

## Rural Hydrology Example Answers:

Please note: Hydrology is a subjective field of engineering. There are many steps in the design process where you will make decisions others may disagree with. These notes represent one possible solution for this design point.

### Watershed Delineation:

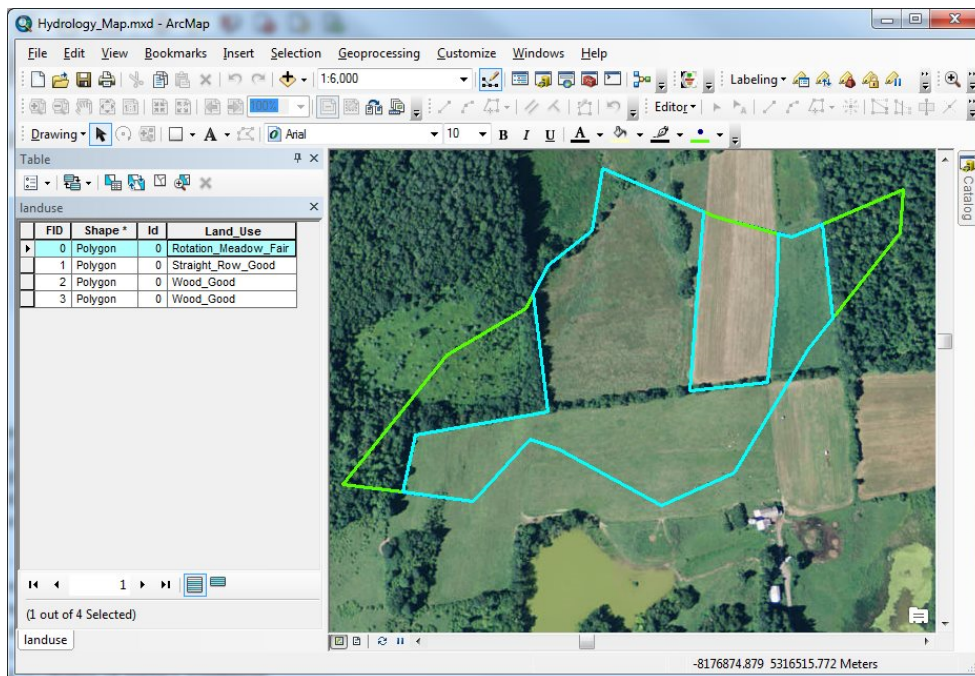
Part of the reason I picked this design point is the weird warped saddle area near the pond at the sound end of the picture. This would be a great location to field verify when you're on site. In this case all we have to go by are the contours.



Watershed delineation is somewhat subjective, so it's okay if your boundary doesn't quite match this one!

### Land Use Areas:

Cutting the watershed into land use areas is another subjective task. You may notice that your fields have different colors from the ones I have here. This is likely because the farmer is rotating crops through each field – (corn, hay, alfalfa, soybeans, etc). In this case, what CN value should we use if we know the land use will be different the next year? One approach would be to use the worst case scenario (corn) on all fields for a conservative design. However, this will create too much runoff and oversized hydraulics. Instead, use the cover at time of design, but use the poor and good hydrologic conditions qualifiers to describe whether it's in rotation. For example, if you have corn followed by hay, use the CN value for "Straight Row, Good Condition." If you have alfalfa followed by corn, use the CN value for "Close seeded or broadcast legumes, Poor Condition." Here are the land use areas that I chose:



After intersecting the land use layer with the hydrologic soil group layer, you should have something that looks like this:



After adding an “Acres” column to the intersected layer’s attribute table, exporting the table text and creating a pivot table in Excel, you should have something like this:



