Colorado River
Decision Support System

White River Basin
Water Resources Planning Model

FINAL

for
Colorado Water Conservation Board
Colorado Division of Water Resources

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1.0 EXECUTIVE SUMMARY

The White River Water Resources Planning Model (White Model) was developed jointly by the Colorado Water Conservation Board and the Division of Water Resources as part of the Colorado River Decision Support System (CRDSS). The objective was to develop a monthly water allocation and accounting model which includes 100 percent of the basin's consumptive use and would be capable of making comparative analyses for the assessment of historic and future water management policies.

1.1 Background

The White River basin lies just north of the Colorado River basin in northwestern Colorado. The White River drains all or parts of Rio Blanco and Garfield counties and supplies an annual flow of approximately 595,100 acre-feet to the Green River.

The White River basin contains a minimal amount of complexity and an abundant supply of water. Only two reservoirs (Taylor Draw and Big Beaver) are greater than 1,500 ac-ft. Piceance Creek is the primary stretch of river subject to administrative regulation. On the mainstem of the White River, the reach between Miller Creek and Flag Creek contains several relatively large, senior diverters which historically have placed a call on the White River once, in 1977.

1.2 Approach

The White River Basin Model was developed using StateMod, the State of Colorado's Stream Simulation Model, and is operated on a monthly time step from water years 1975 to 1991**.** It was developed in two steps as follows:

1. Phase II, completed in October 1996, explicitly modeled approximately 18,700 acres of irrigated land, 88 key diversions, 2 reservoirs and 6 instream flow reaches. Key structures were identified using the following approach:

    - A list of diversion structures, based on the structure's net absolute decreed amount, was compiled and ranked form largest to smallest.
    - The list was shortened by including those structures that represent 75 percent of the basin's net absolute decreed amounts.
    - Meetings were held with division and district engineers in the basin and the preliminary list of structures was refined to include structures that were considered important by the district engineers. Also, some structures were removed from the model because they historically diverted significantly less than the decree amount, or they were abandoned.

2. Phase IIIa enhanced the previous model to account for 100 percent of the basin's consumptive use. This was accomplished using the following procedure:

- Sixteen (16) aggregated irrigation structures were added to represent the remaining irrigated lands, which were not explicitly modeled in Phase II (approximately 6,400 acres).

- Two (2) aggregated reservoirs were added to represent the remaining decreed storage not explicitly modeled in Phase II (approximately 4,200 ac-ft).

- Two (2) aggregated stock ponds were added to represent stock pond storage not explicitly modeled in Phase II (approximately 4,800 ac-ft).

- One (1) aggregated municipal and industrial (M&I) demand was added to represent the remaining M&I consumptive use not explicitly modeled in Phase II (approximately 1,100 ac-ft).

- Miscellaneous refinements to the Phase II product (see Section 6.0, Calibration)

This report supersedes the previous work by documenting the results of both development efforts (Phase II and IIIa). Appendix D, Enhanced White River Model, describes the activities associated with the Phase IIIa activities.

1.3 Results

The key results of the CRDSS White River modeling effort are as follows:

- Using StateMod, a water resources planning model has been developed that can make comparative analyses of historic and future water management policies in the White River basin.

- The model has been calibrated for a study period extending from water years 1975 to 1991, a time period in which basin operations have been relatively constant.

- The calibration is considered good, based on a comparison of historic to simulated stream flows, reservoir contents, and diversions.

- A baseline data set has been prepared which, unlike the calibration data set, assumes all existing water resources systems were on line and operational from water years 1975 to 1991. This baseline set is appropriate for evaluating various “what if” scenarios over a hydrologic time period containing dry, average, and wet hydrologic cycles.

1.4 Future Enhancements

The White Model was developed to include 100 percent of the basin’s consumptive use through a combination of explicitly and aggregated structure modeling. Future enhancements to the White Model could include the following but are not recommended at this time:

- Additional evaluation and refinement of the climate gages and procedures used to estimate demands associated with irrigated acreage.

- Incorporation of additional information through consultation with the division engineer and other major water users regarding historic and future reservoir operations.

2.0 INTRODUCTION

2.1 Basin Description

The White River basin lies in the northwest portion of Colorado to the south of the Yampa River basin and north of the Colorado River basin. Approximately 2,600 square miles of drainage area contribute to flows at the White River gage at the Colorado-Utah state line. Elevations within the basin range from over 7,500 feet (amsl) in the headwater areas near the town of Buford, to about 5,400 feet (amsl) near the town of Rangely, Colorado. The major tributaries to the White River include the North and South Fork of the White River and Piceance Creek. Average annual streamflow in the White River at the Colorado-Utah state line is about 595,100 acre-feet.

The principal water use in the White River basin is irrigation. Non-agricultural diversions include the towns of Rangely and Meeker, and the California Company water plant. A single trans watershed diversion, the Coal Creek feeder ditch, is included in the model and transports water from Fawn Creek on the North Fork of the White to Coal Creek, also in the White River basin.

Two reservoirs are explicitly modeled in the White River Model, Taylor Draw Reservoir on the mainstem of the White River and Big Beaver Creek Reservoir on Big Beaver Creek. Taylor Draw Reservoir has a storage volume of 13,800 acre-feet while Big Beaver Creek Reservoir has a storage volume of 7,658 acre-feet. Both of these reservoirs are used primarily for recreation and supply little to no water for irrigation. Figure 2.1a shows the general layout of the White River basin.

2.2 Water Resources Developments

The White River basin has had no water resources developments in the form of federal storage projects and pipelines.

2.3 Historical Water Rights Administration

Historical water rights have been administered in the White River basin on the basis of direct flow priorities where senior direct flow rights will call out junior diverts elsewhere on the river. No special cases of water rights administration were identified in the White River basin.

The senior direct flow rights on the mainstem of the White River between Flag Creek and Miller Creek have only had to call out junior diverts once, in 1977. Piceance Creek, a tributary to the White, is routinely subject to administrative regulation during the irrigation season.

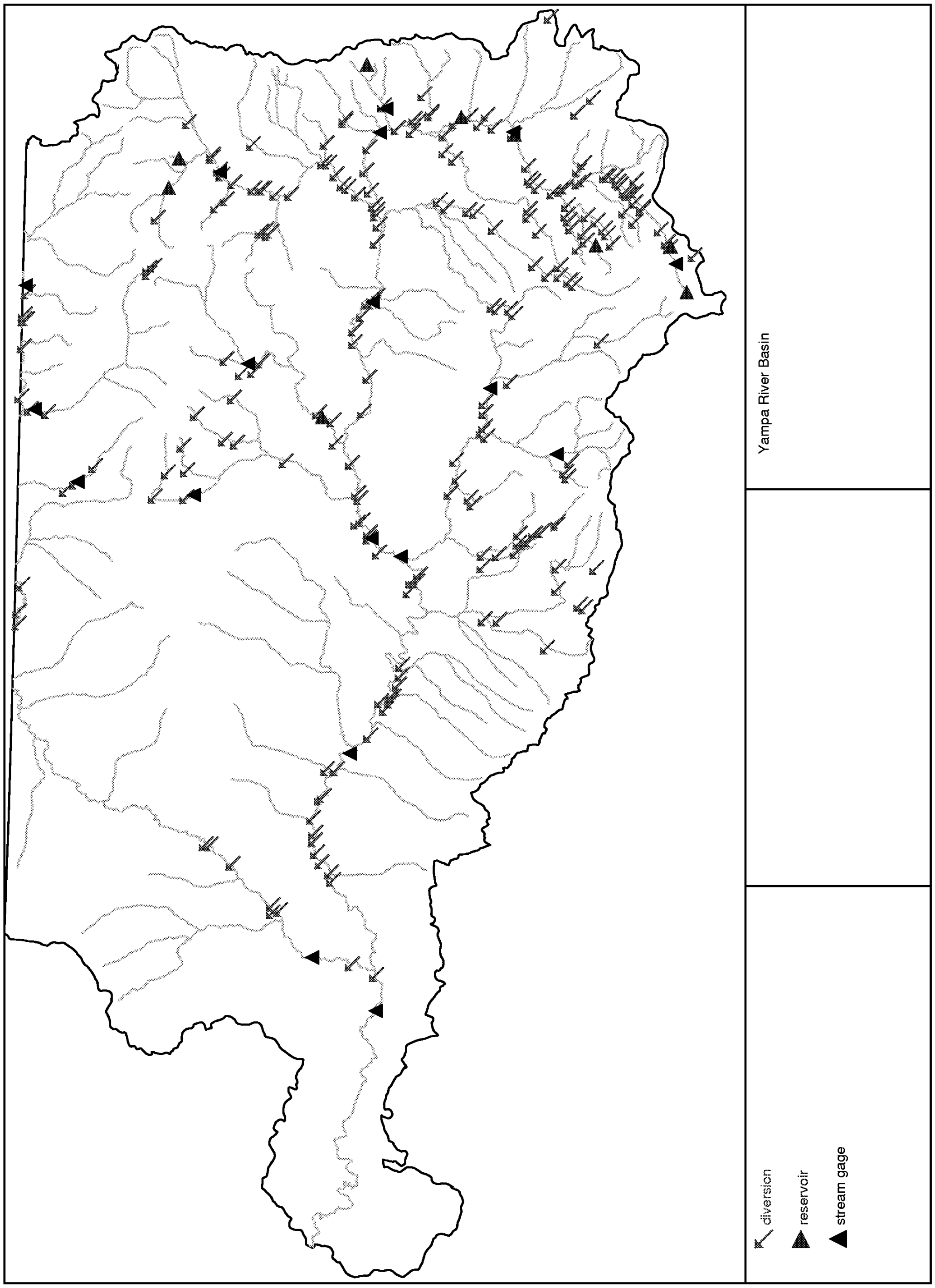

Figure 2.1a
General Basin Layout

3.0 MODEL DEVELOPMENT

The White River Basin Model was developed jointly by two agencies, the Colorado Water Conservation Board (CWCB) and the Division of Water Resources (DWR), as part of the Colorado River Decision Support System (CRDSS). The objective of the model was to develop a monthly water allocation and accounting model. Which would be capable of making comparative analyses for the assessment of historic and future water management policies. Typical comparative analyses for which the model is well suited include:

- Impact of potential future reservoir operations on existing water users
- Impact of potential future compact river calls on existing water users
- Impact of potential future instream flow requirements on existing water users
- Safe yield of a potential future reservoir or diversion

For a complete description of the types of comparative analyses for which the model was developed, see the *Colorado River Decision Support System Feasibility Study, 1993*.

3.1 Prior White River Basin Modeling

There have been no recent (within the past 10 years) water resources modeling efforts involving the White River basin. Kent Holt of Division 6 developed a water allocation model based on a priority system for the White River in the early 1970s that included only the major diversion structures on the mainstem. Information from this work was considered out-dated and was not used in the CRDSS modeling efforts.

The Colorado River Simulation Model (CORSIM II) is a proprietary computer model, which was originally developed, in the early 1970's. Until recent years, the CORSIM II model has been considered the most comprehensive modeling effort of hydrology and water rights for the main stem of the Colorado River and its principal tributaries (including the White). The CORSIM II model is proprietary to its sponsors and accordingly, detailed review of the databases and operational logic could not be performed for possible inclusion in the White Model.

3.2 Modeling Approach

The White Model was developed using StateMod, the State of Colorado's Stream Simulation Model. The key components of the model include the following:

- Simulates tributaries and mainstem river systems through the use of a tree- structured network design.

- Simulates direct flow, instream flow, storage, and operational rights under the Prior Appropriation System as a function of water availability, priority, decreed amount, demand, structure capacity, and location.

- Simulates a wide variety of operating agreements and exchanges between one or more structures through user-supplied input data.

- For a given structure, simulates one or more return flow patterns returning to one or more stream nodes to represent the impact of surface and ground water returns on the stream system.

- Simulates Transmountain imports and diversions from a basin.

- Uses an efficient, direct solution algorithm, which recognizes the impact of a diversion's return flows during the current time step without having to iterate.

- Estimates a base or natural streamflow from gaged or estimated streamflow, diversion, and reservoir data.

- Performs extensive input data checking.

- Provides extensive output reporting capabilities.

- Operates on both a PC and a workstation.

- Is available to the public and maintained by the State of Colorado.

The White Model is operated on a monthly time step from water years 1975 to 1991. It was developed in two steps as follows:

1. Phase II, completed in October 1996, explicitly modeled approximately 18,700 acres of irrigated land, 88 key diversions, 2 reservoirs and 6 instream flow reaches. Key structures were identified using the following approach:

    - A list of diversion structures, based on the structure's net absolute decreed amounts, was compiled and ranked form largest to smallest.

    - The list was shortened by including those structures that represent 75 percent of the basin's net absolute decreed amounts.

    - Meetings were held with division and district engineers in the basin and the preliminary list of structures was refined to include structures that were considered important by the district engineers. Also, some structures were removed from the model because they historically diverted significantly less than the decree amount, or they were abandoned.

2. Phase IIIa enhanced the previous model to account for 100 percent of the basin's consumptive use. This was accomplished using the following procedure:

    - Sixteen (16) aggregated irrigation structures were added to represent the remaining irrigated lands, which were not explicitly modeled in Phase II (approximately 6,400 acres).

    - Two (2) aggregated reservoirs were added to represent the remaining decreed storage not explicitly modeled in Phase II (approximately 4,200 ac-ft).

- Two (2) aggregated stock ponds were added to represent stock pond storage not explicitly modeled in Phase II (approximately 4,800 ac-ft).

- One (1) aggregated municipal and industrial (M&I) demand was added to represent the remaining M&I consumptive use not explicitly modeled in Phase II (approximately 1,100 ac-ft).

- Miscellaneous refinements to the Phase II product (see Section 6.0, Calibration)

Three data sets were developed for the White Model: historic, calculated, and baseline. The historic data set was used to develop baseflows and calibrate parameters such as return flows. It provides results, which allow the modeled hydrology to be checked against recorded streamflows along with the ditch efficiencies and return flow patterns to be evaluated.

The calculated data set uses the historic data set as its foundation, but it allows selected ditch systems and reservoirs to operate by demand. The demands are computed using irrigated acreage and current crop patterns from the State's 1993 geographic information system (GIS) coverage.

The baseline data set uses the calculated data set as its foundation; thus allowing selected ditch systems and reservoirs to operate by demand. A baseline data set has been prepared which, unlike the calibration data set, assumes all existing water resources systems were on line and operational from water years 1975 to 1991. This baseline set is appropriate for evaluating various "what if" scenarios over a long hydrologic time period containing dry, average, and wet hydrologic cycles.

3.3 File Directory Convention

To assist in file organization and maintenance of the official State data, the files associated with a basin model and the Data Managment Interfaces (DMI's) used to generate that data have been organized as follows: (Note these directory conventions are not a requirement of the model, simply a data management convention for official State data. Also, the directory ./Ts_files is often omitted when time series files are stored in the directory where they are used.)

Directory	Description
./statemod/basin_name	Model data and results
./statemod/basin_name/Makenet/	Supporting files for the DMI **makenet**
./statemod/basin_name/Watright/	Supporting files for the DMI **watright**
./statemod/basin_name/Demandts/	Supporting files for the DMI **demandts**
./statemod/basin_name/Tstool/	Supporting files for the DMI **tstool**
./statemod/basin_name/Ts_files	Time series files used to replace or supplement database information.
./statemod/basin_name/GIS/	Supporting files for the GIS program **ArcView**

Where: basin_name = coloupT for the Colorado, gunnT for the Gunnison, sanjuanT for the San Juan, whiteT for the White and yampaT for the Yampa.

3.4 File Naming Convention

Within each basin, several official State data sets are maintained to archive the calibration and simulation phases of modeling as follows: (Note these naming conventions are not a requirement of the model, simply a data management convention for official State data.)

File Name	Description
basin_name.*	Generic basin files
Basin_nameTBF*	Basin files specific to the baseflow generation process.
basin_nameH.*	Basin files specific to the historical data set (e.g. historical diversion and reservoir time series).
basin_nameC.*	Basin files specific to the calculated data set (e.g. calculated demands from the consumptive use model, reservoir targets rather than historical EOM contents).
basin_nameB.*	Basin files specific to the baseline data set (e.g. current conditions for reservoirs and municipal, industrial and transmountain demands).

Where: basin_name = coloupT for the Colorado, gunnT for the Gunnison, sanjuanT for the San Juan, whiteT for the White and yampaT for the Yampa.

3.5 Data Centered Model Development

The water resources planning model data presented in this report was developed using a fully integrated data centered approach which allows information to flow from a central database to StateMod input files using programs called Data Management Interfaces (DMI's). In very general terms, a DMI does the following:

- Takes a user-supplied list of commands and structures to be modeled.
- Accesses the database to select data associated with those structures.
- Revises or adds to information found in the database.
- Formats information for use by the Water Resource Planning Model, StateMod.
- Provides one or more reports of the DMI operation.

The above procedure is extremely efficient because it (1) allows new structures or information to be added quickly and efficiently once the central database is updated, (2) allows the user to focus on the system operation without being burdened with model input formats, (3) is self-documenting by automatically transferring the user-supplied commands file to a header on top of each output file, and (4) recognizes that official data stored in the database often needs enhancement before it can be used for modeling. Two examples of such a required database enhancement are as follows: The San Juan Chama diversion in Division 7 has historically diverted water from Colorado to New Mexico but has no decreed water rights. The Government Highline diversion in Division 5 has historic diversion records that represent several users that must be broken into individual irrigation and power users for modeling purposes.

The following is a summary of the ten steps taken to construct the Gunnison Model input files using a data centered approach.

<u>Step – 1 Network and River Station Files</u> To create the StateMod Network and River Station files, the user must develop a network file *(*.net)* that contains all diversions, reservoirs, instream flow reaches, and streamflow gages to be included in the model, and a file of **makenet** commands

(**commands*). Also, this file contains drainage area and average precipitation data used to prorate gaged streamflow data to ungaged (baseflow) locations. Files created or used by the DMI **makenet** are described below. See the **makenet** and StateMod documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	**Type**	**Description**
**.net*	Input	**Makenet** River Network File
**commands*	Input	**makenet** control file
**.rin*	Output	StateMod River Network File
**.ris*	Output	StateMod River Station File
**.rib*	Output	StateMod Baseflow File
makenet.ord	Output	River Order Report
makenet.ps	Output	River Network Schematic PostScript File
makenet.chk	Output	**makenet** process report summary
makenet.log	Output	**makenet** process report detail

<u>Step – 2 Direct Diversion Structure and Water Right Files</u> To create the StateMod Direct Diversion Structure and Water Right files, the user provides the river network file (**.rin*) provided by Step 1, a file that contains non-default return flow location information (**.rtn*) and a file of watright commands (*dds_commands*). Files created or used by the DMI **watright** in this step are described below. Note the direct diversion file (**.dds*) resulting from this step may be preliminary because the DMI **demandts**, executed in Step 9, allows the structure capacity to be updated based on the maximum recorded diversion. See the **watright** and StateMod documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	**Type**	**Description**
**.rin*	Input from Step 1	StateMod River Network File
**.rtn*	Input	Non-default Return Flow Location File
**commands*	Input	**watright** control file
**.dds*	Output	StateMod Direct Diversion Structure File (preliminary)
**.ddr*	Output	StateMod Direct Diversion Right File
watright.log	Output	**watright** process report detail

<u>Step – 3 Instream Flow Structure, Water Right and Annual Demand Files</u> To create the StateMod Instream Flow Structure, Water Right and Annual Demand files, the user provides the river network file (**.rin*) provided by Step 1 and a file of **watright** commands (*isf_commands*). Files created or used by the DMI **watright** in this step are described below. Note an Instream Flow Annual Demand file can be created in this step because instream flow demands do not generally change over time. See the **watright** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
**.rin*	Input from Step 1	StateMod River Network File
**commands*	Input	**watright** control file
**ifs*	Output	StateMod Instream Flow Structure File
**.ifr*	Output	StateMod Instream Flow Right File
**ifa*	Output	StateMod Instream Flow Annual Demand File
watright.log	Output	**watright** process report detail

<u>Step – 4 Reservoir Structure and Water Right Files</u> To create the StateMod Reservoir Structure and Water Right files, the user provides the river network file (**.rin*) provided by Step 1 and a file of **watright** commands (*res_commands*). Files created or used by the DMI **watright** in this step are described below. See the **watright** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
**.rin*	Input from Step 1	StateMod River Network File
**commands*	Input	**watright** control file
**.rer*	Output	StateMod Instream Flow Right File
**res*	Output	StateMod Instream Flow Structure File
watright.log	Output	**watright** process report detail

<u>Step – 5 Historical Streamflow File</u> To create a StateMod Historical Streamflow File, the user provides a file of **tstool** commands (*commands). Files created or used by the DMI **tstool** in this step are described below. Note all the data required to control data filling is provided to **tstool** and documented in the **commands* file. See the **tstool** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
**commands*	Input	**tstool** control file
**.rih*	Output	StateMod Historical Streamflow File
tstool.log	Output	**tstool** process report detail

<u>Step – 6 Historical End-of-Month Reservoir Content File</u> To create a StateMod Historical End-of-Month Reservoir Content File, the user provides a file of **tstool** commands (**commands*). Files created or used by the DMI **tstool** in this step are described below. Note all the data required to control data filling is provided to **tstool** and documented in the **commands* file. See the **tstool** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
**commands*	Input	**tstool** control file
**.eom*	Output	StateMod Historical End-of-Month Reservoir Content File
tstool.log	Output	**tstool** process reporting

<u>Step – 7 Reservoir Target Contents File</u> To create a StateMod Reservoir Target Contents File, the user provides a file of **tstool** commands (**commands*). Files created or used by the DMI **tstool** in this step are described below. Note all the data required to control data filling is provided to **tstool** and documented in the **commands* file. See the **tstool** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
*commands	Input	**tstool** control file
*.tar	Output	StateMod Reservoir Target file
tstool.log	Output	**tstool** process reporting

<u>Step – 8 Historical Diversion File</u> To create a StateMod Historical Diversion File, the user provides the direct diversion station file (**.dds*) provided by Step 1 and a file of **demandts** commands (**commands*) to generate a file of historical diversions. Files created or used by the DMI **demandts** in this step are described below. Note all the data required to control data filling is provided to **demandts** and documented in the **commands* file. See the **demandts** and **StateMod** documentation for further information pertaining to the format and data contained in each input file and output file, respectively.

