StateWB Documentation

Water Budget and

Consumptive Use and Losses

Reporting Tool

Version 2

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StateWB Documentation

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0.0 Acknowledgments

This Water Budget and CU and Losses Reporting Tool was developed by Leonard Rice Engineers, Inc (LRE) under contract with the Colorado Water Conservation Board (CWCB).

1.0 Introduction

The State of Colorado's Water Budget and Consumptive Use and Losses Reporting Tool (StateWB) was developed to perform three functions: 1) calculate a basin-wide water balance, 2) generate a consumptive use and losses summary, and 3) generate a Consumptive Use and Losses Report. These three functions were combined into the same tool because they rely upon common input files used for the three functions.

StateWB is a Microsoft Access database which utilizes custom forms for data entry and queries and code to calculate the water budget and generate the CU and Losses reports. For the Consumptive Use and Losses Report, the tool also includes a MS Word document that is linked to the database using built-in mail-merge functionality. This document describes how to use StateWB and presumes the reader has a basic understanding of the Microsoft Access application and water budget analysis in general. It is intended for use by engineers, water resource planners, and others involved in water management decision-making.

1.1 Calculations

To calculate a water balance, StateWB performs the following simple water budget mass balance equation where inflows less outflows equal changes in storage:

Inflows – Outflows = Changes in Storage

Inflows

- Gaged Surface Water Inflow
- Ground Water Inflow
- Imports
- Precipitation
- Ungaged Surface Water Inflow

Outflows

- Crop Consumptive Use
- Exports
- Gaged Surface Water Outflow
- Ground Water Outflow
- Livestock Consumptive Use
- Municipal and Industrial Consumptive Use
- Native Vegetation Consumptive Use
- Reservoir Evaporation

Changes in Storage

- Change in Ground Water Storage
- Change in Surface Water Storage

When calculating a water balance, one of the inflow, outflow, or change in storage components must be designated as the **Residual**. StateWB calculates the residual as the inflows less the outflows plus/minus change in storage:

Residual = Inflows – Outflows +/- Change in Storage

The residual can be used to estimate an unknown water budget component or group of components. In addition, it can be used to determine how sensitive the water budget is to a single water budget component or to a group of components. StateWB allows more than one water budget component to be missing from the input data set. The sum of all missing components is included in the calculated residual.

The StateWB tool is also used to generate the CU and Losses Summary and Report. The CU and Losses Summary summarizes the consumptive use associated with agriculture, livestock, reservoir and stockpond evaporation, municipal use, mineral uses, thermal electric power generation, and exported water for a specific user-specified basin. The CU and Losses Report summarizes these consumptive uses specifically for the Colorado River basin within the State of Colorado. The individual basins for which the analysis is performed include the White, Yampa, Gunnison, Upper Colorado, and San Juan/Dolores River basins. The CU and Losses Report can be used as a comparison to the U.S. Bureau of Reclamation report on Consumptive Use and Losses in the Colorado River Basin required by the Upper Colorado River Compact. The StateWB tool requires input files for each of these consumptive use components, then generates the report by inserting the consumptive use data into a document template and generating the supporting graphs.

1.2 Installation

To install StateWB, copy the Access database and the CU and Losses Report document to the same directory location. The directory may be on a local hard drive or on a server. The two State WB files include:

- CDSS_WB_and_CUandLossesTool.mdb
- CULOSS_linkedreport.doc

2.0 Graphical User Interface

This section provides the following information about the StateWB graphical user interface (GUI):

2.1 Introduction
2.2 Generate a Water Budget
2.3 Generate a CU and Losses Summary
2.4 Generate the Colorado River Basin CU and Losses Report

2.1 Introduction

2.1.1 Water Budget

When using the StateWB GUI to calculate a water budget, the calculations are based on information in the response file (*.rwb). The response file provides model parameter settings and either contains the input data (for average annual scenario) or lists the names of input data files to be read by the model (for annual and monthly scenarios).

The GUI provides a means to define scenarios. It guides the user through browsing for input files, setting the study period, and specifying the residual factor. The user can then save the scenario information to a response file (.rwb).

The StateWB GUI allows the user to select from three different time scale scenarios to calculate a water budget. The user can choose to run and view a subset of the available period of record in the input files.

- *Average Annual* – Using this time scale, provide a single value for each input component in the water balance directly through the GUI. Each component represents the average annual value for that component over the entire analysis period.

- *Annual* – For this time scale, input files provide an annual total value for each year of the analysis period.

- *Monthly* - For this time scale, input files containing monthly values are provided for each year of the analysis period.

With *Annual* and *Monthly* scenarios, input files reflecting the annual or monthly time series data must be formatted in the standard StateMod (.stm) format. The StateWB GUI does not check that all user-supplied data are reasonable. It is the responsibility of the user to error check the input data prior to calculating the water budget.

2.1.2 CU and Losses Summary

When generating a CU and Losses summary for a specific basin, the calculations are based on information in the CU and Losses summary response file (*.rcs). The response file provides model parameters, including the reporting period, the percent of incidental losses to be

included in the calculations, and the names of input data files to be read by the model. The incidental losses reflect non-crop consumptive use incidental to irrigation, as termed by the USBR CU and Losses Report documentation. If incidental losses are not considered, a zero must be entered for the incidental loss factor.

The GUI provides a means to define scenarios. It guides the user through browsing for input files, setting the study period, and specifying the incidental loss factor. The user can then save the scenario information to a response file (.rcs).

2.1.3 CU and Losses Report

When generating the CU and Losses Report for the Colorado River basins, the calculations are based on information in the CU and Losses report response file (*.rcl). The response file provides the model parameters including the reporting period, the percent of incidental losses to be included in the calculations, and the file path of the folders containing the input files to be read by the model. The incidental losses reflect non-crop consumptive use incidental to irrigation, as termed by the USBR CU and Losses Report documentation. If incidental losses are not considered, a zero must be entered for the incidental loss factor.

Note that all of the input files associated with each basin need to reside together in a single folder. This folder convention allows the user to only have to specify five file paths (one for each basin) rather than having to separately specify 55 input files. Within each basin directory, the 11 input files must meet strict file naming conventions (see Figure 1).

The GUI provides a means to define scenarios. It guides the user through browsing for input file paths, setting the study period and incidental loss factor. The user can then save the scenario information to a response file (.rcl).

1. The first two characters of each file name represents the basin:

cm	= Upper Colorado River Basin	ym	= Yampa River Basin
gm	= Gunnison River Basin	sj	= San Juan River and Dolores River Basins
wm	= White River Basin		

2. The next 2 - 6 characters represent the data type:

IWR	= Irrigation Water Requirement	MINERL	= Mineral Use
CROPCU	= Supply-limited Crop Consumptive Use	THERM	= Thermal Use
CROPAC	= Crop Acreage	MUNICU	= Other Municipal and Industrial Uses
LIVSTK	= Livestock Consumptive Use	EXPIN	= Exports Inside the System
STKEV	= Stockpond Evaporation	EXPOUT	= Exports Outside the System
RESEV	= Reservoir Evaporation		

3. Each file should have an .STM extension.

4. The program is not case sensitive (all parts of file names may be upper or lower case).

Figure 1 - File Naming Conventions for CU and Losses Report Inputs

2.1.4 Important Notes about File Names, Formats, and Directory Paths

Input files must be in the standard StateMod (*.stm) format. For this reason, the input files should be prepared using TSTool, because it generates StateMod formatted files as part of its built-in functionality. Currently, water budget datasets for the Rio Grande and South Platte River basins are available on the CDSS website.

Where to find more information

- The TSTool Data Management Interface program and documentation discussing its interaction with HydroBase as well as its filling and formatting capabilities are available on the CDSS website <cdss.state.co.us>
- The datasets for the Rio Grande and South Platte River basins water budgets, as well as supporting documentation, are also available on the CDSS website <cdss.state.co.us>.

The tool takes advantage of the Microsoft Access platform's built-in functionality for quick development of queries, reports, and forms. Along with those advantages, however, come some limitations that affect file names, file formats, and file directory paths:

- File paths must be shorter than 59 characters
- File paths and file names may only contain letters, numbers, and underscores (no spaces or special characters)
- Missing data for StateMod standard formatted files are set to -999. These are actual data values from the perspective of the StateWB Tool, and should not be used in place of real values. Provide only complete data sets to the program using filling options, if necessary, available in TSTool.

Other specifications for file naming conventions and file formats are specific to the different utilities in the tool, and are called out in the sections below.

2.2 Generate a Water Budget

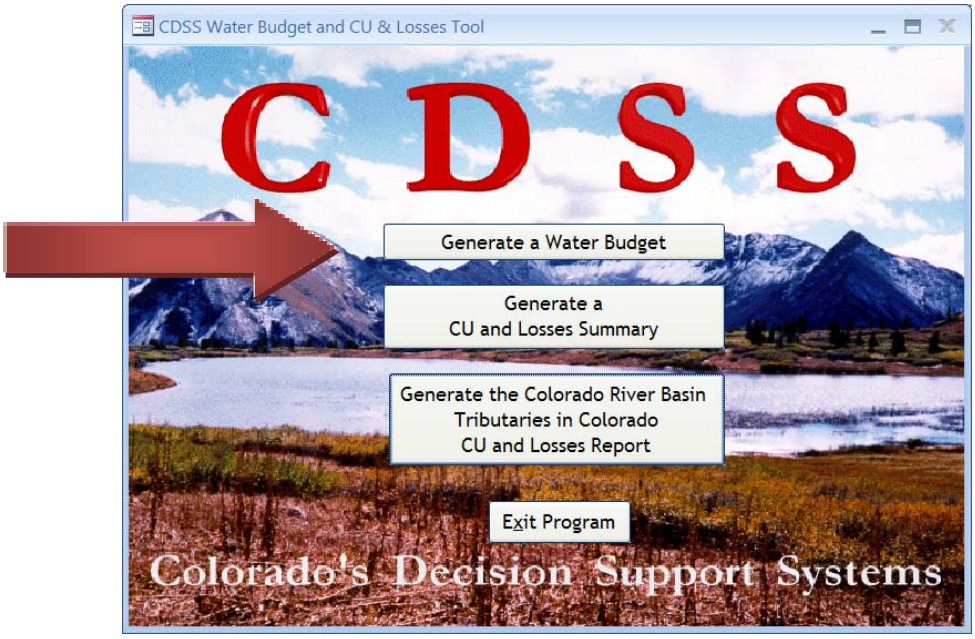


Figure 2 - State Water Budget Reporting Tool, Main Form – Water Budget Utility

To create a water budget, click on the 'Generate a Water Budget' button within the CDSS Water Budget Reporting tool as shown in Figure 2 above. The *Water Budget Setup* user form, as shown in Figure 3, then opens to allow the user to begin entering data needed to perform the water budget analysis.

2.2.1 Setting up the Water Budget

It is recommended that the *Water Budget Setup* form be completed in the order shown.

For **Step 1**, select the time scale on which the water budget will be based. Once the time scale has been defined, the Specify Data button in **Step 2** becomes activated. Clicking on the Specify Data button opens another form called *Water Budget Input Data*. Depending on the time scale selected, this will display either Figure 4 (Average Annual Inputs Form) or Figure 5 (Annual or Monthly Inputs Form).

