# 

# **RiverWare in HEC-RTS and CWMS - Training Modules**

# Updated September 2023



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## 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.

Name	Download File	Information			
RiverSMART Software Suite	Version 9.1.2	Release Notes			
	Version 9.1.1	Release Notes			
	Riverware installation, install R RiverSMART will be installed as	iverWare using the above links and well.			
	Download previous versions of RiverSMART HERE.				
	Download previous versions of	RiverSMART HERE.			
RiverWare Dongle Driver	Download previous versions of GUI-based Installer (zip) Command-line Installer (zip)	RiverSMART HERE.			

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 \j ar\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\

Ri verWare. i nstal l i nfo 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 Ri verWare. 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.

Ver	ify 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.								
	<b>Tip:</b> While here, we recommend creating a shortcut to this executable and moving it to your desktop or start menu.								
	<b>Note:</b> 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.								
👸 HEC-RTS - N	o Watershed – 🗆 🗙								
File View Maps	Watershed Models Scripts Tools Window Help								
12 🖻 🖆	🖬 🚳 🖷 🖷 🖷 🐐 🖗 🌞 🕸 💧 🚟 🚾 📢 🔛 PY 🚟 🔺 🕑								
🕷 Acquisition	Wisualization Wodeling Setup								
😂 No Watershe	d								
	Click the icon and it will open RiverWare								
	<b>Tip:</b> 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 <b>riverWare</b> . <b>instal linfo</b> and <b>RiverWare</b> . <b>ver</b> 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 Op	en 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 Guadal upe

For the location, browse to the training folder C: \CWMSRi verWareTrai ni ng\Guadal upe

Select **OK** and **OK** to get back to the Open Watershed dialog box.

Select Guadal upeStart and OK.

**Note:** Guadal upeFi ni sh 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**.

Open Forecast						
Existing						
Name	C	Description				
WithResSim	Ir	nitial Forecast for CWMS	trai	^		
				¥		
Open						
Name:	WithResSim					
Description:	Initial Forecas	t for CWMS trainiiu				
Open Cancel						

Select Wi thResSi m and Open

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

Time	Windov	v			
Fored	ast Tin	ne:	17Ju	in2004 Time:	1000
Extra	ct Start.		08Ju	in2004 Time:	1000
Start	Time:		08.Ju	in2004 Time:	1000
End	lime:		26Ju	in2004 Time:	1000
Displ	ay Time	Zone:	GMT+00:0	D	
Foreca	sts				-
No!	Rains-	ResSin	n - QOEOFO	ото	
	MEP				
	LUNG A	W0 40	<i></i>		
	rima_r	WG_AD			
	F:CAVI	OPS			
ia-📑	Foreca	st			
- Rai	ns-Res	Sim - V	VOEOFOYO		
	withfutu	repreci	p		
		WC AD			
12	rimo	wo_no	9		
-	F:CAVI	OPS			
B 🖶	withfut	reprec	ip		
Report	s				
			Comp	oute Log	
			Forecas	t DSS File	
				a martine and the second second	

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 "MyGuadal upe". Enter a description if you'd like.

8		Save Watershed As	
Watershed Name:	MyGuadalu	pe	
Description:	Training cla	iss exercise watershed. Demo purposes only	
Watershed Location:	Guadalupe		v
Unit System:	English		~
Map Layers:	Add Map	Layers	
Coordinate System:	USA_Conti	guous_Albers_Equal_Area_Conic_USGS_ver	Edit.
Server:	Local v	Login Server Setup	
Settings			
I.S. Time Zon	es	<ul> <li>International Time</li> </ul>	e Zones
Settings U.S. Time Zon (GMT -00:00) Gre	es enwich Mear	International Time	e Zones

#### 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:

	Save Watershed As						
CWMS 3.x Watershed File: lupe/watershed/GuadalupeStart/GuadalupeStart.wtrsh							
Save As Progress							
Saving FIA			^				
FIA save as comple	ete						
Saving MetVue							
MetVue save as con Saving TimeSeries Saving TimeSeries Saving cavi folder Parsing source wal	mplete Icons As Icons As complete. tershed file						
Adding 5 Maps to w Done updating map Saving watershed Save As Complete.	vatershed ps.						
Adding 5 Maps to w Done updating map Saving watershed. Save As Complete.	vatershed ps.		>				
Adding 5 Maps to w Done updating maj Saving watershed Save As Complete.	vatershed ps. Watershed Component	# Model Alternatives Ir	> mported				
Adding 5 Maps to w Done updating maj Saving watershed Save As Complete.	vatershed ps. 	# Model Alternatives In	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS	# Model Alternatives In 4 9	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP	# Model Alternatives In 4 9 2	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP RAS	# Model Alternatives In 4 9 2 9	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP RAS FIA	# Model Alternatives In 4 9 2 9 0	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP RAS FIA FIA MetVue	# Model Alternatives In 4 9 2 9 0 0 0	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	Vatershed ps. Watershed Component ResSim HMS MFP RAS FIA KAS FIA MetVue Time Series Icons	# Model Alternatives In 4 9 2 9 0 0 0	> mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP RAS FIA MetVue Time Series Icons Maps	# Model Alternatives In 4 9 2 9 0 0 0	mported				
Adding 5 Maps to w Done updating maj Saving watershed. Save As Complete.	vatershed ps. Watershed Component ResSim HMS MFP RAS FIA MetVue Time Series Icons Maps	# Model Alternatives In 4 9 2 9 0 0	mported				

Click CI ose and CI ose 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.

