RiverWare in HEC-RTS and CWMS - Training Modules

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Contents

2 Setting up the HEC-RTS and CWMS RiverWare Plugin

In this exercise, you will set up the HEC-RTS and CWMS RiverWare Plugin and ensure that it shows up in CAVI.

2.1 Installing RiverWare and RTS/CWMS

These steps will have likely been completed before the class. They are repeated here for completeness.

Installing RiverWare

❑ Obtain RiverWare version 9.1.2 (or 9.1.x) from https://riverware.org. Credentials to download the installation files are provided separately.

❑ Install RiverWare as per the instructions.

This document assumes that RiverWare release 9.1.2 (or 9.1.x) is installed in the default location. For example:

```
C:\Program Files\CADSWES\RiverWare 9.1.2\
```

It will work if you have installed it in another location, but references to directory and file paths will need to be adjusted accordingly.

Installing RTS/CWMS

Please obtain HEC-RTS or CWMS release 3.3.0 from HEC and follow the installation instructions. This training assumes that RTS/CWMS is installed in:

```
C:\HEC\CAVI-3.3.0\
```

References to directory and file paths will need to be adjusted accordingly if installed in a different directory.

> **Note:** We will use the terminology “RTS/CWMS” when referring to the system. We will refer to the interface for both as the CAVI.

Make sure to also install HEC-RAS for this class. You can download the installer by double clicking on

```
C:\HEC\CAVI-3.3.0\HEC-RAS\6.3.1\RAS 6.3.1 Installer Download
```

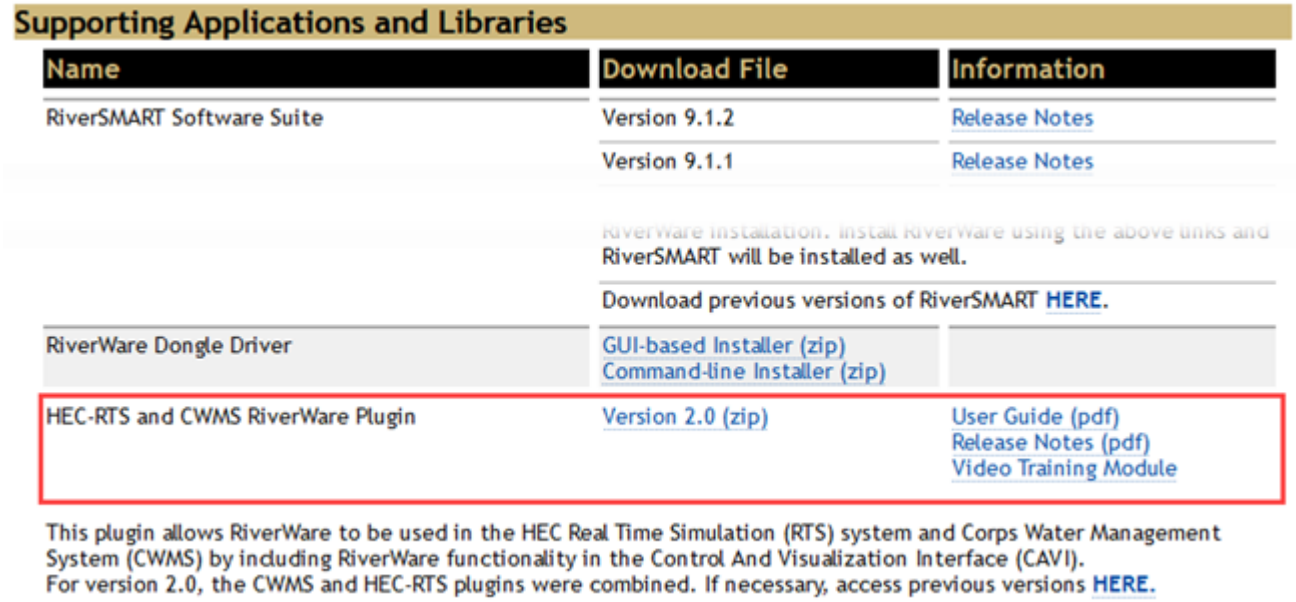
Then install the program as per the instructions.

2.2 Obtain the Plugin files

❑ Navigate to the following URL:

https://cadswes2.colorado.edu/downloads/riverware/releases/index.html

❑ On the lower portion of the page, download the “HEC-RTS and CWMS RiverWare Plugin” with the file name RTS_CWMS_RiverWarePlugin_v2.0.zip.



Supporting Applications and Libraries

Name	Download File	Information
RiverSMART Software Suite	Version 9.1.2	Release Notes
	Version 9.1.1	Release Notes
	RiverSMART will be installed as well.	
	Download previous versions of RiverSMART HERE.	
RiverWare Dongle Driver	GUI-based Installer (zip) Command-line Installer (zip)	
HEC-RTS and CWMS RiverWare Plugin	Version 2.0 (zip)	User Guide (pdf) Release Notes (pdf) Video Training Module

This plugin allows RiverWare to be used in the HEC Real Time Simulation (RTS) system and Corps Water Management System (CWMS) by including RiverWare functionality in the Control And Visualization Interface (CAVI).
For version 2.0, the CWMS and HEC-RTS plugins were combined. If necessary, access previous versions HERE.

❑ Using windows tools, WinRar or 7Zip, unzip the files to a temporary folder, such as C:\Temp.

The installation consists of three files plus supporting documentation:

- RTS_CWMS_RiverWarePlugin.jar – The RTS and CWMS RiverWare plugin Java archive file.
- RiverWare.installinfo – The RiverWare installation information file.
- RiverWare.ver – The RiverWare version file.
- HEC-RTS and CWMS RiverWare Plugin Release Notes.pdf – An overview of the changes in each release.
- HEC-RTS and CWMS RiverWare Plugin User Guide.pdf – A help document similar to this one that contains the RiverWare plugin installation guide.

2.3 Adding RiverWare to the CAVI

Use the following procedure to add the RiverWare plugin to the CAVI. These steps involve copying files from one location to another; we recommend using windows explorer but you can use whatever tools your are comfortable with. Also, edit text files with Notepad ++, Notepad or any other text editor. Make sure to save as plain text.

Copy the RiverWare plugin Java archive file

❑ Copy RTS_CWMS_RiverWarePlugin.jar to the folder **`C:\HEC\CAVI-3.3.0\CAVI\jar\ext`**

The model plugins in this directory are named with prefixes which determine the order in which they appear in the CAVI, but which otherwise have no impact on model behavior. For example, the CAVI typically displays the models HMS, ResSim, and RAS in that order as the associated plugins have the following names:

```
S10hmsPlugin.jar
S15resSimPlugin.jar
S20rasPlugin.jar
```

❑ Rename **RTS_CWMS_RiverWarePlugin.jar** to **S16RTS_CWMS_RiverWarePlugin.jar** to have the RiverWare plugin appear after ResSim.

Copy the RiverWare installation information and version files

❑ Copy **`RiverWare.installinfo`** to **`C:\HEC\CAVI-3.3.0\CAVI\config\`**

`RiverWare.installinfo` contains the directory path of the RiverWare installation directory:

```
<InstallLocation>C:\Program Files\CADSWES\RiverWare
9.1.2\</InstallLocation>
```

The value is currently set to the default location for the 9.1.2 release; if a different release (e.g., 9.2.1) is installed or if RiverWare is installed in a different location, then edit the file.

❑ Copy **`RiverWare.ver`** to **`C:\HEC\CAVI-3.3.0\CAVI\config\`**

RiverWare.ver contains the RiverWare version:

```
9.1.2+
```

The value is currently set for the 9.1 release. The "+" indicates it can be used for later releases (9.1.2, 9.1.3, etc).

❑ If you are using RiverWare version 9.1.2 for this class, please edit the file. Otherwise, you should not need to edit this file.

Verify the installation

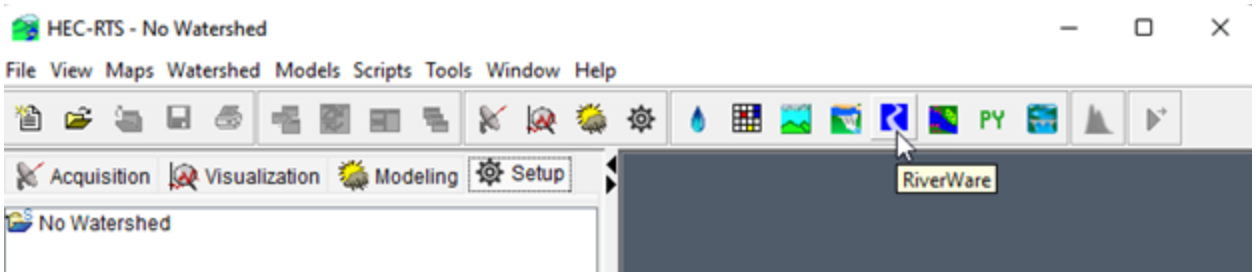
- ❑ In a windows explorer, navigate to `C:\HEC\CAVI-3.3.2\CAVI`
- ❑ Double click on HEC-RTS.exe (or CAVI.exe) to open the CAVI.

  Tip: While here, we recommend creating a shortcut to this executable and moving it to your desktop or start menu.

  Note: If using CWMS, a login screen opens. All files are local for this class, so no need to connect to a server. Select OK to continue.

- ❑ Select OK

  The CAVI opens. At this stage, you should see a RiverWare icon in the toolbar as shown in the screenshot.



- ❑ Click the icon and it will open RiverWare

  Tip: RiverWare windows sometimes open behind the CAVI. Move the CAVI and click on the RiverWare title bar to move it forward.

- ❑ Ensure it is RiverWare version 9.1.2.

  If this did not work, go back to your **`riverWare.installinfo`** and **`RiverWare.ver`** files and make sure they are correct and in the right place. Contact the instructor for help if it still does not work.

- ❑ Leave the CAVI open.

2.4 Open the Watershed

- ❑ Use the **File** and then **Open Watershed** menu

  If you've used the CAVI before, there are likely one or more Available Locations. We will need to add this training's watershed location.

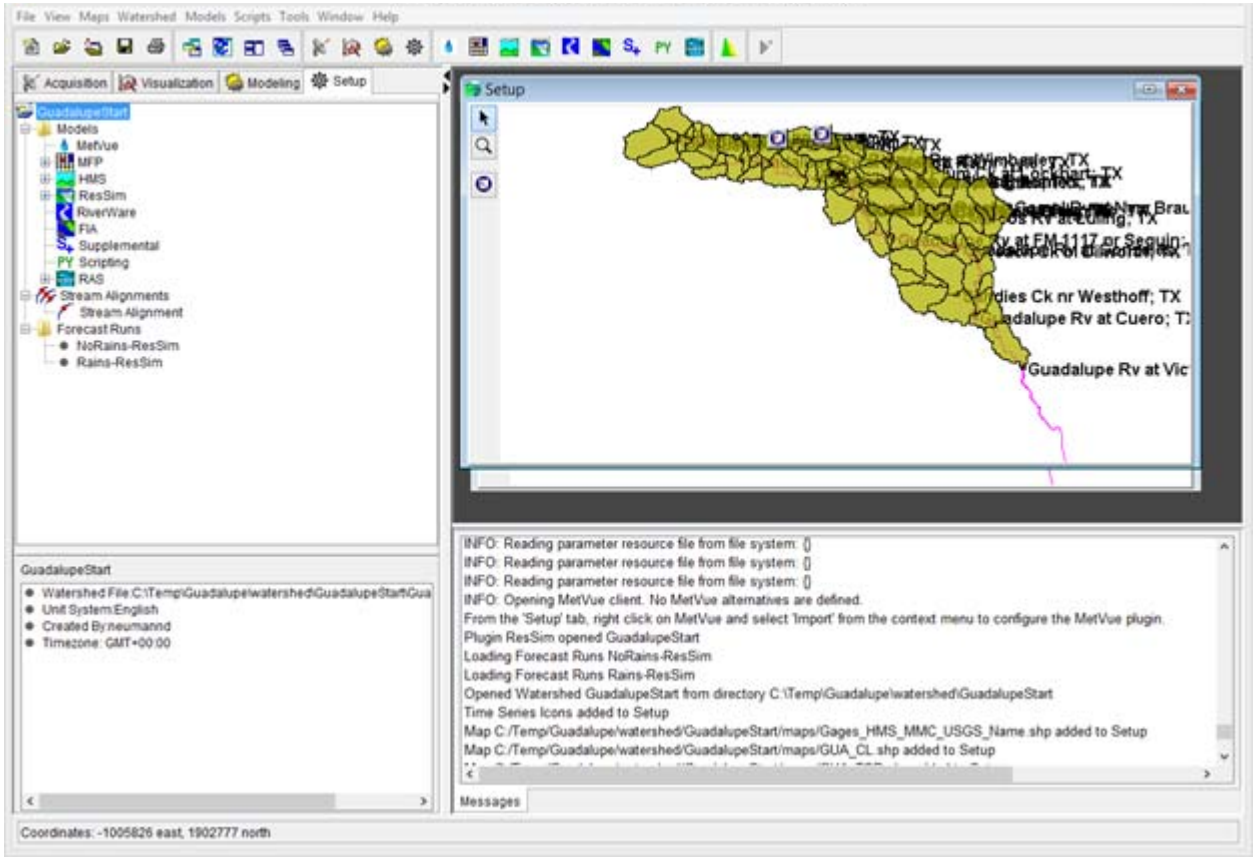
- ❑ Select **Edit**
- ❑ Select **Add Location**

- ❑ For the **Name**, specify `Guadalupe`
- ❑ For the location, browse to the training folder `C:\CWMSRiverWareTraining\Guadalupe`
- ❑ Select **OK** and **OK** to get back to the Open Watershed dialog box.
- ❑ Select `GuadalupeStart` and **OK**.

Note: `GuadalupeFinish` is the completed watershed with the RiverWare model already added. It is a backup and for reference.

Tip: Sometimes the CAVI opens confirmation dialog boxes behind the main window. If it seems like the CAVI has frozen or not responding, check behind the window for confirmation or message box.

The watershed opens as shown.

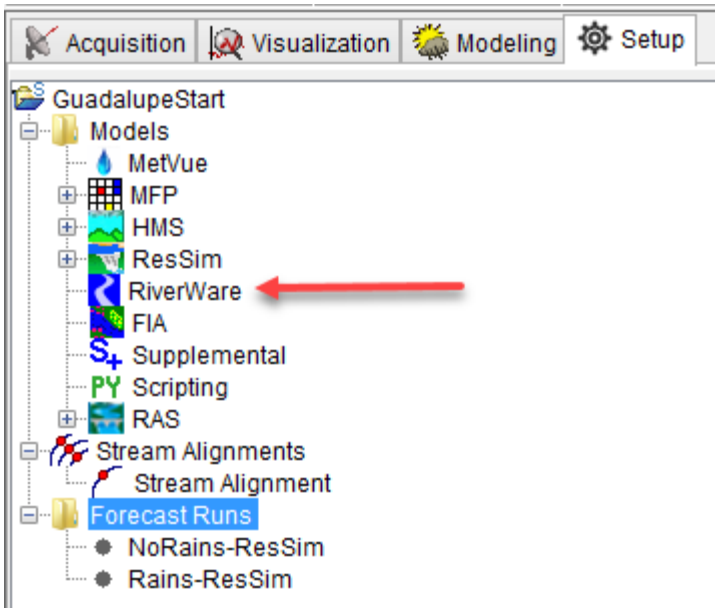


2.5 Understand the Watershed

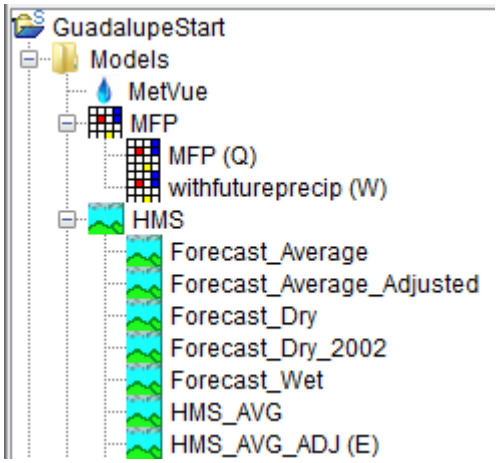
We will not try to explain all of the concepts, map interfaces, and views within the CAVI. This is a course on integrating a RiverWare model. For more information on RTS/CWMS, consult the documentation using the help menu.

In this section we will point out a few items to acquaint you with the watershed.

❑ On the Setup tab, you should see RiverWare as one of the models. We'll come back to this later.

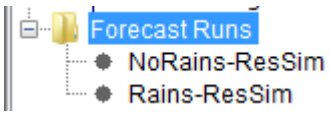


❑ Expand the tree view "+" icons for MFP, HMS, ResSim and RAS.



These are the models that have been imported. We'll only use a small number of these models in our exercises.

❑ Under Forecast Runs, notice we have two runs defined, NoRains-ResSim and Rains-ResSim:



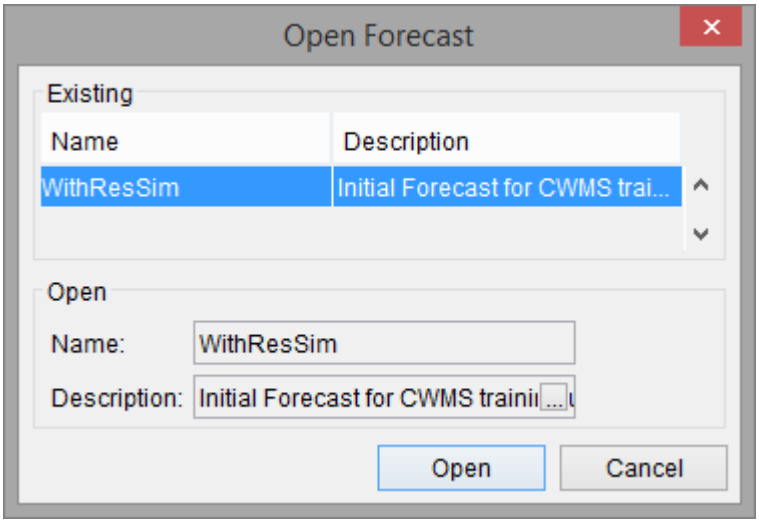
We'll later create analogous Forecast Runs that include RiverWare.

2.6 Compute Using the Existing Setup

Before we introduce the RiverWare model into the system, let's make sure this watershed computes with the existing setup. This will allow you to verify that all of the existing components are working.

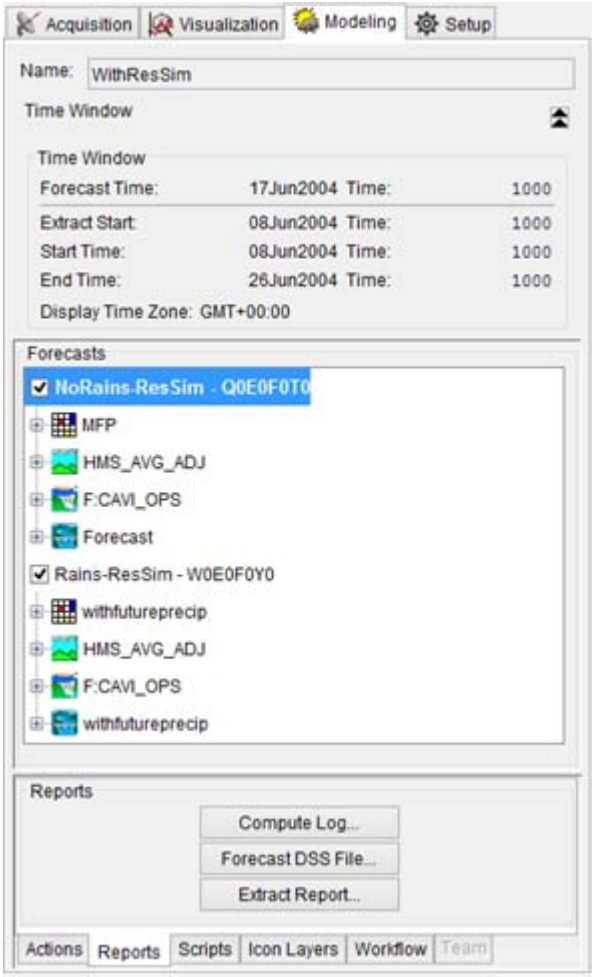
Open the Forecast Runs

❑ Select the **Modeling** tab, select **Forecast** and then **Open**.



❑ Select `WithResSim` and **Open**

❑ The forecast opens with two runs, NoRains-ResSim and Rains-ResSim



This forecast will run MFP, HMS, ResSim and RAS:

- NoRains-ResSim will use the `MFP` alternative and Forecast RAS. The model alternative keys are Q0E0F0T0. It simulates the case where no future rains are predicted.
- Rains-ResSim will use `withfutureprecip` alternative for MFP and RAS. The model alternative keys are W0E0F0Y0. It simulates a case where two additional storms are forecast over the next three days.

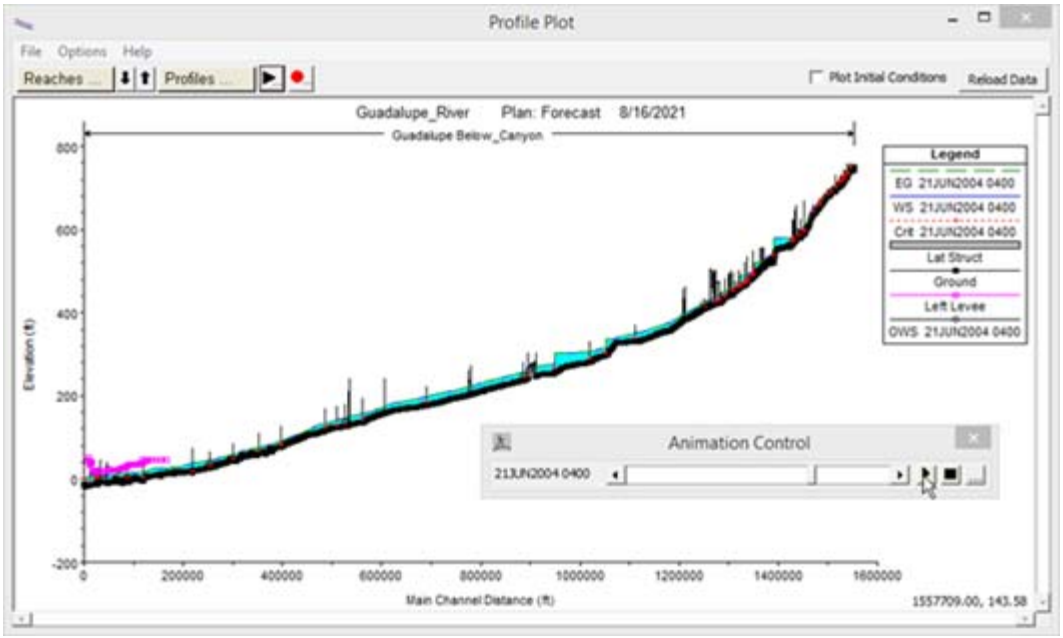
Compute

❑ Select NoRains-ResSim and click **Compute** in the Actions tab.

The models will start a compute. This could take a few minutes or more depending on your hardware.

