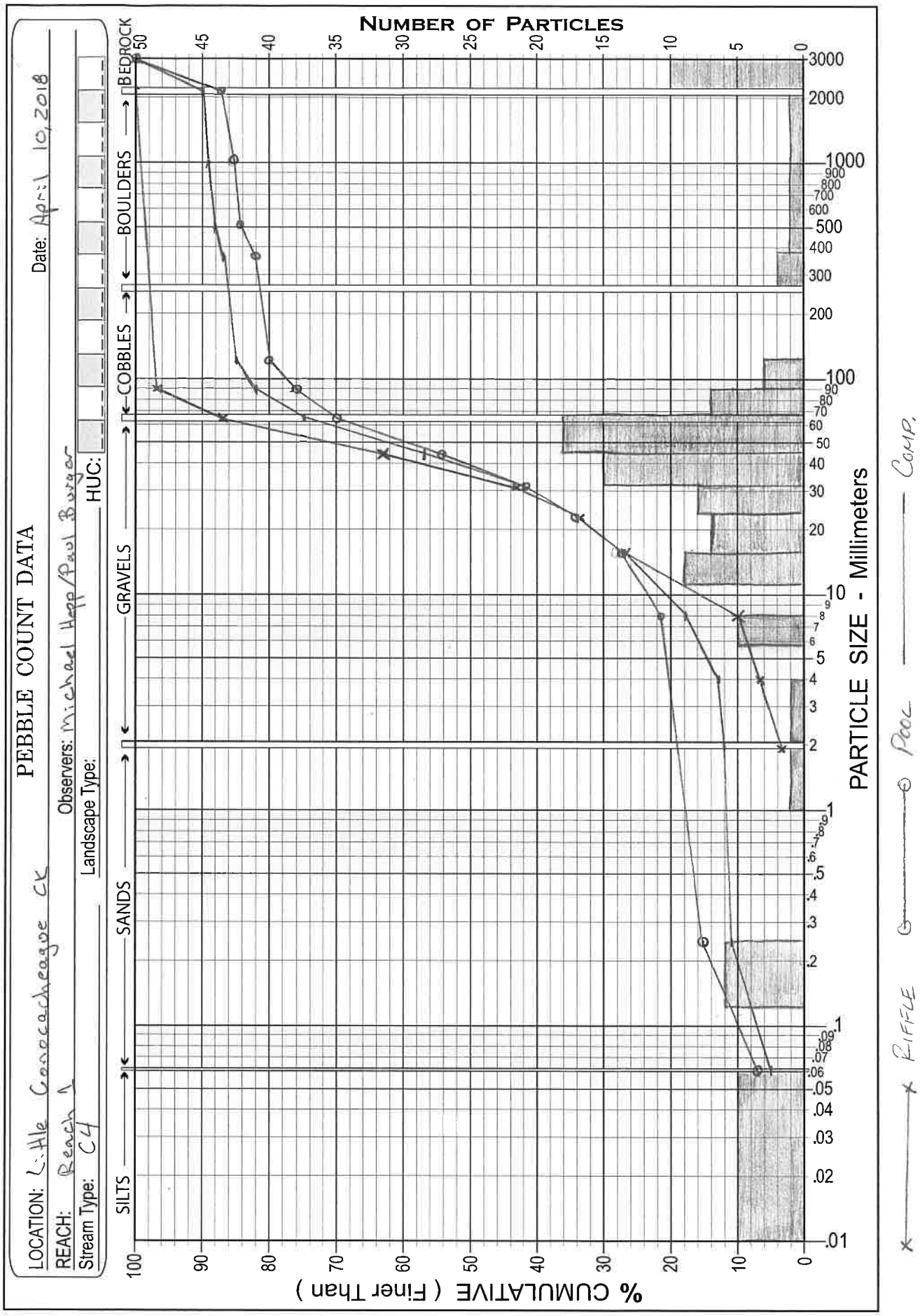
Total 324
Riffle 93 29%
Pool 231 71%

Surface armoring - sand & fine sand underneath washes away when you remove larger material

Copyright © 2018 Wildland Hydrology



Copyright © 2018 Wildland Hydrology


PEBBLE COUNT DATA
LOCATION: Little Conococheague CK
Date: April 10, 2018
REACH: Reach 1
Observers: Michael Hepp/Paul Burger
Stream Type: C4
Landscape Type:
HUC:
NUMBER OF PARTICLES
SILTS
SANDS
GRAVELS
COBBLES
BOULDERS
BEDROCK
PARTICLE SIZE - Millimeters
% CUMULATIVE (Finer Than)
RIFFLE
POOL
CAMP.

