

Runoff Curve Number Derivation using the Miller Method

Estimating a Runoff Curve Number (RCN) for the SCS method requires some judgment by combining land use with the hydrologic soil group. The hydrologic soil groups have been well defined by the Natural Resources Conservation Service (NRCS) and are published by County, as well as digitally mapped. The true judgment comes with defining the landuse, and further complicating the process is that landuse boundaries very seldom align with soil boundaries. Thus, the designer has three options:

1. Use a GIS (Arcview or equivalent) program to derivate soil/landuse combinations through vector analysis.
2. Establish a square grid system and apply a soil/landuse value for each square (Miller Method).
3. Estimate using rough eyeball method (not recommended).

Option 1 is the most desired method, however, the limiting factor in performing this method is the landuse data. Most landuse shapefiles from the Michigan Department of Technology, Management, and Budget's database have not been updated since 1978.

Option 2 (Miller Method) utilizes a square grid system to define a soil/landuse combination for an individual square to determine a percentage based on the total watershed. The method employs the same concept that a computer uses to render a digital image. Each pixel is assigned a color, and the smaller the pixel, the sharper the image appears on the screen. The procedure is as follows:

1. Delineate the watershed boundary.
2. Copy watershed boundary over the top of the soil survey. If the soil survey does not include up to date aerial photographs, refer to recent photographs for appropriate landuse derivations.
3. Establish an appropriately sized grid for the size of the watershed as well as variances in soil and landuse (see Table 3-2). Most watershed shapes are irregular, so often the squares will extend slightly beyond the limits of the watershed boundary.
4. Count the number of squares covering the watershed. The total area of the squares should be within 6% of the total watershed area.
5. Determine the number of soil/landuse combinations available within the watershed. Establish a number and/or color for each combination. Complex soil groups should be considered as an additional soil/landuse combination.
6. Assign a soil/landuse number and/or color for each square.
7. Count the total number of squares for each soil/landuse type. Verify that the total is equal to the total number of squares in the grid.
8. Assign percentages to compute the average RCN for the subject watershed.

Table 3–2 – Typical Grid Dimensions for Specific Drainage Areas

Drainage Area	*Square size
20 acres – 0.5 mi ²	200 feet x 200 feet
0.5 mi ² – 1 mi ²	400 feet x 400 feet
1 mi ² – 2 mi ²	500 feet x 500 feet

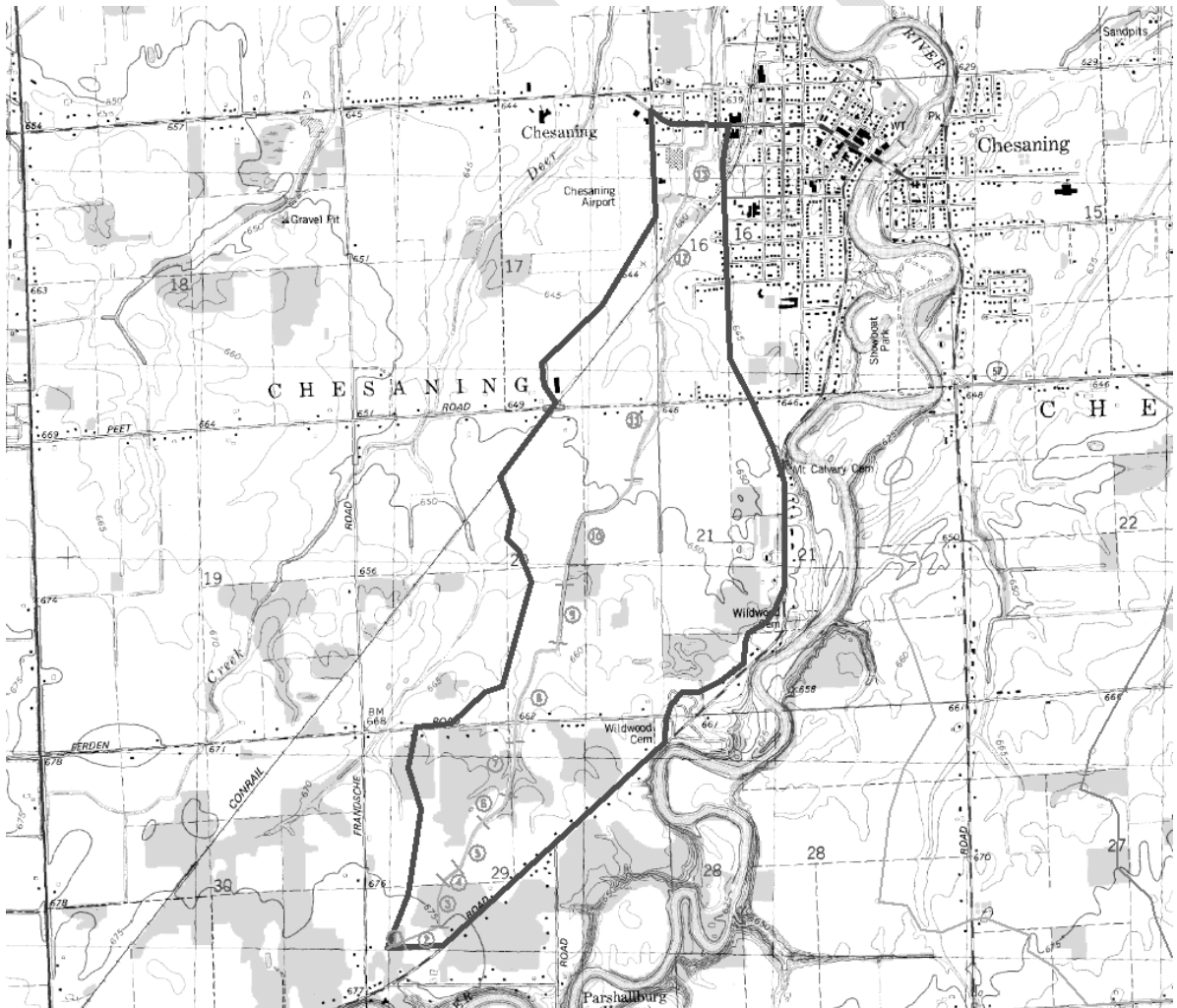
*If there is little soil/landuse variance in the watershed, a larger square could be used. Intuitively, if the watershed includes extreme variances in soil/landuse combinations (such as in urban areas) the squares should be smaller. Contact the Design Engineer – Hydraulic/Hydrology for additional assistance.

