Embedding a 1D structure in a 2D domain

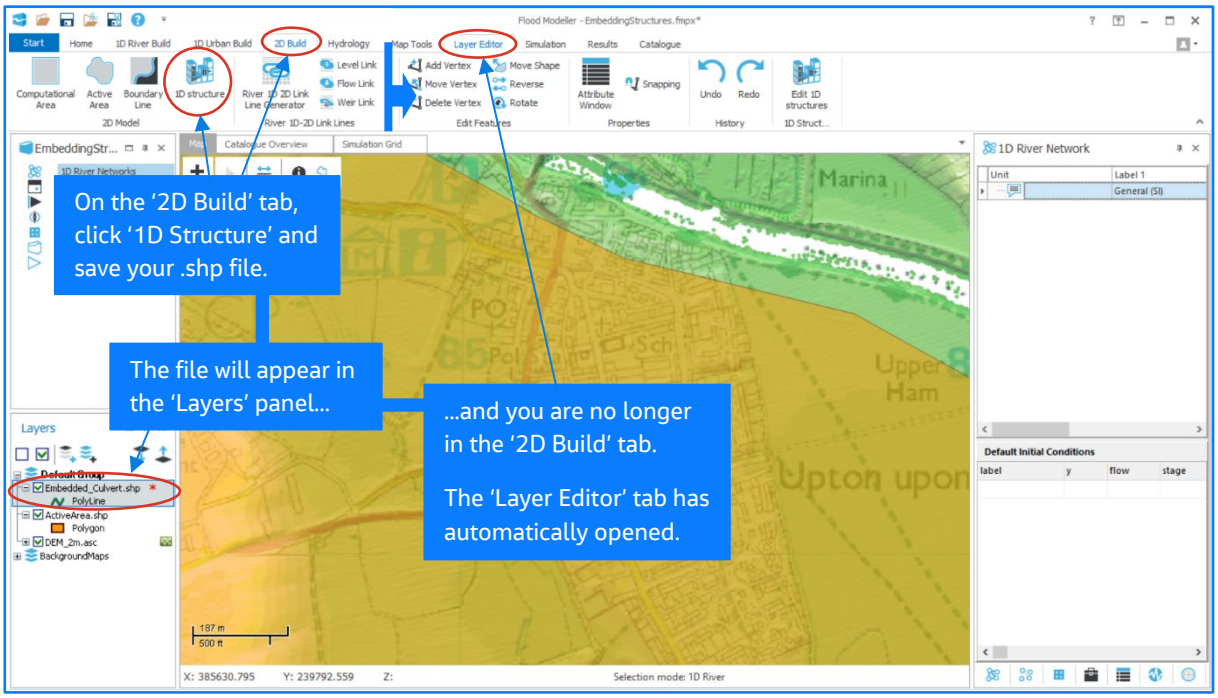
How is this done?

Once you have defined your 2D model extent, i.e. one or more active area polygons, you can then proceed to define any structures that lie within these areas. These 1D elements then must be added to the 2D simulation. This process is broken down into 8 simple steps:

1. Create a new shapefile to represent your structure

On the '2D Build' tab of main toolbar, select the '1D Structure' tool. You will be prompted to specify a filename for the new shapefile that will be created.