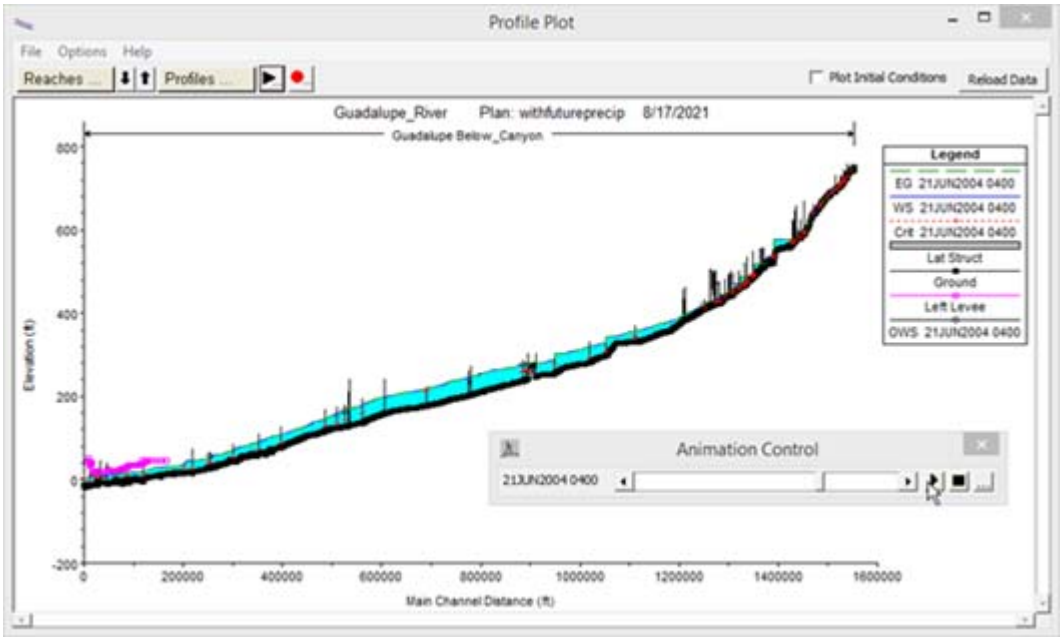
❑ Right click on the RAS model and choose **Profile Plot**.

A profile opens. You can animate this to see how the flood wave routes through the system. This alternative has lower inflows forecasted. You can see the reduced flood wave in the RAS profile plot.



❑ Repeat with Rains-ResSim. Select the run and click Compute. There are a few different ways to do this.

This has a large volume of water coming into the system and a larger flood wave. This is for demonstration purposes only.



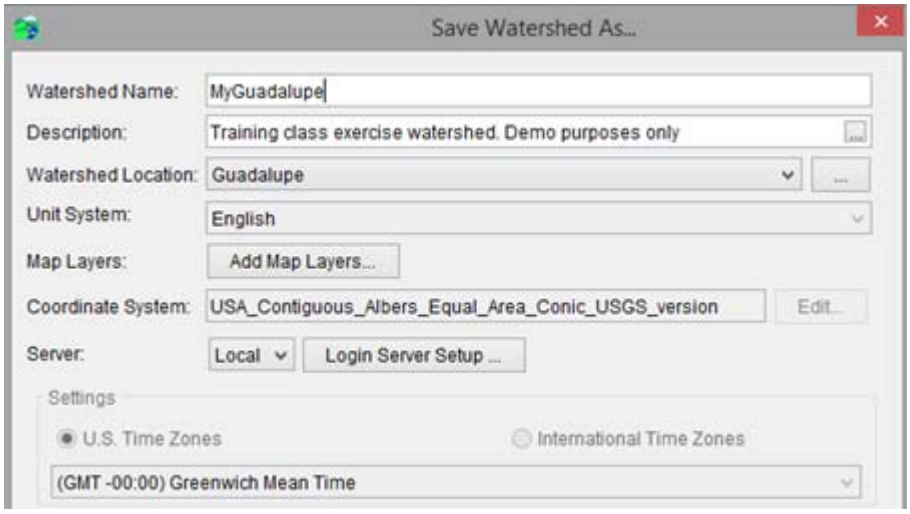
❑ Close the Profile plot.

Save as a new watershed name

Now that we have explored using a watershed and forecast runs with ResSim let's save this as a new watershed:

❑ Use the **File** and then **Save Watershed As** menu.

❑ In the dialog, specify the **Watershed Name** as "`MyGuadalupe`". Enter a description if you'd like.



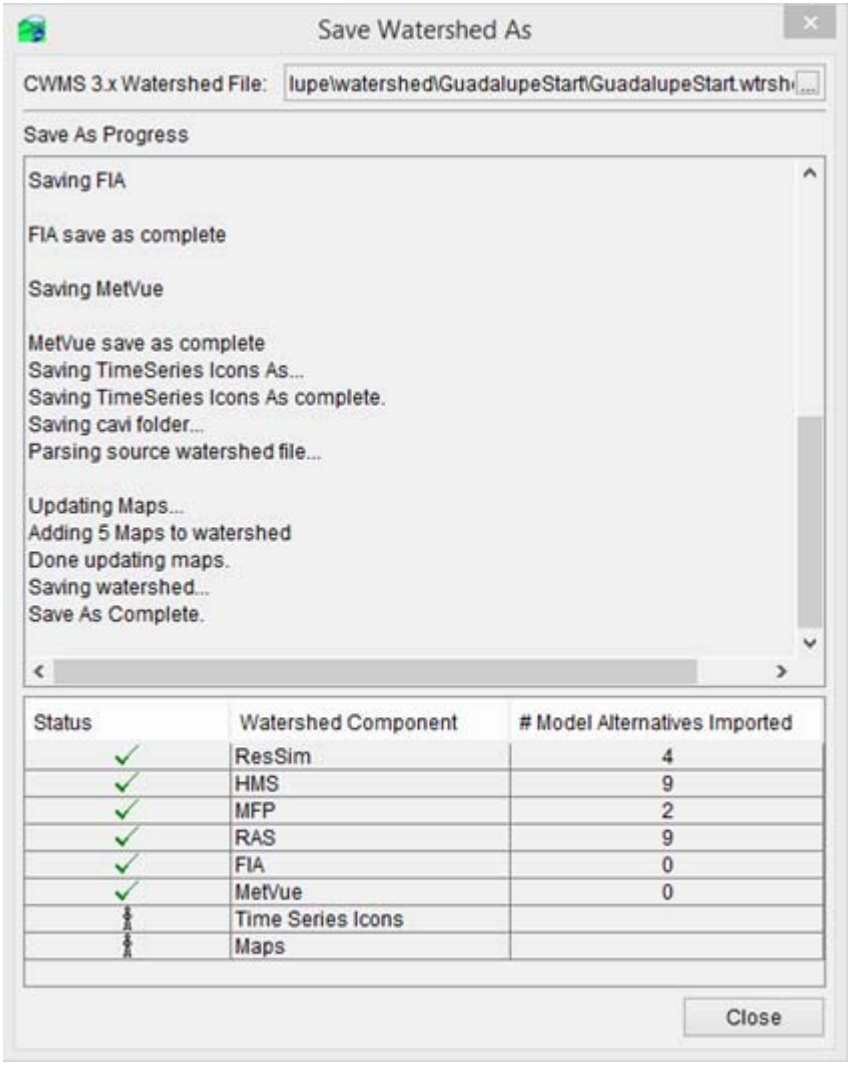
❑ Select OK.

A watershed summary dialog opens

❑ Select OK again.

❑ If you get a "Replace Existing HEC-HMS project" confirmation, select Yes.

RTS/CWMS will create the new folder in the watershed folder and “import” all of the models into the watershed. The result should look like this:



❑ Click `Close` and `Close` again on the **Next Steps** dialog.

We are done for now.

❑ Close the CAVI. Save any models it recommends saving.

In the next exercise, we will prepare the RiverWare model for import to this watershed.

3 Preparing the RiverWare model

This exercise will all take place in RiverWare. You will start with a model of the Guadalupe basin and prepare it for import to the CAVI. The exercise will go through the following topics:

- Understand the spatial and temporal scope of the model.
- Look at the rules for the basin.
- See the geospatial view
- Look at the Data Management Interfaces required by RTS/CWMS
- Open SCTs and Scripts that will be imported to CAVI
- View and create output devices that will be used in the CAVI

At the end of this exercise, you will have a model that is ready to import into the CAVI.

> **Note:** As this is only a training exercise, there may be many other things you need to do to get a model ready for import. Often it is an iterative process where you import the model to the CAVI, realize it is isn't quite right, so you modify it and make changes. Then either re-import it or copy the modified version to the correct location. We'll discuss that more in "How to make Changes to a RiverWare Model" on page 6–3.

3.1 Scope of the model

❑ Open RiverWare (9.1.2).

❑ Load the model:
`C:\CWMSRiverWareTraining\RiverWareFiles\GuadalupeBasinHourlySTART.mdl`

The model opens with the Geospatial View shown and centered on Canyon reservoir.

❑ Open the Run Control using the **Control** and then **Run Control Panel** menu.

Notice the run has the following parameters:

- **Timestep: 1 Hour**
- **Initial: 9:00 June 17, 2004**
- **Start: 10:00 June 17, 2004**
- **Finish: 10:00 June 26, 2004**

In our exercise, we will be forecasting for the same time, June 17, 2004 10:00, the start time-step. This sample model has preliminary inflows used for testing. The CAVI will take care of importing the real data and advancing the model.

> **Tip:** In a real-time forecasting situation, you would likely use yesterday's model as a starting point. RTS/CWMS will move it forward for you by creating a new forecast. We'll get to that in "Create New Forecast Runs" on page 4–6.

❑ Close the Run Control.

❑ On the workspace, use the scrolling, zooming, and Locator Views to navigate through the model.

In general, the flow is from northwest to southeast or top left to lower right on the workspace.

❑ Explore some of the user methods in the model by opening objects and looking at the Methods tab. Following are some points to highlight:

- The model has only one storage reservoir, Canyon. It has a bare crest unregulated spillway. It also has Conservation and Flood Pool, Operating Level Balancing Flood Control, Surcharge Releases, and Low Flow Releases. It uses many of the common USACE-SWD modeling techniques.
- There are five downstream control points that have Regulation Discharge methods. The Regulation Discharge represents the allowable channel capacity.
- Reaches route water using Muskingum with Segments, Modified Puls, or Step Response routing. These routing methods and parameters mirror the HEC-HMS model that we will see in later exercises.
- Gages are used to represent the unregulated inflow locations. The use of these mirrors the HEC-HMS model that we will use in the CAVI, including the naming convention.
- Confluences are used to join flows from the gages with the main river channel.
- There are a few data objects that hold routing coefficients and other user data.

As you can see, this model was set up to easily fit into the CAVI and mirror the HEC-HMS and other models. This makes the data transfer easier to configure.

> **Tip:** If you have an existing RiverWare model, changes may need to be made to better mirror RTS/CWMS functionality. Each model is different and there is no way to generalize the changes necessary!

3.2 The Geospatial View

When this model opens, it always shows the Geospatial View.

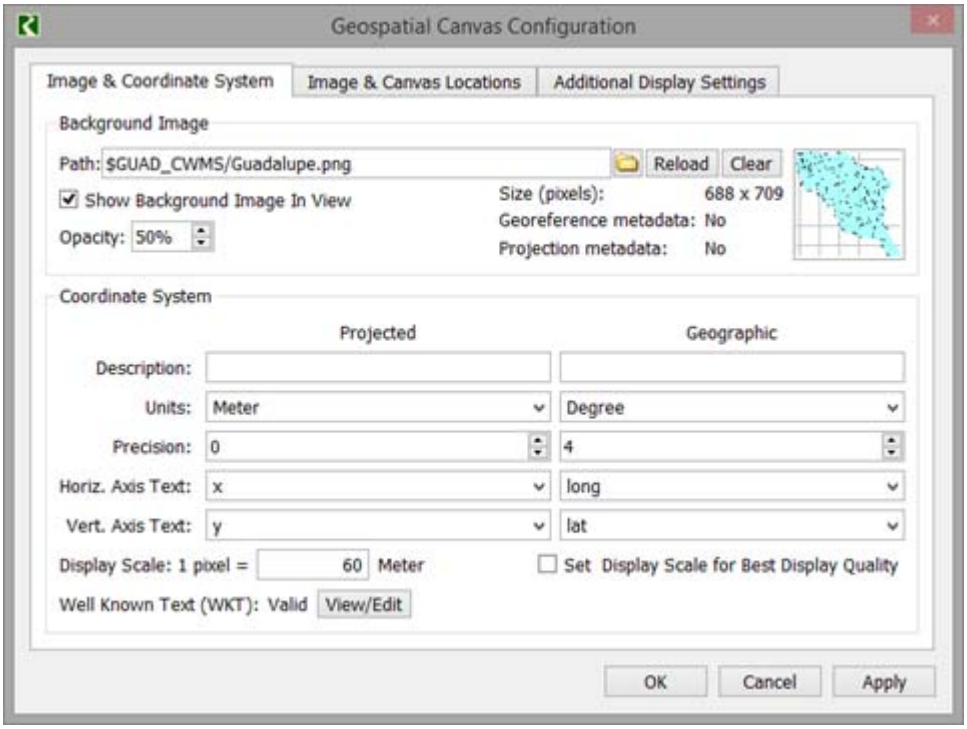
❑ Switch to the Simulation View

This view spreads out the objects a bit more and provides the common configuration where flow is from up to down in a linear fashion.

The CAVI will default to show the geospatial view so let's go back to that

❑ Switch back to the Geospatial View

❑ Right-Click anywhere on the workspace and select Canvas Properties



This dialog is used to specify the image to show, the coordinate system and to locate that image on the canvas.

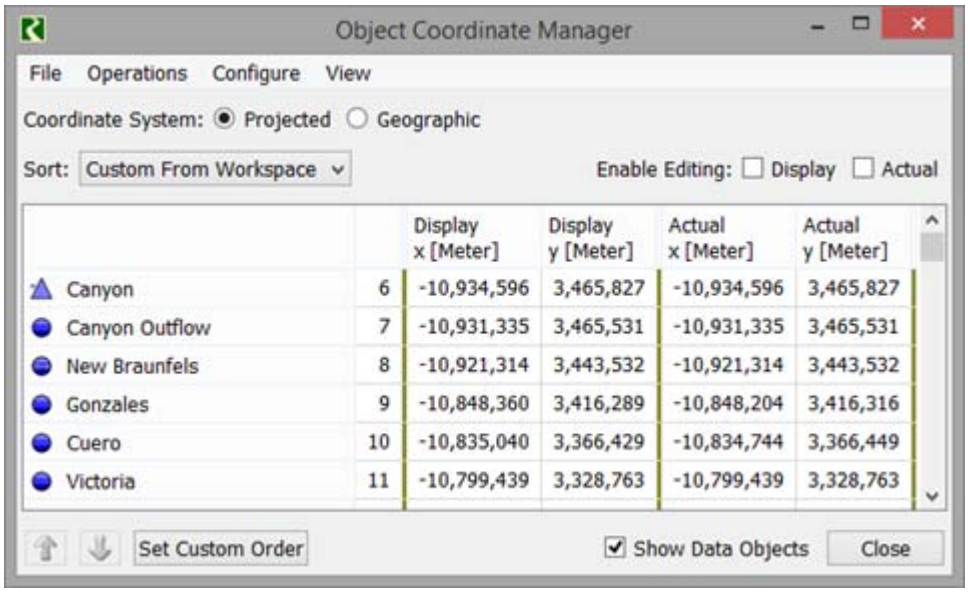
> **Tip:** In a real model, you may need to set up the geospatial view with reasonable object locations. No background image is necessary as the CAVI provides map layers, but a background image may be useful to locate the objects on the RiverWare workspace.

See the RiverWare documentation, User Interface chapter, and Workspace section for more information on this window and how to set up the geospatial view.

> **Tip:** Use the same projection and coordinates system used by the CAVI. Then the objects will show up correctly in the CAVI.

❑ Click Cancel to close the configuration dialog.

❑ Right-Click anywhere on the workspace and select Object Coordinates



This dialog shows both the Display and Actual coordinates for each object in the model. It is important as the CAVI will use the Display Coordinates when placing RiverWare objects on the map. In our model, the Display and Actual are the same, but in a real model, you may wish to have different coordinates.

Currently shown are **Projected** X and Y coordinates. You can select the **Geographic** option to see Latitude and Longitude.

This dialog also allows you to import and export display and actual coordinates from a shape file. If you have tools to create a shape file of your objects and coordinates, this can be a relatively easy way to set up the object coordinates. Alternatively, you can just move the objects around on the workspace, thereby changing the display coordinates.

Again, see the help for more information.

❑ When finished, close the dialog box.

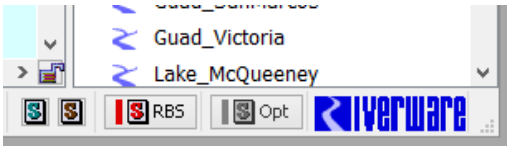
3.3 Operating Rules

Although not mandatory, most models will have a ruleset that represents the operating policy of the basin.

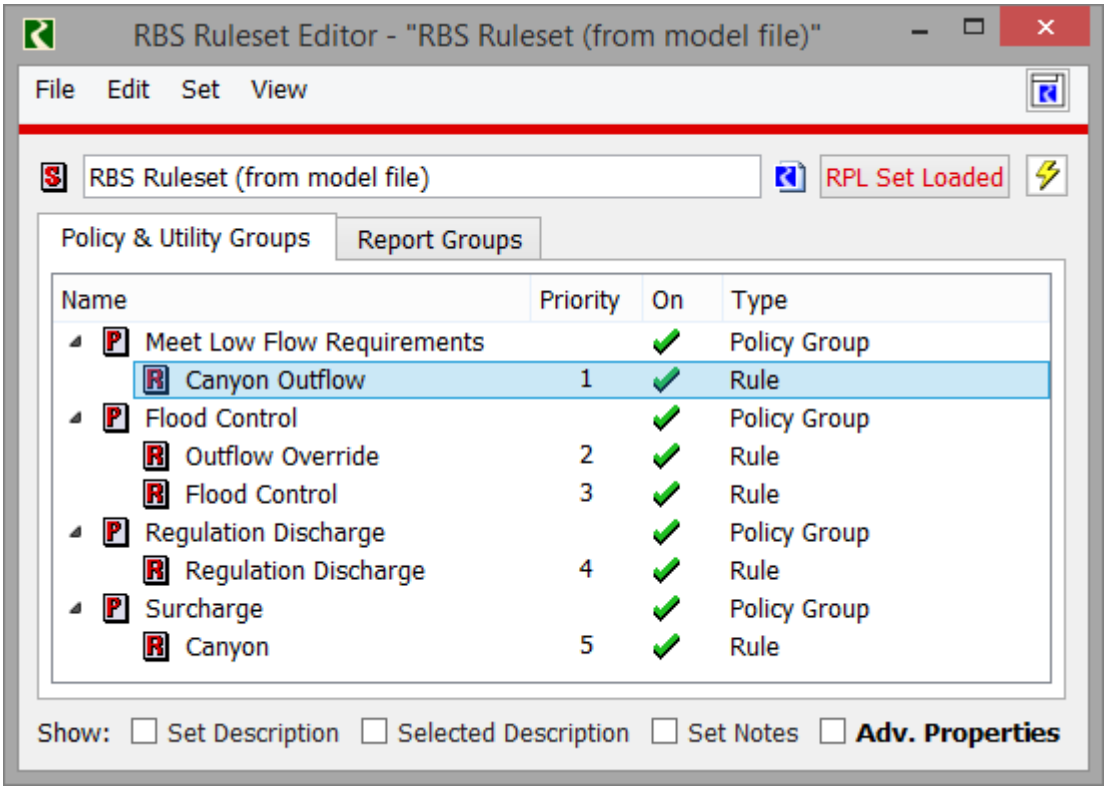
Ruleset Investigation

Let’s look at the rules for this sample Guadalupe model.

❑ Select the RBS button on the lower right to open the loaded ruleset

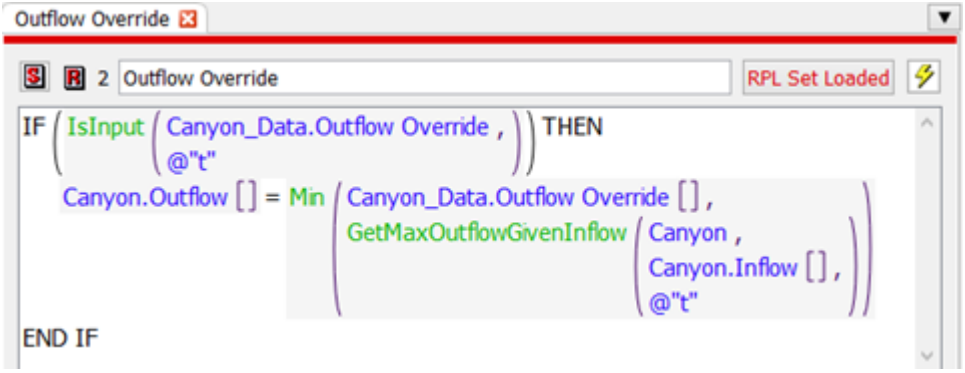


The ruleset opens.



There are four rules that represent the standard USACE-SWD modeling techniques including Surcharge (5), Regulation Discharge (4), Flood Control (3) and Low Flow Requirements (1). See the USACE-SWD modeling techniques section of the RiverWare documentation for more information.

❑ Double click rule number 2, Outflow Override



This rule is necessary as this is an Operations model and there needs to be a way to override the rule computed reservoir outflows. In this case, the overrides are specified in the `Canyon_Data.Outflow Override` slot. Rule 2 moves the data over to the Outflow slot when it is the override value is input. It is higher priority than Flood Control, so can *override* the computed values. We'll use this slot when we get into the CAVI and are operating the system.

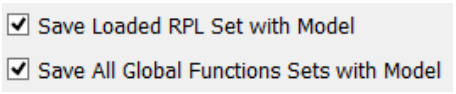
RPL Set Save Location and other Parameters

The ruleset and global function RPL sets MUST be saved in the model file for them to work in the CAVI. Let's look at that configuration option:

❑ On the main workspace, open the **Run Control** dialog box.

❑ Use the **View** and then **Rulebased Simulation Run Parameters** menu.

Notice the two options are checked to save the RPL sets in the model:



While in this dialog box, also notice that the Number of Post-Run Dispatch Timesteps is set to 90 to match the flood control Forecast Period.

This setting is necessary for the USACE-SWD modeling techniques to allow objects to solve during the Forecast Period at the end of the run. We need to set this here so that it doesn't issue red error messages when running in the CAVI and stop the overall simulation.

❑ Select **Close** on the Parameters dialog

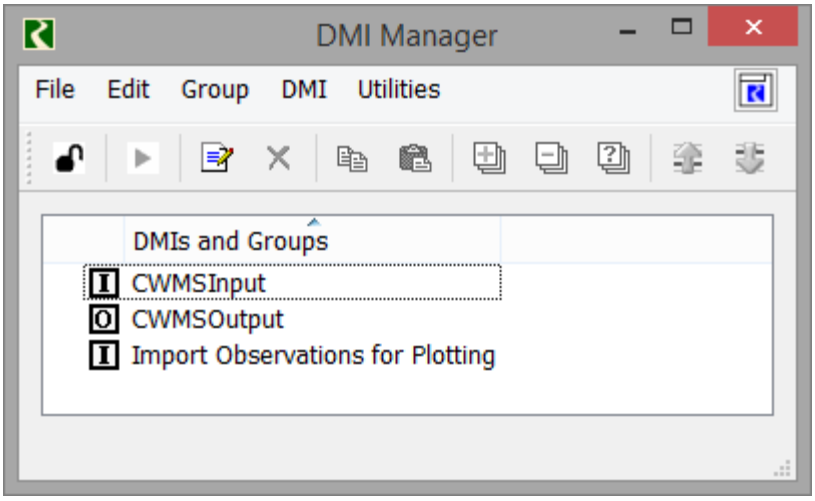
3.4 Data Management Interfaces

The CAVI executes the models in sequence transferring data from one model to the next. Within RiverWare, DSS Data Management Interfaces (DMIs) must be configured to

- define the slot data that is imported into the model before a run and
- define the slot data that is exported after a run.

