

Technical Documentation Version 8.0

Output Utilities and Data Visualization



Center for Advanced Decision Support for Water and Environmental Systems (CADSWES)

UNIVERSITY OF COLORADO **BOULDER**

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Chapter 1
Output Manager

Topics

- About the Output Manager, page 1
- Sorting, page 2
- Exporting and Importing Output Devices, page 2
- Output Devices for Aggregated Values, page 3
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About the Output Manager

The Output Manager allows you to create output devices to view output and model information in various ways:

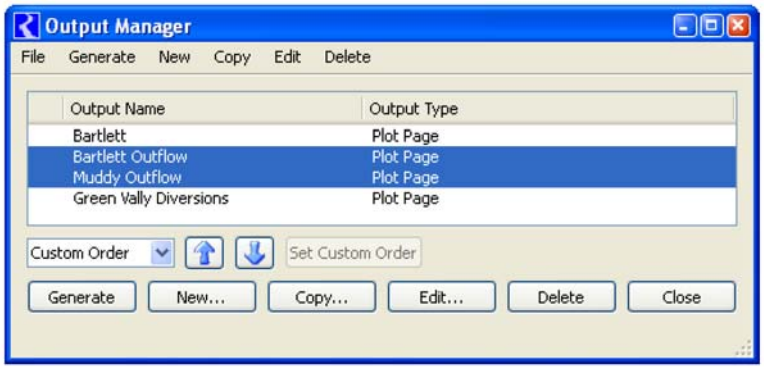
- **Plot Page**: A plot within RiverWare showing various forms of data in a user configured layout. See "Plot Page" on page 5.
- **RiverWare Data File** (RDF): create an external file using RDF format. See "Creating RDF and CDF data files" on page 6.
- **Comma-Delimited File**: create an external file with **one line per slot** using commas as delimiters. See "Creating RDF and CDF data files" on page 6.
- **Comma-Separated Values File**: create an external file with **one line per timestep** value using commas as delimiters. See "Creating a Comma-separated Values File" on page 6.
- **Excel File**: create an external Excel file. See "Creating an Excel Spreadsheet" on page 8.
- **Tabular Series Slot Reports**: Create an external HTML or text file that shows series data as tabular values. See "Creating a Tabular Series Slot Report" on page 9.
- **Model Report**: Create an external HTML file that shows information about the model, the data, the policy, or other output devices. See "Creating a Model Report" on page 10.
- **Charts**: Create a pie chart within RiverWare. See "Creating a Chart" on page 11.
- **Output Canvas**: Create a highly customized canvas that can show teacup diagrams and other data visualization diagrams. See "Creating an Output Canvas" on page 12.

The Output Manager is accessed through the **Utilities** menu from the workspace or by selecting **Output Manager** on the main workspace toolbar. The Output Manager dialog appears.

Chapter 1
Output Manager

The Output Manager lists all of the currently existing output devices. Output devices are any defined format for generating data output.





Sorting

In the Output Manager, output devices can be reordered by selecting the buttons near the bottom of the window. The **Up** and **Down** arrows are used to move one or more selected objects up or down in the list. These buttons are only available for the **Custom Order**. When selecting **Sort By Column**, the **Set Custom Order** button is displayed and active. This button sets the currently displayed order as the new **Custom Order**, switches the sort menu to **Custom Order**, and enables the **Up** and **Down** buttons. A warning message dialog is presented to alert the user that the custom order will be overwritten. This functionality allows the user to first sort by one of the columns, save the order as custom, then make detailed changes by selecting the **Up** and **Down** arrows. Any further changes to the **Custom Order** are saved automatically.



Exporting and Importing Output Devices

Output devices can be exported to a file.

- Select the devices to be exported (devices can be of any type).
- Select the **File**, then **Export Selected Outputs** menu.
- Select or enter a desired file path and name in the resulting **File Chooser** dialog and select **Save**.

Output devices that have been saved to a file can then be imported into any model.

1. Select the **File**, then **Import** menu of the **Output Manager** dialog.
2. Select the import file in the resulting File Chooser dialog and select **Open**.

An informational dialog is displayed that summarizes the devices that were imported. Unique names are created (via a numbered suffix) for any devices with names that already exist as outputs in the model. Imported devices will appear in the **Output Manager** list.

If devices are created in one model, they can all be exported to a file and imported into the other model. If the same objects and slots are present in the second model, the devices will be fully specified with valid slot pointers in all the devices

If plots are exported from one model and imported into another one that does not have the same objects and slots, the curves will not have valid slots. In the Plot Page configuration, the following message is displayed.

Plot has curves without valid slots - generate plot and configure curves to select slots

You must generate the plots and then the curves will appear in the legend of the plot, but without any data for the curves. You can then configure and select new slots; see "Edit Menu" on page 32 for details.

If non-plot output devices (Excel, RDF, CDF, Chart) are exported from one model and imported into another one that does not have the same objects and slots, the devices cannot currently be updated with slots from the new model. This will be addressed in the future.

Output Devices for Aggregated Values

All output devices support outputs at the model timestep size. But sometimes, you want or need to output data at a different timestep size. For example, if you are running an operations model with a 1 Hour timestep, perhaps you would like to output daily totals in a model report. Certain output devices can optionally summarize data; for example, Tabular Series Slot Reports will show you specified statistics (Min, Mean, Max) at fixed intervals (E.g. every 24th timestep) or at 1 Month intervals. These values are shown in addition to the single interval values. But, time series of aggregated information is not directly available from any of the devices. The general approach used in RiverWare is that you must create slots that represent the aggregated values. This section provides some guidance and approach for creating aggregated slots and then showing them in output device.

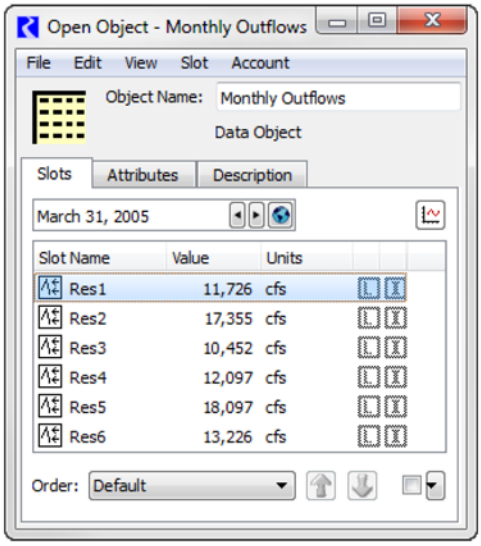
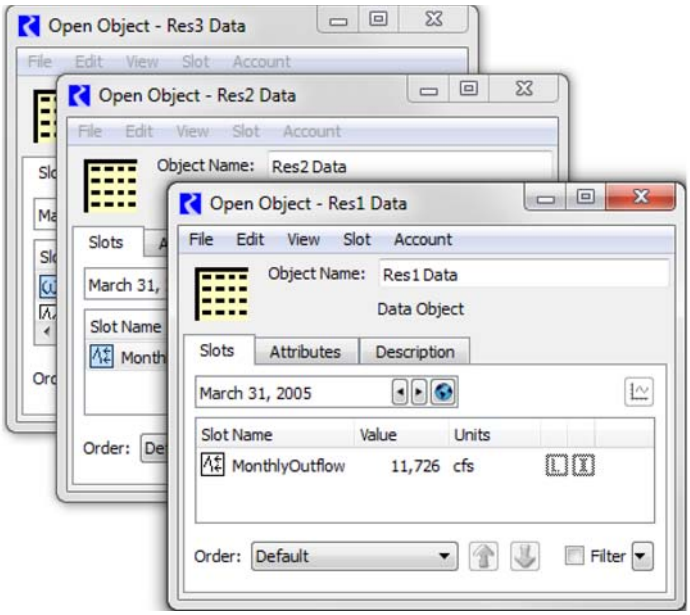
A general approach for showing aggregated values is to create slots that represent the aggregated values and then include them in your report. There are two types of slots that can be used, as follows:

- **Time Aggregation Series Slots**. Create a Time Aggregation Series Slot. This slot references a smaller timestep series slot in your model and aggregates (Sum, Avg, Min, Max, Last, First) the values to a larger timestep (1 Day, 1 Month, 1 Year). See "Time Aggregation Series Slots" in *User Interface*.
- **Series Slots with Expression**. Create an expression slot and develop a RPL expression that performs the aggregation. There are many RPL predefined functions and operators that can be used in the expression, such as SumSlot function, SumFlowsToVolume function, SUM operator, and the AVE operator. See "Series Slots With Expression" in *User Interface*.

It is usually easier and quicker to configure **Time Aggregation Series Slots**. But Expression Slots provide flexibility and customization if the aggregation function or time range that you wish to use is different than the provided functions.

Often, for output devices, you wish to show the same aggregated slots for many different objects. Let's assume we wish to show the average monthly flow (in a model with a timestep of 1 Day) for six different reservoirs. In this example, we will show Time Aggregation Series slots. There are two main approaches to organize the aggregated slots for this calculation as shown in Table 1.1. Also shown are advantages and disadvantages for both.

Table 1.1

A. One data object that contains one aggregation slot per reservoir.	B. Create custom aggregation slots on accompanying data objects or directly on the simulation object.
	
Advantages	
This structure keeps all the data in one place. In addition, for Time Aggregation Series Slots, you can use the Create Similar Slots for Different Objects functionality. This setup works especially well for Tabular Series Slot Reports. See "Creating Similar Time Aggregation Series Slots for Different Objects" in *User Interface* for details.	Having one data object per object provides a place for all user defined data in one location. Creating custom slots directly on the simulation object keeps all the data in one place. Either format works well for **Charts** and the **Output Canvas**.
Disadvantages	
This structure does not support **Charts** or the **Output Canvas**. These two devices assume data is on each objects or an associated data object.	It is harder to create or add a slot to many objects once they are created. This can be mitigated by selecting **Copy Slots to Objects** functionality. See "Copy Slots to Objects" in *User Interface* for details.
Naming Conventions	
Make sure to use the same naming convention for the slots as you do for the Objects	Make sure to use a consistent naming convention for slot names so they are accessible by the Output devices.

Output Types

The following outputs can be generated by RiverWare:

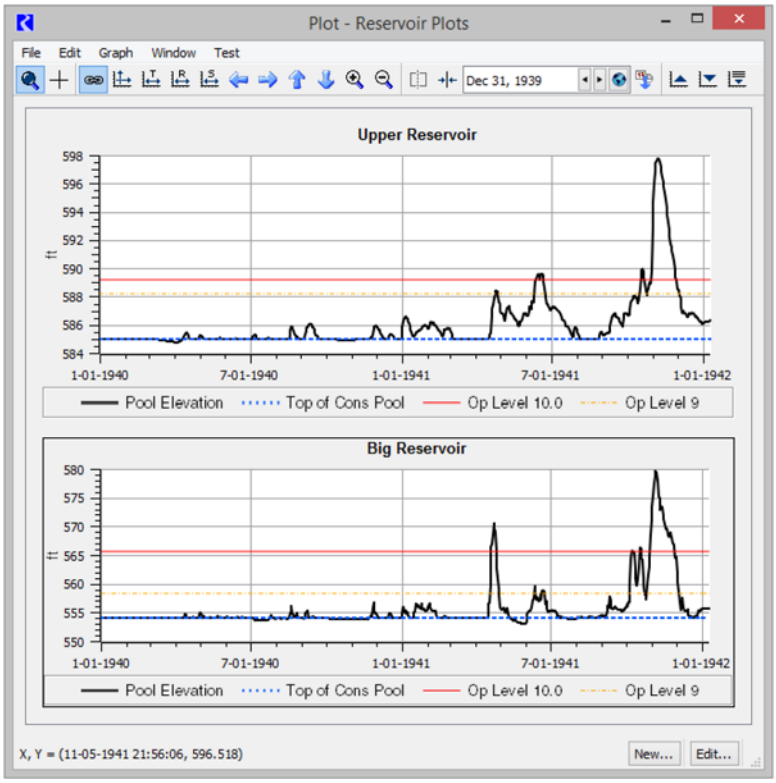
- Plot Page
- RiverWare Data File (.rdf); see "RiverWare Data Format (RDF)" on page 221 for details.

- Comma-Delimited File (.cdf)
- Comma-separated Values File (.csv)
- Excel spreadsheet
- Tabular Series Slot Report (text or html)
- Model Report
- Chart
- Output Canvas

Plot Page

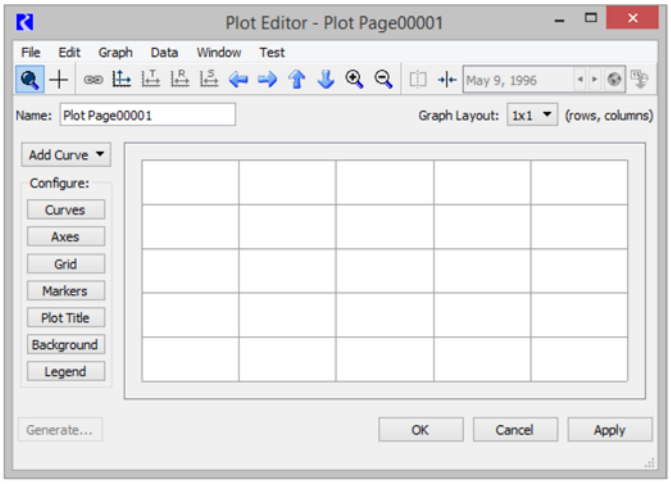
The Plot Page output device allows you to plot data. Figure 1.1 is a sample. See “Plotting” on page 13 for additional information.

Figure 1.1 Sample 2X1 plot page



Creating a New Plot Page

To create a new plot page, select **New**, then **New Plot Page** from the **Output Manager** dialog**.** A blank **Plot Page Editor** dialog appears. See "Plot Page Editor" on page 16 for details on adding curves and configuring plots.



Creating RDF and CDF data files

The steps for generating RDF and CDF files are similar, so we will explore creating only the RiverWare Data File. To create a Comma-Delimited File (one line per slot), use the following steps and generate a .cdf file instead of a .rdf file.

1. In the **Output Manager** select **New**, then **New Riverware Data File** from the menu bar at the top of the dialog**.** A new **Riverware Data File:** window appears with the name **Riverware Data File: Riverware Data File00001**. Notice that in the **Output Type:** selector the **RiverWare Data Format File** is chosen.
2. Select the appropriate slots
3. In the **Output File:** field type a path and file name. These files should end in .rdf as the .rdf extension is for RiverWare Data File.
4. Select **Save**. The output device window closes and its name turns black in the **Output Manager**.
5. In the **Output Manager** dialog, select the device then select **Generate.** A new output file has been created in the specified directory.

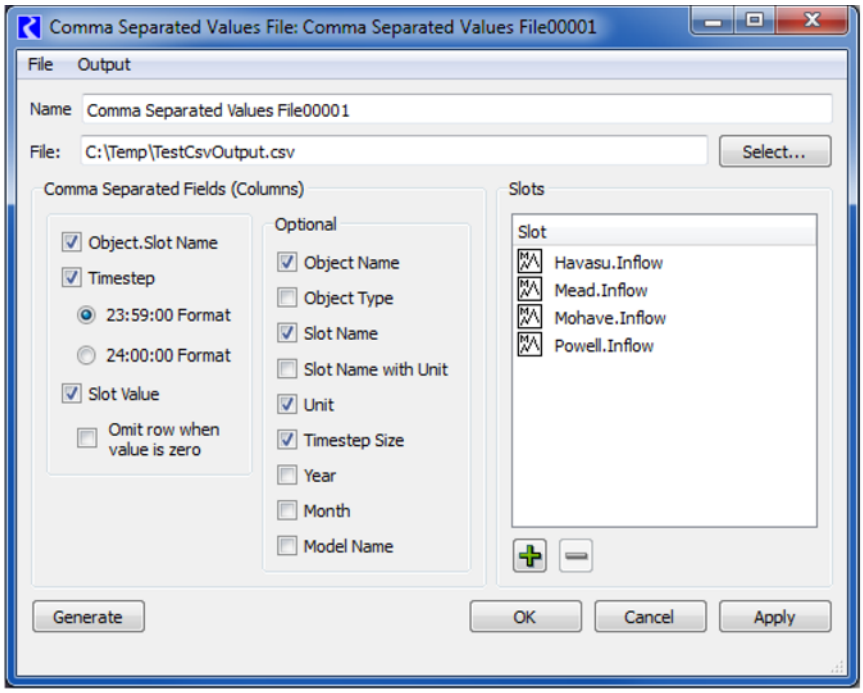
Use the **Slots** menu to show slots in an SCT. The **Slots**, then **SCT**, then **More** selections are available for these Output Devices. These two operations show the items selected within the Output Device's slot list in an SCT, either in a new SCT or in the single open SCT. The latter operation is available only if exactly one open SCT is visible (not minimized

Creating a Comma-separated Values File

Following are the steps to create a Comma-separated Values (CSV) file. The CSV file has one line per timestep and includes many other fields, some automatically and some optionally. This CSV format is designed to be used in Excel or the Tableau software.

1. In the **Output Manager** select **New**, then **New Comma-Separated Values File** from the menu bar at the top of the dialog.

   A new **Comma Separated Values File** window appears with the name **Comma Separated Values File00001**. The fields in the left list always remain checked for output as columns to the file.



2. Select a timestep option for the format of the written time. RiverWare uses end of timestep format for all datetime references. Thus for a 1 Month timestep, July 2014 would be fully specified as 7/31/2014 24:00. Tableau and Excel do not have a concept of 24:00 as a time but would instead use 8/1/2014 00:00 for the same point in time. Therefore with the proper timestep option selected in the dialog, one minute is subtracted from all timestep values (e.g. 7/31/2014 23:59) to assure that they appear with the appropriate day and month references in Excel and Tableau.
3. If desired, check the option to **Omit rows when value is zero**. When selected, rows are not written to the output file when the slot's value for that row is zero. The value is considered zero, in this case, if the absolute value is less than 1×10^{-8}.
4. Check any of the **Optional** fields for output as additional columns in the file.
5. Select the desired slots for output by selecting **+**.
6. In the **File:** field type a path and file name or select a file. The file should end in .csv to indicate a comma-separated values file.
7. Select **OK**.
8. In the **Output Manager** dialog, select the device then select **Generate.** A new output file is created in the specified directory. Figure 1.2 shows an example format.

Figure 1.2

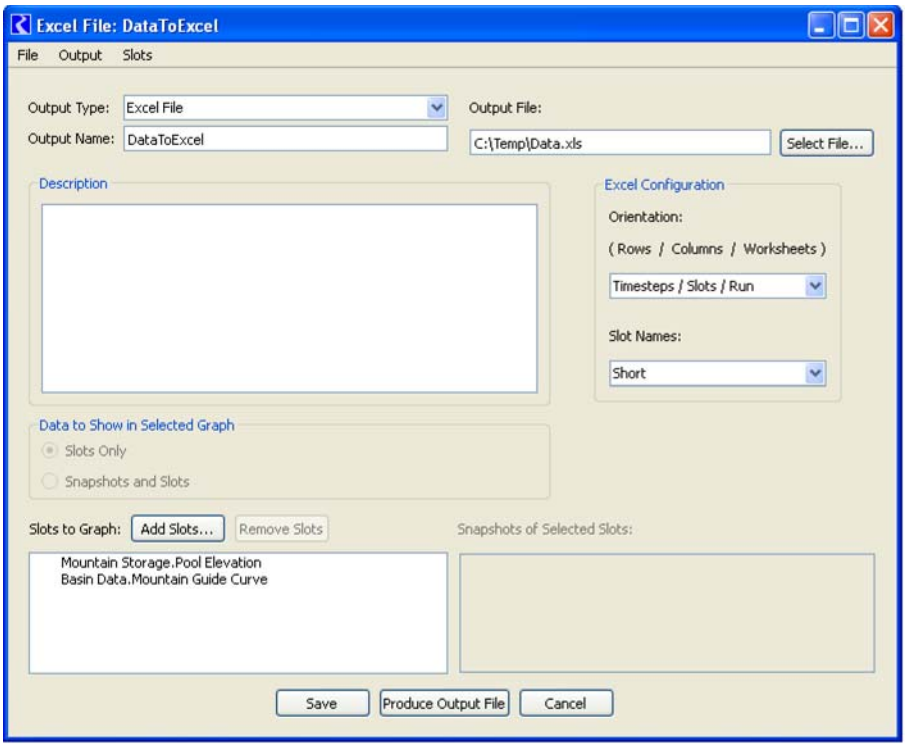
```
1  Object.Slot,Timestep,Slot Value,Object Name,Slot Name,Unit,Timestep Size
2  Havasu.Inflow,01-31-2013 23:59:00,393747,Havasu,Inflow,acre-ft/month,Month
3  Havasu.Inflow,02-28-2013 23:59:00,543457,Havasu,Inflow,acre-ft/month,Month
4  Havasu.Inflow,03-31-2013 23:59:00,653595,Havasu,Inflow,acre-ft/month,Month
5  Havasu.Inflow,04-30-2013 23:59:00,777034,Havasu,Inflow,acre-ft/month,Month
6  Havasu.Inflow,05-31-2013 23:59:00,658353,Havasu,Inflow,acre-ft/month,Month
7  Havasu.Inflow,06-30-2013 23:59:00,724524,Havasu,Inflow,acre-ft/month,Month
8  Havasu.Inflow,07-31-2013 23:59:00,726640,Havasu,Inflow,acre-ft/month,Month
```

Creating an Excel Spreadsheet

Following are the steps to create an Excel spreadsheet.

1. In the **Output Manager** select **New**, then **New Excel File** from the menu bar at the top of the dialog.

   A new **Excel File:** window appears with the name **Excel File00001**. In the **Output Type:** selector the **Excel File** is chosen.



2. Select the appropriate slots.
3. In the **Output File:** field type a path and file name or select a file. These files should end in .xls or .xlsx to indicate it is an Excel spreadsheet.
4. Select from the **Orientation** drop-down box. This configures how slots, timesteps, and runs are translated into rows, columns, and worksheets in Excel.

5. Select from the **Slot Names** drop-down box. This configures how slot names are written into the Excel data sheets. Options are as full names, automatically shortened names (lower case vowels removed), or index names (Slot0, Slot1, etc.).
6. Select **Save**. The output device window closes and its name turns black in the **Output Manager.**
7. In the **Output Manager** dialog highlight the new device, select **Generate.** A new output file has been created in the specified directory.

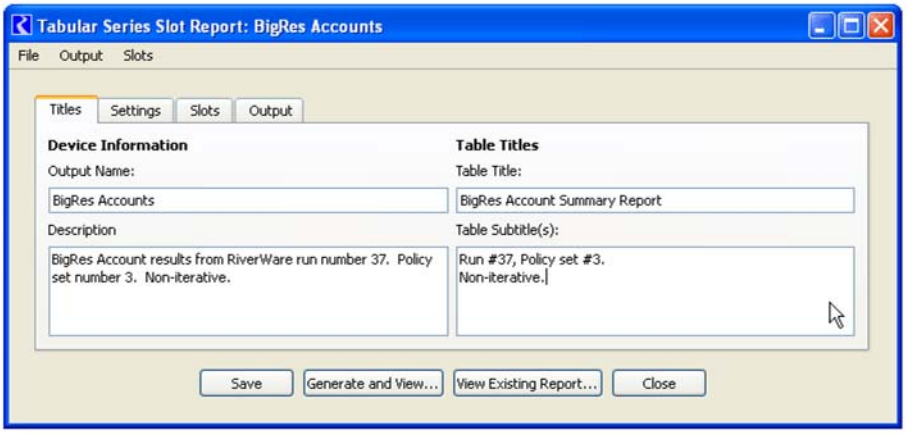
Creating a Tabular Series Slot Report

A **Tabular Series Slot Report** is an output device which generates a plain text or HTML document showing, in a table or multiple tables, series values for a set of slots. See "Tabular Series Slot Report" on page 79 for details.

New report configurations are created within the Output Manager dialog. Use the following steps to create a new report.

1. In the **Output Manager** select **New**, then **New Tabular Series Slot Report** from the menu bar at the top of the dialog**.**

   A new **Tabular Series Slot Report:** window appears with the name **Slot Report00001**.



2. Configure the new report using the dialog. See "Configuring Tabular Series Slot Reports" on page 81 for details.
3. Once configured, select **Save** (The output device window closes and its name turns black in the **Output Manager)** or select **Generate and View** to see the resulting file.
4. Alternatively, to generate and view the report, from the **Output Manager** dialog, highlight the new device, select **Generate.**

See "Tabular Series Slot Report" on page 79 for additional information.

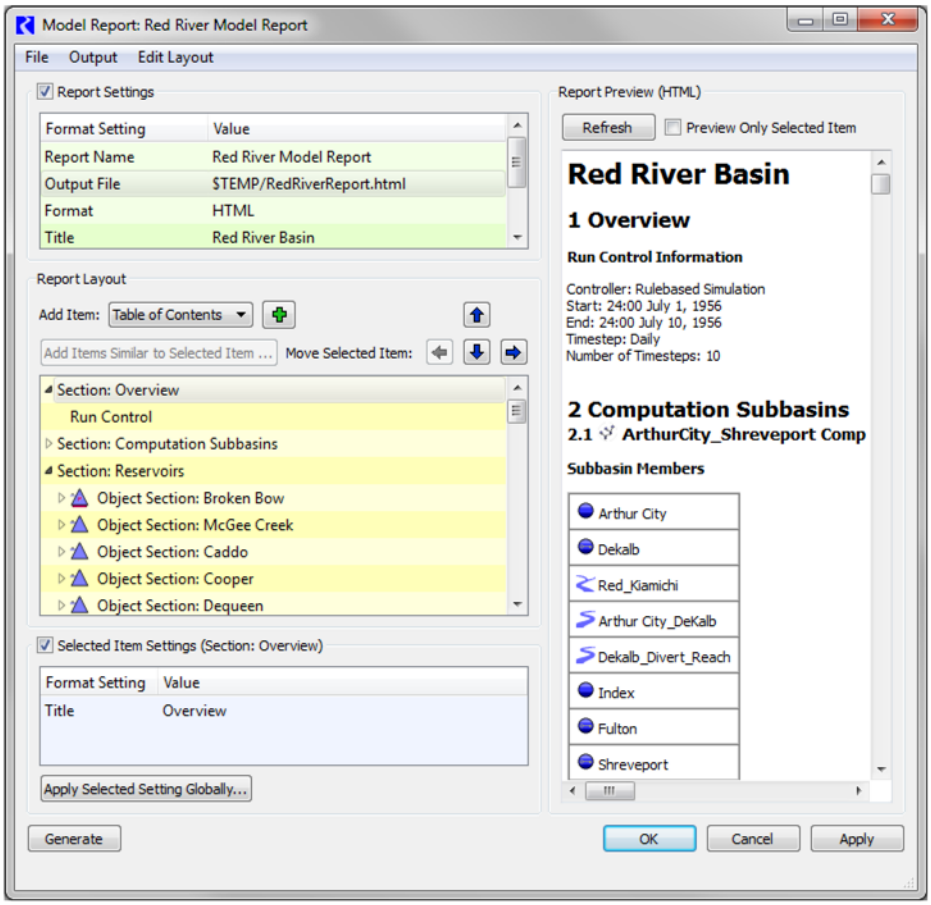
Creating a Model Report

A **Model Report** is an output device which generates an HTML document showing information about a model including slots, selected methods, run range, and subbasin membership. See "Model Report" on page 95 for details.

New report configurations are created within the Output Manager dialog. Use the following steps to create a new report in the **Output Manager**.

1. Select **New**, then **New Model Report** from the menu bar at the top of the dialog.

   A new **Model Report:** window appears.



2. Configure the new report using the dialog. See "Configuring Model Reports" on page 96 for details.
3. Once configured, select **Ok**. The output device window closes and its name turns black in the **Output Manager**.
4. Alternatively, to generate and view the report, from the **Output Manager** dialog, highlight the new device, select **Generate.**

See "Model Report" on page 95 for additional information.

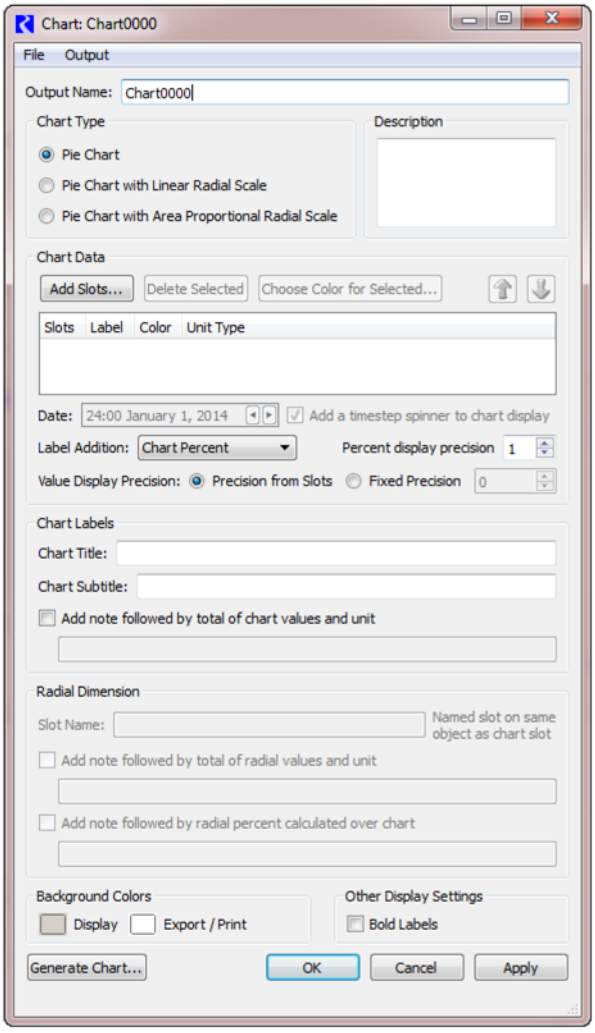
Creating a Chart

A **Chart** is an output device which generates a pie chart of data from specified slots. See "Chart" on page 129 for details.

New chart configurations are created within the Output Manager dialog. Use the following steps to create a new chart.

1. In the **Output Manager** select **New**, then **New Chart** from the menu bar at the top of the dialog**.**

   A new **Chart:** window appears with the name **Chart00001**.



2. Configure the new chart using the dialog. See "Configuring Charts" on page 132 for details.
3. Once configured, select **Ok** (The output device window closes and its name turns black in the **Output Manager)** or select **Generate Chart** to see the resulting chart.
4. Alternatively, to generate and view the chart, from the **Output Manager** dialog, highlight the new device, select **Generate.**

See “Chart” on page 129 for additional information.

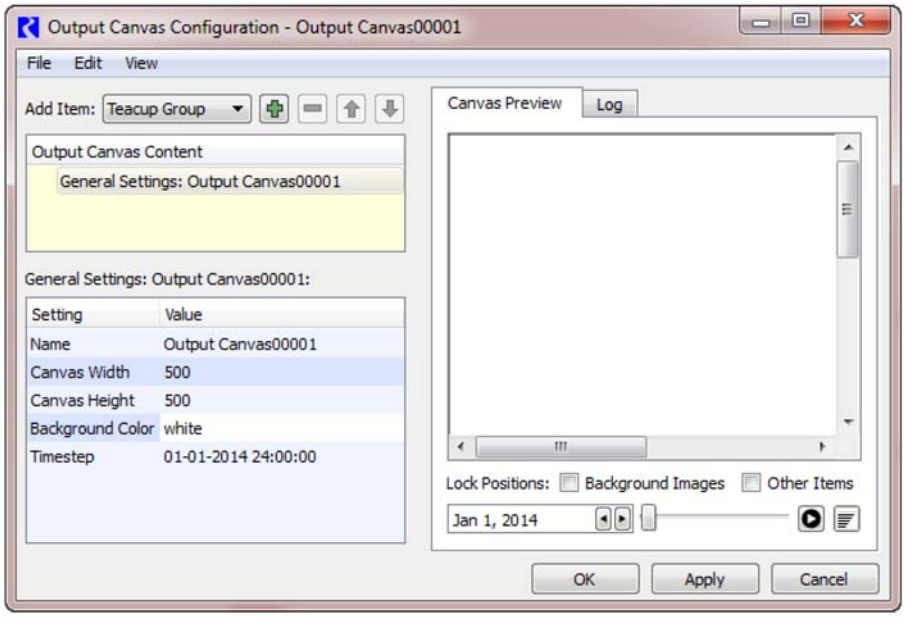
Creating an Output Canvas

An Output Canvas is an output device which generates Teacup diagrams and other data visualization utilities. See “Output Canvas” on page 147 for details.

New Output Canvas configurations are created within the Output Manager dialog. Use the following steps to create a new Output Canvas.

1. In the **Output Manager** select **New**, then **New Output Canvas** from the menu bar at the top of the dialog**.**

   A new **Output Canvas** window appears.



2. Configure the new canvas using the dialog. See “Configuring an Output Canvas” on page 151 for details.
3. Once configured, select **Ok** (The output device window closes and its name turns black in the **Output Manager)**.
4. Alternatively, to generate and view the canvas, from the **Output Manager** dialog, highlight the new device, select **Generate.**

See “Output Canvas” on page 147 for additional information.

Chapter 2
Plotting

The Plotting utility provides a means for plotting the data stored in RiverWare slots. This plotting tool is very flexible and user-configurable.

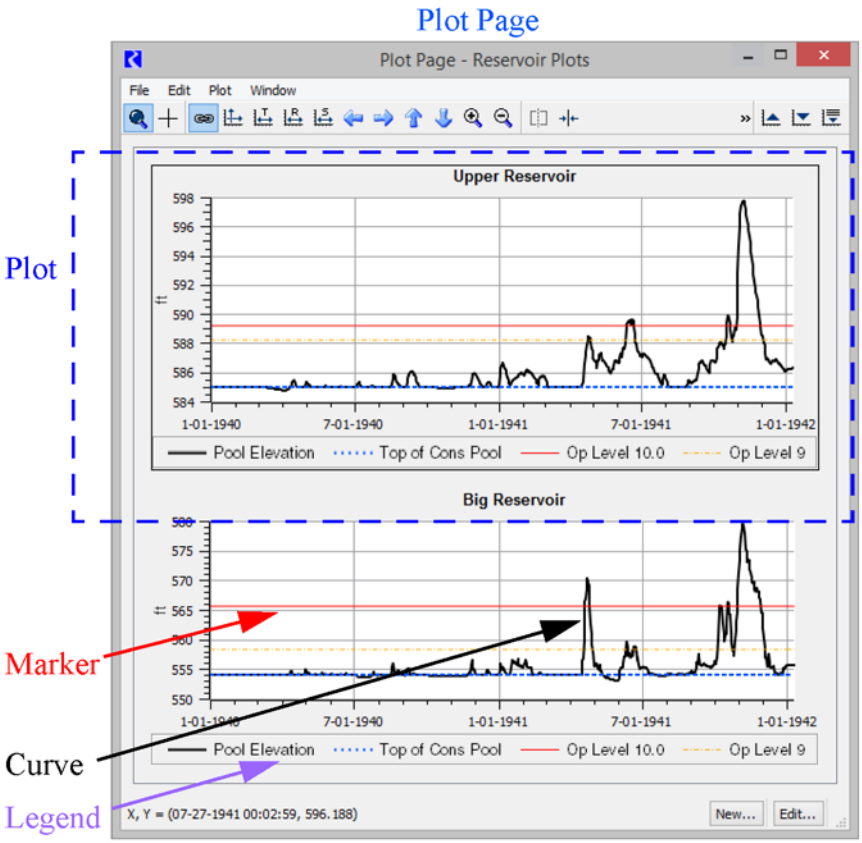
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Plotting Components

The basic components of a plot are as follows. Figure 2.1 is an illustration.

Figure 2.1 Basic components of a Plot Page.



Plot Page

A Plot Page is a grid of one or more Plots. This can be configured to have multiple layouts from a 1X1, 2X1, 3X3 plots.

Plot

The a Plot consists of a set of X and Y axes (one or two of each). The plot contains **Curves**, **Markers** and a **Legend**. It also has a configurable grid, background color and title.

Curves

Curves represent slot data.

Markers

Markers represent x and/or y values shown with a vertical and/or horizontal line and possibly a label.

Legend

A Legend provides a key to the curves and possibly markers. Curves and markers are optionally shown in the legend.

Plotting Structure and Interface

Like other Output devices, the plot consist of a dialog used to edit and configure the Plot Page and a view of the completed Plot Page. Following is an overview of each part of the plotting utility.

Plot Page Editor

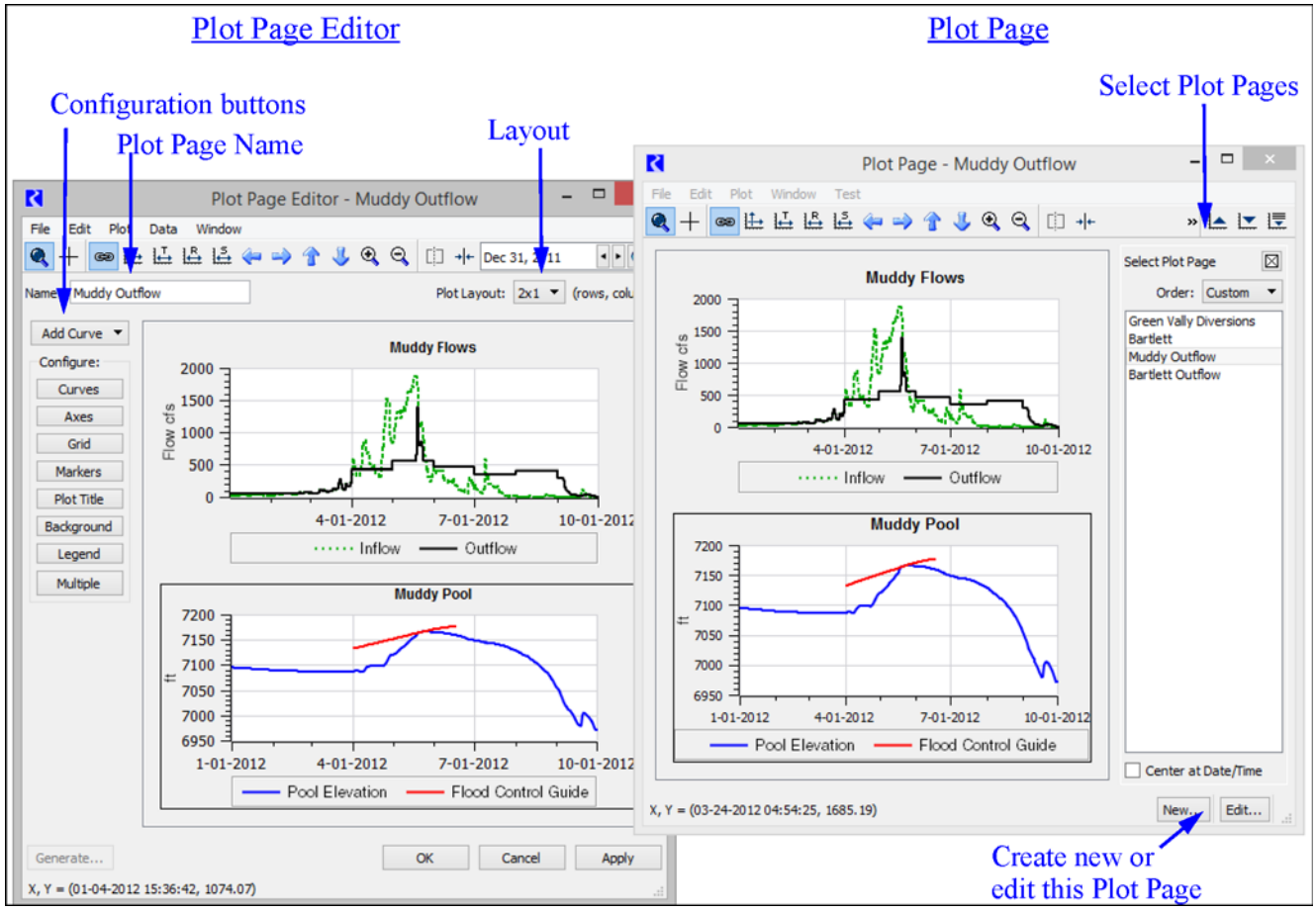
The Plot Page Editor is where all editing is performed. This includes defining the layout (1X1, 2X1, 3X3), adding curves, choosing the slots for curves, and configuring the appearance in terms of colors, line widths, etc. See "Plot Page Editor" on page 16 for details. You can edit multiple plots at once by selecting the Configure Multiple Plots and Curves dialog. See "Configuring Multiple Plots and Curves" on page 49 for details.

Plot Page

The **Plot Page** displays the saved plots and provides interaction with multiple plots. This is shown in Figure 2.2. In addition, the Plot Page can optionally show the list of saved plot pages in the model. You can then select through them to view the various data. See "Plot Page" on page 56 for details.

Figure 2.2 shows that both dialogs share a common tool bar that has navigation controls. See "Plot Page Navigation" on page 59 for descriptions of the controls.

Figure 2.2 Annotated screenshots of the Plot Page Editor and Plot Page Viewer



Plot Page Editor

The Plot Page Editor is used to edit and configure the layout, appearance, and data shown. In this section we describe how to use the Plot Page Editor to configure a Plot Page.

Accessing the Plot Page Editor

There are a number of ways to access the Plot Page Editor, as follows:

- From the main workspace, select **Utilities**, then **Plot Page,** or select **Plotting** .

  If there are no pre-configured plots saved in the model, this opens the **Plot Page Editor**. If there are pre-configured plots already saved in the model file, this will open the Plot Page dialog with the most recently selected plot displayed.
- From the Plot Page dialog, select **New** in the bottom right corner to open a blank **Plot Page Editor**. Select **Edit** to open the **Plot Page Editor** for the currently selected Plot Page.
- From the Plot Page dialog, select **Edit, then Create New Plot** from the menu bar to open a blank **Plot Page Editor**. Select **Edit, then Edit Selected Plot** to open the **Plot Page Editor** for the currently selected Plot Page.
- From the **Output Manager**, select **New, then New Plot Page** Alternatively, select an existing Plot Page in the list of output devices, and then select **New.** This will open a blank **Plot Page Editor**.
- From the **Output Manager**, select an existing Plot Page in the list of output devices, and then select **Edit**. This will open the **Plot Page Editor** for that Plot Page. Alternatively, double-select the Plot Page name to open the Editor, or select **Edit, then All Plot Pages**.
- From the Open Object dialog, highlight one or more slots and select **Slot**, then **Plot Slots** or select the plot icon.

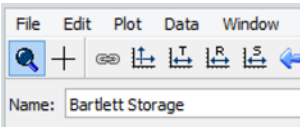
   This opens the **Plot Page Editor** with the selected slot(s) already plotted.
- From the Open Slot dialog, select **File, then Plot** or select the plot icon.  This opens the **Plot Page Editor** with the slot plotted.
- From a SCT, highlight one or more slots and select **Slots, then Plot Slots** or select the plot icon. 

Editing a Plot Page

All configuration for a Plot Page is carried out in the **Plot Page Editor**. You can plot series slots, table slots, scalar slots, and periodic slots. Series slots can be plotted with time on the x-axis, or two series slots can be plotted against each other. Multiple curves can be plotted on the same plot (set of axes), and multiple plots can be shown in different *panels* of a Plot Page.

> **Note:** You must either give the **Plot Page** a name and select **Apply** or **OK** in the **Plot Page Editor** or save the **Plot Page** using **File**, then **Save As** to preserve the Plot Page configuration. Otherwise, when you close the **Plot Page Editor**, the **Plot Page** changes will be lost.

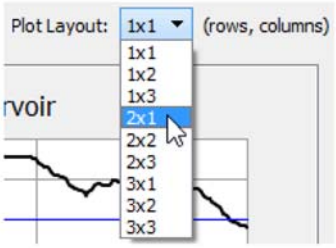
Give each Plot Page a name in the Name field near the top left of the **Plot Page Editor**. This is the name that will appear in the Plot Page Selection list in the Plot Page dialog and in the Output Manager.



All editing of a Plot Page in the **Plot Page Editor** applies to the configuration of the Plot Page (e.g., the slots associated with the plots, layout, and line and color choices). Because plots are automatically updated with new slot information (after a new run or after user input values have been changed), a saved Plot Page does not preserve the results of a particular model run. Snapshots can be used to preserve the results of model runs; see "Snapshots" on page 195 for details.

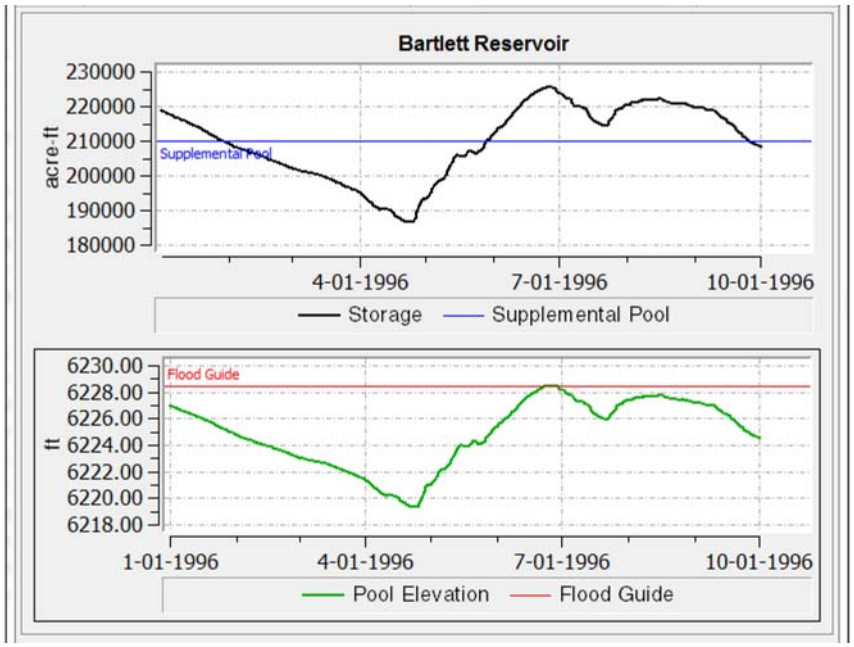
Plot Page Layout

Plots can be added to a Plot Page in the **Plot Page Editor** by selecting **Window**, then **Set Layout.** Alternatively, select the **Plot Layout** dropdown menu near the top right of the **Plot Page Editor**.



From either of these layout menus, you can choose the number of plots that appear in the Plot Page. You may change the Plot Page from a 1X1 array of plots to as many as a 3X3 array. When the display size of the Plot Page dialog changes, the plots are automatically updated to occupy the new dialog size. Figure 2.3 is a sample.

Figure 2.3 2X1 Plot Page



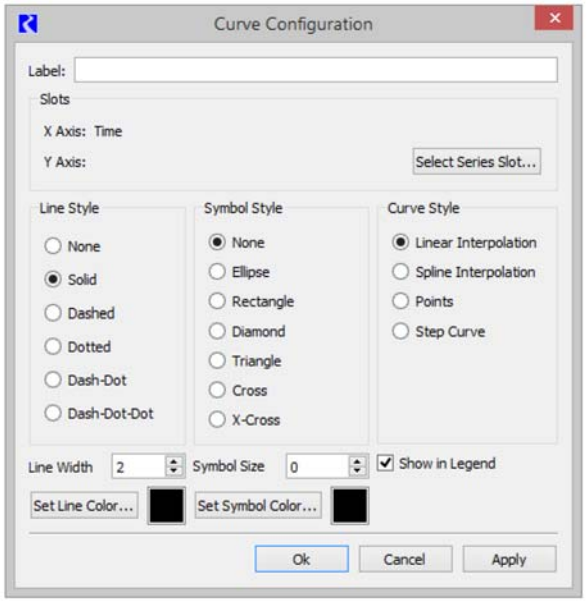
Whenever more than one plot is displayed, configuration changes will apply to the selected plot, which has a black outline around it.

Adding a Curve or Marker to a Plot

There are several methods to add a new curve to a plot. Descriptions for adding a series curve follow. The steps are similar for adding other types of curves and Markers. See “Types of Curves” on page 41 and “Marker Configuration” on page 27 for additional information.

- Select the **Add Curve** menu near the top left of the **Plot Page Editor**, and select **Series**.
- Select **Data**, then **Add Series Curve**
- Right-click the blank plot area and select **Add Series Curve**

- Select **Data**, then **Membership,** and select **Add Series Curve**.



Note: From the Add Curve and similar menus you can directly add a curve for a Snapshot slot associated with a slot on the selected plot. See "Adding Associated Snapshot Curves" on page 48 for additional information.

Curve Configuration

In the resulting Curve Configuration dialog, select **Select Series Slot** to bring up the Slot Selector. After selecting the desired slot and setting the curve configuration options, select **OK** in the Curve Configuration dialog to add the curve to the plot.

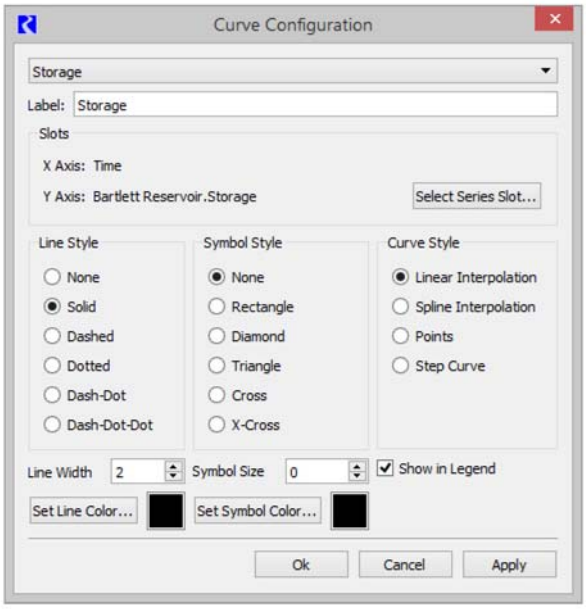
Alternatively, it may be more convenient to quickly plot a slot directly from the Open Slot dialog, Open Object dialog or SCT.

- From the Open Object dialog, highlight one or more slots and select **Slot**, then **Plot Slots** or select the plot icon. 
- From the Open Slot dialog, select **File**, then **Plot** or select the plot icon. 
- From a SCT, highlight one or more slots and select **Slots, then Plot Slots** or select the plot icon. 

The Curve Configuration dialog can be opened to edit an existing curve in any of the following ways:

- Select **Curves** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Curve Configuration** from the menu bar of the **Plot Page Editor**.
- Right-click a curve label in the legend and select **Configure.**

- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Curves.**



The slot associated with a curve can be changed. Select **Select Series Slot** to display a Slot Selector and select the desired new slot.

The name for the curve displayed in the plot legend can be modified in the **Label** field. By default the Object.Slot name is used.

The **Curve Configuration** window offers a selection of line and symbol styles. It lets you select how you want individual curves to be calculated/displayed. Options include the following:

- **Linear Interpolation**: Connect points with a line
- **Spline interpolation**: Use a “natural cubic spline” to fit a curve to the data. The curve is actually a series of spline interpolated points connected by lines. The algorithm creates three times the number of data points for use in the spline curve.
- **Points**: Only show the points.
- **Step Curve:** Show horizontal lines to the left of each data point in the series. These interval values are then connected by vertical lines to create a step. A step curve is the default curve style for slots involving units of flow since flow is an average value over a timestep.

To choose from one of several basic colors, or customize and save colors, select **Set Line Color** or **Set Symbol Color**. This opens the **Set Color** dialog. Use this dialog to choose one of several pre-defined colors, or to create and save special colors from an interactive palette. To create a custom color, move the cursor over the palette to find and select a desired color tone and hue. In the lower-right of the dialog, select **Save to Custom Colors** to save the curve within **Custom Colors**. To change the color properties of any custom color, select that particular color and make adjustments with the palette. Although you make adjustments to the pre-determined colors in the same manner, the changes are not saved unless you have entered them as custom colors.

The **Curve Configuration** also allows you to specify whether the curve should be shown in the Legend. Select the **Show in Legend** checkbox. You can also remove a curve from the legend by right-clicking the item in the legend and choosing **Remove From Legend**.

To delete a curve from a plot, right-select the curve name in the plot legend. Then in the resulting context menu select **Delete Curve**.

Axis Configuration

Access the Axis Configuration dialog in one of the following ways:

- Select **Axes** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Axis Configuration** from the menu bar of the **Plot Page Editor**.
- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Axes.**

Use the Axis Configuration to control the appearance of the axes. First select the desired Left Y, Right Y, Lower X or Upper X axis. The configuration options are different for numeric data versus time series data. First described are common settings and then the settings that are unique for numeric axes, then below for time axes.

Common Configuration

The following configuration options are common to numeric and time axes.

- **Title**: The axis label can be combinations of a user-supplied **Label** and the **Unit Name**. By default the unit name is used as the axis label.



- **Label Angle:** Use the **Label Angle** menu to choose from one of the seven rotations.

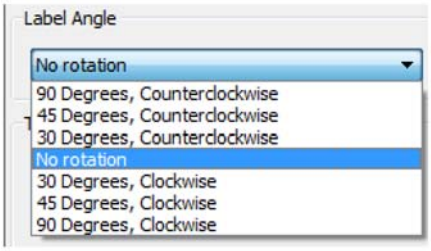
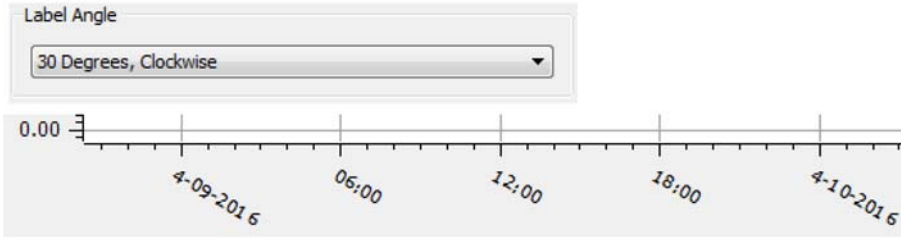


Figure 2.4 is an example of one of the options and the resulting axis labels.

Figure 2.4

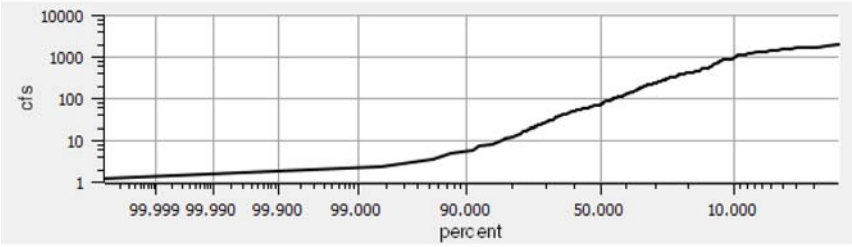


Numeric Axis

The following configuration options apply to numeric axes only.

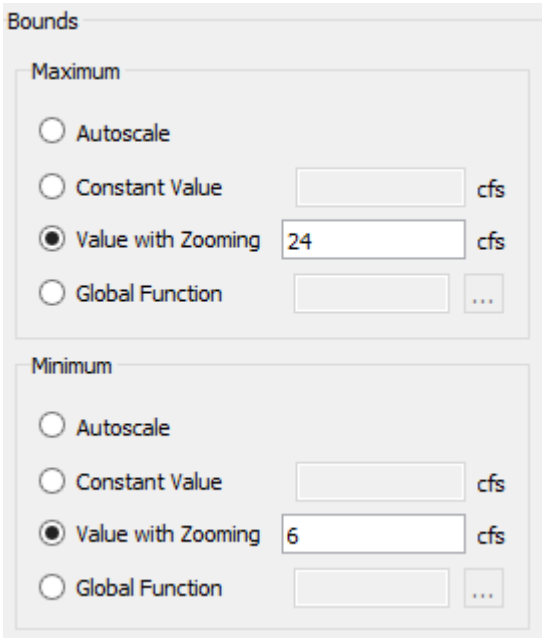
- **Numeric Scale:** You can configure numeric axes to use a **Linear** or **Logarithmic** scale. If the units displayed are percent, you also have the option to select a **Probability** scale as you would see on normal probability paper. On such a scale, normally distributed values will plot as a straight line. Figure 2.5 is a sample.

Figure 2.5



- **Bounds:** Set the **Minimum** and **Maximum** bound, the plotted range on each numeric axis. Figure 2.6 shows the options for both bounds.

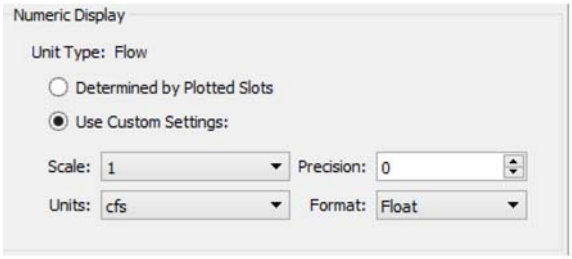
Figure 2.6 Axis bound configuration



The options are as follows:

- **Autoscale**: Automatically determine the bound to contain the values, often with some padding.
- **Constant Value**: Use a constant value when the plot is shown. Zooming or panning in the Plot Editor will not be remembered the next time the plot is shown.
- **Value with Zooming**: Use the value shown but any zooming or panning on the Plot Editor, when applied, will be used as the new value.
- **Global Function**: Specify a global function that returns a numeric value in the axis unit type.

- **Numeric Display:** Set the format of the numeric display using the options. Select one of the following options:
  - **Determine by Plotted Slots**: The axis will use the display settings for the first slot assigned to the plot. These are based on the Unit Scheme rules for that slot.
  - **Use Custom Settings**: Specify the settings for this axis. Change the Scale, Precision, Units, or Format. Format choices include **Float** (the default), **Scientific** (e.g. "1.046 E4"), or **Scientific/Float**. The Scientific/Float format uses Float format if the number is within a specific range, beyond which, the Scientific format is used.



- **Tick Marks:** Specify the **Max Major Ticks** and **Max Minor Ticks** to show.

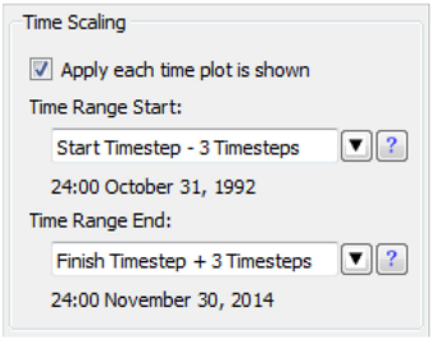
Note: This is the maximum possible; often there will be fewer tick marks shown.

Time Series Axis

Time series axes have alternative controls for the configured range and format. Time scales are always plotted linearly. The number of tick marks are computed automatically. Major and minor ticks are placed at reasonable time intervals based on the amount of time shown on the plot. For example, if you are plotting a year of data, the ticks will be on the start of each month. If you are plotting a month of data, the ticks will be on each day.

The Time Scaling panel includes the following fields:

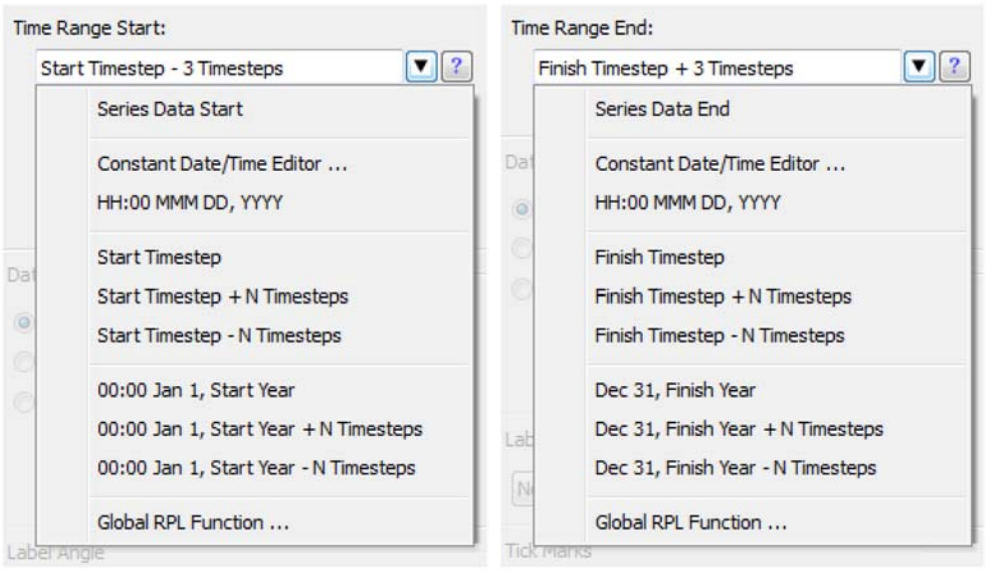
- The **Apply each time plot is shown** checkbox. If this is selected, the configured time range is shown every time the plot is generated (regardless of the last zoom/scaling). In addition, with this on, the graph is also automatically re-scaled when the model's Run Range is changed.



- **Time Range Start** and **Time Range End** editable selectors to define the time range.

These time controls are editable text and use the same symbolic datetime representation as RPL DATETIMES; see "DATETIME" in *RiverWare Policy Language (RPL)* for details. Text below the editor field indicates the actual datetime of the entered symbolic time text (if it is valid), or "undefined." You can also use the drop-down menu to specify one of the common datetimes. Some of these are expressions which must be edited to become valid, e.g. by

replacing “N” with a nonnegative integer and the **HH:00 MMM DD, YYYY** formula, where you substitute the hour, month, day and year.



The **Series Data Start** and **Series Data End** represent the earliest and latest datetimes based on data within the plot’s series curves.

The **Constant Datetime Editor** selection opens a separate dialog to specify the datetime using a selector configured for the model's timestep size.



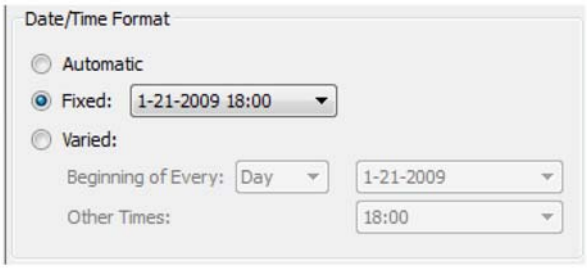
The choices with **00:00 Jan 1**, and **Dec 31**, specify the beginning and end of a year expression, optionally plus or minus a specified number of timesteps.

The **Global RPL Function** opens a Function Selector to select a RPL function in a Global Function Set. The selected function must have a return type of DATETIME, and must not have any arguments.

Select **Help** (question mark icon) on the right side of the symbolic datetime editor to show a description of symbolic datetime representations.

Alternatively, enter any RPL fully specified DATETIME expression; see “DATETIME” in *RiverWare Policy Language (RPL)* for details.

For time series (i.e. lower x axis typically), you can specify the Date/Time Format.



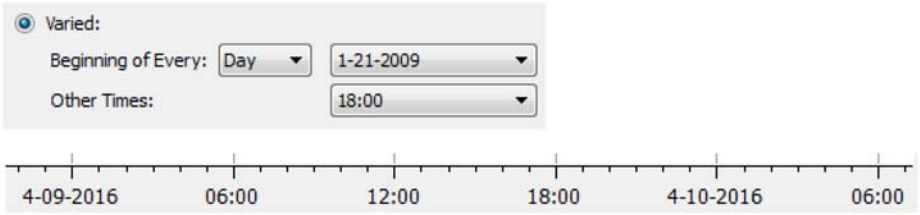
- **Automatic** mode supports the traditional format. Date labels on the time axis are presented based on the overall time range of the plotted series data:
  - Time range > 3 days: 1-21-2009
  - Time range < 3 days: 01-21-2009 18:00
- **Fixed** mode provides a single format for all labeled tick-marks.



- **Varied** mode displays date/time axis label text in two different selected formats:
  - One format for date/times starting at the beginning of every **Year**, **Month**, or **Day**, and
  - A different format for all other date/times.

For example, Figure 2.7 shows a varied format, with the full date at the beginning of the day and just the time for all other labels. The resulting axis is shown.

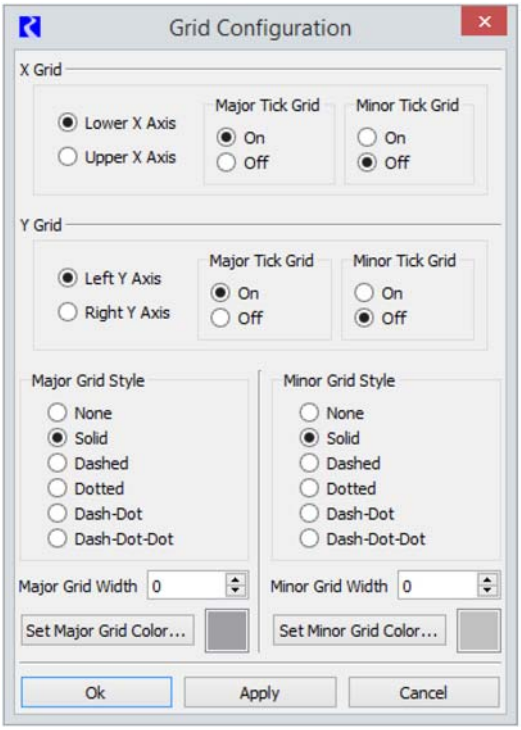
Figure 2.7



Grid Configuration

Access the Grid Configuration dialog in one of the following ways:

- Select **Grid** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Grid Configuration** from the menu bar of the **Plot Page Editor**.
- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Grid**

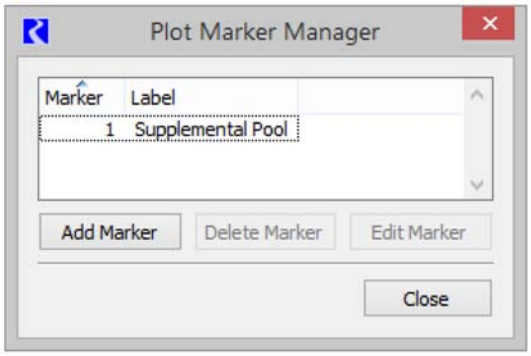


In the Grid Configuration dialog you may select whether major and minor grid lines are visible on each axis. You also select from this dialog the grid line style and color.

