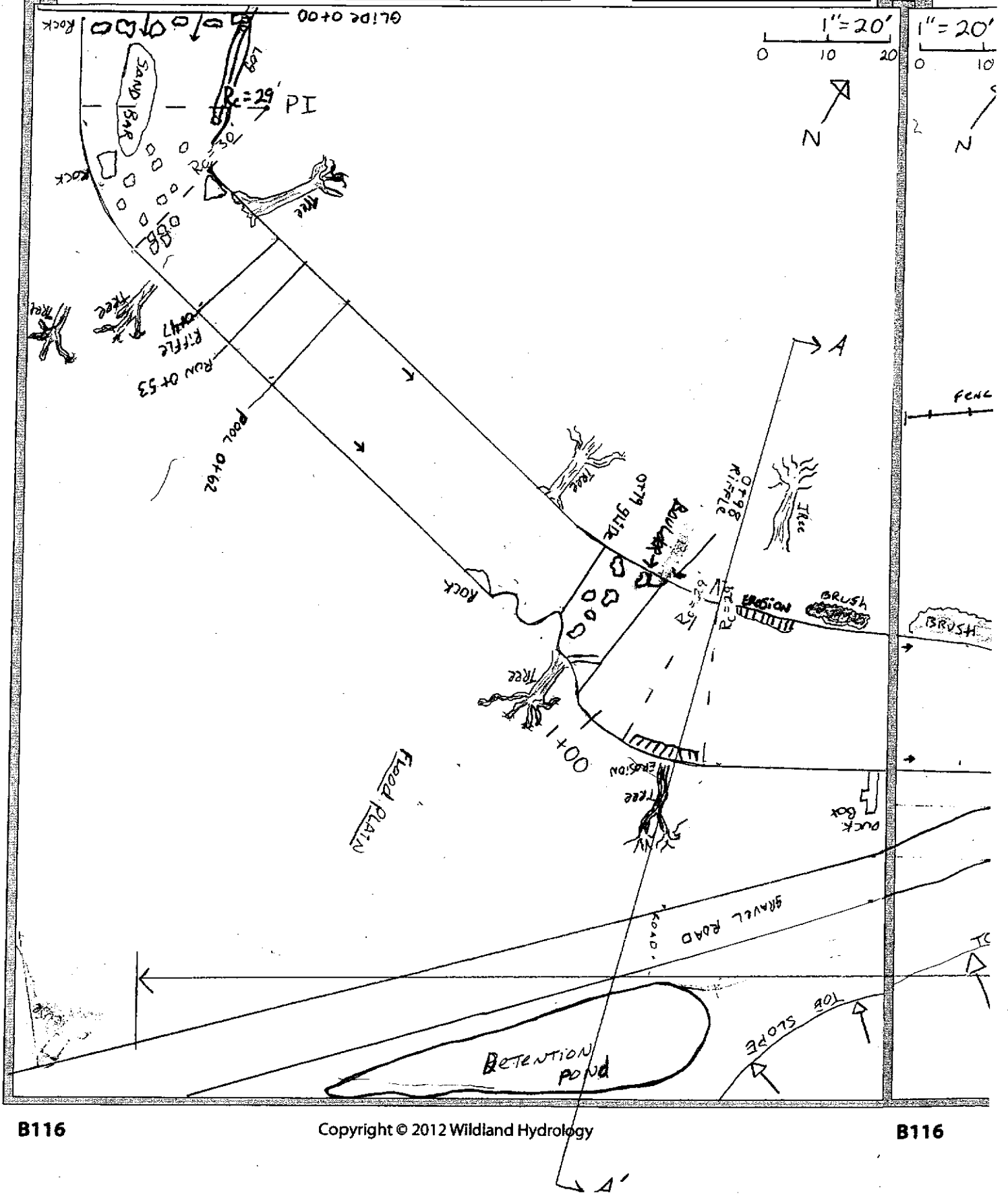
AREA-SITE LOCATION....REACH MAP

Stream: Marsh Run Reach: 4

Drawn By: Team 4 Date: 4/26/12



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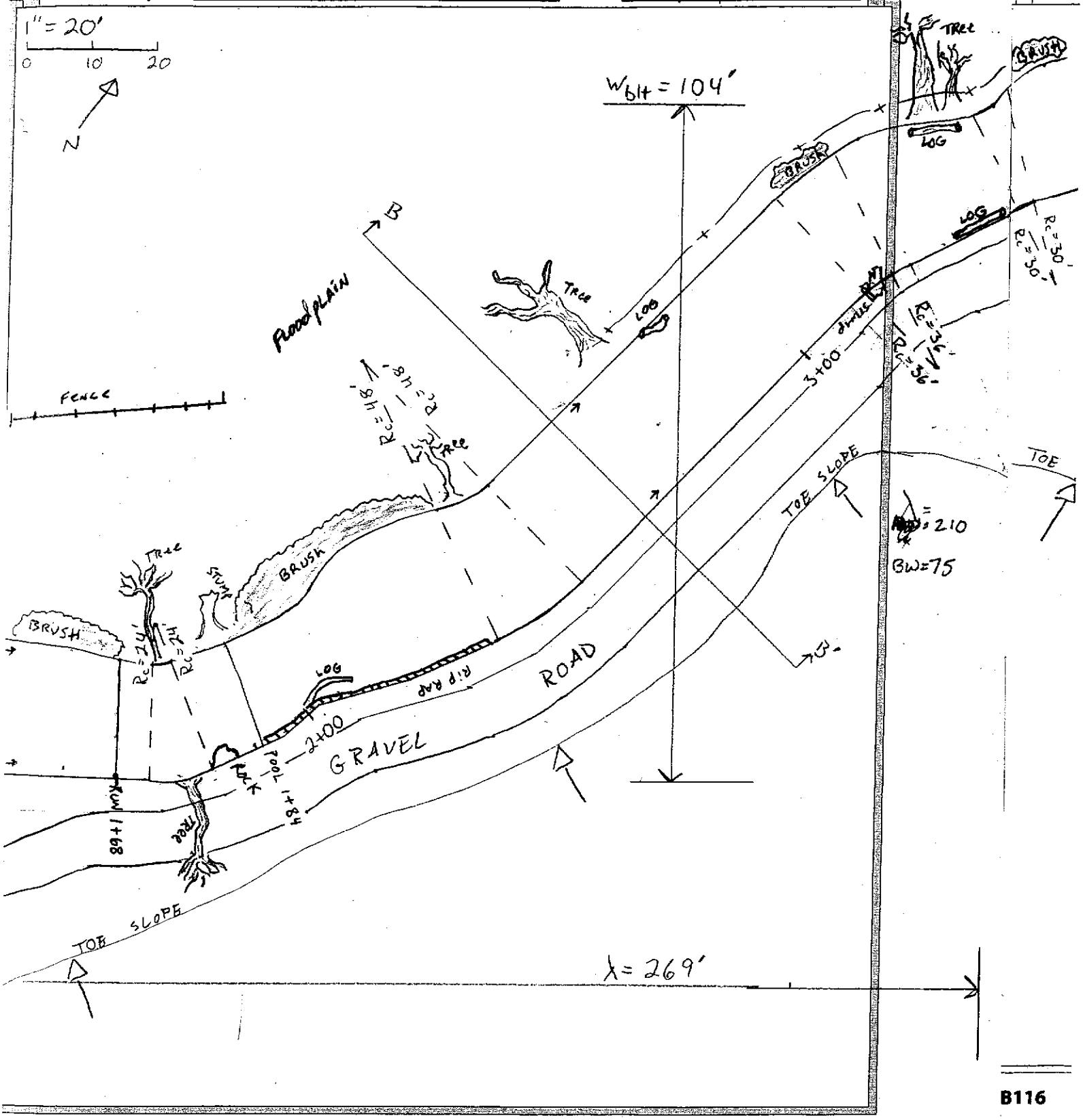
AREA-SITE LOCATION....REACH MAP

Stream: Marsh Run Reach: 4

Drawn By: Team 4 Date: 4/26/12



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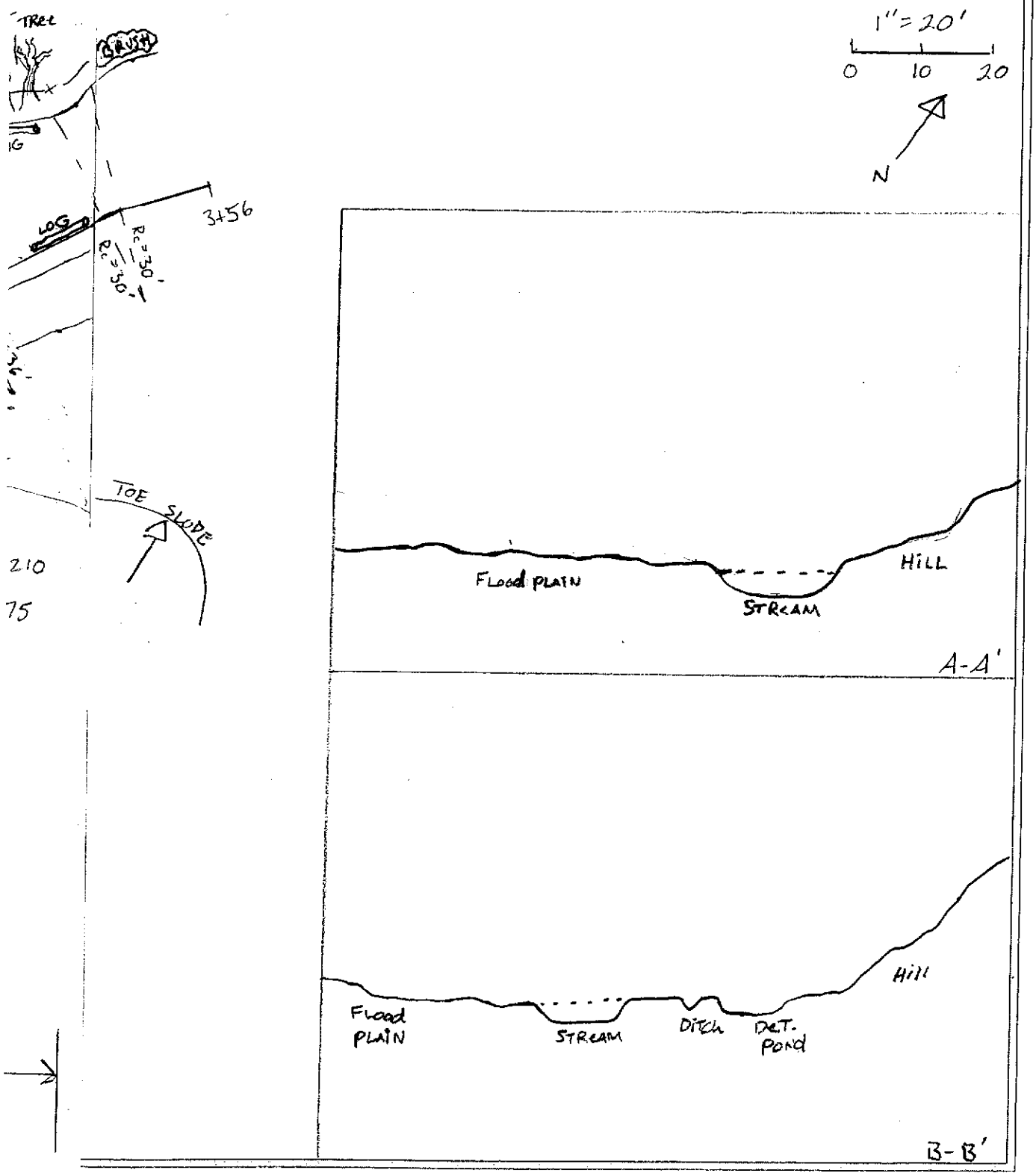
AREA-SITE LOCATION....REACH MAP

