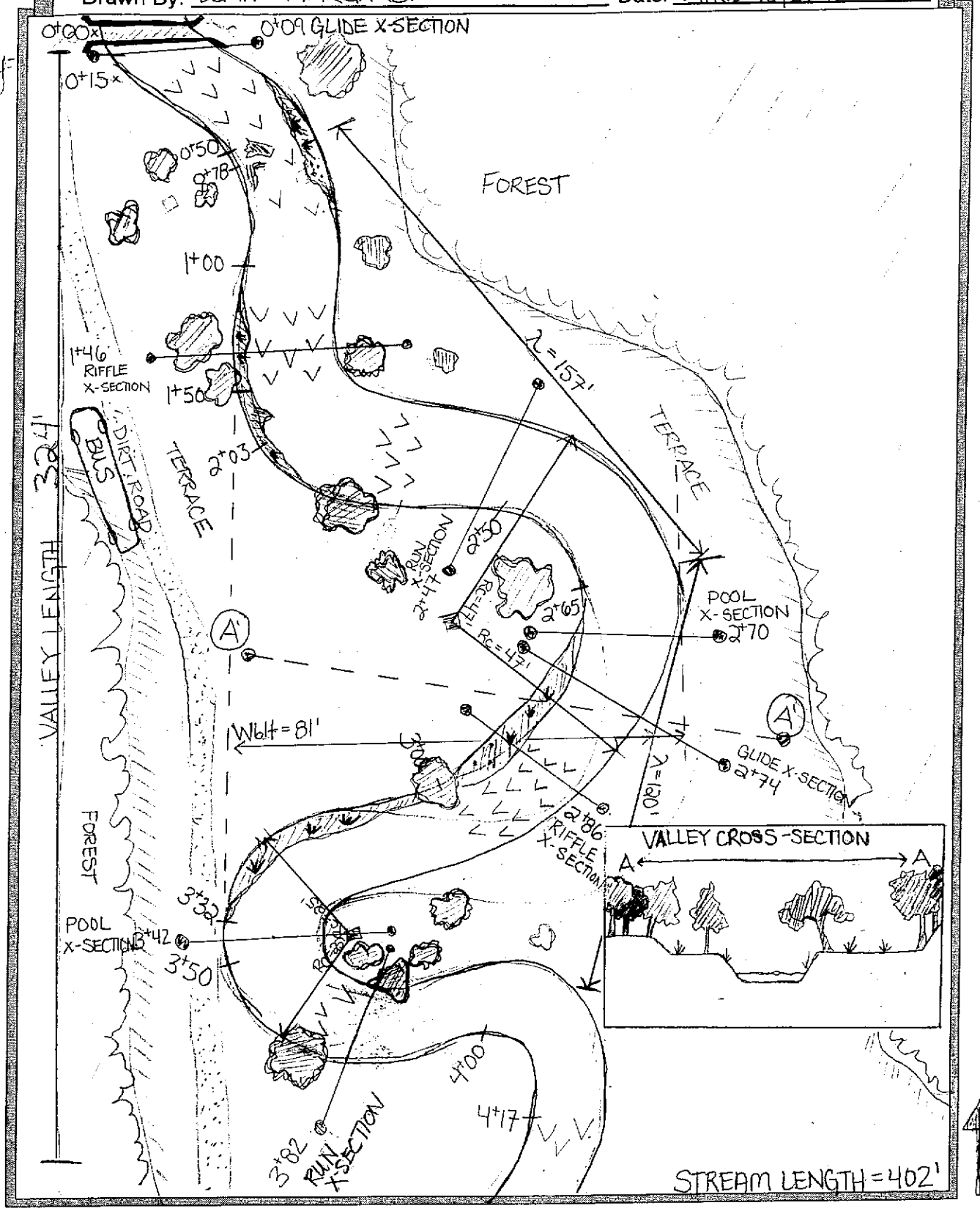
AREA-SITE LOCATION...REACH MAP

Stream: MARSH RUN Reach: 2

Drawn By: LEAH & MARGARET Date: APRIL 18, 2013



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

Station NAME:	Marsh Run	Station Number:	2
LOCATION:	Washington Co., MD		
Period of Record:	49 yrs	Mean Annual DISCHARGE:	cfs
Drainage AREA:	acres 18.9 mi²	Drainage Area Mn Elev:	ft
Reference REACH SLOPE:	ft/ft	Valley Type:	VIII
Stream Type:	F	HUC:	

