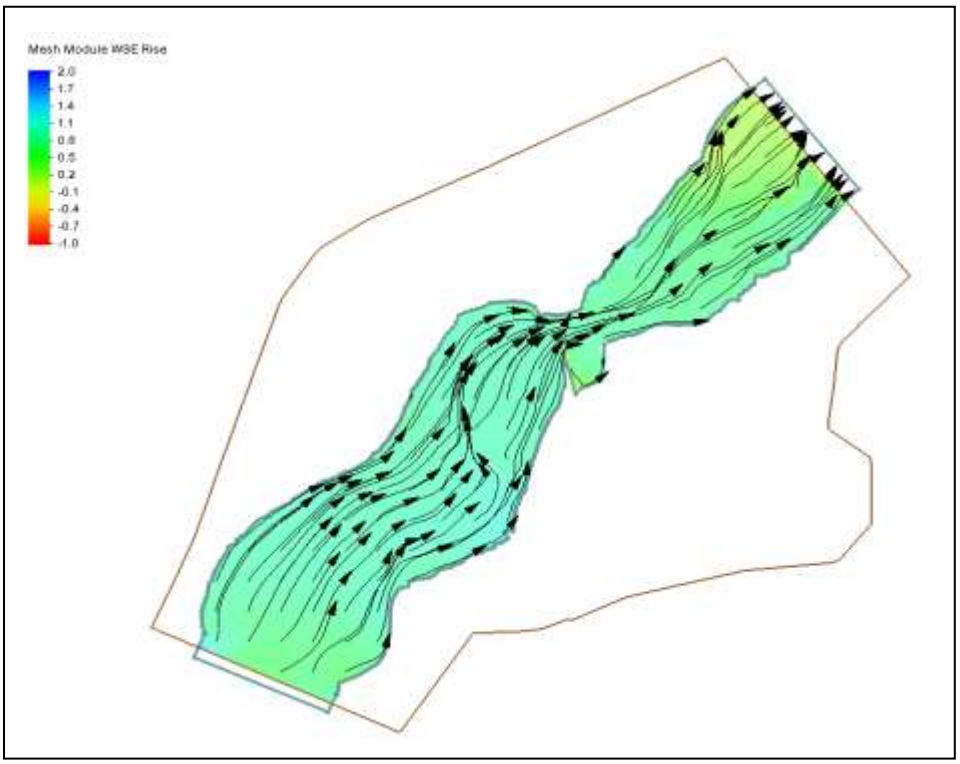
SMS

v. 13.1

SMS 13.1 Tutorial

Floodway Delineation Using 1D Cross Sections



Objectives

Learn to define a predicted floodway for a river reach.

Prerequisites

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

Requirements

- Map Module
- Mesh Module
- Scatter Module
- SRH-2D

Time

- 20–30 minutes

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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 one 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: three separate methods of defining floodways have been investigated. The other 2 will be illustrated in separate tutorials.)

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.
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. Select "Project Files (*.sms)" from the *Files of type* drop-down.

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

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.

