THE DEVELOPMENT OF AN OPERATIONAL WATER QUANTITY MODEL

by

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ACKNOWLEDGEMENTS

Since this report is based on various principles of hydrology, hydraulics, mathematics, numerical analysis, data collection and computer programming, many professionals were helpful. In the initial stages, Dr. Clyde Kiker, Assistant Professor of Food and Agricultural Economics, University of Florida. examined our overall routing methodology and made several constructive comments and suggestions. We greatly appreciate his assistance and advice. Mr. Nagendra Khanal of the Groundwater Division is gratefully acknowledged for extending his helping hand in understanding the procedure and various concepts associated with the FCD sub-basin model. During the hydrologic data collection stage, Messrs. Robert Taylor, Vincent Faraone, Art Nelson and Ernesto Gallego of the Hydrology Division helped us in completing the tedious and laborious task of input data generation. Discussion with Mr. Richard Irons on the stage-discharge relationships for the controlling structures of the lower Kissimmee was constructive in examining these formulations on a comparative basis. Mr. John Lynch of the Data Processing Division is acknowledged for providing programs to transfer hydrologic data from paper tapes and computer cards to more convenient tapes and also to Mr. Harold Nelson for his cooperation in putting the illustrations in final form. Finally, acknowledgements are also due to many others who assisted directly or indirectly in developing the procedure of the operational water quantity model in its final stage.

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NOTATIONS USED IN THIS REPORT

$(\Delta S)_{t+1}$	Change in lake storage int ime t+1,
α	Velocity head coefficients,
A	Cross-sectional areas of the channel,
A1,A2,...,A8,A9	Constants for converting storage into stage,
a,b	Constants,
AREA	Area for Nth sub-basin (sq. miles),
B0,B1,...,B5,B6	Constants for conveyance as a function of water surface elevation,
CNR	Total number of cascades in any of the 4 reservoirs,
CONST	An integer used to divide storage value to make it small,
D	Total depth of subsurface profile,
DIS	Length of canal or reach (feet),
DPE	Precipitation excess for Δt,
DUM	Scratch space,
DWTM	Depth to free water where evaporation from the soil surface ceases,
DX	Distance between reaches i+1 and i,
EH	Effective head = $H_2 - H_1$,
END	Routed values of discharge,
EP	Pan evaporation, weekly values,
F	Movement of water between layers,
FQ	Array containing all values of QVOL,
FQ1	Cumulative daily value of water recovered from soil, reservoir up to the day, MP,
FQ2	Cumulative daily value of water in overland reservoir up to the day, MP

NOTATIONS (continued)

g	Gravitationl acceleration,
G	Amount of free water in a layer when saturated,
GI	Growth index, weekly values,
GD	That portion of G which will drain to a surface water body,
GO	Gate operations at 6 hour intervals (ft),
H_2	Headwater elevation,
H_1	Tailwater elevation,
H.R.	Hydraulic Radius = $\frac{A}{P}$,
I_{t+1}	Inflows during the time t+1,
IDAY	Beginning date of execution (Julian),
INO	Total number of grid points located in Nth sub-basin,
IPR & PR	Precipitation values,
ISAV	Days for which 2400 hour values will be retained on file (Julian day),
ISDAY	The day whose initial conditions are to be used for current run (Julian day),
IT	Days on which state conditions are saved (Julian),
LDAY	Ending date of execution (Julian),
MP	Julian day number,
n	Manning's roughness coefficient,
NEL	Total number of days to be skipped from the run, e.g., February 30, 31, June 31, etc.,
NELI	The actual days to be skipped in the current run,
NOD	Total number of days for which run is to be made,
NPR	Cumulative daily rainfall to the day, MP,
NSUB	Sub-basin ID number = 1, 2,..., 19, 20,

NOTATIONS (continued)

O_{t+1}	Outflows during the time t+1,
P	Wetted perimeter,
PC	±, depending whether the computation proceeds downstream or upstream,
p,r,s	constants,
PPAN	Ratio of $EPmax/ETmax$,
Q	Profile dishcarge, in/hr,
Q16	Discharge from C-36 into Hatchineha (cfs),
QFII	Eight values of routed runoff each at 3 hour intervals for the day, MP,
Q17	Discharge from C-37 into Lake Kissimmee (cfs),
QHAT	Discharge from Hatchineha into C-37 (cfs),
QN	Net water in the system,
Q(N)	Discharge through control structure No. N,
RN	Channel Roughness or resistence,
S	Storage,
SA	Available storage, inches of H_2O,
SA5	Currently available storage in soil profile at the end of day, MP,
SE	Energy gradient,
SG	Storage, inches, in profile that corresponds to selected Q's.,
SO	Slope along streambed,
ST	Lake stage (feet),
STOR	Lake storage (ac. ft.),
SUBQ	Streamflow contributing to any structure at 6 hour intervals,
T	Top width of the channel C/S,

NOTATIONS (continued)

TAS	Total available storage in a layer of soil, inches H_2O,
TFC	Cumulative daily value of deep percolation loss up to the day, MP,
TLOS1	Cumulative daily value of evaporation loss up to the day, MP,
TLOS2	Cumulative daily value of transpiration loss up to the day, MP,
TK	Time constant corresponding to each of the 4 reservoirs used in routing,
TWS	Tailwater stage (feet),
V	Velocity
VD	Depth of water in surface depressions expressed in inches over entire watershed,
VDM	Maximum amount of water that can be stored in surface depressions, expressed in inches over the entire watershed,
WSE	Water surface evaluation
Y	Depth
Y_i	Depth in reach i
LAKES	Lake numbers of lakes 1, 2 and 3
LINKS	Link (1) = link number of Lake 3 to lake 1 Link (2) = link number of lake 3 to lake 2 These numbers are the line numbers of array map
STAGE	Stage (1) = stage of lake 1 at some time T Stage (2) = stage of Lake 2 at some time T
QINFL	Local inflow into lake 3 in cfs
STAGET	New stage of lake 3 at time T + 3 hrs.
QCHAN	Discharge in cfs in the 2 links at time T + 3 hrs.

NOTATIONS (continued)

NGATES(1)	Number of gates in structure between lake 3 and lake 1 if present
NGATES(2)	Number of gates in structure between lake 3 and lake 2 if present
(GO(I.1),I=1,6)	Gate openings of 1st structure if present
(GO(I.2),I=1,6)	Gate openings of 2nd structure if present
MAP	Map giving lake, structure and canal linkage
Q	Initial estimate of discharge through links 1 and 2 in cfs
QNEW	Newest estimate of discharge through links 1 and 2 in cfs
QBAR	Current average discharge through links 1 and 2 in cfs
STOR	Initial storage in lake 3
STORE	Newest estimate of storage in lake 3 at time T + 1
STORT	Previous estimate of storage in lake 3 at time T + 1
STORT	Previous estimate of storage in lake 3 at time T
EBR	Difference in storage in lake 3 corresponding to .02 feet stage above initial stage
IGO	Indicator for each link = 1 if channel control = 2 if structure control
JS	Structure number for each link, = 0 if no structure
STAGENR	Structure stage at side nearest lake 3
STAGEFAR	Structure stage at side furthest from lake 3
STGLAKES	Array of current stages in the 14 lakes
NEAREST	Array of pointers to the structure stages nearest and furtherest from each lake
STGSTRUC	Array of current stages at the 14 structures

NOTATIONS (continued)

QLINK	Array of current discharges in the 25 channels
LLINK	Array of lake numbers to which QLINK refers
	+Q, lake 5 means flow into lake 5
	-Q lake 5 means flow out of lake 5
QA	Array of average discharges in the 25 channels
E069	The existing FCD Computer program for multivariate analysis
E070	The existing FCD computer program for the channel sectional analysis
E081	The existing FCD backwater program
E049	The existing computer program for checking the stages and gate operations data on the paper tape
E040	The existing FCD computer program for converting breakpoint stages and gate opening data into 3 hr. values
US, U.S.S.	Upstream stage
DS, D.S.S.	Downstream stage
CUS	Computed upstream stages
Ufact	Correction factor for upstream stage
Stor	Storage
CStor	Computed storage
Sfact	Correction factor for storage
Q	Mean discharge in cfs
Factor Q	Correction factor for discharges of seven channels of upper Kissimmee basin
DH	US-DS

ABSTRACT

As a part of the in-house project on hydrologic studies of the Kissimmee Basin (FCD Program No. 8430), a recently developed operational water quantity model is presented in this report.

Essential components of the operational water quantity model include a sub-basin model, routing model and their combination. Using the rainfall input, initial state conditions and basin parameters, the sub-basin model estimates the amounts of overland flow, sub-surface flow, surface storage, sub-surface storage, water losses and the streamflows contributed by each of the 19 sub-basins of the upper and lower Kissimmee Basin. An iterative type routing model is then designed to distribute the simulated streamflows through the primary conveyance system of lakes, canals and channelized river managed by gate operations at the controlling structures. The developed methodology for combining the sub-basin model with the routing model is demonstrated for the Kissimmee River system for the year 1970 by considering 21 canals, 14 lakes and 14 controlling structures..

The final outcome of the model relates to simulated lake stages, water levels at tailwater and headwater sides of the controlling structures and simulated discharges through controlling structures every 3 hours for the full year of 1970. The comparison of simulated values with the corresponding historical data indicates clearly the "working" of all individual pieces of the operational water quantity model. Since this is the first time the authors were able to pull together various interacting elements into a broad and practical water quantity model, a series of parametric sensitivity analyses were performed to evaluate the relative importance of the various links of the model. These parametric analyses demonstrate clearly the subsequent improvements in simulated lake stages.

While developing the operational water quantity model, the following secondary tasks were completed:

1. Processing the cross-sectional survey data for all the pertinent channel sections of the upper and lower Kissimmee Basin to convert such field data in computer usable form.

2. Developing stage-storage-discharge relationships for channels of the upper and lower Kissimmee Basin.

3. Testing stage -storage relationships for 14 lakes in the upper Kissimmee Basin.

4. Evaluating discharge formulations for the controlling structures of five pools of the lower Kissimmee Basin.

5. Generating three hourly gate openings for S-57, S-58, S-59, S-60, S-61, S-62, S-63, S-63A, S-65, S-65A, S-65B, S-65C, S-65D and S-65E for the calendar year of 1970.

6. Obtaining three hourly tailwater and headwater historical stages at S-57, S-58, S-59, S-60, S-61, S-62, S-63, S-65 and S-65E for the year 1970 from original paper tapes.

It is felt that information provided directly by the model, and secondary information generated in developing the model, forms a strong data base which can be useful in current as well as future management studies and operations of the Kissimmee Basin.

CHAPTER 1

1.1 INTRODUCTION

Due to the rapid growth pattern observed in recent years in south Florida, there has been increasing concern over the abilities of the existing water system to satisfy the overwhelmingly increased water requirements. Since the Kissimmee Basin, Lake Okeechobee, and Everglades systems form the major inter-connected water system of central and southern Florida, it seemed clear to first investigate various performance characteristics of the component parts of this system and then to study the interactions between these component parts. Considering these facts: (a) the Kissimmee River drains into Lake Okeechobee and is its primary supply, and (b) Lake Okeechobee is a large, relatively shallow lake which satisfies the water supply requirements of many surrounding communities and the Everglades Agricultural Area, as well as being a back-up supply for the southeast coastal region and Everglades National Park, the Kissimmee-Okeechobee system has become a focal point of discussion regarding its functional capability to perform the expected tasks.

1.2 NATURE OF THE PROBLEM

The basic point underlying the evaluation of the performance of a given water system (for example, the Kissimmee-Okeechobee system) is related to the basic understanding of the possible interactions within and between the component parts of the water system. Speaking more specifically, the nature of the problem is geared to the following questions for the Kissimmee-Okeechobee system:

a. What are the effects of the channelized Kissimmee River on hydrologic, nutrient transport, water quality and ecological characteristics of the Kissimmee-Okeechobee system?

b. What is the base-line land use information available for this area?

c. What are the effects of urbanization and existing controlled system of the Kissimmee River on flood volume, flood intensity, and water quality that drains into Lake Okeechobee?

d. How do the operations of controlling structures affect the movement of water, water surface elevations and the percentages of marshes under water?

e. What are the different methods to generate water quantity, to estimate water quality and to gather land planning data for the Kissimmee Basin to better understand the water quality-quantity and land use relationships?

To answer some of these questions in a more scientific way, efforts were made by various interdisciplinary teams of private institutions and governmental agencies to look into the interdisciplinary nature of the problem (3, 26).

This particular study is oriented toward providing a tool to respond specifically to operational questions such as: How will the system react to a specific set of climatic inputs or to a specific change in operational regime, etc.?

1.3 SPECIFIC OBJECTIVES OF THIS STUDY

The main emphasis of this study is toward the development of hydrologic analysis in light of the FCD sub-basin model and an associated routing system. More specifically, the objectives of this study are:

a. To generate 3-hour discharge data for the ten year period (January 1961 to December 1970) for 19 planning units of the Kissimmee Basin using the available basin parameters, state conditions and daily rainfall inputs in the FCD sub-basin model;

b. To verify generated data in all possible ways;

c. To develop routing methodologies to distribute these generated values through the Kissimmee Basin system of lakes, canals, and control structures;

d. To collect stages and gate opening data coupled with initial conditions at all control structures;

e. To formulate the backwater functions for all the channel reaches of the main-stem Kissimmee system;

f. To compile and to develop (if necessary) the formulations of lake stage-storage relationships, control structure rating curves, and channel ratings for the upper and lower Kissimmee Basin;

g. To design a generalized computer program to include all of the routing steps;

h. To evaluate the results of the routing model; and

i. To perform parametric sensitivity analysis.

CHAPTER 2

DEVELOPMENTAL STEPS OF THE STUDY

In technical terms, the whole routing methodology (which is the main subject matter of this report) is essentially a simulation technique based largely on the combination of various modeling concepts, statistical formulations and the available practical hydraulic engineering information for the controlled water system of the Kissimmee Basin. Since an initial and important step (known as the FCD Sub-basin Model) of such simulation analysis is related to the concepts of watershed modeling, an effort is made in the following section to simply outline the available watershed models so that the selected methodology in the FCD sub-basin model can be better looked at in this perspective.

2.1 FUNDAMENTALS OF WATERSHED MODELING

Various investigators have studied large and small sized watersheds from different and perhaps unique viewpoints. As a result, there exists a variety of watershed models which can be applied to generate different types of hydrologic information suitable for wide ranges of application (10). Among the long list of these numerous models (33), some of the major hydrologic watershed models are:

a. Stanford Watershed Model. (11)
b. Illinois Hydrologic Model. (21)
c. Harvard Model (Thomas-Fiering Model). (14,15)
d. HEC Model. (4,5,44)
e. Travelers Research Center Model. (6)
f. Linear-nonlinear System Response Model for Overland Flow. (6)
g. Hydrometeorological Approach. (35)
h. USDA HL-70 Model of Watershed Hydrology. (18,19)

It is to be noted here that all of these models are developed on different principles, assumptions and mathematical types like stochastic empirical, deterministic, empirical, etc., etc. (10). Since these models are included in an in-house report by one of the authors (34), their discussions are not repeated in this report.

The watershed model used in this study is based on the USDA HL-74 model. The particular approach was selected by Holtan, et. al., of the USDA to formulate the USDA HL-74 model of Watershed Hydrology (18,19). In their methodology water related agricultural parameters and coefficients were obtained from field experiments to develop empirical relationships for evapotranspiration, infiltration, deep seepage and routing coefficients for water movement in the soil characterizing the different hydrologic capacities of the soil types.

2.2 NEED OF OPERATIONAL WATERSHED MODELS

Although all these models are developed with different purposes, methodologies, tools and settings, they are conceptually valid only for natural hydrologic drainage systems. Therefore, it seems that these models have to be modified in some fashion to analyze the controlled water systems of the FCD

in general, and lake, channel and control structure systems of the Kissimmee Basin, in particular. It appears that this particular practical thinking created a need for the development of an operational watershed model to include operational characteristics of the FCD water system, coupled with theoretical and experimental data for formulating basic hydrologic processes.

From the analytical framework standpoint, simulation and optimization techniques with stochastic and deterministic inputs are being used in planning and design of water systems. Considering the necessary assumptions and speculated conditions required for getting the mathematical solution in most cases, these design models give general answers to the overall problem and do not generate the most desired product for operational needs (25). As pointed out by Lindahl and Hamrick that operationally oriented models must give specific answers to very specific questions and circumstances, it becomes essential to develop a practical model (with adequate theoretical basis) to function as a short term and long term decision-making aid within an operational framework and within existing peripheral monitoring capabilities for the typical water system of the FCD. Accordingly, a program was initiated to develop models in this direction (24,25). The description of the structure, component parts, and past and present developmental procedures associated with these models, is attempted in the following section.

2.3 COMPONENTS OF THE FCD HYDROLOGIC MODEL

From an operational standpoint, the basic objectives of the FCD Hydrologic Model (often called the operational watershed model) are:

a. To generate discharge-time curves at various points in the system,

b. To simulate stages at both sides of various control points or structures (39,40), and

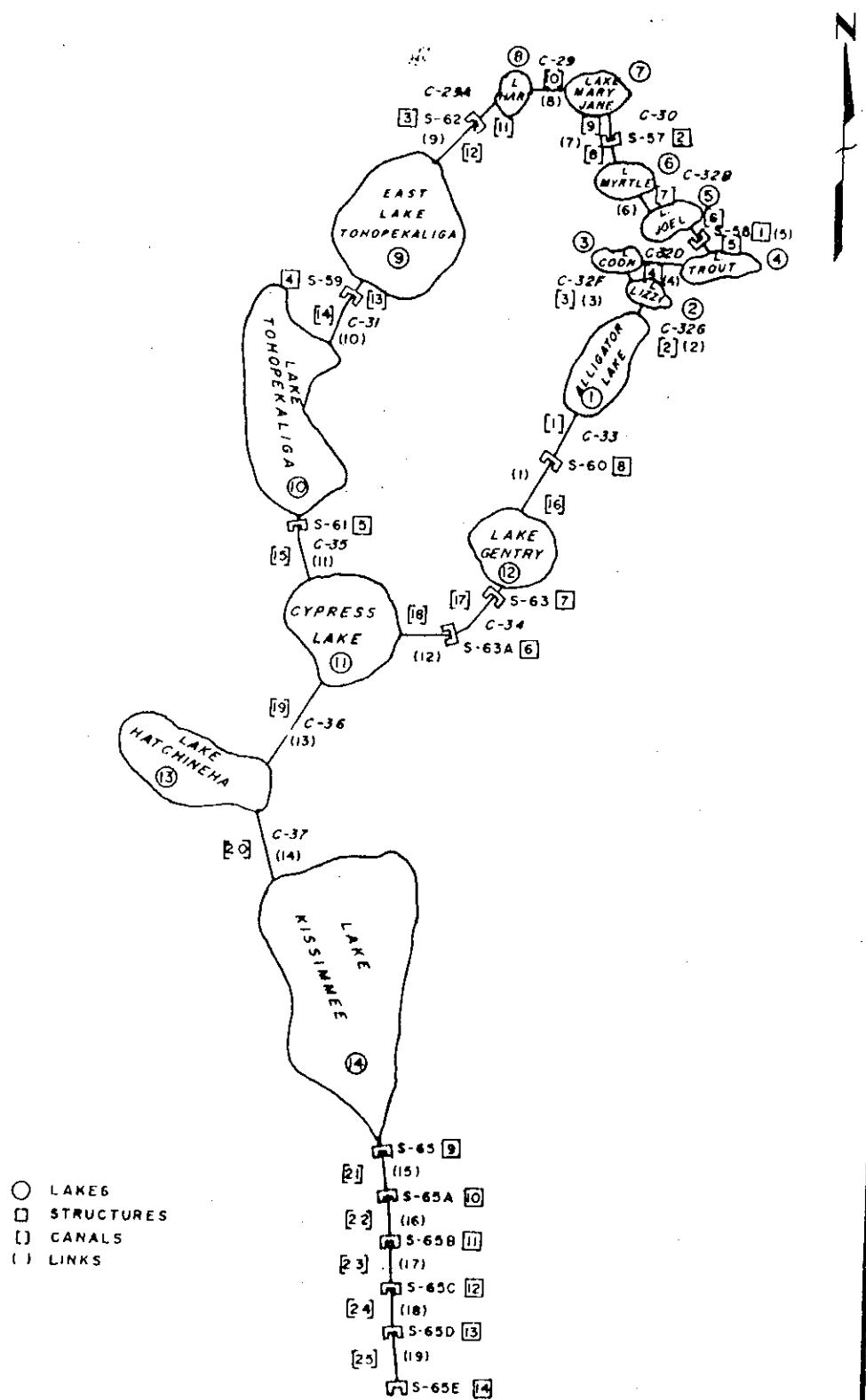
c. To include operational parameters (such as a set of gate operations) in the overall simulation methodology to generate practical information sought in a. and b.

To develop a methodology in these directions, a controlled and typical water system (with lakes, channels, channelized river and control structures) of the Kissimmee Basin is first selected. This whole area of 3,000 square miles is then divided into 19 planning units based on the drainage characteristics of these areas. The size and nature of the Kissimmee River Basin with its structural components and its subdivisions into planning units are depicted in Figures 1 and 2. Having broken down the Kissimmee Basin into 19 drainage areas, the next obvious questions in light of our final objectives are:

a. What are the key hydrologic components of the terrestrial branch of the hydrologic cycle for each of these planning units?

b. How much water is contributed to various hydrologic processes from the rainfall inputs derived from the existing rain gaging network?

