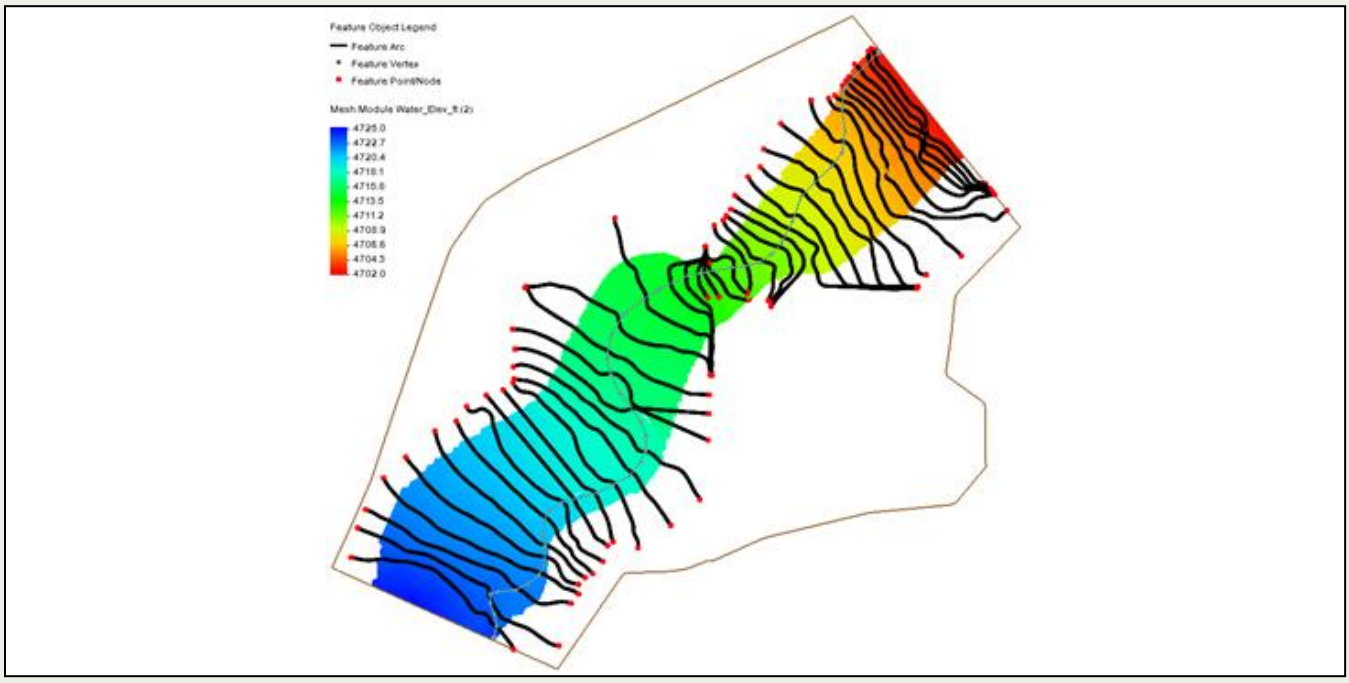
SMS 14.0 Tutorial

Floodway Methods

Overview of using the floodway coverage



Objectives

Learn how to create a floodway coverage with arcs delineating the floodway zone using both the encroachment and unit discharge method.

Prerequisite Tutorials

- Overview
- Map Module
- SRH-2D
- Floodway Delineation

Required Components

- SMS Core
- SRH-2D Interface & Model

Time

- 25–35 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 to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.[1]

This tutorial demonstrates 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.

In the first section of the tutorial, the floodway extents will be calculated using the original SRH-2D result datasets. This will be done twice, using the encroachment method and again with the unit discharge method.

To further examine the floodway tool, a floodway simulation will be created to verify the results. Then floodway cross sections will be generated to compare results. After the cross sections have been cleaned up, a summary table will be generated to compare the datasets along the cross sections.

2 Getting Started

Start by importing a project file containing setup data needed for this tutorial:

1. Launch the SMS application.
2. Select the *File* | **Open…** menu command to bring up the *Open* dialog.
3. From the *Files of type* drop-down, select “Project Files (*.sms)”.
4. Navigate to the *data_files* folder for this tutorial.
5. Select the “start.sms” file.
6. Click the **Open** button to import the project and exit the *Open* dialog.