File	Type	Description
**commands*	Input	**demandts** control file
**.ddh*	Output	**StateMod** Historical Direct Diversion File
demandts.log	Output	**demandts** process report detail

<u>Step – 9 Demand Files</u> To create StateMod Demand files requires a relatively complicated set of procedures that varies for the Historical, Calculated and Baseline data sets. Other complicating factors include the type of use (agricultural vs. M&I) and whether a structure is modeled explicitly or as a part of an aggregated group. The approach used to develop StateMod demand files utilize the consumptive use model **CRDSS-CU**, the DMI **demandts** and miscellaneous data stored in the central database such as structure location, crop acreage, crop mix and regional temperature and climate. Appendix D, Section D9 describes the development of demand data for StateMod in detail.

<u>Step - 10 Other StateMod Files</u> The remaining input files required for StateMod execution are relatively small and are typically created from an example provided with StateMod program. These files include the response file (*.rsp), operation file (*.opr), delay table file (*.dly), control file

(*.ctl), geographic information system file (*.gis), and output request file (*.out). Details concerning each of these files are discussed in Section 4, Input Description of the StateMod Manual.

4.0 MODELED HISTORIC DATA DESCRIPTION

Three data sets were developed for the White Model: the historic, the calculated, and the baseline. The historic data set was used to develop baseflows and calibrate the model. It provides results that allow the hydrology to be checked and ditch efficiency and return flows to be evaluated. The calculated data set builds upon the historic data set by allowing selected ditch systems and reservoirs to operate by demand rather than by historic diversions or end-of-month (EOM) contents. The baseline data set builds upon the calculated data by allowing reservoirs, structures, and operating rules that were constructed or have changed during the study period to operate in a consistent manner for the entire study period. This chapter describes the historic data set. Chapter 5 describes any changes made for the calculated and baseline data sets.

As described in section 3.2, White River Basin model data was developed in two steps (Phase II and Phase IIIa). A detailed description of the modeling input files can be found in the StateMod Users' Manual. **Appendix A (http://cdss.state.co.us)** contains all of the input files. Appendix B contains discussions concerning those structures that were modeled in a manner that was not consistent with standard modeling procedure. Appendix C contains information that is specific to a structure along with summary discussions on various aspects of the modeling effort. Appendix D contains data associated with the Phase IIIa enhancements.

To simplify the review and maintenance of this document, small tables are included with the text while large tables or those generated by StateMod are included at the end of the chapter. Table numbering corresponds to the section that introduces the table. For example, Table 4.1.1a was the first table referenced in section 4.1.1.

4.1 River System

The White river basin system is described in the Colorado River Decision Support System (CRDSS) White Model by five files:

4.1.1 River Network File - whiteT.rin

The river network file describes the location and connectivity of each river location and structure modeled in the basin. For the White River, the network starts at the headwaters of the North and South Fork of the White River and ends at gage number 09306395, White River near the Colorado-Utah state line. Figure 4.1.1a illustrates the modeled network in terms of the physical river system. **Appendix A (http://cdss.state.co.us)** contains the whiteT.rin file.

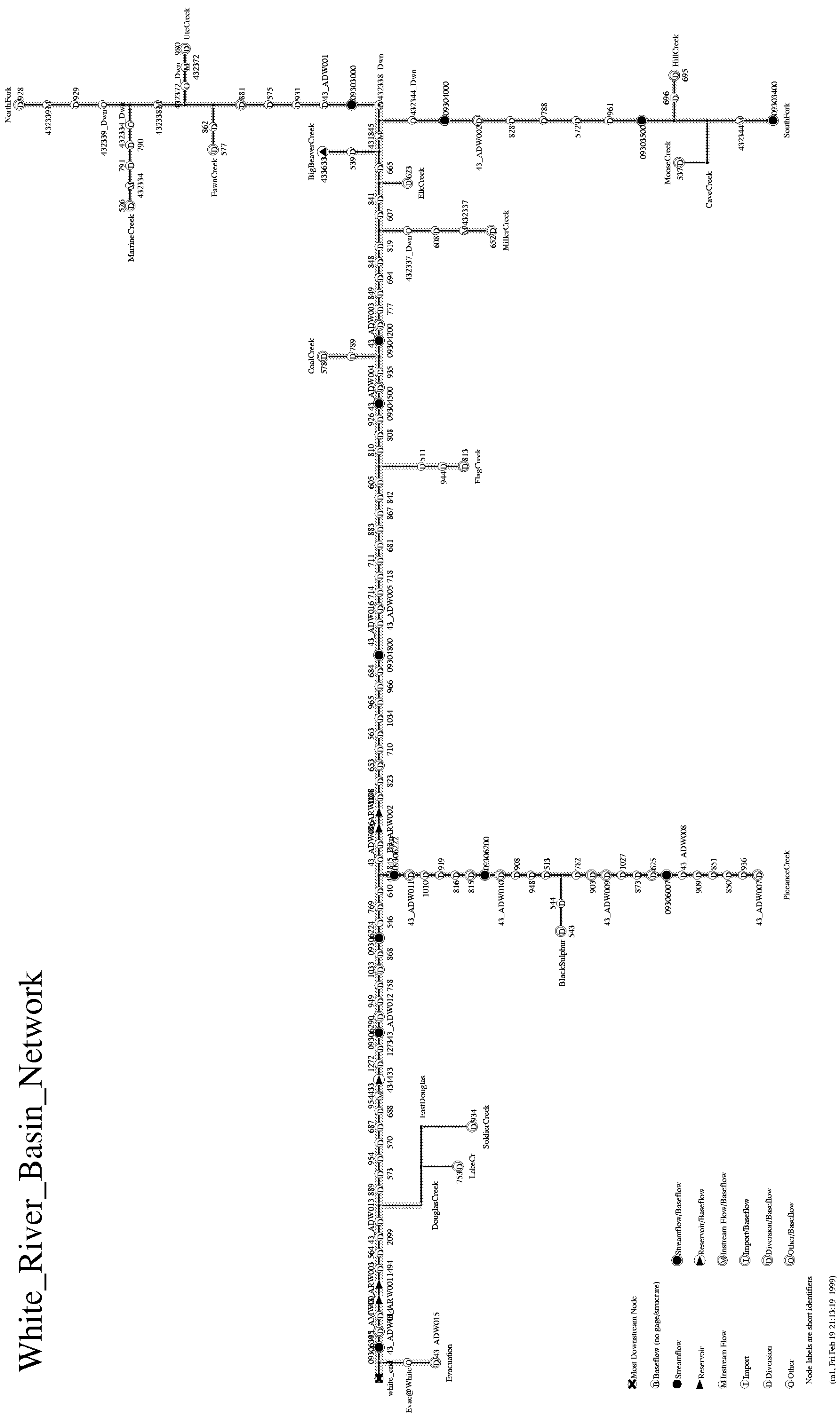

Figure 4.1.1a. Modeled Network

Phase IIIa enhancements which impacted the river network file include the addition of sixteen (16) aggregated irrigation demands, six (6) explicitly modeled structures, two (2) aggregated reservoirs, two (2) aggregated stock ponds, and one (1) aggregated municipal and industrial demand. In addition, the river network was revised to replace 57 explicitly modeled instream flows with seven (7) instream flow reaches. Appendix D, Section D.12 describes these Phase IIIa enhancements. **Table 4.1.1a** shows how these river nodes were divided into various structural and non-structural locations.

Table 4.1.1a

River Network Elements

Type	Number
Diversion	111
Instream Flow	8
Reservoirs	6
USGS Gages	13
Total	138

4.1.2 River Station File - whiteT.ris

The river station file is used to describe the name and location of base streamflow data in the river basin. The number of entries corresponds to the number of time series contained in the base streamflow file whiteH.xbm. These input files are identified in **Appendix A (http://cdss.state.co.us)**. Presented in Table 4.1.1a are gaged flows included at 13 locations throughout the White River basin. In addition, 22 ungaged baseflows were included for a total of forty-five hydrologic inflows to the White Model.

Phase IIIa enhancements which impact the river station file include the addition of one (1) new base flow at a new tributary (43_ADW015 Evacuation Creek) and the deletion of one redundant base flow (430714 on the White River). In addition, 10 base flow nodes were moved from a stream gage to an aggregated node so that total upstream depletions would be represented at the gage while making the gaged amount of water available to the aggregated nodes. These new base flow nodes occurred at the following locations: 43_ADW002, 43_ADW003, 43_ADW004, 43_ADW005, 43_ADW007, 43_ADW009, ADDW_010, 43_ADW011, 43_ADW012, and 43_ADW014. Appendix D, Section D.3 describes these Phase IIIa enhancements.

4.1.3 Base Streamflow File - whiteH.xbm

Base streamflows represent gaged and ungaged streamflows that have had the impact of historic diversions, return flows, and reservoir operations removed. The whiteH.xbm file contains base streamflow estimates from water years 1975 to 1991 within the White River at the locations described in the river station file, whiteT.ris. The base streamflows shown in Table 4.1.3a represent the conditions upon which simulated diversion, reservoir, and minimum streamflow demands are superimposed. This file was generated by the baseflow module of StateMod using historic streamflows, diversions, end-of-month contents of modeled reservoirs, and estimated diversion efficiencies and return flow patterns.

Phase IIIa enhancements, which impact the base streamflow file, include the reevaluation and revision of drainage areas and average precipitation data at selected locations. Appendix D, Section D.13 describes these Phase IIIa enhancements.

TABLE 4.1.3a
Streamflow Comparison
Average (acre-feet/year) 1975-1991

#	ID	Name	Base Streamflow	Historical Streamflow
1	9303000	NF WHITE R AT BUFORD_FLO	238135	235947
2	9303400	SF WHITE R NR BUDGRE_FLO	147632	147632
3	9303500	SF WHITE R NR BUFORD_FLO	194376	193873
4	9304000	SF WHITE R AT BUFORD_FLO	194142	189533
5	9304200	WHITE R AB COAL CREE_FLO	489468	414807
6	9304500	WHITE RIV NR MEEKER _FLO	498963	461026
7	9304800	WHITE R BELOW MEEKER_FLO	518134	496214
8	9306007	PICEANCE CK BL RIO B_FLO	16018	14857
9	9306200	PICEANCE CK BL RYAN _FLO	33547	27967
10	9306222	PICEANCE CK AT WHITE_FLO	36854	32097
11	9306224	WHITE R AB CROOKED W_FLO	573485	544716
12	9306290	WHITE R BL BOISE CRK_FLO	574538	543720
13	9306395	WHITE R NR COLO STAT_FLO	599188	558654

4.1.4 Historic Streamflow File - whiteT.rih

The whiteT.rih file contains historic streamflow records that are used for baseflow generation and model calibration. Appendix C describes the technique used to fill data gaps, along with the data filling results. The locations of streamflow gages modeled are shown in Figure 4.1.1a. For a more detailed discussion on the historic streamflow file, see the StateMod Users' Manual.

Sixteen (16) United States Geological Survey (USGS) streamflow gages were initially identified for inclusion in the White Model. Not all gaging stations were in operation during the entire study period, and of the 16 gaging stations identified, 13 were used. Table 4.1.3a presents the historic flows for the water years 1975-1991 and the average estimated base streamflows at each of the 14 USGS gages used in the baseflow development and model calibration. The difference between baseflow and historic streamflows presented in Table 4.1.3a may be interpreted as historic basin depletions.

4.1.5 Baseflow File - whiteT.rib

The baseflow file contains proration factors that allow baseflows estimated at gaged locations to be distributed to ungaged locations throughout the basin. Proration factors were developed at selected points throughout the river basin using the following guidelines:

- The most upstream diversion structure in each tributary
- Critical points of interest, such as river confluence points
- All reservoir locations

The whiteT.rib input file contains the proration factors used by StateMod to distribute gaged flows throughout the river basin. At a given baseflow location, proration factors were developed using one of two techniques, the gain approach or the nearby gage approach. For the gain approach, proration factors were defined as the fraction of the reach gain that was estimated to be tributary to a baseflow point. These factors were determined by normalizing the local volumetric runoff (local area times local average precipitation) by the corresponding incremental runoff. The incremental runoff was determined by taking the difference of the total volumetric runoff between successive USGS gage locations.

The gain approach was used as the default technique in the White Model. However, at several locations, the prorated hydrograph developed using the gain approach showed an attenuated shape that was not representative of a “natural” hydrograph. This occurred predominantly in the headwater areas where the hydrograph is dominated by runoff from spring snowmelt. In these situations, the nearby gage approach was used. For the nearby gage approach, the proration factor was determined as a function of a stream gage in a neighboring tributary, by comparing the local volumetric runoff. This procedure was applied on Coal Creek, Miller Creek, Big Beaver Creek, Elk Creek, Flag Creek, Black Sulpher Creek, Soldier Creek, Lake Creek and Evacuation Creek. Details concerning these cases can be found in Appendix B**.** The final proration factor file (whiteT.rib) for the StateMod implementation for the White River basin can be found in **Appendix A (http://cdss.state.co.us)**.

Phase IIIa enhancements, which impact the baseflow file, include the reevaluation and revision of drainage areas and average precipitation data at selected locations. In addition, a new baseflow was added at Evacuation Creek. Appendix D, Section D.13 describes these Phase IIIa enhancements.

4.2 Diversions

Five files describe diversions in the White Model:

4.2.1 Direct Diversion Station File - whiteT.dds

The whiteT.dds file describes the physical properties of each diversion simulated in the White Model. As described in Table 4.1.1a, 111 key diversions (see Section 1.2) were modeled. Table 4.2.1a presents the structures that were modeled, their capacity, area served, average annual system efficiency, and average annual demand**.** Structures with zero or -999 acres, zero efficiency, or 100 percent efficiency represent municipal, industrial, and/or transbasin diversions.

The Six-digit structure IDs used by the model and presented on Table 4.1.1a are a combination of water district number and structure ID obtained from DWR's structure and water rights tabulations. Aggregated irrigation structures were identified sequentially as 43_ADW001 for Aggregated Diversion White River basin. Similarly, Aggregated municipal and industrial structures were named 43_AMW001 for Aggregated Municipal White River basin.

System efficiencies describe the percentage of water diverted at a structure headgate that is consumed. The portion of a diversion that is not consumed returns to the stream system and is available for subsequent diversion. Efficiencies were estimated for different structures types as follows:

- For explicitly modeled irrigation structures, a constant efficiency was determined for each month of the year based on the ratio of average historic monthly diversions and the estimated farm irrigation requirement.
- For aggregated irrigation diversions, monthly efficiencies were assigned to be the average acreage weighted efficiency of explicitly modeled structures.
- For explicitly modeled M&I diversions a constant efficiency was determined based on use and engineering judgment.
- For aggregated M&I diversions an efficiency of 100% assigned because it was modeled as a depletion.

Return flow locations specify where return flows will re-enter the stream system. Table 4.2.1b presents the return flow locations and patterns for each structure in the White Model. As presented, all modeled structures use the irrigation delay pattern (1) described in Section 4.2.2 except for four structures, which employ the municipal and industrial return pattern (4). These structures are the Coal Creek Feeder Ditch, the towns of Rangely and Meeker, the California company water plant, and the Aggregated Municipal and Industrial Diversion.

Phase IIIa enhancements which impact the direct diversion file include addition of six (6) explicitly modeled structures, 16 aggregated diversions, and 1 aggregated municipal and industrial diversion. Appendix D, Section D.3 lists the individual structures associated with each aggregated diversion.

Appendix D, Section D.10 describes the development of the aggregated municipal and industrial demands as the difference between M&I diversions explicitly modeled in Phase II and the consumptive use. As presented in the Task memorandum 2.09-11, Non-Evapotranspiration (Other Uses) Consumptive Uses and Losses in the White River Basin (8/16/96).

The data sources for each key field in diversion station file **(**whiteT.dds) are listed below**.**

TABLE 4.2.1c
Direct Flow Diversion Data Source Summary

Key Field	Data Source
Explicit Diversion ID	State Engineer's Office
Aggregated Diversion ID	User defined
Diversion Capacity	State Engineer's Office
Acre Irrigated	State Engineer's Office
Historic Diversions	State Engineer's Office
System Efficiencies	Calculated
Return Flow Locations	W.W. Wheeler

4.2.2 Return Flow Delay File - whiteT.dly

The whiteT.dly file describes the estimated re-entry of return flows into the river system. These lagged times represent the combination of surface and subsurface returns. As presented in Table 4.2.2a, two patterns were used in the White River basin; neither exceeded six months in duration. Agricultural rights were assigned to return flow Pattern 1. Municipal and industrial rights were assigned to return flow Pattern 4. Appendix C, Section 1.3.3 documents the development of the irrigation return flow patterns.

No Phase IIIa enhancements were made which impact the return flow delay file.

TABLE 4.2.2a
Return Flow Properties (percent)

Pattern	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Total
1	75.3	17.0	5.4	1.8	0.5	0	100
4	100	0	0	0	0	0	100

4.2.3 Historic Diversion File - whiteT.ddh

Historic diversions are used to estimate baseflows and for calibration. The historical diversion data file summarized in Table 4.2.1a**,** introduced in Section 4.2.1, contains historic diversion estimates for each of the structures modeled in the basin.

The historic diversion file was developed using the Data Management Interface (DMI) ***demandts*** for different structure types as follows*:*

- For explicitly modeled irrigation and M&I structures, the DMI ***demandts*** accesses the CRDSS database for historic diversion records. Missing monthly values were filled with the average diversion if the structure existed during the study period or zero if it had not been constructed.
- For aggregated irrigation structures, the DMI ***demandts*** reads a consumptive irrigation requirement estimate and basin wide system efficiency to develop an estimated historic diversion time series.
- For aggregated M&I diversions, historic diversions were estimated to equal their estimated depletion since they are modeled with an efficiency of 100%.

Phase IIIa enhancements which impact the historic diversion file include the addition of 16 aggregated diversions, 6 explicitly modeled structures and 1 aggregated municipal diversion. Appendix D, Section D.9 describes these Phase IIIa enhancements.

4.2.4 Direct Diversion Demand File - whiteH.ddm

The whiteH.ddm file contains monthly direct flow demands for each structure modeled in the White Model. For the historical data set, demands were estimated to equal historical diversions. Chapter 5 describes how demands were estimated for the calculated and baseline data.

