WMS 11.2 Tutorial

HEC-HMS Modeling Multiple Sub-basins

Learn how to create multiple sub-basins using HEC-HMS

Objectives

Divide a single watershed into multiple sub-basins, and define routing between sub-basins.

Prerequisite Tutorials

- DEM Delineation
- HEC-HMS Modeling

Required Components

- WMS Core
- HEC-HMS Model

Time

- 15–30 minutes

1 Introduction

Sub-basins are used to break up a watershed into regions of similar hydrologic characteristics, based off of soil and land use data, and other parameters as specified. This can be useful in obtaining more accurate analysis of the watershed, as using sub-basins accounts for the specific lag time that each area of a watershed will contribute to the overall discharge of the watershed. Using a previously delineated watershed, this tutorial will go through the necessary steps of delineating a sub-basin, updating the parameters, setting up routing parameters, and ultimately running HEC-HMS for a complete analysis.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.

The Graphics Window of WMS should refresh to show an empty space.

4. Click **Open** to bring up the *Open* dialog.
5. Change the *Files of type* to "WMS XMDF Project File (*.wms)".
6. Navigate to *subbasin\subbasin* and select "hec-1_SingleWatershed.wms" and select **Open** to close the *Open* dialog and import the project file.
7. Turn off " Land Use" and " Soil Type" in the Project Explorer.
8. Right-click on " Drainage" and select **Zoom To Layer**.

3 Adding Sub-basins and Routing

This section explains how to subdivide the watershed into two upper basins and one lower basin and define routing for the reaches that connect the upper basins to the watershed outlet.

3.1 Delineating the Sub-basin

1. Click **Display Options** to bring up the *Display Options* dialog.

2. Select “Map Data” from the list on the left.
3. On the *Map* tab, turn on *Vertices* and click on the button to bring up the *Point Properties* dialog.
4. Enter “3” as the *Radius* and click **OK** to close the *Point Properties* dialog.
5. Click **OK** to close the *Display Options* dialog.
6. **Zoom** in to the area shown in Figure 1.

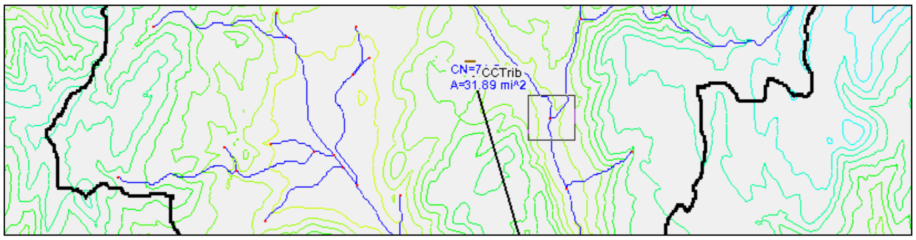

Figure 1 Zoom to the area indicated by the box near the center of the basin

7. Switch to the **Drainage Module**.
8. Using the **Select Feature Vertex** tool, right-click the vertex just below the main branching point (Figure 2).
9. Select **Vertex** → **Outlet**.

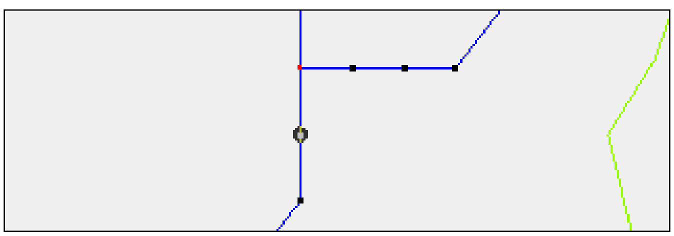

Figure 2 Select the vertex just below the junction point

This creates an outlet point just below the branch in order to have a single upstream basin (Figure 3). To create a separate basin for each upstream branch, define the branching node as an outlet.

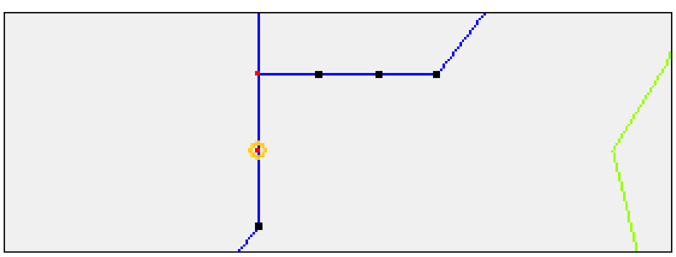

Figure 3 The selected vertex is now an outlet

10. **Frame** the project.
11. **Zoom** in to the area shown in Figure 4.

