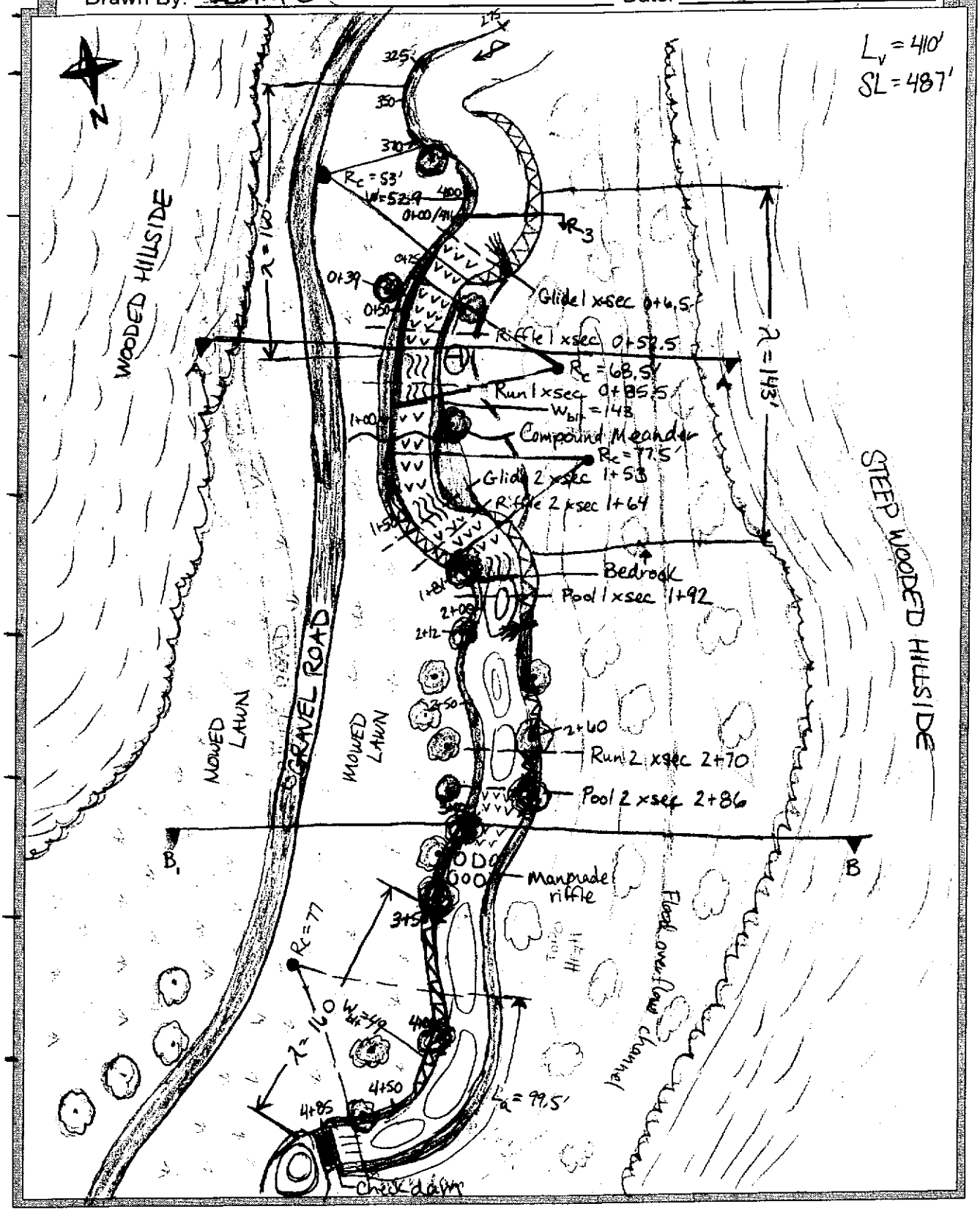
AREA-SITE LOCATION...REACH MAP

Stream: MARSH RUN Reach: 3

Drawn By: TEAM 3 Date: 4.18.13



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 3
Date:	4/18/2013	Stream Type:	F4	Valley Type:	VIII
Observers:	Team 3			HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	27.03	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.26	d_{bkf} (ft)
Bankfull Riffle WIDTH	21.50	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	22.21	W_p (ft)
D_{84} at Riffle	102.67	Dia. (mm)	D_{84} (mm) / 304.8	0.34	D_{84} (ft)
Bankfull SLOPE	0.0056	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)	3.62	R / D_{84}
Drainage Area	18.9	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.469	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	2.80	ft / sec	75.75	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.0417	3.04	ft / sec	82.12	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. 2-20) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.05	2.53	ft / sec	68.49	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 $n =$ 0.053	2.40	ft / sec	64.98	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	2.91	ft / sec	78.77	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 = 2.1 year	2.96	ft / sec	80.00	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	3.96	ft / sec	107.00	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 3**			
Basin:	Drainage Area: **12096** acres	**18.9**	mi^2
Location:			
Twp.&Rge: ;	Sec.&Qtr.: ;		
Cross-Section Monuments (Lat./Long.): **0 Lat / 0 Long**		Date: **04/18/13**	
Observers: **Team 3**		Valley Type: VIII(b)	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**21.5**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.26**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**27.03**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**17.06**	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.	**1.58**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**28.06**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.31**	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.	**10.64**	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.	**0.00559**	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).	**1.19**	

Stream Type **F 4/1** (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 - Reach 1**

Observers: **Team 3** Date: **04/18/13** Valley Type: **XIII** Stream Type: **F 4/1**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	23.6	21.5	25.6	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	26.37	25.70	27.03
Mean Riffle Depth (d_{bkf})	1.13	1	1.26	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	21.33	17.06	25.60
Maximum Riffle Depth (d_{max})	1.51	1.44	1.58	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.347	1.254	1.440
Width of Flood-Prone Area (W_{fpa})	31.9	28.1	35.7	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.350	1.305	1.395
Riffle Inner Berm Width (W_{ib})	9.12	0	18.2	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.424	0.000	0.848
Riffle Inner Berm Depth (d_{ib})	0.35	0	0.69	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.276	0.000	0.551
Riffle Inner Berm Area (A_{ib})	6.33	0	12.7	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.235	0.000	0.469
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	13.1	0	26.3					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	20	16.8	23.1	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	0.847	0.714	0.980
Mean Pool Depth (d_{bkfp})	1.98	1.94	2.01	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.752	1.717	1.779
Pool Cross-Sectional Area (A_{bkfp})	39.3	33.8	44.8	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.490	1.281	1.700
Maximum Pool Depth (d_{maxp})	3.28	3.18	3.37	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.903	2.814	2.982
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})	20.4	18.5	22.3	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.868	0.787	0.947
Mean Run Depth (d_{bkfr})	1.35	1.14	1.56	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.195	1.009	1.381
Run Cross-Sectional Area (A_{bkfr})	27.1	25.4	28.8	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	1.028	0.963	1.094
Maximum Run Depth (d_{maxr})	1.9	1.89	1.9	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.681	1.673	1.681
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	15.7	11.9	19.6	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	25.9	25	26.8	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	1.099	1.060	1.138
Mean Glide Depth (d_{bkfg})	1.06	0.89	1.22	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.938	0.788	1.080
Glide Cross-Sectional Area (A_{bkfg})	27.1	23.9	30.4	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	1.029	0.906	1.152
Maximum Glide Depth (d_{maxg})	1.45	1.26	1.64	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.283	1.115	1.451
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	25.3	20.5	30.1	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	####	0.000	####
Glide Inner Berm Width (W_{ibg})	12.1	0	24.2	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.452	0.000	0.904
Glide Inner Berm Depth (d_{ibg})	0.38	0	0.76	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.429	0.000	0.858
Glide Inner Berm Area (A_{ibg})	9.25	0	18.5	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.388	0.000	0.775

