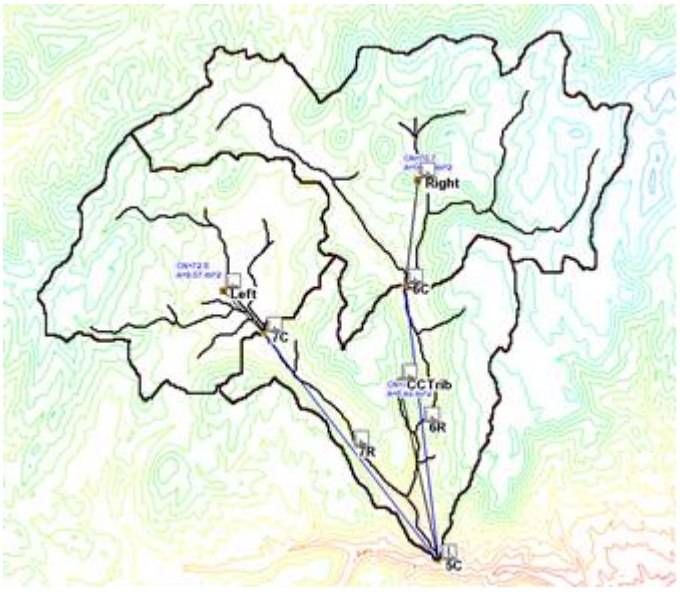
WMS 11.2 Tutorial

HEC-1 Modeling Multiple Sub-basins

Learn how to create multiple sub-basins using HEC-1



Objectives

Divide a single watershed into multiple sub-basins and define routing between sub-basins. Prepare the model to be run using HEC-1.

Prerequisite Tutorials

- DEM Delineation
- HEC-1 Modeling

Required Components

- WMS Core
- HEC-1 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-1 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 *hec-1\hec-1* and **Open** "CCTribHEC1.wms" to close the *Open* dialog and import the project file.

3 Adding Sub-basins and Routing

The watershed will now be subdivided into two upper basins and one lower basin. Routing will also be defined for the reaches that connect the upper basins to the watershed outlet.

3.1 Delineating the Sub-basin

1. Switch to the **Drainage Module** .
2. **Zoom** in to the location indicated by the box in Figure 1.
3. Click **Display Options** to open the *Display Options* dialog.

4. Select “Map Data” from the list on the left.

5. On the *Map* tab, turn on *Vertices* and click the  to the right to bring up the *Point Properties* dialog.

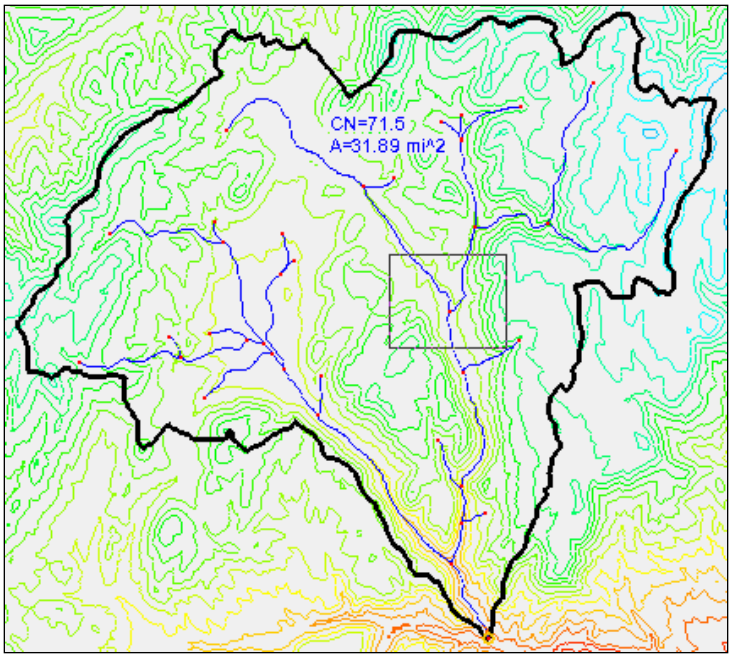


Figure 1 Zoom area for upper right sub-basin

6. Enter “3” as the *Radius* and click **OK** to close the *Point Properties* dialog.

7. Click **OK** to close the *Display Options* dialog.

8. Using the **Select Feature Vertex** tool, select the vertex that is just below the main branching point (Figure 2).

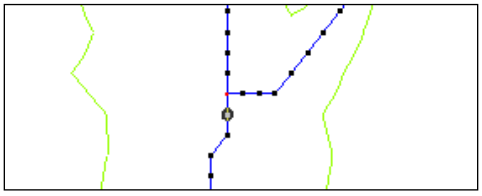


Figure 2 Vertex just below branch

9. Select *DEM* **| Node ↔ Outlet**.

The outlet point was created just below the branch so that only a single upstream basin was created (Figure 3). If a separate basin is desired for each upstream branch, the branching node (rather than the vertex below it) should be defined as an outlet. WMS always assumes one separate basin for each upstream branch connected to an outlet node.

