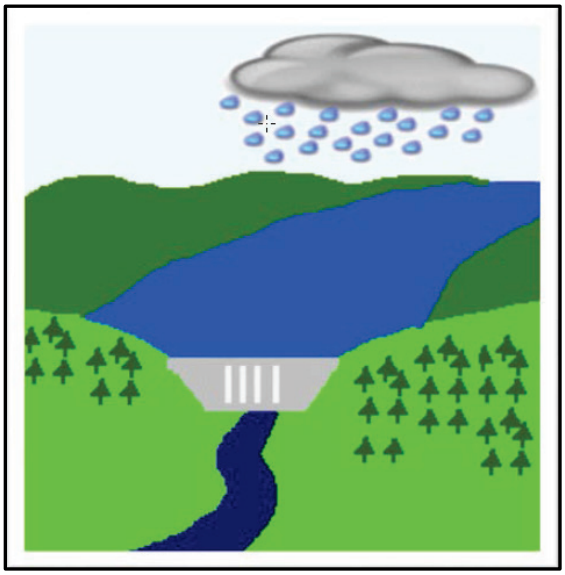
US Army Corps
of Engineers
Hydrologic Engineering Center

Real-Time Simulation (HEC-RTS) Quick Start Guide



Version 3.1
Jan 2019

CPD-96a

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
29-01-2019	Computer Program Documentation	

4. TITLE AND SUBTITLE
HEC-RTS, Real-Time Simulation
Quick Start Guide
Version 3.1

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
CEIWR-HEC

5d. PROJECT NUMBER

5e. TASK NUMBER

5F. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers
Institute for Water Resources
Hydrologic Engineering Center (HEC)
609 Second Street
Davis, CA 95616-4687

8. PERFORMING ORGANIZATION REPORT NUMBER
CPD-96a

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/ MONITOR'S ACRONYM(S)

11. SPONSOR/ MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Hydrologic Engineering Center's (HEC) Real Time Simulation (HEC-RTS) software is based on the CWMS software for use by non-USACE offices. HEC-RTS still provides the same data and information that CWMS provides, HEC-RTS just performs these functions in a different manner than CWMS. HEC-RTS provides support for operational decision making by forecast simulation modeling using any combination of the following models: rainfall-runoff modeling with HEC-HMS (Hydrologic Modeling System software) based on gaged or radar-based precipitation, Quantitative Precipitation Forecasts (QPF) and other future precipitation scenarios provides forecasts of uncontrolled flows into and downstream of reservoirs, simulation of reservoir operations with either HEC-ResSim (Reservoir System Simulation) or CADSWES's RiverWare provides operational decision information for the engineer, the river hydraulics program HEC-RAS (River Analysis System) computes river stages and water surface profiles for these scenarios, an inundation boundary and depth map of water in the floodplain can be calculated from HEC-RAS results using the RAS Mapper tool, and the impacts of different flow alternatives are computed by HEC-FIA (Flood Impact Analysis).

15. SUBJECT TERMS
HEC, HEC-RTS, real time simulation, software, CWMS, Corps Water Management System, USACE, forecast, simulation, operational decisions, HEC-HMS, rainfall-runoff modeling, precipitation, radar-based, QPF, Quantitative Precipitation Forecasts, uncontrolled flows, flows, reservoirs, reservoir operations, HEC-ResSim, RiverWare, HEC-RAS, river stages, water surface profiles, inundation boundary maps, depth maps, floodplain, RAS Mapper Tool, impacts, HEC-FIA

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER
U	U	U	UU	90	

Real-Time Simulation (HEC-RTS)

Quick Start Guide

Version 3.1
Jan 2019

U.S. Army Corps of Engineers
Institute for Water Resources
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616

(530) 756-1104
(530) 756-8250 FAX
www.hec.usace.army.mil

CPD-96a

Real-Time Simulation, HEC-RTS, Quick Start Guide

Use of the software described by this document is controlled by certain terms and conditions. The user must acknowledge and agree to be bound by the terms and conditions of usage before the software can be installed or used. The software described by this document can be downloaded for free from our internet site (www.hec.usace.army.mil).

HEC cannot provide technical support for this software to non-Corps users. See our software vendor list (on our web page) to locate organizations that provide the program, documentation, and support services for a fee. However, we will respond to all documented instances of program errors. Documented errors are bugs in the software due to programming mistakes not model problems due to user-entered data.

Note: The HECE-RTS software is based on the Corps Water Management System (CWMS) software that is available to U.S. Army Corps of Engineers (USACE) offices only. Both software packages share the same directory structure, so a watershed can be built and used with either program. HEC-RTS uses only HEC-DSS and does not connect to a server, while the CWMS software connects to a server and a database.

Table of Contents

Table of Contents

Chapter **Page**

List of Figures

Page

List of Figures

Page

List of Figures

Page

Chapter 1

HEC-RTS (Real Time Simulation)

1.1 Introduction

The U.S. Army Corps of Engineers (USACE) operates more than 700 storage reservoir, lock and dam, and diversion projects constructed under the USACE's Civil Works water resources program. The USACE water management mission is to regulate river flow with these projects to provide national benefits of flood control, navigation, hydroelectric power generation, water supply, irrigation, erosion control, water quality, environmental enhancement, and other authorized purposes. For USACE offices, the Corps Water Management System (CWMS) software was developed to aide in addressing real-time decisions. CWMS expanded and enhanced the data and information available to USACE staff members who must make decisions about the operation of Federal water management facilities or who must monitor and approve such decisions made by operation partners. The data and information made available through CWMS includes precipitation data and flow forecasts as well as data and information about the current state of watersheds, likely future state of watersheds, and consequences of management actions. The data and information help water managers and others make informed operation decisions.

The Hydrologic Engineering Center's (HEC) Real Time Simulation (HEC-RTS) software is based on the CWMS software for use by non-USACE offices. HEC-RTS still provides the same data and information that CWMS provides, HEC-RTS just performs these functions in a different manner than CWMS. HEC-RTS provides support for operational decision making by forecast simulation modeling using any combination of the following models: rainfall-runoff modeling with HEC-HMS (Hydrologic Modeling System software) based on gaged or radar-based precipitation, Quantitative Precipitation Forecasts (QPF) and other future precipitation scenarios provides forecasts of uncontrolled flows into and downstream of reservoirs, simulation of reservoir operations with either HEC-ResSim (Reservoir System Simulation) or CADSWES's RiverWare provides operational decision information for the engineer, the river hydraulics program HEC-RAS (River Analysis System) computes river stages and water surface profiles for these scenarios, an inundation boundary and depth map of water in the floodplain can be calculated from HEC-RAS results using the RAS Mapper tool, and the impacts of different flow alternatives are computed by HEC-FIA (Flood Impact Analysis). The user-configurable sequence of modeling software allows water managers to evaluate operational decisions for reservoirs and other control structures, and view and compare hydraulic and economic impacts for various "what if?" scenarios.

Version 3.1.1 of HEC-RTS shares a common interface with the Watershed Analysis Tool (HEC-WAT) and several other HEC software applications. The common framework allows models to be used in either a planning alternative application or for real-time forecasting and decision making. The framework provides mechanisms for HEC-RTS to communicate directly with the software applications, running as independent processes.

HEC-RTS and the software applications share a common geo-referenced **Desktop Pane** (Figure 1.1) that can have an Internet map background, such as Google® or Bing®. Each software application registers and draws geo-referenced model objects on the map panel, such as a reach, cross-section, subbasin, junction, etc. When a user selects one of those objects, HEC-RTS sends a message to the software application and the software application displays a dialog box associated with that object. For example, by selecting a cross section from a map window, the user will bring up the HEC-RAS Geometry Editor for that cross section.

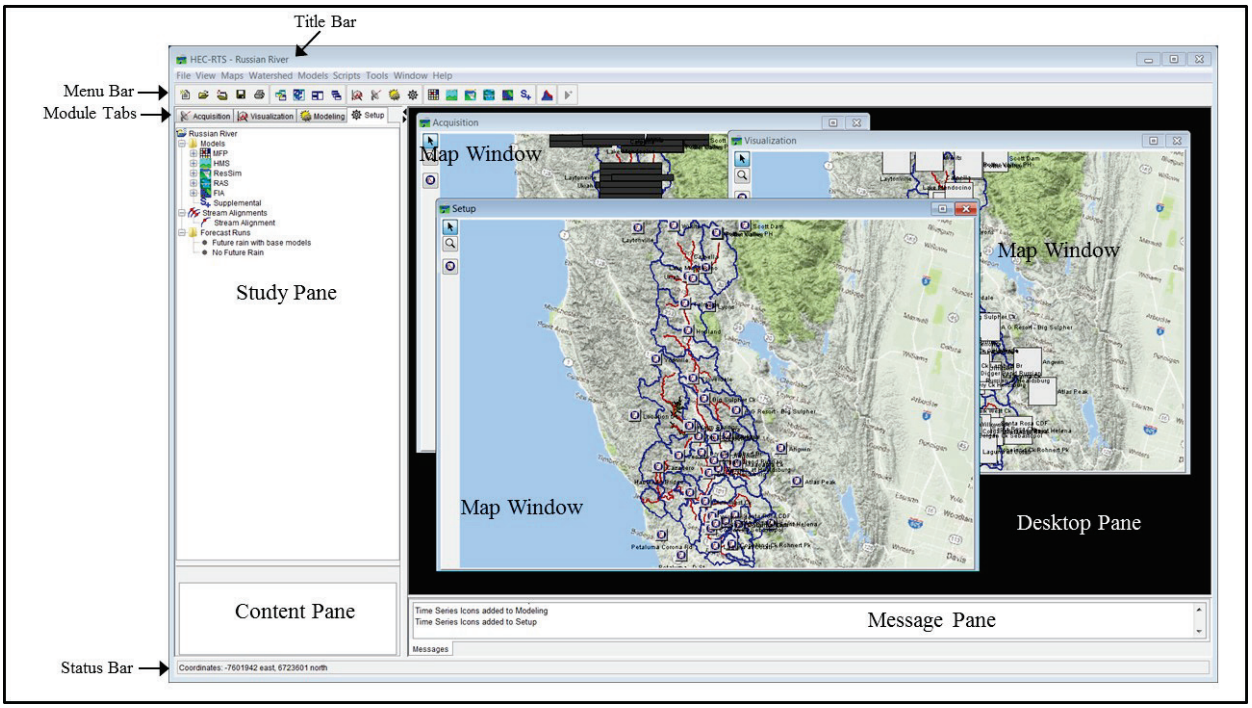


Figure 1.1 HEC-RTS Main Window

When in the **Modeling Tab**, there is an **Actions** and **Reports** panel. From the **Actions Panel**, when a model is selected, that model displays a list of commands (buttons) that can performed by that model, such as compute, set loss rates, change routing coefficients, etc. Selecting a command brings up the appropriate software application editor or performs an action. Similarly, the **Reports Panel** displays a list of commands for reports (plots, tables) from each of the software applications, which are displayed when selected.

The integration with HEC-RAS provides a mechanism for computing flood inundation maps in real-time using forecasted flows from HEC-HMS and HEC-ResSim. The inundation maps can display flood depths and boundaries based on various rainfall scenarios and/or reservoir operations or other alternatives that can affect stages and flow. The maps are overlaid on an Internet map background (chosen by the user) or a geo-referenced photo, allowing the user to zoom in and see detailed depths. The HEC-RAS Mapper Tool can write selected maps in a Google® format that can be placed on a server and seen in the field on an iPad or smart phone.

This document is a guide to setting up a watershed for HEC-RTS and is not comprehensive. The Quick Start Guide is intended to be used along with the User's Manual.

1.2 Data and Information Needed by Water Managers

To make informed operation decisions, water managers need:

- Current and potential future scenarios of precipitation.
- Data that describes the current state of watersheds, channels, and water management facilities, including reservoirs, diversions, and other controllable features of the system.
- Information about the likely future state (e.g., one hour to two weeks) of the watersheds, channels, and management facilities.
- Information about the consequences of management actions that alter future states of the natural and managed systems.

Data that describes the current state of the system comes from a network of environmental sensors. These sensors, which are owned and operated by Federal, state, and local government agencies, utility companies, and commercial enterprises, measure:

- Weather conditions, including air temperature, precipitation depths and rates, and evaporation depths and rates.
- Watershed states, including snow accumulation.

- Depth, velocity, and other conditions in streams, rivers, canals, and other waterways.
- Lake or reservoir level (from which storage volume may be inferred), rates of release of water through outlets, settings of spillway gates, and other conditions of lakes, reservoirs, and diversions.

Data from sensors are transmitted by radio, satellite, telephone, the Internet, and other media to receiving sites, and then to water managers. There, the data is decoded, transformed, checked for quality (validated), and stored in databases. With this data, water managers have near-real-time reports on the current state of the watersheds, channels, and management features.

Using the environmental data from the databases, as well as forecasts, as inputs to models of watershed and channel processes, water managers can forecast future availability of water. A water manager can predict the runoff from a watershed hours or even days into the future as a consequence of estimated rain and rain falling now or in the past on the watershed. To do so, the water manager uses a mathematical model that simulates infiltration, overland flow, baseflow, channel flow, and other relevant watershed and channel processes.

With models of water control facilities, water managers can simulate and assess the impact of operation alternatives. For example, a water manager can determine which of two operation alternatives will more likely result in higher downstream water levels due to a large storm. The forecast of future inflow, combined with a mathematical model of the behavior of the reservoir and the downstream channel, makes this possible.

One operation alternative could be to release water now from a rapidly filling reservoir to accommodate future inflows. Another alternative could be to delay release in anticipation that inflows will diminish and large releases will not be required. The manager has, with analysis software, the capability to compare these operation alternatives in a quantitative manner.

Information from the simulation permits the water manager to assess the economic, environmental, life safety, and other consequences of the operation alternatives. This information will lead to better-informed decisions.

1.3 HEC-RTS Overview

HEC-RTS provides data and information needed to water managers readily through DSS (HEC, Data System Storage software) files, and to a database system that the user creates. The graphical user interface (GUI) provides a user with the ability to configure watersheds, view and edit data/information, create and run forecasts, and view results. The functions of HEC-RTS are organized into four groups, or modules: **Setup, Acquisition, Visualization**, and **Modeling** (Figure 1.1).

The **Setup** module where the user will setup the watershed. The user develops a visual representation of the watershed to display in the GUI that is map-based. In the **Setup** module, the user can configuring inputs, models, and outputs that describe a watershed's behavior.

Tip An HEC-RTS watershed is a set of data, information, models, and images that represent watershed lands and the channels, gages, and water control features within the watershed.

The **Acquisition** module is where the acquisition of data from DSS files, validating the quality of incoming data, transforming the data (e.g., stage to flow), and editing the data, for a watershed happens.

The **Visualization** module provides commands for data visualization, like, displaying observed and forecasted data to evaluate the hydrometeorological state of the watershed. In the **Visualization** module, HEC-RTS provides tools to facilitate review of large amounts of data, including summaries presented as graphs, tables, spreadsheets, charts, river profiles, maps, or sometimes a combination of these. Within the **Visualization** module, the summaries are linked to a watershed map, so that a user can click on an icon and immediately view the data associated with that location or also view computational results.

The **Modeling** module is where the user will run forecasts; the user will create forecasts, and then forecast and view results. HEC-RTS links the analysis software so that individual models are executed in an orchestrated manner. Data and other inputs are passed to each piece of software through a DSS file (*forecast.dss*).

Tip A forecast is a simulation of watershed processes and consequences of flooding based on input data and information and hydrologic, reservoir operation, hydraulic, and impact analysis models. Forecast results include flow and stage in the channel from watershed runoff, reservoir release schedules, floodplain inundation maps, floodplain consequence reports, and reports listing actions for emergency responders to take. These results inform water management decision making.

HEC-RTS analysis software meets modern software standards, includes an easy-to-use GUI, and executes within current operating systems. The main analysis software are:

HEC-MetVue Processes observed meteorological data for input to HEC-HMS. Inputs are either point or gridded estimates of meteorological data such as precipitation and temperature. Outputs are observed meteorological time series formatted for compatibility with HEC-HMS.

MFP Processes meteorological forecasts for input to HEC-HMS. Inputs are forecasted meteorological data such as precipitation and temperature. The user can enter these forecasts manually or obtain them from external sources such as NWS (National Weather Service).

HEC-HMS Simulates watershed response to precipitation. Inputs may include observed or forecasted precipitation, temperature, snowpack, and other environmental conditions. Outputs include flows throughout the watershed, including inflows to reservoirs and local flows below the reservoirs.

HEC-ResSim Simulates behavior of reservoirs and linking channels, following user-specified operations for reservoir release decision making. Inputs include flows into reservoirs and unregulated flows downstream of reservoirs (from HEC-HMS). Outputs include reservoir releases, downstream regulated flows, and reservoir storage conditions.

HEC-RAS Simulates behavior of channels and adjacent floodplains. Simulation of channels is in one dimension, and simulation of adjacent floodplains is in one or two dimensions. The output from HEC-RAS permits determination of water surface elevations corresponding to flows computed by HEC-HMS or HEC-ResSim. Inputs include flows, and outputs include water surface elevations, depth grids, and inundation maps.

HEC-FIA Estimates the consequences of flow or water surface elevations in the system. Inputs include computed or observed flows or water surface elevations throughout the flood plain. Outputs include economic, life loss, or other measures of impact, or optionally, information on actions to be taken in response to flows or water surface elevations that will be experienced.

HEC-RTS ensures that those who need to know the current state of the defined watershed and likely future states have access to that information. The capability to access this information is accomplished using information sharing technology, including specially designed websites for display.

Chapter 2

Installing HEC-RTS

2.1 Requirements

- Installation - about 3 GB of hard disk space
- Memory - HEC-RTS Russian River watershed - 1 GB
- Operating System - Windows 64-bit
- Java - HEC-RTS runs Java 8, which is included and run under the HEC-RTS installation folder

2.2 Installation

- Install HEC-RTS using the self-extracting exe file (i.e., C:\Programs) – double-click on "*HEC-RTS 3.1.1.exe*".
- HEC- RAS Install - If HEC-RAS Version 5.0.7 has not been installed on your computer then do the following:
    - Double-click on the "*HEC-RAS_507_ Without_Examples.exe*" (file is located in …/*HEC-RTS-v3.1.1/HEC-RAS/5.0.7*) and follow the installation wizard to install HEC-RAS 5.0.7. System administrator rights are required.
- Install the Russian River Watershed using the zip file - "*RussianRiverRTS_v4.zip*".

- To create an HEC-RTS shortcut, from the *HEC-RTS-v3.1.1* directory, right click on "*HEC-RTS.exe*" and drag to the desktop. Release, and from the shortcut menu click **Create shortcuts here**, an HEC-RTS shortcut will appear.

Before running HEC-RTS 3.1.1 for the first time, the user needs to decide on a general location that will contain all HEC-RTS watersheds. It is recommend that the Users directory should not be selected, but a location be chosen that other users can easily access. The user will create the directory using Windows File Explorer. The first time HEC-RTS is run, the user will be asked to agree to the terms and conditions for HEC-RTS, as well as the terms and conditions for the individual modeling software.

HEC-RTS has a requirement for watersheds to be stored in a location. Since this is the first time that HEC-RTS has been run, a **No Watershed Locations** message window will appear (Figure 2.1) letting the user know that watershed locations have not been defined and would the user like to create a watershed location. If the user clicks **Yes**, the **No Watershed Locations** message window will close (Figure 2.1), and the **Create Watershed Locations** dialog box (Figure 2.2) will open. The user can now define watershed locations (Chapter 3). If the user clicks **No**, the **No Watershed Locations** message window will close (Figure 2.1), and the user can create watershed locations later on (Chapter 3, Section 3.2).

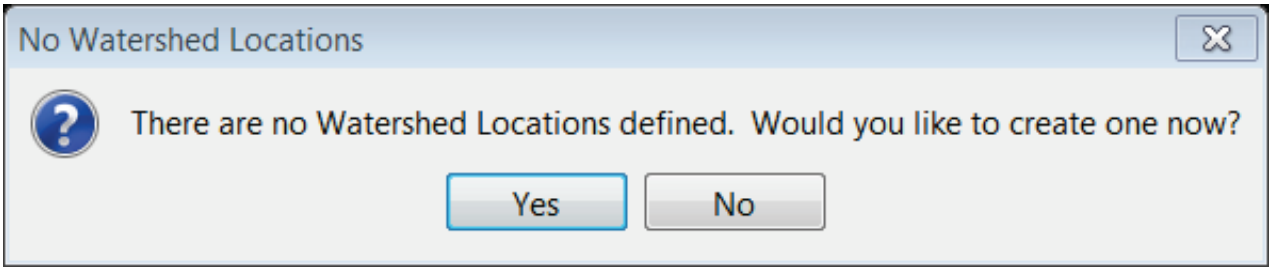


Figure 2.1 No Water Locations Message Window

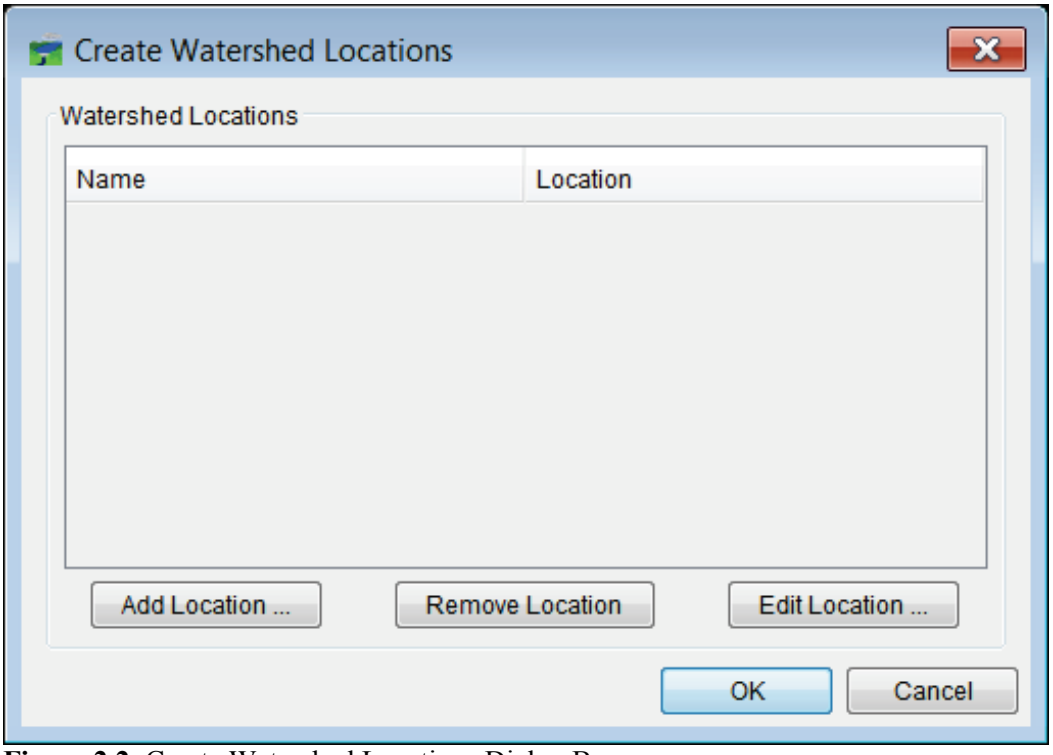


Figure 2.2 Create Watershed Locations Dialog Box

2.3 Starting HEC-RTS

When starting HEC-RTS, double-click the HEC-RTS icon (shortcut) on the desktop. The splash dialog box (Figure 2.3) for HEC-RTS will open and will appear for a few seconds, and then the main window of HEC-RTS will appear (Figure 2.3). HEC-RTS is now ready for use.

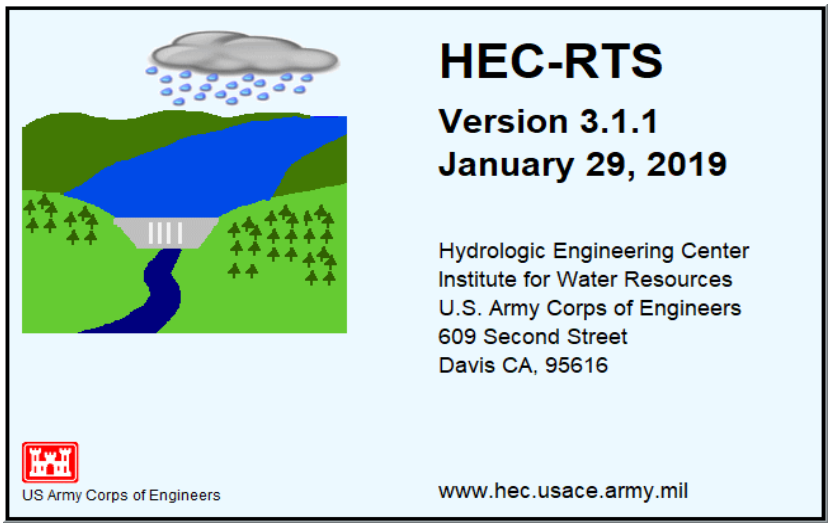


Figure 2.3 HEC-RTS Splash Dialog Box

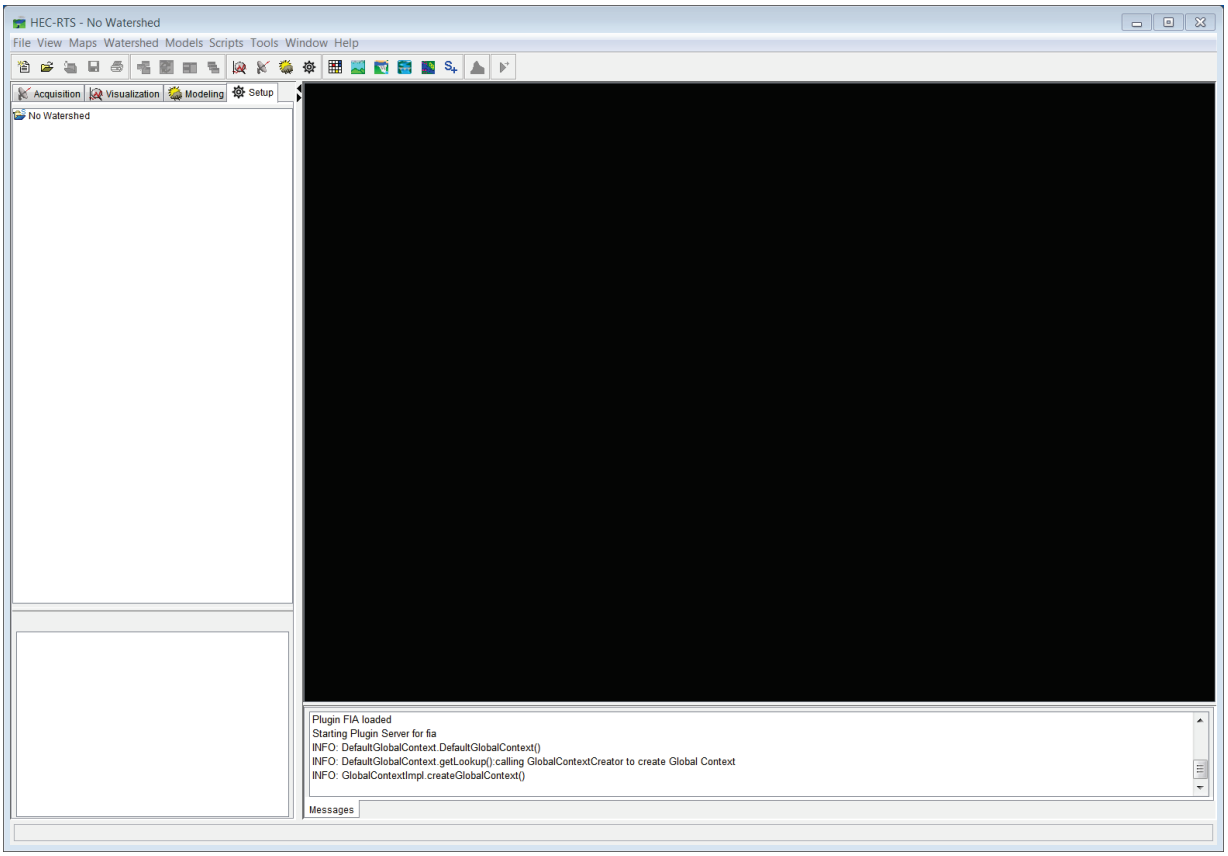


Figure 2.4 HEC-RTS Main Window

2.4 About the Quick Start Guide

This document is a guide to setting up an HEC-RTS watershed. The document is not comprehensive and is intended to be used along with the HEC-RTS User's Manual. Some areas will cover detail, where others will refer the reader to other documentation. This document is intended to provide a user who is implementing a watershed in HEC-RTS a step-by-step process.

Chapters 3 and 4 provide the user with an overview of the HEC-RTS framework. Chapter 5 introduces the user to creating an HEC-RTS study from scratch. Chapters 6 thru 9 are standalone chapters that lead a user thru creating an HEC-RTS study by importing individual models (Chapter 6); integrating models (Chapter 7); setting up the HEC-HMS model for forecast optimization (Chapter 8); and, incorporating Time Series Icons for both archived and real-time data (Chapters 9 and 10).

Chapter 3

HEC-RTS Interface

The graphical user interface (GUI) is the steering wheel of HEC-RTS. The GUI features graphical menus and tools organized by function, or modules. The four modules are:

- **Setup** for watershed configuration.
- **Acquisition** for data acquisition, monitoring, validation, and editing.
- **Visualization** for viewing data.
- **Modeling** for setting up and executing analysis software for forecasting and viewing results.

This chapter provides an overview of the GUI and basic functions. Here are three navigation tips:

- For simplicity, the GUI "hides" commands that are not applicable to the module or element the user is working on. Thus, if an option appears to be missing, make sure that the correct module or element has been selected and that the option is applicable for that selection.
- Directory trees list elements configured in the watershed. When a user configures a new element, it will be added to the directory tree.
- Commands related to a selected element are typically accessible by right-clicking on the element.

3.1 Starting HEC-RTS

When starting HEC-RTS, double-click the HEC-RTS icon on a user's desktop if a shortcut has been placed there, or locate it in the folder where RTS was placed. The HEC-RTS splash dialog box will open (Figure 2.3). The splash dialog box appears for a few seconds, and then the main window of HEC-RTS will display (Figure 2.4). The user is now ready to start using HEC-RTS.

3.2 Opening an Existing Watershed

In HEC-RTS, a **watershed** is a set of data, information, models, and images that represent lands and the channels, gages, and water control features within the watershed. A user may open an existing watershed from any of the modules. (If the user needs to create a new watershed, refer to Section 5.1. There are two methods available to open a watershed. First, if the user has opened the watershed before, from the HEC-RTS main window (Figure 2.4), from the **File** menu, point to **Recent Watersheds,** and click on the watershed name. The second way to open a watershed follows:

1. If watershed locations have not been set, from the HEC-RTS main window (Figure 2.4), from the **Tools** menu, click **Options**. The **Options** dialog box will open (Figure 3.1).

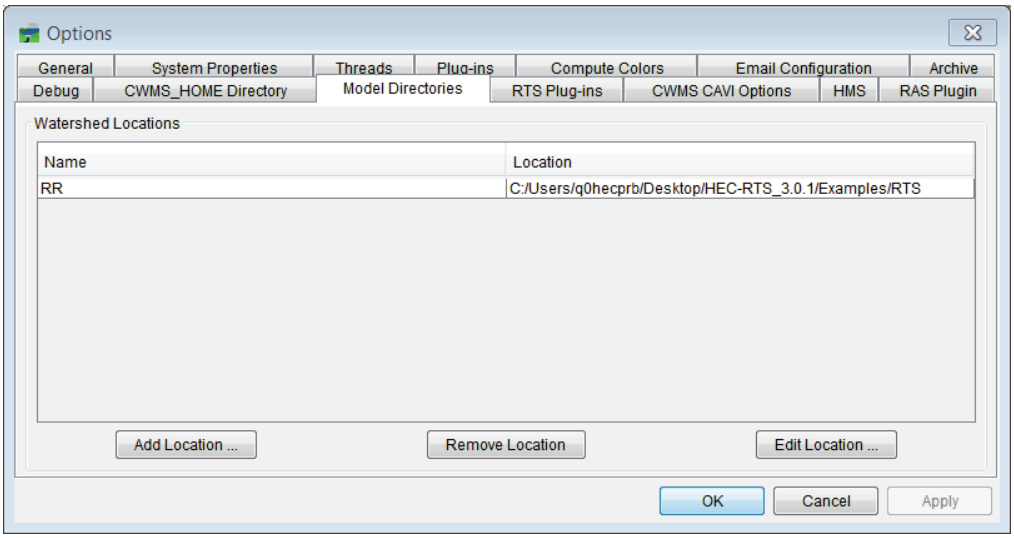


Figure 3.1 Option Dialog Box

2. Click **Model Directories**, from this tab the user will create watershed locations. Click **Add Location**, the **Add Watershed Location** dialog box will open (Figure 3.2). Enter a name for the watershed location in the **Name** field.

