Geometry & Sketch Map

Geometry Instructions.....A51

Sketch Map.....A51

Sinuosity.....A54

Belt Width.....A54

Stream Meander Length.....A55

Linear Wavelength.....A56

Radius of Curvature.....A56

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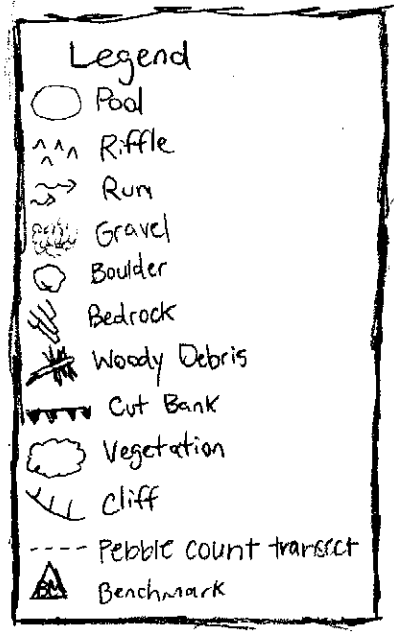
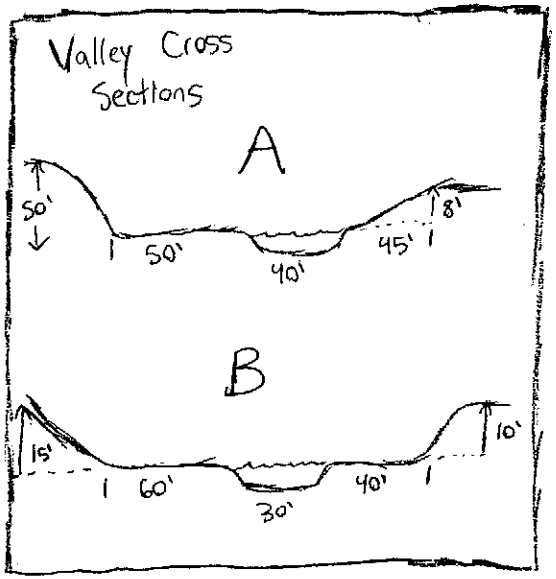
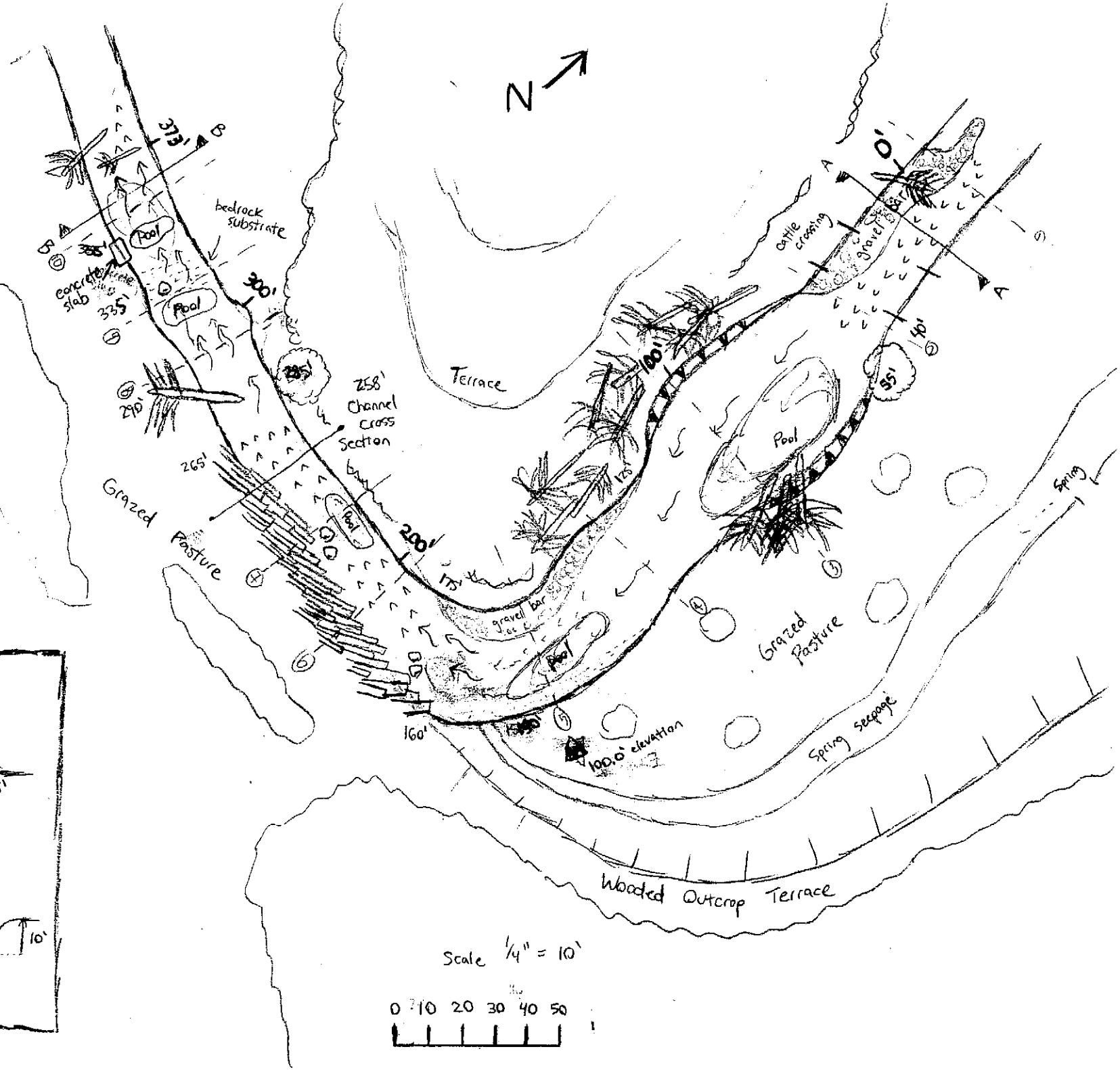
Little Conococheague Creek
Washington County, MD
March 31, 2015
Team 2 - Reach 2



