9 VIEWING RESULTS

After the model has finished the steady or unsteady flow computations the user can begin to view the output. Output is available in a graphical and tabular format. The current version of the program allows the user to view cross sections, water surface profiles, general profiles, rating curves, X-Y-Z perspective plots, hydrographs, detailed tabular output at a single location, and summary tabular output at many cross sections. Users also have the ability to develop their own output tables. Additionally, if your model is georeferenced, you can also create inundation maps, and perform animations of inundated areas within HEC-RAS Mapper. This section will discuss the following:

- Cross Sections, Profiles, and Rating Curves
- 3D Perspective Plots
- Stage and Flow Hydrographs
- Breach Hydrograph Plot
- Tabular Output
- Viewing Results From The River System Schematic
- Viewing Computational Level Output for Unsteady Flow
- Viewing Ice Information
- Viewing Data Contained in an HEC-DSS File
- Exporting Results to HEC-DSS
- Inundation Mapping with HEC-RAS Mapper

Cross Sections, Profiles, and Rating Curves

Graphical displays are often the most effective method of presenting input data and computed results. Graphics allow the user to easily spot errors in the input data, as well as providing an overview of the results in a way that tables of numbers cannot.

Viewing Graphics on the Screen

To view a graphic on the screen, select **Cross Sections, Water Surface Profiles**, or **Rating Curves** from the **View** menu on the HEC-RAS main window. Once you have selected one of these options, a window will appear with the graphic plotted in the viewing area. An example cross-section plot is shown in Figure 8-1. The user can plot any cross section by simply selecting the appropriate reach and river station from the list boxes at the top of the plot. The user can also step through the cross section plots by using the up and down arrows.

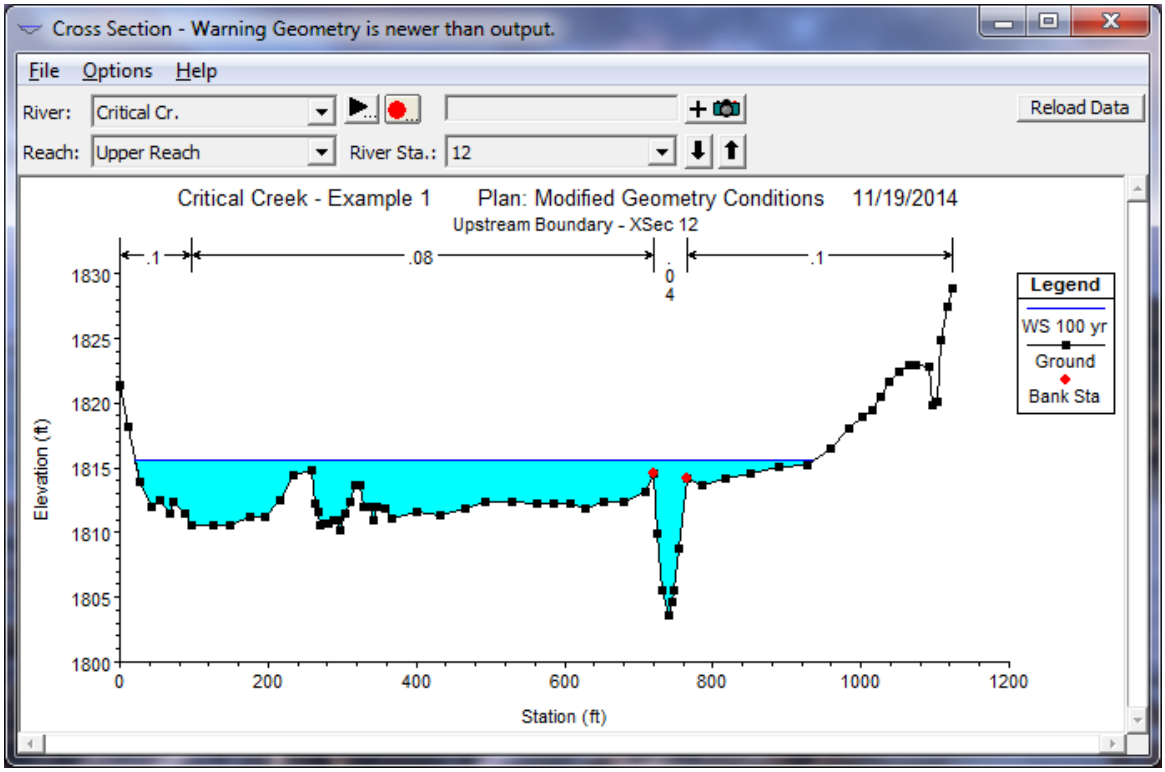


Figure 8 1 Example Cross Section Plot

An example profile plot is shown in Figure 8-2. The profile plot displays the water surface profile for the first reach in the river system. If there is more than one reach, additional reaches can be selected from the Options menu on or the reach button at the top of the window.

An example rating curve plot is shown in Figure 8-3. The rating curve is a plot of the water surface elevation versus flow rate for the profiles that were computed. A rating curve can be plotted at any location by selecting the appropriate reach and river station from the list boxes at the top of the plot.

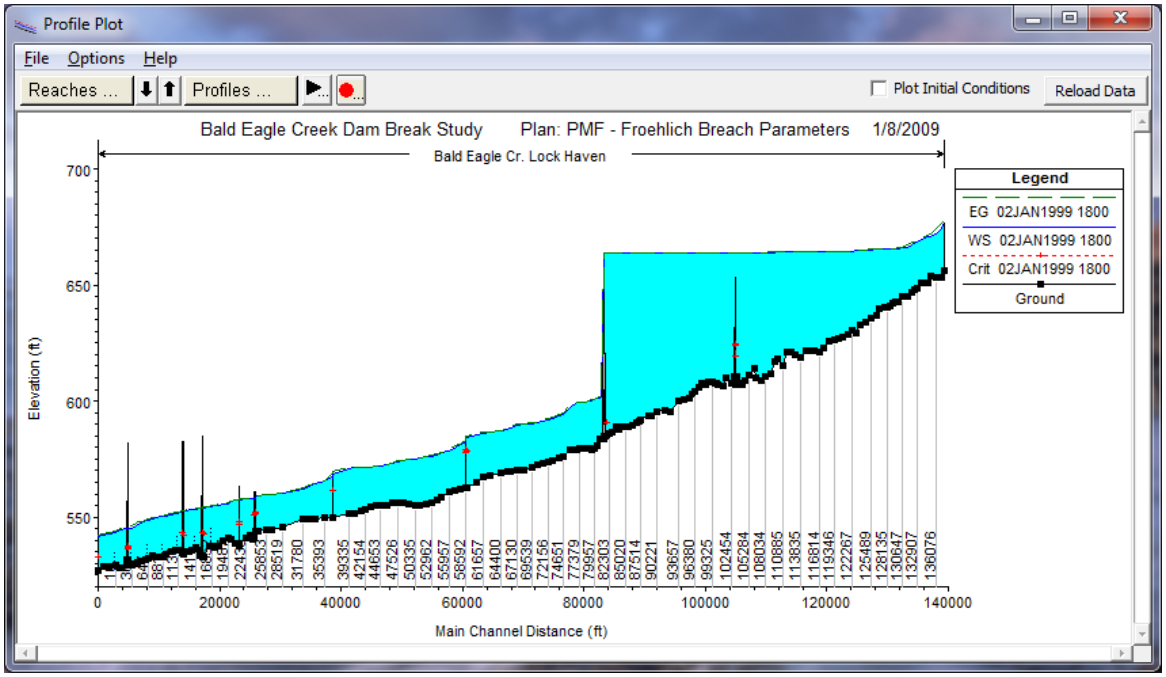


Figure 8 2 Example Profile Plot

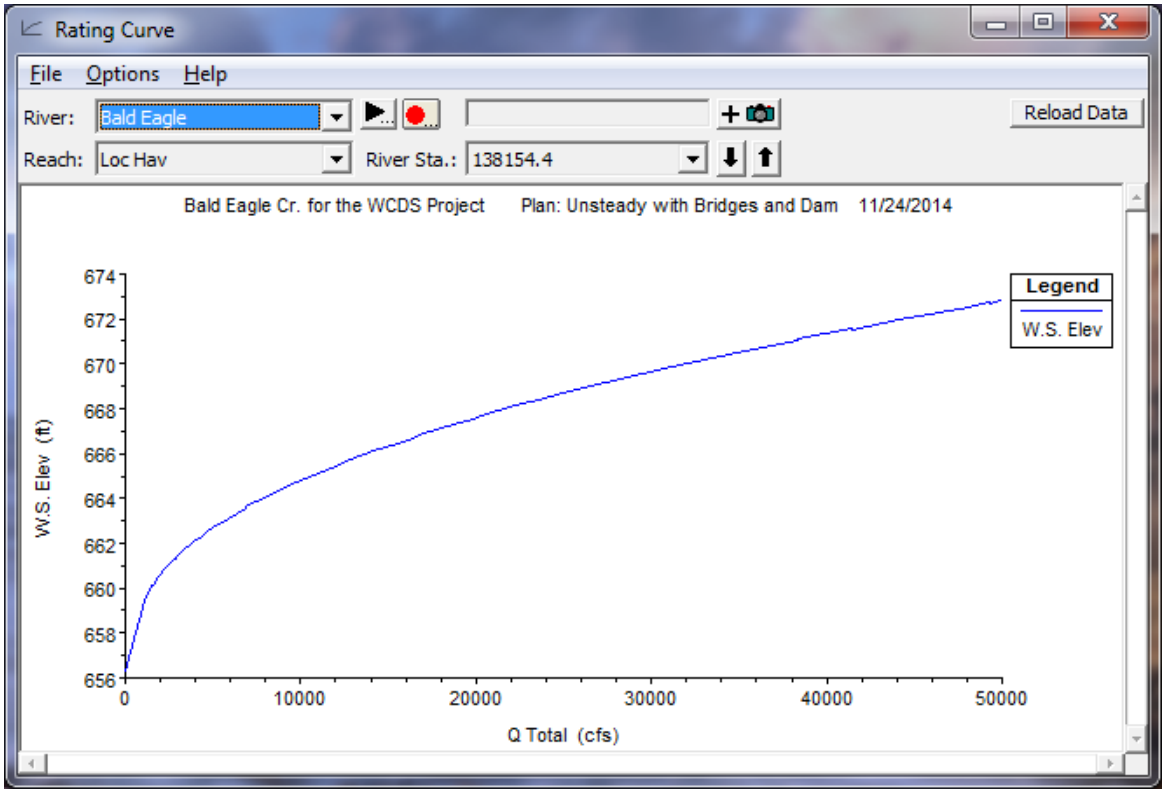


Figure 8 3 Example Rating Curve Plot

Graphical Plot Options

Several plotting features are available from the **Options** menu on all of the graphical plots. These options include: zoom in; zoom out; selecting which plans, profiles, reaches and variables to plot; and control over labels, lines, symbols, scaling, grid options, zoom window location, font sizes, and land marks. In addition to using the options menu at the top of each graphic window, if a user presses the right mouse button while the cursor is over a graphic, the options menu will appear right at the cursor location. In general, the options are about the same on all of the graphics.

Zoom In. This option allows the user to zoom in on a portion of the graphic. This is accomplished by selecting **Zoom In** from the **Options** menu, then specifying the area to zoom in on with the mouse. Defining the zoom area is accomplished by placing the mouse pointer at a corner of the desired zoom area. Then press down on the left mouse button and drag the mouse to define a box containing the desired zoom area. Finally, release the left mouse button and the viewing area will display the zoomed-in graphic. A small window showing the entire graphic will be placed in one of the corners of the graphic. This window is called the **Zoom Window**. The Zoom Window shows the entire graphic with a box around the zoomed in area. The user can move the zoom box or resize it in order to change the viewing area.

Zoom Previous. This option will re-display the graphic back to the size that it was one operation previous (i.e. if I zoomed in three times, then select Zoom Previous, the window would go back to the size it was after the second zoom in). HEC-RAS will remember the last 10 window sizes of the graphic and allow the user to use the Zoom Previous to go back through them.

Zoom Out. This option doubles the size of the currently zoomed in graphic.

Zoom In/Out Shortcut. User can now use the mouse wheel to zoom in and out. Place the mouse pointer over the location where you want to zoom in and push the mouse wheel foreword. To zoom out, pull the mouse wheel back.

Full Plot. This option re-displays the graphic back into its original size before you zoomed in. Using the **Full Plot** option is accomplished by selecting **Full Plot** from the **Options** menu.

Pan. This option allows the user to move the graphic around while in a zoomed in mode. After zooming in, to move the graphic around, select **Pan** from the **Options** menu. Press and hold the left mouse button down over the graphic, then move the graphic in the desired direction. A shortcut to selecting the Pan option is to hold down the **Shift Key** to put the pointer into the Pan mode. Simply release the Shift Key to turn off the Pan mode.

Measuring Tool. On any of the HEC-RAS graphics, even the river system schematic, the user can turn on a measuring tool and draw a multi point line (Called a polyline), and HEC-RAS will report back the length of the line, the area of the polygon formed by connecting the first and last point drawn, the dx length, the dy length, and the slope (dx/dy). To use this option simply hold down the **Control Key** while over the graphic, then draw the multi point line by pressing the left mouse button at each location you want to have a point. To end the line, simple release the Control key after the last point is drawn.

Animate. This option was developed for unsteady flow output analysis, but can also be used for steady flow output. This option works with the cross section, profile, and X, Y, Z perspective plots. When this option is selected, a window will appear that allows the user to control the animation of any currently opened graphics. The user has the option to too "play" a graphic, which means to step

through the time sequence of computed profiles. In a steady flow analysis, it can be used to switch between the profiles conveniently.

Plans. This option allows the user to select from the available Plans for plotting. The default plan is the currently opened plan. The user can select additional plans to view for comparison of results graphically.

Profiles. This option allows the user to select which profiles they would like to have displayed on the graphic. This option does not apply to the rating curve, it automatically plots all of the profiles.

Reaches. This option allows the user to select which river reaches they would like to have displayed. This option only applies to the profile plot.

Variables. This option allows the user to select whatever variables are available for plotting. The number and type of variables depends on what type of graphic is being displayed. The following is a list of variables that can be found on the profile plot: water surface, energy, critical water surface, observed water surfaces, Left main channel bank elevation, right main channel bank elevation, reach labels, ice cover, left and right levees, pilot channels, sediment elevations, and left and right lateral structures. The cross section plot is has the following eight variables: water surface, filled in water surface, energy, critical depth, observed water surface, ice cover, Manning's n values, and pilot channels.

Labels. This option allows the user to change the labels for the plot caption, as well as the labels used for the axis. The user can select any or all of the following items to be added to the caption: project title, plan title, run date, run time, geometry title, flow title, river and reach names, cross section descriptions, cross section river stationing, cross section node names, and any user defined additional text.

Lines and Symbols. This option allows the user to change the line types, line colors, line widths, symbol types, symbol sizes, and symbol colors, fill patterns, and the line labels. When the user selects this option, a window will appear as shown in Figure 8-4.

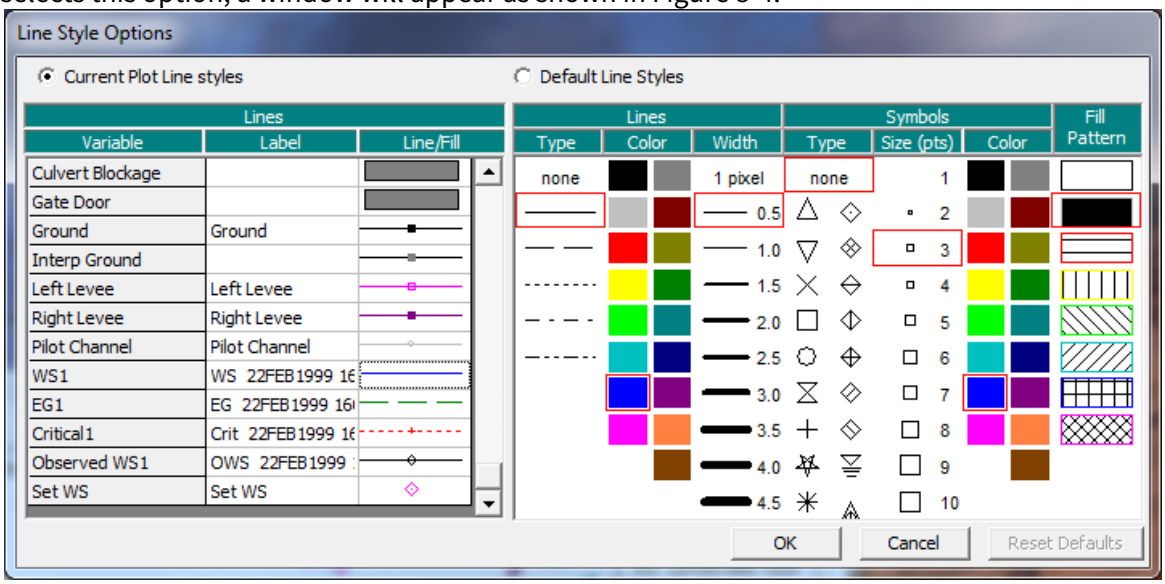


Figure 8 4 Line and Symbol Options Window

When the Line and Symbol Options window comes up, it will list only the information from the current plot. When this window is in the "Current Plot Line Styles" mode, the user can only change the information for the current plot. If the user wants to change the default line and symbol options for all of the plots, they must select **Default Line Styles** at the top of the window. When this option is selected, the user will be able to change the label, line, and symbol options for every variable that is plotted in the program. To use this option, the user finds the variable that they want to change from the list on the left side of the window. Select that variable by clicking the left mouse button while over top of the variable. Once a variable is selected, the options that are set for that variable will be highlighted with a red box around each option. The user can change whatever option they want, as well as changing the label for that variable. If a variable does not have a default label, you cannot enter one for that variable. Once the user has made all of the changes that they want to all of the desired variables, they should press the **OK** button. The changes will be saved permanently, and any plot that is displayed within HEC-RAS will reflect the user-entered changes.

Scaling. This option allows the user to define the scaling used for the plot. Users are allowed to set the minimum, maximum, and labeling increment for the X and Y axis. Scaling can be set temporarily, or scaling can be set to be persistent (scaling stays constant for all cross sections). Persistent scaling is only available for the cross section and rating curve plots.

Grid. This option allows the user to overlay a grid on top of the graphic. Users have the option to have both major and minor tics displayed, as well as a border around the plot.

Zoom Window Location. This option allows the user to control which corner of the plot that the zoom window will be placed, and the size of the window.

Font Sizes. This option allows the user to control the size of all of the text displayed on the graphic.

Land Marks. This option is specific to profile plots. With this option the user can turn on additional labels that will be displayed as land marks below the invert of the channel. Three types of land marks can be displayed: cross section river stations; node names; or cross section descriptions. In addition to these three variables, once one of the three are displayed, the user can select to edit the land mark labels. This will allow the user to put a label at a specific location on a plot.

Plotting Velocity Distribution Output

The user has the option of plotting velocity distribution output from the cross section viewer. Velocity distributions can only be plotted at locations in which the user has specified that flow distribution output be calculated during the computations. To view the velocity distribution plot, first bring up a cross section plot (select "Cross Sections" from the view menu of the main HEC-RAS window). Next, select the cross section in which you would like to see the velocity distribution output. Select **Velocity Distribution** from the **Options** menu of the cross section window. This will bring up a pop up window (Figure 8-5) that will allow you to set the minimum velocity, maximum velocity, and velocity increment for plotting. In general, it is better to let the program use the maximum velocity range for plotting. Next, the user selects **Plot Velocity Distribution**, then press the "OK" button and the velocity distribution plot will appear as shown in Figure 8-6.

For details on how to select the locations for computing the velocity distribution, see Chapter 7 and 8 of the User's Manual. For information on how the velocity distribution is actually calculated, see Chapter 4 of the Hydraulic Reference Manual.

