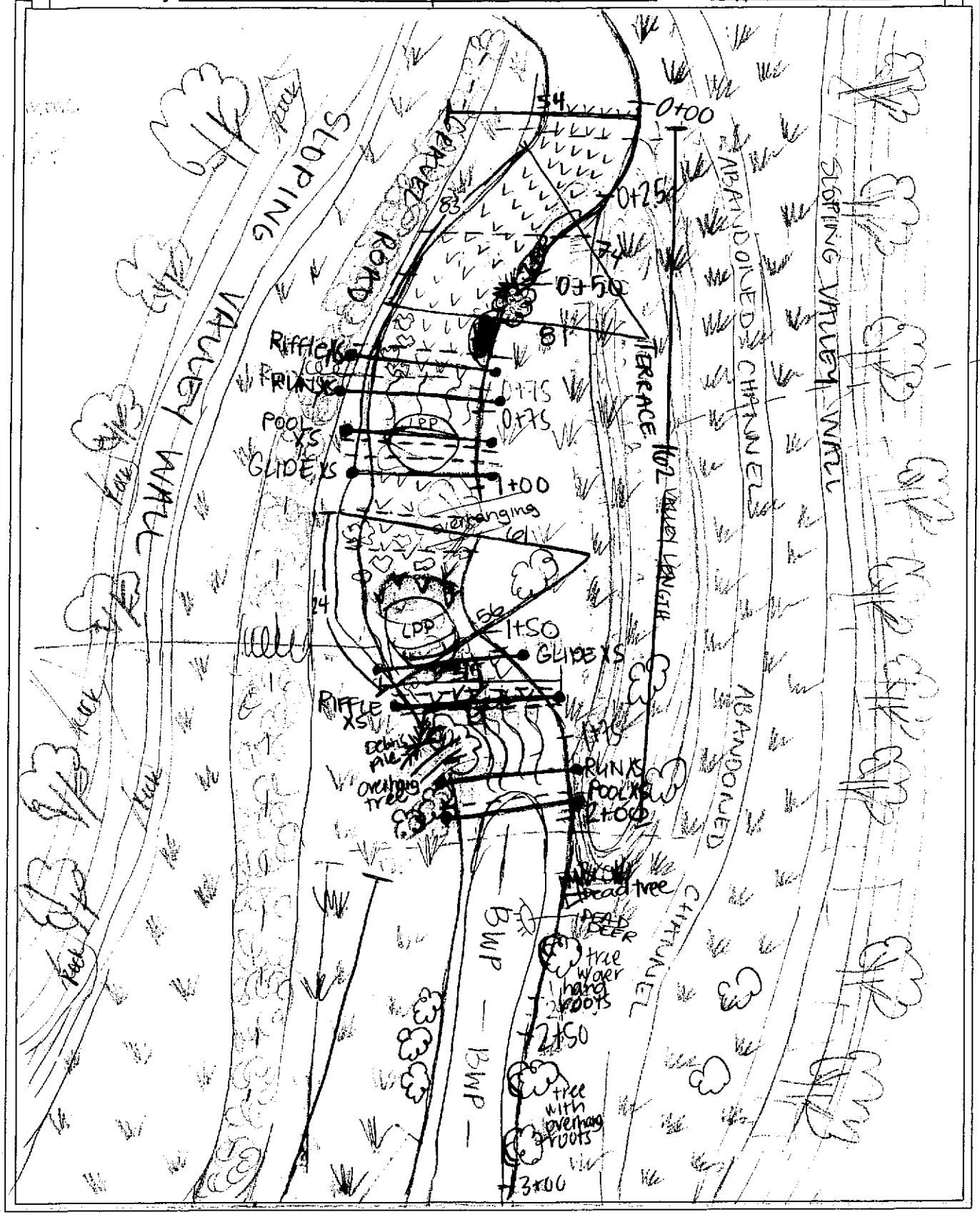
TEAM #3 Marsh Run at Grimes 4/16/15

AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Marsh Run at Grimes Site/Reach: Reach 3 PG 1

Drawn By: Team 3. - C. Brown & S. Abel Date: 4/16/15



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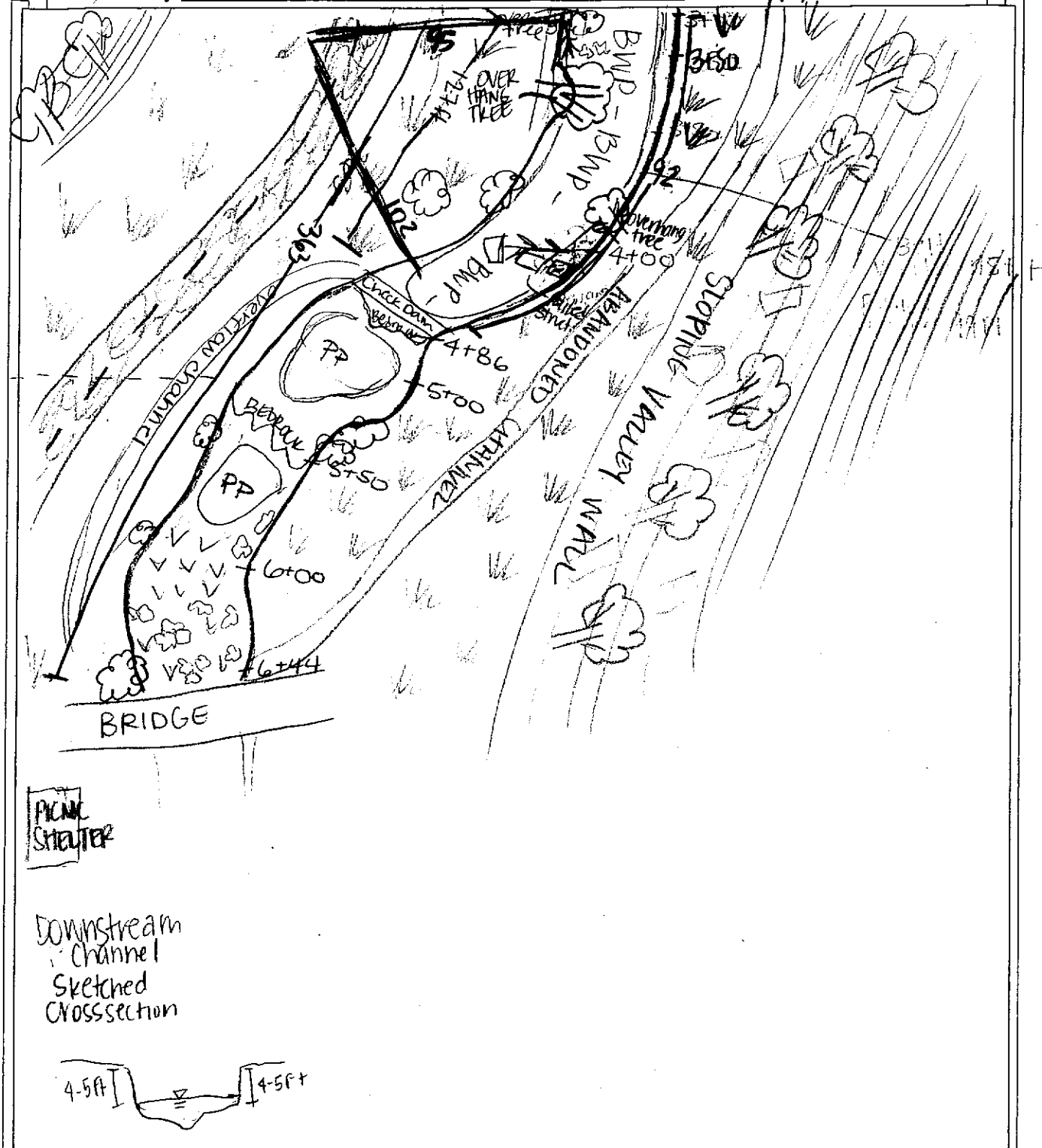
AREA-SITE LOCATION....REACH MAP

PG 2

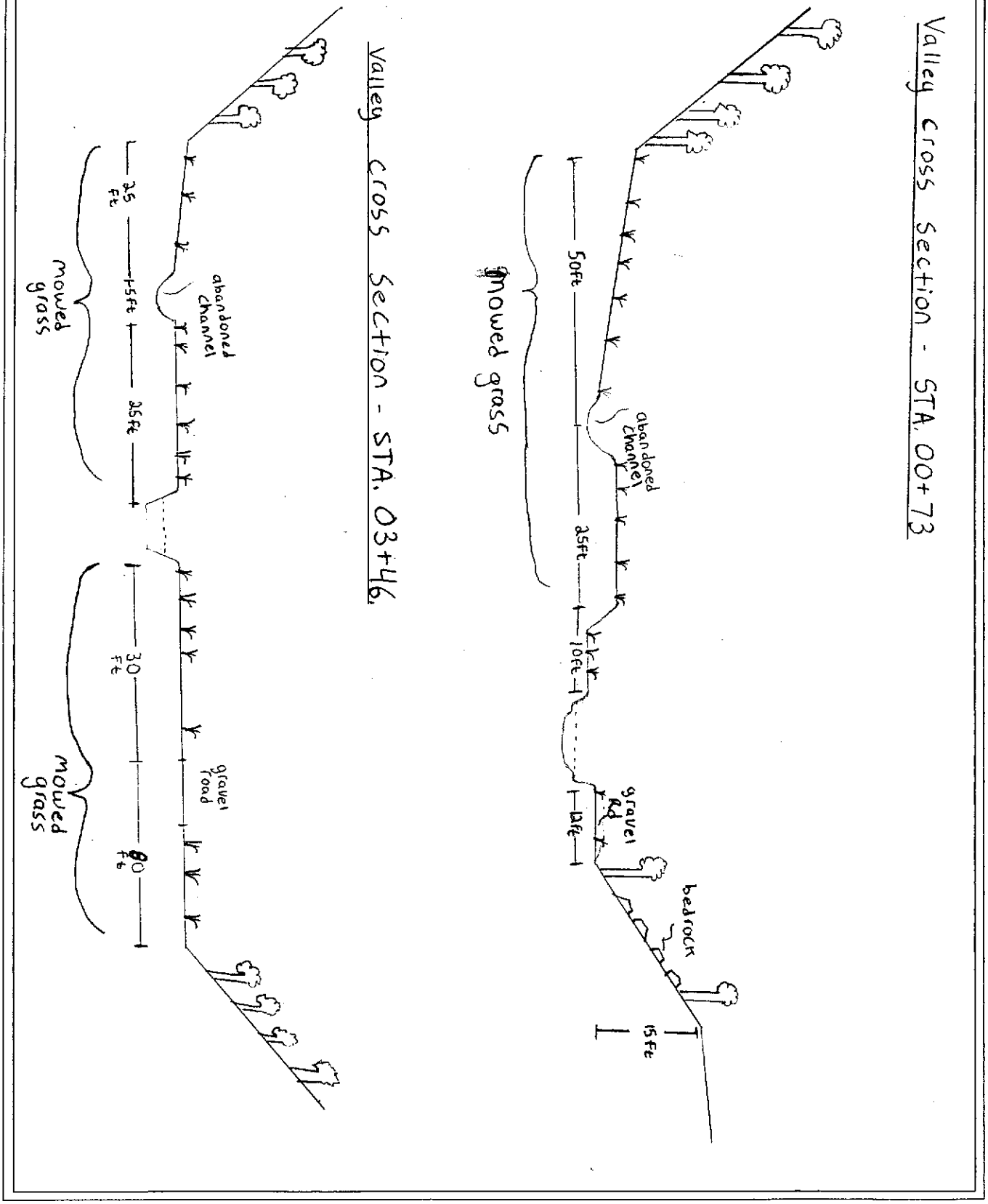
Stream/Drainage: Marsh Run at Grimes Site/Reach: Reach 3

Drawn By: Team 3 - C. Brown & S. Abel Date: 4/16/15



AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Marsh Run at Grimes Site/Reach: Reach 3
Drawn By: Team 3 Date: 4/16/15



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Worksheet B-4. Dimensionless ratios of the ten pool types (*Second Field Day*).

Stream: Marsh Run at Grimes Location: Washington County, MD

Observers: Stream Type: Valley Type: C-AL-AD Date: 4/16/15

Pool Type		Dimensional Values: Pool Length (L_p)	Pool Max Depth (d_{maxp})	Pool Slope (S_p)		Dimensionless Ratios: Pool Length to Riffle Width (L_p / W_{bkf})	Pool Max Depth to Riffle Mean Depth (d_{maxp}/d_{bkf})	Pool Slope to Average Slope (S_p / S)
1. Lateral Scour Pool (LSP)	Mean	~~16.05~~			Mean			
	Min.	~~16.05~~			Min.			
	Max.	~~16.05~~			Max.			
2. Contraction Scour Pool (CSP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
3. Step/Pool (SP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
4. Backwater Pool (BWP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
5. Plunge Pool (PP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
6. Pocket Water Pool (PWP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
7. Lateral Protrusion Pool (LPP)	Mean	20.07	2.89	0.00365	Mean	0.907	1.77	0.562
	Min.	16.05	2.4	0.00333	Min.	0.704	.913	0.513
	Max.	24.83	3.37	0.00396	Max.	1.09	2.07	0.61
8. Straight Dissipator Pool (SDP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
9. Converging Confluence Pool (CCP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			
10. Compound Pool (CP)	Mean				Mean			
	Min.				Min.			
	Max.				Max.			

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Marsh Run @ Grimes, Team 3, Reach 3, Wash County MD 4/16/15

Worksheet B-5. Procedure to validate hydraulic relations using gage station data.

1. Obtain the drainage area associated with the gaging station.
2. Obtain the field-determined bankfull discharge at the gaging station (**Figure B-43**).
3. Obtain the bankfull channel dimensions from the gaging station hydraulic geometry relationships (discharge *vs.* width, depth, area, and velocity).
4. Measure the average water surface slope.
5. Perform an active bed pebble count on the riffle to obtain D_{84}.
6. Determine the stream type.
7. Solve for Manning's 'n' at the bankfull stage: $n = (1.49R^{2/3}S^{1/2})/\bar{u}$ (use the bankfull mean velocity from Step 3).
8. Calculate relative roughness: R/D_{84}. Make sure that D_{84} is converted from millimeters to feet. Hydraulic radius (R) and mean depth (d_{bkf}) are often used interchangeably when width/depth ratios are greater than 12.
9. Calculate shear velocity: $u^* = (gRS)^{1/2}$.
10. Calculate friction factor: $\bar{u}/u^*$.
11. Plot bankfull discharge as a function of drainage area on the appropriate regional curve.
12. Plot bankfull channel dimensions as a function of drainage area on the appropriate regional curve (note stream type of plotted values using unique symbols).
13. Plot relative roughness by friction factor (**Figure B-34**) (Example in **Figure B-39**).
14. Plot Manning's 'n' by friction factor (**Figure B-35**) (Example in **Figure B-40**).
15. Plot Manning's 'n' by stream type (**Figure B-36**) (Example in **Figure B-41**).