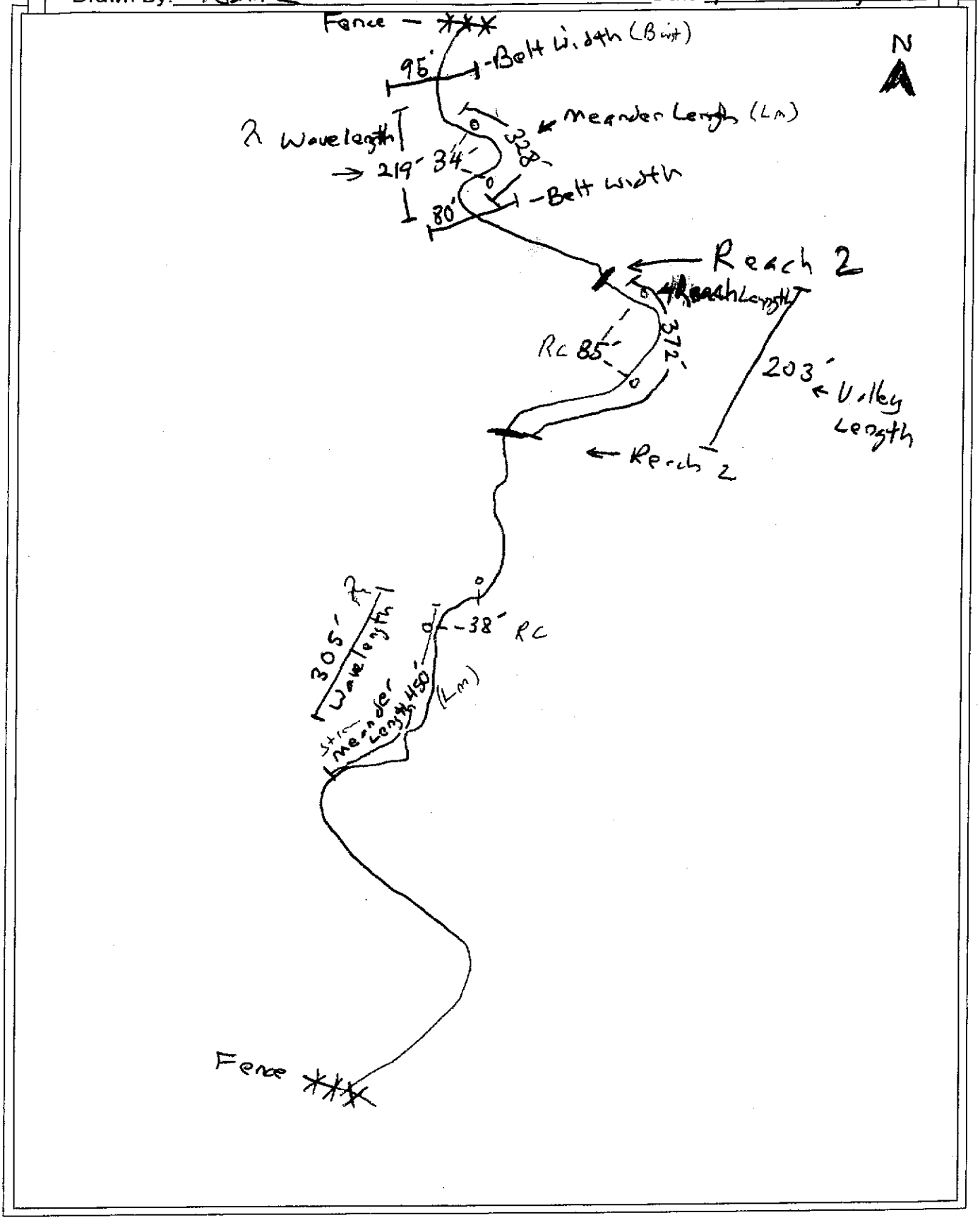




AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Little Conococheague Creek Site/Reach: 2, Team 2

Drawn By: Team 2 Date: March 31, 2015



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Cross-Sections

Cross-section Overview.....A15

Cross-section Instructions..... A19

Cross-section Forms..... A22

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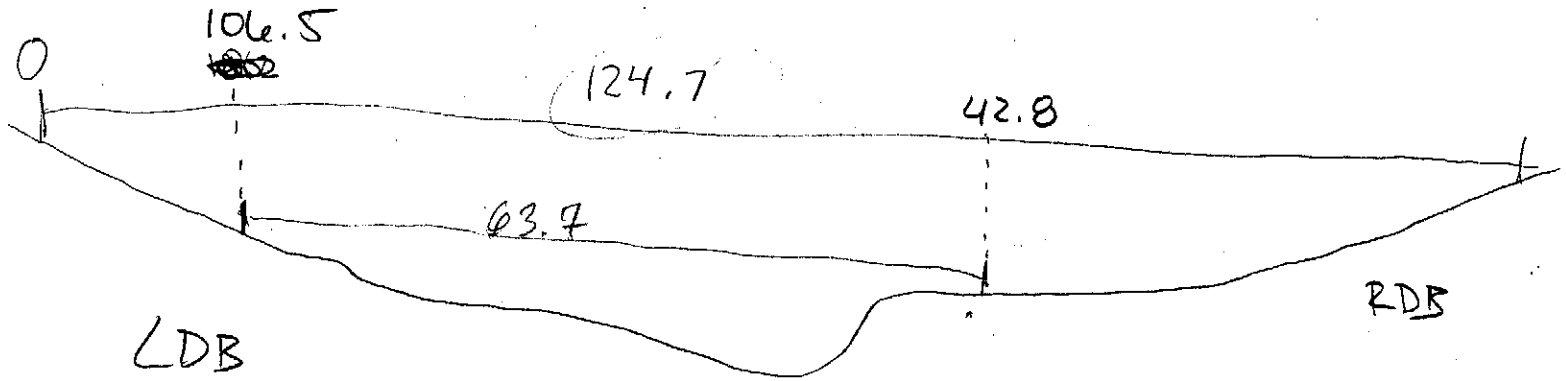
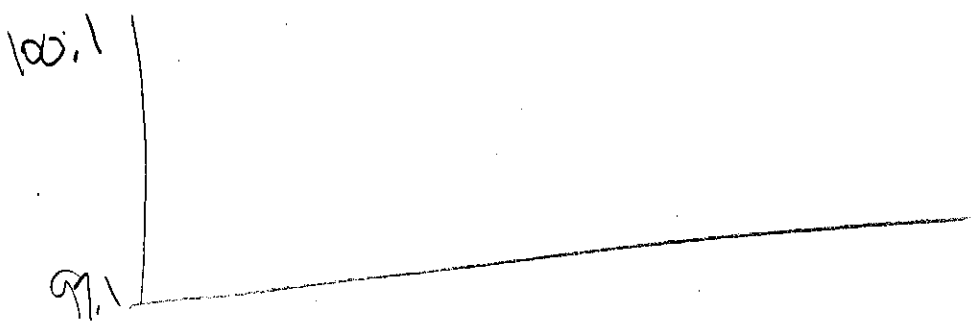
$$\begin{array}{r} {}^{1}{}^{2} \\ 348 \\ 3 \\ \hline 1031 \end{array}$$

