

## CHAPTER 9

# Viewing Results

After the model has finished the steady flow profile computations or the unsteady flow post-processor, you 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, profiles, rating curves, hydrographs, X-Y-Z perspective plots, detailed tabular output at a single cross section, and limited tabular output at many cross sections. Users also have the ability to develop their own output tables.

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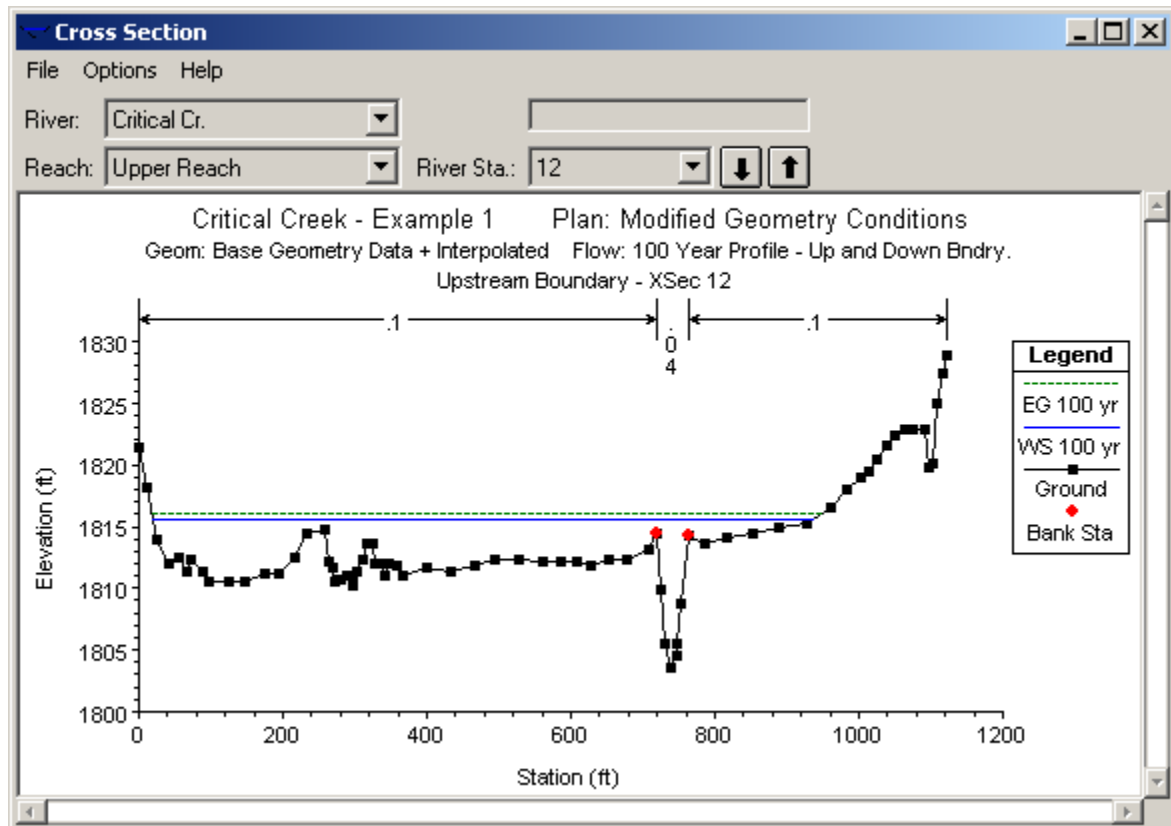
- Cross Sections, Profiles, and Rating Curves
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- Viewing Ice Information
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## Cross Sections, Profiles, and Rating Curves

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, 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 9.1. 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 9.1 Example Cross Section Plot

An example profile plot is shown in Figure 9.2. 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 the plot.

An example rating curve plot is shown in Figure 9.3. 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.