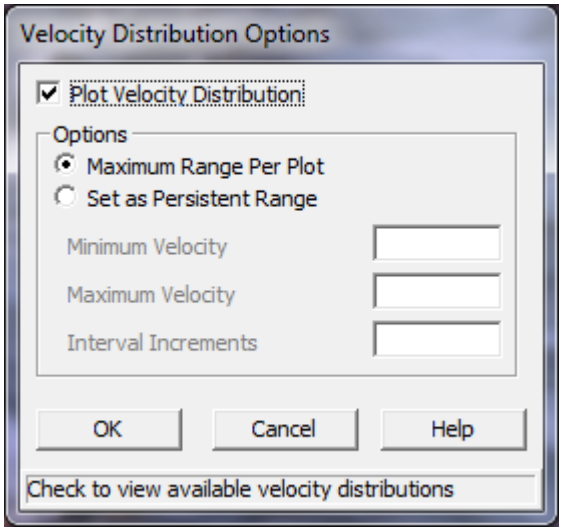


Figure 8 5 Velocity Distribution Options

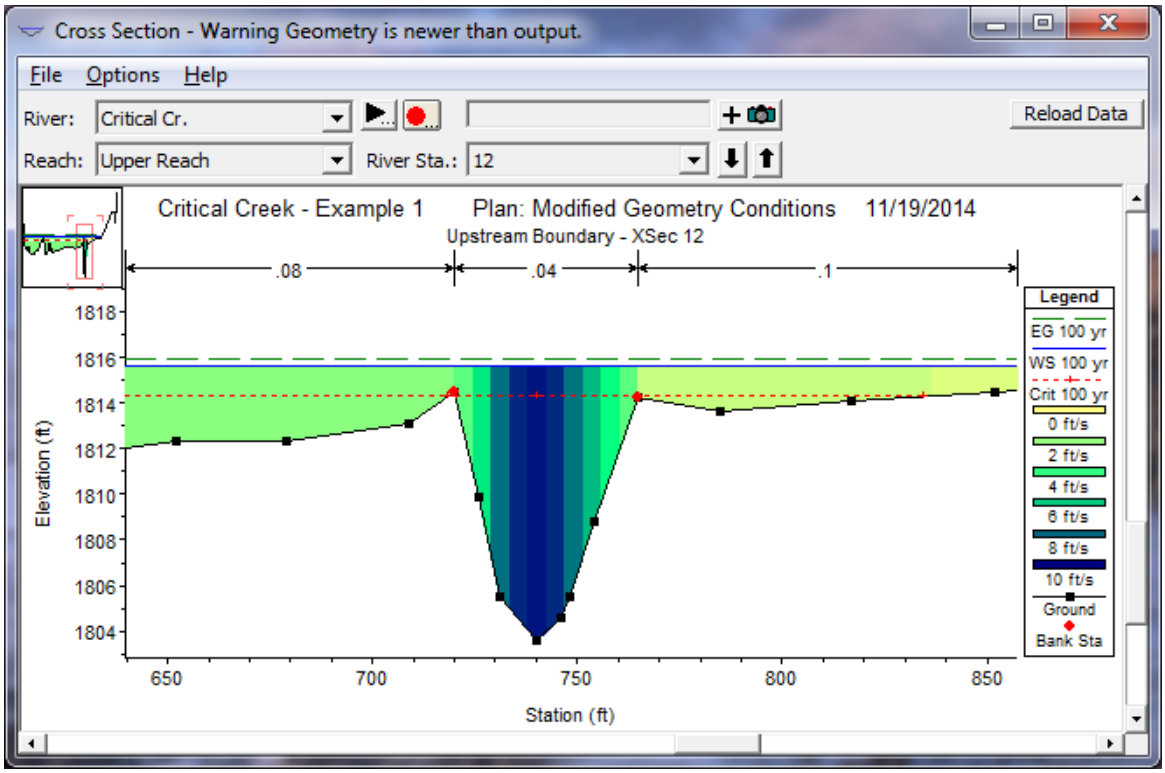


Figure 8 6 Velocity Distribution Plot

Plotting Other Variables in Profile

To plot variables other than the water surface in profile, select **General Profile Plot** from the View menu of the main HEC-RAS window. Any variable that is computed at a cross section can be displayed in profile. An example would be to plot velocity versus distance. Other variables can be selected from the **Plot Variables** option under the **Options** menu of the plot. The user can plot several different variable types at one time (e.g., velocity and area versus distance), but the scaling may not be appropriate when this is done. Once a user has selected variables for plotting in profile,

the plot can be saved as a User Defined Plot. This is accomplished by selecting **Save Plot** from the **Options** menu at the top of the window. Once a user saves a plot, the plot can be recalled for any data set from the **User Plots** menu at the top of the window. An example of plotting variables in profile is shown in Figure 8-7. Additionally, the general profile plot has some predefined plots that the user can pick from. The predefined plots can be found under the **Standard Plots** menu at the top of the graphic window.

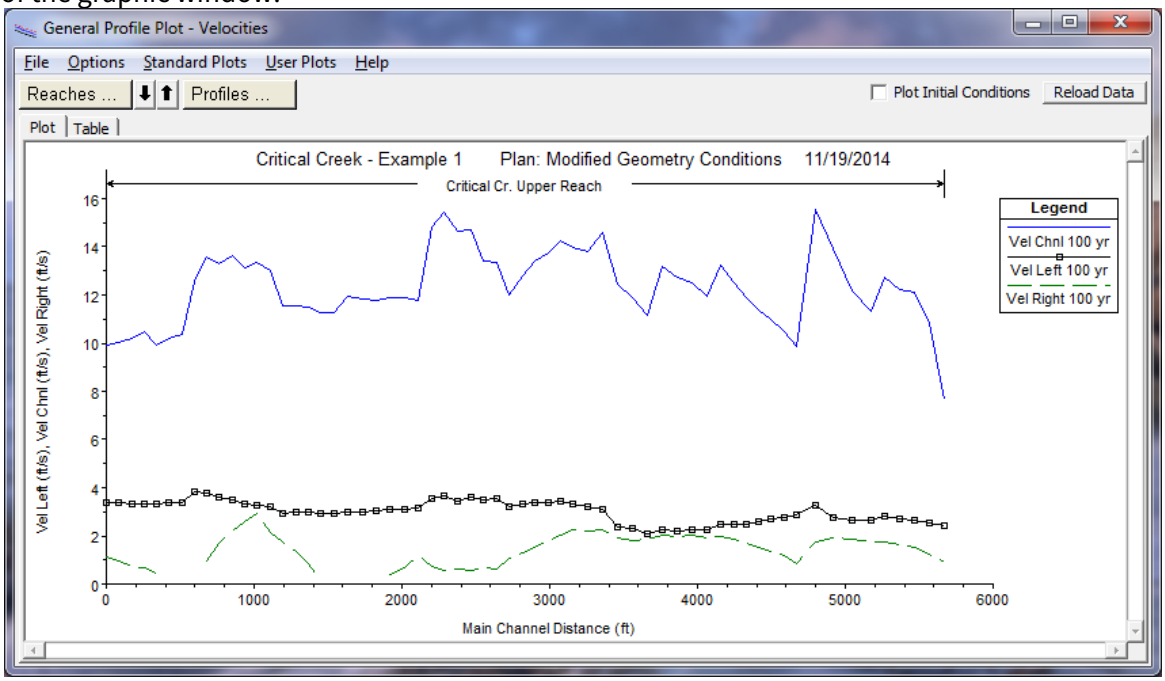


Figure 8 7 General Profile Plot of Variables Versus Distance

Plotting One Variable versus Another

The rating curve plotting window has the ability to plot other variables besides discharge versus water surface elevation. Any variable that is computed at a cross section can be displayed against another computed variable (or variables). An example of this capability is shown in Figure 8-8. In this example, Discharge (x-axis) is being plotted against total flow area and main channel flow area (y-axis).

To plot other variables, the user selects the **X Axis Variable** and **Y Axis Variables** from the **Options** menu of the rating curve plotting window. When selected variables to plot, keep in mind that all variables selected for a particular axis should have a similar range in magnitude.

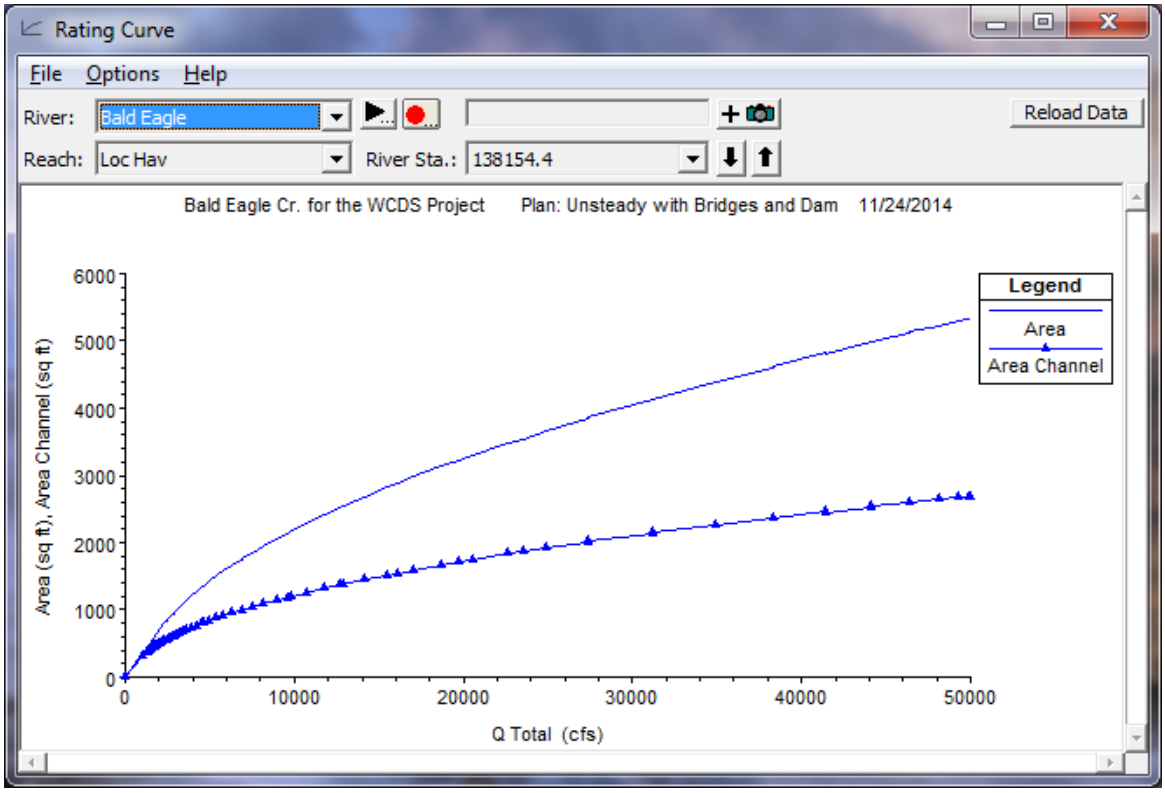


Figure 8 8 Example of Plotting One Variable Against Other Variables

Sending Graphics to the Printer or Plotter

All of the graphical plots in HEC-RAS can be sent directly to a printer or plotter. The printer or plotter used depends on what you currently have set as the default printer or plotter in the Windows Print Manager. To send a graphic to the printer or plotter, do the following:

1. Display the graphic of interest (cross section, profile, rating curve, X-Y-Z, or river system schematic) onto the screen.
2. Using the available graphics options (scaling, labels, grid, etc.), modify the plot to be exactly what you would like printed.
3. Select **Print** from the **File** menu of the displayed graphic. When this option is selected, a pop up window will appear allowing you to modify the default print options. Change any desired options and press the Print button. The graphic will be sent to the Windows Print Manager. The print manager will then send the plot to the default printer or plotter.

Note: The user can print multiple cross-sections at one time by using the **Print Multiple** option from the **File** Menu of the cross section and rating curve plots. This option also allows the user to establish how many cross sections or rating curves they would like to have printed on each page.

Sending Graphics to the Windows Clipboard

All of the HEC-RAS graphics can be sent to the Windows Clipboard. Passing a graphic to the clipboard allows that graphic to then be pasted into another piece of software (i.e., a word processor or another graphics program). To pass a graphic to the windows clipboard, and then to another program, do the following:

1. Display the graphic of interest on the screen.
2. Using the options menu, modify the plot to be exactly what you want.
3. Select **Copy Plot to Clipboard** from the **File** menu of the displayed graphic. The plot will automatically be sent to the Windows Clipboard.
4. Bring up the program that you want to paste the graphic into. Select **Paste** from the **Edit** menu of the receiving program. Once the graphic is pasted in, it can be re-sized to the desired dimensions.

HEC-RAS sends and displays all graphics in a Window's Meta file format. Since Meta files are vector based graphics, the graphic can be resized without causing the image to distort.

3D Perspective Plots

Another type of graphic available to the user is the 3D Perspective Plot. The 3D plot is a 3-dimensional plot of the terrain on the computed results (Depth, water surface, velocity, etc.). The HEC-RAS 3D Viewer was developed to help engineers convey hydraulic modeling results to decision-makers. The HEC-RAS 3D Viewer is accessed from either the HEC-RAS program or inside RAS Mapper. The 3D Viewer provides a three-dimensional visualization of HEC-RAS simulation results and terrain data.

To access the 3D Viewer through the HEC-RAS program interface, go to **View | 3D View ...** menu item or press the **3D Viewer** button, shown below.

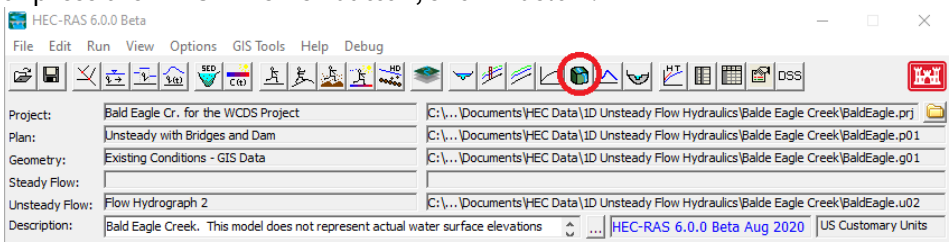


Figure 8 9. HEC-RAS Main Window with 3D Viewer Button.

To access the 3D Viewer through RAS Mapper, press the **3D Viewer** button, shown below.

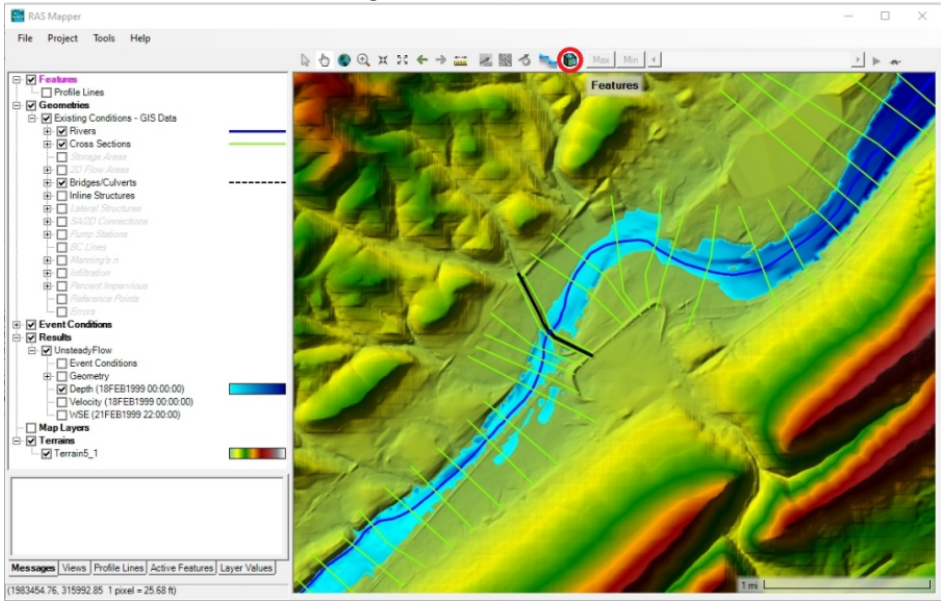


Figure 8 10. 3D Viewer Access Button in HEC-RAS Mapper.

Then select the result to show in the 3D Viewer

Another way to access the 3D Viewer is by right clicking on a particular result and selecting the **View Result in 3D** menu item

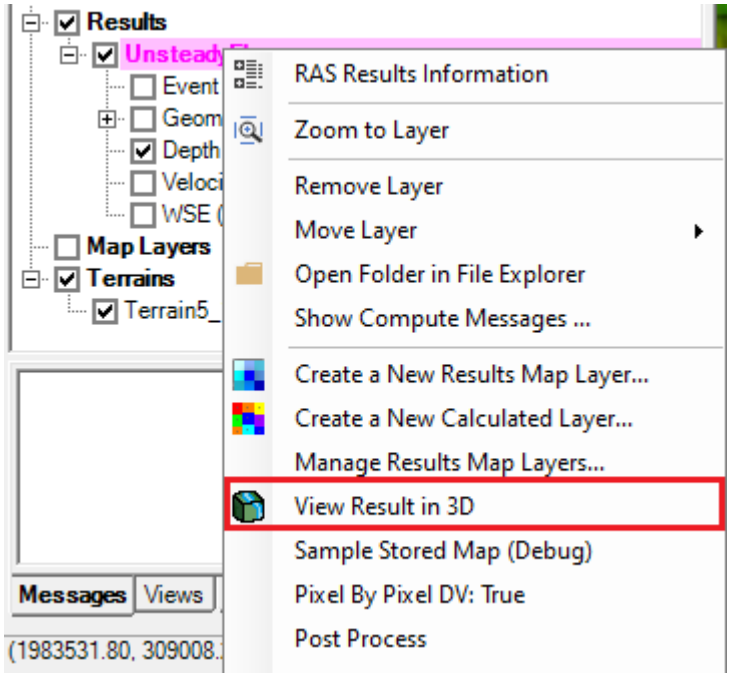


Figure 8 11. Selecting the 3D Viewer from HEC-RAS Mapper Menu.

The last way to access the 3D Viewer is by right clicking a particular result map and selecting the **View Map in 3D Viewer** menu item

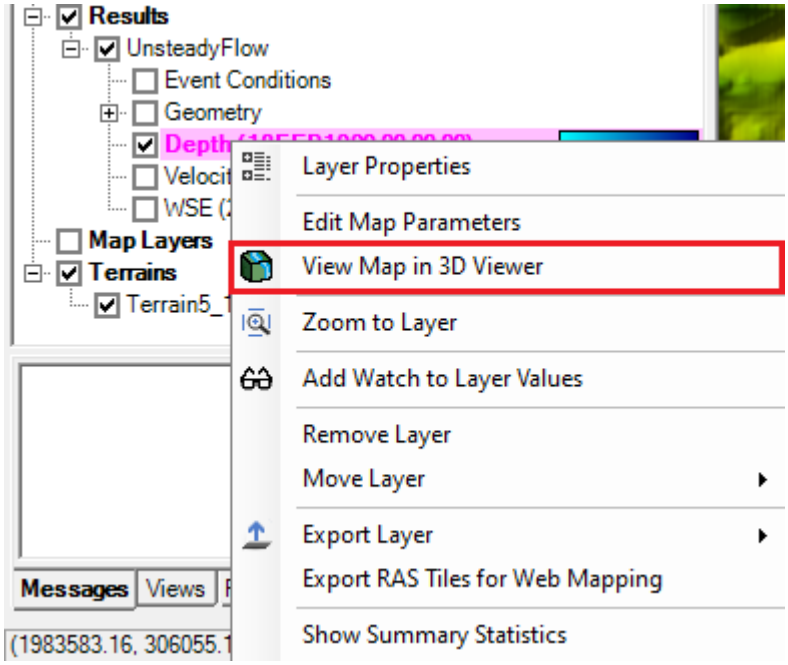
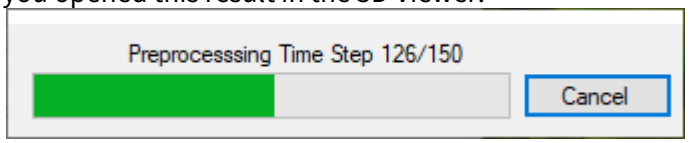


Figure 8 12. Accessing 3D Viewer from a Result Map Layer.

Pre-processing Results for 3D Viewing

Performing any of the various ways to access the 3D Viewer will bring up a pre-proccessing window if this is the first time you have run the 3D Viewer or if you have cancelled pre-processing the last time you opened this result in the 3D Viewer.