124.7/34.8 =

$$\begin{array}{r} \sim 3.6 \\ 34.8\overline{)124.7} \\ \underline{103.1} \\ 21.6 \end{array}$$





$$\frac{124.7}{34.8}$$

4 7.64 - 5.88 = 1.86

SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: 2 RIFFLE X-SECTION Date: 3/31/15

Location: 02+58, MD, LITTLE CONOCACHEAGUE CREEK, WASHINGTON CO.

Party / Notes: SD, LY, WS TEAM 2 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		4.79	104.79		100	
2	00+00			4.13	100.66	
3	00+03.6			4.58	100.21	
4	00+05			4.68	100.11	BKF?
5	00+06			4.82	99.97	BKF?
6	00+06.5			4.92	99.87	BKF?
7	00+07.3			5.10	99.69	
8	00+10.2			5.87	98.92	
9	00+12.8			5.93	98.86	DEPOSIT SIDEBAR
10	00+15.4			6.41	98.38	DEPOSIT SIDEBAR
11	00+16.8			6.60	98.19	LEW
12	00+19.4			7.17	97.62	
13	00+21			7.64	97.15	TW — CONTRACTUAL POOL BEHIND BEDROCK
14	00+24.2			7.39	97.40	~~TW~~
15	00+26.7			7.26	97.53	
16	00+30.7			7.19	97.60	
17	00+32.8			7.20	97.59	
18	00+34.2			7.35	97.44	
19	00+36.1			7.31	97.48	
20	00+37			7.08	97.71	
21	00+38.1			6.66	98.13	
22	00+38.3			6.58	98.21	REW
23	00+39			5.68	99.11	
24	00+40.3			4.70	100.09	BKF
25	00+42.9			4.36	100.43	
26	00+48.1			4.76	100.03	
27	00+55.6			4.30	100.49	
28	00+63.7			3.90	100.89	

WAYPOINT 153

6 7.64 5.88 1.86

40.3 34.8

BACK WATER BEHIND ROOT

5 6.60 4.68 1.92

5 6.60 4.82 1.78

5 6.60 4.92 1.68

5 6.58 4.70 1.88

ELEV OF FPA 102.9

6 7.64 4.70 2.94

2.94 2 5.88

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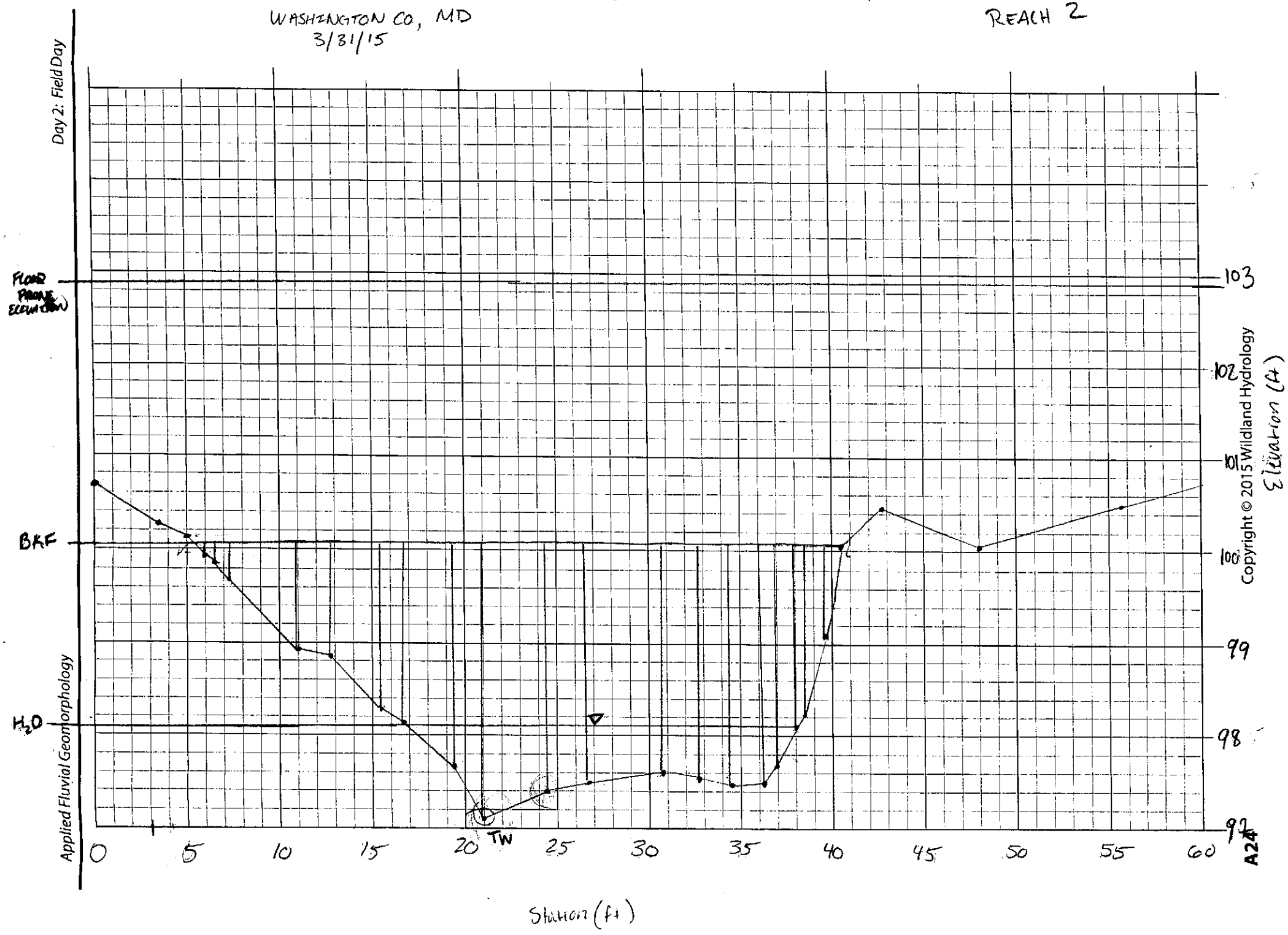
LITTLE CONOCACHEAGUE CREEK - XS-1 @ 258' ON LONGPRO