Microsoft Excel - rural\_areas\_export.txt

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER ANALYZE DESIGN

Row Labels

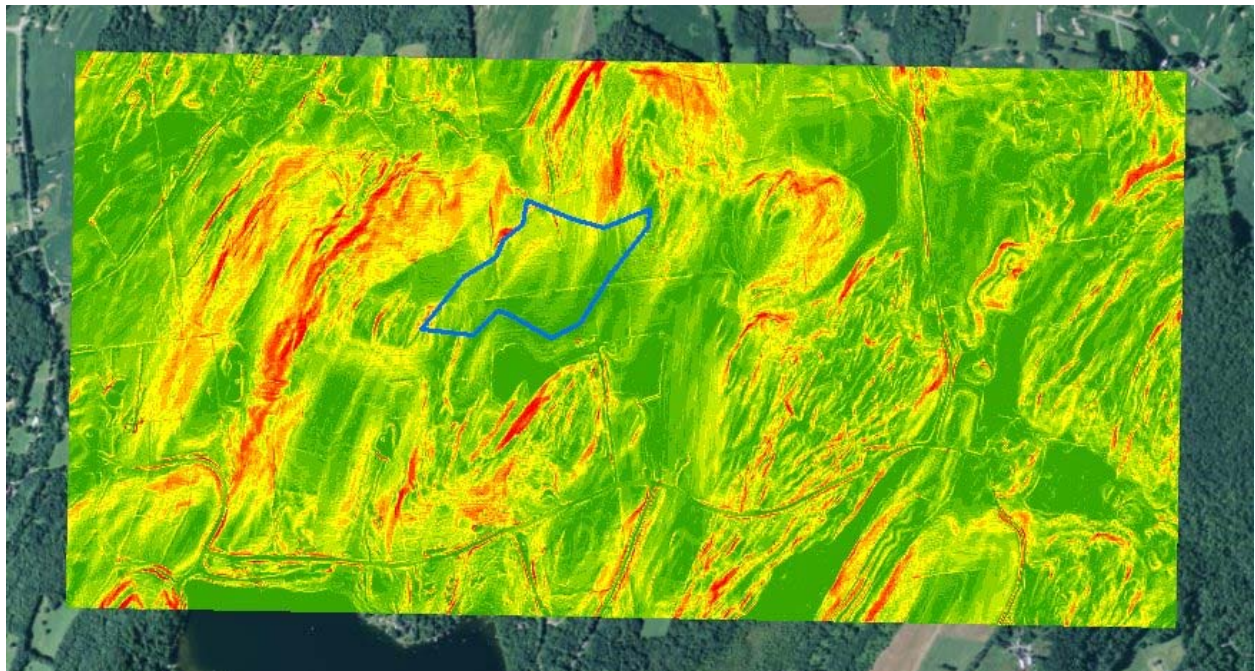
	A	B	C	D	E	F
1	SdvOutput	Land_Use	Acres		Row Labels	Sum of Acres
2		Rotation_Meadow_Fair	0.524567		C	45.64110325
3	C	Rotation_Meadow_Fair	2.481725		Rotation_Meadow_Fair	29.64564171
4	C	Straight_Row_Good	0.557701		Straight_Row_Good	7.179923499
5	C	Wood_Good	0.1192		Wood_Good	8.81553805
6	D	Rotation_Meadow_Fair	8.85E-06		D	6.6516803
7	D	Wood_Good	1.945267		Rotation_Meadow_Fair	4.631967678
8	C	Rotation_Meadow_Fair	8.598619		Wood_Good	2.019712622
9	C	Straight_Row_Good	2.801021		(blank)	0.524566723
10	C	Wood_Good	2.859924		Rotation_Meadow_Fair	0.524566723
11	C	Rotation_Meadow_Fair	0.623237		Grand Total	52.81735028
12	C	Wood_Good	4.488373			
13	D	Rotation_Meadow_Fair	4.631959			
14	D	Wood_Good	0.074445			
15	C	Rotation_Meadow_Fair	17.94206			
16	C	Straight_Row_Good	3.821202			
17	C	Wood_Good	1.34804			
18						
19						

rural\_areas\_export

READY 100%

**Note:** In this case, there was one area where the hydrologic soil group was undefined. This will happen from time to time and those areas should be assumed to have a "D" rating.