Gaging Station Name: **Gaging Station Number:**

Drainage Area (mi^2)	Bankfull Discharge Q_{bkf} (cfs)	Bankfull Width W_{bkf}	Bankfull Mean Depth d_{bkf} (ft)	Bankfull Area A_{bkf} (ft^2)	Bankfull Velocity $\bar{u}_{bkf}$ (ft/s)	Ave. Water Surface Slope S (ft/ft)	D_{84} (mm)	D_{84} (ft)	Stream Type	Manning's 'n'	Relative Roughness R/D_{84} (ft/ft)	Shear Velocity u^* (ft/s)	Friction Factor $\bar{u}/u^*$
18.9	111	18.5	1.85	38	2.8	0.0065	92.9		B/C	0.044	4.00	0.517	5.42

3-99

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Team 3 Marsh Run @ Grimes

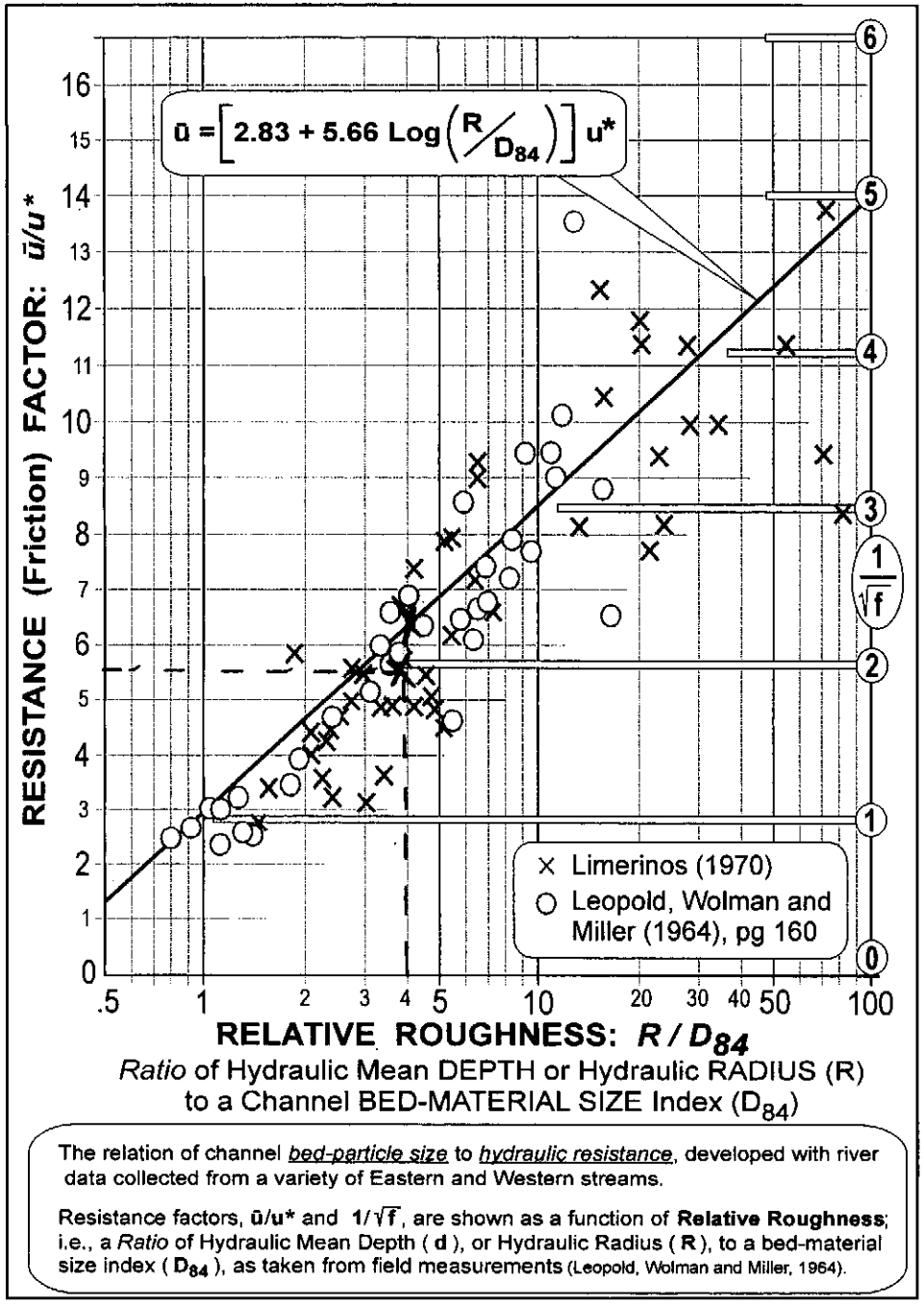

Figure B-34. Relative roughness (R/D_{84}) *vs.* friction factor ($\bar{u}/u^*$).

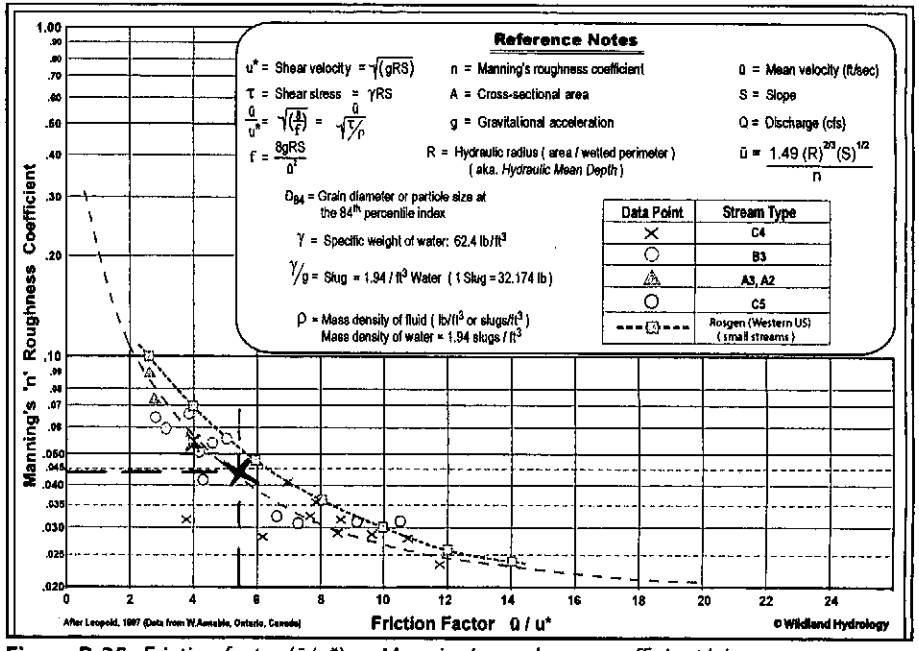

Figure B-35. Friction factor ($\bar{u}/u^*$) *vs.* Manning's roughness coefficient 'n'.

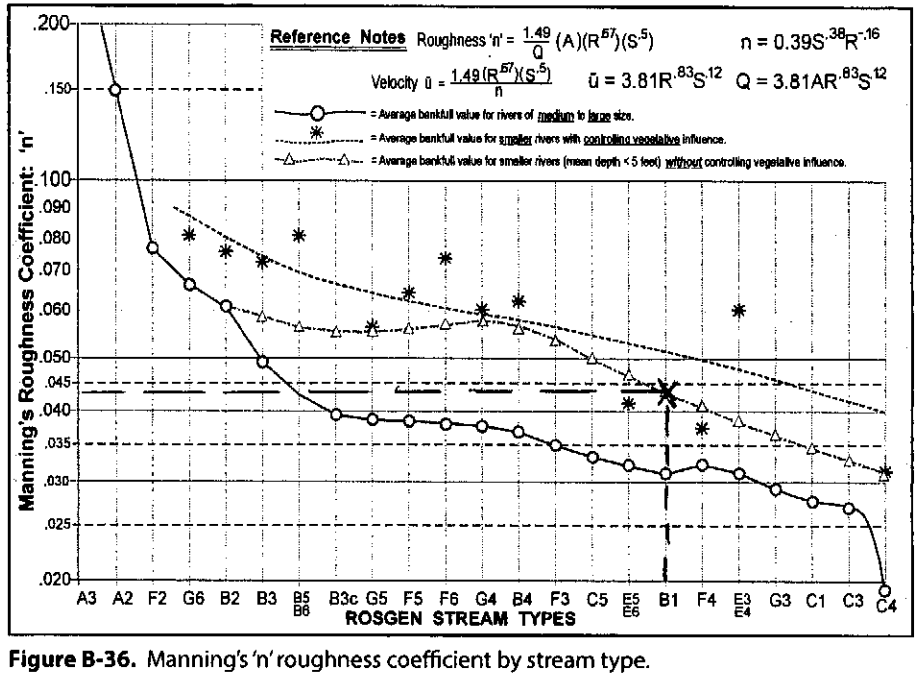

Figure B-36. Manning's 'n' roughness coefficient by stream type.

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Summary....*USGS GAGE STATION* Data / Records for STREAM CHANNEL CLASSIFICATION

Station NAME:	Marsh Run	Station Number:	3
LOCATION:	Washington County		
Period of Record:	2 yrs	Mean Annual DISCHARGE:	cfs
Drainage AREA:	— acres 18.9 mi²	Drainage Area Mn Elev:	ft
Reference REACH SLOPE:	0.0065 ft/ft	Valley Type:	C-AL-AD
Stream Type:	B/C	HUC:	

"BANKFULL" CHARACTERISTICS

Determined from FIELD MEASUREMENT			Determined from GAGE DATA Analysis		
Bankfull WIDTH (W_{bkf})	22.8	ft	Bankfull WIDTH (W_{bkf})	18.9	ft
Bankfull Mean DEPTH (d_{bkf})	1.27	ft	Bankfull MEAN DEPTH (d_{bkf})	1.85	ft
Bankfull Xsec AREA (A_{bkf})	28.9	ft²	Bankfull Xsec AREA (A_{bkf})	38	ft²
Wetted PERIMETER (W_P)	23.68	ft	Wetted PERIMETER (W_P)	22.2	ft
Bankfull STAGE (Gage Ht)	N/A	ft	Bankfull STAGE (Gage Ht)	2.17	ft
Est. Mean VELOCITY (u)	3.49	ft/sec	Mean VELOCITY (u)	2.8	ft/sec
Est. Bkf. DISCHARGE (Q_{bkf})	100.89	cfs	Bankfull DISCHARGE (Q_{bkf})	111.5	cfs

Bankfull DISCHARGE associated with **"field-determined"** Bankfull STAGE (From Gage Height reading at Staff Plate and tabular Stage-Discharge curve data) — cfs

Recurrence Interval (Log-Pearson) associated with **"field-determined"** Bankfull Discharge — 1.95 yrs

From the *Annual Peak Flow Frequency Analysis* data for the Gage Station, determine:

1.5 Year R.I. Discharge =	76	cfs	10 Year R.I. Discharge =	278	cfs
2.0 Year R.I. Discharge =	110	cfs	25 Year R.I. Discharge =	450	cfs
5.0 Year R.I. Discharge =	200	cfs	50 Year R.I. Discharge =	459	cfs

MEANDER GEOMETRY

Meander Wavelength (L_m)	208	ft	Radius of Curvature (R_C)	77.5	ft
Belt Width (W_{blt})	45	ft	Meander Width Ratio (W_{blt}/W_{bkf})	1.97	ft/ft

HYDRAULIC GEOMETRY

Based on *USGS Discharge Summary Notes* data (Form 9-207) and regression analyses of measured discharge (Q) with the hydraulic parameters of Width (W), Area (A), Mean Depth (d) & Mean Velocity (u), determine the *intercept coefficient* (a) and the *slope exponent* (b) values for a power function of the form $Y = aX^b$, when Y is one of the selected hydraulic parameters and X is a given discharge value (Q).

	Width (W)	Depth (d)	Area (A)	Velocity(u)
Intercept Coefficient a)	9.32	0.38	3.443	0.281
Slope Exponent b)	0.186	0.333	0.519	0.483

Hydraulic Radius $R = A / W_P$	1.22	ft	Manning's "n" at Bankfull Stage	0.040	Coeff.

$$\text{"n"} = 1.4895\,[(\text{Area})(\text{Hydraulic Radius}^{2/3})(\text{Slope})^{1/2}]/Q_{bkf}$$