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## 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: \CWMSRi verWareTrai ni ng\Ri verWareFiles\Guadal upeBasi nHourlySTART. md I

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 timestep. 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

8		Geospatial Ca	invas Cont	iguration		_	5
mage & Coordinate	e System	Image & Canvas Lo	ocations	Additional (	Display Set	tings	
Background Image	9						
Path: \$GUAD_CWMS/Guadalu Show Background Image I Opacity: 50%		ipe.png			Reload	Clear	All the second
		View Size Geor Proje		e (pixels): 688 x 709 reference metadata: No jection metadata: No			
Coordinate System	n	Projected			Coord	ranhie	
Description:		Projected			Geog	raprac	
Units:	Meter		v	Degree			¥
Precision:	0			4			0
Horiz. Axis Text:	x		v	long			~
Vert. Axis Text:	y:		v	lat			~
Display Scale: 1 p	ixel =	60 Meter		Set Displa	ay Scale fo	r Best D	Display Quality

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** 

Object Coordinate Manager						×
File Operations Configure V	iew					
Coordinate System:      Projected	⊖ Ge	ographic				
Sort: Custom From Workspace			Enable	Editing: 🗌 Di	splay 🗌 Ac	tual
		Display x [Meter]	Display y [Meter]	Actual x [Meter]	Actual y [Meter]	^
🛆 Canyon	6	-10,934,596	3,465,827	-10,934,596	3,465,827	1
Canyon Outflow	7	-10,931,335	3,465,531	-10,931,335	3,465,531	1
New Braunfels	8	-10,921,314	3,443,532	-10,921,314	3,443,532	1
Gonzales	9	-10,848,360	3,416,289	-10,848,204	3,416,316	1
Cuero	10	-10,835,040	3,366,429	-10,834,744	3,366,449	1
	11	-10 799 439	3,328,763	-10,799,439	3,328,763	1

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

> 📑	Zake_McQueeney	~
88		

The ruleset opens.

RBS Ruleset Editor - "RBS Ruleset (from model file)" – 🗖 🗙								
File Edit Set View								
RBS Ruleset (from model file)   RPL Set Loaded								
Policy & Utility Groups	Report Groups							
Name		Priority	On	Туре				
Meet Low Flow Flow Flow	Meet Low Flow Requirements		1	Policy Group				
R Canyon Outfl	ow	1	<ul> <li>Image: A second s</li></ul>	Rule				
Flood Control			<ul> <li>Image: A set of the set of the</li></ul>	Policy Group				
R Outflow Over	ride	2	<ul> <li>Image: A set of the set of the</li></ul>	Rule				
R Flood Control	l	3	<ul> <li>Image: A set of the set of the</li></ul>	Rule				
🔺 P Regulation Disch	arge		<ul> <li>Image: A set of the set of the</li></ul>	Policy Group				
Regulation Di	scharge	4	<ul> <li>Image: A set of the set of the</li></ul>	Rule				
Surcharge			<ul> <li>Image: A set of the set of the</li></ul>	Policy Group				
R Canyon		5	<ul> <li>Image: A second s</li></ul>	Rule				
Show: Set Description	Selected De	escription	S	et Notes 🗌 Adv. Properties				

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:

- ✓ Save Loaded RPL Set with Model
- ✓ Save All Global Functions Sets with 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.

Number of Run Cycles	1	▲ ▼
Number of Post-Run Dispatch Timesteps	90	E <b></b>
Maximum Rule Executions Per Timestep	50	•

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.

R	DMI Manager	-		×
File Edit Group	DMI Utilities			R
🖌 🕒 📄 🖻	× 19 19 9	2	Ŷ	悲
DMIs and G CWMSInput CWMSOutp I Import Obs	t ut ervations for Plotting			
				.::

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)

				Dat	tabase	DMI - (	CWMSInput			>
atasets Slots										(e
atabase DMI Name: CWMSInput										
Type Input O Output	n Warnings	Record In	vocations	(						
DMI Configuration	DEC Confi	nuration 🖂 III	learned Cl	ot Calactic					Column Widther 🛞 Juda Di	O Manual
Dataset	On	A Part	B Part	C Part	D Part	E Part	F Part	Begin	End	Units
				-		Provide state	Contractory of the second s	10000	in the	
<ul> <li>CWMS DSS</li> </ul>	11		<object></object>	<slot></slot>			W0E0			
CWMS DSS     HMS Inflows to Gage Infl	11		<0bject>	<slot></slot>			WOED	Start Timestep - 5 Timesteps	Finish Timestep + 120 Time	esteps
CWMS DSS HMS Inflows to Gage Infl Initial Timestep	1 2 2	Guadalupe	<object></object>	<slot></slot>			OBS-CDT	Start Timestep - 5 Timesteps	Finish Timestep + 120 Time	esteps
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation	11	Guadalupe	<object></object>	<slot></slot>			OBS-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep	Finish Timestep + 120 Time	esteps ps
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation     M Canyon Pool Elev	11	Guadalupe	<0bject>	<slot> <slot> ELEV</slot></slot>		1HOUR	DES-CDT DES-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep 08 Jun 2004 10:00	Finish Timestep + 120 Time Start Timestep - 1 Timeste 17 Jun 2004 09:00	esteps ps ft
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation     Mo Canyon-Pool Elev     Observed Outflow	1 <b>J</b> 2 <b>J</b> 3 <b>J</b>	Guadalupe Guadalupe Guadalupe	<0bject> <0bject> SMCT2 <0bject>	<slot> <slot> ELEV <slot></slot></slot></slot>		1HOUR	OBS-CDT OBS-CDT OBS-OUT-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep 08 Jun 2004 10:00	Finish Timestep + 120 Time s Start Timestep - 1 Timeste 17 Jun 2004 09:00	esteps ps ft
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation     M Canyon-Pool Elev     Observed Outflow     Reservoir Outflow Init	1 J 2 J 3 J	Guadalupe Guadalupe Guadalupe	<object> <object> SMCT2 <object></object></object></object>	<slot> <slot> ELEV <slot></slot></slot></slot>		1HOUR	085-CDT 085-CDT 085-CDT 085-OUT-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep 08 Jun 2004 10:00 Start Timestep - 216 Timestep	Finish Timestep + 120 Time s Start Timestep - 1 Timeste 17 Jun 2004 09:00 s Start Timestep -1 Timestep	esteps ps ft
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation     M_ Canyon.Pool Elev     Observed Outflow     Reservoir Outflow Init     M_ Canyon.Outflow	1 / 2 / 3 /	Guadalupe Guadalupe Guadalupe Guadalupe	<object> <object> SMCT2 <object> SMCT2</object></object></object>	<slot> <slot> ELEV <slot> FLOW</slot></slot></slot>		1HOUR 1HOUR	OBS-CDT OBS-CDT OBS-OUT-CDT OBS-OUT-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep 08 Jun 2004 10:00 Start Timestep - 216 Timestep 08 Jun 2004 10:00	Finish Timestep + 120 Time s Start Timestep - 1 Timeste 17 Jun 2004 09:00 s Start Timestep -1 Timestep 17 Jun 2004 09:00	esteps ps ft os cfs
CWMS DSS     HMS Inflows to Gage Infl     Initial Timestep     Reservoir Initial Elevation     M_ Canyon-Pool Elev     Observed Outflow     Reservoir Outflow Init     M_ Canyon.Outflow     C		Guadalupe Guadalupe Guadalupe Guadalupe	<object> <object> SMCT2 <object> SMCT2</object></object></object>	<slot> <slot> ELEV <slot> FLOW</slot></slot></slot>		1HOUR 1HOUR	OBS-CDT OBS-CDT OBS-OUT-CDT OBS-OUT-CDT	Start Timestep - 5 Timesteps Start Timestep - 216 Timestep 08 Jun 2004 10:00 Start Timestep - 216 Timestep 08 Jun 2004 10:00	Finish Timestep + 120 Time s Start Timestep - 1 Timeste 17 Jun 2004 09:00 s Start Timestep - 1 Timesteg 17 Jun 2004 09:00	esteps ps ft os cfs >