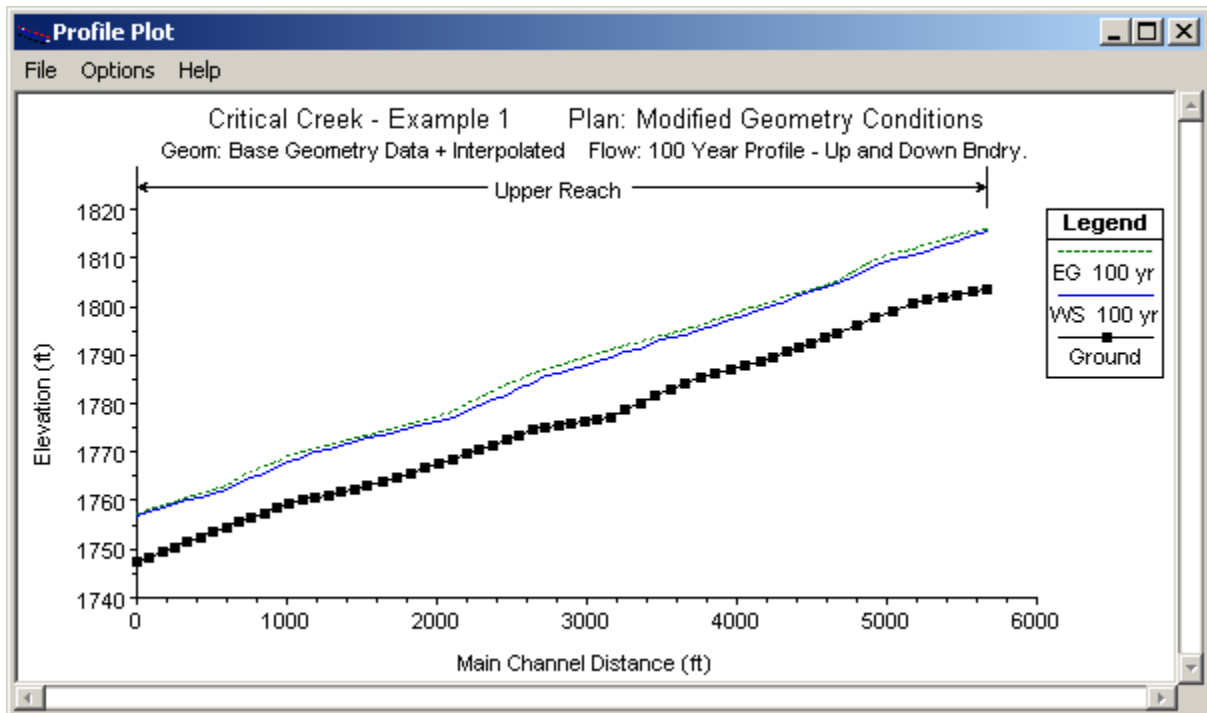


Figure 9.2 Example Profile Plot

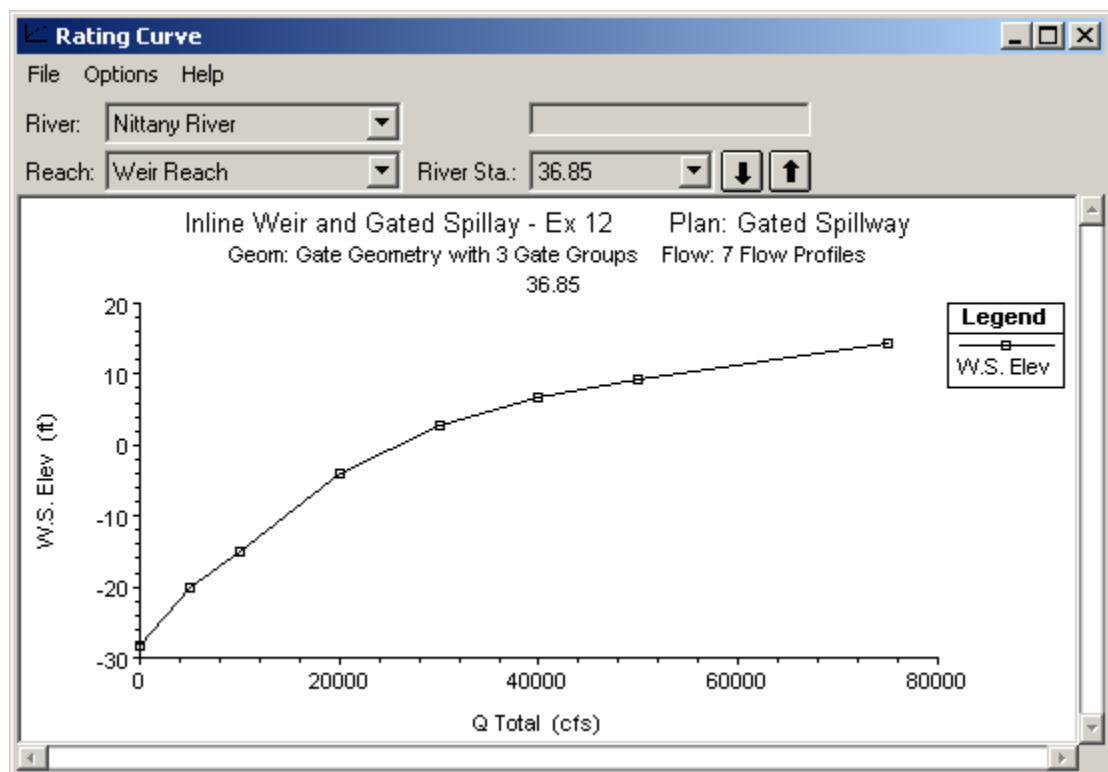


Figure 9.3 Example Rating Curve Plot

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

**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.

**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.

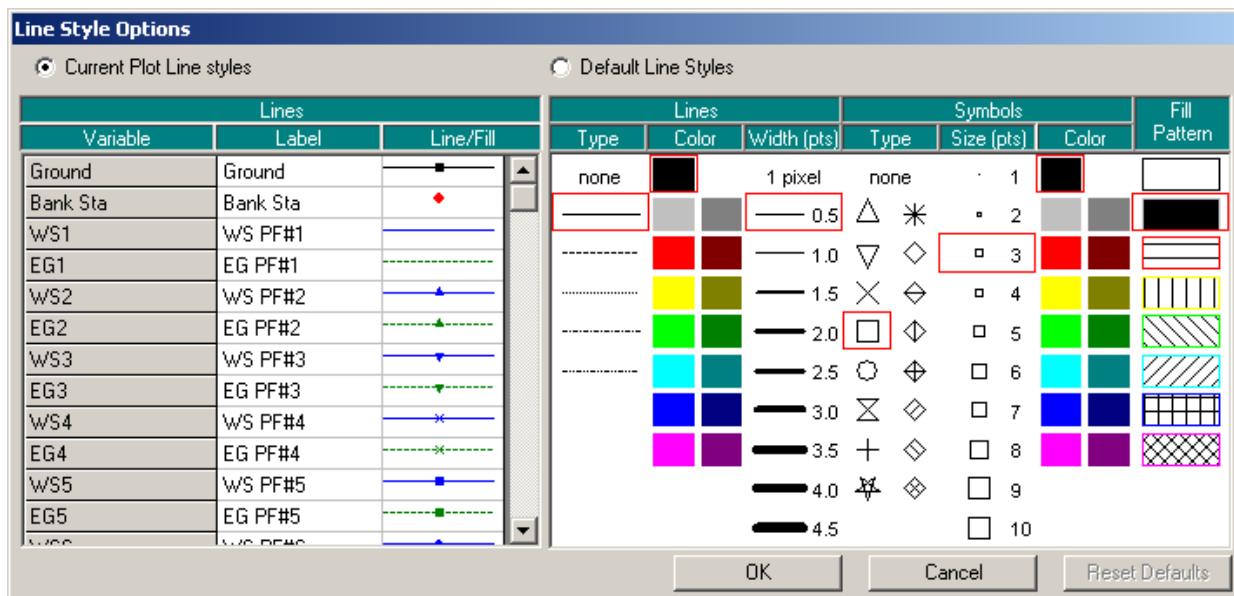
**Profiles.** This option allows the user to select which profiles they would like to have displayed on the graphic. This option does not apply to the rating curve, it automatically plots all of the profiles.

**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 what ever 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, reach labels, and left and right main channel bank stations. The cross section plot is limited to the following four variables: water surface, energy, critical water surface, and Manning's n values.

**Labels.** This option allows the user to change the labels at the top of the plot. 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, 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, symbol colors, fill patterns, and the line labels. When the user selects this option, a window will appear as shown in Figure 9.4.



**Figure 9.4 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 ticks 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 zoom window. The zoom window appears whenever the user has selected the Zoom In option.

**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. Two types of land marks can be displayed, cross section river stations or cross section descriptions. In addition to these two variables, once one of the two are displayed, the user can select to edit the land mark labels.

## 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 9.5) 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 9.6.

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.

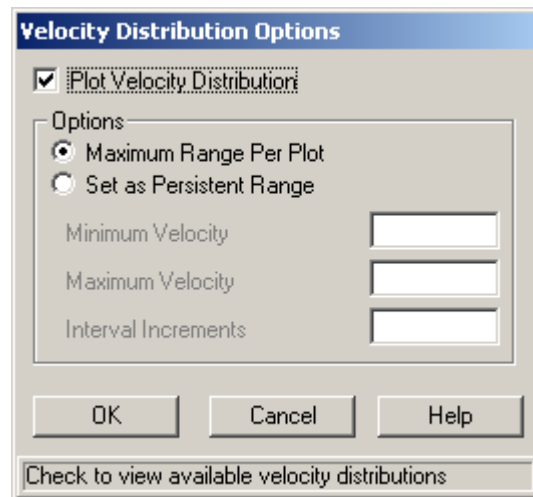


Figure 9.5 Velocity Distribution Options

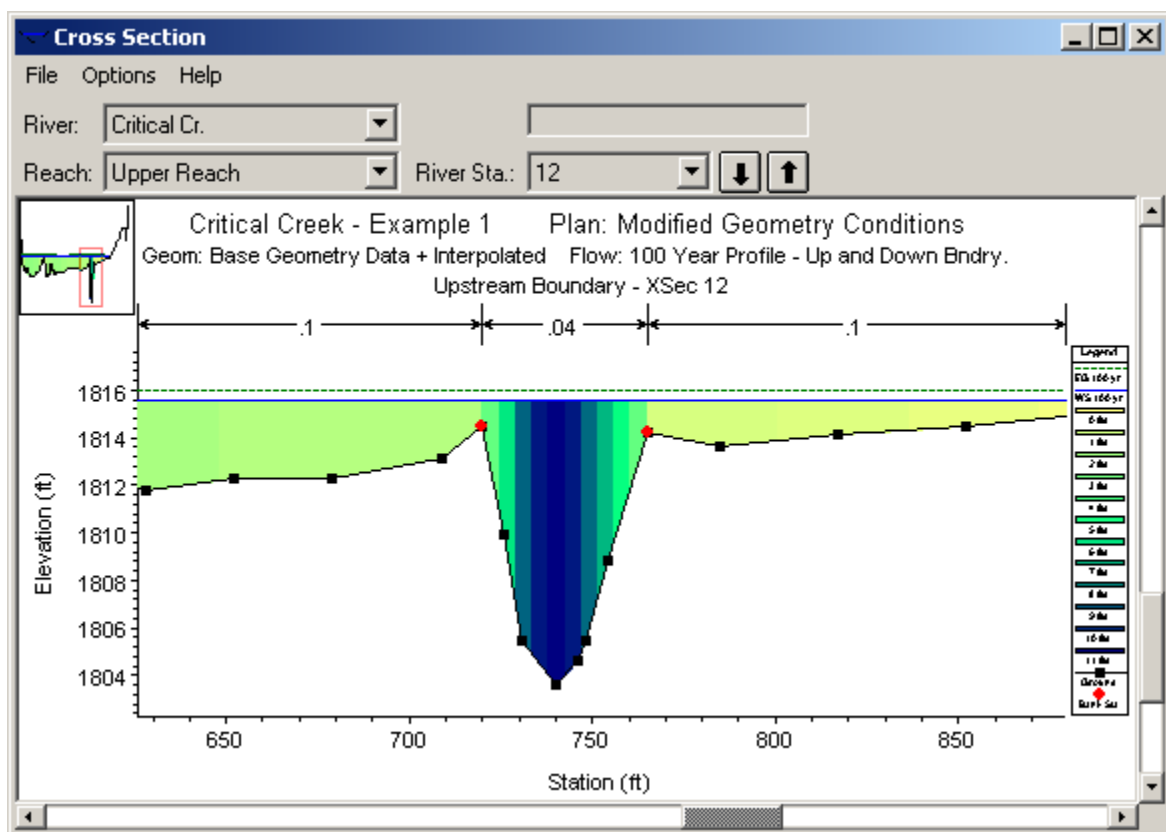


Figure 9.6 Velocity Distribution Plot

## Plotting Other Variables in Profile

To plot variables other than the water surface in profile, select **General Profile** 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 **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. An example of plotting other variables in profile is shown in Figure 9.7.

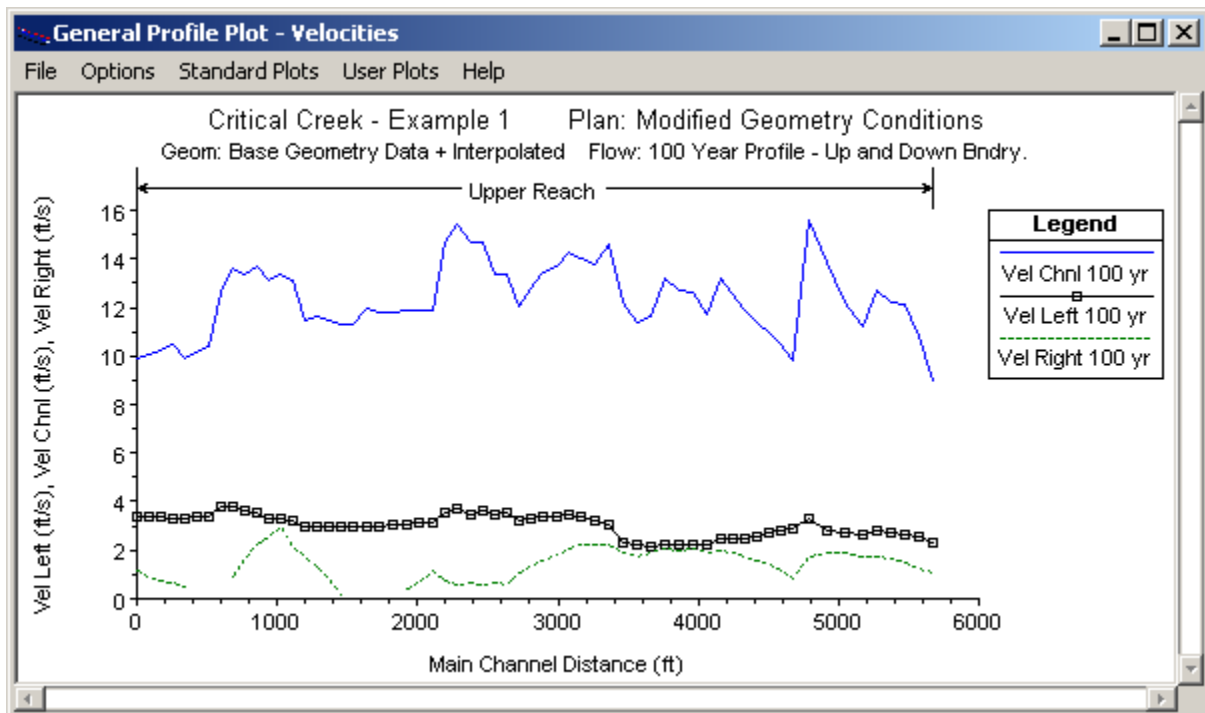


Figure 9.7 General Profile Plot of Variables Versus Distance

## 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 9.8. 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 Variable** 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.