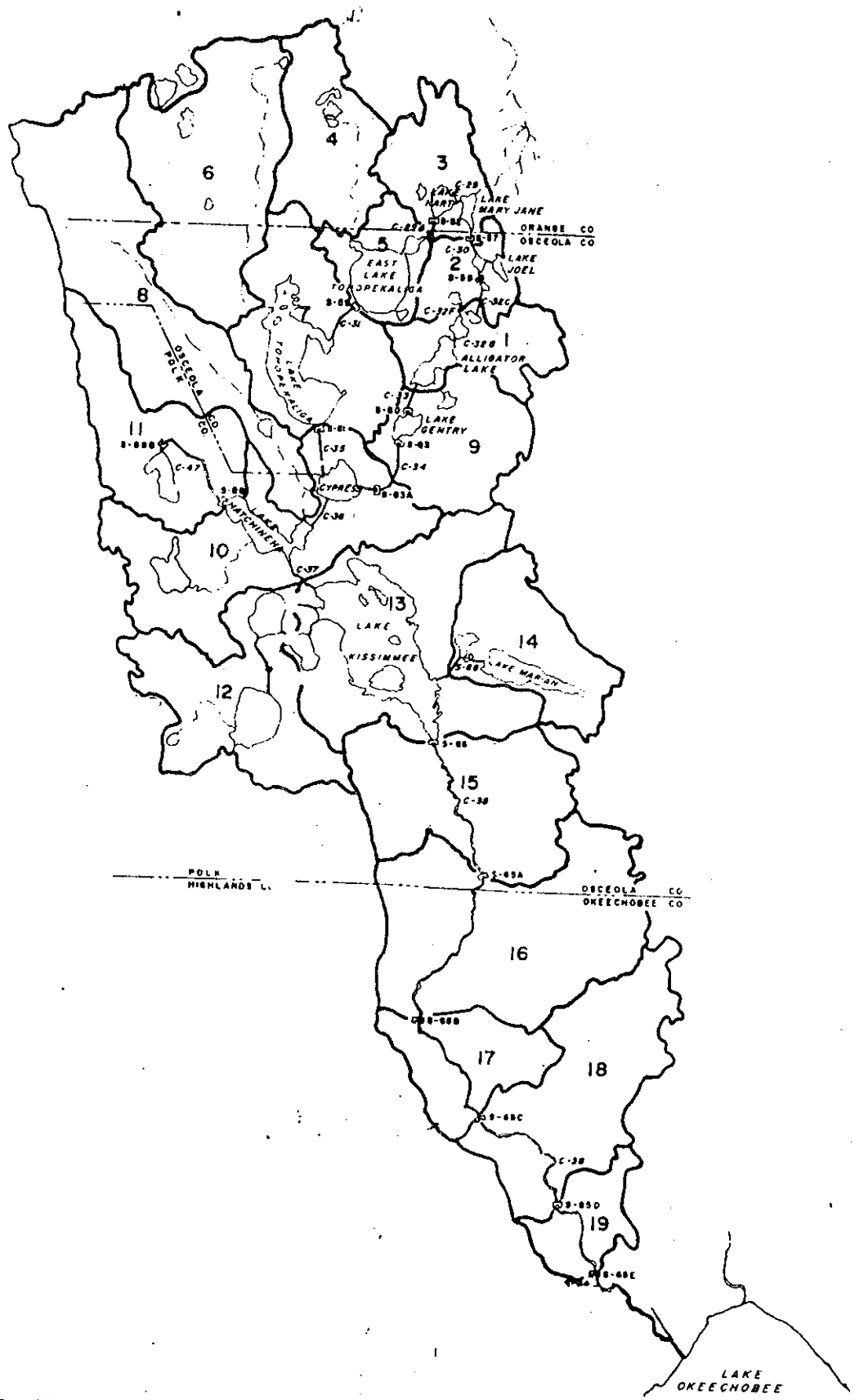
c. How much water flows out from each of these planning units?



CHAIN OF UPPER KISSIMMEE LAKES AND LOWER KISSIMMEE FIVE POOLS

NOT TO SCALE

FIGURE 1



MAP SHOWING APPROXIMATE LOCATION OF THE 19 PLANNING UNITS

d. In what way does the water in different processes get distributed through the controlled system of lakes, channels and operating gates?

To provide some answers to these basic questions, an attempt is made to develop the FCD Hydrologic Model in three stages and thus, the developmental procedure is broken down into the following three component parts in chronological order:

a. Sub-basin model,

b. Routing procedure, and

c. A routing methodology to couple the routing technique with the sub-basin model.

Basic computational steps involved in our FCD Hydrologic Model (including the above mentioned three component parts) are outlined in Figure 3. As depicted in Figure 3, broadly speaking, rainfall inputs coupled with basin parameters (reflecting the characteristics of the planning unit) and state conditions are used in the sub-basin model to generate discharge values on a 3 hour basis. After verifying the output of the sub-basin model to the maximum extent possible, as a next step, backwater functions, initial conditions and operational data sets are developed and are used in the routing procedure to simulate stages and discharges for control points in the upper and lower Kissimmee Basin. After comparing these simulated values (i.e., routed values) with recorded values, sensitivity analysis (if required) can be performed to examine the effects of certain coefficients or assumptions or formulations on the final output of this model. With these computational steps, it is expected that this methodology would directly address the previously mentioned three basic questions. General concepts, specific details and developmental procedures associated with each of these components are discussed in the following section.

2.4 DESCRIPTION OF THE SUB-BASIN MODEL

The basic foundation on which the FCD sub-basin model was developed and modified by Storch, Lindahl, Sinha, Hamrick, Khanal, Shahane and Berger is essentially a parametric approach for formulating the physical system of the Kissimmee Basin in terms of hydraulic simulation (2,22,24,25,40,41,42). Considering the land phase of a hydrologic cycle, a conceptual watershed model (also known as a simplified catchment model) is first outlined by identifying various realistic hydrologic processes applicable to the Kissimmee sub-basins under investigation. This flow diagram is shown in Figure 4. As depicted in Figure 4, the rainfall event becomes a main driving force for triggering the component parts (such as surface storage, overland flow, channel flow, flow through soil reservoirs, water losses and basin outflow) of the Kissimmee sub-basins. To evaluate each of these processes in a quantitative manner, a classical parameter approach is used to evaluate spatial and time distributions of precipitation inputs in various hydrologic processes. In this approach, among various available formulations for estimating the water quantities associated with these surface and sub-surface components, empirical relationships with parameters reflecting the physical characteristics of soil, vegetation types and retention properties of the basin are selected. These empirical relationships are largely based on field and laboratory experiments coupled with

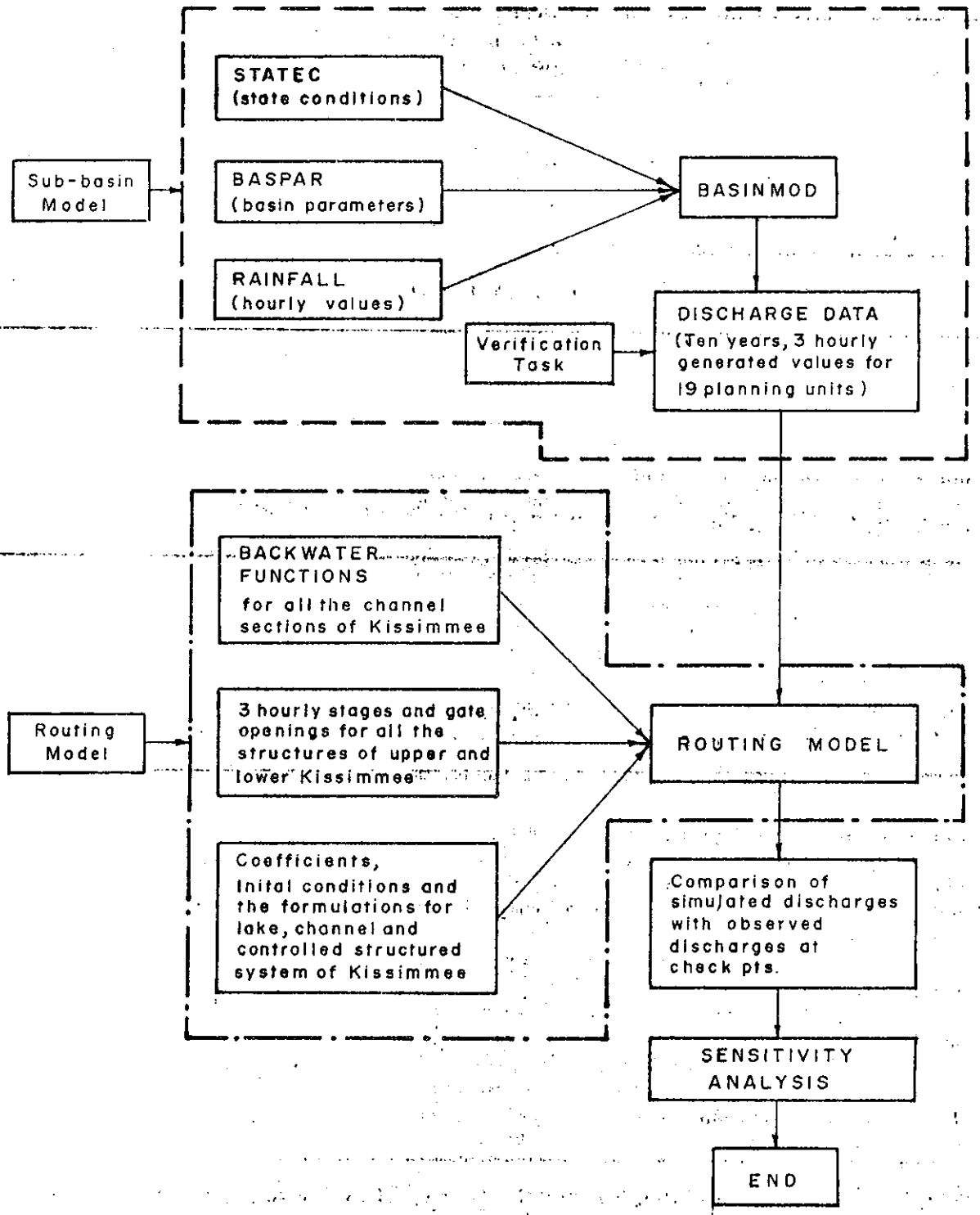


Figure 3 FLOW CHART OF MAJOR COMPUTATIONAL STEPS INVOLVED IN F.C.D. WATER QUANTITY MODEL

climatological, hydrological and topographical observations (18,19,20,22, 40,41,42,43). Considering these various formulations, the computational procedure for various response phases of Figure 4 is outlined and explained below.

2.4.1 COMPUTIONAL STEPS OF THE SUB-BASIN MODEL

For computational clarity, the response phases to rainfall inputs depicted in Figure 4 are rearranged in more detail as shown in Figure 5. It can be seen from Figure 5 that the major computational steps are related to

a. Processing of input rainfall values.

b. Formulations of infiltration phenomenon.

c. Surface storage and overland flow equations.

d. Estimation of water losses.

e. Quantification and routing of sub-surface flows through a multi-layered soil system.

Since the detailed descriptions and discussions of rationale behind these formulations are given by Lindahl, Sinha, Hamrick and Khanal (22,24, 25,40,41,42), these formulations are presented for familiarization with the nature of computational procedure involved in the FCD sub-basin model and also to retain continuity in understanding the overall development of operational watershed models.

2.4.1.1 PROCESSING OF INPUT RAINFALL VALUES

Based on the available network of raingaging stations over the entire Kissimmee Basin, rainfall values are obtained for each of 19 planning units by the following steps:

1. Averaging procedure for daily point rainfall values of surrounding representative stations, and

2. Rainfall synthesis converting daily values of sub-basins to hourly values of rainfall.

As given in Tables 1, 2, 3 and 4, daily rainfall values for the 19 planning units are obtained from either averaging out 8 stations (as done for sub-basins 1 and 2) or from representative nearby gain gaging stations. These values are obtained for a ten year period (1961-1970).

These recorded daily rainfall values are further synthesized to generate hourly values using Pattison's methodology (42). In this approach, four classes of daily rainfall persistence and ten daily rainfall classes are formed. Assuming the linear stochastic model between consecutive hourly rainfall values, the coefficients of the model are obtained by regression analysis and conditional probabilities coupled with a random number generator. This methodology is applied to 18 years of hourly rainfall data at station

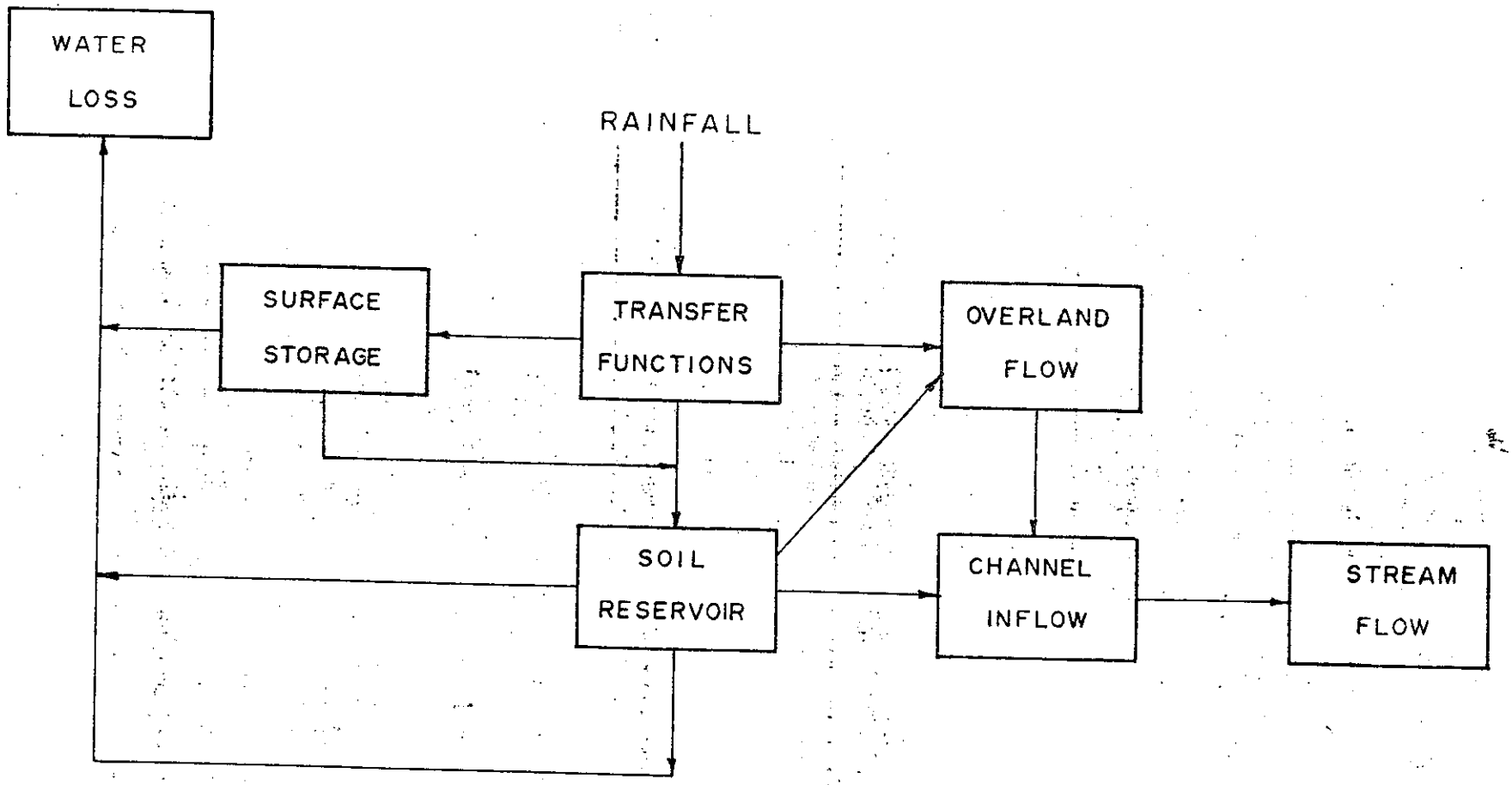


Figure 4 A SIMPLIFIED CONCEPTUAL WATERSHED MODEL

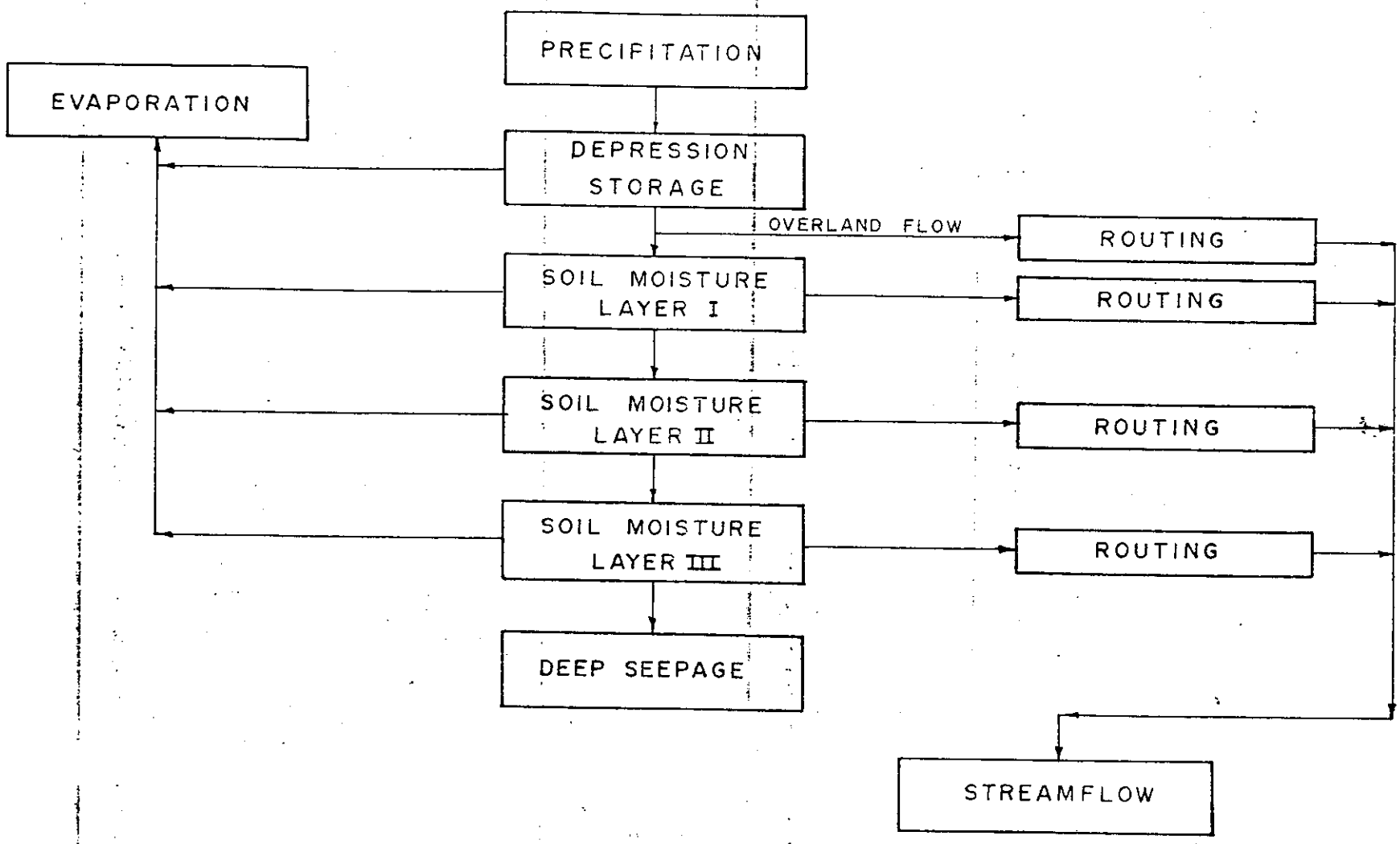


Figure 5 F. C. D. SUB-BASIN MODEL

Table 1. Rainfall Stations and Station Names Used in the FCD Model (42)

YEARS 1961 - 1967	
Basin No.	Station Name
1	Average of 8 Stations
2	Average of 8 Stations
3	Lake Hart
4	Orlando
5	Lake Hart
6	Isleworth
7	Kissimmee II
8	Isleworth
9	Average of 8 Stations
10	Mountain Lake
11	Lake Alfred
12	Mountain Lake
13	Indian Lake Estates
14	Nittaw
15	Indian Lake Estates
16	Fort Drum
17	Cornwell
18	Lake Placid
19	Okeechobee H.G. #6

Table 2. Rainfall Stations and Station Names Used in the FCD Model (42)

YEAR 1968	
Basin No.	Station Name
1	Average of 8 Stations
2	Average of 8 Stations
3	Myrtle Lake
4	Orlando
5	Lake Hart
6	Isleworth
7	Kissimmee II
8	Isleworth
9	Average of 8 Stations
10	Mountain Lake
11	Lake Alfred
12	S. Ranch
13	Indian Lake Estates
14	Nittaw
15	Indian Lake Estates
16	S65-B
17	Cornwell
18	S65-D
19	Okeechobee H.G. #6

Table 3. Rainfall Stations and Station Names Used in the FCD Model (42)

YEAR 1969	
Basin No.	Station Name
1	L73 S.R. 520
2	Beeline Highway
3	Lake Hart
4	Orlando
5	St. Cloud Airpark
6	Isleworth
7	Kissimmee II
8	Kissimmee Field Stat.
9	Lake Myrtle
10	Mountain Lake
11	Lake Alfred
12	Mountain Lake
13	Indian Lake Estates
14	Nittaw
15	S65-A
16	S65-B
17	S65-C
18	S65-D
19	S65-E

Table 4. Rainfall Stations and Station Names Used in the FCD Model (42)

YEAR 1970	
Basin No.	Station Name
1	L.R. 73 S.R. 520
2	Beeline Highway
3	Lake Hart
4	Orlando
5	St. Cloud Airpark
6	Reedy Creek
7	Kissimmee II
8	Taft
9	Lake Myrtle
10	Mountain Lake
11	Lake Alfred
12	Mountain Lake
13	Indian Lake Estates
14	Nittaw
15	S65-A
16	S65-B
17	S65-C
18	S65-D
19	S65-E

Kissimmee II to estimate sets of conditional probabilities and regression coefficients which are subsequently used to decompose daily rainfall values into hourly values at all planning units (42).

Thus, using these two steps, the hourly rainfall values are obtained for 19 sub-basins of the Kissimmee Basin for ten years (1961-1970).