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 ٠ the "Extract" list as it can be considered observed.
- The Observed Outflow dataset represents pre-run Outflows. This data will also come from ٠ 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

		Data	abase DMI - CV	VMSOutput					>
atasets Slots									1
atabase DMI Name: CWMSOutput									
Type O Input ( Output	Warnings	Reco	rd Invocations						
DMI Configuration Show: 🗹 DSS Part Information 🗌	DSS Confi	guration	Unused Slot S	Selections	Column	Widths:	⊛ Au	to Fit 🔿 Man	ual
Dataset	On	A Part	8 Part	C Part	D Part	E Part	F Part	Begin	^
<ul> <li>CWMS DSS out</li> </ul>	1 🥒		<object></object>	<slot></slot>			MOHO		
<ul> <li>Reservoir Outflow Slots</li> </ul>	1							Start Timeste	
Canyon.Outflow			CANYON_OUT	FLOW		1HOUR	MOHO	08 Jun 2004	1
Canyon.Spill			CANYON_OUT	SPILL		1HOUR	MOHO	08 Jun 2004	1
Reservoir Other Slots	1							Start Timeste	2
<ul> <li>Control Point Reg Discha</li> </ul>	1							Start Timeste	
Cuero.Regulation			Cuero	Regulation Discharge		1HOUR	MOHO	17 Jun 2004	1
New Braunfels.R			New Braunfels	Regulation Discharge	15	1HOUR	MOHO	17 Jun 2004	1.
<								>	1
227722 1							1100120-0	12271 I	
Reset						ЭК	Cano	cel App	ly .

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 ~\CWMSRi verWareTrai ni ng\Ri verWareFi I es\Guadal upeOperati ons. SCT

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

ne con	51065	Aggregatio	on View	Config DMI	Run Scripts	Diagnos	tics Go T	0	
F 🖬	<b>E</b> 10		3 🛠 🛛	• 🔞 🖩 🗖		III 🛪 🗖	RA	740.7602323532	Alt Units
Series Slots	Edit	Series Si	ot List S	calar Slots	Other Slots C	bject Grid	1		
Timestep	Day	Canyor Inflow cfs	Op Level NONE	Canyon Pool Elevation ft	Canyon Storage acre-ft	Canyon Outflow cfs	Outflow Override cfs	Outflow Reg Discharge cfs	î
6/17 9:00	Thu	74	6,60	914.7	427,948	4,706	NaN	NaN	
6/17 10:00	Thu	73	6.60	914.7	427,993	200	NaN	12,000	
6/17 11:00	Thu	2,18	6.60	914.8	428,157	200	NaN NaN	12,000	
6/17 12:00	Thu	4,44	6.61	914.8	428,507	200	NaN	12,000	
6/17 13:00	Thu	5,91	6.62	914.8	428,980	200	NeN 🔳	12,000	
6/17 14:00	Thu	7,80	6.63	914.9	429,608	200	NaN 🔳	12,000	
6/17 15:00	Thu	10,842	6.65	915.0	430,488	200	NaN 🗎	12,000	
6/17 16:00	Thu	14,854	6.67	915.2	431,699	200	III NaN	12,000	~
¢	2	4							2
Canyon	Control	Points	All Slots						

Repeat this process and open the following SCT:

C: \CWMSRi verWareTrai ni ng\Ri verWareFiles\Guadal upeOperationsHorizontal.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: \CWMSRi verWareTrai ni ng\Ri verWareFi I es\Guadal upeGageI nfl ows. 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.

	- 5	N 10 10 10	* • @			760265247244	Alt Linite	j
Series Slots	Edi	t Series Slot List	Scalar Slots	Other Slots   Object	Grid	1.700203247344	Alt Units	51
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	ľ
6/17 10:00	Thu	2	6	18	7	594	139	and and
5/17 11:00	Thu	. 4	1,441	18	12	593	148	ļ
5/17 12:00	Thu	12	3,590	18	29	596	254	
6/17 13:00	Thu	24	4,486	18	64	677	752	
/17 14:00	Thu	37	4,853	18	117	960	1,993	
/17 15:00	Thu	47	5,220	18	191	1,522	4,105	l
/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	
/17 18:00	Thu	1,125	6,321	369	488	4,333	13,095	i
2	>	<					>	1

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

l	٢.				SCT	Guad	alupe	eGageli
	File Edit	Slots	Aggregation	View	Config	DMI	Run	Script
	8 🖬 🖬		2 🛯 🔀	] 🔏 🕨	Ø		₩.	
	Series Slots	Ec	lit Series S Plot	t Slots	eted ele		Other S	Slots
	Timestep	Day	BearCr_su .Gage Inflo	tue sele tu W	.Gage I cfs	ick_S(	)10	DryCo .Gage cfs
	6/17 9:00	Thu		2			6	
	6/17 10:00	Thu		2			6	
	6/17 11:00	Thu		4			1 441	

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.