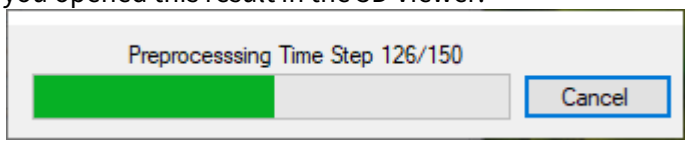


The 3D Viewer has to do much more processing compared to RAS Mapper to show a time step in the simulation. Pre-processing offloads the processing to a file in the same directory as the result file that was selected. It will be named the same except the extension will be sqlite.

Pre-processing will make subsequent loading for this result to be a smoother experience. It will also make playing the results animation smoother. Pre-processing is optional, press the Cancel button if you do not wish to pre-process at this time.

3D Viewer

Performing any of the various ways to access the 3D Viewer will bring up a pre-proccessing window if this is the first time you have run the 3D Viewer or if you have cancelled pre-processing the last time you opened this result in the 3D Viewer.



The 3D Viewer has to do much more processing compared to RAS Mapper to show a time step in the simulation. Pre-processing offloads the processing to a file in the same directory as the result file that was selected. It will be named the same except the file extension will be "3DViewerCache.sqlite".

Muncie.p03.hdf	2/1/2021 7:50 PM	HDF File	15,268 KB
Muncie.p03.3DViewerCache.sqlite	3/19/2021 2:03 PM	SQLITE File	79,344 KB

Pre-processing will make subsequent loading for this result to be a smoother experience. It will also make playing the results animation smoother. Pre-processing is optional, pressing the Cancel button will stop the pre-processing step.

Pre-processing file size is dependent on area extent and density of hydraulic results. For example, more 2D cells means bigger file size.

The 3D Viewer interface, shown below, is comprised of a menu, a toolbar, a mini-map and the view itself.

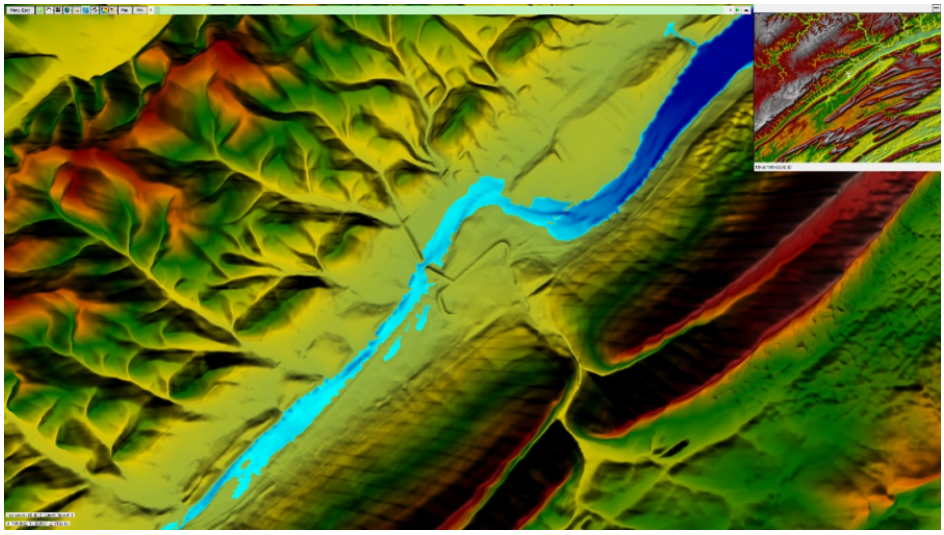


Figure 8 13. 3D Viewer Interface.

Menu and Options

To access the menu to see options, help, and to quit the application, either click on the menu button on the top left corner or press the escape key.

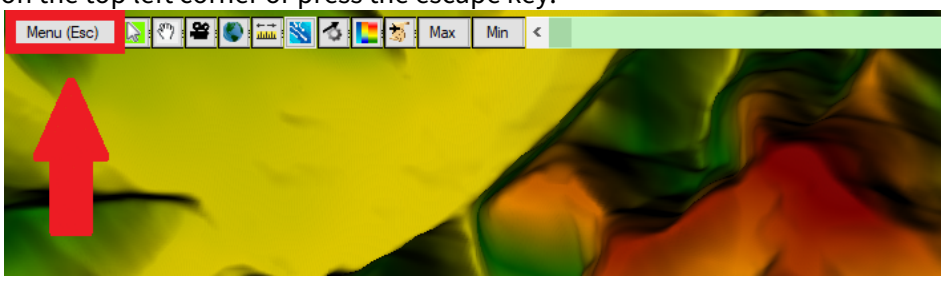
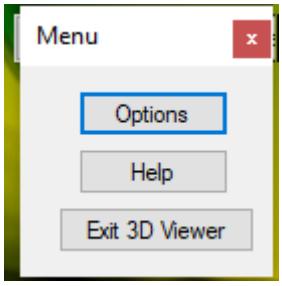


Figure 8 14. 3D Viewer Menu and Options Buttons.



When the Options button is selected a window will appear with four Tabs (General; Graphics; Controls; and Particle Tracing). The following tables describe each of the options on the four Tabs.

General Options

Table 8 1. General Options

Option	Description
Water During Animation	When this option is turned on, the water resolution will be the same resolution as the terrain, based on Level of Detail settings. Animation may play slower than usual with this option turned on
Z Scale	How much the terrain elevation is scaled by. Higher value exaggerates the elevations of the terrain, making it easier to see subtle changes in terrain.

Graphics

Table 8 2. Graphics Options

Option	Description
Aspect Ratio	The aspect ratio of the desired resolution. Most monitors are 16:9 aspect ratio. Changing the aspect ratio will change the available resolutions.
Resolution	The resolution of rendering in 3D. Higher resolution means more detail. Can only set resolution to resolutions available for your monitor.
Level of Detail	Controls the distance at which lower resolution 3D models are used Higher level of detail means more distance before lower resolution 3D models are used.
Shading Mode	Controls how shading is done. Sharp shading will create a more accurate representation of shading, at a cost of performance. Smooth shading is less accurate but more performant

Controls

There are three ways to control the 3D Viewer, mouse and keyboard, just mouse, and a game controller. These controls options controls certain aspects of using the mouse, keyboard, and game controller.

Table 8 3. Controls for mouse and controller sensitivity.

Option	Description
Mouse Sensitivity	Controls how much the view changes with mouse movement. Higher sensitivity means more view change with mouse movement. Default is 0.1
Controller X Sensitivity	Control how much the view changes with the right stick of the game controller, horizontal axis only. Default is 0.3
Controller Y Sensitivity	Control how much the view changes with the right stick of the game controller, vertical axis only. Default is 0.15
Invert Y Axis	When this is turned on, moving the vertical axis on either the mouse or game controller will change the view in the opposite direction. Default is off

Pressing the **Change Key/Controller bindings** button will bring up a different window where you can change the various bindings for all the controls of the 3D Viewer.
Table 8 4. Controls for Moving around within the 3D Viewer.

Action	Default Key Binding	Default Controller Binding	Description
Move Forward	W	Left Stick up	Moves the viewer forward in space
Move Backward	S	Left Stick down	Moves the viewer backward in space
Strafe Left	A	Left Stick Left	Moves the viewer in a left side-step fashion in space
Strafe Right	D	Left Stick Right	Moves the viewer in a right side-step fashion in space
Increase Elevation	Space	Right Shoulder Button	Moves the viewer up in space
Decrease Elevation	Left Control	Left Shoulder Button	Moves the viewer down in space
Change Results Map	M	North Button (Y on Xbox, Triangle on PS)	Changes the results map between 4 different maps, a realistic map, depth map, velocity map, and water surface elevation map
Toggle Particles	P	West Button (X on Xbox, Square on PS)	Turns on or off the particle tracing effect
Flight Path Play/ Pause	Return (Enter)	East Button (B on Xbox, Circle on PS)	While a flight path is active, will either play the path or pause it.
Increase Viewer Speed	Right Arrow	Right Directional Arrow	Makes the viewer travel faster. The viewer can only go so fast however.
Decrease Viewer Speed	Left Arrow	Left Directional Arrow	Makes the viewer travel faster. The viewer can only go so slow however.
Turn Left	Unbound	Right Stick Left	Rotates the view to the left

Turn Right	Unbound	Right Stick Right	Rotates the view to the right
Profile Increment Increase	Up Arrow	Up Directional Arrow	While the animation is playing, the number next to the play button shows how many profiles advance every time the scroll bar scrolls. This increases that number.
Profile Increment Decrease	Down Arrow	Down Directional Arrow	While the animation is playing, the number next to the play button shows how many profiles advance every time the scroll bar scrolls. This decreases that number.
Change View Up	Unbound	Right Stick Up	Rotates the view up **(No changeable binding yet)**
Change View Down	Unbound	Right Stick Down	Rotates the view down **(No changeable binding yet)**
Toggle Mouse Pointer	Tab	Left Trigger Button	Will either show or hide the mouse pointer **(No changeable binding yet)**

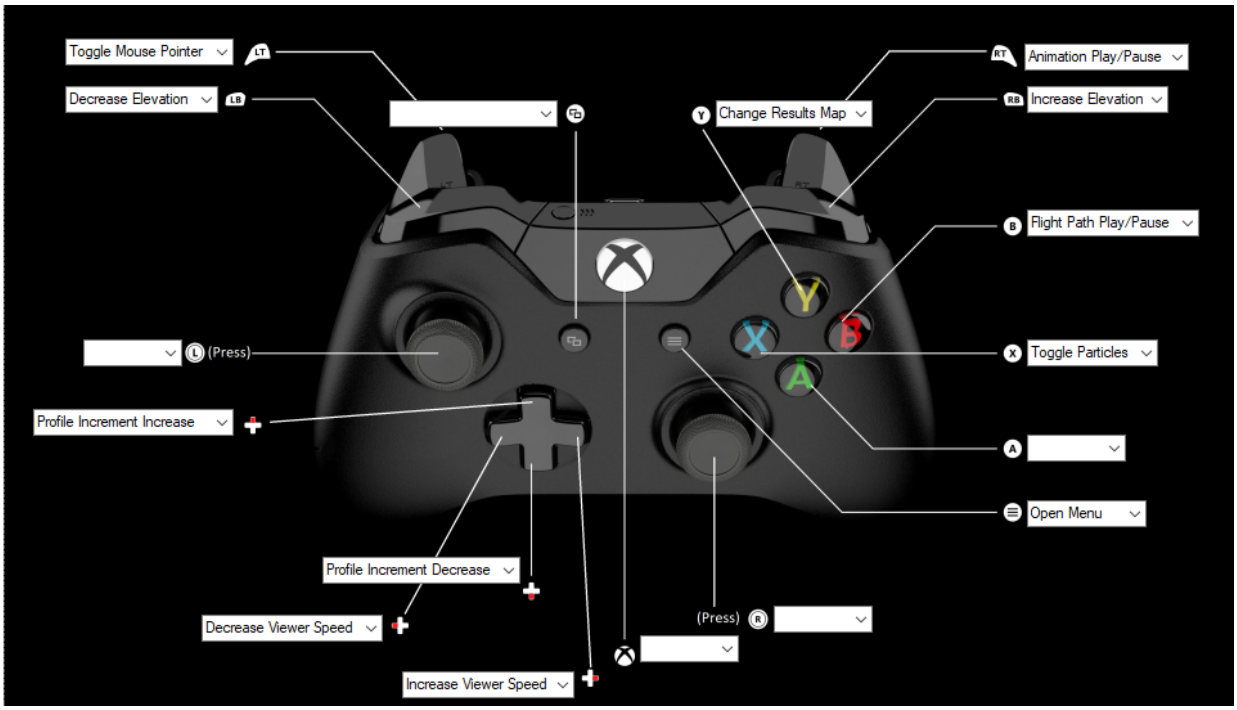


Figure 8 15. Spatial representation of action bindings for an Xbox controller.

Particle Tracing

Table 8 5. Controls for Controlling Particle Tracing.

Option	Description
Speed	Refers to the animation speed of the particle trace. Default value is 1.
Density	Refers to concentration of tracers in an area. Default value is 1.
Width	Refers to the width of the particle. Default value is 5.

Lifetime Refers to how long the particle exists on screen before it disappears and a new particle spawns in its place. Default value is 300.

#Particles Refers to how many particles are shown at any one time. Default value is 10,000.

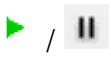
RGB Changes the color of the tracers. Each field accepts an integer between 0 and 255. R corresponds to Red, G corresponds to Green and B corresponds to Blue

Toolbar

The Toolbar is located at the top left of the 3D Viewer window. The following Table describes each of the tools.

Table 8 6. Description of each of the 3D Viewer Tools located on the Toolbar.

Tool	Description
Select	Wherever the select pointer is at, it will show the value of either the terrain elevation or water surface value, dependent on the map type chosen. While using the select pointer it's possible to navigate through the terrain through middle-clicking and dragging on the terrain.
Pan	Left click with the pan pointer to navigate through the terrain by clicking and dragging the terrain.
Change Camera Modes	Allows you to change how the 3D Viewer is controlled. When in helicopter mode , the viewer will move forward, backward, left and right on a plane. Elevation is controlled by the elevation up and down keys When in airplane mode , the viewer will move forward in space in relation to where it is currently looking. For example, this means that looking straight up and going forward will cause the viewer to go straight up. **(Not Implemented Yet)**
Zoom to Entire Extent	Zooms to the maximum viewable extent of the terrain, and forces the viewer to look straight down.
Measure Tool	Measure the distance in map units. **(Not Implemented Yet)**
Toggle Particle Tracing	Toggles whether particles show on the water surface.

Particle Tracing Options		A shortcut to get to Particle Tracing Options
Change Results Map		Changes the results map between 4 different maps, a realistic map, depth map, velocity map, and water surface elevation map
Select a Flight Plan		Opens the flight plan window to choose a flight plan. See Flight Plans/Paths section for more information.
Set to Simulation Maximum	Max	Sets the water surface to simulation maximum.
Set to Simulation Minimum	Min	Sets the water surface to simulation minimum.
Animation Bar		Change the animation bar position to change the time of the simulation. When a portion of the animation bar is grey, it means that the simulation has not loaded at that time yet.
Play/Pause		Plays or pauses the animation
Profile Increment	+1, +2, +3, +5, +10, +25, +50, +100	This number indicates how many profiles advance every time the scroll bar scrolls. This will also start loading portions of the simulation that fall on the increments.
Change Animation Speed		Changes the delay before changing time step in the animation. Note that there is an inherent delay that is unavoidable for each time step. That delay depends on whether you pre-processed the dataset, and whether you have high resolution water turned on during animation. **(Not Implemented Yet)**

Min map

The mini map is shown to assist with acquiring bearings when using the 3D Viewer. Shown in the Figure below is an example of the mini map, which is displayed in the upper right hand corner of the 3D Viewer.

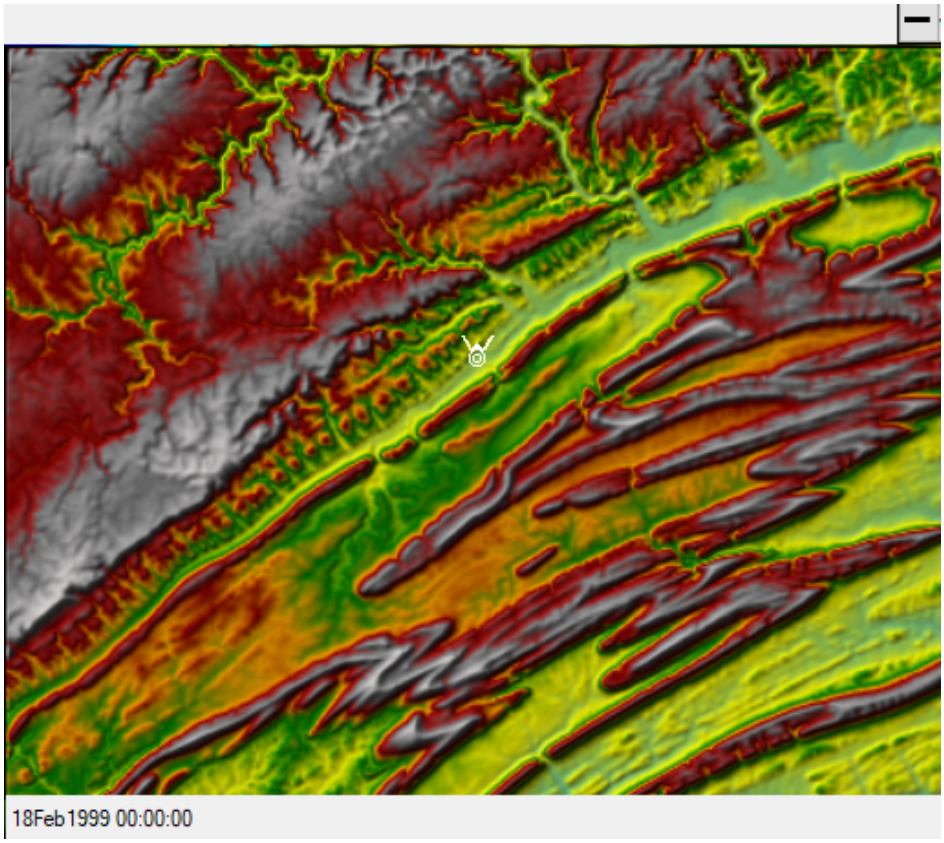


Figure 8 16. Example of the 3D Viewer Mini Map.

There are three components to the mini map, which are explained in the Table below.
Table 8 7. Components of the 3D Viewer Mini Map.

Component	Description
Hide/Show Button	On the top right of the mini-map is a button that will hide or show the mini-map.
Mini-map	A character on the mini-map shows where the viewer is in relation to the map, and also shows what direction the viewer is currently facing. Here the character is facing north The mini-map also grants the ability for the viewer to be moved anywhere on the map. With either the Select or Pan tool, left click anywhere to move the viewer to that location. The left mouse button can also be held down to move the viewer with the mouse drag.
Simulation Date/Time	Shows the current Date/Time for the simulation

Speed/Position Information

On the bottom left corner of the viewer is information about the viewer's speed and its position. A description of these components is in the Table below.

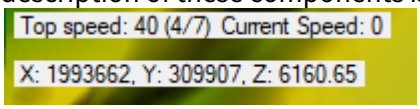


Table 8 8. Speed and Location Components.

Component	Description
Top Speed	The maximum speed that the viewer can currently travel. Can be increased/decreased with the Increase/Decrease Viewer Speed key bindings. The fraction shows what top speed is currently selected out of the possible top speeds. The top speeds are generated based on terrain size.
Current Speed	While the viewer is moving, the current speed will update to show the viewer's current speed.
X,Y	The position of the viewer on the XY plane. These coordinates are the same ones used in RAS Mapper
Z	The elevation of the viewer

Notes on Large Terrains/Dense Models

The 3D viewer currently works better for dense terrains that are are on the smaller side. The initial loading process (the splash screen) has to create a node for every terrain tile in the terrain model, so if the terrain is expansive and it has high resolution data, it may take a little bit of time before the 3D Viewer can load. The 3D Viewer's current Level of Detail implementation also works better for less expansive terrains. There are tools for cutting terrains to either a certain view extent, or the extent of the geometry. It is possible you may have to cut small sections and view the various sections separately. See Exporting RAS Terrains

How To Use the 3D Viewer

Movement

How movement works on the keyboard/controller depends on what camera mode the 3D Viewer is currently set. By default, the 3D Viewer is set to Helicopter mode ( ), which means the movement keys will move the viewer as if it's on a geometric plane. For example, pressing the forward key will move the viewer forward.

Movement for the mouse works the same for either camera mode. If the cursor is currently the Select cursor ( ), middle-click and drag on the terrain will move the viewer proportional to how much the mouse is dragged. If the cursor is the Pan cursor ( ), then a left-click and drag is all that is needed.

Changing View/Rotation

Changing the view of the viewer is accomplished through the mouse or the right stick on the controller. It can also be done through the keyboard but the keys are unbound by default to discourage using the keyboard.

To change the view with the mouse right-click and drag on the screen. This only applies when the mouse cursor is visible. If the view changes too little with the mouse drag then you can change the mouse sensitivity in the options. When the mouse cursor is not visible there is no need to right-click, the view will change with mouse movement. See Mouse Lock/Unlock for more information.