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 3**	
Observers: **Team 3**	Date: **04/18/13**	Valley Type: **XIII**	Stream Type: **F 4/1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	3.97	ft/sec	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	107.2	cfs	Drainage Area	18.9	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	154	143	160	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	6.552	6.072	6.794
Stream Meander Length (L_m)	161	158	165	ft	Stream Meander Length Ratio (L_m / W_{bkf})	6.828	6.688	7.006
Radius of Curvature (R_c)	69	53	77.5	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	2.930	2.251	3.291
Belt Width (W_{blt})	51	49	52.9	ft	Meander Width Ratio (W_{blt} / W_{bkf})	2.166	2.081	2.246
Arc Length (L_a)	95.4	66.5	114	ft	Arc Length to Riffle Width (L_a / W_{bkf})	4.051	2.824	4.820
Riffle Length (L_r)	38.8	16.7	65.5	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	1.647	0.709	2.780
Individual Pool Length (L_p)	22.3	15.4	33.4	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.945	0.654	1.417
Pool to Pool Spacing (P_s)	47.9	35.9	59.9	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	2.035	1.526	2.544

Channel Profile

Valley Slope (S_{val})	0.0067	ft/ft	Average Water Surface Slope (S)	0.00559	ft/ft	Sinuosity (S_{val} / S)	1.19	
Stream Length (SL)	487	ft	Valley Length (VL)	410	ft	Sinuosity (SL / VL)	1.19	
Low Bank Height (LBH)	start 3.26	ft	Max Depth (d_{max})	start 1.61	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start 2.02	
	end 1.82	ft		end 1.19	ft		end 1.53	

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.008	0.003	0.016	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	1.460	0.569	2.826
Run Slope (S_{run})	0.005	0.003	0.007	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	0.907	0.581	1.231
Pool Slope (S_p)	0.002	0.001	0.004	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.327	0.123	0.633
Glide Slope (S_g)	0.003	0.000	0.007	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.515	0.000	1.166
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})	1.47	1.35	1.6	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.3	1.195	1.42
Max Run Depth (d_{maxrun})	1.96	1.64	2.47	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.73	1.451	2.19
Max Pool Depth (d_{maxp})	3.18	2.25	4.02	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.81	1.991	3.56
Max Glide Depth (d_{maxg})	1.6	1.38	1.78	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.42	1.221	1.58
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	22			D_{16}	0.05			17.55	mm
% Sand	17			D_{35}	1			26.63	mm
% Gravel	21			D_{50}	10.64			38.5	mm
% Cobble	6			D_{84}	Bedrock			102.67	mm
% Boulder	0			D_{95}	Bedrock			154	mm
% Bedrock	34			D_{100}	Bedrock			256	mm

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

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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 **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: Marsh Run @ Grimes, MD **Gaging Station Number:** 01617800

Drainage Area (mi²)	Bankfull Discharge Q_{bkf} (cfs)	Bankfull Width W_{bkf}	Bankfull Mean Depth d_{bkf} (ft)	Bankfull Area A_{bkf} (ft²)	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	107.2	22	1.8	40	2.7	0.00559	102.67	.34	F4/1	0.056	4.59	0.53	5.09

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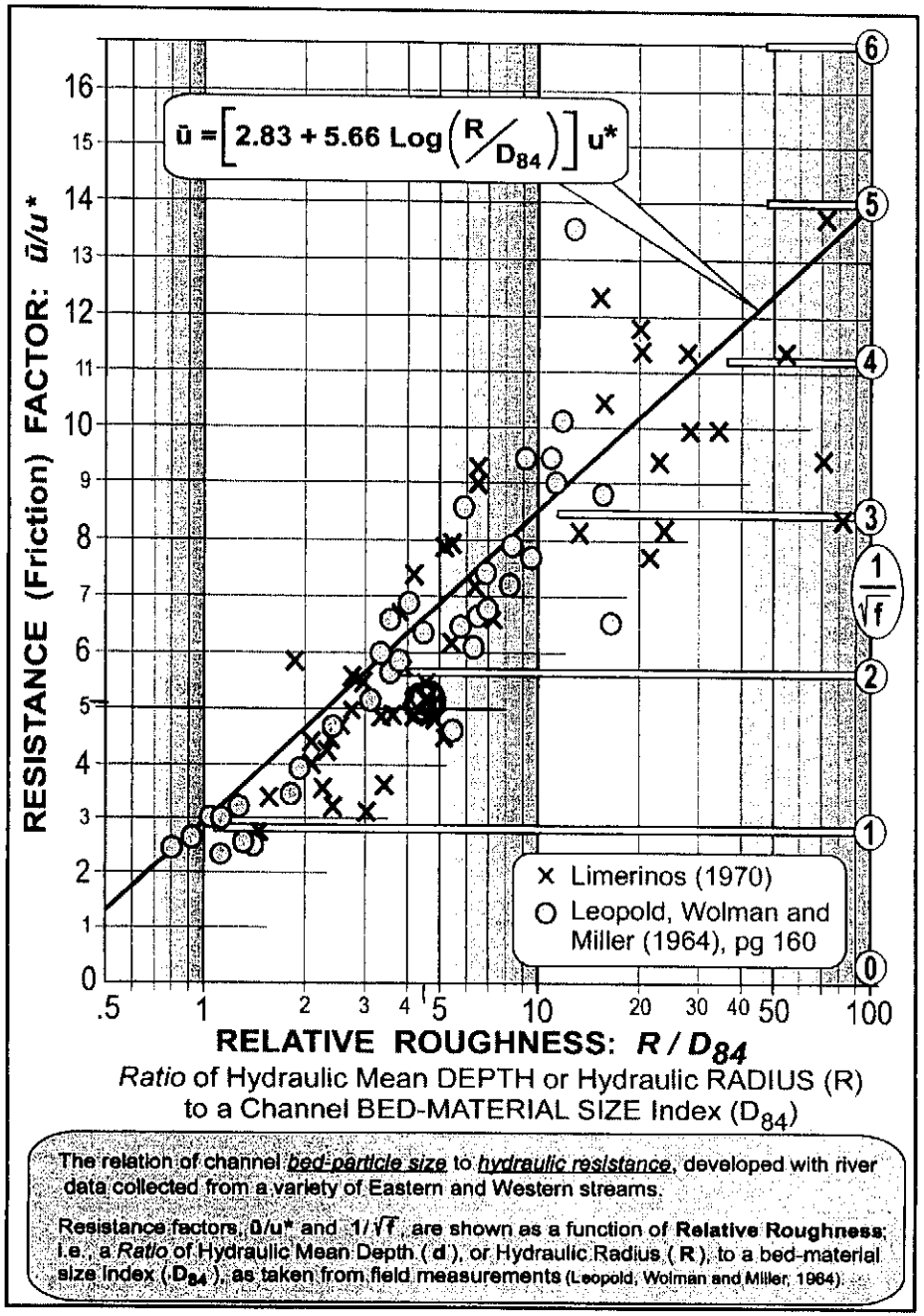

