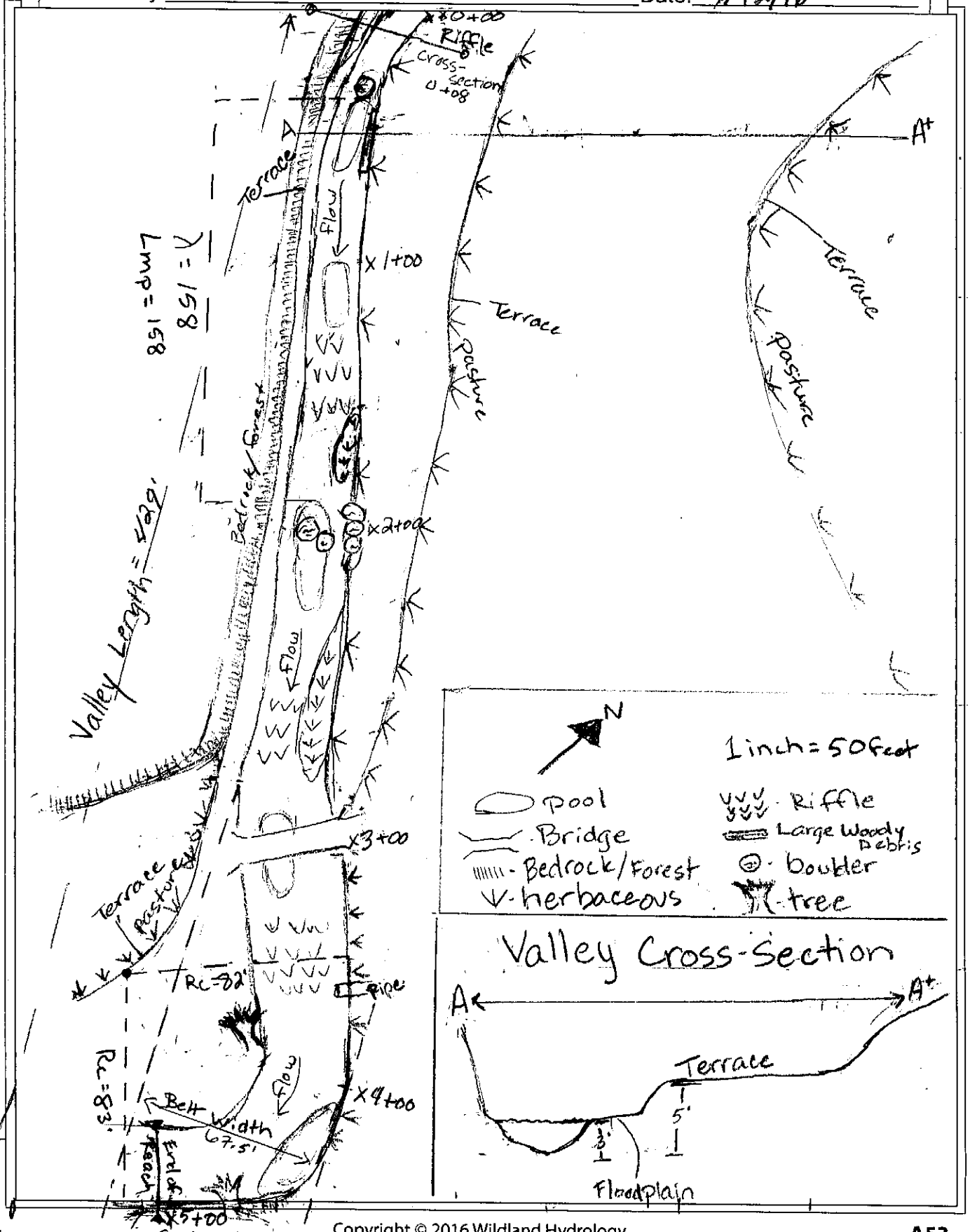
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Little Conocacheague Creek Site/Reach: 4

Drawn By: Date: 4/12/16



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SURVEY DATA → CROSS-SECTION 1

SITE: Conococheague Creek Date: 4/12/2016

Location:

Party / Notes: 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	0.00			4.74	95.29	FP
2	1.0			4.77	95.23	G
3	5.0			4.84	95.11	G
4	6.4			4.92	95.09	Mat
5	8.7			5.33	94.67	
6	9.0			5.49	94.51	LBF
7	10.4			6.18	93.82	SL OLK
8	12.0			6.62	93.38	
9	14.6			6.92	93.08	
10	15.7			7.18	92.82	
11	17.4			7.32	92.68	LEW/WS
12	19.3			7.69	92.31	CD
13	20.6			7.48	92.52	|
14	21.9			7.63	92.37	|
15	23.5			7.9	92.1	|
16	26.1			8.18	91.82	Thalweg
17	28.3			7.94	92.06	
18	30.3			7.91	92.09	
19	32.0			7.21	92.79	REW
20	33.8			5.71	94.29	Bk
21	34.45			5.49	94.51	RBF
22	35.5			5.26	94.74	end Bedrock
23						
24						
25						
26						
27						
28						

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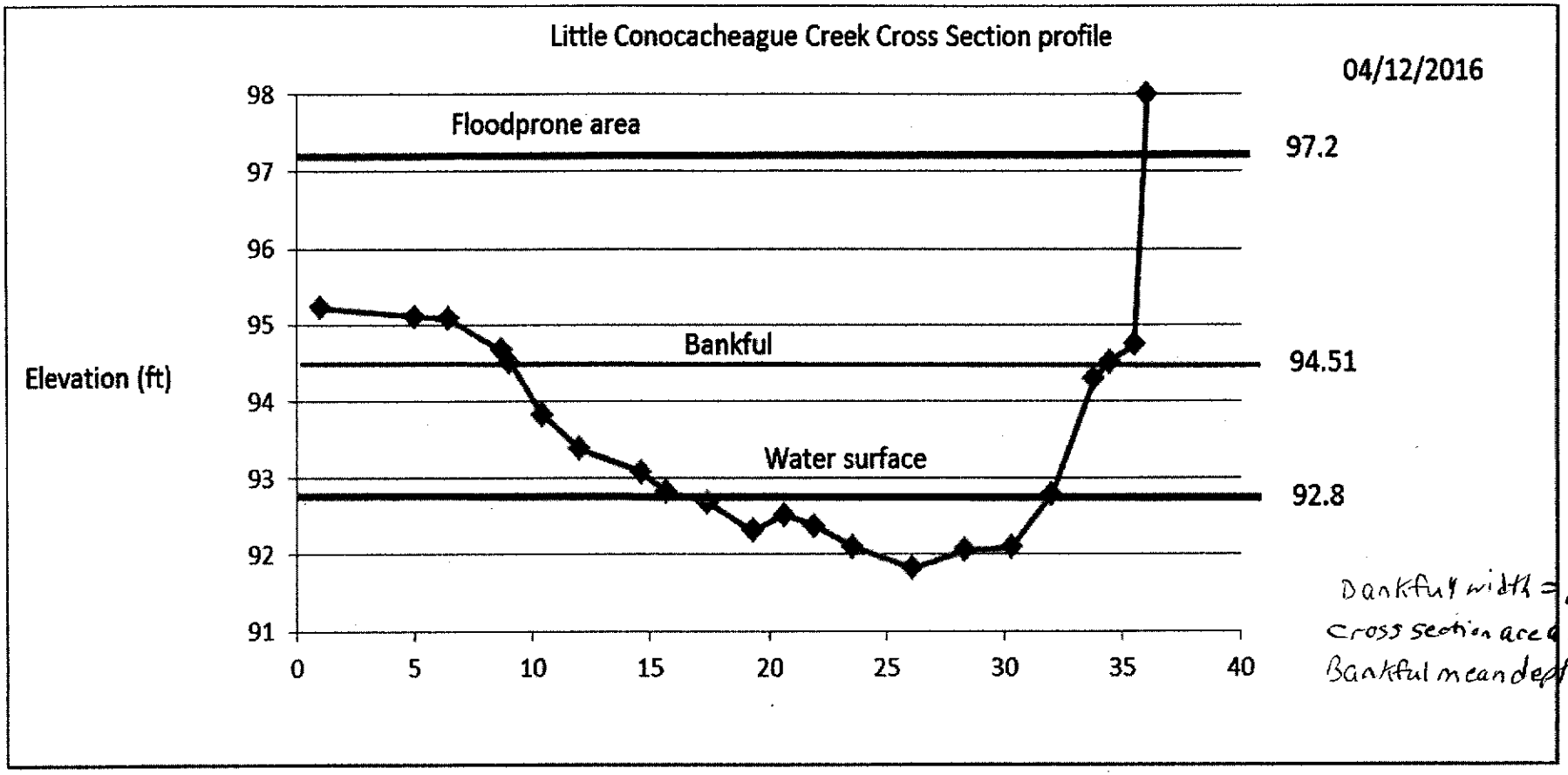
Little Conocacheague Creek Cross Section profile
04/12/2016
Floodprone area
97.2
Bankful
94.51
Water surface
92.8
Elevation (ft)
98
97
96
95
94
93
92
91
0
5
10
15
20
25
30
35
40
Bankful width = 25.45
Cross section area = 45.27
Bankful mean depth = 1.78