WASHINGTON CO, MD
3/31/15

TEAM 2
REACH 2



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Longitudinal Profile

Longitudinal Profile Overview.....A27

Longitudinal Profile Instructions.....A28

Plan and Profile Diagram of Longitudinal Profile.....A29

Low Bank Height & Degree of Channel Incision.....A32

Longitudinal Profile Forms.....A34

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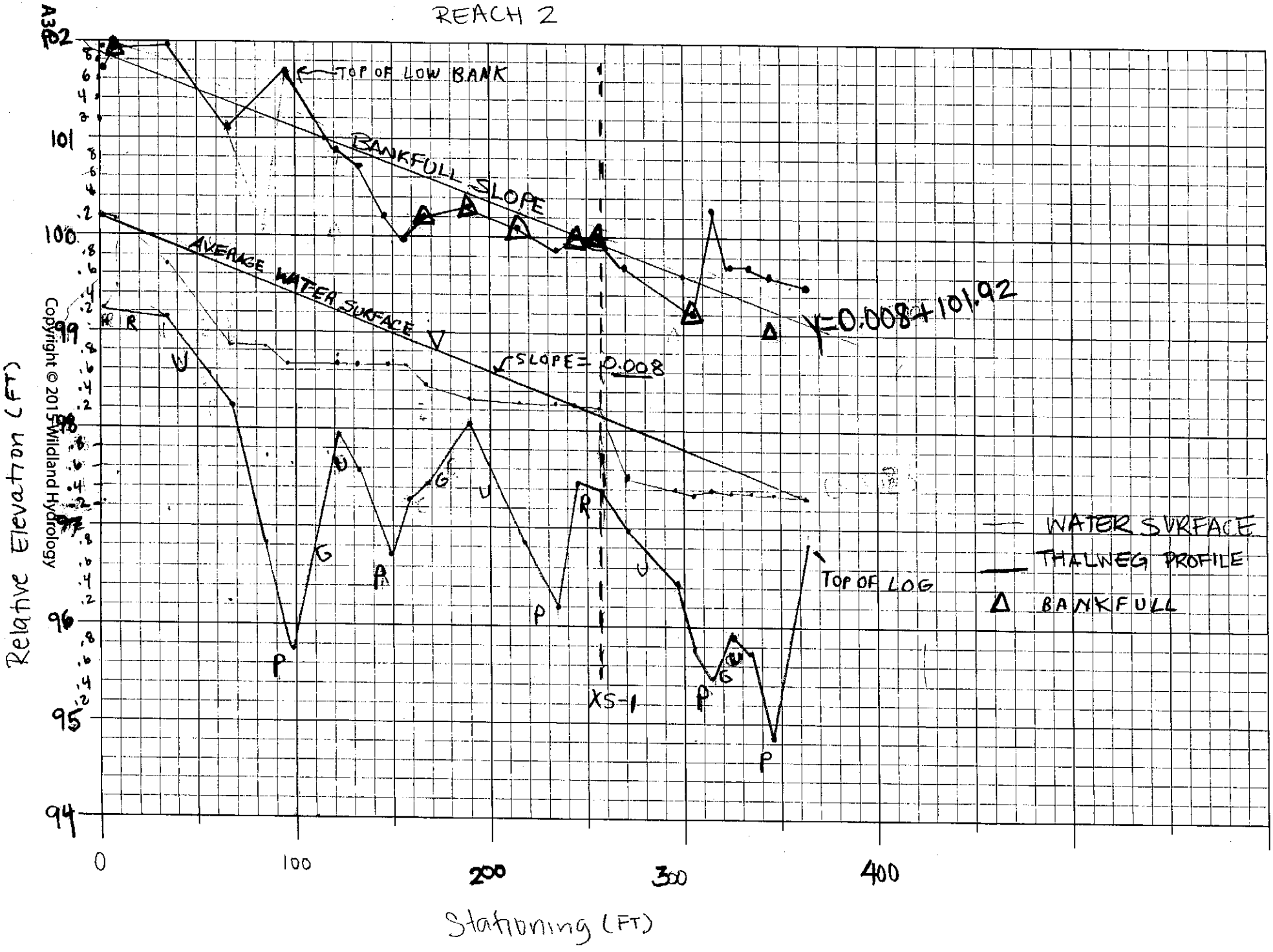
TEAM 2

LONGITUDINAL PROFILE

REACH 2

3/31/15



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SURVEY DATA ⟹ LONGITUDINAL PROFILE 1

SITE: Little Conococheague Date: 3-31-15

Location: Reach 2

Party / Notes: Profile Team 2 HUC:

BM elev = 100

FS = 7.37

	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	1		107.37	8.14	99.23	7.17	100.2			5.62	101.75	riffle
2	9			7.91	99.46	7.18	100.19	5.40*	101.97	5.40	101.97	
3	35			8.21	99.16	7.67	99.7			5.39	101.98	
4	67			9.14	98.23	8.53	98.84			6.26	101.11	run
5	85			10.56	96.81	8.66	98.71			6.90	100.47	pool
6	98			11.60	95.75	wa 2.9 98.65	98.65			5.69	101.69	DMAX
7	122			9.50	97.87	8.68	98.69	7.30?	100.07	6.55	100.82	glide
8	133			9.78	97.59	8.71	98.66			6.64	100.73	pool
9	149			10.65	96.72	8.71	98.66			7.17	100.2	DMAX
10	159			10.10	97.27	8.71	98.66			7.47	99.9	glide
11	168			9.95	97.42	8.72	98.65	7.16*	100.21	7.16	100.21	riffle
12	190			9.31	98.06	8.93	98.44	7.06*	100.31	7.06	100.31	run
13	219			10.54	96.83	9.04	98.33	7.25*	100.12	7.25	100.12	pool
14	235			11.17	96.2	9.05	98.32			7.53	99.84	dmax
15	245			9.93	97.44	9.05	98.32	7.32*	100.05	7.32	100.05	riffle
16	258			9.98	97.39	9.15	98.22	7.28*	100.09	7.28	100.09	XS-1
17	271			10.44	96.93	9.90	97.47			7.60	99.77	run
18	296			10.94	96.43	9.97	97.4	8.37?	99.00	* tree roots/ disturbance		pool
19	306		107.37	11.58	95.79	10.02	97.35					
20	TP1 → 7.34	7.34	105.95	8.76	BS =	7.34						
21	306		105.95	—		—		6.76*	99.19	6.76	99.19	
22	315		105.95	10.46	95.49	8.55	97.4			5.66	100.29	DMAX
23	325		105.95	10.05	95.9	8.57	97.38			6.27	99.68	glide
24	335		105.95	10.21	95.74	8.57	97.38			6.30	99.65	pool
25	348		105.95	11.10	94.85	8.58	97.37	6.83*	99.12	6.39	99.56	dmax
26	373		105.95	9.12	96.83	8.59	97.36			6.48	99.47	top log
27												