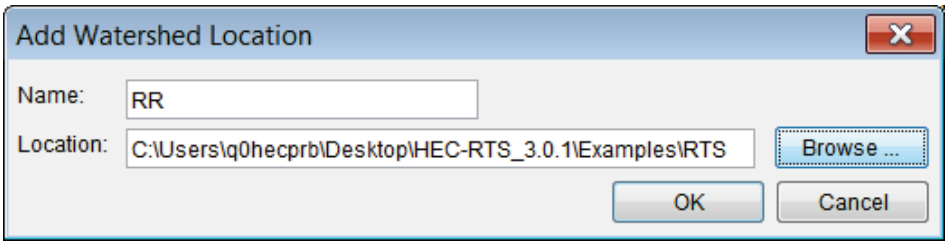


Figure 3.2 Add Watershed Location Dialog Box

3. In the **Location** field, the user can either enter a directory or click **Browse**. The **Select Watershed Location** Browser will open (Figure 3.3) and the user can browse to the appropriate location. Click **Open**, the **Select Watershed Location** Browser will close

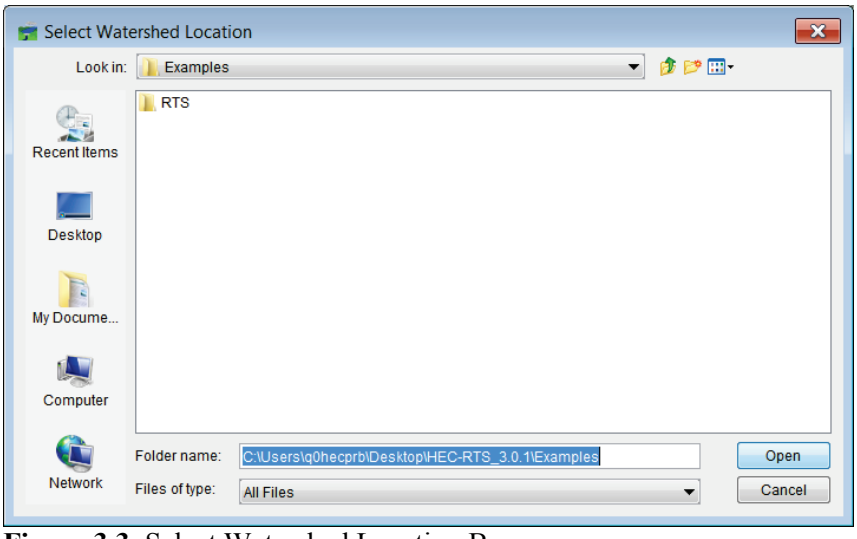


Figure 3.3 Select Watershed Location Browser

(Figure 3.3), the selected location will now appear in the **Location** field of the **Add Watershed Location** dialog box (Figure 3.2). Click **OK**, the **Add Watershed Location** dialog box will close (Figure 3.2), and the defined watershed location will appear on the **Model Directories** tab of the **Options** dialog box (Figure 3.1). Click **OK**, the **Options** dialog box will close (Figure 3.1).

4. From the HEC-RTS main window (Figure 2.4), from the **File** menu click **Open Watershed**. The **Open Watershed** dialog box will open (Figure 3.4).

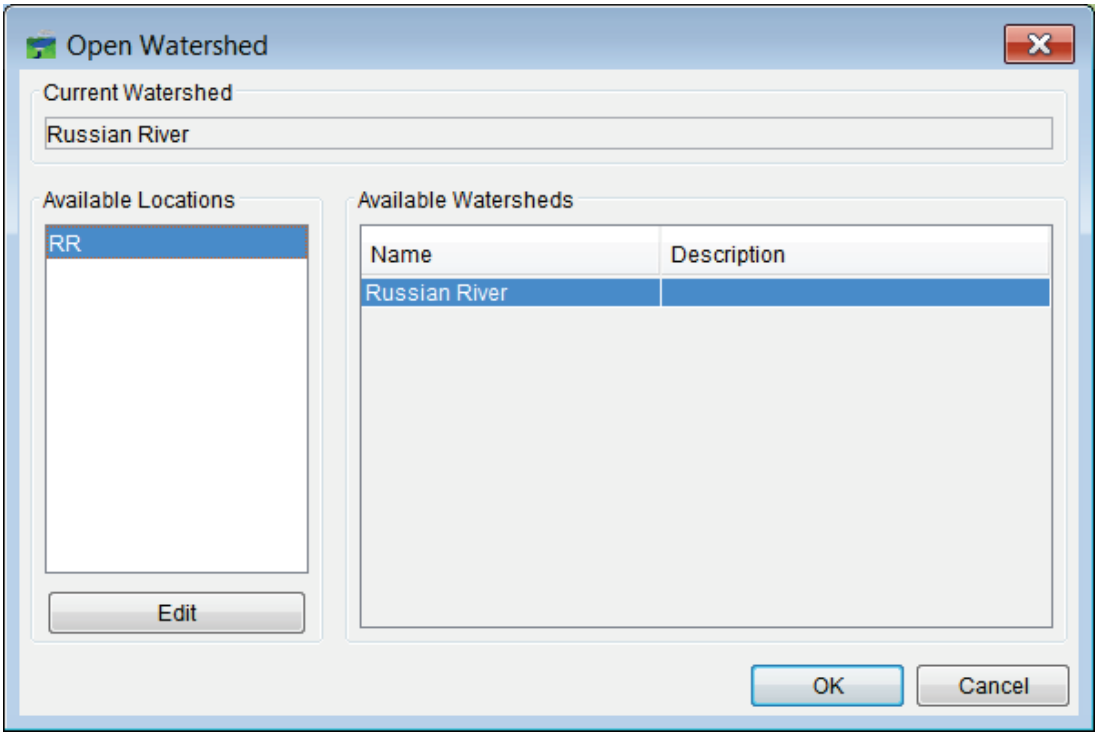


Figure 3.4 Open Watershed Dialog Box

5. From the **Available Locations** box (Figure 3.4), select the location. From the **Available Watersheds** box (Figure 3.4), select the appropriate watershed. Click **OK**, the **Open Watershed** dialog box will close (Figure 3.4), and the selected watershed will appear in the HEC-RTS main window (Figure 1.1).

> **Tip** There can only be one watershed open at a time. Therefore, if a watershed is open and an attempt is made to open another watershed, HEC-RTS will close the initially opened watershed. HEC-RTS first prompts the user to save the watershed.

3.3 HEC-RTS Main Window

The HEC-RTS main window (Figure 3.5) displays the framework for the HEC-RTS software that allows users to enter data, review data, create alternatives, run forecasts, and view results. The **Title Bar** (Figure 3.5) displays the HEC-RTS watershed title. After a watershed is opened, the name of the watershed will appear in the **Title Bar**.

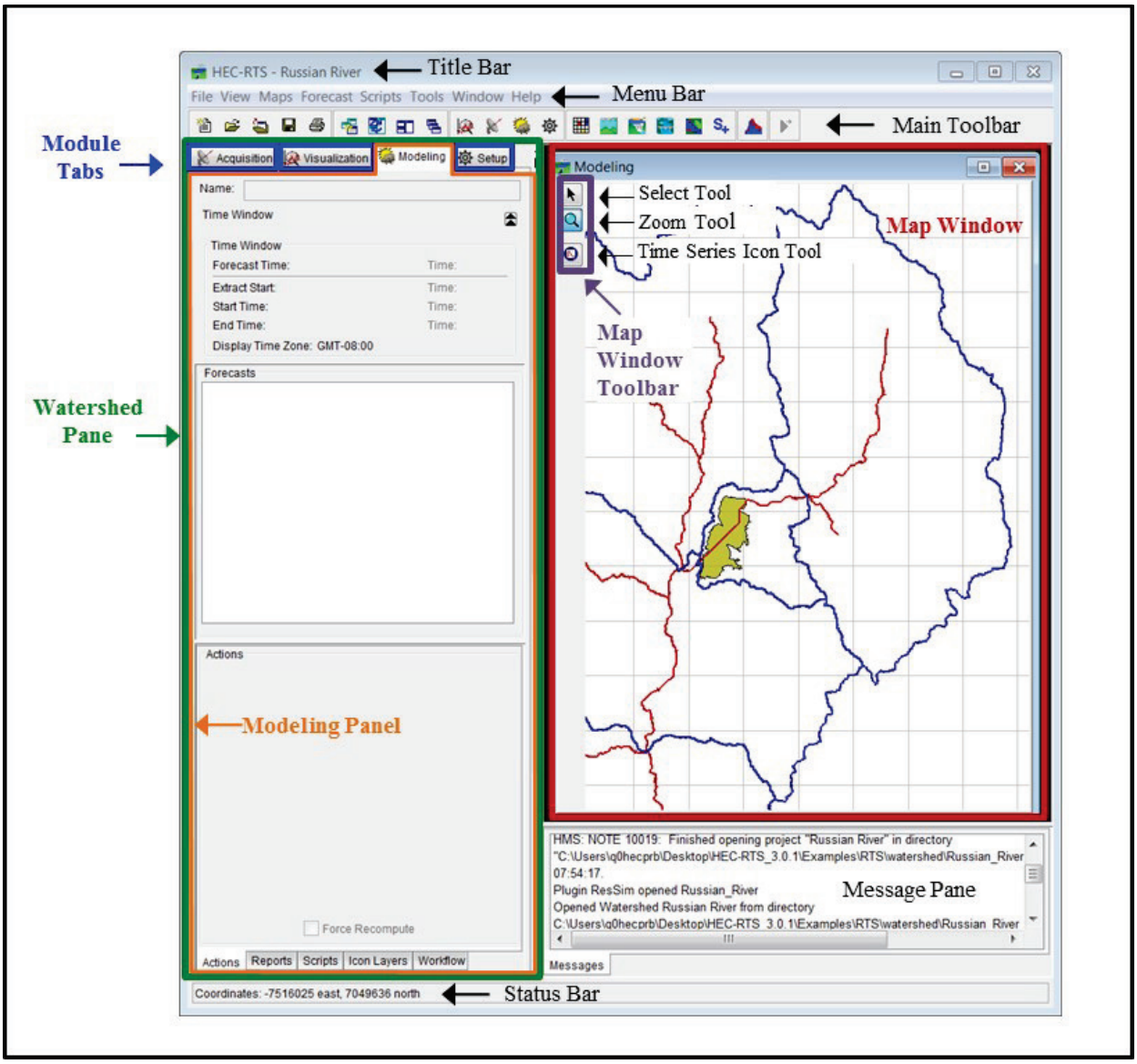


Figure 3.5 HEC-RTS Main Window Components

The basic components of the HEC-RTS main window are:

Menu Bar	General and module-specific menus.
Main Toolbar	Shortcut icons for menu commands.
Module Tabs	There are four modules in HEC-RTS: **Setup, Acquisition, Visualization**, and **Modeling**. Each module has specific commands (menus, tools, map windows).
Watershed Pane	The area where the module tabs are located.
Map Window	Used to setup and display the watershed representation, which is geographically-referenced (geo-referenced).

Map Window Toolbar Tools used to setup and navigate within the map window.

Messages Pane Displays a scrolling list of messages. System output log information appears in this window from the time you start HEC-RTS until you exit. Messages related to incoming data are colored coded based on the quality of the data. Messages may also report a problem with a system component; problems with field equipment; a caution, warning, or flood event; or other critical situations.

Status Bar Displays map coordinates when the select tool is hovering over a location in the map window.

3.3.1 Menu Bar

The **Menu Bar** (Figure 3.5) of HEC-RTS provides the user with many commands to perform various functions. For more details check the HEC-RTS User's Manual. For this manual, an overview of each menu that is available in the HEC-RTS software is provided.

File From this menu (appears in all modules), the user can create, open, close, upload, or download a watershed; save data associated with the watershed; view watershed properties; print the map window; and, exit HEC-RTS. In addition, most recently opened watersheds are located at the bottom of the **File** menu. Available commands are: **New Watershed, Open Watershed, Close Watershed, Upload/Download Watershed, Save Watershed, Save Watershed As**, **Watershed Properties, Print Map, Recent Watersheds,** and **Exit**.

Edit This menu will appear in all modules and is module specific. Typically, the edit options will be relevant to data element(s) for a specific module.

View This menu is used to add or remove interface items (toolbar icons, the watershed pane, the messages bar, and the status bar); see what units, which time zone, and which coordinate system are being used for viewing; save, restore and manage layouts; choose whether or not to display the default computation point layer within the map window; select which modules tabs will be shown in the watershed pane; and view a list of watershed files.

Reports This menu is module specific and provides access to reports produced for the selected module.

Scripts This menu allows the user to execute existing scripts, create, test new scripts and run scripts. Available commands are: Script **Editor, Schedule, Script Job Status,** and **Run**.

Tools This menu allows the user to access data (HEC-DSSVue); utility software; set options for HEC-RTS; specify plug-in editor locations to use; view the "*console.log*" file; view log files of HEC-DSSVue and the other software applications; and, view memory usage. Available commands are: **HEC-DSSVue, Applications, Options, Model Version Editor, Console Output, Logs**, and **Memory Monitor**.

Window This menu allows the user to select how to view and select multiple windows, which modules the user wants to view. Available commands are: **Duplicate Window, Detach Window, New Map Window, Map Window Properties, Sync Map Windows, Tile**, **Cascade**, **Next Window**, and **Previous Window**.

Help Displays current version information about HEC-RTS.

3.3.2 Map Window Toolbar

The primary set of tools in the map window toolbar (Figure 3.5) are - **Select Tool**, **Zoom Tool**, and **Time Series Icon Tool**. The tools change the appearance and functionality of the mouse. Other tools appear in the toolbar depending on which module the user has selected. An overview of the tools is provided, and further details about the tools are provided throughout this manual.

The **Select Tool** allows the user to select elements in the map window. Also, after zooming in, the user can use the **Select Tool** to pan.

The **Zoom Tool** allows the user to zoom in and out of the map window. To zoom in, hold the mouse button down and outline the area to be enlarged. Right-click to zoom out.

The **Time Series Icon Tool** allows the user to select time series icons on the map window. To select multiple icons, hold down the **SHIFT** key, and click on the time series icons that are to be selected. The user can access commands related to a time series icon by right-clicking the appropriate time series icon.

3.3.3 Time Series Icon Controls

Time Series Icon Controls (Figure 3.6) allow the user to select the attributes for the time series layers that are displayed within the watershed. For time series icon controls panel to display, a time series layer must be created and data must be available for at least one of the time series icons associated with a time series layer. The tab is available in all modules, except the **Setup** module.

Figure 3.6 Time Series Icon Controls

Icon Type The **Icon Type** list (Figure 3.6) forces all icons within the map window to display as the selected **Icon Type**. The **Default** option in the list will display the time series icons for a watershed as they were set in the **Setup** module.

Value Allows the user to display the time series icon's data as labels (Figure 3.7), which displays next to or on the location of the associated time series icon. For

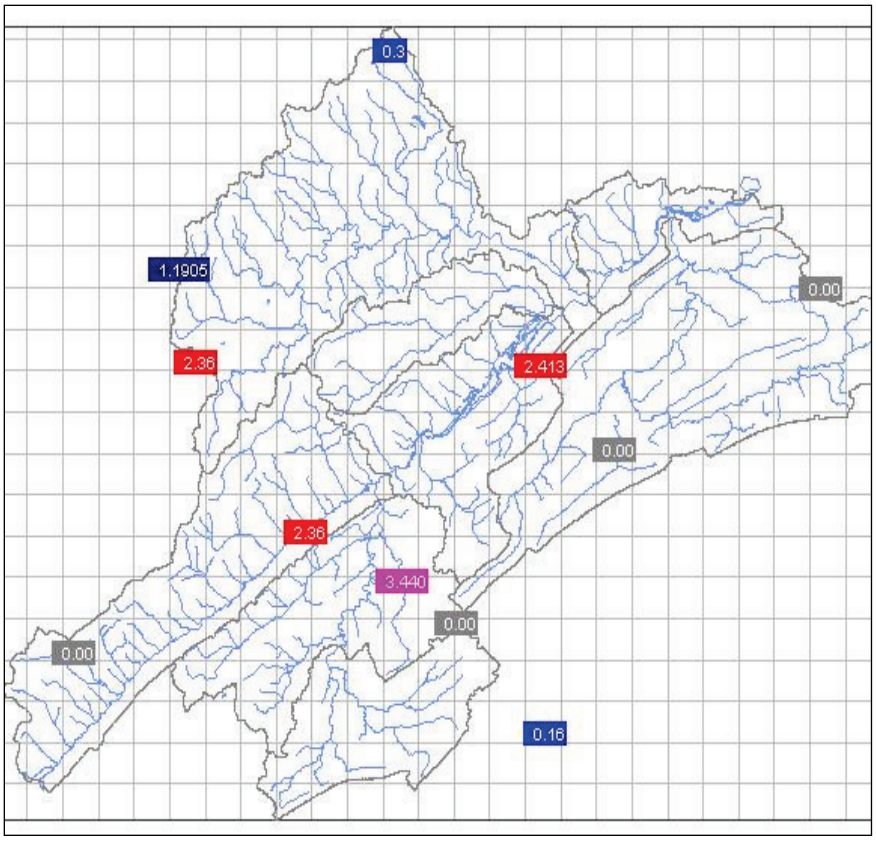


Figure 3.7 Time Series Icons - Value Labels

example, the user can choose to display the data's total, minimum, and maximum values as labels. Multiple values can be selected at once.

Layer Allows the user to select which layer or layers are visible in the map window. Multiple layers can be selected at once.

3.4 Map Window Elements

Map Window (Figure 3.5) elements allow the user to represent watershed data visually in a geo-referenced context and interact with associated data. The user can create elements and edit the element properties in the **Setup** module. In the **Acquisition, Visualization**, and **Modeling** modules, the user can plot and tabulate data and results associated with the elements. Additional commands are available according to the selected module.

3.5 Viewing of Data and Results

Data can be viewed from both the **Acquisition** and **Visualization** modules. Data is viewed from plots or tables.

Results are viewed from the **Modeling** module through plots and reports. (Reports available in the **Setup** module provide the user with information on the display elements that have been defined for the watershed.)

Chapter 4

Reviewing Results

4.1 Viewing of Data and Results

Data can be viewed from both the **Acquisition** and **Visualization** modules through plots or tables. Results are viewed from the **Modeling** module through plots and reports. (Reports available in the **Setup** module provide the user with information on the display elements that have been defined for the watershed.)

4.2 Features of Plots

HEC-RTS plots offer data and results specific to the active module. The data that can be viewed was defined by the user in the **Setup** module at the time series icon locations. Modeling results can also be viewed at time series icons or at individual modeling elements (e.g., reservoirs). For example, in the **Acquisition** module, the plot for one time series icon might open a two-dimensional graph of incoming data at a specific location, while, in the **Modeling** module, the same time series icon might plot reservoir modeling results at that location (Figure 4.1).

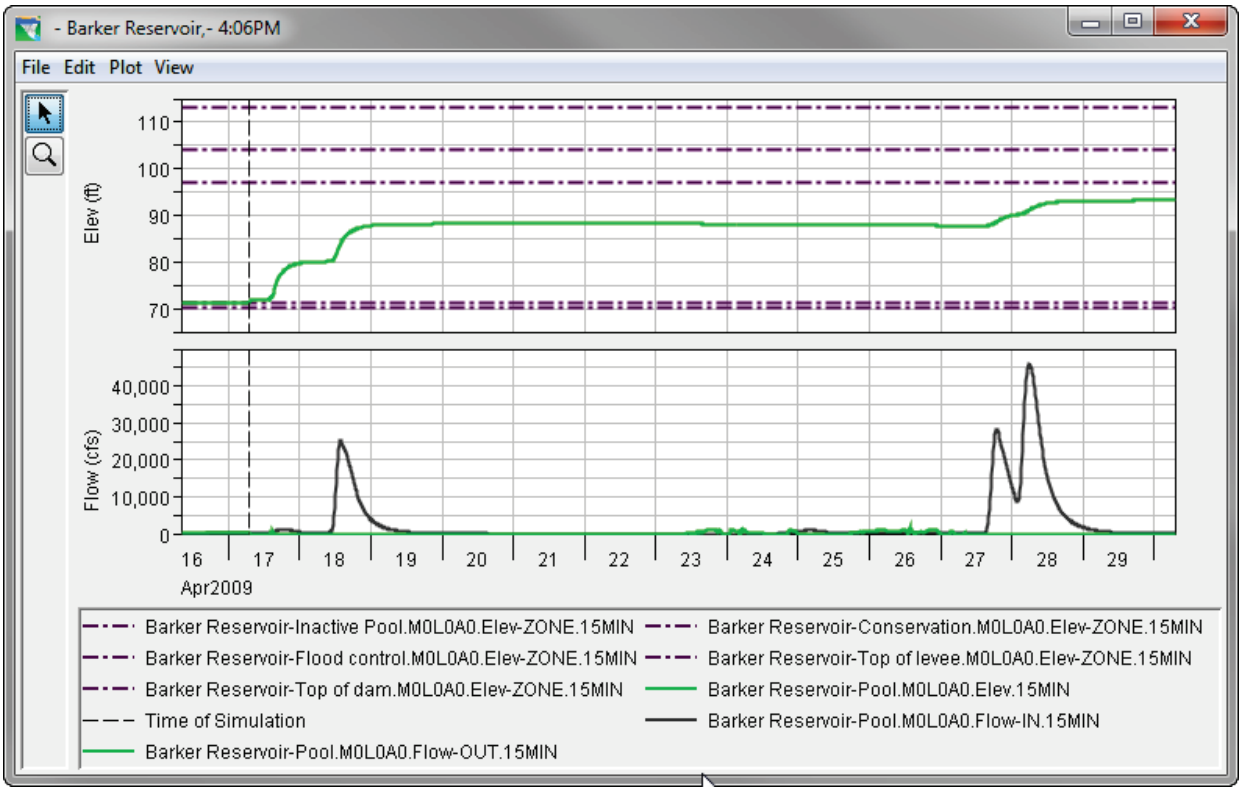


Figure 4.1 Sample Plot: Reservoir Modeling Results

The plot displays the location name in the title bar and has axis labels and a color-coded legend for the data contained in the plot. When a plot depicts results of a model alternative, as in Figure 4.1, a dashed vertical line represents the time of forecast. The **Zoom Tool** from the plot window operates the same as described in Section 3.3.2.

The user can customize the appearance of plots through the use of several editors. To access these editors, use the **Select Tool** and right-click on different elements of the plot (e.g., lines, axis). The user can also access these editors through the **Edit** and **View** menus in the **Plot** dialog box (Figure 4.1). The following provides an overview of the different editors (see Appendix I of the HEC-RTS User's Manual for more details on customizing plots):

Curve Properties Right-clicking on a plot curve or point allows the user to open a curve properties editor where curve colors, styles, and weights as well as labels and quality symbols can be edited.

Viewport Properties Right-clicking on the viewport of a plot allows the user to open an editor where the border, background, and gridlines of the plot can be customized.

Title Properties Right-clicking on a plot axis allows the user to open a title properties editor where the title of a plot can be customized.

Axis Properties Right-clicking on a plot axis allows the user to open an axis properties editor where the axis scale and tic marks can be customized.

Legend Properties Right-clicking on the legend of a plot allows the user to open an editor where the user can add a title and add icons and text to the left and right blocks of a plot.

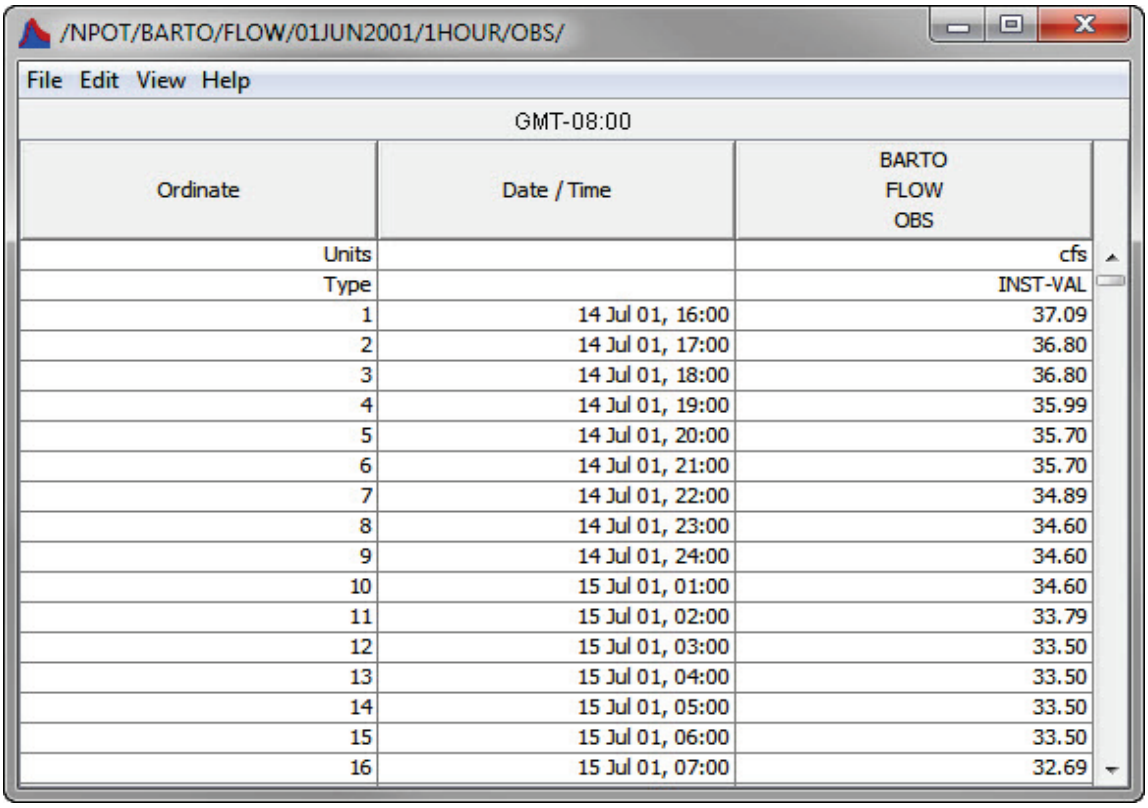
Label Properties Right-clicking on an axis label or plot legend allows the user to open a label properties editor where the user can add or change the background color of labels or add a border to the labels.

Spacer Properties If multiple plots are available in the plot window, the user can right-click on the space between the plots to access the **Space Properties Editor**. From the **Space Properties Editor** adjustments can be made to the space between plots.

Polygon Properties Right-clicking on a polygon allows the user to open a polygon properties editor where borders and backgrounds can be customized.

4.3 Features of Tables

The same data and information viewed from a plot can also be viewed in tabular form (Figure 4.2). As with plots, the type of data and results displayed depends on the properties the user defined for each time series icon.



Ordinate	Date / Time	BARTO FLOW OBS
Units		cfs
Type		INST-VAL
1	14 Jul 01, 16:00	37.09
2	14 Jul 01, 17:00	36.80
3	14 Jul 01, 18:00	36.80
4	14 Jul 01, 19:00	35.99
5	14 Jul 01, 20:00	35.70
6	14 Jul 01, 21:00	35.70
7	14 Jul 01, 22:00	34.89
8	14 Jul 01, 23:00	34.60
9	14 Jul 01, 24:00	34.60
10	15 Jul 01, 01:00	34.60
11	15 Jul 01, 02:00	33.79
12	15 Jul 01, 03:00	33.50
13	15 Jul 01, 04:00	33.50
14	15 Jul 01, 05:00	33.50
15	15 Jul 01, 06:00	33.50
16	15 Jul 01, 07:00	32.69

Figure 4.2 Data in Tabular Form

The appearance of tables can be customized through the use of commands available from the menu bar of the tabular form. The user can add commas; separate date/time into two separate columns; make the year four digits; specify the decimal precision of the data; show the quality of the data; show missing data as a value (e.g., -901.0); copy selected cells or the whole table; print; plot; resize the columns of the table; and export, the table to an ASCII file.

4.4 Printing and Exporting Plots and Tables

Plots and tables can be printed, copied and pasted into other applications, and exported as summary files. For a more detailed description of printing and exporting, see Appendix J of the HEC-RTS User's Manual.

4.5 Features of Photos and Webcam Images

Photos, webcam images, web pages, or documents can be assigned to time series icons. By adding images to an icon in the **Setup** module, the user can then access images in the **Visualization, Acquisition**, and **Modeling** modules through the icon shortcut menu. Images and webcams can be viewed in their own separate dialog or as icons on the map window. Figure 4.3 shows a satellite image that can be viewed from a time series icon. If a time series icon represents a dam, links can be assigned to the icon that might be a webcam that displays a real-time video of an actual outlet on that dam. The time series icons could also have access to pictures of the dam and reports providing details about the dam. For further information on how to set these features up, see Chapter 18 of the HEC-RTS User's Manual.

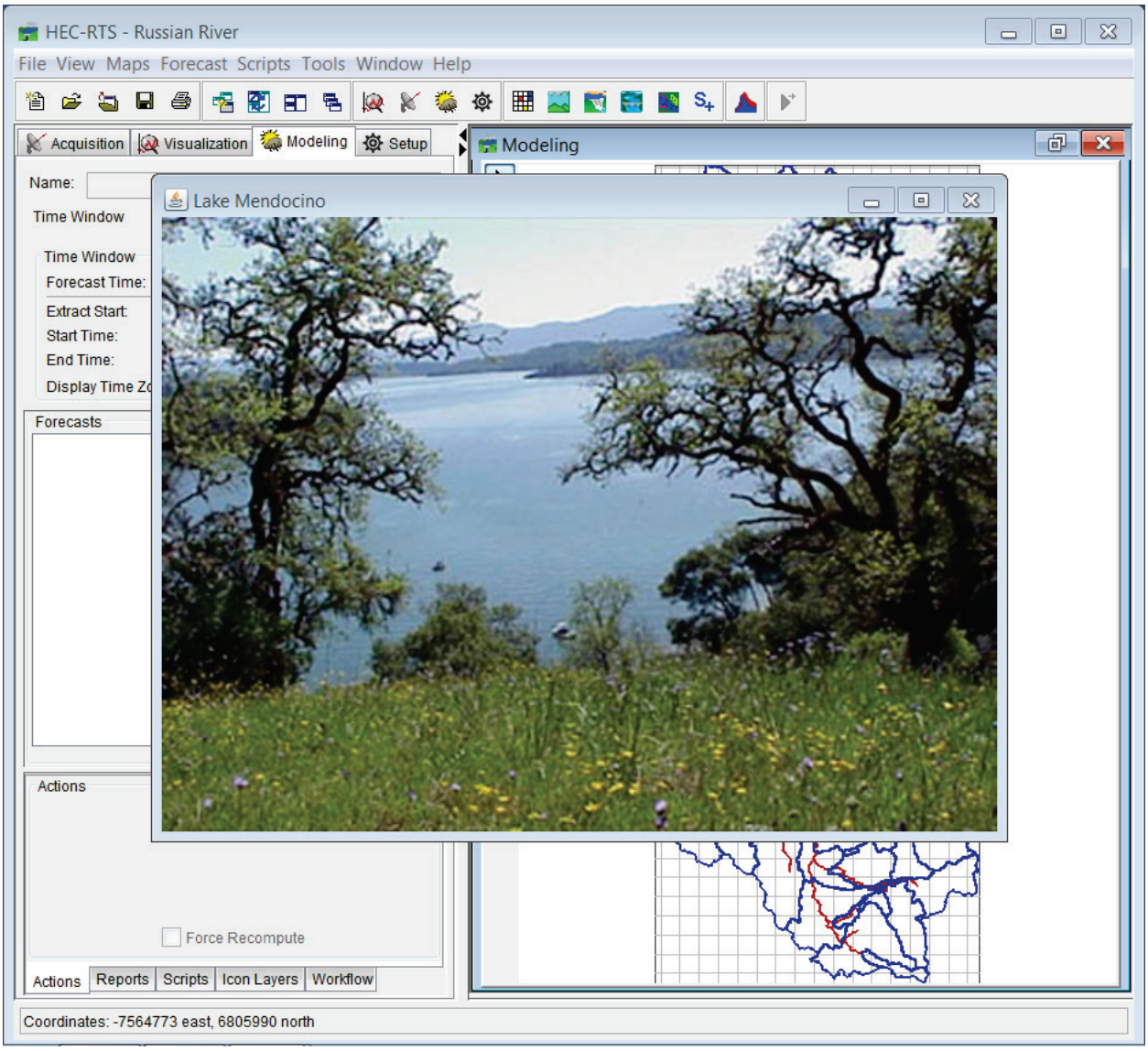


Figure 4.3 Viewing an Image from a Time Series Icon

4.6 Running Scripts from Icons

Scripts can be assigned to individual time series icons. The scripts can be used to update the data at given intervals, compute other information from the data, or complete other tasks. Scripts are assigned to the icons in the **Setup** module, through the **Time Series Icon Editor**. Scripts can also be created in the provided **Script Editor**. For more detailed information on assigning and using scripts, see Appendix H of the HEC-RTS User's Manual.

Chapter 5

Create a New HEC-RTS Watershed

5.1 Create an HEC-RTS Watershed

To create a new watershed:

1. From the HEC-RTS main window (Figure 5.1), from the **Setup** module, from the **File** menu, click **New Watershed**. The **Create New Watershed** dialog box (Figure 5.2) will open.

