Modeling Flood Hazards Unit 4: Hydraulic Modeling and Flood Inundation Mapping using HEC-RAS

Venkatesh Merwade (Purdue University) and Jim McNamara (Boise State University)

*Unit 4 introduced students to the basics of 1D modeling and the steps involved in conducting a 1D steady state hydraulic simulation. The objective of this exercise is to test students’ ability to successfully run the hydraulic simulations and interpret the modeling results within the context of flood inundation mapping.*

# Introduction

Conducting a simulation is the first successful step in modeling, but interpreting the results and understanding the sensitivity of these results to key factors and/or parameters is critical in creating a good and robust model. This exercise is developed to develop students’ skills running a model, interpreting the results and testing the sensitivity of the model results to surface roughness parameter (Manning’s n).

# Creating Flood Inundation Maps

Run the Wabash River HEC-RAS model for the flows in Table 1 of the HEC-RAS Modeling Tutorial and report the following in tabular format: (i) average water surface elevation for the downstream Wabash Reach for each simulation, (ii) average inundation width (top water width) for the downstream Wabash Reach for each simulation, and (iii) area of the inundation polygon for all three reaches for each simulation.

* Create a plot of average water surface elevation (WSE) for the downstream Wabash Reach (y-axis) and return period (x axis)
* Create a plot of total inundation area (y-axis) and return period (x axis)

# Sensitivity of Hydraulic Modeling output to Manning’s roughness coefficient

Change the channel’s Manning’s n for all cross-sections by -20, -10, +10 and +20 percent and record the average WSE for the 2-year flow simulation. Similarly, by retaining the channel roughness to its original value, change the ROB and LOB roughness by same percentages and record the average WSE for the 2-year simulation.

* Create a plot to show the average WSE (y-axis) and the channel roughness value (x-axis) for the downstream Wabash Reach
* Create a plot to show the average WSE (y-axis) and the overbank roughness value (x-axis) the downstream Wabash Reach

# Turn-in

Turn-in the table and the four plots with a brief write-up on your thoughts on how the average WSE and flood inundation area changes with return-period. Specifically discuss:

* Whether the relationship between the hydrology (flow) and the flood inundation is linear or non-linear.
* The effect of channel Manning’s n and overbank roughness on hydraulic simulation results for different flow conditions.
* Now that you know how to do flood modeling, what would you apply this method to next and why?
* A county planning office needs information on how cutting trees along a river reach upstream of a town, might impact flooding in the town. In a few simple sentences, explain how the trees change flow during floods.