U.S. Department of the Interior
U.S. Geological Survey

Hydrologic Data for Water Years 1933–97 Used in the River and Reservoir Operations Model, Truckee River Basin, California and Nevada

Open-File Report 00-478

Prepared in cooperation with the
TRUCKEE–CARSON PROGRAM

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Report Documentation Page	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE **2000**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**
4. TITLE AND SUBTITLE **Hydrologic Data for Water Years 1933-97 Used in the River and Reservoir Operational Model, Truckee River Basin, California and Nevada**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Department of the Interior 1849 C Street, NW Washington, DC 20240**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

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

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**SAR**	**43**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

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By Steven N. Berris, Glen W. Hess, *and* Larry R. Bohman

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Carson City, Nevada
2001

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Multiply	By	To obtain
acre-foot (acre-ft)	1233	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

Temperature: Degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by using the formula °F = [1.8 (°C)] + 32. Degrees Fahrenheit can be converted to degrees Celsius by using the formula °C = 0.556 (°F − 32).

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929, formerly called “Sea-Level Datum of 1929”), which is derived from a general adjustment of the first-order leveling networks of the United States and Canada.

List of Acronyms:

BOR: Bureau of Reclamation
ESP: Extended Streamflow Prediction
FWM: Federal Water Master
HRU: Hydrologic Response Units
M&I: Municipal and industrial
NRCS: National Resources Conservation Services
NWS: National Weather Service
P.L.: Public Law
PRMS: Precipitation-Runoff Modeling System
SPPC: Sierra Pacific Power Company
TMUGL: Truckee Meadows Ungaged Gains and Loses
TMWRF: Truckee Meadows Water Reclamation Facility
TROA: Truckee River Operating Agreement
USCOE: U.S. Army Corps of Engineers
WQSA: Water Quality Settlement Agreement

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ABSTRACT

Title II of Public Law 101-618, the Truckee–Carson–Pyramid Lake Water Rights Settlement Act of 1990, provides direction, authority, and a mechanism for resolving conflicts over water rights in the Truckee and Carson River Basins. The Truckee–Carson Program of the U.S. Geological Survey, to support implementation of Public Law 101-618, has developed an operations model to simulate lake/reservoir and river operations for the Truckee River Basin including diversion of Truckee River water to the Truckee Canal for transport to the Carson River Basin. Several types of hydrologic data, formatted in a chronological order with a daily time interval called "time series," are described in this report. Time series from water years 1933 to 1997 can be used to run the operations model. Auxiliary hydrologic data not currently used by the model are also described. The time series of hydrologic data consist of flow, lake/reservoir elevation and storage, precipitation, evaporation, evapotranspiration, municipal and industrial (M&I) demand, and streamflow and lake/reservoir level forecast data.

INTRODUCTION

The Truckee River has a long history of providing water for a variety of economic, recreational, and environmental uses. Truckee River water is used for power generation upstream from Reno; municipal and industrial (M&I) supply for the Lake Tahoe Basin, Town of Truckee, and the Reno–Sparks vicinity (hereafter referred to as the Truckee Meadows); irrigation in both the Truckee and Carson River Basins; maintenance of Pyramid Lake levels (fig. 1 and pl. 1), and for providing flows for spawning of the endangered cui-ui lakesucker and the threatened Lahontan cutthroat trout. The diversity of user interests, each with a demand on the limited water resource, has resulted in long-standing and intense conflicts among various economic, political, ecological, and institutional entities. The diversity in interests also provides a wide range of alternatives for planning, allocating, and managing the water resources.

Title II of Public Law (P.L.) 101-618, the Truckee–Carson–Pyramid Lake Water Rights Settlement Act of 1990 (104 Statute 3289), provides direction, authority, and a mechanism for resolving conflicts over water and water rights in the Truckee and Carson River Basins. One component of P.L. 101-618 provides for the negotiation and development of new operating criteria, known as the Truckee River Operating Agreement (TROA), to balance interstate and interbasin allocation for water rights among the many interests competing for water from the Truckee River. In addition to TROA, the Truckee River Water Quality Settlement Agreement (WQSA), signed in 1996, provides for the acquisition of water rights to resolve water-quality problems during low-flow periods along the Truckee River in Nevada while simultaneously providing additional water for fish and wildlife resources. Efficient execution of many of the planning, management, or environmental assessment requirements of TROA and WQSA will require detailed hydrologic data. Analytical modeling tools constructed and evaluated with this hydrologic data could help assess effects of alternative management and operational scenarios related to Truckee River operations, water-rights transfers, and changes in irrigation practices.

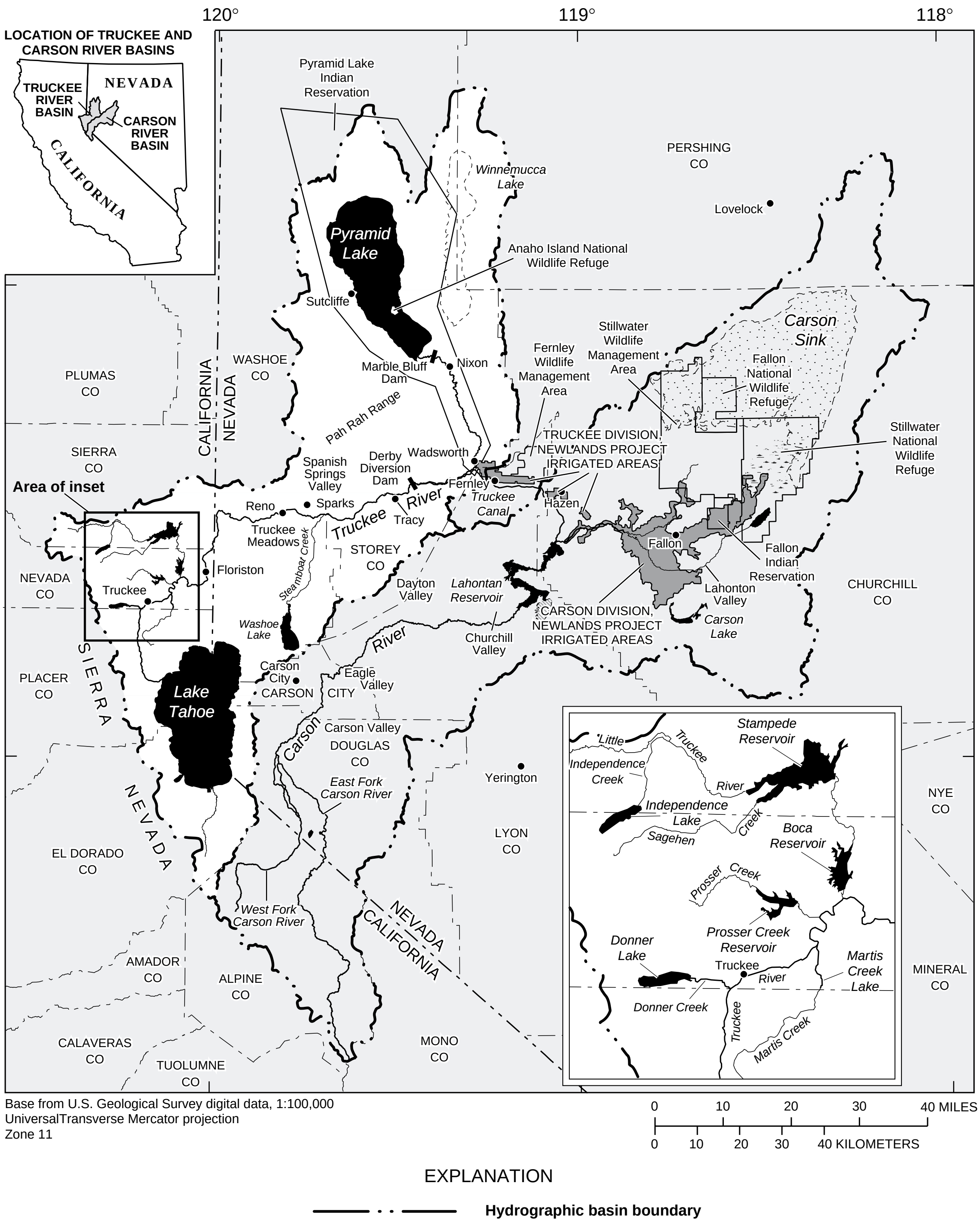

Figure 1. Location of study area, California and Nevada

The Truckee–Carson Program of the USGS was established by the Department of the Interior to support implementation of P.L. 101-618 by (1) compiling records from the multiagency gaging station network into a consistent long-term data base to provide reliable data in support of modeling activities in the Truckee River and Carson River Basins, (2) establishing new streamflow and water-quality gaging stations for more complete hydrologic information and more consistent support of river operations, and (3) developing a modeling system to support efficient water-resources planning, management, and allocation. Modeling activities within the USGS Truckee–Carson Program include the following components:

- Flow-routing models of the Truckee River and Carson River (upstream from Lahontan Reservoir), major tributaries, lakes/reservoirs, and the Truckee Canal (Berris, 1996, and Hess, 1996).
- Precipitation–runoff models for the headwater source areas of both basins (Jeton, 1999, 2000).
- Stream-temperature and total dissolved-solids models of the Truckee River (Taylor, 1998).
- Operation models which simulate lake/reservoir and river operations, including the Truckee Canal, for both basins (Berris and others, 2001; Hess and Taylor, 1999).

The USGS compiled existing hydrologic data and augmented the streamflow data network with additional data collection sites to satisfy the operations modeling needs of the Truckee–Carson Program. The USGS Truckee River Basin operations model discussed in Berris and others (2001) includes flow routing and river and reservoir operations. The daily operations model simulates flow and operations for three options. The first option simulates current (1998) operational practices. The second option combines current operations and those proposed in draft TROA[1] and WQSA. A third option simulates WQSA without draft TROA. The operations model was designed to provide simulations which allow comparison of the effects of alternative management practices or allocations on streamflow or lake/reservoir storages in the Truckee River Basin over long periods of time. Because the model was not intended to reproduce historical values, it was not calibrated using statistical comparisons of observed and simulated values.

Time-series data of streamflow, evapotranspiration, precipitation, evaporation, M&I demand, and streamflow and lake/reservoir level forecasts for water years[2] 1933–97 are necessary to run the operations model for long-term simulations. The period of data, water years 1933–97, was chosen because it represented the longest period of time for which sufficient observed or synthesized daily hydrologic data were available to satisfy the input requirements of the Truckee River Basin operations model. This period represents a wide range of hydrologic and climatic conditions. Additionally, the streamflow, evapotranspiration, precipitation, and evaporation data can be used to run the Truckee River flow-routing model discussed in Berris (1996).