2.4.1.2. FORMULATIONS FOR INFILTRATION PHENOMENON

Since part of the rainfall is infiltrated in the ground and the remaining excess appears as surface water, it is essential to estimate the capacity of the rate of infiltration from sub-surface as well as from a surface water quantity standpoint. Again, capacity rate of infiltration is a function of type of soil, vegetation cover and drainage characteristics of the soil. A modified form of the empirical equations originally developed by Holtan (19) is used in quantifying the infiltration phenomenon. Such equations are

$$f = A(SA)^{1.4} \text{ for } SA \geq G$$

and

$$f = A(SA)^{1.4} + FC \text{ for } SA < G$$

where

f = capacity rate of infiltration,

A = surface penetration index,

SA = storage currently available in the soil reservoir,

FC = deep percolation, and

G = total amount of free or gravitational water in a soil profile of selected depth (18,19,24,25,40,41,42).

Among many formulations and concepts proposed by Green, Kostivkov, Horton and Phillips, the above equations are chosen for the following reasons:

1. Availability of recorded field data to estimate the coefficients of the equations,

2. Adequate mathematical and theoretical bases for converting the rate of infiltration into the infiltration volume, and

3. Practical verification of these formulations on small experimental plots with various vegetation types (24).

2.4.1.3 SURFACE STORAGE AND OVERLAND FLOW

Besides infiltration, a part of precipitation is stored in surface depressions. Such surface storage is computed as

VDM = maximum volume of surface storage

$$= d \sum_{i=1}^{N} bi$$

where

N = number of surface depressions,

bi = area of ith surface depressions, and

d = average depth of N surface depressions (24,40).

After percolating a part of precipitation inputs into the ground and after a part is stored in surface depressions, precipitation excess is contributed to overland flow. Mathematically, it is computed from simple subtraction as

Overland flow = OF = P - f when VD = VDM and P > f

where

P = precipitation input,

f = infiltration rate,

VD = amount of water currently stored in surface depressions,

VDM = maximum volume of surface storage (40,41).

2.4.1.4 ESTIMATION OF WATER LOSSES

In the sub-basin model, water losses are considered as the part of precipitation input that reaches the ground surface but never appears at the watershed outlet (24,40,41,42). With this definition, water loss can occur in different categories; i.e., water loss due to direct soil evaporation, evapotranspiration by existing vegetation and water loss due to deep percolation. These losses in turn are functions of various factors as shown in the following formulations:

1. Water loss due to direct soil evaporation,

$$\text{Loss 1} = C_1\left(1 - \frac{DWT}{DWTM}\right)\left\{\frac{EP(NW)}{24}\right\}(DT)$$

2. Portion of water that is lost due primarily to the existing vegetation,

$$\text{Loss 2} = C_2(G_1)\,(NW)\left\{\frac{EP(NW)}{24}\right\}(DT)$$

3. Water loss due to deep percolation,

$$\text{Loss 3} = (FC)\,(DT)$$

where

C_1 = ratio of maximum evapotranspiration to maximum pan evaporation value,

DWT = water table depth

$$= \frac{(SA)\ (D)}{G}$$

D = total depth of soil profile,

G = total amount of free gravity water that could exist in a soil profile,

DWTM = maximum depth to water table at which DWT will have a negligible contribution toward Loss 1,

EP = pan evaporation,

NW = number of the week,

DT = time increment,

C_2 = constant = 0.78

G_1 = an overall growth index for the existing vegetation,

FC = rate of infiltration,

SA = storage currently available in reservoir C.

Adding these three losses together gives the total loss of water from a given soil profile. This value of total water loss is used in estimating the recovery of water from the soil reservoir to the main channel.

2.4.1.5 QUANTIFICATION AND ROUTING OF SUB-SURFACE FLOW

The basic purpose of this computational step is to estimate the spatial and time connection of sub-surface flow from different soil reservoirs to the main channel. Thus, the first task is to determine the number of reservoirs. This is done by the reverse integration of the runoff hydrograph by establishing storage-flow relationships for a simple recession curve. Using this technique, it is estimated that for our 19 planning units, soil profile can be represented by not more than three soil reservoirs. After determining the number of soil reservoirs, the basic continuity equation and a storage outflow curve is combined to develop the following equations which can provide contributions of each soil reservoir to the stream channel and also the total storage available in these reservoirs.

$$2\ (DELF) - Q_1(DT) + 2\ S_1 = C_4$$

$$2\ S_2 + Q_2(DT) = C_5 \text{ and}$$

$$(S_i)_{t+1} = (S_i)_t + (f_i^R - f_i^D) - Q_i - WLT)\ (DT)$$

where

DELF = volume of water that infiltrated during a DT

Q_1 = sub-surface discharge into the stream channel at time 1,

Q_2 = sub-surface discharge at time 2,

$(S_i)_{t+1}$ = total storage available in a soil reservoir i at time t+1,

i = reservoir number = 1,2,3,4,

f_i^R = recharge rate to i^{th} reservoir.

Q_i = sub-surface discharge or lateral outflow into the stream channel from i^{th} reservoir.

WLT = sum of losses at time t.

Using these equations, an iterative procedure is designed to obtain the final value of discharge (Q_2) in such a way that the absolute difference between C_4 and C_5 is within the tolerance limit of 0.01. These estimations of sub-surface discharge through various soil reservoirs are combined with the following Nash's routing equation to obtain time distribution of water at the watershed outlet (2, 24,40,41,42).

$$u(o,t) = \left(\frac{1}{k(n-1)!}\right) \left(\frac{t^{N-1}}{k}\right) \left(e^{-t/k}\right)$$

where

t = time

N = number of reservoirs, i+1, ...4,

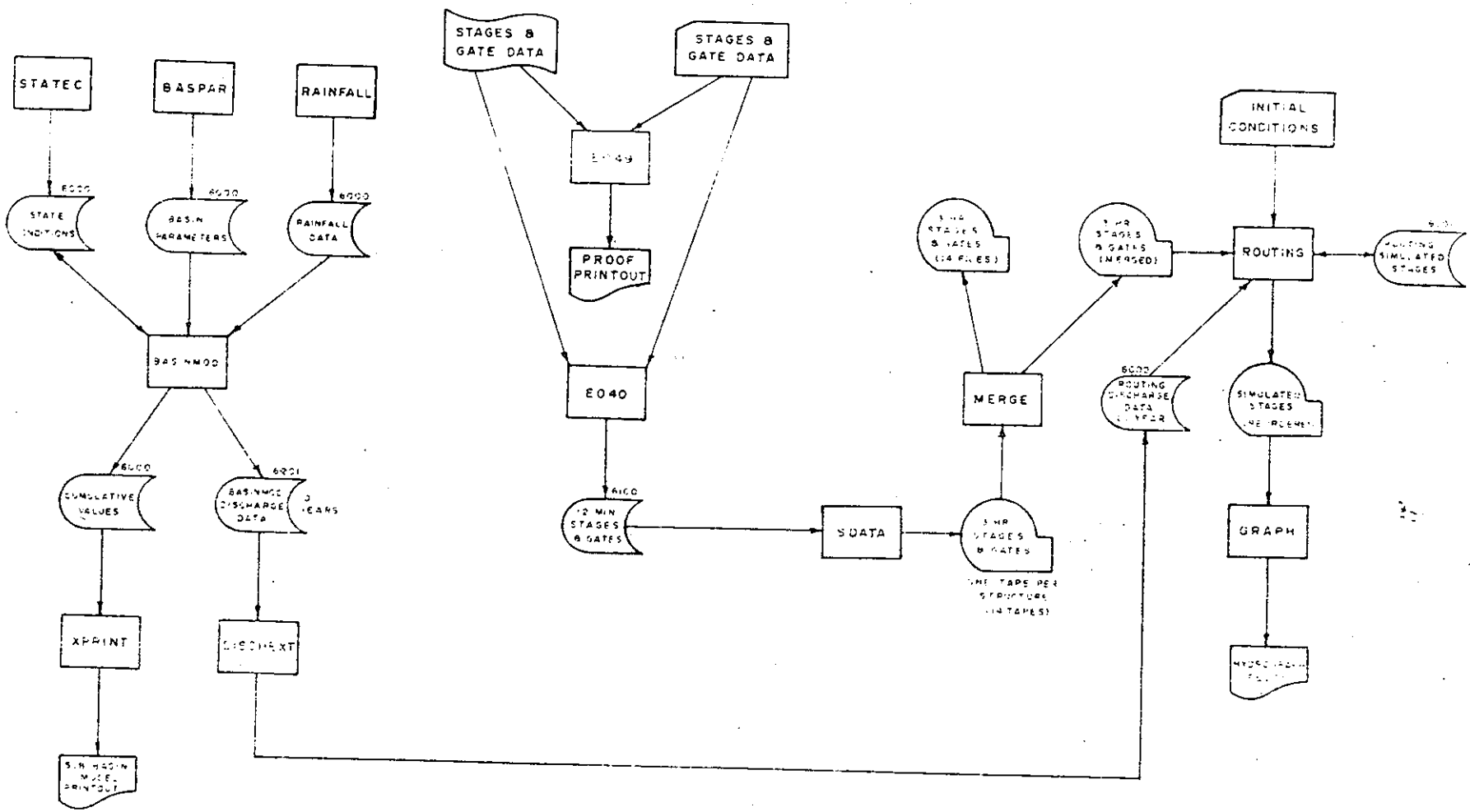
k = a time constant,

e = naperian base.

All these computational steps are included in a computer program called BASINMOD. Its relative position with respect to other steps of an overall sub-basin model is depicted in Figure 6. As shown in Figure 6, rainfall values, basin parameters and storage state conditions are required as input data to the BASINMOD program. Since the rainfall generation procedure and storage state conditions are already described in earlier sections, input data set including actual basin parameters, various coefficients and constants used in the sub-basin model are presented in the following section.

2.4.2 INPUT DATA REQUIREMENTS

To carry out the computational steps outlined in the previous section for the 19 planning units of the Kissimmee Basin, the parameters of the equations should be known. Since these parameters represent the agricultural-related water characteristics of the basin, they are estimated based on the available research publications of the ARS and many reports delineating regional characteristics (22,24,40,41,42).



SYSTEM CHART OF THE OVERALL WATER QUANITY MODEL

FIGURE 6

To compute infiltration characteristics, the appropriate basin parameters are:

a. Currently available storage in three soil reservoirs (i.e., TAS(1), TAS(2) and TAS(3)).

b. Constant rates of infiltration in three layered soil systems (designated as F(1), F(2), and F(3)).

c. Total amount of gravitational water in these three layers (i.e., (G(1), G(2) and G(3)).

d. Portion of G that will be drawn into surface water (i.e., GD(1), GD(2) and GD(3)).

e. Total assumed depth of the soil profile (D).

These values are compiled in Table 5 (42).

In addition, for estimating three types of water losses, overland flow and sub-surface flow, the following parameters are given in Table 6:

a. Maximum depth of water table at which water loss is insignificant (DWTM).

b. Maximum volume of surface storage (VDM).

c. Ratio of evapotranspiration and maximum pan evaporation value (PPAN).

d. Sub-surface discharges through three soil layers Q(1), Q(2) and Q(3).

e. Corresponding storages in these three soil reservoirs SG(1), SG(2), and SG(3).

Finally, routing coefficients to combine flows from three sub-surface layers with the overland flow are provided in Table 7 for representative locations in the Kissimmee Basin.

2.4.3 RESULTS, DISCUSSIONS AND VERIFICATIONS

2.4.3.1 RESULTS

Using the basic steps outlined in Figure 6 and formulations discussed previously, a computer program was developed to take rainfall inputs and to estimate subsurface flow, surface flow, total losses, deep seepage, available storage in soil, storage in depression (at the end of the day), and mean streamflows for 19 planning units for the ten year period (1961-1970). These generated values are on a daily basis (although values can be generated for shorter periods of one hour) and are compiled in ten separate files constituting several hundred pages. The listing and the description of computer programs with a main program of BASINMOD and subprograms of STATEC, BASPAR and RAINFALL are reported in reference No. 37.

Table 5. Input basin parameters used in the sub-basin model

Basin Parameters	Planning Units 1	2	3	4	5	6	7
TAS(1)	0	0	0	0	0	0.0	0
F(1)	0	0	0	0	0	0.0	0
G(1)	0	0	0	0	0	0.0	0
GD(1)	0	0	0	0	0	0.0	0
Q(1)	0	0	0	0	0	0.0	0
TAS(2)	0	0	0	0	0	0.0	0
F(2)	0	0	0	0	0	0.0	0
G(2)	0	0	0	0	0	0.0	0
GD(2)	0	0	0	0	0	0.0	0
Q(2)	0	0	0	0	0	0.0	0
TAS(3)	20.8	22.5	18.5	18.6	21.5	22.0	19.5
F(3)	0.0003	0.0003	0	0.0005	0	0.001	0
G(3)	8.1	8.3	6.8	7.2	7.8	9.00	7.8
GD(3)	6.48	5.8	5.5	5.1	5.2	7.5	4.9
Q(3)	0.016	0.012	0.0218	0.012	0.0145	0.01	0.01
D	48	42	46	42	40	50.00	41.0
SG(1)	0	0	0	0	0	0	0
SG(2)	0	0	0	0	0	0	0
SG(3)	5.35	5.8	5.5	5.1	5.2	7.5	5.2
DWTM	27	27	27	27.0	27	30	27
YDM	.20	0.15	0.15	0.15	0.1	.20	0.10
CNR(1)	0	0	0	0	0	0	0
TK(1)	0	0	0	0	0	0	0
CNR(2)	0	0	0	0	0	0	0
TK(2)	0	0	0	0	0	0	0
CNR(3)	4.0	3	5	3	4	5	3
TK(3)	50	45	27	40	30	50	54
CNR(4)	2.0	3	3	3	3	3	3
TK(4)	25.0	13.0	14	13	15	30	15

Table 6.

Basin Parameters	8	9	10	11	12
TAS(1)	0.0	0	0	0	0
F(1)	0.0	0	0	0	0
G(1)	0.0	0	0	0	0
GD(1)	0.0	0	0	0	0
Q(1)	0.0	0	0	0	0
TAS(2)	0.0	0	0	0	0
F(2)	0.0	0	0	0	0
G(2)	0.0	0	0	0	0
GD(2)	0.0	0	0	0	0
Q(2)	0.0084	0	0	0	0
TAS(3)	39.4	14.8	37	0	37
F(3)	0.001	0	0.001	0.001	0.001
G(3)	21.8	5	27	19.8	27
GD(3)	12.9	4	20.6	15.0	20.6
Q(3)	0.0018	0.0179	0.025	0.002	0.025
D	62.0	40	57	60	57
SG(1)	0	0	0	0	0
SG(2)	0	0	0	0	0
SG(3)	12.9	4.0	20.6	15	20.6
DWTM	30	27	30	30	30
YDM	0.15	0.125	0.1	0.3	0.1
CNR(1)	0	0	0	0	0
TK(1)	0	0	0	0	0
CNR(2)	3.0	0	0	3.0	0
TK(2)	100.0	0	0	95	0
CNR(3)	2.0	3	2	2	2
TK(3)	360	44	144	390	144
CNR(4)	4.0	4	3	4	3
TK(4)	24.0	14	30	23	30

Table 7.

Basin Parameters	Planning Units 13	14	15	16	17	18	19
TAS(1)	0	0	0	0	0	0	0
F(1)	0	0	0	0	0	0	0
G(1)	0	0	0	0	0	0	0
GD(1)	0	0	0	0	0	0	0
Q(1)	0	0	0	0	0	0	0
TAS(2)	0	0	0	0	0	0	0
F(2)	0	0	0	0	0	0	0
G(2)	0	0	0	0	0	0	0
GD(2)	0	0	0	0	0	0	0
Q(2)	0	0	0	0	0	0	0
TAS(3)	23.0	23.0	24	24	24	24	24
F(3)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
G(3)	9.1	9.1	9.0	9.0	9.0	9.0	9.0
GD(3)	7.1	7.1	7.2	7.2	7.2	7.2	7.2
Q(3)	0.004	0.004	0.01	0.01	0.01	0.01	0.01
D	52	52	50	50	50	50	50
SG(1)	0	0	0	0	0	0	0
SG(2)	0	0	0	0	0	0	0
SG(3)	7.1	7.1	7.2	7.2	7.2	7.2	7.2
DWTM	27	27	27	27	27	27	27
YDM	0.25	0.25	0.20	0.2	0.2	0.2	0.2
CNR(1)	0	0	0	0	0	0	0
TK(1)	0	0	0	0	0	0	0
CNR(2)	0	0	0	0	0	0	0
TK(2)	0	0	0	0	0	0	0
CNR(3)	2	2	4	4	4	4	4
TK(3)	80	80	55	55	55	55	55
CNR(4)	3	3	2	2	2	2	2
TK(4)	14	14	14	14	14	14	14

2.4.3.2 DISCUSSIONS

Since huge quantities of data are processed to provide hydrologic information of various types, there is great potential in examining such information from many different angles, depending on the task at hand. However, there are certain basic points that are always to be remembered before extending or utilizing such generated hydrologic information to any other beneficial use.

The first important point is that the output of the sub-basin model is the result of a man-made simulation procedure using various mathematical equations representing, in the best known engineering way, the hydrologic processes of the physical system. Since the coefficients used in selected formulations are based partially on experiments of local conditions and also on qualitative judgment developed from the practical feel of the region, it is to be cautioned that extensions of these generated values to a new drainage basin with limited available data may lead to erroneous conclusions.

Secondly, the output of the sub-basin model gives a hydrograph (streamflows with time) only at the outlet of each of the 19 drainage basins. These values of streamflows represent the total quantity of water that is contributed by the assumed physical system with its assumed conceptual hydrologic components. These generated values do not provide any information regarding the separate contribution from lake or channel systems.

Thirdly, if a structure is located at the end of a drainage basin, the amount of water that will be allowed to flow through that structure may be quite different than the values given by the sub-basin model because of the fact that the operational characteristics of the water system (i.e., operating schedule of gate operations) is not included in computing these sub-basin streamflows. In other words, the sub-basin model output is to be further processed in the routing procedure to include its distribution through subsystems (like lakes and channels) and to include operational characteristics of the control structures.

2.4.3.3 VERIFICATIONS

As reported by Shahane, although past efforts of Lindahl, Sinha, Storch, Hamrick and Khanal were instrumental in developing a hydrologic model as a part of an overall operational watershed for the FCD area, the verification of the model was not pursued to the fullest extent at that point in time (36). In view of the fact that the outcome of the FCD hydrologic model constitutes a large, useful and basic data base of the streamflows from 19 planning units of the Kissimmee River Basin, additional verification is warranted.

Although it can be argued that the direct comparison of recorded values through the control structures of the Kissimmee with the simulated streamflows of the sub-basin model is like comparing apples with oranges, the verification task can still suggest in some fashion the critical points which, in turn, show the direction in which further improvements and refinements can be made in the sub-basin model.

With this particular thinking, an effort is made to compare the output of the FCD sub-basin model with the available recorded values. Such verification procedures include:

a. indirect comparisons in terms of correlation coefficients, and

b. direct graphical comparisons with the available historical data.

The methodology of the sub-basin model with its pieces is first applied to the Taylor Creek drainage basin of 100 square miles located on the north side of Lake Okeechobee. Since the hydraulic, hydrologic and agricultural characteristics of the Taylor Creek watershed are well monitored by the ARS of the Department of Agriculture, and since this drainage area was in its natural form with no control structures to change its natural drainage characteristics during the test period, it was an ideal place to verify and test the FCD sub-basin model. The results of such an effort are depicted in Figure 7 (2,41). Graphical comparisons of mean daily streamflows shown in Figure 7 indicate clearly the adequacy of the sub-basin model and suggest the appropriate choice of coefficients covering the key hydrologic processes.

When the same sub-basin model is applied to each of the 19 drainage basins (also known as planning units) of the Kissimmee, the streamflows at the mouth of these drainage areas can be generated. However, due to the controlled nature of the Kissimmee water system, the total quantity of water passing through control structures can be substantially less or more depending upon the operating schedule of gate openings to control the water levels in the system. As a result, the verification task becomes increasingly difficult because the amount of water contributed by the planning unit (estimated by the sub-basin model) and water released through the structure (if the structure is at the end of the planning unit) are not the same for the typical controlled system of the Kissimmee. Among the 19 planning units, only 2 planning units (Boggy Creek basin, No. 4 and Shingle Creek drainage basin, No. 6) are near natural states (with no control structures) having recording stations at the outlet points. Therefore, these planning units (No.4 and No. 6) are the only available testing sites. In addition, four large areas are also formed by combining several planning units so that total quantity from these large combined basins can be compared with the recorded flows through the corresponding control structure located at the end of the large combined basin. For example, planning units 15, 16, 17, 18 and 19 can be combined to form a large lower Kissimmee Basin with S-65 located at one end and S-65E located at the other end, and thus, recorded flow from the total area of the lower Kissimmee is computed simply by subtracting the recorded flow at S-65 from the recorded flow at S-65E for a period of ten years. At the same time, simulated streamflows of planning units 15, 16, 17, 18 and 19 are added algebraically to obtain simulated streamflows for the lower Kissimmee Basin. These two sets are further compared by estimating simple correlation coefficients. This procedure is repeated for the other four combinations with the following planning units and governing control structures.