$$n = 1.4895\left[(28.9)(1.22)^{2/3}(0.0065)^{1/2}\right]/100.89$$

Valley Length
C - 162 valley length
F - 363 ft

Stream length
C - 208 ft
F - 586 ft

linear wavelength
162 ft
127 ft

Radius of curvature
81, 74 → 77.5
56, 64 → 60
95, 102 → 98.5

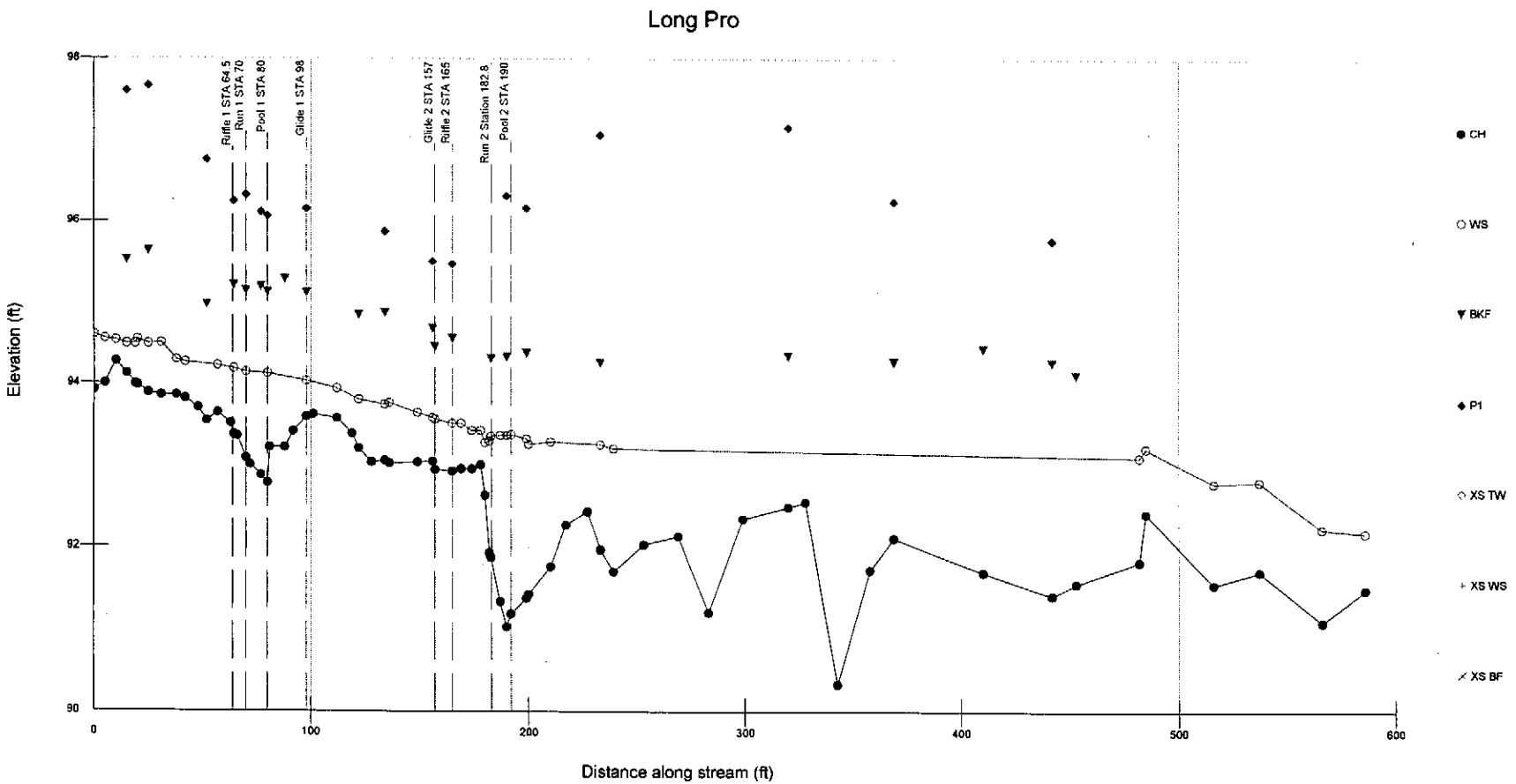
Arc length
83 ft
24 ft
92 ft

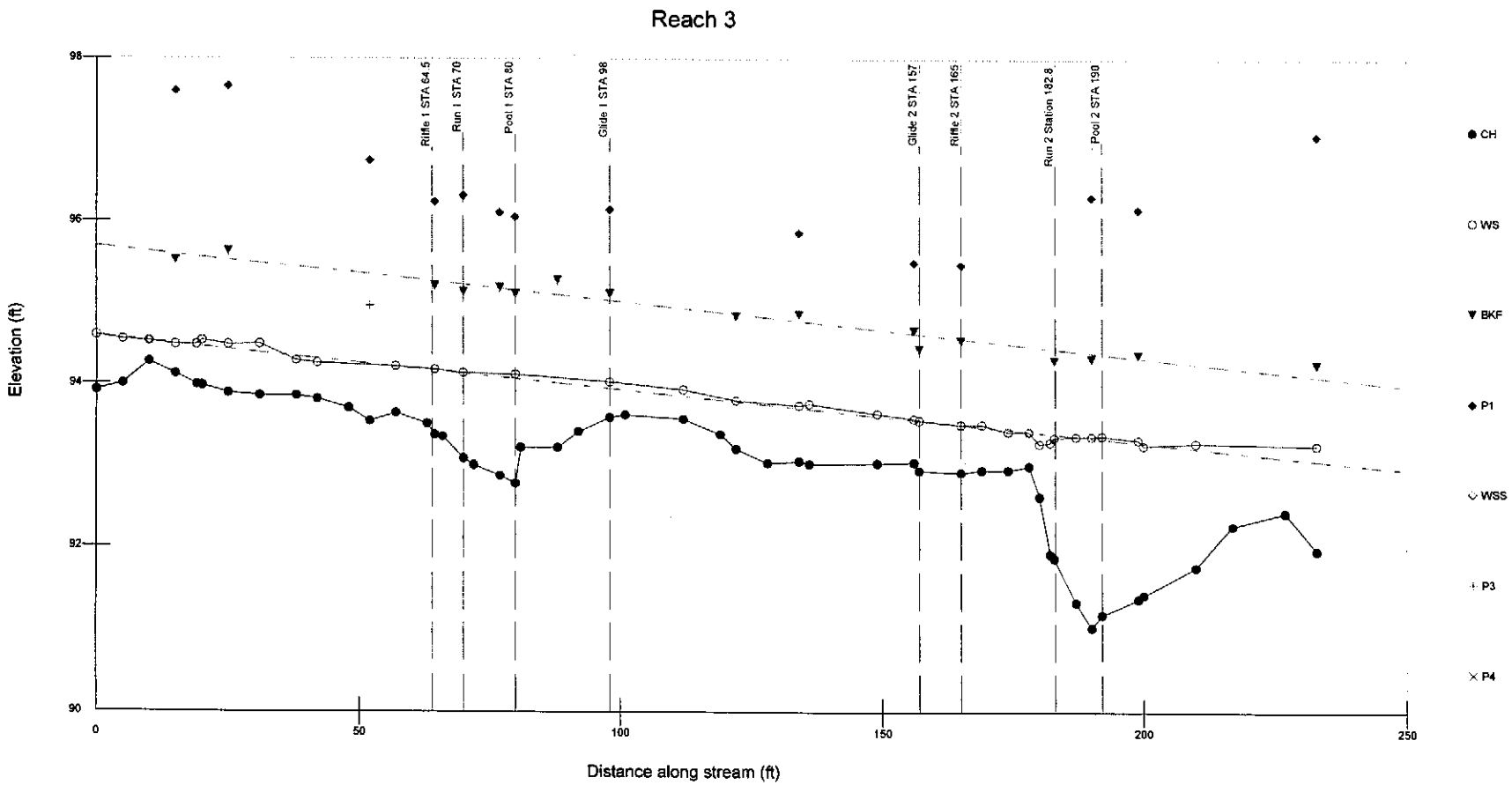
Belt width
45 ft
54 ft
45 ft

Sinuosity
1.15 - F
1.28 - C

	Min	Max	average
valley length:	162	363	262.5
Meander length:	208	586	397
linear wavelen:	127	162	144.5
Radius of curve:	60	98.5	78.67
arc length:	24	92	66.3
belt width:	45	54	48
Sinuosity:	1.15	1.28	1.215

too long because inc. entire reach which was not same stream type.


Long Pro
Elevation (ft)
Distance along stream (ft)
Riffle 1 STA 64.5
Run 1 STA 70
Pool 1 STA 80
Glide 1 STA 98
Glide 2 STA 157
Riffle 2 STA 165
Run 2 Station 182.8
Pool 2 STA 190
CH
WS
BKF
P1
XS TW
XS WS
XS BF


Reach 3
Elevation (ft)
98
96
94
92
90
0
50
100
150
200
250
Distance along stream (ft)
Riffle 1 STA 64.5
Run 1 STA 70
Pool 1 STA 80
Glide 1 STA 98
Glide 2 STA 157
Riffle 2 STA 165
Run 2 Station 182.8
Pool 2 STA 190
CH
WS
BKF
P1
WSS
P3
P4

SURVEY DATA ⟶ **LONGITUDINAL PROFILE 2**

SITE: Marsh Run @ Grimes Date: 4/16/15

Location: Reach #3

Party / Notes: Team #3 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	
28	00+00	1.78	101.78										
29	00+00			7.86	93.92	7.19	94.59					RIFFLE	
30	00+05			7.78		7.24							
31	00+10			7.51		7.26							
32	00+15			7.66		7.30		6.26		4.18			
33	00+19			7.79		7.30							
34	00+20			7.80		7.25							
35	00+25			7.89		7.30		6.15		4.12			
36	00+31			7.92		7.29							
37	00+38			7.92		7.49							
38	00+42			7.96		7.52							
39	00+48			8.07		7.68							
40	00+52			8.23		7.69		6.82		5.03			X-SECTION
41	00+57			8.13		7.56							
42	00+63			8.26		7.64							
43	00+64.5			8.40		7.65		6.58		5.54			X-SECTION
44	00+66			8.42		7.71						RUN	
45	00+70			8.69		7.62		6.65		5.46			X-SECTION
46	00+72			8.77		7.69							
47	00+77			8.90		7.61		6.80		5.67		POOL	
48	00+80			9.00		7.63		6.67		5.72			X-SECTION
49	00+81			8.56		7.59							
50	00+88			8.56		7.59		6.51				GLIDE	
51	00+92			8.36		7.62							
52	00+98			8.18		7.75		6.67		5.63			X-SECTION
53	01+01			8.15		7.69						RIFFLE	
54	01+12			8.20		7.94							

DIFFERENCE 1.2 TEAM 4

00+21 – 00+45 LSP LDB

CSP RDB 00+77 – 00+81

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 3**

SITE: Marsh Run Date: 4/16/15

Location: Reach #3

Party / Notes: Team 3 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	
55	01+19			8.39		8.06						RIFFLE	
56	01+22			8.57		7.97		6.94					
57	01+28			8.74		8.12							
58	01+34			8.72		8.03		6.92		5.91		RUN	?
59	01+36			8.75		8.01						RUN	?
60	01+49			8.74		8.13						Glide ~~RIFFLE~~	
61	01+56			8.73		8.19		7.11		6.28		Glide	
62	01+65			8.85		8.26		7.23		6.31		riffle	X-SECTION
63	01+69			8.82		8.26							
64	01+74			8.82		8.35							
65	01+78			8.77		8.35							
66	01+80			9.15		8.50						RUN	
67	01+82			9.85		8.48							~~XS-Run~~
68	01+87			10.44		8.41						POOL	
69	01+90			10.75		8.41		7.45		5.47			
70	01+92			10.59		8.40							XS-Pool
71	01+99			10.40		8.45	93.33	7.40		5.62		Glide?	
72	02+00			10.35		8.52							
73	02+10			10.01		8.49							
74	02+17			9.51		8.40						Glide	
75	02+27			9.34		8.41						Glide	
76	02+33			9.81		8.52		7.52		4.72		Pool	
77	02+39			10.07		8.57							
78	02+53			9.75		8.33							
79	02+69			9.65		8.42							
80	02+83			10.57		8.5							
81	02+99			9.43		8.49							

POCKET POOLS FOUND IN RIFFLE

DOT LCSP? OR ?

End of C
Start F

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 4**

SITE: Marsh Run Date: 4/16/15

Location: Reach #3

Party / Notes: Team 3 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
82	03+20			9.28		8.42		7.43		4.62		Pool
83	03+28			9.22		8.5						↓
84	03+43			11.45		8.45						
85	03+58			10.05		8.48						
86	~~[illegible]~~											
87	TP1'	1.78	101.53	1.53	100							
88	03+69			9.42		8.2		7.25		5.28		
89	04+10.3			9.83		8.23		7.09				
90	04+42			10.12		8.42		7.26		5.76		
91	04+53			9.97		8.43		7.41				
92	04+82			9.7		8.12						
93	04+85			9.11		8.31						check dam
94	05+16			9.98		8.74						Pool Plunge
95	05+37			9.82		8.72						check dam
96	05+66			10.44		9.3						Pool plunge
97	05+86			10.04		9.35	92.18					TR riffle
98												
99	~~[illegible]~~	1.53		3.68								~~Glide X-S~~
100	BM	3.68	103.68	1.53	100							
101	01+82.8			11.8	91.88	10.32		9.37				X-Section
102	01+57			10.73	92.95	10.09		9.23				X-Section
103	BM	3.66										
104												
105												
106	~~01+82.8~~			~~9.65~~		~~8.17~~		~~7.22~~				
107	~~01+57~~			~~8.58~~	~~95.1~~	~~7.96~~		~~7.08~~	~~96.6~~			
108												

