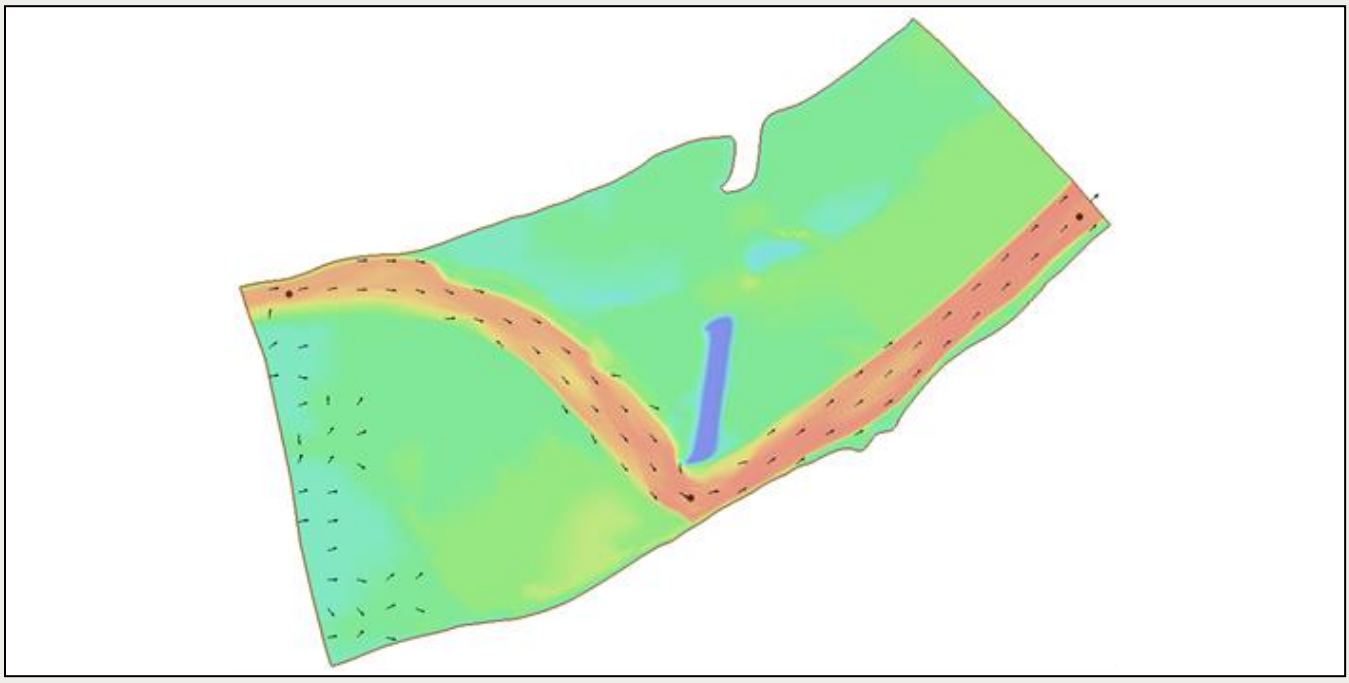
SMS 13.3 Tutorial

SRH-2D – Additional Boundary Conditions

Exploring Boundary Conditions with SRH-2D



Objectives

Learn techniques for using various additional boundary conditions with the Sedimentation and River Hydraulics – Two-Dimensional (SRH-2D) engine.

Prerequisite Tutorials

- Overview
- SRH-2D
- SRH-2D Post-Processing

Required Components

- SMS Core
- SRH-2D Model & Interface

Time

- 20–30 minutes

1 Introduction

The Sedimentation and River Hydraulics – Two-Dimensional (SRH-2D) model is a two-dimensional (2D) hydraulic, sediment, temperature, and vegetation model for river systems developed at the United States Bureau of Reclamation (USBR) and sponsored by the United States Federal Highway Administration (FHWA).

This tutorial builds on previous SRH-2D tutorials and illustrates additional boundary conditions to represent transient conditions or ungauged outflow. Each major section of this tutorial can be completed independently and in any order.

2 Using a Hydrograph as the Inflow Boundary Condition

This section shows how to define the inflow, create monitor points, update the model control for proper output, and then run SRH-2D. The unsteady state model allows using a hydrograph inflow instead of a constant discharge.