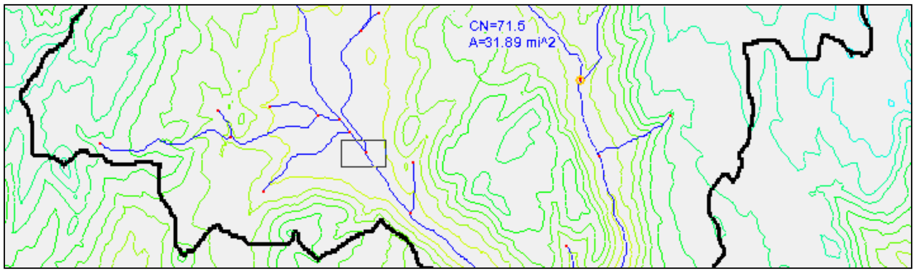

Figure 4 Zoom to the area indicated by the box on the right side

12. Using the **Select Feature Vertex** tool, select the vertex just below the main branching point (Figure 5).

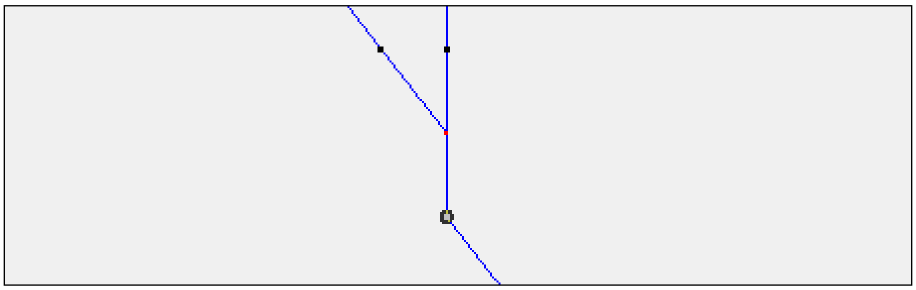

Figure 5 Select the vertex just below the junction

13. Right-click and select **Vertex** → **Outlet** to create the outlet point.
14. **Frame** the project.
15. Select *DEM* **| Delineate Basins Wizard** to bring up the *Stream Feature Arc Options* dialog.
16. If advised that all existing feature data will be deleted and recreated, click **OK**.
17. Click **OK** to accept the defaults, close the *Stream Feature Arc Options* dialog, and open the *Units* dialog.
18. Click **OK** to accept the defaults and close the *Units* dialog.

The drainage basin should now be divided into three sub-basins (Figure 6).

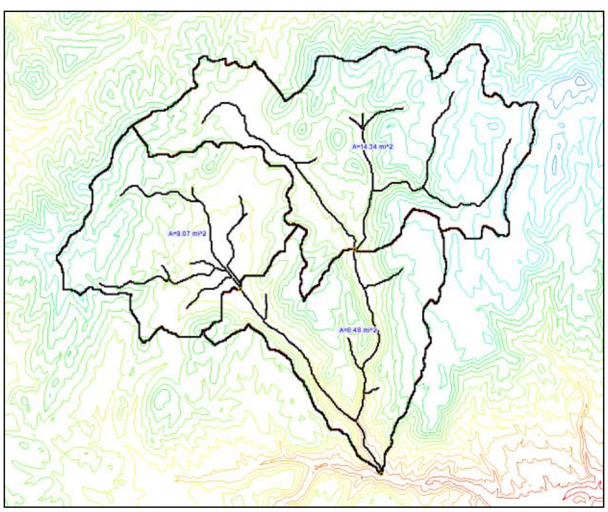

Figure 6 The three sub-basins after delineation

3.2 Updating the Basin Parameters

The next step is to re-compute the CN values and define precipitation and lag time for the basins.

1. Switch to the **Hydrologic Modeling Module** .
2. Select *Calculators* **| Compute GIS Attributes…** to bring up the *Compute GIS Attributes* dialog.
3. Click **OK** to accept the defaults and close the *Compute GIS Attributes* dialog and bring up the *View Data File* dialog. If the *Never ask this again* option has previously been turned on, this dialog will not appear. In this case, skip to step 5.
4. Select the desired text editor from the *Open With* drop-down, then click **OK** to close the *View Data File* dialog and open the "cn_report.txt" file in the selected text editor.