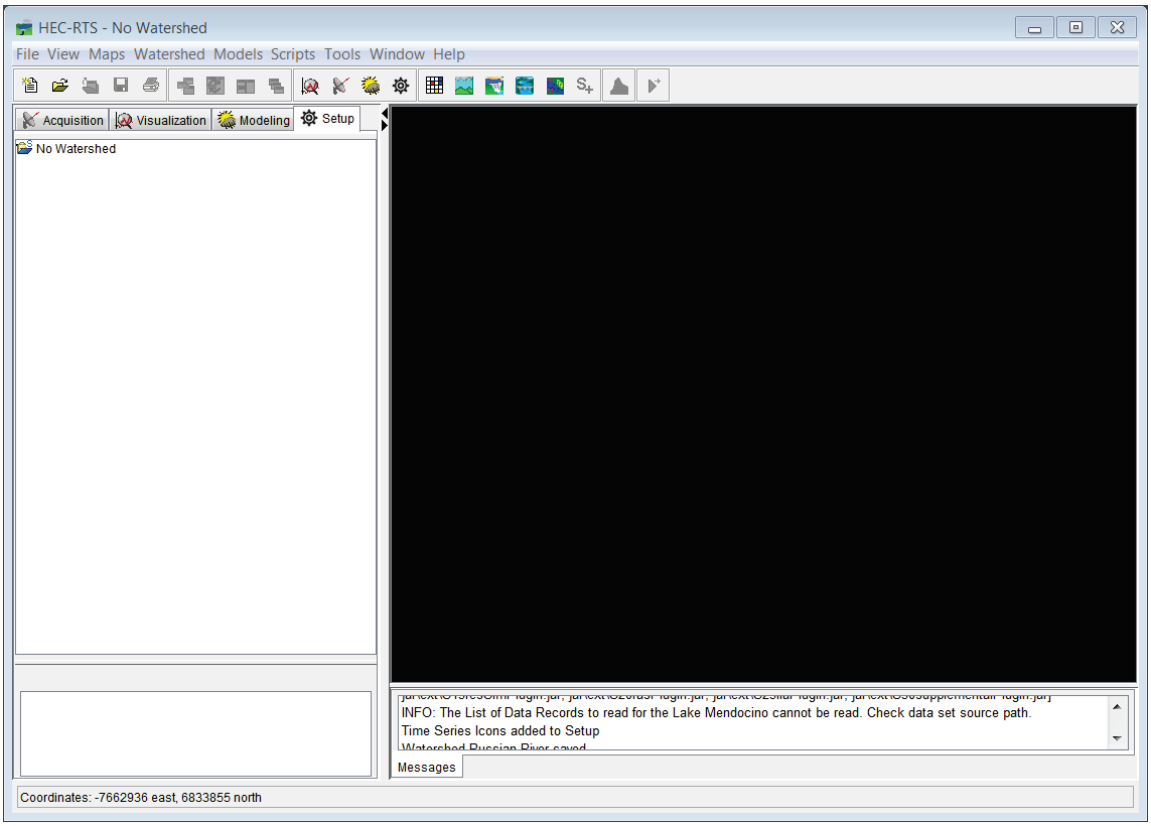


Figure 5.1 HEC-RTS Main Window – Setup Module

2. Enter a name for the watershed in the **Watershed Name** box (Figure 5.2). Optionally, the user can enter a description of the watershed in the **Description** box (Figure 5.2), enter a description for the new watershed.

3. From the **Watershed Location** list (Figure 5.2), select a watershed location that has been created (Section 3.2).

4. The default unit system is English, from the **Unit System** list (Figure 5.2) the other choice is **SI** (metric).

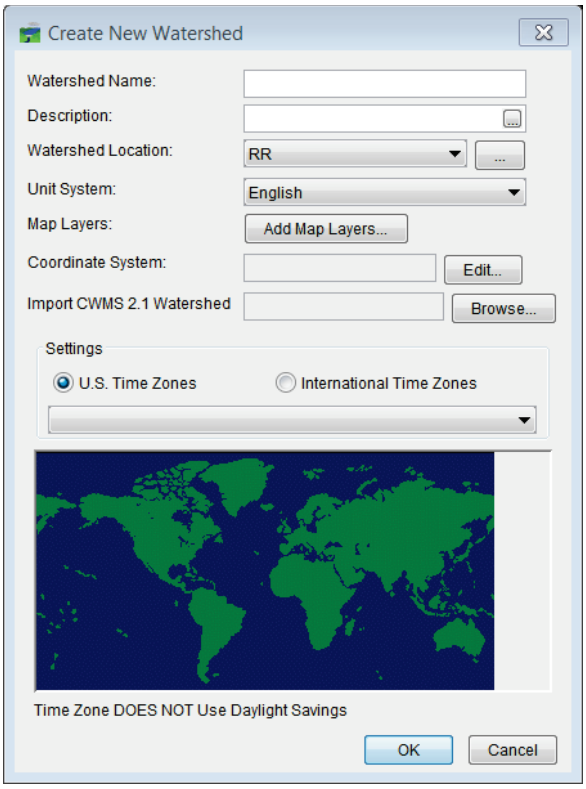


Figure 5.2 Create New Watershed Dialog Box

5. The user can add background shapefiles at this time by clicking **Add Map Layers** (Figure 5.2), the **Select Map to Add** browser will open (Figure 5.3). From the browser the user will navigate to where the background shapefiles for the watershed are located, select the shapefile, click **Open**, the **Select Map to Add** browser will close (Figure 5.3). The user can also add map layers to the watershed after the initial setup of the watershed (Section 5.2).

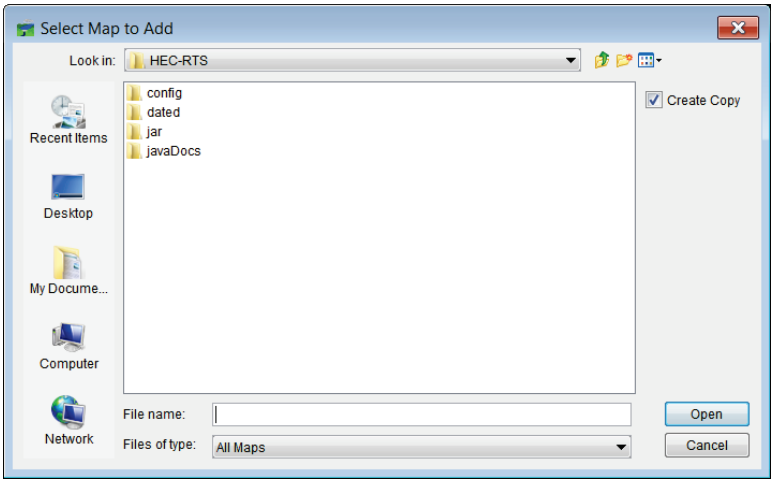


Figure 5.3 Select Map to Add Browser

6. Next, the projected coordinate system of the watershed needs to be set. From the **Create New Watershed** dialog box (Figure 5.2), click **Edit** (by the **Coordinate System** box), the **Map Coordinate Information** dialog box will open (Figure 5.4).

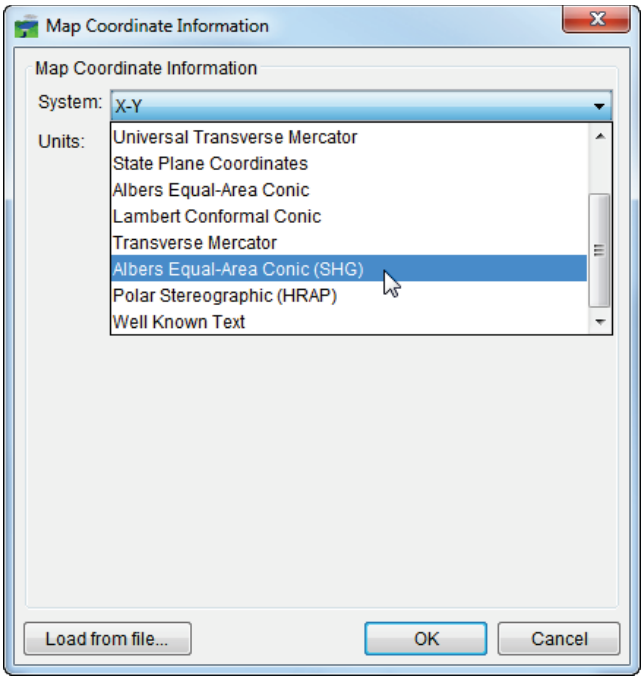


Figure 5.4 Map Coordinate Information Dialog Box

7. For HEC-RTS 3.1.1, the watershed must have a map coordinate system defined, this includes all of the map layers and the models. To get the correct projected coordinate system, click **Load from File** (Figure 5.4), an **Open** browser will open (Figure 5.5). Browse to the location where a map layer with the correct projected coordinate system, select the map layer, click **Open**. The **Open** browser will close (Figure 5.5) and now the **Map Coordinate Information** dialog box will contain information about the projected coordinate system (Figure 5.6). Click **OK**, the **Map Coordinate Information** dialog box will close (Figure 5.6). Now on the **Create New Watershed** dialog box, the **Coordinate System** box (Figure 5.2) contains the name of the projected coordinate system (i.e., *USA_Continguous_Albers_Equal_Area_Conic_USGS_version*) for the watershed.

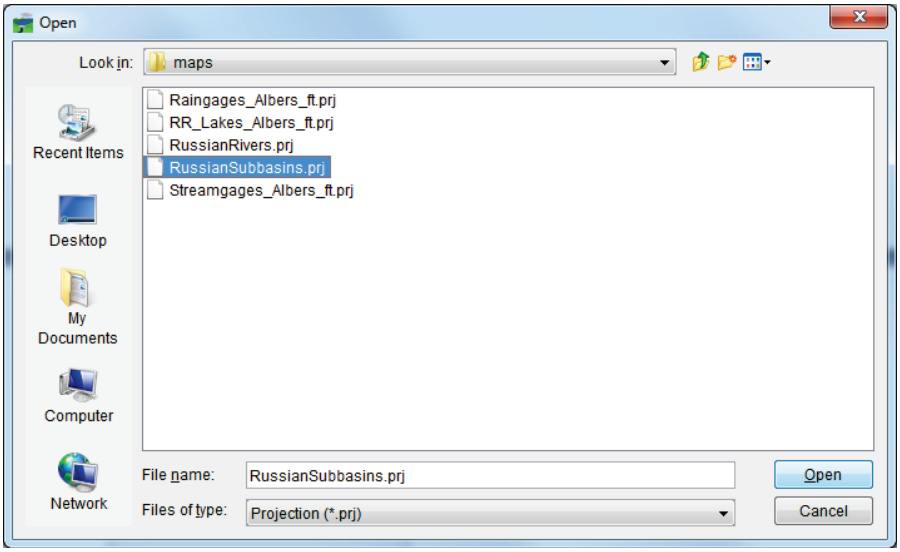


Figure 5.5 Open Browser

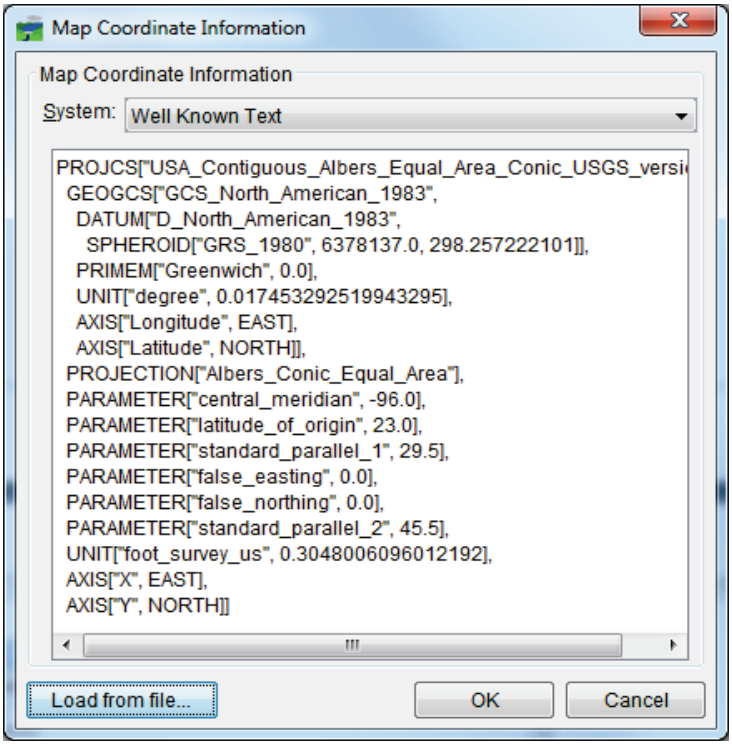


Figure 5.6 Setting Projection Based on Existing Projection

8. From the settings box, the user can select the time zone based on **United States Time Zone** (default) or **International Time Zones** (Figure 5.2). From the list, select the appropriate time zone for the watershed. Note that HEC-RTS runs models in "watershed time", which is the time zone without any “daylight saving” component. (The models are generally unable to handle the daylight savings time shift. HEC-RTS can handle the shift if the view time zone is set correctly.).

9. Click **OK**, the **Create New Watershed** dialog box will close (Figure 5.2), and the **Watershed Summary** dialog box will open (Figure 5.7). The Watershed Summary provides a summary about the created watershed and lets the user know that certain items cannot be changed when a watershed is created.

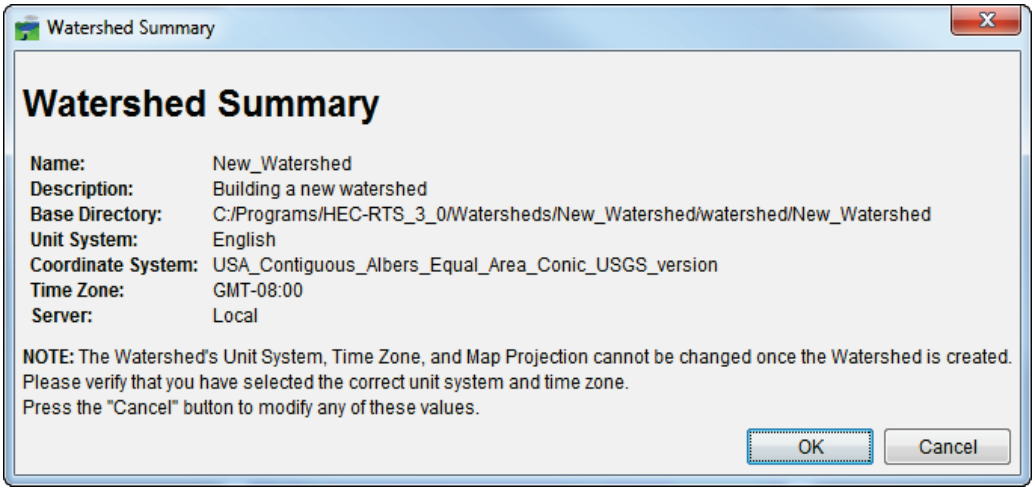


Figure 5.7 Watershed Summary Dialog Box

10. Click **OK**, the **Watershed Summary** dialog box will close (Figure 5.7), and the HEC-RTS main window (Figure 1.1) will now contain the new watershed. Also, a **Next Steps** dialog box will open (Figure 5.8) that provides the user with a list of what to do next in creating an HEC-RTS watershed.

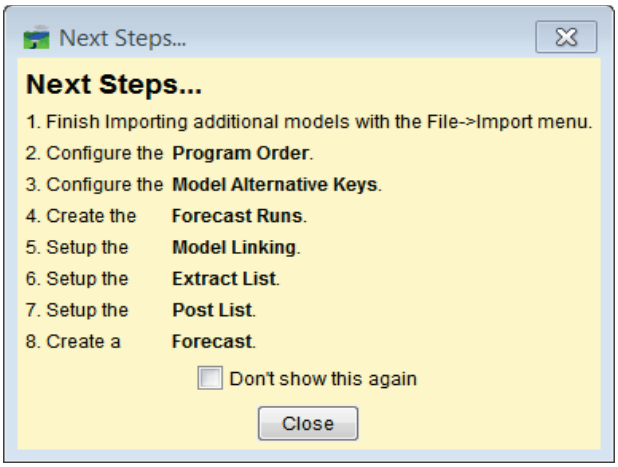


Figure 5.8 Next Steps Dialog Box

5.2 Add Map Layers

If during the creation of an HEC-RTS watershed, the user made the decision not to add map layers, this section provides the user with the necessary steps to add map layers to a watershed.

1. From the HEC-RTS main window (Figure 5.1), from the **Maps** menu, click **Map Layers**. The **Map Layers** dialog box (Figure 5.2) will open.

2. From the **Layers** menu (Figure 5.9), click **Add Maps**, the **Select Map to Add** Browser will open (Figure 5.3). Click **Create Copy** (Figure 5.3), this will make a copy of the selected map layer(s) in the HEC-RTS watershed directory. From the browser the user will navigate to where the map layer(s) for the watershed are located, select the map layer, click **Open**, the **Select Map to Add** Browser will close (Figure 5.3).

3. The **Map Layers** dialog box (Figure 5.9) will update, with the name of the selected map layer appearing in the **Map Layers Tree** (Figure 5.9). Also, the active map window (Figure 1.1) will update with the added map layer.

4. When all the necessary map layers have been added to the watershed, click **OK**, the **Map Layers** dialog box will close (Figure 5.9).

5.3 Add Background/Internet Maps

HEC-RTS is able to load Google® and Bing® maps from the Internet, these background maps are very helpfully when viewing and describing the watershed during meetings. Alternatively, geo-referenced images (e.g., .MrSid) can be added so that a background map will still display when Internet connectivity is not available.

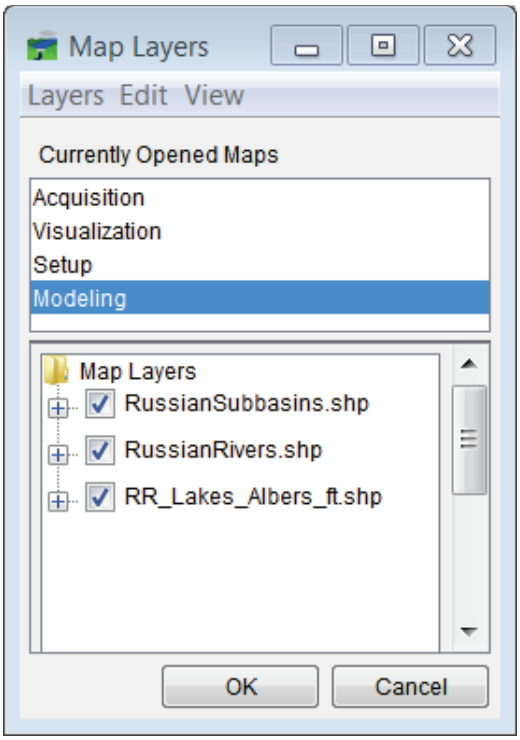


Figure 5.9 Map Layers Dialog Box

5.3.1 Add an Image

1. From the HEC-RTS main window (Figure 1.1), from the **Maps** menu, click **Map Layers**. The **Map Layers** dialog box (Figure 5.2) will open.

2. From the **Layers** menu (Figure 5.10), click **Import Image,** an **Open Browser** will open (Figure 5.5). From the browser the user will navigate to where the image file is located, select the image file, click **Import**, the **Open Browser** will close (Figure 5.5).

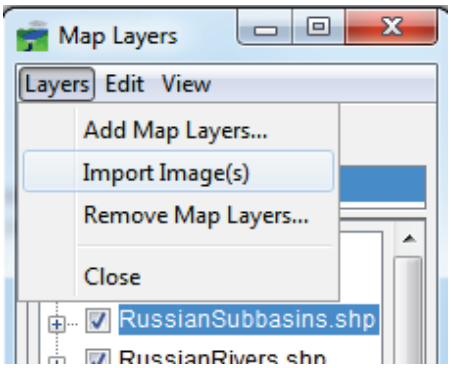


Figure 5.10 Map Layer Dialog Box – Layers Menu - Importing Image(s)

3. The **Define Image Extents** dialog box will open (Figure 5.11). The user will need to provide the extent information for the image file. Once the extent information has be entered, click Finish, the **Define Image Extents** dialog box will close (Figure 5.11). The selected image file has now been added to the HEC-RTS watershed. For further information on the image extent information, please see the HEC-RTS User's Manual.

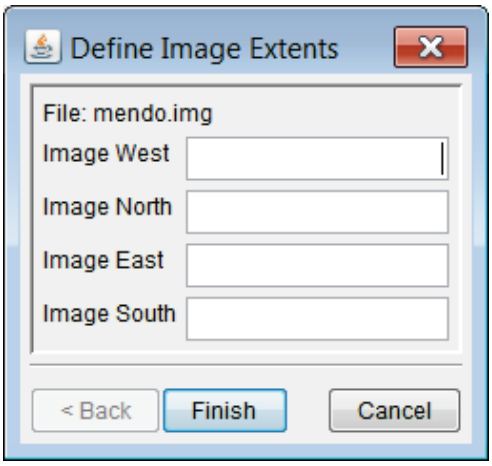


Figure 5.11 Define Image Extents Dialog Box

5.3.2 Add an Internet Map

To add an Internet map to an HEC-RTS watershed, the user must have Internet connection.

1. From the HEC-RTS main window (Figure 5.1), from the **Maps** menu, point to **Add Internet Map** (Figure 5.12). From the submenu there are seven option from which the user can choose.

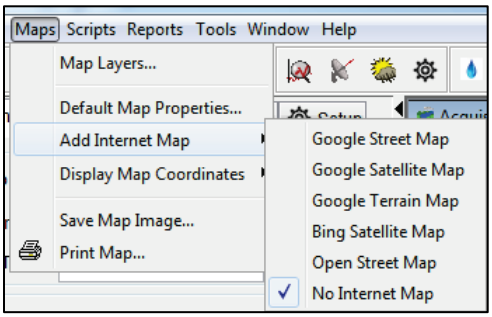


Figure 5.12 Maps Menu - Add Internet Map

2. Normally, a **Google Terrain Map** is best for a larger (zoomed-out) view of the watershed. When zoomed-in on the watershed, the **Goggle Satellite Map** (Figure 5.13) is often best.

3. Depending on where location of the watershed, the selected map might be fuzzy if the coordinate system is not the same as the background map. Usually, the Internet map and watershed coordinate systems are different (Internet maps use a variation of UTM). Since background maps are solid, translating pixels to a different coordinate system can misalign them slightly or cause a slight distortion. This is truer for the edges of the United States continent, than in the middle areas. From the **Maps** menu (Figure 5.12), point to **Display Map Coordinates**, click **Internet**, the fuzziness will be corrected in the display. Be aware that certain setup items in HEC-RTS will not work when the display map coordinates are set to **Internet**, use this option only when displaying the watershed for meetings.

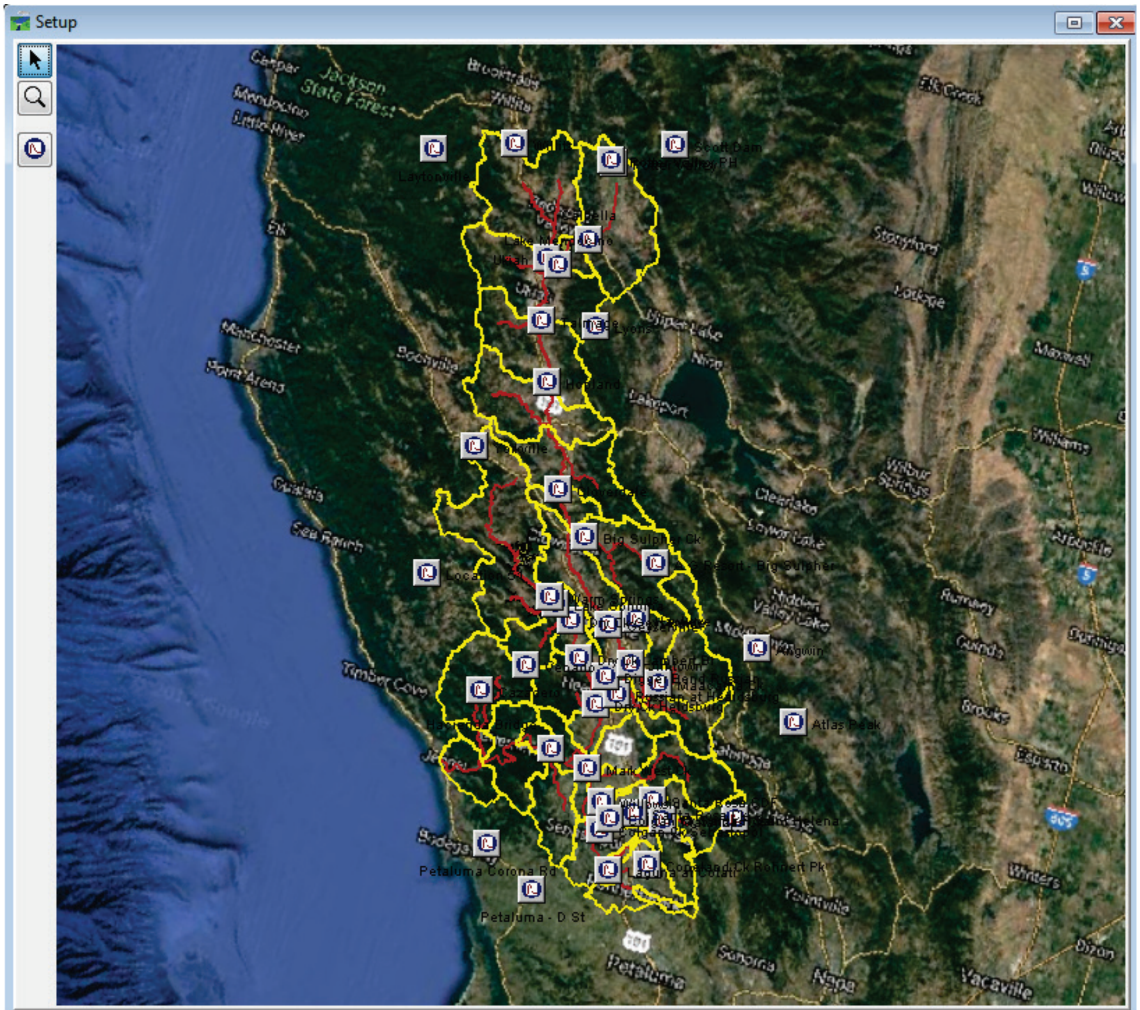


Figure 5.13 Watershed Projection on Top of Satellite Map

5.4 Adjust Map Layers

Once a map layer is in the HEC-RTS framework the user can make adjustments to the layer. From the HEC-RTS main window (Figure 1.1), from the **Maps** menu, click **Map Layers**. The **Map Layers** dialog box (Figure 5.2) will open. Now the user can see which **Map Window** is currently active and what map layers are available in that map window. To change the color and the fill aspects of a map layer do the following:

1. From the **Map Layers** tree (Figure 5.9), right click a map layer, depending on what type of map layer it is, the shortcut menu (Figure 5.14) will be different.

2. For example, Figure 5.14 displays a shortcut menu that allows the user to expand/collapse the *RussianSubbasins.shp* leaf; move the shapefile to different positions in the tree (**Move To Top/Move To Bottom, Move up/Move Down**); show the legend of the shapefile; change the label of the shapefile; edit the properties of the shapefile; set/remove scale factors; copy the map layer to another location; and open the attribute table of the shapefile.

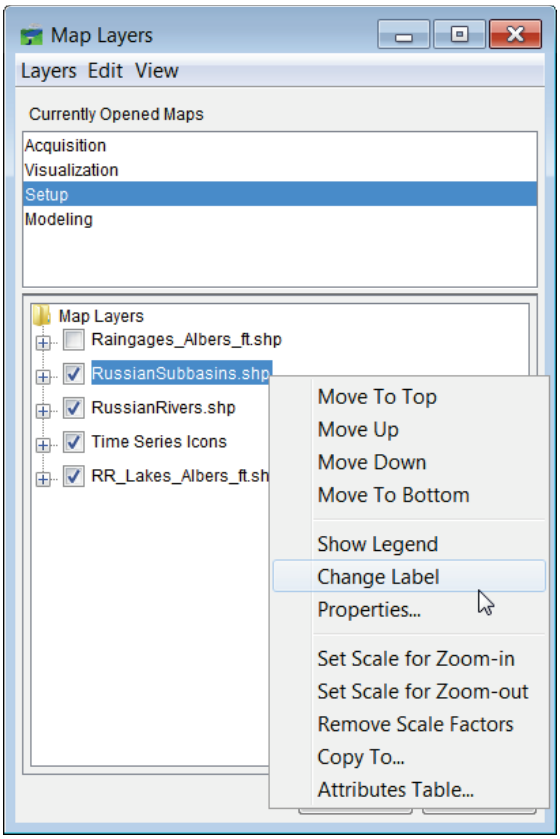


Figure 5.14 Map Layer – Shortcut Menu

3. From the shortcut menu (Figure 5.14), click **Properties**, the **Edit Polygon Properties** dialog box will open (Figure 5.15). In the example (Figure 5.14), the *RussianSubbasins.shp* file is a polygon shapefile. To edit the fill of the active map layer, from the **Fill** tab, change the color or not have a fill. For the example in Figure 5.15, fill will be turned off. So click **Display Fill**, the check mark will clear, meaning that fill is turned off.

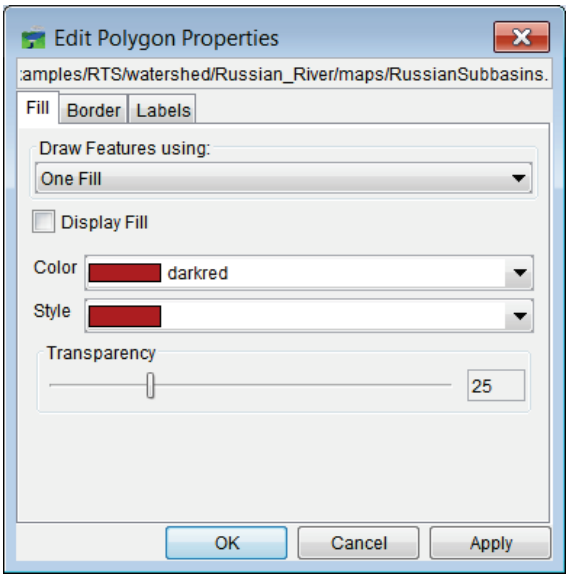


Figure 5.15 Edit Polygon Properties Dialog Box

3. To turn off a map layer - click in the checkbox by *Raingages_Albers_ft.shp*, the rain gages no longer appear on the map window.

4. To display the map window zoomed in, select the **Zoom Tool** . Draw a box around the map layers that are displayed in the **Map Window**. From the **Maps** menu, click **Default Map Properties**, the **Default Map Properties for** dialog box will open (Figure 5.16). Click **Set Map Extents to Display**, click **OK**. The **Default Map Properties for** dialog box will close.

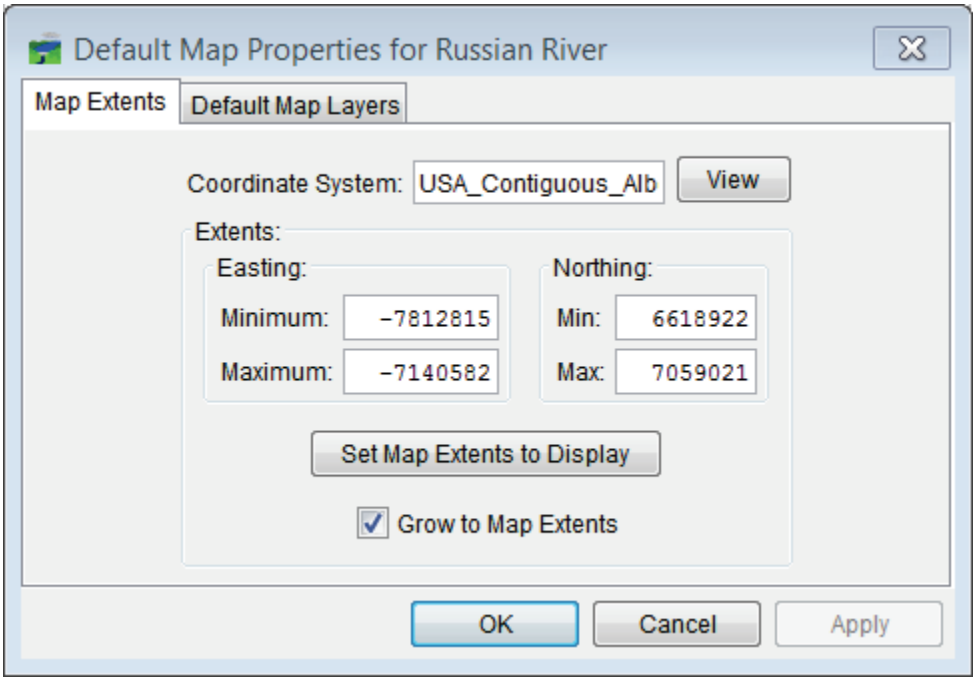


Figure 5.16 Default Map Properties for Dialog Box

This sets the extents for the **Map Window** so that when the study is opened the next time the **Map Window** will be zoomed in to the tighter area.