Stream: Marsh Run Reach: 4

Drawn By: Team 4 Date: 4/26/12



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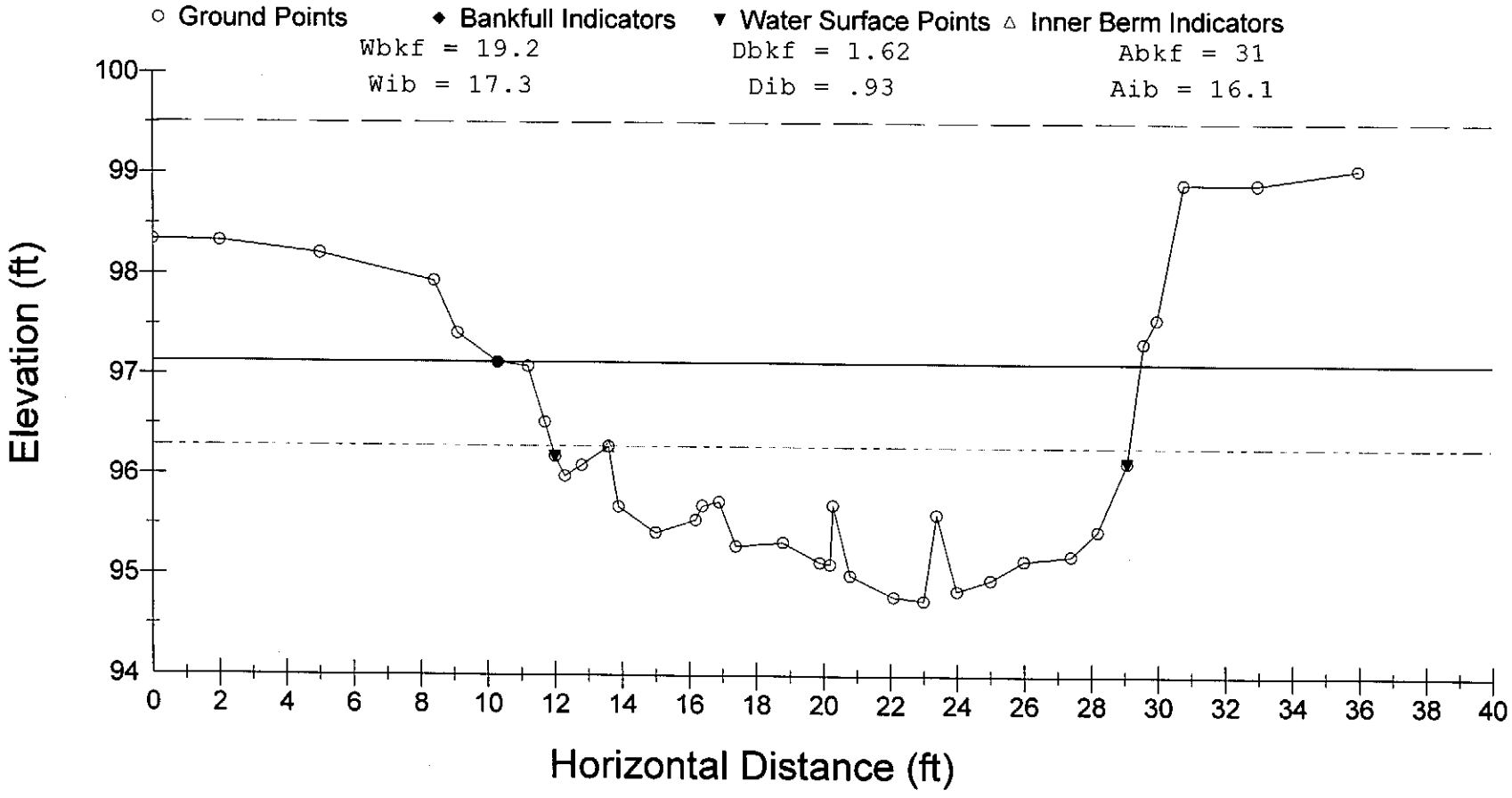
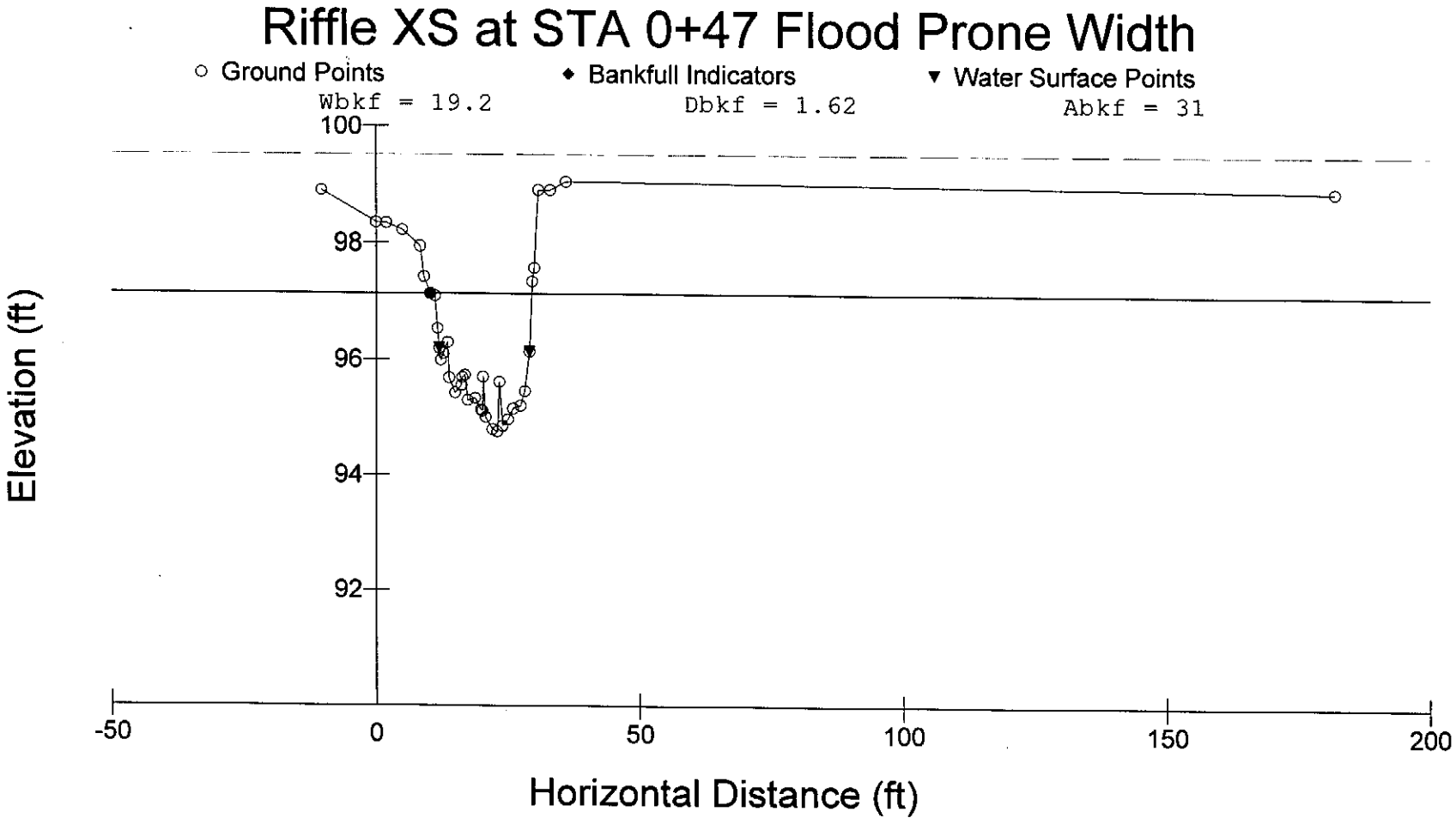
Riffle XS at STA 0+47




Riffle XS at STA 0+47 Flood Prone Width
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 19.2
Dbkf = 1.62
Abkf = 31
100
98
96
94
92
Elevation (ft)
-50
0
50
100
150
200
Horizontal Distance (ft)

SURVEY DATA → CROSS - SECTION 7

SITE: Riffle @ Sta. 0+47 Date: 4/26/12

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	16.2			7.99		
30	16.4			7.85		Flat Rock
31	16.9			7.81		
32	17.4			8.25		Base of Rock
33	18.8			8.21		
34	19.9			8.41		
35	20.2			8.43		Base of Rock
36	20.3			7.84		TO Rock
37	20.8			8.54		Base of Rock
38	22.1			8.75		
39	23			8.79		
40	23.4			7.93		
41	24			8.69		Base of Rock
42	25			8.58		TW
43	26			8.39		
44	27.4			8.34		
45	28.2			8.09		
46	29.1			7.40		REW
47	29.6			6.20		
48	30			5.96		
49	30.8			4.64		
50	33			4.64		Terrace
51	36			4.49		
52	~~~					
53	Cross Section 3 @ 53.0' (RUN)					
54	0			5.479		LEP
55	3.0			4.90		
56	6.0			4.94		
57	9.0			5.09		
58	10.0			5.25		
59	10.5			5.32		

146
36
182

+146' @ RBP to Flood Prone width

-10.3' @ LBP Flood Prone width

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Flood prone width toe to toe

elev 4.65 only for riffle

44						
45	Riffle XS @ LP STN 47					
46	0			5.20		Terrace
47	2.0			5.21		
48	5.0			5.33		
49	8.4			5.60		
50	9.1			6.12		
51	10.3			6.41		BKF
52	11.2			6.45		Edge of Bank
53	11.7			7.01		
54	12			7.35		LEW
55	12.3			7.55		
56	12.8			7.44		Top of Rock
57	13.6			7.25		Apex of Rock
58	13.9			7.86		Base of Rock
59	15			8.12		

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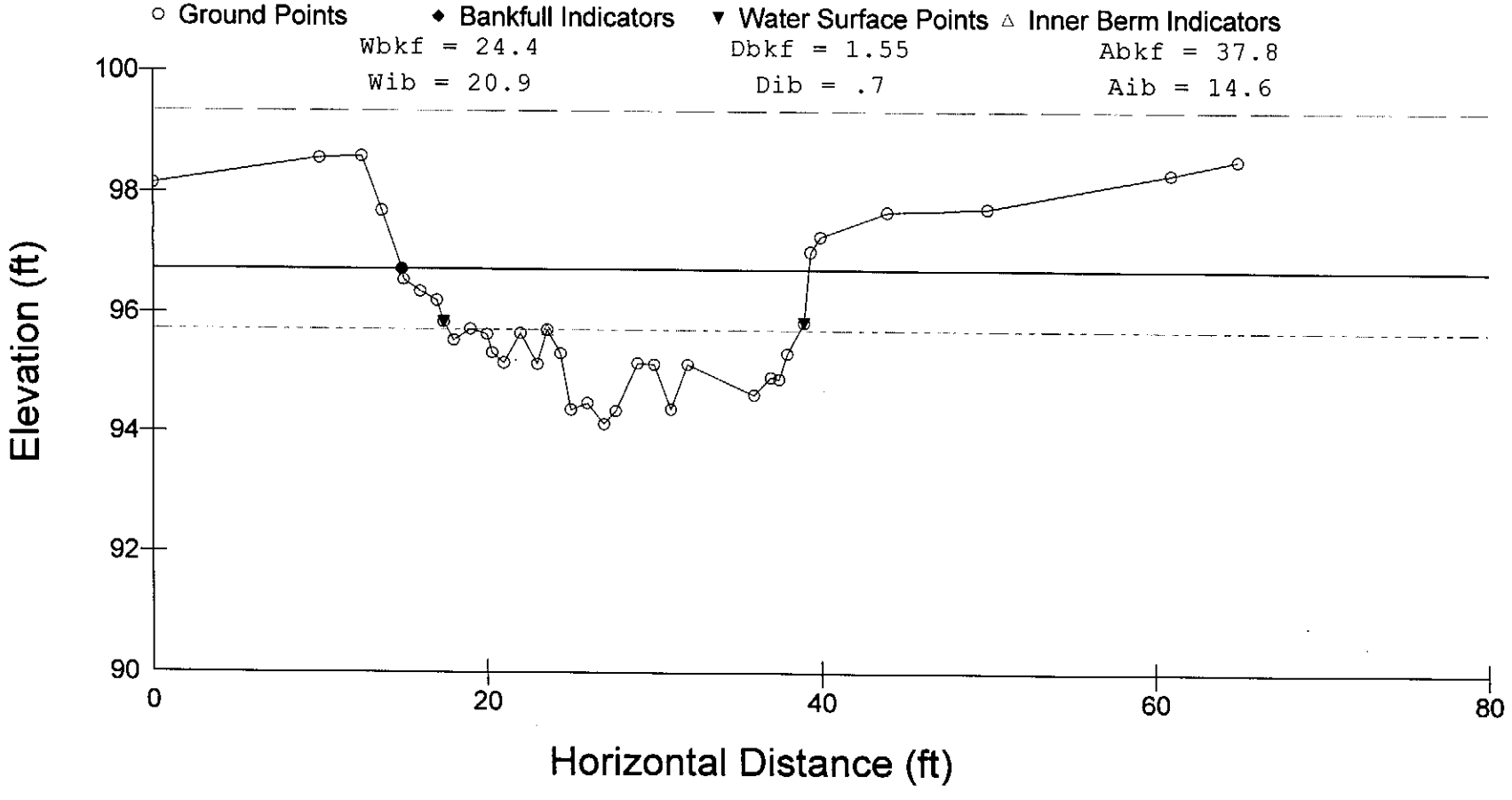
6 Riffle - sta 0+97



sta 97.4 – riffle

SURVEY DATA ⟹ **CROSS - SECTION** 5

SITE: Marsh Run, Reach 4 Date: 4-26-12

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29			103.14			
30	0+00			5.00		LBP
31	0+10.0			4.58		GS
32	0+12.5			4.55		BB
33	0+13.7			5.43		GS
34	0+15.0			6.58	96.56	~~BF~~ ~~E~~ GS
35	0+16.0			6.78		GS
36	0+17.0			6.93		GS
37	0+17.4			7.29	95.85	LEW
38	0+18.0			7.60		CS
39	0+14.9			6.4	96.74	BF – L
40	0+19.0			7.41		CS - rock
41	0+20.0			7.50		CS - rock
42	0+20.3			7.81		CS
43	0+21.0			7.98		CS
44	0+22.0			7.48		CS - rock
45	0+23.0			8.00		CS
46	0+23.6			7.42		CS - rock
47	0+24.4			7.82		CS - rock
48	0+25.0			8.76		CS
49	0+26.0			8.65		CS
50	0+27.0			9.00		CS - rock
51	0+27.7			8.78		CS
52	~~0+29.0~~					~~CS - rock~~
53	0+29.0		103.54	8.38		CS - rock
54	0+30.0		103.54	8.40		CS - rock
55	0+31.0		103.54	9.15		CS
56	0+32.0		103.54	8.4		CS
57	0+36.0		103.54	8.9		CS
58	0+37.0		103.54	8.61		CS
59	0+39.5			8.24		CS

HI different team w/ slight level.