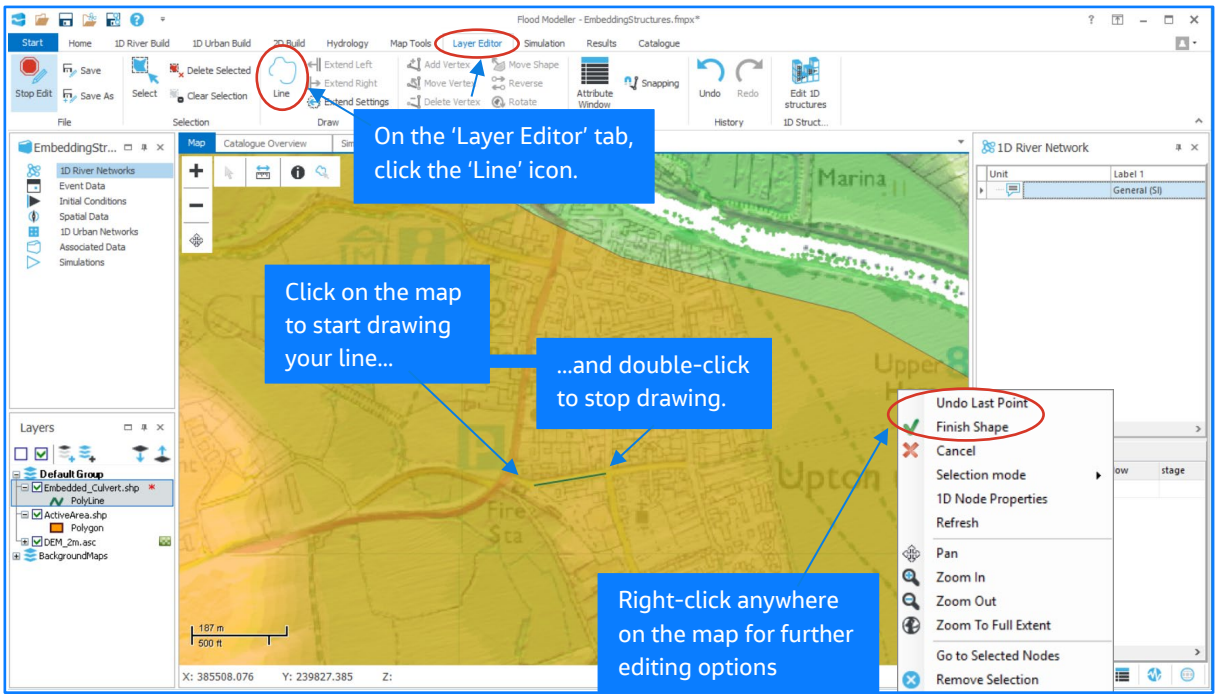
The 'Layer Editor' tab will be automatically activated. This will be configured specifically for creating new polyline shapefiles that will represent your structure locations.



2. Draw a polyline to represent the path taken

For each structure, you will need to first draw a polyline to represent the structure.

Click 'Line' in the toolbar, then click on the map at the starting point of your structure. The starting point of your polyline will be added to the map. Move the mouse to the end of the structure and double-click. A straight line between these points will now show on the map.



Tip: The 'Undo' button in the 'Layer Editor' tab is helpful if you need to try again!

Notes:

For culverts, the line drawn should represent the path taken by the culvert. The 2D solver will calculate the direction from the line; the direction of flow at the inlet will be represented by the first two points in your polyline and the direction at the outlet comes from the last two points. The length of the culvert will be set to the length of the line on the map; this can be overridden by a 'length' attribute in the shapefile.

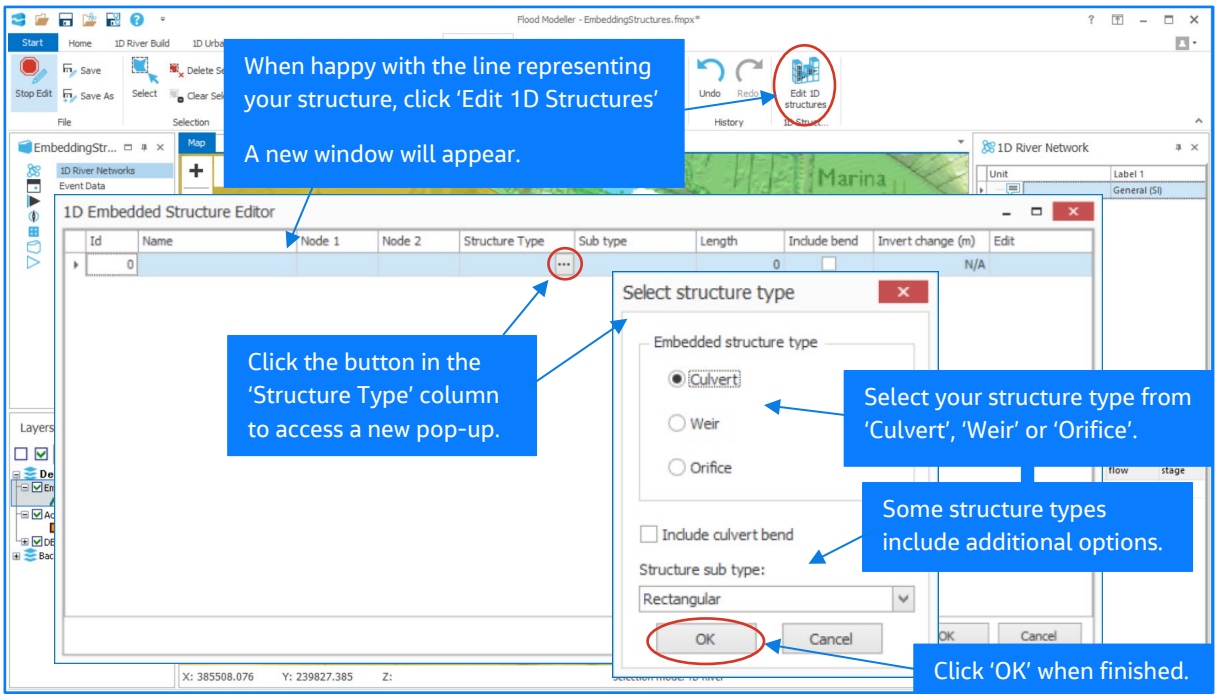
For an orifice, the line drawn defines the 2D grid cells that the calculated orifice flows will pass between. Thus, an orifice structure can provide a simple alternative method for representing a culvert.