Let's look at how these DMIs are configured

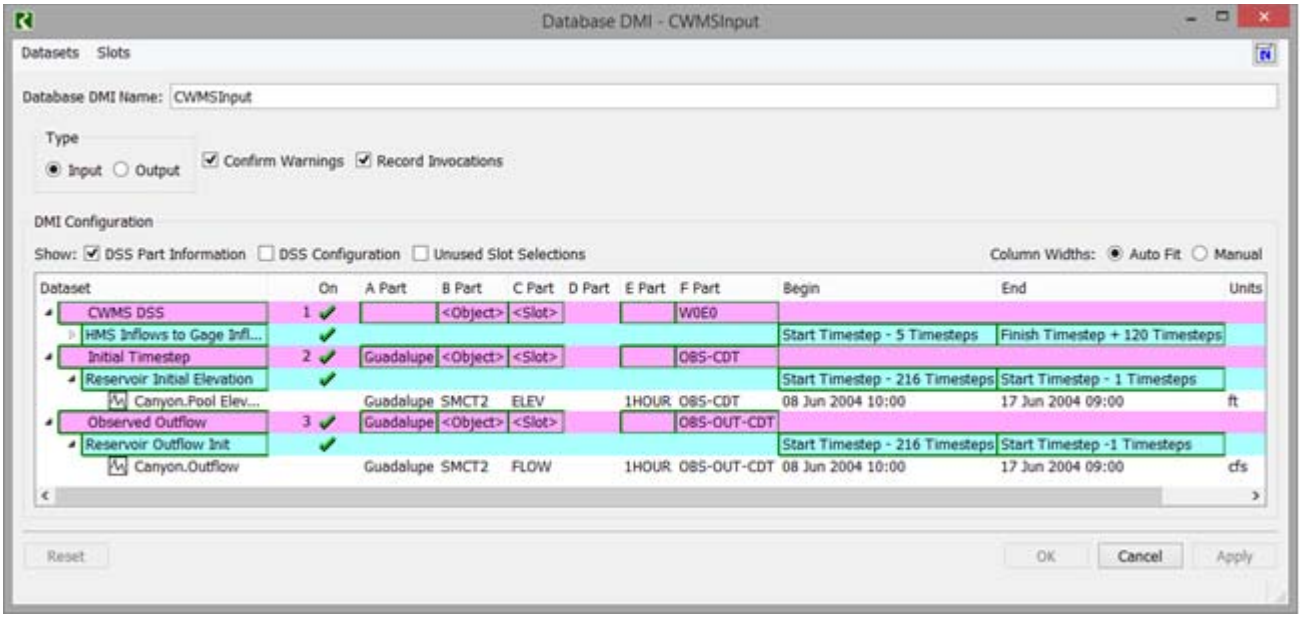
❑ On the main workspace, click the DMI and then DMI Manager menu.



There are three DMIs, but only the first two are used directly by RTS/CWMS, one for input and one for output. (The third will be executed by a script.) The DMIs can be named anything you'd like, but the default names are shown.

❑ Double click the CWMSInput DMI to open it.

❑ Expand the three main pink rows (DSS datasets) and some of the blue rows (slot selections)



This DMI defines the slots that require data to allow the RiverWare model to run.

- The CWMS DSS dataset represents the inflows to each of the gage objects. This data will come from the HEC-HMS model.
- The Initial Timestep dataset represents pre-run Pool Elevations. This data will come from the “Extract” list as it can be considered observed.
- The Observed Outflow dataset represents pre-run Outflows. This data will also come from the “Extract” list.

Each part of the DSS file is also specified for each dataset. In general, part B is the Object name mapped to the correct part using a Name Map. The C part is the slot mapped to the part using a Name Map. The A part is only specified for the two datasets that will come from the Extract list. This must match that part information exactly.

Part D is the time and cannot be changed. Part E is the timestep size and is set to 1HOUR.

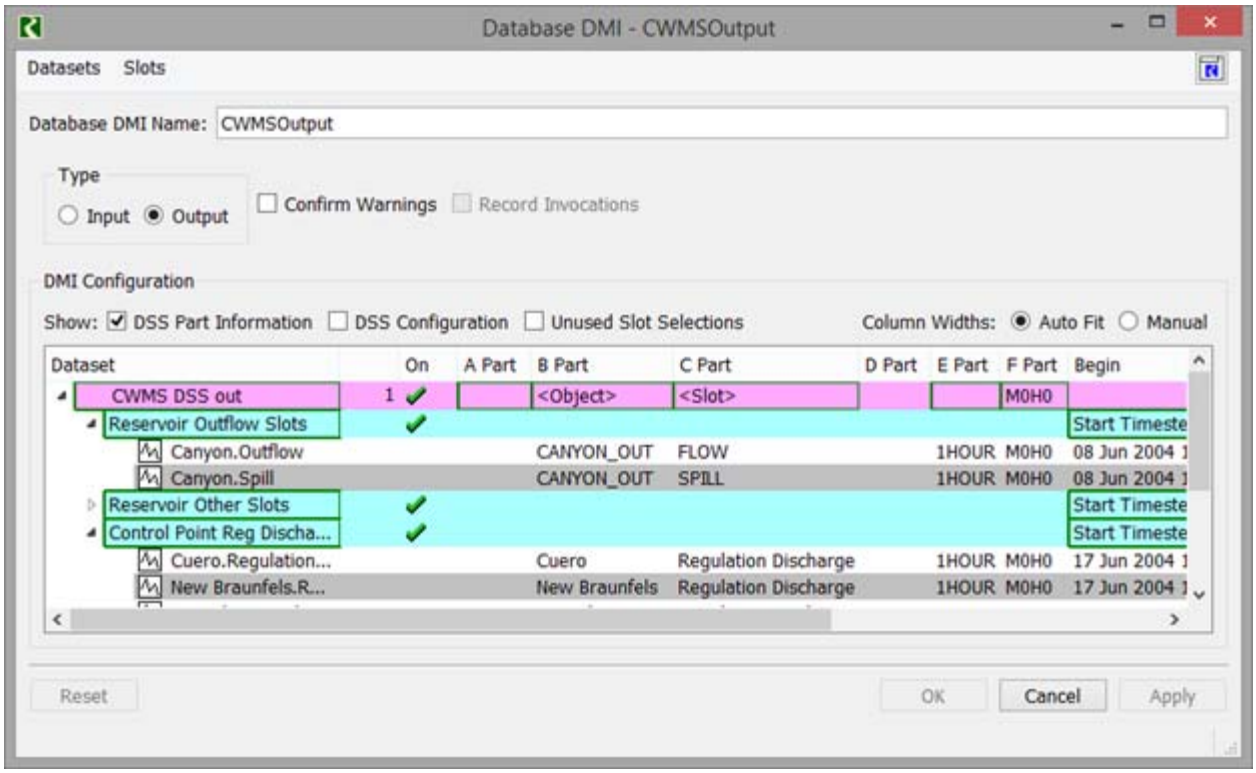
Part F will be substituted by RTS/CWMS to match the Model Alternative Keys. The values specified here are used for testing outside of the CAVI.

> **Tip:** There’s a lot of RTS/CWMS terms above. We’ll get to all of that in the next chapter. Then you can return to the RiverWare model and see how it is set up.

The Begin and End Timestep are specified relative to the Start and Finish timestep. This makes the DMI flexible for any run range.

❑ When finished looking at this DMI, close the dialog.

❑ Repeat by opening the CWMSOutput DMI



This DMI only has one dataset but multiple slot selections. Only a small portion of this data (Outflow and Spill) is used by the downstream model, HEC-RAS. The other values are written out for informational and recording purposes.

❑ When finished, close the dialog using the Cancel button.

3.5 Scripts and SCTs

CWMS provides quick access to the native dialogs for many types of dialogs. Let's first look at Scripts and System Control Tables (SCTs). We have set up these items in the RiverWare model so that it is ready before importing the model into the watershed.

Let's look at a few Scripts and SCTs.

Scripts

Scripts automate processes to save time and ensure the same steps are followed each time.

❑ On the main workspace, select Scripts and then Script Management.

There are three scripts already defined. One for generating all outputs, one to create snapshots, and one to bring pre-run data for plotting purposes. There could be many more with varying

levels of complexity. When we import the RiverWare model into the CAVI, you will see that we need to select these three scripts.

❑ Investigate these simple scripts to learn what they do.

❑ When finished, close any script dialogs and the script manager.

SCTs

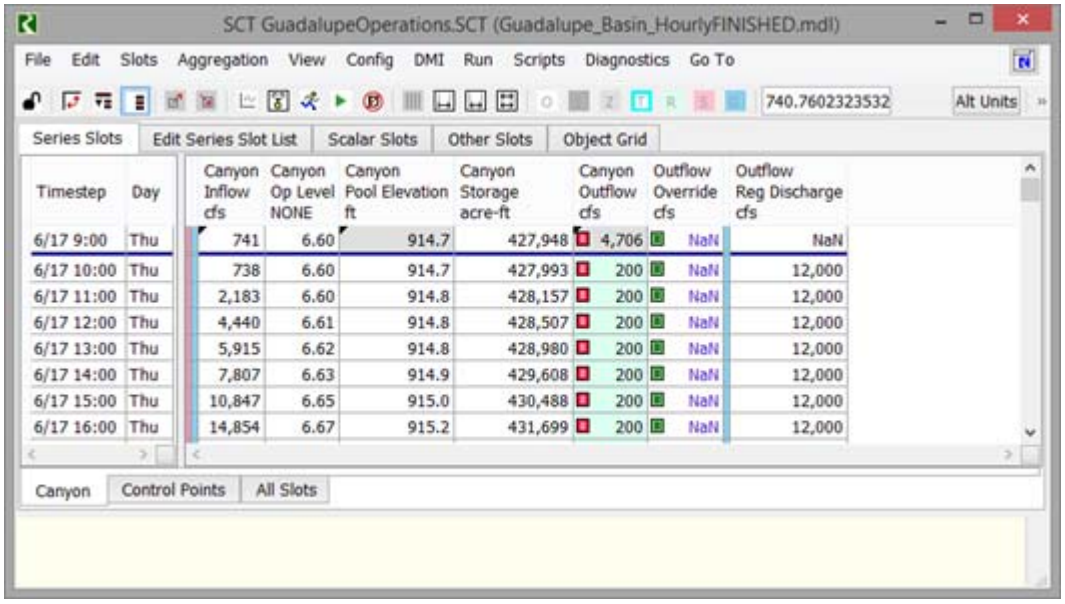
System Control Tables (SCTs) provide a user defined view of the slot data. The content and configuration can be modified to suit your needs.

SCTs are always saved in separate files. Let's open two of these.

❑ From the main workspace, use the **Utilities**, then **SCT**, and then **Open SCT** menu.

❑ Select `~\CWMSRiverWareTraining\RiverWareFiles\GuadalupeOperations.SCT`

The SCT opens. This SCT shows data for Canyon reservoir on one worksheet and all the Control Points on another worksheet.



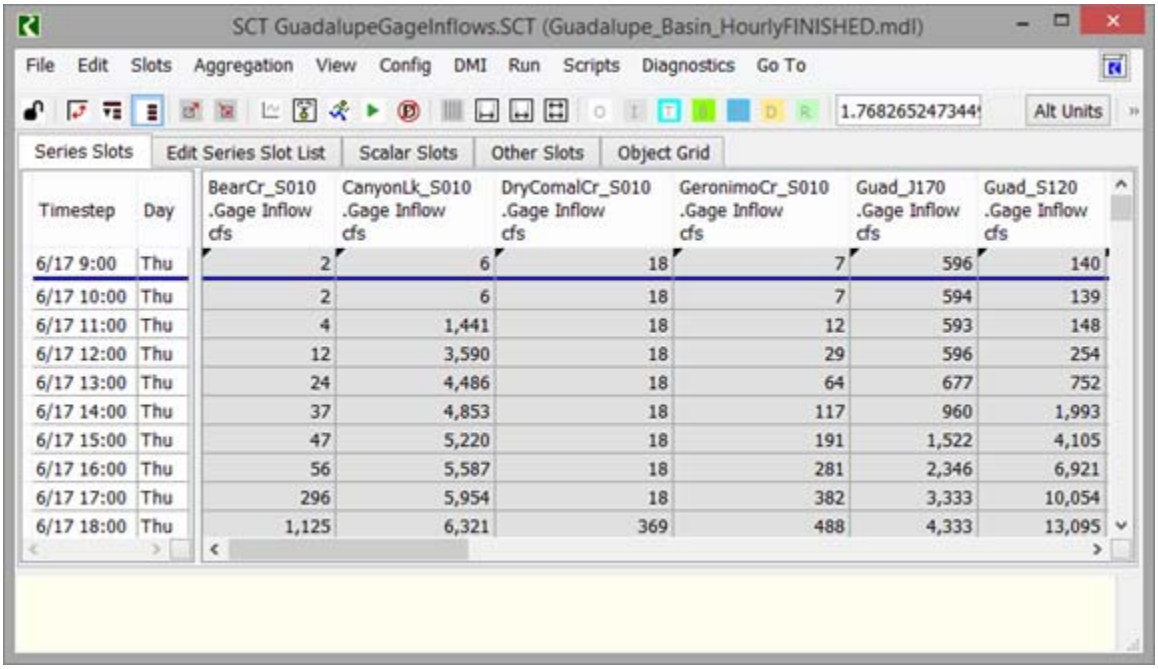
Timestep	Day	Canyon Inflow cfs	Canyon Op Level NONE	Canyon Pool Elevation ft	Canyon Storage acre-ft	Canyon Outflow cfs	Outflow Override cfs	Outflow Reg Discharge cfs
6/17 9:00	Thu	741	6.60	914.7	427,948	4,706	NaN	NaN
6/17 10:00	Thu	738	6.60	914.7	427,993	200	NaN	12,000
6/17 11:00	Thu	2,183	6.60	914.8	428,157	200	NaN	12,000
6/17 12:00	Thu	4,440	6.61	914.8	428,507	200	NaN	12,000
6/17 13:00	Thu	5,915	6.62	914.8	428,980	200	NaN	12,000
6/17 14:00	Thu	7,807	6.63	914.9	429,608	200	NaN	12,000
6/17 15:00	Thu	10,847	6.65	915.0	430,488	200	NaN	12,000
6/17 16:00	Thu	14,854	6.67	915.2	431,699	200	NaN	12,000

❑ Repeat this process and open the following SCT:
`C:\CWMSRiverWareTraining\RiverWareFiles\GuadalupeOperationsHorizontal.SCT`

This is essentially the same SCT as before but oriented horizontally. This may be more convenient or preferred by some for operating a basin. SCTs are flexible so there are many options.

❑ Repeat this process and open the following SCT:
`C:\CWMSRiverWareTraining\RiverWareFiles\GuadalupeGageInflows.SCT`

This SCT shows all of the unregulated inflow points represented by gages. Although less useful for operations, it is the one place where we can access all of the unregulated inflows in one place.



Timestep	Day	BearCr_S010 .Gage Inflow cfs	CanyonLk_S010 .Gage Inflow cfs	DryComalCr_S010 .Gage Inflow cfs	GeronimoCr_S010 .Gage Inflow cfs	Guad_J170 .Gage Inflow cfs	Guad_S120 .Gage Inflow cfs
6/17 9:00	Thu	2	6	18	7	596	140
6/17 10:00	Thu	2	6	18	7	594	139
6/17 11:00	Thu	4	1,441	18	12	593	148
6/17 12:00	Thu	12	3,590	18	29	596	254
6/17 13:00	Thu	24	4,486	18	64	677	752
6/17 14:00	Thu	37	4,853	18	117	960	1,993
6/17 15:00	Thu	47	5,220	18	191	1,522	4,105
6/17 16:00	Thu	56	5,587	18	281	2,346	6,921
6/17 17:00	Thu	296	5,954	18	382	3,333	10,054
6/17 18:00	Thu	1,125	6,321	369	488	4,333	13,095

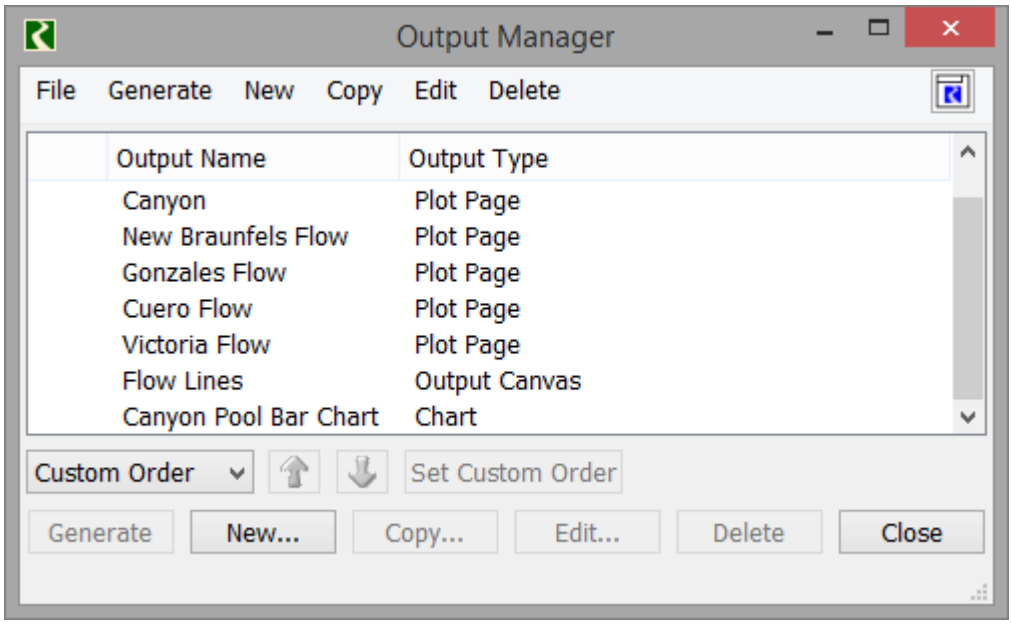
Although you don't need SCTs to use CAVI or even to use RiverWare, they can make your life easier and more efficient by showing only needed data. When we import the RiverWare model, we'll show how to import the separate SCT files as well.

❑ Leave the GuadalupeGageInflows.SCT open for the next section. You can close the other two SCTs.

3.6 Output devices

The final piece of the RiverWare model that is accessible directly from the CAVI are Output Devices: plots, charts and Output Canvasses. In this section, you will look at the pre-existing plots and then create one more. You'll also look at a pre-configured Chart and Output Canvas. We'll see how to import all of these into the CAVI when we get to the next chapter.

❑ From the main workspace, use the **Utilities** and then **Output Management** menu.



Listed are all the different Output Devices that have been created. Let's look at each one.

Plots

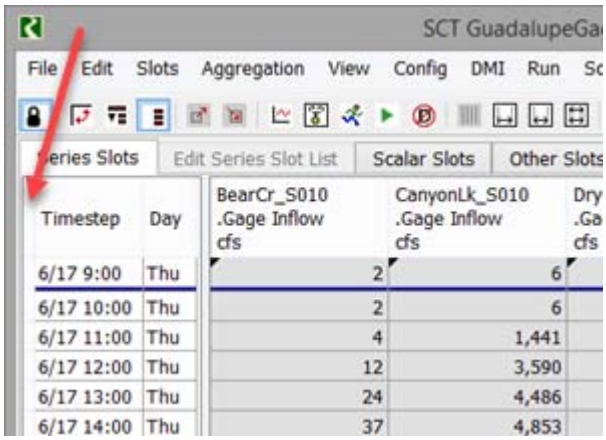
There are five plots already defined, one for the reservoir and one for each control point.

❑ Generate each plot and investigate as desired. Close when finished.

Now let's create one more.

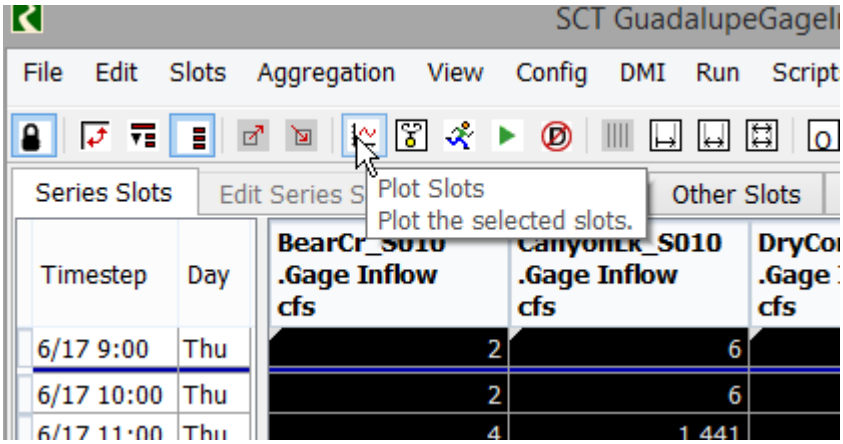
❑ Find the GuadalupeGageInflowsSCT that we said to leave open.

Click in the area just to the left of the Timestep column:

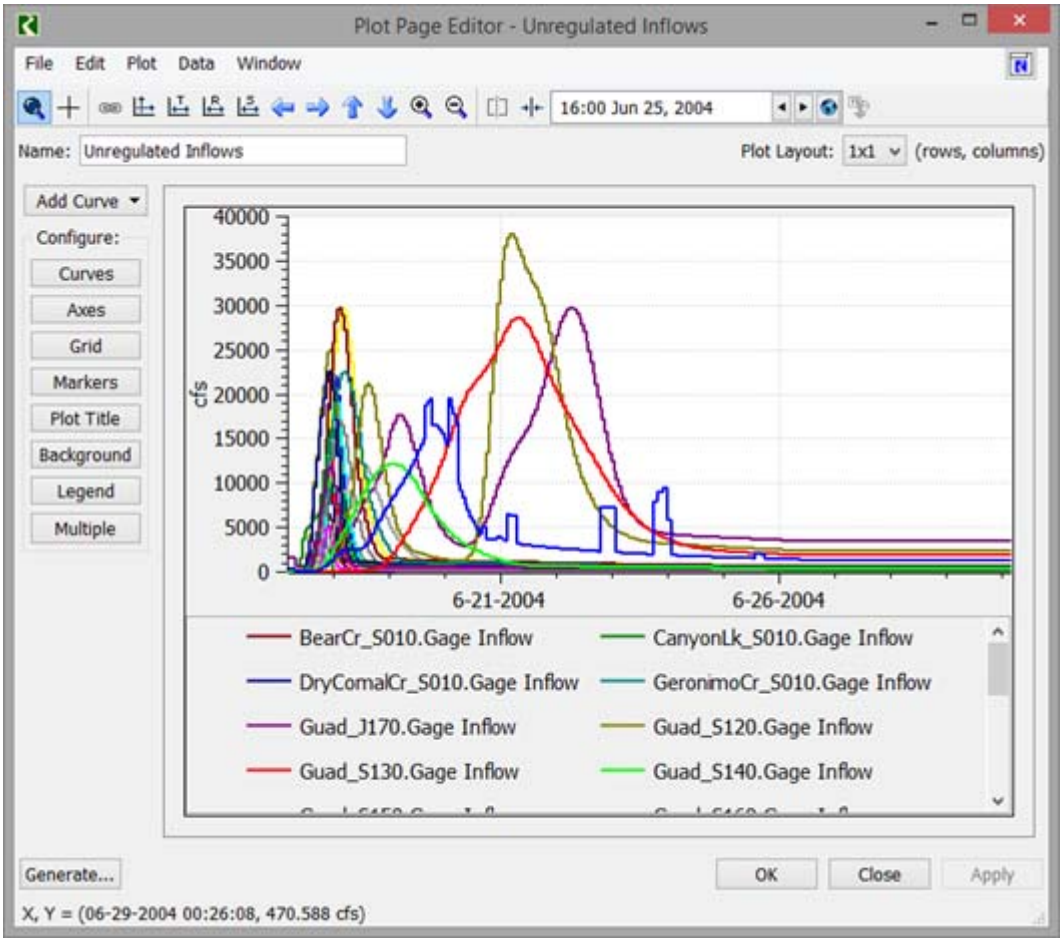


This selects all rows and columns in the SCT.