Purpose and Scope

The purpose of this report is to describe the 1933–97 hydrologic data (time series from water year 1933 through 1997) assembled for use with the USGS Truckee River operations model or other models. The hydrologic data consists of time series of streamflow, lake/reservoir elevation and storage, precipitation, evaporation, evapotranspiration, M&I demand, and forecasts of streamflow and lake/reservoir levels. Auxiliary hydrologic data not currently used by the model also are described. Most of these auxiliary time series do not include the entire 1933–97 period. Auxiliary data might be useful for such objectives as comparing the effects of alternative management scenarios to historical conditions. The time series of hydrologic data consist of flow data collected or estimated by the USGS, U.S. District Court Water Master (FWM), Sierra Pacific Power Company (SPPC), Bureau of Reclamation (BOR), Truckee–Carson Irrigation District, U.S. Army Corps of Engineers (USCOE), Truckee Meadows Water Reclamation Facility (TMWRF), and California Department of Water Resources (DWR).

[1]TROA operations, as described in Berris and others (2001), reflect operational rules and policies presented in the February 1998 draft TROA evaluated in the Draft Environmental Impact Statement/Environmental Impact Report by the Bureau of Reclamation and others (1998).

[2]The term “water year” refers to the 12-month period October 1 through September 30. The water year is designated by the calendar year in which it ends. Thus, the year beginning October 1, 1996, and ending September 30, 1997, is called the “1997 water year.”

Precipitation, evaporation, and temperature data collected or estimated by the National Weather Service (NWS), Natural Resources Conservation Service (NRCS), USGS, or Sierra Hydrotech Engineering Consultants also are compiled. Streamflow and reservoir level/volume forecasts, either from the NRCS or estimated data using modeling techniques, are provided for use with the operations model. Estimates of evapotranspiration losses from the Truckee River by phreatophyte respiration also are included. Data describing M&I demand for Truckee River water were provided by SPPC. Only data in time-series format that are input to the operations model or are auxiliary data are described in this report. Other data that are provided within or simulated by the model code are not described. Thus, for example, return flows from irrigation ditches to the Truckee River are not described in this report because they are simulated by the operations model. For descriptions of these data, see Berris and others (2001).

The time-series data were collected or estimated for sites and subbasins in the Truckee River Basin from upstream from Lake Tahoe to Pyramid Lake. Some data also are included for the Truckee Canal, a small part of the Carson River in the vicinity of Lahontan Reservoir, and Lahontan Reservoir in the Carson River Basin.

Acknowledgments

The authors gratefully acknowledge the support of personnel from Truckee Meadows Water Reclamation Facility, Washoe County Department of Public Works, and U.S. Army Corps of Engineers, Sacramento, Calif., for providing data necessary to produce this report. Tom Scott, Al Olson, and David Overvold of the Bureau of Reclamation, Roderick Hall of Sierra Hydrotech Consultants, Richard Moser of Sierra Pacific Power Company, and several people in the office of the U.S. District Court Water Master, notably Garry D. Stone, Jeff Boyer, Chad Blanchard, Matthew Setty, and David Wathen provided insight into the required hydrologic data necessary to simulate streamflow and river and reservoir operations of the Truckee River Basin. Special thanks to Michael Dettinger (USGS, California District) for assistance with the synthetic historic climate time series, to Steve Markstrom (USGS, National Research Program, Colorado) for modifications to the Extended Streamflow Prediction (ESP) program to accommodate forecasting needs, and John Vaccaro (USGS, Washington District) for help in modifying a subroutine from the Deep Percolation Model which provided data used in the regression analysis of ungaged Truckee Meadows gains/losses.

DESCRIPTION OF DATA REQUIRED FOR RIVER AND RESERVOIR OPERATIONS MODEL

The river and reservoir operations model uses the Hydrological Simulation Program–FORTRAN to simulate daily flow routing and river and reservoir routing operations (Bicknell and others, 1993). HSPF was chosen because it can (1) simulate continuously over time, including periods of storm runoff and low flows, (2) simulate at a daily time step, (3) simulate the hydraulics of complex natural and man-made drainage networks, (4) produce simulation results for many locations along the river and its tributaries, (5) simulate river and reservoir operations, and (6) compute a detailed water budget that accounts for inflows and diversions as well as different categories[3] of water in the river and reservoirs. HSPF is an internationally used non-proprietary program maintained by the Environmental Protection Agency.

Simulation of Truckee River Basin operations and flow routing requires time series of hydrologic data describing inflows (gains) to and outflows (losses) from the river, reservoir, and lake/reservoir reaches[4]. The time series include inflows from or outflows to sources and locations other than from simulated flows routed from upstream reaches. Thus a time series of inflow to a reach may originate from a tributary or drainage area that contributes flow to a reach or may originate from precipitation falling directly on a reach, but does not include inflow routed from an upstream reach. Table 1 contains a listing of all time series data required to simulate operations and flow routing using the daily operations model. Because of the large num-

[3]A category of water is any parcel of water that is individually accounted for in an observed or simulated water budget. A single river, reservoir, lake, or diversion may contain several categories. Water within a category may have specific ownership or have a designated use.

[4]The term, “reach” refers to a reservoir or section of river having uniform hydraulic properties used for simulation of movement of water within a hydrologic network. The reaches defined for the USGS Truckee River Basin operations model are described in Berris and others (2001) and illustrated on plate 1.

ber of time series and many different types of data required by the model, table 1 is organized into five sections: (1) Net Inflow and Tributary Inflow, (2) Climate, (3) Evapotranspiration Losses from Phreatophytes, (4) Forecasts, and (5) M&I Demand. Table 2 lists the sites or basins on plate 1, in downstream order, where required or auxiliary data were collected or estimated using methods described in this report. The reader may note that some of the information in table 1 is repeated in table 2. The purpose of table 1 is to summarize only the data required to run the operations model, while table 2 links the data base to the map on plate 1 and provides additional information on auxiliary stations not required for modeling purposes.

The hydrologic data for water years 1933–97 were either observed or estimated and were consolidated into a single data base. Observed data were measured and obtained from several agencies. "Observed" data refers to data either directly measured at a gage, or data computed directly from one or more measured data attributes at a gage, such as the computation of flow from gage-height measurements. Hydrologic data had to be estimated when observed data were not available to quantify inflows and outflows. The period of data, water years 1933–97, was chosen because a sufficient amount of observed hydrologic data was available for use, both by the operations model and to estimate other required data. This period represents a wide range of hydrologic and climatic conditions.

The Truckee River Basin operations model uses the time series data management program ANNIE (Lumb and others, 1990). ANNIE is an interactive program designed for management of data, which includes file creation, data set management, data analysis, and data display. ANNIE is used for management of the daily time-series data required for simulation of streamflow and reservoir/river operations. Time-series data are stored in a binary data base called a Watershed Data Management (WDM) file. Simulation modules of the USGS Truckee River Basin operations model draw input from and write output to time series files stored in a WDM file. The time series data may be displayed in several formats available as options in ANNIE.

Source code for the simulation program HSPF 12.0 as used for the river and reservoir operations model and ANNIE 2.0 can be run using personal computer (PC) systems or UNIX operating systems and obtained at <http://water.usgs.gov/software>. The source code for HSPF 12.0 contains 1.5 megabytes (PC systems) or 2.0 megabytes (UNIX systems). The source code for ANNIE 2.0 contains 2.2 megabytes (PC systems) or 2.7 megabytes (UNIX systems). The model code for the river and reservoir operations model using HSPF 12.0 (troa.uci, 3.4 megabytes) described in Berris and others, 2001, and the data files using ANNIE 2.0 (mast.wdm, 59.6 megabytes) described in this report can be obtained by contacting the USGS, Nevada District Public Information Assistant, at (775) 887-7649 or by email request to <usgsinfo_nv@usgs.gov>.

Flow Data

Simulation of Truckee River Basin operations and flow routing requires time series of surface-water data to provide flow to model reservoir and river reaches from areas and tributaries that drain to the reaches (table 1). The time series do not include simulated flows routed from upstream reaches. Most of the gaged and ungaged perennial inflows to the Truckee River, Little Truckee River, reservoirs, and tributaries are upstream from the USGS gaging station, Truckee River at Vista, Nev. In contrast, for the Truckee River downstream from the Vista gaging station and for the Truckee Canal, most of the inflows are ephemeral and, as a result, do not normally supply large volumes of water. Surface-water data are described in the following section as flow data observed at gaging stations and flow data estimated by water-balance computations, precipitation–runoff model (USGS Precipitation–Runoff Modeling System [PRMS], Leavesley and others, 1983, 1996) simulations or by statistical methods. Time series commonly contain both observed and estimated data. Observed data are used when available. To provide continuous data to the operations model from water year 1933 through 1997, estimated data are used to fill in the time series when observed data are not available or at locations where observed data are not available.

Observed Flow

Streamflow data computed from gage-height records collected at gaging stations constitute observed streamflow data. Streamflow data collected at gaging stations were used either as direct model input to reservoir and river reaches or for estimation of streamflow data required for model input. Gaging stations that provided streamflow data to the operations model or for estimation of other data are in table 2 and on plate 1.

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model.

[Abbreviations: ESP, Extended Streamflow Prediction program; ft^3/s, cubic feet per second; NRCS, Natural Resources Conservation Service; NWS, National Weather Service; PRMS, Precipitation–Runoff Modeling System; SPPC, Sierra Pacific Power Company; TMUGL, Truckee Meadows ungaged gains and losses; WDM, Watershed Data Management file; acre-ft, acre-feet]

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
				NET INFLOW AND TRIBUTARY INFLOW [a]			
Lake Tahoe	100	Net inflow	ft^3/s	Estimated	*Water balance*: (Change in storage) + (gaged outflow) *Change in storage*: • Lake Tahoe at Tahoe City, Calif. (10337000) *Gaged outflow:* • Truckee River at Tahoe City, Calif. (10337500)	October 1932 to September 1997	103
Truckee River	110–140	Net inflows (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1932 to November 1944	801
				Estimated	Water balance: (Total gaged outflow) – (total gaged inflow) *Total gaged outflow:* • Truckee River near Truckee, Calif. (10338000) *Total gaged inflow*: • Truckee River at Tahoe City, Calif. (10337500) NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	December 1944 to September 1961	
				Estimated	PRMS simulation NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1961 to May 1977	
				Estimated	Water balance: NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	June 1977 to September 1982	

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Truckee River	110–140	Net inflows (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1982 to September 1992	801
				Estimated	Water balance (as above) NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1992 to September 1995	
				Estimated	PRMS simulation NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1995 to September 1996	
				Estimated	Water balance (as above) NOTE: Net inflows in data set 801 apportioned to reaches 110–140 according to drainage area contributing to each reach.	October 1996 to September 1997	
Donner Lake	145	Tributary inflow	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	802
Donner Creek	149	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1993	803
				Estimated	*Water balance:* (Total gaged outflow) – (total gaged inflow) *Total gaged outflow:* • Donner Creek at Highway 89, near Truckee, Calif. (10338700) *Total gaged inflow:* • Donner Creek at Donner Lake, near Truckee, Calif. (10338400)	October 1993 to September 1997	
Truckee River	150, 160	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation NOTE: Net inflows in data set 804 apportioned to reaches 150, 160, 169, and 170 according to drainage area contributing to each reach	October 1932 to September 1997	804
Martis Creek Lake	168	Tributary inflow	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	805
Martis Creek	169	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation NOTE: Net inflows in data set 804 apportioned to reaches 150, 160, 169, and 170 according to drainage area contributing to each reach	October 1932 to September 1997	804