To change the view with a game controller, use the right stick. This only applies when the mouse cursor is not visible. If the view changes too little with the right stick then you can change the controller sensitivity in the options. When the cursor is visible the left stick controls the mouse. See Mouse Lock/Unlock for more information.

Changing Elevation

To change the elevation with the mouse, scroll up to decrease in elevation, scroll down to increase in elevation.

Changing elevation with the keyboard or game controller depends on what camera mode the 3D Viewer is currently set. By default the 3D Viewer is set to Helicopter mode (), in Helicopter mode elevation is changed by pressing the Elevation Up or Elevation Down keys. In Airplane mode (), these keys are disabled, and to change elevation in this mode look in the direction you wish to ascend/descend.

Mouse Lock/Unlock

By default, the mouse is shown and it considered to be "unlocked". The purpose of an unlocked mouse is to allow easy access to the buttons on the user interface.

To make changing the view with the mouse less tedious, the mouse can be "locked" to the screen by pressing the Tab key. This will hide the mouse cursor, but will no longer require the mouse to right-click to change view.

Flight Plans/Paths

The 3D Viewer allows the user to specify a flight path polyline in RAS Mapper for the viewer to follow like a train on tracks

To lay out a flight path, first open RAS Mapper. To open RAS Mapper, on the main RAS window select the **GIS Tools | RAS Mapper** menu item or by pressing the  **RAS Mapper** button, shown below.

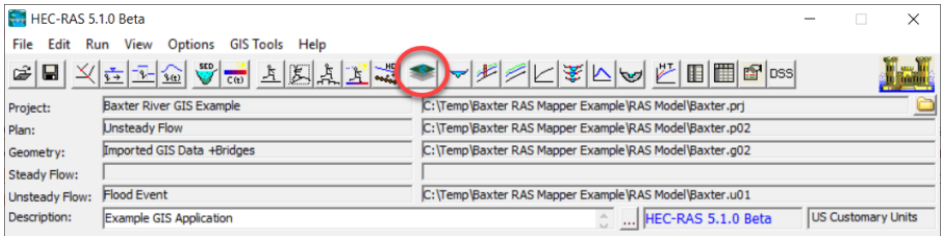


Figure 8 16. HEC-RAS Main Window with HEC-RAS Mapper Button Highlighted.

A flight path layer will be needed to lay out flight paths. To do that right click on **Features** Group in the tree view, and then select **Create New Layer | Flightpath Layer**

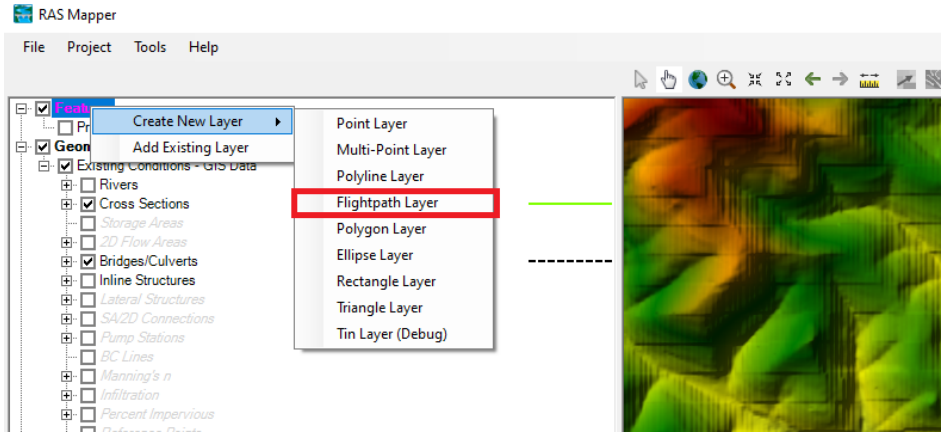


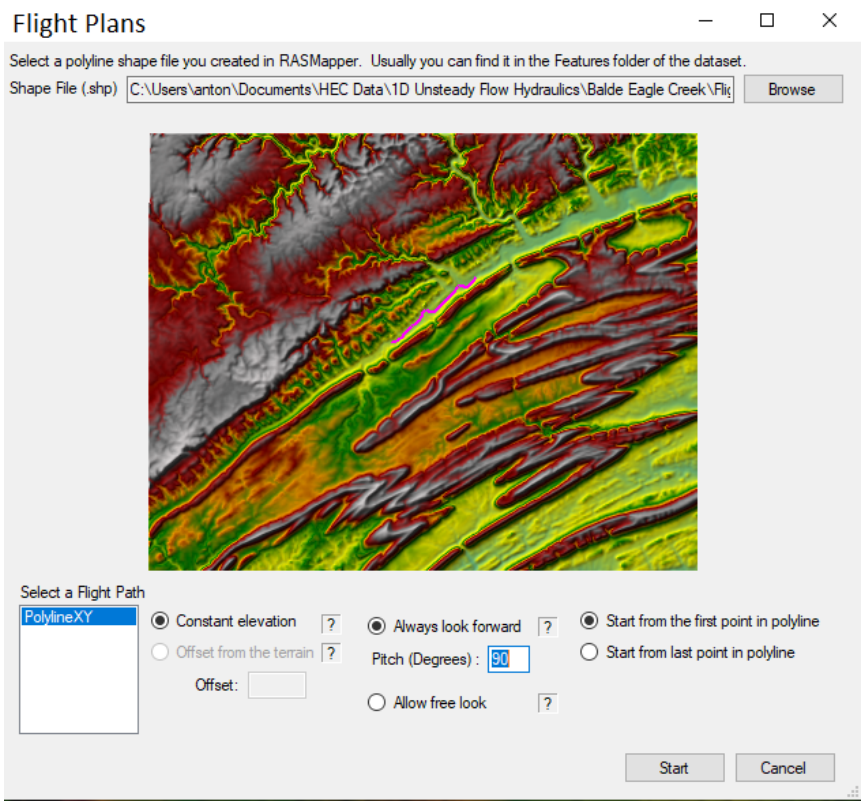
Figure 8 17. HEC-RAS Mapper Menu with Flightpath Layer Selection shown.

Then lay out the polyline you want to use for the flight plan. When you have finished right click the layer and select Stop Editing.
A shape file will be generated under the Flight Paths folder in the root project directory.

Go back to the 3D Viewer and press the Select a Flight Plan button in the toolbar ()

If you saved your flight path layer in the default location, then the form will automatically select the shapefile for you. Otherwise, find the flight path shapefile using the Browse button.

Next, select the polyline from the list on the bottom left of the form.



Option	Description
Constant Elevation	The elevation of the viewer will stay constant throughout the flight path. The elevation can still be changed as described in Changing Elevation section
Offset From The Terrain	Follows the elevation of the terrain at the viewer's position at a constant offset. The elevation can still be changed as described in Changing Elevation section. **(Not Implemented Yet)**
Always Look Forward	The viewer's rotation will stay locked along the polyline. No need to change rotation of the viewer in this mode. Changing the view while the flight path is running will pause the flight plan Pitch is the angle the viewer is looking up or looking down. It can be changed while the flight plan is running.
Allow Free Look	The viewer's rotation will behave the same as before. Changing the view will not pause the flight plan
Start From First/Last Point in Polyline	Where to start on the polyline. Starting from the first point will cause the viewer to go towards the last point. Starting from the last point will cause the viewer to go to the first point

Flight Plan Toolbar

Tool		Description
Play/Pause Flight Plan	/	Continues the flight plan along the flight path, or pauses the flight plan. If the flight plan is paused, the viewer can move freely anywhere. When the flight plan is resumed the viewer will go back along the flight path.
Restart		Restarts the flight plan to either the first point in the flight path or the last point, depending on what direction the flight plan is moving.
Change Direction	/	Changes the direction of the flight plan. The arrow indicates the current direction.
Lock/Unlock Camera	/	When the lock is on this icon, the view will always look forward as described above. When there is no lock then the view is in free look mode, as described above.
Pitch	28	The pitch in degrees, which is the angle at which the viewer is looking up or down.

An example 3D Perspective plot is shown in Figure 8-18. The older X-Y-Z Perspective Plot of 1D cross sections is still available from the View menu.

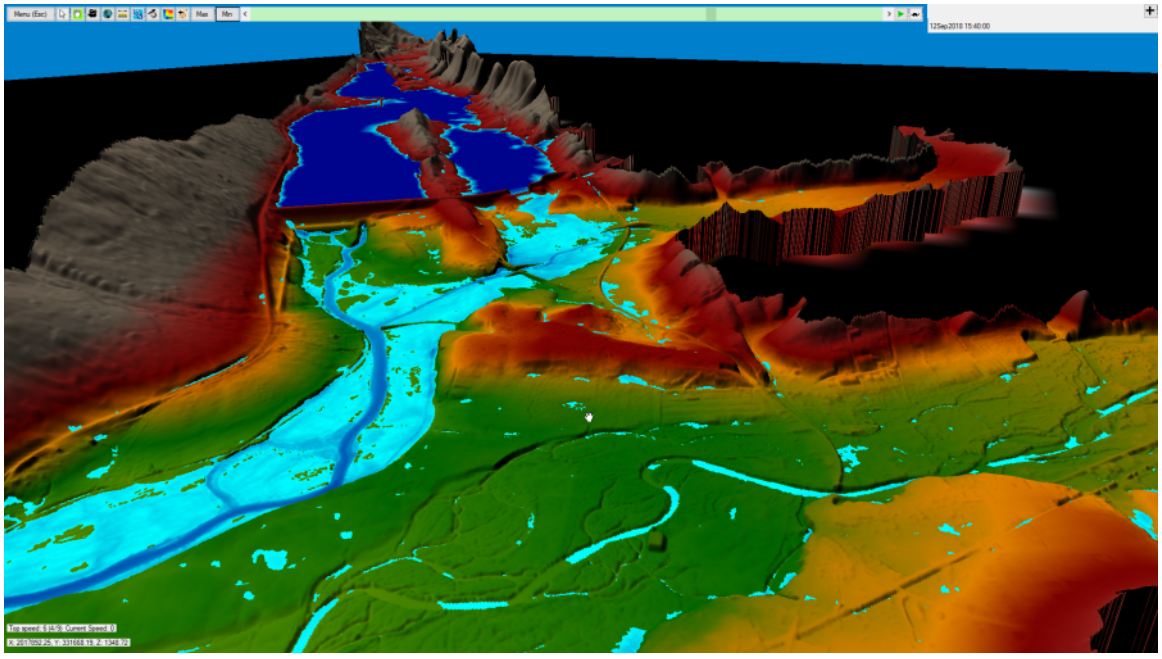


Figure 8 18. Example 3D Perspective Plot.

Breach Hydrograph Plot

If the user is running HEC-RAS in unsteady flow mode (1D or 2D), and you have added breaching information for one or more of the structures that can be breached (Inline structures, Lateral structures, and SA/2D Area Connections), then the **Breach Hydrograph** plot can be used to display key information about the breach.

The Breach Hydrograph plot has three simultaneous plots and a table all on the same window. By default the plot will come up with a summary table at the top, then three plot windows: 1) Stage and flow hydrographs for the structure; 2) Breach bottom width vs time; and 3) Average velocity vs time through the breach. Additionally there is a **Table** Tab just left of the breach. If the Table tab is selected, the user will see a detailed table for the left half of the window, and the plot will be on the right half of the window (the user can adjust the size of both). This table contains all of the time series data being shown in the plots.
An example of the new Breach Hydrograph plot for an inline structure (Dam in this example) is shown in Figure 8-19 below.

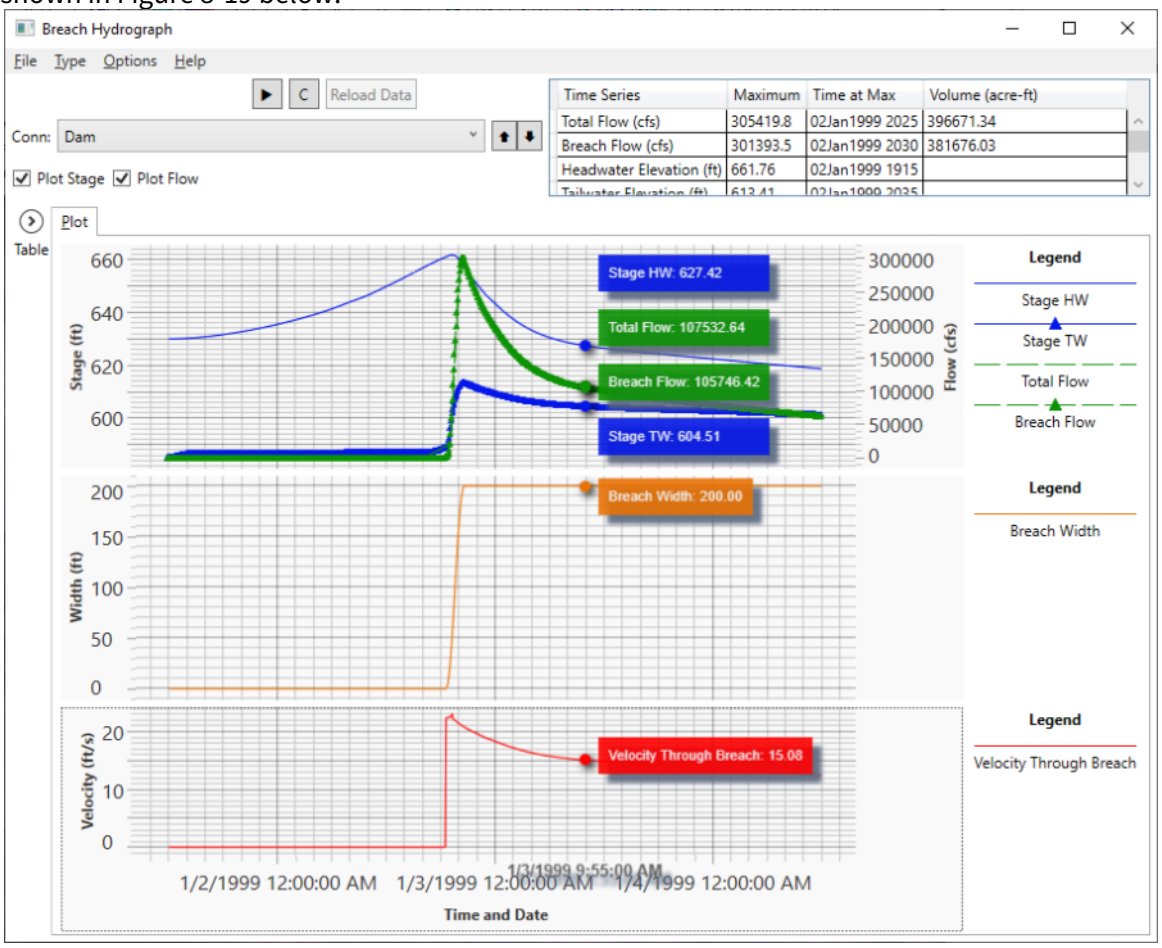


Figure 8 19. Breach Hydrograph Plot for Inline Structure with a Breach.

As shown in Figure 8-19, if the user left clicks on the plot window, a series of "Bobbers" will show up on top of each line, and the value of each line at that point is shown to the right of the Bobber Dot. This is a very handy feature for obtaining the magnitude of each piece of data at the same point in time.

From the **Type** menu at the top of the window, user's can select from the three types of structures that can contain breaching information: Inline Structures; Lateral Structures; and SA/2D Area Connections. Once a Breach Hydrograph Type is selected, the program will only load that type of structure, and only the ones that have breach information.

Under the **Options** menu, there are Options for selecting multiple **Plans** to plot, and there is an option for setting the **number of decimal places** of the numerical values shown on the plot and in the tables.
Additionally, if the user right click on the plot window, a Popup menu will appear with options to: Zoom In; Zoom Previous; Zoom Out; Full Plot; Pan; Select; Point Bobber; Copy to Clipboard; Tabulate; Lines and Symbols; Font sizes and Styles; grid; and Chart options.

Stage and Flow Hydrographs

If the user has performed an unsteady flow analysis, then stage and flow hydrographs will be available for viewing. To view a stage and/or flow hydrograph, the user selects **Stage and Flow Hydrographs** from the **View** menu of the main HEC-RAS window. When this option is selected a plot will appear as shown in Figure 8-20. The user has the option to plot just the stage hydrograph, just the flow hydrograph, or both as shown in the figure. Additionally, there are three tabs on the plot. The tabs are for plotting (**Plot**), viewing the data in tabular form (**Table**), and plotting a rating curve of the event (**Rating Curve**). By default, the window comes up in a plotting mode.

The stage and flow hydrograph plot also has a menu option to select the specific node types to be viewed. By default, the plot comes up with a node type of cross section selected. This allows the user to view hydrographs at cross sections only. Other available node types include: Bridges/Culverts; Inline Structures; Lateral Structures; Storage Areas; Storage Area Connections; and Pump Stations. There are several options available for viewing this graphic. These options are the same as described previously for the cross section, profile, and rating curve plots. Additionally, this graphic can be sent to the windows clipboard, or the printer, as described under the previous plots.

Additional output for the hydrograph plot includes statistics about the hydrographs (peak stage and flow, time of peak, and volume). Also, the user can simultaneously plot observed hydrograph data at locations where they have gaged information stored in a DSS file. The user attaches gaged hydrograph information to cross section locations from the Unsteady Flow Data editor.

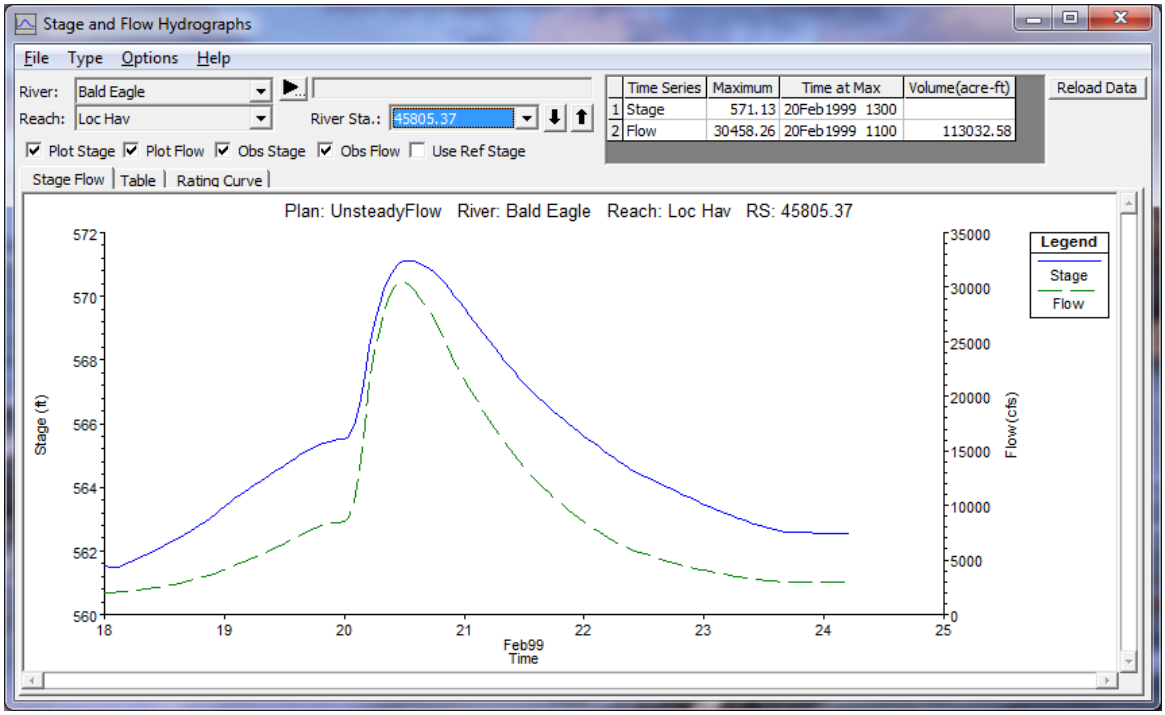


Figure 8 20 Stage and Flow Hydrograph Plot

Tabular Output

Summary tables of the detailed water surface profile computations are often necessary to analyze and document simulation results. Tabular output allows the user to display large amounts of detailed information in a concise format. HEC-RAS has two basic types of tabular output, detailed output tables and profile summary tables.