TP2

3.68
-1.53
2.15

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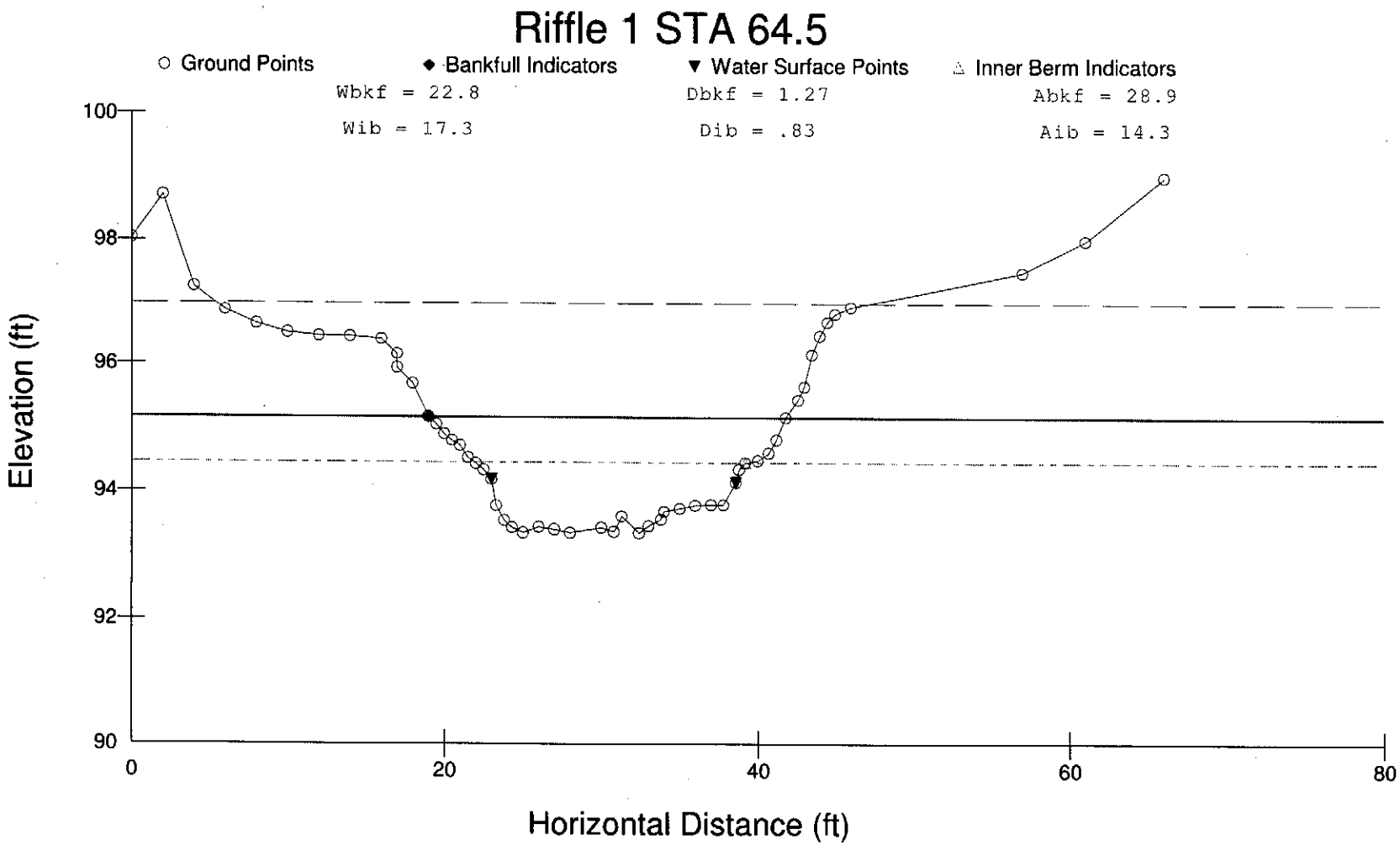
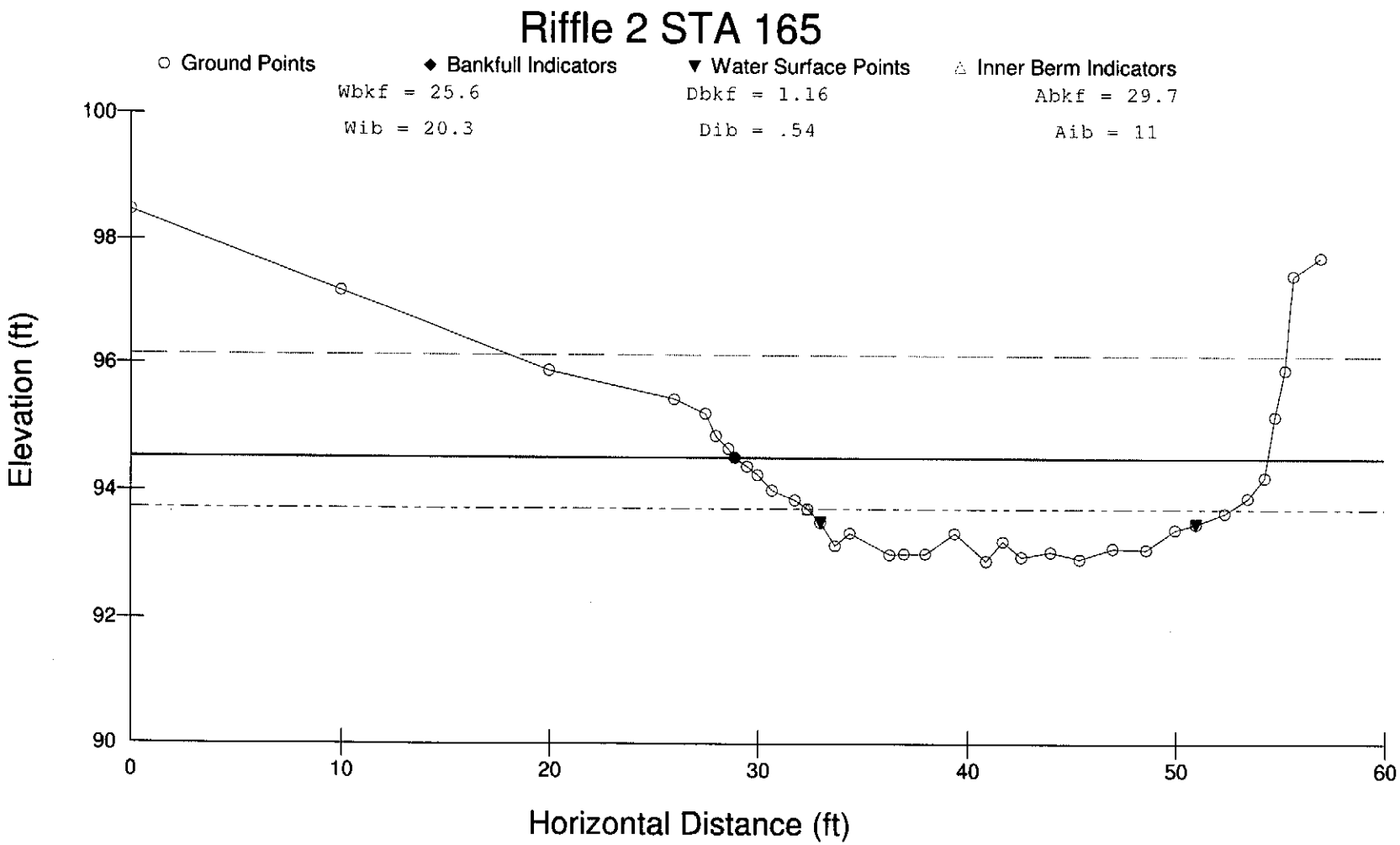
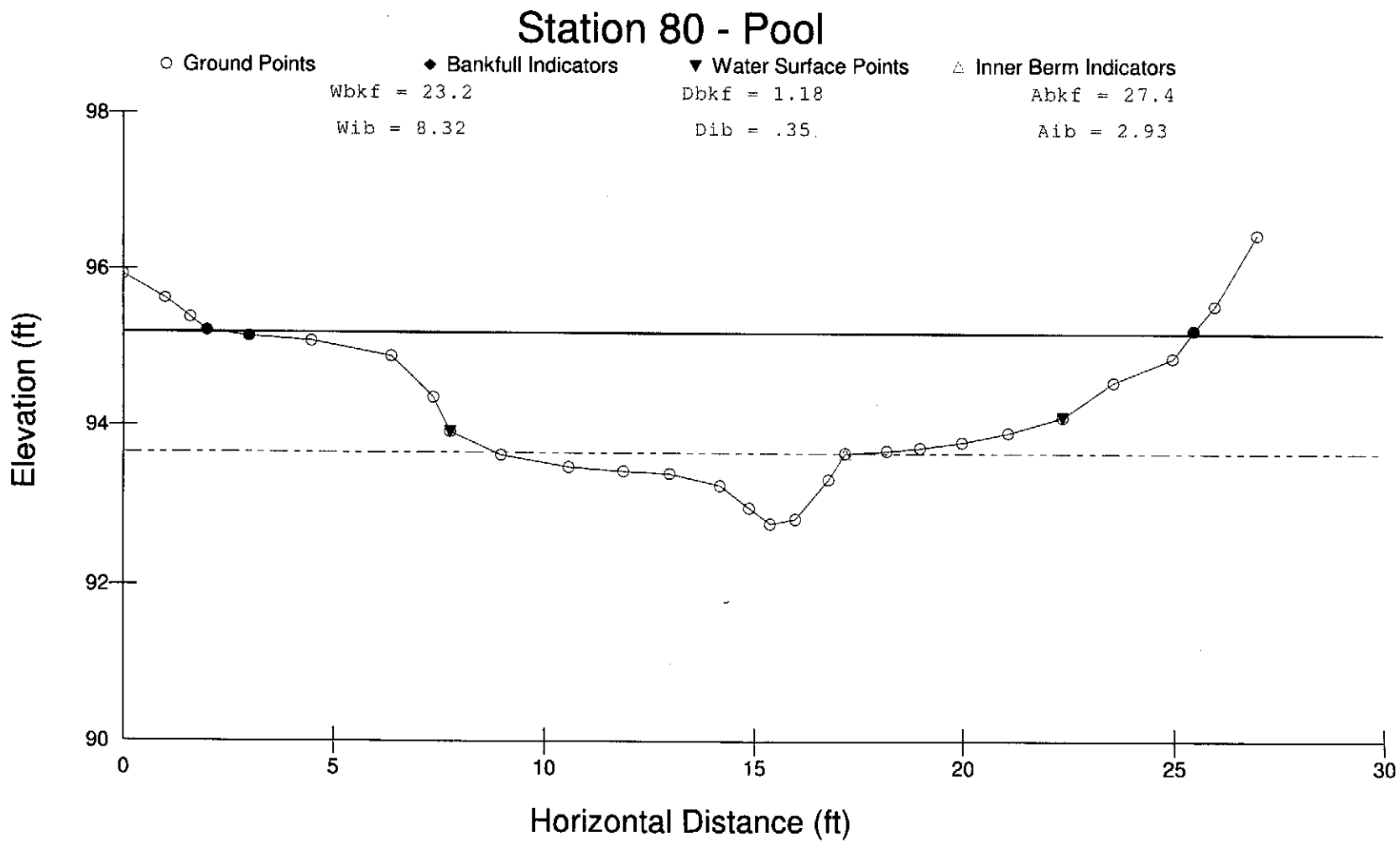
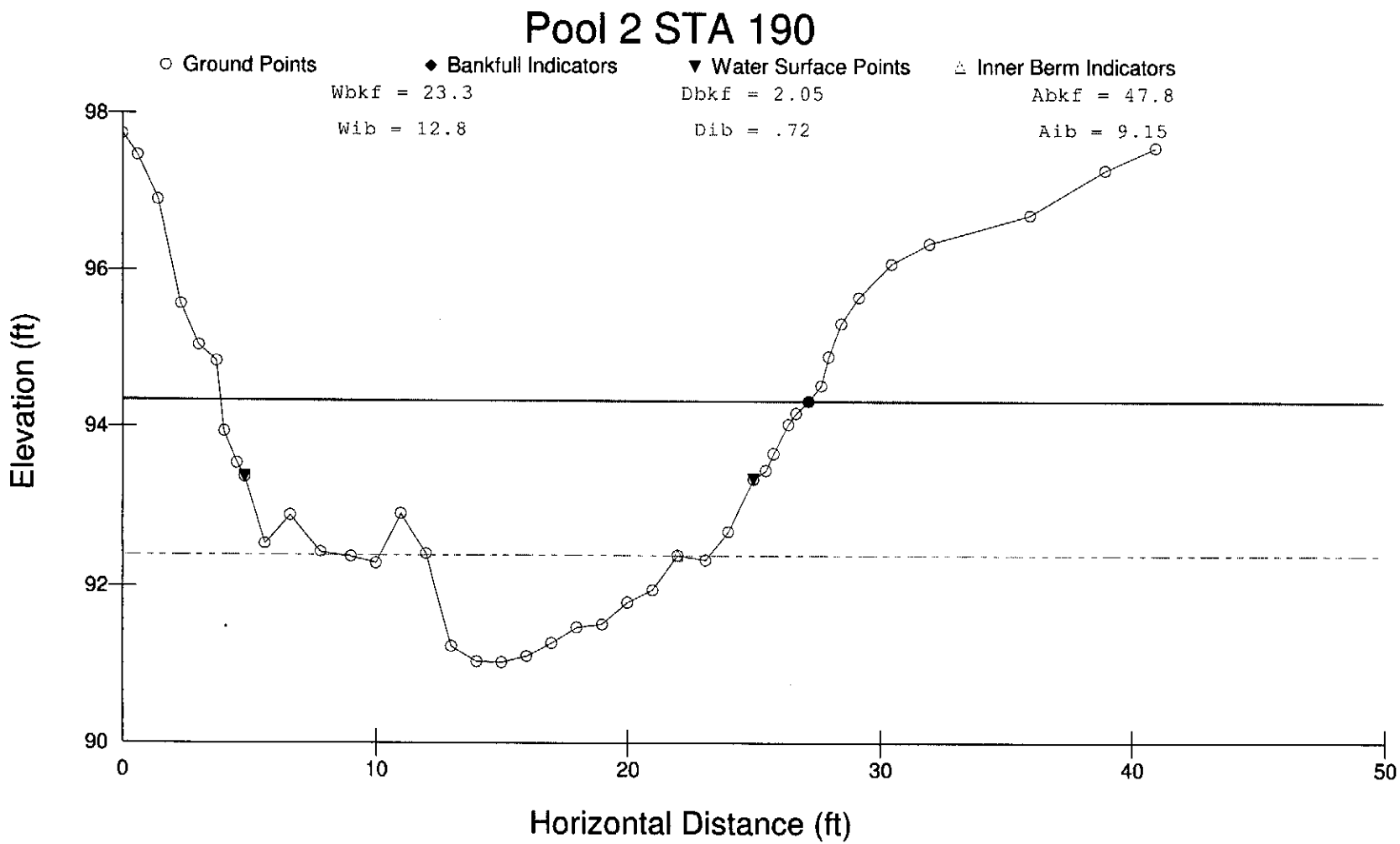
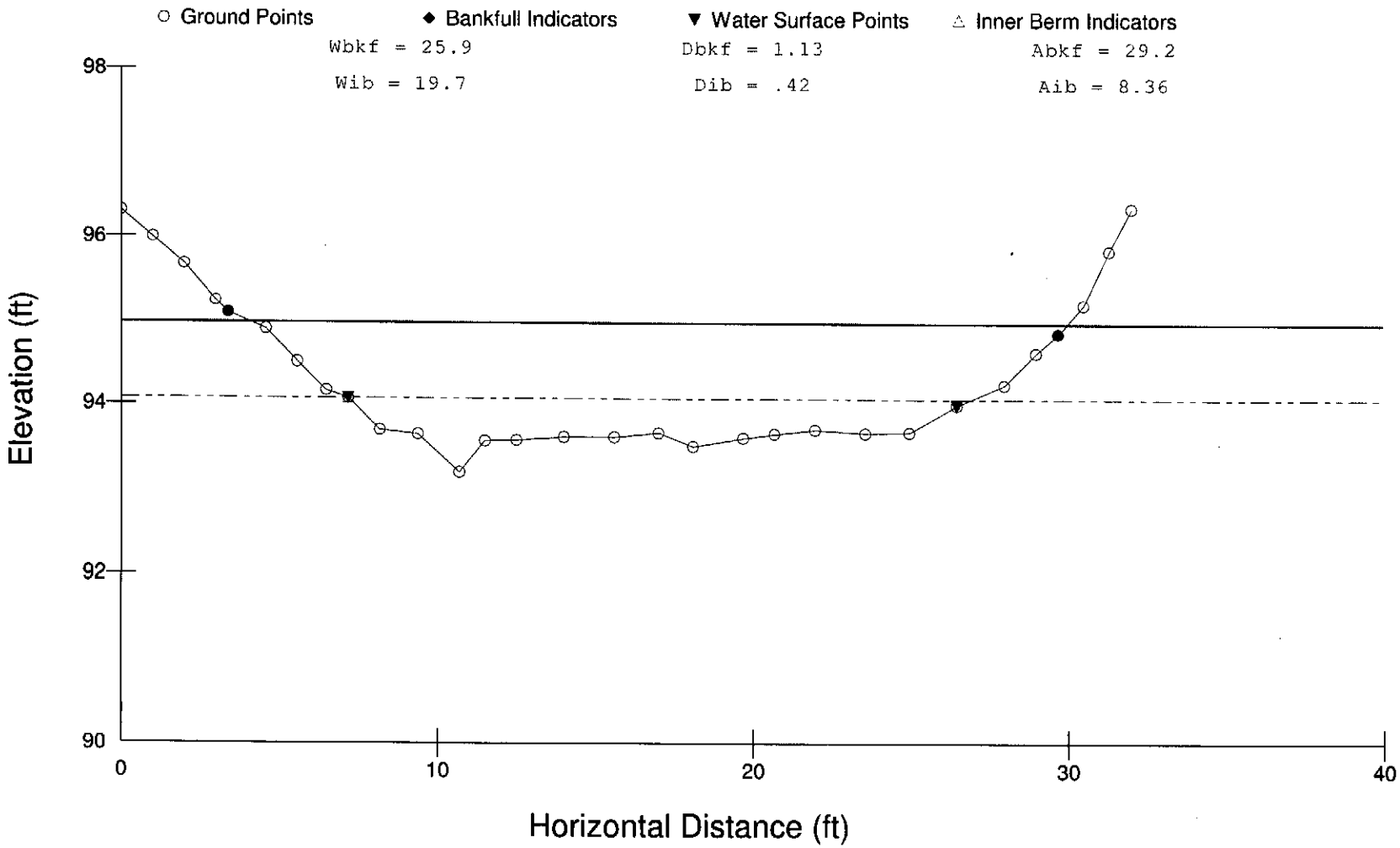

Riffle 1 STA 64.5
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 22.8
Wib = 17.3
Dbkf = 1.27
Dib = .83
Abkf = 28.9
Aib = 14.3
Elevation (ft)
100
98
96
94
92
90
0
20
40
60
80
Horizontal Distance (ft)

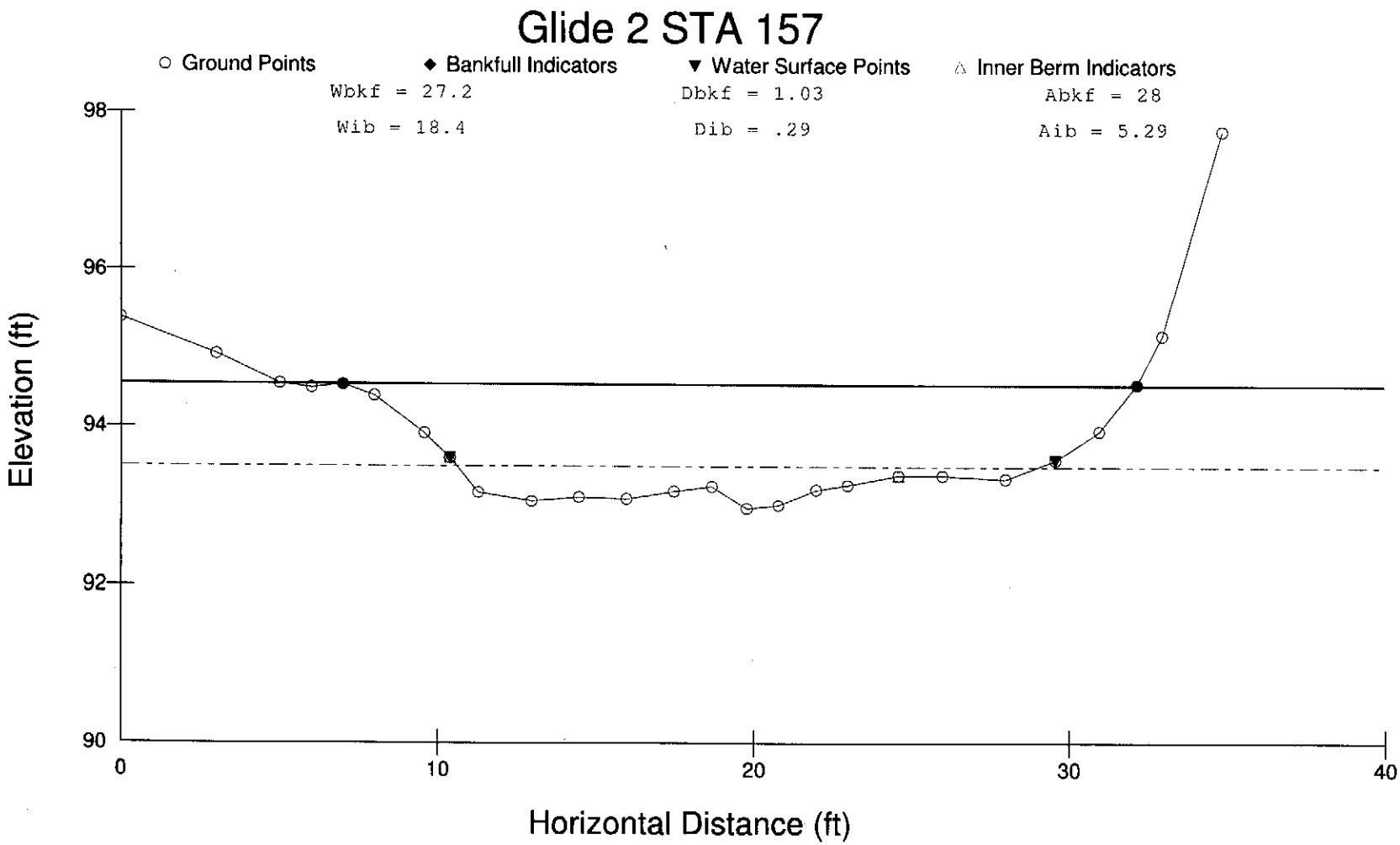

Riffle 2 STA 165
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 25.6
Wib = 20.3
Dbkf = 1.16
Dib = .54
Abkf = 29.7
Aib = 11
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
60
Horizontal Distance (ft)

