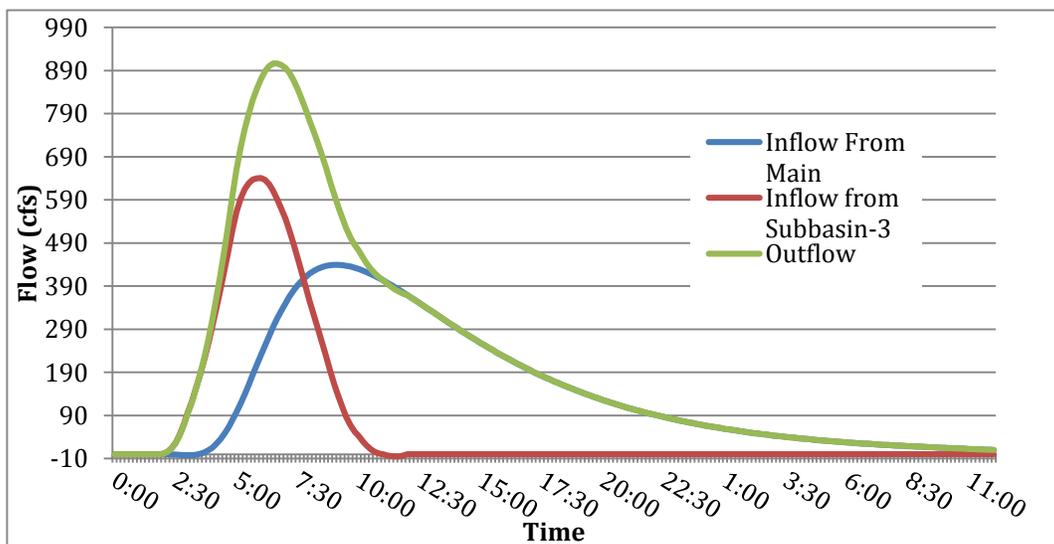
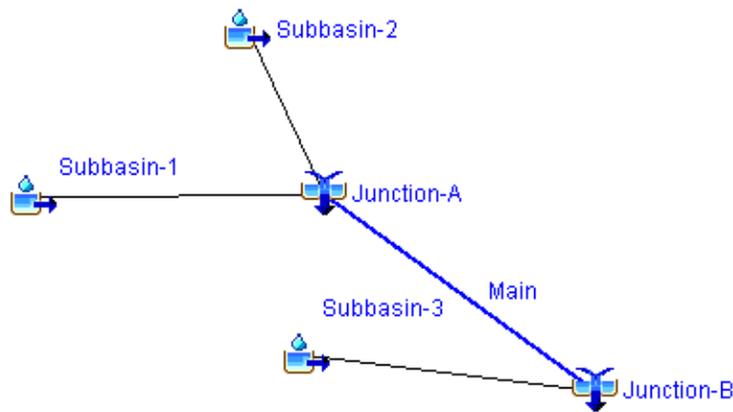


# Chapter Five Case Study

## Unit Hydrograph Determination and Analysis of Reservoir Impacts on Flow Values for a Small Undeveloped Watershed Using HEC-HMS

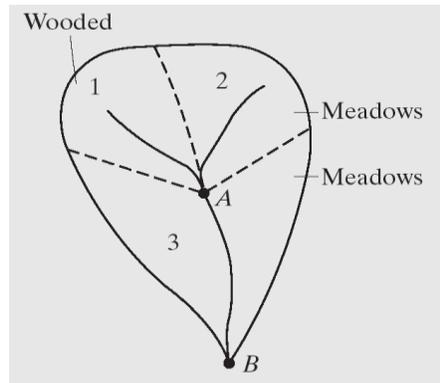
### Preparation:

Before beginning, please note that you will need to have installed HEC-HMS 3.5 on a computer running Windows in order to complete this case study. The software is available as a free download at: <http://www.hec.usace.army.mil/software/hec-hms/download.html>. It is also assumed that you have read chapter five of *Hydrology and Floodplain Analysis Fifth Edition* as well as completed Example 5-1 in your textbook. The example is an excellent reference for much of the methodology described in this case study and its solution constitutes the base model of the watershed that will be altered and analyzed within HMS during this exercise. Figure 1 is a screenshot of the Example 5-1 HEC-HMS basin model and Figure 2 is a graph of the outflow hydrograph for Junction B. Make sure your Example 5-1 results match these figures before continuing. If you have not completed the example, please do so now.



### Introduction:

This case study will analyze the small undeveloped watershed presented in Example 5-1. The watershed is depicted in Figure 3 and its parameters mentioned in Table 1. Analysis will be divided into two exercises: developing a two hour unit hydrograph for the entire watershed and quantifying the impact on the Example 5-1 peak flow values of adding two reservoirs; one located at point A and one located at point B (Figure 3). The unit hydrograph will be developed by scaling the watershed's response to a 2.5in two hour rainfall with totals distributed equally throughout the storm.