#### 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 Guadal upe\_Basi n\_Hourl y. 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, MyGuadal upe.

#### 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.

efault v				
efault Program Order				
Programs				
MFP				
HMS				
ResSim				
RAS				

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

- Select Ri verWare from the Name menu.
- Now remove ResSim: With the ResSim row selected, use the **Edit** and then **Remove** menu. Confirm the removal.

Program Order 7 Program Edit Default Name: \$ .... Description: Default Program Order Programs MFP 1 2 HMS 3 **RiverWare** 4 RAS OK Cancel Apply

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.

R	Import RiverWare Model Alternative		×
General SC	Ts Plot Pages Charts Output Canvases Scripts		
Name:			
Model File:		2	
Input DMI:	CWMSInput		
Output DMI:	CWMSOutput		
Timestep:	5 MINUTE V		
	OK	Canc	el

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: Guadal upe RiverWare Ops Model
- For the **Model File**, select the folder button.
- Select the model file:
  - Use the model you modified in Chapter 3: C: \CWMSRi verWareTrai ni ng\Ri ver-WareFi l es\Guadal upe\_Basi n\_Hourl y. mdl
  - If you didn't quite finish that exercise, use the backup model file. C: \CWMSRi verWare-Trai ni ng\Ri verWareFiles\Guadal upeOpsModel Fi ni shed. mdl
- For the **Input DMI**, we used the default name in the RiverWare model, so leave it as CWMSI nput.
- 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:

2		Impo	ort RiverWare N	Mo	odel Alternative		×
General S	CTs Plot Pages	Charts	Output Canvases	s	Scripts		12
Name:	Guadalupe Riv	erWare Ops	Model				
Model File:	C:\CWMSRiver	WareTrainin	g/RiverWareFiles	s\G	uadalupe_Basin_Hourly.md	e i	2
Input DMI:	CWMSInput						
Output DMI:	CWMSOutput						
Timestep:	1 HOUR					¥	
						OK	Cancel

## 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: \CWMSRi verWareTrai ni ng\Ri verWareFi I es\Guadal upeOperati ons. SCT

Repeat this step twice to select two more SCTs:

- Guadal upeOperati onsHori zontal . SCT
- Guadal upeGageI nfl ows. 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 FI ow Li nes

### 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.

3	Model Alternative Keys
Plugin:	MFP
Key	Model Alternative
Q	MFP
w	withfutureprecip
C	K Cancel Apply

Select **RiverWare** as the Plugin.

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

	Model Alternative Keys*	×
Plugin	RiverWare	¥
Key	Model Alternative	
R	Guadalupe RiverWare Ops Model	
(	OK Cancel Apply	

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, in the Setup tab, in the Setup tab, in the Forecast Rule in the Forecast Rule Eor the Name entry	right-click on the <b>Forecast</b>	Runs and select New.
	For MFP, select Q HMS and RiverW	::MFP are only have one alternation	ve model, so no changes are needed.
	For RAS, select T	Forecast	
3		Forecast Run Edito	r* ×
Forecast Run			
Name NoRains-Re Rains-ResS	esSim iim	Key Q0E0F0T0 W0E0F0Y0	Description
	쒑 New Run	New Ensemble Ru	n 🔀 Delete Run
Name:	NoRains-RiverWar	e	
Description:			
Models			
Program C	)rder: Default	↓ Key	Q0E0R0T0
MFP	Q:MFP		¥
HMS	🔀 E:HMS_AVG_A	4DJ	~
RiverWare	R:Guadalupe F	RiverWare Ops Model	¥
RAS	T:Forecast		~
			OK Cancel Apply
	Select <b>Apply</b> to sa	ave the changes but leave	the dialog open.

Select New Run again

For the Name enter Rai ns-Ri verWare

For MFP, select W:withfutureprecip

For RAS, select Y:withfutureprecip

It should look as follows:

3		Forecast Run Editor*		×
Forecast Run				
Name		Kev	Description	٦
NoRains-Re	sSim	Q0E0F0T0		
Rains-ResSi	m erWare	W0E0F0Y0		-
Norvains-two	ervvare	adeoratio		
	New Run	🖄 New Ensemble Run	🔀 Delete Run	
Name:	Rains-RiverWare			
Description:				
Models				
Program O	rder: Default	√ Key: W	0E0R0Y0	
MFP	W:withfuturepr	ecip	¥	
HMS	🔀 E:HMS_AVG_A	DJ	¥	
RiverWare	R:Guadalupe F	RiverWare Ops Model	¥	
RAS	🚝 Y:withfuturepre	cip	~	
		ОК	Cancel Apply	

Select OK to create the Rains-RiverWare run.

Now there are four Forecast Runs listed.

<u> </u>	📕 Fo	recast Runs
	•	NoRains-ResSim
	•	Rains-ResSim
	•	NoRains-RiverWare
	L., 🔶	Rains-RiverWare