The relation of channel *bed-particle size* to *hydraulic resistance*, developed with river data collected from a variety of Eastern and Western streams.

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

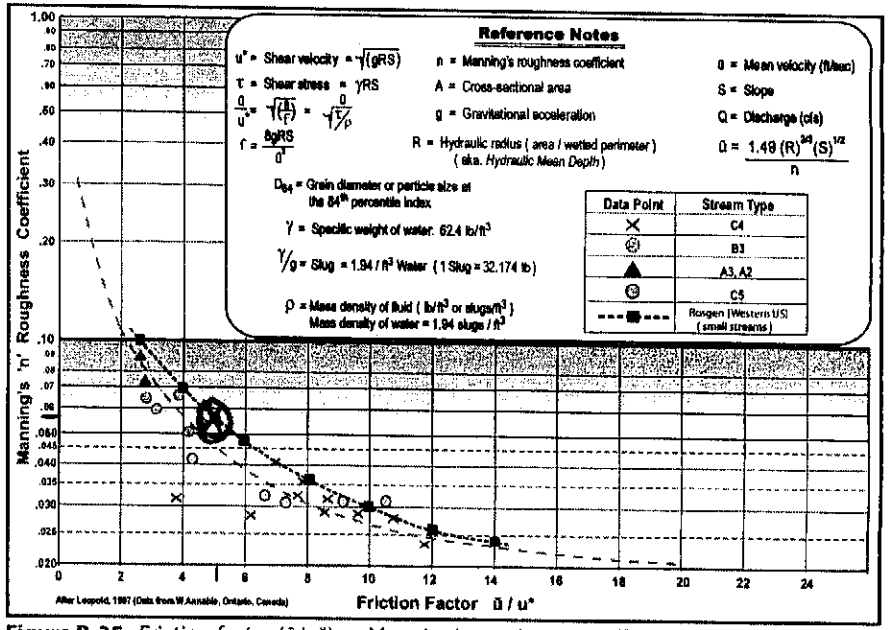

Figure B-35. Friction factor ($\bar{u}/u^*$) *vs.* Manning's roughness coefficient 'n'.

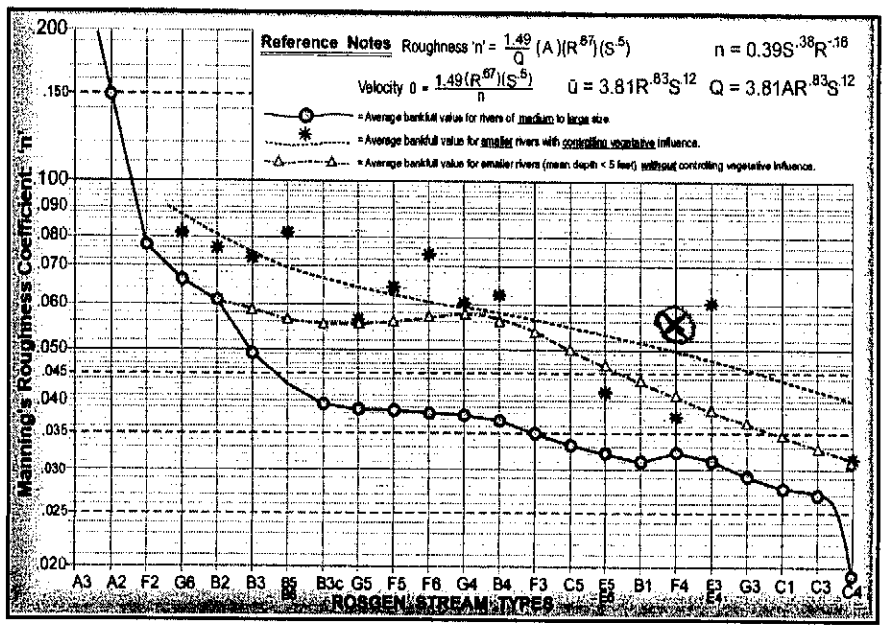

Figure B-36. Manning's 'n' roughness coefficient by stream type.

