PRELIMINARY RESULTS OF THE SIMULATION OF OREGON COASTAL BASINS USING PRECIPITATION-RUNOFF MODELING SYSTEM (PRMS)

By Roderick L. Allen and Antonius Laenen

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CONVERSION FACTORS AND VERTICAL DATUM

To convert from	To	Multiply by
kilometer (km)	mile	0.6214
millimeter (mm)	inch	0.03937
square kilometer (km^2)	square mile	0.3861
cubic meter per second (m^3/s)	cubic foot per second	35.31

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

This report presents the interim results of a study by the U.S. Geological Survey in cooperation with the U.S. Bureau of Land management to evaluate the use of Precipitation-Runoff Modeling System (PRMS) as a tool for analyzing cumulative hydrologic effects. The objective of the study is to eventually model 11 coastal Oregon basins to improve parameter-estimating techniques and to regionalize parameter values used in the model. Calibration of the model to many basins can provide regionally consistent model parameter values that incorporate the variability of physical attributes that govern streamflow in the area. After parameter regionalization, the model can be used to predict changes in hydrologic response resulting from changes in land use, and model parameter values can be transferred to ungaged basins in the region.

To date, the model has been applied to four basins--East Fork Lobster Creek, Flynn Creek, Deer Creek, and Needle Branch, all tributary to the Alsea River. The latter three basins (a control basin, a partially cut basin, and a clear-cut basin, respectively) were extensively monitored from 1959 to 1973 in a paired-basin study that evaluated the effects of logging on streamflow. The current study shows that parameter values calibrated in one basin can be transferred to the other basins to yield similar precision and accuracy. Furthermore, parameter values can be changed in the models to predict the observed post-logging streamflow.

As a test, model parameter values were changed to reflect logging in the Needle Branch basin. Simulated streamflow showed increases in storm peak flows (1-2 percent) and storm-period runoff volume (13 percent), similar to that observed in recorded data. One of the larger differences predicted by model simulation was the simulation of peak discharge for a first fall storm. Predicted peak discharge was about 300 percent larger for post-logging compared with pre-logging conditions. Observed streamflow during post-logging confirms the greater peak and volume yields for the first fall storm. The interim model results are preliminary and subject to change with final calibration of the model to all 11 basins.

Including seven additional basins, as proposed, will expand the data base thus improving estimates of regional parameter values, and will identify the subprocess components in PRMS most critical to the simulation of the rainfall-runoff process in coastal Oregon.

INTRODUCTION

Cumulative effects of any land-management activities can be conceptualized as a cascade of processes--timber harvest, for example, can change runoff patterns, which can change the frequency of masswasting soil erosion events, which may degrade fish habitat, which could affect recreation (Gordon Grant, U.S. Forest Service, oral commun., 1990). Federal land-management agencies are required by law to analyze cumulative hydrologic (and other) effects of proposed land-management activities.

Estimating the effects of human activities on the hydrologic characteristics of an area is a hydrologic problem typically dealt with by constructing physically based models of the hydrologic system (Linsley and others, 1982). A physically based model is one in which the governing physical laws and the model structure are well-known and can be described by the equations of mathematical physics (Woolhiser and Brakensiek, 1982). Estimates of the effects of human activities can then be made by varying the physical parameters of the model.

Background

The U.S. Geological Survey (USGS) in cooperation with U.S. Bureau of Land Management (BLM) is evaluating and applying a Precipitation-Runoff Modeling System (PRMS) for use in analyzing hydrologic cumulative effects for 11 Oregon coastal watersheds. PRMS is a physical-process, distributed-parameter modeling system designed to analyze the effects of various combinations of precipitation, climate, and land use on streamflow, sediment yield, and general basin hydrology (Leavesley and others, 1983). By modeling 11 basins, it is anticipated that relations can be found between basin characteristics, such as drainage area, vegetation, slopes, or soil types, and PRMS model parameters similar to the parameter regionalization done by Dinicola (1990). These relations will provide a means for estimating PRMS parameter values on a regional basis so that the model can be used to make assessments in ungaged basins in the Oregon coastal area.

In fiscal year 1989, BLM and USGS began work on this cooperative project by applying PRMS to East Fork Lobster Creek (Nakama, 1989), one of the 11 basins originally proposed. In the current (fiscal year 1990) work, PRMS has been applied to three additional Oregon coastal basins--Flynn Creek, Deer Creek, and Needle Branch, all tributaries of the Alsea River (fig. 1). The latter three basins were good model candidates because they represented an uncut control basin, a partially clear-cut basin, and a mostly clear-cut basin. These basins were extensively monitored from 1959 to 1973 as part of the Alsea Watershed Study, a paired-basin study of the effects of logging on streamflow, water quality (temperature and sediment concentrations), and fish productivity (Harris, 1977). The history of the Alsea Watershed Study is as follows:

(1) From 1958 through 1965, all three basins were monitored to observe their pre-logging hydrologic characteristics.

(2) In 1966, 87 percent of the Needle Branch basin, and three areas comprising approximately 23 percent of the Deer Creek basin, were logged and burned. As a control, Flynn Creek was left unaltered.

(3) From 1967 through 1972, all three basins were monitored to observe their post-logging physical changes and hydrologic response.

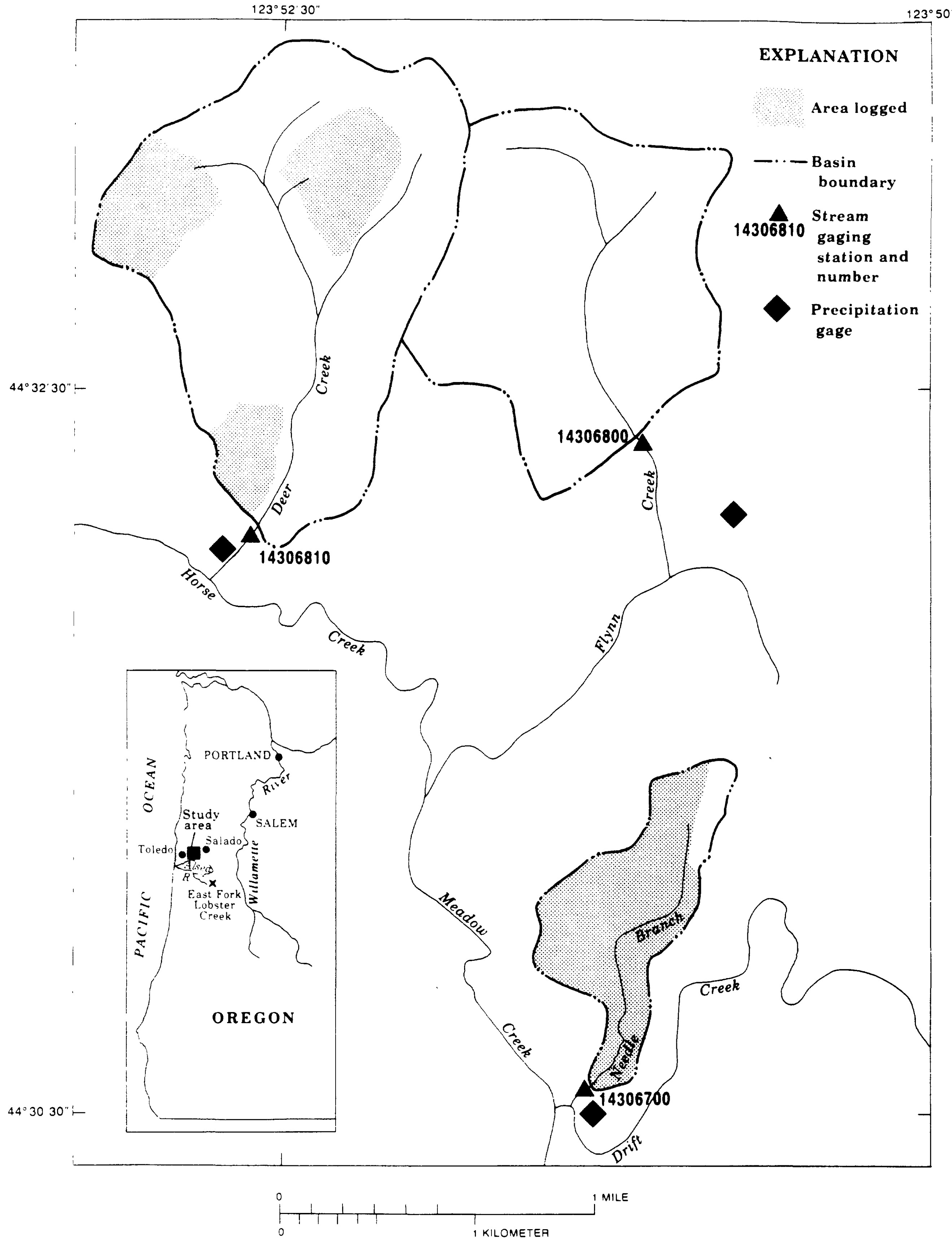

Figure 1.--Locations of study basins in the Alsea River basin, Oregon.

At present, neither BLM nor USGS have a verified, integrated methodology to predict changes in streamflow caused by complex land-use changes. Valid streamflow simulation models for peak flows, mean flows, and low flows need to be developed for use in comprehensive planning in watersheds. Adequate knowledge of overland flow, subsurface flow, and streamflow is a necessary first step in understanding and modeling water-quality changes caused by various management practices.

The objectives of the rainfall-runoff modeling study for 112 coastal Oregon basins are to: (1) calibrate and verify a rainfall-runoff model for each of the basins, (2) evaluate the model as a predictive tool for assessing effects of forest management practices on streamflow, and (3) regionalize model parameter values for use in predicting the hydrologic effects of forest management practices in gaged and ungaged coastal Oregon basins.

Purpose and Scope

The purposes of this report are to: (1) present interim calibrations and verifications of rainfall-runoff models for three basins, (2) evaluate streamflow responses from changes in model parameter values simulating forest management changes, and (3) evaluate the transferability of model parameter values between the three modeled basins. Deer Creek, Flynn Creek, and Needle Branch were modeled with PRMS and results are evaluated in this paper. The results of the simulation of Lobster Creek with PRMS is reported by Nakama (1989). The two modeling efforts will be combined when modeling is complete for all 11 basins and the model parameters will be evaluated for the entire Oregon coastal area.

Description of the Study Area

Flynn Creek, Deer Creek, and Needle Branch (tributaries to Horse Creek, Drift Creek, and the Alsea River) are located in the Coast Range physiographic division of western Oregon, about 4 miles southeast of Toledo (fig. 1). USGS gaging station 14306800, Flynn Creek near Salado, Oregon, has a drainage area of 0.78 mi^2 (square miles). USGS gaging station 14306810, Deer Creek near Salado has a drainage area of 1.17 mi^2. USGS gaging station 14306700, Needle Branch near Salado, Oregon, has a drainage area of 0.27 mi^2. Altitudes range from 440 ft at the Needle Branch gaging station to 1,600 ft at the highest point of the Deer Creek basin. The valleys are V-shaped and cut into the Tyee Sandstone of Tertiary age. The basins are characterized by a heavy canopy of Douglas-fir mixed with alder and are almost completely covered by a heavy growth of understory vegetation, where timber is not harvested. Bushes and alder regrow quickly, where timber is harvested, covering all open areas within a year.

The region is under the influence of a marine climate and experiences pronounced seasonal variations in precipitation volumes and intensities. The average annual precipitation in the vicinity of the basins is about 90 inches, and temperatures generally range from -7°C (degrees Celsius) to 32°C, with a mean of about 10°C. The majority of the annual precipitation falls between October and April. Winter storms, originating from frontal activity occurring over the ocean and moving inland, may last for several days. Although snow storms occasionally pass through, snowpack formation is an unusual occurrence. Summer storms, generally convective in nature, are relatively short in duration compared with winter storms.

PRECIPITATION-RUNOFF MODELING SYSTEM (PRMS)

A schematic diagram of the PRMS watershed model, simplified from the diagram presented by Leavesley and others (1983) to show only the components used in the Oregon Coastal Basins Rainfall-Runoff Modeling Project is shown in figure 2. In PRMS, a basin can be delineated into about 50 watershed subareas. Each watershed subarea is considered homogeneous in its hydrologic response, and is called a hydrologic response unit (HRU) [Leavesley and others, 1983]. PRMS uses distributed parameters--parameters (such as interception storage capacity or vegetation rooting depth) that are spatially variable in the watershed. This flexibility enables PRMS to be used in simulating changes in hydrologic response caused by land-use changes on parts of a basin.

Implementation of the Model

Each of the Alsea Watershed Study basins (Flynn Creek, Deer Creek, and Needle Branch) was divided into HRU's on the basis of slope, aspect, soils, land use, and vegetation. In each basin, all HRU's representing similar soil types were configured to drain into a common subsurface reservoir. One ground-water reservoir was established for each basin. Normally, only one ground-water reservoir and one or more subsurface reservoirs are defined for small watersheds (Leavesley and others, 1983). HRU's selected for Flynn Creek, Deer Creek, and Needle Branch are shown in figure 3.

Each HRU can be further subdivided into one or more overland flow planes (OFP). Channel segments and OFP's are then used to describe the basin flow network for PRMS. The number of HRU's, OFP's, and channel segments used in each of the four basins modeled are shown in table 1.

Data Available for Analysis

Data are available for 1958-72 from U.S. Geological Survey streamflow stations on Flynn Creek, Deer Creek, and Needle Branch. The available data from the Alsea Watershed Study were divided into three periods for modeling purposes (fig. 4):

(1) Model calibration was done for a pre-logging period from July 7, 1959, through December 31, 1961;

(2) Model verification was done for a pre-logging period from January 1, 1962, through February 28, 1964; and

(3) Model simulation was done for a post-logging period from January 1, 1967, through December 31, 1968. This period was used as a second model verification period for Flynn Creek, because Flynn Creek was not logged at this time.

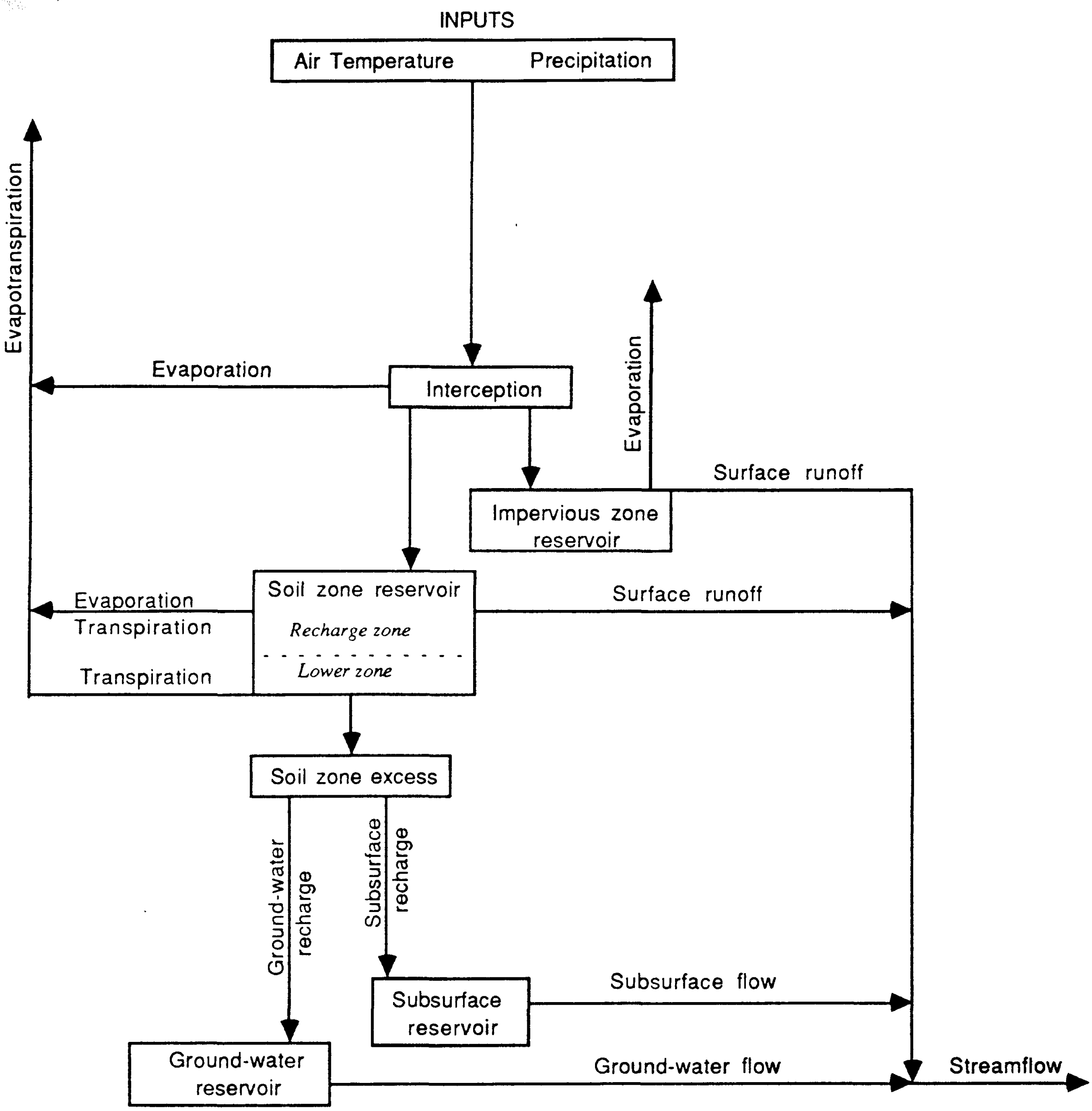

Figure 2.--Schematic diagram of the PRMS (Precipitation-Runoff Modeling System) conceptual watershed model and its input, simplified to show the components used in the Oregon Coastal Basins Rainfall-Runoff Modeling Project. Modified from Leavesley and others, 1983.

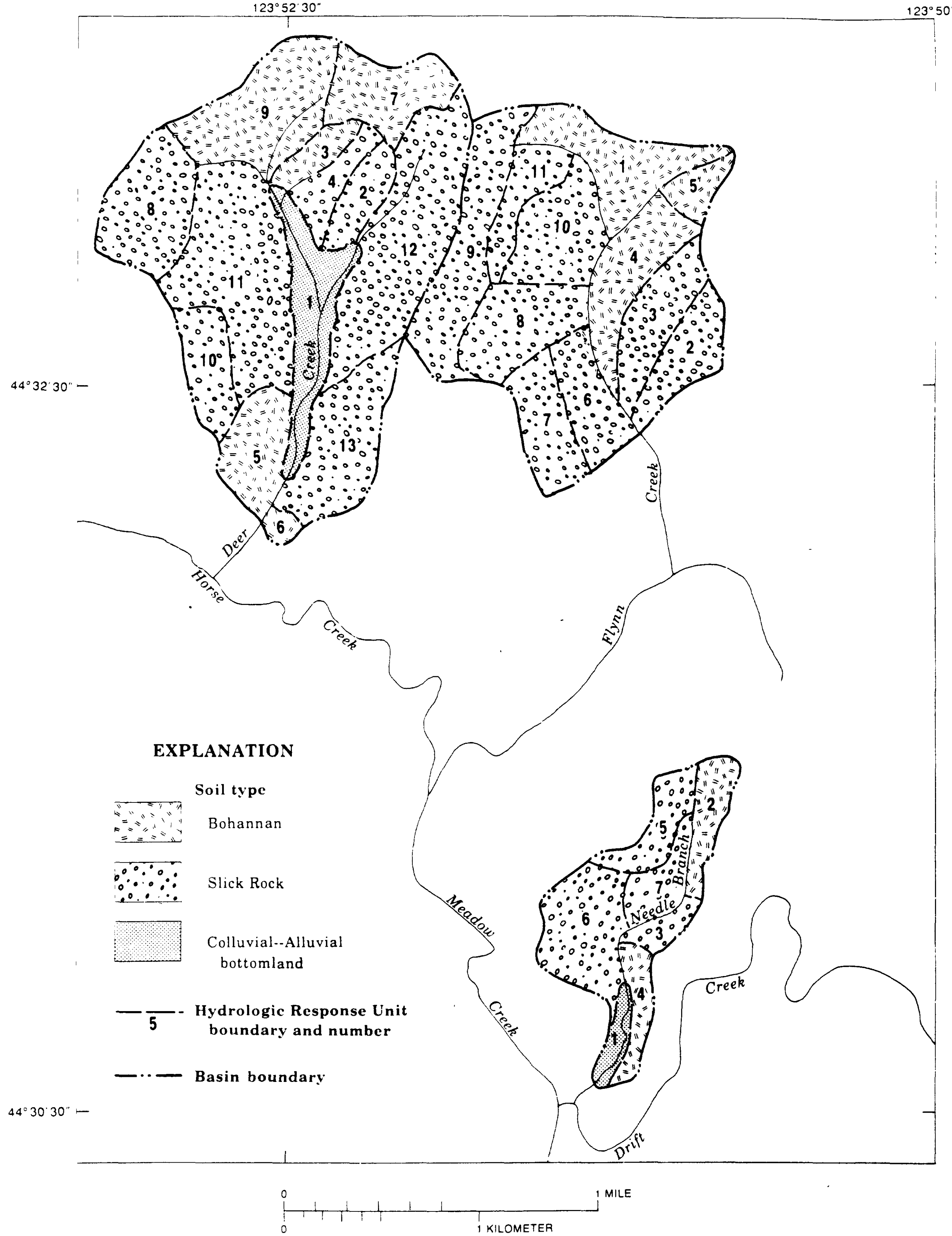

Figure 3.--Hydrologic Response Units and soil types for study basins in the Alsea Basin, Oregon. Units are assumed to have a homogeneous hydrologic response based on similarity of slope, aspect, land-use, soil type, vegetation, geology, and precipitation distribution (Corliss, 1973).

Table 1.--Discretization of reservoirs and Oregon Coastal Basins Rainfall-Runoff Modeling Project basins

[mi^2 = square miles]

Basin	Drainage area (mi^2)	Hydrologic response units	Overland flow planes	Channel segments	Subsurface reservoirs	Ground-water reservoirs
East Fork Lobster Creek	5.7	12	28	14	1	1
Flynn Creek	.78	11	23	18	2	1
Deer Creek	1.17	13	42	21	3	1
Needle Branch	.27	7	14	9	3	1

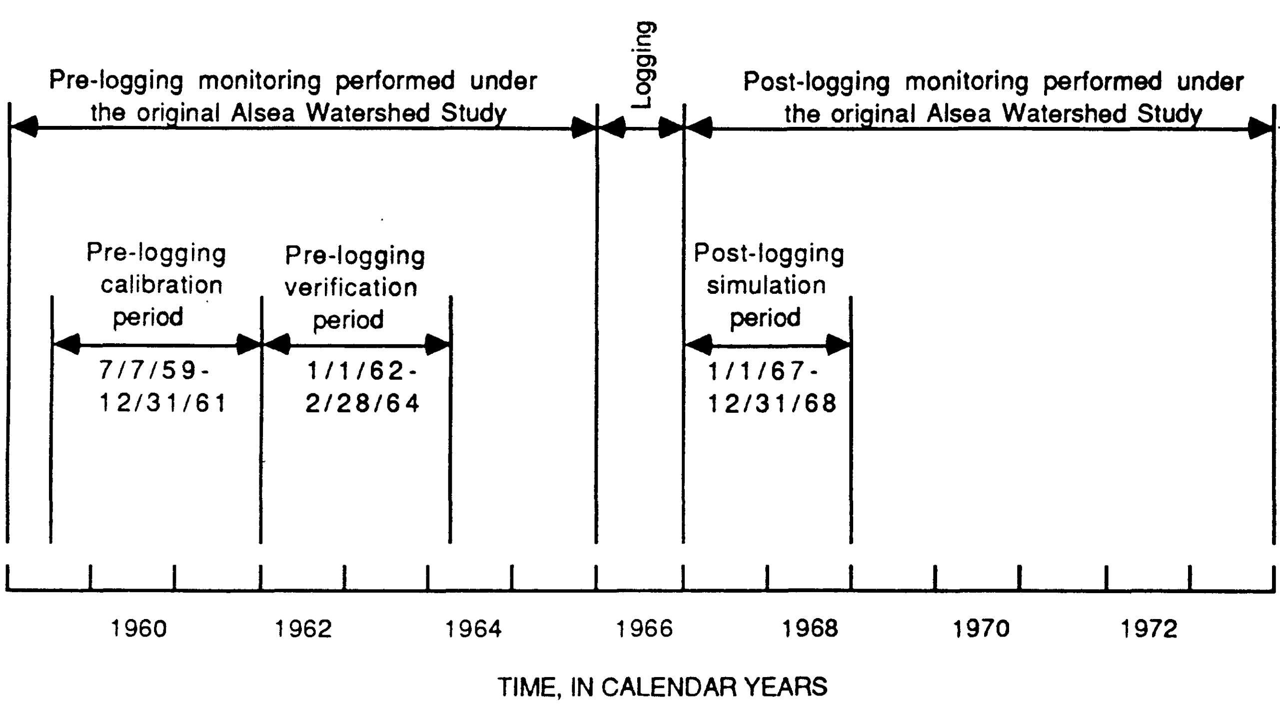

Figure 4.--Timing of the pre-logging calibration period, pre-logging verification period, and post-logging simulation period selected for the Oregon Coastal Basins Rainfall-Runoff Modeling Project. Pre-logging monitoring, logging, and post-logging monitoring were conducted under the Alsea Watershed Study (Harris, 1977).

The length of the aforementioned periods was determined by the availability of precipitation data from the Alsea Watershed Study. Because no data were available before July 7, 1959, initial conditions were defined for the short time frame from July to September 1959, before peak flows and calibration of the model parameters began for the pre-logging condition occurred. Also, the post-logging simulation period was placed as soon after logging as possible to avoid effects of vegetation regrowth. Storm periods were selected for simulation at hourly time-steps during each of these periods (table 2). Storm periods were based on (1) the availability of hourly Deer Creek precipitation data, (2) the inclusion of the highest 5-6 storms during each of the modeling periods, and (3) storms above a peak flow of 40 ft^3/s (cubic feet per second) at Deer Creek.

The model's best fit during calibration and verification periods was judged by observing the largest value for the coefficient of determination between the observed and simulated discharge. The coefficient of determination (R^2) is the proportion of variation in y explained by a relation. A value of 0.95 means that 95 percent of the variation is accounted for by the relation. In the case of a model, the coefficient represents the variation in discharge or volume explained by several relations.

Table 2.--Storm periods selected for the Oregon coastal basins Rainfall-Runoff Modeling Project

Study period	Storm number	Dates
PRE-LOGGING CALIBRATION	1	November 23-26, 1960
July 7, 1959 to	2	February 9-16, 1961
December 31, 1961	3	March 5-7, 1961
	4	March 12-15, 1961
	5	November 21-23, 1961
	6	December 18-22, 1961
PRE-LOGGING VERIFICATION	7	April 26-30, 1962
January 1, 1962 to	8	October 12-15, 1962
February 28, 1964	9	January 5-7, 1964
	10	January 18-21, 1964
	11	January 24-27, 1964
POST-LOGGING VERIFICATION	12	January 26-30, 1967
January 1, 1967 to	13	March 14-16, 1967
December 31, 1968	14	February 3-5, 1968
	15	February 18-20, 1968
	16	February 21-24, 1968
	17	December 9-13, 1968

Although three recording precipitation gages were operated in the original Alsea Watershed Study, one in each basin, there were enough missing periods in the Flynn Creek and Needle Branch precipitation records to warrant use of the Deer Creek daily and hourly precipitation record as PRMS input for all three basins. The Deer Creek rain gage is in close proximity to all three stream gages (fig. 1). Short periods (1-2 days) of missing Deer Creek precipitation record were filled using, in order of preference, regression relations with the Flynn Creek, Needle Branch, and Newport precipitation records (coefficients of determination for the regressions were 0.92, 0.87, and 0.76, respectively). Long periods of missing Deer Creek precipitation record were avoided when selecting the calibration, verification, and post-logging simulation periods. Storm periods were selected during times in which hourly Deer Creek precipitation data were available. Flynn Creek, although used as a control basin, was disturbed prior to 1930 by some homesteads in the basin. The extent of the disturbance was minimal and the time so distant, that for evaluation purposes, Flynn Creek is considered a natural basin.

Air temperature collected at the Deer Creek gage was used for determining the energy input to the system in modeling.

Daily Mode Calibration and Verification

PRMS was calibrated for Flynn Creek, Deer Creek, and Needle Branch using data from the pre-logging calibration period. PRMS was calibrated on Deer Creek first. The Lobster Creek calibration by Nakama (1989) was used to help pick starting model parameters. As a limited test of parameter transferability, calibrated Deer Creek parameters were used directly to simulate Flynn Creek and Needle Branch pre-logging, calibration-period streamflow. PRMS was then calibrated on Flynn Creek and Needle Branch. Parameters requiring adjustment during the daily mode calibration were SCN, SCX, RNSTS, and RNSTW in the overland flow component; RCF and RCP in the subsurface component; and RSEP and RCB in the ground-water component. A description of these and other parameters is given in appendix A. The final set of parameter values for all calibrations is shown in appendix B.

The objective function used during automatic calibrations was the minimization of the sum of absolute differences between daily simulated and observed flow. This objective function was selected to reduce emphasis on peak flows (Loaiciga and Church, 1990).

Because PRMS under-simulated peaks under the general-fit calibration just described, the entire calibration, verification, and simulation approach was repeated with an emphasis on peak flows. Recession coefficients were modified to better represent rapid storm-flow recessions, at the expense of low-flow simulations. A sum-of-squared errors objective function was used during parameter optimization to emphasize peak flows (Loaiciga and Church, 1990). The final set of parameter values determined in this peak-fit calibration for each basin can be found in appendix B. The parameters changed in the general- and peak-fit calibrations and their values are shown in table 3.

Table 3.--Optimized parameter values for best general-fit and best peak-fit in daily mode calibration for Deer Creek

[Only those parameters that are different between the two calibrations are shown]

Model component	Parameter	General-fit	Peak-fit
Subsurface	RCP	0.063	0.180
	SCP	.007	.000
Ground water	RCB	.020	.0944

Storm-mode Calibration and Verification

Six storms were selected in the pre-logging period from July 7, 1959 to December 31, 1961, for storm-mode calibration in all basins. Five storms were selected in the pre-logging period from January 1, 1962, to February 28, 1964, for storm-mode verification. For both periods, all storm events with peaks greater than 40 ft^3/s at the Deer Creek stream gage were used. Parameters requiring adjustment in the storm-mode calibration were the soil parameters of KSAT, PSP, and RGF. Definition for these parameters and other model parameters are found in appendix A.

The sum-of-squared errors objective function was used during parameter optimization in the storm mode to emphasize peak flows (Loaiciga and Church, 1990). Optimization, however, was of minimal use because infiltration was never exceeded by rainfall.

Simulation of Post-Logging

Three approaches were used to evaluate the post-logging simulation period for Needle Branch and Deer Creek:

1. Manually Adjusted Parameters Approach.--Selected parameters of vegetation and soils were adjusted manually using guidelines supplied by BLM (Chester Novak, oral commun., 1989) to represent logging. The adjusted parameter values were used in the PRMS pre-logging calibrated model to simulate the post-logging period streamflow for both Deer Creek and Needle Branch. The simulated streamflow data using manually adjusted parameter values were compared to observed post-logging data.

2. Calibrated then Simulated Approach.--PRMS was re-calibrated using Needle Branch post-logging data. Most of the vegetation and soil parameters manually adjusted in the previous approach were optimized by the model in this approach. The calibrated post-logging parameters from Needle Branch were then used for logged parts of Deer Creek to simulate Deer Creek post-logging streamflow.

Simulated Deer Creek streamflow was compared with observed streamflow, as a verification of the parameter value changes, and the optimized parameter values compared with those manually adjusted.

3. Simulated to Simulated Approach.--Simulated streamflow for Needle Branch was generated using pre-logging and post-logging parameter values. Simulations were compared with each other to evaluate the hydrologic effects of logging.

Guidelines for manual adjustments to parameter values were done in cooperation with BLM. Selected model parameters were adjusted to reflect logging and are as follows:

(1) The predominant vegetation cover (ICOV) was changed from 3 (trees) to 0 (bare).

(2) Summer (COVDNS) and winter (COVDNW) vegetative cover density was set from 0.15 to 0.75 and 0.07 to 0.50, respectively from aerial photographs.

(3) Summer (RNSTS) and winter (RNSTW) rain interception storages were set to 0.05 and 0.03 inches, respectively.

(4) The starting (ITST) and ending (ITND) month for transpiration was set to 5 and 10, respectively.

(5) The maximum available water holding capacity of the soil zone (SMAX) is the difference between field capacity and wilting point of the profile, multiplied by the distance from the surface to the minimum rooting depth. SMAX is divided into two layers. The upper layer is the recharge zone, and the lower layer is the lower zone. The capacity of the recharge zone is REMX. REMX is limited to values equal to or less than SMAX. After clear-cutting, remaining live roots are from grass and shrubs. The maximum available water-holding capacity of the soil zone is reduced because rooting depth is reduced. Manual reductions were from 12, 6.4, and 4.0 inches to 2.4, 1.6, and 1.9 inches for the three soil types in the basin based on soil surveys of pre- and post-logging soils.

(6) As described above, REMX is the water-holding capacity of the upper recharge zone. The recharge zone looses moisture by evaporation and transpiration. The pre-logging value was determined at 0.4 inches. After logging, the soil is less shaded, so evaporation can reach deeper. The post-logging value was set to 0.64 inches, based on the soil-moisture holding capacity of 0.16 inch per inch from soil surveys and an estimated maximum evaporation depth of 4 inches.

(7) The effective impervious area (IMPERV) was initially set equal to the area in roads (0.11), but calibration to observed hydrographs indicated a reduction to 0.035.

PRELIMINARY MODELING RESULTS

Results from this study are preliminary because only three of the 11 basins planned for calibration have been modeled for this report.