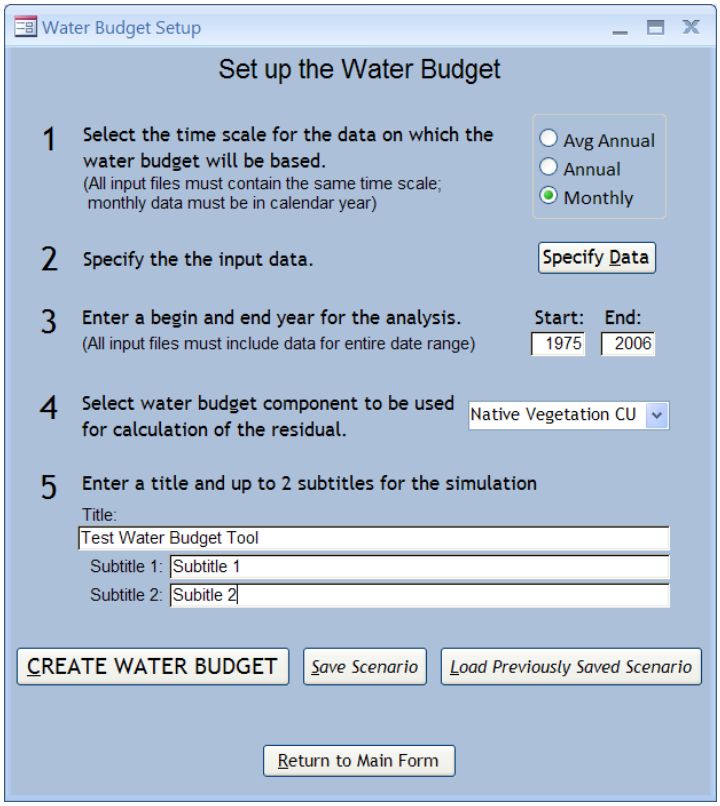


Figure 3 - Water Budget Setup Form

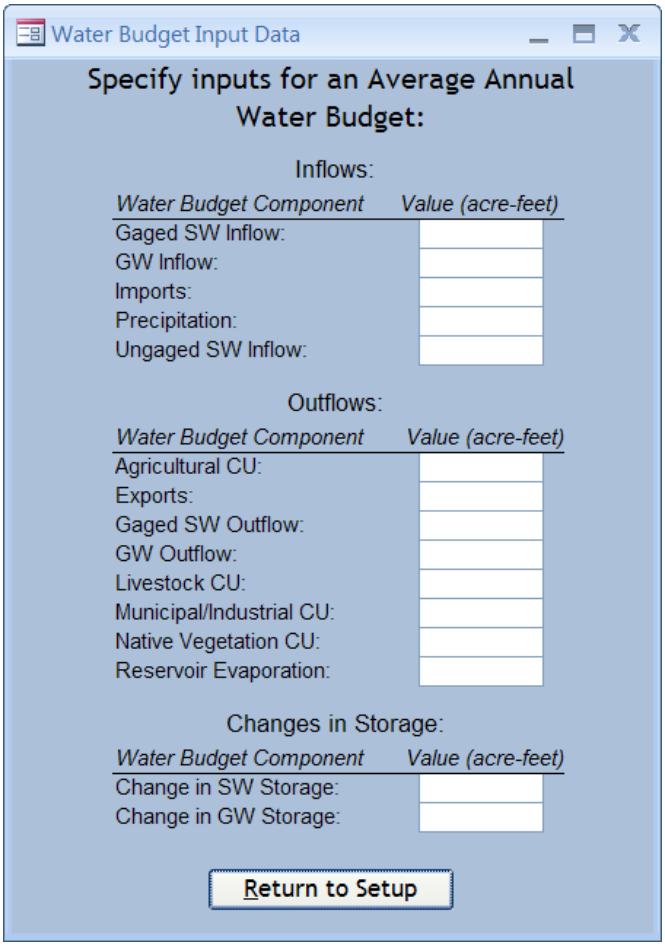


Figure 4 - Average Annual Water Budget Input Form

If the water budget is based on an Average Annual time scale, then all inflows, outflows and changes in storage must be entered into the form shown in Figure 4. All values must be in Acre-Feet.

Note that all types of data may not be applicable and therefore are not required; the analysis will be performed with the user supplied data and the unknown data is included in the 'Residual' component selected on the Setup form under ***Step 4***.

If the water budget is based on an Annual or Monthly time scale, then the data input form includes a folder icon next to each water budget component (see Figure 5) to browse to a file. For each water budget component, either type in the file name and path or browse to select the file. For both the annual and monthly water budgets, each water budget component file must be formatted in the standard calendar year StateMod (.stm) file format.

NOTE: File names and directory paths may NOT have spaces or special characters.

After entering all available Water Budget components, click the *Return to Setup* button on the bottom of the form. This will return the user to the *Water Budget Setup* form (Figure 3).

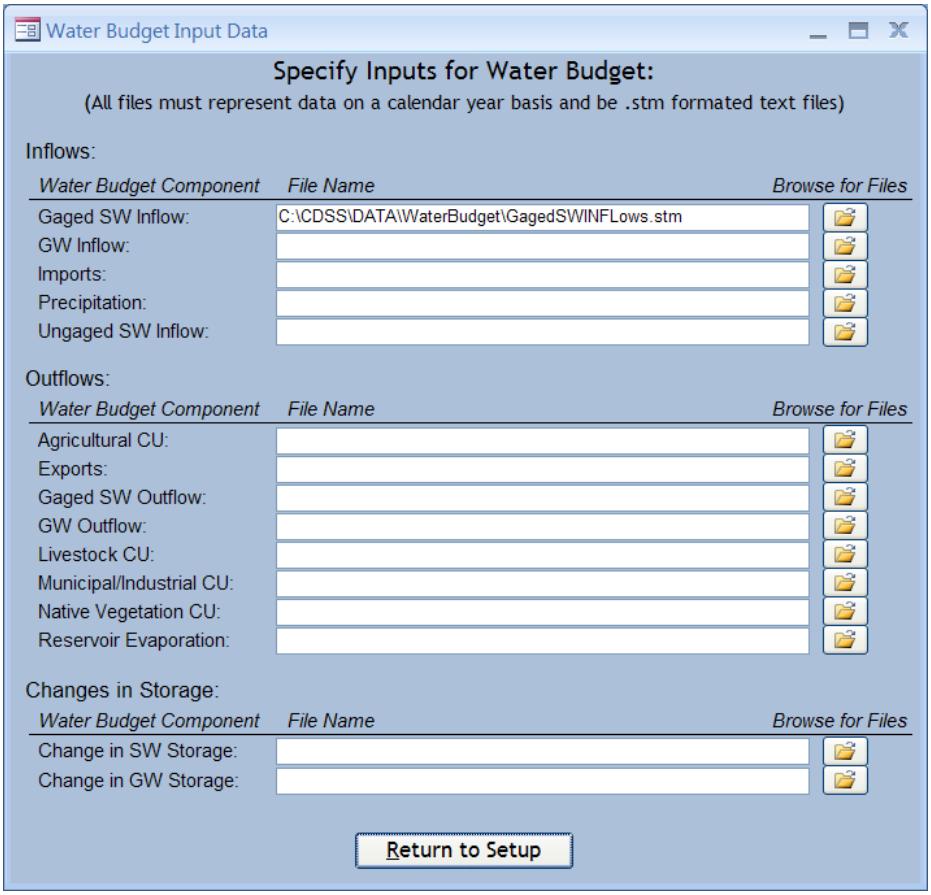


Figure 5 - Annual and Monthly Water Budget Input form

In **Step 3**, specify the begin year and end year of the analysis (see Figure 6). Click within the boxes under "Start:" and "End:" to enter the analysis period. The data must be entered as whole years (YYYY) with no months or days included in the date.

The water budget component to be used as the Residual is specified in **Step 4**; select from the available water budget components under the pull down box. *Note that any water budget parameters not entered into the analysis will be aggregated into the 'Residual' parameter selected by the user.*

In **Step 5**, enter titles and subtitles in the boxes to identify the Water Budget analysis performed. These titles will be displayed at the top of the Water Budget output screens and files.

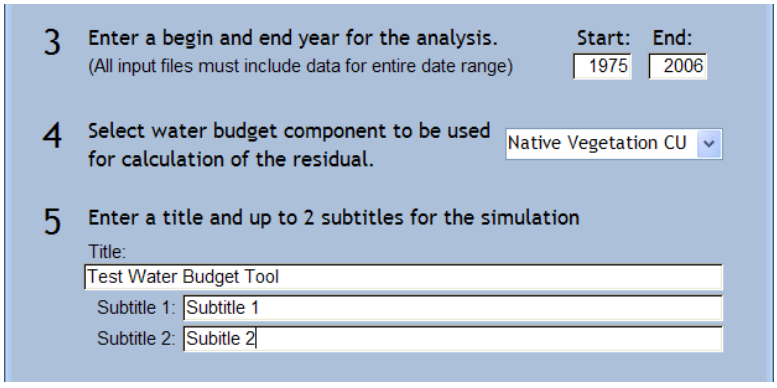


Figure 6 - Water Budget Setup Form, Steps 3, 4, and 5 shown only

2.2.2 Saving a Water Budget Scenario

To save the information entered in the *Water Budget Setup* form, click on the Save Scenario button at the bottom of the form (Figure 7) to create the Water Budget response file (*.rwb) that saves the input information entered on this form.

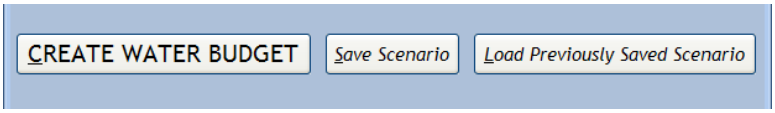


Figure 7 - Water Budget Setup Form, Create, Save and Load shown only

This opens the *Save Water Budget Scenario* form, Figure 8, to enter the file name and browse for the file location.

After the location and file name have been defined, click Save to complete the form. A Scenario may be saved even if all the inputs have not yet been defined.

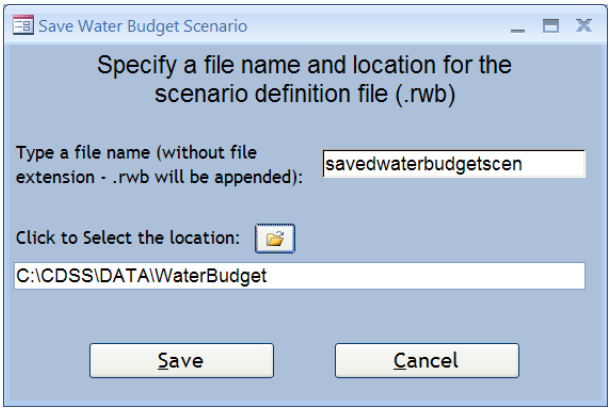


Figure 8 - Save Water Budget Scenario Form

2.2.3 Loading a Saved Water Budget Scenario

To come back to a scenario that has already been saved, click on the Load Previously Saved Scenario in the *Water Budget Setup* form to add data or finish a previous analysis. This opens the *Load Water Budget Scenario* form, Figure 9, and allows the user to browse for the Water Budget response file (*.rwb). Once the correct scenario file has been found, click Load to view the scenario in the *Water Budget Setup* form.