If working this section independently, open the project file by doing the following:

1. If necessary, launch SMS.
2. If SMS is already running, press *Ctrl-N* or select *File* | **New** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.
4. Select *File* | **Open…** to bring up the *Open* dialog.
5. Select "Project Files (*.sms)" from the *Files of type* drop-down.
6. Browse to the *data files* folder for this tutorial and select "CimarronTutorial.sms".

This file contains the SMS project.

7. Click **Open** to open the SMS project file and exit the *Open* dialog.

The project should appear similar to Figure 1. The project has multiple simulations with different boundary condition coverages assigned to each simulation. The tutorial will go through the different simulations to show how changing the boundary condition properties effects the model.

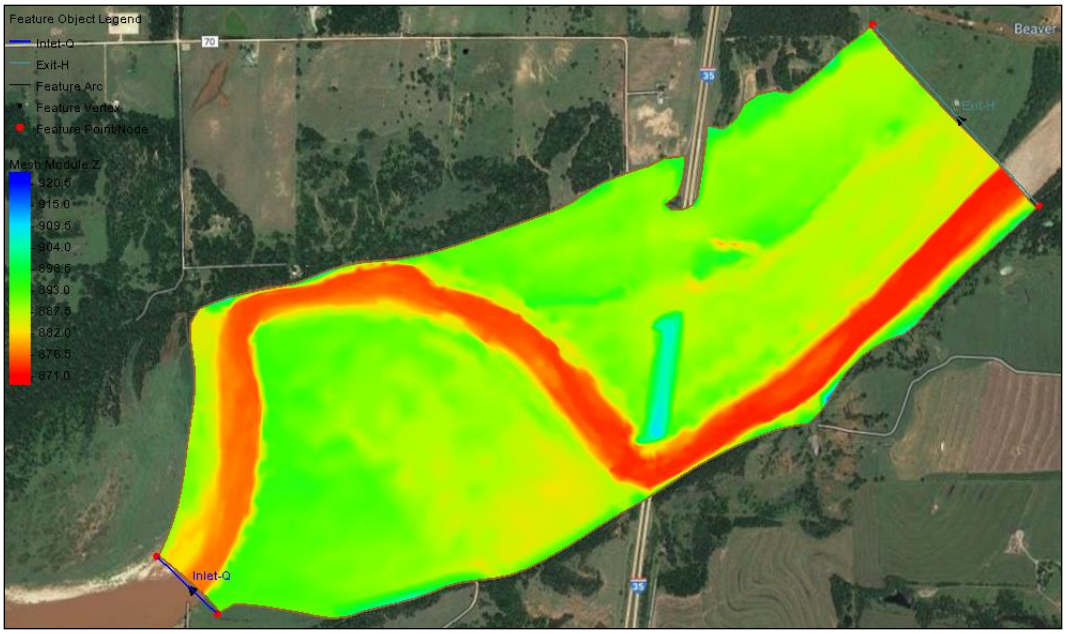


Figure 1 Initial project

2.1 Defining the Inflow Hydrograph

To define the inflow hydrograph:

1. **Zoom** in near the inflow (upstream) boundary on the left side of the model.
2. Turn on and select "Hydrograph BC" in the Project Explorer to make it active.
3. Using the **Select Feature Arc** tool, select the *Inlet-Q* arc.
4. Right-click and select **Assign BC…** to open the *SRH-2D Assign BC* dialog.
5. In the *Discharge options* section, select "Time series" from the *Discharge option* drop-down.
6. Select "hrs -vs- cms" from the drop-down to the right of the **XY Series…** button.
7. Click **XY Series…** to open the *XY Series Editor* dialog.
8. Change the *Number of rows* to "33".
9. Outside of SMS, browse to the *data files* folder for this tutorial and open "InflowHydrograph.xls" in a spreadsheet program.
10. Copy the numerical values from the *Time (hrs)* column in the "InflowHydrograph.xls" file to the *hrs* column in the *XY Series Editor* dialog.
11. Copy the numerical values from the *Flow (cms)* column in the "InflowHydrograph.xls" file to the *vol_per_sec* column in the *XY Series Editor* dialog. The graph should appear as in Figure 2.
12. Click **OK** to close the *XY Series Editor* dialog.
13. Click **OK** to close the *SRH-2D Assign BC* dialog.