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

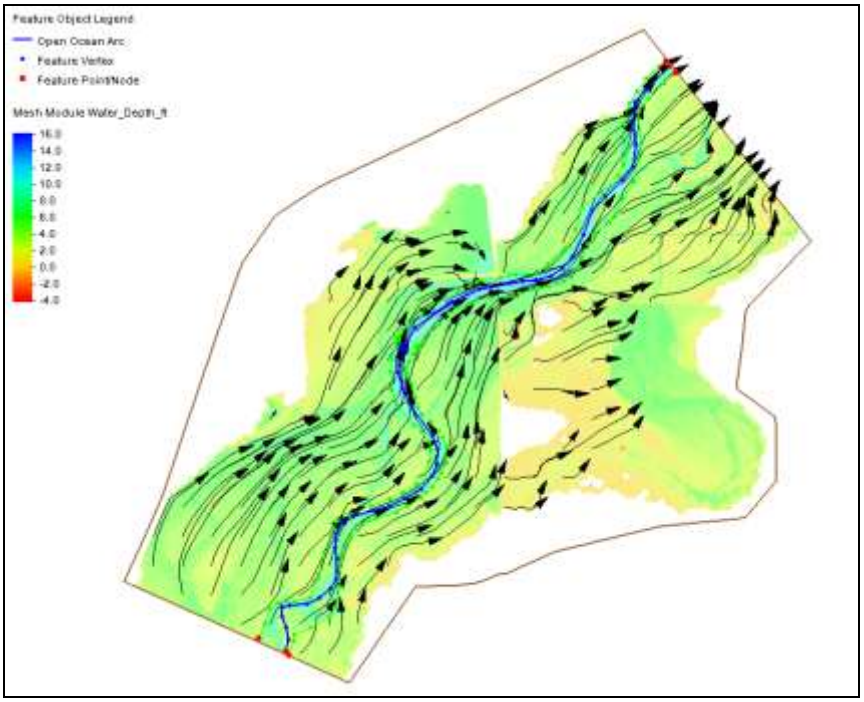

Figure 1 Initial project

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. Click **Select…** to the right of *Geometry* to bring up the *Select Tree Item* dialog.
3. Select "Mesh" from the list and click **OK** to close the *Select Tree Item* dialog.
4. Click **Select…** to the right of *Depth* to bring up the *Select Tree Item* dialog.
5. Select "Water_Depth_ft" under "Q100" in the list and click **OK** to close the *Select Tree Item* dialog.
6. Click **Select…** to the right of *Velocity* to bring up the *Select Tree Item* dialog.
7. Select "Velocity" under "Q100" in the list and click **OK** to close the *Select Tree Item* dialog.

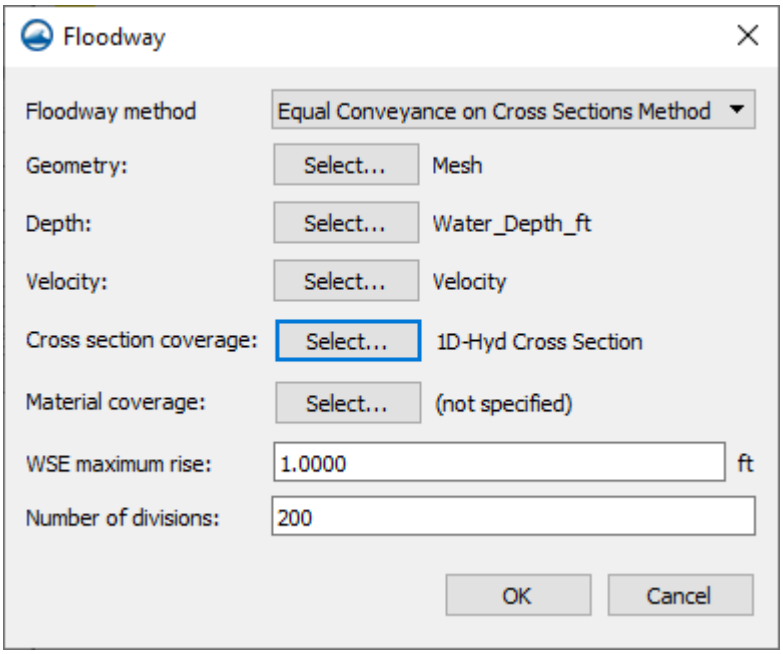

Figure 2 Floodway dialog

8. Click **Select…** to the right of *Cross Section Coverage* to bring up the *Select Tree Item* dialog.
9. Select "1D-Hyd Cross Section" from the list and click **OK** to close the *Select Tree Item* dialog.
10. Leave the other options at the default settings and click **OK** to close the *Floodway* dialog and create the new floodway coverage.

The speed of this process depends on the computer being used.