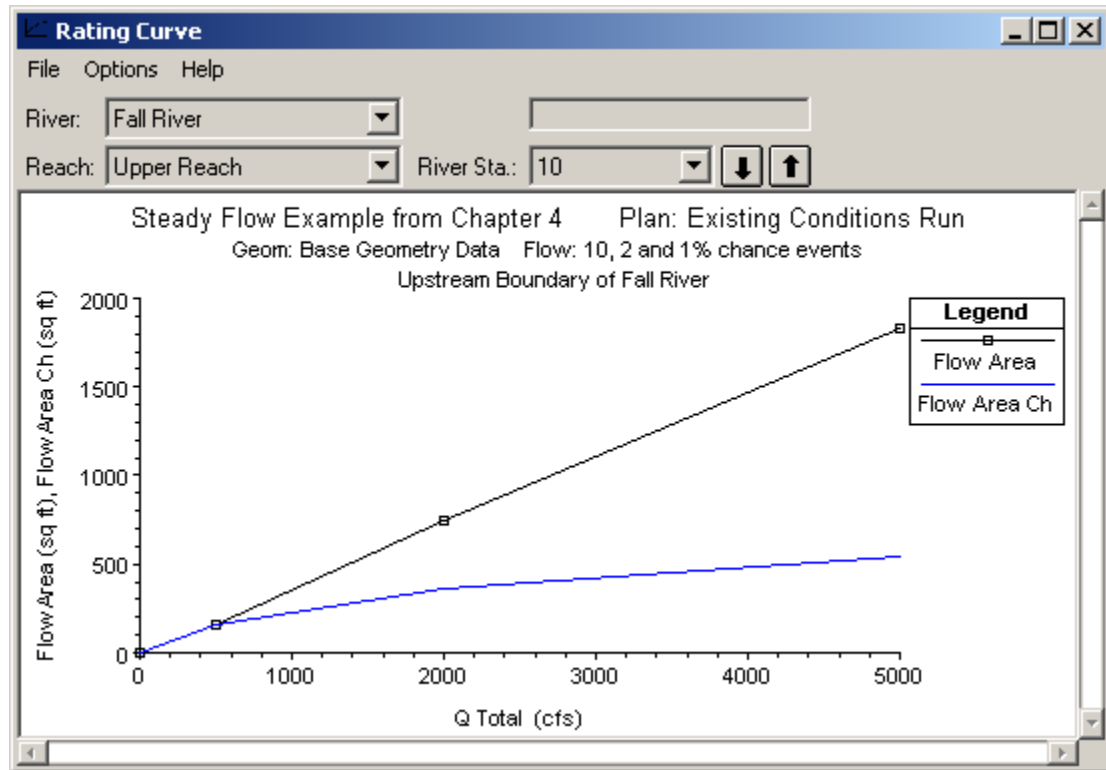


Figure 9.8 Example of Plotting One Variable Against Other Variables

## 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 Current** (or just **Print** on the profile plot) 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 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.

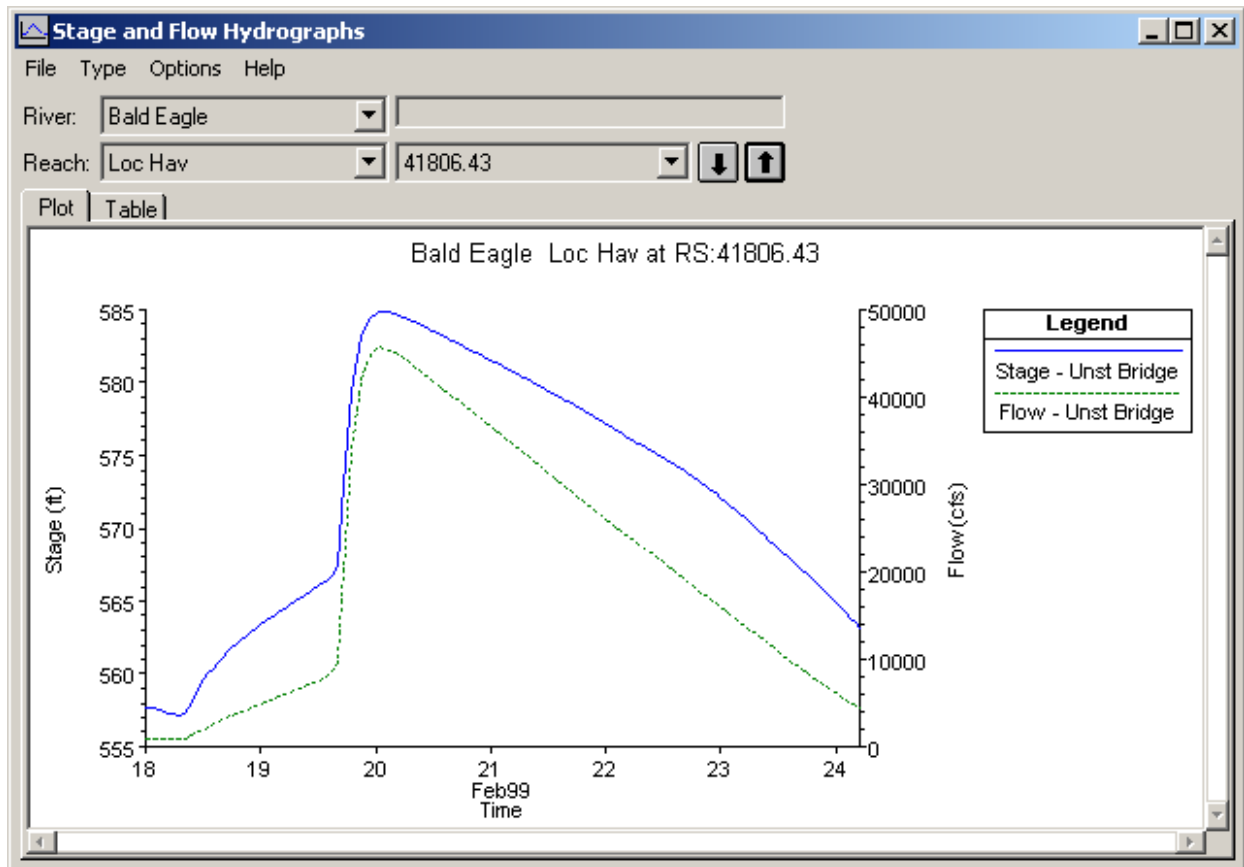
## Stage and Flow Hydrographs

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 9.9. 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 two tabs on the plot. One says **Plot** and the other says **Table**. By default the window comes up in a plotting mode. If the user selects the Table tab, then a table of the hydrograph results will appear.

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 Weirs; Lateral Weirs; Storage Areas; and Hydraulic Connections.

There are several options available for viewing this graphic. These options are the same as described previously for the cross section, profile, and rating

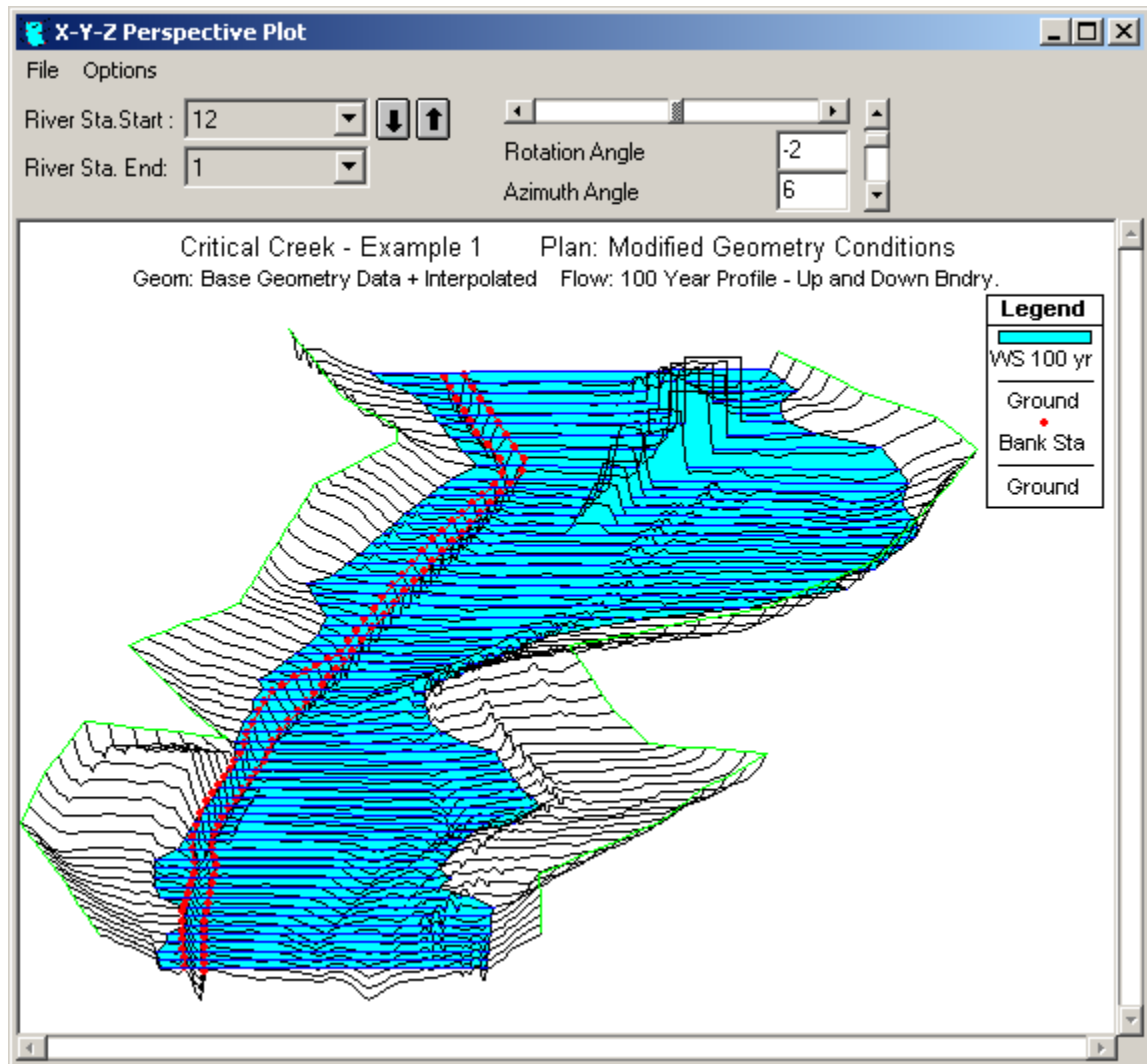
curve plots. Additionally, this graphic can be sent to the windows clipboard, or the printer, as described under the previous plots.



