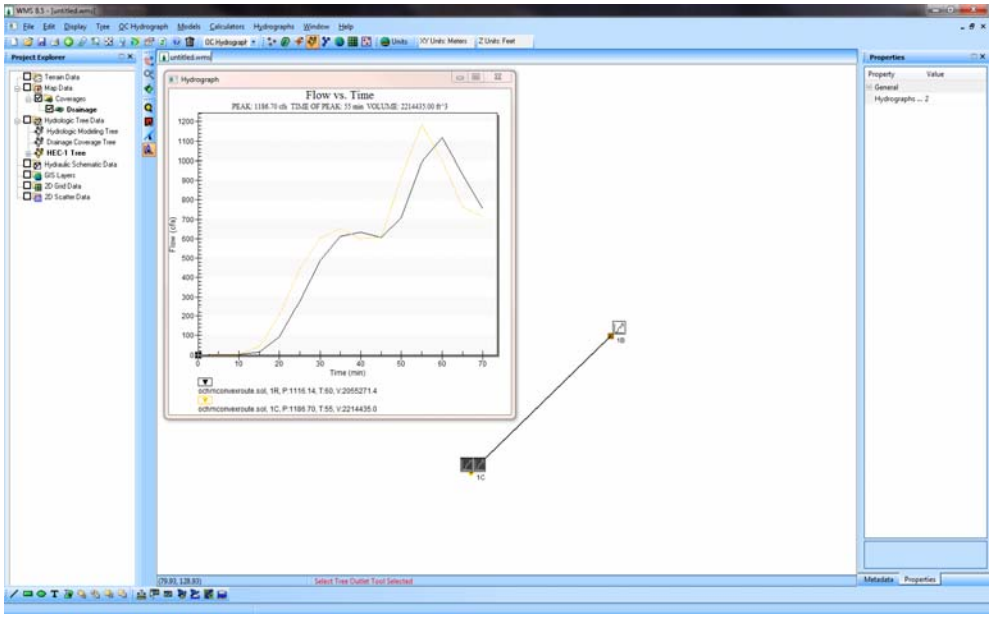
WMS

v. 8.4

WMS 8.4 Tutorial

Watershed Modeling – Orange County Unit Hydrograph

Build and run a unit hydrograph analysis based on methods in the Orange County (California) hydrology manual



Objectives

This tutorial shows you how to define and run basic Orange County unit hydrograph models. Different options are explored for computing and routing hydrographs. This is based on the example problem on page E-26 of the Orange County Hydrology Manual.

Prerequisite Tutorials

- None

Required Components

- Hydrologic Models

Time

- 20-40 minutes

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1 Contents

2 Introduction

This exercise will cover the steps necessary to create a unit hydrograph analysis based on the example problem on page E-26 of the Orange County Hydrology Manual.

3 Orange County Hydrology Manual Example

3.1 Create Hydrologic Tree (Schematic) Model

Close all instances of WMS

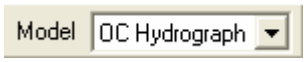
Open WMS

Switch to the *Hydrologic Modeling* module 

Select ***Tree*** **|** ***Add*** **|** ***Outlet*** (or press the O key on the keyboard)

Select ***Tree*** **|** ***Add*** **|** ***Basin*** (or press the B key on the keyboard)

This generates a basic schematic model representing a concentration point with one sub-area.



Make sure that the Model combo box is set to OC Hydrograph

3.2 Enter Job Control Parameters

1. Select ***OC Hydrograph | Job Control…***
2. For the Computational time interval enter 5
3. Set the Number of hydrograph ordinates to 350

NOTE: The number of unit hydrograph ordinates should be enough to cover the duration for the storm event at the computational time interval. For example, if the computational time interval entered is 1 minute, then the number of hydrograph ordinates for a 1-day storm event should be at least 1,440.