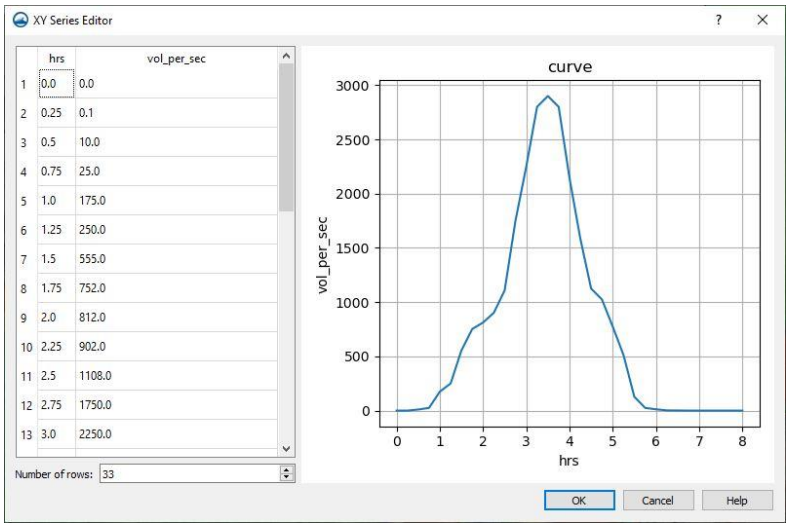


Figure 2 XY Series Editor dialog once values are entered

2.2 Creating Monitor Points

SRH-2D exports solution time series at every monitor point. Using monitor points is useful when the hydraulic parameters need to be determined at specific locations in the model domain. For this project create three monitor points: one near each end of the model and one in the middle.

To do this:

1. Turn on and select "Monitor" to make it active.
2. Using the **Create Feature Point** tool, create three monitor points as shown in Figure 3.

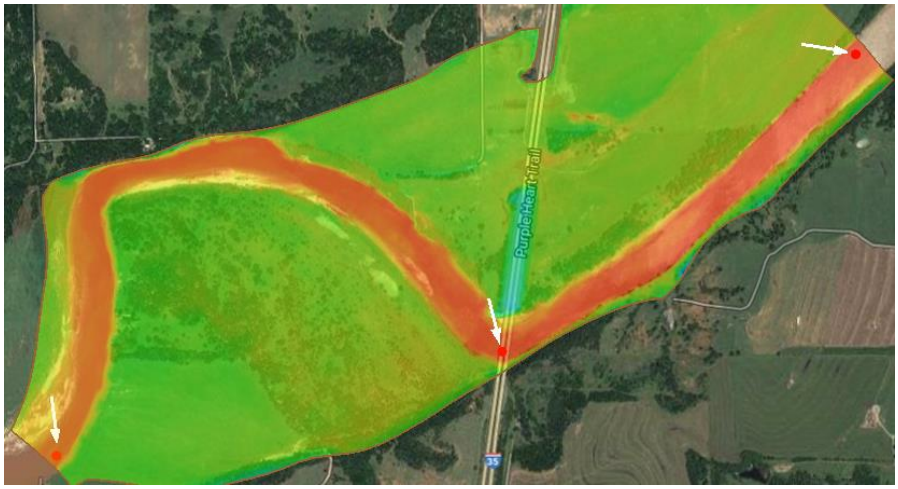


Figure 3 Monitor points at upstream, midway between, and downstream

There are no attributes necessary for these points. However, it is necessary to assign the monitor points coverage to the simulation so that SRH-2D knows where these points are located. In this case, the "Monitor" coverage has been assigned to each of the simulations. These monitor points are not required to run SRH-2D, but they can provide helpful information.

2.3 Running SRH-2D

The hydrograph boundary conditions set on the "Hydrograph BC" coverage have been included with the "Hydrograph" simulation. Now to run the simulation by doing the following:

1. Right-click "Hydrograph" and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue* dialog.
2. Click **OK** if advised that solution items and their associated links in the simulation solution folder will be unloaded before running the simulation.
3. Click **Yes** if advised that one or more coverages will be renumbered before exporting.

SRH-2D plots water surface elevation (WSE) versus time charts at the monitor points as the model run progresses. This provides an idea of how well the model is performing. Once the run completes, the results can be visualized as desired.

4. When SRH-2D has finished running, click **Load Solution** to load the solution files into the project.
5. Click **Close** to close the *Simulation Run Queue* dialog.

