

Recommendation for: Developing Station-Discharge Relationships with HEC-HMS and HEC-RAS (Revised 02/13/2002)

Goal: To define how the discharges from HEC-HMS should be placed in HEC-RAS for the hydraulic analysis.

Recommended Procedure: It is recommended that the following steps (currently being incorporated into the next Design Criteria Manual for the Harris County Flood Control District) be adopted as the method for relating the discharges from the sub-basins to the total channel profile.

1. **Plot Stations of Combination Points:** Plot the combination point of each sub-basin being analyzed on a station-discharge semi-log graph (station being normal and discharge being log). Each combination point should correspond to a channel station.
2. **Plot HEC-HMS Discharges:** Plot the computed discharges obtained from the HEC-HMS model. Where two or more sub-basins combine, it is common to see a vertical drop in discharges at the same station as you move upstream.
3. **Connect Sub-Basin Discharges:** Draw a dotted line from one combined discharge to the next and continue upstream to the end. Review the completed station-discharge graph for consistency and anomalies.
4. **Plot HEC-RAS Discharges:** A station-discharge relationship can be generated from the completed graph and transferred to the corresponding HEC-RAS model. The appropriate discharges for each reach are selected from the graph and input at the upstream HEC-RAS station of each reach. Draw a horizontal solid line between each change in discharge on the station-discharge graph. This line will become vertical at points where the discharge changes, producing a "stair-step" graph. Review the plot for consistency and anomalies and make adjustments as necessary.
5. **Check HEC-RAS Discharges:** Check that the flow distribution is reasonable and reflects the overall functioning of the system. All discharges in the HEC-RAS program should be carried from just downstream of one combination point to just upstream of the next downstream combination point.
6. **Adjustments to HEC-RAS Discharges:** As a general rule, changes of greater than about 5% in flow rate should be avoided by using smaller, more frequent changes in the flow rate. This may not always be possible because of a small number of HEC-RAS cross-sections available within a particular reach. However, when it is possible and necessary, the discharge should be changed to produce smaller "stair-steps" through the reach.
7. **Discharges within the Upstream-Most Sub-Basin:** When identifying the discharges within the furthest upstream sub-basin (assuming the HEC-RAS model extends that far), a drainage area vs. discharge plot for the entire watershed should be plotted on a log-log graph and the discharge extrapolated from the graph and the drainage area to the point of interest.

Assumptions: With the exception of Step #7, this procedure assumes that the discharge varies linearly between computation points. This may not be the case and it may be necessary to modify flows at the confluence of minor unstudied tributaries or to develop a drainage area vs. discharge plot if the drainage area does not accumulate linearly.

Testing Procedure: No testing performed.

Test Results: No testing performed.

Final Notes: This method should not be applied to the storage vs. discharge model being used to develop Modified Puls routing data. This is due to the fact that it is the upstream discharges which are being routed through a reach and, therefore, a consistent discharge should be used throughout the reach.

Committee Resolution: Use traditional approach (i.e., stated approach)

Table 1: Station vs. Discharge Data

HEC-RAS Cross-Section Station (ft)	Computed HEC-HMS Flow Rate (cfs)	Interpolated HEC-RAS Flow Rate (cfs)	HEC-RAS Flow Rate Change (cfs)	HEC-RAS Flow Rate Change (%)	Description
16,000	3,774 cfs	3,774 cfs	-	-	Downstream End of Model
18,000		3,622 cfs	152 cfs	4.20%	Interpolated HEC-HMS Data
20,000		3,470 cfs	152 cfs	4.38%	Interpolated HEC-HMS Data
22,000		3,318 cfs	152 cfs	4.58%	Interpolated HEC-HMS Data
24,000		3,166 cfs	152 cfs	4.80%	Interpolated HEC-HMS Data
26,000	3,014 cfs	3,166 cfs	0 cfs	0%	Downstream of Tributary Confluence
26,000	2,486 cfs	2,486 cfs	n/a	n/a	Upstream of Tributary Confluence
27,000		2,406 cfs	80 cfs	3.33%	Interpolated HEC-HMS Data
28,000		2,326 cfs	80 cfs	3.44%	Interpolated HEC-HMS Data
29,000	2,246 cfs	2,326 cfs	0 cfs	0%	Downstream of Tributary Confluence
29,000	1,735 cfs	1,735 cfs	n/a	n/a	Upstream of Tributary Confluence
31,000		1,682 cfs	53 cfs	3.15%	Interpolated HEC-HMS Data
33,000		1,628 cfs	54 cfs	3.32%	Interpolated HEC-HMS Data
35,000		1,575 cfs	53 cfs	3.37%	Interpolated HEC-HMS Data
37,000		1,522 cfs	53 cfs	3.48%	Interpolated HEC-HMS Data
38,000	1,495 cfs	1,495 cfs	27 cfs	1.81%	Upstream End of Model

Figure 1: Station vs. Discharge Relationship