Simulation of Pre-logging Streamflow

Simulated discharge and observed precipitation and discharge, as calibrated with the best general fit during the pre-logging verification period, for Flynn Creek, Deer Creek, and Needle Branch are shown in figures 5, 6, and 7. One complete water year is plotted in each figure to show a range of flow conditions at a readable scale. For all three streams, error statistics for the daily calibration and verification periods are shown in table 4. Coefficients of determination indicate a goodness of fit that explains at least 92 percent of the total variation in observed mean daily discharge for all basins. Total volume errors indicate that as much as -13.6 percent of the observed runoff volume cannot be accounted for and that a negative bias exists. The most likely cause for this volume bias is rainfall missed by unshielded rain gages. No correction was applied to balance this deficiency.

Simulated and observed hourly discharge using the storm-mode operation of PRMS for the six pre-logging calibration-period storms for Deer Creek are shown figure 8. Storm-flow plots for Needle Branch and Flynn Creek are similar. Because of the large errors obtained in storm simulations when using the general-fit parameter values determined in the calibration in the daily mode, a re-calibration emphasizing peak flows was done in the daily mode. An improvement in storm simulations in the storm mode was obtained, as shown for the Deer Creek calibration period storms in figure 9, but it was at the expense of low-flow simulations, as shown in figure 10 where recessions cannot be matched. Scatter plots of simulated and observed discharge data (fig. 11) show that flows less than approximately 0.5 ft^3/s were under-predicted in the general calibration, and that flows less than about 5.0 ft^3/s are under-predicted in the peak-flow re-calibration.

The simulated storm volumes now fit the observed volumes better and the hydrograph response is closer; however, the simulation of storms 1 and 4 is still poor. Again, the most likely reason for this poor fit is the probable undercatch of rain because of not having wind deflectors attached to the rain gage. Flynn Creek calibration and verification periods are shown in figures 12, 13, and 14. Error statistics for storm flows simulated using the re-calibrated model are shown in table 5.

Simulation of Changes in Streamflow caused by Logging

Needle Branch post-logging storm discharges for storms 12 and 13 are compared with simulated post-logging storm discharges in figure 15. The post-logging storm discharges were simulated using:

1. parameters adjusted manually to represent logging, as shown in table 6;

2. manually adjusted parameters adjusted further by calibration on post-logging data, as shown in table 6; and

3. pre- and post-logging parameters.

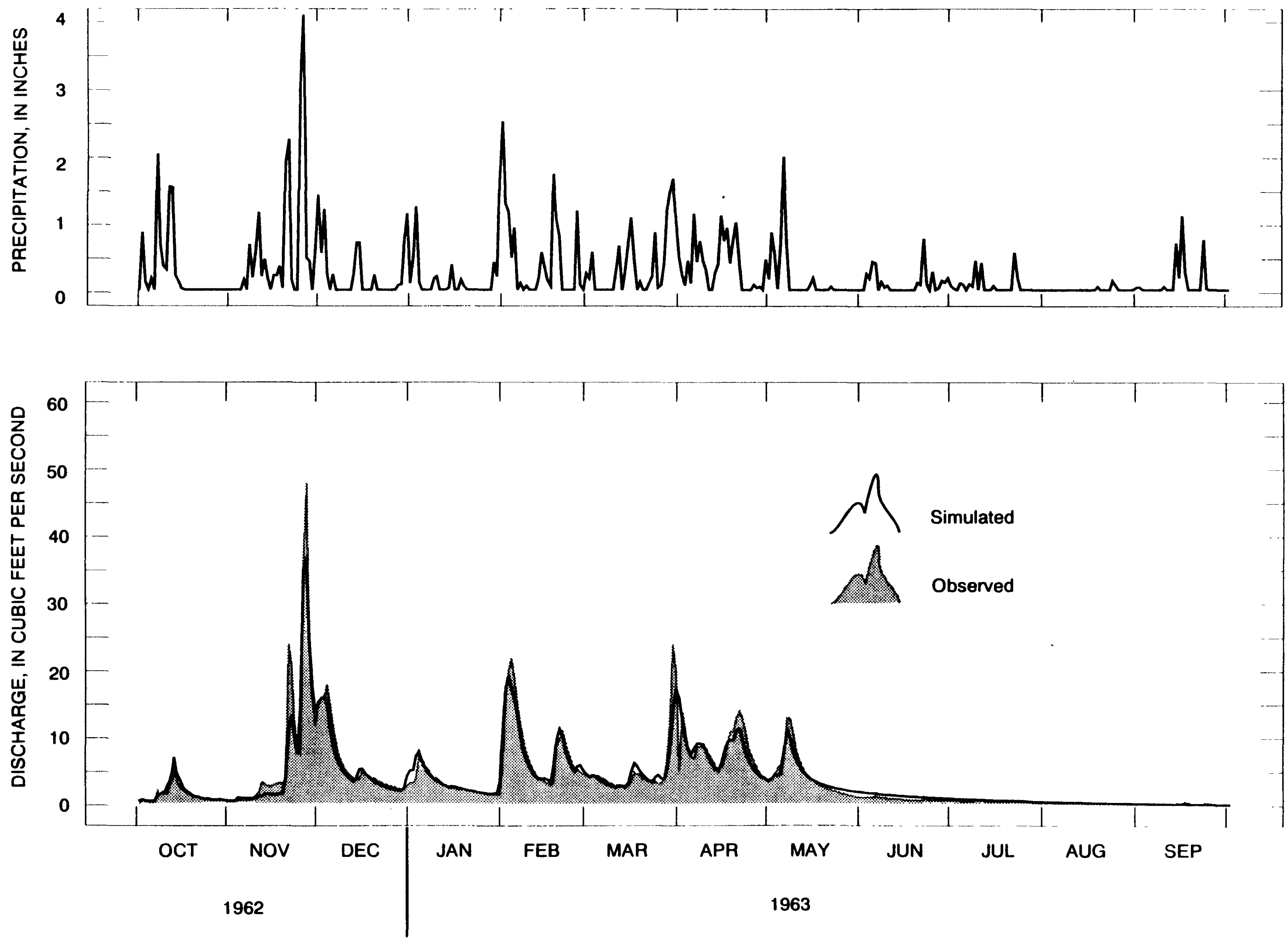

Figure 5.--Observed precipitation and discharge, and simulated discharge of Flynn Creek for one water year in the pre-logging verification period, under the general-fit calibration.

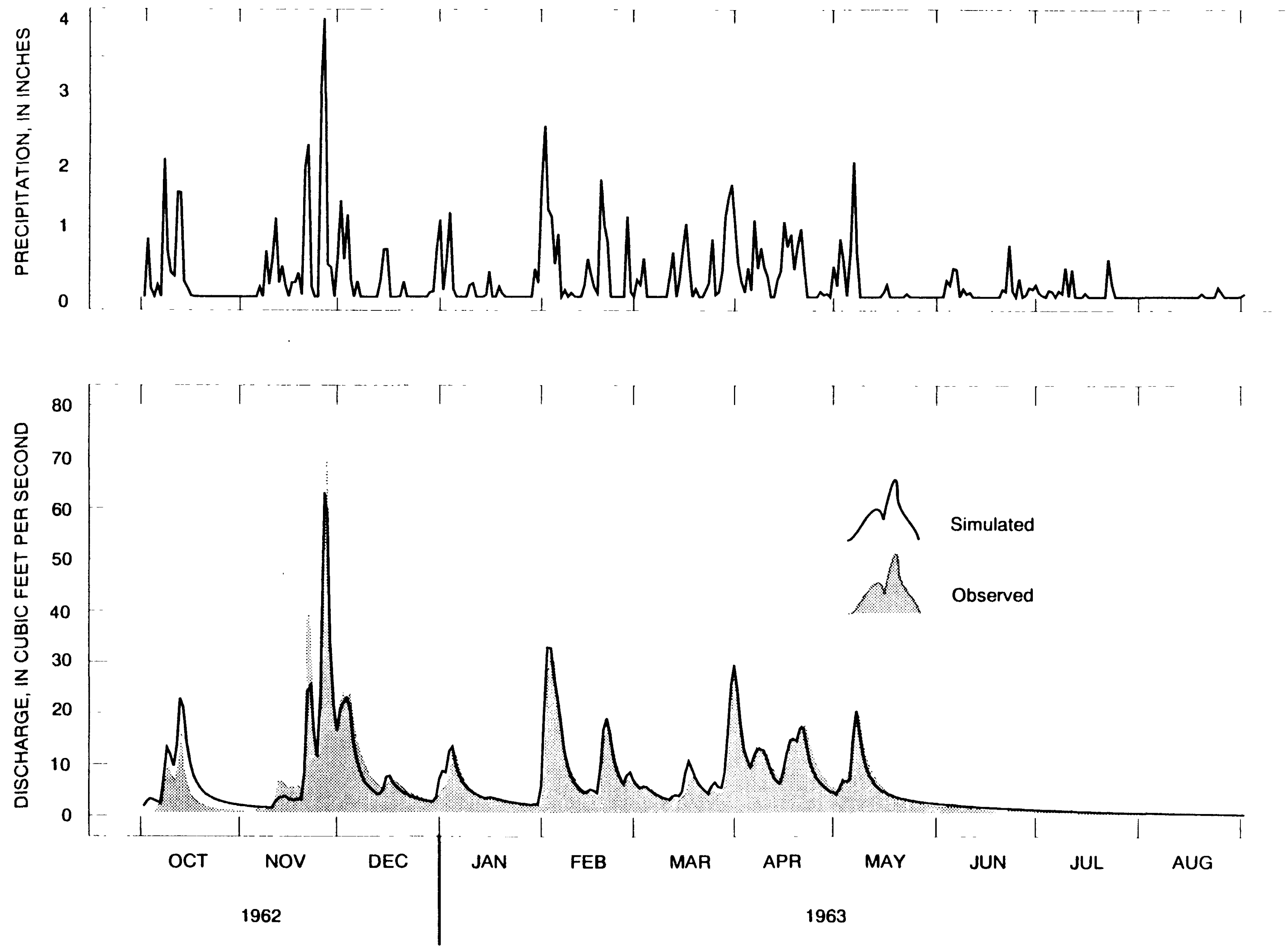

Figure 6.--Observed precipitation and discharge, and simulated discharge of Deer Creek for one water year in the pre-logging verification period, under the general-fit calibration.

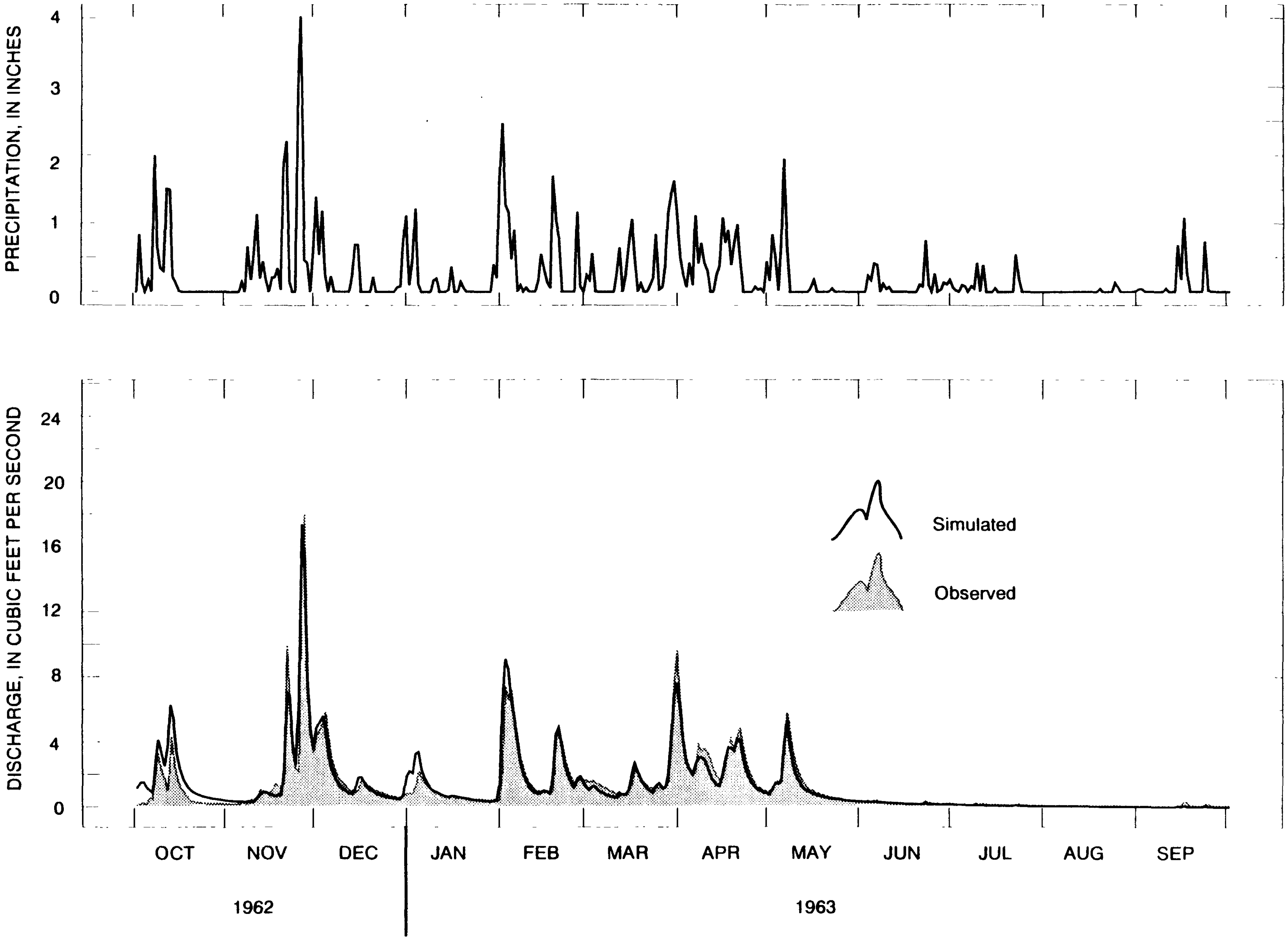

Figure 7.--Observed precipitation and discharge, and simulated discharge of Needle Branch for one water year in the pre-logging verification period, under the general-fit calibration.

Table 4.--Flynn Creek, Deer Creek, and Needle Branch calibration and verification error statistics, based on daily simulated and observed streamflow data, using the general-fit calibration

[An R^2 of 0.95 explains 95 percent of the total variation in observed daily mean discharge. Volume error is simulated minus observed. -- = data not available]

Study period	Flynn Creek	Deer Creek	Needle Branch
	COEFFICIENTS OF DETERMINATION (R^2)		
Pre-logging calibration	0.937	0.930	0.923
Pre-logging verification	.921	.926	.930
Second[2] verification	.933	--	--
	VOLUME ERRORS, IN PERCENT[1]		
Pre-logging calibration	-7.9	-3.7	+2.8
Pre-logging verification	-13.6	-7.6	+.3
Second[2] verification	-2.6	--	--

[1]No adjustment was made to precipitation input data although it is recognized that rain gages were subject to undercatch. Daily averages were used for storm periods.

[2]A second verification could be made with Flynn Creek data because no logging occurred in this basin for that period of time.

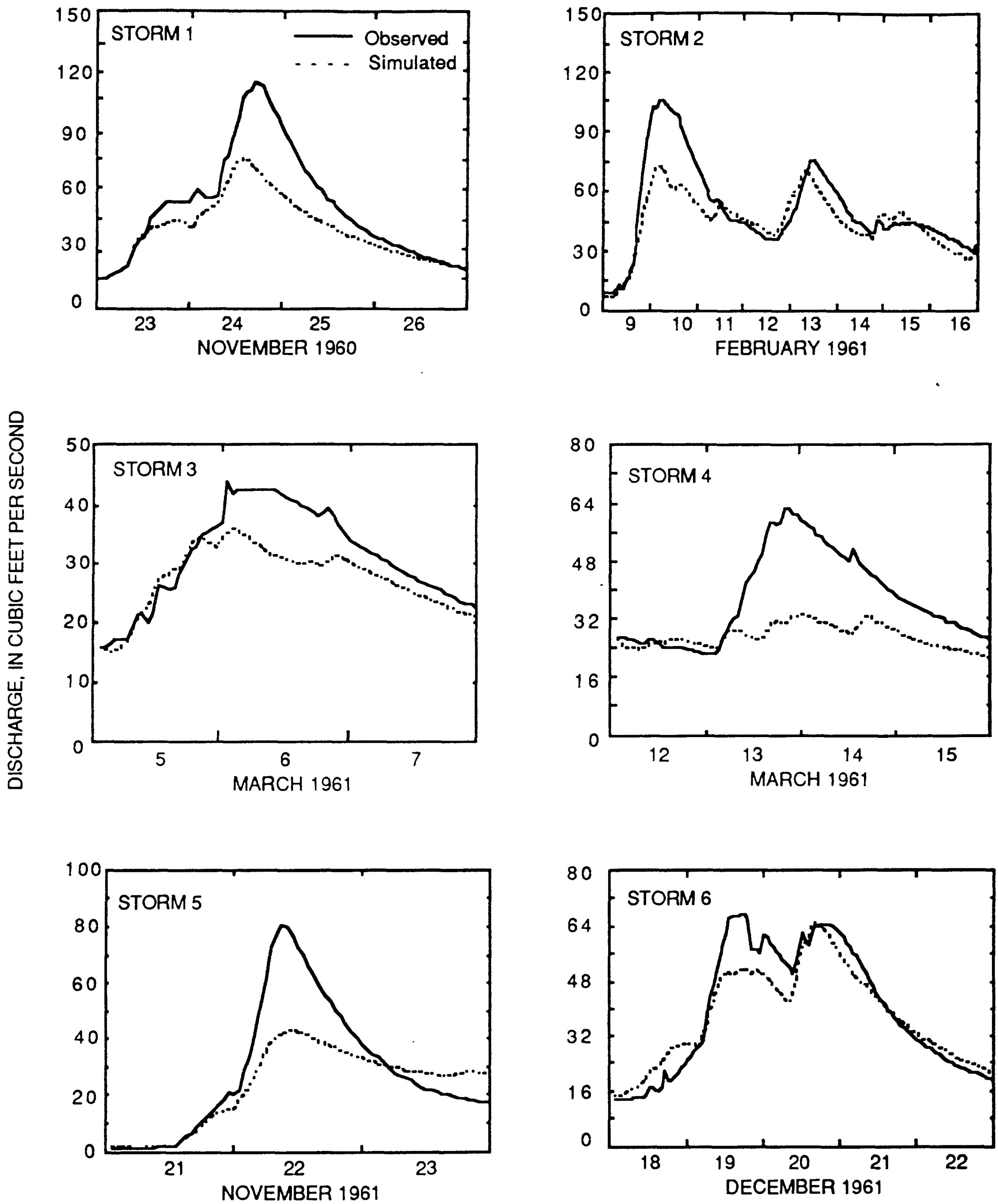

Figure 8.--Observed and simulated storm hydrographs for Deer Creek general-fit calibration. Peak flows were not emphasized in this calibration, and all simulated storms are lower than observed storms.

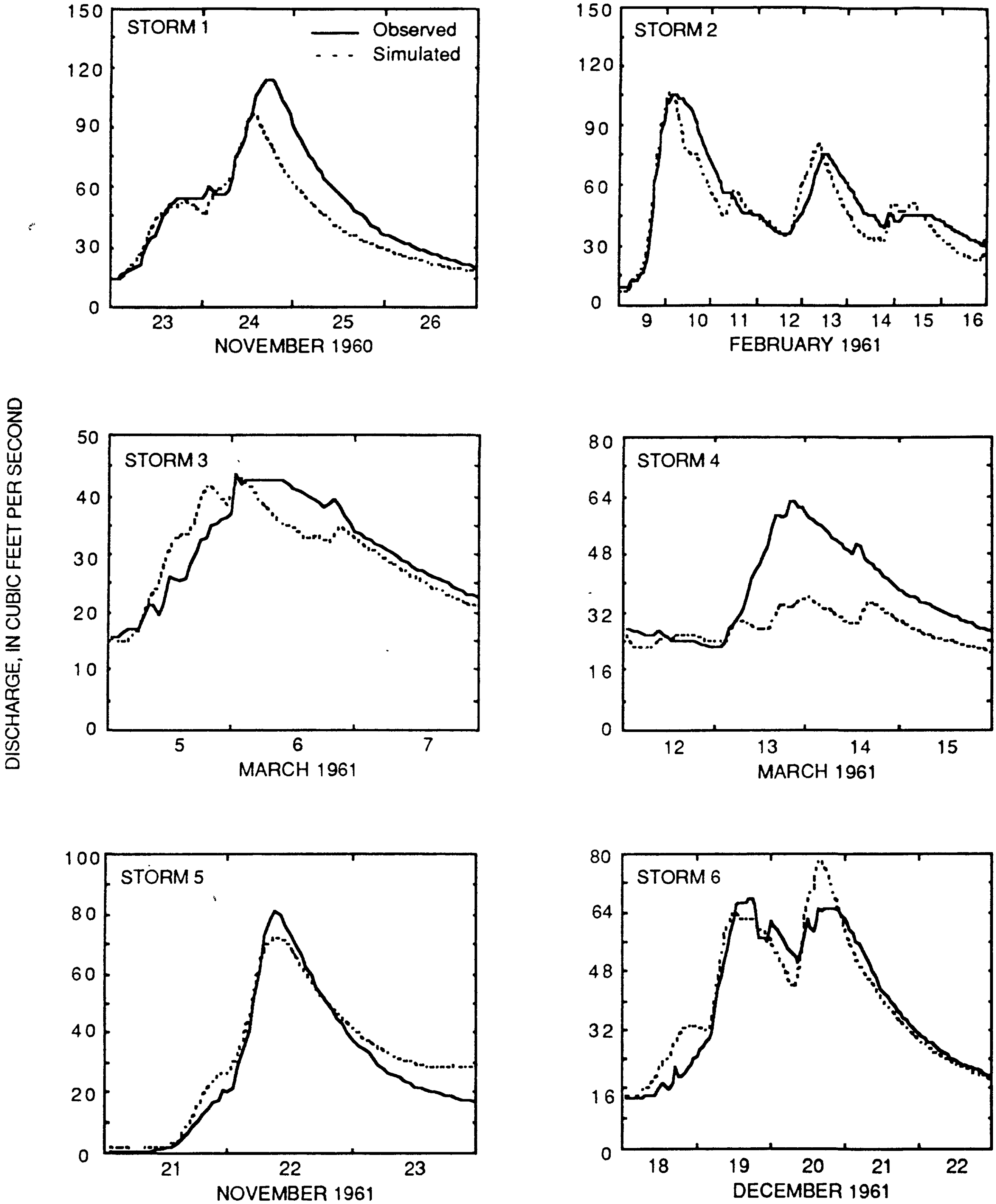

Figure 9.--Observed and simulated storm hydrographs for Deer Creek peak-fit calibration. Peak flows were emphasized for this calibration and except for storms 1 and 4, storm volumes between observed and simulated match. The most likely reason for the mismatch in storm volumes for storms 1 and 4 is that the rain gage recorded less because of high winds. The rain gage did not have a wind deflector.

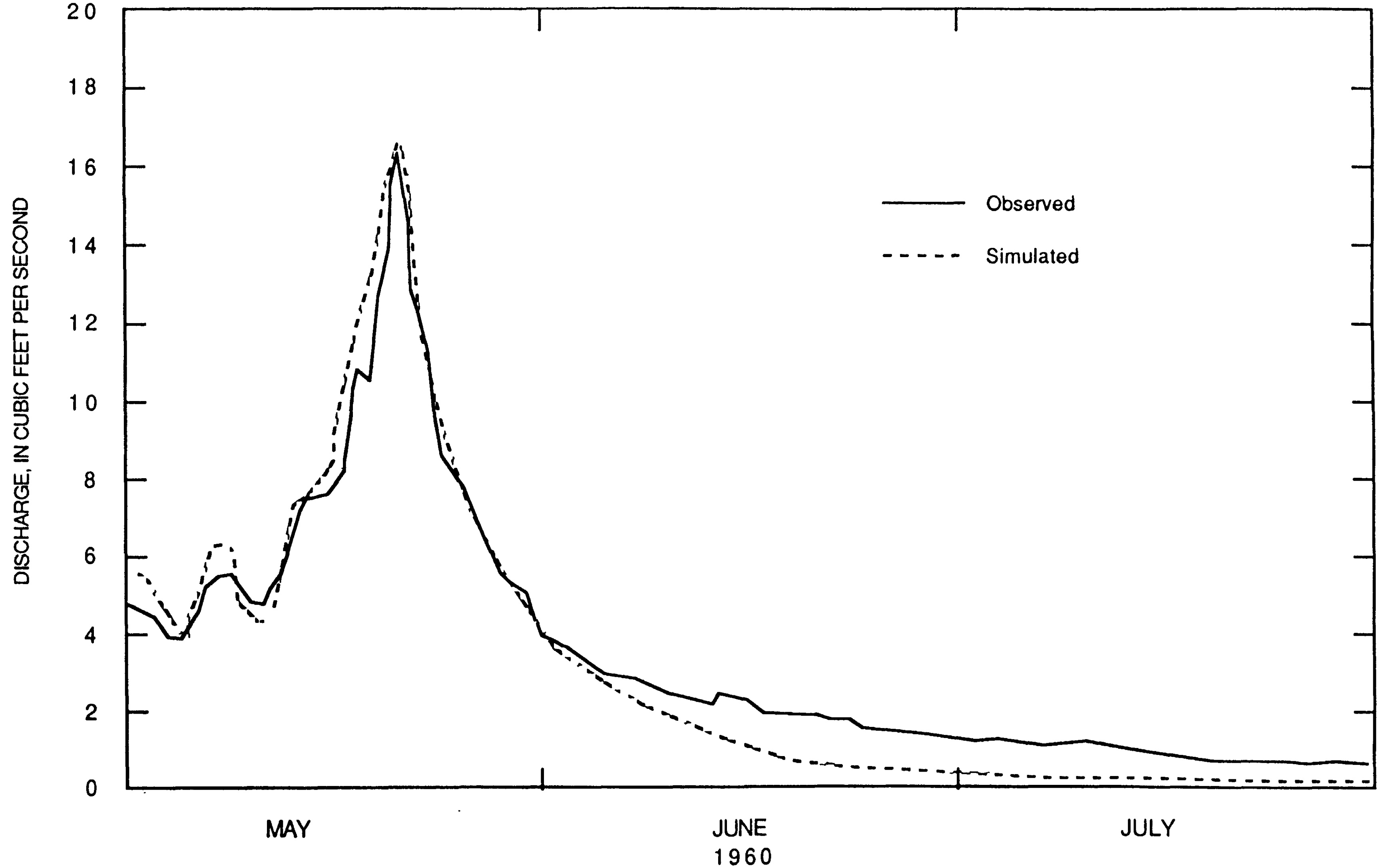

Figure 10.--Observed and simulated discharge for Deer Creek peak-fit calibration during pre-logging. Discharge is simulated based on a calibration in which peak flows were emphasized, resulting in a poor fit between hydrograph ressessions between simulated and observed.

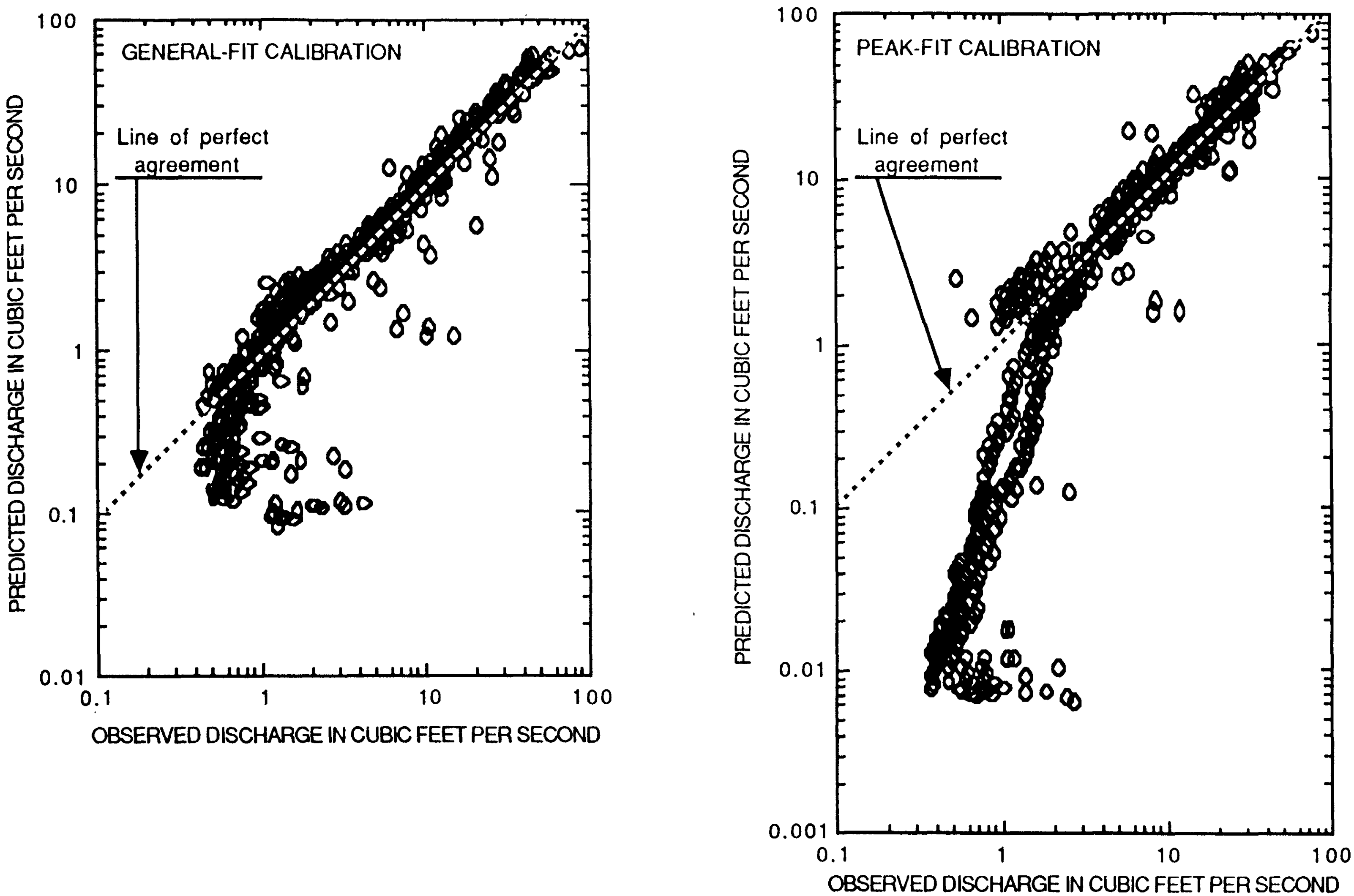

Figure 11.--Comparison of observed and predicted Deer Creek discharge for the general-fit and peak-fit calibration periods. Discharges below approximately 0.5 cubic feet per second are underpredicted in the general-fit calibration; discharges below approximately 5 cubic feet per second are underpredicted in the peak-fit calibration.

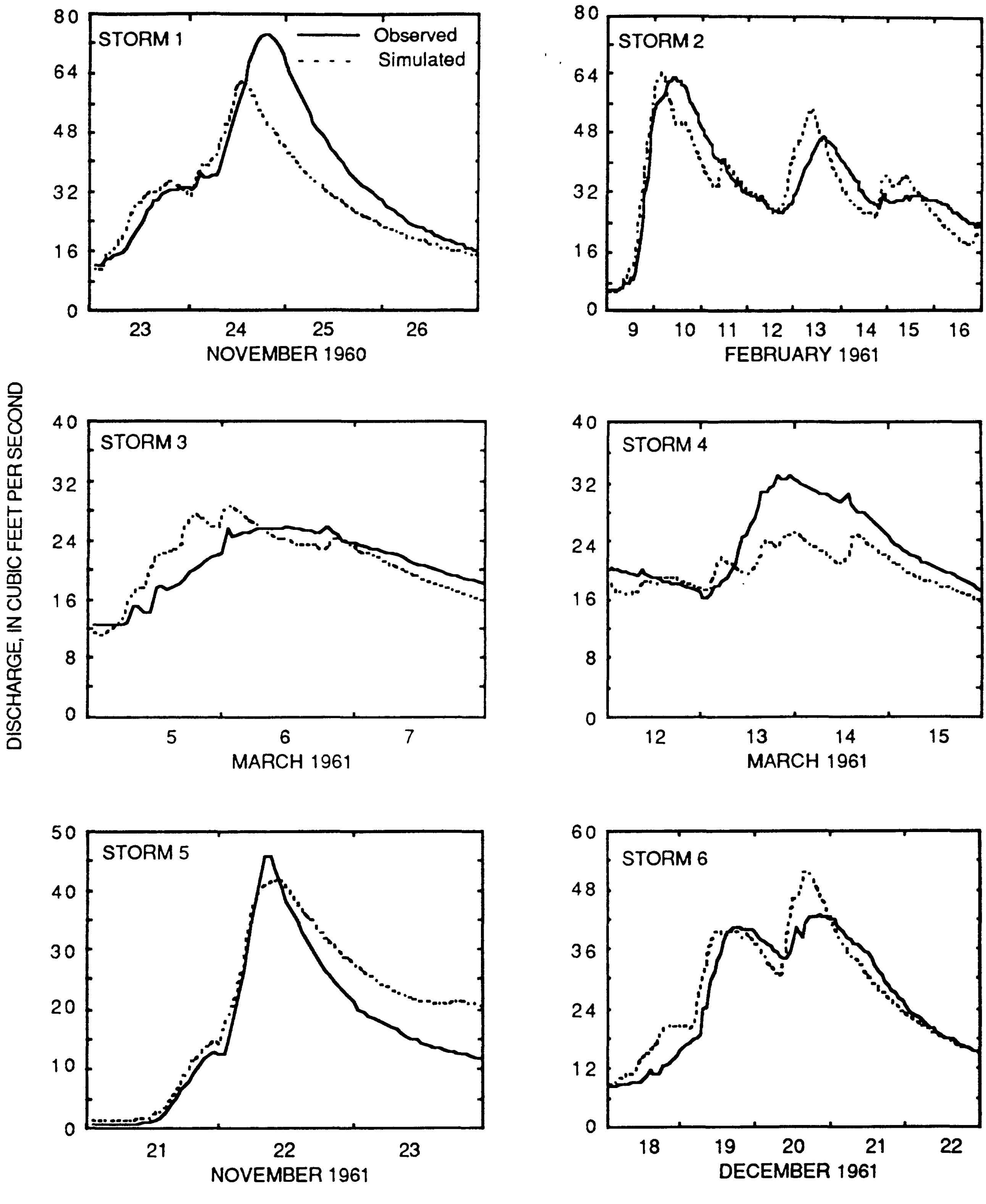

Figure 12.--Observed and simulated storm hydrographs for Flynn Creek using peak-fit calibration.