Miller Method using Microstation:

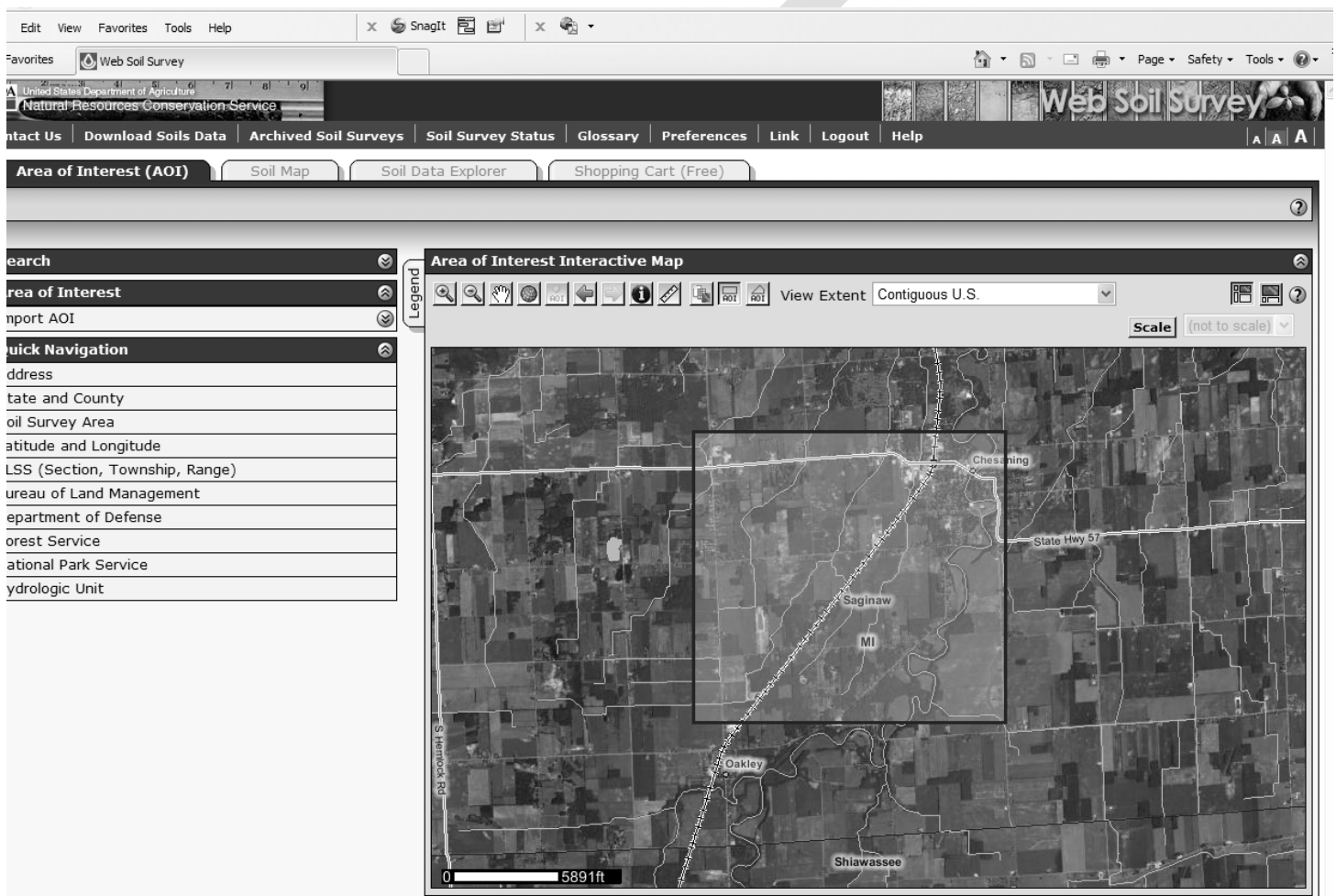
1. Import USGS topographic map using the Microstation Raster Manager. Electronic versions of the USGS topographic maps can be downloaded from the following location:

http://www.michigan.gov/cgi/0,4548,7-158-52927_53037_12540_13546-31264--,00.html.

2. Scale the raster manager using known points on the topographic map, such as the distances between section lines. The easiest way to derive this distance is to scale off using the paper copies of the maps.
3. Double check the scale by comparing distances at an alternate location on the topographic map
4. Delineate the watershed on the paper version of the USGS topographic map. Determine watershed area using a planimeter.
5. Delineate the watershed in Microstation using the Polygon tool.



6. Measure the area of the watershed in Microstation using the Measure Area tool. Verify that the watershed is the same size as the measurement from the paper copy. If they vary, repeat steps 2 and 3.
7. Go to <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>.
8. Click on the green “START WSS” button in the top right portion of the screen:
9. Zoom in so as to include all of watershed, but not much more. Click on the square AOI (Area of Interest) icon in the middle of the screen. Draw a square that covers at least the entire watershed.



10. Click on the “Soil Map” tab at the top left of the screen. Click on the “Printable Version” icon at the top right of the screen.

http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

File Edit View Favorites Tools Help

Web Soil Survey

USDA United States Department of Agriculture
Natural Resources Conservation Service

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Area of Interest (AOI) **Soil Map** Soil Data Explorer Shopping Cart (Free)

Printable Version Add to Shopping Cart

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Map Unit Legend

Saginaw County, Michigan (MI145)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10C	Grattan sand, 4 to 12 percent slopes	11.9	0.2%
12	Corunna sandy loam	33.0	0.5%
13	Belleville fine sand	66.9	1.0%
15B	Wixom sand, 0 to 4 percent slopes	1,410.1	21.6%
22B	Parkhill-Wixom complex, 0 to 4 percent slopes	114.9	1.8%
23A	Capac loam, 0 to 3 percent slopes	845.3	13.0%
24	Parkhill loam	712.2	10.9%
26A	Pipestone sand, loamy substratum, 0 to 3 percent slopes	1,444.0	22.2%
28A	Parkhill-Capac complex, 0 to 3 percent slopes	25.1	0.4%
29	Sloan silt loam, frequently flooded	49.6	0.8%
31A	Pipestone sand,	719.7	11.0%

Soil Map

Printable Version Options

Report Options

Title Soil Map; Saginaw County, Michigan

Subtitle (optional) Area of Interest Name: (none defined)
 Custom Subtitle:

None

Map Options

Map Scale Automatic

Printed Sheet Size D (22" x 34") — 1 sheet

Show UTM Coordinate Ticks

Cancel View

11. Change the Printed Sheet Size to "D (22" x 34)" – 1 sheet". Verify that the "Show UTM Coordinate Ticks" is checked. Click "View".
12. Save an electronic copy of the file in PDF format.
13. Using the Microstation Raster Manager, import the soil map that was just saved. Scale the map using the scale location at the bottom left of the image.
14. Copy the watershed polygon to appropriate location on the soils map.
15. Using the Place Line tool in Microstation, draw a straight line south to north along the westernmost location of the watershed. Make sure to draw the line long enough to cover the watershed from south to north.
16. Repeat step 15 from West to East along the southernmost boundary of the watershed.