Marker Configuration

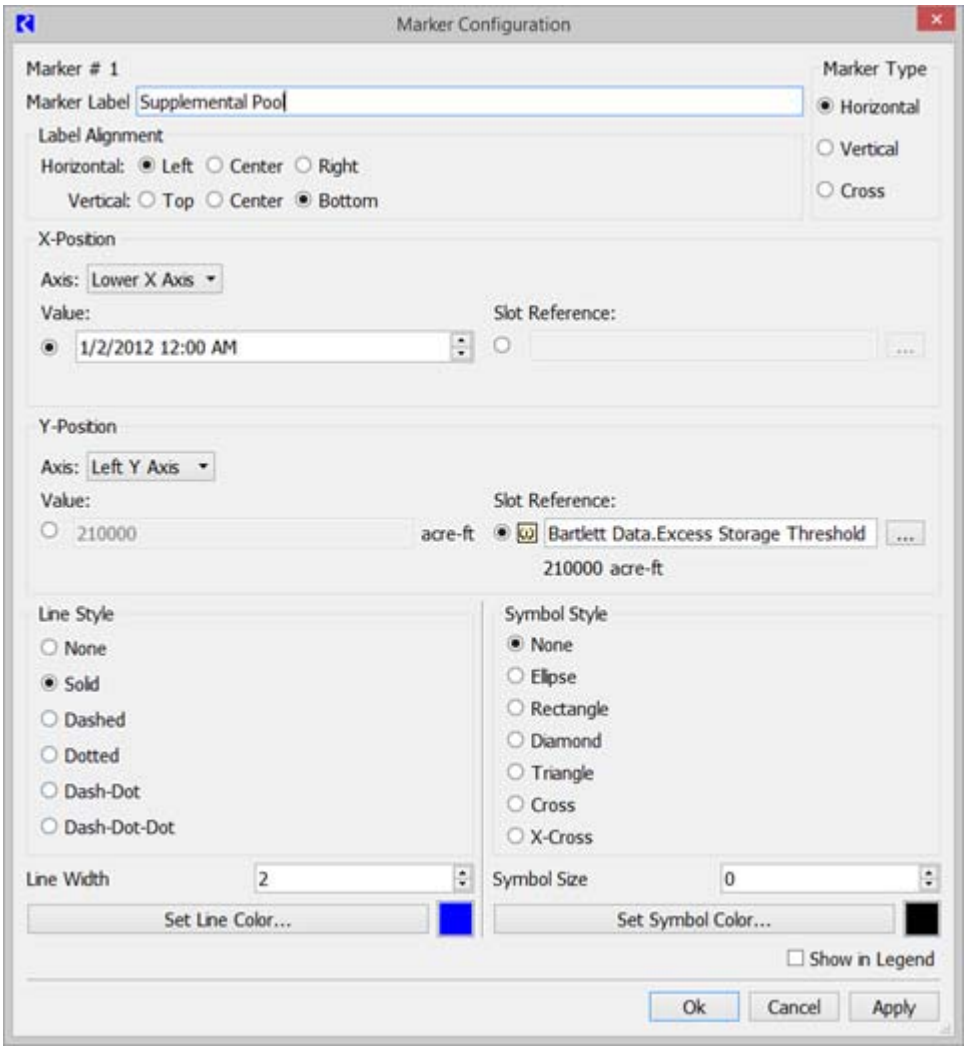
Markers allow you to add horizontal or vertical lines on a plot marking some important threshold or boundary. You can add, delete or edit markers from the Marker Manager. Access the Marker Manager in one of the following ways:

- Select **Markers** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Marker Manager** from the menu bar of the **Plot Page Editor**.
- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Markers.**



Add a marker by selecting **Add Marker** in the Marker Manager. To edit the marker, highlight the marker in the **Marker Manager** and select **Edit Marker**.

The **Marker Configuration** dialog box provides marker configuration options.



In the upper-right, under **Marker Type**, select the axis/axes in which the marker appears. The horizontal marker creates a line at a specified Y value, the vertical marker creates a line at a specified X value, and the cross marker creates both a horizontal and vertical line. Optionally, add a label to the marker in the **Marker Label** field, and its position can be set by selecting the appropriate **Horizontal** and **Vertical Alignment** option.

Next, select the location of the marker on each axis, in the X-Position and Y-Position regions. Select the desired axis (Lower X or Upper X / Left Y or Right Y) and then specify either:

- Value: Enter a static value in the axis units. For an X-axis displaying time, toggle through timestep intervals, using the arrows or type in the text.
- Slot Reference: Use the button to open a slot selector and select a scalar slot that holds the marker value. Once chosen, the value will be shown. The slot must be a scalar slot (regular scalar or scalar with expression) and have the same unit type as the axis. Use this option if the value referenced by the marker will change via DMI, Initialization Rule, Script or user input.

Also, in the **Marker Configuration**, specify the Line Type, Line Width, Line Color, Symbol Style, Symbol Size, and/or Symbol Color.

Specify whether to display a legend entry for the marker by selecting the **Show in Legend** checkbox. You can also remove a marker from the legend by right-clicking the item in the legend and selecting **Remove From Legend**.

Set Plot Title

A separate title can be given to each plot in a Plot Page. Access the Plot Title Editor in one of the following ways:

- Select **Plot Title** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Set Plot Title** from the menu bar of the **Plot Page Editor**.
- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Title.**

In the resulting Plot Title dialog, provide a customized name for the plot. Then select **OK** or **Apply**. The font for the plot title can be changed in the Plot Settings; see "Plot Page Settings" on page 32. However, the font is a user setting and will apply for all plot titles in RiverWare for that user.

Set Background Color

Access a color selector for the plot background in one of the following ways:

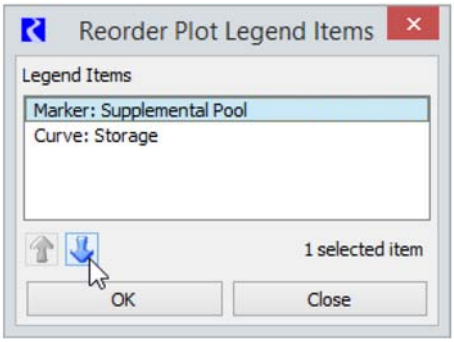
- Select **Background** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Set Background Color** from the menu bar of the **Plot Page Editor**.
- Right-click the plot area, and then in the resulting context menu select **Configure**, then **Background Color.**

Select the desired background color from the color selector dialog.

Reorder Legend

Access the Reorder Plot Legend dialog in one of the following ways:

- Select **Legend** on the left side of the **Plot Page Editor** dialog.
- Select **Edit**, then **Reorder Legend** from the menu bar of the **Plot Page Editor**.
- Right-click one of the legend items in the plot, and then in the resulting context menu select **Reorder Legend.**



Select one or more curves or markers and use the **Up** and **Down** arrows to re-arrange the order. Curves or Markers in the italics font are not shown in the legend (based on their Curve/Marker configuration) but are still listed in the Reorder dialog.

Plot Page Editor Menus

Following is a description of each menu in the **Plot Page Editor**.

File Menu

The **File** drop-down menu offers options for saving Plot Pages in the model, creating templates or similar Plot Pages, exporting the Plot Page to a file, and exporting or printing plot images. Following are descriptions of the available selections.

- **Save As**: Select **Save As** to save the Plot Page with a name if it does not already have one (same as entering a name in the **Name** field of the Plot Page Editor and selecting **Apply**). If the Plot Page has already been saved with a name, the **Save As** selection can be used to save a copy of the Plot Page with a new name. In both cases the new name will be added to the Plot Page Selection List in the Plot Page dialog. Saving a Plot Page will preserve the configuration of the Plot Page (e.g., the slots associated with the plots, layout, and line and color choices). Because plots are automatically updated with new slot information (after a new run or after user input values have been changed), a saved Plot Page does not preserve the results of a particular model run. Snapshots can be used to preserve the results of model runs; see "Snapshots" on page 195 for details.

  Note: You must either save a Plot Page using Save As or give the Plot Page a name and select **Apply** in the Plot Page Editor to preserve a Plot Page configuration. Otherwise, when you close the Plot Page Editor, the Plot Page is lost.

- **Save As Template** allows you to save the current Plot Page as a template. See "Plotting Templates" on page 63 for details on creating and using templates.

- **Create Similar Plot Pages** allows you to directly create Plot Pages similar to the existing Plot Page using different objects, accounts, slots, or supplies depending on which sub-menu is selected. See "Creating Similar Plot Pages" on page 71 for details.

- **Import Plot Page Configurations** allows you to import Plot Page Configurations that have been exported to a file. Select a desired import file from the resulting **File Chooser** dialog and select **Open**. An informational dialog is displayed that summarizes the devices that were imported. Unique names are created (via a numbered suffix) for any Plot Pages with names that already exist as Plot Pages in the model.

  Note: This is the same import capability that is available through the Output Manager; see "Exporting and Importing Output Devices" on page 2 for details.

  Note: If Plot Pages are exported from one model and imported into another one that does not have the same objects and slots, the curves of the plots will not have valid slots associated with them.When you generate the Plot Pages, the curves will appear in the legend of the plots, but without data for the curves. You can then select new slots using the curve configuration section; see "Curve Configuration" on page 19 for details.

- **Export Plot Page Configuration** allows the selected Plot Page configuration to be exported to a file. Select or enter a desired file path and name in the resulting **File Chooser** dialog, and select **Save**. All Plot Page configuration information is saved to the file.

- **Export Image** allows saving of the image of a selected plot or all plots on the Plot Page to a graphics file. The graphics file can be in one of a number of image formats. Other options include the export image's size (number of pixels) and resolution (low-medium-high). See "Printing and Exporting Plots" on page 74 for additional information.
- **Print Preview** will show of preview of the plot as it would appear on the specified printer. See "Printing and Exporting Plots" on page 74 for additional information.
- **Print** will send a selected plot or all plots on the plot page to your printer. See "Printing and Exporting Plots" on page 74 for additional information.

Edit Menu

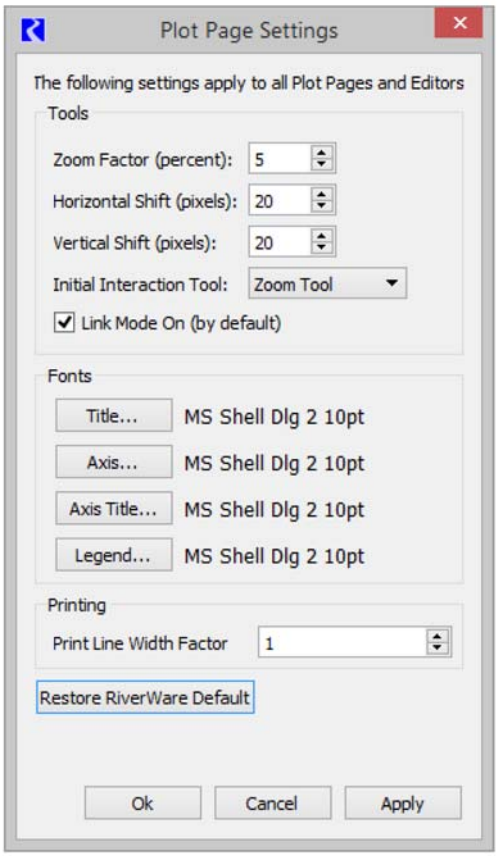
The **Edit** menu lets you access several configuration options.

- **Copy Plot Image** copies the plot or plot page as an image for pasting to a document or email. See "Copy Plot as an Image" on page 77 for additional information.
- **Configure Multiple Curves and Plots** has the same behavior as selecting **Multiple**. See "Curve Configuration" on page 19 for details.
- **Curve Configuration** has the same behavior as selecting **Curves**. See "Curve Configuration" on page 19.
- **Marker Manager** has the same behavior as selecting **Markers**. See "Marker Configuration" on page 27.
- **Set Plot Title** has the same behavior as selecting **Plot Title**. See "Set Plot Title" on page 30.
- **Grid Configuration** has the same behavior as selecting **Grid**. See "Grid Configuration" on page 27.
- **Axis Configuration** has the same behavior as selecting **Axes**. See "Axis Configuration" on page 21.
- **Reorder Legend** has the same behavior as selecting **Legend**. See "Reorder Legend" on page 30.

Plot Page Settings

Select **Edit**, then **Plot Page Settings** menu to display the **Plot Page Settings** dialog which allows you to change settings for fonts, and how tools behave. Plot settings are saved with a user account on a particular machine rather than with the Plot Page or model file. This allows you to restore your default settings as desired.

Figure 2.8



The top of **Plot Dialog Settings** controls the tools that appear on the plot dialog. Selections at the top of this dialog box let you determine

- **Zoom Factor**: the extent to which the plot size is enlarged or decreased when you select the Zoom tool.
- **Shift**: here is also a function that lets you set the number of pixels to which the plot is moved along either axis with the translate tool. You can enter these values manually or toggle them with the arrows adjacent to each window.
- **Initial Interaction Tool**: Also, you may select whether the default mouse tool zooms or re-centers the plot.
- **Link Mode On:** whether the link mode is on or off by default. In the event that there is more than one plot in a Plot Page at any given time, use the link mode. Having the link mode on causes any manipulation, such as zooming or translating along an axis, to be carried out by all of the plots in the Plot Page.

The **Plot Dialog Settings** has options to customize the fonts used for the plot Title, Axis, Axis Title, and Legend separately. There are options for various font sizes, styles and types. The font characteristics are stored per user—not as part of the model file. This eliminates potential problems with loading plots on machines that may not have the same set of available fonts.

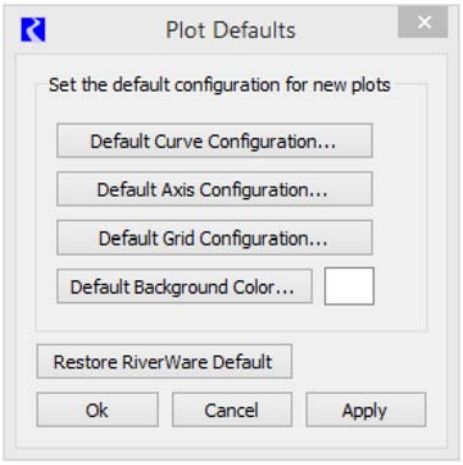
Note: Changes to the settings and fonts in the Plot Page Settings will apply to all existing plots.

The **Print Line Width Factor** is used to specify how wide you would like printed lines on paper or PDFs. During printing, all of the slot curves' and markers' line widths are increased using a function of this factor in order to give the lines a proper appearance when printing. Default is 1, but you can increase it as needed.

Select **Restore RiverWare Default** to restore the system defaults; as shown in Figure 2.8. For Fonts, MS Shell Dlg 2 is used as the RiverWare default for all fonts. This selected font essentially tells the system to decide which font to use. In most cases, the Tahoma font is displayed.

Configuration Defaults

The **Edit, then Configuration** menu opens the Plot Defaults for curves, axes, grids, and background color. These configuration options set the defaults for new plots.

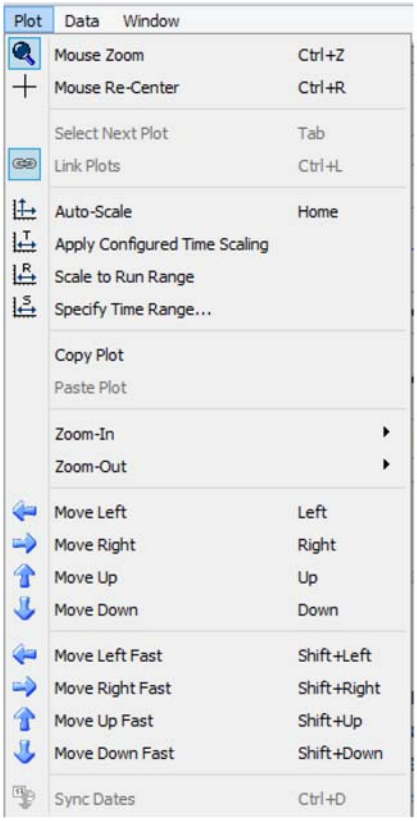


- **Default Curve Settings** sets default line, symbol, and curve styles.
- **Default Axis Settings** sets defaults for the axes, including the following:
  - Format for the numeric display on the axes.
  - Time scaling used when the plot is created. See "Time Series Axis" on page 24 for additional information on use of this format.
  - Default Date/Time Format
  - Major and minor tick mark settings.
  - Two-column table slot defaults. This setting allows table slots with length units in the first column to be shown with the length unit as the vertical axis. This overrides the default behavior. See "Table Curves" on page 42 for additional information.
- **Default Grid Settings** sets default major and minor grid styles, width and color.
- **Default Background Color** sets the color used by default for the plot background.

Select **Restore RiverWare Default** restore the system defaults. These include a white background, curve line thickness of 2, major grid line thickness of 1, with dotted grey line type. There are no minor grid lines.

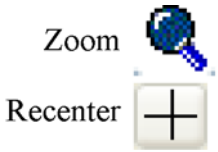
Plot Menu

The **Plot** drop-down menu displays options that deal with an individual plot or panel including zoom and scaling capabilities. For easy access, many of the functions listed here also appear on the toolbar and the plot right-mouse context menu, or you can execute them using key commands. These include the **Auto-scale**, **Zoom-In**, **Zoom-Out**, and **Move** commands. Next to each command are displayed keyboard shortcuts for each action.



Following is a description of each command in the **Plot** menu.

Mouse Zoom/ Mouse Recenter



The **Mouse Zoom** and **Mouse Recenter** features determine the function of the mouse icon. The **Recenter** tool displays crosshairs as a mouse icon and causes the plot to be centered around the point at which the mouse is selected. The **Zoom** tool displays a magnifying glass cursor icon, which lets you select a zoom rectangle by click-and-dragging the mouse.

Select Next Plot

Selects the next plot, shortcut: **Tab** key. In a multi-column layout, the next plot is the one to the right, then down.

Link Plots 

If there is more than one plot in the **Plot Dialog** the **Link Plots** tool is active, letting you do manipulation operations on all of the plots in unison (including AutoScale, the Shift Tools, the Zoom Tools, Date Spinner, and Date Center). If **Link** is off, you manipulate the currently selected plot (selected by selecting the plot or by using **Tab** to toggle). If you are using only one plot, this function is not available. You may not link plot customization operations—they must be performed on individual plots.

Auto-Scale 

The **Auto-Scale** feature scales and translates the plot to include the entire range of data.

Apply Configured Time Scaling 

The **Apply Configured Time Scaling** feature scales and translates the plot to the range configured on the axis. This can be a symbolic or absolute time range. In addition, you can configure the plot to always use this configured time range when opening the plot. See "Time Series Axis" on page 24 for more information.

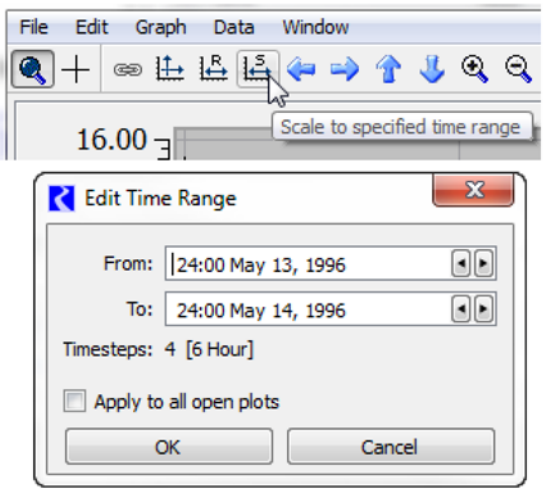
Note: This operation does not affect the y axis scaling.

Scale to Run Range 

The **Scale to Run Range** scales the x axis to the run range defined on the run control. It is available only for times series plots. The y axis display is not affected.

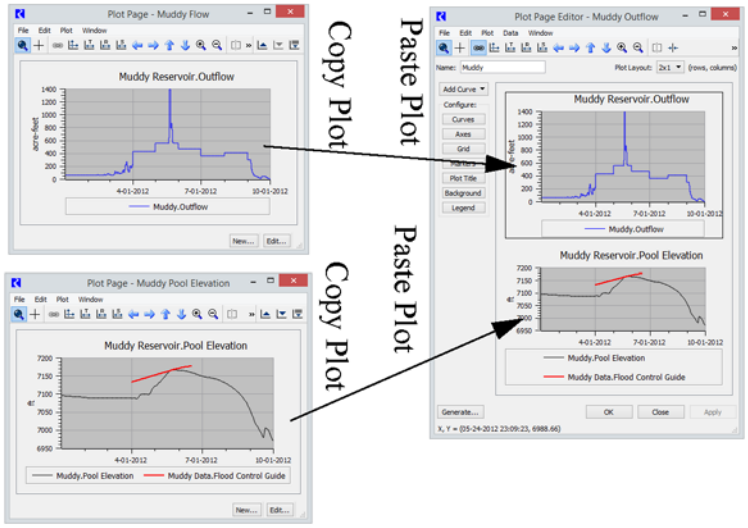
Specify Time Range 

The **Specify Time Range** operation scales the plot to a range that you specify in the dialog. This operation does not affect the y axis scaling. There is also the option to **Apply to All Open Plots.** This sets the visible range of all open plots to the specified range. Each Plot Page would need to be saved to preserve that range.



Copy Plot / Paste Plot

The **Copy Plot** menu item allows you to copy the selected plot to the plotting clipboard and then the **Paste Plot** menu item allows you to paste that plot to a new location. These two menus allow you to quickly combine or separate multi-layout Plot Pages. For example, you may have two great 1X1 Plot Pages configured as desired. Now you wish to combine those individual plots into a 2X1 Plot Page so that you can see them on a linked x axis. Select one of the plots, and copy it. Then create a new 2X1 Plot Page and paste the first plot onto one of the empty plot panels. Repeat the copy for the second plot, and then paste it into the empty plot panel in the 2X1 layout.



Note: This option is used to copy the plot for use in another plot. If you want to copy the plot as an image and paste it in a document, use **Edit Copy Plot Image. See** "Copy Plot as an Image" on page 77 for details.

Zoom Tools



The **Zoom** feature zooms in or out on the center of the plot dialog.

Note: Use the middle mouse wheel to zoom in/out on either the plot area or an axis. See "Mouse Button Actions" on page 63 for additional information.

Move Tools



The **Move** tools shift the plot in either the X or Y direction. You set the magnitude of the move from the **Plot Page Settings**. There are also options to do a rapid move. Use the arrow keys as shortcuts. Use the Shift-Arrow or Shift-select to do a rapid move.

Note: Click the middle mouse button/wheel to pan the plot area. See "Mouse Button Actions" on page 63 for additional information.

Sync Dates

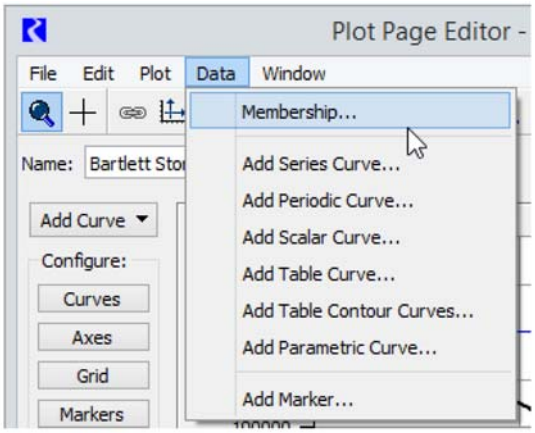


The **Sync Dates** feature synchronizes the dates on all plots in the selected column. If there is only one plot on the Plot Page, this function is not available.

Plots can be autoscaled individually or together. To autoscale or manipulate multiple plots in unison, they must first be linked. Plots can be linked by selecting **Plot**, then **Link Plots** or select **Link Plots**. Autoscaling the plots is then achieved by selecting **Plot**, then **Autoscale** or selecting **Autoscale**.

Data Menu

The Data menu is used to add data or markers to the plot.



Membership

From the **Data, then Membership** menu, the user can add or view the various types of plots.

Add Curve Functions

The **Data** drop-down also lets you select each slot type individually with the **Add Series Curve**, **Add Periodic Curve**, **Add Scalar Curve**, **Add Table Curve**, **Add Table Contour Curves**, and **Add Parametric Curve** items. Selecting one of these commands prompts the **Curve Configuration** dialog for the specific curve to appear.

Add Marker

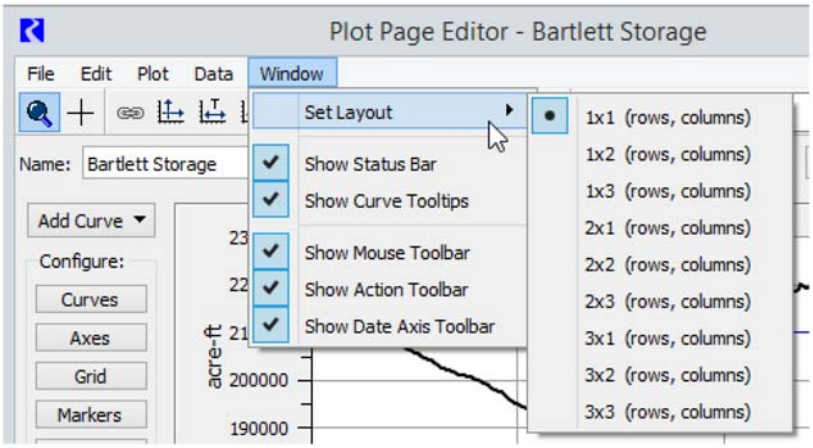
Lets you insert a marker into the plot.

To insert a marker into the plot: Select **Add Marker.** The **Marker Manager** dialog appears. See “Marker Configuration” on page 27 for details.

Window Menu

Set Layout

In the **Window**, then **Set Layout** drop-down menu of the **Plot Page Editor,** you select the number of plots that appear in the plot dialog. To change the dialog from a 1X1 array of plots to as many as a 3X3 array: Select the **Set Layout** menu item.



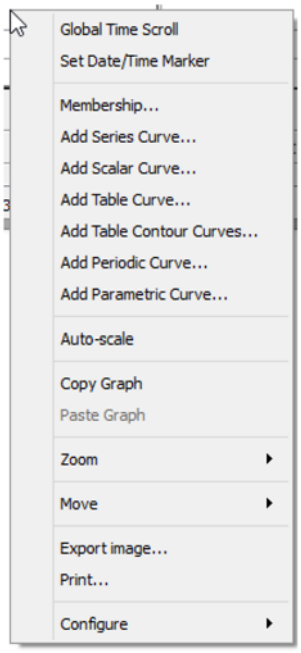
When the display size changes, the plots are automatically updated to occupy the new dialog size.

You can then copy and paste individual plots by selecting **Plot**, then **Copy Plot** and **Plot**, then **Paste Plot**. See "Copy Plot / Paste Plot" on page 37 for details.

Context Menus

The plotting dialog allows the concept of context sensitive right-mouse functions. This lets you manipulate, configure, and export or print a plot using the menus. **Global Time Scroll** allows you to move all dialogs in the model (including future ones) to the date at which you selected. This is especially useful for debugging. When the Global Time Scroll is activated on a plot, a dotted red vertical marker line can be shown on the plot. This line can

be hidden by selecting the **Date** Spinner in the toolbar. See “Toolbar Actions” on page 60 for additional information.



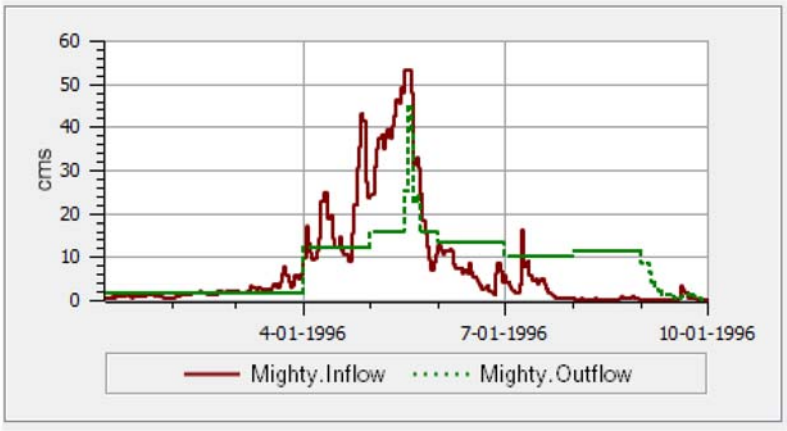
Types of Curves

There are six types of curves described in the following sections: Series, Scalar, Table, Table Contour, Periodic, and Parametric.

Series Curves

A Series Curve plots a timeseries of data from a Series Slot. The x-axis is time and the y-axis is the value. Multiple series can be plotted on one curve and can have multiple axes. Figure 2.9 is an example of two series curves.

Figure 2.9



The displayed time range of the plot is initially taken from the setting in the axis defaults. To view or modify the setting, in any **Plot Dialog**, select the **Edit** menu's **Configuration Defaults** item (see "Configuration Defaults" on page 34). This brings up the Plot Defaults dialog. In the **Plot Dialog Settings** dialog, select **Default Axis Configuration**. This displays the **Axis Default Configuration Settings** dialog. To specify the initial time range shown, select the desired start and end range of the plot. See "Time Series Axis" on page 24 for descriptions of the options.

Scalar Curves

A Scalar Curve plots a single value from a Scalar Slot on a time series plot. Usually, the x-axis is time and the y-axis is the value. The only exception is if the scalar slot has the datetime unit type. In which case, the scalar curve is plotted as a vertical line. Figure 2.10 shows two elevation scalar slots plotted as horizontal lines along with one datetime scalar slot plotted as a vertical line.

Figure 2.10

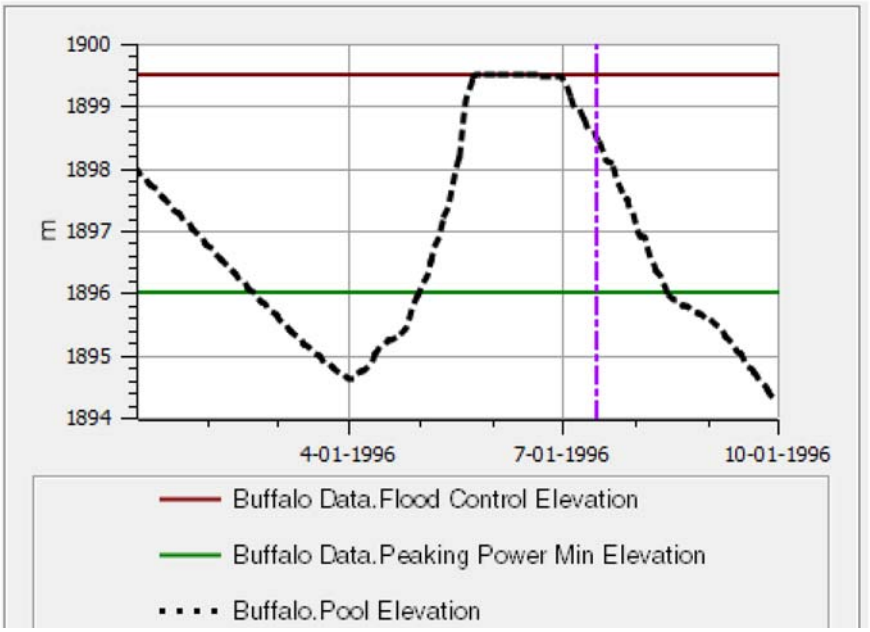
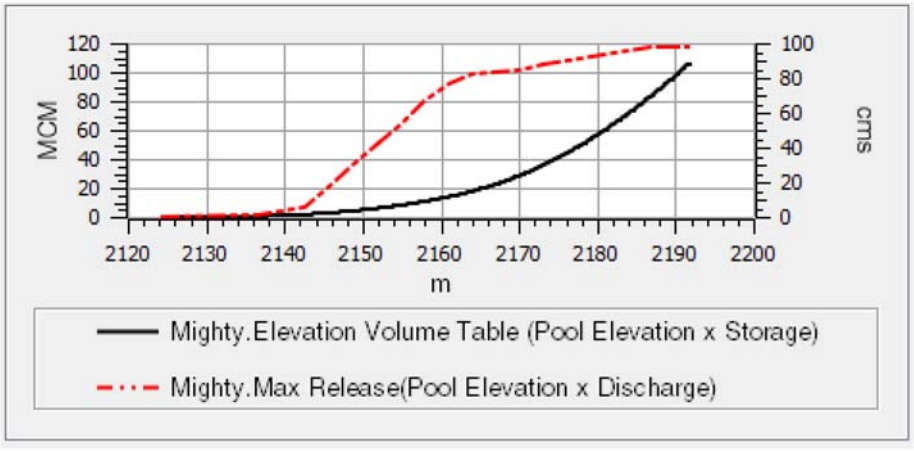


Table Curves

A table curve plots two sets of data from a table slot. Multiple table curves can be shown on one plot using one or more sets of axes. Figure 2.11 is a plot with two table curves and two y-axes.

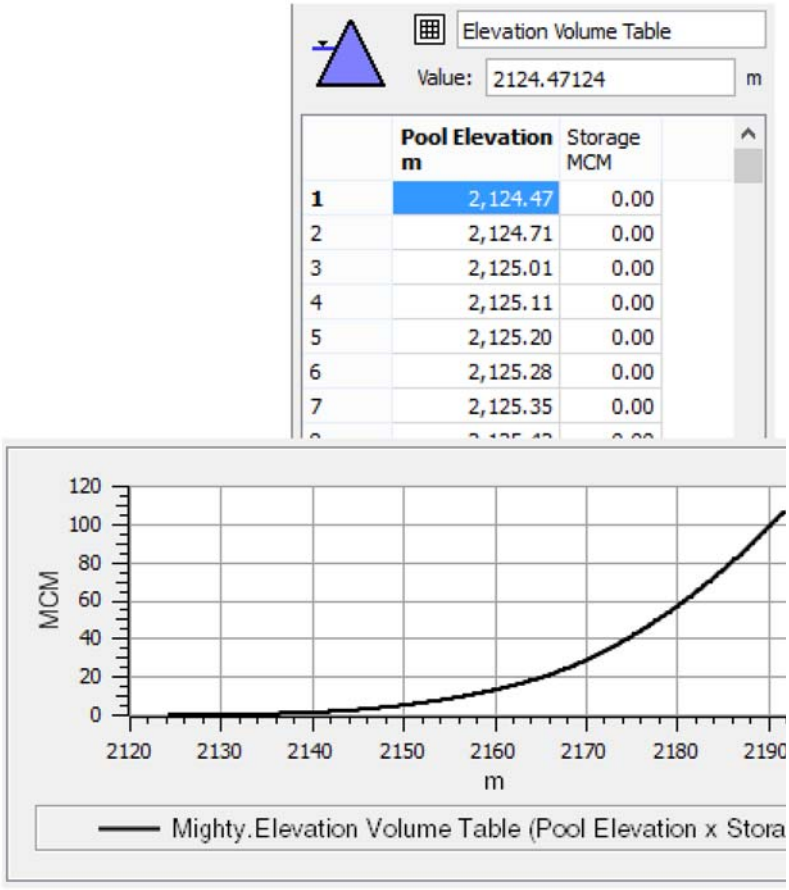
Figure 2.11



When plotting a Table Slot *with more than two columns*, the user has the opportunity to pick particular columns for the X and Y axes.

When plotting a *two-column Table Slot,* the numeric values from the first column are plotted along the horizontal ("X") axis, and the values from the second column are plotted along the vertical ("Y") axis, by default. See Figure 2.12. This can be changed within the configuration. The default configuration is often not ideal for elevation plots where the length unit would more naturally be on the Y axis. To override this, use the **Two-Column Table Slot: Plot Axes Assignment Override** checkbox in the defaults described in the remainder of this section.

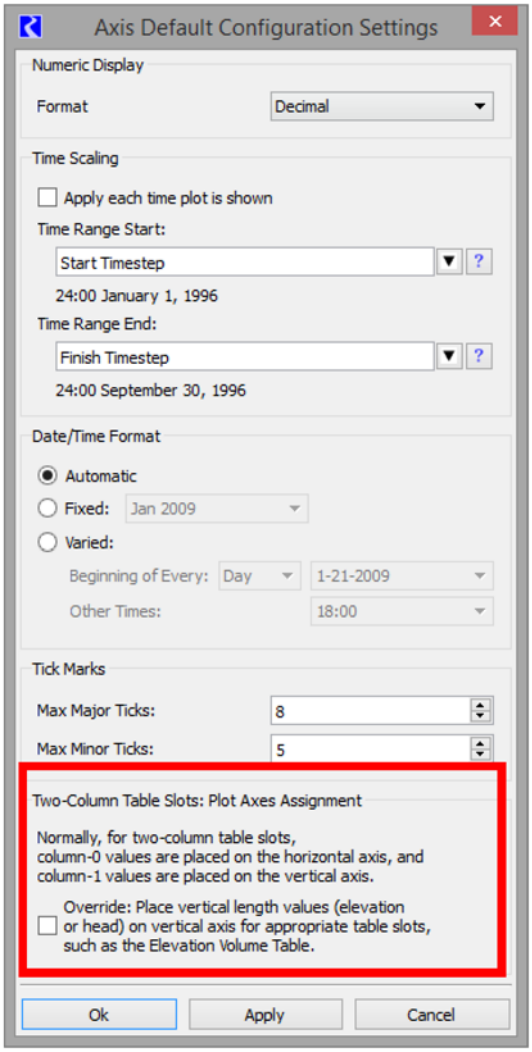
Figure 2.12



To view or modify this setting, in any **Plot Page Editor**, select **Edit**, then **Configuration Defaults** item (see "Configuration Defaults" on page 34). This brings up the Plot Defaults dialog. Select **Default Axis Configuration**. This brings up the Axis Default Configuration Settings dialog.

The setting is represented by the **Override** checkbox in Figure 2.13.

Figure 2.13



This setting is associated with the RiverWare model file rather than with user-login based configuration.

> **Note:** This differs from other defaults related to plot configuration—these are generally stored as user-login based configurations.

The automatic switching of plot axes is applied at the time of creation of the plot -- so changing the setting of this toggle does not effect plots already created and saved with a RiverWare model file.

When the toggle is checked and a new plot is created, the standard mapping of two-column Table Slot columns to the plot axes is reversed on certain Table Slots. The plot axes reversal will occur if the following criteria are true:

- Column 0 is determined to be a “vertical distance”, and
- Column 1 is determined to NOT be a “vertical distance”

A Table Slot column entity is regarded as a “vertical distance” if both of these are true:

- The unit type of the column is LENGTH, and

- The column label is blank OR the column label contains the substring “ELEV” or “HEAD”, in either upper case, lower case or mixed case.

When these conditions are met, the plot will be created with reversed axes. In Figure 2.14, the second image depicts an axes reversal of the plot on the left as a result of this setting.

Figure 2.14

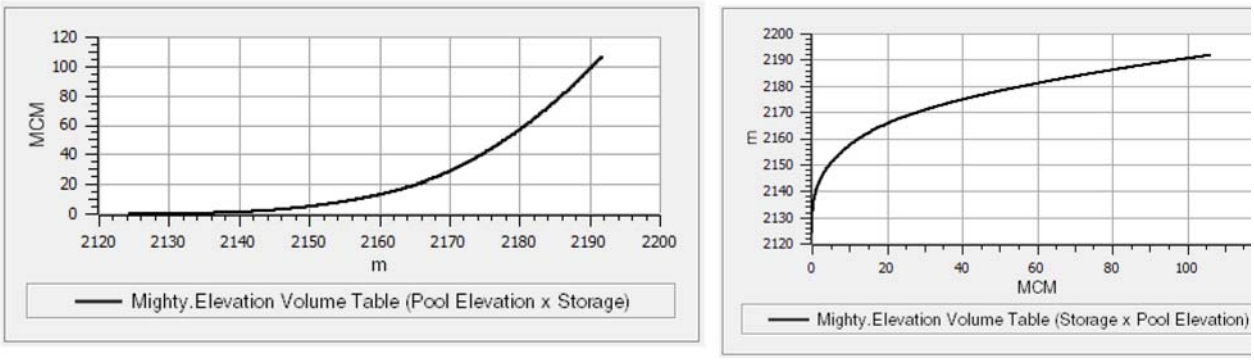
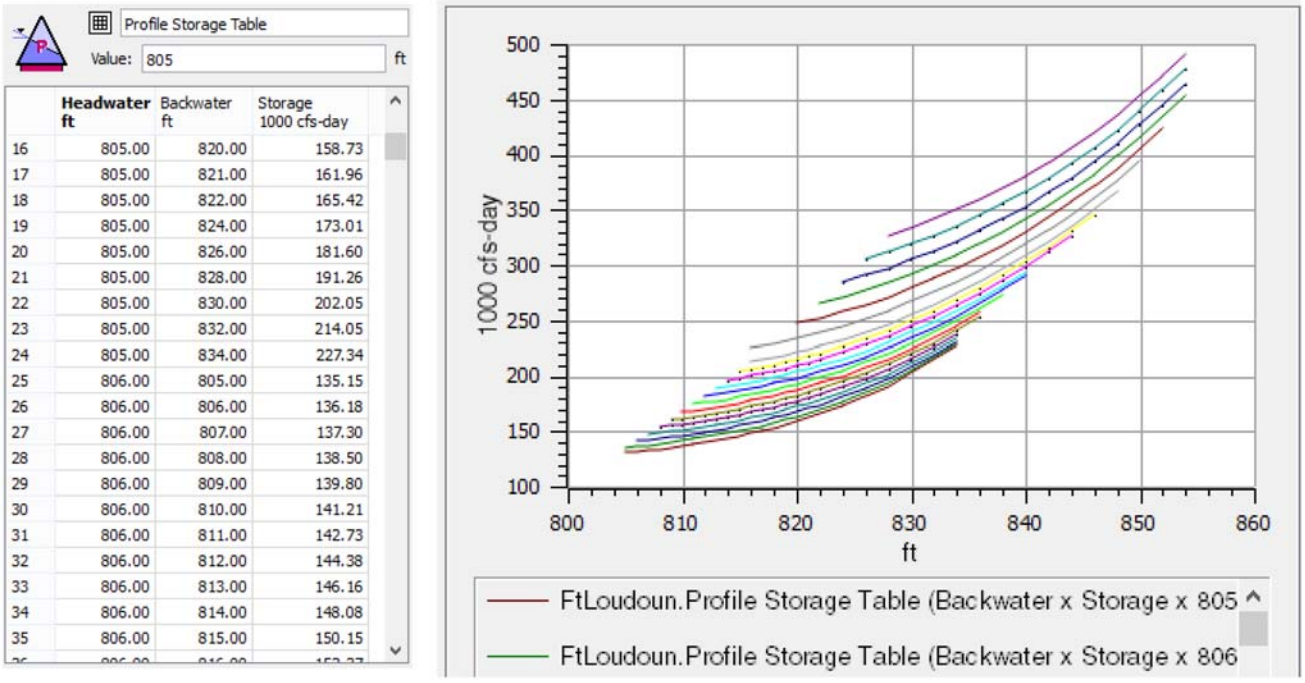


Table Contour Curves

A table contour curve is used to plot a three dimensional table. Figure 2.15 is an example of a table contour curve representing the headwater backwater, storage curve. Each curve represents a given Headwater.

Figure 2.15



Periodic Curves

A periodic curve is used to plot a column of a periodic slot (y-axis) versus the time on the x-axis. The user is able to specify the column to plot. The curve is shown for whatever time range is plotted. If there are not other plots on the curve, it defaults to the run length. Select **Scale to Specified**  to enter your desired range of dates.

Figure 2.16

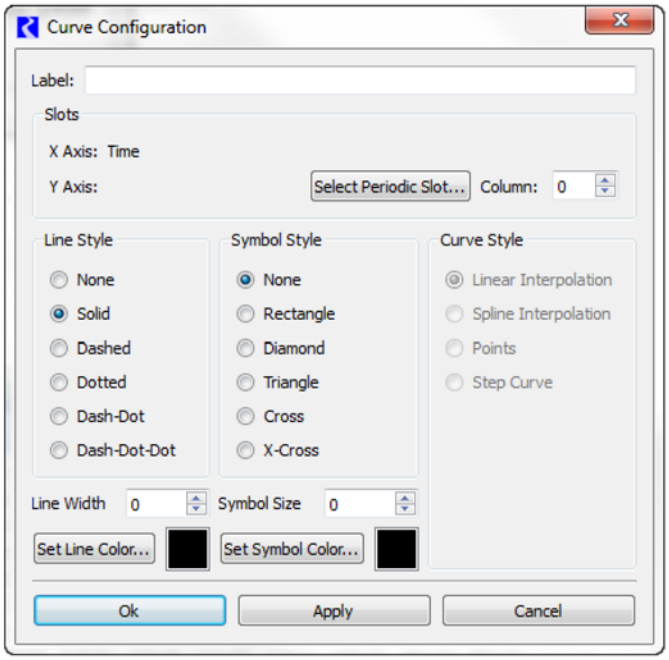
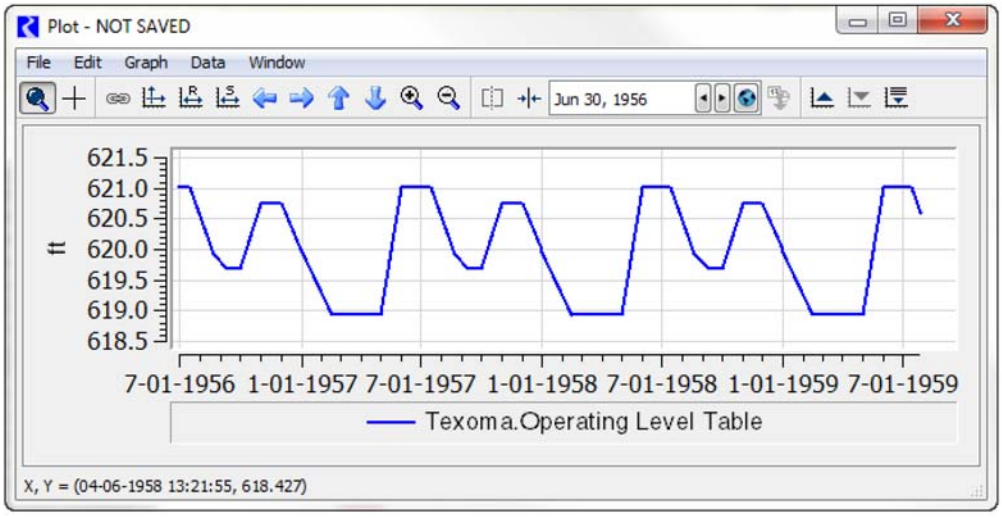


Figure 2.17 is a plot of one of the levels from an operating level table. The curve repeats, showing the periodic nature.

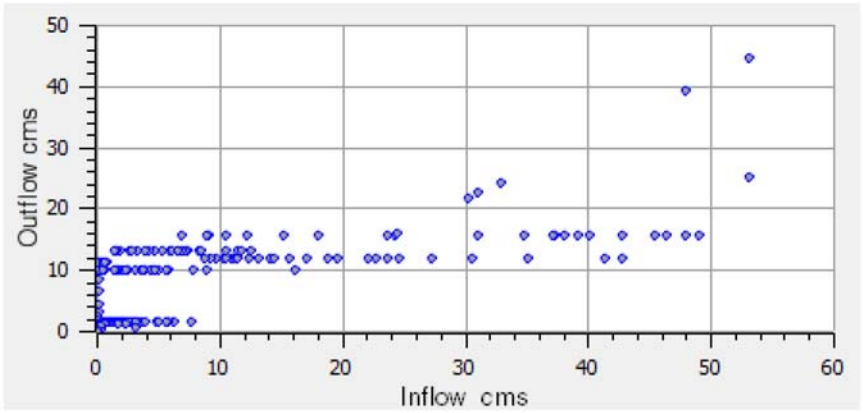
Figure 2.17



Parametric Curves

A parametric curve is used to plot one set of series data against another set of series data. The user selects a series slot for the x-axis and another series slot for the y-axis. In Figure 2.18, Inflow is plotted against Outflow to see if there is any relationship between the two.

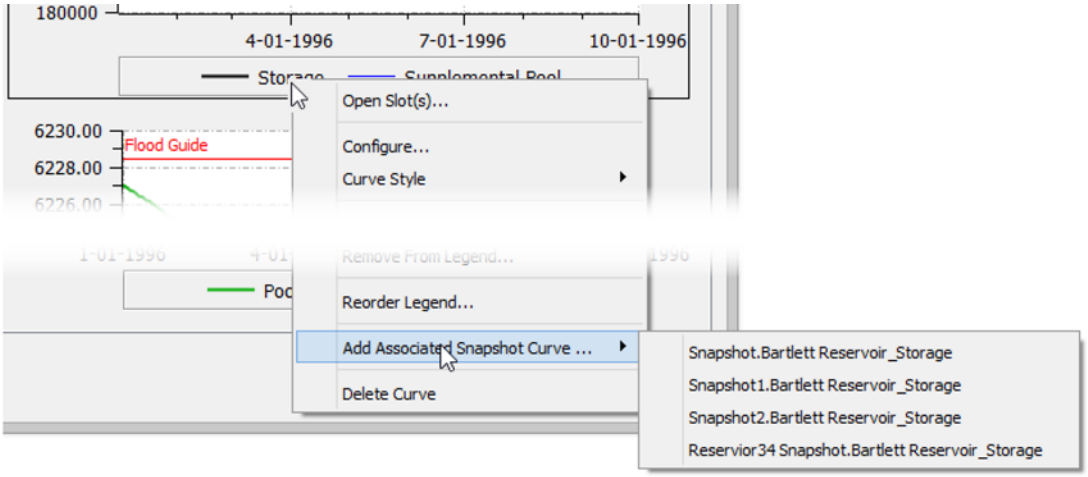
Figure 2.18



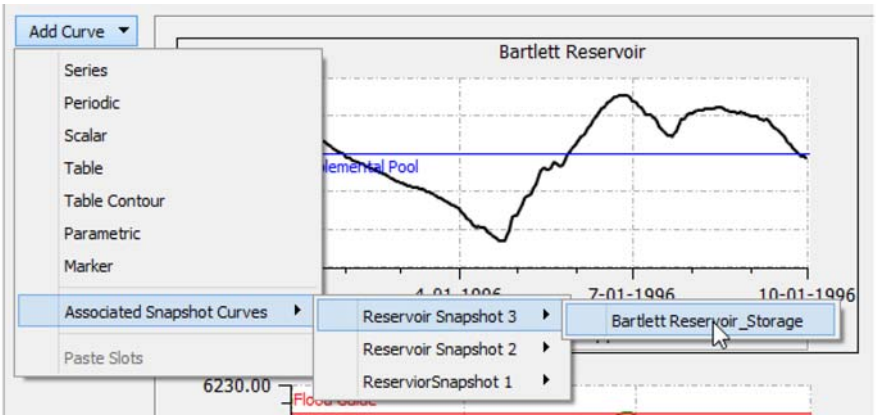
Adding Associated Snapshot Curves

Snapshots are way to preserve results between runs; see "Snapshots" in *Output Utilities and Data Visualization* for details. For comparison, it is useful to plot both the slot and one or more of its snapshots. The plotting utility allows you to quickly add curves for the associated snapshots. Given a plot that contains curves for a slot of interest, there are the following ways to add curves for the associated snapshots from the Plot Editor.

- Right-click the legend for the slot and select **Add Associated Snapshot Curve** and then select the desired snapshots. In this case, only the snapshots of the given slot are shown.



- Select **Add Curve** and select **Add Associated Snapshot Curve** and then select the desired snapshot and slots. In this case, snapshots of all slots on the selected plot are shown in the menu.



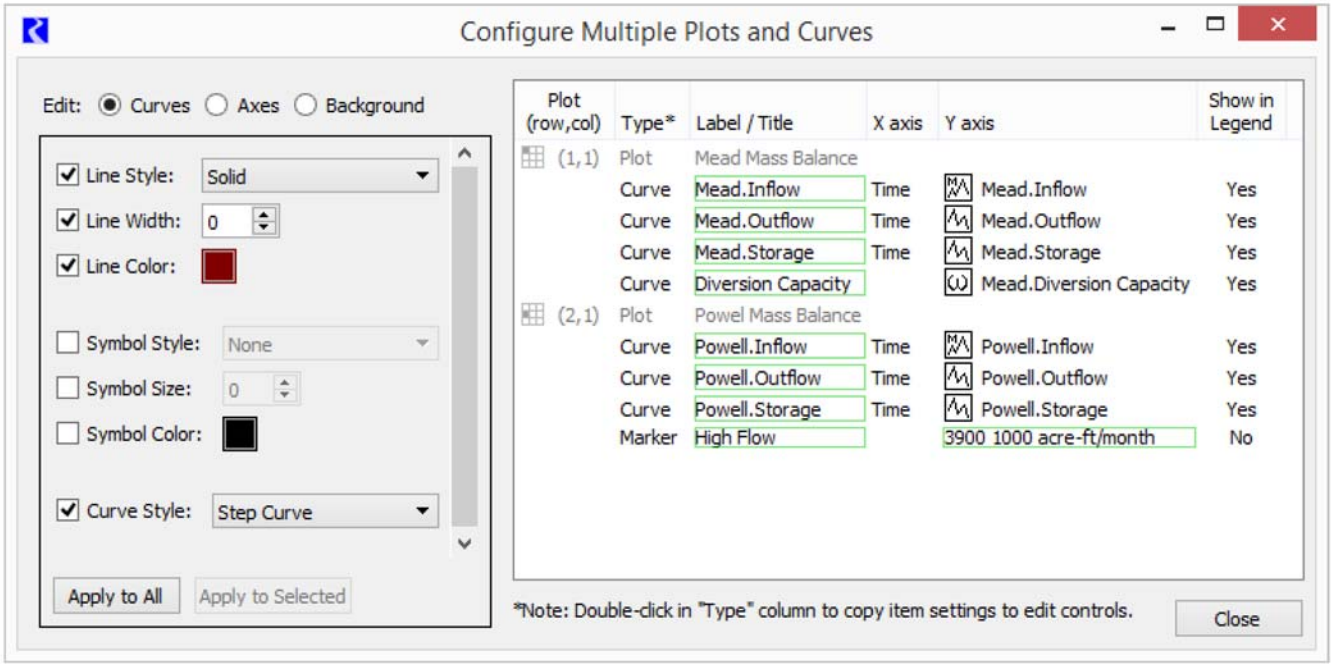
- Right-click the plot area (or use the **Data** menu) and select **Add Associated Snapshot Curve** and then select the desired snapshot slots. In this case the snapshots of all slots on the selected plot are shown.

In all cases, the **Add Associated Snapshot Curve** only is shown when there are snapshots of the plotted slot and there is not already a curve for that slot. Once added, the curves of snapshot slots are no different than other curves. The labels are SnapshotName.OrginalObject_Slot.

Configuring Multiple Plots and Curves

The Configure Multiple Plots and Curves dialog allows you to Edit the appearance of multiple plots or curves in one location. Most plot settings for the optional nine separate plots within a plot page are editable within the dialog. The user can select multiple items within a plot page, e.g. curves and markers, and apply selected settings to those items in a single operation. The dialog is shown in Figure 2.19.

Figure 2.19

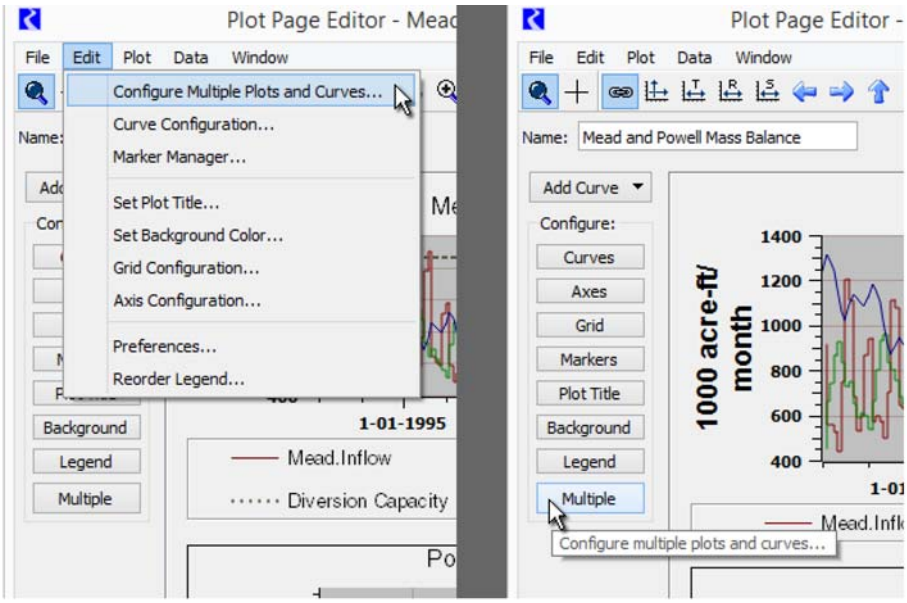


Accessing the Configure Multiple Plots and Curves Dialog

The **Configure Multiple Plots and Curves** dialog is accessible from the **Plot Page Editor** dialog via the **Edit** menu operation and the **Multiple configuration**. See Figure 2.20.

- Select **Edit**, then **Configure Multiple Plots and Curves** from the menu bar of the Plot Page Editor.
- Select **Multiple** on the left side of the **Plot Page Editor** dialog.

Figure 2.20

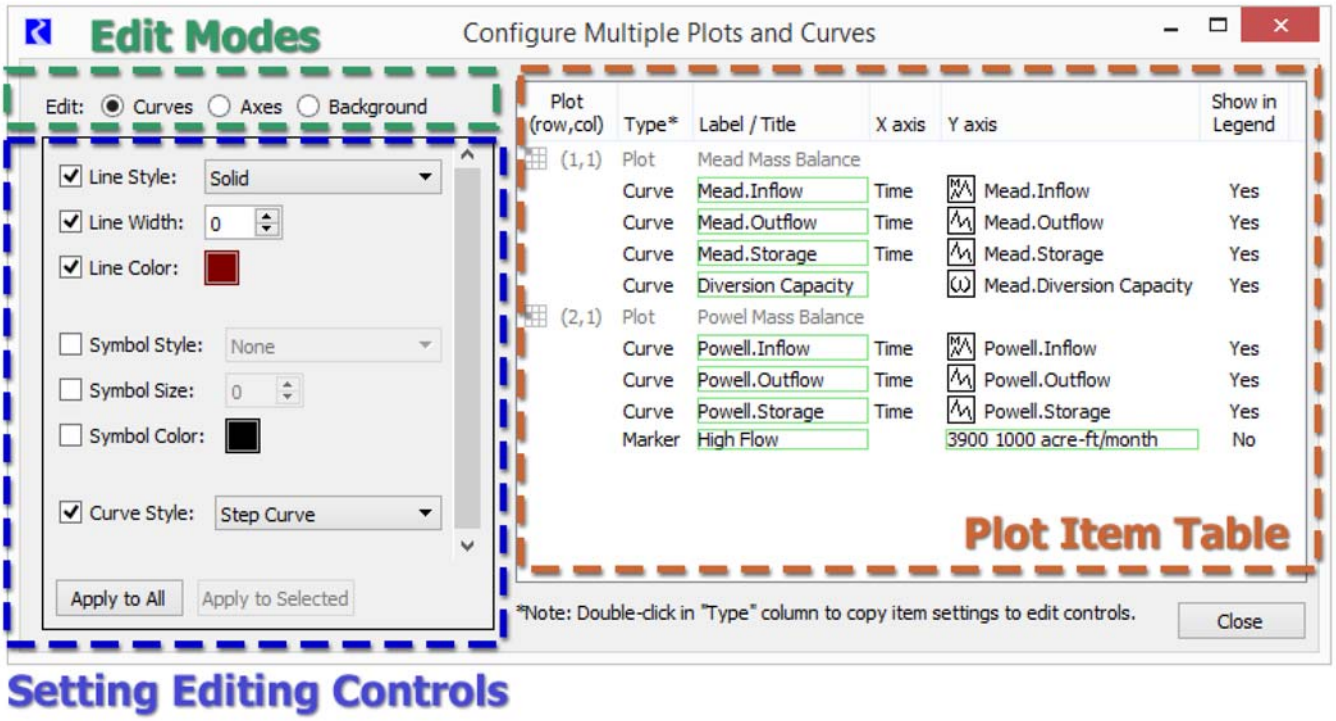


Tour of the Configure Multiple Plots and Curves Dialog

This dialog has three major panels as follows and noted in Figure 2.22.

- Edit modes for Curves, Axes, and Background
- Setting Editing Controls that provides controls based on the mode
- Plot Item Table with items for plots, curves and markers.

Figure 2.21



Directly editable cells within the plot item table are indicated with a green border. Double-clicking such cells starts an edit. These are typically used for editing labels, titles, and marker values.

Figure 2.22



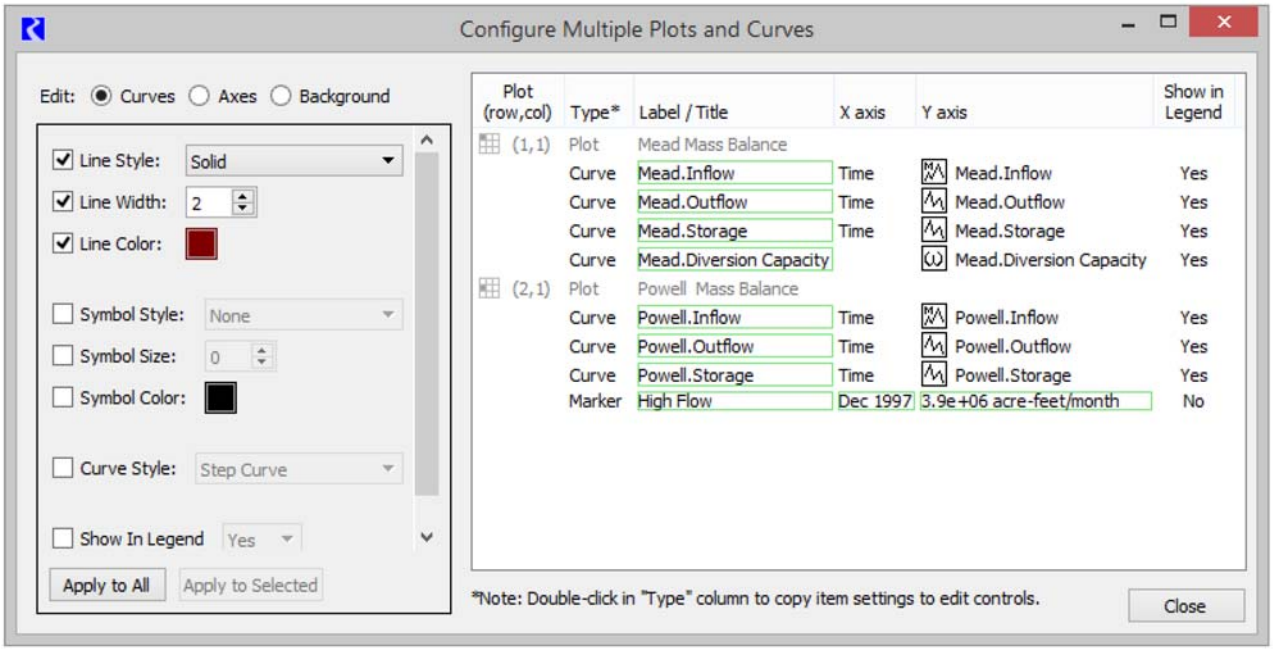
Selecting **Apply to Selected** or **Apply to All**s applies the checked or enabled settings in the left panel to the selected (or all) items selected in the right panel.

> **Note:** Edits made to this dialog are applied to the plot page being edited in the Plot Editor Dialog. In that dialog, you can either accept those changes (OK or Apply) or Cancel those changes.

Curve and Marker Editing

In **Curves** edit mode, the curve and marker items within the plot item list are active. Double-clicking an item either starts an in-cell edit within the selected cell or copies that curve or marker's setting values to the editing controls panel. Curves' and markers' label text and markers' values can be directly edited.

Figure 2.23



All of the setting operations provided in the Curve Configuration dialog are provided in the **Configure Multiple Plots and Curves** dialog. See "Curve Configuration" on page 19 for details.

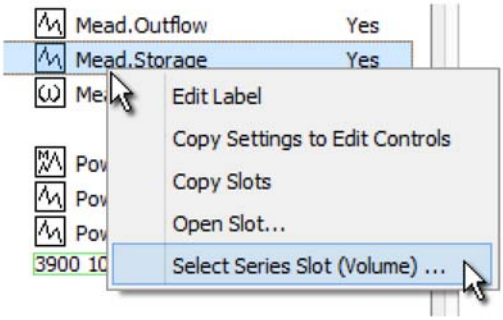
Various operations for curves and markers are supported with a context (right-click) menu:

- **Edit Label** -- initiates an edit in the **Label / Title** column. Double click a label to edit, as well.
- **Copy Setting to Edit Controls** -- copies the values of the selected item to the Setting Editing Controls panel. This is the same as double-clicking a non-editable cell.
- **Copy Slots** -- copies the selected plot items' slots to the RiverWare slot clipboard. The full names of those slots are also copied to the system clipboard.
- **Open Slot** -- shows the Open Slot Dialog for the selected slot.
- **Select Slot** -- shows the general slot selector to replace a curve's slot with a different slot. Only a slot of the same type (e.g. Series Slot) and unit type (e.g. Flow) can be used.