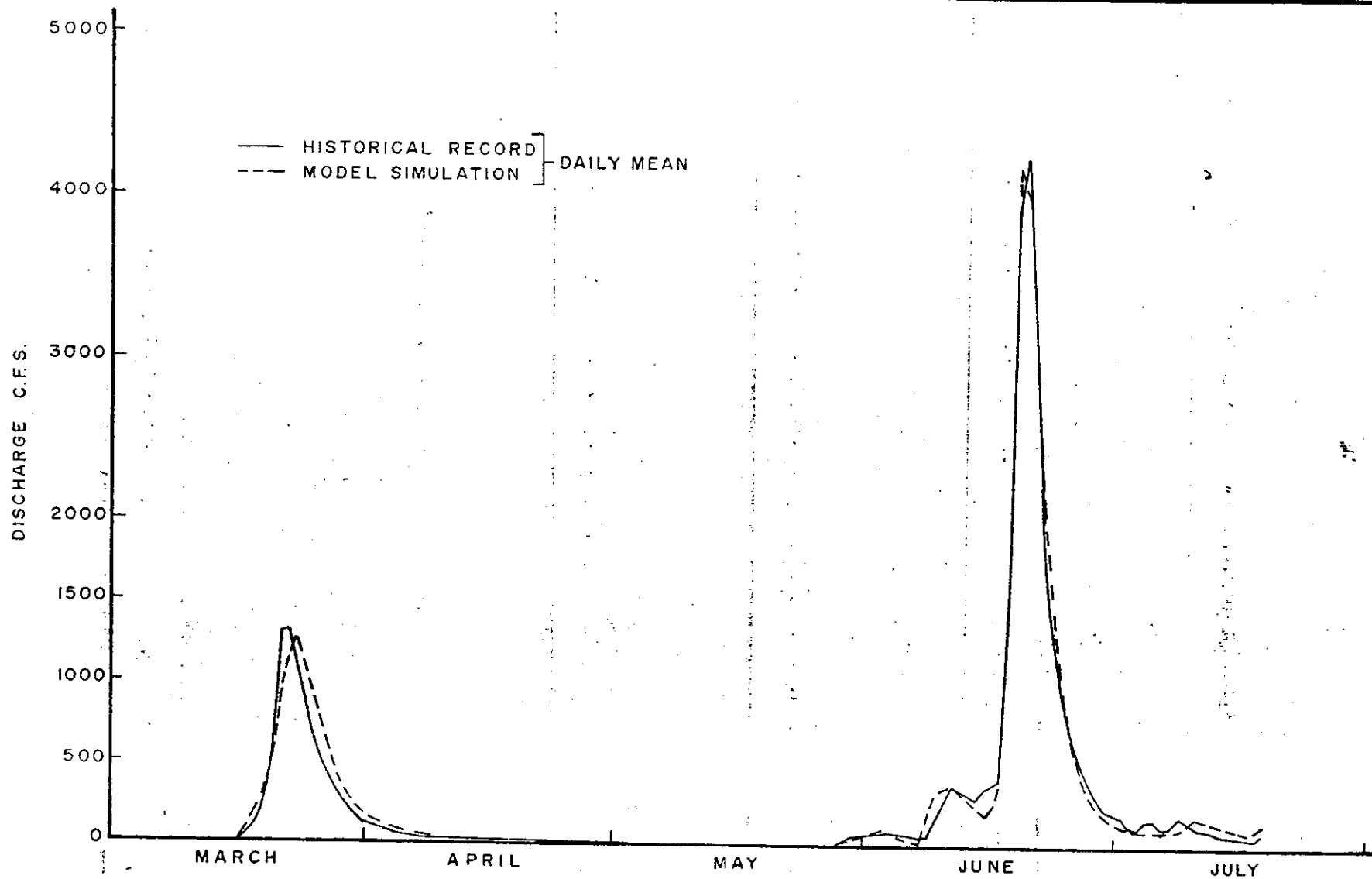


Figure 7 COMPARISON OF SIMULATED AND RECORDED DISCHARGE FOR TAYLOR CREEK (8,9)

COMBINATION NO.	PLANNING UNITS THAT ARE INCLUDED	UPSTREAM RECORDING STRUCTURE	DOWNSTREAM RECORDING STRUCTURE
4	1,2,3,4,5,6,7	-	S-61
3	1,2,3,4,5	-	S-59
5	1,2,3,4,5,6,7,8,9,10,11	-	Recording station at Lake Wales
6	All 19 planning units	-	S-65E

Correlation coefficients between simulated values and recorded values for six drainage areas with varying sizes are depicted in Table 8. The results included in Table 8 suggest the following points:

a. The sub-basin model, when applied to individual planning units, can generate realistic streamflows with fairly good correlations in their monthly time series.

b. A simple addition of the outputs from the sub-basin model to obtain simulated flows for combined planning units seems to reduce correlation coefficients partially because time lags of the corresponding streamflows are not accounted for and large planning units tend to become controlled units. This point clearly suggests the need for the development of the routing procedure to be coupled with the sub-basin model output.

c. A slight beneficial averaging effect is observed when the correlation coefficient is improved as the size of the drainage area approaches the total Kissimmee area.

In addition to these two ways of comparing our results with the recorded values, an effort is also made to use the available yearly historical data (with wet and dry period values) compiled by the Hydrology Division of the FCD. Graphical comparisons are shown in Figures 8 to 35. Useful statistical numbers to facilitate further comparisons are also given in Tables 9 and 10. As mentioned earlier, the main purpose of comparing these two data sets (which are conceptually similar but are different from an operational standpoint) is to pinpoint the missing parameter or hydrologic process (if any) in the sub-basin model. Looking at all comparative tables and figures in light of the above purpose, the following observations can be made:

a. Considering two different techniques of estimating precipitation values for upper, lower and the entire Kissimmee, precipitation

Table 8. A Comparison of Simulated (FCD Model Generated) and observed Streamflows in Terms of Correlation Coefficients for the Following Six Different Sized Kissimmee Drainage Basins.

Drainage Area	Size of Drainage Area	Correlation Coefficients
1 *	89.67 sq. miles	0.90
2 **	185.66 sq. miles	0.71
3 ***	298.69 sq. miles	0.67
4 ****	617.12 sq. miles	0.54
5 *****	1134.57 sq. miles	0.63
6 ******	2300 sq. miles	0.70

* Boggy Creek, Planning Unit 4,

** Shingle Creek, Planning Unit 6,

*** Combination No. 3 given on previous page

**** Combination No. 4 " " " "

***** Combination No. 5 " " " "

****** Entire Kissimmee basin.

Table 9. Correlation coefficients between historical and sub-basin simulated streamflows for lower, upper and entire Kissimmee basin.

Basin	Type of Period	First Set of Correlation Coefficients for Rainfall	Runoff
LOWER	Annual Values	0.6651	0.5027
	Dry Season	0.8122	0.6656
	Wet Season	0.9287	0.5593
	Cumulative Annual Values	0.9998	0.9549
UPPER	Annual Values	0.8622	0.3620
	Dry Season	0.8122	0.6656
	Wet Season	0.9777	0.7613
	Cumulative Annual Values	0.9995	0.9934
ENTIRE	Annual Values	0.9378	0.6440
	Dry Season	0.8333	0.7657
	Wet Season	0.9777	0.7613
	Cumulative Annual Values	0.9998	0.9883

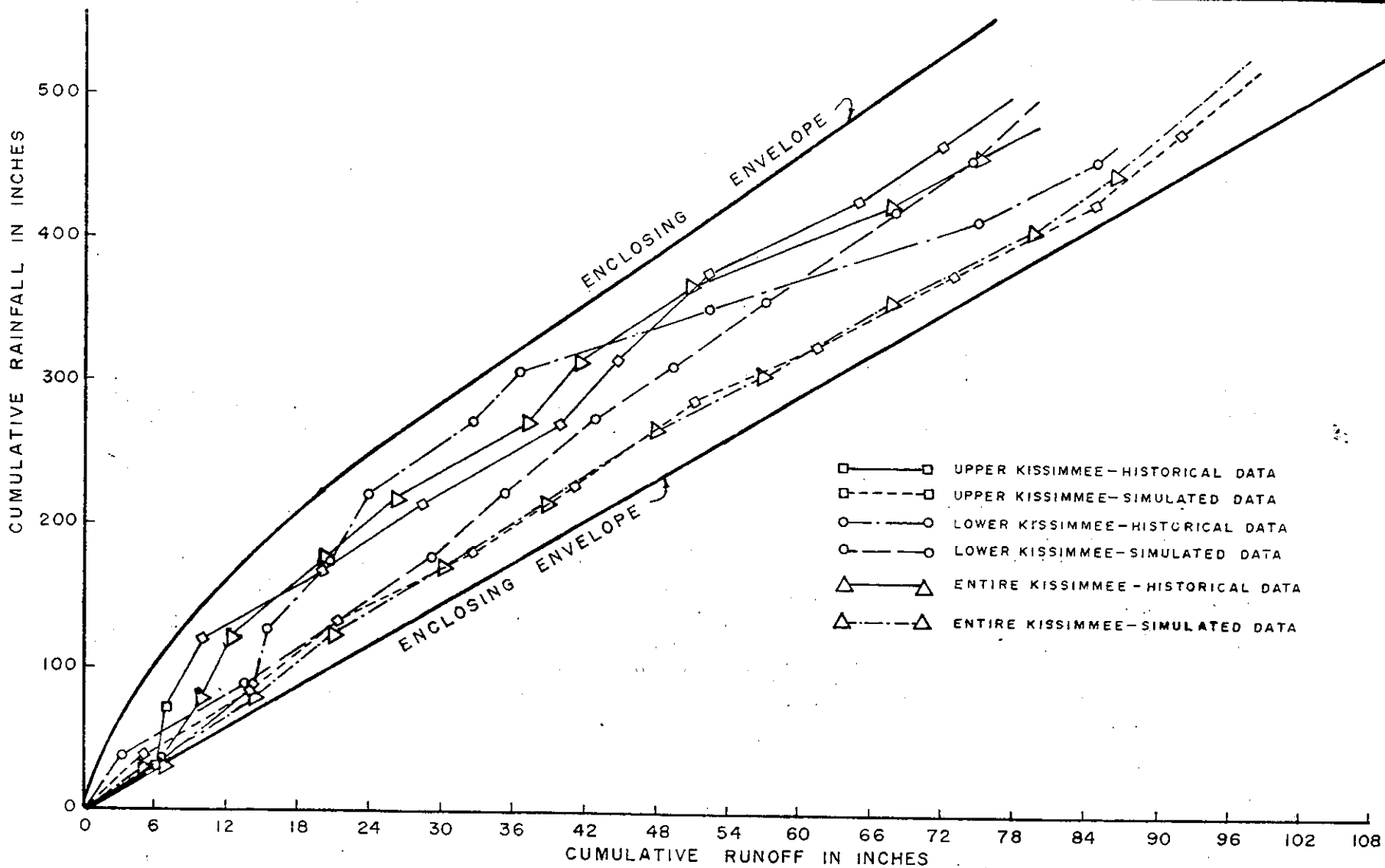
Table 10. "t" values for comparing historical and simulated streamflows for lower, upper and entire Kissimmee basin.

Basin	Type of Period	First Set of "t" values for Rainfall	Runoff
LOWER	Annual values	0.289	-0.189
	Dry Season	+0.469	-1.519
	Wet Season	0.03	0.01
	Cumulative Annual Values	-1.906	-3.135
UPPER	Annual Values	1.839	2.823
	Dry Season	1.38	-1.04
	Wet Season	-1.379	9.91
	Cumulative Annual Values	-1.2662	-6.249
ENTIRE	Annual Values	-0.070	2.823
	Dry Season	1.58	-0.689
	Wet Season	-0.661	5.62
	Cumulative Annual Values	-5.839	-6.472

inputs to the sub-basin model are in agreement with the historical data because of the high observed correlation coefficients (ranging from 0.8622 to 0.9999) and "t" values being within the confidence limit of 99.5% indicating that two data sets come from the same normal population. These observed results do indeed increase the confidence in the stochastic methodology of rainfall decomposition used in the sub-basin model.

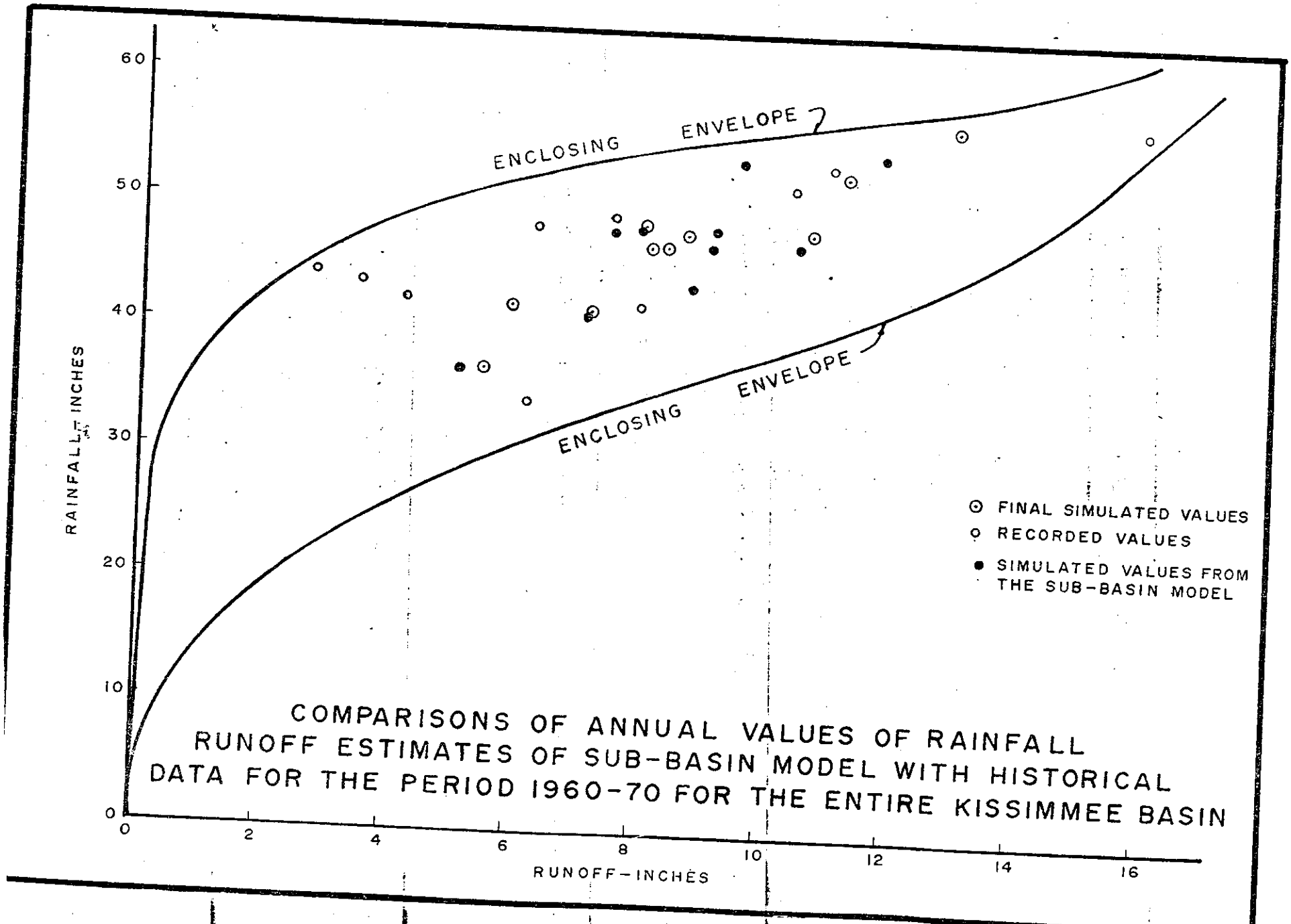
b. As far as runoff values are concerned, general conclusions are not possible from their comparisons. However, some categorical peculiarities can be observed. It is consistently noted from Figures 3 to 36 that simulated streamflows of the sub-basin model for the wet period for the upper and entire Kissimmee Basin are higher than the historical values. This observation is also reflected in Figure 8 for cumulative values. Statistically, this particular observation is further substantiated when the corresponding "t" values of the runoff series for the upper and entire basins lie outside the confidence limits of 99.5% suggesting clearly that two data sets do not come from the same normal population. Due to the nature of the physical reasoning attached to the "coefficient of correlation", the variation in this statistical parameter will not reinforce this observation. Based on this discussion, it seems that the sub-basin model produces an output (for the wet period) which is consistently higher for the upper basin. This particular observation leads to an important conclusion that evaporation from the free surface of the chain of lakes of the upper Kissimmee should be accounted for in the subsequent routing model to improve the output of the sub-basin model. This point is also observed by Dr. Kiker during his previous similar investigations (23).

In a nutshell it can be summarized that, based on all the possible comparisons made in Figures 8 to 35, the sub-basin model generates hydrologic information which correlates fairly well with the recorded values; although further improvement is necessary by developing a routing methodology to account for time and spatial distribution of sub-basin streamflows, and storage characteristics coupled with evaporation adjustments. At this point, it is anticipated that further refinement in some key basin parameters of the sub-basin model may be necessary after all the pieces (such as sub-basin model, routing model, hydraulic formulations and computer programs) are put together, and after realistic routed values for the upper and lower Kissimmee basin are obtained. The developmental procedure of such a routing methodology along with the expected parametric sensitivity analyses are the subject matters of the subsequent chapters.



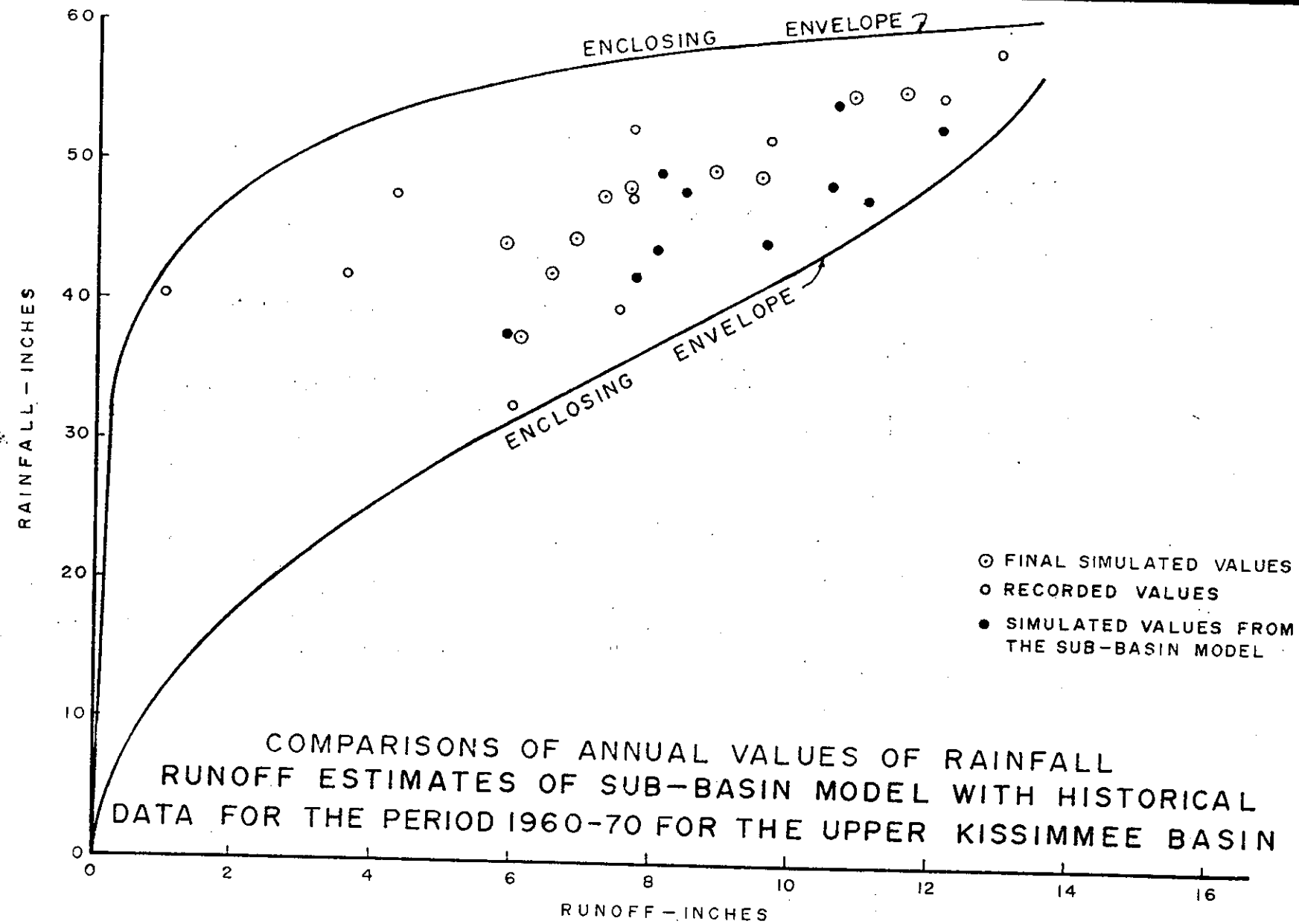
COMPARISON OF SIMULATED AND RECORDED CUMULATIVE VALUES OF RAINFALL AND RUNOFF FOR UPPER, LOWER AND ENTIRE KISSIMMEE BASIN