Site: LITTLE CONOCACHEAGUE CREEK

Location: REACH 1 HUC:

Observers: P. BURGER / M. HEPP

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: 1		
							Date: 3/10			Date: 3/10			Date: 3/10		
	Silt / Clay	< .062	S/C							5	5/70 7.1	7.1	5	5	5
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25								6	8.6	15.7	6	6	11
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2					1	1/30 3.3	3.3				1	1	12
.08 - .16	Very Fine	2 - 4	GRAVEL				1	3.3	6.6				1	1	13
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8					1	3.3	1.0	4	5.7	21.4	5	5	18
.31 - .44	Medium	8 - 11.3													
.44 - .63	Medium	11.3 - 16					5	16.7	26.7	4	5.7	27.1	9	9	27
.63 - .89	Coarse	16 - 22.6					2	6.7	33.3	5	7.1	34.3	7	7	34
.89 - 1.3	Coarse	22.6 - 32					3	10.0	43.3	5	7.1	41.4	8	8	42
1.3 - 1.8	Very Coarse	32 - 45					6	20.0	63.3	9	12.9	54.3	15	15	57
1.8 - 2.5	Very Coarse	45 - 64					7	23.3	86.7	11	15.7	70.0	18	18	75
2.5 - 3.5	Small	64 - 90	COBBLE				3	10.0	90.0	4	5.7	75.7	7	7	82
3.5 - 5.0	Small	90 - 128								3	4.3	80.0	3	3	85
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER							2	2.9	82.9	2	2	87
14.3 - 20	Small	362 - 512								1	1.4	84.3	1	1	88
20 - 40	Medium	512 - 1024								1	1.4	85.7	1	1	89
40 - 80	Large-Vry Large	1024 - 2048								1	1.4	87.1	1	1	90
	Bedrock		BDRK				1	3.3	100	9	12.9	100	10	10	100
Stream Type: C4			Landscape Type:			TOTAL→	30			70			100		

Copyright © 2018 Wildland Hydrology

Site: Little Conococheague CR

Location: Reach 1 HUC:

Observers: Burger/ACPD

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		卌					5	7.14	7.14	5	5	5
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND		卌					6	8.57	15.71	6	6	11
	Medium	.25 - .50	SAND												
	Coarse	.50 - 1.0	SAND												
.04 - .08	Very Coarse	1.0 - 2	SAND	1			1	.033	.033				1	1	12
.08 - .16	Very Fine	2 - 4	GRAVEL	1			1	.033	.066				1	1	13
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL	1	1111		1	.033	.100	4	5.71	21.42	5	5	18
.31 - .44	Medium	8 - 11.3	GRAVEL												
.44 - .63	Medium	11.3 - 16	GRAVEL	卌	1111		5	.167	.267	4	5.71	27.13	9	9	27
.63 - .89	Coarse	16 - 22.6	GRAVEL	11	卌		2	.067	.333	5	7.14	34.27	7	7	34
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	111	卌		3	.10	.433	5	7.14	41.41	8	8	42
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	卌 1	卌 1111		6	.20	.633	9	12.86	54.27	15	15	57
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	卌 111	卌 卌 1		7	.233	.867	11	15.71	69.98	18	18	75
2.5 - 3.5	Small	64 - 90	COBBLE	111	1111		3	.10	.967	4	5.71	75.69	7	7	82
3.5 - 5.0	Small	90 - 128	COBBLE		111					3	4.28	79.97	3	3	85
5.0 - 7.1	Large	128 - 180	COBBLE												
7.1 - 10.1	Large	180 - 256	COBBLE												
10.1 - 14.3	Small	256 - 362	BOULDER		11					2	2.86	82.83	2	2	87
14.3 - 20	Small	362 - 512	BOULDER		1					1	1.43	84.26	1	1	88
20 - 40	Medium	512 - 1024	BOULDER		1					1	1.43	85.69	1	1	89
40 - 80	Large-Vry Large	1024 - 2048	BOULDER		1					1	1.43	87.12	1	1	90
	Bedrock		BDRK	1	卌 1111		1	.033	1000	9	12.86	100	10	10	100
Stream Type: C4			**Landscape Type:**			TOTAL→	30			70			100		

卌 卌 卌 卌 0+67 卌 卌 2+34
卌 卌 卌 卌 0+98.4 卌 卌
卌 卌 卌 卌 1+36 卌 卌 3+15
卌 卌 1+50

30 70

Some bedrock
Control on pools
Some concrete on pool edge

Copyright © 2018 Wildland Hydrology

Worksheet 1. Field Form for Level II Stream Classification.