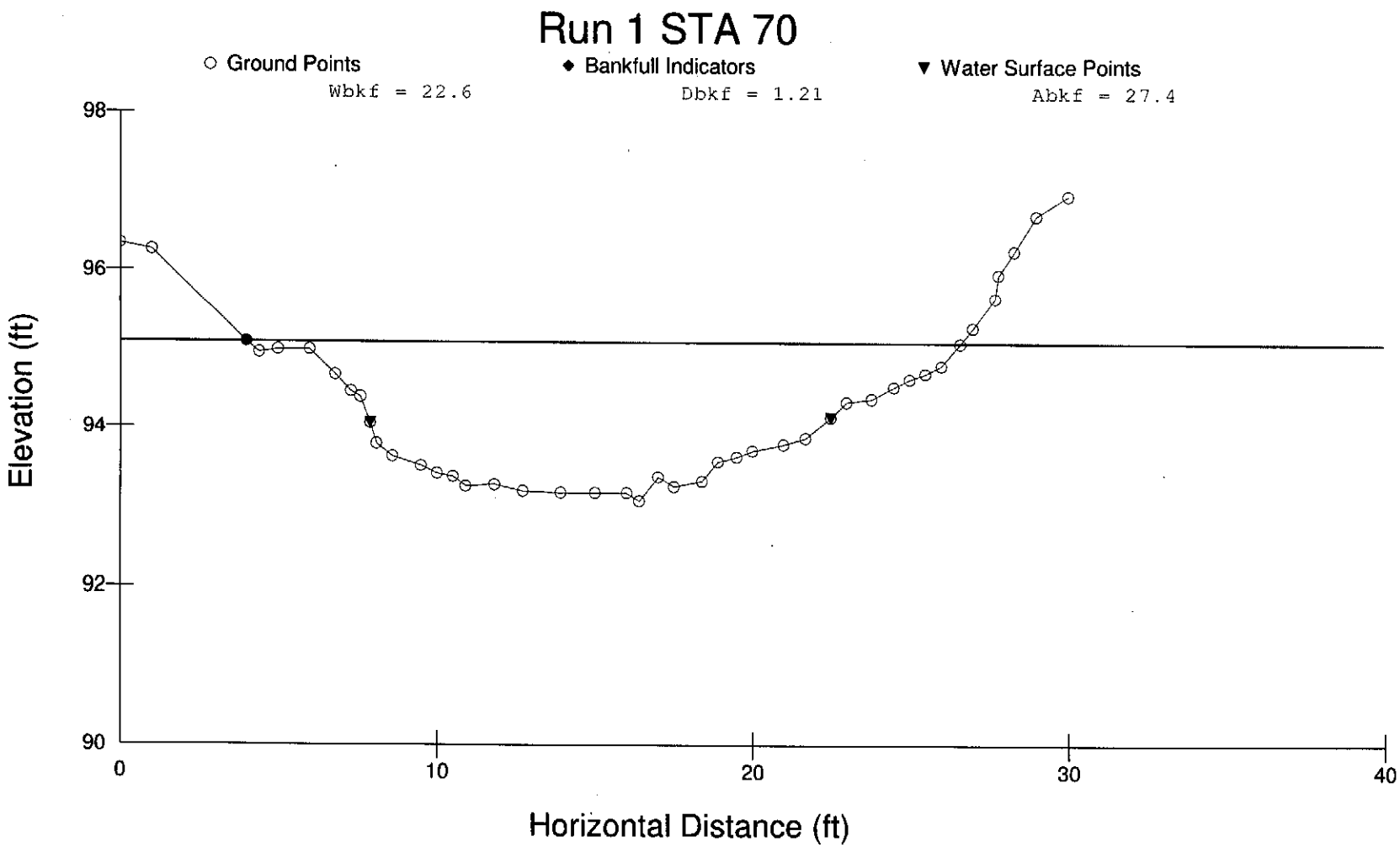

Station 80 - Pool
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 23.2
Wib = 8.32
Dbkf = 1.18
Dib = .35
Abkf = 27.4
Aib = 2.93
Elevation (ft)
98
96
94
92
90
0
5
10
15
20
25
30
Horizontal Distance (ft)

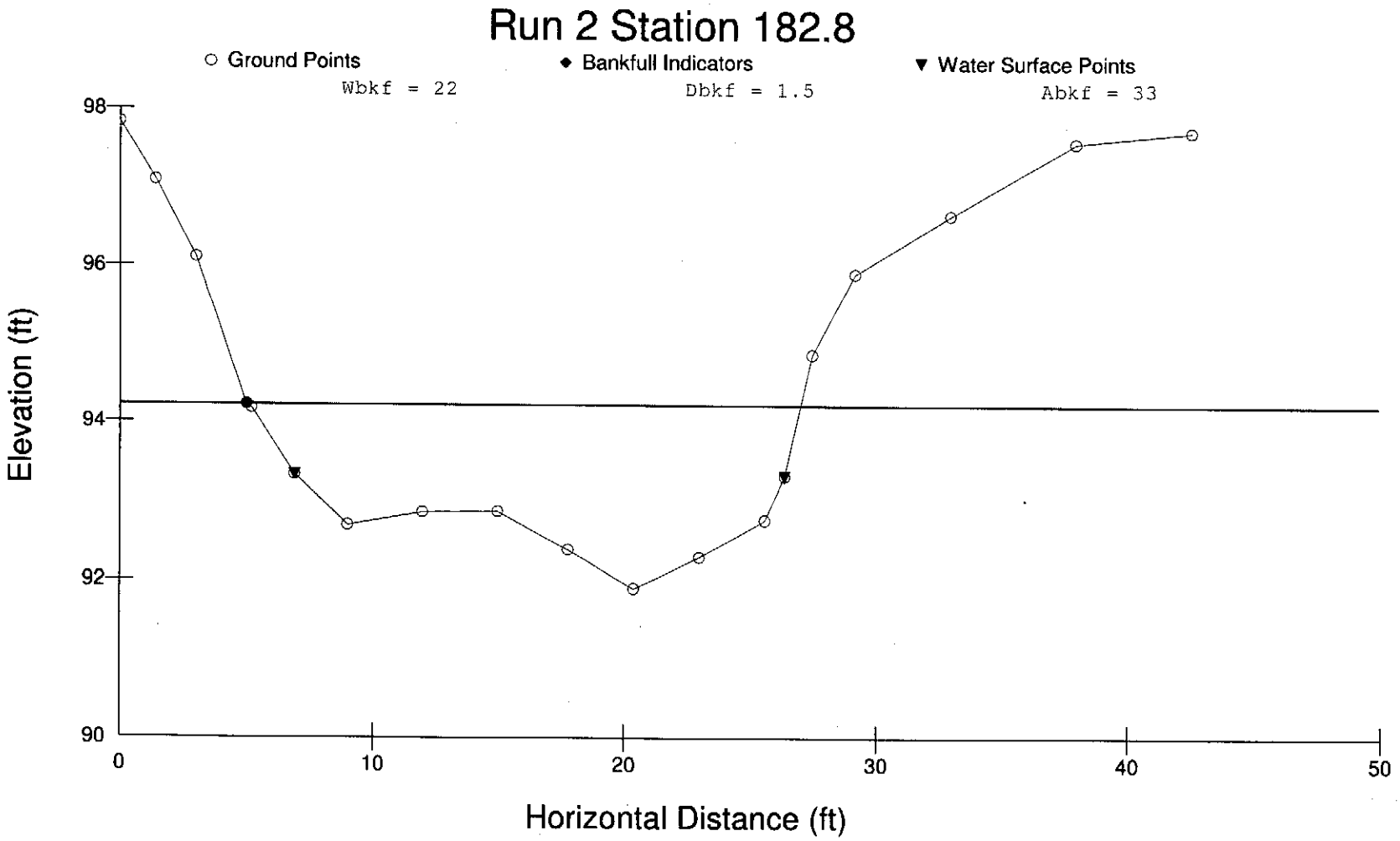

Pool 2 STA 190
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 23.3
Wib = 12.8
Dbkf = 2.05
Dib = .72
Abkf = 47.8
Aib = 9.15
Elevation (ft)
98
96
94
92
90
0
10
20
30
40
50
Horizontal Distance (ft)

Glide 1


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 25.9
Wib = 19.7
Dbkf = 1.13
Dib = .42
Abkf = 29.2
Aib = 8.36
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Glide 2 STA 157
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 27.2
Wib = 18.4
Dbkf = 1.03
Dib = .29
Abkf = 28
Aib = 5.29
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Run 1 STA 70
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22.6
Dbkf = 1.21
Abkf = 27.4
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Run 2 Station 182.8
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22
Dbkf = 1.5
Abkf = 33
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

SURVEY DATA → CROSS - SECTION 1

SITE: Team 3 (Marsh Run @ Grimes) Date: 4-16-15

Location: Reach 3 @ STATION 64.5

Party / Notes: Riffle #1 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	0.96	100.96		100.00	Benchmark/Rock
2	0+00			2.93		
3	2			2.25		
4	4			3.71		
5	6			4.10		
6	8			4.32		
7	10			4.46		
8	12			4.51		
9	14			4.52		
10	16			4.56		LOWBANK?
11	17			4.80		
12	17.50			5.02		
13	18			5.27		
14	19			5.80		BANKFULL?
15	19.50			5.92		
16	20			6.07		
17	20.5			6.17		
18	21			6.25		
19	21.5			6.44		
20	22			6.53		
21	22.5			6.63		
22	23			6.78		LEWATER
23	23.3			7.19		
24	23.8			7.43		
25	24.3			7.54		
26	25			7.62		
27	26			7.53		
28	27			7.57		

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SURVEY DATA ⟹ **CROSS - SECTION** 5 St 165

SITE: XSEC Riffle #2 Team # 3 Date: 4-16-15

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	BM	2.95	102.95		100.00	Benchmark
30	0+00			4.48		Floodplain Area
31	10			5.77		
32	20			7.05		
33	26			7.50		TOP OF LOW BANK
34	27.5			7.73		
35	28			8.08		
36	28.6			8.28		
37	28.9			8.42		BKFull
38	29.5			8.56		
39	30			8.69		
40	30.7			8.93		
41	31.8			9.08		
42	32.4			9.22		
43	33			9.43		LE WATER
44	33.7			9.80		
45	34.4			9.60		
46	36.3			9.94		
47	37			9.93		
48	38			9.93		
49	39.4			9.60		
50	40.9			10.04		Thalweg
51	41.7			9.73		
52	42.6			9.98		
53	44			9.90		
54	45.4			10.01		
55	47			9.84		
56	48.6			9.86		
57	50			9.54		
58	51			9.45		RE WATER
59	52.4			9.28		

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TEAM #3 Marsh Run @ Grimes 4/16/15

SURVEY DATA ⟹ **CROSS - SECTION** 1

SITE: Team #3 Date: 4-16-15

Location: Reach 3 @ Station 182.8

Party / Notes: Run 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)	2.69	102.69		100	Benchmark
2	0.0	.36		4.86		
3	1.4	5.65		5.60		Top of Bank
4	3.0	6.		6.58		
5	5.0			8.46		Bankfull
6	5.2			8.51		
7	6.9			9.36		Edge LE Water
8	9.0			10.0		
9	12.0			9.84		
10	15.0			9.83		
11	17.8			10.31		
12	20.4			10.79		T Thalweg
13	23.0			10.40		
14	25.6			9.93		
15	26.4			9.37		Edge RE Water
16	27.5			7.81		Top of Bank
17	29.2			6.78		
18	33.0			6.03		
19	38.0			5.11		
20	42.6			4.96		
21						
22						
23						
24						
25						
26						
27						
28						

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SURVEY DATA ⟹ **CROSS - SECTION 2** RUN XSEC

SITE: ST. 70 → RUN XSEC #1 Team #3 **Date:** 4-16-15

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	Bm	0.96	100.96		100	Benchmark
30	0			4.62		Top of LBank
31	1			4.70		
32	4			5.87		Bankfull ✓
33	4.4			6.01		
34	5			5.97		
35	6			5.97		
36	6.8			6.29		
37	7.3			6.5		
38	7.6			6.57		
39	7.9			6.90		LE WATER
40	8.1			7.16		
41	8.6			7.32		
42	9.5			7.44		
43	10			7.54		
44	10.5			7.58		
45	10.9			7.70		
46	11.8			7.68		
47	12.7			7.76		
48	13.9			7.78		
49	15			7.78		
50	16			7.78		
51	16.4			7.88		thalweg
52	17.0			7.58		
53	17.5			7.70		
54	18.4			7.63		
55	18.9			7.38		
56	19.5			7.32		
57	20			7.24		
58	21			7.16		
59	21.7			7.08		

(Pool ST80 (4.62) 98)

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SURVEY DATA ⟹ **CROSS - SECTION** 3

SITE: Pool #1 ST 80 Date: 4-16-15

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	BM	0.96	100.96		100	
30	0			5.03		Top Low Bank
31	1			5.34		
32	1.6			5.59		
33	2.0			5.76		BF
34	3.0			5.83		BF ?
35	4.5			5.89		
36	6.4			6.08		
37	7.4			6.60		
38	7.8			7.04		LEW
39	9.0			7.33		
40	10.6			7.48		
41	11.9			7.53		
42	13.0			7.56		
43	14.2			7.71		
44	14.9			7.99		
45	15.4			8.19		TW
46	16.0			8.13		
47	16.8			7.63		
48	17.2			7.30		
49	18.2			7.27		
50	19.0			7.23		
51	20.0			7.16		
52	21.1			7.04		
53	22.4			6.84		REW
54	23.6			6.40		
55	25.0			6.09		
56	25.5			5.74		BF
57	26.0			5.42		
58	27.0			4.50		
59						

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LONG PRO
ST
191.5

SURVEY DATA ⟹ **CROSS - SECTION** 6

SITE: Pool #2 Team #3 Date:

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	2.95	102.95		100	Benchmark
30	0			5.21		Top of High Bank
31	0.6			5.48		
32	1.4			6.05		
33	2.3			7.39		
34	3			7.92		
35	3.7			8.12		
36	4			9.01		
37	4.5			9.41		
38	4.8			9.58		LE WATER
39	5.6			10.42		
40	6.6			10.06		
41	7.8			10.53		
42	9			10.59		
43	10			10.67		
44	11			10.04		
45	12			10.55		
46	13			11.72		
47	14			11.92		
48	15			11.93		Thalweg
49	16			11.85		
50	17			11.68		
51	18			11.48		
52	19			11.44		
53	20			11.16		
54	21			11.00		
55	22			10.57		
56	23.1			10.63		
57	24			10.26		
58	25			9.60		RE WATER
59	25.5			9.49		

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SURVEY DATA → **CROSS - SECTION 4**

SITE: ST98 - Glide XS (Marsh Run Grimes) **Date:** 4/16/15

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	0.96	100.96		100	
30	0			4.65		TOP LOW BANK
31	1			4.97		
32	2			5.29		
33	3			5.73		
34	3.4			5.88		BF
35	4.6			6.07		
36	5.6			6.46		
37	6.5			6.80		
38	7.2			6.89		LEW
39	8.2			7.26		
40	9.4			7.31		
41	10.7			7.76		
42	11.5			7.39		
43	12.5			7.38		
44	14.0			7.34		
45	15.6			7.34		
46	17.0			7.29		
47	18.1			7.45		TW
48	19.7			7.35		
49	20.7			7.30		
50	22.0			7.25		
51	23.6			7.29		
52	25.0			7.28		
53	26.5			6.96		REW
54	28.0			6.72		
55	29.0			6.34		
56	29.7			6.11		BF?
57	30.5			5.77		
58	31.3			5.12		
59	32.0			4.61		

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2nd H.I. TEAM #3 MARSH RUN @ GRIMES 4/16/15

SURVEY DATA ⟹ **CROSS - SECTION** 8

SITE: Glide #2, Team #3 Station 157 Date: 4-16-15

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	2.95	102.95			
30	0			7.58		
31	3			8.04		
32	5			8.41		
33	6			8.46		
34	7			8.42	94.53	BF
35	8			8.56		
36	9.6			9.03		
37	10.4			9.34		LEW
38	11.3			9.78		
39	13.0			9.89		
40	14.5			9.84		
41	16.0			9.86		
42	17.5			9.76		
43	18.7			9.70		
44	19.8			9.98	92.97	TW
45	20.8			9.94		
46	22.0			9.74		
47	23.0			9.68		
48	24.6			9.56		
49	26.0			9.56		
50	28.0			9.60		
51	29.6			9.36		REW
52	31.0			8.99		
53	32.2			8.40		BF
54	33.0			7.78		
55	34.9			5.17		
56						
57						
58						
59						