taken w/ slight level

HI Melissa's slightly

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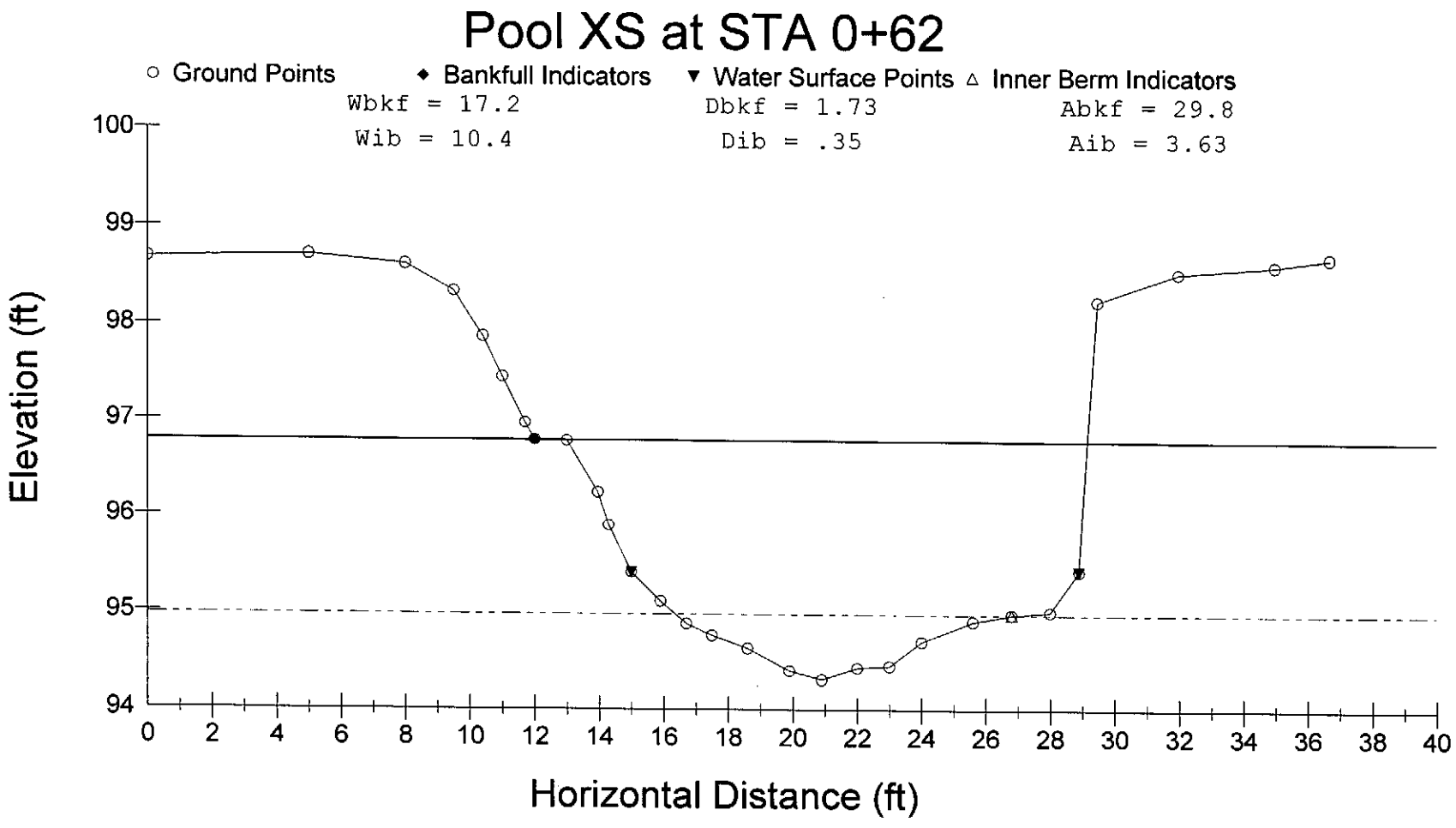
Sta 97.4 cont'd. ripple

sta.	HI	FS	Elevation	notes
0+38.0	103.14	8.21		LS
0+39.0	[redacted]	7.29	95.85	REW
0+39.4		6.10		SB-R
0+40.0		5.85		[redacted] GS
0+44.0		5.43		GS
0+50.0		5.37		GS
0+61.0		4.83		GS
0+65.0		4.6		RBP

7 flood prone area width = 220'

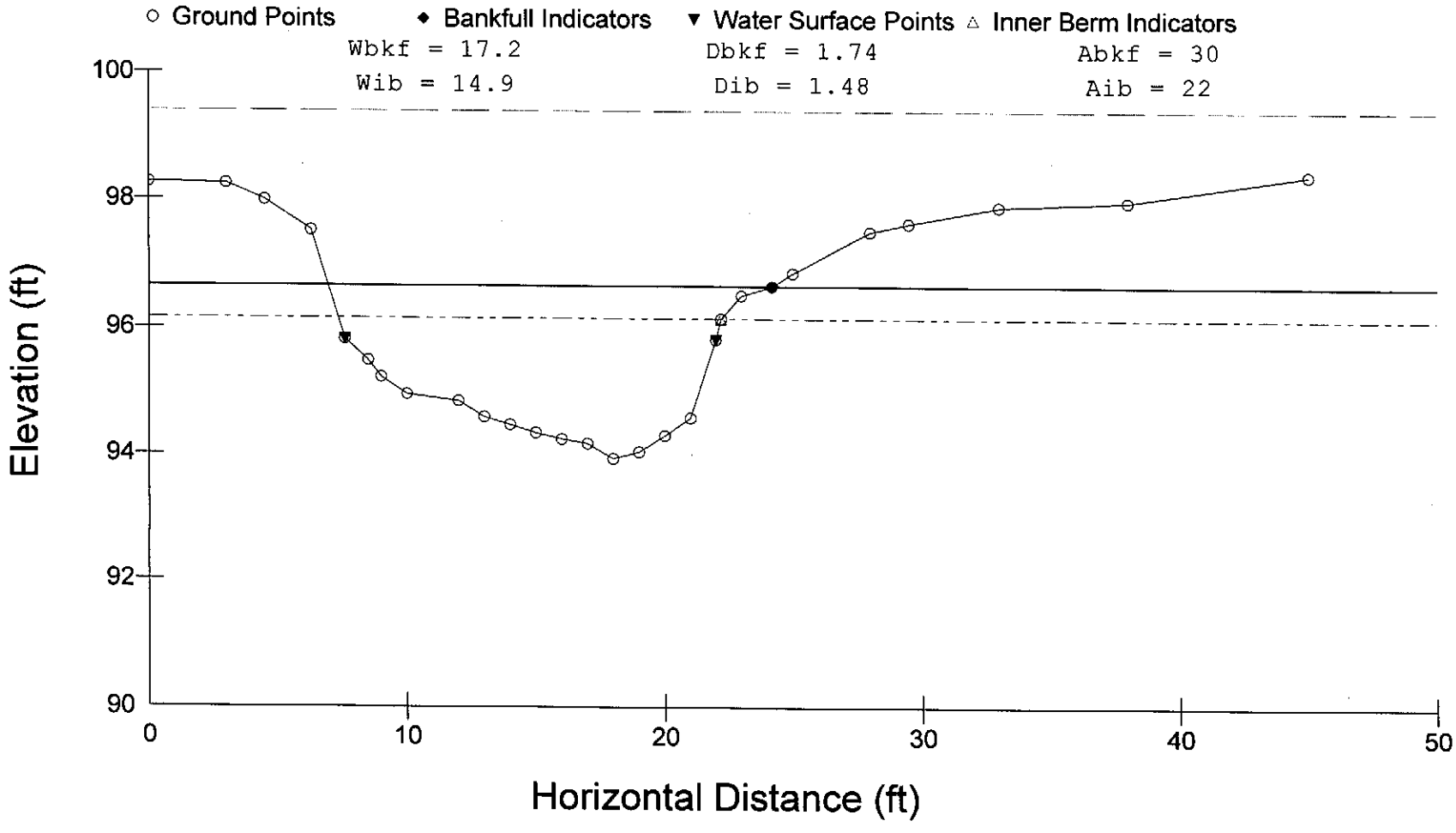

Pool XS at STA 0+62
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 17.2
Dbkf = 1.73
Abkf = 29.8
Wib = 10.4
Dib = .35
Aib = 3.63
Elevation (ft)
100
99
98
97
96
95
94
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Horizontal Distance (ft)

(5)

620' Pool
Long PRO

STATION	MEASUREMENT	NOTE
0	4.86	Left RW
5.0	4.83	
8.0	4.92	
9.5	5.20	
10.4	5.67	
11.0	6.09	
11.7	6.57	
12.0	6.75	BANKFOW
13.0	6.76	
13.9	7.30	
14.3	7.64	LEW
15.0	8.13	
15.9	8.43	
16.7	8.66	
17.5	8.78	
18.6	8.91	
19.9	9.14	
20.9	9.23	
22.0	9.11	TOP Rock
23.0	9.09	
24.0	8.84	
25.6	8.63	
26.8	8.56	
28.0	8.53	
28.9	8.11	Right Edge HD
29.5	5.29	
32.0	5.00	
35.0	4.92	
36.7	4.84	

Pool @ sta 1+83


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 17.2
Wib = 14.9
Dbkf = 1.74
Dib = 1.48
Abkf = 30
Aib = 22
100
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

station 183.5 - pool

flood prone area = 160'

SURVEY DATA ⟶ **CROSS - SECTION** 3

SITE: Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0+00		103.14	4.88		LBP
30	0+3.0			4.90		GS
31	0+4.5			5.16		GS
32	0+6.3			5.63		BS
33	0+7.6			7.32		TEW
34	0+8.5			7.66		CS
35	0+9.0			7.92		CS
36	0+10.0			8.19		CS
37	0+12.0			8.30		CS
38	0+13.0			8.55		CS
39	0+14.0			8.64		CS
40	0+15.0			8.80		CS
41	0+16.0			8.90		CS
42	0+17.0			8.97		CS - rock
43	0+18.0			9.21		CS - TW
44	0+19.0			9.10		CS
45	0+20.0			8.84		CS - rock
46	0+21.0			8.56		CS - rock
47	0+22			7.32	95.82	TEW
48	0+22.2			6.99		GS - overhanging bank
49	0+23			6.63		GS
50	0+24.2			6.48	96.66	BF
51	0+25.0			6.27		GS
52	0+28.0			5.65		SB
53	0+29.5			5.52		GS - road - L
54	0+33.0			5.26		GS - road (mid)
55	0+38.0			5.18		GS - road - R
56	0+45.0			4.76		RBP
57						
58						
59						

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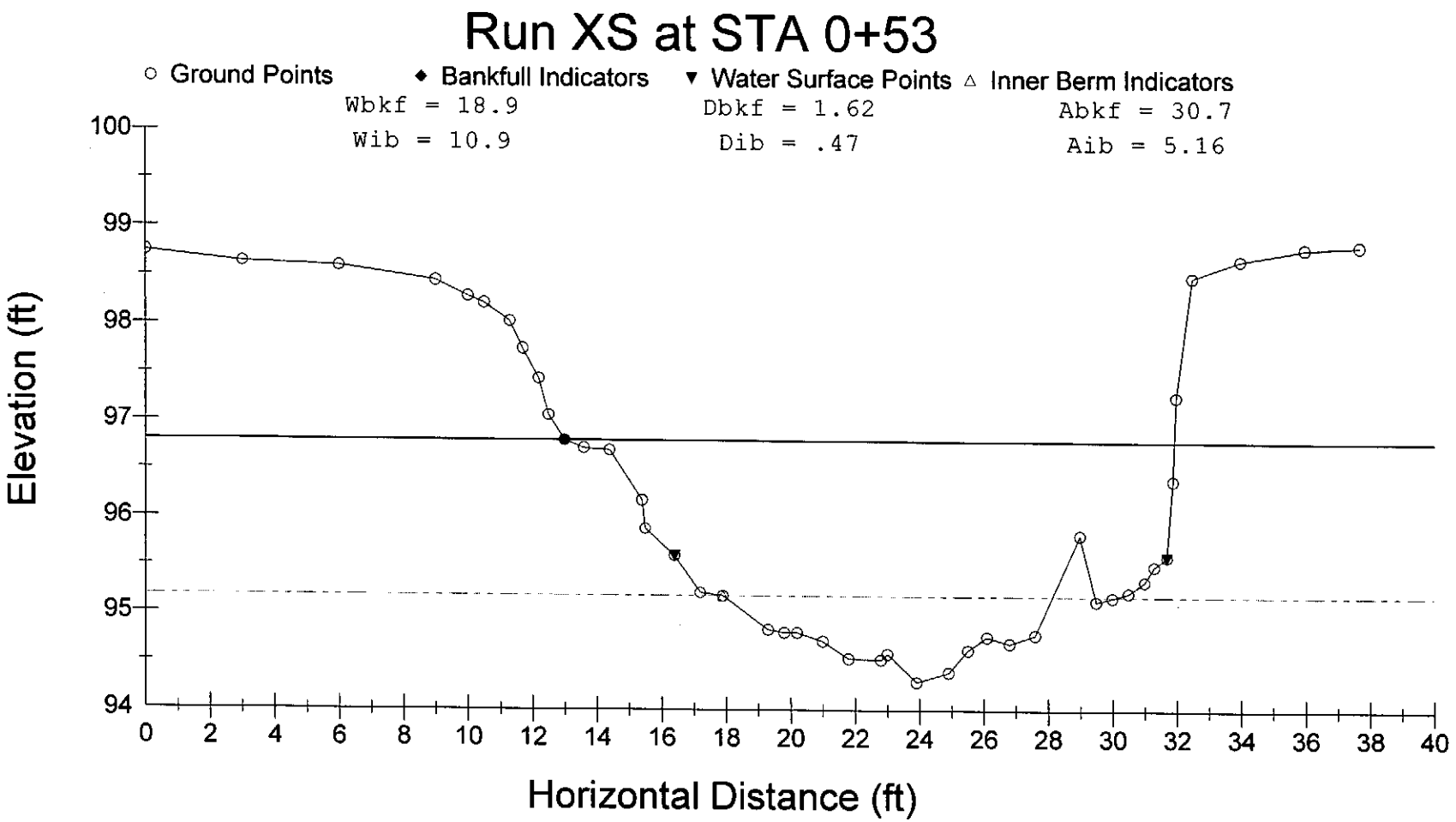
Run XS at STA 0+53
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 18.9
Wib = 10.9
Dbkf = 1.62
Dib = .47
Abkf = 30.7
Aib = 5.16
Elevation (ft)
100
99
98
97
96
95
94
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Horizontal Distance (ft)

SURVEY DATA ⟹ CROSS - SECTION 1

SITE: Date:

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	11.3				5.51	
2	11.7				5.79	
3	12.2				6.10	
4	12.5				6.48	
5	13.0				6.74	
6	13.6				6.82	
7	14.4				6.84	
8	15.4				7.36	
9	15.5				7.66	LEW
10	16.4				7.94	LEW
11	17.2				8.33	
12	17.9				8.36	IB
13	19.3				8.71	
14	19.8				8.74	
15	20.2				8.74	
16	20.0				8.83	
17	21.8				9.01	
18	22.8				9.02	BASE ROCK
19	23.0				8.96	TOP ROCK
20	23.9				9.25	BASE ROCK / THALWEG
21	24.9				9.15	BASE ROCK
22	25.5				8.92	TOP ROCK
23	26.1				8.78	TOP ROCK
24	26.8				8.85	
25	27.6				8.76	
26	29.0				8.78	BASE RAL
27	29.5				8.41	
28	30.0				8.37	

36.0 4.74
37.7 4.71

30.5
31.0
31.3

8.32
8.20
8.04

31.7 7.94 REW
31.9 7.14

32.0 6.27
32.5 5.04
34.0 4.96

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to
Flood
Prone
width

52						
53	Cross Section 3 @ 53.0' (RUN)					
54	0			5.479		LEP
55	3.0			4.90		
56	6.0			4.94		
57	9.0			5.09		
58	10.0			5.25		
59	10.5			5.32		