  Note: Current support for marker editing is limited to the settings that are also available for curves. This includes all setting operations provided by the Marker Configuration dialog and the Plot Marker Manager. See "Marker Configuration" on page 27 for details. The following edits are not yet supported:

  - Marker Type: Horizontal / Vertical / Cross
  - Label Alignment: Left, Center, Right / Top, Center, Bottom
  - Axis Assignment: Lower/Upper X Axis, Left/Right Y Axis.

Figure 2.24



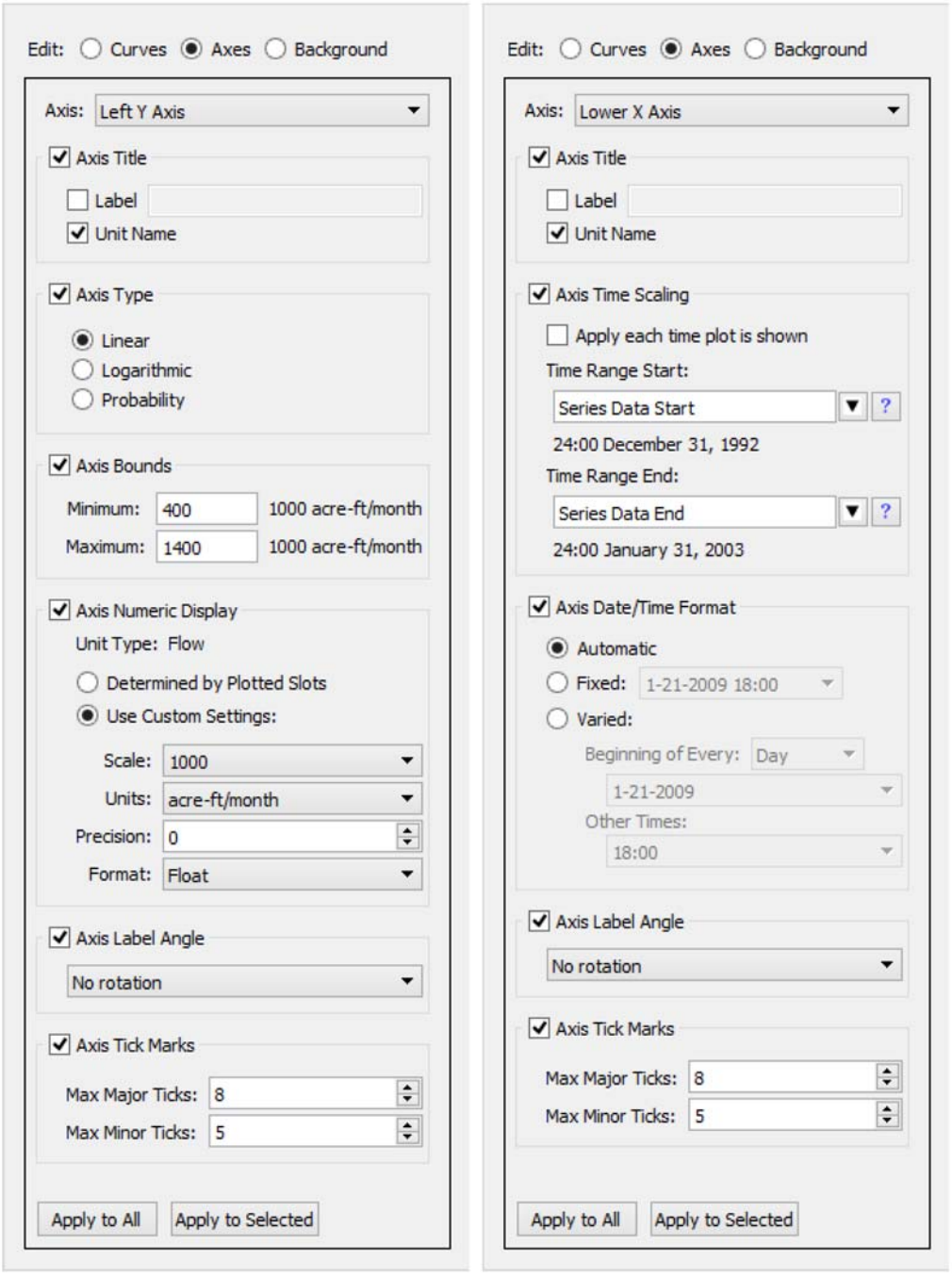
Axis Editing

In the **Axes** edit mode, the plot items (not curve and marker items) within the plot item table are enabled for selection.

Select which of the four axes are to be modified (Left Y, Lower X, etc) among the selected plots.

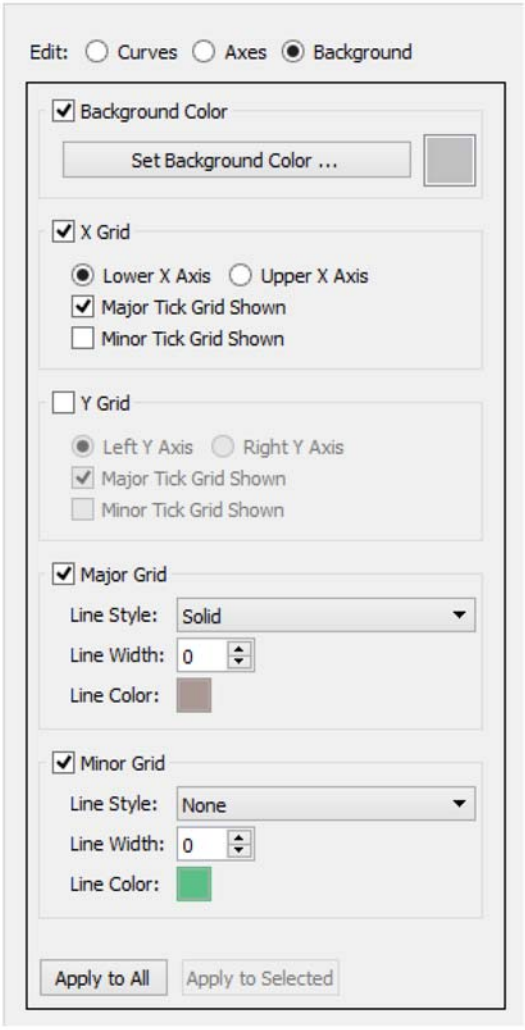
Only those settings appropriate for the selected axis are presented. I.e. DateTime axes support different settings than numeric axes.

All setting operations supported in the Axis Configuration dialog are supported in the **Configure Multiple Plots and Curves** dialog. See "Axis Configuration" on page 21 for details.



Background Editing—Background Color and Plot Grid

As with **Axes** edit mode (see "Axis Editing" on page 54**),** in **Background** edit mode, the plot items (not curve and marker items) within the plot item table are enabled for selection. Changes to plot background color and grid configuration can be applied to the selected plots, or to all plots in the plot page.



All setting operations supported in the Grid Configuration dialog are supported in the **Configure Multiple Plots and Curves** dialog. See "Grid Configuration" on page 27 for details.

Plot Page

Once a Plot Page has been configured in the Plot Page Editor, it can be viewed in the Plot Page dialog. Use of the Plot Page dialog is described in this section.

Accessing the Plot Page

The Plot Page dialog can be accessed in the following ways:

- From the main workspace, select **Utilities**, then **Plot Page** or select **Plotting**  .

  If there are no pre-configured plots saved in the model, this will open the **Plot Page Editor**. If there are pre-configured plots already saved in the model file, this will open the Plot Page dialog with the most recently selected plot displayed.
- From the **Plot Page Editor**, select **Generate** in the bottom left corner to open the Plot Page dialog for the Plot Page currently open in the Editor.
- From an already open Plot Page dialog, select **File, then Open** from the list of Plot Pages saved in the model file to open a Plot Page dialog displaying that plot.
- From the **Output Manager**, select an existing Plot Page in the list of output devices, and then select **Generate**. This will open a Plot Page dialog displaying that plot. Alternatively, select **Generate, then Generate Selected Outputs** from the menu bar.

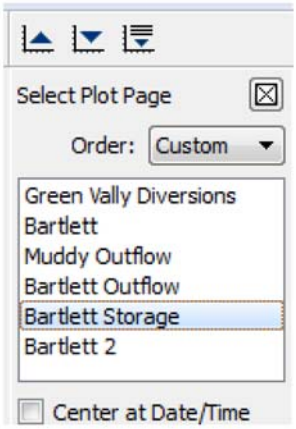
Using the Plot Page

Most of the tools and actions used in the Plot Page dialog are the same as those used in the **Plot Page Editor**. See "Editing a Plot Page" on page 16 for details.

Components of the Plot Page dialog that are not in the **Plot Page Editor** are the Plot Page List, and the **New** and **Edit**s.

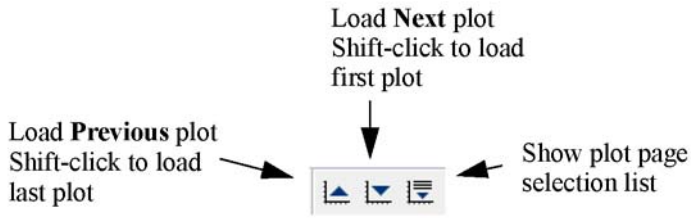
Select Plot Page List

The right portion of the Plot Page has controls to step through saved Plot Pages. Select any of the items to open that Plot Page in the current window. Right-click any item to add the slots in that list to an SCT. If the Select Plot Page List is not shown, select the  button, or select **Window**, then **Show Plot Page Selection List**.



The buttons on the toolbar can also be used to navigate the list of plots or show the plot list. See Figure 2.25.

Figure 2.25

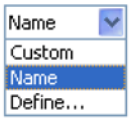


Select ☒ to close the plot list.

The Plot Pages in the selection list are ordered using the **Order** menu, as follows:

- **Custom**: Use the custom order as defined by the user. See the third option for how to define this order.
- **Name**: The plot pages are sorted alphabetically by name.
- **Define:** This option takes the user to the Output Manager where a custom order can be defined. See "Sorting" on page 2 for additional information.

  Note: In the Plot Page list, only Plot Pages are shown, so only the relative order in the Output Manager is important. Other types of output devices can be intermixed as desired



Create New Plot Page

To create a new Plot Page from the Plot Page dialog, select **New** in the bottom right corner. This will open a blank **Plot Page Editor**.

Edit Plot Page

To edit the current Plot Page, select **Edit** in the bottom right corner. This will open the **Plot Page Editor** for the current Plot Page.

Plot Page Menus

Following is a description of each menu in the Plot Page dialog.

File Menu

The **File** drop-down menu offers options for opening a new Plot Page, exporting the Plot Page to a file and printing plot images. Following are descriptions of the available selections.

- **Open**: Selecting the **Open** menu item will show the Plot Page Selection list at the right of the Plot Page Dialog; see "Select Plot Page List" on page 57. If the Plot Page Selection list is already displayed, then the **Open** menu item will be disabled.

- **Export Plot Page Configuration** allows the selected Plot Page configuration to be exported to a file. Select or enter a desired file path and name in the resulting **File Chooser** dialog, and select **Save**. All Plot Page configuration information is saved to the file.
- **Export Image** allows saving of the image of a selected plot or all plots on the Plot Page to a graphics file. The graphics file can be in one of a number of image formats. Other options include the export image's size (number of pixels) and resolution (low-medium-high). See "Printing and Exporting Plots" on page 74 for additional information.
- **Print Preview** will show of preview of the plot as it would appear on the specified printer. See "Printing and Exporting Plots" on page 74 for additional information.
- **Print** will send a selected plot or all plots on the plot page to your printer. See "Printing and Exporting Plots" on page 74 for additional information.

Edit Menu

The **Edit** menu options to create a new Plot Page or edit the current Plot Page.

- **Create New Plot** will open a blank Plot Page Editor. This is the same as selecting **New** in the bottom right corner of the Plot Page.
- **Edit Selected Plot** will open the Plot Page Editor for the current Plot Page. This is the same as selecting **Edit** in the bottom right corner of the Plot Page.
- **Copy Plot Image** copies the plot or plot page as an image for pasting to a document or email. See "Copy Plot as an Image" on page 77 for additional information.

Plot Menu

The options in the **Plot** menu are the same as for the Plot Page Editor, with the exception that there is no option to paste a plot into a Plot Page. See "Plot Menu" on page 35 for details. A plot can only be pasted into a Plot Page Editor. (More generally, changes to the Plot Page configuration can only be made in the Plot Page Editor.)

Window Menu

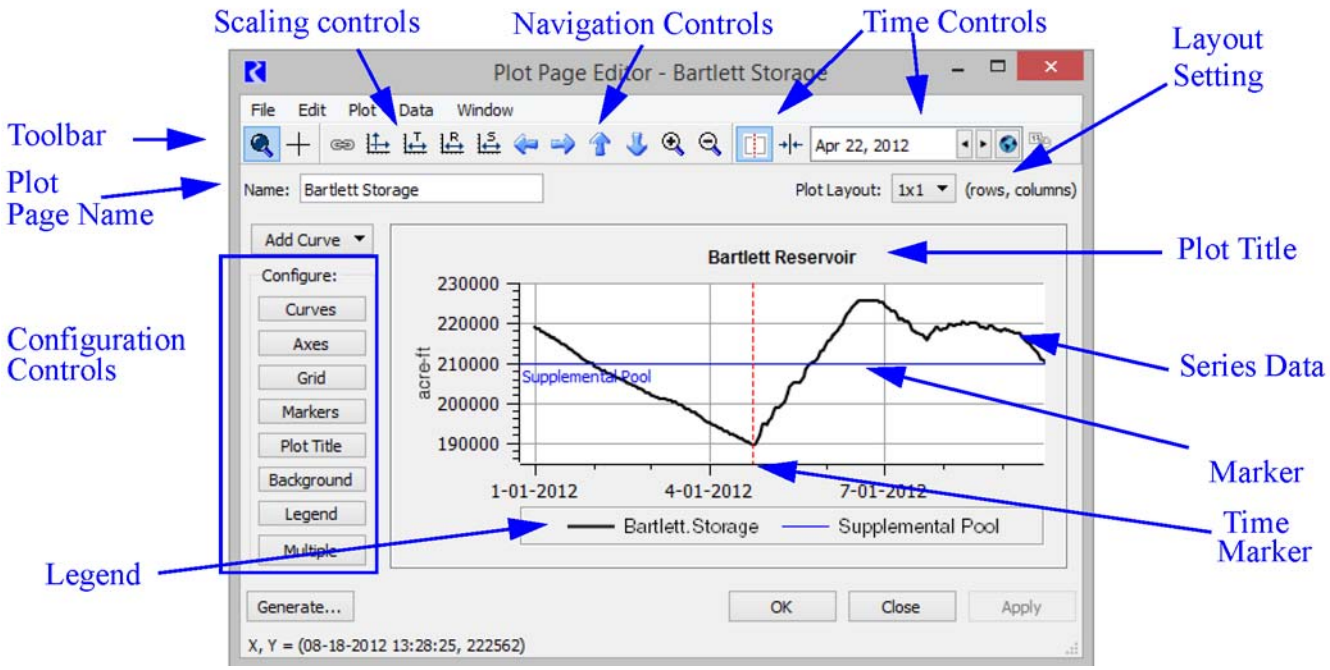
The **Window** menu includes an option to show or hide the Plot Page Selection List. See "Select Plot Page List" on page 57 for details.

Other options in the **Window** menu show or hide components of the tool bar.

Plot Page Navigation

Following are common actions used to navigate, scale, and otherwise view a plot in both the Plot Page and Plot Page Editor. Figure 2.26 shows a sample Plot Page Editor dialog.

Figure 2.26 Plot Page Editor dialog box



Toolbar Actions

Following is a description of the toolbar buttons. Use these buttons to scale, zoom, and navigate through the plot. These buttons apply for both the **Plot Page Editor** and the Plot Page dialog.

Table 2.1 Toolbar buttons

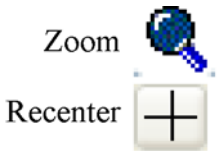
Button	Description
Mouse Zoom/ Mouse Recenter 	The **Zoom** tool displays a magnifying glass cursor icon, which lets you select a zoom rectangle by click-and-dragging the mouse. The **Recenter** tool displays crosshairs as a mouse icon and causes the plot to be centered around the point at which the mouse is selected.
Link Plots 	If there is more than one plot in the Plot Page, the **Link Plots** tool is active, letting you do manipulation operations on all of the plots in unison (including AutoScale, the Shift Tools, the Zoom Tools, Date Spinner, and Date Center).
Auto-Scale 	The **Auto-Scale** feature scales and translates the plot(s) to include the entire range of data.

Table 2.1 Toolbar buttons

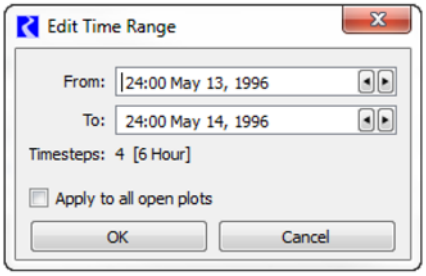
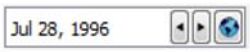
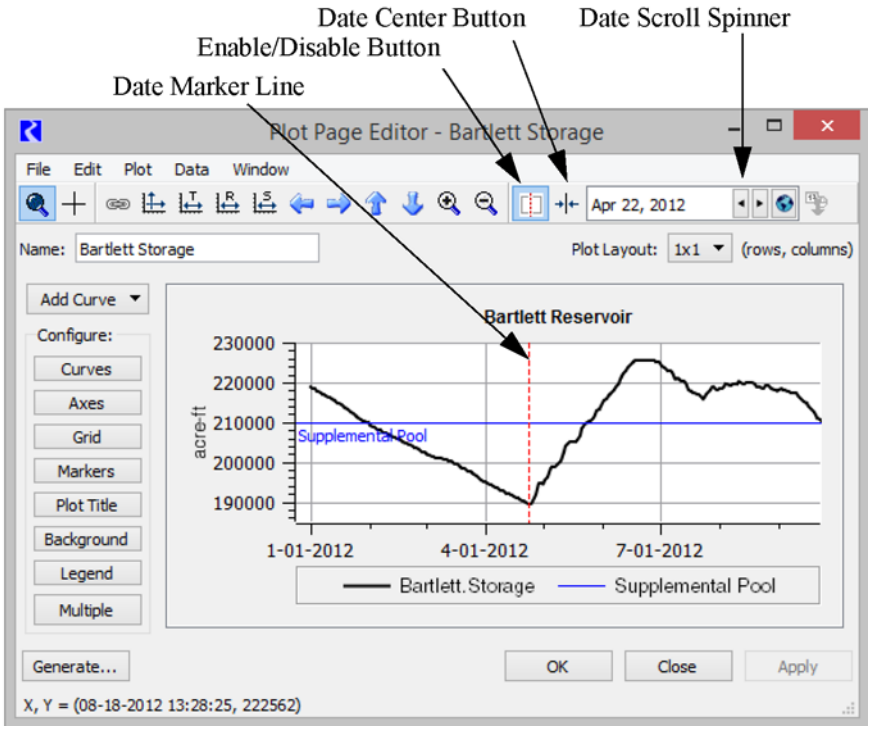
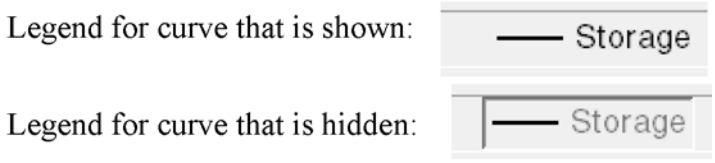
Button	Description
Apply Configured Time Scaling 	The **Apply Configured Time Scaling** feature scales and translates the plot(s) to the range specified in the Axis Configuration. This can be a symbolic or absolute time range. In addition, you can configure a plot to always use this configured time range when opening the plot. See "Time Series Axis" on page 24 for additional information. This operation does not affect the y axis scaling.
Scale to Run Range 	The **Scale to Run Range** scales the x axis to the run range defined on the Run Control. It is available only for times series plots. The y axis display is not affected.
Scale to Specified Range 	The **Scale to Specified Range** scales the plot(s) to a range that you specify in the dialog. This operation does not affect the y axis scaling. When the button is shift-selected, all open Plot Page dialogs are raised to the top and the time range is synchronized to the specified time range of the selected plot. 
Zoom Tools 	The **Zoom** feature zooms in or out on the center of the plot dialog, on either the X, Y, or both axes. Use the middle mouse wheel to zoom in/out on either the plot area or independent axes. See "Mouse Button Actions" on page 63 for additional information.
Date Spinner 	The **Date Spinner** is used to scroll to a specified date.
Date Center 	The **Date Center** icon is used in conjunction with the **Date Spinner** to center the plot on the specified date.

Table 2.1 Toolbar buttons

Button	Description
Date Marker 	The **Date Marker** icon is used to show a red marker line at the specified date in the **Date Spinner**. This feature works in two ways. If the plot is showing the entire timeseries, i.e. it was auto-scaled using the **Auto-scale**  icon, the **Date Marker** will move to the specified date but the plot will not be re-centered. If the plot is not auto-scaled, i.e. it has been zoomed or panned, the **Date Marker** will center the plot on the specified date. The line can be hidden or shown by selecting the button. The marker line will be shown on all linked plots, but not on unlinked plots. 
Sync Dates 	The **Sync Dates** feature syncs the dates on all plots. If there is only one plot in the plot page, this function is not available.
Legend	The legend shows the curves displayed in the plot. Select a curve name in the legend to temporarily hide that curve. Select again to show it The hidden/shown status is preserved within a RiverWare session but is not saved to the model file. All curves/markers are shown when the plot is first opened. Right-selecting the curve name will show a context menu with options to edit the curve configuration, remove from legend, reorder the legend, or to delete the curve. 

Mouse Button Actions

There are three special operations provided by the middle mouse button and/or wheel:

Mouse Wheel Plot Zoom

While the cursor is in the main plot area, use the mouse wheel to zoom both axes. The plot will remain centered during zooming operations regardless of cursor position.

Single Axis Plot Zoom

When the cursor is positioned over an axis, use the mouse wheel to zoom the plot in or out along only that axis. This single axis zoom also supports zooming independent Left or Right Y axes and Top or Bottom X axes.

Plot Panning

While the cursor is in the main plot area, click the middle mouse button/wheel to pan the plot in any direction. During panning, the cursor changes to a closed-hand shape to indicate panning is in progress.

Note: On some devices, the middle button is the wheel itself while on others, there may be a middle button separate from the wheel.

Plotting Templates

Plot Templates allow you to create a Plot Page involving particular slots on particular objects and then generalize this Plot Page as a *Template*. You can then apply the Template to other objects and slots of the same type. This is useful when you have data that you wish to plot for many objects or slots.

For example, for a basin with 10 reservoirs, you may wish to view Storage and a guide curve, Outflow and flow targets, and Energy produced. You wish to view this exact same data in the same plotting format for each reservoir. Plot Templates allow you to create and configure one Plot Page, save that as a Template and then apply that to the other 9 reservoirs in the basin.

Another example, you might create a 3X1 Plot Page that has the following curves by plot:

- BigReservoir.Pool Elevation and BigDataObject.FloodGuide
- BigReservoir.Storage and DeepReservoir.Storage
- BigReservoir.Outflow

Turning this Plot Page into a Template will give you the ability to easily substitute reservoirs, for example, into the Template:

- SmallReservoir for BigReservoir
- ShallowReservoir for DeepReservoir
- SmallDataObject for BigDataObject

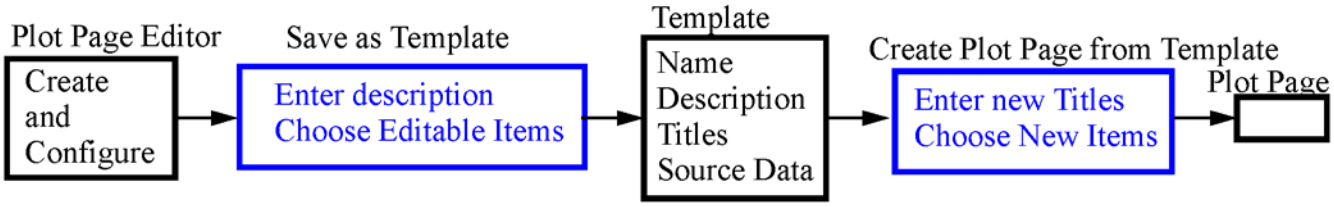
This could then create the 3X1 Plot Page that has the following curves by plot:

- SmallReservoir.Pool Elevation and SmallDataObject.FloodGuide
- SmallReservoir.Storage and ShallowReservoir.Storage

- SmallReservoir.Outflow

The three aspects of creating and using Plot Templates are illustrated in Figure 2.27 and described in the following sections.

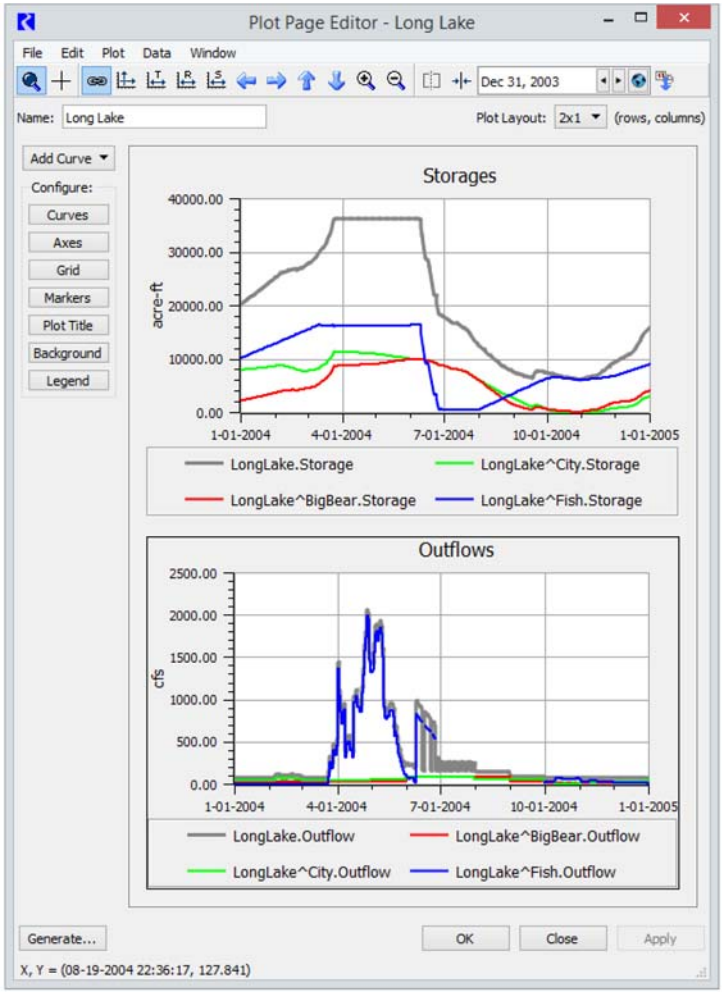
Figure 2.27



Create and Configure a Base Plot Page

A Plot Template is created from an existing Plot Page. Thus, it is important to configure the Plot Page as desired before saving it as a Template. Make sure you have your colors, line widths, axis labels, axis precision, and titles correct. Once you save the Plot Page as a Template, you cannot change these settings in the Template itself. You can change any configuration setting in Plot Pages generated from the Template, but configuring it as desired in the first place, can save you time. Figure 2.28 is the original Plot Page used in the subsequent example screenshots.

Figure 2.28

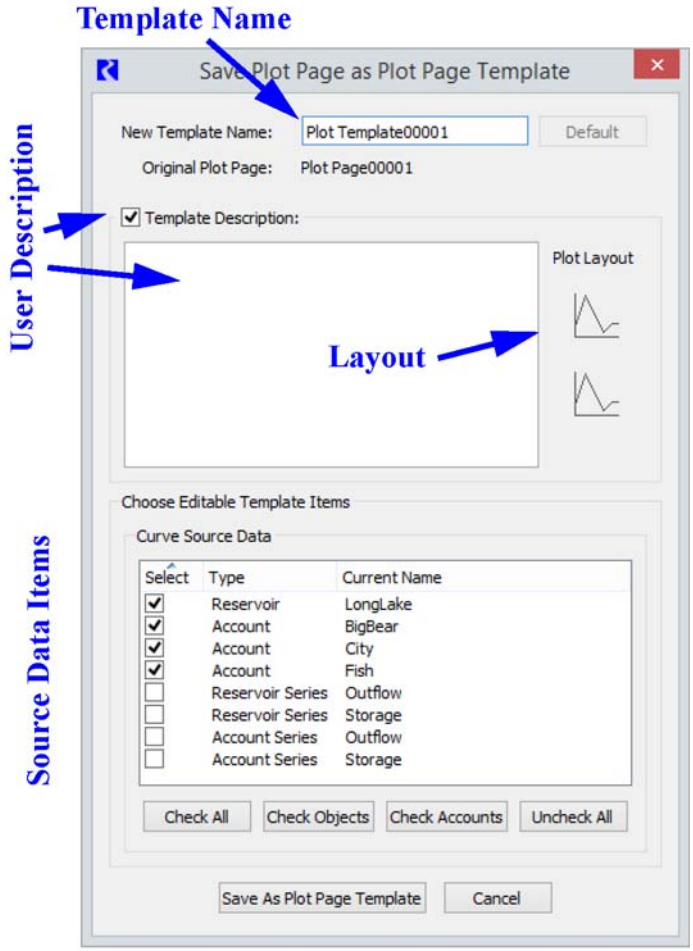


Save a Plot Page as a Template

Once a Plot Page is configured as desired, you can save it as a Template. From the **Plot Page Editor**, select: **File**, then **Save As Template,**

This opens the **Save Plot Page as Plot Page Template** dialog shown in Figure 2.29.

Figure 2.29



In the **Save Plot Page as Plot Page Template** dialog, the user specifies the Name of the new template, and any Descriptive text about the plots in the template. This description can optionally be hidden by selecting the checkbox next to the **Template Description**. You should enter enough text in here to describe the items in the template. The graph layout is shown to help describe the template. Tooltips (mouse-hover) on the graph icon show the Title for each graph.

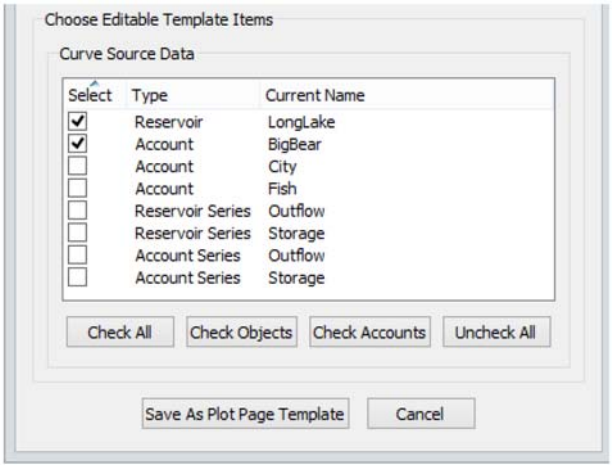
The bottom part of the dialog, **Choose Editable Template Items** is where you specify which items in the plot you want to make editable in the template. Select the checkbox of each desired item. Options include the following:

- Objects
- Accounts
- Slots
- Supplies

Because certain slots (like Hydrologic Inflow) are only available for certain objects, (Reservoirs). The slots are broken into further types such as “Reservoir Series” or “Account Series”. Also, because certain objects only have certain slots, substitution is limited to like objects. Thus, in the same screenshot, Long Lake is classified as a “Reservoir”.

In Figure 2.30, we select the first two items in the list: Long Lake Reservoir and Big Bear Account.

Figure 2.30



Buttons at the bottom of the frame allow you to **Check All**, **Check Objects**, **Check Accounts**, **Uncheck All**.

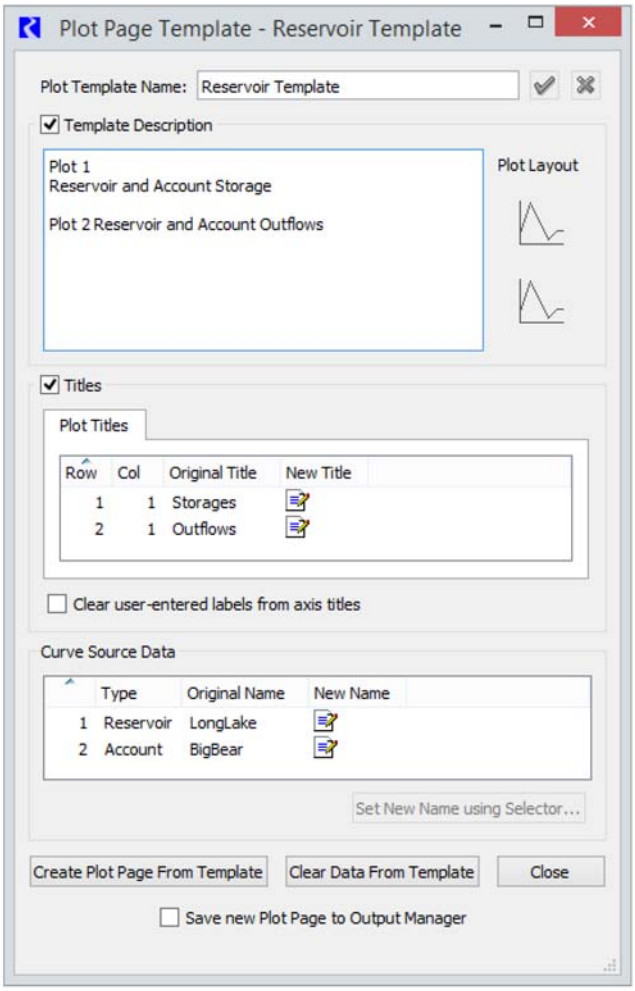
When finished, select **Save As Plot Page Template**. The dialog closes and the Output Manager opens with the newly created Plot Page Template selected.

If the **Save As Plot Page Template** is inactive, the tooltip describes the reason.

Apply the Template

Once the Template has been created, it is stored in the **Output Manager**. From the **Output Manager**, highlight the template item and select **Generate** or **Edit** (or double-click the item). The **Plot Page Template** dialog opens. It shows the Template's Name, Description, Titles, and Curve Source Data as described in the following sections.

Figure 2.31



Plot Template Name

The Plot Template Name is shown. If you would like to change the name of the template, enter a new name and select the green check to confirm.

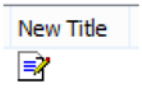
Template Description

This shows the description entered when the template was created. This description is not editable. The region also shows the layout for informational purposes. Tooltips (mouse-hover) on the graph icon show the original Title for each plot.

Titles

The titles for the original plots are shown. You can hide the whole region by clearing the **Titles** checkbox.

Edit titles as necessary by selecting the **New Title** cell and entering new text.



To clear any user-entered labels from the axes titles in new plots, check the **Clear user-entered labels from axis titles** box. If you want to keep user-entered labels for the axes, leave the box unchecked. Any unit labels for the axes will be recomputed based on the units for the newly plotted slots.

Curve Source Data

The Curve Source Data region is where you substitute new items for the originals. You can do this in either of the following ways.

- Select the **New Name** field and enter new text.



- Select a row and then select **Set New Name using Selector** This opens the Selector dialog preset to the appropriate type. For example, if you are substituting for a Reservoir, the selector will only allow you to select from Reservoirs.

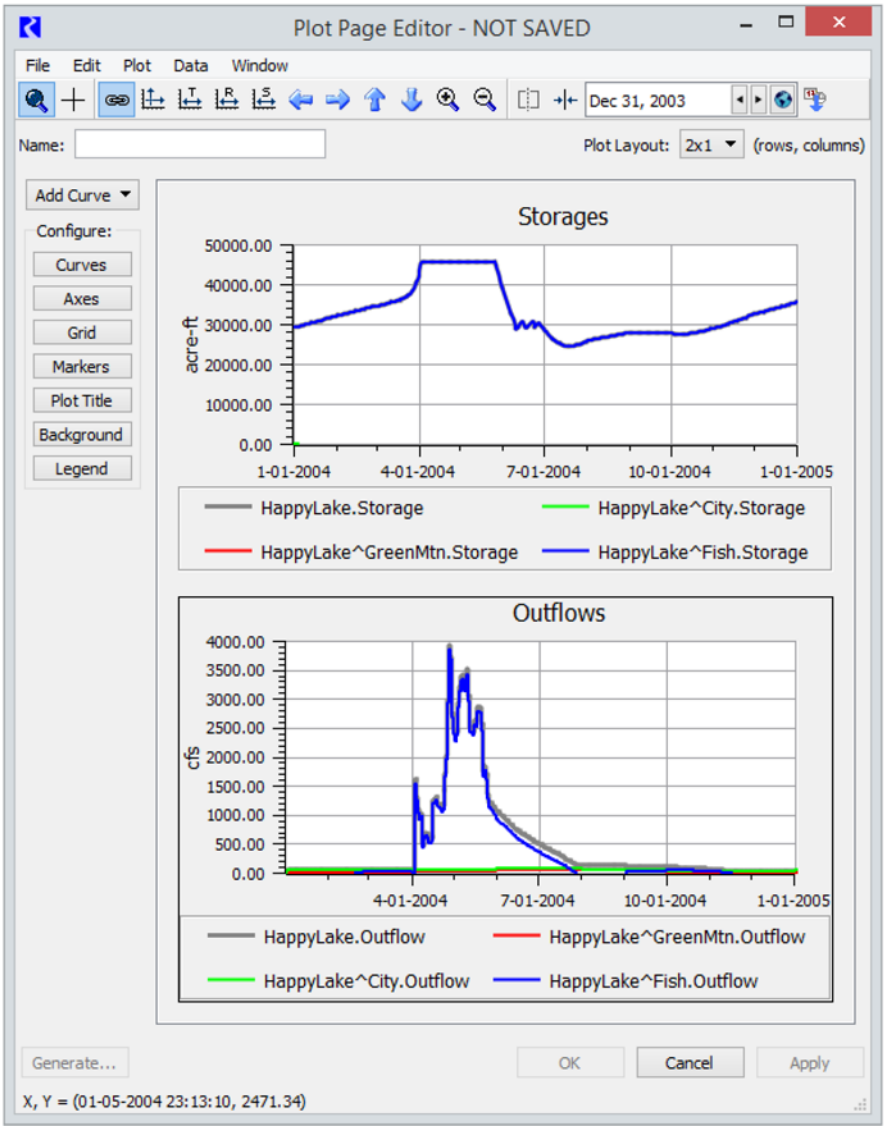
Buttons

The buttons at the bottom of the window allow you to create the plot, clear the data (**New Titles** and **New Names**) from the template or close the dialog.

A final checkbox at the bottom, when checked, will open a **Save As** dialog allowing you to immediately save the generated plot to the **Output Manager**.

When you **Create Plot Page From Templat**e a Plot Page is created with the new data substituted for the old, see Figure 2.32. If you left any New Name fields blank, the Template's original values will be used. Also, if your Template does not apply to certain data in the Plot Page, it will just be plotted as it was originally

Figure 2.32



The Template remains open and has not changed. You can then specify new source data for the Template, Clear Data from Template or close the dialog.

In the generated Plot Page, if the source data does not exist, the Plot Page will be created with a placeholder. For example, in Figure 2.32, the Storages plot has no HappyLake^GreenMtnStorage, so there is a legend item, but no data is plotted. You can pick new slots for such curves or delete them using the menu shown by right-clicking the curve in the legend.

If no data can be plotted at all (for example you specified an object that does not exist on the workspace), the plot may be completely blank with no axis.

Also, the plots are zoomed as they were in the original plot, you may need to select **Auto Scale**  to see the new curves.

The newly created Plot Page is a normal Plot Page that you can edit and/or save to the Output Manager as desired. It can also be saved as a Plot Template, possibly replacing the original template from which it was generated.

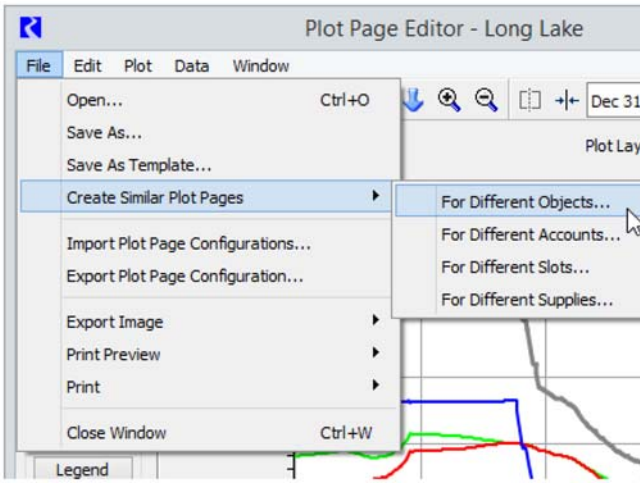
Creating Similar Plot Pages

The Create Similar Plot Pages utility allows you to create one or more plots that are similar to the current plot. You can create Plot Pages similar to the existing Plot Page when you only want to replace objects, accounts, slots, or supplies that are the source of data for curves on the Plot Page. This approach is similar to Plot Templates, but Plot Templates allow you to replace multiple entities, like both objects and slots, for example. A Template only creates one Plot Page at a time. However, creating similar plot pages is more direct; you do not have to create an intermediate Template. Also, creating similar Plot Pages applies to multiple items (like four reservoir objects) at one time, allowing you to create **multiple** new Plot Pages in one action. See "Plot Page" on page 56 for details.

Accessing the Similar Plot Pages Utility

To create a similar Plot Page, from the Plot Page Editor, select **File**, then **Create Similar Plot Pages**. Then, select the desired item type you wish to change:

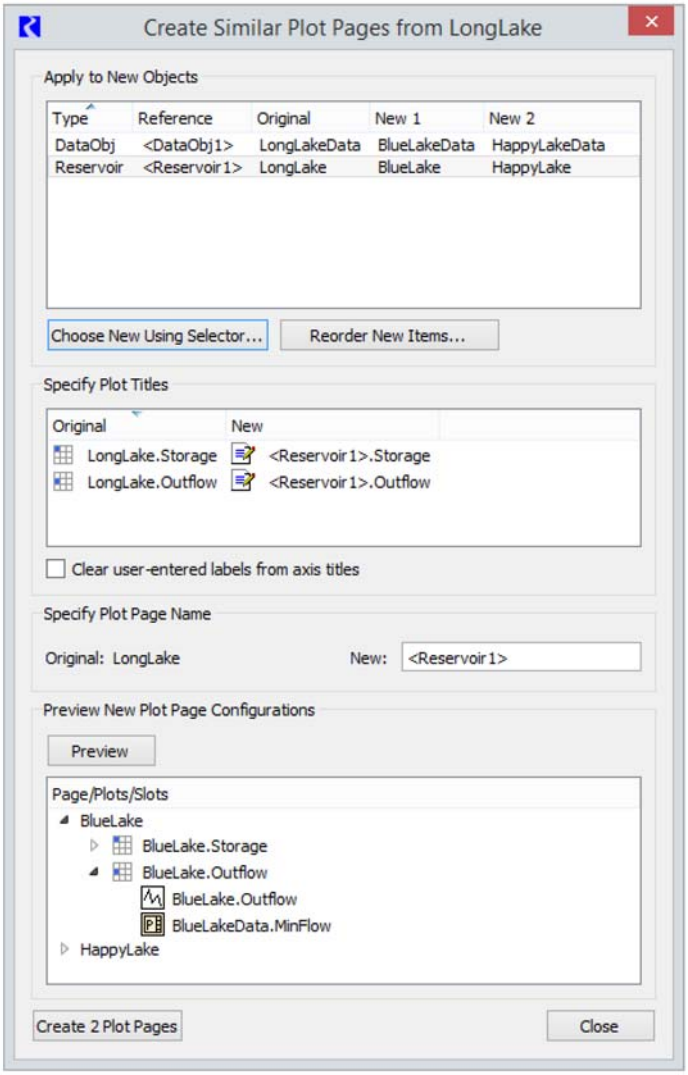
- **For Different Objects**
- **For Different Accounts** (when accounting is enabled)
- **For Different Slots**
- **For Different Supplies** (when accounting is enabled)



Create Similar Plot Pages Tour

The **Create Similar Plot Pages** dialog is modified based on the type of item that will be substituted, so the screenshots may not match for other items. The **Create Similar Plot Pages** dialog is used by selecting and

configuring items in each of four areas from top to bottom. These four areas are described in the following sections.

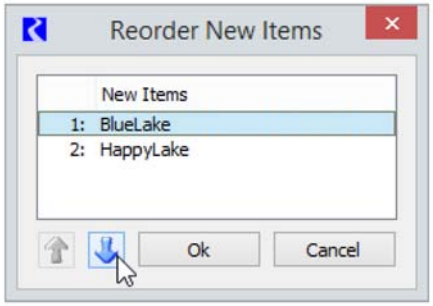


Apply to New Objects/Accounts/Slots/Supplies

Use the Apply to New Objects/Accounts/Slots/Supplies area to specify the different items you wish to use. For example, if you wish to create similar Plot Pages for different objects, use the Apply New Objects area to select those new objects. Replacement items are chosen by selecting **Choose New Using Selector**. Multiple items can be selected, in which case there will be multiple New columns populated with the items. A new Plot Page will be created for each New column, thus you can create multiple plot pages at once.

If there is more than one row in the objects list, the same number of new items should be selected for each row; there is a one to one matching of items across rows for a new Plot Page. Alternatively, one new item can be selected for a row, in which case that same new item will used in all Plot Pages if the other rows do have multiple new items.

By default, multiple items are listed in alphabetical order. If the new objects do not match properly across the rows for the desired Plot Pages, the items can be reordered for a row by selecting **Reorder New Items**. This brings up a dialog with a list of the items, which can be reordered by selecting an item and selecting **Up** and **Down** arrows to move them as desired.



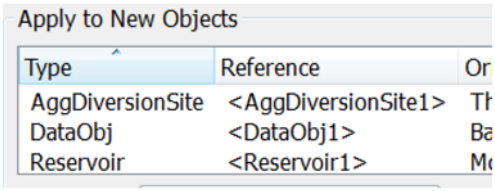
Specify Plot Titles

The **Specify Plot Titles** portion of the **Create Similar Plot Pages** dialog shows the original titles for the different plots in the original Plot Page and how corresponding new titles for new plots look when the original object names are represented as entities using the object reference names. For example, when substituting reservoir objects, the entity might be <Reservoir1>. Entities are of the following types:

- <ObjectType#>
- <Account#>
- <Supply#>
- <ObjectType Series#>
- <Account Series#>

Object reference name entities will be replaced with the appropriate new object name when a new Plot Page is created. The new title representation can be selected and edited as desired by the user. Even if not shown, you can type in the entity from above to use it in new plot titles. To determine which reference name entities you can use, look at the Reference column in the top panel.

If there are user-entered labels for plot axes in the original plot page, they can be cleared for newly generated plots by checking the **Clear user-entered labels from axis titles** box. If the box is unchecked, any user-entered titles for axes will be carried over to the new plots.



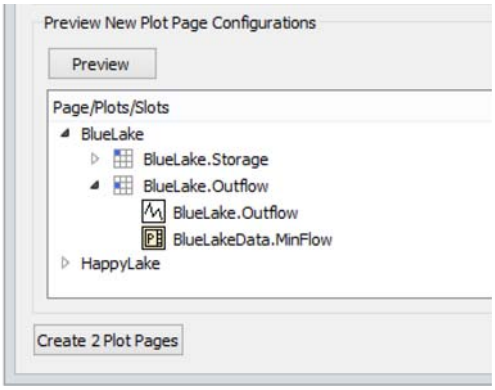
Specify Plot Page Name

Similar to plot titles, the **Specify Plot Page Name** portion of the dialog shows a new name with original object names replaced with object reference entities. These entities will be replaced with the corresponding new object name when new Plot Pages are created. The new name representation can be edited by the user. See above for more information on entities.

Note: If the resulting new name for a Plot Page is not unique in the Output Manager, an index number is added to the end and incremented until the name is unique.

Preview

The **Preview New Plot Page Configurations** section of the dialog allows you to preview in a tree-view the Plot Pages that will be generated based on the information entered into the dialog. This listing includes the save name for each Plot Page, the plot title for each plot on the page, and the slots that will be placed onto each plot. This gives the user the opportunity to review basic information about the Plot Pages that will be created before actually generating them.



Create N Plot Pages

The **Create N Plot Pages** button creates the new plot pages based on the information entered into the dialog and gives you feedback about how many plot pages were created. From the informational dialog, you can select to either **Create more plot pages** to go back to the Create Similar Plot Pages dialog or **View in Output Manager** to go to the Output Manager with the new plot pages selected (Select **Generate** to view the plot pages.). In either case, the new Plot Pages appear in the **Output Manager** and are available for viewing or editing just like any other Plot Page.

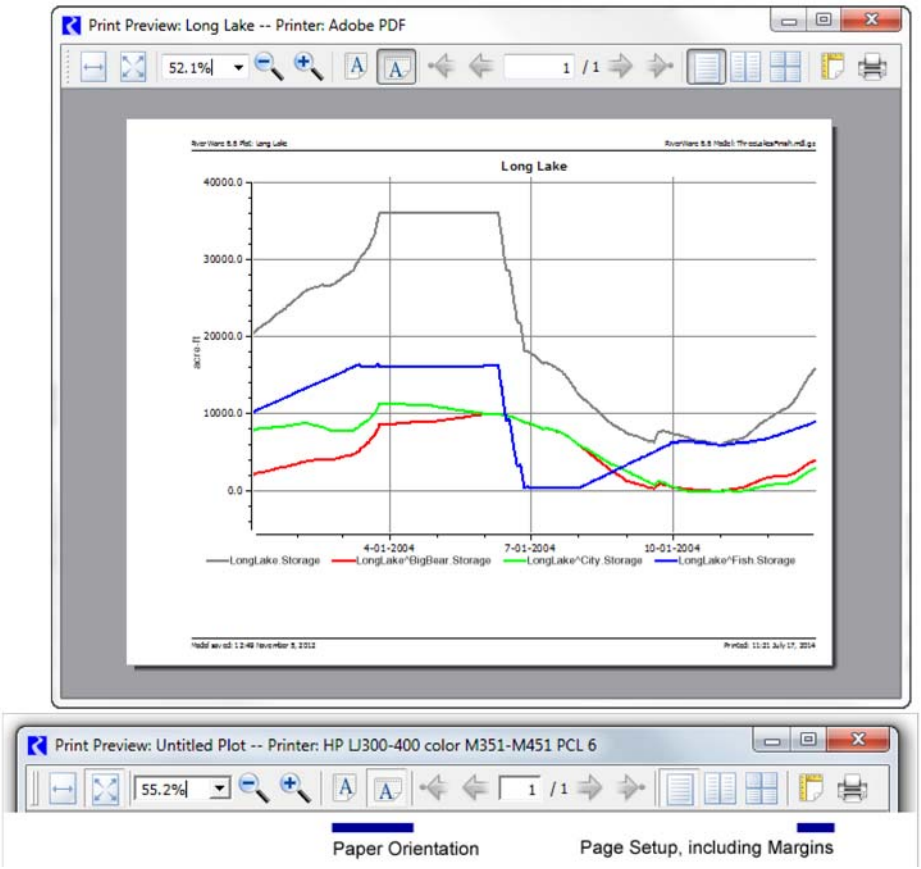
Printing and Exporting Plots

You can print or export plots to image files from both the Plot Page dialog and the Plot Page Editor in the same manner. You can print or export either individual plots or entire Plot Pages.

Print Preview

To preview a plot from either the Plot Page dialog or the Plot Page Editor, select **File**, then **Print Preview,** then **All Plots.** (or **Selected Plots)**. This will preview a plot as it would appear using the specified printer. Selecting **All Plots** will show all plots on the Plot Page. Selecting **Selected Plots** will only show the single selected plot. You can change the printer by selecting **File, then Print Preview, then Choose Printer**. The print preview shows a preview of the plot, as shown in Figure 2.33.

Figure 2.33



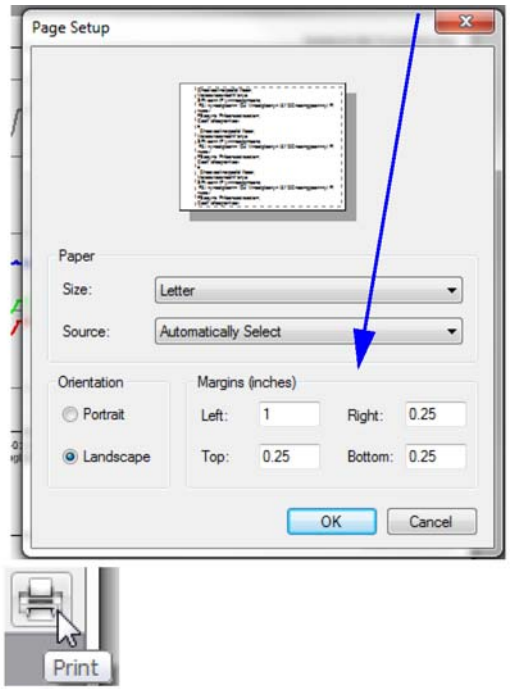
The following printer settings can be made within the Print Preview dialog.

- Paper Orientation (Portrait or landscape)
- Margins

This is the only place where print margins can be configured. The margin settings made in the **Page Setup** dialog will persist—including to subsequent RiverWare sessions—and apply to all printer use within RiverWare.

> **Note:** The relative curve line thicknesses shown in the plot preview image may not exactly match that of the actual printed page.
>
> **Note:** Printing from the Plot Print Preview dialog using its **Print** button does not apply the curve line thicknesses for printed output. When printing from the Plot Print Preview dialog, curves and markers will generally be too thin to clearly see. Select **File**, then **Print**, then **All/Selected Plots** to use the thickness adjustment. See "Plot Page Settings" on page 32 for details.

Figure 2.34



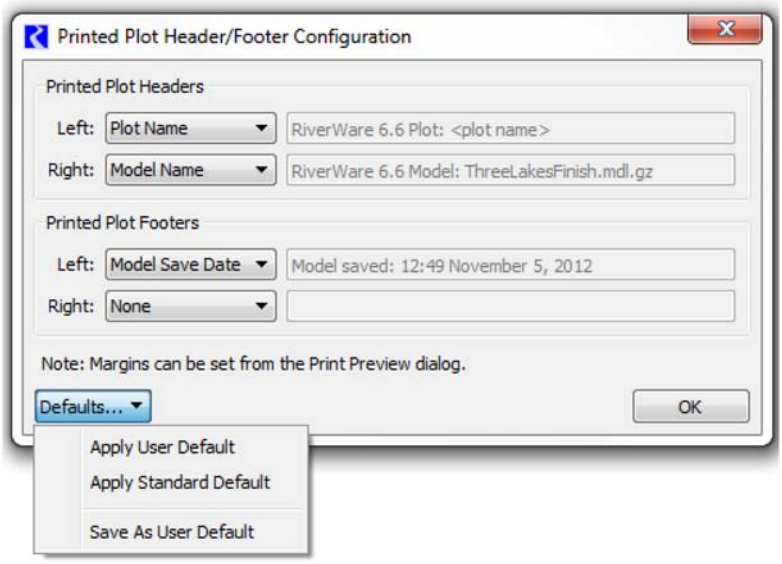
Printing

Plots can be printed from the Plot Page dialog or the **Plot Page Editor** in the same manner. To print a single plot, either right-select the desired plot and select **Print** from the context menu, or select **File, then Print, then Selected Plot**. To print all plots select **File, then Print, then All Plots.** The **Printer** dialog lets you select the desired printer and host. It also offers such basic page layout configuration capabilities as color/grayscale prints, paper format and size, and the printing range.

> **Note:** The widths of lines printed is based on the specified width and the Print Line Width Factor. See "Plot Page Settings" on page 32 for details.

Also, you can define the headers and footers to be used on the printed plots. Select **File, then Print,** then **Printed Header/Footer Configuration**. In this dialog, you can specify the items to show for the Left and Right Headers and Footers. Choose from the available items or specify **Custom** and enter your own text.

Select **Defaults** to save the current settings as User Default (saved with your user settings). Apply your custom defaults or the standard defaults as desired to other plots. The header and footer configuration are saved with the Plot Page and thus can only be modified from the **Plot Page Editor**.



Copy Plot as an Image

Select **Edit**, then **Copy Plot Image**, then **All/Selected Plots** to copy all or selected plots as an image to the system clipboard. Then you can paste the image into a document or email. The size of the copied plot is taken directly from the size of the dialog on the screen in terms of pixels.

Exporting

To export a single plot, either right-select the desired plot and select **Export Image** from the context menu, or select **File, then Export Image, then Selected Plot**. To export all plots on the Plot Page, select **File, then Export Image, then All Plots** The resulting dialog allows you select the export image file extension, size, resolution, and destination. The available file type extensions are: *.bmp, *.jpeg, *.pbm, *.pgm, *.png, *.ppm, *.xbm or *.xpm.

> **Note:** The image resolution affects only file formats that use compression. In general, you should use the highest resolution. Also, the **Export Image** dialog does not automatically append the file extension. When you type the target file name, you must assign the appropriate extension.

Chapter 2
Plotting

Chapter 3
Tabular Series Slot Report

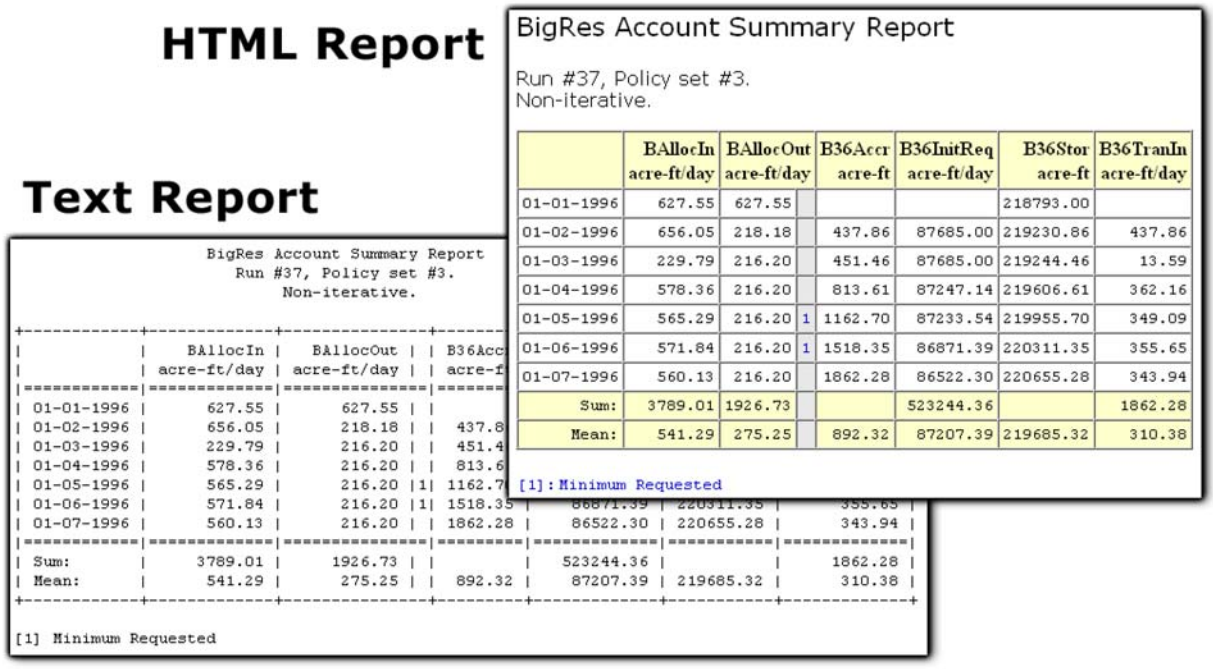
Topics

- About the Tabular Series Slot Report, page 79
- Creating a New Tabular Series Slot Report Configuration, page 81
- Configuring Tabular Series Slot Reports, page 81
- Generating Tabular Series Slot Reports, page 92
- File Type Association Manager, page 93
- Viewing an Existing Tabular Series Slot Report, page 94

About the Tabular Series Slot Report

The Tabular Series Slot Report is an output device that generates a plain text or HTML document showing, in a table or multiple tables, values for a set of series slots. The data for each series slot is displayed in one column of the table.

Figure 3.1



The configurable properties of the document include the following:

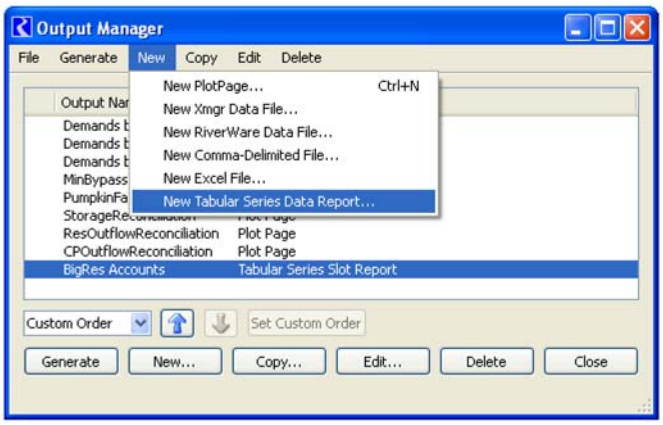
- Title and subtitle text
- Description
- The ordered list of series slots, and optional alternate column labels for each slot column.
- The series date range (with an option to use the model run date range)
- A choice of showing the full range in a single table, or a separate table for a fixed number of timesteps, or a table for each month.
- When selecting separate tables, the printed output can optionally include page breaks between tables.
- Optional omission of slots having only “NaN” values or only “NaN” or zero values.
- Optional display of NaNs and/or Zeros as blanks.
- For the HTML report, configurable fonts and cell background colors for various types of text and numeric data.
- Optional user specified slot column labels and units
- Optional wrapping of column labels

Creating a New Tabular Series Slot Report Configuration

Tabular Series Slot Report configurations are stored in the RiverWare file as an Output Device.

New report configurations are created in the Output Manager dialog. Use the following steps to create a new report.

1. From the RiverWare workspace menu, select the **Utilities**, then **Output Management**.
2. From the Output Manager dialog menu, select the **New**, then **New Tabular Series Slot Report**.
3. Fill out the full configuration for the new report and select **Save**. See "Generating Tabular Series Slot Reports" on page 92 for instructions.

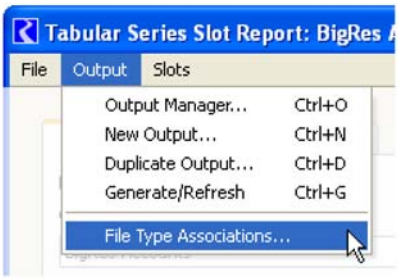


Configuring Tabular Series Slot Reports

When creating (or editing) a Tabular Series Slot Report configure these four tabs:

- **Titles**
- **Settings**
- **Slots**
- **Output**

Additionally, the **Output**, then **File Type Associations** menu item is particular to **Tabular Series Slot Reports**. See "File Type Association Manager" on page 93 for details.

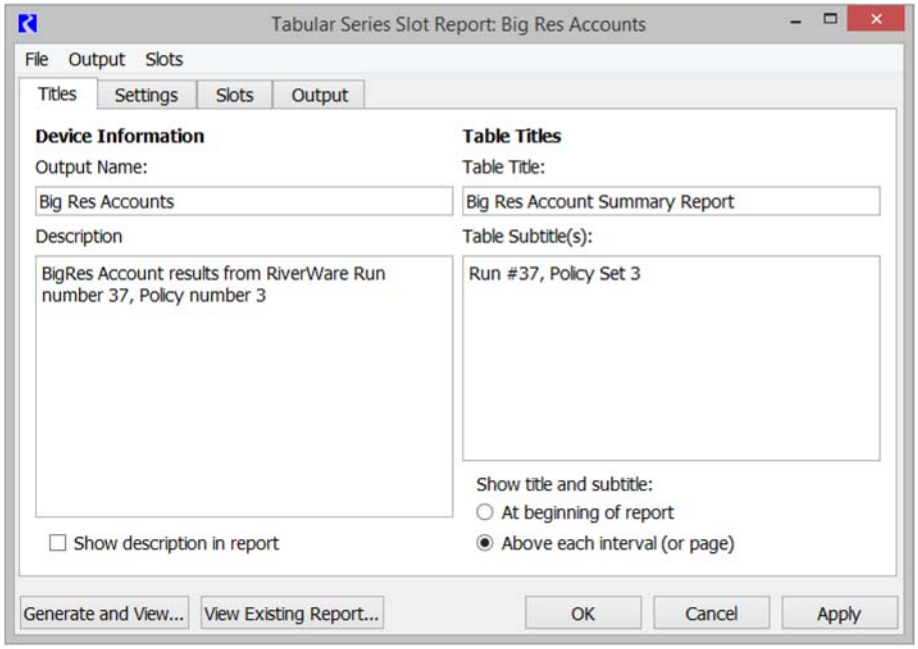


Titles Tab

On the **Titles** tab, enter text for the following items:

- **Output Name**: The name of the Output Device for this report configuration. This is not shown in the report.
- **Description**: Optionally shown in the generated report by selecting the checkbox.
- **Table Titles**: Shown at the beginning and optionally above each time interval table (on each printed page, if page breaking is selected).
- **Table Subtitle(s)**: a multiple line note shown directly below each **Table Title**.