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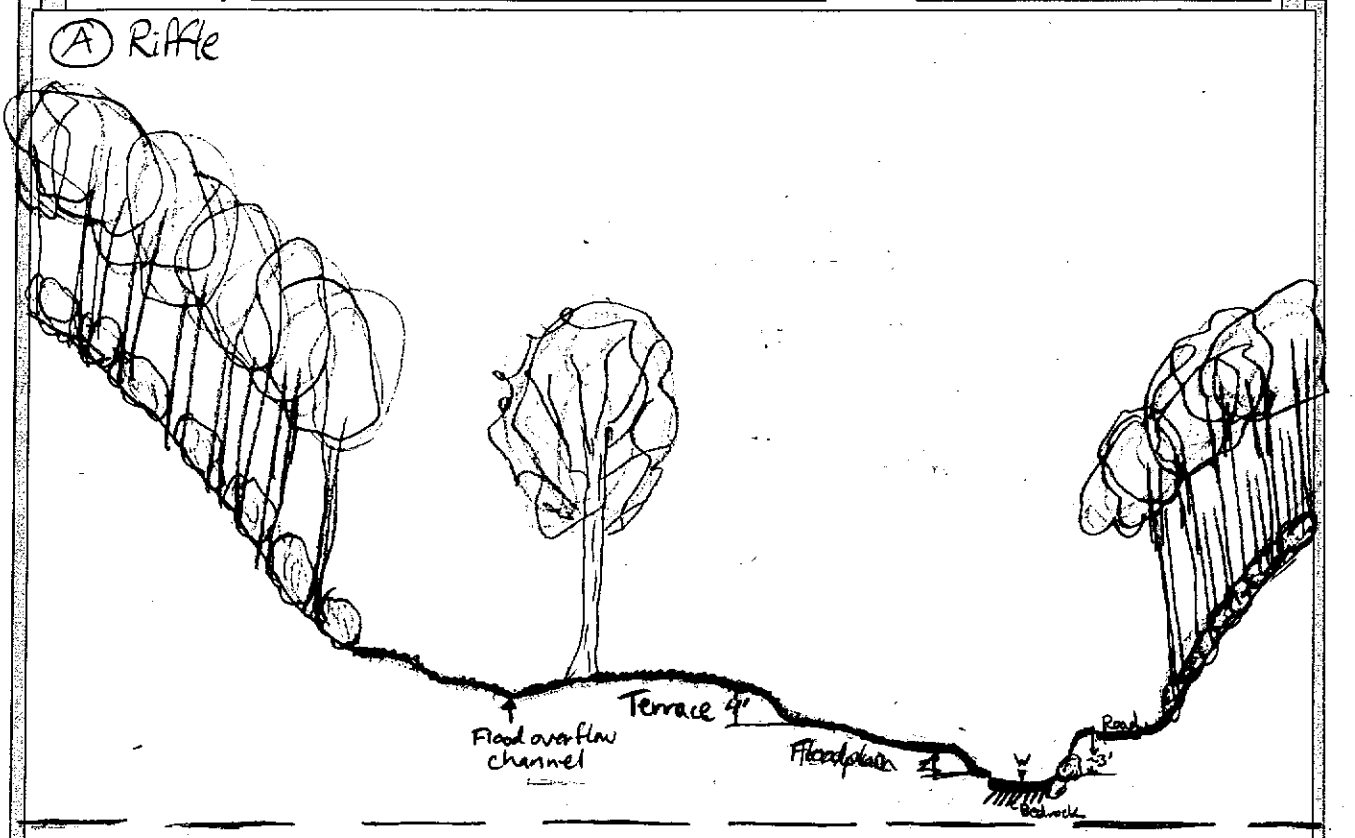
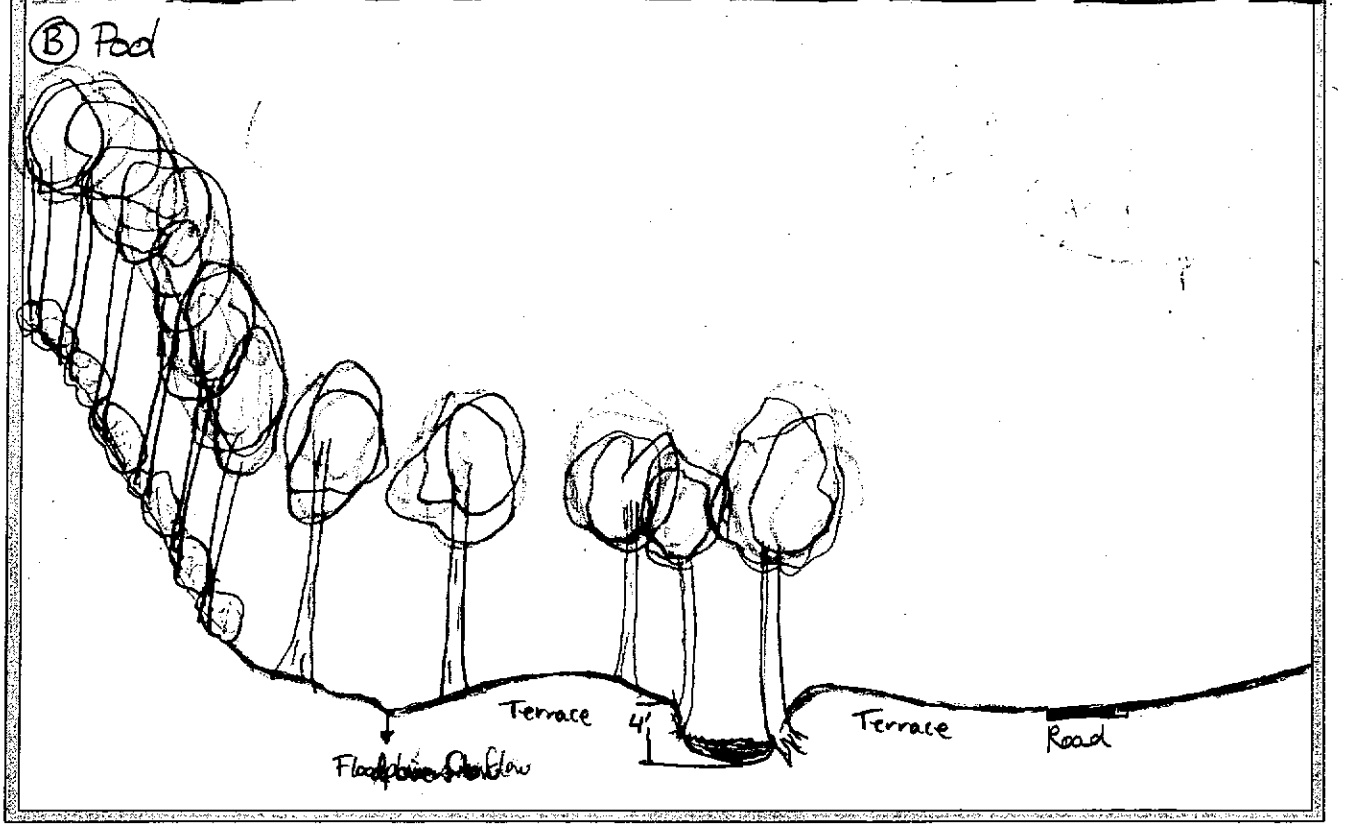
AREA-SITE LOCATION...REACH MAP