**Figure 9.9 Stage and Flow Hydrograph Plot**

## X-Y-Z Perspective Plots

Another type of graphic available to the user is the X-Y-Z Perspective Plot. The X-Y-Z plot is a 3-dimensional plot of multiple cross sections within a reach. An example X-Y-Z Perspective plot is shown in Figure 9.10.



**Figure 9.9 Example X-Y-Z Perspective Plot**

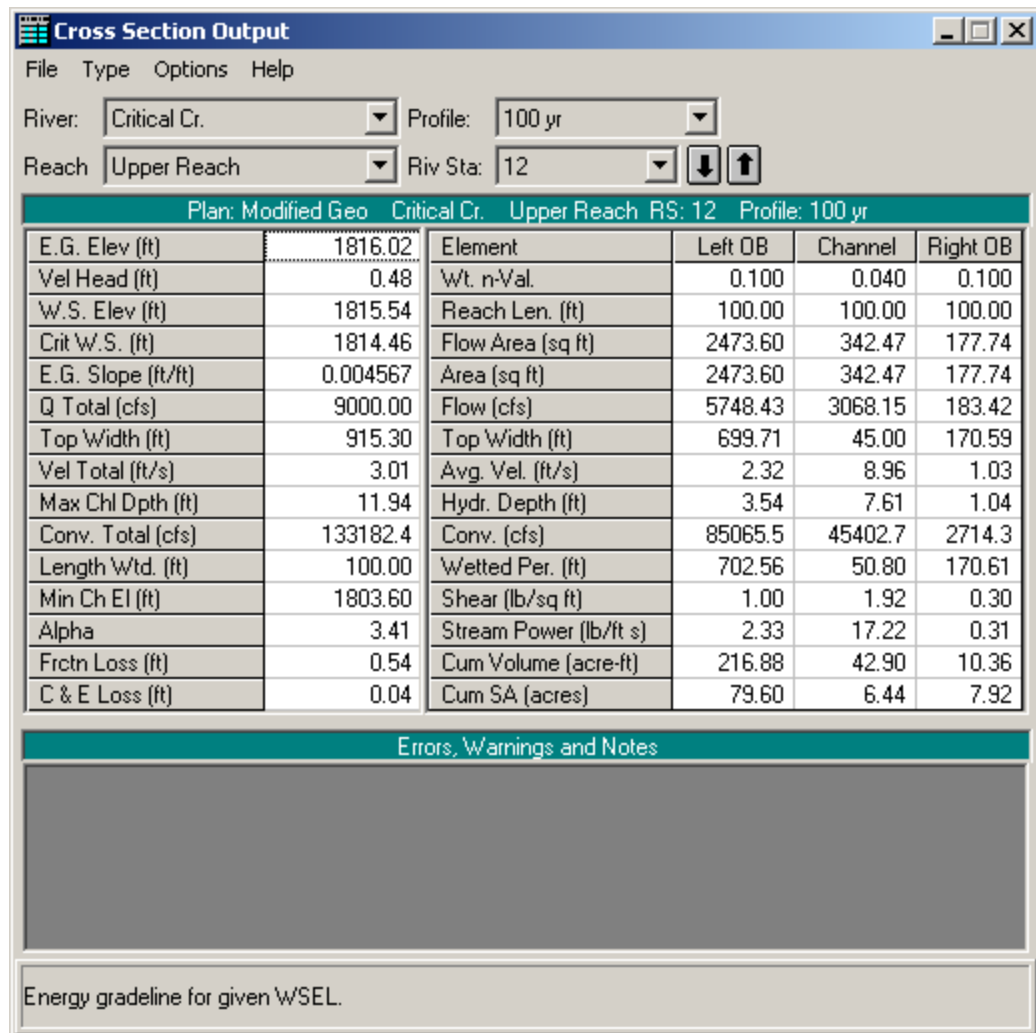
The user has the ability to select which reaches to be plotted, the range of the river stations, and which plans and profiles to be displayed. The plot can be rotated left and right, as well as up and down, in order to get different perspectives of the river system. Zoom in and zoom out features are available, as well as the ability to move around with scroll bars. The user can choose to overlay the water surface or not. The user has the ability to overlay a grid on the plot, as well as a legend and labels at the top. The graphic can be sent to the printer/plotter or the clipboard just like any other plot. Sending the graphic to the printer or clipboard is accomplished by selecting the **Print** or **Clipboard** options from the **File** menu. The user also has the option to reverse the order in which the water surface profiles are displayed. This option allows the user to display the higher water surfaces first, such that the lower profiles are not covered up.

## 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 Table** from the **View** menu of the main HEC-RAS window. An example detailed output table is shown in Figure 9.10.



The screenshot shows the 'Cross Section Output' window in HEC-RAS. The window has a menu bar with 'File', 'Type', 'Options', and 'Help'. Below the menu bar are input fields for 'River' (set to 'Critical Cr.'), 'Profile' (set to '100 yr'), 'Reach' (set to 'Upper Reach'), and 'Riv Sta' (set to '12'). There are also up and down arrow buttons next to the 'Riv Sta' field. The main area of the window displays a table of hydraulic data for the specified cross section. The table has two main sections: a left column for various hydraulic parameters and their values, and a right section with multiple columns for different components of the cross section (Left OB, Channel, Right OB). Below the table is a section for 'Errors, Warnings and Notes' which is currently empty. At the bottom of the window, there is a text box that says 'Energy gradeline for given WSEL.'

Plan: Modified Geo Critical Cr. Upper Reach RS: 12 Profile: 100 yr					
E.G. Elev (ft)	1816.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.	0.100	0.040	0.100
W.S. Elev (ft)	1815.54	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1814.46	Flow Area (sq ft)	2473.60	342.47	177.74
E.G. Slope (ft/ft)	0.004567	Area (sq ft)	2473.60	342.47	177.74
Q Total (cfs)	9000.00	Flow (cfs)	5748.43	3068.15	183.42
Top Width (ft)	915.30	Top Width (ft)	699.71	45.00	170.59
Vel Total (ft/s)	3.01	Avg. Vel. (ft/s)	2.32	8.96	1.03
Max Chl Dpth (ft)	11.94	Hydr. Depth (ft)	3.54	7.61	1.04
Conv. Total (cfs)	133182.4	Conv. (cfs)	85065.5	45402.7	2714.3
Length Wtd. (ft)	100.00	Wetted Per. (ft)	702.56	50.80	170.61
Min Ch El (ft)	1803.60	Shear (lb/sq ft)	1.00	1.92	0.30
Alpha	3.41	Stream Power (lb/ft s)	2.33	17.22	0.31
Frctn Loss (ft)	0.54	Cum Volume (acre-ft)	216.88	42.90	10.36
C & E Loss (ft)	0.04	Cum SA (acres)	79.60	6.44	7.92

Errors, Warnings and Notes

Energy gradeline for given WSEL.

**Figure 9.10 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.

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 9.12.

Plan: plan2 Fall River Upper Reach RS: 10.1 Profile: 50 yr Culvert ID: Circular Culv: Circular			
Culv Q (cfs)	182.18	Culv Ful Lngh (ft)	100.00
# Barrels	1	Culv Vel US (ft/s)	3.62
Q Barrel (cfs)	182.18	Culv Vel DS (ft/s)	3.62
E.G. US. (ft)	81.78	Culv Inv El Up (ft)	70.50
W.S. US. (ft)	81.66	Culv Inv El Dn (ft)	70.25
E.G. DS (ft)	81.56	Culv Frctn Ls (ft)	0.04
W.S. DS (ft)	81.43	Culv Ext Lss (ft)	0.07
Delta EG (ft)	0.21	Culv Ent Lss (ft)	0.10
Delta WS (ft)	0.23	Q Weir (cfs)	961.94
E.G. IC (ft)	75.26	Weir Sta Lft (ft)	118.32
E.G. OC (ft)	81.77	Weir Sta Rgt (ft)	350.68
Culvert Control	Outlet	Weir Submerg	0.79
Culv WS Inlet (ft)	78.50	Weir Max Depth (ft)	1.78
Culv WS Outlet (ft)	78.25	Weir Avg Depth (ft)	1.62
Culv Nml Depth (ft)		W'r Flw Area (sq ft)	376.62
Culv Crit Depth (ft)	3.37	Min Weir El (ft)	80.01

