HEC-HMS Lab 10 – Reservoir Routing in HEC-HMS

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Learning outcomes

The objective of this lab is to learn how to use HEC-HMS to route a hydrograph through a reservoir. By the end of the exercise, students will know:

1) How to develop storage-discharge relationship for a reservoir with broad crested weir
2) Use paired data in HEC-HMS
3) Use reservoir element in HEC-HMS and route the hydrograph through it

Student Time Required: 60 – 90 minutes

Problem Statement

DeKalb County in Indiana just finished its storm water master plan to determine the 100-year design flow. It was found that the existing treatment plant may not be able to handle the peak flow resulting from the 100-year storm. You are hired as a consultant to determine how much reduction in the peak flow can be obtained if the flow is passed through an existing reservoir before reaching the treatment plant.

Instructions

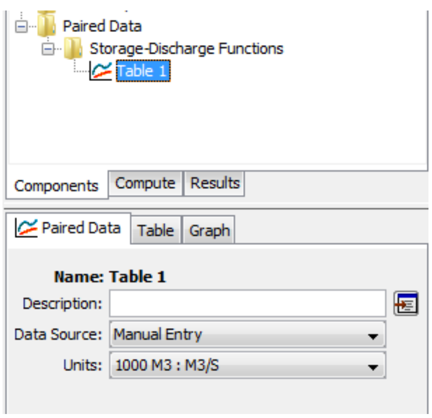
1) Create new HEC-HMS project and name it as Lab5 or any other name you would like to give. Save it in a new folder. Use some logical name for this new folder so you do not mix files from multiple labs.
2) Create a basin model to include one sub-basin with the following characteristics:
   - Area = 700 km^2
   - Use SCS method for computing rainfall losses with the following parameters: CN = 70, impervious cover = 0, Initial abstraction = 0
   - Use SCS unit hydrograph for transformation with the lag time as 100 minutes.
   - Use None for all other methods. (No canopy, no surface and no baseflow)

3) Create the Meteorologic Model by using the one day 100-year storm data in Table A.

Table A

Rainfall Depths for Various Return Periods						
Depth (inches)						
Duration (mins)	Return Period (years)					
	2	5	10	25	50	100
5	0.39	0.50	0.57	0.66	0.72	0.78
10	0.60	0.77	0.88	1.00	1.09	1.18
15	0.74	0.94	1.08	1.24	1.35	1.47
30	0.99	1.29	1.50	1.75	1.93	2.12
60	1.21	1.62	1.90	2.27	2.54	2.83
120	1.44	1.94	2.28	2.74	3.10	3.48
180	1.53	2.04	2.43	2.94	3.33	3.75
360	1.80	2.40	2.88	3.48	3.96	4.50
720	2.04	2.76	3.24	3.96	4.56	5.04
1440	2.40	3.12	3.84	4.56	5.04	5.76

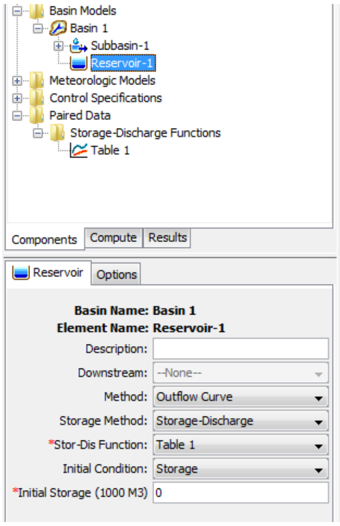
4) Create Control Specification File with a time step of 10 min and simulation time of 36 hours.
5) Run the model and record the peak flow.
6) Add a reservoir (Reservoir-1) element to the basin model and link it to the basin model by using the downstream information in the subbasin element.
7) Using the Components menu, create a new table (Table 1) of Storage-Discharge function by using the Paired Data Manager
8) Use Manual Entry for the data source and SI units for Table 1 as shown below.



Next, populate the table manually (copy/paste from Excel) by creating the storage-discharge function as described in Appendix 1.

Save your project.

Next, select the Reservoir element, and choose the routing method as "Outflow Curve", storage method as "Storage-Discharge" and use Table 1 to provide the storage discharge function. Also make sure the initial condition is Storage = 0.



Save your project, and run the simulation.

Look at the results for both the sub-basin and the reservoir. The results (graph) for the reservoir will show dashed green line (change in storage with time), dashed blue line (input hydrograph/outflow from the subbasin) and solid blue line (outflow from the reservoir/final routed hydrograph).