FIGURE 8



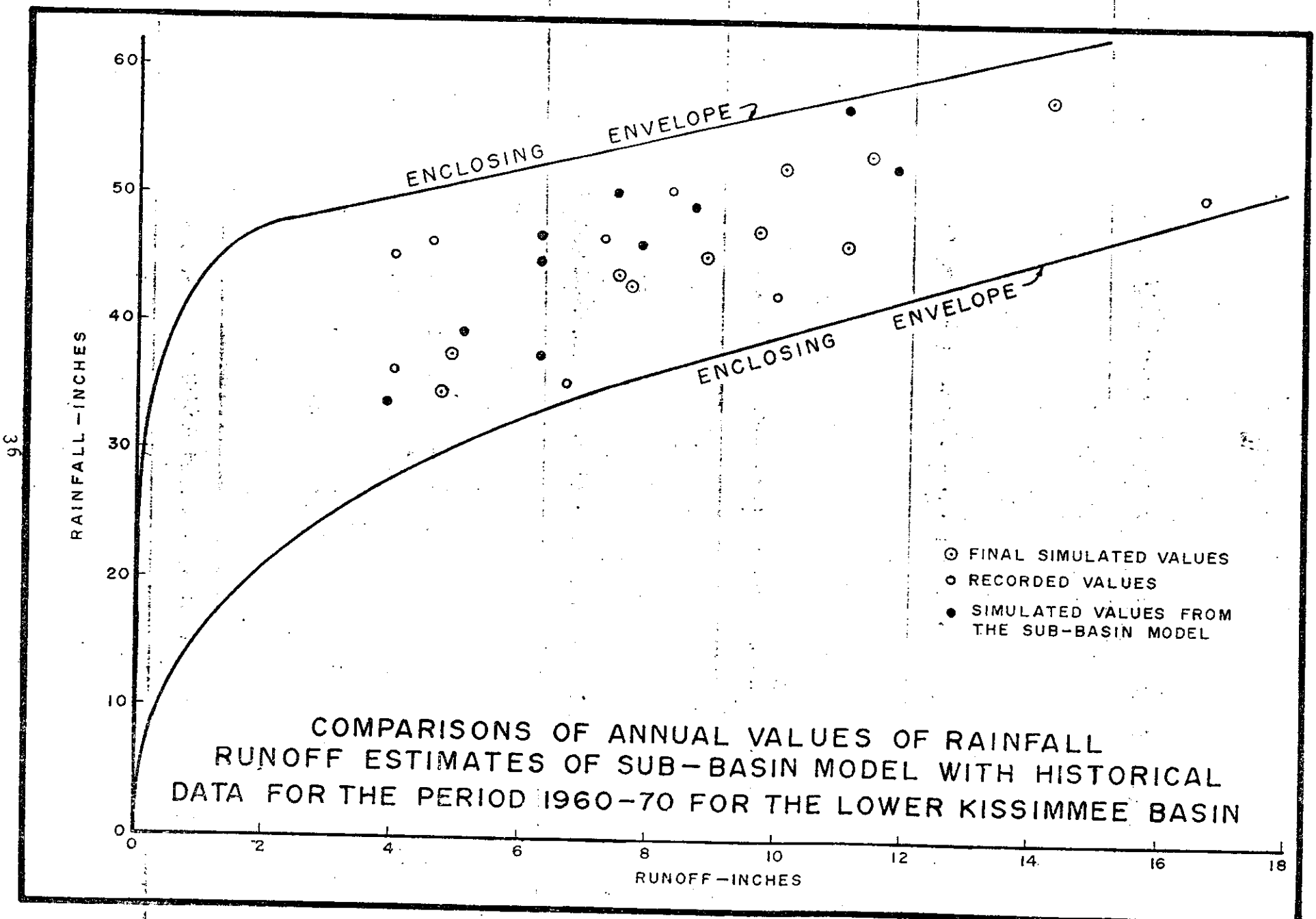
COMPARISONS OF ANNUAL VALUES OF RAINFALL RUNOFF ESTIMATES OF SUB-BASIN MODEL WITH HISTORICAL DATA FOR THE PERIOD 1960-70 FOR THE ENTIRE KISSIMMEE BASIN

FIGURE 9



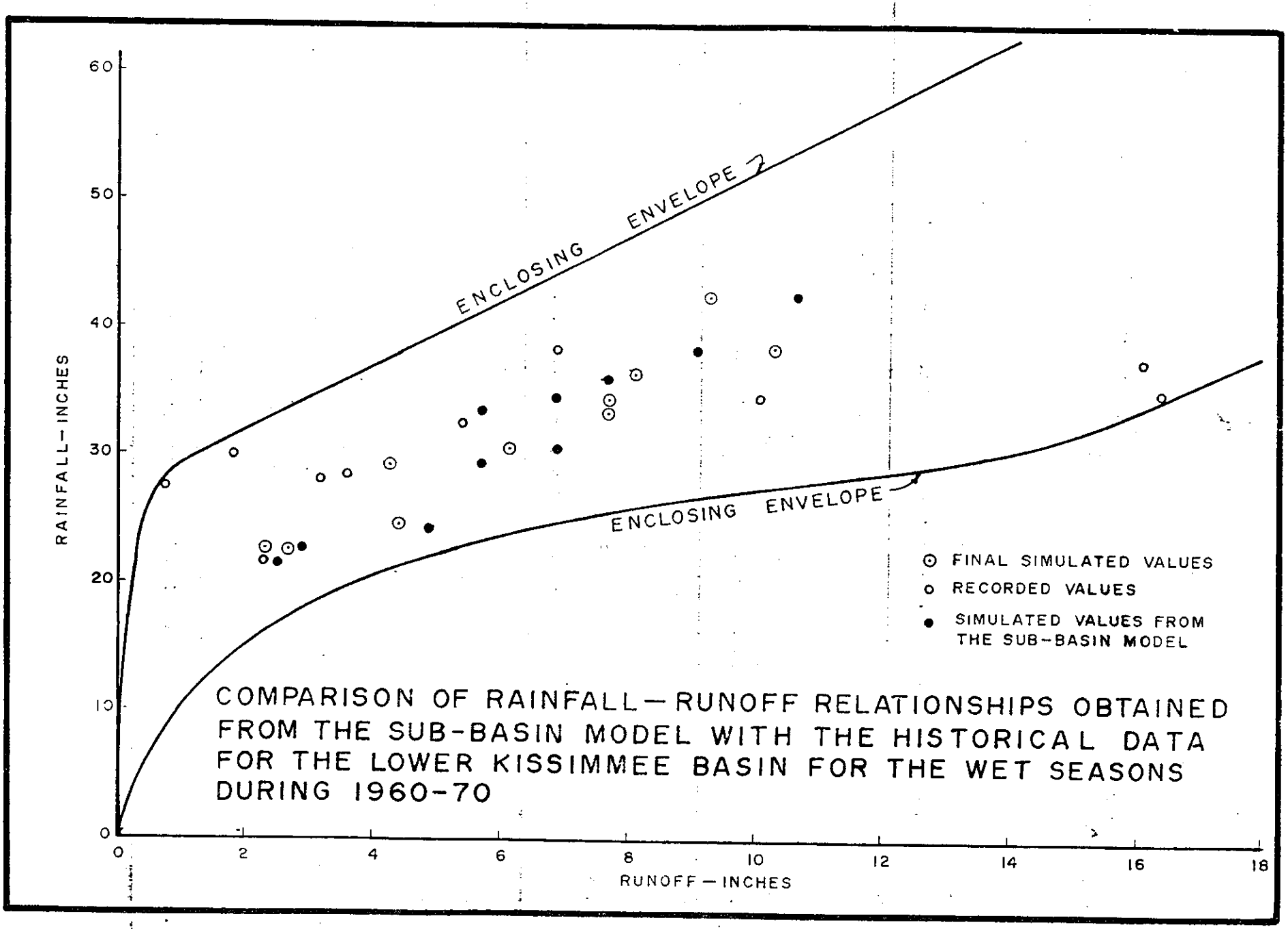
COMPARISONS OF ANNUAL VALUES OF RAINFALL RUNOFF ESTIMATES OF SUB-BASIN MODEL WITH HISTORICAL DATA FOR THE PERIOD 1960-70 FOR THE UPPER KISSIMMEE BASIN

FIGURE 10



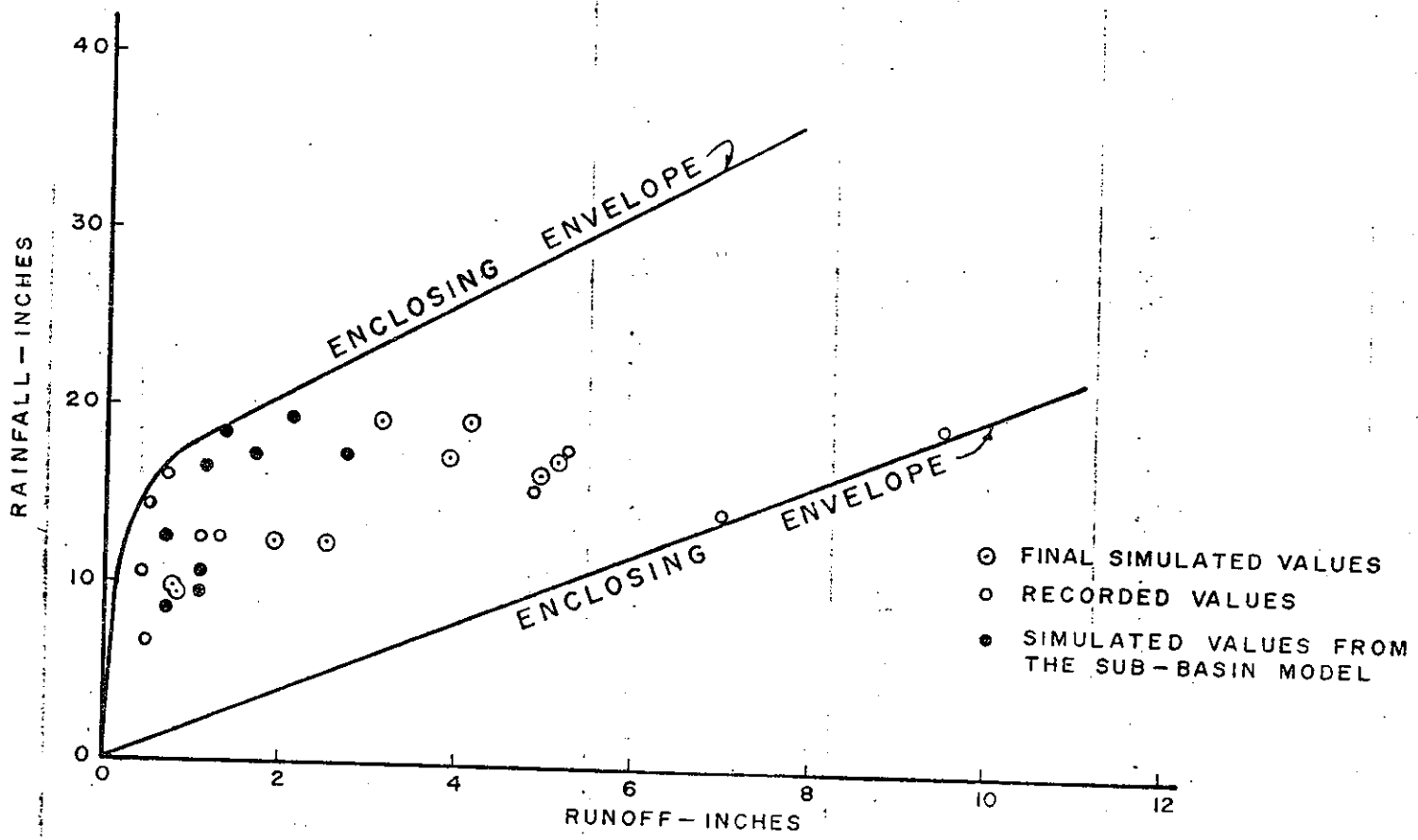
COMPARISONS OF ANNUAL VALUES OF RAINFALL RUNOFF ESTIMATES OF SUB-BASIN MODEL WITH HISTORICAL DATA FOR THE PERIOD 1960-70 FOR THE LOWER KISSIMMEE BASIN

FIGURE 11



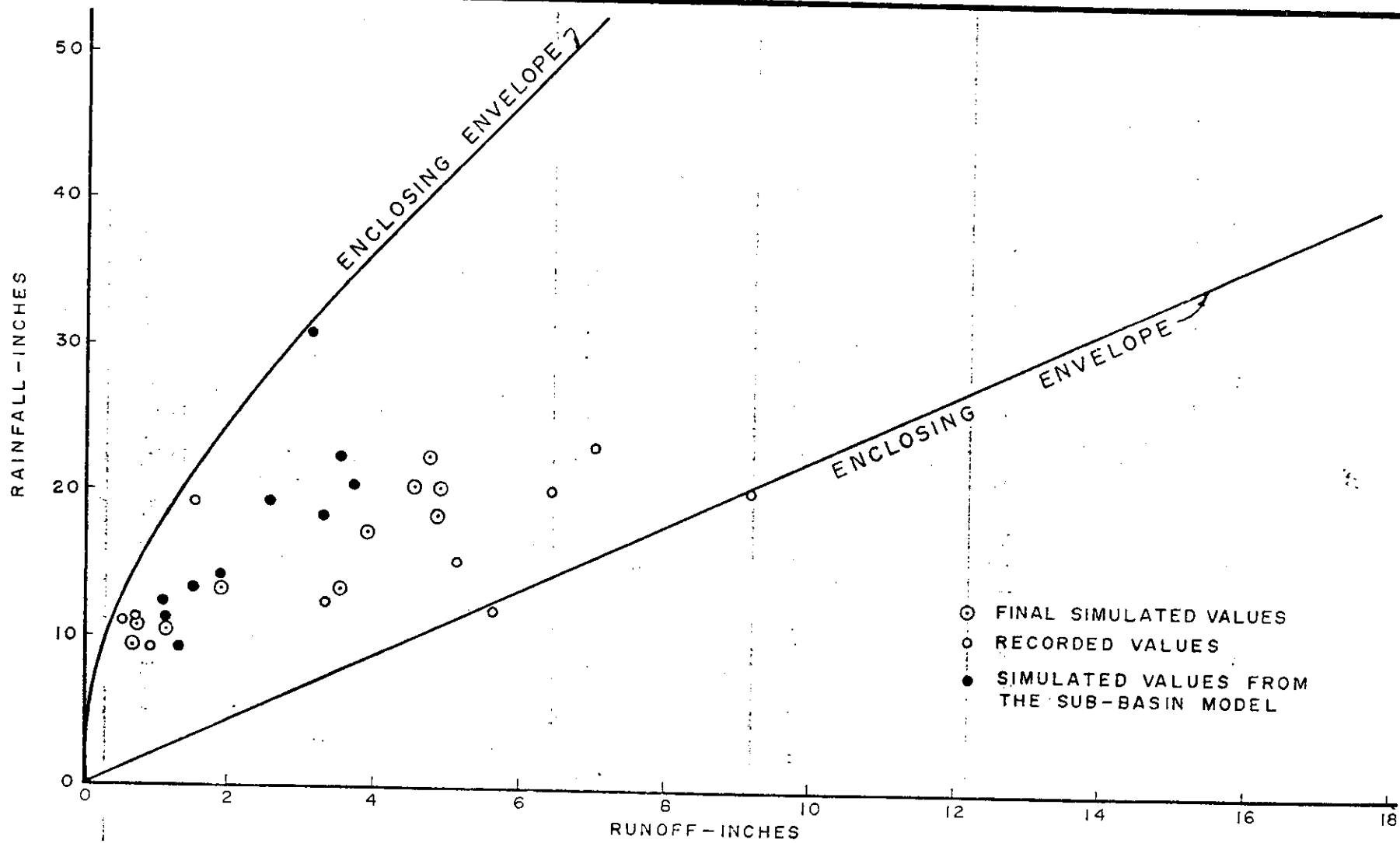
COMPARISON OF RAINFALL—RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB-BASIN MODEL WITH THE HISTORICAL DATA FOR THE LOWER KISSIMMEE BASIN FOR THE WET SEASONS DURING 1960-70

FIGURE 12



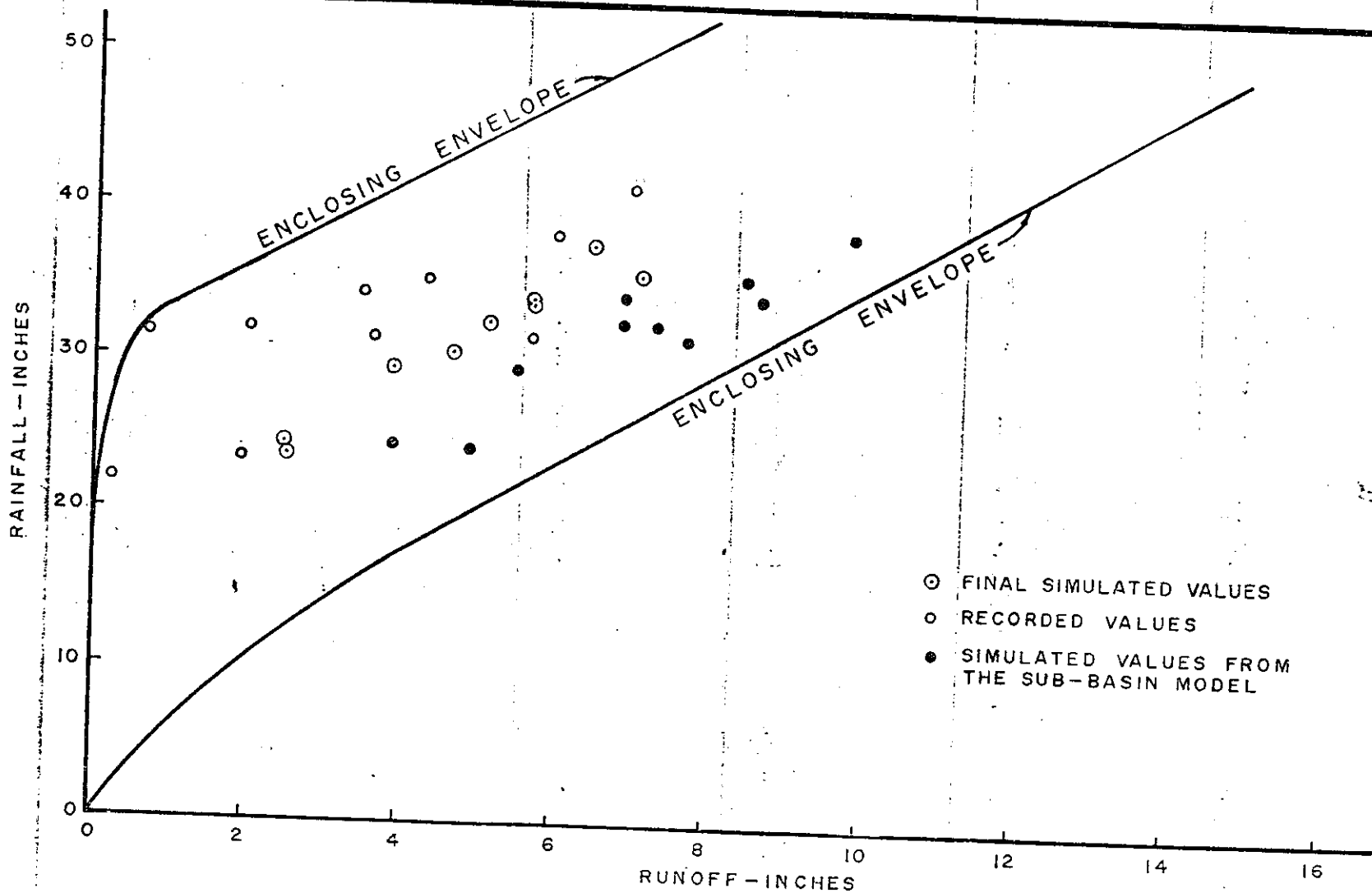
COMPARISON OF RAINFALL–RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB-BASIN MODEL WITH THE HISTORICAL DATA FOR THE LOWER KISSIMMEE BASIN FOR THE DRY SEASONS DURING 1960–70

FIGURE 13



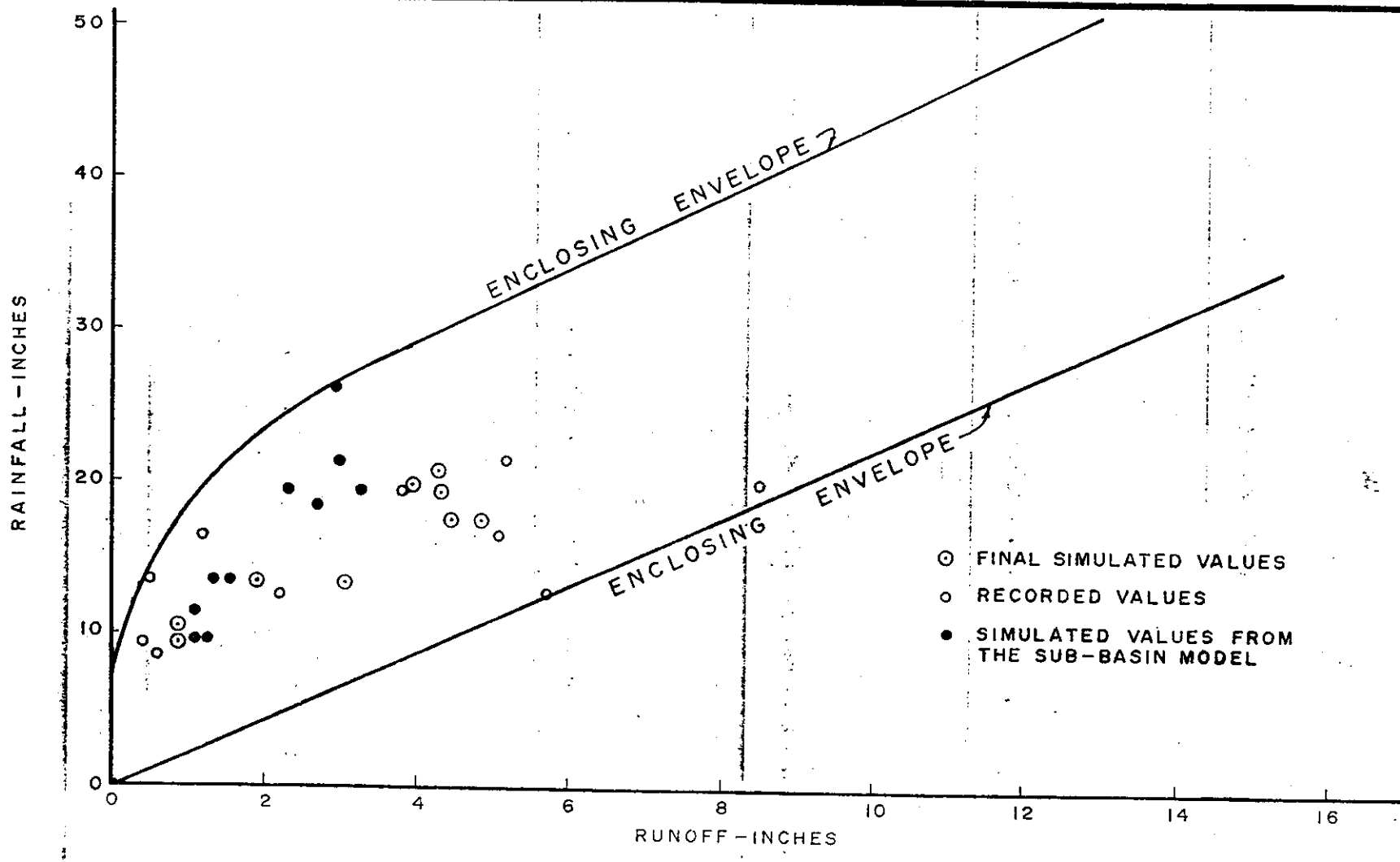
COMPARISON OF RAINFALL-RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB-BASIN MODEL WITH THE HISTORICAL DATA FOR THE UPPER KISSIMMEE BASIN FOR THE DRY SEASONS DURING 1960-70