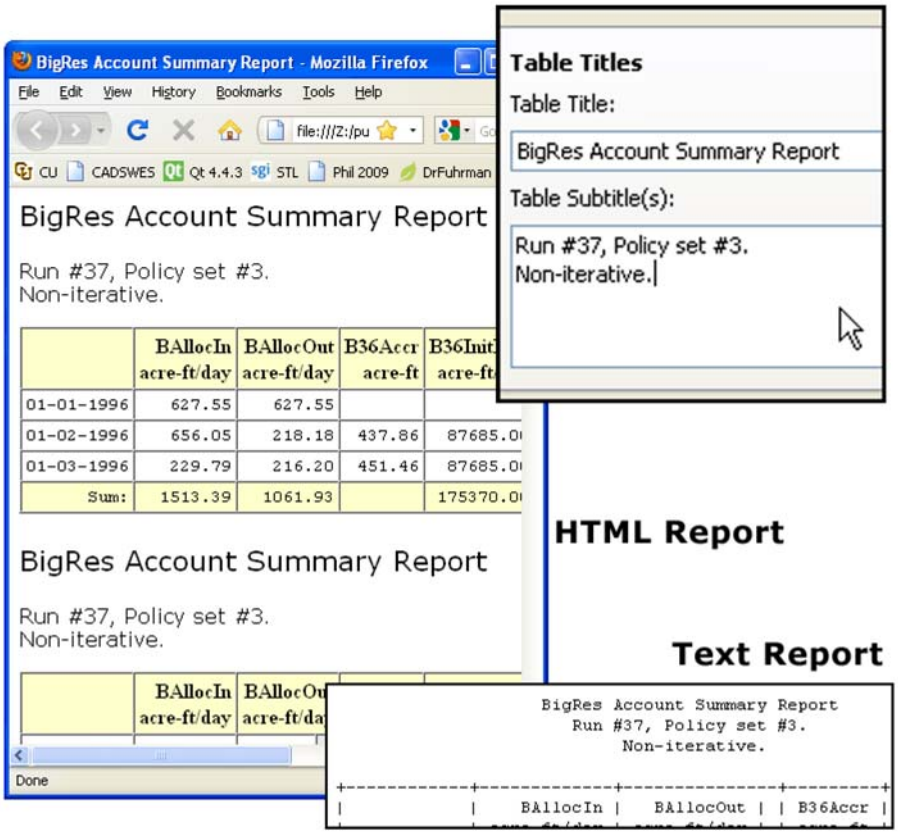
Figure 3.2



Titles and subtitles are optionally shown at the beginning of the report or before each interval by selecting the checkboxes. Figure 3.3 illustrates the use of the **Table Title** and **Table Subtitle** in both the generated plain text and

HTML reports. For the HTML report, title text fonts for both of these titles are configurable. See “Output Tab” on page 89 for details.

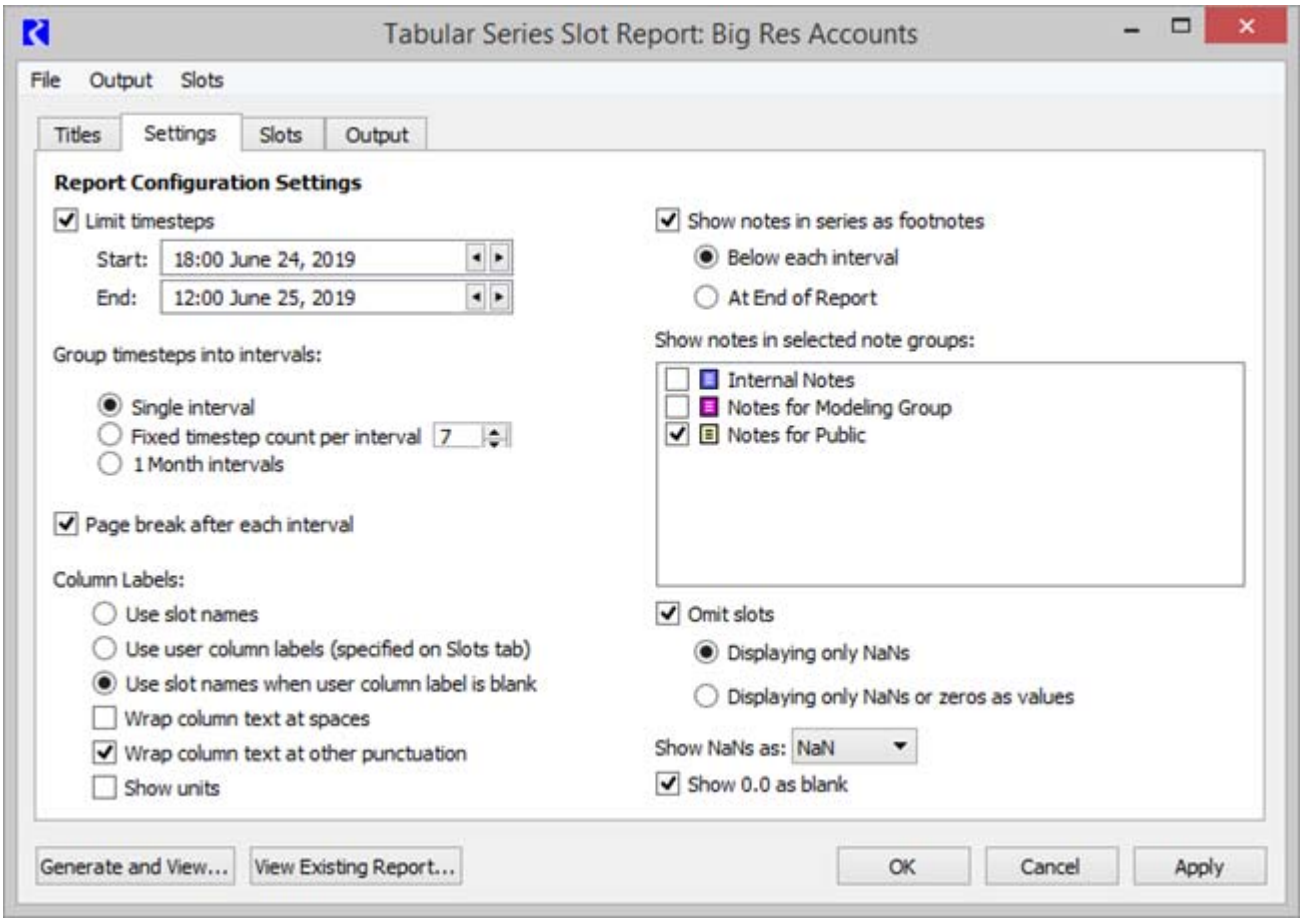
Figure 3.3



Settings Tab

The **Settings** tab is shown in Figure 3.4.

Figure 3.4 Screenshot of the Tabular Series Slot Report Setting tab



On this tab, you can do the following:

- Optionally limit the series output time range

  Note: The timestep size is controlled by the slots chosen. The slots must all have the same timestep size or the model's timestep size is used.

- Specify how the full time range will be divided into distinct interval tables.
- Optionally break each interval on its own printed page.
- Specify how the column labels appear, as follows:
  - Use the Slot name directly,
  - Substitute alternate column labels for the full slot names. Alternate (user supplied) column labels are specified for each slot on the Slots tab. (See the image), or

– Use the slot name when the user specified label is blank.



	BigRes^AllocatableFlow.Outflow		BigRes^1936.Accrual	BigRes^1936.Initial Request		BigRes^1936.Storage
01-04-1996	216.20		813.61	87247.14		219606.61

	BAllocOut	B36Accr	B36InitReq	B36Stor
01-04-1996	216.20	813.61	87247.14	219606.61

- Wrap column text at spaces
- Wrap column text at other punctuation
- Show units in column headers.

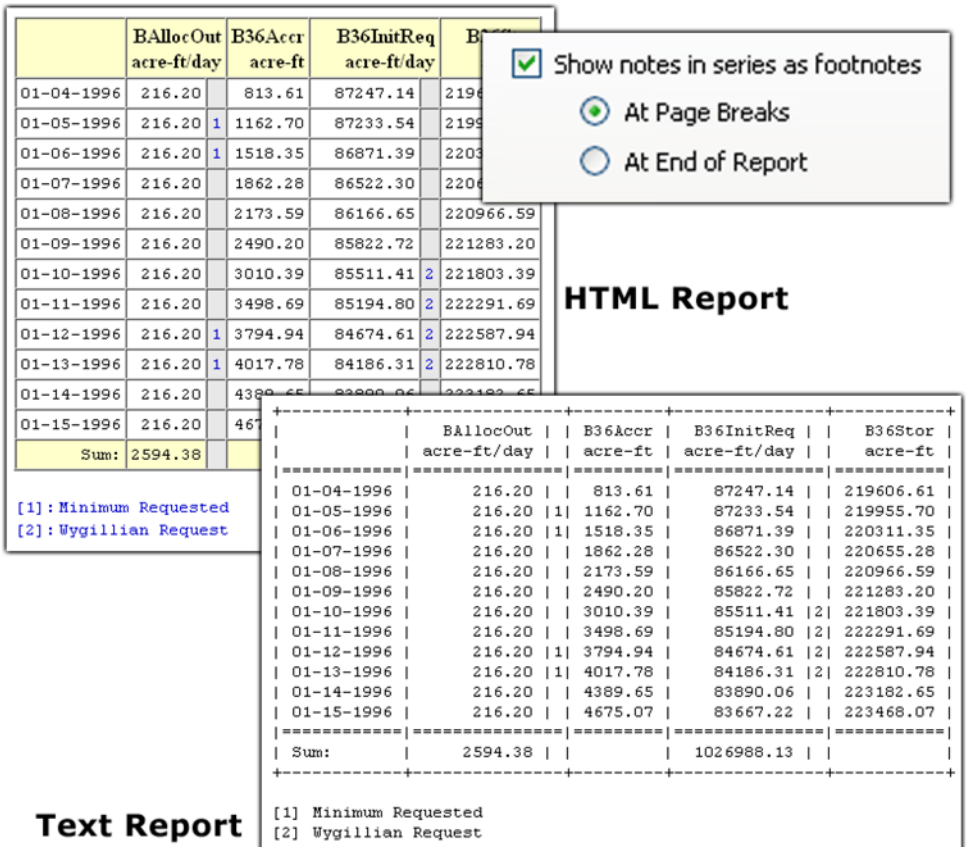


	BAllocOut		B36Accr	B36InitReq		B36Stor
01-04-1996	216.20		813.61	87247.14		219606.61
01-05-1996	216.20	1	1162.70	87233.54		219955.70

	BAllocOut acre-ft/day		B36Accr acre-ft	B36InitReq acre-ft/day		B36Stor acre-ft
01-04-1996	216.20		813.61	87247.14		219606.61
01-05-1996	216.20	1	1162.70	87233.54		219955.70

- Choose to show Notes (series text annotations) which have been added to specific timesteps on various series slots. Note text is shown as footnotes, either below each table (on each printed page), or at the end of the entire report. Figure 3.5 illustrates the effect of enabling the display of "notes" within the two types of reports (HTML and plain text). In Figure 3.5, two of the four series slots have notes.
- Choose which Note Groups to show. If showing notes as footnotes, specify which Note Groups you would like to include in the report. This functionality provides flexibility in the content, for example only showing certain notes to a stakeholder group.

Figure 3.5



- Choose to exclude slots displaying only NaN values, or only NaN or Zeros values.

  Note: For the second item, the display values (precision, scale, unit) are used in the comparison to zero.

  Note: Omit slots that display NaNs or zero as values. Some slots with small values could be omitted with this setting because the slot's unit scheme rules are used for the comparison to zero. For example, an underlying value of 1 cfs displayed on a slot with precision = 2, units = cfs, scale = 1000 is considered zero because the value is displayed as 0.00 1000cfs.

- Show NaNs as:
  - NaN
  - blank
  - 0.0
- Show 0.0 as blank

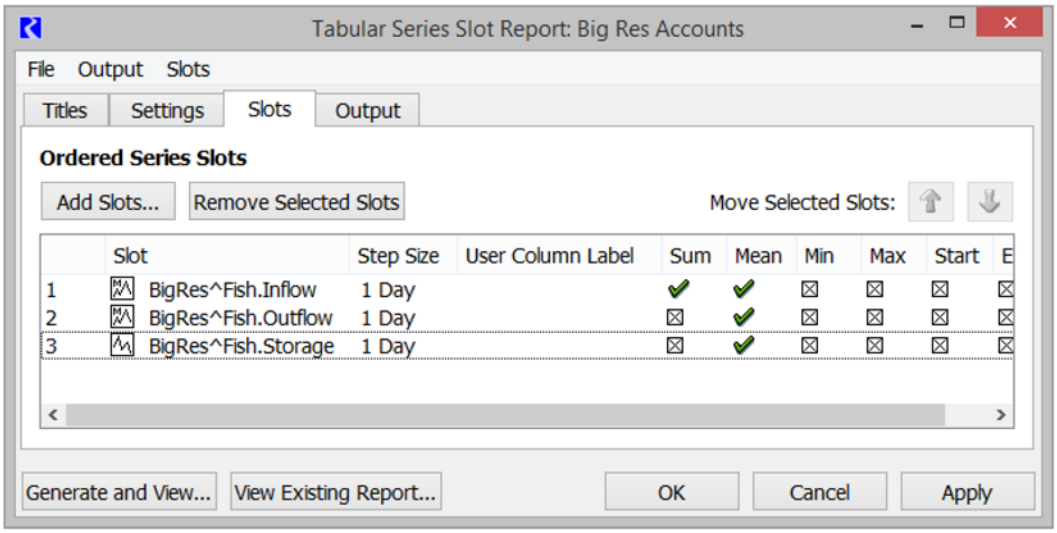
  Note: If you choose to display NaN values as 0.0 and to display 0.0 values as blank, the first control takes precedence; that is, NaN values are displayed as 0.0.

As with various other text components of the report, the font properties (font family, size, color) of the note footnotes are configurable as described in the **Output** tab section. See "Output Tab" on page 89 for details.

Slots Tab

On the **Slots** tab, specify the slots as an ordered list of series slots.

Figure 3.6



Add slots by choosing slots using the slot selector. This is accessible in the following ways:

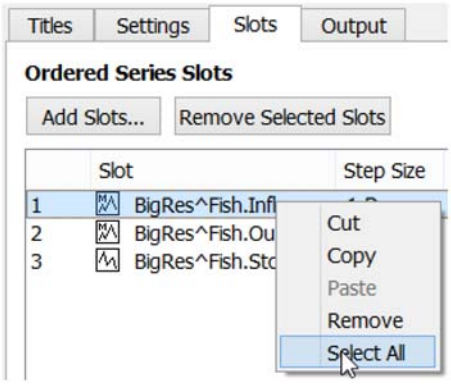
- Select **Add Slots**.
- By selecting **Slots**, then **Add_Slots**.

Slots in the Slot Clipboard (which were cut or copied from other Slot Lists) can be added to the slot list in these ways:

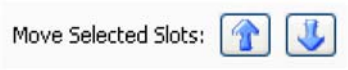
- Select **Slots**, then **Paste**.
- Select **Paste** (by right-clicking the slot list).

Figure 3.7 shows the context (right-click) menu supported within the slot list. The **Cut**, **Copy**, and **Remove** items operate on the full slot item selection. The **Cut, Copy** and **Paste** items interact with the RiverWare Slot Clipboard. These operations are also available in the “Slots” menu.

Figure 3.7

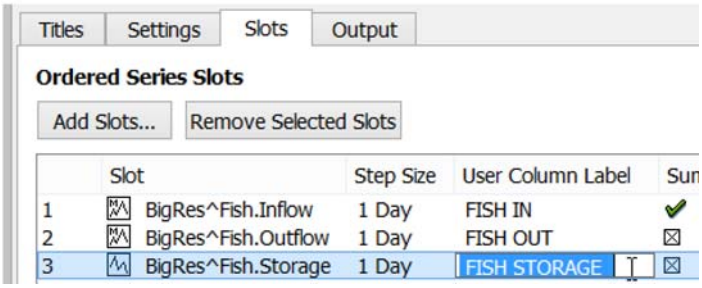


The order of the slots in the list will be used as the order of slots in the generated report. The selected slot items can be moved up or down in the list using the arrow buttons.



Text in the **User Column Label** column is editable and is used in column headers for the respective slot, based on the configuration defined on the **Settings** tab. Double-click on that cell to edit the text.

Figure 3.8



Note: Slots with multiple timestep sizes can be intermixed; each timestep in the model will be shown. If all the slots have the same timestep size, then the report will use that timestep size for display. See "Output Devices for Aggregated Values" on page 3 for details on creating aggregated data for display in this or other output devices.

Turn on summary rows for any of the slots (by selecting those cells, to toggle on or off the green check marks), the relevant summary rows are added to the report tables. The following column summary functions are supported:

- Sum
- Mean (average)
- Min (minimum value)
- Max (maximum value)
- Start (the top value in the table column)
- End (the bottom value in the table column)

Note: "NaN" values do not contribute to the arithmetic computation. (In particular, they do not effect the Mean computation).

Figure 3.9

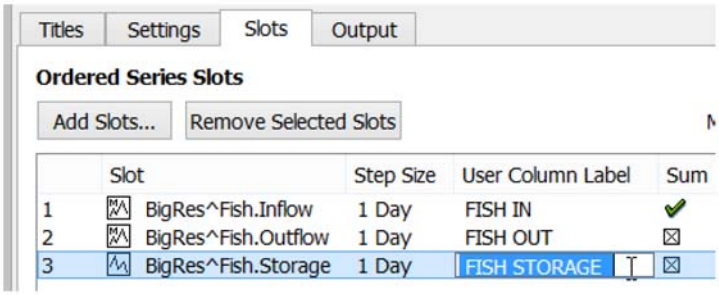


Figure 3.10 illustrates the effect of the summary checks in Figure 3.9, for the HTML and plain text reports.

Figure 3.10

```
                    Big Res Account Summary Report
                        Run #37, Policy Set 3

+------------+---------+----------+--------------+
|            | FISH IN | FISH OUT | FISH STORAGE |
|            |     cfs |      cfs |      acre-ft |
|============|=========|==========|==============|
| 01-01-2005 |   139.0 |     80.0 |     52,474.0 |
| 01-02-2005 |   152.1 |     80.0 |     52,617.8 |
| 01-03-2005 |   162.7 |     80.0 |     52,783.8 |
| 01-04-2005 |   137.2 |     80.0 |     52,898.1 |
| 01-05-2005 |   164.6 |     80.0 |     53,065.9 |
| 01-06-2005 |   156.6 |     80.0 |     53,217.8 |
| 01-07-2005 |   143.6 |     80.0 |     53,343.8 |
| 01-08-2005 |   129.9 |     80.0 |     53,445.7 |
| 01-09-2005 |   135.2 |     80.0 |     53,556.6 |
| 01-10-2005 |   132.4 |     80.0 |     53,660.4 |
| 01-11-2005 |   140.9 |     80.0 |     53,781.3 |
| 01-12-2005 |   153.6 |     80.0 |     53,927.4 |
| 01-13-2005 |   144.2 |     80.0 |     54,054.6 |
| 01-14-2005 |   167.9 |     80.0 |     54,229.3 |
| 01-15-2005 |   162.6 |     80.0 |     54,393.1 |
|============|=========|==========|==============|
| Sum:       | 2,222.3 |          |              |
| Mean:      |   148.2 |     80.0 |     53,430.0 |
| Min:       |   129.9 |          |     52,474.0 |
| Max:       |   167.9 |          |     54,393.1 |
+------------+---------+----------+--------------+
```

Big Res Account Summary Report

Run #37, Policy Set 3

	FISH IN cfs	FISH OUT cfs	FISH STORAGE acre-ft
01-01-2005	139.0	80.0	52,474.0
01-02-2005	152.1	80.0	52,617.8
01-03-2005	162.7	80.0	52,783.8
01-04-2005	137.2	80.0	52,898.1
01-05-2005	164.6	80.0	53,065.9
01-06-2005	156.6	80.0	53,217.8
01-07-2005	143.6	80.0	53,343.8
01-08-2005	129.9	80.0	53,445.7
01-09-2005	135.2	80.0	53,556.6
01-10-2005	132.4	80.0	53,660.4
01-11-2005	140.9	80.0	53,781.3
01-12-2005	153.6	80.0	53,927.4
01-13-2005	144.2	80.0	54,054.6
01-14-2005	167.9	80.0	54,229.3
01-15-2005	162.6	80.0	54,393.1
Sum:	2,222.3		
Mean:	148.2	80.0	53,430.0
Min:	129.9		52,474.0
Max:	167.9		54,393.1

Output Tab

The **Output** tab is used to specify the file type, path, and any HTML formatting.

On the **Output** tab, specify the following:

- The type of file to be generated (plain text or HTML).
- The file path where the **plain text** report file will be generated.

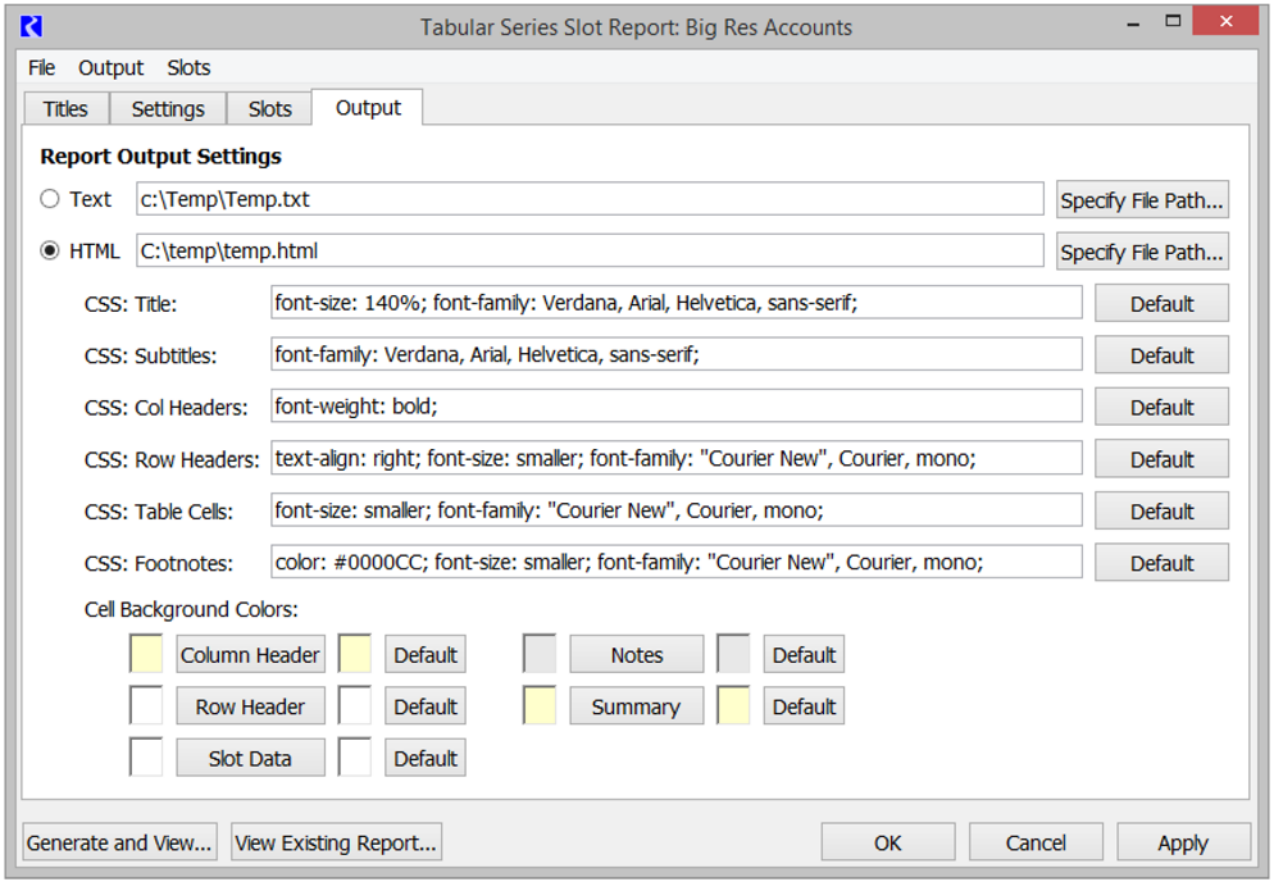
- The file path where the **HTML** report file will be generated.

  Note: File paths may contain environment variables: e.g. ${REPORT_DIR}\MyReport.html

  Note: If the file does not already exist, it will be created. If it does exist, it will be overwritten. If the file does not exist, you will need to type in a file name in the file selector.

- For an HTML report file, specify the following:
  - CSS style formulas for various types of text appearing in the report. See "HTML Report CSS Text Styles" on page 90 for details.
  - Background Colors for various table cells. See "HTML Report Table Cell Colors" on page 91 for details.

Figure 3.11



HTML Report CSS Text Styles

The fonts for six different uses of text in the HTML report are configured using Cascading Style Sheet (CSS) formulas. This typically includes font family, text color, size, bolding / italics, etc.

Figure 3.12 illustrates the six different configurable text types. Figure 3.13 (a detail from the **Output** tab) shows the initially implemented default CSS formulas. The default formulas can be restored by selecting the respective **Default** button. Hovering over a **Default** shows the default CSS formula in a tooltip.

Figure 3.12

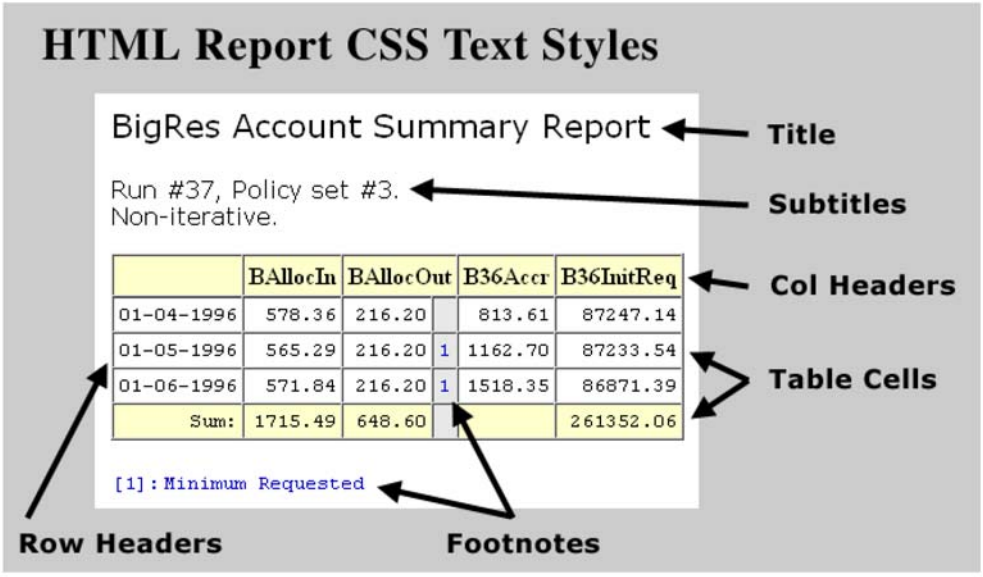
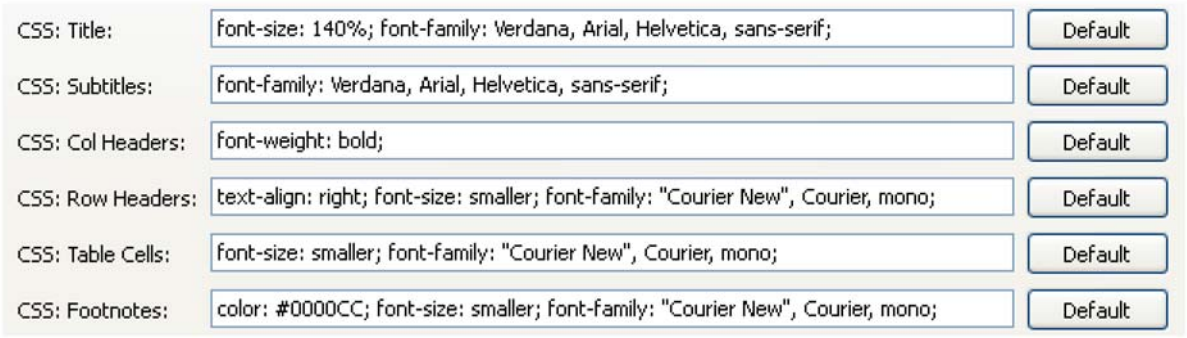


Figure 3.13



CSS is an HTML-associated style sheet technology standardized by the World Wide Web Consortium. See the following URL:

`http://www.w3.org/Style/CSS/`

Many free tools are available which can be used to create CSS style formulas, including most HTML editors. Following is the URL of a free online CSS style formula tool (which was found by Googling “Online CSS editor”):

`http://cssmate.com/csseditor.htm`

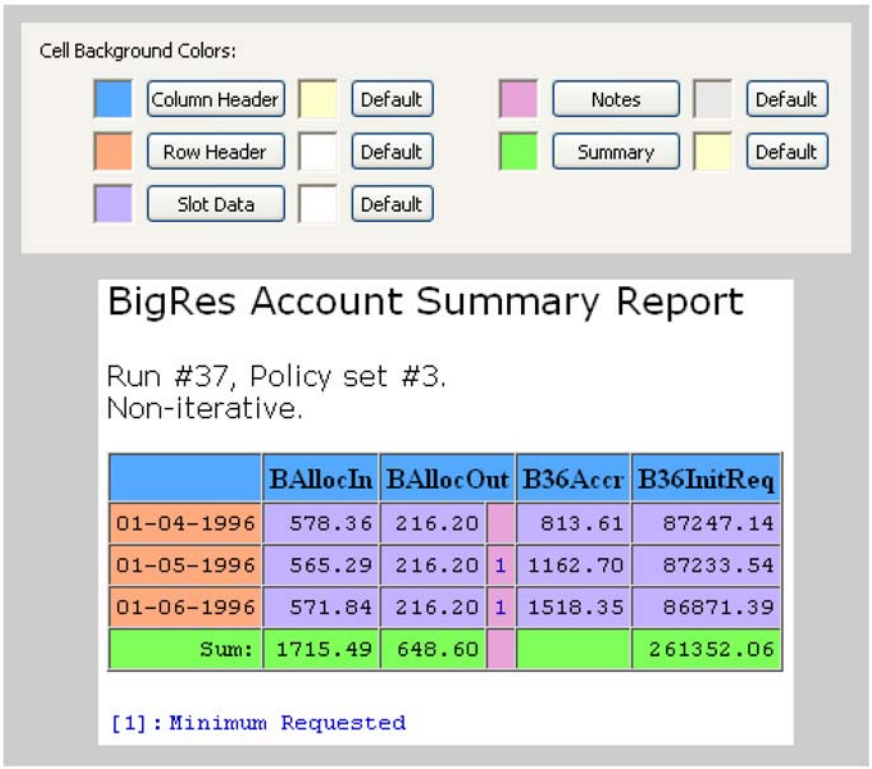
Six-character color codes for particular colors (see the Footnotes CSS formula “0000CC” in Figure 3.13, for example) can be computed using the color selection capabilities. See “HTML Report Table Cell Colors” on page 91 for details.

HTML Report Table Cell Colors

The background color for five different types of table cells are configurable by choosing them.

Figure 3.14 illustrates the five different configurable table cell color types.

Figure 3.14



On the **Output** tab, selecting the titled buttons (e.g. **Column Header**) shows a color chooser to select the desired color. Any color setting can be reverted to the default color by selecting the respective **Default** button.

On the **Output** tab, hovering the mouse over a color display window (square) shows the six hexadecimal digit RGB (Red-Green-Blue) color code in a tooltip. This is an HTML color encoding convention. Each of the three colors (Red, Green, Blue) has a two hexadecimal digit value from 0 (“00”) to 255 (“FF”). Higher numbers are lighter colors; Black is “000000” and White is “FFFFFF”.



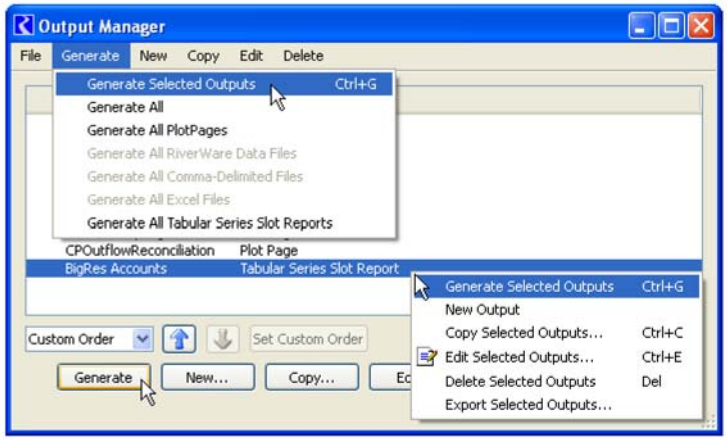
Generating Tabular Series Slot Reports

Once configured, a Tabular Series Slot Report can be generated in several ways, resulting in the creation of either a plain text file or an HTML file.

From the Output Configuration manager, a Tabular Series Slot Report can be generated in three ways. After selecting the desired report list item, do one of the following:

- Select **Generate**, or
- Select the **Generate**, then **Generate Selected Objects** menu item, or
- Select the **Generate Selected Outputs** context (right-click) menu item.

Figure 3.15



Or, from the **Output Configuration** dialog for a particular Tabular Series Slot Report, the report can be generated in either of the following ways:

- Select **Generate**, or
- Select the **Output**, then **Generate/Refresh** menu item.

An error dialog will be shown in these two circumstances:

- The configured file path for the selected output type (plain text or HTML) is invalid, or is not writable.
- The slot list is empty.

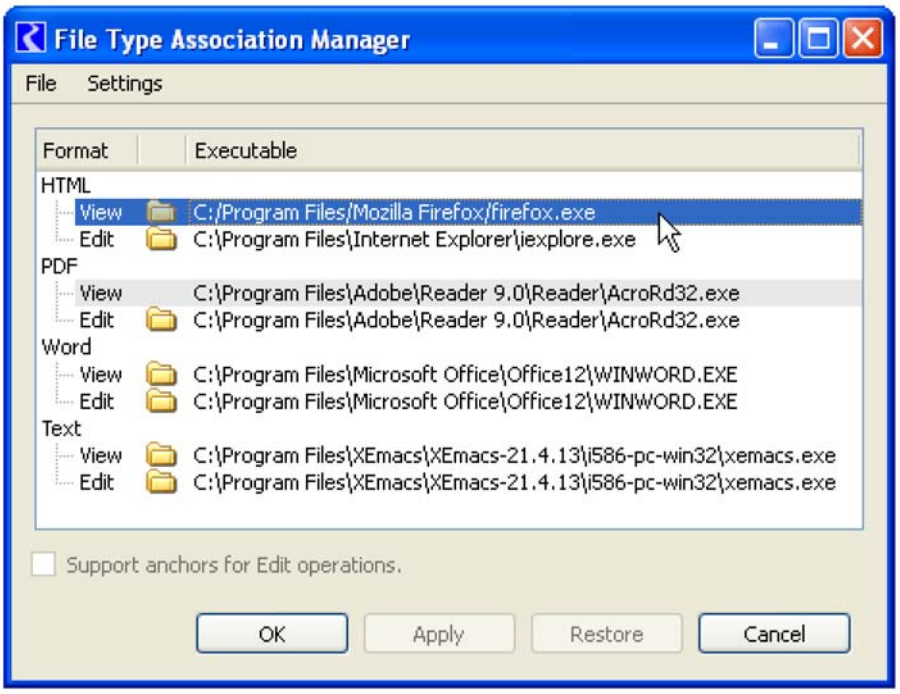
After the report file is generated, the following actions occur:

- The file path of the generated file is copied to the system clipboard.
- This dialog box is shown to report that path, and to give the option of viewing the report file in an external viewer application, which is a program configured using the File Type Associations manager (see "File Type Association Manager" on page 93). In the case of a plain text report file, you are given the option of using either the viewer for text files or the viewer (browser) for HTML files, if those are distinct. In the case of an HTML report, only the web browser option is available.

File Type Association Manager

When you choose to show a generated report file, an external program is launched. The file paths of external programs for viewing files of various types is configured in the **File Type Association Manager**. For the **Tabular Series Slot Report**, the HTML View executable is the only relevant one.

These settings persist with the user's login account, *not* with the currently loaded RiverWare model file.

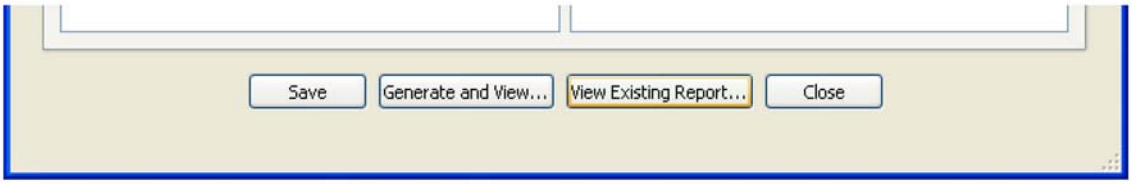


This dialog is accessible as follows:

- From the RiverWare Workspace's **Utilities** menu, and
- The Output Configuration dialog for Tabular Series Slot Reports; select **Output**, then **File Type Associations**.

Viewing an Existing Tabular Series Slot Report

The Output Configuration dialog for Tabular Series Slot Reports has a convenience function for opening an already generated report file.



View Existing Report opens a file chooser. Complete the file selection (for an existing file), then an external viewer program is launched to view that file.

Note: The HTML viewer is always used for this operation, even if the file is a plain text file.

Chapter 4
Model Report

The Model Report is an output device that generates an HTML document describing the model and/or RPL set. The Model Report is flexible with respect to both the contents and appearance of the report, allowing you to configure both the information contained in the report as well as how the information is formatted.

The following sections describe how to set up a model report and all the pieces and configuration options available.

Topics

- Model Report Uses, page 95
- Creating a New Model Report Configuration, page 95
- Configuring Model Reports, page 96
- Model Report Generation, page 108
- Report Items Reference, page 108

Model Report Uses

Following are some uses for model reports.

- Documenting the model by showing table and scalar data, method selection, subbasin membership, etc.
- Documenting a ruleset, goalset or any RPL Set using Report Groups
- Documenting the accounting system by including information on accounts, supplies, exchanges and general settings.
- Providing modeled results to stakeholders or others by including other output devices in the report. These devices can include plot pages, charts, and tabular series slot reports.

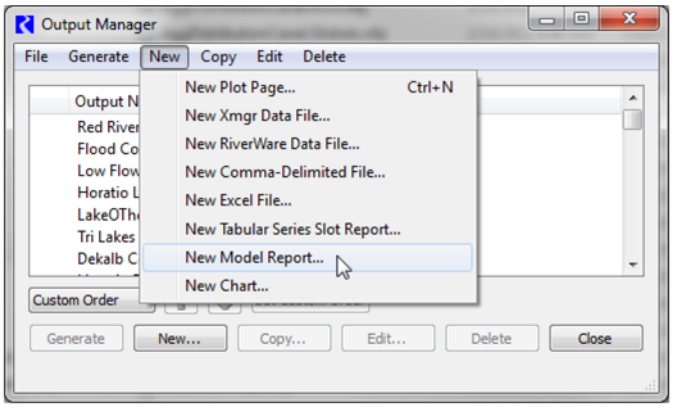
Creating a New Model Report Configuration

Model Report configurations are Output Devices (like Plot Pages or RiverWare Data Files, etc.). Model Reports are created within the Output Manager dialog.

Use one of the following methods to create a new Model Report:

- From the RiverWare workspace menu, select the **Utilities, then Output Management**.
- From the Output Manager dialog menu, select the **New, then New Model Report.**

- Configure the new Model Report and select **OK**. See “Configuring Model Reports” on page 96 for instructions.



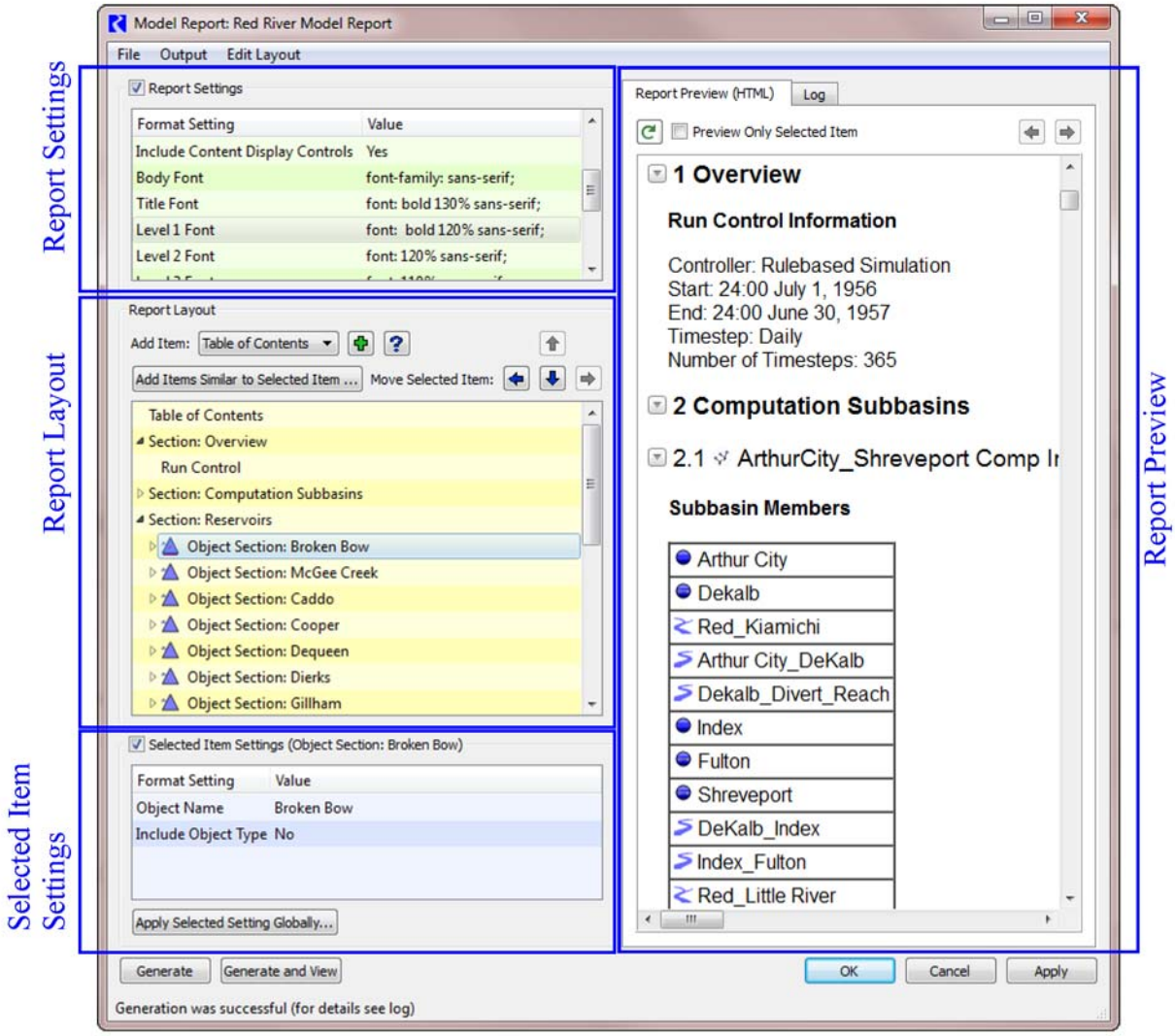
Configuring Model Reports

The **Model Report** configuration dialog allows you to create or change a report. It consists of the following areas, as shown in Figure 4.1.

- **Report Settings.** Aspects of the configuration which apply to the entire report, e.g., the name of the report, the output file name, and the overall appearance of the output file.
- **Report Layout**. Specification of the content to be included in the report, as well as the ordering and sectional organization of that content.
- **Selected Item Settings**. Control of the report formatting as specified on a per-item basis.
- **Report Preview**. View the report in a simplified HTML browser to quickly see what it will look like. Preview the entire report or a selected section.

In the remainder of this section, each of these areas is described in more detail.

Figure 4.1

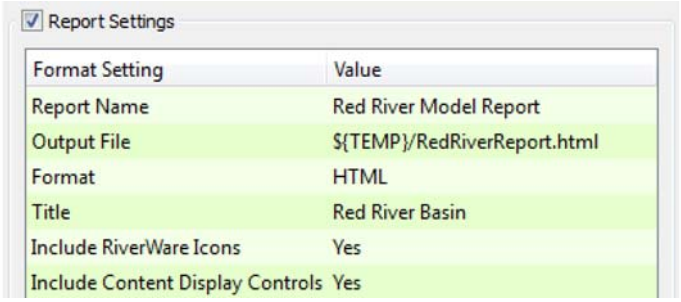


In general, to create a new report, start with the **Report Settings**, then use the **Report Layout** to define what you want to have in the report. Use the **Selected Item Settings** to configure each item in the report. **Refresh** the preview as needed to get an idea of what the report will look like. For long reports, select the **Preview Only Selected Item** checkbox (see "Report Preview Tab" on page 106) to only show the selected portion of the report. If you plan to have similar sections for multiple objects, fully configure the section for one object, then select **Add Items Similar to Selected Item** to create sections for all other objects. See "Report Layout Area" on page 99 for details.

Report Settings Area

The **Report Settings** area displays settings which apply to the entire model report. There is one row for each setting, presented by name and value. To change a setting's value, select the appropriate value cell, enter the new value and hit return (or select outside the editing window). When appropriate for the particular type of value being

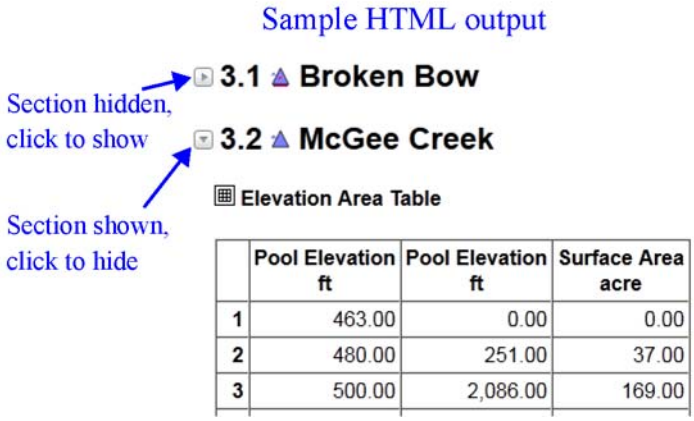
edited, a **More** (ellipsis) button is displayed next to the cell; selecting **More** will bring up a dialog to assist with the editing process. For example, when entering the name of an file, the button brings up a file chooser.



The following report settings are currently supported:

- **Report Name**. The name of the output device as displayed in the Output Manager dialog.
- **Output File**. The name of the file to which the report should be written. This should typically be a fully specified path (e.g., C:\Reports\MyReport.html) but may contain references to environment variables (e.g., ${REPORT_DIR}\MyReport.html). Within the file chooser, and html/htm filter is available. In addition, ".html" will be automatically appended to the file name, if not specified.
- **Title. T**he title of the report. If provided, this text will appear at the top of the report.
- **Include RiverWare Icons.** If "Yes", then references to workspace objects in the report will be accompanied by the appropriate RiverWare icon. When the report is generated, the image files corresponding to these icons will be written to a subdirectory at the same level as the output file. For example, if the output file is "`C:\Reports\MyReport.html`, then the images will be written to the directory `C:\Reports\RiverWareReportImages`, which is created by RiverWare as necessary.
- **Include Content Display Control.** If "Yes", the generated HTML file will include hide/show controls to the left of each section. These controls allow you to hide or show that section's content.

  Note: The HTML display must support Javascript.



- **Embed Images in HTML File**. If "Yes" (the default), any images included or generated by the report are embedded in the HTML file. For example If "No", any images are included in the `RiverWareReportImages` folder. Embedded images make it easier to email or upload a HTML report. Non-embedded images allow for all the images to be organized separately and minimizes the size of the output HTML file.

Note: Not all applications support the display of images embedded within HTML documents. For example, while most browsers support this feature of HTML, Microsoft Word 2016 does not, so use of this feature can make the report less portable.

- **Body Font.** The font used for text in the body of the report. This and other fonts are specified in font declaration format used by cascading style sheets (CSS). The specification can be edited in line, or selected with a font chooser.
- **Title Font.** The font used for the report title.
- **Level 1 Font.** The font used for top level section titles.
- **Level 2 Font.** The font used for second level section titles.
- **Level 3 Font.** The font used for third level section titles.
- **Level 4 Font.** The font used for fourth level section titles.
- **Level 5 Font.** The font used for fifth level section titles
- **Include Date In Output File Name.** If enabled, each occurrence of the string **"**DATE**"** in the output file name will be replaced with the current date (in the ISO 8601 extended format, YYYYMMDD).
- **Include Time In Output File Name.** If enabled, each occurrence of the string "TIME" in the output file name will be replaced with the current time (in the ISO 8601 format, HHMMSS).

Once editing of the report settings is complete, the **Report Settings** area can be hidden by clearing the associated checkbox.

Report Layout Area

You control the content of the report in the **Report Layout** area. This content is organized by items, and you specify the report contents by indicating which items should be included, the order in which these items should appear, and their organization into sections. Select  for a description of each item, which is similar to the information in Table 4.1.

Table 4.1 Available Model Report items and their description

Item	Description
Table of Contents, page 126	Lists the sections in the report, with hyperlinks to their locations.
Model Information, page 114	Lists the information contained in the Model Info dialog (accessed from the workspace using **File**, then **Model Info**), including the model's save history and the specified comments.
Accounting System Settings, page 110	Lists the information on the accounting system including range, accrual date, water types, owners, etc. This is the information shown in the **Accounting,** then **Account System Configuration** dialog.
Run Control, page 121	Shows the information contained in the single run control dialog, including the controller, start and end dates, and timestep size.
Run History, page 122	Shows status information about the last run including version, user, controller, start time, duration, and completion status.

Table 4.1 Available Model Report items and their description

Item	Description
Section, page 123	Presents a titled section whose contents are controlled by the items in the section.
Object Section, page 114	Creates a section for a workspace object, whose title is the name of that object and whose contents are controlled by the items in the section.
Slot, page 123	Shows a slot's name, description, and values. For, table, periodic and scalar slots, the values are shown. For series slots, a plot of the time series is shown. For Expression Slots, the RPL expression is shown along with a plot (series) or value (scalar).
Slot Value Table, page 124	Presents a table showing the name and a single value for one or more selected slots. Each row of the table is a slot. Columns include the Slot, Object (optional), Account (optional), Value, and Units.
Scalar Slot Grid, page 122	Presents a table showing a grid of scalar slot values. The rows of the table represent objects while the columns represent one or more named scalar slots.
Periodic Slot Table, page 116	Shows a table where the rows represent the time intervals of a periodic slot and the columns represent the columns in one or more periodic slots. These are used to display periodic slots that have only one column.
Method Table, page 113	Displays a table of the method categories and the selected method in each category. When accounting is enabled, this table includes Object Level Accounting Methods.
Account Section, page 109	Displays a section describing an account on the workspace. The title is the name of the account. Sub-sections can be added to an account section.
Account Table, page 109	Presents a table with a list of accounts (often those for a single simulation object) and optional columns for several account attributes including type, water type, water owner, and priority date.
Supply Table, page 125	Presents a table of supplies and optional columns for supply attributes including type, release type, and destination.
Account Method Table, page 108	Displays a table with an account's method categories and the selected method in each category. Note: These are account level methods, not object level methods.
Subbasin, page 125	Shows a table of the members of a subbasin.
Link Table, page 112	Presents a table of the physical links to slots on the specified object, optionally limited to links to the slots on a second specified object.
Text, page 127	Prints user defined text. The text can be Plain Text or Rich Text which allows formatting.
Image, page 111	Shows an Image imported from a file. An optional caption setting is provided.
RPL Set, page 120	Displays a section for each policy and utility group in a RPL set.
RPL Group, page 117	Displays a section for a single policy or utility group in a RPL set.
RPL Rule/Goal, page 118	Displays a section for a single RPL item (Rule/Goal/Accounting Method).
RPL Statement, page 121	Shows a single top-level RPL Statement within a RPL Block (a Rule, Goal, User-Defined Accounting Method or Initialization Rule).

Table 4.1 Available Model Report items and their description

Item	Description
Plot Page, page 116	Displays an image of an existing plot page output device. Use the Plot Page's timesteps or override with an optional setting.
Chart, page 110	Displays an image of an existing Chart output device. Use the configured timestep or override with an optional setting.
Output Canvas, page 115	Displays an image of an existing Output Canvas device.Use the configured timestep or override with an optional setting. See "Output Canvas" on page 147 for additional information.
Tabular Series Slot Report, page 126	Displays an existing Tabular Series Slot Report output device in either HTML or text format. The title defined within the Tabular Series Slot Report is extracted from the report and presented as a report item title text within the generated Model Report. Use the configured timesteps or override with an optional setting.

The following operations allow you to create the report layout and arrange its items as desired.

Table 4.2

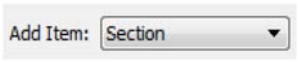
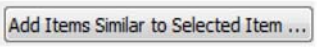
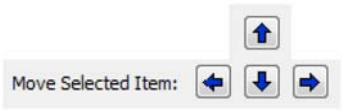
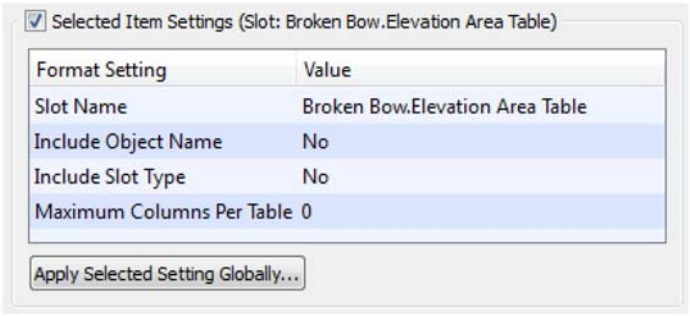
Button	Description
Add Item 	Use the menu to chose an item to add to the layout. Then select **Plus**  to add the selected item. The new item is added below the currently selected item, either at the same sectional level or as a child of the selected item, as appropriate for the types of the new and selected items. (If the new item is not initially in the desired location, it can be moved as discussed below.) A similar action can be accomplished by selecting **Edit Layout**, then **Add Item**, and then choosing the desired item type.
Add Items Similar to Selected Item 	When an item associated with an **object** is selected, this button is enabled. When this button is selected, you can use the object selector to select multiple objects. A copy of the selected report item is made for each selected object, with the original object reference replaced with the object selection. For example, if an Object Section item associated with Reservoir A is currently selected and this button is selected, then you select Reservoir B and Reservoir C, then two new Object Section items will be added. Each will be identical to the Reservoir A item except that all references to Reservoir A in one will be replaced with references to Reservoir B, and similarly, Reservoir A references will be replaced with Reservoir C references in the other item.
Move arrows 	These buttons can be used to move the selected item up or down or to change the sectional organization by making an item a child of item above it (right arrow, **make child**, or "move in") or a sibling of the parent item (left arrow, **Promote**, or "move out").

Table 4.2

Button	Description
Drag and drop	An item can be dragged from one location to another to move it, or it can be dragged from the Report Layout of one model report configuration dialog to that of another dialog to add a copy.
Edit operations	The following standard edit operations can be accessed via the right-click context menu or the **Edit Layout** menu: **Cut**, **Copy**, **Paste**, **Delete**. In addition the Edit Layout menu provides the **Paste Below Selected Item** which adds the buffered item as a new item instead of overwriting the selected item. Initially section items are displayed collapsed; in addition to individually collapsing and expanding the contents of section items in the Report Layout, the right-click context menu provides the **Expand All** and **Collapse All** options.

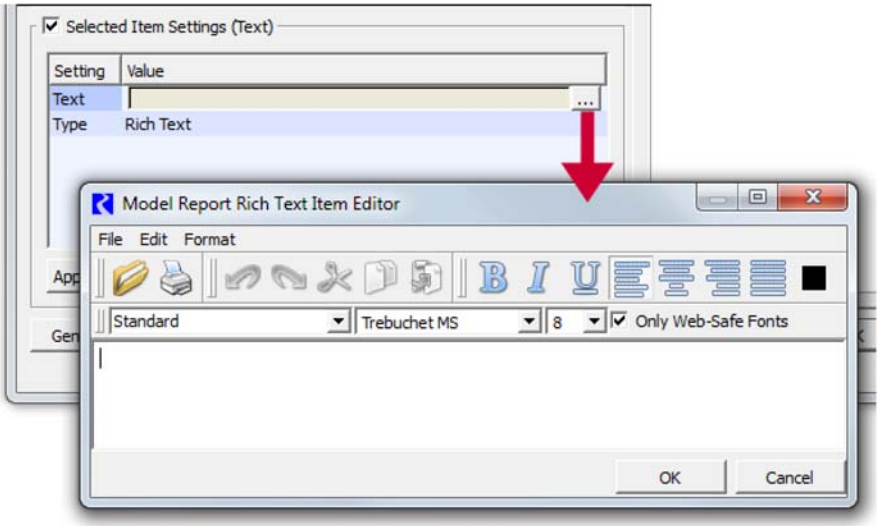
Selected Item Settings Area

The **Selected Item Settings** area allows you to control the appearance of individual report items. This area lists the settings which apply to the item currently selected in the **Report Layout** area, and allows them to be edited by selecting the current setting value. See "Report Items Reference" on page 108 for details about the settings that apply to each type of report item.



Text Considerations

Newly created Text Items are in the **Rich Text** mode by default. When in this mode, an advanced editor is shown for editing the text item content. This is initiated by selecting **More** after double-clicking the Text setting's value field



The **Rich Text Item Editor** supports many common formatting operations; these are generally applied to the selected portion of the text content. Options include bold, italics, underline, subscripts, superscripts, alignment (left, right or center), and text color.

Superscripts and subscripts can be applied from the **Format** menu. Superscripts and subscripts appear very small in the Rich Text Editor. But the Model Report editor's preview panel does represent superscripted and subscripted text accurately (as it would in a browser). There is no size reduction of the font in subscripts and superscripts. You may want to also reduce the size of, especially subscripts, by applying a smaller text size. In addition, there is no way to remove the super and subscripts. Delete and re-enter text that you wish to have normal formatting.

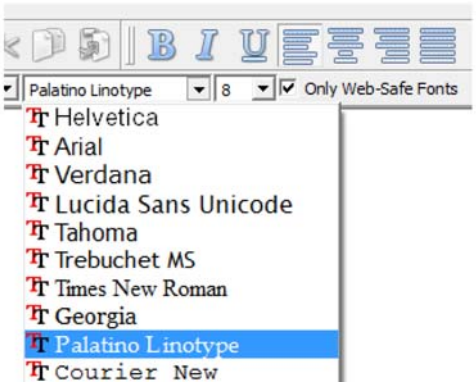
In general, tabs are not supported in HTML documents. To work around this, the tab key in the Rich Text Editor results in four non-breaking spaces in the generated HTML file. Shift-space bar results in 1 non-breaking space.

Copying and pasting basic formatted text content from an external application (e.g. a web browser, or Microsoft Word), using the system clipboard, is supported. Also, it is possible to Import an existing HTML or text document; doing so replaces the editor's prior content.

The editor supports Undo and Redo operations, so it is very reasonable to experiment with the available formatting operations. However, the graphical rendering by this editor doesn't precisely match the appearance of content in the generated HTML document. Formatting should be checked in the Model Report configuration dialog's preview panel after applying changes to rich text Text items.

Any font on the user's system can potentially be applied to rich text content. (A typical Windows system supports over 300 different fonts). However, since the generated RiverWare Model Report is an HTML document, and since web browsers generally rely on the fonts available on the viewer's system, we recommend the use of the Only Web-

Safe Fonts option which limits the font selection to fourteen of the most commonly supported fonts. This is selected by default.



Once rich text has been entered, switching back to “Plain Text” mode causes the loss of any formatting and text attributes which had been applied. For this reason, a confirmation dialog is presented to the user when switching to “Plain Text”.

Additional Setting Features

Following are additional features that apply to one or more item types and their settings.

Apply Selected Setting

Globally Selecting **Apply Selected Setting Globally** will search the report layout for items that have a different value for the selected setting. If any such settings exist, then you will be asked to confirm that you would like to copy the selected setting’s value to these items, that is, to bring all of values for the selected setting into agreement.

Date/Time Specification

Date/times can be specified as follows:

- Enter them explicitly by typing in the date.
- Specify by **More** , which opens the Date/Time selector.
- Use the menu, shown in Figure 4.2 to select one of the common formats. Then specify any of the pieces necessary like integers “N”, Hour (H), Minute (M), Day (D), Year (N). See “DATETIME” in *RiverWare Policy Language (RPL)* for details on Date/Time. Basically, any fully specified Date/Time can be used.

  Note: No @ or quotes “ ” are necessary when specifying the Date/Time. Any errors in computation of the timestep are reported on the Log tab. See “Log Tab” on page 107.
- Use a Global Function. To allow additional flexibility specifying Date/Time, you can specify a RPL function from an opened Global Function Set. See “Global RPL Functions” in *RiverWare Policy Language (RPL)* for details. You must enter the name of the function in the form: function(). This function must meet the following requirements:

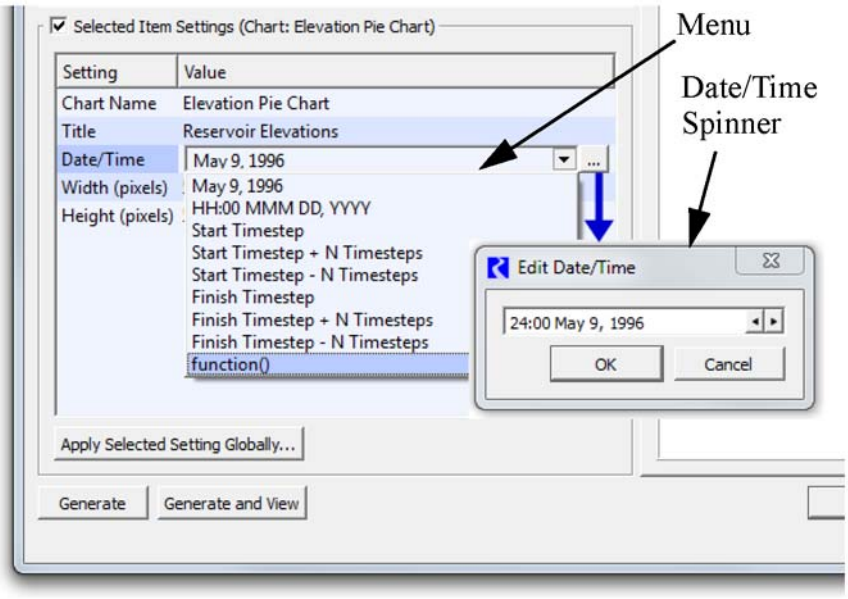
  Return a fully specified DATETIME variable

  Not have any arguments

Any errors in computation of the timestep are reported on the Log tab "Log Tab" on page 107.

- If you leave the Date/Time blank, then the default timestep for that setting is used. Typically this is the timestep(s) configured on the Output Device or the default run range.

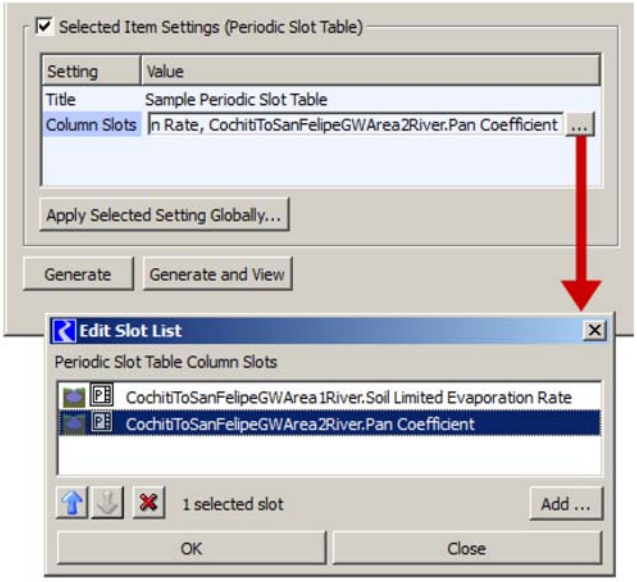
Figure 4.2



Lists of Items

For the **Periodic Slot Table** and **Scalar Slot Grid**, you specify an ordered list of Objects, Slots and/or Slot Names. This ordered list is specified in a separate dialog called the Edit <Item> List as shown in Figure 4.3. Select **Add** to open the selector in the appropriate mode and select the desired items.

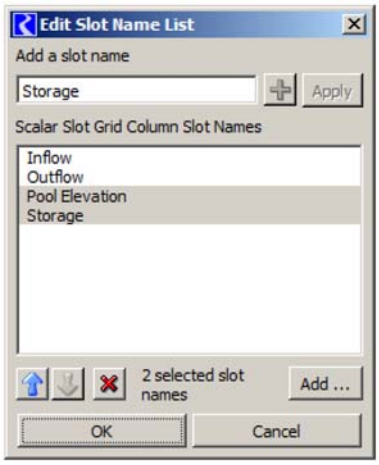
Figure 4.3



Use the blue arrows to rearrange the items in the list. This ordering is preserved in the model report. Use the red X to delete the item.

For the **Scalar Slot Grid**, you specify names of slots, not specific slots on objects. In this mode, the slot name can be typed into the box at the top of the dialog (as shown in Figure 4.4) or chosen from the selector by selecting **Add**. The list preserves only the Name of the slots.

Figure 4.4



Report Preview Tab

The first tab of the panel on the right side of the dialog provides a preview of what the output report will look like in an external application. Selecting **Refresh** will generate output corresponding to the current layout and

settings. Checking the **Preview Only Selected Item** will display only the output generated by the item selected in the Report Layout area. This setting is very useful for long reports where you only want to preview a small portion.