Detailed Output Tables

Detailed output tables show hydraulic information at a single location, for a single profile. To display a detailed output table on the screen, select **Detailed Output Tables** from the **View** menu of the main HEC-RAS window. An example detailed output table is shown in Figure 8 21.

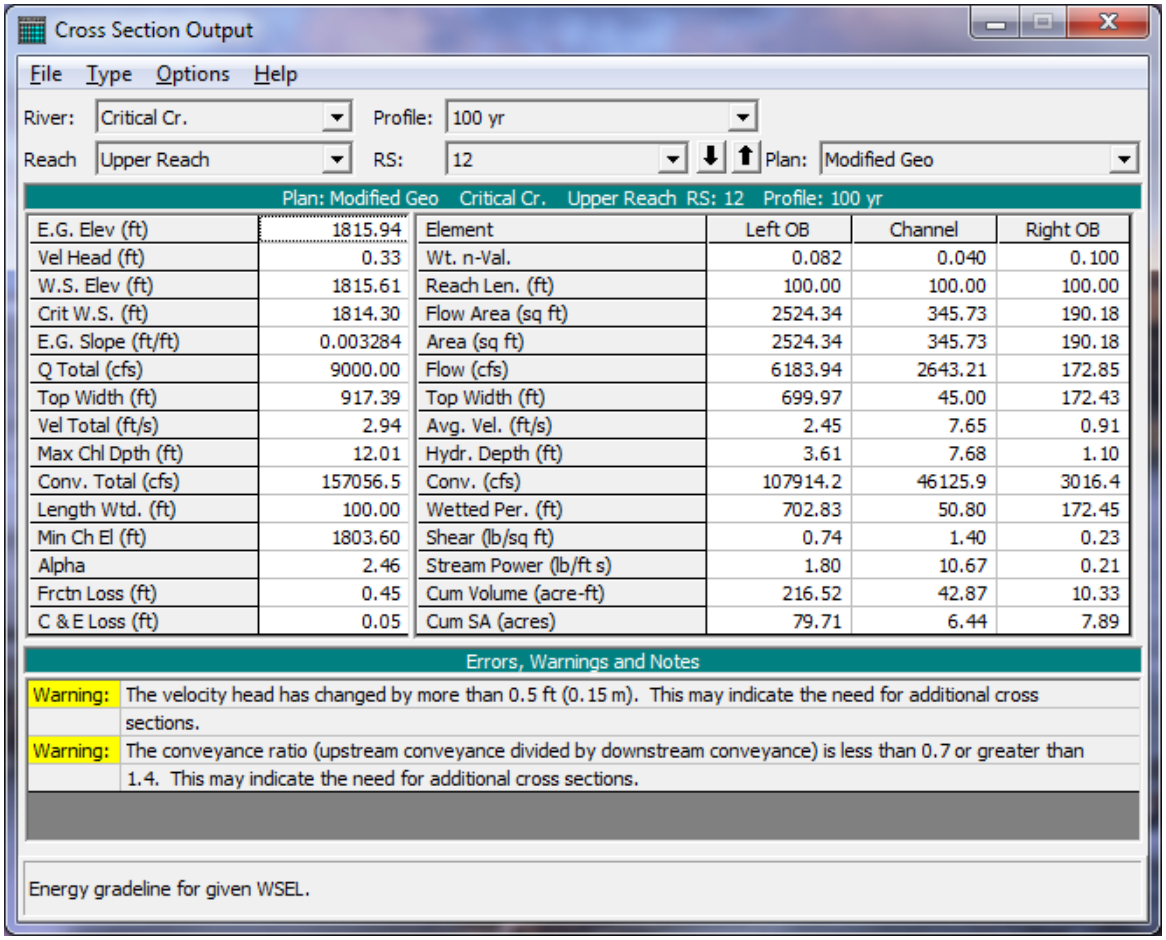


Figure 8 21 Example Cross Section Detailed Output Table

By default, this table comes up displaying detailed output for cross sections. Any cross section can be displayed in the table by selecting the appropriate river, reach and river station from the list boxes at the top of the table. Also, any of the computed profiles can be displayed by selecting the desired profile from the profile list box. Additionally, different plans can be viewed by selecting a plan from the plan list box.
Users can also view detailed hydraulic information for other types of nodes. Other table types are selected from the **Type** menu on the detailed output table window. The following types are available in addition to the normal cross section table (which is the default):

Culvert. The culvert table type brings up detailed culvert information. This table can be selected for normal culverts, or for culverts that are part of a multiple opening river crossing. An example culvert specific table is shown in Figure 8-22.

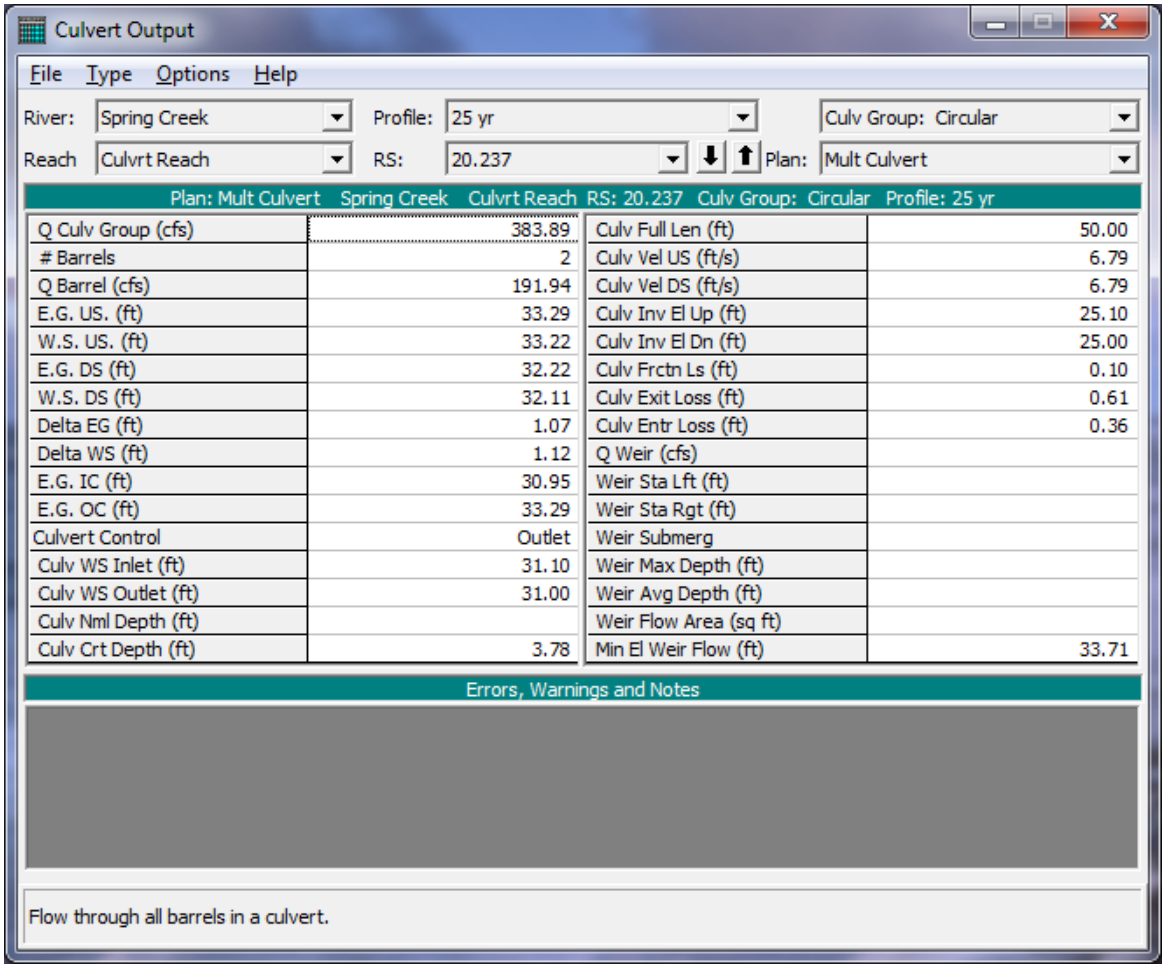


Figure 8 22 Example Culvert Type of Cross Section Table

Bridge. The bridge table type brings up detailed output for the cross sections inside the bridge as well as just upstream of the bridge. The bridge table type can be selected for normal bridge crossings, or for bridges that are part of a multiple opening river crossing. An example of the bridge specific cross section table is shown in Figure 8-23.

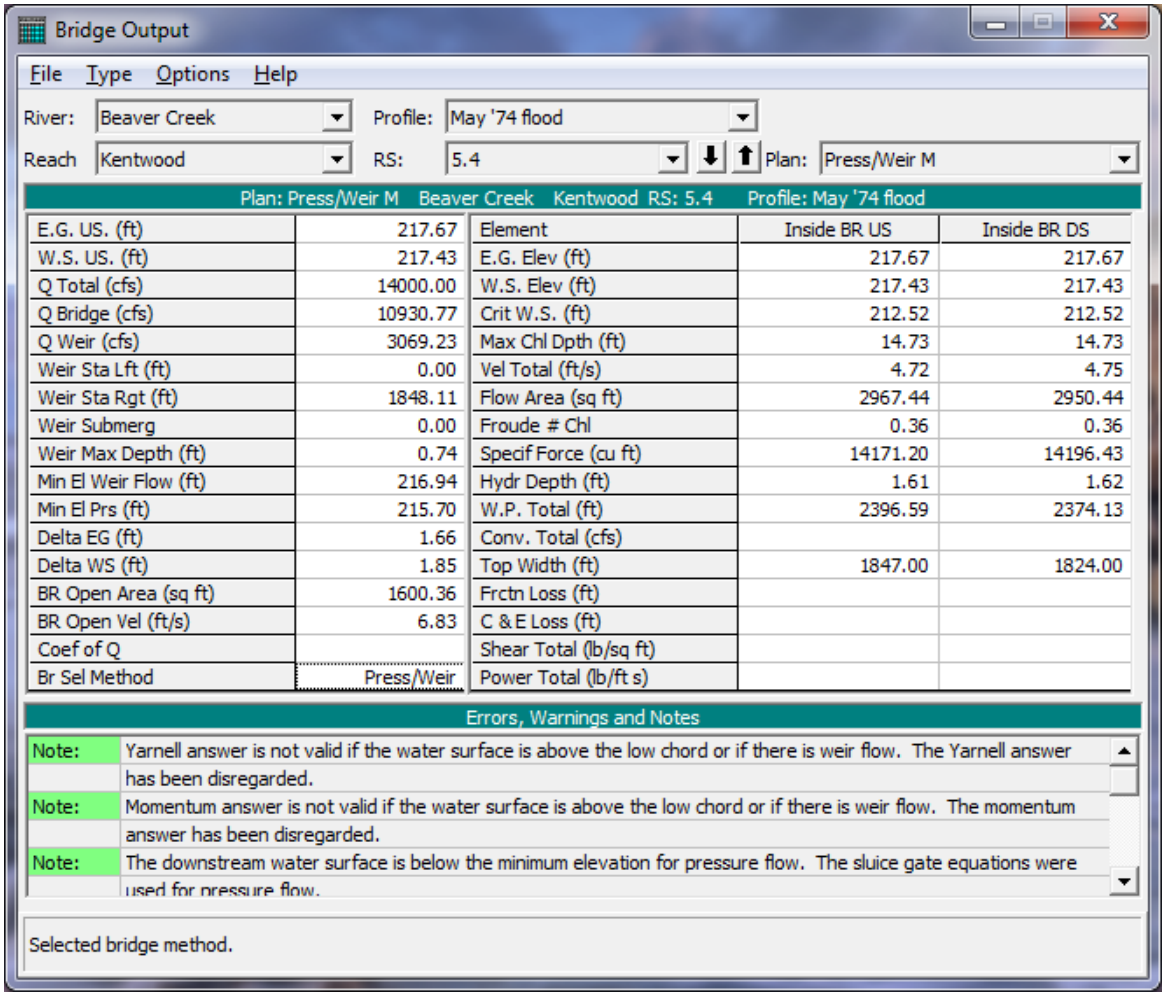


Figure 8 23 Example Bridge Type of Cross Section Table

Multiple Opening. The multiple opening type of table is a combination of the cross section table and the bridge and culvert tables. That is, if the user has defined multiple opening (bridges, culverts, and conveyance areas), then this table can be used to view the hydraulic results for each specific opening.

Inline Structure. The Inline Structure type of table can be used to view detailed output for any inline weirs and/or gated spillways that have been entered by the user.

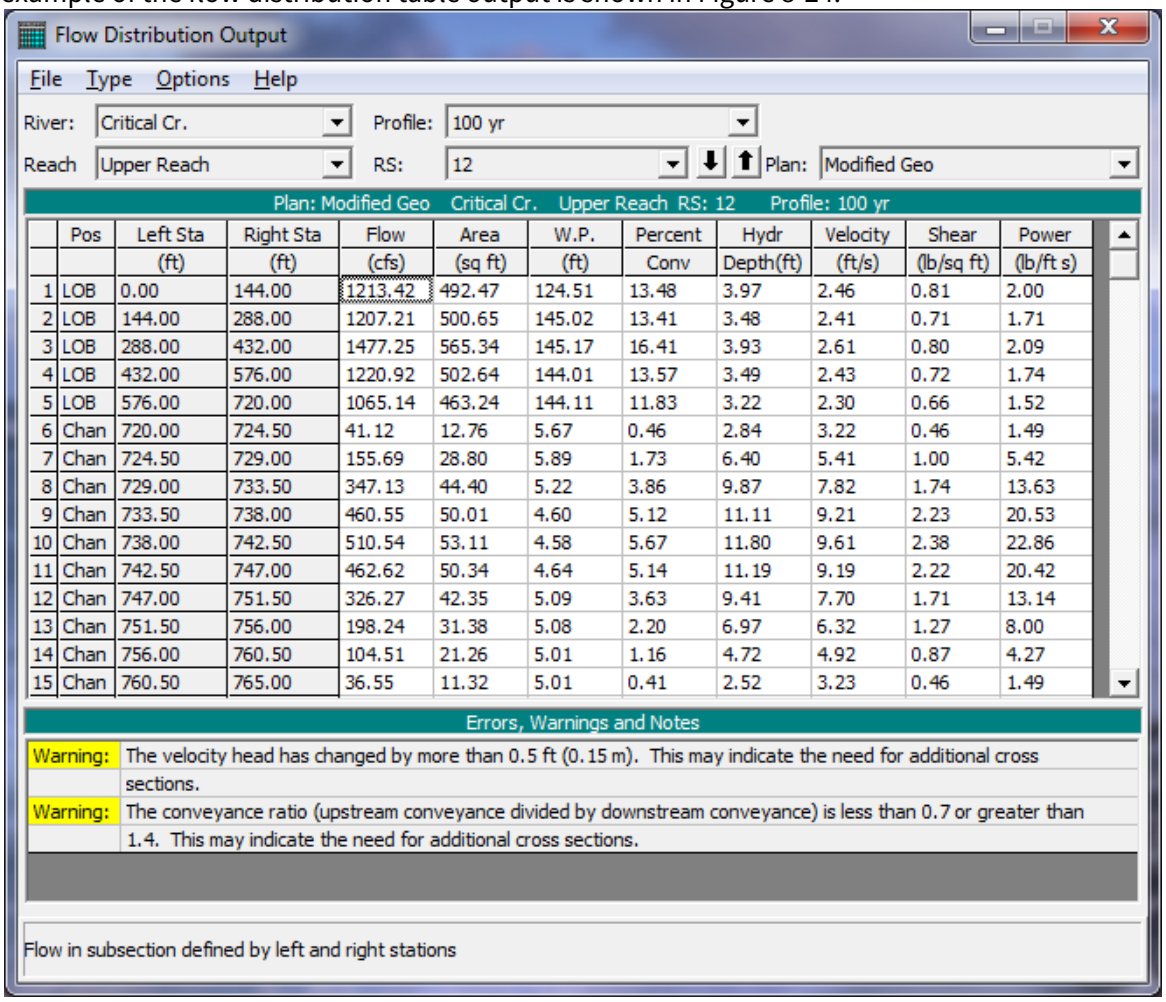
Lateral Structure. The Lateral Structure type of table can be used for viewing detailed output from a lateral weir, gated spillway, culvert, and rating curves.

Storage Area. This table provides output about an individual storage area. Information includes water surface elevation, total inflow, total outflow, and net inflow.

Storage Area Connection. This table provides detailed information about storage area connections. Storage area connections can consist of weirs, gated spillways, and culverts.

Pump Stations. This table provides detailed information about pump stations. Pump station output includes to and from water surface elevations, total flow, flow through each pump group, flow through each pump, head difference, and efficiency.

Flow Distribution In Cross Sections. The Flow Distribution table type can be used to view the computed flow distribution output at any cross section where this type of output was requested. An example of the flow distribution table output is shown in Figure 8-24.



	Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1	LOB	0.00	144.00	1213.42	492.47	124.51	13.48	3.97	2.46	0.81	2.00
2	LOB	144.00	288.00	1207.21	500.65	145.02	13.41	3.48	2.41	0.71	1.71
3	LOB	288.00	432.00	1477.25	565.34	145.17	16.41	3.93	2.61	0.80	2.09
4	LOB	432.00	576.00	1220.92	502.64	144.01	13.57	3.49	2.43	0.72	1.74
5	LOB	576.00	720.00	1065.14	463.24	144.11	11.83	3.22	2.30	0.66	1.52
6	Chan	720.00	724.50	41.12	12.76	5.67	0.46	2.84	3.22	0.46	1.49
7	Chan	724.50	729.00	155.69	28.80	5.89	1.73	6.40	5.41	1.00	5.42
8	Chan	729.00	733.50	347.13	44.40	5.22	3.86	9.87	7.82	1.74	13.63
9	Chan	733.50	738.00	460.55	50.01	4.60	5.12	11.11	9.21	2.23	20.53
10	Chan	738.00	742.50	510.54	53.11	4.58	5.67	11.80	9.61	2.38	22.86
11	Chan	742.50	747.00	462.62	50.34	4.64	5.14	11.19	9.19	2.22	20.42
12	Chan	747.00	751.50	326.27	42.35	5.09	3.63	9.41	7.70	1.71	13.14
13	Chan	751.50	756.00	198.24	31.38	5.08	2.20	6.97	6.32	1.27	8.00
14	Chan	756.00	760.50	104.51	21.26	5.01	1.16	4.72	4.92	0.87	4.27
15	Chan	760.50	765.00	36.55	11.32	5.01	0.41	2.52	3.23	0.46	1.49

Figure 8 24 Example of the Flow Distribution Type of Table

At the bottom of each of the detailed output tables are two text boxes for displaying messages. The bottom text box is used to display the definition of the variables listed in the table. When the user presses the left mouse button over any data field, the description for that field is displayed in the bottom text box. The other text box is used to display any Errors, Warnings, and Notes that may have occurred during the computations for the displayed cross section.