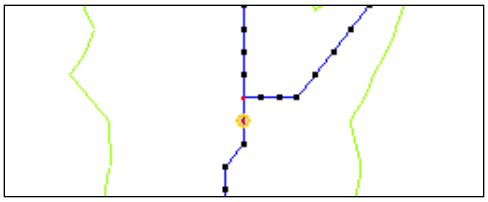


Figure 3 The new outlet point

10. **Frame** the project.
11. **Zoom** in to the location indicated by the box in Figure 4.

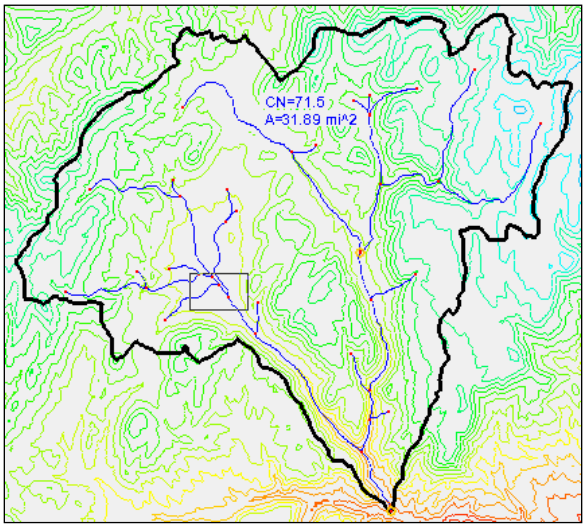


Figure 4 Zoom area for upper left sub-basin

12. Using the **Select Feature Vertex** tool, select the vertex just below the feature node where the streams branch (Figure 5).

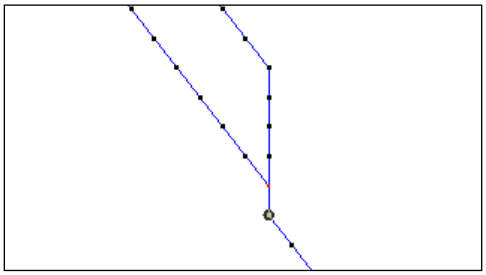


Figure 5 Select the vertex below the branch

13. Select *DEM* **| Node ↔ Outlet** to create the sub-basin outlet (Figure 6).

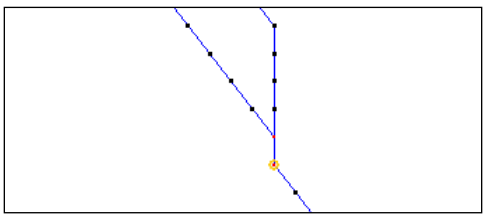


Figure 6 Outlet point for top left sub-basin

14. **Frame** the project.

15. Select *DEM* **| Delineate Basins Wizard** to bring up the *Stream Feature Arc Options* dialog.
16. Click **OK** when prompted to delete all existing feature data.
17. Click **OK** to close the *Stream Feature Arc Options* dialog and bring up the *Units* dialog.
18. Click **OK** to close the *Units* dialog, finish delineating the watershed, and compute the basin data.

The project should appear similar to Figure 7.