"BANKFULL" CHARACTERISTICS

Determined from FIELD MEASUREMENT			Determined from GAGE DATA Analysis		
Bankfull WIDTH (W_{bkf})	26.9	ft	Bankfull WIDTH (W_{bkf})	22	ft
Bankfull Mean DEPTH (d_{bkf})	1.25	ft	Bankfull MEAN DEPTH (d_{bkf})	1.8	ft
Bankfull Xsec AREA (A_{bkf})	33	ft²	Bankfull Xsec AREA (A_{bkf})	40	ft²
Wetted PERIMETER (W_P)	28.9	ft	Wetted PERIMETER (W_P)	25.6	ft
Bankfull STAGE (~~Gage Ht~~)	1.71	ft	Bankfull STAGE (Gage Ht)	2.38	ft
Est. Mean VELOCITY (u)	3.25	ft/sec	Mean VELOCITY (u)	2.5	ft/sec
Est. Bkf. DISCHARGE (Q_{bkf})	107.21	cfs	Bankfull DISCHARGE (Q_{bkf})	107.2	cfs

Bankfull DISCHARGE associated with "field-determined" Bankfull STAGE (From Gage Height reading at Staff Plate and tabular Stage-Discharge curve data)	107.21	cfs
Recurrence Interval (Log-Pearson) associated with "field-determined" Bankfull Discharge	2	yrs

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

1.5 Year R.I. Discharge =	71	cfs	10 Year R.I. Discharge =	278	cfs
2.0 Year R.I. Discharge =	104	cfs	25 Year R.I. Discharge =	450	cfs
5.0 Year R.I. Discharge =	192	cfs	50 Year R.I. Discharge =	459	cfs

MEANDER GEOMETRY

Meander Wavelength (L_m)	153	ft	Radius of Curvature (R_C)	47	ft
Belt Width (W_{blt})	62	ft	Meander Width Ratio (W_{blt}/W_{bkf})	2.3	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)	9.6307	0.4066	3.916	0.258
Slope Exponent b)	0.1934	0.3106	0.504	0.4928

Hydraulic Radius $R = A / W_P$	1.56	ft	Manning's "n" at Bankfull Stage	0.04	Coeff.

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

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

Stream: **Marsh Run** Location: **Reach - Reach 2**

Observers: **Team2** Date: **04/18/13** Valley Type: **VIII** Stream Type: **F 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})	24.4	22.4	26.4	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	30.37	27.72	33.01
Mean Riffle Depth (d_{bkf})	1.25	1.24	1.25	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	19.57	18.02	21.11
Maximum Riffle Depth (d_{max})	1.79	1.71	1.86	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.434	1.368	1.500
Width of Flood-Prone Area (W_{fpa})	33.1	32.9	33.2	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.366	1.257	1.474
Riffle Inner Berm Width (W_{ib})	16.7	16.2	17.2	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.689	0.651	0.727
Riffle Inner Berm Depth (d_{ib})	0.38	0.16	0.6	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.309	0.131	0.487
Riffle Inner Berm Area (A_{ib})	6.31	2.81	9.8	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.220	0.085	0.354
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	66.1	26.9	105					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	20.8	19.4	22.3	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	0.854	0.795	0.913
Mean Pool Depth (d_{bkfp})	1.84	1.74	1.94	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.472	1.392	1.552
Pool Cross-Sectional Area (A_{bkfp})	38.3	37.7	38.8	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.259	1.240	1.279
Maximum Pool Depth (d_{maxp})	3.03	2.51	3.55	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.424	2.008	2.840
Pool Inner Berm Width (W_{ibp})	0	0	0	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.000	0.000	0.000
Pool Inner Berm Depth (d_{ibp})	0	0	0	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.000	0.000	0.000
Pool Inner Berm Area (A_{ibp})	0	0	0	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.000	0.000	0.000
Point Bar Slope (S_{pb})	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	0.000	0.000	0.000

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	18.7	14.2	23.2	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.766	0.581	0.950
Mean Run Depth (d_{bkfr})	1.64	1.6	1.67	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.312	1.280	1.336
Run Cross-Sectional Area (A_{bkfr})	30.3	23.6	37	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	0.998	0.778	1.218
Maximum Run Depth (d_{maxr})	2.32	2.25	2.38	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.856	1.800	1.904
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	11.5	8.48	14.5	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	25	21.7	28.3	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	1.027	0.892	1.161
Mean Glide Depth (d_{bkfg})	1.23	1.17	1.28	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.984	0.936	1.024
Glide Cross-Sectional Area (A_{bkfg})	30.4	27.8	33	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	1.001	0.915	1.087
Maximum Glide Depth (d_{maxg})	1.81	1.79	1.83	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.448	1.432	1.464
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	20.6	17	24.2	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	0.000	0.000	0.000
Glide Inner Berm Width (W_{ibg})	0	0	0	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.000	0.000	0.000
Glide Inner Berm Depth (d_{ibg})	0	0	0	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.000	0.000	0.000
Glide Inner Berm Area (A_{ibg})	0	0	0	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.000	0.000	0.000