Previous and **Next** arrows  provide navigation backwards and forwards to locations in the document which have been visited by selecting a link.

> **Note:** Many applications are capable of displaying an HTML document (e.g., this panel of RiverWare, Mozilla Firefox web browser, and Microsoft Word editor), but different applications often display the same HTML differently. It is always a good idea to test your model report in a range of browsers to ensure it looks reasonable.

Log Tab

This tab provides a textual description of the report generation process. The log contains details such as: the time at which generation began and ended, the output file path, the directory to which image files were written, and how many new images were written there. When a problem occurs during preview generation, the details will be reported here (and typically not in the diagnostic dialog). If the preview does not looks as expected, the log will often explain problems encountered.



Additional Buttons and Menu Actions

Following are descriptions of the remaining buttons and menu actions:

- **Generate**: Select **Generate** to create the model report output file in the path specified by the Output File setting.
- **Generate and View**: Generate the report and open the file using the program specified by selecting **Output,** then **File Type Associations**.

- **OK**: Select **OK** to save any unapplied changes and close the configuration dialog.
- **Cancel**: Select **Cancel** to discard any unapplied changes and close the configuration dialog.
- **Apply**: Select **Apply** to save to the Output Manager any changes since the last apply.

  Note: For these changes to be reflected in the model file, a separate model file save is required.

Select **File**, then **Export** to create a file containing the model report configuration. This file can then be imported via the Output Manager into another model.

Model Report Generation

When a Model Report is generated from the Model Report configuration dialog or from the Output Manager dialog, an HTML file is created at the location specified in the Output File setting. This file can then be viewed by any external application appropriate for viewing HTML.

Note: If the report is generated and **Embed Images in HTML file** disabled, then image files corresponding to the images will be written to a subdirectory at the same level as the output file. For example, if the output file is `C:\Reports\MyReport.html`, then the images will be saved to the directory: `C:\Reports\RiverWareReportImages`, which is created by RiverWare as necessary. See "Report Settings Area" on page 97 for details.

Report Items Reference

This section provides details about the settings that apply to each type of report item.

Account Method Table

Item Type	Account Method Table	
Description	Displays a table with an account's method categories and the selected method in each category. Note: These are account level methods, not object level methods.	
Setting	**Type**	**Notes**
Selection	Single Selection	The account whose methods should be displayed
Title	Single line text	The text to appear as the table title
Show Only Non-default Methods	Yes/No	If yes, only categories with a non-default method selected are included in the table.
Sample	**Account Methods** **Category** / **Method** Appropriation Request Adjustment / None Conservation Pool Fill Factor / None Initial Request / Fill Conservation Pool	

Account Section

Item Type	Account Section	
Description	Displays a section describing an account on the workspace. The title is the name of the account. Sub-sections can be added to an account section.	
Setting	**Type**	**Notes**
Account Name	Single Selection	The account associated with this section.
Include Account Type	Yes/No	If Yes, the account type is included in the section title.
Show Description	Yes/No	Not applicable.
Sample	1 SandyReservoir^Fish	

Account Table

Item Type	Account Table	
Description	Presents a table with a list of accounts (often those for a single simulation object) and optional columns for several account attributes including type, water type, water owner, and priority date	
Setting	**Type**	**Notes**
Selection	Multiple Selection	The accounts to include in the table
Title	Single line text	The text to appear as the table title
Include Object Name	Yes/No	
Include Account Name	Yes/No	
Include Water Owner	Yes/No	
Include Water Type	Yes/No	
Include Priority Date	Yes/No	

Sample

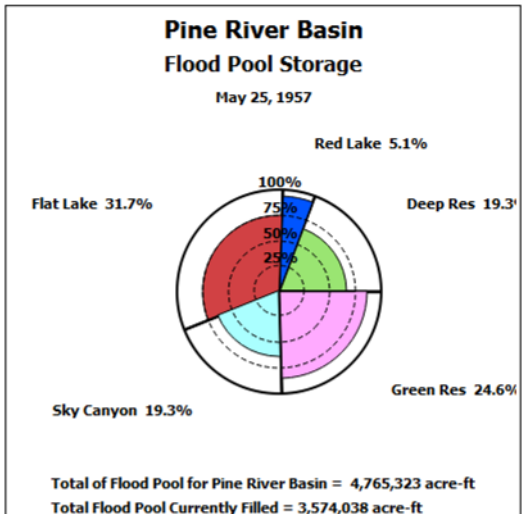
Object	Account	Water Owner	Water Type	Priority Date
SandyReservoir	Chaco	RedRiver	Chaco	Jan. 1, 1985 02:00
SandyReservoir	Fish	Fish	Nymph	Apr. 13, 2005 06:00

Accounting System Settings

Item Type	Accounting System Settings	
Description	Lists the information on the accounting system including range, accrual date, water types, owners, etc. This is the information shown in the **Accounting, then Account System Configuration** dialog.	
Setting	**Type**	**Notes**
Include Account Water Owners	Yes/No	If yes, show a table of all user-defined Water Owners.
Include Account Water Types	Yes/No	If yes, show a table of all user-defined Water Types.
Include Supply Release Types	Yes/No	If yes, show a table of all user-defined supply Release Types.
Include Supply Destinations	Yes/No	If yes, show a table of all user-defined supply Destination Types.
Sample	**Accounting System Settings** Begin Accrual: December 31 Rent Return: December 31 Begin Accounting Period: December 31, 2004 End Accounting Period: December 31, 2005 Maximum Iterations (for all accounts): 20 Allow Equal Priority Dates for Accounts: No **Account Water Owners**: Fish, Lower, RedRiver, Upper **Account Water Types**: Chaco, Fish, Nymph	

Chart

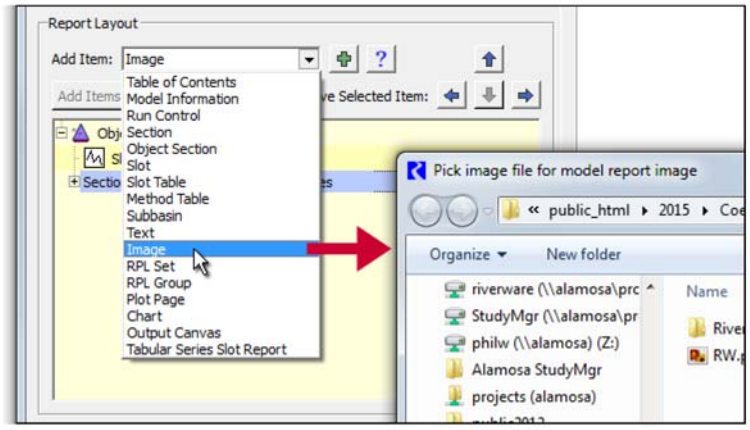
Item Type	Chart	
Description	Displays an image of an existing Chart output device. Use the configured timestep or override with an optional setting.	
Setting	**Type**	**Notes**
Chart Name	Single Selection	The existing chart device to include in the report
Title	Single line text	The text to appear above the chart.
Date/Time	Date/Time	The timestep to be used for series data within the chart. If left blank, the timestep defined on the chart is used. If specified, that date is used. See "Date/Time Specification" on page 104 for additional information.

Item Type	Chart	
Description	Displays an image of an existing Chart output device. Use the configured timestep or override with an optional setting.	
Setting	Type	Notes
Chart Width (pixels)	Integer	The width of the chart in pixels. The default is 500.
Chart Height (pixels)	Integer	The height of the chart in pixels. The default is 500.
Sample		

Image

Item Type	Image	
Description	Shows an Image imported from a file. An optional caption setting is provided.	
Setting	Type	Notes
Image Name	Single-line text	The image name is used only to identify the image within the Report Layout tree. It is initially taken from the imported image's file name.
Caption	Multi-line text	A string of text to appear below the image. For more information on images, see the text below the table.

When you add an **Image** to the layout, a file selector is opened which allows you to select an image file.



After picking an image file, a new **Image** item is created. Optional **Caption** text can be specified with each image item. In the generated model report, caption text is shown under the image. For sufficiently wide images (at least 300 pixels wide), the caption is horizontally centered below the image and wrapped to the image width. Captions for narrower images are not constrained in this way; they appear under the image, left aligned, and flowing to the full display width of the generated model report page. It is not currently possible to select a different image for an existing image item. If a different image is desired, a new image item must be created. (You may wish to retain the old image item during the creation of the new image item so that the old image caption text can be copied and pasted to the new image item).

For imported images, the Image data is stored in the model file in the model report output device configuration. Including many large images in a model report configuration could potentially increase the size of the model file significantly and could result in slower model file loading.

• Link Table

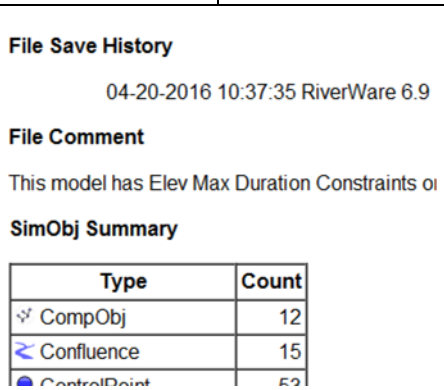
Item Type	Link Table	
Description	Presents a table of the physical links to slots on the specified object, optionally limited to links to the slots on a second specified object.	
Setting	**Type**	**Notes**
Title	Single line text	The text to appear as the table title

Item Type	Link Table	
Description	Presents a table of the physical links to slots on the specified object, optionally limited to links to the slots on a second specified object.	
Setting	Type	Notes
Object Name 1	Object Selection	
Object Name 2	Object Selection	If specified, only the links between slots on Object 1 and Object 2. If not specified, any links from slots on Object 1 will be shown.
Sample	**Sample Link Table One** **Mead** | | **Linked to Slots** Inflow <--> CoRivVirginToMead.Outflow Outflow <--> CoRivMeadToMohave.Inflow Diversion <--> SNWPDiversion.Total Diversion Return Flow <--> SNWPDiversion.Total Return Flow Available for Diversion <--> SNWPDiversion.Total Available Water **Sample Link Table Two** **CoRivMohaveToHavasu:RRMohStmPlnt** | **MohaveSteamPlant** Return Flow <--> Total Return Flow Available For Diversion <--> Total Available Water Diversion <--> Total Diversion	

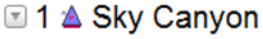
• Method Table

Item Type	Method Table	
Description	Displays a table of the method categories and the selected method in each category. When accounting is enabled, this table includes Object Level Accounting Methods.	
Setting	Type	Notes
Object Name	Single Selection	
Title	Single line text	If present, will appear as the title of the table.
Show Only Non-default Methods	Yes/No	
Sample	**Selected Methods** **Category** | **Method** Power | Peak Power Equation with Off Peak Spill Power Release | Peak Power Equation with Off Peak Spill Release Evaporation and Precipitation | Input Evaporation Hydrologic Inflow | Forecast Hydrologic Inflow	

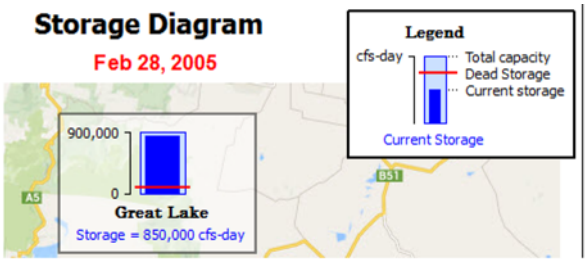
Model Information

Item Type	Model Information	
Description	Lists the information contained in the Model Info dialog (accessed from the workspace using **File**, then **Model Info**), including the model's save history and the specified comments.	
Setting	**Type**	**Notes**
Include File Save History	Yes/No	
Include File Comment	Yes/No	
Sample		

Object Section

Item Type	Object Section	
Description	Creates a section for a workspace object, whose title is the name of that object and whose contents are controlled by the items in the section.	
Setting	**Type**	**Notes**
Object Name	Single Selection	
Include Object Type	Yes/No	
Show Description	Yes/No	Optionally include the description shown on the Description tab in the Open Object dialog.
Sample		

Output Canvas

Item Type	Output Canvas	
Description	Displays an image of an existing Output Canvas device. Use the configured timestep or override with an optional setting. See "Output Canvas" on page 147 for additional information.	
Setting	**Type**	**Notes**
Output Canvas Name	Single Selection	The existing Output Canvas device to include in the report
Title	Single line text	The text to appear above the canvas image.
Date/Time	Date/Time	The timestep to be used for series data within the output canvas. If left blank, the timestep defined on the canvas is used. If specified, that date is used. See "Date/Time Specification" on page 104 for additional information.
Max Width (pixels)	Integer	The maximum width of the canvas in pixels. The default is 10000. The image is the natural size or smaller and the aspect ratio from the original canvas is maintained.
Max Height (pixels)	Integer	The maximum height of the canvas in pixels. The default is 10000. The image is the natural size or smaller and the aspect ratio from the original canvas is maintained.
Sample		

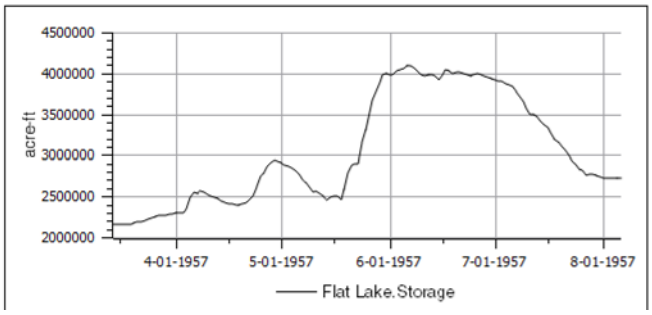
Periodic Slot Table

Item Type	Periodic Slot Table	
Description	Shows a table where the rows represent the time intervals of a periodic slot and the columns represent the columns in one or more periodic slots. These are used to display periodic slots that have only one column. Note: An error is generated if periodic slots having different overall periods are included. However, different time interval configurations can be represented within a single Periodic Slot Table. This includes mixes of regular interval and irregular interval configurations, and different specific interval start times.	
Setting	**Type**	**Notes**
Title	Single line text	If present, will appear as the title of the table.
Column Slots	Sortable Slot Selection	See "Lists of Items" on page 105 for details on selecting lists of items,
Sample		

	Kaw .Max Low Flow Delivery Rate cfs	Keystone .Max Low Flow Delivery Rate cfs
Jan	156.0	200.0
Feb	156.0	220.0
Mar	156.0	220.0
Apr	156.0	220.0

Plot Page

Item Type	Plot Page	
Description	Displays an image of an existing plot page output device. Use the Plot Page's timesteps or override with an optional setting.	
Setting	**Type**	**Notes**
Plot Page Name	Single Selection	
Title	Single line text	If present, will appear as the title of the plot page.
Width (pixels)	Integer	
Height (pixels)	Integer	

Item Type	Plot Page	
Description	Displays an image of an existing plot page output device. Use the Plot Page's timesteps or override with an optional setting.	
Setting	Type	Notes
Start Date	Date/Time	Specify the date/times to use in the report, if desired. This will override the Plot Page dates when specified. See "Date/Time Specification" on page 104 for details.
End Date	Date/Time	
Sample		

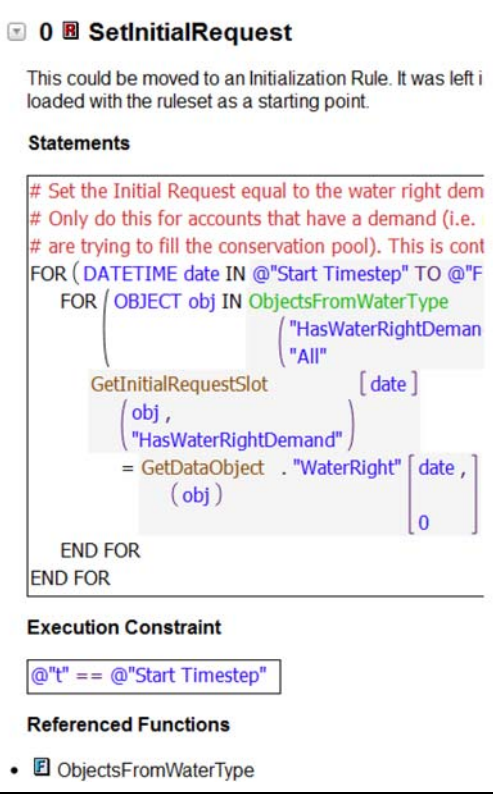
RPL Group

Item Type	RPL Group	
Description	Displays a section for a single policy or utility group in a RPL set.	
Setting	Type	Notes
Set	Single Selection	These items might generate output for a RPL Report Group, and that group might include references to workspace objects, slots, or subbasins, so these items include format settings that apply to slots, objects, and subbasins. For example, each includes the "Slot: Include Object Name" setting which is used when generating output for a RPL Report Group containing a slot. See "Blocks and Groups" in *RiverWare Policy Language (RPL)* for details on groups. See "RPL Printing and Formatting" in *RiverWare Policy Language (RPL)* for details on the RPL selector.
Group	Single Selection	
Show Execution Properties	Yes/No	Show the index or priority range of the group (where applicable) and whether the group is enabled or disabled.
Show Descriptions	Yes/No	Include the Descriptions entered on each RPL Editor dialog. See "Descriptions" in *RiverWare Policy Language (RPL)* for details.
Show Notes	Yes/No	Include the Notes entered on each RPL Editor dialog. See "Notes" in *RiverWare Policy Language (RPL)* for details.

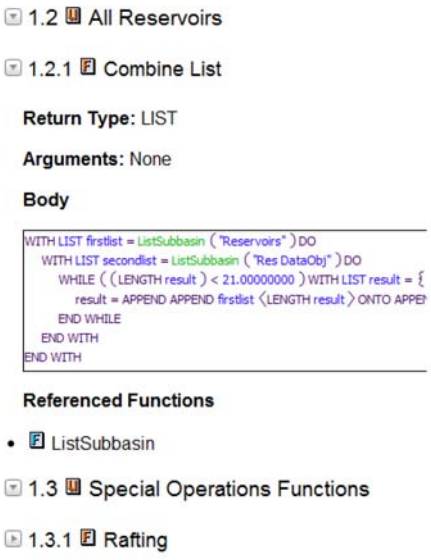
Item Type	RPL Group	
Description	Displays a section for a single policy or utility group in a RPL set.	
Setting	**Type**	**Notes**
Show RPL Comments	Yes/No	Include Comments that are inline in the RPL Expression. See "Comments" in *RiverWare Policy Language (RPL)* for details.
List Rules in Order of Execution	Yes/No	For Policy Groups in RBS Rulesets, Initialization Rules Sets, and Iterative MRM Rules Sets, when set to Yes, the rules are displayed based on the Agenda Order. (See "Show Advanced Properties" in *RiverWare Policy Language (RPL)* for details on the Agenda Order.) When set to No, rules are displayed in the order they are shown in the RPL Set Editor. For Report Groups, Optimization Goal Sets, Accounting Methods and functions, this setting has no effect. These items are always displayed in the same order as in the RPL Set Editor.
Sample		

RPL Rule/Goal

Item Type	RPL Rule/Goal	
Description	Displays a section for a single RPL item (Rule/Goal/Accounting Method/Init Rule).	
Setting	**Type**	**Notes**
Set	Single Selection	
Rule / Goal / Method / Init Rule	Single Selection	The Setting name depends on the type of set selected.
Show Execution Properties	Yes/No	Show the index, priority, and flag where applicable and whether the item is enabled or disabled.
Show Description	Yes/No	Include the Descriptions entered on each RPL Editor dialog. See "Descriptions" in *RiverWare Policy Language (RPL)* for details.

Item Type	RPL Rule/Goal	
Description	Displays a section for a single RPL item (Rule/Goal/Accounting Method/Init Rule).	
Setting	**Type**	**Notes**
Show Notes	Yes/No	Include the Notes entered on each RPL Editor dialog. See "Notes" in *RiverWare Policy Language (RPL)* for details.
Show RPL Comments	Yes/No	Include Comments that are inline in the RPL Expression. See "Comments" in *RiverWare Policy Language (RPL)* for details.
Sample		

RPL Set

Item Type	RPL Set	
Description	Displays a section for each policy and utility group in a RPL set.	
Setting	**Type**	**Notes**
Set	Single Selection	These items might generate output for a RPL Report Group, and that group might include references to workspace objects, slots, or subbasins, so these items include format settings that apply to slots, objects, and subbasins. For example, each includes the "Slot: Include Object Name" setting which is used when generating output for a RPL Report Group containing a slot. See "Blocks and Groups" in *RiverWare Policy Language (RPL)* for details on groups. See "RPL Printing and Formatting" in *RiverWare Policy Language (RPL)* for details on the RPL selector.
Show Policy Groups	Yes/No	
Show Utility Groups	Yes/No	
Show Global Groups	Yes/No	
Show Execution Properties	Yes/No	For each item in the set, show the index, priority, and flag where applicable and whether the item is enabled or disabled.
Show Descriptions	Yes/No	Include the Descriptions entered on each RPL Editor dialog. See "Descriptions" in *RiverWare Policy Language (RPL)* for details.
Show Notes	Yes/No	Include the Notes entered on each RPL Editor dialog. See "Notes" in *RiverWare Policy Language (RPL)* for details.
Show RPL Comments	Yes/No	Include Comments that are inline in the RPL Expression. See "Comments" in *RiverWare Policy Language (RPL)* for details.
List Rules in Order of Execution	Yes/No	For RBS Rulesets, Initialization Rules Sets, and Iterative MRM Rules Sets, when set to Yes, the rules are displayed based on the Agenda Order. (See "Show Advanced Properties" in *RiverWare Policy Language (RPL)* for details on the Agenda Order.) When set to No, rules are displayed in the order they are shown in the RPL Set Editor. For Report Groups, Optimization Goal Sets, Accounting Methods and functions, this setting has no effect. These items are always displayed in the same order as in the RPL Set Editor.

RPL Statement

Item Type	RPL Statement	
Description	Shows a single top-level RPL Statement within a RPL Block (a Rule, Goal, User-Defined Accounting Method or Initialization Rule).	
Setting	**Type**	**Notes**
Set	Single Selection	
Rule / Goal / Method / Init Rule	Single Selection	The Setting name depends on the type of set selected.
Statement	Single Selection	The RPL Statement within the selected RPL Block. Statement items are presented in a menu in the form of the statement number (1) and the Statement name. Note: The default statement name is the statement type (Assignment, Print, etc.). You can rename statements as follows. From the main RPL Set editor, Select **View**, then **Show Statements**. Locate the desired statement in the tree-view. Right-click the statement and select **Rename**. Enter a new name.
Title	Text	Optional title text placed above the RPL Statement. The line editor includes a **Set to Rule and Statement Name** button, which recomputes the title from the RPL Block and Statement names.
Show RPL Comments	Yes/No	Include comments that are inline in the RPL Expression.
Sample	**Set Initial Conditions on Keystone - Statement 1: Assignment Statement** Keystone.Pool Elevation [@"t - 1"] = Keystone Data.Initial Pool Elevation [@"t - 1"]	

Run Control

Item Type	Run Control	
Description	Shows the information contained in the single run control dialog, including the controller, start and end dates, and timestep size.	
Setting	**Type**	**Notes**
N/A		
Sample	**Run Control Information** Controller: Rulebased Simulation Start: 24:00 March 14, 1957 End: 24:00 August 5, 1957 Timestep: Daily Number of Timesteps: 145	

Run History

Item Type	Run History	
Description	Shows status information about the last run.	
Setting	**Type**	**Notes**
Include RiverWare Version	Yes/No	Show the RiverWare version used for the last run.
Include User	Yes/No	Show the user name for the user that made for the last run.
Include Controller	Yes/No	Show the RiverWare controller used for the last run.
Include Run Start Time	Yes/No	Display the time at which the last run was started.
Include Run Duration	Yes/No	Display the duration of the last run.
Include Run Status	Yes/No	Show the status of the last run including Finished, Aborted, Stopped, etc.
Sample	**Run History** RiverWare Version: RiverWare 7.1 User: philw Controller: Simulation Run Started: 13:09 January 5, 2017 Run Duration: 33 hours : 57 minutes Run Status: Finished	

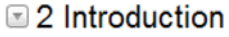
Scalar Slot Grid

Item Type	Scalar Slot Grid	
Description	Presents a table showing a grid of scalar slot values. The rows of the table represent objects while the columns represent one or more named scalar slots.	
Setting	**Type**	**Notes**
Title	Single line text	If present, will appear as the title of the table.
Row Objects	Sortable Object List	See “Lists of Items” on page 105 for details on selecting lists of items.
Column Slots	Slot Name List	See “Lists of Items” on page 105 for details on selecting lists of items.

Sample

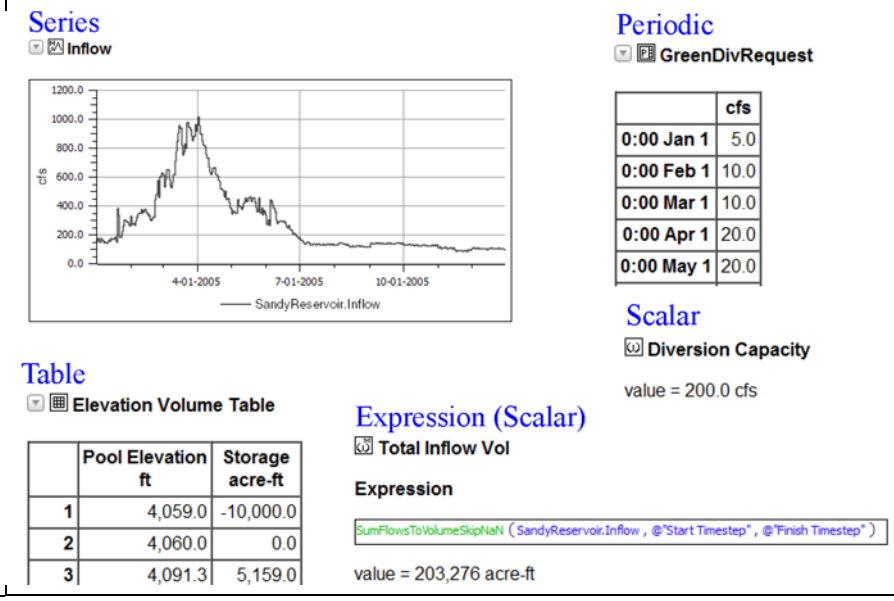
Object	Head Loss ft	Balance Period NONE	Forecast Period NONE
Kaw	1.0	3.0	10
Pensacola	1.0	3.0	10
Keystone	1.0	3.0	10

Section

Item Type	Section	
Description	Presents a titled section whose contents are controlled by the items in the section.	
Setting	**Type**	**Notes**
Title	Single line text	The text used as the section name.
Sample		

Slot

Item Type	Slot	
Description	Shows a slot's name, description, and values. For, table, periodic and scalar slots, the values are shown. For series slots, a plot of the time series is shown. For Expression Slots, the RPL expression is shown along with a plot (series) or value (scalar)	
Setting	**Type**	**Notes**
Slot Name	Single Selection	
Include Object Name	Yes/No	
Include Account Name	Yes/No	
Include Slot Type	Yes/No	
Maximum Columns Per Table	Integer	If positive, values may be displayed in multiple tables as needed.
Plot Width (pixels)	Integer	Applies to SeriesSlots whose values are plotted.
Plot Height (pixels)	Integer	Applies to SeriesSlots whose values are plotted.
Add PE/Storage Column	Yes/No	For certain table slots like the reservoir's Elevation Area Table, a column of storage values corresponding to the elevations (using the Elevation Volume Table) are shown. Select **No** to not show this Storage column.
Start Date	Date/Time	Specify the date/times to use in the plot of series data, if desired. This will override the default dates when specified. See "Date/Time Specification" on page 104 for details.
End Date	Date/Time	

Item Type	Slot	
Description	Shows a slot's name, description, and values. For, table, periodic and scalar slots, the values are shown. For series slots, a plot of the time series is shown. For Expression Slots, the RPL expression is shown along with a plot (series) or value (scalar)	
Setting	**Type**	**Notes**
Show Description	Yes/No	Include the description entered on the **Open Slot** dialog.
Show RPL Comments	Yes/No	For Expression Slots, show the RPL inline comments.
Samples		

Slot Value Table

Item Type	Slot Value Table	
Description	Presents a table showing the name and a single value for one or more selected slots. Each row of the table is a slot. Columns include the Slot, Object (optional), Account (optional), Value, and Units.	
Setting	**Type**	**Notes**
Selection	Multiple Selection	
Title	Single line text	If present, will appear as the title of the table.

Item Type	Slot Value Table	
Description	Presents a table showing the name and a single value for one or more selected slots. Each row of the table is a slot. Columns include the Slot, Object (optional), Account (optional), Value, and Units.	
Setting	Type	Notes
Include Object Name	Yes/No	
Include Account Name	Yes/No	
Sample		

Object	Slot	Value	Units
Kaw	Maximum Power Pool Drawdown	4.0	ft
Keystone	Maximum Power Pool Drawdown	15.0	ft
Pensacola	Maximum Power Pool Drawdown	20.0	ft
Tenkiller	Maximum Power Pool Drawdown	3.0	ft

Subbasin

Item Type	Subbasin	
Description	Shows a table of the members of a subbasin.	
Setting	Type	Notes
Subbasin	Single Selection	
Sample		

Subbasin: PowerReservoir

Sky Canyon
Green Res

Supply Table

Item Type	Supply Table	
Description	Presents a table of supplies and optional columns for supply attributes including type, release type, and destination.	
Setting	Type	Notes
Selection	Multiple Selection	The Supplies to include in the table
Title	Single line text	The text to appear as the table title
Include Supply Type	Yes/No	Show whether the supply is an Inflow/Outflow, Diversion/Return Flow, or Transfer supply

Item Type	Supply Table	
Description	Presents a table of supplies and optional columns for supply attributes including type, release type, and destination.	
Setting	Type	Notes
Include Release Type	Yes/No	
Include Destination	Yes/No	
Sample		

Supply	Type	Release Type	Destination
SandyReservoir Chaco to LeakyReach Chaco	Inflow/Outflow	Diversion	NONE
SandyReservoir Fish to LeakyReach Fish	Inflow/Outflow	InstreamFlow	NONE

Table of Contents

Item Type	Table of Contents	
Description	Lists the sections in the report, with hyperlinks to their locations.	
Setting	Type	Notes
Title	Single line text	
Sample		



Tabular Series Slot Report

Item Type	Tabular Series Slot Report	
Description	Displays an existing Tabular Series Slot Report output device in either HTML or text format. The title defined within the Tabular Series Slot Report is extracted from the report and presented as a report item title text within the generated Model Report. Use the configured timesteps or override with an optional setting.	
Setting	Type	Notes
Tabular Series Slot Report Name	Single Selection	The existing tabular series slot report device to include in the report
Tabular Series Slot Report Format	HTML/Text	Tabular Series Slot Reports can be generated as an HTML table or as a Text table.

Item Type	Tabular Series Slot Report	
Description	Displays an existing Tabular Series Slot Report output device in either HTML or text format. The title defined within the Tabular Series Slot Report is extracted from the report and presented as a report item title text within the generated Model Report. Use the configured timesteps or override with an optional setting.	
Setting	**Type**	**Notes**
Start Date	Date/Time	Specify the date/times to use in the report, if desired. This will override the Tabular Series Slot Report dates. See "Date/Time Specification" on page 104 for details.
End Date	Date/Time	
Sample		

	Deep Res	Flat Lake	Red Lake	Sky Canyon
03-14-1957	11,980	186	10,886	103
03-15-1957	11,980	186	8,086	103
03-16-1957	2,383	0	1,823	103
03-17-1957	549	0	934	103
03-18-1957	1,171	186	988	103
Mean:	5,613	112	4,543	103

Text

Item Type	Text	
Description	Prints user defined text. The text can be Plain Text or Rich Text which allows formatting.	
Setting	**Type**	**Notes**
Text	Multi-line text	Select **More** to edit the text in a dialog.
Type	Rich or Plain	Specify whether the text is **Plain Text** (non-formatted letters and numbers) or **Rich Text** (formatted with fonts, colors, size, bullets etc). See "Text Considerations" on page 103 for details on Rich Text.

Chapter 4
Model Report

Chapter 5
Chart

The Chart is an output device that generates a chart for data stored in series, periodic, and scalar slots. You can show this for a single timestep or include a date slider which you can also animate. You can even export the chart to an image file or a movie of the animation.

Topics

- Chart Types, page 129
- Creating a New Chart Configuration, page 132
- Configuring Charts, page 132
- Chart Display, page 138
- Animation, page 139
- Exporting and Printing, page 140

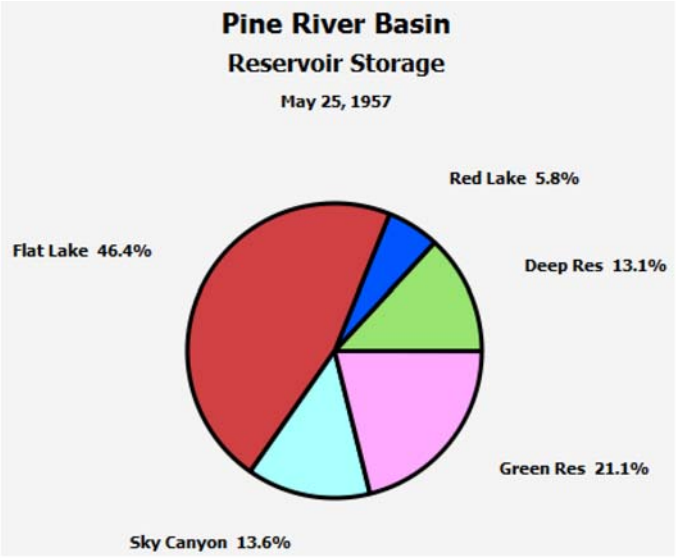
Chart Types

Four types of charts are available for generation from the chart device.

Standard Pie Chart

The slices are drawn and colored in proportion to each slot's part of the total.

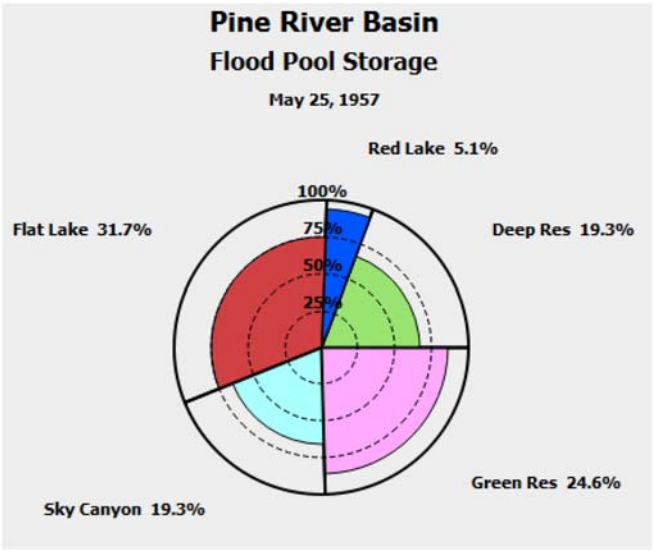
Standard Pie Chart



Pie Chart with Linear Radial Scale

The chart shows a radial dimension of data in addition to the data creating the pie slices. For example, the pie slices could show each reservoir's portion of the total flood pool storage that exists in the basin if all flood pools were filled. The radial dimension could show how much of each reservoir's flood pool is actually filled at a certain timestep. Only the actual storage part of the pie slice is colored. The radial dimension has a linear scale.

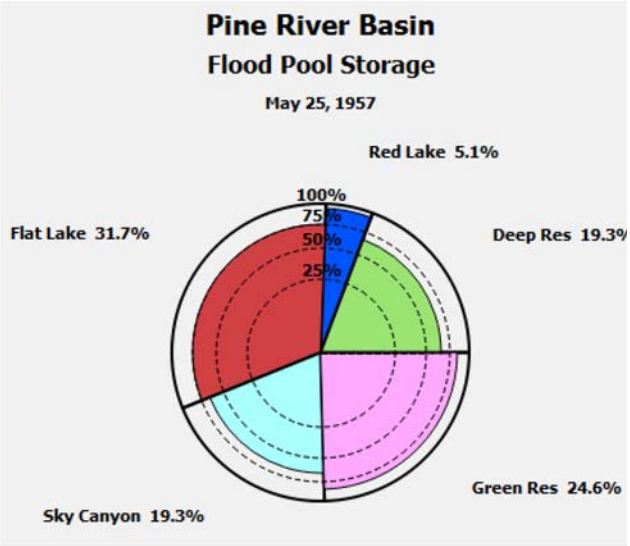
Linear Radial Scale



Pie Chart with Area-proportional Radial Scale

This pie chart option is similar to the linear scale but displays the radial dimension as an area-proportional scale.

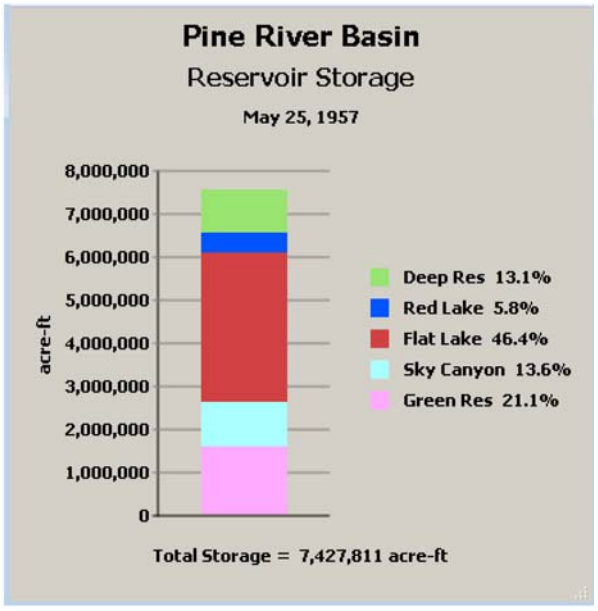
Area-Proportional Radial Scale



Stacked Bar Chart

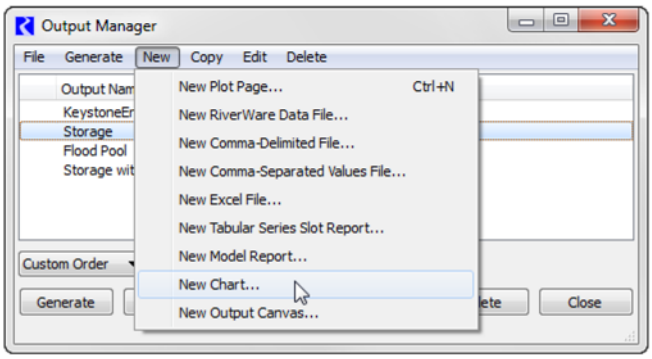
A single bar is drawn and colored in proportion to each slot's part of the total. The chart can accommodate negative values and will display values both above and below a zero line.

Stacked Bar Chart



Creating a New Chart Configuration

Chart configurations are **Output Devices** (i.e. like a Plot Page, RiverWare Data File, Comma-Delimited File or Excel File).Chart configurations are created within the Output Manager dialog.



Use the following steps to create a new chart.

1. From the RiverWare workspace menu, select **Utilities**, then **Output Management**.
2. From the Output Manager dialog menu, select **New**, then **New Chart**.
3. Complete the full configuration for the new chart and select **Save**. See "Configuring Charts" on page 132 for details.

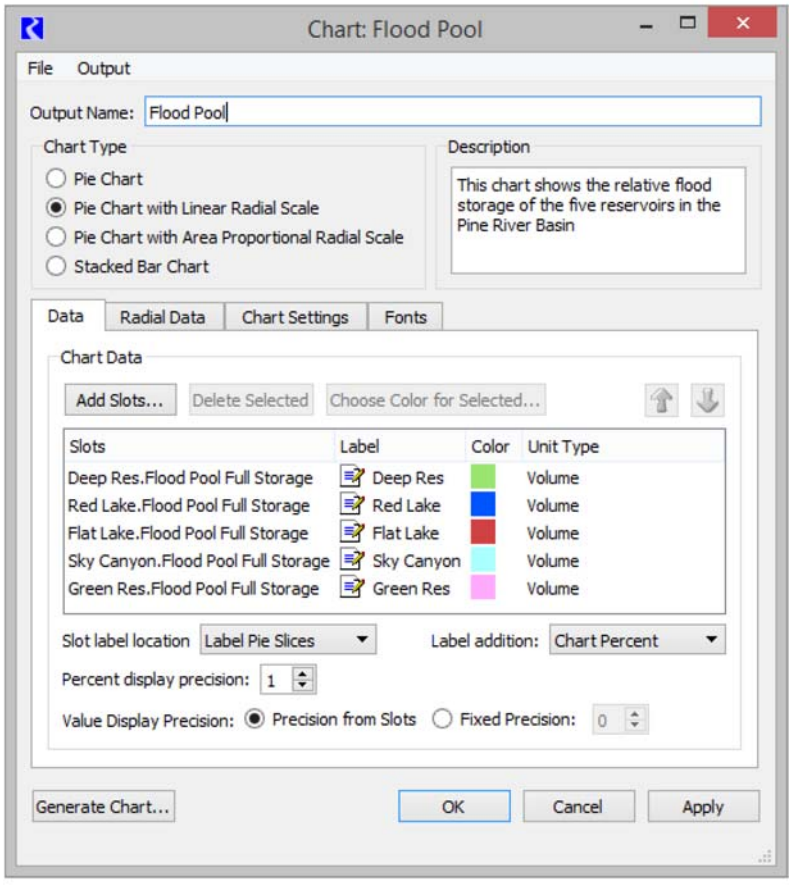
Configuring Charts

When creating (or editing) a **Chart** configuration, the configurable properties of a chart include the following. See Figure 5.1.

- Name of Output Device
- Description
- Chart Type
- Data, including:
  - Slots
  - Labels
  - Colors
  - Label Location
  - Label Addition
  - Display Precision
- Radial Data, if applicable, including:
  - Radial Slot Name
  - Note for Radial Total

  - Note for Radial Percent
- Chart Settings
  - Chart Title
  - Chart Subtitle
  - Note for Chart Total
  - Background Color for display and printing
  - Other settings including **Bold Labels**
  - Display Date
  - Option to show timestep controls and timestep
- Fonts, used to control the size and font used for all text shown on the chart.

Figure 5.1



Following are descriptions of these options.

Output Name

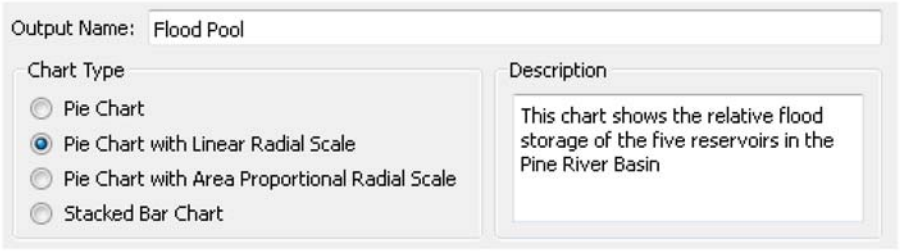
Output Name is the name of the device that will appear in the Output Manager's list of devices.

Description

The **Description** box allows text describing the chart to be saved with the device - this text does not appear on the chart itself.

Chart Type

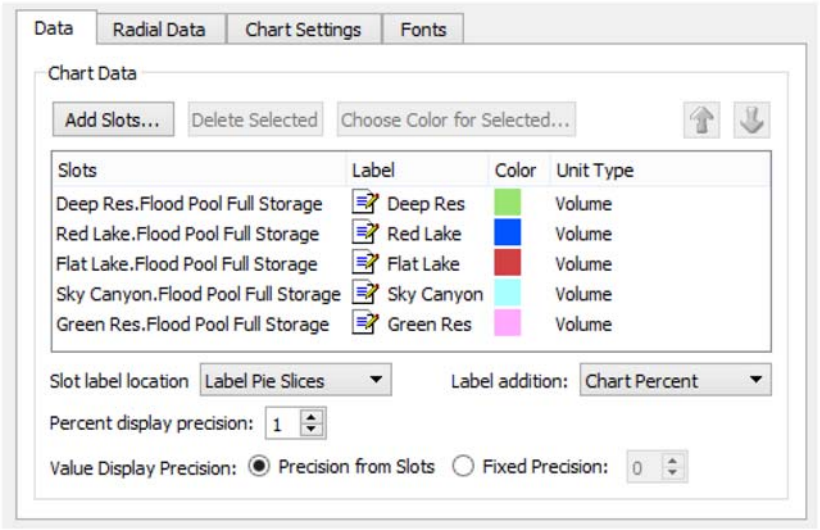
Chart Types specify one of the chart types as shown. See "Chart" on page 129 for descriptions.



Data Tab

The **Chart Data** frame contains the slots to be shown as the main dimension of the chart. Select **Add Slots** to open a slot selector to select series, periodic, or scalar slot data for inclusion in the chart. The slot/row is given a default **Label** that will appear on the chart. Selecting or double-clicking the label allows editing of the text. Colors can be changed by selecting a row and selecting **Choose Color for Selected**. The **Unit Type** of the slot is shown for reference. If unit types do not match for selected slots, a warning dialog is generated as a chart cannot be created from slots with mismatched unit types.

Figure 5.2



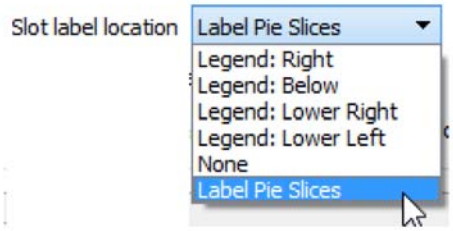
Note: See "Output Devices for Aggregated Values" on page 3 for details on creating aggregated data for display in this or other output devices.

Slots are ordered in the chart by the order in the slot list. The slot order can be rearranged by selecting rows and selecting the **Up** and **Down** arrows. In a pie chart the first piece of the pie starts at 3 o'clock and then proceeds counterclockwise (anticlockwise).

The **Slot Label Location** combo box allows a choice of where the slots will be labeled on the chart. See Figure 5.3.

- **Legend: Right** shows a color block and the slot name for each slot in a legend positioned to the right of the chart.
- **Legend: Below** shows a color block and the slot name for each slot in a legend positioned directly below the chart.
- **Legend: Lower Right** shows a color block and the slot name for each slot in a legend positioned below the chart and to the right of any timestep controls being shown.
- **Legend: Lower Left** shows a color block and the slot name for each slot in a legend positioned below the chart and to the left of any timestep controls being shown.
- **None**: No legend or labels are shown. This is often desirable when the chart is included on an Output Canvas and canvas lines are used to label the pie slices.
- **Label Pie Slices** is only applicable to pie-type charts and places slot labels around the pie at the slice for a slot.

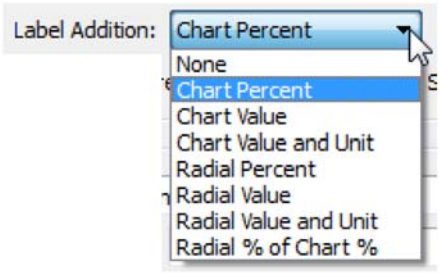
Figure 5.3



The **Label Addition** menu provides a choice of items that can be added after the slot labels on the chart. The radial choices are only shown if a radial type chart is selected. See Figure 5.4.

- **None** adds nothing to the slot label.
- **Chart Percent** adds the percent of the slot's contribution to the total (Red Lake 20.4%).
- **Chart Value** adds the amount of the slot's contribution to the total (Red Lake 1135358).
- **Chart Value and Unit** adds the amount of the slot's contribution along with its unit (Red Lake 1135358 acre-ft).
- **Radial Percent** adds the percent of the slot's contribution that is colored in (Red Lake 63.2%).
- **Radial Value** adds the amount of the slot's contribution that is colored in (Red Lake 717546).
- **Radial Value and Unit** add the amount of the slot's contribution that is colored in along with its unit (Red Lake 717546 acre-ft).
- **Radial % of Chart %** adds the percent that is colored of the percent contribution to the total (Red Lake 63.2% of 20.4%).

Figure 5.4

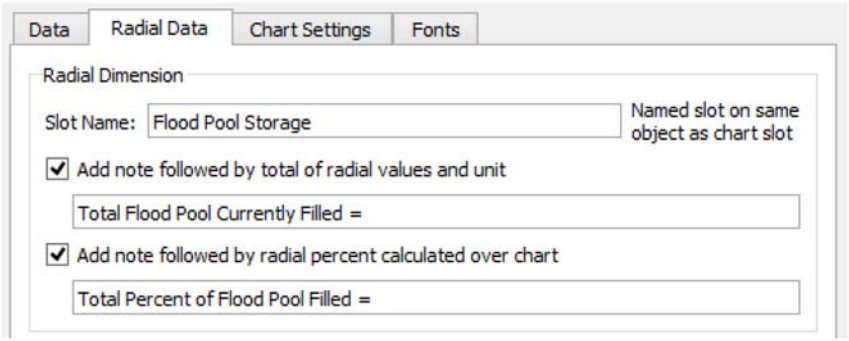


The **Percent display precision** selector controls the precision with which percent values in labels are shown. Two options are provided for specifying the precision of values shown in labels. The **Precision from Slots** option displays a value in the precision that is assigned to the slot from which the values comes. The **Fixed Precision** option displays all values with the precision specified in the adjacent spin box.

Radial Data Tab

The **Radial Dimension** frame is enabled only if a radial type chart is selected. The **Slot Name** field is where the name of the slot for the radial dimension data is indicated. For each slot in the **Chart Data** list, the corresponding slot is found on the same object as the slot. The radial percent value, determining how much of a slot's portion is colored, is calculated as the radial slot value divided by the slot value. The unit types of the slot and the radial slot must match or the chart cannot be generated.

Figure 5.5



There are also options to add radial notes to the bottom of the chart display.

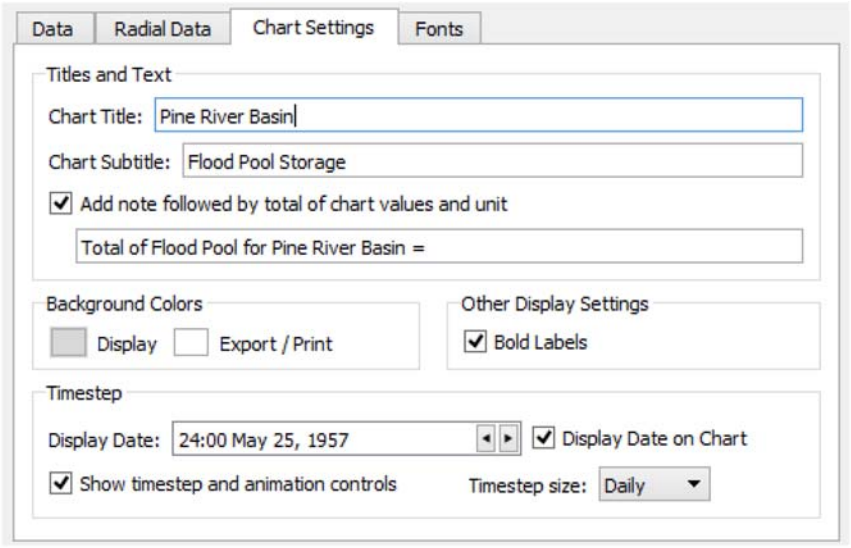
- **Add note followed by total of radial values and unit** - the text is shown as a note followed by the total of all the radial slot values on the chart along with the unit. (Total Flood Pool Currently Filled = 353407 acre-ft).
- **Add note followed by radial percent calculated over chart** - the text is shown as a note followed by a percent calculated as the total of all radial slot values divided by the total of all chart slot values (Total Percent of Flood Pool Currently Filled = 63.5%).

Chart Settings tab

The **Titles and Text** frame allows entry of text for the **Chart Title** that is centered at the top of the chart display and the **Chart Subtitle** that appears underneath it. Also in this frame is the option to **Add note followed by total of chart values and unit**. When checked, the entered text is shown as a note on the bottom of the chart

followed by the total of all slots' values with its unit. (Total of Flood Pool for Pine River Basin = 5,565,480 acre-ft).

Figure 5.6



Use the two buttons in the **Background Colors** frame to change the color of the background for display (on screen) and for exporting and printing.

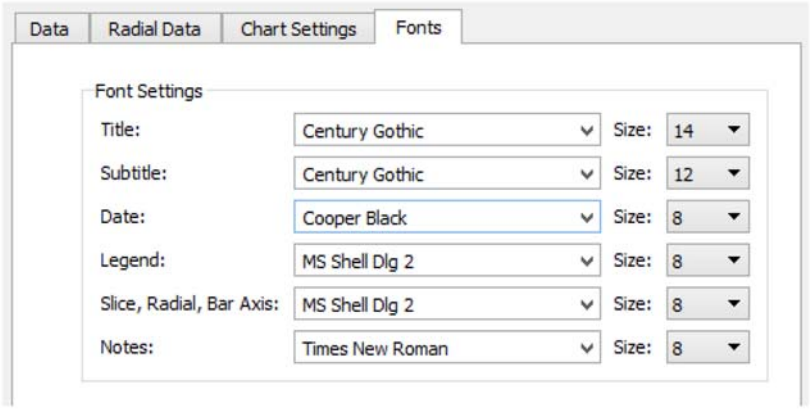
In the **Other Display Settings** frame, you can choose whether or not to have **Bold Labels** on the text displays.

In the **Timestep** frame, use the **Display Date** field to specify the date at which data is shown. Also, optionally specify if you would like to **Show timestep and animation controls**. These controls allow you to step through timesteps on the chart. See "Animation" on page 139 for details. In addition, if you would like to show only data for a larger timestep, select an alternative **Timestep size**. For example, maybe in a model with a 1 Hour timestep, you only want to step through the data at the end of each day. If you do select a larger timestep, the chart will be shown at the **Display Date** rounded up, if necessary, to the next valid timestep. If you don't want to show the date on the chart, deselect the **Display Date on Chart** control.

Fonts tab

The text fonts can be changed by selecting **Fonts**. In each text element menu, select a named font, and in the associated **Size** menu select the font size.

Figure 5.7



General Buttons

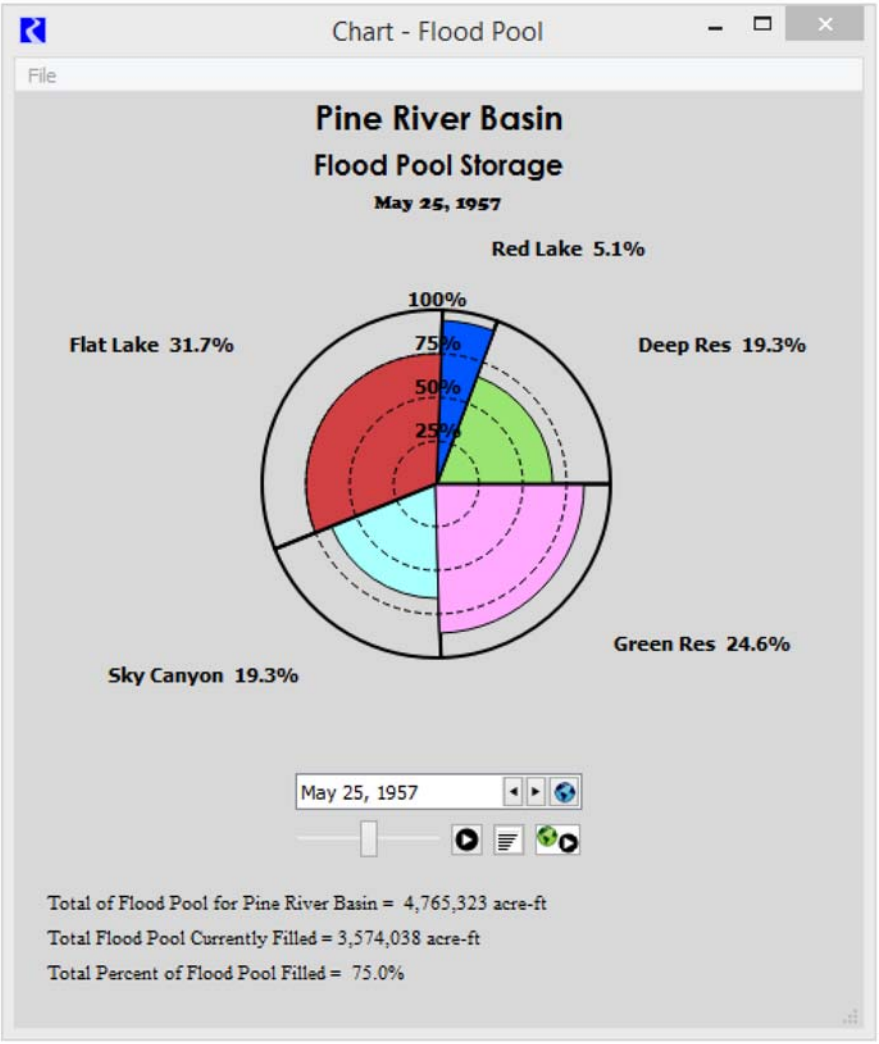
The chart is shown by selecting **Generate Chart** at the bottom of the dialog. Once a chart display is generated, it is updated with future configuration changes made in the configuration dialog when the chart is regenerated.

Select **OK** to save the current configurations to the output device and close the dialog. Selecting **Cancel** will ignore any unsaved configuration changes and close the dialog. **Apply** will save the current configurations to the chart device and leave the configuration dialog open.

Chart Display

When a chart is generated from the chart configuration dialog or from the Output Manager dialog, a chart display dialog is created. Figure 5.8 is a pie chart with a linear radial dimension.

Figure 5.8

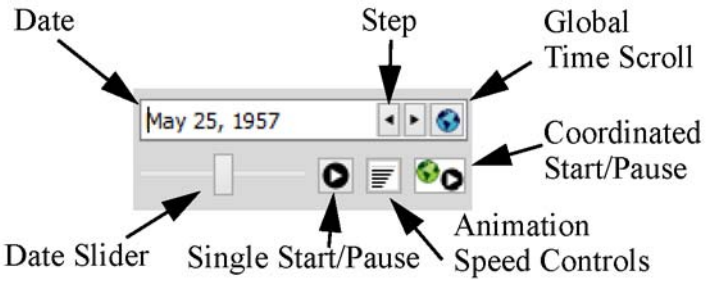


If series or periodic slot data are being displayed, the timestep date for the display is listed under the subtitle. Optional notes that are specified in the configuration are displayed starting in the lower left corner.

Animation

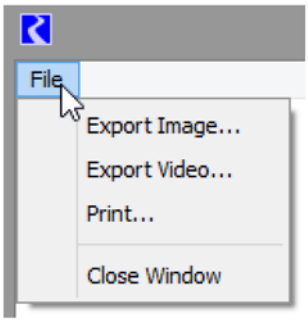
If the timestep controls have been added in the configuration, the controls appears under the chart as shown in Figure 5.9. These controls allow the chart display to be stepped forward and backward through the timesteps. Select **Start** to animate through time. Use the date slider to see where you are in time and the animation speed controls to change the speed (seconds per frame). Select **Coordinated Start/Pause** to animate all opened charts and Output Canvas at the same time. When in coordinated animation mode, you can stop all animations from any dialog. But, from the dialog in which you started the global animation, you can select the single pause to pause all dialogs. Then use the slider to move the date for all dialogs globally. Select **Coordinated Start/Pause** to end the coordinated animation.

Figure 5.9



Exporting and Printing

The **File** menu at the top of the chart display allows the chart to be printed or exported as an image or a video.



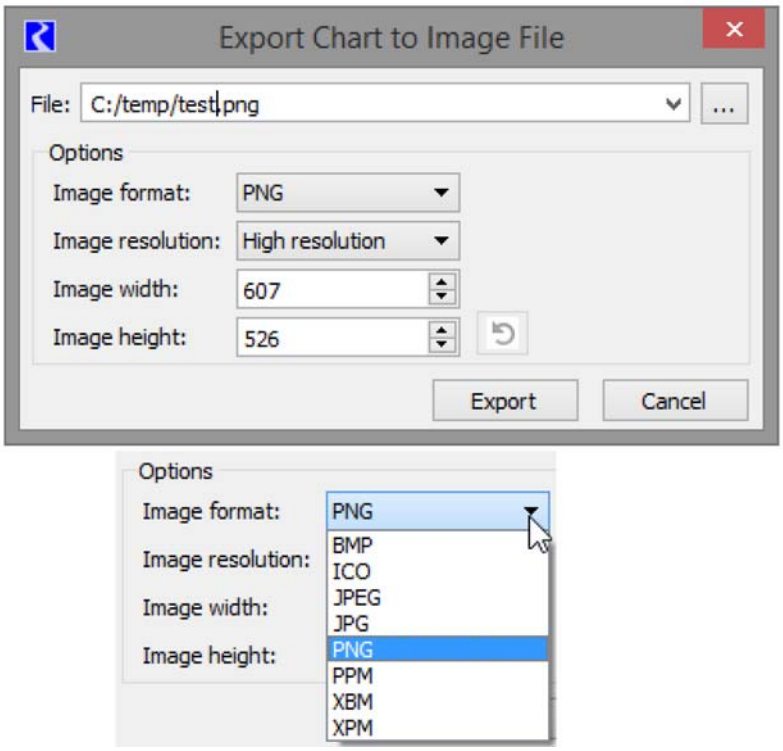
Note: When the chart display is printed or saved as an image, the **File** menu and the date spinner, if present, are hidden. The resulting graphic then shows the date beneath the subtitle. Within the configuration, you can specify the color of the chart background for export and printing. The default is white. See "Configuring Charts" on page 132 for details.

Export Image

Select **Export Image** to export an image of the chart to a file. Figure 5.10 shows the Export dialog. Specify the File name and modify any configuration options.

Eight different image formats are available for saving the image file, as shown in the bottom part of Figure 5.10. Resolution and sizing options are also provided in the configuration.

Figure 5.10



Print Image

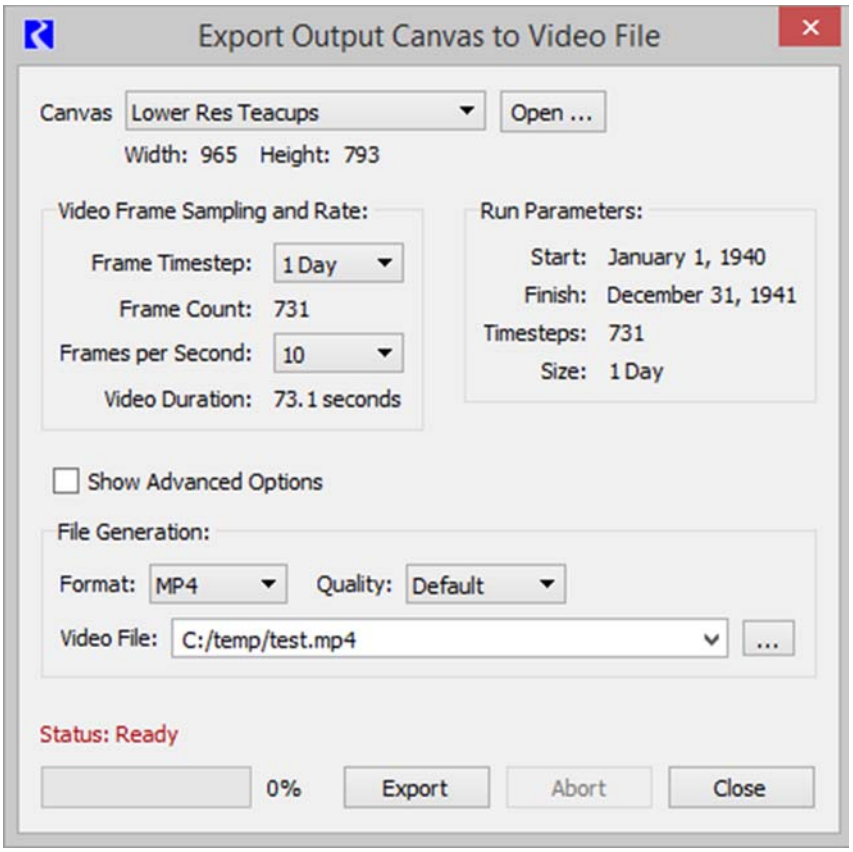
Standard print options are available to select a printer and then configure the printer.

Export Video

Use the **Export Video** menu to generate a video file of the chart animation.

This tool works by creating images of the chart at specified intervals as the chart is animated. The images are then combined into a movie file using an external process. You have control over both the sampling of the animation and the creation of the output file.

Figure 5.11



Chart

First specify the desired chart if it is not the one used to open the dialog. The height and width can be changed from the Chart Dialog, but not from this dialog.

Video Frame Sampling and Rate

In this area, you specify how the Chart animation is sampled including the timestep size to use and the speed of the animation in Frames per Second.

For reference, the right side shows the Run Parameters including Start and Finish Timesteps, number of timesteps in the run, and timestep size.

In the left portion, you select the timestep size, either the run timestep size or select a larger timestep size for sampling the animation. The total number of frames is computed based on the run parameters and the timestep size.

Also specify a frame rate for the animation. 5 frames per second is a good starting point.

The video duration is computed based on the frame count and frame rate.

File Generation

File generation can have complicated configuration options because of all the moving parts that must work together. As a result, the dialog provides two ways to configure the output file. The default basic configuration is usually sufficient for most users. Those who want more control over the options can **Show Advanced Options** to see advanced configuration.