10.34-C / 504 Slope = 0.004 0.4%

SURVEY DATA ⟹ LONGITUDINAL PROFILE 1

SITE: Team 4 Date: 7.07

Location:

Party / Notes: Lindsey, Bryan, Keith HUC:

	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instru-ment 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			10.00									
2	0+0			8.59		8.00				5.82	3.42	TR
3	0+7			8.89		8.33				5.82		Cross
4	0+20			9.68		8.54						TN
5	0+35			10.13		8.59						TP
6	0+41			10.51		8.60						middle pool
7	0+55			9.80		8.81		6.85				TG A1.76
8	0+62			9.62		8.65				6.61		TN
9	0+77			9.38		8.64		6.92				MN A 1.65 1.72
10	0+95			10.11		8.36		6.93		6.98		TP A 1.46 1.75
11	1+20			9.78		8.69		6.95				TG 1.59 1.74
12	0+130			9.26		8.69						TR
13	0+147			10.35		8.99		7.09		6.93		mid riffle pool A 1.9
14	0+157			9.96		9.03						TN
15	0+193			10.19		9.05		7.44		5.80		TP A 1.61
16	1+01			10.05		9.07						MP scour boulder
17	1+27			10.16		9.12						MP
18	1+51			10.40		9.12						TG
19	1+66			9.61		9.13						TR
20	1+80			10.39		9.13						TN
21	1+90			10.71		9.14						TP
22	2+22			9.69		9.14						TG
23	2+30			9.52		9.17				7.10		TR
24	2+82			10.81		10.22				9.85		TP
25	2+14			13.57		10.24				7.73		MP
26	4+91			11.43		10.24		8.49		7.63		TG 1.75
27	5+04			11.12		10.24						EG

9.83 7.37 BF 8.69 HS 1.32

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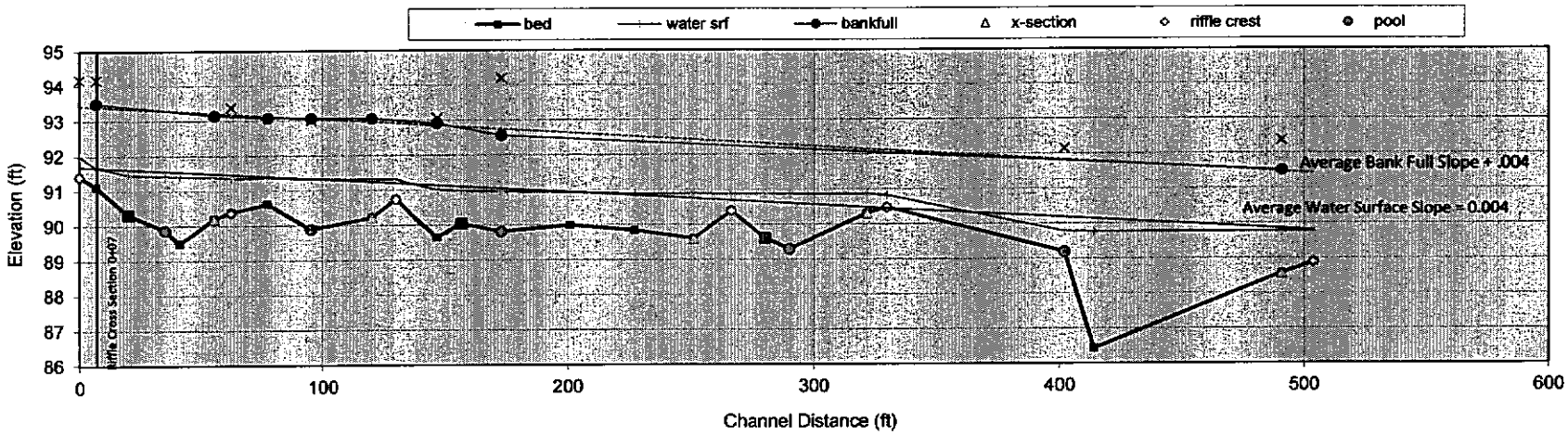
Long Pro Stream Profile



	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.004	—	504.0	—	—	—
riffle	1.1 (0 - 2.7)	275 (0 - 675)	33.2 (14 - 72)	—	—	—
pool	0.05 (0 - 0.1)	12.5 (0 - 25)	48.8 (20 - 89)	—	91.8 (60 - 117)	—
run	0.19 (0.1 - 0.33)	47.5 (25 - 82.5)	13.7 (10 - 16)	—	—	—
glide	0.2 (0 - 0.57)	50 (0 - 142.5)	10.6 (7 - 15)	—	—	—

