

Demonstration of RiverWare, RiverSMART and RiverWISE Decision Support Tools

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Extended Abstract

RiverWare, RiverSMART and RiverWISE are decision support tools that assist water managers with forecasting, scheduling, operations, planning, scenario analysis and stakeholder communication. This demonstration will show the setup, user interface, operation and real applications of these three software tools. Following is a description of each tool and the demonstrations that will be presented.

RiverWare

Central to the toolset is the RiverWare application, a river and reservoir modeling tool used by water managers, planners, consultants, utilities, researchers and stakeholders for forecasting and scheduling reservoir and hydropower operations, water rights and water accounting, developing and evaluating alternative operating policies and planning new projects. This demonstration will show how object-oriented models are constructed from the palette of objects and linked together to form a river system network as shown in Figure 1. Data can be easily loaded into RiverWare from various sources including any database, from files including Excel, HEC DSS, and text files, or from various web data services.

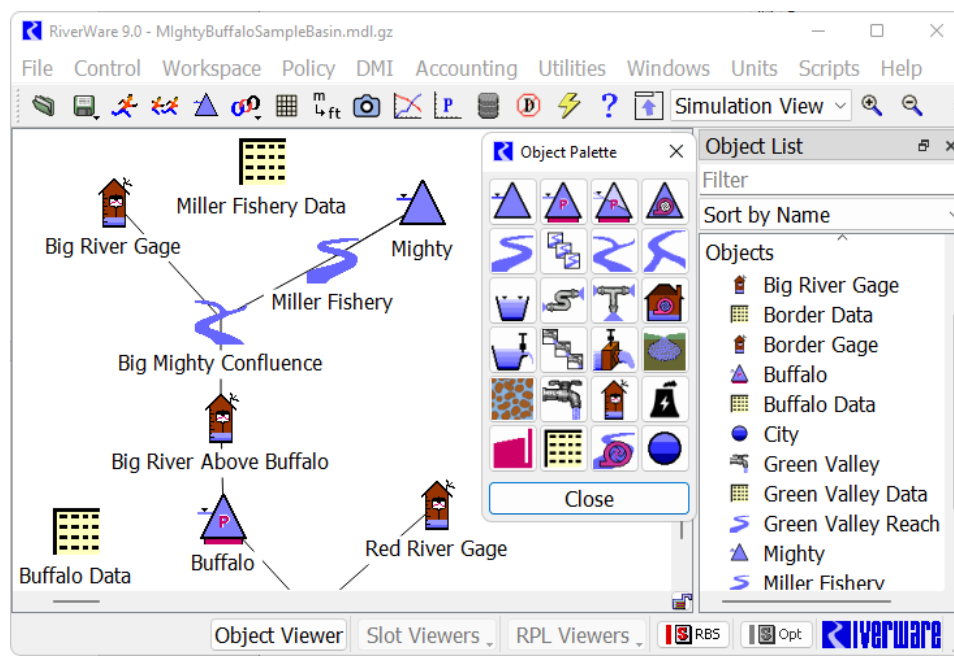


Figure 1. RiverWare Workspace and Object Palette

Simulation demonstrations will include hydrologic processes in rivers and reservoir, consumptive uses and return flows, distribution canals, groundwater interaction and pumping, pipe flows, hydropower and pumped storage, inline pumping and hydropower plants. The user specifies combinations of known time series values to solve for the unknown values, often in an exploratory manner. This solution technique is often used for near real-time operations.

The rulebased simulation solution approach is driven by prioritized, logical rules that represent the multi-objective operating policies such as flood control, water supply, environmental flows and hydropower production. Figure 2 shows two sample rules demonstrating the RiverWare Policy Language used to write rules and other user defined logic.