#### 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)

			Extrac	t Edi	tor				
iquired Input									
estination									0
UADALUPE/NF GUAD	S020/PRECIP-INC/31Ma	1/2002 - 31Jul2002/1HOUR	OBS-CDT	i -					
UADALUPE/SF GUAD	S010/PRECIP-INC/31Ma IO/PRECIP-INC/31Ma/20	(2002 - 31Jul2002/1HOUR) 02 - 31 Iul2002/1HOUR/0R/	OBS-CDT/	-					
UADALUPE/JOHNSON	CR S010/PRECIP-INC/3	1May2002 - 31Jul2002/1HO	UR/OBS-C	DT/					
UADALUPE/JOHNSON	CR S020/PRECIP-INC/3	1May2002 - 31,Jul2002/1HO	UR/OBS-C	107/					
		Add T	e Group	F	iter List				
And Linking			12						
raci Linking	T Educt Crown educ	tation							
Extract Groups	Emaci Group, ensac	Lane of							
idractarino (Runs by	Type: Time Series	Run by Default							
	DSS File / Jdat	DSS File / IdatabaseEnterast Dataleytract Interast dos					DSS Stor	age Options	
	Override Prot					ide Protection			
	Time Window				Parate		Regular	Desines III	
	Start Extract Start		Offset	+0	minutes	~	terr and an	Replace Mil	
	End: Forecast Tir	me v	Offset	+0	minutes	÷	irregutar.	Merge	•
	From extract_foreca	ast.dss			To forecast	dss			Q
	GUADALUPENE G	UAD S010/PRECIP-INC/31	Mar2002 -	31Jul	2002/10/GUADALUP	ENF GUAD	S010/PREC	CIP-INC/31Mar2002	- 31Jul2002/1( ^
	GUADALUPENE G	UAD S020/PRECIP-INC/31	May2002 -	31Jut	2002/10/GUADALUP	ENF GUAD	S020/PREC	CIP-INC/31May2002	- 31Jul2002/1
	GUADALUPE/GUAD	S010/PRECIP-INC/31May	2002 - 31J	ul2000	2002/16/GUADALUP	E/GUAD S01	IMPRECIP-I	NC/31May2002 - 31.	Jul2002/1HOL ¥
New Extract Group	Add Extract Ense	mbl Add Extract Dat	a Set	Re	move From Group	Browse	From	Browse To	Filter List
New Extract Group	Add Extract Ense	mbl Add Extract Dat	a Set	Re	move From Group	Browse	From.	Browse To	Filter List.

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.

Forecast Run:	NoRains-River	Ware			*			
Model Requiring Input	MEP-MEP				~	C	Select Input Model Alternativ	0
Locatio	n	Parameter	Inpu	t From		Lo	cation/Parameter	Г
Cobserved Preci	p Gage NF_Gu	Precipitation	Extract List	¥	/GUADA	UPEN	F_GUAD_S010/PRECIP-INC/	^
2 Observed Preci	p Gage NF_Gu	Precipitation	Extract List	×	/GUADA	UPEN	F_GUAD_S020/PRECIP-INC/	
2. Observed Preci	p Gage SF_Gu_	Precipitation	Extract List	v	GUADA	UPE/S	F_GUAD_S010/PRECIP-INC/	
								-

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:

Forecast Run:	NoRains-	RiverWare			~			
Iodel Requiring Input	HMS-H	HMS_AVG_ADJ			¥	C	Select Input Model Alterna	the
Iodel Linking for HMS_	AVG_ADJ o	ontains 76 Location(s) that are out of d	ate.					
Locatio	n	Parameter	Input From	n		Lo	cation/Parameter	
Q CypressCr_GR	S010	Precipitation	MEP-MEP	¥	Cypress	Cr_GR	_S010 - Precipitation	v /
R DryComalCr_Si	010	Precipitation	MEP-MEP	~	DryCom	alCr_S	010 - Precipitation	¥
PlumCr_S010		Precipitation	MFP-MFP	¥	PlumCr,	_S010 -	Precipitation	¥
HNFT2_NEGR		Flow	Extract List	¥	/N FK G	UADAL	UPE RVIHUNT TX/FLOW/0	v
A HNTT2_GR		Flow	Extract List	~	/GUADA	LUPER	WHUNT TX/FLOW/01MAY	~
JCIT2_Johnson	Cr	Flow	Extract List	. 4	/JOHNS	ON CK	INGRAM TX/FLOW/01MAY	ч.
And in the second states in the second states and the			and the second sec	and in free of	and the second state of the			manual (

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.

Forecast Run:	NoRains-RiverWare	IoRains-RiverWare v			
lodel Requiring Input	RiverWare-Guadalupe RiverWare Ops Model			Select Input Mode	Alternative
Location	Parameter	Input From		Location/Param	ater
Canyon	Outflow	Extract List	¥ /	Guadalupe/SMCT2/FLC	W//1HO
- 🧟 Canyon	Pool Elevation	Extract List	~ /	Guadalupe/SMCT2/ELE	V//1HO
Guad_S150	Gage Inflow	Extract List	¥ //	Guad_S150/FLOW//1H	OUR//
- 🧟 Guad_S170	Gage Inflow	Extract List	¥ /	Guad_S170/FLOW//1H	OUR//
CanyonLk_S010	Gage Inflow	Extract List	× 1	CanyonLk_S010/FLOV	///1HOU
Guad_J170	Gage Inflow	Extract List	× //	Guad_J170/FLOW//1H	OUR//
Guad_S120	Gage Inflow	Extract List	¥ /	Guad_S120/FLOW//1H	OUR//
Highlighted text indicate	s duplicate linking				
		Browse			
Model IIO			or	Consol	(apple)

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 Infl ow items, rows 3 - 25

Use the Select Input Model Alternative

In the dialog that opens, select HMS-HMS\_AVG\_ADJ

And a second sec				
2 SanMarcos_J09	60 Gage Inflow	Extract List	×	//Sar
2 Guad_S200	Gage Inflow	Extract List	¥.	//Gua
2 PeachCr_J060	Select In	nput Model Alternative	a 📕	×
2 Guad_S220			-	~
. Guad_S210	Input Model Alternative:	HMS-HMS_AVG_ADJ	1	
2. SandiesCr_R0		ОК	Cancel	
2 Guad_S240	Gage innow	Extract List	v,	rGU
A				

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

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

e	🔒 SanMarcos_J090 👘	Gage Inflow	HMS-HMS_AVG_ADJ	¥	SanMarcos_J090 - Flow	¥
	🗜 Guad_S200	Gage Inflow	HMS-HMS_AVG_ADJ	<	Guad_S200 - Flow	×
	ReachCr_J060	Gage Inflow	HMS-HMS_AVG_ADJ	~	PeachCr_J060 - Flow	¥

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.

