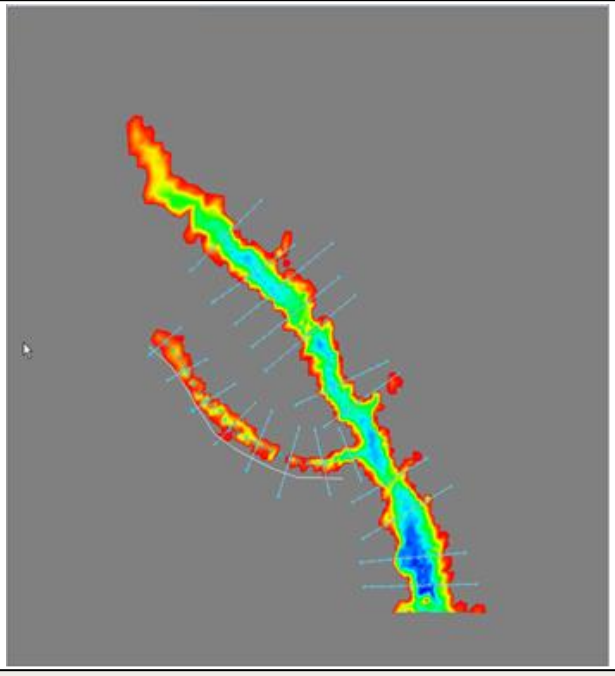
WMS 11.2 Tutorial

Floodplain Delineation

Learn how to use the floodplain delineation tools



Objectives

Experiment with the various floodplain delineation options in WMS. Delineate floodplains using water surface elevations that have been computed using HEC-RAS. Learn how to determine floodplain boundaries and to generate flood impact, extent and depth polygons.

Prerequisite Tutorials

- HEC-RAS Analysis

Required Components

- WMS Core
- HEC-RAS Model Ing.

Time

- 20–30 minutes

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1 Introduction

This exercise demonstrates how to perform floodplain delineation with WMS. Before WMS can delineate a floodplain, an elevation TIN (Triangulated Irregular Network) as well as a scatter point dataset with river stage values must be provided. TIN elevations might be obtained from survey data, or by converting DEM (Digital Elevation Model) points to TIN vertices. River stage files can be assembled manually, or read in from a HEC-RAS project file.

This exercise will show how to delineate a floodplain based on water surface elevations for a river and a TIN which represents the topography for the area. The exercise will instruct how to:

- Experiment with the various floodplain delineation options, including search radius, flow path, and quadrants.
- Use a flood barrier coverage to restrict flood waters.
- Generate flood depth, impact, and extent coverages.

2 Delineation from HEC-RAS Data

2.1 Reading the HEC-RAS Solution

This section will use water surface elevations computed as a result of a separate exercise that builds a HEC-RAS project.

1. Select *File* **| Open** to activate the *Open* dialog.
2. Navigate to the data files for this tutorial, titled *flood*.
3. Select the file “flood.wpr” and click **Open** to exit the *Open* dialog.
4. In the Project Explorer, turn off “ Land”.
5. Switch to the **Hydraulic Modeling Module** .
6. Select **Display Options** to open the *Display Options* dialog.
7. On the *1-D Hydraulic River* tab, turn off *River Hydraulic Schematic*.
8. Select **OK** to exit the *Display Options* dialog.
9. Select *HEC-RAS* **| Read Solution** to activate the *Open* dialog.
10. Select the file “hecrun.prj” and click **Open** to exit the *Open* dialog.

The HEC-RAS solution is read in as a set of scatter points, with one water surface elevation for each cross section. The floodplain delineation interpolation will work much

better if there are more points than the sparsely spaced points that are part of the solution. To increase the density of the scatter points, interpolate between existing points to create additional points along the centerline and cross section arcs. Since the water surface is assumed constant along a cross section and varies linearly between this does not violate any of the modeling assumptions.