SRH-2D creates a DAT file at each of the monitor points. These DAT files are located in the *data files\CimarronTutorial_models\SRH-2D\Hydrograph* folder and contain all the model output parameters exported for each monitor point. The values in these files can be used for hydraulic analysis and designs. A spreadsheet program can also be used to plot these values.

SMS also created several scalar and vector datasets under the "I-35" mesh in the Project Explorer.

3 Using a Rating Curve on the Downstream Boundary

This section of the tutorial shows how to use a rating curve on the downstream boundary. It will first be defined, the model control will be updated, and SRH-2D will be run.

3.1 Defining the Rating Curve

1. **Zoom** in near the downstream boundary on the right side of the model (labeled "Exit-H" in Figure 1).
2. Select the "Rating Curve BC" coverage in the Project Explorer to make it active.
3. Using the **Select Feature Arc** tool, click on the *Exit-H* arc to select it.
4. Right-click and select **Assign BC…** to bring up the *SRH2D Assign BC* dialog.
5. Select "Exit-H (subcritical outflow)" from the *BC Type* drop-down.
6. In the *Exit water surface options* section, select "Rating curve" from the *Water surface (WSE) option* drop-down.
7. Select "cms-vs-meters" from the drop-down just to the right of the **XY Series…** button.
8. Click the **XY Series…** button to open the *XY Series Editor* dialog.

9. Change the *Number of rows* to “6”.
10. Outside of SMS, browse to the *data files* folder for this tutorial and open “RatingCurve.xls” in a spreadsheet program.
11. Copy the values from the *Flow (cms)* column in the “RatingCurve.xls” file to the *vol/sec* column in the *XY Series Editor* dialog.
12. Copy the values from the *Elevation (m)* column in the “RatingCurve.xls” file to the *WSE* column in the *XY Series Editor* dialog. The graph should appear as in Figure 4.
13. Click **OK** to close the *XY Series Editor* dialog.
14. Click **OK** to close the *SRH2D Assign BC* dialog.

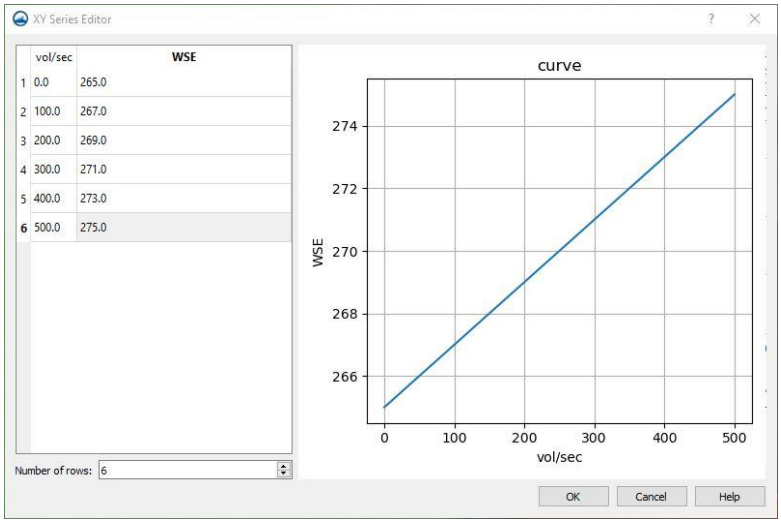


Figure 4 Rating curve in the XY Series Editor dialog

3.2 Running SRH-2D

The hydrograph boundary conditions set on the “ Rating Curve BC” coverage have been included with the “ Rating Curve” simulation. Now to run the simulation by doing the following:

1. Right-click “ Rating Curve” and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue* dialog.
2. Click **OK** if advised that solution items and their associated links in the simulation solution folder will be unloaded before running the simulation.
3. Click **Yes** if advised that one or more coverages will be renumbered before exporting.
4. When SRH-2D has finished running, click **Load Solution**.
5. Click **Close** to exit the *Simulation Run Queue* dialog.

SRH-2D will plot water surface elevation (WSE) versus time charts at the monitor points as the model run progresses. This provides an idea of how well the model is performing. Once the run completes, the results can be visualized as desired.

SRH-2D creates a DAT file at each of the monitor points. These DAT files are located in the *data files\CimarronTutorial_models\SRH-2D\Rating Curve* folder and contain all the model output parameters exported for each monitor point. The values in these files

can be used for hydraulic analysis and designs. A spreadsheet program can also be used to plot these values.