4. Select OK

3.3 Define the Storm Event

1. Select ***OC Hydrograph | Define Storm…***
2. Change the Frequency to 100 year
3. Select OK

3.4 Edit Sub-area Parameters

1. Use the *Select Basin* tool to select the sub-area labeled 1B
2. Select ***OC Hydrograph | Edit Parameters…***
3. Click on the Basin Data… button
4. Enter an Area of 5 sq. miles (3200 acres)
5. Toggle on Enter base flow
6. In the STRTQ field enter -10 to represent a base flow of 10 cfs/sq. mile
7. Select OK

3.5 Develop Effective Precipitation

1. Click on the Effective Precipitation… button
2. Enter a Fm value of 0.19
3. Enter a Ybar value of 0.337
4. Click on the Next > button to view the effective precipitation
5. Click Done

3.6 Define the Unit Hydrograph

1. Click on the Unit Hydrograph Method… button
2. Enter a Lag time of 0.75

3. Toggle on the Valley developed S-graph
4. Set the weight for the Valley developed S-graph to 1.0
5. Click the Plot Unit Hydrograph button
6. Select OK
7. Click the Done button on the Edit Orange County Unit Hydrograph Parameters dialog

4 Running the Simulation

1. Select ***OC Hydrograph | Run Simulation…***
2. Click the browse button  next to the Input File
3. For the file name enter "ochme-26" and click Save (this specifies the file name but does not actually save it)
4. Verify that Save file before run is toggled on
5. Select OK
6. Select Close once HEC-1 finishes running (you may have to wait a few seconds to a minute or so)
7. Double-click either hydrograph icon

You can view a plot of the average runoff hydrograph ordinates as shown in Figure 4-1. Draw a smooth curve in order to determine the peak discharge as outlined on page E-40 of the Orange County Hydrology Manual.

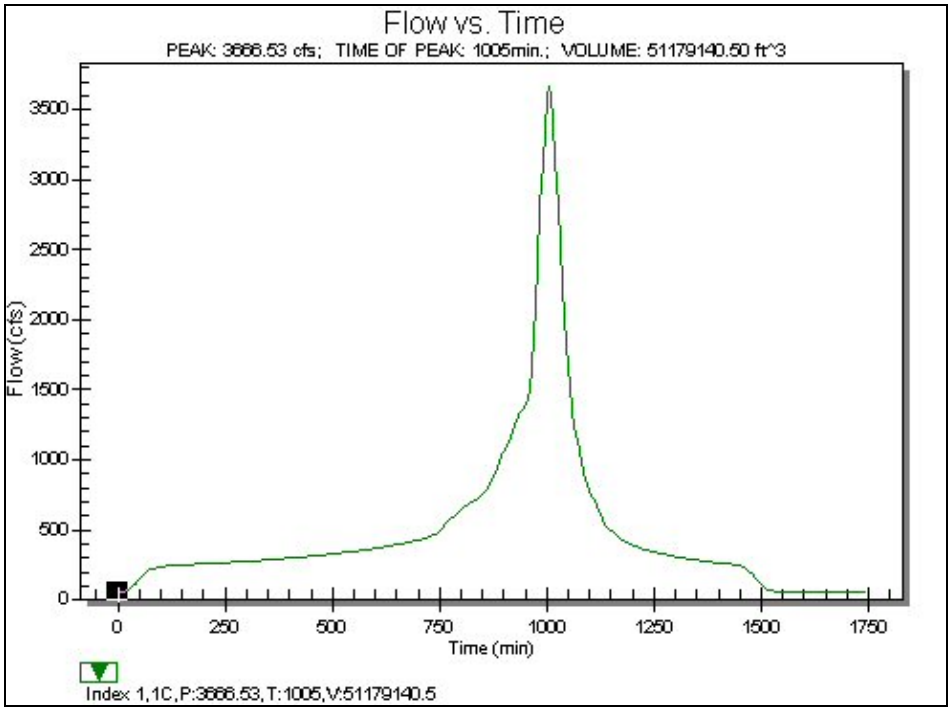


Figure 4-1: Runoff hydrograph

8. Click on the X to close the Plot Window

5 Saving Files

1. Select ***OC Hydrograph | Save HEC-1 File…***
2. Enter a file name and select the Save button to save a HEC-1 input file (*.hc1)

The HEC-1 input file contains all of the standard HEC-1 cards and parameters. It does not have any of the input parameters such as point precipitation values and S-graph data that are used to generate HEC-1 input.