❑ With all rows selected, click the Plot button



A new plot is created that shows all the unregulated flows into the basin. Again, these are just test flows, we'll get the real flows in the CAVI from HEC-HMS.



❑ Give this plot a name: Unregulated Inflows as shown:

We'll import this plot into the CAVI in the next chapter.

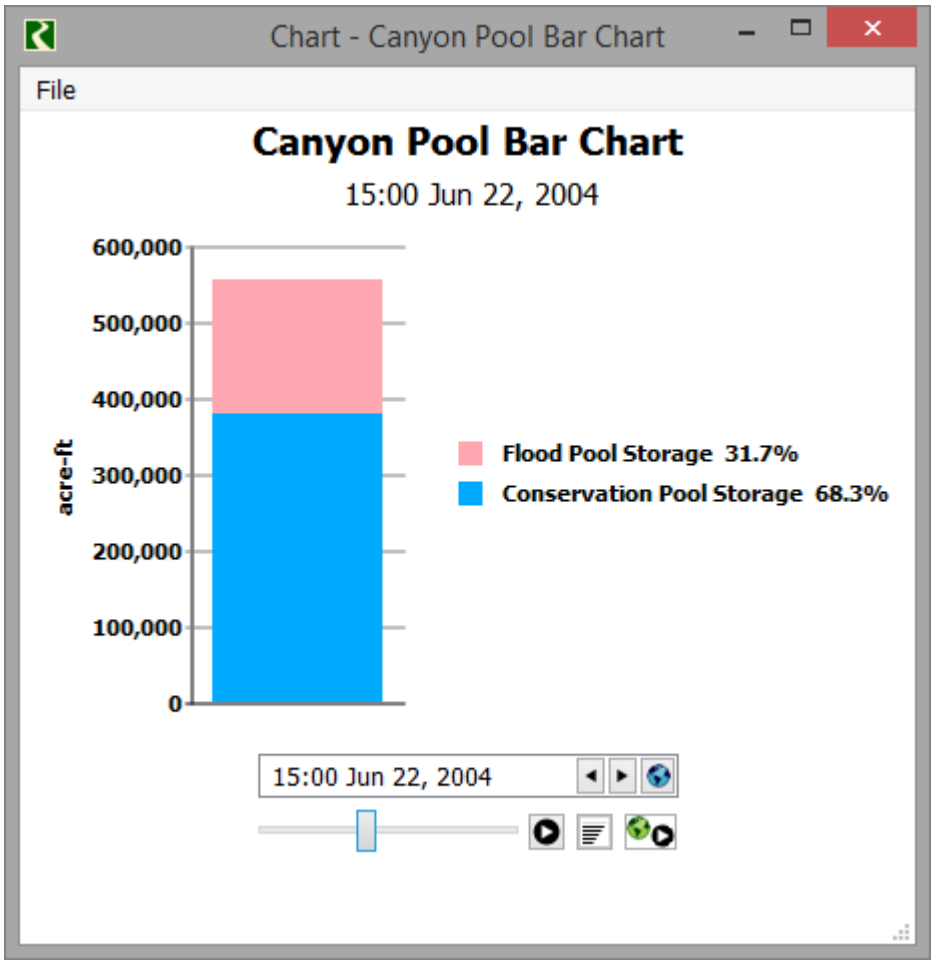
❑ Select OK to close this plot.

Charts

There is one pre-configured chart named **Canyon Pool Bar Chart**.

❑ In the Output Manager, highlight that row and select the Generate button.

The chart is created and shows a bar chart of the relative storage in Canyon differentiated between the flood and conservation pools.



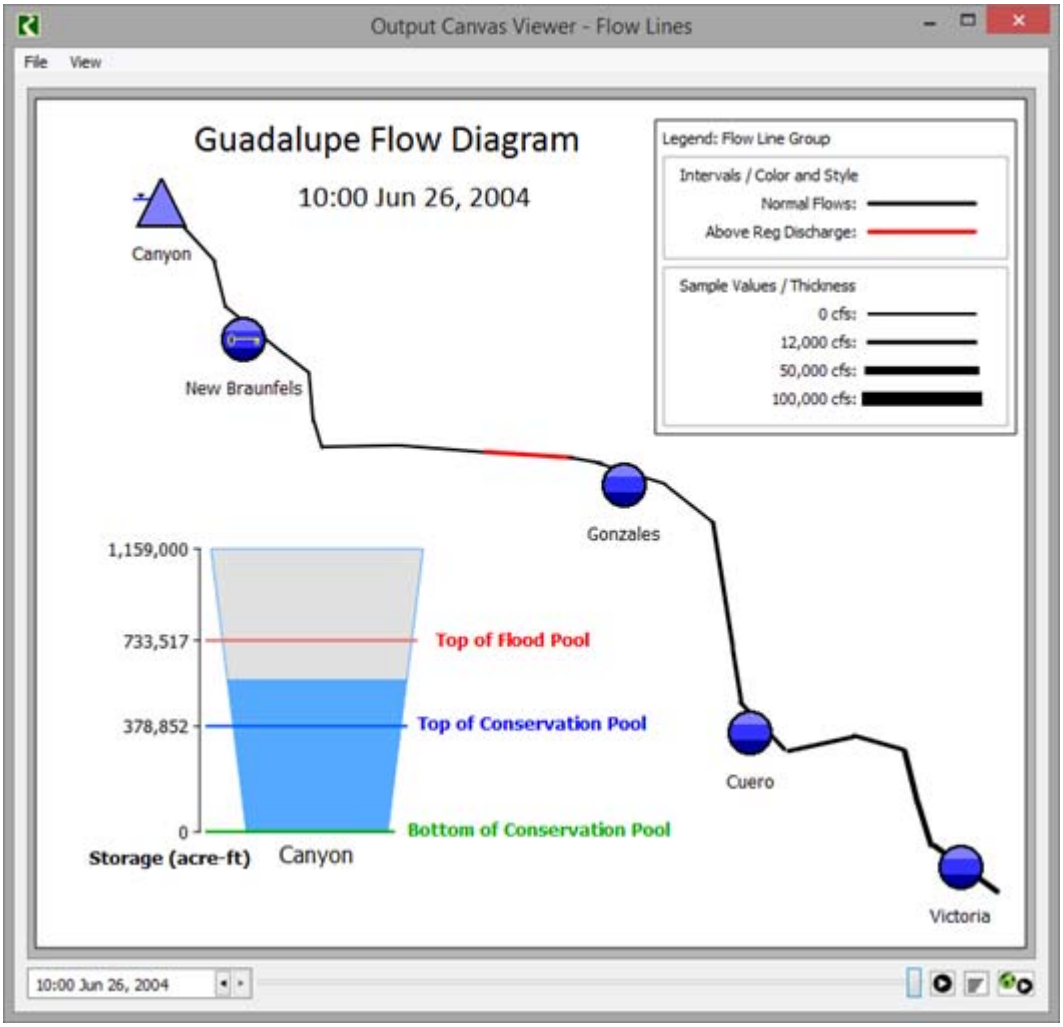
❑ When finished close the chart.

Output Canvas

There is one pre-configured Output Canvas named **Flow Lines.**

❑ In the Output Manager, highlight that row and select the Generate button.

The output canvas shows a teacup diagram of the Canyon storage, again differentiated by operating levels and pools. It also shows lines that represents the flows in the river. Advance the time slider and watch the lines get thicker as more flow goes through the river and change to red as the Control Point flow goes above the regulation discharge at each control point.



❑ When finished close the canvas.

> **Tip:** These output devices are simple but show some of the functionality that you may want to consider implementing. See the documentation and video tutorials on riverware.org for more information on the Output Canvas.

We will import and show these directly from the CAVI in the next chapter.

❑ Use the File and then Save As. Enter the name `Guadalupe_Basin_Hourly.mdl`.

> **Tip:** No ".gz" is necessary because the model is small. With a .mdl extension, the model has the RiverWare logo in the windows explorer.

❑ In the confirmation, select to **Save Outputs in Model File** with a Precision of 12.

❑ Exit RiverWare as this ends the tutorial.

4 Setting up the RiverWare Model in the CAVI

In this exercise, you will prepare the watershed and then import the RiverWare model.

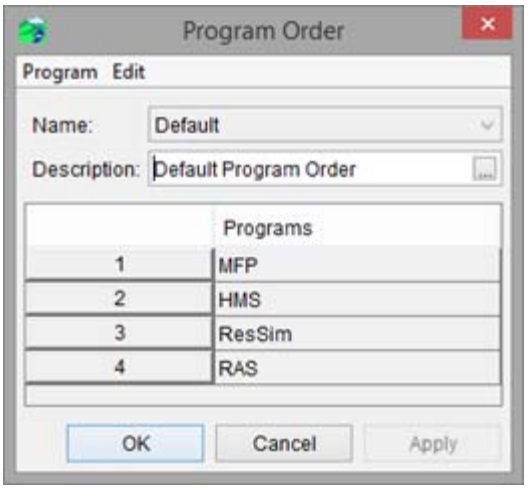
- Open the existing watershed
- Define a new program order
- Import the RiverWare model
- Define the model alternative keys
- Create new forecast runs

❑ First, open the CAVI and load the watershed you saved at the end of Chapter 4, `MyGuadalupe`.

4.1 Define Program Order

In this section, we'll provide instructions on how to replace ResSim with RiverWare in the Program Order. A watershed can only have one program order so once this is finished, we won't be running ResSim anymore. We could set it up to run both models, but for simplicity and run time, we'll just transition the watershed to use RiverWare.

❑ With the **Setup** tab selected, use the **Models** and then **Program Order** menu to open the following dialog.

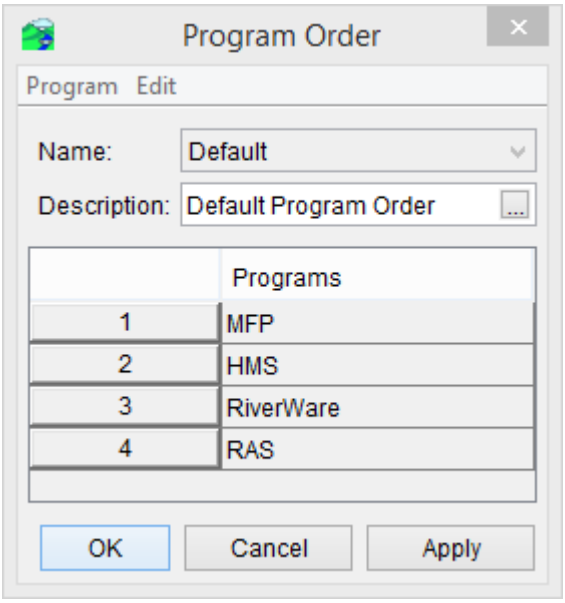


❑ Select the **ResSim** row and use the **Edit** and then **Insert Before** menu.

❑ Select `RiverWare` from the **Name** menu.

❑ Now remove ResSim: With the ResSim row selected, use the **Edit** and then **Remove** menu. Confirm the removal.

The Program Order should look like this:



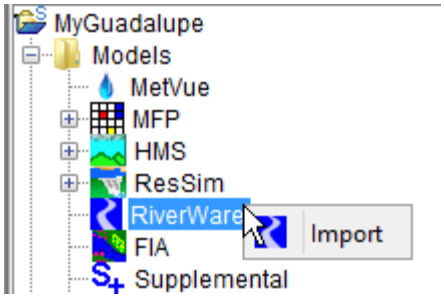
❑ Select **OK** and **Yes** on the confirmation.

Finally, we are ready to import the RiverWare model.

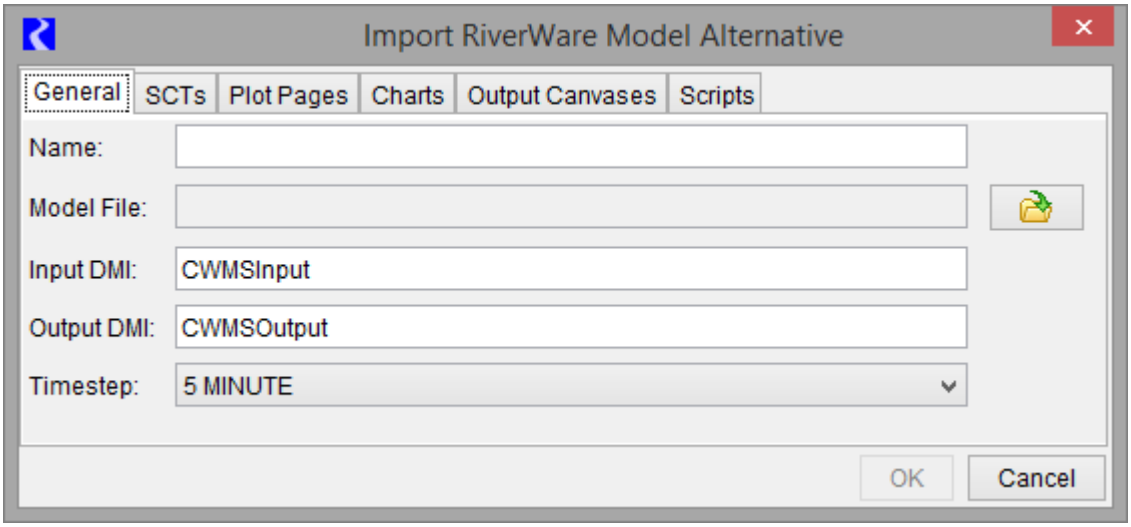
4.2 Import the RiverWare Model

In this section, we will import the Guadalupe RiverWare Operations Model into the watershed.

❑ In the **Setup** tab, right click on the RiverWare row. Select **Import**



The **Import RiverWare Model Alternative** dialog opens.



The dialog has six tabs with the steps for each described in the following sections.

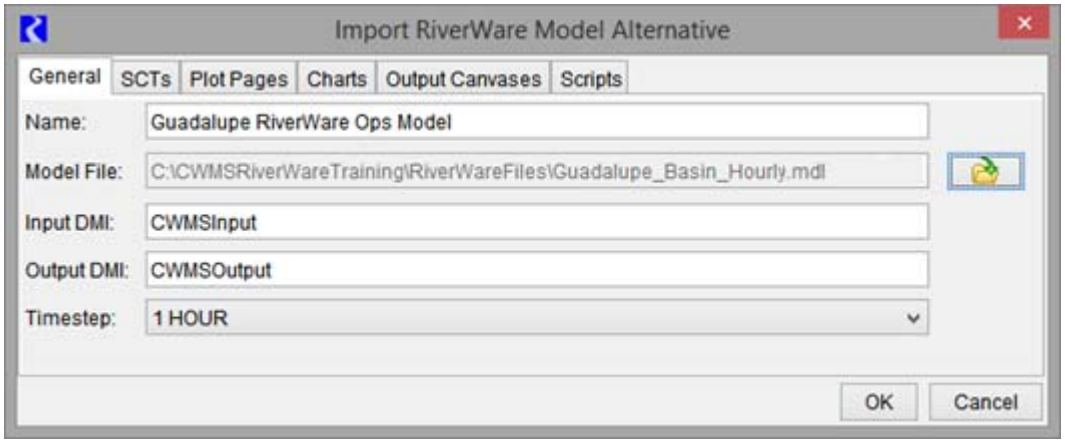
General

The general tab is where you specify the name, model file, DMIs and timestep.

- ❑ For the **Name**, type: `Guadalupe RiverWare Ops Model`
- ❑ For the **Model File**, select the folder button.
- ❑ Select the model file:
  - Use the model you modified in Chapter 3: `C:\CWMSRiverWareTraining\RiverWareFiles\Guadalupe_Basin_Hourly.mdl`
  - If you didn't quite finish that exercise, use the backup model file. `C:\CWMSRiverWareTraining\RiverWareFiles\GuadalupeOpsModelFinished.mdl`
- ❑ For the **Input DMI**, we used the default name in the RiverWare model, so leave it as `CWMSInput`.
- ❑ For the **Output DMI**, we also used the default name in the RiverWare model, so leave it as `CWMSOutput`.
- ❑ For the Timestep, change it to 1 HOUR.

> **Tip:** We'll show how to use a 1 DAY model in "Using A RiverWare Model with a Different Timestep" on page 6–5

It should look similar to this:



SCTs

❑ Switch to the SCT tab

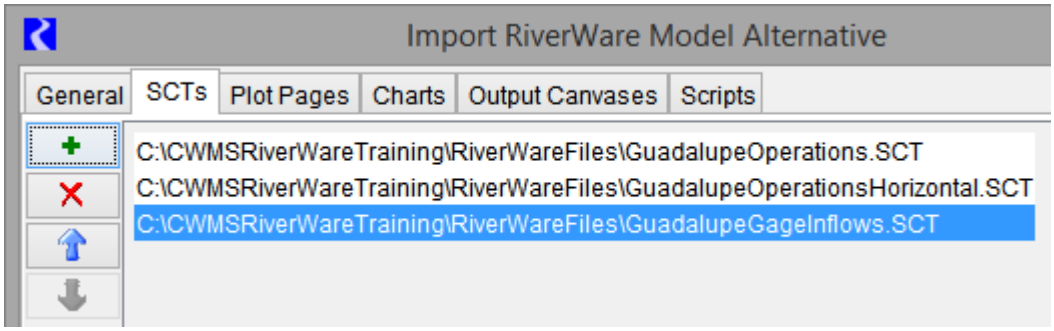
Since SCTs are always saved as separate files, we must select each one.

❑ Use the "+" button and select:
`C:\CWMSRiverWareTraining\RiverWareFiles\GuadalupeOperations.SCT`

❑ Repeat this step twice to select two more SCTs:

- `GuadalupeOperationsHorizontal.SCT`
- `GuadalupeGageInflows.SCT`

It will look like the following (with your paths, of course)



Plot Pages

❑ On the **Plot Pages** tab, select all six plot pages.

Remember in Chapter 3, we created the `Unregulated Inflows` plot. This step will make it available directly from the CAVI.

Charts

❑ On the **Charts** tab, select the one chart **Canyon Pool Bar Chart**

Output Canvases

❑ On the **Output Canvas** tab, select the one output canvas `Flow Lines`

Scripts

❑ On the **Scripts** tab, select all three scripts.

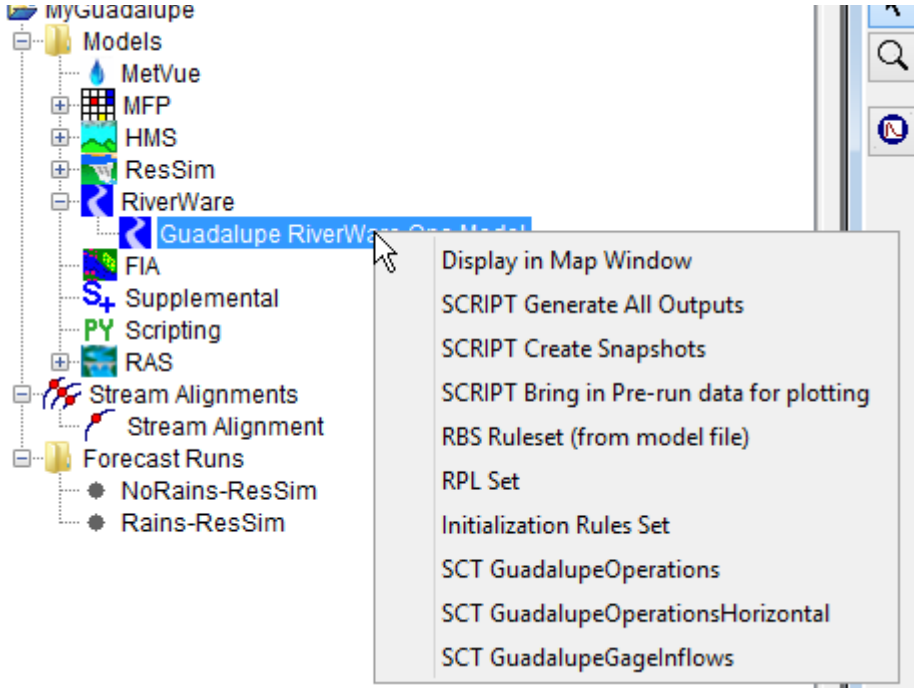
Do the Import

The Import configuration is complete.

❑ Select OK to import the model.

Behind the scenes, the CAVI is copying the model files from the specified folder to the Watershed\<name>\riverware folder. It takes a minute or so for the model to import.

Now the RiverWare model shows up in the list under RiverWare. Right click to see menus for many of these items you just configured.

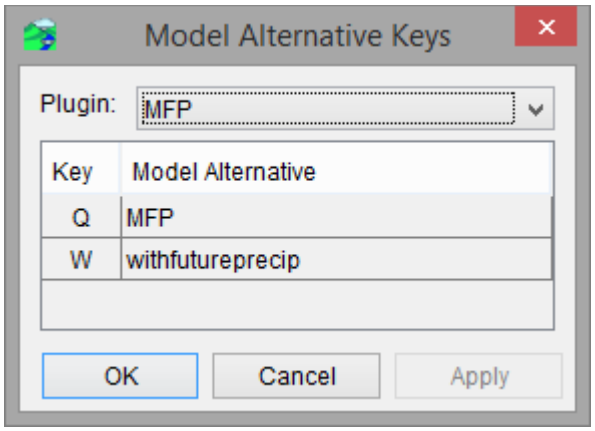


4.3 Define the Model Alternative Keys

For each model alternative, we need to define the Model Alternative Key. This defines how the data is accessed in the `forecast.dss` files.

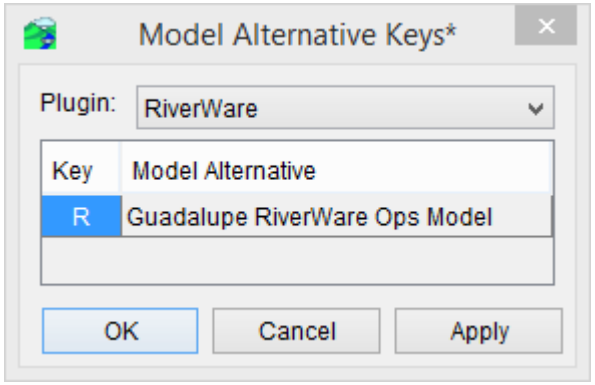
❑ In the **Setup** tab, use the **Models** and then **Model Alternative Keys** menu.

It shows the keys for MFP as Q and W.



❑ Select **RiverWare** as the Plugin.

❑ Enter **R** in the row for the Guadalupe RiverWare Ops Model:

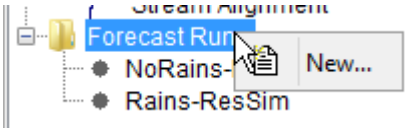


❑ Select OK to save and close.

4.4 Create New Forecast Runs

As noted in the RTS/CWMS help "A *forecast run* is a single forecast scenario defined by a specific set of data, information, and model alternatives." Let's create two forecast runs to go along with the two we already have.

❑ In the **Setup** tab, right-click on the **Forecast Runs** and select **New**.