Stream: MARSH RUN Reach: 3

Drawn By: TEAM 3 Date: 4.18.13





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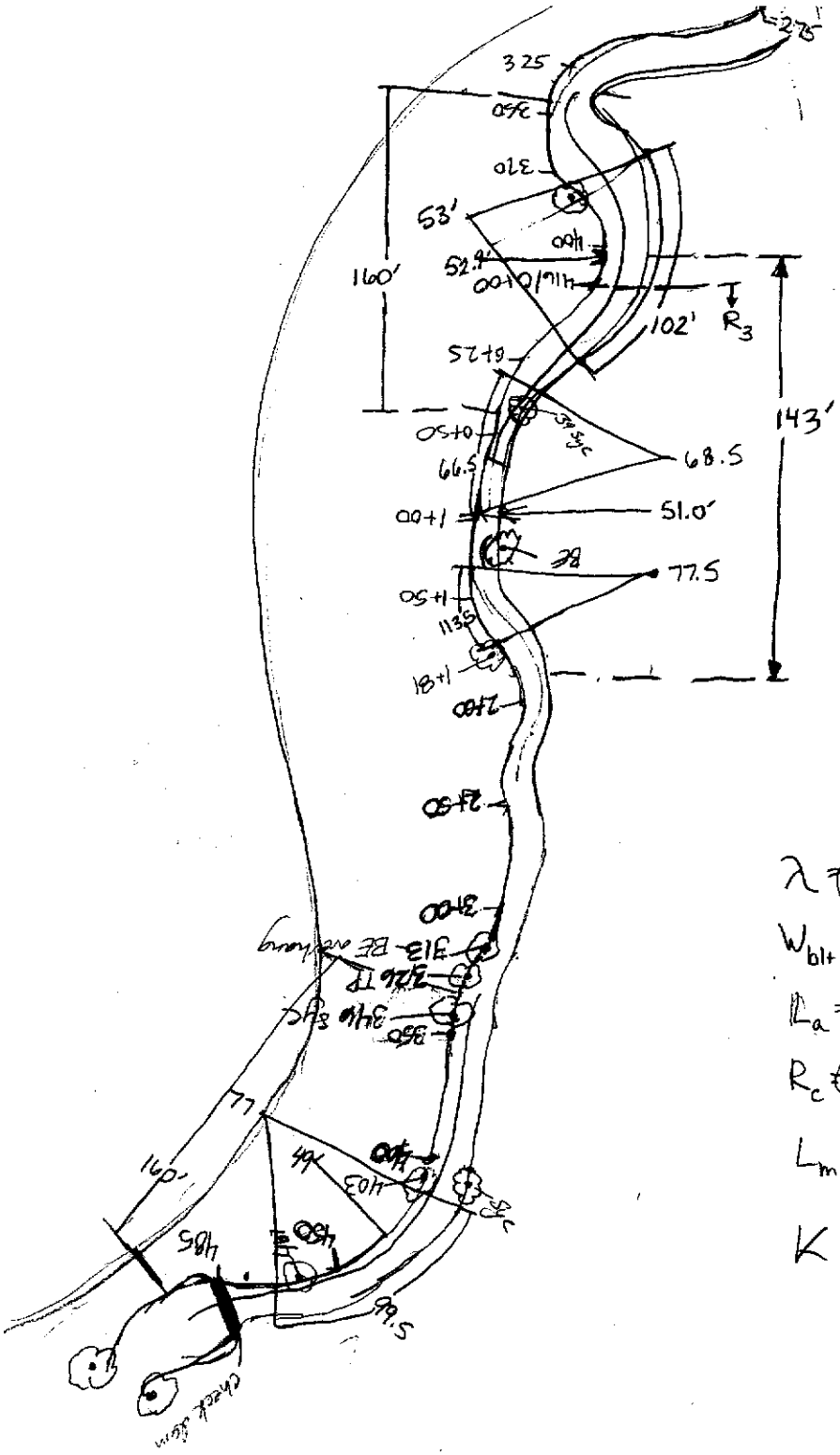


416
-345
71

31.5 x 5 = 157.5
32 x 5 = 160
32 x 5 = 165

$\lambda = 143 + 160 + 160 = 463/3 = \boxed{154.3}$

$W_{blt} = \boxed{52.9} + 51 + \boxed{49} = \boxed{51}$

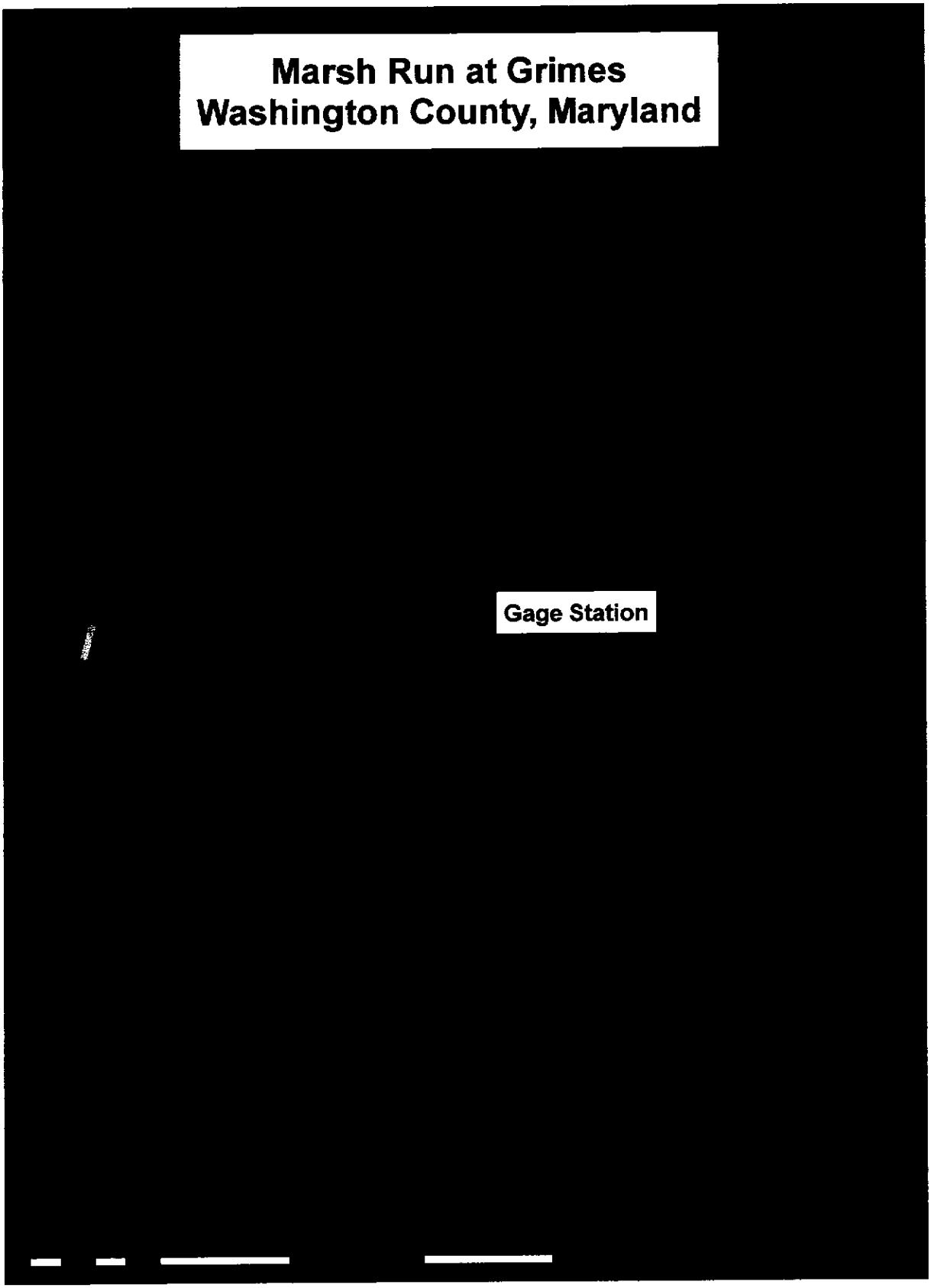
$L_a = 102 + 66.5 + 113.5 + 99.5 = 381.5/4 = \boxed{95.4}$

$R_c = 53 + 68.5 + 77.5 + 77 = 276/4 = \boxed{69}$

$L_m = 160 + 157.5 + 165 = 482.5/3 = \boxed{160.8}$

$K = 48'/410 = \boxed{1.19}$

560



USGS Gage 01617800
DA = 18.9 sq. mi.