1. Turn off "Materials" in the Project Explorer.
2. Activate the "1D-Hyd Centerline" coverage in the Project Explorer.
3. Select *River Tools* **| Interpolate Water Surface Elevations** to open the *Interpolate Stages* dialog.
4. For *Create a data point*, choose "At a specified spacing" from the drop-down menu.
5. Enter "60" for the *Data point spacing*.
6. Select **OK** to exit the *Interpolate Stages* dialog.
7. Select the "1D-Hyd Cross Section" coverage from the Project Explorer.
8. Select *River Tools* **| Interpolate Water Surface Elevations** to open the *Interpolate Stages* dialog.
9. Select **OK** to interpolate with the options set as before and to exit the *Interpolate Stages* dialog.

Notice that the screen is more densely populated with scatter points. Note that along the centerline arcs, the scatter points have been interpolated in a linear fashion, while along cross section arcs, the points that were added have the same data value as the original point.

2.2 Using a Flood Barrier Coverage

WMS allows confining a delineation from the given elevation data by creating a flood barrier coverage. Arcs representing ridges or levees (existing or proposed) may be created in the model, and these in turn alter the floodplain delineation by restricting interpolation of the floodplain so that values on the dry side of the levee are not interpolated. In this exercise, a map file of arcs representing a proposed levee will be used to demonstrate the effects of incorporating a flood barrier coverage.

1. Select *File* **| Open** to access the *Open* dialog.
2. Select the file "levee.map" and click **Open** to exit the *Open* dialog.

Two new coverages are now added to the "Map Data" folder in the Project Explorer. The coverage entitled "proposed levee" is a flood barrier coverage and "breakline" is a general coverage.

3. Verify that "proposed levee" is the active coverage in the Project Explorer.
4. Using the **Zoom** tool, zoom in around the proposed levee as shown in Figure 1. The proposed levee is located along the west bank of the tributary stream.

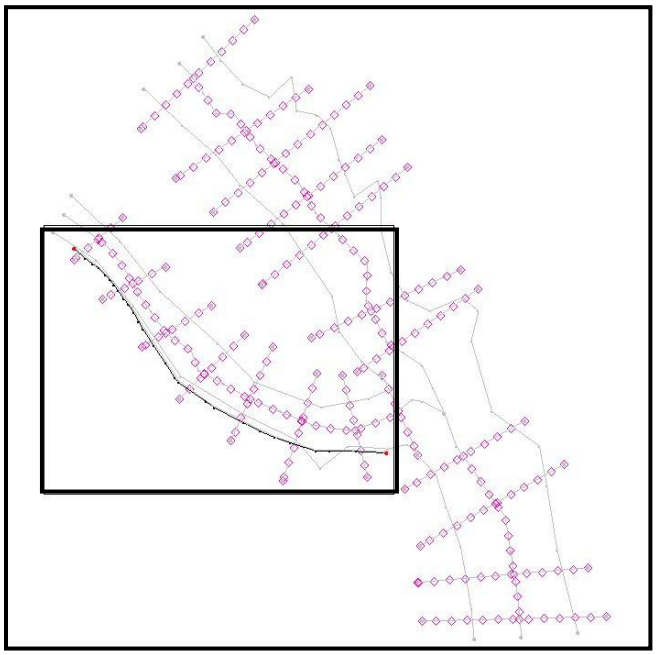

Figure 1 Zoom in on the arc representing the levee

Contouring of floodplain datasets in WMS is based on TIN vertices. Therefore, it is important to make any necessary changes to the TIN before performing floodplain delineation, especially if comparisons are to be made between different scenarios.

The flood extent is contoured to midpoints on triangle edges between flooded and dry areas. It is therefore recommended that a breakline be created on the "river side" of the flood barrier coverage in order to improve the visualization of the delineated floodplain. This breakline and the flood barrier are then forced into the TIN, effectively confining the flood contours between the two.

The next step is to force the flood barrier and breakline arcs into the TIN. The breakline is located immediately to the east of the flood barrier (It probably cannot be seen unless zooming in closely around the flood barrier arc).