Next we need to compute the time of concentration. After creating a slope raster from the 2m DEM Mosaic, you should have something like this (ArcGIS default color scheme):



Running Zonal Statistics using the slope raster and watershed shapefiles gives the following output:

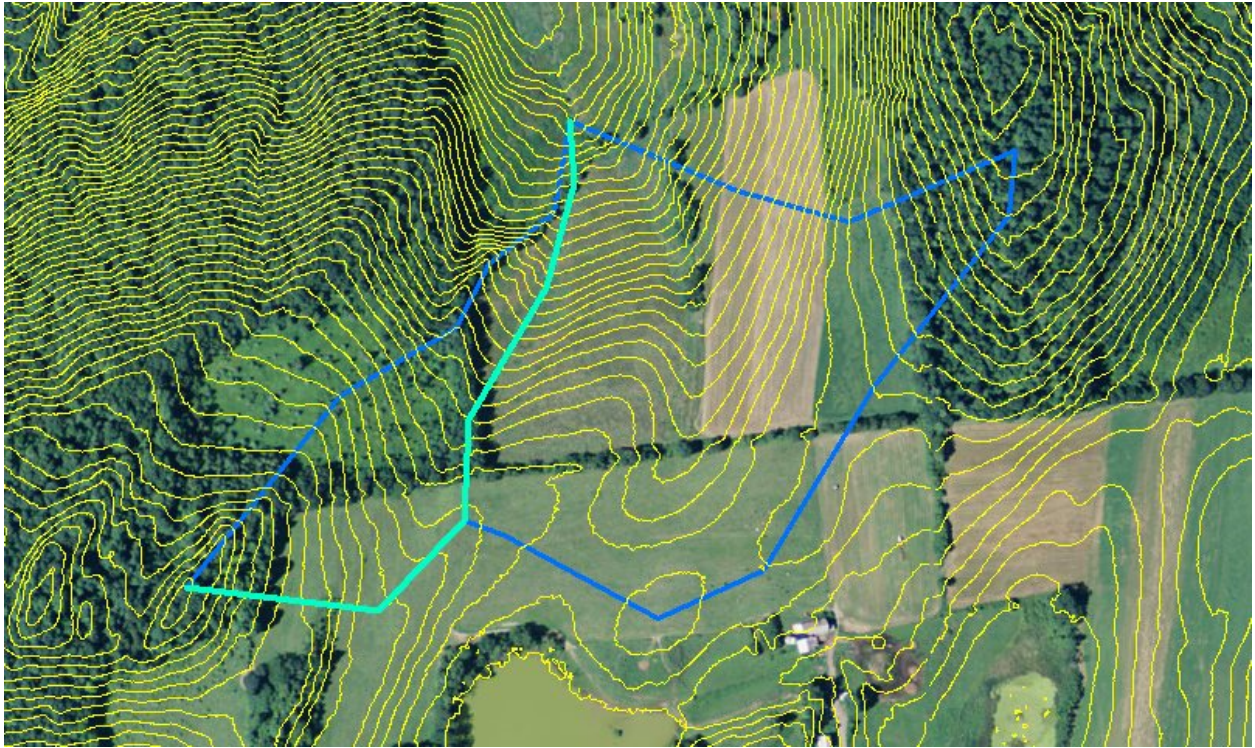
Table					
Mosaic_and_watershed					
	OBJECTID *	Id	COUNT	AREA	MEAN
▶	1	0	28456	11382	15.222403

Navigation: 1 (0 out of 1 Selected)

Mosaic\_and\_watershed



The last thing we need is the longest flow path through the watershed, which I estimated as follows:



The length of this path is 1814 feet.