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Truckee River	170	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation NOTE: Net inflows in data set 804 apportioned to reaches 150, 160, 169, and 170 according to drainage area contributing to each reach	October 1932 to September 1997	804
Prosser Creek Reservoir	178	Tributary inflow	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	807
Truckee River	180	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulations NOTE: Net inflows in data set 806 apportioned to reaches 180, 210, 220, 230, and 240 according to drainage area contributing to each reach	October 1932 to September 1997	806
Little Truckee River	185	Tributary inflow: upstream boundary to Little Truckee River	ft^3/s	Estimated	PRMS simulation	October 1932 to June 1993	808
				Observed	Sum of: Little Truckee River below Diversion Dam, near Sierraville, Calif. (10341950) AND Little Truckee Ditch at Head (California Dept. of Water Resources station no. 264)	July 1993 to September 1997	
Little Truckee River	185	Net inflow	ft^3/s	Estimated	PRMS simulation NOTE: Net and tributary inflows in data set 812 for reaches 185, 188, 189, 194, and 195, and 199 input directly to Stampede Reservoir reach 199, not Little Truckee River reach 185. See entry for Stampede Reservoir reach 199.	October 1932 to September 1997	812
Independence Lake	187	Tributary inflow	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	810
Independence Creek	188, 189	Net inflow	ft^3/s	Estimated	PRMS simulation NOTE: Net and tributary inflows in data set 812 for reaches 185, 188, 189, 194, 195, 198, and 199 input directly to Stampede Reservoir reach 199, not Independence Creek reaches 188 and 189. See entry for Stampede Reservoir reach 199.	October 1932 to September 1997	812
Little Truckee River	194, 195	Net inflow	ft^3/s	Estimated	PRMS simulation NOTE: Net and tributary inflows in data set 812 for reaches 185, 188, 189, 194, 195, 198, and 199 input directly to Stampede Reservoir reach 199, not Little Truckee River reaches 194 and 195. See entry for Stampede Reservoir reach 199.	October 1932 to September 1997	812

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Sagehen Creek	198	Upstream tributary inflow to Sagehen Creek	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1953	811
				Observed	Sagehen Creek near Truckee, Calif. (10343500)	October 1953 to September 1997	
Sagehen Creek	198	Net inflow	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	812
					NOTE: Net and tributary inflows in data set 812 for reaches 185, 188, 189, 194, 195, 198, and 199 input directly to Stampede Reservoir reach 199, not Sagehen Creek reach 198. See entry for Stampede Reservoir reach 199.		
Stampede Reservoir	199	Tributary inflow (does not include inflow from upstream reaches)	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	812
					NOTE: Net and tributary inflows in data set 812 input directly to Stampede Reservoir reach 199. Data set 812 contains the net and tributary inflows to reaches 85, 188, 189, 194, 195, 198, and 199.		
Little Truckee River	208	Net inflow (does not include inflow from upstream reaches.	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	813
Boca Reservoir	209	Tributary inflow (does not include inflow from upstream reaches.	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	814
Truckee River	210–220	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	806
					NOTE: Net inflows in data set 806 apportioned to reaches 180, 210, 220, 230, and 240 according to drainage area contributing to each reach		
Truckee River	230	Net inflow (does not include inflows from upstream reaches or Bronco Creek (see below))	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1997	806
					NOTE: Net inflows in data set 806 apportioned to reaches 180, 210, 220, 230, and 240 according to drainage area contributing to each reach		
Truckee River	230	Tributary inflow from Bronco Creek	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1993	815
				Observed	Bronco Creek at Floriston, Calif. (10345700)	October 1993 to September 1997	
Truckee River	240	Net inflow (does not include inflows from upstream reaches)	ft^3/s	Estimated	PRMS simulations	October 1932 to September 1997	806
					NOTE: Net inflows in data set 806 apportioned to reaches 180, 210, 220, 230, and 240 according to drainage area contributing to each reach		

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data: Description	Data: Units	Data: Type	Data: Source (collection site OR method of estimation or forecast)	Watershed data management file: Period of record	Watershed data management file: Data set number
Truckee River	250–280	Net inflow: TMUGL	ft^3/s	Estimated	Regression analysis	October 1932 to September 1980	8939
				Estimated	Water balance	October 1980 to September 1992	
				Estimated	Regression analysis	October 1992 to September 1997	
					NOTE: Net inflows in data set 8939 for reaches 250–390 input directly to Truckee River reach 380. No flow input to Truckee River reaches 250–280. See entry for Truckee River reach 380.		
Truckee River	280	Tributary inflow from Dog Creek	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1993	510
				Observed	Dog Creek at Verdi, Nev. (10347310)	October 1993 to September 1997	
Truckee River	290–320	Net inflow: TMUGL	ft^3/s	Estimated	Regression analysis	October 1932 to September 1980	8939
				Estimated	Water balance	October 1980 to September 1992	
				Estimated	Regression analysis	October 1992 to September 1997	
					NOTE: Net inflows in data set 8939 for reaches 250–390 input directly to Truckee River reach 380. No flow input to Truckee River reaches 290–320. See entry for Truckee River reach 380.		
Truckee River	320	Tributary inflow from Hunter Creek	ft^3/s	Estimated	PRMS simulation	October 1932 to September 1961	530
				Observed	Hunter Creek near Reno, Nev. (10347600), SPPC	October 1961 to September 1971	
				Estimated	PRMS simulation	October 1971 to September 1977	
				Observed	Hunter Creek near Reno, Nev. (10347600), SPPC	October 1977 to September 1992	
				Estimated	PRMS simulation	October 1992 to September 1997	
Truckee River	330–370	Net inflow: TMUGL	ft^3/s	Estimated	Regression analysis	October 1932 to September 1980	8939
				Estimated	Water balance	October 1980 to September 1992	
				Estimated	Regression analysis	October 1992 to September 1997	
					NOTE: Net inflows in data set 8939 for reaches 250–390 input directly to Truckee River reach 380. No flow input to Truckee River reaches 330–370. See entry for Truckee River reach 380.		

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Truckee River	380	Net inflow: TMUGL	ft^3/s	Estimated	Regression analysis NOTE: Net inflows in data set 8939 input directly to Truckee River reach 380. Data set 8939 contains the net inflows to reaches 250–390.	October 1932 to September 1980	8939
Truckee River	380			Estimated	*Water balance:* (total gaged outflow) – (total gaged inflow) *Total gaged outflow:* • Truckee River at Vista, Nev. (10350000) • Total agricultural diversions from river reaches 250–390 • Total M&I diversions from river reaches 250–390 *Total gaged inflow:* • Truckee River at Farad, Calif. (10346000) • Dog Creek at Verdi, Nev. (10347310) • Hunter Creek near Reno, Nev. (10347600) • Total agricultural returns to river reaches 250–390 • Total M&I returns to river reaches 250–390 NOTE: Net inflows in data set 8939 input directly to Truckee River reach 380. Data set 8939 contains the net inflows to reaches 250–390.	October 1980 to September 1992	
				Estimated	Regression analysis NOTE: Net inflows in data set 8939 input directly to Truckee River reach 380. Data set 8939 contains the net inflows to reaches 250–390.	October 1992 to September 1997	
Truckee River	390	Net inflow: TMUGL	ft^3/s	Estimated	Regression analysis	October 1932 to September 1980	8939
				Estimated	Water balance	October 1980 to September 1992	
				Estimated	Regression analysis NOTE: Net inflows in data set 8939 for reaches 250–390 input directly to Truckee River reach 380. No flow input to Truckee River reach 390. See entry for Truckee River reach 380.	October 1992 to September 1997	

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Truckee River	400–580	Tributary inflow: No inflows other than from upstream reaches input to reaches 390–580.	—	—	—	—	—
Truckee Canal	61–69	Tributary inflow: No inflows other than from upstream reaches input to reaches 61–69.	—	—	—	—	—
Lahontan Reservoir	49	Inflow to Lahontan Reservoir	ft^3/s	Observed	Carson River near Fort Churchill, Nev. (10312000)	October 1932 to September 1997	2750
				CLIMATE			
Lake Tahoe	100	Precipitation [b]	—	—	—	—	—
		Evaporation [c]	—	—	—	—	—
Truckee River	110–140	Precipitation [d]	—	—	—	—	—
		Evaporation [e]	—	—	—	—	—
Donner Lake	145	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Donner Memorial State Park (NWS 062467)	October 1932 to September 1953	880
				Observed and partially estimated	Donner Memorial State Park (NWS 062467) Missing periods estimated using data from: • Tahoe City (NWS 068758)	October 1953 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Tahoe City (NWS 068758) • Miscellaneous evaporation stations in Lake Tahoe vicinity [f]	October 1932 to September 1997	885
Donner Creek	149	Precipitation[d]	—	—	—	—	—
		Evaporation[e]	—	—	—	—	—
Truckee River	150, 160	Precipitation [g]	—	—	—	—	—
		Evaporation [h]	—	—	—	—	—

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Martis Creek Lake	168	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Boca (NWS 060931)	October 1932 to June 1948	882
				Observed	Boca (NWS 060931) Missing periods estimated using data from: • Truckee Ranger Station (NWS 069043) OR if not available: • Reno (NWS 326779)	July 1948 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Boca [i] (NWS 060931)	October 1932 to September 1997	886
Martis Creek	169	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Truckee River	170	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Prosser Creek Reservoir	178	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Boca (NWS 060931)	October 1932 to June 1948	882
				Observed	Boca (NWS 060931) Missing periods estimated using data from: • Truckee Ranger Station (NWS 069043) OR if not available: • Reno (NWS 326779)	July 1948 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Boca[i] (NWS 060931)	October 1932 to September 1997	886
Truckee River	180	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Little Truckee River	185	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Independence Lake	187	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Sagehen Creek (NWS 067641)	October 1932 to May 1953	881
				Observed and partially estimated	Sagehen Creek (NWS 067641) Missing periods estimated using data from: • Donner Memorial State Park (NWS 062467) OR if not available: • Truckee Ranger Station (NWS 069043)	June 1953 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Tahoe City (NWS 068758)[f] • Miscellaneous evaporation stations in Lake Tahoe vicinity	October 1932 to September 1997	885
Independence Creek	188, 189	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Little Truckee River	194, 195	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Sagehen Creek	198	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Stampede Reservoir	199	Precipitation	inches	Estimated	1. Statistical correlation of regional time series to develop synthetic data representing: • Boca (NWS 060931) 2. Resulting time series multiplied by 0.67	October 1932 to June 1948	882
				Estimated	Time series for the following stations multiplied by 0.67: • Boca (NWS 060931) Missing periods estimated using data from: • Truckee Ranger Station (NWS 069043) OR if not available: • Reno (NWS 326779)	July 1948 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Boca[i] (NWS 060931)	October 1932 to September 1997	886