Phase IIIa enhancements which impact the direct diversion demand file are associated with the addition of 16 aggregated diversions, 6 explicitly modeled structures and 1 aggregated municipal diversion. Appendix D, Section D.9 describes these Phase IIIa enhancements.

4.2.5 Direct Diversion Right File - whiteT.ddr

The whiteT.ddr file contains water rights information for each structure in the direct diversion station file, whiteT.dds. Table 4.2.5a presents the administration number and decreed amount for each structure modeled. They were determined for different structure types as follows:

- Explicitly modeled irrigation and M&I water rights were taken from the CRDSS database and correspond to the State Engineer's official water rights tabulation
- Free water rights, with an extremely junior administration number of 999999.00000, were added whenever historic diversions were observed to exceed decreed rights during calibration.
- Aggregated irrigation rights were assigned a weighted administration number for each of 8 water right classes based on water rights associated with an aggregated group and their decreed amount tabulated in the CRDSS database. Water right classes were determined using historic call information and incremental right sizes (see Appendix D, Section D.5).
- Aggregated M&I water rights, modeled as a depletion, were assigned an amount equal to their depletion and assigned a very senior administration number of 1.00000.

Phase IIIa enhancements which impact the direct diversion right file include the addition of 16 aggregated diversions, 6 explicitly modeled structures and 1 aggregated municipal diversion. Appendix D, Section D.5 describes these Phase IIIa enhancements.

4.3 Reservoirs

Five input files describe reservoirs in the White Model:

4.3.1 Reservoir Station File - whiteT.res

The whiteT.res file describes the physical properties of each reservoir simulated in the White River basin. **Table 4.3.1a** summarizes the key data associated with the two reservoirs modeled. Aggregated reservoirs (reservoirs 3 and 4) were added in Phase IIIa to represent decreed storage not modeled explicitly. Aggregated stock ponds (reservoirs 5 and 6) were added in Phase IIIa to represent stock pond consumptive use. Both the aggregate reservoirs and stock ponds were separated into two structures each (4 total) and located at the following: one on the White River above the state line gage and another above the confluence with Piceance Creek. These general locations were selected based on reservoir locations and stock pond assignment to Hydrologic Units.

Table 4.3.1a
Reservoir Summary

#	ID	Name	Cap. (af)	# Owners
1	433633	BIG BEAVER CK RESERVOIR	7658	1
2	434433	TAYLOR DRAW RES	13800	1
3	43_ARW001	43_ARC001	2117	1
4	43_ARW002	43_ARC002	2117	1
5	43_ARW003	43_ARC003	2388	1
6	43_ARW004	43_ARC004	2388	1

Available data related to the physical capacity of the selected reservoirs included dead storage, where applicable, and total active storage, which were both operated to provide an adequate recreation pool. As **Table 4.3.1b** shows, these data were obtained from various sources, including the reservoir owners, the division engineers, and filing maps associated with the storage rights for the reservoir.

TABLE 4.3.1b
Reservoir Source Summary

Key Field	Data Source
Structure Storage Capacity	Owners/Division Engineer
Number of Owners	Owners/Division Engineer
Area Capacity Tables	Owners/Division Engineer

For all reservoirs, the One Fill Rule Administration date was assigned to be November 1. Taylor Draw and Big Beaver Reservoirs (explicitly modeled structures) had their area capacity data obtained from owners or as built drawings. Aggregated reservoirs and stock ponds were assigned a simple 2 point area capacity curve which assumed an average depth of 10 feet.

Phase IIIa enhancements which impact the reservoir station include the addition of two aggregated reservoirs and two aggregated stock ponds. Appendix D, Section D.11 describes these Phase IIIa enhancements.

4.3.2 Net Evaporation File - whiteT.eva

The evaporation file (whiteT.eva) contains annual evaporation data (12 average values for every year). The annual net evaporation file was estimated by subtracting the weighted average effective monthly precipitation from the estimated gross monthly free water surface evaporation. The following precipitation station was used in the calculation of annual net reservoir evaporation for each of the White reservoirs:

- Meeker

Annual estimates of gross free water surface evaporation were taken from National Oceanic and Atmospheric Administration (NOAA) Technical Report NWS 33. The annual estimates of evaporation were distributed to monthly values based on elevation through the distributions listed in **Table 4.3.2a**. These monthly distributions are those used by the State Engineer's Office.

TABLE 4.3.2a
Monthly Distribution of Evaporation as a Function of Elevation (percent)

Month	greater than 6,500 ft	less than 6,500 ft
Jan	3.0	1.0
Feb	3.5	3.0
Mar	5.5	6.0
Apr	9.0	9.0
May	12.0	12.5
Jun	14.5	15.5
Jul	15.0	16.0
Aug	13.5	13.0
Sep	10.0	11.0
Oct	7.0	7.5
Nov	4.0	4.0
Dec	3.0	1.5

Table 4.3.2b shows the net monthly free water surface evaporation estimates for the White Model. Note negative values in the winter indicate more precipitation than evaporation.

TABLE 4.3.2b
Net Monthly Free Water Surface Evaporation (inches)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Net Evap	.13	.04	-.05	-.06	.02	.09	.16	.30	.41	.41	.27	.24

No Phase IIIa enhancements were made which impacted the annual net evaporation file.

4.3.3 Reservoir End-of-Month Content File - whiteT.eom

The historic end-of-month (EOM) reservoir contents for the water years 1975-1991 for each reservoir modeled in the White River basin are used by the baseflow simulation component to simulate reservoir storage and evaporation impacts on gaged streamflows. Historic EOM contents are also used in the historic reservoir target file and for calibration.

All reservoirs, except Taylor Draw, were modeled as operating for the entire study period (1975 - 1991). Taylor Draw was modeled beginning in December 1984 to correspond to its completion date. EOM content for Taylor Draw and Big Beaver (explicitly modeled structures) were estimated to be full because they are used for recreation only. EOM content for the aggregated stock ponds were estimated to be full because historical data is unavailable. EOM content for the aggregated reservoirs were assigned their estimated operation as follows: 100% full from October to June, 75% full in July, 50% full in August and empty in September. This seasonal operation schedule was developed to simulate historic reservoir use for irrigation.

Phase IIIa enhancements which impact the reservoir EOM file include the addition of two aggregated reservoirs and two aggregated stock ponds. Appendix D, Section D.11 describes these Phase IIIa enhancements.

4.3.4 Reservoir Target File - whiteTH.tar

Reservoir EOM targets (or monthly rule curves) provide reservoir operation data to the White Model. The historic data set targets were set to the EOM contents. Chapter 5 describes the targets used for the calculated and baseline data sets.

Phase IIIa enhancements which impact the reservoir target file include the addition of two aggregated reservoirs and two aggregated stock ponds. Appendix D, Section D.11 describes these Phase IIIa enhancements.

4.3.5 Reservoir Right File - whiteT.rer

The whiteT.rer file contains the water rights associated with each reservoir in the Reservoir Station File (whiteT.res). Table 4.3.5a summarizes the administration number, decreed amount, and whether it is used as a first or second fill for each structure modeled. They were determined for different structure types as follows:

- Explicitly modeled reservoir water rights were taken from the CRDSS database and correspond to the State Engineer's official water rights tabulation.
- Aggregated reservoir rights were assigned a weighted administration number for each of 8 water right classes based on water rights tabulated in the CRDSS database. Water right classes were the same as those used for aggregated irrigation diversions (see Appendix D, Section D.5).
- Aggregated stock pond rights were assigned an amount equal to their capacity and a very senior administration number of 1.00000.

Phase IIIa enhancements which impact the reservoir right file include the addition of two aggregated reservoirs and two aggregated stock ponds. Appendix D, Section D.11describes these Phase IIIa enhancements.

4.4 Instream Flows

Instream flows are described in the CRDSS White Model by three files:

- *4.4.1 Instream Station File*
- *4.4.2 Instream Demand File*
- *4.4.3 Instream Right File*

4.4.1 Instream Station File - whiteT.isf

Table 4.4.1a shows the instream flow **reaches** included in the White Model along with their location and average annual demand. Section 4.4.2 describes how instream demands were estimated.

Phase IIIa enhancements which impact the instream station include replacing 37 instream points with six- (6) instream flow reaches. This enhancement was implemented to satisfy instream flow decree requirements and required a revision to the StateMod program. In addition one (1) new instream flow reach was added for Ute Creek which was inadvertently omitted in Phase II. Appendix D Section D.1 and D.12 describe these Phase IIIa enhancements.

4.4.2 Instream Demand File - whiteT.ifa

The instream flow demands were developed from decreed amounts and comments in the state engineer's water rights tabulation. Twelve monthly instream flow demands were used for each year of the simulation. The whiteT.ifa contains monthly demands for each instream flow structure included in the White Model.

Phase IIIa enhancements, which impact the instream demand file, are the same as described in section 4.4.1. Appendix D Section D.1 and D.12 describe these Phase IIIa enhancements.

4.4.3 Instream Right File - whiteT.ifr

Water rights for each instream flow modeled in the White River basin are contained in the whiteT.ifr file. Table 4.4.3a summarizes the administration number and decreed amount for each instream flow structure modeled which were obtained from the CRDSS database and correspond to the State Engineer's official water rights tabulation.

Phase IIIa enhancements which impact the instream right file are the same as described in Section 4.4.1, Appendix D Section D.1 and D.12 describe these Phase IIIa enhancements.

4.5 Operating Criteria File

The operations file describes unique operational rules required to operate reservoirs, diversions and instream flows in a river basin. The operational file (whiteTH.opr) for the StateMod implementation of the White River Basin was developed from interviews with the Division Engineer on April 26, 1995 and engineering judgment. To simplify review, they are arranged by water supply into the following:

- 4.5.1 Ryan and Square S Ditch

4.5.1 Ryan and Square S Ditch

Ryan Ditch, located on Piceance Creek, diverts under the Square S water rights on Piceance Creek. The operating rules required to administer this operation are displayed on **Table 4.5.1a.** Note the first six are required to allow each of the 6 Square S water rights to divert to itself (the Square S), while the last 6 allow each Square S water right to serve Ryan Ditch.

TABLE 4.5.1a
Square S and Ryan Ditch Operating Rules

#	Rule Name	Administration Number	On/ Off	Destination ID	Destination Name	Rule Type	Rule Description
1	Opr Square S to itself	12571.00000	1	430948	SQUARE S CONS D SYS	11	Carrier
2	Opr Square S to itself	12756.00000	1	430948	SQUARE S CONS D SYS	11	Carrier
3	Opr Square S to itself	13270.00000	1	430948	SQUARE S CONS D SYS	11	Carrier
4	Opr Square S to itself	13274.00000	1	430948	SQUARE S CONS D SYS	11	Carrier
5	Opr Square S to itself	13509.00000	1	430948	SQUARE S CONS D SYS	11	Carrier
6	Opr Square S to itself	32172.24592	1	430948	SQUARE S CONS D SYS	11	Carrier
7	Opr Square S to RYAN D	12571.00000	1	430908	RYAN DITCH	11	Carrier
8	Opr Square S to RYAN D	12756.00000	1	430908	RYAN DITCH	11	Carrier
9	Opr Square S to RYAN D	13270.00000	1	430908	RYAN DITCH	11	Carrier
10	Opr Square S to RYAN D	13274.00000	1	430908	RYAN DITCH	11	Carrier
11	Opr Square S to RYAN D	13509.00000	1	430908	RYAN DITCH	11	Carrier
12	Opr Square S to RYAN D	32172.24592	1	430908	RYAN DITCH	11	Carrier

TABLE 4.2.1a
Direct Flow Diversion Summary
Average 1975-1991

#	Mode ID#	Name	Cap (cfs)	Area (acres)	Monthly Average System Efficiency (percent)	Average Annual Demand (af)
1	430511	B A & B DITCH NO 1	9	92	8	1423
2	430513	B M & H DITCH 1	10	217	33	787
3	430526	BARBOUR NORTH SIDE D	8	23	2	1361
4	430537	BECKMAN DITCH	17	301	21	1895
5	430539	BIG BEAVER DITCH	5	66	6	1320
6	430543	BLACK EAGLE D NO 1	6	36	12	318
7	430544	BLACK EAGLE D NO 2	6	61	21	308
8	430546	BLAIR DITCH	13	191	25	1213
9	430563	CALHOUN DITCH	8	71	42	289
10	430564	CALIFORNIA CO WATER PL	14	-999	100	3831
11	430570	CALVAT DITCH	8	35	14	735
12	430572	CHARLIE SMITH DITCH	16	140	18	1039
13	430573	CHASE & COLTHARP D	20	89	27	795
14	430575	CLOHERTY DITCH	7	44	16	778
15	430577	COAL CREEK FEEDER DITCH	25	-999	0	728
16	430578	COAL CREEK MESA DITCH	63	688	30	3162
17	430605	DORRELL DITCH 2	2	59	29	371
18	430607	DREIFUSS DITCH	15	75	8	1270
19	430608	DREYFUSS DITCH	6	77	7	1197
20	430623	ELK CREEK DITCH	8	154	20	931
21	430625	EMILY DITCH	6	110	13	873
22	430640	FORNEY CORCORAN DITCH	11	142	18	1164
23	430652	G V DITCH	7	49	5	1389
24	430653	GEORGE S WITTER DITCH	15	141	20	1527
25	430665	GREENSTREET DITCH EXT	9	93	18	560
26	430681	HAY BRETHERTON DITCH	22	265	7	4832
27	430684	HAY DITCH 2	5	46	10	624
28	430687	HEFLEY PUMP PLANT NO 1	16	191	52	638
29	430688	HEFLEY PUMP PLANT NO 2	20	79	26	645
30	430694	HIGHLAND DITCH	249	1851	6	34244
31	430695	HILL CREEK NO 3 DITCH	10	52	16	823
32	430696	HILL CREEK NO 2 DITCH	15	77	7	1925
33	430710	IMES & REYNOLDS DITCH	24	153	9	2308
34	430711	INDEPENDENT DITCH	5	114	27	511
35	430714	IVO E SHULTS D & PUMP	5	22	4	450

TABLE 4.2.1a
Direct Flow Diversion Summary
Average 1975-1991

#	Mode ID#	Name	Cap (cfs)	Area (acres)	Monthly Average System Efficiency (percent)	Average Annual Demand (af)
36	430718	JAMES HAYES DITCH	4	144	13	1396
37	430753	LAKE CREEK POOL DITCH	7	12	8	286
38	430758	LAWRENCE DITCH NO 1	5	82	28	577
39	430769	LITTLE DITCH	10	186	12	2069
40	430777	LOWLAND DITCH	8	73	5	2137
41	430782	M H M GERMAN CONS D	18	255	31	852
42	430788	MARCOTT DITCH	22	235	11	3956
43	430789	MARTIN DITCH	9	21	5	1138
44	430790	MARVINE DITCH 1	10	81	20	606
45	430791	MARVINE DITCH 3	5	26	7	468
46	430808	MEEKER DITCH	26	129	3	4635
47	430810	MEEKER WATER SYS PL	7	-999	30	624
48	430813	MELVIN DITCH	16	65	19	397
49	430815	METZ & REIGAN DITCH	3	68	7	1019
50	430816	METZ DITCH	2	73	8	943
51	430819	MILLER CREEK DITCH	124	2226	9	29673
52	430823	MINER MARTIN DITCH	5	50	13	538
53	430828	MOONEY DITCH	10	89	18	951
54	430841	NEW ARCHER WARNER DITCH	5	54	12	833
55	430842	NIBLOCK DITCH	83	1384	13	13878
56	430848	OAK RIDGE PARK DITCH	133	1864	10	23423
57	430849	OLD AGENCY DITCH	35	567	9	7666
58	430850	OLDLAND DITCH 1	7	120	13	945
59	430851	OLDLAND DITCH 2	9	31	5	702
60	430862	PATTISON DITCH NO 1	7	67	21	489
61	430867	PEASE DITCH	26	229	7	4607
62	430868	PEDRICK DITCH	20	364	16	2850
63	430873	PICEANCE CREEK DITCH	4	112	12	960
64	430881	POTHOLE DITCH	8	89	12	985
65	430883	POWELL PARK DITCH	83	1784	17	13064
66	430889	RANGELY WATER PLANT	31	-999	30	1083
67	430903	ROBERT MCKEE DITCH	6	138	11	1348
68	430908	RYAN DITCH	14	98	43	221
69	430909	RYE GRASS DITCH	8	164	21	850
70	430919	SAYER DITCH	6	27	10	386
71	430926	SHERIDAN & MORTON D	7	35	21	895

TABLE 4.2.1a
Direct Flow Diversion Summary
Average 1975-1991

#	Mode ID#	Name	Cap (cfs)	Area (acres)	Monthly Average System Efficiency (percent)	Average Annual Demand (af)
72	430928	SIMPSON DITCH	5	35	8	597
73	430929	SIZEMORE DITCH 1	5	26	9	413
74	430931	SKELTON DITCH	8	13	1	1103
75	430934	SOLDIER CREEK DITCH	7	57	27	418
76	430935	SOUTH SIDE HIGHLINE D	33	428	7	6644
77	430936	SPAULDING D	5	41	9	479
78	430944	SPROD DITCH 1	6	140	21	887
79	430948	SQUARE S CONS D SYS	29	303	17	1896
80	430949	STADTMAN DITCH	12	52	30	524
81	430954	STOREY DITCH 1	10	72	51	270
82	430961	SWEEDE DITCH	21	220	16	2261
83	430965	THOMAS DITCH	7	75	30	415
84	430966	THOMAS DITCH 2	10	70	31	305
85	430980	UTE CREEK DITCH	9	61	3	2850
86	431010	WHITE RIVER MESA DITCH	13	119	19	718
87	431027	BELOT MOFFAT DITCH	13	117	11	1215
88	431033	LAWRENCE DITCH	5	87	38	553
89	431034	MCDOWELL DITCH	8	131	35	496
90	431108	JACOBS PUMP & PL	4	99	29	451
91	431272	COX_PUMP_NO_1	18	205	44	980
92	431273	REIGAN_PUMP_NO_1	6	124	55	477
93	431494	GOFF DITCH	10	66	28	604
94	432099	KENNEY PUMP NO 1	14	98	32	672
95	43_ADW001	NORT_ADW WhiteNorthF	27	260	13	2260
96	43_ADW002	SOUT_ADW WhiteSouthF	19	246	13	2142
97	43_ADW003	WHIT_ADW WhiteAbCole	46	596	13	5181
98	43_ADW004	WHIT_ADW WhiteNrMeek	23	452	13	3932
99	43_ADW005	WHIT_ADW WhiteNBLMee	10	156	13	1354
100	43_ADW006	WHIT_ADW WhiteAbPice	5	94	13	817
101	43_ADW007	PICE_ADW PicCrUpper	34	425	13	3695
102	43_ADW008	PICE_ADW PicCrBlRioB	17	181	13	1571
103	43_ADW009	PICE_ADW PicCrAbHunt	38	460	13	3998
104	43_ADW010	PICE_ADW PicCrBlRyan	28	551	13	4789
105	43_ADW011	PICE_ADW Piceance@Wh	999	317	13	2759
106	43_ADW012	WHIT_ADW WhiteBlBois	999	617	13	5363
107	43_ADW013	WHIT_ADW WhiteBlDoug	37	504	13	4383

TABLE 4.2.1a
Direct Flow Diversion Summary
Average 1975-1991

#	Mode ID#	Name	Cap (cfs)	Area (acres)	Monthly Average System Efficiency (percent)	Average Annual Demand (af)
108	43_ADW014	WHIT_ADW WhiteNrStat	40	430	13	3738
109	43_ADW015	EVAC_ADW Evac Creek	16	151	13	1311
110	43_ADW016	WHIT_ADW WhiteSBLMee	25	410	13	3565
111	43_AMW001	43_AMW001_AGG_M&I	999	-999	100	1104