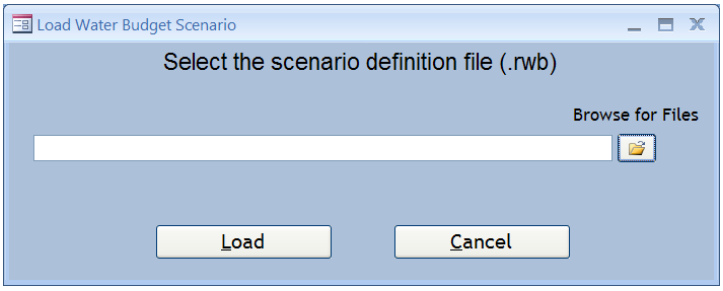


Figure 9 - Load Water Budget Scenario Form

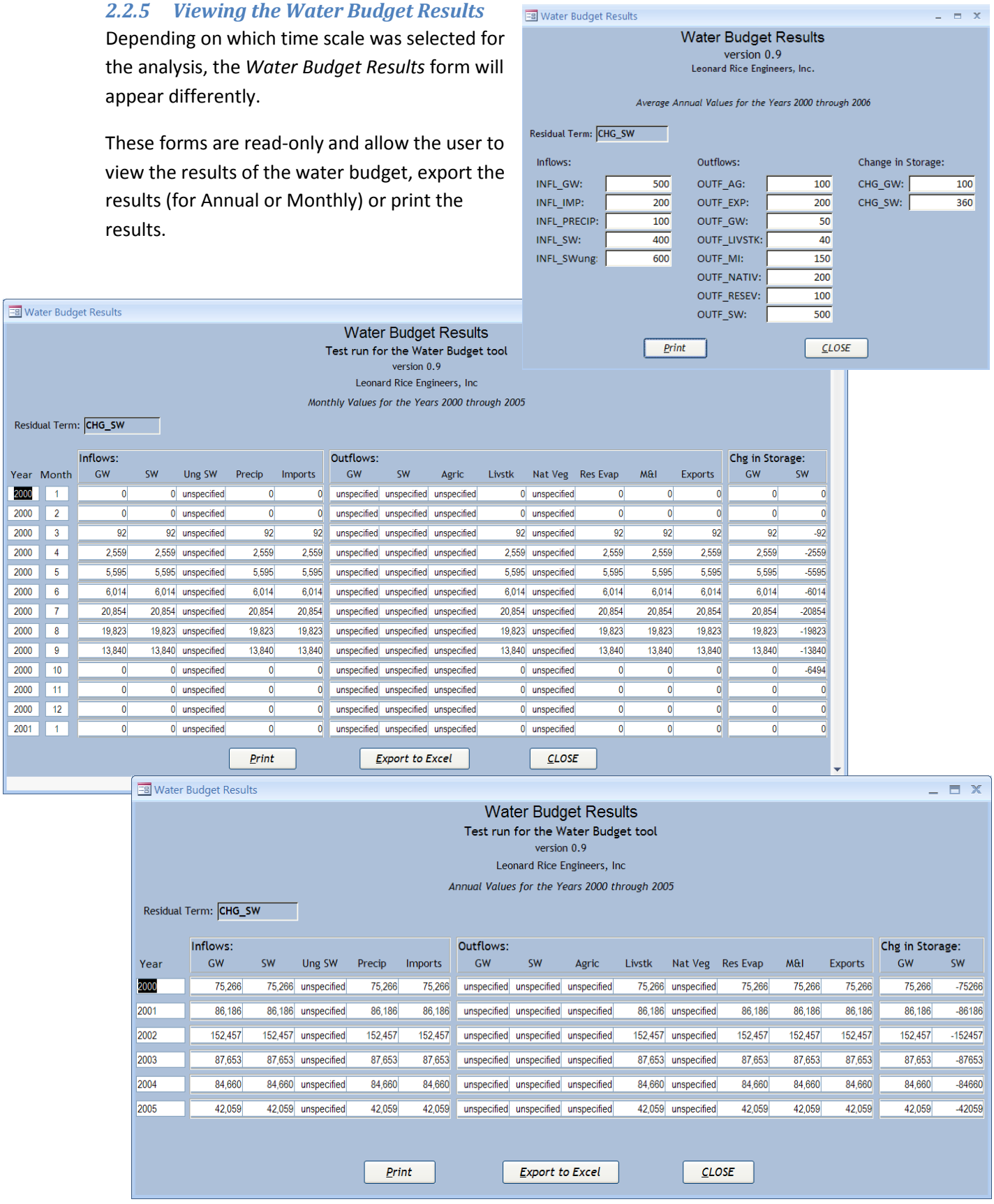
2.2.4 Running the Water Budget Scenario

When the *Water Budget Setup* Form is completed, click on the *CREATE WATER BUDGET* button to execute the analysis. The program then performs the analysis, providing progress screens as it calculates the water budget. The results of the water budget analysis will be shown in the form, *Water Budget Results* (Figure 10).

2.2.5 *Viewing the Water Budget Results*

Depending on which time scale was selected for the analysis, the *Water Budget Results* form will appear differently.

These forms are read-only and allow the user to view the results of the water budget, export the results (for Annual or Monthly) or print the results.



Year	Month	Inflows: GW	SW	Ung SW	Precip	Imports	Outflows: GW	SW	Agric	Livstk	Nat Veg	Res Evap	M&I	Exports	Chg in Storage: GW	SW
2000	1	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	0
2000	2	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	0
2000	3	92	92	unspecified	92	92	unspecified	unspecified	unspecified	92	unspecified	92	92	92	92	-92
2000	4	2,559	2,559	unspecified	2,559	2,559	unspecified	unspecified	unspecified	2,559	unspecified	2,559	2,559	2,559	2,559	-2559
2000	5	5,595	5,595	unspecified	5,595	5,595	unspecified	unspecified	unspecified	5,595	unspecified	5,595	5,595	5,595	5,595	-5595
2000	6	6,014	6,014	unspecified	6,014	6,014	unspecified	unspecified	unspecified	6,014	unspecified	6,014	6,014	6,014	6,014	-6014
2000	7	20,854	20,854	unspecified	20,854	20,854	unspecified	unspecified	unspecified	20,854	unspecified	20,854	20,854	20,854	20,854	-20854
2000	8	19,823	19,823	unspecified	19,823	19,823	unspecified	unspecified	unspecified	19,823	unspecified	19,823	19,823	19,823	19,823	-19823
2000	9	13,840	13,840	unspecified	13,840	13,840	unspecified	unspecified	unspecified	13,840	unspecified	13,840	13,840	13,840	13,840	-13840
2000	10	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	-6494
2000	11	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	0
2000	12	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	0
2001	1	0	0	unspecified	0	0	unspecified	unspecified	unspecified	0	unspecified	0	0	0	0	0

Year	Inflows: GW	SW	Ung SW	Precip	Imports	Outflows: GW	SW	Agric	Livstk	Nat Veg	Res Evap	M&I	Exports	Chg in Storage: GW	SW
2000	75,266	75,266	unspecified	75,266	75,266	unspecified	unspecified	unspecified	75,266	unspecified	75,266	75,266	75,266	75,266	-75266
2001	86,186	86,186	unspecified	86,186	86,186	unspecified	unspecified	unspecified	86,186	unspecified	86,186	86,186	86,186	86,186	-86186
2002	152,457	152,457	unspecified	152,457	152,457	unspecified	unspecified	unspecified	152,457	unspecified	152,457	152,457	152,457	152,457	-152457
2003	87,653	87,653	unspecified	87,653	87,653	unspecified	unspecified	unspecified	87,653	unspecified	87,653	87,653	87,653	87,653	-87653
2004	84,660	84,660	unspecified	84,660	84,660	unspecified	unspecified	unspecified	84,660	unspecified	84,660	84,660	84,660	84,660	-84660
2005	42,059	42,059	unspecified	42,059	42,059	unspecified	unspecified	unspecified	42,059	unspecified	42,059	42,059	42,059	42,059	-42059

Figure 10 - Water Budget Results Forms

2.2.6 *Printing and Exporting the Water Budget Results*

To print results from any of the results forms, click the *Print* button on the results form. This will bring up the form shown in Figure 11. Select a printer and click *Print*.

Clicking the *Export* button on either the Annual or Monthly results form brings up the *Export Water Budget Results Form* (Figure 12). This form allows the user to output all results into an Excel workbook (.xls) or to save the residual data in a standard .stm format.

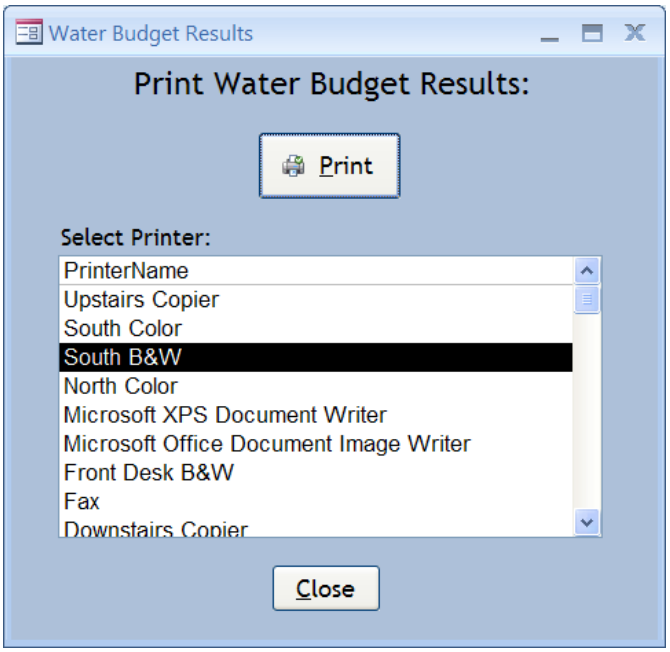


Figure 11 - Print Water Budget Results Form

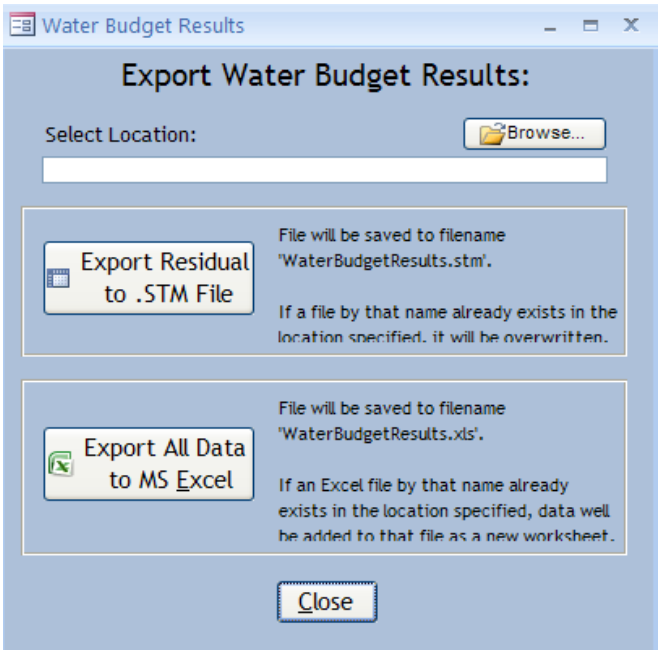


Figure 12 - Export Water Budget Results Form

2.3 Generate a CU and Losses Summary

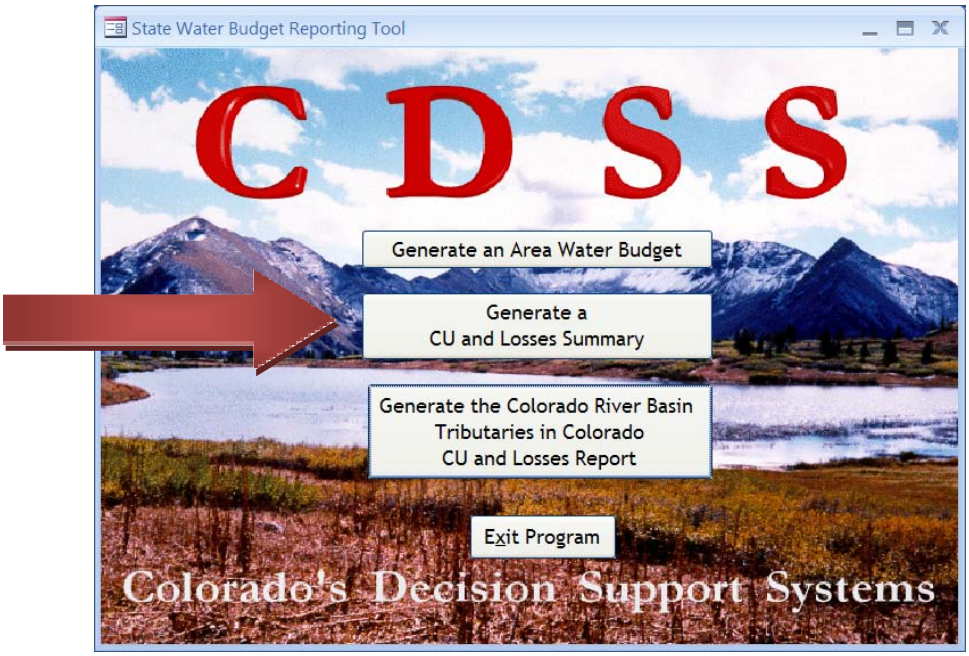


Figure 13 - State Water Budget Reporting Tool, Main Form – CU and Losses Summary Utility

To start the CU and Losses Summary, select the *Generate a CU and Losses Summary* button on the Main Form. This opens the *CU and Losses Summary Setup* form, as shown in Figure 14.

2.3.1 Setting up the CU and Losses Summary

It is recommended that the *CU and Losses Summary Setup* form be completed in the order shown.

Step 1 is to specify the input data. Clicking on the *Specify Data* button will bring up the *CU and Losses Summary Input Data* form, as shown in Figure 15.