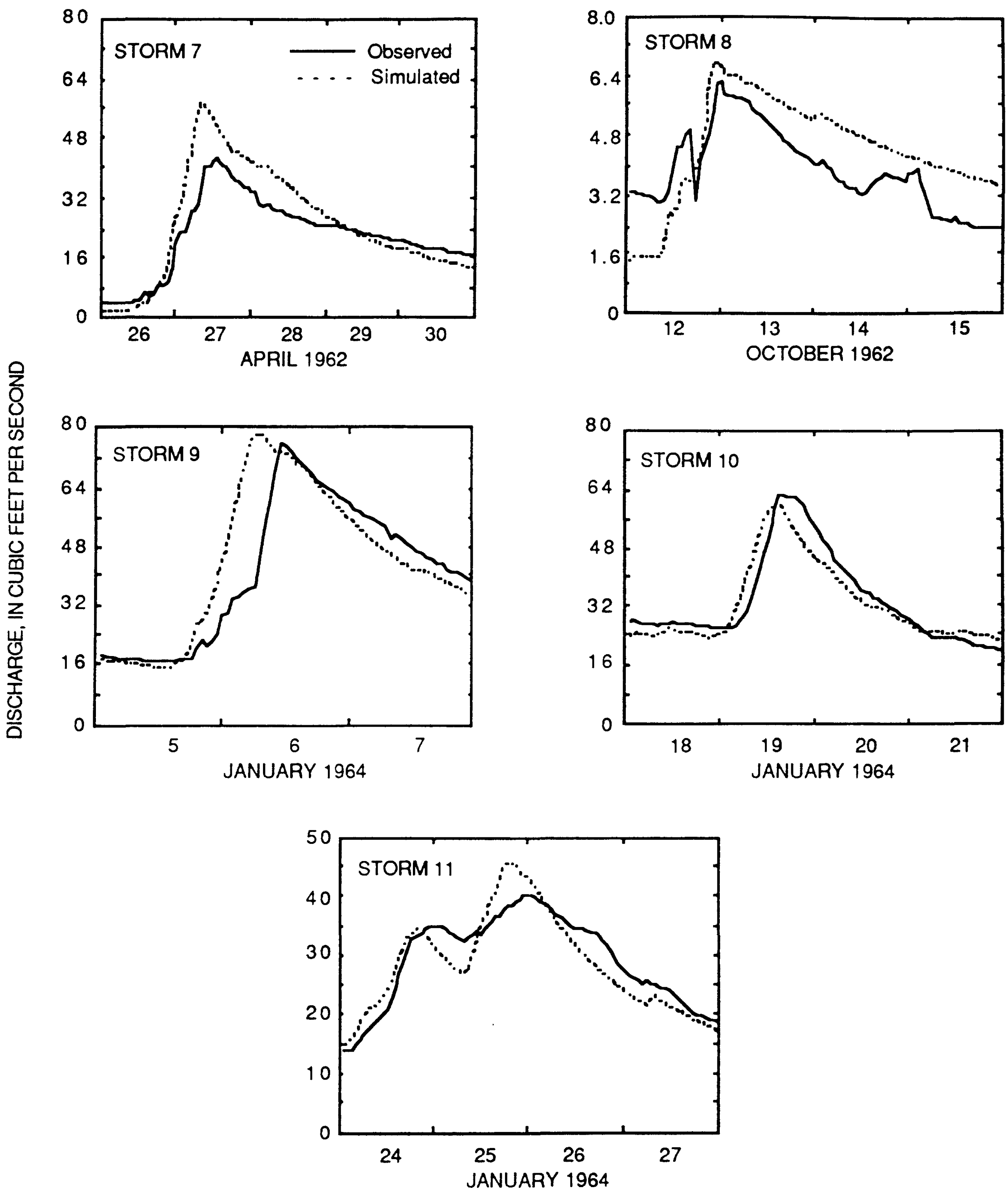

Figure 13.--Observed and simulated storm hydrographs for Flynn Creek in the first verification period using peak-fit calibration.

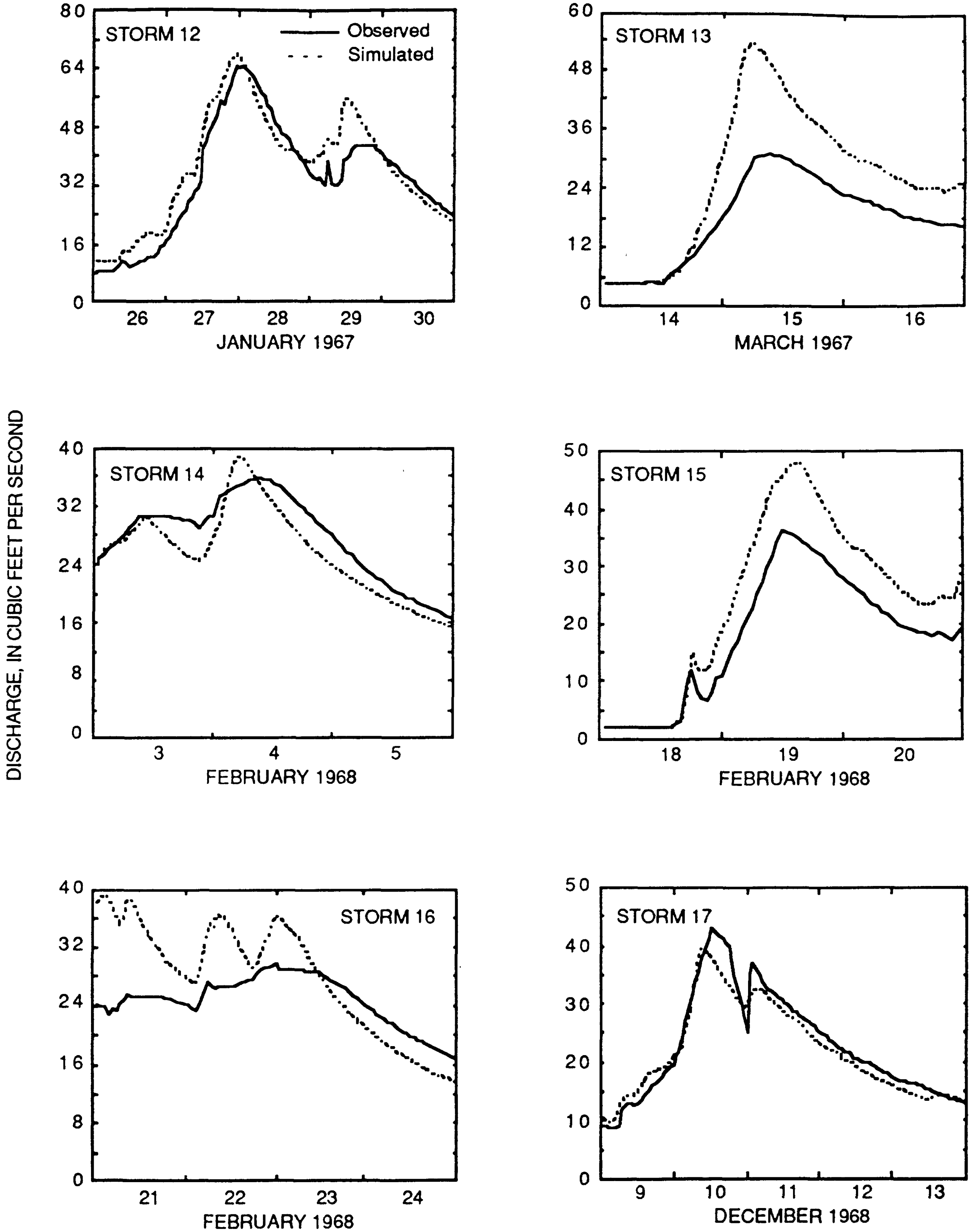

Figure 14.--Observed and simulated storm hydrographs for Flynn Creek in second verification period using peak-fit calibration.

Table 5.--Flynn Creek, Deer Creek, and Needle Branch calibration and verification storm period error statistics, using the peak-fit calibration

[An R^2 of 0.95 explains 95 percent of the total variation in observed daily mean discharge. Volume error is simulated minus observed. -- = data not available]

Study period	Flynn Creek	Deer Creek	Needle Branch
COEFFICIENTS OF DETERMINATION FOR STORM PEAKS (R^2)			
Pre-logging calibration	0.816	0.770	0.754
Pre-logging verification	.967	.967	.827
Second[2] verification	.546	--	--
STORM VOLUME ERRORS, IN PERCENT[1]			
Pre-logging calibration	+2.5	+7.9	+3.3
Pre-logging verification	-1.6	-.3	-11.4
Second[2] verification	-10.8	--	--

[1]No adjustment was made to precipitation input data although it is recognized that rain gages were subject to undercatch.

[2]A second verification could be made with Flynn Creek data because no logging occurred in this basin for that period of time.

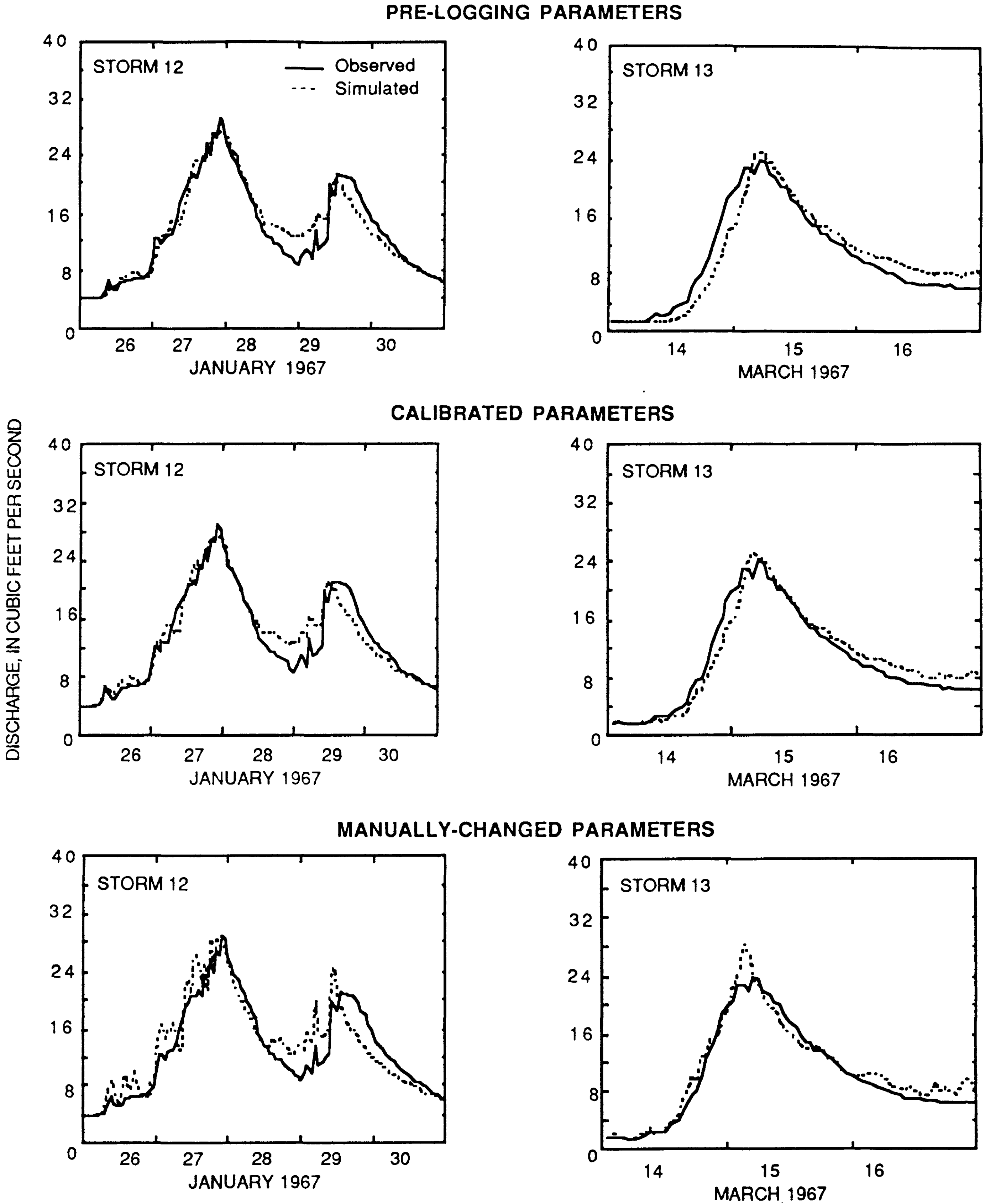

Figure 15.--Observed and three simulations of Needle Branch storm discharge for storms 12 and 13 in the post-logging period. Simulations are based on parameters set during a pre-logging calibration, parameters set manually to represent logging, and parameters calibrated to represent logging. Calibrations emphasized peak flows.

Table 6.--Parameter changes used to represent logging in Needle Branch and Deer Creek basins

[Parameter changes were made only to the hydrologic response units which were logged in each basin. (a) Value not changed from the manually adjusted value during post-logging calibration; (b) Value set by examining areal photos--see table 10 for range of values; (c) Values set at the maximum reasonable limit (SMAX) for each soil type; (d) Soil type colluvial/ alluvial (Corliss, 1973); (e) Soil type slickrock (Corliss, 1973); (f) Soil type bohannon (Corliss, 1973)]

Precipitation-Runoff Modeling System Parameter	Definition	Pre-logging value for Needle Branch	Manually set post-logging value	Calibrated post-logging value
ICOV	Predominant vegetation cover (3 for trees; 0 for bare)	(b) 3	(b) 0	0
COVDNS	Summer vegetation cover density (decimal)	(b)	0.15	.15
COVDNW	Winter vegetation cover density (decimal)	(b)	.50	.50
RNSTS	Summer rain interception storage (inches)	.501	.05	.25
RNSTW	Winter rain interception storage (inches)	1.17	.03	.03
ITST	Month transpiration starts	(b)	(b)	(a)
ITND	Month transpiration ends	(b)	(b)	(a)
SMAX	Maximum available water-holding capacity of soil profile (inches) Values shown for three soil types	(d) 12.0 (e) 6.4 (f) 4.0	2.4 1.6 1.9	2.4 1.6 1.9
REMX	Maximum available water-holding capacity of recharge zone (inches)	(d) .4 (e) .4 (f) .4	.64 .64 .64	(d) 2.4 (d) 1.6 (d) 1.9
IMPERV	Effective impervious area (decimal)	(b) 0	(b) .11	.035

The following narrative is the hypothesis used to simulate the timber harvest condition for Needle Branch (see table 6):

> When timber is harvested, the predominant cover (ICOV) is changed from trees (3) to bare (0) and cover density in summer (COVDNS) was set to 0.15 from 1.00 and in winter (COVDNW) was set to 0.5 from 0.87 using aerial photos as guides. Summer and winter rain interception (RNSTS and RNSTW) were optimized by the model in both pre- and post-logging periods and these values used. After harvest, interception is dramatically reduced. The month that transpiration will start (ITST) and end (ITND) was established using field acumen and aerial photos. The starting month of 5 and ending month of 10 were used. The maximum available water-holding capacity (SMAX in inches of water) for the three soil types in the basin were set from values of total rooting zone depths given in a soil survey. At harvest, these depths were decreased from values given in the same survey. REMX, the maximum available water-holding capacity, is increased to SMAX values at harvest. None of the soil infiltration parameters were decreased for the harvest scenario, because they were much greater than precipitation and they would need to be reduced significantly for any change in infiltration. For harvest, impervious area was increased because of roads, skid trails, and landing areas shown on aerial photos. In calibration, this area was reduced by approximately one-third because not all the defined impervious area is covered by an impervious material.

Simulations based on manually adjusted parameters show responses to precipitation that are quicker than the actual response. These simulated quick responses were slowed down in the post-logging calibration simulations, primarily by reducing the effective impervious areas to 30 percent of the manually selected values.

Storms 12 and 13 are shown because they are simulated reasonably well. Even though these storms are simulated reasonably well, the simulations based on parameters changed to reflect logging are not significantly better than the simulations based on pre-logging parameters (fig. 15). Modeled changes due to logging appear to be smaller than the errors between model simulations and observed data. Therefore, the approach was revised to comparing pre-logging and post-logging simulations in order to determine estimated streamflow changes due to logging.

Comparisons Between Simulations

Although general-fit and peak-fit calibrations are shown in this report, the final model calibration for Needle Branch, Deer Creek, and Flynn Creek has not yet been achieved in the overall study because the remaining eight coastal Oregon basins have not been modeled as proposed. The following comparison between simulation of pre- and post-logging scenarios, therefore, is also subject to revision. Results of these preliminary simulations agree with other published findings.

Post-logging simulated storm and daily summer discharge for Needle Branch are shown in figures 16 and 17. Three simulations are presented:

1. Discharge is simulated with pre-logging parameters. This represents the estimated no-logging discharge.

2. Discharge is simulated with post-logging calibrated parameters, with 19.5 acres of the 173-acre basin covered by roads (3.5 percent impervious). This is the road density determined from actual post-logging areal photographs.

3. Discharge is simulated with post-logging calibrated parameters, with 65 acres of the 173-acre basin covered by roads (11 percent impervious - hypothetical road density).

Statistics describing the changes between simulated no-logging discharge and simulated after-logging discharge at 3.5 percent and 11-percent impervious areas are shown in table 7. The following published information is available for comparison with table 7:

1. For the Needle Branch basin, Harris (1977) reported that mean post-logging peak flow was 20 percent greater than the expected mean; however, the increase is not statistically significant. A calibrated PRMS model simulated a post-logging period increase of 1.3 percent. The impervious area was 3.5 percent of the basin for post-logging.

2. For the Needle Branch basin, Harris (1977) reported that mean post-logging 3-day high-flow storm volume was 17.3 percent greater than the expected mean. The calibrated PRMS model simulated a storm volume increase of 0.9 percent for the post-logging period.

3. For the Needle Branch basin, Harris (1977) reported that the 7-year post-logging mean runoff was 26 percent greater than the expected mean runoff. The calibrated PRMS model simulated an increase of 12.8 percent for water year 1968 (not necessarily the mean change).

4. For two basins in the H.G. Andrews Experimental Forest (not part of the Alsea Watershed Study), clearcut in patches totaling 25 percent of each basin's area, Harr (1980) reported that annual water yields and the size of instantaneous peak flows were not significantly changed. The calibrated PRMS model simulated an increase in annual water yield of 12.8 percent for the post-logging period for Needle Branch.

One of the larger differences predicted by the simulation comparisons is the first fall storm in October 1967 (fig. 17). The comparison of simulated post-logging discharge at 11 percent road density with the observed discharge is shown in figure 18. This figure verifies model simulation of antecedent soil-moisture conditions and of storm response with imposed impervious area. The simulated and observed first-fall-storm peaks agree well. The probable reason for a greater flow in a first fall storm is due to the increased impervious area. This condition is masked in larger magnitude events.

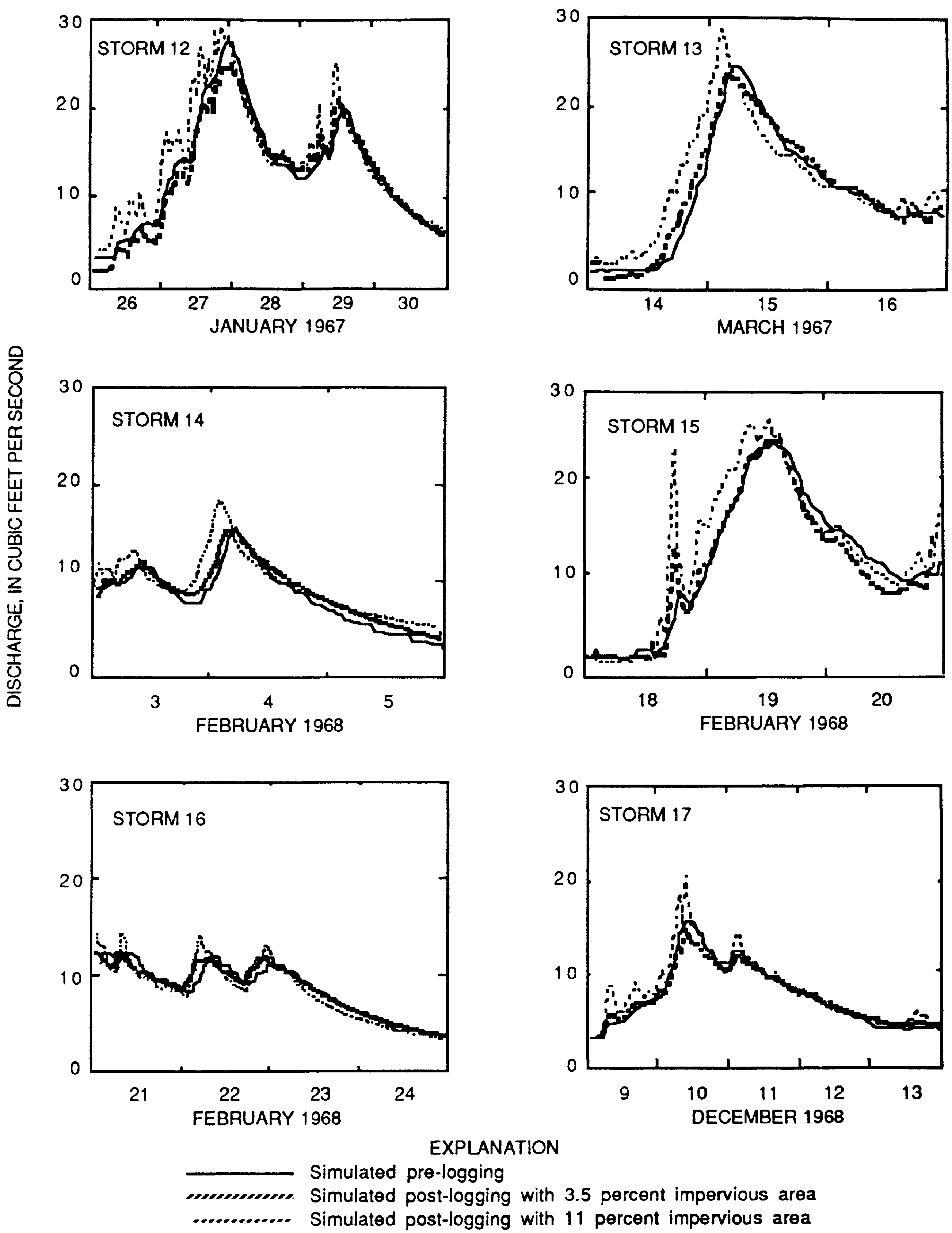

Figure 16.--Simulated pre-logging discharge, simulated post-logging discharge with 3.5 percent of basin impervious, and simulated post-logging discharge with 11 percent of basin impervious, for Needle Branch, for six periods. Changes Changes from the solid to the bold-dashed lines represent simulated changes due to the logging which occured in 1966.

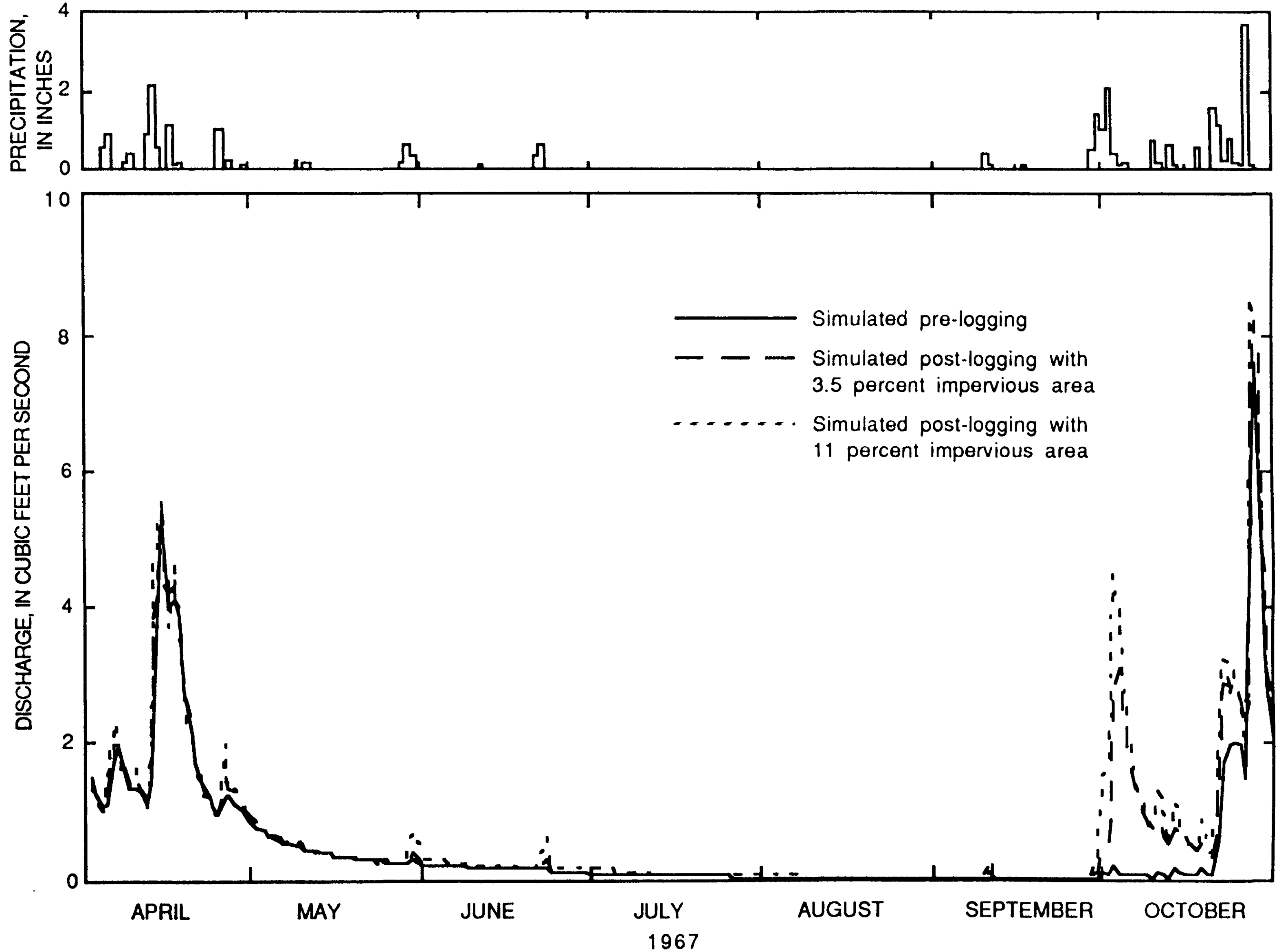

Figure 17.--Observed daily precipitation, simulated pre-logging discharge, simulated post-logging discharge with 3.5 percent of basin impervious, and simulated post-logging discharge with 11 percent of basin impervious, for Needle Branch, for a summer period.

Table 7.--Effects of logging Needle Branch with 3.5 and 11.5 percent simulated impervious area, compared to simulated no-logging streamflow

Streamflow characteristic	Percent change: Logging with 3.5 percent impervious area	Logging with 11 percent impervious area
Peak flows for storm periods 12-17, based on peak-flow calibration	+1.3	+12.2
Storm volumes for storm periods 12-17, based on peak-flow calibration	+.9	+1.9
Discharge volume for water year 1968, based on general calibration using daily data	+12.8	+18.4

Source of Errors in Simulations

Errors in discharge simulations produced by rainfall-runoff models result from many sources. Three sources considered here are (1) errors in model structure, (2) errors in parameter estimates, and (3) errors in raw data used for model input and for comparison with model output.

Errors in the model structure occur because all models are simplifications of reality and, thus, introduce distortion (Woolhiser and Brakensiek, 1982). Beven (1989) states,

> Our simulation models, even the most complex available, ... are extreme simplifications of reality. We know that the descriptive equations that underlie these models are good descriptors of processes occurring in well defined, spatially homogeneous, structurally stationary model catchments and hillslopes in the laboratory. We can feel less assured that those equations may describe the complex three-dimensional spatially heterogeneous and time varying system that is a real catchment.

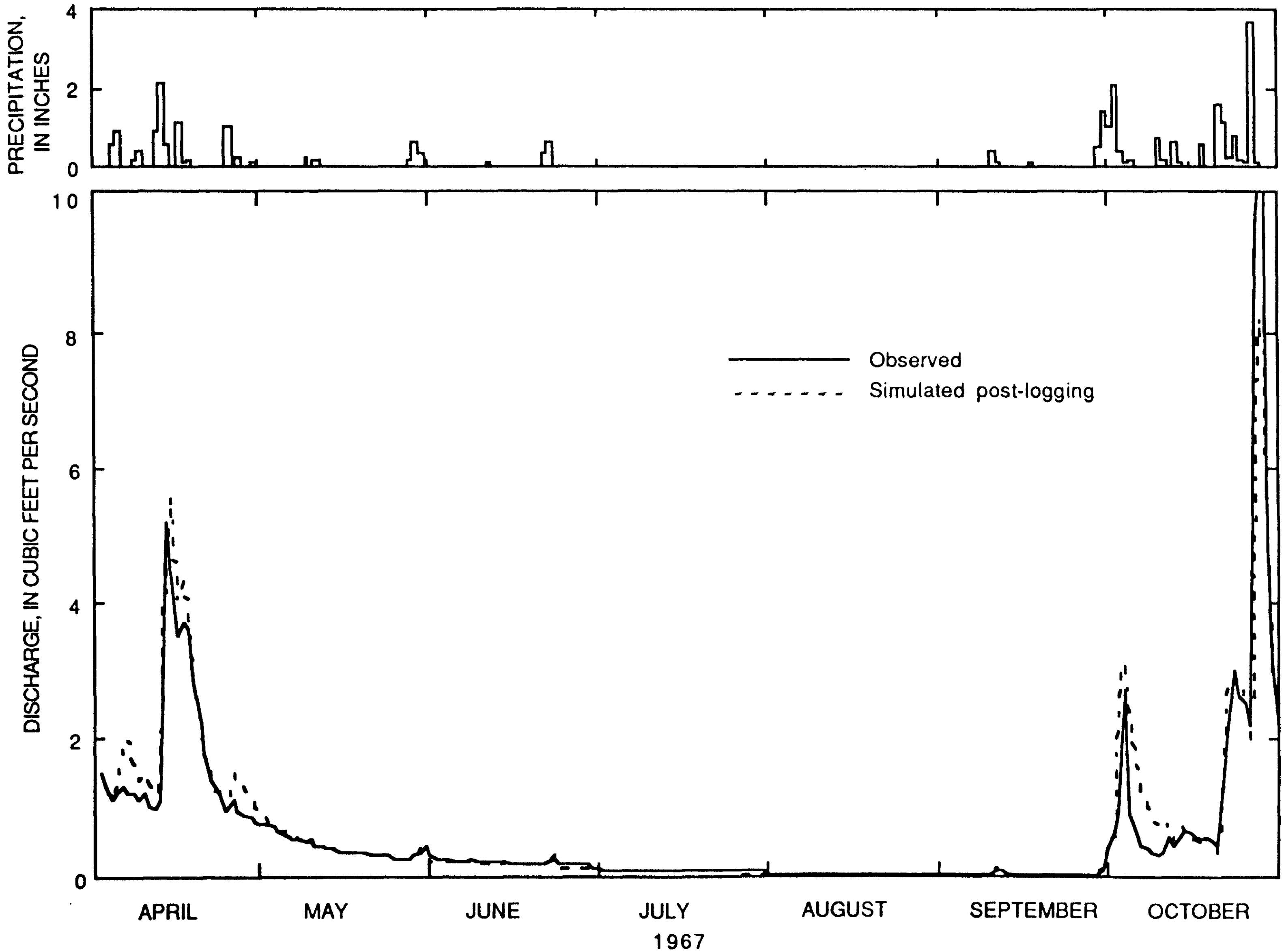

Figure 18.--Observed precipitation and simulated post-logging discharge with 3.5 percent of basin impervious compared to observed discharge for Needle Branch, for a summer period.

Errors in parameter estimates, based on observations of rainfall and runoff, have "long been an object of concern in hydrology" (Beck and others, 1990). Beck cites, among other examples, work by Johnston and Pilgrim (1976), in which a true optimum set of nine model parameters was not found in more than 2 years of full-time work concentrated on one watershed. Beven, (1989), states, "It appears that three to five parameters should be sufficient to reproduce most of the information in a hydrological record." Attempts to estimate more than three to five parameters may, therefore, be overextending the information available in a hydrologic record. Even if a perfect parameter-estimation technique was available, parameter estimates would still be subject to sampling errors if they were calculated using a different period of record (different estimates would result - Woolhiser and Brakensiek, 1982).