Subbasin Number	TC (hr)	R (hr)	SCS Curve Number	% Impervious (%)	Area (mi <sup>2</sup> )
1	2.5	5.5	66	0	2.5
2	2.8	7.5	58	0	2.7
3			58	0	3.3

Table 1 - Watershed parameters.

### PART 1 - Unit Hydrograph Determination

#### Procedure:

For the unit hydrograph determination, the basic parameters and setup of the Example 5-1 model were maintained. In HMS, the Example 5-1 basin model was duplicated and renamed *Unit Hydrograph*. Before running the simulation, the following alterations were made:

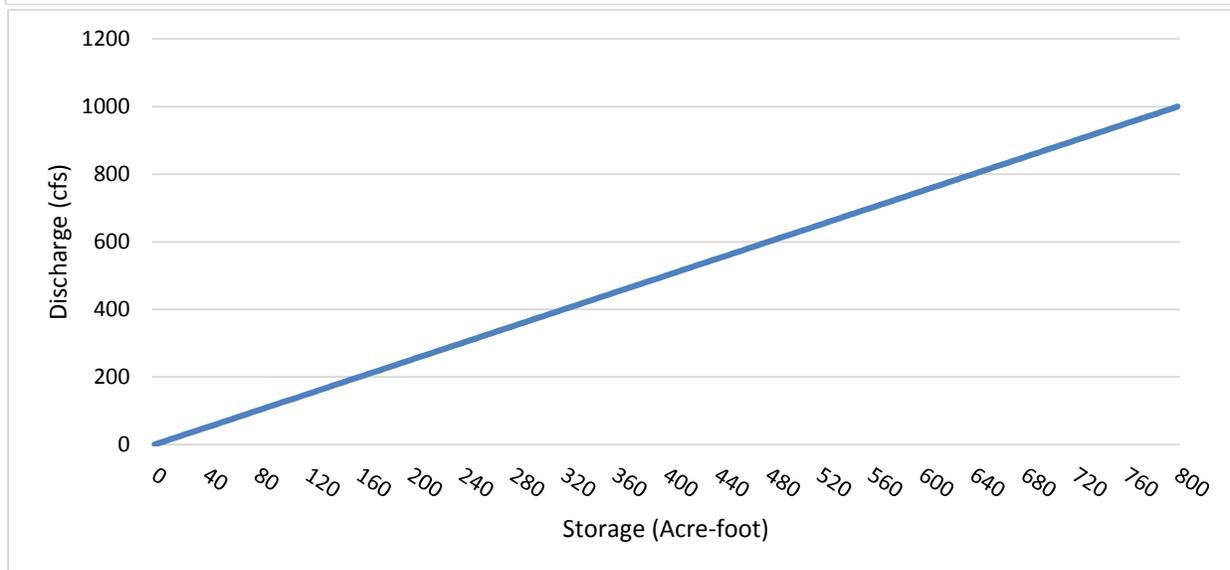
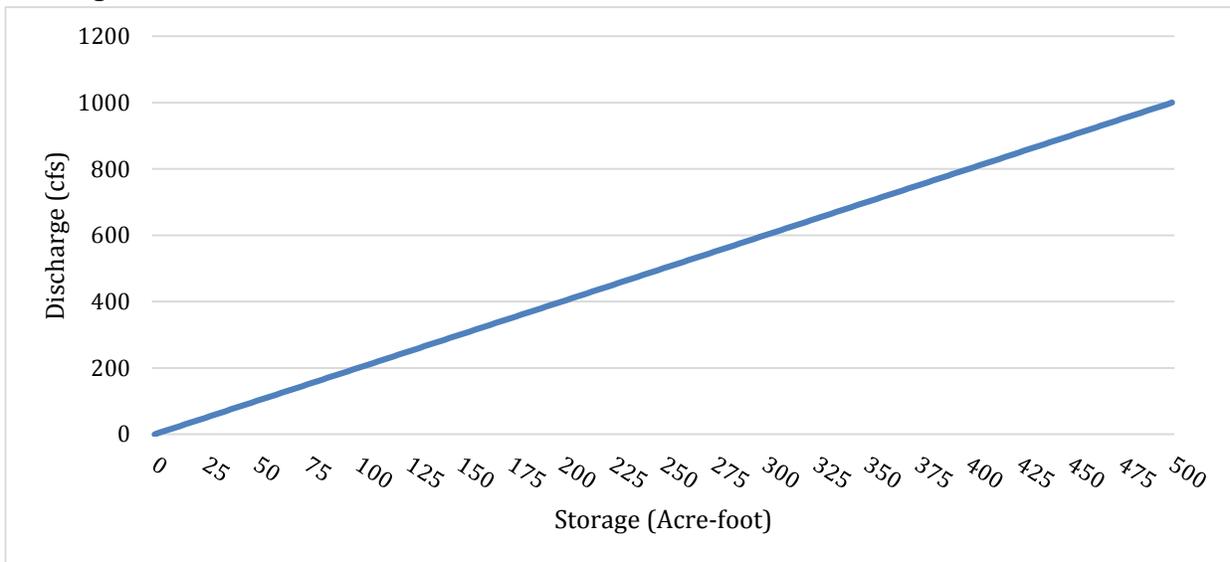
- Loss rates were changed to "None" for each subbasin from "SCS Curve Number" as they will be ignored during unit hydrograph development
- A new rain gauge was created with 2.5 inches of total rainfall evenly distributed throughout a 2 hour storm (1.25in/hr for two hours, starting at 00:00 01Jan2000)
- A new meteorologic model was added to associate the new rain gauge with the basin model and the three subbasins
- A new control specification was created to span the hour time period between 00:00 01Jan2000 and 00:00 02Jan2000
- A new simulation run was created, selecting the new basin, meteorologic model, and control specification