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

Stream: **Marsh Run, Reach - Reach 2**			
Basin:	Drainage Area: **12173** acres	**19.02**	mi^2
Location:			
Twp.&Rge: **;**	Sec.&Qtr.: **;**		
Cross-Section Monuments (Lat./Long.): **0 Lat / 0 Long**		Date: **04/18/13**	
Observers: **Team2**		Valley Type: VIII(b)	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**26.39**	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}).	**1.25**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**33.01**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**21.11**	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.	**1.71**	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.	**33.17**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.26**	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.	**78**	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.	**0.0058**	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).	**1.24**	

Stream Type **F 1** (See **Figure 2-14**)

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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 2
Date: 4/18/2013	Stream Type: F1	Valley Type:	VIII
Observers:		HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	33.01	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.25	d_{bkf} (ft)
Bankfull Riffle WIDTH	26.39	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	26.96	W_p (ft)
D_{84} at Riffle	78.00	Dia. (mm)	D_{84} (mm) / 304.8	0.26	D_{84} (ft)
Bankfull SLOPE	0.0060	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)	4.77	R / D_{84}
Drainage Area	19.0	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.485	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	3.25	ft / sec	107.21	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.0379	3.48	ft / sec	114.78	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. 2-20) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$		ft / sec		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 $n =$ 0.054	2.44	ft / sec	80.54	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	3.33	ft / sec	110.06	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	3.15	ft / sec	103.90	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	3.25	ft / sec	107.20	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 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run**		Location: **Reach - Reach 2**	
Observers: **Team2**	Date: **04/18/13**	Valley Type: **VIII**	Stream Type: **F 1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	3.24	ft/sec	Estimation Method	FRICTION FACTOR	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	107	cfs	Drainage Area	19.02	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	139	120	157	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	5.704	4.924	6.442
Stream Meander Length (L_m)	153	129	178	ft	Stream Meander Length Ratio (L_m / W_{bkf})	6.278	5.293	7.304
Radius of Curvature (R_c)	36	25	47	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	1.477	1.026	1.929
Belt Width (W_{blt})	62	43	81	ft	Meander Width Ratio (W_{blt} / W_{bkf})	2.544	1.764	3.324
Arc Length (L_a)	76	64	88	ft	Arc Length to Riffle Width (L_a / W_{bkf})	3.119	2.626	3.611
Riffle Length (L_r)	67.5	20.9	114	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	2.769	0.856	4.682
Individual Pool Length (L_p)	26.5	20.9	36.2	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	1.087	0.857	1.484
Pool to Pool Spacing (P_s)	72	67.9	76.1	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	2.954	2.785	3.122

Channel Profile

Valley Slope (S_{val})	0.0072	ft/ft	Average Water Surface Slope (S)	0.006	ft/ft	Sinuosity (S_{val} / S)	1.24
Stream Length (SL)	402	ft	Valley Length (VL)	324	ft	Sinuosity (SL / VL)	1.24

Low Bank Height (LBH)	start	2.05	ft	Max Depth (d_{max})	start	1.67	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start 1.23
	end	3.8	ft		end	1.62	ft	end 2.35

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.014	0.007	0.019	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	2.302	1.088	3.143
Run Slope (S_{run})	0.015	0.006	0.029	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	2.487	1.047	4.823
Pool Slope (S_p)	0.001	0.001	0.003	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.245	0.107	0.457
Glide Slope (S_g)	0.011	0.008	0.015	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	1.895	1.308	2.482
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})	1.92	1.85	1.99	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.54	1.48	1.59
Max Run Depth (d_{maxrun})	2.23	1.8	2.65	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.78	1.44	2.12
Max Pool Depth (d_{maxp})	3.4	3	3.98	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.72	2.4	3.18
Max Glide Depth (d_{maxg})	1.37	1.13	1.6	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.1	0.904	1.28
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	6	7		D_{16}	5.7	6.27		5.27	mm
% Sand	5	5		D_{35}	145.33	41.75		12.08	mm
% Gravel	18	24		D_{50}	Bedrock	128		19.3	mm
% Cobble	9	23		D_{84}	Bedrock	Bedrock		78	mm
% Boulder	4	0		D_{95}	Bedrock	Bedrock		117.14	mm
% Bedrock	58	41		D_{100}	Bedrock	Bedrock		180	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.

Validation of Hydraulic Relationships Using Gaging 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 $\bar{u}/u^*$
19.02	107.2	22	1.8	40	2.7	0.0058	78	0.26	F1	0.04	4.77	0.485	6.67

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SURVEY DATA ⟶ **CROSS - SECTION** 1