Errors are present in all data used in this study. The USGS rated the daily discharge data as excellent (Deer Creek, 1966 water year, for example) to fair (Flynn Creek, discharges below 1 ft^3/s, 1959 water year, for example). These ratings mean that about 95 percent of the daily discharges are within 5 to 15 percent of the actual values (U.S. Geological Survey, historical files and 1972). No quantitative estimates of errors were made in the precipitation and temperature data. A scatter plot of hourly precipitation at the Flynn Creek and Deer Creek precipitation gages for two storms during the pre-logging calibration period indicates the error involved in assuming that one precipitation gage correctly registers spatially variable precipitation for all three basins (fig. 19). These two gages were located within 1.5 miles of each other. The error in the final simulated storm discharges attributed to spatially variable precipitation is indicated in figure 20, where observed Flynn Creek storm discharges are compared with simulated discharges obtained using the Deer Creek or the Flynn Creek precipitation records. Much of the error in simulated discharge for storm 4, for example, could have resulted from non-representative or incorrectly gaged precipitation.

There is probably one other large source of error associated with the precipitation data. None of the three rain gages used in data collection were equipped with wind deflectors. Wind can cause significant errors (deficiencies) in rainfall catch. Larson and Peck (1974) found approximately 10 percent and 20 percent catch deficiency in liquid precipitation for winds of 10 mph (miles per hour) and 20 mph, respectively, for gages without wind deflectors. No wind data were collected for this project to define a possible correction. This error source could account for some of the observed spatial variability and large volume errors associated with storms.

Transferability of Model Parameter Values

Error statistics obtained when the initial Deer Creek calibrated parameters were used directly for simulating Flynn Creek and Needle Branch discharge are shown in table 8; the statistics indicate that calibrated parameters transfer well among these three basins. This may be due, in part, to use of a common precipitation record for all basins. However, it is an indication that using a calibrated parameter set from one of the currently calibrated basins for a similar basin in the area is reasonable. Inputs for final general-fit and peak-fit calibrations

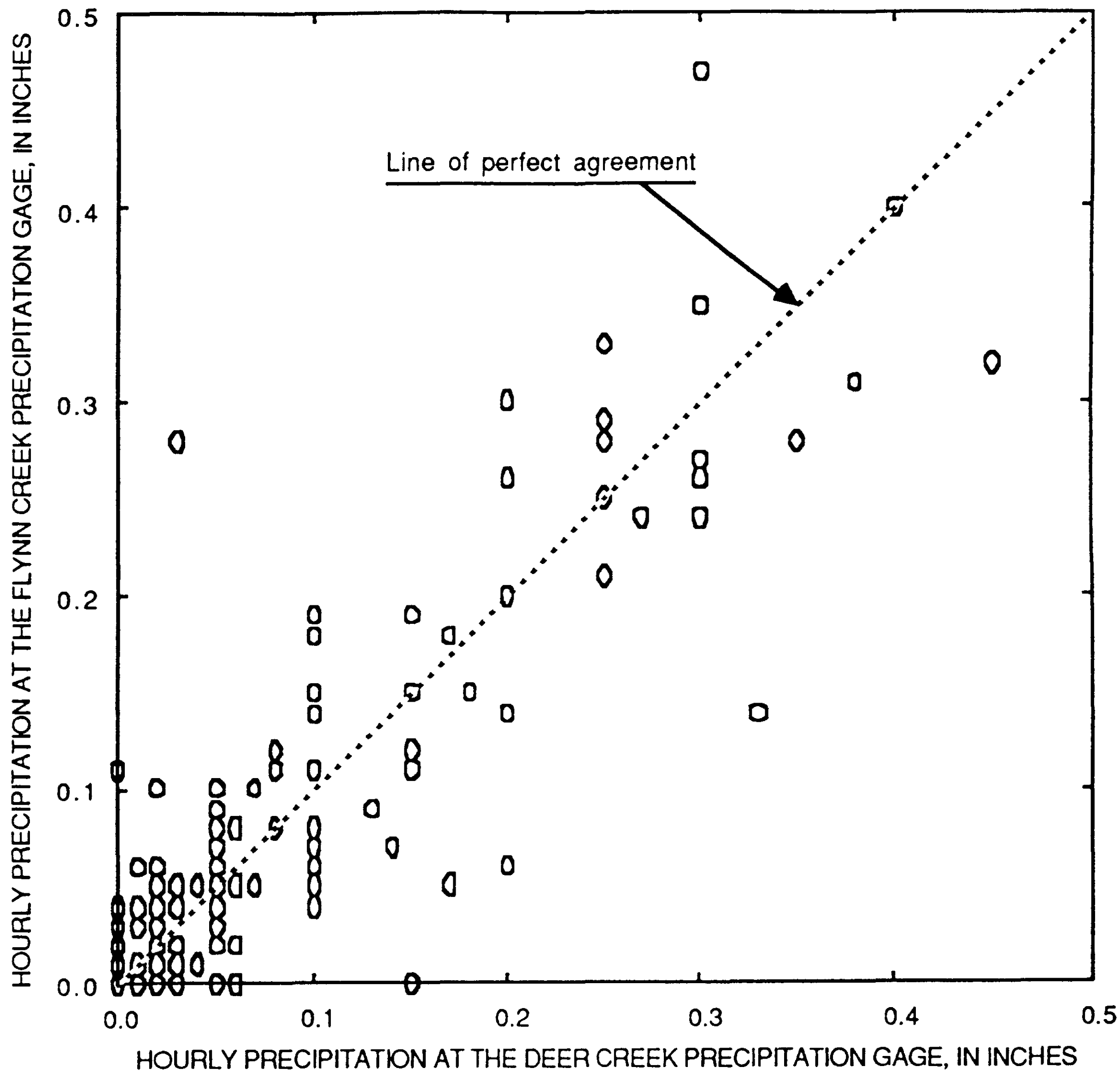

Figure 19.--Hourly precipitation data recorded at the Deer Creek and Flynn Creek precipitation gages during storms 5 (November 21-23, 1961) and 6 (December 18-22, 1961).

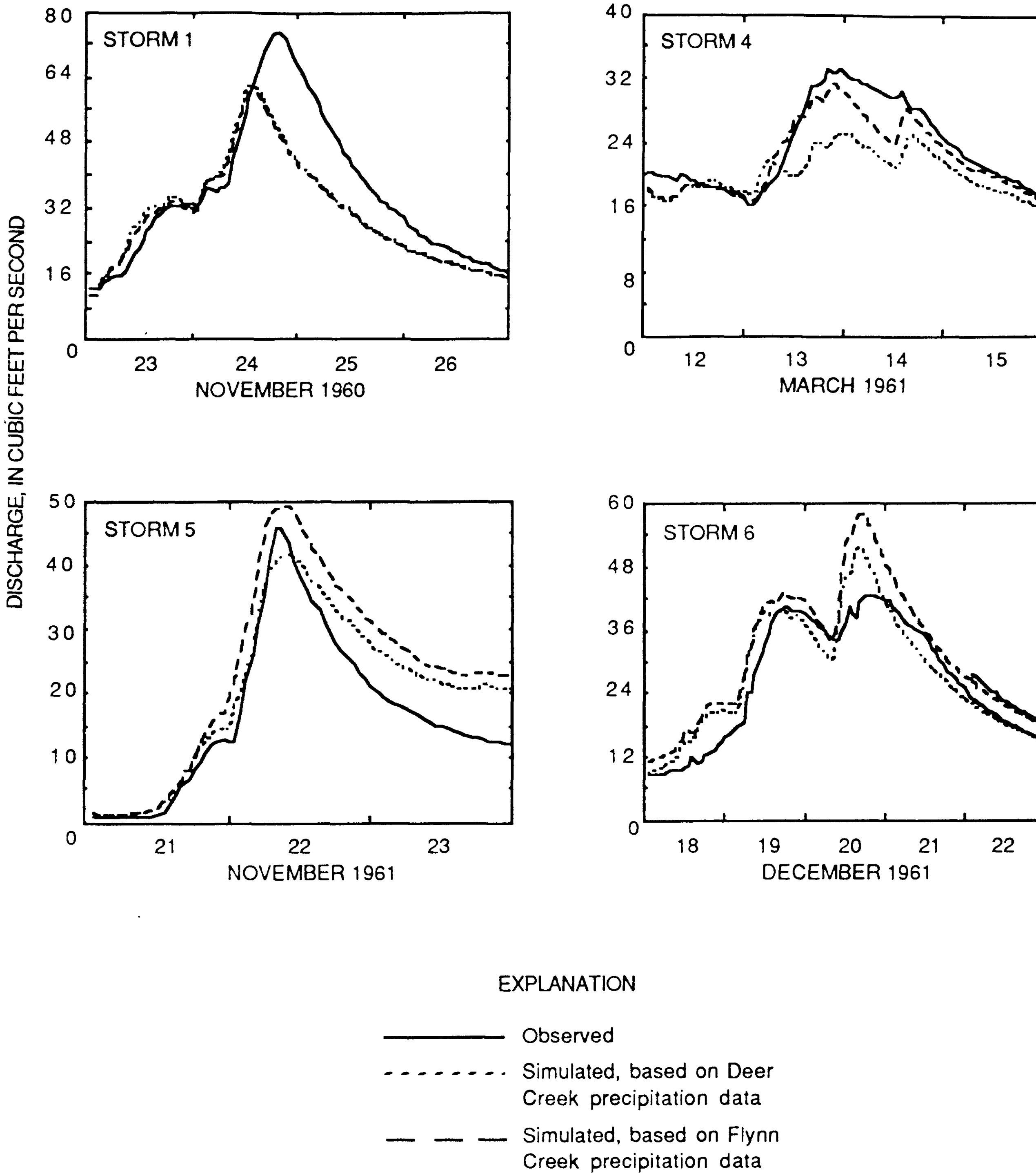

Figure 20.--Observed and simulated storm hydrographs for Flynn Creek using Flynn Creek and Deer Creek precipitaton data. Flynn Creek hourly precipitation data were not available for storms 2 and 3.

Table 8.--Error statistics for simulations using Deer Creek calibrated parameters directly for simulating Flynn Creek and Needle Branch discharge

Error statistic	Deer Creek	Transfer to Needle Branch	Transfer to Flynn Creek
Coefficient of determination for daily flows, using the general-fit calibration	0.930	0.905	0.949
Coefficient of determination for low flows (May through September), using the general-fit calibration	.886	.885	.907
Coefficient of determination for peak flows, using the peak-fit calibration	.947	.934	.936

for Flynn Creek, Deer Creek, and Needle Branch are found in appendix B. In addition, selected parameter values and the way in which they were adjusted for final calibration are listed in table 9. Final calibrated parameters used in East Fork Lobster Creek also are presented, although they may not be directly comparable because of differences in calibration style. For example, the East Fork Lobster Creek simulation used pan-evaporation data instead of temperature data for estimating potential evapo-transpiration. The range of values for parameters that are based on physical basin characteristics when modeling Flynn Creek, Deer Creek, and Needle Branch are shown in table 10.

Because calibration is always somewhat subjective, there is a need for re-calibration of East Fork Lobster Creek using temperature data, to obtain comparable parameter estimates, and a need for re-calibration of all four basins during future work on other basins in the original 12 proposed, in order to obtain comparable parameter sets. Fall storms also will be evaluated.

Five parameters proved most sensitive in model calibration; RNSTS, RNSTW, SEP, RCP, and RCB. Sensitivity was tested by varying these parameters through the expected deviation in the coastal Oregon area, and then observing changes in the simulated discharge. The sensitivity of the five parameter values are shown in table 11. Of these parameters, summer and winter interception are varied in management scenarios when simulating changes in timber densities. The model is sensitive to an error in summer or winter interception storage that could create a resultant model error of ±1 percent.

Table 9.--Final calibrated parameters for Flynn Creek, Deer Creek, Needle Branch, and East Fork Lobster Creek, for the Precipitation-Runoff Modeling System

[(a) Parameters taken from physical measurements are not shown; (b) Not active in the final calibration; (c) Parameter varied by month, but the same values were used for all three streams; (d) Parameter was spatially variable; (e) Five parameters set by calibration for Flynn Creek, Deer Creek, and Needle Branch because there is no way to quantify them with field or laboratory data; (f) These parameters were varied in calibration, and then left as they were originally set; (g) Calibration indicated this parameter should be set high; (h) This was calibrated on Deer Creek, and left unchanged on Flynn Creek and Needle Branch. All final values for these parameters are shown in appendix B]

Para-		Flynn Creek		Deer Creek		Needle Branch		East Fork
meter (a)	Application	General	Peak	General	Peak	General	Peak	Lobster Creek
RSEP	Percolation (inches/day)	(b)	(b)	(b)	(b)	(b)	(b)	0.08
GSNK	Loss coefficient	(b)	(b)	(b)	(b)	(b)	(b)	.01
CTS (h)	Evapo-transpiration	(c)	(c)	(c)	(c)	(c)	(c)	(b)
RCB (e)	Baseflow	0.0236	0.0944	0.0196	0.0944	0.0232	0.0944	.02
RCF	Interflow	(b)	(b)	(b)	(b)	(b)	(b)	.02
RCP (e)	Interflow	.0401	.12	.0668	.18	.0931	.20	.23
RNSTS (e)	Summer Interception (inches)	1.0	.501	.562	.501	.587	.501	.22(d)
RNSTW (e)	Winter Interception (inches)	.397	1.17	.176	1.17	.183	1.17	.22(d)
SCX	Runoff (decimal percent)	(b)	(b)	(b)	(b)	(b)	(b)	.10
SCN	Runoff (decimal percent)	(b)	(b)	(b)	(b)	(b)	(b)	.0016
SC1	Runoff (decimal percent)	(b)	(b)	(b)	(b)	(b)	(b)	.30

Table 9.--Final calibrated parameters for Flynn Creek, Deer Creek, Needle Branch, and East Fork Lobster Creek, for the Precipitation-Runoff Modeling System--Continued

Parameter (a)	Application	Flynn Creek General	Flynn Creek Peak	Deer Creek General	Deer Creek Peak	Needle Branch General	Needle Branch Peak	East Fork lobster Creek
RETIP (f)	Retention on impervious area (inches)	0.1	0.1	0.1	0.1	0.1	0.1	0.20
SEP (e)	Percolation (inches per day)	.133	.413	.154	.413	.119	.413	(d)
UPCOR (f)	Precipitation	1.0	1.0	1.0	1.0	1.0	1.0	(d)
DRCOR (f)	Precipitation	1.0	1.0	1.0	1.0	1.0	1.0	(d)
KSAT (g)	Hydraulic conductivity (inches per hour)	20	20	20	20	20	20	8.5

Table 10.--Ranges of parameter values selected for physically based parameters for Flynn Creek, Deer Creek, and Needle Branch, for modeling with Precipitation-Runoff Modeling System for pre-logging

Parameter	Brief description	Unit	Flynn Creek	Deer Creek	Needle Branch
SLP	Slope	Decimal	0.13-0.14	0.05-0.64	0.05-0.69
ELV	Elevation	Feet	700-940	680-1360	450-900
ICOV	Predominant vegetation cover	0=bare 1=grasses 2=shrubs 3=trees	3	3	3
COVDNS	Summer vegetation cover density	Decimal	0.90	0.80-0.95	0.50-1.00

Table 10.--Ranges of parameter values selected for physically based parameters for Flynn Creek, Deer Creek, and Needle Branch, for modeling with Precipitation-Runoff Modeling System for pre-logging--Continued

Parameter	Brief description	Unit	Flynn Creek	Deer Creek	Needle Branch
COVDNW	Winter vegetation cover density	Decimal	0.44-0.70	0.10-0.70	0.50-0.87
ITST	Month to look for start of transpiration		1-4	1-4	1
ITND	Month transpiration ends		11-12	11-12	12
ISOIL	Soil type	1=sand 2=loam 3=clay	2	2	2
SMAX	Maximum available water-holding capacity of soil profile	Inches	4.0-6.4	4.0-12.0	4.0-12.0
REMX	Maximum available water-holding capacity of recharge zone	Inches	0.4	0.4	0.4
IMPERV	Effective impervious area	Decimal	0.00-0.03	0.00	0.00-0.09
FLGTH	Length of overland-flow plane	Feet	257-1917	65-1459	275-764
TYPE	Channel type	3=triangular open channel	3	3	3
FRN	Mannings "n" for channel segments	-	0.05	0.05	9.05

Table 11.--Sensitivity analysis results

[(a) This estimate was obtained using the Precipitation-Runoff Modeling System sensitivity analysis routine. The reported values are joint sensitivities--sensitivities which include uncertainty in related parameters (Leavesley and others, 1983)]

Parameter	Brief description	Estimated value for Deer Creek calibrations		Estimated sensitivity of the general calibration value (a)	Change in average modeled peak discharges obtained using the general calibration value plus the estimated sensitivity, in percent
		General	Peak		
RNSTS	Summer interception storage (inches)	0.562	0.501	+/- 0.3	-1.0
RNSTW	Winter interception storage (inches)	.176	1.17	+/- .3	-1.0
SEP	Ground-water recharge constant	.154	.413	+/- .0122	-.6
RCP	Interflow recession constant	.0668	.18	+/- .0052	+2.7
RCB	Baseflow recession constant	.0196	.0944	+/- .0011	+.07

BENEFITS OF MODELING ADDITIONAL BASINS

The modeling of eight additional basins, as oringinally proposed, wwould expand the data base, thus improving estimates of regional parameter values, and wwould indicate the components in PRMS most critical to the simulation of the rainfall-runoff process in coastal Oregon. The regionalization of model parameter values would allow for the prediction of streamflow effected by forest management practices in gaged and ungaged coastal Oregon basins.

SUMMARY

Modeling of three Alsea Basins--Flynn Creek, Deer Creek, and Needle Branch--has shown that parameters calibrated in one basin can be transferred to the other basins, and that parameters associated with land management, such as interception and infiltration, can be changed to predict post-logging situations. Closeness of fit, as determined by the coefficient of determination, changes little with the transfer of calibrated parameters from one basin to another for daily flow, low flow, and peak flow. Preliminary model calibration simulated post-logging changes in Needle Branch that show an increase in annual discharge volume (13 percent) similar to that observed in published data and that show a small increase of peak flows (1-2 percent).

Observed rainfall, both on an annual basis and for several storm periods, are lower in volume than observed runoff. Without adjustment of the total volume, and without removing obviously erroneous storm periods from calibration, the model becomes biased. Spatial distribution of precipitation on an hourly basis is highly variable and can also bias model results for a particular period or storm event. Coefficients of determination indicate that statistically, close relations can be defined between modeled and observed flows.

For peak flows, coefficients of determination were improved by recalibration (peak-fit calibration) of the model. Primary model parameter values that were changed in recalibration were those associated with subsurface and ground-water flow. Although these were the most sensitive parameters affecting the peak-flow response in the right direction, these might not have been the correct physical parameter values to change. Recalibration of the model, using parameters defined in regionalization using all 11 of the proposed basins, may alter the peak-fit calibration shown in this report.

In this interim study, changes in runoff resulting from various management strategies were equal to or smaller than errors in modeled runoff attained through calibration. For example, simulated discharge for Needle Branch under logged conditions results in a 12.8 percent increase in predicted annual flow volumes. The calibrated model yielded an +11.4 percent error in simulating pre-logging peak volumes. A 12.8 percent post-logging increase is meaningful even though the model has a volume error of +11.4 percent because the post-logging change is compared with modeled pre-logging flows. The accuracy of the management-change scenario is dependent on the accuracy of the model representation of the physical processes involved and the accuracy of model parameter changes; it is not as dependent on the accuracy of input data.

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APPENDIX A

Definitions of Precipitation-Runoff Modeling System parameters

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Definitions of Precipitation-Runoff Modeling System parameters

Parameter	Description
COVDNS	Summer cover density for major vegetation for each hydrologic-response unit (decimal percent)
COVDNW	Winter cover density for major vegetation for each hydrologic-response unit (decimal percent)
DRCOR	Daily precipitation correction factor for rain for each hydrologic-response unit
DRN	Drainage factor for redistribution of saturated moisture storage as a fraction of KSAT -- storm mode
DTM	Routing interval for overland flow or channel segment -- storm mode (minutes)
ELV	Elevation of hydrologic-response unit (feet above MSL)
EVV	Evaporation pan coefficient for months 1-12
FLGTH	Length of overland flow plane or channel segment feet -- storm mode
FRN	Roughness parameter for overland flow plane or channel segment -- storm mode
GSNK	Coefficient to compute seepage from each ground-water reservoir to a ground-water sink
GW	Storage in each ground-water reservoir (acre - inches)
HRU	Hydrologic-response unit
ICOV	Vegetation cover type for each hydrologic-response unit (0=bare,1=grasses, 2=shrubs, 3=trees
IDUS	Data use switch for data types 1-10
IMPERV	Percent impervious area for each hydrologic-response unit (decimal percent)
IPET	Potential evapotranspiration method switch (0=Jensen-Haise, 1=Hamon, 2=use pan data)
IRU	Index for specific hydrologic response unit
ISOIL	Soil type for each hydrologic-response unit (1=sand, 2=loam, 3=clay)

Definitions of Precipitation-Runoff Modeling System parameters--Continued

Parameter	Description
ISSR1	Switch surface runoff method switch (0=linear, 1=nonlinear)
SUN	Switch storm subsurface and ground water routing switch (0=not done, 1=subsurface and ground water included in storm mode computation)
ITND	Month that transpiration ends for each hydrologic-response unit
ITST	Month to begin checking for start of transpiration for each hydrologic-response unit
ITSW	Transpiration switch for each hydrologic-response unit (0=vegetation dormant, 1=vegetation transpiring)
KDS	Index of rain gage associated with each hydrologic-response unit
KGW	Index of ground-water reservoir receiving seepage from each hydrologic-response unit
KRES	Index of subsurface reservoir receiving seepage from each hydrologic-response unit
KRSP	Index of ground-water reservoir receiving seepage from each subsurface reservoir
KSAT	Hydraulic conductivity of transmission zone (inches per hour) -- storm mode
LBC	I.D. of overland flow plane providing lateral inflow to channel segment - storm mode
NCRSEG	Number of channel routing segments -- storm mode
NDS	Number of rain gage data sets
NDTY	Number of data types used in simulation
NDX	Number of intervals to subdivide overland flow planes
NGW	Number of ground-water storage reservoirs
NIRU	Hydrologic-response unit associated with overland flow plane -- storm mode
NOFSEG	Number of overland flow planes -- storm mode

Definitions of Precipitation-Runoff Modeling System parameters--Continued

Parameter	Description
NRES	Number of subsurface storage reservoirs
NRU	Number of hydrologic response units
NS	Number of hydrograph segments in storm period -- storm mode
NSP	Number of storm periods -- storm mode
PARMCA	Five digit code to identify each type of input climate, precipitation and discharge data
PARM1	Kinematic parameter alpha for type = 4 or width of channel for channel type = 1 or 3 -- storm mode
PCRID	Identification characters for overland flow planes, channel and reservoir segments and junctions -- storm mode
PERV	Percent of pervious area on each hydrologic-response unit (decimal)
PSP	Combined effect of moisture deficit and capillary potential (inches) -- storm mode
RBA	Index of overland flow segment to be used as input to channel segment -- storm mode
RBC	Overland flowplane providing lateral inflow to channel segment - - storm mode
RC	Routing coefficient for each ground-water reservoir
RCF	Linear routing coefficient for each subsurface reservoir
RCP	Nonlinear routing coefficient for each subsurface reservoir
RECHR	Storage in upper part of soil profile where losses occur as evaporation and transpiration (inches)
REMX	Maximum value of RECHR for each hydrologic-response unit (inches)
RES	Storage in each subsurface reservoir (acre - inches)
RESMX	Coefficient for routing water from each subsurface reservoir to ground-water reservoir

Definitions of Precipitation-Runoff Modeling System parameters--Continued

Parameter	Description
RETIP	Maximum retention storage on impervious area for each hydrologic-response unit (inches)
REXP	Coefficient for routing water from each subsurface reservoir to ground-water reservoir
RGF	Ratio of combined effects of moisture deficit and capillary potential at wetting front from wilting point to field capacity -- storm mode
RNSTS	Interception storage capacity of unit area of vegetation for rain during summer period, for each hydrologic-response unit (inches)
RNSTW	Interception storage capacity of unit area of vegetation for rain (inches) during winter period, for each hydrologic-response unit
RSEP	Seepage rate from each subsurface reservoir to ground-water reservoir (inches per day)
RSTOR	Retention storage on impervious area for each hydrologic-response unit
SCN	Minimum contributing area for surface runoff when ISSR1=0; coefficient in contributing area -- soil moisture index relation when SSR1=1
SCX	Maximum possible contributing area for surface runoff as proportion of each hydrologic-response unit
SC1	Coefficient in surface runoff contributing area -- soil moisture index relation
SEP	Seepage rate from soil moisture excess to each ground-water reservoir (inches per day)
SMAV	Daily available water in soil profile for each hydrologic-response unit (inches)
SMAX	Maximum available water holding capacity of soil profile for each hydrologic-response unit (inches)
STAIDC	Array of 16 digit station identification numbers for climate data

Definitions of Precipitation-Runoff Modeling System parameters--Continued

Parameter	Description
STAIDP	Array of 16 digit station identification numbers for precipitation data
THRES	Minimum depth of flow for continuation of routing (feet) -- storm mode
TYPE	Type of overland flow plane or channel routing segment -- storm mode
UPCOR	Storm precipitation correction factor for each hydrologic-response unit
UP1	Upstream inflow segment for channel routing segment -- storm mode
UP2	Upstream inflow segment for channel routing segment -- storm mode
UP3	Upstream inflow segment for channel routing segment -- storm mode

APPENDIX B

Input Data for Final Model Calibration

APPENDIX B

Flynn Creek daily pre-calibration model output

PRMS -- VERSION 0888

```
IOPT=   0     ISIM=   2     IOBS=   1     ISEN=   0     PROB=   0
IDOUT=  3     IUOUT=  2     SCODE=OR      IPSW=   0
IPET=   1     ISSR1=  1     MRDC=   2     ISUN=   1     ILPS=   0
NYR=    4     NDS=    1     NRU=   11     NRD=   12     NRES=   2    NGW=   1    NSTOR=   0    DAT=        502.00
NTS=    1     NPLW=         ONDC=   0
BYR/BMO/BDY= 1959/ 7/ 8     EYR/EMO/EDY= 1961/12/31
MFS=  5     MFN=  9
```

DATA TYPE	PARAMETER CODE	STATISTIC CODE	DSN	STATION ID
DAILY DISCHARGE	60	3	10	D000000000000010
DAILY EVAP	0	0	0	
DAILY MAX TEMP	99998	1	41	D000000000000040
DAILY MIN TEMP	99998	2	40	D000000000000040
DAILY SOLAR RAD	0	0	0	
SNOW PILLOW	0	0		
USER VARIABLE 2	0	0	0	
UNIT DISCHARGE	60	11	11	U000000000000011
DAILY PRECIP	45	6	20	D000000000000020
UNIT PRECIP	45	6	21	U000000000000021

POT SOLAR RADIATION

1	HOR	261.3	285.9	328.8	391.1	470.0	559.4	654.1	747.4	832.0	905.0	961.9	1001.3	1023.9
2	S05	517.5	541.4	580.8	634.3	697.0	761.5	822.9	876.4	918.2	949.1	969.3	981.2	987.4
3	SE48	142.0	163.5	202.3	260.6	337.6	428.6	529.1	632.0	729.1	815.9	886.1	935.7	984.9
4	S56	417.9	442.5	484.2	542.4	612.8	688.5	764.2	834.4	893.7	941.6	976.5	999.3	1011.9
5	NW56	184.7	207.3	247.4	306.9	383.9	473.4	570.6	668.5	759.6	839.9	904.0	948.9	975.1
6	E48	155.3	177.6	217.5	277.2	355.5	447.6	548.7	651.7	748.5	834.5	903.8	952.7	981.4
7	NW56	202.8	226.4	267.9	329.2	408.0	499.1	597.4	696.0	787.1	867.0	930.5	974.8	1000.6
8	S40	227.6	251.9	294.4	356.8	436.3	527.6	625.3	722.4	811.5	889.1	950.3	992.8	1017.5
9	E46	241.7	266.0	308.5	370.5	449.3	539.4	635.2	730.1	816.8	891.8	950.8	991.7	1015.3
10	SE64	380.0	404.6	446.4	505.1	576.4	653.6	731.4	804.2	866.3	916.9	954.3	978.9	992.6
11	E42	328.7	353.5	396.1	456.8	532.1	615.6	701.8	784.6	857.7	919.1	966.0	997.6	1015.6
12	E40	385.4	410.0	451.7	510.1	580.8	657.2	734.0	805.4	866.3	915.6	951.8	975.5	988.7

```
RDM(1-12)= -0.13 -0.13 -0.10 -0.08 -0.08 -0.07 -0.07 -0.07 -0.08 -0.08 -0.13 -0.13
RDC(1-12)=  1.83  1.83  1.60  1.46  1.46  1.42  1.42  1.42  1.46  1.46  1.83  1.83
MRDC=  2   PARS=  0.44   PARW=  0.50   RDB=  0.25   RDP=  0.61   RDMX=  0.80   RTB=  1.00   RTC=  1.00   ITSOL=  1
TSOLX(1-12) -   50.0   50.0   50.0   50.0   55.0   60.0   70.0   70.0   60.0   50.0   50.0   50.0
```

SUNLIGHT HOURS/12

1	HOR	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3
2	S05	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1
3	SE48	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2
4	S56	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2
5	NW56	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.1
6	E48	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2
7	NW56	0.6	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2
8	S40	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.2
9	E46	0.6	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.2
10	SE64	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
11	E42	0.7	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2
12	E40	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1

Flynn Creek daily pre-calibration model output--Continued

RMXA= 0.80 RMXM= 0.60 MTSS= 8 MTSE= 9 ARSA= 0.05 ARSM= 0.20
CSEL(1-5)= 50.
MPCS= 0 MPCN= 0 MPC1= 0 PCONR= 1.00 PCONS= 1.00
PCR(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00
PCS(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00
CTS(1-12)= 0.008700 0.013400 0.009200 0.010600 0.010100 0.013900 0.016100 0.015300 0.011700 0.019300 0.013500 0.007300
CTW= 0.50
PAT(1-12)= 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00
AJMX(1-12)= 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
TLX(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
TLN(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
EVC(1-12)= 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750
ISP1= 90 ISP2=120 EAIR= 1.000 FWCAP= 0.05 DENI= 0.20 DENMX= 0.60 SETCON= 0.10 BST= 32.00
CECN(1-12)= 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00

#	RES	RSEP	RESMX	REXP	KRSP	RCF	RCP
1	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0401000
2	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0401000

#	GW	GSNK	RCB
1	2.000	0.000	0.0236

IRU	IRD	ITST	ITSW	TXAJ	RNSTS	SNST	COVDS	ICOV	SMAX	REMX	SCN	SRX	RETIP	SEP	KRES
	ELEV	ITND	CTX	TNAJ	RNSTW	TRNCF	COVDW	ISOIL	SMAV	RECHR	SC1	SCX	IMPRV	KSTOR	KGW
1	2	1	1	0.00	1.00	0.01	0.90	3	4.39	0.40	1.00000	2.00	0.10	0.13	2
	860.	12	0.00	0.00	0.40	1.00	0.70	2	1.00	0.00	1.00000	0.00	0.03	0	1
2	3	4	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	800.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.00	0	1
3	4	4	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	800.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.00	0	1
4	5	4	1	0.00	1.00	0.01	0.90	3	4.39	0.40	1.00000	2.00	0.10	0.13	2
	880.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.00	0	1
5	6	1	1	0.00	1.00	0.01	0.90	3	4.39	0.40	1.00000	2.00	0.10	0.13	2
	940.	12	0.00	0.00	0.40	1.00	0.70	2	1.00	0.00	1.00000	0.00	0.00	0	1
6	7	1	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	700.	12	0.00	0.00	0.40	1.00	0.70	2	1.00	0.00	1.00000	0.00	0.00	0	1
7	8	4	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	860.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.00	0	1
8	9	4	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	840.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.00	0	1
9	10	4	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	1240.	11	0.00	0.00	0.40	1.00	0.40	2	1.00	0.00	1.00000	0.00	0.03	0	1
10	11	1	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	800.	12	0.00	0.00	0.40	1.00	0.70	2	1.00	0.00	1.00000	0.00	0.00	0	1
11	12	1	1	0.00	1.00	0.01	0.90	3	6.17	0.40	1.00000	2.00	0.10	0.13	1
	1040.	12	0.00	0.00	0.40	1.00	0.70	2	1.00	0.00	1.00000	0.00	0.00	0	1

Flynn Creek daily pre-calibration model output--Continued

IRU	IDS	SLOPE	AREA	PERV AREA	IMPERV AREA	UPCOR	DRCOR	DSCOR	TST	KTS	KSP	KDC	AIMX	PKFAC
1	1	0.40	61.7	59.8	1.9	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
2	1	0.40	36.7	36.7	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
3	1	0.26	45.8	45.8	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
4	1	0.40	52.4	52.4	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
5	1	0.33	14.1	14.1	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
6	1	0.26	39.8	39.8	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
7	1	0.13	33.7	33.7	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
8	1	0.17	56.8	56.8	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
9	1	0.47	76.9	74.6	2.3	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
10	1	0.24	55.7	55.7	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
11	1	0.50	28.4	28.4	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00

TOTAL			502.0	497.8	4.2									

```
1BYR= 1959 BMO=    7 BDY=    8
 NSP=    6
   1  11960112319601126  NE= 16
 INV=1959
 INV=1960
   2  11961 2 91961 216  NE= 16
   3  11961 3 51961 3 7  NE= 16
   4  11961 3121961 315  NE= 16
   5  11961112119611123  NE= 16
 INV=1961
   6  11961121819611222  NE= 16
 INV=1962
```

STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)

IRU	KSAT	PSP	RGF	DRN
1	20.000	0.010	50.000	2.000
2	20.000	0.010	50.000	2.000
3	20.000	0.010	50.000	2.000
4	20.000	0.010	50.000	2.000
5	20.000	0.010	50.000	2.000
6	20.000	0.010	50.000	2.000
7	20.000	0.010	50.000	2.000
8	20.000	0.010	50.000	2.000
9	20.000	0.010	50.000	2.000
10	20.000	0.010	50.000	2.000
11	20.000	0.010	50.000	2.000

Flynn Creek daily pre-calibration model output--Continued

WY	WYD	#HS	ST#	RFL	SFL	BEGIN AND END TIMES FOR #HS
1961	54	1	1	0	1	0.1440.
1961	55	1	1	1	1	0.1440.
1961	56	1	1	1	1	0.1440.
1961	57	1	1	1	0	0.1440.
1961	132	1	2	0	1	0.1440.
1961	133	1	2	1	1	0.1440.
1961	134	1	2	1	1	0.1440.
1961	135	1	2	1	1	0.1440.
1961	136	1	2	1	1	0.1440.
1961	137	1	2	1	1	0.1440.
1961	138	1	2	1	1	0.1440.
1961	139	1	2	1	0	0.1440.
1961	156	1	3	0	1	0.1440.
1961	157	1	3	1	1	0.1440.
1961	158	1	3	1	0	0.1440.
1961	163	1	4	0	1	0.1440.
1961	164	1	4	1	1	0.1440.
1961	165	1	4	1	1	0.1440.
1961	166	1	4	1	0	0.1440.
1962	52	1	5	0	1	0.1440.
1962	53	1	5	1	1	0.1440.
1962	54	1	5	1	0	0.1440.
1962	79	1	6	0	1	0.1440.
1962	80	1	6	1	1	0.1440.
1962	81	1	6	1	1	0.1440.
1962	82	1	6	1	1	0.1440.
1962	83	1	6	1	0	0.1440.