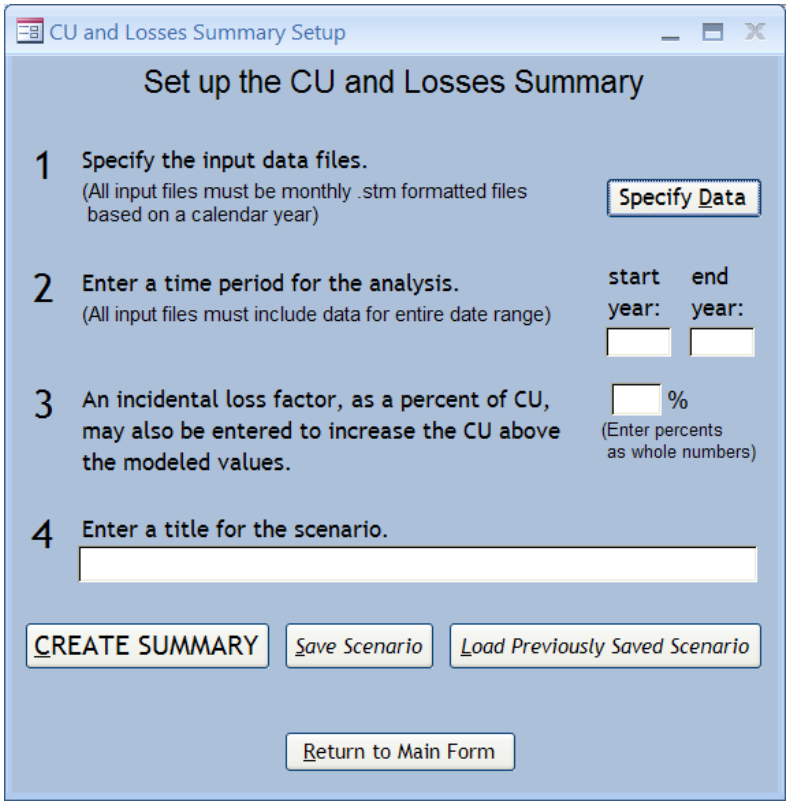


Figure 14 - CU and Losses Summary Setup Form

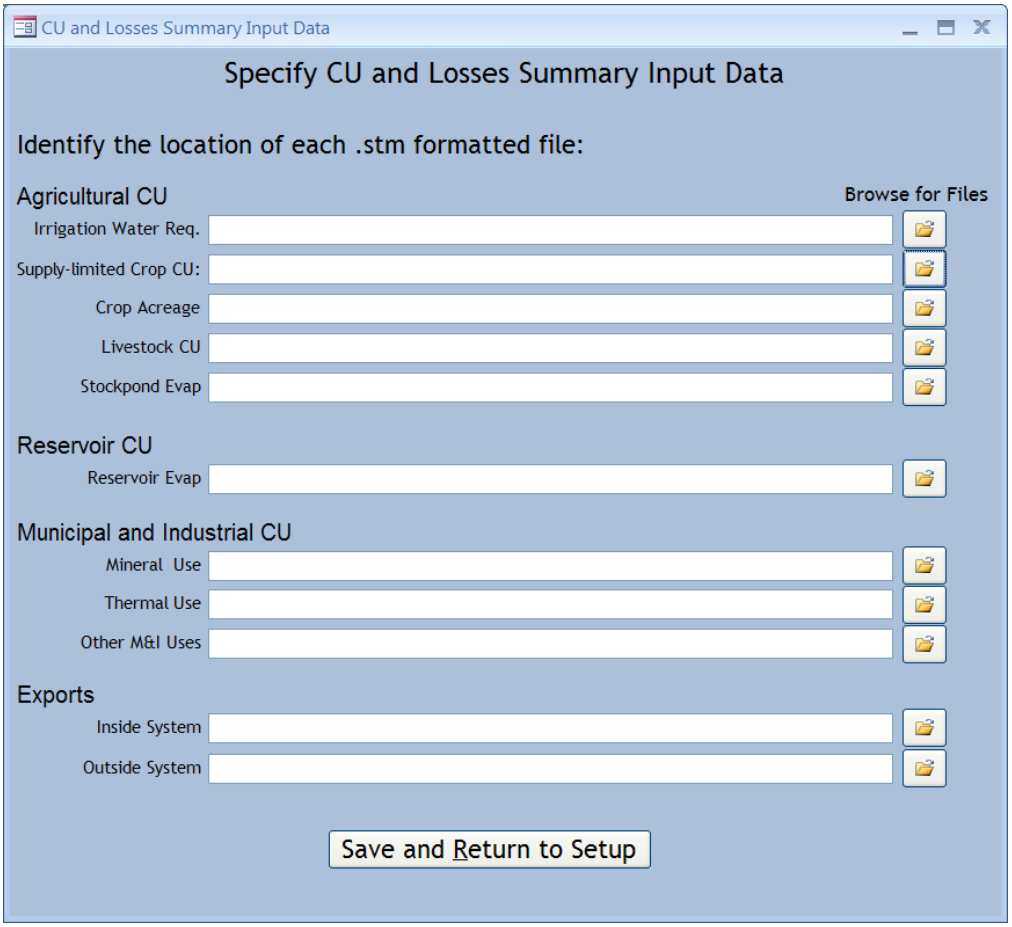


Figure 15 - CU and Losses Summary Input Data Form

For each input, either type in the file name and path or browse for the file. Each file specified must be in the standard monthly calendar year StateMod (.stm) format. ***NOTE: File names and directory paths may NOT have spaces or special characters and must be less than 59 characters in length.***

All input files must be provided. If a specific data type is not applicable, a zero data file must be created. Once all components of the Summary are specified with the appropriate .stm files, select *Save and Return to Setup*. This will bring the user back to the Setup form

(Figure 16).

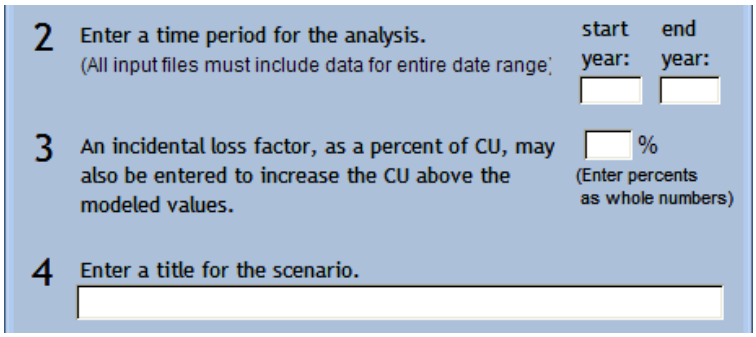


Figure 16 - CU and Losses Summary Setup Form, Steps 2, 3, and 4 shown only

For **Step 2**, enter a time period for the report. The dates must be entered in

whole years (YYYY) with no month or day included in the date. This time period must fall within the period of data available in the input files.

In **Step 3**, enter a percentage as a whole number to represent the incidental loss factor. The incidental losses reflect non-crop consumptive use incidental to irrigation, as termed by the USBR CU and Losses Report documentation. If incidental losses are not considered, a zero must be entered for the incidental loss factor.

Step 4 allows a title to be entered to identify the scenario for future use. The title will be included on the CU and Losses Summary output files.

2.3.2 Saving a CU and Losses Summary Scenario

To save the information entered in the Setup form, click on the *Save Scenario* button to create the response file (*.rcs) that saves the input information entered on this form. This opens the *Save CU and Losses Summary Scenario* form, shown in Figure 17. Enter the file name or browse for the file location.

After the location and file name have been defined, click Save to complete the form. A Scenario may be saved even if all the inputs have not yet been defined.

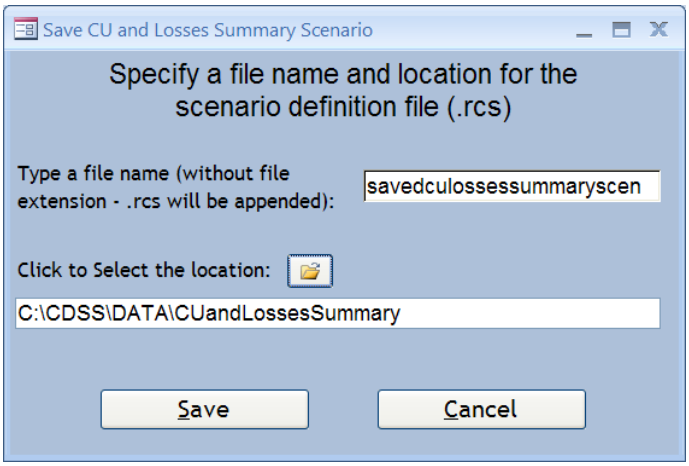


Figure 17 - Save CU and Losses Summary Scenario Form

2.3.3 Loading a Saved CU and Losses Summary Scenario

To come back to a scenario that has already been saved, click on the *Load Previously Saved Scenario* button to add data or finish a previous analysis. This opens the *Load CU and Losses Summary Scenario* form, Figure 18. Enter a file for the response file (*.rcs) or browse for the file. Once the correct scenario file has been found, click Load to view the scenario in the *CU and Losses Summary Setup* form.

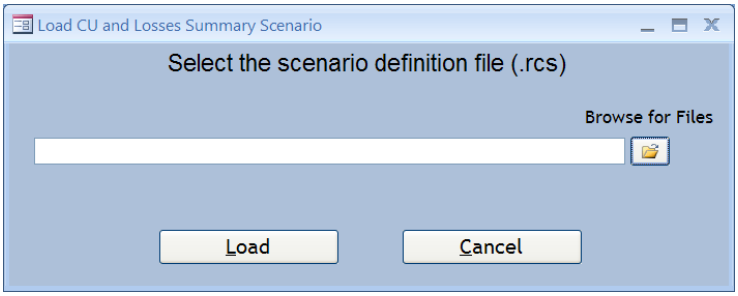


Figure 18 - Load Water Budget Scenario Form

2.3.4 Running the CU and Losses Summary Scenario

When the *CU and Losses Summary Setup* Form is completed, click on the *CREATE SUMMARY* button to execute the analysis. The program performs the analysis and displays the results. A progress window is supplied updating the users on the progress of the execution.

2.3.5 Viewing the CU and Losses Summary Results

The results form has four tabs located in the upper left area of the form. These allow navigation between the results tables. Table 1 is a summary of Consumptive Use and Losses by category and year (Figure 19). Tables 2 and 3 are Irrigation CU Losses only, broken out by Water District (Figure 20). Figure 1 shows the results from Table 1 in a stacked bar graph (Figure 21).