Detailed Output Table Options

Plans. This option allows the user to select which plan, and therefore output file, they would like to view. This option is available from a list box at the upper right-hand side of the window.
Under the **Options** menu of the cross-section table window, the user has the following options:

Include Interpolated XS's. This option allows the user to either view interpolated cross-section output or not. Turning the "include interpolated XS's" option on (which is the default), allows interpolated sections to be selected from the river station box. Turning this option off gets rid of all

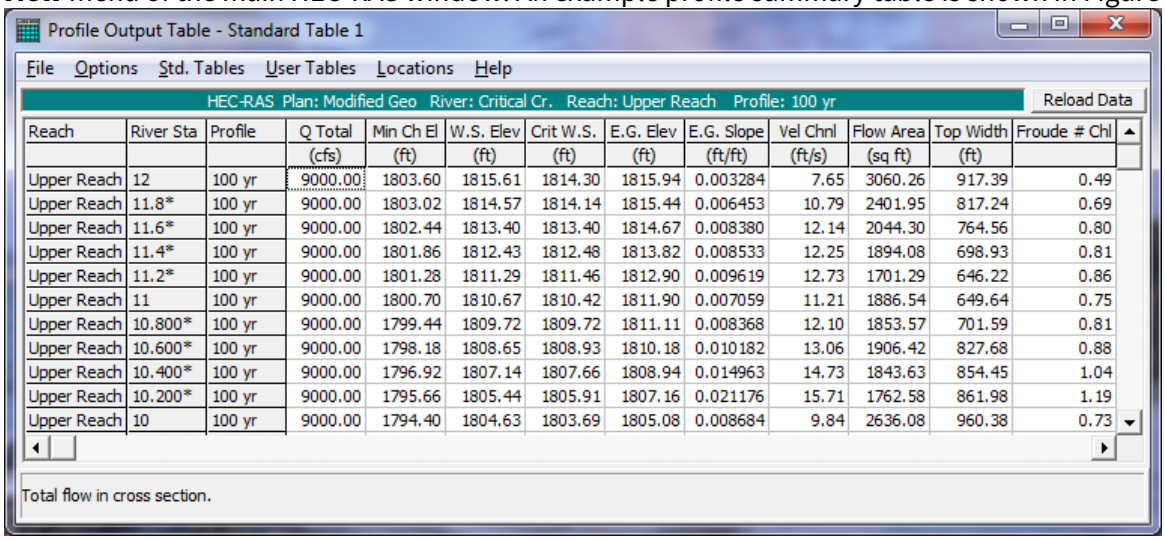
the interpolated sections from the river station selection box, and only the user entered cross-sections are displayed.

Include Errors, Warnings, and Notes in Printout. This option allows the user to have the errors, warnings, and notes information printed below the table, when the option to print the table is selected.

Units System for Viewing. This option allows the user to view the output in either English or Metric units. It does not matter whether the input data is in English or Metric, the output can be viewed in either system.

Profile Summary Tables

Profile summary tables are used to show a limited number of hydraulic variables for several cross sections. To display a profile summary table on the screen, select **Profile Summary Table** from the **View** menu of the main HEC-RAS window. An example profile summary table is shown in Figure 8-25.



Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upper Reach	12	100 yr	9000.00	1803.60	1815.61	1814.30	1815.94	0.003284	7.65	3060.26	917.39	0.49
Upper Reach	11.8*	100 yr	9000.00	1803.02	1814.57	1814.14	1815.44	0.006453	10.79	2401.95	817.24	0.69
Upper Reach	11.6*	100 yr	9000.00	1802.44	1813.40	1813.40	1814.67	0.008380	12.14	2044.30	764.56	0.80
Upper Reach	11.4*	100 yr	9000.00	1801.86	1812.43	1812.48	1813.82	0.008533	12.25	1894.08	698.93	0.81
Upper Reach	11.2*	100 yr	9000.00	1801.28	1811.29	1811.46	1812.90	0.009619	12.73	1701.29	646.22	0.86
Upper Reach	11	100 yr	9000.00	1800.70	1810.67	1810.42	1811.90	0.007059	11.21	1886.54	649.64	0.75
Upper Reach	10.800*	100 yr	9000.00	1799.44	1809.72	1809.72	1811.11	0.008368	12.10	1853.57	701.59	0.81
Upper Reach	10.600*	100 yr	9000.00	1798.18	1808.65	1808.93	1810.18	0.010182	13.06	1906.42	827.68	0.88
Upper Reach	10.400*	100 yr	9000.00	1796.92	1807.14	1807.66	1808.94	0.014963	14.73	1843.63	854.45	1.04
Upper Reach	10.200*	100 yr	9000.00	1795.66	1805.44	1805.91	1807.16	0.021176	15.71	1762.58	861.98	1.19
Upper Reach	10	100 yr	9000.00	1794.40	1804.63	1803.69	1805.08	0.008684	9.84	2636.08	960.38	0.73

Figure 8 25 Example Profile Table

There are several standard table (Std. Tables) types available to the user. Some of the tables are designed to provide specific information at hydraulic structures (e.g., bridges and culverts), while others provide generic information at all cross sections. The standard table types available to the user are:

Standard Table 1. The is the default profile type of table. This table gives you a summary of some of the key output variables.

Standard Table 2. This is the second of the standard summary tables. This table provides information on the distribution of flow between the left overbank, main channel, and right overbank. This table also shows the friction losses, as well as contraction and expansion losses that occurred between each section. Energy losses displayed at a particular cross section are for the losses that occurred between that section and the next section downstream.

Four XS Culvert. This standard table provides summary results for the four cross sections around each of the culverts in the model. The four cross sections are the two immediately downstream and

the two immediately upstream of the culvert. This table will list all of the culverts in the model for the selected reaches.

Culvert Only. This standard table provides hydraulic information about the culvert, as well as the inlet control and outlet control computations that were performed.

Six XS Bridge. This table provides summary results for the six cross sections that make up the transition of flow around a bridge. The six cross sections include the two cross sections just downstream of the bridge; the two cross sections inside of the bridge; and the two cross sections just upstream of the bridge. The program will display results for all the bridges in the model within the selected reaches. When viewing this table, on occasion there will be no displayed results for the cross sections inside of the bridge. This occurs only when the user has selected a bridge modeling approach that does not compute results inside of the bridge. This includes: Yarnell's method; both pressure flow equations; and pressure and weir flow solutions.

Bridge Only. The bridge only table shows summary information specifically for bridges.

Bridge Comparison. The bridge comparison table shows the results for all of the user selected bridge modeling approaches that were computed during the computations. For example, the program can calculate low flow bridge hydraulics by four different methods. The resulting upstream energy for the user selected methods will be displayed in this table.

Multiple Opening. This table shows a limited number of output variables for each opening of a multiple opening river crossing.

Four XS Inline Structure. This table displays summary results of the four cross sections immediately around an inline weir and/or gated spillway. The four cross sections are the two immediately upstream and the two immediately downstream of the inline weir and/or gated spillway.

Inline Structure. This table shows the final computed water surface and energy just upstream of each of the inline weir and/or gated spillways. In addition to these elevations, the table displays the total flow, the flow over the weir, and the total flow through all of the gates.

Lateral Structure. This table shows a limited set of output variables for all of the lateral weir/ spillway structures within the selected reaches.

Encroachment 1, 2, and 3. These three standard tables provide various types of output for the computations of floodway encroachments.

HEC-FDA. This table provides information that can be exported to the HEC Flood Damage Analysis (FDA) program. The table displays total flow, channel invert elevation, and water surface elevation.

HEC-5Q. This table provides information that can be exported to the HEC-5Q (river and reservoir water quality analysis) program. The table displays only the specific parameters required by the HEC-5Q program.

Ice Cover. This table shows summary output of ice information. This table was designed for performing a study that includes ice cover.

Junctions. This summary table provides a limited set of output for all of the cross sections that bound a junction. This table will show this output for all of the junctions found in the model.

Storage Areas. This table shows a limited amount of output for all of the storage areas in the model. Output includes: water surface elevation; minimum storage area elevation; surface area; and volume.

Conn with Culverts. This table will show summary output for storage area connections that contain culverts.

Pump Stations. This table shows a limited amount of output for any of the pump stations contained within the model.
To view one of the types of tables, select the desired table type from the **Std. Tables** menu on the profile summary table. In addition to the various types of profile tables, the user can specify which plans, profiles and reaches to include in the table. The plans, profiles and reaches options are available from the **Options** menu on the profile plot.
The user also has the ability to turn the viewing of interpolated cross sections on or off. The default is to view all cross-sections, including the interpolated ones. To prevent the interpolated sections from showing up in the table, de-select **Include Interpolated XS's** from the **Options** menu.

Another feature available to users is the ability to set the number of decimal places that will be displayed for any variable of the pre-defined tables. Once a pre-defined table is selected from the **Tables** menu, select **Standard Table # Dec Places** from the **Options** menu. A window will appear displaying the current number of decimal places for each variable. The user can change the number of decimal places to whatever they wish.

User's also have the ability to view summary output tables in either English or metric units. This is available from the **Options** menu on the profile tables. It does not matter whether the input data is in English or metric, the output can be viewed in either system.

User Defined Output Tables

A special feature of the profile summary tables is the ability for users to define their own output tables. User defined output tables are available by selecting **Define Table** from the **Options** menu of the profile table. When this option is selected, a window will appear, as shown in Figure 8-26. At the top of the window is a table for the user selected variable headings (Table Column Headings), the units, and the number of decimal places to be displayed for each variable. Below this table is a table containing all of the available variables that can be included in your user-defined table. The variables are listed in alphabetical order. In addition to the variable names, to the right of each variable is a description.

To add variables to the column headings, simply double click the left mouse button while the mouse pointer is over the desired variable. The variable will be placed in the active field of the table column headings. To select a specific column to place a variable in, click the left mouse button once while the mouse pointer is over the desired table column field. To delete a variable from the table headings, double click the left mouse button while the mouse pointer is over the variable that you want to delete. The number of decimal places for each variable can be changed by simply typing in a new value.
User defined tables are limited to 15 variables. Once you have selected all of the variables that you want, press the **OK** button at the bottom of the window. The profile table will automatically be updated to display the new table.

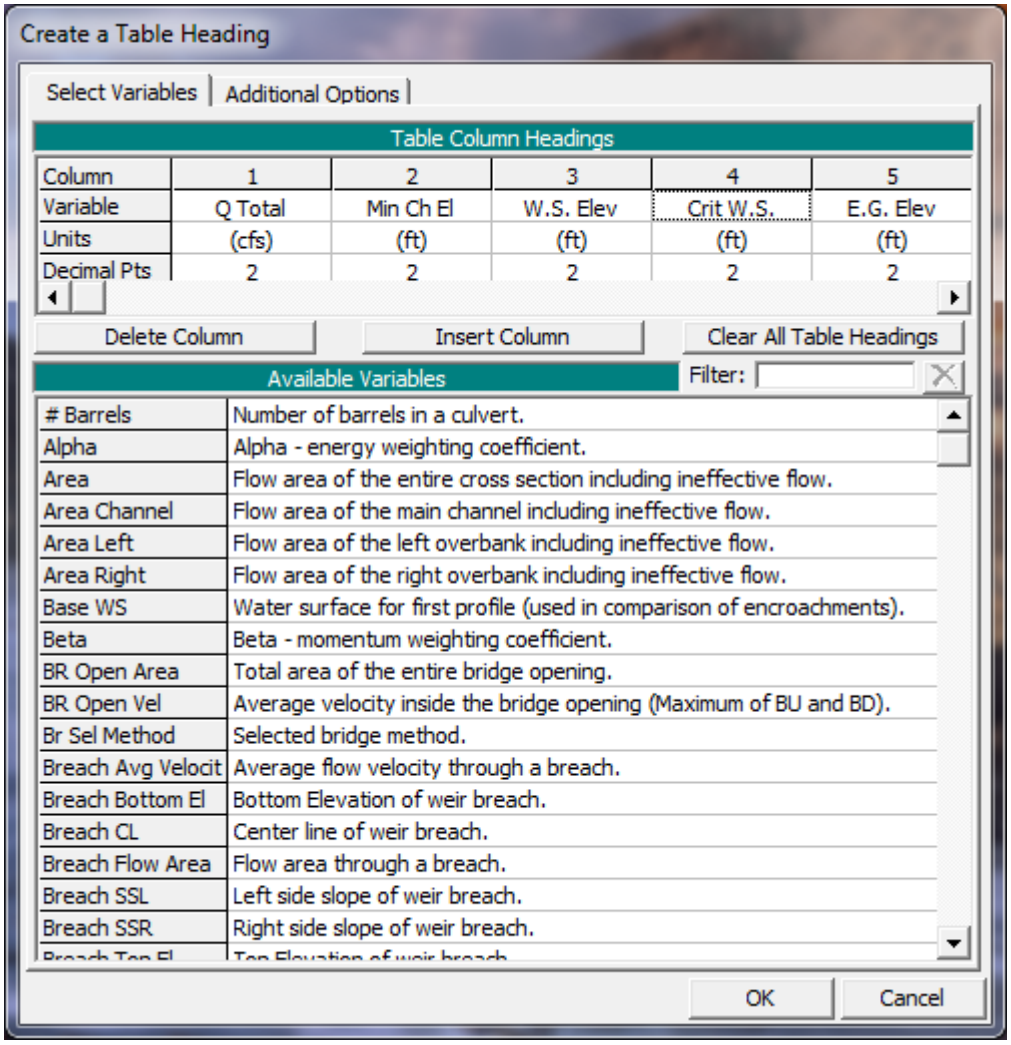


Figure 8 26 User Defined Tables Window

Once you have the table displayed in the profile table window, you can save the table headings for future use. To save a table heading, select **Save Table** from the **Options** menu on the profile table window. When this option is selected, a pop-up window will appear, prompting you to enter a name for the table. Once you enter the name, press the **OK** button at the bottom of the pop-up window. The table name will then be added to a list of tables included under the **User Tables** menu on the profile table window. To delete a table from the list of user defined tables, select **Remove Table** from the **Options** menu of the profile table window. When this option is selected, a pop-up window will appear displaying a list of all the user-defined tables. Click the left mouse button over the tables that you want to delete, then press the **OK** button. The selected tables will then be deleted from the **User Tables** menu list.

Sending Tables to the Printer

To send a table to the printer, do the following:

1. Bring up the desired table from the tabular output (cross section or profile tables) section of the program.
2. Select **Print** from the **File** menu of the displayed table. When this option is selected, a pop-up window will appear allowing you to modify the default print options. Once you have set the printer with the desired

options, press the **Print** button. The table will be sent to the Windows Print Manager. The Windows Print Manager will control the printing of the table.

The profile summary type of tables allow you to print a specific portion of the table, rather than the entire table. If you desire to only print a portion of the table, do the following:

1. Display the desired profile type table on the screen.
2. Using the mouse, press down on the left mouse button and highlight the area of the table that you would like to print. To get an entire row or column, press down on the left mouse button while moving the pointer across the desired row or column headings.
3. Select **Printer** from the **File** menu of the displayed table. Only the highlighted portion of the table and the row and column headings will be sent to the Windows Print Manager.

Sending Tables to the Windows Clipboard

To pass a table to the Windows Clipboard, and then to another program, do the following:

1. Display the desired table on the screen.
2. Select **Copy to Clipboard** from the **File** menu of the displayed table.
3. Bring up the program that you want to pass the table into. Select **Paste** from the **Edit** menu of the receiving program.

Portions of the profile tables can be sent to the Clipboard in the same manner as sending them to the printer.

Viewing Results from the River System Schematic

The user has the option of either bringing up graphics and tables from the **View** menu on the main HEC-RAS window (as discussed above), or from the river system schematic (found under geometric data). Once data have been entered, and a successful simulation has been made, the user can interact with the river system schematic. When the left mouse button is pressed over the river system schematic, a pop-up menu will appear listing options that are relevant to the area of the schematic that is located under the mouse pointer. An example of this is shown in Figure 8-27.

In Figure 8-27, the pop-up menu shown comes up whenever the user presses the left mouse button over a cross section. In this particular example, the mouse button was pressed over the cross section located at river station 9.9 of the Upper reach of Fall river. As shown in the menu, the user has the choice of editing the cross section data; plotting the cross section; plotting the profile for the reach containing this cross section; bringing up the XYZ plot for that reach; viewing tabular output; plotting the computed rating curve at this cross section; or viewing a picture of the location. Other popup menus are available for bridges; culverts; junctions; and reach data.

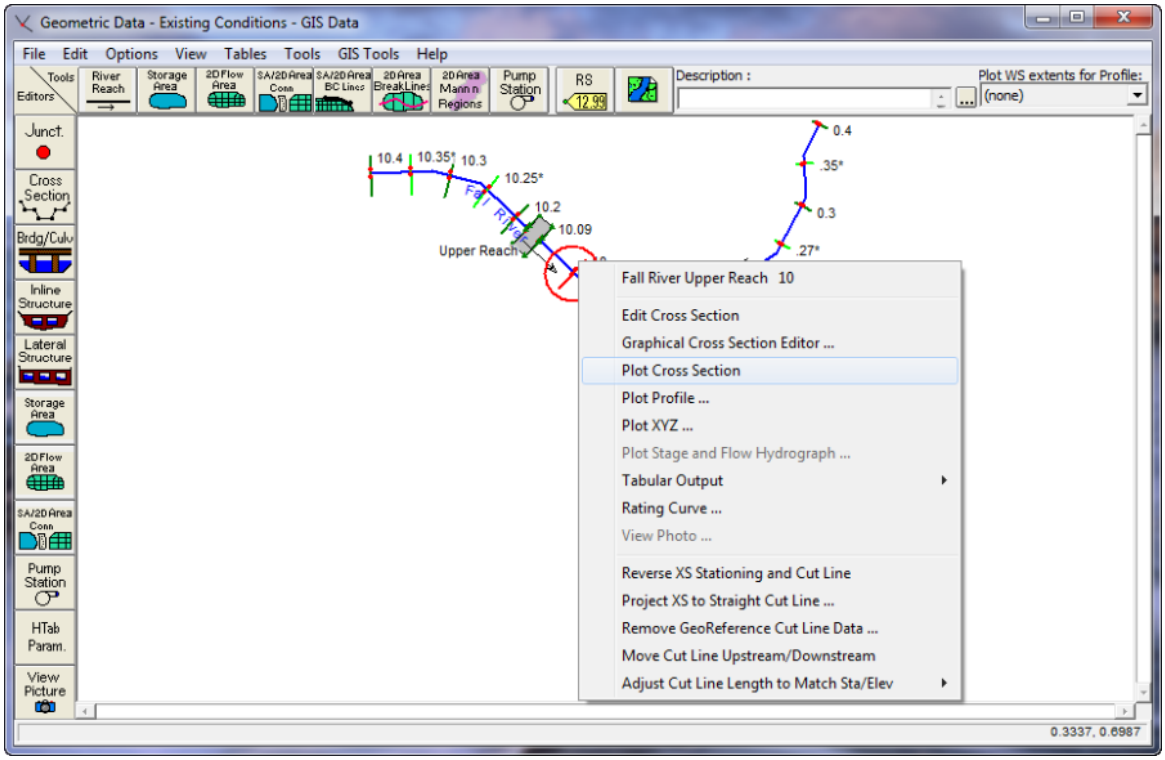


Figure 8 27 Geometric Data Window with Popup Menu

Viewing Computational Level Output for Unsteady Flow

When performing an unsteady flow analysis the user can optionally turn on the ability to view output at the computation interval level. This is accomplished by checking the box labeled **Computation Level Output** on the Unsteady Flow Analysis window (In the Computations Settings area on the window). When this option is selected an additional binary file containing output at the computation interval is written out. After the simulation the user can view computation level output by selecting either **Unsteady Flow Spatial Plot** or **Unsteady Flow Time Series Plot** from the **View** menu of the main HEC-RAS window. Shown in Figure 8-28 is an example of the Spatial Plot.