FIGURE 14



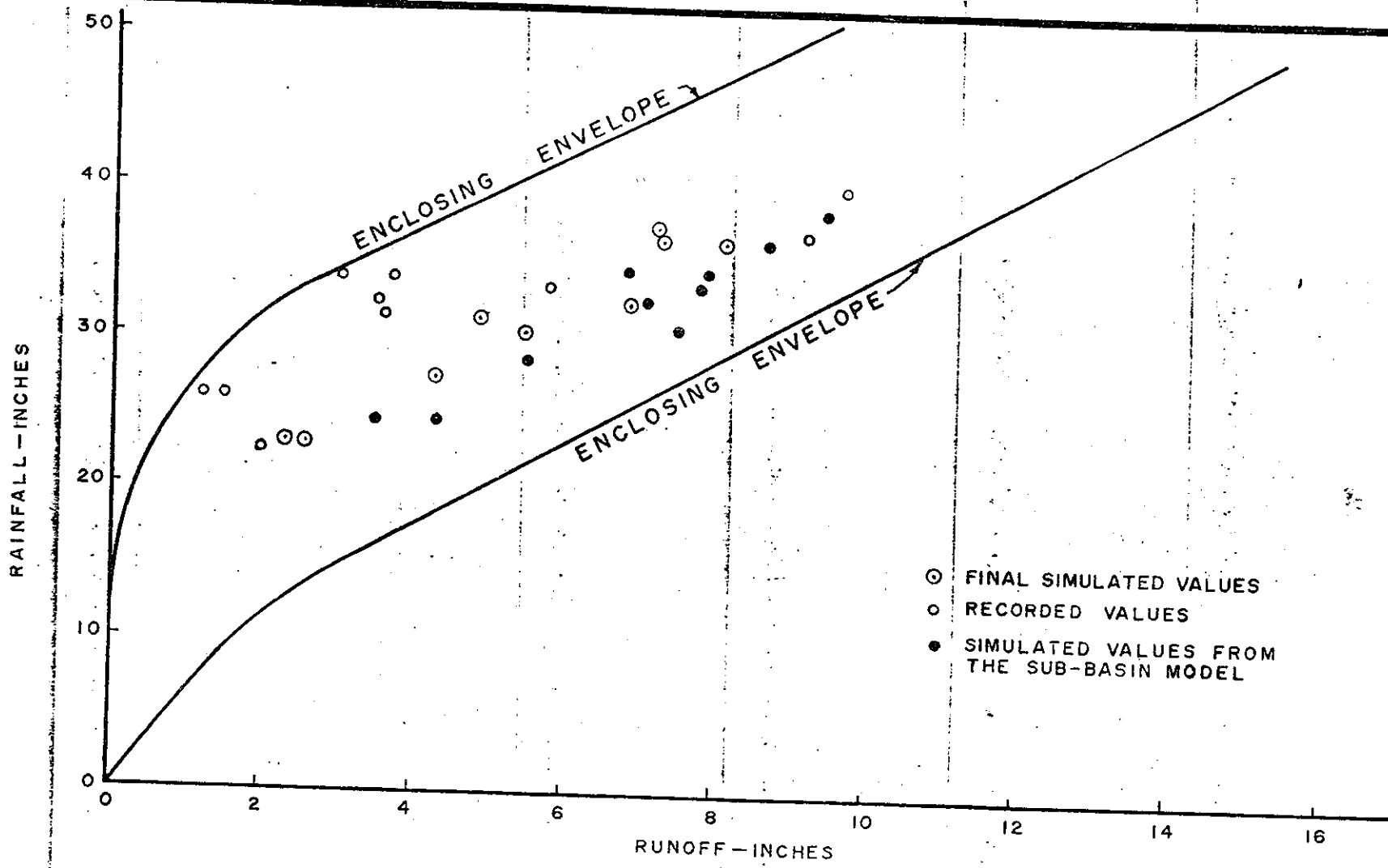
COMPARISON OF RAINFALL—RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB—BASIN MODEL WITH THE HISTORICAL DATA FOR THE UPPER KISSIMMEE BASIN FOR THE WET SEASONS DURING 1960-70

FIGURE 15



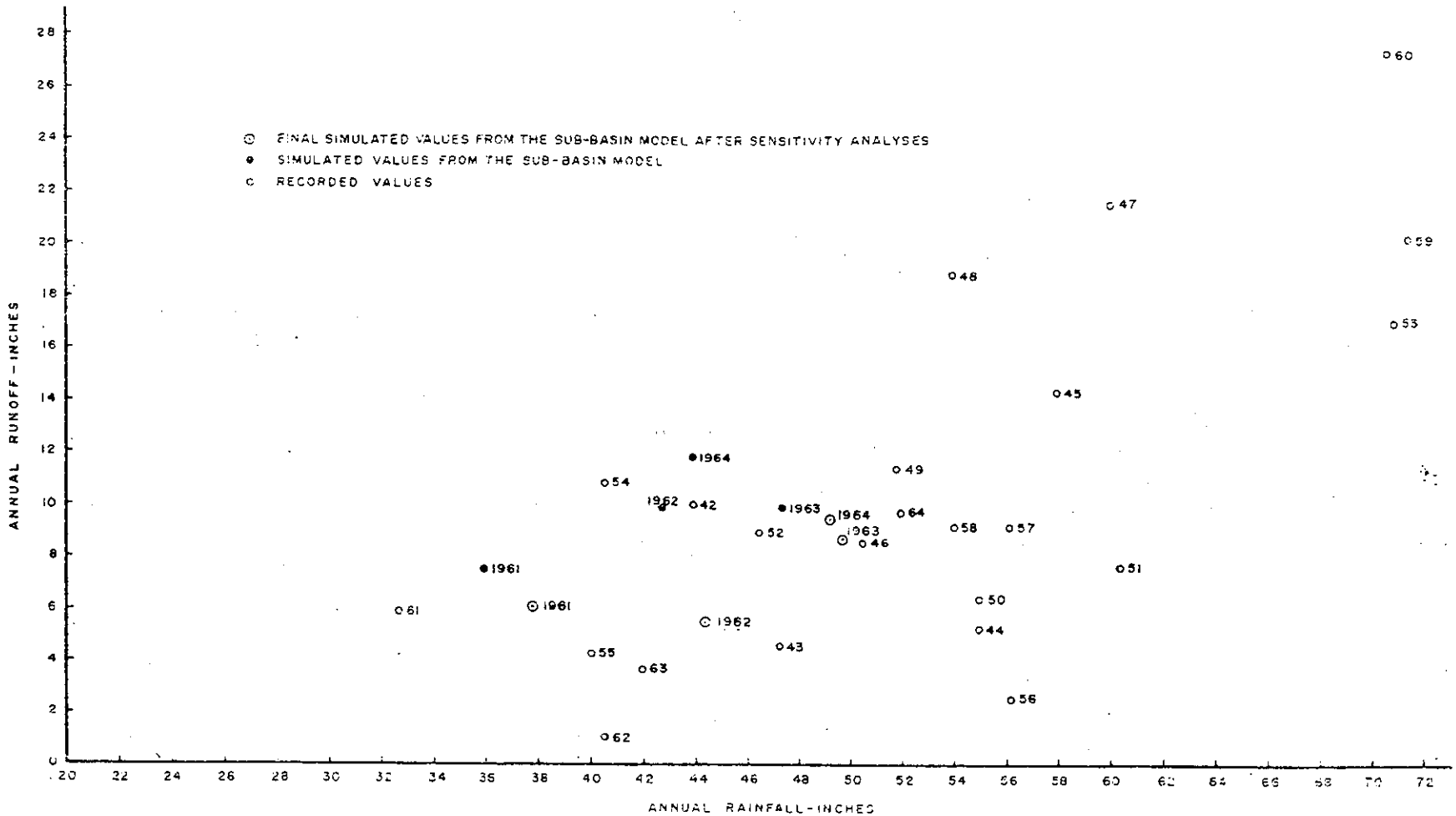
COMPARISON OF RAINFALL-RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB-BASIN MODEL WITH THE HISTORICAL DATA FOR THE ENTIRE KISSIMMEE BASIN FOR THE DRY SEASONS DURING 1960-70

FIGURE 16



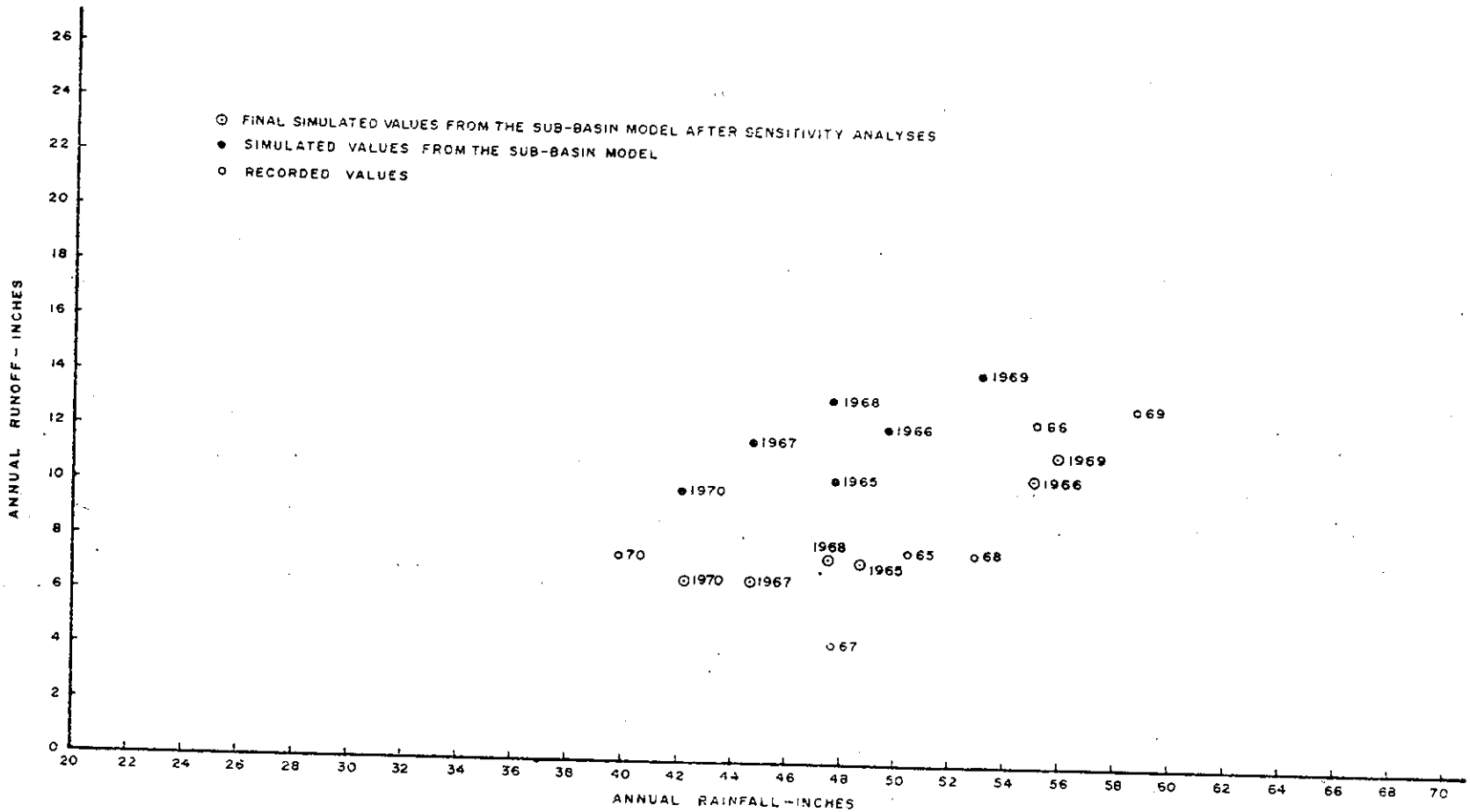
COMPARISON OF RAINFALL-RUNOFF RELATIONSHIPS OBTAINED FROM THE SUB-BASIN MODEL WITH THE HISTORICAL DATA FOR THE ENTIRE KISSIMMEE BASIN FOR THE WET SEASONS DURING 1960-70

FIGURE 17



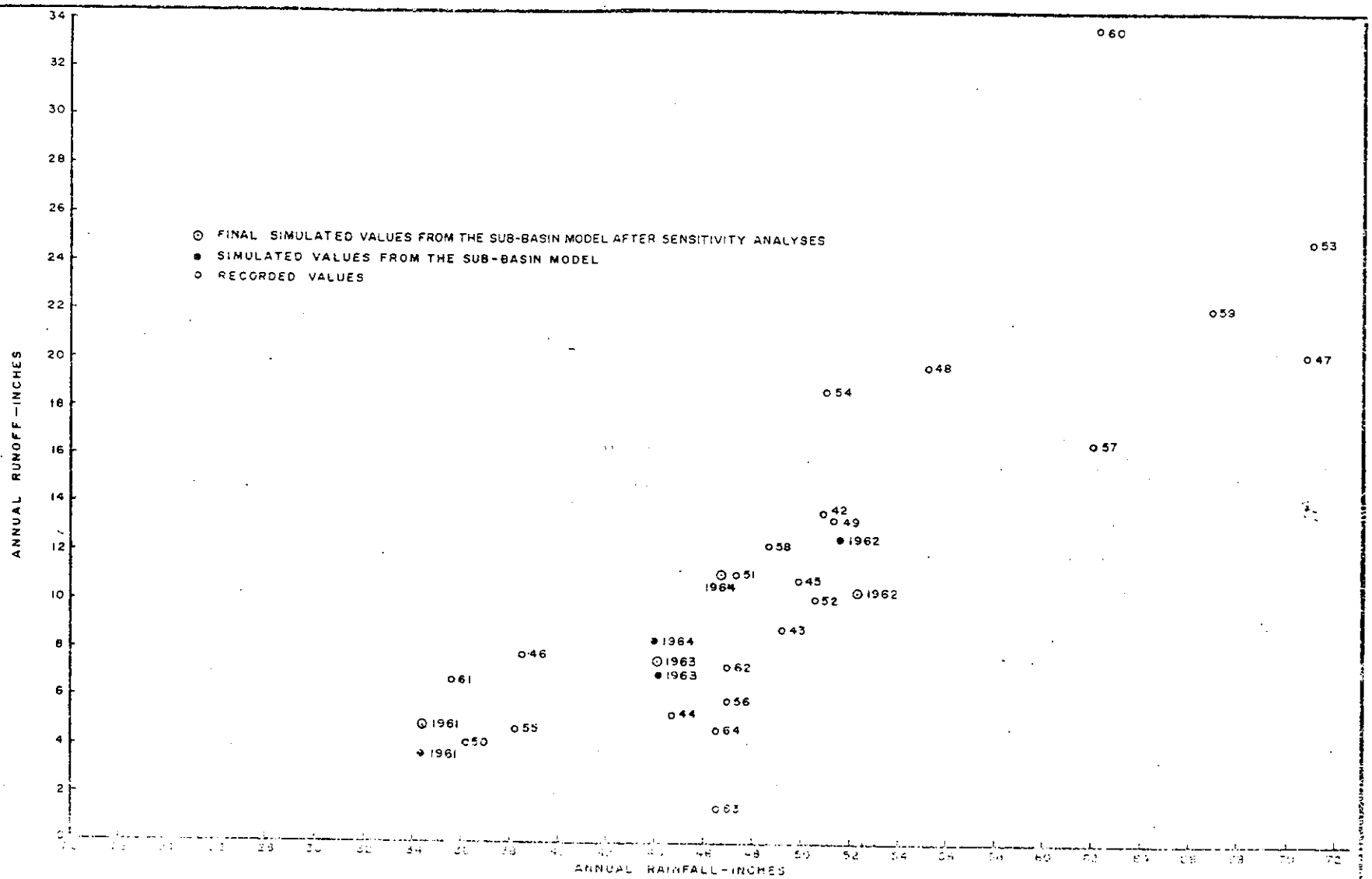
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON UPPER KISSIMMEE BASIN FOR PERIOD 1942-1964

FIGURE 16



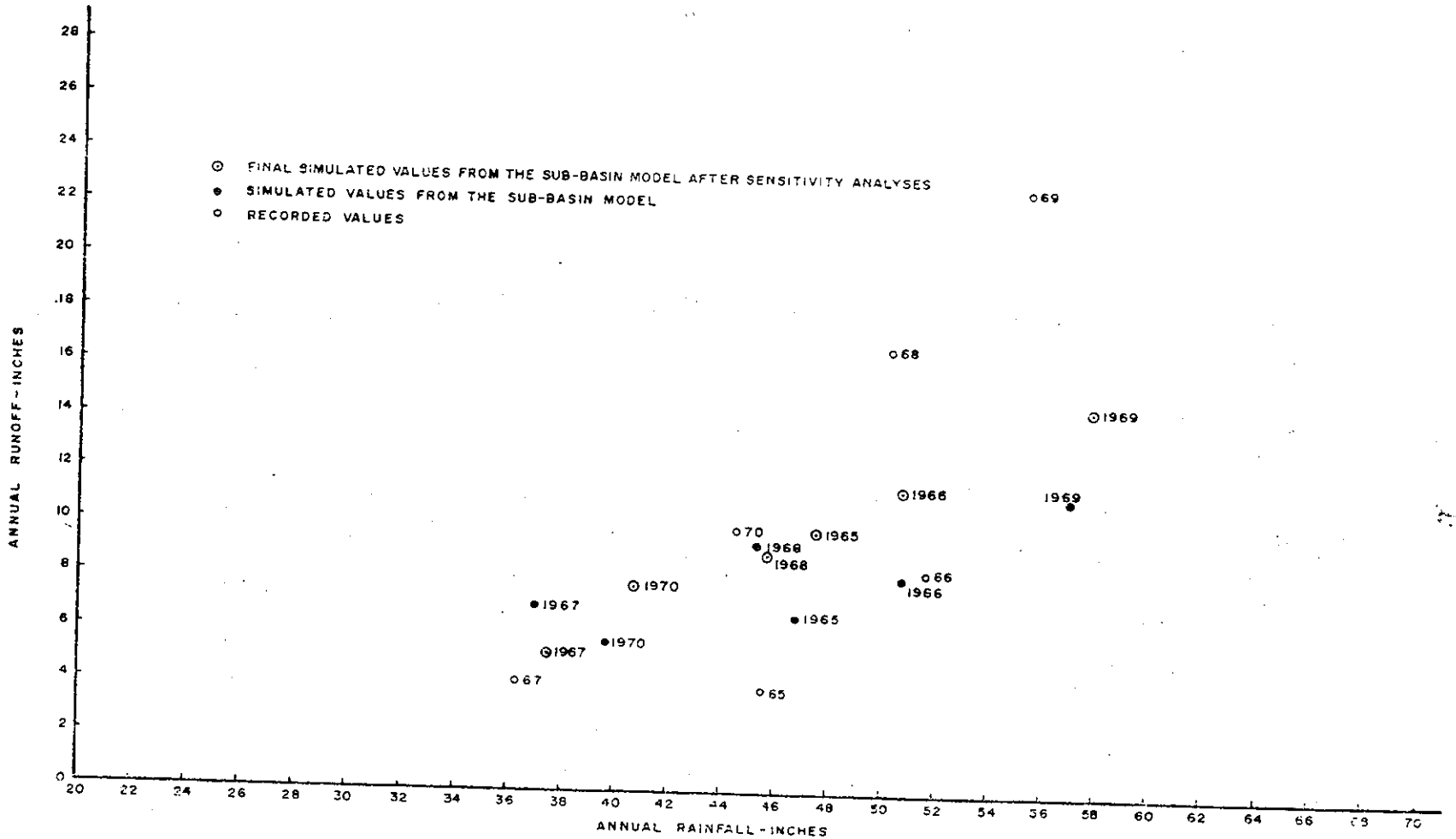
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON UPPER KISSIMMEE BASIN FOR PERIOD 1965-1970

FIGURE 19



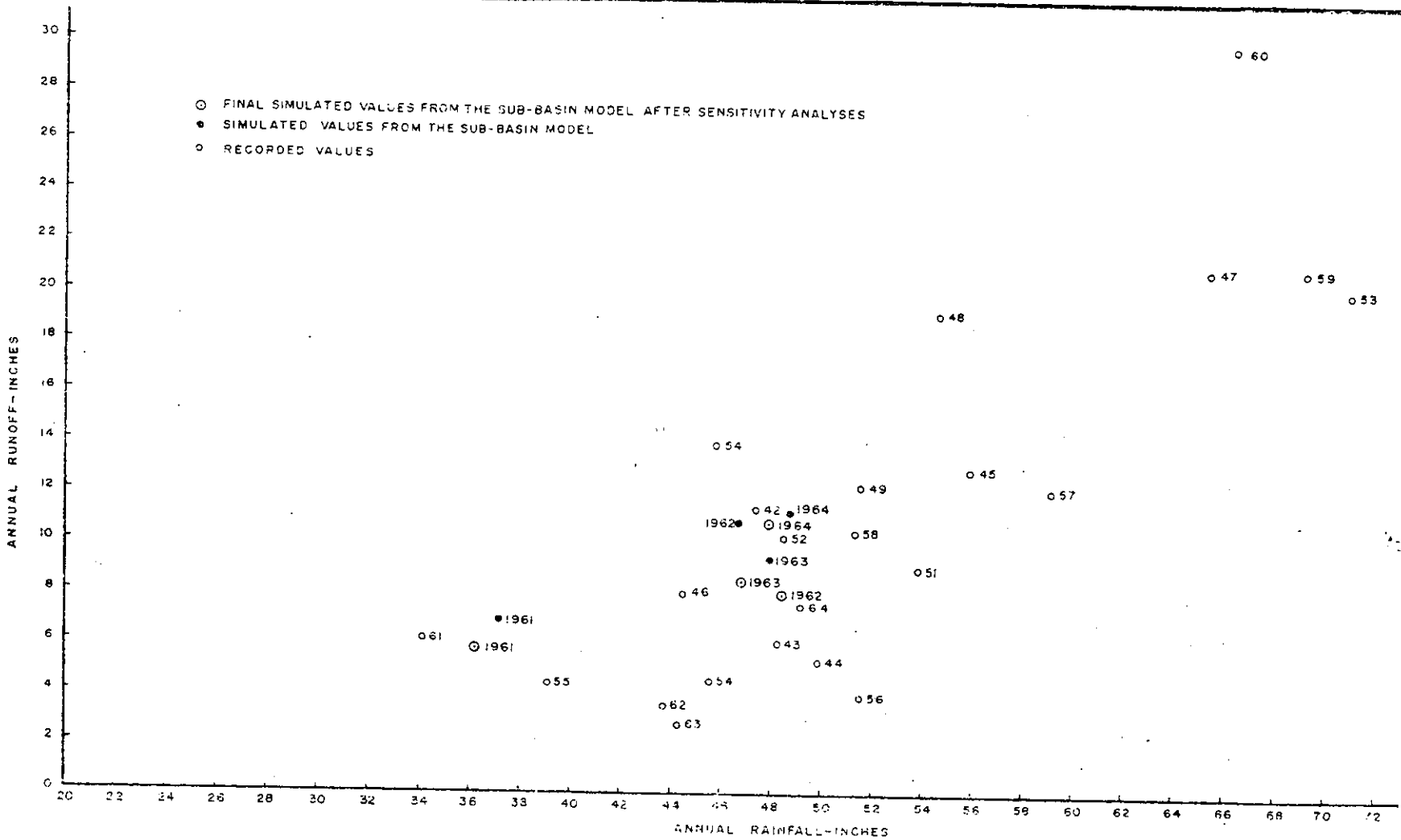
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON LOWER KISSIMMEE BASIN FOR PERIOD 1942-1964