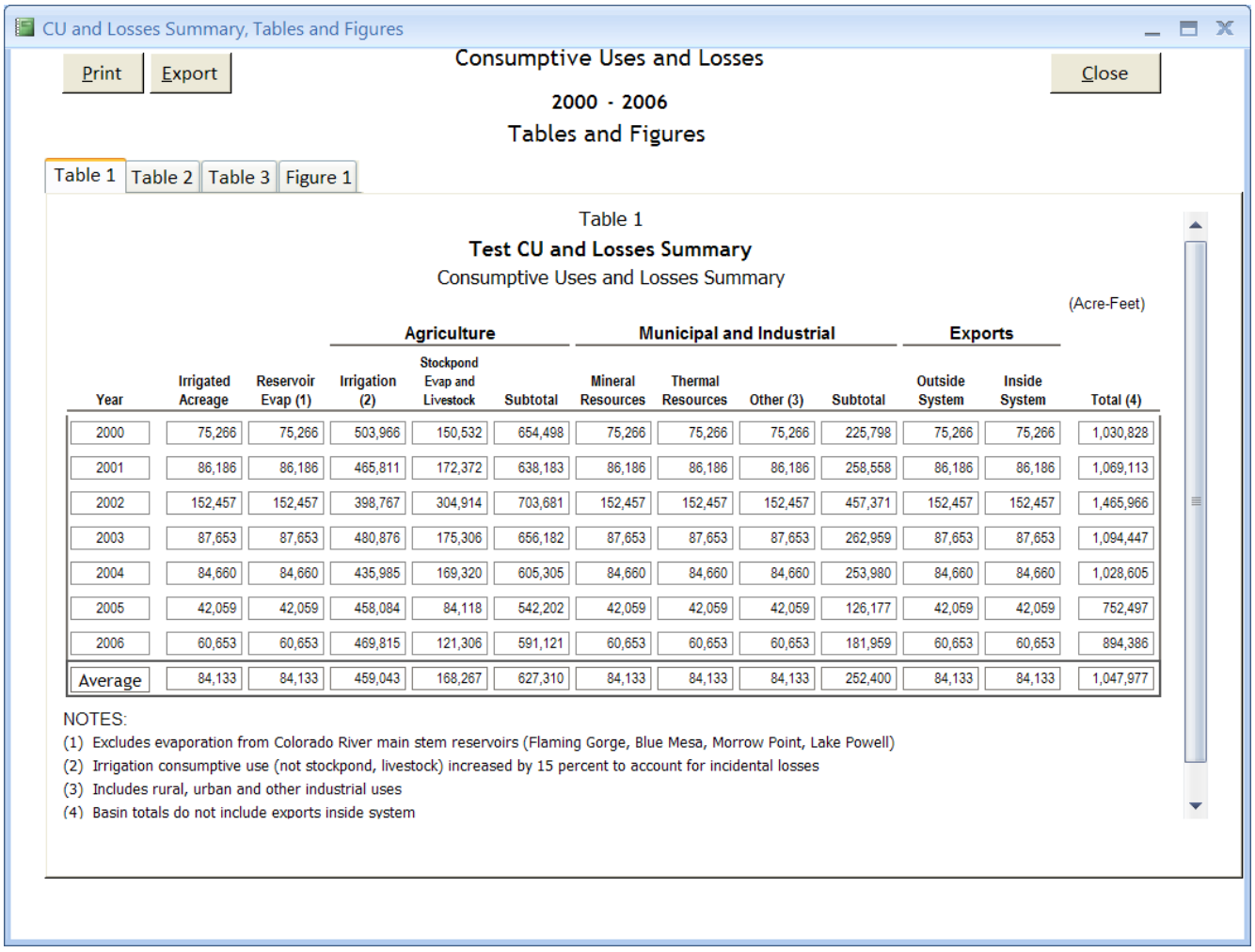


Figure 19 - CU and Losses Summary Results Form – Overview

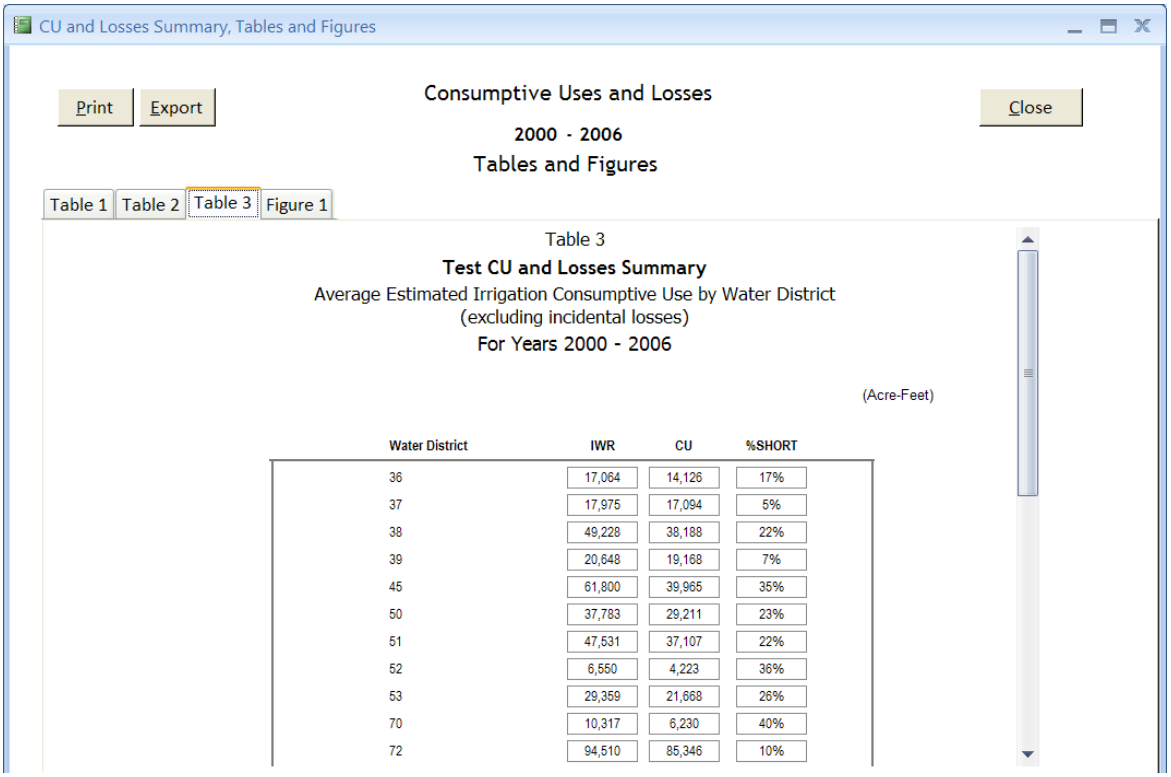


Figure 20 - CU and Losses Summary Results Form – Irrigation CU

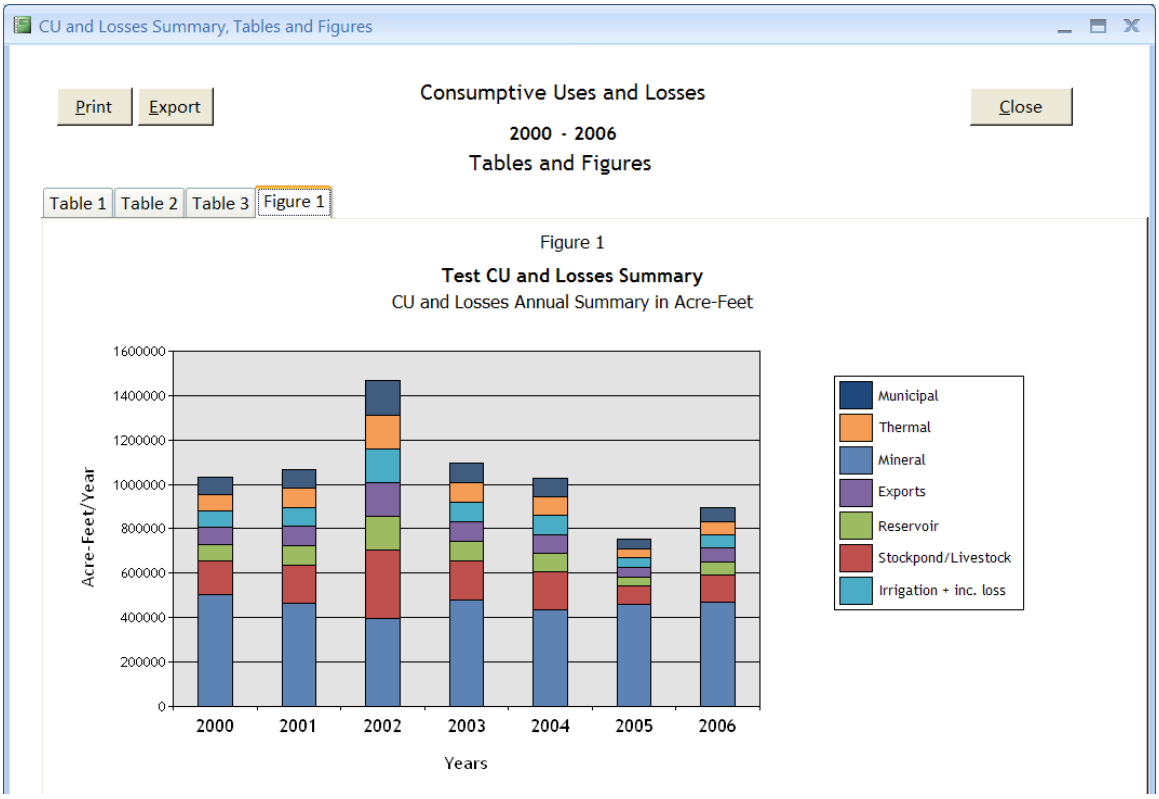


Figure 21 - CU and Losses Summary Results Form – Summary Bar Graph

2.3.6 *Exporting and Printing the CU and Losses Summary Results*

Clicking *Export* on the Results form will bring up the *Export CU and Losses Summary Tables* form shown in Figure 22, which allows the user to output the file into an Excel workbook (.xls) or to save the tables and graph as a Rich Text File (.RTF) and, if desired, open the tables in Word after the export. In either case, the output file(s) will be assigned a default name and put in the directory specified. ***File(s) with the default name(s) already existing in that location will be overwritten; save previously created output files to new names first.***

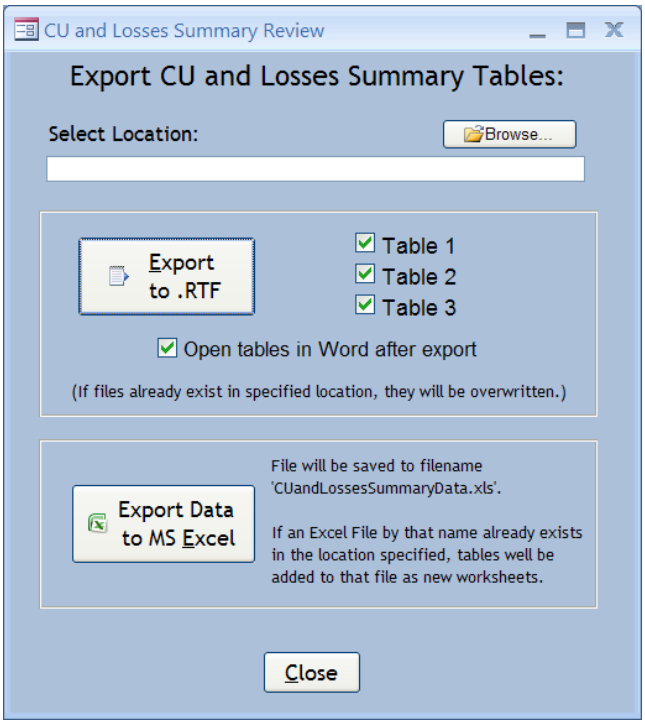


Figure 22 - CU and Losses Summary Export Form

To print, click *Print* on the Results form. This will bring up the form shown in Figure 23. Select a printer and click *Print* to send the data to the selected printer.

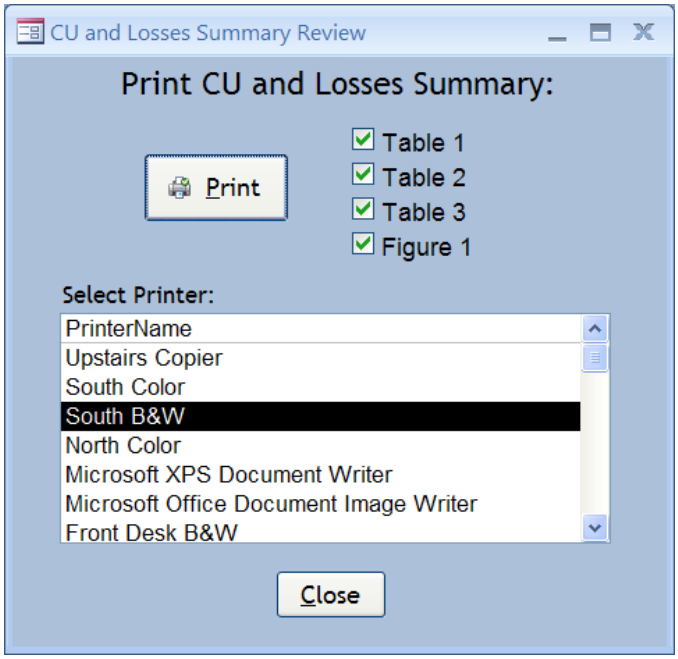


Figure 23 - CU and Losses Summary Print Form

2.4 Generate the Colorado River Basin CU and Losses Report

Figure 24 - State Water Budget Reporting Tool, Main Form – CU and Losses Report Utility

This function generates the Colorado River Basin Tributaries in Colorado CU and Losses Report. To start the Report, select the *Generate the Colorado River Basin Tributaries in Colorado CU and Losses Report* button on the Main form. This brings up the *CU and Losses Report Setup* form, as shown in Figure 25.

2.4.1 Setting up the CU and Losses Report

Step 1 is to specify the input data. Clicking on the *Specify Data* button will bring up the *CU and Losses Report Input Data* form, as shown in Figure 26.