Basic Configuration

The basic configuration provides three configuration options:

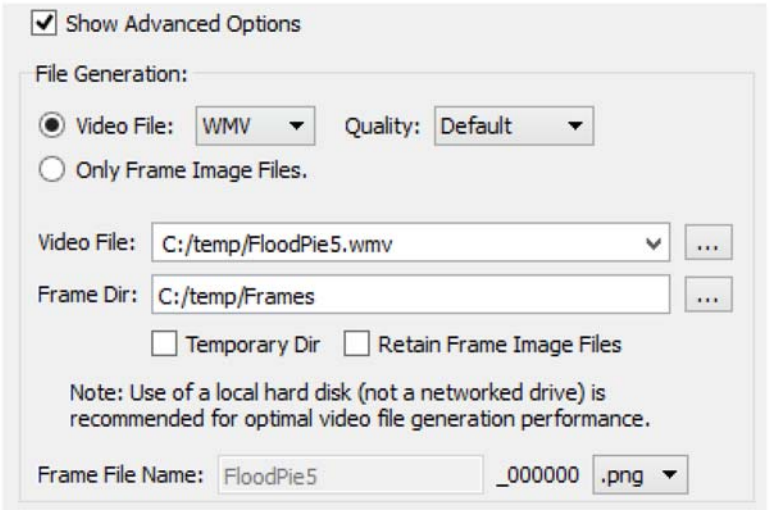
- **Format**: Select from one of the four supported formats. See Table 5.1 for descriptions of the formats and the quality.
- **Quality**: Select **Default**, **Higher**, **Moderate**, or **Lower**. This option is not available for GIFs or WEBM.
- **Video File**: Specify the file to create. Either type it in (include the file extension) or use the file chooser to navigate to the desired directory.

Table 5.1 Video format comparison

Format	Description and usage
MP4	This format displays well in PowerPoint and external players like widows media player.
WEBM	This format works well when displayed in modern browsers like Firefox or Chrome. It cannot be shown in PowerPoint without an extension.
WMV	This format displays well in PowerPoint and external players like widows media player.
GIF	This format is very simple and shows the images repeating over and over, usually in a browser. There are no controls to start/stop/pause the video. Image quality is not as good as other options

Advanced Options

When you select **Show Advanced Options**, you have full control over all aspects of the video file generation. Following are descriptions of the elements of advanced configuration.



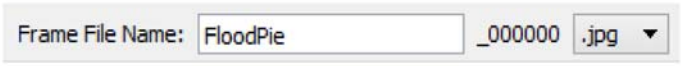
1. Choose whether you want to generate a **Video File** or generate only the **Frame Image Files**.

- **Video File**: Select the Video File format and Quality. See Table 5.1 for descriptions of the formats and the quality.
- **Only Frame Image Files**: The utility will create only image files at each timestep. They will not be combined into a video file. This option is useful if you have an alternative program that you want to use to assemble the images into a video. When this option is selected, there is no need to specify a **Video File** name.

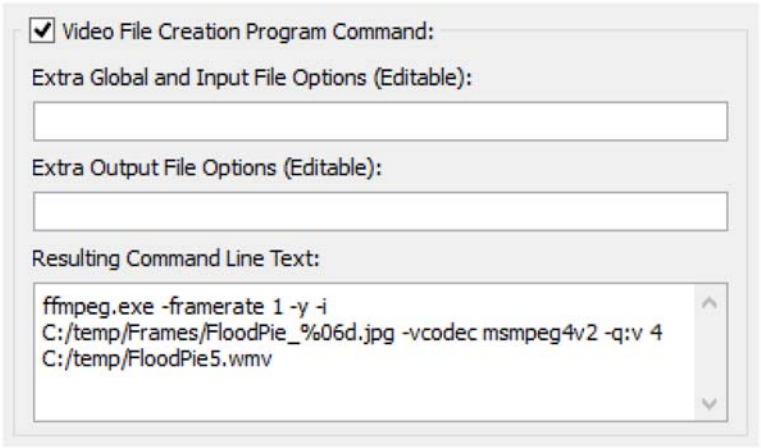
2. Specify the location on the file system for the following:
   - **Video File**: The location and name of the video file to create.
   - **Frame Dir**: This shows the directory where the images files will be created. By default, this is the user's temporary directory. If you deselect the **Temporary Dir** box, then you can specify any other directory.
3. If generating a video file, you can specify if you would like to retain the created image files by checking the **Retain Image Frame Files**. If not checked, they will automatically be deleted after the video file generation is complete.



4. If you have selected **Only Frame Image Files** described above, you can also specify an alternative filing naming convention in the **Frame File Name** field. You can also choose to use JPG or PNG files.



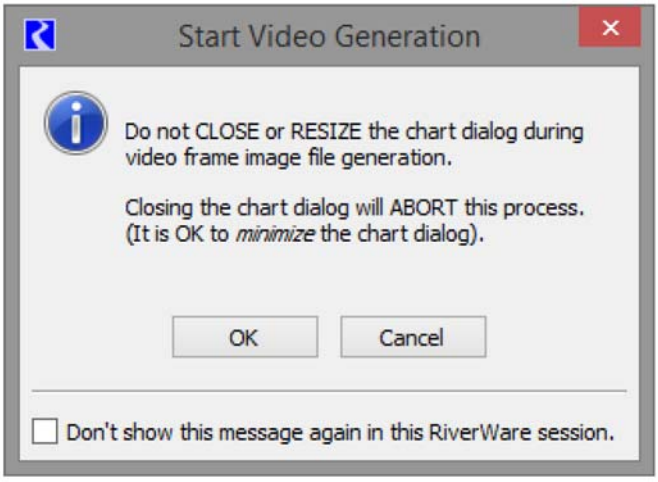
5. The lower half of the configuration has options for **Video File Creation Program Command**. This optional panel allows you to further tweak or modify the arguments and commands that are passed to the external program. You can specify either or both of the following elements.
   - **Extra Global and Input File Options**: These options are added to the input side, before the image files are specified. No further information is provided on available options.
   - **Extra Output File Options**: These options are added on the output side, right before the output file specification. No further information is provided on available options.



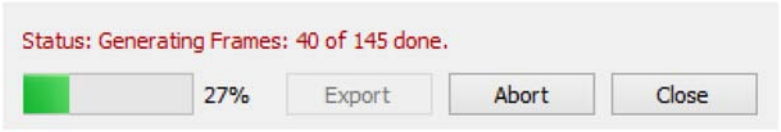
6. The resulting command line is shown in the **Resulting Command Line Text** field. This shows you exactly what will be executed. Copy is available if necessary.

Creating the Video File

When you choose to create the file by selecting **Export**, a dialog shows a confirmation before starting the generation. You should not close or resize the Chart dialog during video file generation or the process will be terminated.



Select **OK** to generate the video file. The dialog shows the status of the export.



When finished, it shows the following status.



You can now navigate to the directory where the file was exported and view the file in the appropriate application. In addition, a log file is produced in that same directory with further debugging information on the generation process.

Chapter 5
Chart

Chapter 6
Output Canvas

An Output Canvas is an output device that shows various data visualization tools.

Topics

- About Teacups and Flow Lines, page 147
- Output Canvas Features, page 149
- Creating a New Output Canvas, page 150
- Configuring an Output Canvas, page 151
- Canvas Items Reference, page 154
- Additional Information on Certain Settings, page 163
- Canvas Viewer, page 176
- Printing, page 177
- Animation, page 178
- Export Video, page 179
- Showing Canvas Items on the Workspace, page 183
- Instructions to Create a Teacup Diagram, page 184
- Instructions to Create a Flow Line Diagram, page 190

About Teacups and Flow Lines

You can create Teacups that show the value (often storage) against some full value for that object (full reservoir). You can show multiple teacups in a group to display the relative fullness of many different items. Teacups can be rectangles or trapezoids. See Figure 6.1.

You can also create Flow Lines, which often represent the flow of water in a river network. You can configure the flow lines to change thickness based on the flow compared to other values in a group, and change color and line type as the flow crosses thresholds defined on each particular flow line. See Figure 6.2.

Figure 6.1 Output Canvas showing Teacups and a Chart

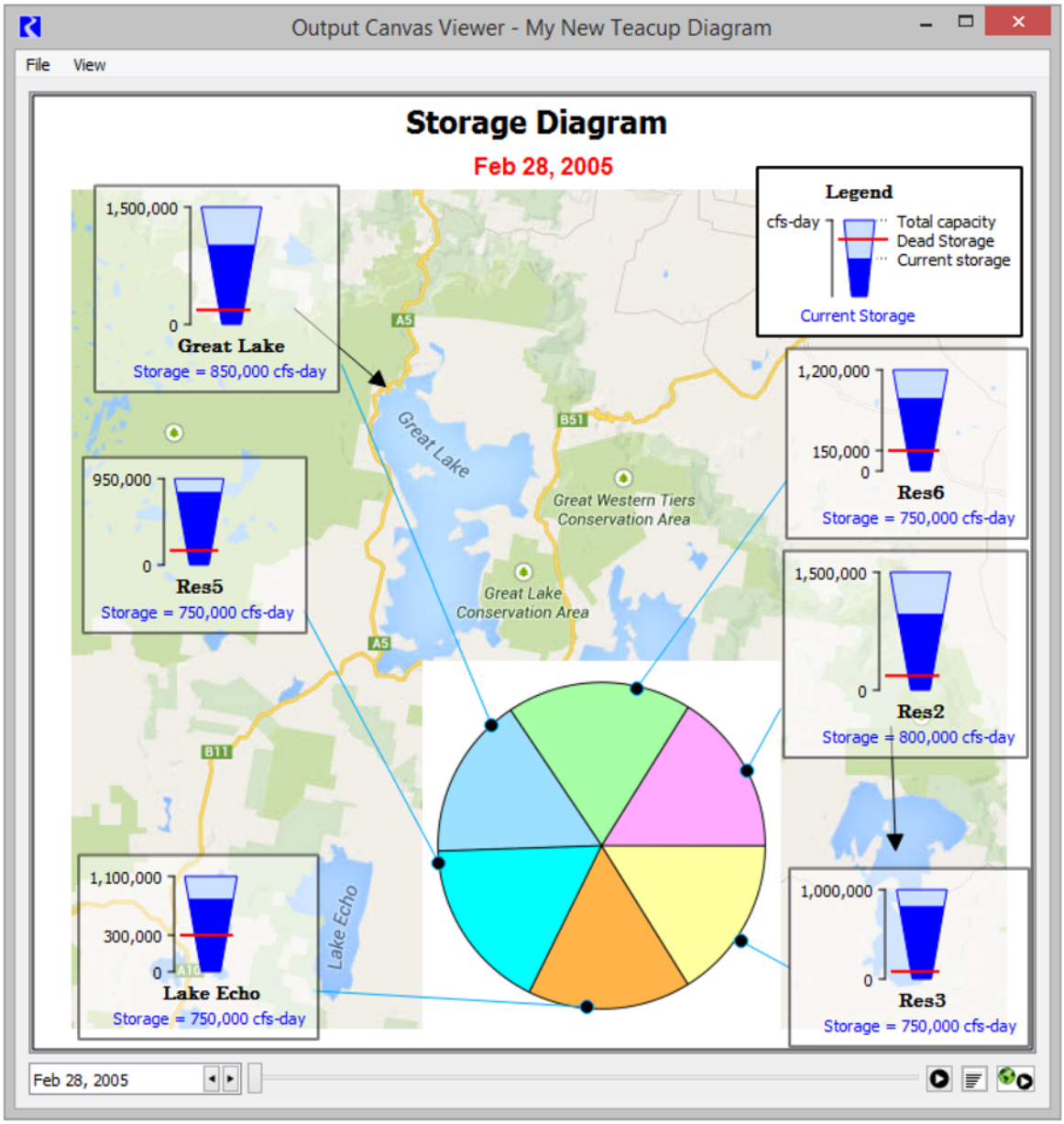
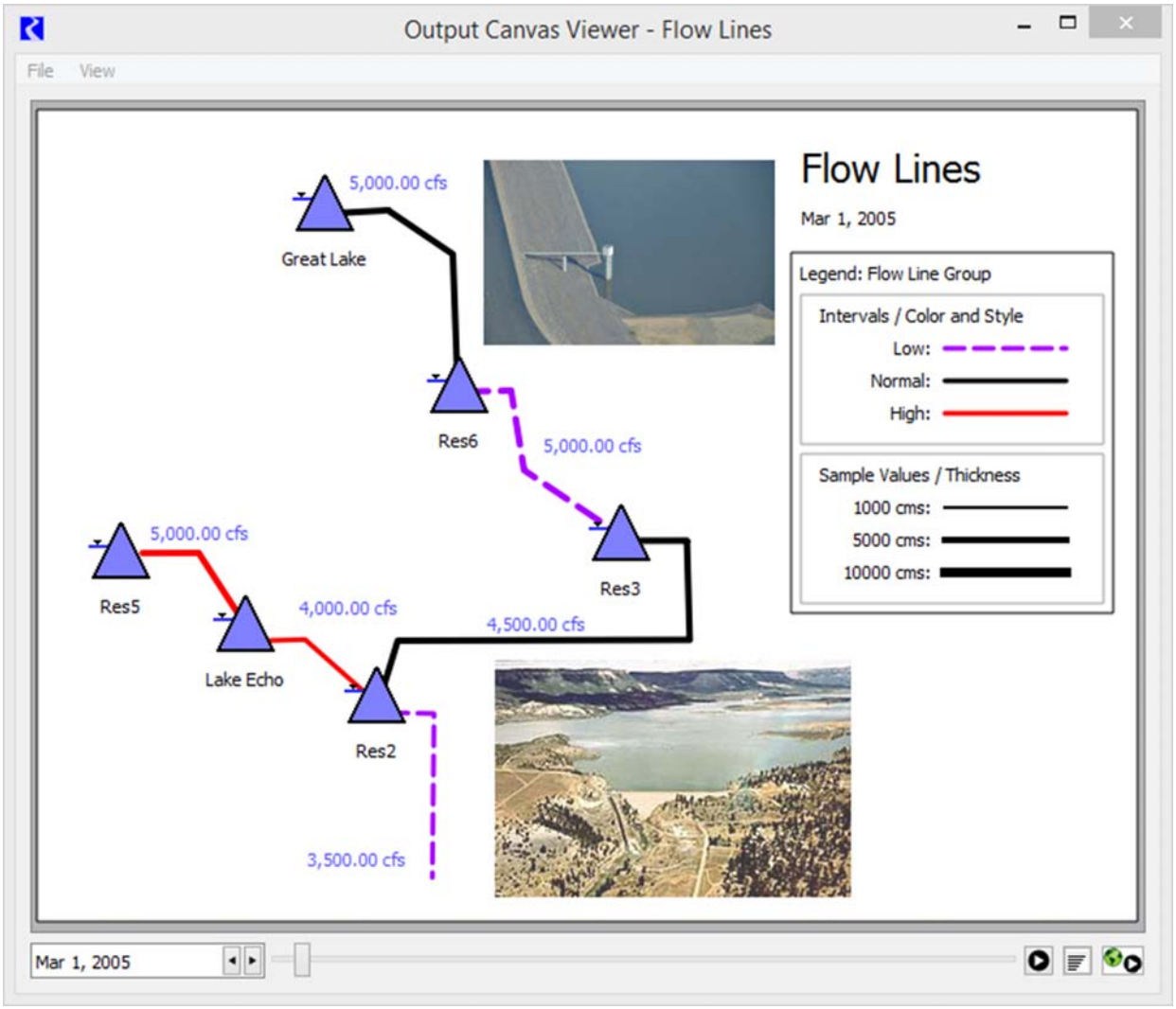


Figure 6.2 Output Canvas showing flow lines and Object Icons



Output Canvas Features

Following are some features of the Output Canvas.

- You can show multiple groups of teacups that each contain multiple teacups. Within a group, consistent scaling is maintained for comparison.
- Data shown on a canvas is typically based on multiple objects; for example, all the reservoirs in a basin. The data can be on the object itself or on an accompanying data object.
- On a Teacup, you can show marker lines and text values representing key levels.
- All colors and text fonts are user settings so they can be changed as desired.
- Bounding boxed and the Legend are optional components that you can configure.

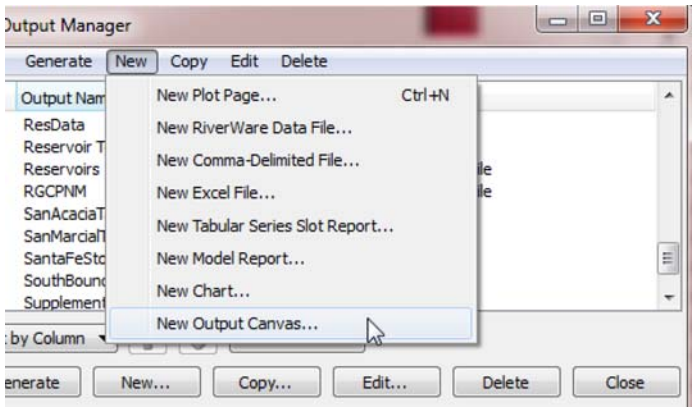
- Flow Line groups can be created to represent a river network.
- Flow Lines get thicker as their values increase. The thickness is relative to the values in all Flow Lines in the group.
- Flow Lines change color and line type as the value crosses user defined thresholds. For example, a line could turn red if the flow drops below a minimum flow.
- RiverWare Object icons can be added to the canvas for reference. Labels and dynamic text can be added below them as well as bounding boxes.
- Images can be added to the canvas as Background or Foreground Images.
- Free standing configurable text can be added to the canvas. This text can be a string, reference a slot value (or two values), or show the current timestep.
- The data shown is typically for a specific timestep. Controls at the bottom of the device allow you to scroll through the timesteps or even animate the time range.
- The Output Canvas can be exported as an image for use in other applications or included as an image in a Model Report.
- The Output Canvas can be exported as a video/movie file. See "Export Video" on page 179 for more information on exporting a video.
- Additional data visualizations will be made available on the Output Canvas in future releases.

The remainder of this section describes how to create, configure, and view the Output Canvas. See "Instructions to Create a Teacup Diagram" on page 184 for instructions on creating a teacup diagram.

Creating a New Output Canvas

Output Canvas configurations are **Output Devices** (like Plot Pages or RiverWare Data Files, etc.). The Output Canvas is created within the Output Manager dialog. Use one of the following methods to create a new Output Canvas:

- From the RiverWare workspace menu, select the **Utilities, then Output Management**.
- From the Output Manager dialog menu, select the **New, then New Output Canvas.**



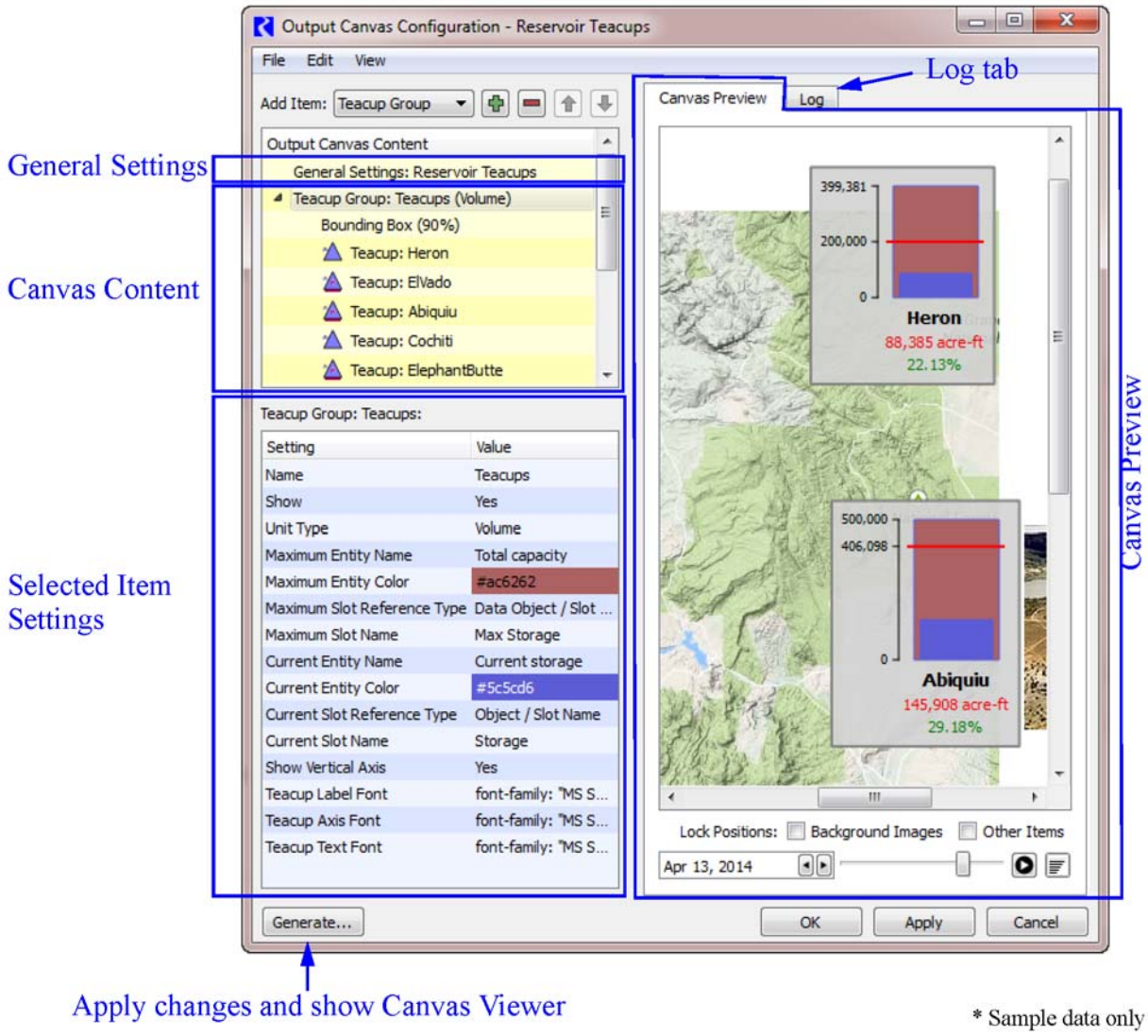
Configuring an Output Canvas

The **Output Canvas** configuration dialog allows you to create or change a canvas. It consists of the following areas, as shown in Figure 6.3.

- **General Settings**: aspects of the configuration which apply to the entire Canvas, e.g., the name of the Canvas, the height and width, and the background color.
- **Canvas Content**: Specification of the content to be included in the Canvas.
- **Selected Item Settings**: Control of the Canvas formatting as specified on a per-item basis.
- **Canvas Preview**: View the Canvas to quickly see what it will look like and arrange the items as desired.

In the remainder of this section, each of these areas is described in more detail.

Figure 6.3



The following sections describe all the pieces of the Output Canvas.

General Settings

The **General Settings** item display settings apply to the entire Output Canvas. To change a setting's value, select the appropriate value cell, enter the new value and press Return (or select outside the editing window). See "General Settings" on page 154 for details.

Canvas Content

You control the content of the Canvas in the **Canvas Layout** area. This content is organized by items, and you specify the Canvas contents by indicating which items should be included. Table 6.1 gives a description of each item and lists all the features you can show on a Canvas.

Table 6.1

Item	Description
General Settings, page 154	Settings which apply to the entire canvas. This is always shown and cannot be deleted.
Teacup Group, page 155	Teacups are shown in groups so that all data is consistent across the group. The Teacup Group defines the slots to use, where they are located, the size of the bars in the teacup, and the fonts for the label, axis, and text items. Teacup Groups can have bounding boxes, text items, and markers that are displayed for each teacup. In addition, a Teacup Group can have a Teacup legend to provide a key; see "Teacup Legend" on page 156.
Teacup Legend, page 156	A Teacup Legend is part of a Teacup Group and provides a key to the teacups. The maximum value, the current value, markers, text and the units are shown in the legend.
Teacup, page 156	A teacup is shown for an object in the model. You can modify the name and change the corresponding data object, if necessary.
Object Icon Group, page 156	The Object Icon Group contains RiverWare icons representing the objects shown on the workspace. Object icons are shown in groups so that the text labels are consistent. Object Icon Groups can have bounding boxes and text items that are displayed for each Object icon.
Object Icon, page 157	The Object Icon specifies the Object to include in an Object Icon Group. You can also specify the labels to show and size for each icon.
Marker, page 157	Markers, representing a slot value, are horizontal lines shown on each teacup. Markers are added to the Teacup Group. You specify the line color, style and the slots to use.
Text Group, page 157	A text group is a container for free standing text on the canvas. You can name the group and specify the font to use for all text items in the group.
Text Item, page 158	There are two kinds of text items: 1. Free-standing text items are single-lines of text shown on the canvas. 2. Text items in teacup groups are single-lines of text shown below the teacup label of each teacup. Text items represent static text, one slot value, or the relationship of two slot values or a timestep. You specify the type of text you want and the corresponding slots. Also specify the color and any prefix or suffix text.
Bounding Box, page 158	For better appearance, you may wish to add Bounding Boxes to Teacup Groups or Object Icon Groups so that a box is drawn around each teacup or icon. You can specify the color of the background and its opacity and the border color.

Table 6.1 (Continued)

Item	Description
Flow Line Group, page 159	Flow Lines are shown in groups so that all data is consistent across the group. The Flow Line Group defines the unit type, minimum, and maximum values and their respective thicknesses along with the interval configuration.
Flow Line, page 159	The Flow Line item is part of a Flow Line Group. The Flow Line defines the specific slot to use along with the thresholds to use on that flow line.
Flow Line Legend, page 159	The Flow Line Legend provides a key to the intervals and thicknesses of lines in the Flow Line Group.
Canvas Line Group, page 161	The Canvas Line Group is a container for Canvas Lines. Canvas Lines in the group have the same thickness, color, symbol type and size.
Canvas Line, page 162	Canvas Lines are used to create pointers or other line indicators on the canvas. Canvas lines are polylines with as many nodes as needed.
Image Group, page 162	Image Groups are containers for Images.
Image, page 162	You can add any jpg or png image to an image group. The image is then embedded in the output device. Also specify if it is on the foreground layer or background layer.
Chart Group, page 162	Chart Groups are containers for charts.
Chart, page 163	A Chart item is used to show a previously defined Chart within a Chart Group.

The following operations allow you to create the Canvas layout and arrange its items as desired:

- **Add Item** 

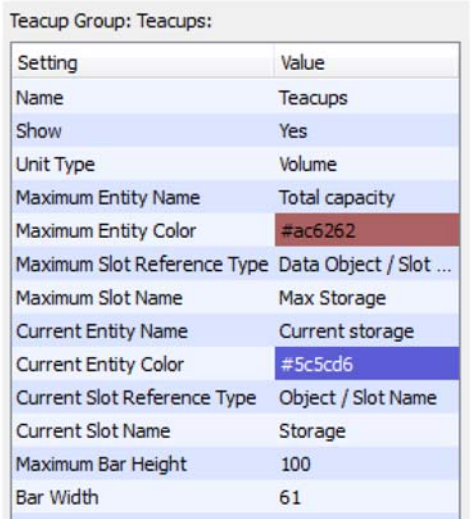
Use the menu to select an item to add to the layout.

  Select **Plus**  to add the selected item. This button is active only when the item can be added. For example, Teacups must be added when a Teacup Group is selected.

- Select **Minus**  to delete an item from the list.
- The **Move** arrows: These buttons can be used to move the selected item up or down when possible.
- **Edit operations**: The following standard edit operations can be accessed via the right-click context menu or the Edit Layout menu: **Cut**, **Copy**, **Paste**, **Delete**.

Selected Item Settings

The **Selected Item Settings** area allows you to control the appearance of individual Canvas items. This area lists the settings that apply to the item currently selected in the **Output Canvas Content** area, and allows editing by selecting the current setting value. See "Canvas Items Reference" on page 154 for details.



Canvas Items Reference

This section provides details about the settings that apply to each type of Canvas item.

General Settings

These are settings that apply to the entire canvas. This is always shown and cannot be deleted.

Setting	Type	Notes
Name	Single line text	
Canvas Width	Value in pixels	
Canvas Height	Value in pixels	
Background Color	Color Chooser	See "Color Chooser" on page 163 for details.
Timestep	Datetime Text	Usually the date shown is controlled by the date controls in the preview or on the canvas itself
Show on Simulation View	Yes/No	Show supported items on the appropriate workspace view. See "Showing Canvas Items on the Workspace" on page 183 for details.
Show on Geospatial View	Yes/No	

Teacup Group

Teacup Groups are a container for Teacups so that all data is consistent across the teacups in the group. The Teacup Group defines the slots to use, where they are located, the size of the bars in the teacup, and the fonts for the label, axis, and text items. Teacup Groups can have bounding boxes, text items, and markers that are displayed for each teacup. In addition, a Teacup Group can have a Teacup legend to provide a key. See "Teacup Legend" on page 156 and "Instructions to Create a Teacup Diagram" on page 184 for additional information.

Setting	Type	Notes
Name	Text	
Show	Yes/No	
Unit Type	Menu Selection	Values shown will use the Unit Scheme definition for the specified Unit Type. Select **View**, then **Unit Scheme Manager** to see the scheme.
Precision	Selection	Select the precision of numeric values shown. See "Precision" on page 164 for details.
Maximum Entity Name	Text	
Maximum Entity Color	Color Chooser	See "Color Chooser" on page 163 for details.
Maximum Slot Reference Type	Object/Slot Name or Data Object/Slot Name	Choose whether the specified Maximum slot is on the object itself or an accompanying data object. See "Slot Reference Type" on page 164 for details.
Maximum Slot Name	Slot Selection	The slot used for the larger bar on the teacup. See "Slot Selections" on page 165 for details.
Current Entity Name	Text	
Current Entity Color	Color Chooser	See "Color Chooser" on page 163 for details.
Current Slot Reference Type	Object/Slot Name or Data Object/Slot Name	Choose whether the specified current slot is on the object itself or an accompanying data object. See "Slot Reference Type" on page 164 for details.
Current Slot Name	Slot Selection	The slot used for the smaller (current) bar on the teacup. See "Slot Selections" on page 165 for details.
Teacup Geometry	Selection	The shape of the teacups. Select either rectangular, trapezoidal congruent, or trapezoidal constant Top/Bottom. See "Teacup Geometry" on page 167 for details.
Show Gap	Yes/No	Specify if there is a horizontal gap between the current and maximum value. See "Show Gap" on page 169 for details.
Maximum Teacup Height	Number	Height of the largest teacup in the group.
Teacup Width	Number	Width of all the rectangular teacup bars in the group.
Teacup Bottom Width	Number	Width of the bottom of all the trapezoidal teacups.
Teacup Top Width	Number	Width of the top of all the trapezoidal teacups (Constant Top/Bottom)
Show Vertical Axis	Yes/No	

Setting	Type	Notes
Label Font	Font Selector	The font used for the teacup labels.
Axis Font	Font Selector	The font used for the teacup axis.
Text Font	Font Selector	The font used for all text items in the group.

Teacup Legend

A Teacup Legend is part of a Teacup Group and provides a key to the teacups. The maximum value, the current value, markers, text and the units are shown in the legend.

Setting	Type	Notes
Label	Text	The text used for the label on the legend.
X Position	Number	See "Position" on page 164 for details.
Y Position	Number	See "Position" on page 164 for details.

Teacup

A teacup is shown for the selected objects. You can modify the name and change the corresponding data object, if necessary. See "Instructions to Create a Teacup Diagram" on page 184 for details.

Setting	Type	Notes
Label	Text	The text used for the label on the teacup.
Reference Object	Object Selection	Use the selector to select the object for this teacup. Usually this is a Reservoir object.
Reference Data Object	Object Selection	Use the selector to select the data object related to the reference object. This is usually located automatically if available.
X Position	Number	See "Position" on page 164 for details.
Y Position	Number	See "Position" on page 164 for details.

Object Icon Group

The Object Icon Group contains RiverWare icons representing the objects shown on the workspace. Object icons are shown in groups so that the text labels are consistent. Object Icon Groups can have bounding boxes and text items that are displayed for each Object icon.

Setting	Type	Notes
Name	Text	The name of the group as shown in the Output Canvas Content group
Show	Yes/No	

Setting	Type	Notes
Precision	Selection	Select the precision of numeric values shown. See “Precision” on page 164 for details.
Label Font	Font Selector	The font used for all Object Icon Labels
Text Font	Font Selector	The font used for all text items added to the Object Icon Group

Object Icon

The Object Icon item specifies the Object(s) to include in an Object Icon Group. You can also specify the labels to show for each icon.

Setting	Type	Notes
Label	Text	The label to use for the icon.
Reference Object	Object Selection	The object for which you would like to show the icon
Reference Data Object	Object Selection	Use the selector to select the data object related to the reference object. This is usually located automatically if available.
X Position	Number	See “Position” on page 164 for details.
Y Position	Number	See “Position” on page 164 for details.
Scale	Number	Specify the relative scale of the icon. The valid range is from 20-200%

Marker

Markers, representing a slot value, are horizontal lines shown on each teacup. Markers are added to the Teacup Group. You specify the line color, style and the slots to use.

Setting	Type	Notes
Label	Text	The text used for the marker on the legend.
Line Color	Color Chooser	See “Color Chooser” on page 163 for details.
Line Style	Menu	
Slot Reference Type	Object/Slot Name or Data Object/Slot Name	Location of the slot to use for the marker. See “Slot Reference Type” on page 164 for details.
Slot Name	Slot Selection	The slot used for marker. See “Slot Selections” on page 165 for details on this selection.

Text Group

A text group is a container for free standing text on the canvas. You can name the group and specify the font to use for all text items in the group.

Setting	Type	Notes
Name	Text	This text is used to identify the group
Show	Yes/No	
Precision	Selection	Select the precision of numeric values shown. See "Precision" on page 164 for details.
Font	Font Selector	The font used for all Text Items in the group.

Text Item

There are two kinds of text items: 1. Free-standing text items are single-lines of text shown on the canvas. 2. Text items in teacup groups are single-lines of text shown below the teacup label of each teacup.

Text items represent static text, one slot value, or the relationship of two slot values or a timestep. You specify the type of text you want and the corresponding slots. Also specify the color and any prefix or suffix text.

Setting	Type	Notes
Text Type	Menu Choice	Select one of the types of text. See "Text Types" on page 165 for details.
Text Color	Color Chooser	See "Color Chooser" on page 163 for details.
Prefix Text	Text	String to include before the Text Item
Suffix Text	Text	String to include after the Text item
Slot 1 Reference Type	Object/Slot Name or Data Object/Slot Name	Location of the slot to use for the text item. See "Slot Reference Type" on page 164 for details.
Slot 1 Name	Slot Selections	See "Slot Selections" on page 165 for details.
Slot 2 Reference Type	Object/Slot Name or Data Object/Slot Name	Location of the slot to use for the marker. See "Slot Reference Type" on page 164 for details.
Slot 2 Name	Slot Selections	For Text items that show or use two values, this is the second slot. It is only shown for Text items with two slots.
Legend Text	Text	The text that is displayed on the legend.

Bounding Box

For better appearance, you may wish to add Bounding Boxes to Teacup Groups or Object Icon Groups so that a box is drawn around each teacup or icon. You can specify the color of the background and its opacity and the border color.

Setting	Type	Notes
Show	Yes/No	
Opacity	Number	This value must be between 0 and 100, inclusive.

Setting	Type	Notes
Background Color	Color Chooser	See "Color Chooser" on page 163 for details.
Show Border	Yes/No	
Border Color	Color Chooser	See "Color Chooser" on page 163 for details.

• Flow Line Group

Flow Lines are shown in groups so that all data is consistent across the group. The Flow Line Group defines the unit type, minimum, and maximum values and their respective thicknesses along with the interval configuration. See "Instructions to Create a Flow Line Diagram" on page 190 for details.

Setting	Type	Notes
Name	Text	
Show	Yes/No	
Unit Type	Menu	The Unit Type to use for all flow lines in the group.
Minimum Value	Number and units	The value representing the minimum. Any values less than this will be shown with the minimum thickness.
Minimum Thickness	Number of pixels	The thickness corresponding to the minimum value. See "Flow Line Thickness" on page 170 for details on thickness.
Maximum Value	Number and units	The value representing the maximum. Any values greater than this will be shown with this thickness.
Maximum Thickness	Number of pixels	The thickness corresponding to the maximum value. See "Flow Line Thickness" on page 170 for details on thickness.
Interval Definitions	Number of intervals	Select the button to open a dialog where the intervals are defined. See "Flow Line Color and Style" on page 171 for details. When finished, the number of intervals is shown.

• Flow Line

The Flow Line item is part of a Flow Line Group. The Flow Line defines the specific slot to use along with the thresholds to use on that flow line. See "Instructions to Create a Flow Line Diagram" on page 190 for details.

Setting	Type	Notes
Label	Text	The flow line label.
Reference Slot	Slot Selection	The Slot that provides the values for the Flow Line.
Threshold 1 ...	Number and units	As configured in the Flow Interval Definition, each flow line will have the same number of Thresholds. Specify the value for each threshold. See "Flow Line Color and Style" on page 171 for details.
... Threshold 8	Number and units	

• Flow Line Legend

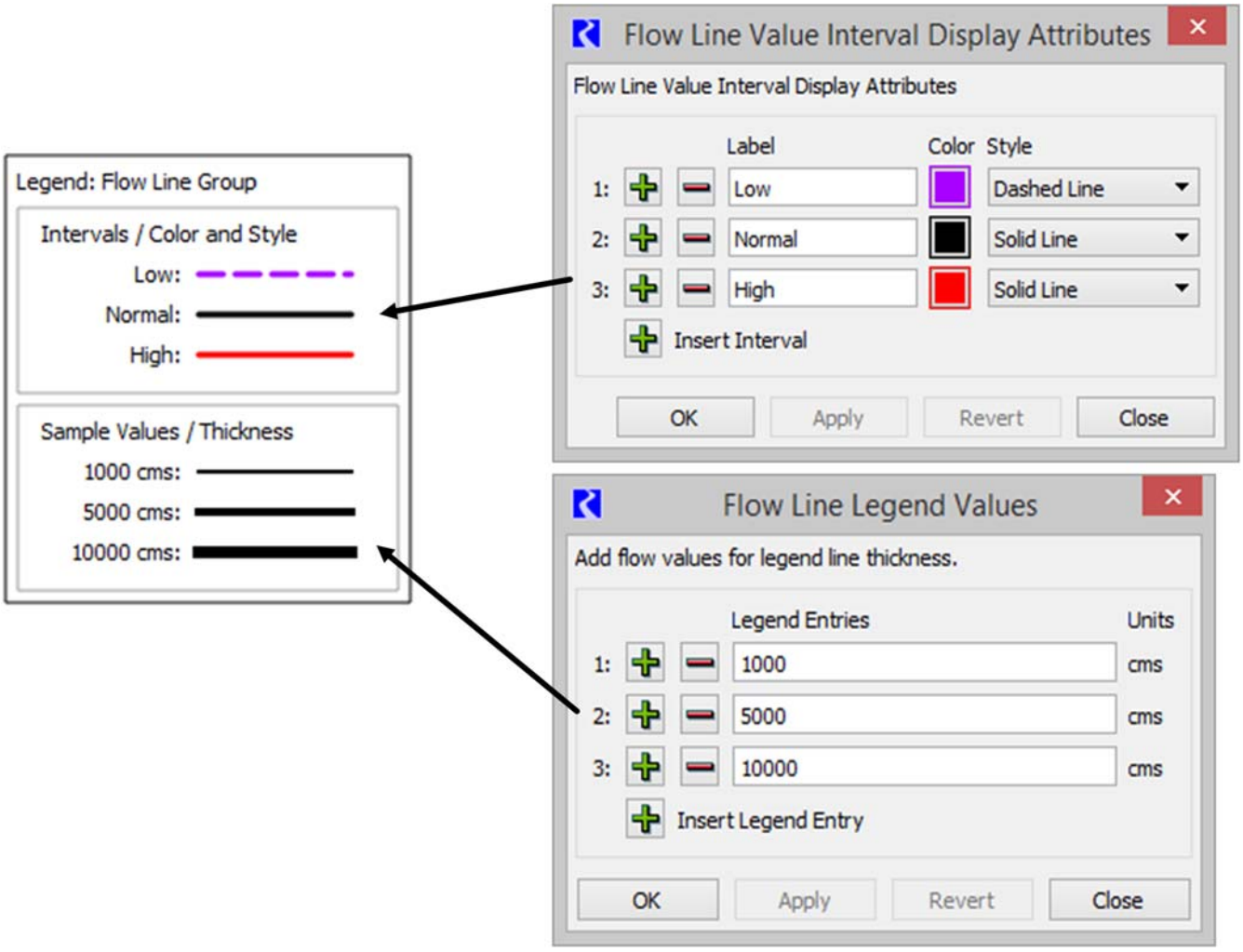
A Flow Line Legend can be added to a Flow Line Group to provide a key that describes the intervals defined in a flow line group and show sample lines that represent the thickness at various values.

Setting	Type	Notes
Flow Line Legend Label	Text	The label to show at the top of the legend.
X Position	Number	See “Position” on page 164 for details.
Y Position	Number	See “Position” on page 164 for details.
Flow Line Legend Values	Number of Sample Values	Select the setting and then click the button to open a dialog in which you define the sample values. See below for details. When finished, the number of sample values is shown.

As shown in Figure 6.4, the top part of the legend provides a key to the intervals defined on the Flow Line Group. The intervals are defined and labeled on the Flow Line Group through the Interval Definitions setting. See “Flow Line Color and Style” on page 171 for details.

The bottom panel in the legend provides a key to the line thickness and the values they represent. You define which values you would like to show. In the Flow Line Legend Value setting, click the button to open the dialog. Use the plus and minus buttons to add/delete entries. For each sample defined, a solid black line will appear in the legend with the appropriate thickness with respect to the Flow Line Group's minimum and maximum flow values and their defined thickness.

Figure 6.4 Screenshot showing a Flow Line Legend and the configuration dialogs



Canvas Line Group

The Canvas Line Group is a container for Canvas Lines. Canvas Lines in the group have the same thickness, color, symbol type and size.

Setting	Type	Notes
Name	Text	
Show	Yes/No	
Line Thickness	Number of Pixels	The thickness of the lines
Line Color	Color Chooser	See "Color Chooser" on page 163 for details.

Setting	Type	Notes
Symbol Type	Menu	Select either None, Arrow, Dot, or Triangle. The symbol is only shown on one end of the line.
Symbol Size	Number	Specify the size of the symbol.
Symbol Color	Color Chooser	See "Color Chooser" on page 163 for details.

Canvas Line

Canvas Lines are used to create pointers or other line indicators on the canvas. Canvas lines are polylines with as many verticies as needed.

Setting	Type	Notes
Label	Text	The canvas line label.

Image Group

Image Groups are containers for Images.

Setting	Type	Notes
Name	Text	
Show	Yes/No	

Image

You can add any jpg or png image to an image group. The image is then embedded in the output device. Also specify if it is on the foreground layer or background layer.

Setting	Type	Notes
Name	Text	By default, this is the original image file name.
Layer	Foreground/ Background	Select the layer on which the image lives. Background images can be separately locked into position on the Canvas Preview.
Image Opacity	Number	This value must be between 0 and 100, inclusive.
X Position	Number	See "Position" on page 164 for details.
Y Position	Number	See "Position" on page 164 for details.
Scale	Number	Specify the relative scale of the image. Either enter the number as a setting (20-400%) or drag the re-scale icon on the canvas to resize. 

Chart Group

A chart group is a container for Chart items.

Setting	Type	Notes
Name	Text	
Show	Yes/No	

• Chart

Chart items contain a reference to an existing Chart output device within the model. The chart is drawn with the canvas' reference timestep date/time. The canvas is drawn either with its native background color or with a background and frame specified by an optional “Bounding Box” added to the containing Chart Group. This is similar to the bounding box support for Teacups and Teacup Groups.

Setting	Type	Notes
Chart Name	Selection	Select the name of the previously configured chart device.
Width	Number	The width of the chart in pixels. See “Chart Configuration” on page 173 for details on chart sizing.
Height	Number	The height of the chart in pixels. See “Chart Configuration” on page 173 for details on chart sizing.
Scale	Percent	Scaling factor; must be less than or equal to 100%. See “Chart Configuration” on page 173 for details on chart sizing.
X Position	Number	See “Position” on page 164 for details.
Y Position	Number	See “Position” on page 164 for details.

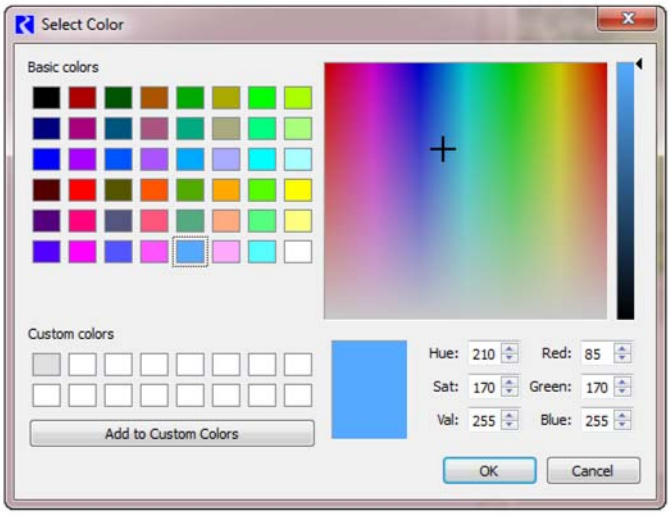
Additional Information on Certain Settings

The following sections provide additional information that is shared among one or more settings.

Color Chooser

For all of the colors settings on the canvas, the settings allow you to specify the color in a number of ways. Usually you should use the color selector to specify the desired color. You can select the color from the palette, specify

RGB values, or specify Hue/Sat/Val from the dialog. From the text setting, you can also type the hexadecimal color or type in an HTML color name.



Position

For all of the X and Y Position Settings, you can do the following:

- Specify the coordinates on the canvas as the number of pixels from the top left. This provides a fine level of control over the positions.
- Drag the item on the canvas. (preferred)

When either the number is changed or the item is dragged on the canvas, the other updates accordingly.

Precision

For Teacup, Text, and Object groups, select the precision of numeric values shown. Choose from a fixed precision 0-6 or use the precision defined on the Unit Scheme. Select **View**, then **Unit Scheme Manager** to see the scheme.

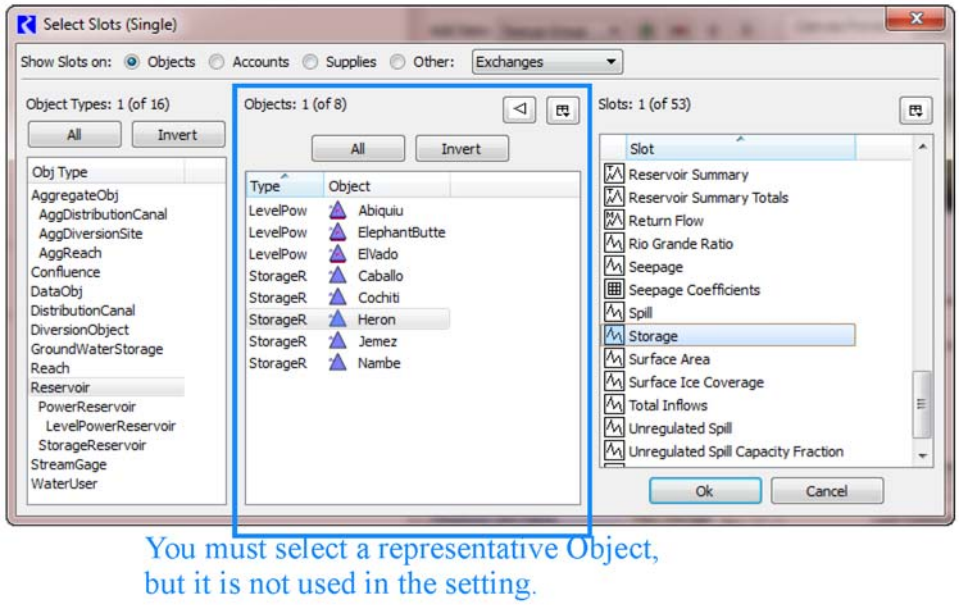
Slot Reference Type

For all of the Slot Reference Type settings, choose whether the slot is on the reference object or its accompanying data object. **Object/Slot Name** is for the specific object. **Data Object/Slot Name** is for the accompanying data object. The Output Canvas will try to find an accompanying data object by searching for the object's name and the string "Data". You can modify the data object to use if it is not correctly found. See "Output Devices for Aggregated Values" on page 3 for details on creating aggregated data for display in this or other output devices.

Slot Selections

Specify the slot name or use the selector to select a representative slot. For these, you are choosing the slot only, but to do this, you must select a specific object first. The Object part is removed and only the Slot Name is used.

Figure 6.5



Following are some special provisions regarding the slots:

- When a multiple-column slot is selected, the slot's first column matching the Teacup Group's unit type is used.
- For the Maximum slot:
  - When a Series Slot or Periodic Slot is used, the maximum value found within the slot column is used. With this in mind, you can pick the same series slot for both Maximum and Current teacup values, i.e. Storage. Then the teacup will show current Storage compared to largest Storage in that series.
  - When a Table Slot is used, the value in the last row is used. This allows use of Reservoirs' Elevation Volume Table for the maximum Storage value.

Text Types

The Text Item allows you to show text or values on each teacup, object icon, or on the canvas. Specify the type of text using the **Text Type** setting. Table 6.2 shows the possible values and gives a description of each.

> **Note:** Prefix and suffix settings are available for all except the Plain Text. In the Example column, the prefix and suffix are normal text while the filled in value is **Bold**.

Table 6.2

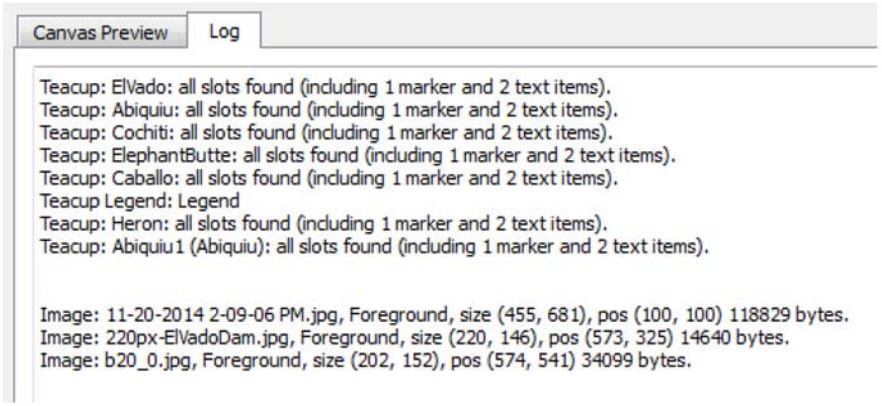
Text Type	# of Slots	Notes	Example
Plain Text	0	Static text. Prefix and Suffix are not supported. Edit the text in the in line text editor or use the dialog for longer text. Line breaks are supported.	CURRENT RESERVOIR CONDITIONS
Value	1	Display the value of a slot.	Storage = 454,323 acre-feet
Value (Priority)	1	Display the value of a slot and its priority.	Storage = 454,323 acre-feet (Priority 32)
Value / Value	2	Display the value of a two slots separated by "/".	Big Res has 5,342 m3 / 6000 m3 possible
Percent	2	Display the computed percent of the two slot values.	Storage = 89.0% full
Percent Maximum	1	Display the computed percent of the current value to the maximum value found in the slot. These are only available for text items in Teacup Groups	Storage = 73.1% of modeled maximum
Timestep	0	Display the canvas' timestep as a text label. This is particularly useful when exporting the canvas to an image or a Model Report where the timestep controls aren't shown.	Timestep: Feb 14, 2013

Fitting Teacups and Object Icons

If you want your teacups and object Icons to match the general layout of your simulation view, you can select **Edit**, then **Fit Teacups using Simulation View positions**. This rearranges all existing Teacups and Objects with respect to the positions of the corresponding simulation objects within the simulation view.

Log

This tab provides a textual description of the Canvas generation process. The log contains details such as whether slots were found or not and image size and position. When a problem occurs during generation, the details will be reported here.



Teacup Configuration

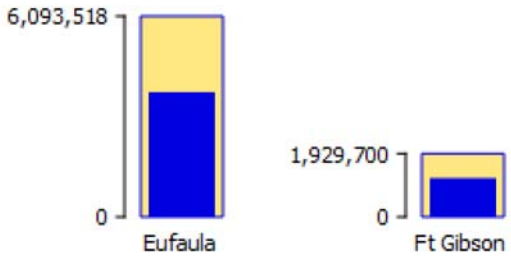
This section describes additional configuration options for Teacups, particularly the geometry and appearance.

Teacup Geometry

For any particular teacup group, you can choose between the following Teacup Geometry options.

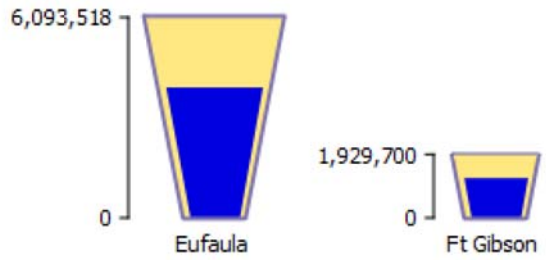
- **Rectangular**: Each teacup is shown as an equal width rectangular bar.

Figure 6.6



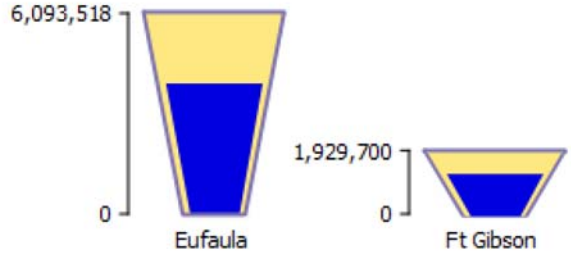
- **Trapezoidal, Congruent**: The Maximum Teacup Top Width setting is used for the teacup having the largest maximum value. The top widths of all other teacups in the group are computed to make the trapezoid congruent to the largest teacup. The side slope of all teacups is constant.

Figure 6.7



- **Trapezoidal, Constant Top and Bottom Widths**: Each teacup has the same top and bottom width. The side slope of teacups is not the same among teacups in the group.

Figure 6.8

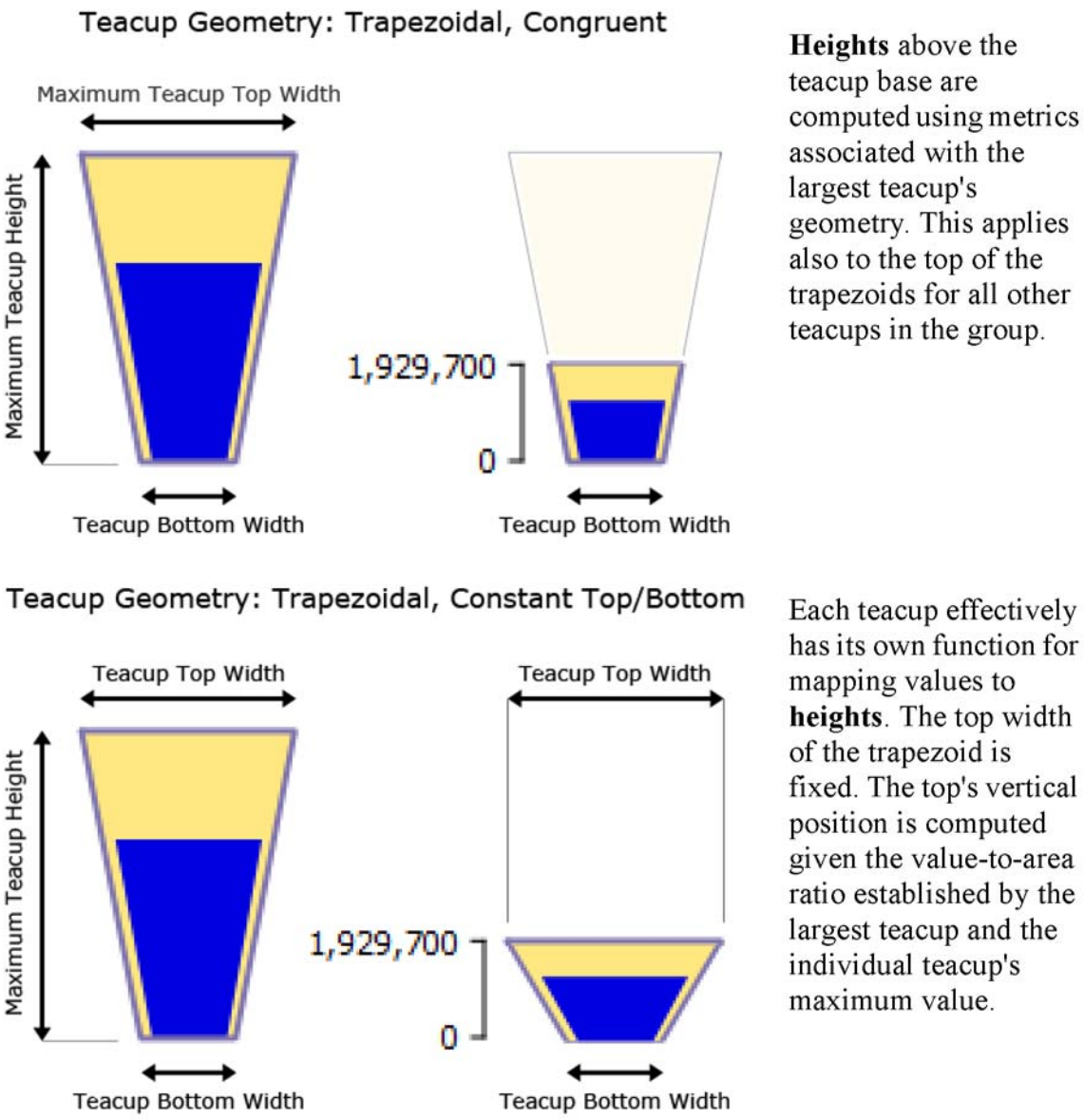


The Maximum Teacup Height applies to the teacup having the largest maximum value. The height of the teacups is computed as follows:

- In the Rectangular geometry, all other teacup values are mapped to a vertical position above the teacup's base, proportional to the value-to-vertical-pixel ratio defined by the largest teacup.
- For both Trapezoidal geometries, a value-to-area ratio is computed from the largest teacup. That computed value-to-area ratio is then used for computing geometries within all teacups within the teacup group.

Figure 6.9 shows these geometries, as applied to the largest teacup in the group and another teacup in the same group.

Figure 6.9

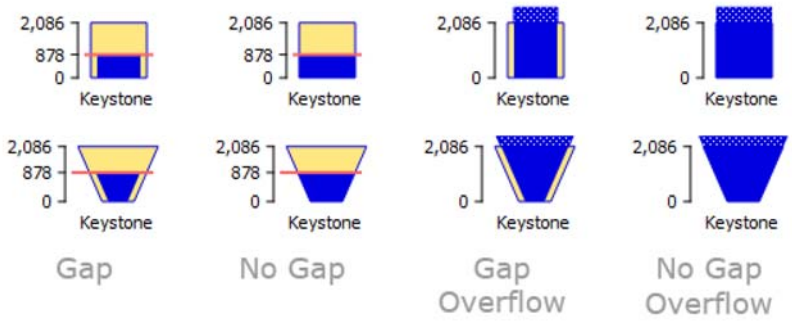


Show Gap

The Show Gap configuration option shows or hides the horizontal gap between the inner current rectangle (or trapezoid) and the outer maximum rectangle (or trapezoid). Figure 6.10 shows examples.

Note: Overflow values are shown with a dotted region.

Figure 6.10



Flow Line Configuration

Flow lines have a few additional configuration options that are described in the following section. See "Instructions to Create a Flow Line Diagram" on page 190 for details.

Flow Line Thickness

Each flow line's thickness is an interpolation based on minimum and maximum values and thicknesses. The maximum value should be devised in relationship to the maximum values amongst all flow lines in the group.

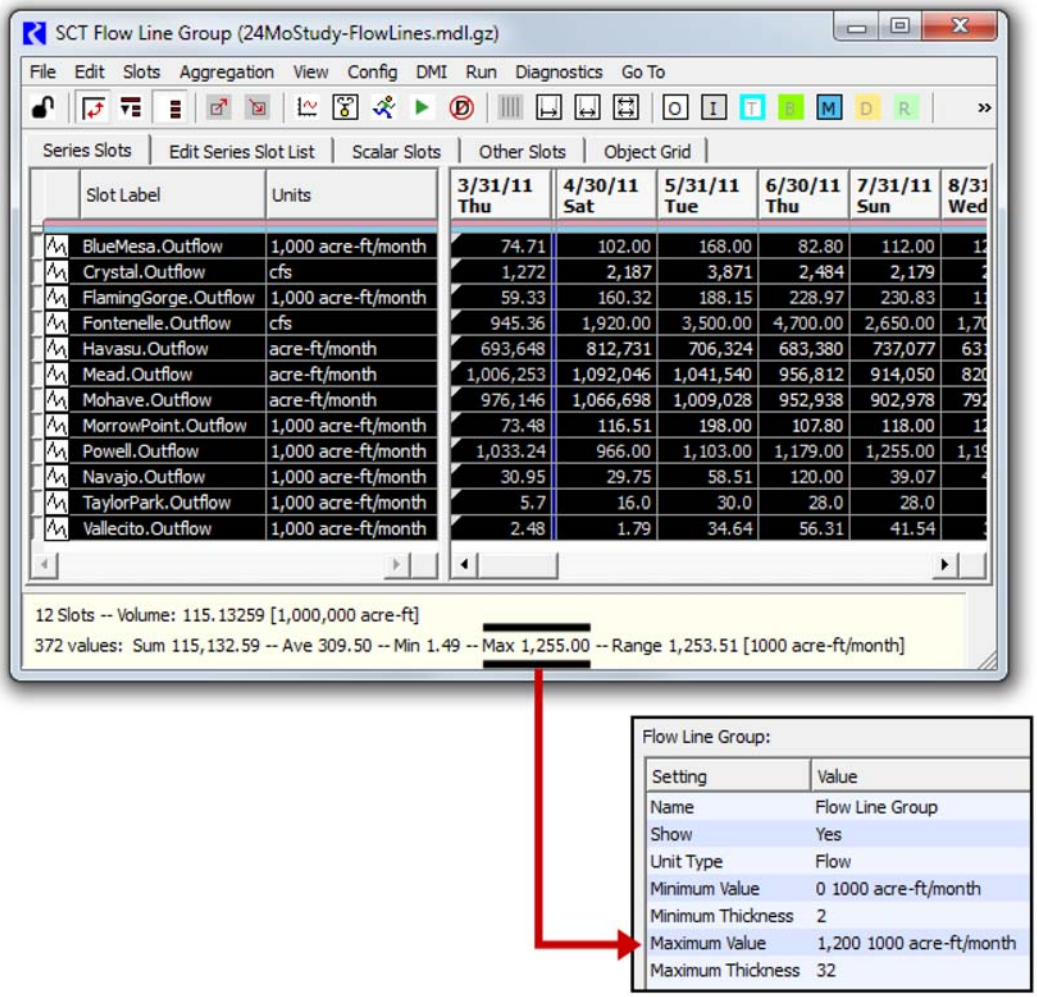
A flow line's thickness is computed from value and thickness interpolation settings defined within the containing flow line group.

At the reference timestep, when a flow line's value is...	... the flow line is drawn with
Equal to or less than the Minimum Value	the Minimum Thickness.
Between the Minimum and Maximum Values	Linear interpolation between Minimum and Maximum Thicknesses.
Equal to or greater than the Maximum Value	the Maximum Thickness.

> **Note:** There is no expectation that all encountered values will be within the Minimum and Maximum Value range. Flow line thickness for values outside that range will be shown at the respective Minimum or Maximum Thickness.
>
> **Tip:** Sample flow lines and the subsequent thickness can be shown on a Flow Line Legend. See "Flow Line Legend" on page 159 for more information.

A reasonable minimum value is 0.0. The maximum value should be chosen which exceeds most slot values among all flow lines in the flow line group in the full time series. One way to determine a good maximum value for a flow line group is shown in Figure 6.11. This involves the following steps.

Figure 6.11



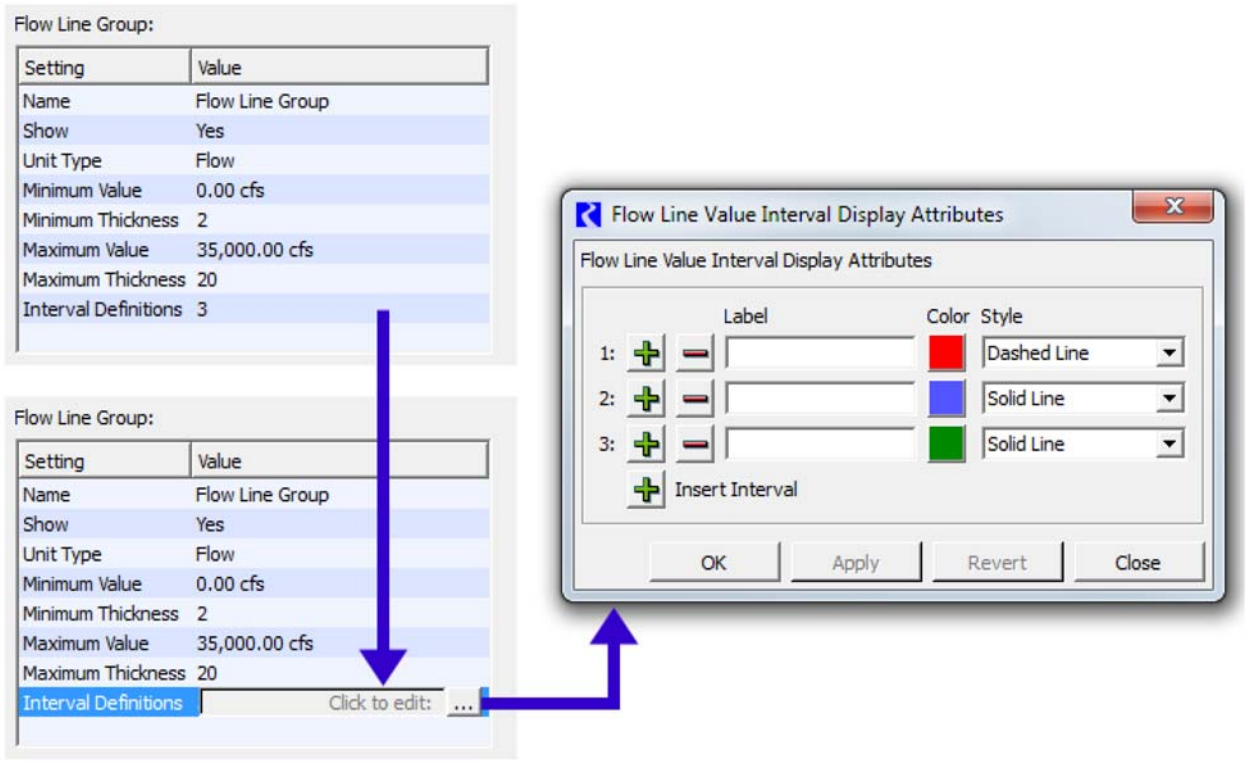
1. Right-click any of the flow lines within the flow line group and select: **Flow Line Group**, then **Show Slots in new SCT**.
2. In the resulting SCT, select all cells. (This can be done with a single select the top-left corner of the series data table).
3. In the selection statistics along the bottom of the SCT, notice the **Max** value.
4. Enter a number slightly larger in the Flow Line Group's **Maximum Value** settings.