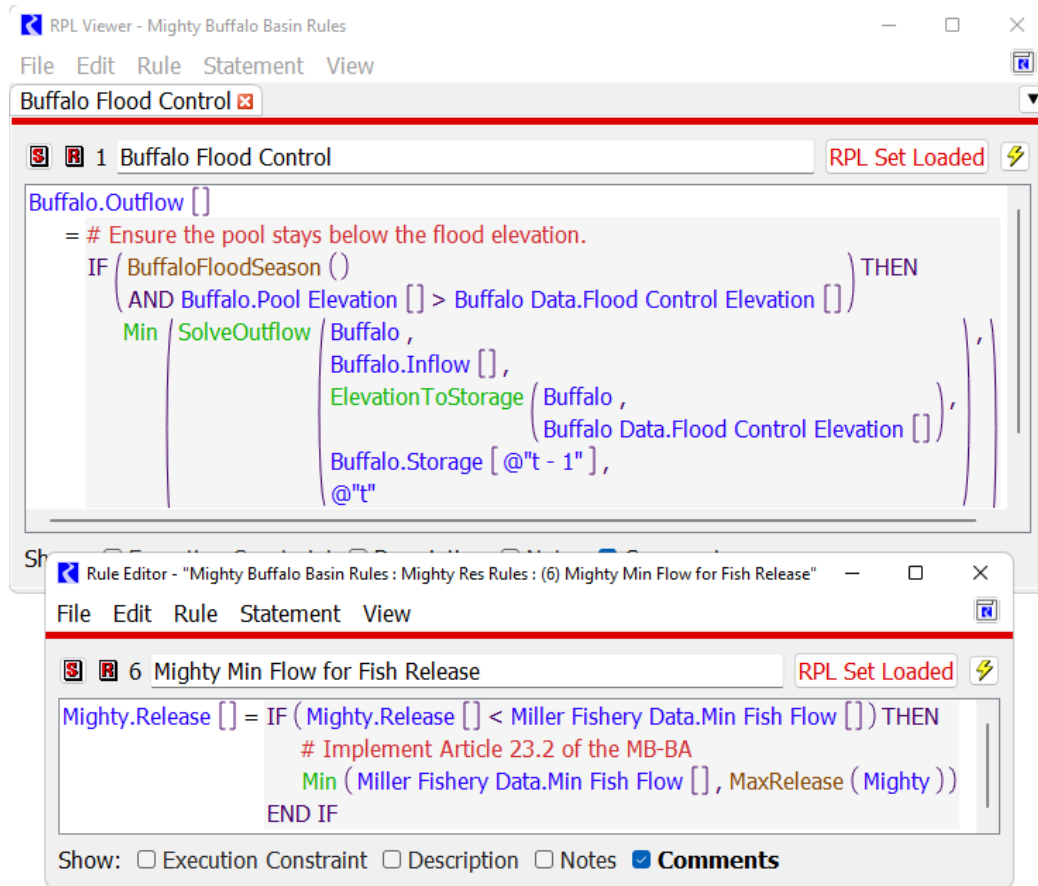


Figure 2. Screenshot of Sample RiverWare Policy Language Rule Logic

We'll show how to create and execute these policies, using them to produce operating schedules, manage flood events or evaluate alternatives for EIS analysis. RiverWare also models water ownership and can perform water accounting calculations – we'll demonstrate how agencies use RiverWare for prioritized water allocation, to operate with rules based on water ownership, and to perform after-the-fact legal accounting.

The third solution approach involves an optimization solution that is driven by prioritized goals that represent policy constraints and objectives. We'll demonstrate how utilities use RiverWare's pre-emptive linear goal programming to optimize hydropower production while meeting water management constraints.

We will demonstrate RiverWare’s many utilities for viewing, analyzing and visualizing data including a fully featured plotting utility, outputs to HTML reports, pie charts, and tea cup diagrams. There are many options for exporting data from RiverWare including outputs to any database or direct export to Excel, HEC DSS, and HDB.

Finally, we will demonstrate RiverWare’s multiple run management utilities that can be used to automate thousands of runs—on one or more computer processors—to produce probabilistic outputs. We’ll show how the results of these runs can be imported back into RiverWare as an Ensemble Data Set and analyzed using the Ensemble Data Tool to perform statistics across traces, compute regressions on scalar trace data, and compute duration curves.

RiverSMART

The RiverWare Study Manager and Research Tools (RiverSMART) tool automates a planning study by organizing and running scenarios of hydrologic inputs, demand inputs and policy sets and then provides utilities to analyze and compare the results from these scenarios. Using this approach, water managers can simulate proposed operating policy changes through climate change hydrologies to analyze impacts and compare alternatives.

In the demonstration, we will show how the various components of a planning study are configured by adding “Events” and “Files” to the workspace. We’ll describe the various events that can be used to define the inputs to the study including the Hydrology Simulator, RiverWare Model, RiverWare DMI, RiverWare RPL set, and RiverWare MRM. A screenshot of a sample study is shown in Figure 3.