3. Select ***File | Save As…*** 
4. Enter a file name and select the Save button to save a WMS project file (*.wpr)

The WMS project file stores all of the HEC-1 input data for each sub-area and concentration point as well as the data used to generate the HEC-1 input.

6 Flow-through Routing

Flow-through routing is also known as storage routing using the Modified-Puls method. Open a HEC-1 file that already has the inflow and job control parameters defined for the flow-through routing example on page F-9 of the Orange County Hydrology Manual. Enter the routing parameters and view the routed hydrograph after running the simulation.

6.1 Open Unit Hydrograph File

1. Select ***File | New*** 
2. Select No if prompted to save changes to the project
3. Switch to the *Hydrologic Modeling* module 
4. Select ***OC Hydrograph | Open HEC-1 File…***
5. Locate the folder ***C:\WMS80\tutorial\OrangeCounty\UnitHydro***
6. Open *"OCHMFlowThru.hc1"*

6.2 Define Routing

1. Use the *Select Outlet* tool  to select the concentration point labeled 1C
2. Select ***OC Hydrograph | Edit Parameters…***
3. Click the Routing Data… button
4. Change Routing type to Storage (RS)
5. Choose Reservoir and click on the Define button
6. In the Outflow section of the dialog choose Known outflow

7. Toggle on SE and click on the Define button
8. Enter the values in the Elevation column of Table 6-1

Table 6-1: Elevation, storage, and discharge data

Elevation (SE)	Outflow (SQ)	Volume (SV)
0.0	0.0	0.0
1.0	4.2	14.4
2.0	12.0	28.8
3.0	51.7	43.2
4.0	114.7	57.6
5.0	186.8	72.0
6.0	263.2	86.4

9. Select the remaining cells in the column and hit the DELETE key on the keyboard so that the cells are blank
10. Select OK
11. Toggle on SQ and click on the Define button
12. Enter the values in the Outflow column of Table 6-1
13. Select the remaining cells in the column and hit the DELETE key on the keyboard so that the cells are blank
14. Select OK
15. In the Volume section of the dialog choose Known volume
16. Toggle on SE and click on the Define button
17. Change the Selected curve to 1C Outflow elev
18. Select OK
19. Toggle on SV and click on the Define button
20. Enter the values in the Volume column of Table 6-1
21. Select the remaining cells in the column and hit the DELETE key on the keyboard so that the cells are blank
22. Select OK
23. Select OK in the HEC-1 Reservoir Routing Options dialog
24. Select OK in the HEC-1 Routing Data dialog
25. Select Done in the Edit Orange County Unit Hydrograph Parameters dialog

6.3 Run the Simulation

1. Select ***OC Hydrograph | Run Simulation…***
2. Click the browse button  next to the Input File
3. For the file name enter "OCHMFlowThruRoute" and click Save (this specifies the file name but does not actually save it)
4. Verify that Save file before run is toggled on
5. Select OK

6. Select Close once HEC-1 finishes running (you may have to wait a few seconds to a minute or so)
7. Select one of the two hydrograph icons displayed at the concentration point labeled 1C
8. Hold the SHIFT key down and double-click on the other hydrograph icon

Figure 6-1 shows the inflow and the routed outflow hydrographs.