SITE: MARSH RUN Date: 4/18/13

Location: RIFFLE 1 STA 1+46

Party / Notes: PHIL + MICHAEL 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	2.11	102.11		100	
2	0+00			1.14		LEFT PIN
3	0+03.1			2.24		
4	0+09.9			3.18		
5	0+21.8			3.76		TOP OF BANK
6	0+23.3			~~5.7~~ 4.54		
7	0+24.5			5.47		BKF (?)
8	0+25.5			6.03		
9	0+26.3			6.49		LEDW
10	0+27.7			6.92		TOE
11	0+30.4			7.15		
12	0+33.0			7.17		TWG
13	0+35			6.94		
14	0+37.4			6.85		
15	0+42.3			6.9		
16	0+44.5			6.8		
17	0+46.1			6.5		REDW
18	0+47.9			6.24		
19	0+49.3			5.99		
20	0+50.4			5.83		
21	0+50.9			5.44		BKK ?
22	0+52.6			~~4.68~~ 5.04		
23	0+52.6			4.68		
24	0+53.7			4.54		
25	0+56.1			3.12		RT TOB
26	0+59.1			2.56		
27	0+61.6			2.66		
28	0+69.8			3.26		LEFT PIN

~~4.04 - 5.44~~

7.17
5.47
1.70

7.17
-3.4
3.77

1+00
2.48

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Marsh Run Team 2 Reach 2

SURVEY DATA → CROSS-SECTION 2

SITE: 2+45.6 RUN X-SECT

Date: 4/16/13

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	0+00			3.3		LEFT PIN
30	0+11			4.36		
31	0+22.2			4.06		L TOB
32	0+25.7			6.3		BKF
33	0+27.2			7.09		L WSEL
34	0+29.8			7.62		EDGE OF SAPROLITE
35	0+30			8.37		
36	0+32.8			8.6		
37	0+35.2			8.68		TWG
38	0+36.1			8.4		
39	0+37.2			8.28		
40	0+38.6			7.84		
41	0+42			8.14		
42	0+45			7.82		
43	0+46.6			7.55		
44	0+47.4			7.34		
45	0+48.1			7.09		R WSE / RT. TOE
46	0+50.8			4.24		R TOB
47	0+64.2			3.9		
48	0+69			3.38		~~LEF~~ RT PIN
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

8.68
-6.3
1.38 = [illegible]
x =
2.76
~~[illegible]~~
~~[illegible]~~

8.68
- 2.76
5.92

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Marsh Run Team 2 Reach 2

SURVEY DATA → **CROSS - SECTION 3**

SITE: POOL 2+70 Date:

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	0+00			4.32		LEFT PIN
30	0+20.8			4.26		L TOB
31	0+23.9			6.6		
32	0+25.1			7.7	7.08	TOE OF SLOPE / L WSEL
33	0+25.7			7.31		
34	0+26.1			8.31		
35	0+27			8.53		
36	0+29.2			8.82		
37	0+31.3			8.9		
38	0+33.4			8.91		TWG
39	0+34.4			8.72		
40	0+35.4			8.52		
41	0+38.2			8.08		
42	0+43.7			7.74		
43	0+44.4			7.1		R WSEL
44	0+45			6.74		
45	0+45.4			6.57		
46	0+45.9			6.4		
47	0+47			4.84		
48	0+48			4.46		
49	0+49			4.26		
50	0+66			4.12		RT PIN
51						
52						
53						
54						
55						
56						
57						
58						
59						

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Marsh Run Team 2 Reach 2

SURVEY DATA ⟹ **CROSS - SECTION 4**

SITE: GLIDE ~~2+76~~ 2+74 Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	0+00			4.19		R. PIN
30	0+16			4.30		
31	0+18			4.79		L. TOB
32	0+19			5.58		
33	0+21.2			7.05		L TOE
34	0+21.8			7.05		L WSEL
35	0+23.3			7.22		
36	0+24.8			7.9		
37	0+26.7			7.9		
38	0+30.2			7.76		
39	0+32.8			7.76		
40	0+34.2			7.94		
41	0+35.5			8.12		
42	0+37.1			7.91		
43	0+38.6			7.67		~~L TOE~~ RT TOE
44	0+39.4			7.44		
45	0+39.6			7.14		R WSEL
46	0+40.6			6.62		
47	0+41.8			6.26		
48	0+42.4			5.78		
49	0+43.4			5.88		RT TOB
50	0+44.7			4.5		
51	0+49			4.08		RT PIN
52						
53						
54						
55						
56						
57						
58						
59						

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(Station 300+116.2)

SURVEY DATA → CROSS - SECTION 3

SITE: Lower Riffle Date: 4/15/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
59	BM	5.11 / 2.73				
60	0	→		2.13		
61	5.7	4.99		4.93		
62	8.2	5.06		5.06		
63	9.4			5.40		
64	9.65			5.83		
65	10.8			6.225		
66	11.48			7.37		
67						
68						
69						
70						
71						
72						
73						
74						
75	Station	0 ~~300~~ + 286			Lower Riffle	
76	BM	2.11				
77	0			3.72		
78	3			4.07		
79	5.15			4.4		top of lowbank
80	7.1			6.64		
81	7.8			6.87		
82	8.25			7.03		
83	9.45			~~7.20~~ 7.23		LEW more hist
84	10.2			7.41		
85	10.7			7.58		
86	10.9			7.75		
87	11.5			7.64		
88	12.65			7.72		