Save the project under a different name.

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

7. From the *Menu* bar, select the *File* | **Save As…** menu command to open the *Save As* dialog.
8. Save the project as “Floodway.sms”.

The initial project should appear similar to Figure 1. This project includes an SRH-2D simulation with results datasets.

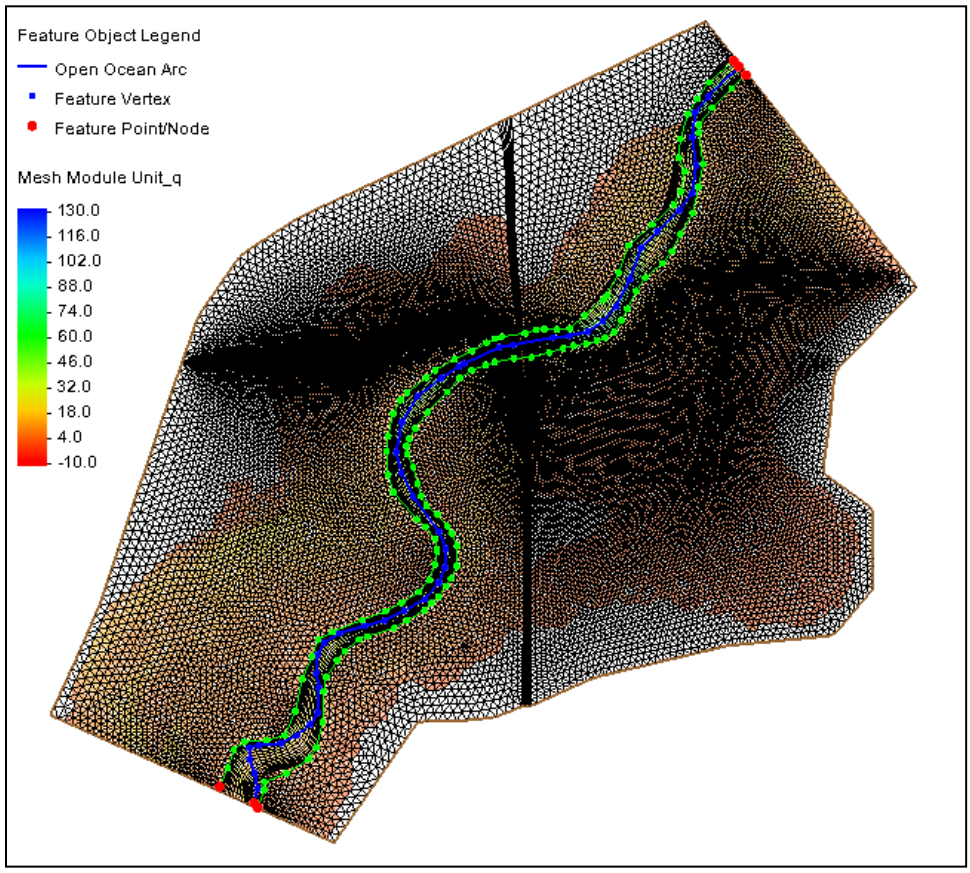

Figure 1 Initial project with the Unit_q solution selected

3 Using the Encroachment Method

The first step is to use the encroachment method in the Floodway tool to generate a new coverage containing the floodway limits based on the datasets selected in the *Floodway* dialog. The encroachment method creates cross sections along the centerline and uses the computed depth and velocity datasets to determine the floodway along the edges of the cross sections. This method requires creating cross sections that span the area of interest and changes in directions.

1. Right-click “ 1D-Hyd Centerline” map coverage and select the **Floodway…** context menu command to bring up the *Floodway* dialog.
2. From the *Floodway method* drop-down menu, select “Equal conveyance on cross section method”.
3. To the right of *Geometry*, click the **Select…** button to bring up the *Select Tree Item* dialog.