FIGURE 20



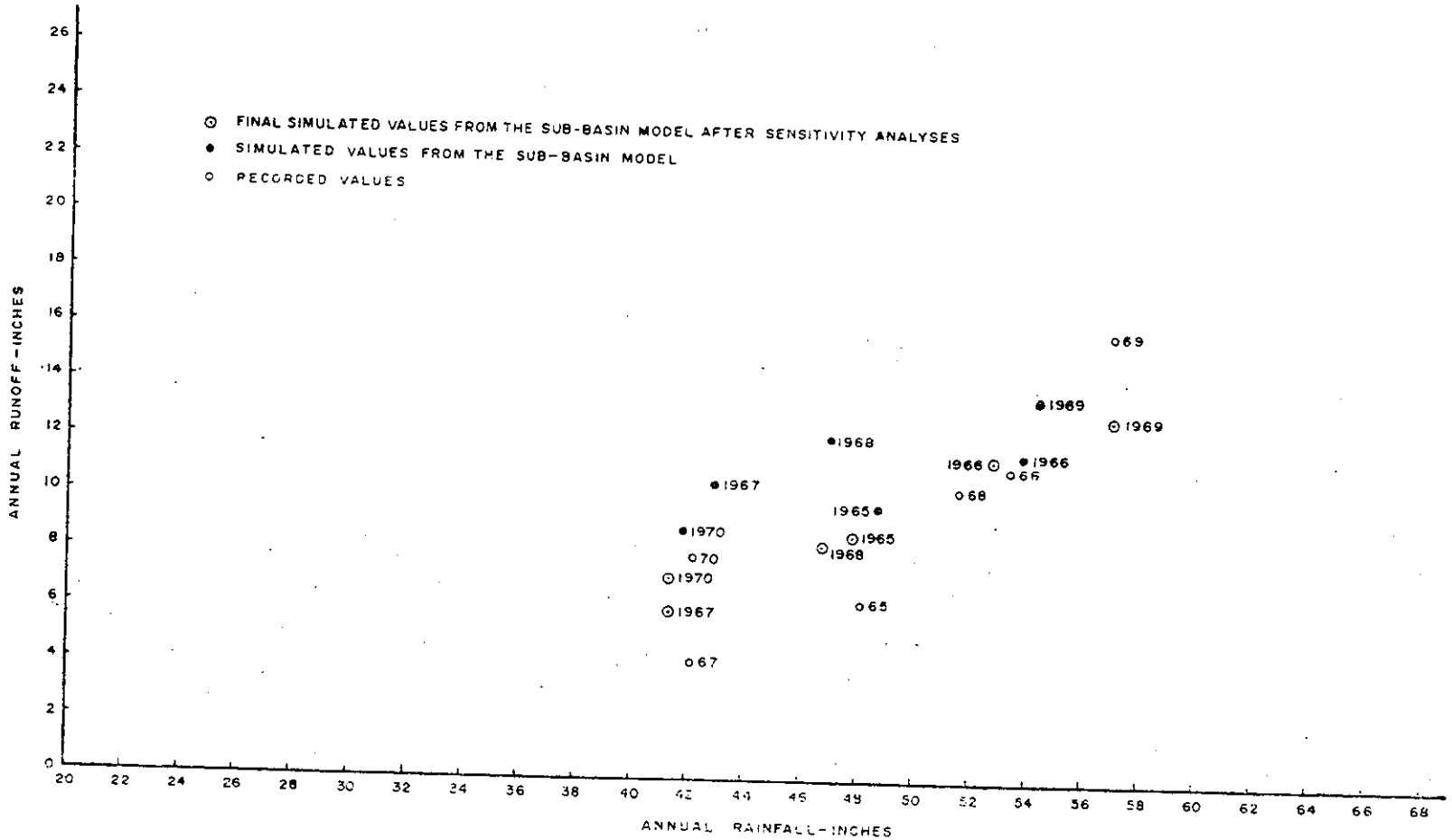
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON LOWER KISSIMMEE BASIN FOR PERIOD 1965-1970

FIGURE 21



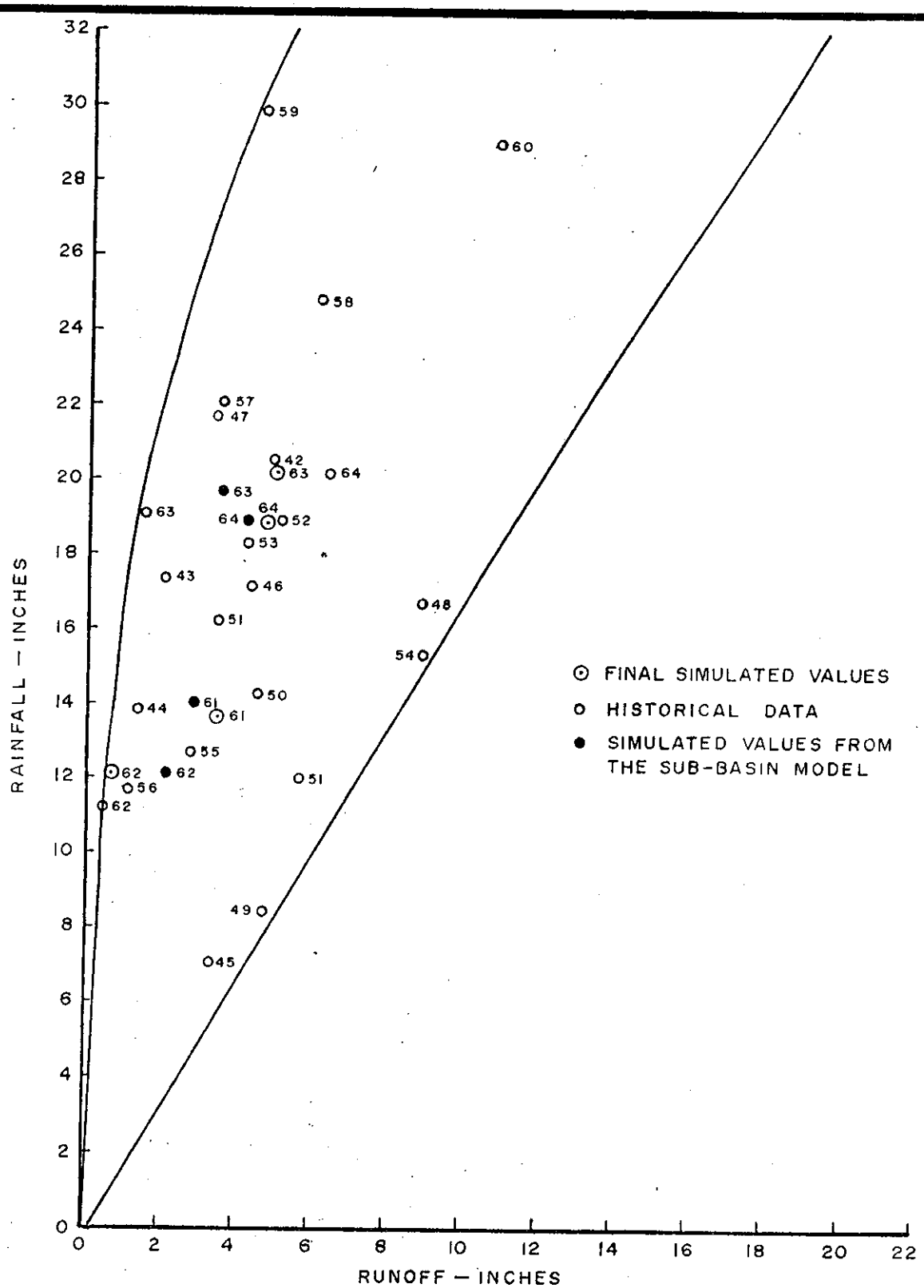
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON ENTIRE KISSIMMEE BASIN FOR PERIOD 1942-1964

FIGURE 22



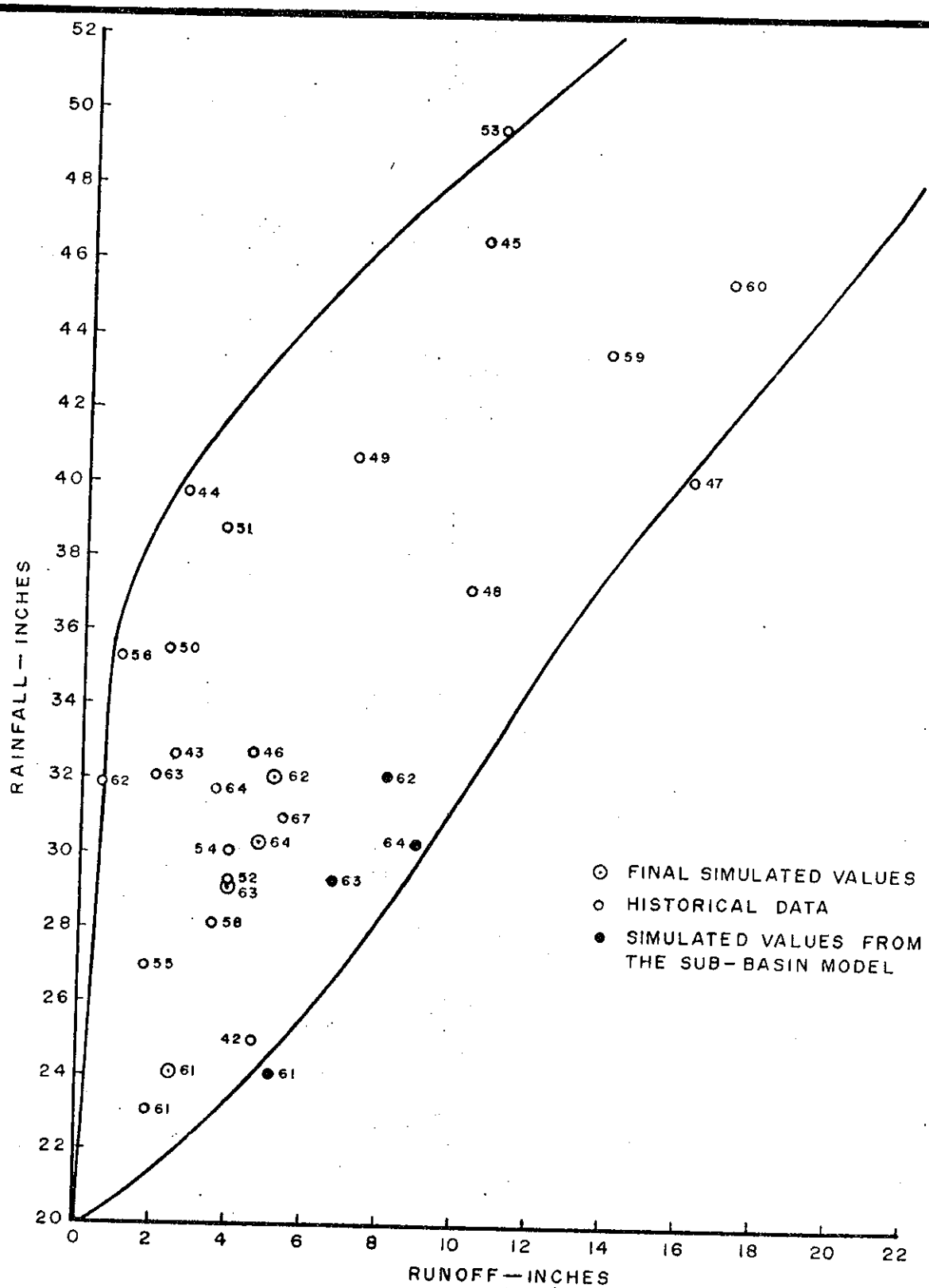
COMPARISON OF ANNUAL RAINFALL
RUNOFF RELATIONS ON ENTIRE KISSIMMEE BASIN FOR PERIOD 1965-1970

FIGURE 23



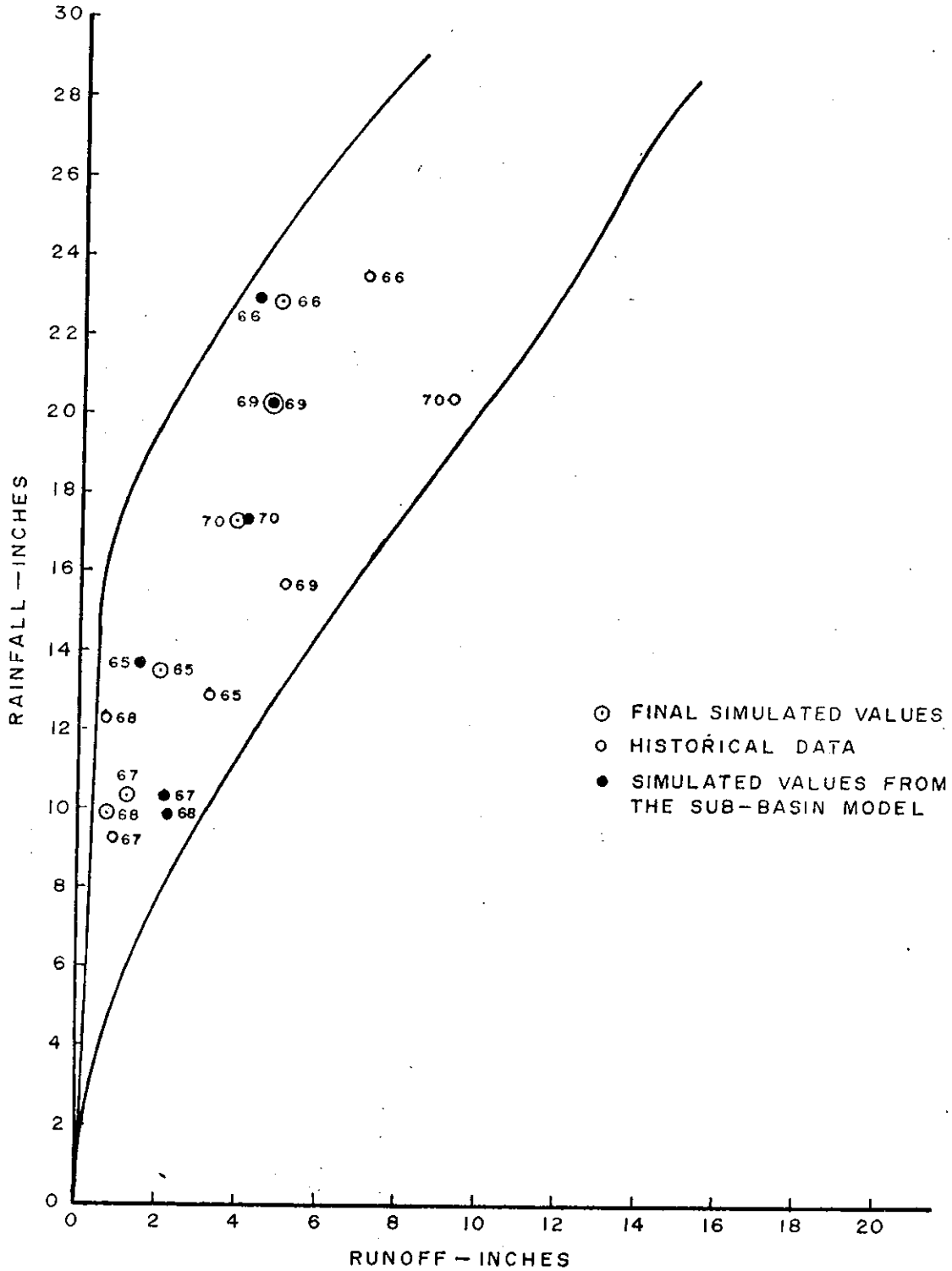
COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON UPPER KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 24



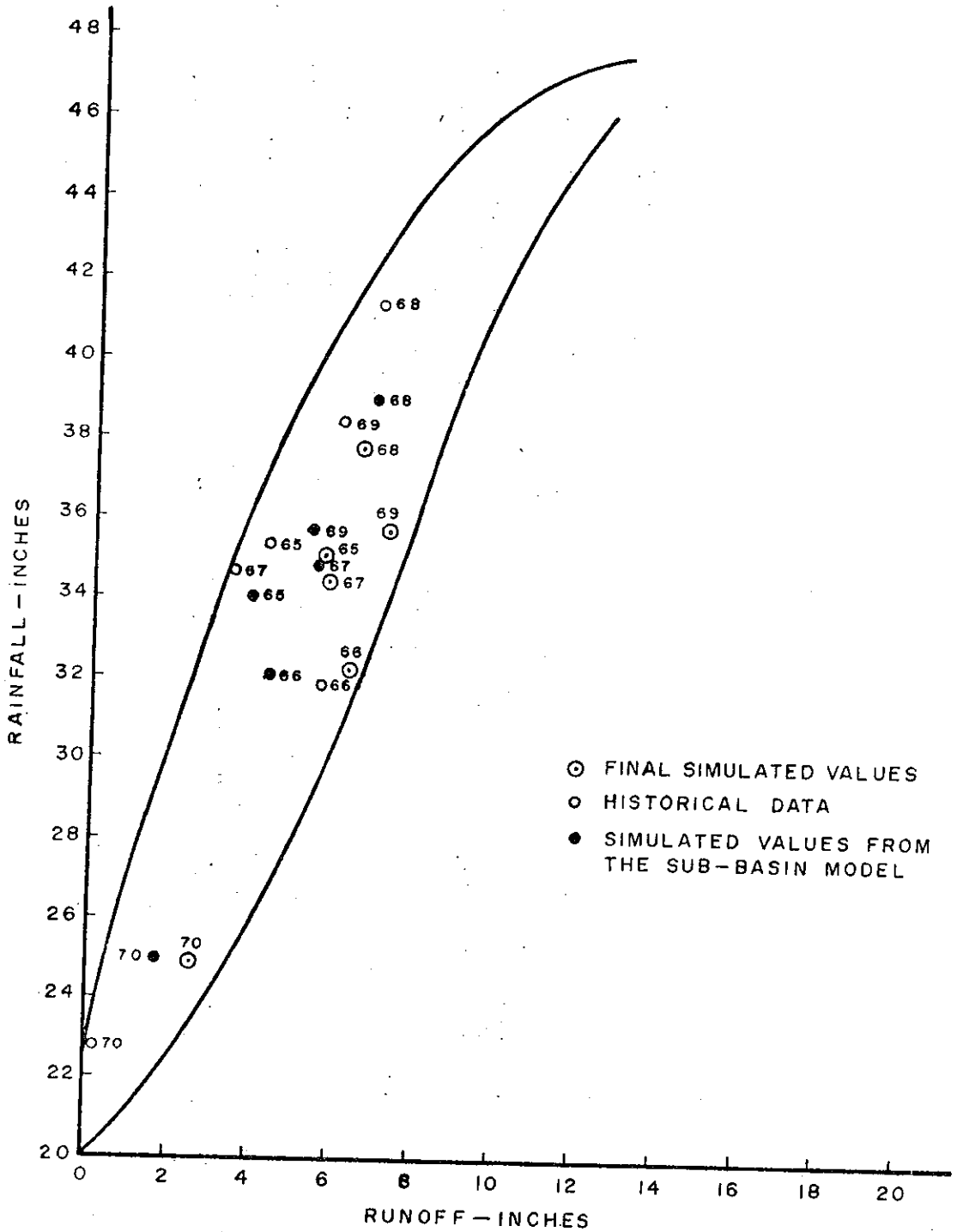
COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON UPPER KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 25