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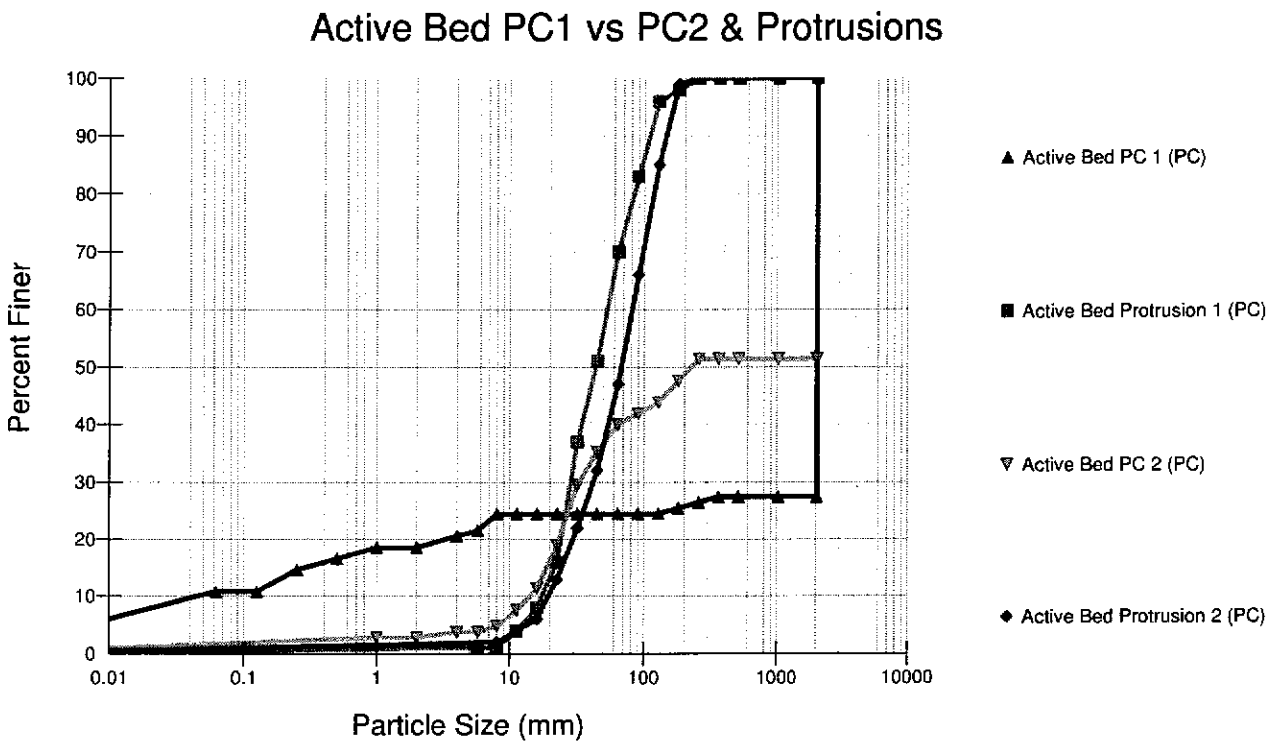
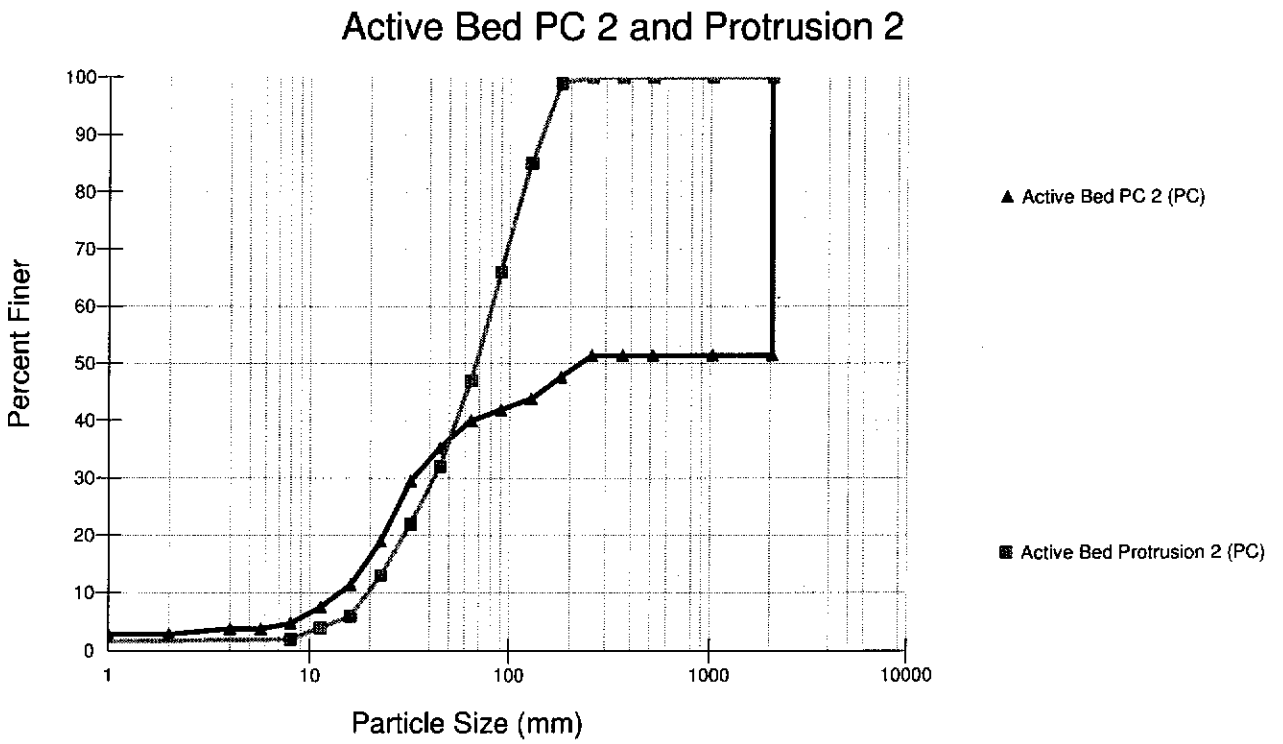
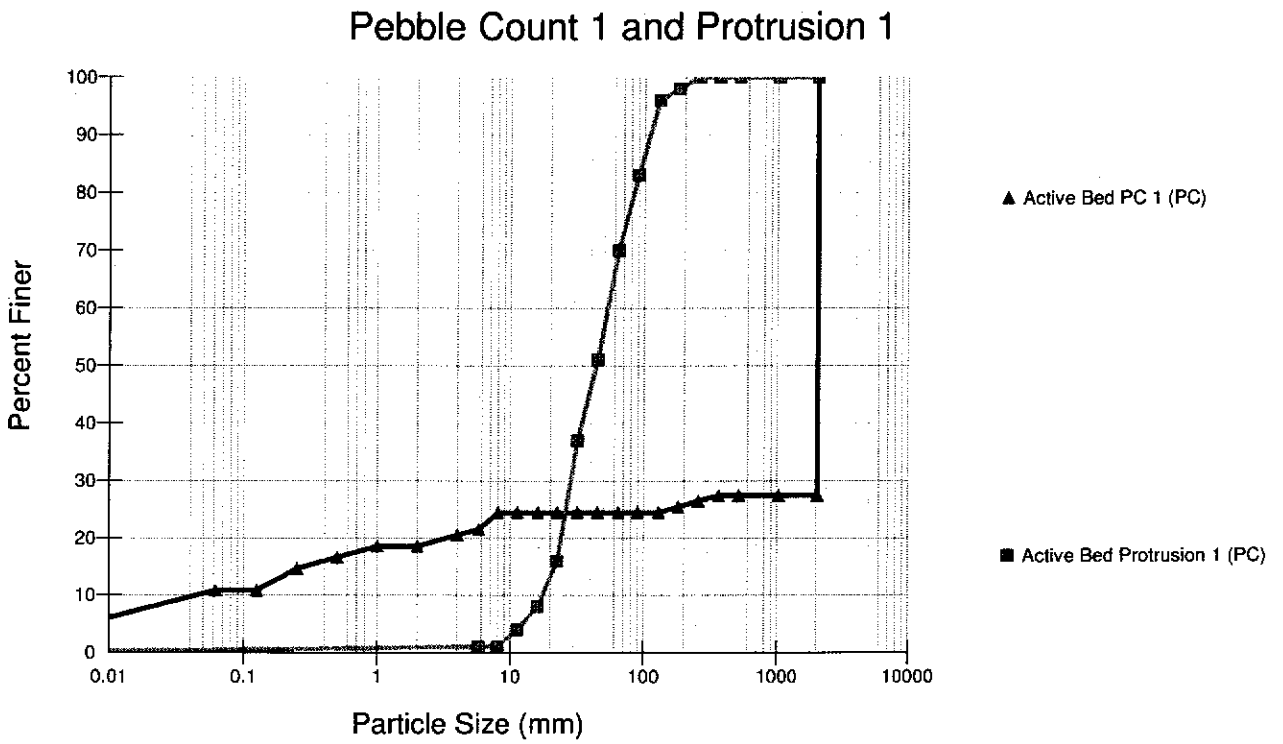
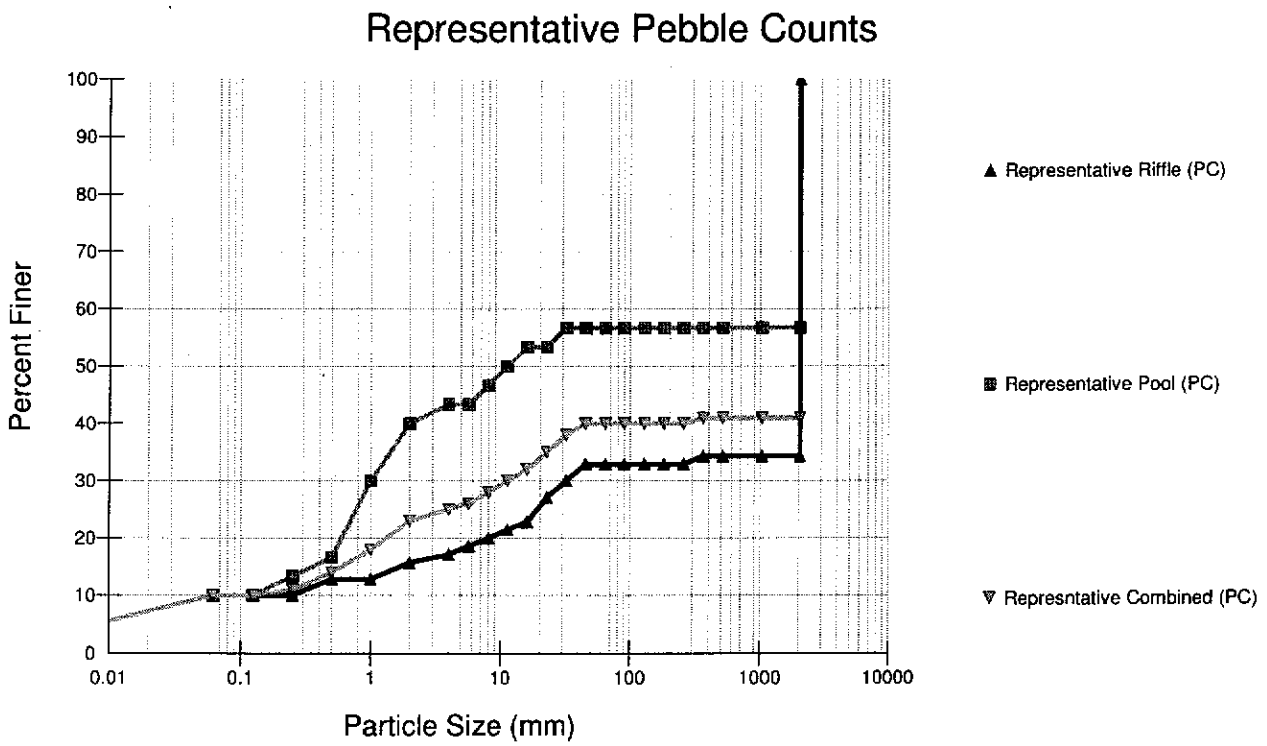

Active Bed PC1 vs PC2 & Protrusions
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Active Bed PC 1 (PC)
Active Bed Protrusion 1 (PC)
Active Bed PC 2 (PC)
Active Bed Protrusion 2 (PC)


Active Bed PC 2 and Protrusion 2
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
1
10
100
1000
10000
Particle Size (mm)
Active Bed PC 2 (PC)
Active Bed Protrusion 2 (PC)


Pebble Count 1 and Protrusion 1
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Active Bed PC 1 (PC)
Active Bed Protrusion 1 (PC)


Representative Pebble Counts
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Representative Riffle (PC)
Representative Pool (PC)
Represntative Combined (PC)

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TEAM #3 Marsh Run 2 Grines 4/16/15

River Morphology & Applications — Second Field Day Instructions & Forms

Site: Marsh Creek (Channel) Date: 4/16/15

Location: Reach 3 HUC:

Party: Team 3

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 70% 1	POOL 30% 2	COMP. 3	RIFFLE (1) Reach: Date: 4/16/15 TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C				7			3					
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25								1					
	Medium	.25 - .50					2			1					
	Coarse	.50 - 1.0								4					
.04 - .08	Very Coarse	1.0 - 2					2			3					
.08 - .16	Very Fine	2 - 4	GRAVEL				1			1					
.16 - .22	Fine	4 - 5.7					1								
.22 - .31	Fine	5.7 - 8					1			1					
.31 - .44	Medium	8 - 11.3					1			1					
.44 - .63	Medium	11.3 - 16					1			1					
.63 - .89	Coarse	16 - 22.6					3								
.89 - 1.3	Coarse	22.6 - 32					2			1					
1.3 - 1.8	Very Coarse	32 - 45					2								
1.8 - 2.5	Very Coarse	45 - 64													
2.5 - 3.5	Small	64 - 90	COBBLE												
3.5 - 5.0	Small	90 - 128													
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER				1								
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK				46			13					
Stream Type:			Valley Type:			TOTAL→	70			30					

TEAM #3 Marsh Run @ Grimes 4/16/15

River Morphology & Applications

Second Field Day Instructions & Forms

PROTRUSION HEIGHTS @ Active riffles

Site: Marsh Run at Grimes Date: 4/16/15

Location: Wash County MD HUC: 0+64.5 1+65

Party: Team 3

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	~~POOL~~ RIFFLE 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	11	Ø										
	Very Fine	.062 - .125	SAND	Ø	Ø										
	Fine	.125 - .25	SAND	4											
	Medium	.25 - .50	SAND	2											
	Coarse	.50 - 1.0	SAND	2	3										
.04 - .08	Very Coarse	1.0 - 2	SAND	Ø											
.08 - .16	Very Fine	2 - 4	GRAVEL	2	1										
.16 - .22	Fine	4 - 5.7	GRAVEL	1											
.22 - .31	Fine	5.7 - 8	GRAVEL	3	1										
.31 - .44	Medium	8 - 11.3	GRAVEL		3										
.44 - .63	Medium	11.3 - 16	GRAVEL		4										
.63 - .89	Coarse	16 - 22.6	GRAVEL		8										
.89 - 1.3	Coarse	22.6 - 32	GRAVEL		11										
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL		6										
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL		5										
2.5 - 3.5	Small	64 - 90	COBBLE		2										
3.5 - 5.0	Small	90 - 128	COBBLE		2										
5.0 - 7.1	Large	128 - 180	COBBLE	1 1	4										
7.1 - 10.1	Large	180 - 256	COBBLE	1 1	4										
10.1 - 14.3	Small	256 - 362	BOULDER	1 1											
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK	74	51										
Stream Type:			**Valley Type:**			TOTAL→»									