4. Select "Mesh" from the list and click the **OK** button to close the *Select Tree Item* dialog.
5. To the right of *Depth*, click the **Select…** button to bring up the *Select Tree Item* dialog.
6. Select "Water_Depth_ft" in the list and click the **OK** button to close the *Select Tree Item* dialog.
7. To the right of *Velocity*, click the **Select…** button to bring up the *Select Tree Item* dialog.
8. Select "Velocity" in the list and click the **OK** button to close the *Select Tree Item* dialog.
9. To the right of *Cross section coverage*, click the **Select…** button to bring up the *Select Tree Item* dialog.
10. Select "1D-Hyd Cross Section" from the list and click the **OK** button to close the *Select Tree Item* dialog.
11. To the right of *Material coverage*, click the **Select…** button bring up the *Select Tree Item* dialog.
12. Select "Materials" from the list and click the **OK** button to close the *Select Tree Item* dialog.
13. For the *WSE maximum rise,* enter "1.0" ft.
14. For the *Number of divisions,* enter "200".
15. From the *Smoothing* drop-down menu, select "Complex smoothing".
16. Turn on the *Enforce banks* checkbox.

Click the **OK** button to close the *Floodway* dialog and create the new floodway coverage.

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

17. Once it appears, select the "Floodway Est. WSE Rise = 1" map coverage to make it active and review the arcs that were generated. Hide the "Mesh" if necessary.
18. Turn on the "Floodway Materials" coverage checkbox and select to make it active and review the arcs that were generated.

The project should appear similar to Figure 2.

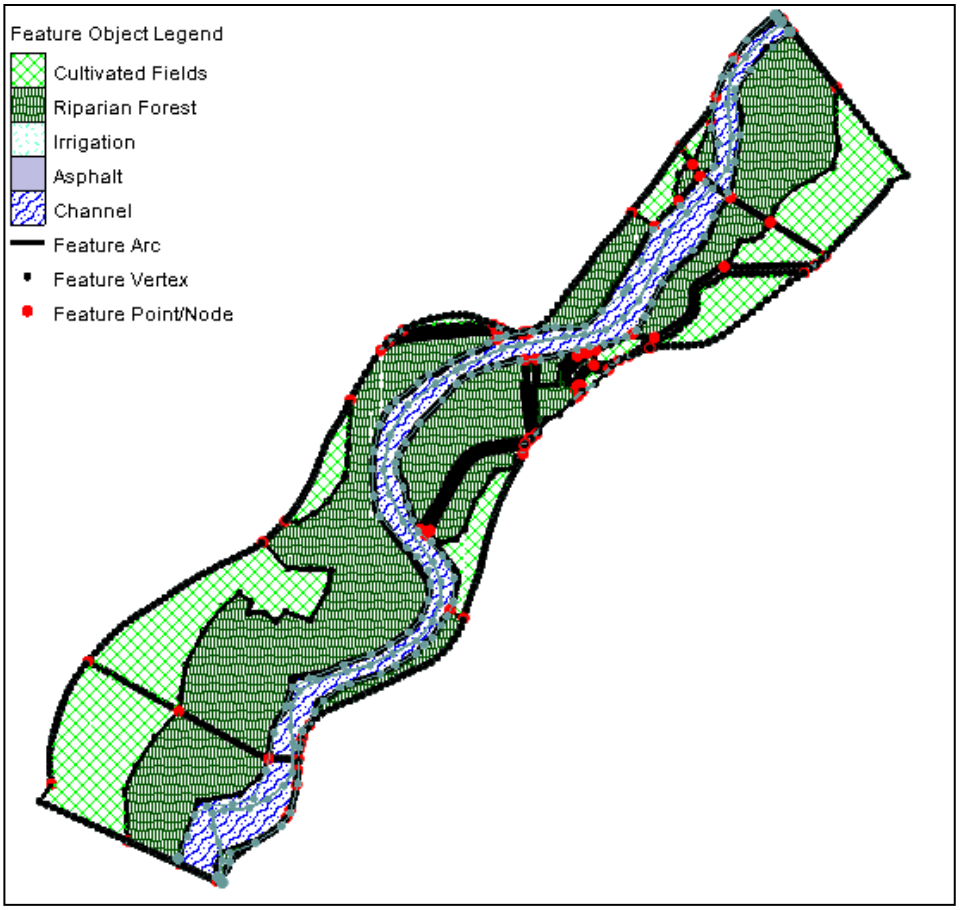

Figure 2 Approximate floodway extents and materials are visible

4 Using the Unit Discharge Method

The Unit Discharge method creates contours at the specified unit discharge, smooths, and prunes the arcs to form the floodway…

1. Right-click the "1D-Hyd Centerline" coverage and select the **Floodway…** context menu command to bring up the *Floodway* dialog.
2. From the *Floodway Method* drop-down menu, select "Unit discharge method".
3. To the right of *Geometry*, click the **Select…** button to bring up the *Select Tree Item* dialog.
4. Select "Mesh" from the list and click the **OK** button to close the *Select Tree Item* dialog.
5. From the *Unit Q method* drop-down menu, select "Specify depth and velocity".
6. To the right of *Depth*, click the **Select…** button to bring up the *Select Tree Item* dialog.
7. Select "Water_Depth_ft in the list and click the **OK** button to close the *Select Tree Item* dialog.
8. To the right of *Velocity magnitude*, click the **Select…** button bring up the *Select Tree Item* dialog.