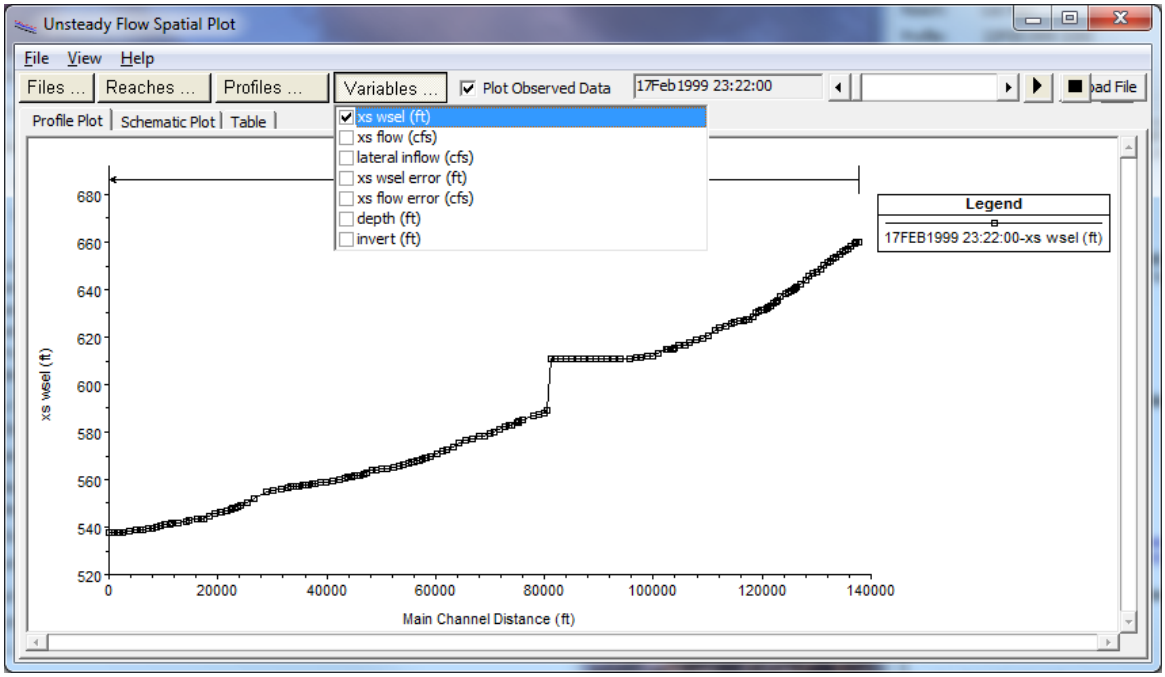


Figure 8 28. Unsteady Flow Spatial Plot for Computational Interval Output

As shown in Figure 8-28, the user can view either a profile plot, a spatial plot of the schematic, or tabular output. The user can select from a limited list of variables that are available at the computation level output. These are water surface elevation (XS WSEl); Flow (XS Flow); computed maximum error in the water surface elevation (XS WSEL ERROR); computed maximum error in the flow (XS FLOW ERROR); and maximum depth of water in the channel (DEPTH). Each of the plots can be animated in time by using the video player buttons at the top right of the window. This type of output can often be very useful in debugging problems within an unsteady flow run. Especially plotting the water surface error and animating it in time.

The other type of plot available at the computation interval output level is the **Unsteady Flow Time Series Plot.** When this option is selected the user will get a plot as shown in Figure 8-29.

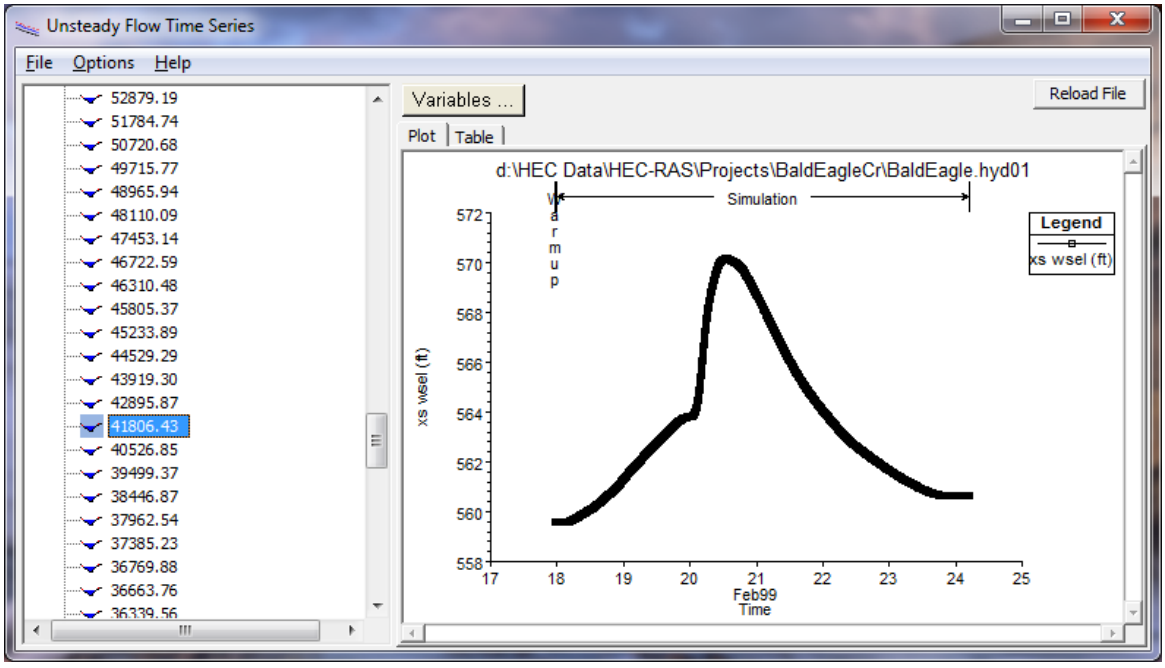


Figure 8 29. Unsteady Flow Time Series Plot at Computation Interval Level

As shown in Figure 8-29, the user has the option to plot or tabulate the time series output. Additionally, the user can select from five variables to display on the plot/table. The variables are chosen from the Variables button at the top of the window.

Viewing Ice Information

River ice information can be viewed both in a graphical and tabular format.

Graphical Ice Information

To view graphical ice information on the screen, select either **Cross Sections**, **Profiles**, or **X-Y-Z Perspective Plot** from the View menu on the HEC-RAS main window.

Cross Section Plot. Figure 8-30 is an example cross section plot displaying ice. The ice cover is displayed by selecting **Variables** under the **Options** menu, then selecting the **Ice Cover** option. The ice thicknesses in the right overbank, main channel, and left overbank are displayed. The default color and fill pattern can be changed by the user by selecting **Lines and Symbols** under the **Options** menu. Note that multiple profiles and multiple plans can be displayed on the same plot.

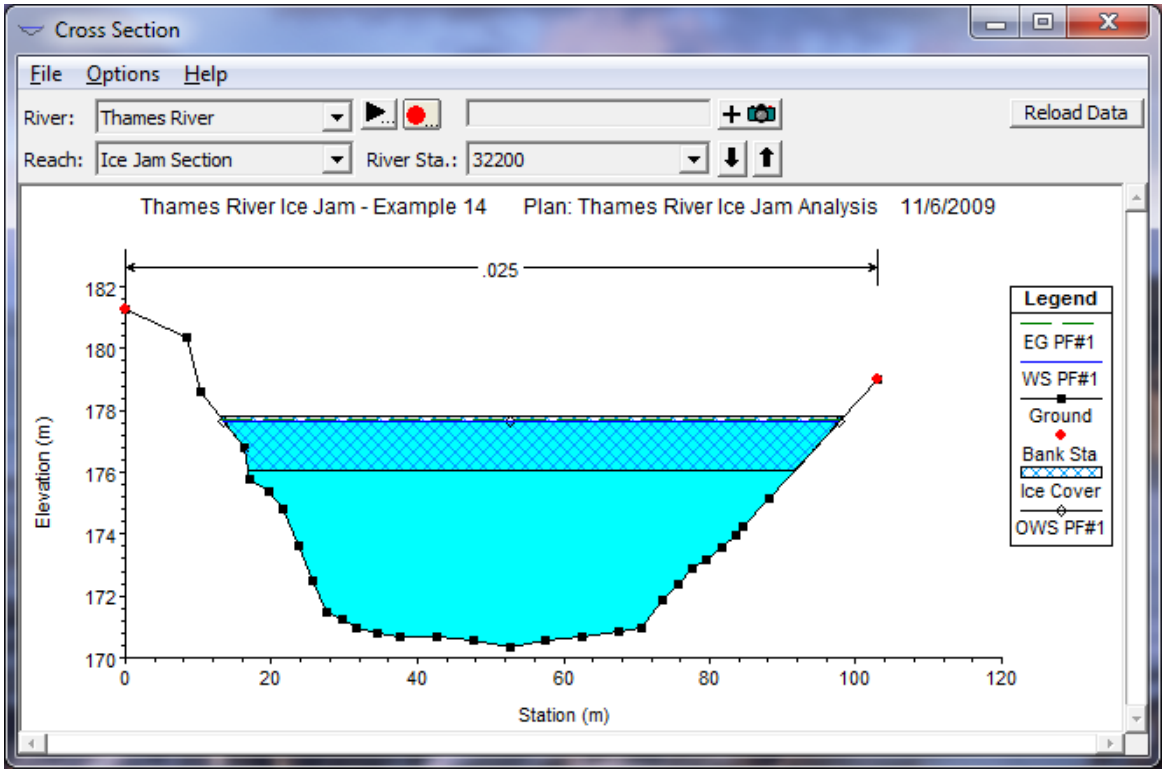


Figure 8 30 Cross Section Plot with Ice

Profiles Plot. An example of a profile plot with ice is shown in Figure 8-31. In this case, the **WS-EG Profile** was selected. As with the Cross Section plot, the ice cover is displayed by selecting **Variables** under the **Options** menu, then selecting the **Ice Cover** option. The ice thicknesses in the right overbank, main channel, and left overbank are displayed. The default color and fill pattern can be changed by the user by selecting **Lines and Symbols** under the **Options** menu. Note that multiple profiles and multiple plans can be displayed on the same plot.

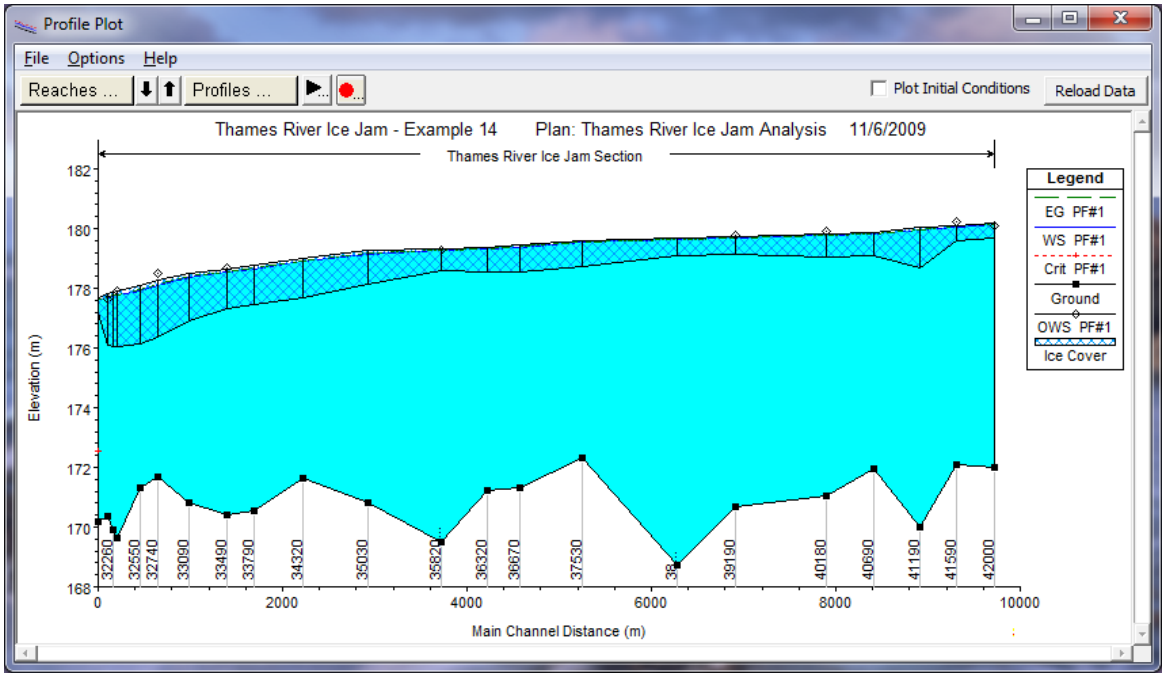


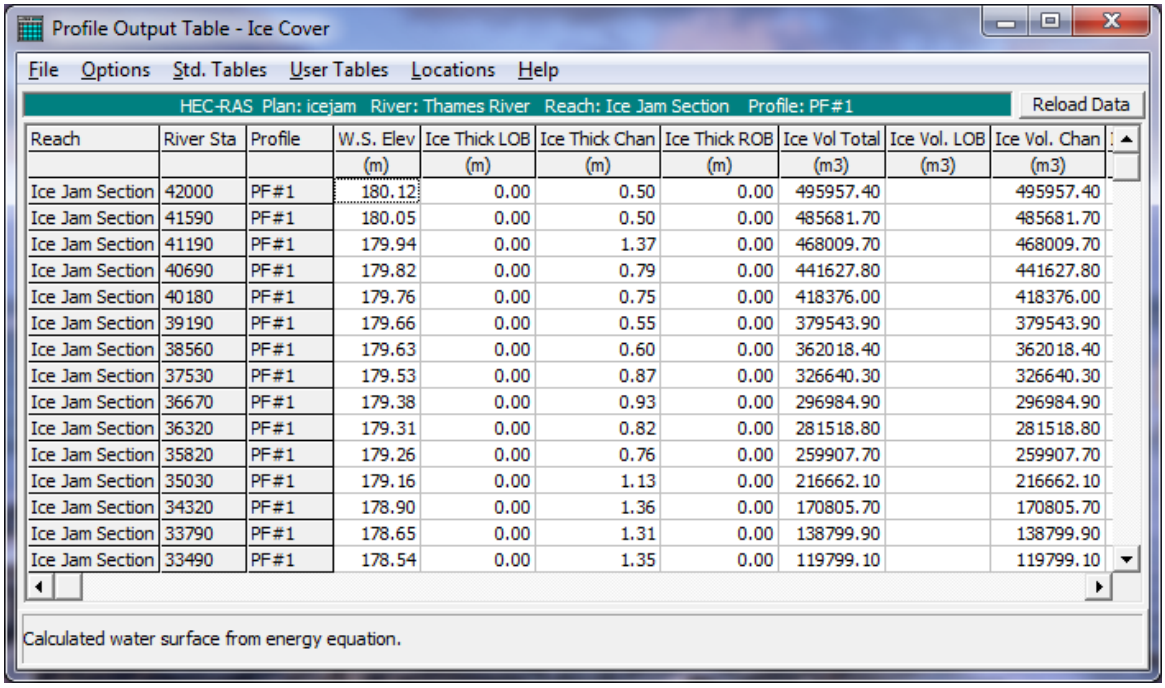
Figure 8 31 Profile Plot with Ice Cover

Ice information can also be displayed in profile plots by selecting the **General Profile** option and then selecting **Variables** under the **Options** menu. This provides a number of ice variables, including ice volume in the channel, left, and right overbanks; ice thickness in the channel, left, and right overbanks; top of ice elevation in the channel, left, and right overbanks; and bottom of ice elevations in the channel, left, and right overbanks. These plots can all be viewed in different widow sizes and printed.

X-Y-Z Perspective Plot. As with the Cross-Section plot, the ice cover is displayed by selecting **Variables** under the **Options** menu, then selecting the **Ice Cover** option. The ice thicknesses in the right overbank, main channel, and left overbank are displayed. The default color and fill pattern can be changed by the user by selecting **Lines and Symbols** under the **Options** menu.

Tabular Ice Information

Tabular information describing the results of the ice calculations can be displayed by selecting **Profile Summary Table** under the **View** menu on the HEC-RAS main window. Ice information is available directly by selecting the **Ice Cover** option under the **Std. Tables** menu of the Profile Table window. The Ice Cover option provides a table that includes the ice volume, ice thickness, and composite Manning's n value for the main channel, left overbank, and right overbank. In addition, the Ice Cover Table includes the water surface elevation and the cumulative ice volume starting from the downstream end of the channel. An example table of ice information is shown in Figure 8-32. Tables of ice information can also be created using the **Define Table** option under the **Options** menu of the Profile Table window.



Reach	River Sta	Profile	W.S. Elev (m)	Ice Thick LOB (m)	Ice Thick Chan (m)	Ice Thick ROB (m)	Ice Vol Total (m3)	Ice Vol. LOB (m3)	Ice Vol. Chan (m3)
Ice Jam Section	42000	PF#1	180.12	0.00	0.50	0.00	495957.40		495957.40
Ice Jam Section	41590	PF#1	180.05	0.00	0.50	0.00	485681.70		485681.70
Ice Jam Section	41190	PF#1	179.94	0.00	1.37	0.00	468009.70		468009.70
Ice Jam Section	40690	PF#1	179.82	0.00	0.79	0.00	441627.80		441627.80
Ice Jam Section	40180	PF#1	179.76	0.00	0.75	0.00	418376.00		418376.00
Ice Jam Section	39190	PF#1	179.66	0.00	0.55	0.00	379543.90		379543.90
Ice Jam Section	38560	PF#1	179.63	0.00	0.60	0.00	362018.40		362018.40
Ice Jam Section	37530	PF#1	179.53	0.00	0.87	0.00	326640.30		326640.30
Ice Jam Section	36670	PF#1	179.38	0.00	0.93	0.00	296984.90		296984.90
Ice Jam Section	36320	PF#1	179.31	0.00	0.82	0.00	281518.80		281518.80
Ice Jam Section	35820	PF#1	179.26	0.00	0.76	0.00	259907.70		259907.70
Ice Jam Section	35030	PF#1	179.16	0.00	1.13	0.00	216662.10		216662.10
Ice Jam Section	34320	PF#1	178.90	0.00	1.36	0.00	170805.70		170805.70
Ice Jam Section	33790	PF#1	178.65	0.00	1.31	0.00	138799.90		138799.90
Ice Jam Section	33490	PF#1	178.54	0.00	1.35	0.00	119799.10		119799.10

Figure 8 32 Ice Cover Table

Viewing Data Contained in an HEC-DSS File

The HEC-RAS software can write and read data to and from the HEC-DSS (Data Storage System) database. The steady flow portion of HEC-RAS can read flow data to be used as profile information, and can write water surface profiles, storage-outflow information, and rating curves. The unsteady flow portion of HEC-RAS can read complete hydrographs (stage and flow), profiles, rating curves, as well as gate settings to be used during a simulation. Observed data contained in a DSS file can be attached to specific cross sections for comparison with computed results at those locations, and computed profiles and hydrographs are written to the DSS file during an unsteady flow simulation.

Because a DSS file can be used to share information between different HEC programs (such as HEC-HMS and HEC-RAS), it is often necessary to be able to view data contained within a DSS file. A DSS viewer is available from within the HEC-RAS software. To bring up the DSS viewer select **DSS Data** from the **View** menu of the main HEC-RAS window (Or press the button labeled **DSS** on the main window). When this option is selected a window will appear as shown in Figure 8-33.

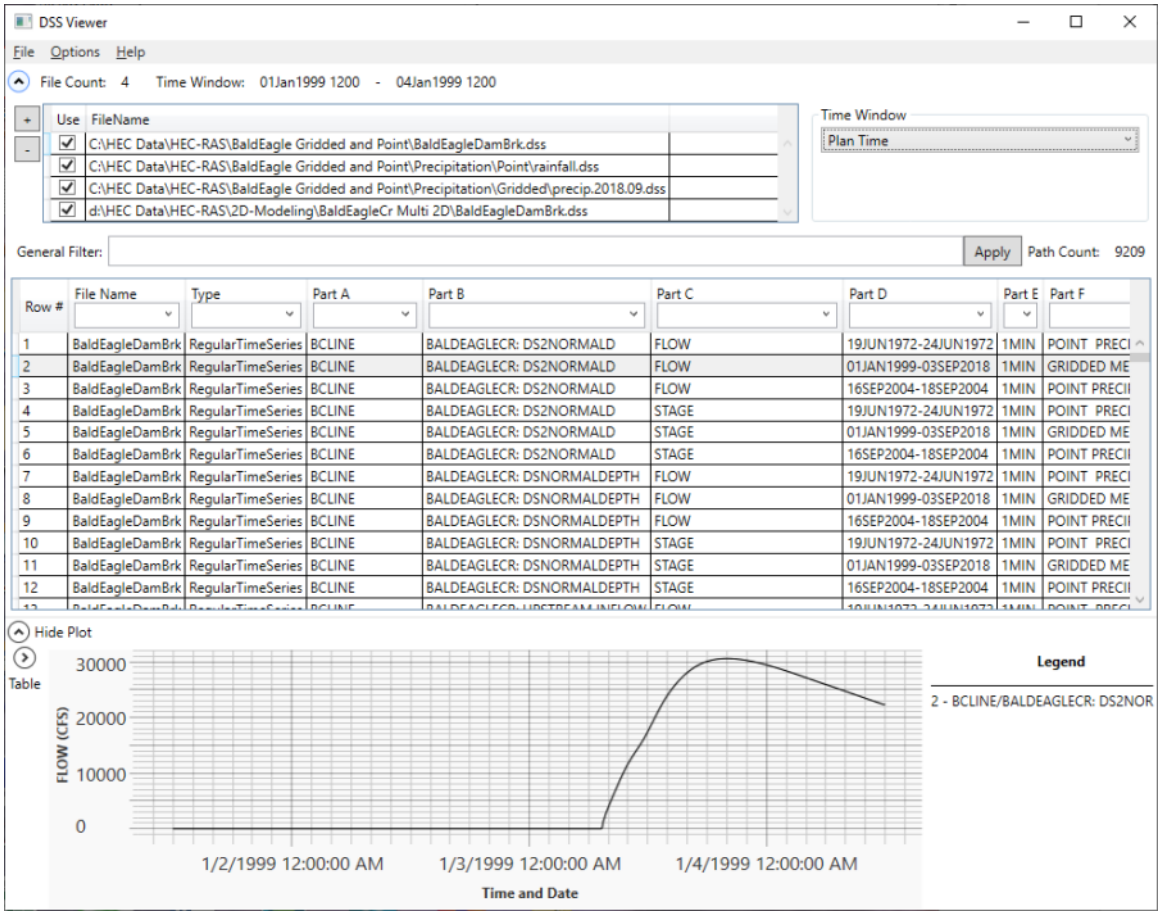


Figure 8 33 HEC-DSS Viewer Window

As shown in Figure 8-33, all of the DSS files associated with the current Plan will be loaded and are shown at the top of the window. Users can turn specific DSS files on and off. Additional DSS files not associated with the project can also be loaded by pressing the plus button to the left of the table. When a DSS file(s) is selected, a list of the available pathnames within that file will show up in the table. Each DSS pathname represents a record of data stored within the DSS file(s). The user can select one or more DSS pathnames to be plotted and/or tabulated. A pathname is selected by using the left mouse button to select a row(s) in the table. Users can use the Control Key plus left mouse click to select additional pathnames. Additionally, the Shift key can also be used to select a range of pathnames. Once a Pathname or Pathnames are selected, the data will be plotted in the Plot window below the Pathname table as shown in Figure 8-33.