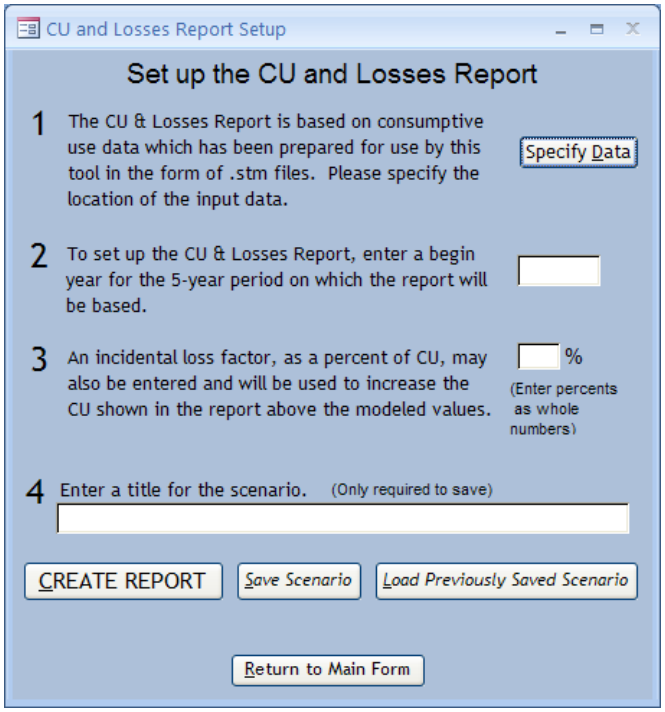


Figure 25 - CU and Losses Report Setup Form

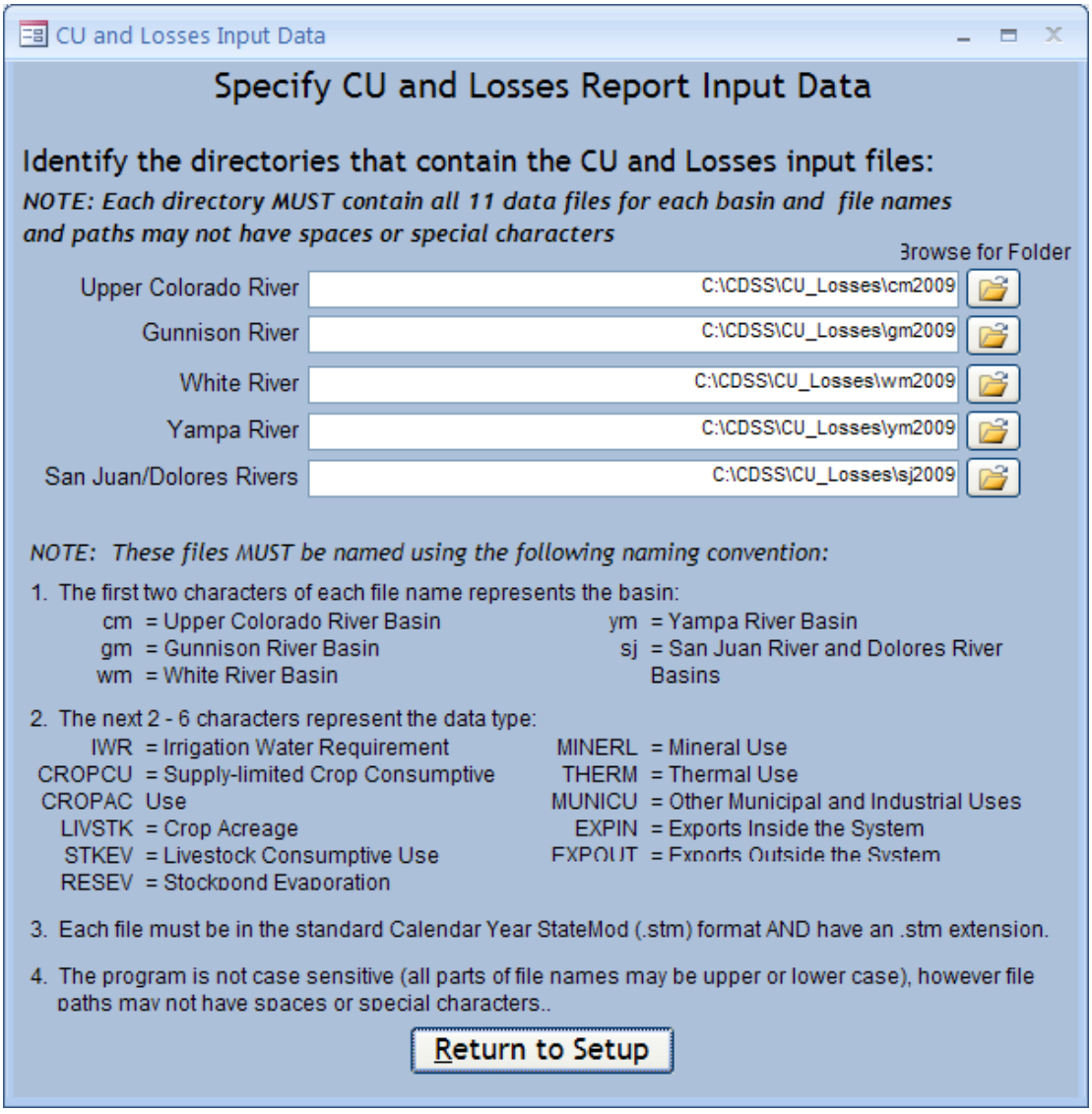


Figure 26 - CU and Losses Report Input Data Form

Type in the folder paths or browse to the location of the folder that contains all of the CU and Losses input files for the specified basin.

NOTES:

- *The input file naming conventions shown in the bottom half of the form must be followed when creating the input files in order for the GUI to properly read all files. These file name constraints allow the user to only have to specify five file paths (one for each basin) rather than having specify 55 file names.*
- *All of the input files must be in the standard monthly calendar year StateMod (*.stm) format.*
- *All of the data components must be included in each basin folder, represented by zero data if the component is not applicable for a specific basin.*

- *A single folder is selected for each of the Colorado sub-basins (Yampa, White, Colorado, Gunnison, San Juan/Dolores).*
- *File names and directory paths may NOT have spaces or special character.*

The decision to use standard file names is to manage the information the user must enter to create a CU and Losses Report. To manage CU and Losses input data and 'track' updates, it is recommended that folder names bo used. For instance, if new CU and Losses data for the Gunnison basin is generated in 2010, it could be included under c:\CDSS\Data\CULosses2010\gmdata.

When finished entering all folders, select the button at the bottom of the form, Return to Setup, to return to the Setup form.

For **Step 2**, enter the beginning year for which the 5-year period the report will be based on. The date must be entered as a whole year (YYYY) without the month or day included in the date. This time period must fall within the period of data available in the input files.

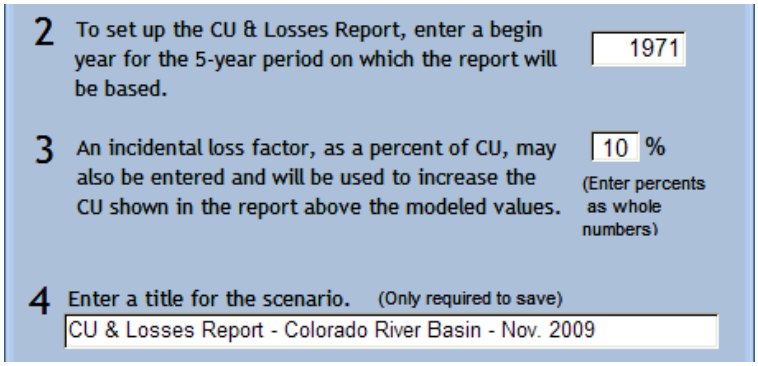


Figure 27 - CU and Losses Report Setup Form, Steps 2 - 4, Create, Save, and Load shown only

Step 3 allows the user to enter a percentage as a whole number that will represent the incidental loss factor. The incidental losses reflect non-crop consumptive use incidental to irrigation, as termed by the USBR CU and Losses Report documentation. If incidental losses are not considered, a zero must be entered for the incidental loss factor.

In **Step 4**, a title may be added to identify the CU and Losses Report.

2.4.2 Saving a CU and Losses Report Scenario

To save the information entered in the Setup form, click on the *Save Scenario* button (Figure 27) to create the response file (*.rcl) that saves the input information entered on this form. This opens the *Save CU and Losses Report Scenario* form, shown in Figure 28, for entering the file name or browsing for the file location.

After the location and file name have been defined, click Save to complete the form. A scenario may be saved even if all the inputs have not yet been defined.

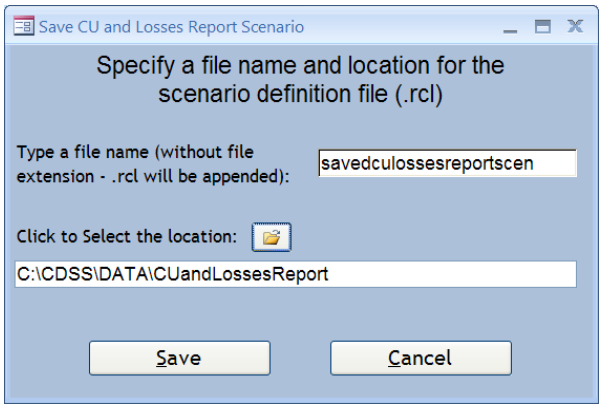


Figure 28 - Save CU and Losses Report Form

2.4.3 Loading a Saved CU and Losses Report Scenario

To come back to a scenario that has already been saved, click on the *Load Previously Saved Scenario* button (Figure 27) to add data or finish a previous analysis. This opens the *Load CU and Losses Report* Scenario form; browse for the response file (*.rcl). Once the correct scenario file has been found, click Load to view the scenario in the *CU and Losses Report Setup* form.

2.4.4 Running the CU and Losses Report Scenario

When the *CU and Losses Report Setup* Form (Figure 25) is completed, click on the *CREATE REPORT* button to execute the analysis (Figure 27). The program first checks that all the input files are available and in calendar year, .stm format, and then performs the analysis and displays the results. A progress window is provided to show the progress of the execution.

2.4.5 Viewing the CU and Losses Report Results

Completion of the analysis opens the *CU and Losses Report Output Options* form, as shown in Figure 29. There are two buttons that serve as options for the user to review the results of the report.

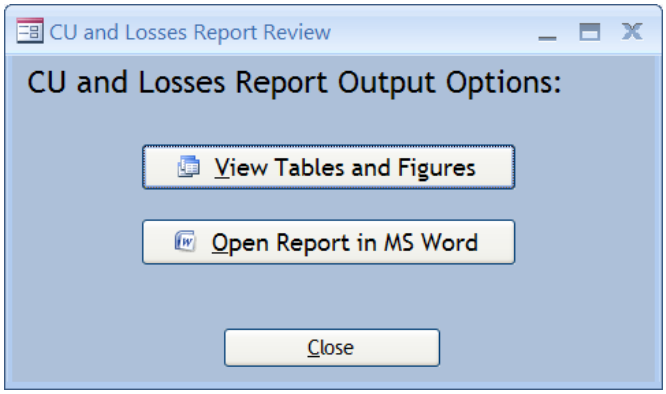


Figure 29 - CU and Losses Report Output Options

The *View Tables and Figures* button opens a read-only form called *CU and Losses Report, Tables and Figures*. There are 13 Table tabs (Figure 33) and a Figure tab (Figure 34) to review the results of the CU and Losses Report.

From the *CU and Losses Report Output Options* form, a report can be opened directly in MS Word by clicking on the *Open Report in MS Word* button. This opens a linked Microsoft mail-merge document which looks at the database and refreshes linked fields throughout the document to reflect the CU and Losses Report results.

In order to activate this link, 1) select the linked Word .DOC file and 2) select the CU and Losses Tool .MDB file. Figure 30 and Figure 31 illustrate these prompts and which files the user should select in each case. These files will be located where they were copied as described under Installation (see section 1.2).

Once opened, the report can be saved. A standard report format, similar to the USBR report, is used by the program and the data provided by input data is used to complete the report.

