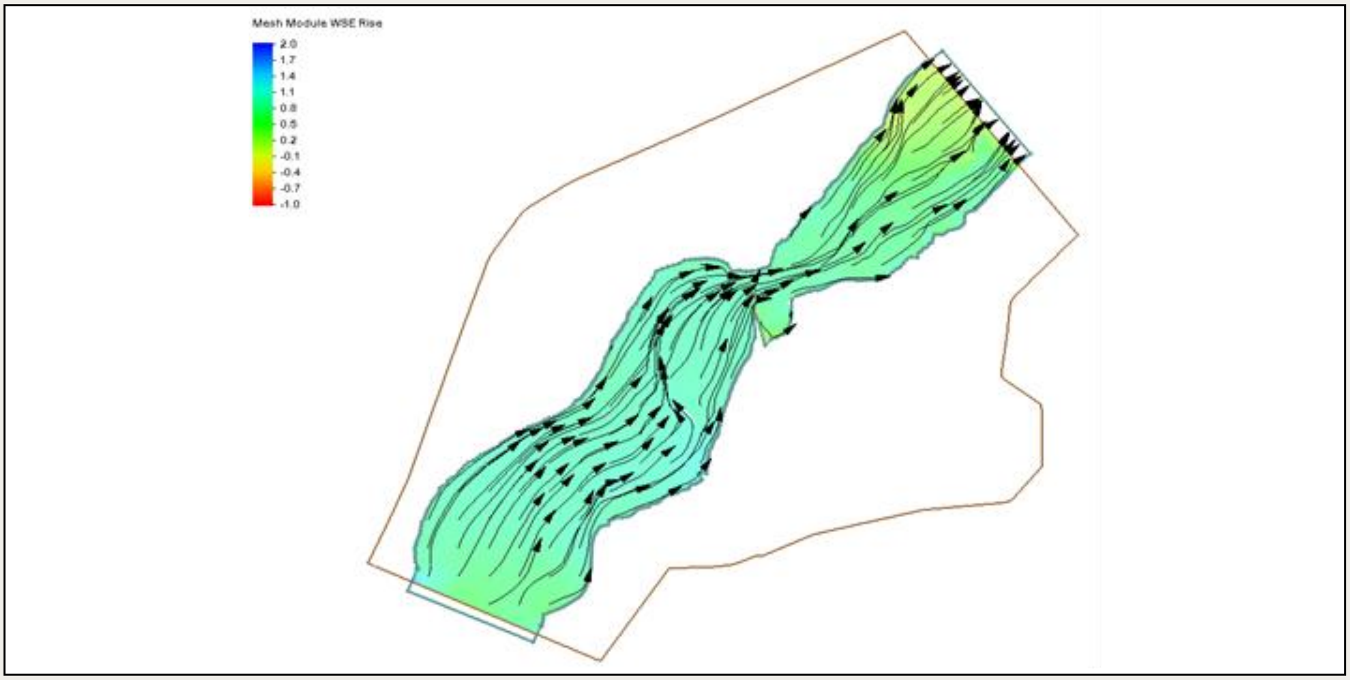
SMS 14.0 Tutorial

Floodway Delineation – Equal Conveyance

Defining a floodway using 1D Cross Sections



Objectives

Learn to define a predicted floodway for a river reach.

Prerequisite Tutorials

- Overview
- Map Module
- Mesh Generation
- SRH-2D

Required Components

- SMS Core
- SRH-2D Interface & Model

Time

- 20–30 minutes
- Additional 30 minutes for model run time

1 Introduction

A floodway is defined by the Federal Emergency Management Agency (FEMA) as:

> The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.[1]

This tutorial demonstrates a method for delineating a floodway in SMS using a 1D hydraulic centerline and cross section coverages, along with results from a hydraulic simulation containing water depth and velocity datasets. All input data can be found in the *data file*s folder for this tutorial.

Note: other methods of defining floodways have been investigated. The “Floodway Delineation – Unit Q” tutorial illustrates another method using unit flow rates with related tools.

In the first section of the tutorial, the floodway extents will be calculated using the original SRH-2D result datasets.

To further examine the floodway tool, the original simulation will be duplicated again and a new materials coverage will be created by merging the original materials coverage and the floodway results. The new materials coverage will be included in the new simulation.

A comparison of the water levels will then be set up to illustrate evaluation of the floodway.

2 Getting Started

To begin the tutorial, import the project files.