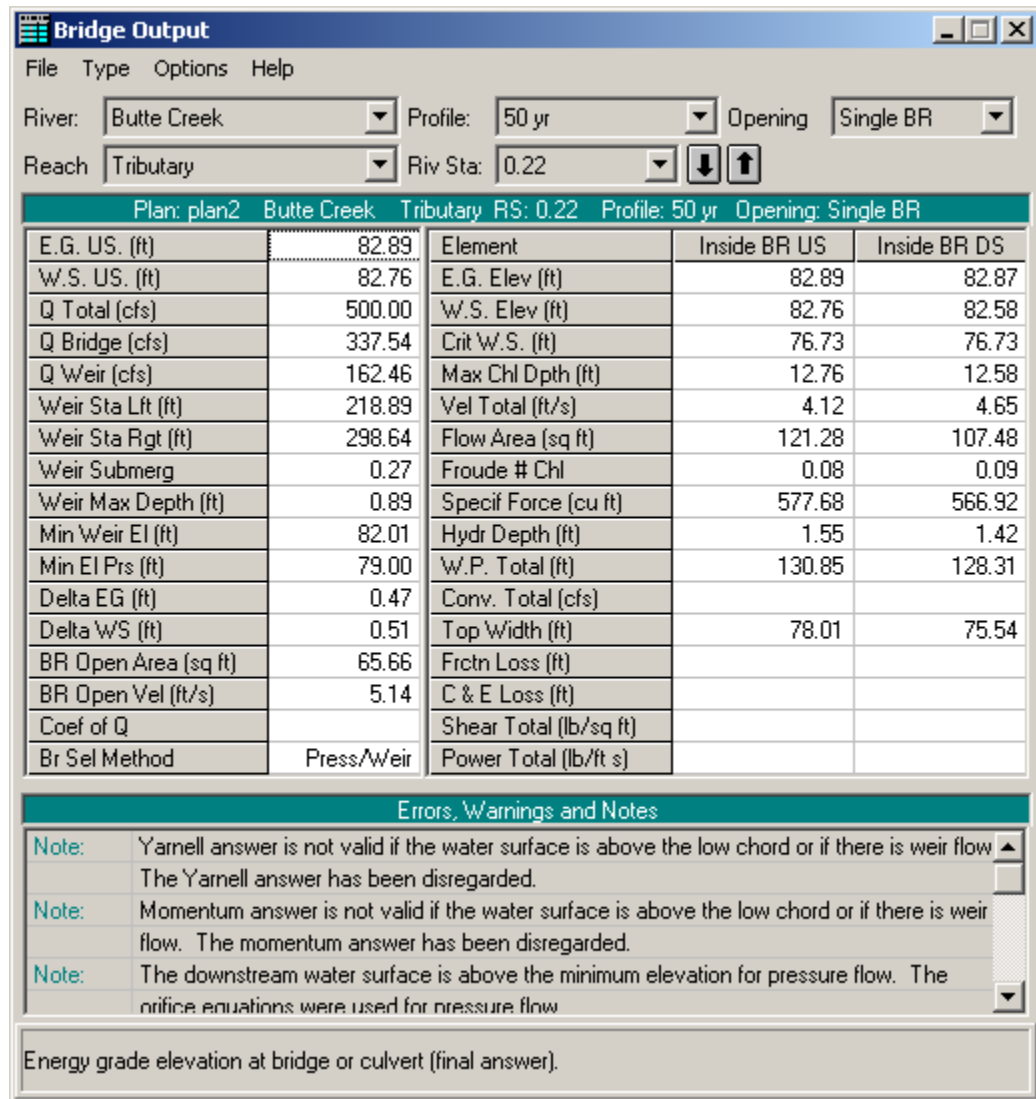
  

Errors, Warnings and Notes	
Flow through all barrels in a culvert.	

**Figure 9.12 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 9.13.



**Figure 9.13 Example Bridge Type of Cross Section Table**

**Conveyance.** The conveyance type of table is the same as a normal cross section table. The only difference is that a conveyance type of table is used to view the hydraulic results of a portion of a multiple opening river crossing. That is, if the user has defined an open channel flow type of opening (i.e., conveyance area), at a multiple opening crossing, then this table can be used to view the hydraulic results for that specific opening.

**Inline Weir/Spillway.** The Inline Weir/Spillway 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 Weir/Spillway.** The Lateral Weir/Spillway type of table can be used for viewing detailed output from a lateral weir/spillway structure.

**Flow Distribution.** 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 9.14.

Flow Distribution Output

File Type Options Help

River: Critical Cr. Profile: 100 yr

Reach: Upper Reach Riv Sta: 12

Plan: Modified Geo Critical Cr. Upper Reach RS: 12 Profile: 100 yr

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
0.00	72.00	298.90	150.01	52.17	3.32	2.90	1.99
72.00	144.00	912.27	333.48	72.08	10.14	4.63	2.74
144.00	216.00	804.58	309.20	72.05	8.94	4.29	2.60
216.00	288.00	326.78	181.00	72.97	3.63	2.51	1.81
288.00	360.00	585.69	257.11	73.14	6.51	3.57	2.28
360.00	432.00	755.81	297.79	72.03	8.40	4.14	2.54
432.00	504.00	603.51	260.15	72.01	6.71	3.61	2.32
504.00	576.00	498.87	232.05	72.00	5.54	3.22	2.15
576.00	648.00	557.22	247.99	72.01	6.19	3.44	2.25
648.00	720.00	404.78	204.82	72.10	4.50	2.84	1.98
LB 720.00	724.50	46.34	12.43	5.67	0.51	2.76	3.73
724.50	729.00	179.78	28.47	5.89	2.00	6.33	6.31
729.00	733.50	403.52	44.07	5.22	4.48	9.79	9.16

Errors, Warnings and Notes

Flow in subsection defined by left and right stations

**Figure 9.14** Example of the Flow Distribution Type of Table

**Hydraulic Connections.** The Hydraulic Connections table type can be used to view detailed output for any user entered hydraulic connections between storage areas and river reaches.

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

Under the **Options** menu of the cross section table window, the user has the following options:

**Plans.** This option allows the user to select which plan, and therefore output file, they would like to view.

**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 9.15.

Reach	River Sta	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	9000.00	1803.60	1815.54	1814.46	1816.02	0.004567	8.96	2993.81	915.30	0.57
Upper Reach	11.8*	9000.00	1803.02	1814.58	1814.14	1815.44	0.006443	10.78	2403.45	817.51	0.69
Upper Reach	11.6*	9000.00	1802.44	1813.40	1813.40	1814.67	0.008386	12.14	2043.65	764.50	0.80
Upper Reach	11.4*	9000.00	1801.86	1812.43	1812.47	1813.82	0.008533	12.25	1894.08	698.93	0.81
Upper Reach	11.2*	9000.00	1801.28	1811.29	1811.46	1812.89	0.009621	12.73	1701.14	646.20	0.86
Upper Reach	11	9000.00	1800.70	1810.68	1810.42	1811.90	0.007043	11.20	1888.44	651.48	0.75
Upper Reach	10.75*	9000.00	1799.13	1809.51	1809.51	1810.91	0.008530	12.22	1854.70	699.37	0.82
Upper Reach	10.5*	9000.00	1797.55	1807.93	1808.34	1809.61	0.012265	13.89	1866.64	830.45	0.96
Upper Reach	10.25*	9000.00	1795.97	1805.90	1806.41	1807.69	0.019512	15.59	1795.08	857.69	1.16

Total flow in cross section.

Figure 9.15 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.** This 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 Weir.** 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 Weir Only.** 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 Weir/Spillway.** 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.

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 what ever they wish.

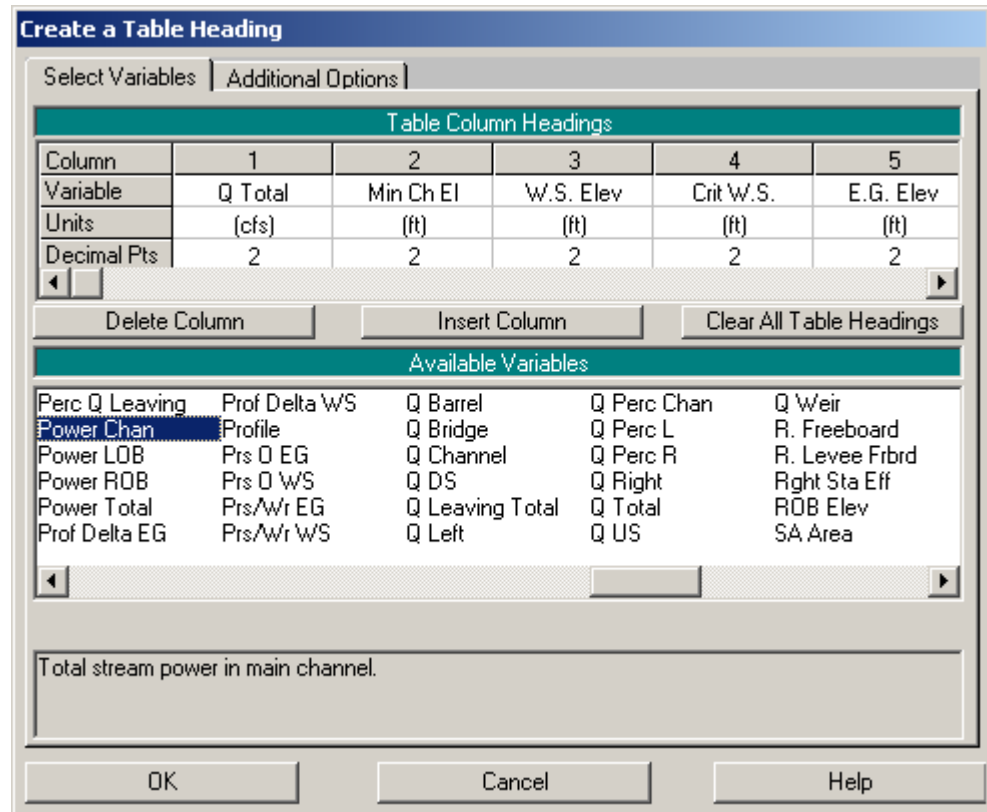
User's also have the ability to view profile output tables in either English or metric units. This is available from the **Options** menu on the profile tables. It does not matter whether the input data is in English or metric, the output can be viewed in either system.