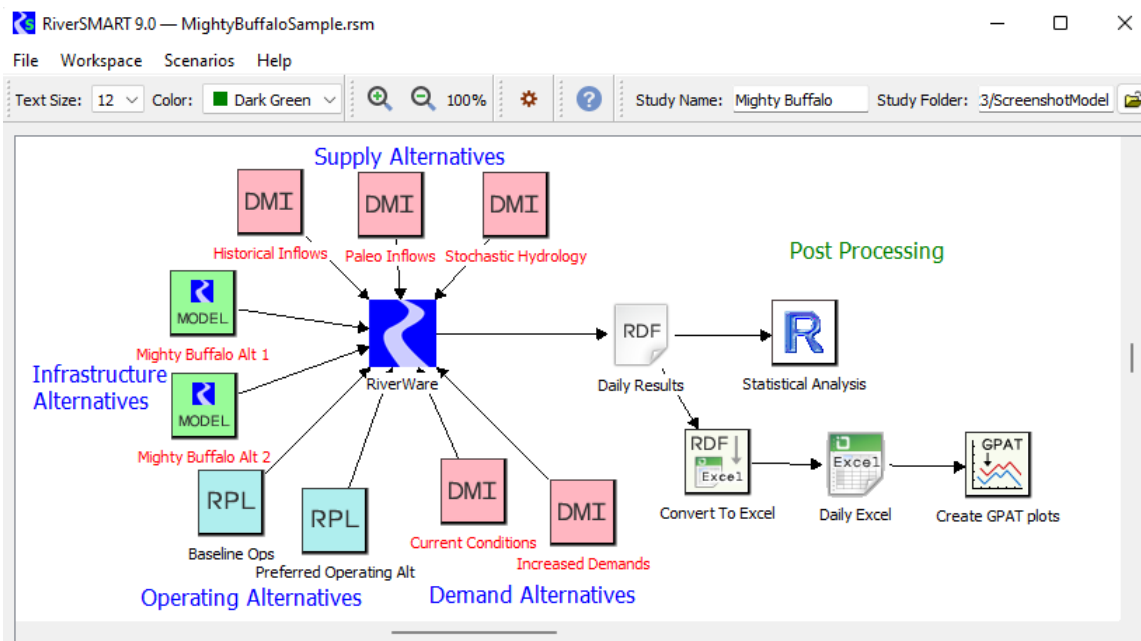


Figure 3. Screenshot of Sample RiverSMART Study Workspace

We’ll show how to generate scenarios, which are the combinations of the alternatives. For example, in the sample study shown in in Figure 3, there are three supply or hydrology alternatives, two model or infrastructure alternatives, two operating policy alternatives, and two demand alternatives. RiverSMART multiplies those together to generate 24 scenarios to

simulate. We'll show how to simulate the scenarios to produce the results in the form of text files, Excel files or other common file formats.

Although the RiverWare model often does much of the statistical post processing of a single trace, RiverSMART has further post processing that can be performed across traces and scenarios. We will demonstrate how the probabilistic results can be post-processed using various techniques. We will describe the post processing events including the R plugin, the Graphical Policy Analysis Tool (GPAT) graphs plugin, and file processing events.

Finally, we'll show how the entire study can be archived so that inputs, models, policy sets, and results can be stored and results reproduced as needed.

RiverWISE

Whereas RiverSMART provides structure for modelers to perform large studies with many inputs and resulting scenarios, the RiverWare Interactive Scenario Explorer (RiverWISE) allows inexperienced or novice users to try a few scenarios to explore and understand how the system responds to the inputs. The RiverWISE application allows stakeholders and other interested parties to explore a RiverWare model, develop alternative scenarios, simulate those scenarios, and investigate and compare the results, all in a free or low-cost tool. RiverWISE provides an intuitive, controlled environment for stakeholders to experiment with a special version of a RiverWare model.

A model developer or author configures and exports a RiverWISE file from a RiverWare model; it includes the object network, baseline input data and operating rules, a set of input variables that can be modified by the stakeholder for scenario exploration, and a set of output variables that can be analyzed. Once exported, the WISE file can be shared with stakeholders who wish to explore the effects of alternative inputs on the outputs and compare with the baseline. This demonstration will note the export process but will focus on the stakeholder experience.