start of each feature

start of bedrock

no glide due to bedrock

* group designated

?

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Pebble Counts

Pebble Count Overview.....A39

Representative Pebble Count Instructions.....A41

Active Bed Riffle Pebble Count Instructions.....A41

Pebble Count Forms..... A44

Valley Length = 203 ft

Riffle: 0 - 68, 170 - 200, 248 - 278
68 ft, 30 ft, 30 ft

128 ft / 372 ft = 34.4%

Other: 68 - 170, 200 - 248, 278 - 300
102 ft, 48 ft, 22 ft,

244 ft / 372 ft

65.5%

48
+72
172
+72
244

20 ft
52

Pool: 86 - 109, 143 - 153, 230 - 239, 302 - 330, 343 - 363
23, 10, 9, 8, 20

33
+20
+17
70

70/372 = 18.8% pool
81.2% other

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Active Bed
Riffle Pebble Count

Site: Little Conocacheague Reach 2 Date: 3/3/2015
Location: Washington County HUC:
Party: C.B, M.P, C.M. - 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				1	1	1						
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25					2	2	3						
	Medium	.25 - .50					2	2	5						
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8					1	1	6						
.31 - .44	Medium	8 - 11.3					5	5	11						
.44 - .63	Medium	11.3 - 16					6	6	17						
.63 - .89	Coarse	16 - 22.6					7	7	24						
.89 - 1.3	Coarse	22.6 - 32					10	10	34						
1.3 - 1.8	Very Coarse	32 - 45					9	9	43						
1.8 - 2.5	Very Coarse	45 - 64					16	16	59						
2.5 - 3.5	Small	64 - 90	COBBLE				13	13	72						
3.5 - 5.0	Small	90 - 128					7	7	79						
5.0 - 7.1	Large	128 - 180					4	4	83						
7.1 - 10.1	Large	180 - 256					4	4	87						
10.1 - 14.3	Small	256 - 362	BOULDER				3	3	90						
14.3 - 20	Small	362 - 512					1	1	91						
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK				9	9	100						
Stream Type:			**Valley Type:**			TOTAL→	100								