Stream: Little Conococheague Creek			
Basin:	Drainage Area:	acres	12 mi^2
Location: Reach 1			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: 4/10/18	
Observers: Cole, Luke, Matt		Landscape Type:	

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	21.3	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.8	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	38.5	ft^2
Bankfull Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	11.7	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.	2.2	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.	174	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	8.2	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.	38	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.	0.0048	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).	1.3	ft/ft

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

Copyright © 2018 Wildland Hydrology

Table 1. List of morphological relations and variables to estimate.

Estimate the Following Morphological Relations and Variables			
1. **Bankfull Riffle Width (W_{bkf}) (ft)**	22	2. **Bankfull Riffle Mean Depth (d_{bkf})**	1.5
3. **Width/Depth Ratio (W_{bkf} / d_{bkf})**	14.6	4. **Bankfull Riffle Cross-Sectional Area (A_{bkf})**	50 ft²
5. **Width of Flood-Prone Area (W_{fpa})**	350'	6. **Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})**	15.9
7. **Sinuosity (k)**	1.5	8. **Average Water Surface Slope (S)**	0.005
9. **D_{50} Particle Size for Reach**	70mm	10. **Bankfull Discharge (Q_{bkf})**	100
11. **Landscape Type**	confined alluvial	12. **Stream Type**	C4