For weirs, the line drawn represents the direction of the weir crest. The 2D solver will therefore assume flows are perpendicular to the line. The length of the weir will be set to the length of the line on the map; this can be overridden by a 'length' attribute in the shapefile.

3. Assign a 1D structure to your line

After drawing your structure line, click 'Edit 1D Structures'. The '1D Embedded Structure Editor' window opens.

Click the button indicated and then select your structure type from the pop-up window, followed by 'OK'.



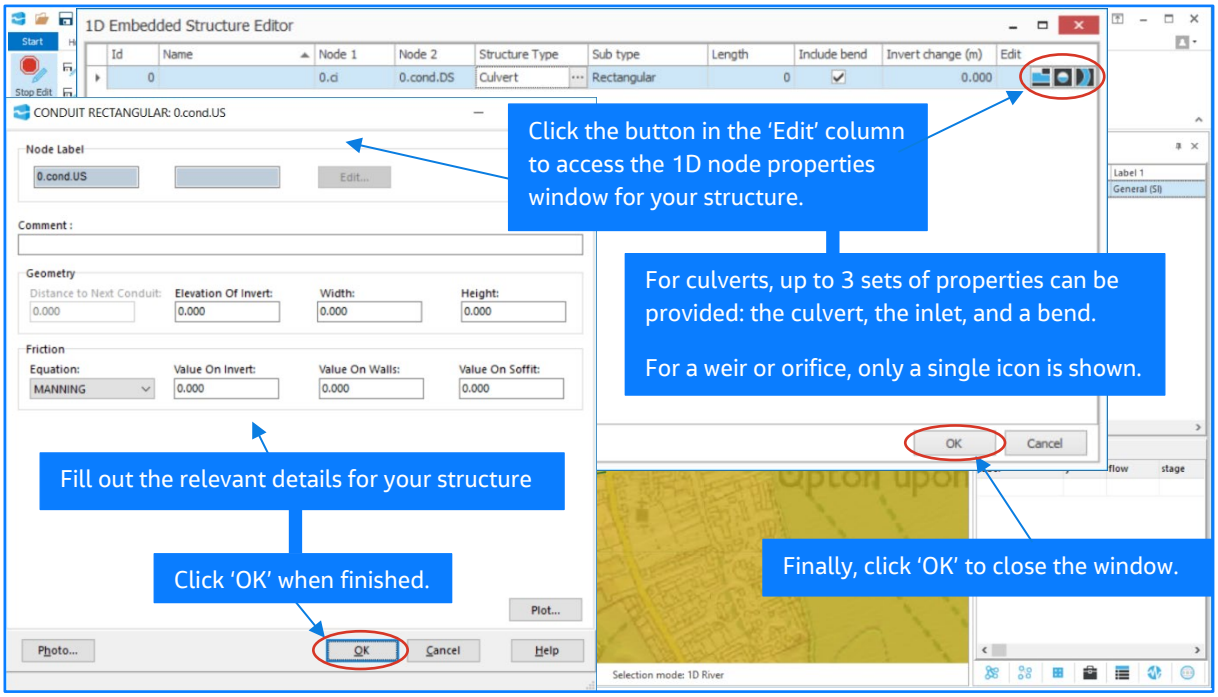
Tip: If you add a weir, a drop-down box allows you to select a weir type (e.g. broad-crested, sharp-crested, etc.). If you add a culvert, a drop-down box allows you to choose the shape of your culvert, and a checkbox is provided to include the effects of a bend if required!

4. Define the 1D structure properties

Now your structure type has been selected, click the icon in the 'Edit' field. The appropriate 1D node property window will open. Fill out the details for your culvert, weir or orifice and click 'OK'.