Cont'd →

Reach 2 Team 2

SURVEY DATA → CROSS - SECTION 4

SITE: Lower Riffle ~~300~~ 0 + 286 (Cont'd) Date: 4/12/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
89	13.9			7.84		
90	14.8			7.83		
91	15.1			7.92		
92	16.3			8.09		
93	17.0			8.10		
94	18.0			8.01		
95	18.9			8.21		TLW
96	19.75			7.95		
97	20.05			8.10		
98	~~20.50~~			—		
99	20.65			8.09		
100	21.6			8.17		
101	22.2			8.10		
102	23.0			8.00		
103	23.5			8.02		
104	24.65			7.72		
105	25.9			7.28		REW
106	26.65			7.20		
107	27.3			6.51		~~RBKF~~ ?
108	28.1			6.35		RBKF
109	28.9			6.41		
110	29.9			6.21		
111	31.3			5.11		right low bank
112	34.5			4.68		
113	43			4.24		
114	~~52.6~~			—		
115	54.85			3.79		
116	57.5			3.47		
117						
118	51+57.5 = 108.5					

Now 14.35 − 8.21 = 1.86 ÷ 2 = 6.32

SURVEY DATA ⟹ CROSS - SECTION 1

SITE: Marsh Run Date: [illegible]

Location: Lower Run (300 + 82)

Party / Notes: ACH + Alley Lutz HUC:

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
1	33.9			5.41	5.41	
2	39.0			4.78	4.78	[illegible]
3	~~80~~ 87			5.10		(rounded)
4	BM			2.73		
5						
6	STA 300 + 42.5					Cross Section Lower Pool
7	BM	2.73				
8						
9	.03			4.22		Top of [illegible]
10	2.[illegible]			4.29		
11	4.0			4.56		
12	5.5			4.87		
13	7.0			5.11		
14	9.0			5.05		
15	15.2			5.30		Top LOW bank
16	17.0			5.40		
17	17.9			5.56		
18	18.78 ~~18.80~~			5.83		
19	19.15			6.06		
20	19.55			6.28		
21	19.93			6.73		
22	20.23			6.84		BKF?
23	21.0			6.83		BKF
24	21.5			7.05		
25	22.0			7.265		
26	22.45			7.64		LEW
27	23.80			8.21		
28	24.78			8.34		

Reach 2 Team 2 ~~Reach 1~~

SURVEY DATA ⟹ CROSS - SECTION 2

SITE: Marsh Run Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	Lo[illegible]		Poo[illegible]	[illegible]		Con[illegible]
30	25.70			8.38		
31	26.18			8.51		
32	27.15			8.58		
33	27.47			9.82		
34	28.69			10.[illegible]		TWG
35	29.42			9.95		
36	30.33			9.71		
37	31.10			9.66		
38	31.86			9.60		
39	32.48			9.67		
40	33.38			9.68		
41	34.45			9.65		
42	35.23			9.72		
43	~~35.74~~			~~9.53~~		
44	35.80			9.54		
45	35.98			9.35		step of consolidated material
46	36.45			8.34		
47	37.02			8.20		
48	37.61			7.98		
49	38.37			8.81		
50	38.64			7.59	REW	R[illegible]
51	38.98			7.36		
52	39.48			6.89		
53	40.22			6.41		
54	41.13			5.62		
55	42.40			4.83		Top of [illegible] bank
56	43.3			4.68		
57	63.0			4.00		
58						Begins Heading uphill

LBKF
LEW THL

SURVEY DATA ⟹ CROSS - SECTION 5

SITE: Marsh Run Team 2 Reach Lower Run Date: 4/18/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	0.00			4.05		LEP/TOP OF TERRACE
30	2			4.27		
31	5.3			4.85		
32	6.5			5.18		
33	8.3			5.56		
34	9.5			6.00		
35	10.8			6.20		
36	12.1			6.63		
37	12.7			7.00		LBKF? undercut due to roots
38	13.0			7.64		inner berm
39	13.2			8.45		LEW (land) 8.45
40	13.2			~~7.90~~ 8.09		WS 8.45 - 0.36 backwater behind stump
41	14.8			8.70		backwater behind stump
42	15.7			8.99		
43	16.4			8.88		
44	17.0			8.99		
45	17.4			9.04		
46	18.0			8.79		
47	18.4			8.82		
48	18.8			8.73		
49	19.1			8.75		
50	19.4			8.97		
51	20.1			8.76		
52	20.5			8.97		
53	20.8			8.97		
54	21.3			8.81		
55	21.7			8.81		
56	22.0			8.99		
57	22.5			9.09		
58	23.1			9.25		THL
59	23.5			8.41		

13.2 8.45

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SURVEY DATA ⟹ CROSS - SECTION 6