Chapter 6

Importing Models

Before importing any models:

- Be sure that models run without errors. If the model does not run outside of HEC-RTS, the model will not run inside of HEC-RTS. Fix any problems before importing.
- Where possible, use relative paths to files, not absolute paths.
- The directories where models are located are "clean". Backup original directories and remove all log, output and temporary files. Also, remove DSS files containing historical data used for calibration. Keep DSS files that contain model parameters, such as storage-elevation-area curves. Have a trim, pristine directory with only those files needed for real-time execution.
- Keep blank spaces and dashes out of names and files; for example, HEC-HMS will change dashes "-" to underscores "_" without HEC-RTS knowing it. Do not use unnecessary non-alpha characters.
- Many errors have arisen due to either messy directories or not checking that models run correctly on the PC environment. Errors are more difficult to track down through HEC-RTS than directly from the models themselves.

6.1 Program Order

HEC-RTS can run with zero to four models. The user should setup a program order to only include those models that will run. For example, if the interest is in forecasting local flow and stage, and real-time inundation maps, then the **Program Order** might only include HEC-HMS and HEC-RAS.

From the HEC-RTS main window (Figure 1.1), click **Setup** module, from the **Models** menu, click **Program Order**. The **Program Order** dialog box will open (Figure 6.1), displaying the default program order. The program order identifies which models will be run and the order in which those models will be run. A user can create a new program order and add or remove programs, for this manual, the default program order will be used. Refer to Chapter 16 of the HEC-RTS User's Manual for further details.

6.2 Import an HEC-Res-Sim Model

Since the HEC-ResSim model contains the **Stream Alignment** and other elements that describe the watershed, it is recommended that the user import the HEC-ResSim model first for an HEC-RTS watershed.

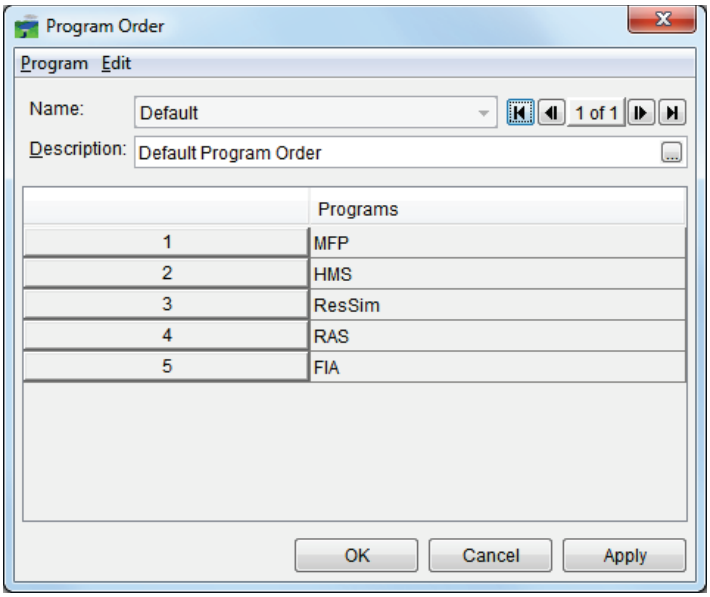


Figure 6.1 Program Order Dialog Box

To import an HEC-ResSim model:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), point to **Import**, click **ResSim**. An **Import Type** message window (Figure 6.3) will open, asking the user do you want to import just an HEC-ResSim alternative, or import the entire HEC-ResSim watershed. Since the idea is to build the HEC-RTS watershed using information from the HEC-ResSim watershed, click **Watershed**.

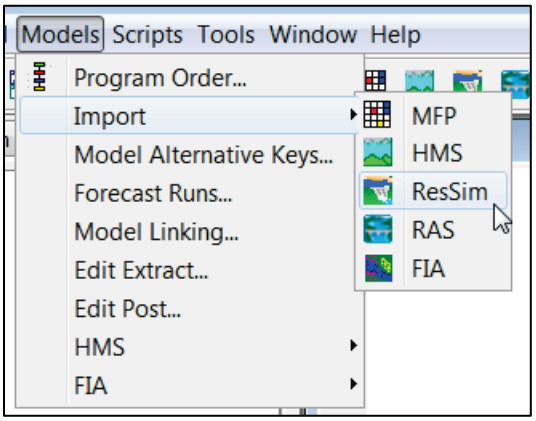


Figure 6.2 Setup Module - Models Menu - Import

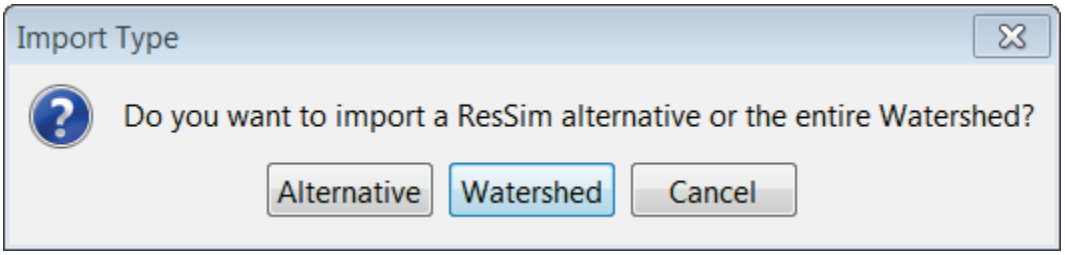


Figure 6.3 Import Type Message Window

2. A **Select Watershed File to Import From** Browser will open (Figure 6.4). From the browser the user will navigate to where the HEC-ResSim model is located, select a *.wksp file, click **Open**, the **Select Watershed File to Import From** Browser will close (Figure 6.4).

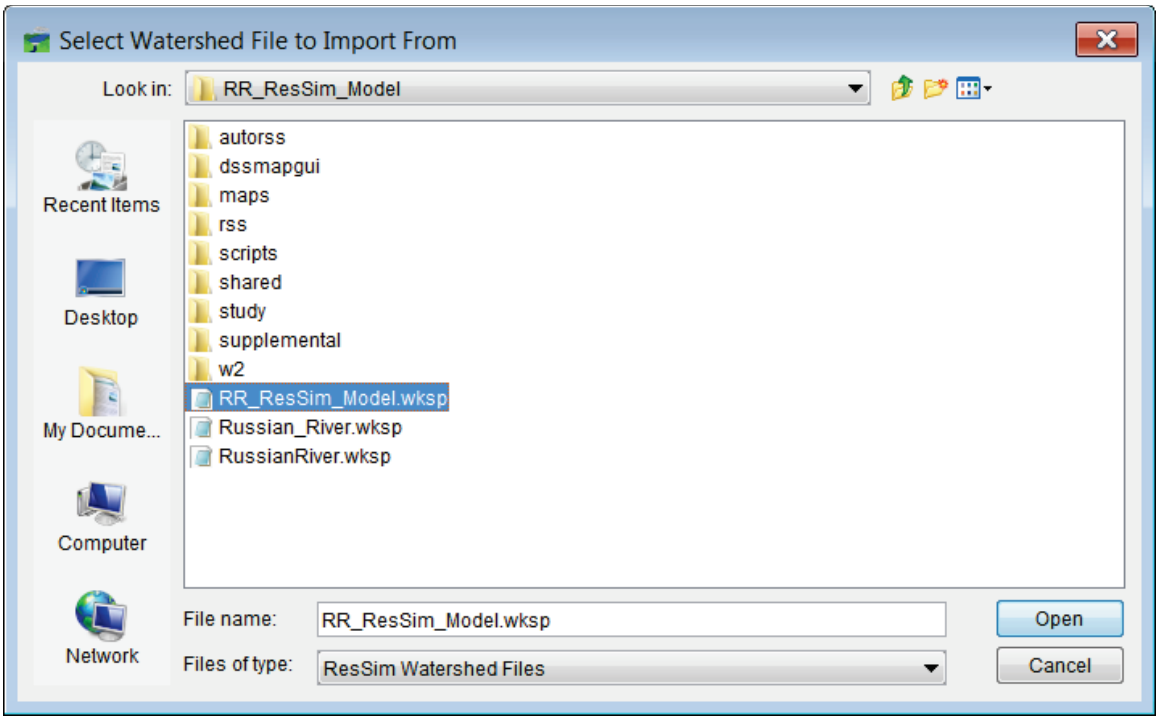


Figure 6.4 Select Watershed File to Import From Browser

3. A ResSim import progress dialog box will open, once the import is finished an **Import Finished** message window (Figure 6.5) will open. Click **OK**, the **Import Finished** message window (Figure 6.5) will close, the stream alignment will display in the map window, and from the watershed tree (Figure 6.6), from the **Models** folder, expand ResSim, and the list of HEC-ResSim alternatives is displayed.

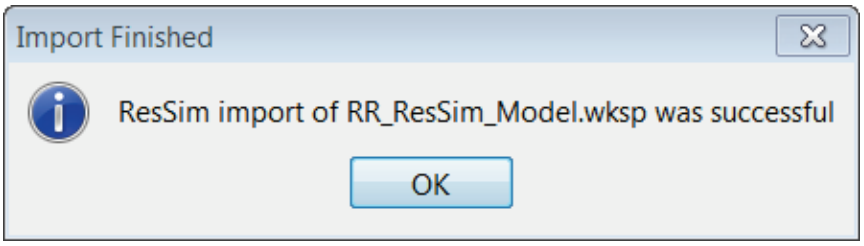


Figure 6.5 Import Finished Message Window

6.3 Import an HEC-HMS Model

Now let's import the HEC-HMS model into the HEC-RTS watershed. Depending on what version of HEC-HMS the model was built with, during the import process HEC-HMS may automatically update the HEC-HMS model to the current version. The HEC-HMS model will no longer work with the version the model was created in, so a full back up of the HEC-HMS model is recommended.

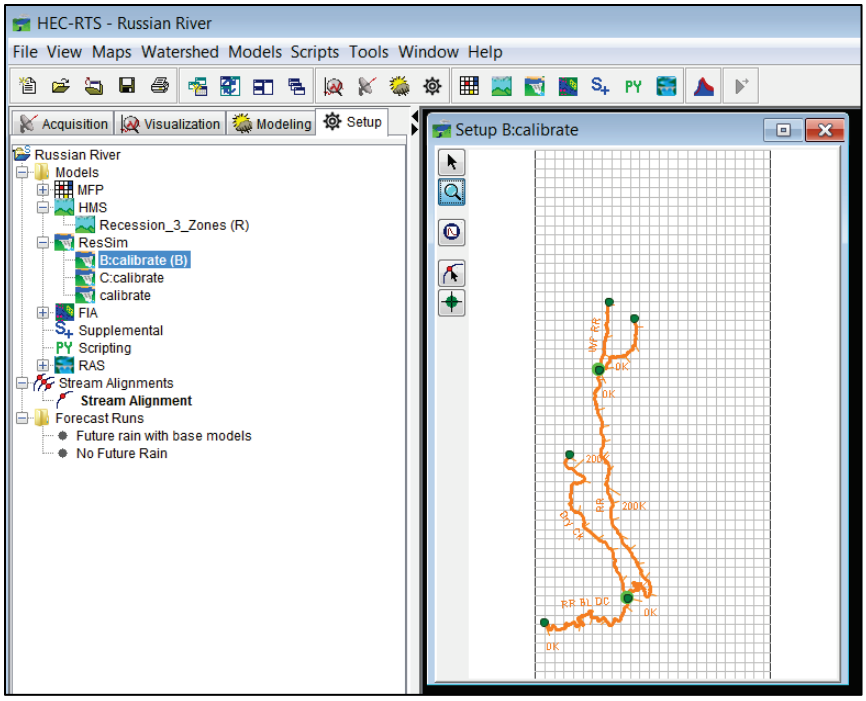


Figure 6.6 HEC-RTS Main Window – Watershed Tree - ResSim Alternatives

To import an HEC-HMS model:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), point to **Import**, click **HMS**. An HEC-HMS **Select Project File** Browser will open (Figure 6.7). From the browser the user will navigate to where the HEC-HMS model is located, select a *.hms file, click **Select**, the **Select Project File** Browser will close (Figure 6.7).

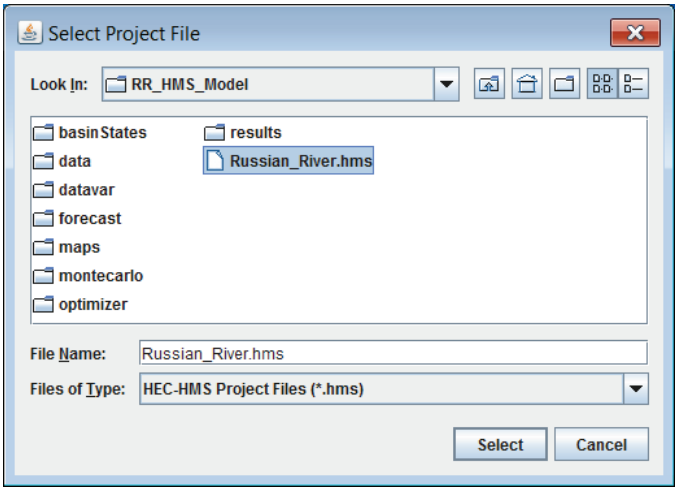


Figure 6.7 HEC-HMS Select Project File Browser

2. The HEC-HMS import process will begin, when the import of the HEC-HMS model is complete, the user is returned to the HEC-RTS main window (Figure 1.1). From the **Watershed Tree** (Figure 6.6), from the **Models** folder, expand HMS, and the list of HEC-HMS runs is displayed.

6.4 Create MFP Alternatives

Once the HEC-HMS model has been imported, the user can now create an MFP (Meteorological Forecast Processer) alternative. MFP is a rather simple process that takes observed precipitation grids and combines it with forecasted precipitation grids to make a continuous set of grids for HEC-HMS to run with. The first alternative that a user might create would be "no future precipitation", with zero precipitation after the "time of forecast".

To create an MFP alternative:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Watershed Tree** menu (Figure 6.8), right-click **MFP** (Figure 6.8). From the shortcut menu (Figure 6.8), click **New**, the **Create New MFP Alterative** dialog box will open (Figure 6.9).

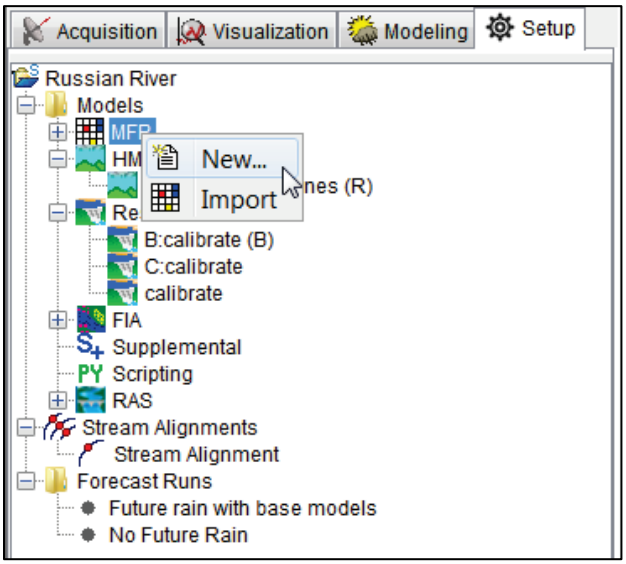


Figure 6.8 Watershed Tree – MFP Shortcut Menu

2. Enter a name for the MFP alternative in the **Name** box (Figure 6.9). The user can enter an optional description about the MFP alternative in the **Description** box (Figure 6.9). From the **Basin Model** list (Figure 6.9), select the appropriate HEC-HMS basin model. Next, the user needs to select the appropriate HEC-HMS meteorologic model from the **Meteorologic Model** list (Figure 6.9). The last item to configure is the number of precipitation zones, **Precipitation Zone Configuration** list (Figure 6.9).

3. Click **OK**, the **Create New MFP Alterative** dialog box will close (Figure 6.9). From the **Watershed Tree** (Figure 6.6), from the **Models** folder, expand **MFP**, and the name of the created MFP alternative is listed. From the **Watershed Tree**, right-click on an MFP alternative, from the shortcut menu click **Edit Alternative**, the **MFP Alternative Editor** will open (Figure 6.10). Further information (future precipitation, temporal distribution) for the MFP alternative needs to be input (refer to the HEC-RTS User's Manual for further information).

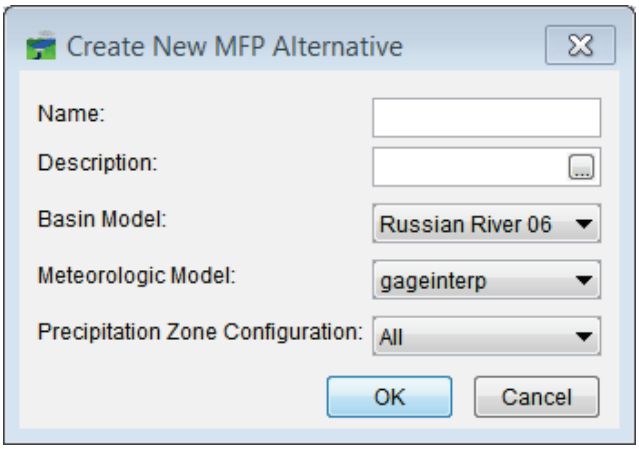


Figure 6.9 Create New MFP Alternative Dialog Box

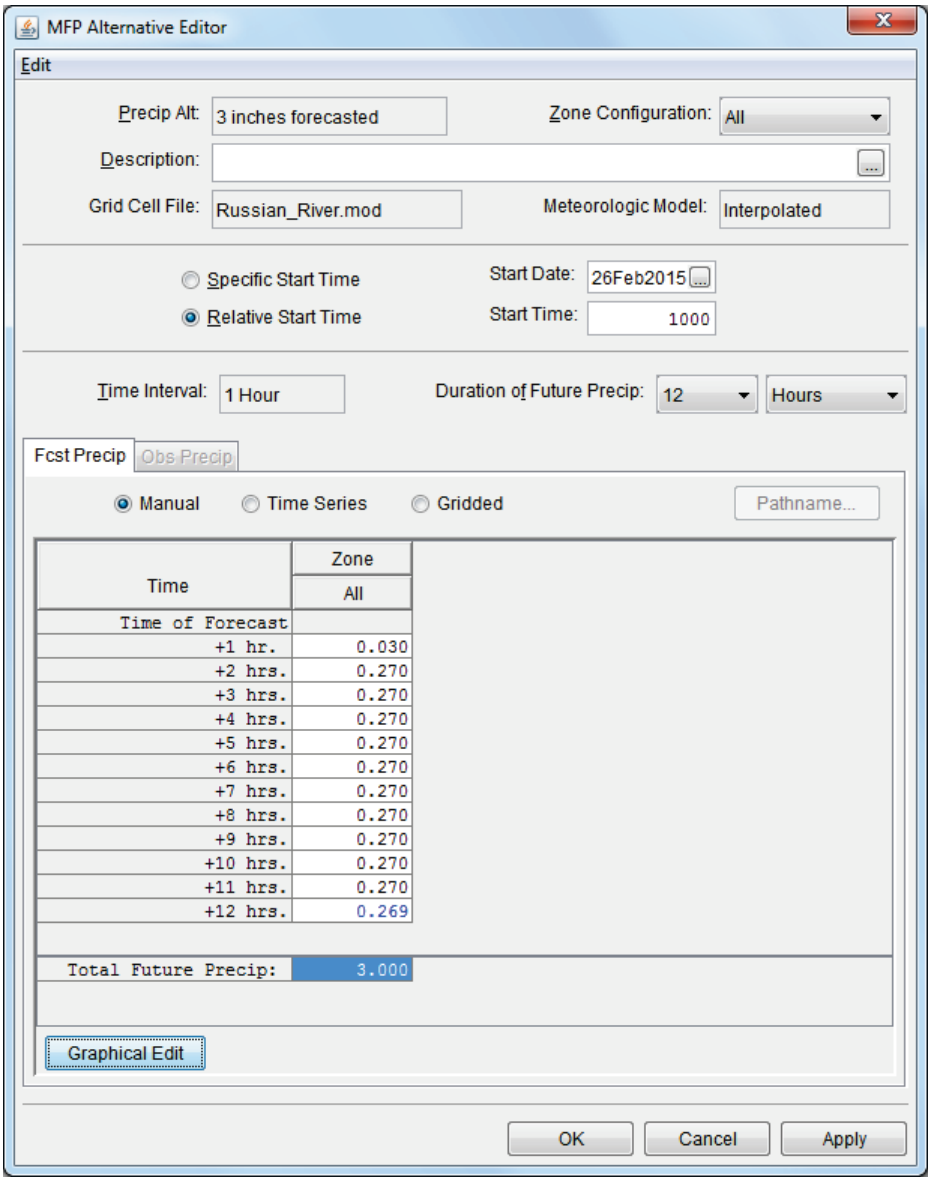


Figure 6.10 MFP Alternative Editor

6.5 Import an HEC-RAS Model

Now let's import the HEC-RAS model into the HEC-RTS watershed:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), point to **Import**, click **RAS**. A **Select RAS project to import from** Browser will open (Figure 6.11). From the browser the user will navigate to where the HEC-RAS model is located, select a *.prj file, click **Open**, the **Select RAS project to import from** Browser will close (Figure 6.11).

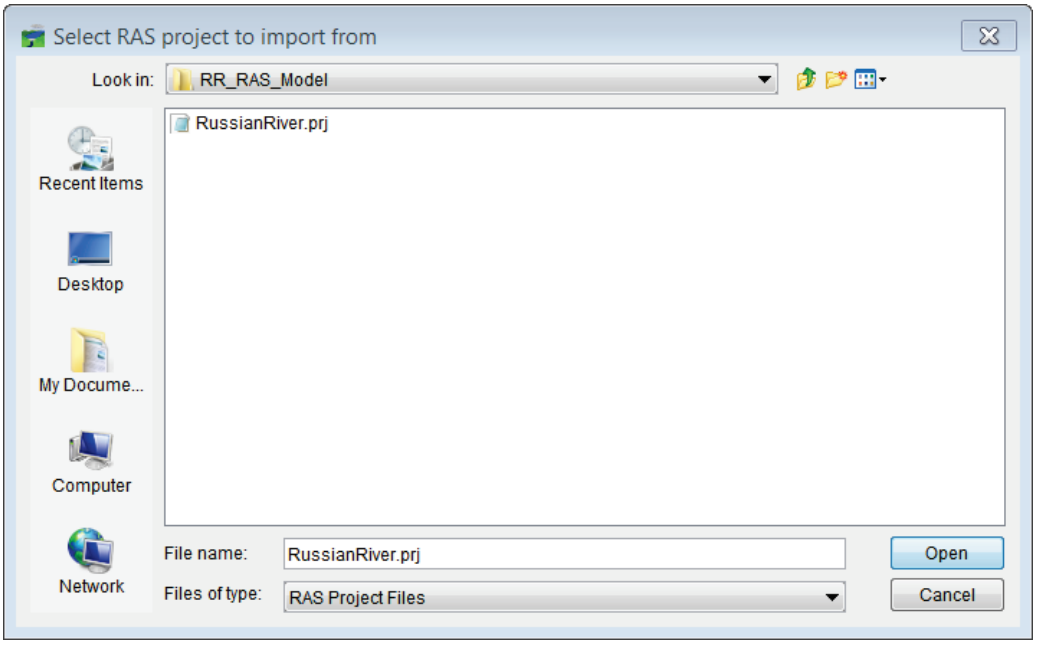


Figure 6.11 Select RAS project to import from Browser

2. The HEC-RAS import process will begin, when the import of the HEC-RAS model is complete, the user is returned to the HEC-RTS main window (Figure 1.1). From the **Watershed Tree** (Figure 6.6), from the **Models** folder, expand RAS, and the list of HEC-RAS plans is displayed.

6.6 Import an HEC-FIA Model

For the HEC-FIA import, the HEC-FIA model needs to have been built with HEC-FIA Verison 3.0 or later; the import process will not import any EC-FIA models that were built with earlier versions of HEC-FIA.

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), point to **Import**, click **FIA**. An **Import Alternatives** dialog box will open (Figure 6.12).

2. Click **Select/Add Project** (Figure 6.12), an **Open Browser** will open (Figure 5.5). From the browser the user will navigate to where the HEC-FIA model is located, select a *.prj file, click **Open**, the **Open** Browser will close (Figure 5.5).

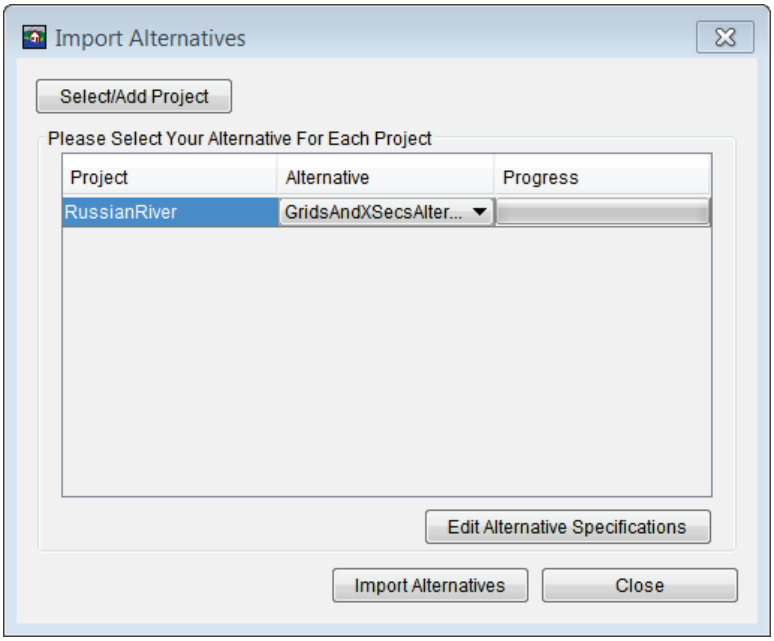


Figure 6.12 Import Alternatives Dialog Box

3. The table in the **Please Select Your Alternative For Each Project** box (Figure 6.12) will list the selected HEC-FIA model. From the **Alterative List** (Figure 6.12), select the HEC-FIA alternative to be used in the HEC-RTS watershed.

4. Click **Import Alternatives** (Figure 6.12), the import will start, and in the Progress column of the table (Figure 6.12) a green progress bar will display letting the user know how the import is progressing. An **Information** message window (Figure 6.13) will display when the HEC-FIA model import is finished, click **OK**. The **Information** message window (Figure 6.13) will close.

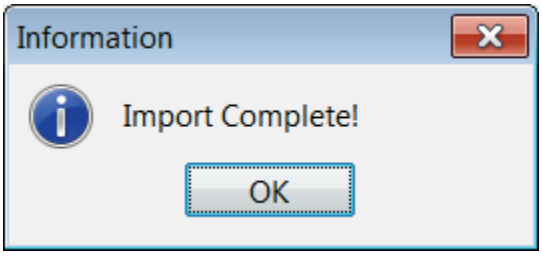


Figure 6.13 Information Message Window

5. From the **Import Alternatives** dialog box (Figure 6.12) click **Close**, the **Import Alternatives** dialog box will close (Figure 6.12). The user is returned to the HEC-RTS main window (Figure 1.1). From the **Watershed Tree** (Figure 6.6), from the **Models** folder, expand FIA, and the list of HEC-FIA alternatives is displayed.

All the models have been imported, the next step is to associate alternatives keys (used in the F-part of the DSS pathname) with each model's alternatives, and then link the model alternatives together – model integration.

Chapter 7

Model Integration

Data is exchanged between models in an HEC-RTS forecast using a DSS file and with pathnames that contain an F-part that identify the model and scenario (alternative). Each individual model or model input/output is called an **Alternative**. An alternative may be different reservoir operations, or a different forecast for precipitation, or different loss or routing parameters. For example, typically in an HEC-RTS study, there might be at least three (future) precipitation alternatives - No Future Precipitation, QPF, User Specified.

Each model alternative is assigned an alpha-numeric character, or "key", that identifies the alternative. Different models may use the same character (e.g., B for base HMS and B for a ResSim alternative.) The model alternative keys are concatenated together to form a "Run Key", which is used in the F-part of a DSS pathname to identify the dataset.

For example, for a QPF alternative for MFP, which combines observed precipitation and future precipitation, the MFP alternative would be assigned the letter "Q". The HEC-HMS model needs the precipitation from the MFP alternative to generate flows, both observed and forecasted. So, HEC-HMS would look for pathnames with an F-part of "Q". The HEC-HMS model was calibrated for wet conditions, so the HEC-HMS alternative might be assigned the letter "W". The HEC-ResSim needs the HEC-HMS flows, so HEC-ResSim would be looking for pathnames with an F-part of "QW". The HEC-ResSim model is a standard operation model which means the assignment might be the key "S". HEC-RAS model needs the flows out of the reservoir, so HEC-RAS would be looking for pathnames with an F-part of "QWS". HEC-RAS then compute stages and writes those stages out to pathnames with an F-part of "QWSB" (the HEC-RAS model having a key of "B"). In turn, the HEC-FIA model would need the stages from the HEC-RAS model and would be looking for pathnames with an F-part of "QWSB".

Reports, output, log files, etc. all use this convention to identify the complete dataset that they represent. In short, if a "%" represents a model, then log files and the F-parts of the DSS pathnames used will be:

- % - output from MFP
- %% - output from HEC-HMS
- %%% - output from HEC-ResSim
- %%%% - output from HEC-RAS
- %%%%% - output from HEC-FIA

The user can use these percent signs in the model interface module to identify datasets, especially in time series icons to identify what DSS datasets to use. Currently, a "trial" number (0) is internally appended to each ID key and will appear in the F-part. Trials in HEC-RTS will not be addressed at this time.

7.1 Assign Model Alternative Keys

From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), click **Model Alternative Keys**, the **Model Alternative Keys** dialog box will open (Figure 7.1). For each model (e.g., MFP, HMS) the user will assign a single number or letter to each model alternative that will be used. The same character can be used between different models, but not within the same model.

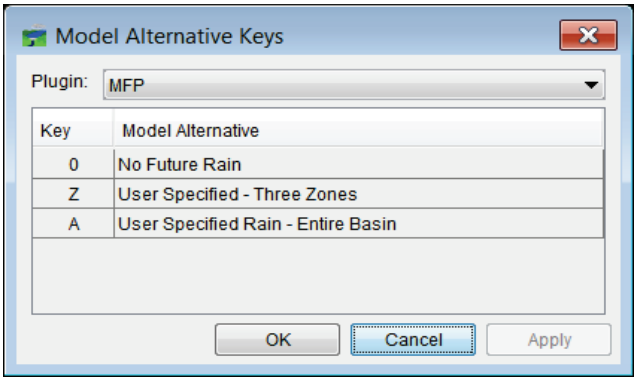


Figure 7.1 Model Alternative Keys Dialog Box

For example, in Figure 7.1, for the MFP model (selected from the **Plugin** list), the user has assigned the number zero (**0**) to the **No Future Rain** MFP alternative; the letter "**Z**" to **User Specified - Three Zones** (each zone will have a different amount of precipitation); and, the letter "**A**" to **User Specified Rain – Entire Basin** (the same amount of precipitation for the entire watershed).

The user needs to perform this assignment for all of the models that will be used in the HEC-RTS watershed. Once the assignments have been made, click **OK**, the **Model Alternative Keys** dialog box will close (Figure 7.1). On the **Watershed Tree** (Figure 7.2), each model alternative that has been assigned a key, will display that key by the alternative name in parentheses. For example, in Figure 7.2, for the HEC-HMS model alternative **Recession_3_Zones**, the key (**R**) is assigned.

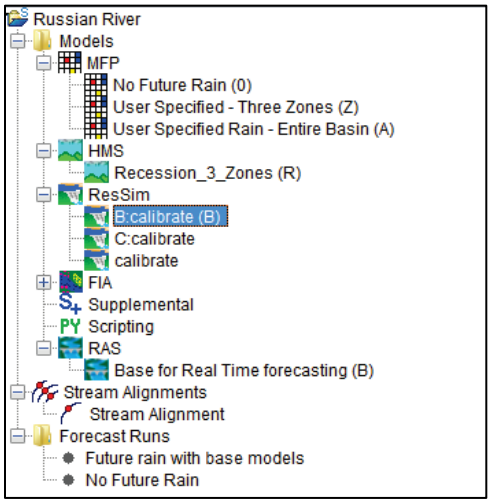


Figure 7.2 Watershed Tree – Model Alternative Keys

7.2 Forecast Runs

Once all the model alternative keys have been assigned, the user can create forecast runs. A forecast run, during a compute, determines the sequence that the models will be executed.

To create a forecast run:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), click **Forecast Runs**, the **Forecast Run Editor** will open (Figure 7.3).

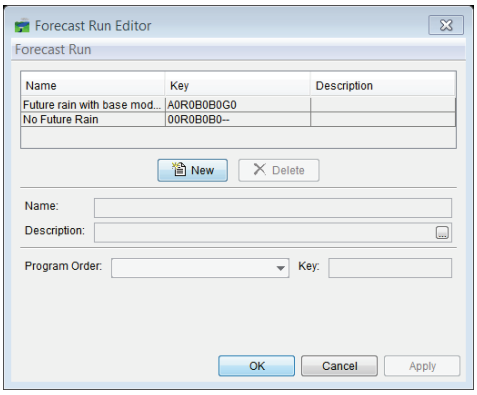


Figure 7.3 Forecast Run Editor

2. Click **New**, the **Forecast Run Editor** will change (Figure 7.4) so that the user can now create a new forecast run. Enter a name for the new forecast run in the **Name** box (Figure 7.4). The user can also enter an optional description in the **Description** box (Figure 7.4).