TABLE 4.2.1b
Return Flow Summary

#	Structure: ID	Name	Returns To: ID	Name	%	Pattern
1	430511	B A & B DITCH NO 1	430605	TRIB_DORRELL DITCH 2_DIV	100	1
2	430513	B M & H DITCH 1	430948	PICE_SQUARE S CONS D_DIV	100	1
3	430526	BARBOUR NORTH SIDE D	432334	MARVINE CREEK MSF _ISF	100	1
4	430537	BECKMAN DITCH	9303500	SF WHITE R NR BUFORD_FLO	100	1
5	430539	BIG BEAVER DITCH	430665	WHIT_GREENSTREET DIT_DIV	75	1
			430841	WHIT_NEW ARCHER WARN_DIV	25	1
6	430543	BLACK EAGLE D NO 1	430544	BLAC_BLACK EAGLE D N_DIV	100	1
7	430544	BLACK EAGLE D NO 2	430513	PICE_B M & H DITCH 1_DIV	100	1
8	430546	BLAIR DITCH	9306224	WHITE R AB CROOKED W_FLO	100	1
9	430563	CALHOUN DITCH	430710	WHIT_IMES & REYNOLDS_DIV	100	1
10	430564	CALIFORNIA CO WATER PL	431494	WHIT_GOFF DITCH _DIV	100	4
11	430570	CALVAT DITCH	430954	WHIT_STOREY DITCH 1 _DIV	100	1
12	430572	CHARLIE SMITH DITCH	430788	SOUT_MARCOTT DITCH _DIV	100	1
13	430573	CHASE & COLTHARP D	430889	WHIT_RANGELY WATER P_DIV	100	1
14	430575	CLOHERTY DITCH	430665	WHIT_GREENSTREET DIT_DIV	75	1
			430931	NORT_SKELTON DITCH _DIV	25	1
15	430577	COAL CREEK FEEDER DITCH	430578	COAL_COAL CREEK MESA_DIV	100	4
16	430578	COAL CREEK MESA DITCH	430848	WHIT_OAK RIDGE PARK _DIV	100	1
17	430605	DORRELL DITCH 2	430842	WHIT_NIBLOCK DITCH _DIV	100	1
18	430607	DREIFUSS DITCH	430848	WHIT_OAK RIDGE PARK _DIV	100	1
19	430608	DREYFUSS DITCH	432337_Dwn	MILLER CRK MSF DOWN _OTH	100	1
20	430623	ELK CREEK DITCH	430841	WHIT_NEW ARCHER WARN_DIV	100	1
21	430625	EMILY DITCH	430873	PICE_PICEANCE CREEK _DIV	100	1
22	430640	FORNEY CORCORAN DITCH	430769	WHIT_LITTLE DITCH _DIV	100	1
23	430652	G V DITCH	432337	MILLER CK MSF _ISF	100	1
24	430653	GEORGE S WITTER DITCH	430823	WHIT_MINER MARTIN DI_DIV	100	1
25	430665	GREENSTREET DITCH EXT	430841	WHIT_NEW ARCHER WARN_DIV	100	1
26	430681	HAY BRETHERTON DITCH	430714	WHIT_IVO E SHULTS D _DIV	100	1
27	430684	HAY DITCH 2	430966	WHIT_THOMAS DITCH 2 _DIV	100	1
28	430687	HEFLEY PUMP PLANT NO 1	430570	WHIT_CALVAT DITCH _DIV	100	1
29	430688	HEFLEY PUMP PLANT NO 2	430687	WHIT_HEFLEY PUMP PLA_DIV	100	1
30	430694	HIGHLAND DITCH	430935	WHIT_SOUTH SIDE HIGH_DIV	90	1
			430926	WHIT_SHERIDAN & MORT_DIV	10	1
31	430695	HILL CREEK NO 3 DITCH	430696	HILL_HILL CREEK NO 2_DIV	100	1
32	430696	HILL CREEK NO 2 DITCH	9303500	SF WHITE R NR BUFORD_FLO	100	1

TABLE 4.2.1b
Return Flow Summary

#	Structure: ID	Name	Returns To: ID	Name	%	Pattern
33	430710	IMES & REYNOLDS DITCH	430653	WHIT_GEORGE S WITTER_DIV	100	1
34	430711	INDEPENDENT DITCH	430718	WHIT_JAMES HAYES DIT_DIV	100	1
35	430714	IVO E SHULTS D & PUMP	43_ADW005	WHIT_ADW WhiteNBLMee_DIV	100	1
36	430718	JAMES HAYES DITCH	430714	WHIT_IVO E SHULTS D _DIV	100	1
37	430753	LAKE CREEK POOL DITCH	43_ADW013	WHIT_ADW WhiteBlDoug_DIV	100	1
38	430758	LAWRENCE DITCH NO 1	430949	WHIT_STADTMAN DITCH _DIV	100	1
39	430769	LITTLE DITCH	430546	WHIT_BLAIR DITCH _DIV	100	1
40	430777	LOWLAND DITCH	43_ADW003	WHIT_ADW WhiteAbCole_DIV	100	1
41	430782	M H M GERMAN CONS D	430513	PICE_B M & H DITCH 1_DIV	100	1
42	430788	MARCOTT DITCH	430665	WHIT_GREENSTREET DIT_DIV	80	1
			430828	SOUT_MOONEY DITCH _DIV	20	1
43	430789	MARTIN DITCH	430935	WHIT_SOUTH SIDE HIGH_DIV	100	1
44	430790	MARVINE DITCH 1	432334_Dwn	MARVINE CREEK MSF DW_OTH	100	1
45	430791	MARVINE DITCH 3	430790	MARV_MARVINE DITCH 1_DIV	100	1
46	430808	MEEKER DITCH	430842	WHIT_NIBLOCK DITCH _DIV	100	1
47	430810	MEEKER WATER SYS PL	430605	TRIB_DORRELL DITCH 2_DIV	100	4
48	430813	MELVIN DITCH	430944	FLAG_SPROD DITCH 1 _DIV	100	1
49	430815	METZ & REIGAN DITCH	430919	PICE_SAYER DITCH _DIV	100	1
50	430816	METZ DITCH	430919	PICE_SAYER DITCH _DIV	100	1
51	430819	MILLER CREEK DITCH	430926	WHIT_SHERIDAN & MORT_DIV	10	1
			430842	WHIT_NIBLOCK DITCH _DIV	40	1
			430694	WHIT_HIGHLAND DITCH _DIV	50	1
52	430823	MINER MARTIN DITCH	431108	WHIT_JACOBS PUMP & P_DIV	100	1
53	430828	MOONEY DITCH	43_ADW002	SOUT_ADW WhiteSouthF_DIV	100	1
54	430841	NEW ARCHER WARNER DITCH	430607	WHIT_DREIFUSS DITCH _DIV	100	1
55	430842	NIBLOCK DITCH	430867	WHIT_PEASE DITCH _DIV	10	1
			430714	WHIT_IVO E SHULTS D _DIV	75	1
			430883	WHIT_POWELL PARK DIT_DIV	15	1
56	430848	OAK RIDGE PARK DITCH	430789	COAL_MARTIN DITCH _DIV	85	1
			430849	WHIT_OLD AGENCY DITC_DIV	15	1
57	430849	OLD AGENCY DITCH	430777	WHIT_LOWLAND DITCH _DIV	100	1
58	430850	OLDLAND DITCH 1	430851	PICE_OLDLAND DITCH 2_DIV	50	1
			430909	PICE_RYE GRASS DITCH_DIV	50	1
59	430851	OLDLAND DITCH 2	430909	PICE_RYE GRASS DITCH_DIV	100	1
60	430862	PATTISON DITCH NO 1	430881	NORT_POTHOLE DITCH _DIV	100	1

TABLE 4.2.1b
Return Flow Summary

#	Structure: ID	Name	Returns To: ID	Name	%	Pattern
61	430867	PEASE DITCH	430714	WHIT_IVO E SHULTS D _DIV	50	1
			430681	WHIT_HAY BRETHERTON _DIV	50	1
62	430868	PEDRICK DITCH	431033	WHIT_LAWRENCE DITCH _DIV	100	1
63	430873	PICEANCE CREEK DITCH	431027	PICE_BELOT MOFFAT DI_DIV	100	1
64	430881	POTHOLE DITCH	430575	NORT_CLOHERTY DITCH _DIV	100	1
65	430883	POWELL PARK DITCH	430714	WHIT_IVO E SHULTS D _DIV	85	1
			430711	WHIT_INDEPENDENT DIT_DIV	15	1
66	430889	RANGELY WATER PLANT	432099	WHIT_KENNEY PUMP NO _DIV	100	4
67	430903	ROBERT MCKEE DITCH	430782	PICE_M H M GERMAN CO_DIV	65	1
			430513	PICE_B M & H DITCH 1_DIV	35	1
68	430908	RYAN DITCH	43_ADW010	PICE_ADW PicCrBlRyan_DIV	100	1
69	430909	RYE GRASS DITCH	43_ADW008	PICE_ADW PicCrBlRioB_DIV	100	1
70	430919	SAYER DITCH	431010	PICE_WHITE RIVER MES_DIV	100	1
71	430926	SHERIDAN & MORTON D	430808	WHIT_MEEKER DITCH _DIV	70	1
			430842	WHIT_NIBLOCK DITCH _DIV	30	1
72	430928	SIMPSON DITCH	432339	NORTH FK WHITE R MSF_ISF	100	1
73	430929	SIZEMORE DITCH 1	432339_Dwn	NF WHITE MSF DOWN _OTH	100	1
74	430931	SKELTON DITCH	43_ADW001	NORT_ADW WhiteNorthF_DIV	100	1
75	430934	SOLDIER CREEK DITCH	43_ADW013	WHIT_ADW WhiteBlDoug_DIV	100	1
76	430935	SOUTH SIDE HIGHLINE D	430926	WHIT_SHERIDAN & MORT_DIV	15	1
			430808	WHIT_MEEKER DITCH _DIV	35	1
			430842	WHIT_NIBLOCK DITCH _DIV	50	1
77	430936	SPAULDING D	430850	PICE_OLDLAND DITCH 1_DIV	100	1
78	430944	SPROD DITCH 1	430842	WHIT_NIBLOCK DITCH _DIV	60	1
			430511	FLAG_B A & B DITCH N_DIV	40	1
79	430948	SQUARE S CONS D SYS	430815	PICE_METZ & REIGAN D_DIV	100	1
80	430949	STADTMAN DITCH	43_ADW012	WHIT_ADW WhiteBlBois_DIV	100	1
81	430954	STOREY DITCH 1	430573	WHIT_CHASE & COLTHAR_DIV	100	1
82	430961	SWEEDE DITCH	430572	SOUT_CHARLIE SMITH D_DIV	85	1
			430788	SOUT_MARCOTT DITCH _DIV	15	1
83	430965	THOMAS DITCH	431034	WHIT_MCDOWELL DITCH _DIV	100	1
84	430966	THOMAS DITCH 2	430563	WHIT_CALHOUN DITCH _DIV	80	1
			431034	WHIT_MCDOWELL DITCH _DIV	20	1
85	430980	UTE CREEK DITCH	432372	UTE CREEK MSF _ISF	100	1
86	431010	WHITE RIVER MESA DITCH	43_ADW011	PICE_ADW Piceance@Wh_DIV	100	1

TABLE 4.2.1b
Return Flow Summary

#	Structure: ID	Name	Returns To: ID	Name	%	Pattern
87	431027	BELOT MOFFAT DITCH	430903	PICE_ROBERT MCKEE DI_DIV	100	1
88	431033	LAWRENCE DITCH	431273	WHIT_REIGAN PUMP NO _DIV	100	1
89	431034	MCDOWELL DITCH	430563	WHIT_CALHOUN DITCH _DIV	100	1
90	431108	JACOBS PUMP & PL	43_ARW004	WHIT_ARW AggStkAbPic_RES	100	1
91	431272	COX_PUMP_NO_1	434433	WHIT_TAYLOR DRAW RES_RES	100	1
92	431273	REIGAN_PUMP_NO_1	431272	WHIT_COX PUMP NO 1 _DIV	100	1
93	431494	GOFF DITCH	43_ARW003	WHIT_ARW AggStkNrSta_RES	100	1
94	432099	KENNEY PUMP NO 1	430564	WHIT_CALIFORNIA CO W_DIV	100	1
95	43_ADW001	NORT_ADW WhiteNorthF	9303000	NF WHITE R AT BUFORD_FLO	100	1
96	43_ADW002	SOUT_ADW WhiteSouthF	9304000	SF WHITE R AT BUFORD_FLO	100	1
97	43_ADW003	WHIT_ADW WhiteAbCole	9304200	WHITE R AB COAL CREE_FLO	100	1
98	43_ADW004	WHIT_ADW WhiteNrMeek	9304500	WHITE RIV NR MEEKER _FLO	100	1
99	43_ADW005	WHIT_ADW WhiteNBLMee	9304800	WHITE R BELOW MEEKER_FLO	100	1
100	43_ADW006	WHIT_ADW WhiteAbPice	431845_Dwn	WHITE RIVER MSF DOWN_OTH	100	1
101	43_ADW007	PICE_ADW PicCrUpper	430936	PICE_SPAULDING D _DIV	100	1
102	43_ADW008	PICE_ADW PicCrBlRioB	9306007	PICEANCE CK BL RIO B_FLO	100	1
103	43_ADW009	PICE_ADW PicCrAbHunt	430903	PICE_ROBERT MCKEE DI_DIV	100	1
104	43_ADW010	PICE_ADW PicCrBlRyan	9306200	PICEANCE CK BL RYAN _FLO	100	1
105	43_ADW011	PICE_ADW Piceance@Wh	9306222	PICEANCE CK AT WHITE_FLO	100	1
106	43_ADW012	WHIT_ADW WhiteBlBois	9306290	WHITE R BL BOISE CRK_FLO	100	1
107	43_ADW013	WHIT_ADW WhiteBlDoug	432099	WHIT_KENNEY PUMP NO _DIV	100	1
108	43_ADW014	WHIT_ADW WhiteNrStat	9306395	WHITE R NR COLO STAT_FLO	100	1
109	43_ADW015	EVAC_ADW Evac Creek	Evac@White	Evac_Crk@White _OTH	100	1
110	43_ADW016	WHIT_ADW WhiteSBLMee	9304800	WHITE R BELOW MEEKER_FLO	100	1
111	43_AMW001	43_AMW001_AGG_M&I	9306395	WHITE R NR COLO STAT_FLO	100	4

TABLE 4.2.5a

Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
1	430511	B A & B DITCH NO 1	13285.00000	1.5
			14010.00000	2.3
			25090.20000	2
			32172.23496	2.75
			99999.00000	5
2	430513	B M & H DITCH 1	13583.00000	5.4
			14905.14353	0.5
			32172.24592	4.3
3	430526	BARBOUR NORTH SIDE D	26159.24360	1
			28350.22414	1.25
			36685.00000	5.45
			99999.00000	5.45
4	430537	BECKMAN DITCH	19973.18428	9.2
			38499.00000	8.2
			99999.00000	8
5	430539	BIG BEAVER DITCH	13609.00000	2
			32172.23155	3.22
			99999.00000	6
6	430543	BLACK EAGLE D NO 1	13620.00000	2
			32172.24592	3.95
7	430544	BLACK EAGLE D NO 2	13620.00000	2
			32172.24592	3.95
8	430546	BLAIR DITCH	29087.12158	6.4
			29087.22827	1.8
			32172.22919	3.65
			32172.29736	1.34
			99999.00000	6
9	430563	CALHOUN DITCH	19237.12290	2.4
			32172.12301	1.67
			32172.13971	1.3
			32172.13972	1.94
			39776.35063	0.86
10	430564	CALIFORNIA CO WATER PL	35679.34529	0.31
			39186.00000	9.69
			40854.00000	3.6
11	430570	CALVAT DITCH	38466.00000	8.4
			99999.00000	10.4

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
12	430572	CHARLIE SMITH DITCH	25796.14554	2
			25796.18918	1
			32172.19144	0.36
			32172.19145	5.05
			38499.00000	7.46
			99999.00000	7.46
13	430573	CHASE & COLTHARP D	28350.15621	7.4
			32172.15766	0.8
			32172.15767	12.29
14	430575	CLOHERTY DITCH	29143.15639	1.45
			32172.15640	2.15
			38518.00000	3.65
			99999.00000	3.65
15	430577	COAL CREEK FEEDER DITCH	22527.21458	25.3
16	430578	COAL CREEK MESA DITCH	13047.00000	10
			13940.00000	7.7
			29449.19889	25.08
			32172.19889	20.17
17	430605	DORRELL DITCH 2	39776.25688	2.4
			99999.00000	5
18	430607	DREIFUSS DITCH	28350.12909	2.34
			32172.14735	4.05
			39776.33746	5.58
			39820.00000	1.5
			41100.00000	1.5
19	430608	DREYFUSS DITCH	18172.13274	2.8
			19502.15888	0.6
			39776.35563	2.49
			99999.00000	4.5
20	430623	ELK CREEK DITCH	11540.00000	1.6
			13264.00000	1
			32172.13423	1.52
			44559.25932	3.13
			44773.00000	0.4
			99999.00000	3
21	430625	EMILY DITCH	13458.00000	2
			32172.24592	3.85
			99999.00000	3

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
22	430640	FORNEY CORCORAN DITCH	32172.17606	6
			32172.22705	5.47
			99999.00000	5
23	430652	G V DITCH	18172.13270	5
			18172.13985	2.4
			99999.00000	5
24	430653	GEORGE S WITTER DITCH	17421.13619	2.5
			17728.00000	1.9
			24362.19113	2.6
			39776.39392	7.9
25	430665	GREENSTREET DITCH EXT	39776.24652	8.9
26	430681	HAY BRETHERTON DITCH	22163.14331	8.4
			32172.14670	6
			37376.00000	7.1
			39202.00000	0.75
			99999.00000	10
27	430684	HAY DITCH 2	19237.12290	1.6
			32172.12301	1.15
			32172.12864	1
			32172.14690	1.44
			99999.00000	3
28	430687	HEFLEY PUMP PLANT NO 1	17416.00000	5.41
			25767.24227	0.2
			28350.13773	0.28
			32172.24228	4.25
			35679.34128	5.6
29	430688	HEFLEY PUMP PLANT NO 2	17416.00000	5
			32172.24228	3.64
			35679.33024	11.4
30	430694	HIGHLAND DITCH	13270.00000	45
			26896.16557	9.1
			32172.16923	48.2
			39776.38837	33
			40791.00000	61
			41954.00000	2.6
			46020.43220	50.1
31	430695	HILL CREEK NO 3 DITCH	38499.00000	9.5
32	430696	HILL CREEK NO 2 DITCH	25767.18891	4

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			32172.20233	5.89
			38499.00000	4.76
			99999.00000	4.76
33	430710	IMES & REYNOLDS DITCH	17421.14200	13.1
			19238.14246	2.2
			19238.18035	1.6
			39776.31600	1
			39776.31776	3.7
			41762.00000	2.05
34	430711	INDEPENDENT DITCH	29449.16221	2.9
			38474.00000	2
			99999.00000	6
35	430714	IVO E SHULTS D & PUMP	39776.34423	5
			99999.00000	5
36	430718	JAMES HAYES DITCH	19097.16917	1
			33748.26767	1.62
			34426.00000	1.62
			99999.00000	10
37	430753	LAKE CREEK POOL DITCH	32172.22547	5
			32172.25702	2
			99999.00000	2
38	430758	LAWRENCE DITCH NO 1	39776.37011	5
			99999.00000	5
39	430769	LITTLE DITCH	13244.00000	3
			20731.18718	2.8
			32172.19097	4.08
			99999.00000	8.08
40	430777	LOWLAND DITCH	13459.00000	1
			13952.00000	0.6
			18539.14458	6.8
			99999.00000	6.6
41	430782	M H M GERMAN CONS D	12549.00000	1.5
			13622.00000	4.67
			14329.00000	1.6
			32172.24592	9.77
42	430788	MARCOTT DITCH	20736.13985	4.7
			20736.20372	0.5
			25767.20558	1.5

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			32172.20923	7.28
			38471.00000	1.35
			38511.00000	2.68
			40384.00000	1
			41440.00000	2
			45655.32322	0.5
			99999.00000	10
43	430789	MARTIN DITCH	12211.00000	3
			13393.00000	1
			32172.19889	5.4
			99999.00000	5.4
44	430790	MARVINE DITCH 1	29143.14508	2.75
			39776.28594	7.59
45	430791	MARVINE DITCH 3	35679.29020	5.2
			99999.00000	5.2
46	430808	MEEKER DITCH	12377.00000	20
			32172.13624	5.7
			46020.45048	0.25
47	430810	MEEKER WATER SYS PL	36648.00000	4
			39313.00000	3
48	430813	MELVIN DITCH	13383.00000	0.5
			14000.00000	1.5
			32172.23484	2.93
			32172.23496	11.49
49	430815	METZ & REIGAN DITCH	12930.00000	3.4
			99999.00000	5
50	430816	METZ DITCH	12755.00000	1
			14076.00000	0.6
			99999.00000	5
51	430819	MILLER CREEK DITCH	19238.16954	57.7
			32172.23139	30.3
			32172.32022	12
			46386.40800	24
52	430823	MINER MARTIN DITCH	32172.18353	2
			32172.19112	3
			99999.00000	3
53	430828	MOONEY DITCH	28028.18520	1.9
			32172.18520	3.72