1. Launch SMS. If it is already launched, press *Ctrl+N* to reset to the default settings. (Save the current file if needed.)
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. From the *Files of type* drop down, select “Project Files (*.sms)”.
4. Browse to the *data files* folder for this tutorial and select “Floodway.sms”.
5. Click **Open** to import the project into SMS.

The project should appear similar to Figure 1. This project includes an SRH-2D simulation with results datasets. The project also includes a set of cross sections

[1] See https://www.fema.gov/glossary/floodway for more details.

spanning the floodway and a " 1D-Hyd Centerline" coverage, which delineates the main channel, and can be used to establish river stationing for each of the cross sections (establishes an order for the cross sections).

Note: when creating a floodway, care should be taken to ensure that the simulation has reached a converged, steady state condition.

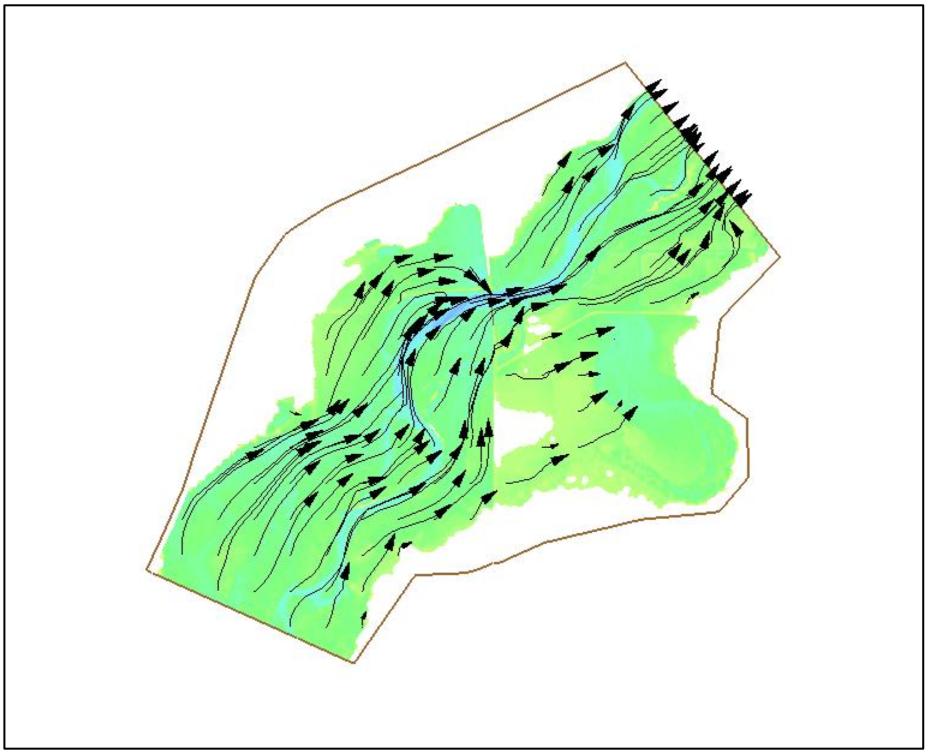


Figure 1 Initial project

3 Creating a Floodway

The first step is to use the Floodway tool to generate a new coverage containing the floodway limits based on the datasets selected in the *Floodway* dialog.

1. Right-click " 1D-Hyd Centerline" and select **Floodway…** to bring up the *Floodway* dialog (Figure 2).
2. To the right of *Geometry*, click **Select…** to bring up the *Select Tree Item* dialog.
3. Select " Mesh" from the list.
4. Click **OK** to close the *Select Tree Item* dialog.
5. To the right of *Depth*, click **Select…** to bring up the *Select Tree Item* dialog.
6. Under " Q100 (SRH-2D)", select " Water_Depth_ft" in the list.
7. Click **OK** to close the *Select Tree Item* dialog.
8. To the right of *Velocity*, click **Select…** to bring up the *Select Tree Item* dialog.
9. Under " Q100 (SRH-2D)", select " Velocity_ft_p_s" in the list.
10. Click **OK** to close the *Select Tree Item* dialog.

