



## Technical Documentation Version 5.1

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# Units

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# CADSWES

**Center for Advanced Decision Support for Water and Environmental Systems**

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# Units Table of Contents

<b>Standard Units .....</b>	<b>1</b>
<b>Unit Converter Dialog .....</b>	<b>2</b>
<b>riverwareDB: RiverWare Resource Database .....</b>	<b>3</b>
Resource Database Location .....	3
Resource Database Format .....	3
Lookup Keys .....	4
Attributes .....	4
Values .....	5
Data Objects .....	5
Example riverwareDB file .....	6

# Units

This document describes the use of units in RiverWare. First, the standard, internal units are described, then the unit converter utility is presented. Next, the riverwareDB file is described which allows users to define default user units before building a model. Note, the units of multiple existing slots can be configured using the **Configure Existing Slots** dialog. This dialog is described in the slots section of the help [HERE \(Slots.pdf, Section 2.\)](#).

## 1. Standard Units

In RiverWare, all calculations are performed in standard or internal units. The internal units are as follows for the standard unit types:

UNIT TYPE	RIVERWARE INTERNAL UNIT
Length	meter
Area	meter <sup>2</sup>
Volume	meter <sup>3</sup>
Velocity	meter / second
Flow	meter <sup>3</sup> / second
Power	megawatt
Energy	megawatt hour
Time	hour
Mass	gram
Heat	joule
Concentration	gram / meter <sup>3</sup>
Temperature*	degrees Celsius
Temperature_F*	degrees Fahrenheit
Specific Heat	joule / gram degree Celsius
DateTime	Fully Specified DateTime

\*Note: As there is no multiplicative factor to convert Celsius to Fahrenheit, Celsius and Fahrenheit are maintained as separate unit types.

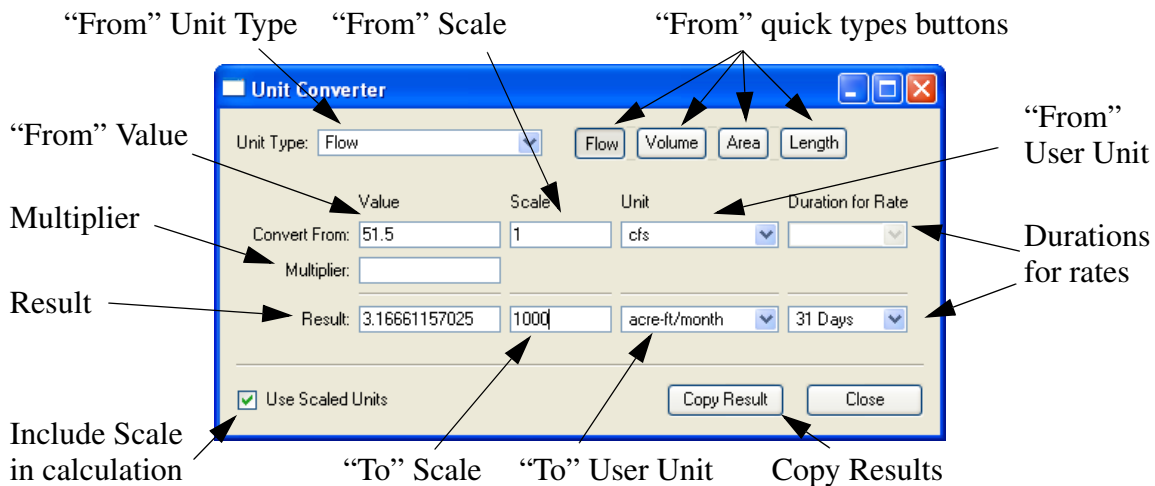
The user can configure any value in RiverWare to be displayed in units other than the standard units. These are called display units or user units. The display units are user-selectable for each set of data. On slots, they may be changed at any time through the slot Configuration menu described [HERE \(Slots.pdf, Section 1.2.5\)](#) or the **Configure Existing Slots** dialog described [HERE \(Slots.pdf, Section 2.\)](#). When data are displayed in the Edit Slot dialog, their values are converted from the internal RiverWare units in which

they are calculated and stored, to User Units for display and export. When data is entered or imported, the values are interpreted by the slot as being in the User Units and are automatically converted to RiverWare internal units for internal storage. This means that the user must change the User Units to match the units of incoming data BEFORE entering or importing data.