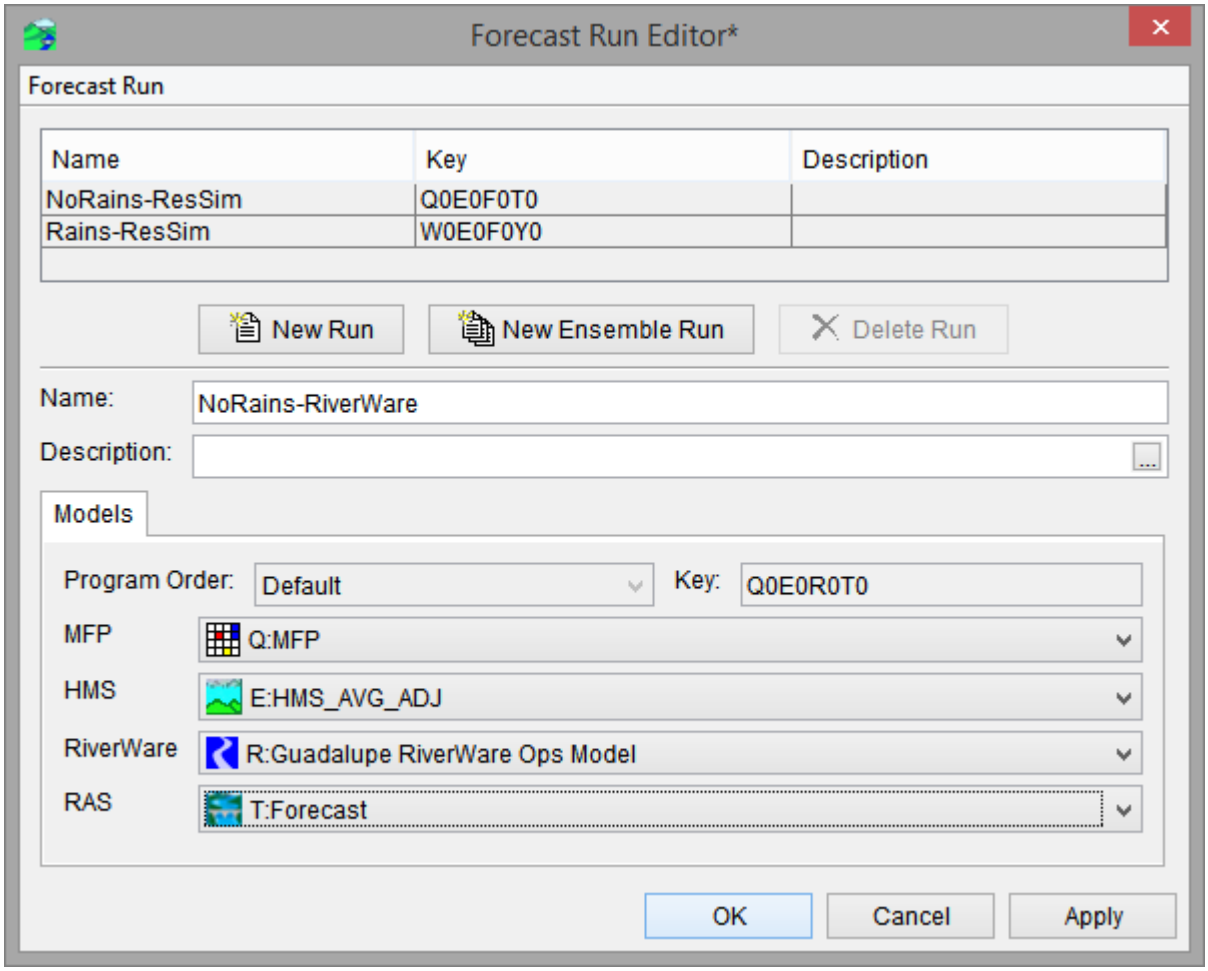
❑ In the Forecast Run Editor, select the **New Run** button.

❑ For the Name enter `NoRains-RiverWare`

❑ For MFP, select Q:MFP

HMS and RiverWare only have one alternative model, so no changes are needed.

❑ For RAS, select T:Forecast

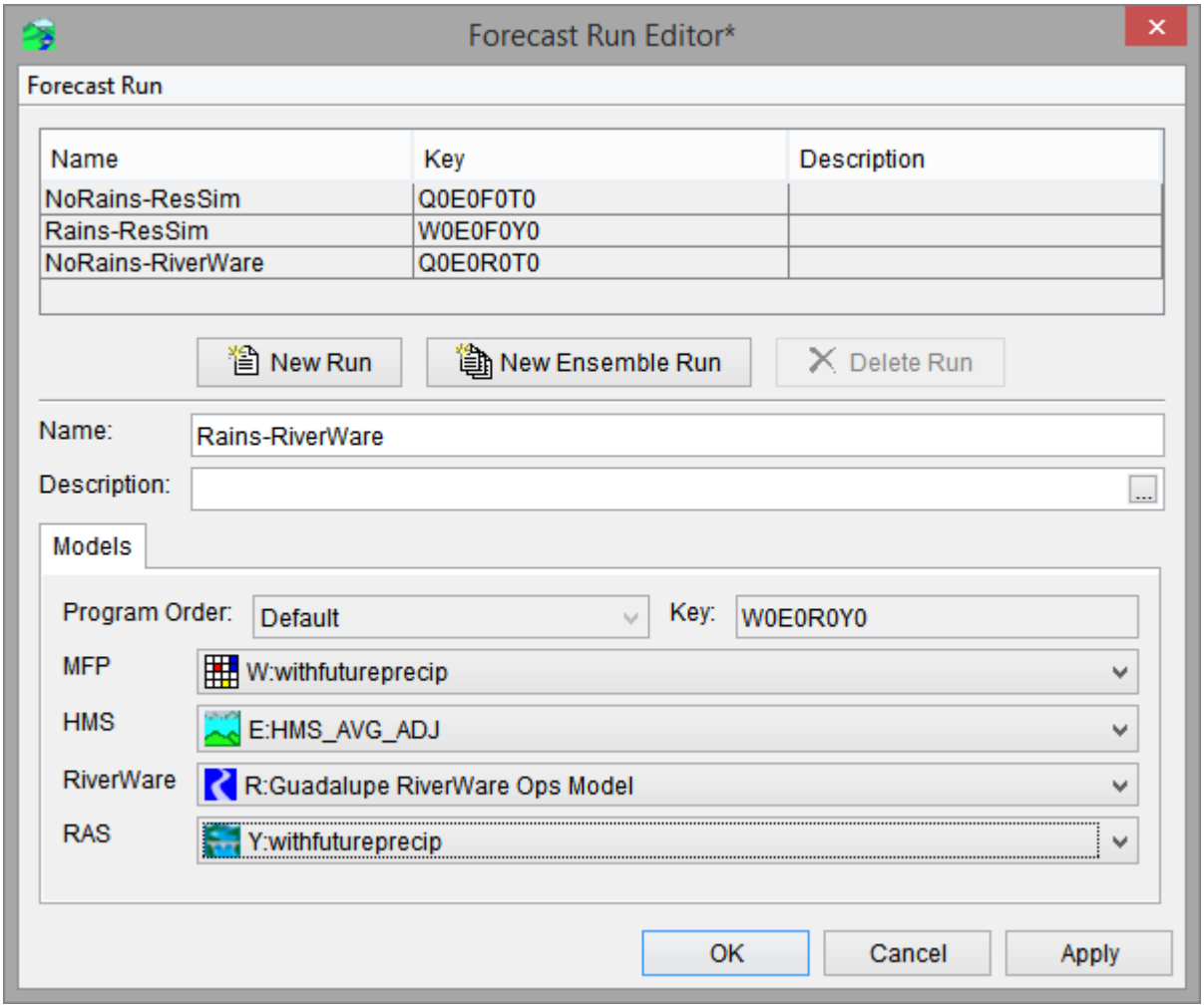


❑ Select **Apply** to save the changes but leave the dialog open.

❑ Select **New Run** again

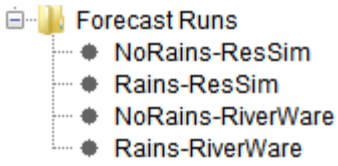
- ❑ For the **Name** enter `Rains-RiverWare`
- ❑ For MFP, select W:withfutureprecip
- ❑ For RAS, select Y:withfutureprecip

It should look as follows:



- ❑ Select OK to create the Rains-RiverWare run.

Now there are four Forecast Runs listed.



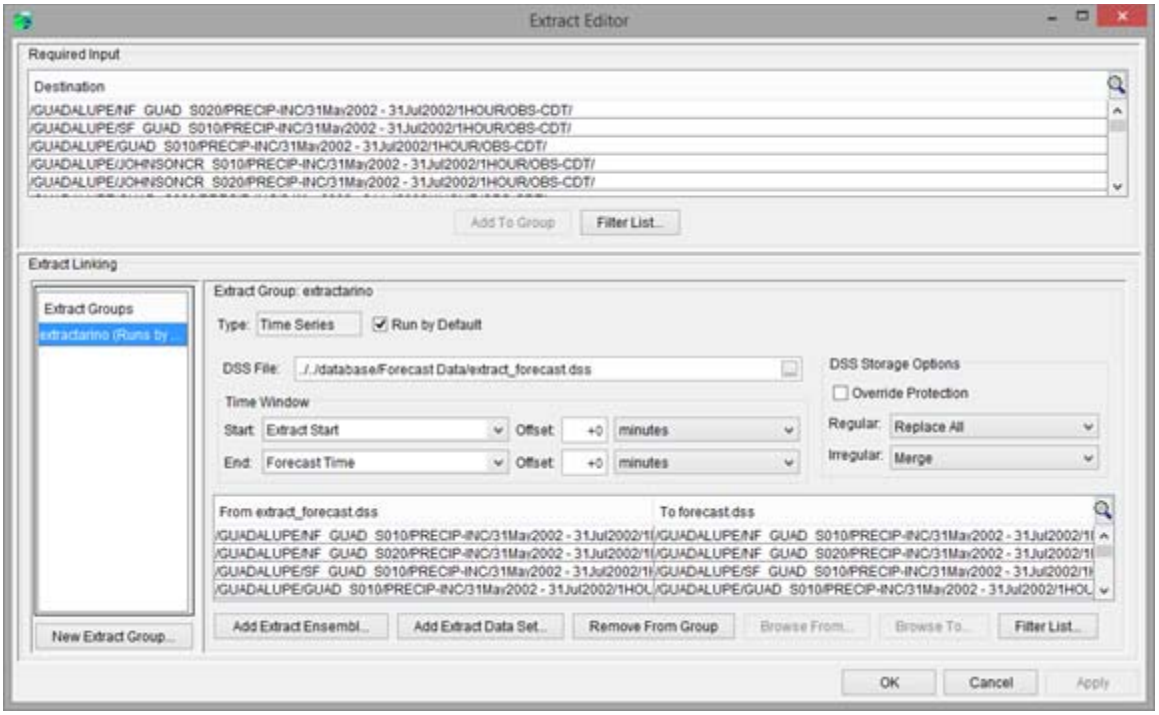
4.5 Define the Model Linking

The next step in the setup is to define where each model gets its required data, either from the extract list or from upstream models.

Extract List

Let's look at the extract configuration first.

❑ Select the **Setup** tab and then use the **Models** and then **Edit Extract** menu. (This may take a moment to refresh)



This extract group was configured to copy files from an extract DSS file to the forecast.dss file. This could be set up to pull data from the CWMS Oracle database (for CWMS) or other locations for RTS. Note that it is configured to **Run by Default**.

❑ In the middle of this dialog, make sure the DSS file points to the `../../database/Forecast Data/extract_forecast.dss`. If not, reselect the file.

❑ If no changes, select **Cancel**. If you made changes, select **OK**.

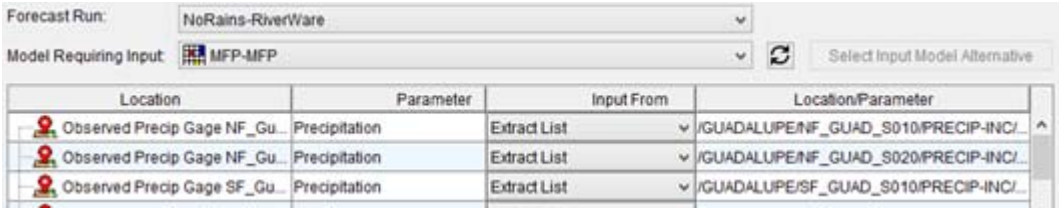
Linking MFP

Since we inserted RiverWare model into the system, we need to configure the model linking for it and for the downstream RAS model. The HMS and MFP models should be OK but let's also verify them.

❑ On the **Setup** tab, select **Models** and then **Model Linking**.

❑ For the **Forecast Run**, select NoRains-RiverWare.

❑ For the Model Requiring Input, select MFP-MFP.



These should all be OK, pointing to the Extract List. No changes are needed.

Linking HMS

Now let's link HMS, some variables point to MFP and some point to the Extract List.

❑ For the **Model Requiring Input**, select **HMS-HMS_AVG_ADJ**.

All precipitation slots should point to MFP while all flows should use the Extract lits.

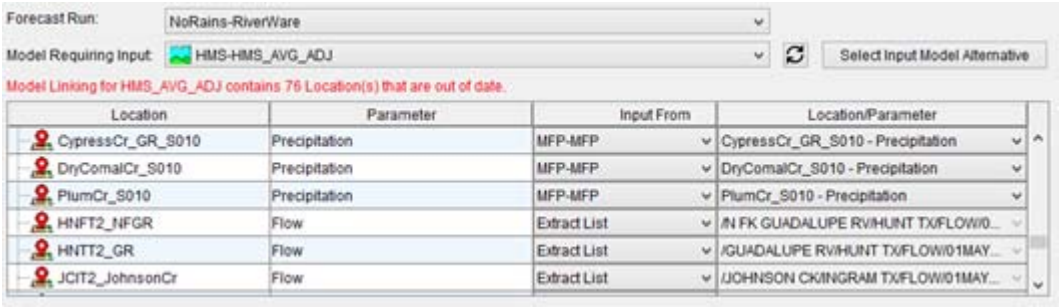
If not, follow this procedure:

1. Use the **Select Input Model Alternative** button
2. To reset these all, select **Extract List**. Select **OK** and **Yes** to confirm.

Now all items point to the Extract List. This isn't quite right either.

3. Select only the rows with `Precipitation` as the parameter
4. Use the **Select Input Model Alternative** button again.
5. This time, select MFP-MFP. Select **OK** and **Yes** to confirm.

The middle of the dialog should look like this:



❑ Select **Apply** if enabled.

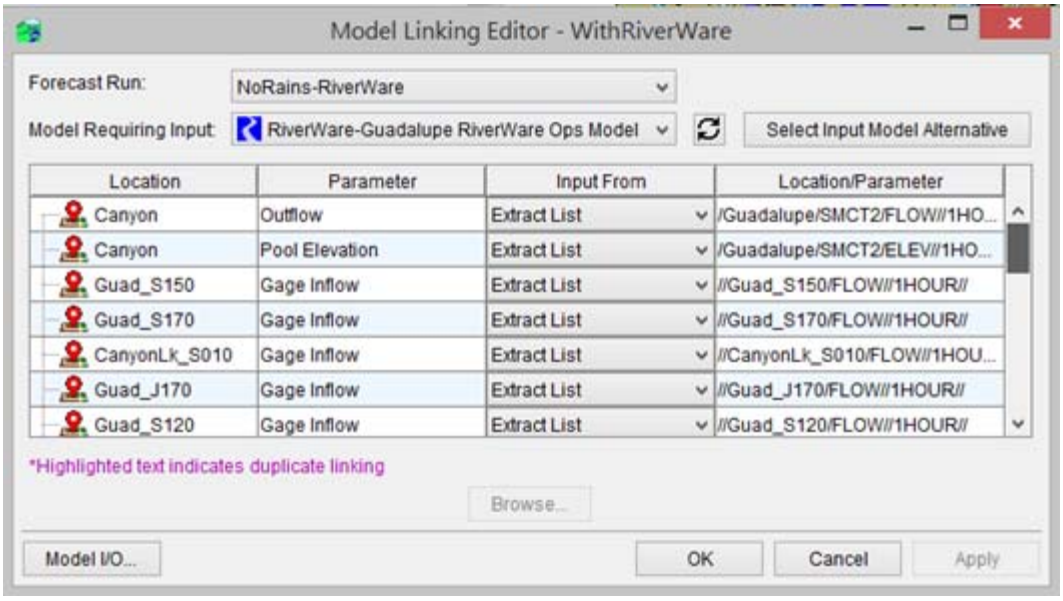
Linking RiverWare

Now, let's link the RiverWare inputs.

Note: The “HEC-RTS and CWMS RiverWare Plugin” currently only supports **one** set of links per watershed. Even though you select the Forecast run in the Model Linking Editor, the RiverWare linking settings apply to all Forecast Runs.

❑ For the **Model Requiring Input**, select **RiverWare-Guadalupe RiverWare Ops Model**.

It shows that all inputs will come from the Extract List.

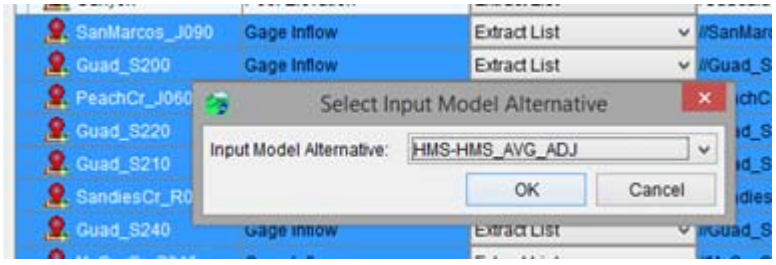


We only want the first two items **Outflow** and **Pool Elevation** to come from the Extract. These are initial values.The rest should come from HMS. We could change each individually, but that is time consuming. Instead, we can set them in one action:

❑ Select **all** `Gage Inflow` items, rows 3 - 25

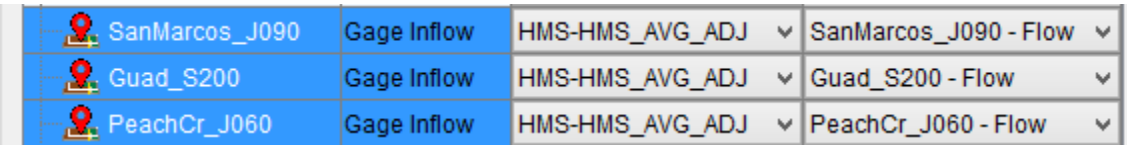
❑ Use the **Select Input Model Alternative**

❑ In the dialog that opens, select HMS-HMS_AVG_ADJ



❑ Select **OK** and **Yes** to confirm.

All rows now say the HMS model and the location/parameter columns correctly match each parameter. For example:



❑ Select **Apply** to save.

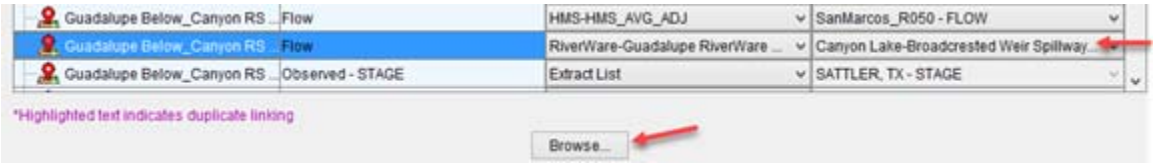
Linking RAS

Let's do RAS next.

❑ Change the **Model Requiring Input**, at the top, to RAS-Forecast.

The CAVI fills in the data pretty well. We only need to change one value:

❑ Select the row for RS293.020.

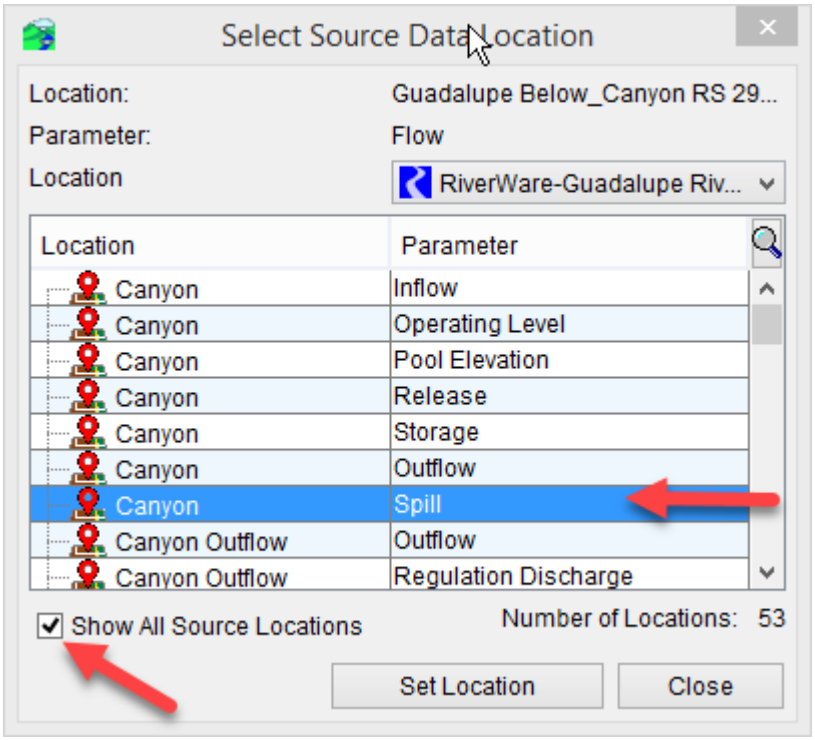


It is trying to link it to Canyon Lake-Broadcrested Weir Flow as that is what it is called in ResSim. We want to link this to the Canyon Spill in RiverWare. This isn't in the list, so...

❑ Select the **Browse** button as shown above.

❑ In the selector, click **Show All Source Locations.**

Now we see the Spill slot.



❑ Select Canyon Spill row and **Set Location.**

❑ Select **Close**

Now in the model linking, it correctly points to Canyon Spill.

That completes the linking for the “NoRains-RiverWare” linking.

❑ Select **OK** to confirm these changes.

Now let’s check the Rains-RiverWare Forecast.

❑ On the **Setup** tab, select **Modles** and then **Model Linking**.

❑ Select the Forecast Run: `Rains-RiverWare`

❑ For the Model Requiring Input, select **HMS-HMS_AVG_ADJ**.

❑ Check that the linking is pointing to MFP-withfutureprecip for all Precipitation slots. All flow slots should use the Extract List. If not, perform the steps in “Linking MFP” on page 4–9.

❑ Check the RiverWare linking for the Rains-RiverWare forecast. The first two (Outflow and Pool Elevation) should point to the Extract list, the rest (Gage Inflows) should use the HMS_AVG_ADJ. If not, perform the steps in “Linking RiverWare” on page 4–10.

❑ Check the RAS linking and make sure row RS293.020 points to Canyon Spill. If not, perform the steps in “Linking RAS” on page 4–12.