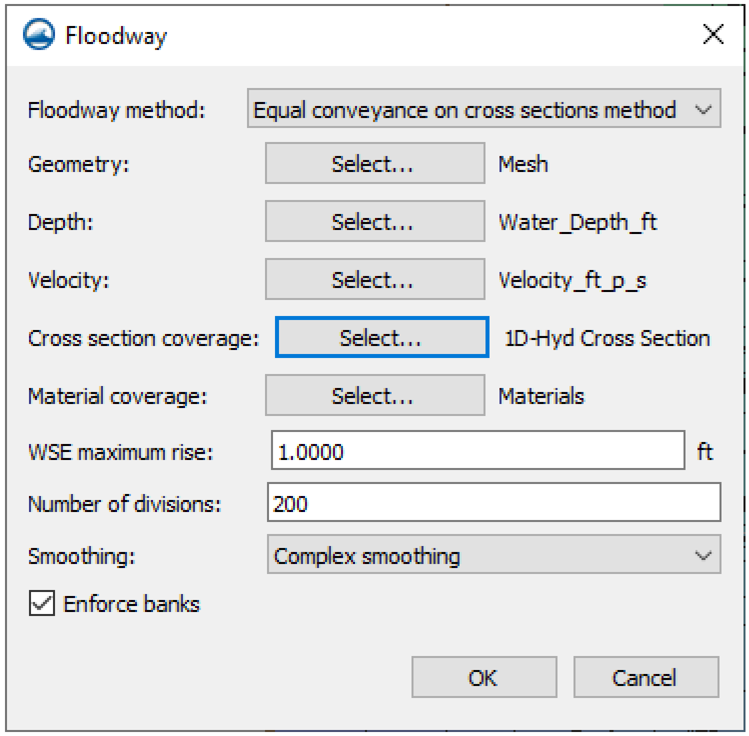


Figure 2 Floodway dialog

11. To the right of *Cross section coverage*, click **Select…** to bring up the *Select Tree Item* dialog.
12. Select " 1D-Hyd Cross Section" from the list.
13. Click **OK** to close the *Select Tree Item* dialog.
14. To the right of *Materials coverage*, click **Select…** to bring up the *Select Tree Item* dialog.
15. Select " Materials" from the list.
16. Click **OK** to close the *Select Tree Item* dialog.
17. Leave the *Number of divisions* defaulted to "200". (This determines how many interpolated cross sections will be created to define the floodway limits.)
18. Leave the other options set to their default options.
19. Click **OK** to close the *Floodway* dialog and create the new floodway coverage.
20. If a warning dialog appears about end points located in wet elements, click **OK**.
21. Once it appears, select " Floodway Est. WSE Rise = 1" to make it active. (This should take between 20 and 30 seconds.)

SMS has now created three new coverages. These include:

- " Floodway Est. WSE Rise = 1" – This includes the computed floodway limits. Note that the floodway cannot cross into the channel (i.e. it is limited by the bank arcs). This is illustrated by the floodway following the bank arc on the left side of the channel on the downstream end.
- " 1D-Hyd Cross Section (2)" – This is a set of cross sections including the input and interpolated cross sections. Equal conveyance contraction is computed on each cross section.

- " Floodway Materials" – This is a new materials coverage created by clipping the input materials coverage to the floodway limits. Elements outside of this limit would be disabled for simulations using this new coverage.

The project should appear similar to Figure 3.

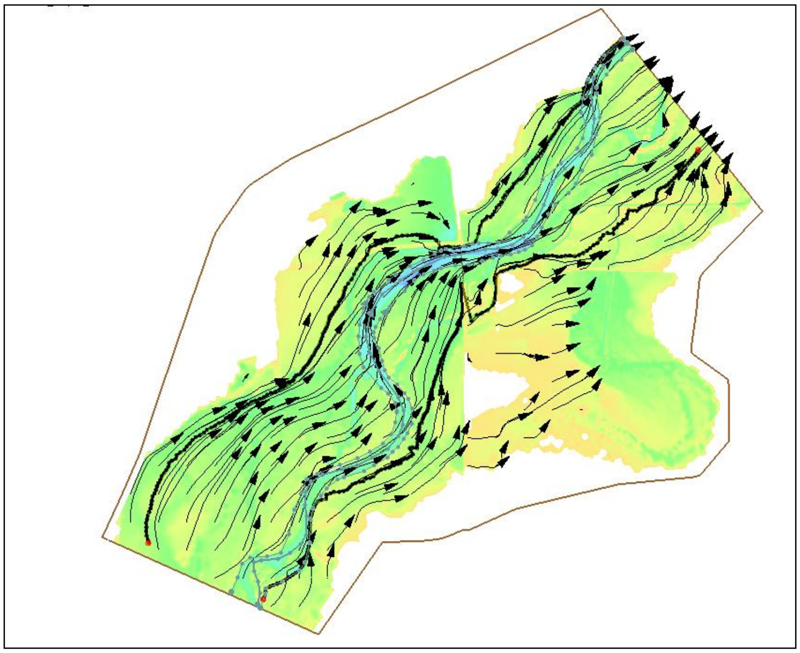


Figure 3 Approximate floodway extents are visible

4 Creating a Floodway Simulation

A new simulation can now be created in order to evaluate the proposed floodway. To accomplish this:

1. Right-click on the " Q100" simulation and select *Tools* | **Generate Floodway Simulation** to open the *SRH-2D Floodway Simulation Generation* dialog.
2. Accept the default value of "1.0" ft for the *WSE Maximum Rise* for the floodway simulation.