Notice the computed CN displayed in the *Runoff Curve Number Report* and above the area label in the WMS graphics window. The recomputed CN values for all three basins are very similar because there is one dominant soil polygon that covers the entire watershed.

5. When done viewing the *Runoff Curve Number Report*, click ✕ and return to WMS.
6. Make note of the label names for the three basins, noting which number belongs to the top right, top left, and bottom basins.

The names of the basins should follow the pattern "1B", "2B", "3B", though the names may be slightly different. This information will be used in the steps below.

7. Using the **Select basin** tool, double-click on the upper right brown basin icon to bring up the *HMS Properties* dialog.
8. Select "All" from the *Show* drop-down.
9. In the *Display options* section, turn on *Loss Rate Method* in the *Display* column and *SCS Curve Number* in the *Show* column.
10. Turn on *Transform* in the *Display* column and *SCS* in the *Show* column.
11. In the *Properties* section in the *Name* column, change the top right basin name to "Right".
12. Change the top left basin name to "Left".
13. Change the bottom basin name to "CCTrib".
14. Click **Compute…** in the *Basin Data* column of the "CCTrib" row to bring up the *Basin Time Computation* dialog.
15. Select "Compute Lag Time" from the *Computation type* drop-down.
16. Select "SCS Method" from the *Method* drop-down.
17. Click **OK** to close the *Basin Time Computation* dialog.
18. Repeat steps 14–17 for the "Left" and "Right" rows. Note that the basins will alphabetize, so after computing the lag time for "CCTrib", the "Left" and "Right" rows will be the bottom two rows.

There is now a computed lag time for each basin (each about 1 hour). Because the CN values have been computed automatically, they do not need to be changed here.

19. Click **OK** to close the *HMS Properties* dialog.

3.3 Setting up the Routing Parameters

If HEC-HMS were run right now, the hydrographs from the upper basins would be combined with the lower basin hydrograph at the watershed outlet without any lag or attenuation because the routing parameters are not yet set. A routing method needs to be defined to instruct HEC-HMS to compute lag and attenuation on the upper basin hydrographs before adding them to the lower hydrograph.

Routing for a reach is always defined at the upstream outlet of the reach in WMS.

1. Using the **Select outlet** tool, double-click on the upper right basin outlet to bring up the *HMS Properties* dialog.
2. Select “Reaches” from the *Type* drop-down.
3. Select “Selected” from the *Show* drop-down.
4. In the *Display options* section, turn on *Method* in the *Display* column and *Muskingum Cunge Std* in the *Show* column.
5. In the *Properties* section, use the *Routing Method* drop-down, to select “Muskingum Cunge”.
6. Scroll to the right and enter “5.0” in the *Bottom Width/Diameter (ft)* column.
7. Enter “1.0” in the *Side Slope (xH:1V)* column.
8. Enter “0.05” in the *Mannings n* column. This is fairly rough, giving an exaggerated routing effect for the purposes of this tutorial.
9. Click **OK** to close the *HMS Properties* dialog.
10. Using the **Select outlet** tool, double-click on the upper left basin outlet to bring up the *HMS Properties* dialog.
11. Repeat steps 2–9.

The project will appear similar to Figure 7.

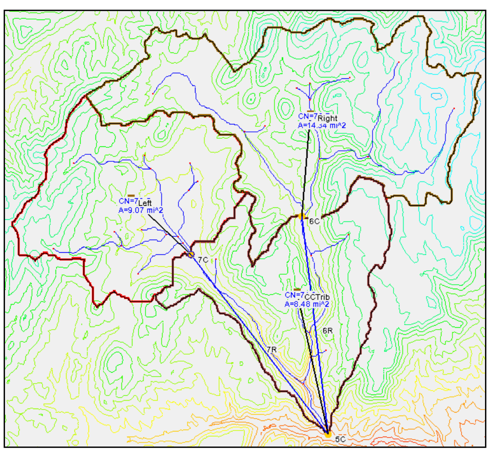

Figure 7 Three sub-basins after upper basins’ output defined

3.4 Running HEC-HMS

Everything is now defined to run a three basin HEC-HMS analysis that includes routing the upper basins through the reaches connecting them to the watershed outlet.