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			38518.00000	4.6
			99999.00000	5
54	430841	NEW ARCHER WARNER DITCH	19636.14171	2.2
			24363.20574	0.3
			32172.20939	2.74
			99999.00000	5
55	430842	NIBLOCK DITCH	12851.00000	2.4
			13620.00000	5.4
			17417.14183	24.8
			32172.14762	29.28
			40715.00000	0.6
			41059.00000	1.35
			41443.00000	5.15
			46386.41443	14.02
			99999.00000	14.02
56	430848	OAK RIDGE PARK DITCH	13868.00000	25
			29143.19083	25.2
			32172.19448	16.59
			39776.24045	10
			39776.31410	22.21
			39776.35168	32
			46493.00000	2
57	430849	OLD AGENCY DITCH	12529.00000	8.5
			12884.00000	5
			13574.00000	2.5
			29449.14762	3.8
			32172.15127	15.6
			99999.00000	25.6
58	430850	OLDLAND DITCH 1	13631.00000	4
			32172.24592	2.9
			99999.00000	2.9
59	430851	OLDLAND DITCH 2	32172.24592	9.47
			99999.00000	3
60	430862	PATTISON DITCH NO 1	22169.15646	2.8
			32172.15858	3.7
			99999.00000	3.7
61	430867	PEASE DITCH	22166.14154	10
			32172.16862	5.98

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			35679.16862	7.68
			38471.00000	0.9
			39180.00000	0.2
			41607.00000	1
			99999.00000	10
62	430868	PEDRICK DITCH	22169.20103	8.4
			28028.15415	2.2
			32172.23117	9.08
			99999.00000	10
63	430873	PICEANCE CREEK DITCH	13342.00000	2
			32172.24592	1.6
			99999.00000	5
64	430881	POTHOLE DITCH	14512.00000	4.8
			21430.19252	1.6
			32172.19617	1.3
			99999.00000	5
65	430883	POWELL PARK DITCH	11079.00000	20
			13559.00000	20
			32172.14762	27.64
			39776.24745	15
			99999.00000	30
66	430889	RANGELY WATER PLANT	35679.35605	2.6
			39352.00000	28.35
67	430903	ROBERT MCKEE DITCH	13622.00000	2.33
			13659.00000	1
			32172.24592	3
			99999.00000	5
68	430908	RYAN DITCH	99999.00000	0
69	430909	RYE GRASS DITCH	14036.00000	2.4
			32172.24592	5.8
			99999.00000	5.8
70	430919	SAYER DITCH	12936.00000	1
			32172.24592	5.26
71	430926	SHERIDAN & MORTON D	19238.13515	2.8
			19502.18353	3
			32172.18718	1.11
			99999.00000	3
72	430928	SIMPSON DITCH	32172.19560	2.5

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			32172.19966	2.7
			99999.00000	2.7
73	430929	SIZEMORE DITCH 1	34424.00000	3.1
			48212.34515	2
74	430931	SKELTON DITCH	29143.13279	1.4
			32172.13301	2.1
			38518.00000	4.8
			99999.00000	10
75	430934	SOLDIER CREEK DITCH	32172.24319	4.3
			32172.25702	2.7
76	430935	SOUTH SIDE HIGHLINE D	12875.00000	4
			13270.00000	4
			13639.00000	4.7
			34425.00000	20.3
			99999.00000	5
77	430936	SPAULDING D	13649.00000	1.6
			32172.24592	3.2
			99999.00000	5
78	430944	SPROD DITCH 1	36695.00000	6
			99999.00000	6
79	430948	SQUARE S CONS D SYS	12571.00000	2.5
			12756.00000	1.5
			13270.00000	2.5
			13274.00000	0.5
			13509.00000	5.2
			32172.24592	16.6
80	430949	STADTMAN DITCH	19768.15571	3.1
			28350.23310	1
			32172.23311	7.7
81	430954	STOREY DITCH 1	36989.00000	10
82	430961	SWEEDE DITCH	25767.17302	5.4
			29090.28334	1.65
			32172.17307	8.69
			35679.17302	5
			99999.00000	5
83	430965	THOMAS DITCH	26896.13980	1
			39776.36659	6
84	430966	THOMAS DITCH 2	32172.18214	1.47

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			32172.18610	2.2
			39776.39628	6
85	430980	UTE CREEK DITCH	32172.15493	2.57
			32172.23480	6.01
			99999.00000	6.01
86	431010	WHITE RIVER MESA DITCH	29085.24569	4.22
			32172.24570	1.4
			32172.24592	7.47
87	431027	BELOT MOFFAT DITCH	13659.00000	4.5
			32172.24592	8
			99999.00000	8
88	431033	LAWRENCE DITCH	32172.30771	2.07
			32172.30772	3.11
			99999.00000	2
89	431034	MCDOWELL DITCH	40778.00000	8
			99999.00000	8
90	431108	JACOBS PUMP & PL	38933.00000	4
91	431272	COX_PUMP_NO_1	32172.19783	3.41
			32172.19792	13.91
92	431273	REIGAN_PUMP_NO_1	19502.13301	1.05
			32172.19783	1.14
			32172.19792	3.59
93	431494	GOFF DITCH	45655.19361	10.2
94	432099	KENNEY PUMP NO 1	19502.12875	14.25
95	43_ADW001	NORT_ADW WhiteNorthF	22911.09839	4.8
			29649.28741	2
			35914.96245	14.59
			40411.86538	5.2
96	43_ADW002	SOUT_ADW WhiteSouthF	25767.14943	1.5
			28625.04118	10.22
			32172.18019	3.25
			33104.95498	3.76
97	43_ADW003	WHIT_ADW WhiteAbCole	12539.00000	1
			17616.51480	9.9
			32172.14701	3.11
			32172.21751	16.9
			41034.69654	13.26
			52595.52017	2

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
98	43_ADW004	WHIT_ADW WhiteNrMeek	13142.22222	1.8
			13619.00000	0.9
			21192.23579	10.4
			25899.88773	2.9
			32172.19624	5.27
99	43_ADW005	WHIT_ADW WhiteNBLMee	13301.00000	2
			22530.17033	2.63
			32172.14385	1.47
			32172.23985	4.01
100	43_ADW006	WHIT_ADW WhiteAbPice	40922.00000	5
101	43_ADW007	PICE_ADW PicCrUpper	12875.50000	4.8
			13607.00000	0.7
			18080.33490	5.9
			29572.21767	0.7
			32172.17835	2.26
			32172.24592	16.92
			47847.13959	3
102	43_ADW008	PICE_ADW PicCrBlRioB	13693.50000	1.2
			17323.61436	2.6
			28590.18435	1.78
			32172.20937	0.72
			32172.24592	6.88
			47847.14731	3.5
103	43_ADW009	PICE_ADW PicCrAbHunt	12756.27778	10.8
			13599.94118	3.4
			14623.12670	4.5
			32172.16500	0.61
			32172.23140	0.86
			32172.24592	6.59
			47847.39716	11.37
104	43_ADW010	PICE_ADW PicCrBlRyan	13356.00000	2.5
			13619.22222	3.6
			16003.49023	5.46
			28705.65416	2.93
			32172.17258	0.54
			32172.24592	5.07
			50873.47569	1.33
105	43_ADW011	PICE_ADW Piceance@Wh	13195.06897	5.8

TABLE 4.2.5a
Direct Flow Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
			13743.00000	2.9
			17778.28324	4.9
			41054.42914	1.51
			46639.62906	3
106	43_ADW012	WHIT_ADW WhiteBlBois	13622.00000	2
			19704.14814	4.9
			26393.07417	5.64
			34065.79845	13.02
			38582.25859	3.06
			47847.32029	17.25
107	43_ADW013	WHIT_ADW WhiteBlDoug	19502.13301	1.4
			30303.99856	4.5
			32172.23295	5.98
			34497.12425	18.8
			45062.55691	6.09
			49856.50376	0.13
108	43_ADW014	WHIT_ADW WhiteNrStat	19502.15354	7.88
			28350.14045	4.79
			46092.69932	27.53
109	43_ADW015	EVAC_ADW Evac Creek	24523.22553	1.45
			35679.26024	9.5
			45655.25353	4.55
110	43_ADW016	WHIT_ADW WhiteSBLMee	13671.44000	5
			20384.90313	5.48
			27265.20179	1.36
			32172.21662	1.92
			34712.71430	4.7
			44716.06110	4.66
			45655.35428	2
111	43_AMW001	43_AMW001_AGG_M&I	1.00000	2

TABLE 4.3.5a
Reservoir Water Right Summary (af)

#	ID	Name	Admin #	Decree (af)	Fill
1	433633	BIG BEAVER CK RESERVOIR	41188.00000	7658	1
2	434433	TAYLOR DRAW RES	41091.00000	13800	1
			48212.47806	3550	1
3	43_ARW001	43_ARW001	1.00000	2117	1
4	43_ARW002	43_ARW002	1.00000	2117	1
5	43_ARW003	43_ARW003	1.00000	2388	1
6	43_ARW004	43_ARW004	1.00000	2388	1

TABLE 4.4.1a
Instream Flow Summary
Average (af/yr) 1975-1991

#	ID	Name	Location	Demand (af)
1	431845	WHITE RIVER MSF	WHITE RIVER MSF _ISF	144796
2	432334	MARVINE CREEK MSF	MARVINE CREEK MSF _ISF	28959
3	432337	MILLER CK MSF	MILLER CK MSF _ISF	7240
4	432338	NORTH FK WHITE R MSF-L	NORTH FK WHITE R MSF_ISF	86877
5	432339	NORTH FK WHITE R MSF-U	NORTH FK WHITE R MSF_ISF	50678
6	432344	SOUTH FORK WHITE R MSF	SOUTH FORK WHITE R M_ISF	57918
7	432372	UTE CREEK MSF	UTE CREEK MSF _ISF	4344
8	954433	TAYLOR_DRAW_BYPASS	TAYLOR DRAW BYPASS _ISF	144796

TABLE 4.4.3a

Instream Water Right Summary (cfs)

#	ID	Name	Admin #	Decree
1	431845	WHITE RIVER MSF	46705.00000	200
2	432334	MARVINE CREEK MSF	46705.00000	40
3	432337	MILLER CK MSF	46751.46705	10
4	432338	NORTH FK WHITE R MSF-L	46705.00000	120
5	432339	NORTH FK WHITE R MSF-U	46751.46705	70
6	432344	SOUTH FORK WHITE R MSF	46751.46705	80
7	432372	UTE CREEK MSF	47609.00000	6
8	954433	TAYLOR_DRAW_BYPASS	41090.99999	200

5.0 CALIBRATION

Three data sets were developed for the White Model: the historic, the calculated, and the baseline.

- The historic data set was used to develop baseflows and calibrate the model. It provides results that allow the hydrology to be checked and ditch efficiency and return flows to be evaluated.
- The calculated data set builds upon the historic data set by allowing selected ditch systems and reservoirs to operate by demand rather than by historic diversions or end-of-month (EOM) contents.
- The baseline data set builds upon the calculated data by allowing reservoirs, structures, and operating rules that were constructed or have changed during the study period to operate in a consistent manner for the entire study period. The baseline data set provides results which are commonly used for a "*what if*" analysis.

This chapter describes the calibration period, procedures and results for the White River Basin. In addition, data changes associated with the calculated and baseline data, which is different than the historic data described in Section 4 are described.

5.1 (H) - Historic Calibration

The historic data set simulates the basin using historic diversions as demands, computed efficiencies, and historic reservoir EOM contents as reservoir fill targets. Calibration activities performed on this data set include:

Demands

- Compare simulated diversions to historic to identify shortages
- Identify any shortages and determine why
- If required, reevaluate proration factors, return flow patterns, and/or operational rights
- Regenerate base flows and rerun simulation

Reservoirs

- Compare simulated reservoir EOM contents with historic EOM contents
- Identify EOM content differences and determine why
- If required, reevaluate proration factors, and/or operational rights
- Regenerate base flows and re-run simulation

Stream Gages

- Compare simulated stream gage flows to historic flows
- Repeat diversion and reservoir steps until simulated stream gage flows approximate historic
- Document reasons for differences in simulated and historic

5.1.1 Historic Calibration Results

The historic data set was used to develop baseflows and to calibrate the model. It provides results that allow the hydrology to be checked and ditch efficiency and return flow patterns to be evaluated. Section 4 describes the input data used for this data set. The main characteristics of this data set are as follows:

- The direct flow diversion demand file (whiteTH.ddm) is the same as the historic diversion file (whiteT.ddh).
- Reservoir targets are estimated to equal historic EOM contents.

The results of the historic calibration are considered good. They are summarized in the following tables and figures:

- Table 5.1.1a summarizes the annual average diversions estimated by the model compared to historic observations for the historic calibration run (StateMod output file whiteTH.xdc).
- Table 5.1.1b summarizes the annual average stream flow estimated by the model compared to historic observations for the historic calibration run (StateMod output file whiteTH.xsc).
- Table 5.1.1c summarizes the water balance for the White River basin from the historic calibration run (StateMod output file whiteTH.xwb). As presented the 1975 to 1991 average consumptive use for the White River Basin was estimated to equal approximately 38,342 af/yr while approximately 567,732 af/yr flows out of the State.
- Figures 5.1.1a **through** 5.1.1f present monthly streamflow, diversion, and reservoir EOM results estimated by the model compared to historic observations at selected key structures from the historic data set (H). Whenever only one line appears on a graph it indicates that the simulated and historic results are the same at the scale presented.

Differences between gaged and modeled results are attributable to the following:

- The distribution of gaged stream flow data to ungaged locations.
- Measurement error associated with diversions and stream flows.
- Use of average monthly efficiencies rather than monthly.
- For aggregated diversions, use of a basin wide efficiency and calculated demands in both the historic and calculated runs.
- A monthly model versus historic daily operations.

5.2.1 (C) - Calculated Calibration

The **Calculated (C)** data set simulates the basin using calculated demands from the consumptive use model, computed efficiencies, and operational reservoir fill targets. The calculated data set builds upon the historic data set by allowing diversion structures and reservoirs to operate by an estimated headgate diversion requirement or reservoir rule. Calibration activities performed on this data set include:

- Display results compared to historic
- Document reasons for differences between simulated and historic
- Adjust historic data set as required

52.1 Calculated Calibration Results

The calculated data set builds upon the historic data set by the following:

- Agricultural structures operate by demands estimated from consumptive use estimates rather than historic diversions.

- Reservoirs operate by targets rather than historic EOM contents. Because the explicitly modeled reservoirs were operated full, the calculated reservoir targets are the same as historic reservoir targets for the White River Basin.

Calculated demands for agricultural diversions for each month of the simulation period were developed based on estimates of consumptive use and efficiencies. The following steps were taken to produce these demands (for additional discussion, see CRDSS Users' Manual, Consumptive Use Model):

- Estimate the consumptive crop requirement at the farm (whiteT.ddc) by running the consumptive use model.
- Estimate headgate demands based on the consumptive crop requirement and monthly structure efficiency estimates. Demands were computed by dividing the consumptive use estimates by the estimated monthly structure efficiencies. Monthly structure efficiencies were estimated by dividing the consumptive use estimates by historic diversion amounts.

The results of the calculated data set are considered good. They are summarized in the following tables and figures:

- Table 5.2.1a summarizes the annual average diversions estimated by the model compared to historic observations for the historic calibration run (StateMod output file whiteTC.xdc).
- Table 5.2.1b summarizes the annual average stream flow estimated by the model compared to historic observations for the historic calibration run (StateMod output file whiteTC.xsc).
- Table 5.2.1c summarizes the water balance for the White River basin from the historic calibration run (StateMod output file whiteTC.xwb). As presented the 1975 to 1991 average consumptive use for the White River Basin was estimated to equal approximately 38,432 af/yr while approximately 567,684 af/yr flows out of the State. Note the 8 ac-ft value presented in the in-out column is the sum of monthly roundoffs, which are within 1 ac-ft per month.
- Figures 5.2.1a **through** 5.2.1f present monthly streamflow, diversion, and reservoir EOM results estimated by the model compared to historic observations at selected key structures from the historic data set (H). Whenever only one line appears on a graph it indicates that the simulated and historic results are the same at the scale presented.

Differences between gaged and modeled results include those described under the Historic Data as well as the following:

- Irrigation demands estimated by a consumptive use equation may not reflect actual on farm demands.

Reservoir targets may not reflect actual reservoir operations.

5.3 - Baseline Data Set

The baseline data set builds upon the calculated data set by allowing future demands, diversions, and reservoirs to operate at current (1991) levels. Adjustments made to the calculated data set for the baseline data set include the following:

- Non-irrigation demands in the whiteTB.ddm (baseline) represent 1991 estimates, repeated for each year of the study period.

- The reservoir target for Taylor Draw Reservoir was adjusted to assume it existed over the entire study period.

Because this data set was developed for a ‘what if’ analysis, no tabular or graphical comparisons between the baseline simulation and historic data are presented.