LBP
Flood
Prone wid

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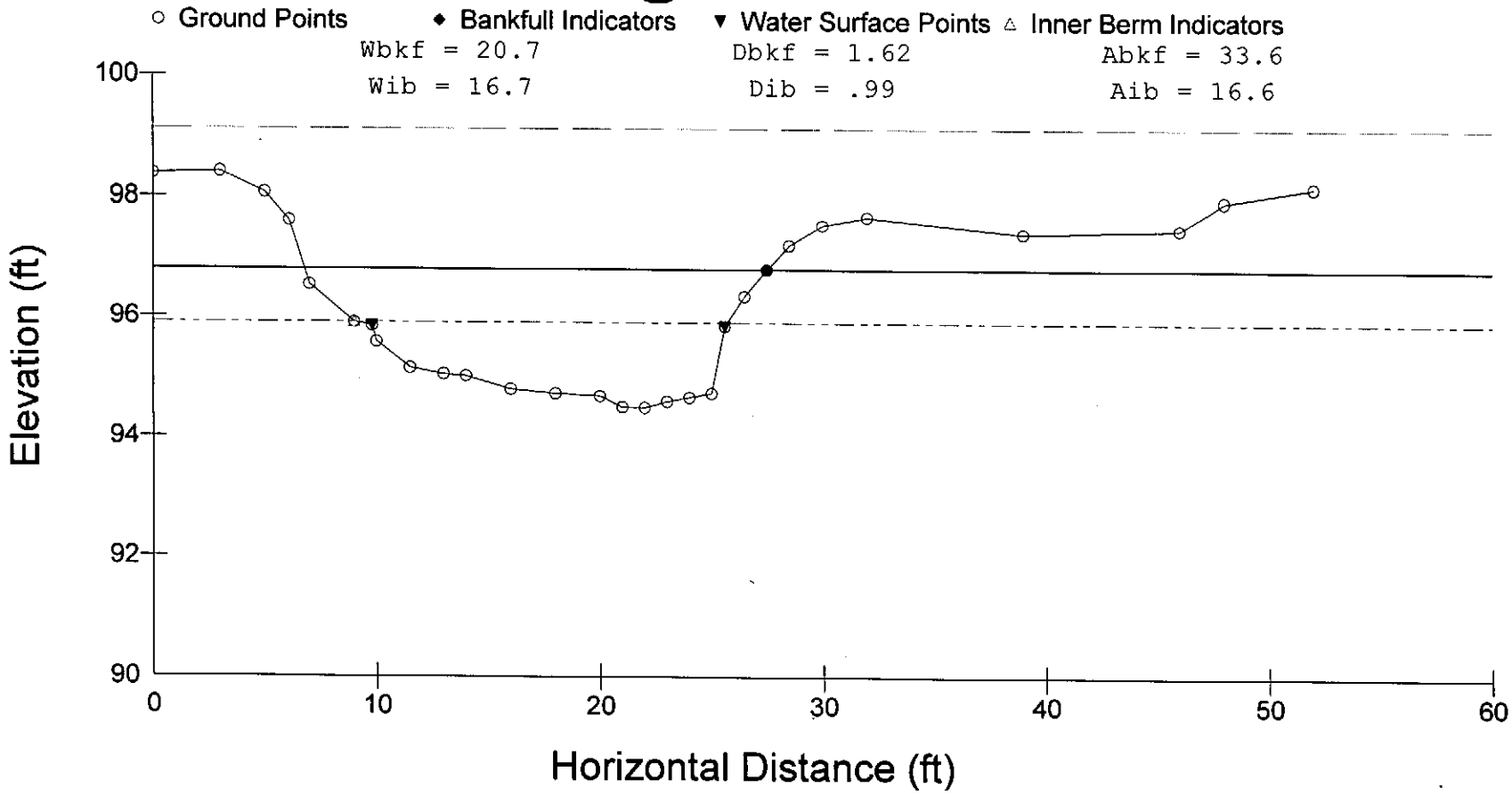
Run @ STA 1+68


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 20.7
Wib = 16.7
Dbkf = 1.62
Dib = .99
Abkf = 33.6
Aib = 16.6
100
98
96
94
92
90
0
10
20
30
40
50
60
Elevation (ft)
Horizontal Distance (ft)

Sta. 168.0 - run

flood prone area = 200'

SURVEY DATA ⟶ **CROSS - SECTION 4**

SITE: Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0+00		103.14	4.77		LBP
30	0+3.00			4.74		GS
31	0+5.0			5.08		GS
32	0+6.1			5.53		BS
33	0+7.0			6.61		GS
34	0+9.0			7.24		GS
35	0+9.8			7.30	95.84	LEW
36	0+10.0			7.57		CS
37	0+11.5			8.0		CS
38	0+13.0			8.1		CS
39	0+14.0			8.13		CS
40	0+16.0			8.35		CS
41	0+18.0			8.42		CS
42	0+20.0			8.46		CS
43	0+21.0			8.64		CS
44	0+22.0			8.65		CS - TW
45	0+23.0			8.55		CS
46	0+24.0			8.48		CS
47	0+25.0			8.41		CS
48	0+25.6			7.30	95.84	REW
49	0+26.5			6.79		GS
50	[illegible]			[illegible]		[illegible]
51	0+27.5			6.34	96.8	BF - R (0.96)
52	0+28.5			5.94		GS
53	0+30.0			5.6		SB
54	0+32.0			5.46		GS
55	0+39			5.74		GS - dirt road LE
56	0+46			5.67		GS - dirt road RE
57	0+48			5.29		GS
58	0+52			4.98		RBP
59	—	—	—	—		

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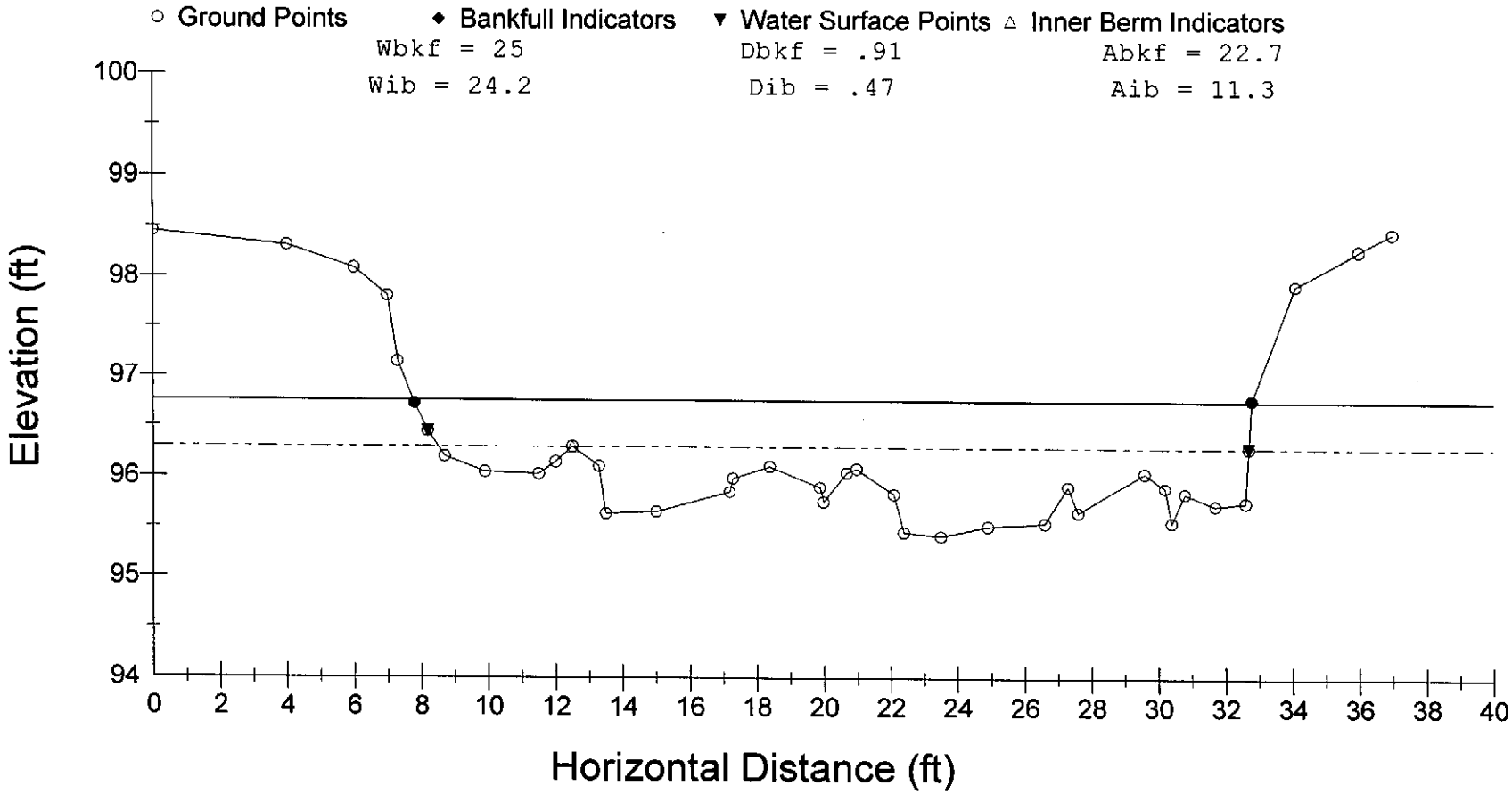
Glide XS at STA 0+00



XS @ LP Stn. 0 - Glide XS

(1)

~~4~~

Bankfull @593.6

*Shoot Corner of Pavilion for common point

BM=100
Rod=3.54
HI=103.54

SURVEY DATA → **CROSS-SECTION 6**

SITE: Marsh Run @ Grimes, MD/Team 4 **Date:** 4/26/12

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0	3.54	103.54	5.09		Terrace
30	4			5.23		
31	6			5.45		
32	7			5.73		
33	7.3			6.39		
34	7.8			6.81		BKF
35	8.[illegible]			7.09		BKF ? Below
36	8.[illegible]			7.34		
37	9.9			7.49		
38	11.5			7.51		Bedrock
39	12.[illegible]			7.39		T.O.Rock
40	~~[illegible]~~			~~[illegible]~~		~~Edge of Rock~~
41	~~[illegible]~~			~~[illegible]~~		~~Bottom of Rock~~
42	~~[illegible]~~			~~[illegible]~~		
43	12.5			7.24		
44	13.3			7.43		Edge of Rock
45	13.5			7.91		
46	15			7.89		
47	17.[illegible]			7.69		Base of Rock
48	17.3			7.55		Side of Rock
49	18.4			7.43		Apex of Rock
50	~~[illegible]~~ 19.9			7.64		~~Edge~~ Top of Rock
51	20			7.79		Edge of Rock (BR)
52	~~[illegible]~~			~~[illegible]~~		
53	20.7			7.49		Top of Rock
54	21.0			7.45		Apex of Rock
55	22.1			7.71		Edge of Rock
56	22.4			8.09		Base of Rock
57	23.5			8.13		
58	24.9			8.03		
59	26.6			8.0		Base of Rock

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SURVEY DATA ⟶ **CROSS - SECTION 8**

SITE: XS @ LP Stn 0 - Glide XS **Date:** 4/26/12

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	27.3			7.63		
30	27.6			7.89		Base of Rock
31	29.6			7.49		
32	30.2			7.64		Edge of Rock
33	30.4			7.99		Bottom of Rock
34	30.8			7.70		Top of Rock
35	31.7			7.82		
36	32.6			7.79		Bottom Edge of Bank
37	32.7			7.24		Right Edge of Water
38	32.8			6.76		BKF?
39	33.3			6.12		BKF ?
40	32.8			6.84		
41	34.1			5.61		
42	36			5.26		
43	37			5.09		
44						
45	Riffle XS @ LP Stn 47					
46	0			5.20		Terrace
47	2.0			5.21		
48	5.0			5.33		
49	8.4			5.60		
50	9.1			6.12		
51	10.3			6.41		BKF
52	11.2			6.45		Edge of Bank
53	11.7			7.01		
54	12			7.35		LEW
55	12.3			7.55		
56	12.8			7.44		Top of Rock
57	13.6			7.25		Apex of Rock
58	13.9			7.86		Base of Rock
59	15			8.12		