SMS has now computed the 1D floodway limits by interpolating the cross sections and computing constriction locations at each cross section. It then connected the cross sections points defining the left and right edges of the floodway as arcs in a new "Floodway Est. WSE Rise = 1" coverage.

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

11. Once it appears, select "Floodway Est. WSE Rise = 1" to make it active.

The project should appear similar to Figure 3.

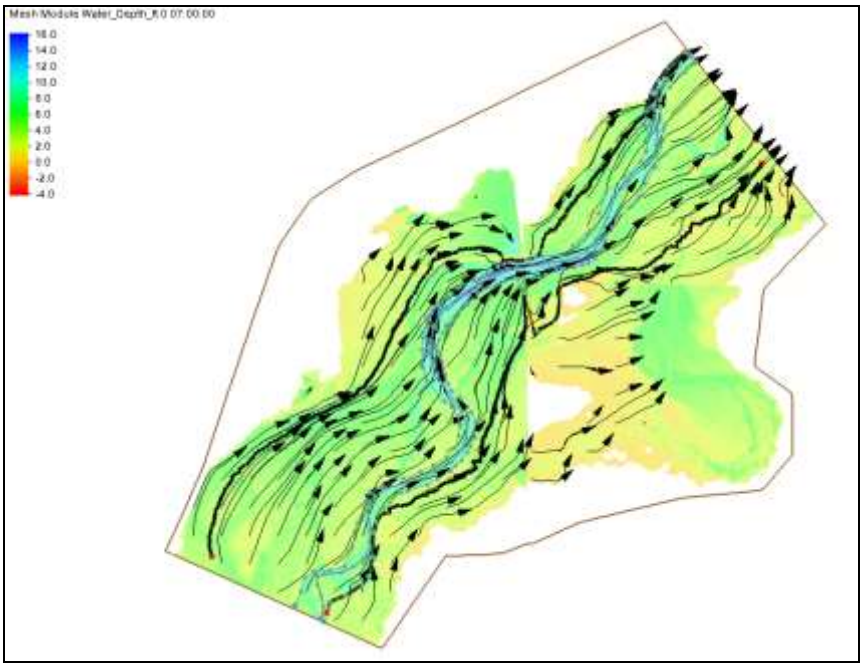

Figure 3 Approximate floodway extents are visible

4 Creating a Floodway Simulation

A new simulation can now be created in order to evaluate the proposed floodway, This can be accomplished by generating a new mesh, limited to the floodway or deactivating all elements outside the floodway. This example uses the former method.

Please refer to the "Mesh Generation" tutorial to review how to generate a mesh limited to the floodway extents.

4.1 Creating a Floodway Boundary Coverage

The floodway coverage ("Floodway Est. WSE Rise = 1") and the "Materials" coverage now need to be combined to define a new materials coverage that will deactivate the cells/elements outside of the floodway. To do this:

1. Turn off "Mesh" in the Project Explorer.

This turns off the display of the mesh so floodway is more easily viewed.

2. Turn on "Mesh Generator".
3. Right-click "Floodway Est. WSE Rise = 1" and select **Duplicate**.
4. Right-click "Floodway Est. WSE Rise = 1 (2)" and select **Rename**.
5. Enter "Floodway Boundary" and press *Enter* to set the new name.
6. Right-click "Floodway Boundary" and select *Type* | *Models* | *SRH-2D* | **Materials**.

The project should appear similar to Figure 4.