All units available in RiverWare are specified in the “units” text file which resides in the same directory as the RiverWare executable. You may view the conversion factors for all units in this file.

## 2. Unit Converter Dialog

The Unit Converter utility is a small calculator on the workspace which computes unit conversions using the same factors used internally by RiverWare. To access the dialog, from the main workspace, select **Utilities** ➤ **Unit Converter**. The converter is displayed. The screenshot shows the dialog with all of the features displayed. Following is the basic order in which the dialog is used and the options available:



- **Unit Type:** The user first selects the unit type for which the calculation should be done. Use the quick types buttons to select one of the four common types (Flow, Volume, Area, or Length) or use the pull-down menu to choose one of the less common types.
- **Value:** Input a value to **Convert From** in the text box
- **Scale:** Specify whether on not to use scale in either the from value or the result by toggling on the **Include Scaled Units** check box. When this box is checked, the Scale area is displayed. Then, enter a scale in the either of the two **Scale** text boxes.
- **Unit:** Specify the user unit using the pull-down menu for both the from line and the result line. The unit menu contain all of the units of the selected type.
- **Duration for Rates:** For units that include a rate (e.g. acre-feet/month) where the time scale is not constant (i.e. monthly or yearly), the user is able to specify the duration. For monthly rates, the user can select 28, 29, 30, or 31 days. For yearly rates, the user can specify 365 or 366 days.

- **Multiplier:** The user can optionally enter a multiplier. The from value is converted to the units of the result and then multiplied by the **Multiplier**.
- **Result:** The result is calculated immediately based on the specified input. The value which appears in the **Result** text field is now in terms of the new units, scale, and any specified multiplier.
- **Copy Result:** Often the user wishes to copy the result to the clipboard. Click the **Copy Results** button to copy the numerical value only. Hold down Shift and click **Copy Result** to copy the result and its scaled units.

The Unit Converter uses the conversion values specified in the “units” text file which resides in the same directory as the RiverWare executable. This file is viewable by the user and can even be modified if necessary.

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## 3. riverwareDB: RiverWare Resource Database

The RiverWare Resource Database provides a convenient means of specifying system-wide attributes including scale and units. For example, the Resource Database could be used to set the units of all Flow values to 1000 cfs. The Resource Database is an ASCII file called “riverwareDB,” which RiverWare loads, once and only once, at start up (i.e. when RiverWare is opened). This section describes the Resource Database file’s format and provides a sample file.

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**Note:** If the user has created a model and forgot to define the default units in the riverwareDB file, the Configure Existing Slots dialog can be used to configure some or all of the existing slots in a model. Click [HERE \(Slots.pdf, Section 2.\)](#) for more information on the Configure Existing Slots utility.

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### 3.1 Resource Database Location

When RiverWare is invoked it searches the following directories, in the order specified, for a Resource Database (“riverwareDB”):

- The directory from which RiverWare is invoked.
- The RiverWare site directory; as specified by the RIVERWARE\_SITE environment variable.
- The RiverWare home directory; as specified by the RIVERWARE\_HOME environment variable.
- The directory which contains the RiverWare executable.

### 3.2 Resource Database Format

The Resource Database file is an ASCII file, containing one resource specification per line. Lines beginning with “#” are comments, and are ignored. The general form of a resource specification is as follows:

<lookup key>.<attribute>: <value>

The <lookup key> identifies which entity the <attribute> applies to, and <value> is the attribute's value. Leading and trailing white space is removed from the <lookup key>, <attribute>, and <value>, but embedded white space is not. Case, punctuation, and embedded white space are important, and must match exactly when querying the Resource Database.

### 3.3 Lookup Keys

The entities which currently query the Resource Database for attribute values are:

- Object/Slot Pairs

When objects are added to the RiverWare workspace (by dragging them from the object palette), the object's slots query the Resource Database for their attributes.

The lookup keys for object/slot pairs may be one of the following:

- <obj\_type>*ObjType*.<slot\_name>*SlotName*[.<col\_name>*ColName*]  
Matches the slot whose name is *SlotName* on objects of type *ObjType*. Additionally, If the slot is a *TableSlot* then the lookup key matches the column whose name is *ColName*.
- <slot\_name>*SlotName*[.<col\_name>*ColName*]  
Matches all slots whose name is *SlotName*, regardless of the object type they are on. Additionally, If the slot is a *TableSlot* then the lookup key matches the column whose name is *ColName*.
- <col\_name>*ColName*  
Matches all columns whose name is *ColName*, regardless of the *TableSlot* they are on.
- <unit\_type>*UnitType*  
Matches all slots whose unit type is *UnitType*.