We will demonstrate how the stakeholder opens RiverWISE and loads the provided WISE file. RiverWISE allows the stakeholder to explore the model layout and see how features of the basin are represented and connected to other features. Figure 4 shows a screenshot of the RiverWISE interface with the model layout window, model description and scenario list. Within the layout view, the stakeholder can zoom and pan the model to view the objects and the links. In addition, the stakeholder creates scenarios on this tab, copying the input data from the baseline scenario or any other saved scenario.

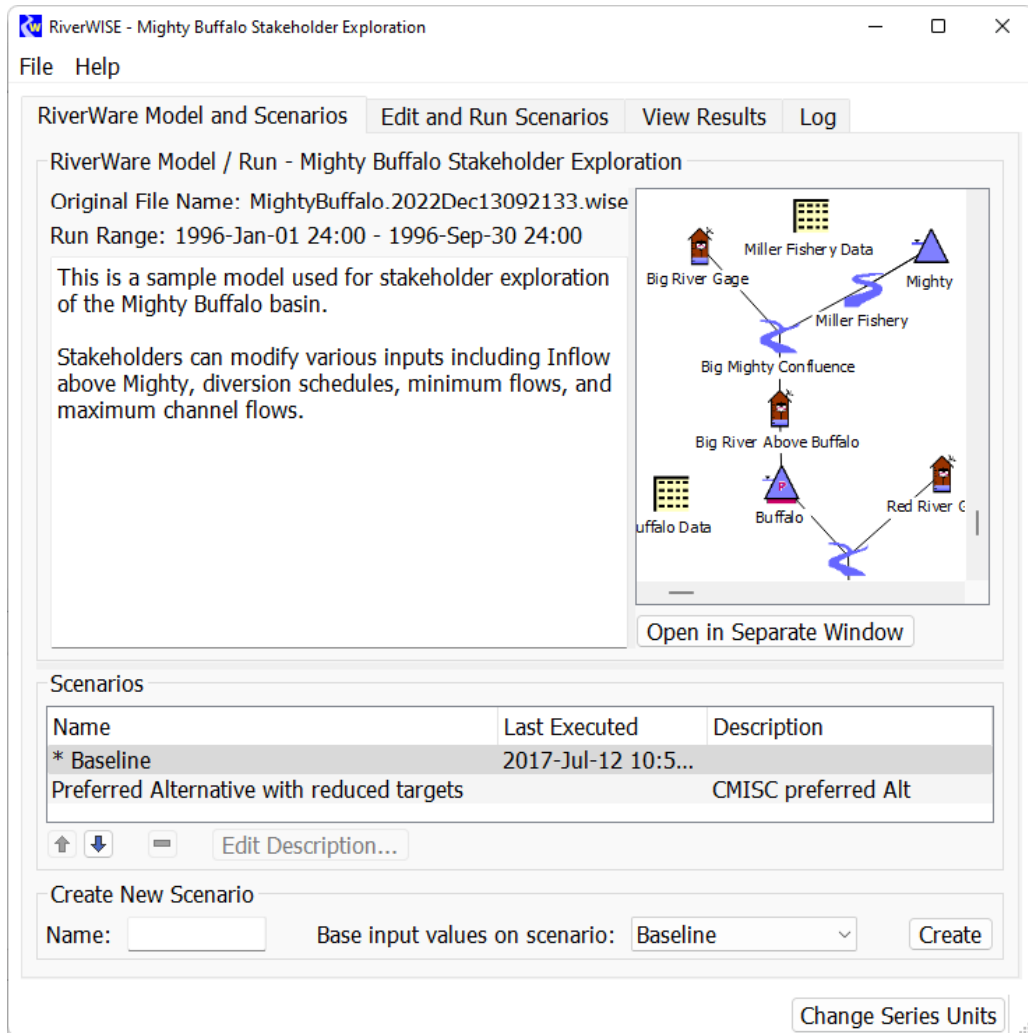


Figure 4. Screenshot of RiverWare Model and Scenario tab

We will show how the stakeholder modifies the input data for a scenario and makes a run on the Edit and Run Scenarios tab, as shown on Figure 5. The stakeholder selects one or more sets of input data and then edits the values either directly, using discrete values, by scaling, or by applying an offset. Values can be copied and pasted to external programs, like spreadsheets, for more complex data manipulation. Plots show how the scenario inputs differ from the baseline or other scenario's input data. The stakeholder uses this tab to make a run by clicking on the green run button.