Plugging the data into EFH2 should look something like the following. I realized upon entering that there is no Rotation-Meadow-Fair so I used poor instead. The EFH2 file is attached to this lecture and screenshots follow:

The screenshot shows the 'Basic data' tab of the EFH-2 software. The interface includes a menu bar (File, Edit, View, Tools, Help) and a toolbar with icons for file operations and help. The 'Basic data' tab contains the following fields:

- Client: Tim
- State: NY
- County: Washington S. NRCC-B
- Practice: Laneway Culvert
- By: Tim
- Date: 9/15/2015
- Drainage Area: 52.7 acres (from RCN Calculator)
- Runoff Curve Number: 81 (from RCN Calculator)
- Watershed Length: 1814 feet
- Watershed Slope: 15.2 percent
- Time of Concentration: 0.21 hours (calculated)

The screenshot shows the 'Rainfall/Discharge data' tab of the EFH-2 software. The 'Rainfall-Type' is set to 'NRCC\_B'. Below this, there is a table with 7 columns: Storm #, Frequency (yrs), 24-HR Rain (in), Peak Flow (cfs), and Runoff (in). The table contains 7 rows of data for different storm frequencies.

Storm #	Frequency (yrs)	24-HR Rain (in)	Peak Flow (cfs)	Runoff (in)
Storm #1	1	2.22	43	.75
Storm #2	2	2.60	60	1.01
Storm #3	5	3.21	87	1.48
Storm #4	10	3.76	114	1.92
Storm #5	25	4.63	159	2.66
Storm #6	50	5.43	201	3.37
Storm #7	100	6.37	252	4.22

EFH-2 Estimating Runoff and Peak Discharge

File Edit View Tools Help

Introduction Basic data Rainfall/Discharge data **RCN**

☐ Urban Area ☐ Developing Urban ☒ Cultivated Agriculture ☐ Other Agriculture ☐ Arid Rangeland

COVER DESCRIPTION			A	B	C	D
Small grain	Straight row (SR)	poor	65	76		88
	Straight row (SR)	good	63	75	7.2	87
	SR + Crop residue	poor	64	75		86
	SR + Crop residue	good	60	72		84
	Contoured (C)	poor	63	74		85
	Contoured (C)	good	61	73		84
	C + Crop residue	poor	62	73		84
	C + Crop residue	good	60	72		83
	Cont & terraced(C&T)	poor	61	72		82
	Cont & terraced(C&T)	good	59	70		81
	C&T + Crop residue	poor	60	71		81
	C&T + Crop residue	good	58	69		80
Close-seeded legumes or rotation meadow	Straight row	poor	66	77		89
	Straight row	good	58	72		85
	Contoured	poor	64	75	29.6	85
	Contoured	good	55	69		83
	Cont & terraced	poor	63	73		83
Cont & terraced	good	51	67		80	

☒ Acres ☐ Percentage

Weighted Curve Number = 81  
Accumulated Area (ac) = 52.70

Accept Clear

EFH-2 Estimating Runoff and Peak Discharge

File Edit View Tools Help

Introduction Basic data Rainfall/Discharge data **RCN**

☐ Urban Area ☐ Developing Urban ☒ Cultivated Agriculture ☐ Other Agriculture ☐ Arid Rangeland

COVER DESCRIPTION			A	B	C	D
<b>OTHER AGRICULTURAL LANDS</b>						
Pasture, grassland or range	poor		68	79		89
	fair		49	69		84
	good		39	61		80
Meadow -cont. grass (non grazed)	----		30	58		78
Brush - brush, weed, grass mix	poor		48	67		83
	fair		35	56		77
	good		30	48		73
Woods - grass combination	poor		57	73		86
	fair		43	65		82
	good		32	58		79
Woods	poor		45	66		83
	fair		36	60		79
	good		30	55	8.8	77
Farmsteads	----		59	74		86

☒ Acres ☐ Percentage

Weighted Curve Number = 81  
Accumulated Area (ac) = 52.70

Accept Clear