SITE: Marsh Run, Group 2 — Lower Run — Date: 4/18/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	24.35			8.36		
30	24.8			8.65		
31	25.3			8.42		
32	25.75			8.21		
33	26.4			8.03		REW root-influenced jump
34	26.6			7.98		root of lg. sycamore
35	27.2			5.74		trunk of lg sycamore
36	28.6			6.03		trunk of lg syc.
37	30.2			5.31		trunk of lg syc.
38	31.4			5.54		off tree, on ground - low bank?
39	33.9			5.41		
40	39.0			4.78		
41	87			5.10		
42	BM	2.73				
43						
44						
45						look at all x-s & ensure happy w/ bankful
46						spend more time on riffle 14b
47						other one's area 27
48						our riffle A was to bkfl = 0.93
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

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3.6

SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Ds of Bridge - Marsh Run @ Grimes **Date:** 4/18/13

Location: Reach 2 0 → 416.5

Party / Notes: Team 2 **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	0	2.11		6.58		5.14						Ds of Bridge - Bot. Gl.
2	14			6.08		5.27		4.26				Top Rif
3	28			6.55		5.65						Mid Rif
4	53			6.51		6.05						Mid Rif
5	62.5			6.46		6.13				4.63		Mid Rif
6	78			7.37		6.26				4.96		Start Run
7	84			7.43		6.30		5.4				Mid Run / Pool
8	105			7.5		6.30				1.95		Top Rif / Pool
9	128.5			7.19		6.51						1/4 Rif
XS 10	146			7.21		6.48		5.51		2.64		Mid Rif
11	218			7.63		6.91		6.31		2.97		~~St. Run~~ End Rif
12	236			8.11		7.03						~~Mid~~ St Run
XS 13	245.6			8.61		7.08		6.27		4.02		Mid Run
14	255			9.22		7.07						End Run / St. Pool
15	258.5			9.14		7.05						End Pool / St. Glide
16	267.5			8.52		7.12						End Gl / St Pool
XS 17	270			9.13		7.06		6.33		4.53		Bot Pool
18	273			8.19		7.11						Top Pool / St. Glide
276.5 XS 19	280.5			7.76		7.22		6.57				End Gl / St. Rif
20	301			8.64		7.29						End Rif / St. Run
21	305			9.48		7.32						End Run / St Pool
22	315			9.37		7.32						Bot Pool
23	337			8.88		7.34						Top Pool
XS 24	342.5			9.76		7.31		6.47		4.37		Bot Pool
25	346			9.49		7.24						Top Pool / St Glide
26	373			7.71		7.24						End Glide / St. Rif
XS 27	381.5			8.46		7.5		6.54		4.62		End Rif / St. Run

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SURVEY DATA → LONGITUDINAL PROFILE 2

SITE: Marsh Run @ Grimes **Date:** 4/18/13

Location:

Party / Notes: Team 2 Pg 2 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	386			9.77		7.54						End Run / St. Pool
29	389			9.7		7.50						Bot Pool / St. Glide
30	393.5			9.16		7.58						End Glide / St. Pool
31	401			10.88		7.55						Bot Pool /
32	402.5			9.07		7.58						Ledge
33	405.0			10.49		7.56						Bot. Pool / St. Glide
34	408			8.67		7.52		6.76		4.86		End Glide / St. Rif
35	416.5			8.58		7.58						Rif
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												

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Site:

Date: 4/18/13

Location:

HUC:

Party: Jack V / John

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	ITEM %	% CUM	POOL (2) TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
							Reach:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C				4	5.7	57	2			6		
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50								1			1		
	Coarse	.50 - 1.0					1	1.4	7.1	2			3		
.04 - .08	Very Coarse	1.0 - 2					1	1.4	8.5				1		
.08 - .16	Very Fine	2 - 4	GRAVEL				1	1.4	9.9	1			2		
.16 - .22	Fine	4 - 5.7					2	2.9	12.8	1			3		
.22 - .31	Fine	5.7 - 8								1			1		
.31 - .44	Medium	8 - 11.3					1	1.4	14.2				1		
.44 - .63	Medium	11.3 - 16					1	1.4	15.6	1			2		
.63 - .89	Coarse	16 - 22.6					2	2.9	18.5				2		
.89 - 1.3	Coarse	22.6 - 32					1	1.4	19.9	1			2		
1.3 - 1.8	Very Coarse	32 - 45					1	1.4					1		
1.8 - 2.5	Very Coarse	45 - 64					4	5.7					4		
2.5 - 3.5	Small	64 - 90	COBBLE				1	1.4		1			2		
3.5 - 5.0	Small	90 - 128					3	4.3					3		
5.0 - 7.1	Large	128 - 180					2	2.9		1			3		
7.1 - 10.1	Large	180 - 256					1	1.4					1		
10.1 - 14.3	Small	256 - 362	BOULDER							3			3		
14.3 - 20	Small	362 - 512					1	1.4					1		
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK			50+	43	6.1		15			58		
Stream Type:			Valley Type:			TOTAL→	70			30			100		

BKF Rocks
Target: 5% = 5

70 30

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PROTRUSION | PEBBLE

Site: Riffle (Active Bed) Sta = 151 Date: 4/18/13

Location: HUC:

Party: Jack V. / John B.