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Little Truckee River	208	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Boca Reservoir	209	Precipitation	inches	Estimated	1. Statistical correlation of regional time series to develop synthetic data representing: • Boca (NWS 060931) 2. Resulting time series multiplied by 0.67	October 1932 to June 1948	882
Boca Reservoir	209			Observed	Time series for the following stations multiplied by 0.67: • Boca (NWS 060931) Missing periods estimated using data from: • Truckee Ranger Station (NWS 069043) OR if not available: • Reno (NWS 326779)	July 1948 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Boca[i] (NWS 060931) converted to daily data	October 1932 to September 1997	886
Truckee River	210–240	Precipitation[g]	—	—	—	—	—
		Evaporation[h]	—	—	—	—	—
Truckee River	250–390	Precipitation[j]	—	—	—	—	—
		Evaporation[k]	—	—	—	—	—
Truckee River	400–570	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Reno (NWS 326779)	October 1932 to February 1937	724
				Observed	Reno (NWS 326779)	March 1937 to September 1977	
				Observed	Wadsworth (NWS 328838)	October 1977 to September 1997	
		Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Boca[i] (NWS 060931)	October 1932 to September 1997	713
Pyramid Lake	580	Precipitation	inches	Estimated	Statistical correlation of regional time series to develop synthetic data representing: • Reno (NWS 326779)	October 1932 to February 1937	884
				Observed	Reno (NWS 326779)	March 1937 to September 1997	

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Pyramid Lake	580	Evaporation	inches	Estimated	Constant daily evaporation for each month based on data collected at: • Miscellaneous evaporation stations in Pyramid Lake vicinity [l]	October 1932 to September 1997	709
Truckee Canal	61–69	Precipitation [m]	—	—	—	—	—
		Evaporation [n]	—	—	—	—	—
Lahontan Reservoir	49	Precipitation [o]	—	—	—	—	—
		Evaporation [p]	—	—	—	—	—
EVAPOTRANSPIRATION LOSSES FROM PHREATOPHYTES [q]							
Truckee River	400	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	740
Truckee River	410	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	741
Truckee River	420	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	742
Truckee River	430	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	743
Truckee River	440	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	744
Truckee River	450	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	745
Truckee River	460	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	746
Truckee River	470	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	747
Truckee River	480	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	748
Truckee River	490	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	749
Truckee River	500	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	750
Truckee River	510	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	751

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Truckee River	520	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	752
Truckee River	530	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	753
Truckee River	540	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	754
Truckee River	550	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	755
Truckee River	560	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	756
Truckee River	570	Evapotranspiration losses	ft^3/s	Estimated	Average monthly evapotranspiration losses from phreatophytes[q]	October 1932 to September 1997	757
FORECASTS							
Lake Tahoe	[r]	April-to-peak closed-gates rise	feet	Forecast	NRCS	October 1932 to September 1997	8990
Little Truckee River above Boca Reservoir, near Truckee, Calif.	[s]	April–July runoff	acre-ft/ 1,000	Forecast	PRMS/ESP	October 1932 to December 1953	8985
					NRCS	January 1954 to September 1997	
Truckee River at Farad, Calif.	[r]	April–July runoff	acre-ft/ 1,000	Forecast	NRCS	October 1932 to September 1997	8980
Carson River near Fort Churchill, Nev.	[r]	April–July runoff	acre-ft/ 1,000	Forecast	NRCS	October 1932 to September 1997	2773
Lake Tahoe	[r]	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9400
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9401
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9402
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9403
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9404
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9405
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9406
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9407

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Donner Lake	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9410
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9411
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9412
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9413
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9414
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9415
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9416
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9417
Martis Creek Lake	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9430
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9431
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9432
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9433
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9434
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9435
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9436
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9437
Prosser Creek Reservoir	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9420
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9421
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9422
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9423
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9424
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9425
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9426
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9427

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
Independence Lake	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9440
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9441
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9442
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9443
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9444
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9445
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9446
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9447
Stampede Reservoir	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9450
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9451
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9452
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9453
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9454
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9455
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9456
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9457
Boca Reservoir	r	April inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9460
		May inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9461
		June inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9462
		July inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9463
		August inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9464
		September inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9465
		October inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9466
		November inflow	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9467
Truckee River at Farad, Calif.	r	April inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9470

Table 1. Hydrologic data required by the USGS Truckee River Basin operations model—Continued

Location	Model/reach number (pl. 1)	Data				Watershed data management file	
		Description	Units	Type	Source (collection site OR method of estimation or forecast)	Period of record	Data set number
		May inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9471
		June inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9472
		July inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9473
		August inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9474
		September inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9475
		October inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9476
		November inflow to Truckee River from unregulated and ungaged tributaries	acre-ft	Forecast	PRMS/ESP	October 1932 to September 1997	9477
M & I DEMAND							
Reno/Sparks vicinity	[t]	M & I demand from surface-water sources	ft^3/s	Estimated	SPPC	October 1932 to September 1997 [u]	8930

[a] The net inflows and tributary inflows described are provided by time series stored in a Watershed Data Management (WDM) file. The inflows do not include those inflows routed from upstream reaches in the USGS Truckee River Basin operations model.

[b] No precipitation data input to reach(es). Precipitation is included in water balance computation of net inflow.

[c] No evaporation data input to reach(es). Evaporation is included in water balance computation of net inflow.

[d] No precipitation data input to reach(es). Precipitation is included in PRMS simulation and water balance computation of net inflow.

[e] No evaporation data input to reach(es). Evaporation is included in PRMS simulation and water balance computation of net inflow.

[f] Evaporation data based on estimates by P.H. McGauhey and others (1963, p. 9).

[g] No precipitation data input to reach(es). Precipitation is included in PRMS simulation of net inflow.

[h] No evaporation data input to reach(es). Evaporation is included in PRMS simulation of net inflow.

[i] Evaporation data based on estimates by R.L. Hall (Sierra Hydrotech, written commun., 1994).

[j] No precipitation data input to reach(es). Precipitation is included in regression equation and water balance computations of TMUGL.

[k] No evaporation data input to reach(es). Evaporation is included in regression equation and water balance computations of TMUGL.

[l] Evaporation data based on estimates by S.W. Hostetler (USGS, oral commun., 1994).

[m] No precipitation data input to reach(es). Precipitation is included in the simulation of Truckee Canal losses in the USGS Truckee River Basin operations model.

[n] No evaporation data input to reach(es). Evaporation is included in the simulation of Truckee Canal losses in the USGS Truckee River Basin operations model.

[o] No precipitation data input to reach(es). Precipitation is included in the simulation of Lahontan Reservoir losses in the USGS Truckee River Basin operations model.

[p] No evaporation data input to reach(es). Evaporation is included in the simulation of Lahontan Reservoir losses in the USGS Truckee River Basin operations model.

[q] Evapotranspiration losses from phreatophytes are only simulated for Truckee River reaches 400–570. Estimates of evapotranspiration losses are based on phreatophyte acreage adjacent to a given reach, average annual evapotranspiration rate for a typical species, and the monthly distribution of annual evapotranspiration. For other channel reaches, evapotranspiration losses are included in PRMS simulations or water balance computations of net inflows, computation of Truckee Meadows ungaged gains and losses (TMUGL), or simulation of Truckee Canal losses in the USGS Truckee River Basin operations model.

[r] Forecast data are not applied to reaches, but are used in the model code of the USGS Truckee River Basin operations model.

[s] Forecast data are not applied to reaches, but are used in the model code of the USGS Truckee River Basin operations model.

[t] M&I demand data are not applied to reaches, but are used in the model code of the USGS Truckee River Basin operations model.

[u] M&I demand data for simulation of M&I demands for water from channel reaches of the Truckee River between Farad and Vista gaging stations based on the index period of 1-95 to 12-95.

Table 2. Basins used for runoff simulations and data-collection sites included in data base

[Abbreviations: AUX, auxiliary data not required for U.S. Geological Survey Truckee River Basin operations model, but may be useful to modeler; BOR, Bureau of Reclamation; CDWR, California Department of Water Resources; dsn, data set number; FWM, U.S. District Court Federal Water Master; M & I, Municipal and Industrial; NRCS, Natural Resources Conservation Service; NWS, National Weather Service; OBS, observed data; OBS/EST, observed and partially estimated data (U.S. Geological Survey estimated data for periods when continuous or accurate data were not available); PRMS, simulated data from Precipitation–Runoff Modeling System; precip., daily precipitation; SIM, primary data required for simulations with U.S. Geological Survey Truckee River Basin operations model: SIM2, secondary data used to compute primary data required for simulation with U.S. Geological Survey Truckee River Basin operations model (data set numbers resulting from computations are in parentheses and correspond to data set numbers in table 1); SPPC, Sierra Pacific Power Company; STAT, estimated precipitation or temperature data by statistical correlation using regional time series (see table 1); TAH, Aggregated ungaged areas in Lake Tahoe basin; temp., daily temperature; TCID, Truckee–Carson Irrigation District; TMWRF, Truckee Meadows Water Reclamation Facility; TRK, Truckee River subbasin; USCOE, U.S. Army Corps of Engineers; USGS, U.S. Geological Survey; WB, estimated data from water-balance computations (see table 1); WDM, watershed data management file; acre-ft, acre-feet; ft^3/s, cubic feet per second]

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data			Watershed data management file	
				Description (units)	Purpose	Type	Period of record	Data-set number
TAH11	—	Aggregated ungaged area in the Lake Tahoe Basin between Ward Creek Subbasin and Third Creek Subbasin.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	821
1	USGS 10336698	Third Creek near Crystal Bay, Nev.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1977	854
						OBS	October 1969 to September 1973 February 1975 to September 1975 October 1977 to September 1997	65
2	USGS 10336700	Incline Creek near Crystal Bay, Nev.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1988	855
						OBS	October 1966 to September 1975 November 1987 to September 1997	75
3	USGS 10336715	Marlette Creek near Carson City, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1973 to September 1997	76
TAH12	—	Aggregated ungaged area in the Lake Tahoe Basin between Incline Creek Subbasin and Glenbrook Creek Subbasin (includes Marlette Creek Subbasin).	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	822
4	USGS 10336730	Glenbrook Creek at Glenbrook, Nev.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1988	857
						OBS	October 1971 to September 1975 November 1987 to September 1997	77
5	USGS 10336740	Logan House Creek near Glenbrook, Nev.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1984	858
						OBS	October 1996 to September 1997	78
TAH14	—	Aggregated ungaged area in the Lake Tahoe Basin between Logan House Creek Subbasin and Edgewood Creek Subbasin.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	823
6	USGS 103367592	Eagle Rock Creek near Stateline, Nev.	USGS	flow (ft^3/s)	AUX	OBS	November 1989 to September 1997	79
7	USGS 10336760	Edgewood Creek at Stateline, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1992 to September 1997	80
TAH15	—	Aggregated ungaged area in the Lake Tahoe Basin from Edgewood Creek Subbasin to basin divide of Trout Creek Subbasin (includes Eagle Rock Creek Subbasin and Edgewood Creek subbasin).	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	824