Presentation Order – *Second Field Day*

As a team, prepare to present the following items in order:

1. Sketch Map
2. Cross-Section Graphs:
   - Riffle Cross-Section(s)
   - Pool Cross-Section(s)
   - Run Cross-Section(s) (if applicable)
   - Glide Cross-Section(s) (if applicable)
3. Longitudinal Profile Graph
4. Representative Pebble Count for Stream Classification (Graph)
5. Active Bed Riffle Pebble Count for Hydraulic Calculations (Graph)
6. Velocity Computation Form (**Worksheet B-2**)
7. Stream Classification Form (**Worksheet B-1**)
8. Morphological Relations & Dimensionless Ratios Form (**Worksheet B-3**)
9. Validation of Hydraulic Relationships Form (**Worksheet B-4**, **Figures B-34** to **B-36**)

Checklist for Team Folder – *Second Field Day*

Folder Holder: Please collect the following items from your team members and insert into your team folder in the order listed below. Please make sure all corrections have been made following your team presentation & give your completed team folder to Dave.

- ☐ Sketch Map
- ☐ Cross-Section Raw Data and Graphs for all Cross-sections Measured
- ☐ Longitudinal Profile Raw Data and Graph
- ☐ Representative Pebble Count Raw Data and Graph
- ☐ Active Bed Riffle Pebble Count Raw Data and Graph
- ☐ Stream Classification Form (**Worksheet B-1**)
- ☐ Velocity Computation Form (**Worksheet B-2**)
- ☐ Morphological Relations & Dimensionless Ratios Form (**Worksheet B-3**)
- ☐ Validation of Hydraulic Relationships Form (**Worksheet B-4**, **Figures B-34** to **B-36**)
- ☐ USB Drive that includes final RIVERMorph™ project file and any other electronic files you may have (e.g., photos, PowerPoint, etc.)

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Second Field Exercise: Gage Station Site

Overview and General Instructions

Objectives

- Reinforce the geomorphic principles discussed in lecture through field application
- Practice applying the Rosgen Stream Classification System in the field
- Calibrate bankfull discharge and develop or validate regional curves
- Validate hydraulic relationships using gage station data

Scope of Exercise

The class will travel to a local stream and collect the basic morphological parameters necessary for stream classification (**Figure B-1**) and stream morphology at a gage station site, including dimension, pattern, profile and channel materials. The class will be divided into four teams, and each team will be assigned a short stream reach. Your team will be divided into several crews. Each crew will gather a portion of the morphological data and site information required from your reach. By the end of the field session, your team will be able to determine the stream type for your reach. Several forms must be completed using the data you collect in the field. Review the forms before you go to the field so you are familiar with the data requirements (**Worksheet B-1**, **Worksheet B-2** and **Worksheet B-3**). Review the morphological parameters discussed below prior to the exercise.

Field Instructions

1. Perform a toothpick survey with your entire team. Walk your designated reach and look for consistent bankfull indicators and a representative riffle for your stream classification cross-section (see **Figure B-5** for guidelines on selecting a cross-section and **Page B20** for a discussion on identifying bankfull). Estimate the variables in **Table B-2**.
2. As a group, select representative riffle, pool, run and glide cross-sections to survey and select the bankfull elevation at each cross-section. The stream must be free to adjust its boundaries at the riffle cross-sections. More than one cross-section for each bed feature must be measured to obtain a range of values. Note that run and glide bed features may not be present in certain stream types (confirm with Dave the number of cross-sections you need to survey).
3. Divide your team into four crews:
   - Cross-Section Crew (**Page B25**)
   - Longitudinal Profile Crew (**Page B65**)
   - Pebble Count Crew (**Page B91**)
   - Geometry & Sketch Map Crew (**Page B107**)
5. Complete the *Checklist for Second Field Day Tasks* (**Page B5**).
6. Combine all team folder items and give folder to Dave. Also copy all FINAL electronic files to team USB drive (e.g., RIVERMorph™ File, presentation, photos, etc.).

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Checklist for *Second Field Day* Tasks

- ☐ Sketch Map (be sure to include items listed in **Table B-14**, including cross-section locations, meander geometry, stationing and valley cross-section) (**Page B109**)
- ☐ Riffle Cross-Sections: Select (2) *representative* riffles & survey (**Page B25**)
  - ☐ Plot each cross-section and determine bankfull width, bankfull cross-sectional area, bankfull mean depth and bankfull maximum depth (**Page B32**)
  - ☐ Entrenchment ratio: Measure flood-prone area width (**Page B29**)
- ☐ Pool Cross-Sections: Select (2) *representative* pools & survey (**Page B25**)
  - ☐ Measure point bar slope (**Page B30**)
- ☐ Run Cross-Sections: Select (2) *representative* runs & survey (if in a Riffle-Pool system)
- ☐ Glide Cross-Sections: Select (2) *representative* glides & survey (if in a Riffle-Pool system)
- ☐ Longitudinal Profile (through your entire reach) (**Page B65**)
  - ☐ Measure thalweg, water surface, bankfull and lowest bank height (if higher than bankfull)
  - ☐ Note type of feature at each survey point (start riffle, pool, glide, run, etc.)
  - ☐ Tie profile to cross-section in elevation and note the location and the bankfull elevation of the cross-section on the profile
  - ☐ Measure water surface facet slopes and max depth measurements from plotted longitudinal profile
- ☐ Representative Pebble Count for Stream Classification (**Page B93**)
- ☐ Active Bed Riffle Pebble Count for Hydraulic Computations (**Page B93**)
- ☐ Sinuosity (k) (**Page B113**)
- ☐ Linear Wavelength (λ), Stream Meander Length (L_m), Belt Width (W_{blt}), Radius of Curvature (R_c), and Arc Length (L_a): Obtain min., max. and mean values (**Page B113**)
- ☐ Riffle Length (L_r), Pool Length (L_p), and Pool-to-Pool Spacing (P_s) measured from plotted longitudinal profile: Obtain min., max. and mean values (**Page B117**)

Worksheets

- ☐ Stream Classification Form: (**Worksheet B-1, Page B16**)
- ☐ Velocity Computation Form: (**Worksheet B-2, Page B17**)
- ☐ Morphological Relations & Dimensionless Ratios (**Worksheet B-3, Pages B18– B19**)
- ☐ Validation of Hydraulic Relationships (**Worksheet B-4, Pages B134– B135**)
  - ☐ Plotting positions of gage station data on the hydraulic relationships (**Figures B-34** to **B-36, Page B135**)

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MARSH RUN TEAM 3 04·18·13 CROSS SECTIONS PG 1 OF 1C