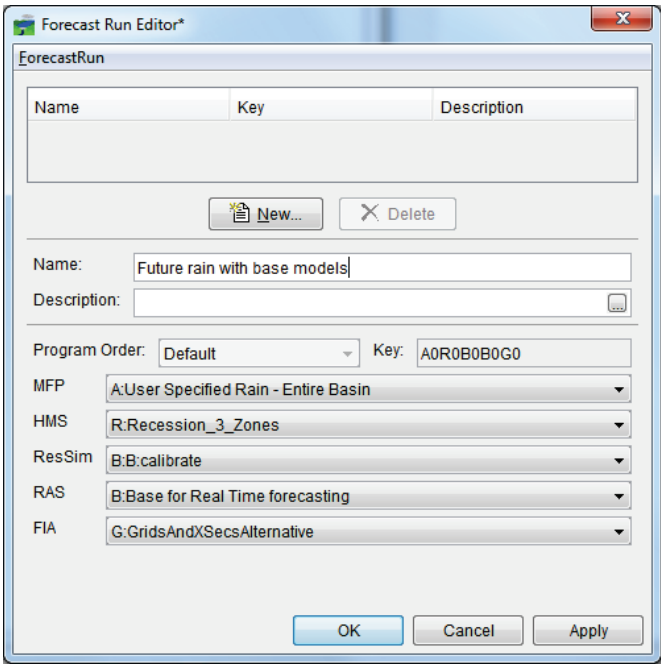


Figure 7.4 Forecast Run Editor – New Forecast Run

3. In the current version of HEC-RTS, the only program order available for use is **Default**, which is displayed in the **Program Order** list (Figure 7.4).

4. From the model alternative lists (e.g., MFP, FIA), the user will select which model alternatives will be computed in the forecast run that is being created. As model alternatives are selected for "key" for the forecast run is being built in the **Key** box (Figure 7.4).

5. Once the user is finished click **Apply**, the newly created forecast run will display in the table on the **Forecast Run Editor** (Figure 7.4). Click **OK**, the **Forecast Run Editor** will close (Figure 7.4), and from the **Watershed Tree** (Figure 7.2), from the **Forecast Runs** folder, created forecast run is displayed.

7.3 Model Linking

Once forecast runs have been defined, the specific output from each model needs to be linked to the input of the following model. HEC-RTS 3.1.1 attempts to do most of this effort for the user, through the model alternatives own linking and the use of identical location names. The user **must** check and adjust all model linkages, as the automated linking usually is not complete. Model linking is done through the **Model Linking Editor** (Figure 7.5). The user will set the modeling linking for a selected forecast run, and for each model alternative that is part of the selected forecast run.

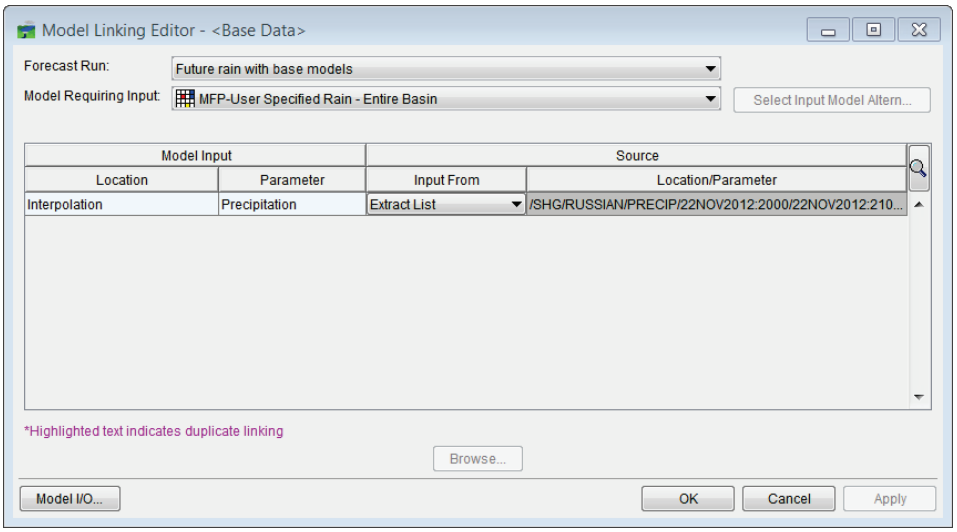


Figure 7.5 Model Linking Editor – MFP Alternative Model Linking

7.3.1 Linking MFP

The linking for an MFP model alternative defaults to the HEC-RTS watershed's extract list (see HEC-RTS User's Manual for further information). HEC-RTS will ask MFP what data (DSS pathname) is needed. MFP will provide the available cases, and HEC-RTS assumes it will be extracted from the observed dataset (database). The dates in the pathname will be changed when a forecast is run. Click **Apply** (Figure 7.5) to save the model linking for the MFP model alternative.

7.3.2 Linking HEC-HMS

Before linking the HEC-HMS model alternatives, review Chapter 8 on the setting up and calibrating of the HEC-HMS model before beginning the linking process. In this case, Figure 7.6, for the HMS model alternative linking, all data, except for the precipitation from MFP will be extracted from the observed data (extract list). From the **Input from column** (Figure 7.6) for the **Location** – *Interpolation* (first row in the table), from the list, select the correct MFP model alternative (Figure 7.6). Validate the rest of the HMS model alternative linking, the user should be able to see right away the advantage of using consistent/identical location names throughout the system. Click **Apply** (Figure 7.6) to save the model linking for the HMS model alternative.

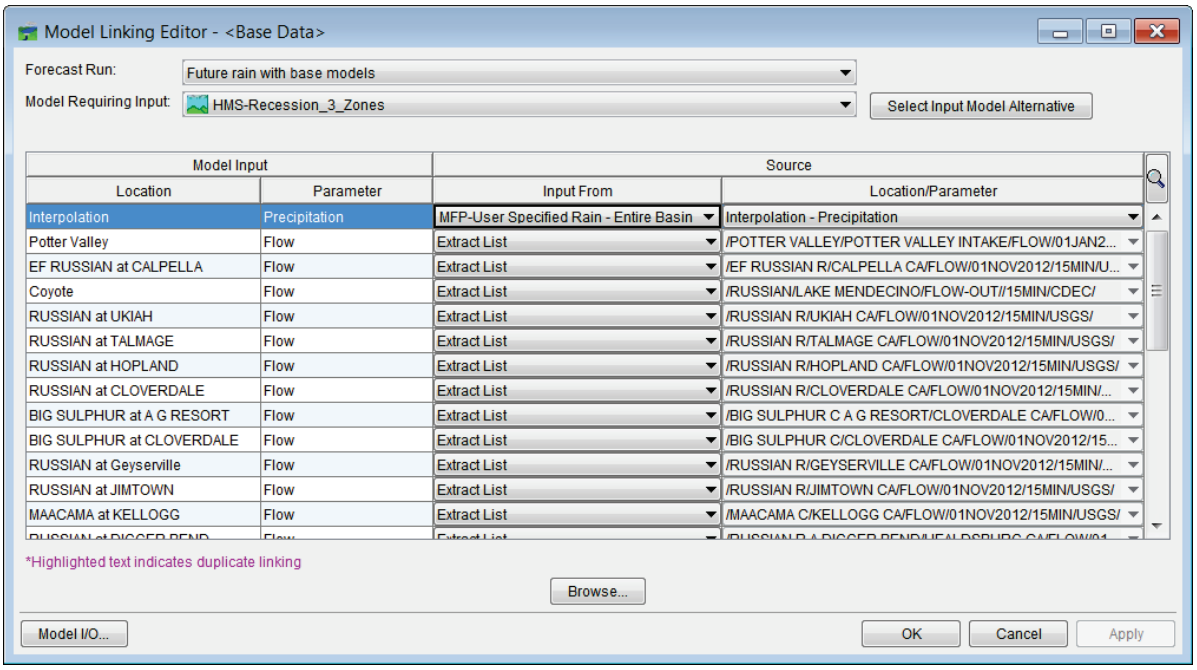


Figure 7.6 Model Linking Editor - HMS Alternative Model Linking

7.3.3 Linking HEC-ResSim

In the example used in this manual, the ResSim model alternative will obtain most of the flows needed from the HMS model alternative, as well as some observed data (such as flows, storage elevations, etc.). Initially, the model linking for the ResSim model alternative defaults to the extract list (Figure 7.7).

1. From the table, highlight all of the locations, with the parameter **Known Flow**, click **Select Input Model Alternative** (Figure 7.7), the **Select Input Model Alternative** dialog box will open (Figure 7.8).

2. From the **Input Model Alternative** list (Figure 7.8), select the correct HMS model alternative. Click **OK**, the **Select Input Model Alternative** dialog box will close (Figure 7.8), and a **Confirm Input Selection** message window will appear (Figure 7.9). The message window is asking the user if this linking is appropriate for the selected rows. Click **Yes**, the **Confirm Input Selection** message window will close (Figure 7.9).

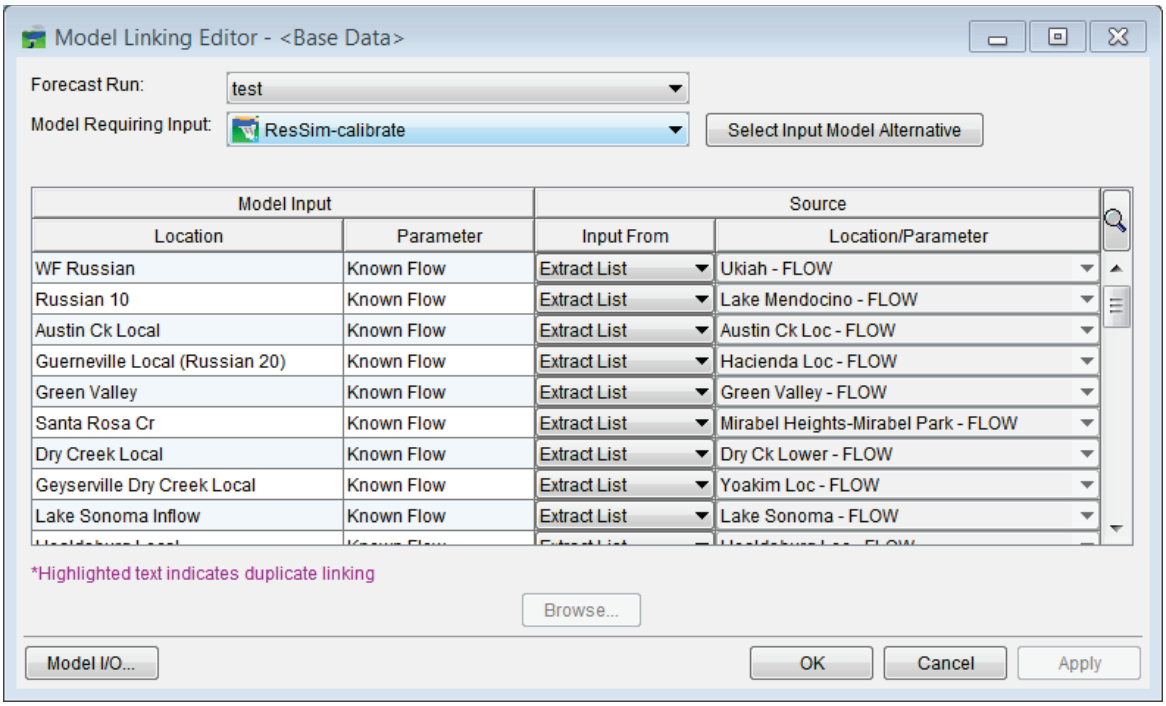


Figure 7.7 Model Linking Editor – ResSim Default Alternative Model Linking

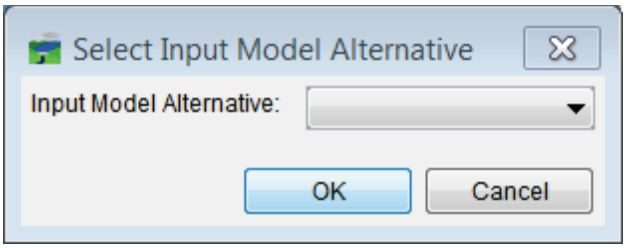


Figure 7.8 S elect Input Model Alternative Dialog Box

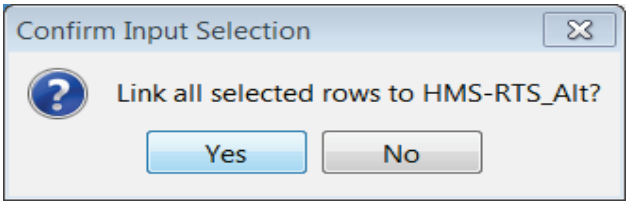


Figure 7.9 Confirm Input Selection Message Window

3. Now on the **Model Linking Editor** (Figure 7.10), all of the selected rows will now have a linkage to an HMS model alternative in the **Input From** (Figure 7.10) column.

4. Instead of following the instructions in Step 2, the user can select a location, click **Browse** (Figure 7.10), the **Select Source Data Location** dialog box will open (Figure 7.11). Using the **Select Source Data Location** dialog box, for some users another way of performing the linking that might be easier than doing the linking from the table (Figure 7.10). Once the user has highlighted the correct location, click **Set Location** (Figure 7.11). The table in the **Model Linking Editor** (Figure 7.10) is updated with the selection made. The user can keep on making selections and changing the linking, until finished.

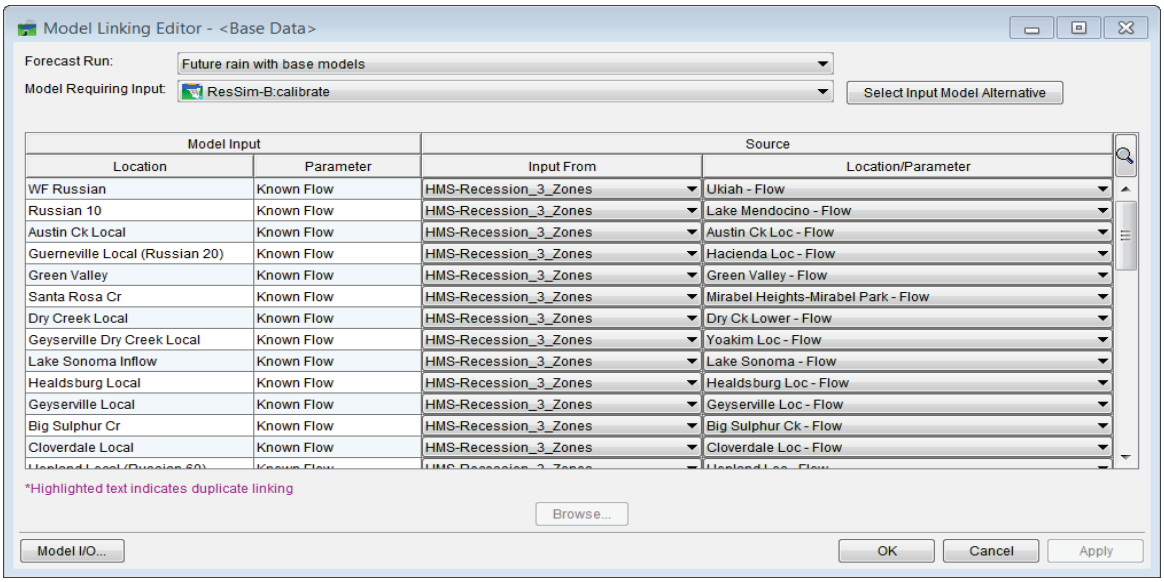


Figure 7.10 Model Linking Editor – ResSim Alternative Model Linking

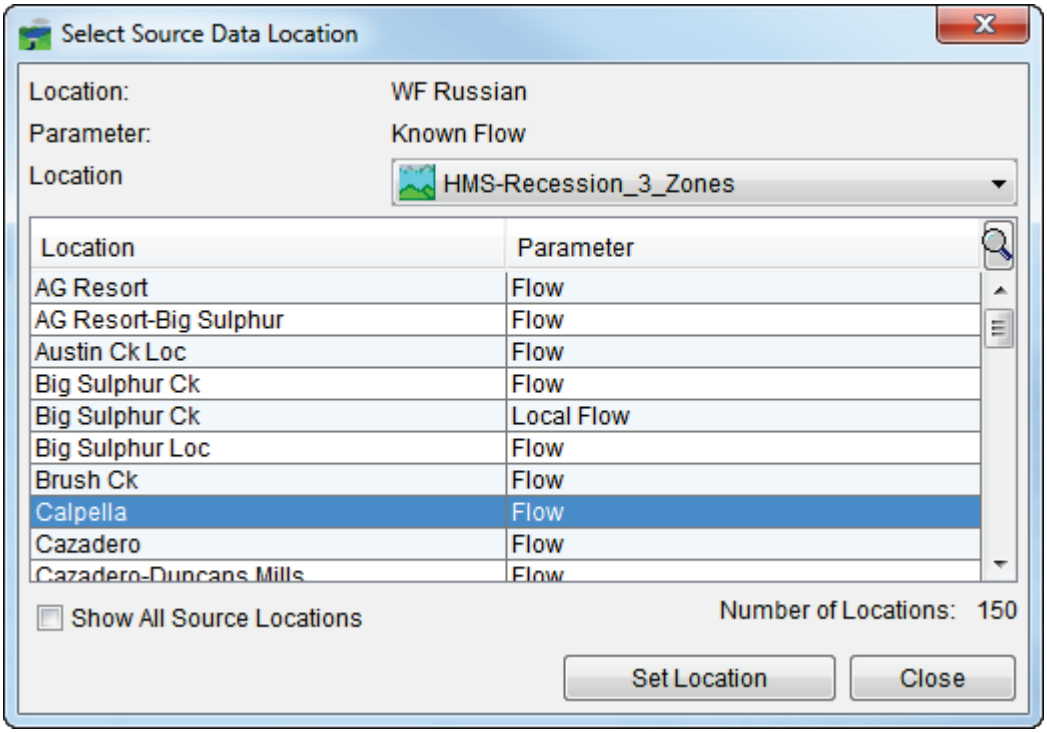


Figure 7.11 Select Source Data Location Dialog Box

5. The user should review the ResSim model linking to check that the correct location and parameter has been selected. HEC-RTS will do the best it can to match datasets, but if location names are not the same, then HEC-RTS tries to match items, and sometimes the software does not select correctly. HEC-RTS does try to help the user, by highlighting items in purple when the software thinks there is a duplicate linking (Figure 7.10).

6. Once the user has verified the linking for the ResSim model alternative, click **Apply** (Figure 7.10) to save the model linking for the ResSim model alternative.

7.3.4 Linking HEC-RAS

Linking a RAS model alternative takes some special treatment, as the RAS model alternative uses river mile identifiers for locations instead of location names. If the RAS model alternative has a location name in the **Description** field of the HEC-RAS **Cross Section Data Editor** (Figure 7.12), then HEC-RTS will try to match that with output from the previous model in the Program Order.

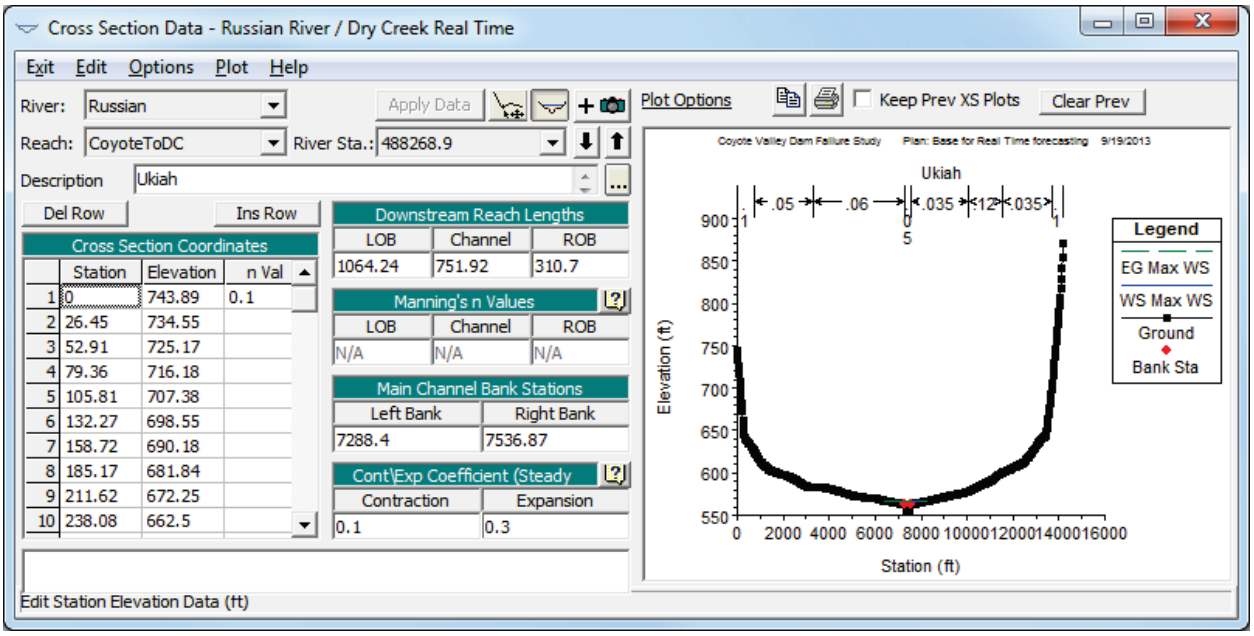


Figure 7.12 HEC-RAS Cross Section Data Editor

For steady flow analysis, the user will need to specify total (maximum) flow at HEC-RAS junction points. The user should have an HEC-HMS or HEC-ResSim junction at each handoff point, and use the total flow. For unsteady flow analysis, the user needs to specify incremental (local) flows at each junction, and HEC-RAS uses that to route the flow.

An important point to remember is that HEC-HMS and HEC-ResSim compute flows at junctions or subbasin outlets, so those flows must be added to the HEC-RAS model at that point (a lateral inflow hydrograph), not distributed along the stream (not a uniform lateral inflow hydrograph). Also, be sure to add the hydrographs from DSS at the correct location; some hydrographs need to be connected to a storage area, some a lateral inflow.

Hydrographs for HEC-RAS may come from HEC-ResSim or HEC-HMS. HEC-HMS generates "Local Flow", which is the flow that is generated between the upstream junction and downstream junction, not including stream flow coming into the downstream junction. (If there is a separate tributary entering a junction, the user must be sure to include that flow. Often that is a separate lateral inflow hydrograph to HEC-RAS, as HEC-HMS does not compute local and tributary as one dataset.) Generally, HEC-ResSim provides the flow out of reservoirs and HEC-HMS provides local flows. HEC-HMS computes locals throughout the basin, HEC-ResSim usually will only produce locals (copied from HEC-HMS) downstream of reservoirs modeled.

In the example used in this manual, the RAS model alternative will obtain most of the flows needed from the HMS model alternative, with two exceptions, where the flows will be obtained from the ResSim model alternative. Initially, the model linking for the RAS model alternative defaults to the extract list (similar to Figure 7.7).

1. From the table, highlight all of the locations, with the parameter **Flow**, click **Select Input Model Alternative** (Figure 7.7), the **Select Input Model Alternative** dialog box will open (Figure 7.8).

2. From the **Input Model Alternative** list (Figure 7.8), select the correct HMS model alternative. Click **OK**, the **Select Input Model Alternative** dialog box will close (Figure 7.8), and a **Confirm Input Selection** message window will appear (Figure 7.9). The message window is asking the user if this is the linking appropriate for the selected rows. Click **Yes**, the **Confirm Input Selection** message window will close (Figure 7.9).

3. Now on the **Model Linking Editor** (Figure 7.13), all of the selected rows will now have a linkage to an HMS model alternative in the **Input From** (Figure 7.13) column.

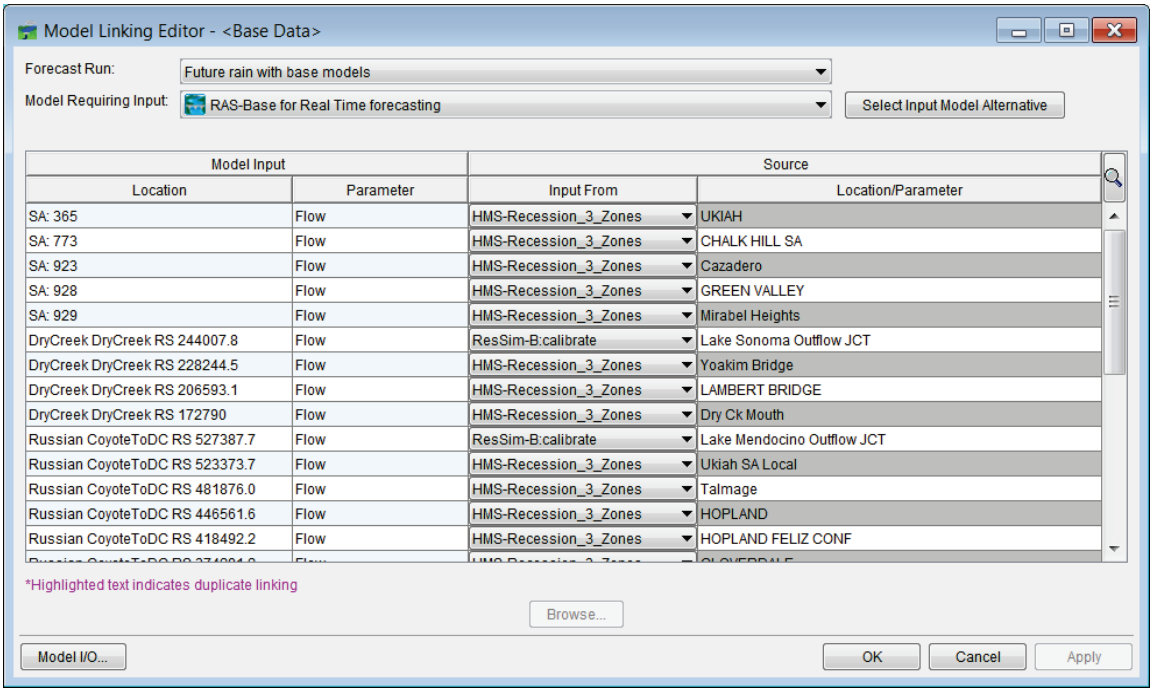


Figure 7.13 Model Linking Editor – RAS Alternative Model Linking

4. There are two locations that need to get flow from a ResSim model alternative. For example, in Figure 7.13, for the location *DryCreek DryCreek RS 244007.8*, from the **Input From** column (Figure 7.13), from the list, select a ResSim model alternative (i.e., *ResSim-B:calibrate*). This location will now get flow from the ResSim model alternative (the other location in the example is *Russian CoyoteToDC RS 527387.7*).

5. Once the user has verified the linking for the RAS model alternative, click **Apply** (Figure 7.13) to save the model linking for the RAS model alternative.

7.3.5 Linking HEC-FIA

A FIA model alternative is usually built with using a RAS model alternative for the stage needed by the FIA model alternative to compute damage. Initially, the model linking for the FIA model alternative defaults to the extract list (similar to Figure 7.7).

1. From the Model Linking Editor (Figure 7.13), click **Select Input Model Alternative** (Figure 7.7), the **Select Input Model Alternative** dialog box will open (Figure 7.8).

2. From the **Input Model Alternative** list (Figure 7.8), select the correct RAS model alternative. Click **OK**, the **Select Input Model Alternative** dialog box will close (Figure 7.8), and a **Confirm Input Selection** message window will appear (Figure 7.9). The message window is asking the user if this linking is appropriate for the selected rows. Click **Yes**, the **Confirm Input Selection** message window will close (Figure 7.9).

3. Now on the **Model Linking Editor** (Figure 7.14), all of the selected rows will now have a linkage to a RAS model alternative in the **Input From** (Figure 7.14) column.

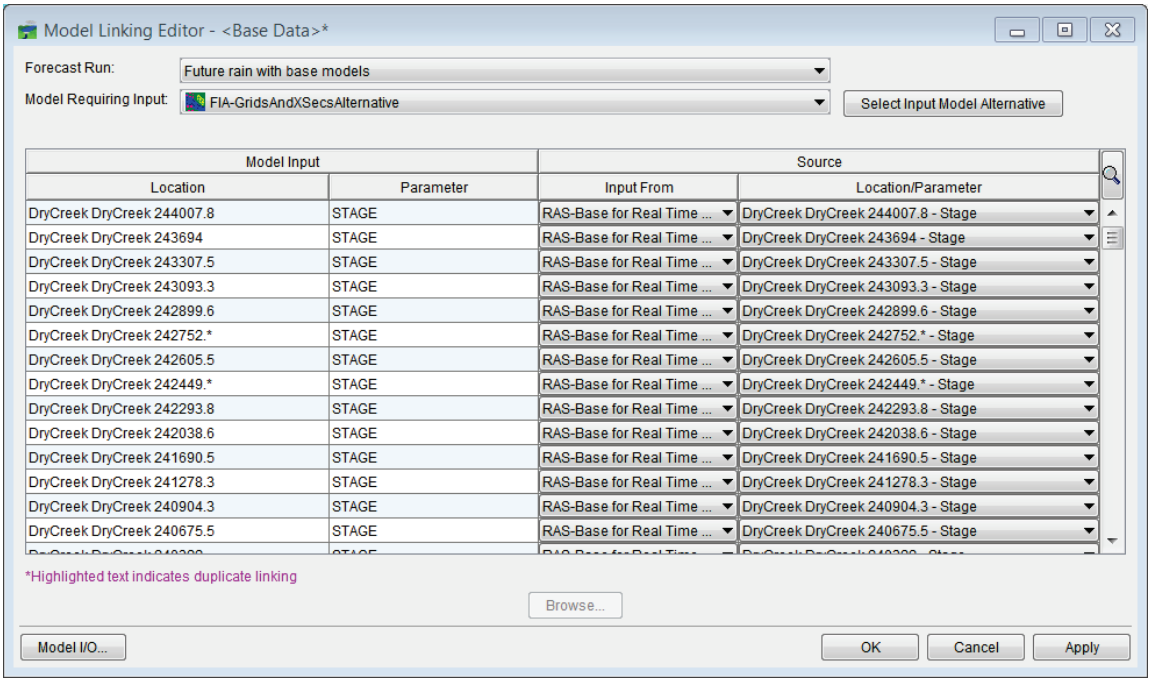


Figure 7.14 Model Linking Editor – FIA Alternative Model Linking

4. Once the user has verified the linking for the FIA model alternative, click **Apply** (Figure 7.14) to save the model linking for the FIA model alternative.

7.4 Extract Setup

The next step requires a watershed database to be setup and that contains data that will be used to make a forecast. Obtaining data will be different for each watershed and user base. Because of that, the setup process is discussed later in Chapter 9 of this manual, as well as chapter 18 of the HEC-RTS User's Manual. After the model alternatives have been linked together, the user needs

to setup the "extracting of data" from the watershed database to the DSS file that will be used during a forecast compute, usually referred to as the *forecast.dss* file. HEC-RTS will gather all the DSS pathnames that were specified as "Extract" in the model linking, and copy those pathnames from the watershed database to the *forecast.dss* file.

When forecast is computed, HEC-RTS will copy all of the models and time series data to a separate directory that usually is named according to the date and time of the forecast. That "forecast time" means that all data up to, and including, that time is known and will be copied to the *forecast.dss* file. All data after that time is generated when the forecast computes.
Creating an extract group:

1. From the HEC-RTS main window (Figure 1.1), click the **Setup** module, from the **Models** menu (Figure 6.2), click **Edit Extract**, the Extract Editor will open (Figure 7.15).

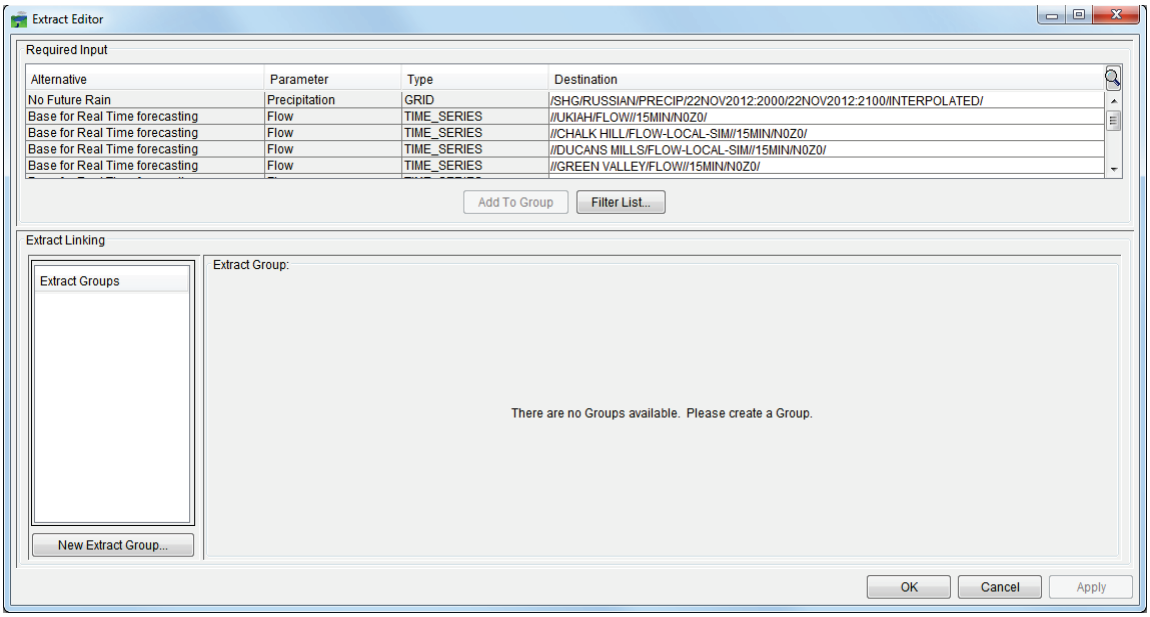


Figure 7.15 Extract Editor

2. Click **New Extract Group** (Figure 7.15), the **New Extract Group** dialog box will open (Figure 7.16). Enter an extract group name in the **Name** box (Figure 7.16). Depending on the type of data being extracted, from the **Type** list (Figure 7.16) select either **Time Series** or **Gridded Data**.