Level II Stream Classification

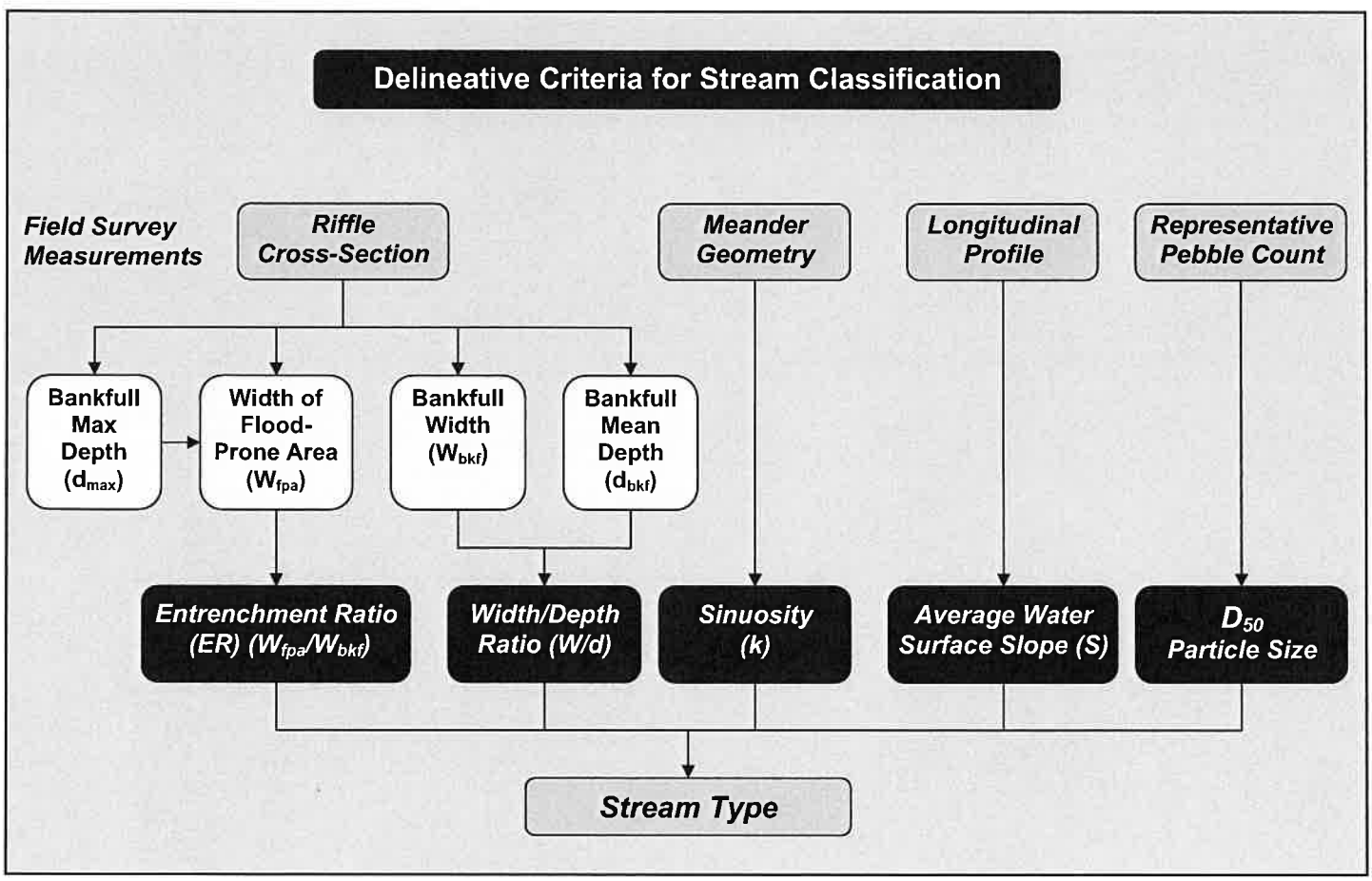


Figure 1. Field survey methods to obtain delineative criteria for stream classification.

Copyright © 2018 Wildland Hydrology

Worksheet 3. Summary of Morphological Variables.

Stream: Little Conococheague Creek		**Location:** Reach I	
Team: I	**Date:** 4/10/18	**Drainage Area:** 12 mi^2	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	21.3	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.8
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	11.7	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	38.8
5. Bankfull Maximum Depth (d_{max}) (ft)	2.2	6. Width of Flood-Prone Area (W_{fpa}) (ft)	174
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	8.2		

Channel Pattern / *Pattern Ratios*

8. Belt Width (W_{blt}) (ft)	Mean:	44'	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean:	2.1
	Min:	N/A		Min:	N/A
	Max:	N/A		Max:	N/A
10. Stream Meander Length (L_m) (ft)	Mean:	154.6'	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean:	7.3
	Min:	N/A		Min:	N/A
	Max:	N/A		Max:	N/A
12. Linear Wavelength (λ) (ft)	Mean:	103.7'	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean:	4.9
	Min:	N/A		Min:	N/A
	Max:	N/A		Max:	N/A
14. Radius of Curvature (R_c) (ft)	Mean:	N/A	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean:	N/A
	Min:	32.5'		Min:	1.5
	Max:	83.2'		Max:	3.9

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	7.5	17. D_{35} (mm)	26	18. D_{50} (mm)	38
19. D_{84} (mm)	75	20. D_{95} (mm)	100	21. D_{100} (mm)	360

Active Bed Riffle Pebble Count

22. D_{16} (mm)	6	23. D_{35} (mm)	24	24. D_{50} (mm)	38
25. D_{84} (mm)	78	26. D_{95} (mm)	2500	27. D_{100} (mm)	BEDROCK

Classification

28. Sinuosity (k)	1.3	29. Average Water Surface Slope (S)	0.0049
30. Stream Type	C4	31. Landscape Type	C-AL-AD

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u^*)	4.22	33. Relative Roughness (R / D_{84})	3.31
34. Manning's 'n' from Friction Factor / Relative Roughness	0.040	35. Manning's 'n' from Stream Type	0.031
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	3.04	37. Estimated Bankfull Discharge (cfs)	118.0
38. Estimation Method Selected for Velocity & Discharge			

Copyright © 2018 Wildland Hydrology

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Little Conococheague Creek	Location:	Reach I
Date: 4/10/18	Stream Type: C4	Landscape Type:	C - AL - AD
Observers:	Team I	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	38.82	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.8	d_{bkf} (ft)
Bankfull Riffle Width	21.3	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$	24.9	W_p (ft)
D_{84} Particle Size at Riffle	78	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	0.26	D_{84} (ft)
Bankfull Slope	0.0049	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	0.86	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	3.31	R / D_{84} (ft / ft)
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.72	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	4.16	ft / sec	161.5	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figures 27–28) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.040	2.36	ft / sec	91.6	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Figure 29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.031	3.04	ft / sec	118.0	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 $n =$ 0.053	1.78	ft / sec	69.1	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) → NA for closed conduit	N/A	ft / sec	N/A	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	N/A	ft / sec	N/A	cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Q Q = ____ year	N/A	ft / sec	N/A	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	2.52 4.01	ft / sec	58 214	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.

Chezy =
$v = C\sqrt{Ri}$
C = coefficient = $m^{1/2}/s$ m = water depth i = bottom slope

Copyright © 2018 Wildland Hydrology