SURVEY DATA → CROSS - SECTION 1

SITE: glide (UPPER MOST REACH) Date 04·18·13

Location: 0 + 6.5 FT

Party / Notes: TEAM 3 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	×	1.78	101.78			Bm (elev=100. Ft
2	0	CHECKED (USED FOR 1-3)		4.18		Top of Bank
3	3			4.04		
4	6.8			4.06		Top of slope
5	8.0			4.99		slope break
6	9.5			6.01		Bank-full *
7	10.0			6.51		BF? BANKFULL CALL
8	10.5			6.80		
9	11.5			7.23		left toe of SLOPE
10	11.8			7.43		LEW
11	12.8			7.66		CS (CHANNEL SHOT)
12	14.0			7.87		CS
13	15.0			7.80		CS
14	16.5			7.91		CS
15	17.7			7.36		TOP OF PROTRUDING ROCK
16	19.0			7.96		SIDE OF PROTRUDING ROCK
17	20.0			7.92		CS
18	22.0			7.87		CS
19	23.0			7.95		CS
20	24.5			8.17		POS. THALWAG
21	26.0			8.17		"
22	27.0			8.08		CS
23	29.0			7.85		CS
24	31.5			8.06		CS
25	33.0			7.46		REW
26	33.4			7.42		RIGHT TOE OF SLOPE
27	34.0			6.80		POS. BANKFULL (LOW?)
28	35.0			6.53		" BNKFULL CALL

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MARSH RUN TEAM 3 04.18.13

CROSS SECTIONS PG 2 OF 10

SURVEY DATA ⟶ **CROSS - SECTION** 2

SITE: GLIDE #1 (UPPER MOST BENCH) STA 0+6.5 Date: 04.18.13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	35.3			6.44		POS. BNKFULL
30	35.8			6.10		POS. BNKFULL
31	36.0			5.80		POS. BNKFULL (HIGH?)
32	37.0			4.79		SLOPE BREAK
33	38.5			4.05		TOP OF BANK
34	43.0			3.92		TERRACE SHOT
35	47.8			4.28		TERRACE SHOT
36	Riffle #1 @		0+52.5			
37	0			3.40		
38	2			3.58		
39	5			4.13		
40	7.6			4.79		TOB
41	10.6			6.70		BKF?
42	11.6			7.40		BKF
43	13.0			7.55		BENCH
44	14.7			8.05		LEW
45	16.5			8.26		CS
46	18.5			8.38		CS
47	20.0			8.41		CS
48	21.0			8.39		CS
49	22.0			8.33		CS
50	23.0			8.37		CS
51	24.0			8.34		CS
52	25.0			8.38		CS
53	26.0			8.42		CS THALWEG
54	27.0			8.40		CS
55	28.0			8.32		CS
56	29.0			8.23		CS
57	30.0			OBSCURED		REW
58	31.0 <31.5			7.85 <7.23		SLOPE BANKFULL
59	32.3			6.84		BANKFULL

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MARSH RUN TEAM 3 04.18.13

CROSS SECTIONS
PG 3 OF 10

SURVEY DATA → CROSS - SECTION 3

SITE: Date:

RIFFLE #1 @ 0.525

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	33.1			6.45		BNKFULL
30	33.8			6.34		BNKFULL ?
31	35.4			5.43		TOP OF BANK
32	36.4			5.26		TERRACE
33	RUN #1 @ 0+85.5					
34	1.0			5.36		TERRACE
35	9.0			5.39		TERRACE
36	12.0			5.76		SLOPE
37	13.5			6.05		SLOPE
38	15.0			6.51		POS. BNKF
39	15.5			6.83		"
40	16.5			6.99		"
41	18.0			7.16		BENCH
42	20.0			7.28		"
43	21.5			7.66		LEFT TOE OF SLOPE
44	21.6			7.72		LEW
45	22.0			8.23		CS
46	24.0			8.30		CS
47	26.0			8.53		CS
48	30.5			8.73		CS (POS. THALWAG)
49	32.0			8.64		CS
50	33.2			8.18		CS
51	35.8			7.69		REW
52	36.0			7.63		RIGHT TOE OF SLOPE
53	37.0			7.26		
54	37.5			7.05		SLOPE BREAK
55	38.0			6.70		POS. BNKF
56	38.5			6.51		POS. BNKF
57	39.0			6.15		POS. BNKF
58	40.0			5.39		SLOPE
59	41.0			5.18		SLOPE
	45.0			4.64		TOP OF BANK

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MARSH RUN TEAM 3 04.18.13 CROSS SECTIONS PG 4 OF 10 BM

DATA ENTERED

SURVEY DATA → LONGITUDINAL PROFILE 3

SITE: Marsh Run Date: 4/18/13

Location: Reach 3 station 1+53 Glide #2

Party / Notes: HUC:

	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Thalweg Fore-Sight FS ft	Thalweg Elevation Elev. ft	Water Surface Fore-Sight FS ft	Water Surface Elevation Elev. ft	Bankfull Fore-Sight FS ft	Bankfull Elevation Elev. ft	Low Bank HI Fore-Sight FS ft	Low Bank HI Elevation Elev. ft	NOTES e.g. Riffle Run Pool Glide
55	Bench	2.32		2.3								HI of Instrument
56	0.0	6.14										Pin
57	2.0	6.19										terrace
58	5.0	6.69										
59	8.0	7.18										
60	10.0	7.49										
61	11.4	7.825										bankfull? (L)
62	13.0	8.05										bankfull ☆ (L)
63	15.0	8.26										
64	17.2	8.80										LEW
65	19.0	9.20										
66	20.0	9.25										
67	21.5	9.24										
68	23.0	9.165										
69	24.1	9.19										
70	26.0	9.31										
71	27.4	9.11										
72	28.7	9.25										
73	30.0	9.14										
74	31.5	9.23										
75	33.0	9.01										
76	34.0	9.00										
77	35.0	9.04										
78	36.9	8.80										REW
79	38.0	8.57										
80	39.6	8.17										RBKF
81	41.0	7.38										

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MARSH RUN TEAM 3 04.18.13 CROSS SECTIONS PG 5 OF 10

DATA Entered

SURVEY DATA → LONGITUDINAL PROFILE 4

SITE: Marsh Run Date: 04/18/13

Location: Station 1+53

Party / Notes: 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	
82	42.7	6.24										
83	45.0	4.73										R TOB
84	48.	4.72										
85												
86												
87												
88												
89												
90												
91												
92												
93												
94												
95												
96												
97												
98												
99												
100												
101												
102												
103												
104												
105												
106												
107												
108												

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MARSH RUN TRIP 3 04.18.13 CROSS SECTIONS PG 6 OF 10

SURVEY DATA → **CROSS - SECTION 6**

SITE: Marsh Run Station 164 Riffle #2 **Date:** 04/18/13

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0.0		2.32	3.97		
30	2.0			4.02		
31	6.0			4.30		terrace
32	9.0			4.86		
33	11.0			5.21		
34	13.0			5.49		
35	17.0			6.08		
36	19.0			6.16		
37	20.7			6.32		
38	21.5			6.32		
39	25.0			6.42		
40	32.0			6.90		terrace
41	33.5			7.20		
42	34.6			7.68		
43	35.7			8.08		L BKF?
44	36.0			8.14		
45	36.7			7.98		L BKF?
46	37.8			8.37		
47	38.4			8.61		
48	39.4			8.88		LEW
49	40.2			9.28		
50	41.4			9.34		
51	42.7			9.28		
52	44.0			9.34		
53	45.5			9.34		
54	46.8			9.37		
55	47.6			9.42		thalweg?
56	48.5			9.27		
57	50.1			9.11		
58	52.0			9.05		
59	53.8			9.16		