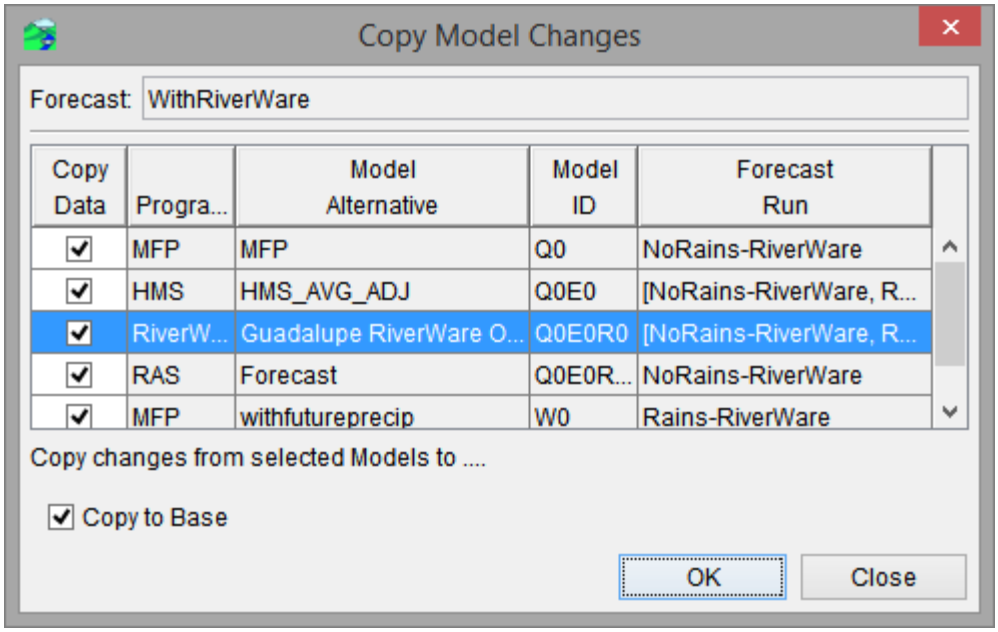
❑ When finished select **OK** to close the Model Linking.

We are all set up to start creating Forecasts in the next chapter.

❑ Save your watershed.

❑ Use the **File** and the **Exit** menu

The following dialog opens if any changes have been made:



❑ Select **OK**

5 Simulating with a RiverWare Model

In this exercise, we will simulate with the RiverWare model. To do this, we need to:

- Define a forecast
- Run the compute
- View results and iterate

This tutorial will walk you through these steps.

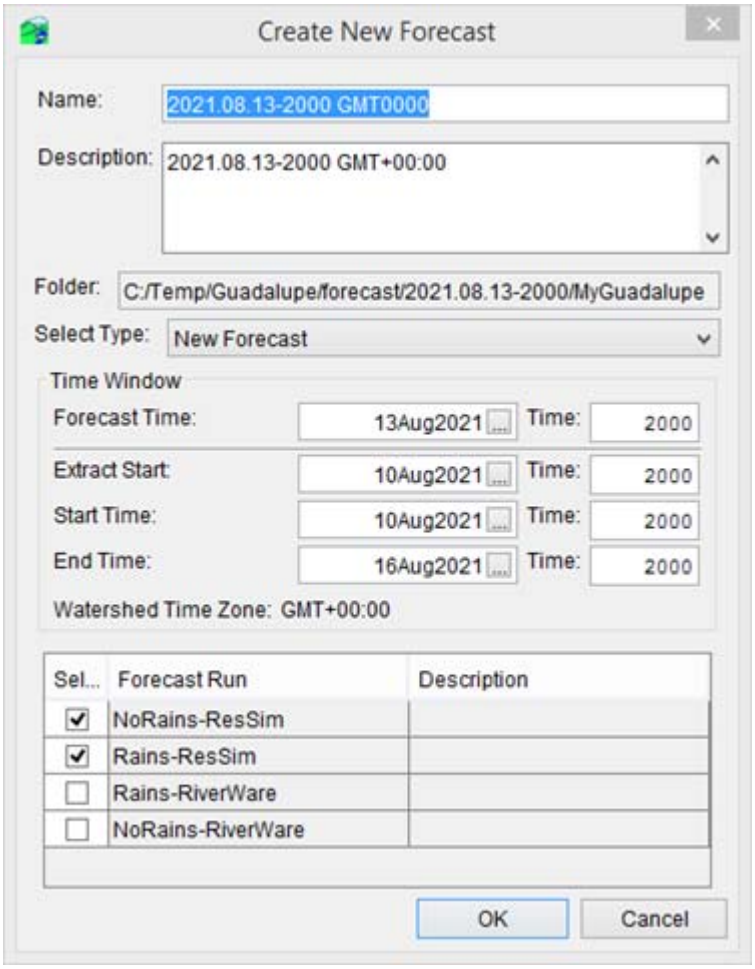
5.1 Define a Forecast

❑ Open the CAVI and load the `MyGuadalupe` watershed you created at the end of Chapter 4.

As the RTS/CWMS help says “A forecast is a time window, that is associated with one or more forecast runs.” Let’s create a forecast that is associated with our “NoRains-RiverWare” and “Rains-RiverWare” forecast runs.

❑ Select the **Modeling** tab

❑ Use the **Forecast** and then **New** menu.



❑ For the Name, enter `WithRiverWare`

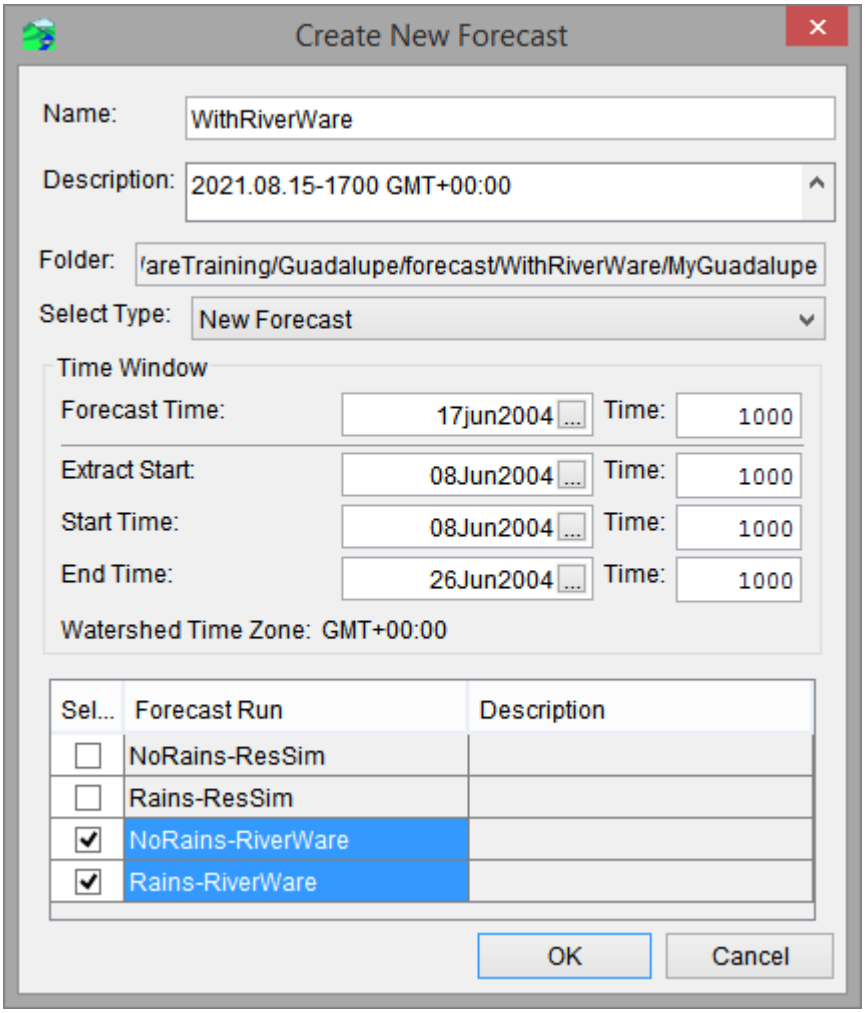
The Create New Forecast dialog defaults to creating a forecast to the time it is created. This assumes you are doing real-time forecasting. In our case, we have data for a June 2004 historical event.

❑ For the times, enter the following, (note, the text/format must match exactly!):

- Forecast Time: 17Jun2004 1000
- Extract Start: 08Jun2004 1000
- Start Time: 08Jun2004 1000
- End Time: 26Jun2004 1000

❑ For the Forecast Runs, de-select the two Res-Sim options and select the two RiverWare options.

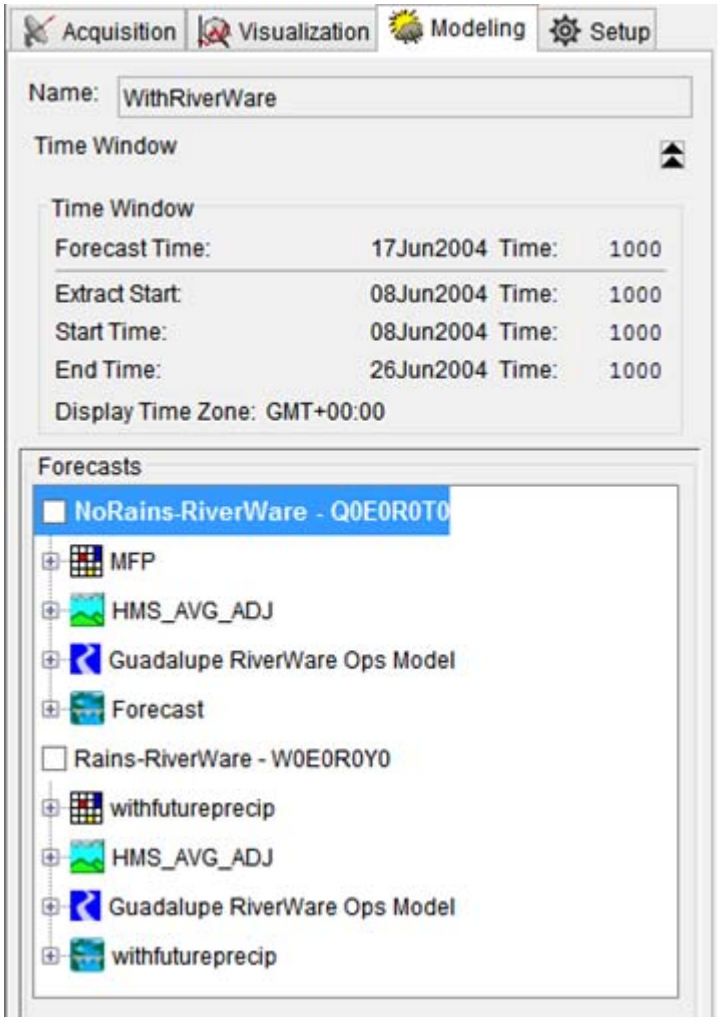
The dialog should look like this:



❑ Select OK

A progress dialog will show the status of copying the watershed models to the forecast folders.

Now the modeling tab will show the forecasts. Note that **NoRains-RiverWare** has the keys Q0E0R0T0 while **Rains-RiverWare** has the W0E0R0Y0 keys.



5.2 Icons on the Map

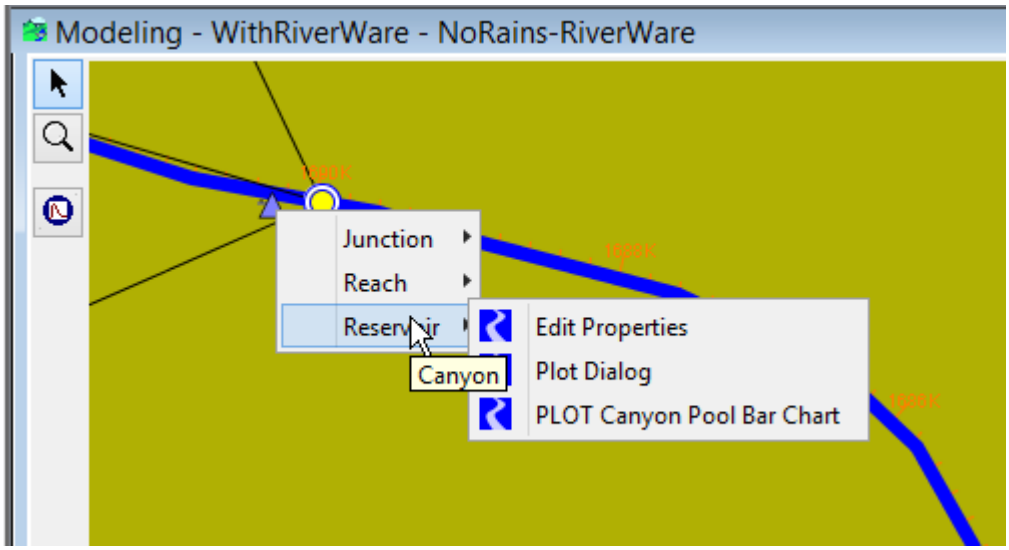
Once a forecast is defined, the RiverWare object icons will now show up on the Modeling map within the CAVI.

❑ Zoom into the map using the mouse wheel or zoom magnifying glass.

RiverWare object icons remain the same size regardless of zoom, but by zooming in, you can differentiate them from other objects.

❑ With the arrow cursor, right-click on an object to get a menu

In the screenshot below, we zoomed in on Canyon and then right-clicked to get the Reservoir menu. We can open the object or look at the plots.

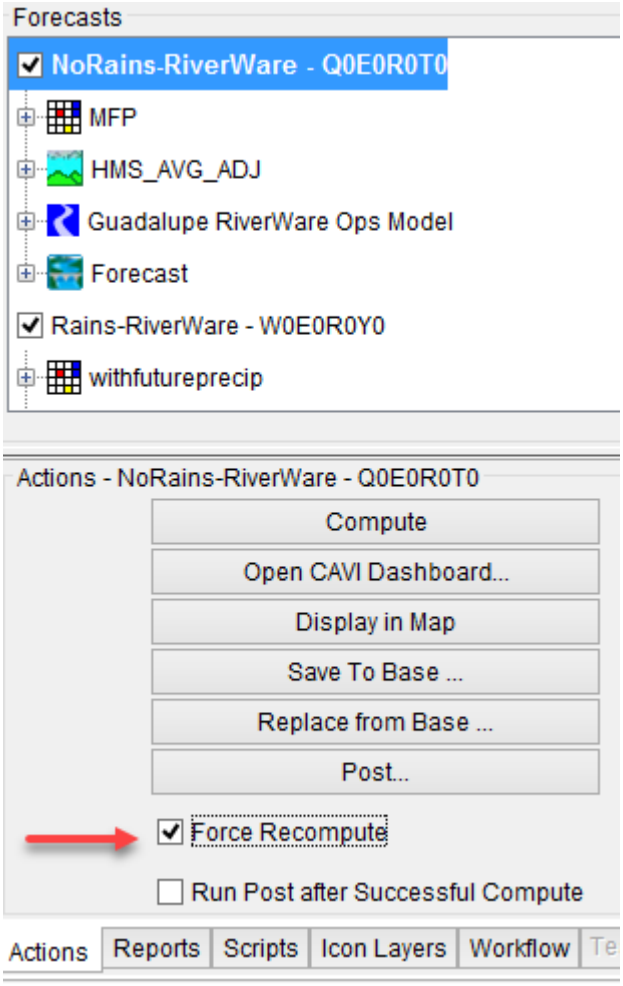


This view could be useful if you are looking for a particular item and know where on the map it is located.

5.3 Compute

As in Chapter 4, a "compute" runs the models in the specified order, transferring data from one model to the next. In this section, we will run our two forecasts that include RiverWare.

❑ With NoRains-RiverWare selected, in the **Actions** tab, select **Force Recompute.**



❑ Then, select the **Compute** button.

Note: There are various ways to start a compute, we'll give you one or two.

The models should run and post messages to the compute progress dialog.

Just like when using the forecast `WithResSim`, the RAS model takes the longest, followed by HMS and RiverWare.

❑ Once RAS finishes, look at the profile plot by right-clicking on the `Forecast` RAS model and selecting **Profile Plot**.

❑ Animate and watch the small flood wave pass.

Now, let's run the larger inflow event in the Rains-RiverWare forecast.

❑ Select the Rains-RiverWare forecast and do a Compute.

Go get a cool drink while you wait for it to finish!

❑ When finished, look at the RAS profile plot.

Notice the larger flood wave passing downstream.

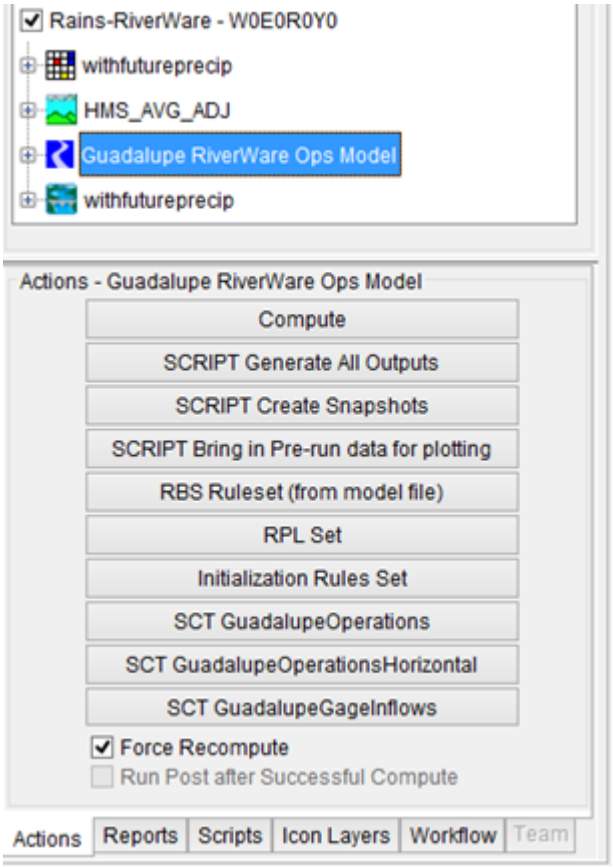
5.4 View results

Within the CAVI, we can see all of the dialogs for each model. This is sometimes referred to as the “Native Model Interface” (NMI). We looked at some of these interfaces while setting up the RiverWare model, but now let’s look at them directly from the CAVI.

Plots, Scripts, Charts, and Output Canvas

Most of the items that you selected when importing the model can be found on the **Actions** and **Reports** tabs when the RiverWare model is selected.

❑ Within the Rains-RiverWare run, select the RiverWare alternative and the **Actions** tab

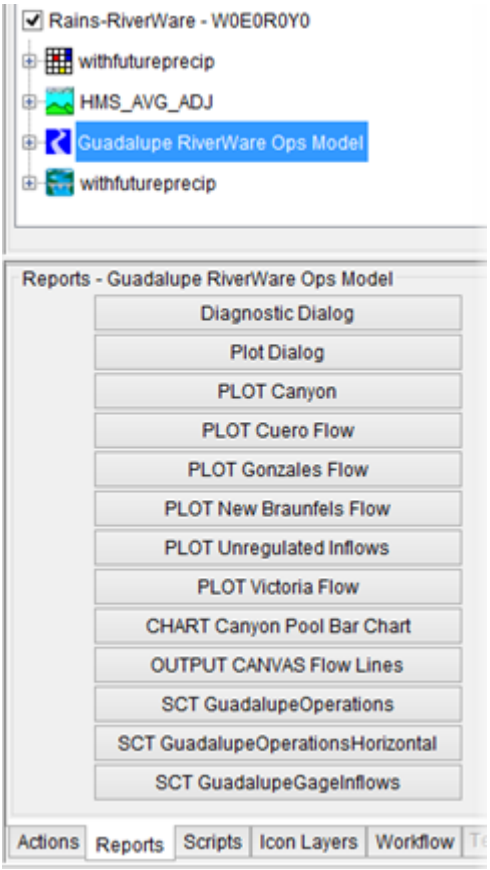


Notice the three Script buttons, the RPL set editor buttons and the SCT buttons.

❑ Click any of these to see what opens.

Note: RiverWare dialogs sometimes open behind the CAVI.

❑ Select the **Reports** tab.



Notice the Plot, Chart, Output Canvas and SCT buttons.

❑ Explore some of these buttons to see the results of the run.

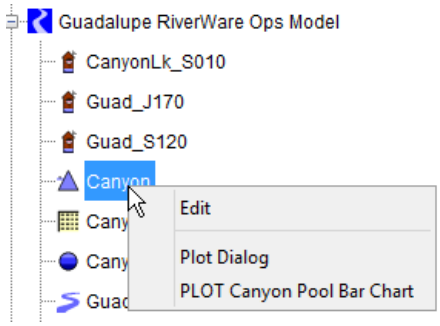
> **Tip:** Right clicking on the RiverWare Model also gives a context menu with both the Action and Reports tab items.

❑ Select the **Scripts** tab.

Notice that there is nothing listed. The RiverWare scripts are on the **Actions** tab. The **Scripts** tab contains only RTS/CWMS scripts and we haven't defined any of those.

❑ Expand the treeview for the RiverWare model and find **Canyon** reservoir. (See the following page for a screenshot)

❑ Right-click to get the following menu:



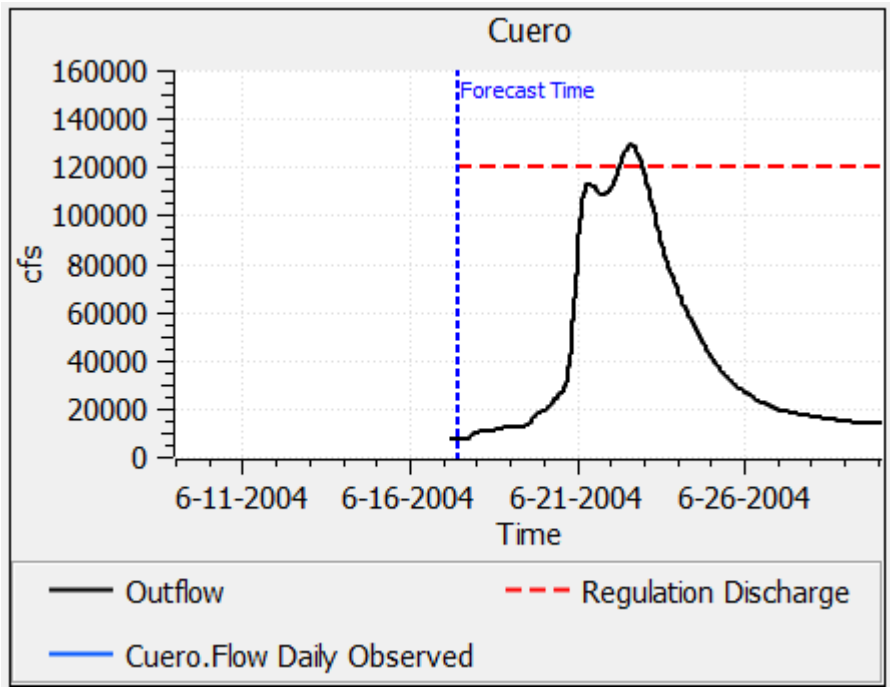
Try the three options:

- **Edit** will open the RiverWare Open Object dialog for Canyon
- **Plot Dialog** will open a general plot viewer with the last plot shown.
- **PLOT Canyon Pool Bar Chart** opens the Chart contains slots from Canyon.

Let's run a script to update some data on the plot

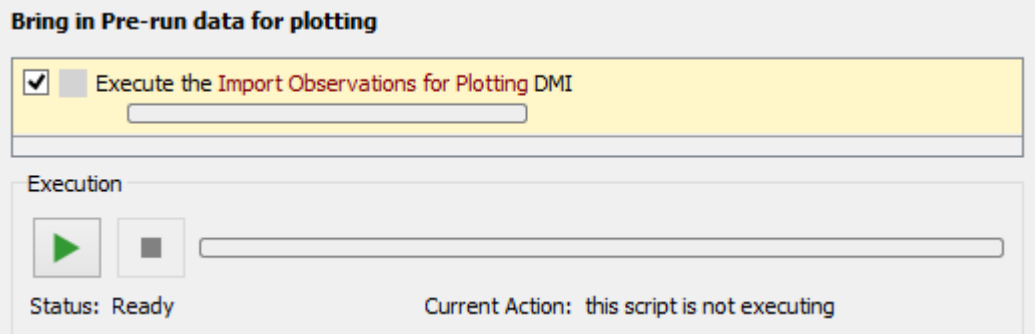
❑ On the Reports tab, select the **PLOT Cuero Flow**.