TABLE 5.1.1a
Comparison Between Historical and Calculated Average Annual Streamflow Volumes
Historical Data Set (acre-feet/year) 1975-1991

River ID	Gaged Flow	Simulated Flow	Delta Flow	Delta Flow (%)	Name
9303000	235947	235959	-12	0	NF WHITE R AT BUFORD_FLO
9303400	147632	147632	0	0	SF WHITE R NR BUDGRE_FLO
9303500	193873	193936	-64	0	SF WHITE R NR BUFORD_FLO
9304000	189533	189709	-176	0	SF WHITE R AT BUFORD_FLO
9304200	414807	414197	610	0	WHITE R AB COAL CREE_FLO
9304500	461026	461624	-598	0	WHITE RIV NR MEEKER _FLO
9304800	496214	496863	-649	0	WHITE R BELOW MEEKER_FLO
9306007	14857	15050	-193	-1	PICEANCE CK BL RIO B_FLO
9306200	27967	28272	-305	-1	PICEANCE CK BL RYAN _FLO
9306222	32097	32464	-367	-1	PICEANCE CK AT WHITE_FLO
9306224	544716	545736	-1020	0	WHITE R AB CROOKED W_FLO
9306290	543720	544750	-1030	0	WHITE R BL BOISE CRK_FLO
9306395	558654	559652	-999	0	WHITE R NR COLO STAT_FLO

TABLE 5.1.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Historical Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430511	1423	1401	22	2	B A & B DITCH NO 1
430513	787	786	0	0	B M & H DITCH 1
430526	1361	1270	91	7	BARBOUR NORTH SIDE D
430537	1895	1603	292	15	BECKMAN DITCH
430539	1320	886	435	33	BIG BEAVER DITCH
430543	318	318	0	0	BLACK EAGLE D NO 1
430544	308	308	0	0	BLACK EAGLE D NO 2
430546	1213	1205	8	1	BLAIR DITCH
430563	289	289	0	0	CALHOUN DITCH
430564	3831	3831	0	0	CALIFORNIA CO WATER PL
430570	735	720	15	2	CALVAT DITCH
430572	1039	1038	1	0	CHARLIE SMITH DITCH
430573	795	795	0	0	CHASE & COLTHARP D
430575	778	777	1	0	CLOHERTY DITCH
430577	728	728	0	0	COAL CREEK FEEDER DITCH
430578	3162	1900	1262	40	COAL CREEK MESA DITCH
430605	371	352	19	5	DORRELL DITCH 2
430607	1270	1269	1	0	DREIFUSS DITCH
430608	1197	994	204	17	DREYFUSS DITCH
430623	931	875	57	6	ELK CREEK DITCH
430625	873	841	31	4	EMILY DITCH

TABLE 5.1.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Historical Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430640	1164	1163	1	0	FORNEY CORCORAN DITCH
430652	1389	1251	138	10	G V DITCH
430653	1527	1527	0	0	GEORGE S WITTER DITCH
430665	560	560	0	0	GREENSTREET DITCH EXT
430681	4832	4760	73	2	HAY BRETHERTON DITCH
430684	624	614	10	2	HAY DITCH 2
430687	638	638	0	0	HEFLEY PUMP PLANT NO 1
430688	645	645	0	0	HEFLEY PUMP PLANT NO 2
430694	34244	34220	24	0	HIGHLAND DITCH
430695	823	743	80	10	HILL CREEK NO 3 DITCH
430696	1925	1859	66	3	HILL CREEK NO 2 DITCH
430710	2308	2308	0	0	IMES & REYNOLDS DITCH
430711	511	492	19	4	INDEPENDENT DITCH
430714	450	450	0	0	IVO E SHULTS D & PUMP
430718	1396	1099	297	21	JAMES HAYES DITCH
430753	286	285	1	0	LAKE CREEK POOL DITCH
430758	577	577	0	0	LAWRENCE DITCH NO 1
430769	2069	1912	157	8	LITTLE DITCH
430777	2137	1857	280	13	LOWLAND DITCH
430782	852	852	0	0	M H M GERMAN CONS D
430788	3956	3819	137	3	MARCOTT DITCH
430789	1138	1107	31	3	MARTIN DITCH
430790	606	606	0	0	MARVINE DITCH 1
430791	468	468	0	0	MARVINE DITCH 3
430808	4635	4635	0	0	MEEKER DITCH
430810	624	624	0	0	MEEKER WATER SYS PL
430813	397	397	0	0	MELVIN DITCH
430815	1019	901	118	12	METZ & REIGAN DITCH
430816	943	550	393	42	METZ DITCH
430819	29673	29646	27	0	MILLER CREEK DITCH
430823	538	529	9	2	MINER MARTIN DITCH
430828	951	949	2	0	MOONEY DITCH
430841	833	716	117	14	NEW ARCHER WARNER DITCH
430842	13878	13872	5	0	NIBLOCK DITCH
430848	23423	23355	68	0	OAK RIDGE PARK DITCH
430849	7666	7459	207	3	OLD AGENCY DITCH
430850	945	898	47	5	OLDLAND DITCH 1
430851	702	609	93	13	OLDLAND DITCH 2
430862	489	489	0	0	PATTISON DITCH NO 1
430867	4607	4606	1	0	PEASE DITCH
430868	2850	2815	36	1	PEDRICK DITCH
430873	960	729	231	24	PICEANCE CREEK DITCH

TABLE 5.1.1b

Comparison Between Historic and Simulated Average Annual Diversion Volumes

Historical Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430881	985	962	23	2	POTHOLE DITCH
430883	13064	12980	85	1	POWELL PARK DITCH
430889	1083	1083	0	0	RANGELY WATER PLANT
430903	1348	1268	80	6	ROBERT MCKEE DITCH
430908	221	221	0	0	RYAN DITCH
430909	850	787	63	7	RYE GRASS DITCH
430919	386	375	11	3	SAYER DITCH
430926	895	855	40	4	SHERIDAN & MORTON D
430928	597	576	21	3	SIMPSON DITCH
430929	413	411	1	0	SIZEMORE DITCH 1
430931	1103	1078	25	2	SKELTON DITCH
430934	418	418	0	0	SOLDIER CREEK DITCH
430935	6644	6630	14	0	SOUTH SIDE HIGHLINE D
430936	479	447	31	7	SPAULDING D
430944	887	827	60	7	SPROD DITCH 1
430948	1896	2117	-221	-12	SQUARE S CONS D SYS
430949	524	524	0	0	STADTMAN DITCH
430954	270	270	0	0	STOREY DITCH 1
430961	2261	2257	4	0	SWEEDE DITCH
430965	415	415	0	0	THOMAS DITCH
430966	305	305	0	0	THOMAS DITCH 2
430980	2850	2699	151	5	UTE CREEK DITCH
431010	718	662	56	8	WHITE RIVER MESA DITCH
431027	1215	1135	80	7	BELOT MOFFAT DITCH
431033	553	548	4	1	LAWRENCE DITCH
431034	496	496	0	0	MCDOWELL DITCH
431108	451	451	0	0	JACOBS PUMP & PL
431272	980	980	0	0	COX_PUMP_NO_1
431273	477	477	0	0	REIGAN_PUMP_NO_1
431494	604	604	0	0	GOFF DITCH
432099	672	672	0	0	KENNEY PUMP NO 1
43_ADW001	2260	2254	6	0	NORT_ADW WhiteNorthF
43_ADW002	2142	2142	0	0	SOUT_ADW WhiteSouthF
43_ADW003	5181	5181	0	0	WHIT_ADW WhiteAbCole
43_ADW004	3932	3926	6	0	WHIT_ADW WhiteNrMeek
43_ADW005	1354	1354	0	0	WHIT_ADW WhiteNBLMee
43_ADW006	817	817	0	0	WHIT_ADW WhiteAbPice
43_ADW007	3695	2951	743	20	PICE_ADW PicCrUpper
43_ADW008	1571	1186	384	24	PICE_ADW PicCrBlRioB
43_ADW009	3998	3942	56	1	PICE_ADW PicCrAbHunt
43_ADW010	4789	4446	343	7	PICE_ADW PicCrBlRyan
43_ADW011	2759	2757	2	0	PICE_ADW Piceance@Wh

TABLE 5.1.1b

Comparison Between Historic and Simulated Average Annual Diversion Volumes

Historical Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
43_ADW012	5363	5363	0	0	WHIT_ADW WhiteBlBois
43_ADW013	4383	4383	0	0	WHIT_ADW WhiteBlDoug
43_ADW014	3738	3738	0	0	WHIT_ADW WhiteNrStat
43_ADW015	1311	1268	43	3	EVAC_ADW Evac Creek
43_ADW016	3565	3565	0	0	WHIT_ADW WhiteSBLMee
43_AMW001	1104	1104	0	0	43_AMW001_AGG_M&I

TABLE 5.1.1c

Water Balance Summary

Historical Data Set (acre-feet/year)

Year	Inflow	Divert	Return	Evap	Outflow	Res. Sto	Delta	CU (1)
1975	643,066	252,474	204,458	1,275	594,375	-600	0	37,013
1976	471,993	265,987	227,466	1,271	432,201	0	0	40,060
1977	274,267	266,438	231,121	1,270	237,691	-11	0	37,916
1978	575,948	283,488	243,181	1,270	534,359	12	0	40,285
1979	598,375	252,177	217,949	1,271	562,877	-1	0	35,714
1980	571,889	260,444	224,949	1,271	535,123	0	0	37,339
1981	378,170	270,026	234,802	1,271	341,674	0	0	35,627
1982	610,161	264,544	233,020	1,271	577,367	0	0	34,822
1983	875,898	248,278	207,192	1,271	833,542	0	0	37,070
1984	1,024,527	247,969	222,402	1,271	997,690	0	0	32,196
1985	901,950	266,615	229,418	2,377	848,716	13,660	0	37,330
1986	911,455	254,906	221,687	2,476	875,759	0	0	39,083
1987	597,949	283,116	243,168	2,476	555,525	0	0	39,083
1988	555,531	322,144	282,201	2,476	513,112	0	0	43,408
1989	475,654	319,965	274,446	2,476	427,659	0	0	46,395
1990	364,344	321,148	282,909	2,466	323,737	-98	0	41,323
1991	495,516	269,127	235,970	2,464	460,038	-143	0	37,145
AVG	607,453	273,462	236,255	1,760	567,732	754	0	38,342

1) Consumptive Use (CU) = Diversion (Divert) * Efficiency + Resevoir Evaporation (Evap)