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MARSH RUN TEAM 3 04.18.13 CROSS SECTIONS PG 7 OF 10

SURVEY DATA ⟶ **CROSS - SECTION 7**

SITE: Marsh Creek Station 164 Date: 04/18/13

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	54.4			9.11		
30	56.2			9.00		
31	58.7			8.79		REW
32	59.8			8.64		
33	61.0			8.00		
34	62.4			6.75		
35	62.9			4.84		
36	63.7			4.59		R TDB
37	68.0			4.51		
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

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MARSH RUN TOUR 3 04·18·13 CROSS SECTIONS PG 8 OF 10

SURVEY DATA ⟶ **CROSS - SECTION 5**

SITE: XS Pool @ STA 1+92 **Date:**

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM			2.15		
30	1			3.78		Terracy
31	3			3.75		↓
32	5			4.02		
33	7			4.57		Slope Break
34	8			5.2		Slope
35	8.9			5.95		Slope
36	9.3			7.02		BKf?
37	10			7.62		BKf ?
38	10.8			8.15		Bkf low
39	11.2			8.69		L EOW
40	12			8.96		Channel
41	13			9.01		" "
42	14.5			9.41		" "
43	16			9.77		" "
44	18			10.22		" "
45	19.5			10.77		" "
46	21			11.11		" "
47	22			11.21		Thalwg
48	23.5			10.94		Channel
49	25			10.61		channel
50	26			10.16		" "
51	27			9.97		" "
52	28.5			9.55		" "
53	30.5			9.04		" "
54	31.4			8.65		R EOW
55	32.3			8.4		
56	33.4			7.84		BKf?
57	34			7.61		BKf?
58	35			6.8		Slope
59	36.2			6.29		Slope Break

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MARSH RUN TOM 3 04.18.13 CROSS SECTIONS PG 9 OF 10

SURVEY DATA ⟹ **CROSS - SECTION 8**

SITE: Pool XS @ 1+92 Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	38			5.8		Bank
30	43			5.28		
31	48			4.4		Terrace
32	51			4.39		Terrace
33	Run XS @ 2+70					
34	BM	1.30		2.15		(TP)
35	0.0			4.00		TERRACE
36	4.0			3.72		TERRACE
37	9.0			3.63		TOP OF BANK
38	9.7			4.21		SLOPE BREAK
39	11.0			5.21		SLOPE
40	11.5			6.11		slope LBF?
41	11.8			6.39		LBKF?
42	12.0			7.04		
43	12.4			7.65		LEW
44	13.0			8.14		Channel
45	14.0			8.57		Channel
46	16.6			8.68		
47	20.0			8.93		THALWAG
48	25.0			8.78		
49	28.0			8.56		
50	29.0			8.46		
51	30.2			7.67		REW
52	30.5			7.08		Slope
53	31.0			6.63		RBKF?
54	31.4			6.00		RBKF?
55	31.8			5.62		RBKF?
56	32.5			5.21		Slope
57	34.0			4.74		RTOB
58	37.0			4.38		terrace
59	40.0			4.00		

45.0

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3.90

MARSH RUN TRIP 3 04.18.13 CROSS SECTIONS PG 10 OF 10

SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: MARSH RUN Pool @ STATION 286 **Date:**

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	TP			1.34		
30		1.94				
31	1.0			3.88		terrace
32	3.0			3.55		
33	6.5			3.33		
34	8.0			3.62		slope
35	10.0			4.37		slope break
36	11.4			5.48		LBF(?)
37	11.5			6.74		
38	13.0			7.72		LEW
~~39~~	~~12.2~~			~~5.94~~		~~tree root, eroded bank~~ → rod on tree root on eroded bank 04/18/13
40	13.5			8.05		in channel / root material
41	14.2			9.8		
42	16.8			10.04		thalweg?
43	17.5			9.65		
44	19.0			9.45		
45	20.5			9.10		
46	22.0			8.94		
47	23.5			8.79		
48	24.5			8.82		
49	26.0			8.36		
50	27.0			8.28		
51	28.0			7.64		REW
52	28.2			7.38		toe of slope
53	28.5			6.86		RBKF (?)
54	28.8			6.36		RBKF (?)
55	29.5			5.78		slope RBKF (?)
56	30.6			4.92		slope break
57	32.1			4.40		RTOB
58	35.0			4.45		terrace
59	39.0			4.48		terrace

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Team 3 - Reach 3

Site: Marsh Run Date: 4/18/13

Location: Representative HUC:

Party: RE BS

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
							Reach:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C	////	~~////~~ ~~////~~ ~~////~~ ///										
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND	////	//										
	Medium	.25 - .50	SAND	//	////										
	Coarse	.50 - 1.0	SAND	//											
.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		/										
.89 - 1.3	Coarse	22.6 - 32	GRAVEL												
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL		/										
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	/											
2.5 - 3.5	Small	64 - 90	COBBLE	/	/										
3.5 - 5.0	Small	90 - 128	COBBLE		//										
5.0 - 7.1	Large	128 - 180	COBBLE		/										
7.1 - 10.1	Large	180 - 256	COBBLE		/										
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK	~~////~~ ~~////~~ ~~////~~											
Stream Type:			**Valley Type:**	~~////~~ ~~////~~ ~~////~~ ////		TOTAL→									

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Protusion

Site: Marsh RUN Date: 4/18/13

Location: Reach 3 HUC:

Party: Team 3 BS, RE

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:			Reach:		
				Date:			Date:			Date:			Date:		
	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		II											
.22 - .31	Fine	5.7 - 8		III											
.31 - .44	Medium	8 - 11.3		IIII											
.44 - .63	Medium	11.3 - 16		IIII											
.63 - .89	Coarse	16 - 22.6		~~IIII~~ ~~IIII~~ ~~IIII~~ IIII											
.89 - 1.3	Coarse	22.6 - 32		~~IIII~~ ~~IIII~~ IIII											
1.3 - 1.8	Very Coarse	32 - 45		~~IIII~~ ~~IIII~~ IIII											
1.8 - 2.5	Very Coarse	45 - 64		~~IIII~~ ~~IIII~~ IIII											
2.5 - 3.5	Small	64 - 90	COBBLE	~~IIII~~ IIII											
3.5 - 5.0	Small	90 - 128		~~IIII~~ ~~IIII~~ I											
5.0 - 7.1	Large	128 - 180		~~IIII~~ I											
7.1 - 10.1	Large	180 - 256		II											
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												
Stream Type:			**Valley Type:**			TOTAL→									

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