Representative

Site: Date: 4/12

Location: HUC:

Party: Group #4

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
	Silt / Clay	< .062	S/C			3	1	1.43	1.43	2	6.67	6.67	3	3	3
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25				7	4	5.71	7.14	3	10	16.67	7	7	10
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2				3	3	4.29	11.43				3	3	13
.08 - .16	Very Fine	2 - 4	GRAVEL			1	1	1.43	12.86				1	1	14
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8				1	1	1.43	14.29				1	1	15
.31 - .44	Medium	8 - 11.3				2	2	2.86	17.15				2	2	17
.44 - .63	Medium	11.3 - 16				4	3	4.29	21.44	1	3.33	20	4	4	21
.63 - .89	Coarse	16 - 22.6				8	6	8.57	30.01	2	6.67	26.67	8	8	29
.89 - 1.3	Coarse	22.6 - 32				18	11	15.71	45.72	7	23.33	50.0	18	18	47
1.3 - 1.8	Very Coarse	32 - 45				17	12	17.14	62.86	5	16.67	66.67	17	17	64
1.8 - 2.5	Very Coarse	45 - 64				13	11	15.71	78.57	2	6.67	73.34	13	13	77
2.5 - 3.5	Small	64 - 90	COBBLE			12	8	11.43	90	4	13.33	86.67	12	12	89
3.5 - 5.0	Small	90 - 128				3	2	2.86	92.86	1	3.33	90	3	3	92
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256				3	2	2.86	95.72	1	3.33	93.33	3	3	95
10.1 - 14.3	Small	256 - 362	BOULDER			1				1	3.33	96.66	1	1	96
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024				1	1	1.43	97.15				1	1	97
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK			3	2	2.86	100	1	3.33	100	3	3	100
Stream Type:			**Valley Type:**			TOTAL→	70	100	100	30	100	100	100		100