1. Right-click on " Drainage Coverage Tree" in the Project Explorer and select **Save HMS File…** to bring up the *Save HMS File* dialog.
2. Select "HMS File (*.hms)" from the *Save as type* drop-down.
3. Enter "CCTribRoute.hms" as the *File name*.
4. Click **Save** to save the HMS file and close the *Save HMS File* dialog.

HEC-HMS will be used to do additional calculations:

5. Locate and launch "HEC-HMS.exe" on the computer being used.
6. Once in HEC-HMS, select *File* **| Open…** to bring up the *Open an Existing Project* dialog.
7. Click **Browse** to bring up the *Select Project File* dialog.
8. Browse to *subbasin\subbasin* and select "CCTribRoute.hms".
9. Click **Select** to open the file and close the *Select Project File* dialog.
10. If asked to convert the file to the current version of HEC-HMS, click **Convert Project**.
11. The *Open File Format* dialog may appear. If so, in the *Open file as* section, select "HMS Basin Files" from the drop-down and click **OK** to close the *Open File Format* dialog.
12. In the HEC-HMS Project Explorer, expand " Basin Models", " Meteorologic Models", and "Control Specifications".
13. Select " Clear Creek Tributary" to expand it and make it active.

To create the simulation, do the following in HEC-HMS:

14. Switch to the *Compute* tab in the HEC-HMS Project Explorer.
15. Select " Run 1" under the " Simulation Runs" folder under " CCTribRoute".
16. Select *Compute* **| Compute Run [Run 1]** to bring up a progress dialog.
17. If necessary, click **Close** when HEC-HMS finishes computing to close the progress dialog.
18. Switch to the *Results* tab in the HEC-HMS Project Explorer.
19. Expand the " Simulation Runs" folder and select " Run 1" to expand the results.
20. Select " Global Summary" to review the peak flows.
21. Select " Graph" below the entry for the junction for the entire basin to view the hydrograph for the entire basin.

Notice that there are four hydrograph curves in the plot (Figure 8). One represents the discharge from the CCTrib basin, one represents routed flow from the right basin, one represents routed flow from the left basin, and the curve with the largest peak represents the superimposed composite of the other three curves.

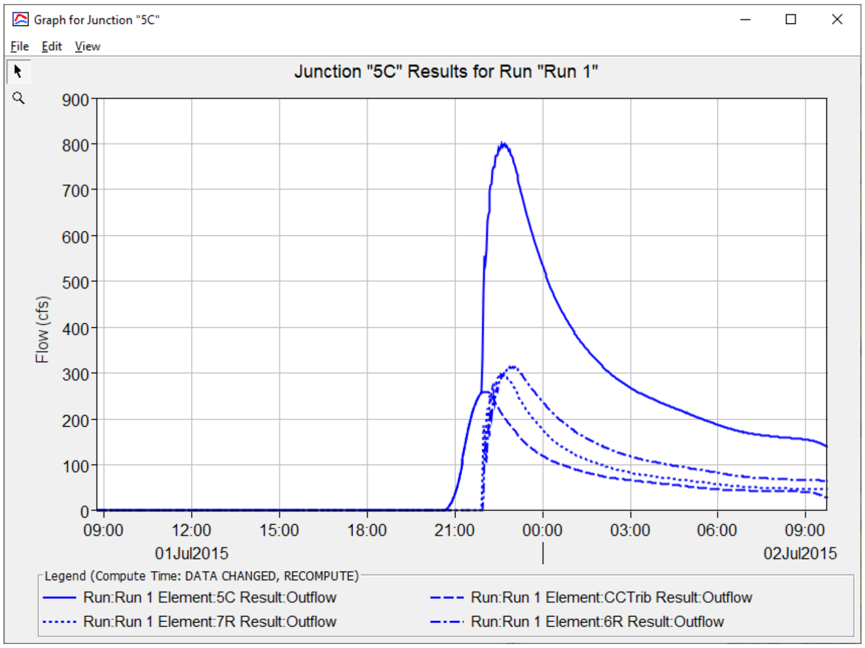

Figure 8 Hydrograph for entire basin, including all three sub-basins

Feel free to explore and review the graphs and charts in each entry below the " Global Summary". Selecting each will cause the results to appear.

22. When finished, close and exit HEC-HMS by selecting *File* **| Exit.**
23. Click **Yes** if prompted to save the project.

4 Conclusion

This concludes the "Modeling Multiple Sub-basins" tutorial. The key concepts discussed and demonstrated include:

- Performing a watershed analysis
- Defining routing parameters
- Saving and running HEC-HMS simulations