9. Select "Vel_Mag_ft_p_s" in the list and click the **OK** button to close the *Select Tree Item* dialog.
10. To the right of *Material coverage*, click the **Select…** button bring up the *Select Tree Item* dialog.
11. Select "Materials" from the list and click the **OK** button to close the *Select Tree Item* dialog.
12. Set the *Threshold* to "10.0" cfs/ft.
13. From the *Smoothing* drop-down menu, select "Complex smoothing".
14. Turn on the *Enforce banks* checkbox.
15. Click the **OK** button to close the *Floodway* dialog and create the new floodway coverage.
16. Once it appears, turn off the "Floodway Est. WSE Rise = 1" and "Floodway Materials" checkboxes.
17. Select "Floodway Unit Q = 10.00" to make it active and review the arcs that were generated.
18. Turn on the "Floodway Materials (2)" coverage checkbox and select to make it active and review the arcs that were generated, refer Figure 3.

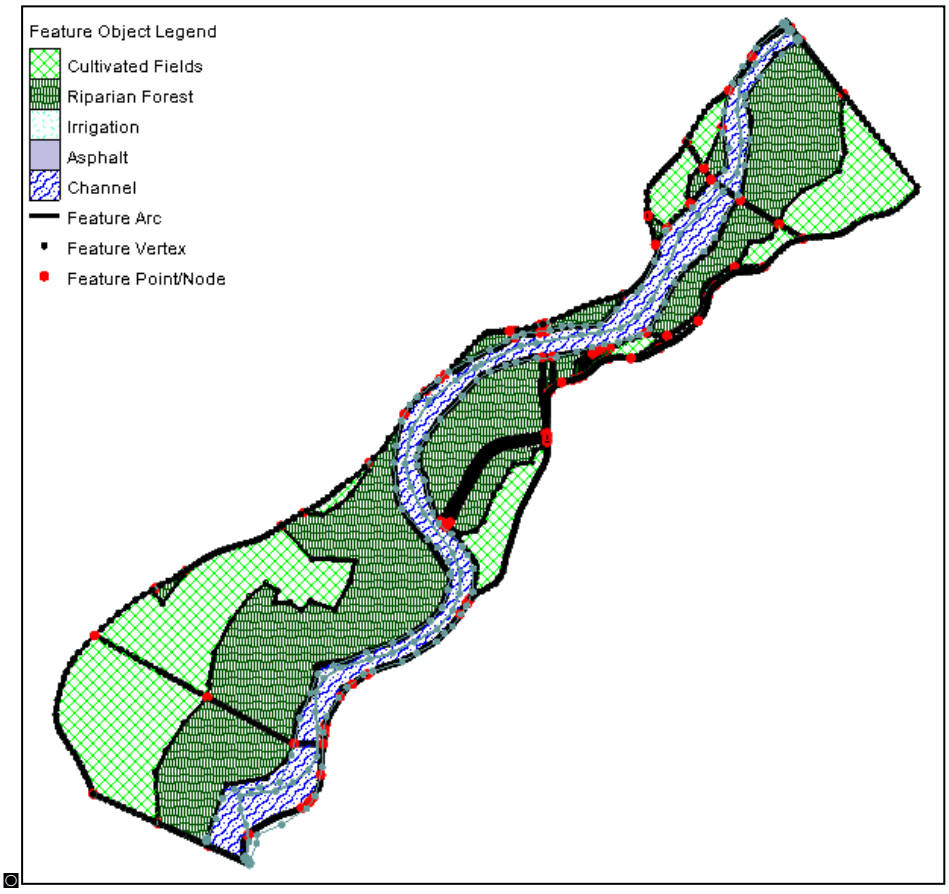

Figure 3 Floodway extents and materials with Unit Discharge method

5 Creating a Floodway Simulation

A new simulation can now be created to evaluate the floodway.