5. Turn off the "1D-Hyd Centerline" coverage in the Project Explorer.
6. Choose the **Select feature Arc** tool.
7. Select the flood barrier arc.
8. Select *Feature Objects* **| Arcs → Breaklines** to access the *Select Arc type* dialog.
9. Choose *Use all arcs as breaklines* and select **OK** to exit the *Select Arc type* dialog and open the *Select Interpolation Option* dialog.
10. Choose *Interpolate Z values from existing TIN* and select **OK** to exit the *Select Interpolation Option* dialog.
11. Activate the "breakline" coverage by selecting it from the Project Explorer.
12. Select the breakline arc.
13. Select *Feature Objects* **| Arcs → Breaklines** to open the *Select Arc type* dialog.
14. Choose *Use all arcs as breaklines* and click **OK** to exit the *Select Arc type* dialog and open the *Select Interpolation Option* dialog.

15. Choose *Interpolate Z values from existing TIN* and select **OK** to exit the *Select Interpolation Option* dialog.

2.3 Delineating the Floodplain

Now that the breaklines have been added to the TIN, the next step is to delineate the flood plain:

1. Switch to the **Terrain Data Module** .
2. Select *Flood* **| Delineate**. The *Floodplain Delineation* dialog will appear.
3. Choose the *User defined flood barrier coverage* option.
4. Make sure the *Search radius* option is turned on and enter "1000" for the *Max search radius*.
5. Make sure the *Flow path* option is turned on and enter "500" for the *Max flow distance*.
6. Make sure the *Quadrants* option is turned on and enter "4" for the *Number of stages in a quadrant*.
7. Select **OK** to exit the *Floodplain Delineation* dialog.

It may take some time for WMS to compute the floodplain delineation.

8. Select *Flood* | **Delineate** to open the *Floodplain Delineation* dialog.
9. In the *Output options* section, change the *Solution Name* to "W.S. Elev-PF 2".
10. Change the *Max search radius* to "500".
11. Turn off the *Flow path* option.
12. Click **OK** to exit the *Floodplain Delineation* dialog.
13. In the Project Explorer, turn on " Land".
14. Select the **Frame** macro.
15. Select the dataset named " W.S. Elev-PF 1_fd" in the Project Explorer. The screen should appear similar to Figure 2.

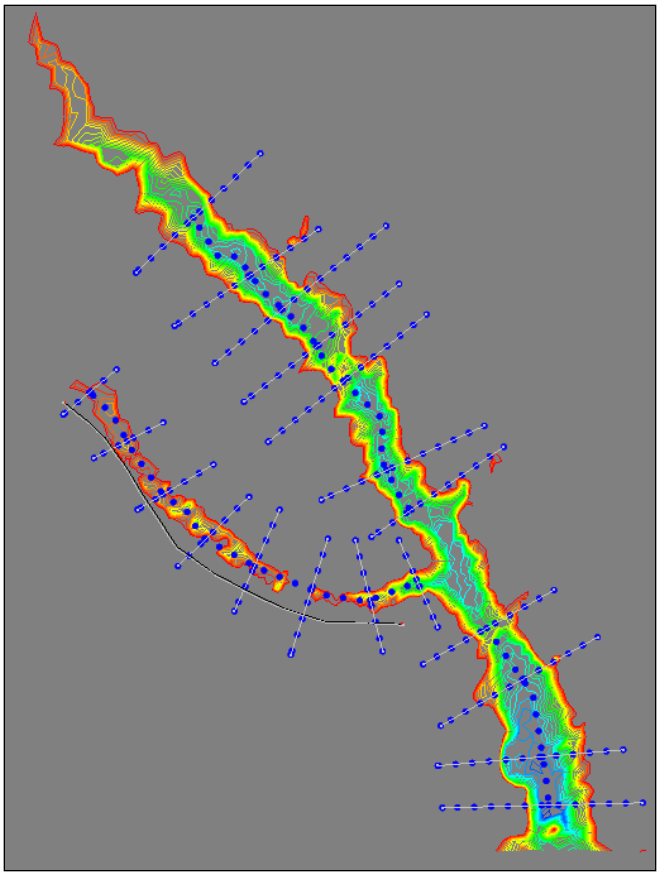

Figure 2 Plot of floodplain depths

These contours correspond to the water depths in the floodplain area. To view the water surface elevation dataset:

16. Select the dataset named "W.S. Elev-PF 1_wl" from the Project Explorer.

3 Creating a Flood Impact Map

WMS can use two separate floodplain delineations to generate a flood impact coverage.