17. Using the Move/Copy Parallel tool in Microstation, copy each line created in Steps 15 and 16 an equal distance to create squares based on Table 3-2.
18. Using the Trim Multiple tool in Microstation, trim each line appropriately so as to define the boundary of the watershed.

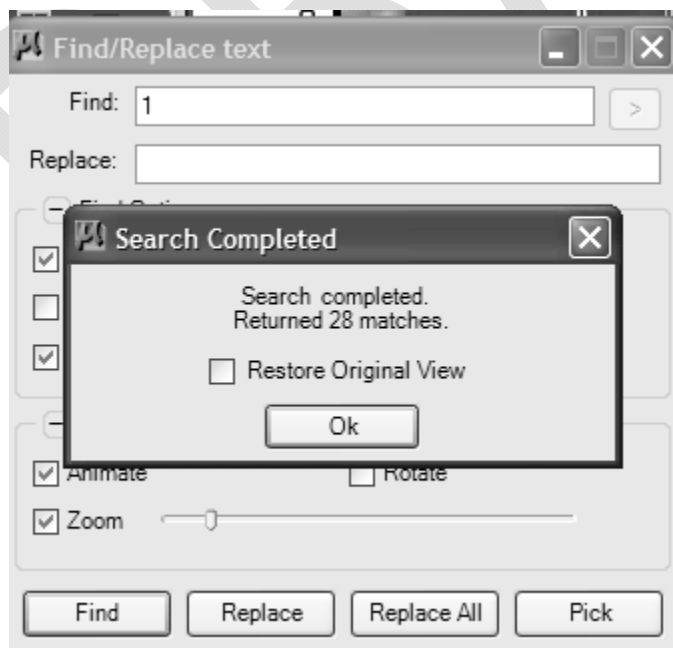
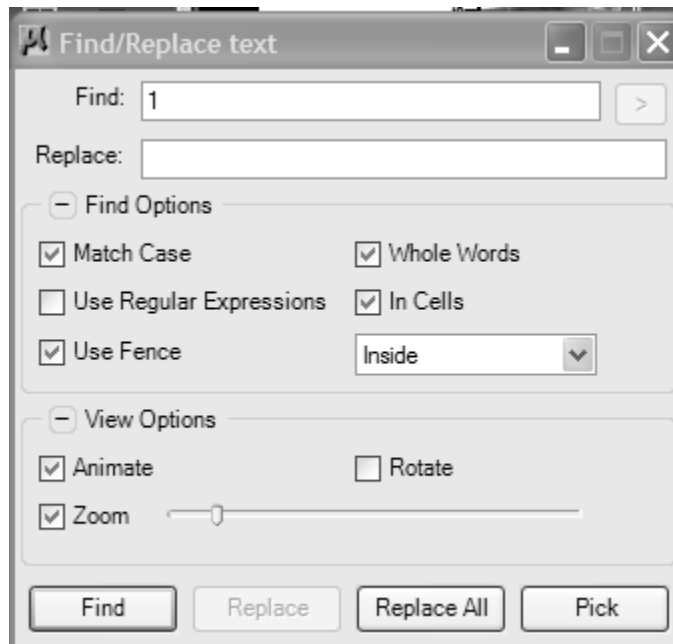


19. Count up the number of squares and label for future reference. Verify that the area covered by the squares is within 6% of the total area of the watershed.
20. Assign a number and color for each soil/landuse combination in the watershed, and appropriately apply to each square within the grid.



Class A	
Crop	1
Res1	2
Res ¹ / ₂	3
Commercial	4
Forest	11
Class B	
Crop	5
Class C	
Crop	6
Class D	
Forest	7
Res1	8
Res ¹ / ₂	9
Open Good	10

21. Count up the number of squares for each soil/landuse combination. The easiest way to do this is by placing a fence around the grid and using the “Find/Replace Text” command under the “Edit” menu:
- In the “Find/Replace text” popup menu, make sure “Match Case”, “Whole Words”, and “Use Fence” are selected.
 - In the “Find:” field, enter the number.
 - Select “Find” multiple times until the final count is displayed.
 - Repeat a – c for additional numbers.



22. Subdivide the numbers based on soil type and landuse to determine percentages. These percentages can then be used to compute the RCN number, either by hand or by the MDEQ Excel Spreadsheet.

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