SMS has done the following:

- Created " BC Q100 (Floodway)" coverage as a copy of " BC Q100" with the specified water level boundaries increased by 1.0 ft.
- Created a new simulation named " Q100 (Floodway)" which is a duplicate of the " Q100" simulation with a couple differences. This simulation references the new boundary condition coverage and does not have a materials coverage.

4.1 Associating the Floodway Materials Coverage with the Simulation

The floodway simulation was created without a materials coverage. However, the creation of the floodway corridor created that coverage. The materials coverage needs to be associated with the simulation.

To do this:

1. Right-click on "Floodway Materials" and select *Apply to* | **SRH-2D Simulation → Q100 (Floodway)**.

The new simulation is now ready to run.

4.2 Running SRH-2D

Computation time varies based on computer speed, number of elements in the simulation, geometry represented by the simulation and the duration of the simulation. The original floodplain simulation for this site (a fairly large model with over 28,000 elements) requires between 6 and 7 hours of simulation time to fill the floodplain. That simulation can take up to 30 minutes to run. By monitoring the plots of the run, it is easy to observe that this floodway simulation converges more quickly (less simulation time). You may want to reduce the simulation time to 4 hours.

Now to run the "Q100 (Floodway)" simulation:

1. Right-click on " Q100 (Floodway)" and select **Save Project, Simulation and Run** to open the *Simulation Run Queue* dialog.
2. Click **Yes** when asked to renumber the "Floodway Materials" coverage.

The *Simulation Run Queue* dialog will appear.

3. Monitor the progress of the simulation using the various plot options.

When SRH-2D finishes, review the plots to ensure that convergence was reached (the flux across inflow and outflow lines match and are steady).

4. Click **Load Solution** to import the solution into SMS.
5. Click **Close** to exit the *Simulation Run Queue* dialog.

The new datasets should appear in the" Mesh" folder under the " Q100 (Floodway) (SRH-2D)" folder in the Project Explorer.

5 Evaluating the Impact of the Floodway

The concept of a floodway requires that the resulting change of water level not exceed a specified amount. In this case, 1.0 ft was specified.

5.1 Creating a WSE Rise Dataset

The following steps produce a dataset of water level rise at each point in the domain caused by constricting the floodplain to the floodway:

1. Turn off all coverages except for " Floodway Est. WSE Rise = 1".
2. Turn on " Mesh" and select it to make it active.
3. Click the **Toolbox** macro to open the *Toolbox* dialog.
4. In the *Tools* tab, expand the " Datasets" folder.
5. Double-click on the **Dataset Calculator** tool to open the *Dataset Calculator* dialog.
6. For *Grid source selection*, set to "Mesh Data/Mesh".
7. For *Data location selection*, set to "Points".

8. Under the *Dataset table*, click the **Add Row** button twice.
9. In row *1*, set the *Dataset* to “Q100 (SRH-2D)/Water_Elev_ft”.
10. In row *2*, set the *Dataset* to “Q100 (Floodway) (SRH-2D)/Water_Elev_ft”.
11. For the *Mathematical expression*, enter “d1-d2”.
12. For the *Output dataset name* enter “WSE Rise”.
13. Click **OK** to run the tool.
14. When the tool finishes, click **OK** to close the *Dataset Calculator* window.
15. Click **Close** to close the *Toolbox* dialog.
16. Select “ WSE Rise” to visualize the impact of the constriction of the floodway.
17. Click the **Contour Options** macro to open the *Display Options* dialog with the *Contours* tab open.
18. Click the **Label Options…** button to open the *Contour Label Options* dialog.
19. Under the *Settings* section, turn on *Automatic labels*.
20. In the *Settings* section, change the drop-down menu to be “One label per contour”.
21. Click **OK** to close the *Contour Label Options* dialog.
22. Click **OK** to close the *Display Options* dialog.

Feel free to review the results using the data visualization tools. For more details on using these tools in SMS, see the “Observation” and “Data Visualization” tutorials.

Refer to the “Floodway Delineation – Unit Q” tutorial for a demonstration of the Floodway Summary Table tool.

6 Conclusion

This concludes the “Floodway Delineation – Equal Conveyance” tutorial.