The details of your structure are added to the table. Certain additional parameters can be adjusted directly from the table. Please note parameters that cannot be adjusted from the table (namely the 'node 1' and 'node 2' fields) should not be edited, including within the attribute properties directly, or via text editors.

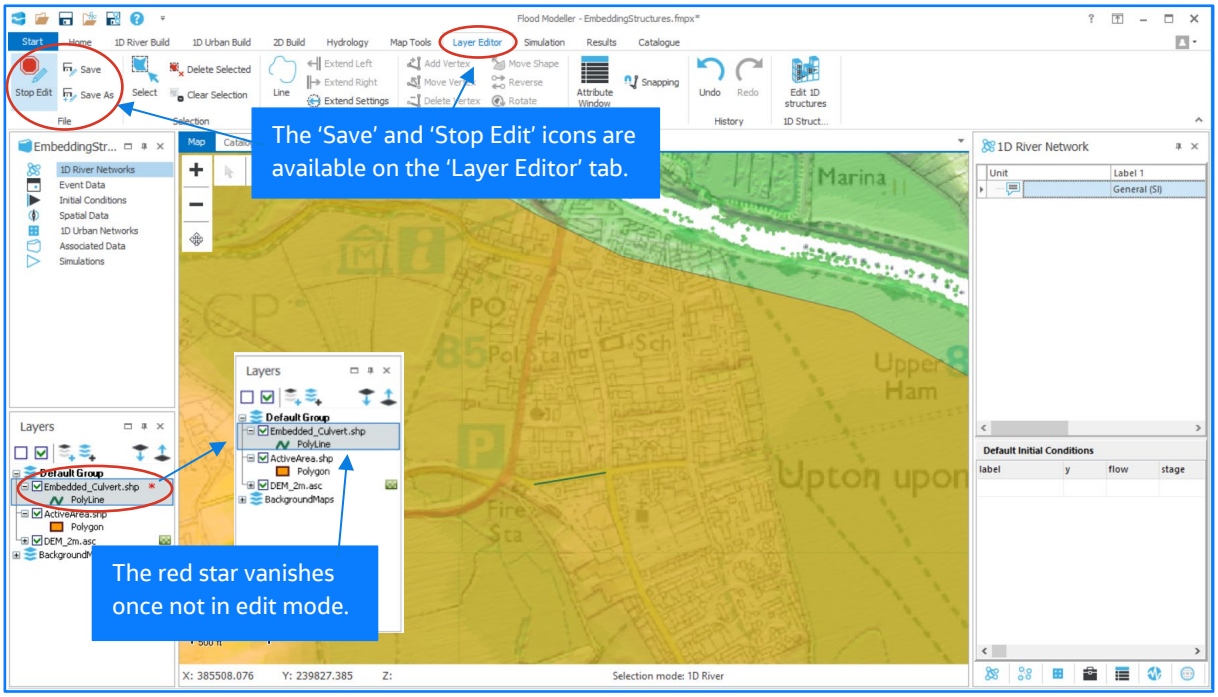
Click 'OK' to close the '1D Embedded Structure Editor' window.



Note: Some of the properties available for the culvert, weir and orifice structures in a 1D river network are not required for embedded structures and so are disabled here (e.g. slots for conduit sections to maintain a minimum flow – as embedded structures can handle running dry).