NUMBER OF OVERLAND FLOW PLANE SEGMENTS IS 23. THEIR CHARACTERISTICS ARE AS FOLLOWS:

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	OF1	1	9	0.0000	99	0	0	1	615.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
2	OF2	1	9	0.0000	99	0	0	1	800.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
3	OF3	1	9	0.0000	99	0	0	1	634.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
4	OF4	1	9	0.0000	99	0	0	1	1176.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
5	OF5	1	1	0.0000	99	0	0	1	661.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
6	OF6	1	1	0.0000	99	0	0	1	572.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
7	OF7	1	1	0.0000	99	0	0	1	436.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
8	OF8	1	1	0.0000	99	0	0	1	404.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
9	OF9	1	11	0.0000	99	0	0	1	1917.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
10	OF10	1	11	0.0000	99	0	0	1	1568.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
11	OF11	1	5	0.0000	99	0	0	1	439.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
12	OF12	1	10	0.0000	99	0	0	1	313.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
13	OF13	1	10	0.0000	99	0	0	1	257.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
14	OF14	1	10	0.0000	99	0	0	1	370.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
15	OF15	1	10	0.0000	99	0	0	1	569.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
16	OF16	1	8	0.0000	99	0	0	1	1302.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
17	OF17	1	4	0.0000	99	0	0	1	895.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
18	OF18	1	4	0.0000	99	0	0	1	1612.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
19	OF19	1	4	0.0000	99	0	0	1	467.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
20	OF20	1	7	0.0000	99	0	0	1	773.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
21	OF21	1	6	0.0000	99	0	0	1	1238.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
22	OF22	1	3	0.0000	99	0	0	1	767.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
23	OF23	1	2	0.0000	99	0	0	1	615.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0

Flynn Creek daily pre-calibration model output--Continued

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	CH1			OF2	OF1	26.0	26.0	0.10	3	0	0	3	800.0	.2400	.050	10.00	10.00	4.25	1.33	60.0	60.0
2	CH2	CH1			OF5	16.7	42.7	0.10	3	0	0	3	1100.0	.4400	.050	10.00	10.00	5.75	1.33	60.0	60.0
3	CH3	CH2		OF12	OF6	32.5	75.2	0.10	3	0	0	3	1600.0	.0700	.050	10.00	10.00	2.29	1.33	60.0	60.0
4	CH4			OF8	OF11	27.1	27.1	0.10	3	0	0	3	1400.0	.2200	.050	10.00	10.00	4.06	1.33	60.0	60.0
5	CH5	CH4		OF7	OF17	33.6	60.7	0.10	3	0	0	3	1100.0	.1100	.050	10.00	10.00	2.87	1.33	60.0	60.0
6	CH6	CH5	CH3			0.0	135.9	0.10	3	0	0	3	500.0	.0400	.050	10.00	10.00	1.73	1.33	60.0	60.0
7	CH7				OF9	17.6	17.6	0.10	3	0	0	3	400.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
8	CH8	CH7		OF14	OF13	25.9	43.5	0.10	3	0	0	3	1800.0	.2500	.050	10.00	10.00	4.33	1.33	60.0	60.0
9	CH9	CH8	CH6		OF18	14.8	194.2	0.10	3	0	0	3	400.0	.0400	.050	10.00	10.00	1.73	1.33	60.0	60.0
10	CH10				OF3	13.1	13.1	0.10	3	0	0	3	900.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
11	CH11	CH10			OF10	10.8	23.9	0.10	3	0	0	3	300.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
12	CH12	CH11			OF15	18.3	42.2	0.10	3	0	0	3	1400.0	.3300	.050	10.00	10.00	4.98	1.33	60.0	60.0
13	CH13	CH12	CH9			0.0	236.4	0.10	3	0	0	3	600.0	.0400	.050	10.00	10.00	1.73	1.33	60.0	60.0
14	CH14				OF4	37.8	37.8	0.10	3	0	0	3	1400.0	.4800	.050	10.00	10.00	6.00	1.33	60.0	60.0
15	CH15	CH14		OF20	OF16	90.5	128.3	0.10	3	0	0	3	1900.0	.1200	.050	10.00	10.00	3.00	1.33	60.0	60.0
16	CH16	CH15	CH13	OF21	OF19	54.8	419.5	0.10	3	0	0	3	1400.0	.0700	.050	10.00	10.00	2.29	1.33	60.0	60.0
17	CH17			OF22	OF23	82.5	82.5	0.10	3	0	0	3	2600.0	.1200	.050	10.00	10.00	3.00	1.33	60.0	60.0
18	CH18	CH17	CH16			0.0	502.0	0.10	3	0	3	3	700.0	.0600	.050	10.00	10.00	2.12	1.33	60.0	60.0

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	1.80	1.34	2.50	1.72	2.90	2.95	3.20	3.79	8.80	9.92	3.20	3.08
2	1.60	1.23	2.40	1.59	2.80	2.81	3.00	3.50	11.00	11.51	3.20	3.14
3	1.40	1.14	2.60	1.94	2.60	2.86	2.80	3.17	10.00	11.17	4.10	4.83
4	1.40	1.06	2.30	1.97	2.40	2.64	2.60	2.90	10.00	11.46	6.70	6.92
5	1.30	0.98	2.10	1.81	2.30	2.40	2.50	2.68	13.00	11.99	8.50	7.63
6	1.20	0.92	2.00	1.66	2.30	2.32	2.50	2.55	18.00	17.23	8.90	7.11
7	1.20	0.94	1.90	1.54	2.20	2.14	2.50	2.58	28.00	21.96	8.90	7.60
8	2.30	1.87	1.80	1.42	2.10	1.98	3.60	3.51	25.00	27.45	11.00	9.49
9	2.80	2.27	1.80	1.33	2.00	1.96	3.50	3.90	39.00	34.57	12.00	9.61
10	2.80	3.16	1.70	1.24	2.00	2.40	3.50	3.72	34.00	29.71	11.00	8.10
11	6.10	5.05	1.70	1.16	3.60	5.20	3.60	3.81	21.00	20.34	9.80	6.85
12	5.70	5.36	1.60	1.10	8.10	8.99	3.40	3.69	16.00	18.90	8.40	6.08
13	4.70	4.51	1.60	1.03	7.80	9.00	3.40	3.50	14.00	18.69	7.20	5.87
14	3.90	3.86	1.40	0.98	7.20	10.12	3.40	3.44	13.00	19.43	6.20	6.13
15	3.30	3.34	1.40	0.92	8.80	11.74	3.30	3.51	17.00	18.72	7.10	6.84
16	2.90	2.93	1.40	0.88	9.40	10.19	4.10	4.58	16.00	14.55	7.20	6.65
17	2.50	2.60	1.40	0.85	8.30	8.29	6.70	6.70	13.00	11.36	6.90	5.77
18	2.30	2.32	1.80	1.40	7.00	7.48	8.00	7.01	11.00	9.25	6.40	5.09
19	2.30	2.19	1.60	1.60	6.00	6.71	7.30	5.95	8.50	7.71	5.70	4.55
20	2.20	1.90	1.80	2.59	5.30	5.93	6.40	5.15	7.10	6.84	5.10	4.11
21	2.10	2.08	2.30	3.18	4.70	5.21	5.70	5.54	6.40	6.12	4.60	3.75
22	5.10	3.85	4.60	6.27	4.30	4.53	5.20	6.22	5.60	5.37	4.10	3.45
23	6.40	4.93	8.40	8.93	4.10	4.90	5.00	6.31	4.90	4.80	3.80	3.19
24	5.50	4.27	6.90	7.68	4.40	6.29	4.60	5.71	4.50	4.36	3.40	2.97
25	4.90	3.64	5.70	6.26	4.70	6.73	4.40	4.97	4.40	4.38	3.20	2.78
26	4.40	3.18	4.90	5.23	4.90	5.88	4.50	4.56	4.00	4.22	3.10	2.68
27	4.00	2.83	4.20	4.45	4.60	5.06	4.90	4.50	3.70	3.86	3.00	2.66
28	3.70	2.55	3.90	4.17	4.30	4.43	6.70	7.14	3.50	3.55	3.10	3.25
29	3.20	2.27	3.40	3.77	4.00	3.92	12.00	9.91	3.40	3.30	6.50	6.28
30	3.00	2.06	3.10	3.32	3.90	4.16	12.00	9.26	0.00	0.00	10.00	10.80
31	2.70	1.88	0.00	0.00	3.50	4.14	9.90	7.74	0.00	0.00	15.00	13.34

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	15.00	12.93	3.50	3.13	3.20	2.82	0.76	0.85	0.40	0.38	0.27	0.19
2	13.00	10.59	3.20	2.86	2.90	2.63	0.73	0.82	0.38	0.37	0.25	0.18
3	11.00	8.55	3.20	2.79	2.80	2.47	0.73	0.80	0.36	0.36	0.23	0.18
4	8.90	7.11	3.00	2.59	2.50	2.33	0.70	0.78	0.36	0.35	0.27	0.17
5	7.40	6.05	2.80	2.43	2.30	2.20	0.70	0.76	0.33	0.35	0.25	0.17
6	6.20	5.24	3.20	3.19	2.10	2.09	0.64	0.74	0.33	0.34	0.23	0.17
7	5.30	4.61	3.30	3.71	2.00	1.99	0.64	0.72	0.31	0.33	0.23	0.16
8	4.70	4.11	3.20	3.46	1.90	1.89	0.61	0.70	0.31	0.32	0.22	0.16
9	4.10	3.71	3.20	3.17	1.80	1.81	0.61	0.68	0.31	0.31	0.22	0.15
10	3.80	3.41	3.10	2.95	1.70	1.73	0.58	0.66	0.31	0.31	0.22	0.15
11	3.70	3.14	3.20	2.84	1.60	1.66	0.58	0.65	0.31	0.30	0.22	0.15
12	3.60	2.99	3.20	3.33	1.60	1.59	0.58	0.63	0.29	0.29	0.22	0.14
13	3.70	3.51	4.50	4.39	1.50	1.53	0.58	0.61	0.27	0.29	0.22	0.14
14	4.60	5.21	4.80	4.52	1.60	1.56	0.58	0.60	0.27	0.28	0.20	0.14
15	6.10	6.11	4.80	4.68	1.50	1.41	0.55	0.58	0.29	0.27	0.20	0.14
16	6.00	5.52	5.30	4.62	1.50	1.40	0.52	0.57	0.27	0.27	0.18	0.13
17	5.70	5.02	6.80	6.07	1.30	1.32	0.50	0.55	0.27	0.26	0.18	0.13
18	6.40	6.43	7.70	6.85	1.30	1.27	0.47	0.54	0.25	0.26	0.18	0.13
19	7.70	8.20	7.40	6.95	1.30	1.25	0.47	0.53	0.25	0.25	0.22	0.12
20	12.00	9.66	11.00	8.95	1.20	1.19	0.45	0.51	0.23	0.24	0.20	0.12
21	13.00	9.85	11.00	9.81	1.10	1.15	0.45	0.50	0.36	0.33	0.18	0.12
22	11.00	8.27	11.00	8.50	1.10	1.11	0.45	0.49	0.45	0.24	0.16	0.12
23	9.20	6.91	9.40	7.13	1.00	1.08	0.42	0.48	0.70	0.43	0.20	0.11
24	7.70	5.92	8.00	6.15	0.99	1.04	0.42	0.46	0.64	0.22	0.18	0.11
25	6.70	5.46	6.80	5.47	0.91	1.01	0.42	0.45	0.42	0.22	0.18	0.11
26	6.00	4.96	5.80	4.84	0.91	0.98	0.42	0.44	0.36	0.21	0.16	0.11
27	5.20	4.47	5.20	4.33	0.87	0.95	0.40	0.43	0.31	0.21	0.15	0.10
28	4.60	3.99	4.60	3.91	0.87	0.93	0.40	0.42	0.29	0.20	0.15	0.10
29	4.10	3.62	4.00	3.57	0.83	0.90	0.38	0.41	0.29	0.20	0.14	0.10
30	3.80	3.31	3.70	3.28	0.79	0.87	0.38	0.40	0.27	0.19	0.14	0.10
31	0.00	0.00	3.40	3.03	0.00	0.00	0.40	0.39	0.31	0.19	0.00	0.00

SUMMARY STATISTICS FOR WATER YEAR 1959

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.00	0.00	0.00	0.00	0	0	0
NOV	0.00	0.00	0.00	0.00	0	0	0
DEC	0.00	0.00	0.00	0.00	0	0	0
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.57	0.78	13.68	18.62	0	24	7
AUG	0.31	0.41	9.48	12.71	2	29	4
SEP	1.41	0.53	42.25	15.85	27	3	2
YEAR	0.77	0.56	65.41	47.18	29	56	15
MFS-MFN	0.77	0.56	65.41	47.18	29	56	6

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Flynn Creek daily pre-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1960

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	3.18	2.66	98.70	82.53	26	5	5
NOV	2.81	2.73	84.20	81.99	19	11	2
DEC	4.60	5.27	142.50	163.39	5	26	7
JAN	4.97	4.89	154.20	151.52	9	22	8
FEB	12.89	12.85	373.80	372.72	17	12	8
MAR	6.69	5.83	207.30	180.60	27	4	7
APR	7.01	5.96	210.20	178.87	26	4	5
MAY	5.27	4.63	163.30	143.50	28	3	5
JUN	1.57	1.54	46.97	46.15	15	15	8
JUL	0.53	0.59	16.52	18.15	1	30	2
AUG	0.34	0.28	10.50	8.79	20	11	11
SEP	0.20	0.14	6.05	4.11	30	0	1
YEAR	4.14	3.91	1514.24	1432.32	223	143	59
MFS-MFN	1.59	1.44	243.34	220.69	94	59	23

SUMMARY STATISTICS FOR WATER YEAR 1961

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.56	0.17	17.49	5.24	30	1	3
NOV	11.25	8.83	337.58	264.85	22	8	6
DEC	4.44	4.79	137.70	148.38	16	15	6
JAN	7.47	7.19	231.50	223.01	23	8	7
FEB	19.15	17.45	536.20	488.71	19	9	10
MAR	14.46	13.49	448.20	418.16	22	9	9
APR	3.52	3.25	105.70	97.63	25	5	3
MAY	2.82	2.14	87.50	66.40	31	0	1
JUN	0.92	0.72	27.75	21.64	30	0	1
JUL	0.40	0.32	12.39	10.06	31	0	1
AUG	0.23	0.16	7.27	4.99	31	0	1
SEP	0.26	0.08	7.92	2.53	30	0	1
YEAR	5.36	4.80	1957.20	1751.60	310	55	39
MFS-MFN	0.93	0.69	142.83	105.62	153	0	1

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

SUMMARY STATISTICS FOR WATER YEAR 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.92	0.24	28.48	7.46	31	0	1
NOV	3.89	4.43	116.59	132.92	4	26	6
DEC	9.61	10.18	298.00	315.62	9	22	6
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.00	0.00	0.00	0.00	0	0	0
AUG	0.00	0.00	0.00	0.00	0	0	0
SEP	0.00	0.00	0.00	0.00	0	0	0
YEAR	4.82	4.96	443.07	456.01	44	48	11
MFS-MFN	0.00	0.00	0.00	0.00	0	0	1

SUMMARY STATISTICS FOR OPTIMIZATION PERIOD 1959 TO 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
TOTAL	4.38	4.06	3979.91	3687.10	606	302	249
MFS-MFN	1.15	0.96	451.58	373.49	276	115	28

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

VERIFICATION CRITERIA

	DAILY		MONTHLY	
	TOTAL	MFS-MFN	TOTAL	MFS-MFN
COEFFICIENT OF DETERMINATION	0.937	0.878	0.985	0.948
(LOGS)	0.942	0.896		
COEFFICIENT OF PERSISTENCE	-11.603	-16.515		
COEFFICIENT OF GAIN FROM DAILY AVERAGES	0.917	0.591		
RESIDUAL-PREDICTED CORRELATION	-0.218	0.107		

ERROR SUMMARY (MFS-MFN PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	78.09	27.58	101.22	41.63	135.53	10.48
MEAN	0.20	0.07	0.26	0.11	0.35	0.03
PERCENT	17.29		22.41		50.98	

ERROR SUMMARY (TOTAL PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	292.80	67.47	676.77	123.84	2435.94	41.81
MEAN	0.32	0.07	0.75	0.14	2.68	0.05
PERCENT	7.36		17.00		37.37	

STORM	PREDICTED VOLUME (INCHES)	ROUTED OUTFLOW (INCHES)	OBSERVED OUTFLOW (INCHES)	PREDICTED PEAK (CFS)	OBSERVED PEAK (CFS)
1	4.97	5.40	6.78	47.34	74.80
2	10.84	11.79	13.05	46.80	62.60
3	2.56	2.78	2.96	24.18	25.80
4	3.47	3.78	4.44	23.35	33.00
5	1.88	2.03	2.38	23.75	45.80
6	5.51	5.99	6.30	41.17	42.80
MEAN	4.87	5.30	5.99	34.43	47.47
LOGS	1.42	1.50	1.63	3.49	3.80

STORM VOLUME ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	6.68	1.26	10.13	0.29
MEAN	1.11	0.21	1.69	0.05
PERCENT	18.60		21.70	

STORM PEAK ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	78.22	1.85	1588.36	0.85
MEAN	13.04	0.31	264.73	0.14
PERCENT	27.46		34.28	

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1 - NUMBER OF PRECIPITATION GAGES
1 - NUMBER OF SEGMENTS SAVED FOR PLTGEN
1 - NUMBER OF SEGMENTS SAVED FOR PRINT, PLOT, AND PLTGEN
3 - NUMBER OF CURVES OUTPUT TO PLTGEN FILE(S)
0 - NUMBER OF PLTGEN SEGMENTS SKIPPED
3    0 NC1, NC2

TIME0 1960   11   23    0    0
TIMEN 1960   11   26   24    0
LAPSED TIME     5761
CH18   5   2          INCDT  240          MAXRD   24
KOUNT    3            KSKIP    0          INC   24    24    24
INC    1    1    1
```

Needle Branch daily pre-calibration model output

```
  PRMS -- VERSION 0888

 IOPT=    0     ISIM=    2     IOBS=    1     ISEN=    0     PROB=    0
 IDOUT=   3     IUOUT=   2     SCODE=OR     IPSW=    0
 IPET=    1     ISSR1=   1     MRDC=    2     ISUN=    1     ILPS=    0
 NYR=     4     NDS=     1     NRU=     7     NRD=     8     NRES=   3    NGW=    1    NSTOR=   0    DAT=        174.60
 NTS=     1     NPLW=    ONDC=    0
 BYR/BMO/BDY= 1959/ 7/ 8     EYR/EMO/EDY= 1961/12/31
 MFS=  5     MFN=  9

  DATA TYPE      PARAMETER STATISTIC          STATION ID
                    CODE      CODE     DSN
DAILY DISCHARGE      60         3       10     D000000000000010
DAILY EVAP            0         0        0
DAILY MAX TEMP    99998         1       41     D000000000000040
DAILY MIN TEMP    99998         2       40     D000000000000040
DAILY SOLAR RAD       0         0        0
SNOW PILLOW           0         0
USER VARIABLE 2       0         0        0
UNIT DISCHARGE       60        11       11     U000000000000011
DAILY PRECIP         45         6       20     D000000000000020
UNIT PRECIP          45         6       21     U000000000000021

 POT SOLAR RADIATION
     1      HOR        261.3   285.9   328.8   391.1   470.0   559.4   654.1   747.4   832.0   905.0   961.9  1001.3  1023.9
     2      SW05       293.6   318.4   361.2   422.9   500.2   587.1   678.2   767.0   846.6   914.6   967.2  1003.2  1023.8
     3      SW67       471.7   495.6   535.6   590.2   654.3   720.9   784.6   840.8   885.3   918.7   941.1   954.6   961.5
     4      NW40        33.5    50.3    83.5   137.5   213.3   308.2   417.9   535.1   650.3   756.6   845.4   910.0   948.2
     5       W69       286.4   309.9   350.5   408.4   480.4   560.6   643.7   724.0   795.1   855.2   901.2   932.4   950.2
     6      SE53       492.9   516.9   556.9   611.5   675.5   741.8   805.1   860.7   904.5   937.2   958.9   971.9   978.6
     7       E36       273.2   297.4   339.4   400.1   476.3   562.2   652.4   740.7   820.1   888.1   940.8   977.0   997.8
     8      SW24       383.6   408.4   450.6   510.0   582.6   661.5   741.5   816.8   881.7   934.9   974.5  1000.8  1015.5

 RDM(1-12)= -0.13 -0.13 -0.10 -0.08 -0.08 -0.07 -0.07 -0.07 -0.08 -0.08 -0.13 -0.13
 RDC(1-12)=  1.83  1.83  1.60  1.46  1.46  1.42  1.42  1.42  1.46  1.46  1.83  1.83
 MRDC=  2   PARS=  0.44   PARW=  0.50   RDB=  0.25   RDP=  0.61   RDMX=  0.80   RTB=  1.00   RTC=  1.00   ITSOL=  1
 TSOLX(1-12) -    50.0     50.0     50.0     50.0     55.0     60.0     70.0     70.0     60.0     50.0     50.0     50.0

 SUNLIGHT HOURS/12
     1      HOR          0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.1      1.1      1.2      1.2      1.3      1.3
     2      SW05         0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1      1.2      1.2      1.2      1.3
     3      SW67         0.6      0.6      0.7      0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.0      1.0
     4      NW40         0.4      0.5      0.5      0.6      0.7      0.8      0.9      1.0      1.0      1.1      1.2      1.3      1.3
     5       W69         0.5      0.5      0.6      0.6      0.7      0.7      0.8      0.8      0.9      0.9      0.9      1.0      1.0
     6      SE53         0.7      0.7      0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.0      1.1      1.1
     7       E36         0.6      0.6      0.6      0.7      0.7      0.8      0.9      0.9      1.0      1.0      1.1      1.1      1.1
     8      SW24         0.7      0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1      1.1      1.2      1.2
```

Needle Branch daily pre-calibration model output--Continued

RMXA= 0.80 RMXM= 0.60 MTSS= 8 MTSE= 9 ARSA= 0.05 ARSM= 0.20
CSEL(1-5)= 50.
MPCS= 0 MPCN= 0 MPC1= 0 PCONR= 1.00 PCONS= 1.00
PCR(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00
PCS(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00
CTS(1-12)= 0.007200 0.011000 0.007600 0.008700 0.008300 0.011500 0.013300 0.012600 0.009600 0.015900 0.011100 0.006000
CTW= 0.50
PAT(1-12)= 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00
AJMX(1-12)= 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
TLX(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
TLN(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
EVC(1-12)= 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750
ISP1= 90 ISP2=120 EAIR= 1.000 FWCAP= 0.05 DENI= 0.20 DENMX= 0.60 SETCON= 0.10 BST= 32.00
CECN(1-12)= 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00

#	RES	RSEP	RESMX	REXP	KRSP	RCF	RCP
1	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0931000
2	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0931000
3	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0931000

#	GW	GSNK	RCB
1	2.000	0.000	0.0232

IRU	IRD	ITST	ITSW	TXAJ	RNSTS	SNST	COVDS	ICOV	SMAX	REMX	SCN	SRX	RETIP	SEP	KRES
	ELEV	ITND	CTX	TNAJ	RNSTW	TRNCF	COVDW	ISOIL	SMAV	RECHR	SC1	SCX	IMPRV	KSTOR	KGW
1	2	1	1	0.00	0.59	0.01	0.90	3	12.00	0.40	0.00000	2.00	0.10	0.12	1
	450.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.31200	0.00	0.00	0	1
2	3	1	1	0.00	0.59	0.01	0.50	3	6.40	0.40	0.00000	2.00	0.10	0.12	2
	840.	12	0.00	0.00	0.18	1.00	0.50	2	1.00	0.00	0.31200	0.00	0.09	0	1
3	4	1	1	0.00	0.59	0.01	0.90	3	4.00	0.40	0.00000	2.00	0.10	0.12	3
	640.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.31200	0.00	0.00	0	1
4	5	1	1	0.00	0.59	0.01	1.00	3	6.40	0.40	0.00000	2.00	0.10	0.12	2
	600.	12	0.00	0.00	0.18	1.00	0.87	2	1.00	0.00	0.31200	0.00	0.00	0	1
5	6	1	1	0.00	0.59	0.01	1.00	3	4.00	0.40	0.00000	2.00	0.10	0.12	3
	900.	12	0.00	0.00	0.18	1.00	0.87	2	1.00	0.00	0.31200	0.00	0.00	0	1
6	7	1	1	0.00	0.59	0.01	1.00	3	4.00	0.40	0.00000	2.00	0.10	0.12	3
	700.	12	0.00	0.00	0.18	1.00	0.87	2	1.00	0.00	0.31200	0.00	0.00	0	1
7	8	1	1	0.00	0.59	0.01	1.00	3	4.00	0.40	0.00000	2.00	0.10	0.12	3
	680.	12	0.00	0.00	0.18	1.00	0.87	2	1.00	0.00	0.31200	0.00	0.00	0	1

IRU	IDS	SLOPE	AREA	PERV AREA	IMPERV AREA	UPCOR	DRCOR	DSCOR	TST	KTS	KSP	KDC	AIMX	PKFAC
1	1	0.05	11.5	11.5	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
2	1	0.67	22.8	20.7	2.1	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
3	1	0.40	10.1	10.1	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
4	1	0.69	19.9	19.9	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
5	1	0.53	26.6	26.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
6	1	0.36	59.9	59.9	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
7	1	0.24	23.8	23.8	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
TOTAL			174.6	172.5	2.1									

Needle Branch daily pre-calibration model output--Continued

```
1BYR= 1959 BMO=    7 BDY=    8
 NSP=    6
   1  11960112319601126  NE= 16
 INV=1959
 INV=1960
   2  11961 2 91961 216  NE= 16
   3  11961 3 51961 3 7  NE= 16
   4  11961 3121961 315  NE= 16
   5  11961112119611123  NE= 16
 INV=1961
   6  11961121819611222  NE= 16
 INV=1962

 STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)
 IRU   KSAT   PSP    RGF    DRN
   1 20.000  0.010 50.000  2.000
   2 20.000  0.010 50.000  2.000
   3 20.000  0.010 50.000  2.000
   4 20.000  0.010 50.000  2.000
   5 20.000  0.010 50.000  2.000
   6 20.000  0.010 50.000  2.000
   7 20.000  0.010 50.000  2.000