## 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 9.16. 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. Below the list of variables is a message box that is used to display the definition of the selected variable.

To get a definition of a particular variable, simply click the left mouse button once while the mouse pointer is over the desired variable. The description of the variable will show up at the bottom of the window. 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 9.16 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 9.17.

In Figure 9.17, 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 10.0 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 pop up menus are available for bridges; culverts; junctions; and reach data.

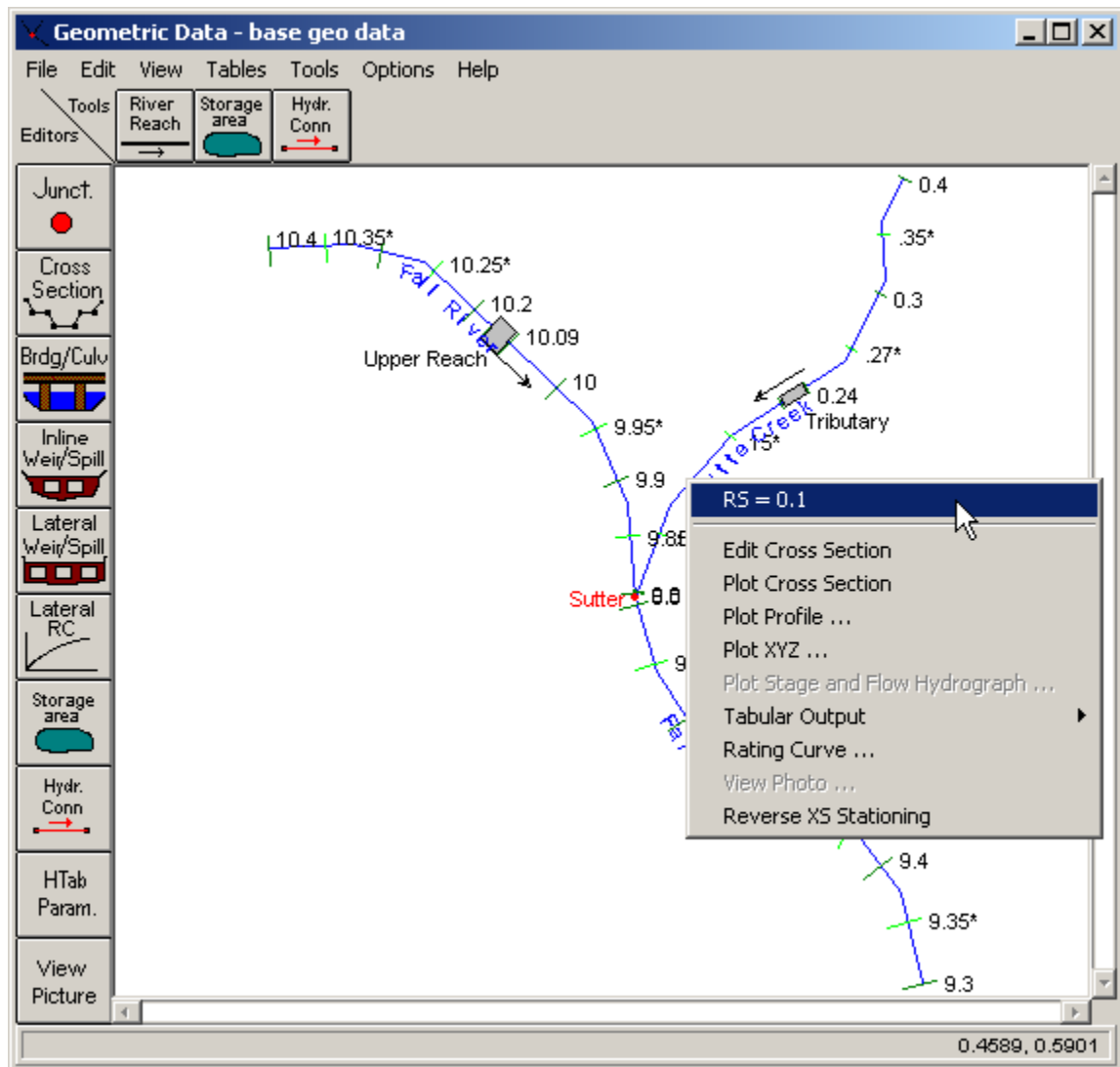


Figure 9.17 Geometric Data Window With Pop up Menu

## Viewing Ice Information

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

### Viewing Graphical Ice Information on the Screen

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 9.18 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.

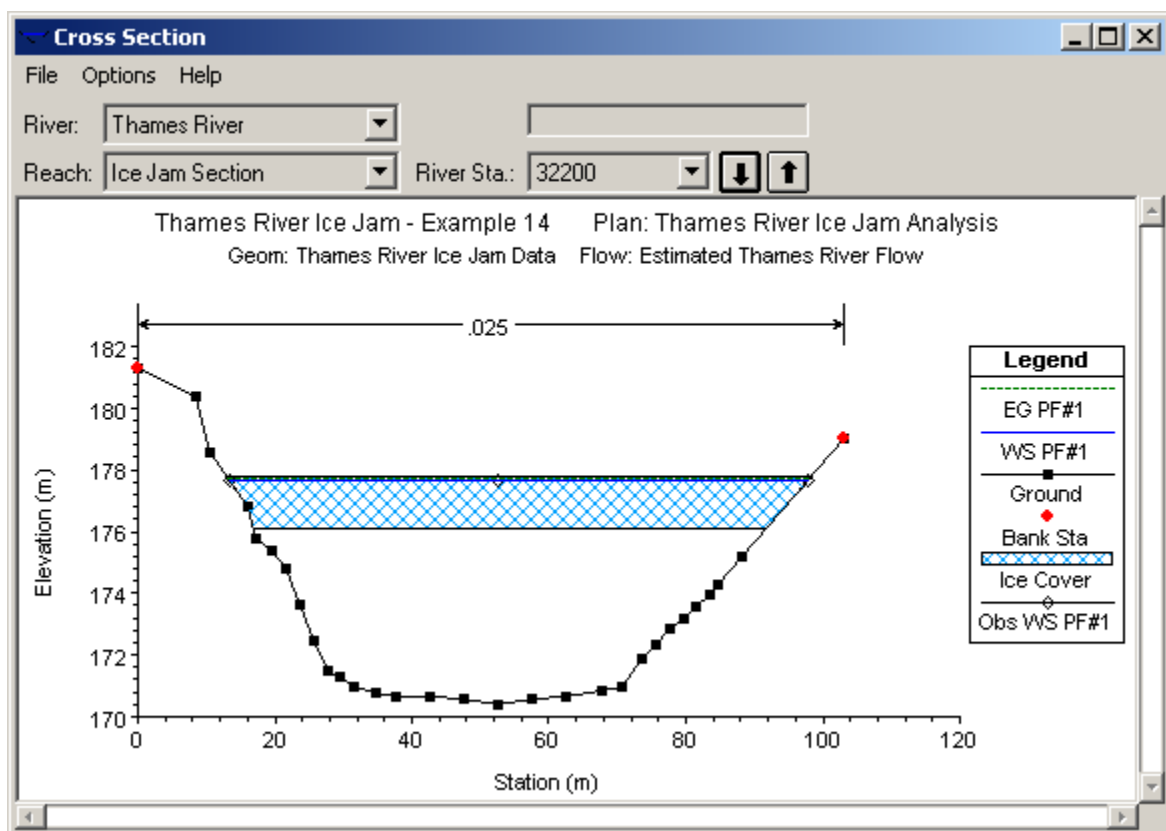
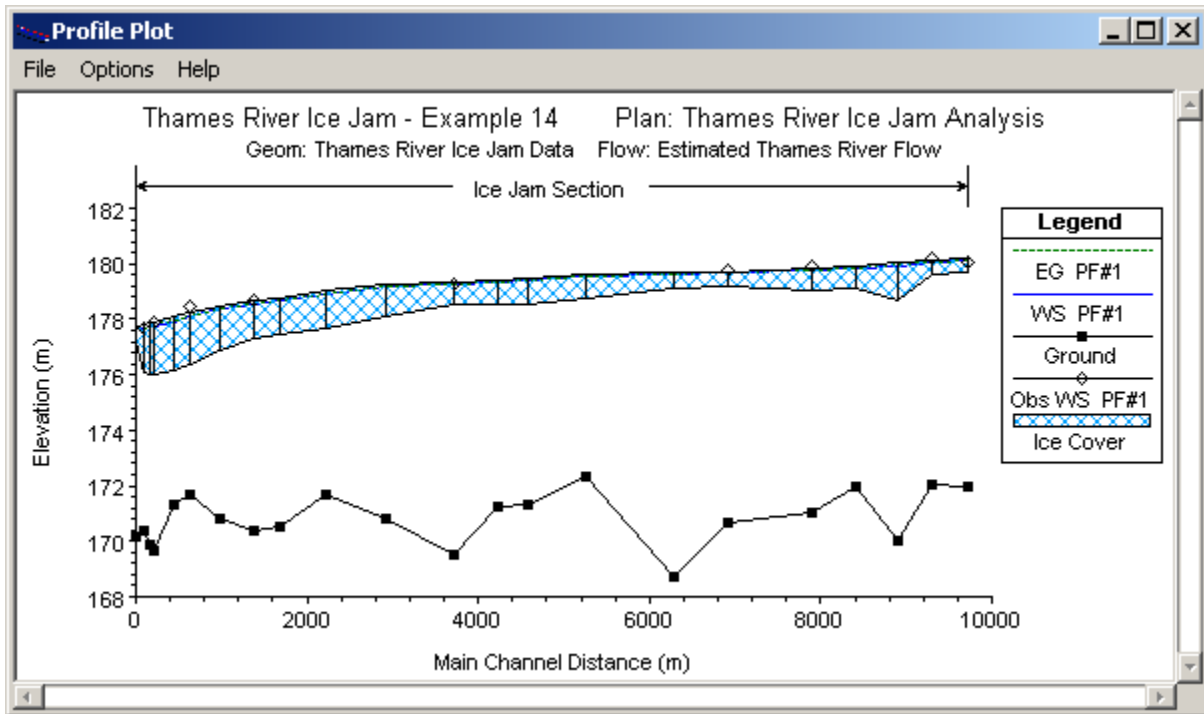


Figure 9.18 Cross section Plot with ice

**Profiles Plot.** An example of a profile plot with ice is shown in Figure 9.19. 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 9.19** 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 window 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.