Flow Line Color and Style

A flow line's color and style are based on the flow line's current value and where it falls within the defined intervals. The intervals are defined for the group while the thresholds are defined on each flow line. The following section describes the Interval definitions, then the threshold specification.

For a Flow Line Group, the **Interval Definitions** setting item indicates the number of intervals currently defined. Double-clicking that item presents **Click to edit** and **More**. Select **More** to show the **Flow Line Value Interval Display Attributes** editor dialog as shown in Figure 6.12.

Figure 6.12



Using the **Plus +** button, specify up to nine intervals (Eight Thresholds). The top interval row is for the lowest flow values -- i.e. not exceeding any of a flow line's threshold values. Each interval definition has a text label (used in a Flow Line Legend), a color, and a line style.

> **Note:** In the current implementation, the non-solid line styles look best with thin flow lines, as the size of the dash or dot is a function of the line thickness.

Once the intervals are configured and you have created flow lines, now you can specify the threshold values for each Flow Line, specify the thresholds in the Threshold 1 through Threshold N settings. Threshold 1 should be a lower flow than Threshold 2, and so forth. Figure 6.13 shows a flow line group with Two thresholds and three Intervals. The values for each threshold are specified on the individual flow lines.

> **Tip:** The labels and specified color and style for each interval can be shown on a Flow Line Legend. See "Flow Line Legend" on page 159 for more information.

Figure 6.13

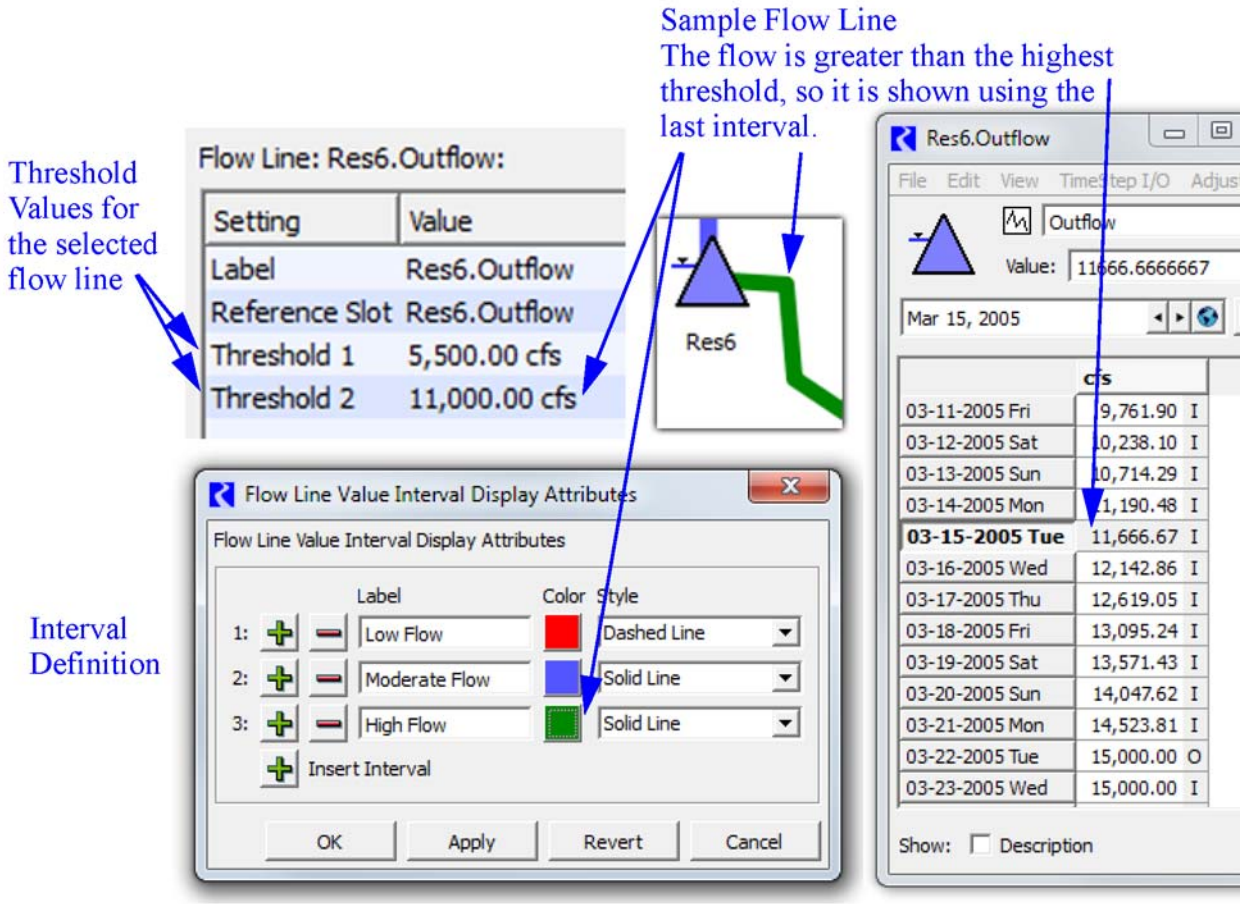


Chart Configuration

When adding a Chart to a Chart Group, the Chart selector is immediately shown.

For Chart items, you can specify the height, width, and a scaling factor either as numerical settings or by dragging on the canvas.

The chart has two dragable points which appear near the bottom-right corner.

- **Scale Chart:**  change scale percent, 10% to 100%. This is percentage is applied to the given height and width.

- **Resize Chart:**  change the shape and size by adjusting the width and height graphically.

These icons can be dragged with the mouse. The drag can be aborted by pressing the ESC key. They also support the illustrated context menu operations.

In addition, the chart can only be reduced in width and height to a certain point at which clipping will occur. If you resize it smaller, then the chart will resize to the minimum. A **Reset Size** operation will also resize the chart to the minimum size. The "Minimum Size" is found iteratively where the chart grows until all components fit on the chart.

Figure 6.14



The settings supported on Chart Groups, Bounding Boxes, and Charts are illustrated in Figure 6.15.

Figure 6.15

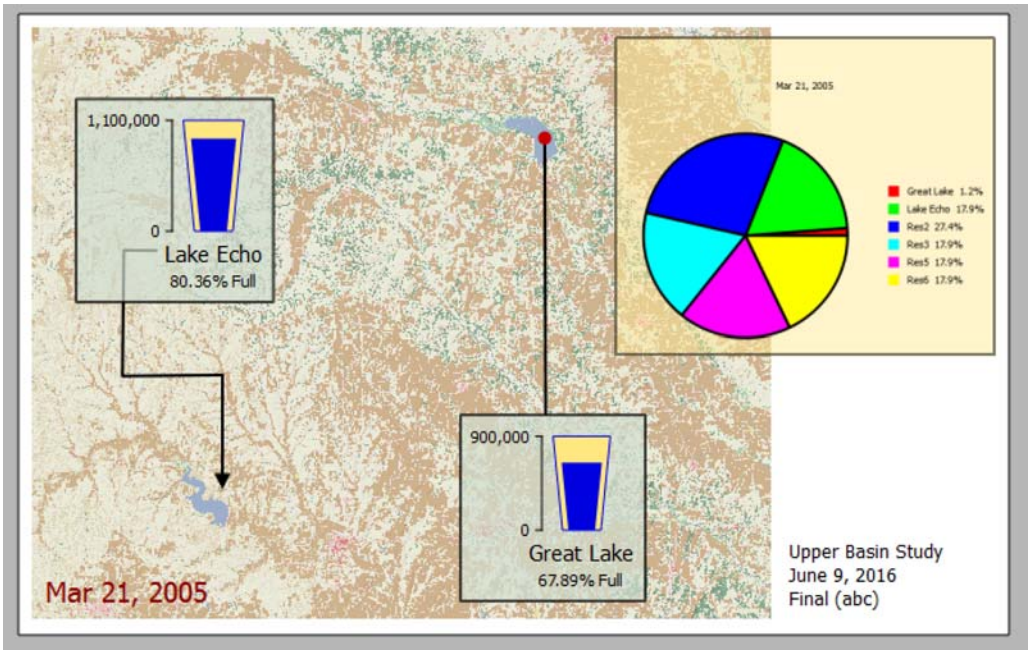
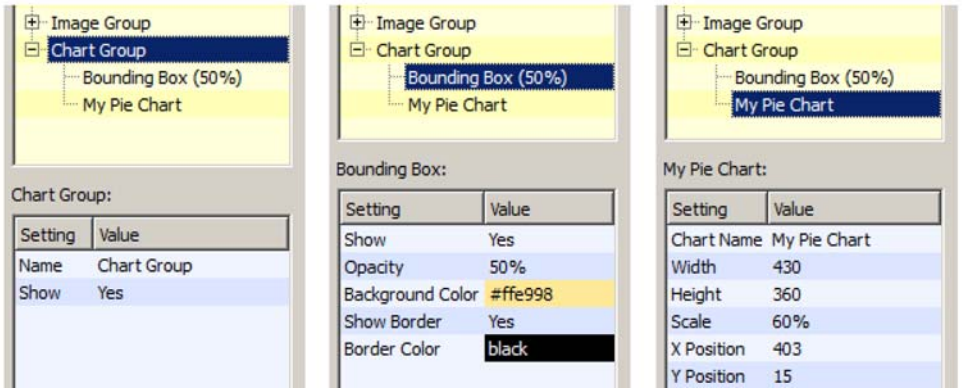
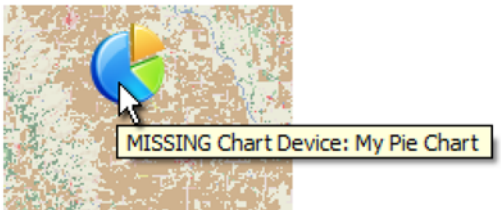


Figure 6.16



If the Chart (output device) referred to from the Chart item is missing (E.g. if the Chart output device was deleted or renamed), the placeholder icon in Figure 6.17 is shown with a tooltip indicating that the chart device is missing.

Figure 6.17



Note: Nearly all chart display and configuration changes (i.e. colors and slots shown) are made from the Chart Configuration dialog, accessible from the Output Manager.

Note: Pie Charts with labels shown in a separate legend look better on an output canvas than those with labeled wedges.

Units

All numeric values are displayed in the units associated with the Teacup Group's unit type, according to the currently active unit scheme. Select **View**, then **Unit Scheme Manager** to show the Unit Scheme Manager dialog. Precision of values is typically controlled by unit scheme but can be overridden on Teacup Groups, Text Groups and Object Icon Groups.

Canvas Preview Tab

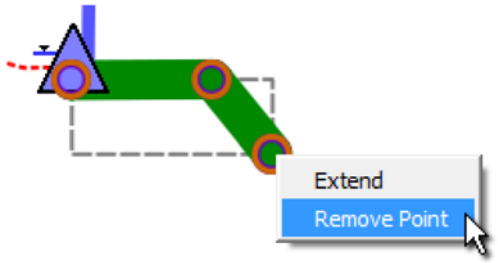
The first tab of the panel on the right side of the dialog provides a live preview of what the output Canvas will look like when generated. In fact, this Canvas Preview should be used to define the layout of all of the items added to the canvas. Drag any item to the desired location. The X and Y Positions will update automatically in the settings.

For Flow lines, anchor points are shown on the single selected flow line. These lines support a context menu with the following operations:

- Insert Point: Add an anchor point within a flow line at the selected position.

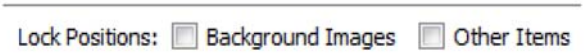
- Extend: Add an additional point beyond the selected end-point. This is available only on the flow line's two end-points.
- Remove Point: remove the anchor point This is enabled only when the flow line has three or more points.

Figure 6.18



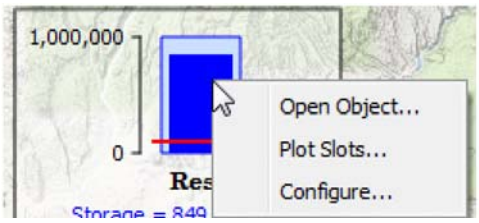
By adding many anchor points, you can use flow line to connect two reservoirs, two teacups, or even follow the river channel on the background image.

You can lock items using the checkboxes at the bottom right. Those images that are set to be background layer are controlled by the **Background Images** checkbox. All other items are locked by selecting the **Other Items** checkbox.



Right-click any item on the preview to get a **Configure** menu. This scrolls the content settings on the left to that section's settings. Additional right-click context-specific menus are available where appropriate.

Figure 6.19



Canvas Viewer

The **Output Canvas Viewer** dialog is shown when the Output Canvas is generated. You can generate from the **Output Manager** or directly from the **Output Canvas Configuration** by selecting **Generate**. On the Viewer, the position of all items is locked and cannot be changed. Animation controls at the bottom allow you to manually or automatically scroll through the run timesteps as described in the next section.

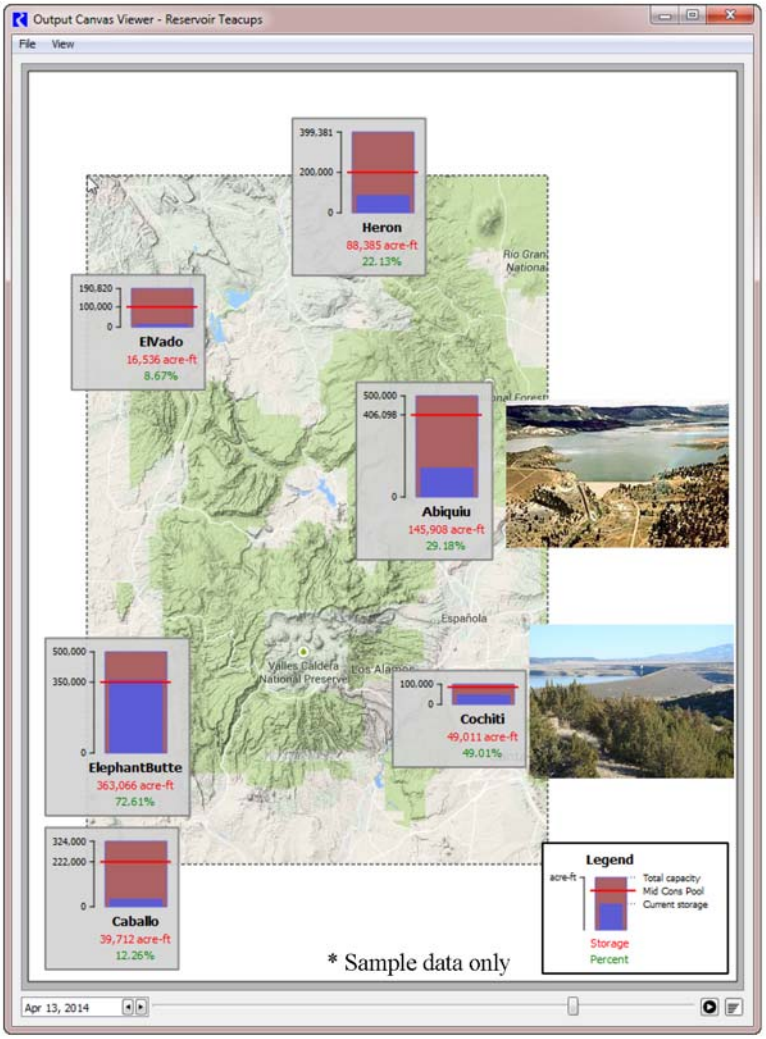
From the viewer, the canvas can be:

- Exported to a movie/video by selecting **File**, then **Export Video**. See "Export Video" on page 179 for more information.

- Exported to an image by selecting **File**, then **Export Image**. This saves the canvas as an image file.
- Copied as an image to the clipboard by selecting **File**, then **Copy Image**. This copies the canvas image to the system clipboard. From there, you can paste it to other applications.

In addition, an image of the canvas can be included in a Model Report. See "Report Layout Area" on page 99 for details.

Figure 6.20

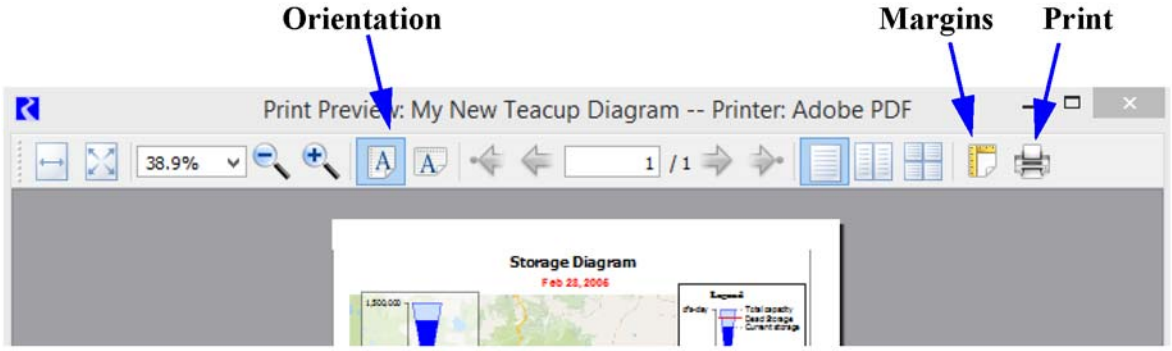


Printing

From the Canvas Viewer, you can print the Output Canvas to a printer or to a PDF file (with appropriate drivers). Select **File**, then **Print Preview**, then **Choose Printer** to select the printer to use. Then select **File**, then **Print Preview**, then **Print Preview** to preview the print. Within the preview, you can set orientation, margins, and then

select **Print** to send it to the printer. Figure 6.21 labels these options. Or, select **File**, then **Print** to get to the Print dialog directly.

Figure 6.21

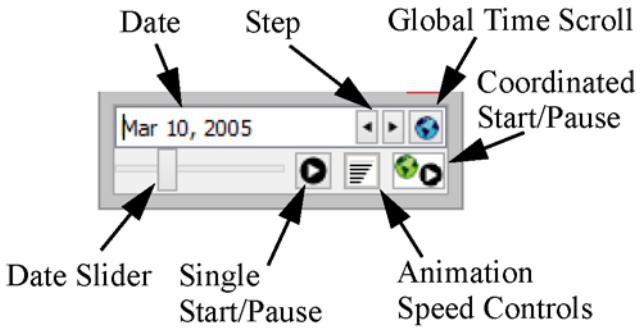


Note: A small canvas is printed at approximately full size; it is not enlarged. A large canvas is printed by scaling down the canvas to fit on the configured page (including margins). Regardless, a light black border is drawn around the canvas.

Animation

A date selector appears below the canvas in both the preview and generated canvas, as shown in Figure 6.22. It allows the display to be stepped forward and backward through the timesteps. Select **Single Start** to animate through time (this dialog only). Use the date slider to see where you are in time and the animation speed controls to change the speed (seconds per frame). On the generated canvas, select **Coordinated Start/Pause** to animate all opened Charts and Output Canvas at the same time. When in coordinated animation mode, you can stop all animations from any dialog. But, from the dialog in which you started the global animation, you can select **Single Pause** to pause all dialogs. Then use the slider to move the date for all dialogs in a coordinated way. Select **Coordinated Start/Pause** to end the coordinated animation.

Figure 6.22

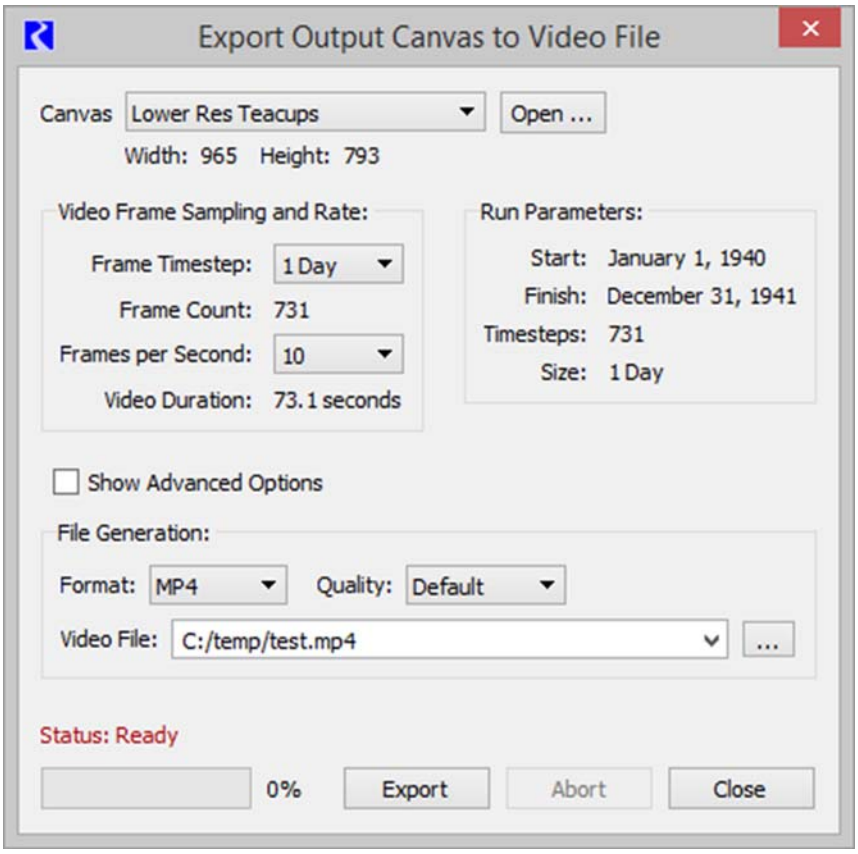


Export Video

Use the **Export Video** menu to generate a video file of the output canvas animation.

This tool works by creating images of the output canvas at specified intervals as the output canvas is animated. The images are then combined into a movie file using an external process. You have control over both the sampling of the animation and the creation of the output file.

Figure 6.23 Screenshot of the Export Output Canvas to Video File dialog



Output Canvas

First specify the desired output canvas if it is not the one used to open the dialog. The height and width is based on the dimensions of the Output Canvas Viewer. It can be changed from the Output Canvas viewer, but not from this dialog.

Video Frame Sampling and Rate

In this area, you specify how the Output Canvas animation is sampled including the timestep size to use and the speed of the animation in Frames per Second.

For reference, the right side shows the Run Parameters including Start and Finish Timesteps, number of timesteps in the run, and timestep size.

In the left portion, you select the timestep size, either the run timestep size or select a larger timestep size for sampling the animation. The total number of frames is computed based on the run parameters and the timestep size.

Also specify a frame rate for the animation. 5 frames per second is a good starting point.

The video duration is computed based on the frame count and frame rate.

File Generation

File generation can have complicated configuration options because of all the moving parts that must work together. As a result, the dialog provides two ways to configure the output file. The default basic configuration is usually sufficient for most users. Those who want more control over the options can **Show Advanced Options** to see advanced configuration.

Basic Configuration

The basic configuration provides three configuration options:

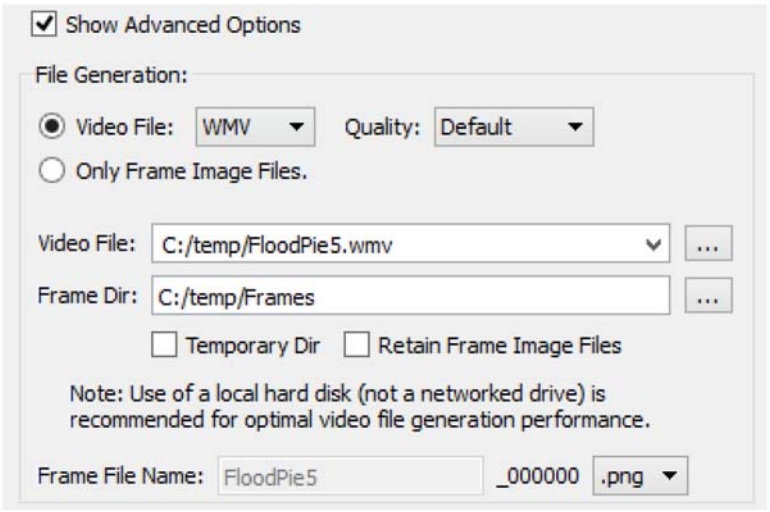
- **Format**: Select from one of the four supported formats. See Table 6.3 for descriptions of the formats and the quality.
- **Quality**: Select **Default**, **Higher**, **Moderate**, or **Lower**. This option is not available for GIFs or WEBM.
- **Video File**: Specify the file to create. Either type it in (include the file extension) or use the file chooser to navigate to the desired directory.

Table 6.3 Video format comparison

Format	Description and usage
MP4	This format displays well in PowerPoint and external players like widows media player.
WEBM	This format works well when displayed in modern browsers like Firefox or Chrome. It cannot be shown in PowerPoint without an extension.
WMV	This format displays well in PowerPoint and external players like widows media player.
GIF	This format is very simple and shows the images repeating over and over, usually in a browser. There are no controls to start/stop/pause the video. Image quality is not as good as other options

Advanced Options

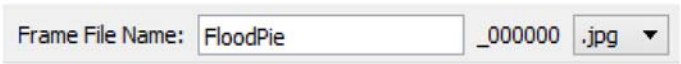
When you select **Show Advanced Options**, you have full control over all aspects of the video file generation. Following are descriptions of the elements of advanced configuration.



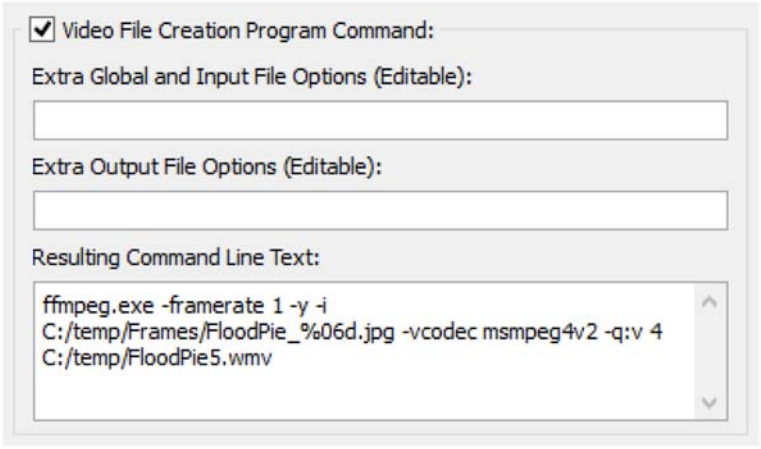
1. Choose whether you want to generate a **Video File** or generate only the **Frame Image Files**.
   - **Video File**: Select the Video File format and Quality. See Table 6.3 for descriptions of the formats and the quality.
   - **Only Frame Image Files**: The utility will create only image files at each timestep. They will not be combined into a video file. This option is useful if you have an alternative program that you want to use to assemble the images into a video. When this option is selected, there is no need to specify a **Video File** name.
2. Specify the location on the file system for the following:
   - **Video File**: The location and name of the video file to create.
   - **Frame Dir**: This shows the directory where the images files will be created. By default, this is the user's temporary directory. If you deselect the **Temporary Dir** box, then you can specify any other directory.
3. If generating a video file, you can specify if you would like to retain the created image files by checking the **Retain Image Frame Files**. If not checked, they will automatically be deleted after the video file generation is complete.



4. If you have selected **Only Frame Image Files** described above, you can also specify an alternative filing naming convention in the **Frame File Name** field. You can also choose to use JPG or PNG files.



5. The lower half of the configuration has options for **Video File Creation Program Command**. This optional panel allows you to further tweak or modify the arguments and commands that are passed to the external program. You can specify either or both of the following elements.
   - **Extra Global and Input File Options**: These options are added to the input side, before the image files are specified. No further information is provided on available options.
   - **Extra Output File Options**: These options are added on the output side, right before the output file specification. No further information is provided on available options.



6. The resulting command line is shown in the **Resulting Command Line Text** field. This shows you exactly what will be executed. Copy is available if necessary.

Creating the Video File

When you choose to create the file by selecting **Export**, a dialog shows a confirmation before starting the generation. You should not close or resize the Output Canvas dialog during video file generation or the process will be terminated.

Select **OK** to generate the video file. The dialog shows the status of the export.



When finished, it shows the following status.



You can now navigate to the directory where the file was exported and view the file in the appropriate application. In addition, a log file is produced in that same directory with further debugging information on the generation process.

Showing Canvas Items on the Workspace

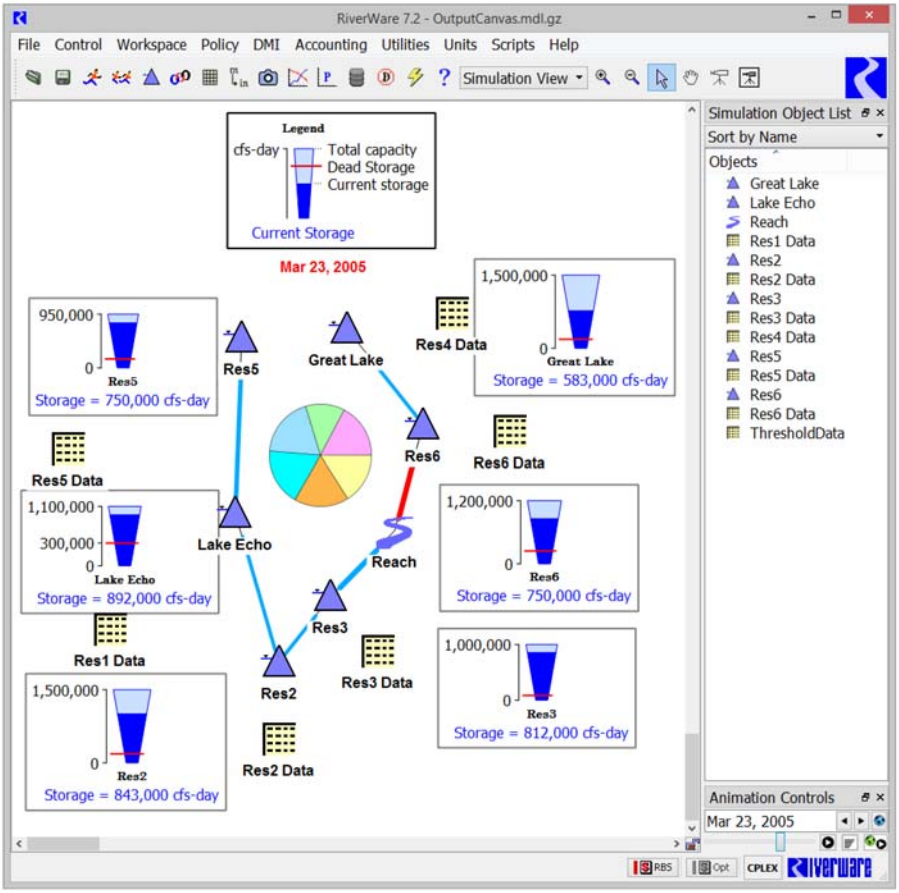
Although the **Output Canvas Viewer** is the best place to see your Output Canvas, sometimes it is desirable to see certain supported Output Canvas items on the Workspace views. Settings on the **Output Canvas Configuration** provide the option to show eligible canvas items on the Geospatial View and/or the Simulation View. See "General Settings" on page 152 for details.

Eligible canvas items are as follows:

- Teacup Groups and Teacups
- Chart Groups and Charts
- Text Groups and Text
- Flow Line Groups and Flow Lines
- Canvas Line Groups and Canvas Lines

  Note: All items of these types will be shown on the specified workspace view; limiting or selecting certain items is not supported

Figure 6.24



When first added to either view, the items are placed in the bottom left of the workspace in an arrangement mimicking that of the output canvas. After they are added, each item may be dragged individually into place. The right-click context menus on the workspace view have the same options as though they were on the Output Canvas. This includes an option to **Configure** the item, which opens the **Output Manager Configuration** with that item selected.

> **Note:** All editing of Canvas Items is performed from the Canvas Configuration. Placement is performed on the workspace views.

For Flow Lines and Canvas Lines, the number of points and relative placement originally comes from the Output Canvas. But, from that point forward, the number of points and location is maintained separately for the Simulation View, Geospatial View and the Output Canvas itself. You can add, remove, or move points as necessary in each view. Thus, you can add more points to a flow line on the Geospatial View than on the simulation view to show more detail, as may be required by the map. All other configuration including colors, line widths, line types, etc are made on the Output Canvas.

In addition, when shown on the workspace, Animation controls are shown in a panel in the lower right part of the workspace. These provide controls to advance the timestep shown on the canvas items through time. See "Animation" on page 178 for details.



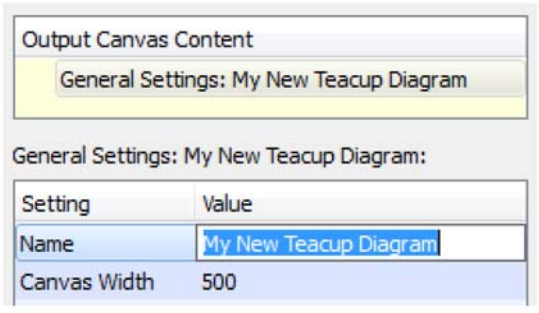
Instructions to Create a Teacup Diagram

Following are instructions to create a teacup diagram from scratch. These are the bare minimum instructions; you'll want to modify fonts, colors and label text to make the diagram look great.

1. From the **Output Manager** dialog menu, select the **New, then New Output Canvas.**

   In general, to create a new Canvas, select **General Settings**, then **Canvas Layout** to define what you want to have in the Canvas. Select **Selected Item Settings** to configure each item in the Canvas.

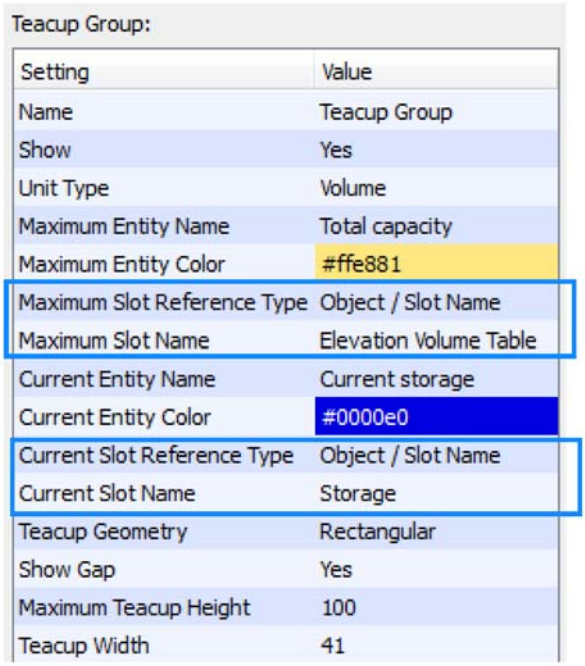
2. In the **General Settings**, specify the **Name**.



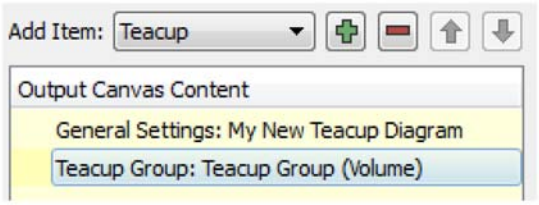
3. Add a **Teacup Group** by selecting it from the **Add Item** menu and selecting **+**.



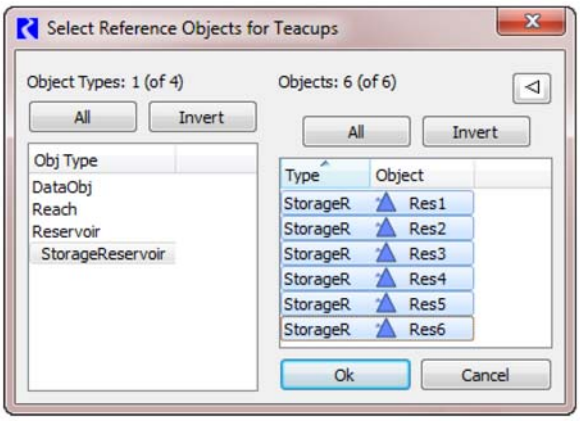
4. Specify the slots to use for the **Current Entity** and **Maximum Entity** by selecting **Maximum Slot Name**, **Reference Type**, **Current Slot Name**, and **Reference Type**.



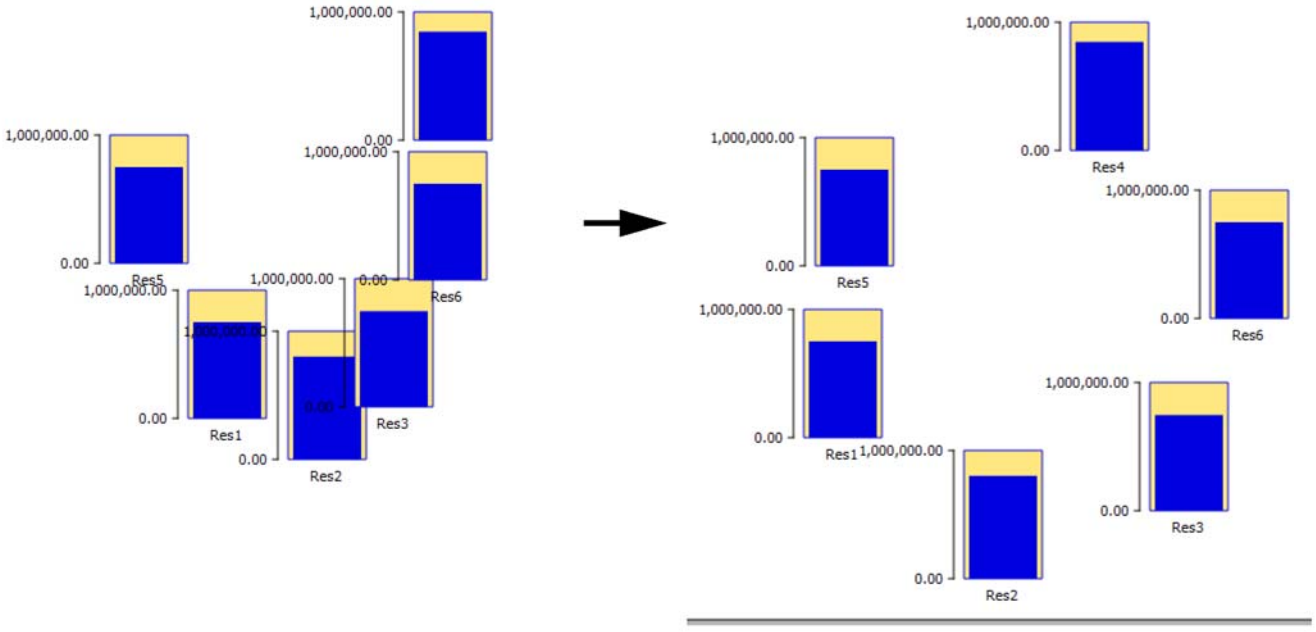
5. Specify the **Teacup Geometry** (rectangular or trapezoid) and whether you would like to **Show Gap** on the side of each teacup.
6. Add **Teacups** to the group. First select the Teacup Group, then select **Teacup** from the **Add Item** menu. Select **+**.



7. Select the objects you wish to use. Make sure to select all the objects you want. One teacup will be created for each object.

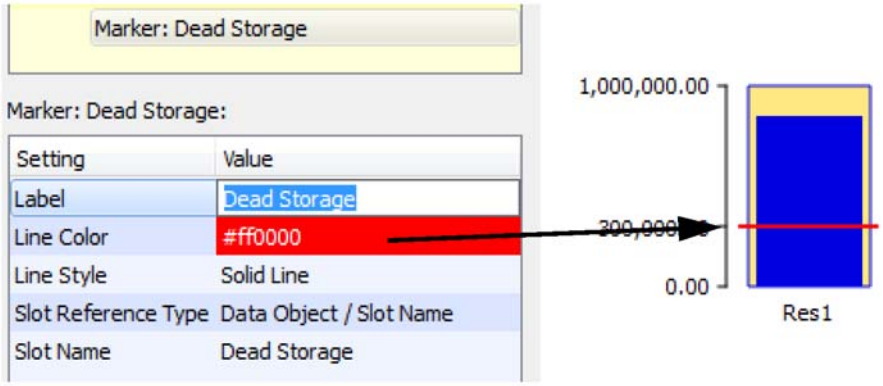


8. This will create a set of teacups and show them on the preview canvas. The initial placement uses the positions of the objects on the Simulation Workspace.On the **Canvas Preview**, drag the teacups to the desired location.



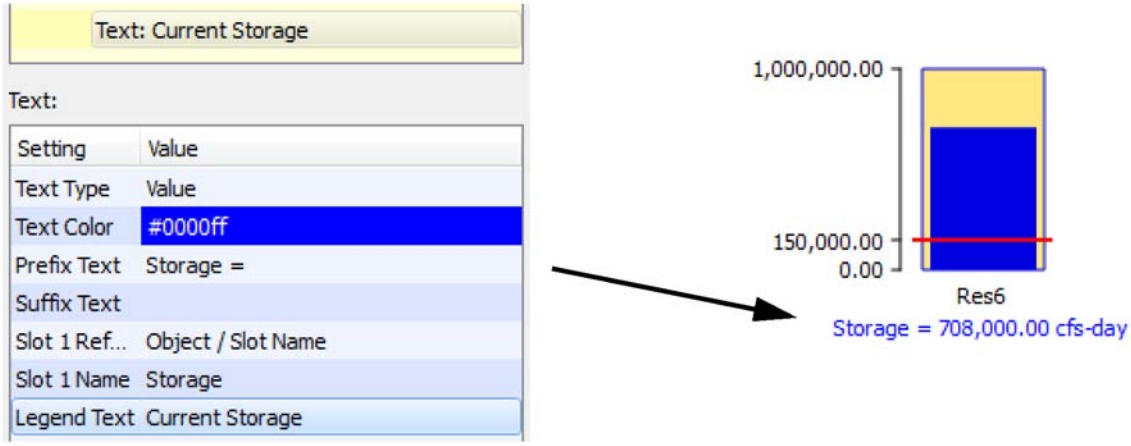
9. In the teacup group, modify the dimensions of the teacups. For rectangular teacups, specify the width of all teacups and the height of the largest teacup in the Settings panel. For trapezoids, specify the bottom width, maximum height, and top widths of the largest teacup. All other teacups will be scaled accordingly.
10. Add Markers to the Teacup Group: First select the Teacup Group, then select **Marker** from the **Add Item** menu. Select **+**.

11. Specify the Slot (series, scalar, periodic) to use for the marker and its location. Specify a better label if desired. This will be shown later on the legend.

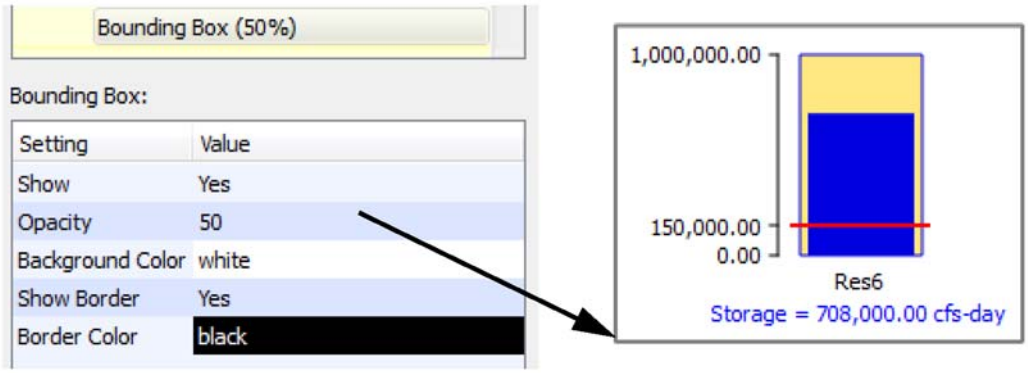


12. Add a Text item. First select the Teacup Group, then select **Text Item** from the **Add Item** menu. Select **+**.

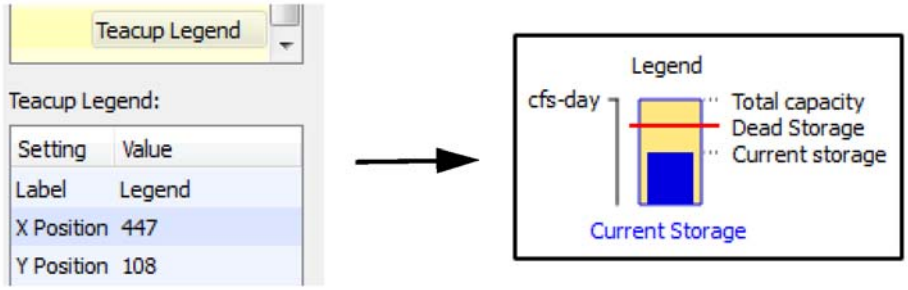
13. In the settings, specify the type of text. For this example, we will add text showing the current storage. Select **Value** for the **Text Type** setting. Specify the prefix, suffix, slot reference, slot name, and Legend Text.



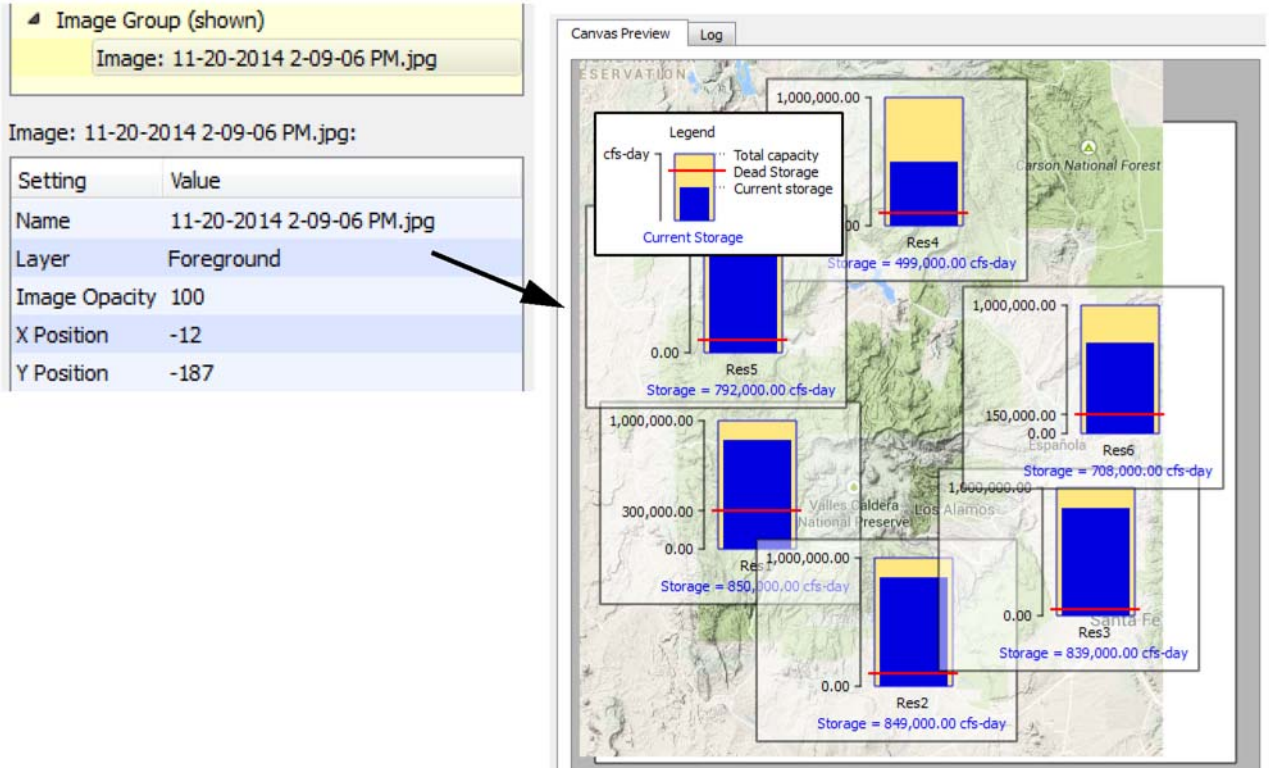
14. If desired, add a **Bounding Box** to the Teacup Group to create a border around each teacup. Select the Teacup Group, then select **Bounding Box** from the **Add Item** menu. Select **+**. Modify the colors or opacity if desired.



15. Add a legend so all of the units, markers, and text values are clearly annotated. Select the Teacup Group, then select **Teacup Legend** from the **Add Item** menu. Select **+**.



16. Add background images and foreground images if desired. Select the **General Settings**, then select **Image Group** from the **Add Item** menu. Select **+**. Select **Image** from the **Add Item** menu. Select **+**. A file chooser opens. Select the desired jpg or png file.



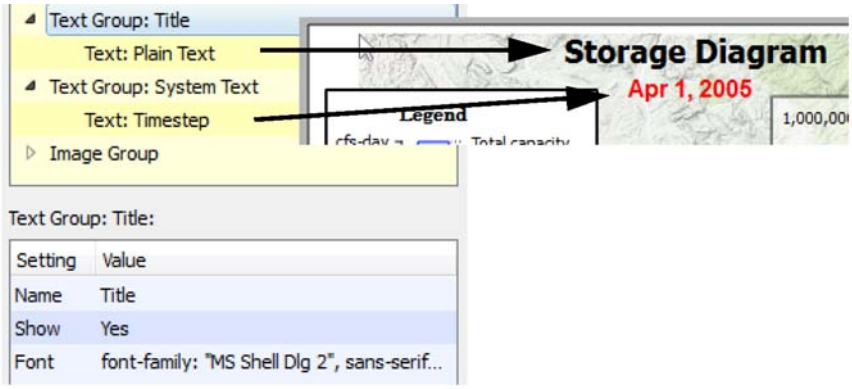
17. At this point, your teacups and images may not fit on the canvas. Following are some possible solutions:
    - Enlarge the canvas by selecting **General Settings** for width and height.
    - Shrink the teacups by selecting **Maximum Bar Height** in the Teacup Group settings.

    Then drag the teacups and images to fit them on the canvas as desired.

18. Add one or more Text Groups and free-standing Text Items. Use these to create a title, show the timestep, or show a system-wide summary variable. Add a **Text Group** by selecting it from the **Add Item** menu and selecting **+**. Specify the desired Font.

19. Add **Text Items** to the group. First select the Text Group, then select **Text Item** from the **Add Item** menu. Select **+**. Figure 6.25 shows two Text Groups that each contain one Text Item. The first is **Plain Text**, while the second is the **Timestep**.

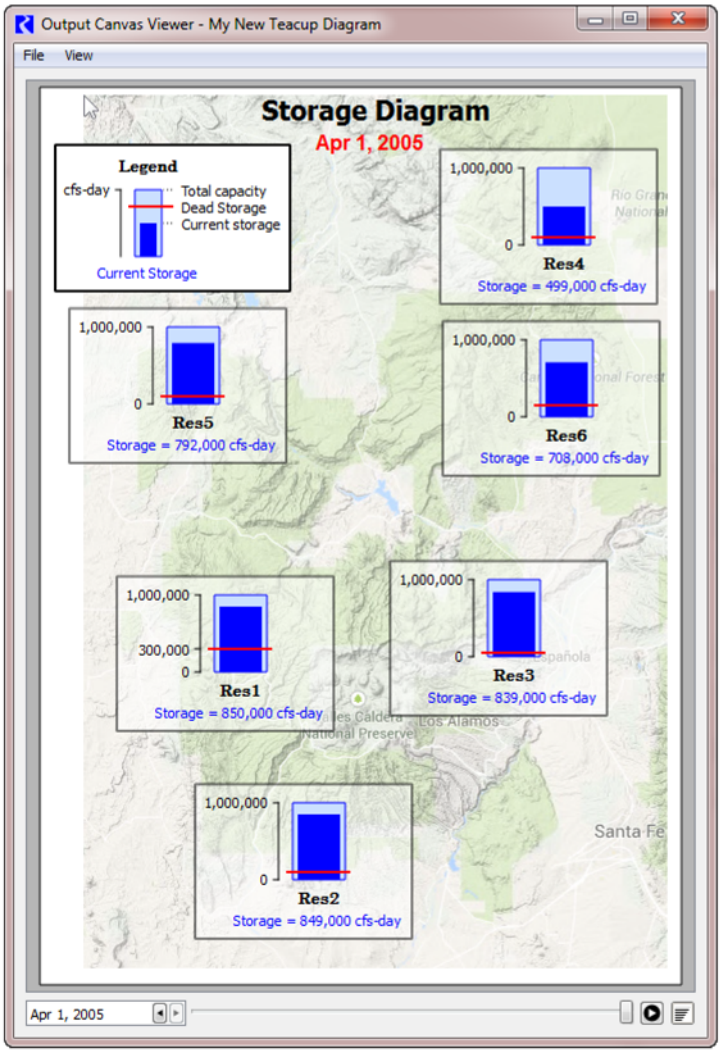
Figure 6.25



20. Modify the colors and fonts to make the canvas look pretty.

21. Select **OK** to save the canvas and then generate the device from the Output Manager. Use the animation controls to watch the teacups change through time. Figure 6.26 shows our result.

Figure 6.26

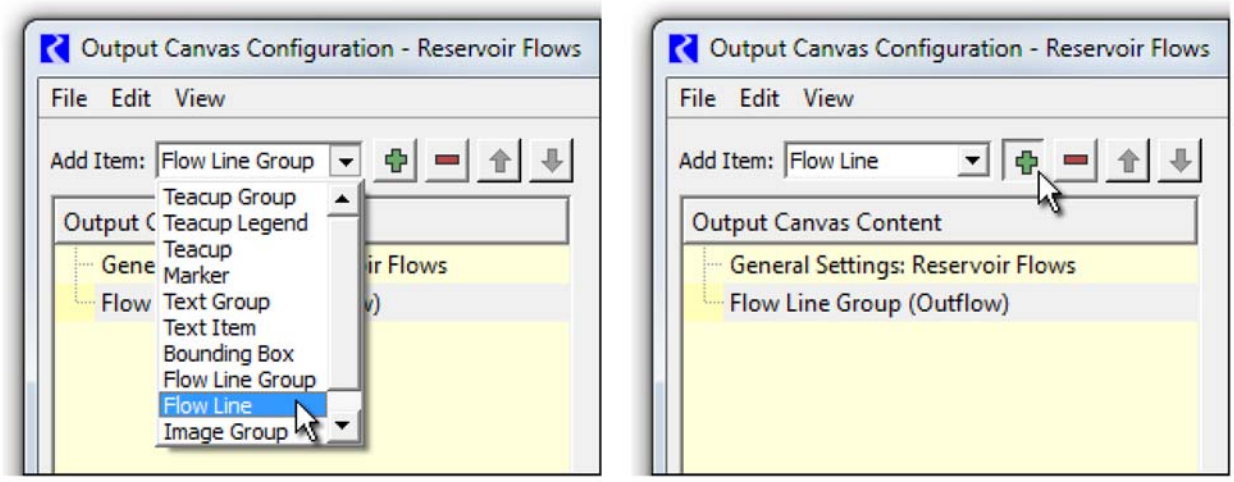


Instructions to Create a Flow Line Diagram

1. Create a new Output Canvas. See Step 1. and Step 2. in “Instructions to Create a Teacup Diagram” on page 184 for instructions.

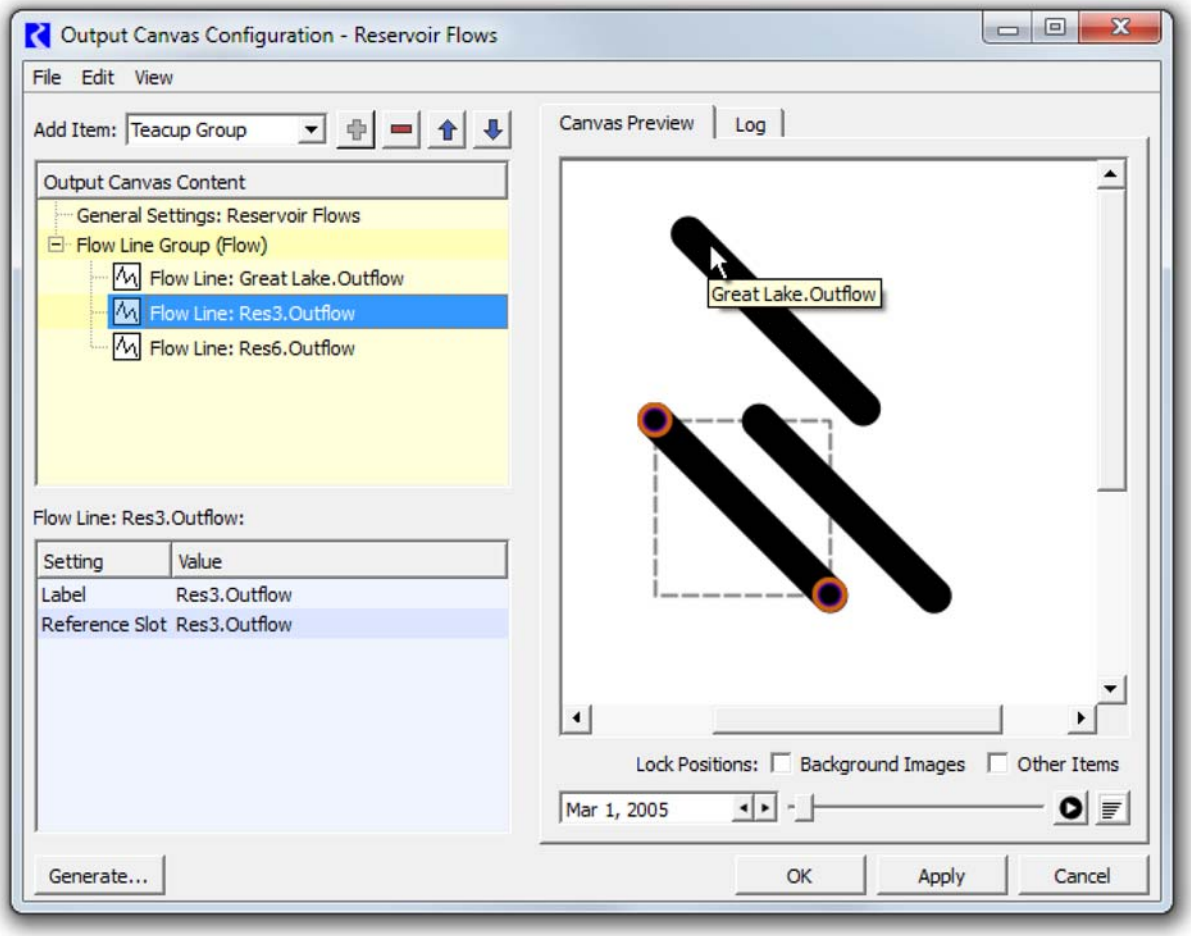
   Note: You can add flow lines to an existing canvas that also shows teacups, object icons, or other items.

2. With the **Flow Line Group** item selected, select **Plus** (**+**).



3. The slots associated with the flow lines within a flow line group must have the same unit type. Double-click the **Unit Type** value to show a unit type menu. Select the desired unit type; generally **Flow** will be appropriate (the default).
4. With the context menu on a Flow Line Group tree item: **Add Item**, then **Flow Line**.
5. Using the selector, select the slots representing the flow lines. Multiple slots can be selected at once and a flow line item will be created for each. They will place on the canvas at a heuristically devised location based on their location within the simulation view.
6. Select a flow line either in the Output Canvas Content tree or within the canvas preview to see the flow line's anchor points. The flow line may be repositioned by dragging the anchor points or the flow line itself.

Additional flow line points can be created, and existing points can be deleted, with right-click context menu operations on the flow line and flow line anchor points.



7. Select the **Flow Line Group** in the **Content** panel. In the settings panel, define the **Minimum** and **Maximum Thickness** and **Minimum** and **Maximum Value**.
8. Also for the group, define **Intervals**; see "Flow Line Color and Style" on page 171 for details.
9. Select each **Flow Line** in the group and provide a value for each **Threshold**. Remember **Threshold 1** is the lowest flow. Threshold 8 is the highest flow.
10. Optionally, add a Flow Line Legend to provide a key to the intervals and line thicknesses. See "Flow Line Legend" on page 159 for details.
11. Optionally add an Image (like a map) as a background or as supporting images.
12. Optionally add **Object Icons** and/or **Teacups** to provide context for your flow lines. Creating Object Icon Groups and then adding icons to it is analogous to creating Teacup Groups and adding teacups to it, but there is less configuration involved as Object Icons don't change over the run. This is described in the steps above.
13. Reposition any item as desired.

14. Add Text groups and text to annotate or label your flow lines, provide the timestep, and a title to your canvas. See Step 18. and Step 19. in “Instructions to Create a Teacup Diagram” on page 184 for instructions.

15. Select **OK** to save the canvas and then generate the device from the Output Manager. Use the animation controls to watch the flow lines change through time. Figure 6.27 and Figure 6.28 show completed sample flow line diagrams.

Figure 6.27

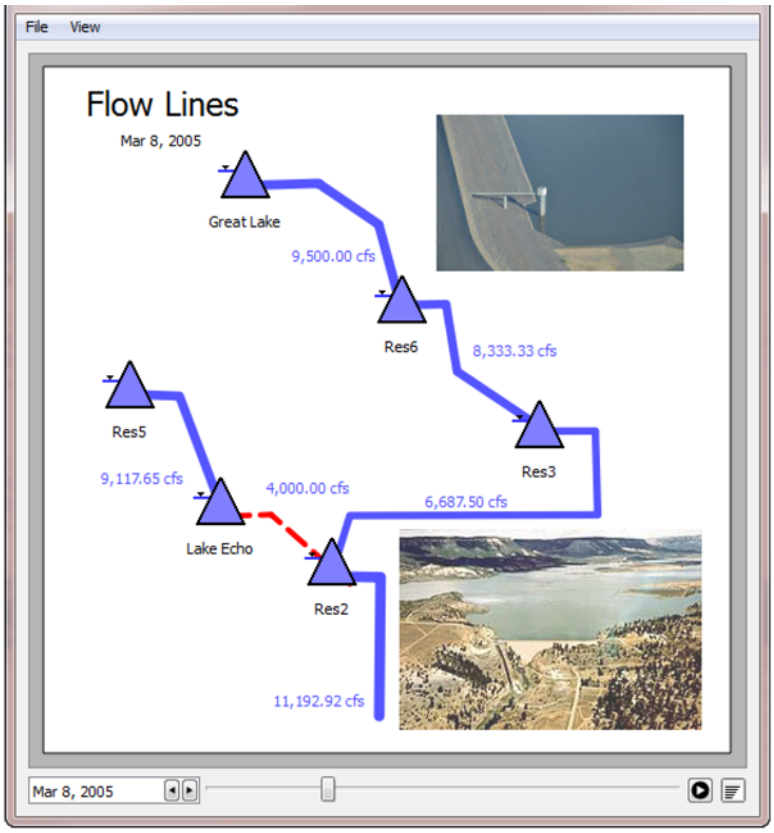
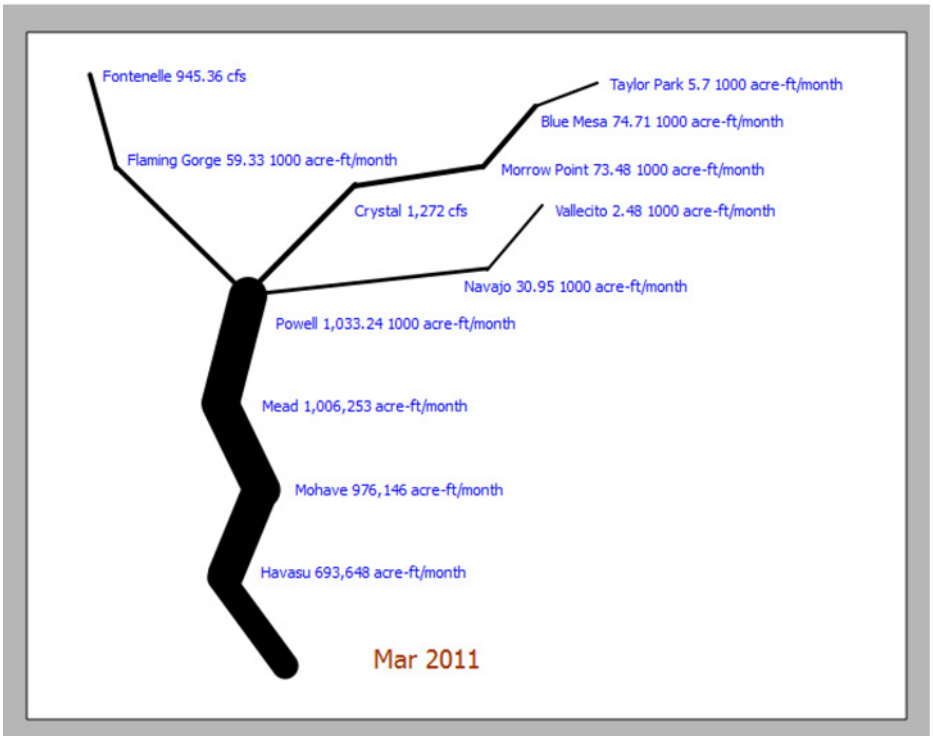


Figure 6.28


Fontenelle 945.36 cfs
Taylor Park 5.7 1000 acre-ft/month
Blue Mesa 74.71 1000 acre-ft/month
Flaming Gorge 59.33 1000 acre-ft/month
Morrow Point 73.48 1000 acre-ft/month
Crystal 1,272 cfs
Vallecito 2.48 1000 acre-ft/month
Navajo 30.95 1000 acre-ft/month
Powell 1,033.24 1000 acre-ft/month
Mead 1,006,253 acre-ft/month
Mohave 976,146 acre-ft/month
Havasu 693,648 acre-ft/month
Mar 2011

Chapter 7
Snapshots

A snapshot preserves a copy of a set of slots for a given run. These slots are saved on a special Data Object created by the Snapshot Manager. Snapshots are useful to examining the results of alternate scenarios as they are the primary way to preserve results between runs.