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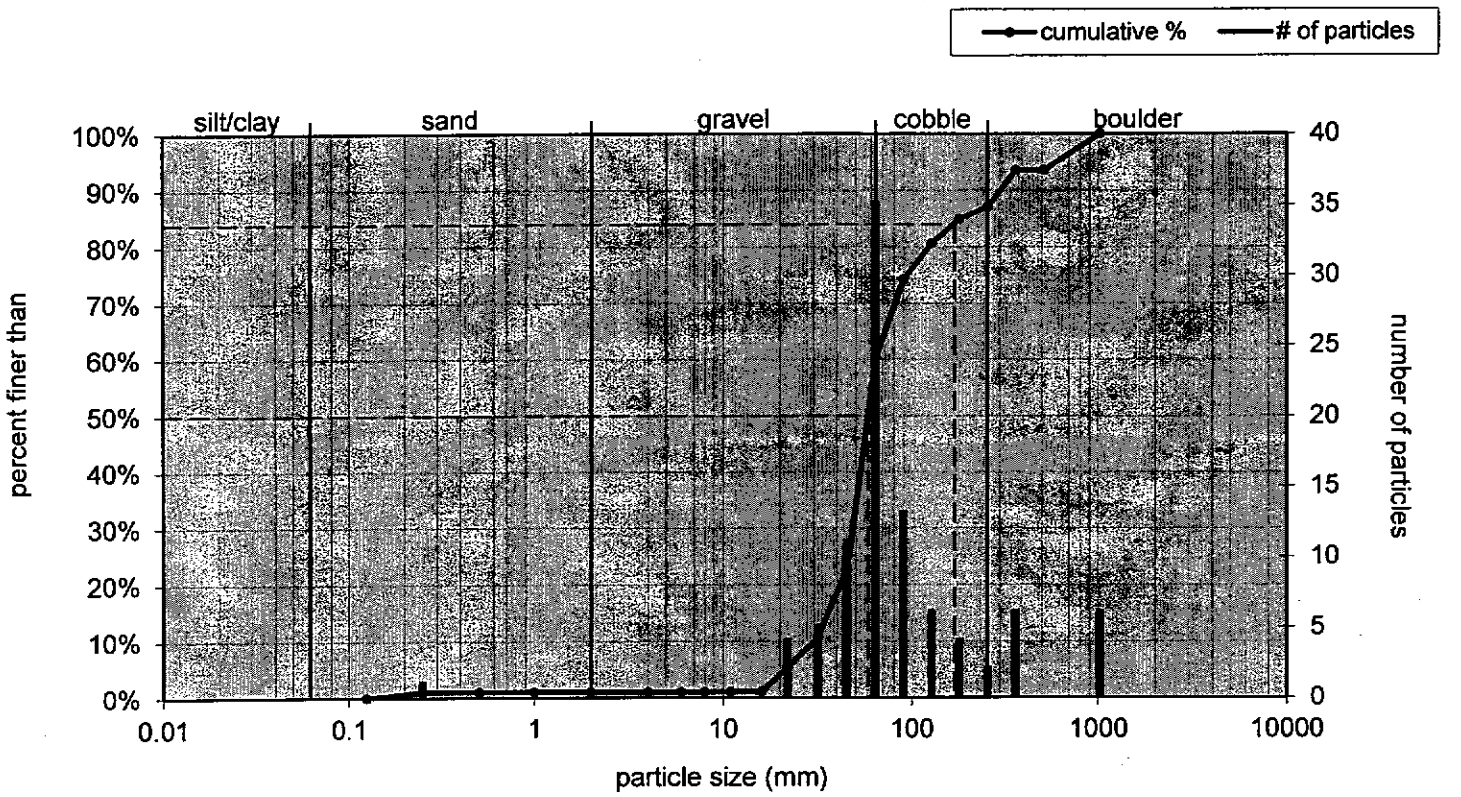
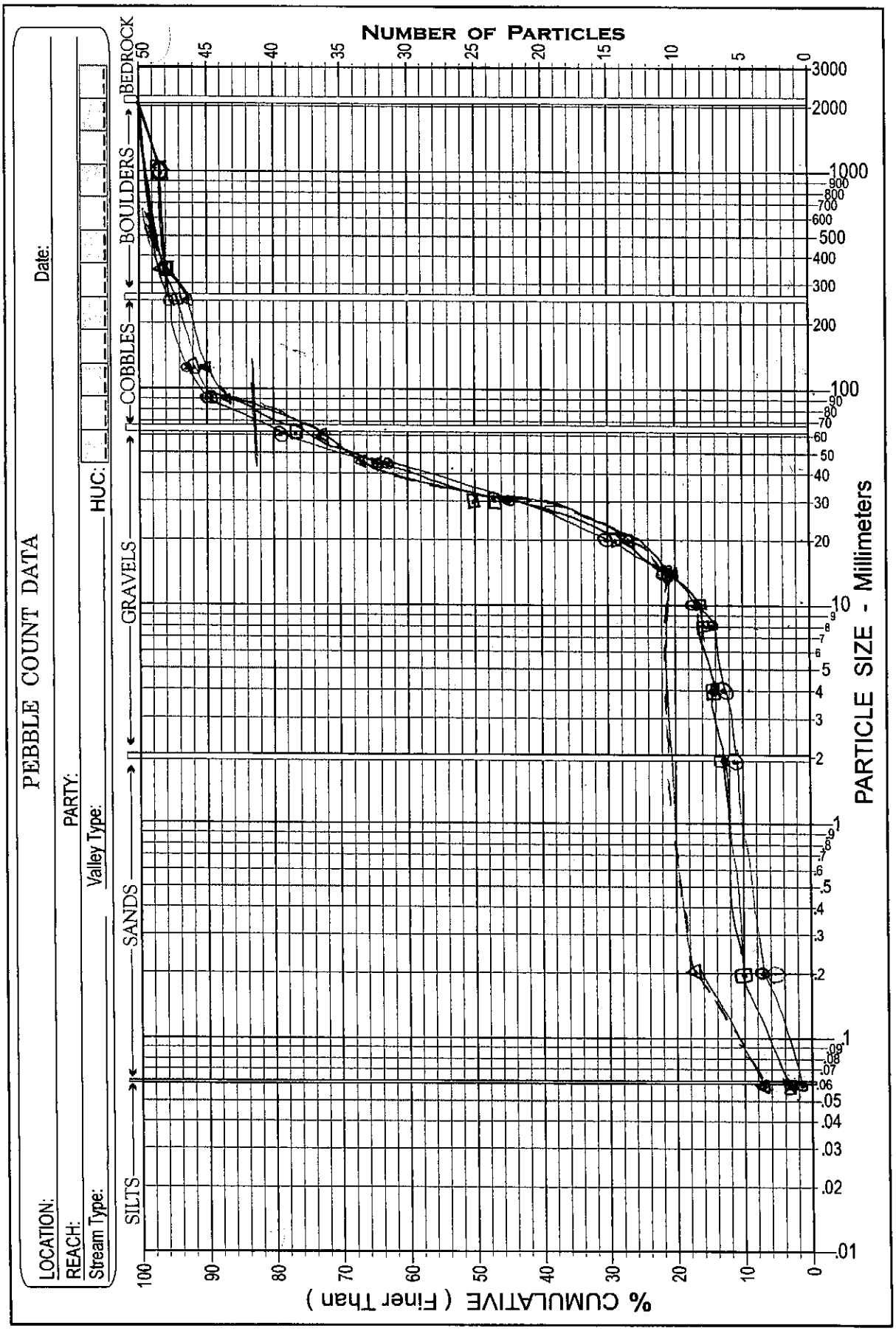
Representitive Riffle Cross Section Pebble Count