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Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Marsh Run Main	Location:	Reach - Reach 3
Date:	4/16/2015	Stream Type:	B1
Valley Type:	VIIIb		
Observers:	TEAM 3	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	28.94	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.27	d_{bkf} (ft)
Bankfull Riffle WIDTH	22.80	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	23.68	W_p (ft)
D_{84} at Riffle	92.92	Dia. (mm)	D_{84} (mm) / 304.8	0.30	D_{84} (ft)
Bankfull SLOPE	0.0068	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.22	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	4.00	R / D_{84}
Drainage Area	18.9	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.517	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	3.23	ft / sec	93.46	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.0402	3.49	ft / sec	100.89	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. 2-20) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.044	3.19	ft / sec	92.17	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 $n =$ 0.057	2.47	ft / sec	71.51	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	3.37	ft / sec	97.48	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Chezy C	0.00	ft / sec	0.00	cfs
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = 2.0 year	3.46	ft / sec	100.00	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	3.85	ft / sec	111.50	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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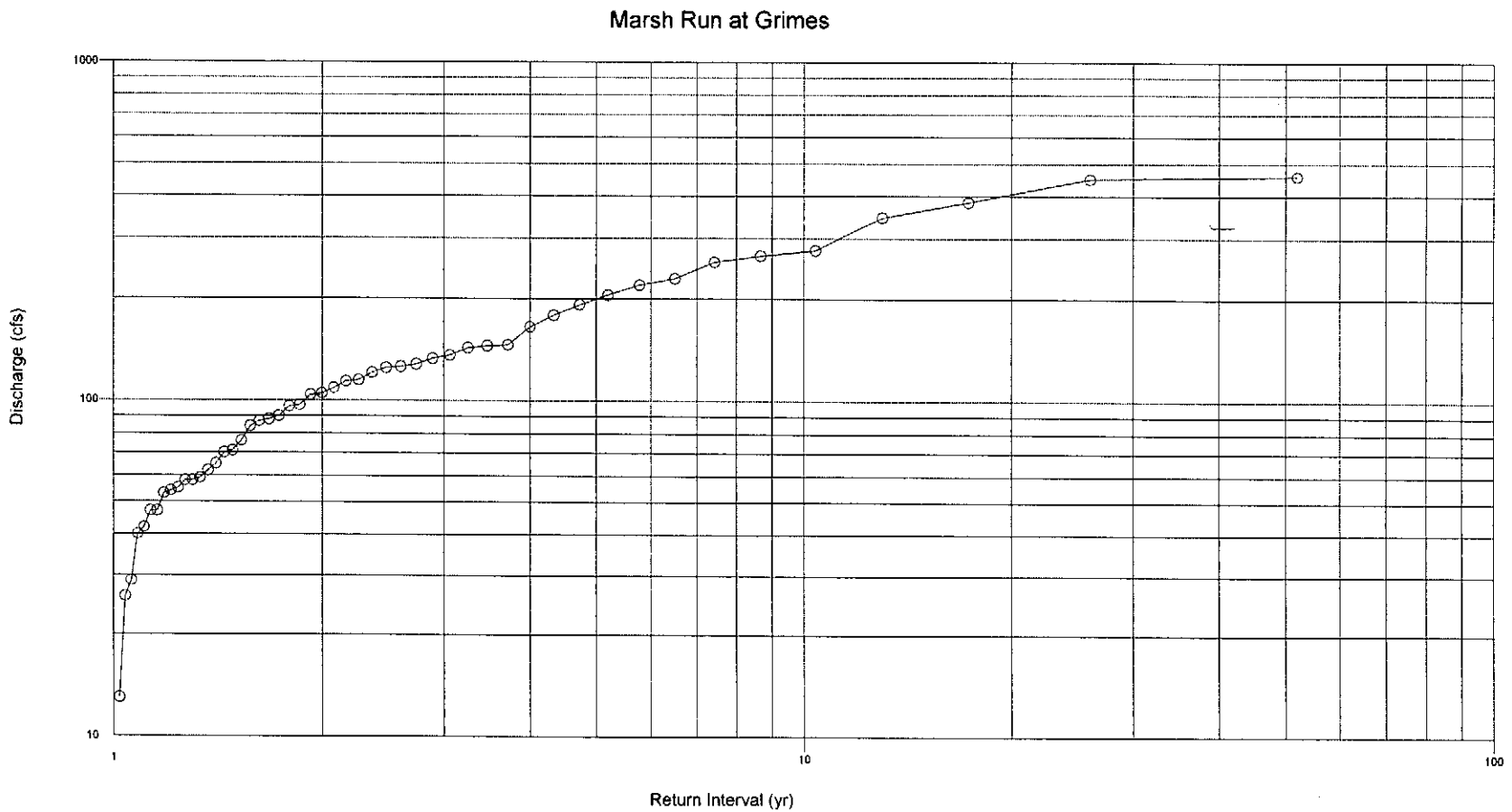
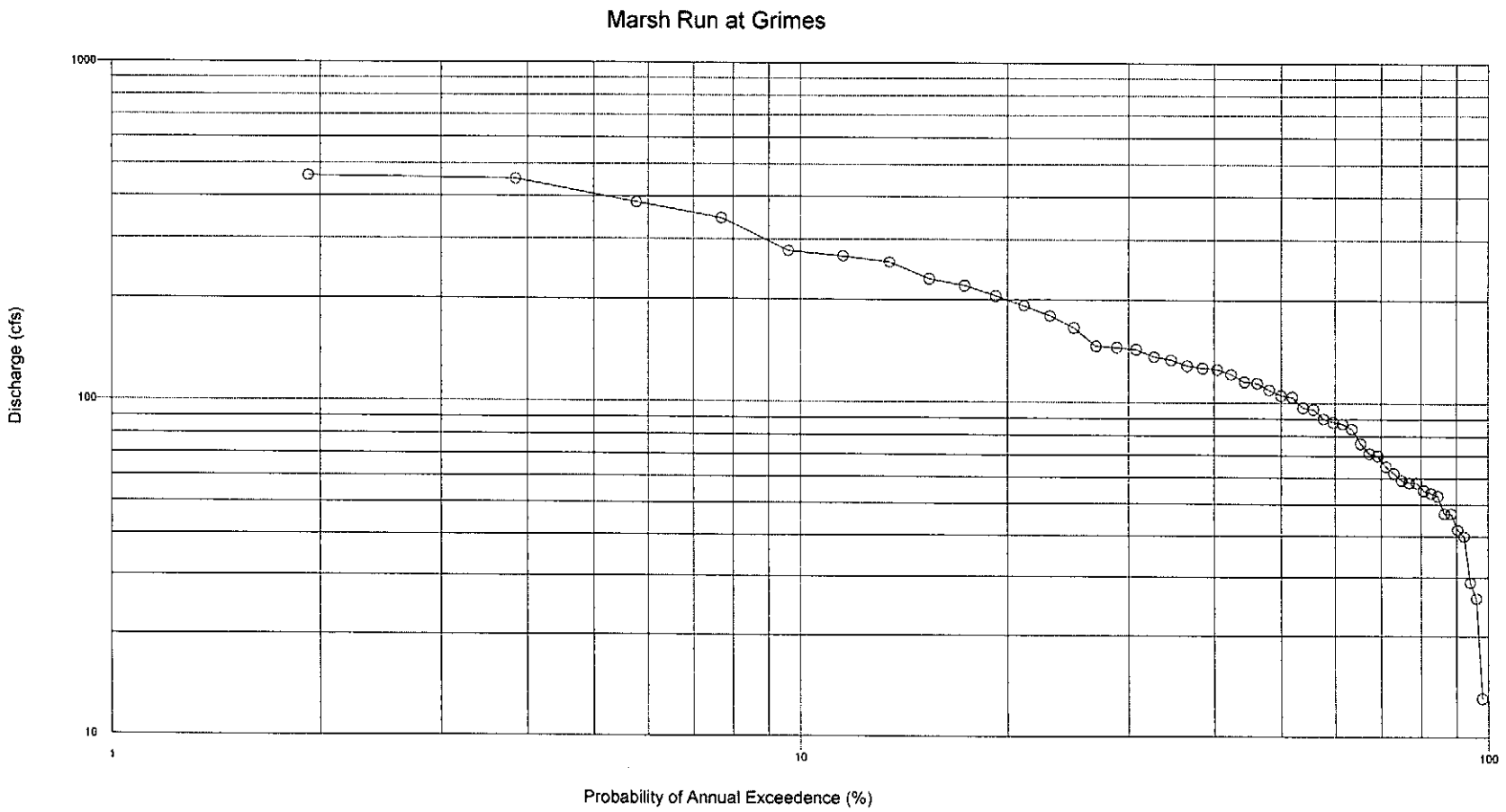
1.07


Marsh Run at Grimes
1000
100
10
Discharge (cfs)
1
10
100
Return Interval (yr)


Marsh Run at Grimes
1000
100
10
Discharge (cfs)
1
10
100
Probability of Annual Exceedence (%)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Marsh Run Main, Reach - Reach 3**		
Basin:	Drainage Area: **12096** acres	**18.9**	mi^2
Location:			
Twp.&Rge: ;	Sec.&Qtr.: ;		
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**	Date: **04/16/15**	
Observers: **TEAM 3**		Valley Type: VIIIb	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**22.8**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.27**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**28.94**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**17.95**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**1.82**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**41.77**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.83**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**2048**	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.	**0.0068**	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 (VS / S).	**1.28**	

Stream Type **B 1c** (See **Figure 2-14**)

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Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run Main** Location: **Reach - Reach 3**

Observers: **TEAM 3** Date: **04/16/15** Valley Type: **VIIIb** Stream Type: **B 1c**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	22.8	22.8	25.6	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	28.94	28.94	29.72
Mean Riffle Depth (d_{bkf})	1.27	1.16	1.27	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	19.99	17.95	22.03
Maximum Riffle Depth (d_{max})	1.72	1.62	1.82	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.415	1.397	1.433
Width of Flood-Prone Area (W_{fpa})	39.5	37.3	41.8	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.646	1.460	1.832
Riffle Inner Berm Width (W_{ib})	18.8	17.3	20.3	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.776	0.759	0.793
Riffle Inner Berm Depth (d_{ib})	0.69	0.54	0.83	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.560	0.469	0.650
Riffle Inner Berm Area (A_{ib})	12.7	11	14.3	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.433	0.371	0.494
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	29.1	21	37.3					

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	23.3	23.2	23.3	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	1.020	1.016	1.023
Mean Pool Depth (d_{bkfp})	1.62	1.18	2.05	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.276	0.929	1.614
Pool Cross-Sectional Area (A_{bkfp})	37.6	27.4	47.8	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.299	0.946	1.652
Maximum Pool Depth (d_{maxp})	2.86	2.41	3.31	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.252	1.898	2.606
Pool Inner Berm Width (W_{ibp})	10.6	8.32	12.8	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.454	0.359	0.548
Pool Inner Berm Depth (d_{ibp})	0.53	0.35	0.72	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.324	0.299	0.349
Pool Inner Berm Area (A_{ibp})	6.04	2.93	9.15	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.149	0.107	0.191
Point Bar Slope (S_{pb})	0.351	0.286	0.415	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	20.74	17.87	23.61

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	22.3	22	22.6	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.979	0.967	0.992
Mean Run Depth (d_{bkfr})	1.36	1.21	1.5	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.071	0.953	1.181
Run Cross-Sectional Area (A_{bkfr})	30.2	27.4	33.1	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	1.045	0.947	1.142
Maximum Run Depth (d_{maxr})	2.17	2.01	2.33	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.709	1.583	1.835
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	16.7	14.7	18.7	ft				

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	26.5	25.8	27.2	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	1.162	1.132	1.192
Mean Glide Depth (d_{bkfg})	1.08	1.03	1.12	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.850	0.811	0.882
Glide Cross-Sectional Area (A_{bkfg})	28.5	28	28.9	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	0.984	0.968	0.999
Maximum Glide Depth (d_{maxg})	1.67	1.57	1.76	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.315	1.236	1.386
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	24.7	23	26.4	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	48.52	46.60	50.45
Glide Inner Berm Width (W_{ibg})	19.5	19.3	19.7	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.737	0.709	0.765
Glide Inner Berm Depth (d_{ibg})	0.4	0.38	0.42	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.375	0.371	0.378
Glide Inner Berm Area (A_{ibg})	7.86	7.37	8.36	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.276	0.263	0.289

Step**	Mean	Min	Max		Step Dimensionless Ratios****	Mean	Min	Max
Step Width (W_{bkfs})	0	0	0	ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})	0.000	0.000	0.000
Mean Step Depth (d_{bkfs})	0	0	0	ft	Mean Step Depth to Riffle Depth (d_{bkfs} / d_{bkf})	0.000	0.000	0.000
Step Cross-Sectional Area (A_{bkfs})	0	0	0	ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})	0.000	0.000	0.000
Maximum Step Depth (d_{maxs})	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	0.000	0.000	0.000
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})	0	0	0					

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

****Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run Main**		Location: **Reach - Reach 3**	
Observers: **TEAM 3**	Date: **04/16/15**	Valley Type: **VIIIb**	Stream Type: **B 1c**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	3.486	ft/sec	Estimation Method	Manning's	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	100.885	cfs	Drainage Area	18.9	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	145	127	162	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	6.338	5.570	7.105
Stream Meander Length (L_m)	397	208	586	ft	Stream Meander Length Ratio (L_m / W_{bkf})	17.41	9.12	25.70
Radius of Curvature (R_c)	78.7	60	98.5	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	3.450	2.632	4.320
Belt Width (W_{blt})	48	45	54	ft	Meander Width Ratio (W_{blt} / W_{bkf})	2.105	1.974	2.368
Arc Length (L_a)	66.3	24	92	ft	Arc Length to Riffle Width (L_a / W_{bkf})	2.908	1.053	4.035
Riffle Length (L_r)	33.9	20.1	57.6	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	1.486	0.882	2.525
Individual Pool Length (L_p)	20.3	17.7	23	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.892	0.775	1.008
Pool to Pool Spacing (P_s)	63.3	58.9	67.6	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	2.774	2.582	2.967

Channel Profile

Valley Slope (S_{val})	0.0087	ft/ft	Average Water Surface Slope (S)	0.0068	ft/ft	Sinuosity (S_{val} / S)	1.28	
Stream Length (SL)	208	ft	Valley Length (VL)	162	ft	Sinuosity (SL / VL)	1.28	
Low Bank Height (LBH) start	2.87	ft	Max Depth (d_{max}) start	1.85	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start	1.55	
Low Bank Height (LBH) end	4.7	ft	Max Depth (d_{max}) end	2.89	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) end	1.63	

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.007	0.007	0.008	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	1.091	0.976	1.237
Run Slope (S_{run})	0.041	0.007	0.075	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	6.082	1.072	11.09
Pool Slope (S_p)	0.004	0.003	0.004	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.537	0.490	0.582
Glide Slope (S_g)	0.003	0.000	0.005	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.384	0.000	0.768
Step Slope (S_s)	0.000	0.000	0.000	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	0.000	0.000	0.000

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	1.63	1.42	1.83	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.28	1.118	1.44
Max Run Depth (d_{maxrun})	2.05	1.62	2.6	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.61	1.276	2.05
Max Pool Depth (d_{maxp})	2.89	2.4	3.37	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.28	1.89	2.65
Max Glide Depth (d_{maxg})	1.47	1.36	1.7	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.16	1.071	1.34
Max Step Depth (d_{maxs})	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	0	0	0

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	10	10		D_{16}	0.75	2.41		22.6	mm
% Sand	13	5.71		D_{35}	22.6	Bedrock		31.1	mm
% Gravel	17	17.15		D_{50}	Bedrock	Bedrock		44.07	mm
% Cobble	0	0		D_{84}	Bedrock	Bedrock		92.92	mm
% Boulder	1	1.43		D_{95}	Bedrock	Bedrock		125.08	mm
% Bedrock	59	65.71		D_{100}	Bedrock	Bedrock		256	mm

[a] Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.
[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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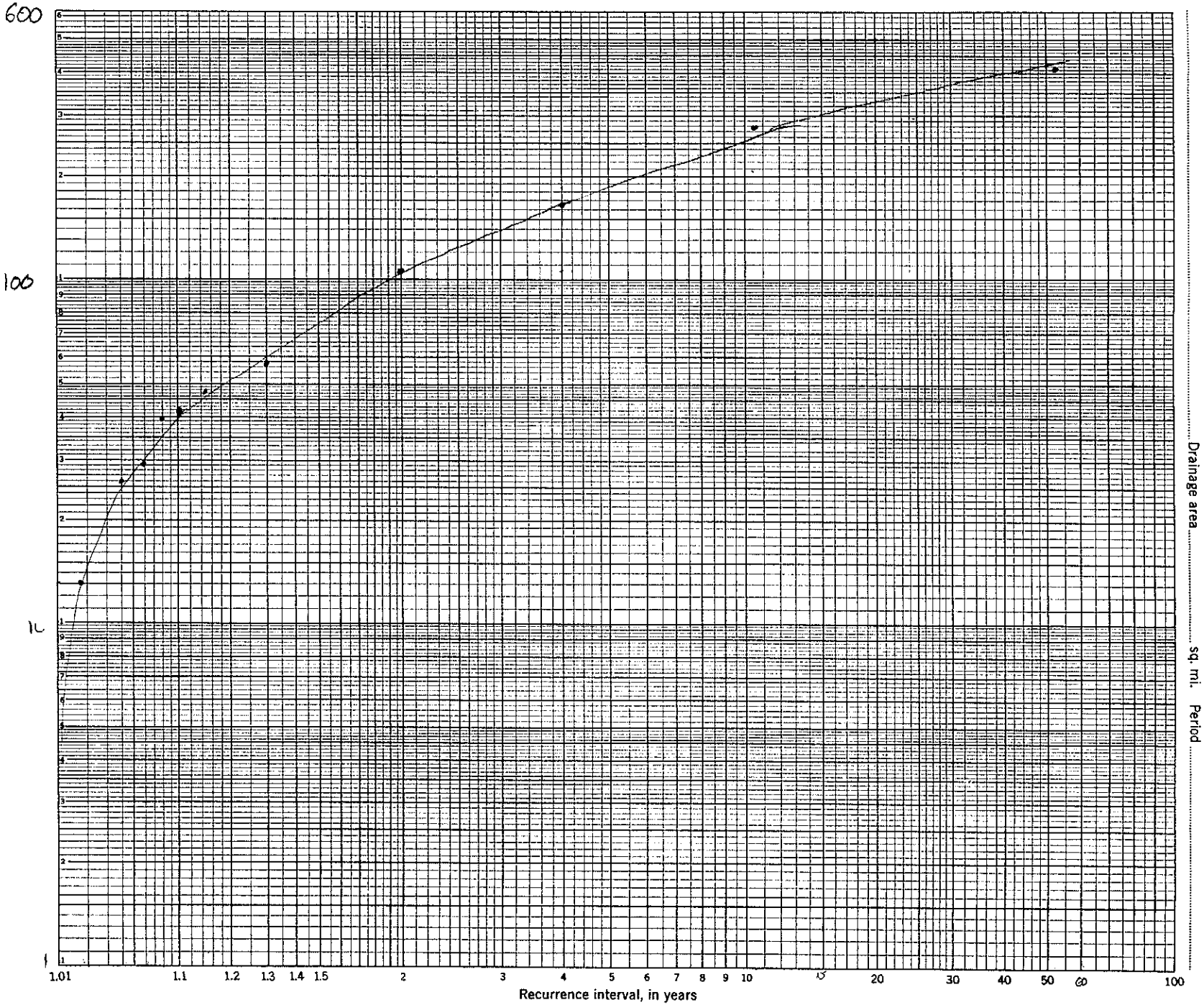
9-179b
Extreme log data plot
April 1955

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File.....