Guadalupe Below_Canyon RS Flow	HMS-HMS_AVG_ADJ	SanMarcos_R050 - FLOW
Guadalupe Below_Canyon RS Flow	RiverWare-Guadalupe RiverWare	Canyon Lake-Broadcrested Weir Spillway
Guadalupe Below_Canyon RS _ Observed - STAGE	Extract List	SATTLER, TX - STAGE

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 Source Data Location		
Location: Parameter:	Guadalupe Below_Canyon RS 2 Flow	9
Location	RiverWare-Guadalupe Riv	~
Location	Parameter	Q
r Canyon	Inflow	~
Canyon	Operating Level	
Canyon	Pool Elevation	
Canyon	Release	1
Canyon	Storage	1
Canyon	Outflow	7
🖳 🤶 Canyon	Spill	
. Canyon Outflow	Outflow	
	Regulation Discharge	~
Show All Source Locations	Number of Locations:	53
	Set Location Close	

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

### Select Close

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

Guadalupe Below_Canyon RS .	Flow	HMS-HMS_AVG_ADJ	۷	SanMarcos_R050 - FLOW	~
Guadalupe Below_Canyon RS .	Flow	RiverWare-Guadalupe RiverWare Ops Model	¥	Canyon - Spill	- ·
Guadalupe Below_Canyon RS .	Observed - STAGE	Extract List		SATTLER, TX - STAGE	. Q

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: Rai ns-Ri verWare

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:

	Copy Model Changes					
Forecast	: WithRiv	erWare				
Сору		Model	Model	Forecast		
Data	Progra	Alternative	ID	Run		
-	MFP	MFP	Q0	NoRains-RiverWare	<u>^</u>	
-	HMS	HMS_AVG_ADJ	Q0E0	[NoRains-RiverWare, R		
<ul><li>✓</li></ul>	RiverW	Guadalupe RiverWare O	Q0E0R0	[NoRains-RiverWare, R		
✓	RAS	Forecast	Q0E0R	NoRains-RiverWare		
-	MFP	withfutureprecip	WO	Rains-RiverWare	~	
Copy cha	Copy changes from selected Models to					
Cop	y to Base					
				OK Close		

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 MyGuadaI upe 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.

Name:		2021.08.13-200	0 GMT00	00		
Description: 2021.08.1		2021.08.13-200	0 GMT+0	0:00		,
Folder:	С:Л	emp/Guadalupe/	forecast/	2021.08.13-	2000/MyG	uadalupe
Select	Type:	New Forecast				~
Time	Windo	w				
Forecast Time:		ime:	13A	ug2021 🛄	Time:	2000
Extra	ct Star	t	10Aug2021 Time: 10Aug2021 Time:		Time:	2000
Start	Time:				2000	
End	Time:		16A	ug2021 🛄	Time:	2000
Wate	rshed	Time Zone: GMT	+00:00		0	
Sel	Fore	cast Run		Descriptio	n	
•	NoR	ains-ResSim				
•	Rain	s-ResSim				
	Rain	s-RiverWare				
	NoR	ains-RiverWare				

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:

3	Create New Forecast			×		
Name:	WithRiverWare	e				
Description:	2021.08.15-17	700 GMT+0	0:00			^
Folder: /are]	Training/Guada	alupe/foreca	st/WithRive	rWare/N	lyGuadalu	pe
Select Type:	New Forecas	t				~
Time Windo	w					
Forecast Tir	me:	17j	un2004	Time:	1000	)
Extract Start	t [	08Jun2004 Time:		1000	)	
Start Time:	[	08Jun2004 Time:		1000	)	
End Time:	[	26Jun2004 Time:		1000	)	
Watershed	Time Zone: Gl	00:00+TN				
Sel Fore	cast Run		Description	n		
NoRa	ains-ResSim					
Rains	s-ResSim					
NoRa	NoRains-RiverWare					
Rains	s-RiverWare					
			ОК		Cancel	

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.

Acquisitio	n 🖗 Visualization	🍇 Modeling	礅 Setup
Name: Witt	RiverWare		
Time Windo	w		B
Time Wind	low		
Forecast	ime:	17Jun2004 Tim	e: 1000
Extract Sta	rt	08Jun2004 Tim	e: 1000
Start Time	16 N	08Jun2004 Tim	e: 1000
End Time:		26Jun2004 Tim	e: 1000
Display Ti	me Zone: GMT+00:0	0	
Forecasts			
NoRain	s-RiverWare - Q0I	EOROTO	
MFP			
🕀 🔜 HMS	_AVG_ADJ		
🕀 💦 Guad	lalupe RiverWare Op	os Model	
🕀 🚼 Fore	cast		
Rains-R	iverWare - W0E0R0	YO	
🕀 🎆 withf	utureprecip		
🕀 🔀 HMS	_AVG_ADJ		
🕀 🔀 Guad	lalupe RiverWare Op	os Model	

## 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.** 

Forecasts					
✓ NoRains	✓ NoRains-RiverWare - Q0E0R0T0				
🖶 🔠 MFP					
🖶 🔀 HMS_	AVG_ADJ				
🗄 【 Guada	alupe RiverWare Ops Model				
🗄 🚟 Forec	ast				
Rains-Ri	verWare - W0E0R0Y0				
🖶 🗰 withfu	tureprecip				
Actions - No	Rains-RiverWare - Q0E0R0T0				
	Compute				
	Open CAVI Dashboard				
	Display in Map				
	Save To Base				
	Replace from Base				
Post					
Force Recompute					
Run Post after Successful Compute					
Actions Rep	oorts Scripts Icon Layers Workflow Te				

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 Wi thResSi m, 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

Rain	Rains-RiverWare - W0E0R0Y0				
🖭 🎹 v	withfutureprecip				
🕀 🔀 H	HMS_AVG_	_ADJ			
⊕- <b>₹</b>	Guadalupe	RiverWa	re Ops Model		
🗄 - 🚟 v	vithfuturep	recip			
Actions	- Guadalu	pe River\	Nare Ops Mod	lel	_
		C	ompute		
	SC	RIPT Ge	nerate All Out	puts	
[	S	CRIPT C	reate Snapsh	ots	
[	SCRIPT	Bring in	Pre-run data f	or plotting	
[	RBS Ruleset (from model file)				
	RPL Set				
		Initializa	tion Rules Se	t	
	SCT GuadalupeOperations				
	SCT GuadalupeOperationsHorizontal				
[	SCT GuadalupeGageInflows				
	Force Recompute Run Post after Successful Compute				
Actions	Reports	Scripts	Icon Layers	Workflow	Team