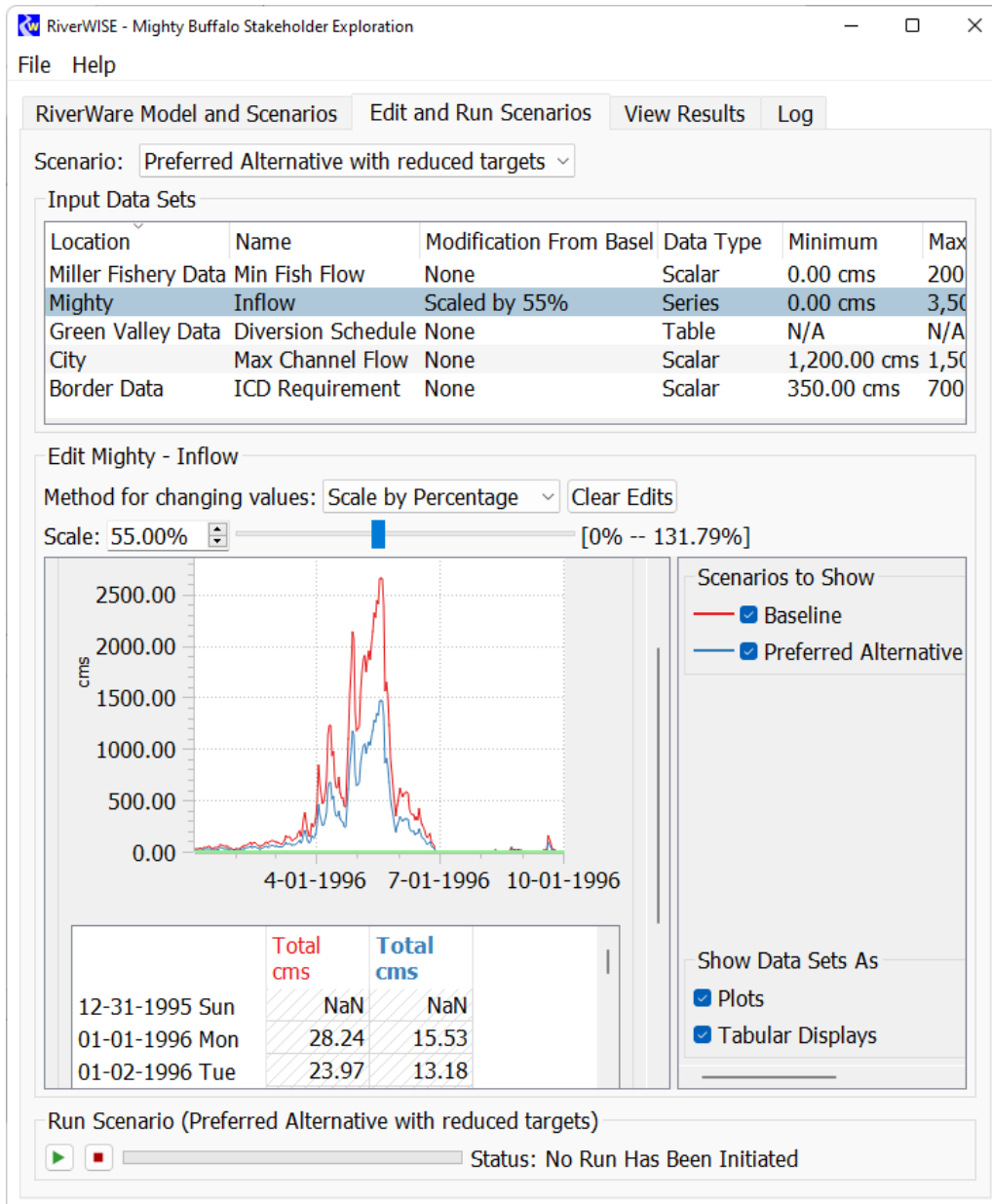


Figure 5. Screenshot of Edit and Run Scenarios Tab

We will show how to view the results of the scenarios, comparing one run to the next. Figure 6 shows a sample View Results tab. The results can be shown as either a plot or tabular data. The user can turn on or off display of different scenarios and data locations to compare the results of the runs. Tabular data and plots can be copied to the system clipboard for sharing results or including in documents or emails. A menu option allows for export of all inputs and outputs to a single Excel file.