The lookup keys are listed from most specific to least specific. If an object/slot pair matches more than one lookup key, the most specific lookup key takes precedence over the less specific lookup keys.

### 3.4 Attributes

For object/slot pairs the attributes may be one of the following:

- units  
A string; the units of the slot or column.
- scale  
A double; the scale of the slot or column.
- format  
A string; the display format of the slot or column (“%d” for integer, “%f” for float, and “%e” for scientific).
- precision  
An integer; the display precision of the slot or column.
- minimum

- A double; the minimum value of the slot or column.
- maximum
  - A double; the maximum value of the slot or column.
- convergence type
  - An integer; the interpretation of the slot's convergence limit, where 0 = None, 1 = Absolute, 2 = Percent, and 3 = Unit Percent.
- convergence limit
  - A double, the slot's convergence limit.
- max iterations
  - An integer; the slot's maximum number of iterations.

### 3.5 Values

The values may be either integer, double, or string, depending upon the attribute.

### 3.6 Data Objects

The riverwareDB file can be used to configure new slots on Data Objects as well. Because slots on data objects are configured by the user, these slots are created with a unit type of NONE. But when the unit type is changed to a specified type in one of the slot configuration dialogs, the user unit would default to that specified by the riverwareDB file. The specifications used in the riverwareDB file to affect data object slots are no different than those with other slots. Following are some examples:

First, the units and the scale can be generically specified for a particular data type. The following creates a specification that all slots whose unit type is flow will default to units of "1000 cfs" (including slots on all objects including data objects):

```
<unit_type>Flow.units: cfs
```

```
<unit_type>Flow.scale: 1000
```

Second, as with other slots, a more specific specification can be created to affect only slots with certain names. Unlike other slots that have fixed names in RiverWare, slots on data objects are named by the user. The user could conceivably name their slots in a way so that units could be specified to affect only certain slots. For example, the user could create slots on multiple data objects that have the names ResInflow and ReachFlow. The following specifications would say ResInflow slots should default to units of acre-feet/day and ReachFlow slots should default to units of cfs:

```
<obj_type>DataObj.<slot_name>ResInflow.units: acre-feet/day
```

```
<obj_type>DataObj.<slot_name>ReachFlow.units: cfs
```

Note that these slots would still get created with a unit type of NONE as is true for all slots on data objects. But when the unit type is changed to flow in one of the individual slot configuration dialogs, the user unit would be default to that specified.

### 3.7 Example riverwareDB file

Following is a sample riverwareDB file. It can be copied directly into a text editor, modified as necessary and saved in the appropriate directory as riverwareDB.

```
# All slots whose unit type is Flow have units of "1000 cfs".
<unit_type>Flow.units: cfs
<unit_type>Flow.scale: 1000
# Except the SlopePowerReservoir's "Inflow 2" slot, which
# has units of "acre-feet/day".
# This is an example of a more specific lookup key taking
# precedence over a less specific lookup
# key.
<obj_type>SlopePowerReservoir.<slot_name>Inflow 2.units: acre-feet/day
<obj_type>SlopePowerReservoir.<slot_name>Inflow 2.scale: 1

# All columns whose name is "Pool Elevation" have units of
# "ft".
<col_name>Pool Elevation.units: ft
# Except the Elevation Volume Table's "Pool Elevation"
# column, which has units of "yd".
# This is another example of a more specific lookup key
# taking precedence over a less specific lookup key.
<slot_name>Elevation Volume Table.<col_name>Pool Elevation.units: yd

# Volumes are in acre-feet
<unit_type>Volume.units: acre-feet
<unit_type>Volume.scale: 1

# Energy and Power are in KWH and MW, respectively.
<unit_type>Energy.units: KWH
<unit_type>Power.units: MW

# All lengths are in feet
<unit_type>Length.units: ft
<unit_type>Length.scale: 1
```

Note that object types, slot names, and column names must appear in the Resource Database exactly as they appear in RiverWare's user interface. This includes case, punctuation, and embedded white space. Note also that slot names and column names which contain periods will cause problems for the Resource Database parser.