5. Save your shapefile

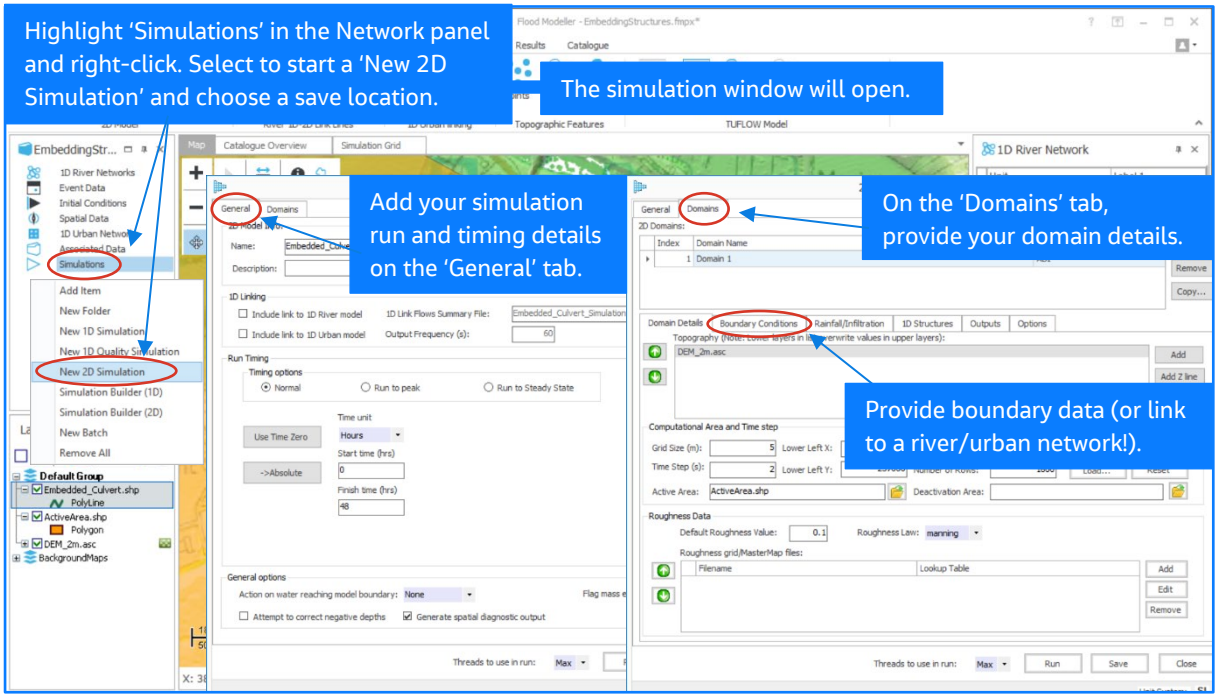
In the 'Layer Editor' tab, click 'Save' and 'Stop Edit'. The shapefile representing your 1D structure is now ready to use!



6. Set up a 2D simulation

Once you have defined your 1D elements, you need to add them to your simulation.

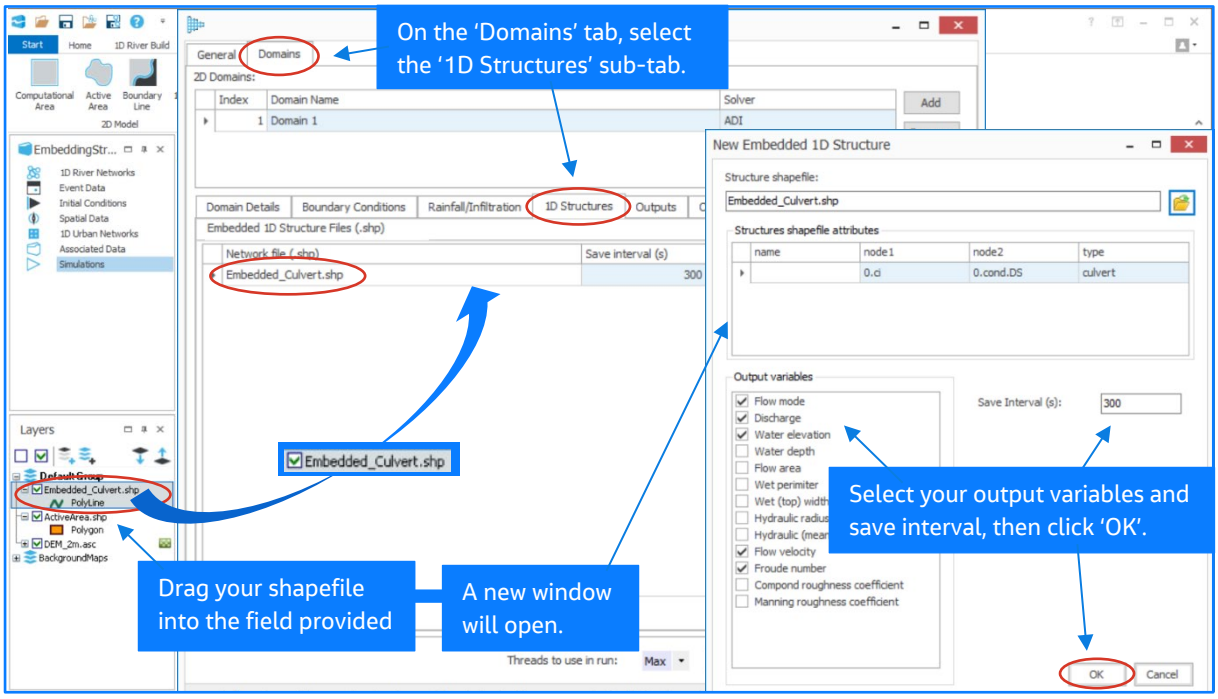
Start a new 2D simulation and provide the simulation type and timing details on the 'General' tab. Define your boundary data for the water entering the system and underlying topography details on the 'Domains' tab, as you would normally.