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data: Description (units)	Data: Purpose	Watershed data management file: Type	Watershed data management file: Period of record	Watershed data management file: Data-set number
8	USGS 10336780	Trout Creek near Tahoe Valley, Calif.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1960	861
						OBS	October 1960 to September 1997	81
9	USGS 10336610	Upper Truckee River at South Lake Tahoe, Calif.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1980	850
						OBS	October 1971 to September 1974	51
							October 1976 to June 1977	
							October 1977 to June 1978	
							March 1980 to September 1997	
TAH16	—	Aggregated ungaged area in the Lake Tahoe Basin between Upper Truckee River Subbasin and General Creek subbasin.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	825
10	USGS 10336645	General Creek near Meeks Bay, Calif.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1980	851
						OBS	October 1980 to September 1997	50
TAH17	—	Aggregated ungaged area in the Lake Tahoe Basin between General Creek Subbasin and Blackwood Creek Subbasin.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1997	826
11	USGS 10336660	Blackwood Creek near Tahoe City, Calif.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1960	852
						OBS	October 1960 to September 1997	55
12	USGS 10336676	Ward Creek at State Highway 89, near Tahoe Pines, Calif.	USGS	flow (ft^3/s)	AUX	PRMS	October 1932 to September 1972	853
						OBS	October 1972 to September 1997	60
13	TCID USGS 10337000	Lake Tahoe at Tahoe City, Calif.	TCID	elevation (feet)	SIM2 (dsn 103)	OBS	October 1932 to September 1957	100
			USGS		SIM2 (dsn 103)	OBS	October 1957 to September 1997	
14	USGS 10337500	Truckee River at Tahoe City, Calif.	USGS	flow (ft^3/s)	SIM2 (dsn 103 and 801)	OBS	October 1895 to September 1997	101
TRK1	—	Aggregated ungaged area in the Truckee River Basin between the USGS gages, Truckee River at Tahoe City, Calif. (10337500) and Truckee River near Truckee, Calif. (10338000).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to November 1944	801
						WB	December 1944 to September 1961	
						PRMS	October 1961 to May 1977	
						WB	June 1977 to September 1982	
						PRMS	October 1982 to September 1992	
						WB	October 1992 to September 1995	
						PRMS	October 1995 to September 1996	
						WB	October 1996 to September 1997	

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data: Description (units)	Data: Purpose	Data: Type	Watershed data management file: Period of record	Watershed data management file: Data-set number
15	USGS 10338000	Truckee River near Truckee, Calif.	USGS	flow (ft^3/s)	SIM2 (dsn 801)	OBS	December 1944 to September 1961 June 1977 to September 1982 October 1992 to September 1995 October 1996 to September 1997	104
TRK2	—	Donner Lake Subbasin	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	802
16	USGS 10338400	Donner Lake near Truckee, Calif.	SPPC	storage (acre-ft)	AUX	OBS/EST	January 1980 to December 1988	110
			USGS		AUX	OBS	January 1989 to September 1997	
17	NWS 062467	Donner Memorial State Park, Calif.	USGS	precip. (inches)	SIM	STAT	October 1932 to September 1953	880
			NWS		SIM	OBS/EST	October 1953 to September 1997	
18	USGS 10338500	Donner Creek at Donner Lake, near Truckee, Calif.	USGS	flow (ft^3/s)	SIM2 (dsn 803)	OBS	July 1929 to October 1935 January 1936 to March 1938 July 1938 to October 1938 January 1939 to February 1943 June 1943 to December 1953 May 1955 to December 1957 October 1958 to September 1997	113
TRK3	—	Aggregated ungaged area in the Donner Creek Subbasin of the Truckee River Basin between the USGS gages, Donner Creek at Donner Lake, near Truckee, Calif. (10338500) and Donner Creek at Highway 89, near Truckee, Calif. (10338700).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1993	803
						WB	October 1993 to September 1997	
19	USGS 10338700	Donner Creek at Highway 89, near Truckee, Calif.	USGS	flow (ft^3/s)	SIM2 (dsn 803)	OBS	March 1993 to September 1997	112
TRK5	—	Martis Creek Lake Subbasin	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	805
20	USGS 10339380	Martis Creek Lake near Truckee, Calif.	USGS	storage (acre-ft)	AUX	OBS	March 1972 to May 1972 June 1972 to September 1990	116
			USCOE		AUX	OBS	October 1990 to September 1997	
21	USGS 10339400	Martis Creek near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	October 1958 to November 1990	122
			USCOE		AUX	OBS	December 1990 to May 1993	
			USGS		AUX	OBS	June 1993 to September 1997	

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data: Description (units)	Data: Purpose	Watershed data management file: Type	Watershed data management file: Period of record	Watershed data management file: Data-set number
TRK4	—	Aggregated ungaged area in the Truckee River Basin between the USGS gages, Truckee River near Truckee, Calif. (10338000) and Truckee River above Prosser Creek, near Truckee, Calif. (10339419). Excludes Donner Creek Subbasin (TRK2 and TRK3), Martis Creek Lake Subbasin (TRK5), and Prosser Creek Reservoir Subbasin (TRK7).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	804
22	USGS 10339419	Truckee River above Prosser Creek, near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	October 1993 to September 1997	129
TRK7	—	Prosser Creek Reservoir Subbasin	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	807
23	BOR USGS 10340300	Prosser Creek Reservoir near Truckee, Calif.	BOR	storage (acre-ft)	AUX	OBS	January 1964 to September 1997	131
24	USGS 10340500	Prosser Creek below Prosser Creek Dam, near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	October 1942 to December 1950 June 1951 to September 1997	134
TRK8	—	Little Truckee River Subbasin upstream of USGS gage Little Truckee River below Diversion Dam, near Sierraville, Calif. (10341950) and CDWR gage Little Truckee Ditch at Head (264).	USGS	flow (ft^3/s)	SIM	PRMS OBS [a]	October 1932 to June 1993 July 1993 to September 1997	808
25	CDWR 264	Little Truckee Ditch at Head	CDWR	flow (ft^3/s)	SIM	OBS	October 1977 to September 1997	499
26	USGS 10341950	Little Truckee River below Diversion Dam, near Sierraville, Calif.	USGS	flow (ft^3/s)	SIM	OBS	June 1993 to September 1997	145
TRK9	—	Independence Lake Subbasin	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	810
27	USGS 10342900	Independence Lake near Truckee, Calif.	SPPC USGS	storage (acre-ft)	AUX AUX	OBS/EST OBS	May 1980 to November 1988 November 1988 to September 1997	150
28	USGS 10343000	Independence Creek near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	August 1968 to September 1997	152
TRK10	—	Sagehen Creek Subbasin upstream of USGS gage Sagehen Creek near Truckee, Calif. (10343500).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1953	811
29	USGS 10343500	Sagehen Creek near Truckee, Calif.	USGS	flow (ft^3/s)	SIM	OBS	October 1953 to September 1997	811
30	NWS 067641	Sagehen Creek, Calif.	USGS NWS	precip. (inches)	SIM SIM	STAT OBS/EST	October 1932 to Mary 1953 June 1953 to September 1997	881
TRK11	—	Stampede Reservoir Subbasin. Excludes Little Truckee River Subbasin (TRK8), Independence Lake Subbasin (TRK9), and Sagehen Creek Subbasin (TRK10).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	812

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data			Watershed data management file	
				Description (units)	Purpose	Type	Period of record	Data-set number
31	BOR USGS 10344300	Stampede Reservoir near Truckee, Calif.	BOR	storage (acre-feet)	AUX	OBS	August 1970 to September 1997	169
TRK12	—	Aggregated ungaged area in the Little Truckee River Basin between Stampede Reservoir and the USGS gage, Little Truckee River above Boca Reservoir near Truckee, Calif. (10344400).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	813
32	USGS10344400	Little Truckee River above Boca Reservoir, near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	September 1930 to September 1997	176
TRK13	—	Boca Reservoir Subbasin downstream of USGS gage, Little Truckee River above Boca Reservoir near Truckee, Calif. (10344400).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	814
33	BOR USGS10344490	Boca Reservoir near Truckee, Calif.	BOR	storage (acre-feet)	AUX	OBS/EST	October 1961 to September 1997	187
34	NWS060931	Boca Reservoir, Calif.	USGS	precip. (inches)	SIM, SIM2 (dsn 8939)	STAT	October 1932 to June 1948	882
			NWS		SIM, SIM2 (dsn 8939)	OBS/EST	July 1948 to September 1997	
35	USGS10344500	Little Truckee River below Boca Dam, near Truckee, Calif.	USGS	flow (ft^3/s)	AUX	OBS	January 1911 to September 1915 January 1939 to September 1997	191
TRK14	—	Bronco Creek Subbasin	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1993	815
36	USGS 10345700	Bronco Creek at Floriston, Calif.	USGS	flow (ft^3/s)	SIM	OBS	October 1993 to September 1997	815
TRK6	—	Aggregated ungaged area in the Truckee River Basin between the USGS gages, Truckee River above Prosser Creek, near Truckee, Calif. (10339419) and Truckee River at Farad, Calif. (10346000). Excludes Prosser Creek Reservoir Subbasin (TRK7), entire Little Truckee River Subbasin (TRK8, TRK9, TRK10, TRK11, TRK12, and TRK13), and Bronco Creek Subbasin (TRK14).	USGS	flow (ft^3/s)	SIM	PRMS	October 1932 to September 1997	806
37	USGS 10346000	Truckee River at Farad, Calif.	USGS	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	January 1909 to September 1997	194
38	FWM T1 USGS 10349350	Steamboat Ditch near Floriston, Calif.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	April 1978 to October 1997	501
39	FWM T2 USGS 10347390	Coldron Ditch at Verdi, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS/EST	April 1978 to June 1994	505