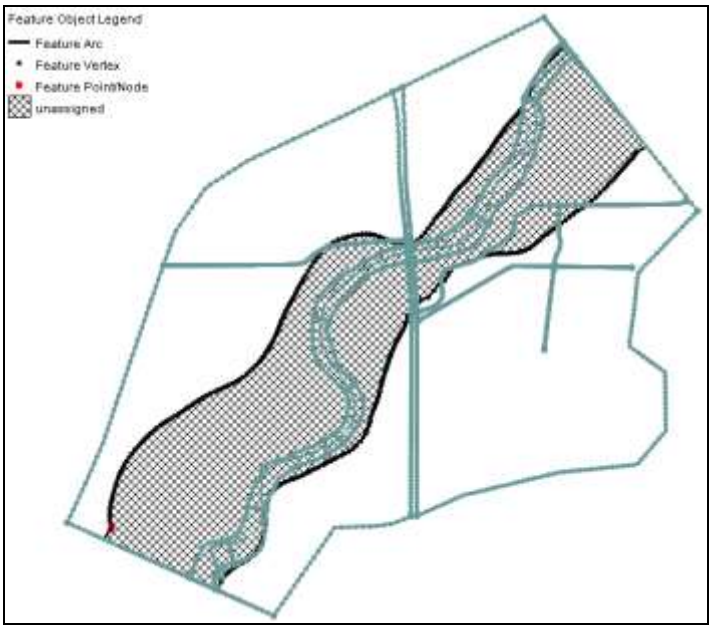

Figure 4 The new Floodway Boundary coverage

4.2 Creating the Floodway Materials Coverage

A floodway simulation needs a material coverage that is a combination of the original materials coverage and the floodway boundary.

To create this:

1. Select "Floodway Boundary".
2. While pressing the *Ctrl* key, select "Materials".

Both coverages should now be selected.

3. Right-click on either and select **Merge coverages** to create a new "Merge coverage".
4. Click **No** when asked if the coverages used for the merge should be deleted.
5. Right-click on "Merge coverage" and select **Rename**.
6. Enter "Floodway Materials" and press *Enter* to set the new name.
7. Select "Floodway Materials" to make it active.
8. Select *Feature Objects* | **Build Polygons.**

This will allow areas outside the mesh to be set to "unassigned" as the material type.

4.3 Specifying "Unassigned" Material Regions

Assigning the polygons outside the floodway region to be "unassigned" will turn them off in simulation run. To do this:

1. Select "Floodway Boundary" to make it active.
2. Using the **Select Polygon** tool, select the floodway polygon.

3. Select *Feature Objects* | **Select Intersecting Objects…** to bring up the *Select Intersecting Objects* dialog.
4. On the *Choose Data to Select* section, select *Feature objects* and select "Polygons" from the drop-down.
5. Select "Floodway Materials" tree list.
6. Click **OK** to close *Select Intersecting Objects* dialog.
7. Right-click in the Graphics Window and select **Invert Selection**.

This selects all polygons outside of the floodway.

8. Right-click and select **Assign Material** to bring up the *Assign Materials* dialog.
9. In the *Materials* section, select "unassigned" from the list and click **OK** to close the *Assign Material Properties* dialog.
10. **Frame** the project.

The project should appear similar to Figure 5.

