Stream Design Workbook

River = Catherine Creek
Reach = CC-44 Phase II

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This workbook is intended to be used as a tool to calculate appropriate target channel form based on standard hydraulic equations and emperical formulea. It is the user's responsibility to ensure that the calculated values are appropriate. All calculated estimates should be verified with more detailed modeling during the design process.

Enter values in blue-shaded cells beginning in column A, then input a guess of max depth in columns G, H, and I. Column "G" is the max depth of the channel in a riffle section at low flow; column "H" is the max depth of the channel in a riffle section at bankfull, and column "I" is the max depth of floodplain adjacent to the main channel. This should be an iterative process, and may require that one or more of the blude-shaded cells are changed multiple times. Once an initial guess in columns G, H, and I are put in, click on the macro button which will solve for the appropriate discharge by changing the max water depth. The low flow is calculated at critical flow depth assuming the riffles control the water surface profile, bankfull and floodplain calculations utilize normal depth calculations. If an "Adjust" message occurs in the bottom width of the bankfull channel (column H) you need to reduce the low flow depth, steepen the low flow side slopes, or increase the bankfull channel width using the width to depth ratio (increase) so that the bottom width of the bankfull channel is equal to or greater than the top width of the low flow channel. Continue to the "Bedload" worksheet to validate the sediment transport capacity of the proposed channel geometry from this sheet. This step may also require several iterations including adjustments on both worksheets. Finally, once the "Cross Section" and "Bedload" sheets are complete, the "Meander Geometry" sheet summarizes details of the proposed target channel form which can be used by the design engineer to help develop a suitable stream channel design.

Target Stream Form

Input	Explanation
13	= W/D = Width/Max Depth Ratio (ft/ft)
2.5	= FP_{width}/BF_{width} = Entrenchment Ratio (ft/ft)
40	= Q_{low} = Baseflow Discharge (cfs)
565	= Q_{bf} = Bankfull Discharge (cfs)
1622	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
0.07	= n_{low} = Manning's n Value (Baseflow)
0.042	= n_b = Manning's n Value (Bankfull)
0.065	= n_{fp} = Manning's n Value (Floodplain)
20	= z_c = Channel Bottom Side-Slopes (_H:1V)
1.5	= z_b = Bank Side-Slopes (_H:1V)
5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
0.0095	= G_v = Valley Gradient (ft/ft)
0.007	= G_c = Channel Gradient (ft/ft)

Calculated Design Estimates

$Low_{critical}$	$Bottom_{critical}$	$Bankfull_{normal}$	Floodplain	Explanation
0.02100	0.02100	0.00700	0.0095	= S = Channel Slope (ft/ft)
40	N/A	565	1622	= Required Discharge (cfs)
0.760	0.867	3.22	1.23	= D_{max} = Max Water Depth (ft)
30.40	34.68	41.86	104.65	= W = Top Width (ft)
NA	NA	34.80	92.35	= B = Bottom Width (ft)
11.55	15.03	105.23	226.38	= A = Cross-Sectional Area (ft)
30.44	34.72	43.33	106.36	= P = Wetted Perimeter (ft)
0.38	0.43	2.43	2.13	= R = Hydraulic Radius (ft)
3.50	3.74	5.36	9.33	= V_{ch} = Channel Velocity Q_{ch} (ft/s)
NA	NA	NA	2.39	= V_{fp} = Floodplain Velocity Q_{fp} (ft/s)
0.50	0.57	1.06	1.58	= τ_{ch} = Channel Shear Stress (lbs/sq ft)
NA	NA	NA	0.66	= τ_{fp} = Floodplain Shear Stress (lbs/sq ft)
40	56	564	1629	= Resulting Discharge (cfs)
1.00	1.00	0.60	0.86	= Froude Number
0.38	0.43	2.51	2.16	= AD = Average Depth (ft)
NA	NA	16.7	NA	= W/D = Width Depth Ratio (ft/ft)

Manning's Formula for Stream Velocity

$$V = \frac{u_m}{n} \cdot R_h^{2/3} \cdot S^{1/2} \qquad U_m = 1.49 \text{ (ft/sec)}$$