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data		Watershed data management file		
				Description (units)	Purpose	Type	Period of record	Data-set number
40	FWM USGS 10347331	Katz Ditch near Verdi, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS/EST	April 1978 to June 1986	509
TRK15	—	Dog Creek Subbasin	USGS	flow (ft^3/s)	SIM, SIM2 (dsn 8939)	PRMS	October 1932 to September 1993	510
41	USGS 10347310	Dog Creek at Verdi, Nev.	USGS	flow (ft^3/s)	SIM, SIM2 (dsn 8939)	OBS	October 1993 to September 1997	510
42	SPPC FWM T4 USGS 10347420	Highland Ditch at Reno, Nev.	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS/EST	October 1977 to December 1997	518
43	USGS 10347460	Truckee River near Mogul, Nev.	USGS	flow (ft^3/s)	AUX	OBS	February 1993 to September 1995 October 1996 to September 1997	202
44	SPPC	Chalk Bluff Water Treatment Plant delivery to M&I System	SPPC	flow (ft^3/s)	AUX	OBS	April 1994 to September 1997	540
45	FWM T5 USGS 10349740	Last Chance Ditch at Hunter Creek, near Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	April 1978 to October 1997	521
46	FWM T6 USGS 10349810	Lake Ditch at Mayberry Drive near Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	April 1978 to October 1997	537
TRK16	—	Hunter Creek Subbasin upstream of USGS gage Hunter Creek near Reno, Nev. (10347600).	USGS	flow (ft^3/s)	SIM, SIM2 (dsn 8939)	PRMS	October 1932 to September 1961 October 1971 to September 1977 October 1992 to September 1997	530
47	USGS 10347600	Hunter Creek near Reno, Nev.	USGS	flow (ft^3/s)	SIM, SIM2 (dsn 8939)	OBS	October 1961 to September 1971 October 1977 to September 1981	530
			SPPC		SIM, SIM2 (dsn 8939)	OBS	October 1981 to September 1992	
48	SPPC	Hunter Creek Water Treatment Plant delivery to M&I System	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to September 1995	529
49	NRCS 19K07S	Mt. Rose Ski Area, Nev.	NRCS	precip. (inches)	SIM2 (dsn 8939)	STAT OBS	October 1932 to September 1980 October 1980 to September 1997	887
50	FWM T7 USGS 10348210	Orr Ditch near Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OGS	October 1977 to October 1997	541
51	SPPC	Idlewild Water Treatment Plant delivery to M&I System	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to March 1994	545
52	FWM T8 USGS 10349938	Cochran Ditch at Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	April 1978 to October 1997	561
53	SPPC	Highland Water Treatment Plant delivery to M&I System	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to May 1996	553
54	SPPC	Highland Plant Spill to Washington Street Drain	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	November 1985 to September 1995	549

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data			Watershed data management file	
				Description (units)	Purpose	Type	Period of record	Data-set number
55	USGS 10348000	Truckee River at Reno, Nev.	USGS	flow (ft^3/s)	AUX	OBS	January 1912 to September 1919 January 1930 to December 1934 January 1943 to December 1943 January 1946 to September 1997	219
56	SPPC	Glendale Water Treatment Plant delivery to M&I System	SPPC	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to September 1997	577
57	FWM USGS 10348150	Sessions Ditch at Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	May 1978 to August 1988	573
58	FWM T9, T9a, —T9b USGS 10348270	North Truckee Ditch at Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to September 1997	569
59	FWM USGS 10349974	Eastman Ditch at Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	November 1977 to October 1985	565
60	FWM T11 USGS 10349971	Pioneer Ditch at Reno, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to October 1997	581
61	NWS 326779	Reno, Nev.	USGS	precip. (inches)	SIM, SIM2 (dsn 8939)	STAT	October 1932 to February 1937	724 [b], 884
			NWS		SIM, SIM2 (dsn 8939)	OBS	March 1937 to September 1997	884
			NWS		SIM	OBS	March 1937 to September 1977	724[b]
			USGS	maximum temp.	SIM2 (dsn 8939)	STAT	October 1932 to February 1937	875
			NWS	degrees Fahrenheit	SIM2 (dsn 8939)	OBS	March 1937 to September 1997	
			USGS	minimum temp.	SIM2 (dsn 8939)	STAT	October 1932 to February 1937	876
			NWS	degrees Fahrenheit	SIM2 (dsn 8939)	OBS	March 1937 to September 1997	
62	FWM T12 USGS 10348310	Glendale Ditch near Sparks, Nev.	FWM	flow (ft^3/s)	SIM2 (dsn 8939)	OBS	October 1977 to June 1996	585
63	USGS 10348200	Truckee River near Sparks, Nev.	USGS	flow (ft^3/s)	AUX	OBS	April 1977 to September 1997	226
64	FWM T59 USGS 10348300	North Truckee Drain at Kleppe Lane near Sparks, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	July 1976 to September 1992	592
			USGS		AUX	OBS	October 1992 to December 1996	
65	FWM T54 USGS 10349980	Steamboat Creek at Cleanwater Way near Reno, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	October 1977 to December 1992	594
			USGS		AUX	OBS	November 1992 to December 1996	
66	TMWRF	TMWRF Outfall at Reno, Nev.	TMWRF	flow (ft^3/s)	AUX	OBS	October 1977 to September 1997	599

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data		Watershed data management file		
				Description (units)	Purpose	Type	Period of record	Data-set number
67	USGS 10350000	Truckee River at Vista, Nev.	USGS	flow (ft^3/s)	SIM2	OBS	January 1900 to December 1907 January 1932 to December 1954 October 1958 to September 1997	277
68	NWS 328761	Virginia City, Nev.	NWS	precip. (inches)	SIM2 (dsn 8939)	STAT OBS STAT OBS STAT OBS STAT OBS STAT OBS STAT OBS	October 1932 to April 1951 April 1951 to November 1951 December 1951 to October 1952 November 1952 to June 1953 July 1953 to September 1953 September 1953 to March 1958 April 1958 to July 1958 August 1958 to November 1960 December 1960 to March 1965 April 1965 to March 1967 April 1967 to April 1968 May 1968 to September 1997	888
69	FWM T16 USGS 10350048	Noce Ditch near Vista, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	October 1977 to August 1989	602
70	FWM T17 USGS 10350150	Murphy Ditch near Vista, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	April 1978 to September 1997	606
71	FWM USGS 10350130	Groton Ditch at Lockwood, Nev. [c]	FWM	flow (ft^3/s)	AUX	OBS/EST	October 1977 to September 1984	610
72	FWM USGS 10350140	Sheep Ranch Ditch near Lockwood, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to September 1978	614
73	FWM T19 USGS 10350320	McCarran Ditch near Patrick, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	April 1978 to October 1997	618
74	FWM USGS 10350475	Hill Ditch opposite Tracy Power Plant at Tracy, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to July 1986	622
75	USGS 10350400	Truckee River below Tracy, Nev.	USGS	flow (ft^3/s)	AUX	OBS	May 1972 to January 1997	315
76	FWM T14 USGS 10351010	Truckee Canal below Derby Dam, near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS	October 1977 to September 1997	626
77	USGS 10351300	Truckee Canal near Wadsworth, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1966 to September 1997	324
78	USGS 10351400	Truckee Canal near Hazen, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1966 to September 1997	330
79	USGS 10312000	Carson River near Fort Churchill, Nev.	USGS	flow (ft^3/s)	SIM	OBS	October 1932 to September 1997	2750
80	USGS 10312100	Lahontan Reservoir near Fallon, Nev.	TCID	storage (acre-ft)	AUX	OBS	October 1965 to September 1997	3000

Table 2. Basins used for runoff simulations and data-collection sites included in data base—Continued

Site or subbasin designation (pl. 1)	Station number	Name of station or location of basin	Operating agency	Data			Watershed data management file	
				Description (units)	Purpose	Type	Period of record	Data-set number
81	USGS 10312150	Carson River below Lahontan Reservoir, near Fallon, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1966 to September 1997	3100
82	USGS 10351600	Truckee River below Derby Dam, near Wadsworth, Nev.	USGS	flow (ft^3/s)	AUX	OBS	January 1918 to July 1958 October 1958 to September 1997	333
83	FWM T15 USGS 10351615	Washburn Ditch at Orchard, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	March 1978 to September 1997	631
84	FWM T21 USGS 10351638	Gregory Ditch near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	April 1978 to September 1997	635
85	FWM T22 USGS 10351635	Herman Ditch near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	October 1977 to August 1997	638
86	FWM T23 USGS 10351630	Pierson Ditch at Interstate-80 Bridge at Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to August 1997	642
87	NWS 328838	Wadsworth, Nev.	NWS	precip. (inches)	SIM	OBS	October 1977 to September 1997	724[b]
88	FWM T24 USGS 10351668	Proctor Ditch at Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to September 1997	646
89	USGS 10351650	Truckee River at Wadsworth, Nev.	USGS	flow (ft^3/s)	AUX	OBS	May 1965 to September 1986 September 1993 to September 1997	354
90	FWM USGS 10352028	Olinghouse #1 Pump near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to September 1997	650
91	FWM T25 USGS 10351660	Fellnagle Ditch near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	October 1977 to September 1996	656
92	FWM T26 USGS 10351682	Gardella Ditch near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	June 1978 to September 1997	658
93	FWM USGS 10352030	Olinghouse #3 Pump near Wadsworth, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to September 1997	662
94	USGS 10351700	Truckee River near Nixon, Nev.	USGS	flow (ft^3/s)	AUX	OBS	October 1957 to September 1997	375
95	FWM T27 USGS 10351755	Indian Ditch near Nixon, Nev.	FWM	flow (ft^3/s)	AUX	OBS/EST	May 1978 to October 1997	666
96	USGS 10336500	Pyramid Lake near Nixon, Nev.	USGS	elevation (feet)	AUX	OBS	June 1926 to September 1997	380

[a] See entries for USGS gages Little Truckee River below Diversion Dam, near Sierraville, Calif. (10341950) and CDWR gage Little Truckee Ditch at Head (264). Observed data consists of total streamflow measured at both gages for the period indicated.

[b] Data set 724 combines precipitation data as follows: Estimated Reno WSFO AP precipitation by statistical correlation using regional time series, October 1932 to February 1937; observed Reno WSFO AP precipitation, March 1937 to September 1977; observed Wadsworth 4 N precipitation, October 1977 to September 1997.

[c] Groton ditch at Lockwood, Nev., and Murphy Ditch near Vista, Nev., were combined in 1985 and are currently known as Murphy Ditch near Vista, Nev.

Observed flow data, used as direct input to reaches, consist of flow records from continuous-recording gaging stations operated by the USGS (table 1). These data describe only a few inflows to the Truckee River, Little Truckee River, and Lahontan Reservoir. Streamflow data from these stations are used directly as input into the Truckee River, Little Truckee River, or Lahontan Reservoir model reaches. Most inflows had to be estimated because observed flow data were not available for direct input to reaches. The following sections describe methods used to estimate data when observed data are not available at model boundaries for a particular time period or location.

Estimated Flow Using Water Balance

Flow data were estimated when and where observed data were not available to quantify inflows from areas and tributaries that drain to reservoir and river reaches. Water-balance computations were used to estimate data for Lake Tahoe and several designated reaches of the Truckee River upstream from the Vista gaging station (table 1 and pl. 1). Water-balance computations used observed data collected at other sites near the location required for model input.

The flow data estimated by water balance computations are net inflows to the designated reaches because they include volume increases (gains) from streamflow, ground water, and precipitation; and volume decreases (losses) from seepage to ground water, evaporation, and phreatophyte evapotranspiration. Net inflow refers to gains or losses other than gaged inflows or outflows measured at boundaries of the given reach or river segment (more than one reach). Thus, if net inflows determined by water balance are negative, then the given reach or segment is losing rather than gaining water.