   WY  WYD  #HS  ST#  RFL  SFL  BEGIN AND END TIMES FOR #HS
  1961   54    1    1    0    1   0.1440.
  1961   55    1    1    1    1   0.1440.
  1961   56    1    1    1    1   0.1440.
  1961   57    1    1    1    0   0.1440.
  1961  132    1    2    0    1   0.1440.
  1961  133    1    2    1    1   0.1440.
  1961  134    1    2    1    1   0.1440.
  1961  135    1    2    1    1   0.1440.
  1961  136    1    2    1    1   0.1440.
  1961  137    1    2    1    1   0.1440.
  1961  138    1    2    1    1   0.1440.
  1961  139    1    2    1    0   0.1440.
  1961  156    1    3    0    1   0.1440.
  1961  157    1    3    1    1   0.1440.
  1961  158    1    3    1    0   0.1440.
  1961  163    1    4    0    1   0.1440.
  1961  164    1    4    1    1   0.1440.
  1961  165    1    4    1    1   0.1440.
  1961  166    1    4    1    0   0.1440.
  1962   52    1    5    0    1   0.1440.
  1962   53    1    5    1    1   0.1440.
  1962   54    1    5    1    0   0.1440.
  1962   79    1    6    0    1   0.1440.
  1962   80    1    6    1    1   0.1440.
  1962   81    1    6    1    1   0.1440.
  1962   82    1    6    1    1   0.1440.
  1962   83    1    6    1    0   0.1440.
```

Needle Branch daily pre-calibration model output--Continued

NUMBER OF OVERLAND FLOW PLANE SEGMENTS IS 14. THEIR CHARACTERISTICS ARE AS FOLLOWS:

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	OF1	1	5	0.0000	99	0	0	1	582.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
2	OF2	1	5	0.0000	99	0	0	1	442.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
3	OF3	1	5	0.0000	99	0	0	1	548.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
4	OF4	1	2	0.0000	99	0	0	1	764.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
5	OF5	1	7	0.0000	99	0	0	1	275.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
6	OF6	1	7	0.0000	99	0	0	1	523.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
7	OF7	1	3	0.0000	99	0	0	1	338.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
8	OF8	1	6	0.0000	99	0	0	1	493.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
9	OF9	1	6	0.0000	99	0	0	1	376.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
10	OF10	1	6	0.0000	99	0	0	1	346.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
11	OF11	1	6	0.0000	99	0	0	1	417.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
12	OF12	1	4	0.0000	99	0	0	1	408.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
13	OF13	1	4	0.0000	99	0	0	1	318.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
14	OF14	1	1	0.0000	99	0	0	1	295.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0

NUMBER OF CHANNEL AND RESERVOIR SEGMENTS IS 9

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	CH1			OF1		10.7	10.7	0.10	3	0	0	3	800.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
2	CH2	CH1		OF5	OF4	31.0	41.7	0.10	3	0	0	3	1300.0	.1100	.050	10.00	10.00	2.87	1.33	60.0	60.0
3	CH3			OF3	OF2	15.9	15.9	0.10	3	0	0	3	700.0	.3200	.050	10.00	10.00	4.90	1.33	60.0	60.0
4	CH4	CH3				0.0	15.9	0.10	3	0	0	3	600.0	.2400	.050	10.00	10.00	4.25	1.33	60.0	60.0
5	CH5	CH4	CH2	OF6	OF7	25.7	83.3	0.10	3	0	0	3	1300.0	.0600	.050	10.00	10.00	2.12	1.33	60.0	60.0
6	CH6			OF9	OF8	31.9	31.9	0.10	3	0	0	3	1600.0	.3600	.050	10.00	10.00	5.20	1.33	60.0	60.0
7	CH7	CH6	CH5		OF12	7.5	122.7	0.10	3	0	0	3	800.0	.0700	.050	10.00	10.00	2.29	1.33	60.0	60.0
8	CH8			OF11	OF10	28.0	28.0	0.10	3	0	0	3	1600.0	.3300	.050	10.00	10.00	4.98	1.33	60.0	60.0
9	CH9	CH8	CH7	OF14	OF13	23.9	174.7	0.10	3	0	3	3	1700.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0

APPENDIX B--Continued

Needle Branch daily pre-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	0.84	1.01	0.95	0.49	1.20	0.84	1.00	1.15	2.80	3.90	0.75	0.83
2	0.74	0.84	0.88	0.45	1.10	0.87	0.93	1.02	4.90	4.57	0.75	0.87
3	0.65	0.72	1.20	0.53	0.99	0.99	0.84	0.90	3.90	4.22	1.20	1.81
4	0.59	0.62	0.91	0.47	0.95	0.90	0.81	0.81	3.80	4.27	2.80	3.01
5	0.56	0.54	0.88	0.43	0.88	0.78	0.75	0.74	5.30	4.47	3.50	3.24
6	0.53	0.48	0.81	0.39	0.84	0.75	0.78	0.70	6.00	7.17	3.00	2.78
7	0.56	0.47	0.77	0.36	0.81	0.69	0.75	0.68	8.70	9.07	2.70	2.96
8	1.30	1.24	0.71	0.33	0.77	0.62	1.40	1.17	7.60	11.29	3.30	3.90
9	2.00	1.69	0.68	0.31	0.71	0.62	1.40	1.46	18.00	13.95	3.40	3.77
10	1.80	2.07	0.65	0.29	0.71	0.86	1.20	1.33	11.00	10.46	2.90	2.86
11	3.70	3.07	0.62	0.27	1.60	2.47	1.20	1.38	5.50	6.02	2.40	2.21
12	2.90	2.86	0.59	0.26	3.00	4.50	1.20	1.31	3.90	5.85	1.90	1.89
13	2.30	2.05	0.56	0.25	2.70	4.02	1.20	1.20	3.40	6.04	1.60	1.85
14	1.80	1.56	0.53	0.23	2.50	4.35	1.20	1.18	3.80	6.65	1.40	2.04
15	1.50	1.23	0.50	0.22	3.80	4.93	1.20	1.22	5.60	6.33	2.60	2.44
16	1.20	1.01	0.47	0.21	3.60	3.82	1.60	1.96	4.60	4.43	2.70	2.33
17	1.10	0.84	0.47	0.21	2.80	2.78	3.00	3.04	3.30	3.16	2.20	1.87
18	0.91	0.72	0.80	0.48	2.20	2.44	3.20	2.90	2.50	2.46	1.80	1.57
19	1.00	0.67	0.62	0.60	1.80	2.12	3.10	2.19	1.90	1.98	1.40	1.34
20	0.91	0.55	0.70	1.14	1.60	1.81	2.60	1.75	1.60	1.78	1.30	1.18
21	0.88	0.83	1.00	1.45	1.40	1.54	2.20	2.02	1.40	1.60	1.10	1.05
22	3.50	2.08	3.30	3.20	1.30	1.28	1.80	2.38	1.20	1.38	0.97	0.95
23	4.00	2.52	5.20	4.42	1.30	1.53	1.60	2.21	1.10	1.22	0.87	0.87
24	2.80	1.92	3.20	3.28	1.70	2.29	1.40	1.80	1.00	1.10	0.78	0.81
25	2.30	1.48	2.30	2.35	2.40	2.50	1.40	1.48	1.00	1.20	0.72	0.75
26	2.00	1.18	1.90	1.78	2.20	2.03	1.40	1.37	0.90	1.19	0.72	0.73
27	1.60	0.98	1.60	1.41	1.80	1.63	1.60	1.44	0.84	1.07	0.69	0.72
28	1.50	0.84	1.60	1.31	1.50	1.35	2.70	2.92	0.81	0.98	0.75	1.02
29	1.30	0.71	1.40	1.17	1.30	1.14	4.80	4.30	0.78	0.90	2.40	2.76
30	1.20	0.62	1.30	0.98	1.30	1.31	4.00	3.67	0.00	0.00	3.80	5.19
31	1.10	0.55	0.00	0.00	1.10	1.34	3.00	2.74	0.00	0.00	5.10	6.07

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	4.80	5.84	0.90	0.88	0.78	0.78	0.16	0.25	0.06	0.11	0.05	0.06
2	4.00	4.51	0.87	0.79	0.72	0.73	0.15	0.24	0.06	0.11	0.05	0.05
3	3.00	3.14	0.81	0.84	0.67	0.68	0.15	0.24	0.06	0.11	0.04	0.05
4	2.30	2.35	0.75	0.82	0.61	0.64	0.15	0.23	0.06	0.11	0.06	0.05
5	1.80	1.86	0.72	0.76	0.56	0.61	0.15	0.22	0.05	0.10	0.05	0.05
6	1.40	1.53	0.90	1.19	0.53	0.58	0.14	0.22	0.05	0.10	0.04	0.05
7	1.20	1.30	1.10	1.54	0.48	0.55	0.13	0.21	0.05	0.10	0.04	0.05
8	1.00	1.12	1.20	1.37	0.46	0.52	0.13	0.21	0.05	0.10	0.04	0.05
9	0.90	0.99	1.00	1.18	0.44	0.50	0.12	0.20	0.05	0.09	0.05	0.05
10	0.84	0.91	0.93	1.05	0.41	0.48	0.12	0.20	0.05	0.09	0.04	0.05
11	0.81	0.83	0.93	1.03	0.39	0.46	0.11	0.19	0.05	0.09	0.04	0.04
12	0.78	0.93	1.10	1.36	0.37	0.44	0.11	0.19	0.05	0.09	0.04	0.04

Needle Branch daily pre-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
13	0.87	1.38	2.30	2.00	0.35	0.43	0.11	0.18	0.04	0.09	0.04	0.04
14	1.30	2.38	2.30	2.00	0.41	0.46	0.11	0.18	0.04	0.08	0.05	0.04
15	2.20	2.80	1.90	2.02	0.37	0.40	0.11	0.17	0.05	0.08	0.05	0.04
16	1.80	2.30	2.00	1.94	0.35	0.40	0.10	0.17	0.04	0.08	0.06	0.04
17	1.60	1.94	2.90	2.73	0.32	0.37	0.10	0.16	0.04	0.08	0.06	0.04
18	1.80	2.74	3.20	3.02	0.30	0.36	0.09	0.16	0.04	0.08	0.03	0.04
19	2.60	3.62	2.60	2.92	0.28	0.36	0.09	0.16	0.04	0.08	0.02	0.04
20	4.40	4.24	4.40	3.94	0.28	0.34	0.08	0.15	0.04	0.07	0.03	0.04
21	4.20	4.08	4.50	4.20	0.26	0.33	0.08	0.15	0.07	0.12	0.02	0.04
22	3.20	3.06	3.80	3.26	0.24	0.32	0.07	0.15	0.12	0.08	0.02	0.03
23	2.50	2.31	2.90	2.47	0.24	0.31	0.06	0.14	0.20	0.17	0.03	0.03
24	2.00	1.85	2.30	2.00	0.23	0.30	0.06	0.14	0.16	0.07	0.03	0.03
25	1.60	1.70	1.90	1.74	0.21	0.29	0.06	0.14	0.09	0.07	0.02	0.03
26	1.40	1.53	1.60	1.50	0.19	0.28	0.06	0.13	0.08	0.06	0.02	0.03
27	1.30	1.34	1.40	1.29	0.18	0.28	0.06	0.13	0.06	0.06	0.02	0.03
28	1.20	1.17	1.20	1.14	0.18	0.27	0.06	0.13	0.05	0.06	0.02	0.03
29	1.00	1.03	1.10	1.02	0.16	0.26	0.05	0.12	0.05	0.06	0.02	0.03
30	0.97	0.93	0.97	0.92	0.16	0.26	0.05	0.12	0.05	0.06	0.03	0.03
31	0.00	0.00	0.90	0.85	0.00	0.00	0.06	0.12	0.06	0.06	0.00	0.00

SUMMARY STATISTICS FOR WATER YEAR 1959

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.00	0.00	0.00	0.00	0	0	0
NOV	0.00	0.00	0.00	0.00	0	0	0
DEC	0.00	0.00	0.00	0.00	0	0	0
JAN	19.37	19.33	0.00	0.00	15	16	7
FEB	10.77	11.65	0.00	0.00	7	21	5
MAR	10.70	12.81	0.00	0.00	5	26	7
APR	7.40	7.98	0.00	0.00	9	21	10
MAY	2.16	2.14	0.00	0.00	15	16	5
JUN	0.95	0.96	0.00	0.00	10	20	6
JUL	0.13	0.27	3.09	6.46	0	24	11
AUG	0.06	0.14	1.98	4.47	0	31	1
SEP	0.73	0.57	21.95	17.18	20	10	5
YEAR	0.32	0.33	27.02	28.11	20	65	24
MFS-MFN	0.32	0.33	27.02	28.11	20	65	5

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Needle Branch daily pre-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1960

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	1.58	1.22	49.07	37.95	26	5	4
NOV	1.24	0.98	37.10	29.27	26	4	5
DEC	1.67	1.91	51.86	59.11	15	16	8
JAN	1.78	1.75	55.26	54.40	14	17	10
FEB	4.04	4.44	117.13	128.70	7	22	9
MAR	1.98	2.12	61.50	65.68	13	18	7
APR	1.96	2.19	58.77	65.71	7	23	6
MAY	1.79	1.73	55.38	53.76	19	12	7
JUN	0.37	0.43	11.13	13.01	0	30	1
JUL	0.10	0.17	3.08	5.39	0	31	1
AUG	0.06	0.09	1.96	2.71	6	25	4
SEP	0.04	0.04	1.11	1.23	7	23	8
YEAR	1.38	1.41	503.35	516.92	140	226	62
MFS-MFN	0.47	0.50	72.66	76.09	32	121	19

SUMMARY STATISTICS FOR WATER YEAR 1961

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.20	0.27	6.11	8.34	23	8	6
NOV	4.09	3.55	122.76	106.40	11	19	9
DEC	1.21	1.58	37.44	49.02	4	27	3
JAN	2.37	2.52	73.50	78.09	16	15	12
FEB	6.17	6.28	172.80	175.84	9	19	8
MAR	4.54	4.61	140.60	142.85	14	17	15
APR	0.89	1.18	26.80	35.51	1	29	3
MAY	0.86	0.79	26.70	24.58	26	5	2
JUN	0.24	0.22	7.17	6.52	21	9	4
JUL	0.09	0.10	2.93	3.04	5	26	5
AUG	0.06	0.05	1.89	1.52	19	12	6
SEP	0.05	0.03	1.57	0.76	28	2	3
YEAR	1.70	1.73	620.27	632.46	177	188	67
MFS-MFN	0.26	0.24	40.26	36.42	99	54	16

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Needle Branch daily pre-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.45	0.38	13.84	11.79	25	6	2
NOV	1.75	1.89	52.39	56.72	1	29	3
DEC	3.33	3.60	103.20	111.51	11	20	8
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.00	0.00	0.00	0.00	0	0	0
AUG	0.00	0.00	0.00	0.00	0	0	0
SEP	0.00	0.00	0.00	0.00	0	0	0
YEAR	1.84	1.96	169.43	180.02	37	55	11
MFS-MFN	0.00	0.00	0.00	0.00	0	0	16

SUMMARY STATISTICS FOR OPTIMIZATION PERIOD 1959 TO 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
TOTAL	1.45	1.50	1320.07	1357.51	374	534	233
MFS-MFN	0.36	0.36	139.94	140.62	151	240	40

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

VERIFICATION CRITERIA

	DAILY		MONTHLY	
	TOTAL	MFS-MFN	TOTAL	MFS-MFN
COEFFICIENT OF DETERMINATION	0.923	0.921	0.989	0.990
(LOGS)	0.939	0.930		
COEFFICIENT OF PERSISTENCE	-14.250	-15.636		
COEFFICIENT OF GAIN FROM DAILY AVERAGES	0.906	0.805		
RESIDUAL-PREDICTED CORRELATION	-0.199	0.078		

Needle Branch daily pre-calibration model output--Continued

ERROR SUMMARY (MFS-MFN PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	-0.68	-3.85	33.46	20.90	13.21	2.74
MEAN	0.00	-0.01	0.09	0.05	0.03	0.01
PERCENT	-0.49		23.91		51.35	

ERROR SUMMARY (TOTAL PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	-37.44	-12.39	264.52	85.69	385.45	21.15
MEAN	-0.04	-0.01	0.29	0.09	0.42	0.02
PERCENT	-2.84		20.04		44.82	

STORM	PREDICTED VOLUME (INCHES)	ROUTED OUTFLOW (INCHES)	OBSERVED OUTFLOW (INCHES)	PREDICTED PEAK (CFS)	OBSERVED PEAK (CFS)
1	5.41	5.83	6.83	21.37	32.40
2	11.94	12.86	12.98	21.74	28.10
3	2.71	2.92	2.78	9.78	9.12
4	3.50	3.78	4.05	8.74	12.50
5	2.88	3.10	3.55	14.78	28.80
6	6.44	6.94	6.57	18.19	17.50
MEAN	5.48	5.91	6.13	15.77	21.40
LOGS	1.56	1.63	1.68	2.70	2.96

STORM VOLUME ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	3.89	0.72	3.89	0.13
MEAN	0.65	0.12	0.65	0.02
PERCENT	10.59		13.14	

STORM PEAK ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	36.53	1.81	373.69	0.82
MEAN	6.09	0.30	62.28	0.14
PERCENT	28.44		36.87	

```
1 - NUMBER OF PRECIPITATION GAGES
1 - NUMBER OF SEGMENTS SAVED FOR PLTGEN
1 - NUMBER OF SEGMENTS SAVED FOR PRINT, PLOT, AND PLTGEN
3 - NUMBER OF CURVES OUTPUT TO PLTGEN FILE(S)
0 - NUMBER OF PLTGEN SEGMENTS SKIPPED
3     0 NC1, NC2

TIME0 1960   11   23    0    0
TIMEN 1960   11   26   24    0
LAPSED TIME    5761
CH9   5   2          INCDT  240         MAXRD   24
KOUNT    3           KSKIP    0
INC   24   24   24          INC    1    1    1
```

APPENDIX B--Continued

Deer Creek daily pre-calibration model output

PRMS -- VERSION 0888

IOPT= 0 ISIM= 2 IOBS= 1 ISEN= 0 PROB= 0
IDOUT= 3 IUOUT= 2 SCODE=OR IPSW= 0
IPET= 1 ISSR1= 1 MRDC= 2 ISUN= 1 ILPS= 0
NYR= 4 NDS= 1 NRU= 13 NRD= 14 NRES= 3 NGW= 1 NSTOR= 0 DAT= 749.50
NTS= 1 NPLW= 0NDC= 0
BYR/BMO/BDY= 1959/ 7/ 8 EYR/EMO/EDY= 1961/12/31
MFS= 5 MFN= 9

DATA TYPE	PARAMETER CODE	STATISTIC CODE	DSN	STATION ID
DAILY DISCHARGE	60	3	10	D000000000000010
DAILY EVAP	0	0	0	
DAILY MAX TEMP	99998	1	41	D000000000000040
DAILY MIN TEMP	99998	2	40	D000000000000040
DAILY SOLAR RAD	0	0	0	
SNOW PILLOW	0	0		
USER VARIABLE 2	0	0	0	
UNIT DISCHARGE	60	11	11	U000000000000011
DAILY PRECIP	45	6	20	D000000000000020
UNIT PRECIP	45	6	21	U000000000000021

POT SOLAR RADIATION

1	HOR	261.3	285.9	328.8	391.1	470.0	559.4	654.1	747.4	832.0	905.0	961.9	1001.3	1023.9
2	S05	303.6	328.4	371.2	432.6	509.5	595.5	685.4	772.7	850.8	917.3	968.5	1003.6	1023.6
3	SE48	477.4	501.6	542.1	597.6	663.1	731.5	797.5	856.2	903.3	939.2	963.7	978.7	986.6
4	S56	620.5	643.3	680.0	727.4	779.2	829.1	872.6	906.1	927.4	938.9	943.6	944.8	944.7
5	NW56	120.5	140.5	176.6	231.6	305.0	392.7	490.5	591.4	687.6	774.1	844.5	894.6	924.1
6	E48	227.3	250.5	291.2	350.5	426.1	512.4	604.6	695.9	779.5	852.0	909.0	948.6	971.5
7	NW56	120.5	140.5	176.6	231.6	305.0	392.7	490.5	591.4	687.6	774.1	844.5	894.6	924.1
8	S40	540.9	564.8	604.1	656.7	716.9	778.2	835.7	885.0	922.5	949.3	966.7	977.0	982.2
9	E46	277.9	301.9	343.5	403.3	478.3	562.5	650.7	736.6	813.5	879.1	929.9	964.6	984.5
10	SE64	653.1	675.3	710.7	755.4	803.1	847.7	884.6	911.0	925.0	929.7	928.8	926.1	923.7
11	E42	276.0	300.1	341.9	402.1	477.6	562.5	651.5	738.3	816.3	882.9	934.4	969.7	990.0
12	E40	229.4	252.9	294.0	354.1	430.7	518.4	611.9	704.6	789.5	863.2	921.2	961.4	984.7
13	NW54	122.6	142.8	179.2	234.7	308.5	396.7	494.8	596.1	692.5	779.2	849.6	899.8	929.3
14	NW32	157.5	179.8	219.9	279.8	358.2	450.5	551.6	654.5	751.2	837.1	906.2	955.0	983.6

RDM(1-12)= -0.13 -0.13 -0.10 -0.08 -0.08 -0.07 -0.07 -0.07 -0.08 -0.08 -0.13 -0.13
RDC(1-12)= 1.83 1.83 1.60 1.46 1.46 1.42 1.42 1.42 1.46 1.46 1.83 1.83
MRDC= 2 PARS= 0.44 PARW= 0.50 RDB= 0.25 RDP= 0.61 RDMX= 0.80 RTB= 1.00 RTC= 1.00 ITSOL= 1
TSOLX(1-12) - 50.0 50.0 50.0 50.0 55.0 60.0 70.0 70.0 60.0 50.0 50.0 50.0

Deer Creek daily pre-calibration model output--Continued

SUNLIGHT HOURS/12

1	HOR	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3
2	S05	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.2	1.3
3	SE48	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1
4	S56	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1
5	NW56	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
6	E48	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1
7	NW56	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
8	S40	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1
9	E46	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
10	SE64	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1
11	E42	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
12	E40	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.1
13	NW54	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
14	NW32	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2

RMXA= 0.80 RMXM= 0.60 MTSS= 8 MTSE= 9 ARSA= 0.05 ARSM= 0.20
CSEL(1-5)= 50.
MPCS= 0 MPCN= 0 MPC1= 0 PCONR= 1.00 PCONS= 1.00
PCR(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00
PCS(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00
CTS(1-12)= 0.008700 0.013400 0.009200 0.010600 0.010100 0.013900 0.016100 0.015300 0.011700 0.019300 0.013500 0.007300
CTW= 0.50
PAT(1-12)= 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00
AJMX(1-12)= 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
TLX(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
TLN(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
EVC(1-12)= 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750
ISP1= 90 ISP2=120 EAIR= 1.000 FWCAP= 0.05 DENI= 0.20 DENMX= 0.60 SETCON= 0.10 BST= 32.00
CECN(1-12)= 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00

#	RES	RSEP	RESMX	REXP	KRSP	RCF	RCP
--	----	----	------	----	----	---------	---------
1	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0668000
2	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0668000
3	0.100	0.000	1.0000	1.0000	1	0.0000000	0.0668000

#	GW	GSNK	RCB
--	-----	-----	------
1	2.000	0.000	0.0196

Deer Creek daily pre-calibration model output--Continued

IRU	IRD	ITST	ITSW	TXAJ	RNSTS	SNST	COVDS	ICOV	SMAX	REMX	SCN	SRX	RETIP	SEP	KRES
	----	----	----	----	-----	-----	-----	-----	----	-----	---	---	-----	-----	----
	ELEV	ITND	CTX	TNAJ	RNSTW	TRNCF	COVDW	ISOIL	SMAV	RECHR	SC1	SCX	IMPRV	KSTOR	KGW
1	2	4	1	0.00	0.56	0.01	0.80	3	12.00	0.40	0.00000	2.00	0.10	0.15	1
	680.	11	0.00	0.00	0.18	1.00	0.15	2	1.00	0.00	0.20600	0.00	0.00	0	1
2	3	1	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	960.	12	0.00	0.00	0.18	1.00	0.40	2	1.00	0.00	0.20600	0.00	0.00	0	1
3	4	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	900.	12	0.00	0.00	0.18	1.00	0.40	2	1.00	0.00	0.20600	0.00	0.00	0	1
4	5	4	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	880.	11	0.00	0.00	0.18	1.00	0.10	2	1.00	0.00	0.20600	0.00	0.00	0	1
5	6	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	850.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.20600	0.00	0.00	0	1
6	7	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	740.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.20600	0.00	0.00	0	1
7	8	1	1	0.00	0.56	0.01	0.80	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	1360.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.20600	0.00	0.00	0	1
8	9	4	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1200.	11	0.00	0.00	0.18	1.00	0.10	2	1.00	0.00	0.20600	0.00	0.00	0	1
9	10	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	1.00	0.00	0.20600	0.00	0.00	0	1
10	11	4	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1300.	11	0.00	0.00	0.18	1.00	0.10	2	1.00	0.00	0.20600	0.00	0.00	0	1
11	12	1	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	1.00	0.00	0.20600	0.00	0.00	0	1
12	13	1	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	1.00	0.00	0.20600	0.00	0.00	0	1
13	14	1	1	0.00	0.56	0.01	0.95	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	800.	12	0.00	0.00	0.18	1.00	0.70	2	1.00	0.00	0.20600	0.00	0.00	0	1

IRU	IDS	SLOPE	AREA	PERV AREA	IMPERV AREA	UPCOR	DRCOR	DSCOR	TST	KTS	KSP	KDC	AIMX	PKFAC
1	1	0.05	58.6	58.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
2	1	0.48	23.3	23.3	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
3	1	0.56	16.2	16.2	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
4	1	0.56	23.8	23.8	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
5	1	0.48	46.3	46.3	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
6	1	0.56	7.1	7.1	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
7	1	0.40	52.3	52.3	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
8	1	0.46	64.4	64.4	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
9	1	0.64	82.2	82.2	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
10	1	0.42	32.7	32.7	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
11	1	0.40	126.4	126.4	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
12	1	0.54	125.6	125.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
13	1	0.32	90.6	90.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00

TOTAL			749.5	749.5	0.0									

Deer Creek daily pre-calibration model output--Continued

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1BYR= 1959 BMO=    7 BDY=    8
 NSP=    6
   1  11960112319601126  NE= 16   INV=1959   INV=1960
   2  11961 2 91961 216  NE= 16
   3  11961 3 51961 3 7  NE= 16
   4  11961 3121961 315  NE= 16
   5  11961112119611123  NE= 16   INV=1961
   6  11961121819611222  NE= 16   INV=1962

 STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)
 IRU   KSAT    PSP    RGF    DRN
   1 20.000  0.010 50.000  2.000
   2 20.000  0.010 50.000  2.000
   3 20.000  0.010 50.000  2.000
   4 20.000  0.010 50.000  2.000
   5 20.000  0.010 50.000  2.000
   6 20.000  0.010 50.000  2.000

 STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)
 IRU   KSAT    PSP    RGF    DRN
   7 20.000  0.010 50.000  2.000
   8 20.000  0.010 50.000  2.000
   9 20.000  0.010 50.000  2.000
  10 20.000  0.010 50.000  2.000
  11 20.000  0.010 50.000  2.000
  12 20.000  0.010 50.000  2.000
  13 20.000  0.010 50.000  2.000

    WY  WYD  #HS  ST#  RFL  SFL  BEGIN AND END TIMES FOR #HS
  1961   54    1    1    0    1   0.1440.
  1961   55    1    1    1    1   0.1440.
  1961   56    1    1    1    1   0.1440.
  1961   57    1    1    1    0   0.1440.
  1961  132    1    2    0    1   0.1440.
  1961  133    1    2    1    1   0.1440.
  1961  134    1    2    1    1   0.1440.
  1961  135    1    2    1    1   0.1440.
  1961  136    1    2    1    1   0.1440.
  1961  137    1    2    1    1   0.1440.
  1961  138    1    2    1    1   0.1440.
  1961  139    1    2    1    0   0.1440.
  1961  156    1    3    0    1   0.1440.
  1961  157    1    3    1    1   0.1440.
  1961  158    1    3    1    0   0.1440.
  1961  163    1    4    0    1   0.1440.
  1961  164    1    4    1    1   0.1440.
  1961  165    1    4    1    1   0.1440.
  1961  166    1    4    1    0   0.1440.
  1962   52    1    5    0    1   0.1440.
  1962   53    1    5    1    1   0.1440.
  1962   54    1    5    1    0   0.1440.
  1962   79    1    6    0    1   0.1440.
  1962   80    1    6    1    1   0.1440.
  1962   81    1    6    1    1   0.1440.
  1962   82    1    6    1    1   0.1440.
  1962   83    1    6    1    0   0.1440.
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Deer Creek daily pre-calibration model output--Continued

NUMBER OF OVERLAND FLOW PLANE SEGMENTS IS 42. THEIR CHARACTERISTICS ARE AS FOLLOWS:

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	OF1	1	8	0.0000	99	0	0	1	381.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
2	OF2	1	8	0.0000	99	0	0	1	1021.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
3	OF3	1	11	0.0000	99	0	0	1	563.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
4	OF4	1	9	0.0000	99	0	0	1	992.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
5	OF5	1	7	0.0000	99	0	0	1	354.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
6	OF6	1	7	0.0000	99	0	0	1	374.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
7	OF7	1	9	0.0000	99	0	0	1	299.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
8	OF8	1	9	0.0000	99	0	0	1	1228.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
9	OF9	1	1	0.0000	99	0	0	1	109.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
10	OF10	1	1	0.0000	99	0	0	1	98.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
11	OF11	1	4	0.0000	99	0	0	1	518.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
12	OF12	1	3	0.0000	99	0	0	1	353.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
13	OF13	1	1	0.0000	99	0	0	1	211.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
14	OF14	1	1	0.0000	99	0	0	1	138.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
15	OF15	1	11	0.0000	99	0	0	1	758.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
16	OF16	1	11	0.0000	99	0	0	1	518.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
17	OF17	1	1	0.0000	99	0	0	1	182.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
18	OF18	1	1	0.0000	99	0	0	1	301.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
19	OF19	1	7	0.0000	99	0	0	1	449.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
20	OF20	1	7	0.0000	99	0	0	1	592.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
21	OF21	1	12	0.0000	99	0	0	1	1387.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
22	OF22	1	2	0.0000	99	0	0	1	406.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
23	OF23	1	12	0.0000	99	0	0	1	229.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
24	OF24	1	1	0.0000	99	0	0	1	327.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
25	OF25	1	12	0.0000	99	0	0	1	546.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
26	OF26	1	12	0.0000	99	0	0	1	607.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
27	OF27	1	1	0.0000	99	0	0	1	149.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
28	OF28	1	1	0.0000	99	0	0	1	448.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
29	OF29	1	10	0.0000	99	0	0	1	909.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
30	OF30	1	10	0.0000	99	0	0	1	871.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
31	OF31	1	11	0.0000	99	0	0	1	961.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
32	OF32	1	11	0.0000	99	0	0	1	520.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
33	OF33	1	1	0.0000	99	0	0	1	65.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
34	OF34	1	1	0.0000	99	0	0	1	176.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
35	OF35	1	13	0.0000	99	0	0	1	956.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
36	OF36	1	13	0.0000	99	0	0	1	1366.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
37	OF37	1	1	0.0000	99	0	0	1	126.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
38	OF38	1	1	0.0000	99	0	0	1	166.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
39	OF39	1	5	0.0000	99	0	0	1	1459.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
40	OF40	1	5	0.0000	99	0	0	1	274.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
41	OF41	1	5	0.0000	99	0	0	1	283.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
42	OF42	1	6	0.0000	99	0	0	1	309.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0

NUMBER OF CHANNEL SEGMENTS IS 21.

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	CH1			OF1	OF2	64.4	64.4	0.10	3	0	0	3	2000.0	.3600	.050	10.00	10.00	5.20	1.33	60.0	60.0
2	CH2	CH1		OF3	OF4	46.4	110.8	0.10	3	0	0	3	1300.0	.0800	.050	10.00	10.00	2.45	1.33	60.0	60.0
3	CH3			OF6	OF5	28.4	28.4	0.10	3	0	0	3	1700.0	.4400	.050	10.00	10.00	5.75	1.33	60.0	60.0
4	CH4	CH3		OF8	OF7	52.6	81.0	0.10	3	0	0	3	1500.0	.1400	.050	10.00	10.00	3.24	1.33	60.0	60.0
5	CH5	CH4	CH2	OF10	OF9	1.9	193.7	0.10	3	0	0	3	400.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0

Deer Creek daily pre-calibration model output--Continued

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
6	CH6			OF12	OF11	40.0	40.0	0.10	3	0	0	3	2000.0	.3900	.050	10.00	10.00	5.41	1.33	60.0	60.0
7	CH7			OF20	OF19	23.9	23.9	0.10	3	0	0	3	1000.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
8	CH8	CH7		OF22	OF21	102.9	126.8	0.10	3	0	0	3	2500.0	.2100	.050	10.00	10.00	3.97	1.33	60.0	60.0
9	CH9			OF15	OF16	58.6	58.6	0.10	3	0	0	3	2000.0	.3300	.050	10.00	10.00	4.98	1.33	60.0	60.0
10	CH10	CH5	CH6	OF14	OF13	4.8	238.5	0.10	3	0	0	3	600.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
11	CH11	CH10	CH9	OF18	OF17	13.3	310.4	0.10	3	0	0	3	1200.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
12	CH12			OF30	OF29	32.7	32.7	0.10	3	0	0	3	800.0	.4400	.050	10.00	10.00	5.75	1.33	60.0	60.0
13	CH13	CH12		OF32	OF31	51.0	83.7	0.10	3	0	0	3	1500.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
14	CH14	CH8		OF24	OF23	15.3	142.1	0.10	3	0	0	3	1200.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
15	CH15			OF25	OF26	39.7	39.7	0.10	3	0	0	3	1500.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
16	CH16	CH15	CH14	OF28	OF27	9.6	501.8	0.10	3	0	0	3	700.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
17	CH17			OF40	OF39	39.8	39.8	0.10	3	0	0	3	1000.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
18	CH18			OF36	OF35	90.6	90.6	0.10	3	0	0	3	1700.0	.4000	.050	10.00	10.00	5.48	1.33	60.0	60.0
19	CH19	CH13	CH16	OF34	OF33	13.3	598.7	0.10	3	0	0	3	2400.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
20	CH20	CH19	CH18	OF38	OF37	6.7	696.1	0.10	3	0	0	3	1000.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
21	CH21	CH20	CH17	OF41	OF42	13.6	749.4	0.10	3	0	3	3	1000.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	2.90	3.34	3.30	2.29	4.10	3.93	4.50	5.15	12.00	15.24	4.60	4.22
2	2.50	2.91	3.00	2.09	4.00	3.67	4.10	4.63	14.00	18.26	4.60	4.38
3	2.30	2.57	3.50	2.23	3.70	3.64	3.90	4.19	14.00	17.07	6.00	7.16
4	2.00	2.29	2.90	2.28	3.50	3.42	3.60	3.82	14.00	17.38	10.00	11.12
5	1.90	2.06	2.80	2.09	3.30	3.10	3.60	3.52	19.00	18.10	14.00	12.24
6	1.80	1.86	2.60	1.92	3.20	2.95	3.60	3.31	28.00	27.57	14.00	11.13
7	1.80	1.70	2.50	1.78	3.20	2.75	3.50	3.27	46.00	35.82	13.00	11.71
8	3.30	3.64	2.40	1.66	2.90	2.55	5.50	4.96	38.00	44.59	15.00	15.10
9	4.40	5.41	2.20	1.55	2.80	2.49	5.50	6.28	61.00	56.08	17.00	15.12
10	4.80	6.64	2.20	1.45	3.10	3.13	5.60	5.72	47.00	45.03	14.00	12.17
11	11.00	10.11	2.00	1.37	5.80	8.09	5.60	5.74	28.00	27.96	11.00	9.93
12	10.00	10.22	2.00	1.30	15.00	15.52	5.20	5.52	21.00	26.00	9.40	8.55
13	7.90	7.89	1.80	1.23	14.00	15.16	5.10	5.09	18.00	26.41	8.20	8.17
14	6.00	6.30	1.80	1.17	11.00	16.47	5.20	4.90	17.00	27.98	7.10	8.65
15	4.80	5.18	1.70	1.11	13.00	19.14	4.90	4.98	25.00	27.10	8.20	9.91
16	4.00	4.36	1.70	1.06	14.00	15.80	6.20	7.04	22.00	20.01	8.80	9.80
17	3.50	3.73	1.60	1.02	12.00	12.00	10.00	10.94	17.00	14.95	8.30	8.31
18	3.00	3.24	2.60	1.72	10.00	10.44	12.00	11.27	14.00	11.87	7.30	7.22
19	3.00	2.86	2.20	2.44	8.20	9.22	11.00	9.10	11.00	9.77	6.40	6.40
20	3.10	2.54	2.60	4.03	7.60	7.92	9.40	7.60	9.80	8.61	5.70	5.76
21	2.80	3.06	3.70	5.39	7.00	6.89	8.20	8.03	8.80	7.73	5.00	5.25
22	8.70	6.83	8.70	10.93	6.40	5.90	7.20	9.13	7.80	6.82	4.60	4.83
23	12.00	9.02	18.00	16.11	6.40	6.51	6.80	8.96	7.00	6.12	4.30	4.49
24	10.00	7.18	13.00	12.78	6.80	9.05	6.20	7.92	6.20	5.58	4.00	4.20
25	8.30	5.86	9.10	9.75	7.50	9.95	6.00	6.77	6.20	5.68	3.70	3.95
26	7.00	4.88	7.10	7.74	7.60	8.45	6.70	6.18	5.60	5.64	3.70	3.74
27	6.00	4.16	5.90	6.33	7.20	7.07	7.10	6.21	5.20	5.18	3.60	3.68
28	5.20	3.61	5.60	5.75	6.50	6.06	10.00	10.92	4.90	4.80	4.00	4.63
29	4.60	3.17	4.70	5.22	5.60	5.30	18.00	16.29	4.70	4.48	10.00	10.26
30	4.00	2.81	4.40	4.49	5.50	5.66	18.00	14.60	0.00	0.00	17.00	19.08
31	3.60	2.53	0.00	0.00	4.80	5.84	13.00	11.51	0.00	0.00	24.00	23.12

APPENDIX B--Continued

Deer Creek daily pre-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	22.00	22.50	4.50	4.34	4.00	4.01	1.00	1.47	0.56	0.76	0.45	0.41
2	18.00	18.22	4.30	4.05	3.60	3.77	1.00	1.44	0.54	0.74	0.41	0.40
3	14.00	13.69	4.10	3.97	3.40	3.56	1.00	1.41	0.54	0.73	0.39	0.39
4	11.00	10.83	3.90	3.81	3.10	3.38	0.96	1.37	0.49	0.71	0.41	0.38
5	8.60	8.92	3.60	3.60	2.80	3.22	0.92	1.34	0.47	0.70	0.41	0.38
6	7.50	7.56	4.50	4.70	2.70	3.08	0.88	1.31	0.47	0.68	0.39	0.37
7	6.50	6.57	4.90	5.92	2.60	2.95	0.84	1.28	0.45	0.67	0.37	0.36
8	5.80	5.81	5.10	5.50	2.40	2.83	0.84	1.26	0.43	0.66	0.36	0.36
9	5.10	5.21	4.90	4.98	2.30	2.72	0.81	1.23	0.47	0.64	0.36	0.35
10	4.70	4.74	4.60	4.57	2.20	2.63	0.81	1.20	0.45	0.63	0.36	0.34
11	4.60	4.35	4.60	4.30	2.10	2.54	0.78	1.18	0.45	0.62	0.36	0.33
12	4.60	4.34	4.70	5.14	2.00	2.45	0.78	1.15	0.43	0.61	0.36	0.33
13	4.80	5.59	6.50	7.17	1.80	2.37	0.78	1.13	0.43	0.59	0.34	0.32
14	5.90	8.85	7.30	7.56	2.20	2.30	0.75	1.10	0.41	0.58	0.34	0.32
15	8.50	10.56	7.10	7.57	2.00	2.23	0.72	1.08	0.41	0.57	0.34	0.31
16	8.50	9.22	7.30	7.51	2.00	2.16	0.69	1.06	0.41	0.56	0.34	0.30
17	7.80	7.99	9.10	9.96	1.70	2.10	0.69	1.03	0.41	0.55	0.34	0.30
18	8.50	10.38	10.00	11.63	1.60	2.04	0.67	1.01	0.41	0.54	0.34	0.29
19	11.00	13.73	9.60	11.35	1.60	1.99	0.67	0.99	0.39	0.53	0.36	0.29
20	18.00	16.06	15.00	14.87	1.60	1.93	0.64	0.97	0.37	0.52	0.36	0.28
21	18.00	16.07	16.00	16.27	1.50	1.88	0.64	0.95	0.49	0.51	0.34	0.28
22	14.00	12.83	14.00	13.43	1.40	1.83	0.61	0.93	0.59	0.50	0.32	0.27
23	11.00	10.28	11.00	10.74	1.30	1.79	0.59	0.91	1.00	0.49	0.34	0.27
24	8.90	8.56	9.40	8.97	1.30	1.74	0.59	0.89	0.92	0.48	0.34	0.26
25	7.80	7.76	8.00	7.79	1.20	1.70	0.59	0.87	0.61	0.47	0.34	0.26
26	7.10	7.06	7.00	6.85	1.20	1.66	0.56	0.86	0.56	0.46	0.32	0.25
27	6.20	6.28	6.40	6.09	1.20	1.62	0.56	0.84	0.49	0.45	0.32	0.25
28	5.60	5.62	5.70	5.49	1.10	1.58	0.54	0.82	0.45	0.44	0.32	0.24
29	5.10	5.09	5.10	5.01	1.10	1.54	0.54	0.81	0.45	0.43	0.31	0.24
30	4.60	4.67	4.60	4.61	1.10	1.51	0.54	0.79	0.43	0.42	0.31	0.23
31	0.00	0.00	4.50	4.28	0.00	0.00	0.56	0.77	0.47	0.42	0.00	0.00

Deer Creek daily pre-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1959

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.00	0.00	0.00	0.00	0	0	0
NOV	0.00	0.00	0.00	0.00	0	0	0
DEC	0.00	0.00	0.00	0.00	0	0	0
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.90	1.00	20.60	23.04	0	23	0
AUG	0.59	0.59	18.26	18.40	13	18	4
SEP	2.72	1.26	81.56	37.82	28	2	2
YEAR	1.43	0.94	120.42	79.26	41	43	4
MFS-MFN	1.43	0.94	120.42	79.26	41	43	5

SUMMARY STATISTICS FOR WATER YEAR 1960

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	5.04	4.58	156.20	141.95	15	16	10
NOV	4.25	4.01	127.60	120.28	20	10	4
DEC	6.96	7.68	215.70	238.08	15	16	8
JAN	7.26	7.21	225.20	223.56	15	16	10
FEB	18.35	18.89	532.20	547.81	19	10	8
MAR	8.92	8.85	276.50	274.27	12	19	9
APR	9.12	9.31	273.70	279.34	12	18	9
MAY	7.01	7.16	217.30	222.02	17	14	9
JUN	2.00	2.37	60.10	71.11	0	30	1
JUL	0.73	1.08	22.55	33.46	0	31	1
AUG	0.50	0.57	15.45	17.64	10	21	2
SEP	0.35	0.31	10.65	9.34	29	1	3
YEAR	5.83	5.95	2133.15	2178.85	164	202	68
MFS-MFN	2.13	2.31	326.05	353.57	56	97	13

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Deer Creek daily pre-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1961

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.95	0.45	29.55	14.06	30	1	3
NOV	16.68	13.75	500.26	412.57	19	11	8
DEC	5.87	6.69	181.90	207.36	11	20	6
JAN	10.68	10.64	331.10	329.80	20	11	11
FEB	27.62	25.24	773.30	706.75	18	10	11
MAR	20.83	19.21	645.80	595.38	16	15	9
APR	4.83	5.24	145.00	157.30	8	22	8
MAY	4.08	3.49	126.50	108.05	28	3	2
JUN	1.33	1.27	39.87	38.06	20	10	5
JUL	0.63	0.65	19.47	20.05	10	21	4
AUG	0.46	0.35	14.24	10.75	31	0	1
SEP	0.43	0.19	12.95	5.75	30	0	1
YEAR	7.73	7.14	2819.94	2605.89	241	124	59
MFS-MFN	1.39	1.19	213.03	182.67	119	34	10

SUMMARY STATISTICS FOR WATER YEAR 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	1.51	0.67	46.83	20.75	29	2	2
NOV	6.08	6.94	182.30	208.28	2	28	3
DEC	14.39	14.46	446.20	448.35	13	18	6
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.00	0.00	0.00	0.00	0	0	0
AUG	0.00	0.00	0.00	0.00	0	0	0
SEP	0.00	0.00	0.00	0.00	0	0	0
YEAR	7.34	7.36	675.33	677.38	44	48	9
MFS-MFN	0.00	0.00	0.00	0.00	0	0	10

SUMMARY STATISTICS FOR OPTIMIZATION PERIOD 1959 TO 1962

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
TOTAL	6.34	6.11	5748.83	5541.38	490	417	137
MFS-MFN	1.69	1.58	659.50	615.50	216	174	28

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Deer Creek daily pre-calibration model output--Continued

VERIFICATION CRITERIA

	DAILY TOTAL	DAILY MFS-MFN	MONTHLY TOTAL	MONTHLY MFS-MFN
COEFFICIENT OF DETERMINATION	0.930	0.886	0.989	0.956
(LOGS)	0.941	0.876		
COEFFICIENT OF PERSISTENCE	-21.038	-17.004		
COEFFICIENT OF GAIN FROM DAILY AVERAGES	0.914	0.672		
RESIDUAL-PREDICTED CORRELATION	-0.249	-0.165		

ERROR SUMMARY (MFS-MFN PERIOD)

	ERRORS NO LOG	ERRORS LOG	ABSOLUTE ERRORS NO LOG	ABSOLUTE ERRORS LOG	SQUARED ERRORS NO LOG	SQUARED ERRORS LOG
SUM	44.00	14.72	122.51	45.58	243.67	15.24
MEAN	0.11	0.04	0.31	0.12	0.62	0.04
PERCENT	6.67		18.58		46.74	

ERROR SUMMARY (TOTAL PERIOD)

	ERRORS NO LOG	ERRORS LOG	ABSOLUTE ERRORS NO LOG	ABSOLUTE ERRORS LOG	SQUARED ERRORS NO LOG	SQUARED ERRORS LOG
SUM	207.44	38.71	973.09	132.03	6003.03	49.88
MEAN	0.23	0.04	1.07	0.15	6.62	0.05
PERCENT	3.61		16.93		40.59	

STORM	PREDICTED VOLUME (INCHES)	ROUTED OUTFLOW (INCHES)	OBSERVED OUTFLOW (INCHES)	PREDICTED PEAK (CFS)	OBSERVED PEAK (CFS)
1	5.19	5.18	6.56	75.49	114.00
2	11.46	11.45	13.04	72.63	106.00
3	2.62	2.62	2.97	35.73	43.90
4	3.46	3.47	4.78	33.10	62.60
5	2.25	2.23	2.72	43.38	81.00
6	6.03	6.02	6.27	65.36	67.40
MEAN	5.17	5.16	6.06	54.28	79.15
LOGS	1.48	1.48	1.66	3.94	4.32

STORM VOLUME ERROR SUMMARY

	ABS VALUE OBF FNC NO LOG	ABS VALUE OBF FNC LOG	SUM OF SQUARES OBF FNC NO LOG	SUM OF SQUARES OBF FNC LOG
SUM	5.33	1.04	6.51	0.23
MEAN	0.89	0.17	1.08	0.04
PERCENT	14.66		17.20	

STORM PEAK ERROR SUMMARY

	ABS VALUE OBF FNC NO LOG	ABS VALUE OBF FNC LOG	SUM OF SQUARES OBF FNC NO LOG	SUM OF SQUARES OBF FNC LOG
SUM	149.22	2.29	4953.16	1.15
MEAN	24.87	0.38	825.53	0.19
PERCENT	31.42		36.30	

Deer Creek daily pre-calibration model output--Continued