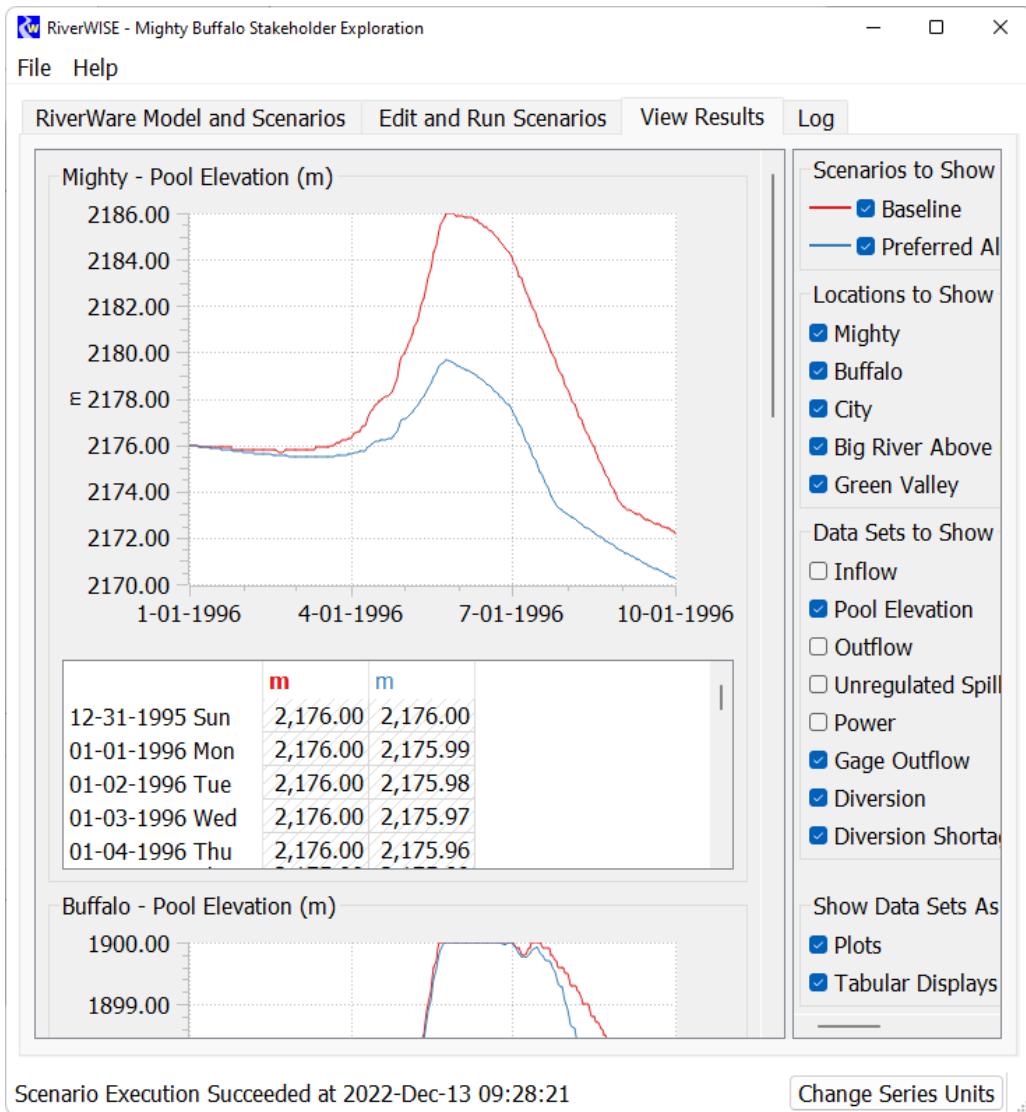


Figure 6. Screenshot of the View Results Tab

Free evaluation versions of the three tools including demonstration models will be given to interested visitors. The RiverWare decision support toolset is developed by the University of Colorado Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) with sponsorship of the Tennessee Valley Authority, the Bureau of Reclamation and the U.S. Army Corps of Engineers.