Net inflows were determined for Lake Tahoe by water balance computations for the entire period from water year 1933 through 1997 because accurate precipitation gains and evaporation losses are not available for model simulations. Estimating net inflow to Lake Tahoe (reach 100) by water balance involves adding the change in storage of that reach to the gaged outflow from the lake. Change in storage is determined from measured stage records of that reach over a selected time period, such as a day. Wind effects at the single gage monitoring water-surface elevation at Lake Tahoe can result in unrealistically large fluctuations in the change-in-storage value when computed on a strict daily basis. Therefore, a five-day moving average of storage was used to compute the change in storage required by the net inflow computation.

Water-balance computations also were used to estimate net inflows to river segments (consisting of one or more reaches). Estimating net inflow to a given river segment by water balance involves subtracting total gaged inflows to the segment from the total gaged outflow from that segment. Water balance computations were used to determine net inflows for the Truckee River (reaches 110–140) between the gages Truckee River at Tahoe City, Calif., and Truckee River near Truckee, Calif., and Donner Creek between Donner Lake and the Truckee River (reach 149) (pl. 1).

Net inflows to the segment of the Truckee River between the Farad and Vista gaging stations (reaches 250–390) were determined partially by water balance computations. Except for inflows from Dog and Hunter Creeks, net inflows for this segment of the river are from (1) water balance computations of net inflows (1981–92), or (2) regression analysis (1933–80, 1993–97). The regression equation estimates Truckee Meadows gains and losses for periods other than 1981–92. During the period 1981–92, observed data from many USGS and FWM gaging stations were available for the water balance computations. Inflows to the Truckee River from Dog and Hunter Creeks were available from two other sources: observed flow data and output from PRMS models, to be discussed in a later section. Net inflows between the Farad and Vista gaging stations, excluding inflows from Dog and Hunter Creeks, were designated as the Truckee Meadows Ungaged Gains and Losses (TMUGL).

Estimated Flow Using Precipitation–Runoff Modeling System

Precipitation–runoff simulations were made by A.E. Jeton (1999 and 2000) using the USGS PRMS (Leavesley and others, 1983, 1996) to provide required inflows to reaches where observed inflows were not available (pl. 1). PRMS is a physically based watershed model designed for simulating runoff from precipitation, and includes the simulation of alpine-snowmelt runoff typical of the Sierra Nevada headwaters of the Truckee River Basin. The spatial variability of land characteristics that affect runoff within a watershed is accounted for in PRMS by conceptual disaggregation of the modeled area into land parcels known as Hydrologic Response Units (HRUs). PRMS computes a daily water-energy balance for each HRU. The area-weighted sum of daily hydrologic fluxes from all HRUs is the simulated basin streamflow. PRMS simulations were made for 31 subbasins surrounding Lake Tahoe and in the Truckee River Basin downstream from Lake Tahoe. Models were constructed for 16 subbasins that had sufficient observed record to allow calibration. Procedures were then developed for regionalizing model parameters to simulate runoff from the remaining 15 ungaged subbasins. Although simulations for the period 1933–97 were made for the nine gaged and six ungaged basins surrounding Lake Tahoe (table 2 and pl. 1), a water balance method was used to reconstruct a time series of net inflows to Lake Tahoe, in lieu of using these tributary data, due to the uncertainty in estimating lake-surface evaporation and precipitation (table 1). The tributary inflows to Lake Tahoe simulated by PRMS are provided as auxiliary data in the data base as listed in table 2.

The remaining 16 subbasins in the Truckee River Basin were used to provide streamflows for subbasins where no records existed, or to extend daily records in those subbasins where continuous records were not available for the full period 1933–97 (tables 1 and 2). Additionally, the PRMS models were used in conjunction with the Extended Streamflow Prediction (ESP) program (Day, 1985) to produce forecasts needed to either extend official NRCS April-July forecasts or to derive other forecasts required by the operations model (table 1). ESP is discussed in a later section.

Calibrated PRMS models for the basins used land use and vegetation cover characteristics documented in GIS coverages produced in the 1970's and 1980's. These characteristics were assumed to be reflective of the entire simulation period (1933–97), which may or may not be a good assumption since urbanization, for example, may have been far less in the early part of the simulation period or slightly more in the 1990's. A second consideration is that observed meteorologic (temperature and precipitation) data were not available at all stations needed to run PRMS for the entire simulation period from 1933 to 1997. For missing periods, historical meteorologic data were synthesized by M.D. Dettinger (U.S. Geological Survey, written commun., 1998) using statistical techniques (tables 1 and 2). Synthesized precipitation data are described in a later section. A third consideration is that PRMS models were calibrated for the water years 1980–97 for subbasins surrounding Lake Tahoe and 1993–97 for most modeled subbasins in the Truckee River Basin downstream from Lake Tahoe (A.E. Jeton, 2000). Streamflow data simulated by these models used for input to the operations model or as auxiliary data may be outside the calibration period. The accuracy of these simulated streamflow data are uncertain.

Estimated Ungaged Gains and Losses in Truckee Meadows Using Water Balance and Regression Analysis

Truckee Meadows ungaged gains and losses (TMUGL) were computed by water balance computations between the Farad and Vista gaging stations, excluding inflows from Dog and Hunter Creeks, for water years 1981–92. TMUGL includes all groundwater inflows, tributary inflows, channel seepage losses, and other gains/losses except inflows from Dog and Hunter Creeks. TMUGL is computed as:

$$\begin{aligned}\text{TMUGL} = \text{Vista flow} - (\text{Farad}\\ + \text{Dog Creek} + \text{Hunter Creek flows})\\ + \text{net agricultural and M\&I diversions.}\end{aligned}$$

The daily values of TMUGL, which can contain positive and negative values, are input to the model upstream of inflows from the TMWRF (table 1, pl. 1).

As a substitute for water-balance estimates of TMUGL, a multiple regression equation was developed to provide TMUGL for the 1933–80 and 1993–97 periods. The dependent variable, TMUGL, computed by water balance for the 1981–92 period, is predicted using two independent variables: daily streamflow for a gaged subbasin (Hunter Creek) and an "index of potential runoff." The index of potential runoff was computed by a subroutine from the Deep Percolation Model (Bauer and Vaccaro, 1987) that uses a degree day method (Chow, 1964, p. 21–32) to determine how much precipitation is available for runoff, how much precipitation will accumulate as snow, and how much snow will melt in a given day. Computation of this index required precipitation and temperature data from several sites in or near the Truckee Meadows (table 2). The Truckee Meadows, except for the Hunter and Dog Creeks subbasins, was divided into areas that represent similar runoff characteristics based on altitude, physiography, and aspect. For each area of similar characteristics, a daily potential runoff index was computed using the precipitation and temperature data. The index was weighted according to each of the measured drainage areas and then summed to derive a single index value representing potential runoff for the entire drainage area between Farad and Vista (excluding the Hunter and Dog Creek Subbasins).

Hunter Creek streamflow and the value of the potential runoff index were then used to formulate a multiple regression model for estimating TMUGL. When estimating daily, as opposed to annual time series, one may find that the relation between independent and dependent variables varies depending on the time of the year. As a result, regression coefficients needed to be seasonally varied to adequately define the relations. One way to account for this variation with few parameters is to use multiple regression with periodic functions (Helsel and Hirsch, 1992, p. 341). This procedure, called trigonometric regression analysis, uses sine and cosine terms to account for seasonality. The resulting multiple regression equation had a coefficient of determination of 0.78. The coefficient of determination indicates the proportion of the total variation of the dependent variable that is explained by the independent variables. Approximately 78 percent of the variation in TMUGL is accounted for by the independent variables.

Limitations and assumptions apply to the daily estimates computed from this regression method. Runoff contributions from Washoe Lake, near the headwaters of the Steamboat Creek drainage, are incorporated in the dependent variable of the regression model. However, because the regression model does not simulate daily storage operations for Washoe Lake, that part of the regression relations associated with contributions from the lake require further study. The water balance computation of TMUGL for the 12 years of data used to derive the equations involved the addition or subtraction of many different gaging station records and many assumptions concerning irrigation return flow quantities. A certain amount of error is inherent in each of these records or estimates, making the accuracy of the water balance, and ultimately the regression equations, uncertain.

Precipitation Data

Simulation of volume increases within river and reservoir reaches in the operations model that are attributable to incident precipitation require time series of daily precipitation data. Observed precipitation data measured at NWS climate stations are used when available from water year 1933 through 1997, but some data also had to be estimated. The precipitation time series are distributed within the operations model to designated reaches representing Truckee River Basin lakes and reservoirs (reaches 145, 168, 178, 187, 199, 209, and 580) and along the Truckee River downstream from the Vista gaging station (reaches 400–570) (climate section of table 1 and pl. 1). Daily precipitation data for time series input to the operations model were collected from the NWS climate stations: Donner Memorial State Park, Calif. (near Donner Lake); Truckee, Calif.; Sagehen Creek, Calif.; Boca Reservoir, Calif.; Reno, Nev.; and Wadsworth, Nev. (table 2; pl. 1).

The time periods of estimated precipitation data in addition to the observed data are listed in table 1 for the reaches that require input time series of precipitation data. Precipitation data were estimated by three methods: (1) adjustment of observed precipitation data, (2) statistical correlation (synthesis) using a regional time series, and (3) filling periods of missing data using observed data from a nearby climate station. Observed precipitation data at the Boca climate station were adjusted by a coefficient of 0.67 prior to input to reservoir reaches for Boca and Stampede Reservoirs. This coefficient was determined based on water-budget analyses for these two reservoirs (A.E. Jeton, U.S. Geological Survey, written commun., 1998), and precipitation input to these reaches is considered estimated.

Daily precipitation data was synthesized by statistical correlation to meet the following two objectives: (1) to extend the historical period of record of the climate station to the entire simulation period of water years 1933–97, and (2) to fill in shorter periods of missing data within the historical period of record of the climate station. Daily precipitation records were extended back to 1933 using a regionally representative time series of daily precipitation data synthesized from six climate stations in the region with records back to the 1930’s. The regional time series was used to synthesize local time series at the appropriate climate stations listed in table 1 using statistical correlative methods (M.D. Dettinger, U.S. Geological Survey, written commun., 1997; Dettinger and Cayan, 1996). Although these synthetic historic data are probably close to what the actual historic data values would have been, synthetic methods tend to lose some variance relative to the real world because of long-term fluctuations that are not well represented by the day-to-day correlations.

Gaps in historical precipitation records also need to be estimated for use in the operations model or for use in estimating other data that is required by the operations model. Periods of missing precipitation data within the historical period of record were estimated by substituting observed data from a nearby climate station with similar precipitation characteristics.

Time series of precipitation are not directly input to reaches where net inflows or losses can be estimated by (1) water balance computations, (2) simulations using the USGS PRMS, or (3) the method described to estimate ungaged gains and losses in the Truckee Meadows. This is because precipitation is already included in those estimates (table 1). For reaches of the Truckee Canal and Lahontan Reservoir, gains from precipitation are included in the net losses simulated within the operations model as described by Berris and others (USGS, 2001) (table 1).