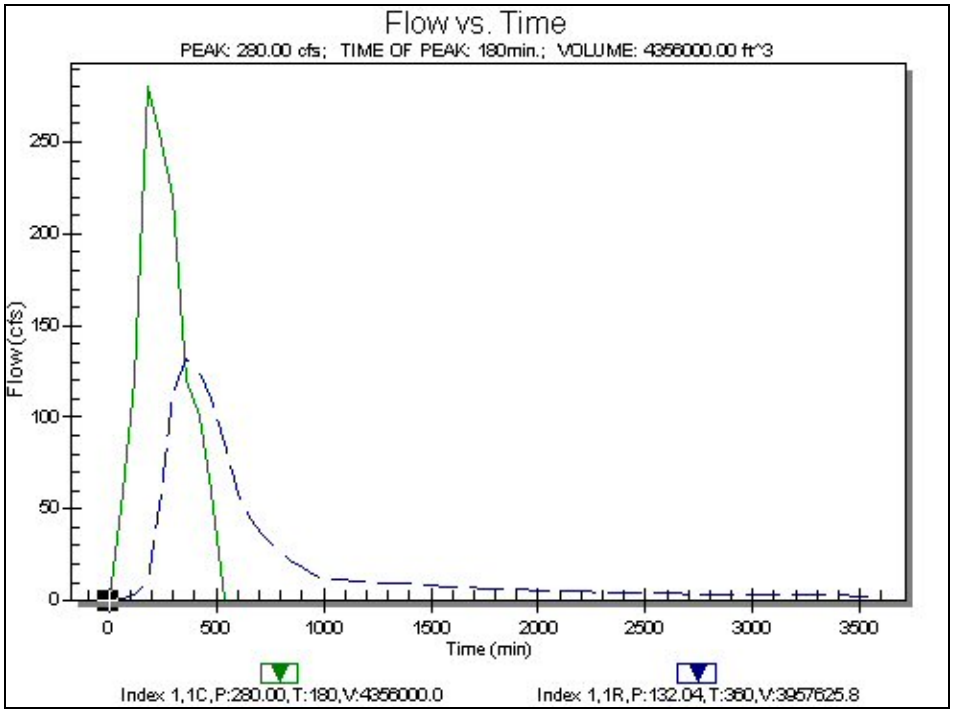


Figure 6-1: Inflow and routed outflow hydrographs for flow-through routing

9. Click on the X to close the plot window

7 Flow-by Routing

7.1 Open Unit Hydrograph File

1. Select ***File | New*** 
2. Select No if prompted to save changes to the project
3. Switch to the *Hydrologic Modeling* module 
4. Select ***OC Hydrograph | Open HEC-1 File…***
5. Open *"OCFlowBy.hc1"*

7.2 Define Routing (Constant Diverted Flow)

1. Use the *Select Outlet* tool  to select the concentration point labeled 1-14C

2. Select ***Tree | Add | Diversion***
3. Use the *Select Diversion* tool  to select the newly created diversion
4. Select ***OC Hydrograph | Edit Parameters…***
5. Click on the Diversion Data… button
6. Click on the Define DI button to define the inflow portion of a rating curve for flow into concentration point 1-14C
7. On the first row enter 0.0
8. On each succeeding row increment the value by 100.0 so that the value on the last row is 1900.0
9. Select OK
10. Click on the Define DQ button to define the diverted flow portion of the rating curve
11. Enter a constant diverted flow of 50.0 in all rows
12. Select OK
13. Select OK
14. Select Done

7.3 Run the Simulation

1. Select ***OC Hydrograph | Run Simulation…***
2. Click the browse button  next to the Input File
3. For the file name enter "OCHMFlowByRoute" and click Save (this specifies the file name but does not actually save it)
4. Verify that Save file before run is toggled on
5. Select OK
6. Select Close once HEC-1 finishes running (you may have to wait a few seconds to a minute or so)
7. Select the hydrograph icon displayed at the concentration point labeled 1-14C
8. Hold the SHIFT key down and double-click on the hydrograph icon labeled 1-14R
9. Click on the X to close the plot window

7.4 Define Routing (Varying Diverted Flow)

1. Use the *Select Diversion* tool  to select the diversion
2. Select ***OC Hydrograph | Edit Parameters…***
3. Click on the Diversion Data… button