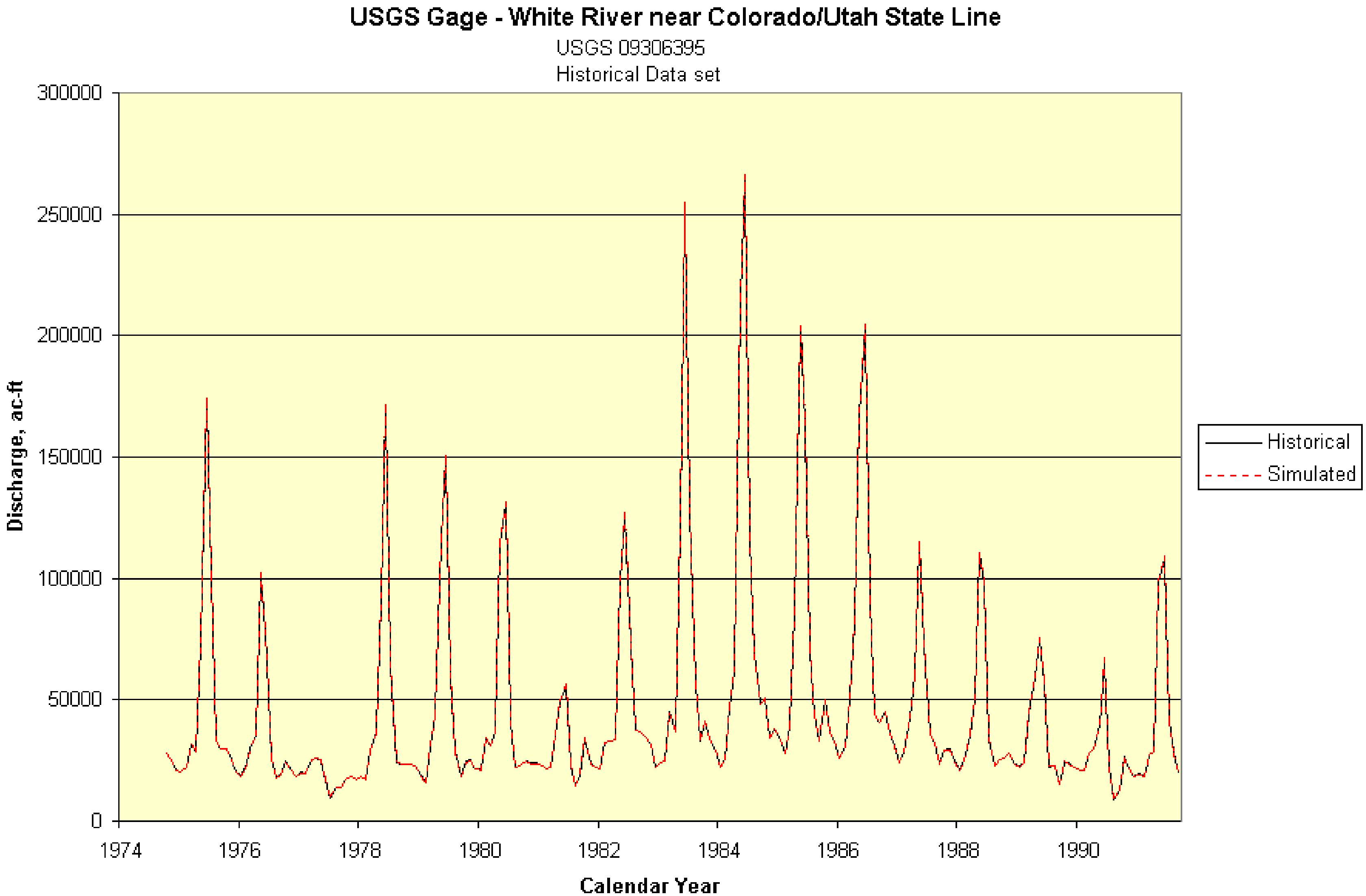

Figure 5.1.1a. Historical Data Set
USGS Gage White River nr Colo/Utah State Line

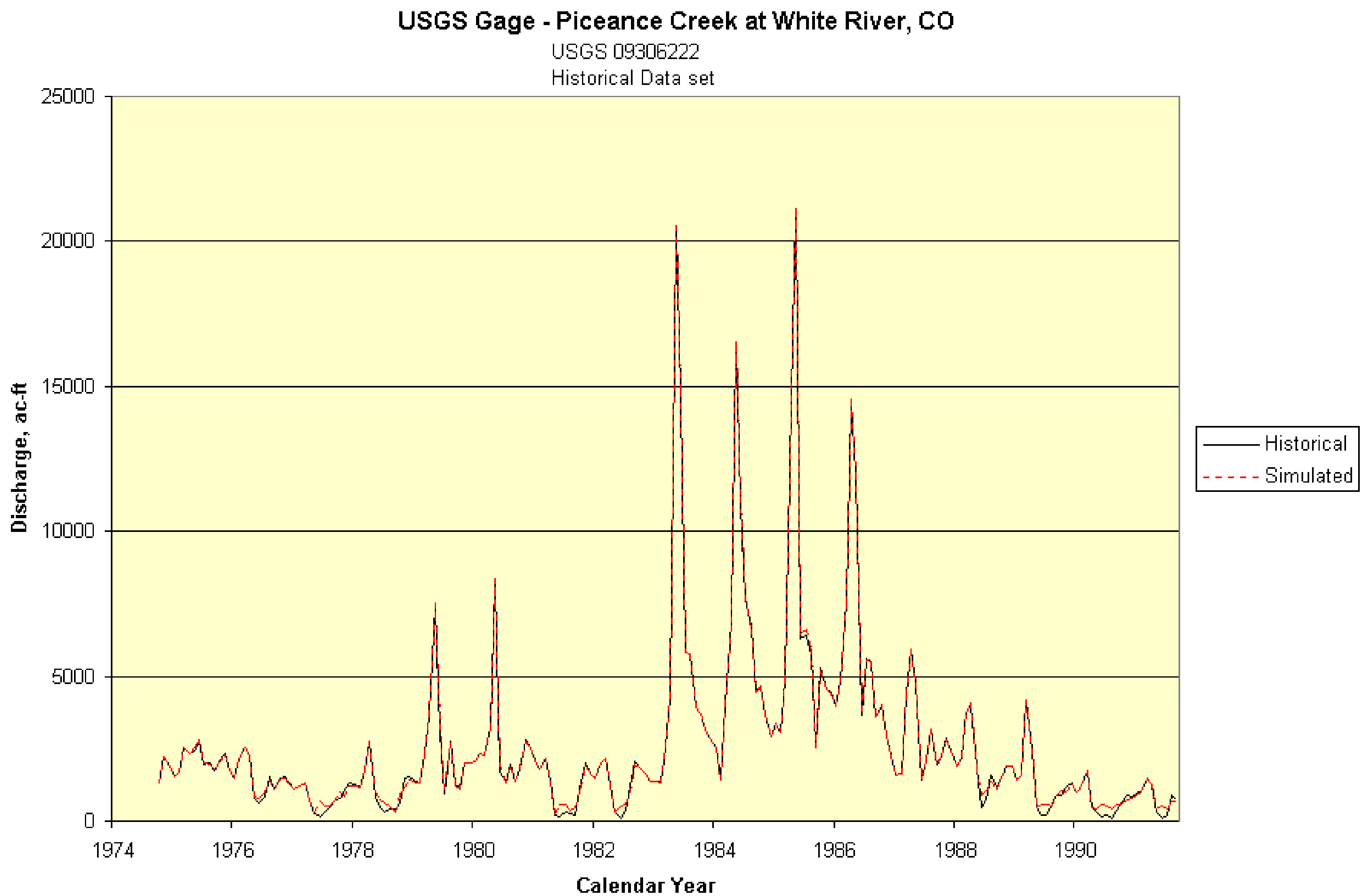

Figure 5.1.1b. Historical Data Set USGS Gage-Piceance Creek at White River CO

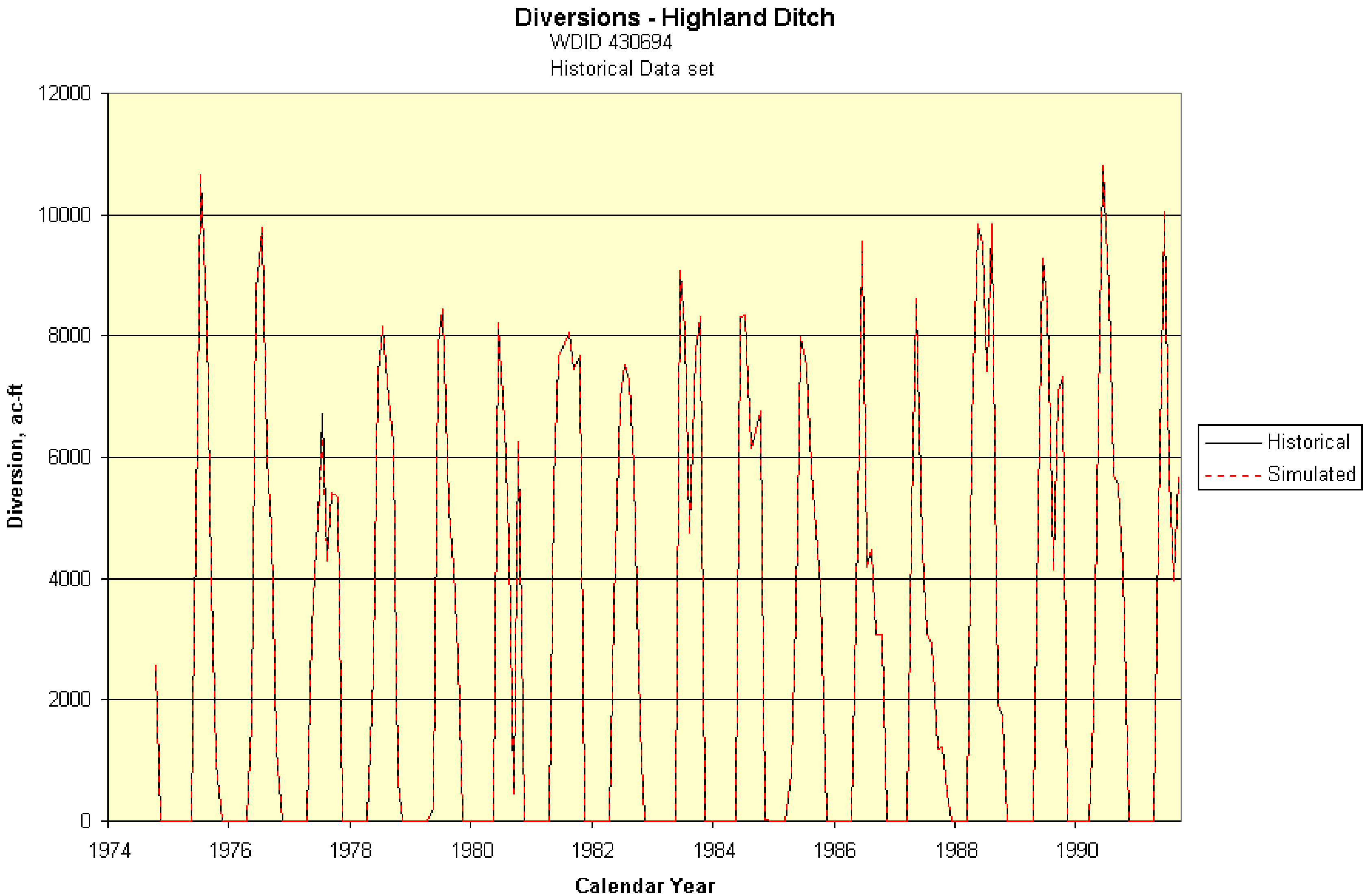

Figure 5.1.1c. Historical Data Set
Highland Ditch

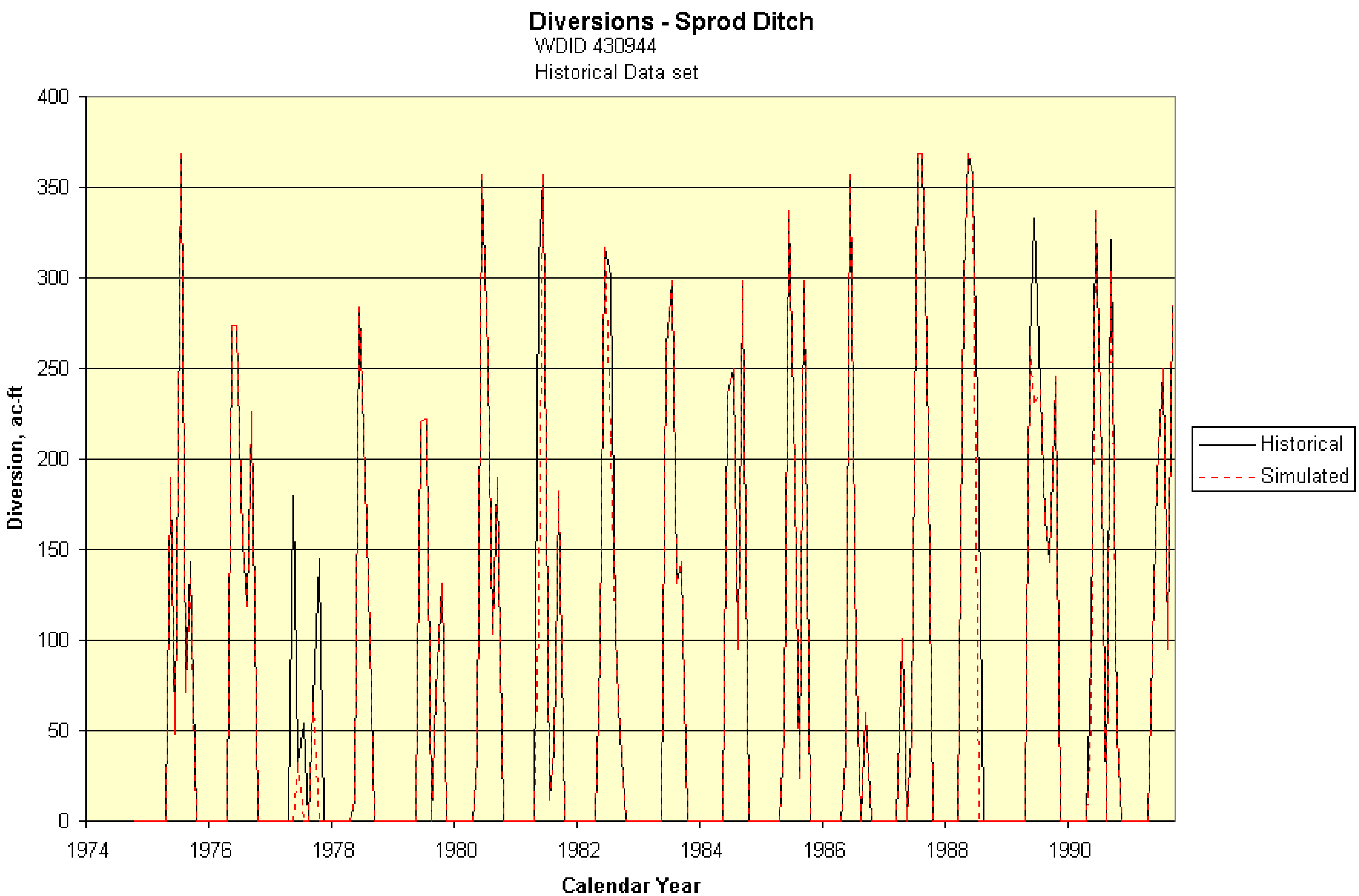

Figure 5.1.1d. Historical Data Set
Sprod Ditch

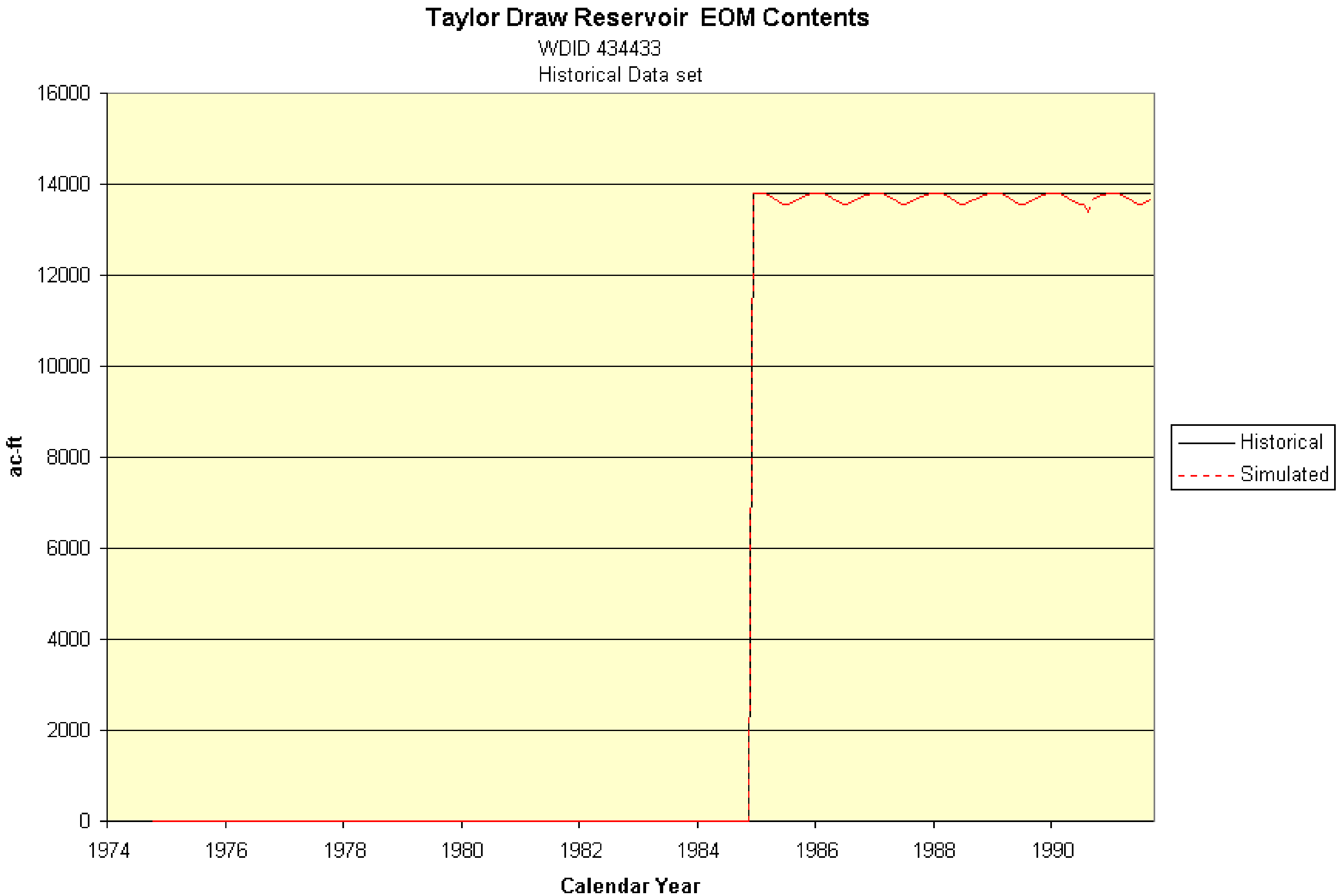

Figure 5.1.1e. Historical Data Set
Taylor Draw Reservoir

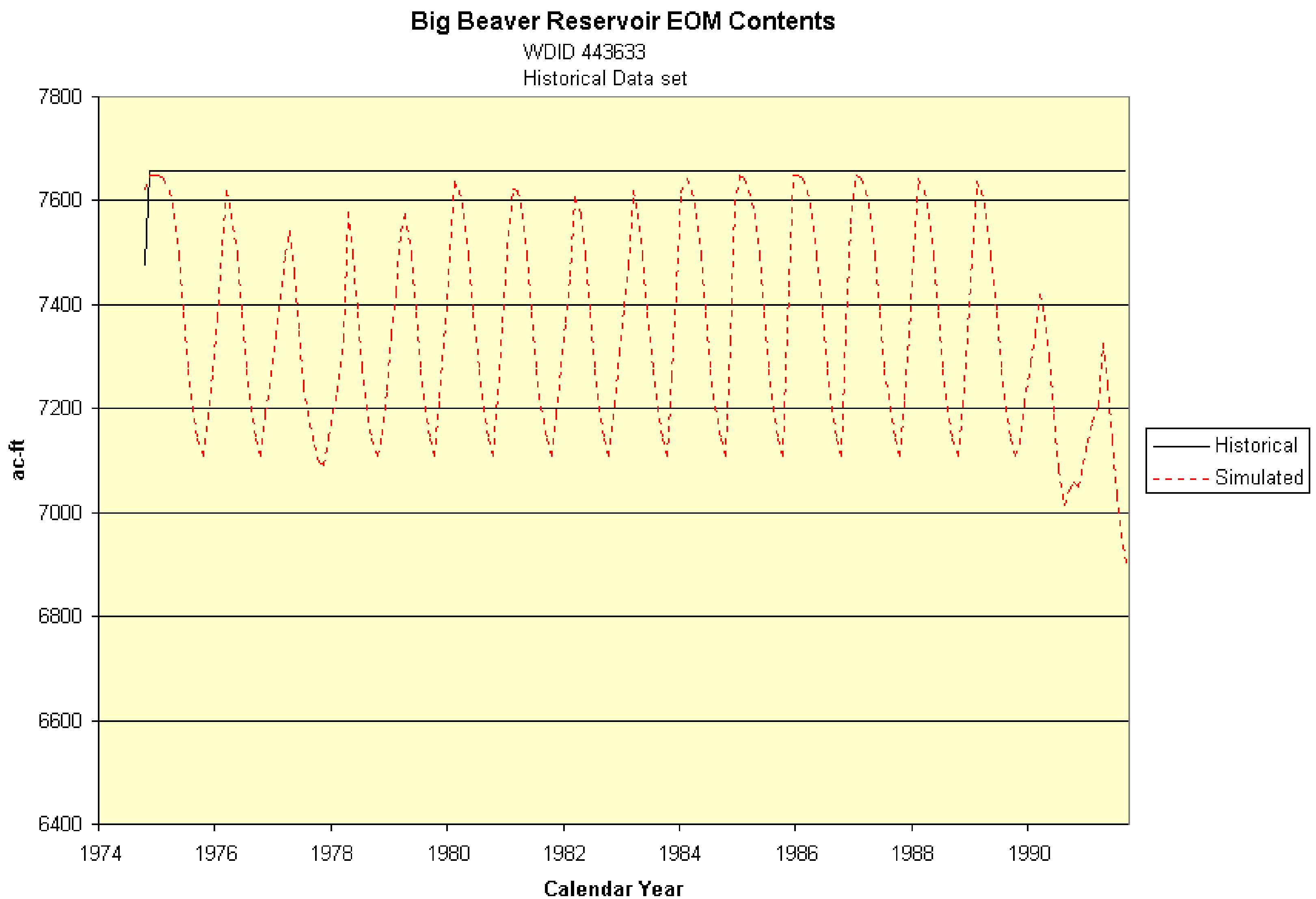

Figure 5.1.1f. Historical Data Set
Big Beaver Reservoir

TABLE 5.2.1a
Comparison Between Historical and Calculated Average Annual Streamflow Volumes
Calculated Data Set (acre-feet/year) 1975-1991

River ID	Gaged Flow	Simulated Flow	Delta Flow	Delta Flow (%)	Name
9303000	235947	235925	22	0	NF WHITE R AT BUFORD_FLO
9303400	147632	147632	0	0	SF WHITE R NR BUDGRE_FLO
9303500	193873	193921	-48	0	SF WHITE R NR BUFORD_FLO
9304000	189533	189642	-109	0	SF WHITE R AT BUFORD_FLO
9304200	414807	414998	-190	0	WHITE R AB COAL CREE_FLO
9304500	461026	461778	-752	0	WHITE RIV NR MEEKER _FLO
9304800	496214	496856	-642	0	WHITE R BELOW MEEKER_FLO
9306007	14857	15150	-293	-2	PICEANCE CK BL RIO B_FLO
9306200	27967	28524	-558	-2	PICEANCE CK BL RYAN _FLO
9306222	32097	32641	-545	-2	PICEANCE CK AT WHITE_FLO
9306224	544716	545831	-1115	0	WHITE R AB CROOKED W_FLO
9306290	543720	544831	-1111	0	WHITE R BL BOISE CRK_FLO
9306395	558654	559604	-950	0	WHITE R NR COLO STAT_FLO

TABLE 5.2.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Calculated Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430511	1423	1413	10	1	B A & B DITCH NO 1
430513	787	789	-2	0	B M & H DITCH 1
430526	1361	1262	99	7	BARBOUR NORTH SIDE D
430537	1895	1618	277	15	BECKMAN DITCH
430539	1320	990	331	25	BIG BEAVER DITCH
430543	318	320	-2	-1	BLACK EAGLE D NO 1
430544	308	306	1	0	BLACK EAGLE D NO 2
430546	1213	1246	-33	-3	BLAIR DITCH
430563	289	303	-14	-5	CALHOUN DITCH
430564	3831	3831	0	0	CALIFORNIA CO WATER PL
430570	735	731	4	1	CALVAT DITCH
430572	1039	1035	4	0	CHARLIE SMITH DITCH
430573	795	798	-3	0	CHASE & COLTHARP D
430575	778	807	-29	-4	CLOHERTY DITCH
430577	728	728	1	0	COAL CREEK FEEDER DITCH
430578	3162	1939	1223	39	COAL CREEK MESA DITCH
430605	371	362	9	2	DORRELL DITCH 2
430607	1270	1243	27	2	DREIFUSS DITCH
430608	1197	1070	128	11	DREYFUSS DITCH
430623	931	904	28	3	ELK CREEK DITCH
430625	873	708	165	19	EMILY DITCH

TABLE 5.2.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Calculated Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430640	1164	1167	-3	0	FORNEY CORCORAN DITCH
430652	1389	1207	182	13	G V DITCH
430653	1527	1569	-43	-3	GEORGE S WITTER DITCH
430665	560	475	85	15	GREENSTREET DITCH EXT
430681	4832	4947	-114	-2	HAY BRETHERTON DITCH
430684	624	622	2	0	HAY DITCH 2
430687	638	722	-84	-13	HEFLEY PUMP PLANT NO 1
430688	645	643	2	0	HEFLEY PUMP PLANT NO 2
430694	34244	34022	222	1	HIGHLAND DITCH
430695	823	725	98	12	HILL CREEK NO 3 DITCH
430696	1925	1819	106	6	HILL CREEK NO 2 DITCH
430710	2308	2254	54	2	IMES & REYNOLDS DITCH
430711	511	511	0	0	INDEPENDENT DITCH
430714	450	458	-9	-2	IVO E SHULTS D & PUMP
430718	1396	1229	167	12	JAMES HAYES DITCH
430753	286	283	4	1	LAKE CREEK POOL DITCH
430758	577	577	0	0	LAWRENCE DITCH NO 1
430769	2069	1960	108	5	LITTLE DITCH
430777	2137	1896	240	11	LOWLAND DITCH
430782	852	879	-27	-3	M H M GERMAN CONS D
430788	3956	3879	77	2	MARCOTT DITCH
430789	1138	1090	48	4	MARTIN DITCH
430790	606	612	-6	-1	MARVINE DITCH 1
430791	468	468	0	0	MARVINE DITCH 3
430808	4635	4594	41	1	MEEKER DITCH
430810	624	624	0	0	MEEKER WATER SYS PL
430813	397	398	-1	0	MELVIN DITCH
430815	1019	873	147	14	METZ & REIGAN DITCH
430816	943	545	398	42	METZ DITCH
430819	29673	29109	564	2	MILLER CREEK DITCH
430823	538	530	9	2	MINER MARTIN DITCH
430828	951	945	7	1	MOONEY DITCH
430841	833	797	36	4	NEW ARCHER WARNER DITCH
430842	13878	13609	269	2	NIBLOCK DITCH
430848	23423	22969	454	2	OAK RIDGE PARK DITCH
430849	7666	7366	301	4	OLD AGENCY DITCH
430850	945	811	134	14	OLDLAND DITCH 1
430851	702	384	318	45	OLDLAND DITCH 2
430862	489	480	9	2	PATTISON DITCH NO 1
430867	4607	4705	-98	-2	PEASE DITCH
430868	2850	2727	123	4	PEDRICK DITCH
430873	960	728	233	24	PICEANCE CREEK DITCH

TABLE 5.2.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Calculated Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
430881	985	959	25	3	POTHOLE DITCH
430883	13064	12319	745	6	POWELL PARK DITCH
430889	1083	1083	0	0	RANGELY WATER PLANT
430903	1348	1184	164	12	ROBERT MCKEE DITCH
430908	221	229	-8	-4	RYAN DITCH
430909	850	563	287	34	RYE GRASS DITCH
430919	386	331	55	14	SAYER DITCH
430926	895	912	-17	-2	SHERIDAN & MORTON D
430928	597	592	5	1	SIMPSON DITCH
430929	413	390	22	5	SIZEMORE DITCH 1
430931	1103	1298	-195	-18	SKELTON DITCH
430934	418	423	-5	-1	SOLDIER CREEK DITCH
430935	6644	6790	-146	-2	SOUTH SIDE HIGHLINE D
430936	479	392	87	18	SPAULDING D
430944	887	850	37	4	SPROD DITCH 1
430948	1896	2028	-132	-7	SQUARE S CONS D SYS
430949	524	528	-4	-1	STADTMAN DITCH
430954	270	312	-43	-16	STOREY DITCH 1
430961	2261	2292	-30	-1	SWEEDE DITCH
430965	415	459	-44	-11	THOMAS DITCH
430966	305	352	-47	-15	THOMAS DITCH 2
430980	2850	2275	575	20	UTE CREEK DITCH
431010	718	527	191	27	WHITE RIVER MESA DITCH
431027	1215	961	254	21	BELOT MOFFAT DITCH
431033	553	560	-7	-1	LAWRENCE DITCH
431034	496	547	-51	-10	MCDOWELL DITCH
431108	451	451	-1	0	JACOBS PUMP & PL
431272	980	1034	-54	-6	COX_PUMP_NO_1
431273	477	518	-41	-9	REIGAN_PUMP_NO_1
431494	604	596	8	1	GOFF DITCH
432099	672	650	21	3	KENNEY PUMP NO 1
43_ADW001	2260	2254	6	0	NORT_ADW WhiteNorthF
43_ADW002	2142	2142	0	0	SOUT_ADW WhiteSouthF
43_ADW003	5181	5181	0	0	WHIT_ADW WhiteAbCole
43_ADW004	3932	3926	6	0	WHIT_ADW WhiteNrMeek
43_ADW005	1354	1354	0	0	WHIT_ADW WhiteNBLMee
43_ADW006	817	817	0	0	WHIT_ADW WhiteAbPice
43_ADW007	3695	2822	873	24	PICE_ADW PicCrUpper
43_ADW008	1571	1023	547	35	PICE_ADW PicCrBlRioB
43_ADW009	3998	3875	124	3	PICE_ADW PicCrAbHunt
43_ADW010	4789	4192	597	12	PICE_ADW PicCrBlRyan
43_ADW011	2759	2715	44	2	PICE_ADW Piceance@Wh

TABLE 5.2.1b
Comparison Between Historic and Simulated Average Annual Diversion Volumes
Calculated Data Set (acre-feet) 1975 -1991

Structure ID	Gaged Divert	Simulated Divert	Delta Divert	Delta Divert (%)	Name
43_ADW012	5363	5363	0	0	WHIT_ADW WhiteBlBois
43_ADW013	4383	4383	0	0	WHIT_ADW WhiteBlDoug
43_ADW014	3738	3738	0	0	WHIT_ADW WhiteNrStat
43_ADW015	1311	1268	43	3	EVAC_ADW Evac Creek
43_ADW016	3565	3565	0	0	WHIT_ADW WhiteSBLMee
43_AMW001	1104	1104	0	0	43_AMW001_AGG_M&I

TABLE 5.2.1c
Water Balance Summary
Calculated Data Set (acre-feet/year)

Year	Inflow	Divert	Return	Evap	Outflow	Res. Sto	Delta	CU (1)
1975	643,066	255,529	209,047	1,275	595,909	-600	0	35,044
1976	471,993	266,670	229,530	1,271	433,582	0	0	39,018
1977	274,267	294,095	255,460	1,266	234,483	-117	0	40,192
1978	575,948	294,582	255,364	1,269	535,342	119	0	41,973
1979	598,375	313,961	269,243	1,271	552,387	-2	0	40,743
1980	571,889	299,867	262,935	1,271	533,686	0	0	39,912
1981	378,170	268,253	231,674	1,271	340,319	0	0	37,706
1982	610,161	206,193	184,692	1,271	587,389	0	0	30,668
1983	875,898	235,228	191,529	1,271	830,928	0	0	35,661
1984	1,024,527	240,272	211,685	1,271	994,669	0	0	33,735
1985	901,950	253,357	218,393	2,377	850,949	13,660	0	38,055
1986	911,455	239,417	205,708	2,476	875,270	0	0	38,710
1987	597,949	244,970	209,007	2,476	559,511	0	0	36,393
1988	555,531	293,958	254,589	2,476	513,685	0	0	42,529
1989	475,654	325,506	281,473	2,476	429,145	0	0	44,855
1990	364,344	318,123	276,591	2,465	320,537	-189	0	41,731
1991	495,516	248,645	218,237	2,457	462,824	-173	0	36,415
AVG	607,453	270,508	233,245	1,759	567,684	747	0	38,432