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	~~POOL~~ 2 Riffle	COMP. 3	RIFFLE (1) Protrusion TOT #	ITEM %	% CUM	~~POOL~~ (2) Pebble Riffle TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C							7					
	Very Fine	.062 - .125	SAND							1					
	Fine	.125 - .25								1					
	Medium	.25 - .50								1					
	Coarse	.50 - 1.0								2					
.04 - .08	Very Coarse	1.0 - 2					2								
.08 - .16	Very Fine	2 - 4	GRAVEL				5			2					
.16 - .22	Fine	4 - 5.7					12			1					
.22 - .31	Fine	5.7 - 8					4			4					
.31 - .44	Medium	8 - 11.3					10			2					
.44 - .63	Medium	11.3 - 16					12			1					
.63 - .89	Coarse	16 - 22.6					10			6					
.89 - 1.3	Coarse	22.6 - 32					4			4					
1.3 - 1.8	Very Coarse	32 - 45					9			4					
1.8 - 2.5	Very Coarse	45 - 64					9								
2.5 - 3.5	Small	64 - 90	COBBLE				13			8					
3.5 - 5.0	Small	90 - 128					7			6					
5.0 - 7.1	Large	128 - 180					3			6					
7.1 - 10.1	Large	180 - 256								3					
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK							41					
Stream Type:			**Valley Type:**			TOTAL→	100			100					

57%

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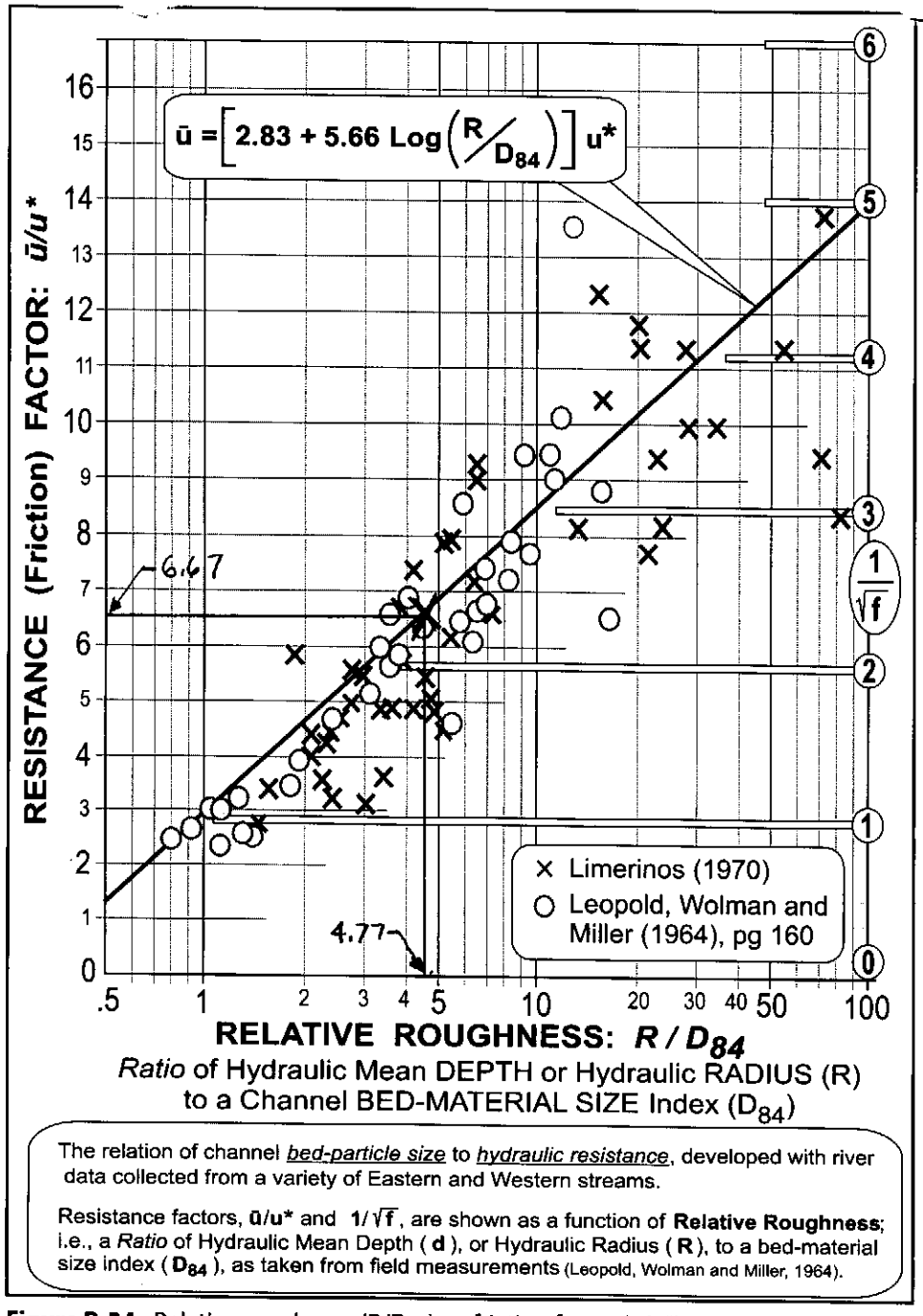

Figure B-34. Relative roughness (R/D_{84}) *vs.* friction factor ($\bar{u}/u^*$).