7.27 − 6.12

7.24 − 6.12 = 1.12

2x d_{max}

Flood Prone Width toe to toe

elev 4.65 only for riffle

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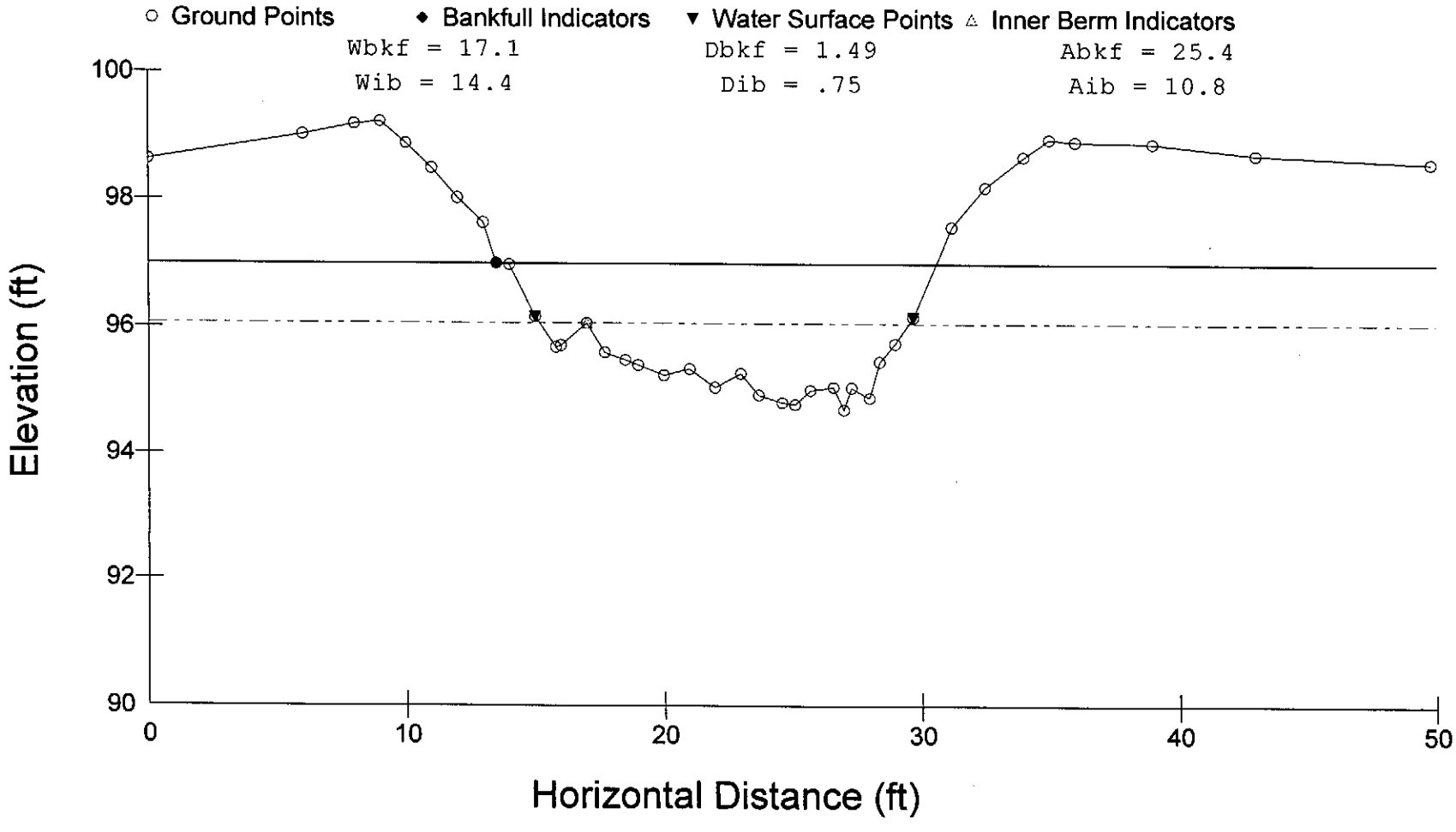
Glide @ sta 0+77



sta 77.3 - glide

floodprone area = 300

SURVEY DATA → **CROSS - SECTION 2**

SITE: Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29		3.36	103.36			BM #35
30	0+00			4.74		LBP
31	0+6.0			4.35		GS
32	0+8.0			4.18		GS
33	0+9.0			4.14		SB
34	0+10.0			4.49		GS
35	0+11.0			4.88		GS
36	0+12.0			5.35		GS
37	0+13.0			5.74		GS
38	0+14.0			6.38		GS
39	~~0+15.0~~ 0+15.0			7.2		~~GS~~ LEW
40	0+15.8			7.68		CS
41	0+16.0			7.65		LS-rock
42	~~0+17.0~~			~~7.3~~		LS-rock
43	0+17.7			7.76		LS-rock
44	0+18.5			7.88		LS-rock
45	0+19.0			7.96		LS
46	0+20.0			8.12		LS
47	0+21.0			8.02		LS
48	0+22.0			8.31		LS
49	0+23.0			8.09		LS - rock
50	023.7			8.43		LS - ~~rock~~
51	0+24.6			8.55		CS - [redacted]
52	0+25.1			8.58		LS - TW
53	0+25.7			8.35		LS
54	0+26.6			8.3		LS
55	0+27.0			8.66		LS
56	0+27.3			8.31		LS
57	0+28.0			8.47		LS - rock
58	0+28.4			7.90		
59	0+29.0			7.61		

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1 = LBP

GS ground shot

SB slope break

BkF bank full

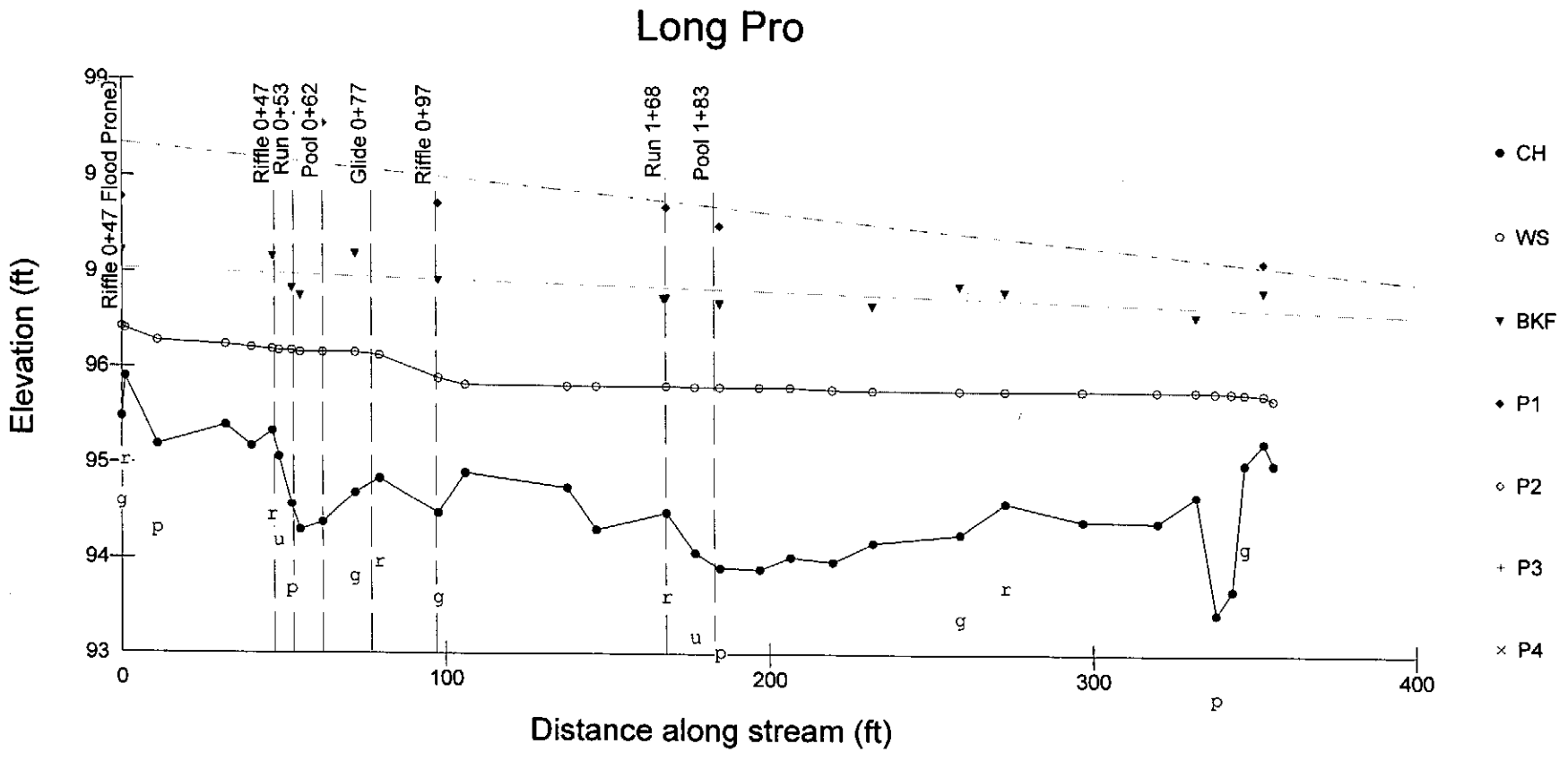
LEW left edge of water

TW thalweg

CS - anything in the water

Sta. 77.3 - glide contd

sta	BS	HI	FS	elev.	Notes
0+29.7	3.36	103.36	7.2		REW
0+31.2			5.8		SB
0+32.5			5.18		GS
0+34.0			4.7		GS
0+35.0			4.42		GS
0+36.0			4.46		GS
0+43.0			4.49		GS
[redacted] 0+39.0			4.67		[redacted]
0+49.8			4.8		REP


Long Pro
Elevation (ft)
Distance along stream (ft)
Riffle 0+47 Flood Prone
Riffle 0+47
Run 0+53
Pool 0+62
Glide 0+77
Riffle 0+97
Run 1+68
Pool 1+83
CH
WS
BKF
P1
P2
P3
P4
93
94
95
96
9
9
0
100
200
300
400

SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Marsh Run Reach 4 **Date:** 4-26-12

Location:

BM 35

11
100
3.14

Party / Notes: Team 4 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	BS	3.14	108.34									
2	0.0			7.66		6.72		5.93 (XS 01)		5.37		G
3	1.0			7.24		6.7*						R
4	11.0			7.95		6.87						
5	32.0			7.75		6.905				6.44		
6	40.0			7.97		6.94						R
7	46.5			7.81		6.96		5.99*				R
8	48.5			8.08		6.9*						
9	55.0			8.85		6.9*		6.40				P
10	52.4			8.58		6.8*		6.32				U
11	62.0			8.77		6.99						P
12	72.0			8.45		6.99		5.96				G
13	79.5			8.30		7.02						R
14	97.7			8.67		7.25		6.20 (6.23)		5.93		R
15	106.0			8.24		7.32						Bedrock
16	137.5			8.39		7.33						
17	146.5			8.84		7.33						
18	168.2			8.66		7.33		6.41				R
19	177.0			9.08		7.34						
20	184.7			9.2*		7.34		6.47				P
21	197.0			9.25		7.34						
22	206.5			9.12		7.34						
23	219.5			9.17		7.36						
24	232.0			8.97		7.37		6.4***				
25	259.0			8.88		7.37		6.28*				
26	273.0			8.55		7.39		6.34				
27	297			8.74		7.37						

1 XS
2 XS
3 4 XS
6 XS
8 XS

Bedrock

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SURVEY DATA → LONGITUDINAL PROFILE 2

SITE: Marsh Run **Date:** 4-26-12

Location: Reach 4

Party / Notes: Team 4 HUC: _____

	Distance, Point, or	Back-Sight	Height of Instru-ment	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	e.g. Riffle Run Pool Glide
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
28	320			8.75		7.37						
29	332			8.47		7.37		6.59				
30	338			9.71		7.38						P
31	343			9.46		7.38						G
32	347			8.13		7.39						G
33	353			7.90		7.40		6.33		6.02		TR
34	356			8.13		7.45						
35												
36												
37												
38												
39	77											G
40	1603							6.42				RB
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												

Bedrock

5 XS

7 XS

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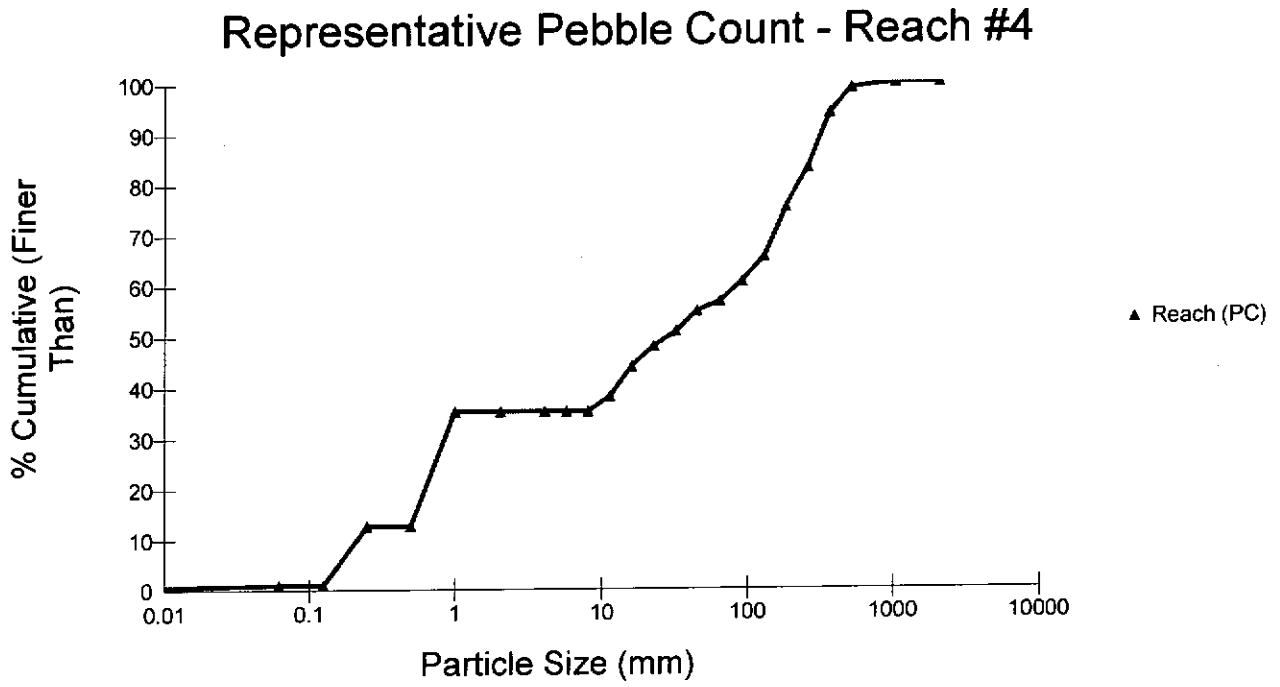
Representative Pebble Count - Reach #4
% Cumulative (Finer Than)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
▲ Reach (PC)

representative reaches

Site: Marsh Run at Grines Date: 4/26/12
Location: Reach 4 HUC:
Party: Team 4

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										1		
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND		☒		1			11			12		
	Medium	.25 - .50	SAND												
	Coarse	.50 - 1.0	SAND		☒ ☒		4			19			23		
.04 - .08	Very Coarse	1.0 - 2	SAND												
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL												
.31 - .44	Medium	8 - 11.3	GRAVEL							3			3		
.44 - .63	Medium	11.3 - 16	GRAVEL							6			6		
.63 - .89	Coarse	16 - 22.6	GRAVEL							4			4		
.89 - 1.3	Coarse	22.6 - 32	GRAVEL							3			3		
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL							4			4		
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL							2			2		
2.5 - 3.5	Small	64 - 90	COBBLE				2			2			4		
3.5 - 5.0	Small	90 - 128	COBBLE				5						5		
5.0 - 7.1	Large	128 - 180	COBBLE				7			3			10		
7.1 - 10.1	Large	180 - 256	COBBLE				8						8		
10.1 - 14.3	Small	256 - 362	BOULDER	☒			11						11		
14.3 - 20	Small	362 - 512	BOULDER				5						5		
20 - 40	Medium	512 - 1024	BOULDER				1						1		
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		DRK	☒ ☒ ☒	☒ ☒		30			28			58		
Stream Type:			**Valley Type:**			TOTAL→	74			85					