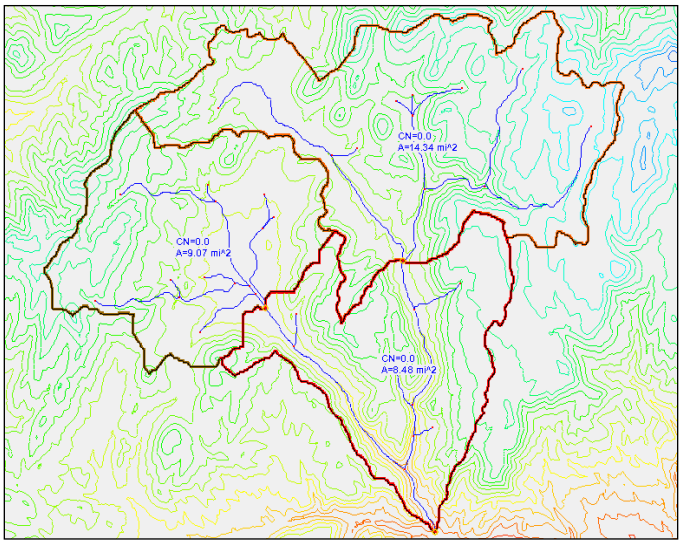


Figure 7 Three sub-basins

3.2 Updating the Basin Parameters

Now recompute 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 update the CN values for all basins, close the *Compute GIS Attributes* dialog, and open the *View Data File* dialog. If the *Never ask this again* option was previously selected, this dialog may not appear. If this is the case, skip to step 5.
4. Select the desired text editor from the *Open With* drop-down and click **OK** to close the *View Data File* dialog and open the CN report in the desired text editor.

Notice that the CN for all three basins is similar. This is because of the dominant soil polygon that covers the watershed.

5. Once done reviewing the CN report, close the text editor and return to WMS.
6. Using the **Select basin** tool, double-click on the upper right basin icon to bring up the *Edit HEC-1 Parameters* dialog.
7. In the *Basin HEC-1 Cards* section, click **Basin Data…** to bring up the *HEC-1 Basin Data* dialog.

8. Enter “Right” as the *Basin name* and click **OK** to close the *HEC-1 Basin Data* dialog.

The *Edit HEC-1 Parameters* dialog is non-modal (or modeless). This means it can be moved to the side so that actions can be taken in the main WMS window without closing the dialog.

9. Move the *Edit HEC-1 Parameters* dialog so all three basins are visible, then select the upper left basin icon.

Notice that the content in the *HEC-1 File Output – select to edit* section of the dialog changed when the new basin was selected. The parameters for the upper left basin can now be edited.

10. Repeat steps 7–8, entering “Left” as the *Basin name*.
11. In the main WMS window, select the lower basin icon.
12. Repeat steps 7–8, entering “CCTrib” as the *Basin name*.

Next, enter simultaneously parameters in common to all basins by selecting all the basins and applying parameters to them. This reduces the number of steps required to apply parameters to the basins.

13. In the main WMS window, select *Edit* **| Select All** to select all three basins.

Notice that the content in the *HEC-1 File Output – select to edit* section of the dialog now displays the parameters for all three basins. The parameters for the upper left basin can now be edited.

14. In the *Basin HEC-1 Cards* section of the *Edit HEC-1 Parameters* dialog, click **Precipitation…** to bring up the *HEC-1 Precipitation* dialog
15. Select *Basin Average* and enter “1.8” as the *Average precipitation*.
16. Click **Define Series** to open the *XY Series Editor* dialog.
17. On the lower right, select “typeII-24hour” from the *Selected Curve* drop-down.
18. Click **OK** to close the *XY Series Editor* dialog.
19. Click **OK** to close the *HEC-1 Precipitation* dialog.
20. Click **Unit Hydrograph Method…** to bring up the *HEC-1 Unit Hydrograph Methods* dialog.
21. Select *SCS dimensionless* and click **Compute Parameters - Basin Data** to bring up the *Basin Time Computation* dialog.
22. In the *Basin* section, select “CCTrib”.
23. Select “SCS Method” from the *Method* drop-down.
24. Repeat steps 22–23 for both “Left” and “Right” in the *Basin* section.
25. Click **OK** to close the *Basin Time Computation* dialog.
26. Click **OK** to close the *HEC-1 Unit Hydrograph Methods* dialog.
27. Click **Done** to close the *Edit HEC-1 Parameters* dialog.

3.3 Setting up the Routing Parameters

If HEC-1 were to be run 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 have not yet been set. A routing method will now be

defined instructing HEC-1 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 (Figure 8) to bring up the *Edit HEC-1 Parameters* dialog.

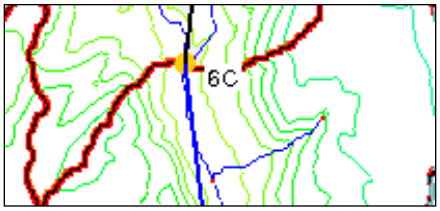


Figure 8 Upper right basin outlet 6C

2. In the *Routing HEC-1 Cards* section, click **Routing Data…** to bring up the *HEC-1 Routing Data* dialog.
3. Select "Muskingum-Cunge (RD)" from the *Routing type* drop-down.
4. In the *Normal Muskingum Cunge parameters* section, enter "5.0" as the *WD*.