After running the simulation, the resulting outflow hydrograph was converted into the 2-hr unit hydrograph by dividing each outflow value by 2.5, thereby scaling the values to reflect 1 inch of total rainfall.

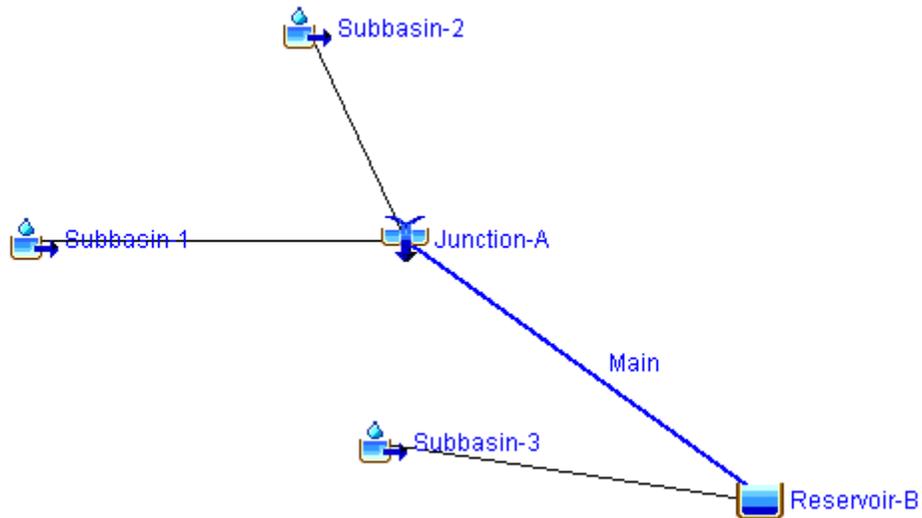
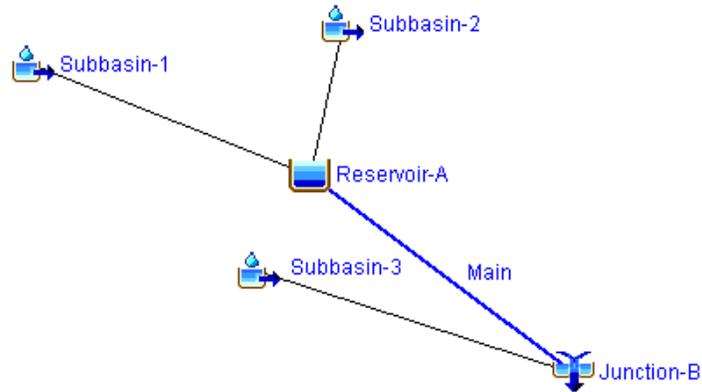
## PART 2 – RESERVOIR ADDITION

### Procedure:

Part 2 of the case study attempted to quantify the individual effects of adding reservoirs in place of Junction A and Junction B on the response of the watershed. Since the addition of the two reservoirs was to be tested independently, two copies the Example 5-1 basin model were made within HMS. Storage discharge relations were developed for each reservoir using the  $S=KQ$  relationship. Two different values of K were used in the reservoirs: 0.5 was used for the reservoir at Junction A and 0.8 was used for Junction B. From the relation, a table of outflow values was developed for each reservoir in Microsoft Excel. Figures 5 and 6 are graphs of these two storage discharge relations.



In the first basin model, Junction A was replaced with a reservoir, which was connected upstream to Subbasins 1 and 2 and downstream to the reach Main. In the second model, Junction B was replaced with a reservoir connected upstream to Subbasin 3 and Main. Figures 7 and 8 depict these layouts in HMS.



Within both basin models, the reservoir's storage method was set to Storage-Discharge. Next, the Excel generated functions storage discharge values were entered into HMS as paired data tables and then associated with the corresponding reservoir. The meteorologic models, control specifications, and gauge data were retained from Example 5-1 and used to create simulation runs for each basin model.