5.1 Creating a New Simulation

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

1. Right-click on the "Q100 replaced" simulation and select the *Tools* | **Generate Floodway Simulation** context menu command to open the *SRH2D Generate Floodway Simulation* dialog.
2. For the *WSE Maximum Rise,* enter "1.0" and from the drop-down select "feet".
3. From the *Material coverage* drop-down menu, select "Project/Map Data/Floodway Materials".
4. Click the **OK** button to close the dialog.

A new simulation will be created that is based on the "Q100 replaced" but incorporates floodway parameters. This new simulation, "Q100 replaced (Floodway)", will appear in the Project Explorer. The materials for this simulation have been replaced with the floodway materials.

The new simulation is now ready to run.

5.2 Running SRH-2D

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

1. Right-click on "Q100 replaced (Floodway)" and select the **Save Project, Simulation and Run** context menu command.
2. Click the **Yes** button when asked to renumber the "Floodway Materials" coverage.

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

3. The *SRH-2D Export Simulation* dialog will open. The dialog will not automatically close because of warnings.
4. Click the **OK** button to exit the *SRH-2D Export Simulation* dialog.

The *Simulation Run Queue* dialog will appear.

5. Click on the *Command line* tab to review progress of the simulation.

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

6. When SRH-2D finishes, review the plots to ensure that convergence was reached (the flux across inflow and outflow lines match and are steady). <TK failed with no action, Matt had similar issue, works in 13.4>
7. Click the **Load Solution** button to import the solution into SMS.
8. Click the **Close** button to exit the *Simulation Run Queue* dialog.

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

6 Creating Comparison Cross Sections

Now that the floodway simulation has been completed, additional cross sections can be generated to compare results along the solution datasets.

6.1 Generating Floodway Cross Sections

Start with generating new cross sections.

1. Right-click on the "1D-Hyd Centerline" coverage and select the **Duplicate** context menu command.
2. Right-click on the new "1D-Hyd Centerline (2)" coverage and select the **Rename** context menu command.
3. For the new *Name*, enter "Floodway Centerline".
4. Select the "Floodway Centerline" coverage to make it active.
5. Using the **Select Feature Arc** dynamic tool, select both bank arcs to either side of the centerline arc and press the *Delete* key.
6. To confirm deleting the arcs, select the **Yes** button.
7. Right-click on the "Q100 replaced" simulation and select the *Tools* | **Generate Hydraulic Evaluation Lines…** context menu command to open the *Generate Floodway Evaluation Lines* dialog.
8. Turn on the *Intersect contours with centerline* checkbox.
9. To the right of *Centerline coverage*, click the **Select…** button to bring up the *Select Centerline Coverage* dialog.
10. Select "Floodway Centerline" from the list and click the **OK** button to close the *Select Centerline Coverage* dialog.
11. To the right of *Water surface elevation dataset*, click the **Select…** button bring up the *Select WSE Dataset* dialog.
12. Select "Water_Elev_ft" (the original set, not from the floodway simulation) from the list and click the **OK** button to close the *Select Centerline Coverage* dialog.
13. For the *Contour length threshold,* enter "100.0".
14. For the *Interval value,* enter "0.5".
15. Turn on the *Specify a range* checkbox.
16. For the *Minimum value*, enter "4702".
17. For the *Maximum value*, enter "4724".
18. For the *Output coverage name,* enter "Floodway Evaluation Lines".
19. Click the **OK** button to close the *Generate Floodway Evaluation Lines* dialog.
20. Select the "Floodway Evaluation Lines" coverage to make it active.
21. Deselect "1D-Hyd Centerline", "Floodway Unit Q = 10.00", "Floodway Materials (2)", "BC Q100 (Floodway)", and "Floodway Centerline" for a clear view.