Notice there is no pre-run data to the left of the Forecast Time marker.



❑ On the actions tab, select the **SCRIPT Bring in Pre-run data for Plotting**

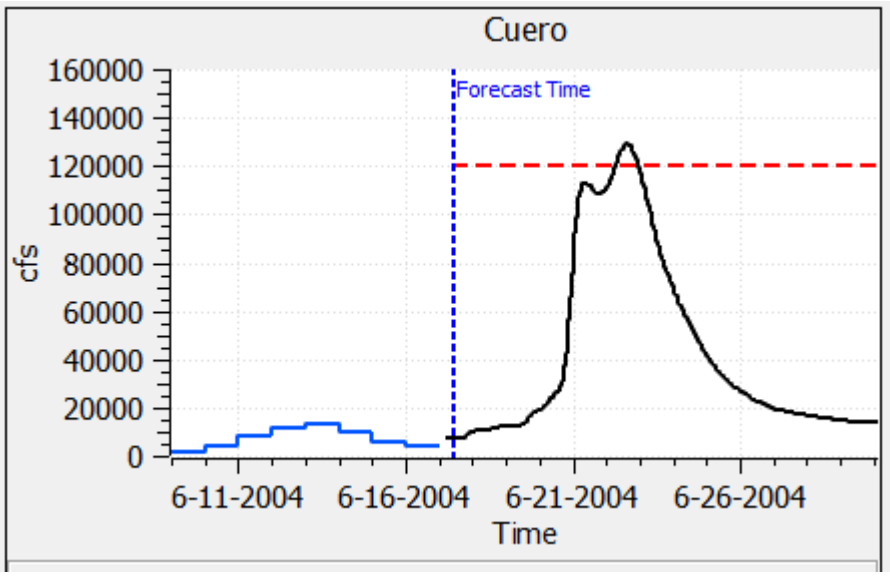
This opens the script dashboard.



❑ Click the green Start button and the script runs and executes a DMI to bring in that data.

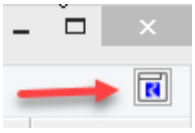
> **Tip:** If you get an error, it is likely the environment variable GUAD_CWMS was not set correctly. You can either go change that and restart the CAVI or go into the DMI Dataset and reselect the correct Excel file.

❑ Back on the Cuero plot, notice there is now daily data shown before the Forecast time.



This exercise example is a little contrived as we could have imported the observed data from the extract list. But it shows how scripting, DMIs and plots can be accessed from CAVI to help with operations.

> **Tip:** Don't forget, you can access any RiverWare dialog from the Workspace. Access the workspace from the CAVI toolbar or use the Show Workspace button in the upper right of many RiverWare dialogs.



5.5 Make Overrides and iterate

In this model, the outflows were computed by rules. As an operator, you might want to set values that are slightly different than the rules computed vales. Most operations models implement functionality that allows overrides. In this model, we have rule 2 Outflow Overrides that was described in "Operating Rules" on page 3–4. Let's put in some overrides.

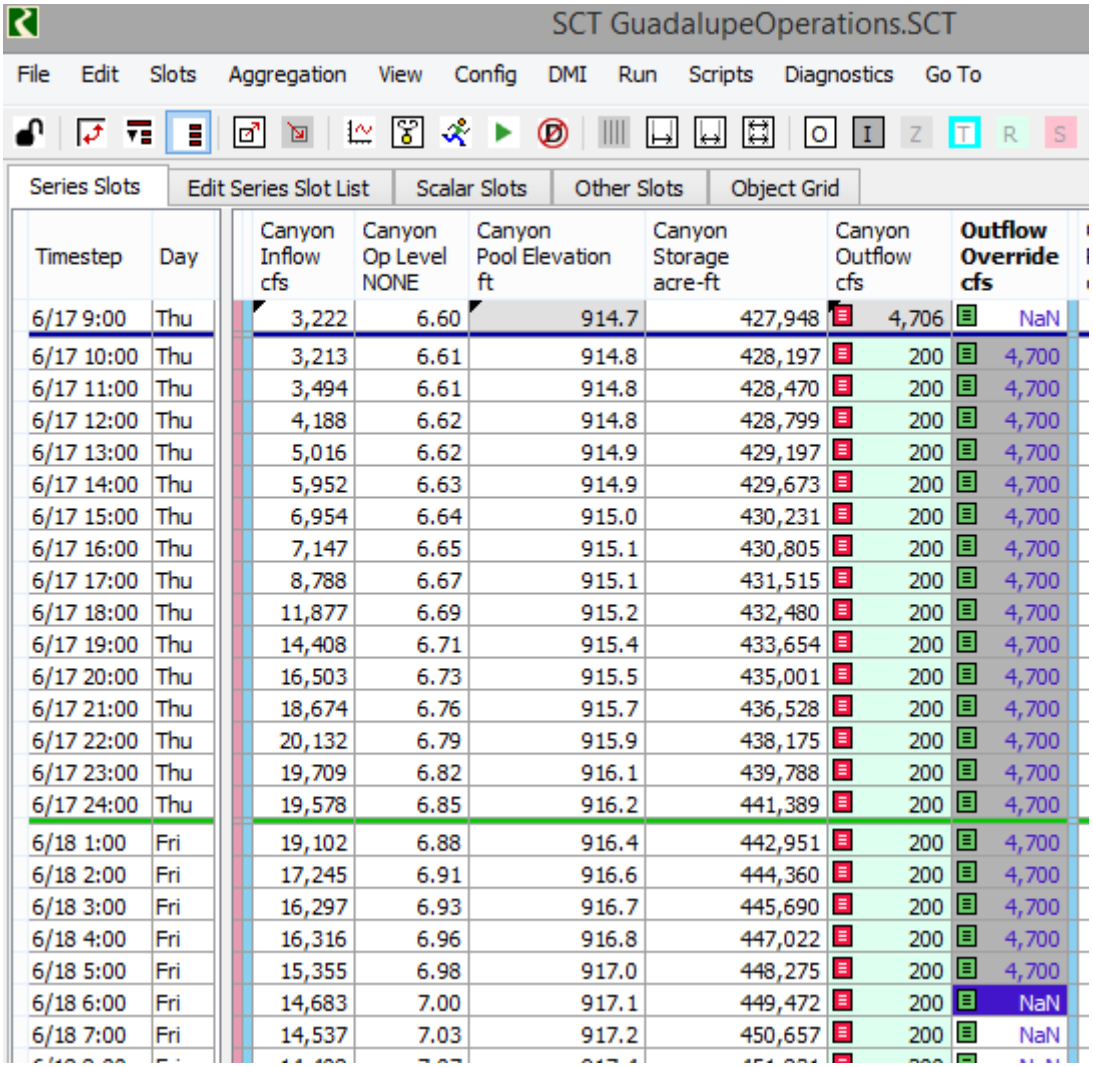
❑ On the Actions tab, select the **SCT GuadalupeOperations** button to open our SCT.

We see that the last known outflow was about 4700cfs on 6/17 9:00, Let's continue using that value until we can make the gate change on the 18th.

❑ Highlight cells in the **Outflow Override** column from 6/17 10:00 to 6/18 5:00.

❑ Type in 4700.

The image below shows what it should look like:



Timestep	Day	Canyon Inflow cfs	Canyon Op Level NONE	Canyon Pool Elevation ft	Canyon Storage acre-ft	Canyon Outflow cfs	**Outflow Override cfs**
6/17 9:00	Thu	3,222	6.60	914.7	427,948	4,706	NaN
6/17 10:00	Thu	3,213	6.61	914.8	428,197	200	4,700
6/17 11:00	Thu	3,494	6.61	914.8	428,470	200	4,700
6/17 12:00	Thu	4,188	6.62	914.8	428,799	200	4,700
6/17 13:00	Thu	5,016	6.62	914.9	429,197	200	4,700
6/17 14:00	Thu	5,952	6.63	914.9	429,673	200	4,700
6/17 15:00	Thu	6,954	6.64	915.0	430,231	200	4,700
6/17 16:00	Thu	7,147	6.65	915.1	430,805	200	4,700
6/17 17:00	Thu	8,788	6.67	915.1	431,515	200	4,700
6/17 18:00	Thu	11,877	6.69	915.2	432,480	200	4,700
6/17 19:00	Thu	14,408	6.71	915.4	433,654	200	4,700
6/17 20:00	Thu	16,503	6.73	915.5	435,001	200	4,700
6/17 21:00	Thu	18,674	6.76	915.7	436,528	200	4,700
6/17 22:00	Thu	20,132	6.79	915.9	438,175	200	4,700
6/17 23:00	Thu	19,709	6.82	916.1	439,788	200	4,700
6/17 24:00	Thu	19,578	6.85	916.2	441,389	200	4,700
6/18 1:00	Fri	19,102	6.88	916.4	442,951	200	4,700
6/18 2:00	Fri	17,245	6.91	916.6	444,360	200	4,700
6/18 3:00	Fri	16,297	6.93	916.7	445,690	200	4,700
6/18 4:00	Fri	16,316	6.96	916.8	447,022	200	4,700
6/18 5:00	Fri	15,355	6.98	917.0	448,275	200	4,700
6/18 6:00	Fri	14,683	7.00	917.1	449,472	200	NaN
6/18 7:00	Fri	14,537	7.03	917.2	450,657	200	NaN

❑ Run the RiverWare model directly from the SCT by clicking on the green start button the toolbar.

The model runs and the Canyon Outflow is set to 4700 cfs for those same timesteps. The 4700cfs overrides the computed flood control computed outflows because Rule 2 is higher priority.

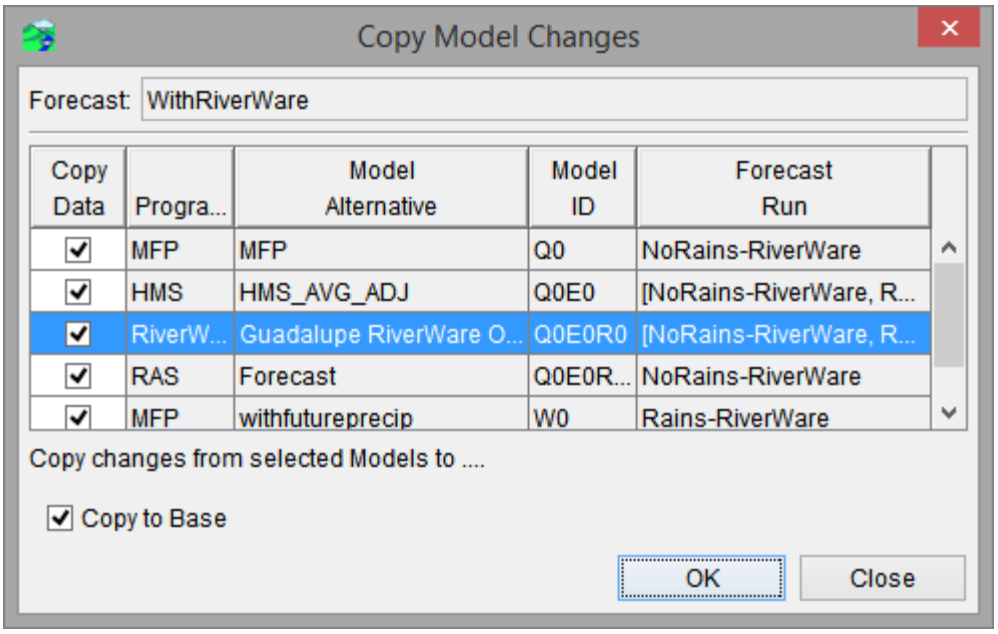
In a real operations, you might need to make additional changes and re-run, iterating many times until you are satisfied. In our case, one change proves that it works.

Now that we have made an override or a change to the data or model and we are confident it works, we should rerun the compute so that the RAS model is updated.

❑ If you'd like, select the **Compute** button and wait for the entire sequence to run.

5.6 Save the Models Back to Base

- ❑ Save your watershed
- ❑ Exit CAVI. The following dialog opens if any changes have been made:



Just like with other models, when you make changes to a forecast, they are only made in the copy in the forecast folder. If you want your changes to be available for subsequent forecasts, you will need to save the data back to the base directory. In that case, select the **Copy to Base.** If you do not want to save your changes for later forecasts, click **Close**.

In our case, we don't need to save our changes as they were just for the training exercise

- ❑ Uncheck **Copy to Base** and select **Close**.

6 Advanced Topics

This section introduces you to the following advanced topics

- Diagnostics and Debugging
- Changing a RiverWare model and items shown in the CAVI
- Running a RiverWare model that has a different timestep from the CAVI watershed

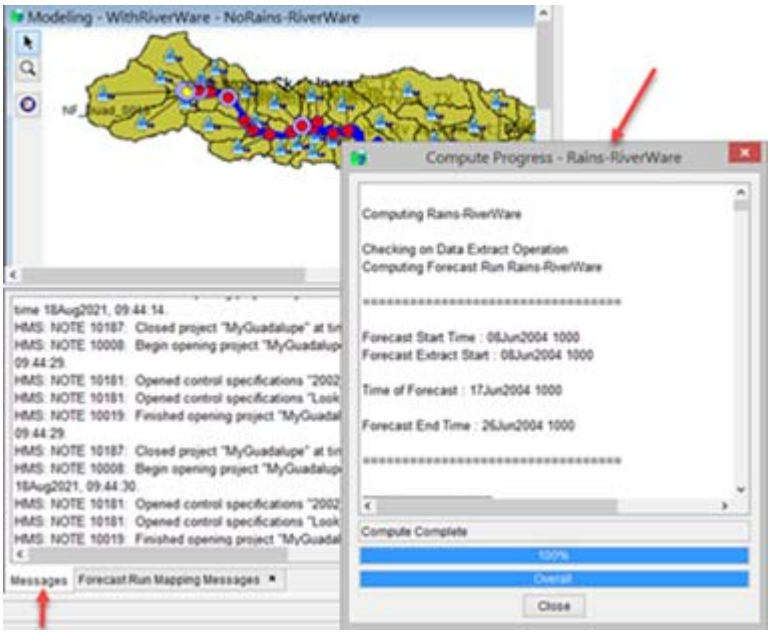
This chapter is mainly informational but there are some exercise steps to follow.

6.1 Diagnostics and Debugging

This section provides some information on how to diagnose problems. This can be complex as there are multiple, different models issuing messages and the CAVI itself issuing diagnostics.

CAVI Logs

The CAVI opens many dialogs and creates log files that include messages about computes. For example, in the following screenshot, there is both the Compute Progress and the CAVI message. These frequently post errors and warnings when they occur:

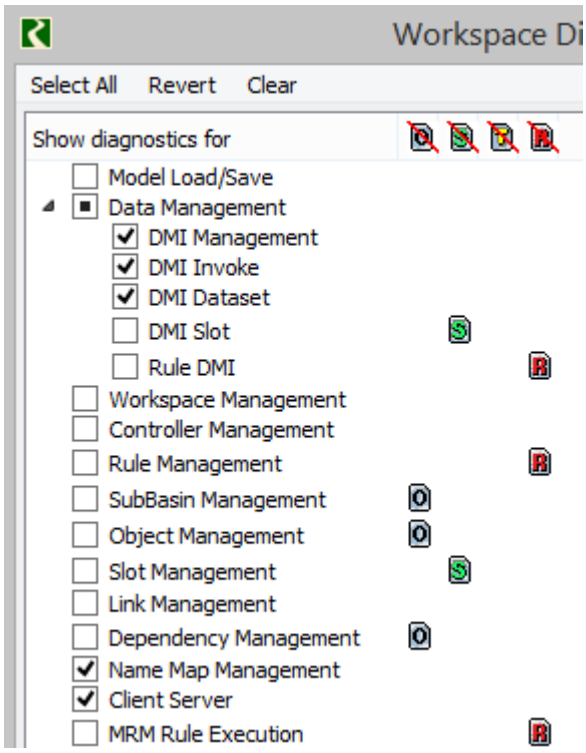


Also, from each model, there is typically a log file that you can open from the **Reports** tab. Use that feature to debug issues with those models. RiverWare diagnostics are described next.

RiverWare Diagnostics

RiverWare posts diagnostic messages on demand to the Diagnostic Output window or to a file. These are all configured from the Diagnostics Manager. See the RiverWare documentation, Debugging and Analysis section.

For debugging RiverWare DMI connection issues with DSS, we suggest using the Workspace diagnostic categories shown in the following image:



And don't forget that RiverWare has the RPL debugger and other debugging tools as described in the help. We cover many of these in the Rulebased Simulation course.

RiverWare log files

In addition, the "HEC-RTS and CWMS RiverWare Plugin" writes debug specific messages to log files in the user's TEMP folder, for example.

- RiverWarePlugin.log
- RwServer.27002.log
- RwCaviPlugin.log

❑ Navigate to your Temp folder by opening a windows explorer and typing %TEMP% in the address bar.

❑ Open the three files listed above in a text editor

The information is very much for debugging issues. Only go to these log files if there is a connection issue or program execution issue you can't debug using RiverWare diagnostics.

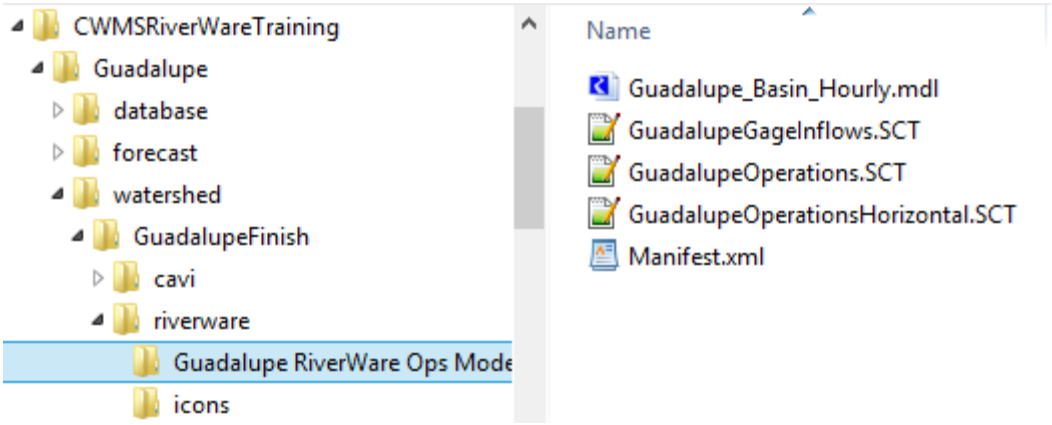
6.2 How to make Changes to a RiverWare Model

In "Preparing the RiverWare model" on page 3–1 we created a RiverWare model with everything we wanted to see in the CAVI. Then in "Setting up the RiverWare Model in the CAVI" on page 4–1 we imported the model into the CAVI.

In a real situations, this process may be iterative. You may find you need to make changes to the RiverWare model and then want to see those changes in the CWS CAVI. Of course making simple changes in the RiverWare model and then saving it back to base will work, but what if you have more major changes or you have new plots, scripts, etc that you want to display in the CAVI as buttons/menus? There are two options:

1. Re-import the RiverWare model. This option is straightforward, but you need to basically start from scratch. See "Setting up the RiverWare Model in the CAVI" on page 4–1 on importing a RiverWare model.
2. Copy in modified model files and then possibly modify the Manifest.xml file. The following section gives more information on how to do this.

❑ In a windows explorer, navigate to the following location:
`C:\CWMSRiverWareTraining\Guadalupe\watershed\MyGuadalupe\riverware\Guadalupe RiverWare Ops Model\`



When you imported a RiverWare model, a folder was created in the Watershed as shown above. Notice the model and the three SCTs we imported.

Also of note, there is the `Manifest.xml` file that defines all of the items in the model that are visible in the CAVI.

❑ Open the Manifest.xml file in a text editor. Our text editor colors the XML tags in blue:

```
<modelAlternative>
  <name>Guadalupe RiverWare Ops Model</name>
  <modelFile>Guadalupe_Basin_Hourly.mdl</modelFile>
  <sctFileList>
    <sctFile>GuadalupeOperations.SCT</sctFile>
    <sctFile>GuadalupeOperationsHorizontal.SCT</sctFile>
    <sctFile>GuadalupeGageInflows.SCT</sctFile>
  </sctFileList>
  <inputDmi>CWMSInput</inputDmi>
  <outputDmi>CWMSOutput</outputDmi>
  <timestep>1 HOUR</timestep>
  <plotList>
    <plot>Canyon</plot>
    <plot>Cuero Flow</plot>
    <plot>Gonzales Flow</plot>
    <plot>New Braunfels Flow</plot>
    <plot>Unregulated Inflows</plot>
    <plot>Victoria Flow</plot>
  </plotList>
  <chartList>
    <chart>Canyon Pool Bar Chart</chart>
  </chartList>
  <canvasList>
    <canvas>Flow Lines</canvas>
  </canvasList>
  <scriptList>
    <script>Generate All Outputs</script>
    <script>Create Snapshots</script>
    <script>Bring in Pre-run data for plotting</script>
  </scriptList>
</modelAlternative>
```

The structure of the XML file is pretty simple. If you create a new plot, chart, canvas, script, or SCT that you want to show as CAVI buttons, you just need to edit this file.

If you make a change to a RiverWare model, you may want to do the following in **BOTH** the watershed and forecast folders:

- Copy/save a new model or SCT file into the folder and make sure it has the same name
- Edit the Manifest.xml with any changes to plots, charts, canvas, scripts, SCTs, or DMIs.

> **Tip:** Make sure to make changes to **both** the watershed and forecast folders. When you created a forecast, the items in the watershed folder are copied to the forecast folder! For example, our forecast folder is: `C:\CWMSRiverWareTraining\Guadalupe\forecast\WithRiverWare\MyGuadalupe\riverware\Guadalupe RiverWare Ops Model`

❑ Since we aren't making any changes at this point, close the Manifest.xml file without saving. Also close the windows explorer.

6.3 Using A RiverWare Model with a Different Timestep

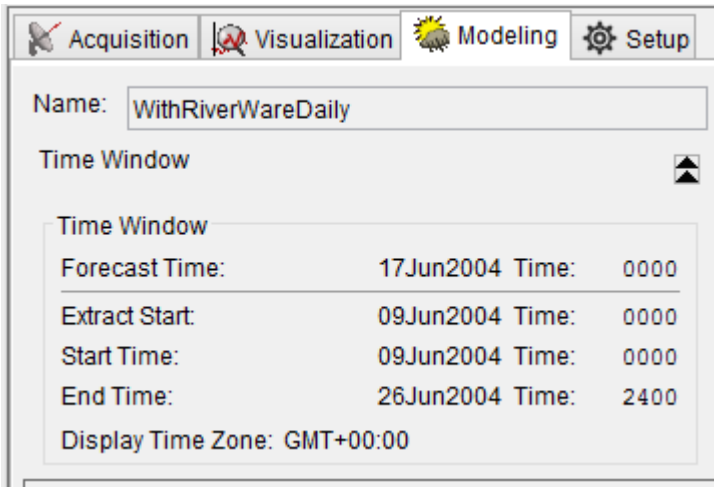
In some basins, the CAVI timestep is different than the desired RiverWare model timestep. Often the RTS/CWMS timestep is 1 hour while the RiverWare model is at a 1 day timestep. 6 hour RTS/CWMS and 1 day RiverWare or 1 hour RTS/CWMS and 6 hour RiverWare are also common.

This section describes the recommended RiverWare setup for this to work.