Evaporation Data

Time series of evaporation data are required for simulation of losses from river and reservoir reaches. The evaporation time series were input to the same river and lake/reservoir reaches of the model as the precipitation time series (table 1). Average monthly evaporation data were estimated by R.L. Hall (Sierra Hydrotech, written commun., 1994), McGauhey and others (1963, p. 9); and S.W. Hostetler (U.S. Geological Survey, oral commun., 1994). The estimates were based on historical data collected at standard pan sites operated by the NWS and other evaporation stations. These estimates assume no variation exists for a given month from year-to-year. Thus, daily evaporation is assumed to be constant for every day of the month. Twelve values, each representing a particular month, are applied to a designated reach for each year of simulation.

Reaches that did not receive input from precipitation time series also did not receive input from evaporation time series. Losses to reaches from evaporation were either accounted for within the water balance methods or in the simulation methods described that provide net inflow to Lake Tahoe and river reaches upstream from Vista. For the Truckee Canal and Lahontan Reservoir reaches, losses from evaporation are included in the net losses simulated within the operations model as described by Berris and others (2001).

Evapotranspiration Losses from Phreatophytes

Time series of streamflow losses due to evapotranspiration from phreatophytes were estimated for use by the operations model for the Truckee River downstream from Vista, reaches 400–570 (table 1; pl. 1) using a method described in Berris (1996, p. 21). A total monthly evapotranspiration rate for each reach was computed by accounting for phreatophyte acreage adjacent to the river channel, annual evapotranspiration rates for typical species, and the monthly distribution of annual evapotranspiration. The monthly distribution of average annual evapotranspiration rates was estimated using guidelines described by Duell (1988). Time series of evapotranspiration losses are not input to reaches where net inflows are estimated because evapotranspiration losses are already included in those estimates. For reaches 250–390 between Farad and Vista streamflow losses from phreatophyte evapotranspiration were included in the computation of TMUGL. For reaches 100–240 between Lake Tahoe and Farad, streamflow losses from phreatophyte evapotranspiration were included in the water balance computations or simulations of net inflows.

Municipal and Industrial Demand

A time series of M&I surface-water demand for the Truckee Meadows is required for the operations model. This time series contains estimated M&I demand from surface-water sources in the Truckee Meadows on the basis of observed M&I demand data obtained from SPPC for the index period of January 1995 through December 1995 (R. D. Moser, Sierra Pacific Power Company, written commun., 1995). These estimates assume there is no variation of daily M&I demand from year-to-year. For model simulations, a growth coefficient based on the index period can be applied to the time series to simulate the increases or decreases in M&I demand resulting from population growth or decline. Thus, this time series could be an index that can be adjusted by the model user. This time series is used to simulate M&I demand for water from channel reaches of the Truckee River between the Farad and Vista gaging stations in the operations model (table 1). In addition to the required time series, auxiliary time series data not required by the operations model describe delivery of water to the Truckee Meadows M&I distribution system (table 2).

Forecast Data

Forecasts of runoff volumes for up to 8 months are required by the operations model at many locations and times during a simulation (table 1). Usually these requirements can be met using published NRCS forecasts. However, NRCS forecasts were not always available for the sites and times where such information was required by the operations model. In such instances, the PRMS models developed by A.E. Jeton (U.S. Geological Survey, written comm., 1998) were used along with the ESP program by the National Weather Service (Day, 1985) to provide the needed forecast information. The following sections describes the forecast data used in the operations model.

Natural Resources Conservation Service Forecasts

Natural Resources Conservation Service forecasts can be used to determine conditions that govern the simulation of various reservoir and river operations. The NRCS provides forecasts of lake levels at Lake Tahoe and flows at the following gaging stations; Little Truckee River above Boca Reservoir, near Truckee, Calif., the Truckee River at Farad, Calif., and the Carson River near Fort Churchill, Nev., (table 1, pl. 1) (Rebecca Wray, written commun., 1995). NRCS forecasts are developed on the basis of snowpack conditions, precipitation, and antecedent streamflow. Forecasts for flow are for those flows that would occur without regulation from upstream reservoirs.

Precipitation–Runoff Modeling System/ Extended Streamflow Prediction Forecasts

The ESP program is used with models such as PRMS to provide a consistent and objective method to forecast future streamflow using current watershed conditions (snowpack, soil moisture, and other basin conditions). For operational models, forecasts are sometimes needed at interim dates for specified durations within a simulation period and at specific locations that do not have available NRCS forecasts (table 1). An interim date, in the context of modeling, is defined as any time step within the model simulation that is not the beginning or ending time step. ESP controls execution of multiple PRMS simulations and manages input data to and output data from PRMS. Each year of historical meteorological data (65 years from 1933–97) provides a possible representation of future conditions. For each required forecast, 65 streamflow traces were generated by PRMS using the historic meteorological data. Initial conditions for each simulated trace are set to the basin conditions of the current (interim) time step for which a forecast is required. Each of the 65 traces represents the forecasted runoff resulting from the initial conditions at the current time step and the given year of applied historic meteorological data used in the PRMS simulation. The simulated streamflow traces are analyzed statistically, and probabilistic forecasts are generated. That simulated PRMS runoff corresponding to the user-specified probability is then selected as the forecasted amount. Although ESP allows the user to select any exceedance probability level, the 50th percentile, or median was used to create the PRMS/ESP forecasts provided in this data base. Similar to NRCS forecasts, all PRMS/ESP forecasts are for flows that would occur without regulation from upstream reservoirs.

The same considerations that applied to the PRMS simulations providing streamflow at ungaged sites or for period of no gaging station records applies to these PRMS/ESP forecasts. These considerations include assumptions regarding land use and vegetation characteristics and the meteorological data that was synthesized for the simulations. In addition, it should be understood that by using the median probability trace, one cannot use hydrologic judgment that might be prudent in actual practice. For example, a particular year might already be classified as dry (having had less-than-average precipitation or snowpack). The forecast time series in the data base documented in this report will assume starting with those dry conditions and will apply median meteorological data to those conditions over the succeeding, user-specified number of days. In actual practice, it might be more appropriate to assume that dry conditions would continue, and the manager might select a probability level of 80 percent or 90 percent instead to provide the most realistic forecast for use in planning operations.

Other Data Not Required for River and Reservoir Operations Model

In addition to mandatory data required to simulate operations, time series are provided which contain lake/reservoir volume and water-surface elevation, streamflow, precipitation, and temperature (auxiliary data in table 2). These data might be useful to the modeler for such objectives as comparing the effects of alternative management scenarios to historical conditions. Many of these data sets do not cover the entire period from 1933–97. Only those periods of record that were available from the source agency, the flow-routing study (Berris, 1996), or those that were estimated or simulated for ancillary purposes are included. This part of the data base includes observed data from sites operated by the USGS, SPPC, the U.S. District Court Water Master, and the USCOE. Some of these data sets contain periods of missing or intermittent data. Some missing periods of record have been simulated using the PRMS model. Also, periods of no record between intermittent data are sometimes interpolated to provide a continuous daily time series.

SUMMARY

Title II of P.L. 101–618, the Truckee–Carson–Pyramid Lake Water Rights Settlement Act of 1990, provides direction, authority, and a mechanism for resolving conflicts over water rights in the Truckee and Carson River Basins. P.L. 101–618 provides a foundation for negotiating and developing operating criteria, known as the TROA to balance interstate and interbasin allocation for water rights among the many interests competing for water from the Truckee River. Additionally, the Truckee River WQSA, signed in 1996, provides for acquisition of water rights to resolve water-quality problems during low flow periods along the Truckee River in Nevada while simultaneously providing additional water for fish and wildlife resources. Efficient execution of many of the planning, management, or environmental assessment requirements of TROA and WQSA will require detailed hydrologic and meteorologic data.

To support implementation of P.L. 101–618, the Truckee–Carson Program of the USGS developed models to support efficient water-resources planning, management, and allocation. The USGS Truckee River Basin operations model includes flow-routing and lake/reservoir and river operations for the Truckee River Basin including diversion of Truckee River water to the Truckee Canal for transport to the Carson River Basin. Time series of several types of hydrologic data for water years 1933–97 are necessary to run the operations model for long term simulations.

This report describes the hydrologic data, as time series from water year 1933 to 1997, that can be used to run the USGS Truckee River operations model. Auxiliary data not currently used by the model, are also described. The time series of hydrologic data consist of flow, lake/reservoir elevation and storage, precipitation, evaporation, evapotranspiration, M&I demand, and streamflow and lake/reservoir level forecast data. The time-series data were collected or estimated for sites and locations in the Truckee River Basin from Lake Tahoe to Pyramid Lake. Data also are included for the Truckee Canal, a small part of the Carson River in the vicinity of Lahontan Reservoir, and Lahontan Reservoir in the Carson River Basin.

Simulation of Truckee River Basin operations requires time series of surface-water data to provide flow to reservoir and river reaches for the 1933–97 period. Observed flow data are used when available, but flow data had to be estimated for periods of when observed data were not available at locations required by the operations model. Flow data were estimated using three methods: (1) water-balance computations using observed data collected at other suitable locations near the location required for model input, (2) precipitation–runoff simulations using the USGS PRMS, and (3) trigonometric regression analysis using daily streamflow from a gaged basin and an index of potential runoff to compute ungaged gains and losses in the Truckee Meadows vicinity.

In addition to flow data, daily precipitation data are provided to the model. Observed precipitation data collected at climate stations are used when available, but to provide necessary data to the operations model from 1933–97, data also had to be estimated. Precipitation data were estimated using three methods: (1) applying an adjustment coefficient to observed precipitation data, (2) extending the records to encompass the entire 1933–97 using statistical correlative methods, or (3) filling in periods of missing record with precipitation data from a nearby climate station with similar precipitation characteristics.

Time series of evaporation and evapotranspiration from phreatophytes are required for simulation of losses from river and reservoir reaches. Average monthly evaporation data were estimated based on historical data collected at NWS standard pan sites and other evaporation stations. Average monthly evapotranspiration data were estimated for specified reaches by determining phreatophyte acreage, annual evapotranspiration rate for a typical species, and the monthly distribution of annual evapotranspiration. The estimates of average monthly evaporation and evapotranspiration assume there is little variation for a given month from year-to-year.

Other data required by the operations model include M&I demand and forecast data. Data representing Truckee Meadows M&I demand for water from the Truckee River were estimated based on observed data obtained from SPPC for 1995. Forecasts of lake levels at Lake Tahoe and flows at various locations were obtained from the NRCS. The operations model requires forecast data at interim dates and at specific locations that do not have available NRCS forecasts. Forecasts were simulated at these locations using the ESP with PRMS.

In addition to mandatory data required to simulate operations, auxiliary time series are provided which contain lake/reservoir volume or water-surface elevation, streamflow, precipitation, or temperature that may be useful to the modeler for comparative purposes.

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