A flood impact coverage shows the difference between two flood depth or water level sets. The differences are divided into ranges or classes.

1. Select *Flood* **|** *Conversion* **|** **Flood** → **Impact Map** to open the *Flood Impact Coverage* dialog.
2. Choose "W.S. Elev-PF 1_fd" from the *Original data set* drop-down menu.
3. Choose "W.S. Elev-PF 2_fd" from the *Modified data set* drop-down menu.
4. Select **OK** to exit the *Flood Impact Coverage* dialog.
5. Select **Yes** to create the coverage.

This new dataset is calculated as W.S. Elev-PF 1_fd – W.S. Elev-PF 2_fd indicating that all values in the second dataset were subtracted from the corresponding values in the first dataset. The new coverage should appear in the Project Explorer as "fic_W.S. Elev-PF 1_fd_W.S. Elev-PF 2_fd".

1. Switch to the **Map Module** .
2. Choose the **Select Feature Polygon** tool.
3. Double-click on any one of the polygons to open the *Flood Extent Attributes* dialog.

The dialog that opens shows the amount of change from the original dataset to the modified dataset, as well as the impact class ID and name.

4. Click **OK** to close the *Flood Extent Attributes* dialog.

4 Creating a Flood Extent Coverage

Flood depth and water level information are stored with the TIN, but WMS allows for the creation of feature objects from this data. In floodplain delineation, it may be useful to create a flood extent coverage. This coverage defines the boundary of the flood and may be exported for use in GIS applications. To create the flood extent coverage:

1. Switch to the **Terrain Module** .
2. Select *Flood* **|** *Conversion* **|** **Flood** → **Extent Coverage** to access the *Flood Extent Coverage* dialog.
3. Select "W.S. Elev-PF 1_fd" from the *Select Flood Depth Data Set* list.
4. Select **OK** to exit the *Flood Extent Coverage* dialog.
5. If prompted, select **OK** to use all arcs.

The flood extent boundary is converted to feature lines and WMS will try to build a polygon enclosing the flooded area. However in this case it reaches the boundary of the TIN and so a complete polygon is not available. Close the polygon manually by creating an arc along the TIN boundary and then choosing to Build Polygons.

5 Creating a Flood Depth Coverage

The flood extent coverage essentially divides the watershed area into two parts: flooded and not flooded. However, it is often necessary to know not only if an area is flooded but also how much flooding has occurred.

It is common to divide the flooded area into zones, each with a depth range. In WMS, these zones are created by making a flood depth coverage. To create a flood depth coverage:

1. Select *Flood* **|** *Conversion* **|** **Flood** → **Depth Map** to open the *Flood Depth Coverage* dialog.
2. Select "W.S. Elev-PF 1_fd" from the *Select flood depth data set* combo box.
3. Note the ranges and attributes of the five "zones" or "flood classes".
4. Select **OK** to exit the *Flood Depth Coverage* dialog.
5. Using the **Zoom** tool, zoom in to view the bottom portion of the main channel.
6. Switch to the **Map Module** .
7. Click on the **Select Feature Polygon** tool.

8. Double-click inside a few of the polygons that have been created. This will bring up the *Flood Extent Attributes* dialog, which include the average flood depth for the zone.
9. Click **OK** to exit the *Flood Extent Attributes* dialog.

6 Conclusion

This exercise demonstrated using WMS to perform floodplain delineations in conjunction with:

- A flood barrier coverage
- Water surface elevations computed with HEC-RAS

Post-processing in the form of creating Flood Extent, Flood Depth, and Flood Impact maps