The cross sections should appear similar to Figure 4

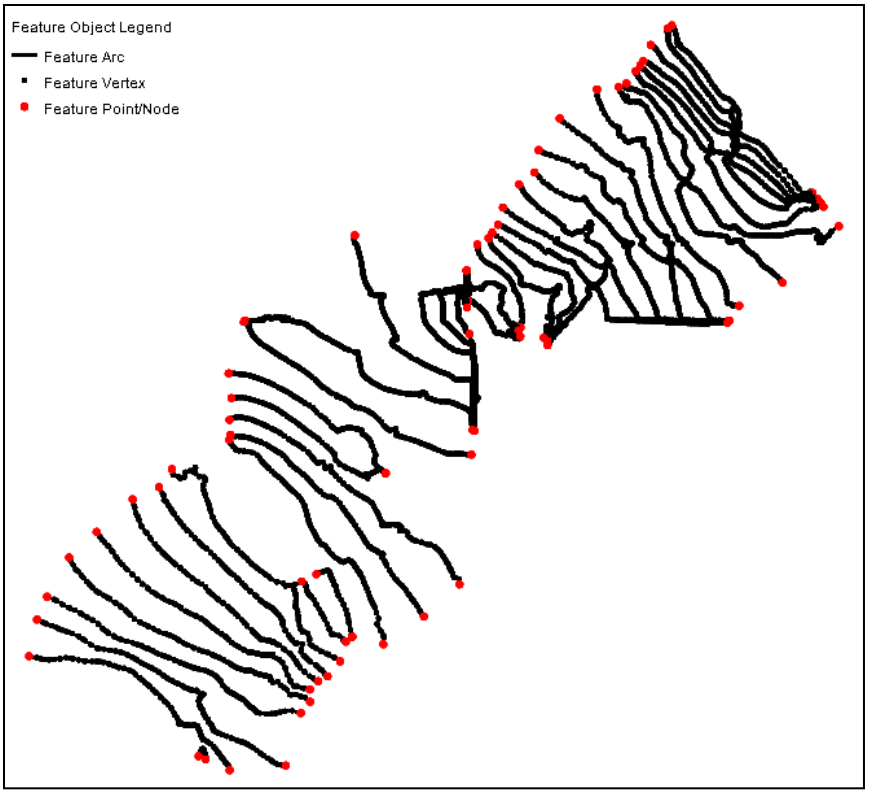

Figure 4 Generated cross section before being cleaned

6.2 Cleaning the Cross Sections

With the new set of cross sections that were just created, some cleanup is needed before a comparison can be made. To do this:

1. Using the **Select Feature Arc** dynamic tool, select the arc at the bottom of the set of cross sections as in Figure 5.
2. Press the *Delete* key and click the **Yes** button to confirm the deletion.