Size (mm)	
D16	37
D35	51
D50	58
D65	72
D84	170
D95	600

Size Distribution	
mean	79.30952
dispersion	2.249301
skewness	0.166994

Type			
silt/clay	0	bedrock	0.07
sand	0.01		
gravel	0.55		
cobble	0.25		
boulder	0.12		



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Active Bed

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												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25				I							1	1	1
	Medium	.25 - .50													
	Coarse	.50 - 1.0		I											
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL	I											
.16 - .22	Fine	4 - 5.7		I											
.22 - .31	Fine	5.7 - 8													
.31 - .44	Medium	8 - 11.3		I											
.44 - .63	Medium	11.3 - 16		II											
.63 - .89	Coarse	16 - 22.6		IIII		IIII							4	4	5
.89 - 1.3	Coarse	22.6 - 32		II		IIII							5	5	10
1.3 - 1.8	Very Coarse	32 - 45		IIII		IIII IIII I							11	11	21
1.8 - 2.5	Very Coarse	45 - 64		IIII IIII IIII III		IIII IIII IIII IIII IIII	IIII IIII						35	35	56
2.5 - 3.5	Small	64 - 90	COBBLE	IIII I		IIII IIII II							13	13	69
3.5 - 5.0	Small	90 - 128				IIII I							6	6	75
5.0 - 7.1	Large	128 - 180		I		IIII							4	4	79
7.1 - 10.1	Large	180 - 256		III		II							2	2	81
10.1 - 14.3	Small	256 - 362	BOULDER	II		IIII I							6	6	87
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024				IIII I							6	6	93
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK	III		IIII II							7	7	100
Stream Type:			**Valley Type:**			TOTAL→							100		