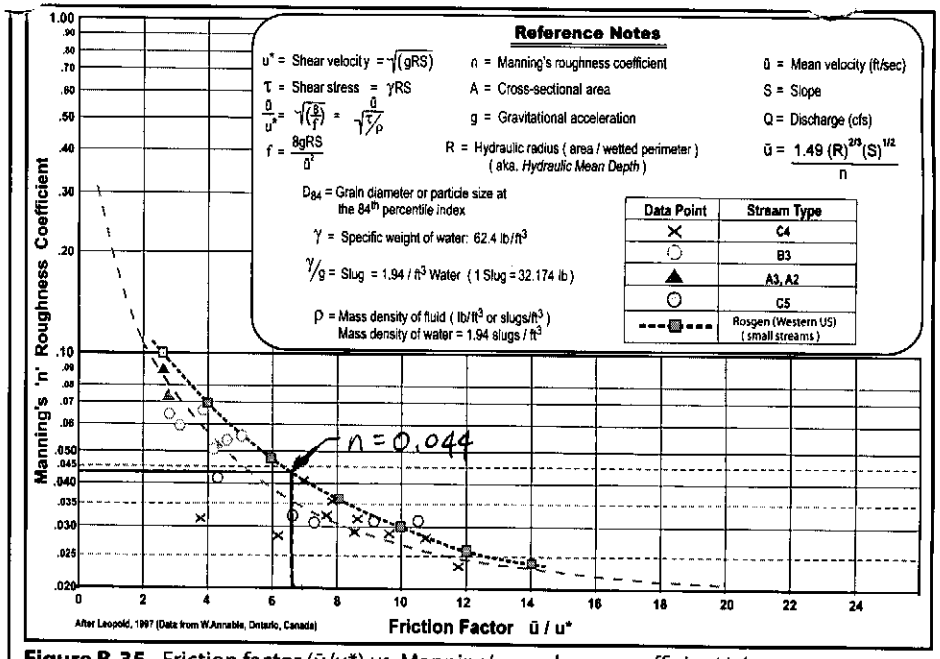

Figure B-35. Friction factor ($\bar{u}/u^*$) *vs.* Manning's roughness coefficient 'n'.

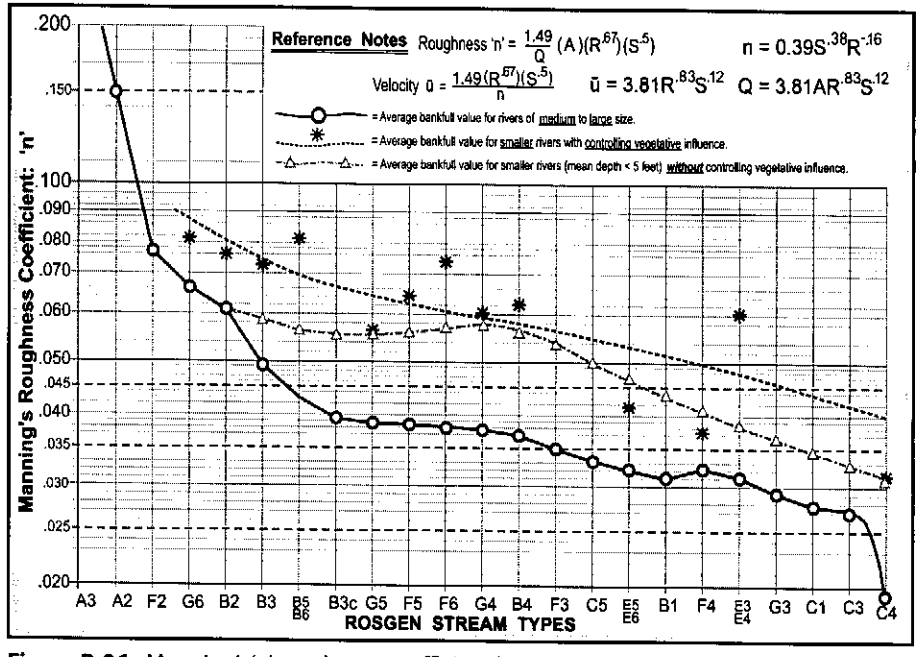

Figure B-36. Manning's 'n' roughness coefficient by stream type.

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