- ❑ First, open the CAVI.
- ❑ Use the **File** and then **Open Watershed** menu.
- ❑ Use the **Edit** button and add a Location that points to ~\CWMSRiverWareTraining\GuadalupeDaily\
- ❑ Once added, return to the Open Watershed dialog, select the new location and the `DailyOpsModel` watershed and open it.

  A watershed opens. It looks very similar to the Guadalupe watershed we have been using.
- ❑ On the Modeling tab, use the **Forecast** menu and open the `WithRiverWareDaily` forecast runs.

  There is only one forecast: `Rains-RiverWare`. It looks similar so far, the only visible difference is that we have moved the Time Window to match end of day periods so it aligns with the RiverWare timestep.

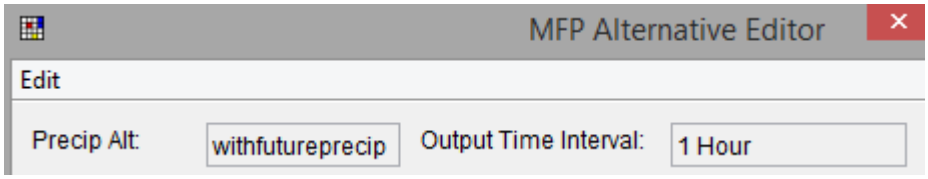


This change was mostly done for convenience. It would be possible to modify the RiverWare rules and DMI's to use a Forecast time that didn't start on 00:00 / 24:00.

Let's verify the HEC models are still at an hourly timestep.

- ❑ Right-click on the MFP withfutureprecip and select **Edit Alternative**.

In the MFP Alternative Editor, the Output Time Interval is 1 Hour.



❑ Close the dialog.

❑ Similarly, right-click on the HMS model and select Forecast Configuration.

The **Time Interval** is 1 Hour.

Thus, both upstream models are computing at a 1 Hour timestep.

❑ Close the dialog.

❑ Open RiverWare using the icon on the toolbar.

❑ Select the Run Control button.

Notice this run has a timestep size of **1 Day** and run range June 16, 2004 to June 26, 2004. Remember in RiverWare, June 16 means it is at 24:00 which corresponds to the CAVI forecast time of June 17 0000. They match! The RiverWare model Finish timestep is 24:00 June 26, 2004 and the CAVI End Time is 26June2004 2400. They also match.

Note, when we created this daily model we started the hourly model and made the following types of changes:

- Modified the timestep size and range.
- Modified the reach routing methods to a simpler method, step response. We then specified reasonable coefficients.
- Modified the Control Point Routing Coefficients.
- Changed DMIs and some RPL logic that had datetimes expressions similar to @"Start Timestep - 216". These were changed to include a timestep size.
- Changed the number of post-run dispatching timesteps from 90 (hours) to 4 (days).

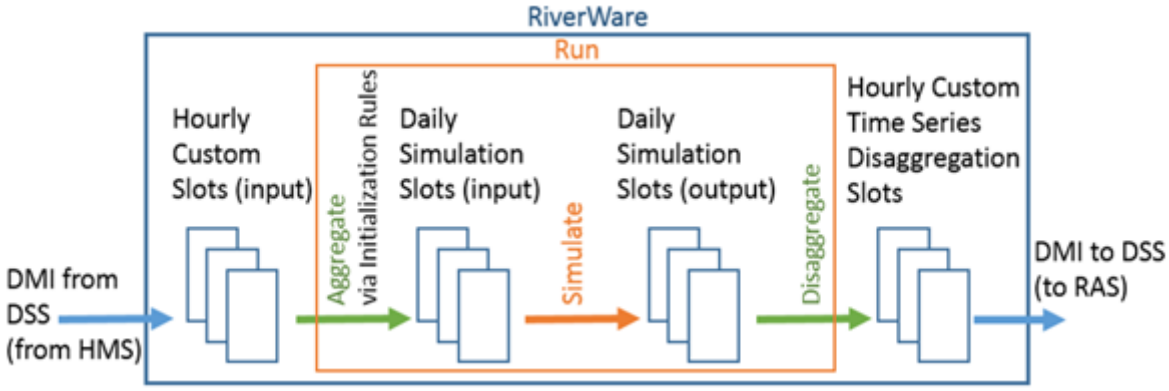
If you have a hourly model and go to a daily model, or vice versa, you would need to make similar changes.

> **Note:** When we imported this RiverWare model into the CAVI as a model alternative, we specified that it had a 1 DAY timestep size in the import general tab.

Overview of Component

To make the RiverWare model work in RTS/CWMS, there were a few steps that were performed to aggregate or disaggregate data within the RiverWare model.

The following diagram gives an overview of the process.



On the left is the input data from the upstream model, HMS. The data must be imported from the forecast.dss file to 1 Hour custom slots that are created on each relevant object. You'll look at these in the next section.

Aggregation is performed using Initialization Rules. The RiverWare run is then made at a daily timestep. At the end of the run, disaggregation is performed via Time Series Disaggregation Slots and exported to the forecast.dss file where it is picked up by RAS.

The following sections walk you through looking these components.

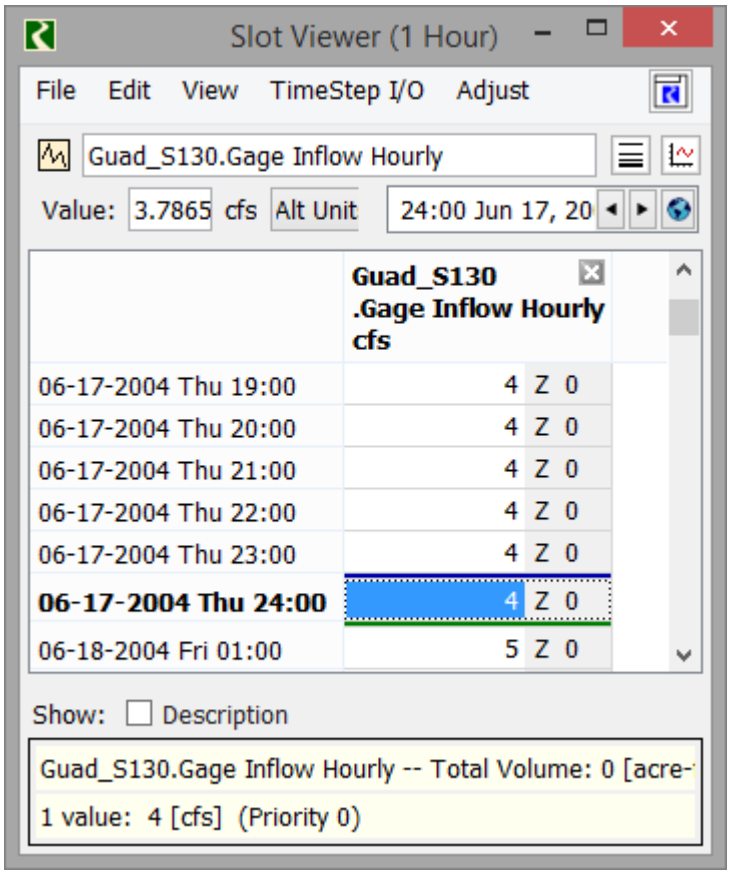
Custom Hourly slots for Input

Let's look at the hourly slots that were created to store the values from HMS.

❑ In the RiverWare model, open any gage object.

Notice there is a custom slot named Gage Inflow Hourly.

❑ Open the Gage Inflow Hourly slot



It has a 1 hour timestep and all the values are set with the Z flag by the DMI.

The other two hourly slots imported are on Canyon reservoir: **Canyon.Outflow Hourly IN** and **Canyon.Pool Elevation Hourly**

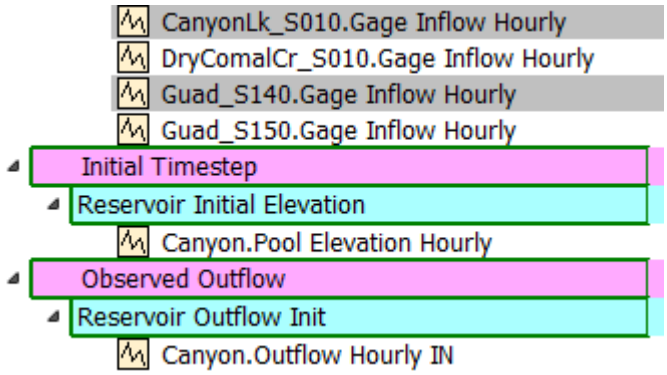
All of these custom slots were created strictly to store the data from HMS and the Extract list.

❑ On the workspace, use the **DMI** and **DMI Manager** menu.

❑ Double click the `CWMS Input DMI` to open it.

❑ Expand the tree views as shown below.

Notice that the CWMS Input DMI is now pulling the values into this slot, not the simulation slots.



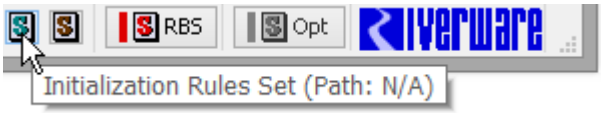
❑ When finished looking at these, close the DMI and the DMI Manager.

Since the hourly data is now coming into custom slots, there must be a way to aggregate it to daily and transfer it to the simulation slots. We'll use initialization rules as described next.

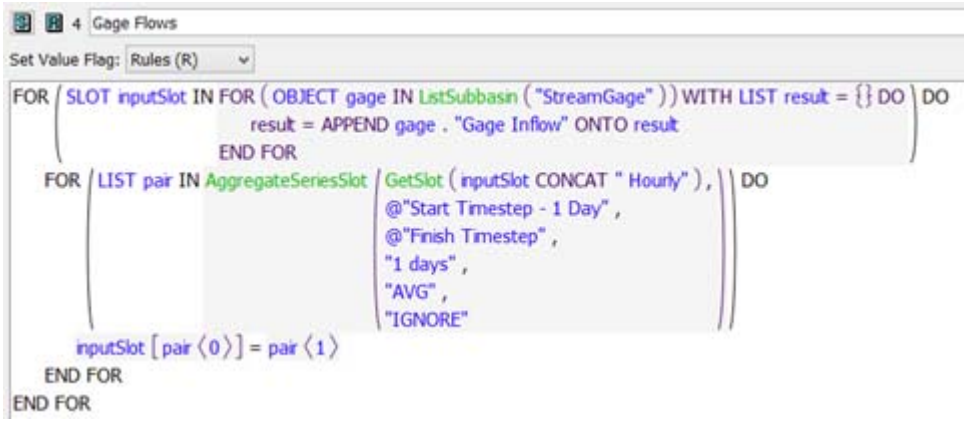
Initialization Rules that Aggregate

Initialization rules are executed at the beginning of the run before almost all other processes. We have created specific initialization rules to aggregate smaller timestep values (1 Hour) to the run timestep (1 Day). The rule loops over all of the desired slots and all of the run time-steps.

❑ On the workspace, select the Initialization Rules Set button on the lower right.



❑ Open rule 4, Gage Flows



In this example, the rule loops over a list of gages in the StreamGage subbasin and builds up a list of Gage Inflow slots.

It then calls a function **AggregateSeriesSlot** that returns a list of simulation slots and the values to set with the aggregated value. The rule then sets the values. The call to **AggregateSeriesSlot** includes a function to get the hourly slot based on the slot to be set, the date range, the timestep size to aggregate to, the aggregation function, and how to handle NaNs. See the RiverWare documentation for more information.

In this case, the slot to set is: **Stream Gage.Gage Inflow**. The hourly data is imported to a custom slot called **Stream Gage.Gage Inflow Hourly**. The first timestep called in the function is early enough to include enough pre-simulation data.

❑ Open Rule 5.

This is a similar rule that aggregates the Canyon.Outflow Hourly values and sets them on Canyon.Outflow, but only for pre-simulation timesteps.

❑ Close both rules and the RPL set.

With these initialization rules, we have taken care of the input side. Now let's look at the output side where we need to disaggregate daily data back to hourly slots.

Custom Disaggregation Slots

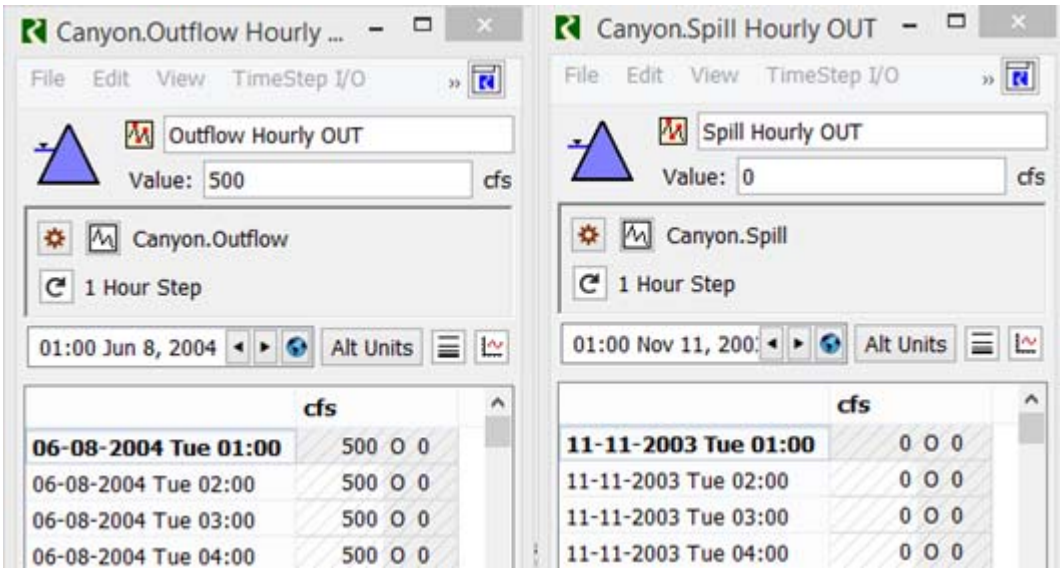
Time Disaggregation Series Slots are custom slots that can be created on any object. There must be one slot for each output that is provided to the downstream model, typically HEC-RAS. The configuration includes:

- The slot to disaggregate.
- The timestep size of the disaggregated value.
- The function to use for disaggregation:
  - **Step**: use the same value for all smaller timesteps. Typically this is for flow values.
  - **Interp:** Interpolate End of Timestep, linearly interpolate from one value to the next. This maintains the values at the end of the larger timestep. This is typically used for Elevation values.

❑ Open the Canyon Reservoir.

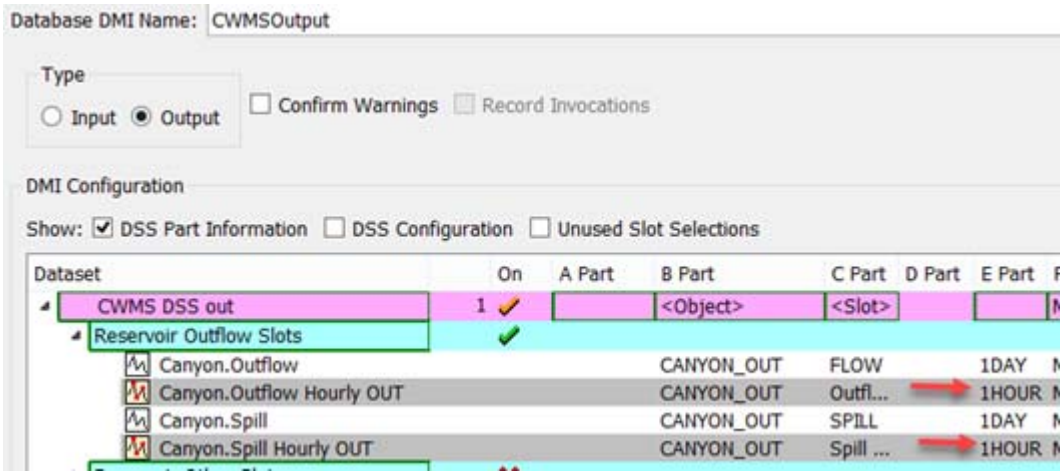
If you remember from "Linking RAS" on page 5–7, there are two time series provided from RiverWare to RAS: Canyon.Outflow and Canyon.Spill. Thus, we created two time disaggregation series slots.

❑ Open Canyon.Outflow Hourly OUT and Canyon.Spill Hourly Out.



Notice they both reference the correct simulation slot and they both use the step function. That is, each repeats the daily flow value for each hour in the day.

❑ Look at the CWMS Output DMI and notice these are the only two slots written out at an hourly timestep.



❑ Close the DMI and the slots.

We are done with the RiverWare interface; let's look at the model linking in the CAVI.

Model Linking

Within the CAVI, the model linking must access the correct hourly slots in the RiverWare model. In the example, the RiverWare input should use the Gage Inflow Hourly slots. These should be linked to upstream inputs, either the HMS results or the Extract list. On the output

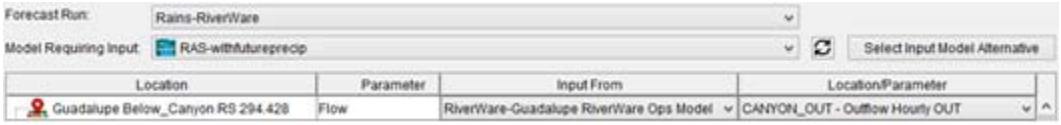
side, the RAS model linking should look for data from RiverWare 1 Hour time disaggregation series slots, for example Outflow Hourly OUT.

❑ In the CAVI, with the **Modeling** tab selected, use the **Forecast** and then **Model Linking** menu.

Rains-RiverWare is selected by default.

❑ Select the RAS model as the **Model Requiring Input**.

Notice RS 294.428 gets input from CANYON_OUT - Outflow Hourly OUT



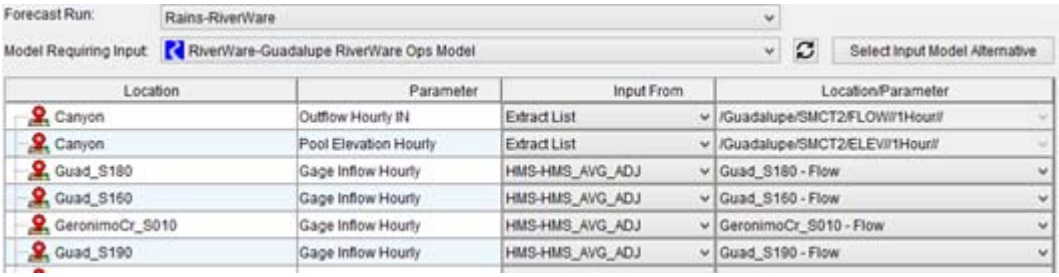
Notice RS 293.20 gets input from CANYON_OUT - Spill Hourly OUT

Those are linking correctly.

❑ Select the RiverWare model as the **Model Requiring Input**.

Due to the bug where the RiverWare linking is not shown correctly, it believes all should come from the Extract List.

❑ Change all Gage Inflow Hourly rows to use the HMS model. A portion of the setup is shown:



Now it is set up correctly to access the hourly slots.

❑ Click OK to apply and close.

Run and View

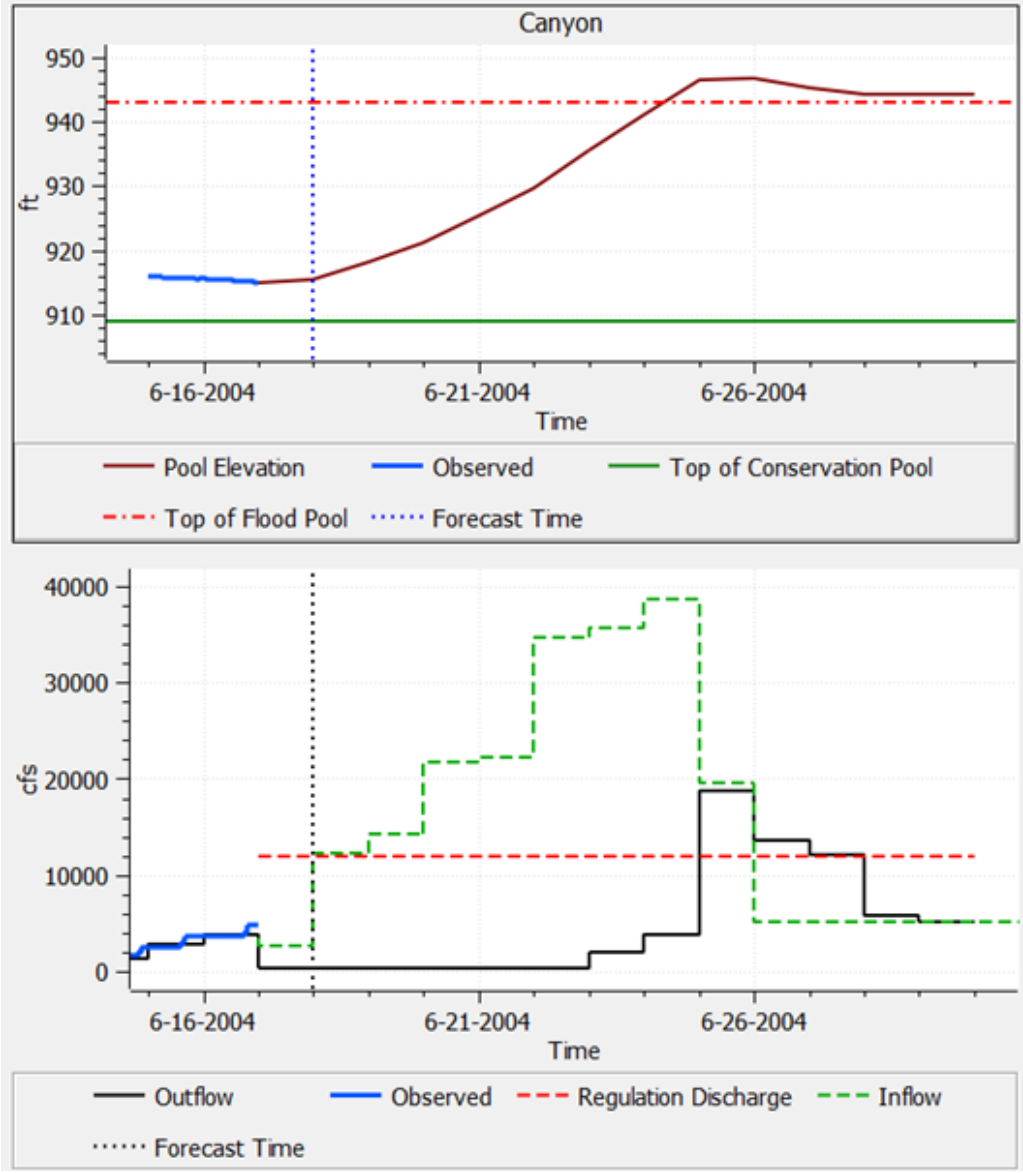
Let's run and investigate the daily RiverWare results

❑ On the Forecasts, start a Compute

It runs through MFP, HMS, and RiverWare but hits an error in RAS. In setting up this tutorial, we did not have enough time to debug this error. But, the run does show how a daily River-Ware model can be used within a RTS/CWMS setting that uses hourly timestep for other models.

Let’s look at the RiverWare results.

❑ On the Report buttons or right-click context menu for the RiverWare alternative, select **PLOT Canyon**.



The curve shows the same general shape as it did for the hourly case, see “Plots, Scripts, Charts, and Output Canvas” on page 5–7, but obviously the timesteps are coarser.

❑ Explore other plots, charts and the output canvas.

Just like when the model had a 1hour timestep, we can also override the reservoir outflows with input values on the Outflow Override slots.

- ❑ If you'd like, repeat the steps in "Make Overrides and iterate" on page 5–11 but now using the daily timestep model.
- ❑ When finished close all RiverWare dialogs.
- ❑ Close your watershed and the CAVI.

This ends the tutorial!