Topics

- About the Snapshot Manager, page 195
- Adding Slots, page 196
- Sorting Slots, page 196
- Taking Snapshots, page 196
- Naming and Viewing Snapshots, page 197
- Viewing Data Membership in Snapshots, page 197
- Plotting Snapshot Slots, page 198

About the Snapshot Manager

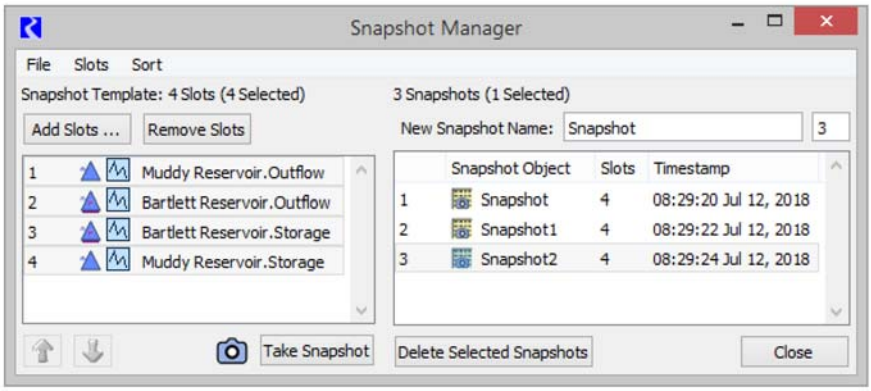
The Snapshot Manager is used to specify the slots of interest and take snapshots of their values after a run. The slots and the snapshots of the slots are listed in the Snapshot Manager so that the saved data can be retrieved. Data saved in the snapshots are available in all of the output formats described earlier in this chapter.

The Snapshot manager is opened by selecting **Utilities, then Snapshot Management** or selecting **Snapshot** from the main RiverWare menu.



The **Snapshot Manager** has two scrollable lists. The left list, the **Snapshot Template** holds the slot names for which snapshots are made. The right list holds the names of the created snapshots, the number of slots in that snapshot and a time stamp indicating when it was created. Above these lists are buttons for adding slots to and

deleting slots from the Snapshot Template and a field to specify the default name used when creating a new snapshot. Generally, each snapshot corresponds to a run, and holds the values of those slots as read-only data.



Adding Slots

Slots to be stored in a new Snapshot are added to the **Snapshot Template:** list by selecting **Add Slots** and then using the Slot selector. Slots that exist in previous snapshots will also be listed in the **Snapshot Template** list.

Sorting Slots

The slots in the **Snapshot Template** list can be sorted by various attributes. From the **Sort** menu one of the following:

- Slot Name
- Slot Type
- Account Name
- Account Type
- Object Name
- Object Type

In addition, the user can configure a sorting order and "save" that order. Select a slot and then select the **Up**  and **Down**  arrows to move the slot in the list. When you have ordered all slots as you would like, select **Sort,** then **Accept New Sort Order** to preserve this ordering. If you wish to return to this sort order after sorting by different attributes, select **Sort Slots by Active Order**.

Taking Snapshots

Taking a snapshot means saving the current values of the slots in the **Snapshot Template:** list. To take a snapshot, select **Take Snapshot** in the **Snapshot Management** dialog. The name of a new snapshot appears in the **Snapshots:** list of the **Snapshot Management** dialog.

Naming and Viewing Snapshots

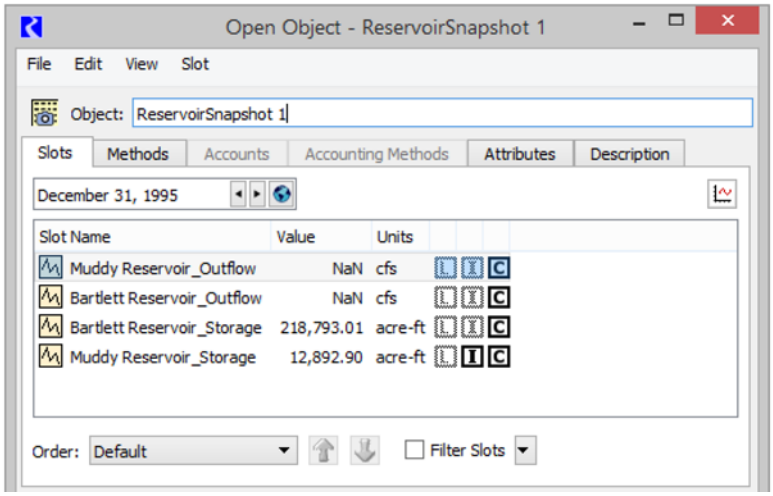
The new snapshot is, in fact, an object on the workspace. The object contains slots which hold the current values of the slots included in the snapshot. When a snapshot is created, a Snapshot object is usually added to the bottom of the workspace and given a default name: **Snapshot**#, where the # is a unique identifier. Before creating a snapshot, however, the user can specify the default name by revising the text displayed in the New Snapshot Name field on the right side of the Snapshot Manager. The name will then be `<User-Specified-Text>#`.

- A Snapshot object is represented by an icon similar to a Data Object with a camera.



- Snapshot objects are opened in the normal way by double-clicking the icon. Like other objects, a snapshot can be renamed as desired. Remember to type <Return> after entering a new name. Figure 7.1 shows an open snapshot object

Figure 7.1



In addition, double-clicking the name of the snapshot in the Snapshot Management dialog opens the object directly. The flags in the slots match the flags in the original slot from which the snapshot was taken. The values in the snapshot slots are read-only, and displayed with crosshatching over the values.

> **Note:** Snapshot slots maintain the same display attributes (units, scale, precision, and format) as their source slot. If you wish to change units of the snapshot slot, you must change the units of the source slots (either from the slot configuration or from the Unit Scheme).

Viewing Data Membership in Snapshots

Since it is possible to add slots to the **Snapshot Template** list at any time, it is useful to see which slots appear in which snapshots. If you highlight a slot in the **Snapshot Template** list in the Snapshot Manager, the corresponding snapshots that contain this slot are highlighted in the **Snapshots** list.

Plotting Snapshot Slots

Any slot in a snapshot object can be plotted like any other slot. In addition, when you have the original slot plotted, there are easy ways to plot the associated snapshot slots. See "Adding Associated Snapshot Curves" on page 48 for details.

Chapter 8
Scenario Management

The Scenario Manager allows editing of a small portion of a RiverWare model without affecting the integrity of a baseline model. With the Scenario Manager, the values of a subset of slots can be altered independently of the baseline model. Models can be viewed and run using these various scenario values without corrupting the values in the baseline model. The Scenario Manager provides a convenient interface to load, edit, and save values for these slots, run the model using these different slot values, and compare the baseline values with the scenario values.

Topics

- About Scenario Management, page 199
- Baseline Model Creation, page 200
- Creating, Editing, and Running Scenarios, page 208
- Saving Scenario Runs, page 218

About Scenario Management

This section describes the basic features of the Scenario Manager and how to construct scenarios.

- If you are creating a scenario baseline model, see "Baseline Model Creation" on page 200.
- If you are a stakeholder and want to make scenario runs, see "Creating, Editing, and Running Scenarios" on page 208.

Scenario Management Terms

The following terms are used when describing scenario management.

Creator / Baseline Developer

The user who transforms a regular model into a Baseline model. This user selects the slots that will be changed and the slots to compare. He/she makes the baseline model run.

Scenario User / Stakeholder

The user(s) who loads a baseline model, creates a scenario, and runs the scenario. This is typically a stakeholder who wishes to run the model in a controlled fashion.

Baseline model

A model that cannot be directly edited by a user. A scenario user can apply different scenarios to a baseline model, but they cannot edit the data in the baseline model directly.

Scenario input slot list

The set of slots that can be edited. This is defined by the initial *creator* of the baseline model and cannot be edited other than changing values by scenario users.

Scenario output slot list

The set of interesting output slots. This is defined by the initial creator of the baseline model and cannot be edited.

Scenario

Alternative data for slots in the scenario input slot list which can be loaded into the model in order to perform model runs.

Baseline Model Creation

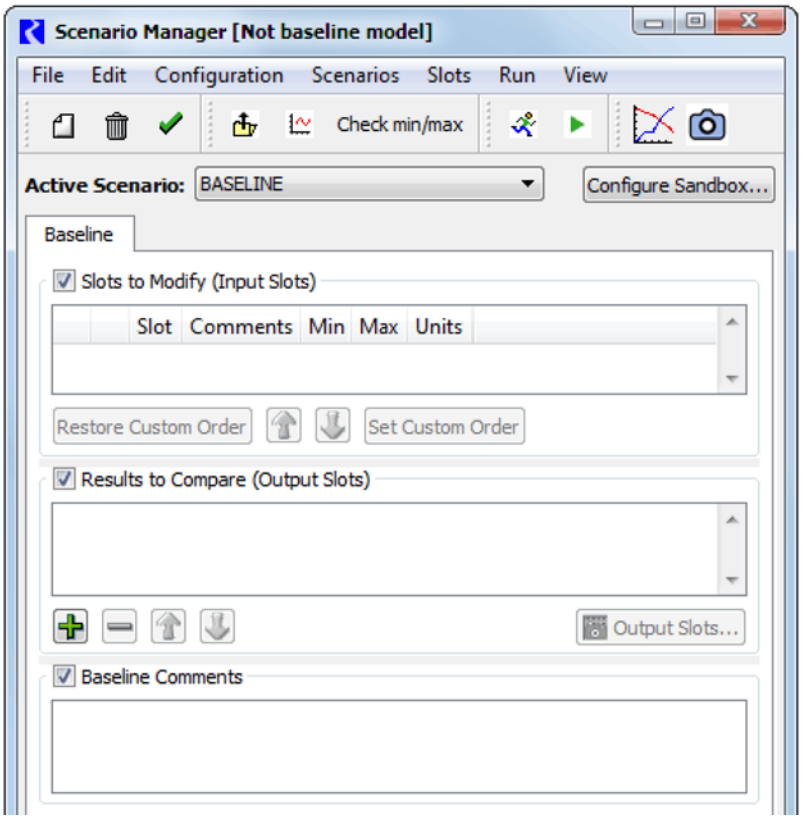
A baseline model must be created before any scenarios can be developed. The baseline model is generated by saving an existing model, with or without a ruleset, as a baseline model. Once a model has been saved as a baseline model, model topology, methods, rulesets, and non-scenario slots become protected from editing. The baseline model cannot be re-saved once it is created unless it is resaved as a non-baseline model. To maintain the integrity of the baseline model, we do not recommend re-saving the model as non-baseline. Following are the steps to create a baseline model from a regular model; these steps are described in detail in the remainder of this chapter:

1. Open a regular model and optionally the ruleset. Open the Scenario Manager.
2. Select the list of Slots to Modify (Input Slots).
3. Select the list of slots that represent the Results to Compare (Output Slots).
4. Enter Baseline comments.
5. Optionally create a Scenario Sandbox.
6. Run the model.
7. Save as Baseline.

Open a Model, Ruleset, and Scenario Manager

To create a baseline model, open the desired model (and ruleset). Open the Scenario Manager from the **Utilities**, then **Scenario Management** menu on the main RiverWare menu.

This will open the Scenario Manager dialog. At this point, the dialog is empty because no slots have been specified. The title bar of the Scenario Manager says "[Not baseline model]" because no baseline scenario slots have been specified or saved.

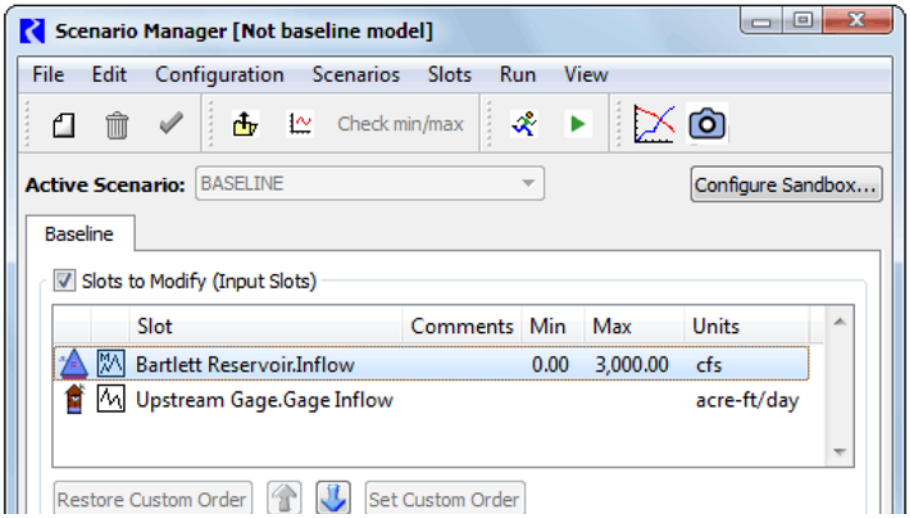


Specify Slots to Modify (Input Slots)

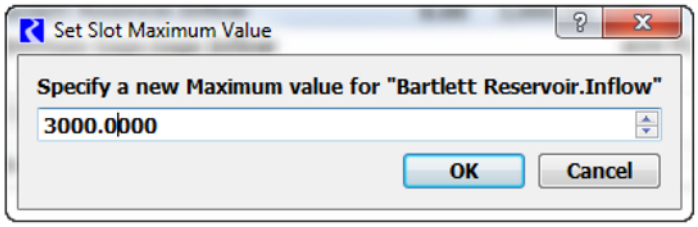
You will need to decide which slots are key to generating different scenarios. This subset of slots will be the only slots that scenario users are allowed to modify values or data to test various scenarios against the baseline scenario. To add the slots that form the baseline scenario select **Configuration**, then **Add Input Slots**.

Use the selector to choose the Scenario Input Slots. The added slots appear under the Slots to Modify (Input Slots).

As creator of the baseline, you can specify a minimum or maximum (or both) value that the slot is not allowed to violate in any scenario.



To specify a minimum or maximum slot value, highlight the slot and select **Configuration**, then **Set Min Value** or **Configuration**, then **Set Max Value** from the menu bar. A dialog window will appear. Enter a value and select the **OK** button. You can also use the **Configuration**, then **Compute Min/Max Values from Baseline Slots** to give you the existing bounds. Once this value is set, it cannot be altered by scenario users.



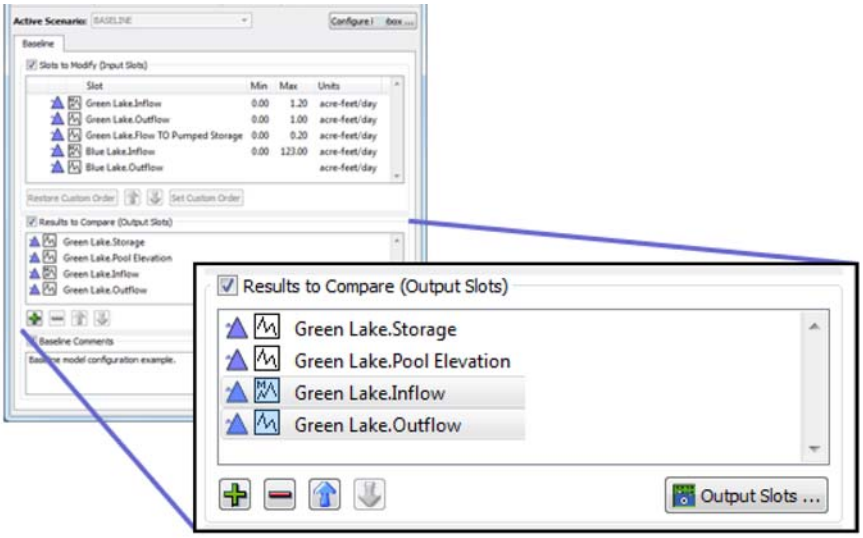
Comments can also be added to the individual slots in the comment field to the right of the slot name and to the scenario in the scenario comment field. To enter a slot comment, highlight the desired slot and single select the **Comment** field next to the slot name. A text cursor will appear. Enter the desired comment.

The list of slots can be ordered in several ways. The current ordering of slots is saved with the model.

- To sort the slots by slot name, object name, slot type (series slot, table slot), and subbasin membership select the **Slots** column header at the top of the slots list. Sorting by subbasin is based on an alphabetized list of the user-defined subbasins which the slot is a member of.
- To sort the slots by the comments, minimum, or maximum values select the appropriate column header at the top of the slots list.
- To specify a custom slot order, highlight a slot and use the up and down arrows.

Specify Results to Compare (Output Slots)

Next, specify which output slots you would like to compare against the baseline and other scenarios. When a scenario run is made, a snapshot will be taken of each of these slots. Define the list of slots in the Results to Compare (Output Slots) slot list. This list is saved in the baseline model and is not modifiable by the stakeholder.



The green  button shows the general slot selector to pick more slots for this list.

The red  button removes the selected slots from this list.

The blue   arrow buttons move the selected slot items up or down within the list. The order of the slots in the list will be the default order of slots within generated Scenario Output Snapshot Objects.

The **Output Slots** button  opens the BASELINE snapshot object which is automatically generated at the completion of a non-scenario run. This button is enabled only when that snapshot object exists within the workspace. If it is not enabled, make a run.

Enter Baseline Comments

To enter the baseline scenario comment, single select the **Baseline Comment** field and enter the desired text.

Create a Scenario Sandbox (Optional)

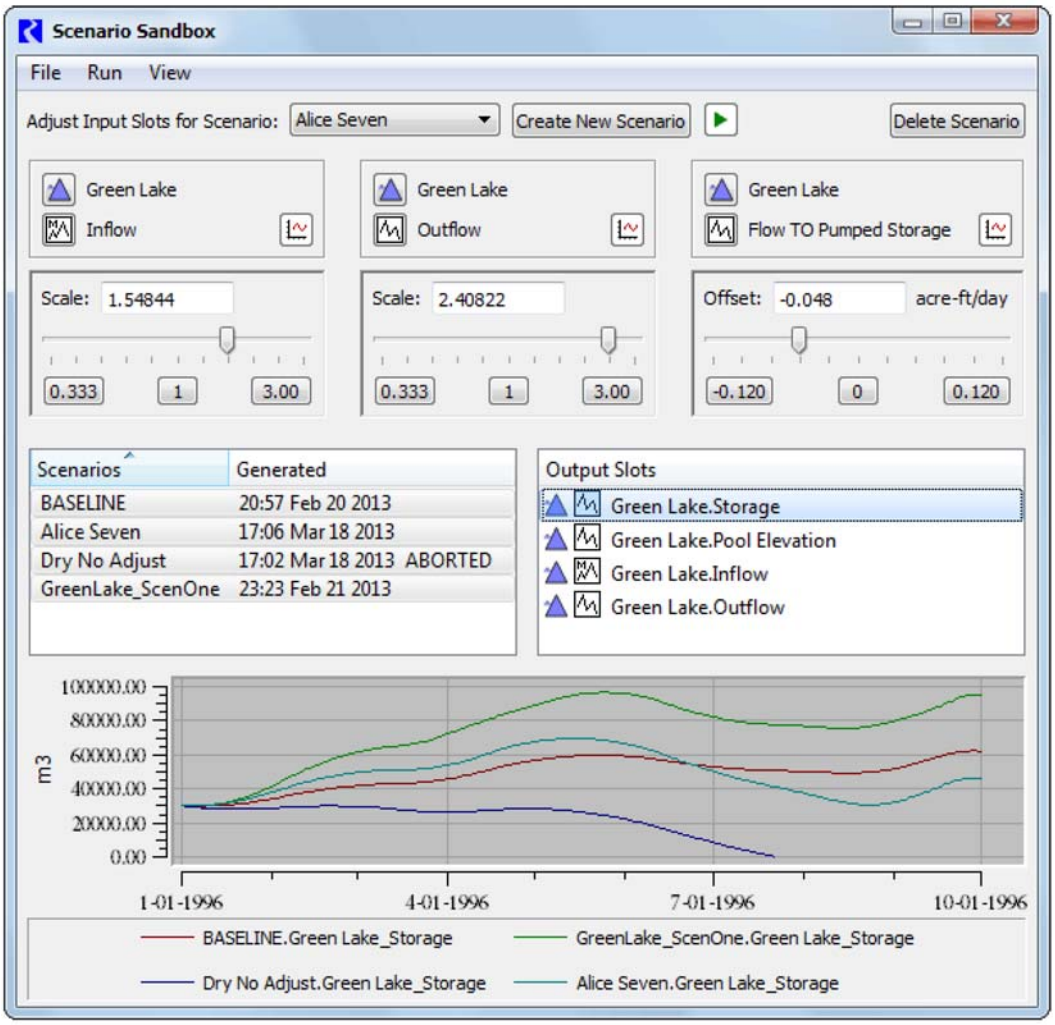
A Scenario Sandbox provides a convenient way for the scenario users (i.e. the stakeholders) to easily create and run scenarios and view results.

The configuration of the sandbox is defined by the baseline creator (i.e. scenario engineer) and the scenario user cannot change the configuration. The current implementation of the Scenario Sandbox supports the following functionality:

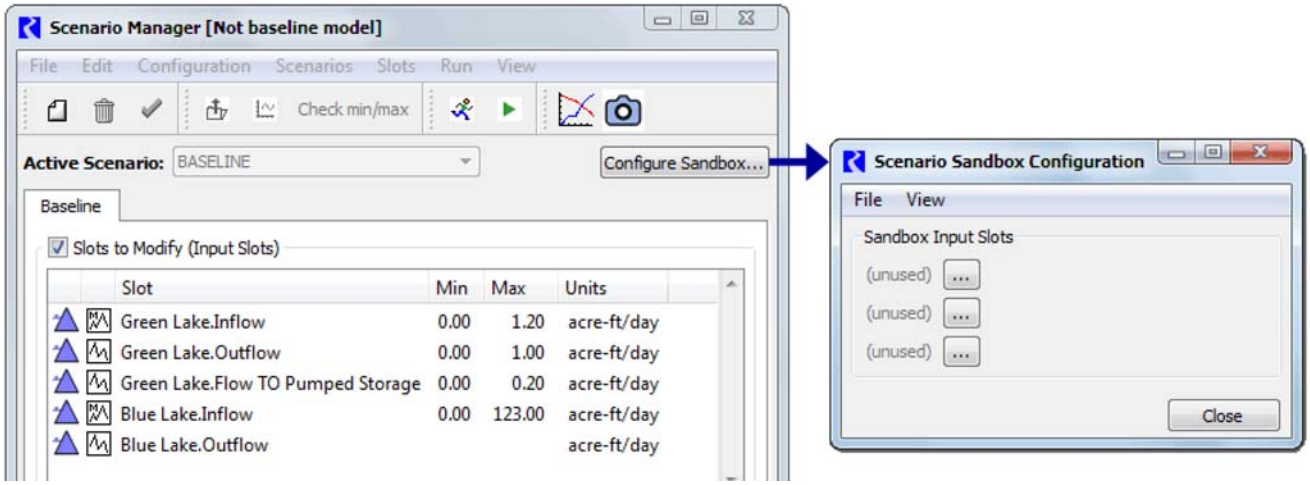
- A single sandbox configuration can be defined within a baseline model.
- Up to three input scenario slots can be adjusted by the stakeholder. Only series slots are supported.
- Slider controls are available to adjust the values of each of the three input scenario slots. Supported transformations from the baseline series values are as follows:
  - Scaling: Multiplying by a factor
  - Offsetting: Adding a positive or negative term specified in the display units for the slot
- The adjusted (scaled or offset) scenario values are automatically *clipped* at these minimum and maximum, if they are defined.
- Plotting of scenario output slots is shown in a plot panel within the sandbox. For a single selected slot among a set of scenario output slots, the plot panel shows the baseline series plus the generated scenario outputs for one or more selected scenarios.

Figure 8.1 shows a sample completed sandbox.

Figure 8.1


Scenario Sandbox
File
Run
View
Adjust Input Slots for Scenario:
Alice Seven
Create New Scenario
Delete Scenario
Green Lake
Inflow
Green Lake
Outflow
Green Lake
Flow TO Pumped Storage
Scale: 1.54844
0.333
1
3.00
Scale: 2.40822
0.333
1
3.00
Offset: -0.048
acre-ft/day
-0.120
0
0.120
Scenarios
Generated
BASELINE
20:57 Feb 20 2013
Alice Seven
17:06 Mar 18 2013
Dry No Adjust
17:02 Mar 18 2013 ABORTED
GreenLake_ScenOne
23:23 Feb 21 2013
Output Slots
Green Lake.Storage
Green Lake.Pool Elevation
Green Lake.Inflow
Green Lake.Outflow
m3
1-01-1996
4-01-1996
7-01-1996
10-01-1996
BASELINE.Green Lake_Storage
GreenLake_ScenOne.Green Lake_Storage
Dry No Adjust.Green Lake_Storage
Alice Seven.Green Lake_Storage

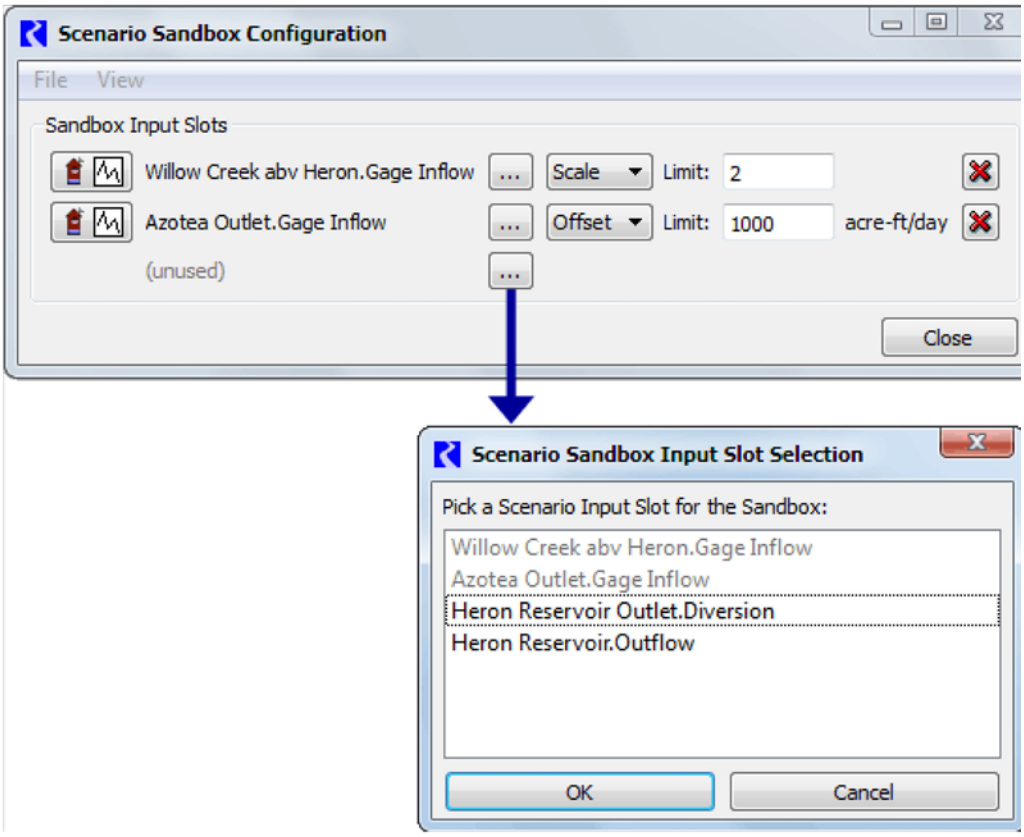
Use the **Create Sandbox** button in the Scenario Manager (available only in non-baseline models) to create a sandbox.



Configure the Scenario Sandbox by selecting up to three scenario input slots to be adjusted by the stakeholder in the sandbox. The configuration for each of these three slots consists of the following:

- **Adjustment Mode**. Whether the slot values are adjustable by *scaling* (multiplying by a factor) or by *offsetting* (increasing by a negative or positive amount).
- **Limits for the adjustment parameters**. These correspond to extreme ends of a slider control. The manner in which these limits are defined is devised such that the slider's mid-point represent no change.
  - For scaling factor values, an upper limit (greater than 1.0) is specified; the lower limit will be the reciprocal of the upper limit.

– For offset term values, a positive upper limit is specified; the lower limit will be the negative of the upper limit.



Note: When a scenario input slot has been included in a sandbox configuration, its values are no longer directly editable, e.g. in its Open Slot dialog or an SCT. (Such slots' values will be "read-only" in those dialogs). This is necessary because the values of such a scenario input slot are *computed* using a linear function on its corresponding baseline slot. However, for individual scenarios within the RiverWare session, the sandbox adjustments can be disabled so that all Scenario Input Slots can be modified in the conventional way.

Run

After configuring the Scenario Manager and the Scenario Sandbox, it is critical that you run the model. This generates the BASELINE output and a new snapshot object is created. These are the data against which all scenario results are compared.

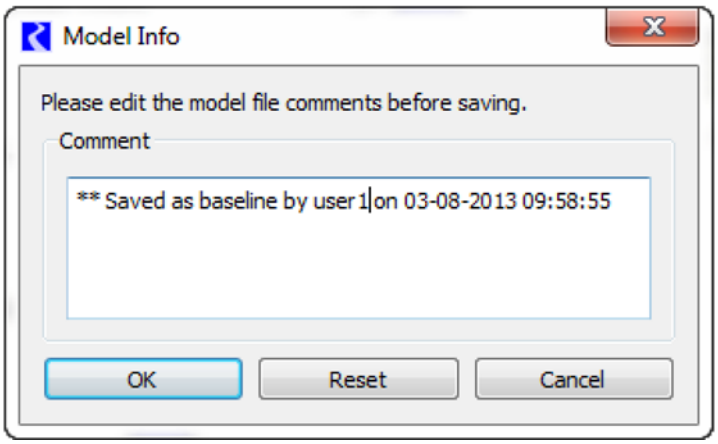
Note: To reiterate, run the model.

Save as Baseline

When you are finished with the configuration, save the entire RiverWare model as a baseline model. This will preserve the baseline scenario slots in the Scenario Manager and ensure that other users are not able to modify the model further, unless they specifically resave the baseline model as non-baseline.

- To save the model as a baseline model, select **File**, then **Save As Baseline** from the main RiverWare menu bar. This will preserve the scenario slot list and all configurations in the Scenario Manager.

To help document the baseline model, you will be prompted with the Model File Info dialog. A comment about the date, time, and username saving the model as a baseline is added to the end of the comment by default. This comment field can be freely edited by the user before saving the model as a baseline.



Once the model has been saved as a baseline model, "[Scenario: BASELINE]" will appear next to the model name in the main RiverWare workspace. The Scenario Manager will also indicate that the model has been saved as a baseline model.

You can now distribute the model to stakeholder scenario users.

Creating, Editing, and Running Scenarios

After the creation of a baseline model, no slots can be added or deleted from the scenario slot list. This is done to preserve the integrity of the baseline model.

> **Note:** From this point forward, this document assumes you are a scenario user (i.e. a stakeholder) and you are making scenario runs.

You have the following options:

- Use a sandbox (if configured) to define and make scenario runs and compare results (easiest option, but limited controls). A sandbox has been configured if the **Scenario Sandbox** button appears on the bottom of the main RiverWare workspace. See "Scenario Sandbox" on page 209 for details.



- Configure the scenarios yourself. Then run and compare results yourself (harder option, but more controls). See "Full Control of Scenarios" on page 214 for details.

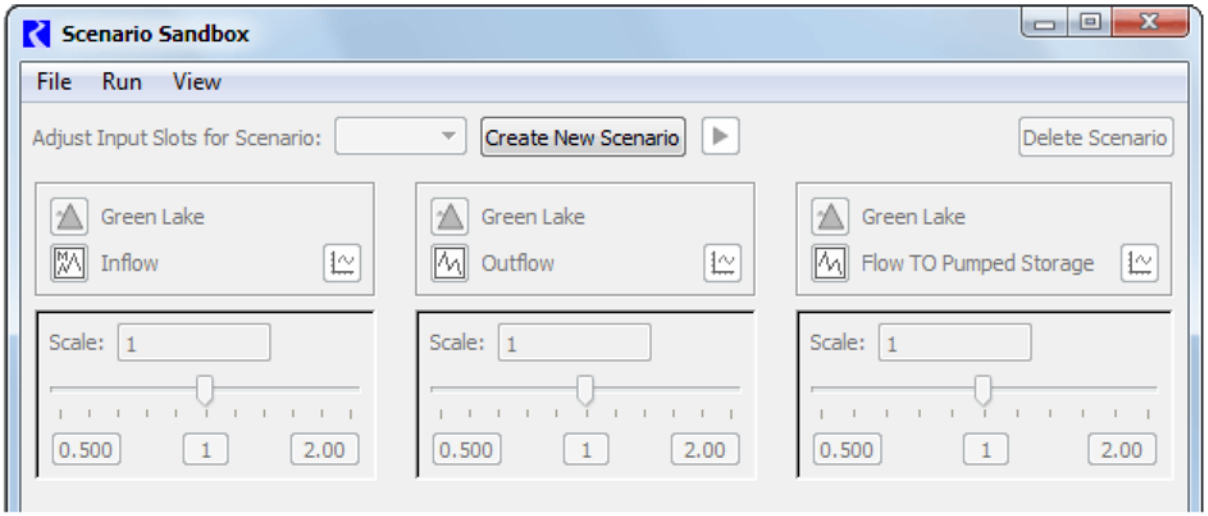
Scenario Sandbox

The Scenario Sandbox is accessible from the RiverWare Workspace and from the Scenario Manager. If a Scenario Sandbox has been configured,

- A Scenario Sandbox button appears on the Workspace's status bar, as shown above
- On the workspace, the **Utilities**, then **Scenario Sandbox** menu item is shown.

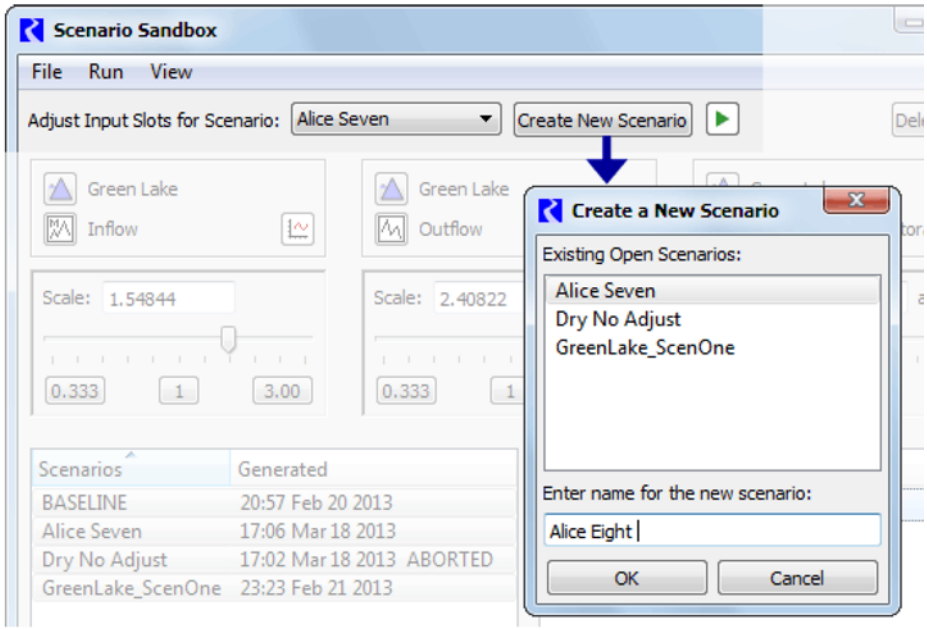
Scenario Sandbox Controls Overview

The Scenario Sandbox presents all the functionality necessary to create and run a scenario within a baseline model.



Create a new scenario

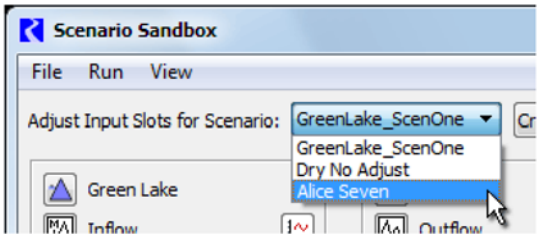
Select the **Create New Scenario** button and enter a new name for the scenario.



Open an existing scenario

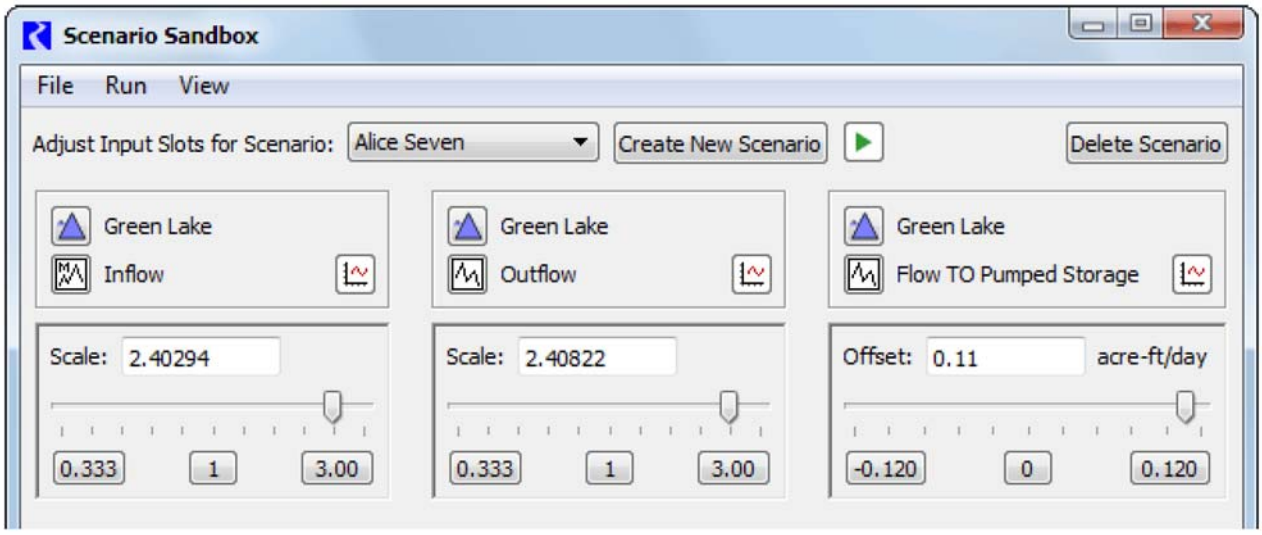
Use the **File**, then **Open Scenario** menu to open an existing, previously saved scenario.

You switch between opened scenarios using the pull-down menu.



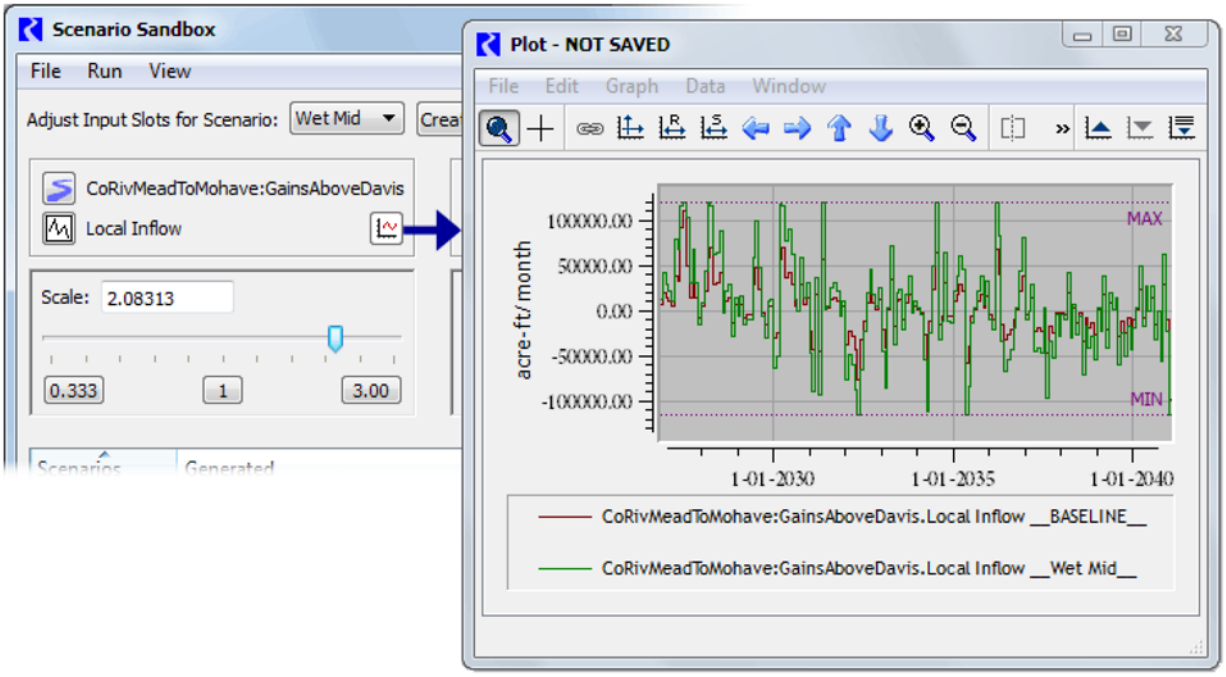
Scenario Sandbox Input Adjustment Controls

Next adjust values using the sliders for up to three scenario input slots. Changes to the sliders effect those input slots of the currently selected scenario.



Each input slot panel contains the following controls:

- Slot Name, including type icons and names of the containing object and the slot.
- A plot button to show a plot dialog with both the adjusted scenario slot values and its baseline slot values. If minimum and/or maximum limits are configured for the scenario slot, those limits are shown as horizontal markers in the plot.



- A slider panel, of either the scale or offset type. Each includes the following:
  - A numeric field showing the value of the current slider position. The field is directly *editable*; editing the value sets the position of the slider.
  - A horizontal slider control.
  - Three numerically labeled buttons. See description below.

The Scale sliders are exponential. The range is based on the upper value set by the scenario engineer. The lower limit of the range is the *reciprocal* of the specified upper value. The mid-point is always "1", which results in no difference from the baseline slot values.

> **Note:** Although the scale slider bar's positions are interpreted exponentially, the slider's tick marks are evenly spaced.

The Offset sliders are linear, and range from the negative value to the positive value of the adjustment limit value set by the scenario engineer. The midpoint is always zero, which results in no difference from the baseline slot values. The Offset values are in the slot display units.

> **Note:** Offsets are applied in user-units; therefore, in the case of irregular time units, such as acre-feet per month, the adjustment to the underlying standard values (e.g. cms) is different depending on the month or year in which the timestep occurs.

The computed scenario slot values are *clipped* at the configured minimum and maximum values for the baseline slot, if those have been configured.

> **Note:** This is not considered an error condition.
>
> **Note:** These minimum and maximum values should not be confused with the adjustment limit values which apply to the *coefficients* of the linear adjustment transform function. These minimum and maximum values are applied to the *results* of that function.

Scenario Sandbox Output Plot Controls

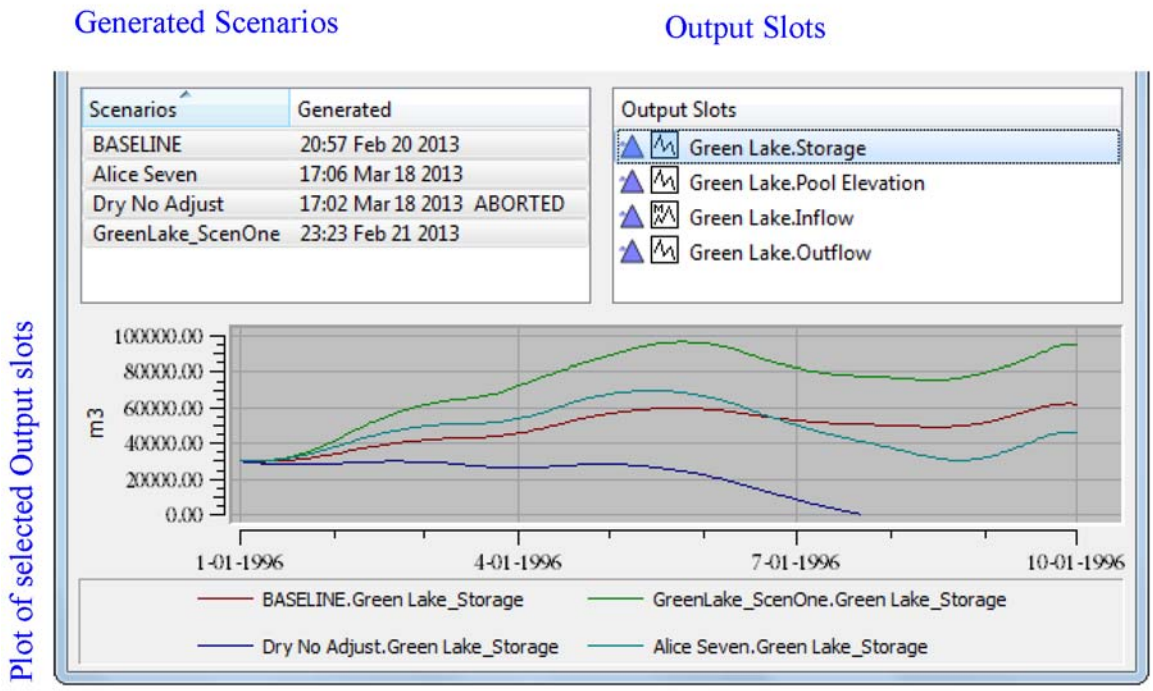
The bottom section of the Scenario Sandbox shows generated scenario results (outputs). Output controls consist of three components:

- A list of the generated scenarios.
- A list of the sandbox's scenario output slots.
- A plot of the selected slots for each scenario selected.

The plot is dynamically updated as the selections in the two lists are changed. A curve is shown for each of the selected scenarios' value of the single selected output scenario slot. A curve for the baseline slot is always shown.

Only scenarios for which a scenario snapshot object has been generated are shown with a "Generated" timestamp. Double-clicking an item on the Generated Scenarios list shows the Open Object Dialog for that snapshot. Figure 8.2 illustrates.

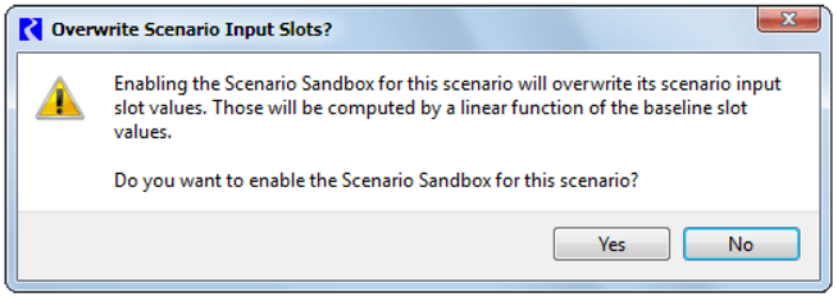
Figure 8.2



Once a new scenario has been created, it must be saved. Use the **File**, then **Save Scenario As** and save the scenario in the desired directory. This can be loaded into subsequent BASELINE model runs for additional analysis.

Disabling the Sandbox

For any particular scenario, full editing of Scenario input slots can be made available by unchecking the checkbox to the left of the Sandbox button on the Scenario Manager. When re-enabling the Sandbox for a scenario, if doing so would effect the values of those input slots, this warning message popup is displayed, providing the option to keep the Sandbox disabled (and preserve the scenario's input slot values).



Full Control of Scenarios

When a sandbox is not configured or you would like to change more than 3 input slots, you can create a scenario and have more control over the inputs. New scenarios to test permutations of the model can only use the slots specified in the scenario slot list, and all input values must fall within the minimum or maximum constraints (if any) set on the slot.

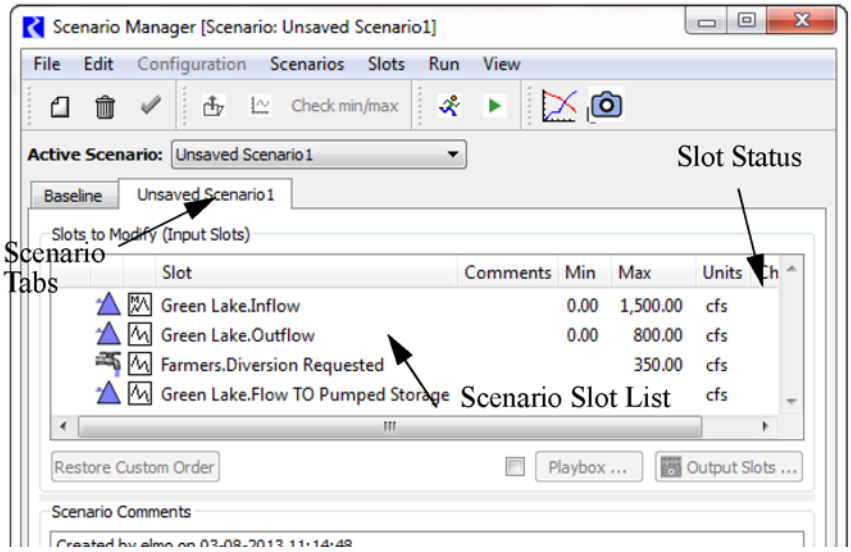
- To create new scenarios, select **Scenarios**, then **New Scenario** from the Scenario Manager menu bar or select the **New Scenario** button. 

A tab with the name of the new scenario will be added next to the baseline tab in the Scenario Manager. Selecting the tabs allows you to toggle between the baseline scenario and other scenarios.

The name of the scenario corresponds to the scenario file's name. A newly created scenario will have the default name "Unsaved Scenario."

- To change the name of a scenario:

  Select **File**, then **Save Scenario As** from the Scenario Manager menu bar. This will add an additional line to the Scenario Comments field indicating the new name of the scenario file.

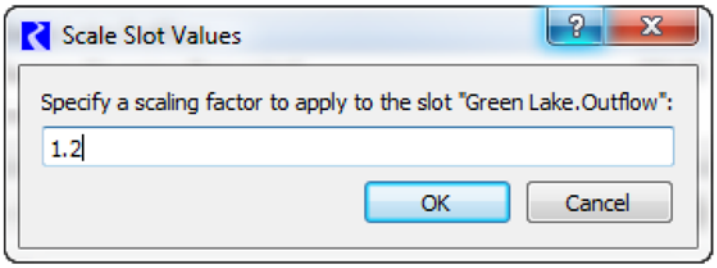


- To input new values into a slot in the scenario slot list and create model permutations:

  Highlight the slot to which you wish to input values and double select the slot name, select **Slots**, then **Open Slot**, or select the **Open Slot** button in the Scenario Manager toolbar. 

  This will bring up the open slot dialog window. You can then import a data file or enter new values by hand for select timesteps or the entire timeseries. Once the slot values have been altered, "Yes" will appear in the slot status Changed field of the Scenario Manager.

- To scale all the values on a slot, select **Slots**, then **Scale Slot**. The values in all the rows and/or columns in the slot will be multiplied by the given scaling factor.



- To restore a slot's values to the original baseline data, select **Slots**, then **Fill With Baseline Values**.
- To ensure that the values entered fall within the minimum or maximum constraints set on the slot, select **Scenarios**, then **Check Min/Max** or select the **Check Min/Max** button. 

  A dialog window will appear, indicating whether or not the new scenario contains valid values.

  Once a new scenario has been created, it must be saved. The first time a scenario is created, it must be saved with the **Save Scenario As** option. Subsequent saves can use the Save Scenario option.To save a new scenario:

- Select **File**, then **Save Scenario As** and save the scenario in the desired directory.

Finally, a convenient way to compare the differences between a slot in various scenarios is to plot the slot against either the baseline slot values or against the values of the slot in other scenarios. You can also plot the slot for a single scenario only. All the plotting options are located in the menu bar of the Scenario Manager under **Slots**, then **Plot Slot**, **Slots**, then **Plot Slot + Baseline**, or **Slots**, then **Plot Slot on All Scenarios**. The slots are plotted in the familiar RiverWare Plot dialog with all features of the Plot dialog active. A sample graphic is provided below, which compares the selected scenario slot with the baseline slot values. The scenario slot name is distinguished from the baseline slot name by the convention: Slot Name_Scenario Name_.

Running a scenario is fairly straight forward. The scenario with which you wish to run the model must be active. Open scenarios by selecting **File**, then **Open Scenario**.

- To make a scenario active, toggle to the desired scenario in the **Active Scenario** field.

  The Scenario Manager will verify that all the slots in the scenario are within the specified minimum/maximum values. If any of the bounds are exceeded, a warning message will be displayed to confirm that this scenario should be loaded.

  A confirmation dialog will then appear, explaining to the user that the slot values in the selected scenario will overwrite the current data in the model. If this is not the intended action, the process can be canceled, and the scenario will not be loaded.

  Upon activating a scenario, the Diagnostics Output Window will appear with an informational message displaying which scenario is currently active.

There are two options for running an active scenario:

- Select the **Start Run** button  in the Scenario Manager toolbar or select **Run**, then **Start Run** from the menu bar.

- To run the scenario through the Run Control dialog, select the **Run Control** button in the Scenario Manager toolbar or select **Run**, then **Run Control Dialog** from the menu bar. 

Comparing Scenario Runs

The Scenario Manager allows for comparisons between slots in the baseline scenario run and various scenario runs or between slots in the various scenario runs. Comparisons are managed through the Snapshot Manager and the Output Manager, which can be accessed through the Scenario Manager.

- To open the Output Manager, select **View**, then **Output Manager** from the menu bar of the Scenario Manager or select the **Output Manager** button in the toolbar. 

- To open the Snapshot Manager, select **View**, then **Snapshot Manager** from the menu bar of the  Scenario Manager or select the **Snapshot Manager** button in the toolbar.

Making Scenario Runs

A snapshot object, or *Scenario Output Snapshot Object*, is automatically created after each scenario run (and also for the baseline run) to capture the values of a prescribed list of slots which generally represent outputs from the run. These new snapshot objects include copies of slots prescribed by the Scenario Engineer.

The association between a scenario and its output snapshot object is based only on the scenario and the object having the same name. This snapshot object will be saved with the scenario when the scenario is saved as a scenario file.

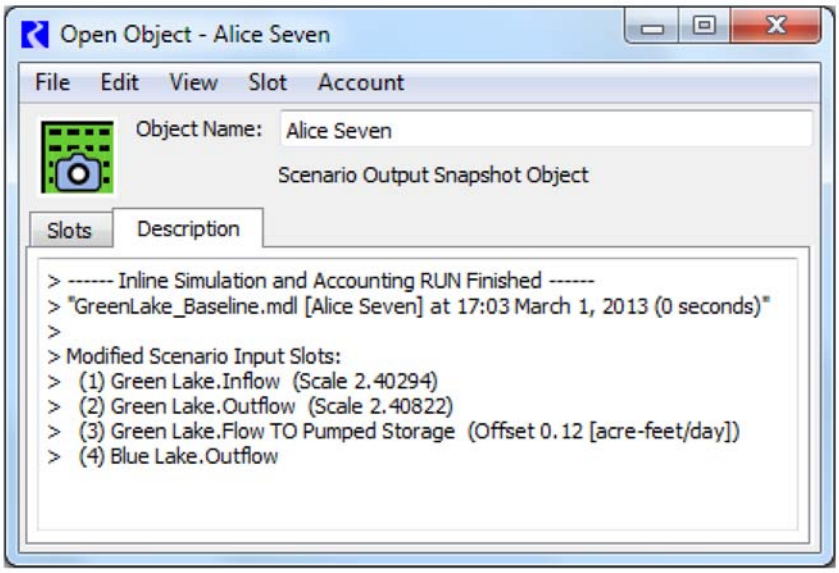
The background color of the snapshot object icon distinguishes the two types of snapshot objects:

- Yellow: Conventional snapshot object created by the user within the Snapshot Manager.
- Green: Scenario Output Snapshot Object automatically created at the end of a baseline or scenario run.

If the Results to Compare (Output Slots) slot list described above is not empty, then, each time a run finishes or aborts, a Scenario Output Snapshot Object having the same name as the active scenario (or else, “BASELINE” in a non-scenario run) is created (or re-created) with the following data:

- Non-editable copies of the slots enumerated in the Results to Compare (Output Slots) list,
- Automatically generated comments in the snapshot object’s description indicating the following:
  - A timestamp of the run completion.
  - A list of scenario input slots which have modifications with respect to the baseline values.
  - For scenario sandbox adjusted slots, also the scale or offset value with which the scenario input slot’s values were computed.

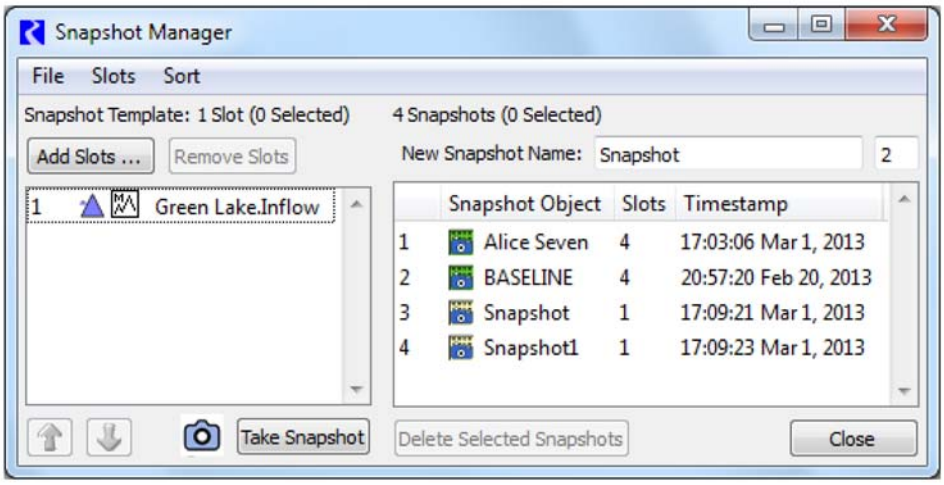
The automatically generated text lines within the snapshot object's description begin with a special character (">") to distinguish them from user-entered comments. All such lines are deleted from the description before generating new comment lines.



Accessing Scenario Output Snapshot Objects

The Open Object Dialog for the scenario's output snapshot object can be shown by selecting the **Output Slots** button on the scenario's tab in the Scenario Manager dialog or in the Scenario Sandbox; see "Scenario Sandbox" on page 209 for details. These buttons are disabled if that snapshot object has not yet been generated.

Also, all existing Scenario Output Snapshot Objects are listed in the Snapshot Manager Dialog, with the snapshot items having a green-background snapshot icon.



Scenario Output Snapshot Object Persistence in Scenario Files

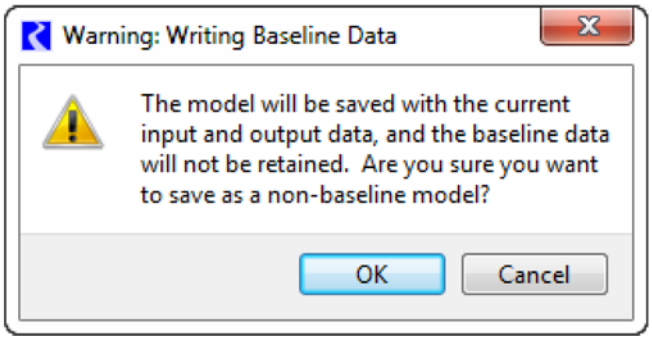
Scenarios are saved in their own files, apart from the baseline model. The scenario's output snapshot object is also saved in that file. When loading a scenario file, the snapshot object is loaded. This will replace any existing snapshot object on the workspace having the same name.

Saving Scenario Runs

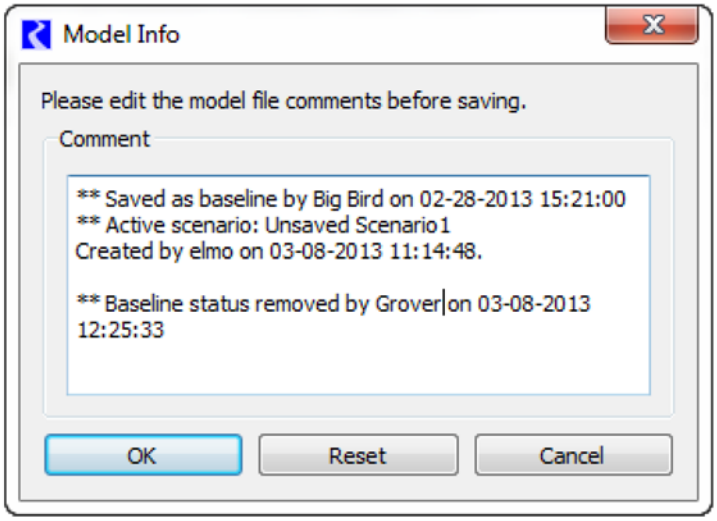
To save the current contents of the model after running a scenario, the model must be saved as a non-baseline model. The resulting non-baseline model will only contain the current input/output values in the model; thus the baseline data will not be saved unless the baseline is the currently active scenario.

- To save the model as a non-baseline model, select **File**, then **Save As Non-Baseline** from the main **Workspace** menu bar.

  A confirmation dialog will be presented, explaining that the saved model will no longer be a baseline model.



  After confirming the save, the Model File Info dialog is presented so the user can document the scenario that is being saved in the model. By default, the comments from the scenario's comment field will appear at the bottom of the Model File Comment field. This field can be freely edited before saving the model.



Chapter 8
Scenario Management

Appendix A
RiverWare Data Format (RDF)

During a multiple run or through the output manager, output can be written to an RDF text file. This section describes the structure of the RiverWare Data Format (RDF) file.

See "RDF Viewer" in *Solution Approaches* for more information on quickly viewing the results of an MRM run using the RDF Viewer.

Topics

- Output File Structure, page 221
- ASCII File Format, page 222

Output File Structure

The output file has the following hierarchical structure, where *package* refers to the set of runs.

- Package name
- Package owner (user who conducts the run)
- Object/slot combinations and units saved for the run
- Number of runs
- Description (text)
- Type (simulation, optimization, etc.)

For each run:

- Start date
- End date
- Timestep
- Duration
- Rule set
- Constraint set
- Slot set
- Consecutive set

For each object/slot combination:

- Value
- Time stamp

Results of multiple runs are the values for any object/slot combinations. Multislots, as well as series and expression slots, are stored as a time series of values. Table and scalar slots are stored as tables of values.

Results from multiple runs are written to a formatted text (ASCII) file. See "ASCII File Format" on page 222 for details.

ASCII File Format

Information on the package level:

```
name:<package name>
owner:<package owner>
description:<multiple run description>
create_date:<yy-mm-dd hh:mm>
number_of_runs:<number of runs>
END_PACKAGE_PREAMBLE
```

For each run:

```
start:<yy-mm-dd hh:mm>
end:<yy-mm-dd hh:mm>
time_step_unit:<timestep unit>
unit_quantity:<number of units in the timestep>
time_steps:<number of timesteps>
slot_set:<input DMI (if slot-based run)>
consecutive:<no = 0, yes = 1>
idx_sequential: <no = 0, yes = 1>
END_RUN_PREAMBLE
```

For each timestep:

```
<yy-mm-dd hh:mm>
```

For each object/slot combination:

```
object_type: <object type>
object_name: <object name>
slot_name: <slot name>
```

If a table slot:

```
rows: <number of rows>
cols: <number of columns>
END_SLOT_PREAMBLE
```

for all rows:

```
<row numbers, one row number per line>
```

for all columns:

```
units: <unit>
scale: <scale>
<values, one value per line>
END_COLUMN
```

If not a table slot:

```
END_SLOT_PREAMBLE
units: <slot units>
scale: <scale>
<values, one value per line>
END_COLUMN
```

Two standalone tools are available to post-process RDF files. These tools can be found on the RiverWare web site. RdfToExcel will write the contents of an RDF file to an Excel workbook, and RdfAnnualizer will take an RDF file with a timestep of less than a 1 Year and aggregate its data to create an RDF file with a 1 Year timestep. Help documentation is packaged with the tools.

Appendix A
RiverWare Data Format (RDF)