Turn-in

- A presentation quality plot of storage discharge function in Excel.
- A presentation quality plot of inflow hydrograph and outflow hydrograph from the reservoir (both graphs in one plot).
- Write few lines on how the flow will get affected after routing it through the reservoir. Specifically, talk about the reduction in the peak value and the delay in the peak
- The county is also interested to know how much additional storage is needed to bring the peak to less than 1000 m3/s. The city can only change the surface area of the reservoir without affecting the weir. Report new surface area of the reservoir (in m^2) and show (1) presentation quality new storage-discharge function plot, and (2) presentation quality inflow and outflow hydrograph resulting from this new reservoir (both hydrographs in one plot).

Appendix A

The reservoir has a surface area of 2.5×10^6 m^2. The water flows out of the reservoir through a broad crested weir (see Figure 1). The equation for the outflow discharge is given as $Q = 1.7LH^{3/2}$, where Q is the discharge in m3/s, L is the length of the weir (400m) and H is the hydraulic head. Using this information, create a storage v/s discharge curve as shown in Figure 2. Assume the initial storage to be zero. Use the value of *d* from zero to six with increments of 0.25 to create the storage discharge curve. Storage is d x surface area. Please note that discharge will only occur when d > 3m as shown in Figure 1.

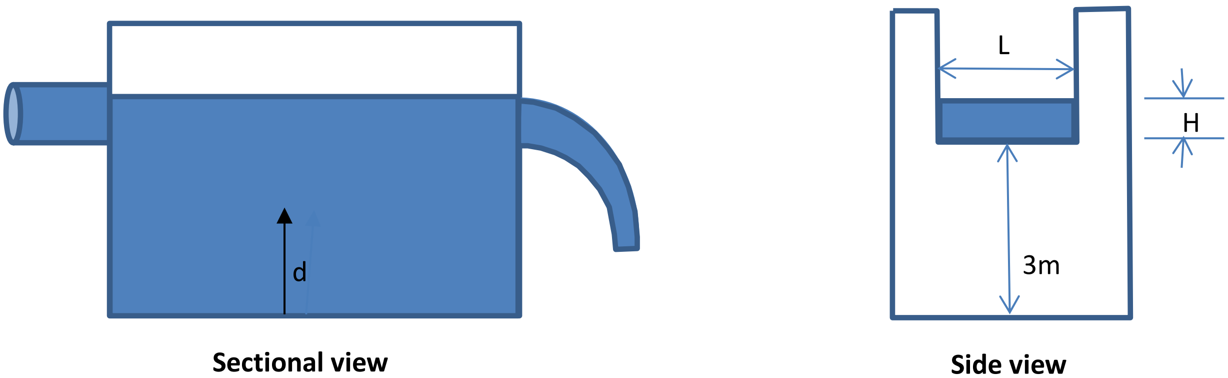


Figure 1 – Reservoir

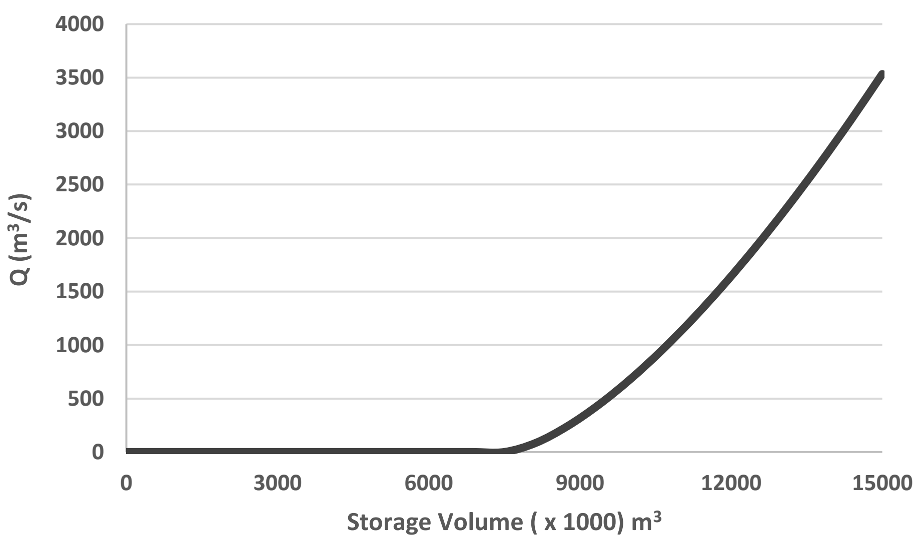


Figure 2 – Storage discharge relationship for reservoir in Figure 1.