This means it will be five feet wide.

5. Enter "1.0" as the *Z*.

This is the side slope, giving it a 1:1 side slope.

6. Enter "0.05" as the *N*.

This is the Manning's roughness. This indicates the surface is fairly rough in order to exaggerate the routing effects for this tutorial.

7. Click **OK** to close the *HEC-1 Routing Data* dialog.
8. In the main WMS window, select the upper left basin outlet (Figure 9).
9. In the *Edit HEC-1 Parameters* dialog, repeat steps 2–7.
10. Click **Done** to close the *Edit HEC-1 Parameters* dialog.

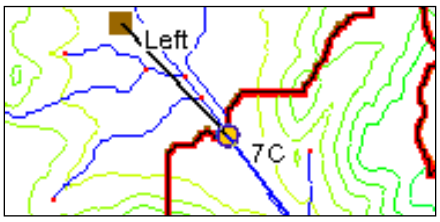


Figure 9 Upper left basin outlet 7C

3.4 Running HEC-1

Everything has now been defined to run a three basin HEC-1 analysis that includes routing the upper basins through the reaches connecting them to the watershed outlet.

1. Select *HEC-1* **| Run Simulation…** to bring up the *HEC-1 Run Options* dialog.
2. Below *Input file*, click to bring up the *Select HEC-1 Input File* dialog.
3. Select "HEC-1 Files (*.hc1)" from the *Save as type* drop-down.

4. Enter “Routing.hc1” as the *File name* and click **Save** to close the *Select HEC-1 Input File* dialog.
5. Turn on *Save file before run* and click **OK** to close the *HEC-1 Run Options* dialog and open the *Model Wrapper* dialog.
6. Once HEC-1 finishes running, turn on Read solution on exit.
7. Click **Close** to import the solution and close the *Model Wrapper* dialog.
8. Using the **Select hydrograph** tool while holding down the *Shift* key, select all of the hydrograph icons, double-clicking on the last one to bring up the Hydrograph dialog.

All hydrographs should appear together in the Hydrograph dialog (Figure 10). Resize hydrograph window and review the hydrographs if desired.

9. Close the *Hydrograph* dialog by clicking in the upper right corner of the window.

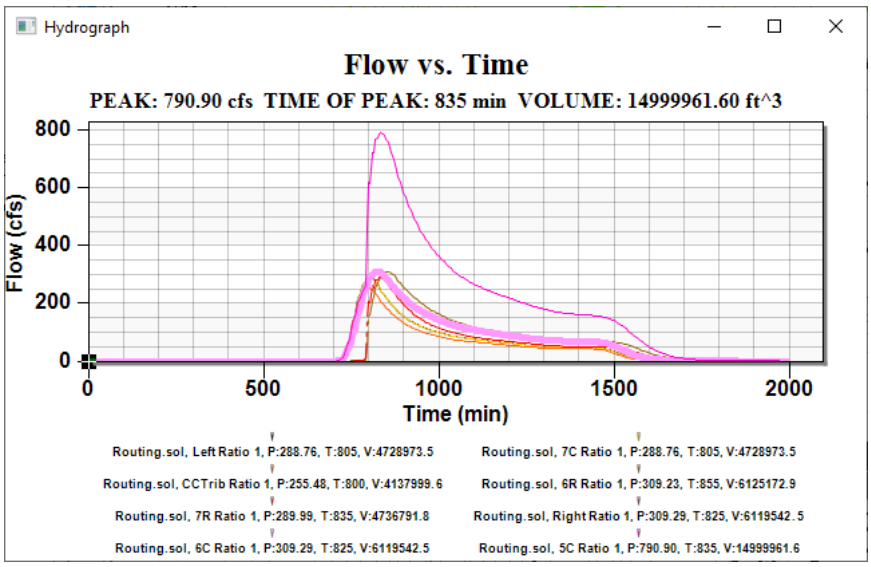


Figure 10 Hydrographs

4 Conclusion

This concludes the “HEC-1 Modeling Multiple Sub-basins” tutorial. The key concepts discussed and demonstrated include:

- Entering job control parameters
- Defining basin parameters such as loss rates, precipitation, and hydrograph methodology for watershed analysis
- Defining routing parameters
- Saving HEC-1 input files
- Reading hydrograph results