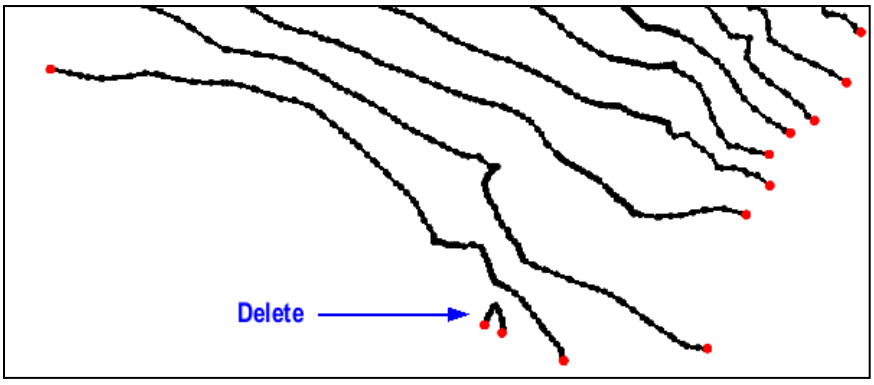

Figure 5 Cross section that needs to be deleted

3. Using the **Select Feature Point** dynamic tool, select the end node of point A shown in Figure 6.

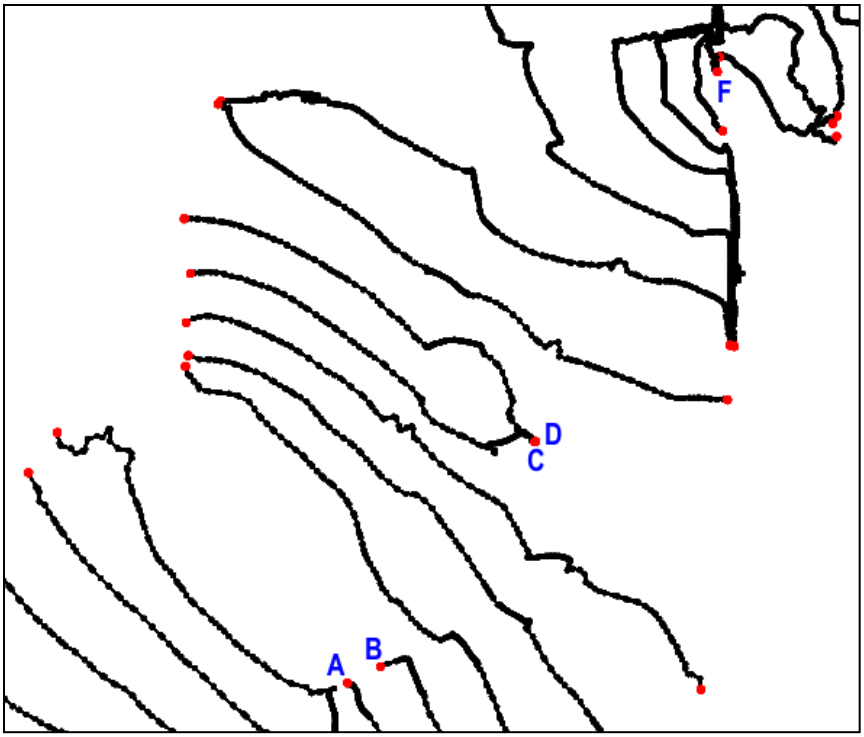

Figure 6 Cross sections that need to be extended

4. Drag the point to extend the cross section as in Figure 7.
5. Turn on the "Floodway Centerline" checkbox to view the centerline.

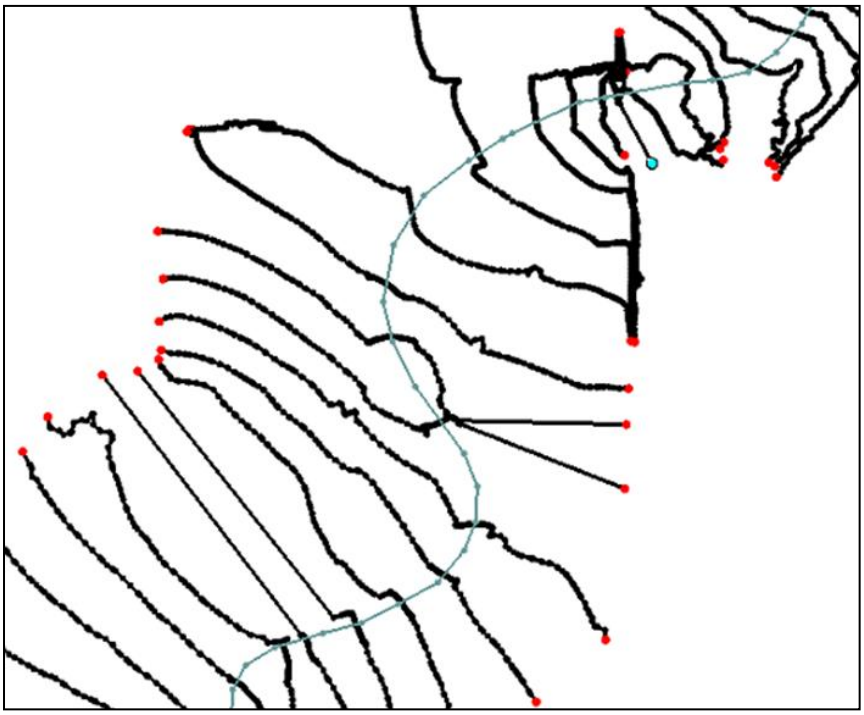

Figure 7 Extended cross sections

6. Repeat steps 3 and 4 for points B, C, D, E, and F in Figure 6 and Figure 7.

7. Using the **Select Feature Arc** dynamic tool, right-click in the Graphics Window and select the **Select All** context menu command.
8. Right-click again and select the **Redistribute Vertices…** context menu command to open the *Redistribute Vertices* dialog.
9. Accept the default settings and click the **OK** button to close the *Redistribute Vertices* dialog.
10. Right-click again and select the **Prune Arc(s)…** context menu command to open the *Prune Arcs* dialog.
11. From the *Feature width type* drop-down menu, select “Constant”.
12. From the *Side to be pruned* drop-down menu, select “Left”.
13. For the *Width,* enter “100”.
14. Click the **OK** button to close the *Prune Arcs* dialog.
15. Repeat steps 10–13 but select “Right” as the *Side to be pruned*.
16. Right-click again and select the **Smooth Arc(s)…** context menu command to open the *Smooth Arcs Tool* dialog.
17. Accept the default setting and click the **OK** button to close the *Smooth Arcs Tool* dialogs.
18. Click anywhere in the Graphic Window to deselect all arcs.