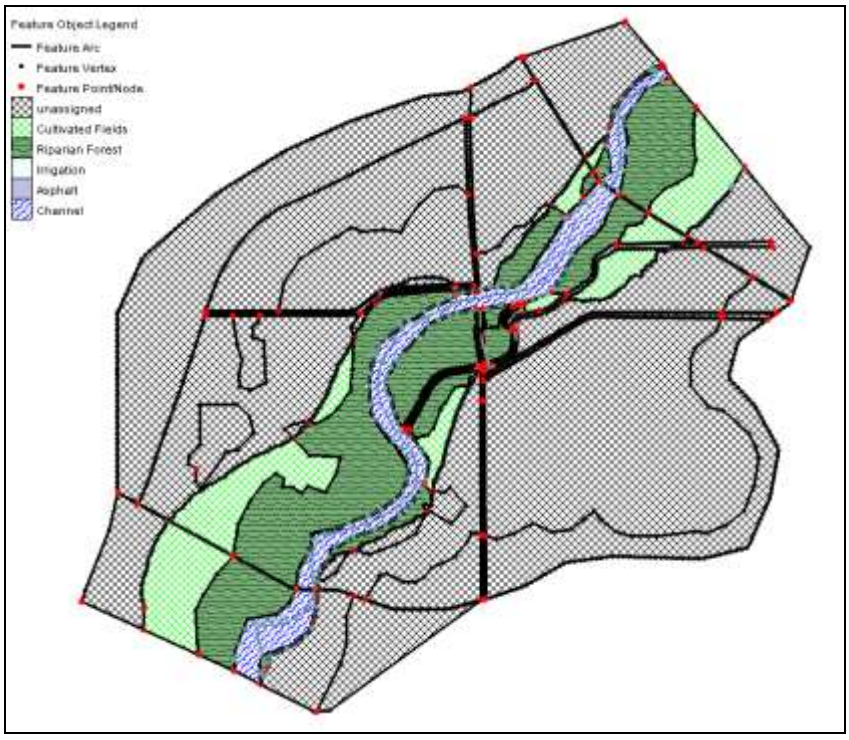

Figure 5 The Floodway Material coverage

4.4 Creating a New Simulation

Now a new simulation can be created, and the new materials coverage can be linked to it.

1. Right-click on "Q100" and select **Duplicate**.
2. Right-click on "Q100 (2)" and select **Rename**.
3. Enter "Floodway" and press *Enter* to set the new name.

4. Right-click on "Materials" under "Floodway" and select **Remove**.
5. Right-click on "Floodway Materials" and select *Apply to* | **SRH-2D Simulations → Floodway**.
6. Right click on "Floodway" and select **Model Control…** to bring up the *SRH-2D Model Control* dialog.
7. Enter "Floodway Simulation" as the *Simulation Description*.
8. Enter "Floodway" as the *Case Name*.

Floodway models often converge in less time than full floodplain models, so they generally do not need run for as long.

9. Enter "3.0" as the *End Time (hours)*.
10. Click **OK** to close the *SRH-2D Model Control* dialog.

The new simulation is now ready to run.

4.5 Running SRH-2D

Now to run the "Floodway Materials" simulation:

1. Right-click on "Floodway" and select **Save Simulation and Run**.

A model check warning will appear stating that there are cells that are unassigned. This is anticipated since they were explicitly turned off.

2. Click **Launch** to continue with the run.
3. Click **Yes** when asked to renumber the "Floodway Materials" coverage.

The *Simulation Run Queue* dialog will appear.

4. Click on the *Monitor Line Plot* tab to review progress of the simulation.

Completion time will vary depending on computer speed. In most cases, it will take a few minutes.

5. When SRH-2D finishes, review the plots to ensure that convergence was reached (the flux across inflow and outflow lines match and are steady) and then click **Load Solution** to import the solution into SMS.
6. Click **Close** to exit the *Simulation Run Queue* dialog.

The new datasets should appear in the "Floodway" folder under "Mesh" 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 foot 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. Select *Data* | **Dataset Toolbox…** to bring up the *Dataset Toolbox* dialog.
4. In the *Tools* section, select *Math* | **Data Calculator**.
5. In the *Datasets* subsection of the *Data Calculator* section, select "d12. Water_Elev_ft" and click **Add to Expression**.
6. In the Calculator subsection, click the **–** (minus) button
7. Select "d7. Water_Elev_ft" and click **Add to Expression**.
8. Enter "WSE Rise" as the *Output dataset name*.
9. Click **Compute** to perform the calculation and create a new "d15. WSE Rise" dataset.
10. Click **Done** to exit the *Dataset Toolbox* dialog.
11. Select "WSE Rise" to visualize the impact of the constriction of the floodway.

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.

6 Conclusion

This concludes the "Floodway Delineation" tutorial. The downstream water surface elevation was not changed in this tutorial. Feel free to experiment by duplicating the "BC Q100" coverage, modifying it, and inserting it into the floodway simulation.

When done experimenting with the SMS interface, exit the program.