## Viewing 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 9.20. 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	W.S. Elev (m)	Ice Vol Total (m3)	Ice Thick LOB (m)	Ice Vol. LOB (m3)	Mann Wtd Left	Ice Thick Chan (m)	Ice Vol. Chan (m3)	Mann Wtd Chnl
Ice Jam Section	42000	180.12	495988.50	0.00			0.50	495988.50	0.04
Ice Jam Section	41590	180.06	485712.10	0.00			0.50	485712.10	0.04
Ice Jam Section	41190	179.94	468037.50	0.00			1.37	468037.50	0.05
Ice Jam Section	40690	179.81	441621.30	0.00			0.80	441621.30	0.04
Ice Jam Section	40180	179.75	418345.20	0.00			0.75	418345.20	0.04
Ice Jam Section	39190	179.66	379597.30	0.00			0.55	379597.30	0.04
Ice Jam Section	38560	179.63	362120.20	0.00			0.60	362120.20	0.03
Ice Jam Section	37530	179.53	326744.20	0.00			0.87	326744.20	0.04
Ice Jam Section	36670	179.38	297092.50	0.00			0.93	297092.50	0.04
Ice Jam Section	36320	179.31	281657.20	0.00			0.81	281657.20	0.04
Ice Jam Section	35820	179.26	260090.30	0.00			0.76	260090.30	0.04
Ice Jam Section	35030	179.15	216810.40	0.00			1.14	216810.40	0.05
Ice Jam Section	34320	178.90	170938.20	0.00			1.35	170938.20	0.05
Ice Jam Section	33790	178.65	138967.60	0.00			1.31	138967.60	0.05
Ice Jam Section	33490	178.54	119983.40	0.00			1.35	119983.40	0.05

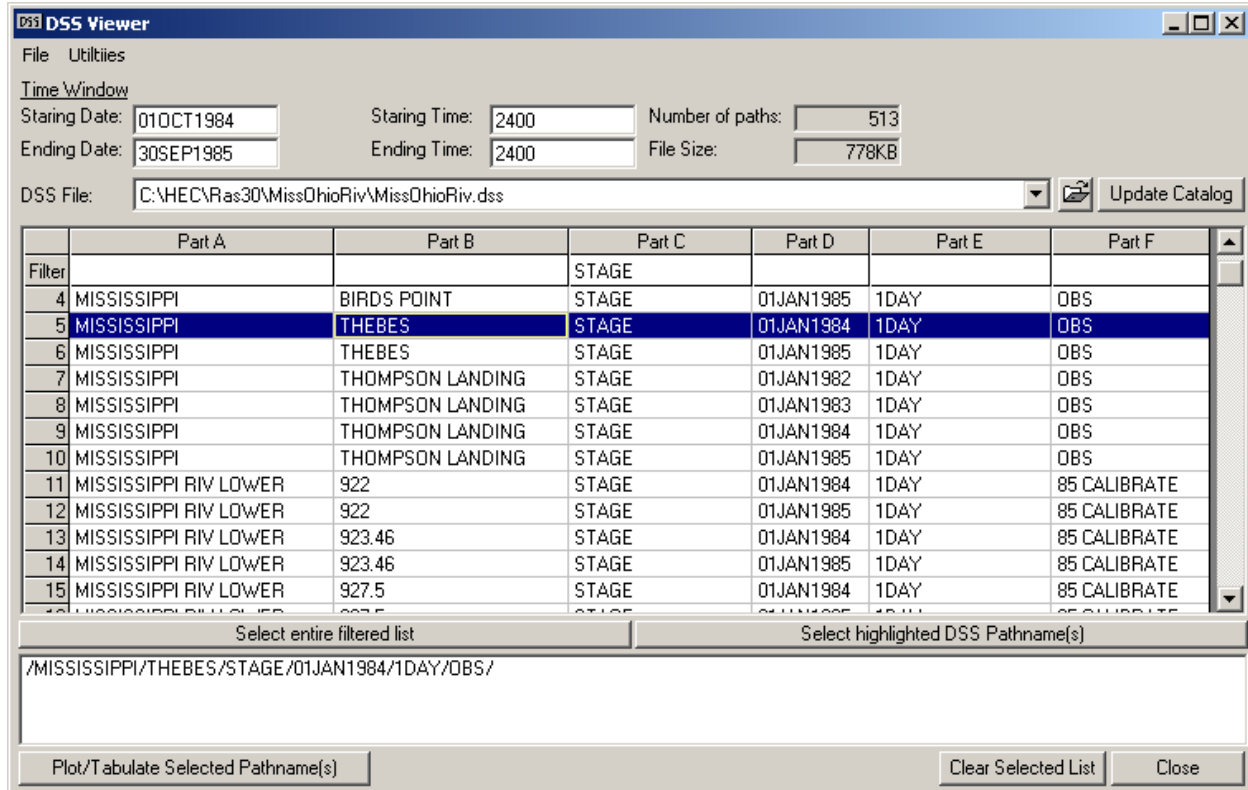
Figure 9.20 Ice Cover Table

## 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), 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

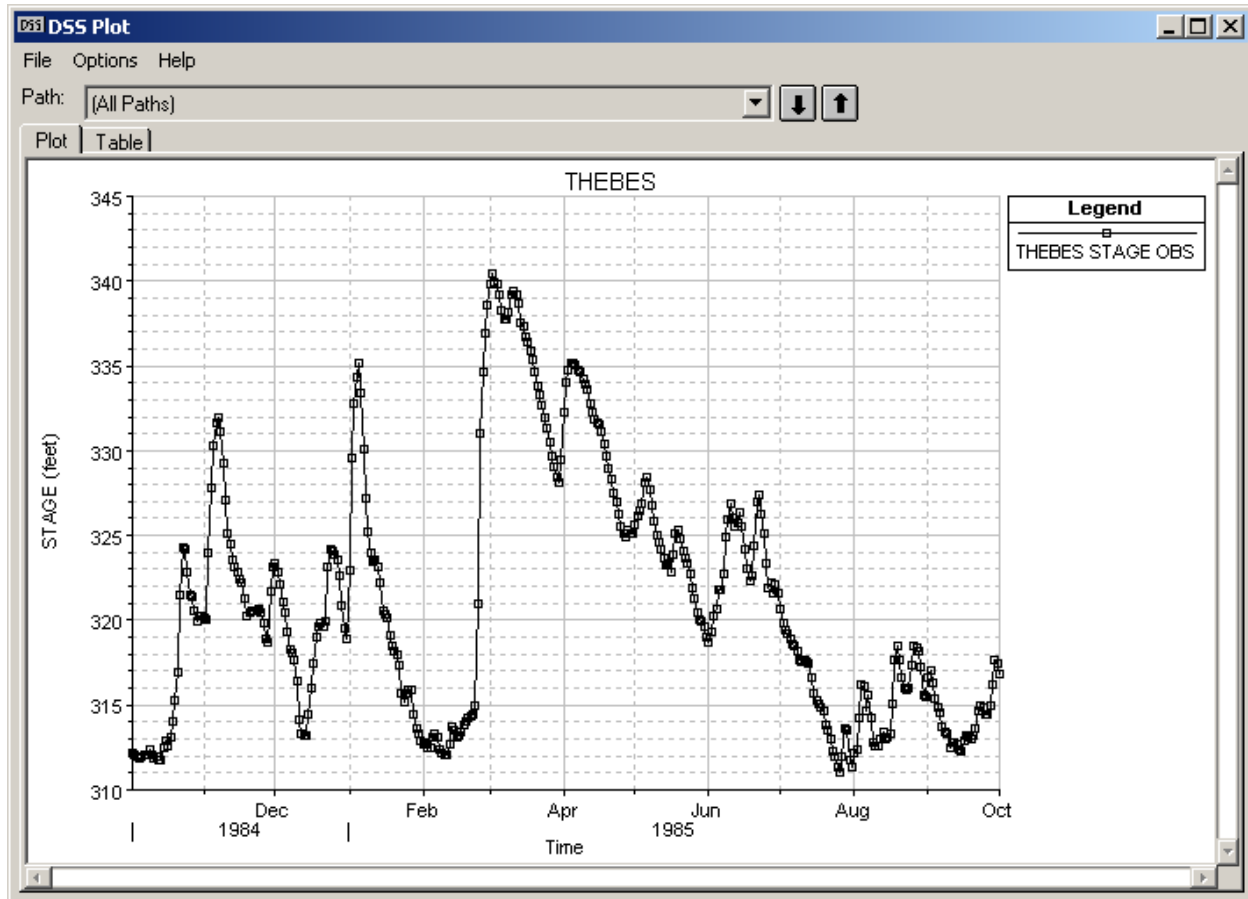
to view data contained within a DSS file. A DSS viewer is available from within the HEC-RAS software. To bring up the DSS viewer select **DSS Data** from the **View** menu of the main HEC-RAS window (Or press the button labeled **DSS** on the main window). When this option is selected a window will appear as shown in Figure 9.21.