```
    1 - NUMBER OF PRECIPITATION GAGES
    1 - NUMBER OF SEGMENTS SAVED FOR PLTGEN
    1 - NUMBER OF SEGMENTS SAVED FOR PRINT, PLOT, AND PLTGEN
    3 - NUMBER OF CURVES OUTPUT TO PLTGEN FILE(S)
    0 - NUMBER OF PLTGEN SEGMENTS SKIPPED
    3     0 NC1, NC2


TIME0 1960    11   23    0    0
TIMEN 1960    11   26   24    0
LAPSED TIME     5761

CH21   5   2          INCDT  240          MAXRD   24
KOUNT    3            KSKIP    0

INC   24   24   24          INC    1    1    1
```

Needle Branch daily post-calibration model output

PRMS -- VERSION 0888

```
IOPT=   0    ISIM=    2    IOBS=   1    ISEN=   0    PROB=   0
IDOUT=  3    IUOUT=   2    SCODE=OR     IPSW=   0
IPET=   1    ISSR1=   1    MRDC=   2    ISUN=   1    ILPS=   0
NYR=    3    NDS=     1    NRU=    7    NRD=    8    NRES=  3   NGW=  1   NSTOR=  0   DAT=   174.60
NTS=    1    NPLW=    0NDC=   0
BYR/BMO/BDY= 1967/ 1/ 1    EYR/EMO/EDY= 1968/12/31
MFS=  5    MFN=  9
```

DATA TYPE	PARAMETER CODE	STATISTIC CODE	DSN	STATION ID
DAILY DISCHARGE	60	3	10	D000000000000010
DAILY EVAP	0	0	0	
DAILY MAX TEMP	99998	1	41	D000000000000040
DAILY MIN TEMP	99998	2	40	D000000000000040
DAILY SOLAR RAD	0	0	0	
SNOW PILLOW	0	0		
USER VARIABLE 2	0	0	0	
UNIT DISCHARGE	60	11	11	U000000000000011
DAILY PRECIP	45	6	20	D000000000000020
UNIT PRECIP	45	6	21	U000000000000021

POT SOLAR RADIATION

1	HOR	261.3	285.9	328.8	391.1	470.0	559.4	654.1	747.4	832.0	905.0	961.9	1001.3	1023.9
2	SW05	293.6	318.4	361.2	422.9	500.2	587.1	678.2	767.0	846.6	914.6	967.2	1003.2	1023.8
3	SW67	471.7	495.6	535.6	590.2	654.3	720.9	784.6	840.8	885.3	918.7	941.1	954.6	961.5
4	NW40	33.5	50.3	83.5	137.5	213.3	308.2	417.9	535.1	650.3	756.6	845.4	910.0	948.2
5	W69	286.4	309.9	350.5	408.4	480.4	560.6	643.7	724.0	795.1	855.2	901.2	932.4	950.2
6	SE53	492.9	516.9	556.9	611.5	675.5	741.8	805.1	860.7	904.5	937.2	958.9	971.9	978.6
7	E36	273.2	297.4	339.4	400.1	476.3	562.2	652.4	740.7	820.1	888.1	940.8	977.0	997.8
8	SW24	383.6	408.4	450.6	510.0	582.6	661.5	741.5	816.8	881.7	934.9	974.5	1000.8	1015.5

```
RDM(1-12)= -0.13 -0.13 -0.10 -0.08 -0.08 -0.07 -0.07 -0.07 -0.08 -0.08 -0.13 -0.13
RDC(1-12)=  1.83  1.83  1.60  1.46  1.46  1.42  1.42  1.42  1.46  1.46  1.83  1.83
MRDC=  2   PARS=  0.44   PARW=  0.50   RDB=  0.25   RDP=  0.61   RDMX=  0.80   RTB=  1.00   RTC=  1.00   ITSOL=  1
TSOLX(1-12) -    50.0   50.0   50.0   50.0   55.0   60.0   70.0   70.0   60.0   50.0   50.0   50.0
```

SUNLIGHT HOURS/12

1	HOR	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3
2	SW05	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.2	1.3
3	SW67	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0
4	NW40	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.3
5	W69	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0
6	SE53	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1
7	E36	0.6	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1
8	SW24	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2

Needle Branch daily post-calibration model output--Continued

RMXA= 0.80 RMXM= 0.60 MTSS= 8 MTSE= 9 ARSA= 0.05 ARSM= 0.20

```
CSEL(1-5)=        50.
MPCS=   0         MPCN=   0     MPC1=   0     PCONR=  1.00     PCONS=  1.00
PCR(1-NRU) -       1.00    1.00    1.00    1.00    1.00    1.00    1.00
PCS(1-NRU) -       1.00    1.00    1.00    1.00    1.00    1.00    1.00
CTS(1-12)= 0.007200 0.011000 0.007600 0.008700 0.008300 0.011500 0.013300 0.012600 0.009600 0.015900 0.011100 0.006000
CTW=    0.50
PAT(1-12)=   40.00   40.00   40.00   40.00   40.00   40.00   40.00   40.00   40.00   40.00   40.00   40.00
AJMX(1-12)=    1.00    1.00    1.00    1.00    1.00    1.00    1.00    1.00    1.00    1.00    1.00    1.00
TLX(1-12)=    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00
TLN(1-12)=    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00    3.00
EVC(1-12)=   0.750   0.750   0.750   0.750   0.750   0.750   0.750   0.750   0.750   0.750   0.750   0.750
ISP1= 90     ISP2=120     EAIR= 1.000     FWCAP= 0.05     DENI= 0.20     DENMX= 0.60     SETCON= 0.10     BST= 32.00
CECN(1-12)=     5.00    5.00    5.00    5.00    5.00    5.00    5.00    5.00    5.00    5.00    5.00    5.00
```

#	RES	RSEP	RESMX	REXP	KRSP	RCF	RCP
1	1.520	0.000	1.0000	1.0000	1	0.0000000	0.0931000
2	1.520	0.000	1.0000	1.0000	1	0.0000000	0.0931000
3	1.420	0.000	1.0000	1.0000	1	0.0000000	0.0931000

#	GW	GSNK	RCB
1	2.300	0.000	0.0232

IRU	IRD / ELEV	ITST / ITND	ITSW / CTX	TXAJ / TNAJ	RNSTS / RNSTW	SNST / TRNCF	COVDS / COVDW	ICOV / ISOIL	SMAX / SMAV	REMX / RECHR	SCN / SC1	SRX / SCX	RETIP / IMPRV	SEP / KSTOR	KRES / KGW
1	2	5	0	0.00	0.26	0.01	0.15	0	2.40	2.40	0.00100	2.00	0.10	0.12	1
	450.	10	0.00	0.00	0.03	1.00	0.07	2	2.37	2.37	0.31200	0.00	0.00	0	1
2	3	1	1	0.00	0.59	0.01	0.75	3	6.40	0.40	0.00100	2.00	0.10	0.12	2
	840.	12	0.00	0.00	0.18	1.00	0.50	2	6.39	0.40	0.31200	0.00	0.03	0	1
3	4	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00100	2.00	0.10	0.12	3
	640.	10	0.00	0.00	0.03	1.00	0.07	2	1.89	1.89	0.31200	0.00	0.06	0	1
4	5	5	0	0.00	0.26	0.01	0.15	0	1.60	1.60	0.00100	2.00	0.10	0.12	2
	600.	10	0.00	0.00	0.03	1.00	0.07	2	1.59	1.59	0.31200	0.00	0.02	0	1
5	6	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00100	2.00	0.10	0.12	3
	900.	10	0.00	0.00	0.03	1.00	0.07	2	1.88	1.88	0.31200	0.00	0.08	0	1
6	7	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00100	2.00	0.10	0.12	3
	700.	10	0.00	0.00	0.03	1.00	0.07	2	1.88	1.88	0.31200	0.00	0.04	0	1
7	8	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00100	2.00	0.10	0.12	3
	680.	10	0.00	0.00	0.03	1.00	0.07	2	1.88	1.88	0.31200	0.00	0.02	0	1

Needle Branch daily post-calibration model output--Continued

IRU	IDS	SLOPE	AREA	PERV AREA	IMPERV AREA	UPCOR	DRCOR	DSCOR	TST	KTS	KSP	KDC	AIMX	PKFAC
1	1	0.05	11.5	11.5	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
2	1	0.67	22.8	22.1	0.7	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
3	1	0.40	10.1	9.5	0.6	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
4	1	0.69	19.9	19.5	0.4	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
5	1	0.53	26.6	24.4	2.2	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
6	1	0.36	59.9	57.7	2.2	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
7	1	0.24	23.8	23.2	0.6	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00

TOTAL			174.6	168.1	6.5									

```
BYR= 1967 BMO=    1 BDY=    1
NSP=    6
 12  11967 1261967 130   NE= 16
 13  11967 3141967 316   NE= 16
 14  11968 2 31968 2 5   NE= 16
INV=1967
 15  11968 2181968 220   NE= 16
 16  11968 2211968 224   NE= 16
 17  1196812 919681213   NE= 16
INV=1968
INV=1969
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STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)

IRU	KSAT	PSP	RGF	DRN
1	20.000	0.010	50.000	2.000
2	20.000	0.010	50.000	2.000
3	20.000	0.010	50.000	2.000
4	20.000	0.010	50.000	2.000
5	20.000	0.010	50.000	2.000
6	20.000	0.010	50.000	2.000
7	20.000	0.010	50.000	2.000

Needle Branch daily post-calibration model output--Continued

WY	WYD	#HS	ST#	RFL	SFL	BEGIN AND END TIMES FOR #HS
1967	118	1	1	0	1	0.1440.
1967	119	1	1	1	1	0.1440.
1967	120	1	1	1	1	0.1440.
1967	121	1	1	1	1	0.1440.
1967	122	1	1	1	0	0.1440.
1967	165	1	2	0	1	0.1440.
1967	166	1	2	1	1	0.1440.
1967	167	1	2	1	0	0.1440.
1968	126	1	3	0	1	0.1440.
1968	127	1	3	1	1	0.1440.
1968	128	1	3	1	0	0.1440.
1968	141	1	4	0	1	0.1440.
1968	142	1	4	1	1	0.1440.
1968	143	1	4	1	0	0.1440.
1968	144	1	5	0	1	0.1440.
1968	145	1	5	1	1	0.1440.
1968	146	1	5	1	1	0.1440.
1968	147	1	5	1	0	0.1440.
1969	70	1	6	0	1	0.1440.
1969	71	1	6	1	1	0.1440.
1969	72	1	6	1	1	0.1440.
1969	73	1	6	1	1	0.1440.
1969	74	1	6	1	0	0.1440.

NUMBER OF OVERLAND FLOW PLANE SEGMENTS IS 14. THEIR CHARACTERISTICS ARE AS FOLLOWS:

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	OF1	1	5	0.0000	99	0	0	1	582.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
2	OF2	1	5	0.0000	99	0	0	1	442.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
3	OF3	1	5	0.0000	99	0	0	1	548.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
4	OF4	1	2	0.0000	99	0	0	1	764.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
5	OF5	1	7	0.0000	99	0	0	1	275.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
6	OF6	1	7	0.0000	99	0	0	1	523.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
7	OF7	1	3	0.0000	99	0	0	1	338.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
8	OF8	1	6	0.0000	99	0	0	1	493.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
9	OF9	1	6	0.0000	99	0	0	1	376.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
10	OF10	1	6	0.0000	99	0	0	1	346.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
11	OF11	1	6	0.0000	99	0	0	1	417.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
12	OF12	1	4	0.0000	99	0	0	1	408.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
13	OF13	1	4	0.0000	99	0	0	1	318.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0
14	OF14	1	1	0.0000	99	0	0	1	295.0	.0000	.000	0.00	0.00	1.50	1.33	5.0	5.0

Needle Branch daily post-calibration model output--Continued

NUMBER OF CHANNEL AND RESERVOIR SEGMENTS IS 9

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	CH1			OF1		10.7	10.7	0.10	3	0	0	3	800.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
2	CH2	CH1		OF5	OF4	31.0	41.7	0.10	3	0	0	3	1300.0	.1100	.050	10.00	10.00	2.87	1.33	60.0	60.0
3	CH3			OF3	OF2	15.9	15.9	0.10	3	0	0	3	700.0	.3200	.050	10.00	10.00	4.90	1.33	60.0	60.0
4	CH4	CH3				0.0	15.9	0.10	3	0	0	3	600.0	.2400	.050	10.00	10.00	4.25	1.33	60.0	60.0
5	CH5	CH4	CH2	OF6	OF7	25.7	83.3	0.10	3	0	0	3	1300.0	.0600	.050	10.00	10.00	2.12	1.33	60.0	60.0
6	CH6			OF9	OF8	31.9	31.9	0.10	3	0	0	3	1600.0	.3600	.050	10.00	10.00	5.20	1.33	60.0	60.0
7	CH7	CH6	CH5		OF12	7.5	122.7	0.10	3	0	0	3	800.0	.0700	.050	10.00	10.00	2.29	1.33	60.0	60.0
8	CH8			OF11	OF10	28.0	28.0	0.10	3	0	0	3	1600.0	.3300	.050	10.00	10.00	4.98	1.33	60.0	60.0
9	CH9	CH8	CH7	OF14	OF13	23.9	174.7	0.10	3	0	3	3	1700.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0

OBSERVED AND PREDICTED RUNOFF FOR WY 1960

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	0.61	0.52	1.60	1.72	4.70	5.19	0.95	1.02	5.70	5.59	1.10	1.12
2	0.95	2.34	1.30	1.36	9.60	6.67	0.84	0.96	6.70	7.12	0.91	0.97
3	2.70	3.10	1.10	1.11	16.00	11.19	0.77	0.86	12.00	9.75	0.80	0.86
4	0.87	2.30	0.96	0.93	13.00	12.47	0.74	0.79	13.00	10.81	0.74	0.77
5	0.61	1.74	0.85	0.80	13.00	10.62	0.74	0.79	6.50	6.22	0.80	1.13
6	0.45	1.31	0.77	0.70	8.30	8.26	0.68	0.71	3.80	3.77	0.68	1.14
7	0.38	1.05	0.71	0.61	7.20	6.14	0.87	1.24	2.70	2.72	0.65	1.36
8	0.35	0.86	0.98	0.87	5.50	4.24	1.10	2.06	2.00	2.09	0.59	1.25
9	0.32	0.72	1.20	1.79	4.00	2.98	7.60	5.22	1.50	1.68	0.54	1.07
10	0.37	0.82	2.40	2.95	3.00	2.63	6.50	5.82	1.20	1.40	0.51	0.94
11	0.55	0.61	2.80	2.77	2.40	2.19	4.00	3.96	1.10	1.20	0.54	1.15
12	0.43	0.50	2.30	2.07	2.20	1.86	3.20	3.26	0.95	1.04	1.80	2.62
13	0.58	0.75	2.00	1.73	1.90	1.53	3.00	2.70	0.84	0.93	3.10	3.38
14	0.66	0.65	1.70	1.43	1.60	1.28	3.60	3.40	0.77	0.84	3.60	3.67
15	0.61	0.56	1.40	1.16	1.40	1.10	5.00	4.11	0.68	0.76	5.20	5.75
16	0.56	0.49	1.30	0.98	1.30	1.09	5.30	4.50	0.62	0.71	8.30	5.36
17	0.50	0.44	1.10	0.85	1.40	1.63	4.90	3.79	0.91	1.04	5.50	4.70
18	0.56	0.56	1.00	0.75	1.30	1.81	3.80	2.72	2.10	3.34	4.00	3.85
19	0.47	0.40	0.91	0.66	1.30	1.68	2.90	2.34	19.00	16.33	3.00	2.74
20	0.43	0.36	0.80	0.60	1.30	1.63	2.30	2.06	9.60	12.05	2.30	2.08
21	1.40	1.45	0.74	0.54	1.70	2.06	1.80	1.69	10.00	12.52	1.80	1.66
22	2.20	2.87	0.71	0.50	3.70	3.61	1.40	1.42	11.00	12.28	1.40	1.37
23	3.00	2.84	0.65	0.46	5.70	3.63	1.20	1.23	9.90	10.29	1.40	1.66
24	2.60	2.87	0.74	0.54	3.80	2.62	1.10	1.08	5.70	5.91	1.40	1.52
25	2.50	2.59	0.62	0.49	3.00	2.06	1.10	1.42	3.60	3.59	3.40	1.89
26	2.20	1.93	0.59	0.43	2.20	1.65	1.00	1.67	2.50	2.59	3.60	1.81
27	9.60	7.12	0.62	0.46	1.70	1.38	0.91	1.50	1.90	1.98	3.40	2.85
28	11.00	8.21	1.00	1.56	1.40	1.18	0.91	1.28	1.50	1.59	5.00	3.44
29	4.90	4.78	5.50	4.40	1.20	1.04	1.20	1.13	1.20	1.32	4.40	2.96
30	3.20	3.16	6.00	6.33	1.10	0.92	2.40	1.87	0.00	0.00	3.20	2.29
31	2.20	2.27	0.00	0.00	0.95	0.89	5.30	4.84	0.00	0.00	2.40	1.80

Needle Branch daily post-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1968

DAY	APRIL OBS	APRIL PRED	MAY OBS	MAY PRED	JUNE OBS	JUNE PRED	JULY OBS	JULY PRED	AUGUST OBS	AUGUST PRED	SEPTEMBER OBS	SEPTEMBER PRED
1	1.90	1.47	0.54	0.51	1.70	3.38	0.25	0.22	0.09	0.09	0.22	0.48
2	1.50	1.24	0.51	0.48	5.50	5.75	0.25	0.21	0.09	0.09	0.20	0.43
3	1.20	1.07	0.48	0.45	4.30	4.66	0.24	0.20	0.09	0.08	0.19	0.39
4	1.20	1.23	0.48	0.45	3.00	3.13	0.23	0.19	0.09	0.08	0.19	0.35
5	1.10	1.39	0.59	0.69	2.20	2.28	0.23	0.19	0.09	0.08	0.19	0.32
6	1.10	1.28	0.51	0.60	1.70	1.75	0.21	0.18	0.09	0.08	0.19	0.30
7	1.20	1.10	0.46	0.56	1.40	1.40	0.20	0.18	0.08	0.08	0.17	0.28
8	1.10	0.97	0.43	0.52	1.10	1.16	0.19	0.17	0.08	0.07	0.17	0.26
9	1.10	0.86	0.39	0.48	0.98	0.98	0.19	0.16	0.07	0.07	0.17	0.24
10	0.98	0.78	0.39	0.46	0.88	0.85	0.18	0.16	0.07	0.07	0.16	0.22
11	0.87	0.71	0.41	0.47	0.80	0.75	0.19	0.18	0.07	0.07	0.16	0.21
12	0.84	0.65	0.43	0.53	0.72	0.67	0.20	0.15	0.07	0.07	0.14	0.20
13	0.77	0.60	0.41	0.43	0.72	0.69	0.19	0.20	0.11	0.06	0.19	0.32
14	0.80	0.56	0.37	0.40	0.61	0.55	0.27	0.19	0.15	0.08	0.42	0.40
15	0.98	0.61	0.35	0.39	0.55	0.50	0.19	0.14	0.10	0.06	0.33	0.17
16	0.95	0.67	0.35	0.37	0.52	0.46	0.17	0.13	0.10	0.06	0.24	0.17
17	0.91	0.61	0.33	0.35	0.48	0.43	0.16	0.13	0.10	0.10	0.20	0.16
18	0.95	0.58	0.33	0.34	0.45	0.40	0.15	0.13	0.11	0.23	0.49	1.17
19	0.91	0.55	0.41	0.46	0.44	0.38	0.17	0.12	0.39	0.13	0.66	1.25
20	0.87	0.57	0.35	0.32	0.40	0.36	0.15	0.12	0.12	0.05	0.65	1.04
21	0.80	0.51	0.46	0.46	0.38	0.34	0.13	0.12	0.10	0.05	0.56	0.83
22	0.74	0.48	0.39	0.45	0.50	0.32	0.13	0.11	0.10	0.09	0.48	0.70
23	0.77	0.53	0.37	0.40	0.38	0.30	0.12	0.11	0.56	0.48	0.43	0.60
24	0.68	0.45	0.41	0.63	0.35	0.29	0.13	0.11	0.37	0.46	0.39	0.52
25	0.68	0.57	1.50	1.18	0.32	0.28	0.12	0.10	0.55	0.69	0.35	0.46
26	0.65	0.51	1.90	1.84	0.31	0.26	0.11	0.10	0.34	0.67	0.35	0.41
27	0.62	0.48	1.90	1.74	0.33	0.29	0.10	0.10	0.44	0.94	0.33	0.37
28	0.56	0.46	1.50	1.40	0.33	0.27	0.10	0.10	0.36	0.87	0.29	0.33
29	0.56	0.44	1.20	1.16	0.30	0.23	0.09	0.09	0.30	0.73	0.29	0.30
30	0.62	0.63	1.00	0.99	0.27	0.22	0.09	0.09	0.25	0.63	0.29	0.28
31	0.00	0.00	0.95	0.89	0.00	0.00	0.09	0.09	0.23	0.55	0.00	0.00

SUMMARY STATISTICS FOR WATER YEAR 1967

	MEAN RUNOFF (CFS) OBSV.	MEAN RUNOFF (CFS) PRED.	TOTAL RUNOFF (CFS DAYS) OBSV.	TOTAL RUNOFF (CFS DAYS) PRED.	# OF RESIDUALS +	# OF RESIDUALS -	# OF RUNS
OCT	0.00	0.00	0.00	0.00	0	0	0
NOV	0.00	0.00	0.00	0.00	0	0	0
DEC	0.00	0.00	0.00	0.00	0	0	0
JAN	5.19	4.96	160.80	153.81	20	11	10
FEB	2.31	2.65	64.69	74.26	4	24	3
MAR	3.21	3.19	99.38	98.96	17	14	9
APR	1.71	1.95	51.38	58.42	8	22	8
MAY	0.41	0.42	12.76	12.97	10	21	12
JUN	0.19	0.16	5.64	4.85	28	2	3
JUL	0.08	0.07	2.50	2.29	26	5	5
AUG	0.04	0.04	1.15	1.13	19	12	5
SEP	0.04	0.04	1.33	1.14	27	3	4
YEAR	1.46	1.49	399.63	407.83	159	114	64
MFS-MFN	0.15	0.15	23.38	22.38	110	43	27

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Needle Branch daily post-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1968

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	1.86	1.94	57.76	60.15	13	18	10
NOV	1.48	1.39	44.35	41.57	23	7	7
DEC	4.09	3.46	126.85	107.23	25	6	4
JAN	2.49	2.30	77.11	71.42	16	15	8
FEB	4.79	4.88	138.97	141.45	7	22	8
MAR	2.45	2.23	76.06	69.17	14	17	4
APR	0.93	0.75	27.91	22.56	26	4	4
MAY	0.65	0.66	20.10	20.40	12	19	5
JUN	1.06	1.11	31.92	33.33	21	9	2
JUL	0.17	0.14	5.22	4.48	28	3	5
AUG	0.19	0.25	5.76	7.86	20	11	6
SEP	0.30	0.44	9.09	13.17	5	25	4
YEAR	1.70	1.62	621.10	592.79	210	156	59
MFS-MFN	0.47	0.52	72.09	79.24	86	67	19

SUMMARY STATISTICS FOR WATER YEAR 1969

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	1.66	1.18	51.60	36.71	30	1	3
NOV	4.42	3.65	132.60	109.45	23	7	8
DEC	6.36	5.17	197.30	160.24	26	5	8
JAN	2.37	2.52	0.00	0.00	16	15	12
FEB	6.17	6.28	0.00	0.00	9	19	8
MAR	4.54	4.61	0.00	0.00	14	17	15
APR	0.89	1.18	0.00	0.00	1	29	3
MAY	0.86	0.79	0.00	0.00	26	5	2
JUN	0.24	0.22	0.00	0.00	21	9	4
JUL	0.09	0.10	0.00	0.00	5	26	5
AUG	0.06	0.05	0.00	0.00	19	12	6
SEP	0.05	0.03	0.00	0.00	28	2	3
YEAR	4.15	3.33	381.50	306.40	79	13	18
MFS-MFN	0.26	0.24	0.00	0.00	0	0	19

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Needle Branch daily post-calibration model output--Continued

SUMMARY STATISTICS FOR OPTIMIZATION PERIOD 1967 TO 1969

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
TOTAL	1.92	1.79	1402.23	1307.02	448	283	362
MFS-MFN	0.31	0.33	95.47	101.62	196	110	46

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

VERIFICATION CRITERIA

	DAILY		MONTHLY	
	TOTAL	MFS-MFN	TOTAL	MFS-MFN
COEFFICIENT OF DETERMINATION	0.920	0.924	0.976	0.977
(LOGS)	0.954	0.918		
COEFFICIENT OF PERSISTENCE	1.102	-11.930		
COEFFICIENT OF GAIN FROM DAILY AVERAGES	0.850	0.933		
RESIDUAL-PREDICTED CORRELATION	0.106	-0.415		

ERROR SUMMARY (MFS-MFN PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	-6.15	-2.57	17.16	10.91	6.16	1.50
MEAN	-0.02	-0.01	0.06	0.04	0.02	0.00
PERCENT	-6.44		17.98		45.46	

ERROR SUMMARY (TOTAL PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	95.21	10.98	269.26	68.53	460.35	15.57
MEAN	0.13	0.02	0.37	0.09	0.63	0.02
PERCENT	6.79		19.20		41.37	

STORM	PREDICTED VOLUME (INCHES)	ROUTED OUTFLOW (INCHES)	OBSERVED OUTFLOW (INCHES)	PREDICTED PEAK (CFS)	OBSERVED PEAK (CFS)
1	8.32	8.99	9.05	23.55	28.80
2	3.69	3.99	4.20	19.14	24.00
3	3.38	3.65	4.25	13.87	15.00
4	4.01	4.32	4.13	19.87	24.40
5	5.17	5.59	5.00	14.52	12.60
6	4.78	5.17	7.19	14.70	23.60
MEAN	4.89	5.28	5.64	17.61	21.40
LOGS	1.54	1.62	1.68	2.85	3.02