upstream pool + downstream
~~long~~ p

60

both pools
pebble count
representative reach

28
57
85

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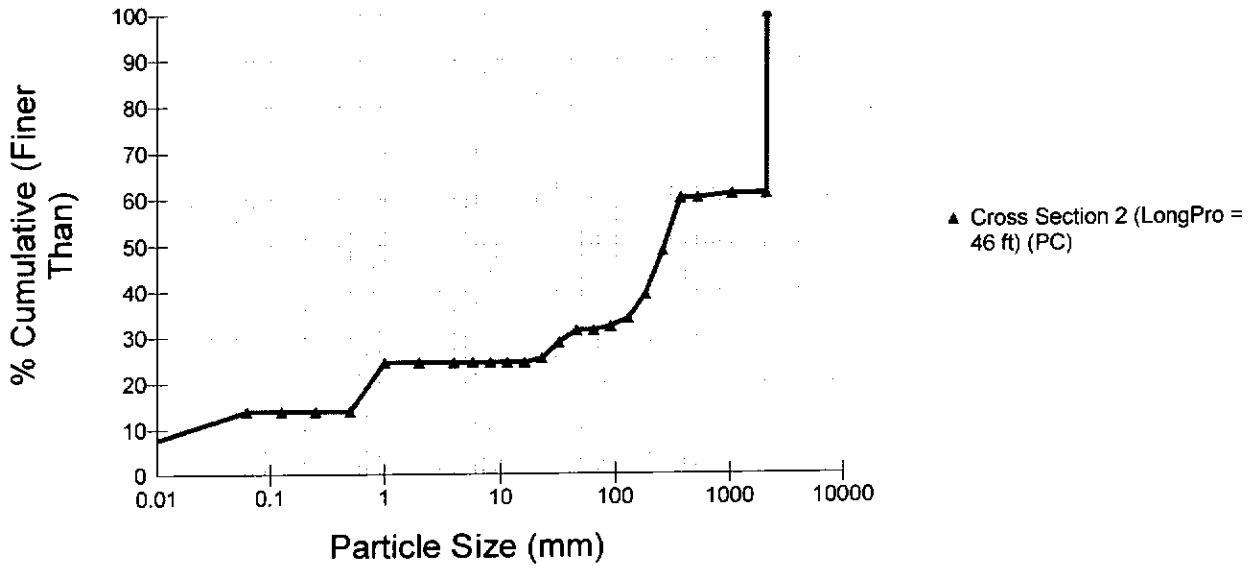
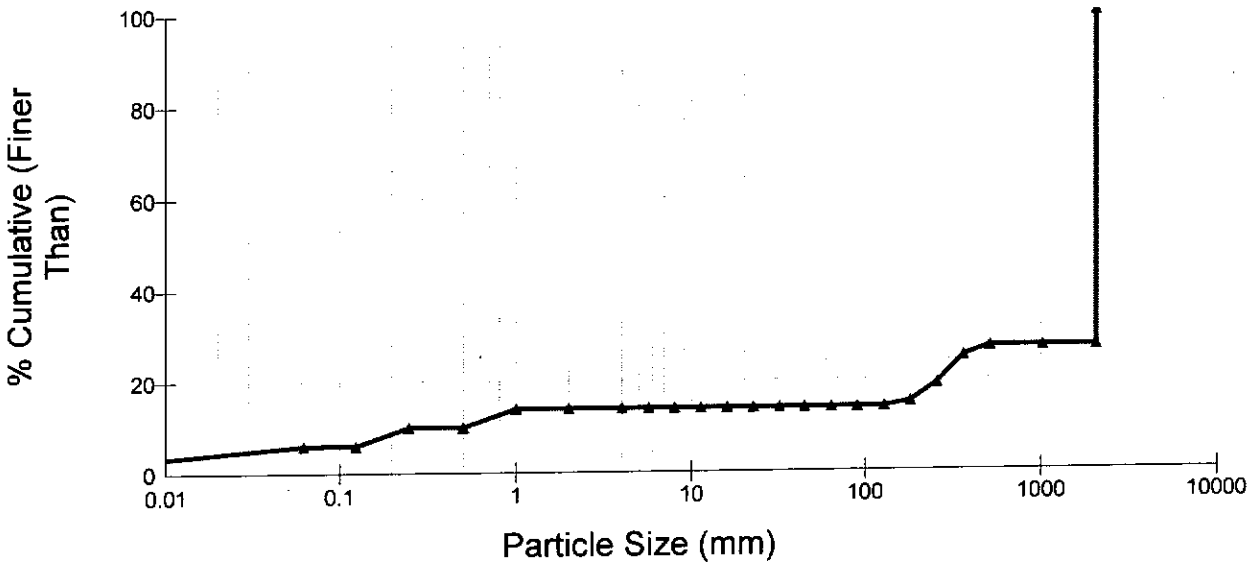
Active Bed Riffle Pebble Count - Cross Section #2 - Reach #4



Active Bed Riffle Pebble Count - Cross Section #6 - Reach #4



Both riffles.

active bed channel

at on long pro

riffle 1 - 96' on long pro riffle 2 - 46' on long pro

Site: Marsh Run 4/26/12 Date:

Location: HUC:

Party: Team 4

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1-96 ft	POOL Riffle 2 - 46	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	6	16										
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND	4											
	Medium	.25 - .50	SAND												
	Coarse	.50 - 1.0	SAND	4	12										
.04 - .08	Very Coarse	1.0 - 2	SAND												
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL												
.31 - .44	Medium	8 - 11.3	GRAVEL												
.44 - .63	Medium	11.3 - 16	GRAVEL												
.63 - .89	Coarse	16 - 22.6	GRAVEL		1										
.89 - 1.3	Coarse	22.6 - 32	GRAVEL		4										
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL		3										
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL												
2.5 - 3.5	Small	64 - 90	COBBLE		1										
3.5 - 5.0	Small	90 - 128	COBBLE		2										
5.0 - 7.1	Large	128 - 180	COBBLE	1	6										
7.1 - 10.1	Large	180 - 256	COBBLE	4	11										
10.1 - 14.3	Small	256 - 362	BOULDER	6	13										
14.3 - 20	Small	362 - 512	BOULDER	2											
20 - 40	Medium	512 - 1024	BOULDER		1										
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK												
Stream Type:			Valley Type:		45 (BDRK)	TOTAL→									

73 (BDRK)

Total 100 | 73 115

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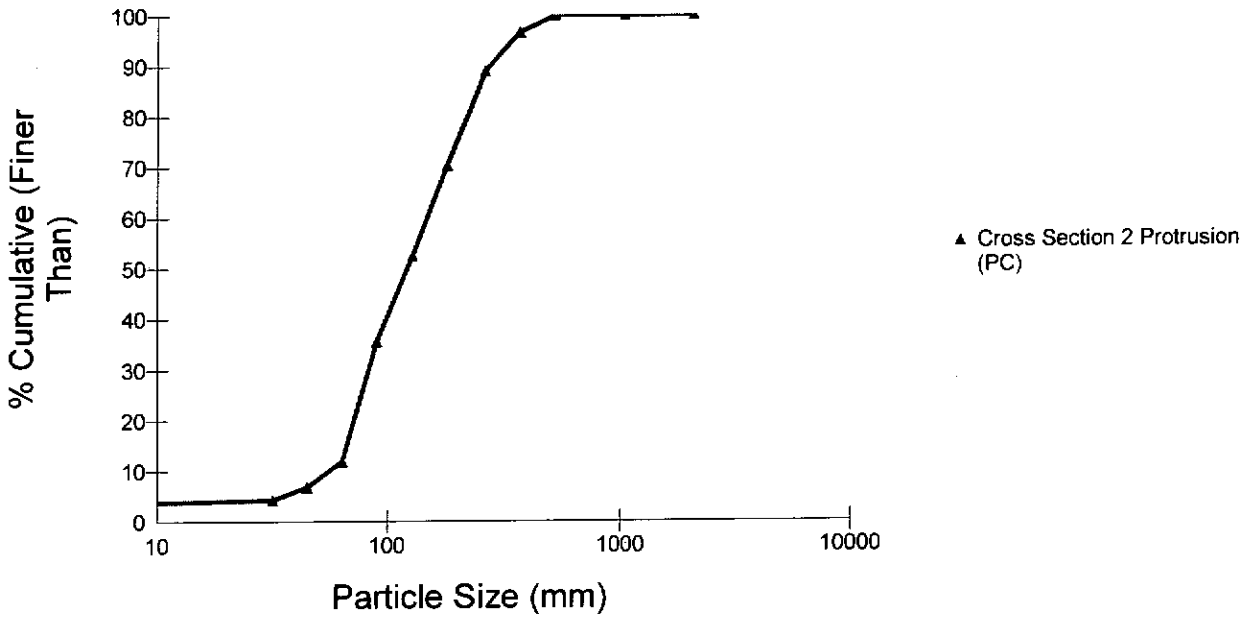
Protrusion Heights - Marsh Run Reach #4



riffle 2

Protrusion Height
@38ft (Long Pro) — i.e., upstream riffle
38-48

Site: Martin Run 4/26/17 Date:
Location: HUC:
Party: Team 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												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	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													
.31 - .44	Medium	8 - 11.3													
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6													
.89 - 1.3	Coarse	22.6 - 32		𝍸			5								
1.3 - 1.8	Very Coarse	32 - 45		𝍸			3								
1.8 - 2.5	Very Coarse	45 - 64		𝍸			6								
2.5 - 3.5	Small	64 - 90	COBBLE	𝍸 𝍸 𝍸			28								
3.5 - 5.0	Small	90 - 128		𝍸 𝍸			20								
5.0 - 7.1	Large	128 - 180		𝍸 𝍸			21								
7.1 - 10.1	Large	180 - 256		𝍸 𝍸			22								
10.1 - 14.3	Small	256 - 362	BOULDER	𝍸			9								
14.3 - 20	Small	362 - 512		𝍸			4								
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												

RIFFLE (1) Reach: Date:
POOL (2) Reach: Date:
COMPOSITE (3) Reach: Date:

Stream Type: ***Valley Type:*** TOTAL→ 118

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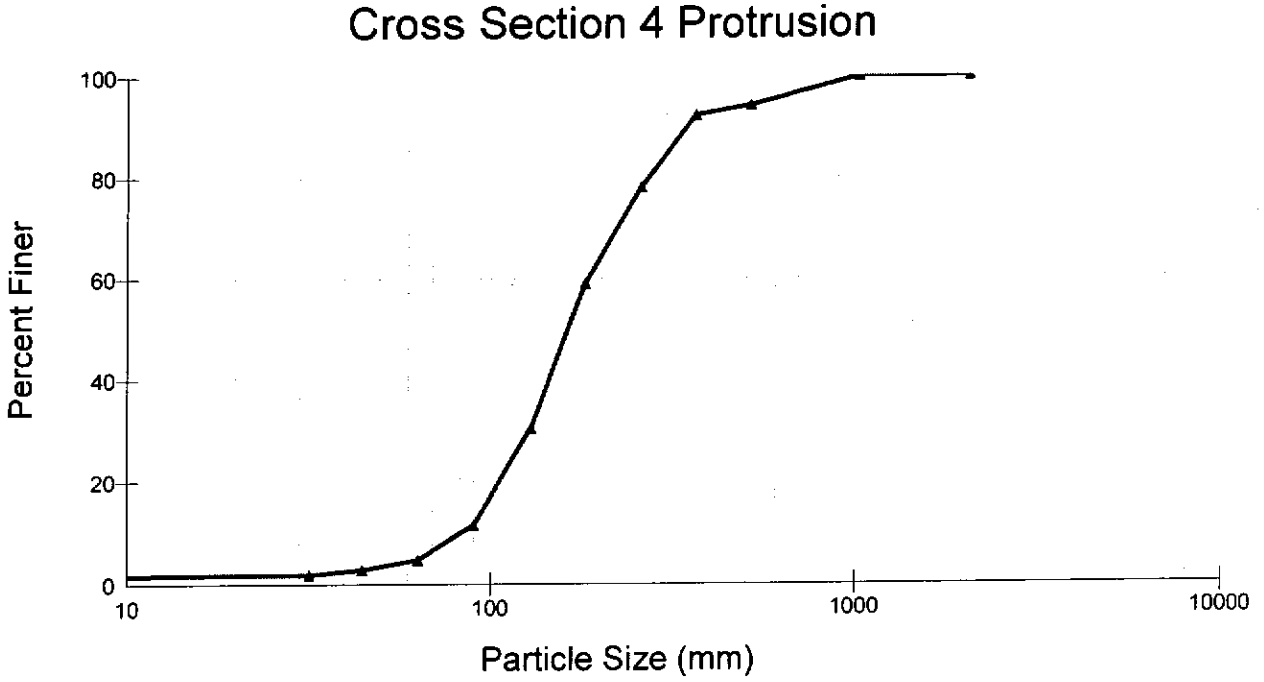
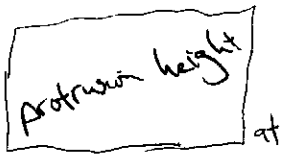

Cross Section 4 Protrusion
Percent Finer
100
80
60
40
20
0
10
100
1000
10000
Particle Size (mm)

riffle 6



at 96' on long pro

Site: Marsh Run 4/26/12 Date:

Location: HUC:

Party: Tegh L

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												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	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													
.31 - .44	Medium	8 - 11.3													
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6													
.89 - 1.3	Coarse	22.6 - 32		⁘			2								
1.3 - 1.8	Very Coarse	32 - 45		⁘			1								
1.8 - 2.5	Very Coarse	45 - 64		⁘			2								
2.5 - 3.5	Small	64 - 90	COBBLE	⌐			7								
3.5 - 5.0	Small	90 - 128		⊠ ⊠			20								
5.0 - 7.1	Large	128 - 180		⊠ ⊠ ⊠			30								
7.1 - 10.1	Large	180 - 256		⊠ ⊠			20								
10.1 - 14.3	Small	256 - 362	BOULDER	⊠ ⌡			15								
14.3 - 20	Small	362 - 512		⁘			2								
20 - 40	Medium	512 - 1024		⌐			6								
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
						TOTAL→	105								