The cross sections should appear similar to Figure 8.

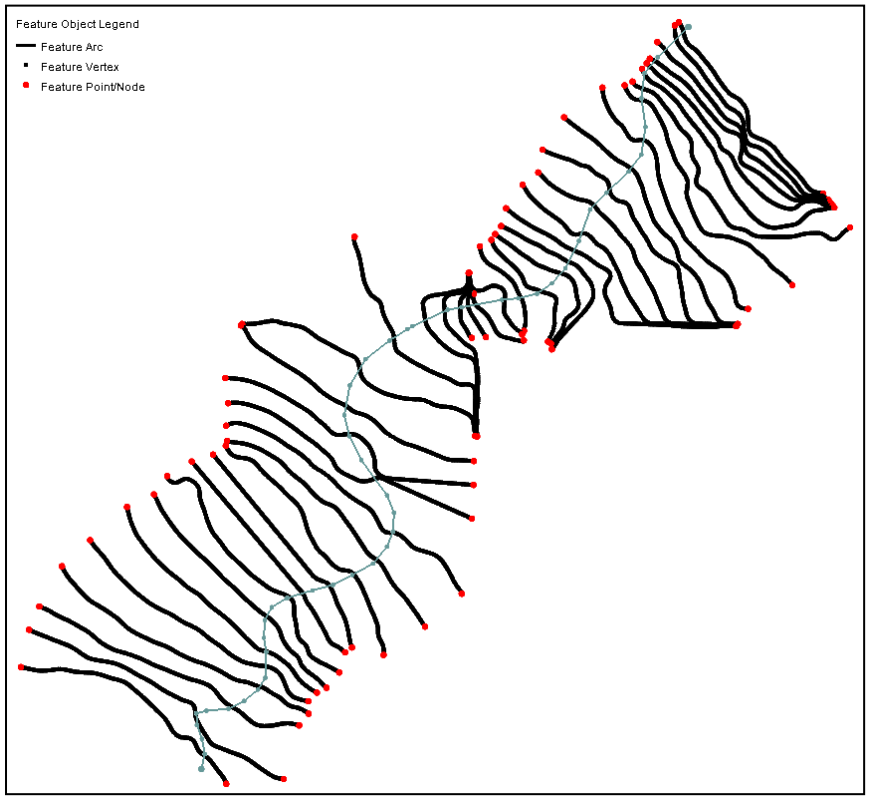

Figure 8 Cross sections after being cleaned up

6.3 Compare Datasets

The Summary Table can be used to compare the datasets from the original simulation to the floodway simulation. To do this:

1. Under the "Q100 replaced (Floodway) (SRH-2D)" simulation folder, right-click on the "Water_Elev_ft" dataset and select the **Duplicate** context menu command.
2. Right-click on the "Floodway Evaluation Lines" coverage and select the *Type* | *Generic* | **1D-Hyd Cross Sections** context menu command.
3. When asked to select a centerline coverage, click the **Yes** button to open a *Select Tree Item* dialog.
4. Select the "Floodway Centerline" coverage and click the **OK** button to close the *Select Tree Item* dialog.
5. Right-click on the "Floodway Evaluation Lines" coverage and select the **Summary table…** context menu command to bring up the *Summary Table Options* dialog.
6. Next to *Data source*, click the **Select…** button to open the *Select Tree Item* dialog.
7. Select the "Mesh" item and click the **OK** button to close *the Select Tree Item* dialog.
8. In the top table, for both *Water_Elev_ft* and *Water_Elev_ft (2)* datasets, turn on the *Min*, *Ave*, and *Max* checkboxes.
9. Select the **Generate table…** button to bring up the *Summary Table* dialog.
10. Compare the datasets in the *Summary Table* dialog.
11. When done, click the **OK** button to close the *Summary Table* dialog.
12. Click the **OK** button to close the *Summary Table Options* dialog.

7 Conclusion

This concludes the "Floodway Methods" tutorial. When done experimenting with the SMS interface, exit the program.