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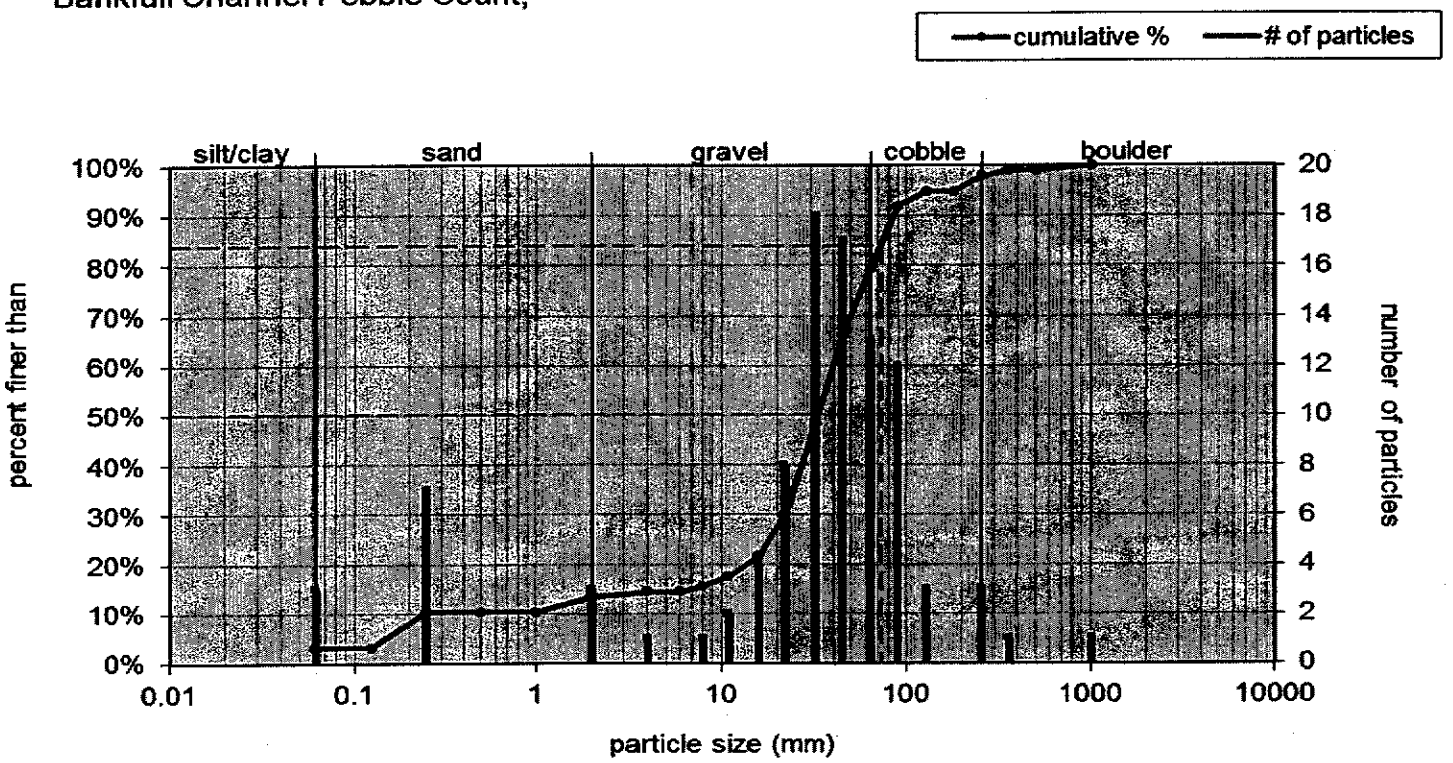
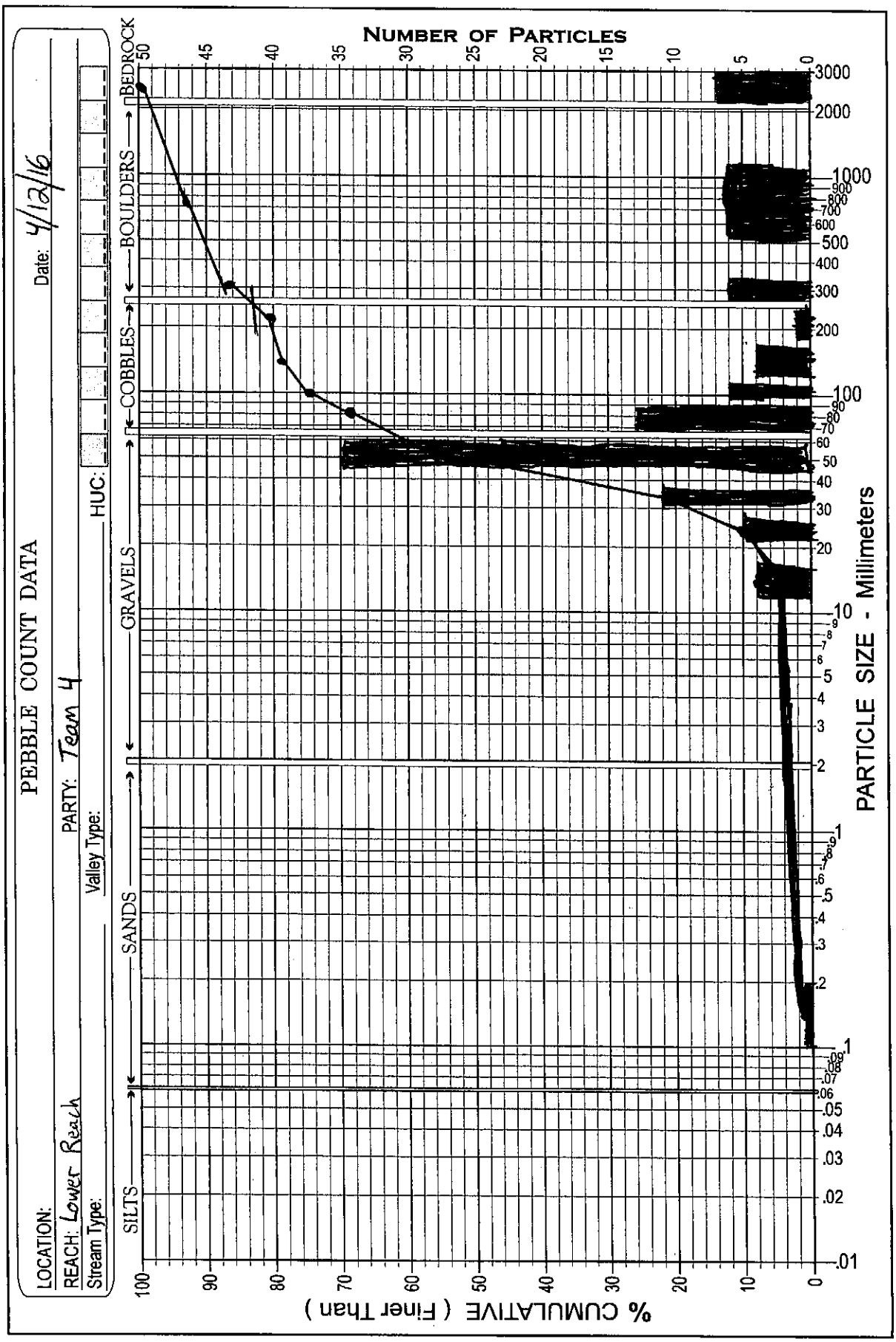
Bankfull Channel Pebble Count, ---