1) Consumptive Use (CU) = Diversion (Divert) * Efficiency + Resevoir Evaporation (Evap)

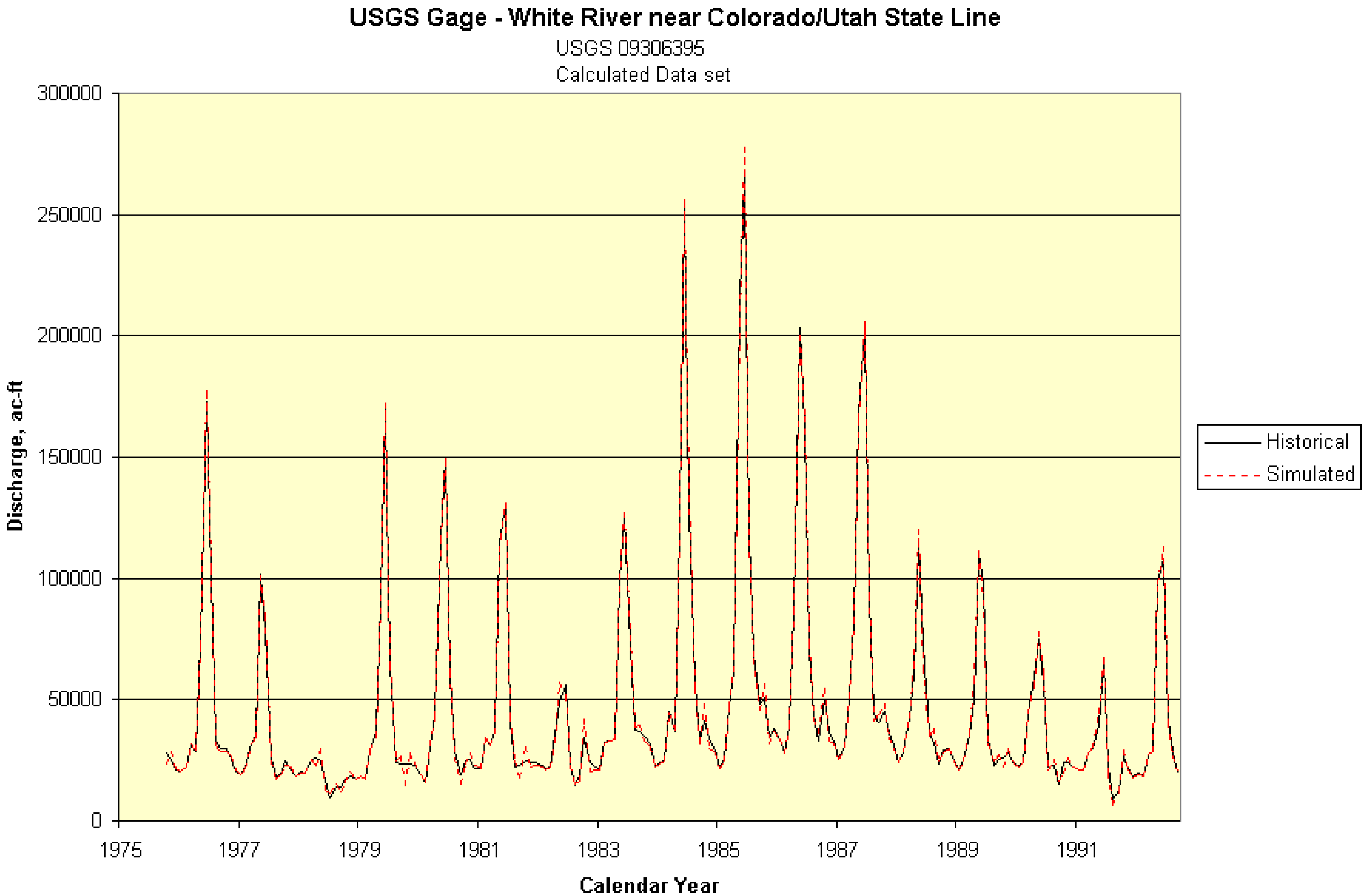

Figure 5.2.1a. Calculated Data Set USGS Gage White River nr Colo/Utah State Line

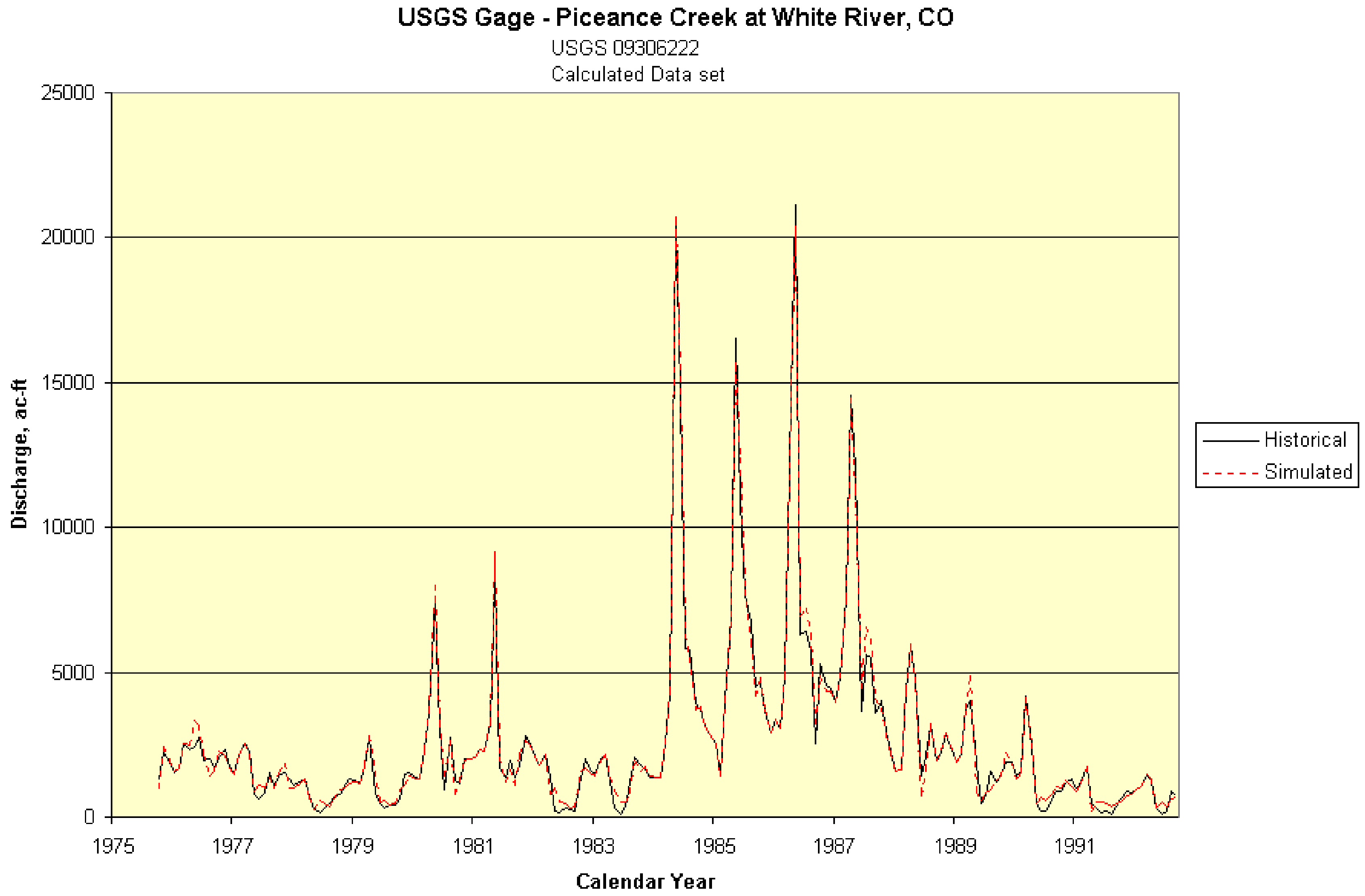

Figure 5.2.1b. Calculated Data Set USGS Gage-Piceance Creek at White River CO

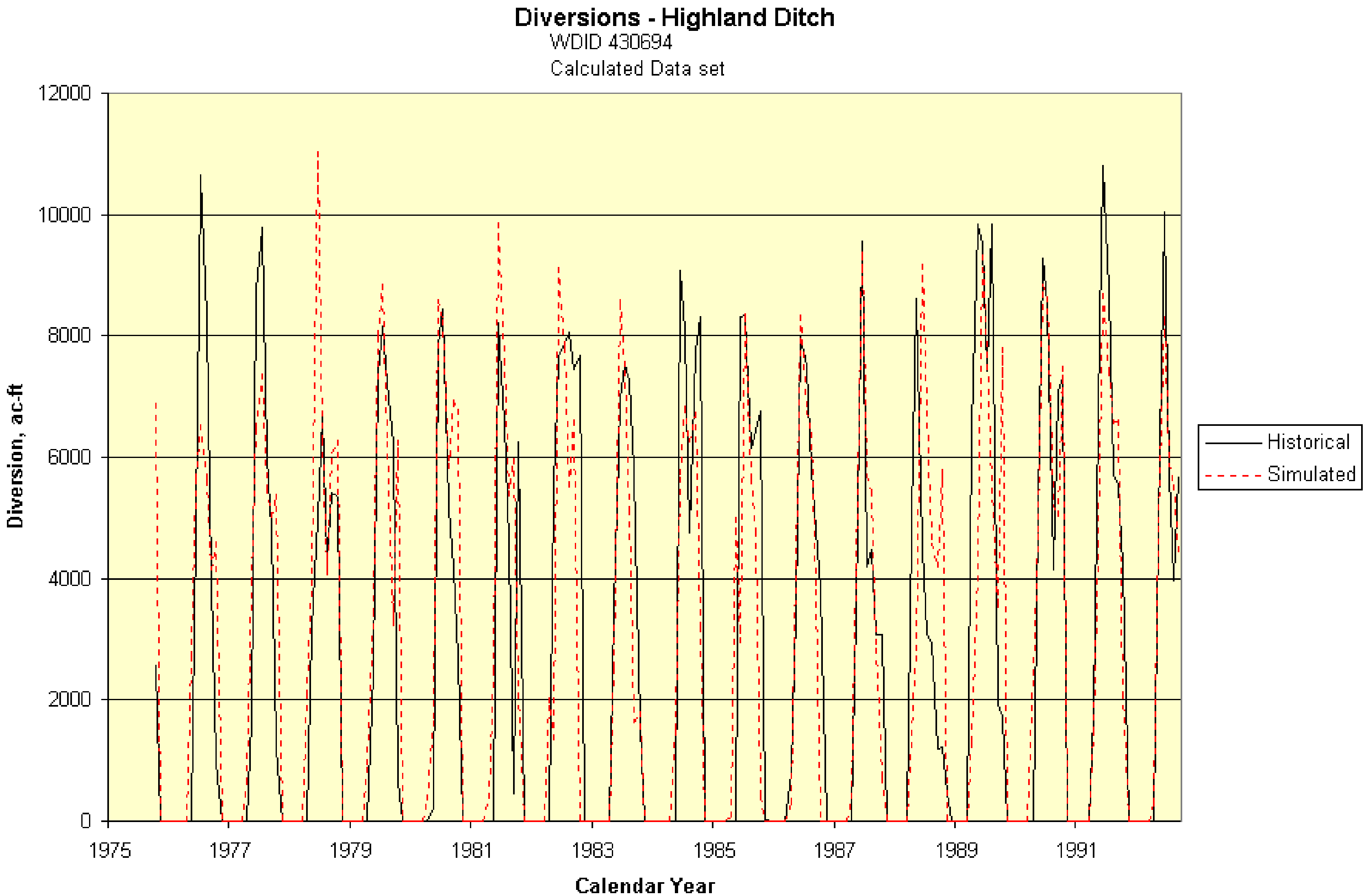

Figure 5.2.1c. Calculated Data Set
Highland Ditch

Figure 5.2.1d. Calculated Data Set
Sprod Ditch

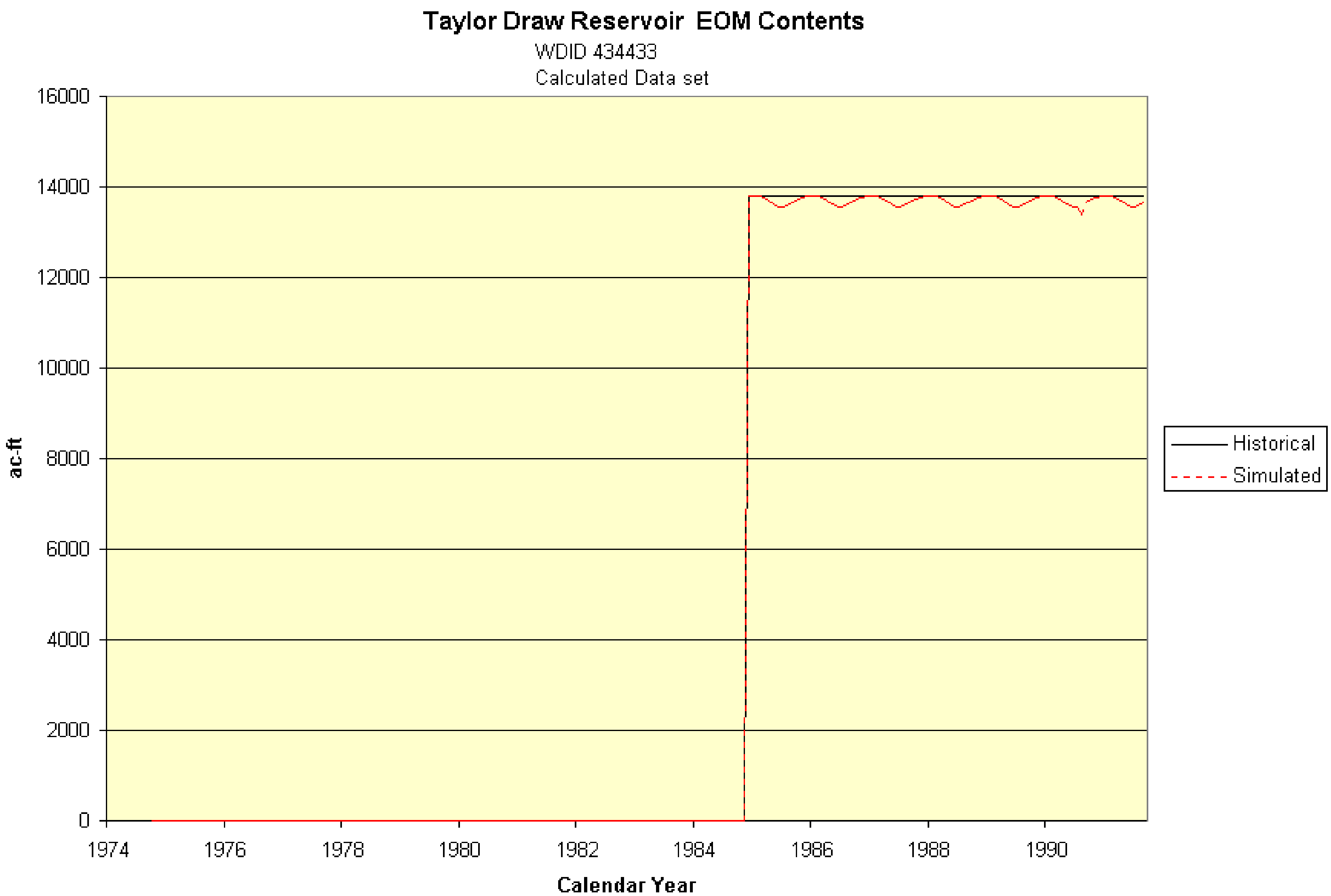

Figure 5.2.1e. Calculated Data Set
Taylor Draw Reservoir

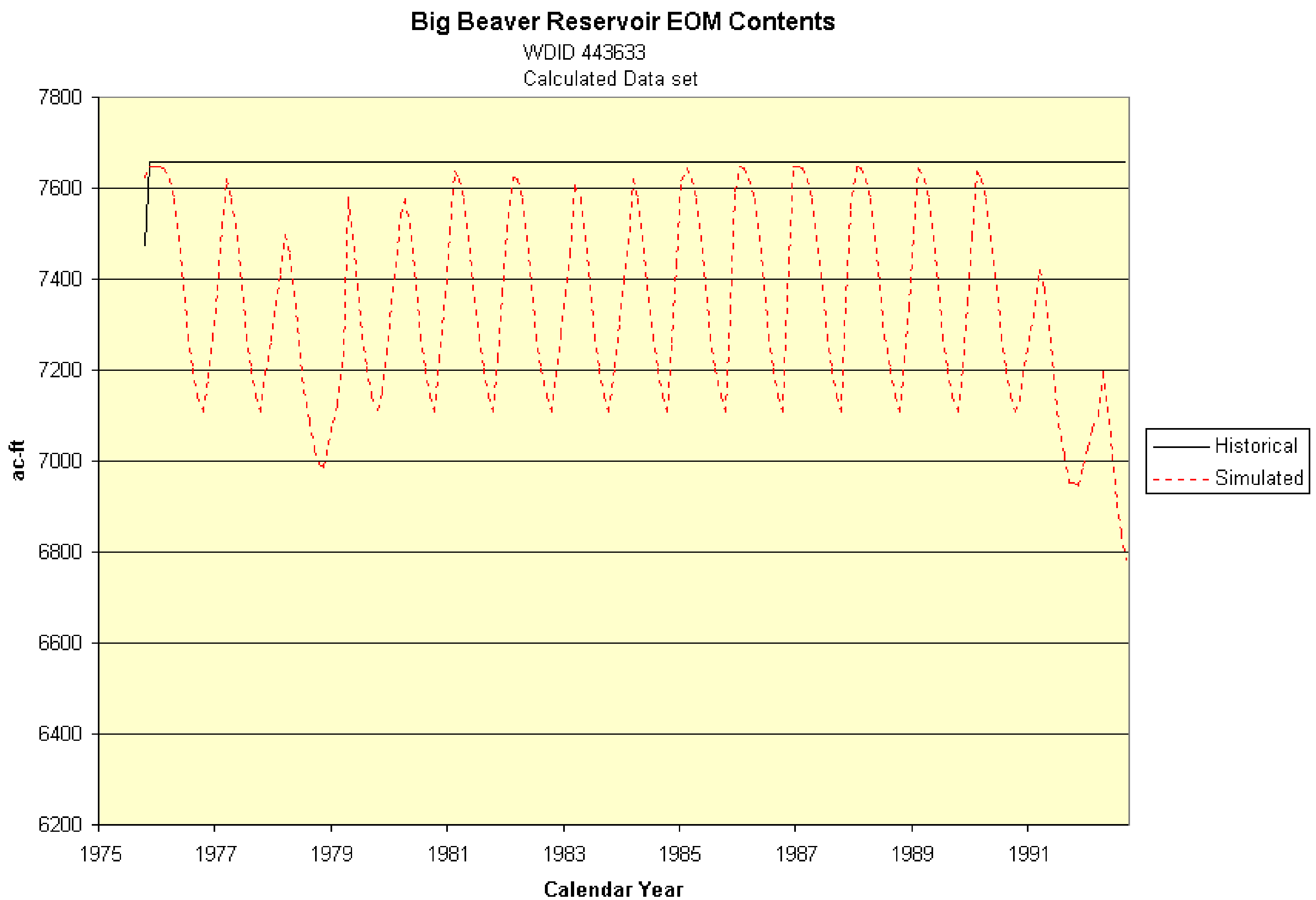

Figure 5.2.1f. Calculated Data Set
Big Beaver Reservoir