Magnitude and frequency of ..... on .....

Drainage area ..... sq. mi. Period .....



E23

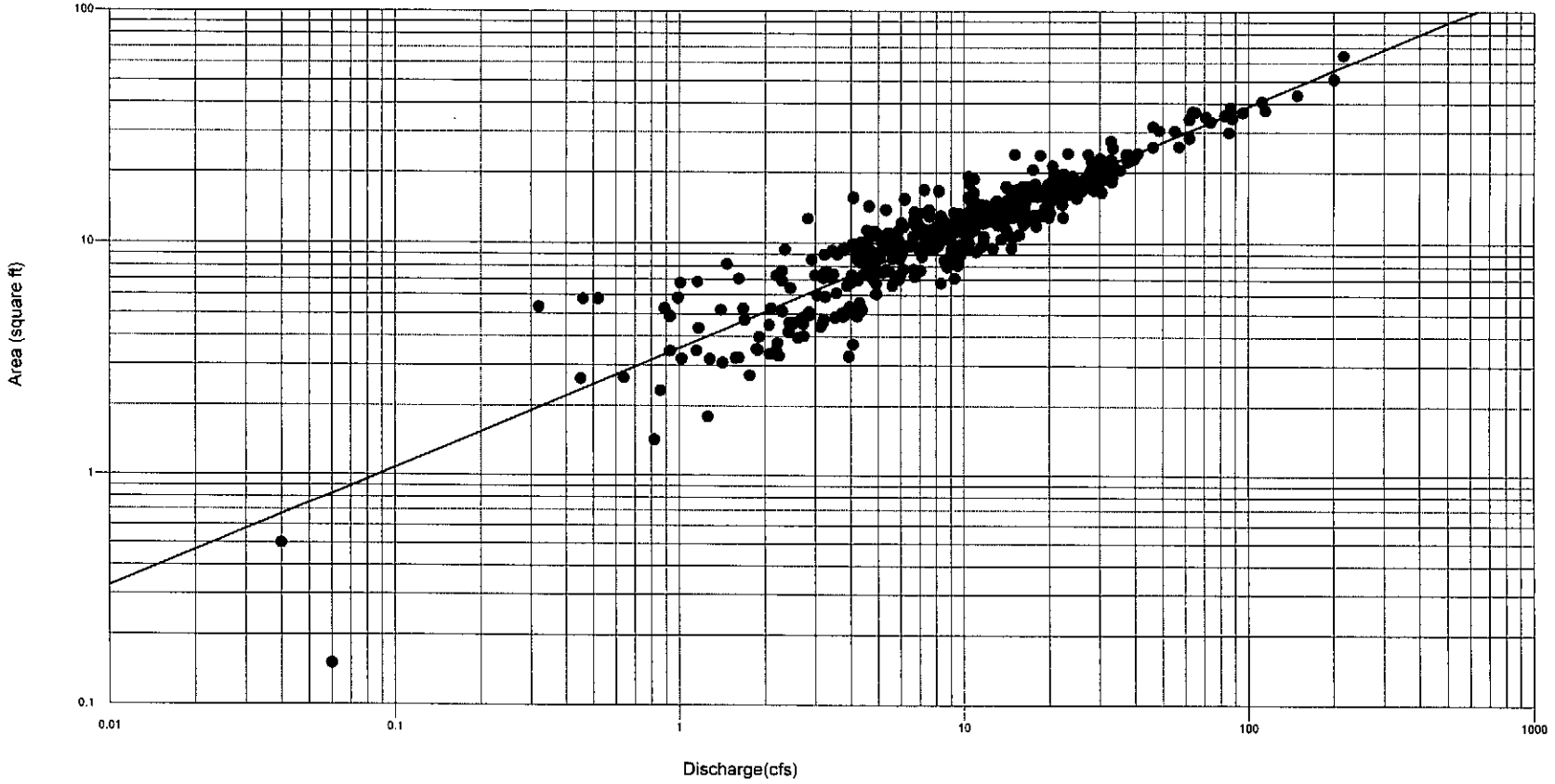
Sheet No. ..... of ..... Sheets. Prepared by ..... Date ..... Checked by ..... Date .....

GPO 863751

$A = 3.543 \times Q^{0.519}$

$R^2 = 0.838$

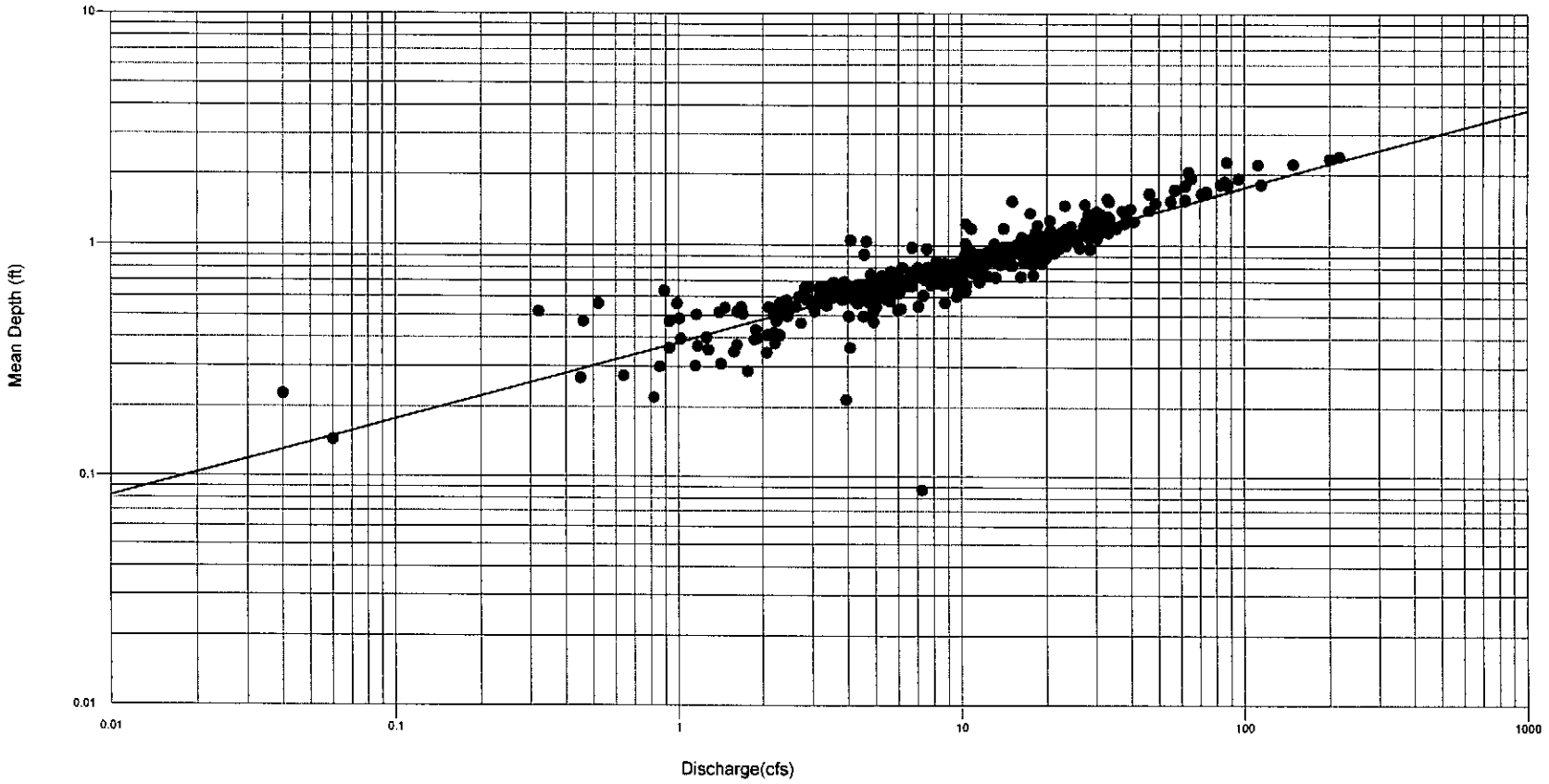
Hydraulic Geometry - Marsh Run at Grimes



$d = 0.380 \times Q^{0.333}$

$R^2 = 0.795$

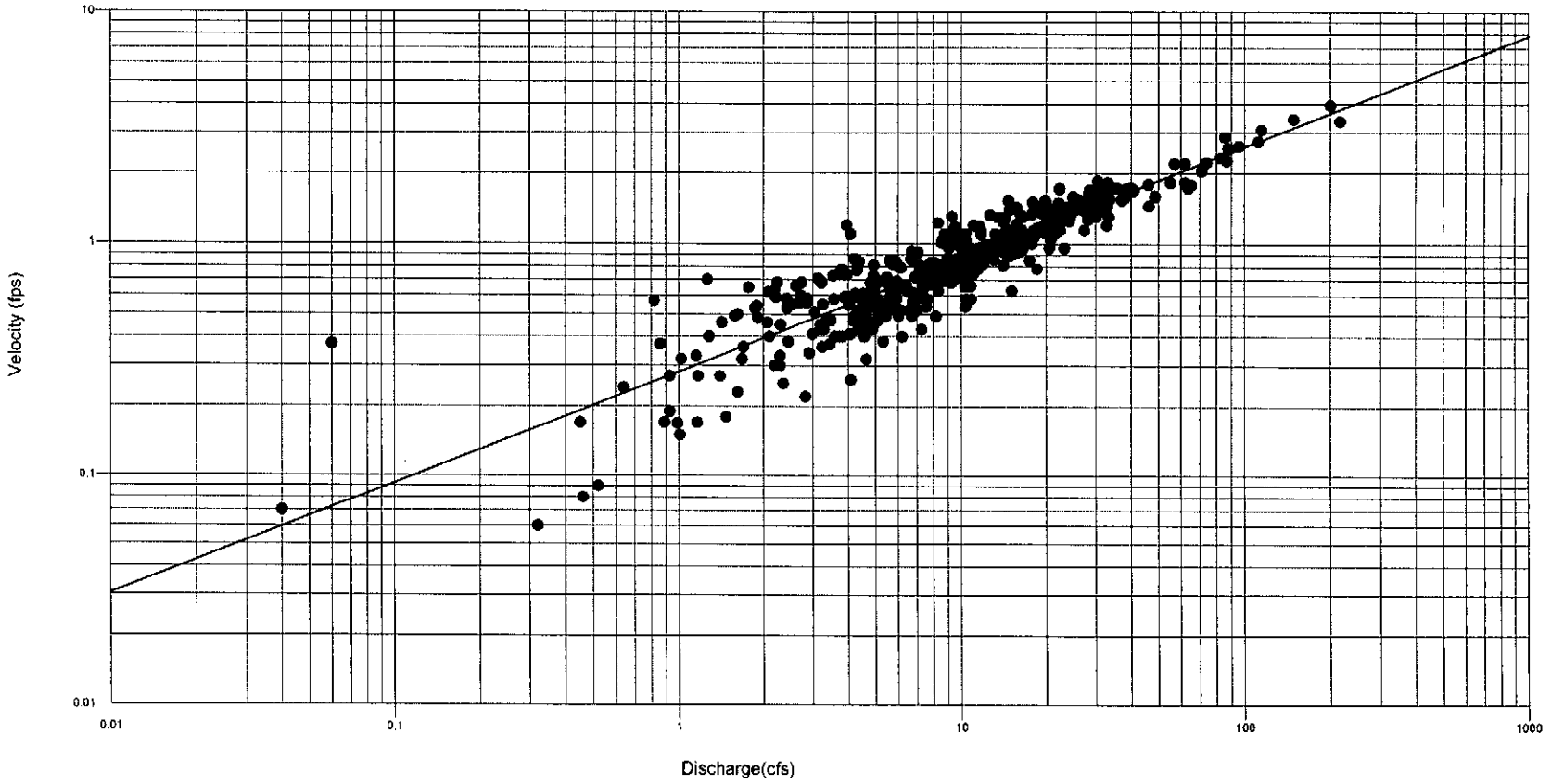
Hydraulic Geometry - Marsh Run at Grimes

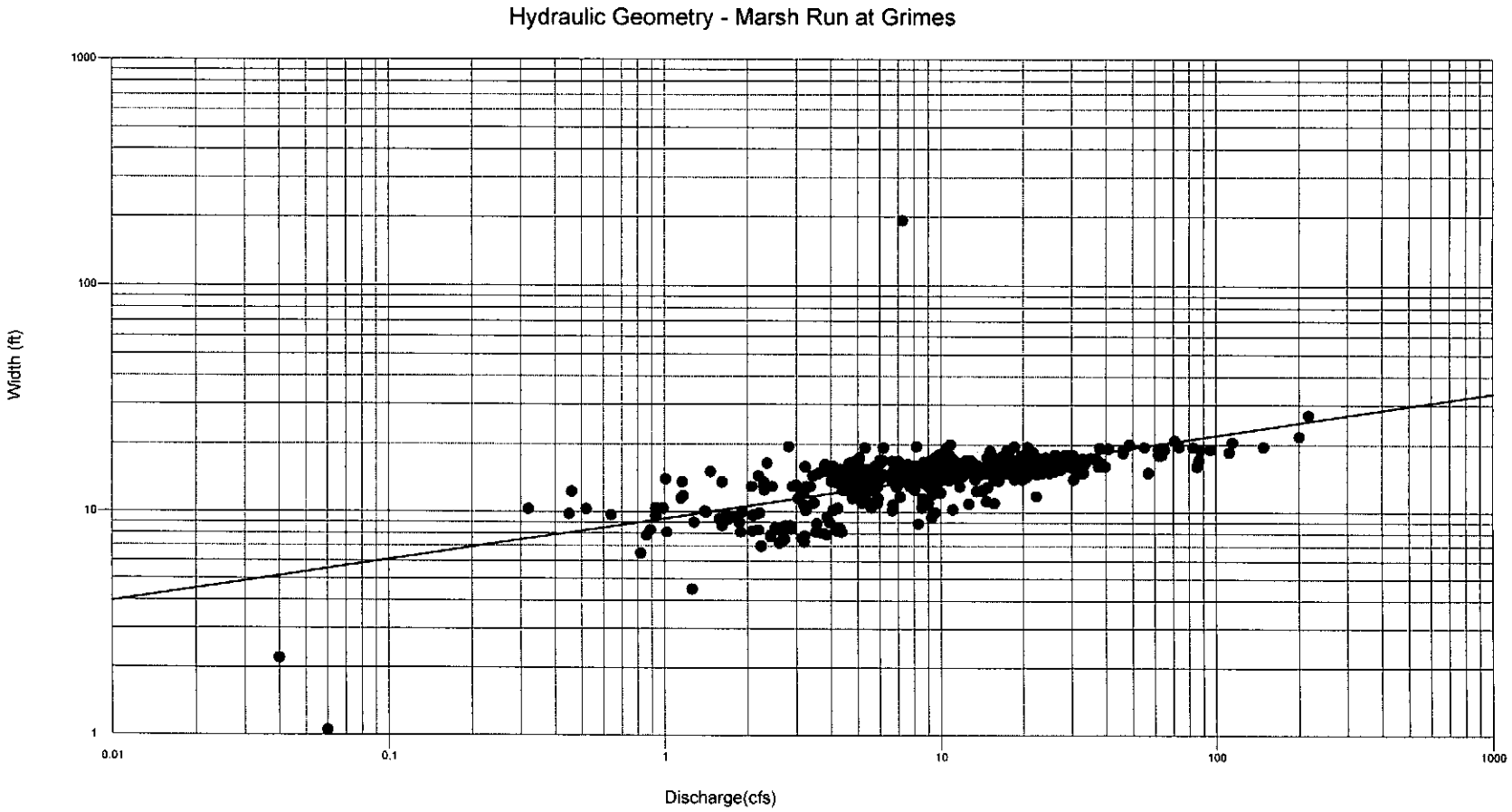


$$\text{Velocity} = 0.281 \times Q^{0.483}$$

$$R^2 = 0.818$$

Hydraulic Geometry - Marsh Run at Grimes



$w = 9.320 \times Q^{0.186}$

$r^2 = 0.426$