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ACTIVE RIFFLE

$D_{50} = 52$ mm

$D_{84} = 180$ mm

Active Bed Riffle

PEBBLE COUNT DATA

LOCATION: Little Conococheague

REACH: 2

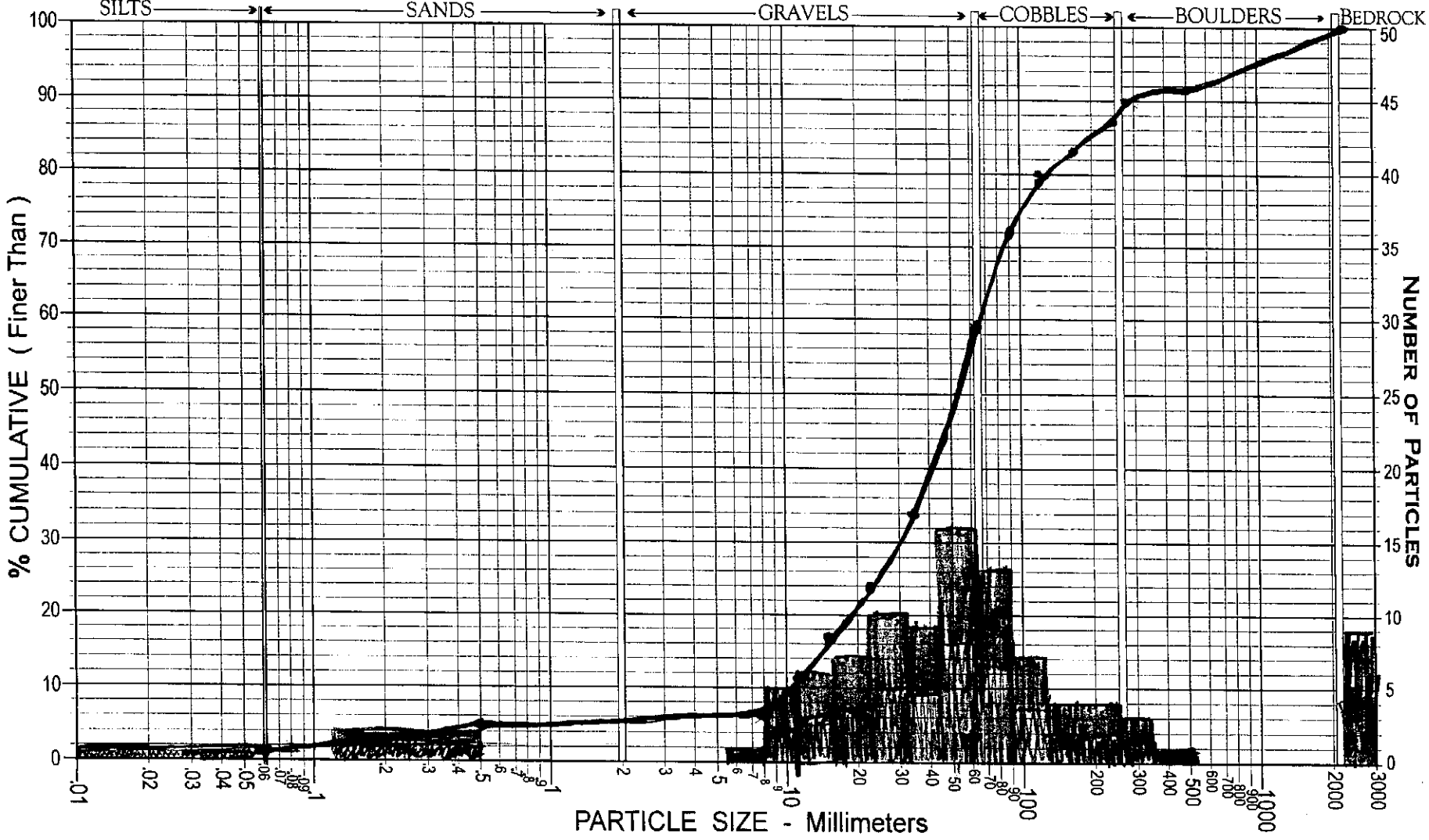
Stream Type: C4/1

PARTY: CD CM MP - Team 2

Valley Type: Confined Alluvial Terrace (VBX4)

Date: 3/31/2015

HUC:



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125
395
54 = 191

Composite
Representative Reach

Site: Little Conococheague Reach 2 Date: 3/31/2015
Location: Washington County HUC:
Party: C.B, M.P, C.M - Team 2

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE and 10thers	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				2	2.5	2.5				2	2	2
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND				4	5	7.5	2	10	10	6	6	8
	Medium	.25 - .50	SAND				2	2.5	10	3	15	25	5	5	13
	Coarse	.50 - 1.0	SAND				4	5	15				4	4	17
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL				1	1.25	16.25				1	1	18
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL				3	3.75	20				3	3	21
.31 - .44	Medium	8 - 11.3	GRAVEL				3	3.75	23.75	1	5	30	4	4	25
.44 - .63	Medium	11.3 - 16	GRAVEL				5	6.25	30	2	10	40	7	7	32
.63 - .89	Coarse	16 - 22.6	GRAVEL				3	3.75	33.75	2	10	50	5	5	37
.89 - 1.3	Coarse	22.6 - 32	GRAVEL				7	8.75	42.5	1	5	55	8	8	45
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL				10	12.5	55	2	10	65	12	12	57
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL				11	13.75	68.75	2	10	75	13	13	70
2.5 - 3.5	Small	64 - 90	COBBLE				5	6.25	75	1	5	80	6	6	76
3.5 - 5.0	Small	90 - 128	COBBLE				2	2.5	77.5				2	2	78
5.0 - 7.1	Large	128 - 180	COBBLE				4	5	82.5				4	4	82
7.1 - 10.1	Large	180 - 256	COBBLE				3	3.75	86.25				3	3	85
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER				1	1.25	87.5				1	1	86
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK				10	12.5	100	4	20	100	14	14	100
Stream Type:			Valley Type:			TOTAL→	80			20			100		