Size (mm)			Size Distribution		Type			
D16	8.7	3.4	mean	25.20119	silt/clay	0.03	bedrock	0.03
D35	24	12	dispersion	3.002612	sand	0.1		
D50	33	17	skewness	-0.12183	gravel	0.64		
D65	44	20			cobble	0.18		
D84	73	29			boulder	0.02		
D95	180	39						



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

Stream:	Little Conococheague Creek
Basin:	Drainage Area: 7680 acres 12 mi²
Location:	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/12/2016
Observers: Team #4	Landscape Type:

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	25.45	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.78	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	45.27	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	14.29	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.	2.69	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.	156.5	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	6.15	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.	33	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.	0.004	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	1.17	ft/ft

Stream Type C4/1 **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:	Little Conocacheague Creek	Location:	
Date:	4/12/2016	Stream Type:	C4/1
Observers:	Team #4	Landscape Type:	Confined Alluvial
		HUC:	02070004

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	45.27	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.78	d_{bkf} (ft)
Bankfull Riffle Width	25.45	W_{bkf} (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	29.01	W_p (ft)
D_{84} Particle Size at Riffle	170	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	0.56	D_{84} (ft)
Bankfull Slope	0.004	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.56	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	2.79	R / D_{84} (ft / ft)
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	0.45	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	3.96	ft / sec	179.3	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. A-27, A-28) $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.037	4.21	ft / sec	191.0	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	4.09	ft / sec	185.5	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 $n =$ 0.04	2.82	ft / sec	127.4	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 Q: $Q =$ 200 year		ft / sec		cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$ 200 / 45.27	4.42	ft / sec	200	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: Little Conocacheague Creek			Location:		
Team: #4		Date: 4/12/2016		Drainage Area: 125 sq. mi.	
Riffle Channel Dimensions					
1. Bankfull Width (W_{bkf}) (ft)	25.45		2. Bankfull Mean Depth (d_{bkf}) (ft)	1.78	
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	14.29		4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	45.27	
5. Bankfull Maximum Depth (d_{max}) (ft)	2.69		6. Width of Flood-Prone Area (W_{fpa}) (ft)	156.5	
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	6.14				
Channel Pattern			***Dimensionless Ratios***		
8. Belt Width (W_{blt}) (ft)	Mean 67.5 Min Max		9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean 2.76 Min Max	
10. Stream Meander Length (L_m) (ft)	Mean 158' Min Max		11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean 6.21 Min Max	
12. Linear Wavelength (λ) (ft)	Mean 158' Min Max		13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean 6.21 Min Max	
14. Radius of Curvature (R_c) (ft)	Mean 82.5' Min 82' Max 83'		15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean 3.24 Min Max	
Channel Particles					
Representative Pebble Count					
16. D_{16} (mm)	5.7	17. D_{35} (mm)	24	18. D_{50} (mm)	33
19. D_{84} (mm)	73	20. D_{95} (mm)	180	21. D_{100} (mm)	bedrock
Active Bed Riffle Pebble Count					
22. D_{16} (mm)	37	23. D_{35} (mm)	51	24. D_{50} (mm)	58
25. D_{84} (mm)	170	26. D_{95} (mm)	600	27. D_{100} (mm)	bedrock
Classification					
28. Sinuosity (k)	1.17		29. Average Water Surface Slope (S)	0.004	
30. Stream Type	C4/1		31. Landscape Type	Confined Alluvial	
Velocity & Discharge					
32. Friction Factor ($\bar{u}$ / u*)	5.36		33. Relative Roughness (R / D_{84})	2.79	
34. Manning's 'n' from Friction Factor / Relative Roughness	0.03		35. Manning's 'n' from Stream Type	0.31	
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	2.41		37. Estimated Bankfull Discharge (cfs)	200	
38. Estimation Method Selected for Velocity & Discharge	Regional curve				

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