4. Click on the Define DQ button to define the diverted flow portion of the rating curve
5. On the first row enter 0.0
6. On each succeeding row increment the value by 50.0 so that the value on the last row is 950.0
7. Select OK
8. Select OK
9. Select Done
10. Select ***Hydrographs | Delete All***
11. Follow the steps in Section 7.3 to run the simulation again and view the results

8 Convex Routing

8.1 Open Unit Hydrograph File

1. Select ***File | New*** 
2. Select No if prompted to save changes to the project
3. Switch to the *Hydrologic Modeling* module 
4. Select ***OC Hydrograph | Open HEC-1 File…***
5. Open *"OCHMConvex.hc1"*

8.2 Define Routing

1. Use the *Select Outlet* tool  to select the concentration point labeled 1C
2. Select ***OC Hydrograph | Edit Parameters…***
3. Click the Routing Data… button
4. Change Routing type to Convex (RV)
5. Enter a L value of 3000
6. Enter a S value of 0.005
7. Enter a N value of 0.015
8. Enter a WD value of 10
9. Select OK
10. Select Done

8.3 Run the Simulation

1. Select ***OC Hydrograph | Run Simulation…***

2. Click the browse button next to the Input File
3. For the file name enter "OCHMConvexRoute" and click Save (this specifies the file name but does not actually save it)
4. Verify that Save file before run is toggled on
5. Select OK
6. Select Close once HEC-1 finishes running (you may have to wait a few seconds to a minute or so)
7. Select one of the two hydrograph icons displayed at the concentration point labeled 1C
8. Hold the SHIFT key down and double-click on the other hydrograph icon

Figure 8-1 shows the inflow and the routed outflow hydrographs.

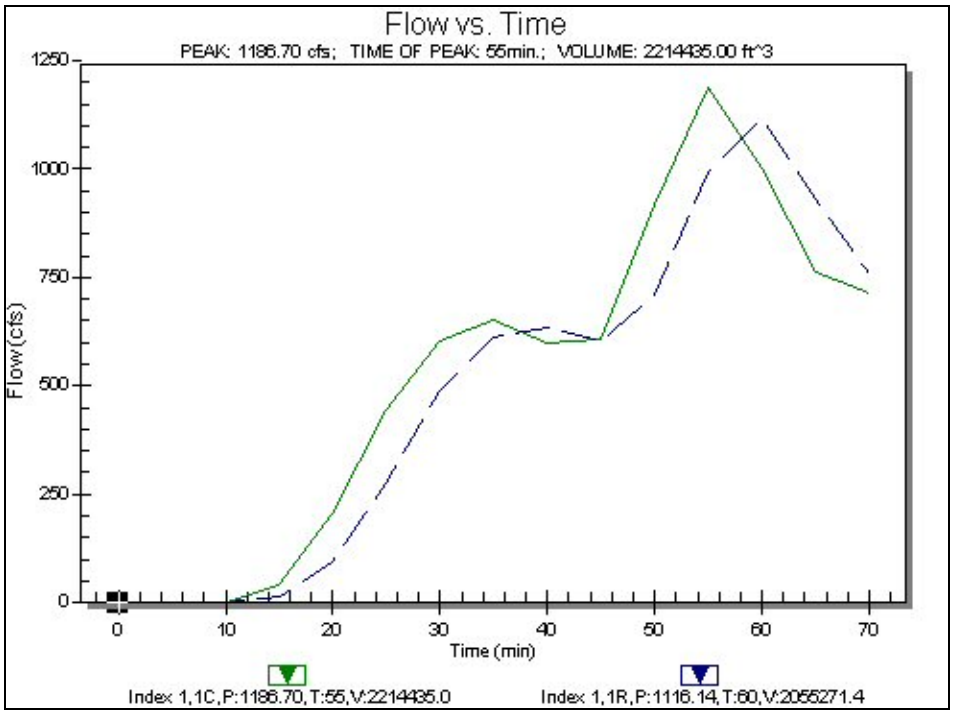


Figure 8-1: Inflow and routed outflow hydrographs for convex routing

9. Click on the X to close the plot window