**Figure 9.21 HEC-DSS Viewer Window**

As shown in Figure 9.21, the user selects a DSS file by pressing the open file button located next to the DSS Filename field. When a DSS file 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. 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, then the button labeled **Select highlighted DSS Pathnames** is pressed and the pathname shows up in the lower box. The final step is to hit the **Plot/Tabulate Selected Pathnames** button, and the data will be plotted. An example plot is shown in Figure 9.22.

As shown in Figure 9.22 there are two tabs on the window, one says **Plot** and the other says **Table**. By default the window comes up plotting the data. To view the data as a table, simply press the table tab.



**Figure 9.22 Example Plot From The HEC-RAS DSS Viewer**

Data can be viewed from one or more DSS files simultaneously. The user simply opens one DSS file and picks the desired pathnames, then opens another DSS file and selects additional pathnames. When the Plot/Tabulate button is pressed, the data from both DSS files will be plotted and/or tabulated.

A few utilities are also available from the DSS viewer. These utilities include: Time Series Importer; Delete Selected Pathnames; and Squeeze the DSS file. The time series importer allows the user to enter regular interval time series data into a table, which can then be imported into a DSS file. To use this option select **Time Series Import** from the **Utilities** menu of the DSS Data Viewer. When this option is selected a window will appear as shown in Figure 9.23.

**Write Time Series Data to DSS**

DSS Filename:

Path:

Date:  Time:  Time interval:

Units:  Type:

Selected Area Global Edits

Time Series Data		
	Date	Data
1	01Oct1984 2400	312.22
2	02Oct1984 2400	312.03
3	03Oct1984 2400	312.01
4	04Oct1984 2400	311.89
5	05Oct1984 2400	311.99
6	06Oct1984 2400	312.09
7	07Oct1984 2400	312.02
8	08Oct1984 2400	312.38
9	09Oct1984 2400	312.09
10	10Oct1984 2400	311.83
11	11Oct1984 2400	311.97
12	12Oct1984 2400	311.78
13	13Oct1984 2400	311.74

**Figure 9.23 DSS Time Series Data Import Utility**

As shown in Figure 9.23, the user first selects a DSS file to import data into. Next a DSS Pathname must be entered for the data to be written to the DSS file. The pathname parts are separated with a “/” between each pathname part. Some parts can be left blank, but the B and C part must be entered at a minimum. Next the user enters the date and time of the first data point, as well as the interval of the data (the interval is selected from the available DSS intervals). Next the data units and data type are selected from the drop down lists. If the lists do not contain the units of your data you can enter them directly into the field. The data is then entered into the table at the bottom. You can cut and paste information into this table, using the standard windows keys of Ctrl-C for cut, and Ctrl-V for paste. There are buttons available to perform the following tasks: set the number of rows in the table (the default is 99); linearly interpolate missing values; delete a row; insert a row; add a constant to a highlighted section of the table; multiply the highlighted section by a factor; and set a highlighted section to a specific value.

The utility labeled **Delete Selected Paths** is used to delete data from the DSS file. The user simply selects the pathnames they want to delete, then selects this option from the **Utilities** menu. A window will appear to asking if you

are sure you want to delete the selected pathnames. If you answer **OK**, then the data will be deleted from the DSS file.

The utility labeled **Squeeze DSS File** is used to compress the DSS file, such that it takes significantly less hard disk space. This is a convenient function if you are working with very large DSS files. To use this option just select **Squeeze DSS File** from the **Utilities** menu. A window will come up asking you if you want to squeeze the currently opened DSS file. If you answer **OK** then the file will be compressed.

## 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 9.24.

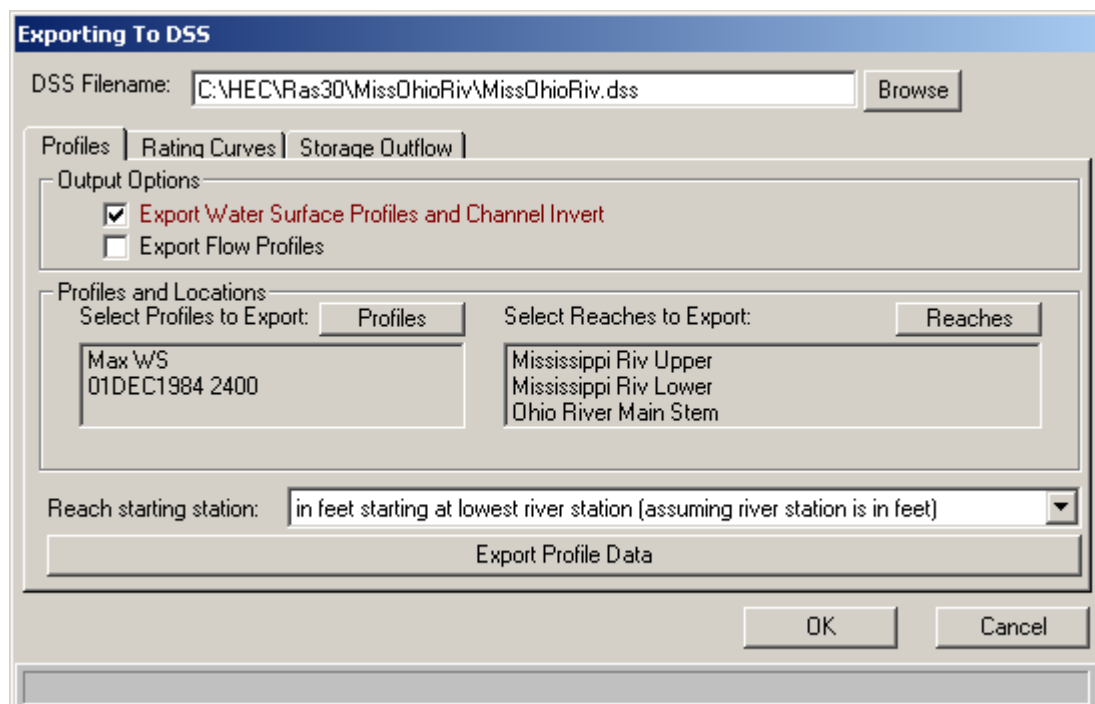
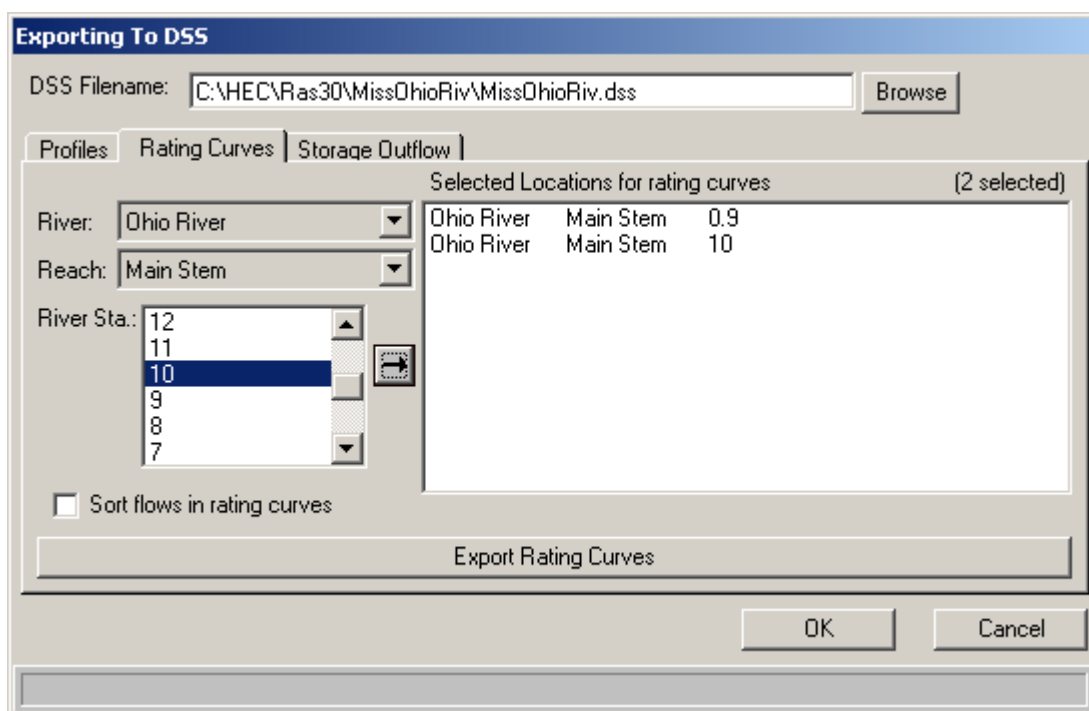


Figure 9.24 Export Computed Results to DSS Window

As shown in Figure 9.24, 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 9.25.



**Figure 9.25 Exporting Computed Rating Curves to HEC-DSS**

As shown in Figure 9.25, 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 9.26.

**Exporting To DSS**

DSS Filename:

Profiles | Rating Curves | **Storage Outflow**

Enter/Selected Volume-Flow Reaches

	River	Upstream Reach	Upstream RS	Downstream Reach	Downstream RS
1	Mississippi Riv	Upper	43.7	Upper	26.7
2	Mississippi Riv	Upper	26.7	Upper	0
3	Ohio River	Main Stem	17.39	Main Stem	0
4	<input type="text"/>				
5					
6					
7					

**Figure 9.26 Exporting Storage-Outflow Information to HEC-DSS**

As shown in Figure 9.26, 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.