3. It is recommend that for an HEC-RTS watershed there should be at least two extract groups, one for gridded precipitation data and another for time series data. Precipitation is processed and stored according to the month name in a specific directory under the home directory. When this directory structure is used, the name of the months are automatically incremented on month boundaries so that the DSS files are a reasonable size and a contiguous dataset can be obtained for use by HEC-HMS. The names of the DSS files with gridded data will be similar to "*precip.2016.03.dss*". For further discussion on data acquisition through **Time Series Icons**, refer to Chapter 9 of this guide and Chapter 18 of the HEC-RTS User's Manual.

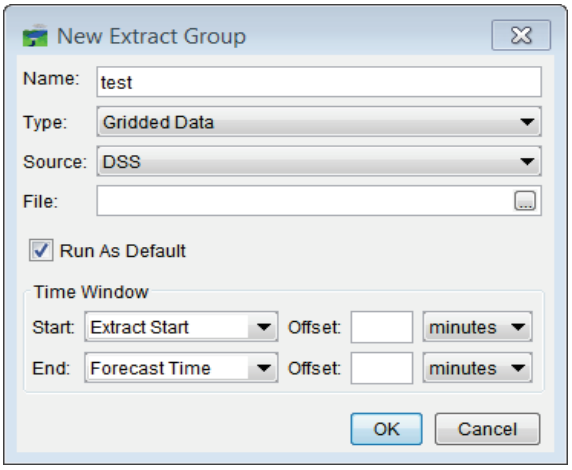


Figure 7.16 New Extract Group Dialog Box – Gridded Data

4. From the **Source** list (Figure 7.16) select the type of data that will be generated for the extract group. For the current version of HEC-RTS, DSS is the only choice for the data type. In the **File** name box (Figure 7.16), enter or browse (click ..., an **Open Browser** will open, Figure 5.5) to the location in the watershed directory for gridded precipitation, and select a gridded precipitation DSS file (with valid data), such as *precip.2016.03.dss*.

5. Click **OK**, the **New Extract Group** dialog box will close (Figure 7.16), and the new extract group will display in the **Extract Groups** box (Figure 7.15). HEC-RTS will have gathered all the pathnames from the model linking for the selected forecast run, that all had an **Input From** (Figure 7.7) selection of *Extract List*. The pathnames are listed in the **Required Input** box of the **Extract Editor** (Figure 7.17). Select the gridded precipitation pathnames, click **Add to Group**. The selected pathnames will display in the table in the lower portion of the Extract Editor (Figure 7.17).

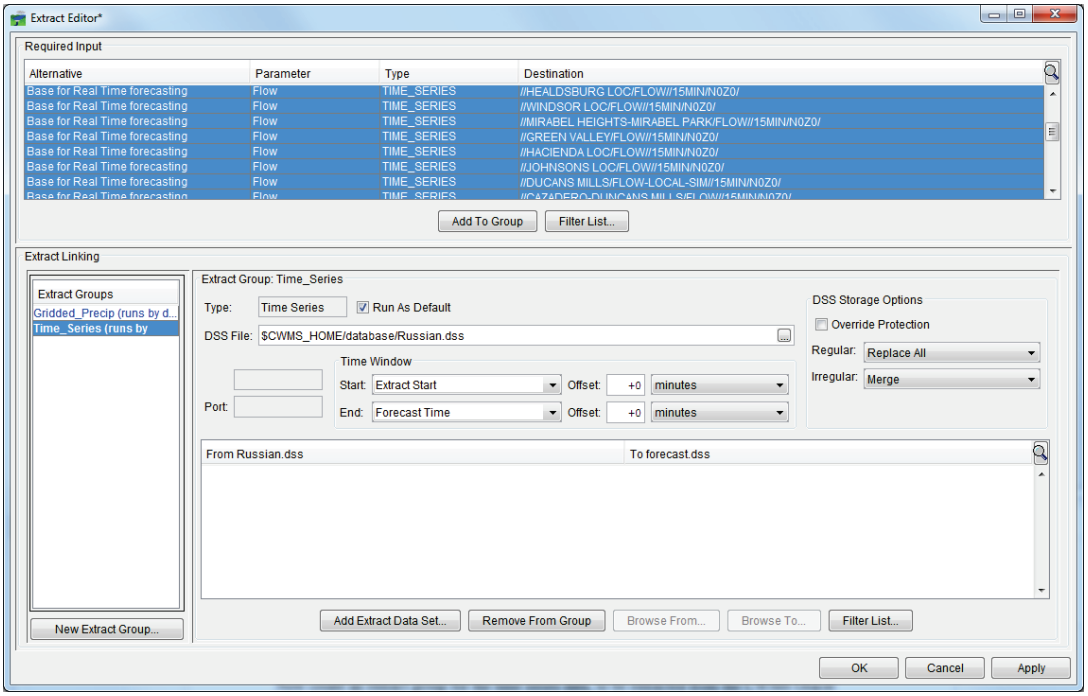


Figure 7.17 Time Series Extract Group

6. Click **Apply,** the extract group will be saved. To create an extract group for the time series data, select a pathname in the top list, then click **Ctrl+A** to select all of the pathnames. Press **Add to Group**.

7. HEC-RTS will try to match datasets, but it is possible some names will not be close enough to have the right dataset selected. Go through the list, verifying each pathname matches to the correct dataset in your main database. When one does not correctly match, double click on the name, click ..., which appears to the right of the selected pathname (Figure 7.18). The **DSS Grid Record Chooser** will open (Figure 7.19).

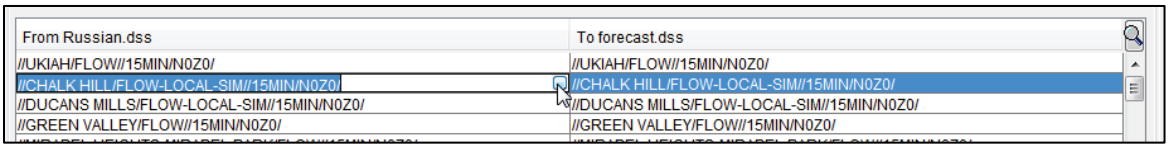


Figure 7.18 Verifying Matching Pathnames

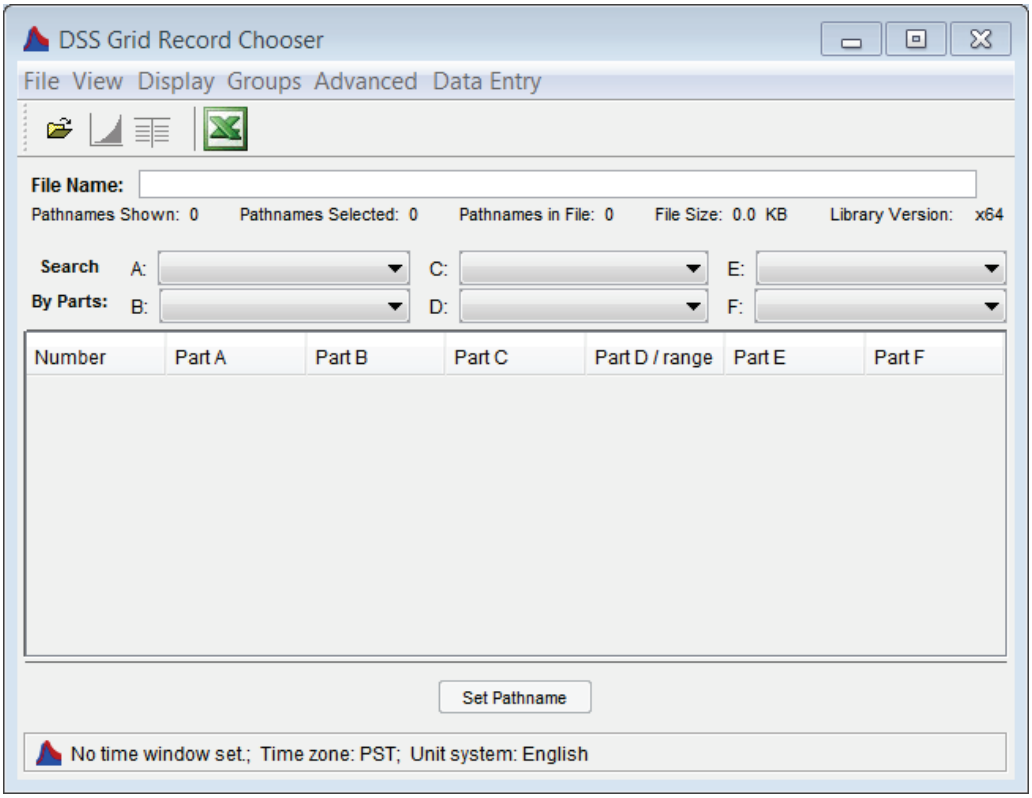


Figure 7.19 DSS Grid Record Chooser

7. From the **DSS Grid Record Chooser** (Figure 7.19), the user can choose the correct pathnames for the dataset. Review all pathnames, and when finished, from the File menu (Figure 7.19) click **Close**. The **DSS Grid Record Chooser** will close (Figure 7.19).

8. Once the user is finished with extract groups, click **OK**, and the **Extract Editor** will close (Figure 7.17).

The user is now at the point where a forecast can be computed. Save the watershed at this point (from the HEC-RTS main window (Figure 1.1), from the **File** menu, click **Save Watershed**).

Now from the HEC-RTS main window, click the **Modeling** module (Figure 3.5). From here, attempt to run a forecast with the current time (assuming you have all the data), or a calibration time.

7.5 Verify Model Linkings

After setting up extract groups, and making sure there is valid data in the watershed database file, the user now need to create a **Forecast Run** and walk through each of the model alternatives to verify the correct time series input and output for each location.

Using historic data, create a forecast for an event time period. Compute each model alternative, one at a time, reviewing all output and time series datasets to ensure the correct data is being used and being computed. Compute and walk through each of the model alternatives before the HEC-RAS model alternative. HEC-RAS uses rivermile naming, the user will need to verify that the correct hydrographs are being read in at the correct locations in the RAS model alternative. Select the RAS model alternative from the **Forecasts** panel (Figure 7.20), click the **Reports** tab (Figure 7.20), and click **Stage and Flow Hydrograph** button. Select the HMS model alternative from the **Forcasts** panel (Figure 7.20) and expand.

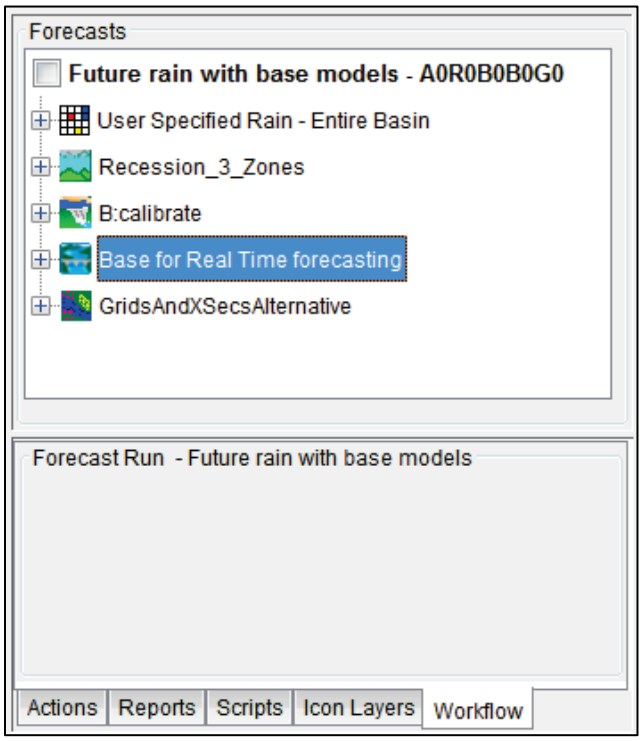


Figure 7.20 HEC-RTS Main Window – Modeling Module - Forecasts Panel

In the RAS plot, select **Plot Flow**, starting at the top most cross section, walk down each cross section plotting the flow and when a latteral inflow hydrograph is located, check that the increased flow is consistent with the hydrograph plot from HMS at that location.

Review the plots for all cross sections in the RAS model making sure the correct latteral inflow hydrographs are used.

Chapter 8

HEC-HMS Setup for HEC-RTS

HEC-HMS can be setup for a HEC-RTS watershed implementation before or after importing the HMS model, but this must be done prior to assigning an alternative key or linking the models. This setup is done from HEC-HMS, not in HEC-RTS.

During an event, good forecasts, need to be made quickly; there is not much time to adjust parameters to optimize the model. To accommodate this, the watershed is divided into "zones", comprised of similar (usually adjacent) subbasins. Zonal parameter editors are available for efficiently modifying parameters to improve model output.

After zones are setup, create an HEC-HMS "forecast alternative", which will contain a basin model, a meteorological model, and zone configurations for loss rate, transform, base flow, and reach routing. Once the HEC-HMS model is part of the HEC-RTS watersheds, the MFP model alternative that will be built will use one of the zones for future precipitation. Zonal editors allow the user to adjust parameters through a table interface or through slider bar editors as shown in Figure 8.1.

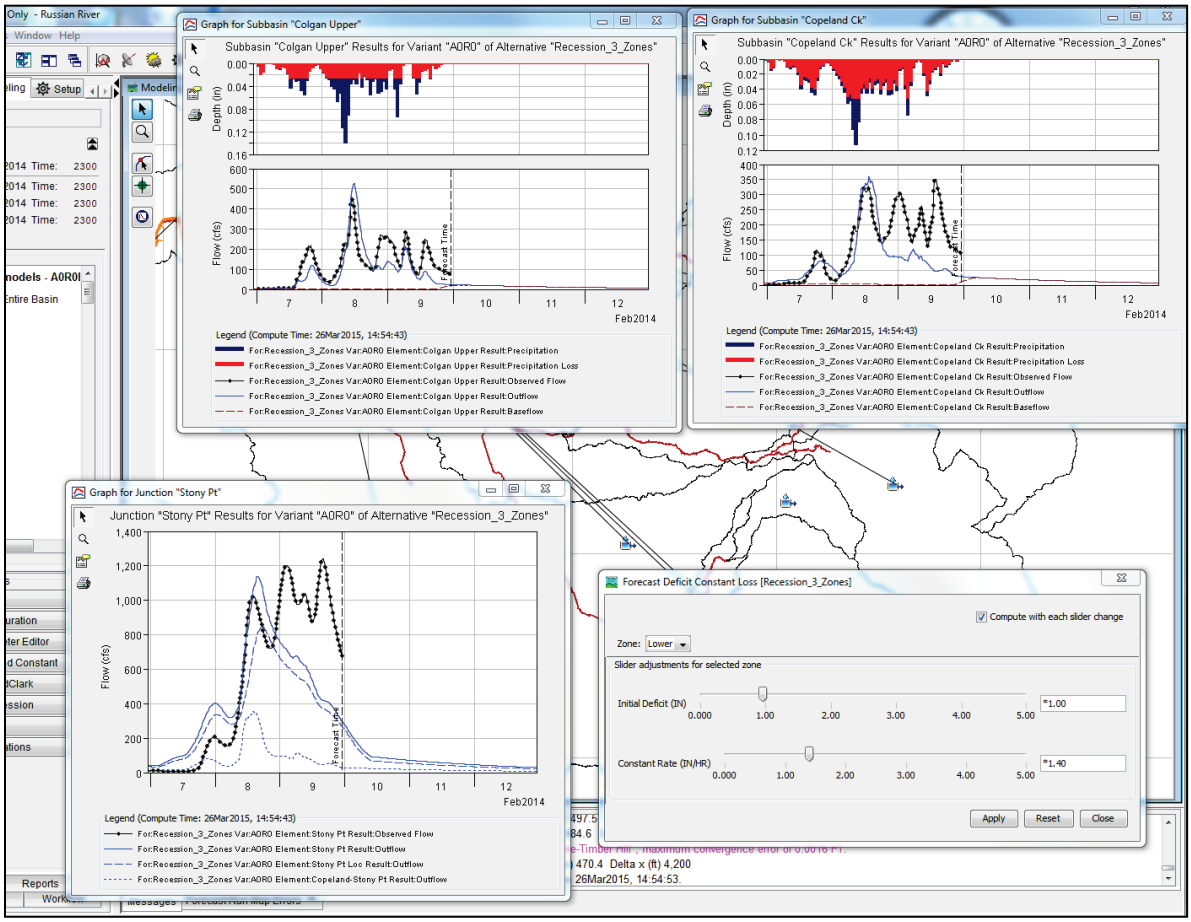


Figure 8.1 HEC-RTS - Use of Slider Bars for Model Calibration

8.1 Zone Configuration

A zone configuration will be applied to the HEC-HMS model based on subbasin locations. Generally, parameters are adjusted for all subbasins within a zone. The user can set each parameter to a specific number for a zone, or multiply/divide the parameter for each subbasin within a zone by a constant, or add/subtract a constant to each parameter for each subbasin, or set the parameter for individual subbasins to specific values. Refer to the HEC-HMS user's manual for a description of setting up zones and configuring a forecast alternative.

For future precipitation, the amount of precipitation is set for the entire zone, and can be specified as a temporal distribution for each zone. The user can also multiply observed precipitation by a percentage for each zone.

8.2 Defining Zones

Define zone in the HEC-HMS model:

1. From the HEC-HMS main window (Figure 8.2), from the **Parameters** menu, click **Zone Configuration Manager**, the **Zone Configuration Manager** will open (Figure 8.3).

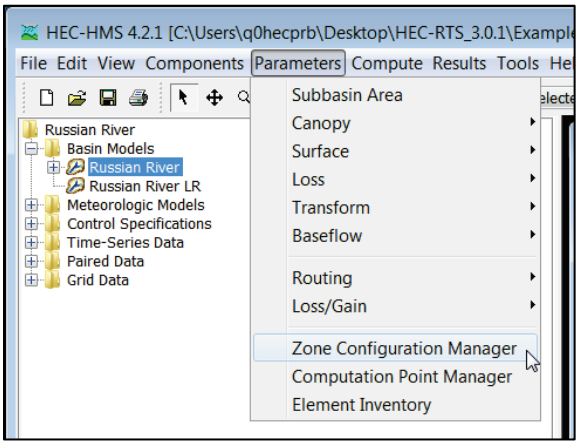


Figure 8.2 HEC-HMS Main Window – Parameters Menu

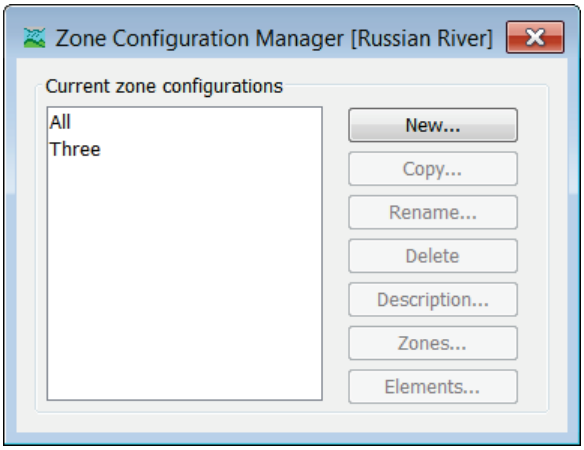


Figure 8.3 HEC-HMS – Zone Configuration Manager

2. Click **New**, the **Create A New Zone Configuration** dialog box will open (Figure 8.4). Provide a name for the zone configuration in the **Name** box (Figure 8.4), an optional description in the **Description** box, and from the **Element Type** list (Figure 8.4) select the element type the zone configuration will be created for. Click **Create**, the **Create A New Zone Configuration** dialog box will close (Figure 8.4) and the name of the new zone configuration will appear on the **Zone Configuration Manager** (Figure 8.3).

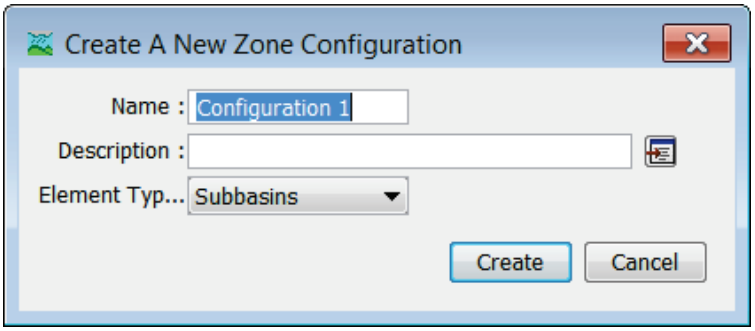


Figure 8.4 HEC-HMS – Create A New Zone Configuration Dialog Box

3. From the **Zone Configuration Manager** (Figure 8.3), select a zone configuration, click **Zones**, a **Zones *[zone configuration]*** dialog box will open (Figure 8.5), click **New**. The **Create a New Zone** dialog box will open (Figure 8.6). For each new zone created enter a name in the **Name** box (Figure 8.6). Click **Create**, the **Create a New Zone** dialog box will close (Figure 8.5). Create as many zones for the zone configuration as necessary, once finished creating zones, close the **Zones *[zone configuration]*** dialog box (Figure 8.5).

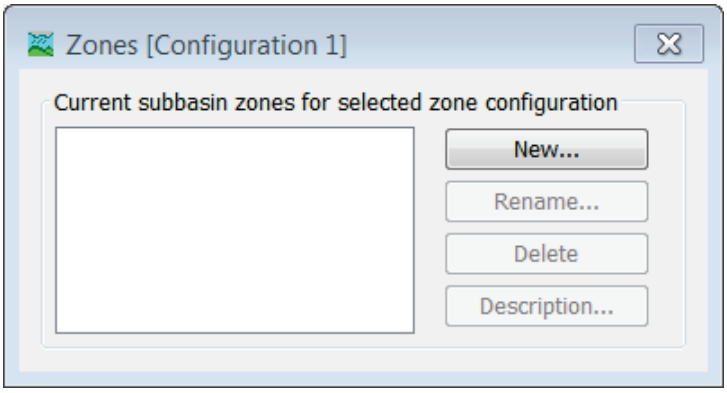


Figure 8.5 HEC-HMS – Zones [zone configuration] Dialog Box

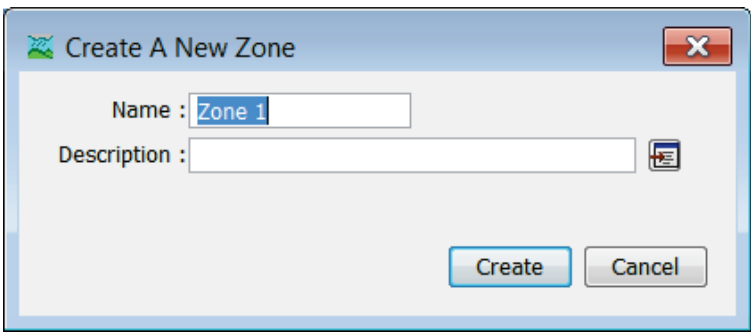


Figure 8.6 HEC-HMS – Create a New Zone Dialog Box

4. Now the user needs to assign each subbasin to one of the zones. From the **Zone Configuration Manager** (Figure 8.3), select a zone configuration, click **Elements**, an **Elements *[zone configuration]*** selector will open (Figure 8.7). From the **Zones** list (Figure 8.7) select the appropriate zone, from the **Unassigned Subbasins** box, select the subbasins that need to be assigned, click **Add**, the selected subbasin names will appear in the box on the right of the **Elements *[zone configuration]*** selector (Figure 8.7). Repeat this until all of the zones have been assigned subbasins, close the **Elements *[zone configuration]*** selector (Figure 8.7).

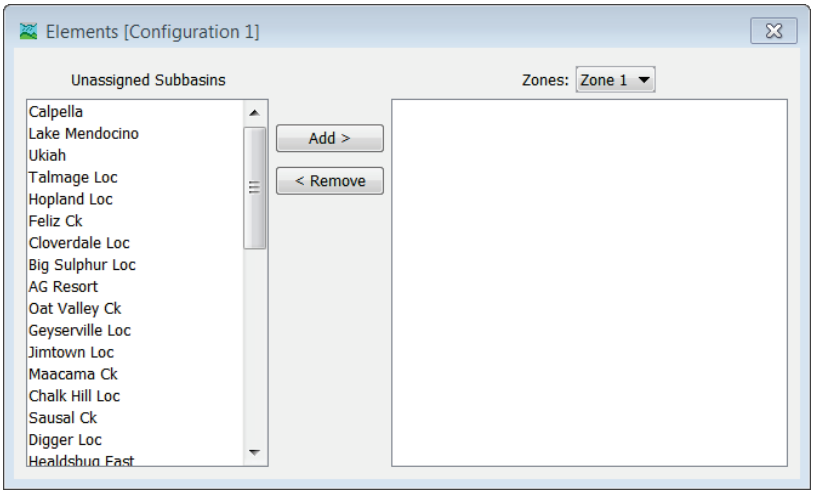


Figure 8.7 HEC-HMS – Elements [zone configuration] Selector

5. Close the **Zone Configuration Manager** (Figure 8.3). The next step is to create an HEC-HMS forecast alternative.

8.3 HEC-HMS Forecast Alternative Setup

Now that all of the parts of an HEC-HMS model have been built, the user needs to configure a forecast alternative. HEC-HMS as various compute types, for HEC-RTS the user will need to create a forecast alternative.

1. From the HEC-HMS main window (Figure 8.8), from the **Compute** menu, click **Forecast Alternative Manager**. The **Forecast Alternative Manager** will open (Figure 8.9).

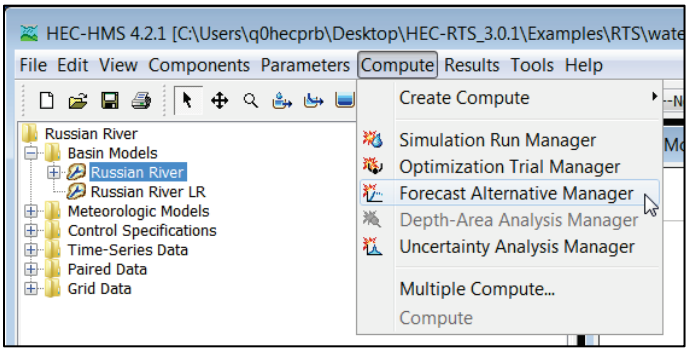


Figure 8.8 HEC-HMS Main Window – Compute Menu

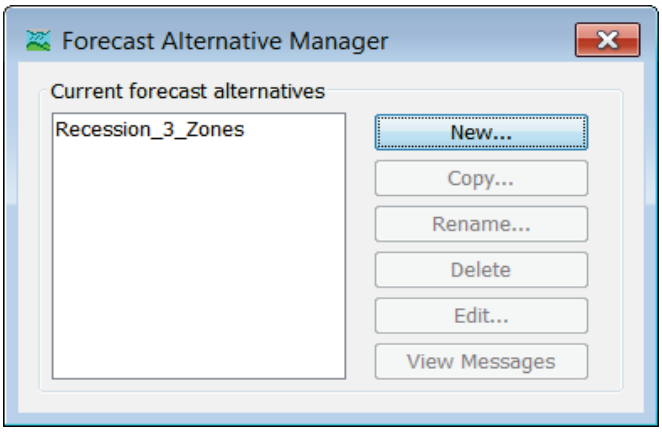


Figure 8.9 HEC-HMS – Forecast Alternative Manager

2. Click **New**, the **Create a Forecast Alternative Wizard** will open (Figure 8.10) from the **Compute** menu, click **Forecast Alternative Manager**. The **Forecast Alternative Manager** will open (Figure 8.9). In the wizard, select the basin model, the met model, time step and zone configuration (Figure 8.10). Click **Finish**, the **Create a Forecast Alternative Wizard** will close (Figure 8.10), and the new forecast alternative name will appear in the **Forecast Alternative Manager** (Figure 8.9). Once the user is finished creating forecast alternative, close the **Forecast Alternative Manager** (Figure 8.9)

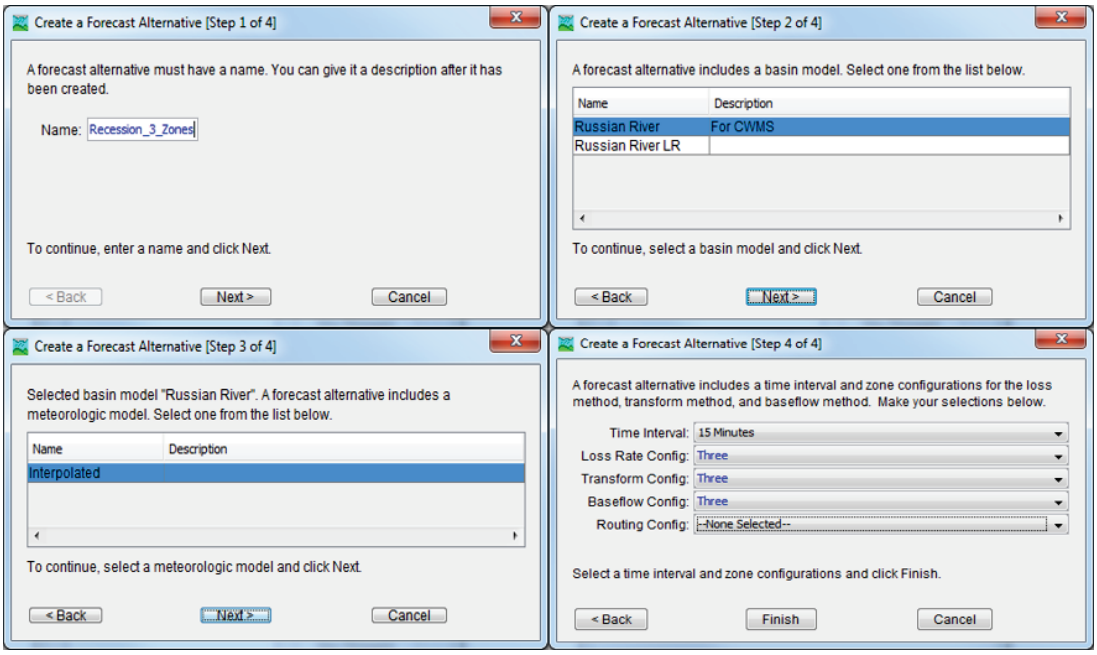


Figure 8.10 HEC-HMS – Create a Forecast Alternative Wizard

8.4 Graphical Parameter Calibration (Slider Bars) Setup

The soil moisture conditions of a watershed have the greatest impact on runoff, after precipitation. One of the most important steps in the process is calibrating the HEC-HMS model to current (soil moisture) conditions; miss-calibration can lead to large errors.

HEC-HMS has a calibration aid to help adjust the model to current conditions, called the "Graphical adjustment of forecast parameters", or "slider bars". Generally, this function is best used on "gaged headwater" subbasins, or a small group of subbasins, so that the user can compare computed verses observed runoff and make adjustments that are not obscured by routing or reservoir issues (e.g., wind changing reservoir elevation.) Flows from gages downstream of a reservoir or in an area that affects flows (e.g., wetlands) and not as helpful for calibrating soil moisture. Review the HEC-HMS model and select those subbasins to use as calibration points. Once the user has adjusted parameters, those adjustments can be made to other (non-calibration) subbasins.

In HEC-RTS, adjustments are made using "zones", a collection of similar subbasins that have similar parameters. Thus when making adjustments to parameters for a subbasin, the user can apply that adjustment to other subbasins in the same zone.

Because of the zone concept, setting up slider bars in HEC-HMS for HEC-RTS is different than setting them up for HEC-HMS in a study mode. After zones, and a forecast alternative have been created, the user can setup the slider bars using the following procedure.

1. From the HEC-HMS main window (Figure 8.11), click the **Compute** tab, from the HEC-HMS study tree, expand **Forecast Alternatives** (Figure 8.11). Right- click on a forecast alternative, from the shortcut menu (Figure 8.11), click **Forecast Slider Adjustment** (Figure 8.11).