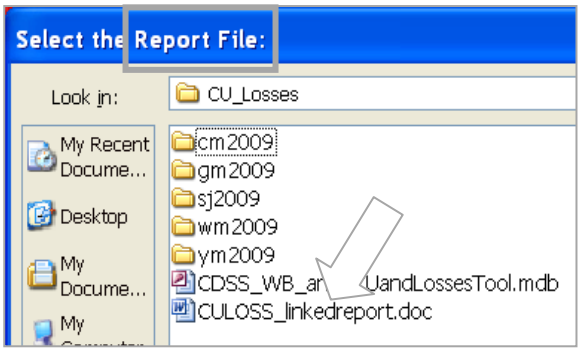


Figure 30 - Selecting the Linked CU and Losses Report File

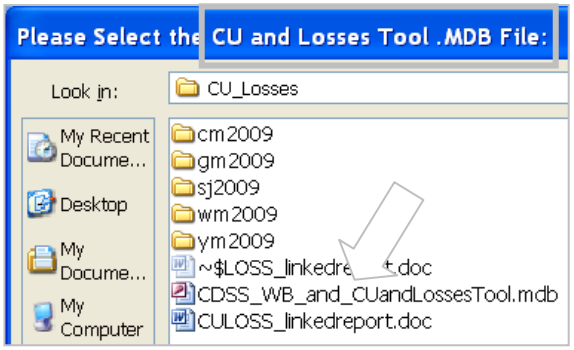


Figure 31 - Selecting the CU and Losses Tool .MDB File

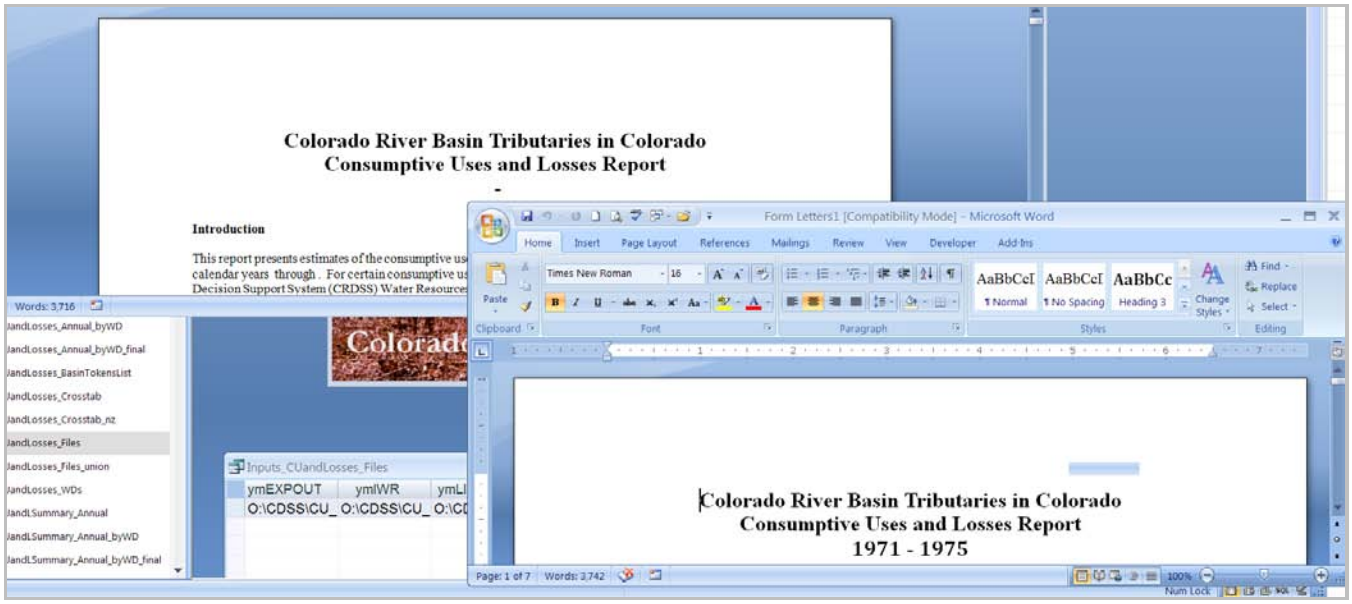


Figure 32 - CU and Losses Mail Merged Report

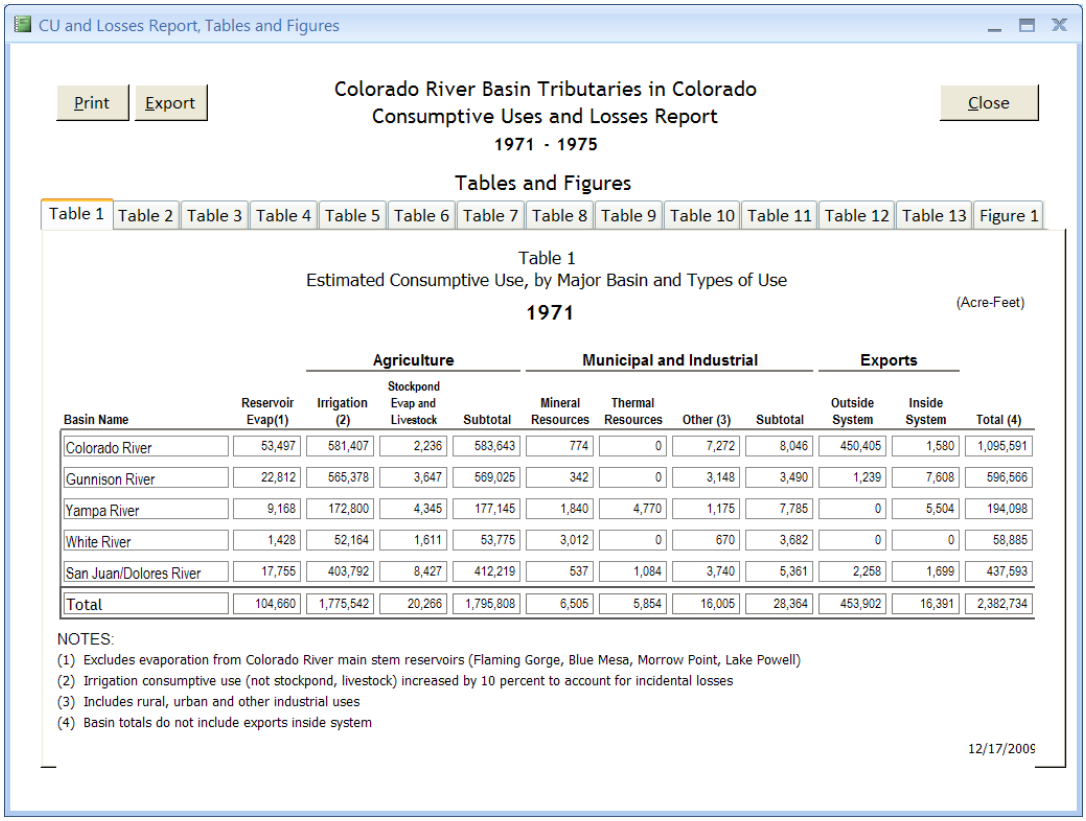


Figure 33 - CU and Losses Report Results Tables

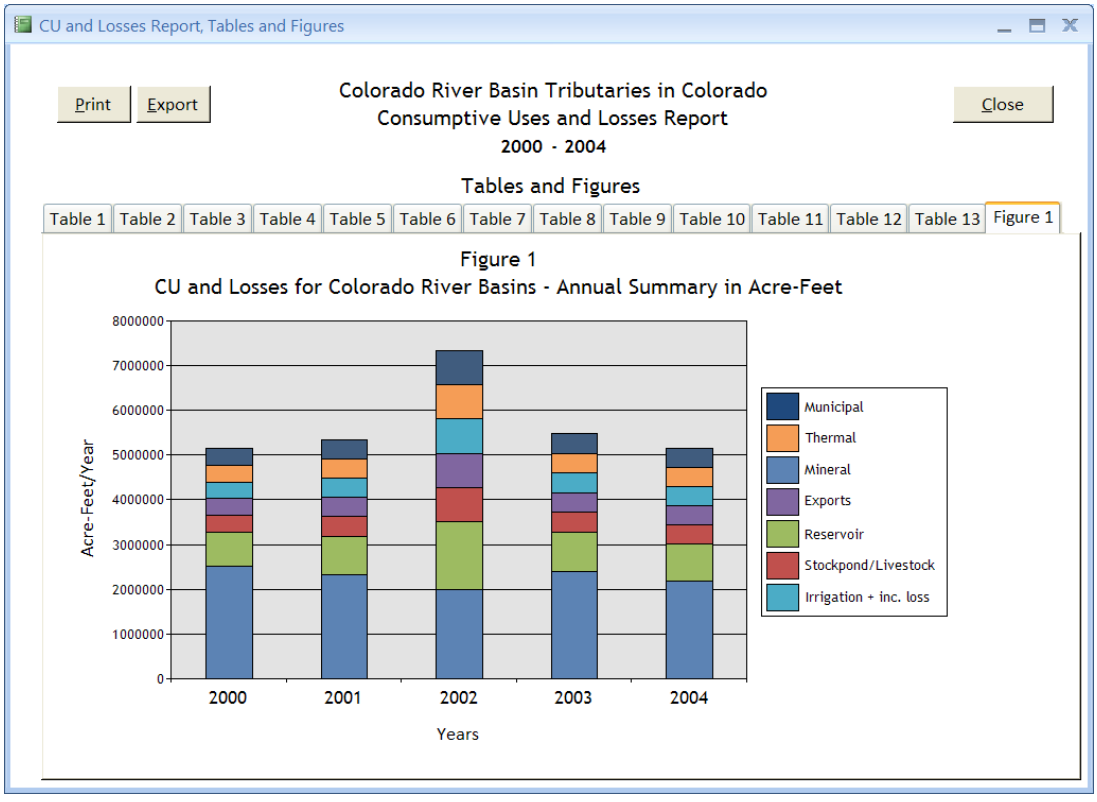


Figure 34 - CU and Losses Report Results Graph

Selected tables can be printed (Figure 35) or exported as Rich Text Files, which can be opened in MS Word (Figure 36). Once exported, the Rich Text Files can be saved in a Word document file format.

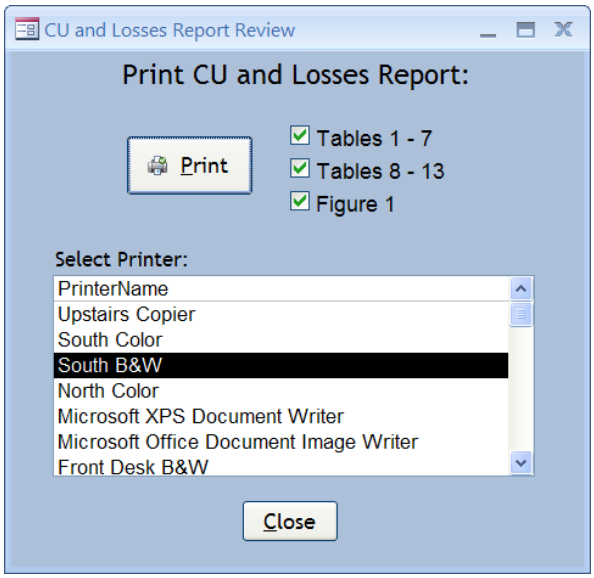


Figure 35 - Print CU and Losses Tables and Figure

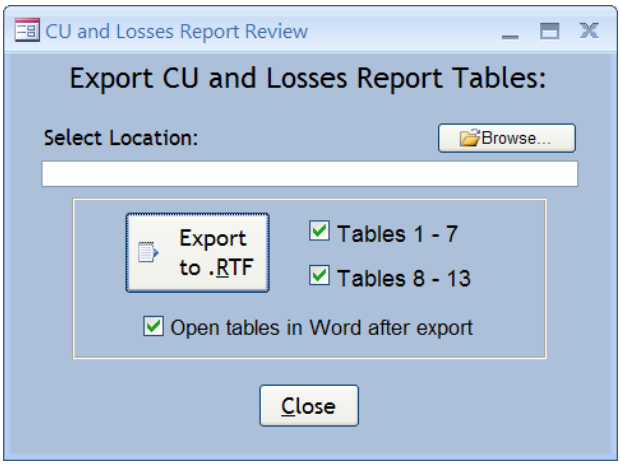


Figure 36 - Export CU and Losses Tables and Figure to .RTF

3.0 Model Description

StateWB is a stand-alone model designed using Microsoft Access. StateWB allows a user to perform a water budget calculation over a defined model area, with inflows, outflows, and changes in storage representing the model area provided as input to the model. StateWB also allows users to create a Consumptive Use and Losses Summary for any period and area or a Colorado River Basin CU and Losses Report over a defined 5-year interval for the Colorado River basin as a whole.