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Representative Reach

Pebble Count

D_{50} = 38 mm

D_{84} = 210 mm

Composite

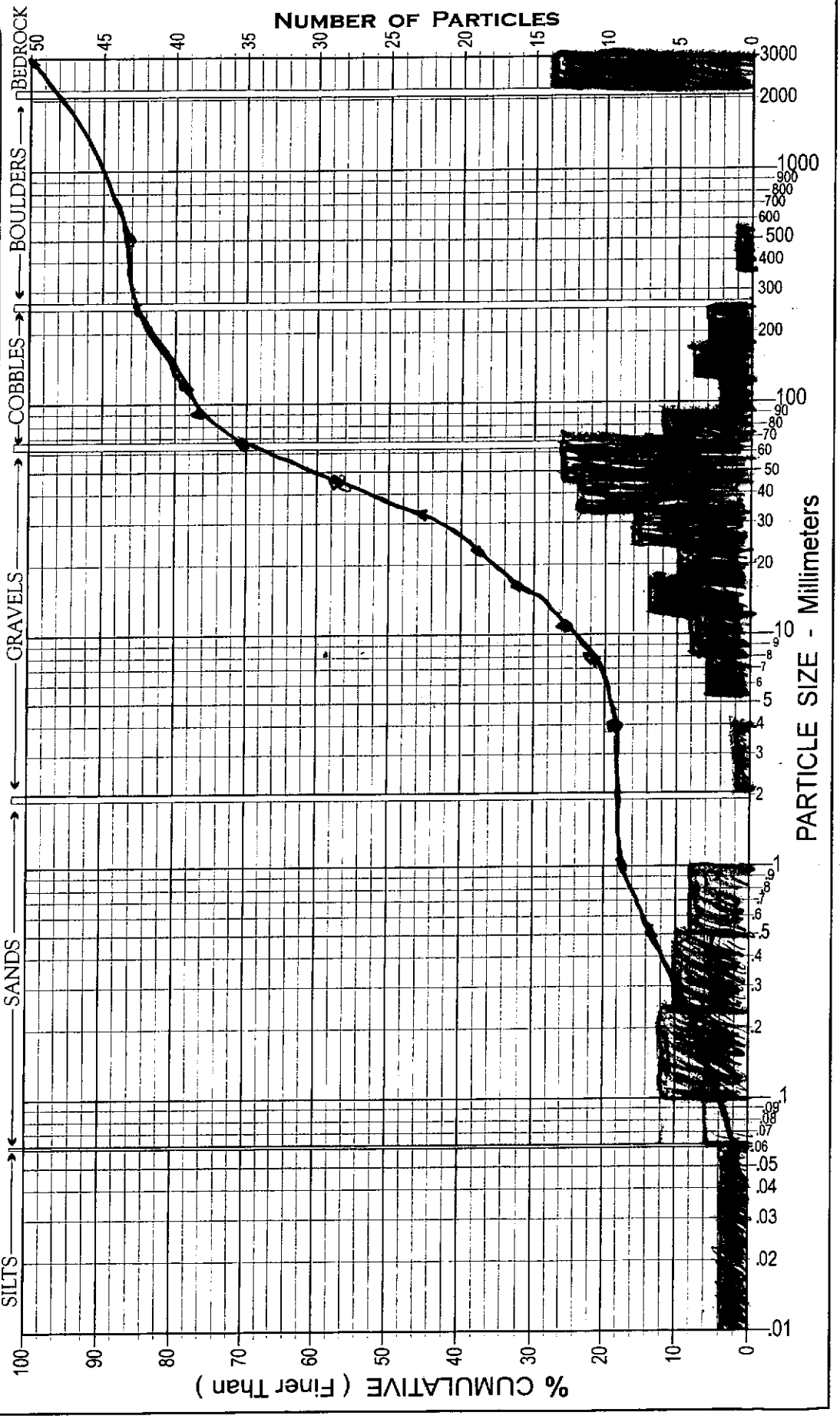
LOCATION: Little Conococheague

REACH: Washington County Reach 2 PARTY: CB CM MP - Team 2

Stream Type: C4/1 Valley Type: Confined alluvial terrace HUC: ____

Date: 3/31/2015

PEBBLE COUNT DATA



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Pebble Count

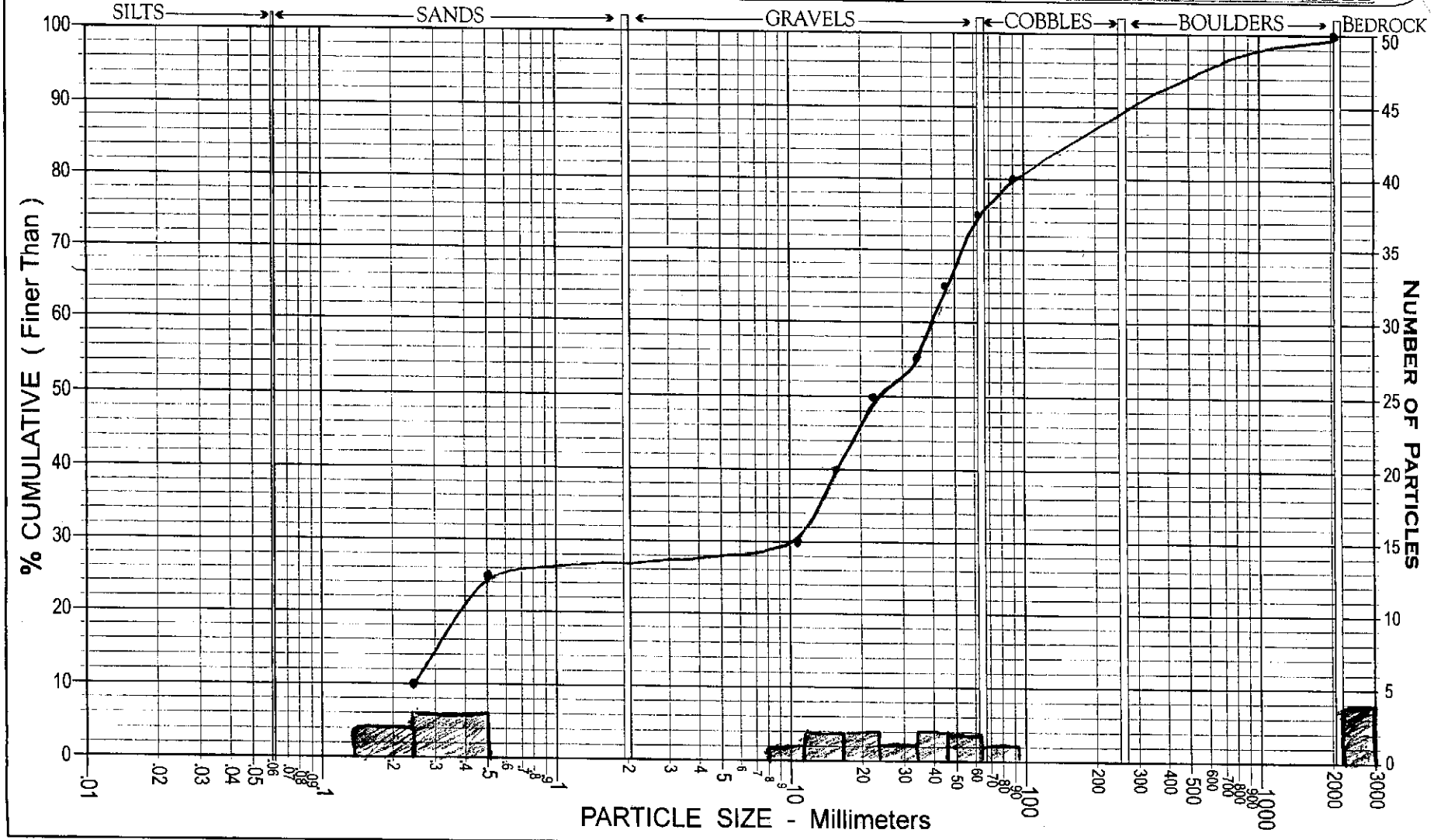
D50 = 22 mm
D84 = 110 mm

Representative Reach – Pool Only

LOCATION: Little Conococheague
REACH: 2
Stream Type: C4-1

PEBBLE COUNT DATA

PARTY: CB CM MP – Team 2
Valley Type: VIIIc
Date: 3/31/15
HUC:



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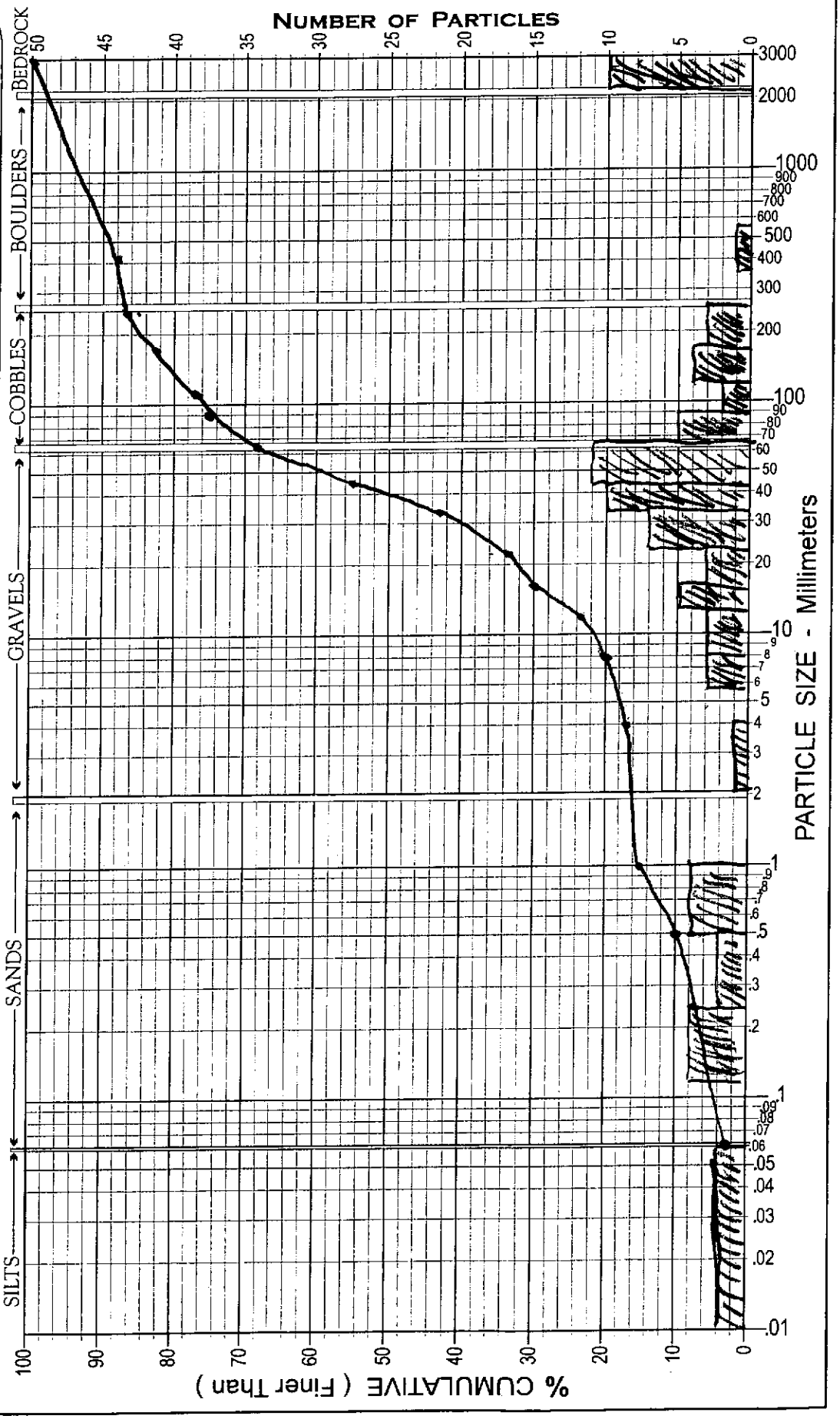
Representative Pebble Count → Riffle Only

D_{50} = 40mm
D_{84} = 195mm

PEBBLE COUNT DATA

LOCATION: Little Conococheague
REACH: Reach 2
Stream Type: C4-1
Valley Type: VIII(c)
HUC:
PARTY: CB, CM, MP - Team 2
Date: 3/31/15



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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Little Conocacheague	Location:	Reach 2 Washington County MD
Date: 3/31/15	Stream Type: C4/1	Valley Type:	VIIIc
Observers:	team 2	HUC:	-- -- -- -- -- -- -- -- -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	67.211	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.93	d_{bkf} (ft)
Bankfull Riffle WIDTH	34.8	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	38.66	W_p (ft)
D_{84} at Riffle	180	Dia. (mm)	D_{84} (mm) / 304.8	0.59	D_{84} (ft)
Bankfull SLOPE	0.008	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.74	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	2.95	R / D_{84}
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.67	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$ (2.95)	3.68	ft / sec	247.19	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.04	4.82	ft / sec	323.95	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.04	4.82	ft / sec	323.95	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 $n =$ 0.057	3.38	ft / sec	227.17	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 = [redacted] year	ungaged	ft / sec	ungaged	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	3.18	ft / sec	214.05	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-1. Field Form for Level II Stream Classification.

Stream: LITTLE CONOCACHEAGUE CREEK	
Basin:	Drainage Area: ~~acres~~ 12 mi²
Location: Reach 2	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 3/31/15
Observers: Team 2	Valley Type: VIIIc ★

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	34.8	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.93	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	67.211	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	18.03	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.	2.94	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.	124.7	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	3.58$\bar{3}$	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.	52	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.	0.008	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).	1.83	

Stream Type C4/1 **See Classification Key (Figure A-2)**

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Worksheet A-3. Summary of Morphological Variables.

Stream: Little Conocacheague		**Location:** Reach 2 Washington County MD	
Team: 2	**Date:** 3/31/15	**Drainage Area:** 12 mi²	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	34.8	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.93
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	18.031	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	67.211
5. Bankfull Maximum Depth (d_{max}) (ft)	2.94	6. Width of Flood-Prone Area (W_{fpa}) (ft)	124.7
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	3.583		

Channel Pattern / *Dimensionless Ratios*

8. Belt Width (W_{blt}) (ft)	Mean	87.5	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	2.51
	Min	80		Min	2.30
	Max	95		Max	2.73
10. Stream Meander Length (L_m) (ft)	Mean	386.5	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	11.1
	Min	323		Min	9.28
	Max	450		Max	12.93
12. Linear Wavelength (λ) (ft)	Mean	262	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	7.52
	Min	219		Min	6.29
	Max	305		Max	8.76
14. Radius of Curvature (R_c) (ft)	Mean	35.7	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.02
	Min	34		Min	0.98
	Max	38		Max	1.09

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	0.8	17. D_{35} (mm)	19	18. D_{50} (mm)	38
19. D_{84} (mm)	210	20. D_{95} (mm)	1800	21. D_{100} (mm)	Bedrock

Active Bed Riffle Pebble Count

22. D_{16} (mm)	16	23. D_{35} (mm)	35	24. D_{50} (mm)	52
25. D_{84} (mm)	180	26. D_{95} (mm)	1000	27. D_{100} (mm)	Bedrock

Classification

28. Sinuosity (k)	1.83	29. Average Water Surface Slope (S)	0.008
30. Stream Type	C4/1	31. Valley Type	VIII c

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u*)	5.5	33. Relative Roughness (R / D_{84})	2.95
34. Manning's 'n' from Friction Factor / Relative Roughness	0.04	35. Manning's 'n' from Stream Type	0.04
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	3.68	37. Estimated Bankfull Discharge (cfs)	247.19
38. Estimation Method Selected for Velocity & Discharge	Friction Factor/Relative Roughness		

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