Needle Branch daily post-calibration model output--Continued

STORM VOLUME ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	4.81	0.91	7.39	0.24
MEAN	0.80	0.15	1.23	0.04
PERCENT	14.21		19.70	

STORM PEAK ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	26.60	1.33	155.90	0.38
MEAN	4.43	0.22	25.98	0.06
PERCENT	20.71		23.82	

```
1 - NUMBER OF PRECIPITATION GAGES
1 - NUMBER OF SEGMENTS SAVED FOR PLTGEN
1 - NUMBER OF SEGMENTS SAVED FOR PRINT, PLOT, AND PLTGEN
3 - NUMBER OF CURVES OUTPUT TO PLTGEN FILE(S)
0 - NUMBER OF PLTGEN SEGMENTS SKIPPED
3    0 NC1, NC2

TIME0 1967    1   26    0    0
TIMEN 1967    1   30   24    0
LAPSED TIME    7201

CH9   5   2

INCDT  300
MAXRD   24
KOUNT    3
KSKIP    0

INC   24   24   24
INC    1    1    1
```

Deer Creek daily post-calibration model output

PRMS -- VERSION 0888

IOPT= 0 ISIM= 2 IOBS= 1 ISEN= 0 PROB= 0
IDOUT= 3 IUOUT= 2 SCODE=OR IPSW= 0
IPET= 1 ISSR1= 1 MRDC= 2 ISUN= 1 ILPS= 0
NYR= 3 NDS= 1 NRU= 13 NRD= 14 NRES= 3 NGW= 1 NSTOR= 0 DAT= 749.50
NTS= 1 NPLW= 0NDC= 0
BYR/BMO/BDY= 1967/ 1/ 1 EYR/EMO/EDY= 1968/12/31 MFS= 5 MFN= 9

DATA TYPE	PARAMETER CODE	STATISTIC CODE	DSN	STATION ID
DAILY DISCHARGE	60	3	10	D000000000000010
DAILY EVAP	0	0	0	
DAILY MAX TEMP	99998	1	41	D000000000000040
DAILY MIN TEMP	99998	2	40	D000000000000040
DAILY SOLAR RAD	0	0	0	
SNOW PILLOW	0	0		
USER VARIABLE 2	0	0	0	
UNIT DISCHARGE	60	11	11	U000000000000011
DAILY PRECIP	45	6	20	D000000000000020
UNIT PRECIP	45	6	21	U000000000000021

POT SOLAR RADIATION

1	HOR	261.3	285.9	328.8	391.1	470.0	559.4	654.1	747.4	832.0	905.0	961.9	1001.3	1023.9
2	S05	303.6	328.4	371.2	432.6	509.5	595.5	685.4	772.7	850.8	917.3	968.5	1003.6	1023.6
3	SE48	477.4	501.6	542.1	597.6	663.1	731.5	797.5	856.2	903.3	939.2	963.7	978.7	986.6
4	S56	620.5	643.3	680.0	727.4	779.2	829.1	872.6	906.1	927.4	938.9	943.6	944.8	944.7
5	NW56	120.5	140.5	176.6	231.6	305.0	392.7	490.5	591.4	687.6	774.1	844.5	894.6	924.1
6	E48	227.3	250.5	291.2	350.5	426.1	512.4	604.6	695.9	779.5	852.0	909.0	948.6	971.5
7	NW56	120.5	140.5	176.6	231.6	305.0	392.7	490.5	591.4	687.6	774.1	844.5	894.6	924.1
8	S40	540.9	564.8	604.1	656.7	716.9	778.2	835.7	885.0	922.5	949.3	966.7	977.0	982.2
9	E46	277.9	301.9	343.5	403.3	478.3	562.5	650.7	736.6	813.5	879.1	929.9	964.6	984.5
10	SE64	653.1	675.3	710.7	755.4	803.1	847.7	884.6	911.0	925.0	929.7	928.8	926.1	923.7
11	E42	276.0	300.1	341.9	402.1	477.6	562.5	651.5	738.3	816.3	882.9	934.4	969.7	990.0
12	E40	229.4	252.9	294.0	354.1	430.7	518.4	611.9	704.6	789.5	863.2	921.2	961.4	984.7
13	NW54	122.6	142.8	179.2	234.7	308.5	396.7	494.8	596.1	692.5	779.2	849.6	899.8	929.3
14	NW32	157.5	179.8	219.9	279.8	358.2	450.5	551.6	654.5	751.2	837.1	906.2	955.0	983.6

RDM(1-12)= -0.13 -0.13 -0.10 -0.08 -0.08 -0.07 -0.07 -0.07 -0.08 -0.08 -0.13 -0.13
RDC(1-12)= 1.83 1.83 1.60 1.46 1.46 1.42 1.42 1.42 1.46 1.46 1.83 1.83
MRDC= 2 PARS= 0.44 PARW= 0.50 RDB= 0.25 RDP= 0.61 RDMX= 0.80 RTB= 1.00 RTC= 1.00 ITSOL= 1
TSOLX(1-12) - 50.0 50.0 50.0 50.0 55.0 60.0 70.0 70.0 60.0 50.0 50.0 50.0

SUNLIGHT HOURS/12

1	HOR	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3
2	S05	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.2	1.3
3	SE48	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1
4	S56	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1
5	NW56	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
6	E48	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1
7	NW56	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
8	S40	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1
9	E46	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
10	SE64	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1
11	E42	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
12	E40	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.1
13	NW54	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
14	NW32	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2

Deer Creek daily post-calibration model output--Continued

RMXA= 0.80 RMXM= 0.60 MTSS= 8 MTSE= 9 ARSA= 0.05 ARSM= 0.20

CSEL(1-5)= 50.
MPCS= 0 MPCN= 0 MPC1= 0 PCONR= 1.00 PCONS= 1.00
PCR(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00
PCS(1-NRU) - 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00
CTS(1-12)= 0.008700 0.013400 0.009200 0.010600 0.010100 0.013900 0.016100 0.015300 0.011700 0.019300 0.013500 0.007300
CTW= 0.50
PAT(1-12)= 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00 40.00
AJMX(1-12)= 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
TLX(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
TLN(1-12)= 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
EVC(1-12)= 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750 0.750
ISP1= 90 ISP2=120 EAIR= 1.000 FWCAP= 0.05 DENI= 0.20 DENMX= 0.60 SETCON= 0.10 BST= 32.00
CECN(1-12)= 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00

#	RES	RSEP	RESMX	REXP	KRSP	RCF	RCP
1	1.660	0.000	1.0000	1.0000	1	0.0000000	0.0668000
2	1.690	0.000	1.0000	1.0000	1	0.0000000	0.0668000
3	1.640	0.000	1.0000	1.0000	1	0.0000000	0.0668000

#	GW	GSNK	RCB
1	3.040	0.000	0.0196

IRU	IRD	ITST	ITSW	TXAJ	RNSTS	SNST	COVDS	ICOV	SMAX	REMX	SCN	SRX	RETIP	SEP	KRES
	ELEV	ITND	CTX	TNAJ	RNSTW	TRNCF	COVDW	ISOIL	SMAV	RECHR	SC1	SCX	IMPRV	KSTOR	KGW
1	2	4	1	0.00	0.56	0.01	0.80	3	12.00	0.40	0.00000	2.00	0.10	0.15	1
	680.	11	0.00	0.00	0.18	1.00	0.15	2	12.00	0.40	0.20600	0.00	0.00	0	1
2	3	5	0	0.00	0.26	0.01	0.15	0	1.60	1.60	0.00000	2.00	0.10	0.15	2
	960.	10	0.00	0.00	0.03	1.00	0.07	2	1.57	1.57	0.20600	0.00	0.04	0	1
3	4	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00000	2.00	0.10	0.15	3
	900.	10	0.00	0.00	0.03	1.00	0.07	2	1.87	1.87	0.20600	0.00	0.01	0	1
4	5	5	0	0.00	0.26	0.01	0.15	0	1.60	1.60	0.00000	2.00	0.10	0.15	2
	880.	10	0.00	0.00	0.03	1.00	0.07	2	1.59	1.59	0.20600	0.00	0.00	0	1
5	6	5	0	0.00	0.26	0.01	0.15	0	1.90	1.90	0.00000	2.00	0.10	0.15	3
	850.	10	0.00	0.00	0.03	1.00	0.07	2	1.88	1.88	0.20600	0.00	0.02	0	1
6	7	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	740.	12	0.00	0.00	0.18	1.00	0.70	2	4.39	0.40	0.20600	0.00	0.01	0	1
7	8	1	1	0.00	0.56	0.01	0.80	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	1360.	12	0.00	0.00	0.18	1.00	0.70	2	4.39	0.40	0.20600	0.00	0.01	0	1
8	9	5	0	0.00	0.26	0.01	0.15	0	1.60	1.60	0.00000	2.00	0.10	0.15	2
	1200.	10	0.00	0.00	0.03	1.00	0.07	2	1.58	1.58	0.20600	0.00	0.04	0	1
9	10	1	1	0.00	0.56	0.01	0.90	3	4.39	0.40	0.00000	2.00	0.10	0.15	3
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	4.38	0.40	0.20600	0.00	0.02	0	1
10	11	4	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1300.	11	0.00	0.00	0.18	1.00	0.10	2	6.15	0.40	0.20600	0.00	0.02	0	1
11	12	1	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	6.16	0.40	0.20600	0.00	0.00	0	1
12	13	1	1	0.00	0.56	0.01	0.90	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	1000.	12	0.00	0.00	0.18	1.00	0.40	2	6.16	0.40	0.20600	0.00	0.01	0	1
13	14	1	1	0.00	0.56	0.01	0.95	3	6.17	0.40	0.00000	2.00	0.10	0.15	2
	800.	12	0.00	0.00	0.18	1.00	0.70	2	6.17	0.40	0.20600	0.00	0.00	0	1

Deer Creek daily post-calibration model output--Continued

IRU	IDS	SLOPE	AREA	PERV AREA	IMPERV AREA	UPCOR	DRCOR	DSCOR	TST	KTS	KSP	KDC	AIMX	PKFAC
1	1	0.05	58.6	58.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
2	1	0.48	23.3	22.4	0.9	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
3	1	0.56	16.2	16.0	0.2	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
4	1	0.56	23.8	23.7	0.1	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
5	1	0.48	46.3	45.6	0.7	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
6	1	0.56	7.1	7.0	0.1	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
7	1	0.40	52.3	51.7	0.6	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
8	1	0.46	64.4	62.1	2.3	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
9	1	0.64	82.2	80.7	1.5	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
10	1	0.42	32.7	32.0	0.7	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
11	1	0.40	126.4	126.0	0.4	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
12	1	0.54	125.6	124.8	0.8	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00
13	1	0.32	90.6	90.6	0.0	1.00	1.00	1.00	0.0	1	0	0	0.01	1.00

TOTAL			749.5	741.3	8.2									

```
BYR= 1967 BMO=    1 BDY=    1
NSP=    6
 12  11967 1261967 130  NE= 16
 13  11967 3141967 316  NE= 16
 14  11968 2 31968 2 5  NE= 16
INV=1967
 15  11968 2181968 220  NE= 16
 16  11968 2211968 224  NE= 16
 17  1196812 919681213  NE= 16
INV=1968
INV=1969
```

STORMFLOW HYDROGRAPH PARAMETERS FOR EACH HYDROLOGIC RESPONSE UNIT(IRU)

IRU	KSAT	PSP	RGF	DRN
1	20.000	0.010	50.000	2.000
2	20.000	0.010	50.000	2.000
3	20.000	0.010	50.000	2.000
4	20.000	0.010	50.000	2.000
5	20.000	0.010	50.000	2.000
6	20.000	0.010	50.000	2.000
7	20.000	0.010	50.000	2.000
8	20.000	0.010	50.000	2.000
9	20.000	0.010	50.000	2.000
10	20.000	0.010	50.000	2.000
11	20.000	0.010	50.000	2.000
12	20.000	0.010	50.000	2.000
13	20.000	0.010	50.000	2.000

Deer Creek daily post-calibration model output--Continued

WY	WYD	#HS	ST#	RFL	SFL	BEGIN AND END TIMES FOR #HS
1967	118	1	1	0	1	0.1440.
1967	119	1	1	1	1	0.1440.
1967	120	1	1	1	1	0.1440.
1967	121	1	1	1	1	0.1440.
1967	122	1	1	1	0	0.1440.
1967	165	1	2	0	1	0.1440.
1967	166	1	2	1	1	0.1440.
1967	167	1	2	1	0	0.1440.
1968	126	1	3	0	1	0.1440.
1968	127	1	3	1	1	0.1440.
1968	128	1	3	1	0	0.1440.
1968	141	1	4	0	1	0.1440.
1968	142	1	4	1	1	0.1440.
1968	143	1	4	1	0	0.1440.
1968	144	1	5	0	1	0.1440.
1968	145	1	5	1	1	0.1440.
1968	146	1	5	1	1	0.1440.
1968	147	1	5	1	0	0.1440.
1969	70	1	6	0	1	0.1440.
1969	71	1	6	1	1	0.1440.
1969	72	1	6	1	1	0.1440.
1969	73	1	6	1	1	0.1440.
1969	74	1	6	1	0	0.1440.

NUMBER OF OVERLAND FLOW PLANE SEGMENTS IS 42. THEIR CHARACTERISTICS ARE AS FOLLOWS:

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	OF1	1	8	0.0000	99	0	0	1	381.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
2	OF2	1	8	0.0000	99	0	0	1	1021.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
3	OF3	1	11	0.0000	99	0	0	1	563.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
4	OF4	1	9	0.0000	99	0	0	1	992.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
5	OF5	1	7	0.0000	99	0	0	1	354.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
6	OF6	1	7	0.0000	99	0	0	1	374.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
7	OF7	1	9	0.0000	99	0	0	1	299.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
8	OF8	1	9	0.0000	99	0	0	1	1228.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
9	OF9	1	1	0.0000	99	0	0	1	109.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
10	OF10	1	1	0.0000	99	0	0	1	98.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
11	OF11	1	4	0.0000	99	0	0	1	518.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
12	OF12	1	3	0.0000	99	0	0	1	353.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
13	OF13	1	1	0.0000	99	0	0	1	211.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
14	OF14	1	1	0.0000	99	0	0	1	138.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
15	OF15	1	11	0.0000	99	0	0	1	758.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
16	OF16	1	11	0.0000	99	0	0	1	518.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
17	OF17	1	1	0.0000	99	0	0	1	182.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
18	OF18	1	1	0.0000	99	0	0	1	301.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
19	OF19	1	7	0.0000	99	0	0	1	449.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
20	OF20	1	7	0.0000	99	0	0	1	592.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
21	OF21	1	12	0.0000	99	0	0	1	1387.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
22	OF22	1	2	0.0000	99	0	0	1	406.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
23	OF23	1	12	0.0000	99	0	0	1	229.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
24	OF24	1	1	0.0000	99	0	0	1	327.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
25	OF25	1	12	0.0000	99	0	0	1	546.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0

Deer Creek daily post-calibration model output--Continued

SEGMENT #	NAME	IDS	IRU	THRES DEPTH	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
26	OF26	1	12	0.0000	99	0	0	1	607.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
27	OF27	1	1	0.0000	99	0	0	1	149.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
28	OF28	1	1	0.0000	99	0	0	1	448.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
29	OF29	1	10	0.0000	99	0	0	1	909.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
30	OF30	1	10	0.0000	99	0	0	1	871.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
31	OF31	1	11	0.0000	99	0	0	1	961.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
32	OF32	1	11	0.0000	99	0	0	1	520.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
33	OF33	1	1	0.0000	99	0	0	1	65.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
34	OF34	1	1	0.0000	99	0	0	1	176.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
35	OF35	1	13	0.0000	99	0	0	1	956.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
36	OF36	1	13	0.0000	99	0	0	1	1366.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
37	OF37	1	1	0.0000	99	0	0	1	126.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
38	OF38	1	1	0.0000	99	0	0	1	166.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
39	OF39	1	5	0.0000	99	0	0	1	1459.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
40	OF40	1	5	0.0000	99	0	0	1	274.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
41	OF41	1	5	0.0000	99	0	0	1	283.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0
42	OF42	1	6	0.0000	99	0	0	1	309.0	.0000	.000	0.00	0.00	0.00	0.00	5.0	5.0

NUMBER OF CHANNEL AND RESERVOIR SEGMENTS IS 21

SEGMENT #	NAME	UPSTREAM SEGMENTS		ADJACENT SEGMENTS		INC. AREA	CUM. AREA	THRES DISC.	TYPE	PRINT IN	PRINT OUT	NDX	LENGTH	SLOPE	ROUGH-NESS	PARM1	PARM2	ALPHA	EXPM	ROUTE INT.	PRINT INT.
1	CH1			OF1	OF2	64.4	64.4	0.10	3	0	0	3	2000.0	.3600	.050	10.00	10.00	5.20	1.33	60.0	60.0
2	CH2	CH1		OF3	OF4	46.4	110.8	0.10	3	0	0	3	1300.0	.0800	.050	10.00	10.00	2.45	1.33	60.0	60.0
3	CH3			OF6	OF5	28.4	28.4	0.10	3	0	0	3	1700.0	.4400	.050	10.00	10.00	5.75	1.33	60.0	60.0
4	CH4	CH3		OF8	OF7	52.6	81.0	0.10	3	0	0	3	1500.0	.1400	.050	10.00	10.00	3.24	1.33	60.0	60.0
5	CH5	CH4	CH2	OF10	OF9	1.9	193.7	0.10	3	0	0	3	400.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
6	CH6			OF12	OF11	40.0	40.0	0.10	3	0	0	3	2000.0	.3900	.050	10.00	10.00	5.41	1.33	60.0	60.0
7	CH7			OF20	OF19	23.9	23.9	0.10	3	0	0	3	1000.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
8	CH8	CH7		OF22	OF21	102.9	126.8	0.10	3	0	0	3	2500.0	.2100	.050	10.00	10.00	3.97	1.33	60.0	60.0
9	CH9			OF15	OF16	58.6	58.6	0.10	3	0	0	3	2000.0	.3300	.050	10.00	10.00	4.98	1.33	60.0	60.0
10	CH10	CH5	CH6	OF14	OF13	4.8	238.5	0.10	3	0	0	3	600.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
11	CH11	CH10	CH9	OF18	OF17	13.3	310.4	0.10	3	0	0	3	1200.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
12	CH12			OF30	OF29	32.7	32.7	0.10	3	0	0	3	800.0	.4400	.050	10.00	10.00	5.75	1.33	60.0	60.0
13	CH13	CH12		OF32	OF31	51.0	83.7	0.10	3	0	0	3	1500.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
14	CH14	CH8		OF24	OF23	15.3	142.1	0.10	3	0	0	3	1200.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
15	CH15			OF25	OF26	39.7	39.7	0.10	3	0	0	3	1500.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
16	CH16	CH15	CH14	OF28	OF27	9.6	501.8	0.10	3	0	0	3	700.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
17	CH17			OF40	OF39	39.8	39.8	0.10	3	0	0	3	1000.0	.5000	.050	10.00	10.00	6.13	1.33	60.0	60.0
18	CH18			OF36	OF35	90.6	90.6	0.10	3	0	0	3	1700.0	.4000	.050	10.00	10.00	5.48	1.33	60.0	60.0
19	CH19	CH13	CH16	OF34	OF33	13.3	598.7	0.10	3	0	0	3	2400.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
20	CH20	CH19	CH18	OF38	OF37	6.7	696.1	0.10	3	0	0	3	1000.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0
21	CH21	CH20	CH17	OF41	OF42	13.6	749.4	0.10	3	0	3	3	1000.0	.0300	.050	10.00	10.00	1.50	1.33	60.0	60.0

APPENDIX B--Continued

Deer Creek daily post-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1968

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	1.70	0.59	3.60	7.25	14.00	20.62	4.70	4.17	18.00	19.49	6.30	6.05
2	1.80	1.45	3.20	5.84	25.00	25.69	4.50	3.89	24.00	27.84	5.50	5.29
3	4.80	1.44	2.60	4.84	37.00	42.80	4.30	3.59	39.00	37.00	4.80	4.70
4	2.40	1.27	2.30	4.09	36.00	50.00	4.00	3.35	45.00	41.73	4.40	4.23
5	1.80	1.22	2.00	3.51	34.00	44.34	3.90	3.25	26.00	26.63	4.40	4.66
6	1.40	1.08	1.80	3.07	25.00	35.60	3.60	3.02	16.00	18.39	3.90	4.85
7	1.10	1.00	1.70	2.71	20.00	27.25	4.10	4.39	12.00	13.60	3.70	5.40
8	0.95	0.93	2.40	2.93	18.00	19.75	5.00	7.13	9.50	10.68	3.40	5.23
9	0.85	0.87	3.90	5.52	14.00	14.28	21.00	17.29	8.00	8.72	3.10	4.67
10	0.90	1.05	6.90	9.56	11.00	12.09	24.00	21.58	6.90	7.34	3.00	4.22
11	1.30	0.83	8.00	9.58	10.00	10.25	14.00	16.34	6.00	6.33	3.00	4.56
12	1.10	0.74	6.40	7.58	9.10	8.56	11.00	13.53	5.20	5.56	4.60	8.79
13	1.40	0.98	5.30	6.37	7.90	7.17	10.00	11.08	4.60	4.97	5.90	12.21
14	1.70	0.80	4.80	5.39	7.20	6.10	11.00	12.95	4.20	4.49	7.30	13.31
15	1.40	0.75	3.90	4.58	6.40	5.30	13.00	15.88	3.80	4.10	13.00	20.49
16	1.30	0.70	3.40	3.98	5.80	4.95	15.00	17.39	3.60	3.80	24.00	21.20
17	1.20	0.67	3.10	3.51	5.70	6.40	15.00	15.63	3.90	4.28	17.00	18.81
18	1.40	0.82	2.90	3.13	5.20	7.28	12.00	11.97	6.90	9.82	12.00	16.45
19	1.30	0.62	2.60	2.82	4.70	6.48	10.00	10.19	58.00	53.32	9.40	12.42
20	1.20	0.59	2.40	2.57	4.40	5.80	8.60	8.93	37.00	44.84	8.00	9.84
21	3.90	1.76	2.20	2.35	5.30	6.82	7.50	7.57	37.00	47.78	6.80	8.09
22	5.60	3.94	2.10	2.17	12.00	12.89	6.60	6.55	41.00	46.77	5.90	6.84
23	6.80	4.95	1.90	2.01	19.00	15.04	5.90	5.77	41.00	41.72	5.70	7.05
24	5.30	5.74	2.10	2.05	13.00	11.53	5.30	5.17	26.00	26.00	5.80	6.65
25	4.80	5.97	2.00	1.92	10.00	9.31	5.10	5.85	18.00	18.85	9.00	7.46
26	4.00	4.89	1.80	1.78	8.10	7.72	4.80	6.68	13.00	13.21	10.00	7.52
27	17.00	19.19	1.80	1.78	6.90	6.57	4.30	6.37	10.00	10.33	11.00	10.42
28	25.00	27.00	2.40	4.75	5.90	5.72	4.00	5.66	8.40	8.40	19.00	13.02
29	10.00	17.55	16.00	14.32	5.20	5.06	4.30	5.08	7.20	7.04	18.00	11.57
30	6.40	12.40	17.00	22.50	4.70	4.54	5.50	5.89	0.00	0.00	13.00	9.46
31	4.60	9.28	0.00	0.00	4.50	4.23	12.00	13.56	0.00	0.00	10.00	7.85

Deer Creek daily post-calibration model output--Continued

OBSERVED AND PREDICTED RUNOFF FOR WY 1968

DAY	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED	OBS	PRED
1	8.50	6.69	2.60	1.85	6.90	9.27	1.40	1.14	0.61	0.50	1.60	0.63
2	7.30	5.83	2.50	1.79	34.00	17.78	1.30	1.10	0.61	0.49	1.40	0.61
3	6.30	5.16	2.40	1.74	21.00	16.36	1.30	1.07	0.60	0.48	1.20	0.58
4	5.90	5.04	2.30	1.72	12.00	12.09	1.20	1.03	0.59	0.47	1.10	0.56
5	5.80	5.24	2.70	2.03	8.60	9.39	1.20	1.00	0.60	0.46	1.00	0.54
6	5.80	5.06	2.60	1.86	6.80	7.57	1.10	0.97	0.57	0.45	1.00	0.53
7	5.70	4.56	2.40	1.80	5.60	6.28	1.10	0.94	0.54	0.44	0.95	0.51
8	5.70	4.16	2.30	1.75	4.80	5.34	1.10	0.92	0.55	0.43	0.89	0.49
9	5.20	3.83	2.20	1.70	4.20	4.62	1.00	0.89	0.51	0.42	0.87	0.48
10	4.80	3.56	2.20	1.65	3.80	4.07	1.00	0.87	0.50	0.41	0.82	0.46
11	4.30	3.33	2.30	1.65	3.50	3.63	1.00	0.88	0.49	0.41	0.82	0.45
12	4.00	3.13	2.30	1.69	3.20	3.27	1.10	0.82	0.48	0.40	0.79	0.43
13	3.70	2.95	2.30	1.53	3.30	3.08	1.00	0.87	0.56	0.39	0.93	0.59
14	3.60	2.79	2.10	1.50	2.90	2.72	1.30	0.84	0.78	0.40	1.50	0.68
15	4.10	2.75	2.00	1.46	2.70	2.52	1.00	0.76	0.62	0.37	1.40	0.40
16	3.90	2.72	1.90	1.42	2.50	2.34	0.95	0.74	0.62	0.37	1.10	0.39
17	3.70	2.53	1.90	1.39	2.30	2.18	0.89	0.72	0.62	0.41	1.00	0.38
18	3.70	2.45	1.80	1.35	2.20	2.05	0.86	0.70	0.70	0.56	2.10	1.24
19	3.70	2.35	2.10	1.48	2.20	1.93	0.89	0.68	1.70	0.44	2.40	0.89
20	3.60	2.34	1.90	1.29	2.00	1.82	0.84	0.67	0.82	0.34	2.40	0.88
21	3.40	2.22	2.20	1.41	1.90	1.73	0.80	0.65	0.70	0.33	2.20	0.79
22	3.20	2.14	2.10	1.35	2.30	1.64	0.77	0.64	0.68	0.37	2.00	0.75
23	3.20	2.16	2.10	1.27	1.90	1.57	0.75	0.62	2.00	0.83	1.80	0.71
24	3.00	2.02	2.10	1.59	1.70	1.50	0.76	0.61	2.00	0.67	1.60	0.67
25	3.00	2.18	4.60	2.62	1.60	1.43	0.76	0.59	2.80	0.76	1.40	0.64
26	3.10	2.05	6.70	4.37	1.60	1.38	0.72	0.58	2.40	0.66	1.30	0.61
27	2.90	1.98	7.60	4.68	1.70	1.37	0.69	0.57	2.90	0.90	1.30	0.58
28	2.80	1.92	6.40	4.13	1.70	1.30	0.67	0.55	3.00	0.74	1.20	0.56
29	2.70	1.87	5.10	3.69	1.60	1.23	0.65	0.54	2.50	0.71	1.10	0.53
30	2.80	2.07	4.30	3.34	1.40	1.18	0.63	0.53	2.10	0.68	1.10	0.51
31	0.00	0.00	3.80	3.09	0.00	0.00	0.62	0.52	1.70	0.66	0.00	0.00

SUMMARY STATISTICS FOR WATER YEAR 1967

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	0.00	0.00	0.00	0.00	0	0	0
NOV	0.00	0.00	0.00	0.00	0	0	0
DEC	0.00	0.00	0.00	0.00	0	0	0
JAN	19.37	19.33	600.60	599.29	15	16	7
FEB	10.77	11.65	301.50	326.08	7	21	5
MAR	10.70	12.81	331.70	397.10	5	26	7
APR	7.40	7.98	222.10	239.46	9	21	10
MAY	2.16	2.14	67.10	66.26	15	16	5
JUN	0.95	0.96	28.37	28.68	10	20	6
JUL	0.49	0.50	15.20	15.61	7	24	7
AUG	0.29	0.27	9.06	8.47	28	3	4
SEP	0.26	0.18	7.75	5.30	30	0	1
YEAR	5.80	6.18	1583.38	1686.27	126	147	43
MFS-MFN	0.83	0.81	127.48	124.34	90	63	19

Deer Creek daily post-calibration model output--Continued

SUMMARY STATISTICS FOR WATER YEAR 1968

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	4.01	4.23	124.40	131.06	21	10	4
NOV	4.08	5.15	122.50	154.45	5	25	5
DEC	12.74	14.52	395.00	450.13	14	17	4
JAN	8.52	9.02	264.00	279.66	12	19	8
FEB	18.59	19.76	539.20	573.03	4	25	6
MAR	8.42	9.14	260.90	283.31	12	19	5
APR	4.31	3.24	129.40	97.10	30	0	1
MAY	2.96	2.07	91.80	64.19	31	0	1
JUN	5.06	4.42	151.90	132.63	20	10	4
JUL	0.95	0.77	29.35	23.99	31	0	1
AUG	1.16	0.52	35.85	15.97	31	0	1
SEP	1.34	0.60	40.27	18.10	30	0	1
YEAR	5.97	6.08	2184.57	2223.64	241	125	31
MFS-MFN	2.28	1.67	349.17	254.88	143	10	5

SUMMARY STATISTICS FOR WATER YEAR 1969

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
OCT	4.38	2.41	135.88	74.84	31	0	1
NOV	14.10	13.98	423.00	419.52	13	17	10
DEC	20.10	21.05	623.00	652.61	10	21	11
JAN	0.00	0.00	0.00	0.00	0	0	0
FEB	0.00	0.00	0.00	0.00	0	0	0
MAR	0.00	0.00	0.00	0.00	0	0	0
APR	0.00	0.00	0.00	0.00	0	0	0
MAY	0.00	0.00	0.00	0.00	0	0	0
JUN	0.00	0.00	0.00	0.00	0	0	0
JUL	0.00	0.00	0.00	0.00	0	0	0
AUG	0.00	0.00	0.00	0.00	0	0	0
SEP	0.00	0.00	0.00	0.00	0	0	0
YEAR	12.85	12.47	1181.88	1146.97	54	38	20
MFS-MFN	0.00	0.00	0.00	0.00	0	0	5

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

Deer Creek daily post-calibration model output--Continued

SUMMARY STATISTICS FOR OPTIMIZATION PERIOD 1967 TO 1969

	MEAN RUNOFF (CFS)		TOTAL RUNOFF (CFS DAYS)		# OF RESIDUALS		# OF RUNS
	OBSV.	PRED.	OBSV.	PRED.	+	-	
TOTAL	6.77	6.92	4949.82	5056.88	421	310	92
MFS-MFN	1.56	1.24	476.65	379.22	233	73	23

RESIDUAL = OBSERVED - PREDICTED
MFS-MFN SEASON IS MAY TO SEP

VERIFICATION CRITERIA

	DAILY		MONTHLY	
	TOTAL	MFS-MFN	TOTAL	MFS-MFN
COEFFICIENT OF DETERMINATION	0.927	0.815	0.986	0.932
(LOGS)	0.940	0.833		
0COEFFICIENT OF PERSISTENCE	-20.161	-14.072		
0COEFFICIENT OF GAIN FROM DAILY AVERAGES	0.872	0.628		
0RESIDUAL-PREDICTED CORRELATION	-0.424	-0.001		

ERROR SUMMARY (MFS-MFN PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	97.43	34.06	116.15	38.72	380.34	12.52
MEAN	0.32	0.11	0.38	0.13	1.24	0.04
PERCENT	20.44		24.37		71.57	

ERROR SUMMARY (TOTAL PERIOD)

	ERRORS		ABSOLUTE ERRORS		SQUARED ERRORS	
	NO LOG	LOG	NO LOG	LOG	NO LOG	LOG
SUM	-107.06	33.85	914.06	114.50	4439.72	39.04
MEAN	-0.15	0.05	1.25	0.16	6.07	0.05
PERCENT	-2.16		18.47		36.40	

1STORM	PREDICTED VOLUME (INCHES)	ROUTED OUTFLOW (INCHES)	OBSERVED OUTFLOW (INCHES)	PREDICTED PEAK (CFS)	OBSERVED PEAK (CFS)
1	7.82	7.80	7.79	81.49	105.00
2	3.21	3.19	2.67	59.21	57.60
3	3.34	3.35	3.47	50.05	50.00
4	3.46	3.43	3.30	65.23	81.40
5	5.14	5.15	4.63	52.50	44.80
6	4.62	4.62	5.25	48.65	71.00
MEAN	4.60	4.59	4.52	59.52	68.30
LOGS	1.47	1.47	1.44	4.07	4.18

Deer Creek daily post-calibration model output--Continued

STORM VOLUME ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	1.98	0.50	0.99	0.06
MEAN	0.33	0.08	0.16	0.01
PERCENT	7.31		8.97	

STORM PEAK ERROR SUMMARY

	ABS VALUE OBF FNC		SUM OF SQUARES OBF FNC	
	NO LOG	LOG	NO LOG	LOG
SUM	71.40	1.04	1375.80	0.28
MEAN	11.90	0.17	229.30	0.05
PERCENT	17.42		22.17	

1

```
1 - NUMBER OF PRECIPITATION GAGES
1 - NUMBER OF SEGMENTS SAVED FOR PLTGEN
1 - NUMBER OF SEGMENTS SAVED FOR PRINT, PLOT, AND PLTGEN
3 - NUMBER OF CURVES OUTPUT TO PLTGEN FILE(S)
0 - NUMBER OF PLTGEN SEGMENTS SKIPPED
3    0 NC1, NC2


TIME0 1967    1   26    0    0
TIMEN 1967    1   30   24    0
LAPSED TIME    7201

CH21   5   2

INCDT  300
MAXRD   24
KOUNT    3
KSKIP    0

INC   24   24   24
INC    1    1    1
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