SMS also created several scalar and vector datasets under the "I-35" mesh in the Project Explorer.

4 Using Variable WSE on the Downstream Boundary

In this section, change the downstream boundary condition to use a time-varying water surface elevation. It will first be defined, the model control will be updated, and SRH-2D will be run.

4.1 Defining a Variable WSE Curve

1. **Zoom** in near the downstream boundary of the model.
2. Select "VWSE BC" in the Project Explorer to make it active.
3. Using the **Select Feature Arc** tool, click on the *Exit-H* arc to select it.
4. Right-click and select **Assign BC…** to bring up the *SRH2D Assign BC* dialog.
5. Select "Exit-H (subcritical outflow)" from the *BC Type* drop-down.
6. In the *Exit water surface options* section, select "Time Series" from the *Water surface (WSE) option* drop-down.
7. Select "hrs-vs-meters" from the drop-down just to the right of the **XY Series…** button.
8. Click the **XY Series…** to open the *XY Series Editor* dialog.
9. Change the *Number of rows* to "11".
10. Outside of SMS, browse to the *data files* folder for this tutorial and open "VariableWSE.xls" in a spreadsheet program.
11. Copy the values from the *Time (hrs)* column in the "VariableWSE.xls" file to the *hrs* column in the *XY Series Editor* dialog.
12. Copy the values from the *Elevation (m)* column in the "VariableWSE.xls" file to the *m or ft* column in the *XY Series Editor* dialog. The plot should appear as in Figure 5.
13. Click **OK** to close the *XY Series Editor* dialog.
14. Click **OK** to close the *SRH-2D Assign BC* dialog.

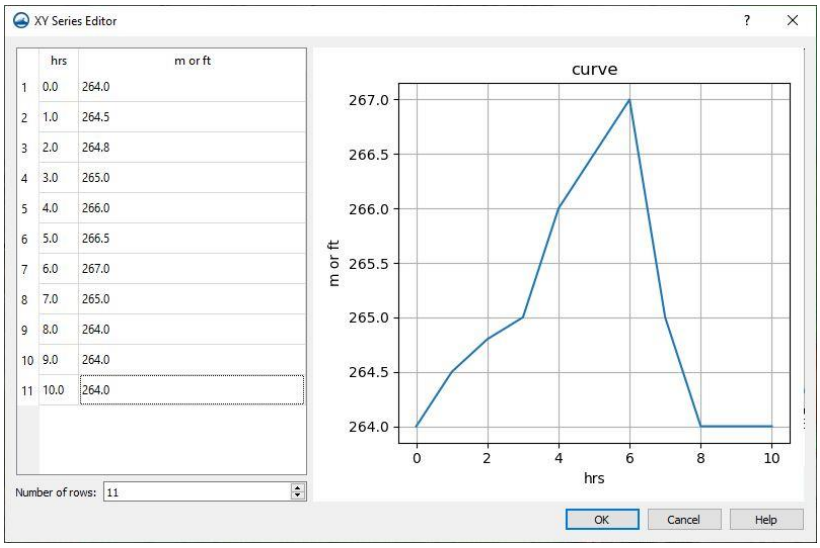


Figure 5 Variable WSE plot in the XY Series Editor dialog

4.2 Running SRH-2D

The hydrograph boundary conditions set on the "VWSE BC" coverage have been included with the "Variable WSE" simulation. Now to run the simulation by doing the following:

1. Right-click "Variable WSE" and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue*.
2. Click **OK** if advised that solution items and their associated links in the simulation solution folder will be unloaded before running the simulation.
3. Click **Yes** if advised that one or more coverages will be renumbered before exporting.
4. When the simulation has finished running, click **Load Solution**.
5. Click **Close** to exit the *Simulation Run Queue* dialog.

SRH-2D creates a DAT file at each of the monitor points. These DAT files are located in the *data files\CimarronTutorial_models\SRH-2D\Variable WSE* folder and contain all the model output parameters exported for each monitor point. The values in these files can be used for hydraulic analysis and designs. A spreadsheet program can also be used to plot these values.

SMS also created several scalar and vector datasets under the "I-35" mesh in the Project Explorer.

5 Conclusion

This concludes the "SRH-2D Additional Boundary Conditions" tutorial. The solutions for all of the simulations can be reviewed and compared using the visualization tools in SMS. If desired, experiment further with the model in SMS or continue to other tutorials.