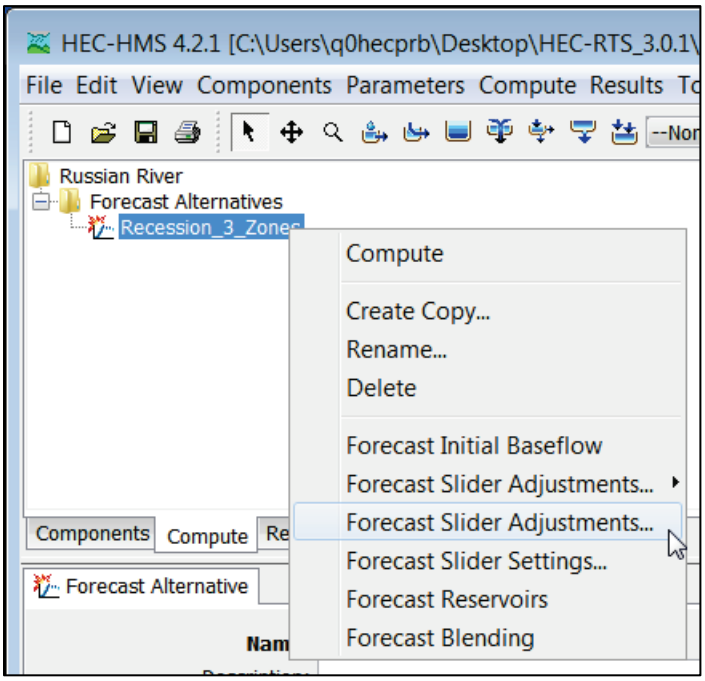


Figure 8.11 HEC-HMS – Compute Tab – Forecast Alternative Shortcut Menu

2. The **Forecast Slider Adjustments [*forecast alternative name*]** dialog box will open (Figure 8.12). From the box, select a zone, click **Select**, the **Select Forecast Slider Adjustments [*forecast alternative name*]** will open (Figure 8.13).

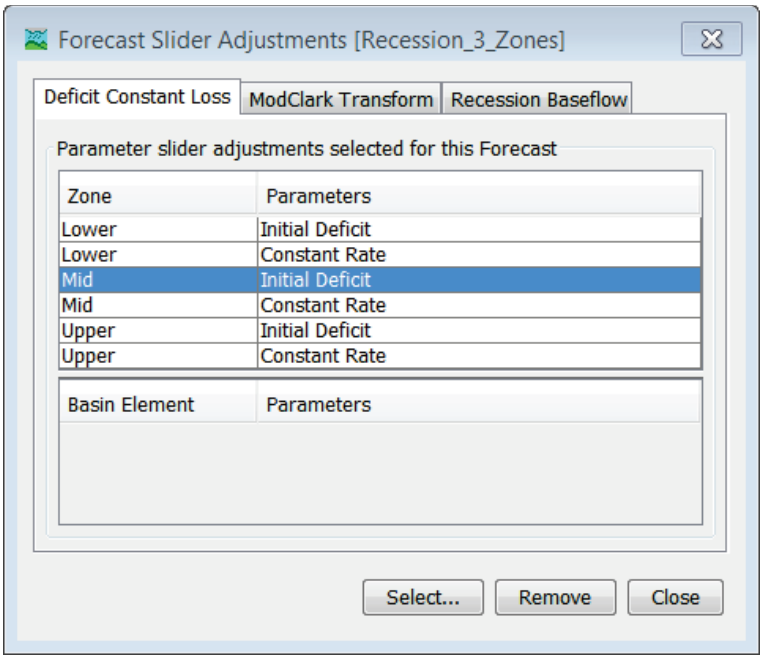


Figure 8.12 HEC-HMS – Forecast Slider Adjustments Dialog Box

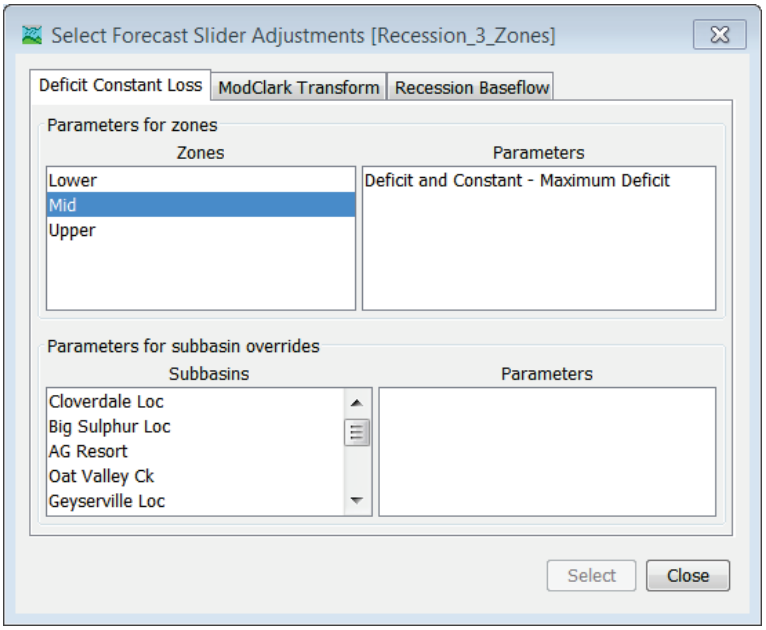


Figure 8.13 HEC-HMS – Select Forecast Slider Adjustments Dialog Box

3. For each of the zones, select the parameters that will be calibrated using slider bars (Figure 8.13). Close the **Select Forecast Slide Adjustments [*forecast alternative name*]** dialog box (Figure 8.13), and also close the **Forecast Slider Adjustments [*forecast alternative name*]** dialog box (Figure 8.12).

4. Right- click on a forecast alternative, from the shortcut menu (Figure 8.11), click **Forecast Slider Settings** (Figure 8.11). The **Forecast Slider Adjustment Settings [*forecast alternative name*]** dialog box will open (Figure 8.14).

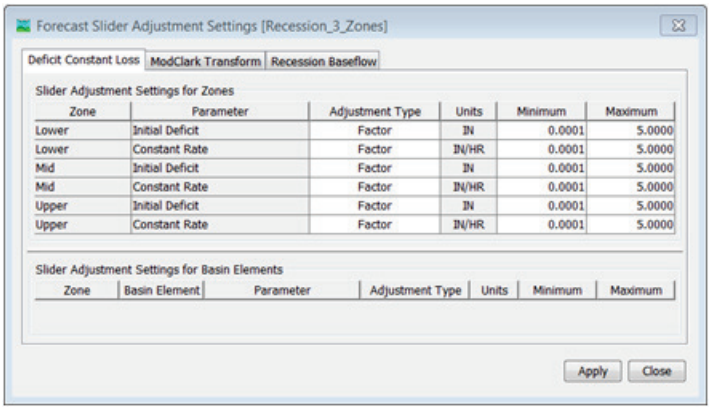


Figure 8.14 HEC-HMS – Forecast Slider Adjustments Settings [forecast alternative name] Dialog Box

5. Adjust the maximum and minimum possible parameter values, as appropriate. When finished with adjustments click **Apply**, click **Close**, the **Forecast Slider Adjustment Settings [*forecast alternative name*]** dialog box will close (**Figure 8.14**).

Now the user has finished making all the necessary setup and adjustments needed to the HEC-HMS model.

1. From the HEC-RTS main window, from the **Modeling** module (Figure 8.15), open a forecast, from the **Forecasts** box, select the HMS model alternative. Click the **Actions** tab (Figure 8.15), click **Combined Parameter Editor**, a **Forecast [*forecast name*]** editor will open (Figure 8.16).

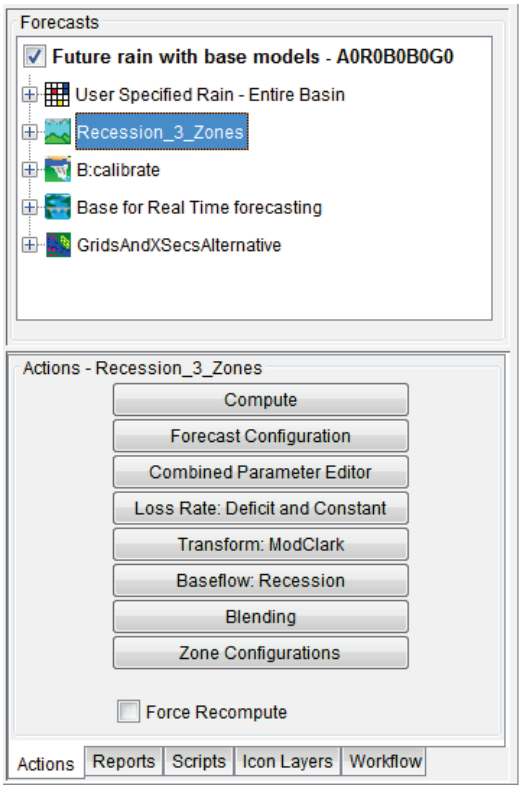


Figure 8.15 HEC-RTS – Modeling Module – Actions Tab

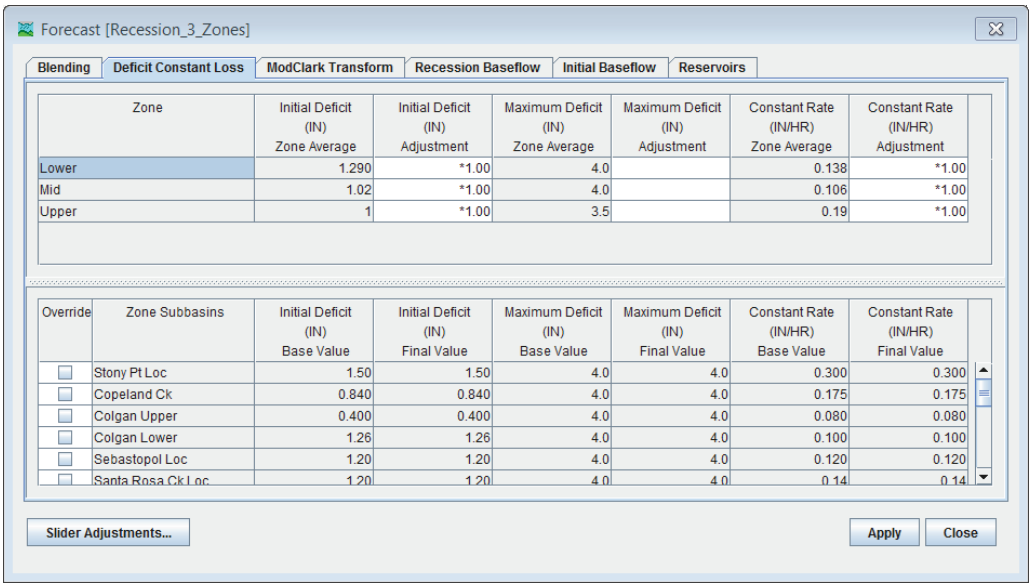


Figure 8.16 HEC-RTS - Forecast [forecast name] Dialog Box

2. Click **Slider Adjustments**, the **Forecast Parameters And Blending** [forecast name] dialog box will open (Figure 8.17). Adjust parameters for each zone by moving the slider bar (Figure 8.17) once the user has the required adjustments click **Apply**. To return to the default setting click **Reset**.

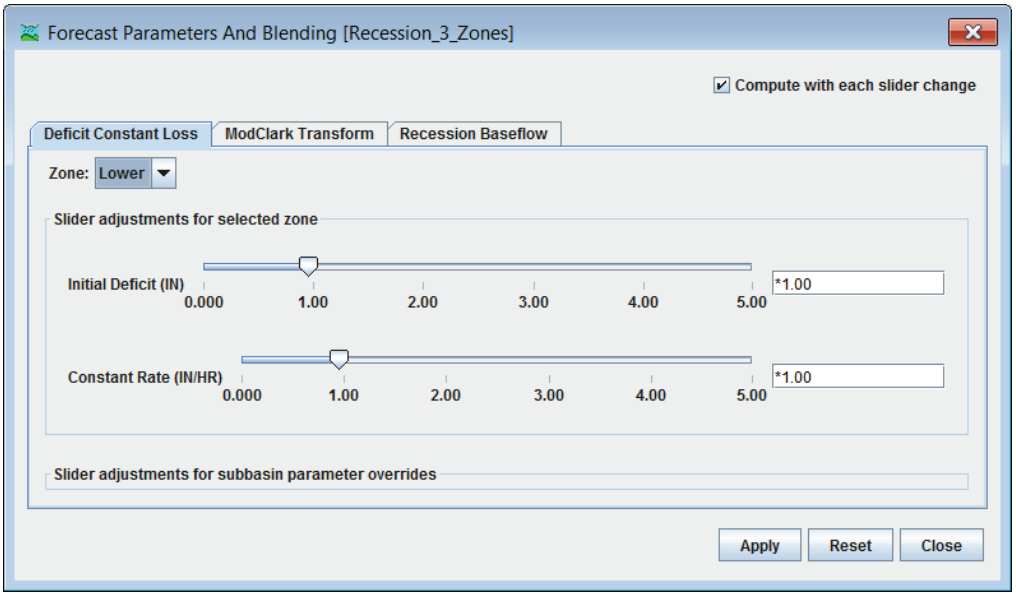


Figure 8.17 HEC-RTS - Forecast Parameters And Blending [forecast name] Dialog Box

3. To adjust parameters, move the slider or type a value in the input field. The user will need hydrograph plots with computed and observed flows, and after adjustments re-compute the HEC-HMS model. Selecting **Compute with each slider change** (Figure 8.17), will make sure that the hydrograph plots are updated; however, this option is not ideal when simulation run times exceed a couple of seconds. Refer to the HEC-HMS User's Manual for more information.

4. When the user is finished with all adjustments click **Close**, the **Forecast Parameters And Blending** [forecast name] dialog box will close (Figure 8.17).

Chapter 9

Time Series Icons

Time series icons provide access to observed and computed time series and paired data. The data may be either from a DSS file, websites, webcams, scripts, spreadsheets, or other files. Time series data can appear as thumbnail plots or color bars. The icons provide easy access for analyzing data and providing location-specific information (e.g., frequently updated pictures of gages, reports on the location).

In addition, datasets may be set to display by turning on or off **Time Series Layers** (Figure 5.9), a subcomponent of map layers. Example layers include: Flow, Stage, Precip, and Modeled Results. Selecting a specific layer allows the user to view certain data types and remove clutter from a map window. Setting up the layers first, and then adding icon datasets to the layers is the recommend way for setting up time series icons. Of course, the watershed database needs to be populated with data before creating time series icons.

9.1 Time Series Layers

The **Time Series Icons Layer** (Figure 5.9) is a default map layer, with the user defining the different specific time series layers. A time series layer is used to display a specific type of data, such as all flow gages, or computed stages. The user can also organize the defined time series layers, for example:

- All
- Flow
- Stage
- Precip
- Elevation
- Lakes
- Modeled

9.2 Creating Time Series Layers

To create a time series layer:

1. From the HEC-RTS main window (Figure 5.1), click the **Setup** module, from the **Maps** menu, click **Map Layers**. The **Map Layers** dialog box (Figure 5.2) will open, right click on **Time Series Icons**, from the shortcut menu (Figure 9.1), and click **Add Icon Layer**.

2. The **New Time Series Icon Layer** dialog box will open (Figure 9.2). Enter a name in the **Name** box (e.g., Flow, Stage, or Precip). The user may enter an optional description in

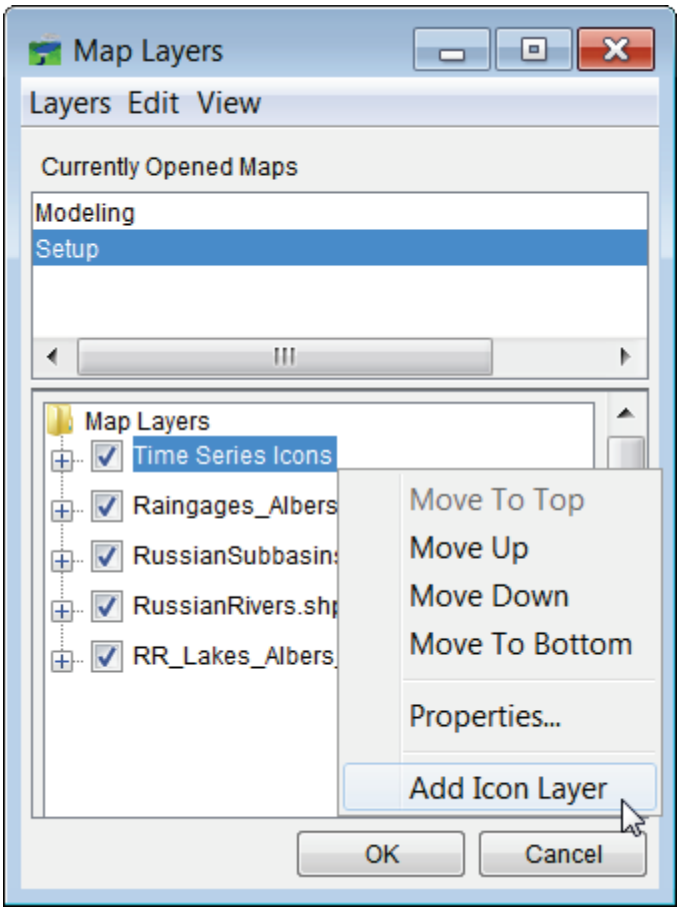


Figure 9.1 Map Layers Dialog Box – Time Series Icons Layer Shortcut Menu

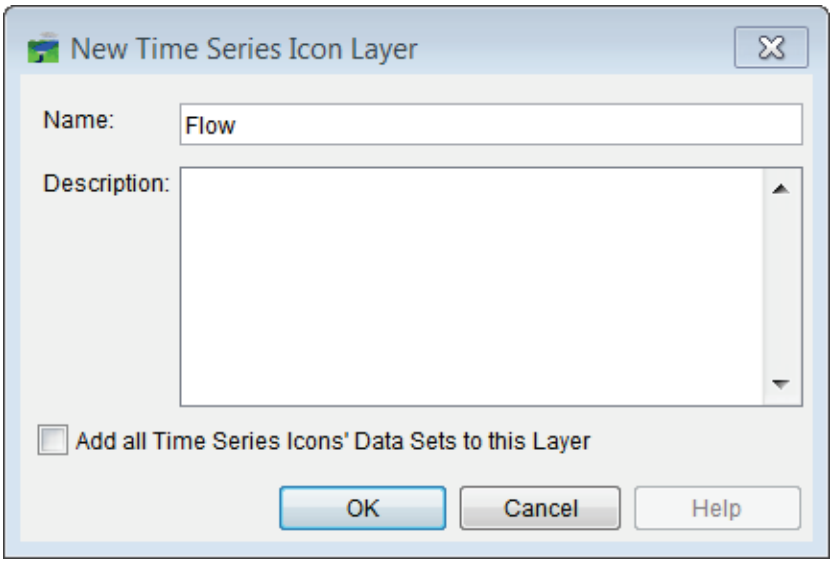


Figure 9.2 New Time Series Icon Layer Dialog Box

the **Description** box (Figure 9.2). If time series icons have been defined, and if the user wants all datasets to include all time series icons, select **Add all Time Series Icons' data sets to this layer** (Figure 9.2). Click **OK**, the **New Time Series Icon Layer** dialog box will close (Figure 9.2).

9.3 Creating Time Series Icons

Time series icons display in the map window of HEC-RTS and indicate sites for which data and information are available. The information can be time series data, images, websites, webcams, scripts, spreadsheets, or other files. Time series data can appear as thumbnail plots or color bars. The icons provide easy access for analyzing data and providing location-specific information (e.g., frequently updated pictures of gages, reports on the location).

To create a time series icon:

1. From the HEC-RTS main window (Figure 5.1), click the **Setup** module, from the **Maps Windows Toolbar**, click the **Time Series Icon Tool** .

2. Find a location on the map window, hold down the **CTRL key**, and click the mouse, an icon will appear with a default name on the map window (Figure 9.3).

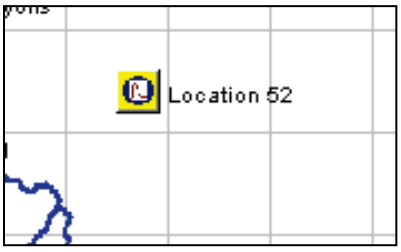


Figure 9.3 Creating a Time Series Icon

3. To associate data with the new time series icon, right-click on the time series icon (**Time Series Icon Tool** should still be selected), from the shortcut menu, click **Edit.** The **Time Series Icon Editor** will open (Figure 9.4).

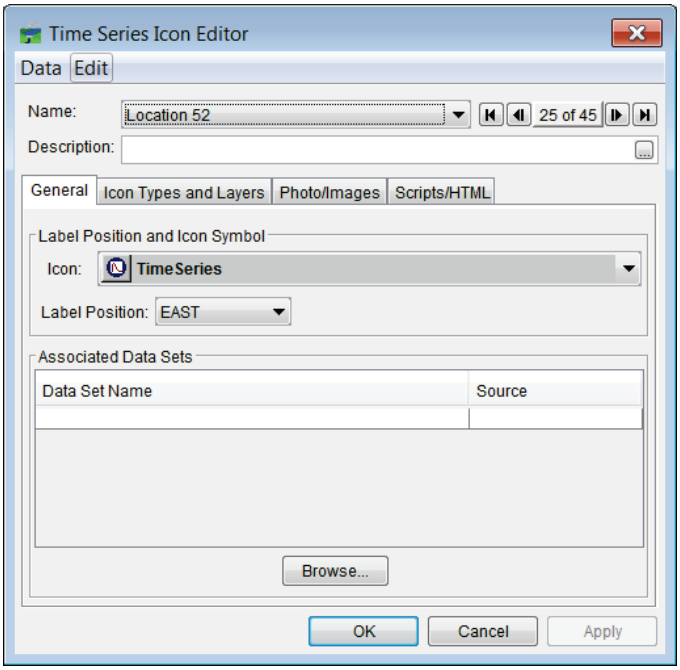


Figure 9.4 Time Series Icon Editor

4. The user can modify/change the name, description, and icon symbol, as appropriate. To rename the time series icon, from the **Edit** menu (Figure 9.4), click **Rename**. The **Rename Time Series Icon** dialog box will open (Figure 9.5), from the **Name** box, the user can change the name of the selected time series icon.

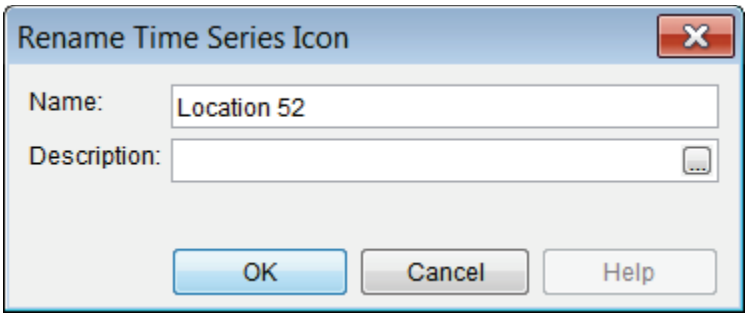


Figure 9.5 Rename Time Series Icon Dialog Box

5. To associate datasets with a time series icon, from the **Data** menu (Figure 9.4), click **Browse**. A dialog box will open (Figure 9.6) that allows the user to select the datasets that will be associated with the time series icon.

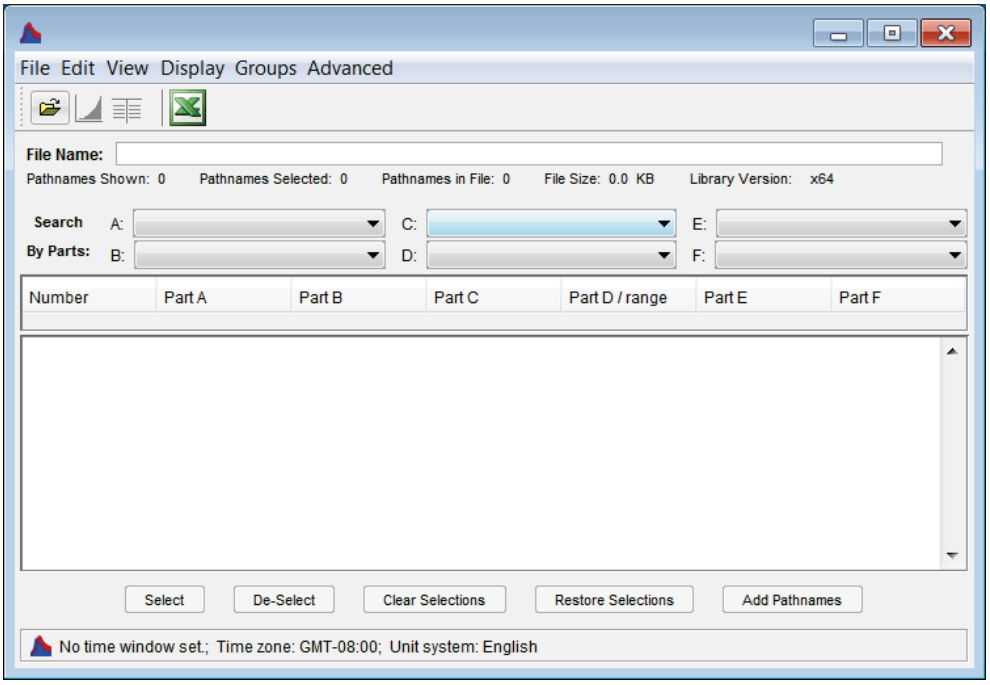


Figure 9.6 Dialog Box – Associating Dataset with a Time Series Icon

6. If user wants to display modeling results from the time series icon, the user will need to select the *forecast.dss* file and select datasets from that file. The dialog box (Figure 9.6) will recognize the data as an alternative and ask the user if wild characters (%) are to be used in the F-part. This will allow the time series icon to display data from the current alternative, rather than the hardwired dataset.

7. To setup the dataset icon types and layers, from the **Times Series Icon Editor** (Figure 9.7), click the **Icon Types and Layers** tab. For the time series icon, from the **Data Set**

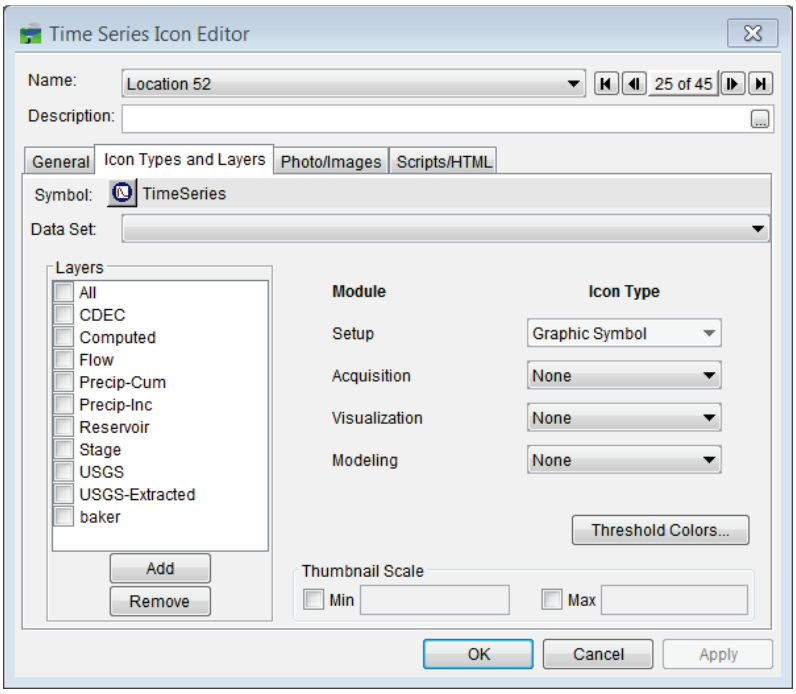


Figure 9.7 Time Series Icon Editor - Icon Types and Layers Tab

list (Figure 9.7) select a dataset. From the **Layers** box (Figure 9.7), select the layers that belong, and from the **Icon Type** list (Figure 9.7) for each module, select the icon graphic. Generally, the icon types correspond to the HEC-RTS module and are as follows:

- Acquisition: Quality Color Bar
- Visualization: Thumbnail Plot or Threshold Color Bar
- Modeling: Thumbnail plot or nothing

Make sure you have **None** selected for the type for model results in the **Acquisition** and **Visualization** modules, as there is no modeling data in those modules.

9.4 Configuring Photo/Web Images Icon, Documents and Scripts

Photos, websites, and webcam images can be assigned to time series icons, along with documents, such as reports or spreadsheets, can also be assigned. Once assigned, these items can be accessed through the icon's shortcut menu in the selected modules and will appear as the icon's image. The following sections describe how to configure photo, images, and webcams or a script, web pages, and documents.

9.4.1 Configuring Images

From the HEC-RTS main window (Figure 5.1), click the **Setup** module, from the **Map Window Toolbar**, click the **Time Series Icon Tool** . From the map window, right-click on the time series icon that is to be modified, from the shortcut menu click **Edit**. The **Time Series Icon Editor** will open (Figure 9.7), click the **Photo/Images** tab (Figure 9.8).

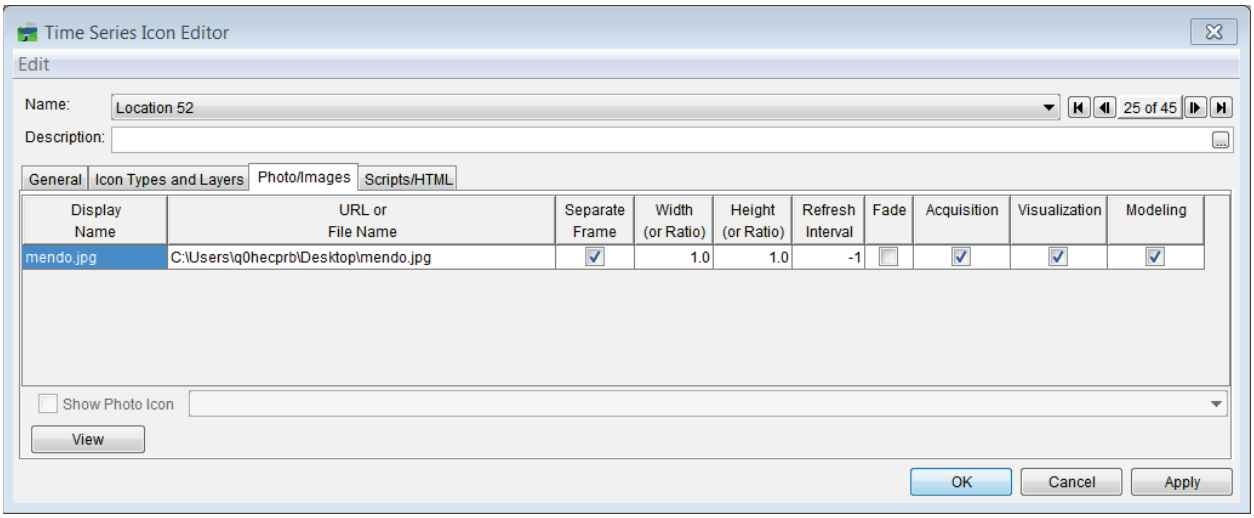


Figure 9.8 Time Series Icon Editor – Photo/Images Tab

From the **Edit** menu (Figure 9.8), click **Browse**, an **Enter Image Browser** will open. Browse to the correct image file, click **Open**, the **Enter Image Browser** will close, and the image location and filename will appear in the table on the **Time Series Icon Editor** (Figure 9.8). Alternatively, image files can be stored and retrieved from DSS, form the Edit menu (Figure 9.8), click **Browse DSS**, a dialog box (Figure 9.6) will open, select the dataset that contains the image file, close the dialog box (Figure 9.6), and the image location and filename will appear in the table on the **Time Series Icon Editor** (Figure 9.8). Alternatively an image file may be available through a website, as in the case of a webcam. If so, type in the URL of the website in the **URL or File Name** column of the table on the **Time Series Icon Editor** (Figure 9.8).

To modify the **display name** of an image, double-click on a cell under the **Display Name** column that corresponds to the image file you want to modify, enter the new name. The **Display Name** will be the text of the menu option in the time series icon's shortcut menu, which will trigger the image to display.

Select **Separate Frame** (Figure 9.8) if the image needs to be displayed in a new window. Specify the **Width (or Ratio)** and **Height (or Ratio)** of the displayed image (Figure 9.8). By default the image will display in the original image size.

The **Refresh Interval** (Figure 9.8) is specific to webcam images. The webcam image is refreshed with a new webcam image the number of seconds specified, starting at zero, which refreshes without any pause. If the **Refresh Rate** is set to ten, the image will be retrieved every ten seconds. To load the image only once, set the **Refresh Rate** to -1.

The **Fade** option (Figure 9.8) is an on/off switch specific to webcam images. This option transitions each image into the next one by displaying ten percent or more of the next image every 0.05 seconds, until the full picture is shown. This gives a smooth motion display of an image.

To add another image to the table, from the **Edit** menu (Figure 9.8), click **Add Row** or **Insert Row**. To remove an image, select the image, from the **Edit** menu (Figure 9.8), click **Delete**

Row. To change the order of images, first select the image, from the **Edit** menu. (Figure 9.8), and click **Move Row Up** or **Move Row Down**.