3.1 Model Foundation

When calculating the water budget, StateWB simulates the following mass balance equation over the defined model area:

Inflow – Outflow = Change in Storage **(1)**

Where:

Inflow = Gaged Surface Water Inflow + **(2)**
Ground Water Inflow +
Imports+
Precipitation +
Ungaged Surface Water Inflow

Outflow = Agricultural Consumptive Use + **(3)**
Exports +
Gaged Surface Water Outflow +
Ground Water Outflow +
Livestock Consumptive Use +
Municipal/Industrial Consumptive Use +
Native Vegetation Consumptive Use +
Reservoir Evaporation

Change in Storage = Change in Ground Water Storage + **(4)**
Change in Surface Water Storage

A positive Change in Storage represents an overall increase in storage and a negative change in storage represents an overall decrease in storage.

Before running the model, the user must select a *Residual*. If input data has been provided for the user-specified residual term, the user will be warned and given the option to select a different residual term. If the user chooses to keep this residual term, the input data for the term is not used. The residual is calculated by rearranging Equation 1:

Residual = Inflow – Outflow – Change in Storage **(5)**

The calculated residual includes the value of the specified residual and any terms for which input data was not provided. If inflows are greater than the sum of outflows and changes in

storage, the calculated residual will be positive. If the sum of outflows and changes in storage are greater than inflows, then the calculated residual will be negative.

When creating the CU and Losses Summary, the consumptive use input data provided to the model is summarized on an annual basis and output in tables and figures. With the exception of adjusting the agricultural consumptive use overall by the incidental loss factor, no other calculation of the data takes place. If an incidental loss factor is provided, the program will adjust agricultural consumptive use data by increasing the annual estimate by the factor indicated by the user.

When creating the CU and Losses Report, the consumptive use input data provided to the model is summarized in 5 year increments for the entire Colorado River Basin. The Colorado River Basin includes the Upper Colorado, Gunnison, San Juan/Dolores, White, and Yampa River basins in Colorado. The program summarizes the consumptive use data by basin into a format comparable to the USBR Colorado River System Consumptive Use and Losses Report. A standard report is generated, as well as supporting tables and graphs using the input data. As with the summary, the only calculation of the input data is the adjustment of agricultural consumptive use due to the incidental loss factor.

3.2 Processing Input Data

The model control variables are read from response files; the water budget response file (*.rwb), the Summary response file (*.rcs) or the Report response file (*.rcl). For the water budget analysis, the input format is specified in the response file; average annual data values are read directly from the response file, or a list of input files containing annual or monthly data is read from the response file. For the Summary response file, a list of input files containing the monthly data is read from the response file. For the Report response file, a list of basin folders containing input files is read from the response file.

As annual and monthly input files are read, the model records the beginning and ending year available for that term. The specified year(s) of analysis must be within the years of data that have been provided.

It is recommended that the user utilize the State's Data Management Interfaces, specifically TSTool, to create input data files. All monthly input files must be in the standard calendar year StateMod format, and the file name and path must not include spaces or special characters. Note that missing data for StateMod standard formatted files is set to -999. The program sees this as actual data and it will be considered as such. Provide only complete data sets to the program. All files must be present for the Summary and Report to be generated. Output data is always presented in calendar year format.

Where to find more information

The documentation and datasets referenced below are available on the CDSS website <cdss.state.co.us>

- Historic Crop Consumptive Use Reports document agricultural crop consumptive use in each basin. Associated StateCU datasets represent 100 percent of the crop acreage and resulting consumptive use in each basin. The documentation and datasets have been developed for the South Platte River basin, Rio Grande basin, and basins in the Colorado River (Upper Colorado, Gunnison, San Juan/Dolores, White and Yampa).
- The 'Other Uses' Consumptive Use and Losses Procedure Manual documents the development of non-agricultural consumptive use (e.g. reservoir evaporation, municipal and industrial CU, livestock CU) for Colorado River basins and the Rio Grande basin.
- The CU and Losses Report for the Colorado River basin, generated by the StateWB program for the 1971 through 2005 period, summarizes the consumptive use and losses for the basin. Comparable to the USBR Colorado River System Consumptive Use and Losses Report available at <www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html>.

4.0 Input Description

This section describes the input files required to operate the StateWB program, including the response files used to designate analysis parameters and the input file data.

4.1 StateWB Response File

The Response File (*.rwb) is the model control file and is required for each StateWB simulation. The response file contains model parameter settings and input data in the case of an average annual data set or a list of input data files in the case of an annual or monthly data set. In general, the top of the response files will contain a variable number of comment lines identified by "#" in column 1. The model does not read or process these lines.

4.1.1 Average Annual Response File

An average annual response file (TimeScale = 1) contains model control settings and the actual average annual data. The average annual value and the term identifier are read free-format, therefore the terms, in acre-feet values, can be listed after each term using space delimiters. The model distinguishes data with a value of zero from missing data. If a term and identifier are not provided in the response file, the model will recognize the term as missing, the output will label the term as missing, and the term will be included in the residual. If a value of zero is assigned to a term in the response file, the model reads the zero value and the term is not included in the residual.

Row-Data	***Program Variable***	***Description***
Row 1-3	*(a120)*	
1-1	Title1	Simulation description
2-1	Title2	Simulation description
3-1	Title3	Simulation description
Row 4-7	*Free Format*	
4-1	TimeScale	Switch indicating format of input data files: 1 = average annual 2 = annual 3 = monthly
5-1	StartYr	Beginning year of simulation
6-1	EndYr	Ending year of simulation
7-1	Residual	Identifier for Residual to be Calculated: INFL_SW Gaged SW Inflow INFL_GW GW Inflow INFL_IMP Imports INFL_PRECIP Precipitation INFL_SWung Ungaged SW Inflow OUTF_AG Agricultural CU OUTF_EXP Exports

OUTF_SW	Gaged SW Outflow
OUTF_GW	GW Outflow
OUTF_LIVSTK	Livestock CU
OUTF_MI	Municipal/Industrial CU
OUTF_NATIV	Native Vegetation CU
OUTF_RESEV	Reservoir Evaporation
CHG_SW	Change in GW Storage
CHG_GW	Change in SW Storage

4.1.2 Annual/Monthly Response File

An annual or monthly response file (TimeScale = 2 or 3) contains model control settings and lists the names of input data files to be read by the model. The file name and the term identifier are read free-format, therefore the file name and path can follow the term with space delimeters. It is recommended, but not required, that identifiers be used as the file extension for a representative file for simulation management (e.g. Gaged Surface Water Inflow File (*.swi) where * refers to a simulation name). If an input file name and identifier are not provided in the response file, the model will treat the term as missing, the output will label the term as missing and the term will be included in the residual. If an input data file name is provided and the input data file contains zero values, the model reads the zero value, and the term is not included in the residual.

Note that this response file follows the same format as shown in section 5.1.1, the TimeScale input determines whether the program will look for average annual terms or data files as input.

4.2 CU and Losses Summary Response File

The Summary Response file (*.rcs) is the model control file and is required for each CU and Losses Summary simulation. The response file contains model parameter settings and a list of input data files. In general, the top of the response files will contain a variable number of comment lines identified by "#" in column 1. The model does not read or process these lines.

Row-Data	***Program Variable***	***Description***
Row 1-3	*(a120)*	
1-1	Title1	Simulation description
2-1	Title2	Simulation description
3-1	Title3	Simulation description
Row 4-7	*Free Format*	
4-1	StartYr	Beginning year of simulation
5-1	EndYr	Ending year of simulation
6-1	IncLoss	Incidental Loss Factor
7-1	InputFile	Input files and descriptions to be included in the analysis:

IWR	Irrigation Water Requirement
CROPCU	Supply-limited Crop Consumptive Use
CROPAC	Crop Acreage
LIVSTK	Livestock Consumptive Use
STKEV	Stockpond Evaporation
RESEV	Reservoir Evaporation
MINERL	Mineral Use
THERM	Thermal Use
MUNICU	Other Municipal and Industrial Uses
EXPIN	Exports Inside the System
EXPOUT	Exports Outside the System

4.3 CU and Losses Report Response File

The Summary Response file (*.rcl) is the model control file and is required for each CU and Losses Report simulation. The response file contains model parameter settings and a list of input data folders, one folder for each sub-basin. The required consumptive use data types must reside in each folder designated with the basin prefix (Colorado = cm, Gunnison = gm, San Juan/Dolores = sj, White = wm, Yampa = ym) and the data type suffix. The following is a list of required data type suffixes.

IWR	Irrigation Water Requirement
CROPCU	Supply-limited Crop Consumptive Use
CROPAC	Crop Acreage
LIVSTK	Livestock Consumptive Use
STKEV	Stockpond Evaporation
RESEV	Reservoir Evaporation
MINERL	Mineral Use
THERM	Thermal Use
MUNICU	Other Municipal and Industrial Uses
EXPIN	Exports Inside the System
EXPOUT	Exports Outside the System

Each file within the folder must be in the standard calendar year StateMod format with the *.stm extenstion. Only a StartYr is required for this analysis, as the Report is automatically generated in 5-year increments. In general, the top of the response files will contain a variable number of comment lines identified by “#” in column 1. The model does not read or process these lines.

Row-Data	***Program Variable***	***Description***
Row 1-3	*(a120)*	
1-1	Title1	Simulation description
2-1	Title2	Simulation description
3-1	Title3	Simulation description
Row 4-7	Free Format	
4-1	StartYr	Beginning year of simulation
5-1	IncLoss	Incidental Loss Factor
6-1	BasinFolders	Basin folders to be included in the analysis: cmFolder Upper Colorado directory gmFolder Gunnison directory ymFolder Yampa directory wmFolder White directory sjFolder San Juan / Dolores directory

4.4 Input File Format

If the StateWB response file (*.rwb) indicates an annual or monthly input file format (TimeScale= 2 or 3), and always with the Summary and Report response files, the inflow file names are specified in the response file. In general, the top of the input data files will contain a variable number of comment lines identified by "#" in column 1. The model does not read or process these lines.

With a monthly scenario, StateWB reads 12 monthly values from the input file and calculates the annual total as the sum of the monthly values. The annual total can be provided in the input file, following the monthly data, but StateWB does not read the annual total. With an annual scenario, StateWB only reads the annual total. Note that several structures can be included in each input file, they will be summed for an overall value. For example, the agricultural consumptive use input file (gmCROPCU.stm) can list all of the structures and their associated CU in the entire Gunnison Basin. The model will sum the structures to determine a single annual value for the Gunnison agricultural consumptive use. Note that missing data for StateMod standard formatted files is set to -999. The program sees this as actual data and it will be considered as such. Provide only complete data sets to the program.

4.4.1 Annual Input File

Each input file has the following standard StateMod time-series (.stm) format:

Row-Data	***Program Variable***	***Description***
Row 1	*(6x,i4,11x,i4,7x,a3)*	
1-1	intInpBegYr	Beginning year of data
1-2	intInpEndYr	Ending year of data
1-3	intInpWyr	CYR for calendar year

(Note that data must be in Calendar Year Format)

Row 2	*(i4,1x,a12,13(f8.2))*	
2-1	intInpYr	Year
2-2	WDID	Structure or simulation identifier (not used by the model)
2-3	sngInpVa(intInpYr, 13)	Annual total in acre-feet

Repeat for each structure and each year intInpBegYr through intInpEndYr.

4.4.2 Monthly Input File

Each input file has the following standard StateMod time-series (.stm) format:

Row-Data	***Program Variable***	***Description***
Row 1	*(6x,i4,11x,i4,7x,a3)*	
1-1	intInpBegYr	Beginning year of data
1-2	intInpEndYr	Ending year of data
1-3	intInpWyr	CYR for calendar year

(Note that data must be in Calendar Year Format)

Row 2	*(i4,1x,a12,13(f8.2))*	
2-1	intInpYr	Year
2-2	WDID	Structure or simulation identifier (not used by the model)
2-3	sngInpVal(intInpYr, 1-12)	Total value for months 1-12 in acre-feet

Repeat for each structure and each year intInpBegYr through intInpEndYr.

5.0 Output Files

StateWB generates several data summaries, graphs and reports depending on the execution of the program. In general, tabular presentation of the output is available for all program executions, and the user has the ability to export and save the tabular data. The contents of the output file depends on the specified time period of the input file (average annual, annual, or monthly). Discussions of how to output and export data can be found in Section 3. Options to save and/or export analysis result data are provided to the user after each analysis is performed. The StateWB program exports data either to an Excel workbook (.xls) or Rich Text File (.rtf). Rich Text File data can be viewed through the Microsoft Word program.