Stream Type: **Valley Type:**

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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**			Location:	**Reach - Reach 4 STA 0+47**
Date:	**4/26/2012**	Stream Type:	**C6/1**	Valley Type:	**VIII**
Observers:	**Team 4**			HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	**31.03**	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	**1.62**	d_{bkf} (ft)
Bankfull Riffle WIDTH	**19.21**	W_{bkf} (ft)	Wetted PERMIMETER ~ (2 * d_{bkf}) + W_{bkf}	**23.11**	W_p (ft)
D50 at Riffle	**122.00**	**Dia.** (mm)	*D50* (mm) / 304.8	**0.40**	***D50*** (ft)
Bankfull SLOPE	**0.0049**	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	**1.38**	**R** (ft)
Gravitational Acceleration	**32.2**	g (ft / sec^2)	Relative Roughness R(ft) / *D50* (ft)	**3.44**	**R / *D50***
Drainage Area	**19.2**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.464**	**u*** (ft/sec)

ESTIMATION METHODS		Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness	$u = [\ 2.83 + 5.66 * Log\ \{\ R / D50\ \}\ ]\ u^*$	**2.72**	ft / sec	**84.42**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19)	$u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ **0.042**	**3.06**	ft / sec	**94.88**	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**	**0.00**	ft / sec	**0.00**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): **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	$u = 1.49 * R^{2/3} * S^{1/2} / n$ $n = 0.39 * S^{0.38} * R^{-0.16}$ $n =$ **0.049**	**2.62**	ft / sec	**81.16**	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) **Darcy-Weisbach (Leopold, Wolman and Miller)**		**2.35**	ft / sec	**72.94**	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** $Q =$ **1.8** **year**		**0.00**	ft / sec	**0.00**	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$		**3.06**	ft / sec	**95.00**	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 **"protrustion 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 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Marsh Run**			Location:	**Reach - Reach 4 STA 0+97**
Date:	**4/26/2012**	Stream Type:	**C6/1**	Valley Type:	**VIII**
Observers:	**Team 4**			HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	**37.75**	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	**1.55**	d_{bkf} (ft)
Bankfull Riffle WIDTH	**24.40**	W_{bkf} (ft)	Wetted PERMIMETER ~ (2 * d_{bkf}) + W_{bkf}	**27.84**	W_p (ft)
D50 at Riffle	**163.50**	**Dia.** (mm)	*D50* (mm) / 304.8	**0.54**	***D50*** (ft)
Bankfull SLOPE	**0.0049**	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	**1.36**	**R** (ft)
Gravitational Acceleration	**32.2**	g (ft / sec^2)	Relative Roughness R(ft) / *D50* (ft)	**2.54**	**R / *D50***
Drainage Area	**19.2**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.461**	**u*** (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 * Log\ \{\ R / D50\ \}\ ]\ u^*$	**2.36**	ft / sec	**89.18**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ **0.044**	**2.90**	ft / sec	**109.42**	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ **0.055**	**2.32**	ft / sec	**87.53**	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 Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ **0.049**	**2.60**	ft / sec	**98.26**	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) **Darcy-Weisbach (Leopold, Wolman and Miller)**	**1.95**	ft / sec	**73.61**	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** $Q =$ **1.8** **year**	**0.00**	ft / sec	**0.00**	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	**3.06**	ft / sec	**95.00**	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 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Marsh Run, Reach 4 - Using Riffle STA 0+47**			
Basin:		Drainage Area: **12256** acres	**19.15**	mi^2
Location:	**Washington Co MD**			
Twp.&Rge: ;		Sec.&Qtr.: ;		
Cross-Section Monuments (Lat./Long.):	**39.511756 Lat / -77.77806 Long**		Date: **04/26/12**	
Observers: **Team 4**			Valley Type: VIII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**19.21**	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}).	**1.62**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**31.03**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**11.86**	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.	**2.38**	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.	**36**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.87**	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.	**28.87**	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.	**0.00485**	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).	**1.15**	

Stream Type **C-6/1** (See **Figure 2-14**)

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

Stream:	**Marsh Run, Reach 4 - Using Riffle STA 0+97**		
Basin:	Drainage Area: **12256** acres	**19.15**	mi^2
Location:	**Washington Co MD**		
Twp.&Rge: ;	Sec.&Qtr.: ;		
Cross-Section Monuments (Lat./Long.):	**39.511756 Lat / -77.77806 Long**	Date: **04/26/12**	
Observers: **Team 4**		Valley Type: VIII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**24.4**	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}).	**1.55**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**37.75**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**15.74**	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.	**2.6**	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.	**65**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**2.66**	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.	**28.87**	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.	**0.00485**	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).	**1.15**	

Stream Type **C-6/1** (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** Location: **Reach 4 Using Riffle STA 0+47**

Observers: **Team 4** Date: **04/26/12** Valley Type: **VIII** Stream Type: **C-6/1**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	21.8	19.2	24.4	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	34.39	31.03	37.75
Mean Riffle Depth (d_{bkf})	1.59	1.55	1.62	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	13.80	11.86	15.74
Maximum Riffle Depth (d_{max})	2.49	2.38	2.6	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.573	1.469	1.677
Width of Flood-Prone Area (W_{fpa})	50.6	36	65	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	2.269	1.874	2.664
Riffle Inner Berm Width (W_{ib})	19.1	17.3	20.9	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.878	0.858	0.898
Riffle Inner Berm Depth (d_{ib})	0.81	0.7	0.93	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.513	0.450	0.575
Riffle Inner Berm Area (A_{ib})	15.3	14.6	16.1	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.453	0.387	0.518
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	24.3	18.5	30					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	17.2	17.2	17.3	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	0.790	0.788	0.791
Mean Pool Depth (d_{bkfp})	1.74	1.73	1.74	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.094	1.088	1.094
Pool Cross-Sectional Area (A_{bkfp})	29.9	29.8	30	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	0.870	0.866	0.874
Maximum Pool Depth (d_{maxp})	2.61	2.48	2.73	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.642	1.560	1.717
Pool Inner Berm Width (W_{ibp})	12.7	10.5	14.9	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.735	0.608	0.861
Pool Inner Berm Depth (d_{ibp})	0.91	0.35	1.48	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.527	0.201	0.852
Pool Inner Berm Area (A_{ibp})	12.8	3.63	22	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.428	0.122	0.733
Point Bar Slope (S_{pb})	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	#####	#####	#####

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	19.8	19	20.7	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.910	0.869	0.950
Mean Run Depth (d_{bkfr})	1.62	1.62	1.62	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.019	1.019	1.019
Run Cross-Sectional Area (A_{bkfr})	32.2	30.7	33.6	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	0.935	0.893	0.976
Maximum Run Depth (d_{maxr})	2.41	2.31	2.51	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.516	1.453	1.579
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	12.2	11.7	12.8	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	21.1	17.1	25	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	0.966	0.784	1.148
Mean Glide Depth (d_{bkfg})	1.2	0.91	1.49	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.755	0.572	0.937
Glide Cross-Sectional Area (A_{bkfg})	24.1	22.7	25.4	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	0.700	0.659	0.740
Maximum Glide Depth (d_{maxg})	1.83	1.35	2.3	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.151	0.849	1.447
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	19.5	11.5	27.5	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	#####	#####	#####
Glide Inner Berm Width (W_{ibg})	19.3	14.4	24.2	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.904	0.840	0.967
Glide Inner Berm Depth (d_{ibg})	0.61	0.47	0.75	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.511	0.506	0.515
Glide Inner Berm Area (A_{ibg})	11.1	10.8	11.3	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.463	0.426	0.500

Step**

Step Dimensions**	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** Location: **Reach 4 Using Riffle STA 0+47**

Observers: **Team 4** Date: **04/26/12** Valley Type: **VIII** Stream Type: **C-6/1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	3.06	ft/sec	Estimation Method	Manning's	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	94.88	cfs	Drainage Area	19.15	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratio	Mean	Min	Max
Linear Wavelength (λ)	241	210	269	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	11.050	9.629	12.334
Stream Meander Length (L_m)	354	342	365	ft	Stream Meander Length Ratio (L_m / W_{bkf})	16.208	15.681	16.735
Radius of Curvature (R_c)	32.8	24	48	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	1.502	1.100	2.201
Belt Width (W_{blt})	89.5	75	104	ft	Meander Width Ratio (W_{blt} / W_{bkf})	4.104	3.439	4.768
Arc Length (L_a)	13.5	7	24	ft	Arc Length to Riffle Width (L_a / W_{bkf})	0.619	0.321	1.100
Riffle Length (L_r)	11.9	1.91	24.2	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.545	0.088	1.110
Individual Pool Length (L_p)	30.5	9.14	74.5	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	1.397	0.419	3.417
Pool to Pool Spacing (P_s)	81.8	37	154	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	3.752	1.696	7.080

Channel Profile

Valley Slope (S_{val})	0.00193	ft/ft	Average Water Surface Slope (S)	0.00485	ft/ft	Sinuosity (S_{val} / S)	1.15
Stream Length (SL)	356	ft	Valley Length (VL)	310	ft	Sinuosity (SL / VL)	1.148387097

Low Bank Height (LBH)	start	2.41	ft	Max Depth (d_{max})	start	1.11	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start	2.171171171
	end	1.34	ft		end	1.35	ft		end	0.992592593

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.014	0.000	0.035	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	2.831	0.019	7.194
Run Slope (S_{run})	0.007	0.003	0.012	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	1.540	0.623	2.456
Pool Slope (S_p)	0.001	0.000	0.002	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.229	0.091	0.419
Glide Slope (S_g)	0.009	0.000	0.035	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	1.779	0.000	7.194
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})	1.82	1.24	2.43	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.144654088	0.779874214	1.528301887
Max Run Depth (d_{maxrun})	2.2	1.53	2.82	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.383647799	0.962264151	1.773584906
Max Pool Depth (d_{maxp})	2.65	1.82	3.21	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.666666667	1.144654088	2.018867925
Max Glide Depth (d_{maxg})	1.8	1.16	2.32	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.132075472	0.729559748	1.459119497
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	0.98	13.91		D_{16}	0.57	0.6		68.54	mm
% Sand	34.31	10.44		D_{35}	0.99	138.86		89.35	mm
% Gravel	21.57	6.95		D_{50}	28.87	268.19		122.31	mm
% Cobble	26.47	17.4		D_{84}	262.58	Bedrock		235.7	mm
% Boulder	16.67	12.17		D_{95}	388.94	Bedrock		339.63	mm
% Bedrock	0	39.13		D_{100}	1023.95	Bedrock		512	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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Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run** Location: **Reach 4 - Using Riffle STA 0+97**

Observers: **Team 4** Date: **04/26/12** Valley Type: **VIII** Stream Type: **C-6/1**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	21.8	19.2	24.4	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	34.39	31.03	37.75
Mean Riffle Depth (d_{bkf})	1.59	1.55	1.62	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	13.80	11.86	15.74
Maximum Riffle Depth (d_{max})	2.49	2.38	2.6	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.573	1.469	1.677
Width of Flood-Prone Area (W_{fpa})	50.6	36	65	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	2.269	1.874	2.664
Riffle Inner Berm Width (W_{ib})	19.1	17.3	20.9	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.878	0.858	0.898
Riffle Inner Berm Depth (d_{ib})	0.81	0.7	0.93	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.513	0.450	0.575
Riffle Inner Berm Area (A_{ib})	15.3	14.6	16.1	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.453	0.387	0.518
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	24.3	18.5	30					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	17.2	17.2	17.3	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	0.790	0.788	0.791
Mean Pool Depth (d_{bkfp})	1.74	1.73	1.74	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.094	1.088	1.094
Pool Cross-Sectional Area (A_{bkfp})	29.9	29.8	30	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	0.870	0.866	0.874
Maximum Pool Depth (d_{maxp})	2.61	2.48	2.73	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.642	1.560	1.717
Pool Inner Berm Width (W_{ibp})	12.7	10.5	14.9	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.735	0.608	0.861
Pool Inner Berm Depth (d_{ibp})	0.91	0.35	1.48	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.527	0.201	0.852
Pool Inner Berm Area (A_{ibp})	12.8	3.63	22	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.428	0.122	0.733
Point Bar Slope (S_{pb})	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	#####	#####	#####

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	19.8	19	20.7	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.910	0.869	0.950
Mean Run Depth (d_{bkfr})	1.62	1.62	1.62	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.019	1.019	1.019
Run Cross-Sectional Area (A_{bkfr})	32.2	30.7	33.6	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	0.935	0.893	0.976
Maximum Run Depth (d_{maxr})	2.41	2.31	2.51	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.516	1.453	1.579
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	12.2	11.7	12.8	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	21.1	17.1	25	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	0.966	0.784	1.148
Mean Glide Depth (d_{bkfg})	1.2	0.91	1.49	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.755	0.572	0.937
Glide Cross-Sectional Area (A_{bkfg})	24.1	22.7	25.4	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	0.700	0.659	0.740
Maximum Glide Depth (d_{maxg})	1.83	1.35	2.3	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.151	0.849	1.447
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	19.5	11.5	27.5	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	#####	#####	#####
Glide Inner Berm Width (W_{ibg})	19.3	14.4	24.2	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.904	0.840	0.967
Glide Inner Berm Depth (d_{ibg})	0.61	0.47	0.75	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.511	0.506	0.515
Glide Inner Berm Area (A_{ibg})	11.1	10.8	11.3	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.463	0.426	0.500

Step**

Step Dimensions**	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** Location: **Reach 4 - Using Riffle STA 0+97**