9.4.2 Configuring a Script or Webpage

From the HEC-RTS main window (Figure 5.1), click the **Setup** module, from the **Map Window Toolbar**, click the **Time Series Icon Tool** . From the map window, right-click on the time series icon that is to be modified, from the shortcut menu click **Edit**. The **Time Series Icon Editor** will open (Figure 9.4), click the **Scripts/HTML** tab (Figure 9.9).

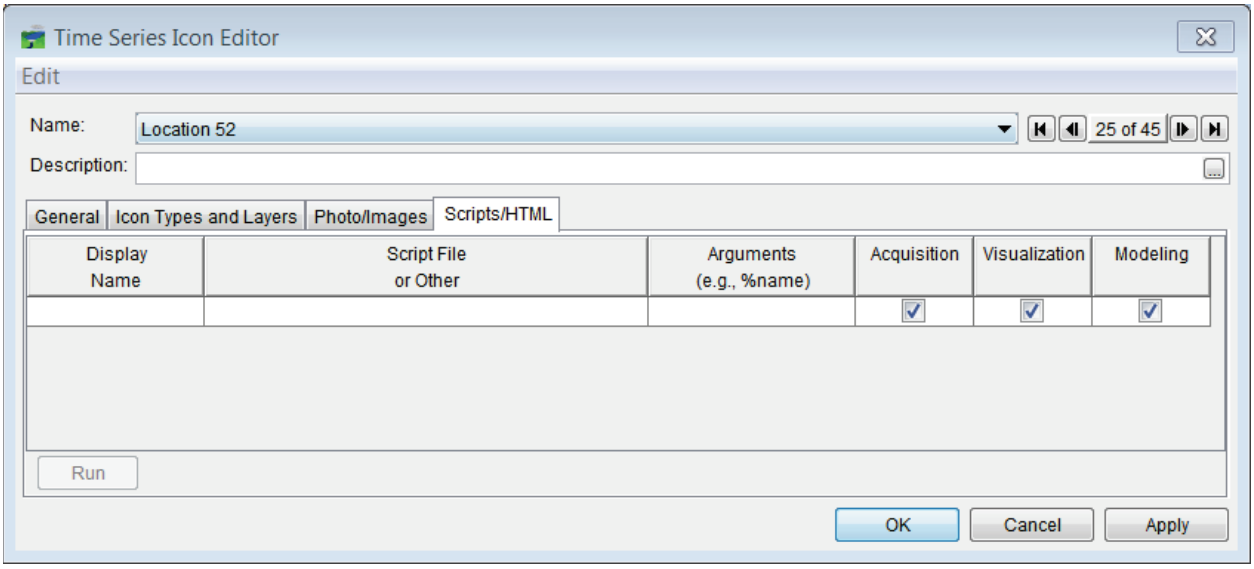


Figure 9.9 Time Series Icon Editor – Scripts/HTML Tab

From the **Edit** menu (Figure 9.9), click **Script Editor/Selector,** the **Script Editor** will open. From the **Script Editor**, highlight the script that will be assigned to the time series icon and click **OK**, the **Script Editor** will close, and the script file will appear in the table (Figure 9.9)

To assign a webpage, type in the URL of the website in the **Script File or Other** column (Figure 9.9), then enter the display name. The display name will be the text of the menu option in the time series icon's shortcut menu, which will trigger the image to display.

Place select from which module (i.e., **Acquisition**, **Visualization**, or **Modeling**) the script file will be available. When all the information is configured, click **Run** (Figure 9.9) to preview the file or script.

Additional time series icon functions are described in the HEC-RTS User's Manual.

Chapter 10

Real-Time Data

The data in the watershed database is compiled in several different ways. Data might be moved into the watershed database via FTP and then automatically loaded; some kind of streaming might be setup; or, a process to retrieve data may be setup. This chapter will cover how data is retrieved for the watershed database.

10.1 Time Series Data

The HEC-RTS interface provides several option for directly importing data from the HEC-DSSVue tool. From the HEC-RTS main window (Figure 3.5), from the **Main Toolbar**, click . The HEC-DSSVue application is opened (Figure 10.1).

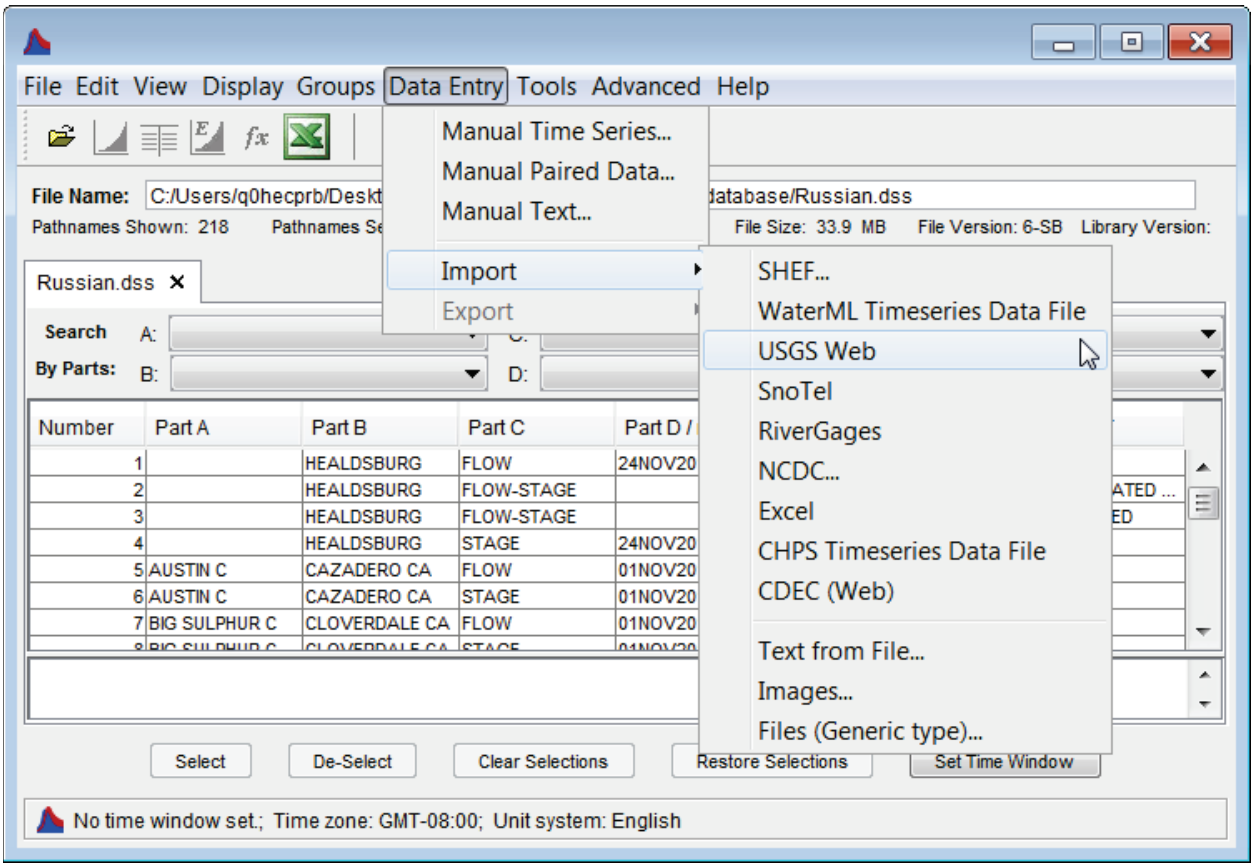


Figure 10.1 HEC-DSSVue – Data Entry Menu – Import Submenu

For example, to import data from the USGS (U.S. Geological Survey), from the HEC-DSSVue main window (Figure 10.1), from the **Data Entry** menu, point to **Import**, click **USGS Web**, the **USGS Download** dialog box will open (Figure 10.2).

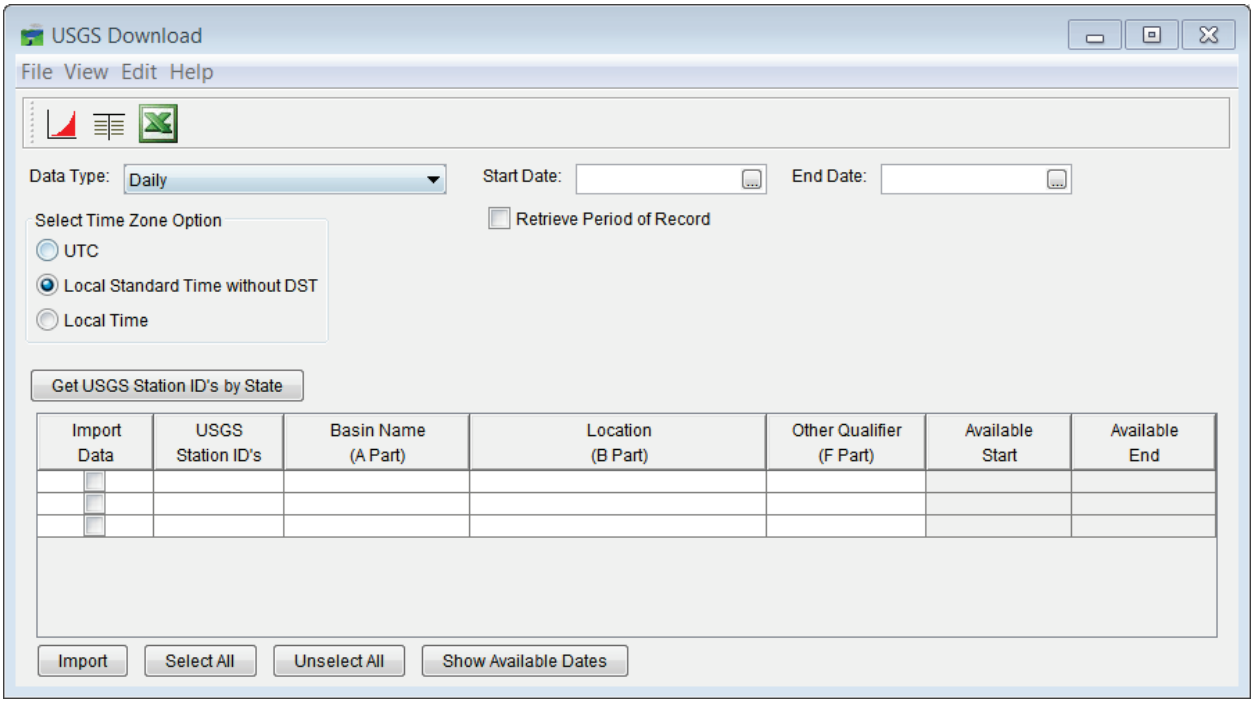


Figure 10.2 USGS Download Dialog Box

For "Real-Time" data, the list of stations is obtained, and then those within the basin are selected (**Import Data** check box). Verify that the selected stations are correct and have the data that is needed. From the **File** menu (Figure 10.3), select **Save Selected Stations**, giving the list a name based on the watershed that is being analyzed (Figure 10.3). A file is automatically saved to the RTS database folder that contains the selected gages.

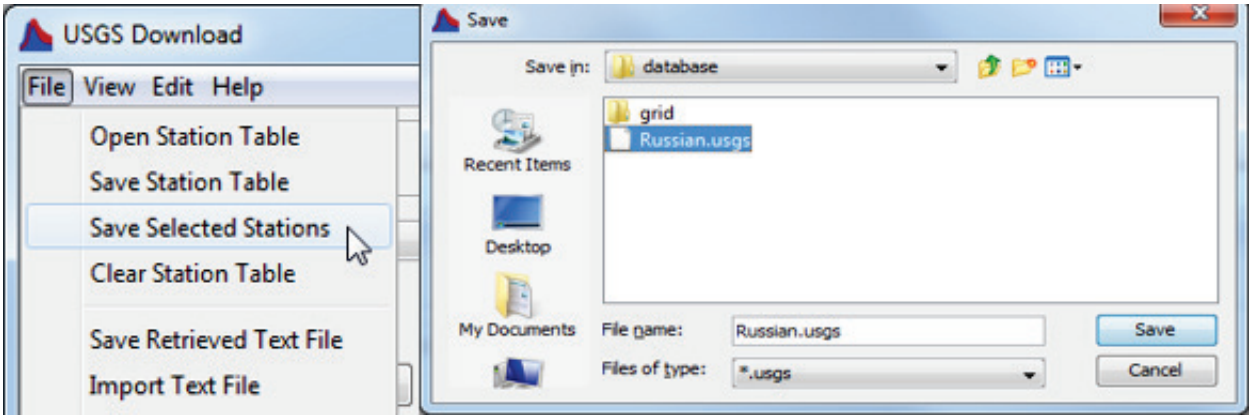


Figure 10.3 Save Selected Stations

This list can now be used in a script to retrieve data, the complete script is displayed in Figure 10.4 and assumes that the station list was saved in a file (*C:/RTS/Database/Russian.usg*s) and that retrieved data will be saved in a DSS file (*C:/RTS/Database/Russian.ds*s).

To add a button for the script on the **Data Acquisition** page, in the lower left panel, right click and select **Edit**. Then select the script name and press the **Add** button, then **OK** (Figure 10.5).

This should cause a button with the script name to show up in that panel (Figure 10.6).

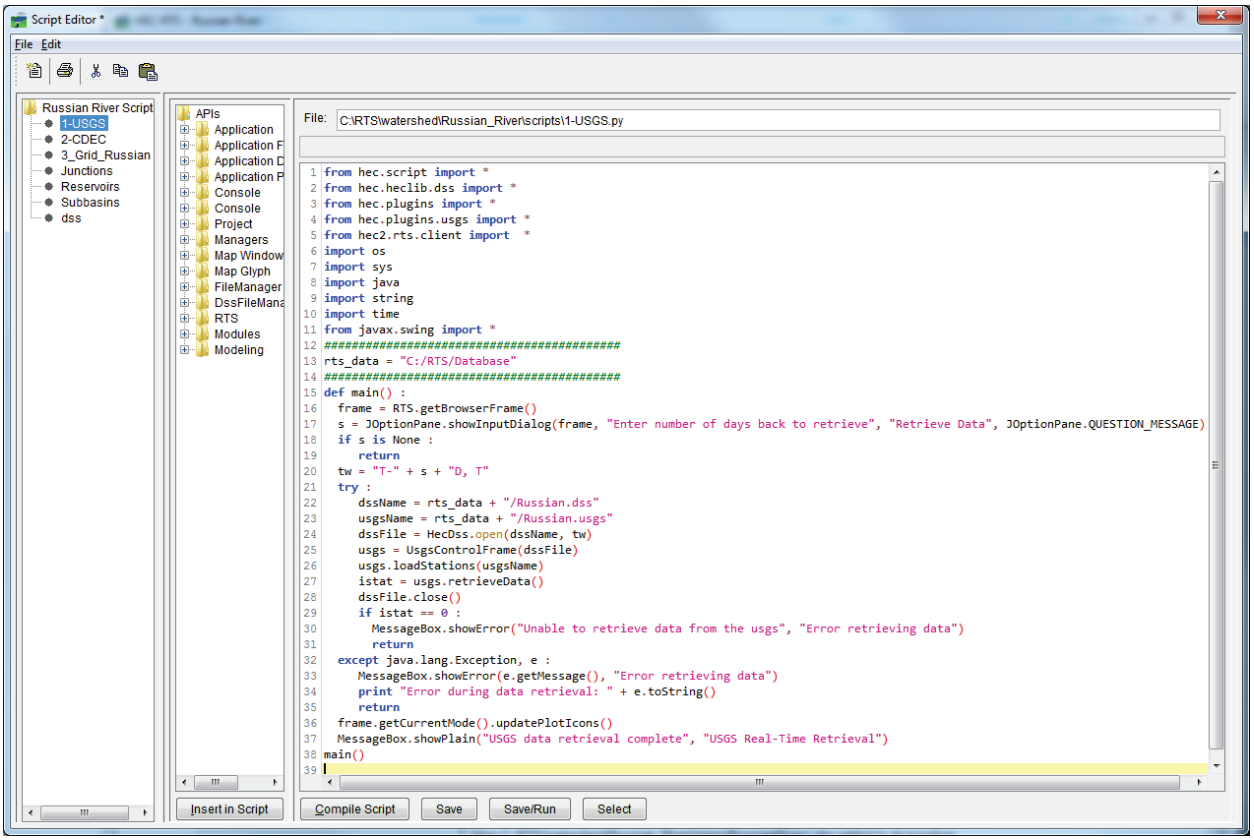


Figure 10.4 Script Editor – USGS Script

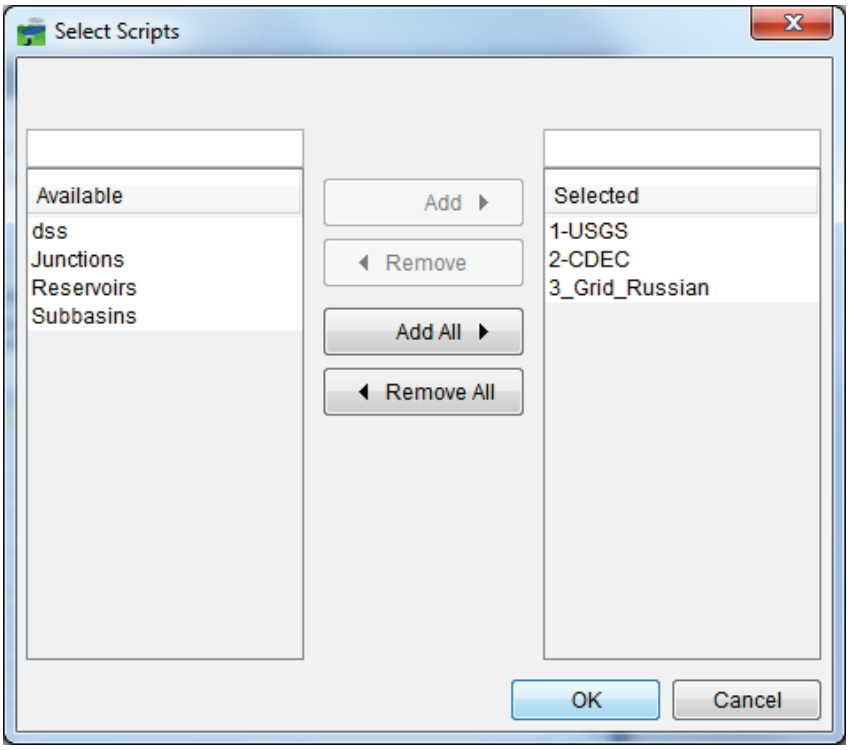


Figure 10.5 Add Button for Script to Acquisition Tab

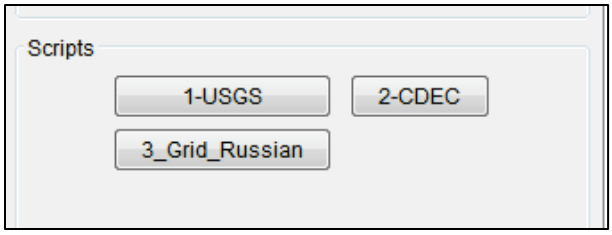


Figure 10.6 Scripts Panel

This script will bring up the following dialog and ask for the number of days back to retrieve data for (Figure 10.7).

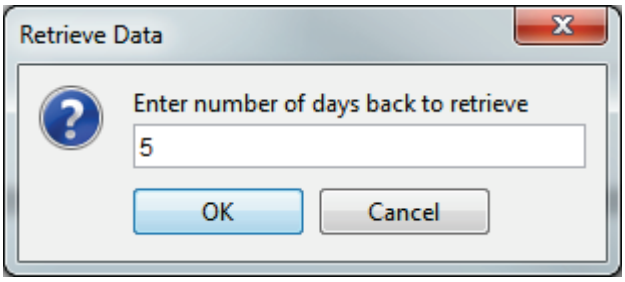


Figure 10.7 Script Data Retrieval

The script will access the USGS NWIS database and save data in the HEC-DSS file specified in the script. Run the script to verify it works. (Note, the first time the script is run, Jython will parse it causing a short delay.)

HEC-RTS contains similar plug-ins to the USGS plug-in that are used in a similar way to retrieve data.

At a later state, the user may wish to run "DATCHK" as part of the script to validate data and assign quality to each value, which shows up as quality-indicative colors on the quality color bars. DATCHK is included with the HEC-RTS package, but will not be describe in this manual. Refer to the DATCHK documentation that is provided with the HEC-RTS install.

10.2 Data Status Summary

As an aid to evaluating observed data in the watershed database, and as an alternative to geo-referenced quality color bar icons, is the **Data Status Summary List** (Figure 10.8). This is essentially a list of quality color bars in a scrollable table format. The data status lists allow the user to organize a list of gages specific to the user's needs. For example, data status lists might be created that show all of the precipitation gages, stream gages, or a mix of both for a specific forecast. The user can create multiple data stats summary lists, as each list stored a separate text file.

To create or display a data status summary list, select **Data Status Summary** from under the **Reports** menu on the **Acquisition** tab.

Selecting this menu will bring up an empty **Data Status Summary** dialog. From here, the user can go to the **File** menu and create a new list, open an existing list, or edit an existing list.

Generally, once datasets have been quality checked with DATCHK or similar, then the user can setup lists.

Creating a **Data Status Summary** list is relatively easy. From the **Edit** menu, select **Browse DSS**, select the pathnames of the datasets needed, then save that list under the **File** menu.

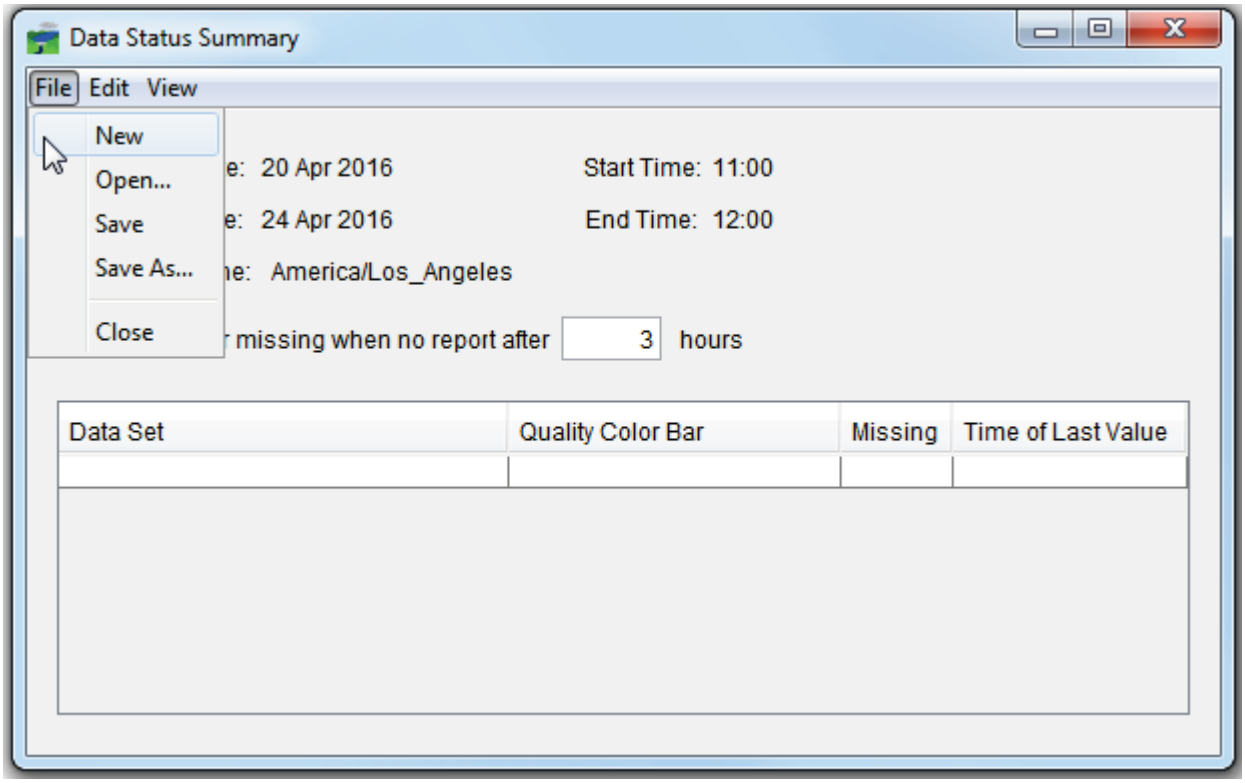


Figure 10.8 Data Status Summary Dialog Box

10.3 Gridded Precipitation

The user may have access to a gridded precipitation product and enter that into the database using the appropriate tools. For this example, there is only point gaged data. Point precipitation is interpolated into a grid set using "gageInterp", which uses latitude/longitude to compute grids. A script included with the example basin, runs gageInterp. Refer to the gageInterp documentation for more information on gageInterp and the script. An example gageInterp input file (Figure 10.9).

10.4 Displaying Gridded Precipitation

Gridded precipitation can be displayed and animated in the **Visualization** module after gridded datasets have been imported into the watershed database. To setup the display, go to the **Visualization** tab and click the **Data Visualization** menu, then **Gridded Data** and **New Grid Set…**. Give the dataset a name and click **OK**.

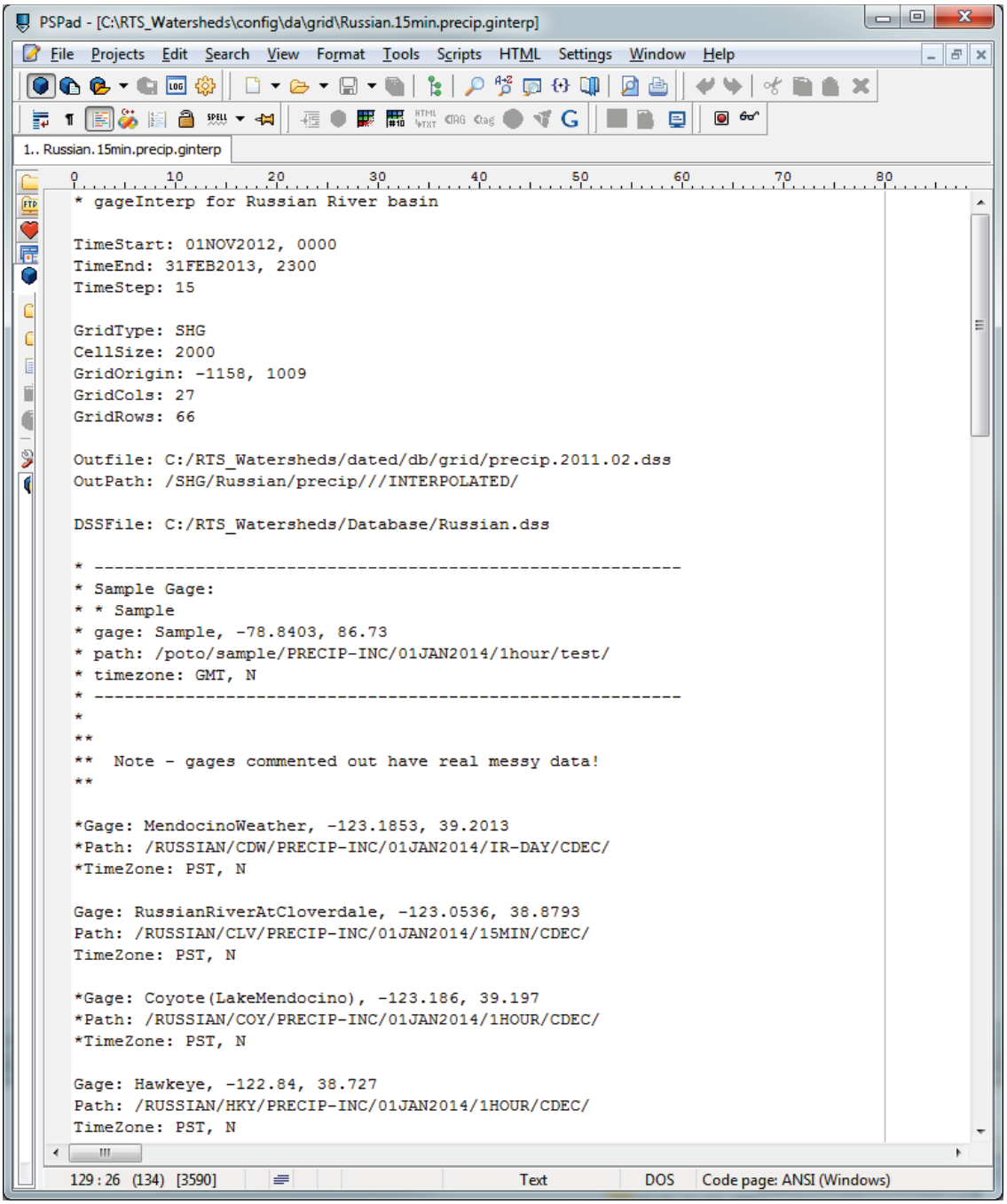


Figure 10.9 Sample gageInterp Input File

The HEC-RTS convention for gridded precipitation files is that they are named according to the year and month of the data and are in the following directory:

$RTS_HOME/dated/db/grid/*parameter*.yyyy.mm.dss

This name is setup in the HEC-GageInterp input file.

From the new **Grid Set** dialog box, select one of the gridded DSS files from the **Add File(s)** button. Then select the pathname parts to fill out the remainder of the dialog (Figure 10.10).

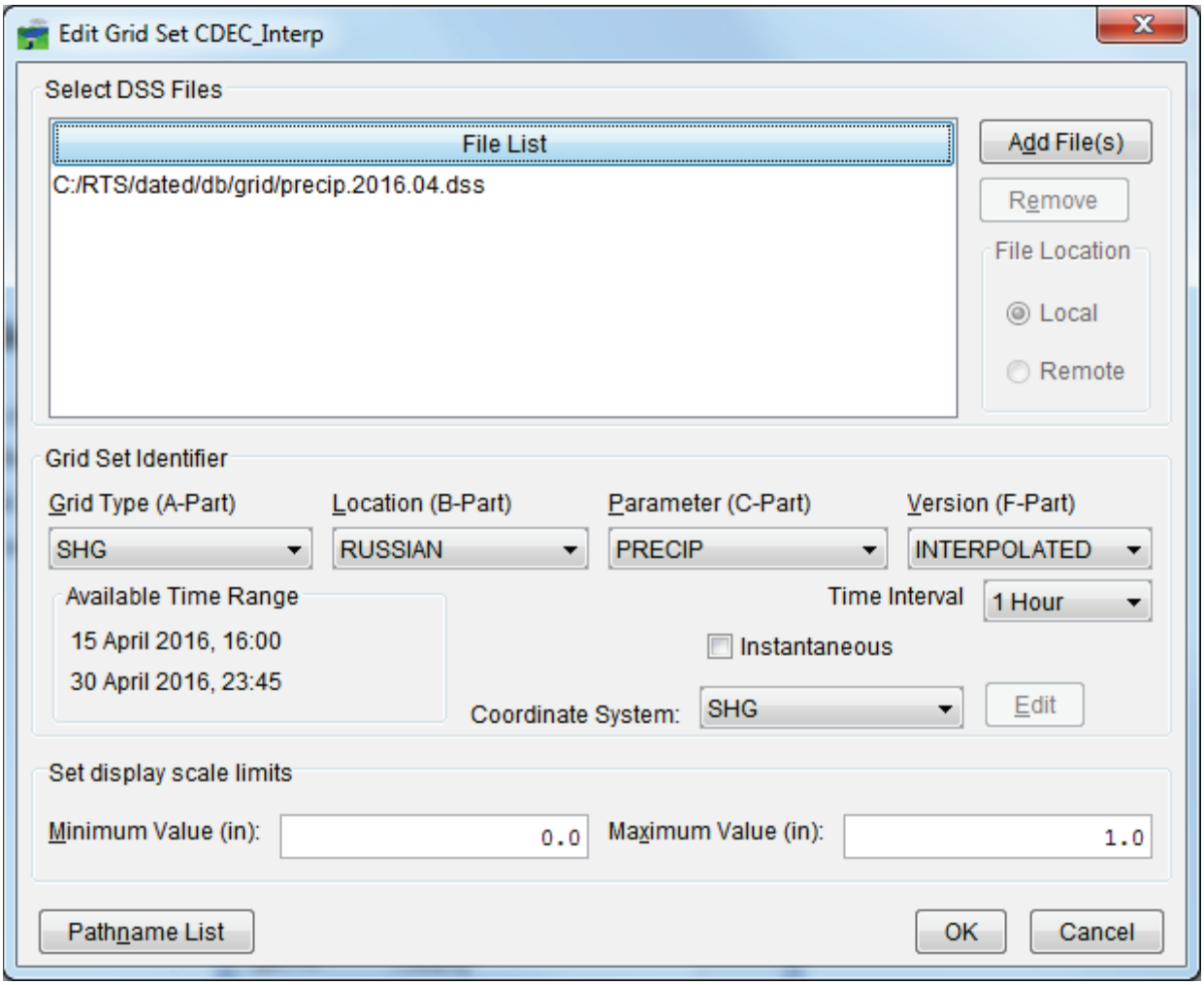


Figure 10.10 Edit Grid Set Dialog Box

After configuring the gridded dataset, the user can turn on the display of the gridded data, and animate the gridded data by selecting the name of the grid set from the **Data Visualization** menu. The date/times in the time panel specifies the grid set times.