7. Add the 1D elements to the 2D simulation

On the 'Domains' tab, select the '1D Structures' sub-tab, and drag the shapefile representing your 1D structure into the field provided.

The 'New Embedded 1D Structure' window will automatically pop up. Select the desired outputs by checking the boxes provided, then click 'OK'.



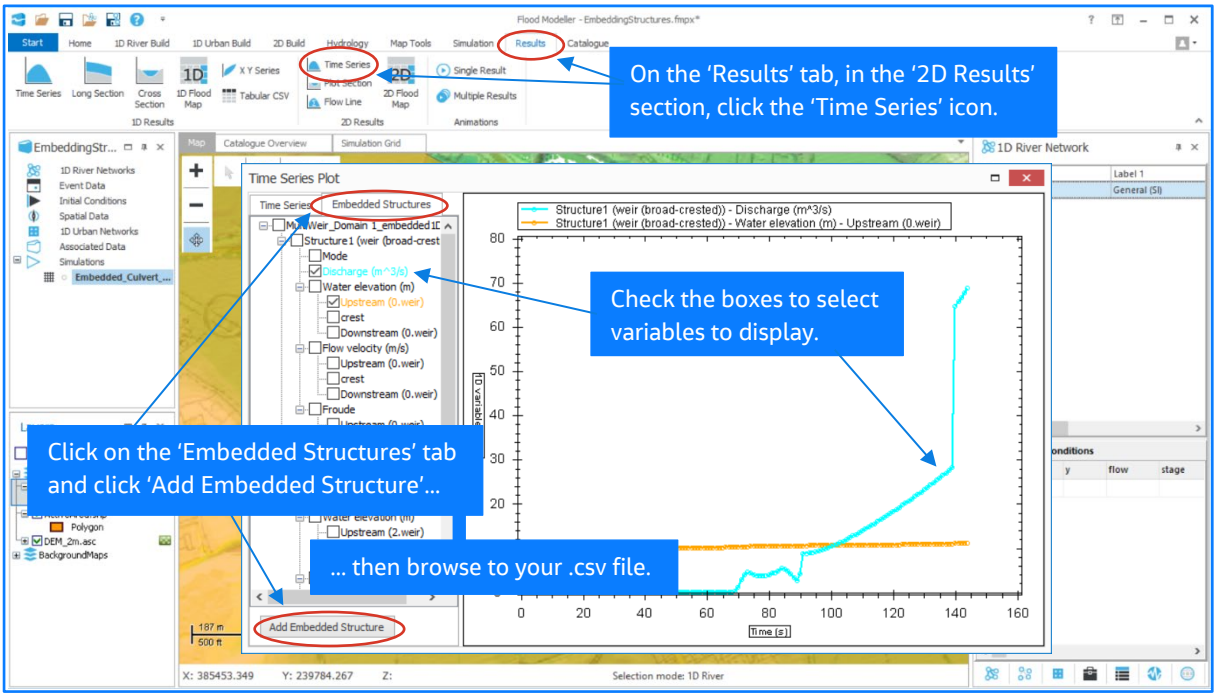
8. View the results from the embedded structures

Repeat the above step as desired to add multiple structures! Save when finished and run your simulation to see the results.

The solver writes the hydraulic data produced from embedded structures to a comma separated text file:

2D model name _ domain name _ embedded1D .csv

Visualise this data by via the '2D Results' section of the 'Results' tab. Click 'Time Series' and navigate to the 'Embedded Structures' tab. Then click 'Add Embedded Structure' and browse to your .csv file. The available variables will be listed and checkboxes are provided to select these for plotting.



More questions you may have:

Can I add multiple structures? Yes! Simply use multiple shapefiles and incorporate these all into a single 2D simulation.

Can I add multiple structures within a single shapefile? Yes! If your preference, add multiple elements to a shapefile and incorporate this single file to your 2D simulation.

Can I use a pre-existing shapefile to represent my structure? Yes! The attributes can be manually added to existing shapefiles.

Can I embed structures and still also link to a river and/or urban network? Yes! Just link to your river and/or urban network as you do normally.

For further information on all embedded structure options, please review the user manual which includes all the relevant technical methodologies detailed.