Observers: **Team 4** Date: **04/26/12** Valley Type: **VIII** Stream Type: **C-6/1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	2.9	ft/sec	Estimation Method	Manning's	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	109.42	cfs	Drainage Area	19.16	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	241	210	269	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	11.050	9.629	12.334
Stream Meander Length (L_m)	364	342	365	ft	Stream Meander Length Ratio (L_m / W_{bkf})	16.208	15.681	16.735
Radius of Curvature (R_c)	32.8	24	48	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	1.502	1.100	2.201
Belt Width (W_{bt})	89.5	76	104	ft	Meander Width Ratio (W_{bt} / W_{bkf})	4.104	3.439	4.768
Arc Length (L_a)	13.5	7	24	ft	Arc Length to Riffle Width (L_a / W_{bkf})	0.619	0.321	1.100
Riffle Length (L_r)	11.9	1.91	24.2	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.545	0.088	1.110
Individual Pool Length (L_p)	30.5	9.14	74.5	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	1.397	0.419	3.417
Pool to Pool Spacing (P_s)	81.8	37	154	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	3.752	1.696	7.080

Channel Profile

Valley Slope (S_{val})	0.00193	ft/ft	Average Water Surface Slope (S)	0.00485	ft/ft	Sinuosity (S_{val} / S)	1.15
Stream Length (SL)	366	ft	Valley Length (VL)	310	ft	Sinuosity (SL / VL)	1.148387097
Low Bank Height (LBH)	start 2.41 / end 1.34	ft	Max Depth (d_{max})	start 1.11 / end 1.35	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start 2.171171171 / end 0.992592593

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.014	0.000	0.035	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	2.831	0.019	7.194
Run Slope (S_{run})	0.007	0.003	0.012	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	1.540	0.623	2.456
Pool Slope (S_p)	0.001	0.000	0.002	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.229	0.091	0.419
Glide Slope (S_g)	0.009	0.000	0.035	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	1.779	0.000	7.194
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})	1.82	1.24	2.43	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.144654088	0.779874214	1.528301887
Max Run Depth (d_{maxrun})	2.2	1.53	2.82	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.383647799	0.962264151	1.773584906
Max Pool Depth (d_{maxp})	2.65	1.82	3.21	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.666666667	1.144654088	2.018867925
Max Glide Depth (d_{maxg})	1.8	1.16	2.32	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.132075472	0.729559748	1.459119497
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	0.98	6		D_{16}	0.57	199		99.12	mm
% Sand	34.31	8		D_{35}	0.99	Bedrock		136.23	mm
% Gravel	21.57	0		D_{50}	28.87	Bedrock		163.53	mm
% Cobble	26.47	5		D_{84}	262.58	Bedrock		299.8	mm
% Boulder	16.67	8		D_{95}	388.94	Bedrock		575.66	mm
% Bedrock	0	73		D_{100}	1023.95	Bedrock		1023.99	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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Worksheet B-4. 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 **FigureB-40**).
14. Plot Manning's 'n' by friction factor (**Figure B-35**) (Example in **Figure B-41**).
15. Plot Manning's 'n' by stream type (**Figure B-36**) (Example in **Figure B-42**).

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	94.98	24.4	1.55	37.75	2.516	0.0048	163.5	0.54	C6/1	0.044	2.54	0.213	5.47

Mean #4, Riffle XS @ STA 0+97

Marsh Rem
4/26/12

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STATION 0+47 (RIFFLE)

Worksheet B-4. 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 **FigureB-40**).
14. Plot Manning's 'n' by friction factor (**Figure B-35**) (Example in **Figure B-41**).
15. Plot Manning's 'n' by stream type (**Figure B-36**) (Example in **Figure B-42**).

$\frac{R}{D_{50}} = 3.44$

$3.44(0.4) = 0$

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	94.95	19.21	1.615	31.03	3.06	.005	122		C611	.042	3.44	0.47	6.5

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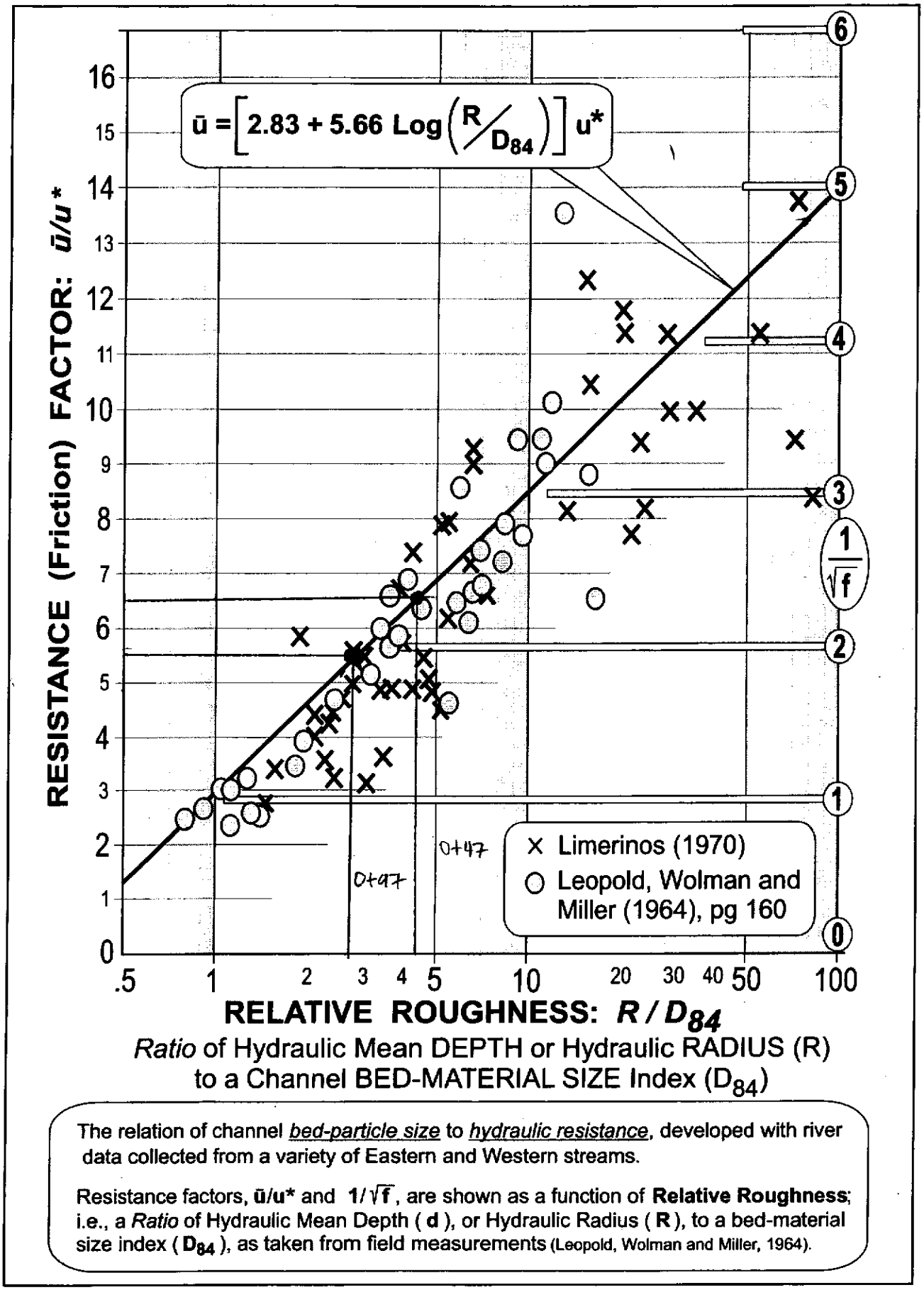

The relation of channel *bed-particle size* to *hydraulic resistance*, developed with river data collected from a variety of Eastern and Western streams.

Resistance factors, $\bar{u}/u^*$ and $1/\sqrt{f}$, are shown as a function of **Relative Roughness**; i.e., a *Ratio* of Hydraulic Mean Depth (**d**), or Hydraulic Radius (**R**), to a bed-material size index (D_{84}), as taken from field measurements (Leopold, Wolman and Miller, 1964).

Figure A-28. Relative roughness (R/D_{84}) *vs.* friction factor ($\bar{u}/u^*$) (Rosgen, 2006b).

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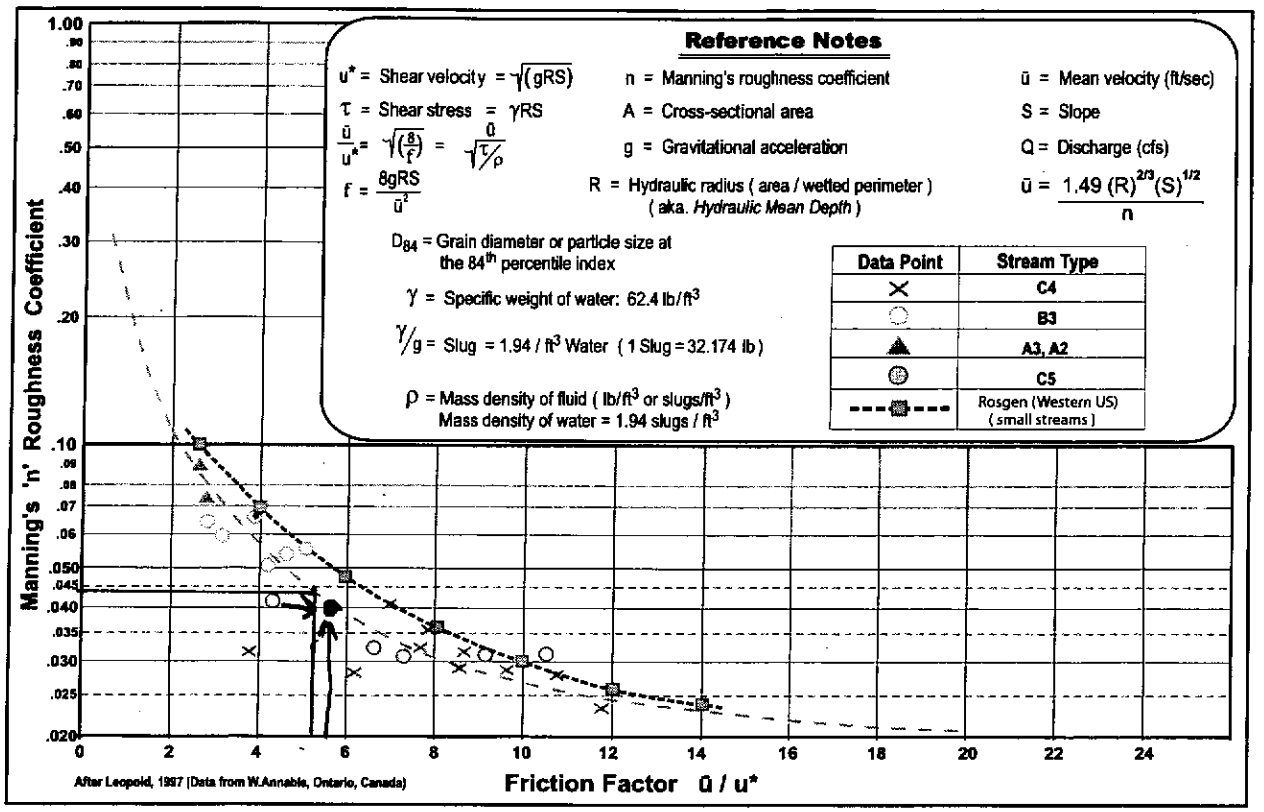

Figure B-35. Friction factor (ū/u*) *vs.* Manning's roughness coefficient 'n' (Rosgen, 2006b).

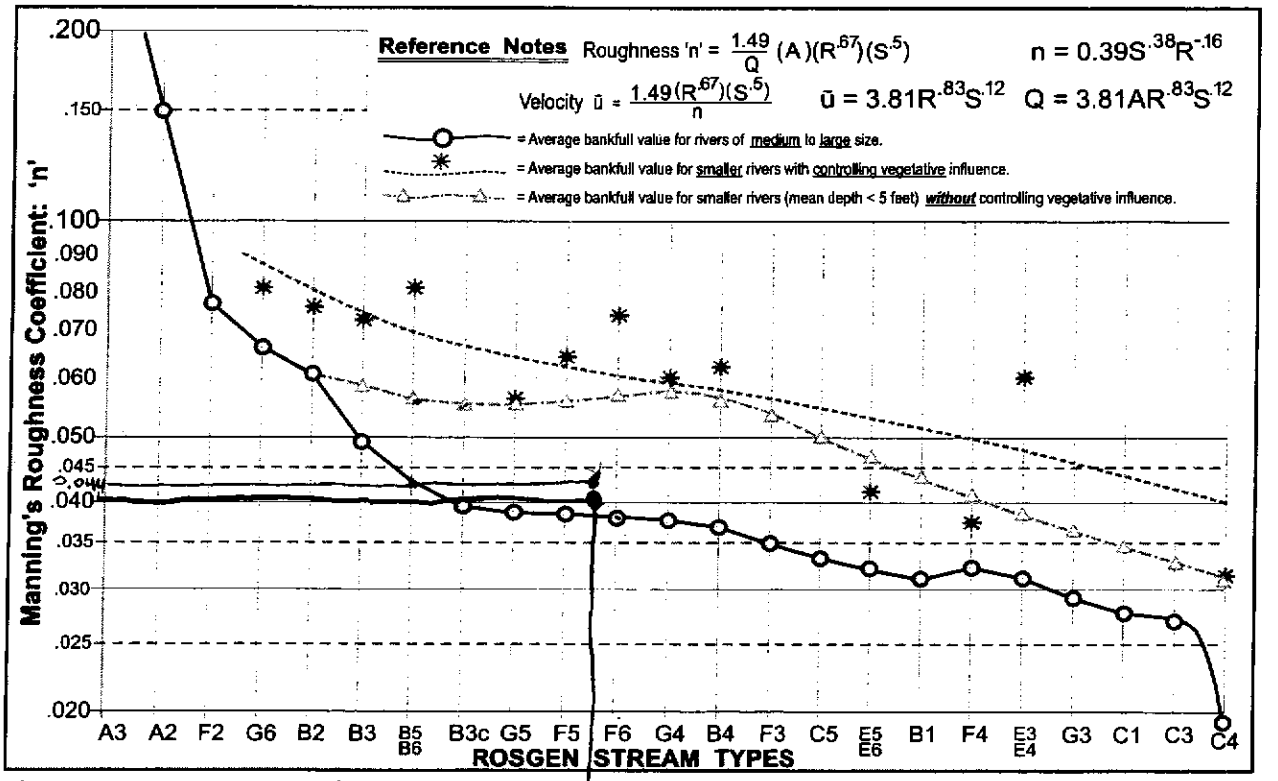

Figure B-36. Manning's 'n' by stream type.

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