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 <b>Reports</b> tab.						
Rain	s-RiverWa	are - W0E	0R0Y0			
🛛 🔠 v	vithfuturep	recip				
0 🔜 H	🖲 🔀 HMS_AVG_ADJ					
⊡- <b>₹</b>	🕮 💦 Guadalupe RiverWare Ops Model					
withfutureprecip						
					_	
Reports	- Guadal	upe River	Ware Ops Mo	del		
		Diagn	ostic Dialog			
Plot Dialog						
PLOT Canyon						
		PLOT	Cuero Flow			
	PLOT Gonzales Flow					
	F	LOT New	v Braunfels Fl	ow		
	PLOT Unregulated Inflows					
PLOT Victoria Flow						
CHART Canyon Pool Bar Chart						
OUTPUT CANVAS Flow Lines						
SCT GuadalupeOperations						
SCT GuadalupeOperationsHorizontal						
	SCT GuadalupeGageInflows					
Actions	Reports	Scripts	Icon Layers	Workflow	T	
	Select 1	Select the Rep Rains-RiverWa Withfuturep Reports - Guadalupe Reports - Guadalupe Reports - Guadalupe Reports - Guadalupe CH CH OL SCT G SCT G	Select the <b>Reports</b> ta Rains-RiverWare - WOE HMS_AVG_ADJ HMS_AVG_ADJ HMS_AVG_ADJ Guadalupe RiverWa Withfutureprecip Reports - Guadalupe River Diagn Plo PLOT PLOT PLOT PLOT OF PLOT OF PLOT OF PLOT OF CHART Can OUTPUT C/ SCT Guadalupe SCT Guadalupe SCT Guadalupe	Select the <b>Reports</b> tab.	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)



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.

Bring in Pre-run data for plotting				
Execute t	he Import Observations for Plotting DMI			
Execution				
Status: Ready	Current Action: this script is not executing			

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**.

K						SCT Gu	adalupeOpe	erations.SC	T	
File	Edit	Slots	A	ggregation	View C	onfig DMI Ru	n Scripts Di	agnostics G	ю То	
-0			L Fe	7 7 1	🗸 ହା 🎿				тр	S
•	14 M				- <u>o</u> v					5
Ser	ries Slots	Ed	it Se	eries Slot Lis	st Scala	r Slots Other S	Slots Object (	Grid		
Tir	nestep	Day		Canyon Inflow cfs	Canyon Op Level NONE	Canyon Pool Elevation ft	Canyon Storage acre-ft	Canyon Outflow cfs	Outflo Overri cfs	w ide
6/:	17 9:00	Thu		3,222	6.60	914.7	427,94	18 📒 4,706	5 🗉 🖪	laN
6/:	17 10:00	Thu		3,213	6.61	914.8	428,19	7 🔲 200	) 🗉 4,3	700
6/:	17 11:00	Thu		3,494	6.61	914.8	428,47	70 🔲 200	0 🗉 - 4,2	700
6/:	17 12:00	Thu		4,188	6.62	914.8	428,79	9 🔲 200	0 🗉 - 4,2	700
6/:	17 13:00	Thu		5,016	6.62	914.9	429,19	7 🔳 200	0 🗉 4,3	700
6/:	17 14:00	Thu		5,952	6.63	914.9	429,67	73 🔲 200	0 🗉 4,3	700
6/:	17 15:00	Thu		6,954	6.64	915.0	430,23	31 🔲 200	0 🗉 4,3	700
6/:	17 16:00	Thu		7,147	6.65	915.1	430,80	5 📃 200	0 🗉 4,3	700
6/:	17 17:00	Thu		8,788	6.67	915.1	431,51	.5 📃 200	0 🗉 4,3	700
6/:	17 18:00	Thu		11,877	6.69	915.2	432,48	80 🔲 200	0 🗉 4,3	700
6/:	17 19:00	Thu		14,408	6.71	915.4	433,65	64 📕 200	0 🗉 4,3	700
6/:	17 20:00	Thu		16,503	6.73	915.5	435,00	1 200	0	700
6/:	17 21:00	Thu		18,674	6.76	915.7	436,52	28 📕 200	0 🗉 4,3	700
6/:	17 22:00	Thu		20,132	6.79	915.9	438,17	75 📕 200	이트 4,:	700
6/:	17 23:00	Thu		19,709	6.82	916.1	439,78	8 🔳 200	0 🗉 4,3	700
6/:	17 24:00	Thu		19,578	6.85	916.2	441,38	9 🔲 200	0 🗉 4,3	700
6/:	18 1:00	Fri		19,102	6.88	916.4	442,95	51 🔳 200	0 🗉 - 4,7	700
6/:	18 2:00	Fri		17,245	6.91	916.6	444,36	0 🔳 🛛 200	0 🗉 - 4,2	700
6/:	18 3:00	Fri		16,297	6.93	916.7	445,69	0 🔳 200	0 🗉 - 4,2	700
6/	18 4:00	Fri		16,316	6.96	916.8	447,02	2 🗉 🛛 200	0 🗉 4,2	700
6/	18 5:00	Fri		15,355	6.98	917.0	448,27	75 🔳 200	0 🗉 4,3	700
6/	18 6:00	Fri		14,683	7.00	917.1	449,47	2 🔳 🛛 200		laN
6/	18 7:00	Fri		14,537	7.03	917.2	450,65	57 📃 200		laN
C 10		- ·		4.4.400	7.07		101 00	u 🗖 👘 🗛		

The image below shows what it should look like:

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:

3	Copy Model Changes					
Forecast	WithRiv	erWare				
Copy Data	Progra	Model Alternative	Model ID	Forecast Run	$\square$	
-	MFP MFP Q0		Q0	NoRains-RiverWare	<u>^</u>	
-	HMS	HMS_AVG_ADJ	Q0E0	[NoRains-RiverWare, R		
~	RiverW	Guadalupe RiverWare O	Q0E0R0	[NoRains-RiverWare, R		
-	RAS	Forecast	Q0E0R	NoRains-RiverWare		
-	MFP	withfutureprecip	W0	Rains-RiverWare	<b>~</b>	
Copy changes from selected Models to						
				OK Close		

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.