There is also an option to the left of the plot to bring up a table of the data shown within the plot. If the user hits the right arrow above the Table option, then a table will appear as shown in Figure 8-34.

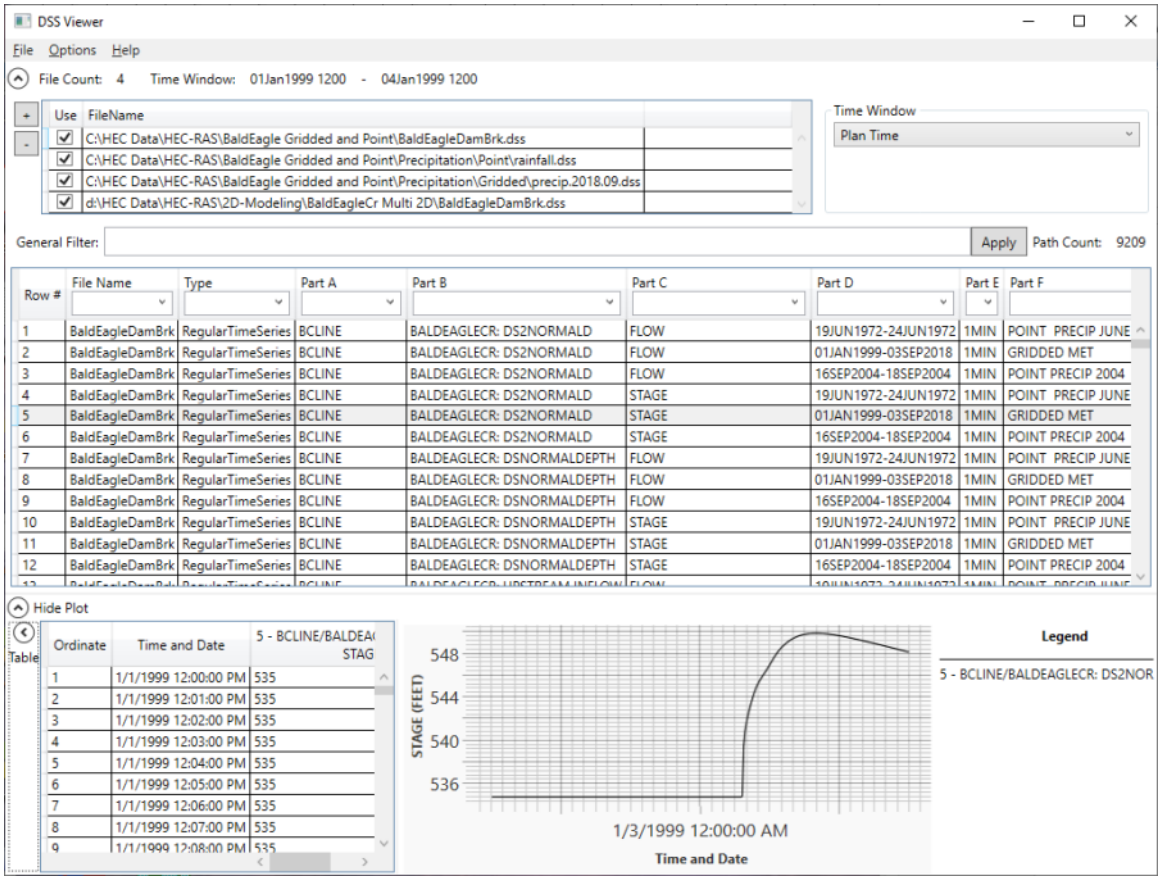


Figure 8 34 Example Plot from the HEC-RAS DSS Viewer

Data can be viewed from one or more DSS files simultaneously. The user simple selects the check box for the desired DSS files and picks the desired pathnames. The data will automatically be plotted and there is the option to tabulate the data.

The user has options available for setting the Time Window for plotting the data. By default, the time window will be set to the currently opened Plans time window. In the upper right corner of the plot is a Time Window drop down that allows the user to select from: Plan Time; All Available Data; and User Specified.

Users also have an option to control the number of decimal places displayed for the data in the tables. This can be selected from the Options menu at the top.

Exporting Results to HEC-DSS

The HEC-RAS software has the ability to export a limited set of results to a HEC-DSS file for both steady and unsteady flow simulations. When performing an Unsteady flow simulation, the program automatically writes stage and flow hydrographs to the DSS file, but only for the user-selected hydrograph output locations. Water surface profiles are also automatically written to the DSS file. The profiles are written for the user selected detailed output interval, as well as the overall maximum water surface profile (profile of the maximum stage at every cross section).

Once a steady flow or unsteady flow simulation is performed, the user can write the following information to a DSS file: water surface profiles; computed rating curves; and storage-outflow information. To export computed results to a DSS file the user selects **Export To HEC-DSS** from the **File** menu of the main HEC-RAS window. When this option is selected a window will appear as shown in Figure 8-35.

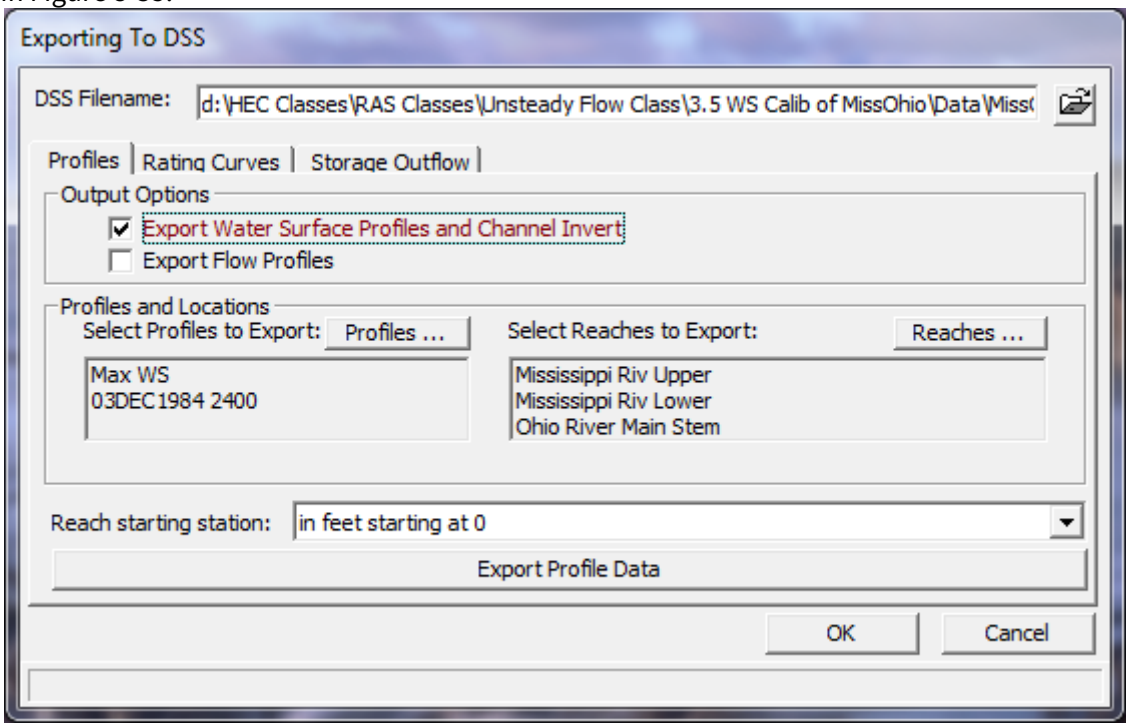


Figure 8 35. Export Computed Results to DSS Window

As shown in Figure 8-35, there are three tabs on the window; one for profiles, rating curves, and storage outflow. To export computed water surface profiles, select the **Profiles** tab from the window. Select the type of profiles that you want to export (water surface elevations or flow). Next select the specific profiles to be exported, as well as the reaches that you want to have profiles for. Select how you want the stationing to be labeled. This is accomplished by selecting one of the options under the field labeled **Reach Starting Station**. The user can have the river stationing labeled in feet or miles, and have it start at zero or whatever the magnitude is of the most downstream cross section. The final option is to press the **Export Profile Data** button, and the data will then be written to the DSS file.

To write computed rating curves to the DSS file select the **Rating Curve** tab. When the rating curve tab is selected, the window will change to what is shown in Figure 8-36.

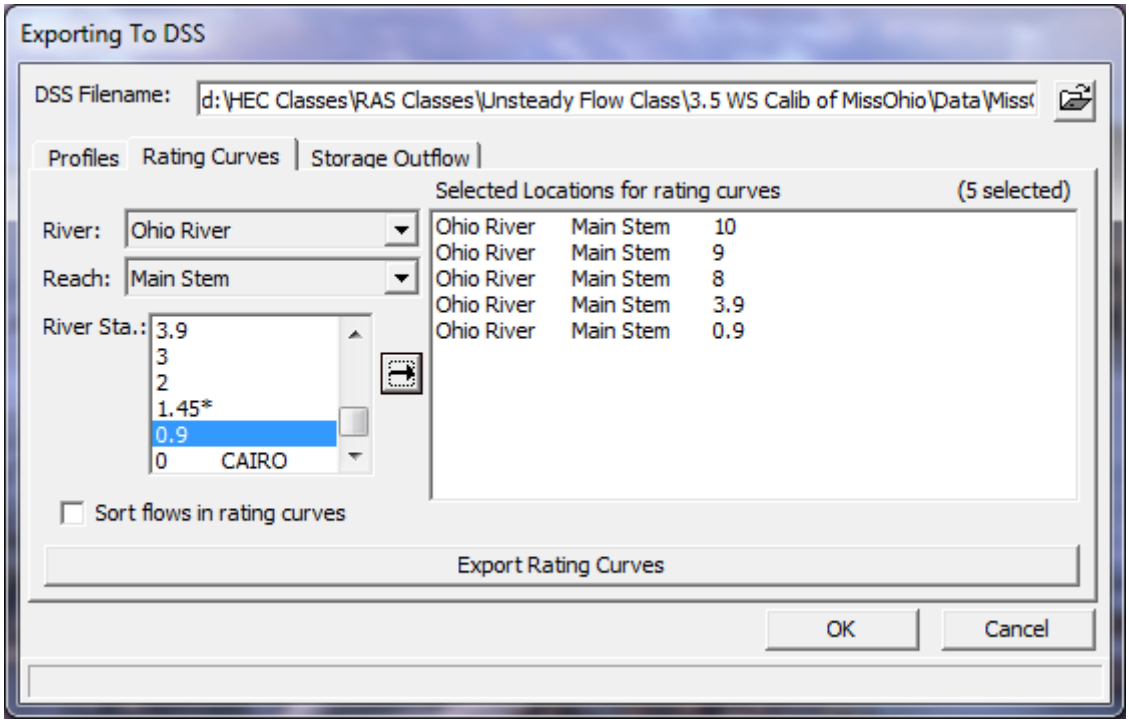


Figure 8 36 Exporting Computed Rating Curves to HEC-DSS

As shown in Figure 8-36, to export a computed rating curve to DSS, select the river, reach, and river stations that you want to have exported to the DSS file. Then simply press the **Export Rating Curves** button to have the program write the data to the DSS file. If your profiles are not in the order from lowest flow to highest flow, turn on the option that says **Sort flows in rating curve**. This option will ensure that the curve is written in the order of increasing flow rate.

The HEC-RAS program computes cumulative storage volumes for each of the water surface profiles. This information can be used for hydrologic routing in a hydrology model such as HEC-HMS or HEC-1. The HEC-RAS program allows the user to write out storage versus volume information to a DSS file. To use this option, select the **Storage Outflow** tab from the Export to DSS window. When this option is selected a window will appear as shown in Figure 8-37.

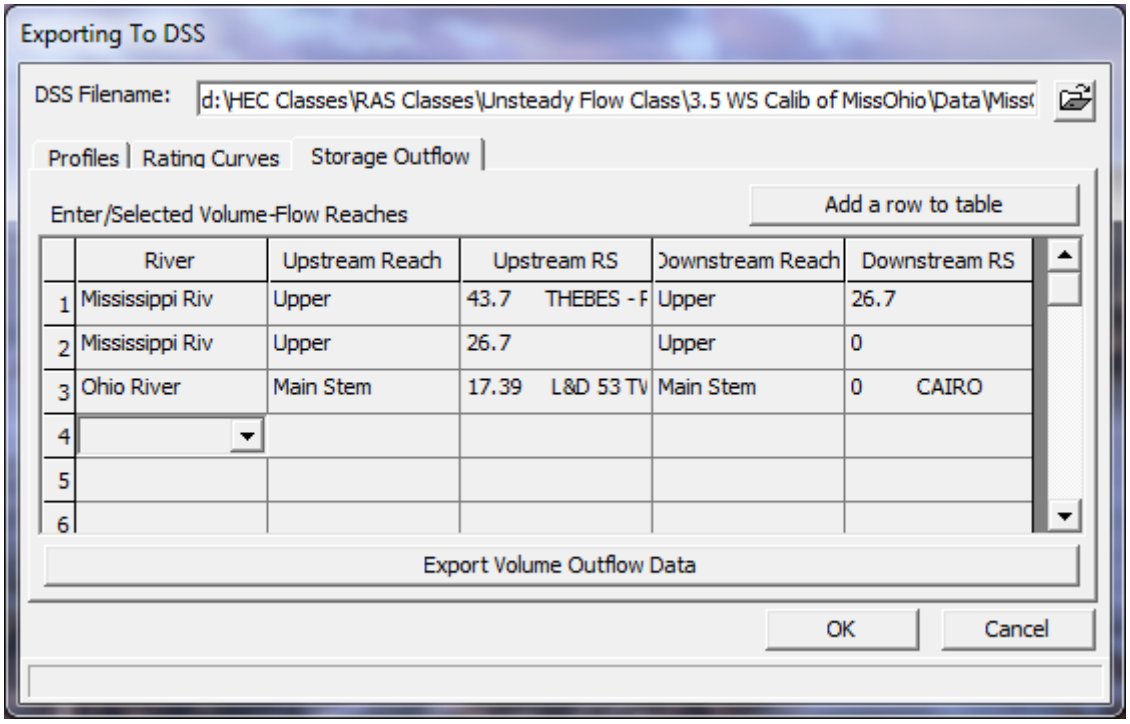


Figure 8 37 Exporting Storage-Outflow Information to HEC-DSS

As shown in Figure 8-37, the user selects the River, upstream reach, upstream river station, downstream reach, and downstream river station to completely define a routing reach in which they want to have storage-outflow information written to the DSS file. This can be done for as many reaches as you want within the model. After all of the reaches are defined, simply press the button labeled **Export Volume Outflow Data** to write the information to the DSS file.

Inundation Mapping with HEC-RAS Mapper

If you have a model that is georeferenced, and you have terrain data to cover the model extents, you can use HEC-RAS Mapper to perform inundation mapping for either steady flow or unsteady flow models. An example of an inundation map developed with HEC-RAS Mapper is shown below in Figure 8-38. For details on how to use HEC-RAS Mapper, please see the HEC-RAS Mapper User's Manual.

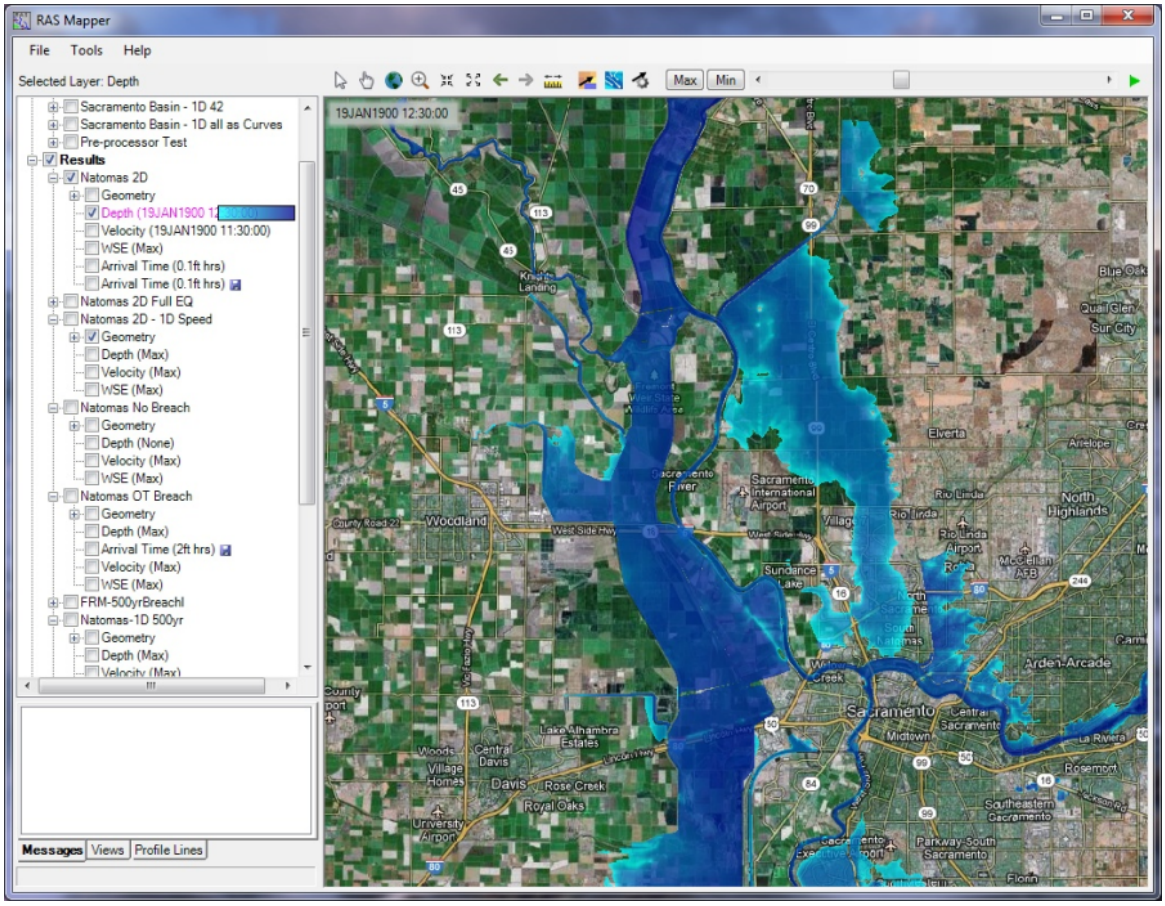


Figure 8 38. Example Inundation map from HEC-RAS Mapper.