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# 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: CWMSRi verWareTrai ni ng Guadal upe Ng Satar Ng



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 Mani fest. 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: \CWMSRi verWareTrai ni ng\Guadal upe\forecast\Wi thRi verW are\MyGuadal upe\ri verware\Guadal upe Ri verWare 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 Dai I yOpsModel 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 Wi thRi verWareDai I y forecast runs.

There is only one forecast: Rai ns-Ri verWare. 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.

🖹 Acqu	isition	👰 Visualiza	ation	縼 Mod	eling	🔅 Setup	
Name:	Name: WithRiverWareDaily						
Time W	Time Window						
Time	Windov	v					
Fored	ast Tim	ne:	17J	un2004	Time	: 0000	
Extra	ct Start:		09J	un2004	Time	: 0000	
Start	Time:		09J	un2004	Time	: 0000	
End 1	Time:		26J	un2004	Time	2400	
Displ	ay Time	e Zone: GMT+	00:00				

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.

		MFP Alter	native Editor	X
Edit				
Precip Alt:	withfutureprecip	Output Time Interval:	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

Slot View	ver (1 Hour) 🛛 🗖 🗙				
File Edit View TimeS	tep I/O Adjust				
M Guad_S130.Gage Inflow Hourly					
Value: 3.7865 cfs Alt Un	it 24:00 Jun 17, 20 🔹 🔊				
	Guad_S130 A Gage Inflow Hourly cfs A				
06-17-2004 Thu 19:00	4 Z 0				
06-17-2004 Thu 20:00	4 Z 0				
06-17-2004 Thu 21:00	4 Z 0				
06-17-2004 Thu 22:00	4 Z 0				
06-17-2004 Thu 23:00	4 Z 0				
06-17-2004 Thu 24:00	4 Z 0				
06-18-2004 Fri 01:00	5 Z 0 🗸				
Show: Description					
Guad_S130.Gage Inflow Hourly Total Volume: 0 [acre-					
1 value: 4 [cfs] (Priority (	))				

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 I nput 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.

		🔼 CanyonLk_S010.Gage Inflow Hourly
		M DryComalCr_S010.Gage Inflow Hourly
		🔼 Guad_S140.Gage Inflow Hourly
		🔼 Guad_S150.Gage Inflow Hourly
⊿		Initial Timestep
	⊿	Reservoir Initial Elevation
		🚧 Canyon.Pool Elevation Hourly
⊿		Observed Outflow
	⊿	Reservoir Outflow Init
		A Canvon.Outflow Hourly IN

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 timesteps.

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

3	5	<b>S</b> RBS	S Opt	ζ.	verwar	
Initialization Rules Set (Path: N/A)						

Open rule 4, Gage Flows

Set Value Flag: Rules (R) *	
FOR SLOT inputSlot IN FOR OBJECT ga result = APPEI END FOR	ge IN ListSubbasin ( "StreamGage" ) ) WITH LIST result = {} DO ND gage . "Gage Inflow" ONTO result
FOR LIST par IN AggregateSeriesSlot	GetSlot ( inputSlot CONCAT " Hourly" ) , @"Start Timestep - 1 Day" , @"Fnish Timestep" , "1 days" , "AVG" , "IGNORE"
inputSlot [pair $\langle 0 \rangle$ ] = pair $\langle 1 \rangle$ END FOR END FOR	

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 **Aggrega-teSeriesSlot** 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.


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.

Databas	e DMI Name: CWMSOutput							
Type O In	nput   Output  Confirm Warn	ings 🔝 Record	f Invocation	15				
DMI Co	onfiguration							
Show:	DSS Part Information DSS	Configuration	Unused S	Slot Selections				
Datas	et	On	A Part	8 Part	C Part	D Part	E Part	F
4	CWMS DSS out	1 /		<object></object>	<slot></slot>			١
4	Reservoir Outflow Slots							
	A Canyon.Outflow			CANYON_OUT	FLOW		1DAY	Þ
	Canyon.Outflow Hourly OUT	r		CANYON_OUT	Outfl	-	1HOUR	ħ
	Canyon.Spill			CANYON_OUT	SPILL		1DAY	P
	Canyon.Spill Hourty OUT			CANYON_OUT	Spill	-	1HOUR	ħ

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

Forecast Run:	Rains-RiverWare v				* * Ø			
Model Requiring Input						Select Input Model Alternative		
Location		Parameter	Input From	LocationParameter		cation/Parameter	1	1
Guadalupe Below_Canyon RS 294.428		Flow	RiverWare-Guadalupe RiverWare Ops Model v	CANYON_OUT - Outflow Hourty OUT		Outflow Hourly OUT	v .	•

Notice RS 293.20 gets input from CANYON OUT - Spill Hourly OUT

🧟 Guadalupe Below\_Canyon RS 293.020 Flow RiverWare-Guadalupe RiverWare Ops Model 🗸 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:

Forecast Run:	Rains-River	Ware		Ŷ				
Model Requiring Input	RiverWare-Guadalupe RiverWare Ops Model					Select Input Model Alte	imative	
Location		Parameter Input From		Location Parameter		ocation/Parameter		
Canyon		Outflow Hourly IN	Extract List	v /Guadah	pe/SMC	T2/FLOW//1Hour//	~	
Canyon		Pool Elevation Hourty	Extract List	/Guadalupe/SMCT2/ELEVI/1Hour//				
Guad_S180		Gage Inflow Hourly	HMS-HMS_AVG_ADJ	v Guad_S	180 - Flo	w	v	
_ Guad_S160		Gage Inflow Hourly	HMS-HMS_AVG_ADJ	v Guad_S	160 - Flo	w	¥	
GeronimoCr_S010		Gage Inflow Hourly	HMS-HMS_AVG_ADJ	GeronimoCr_S010 - Flow		10 - Flow		
_ Guad_S190		Gage Inflow Hourly	HMS-HMS_AVG_ADJ	v Guad_S	190 - Flo	w	~	
the second se			The second se					

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!