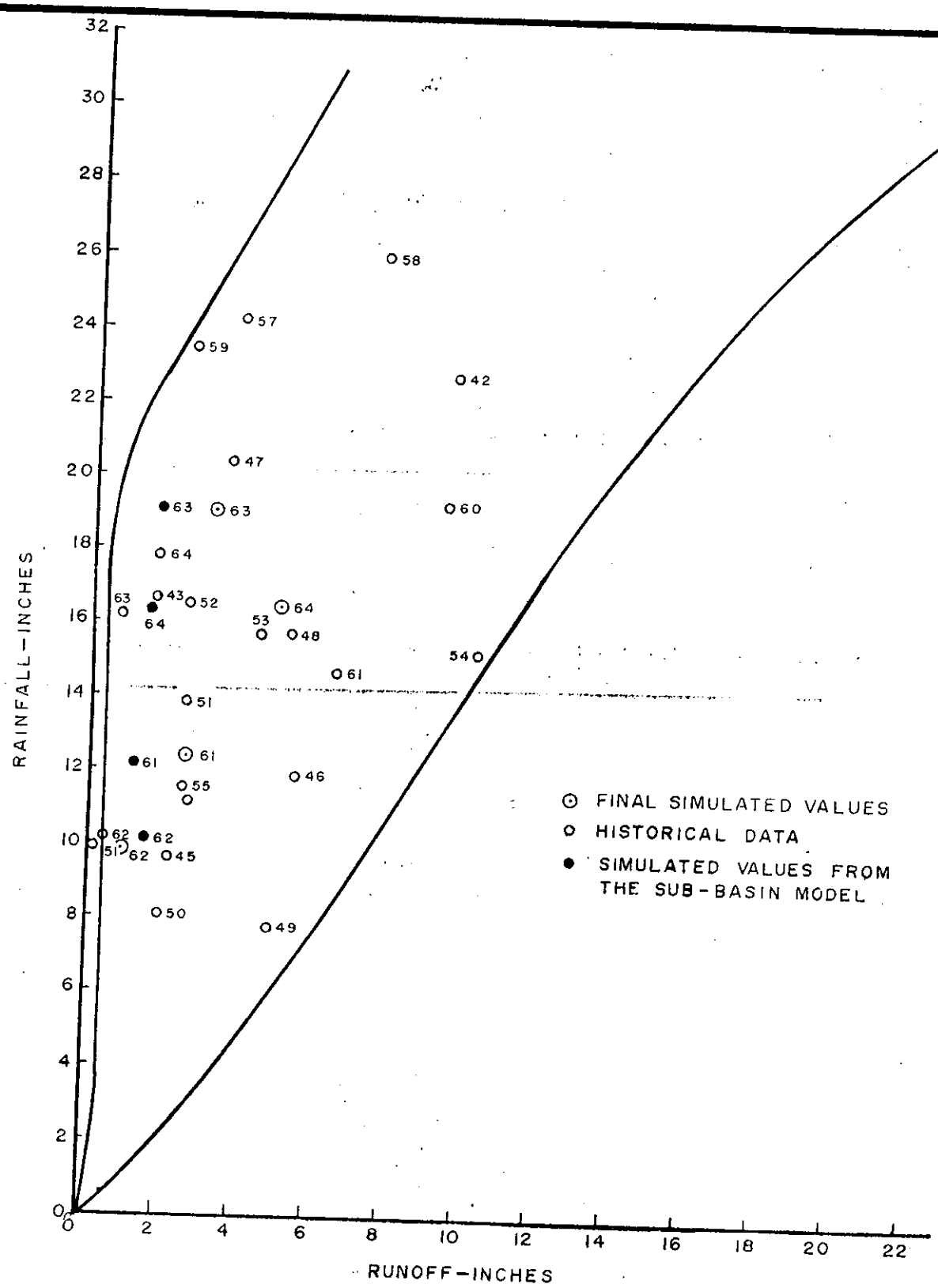
COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON UPPER KISSIMMEE BASIN FOR THE PERIOD 1965-70

FIGURE 26



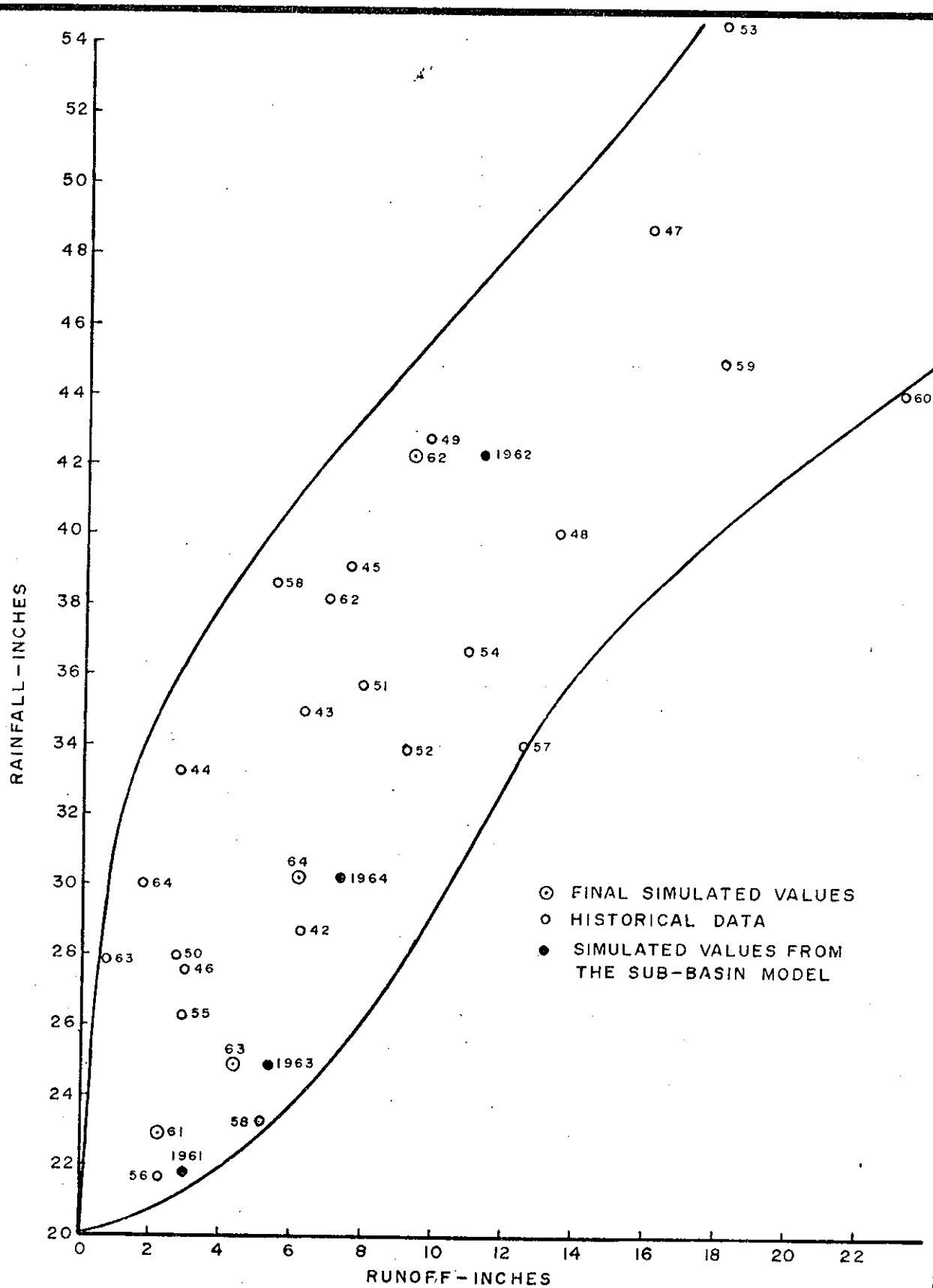
COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON UPPER KISSIMMEE BASIN FOR THE PERIOD 1965-70

FIGURE 27



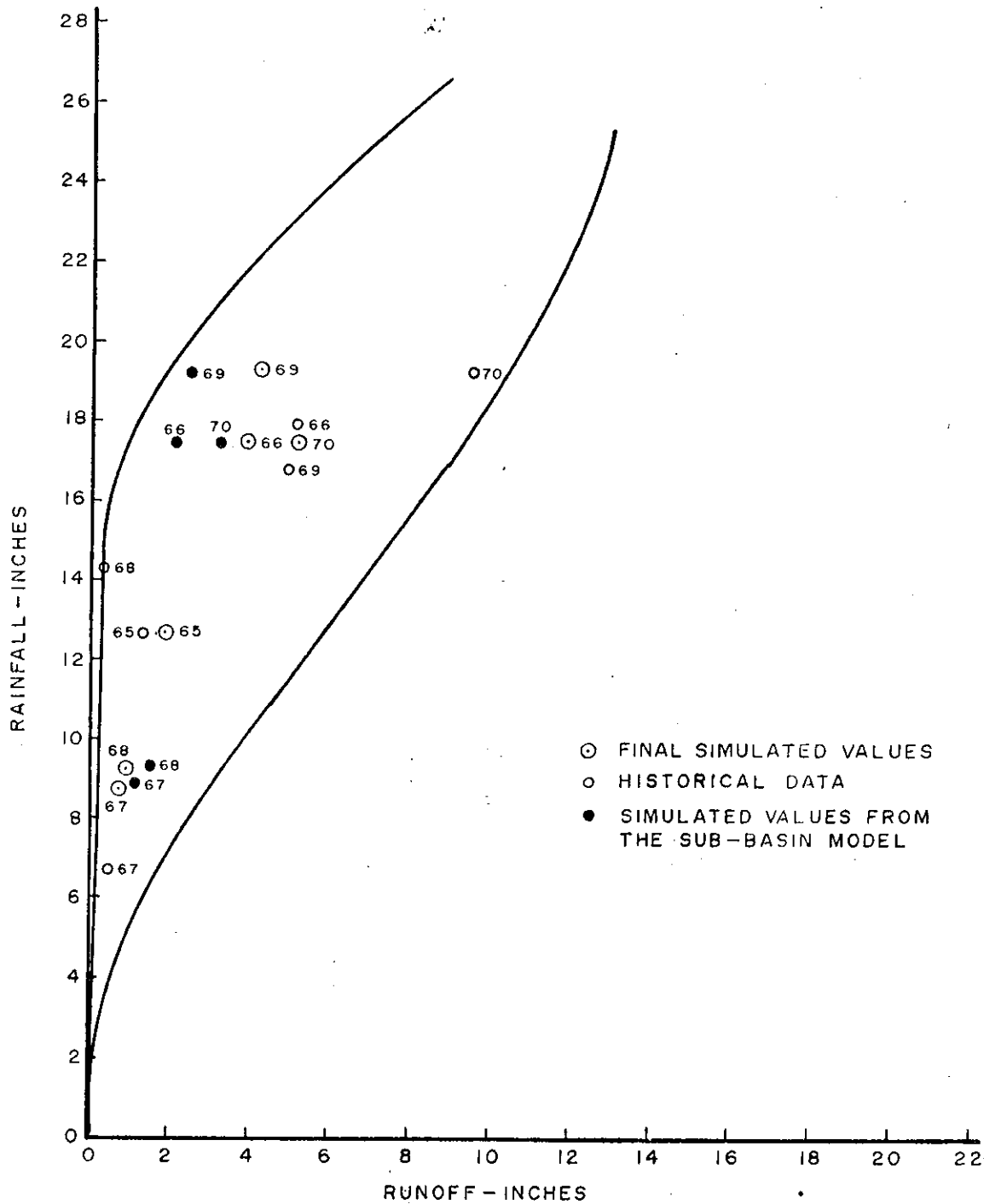
COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON LOWER KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 28



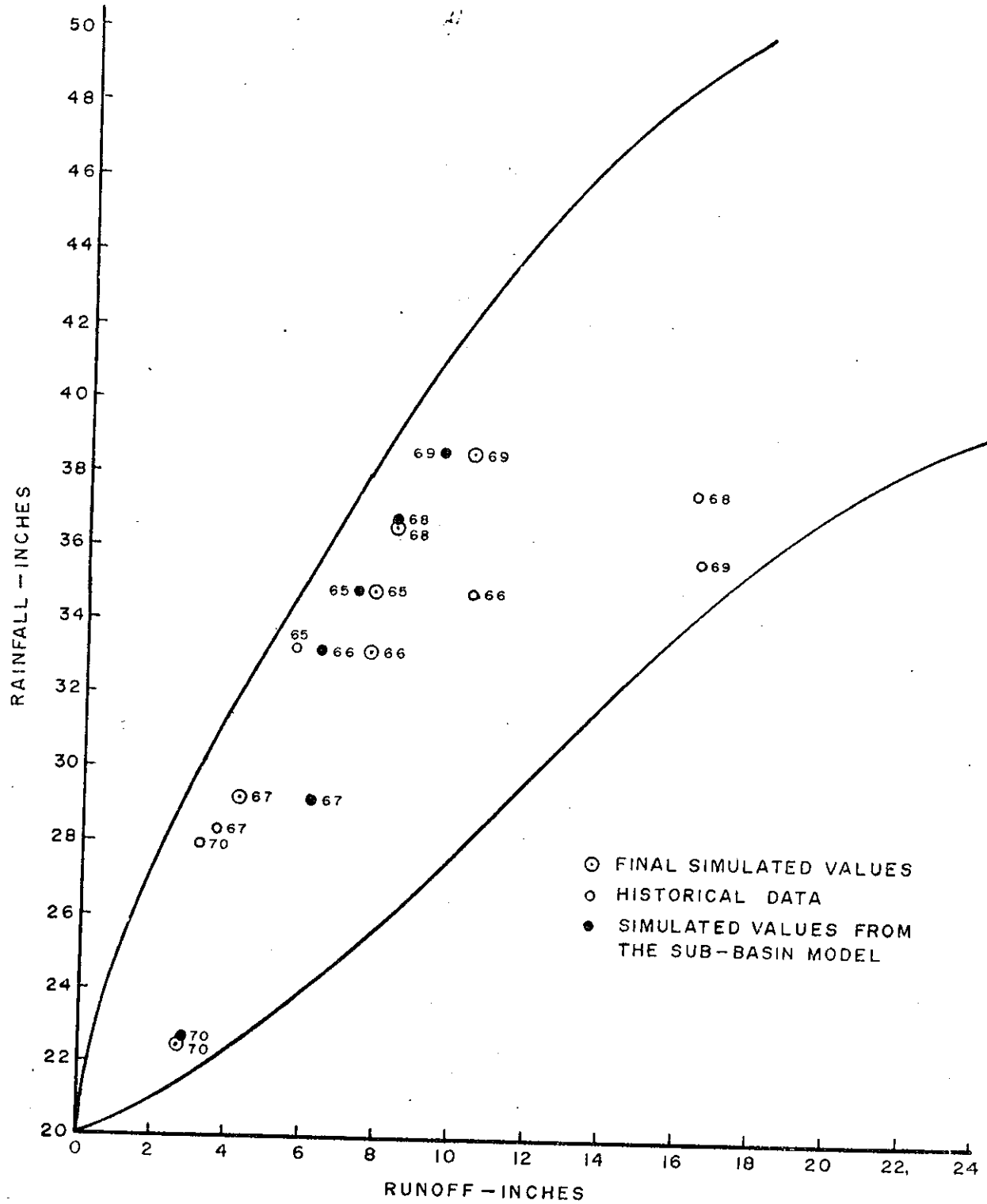
COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON LOWER KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 29



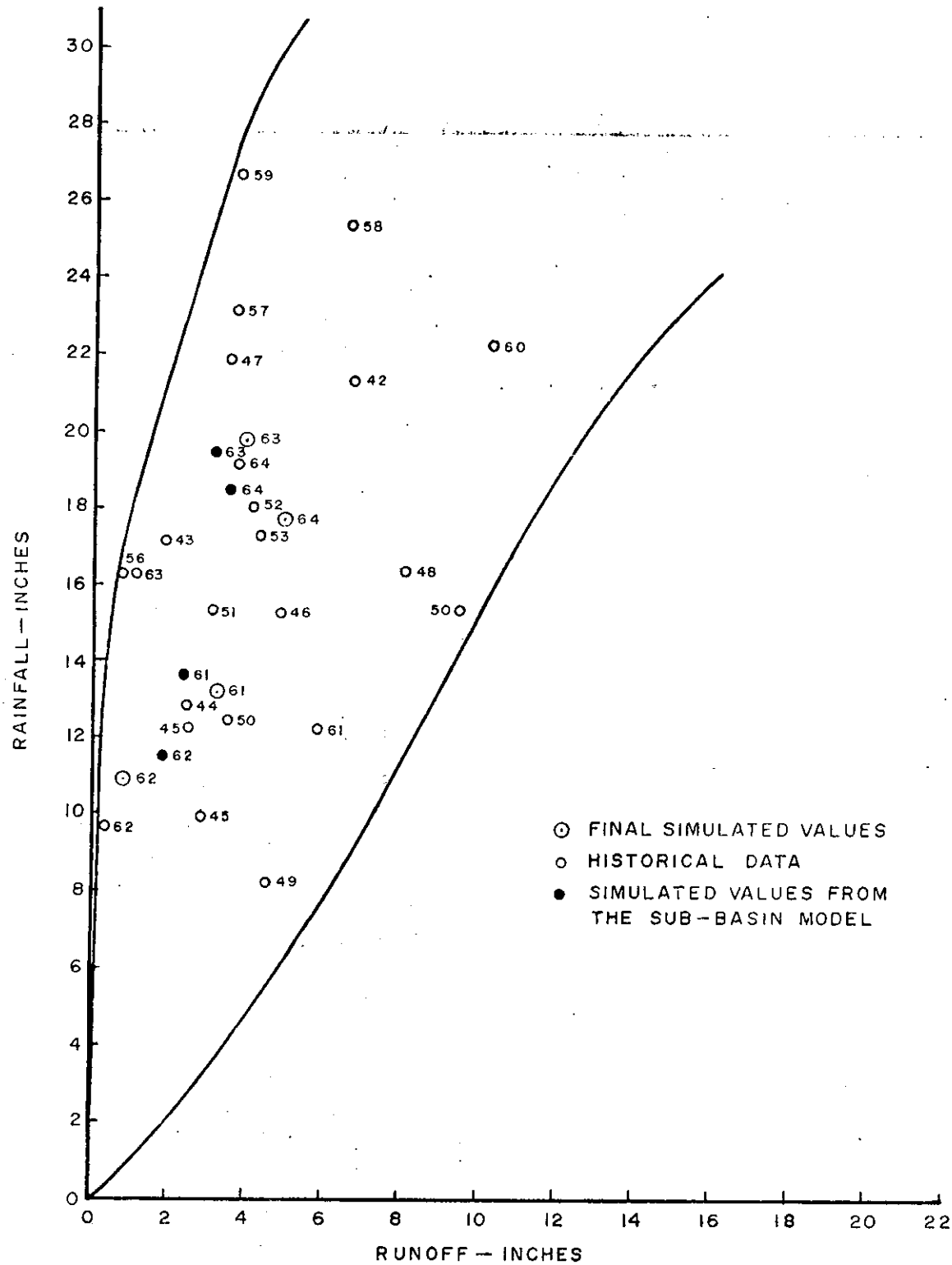
COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON LOWER KISSIMMEE BASIN FOR THE PERIOD 1965-70

FIGURE 30



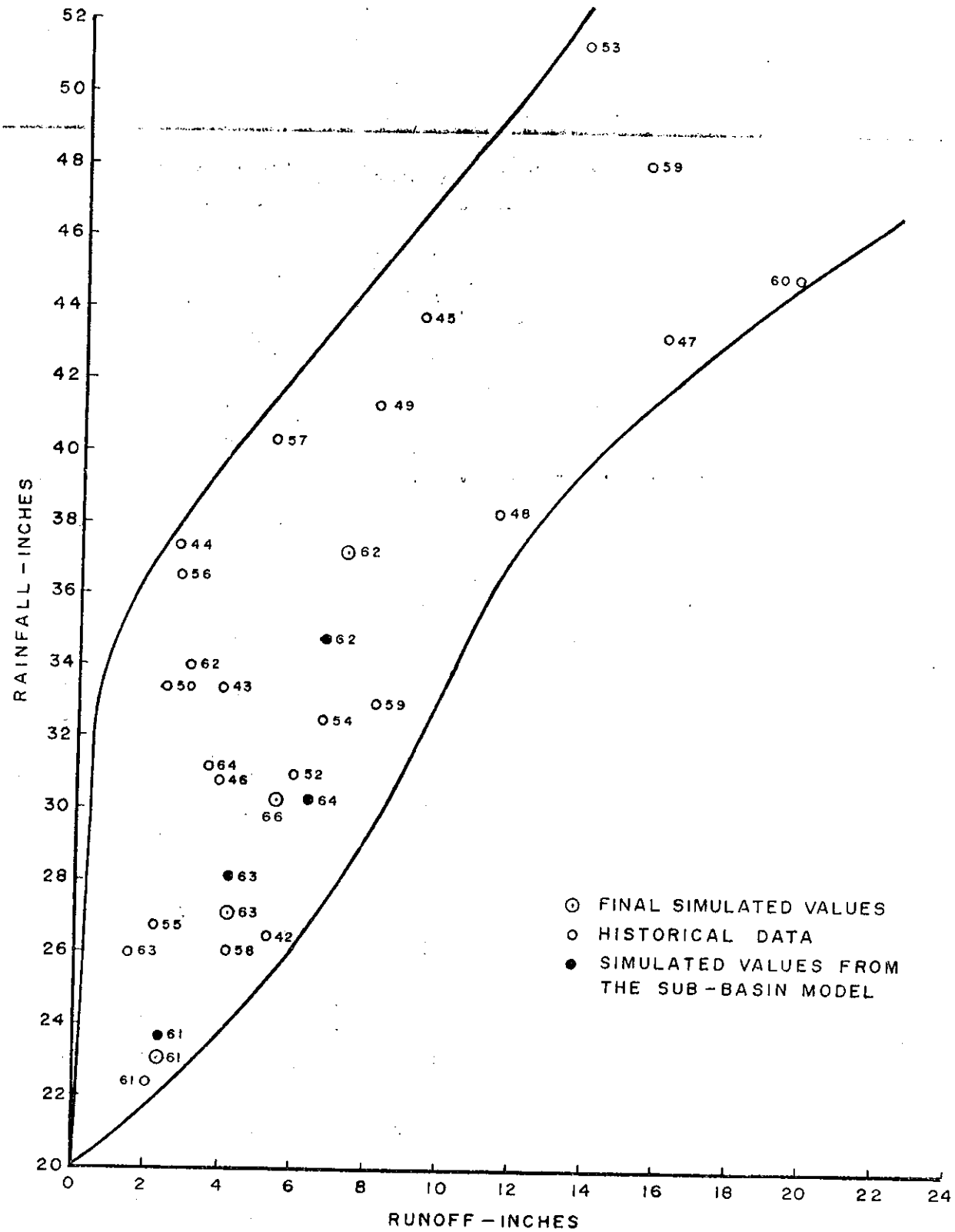
COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON LOWER KISSIMMEE BASIN FOR THE PERIOD 1965-70

FIGURE 31



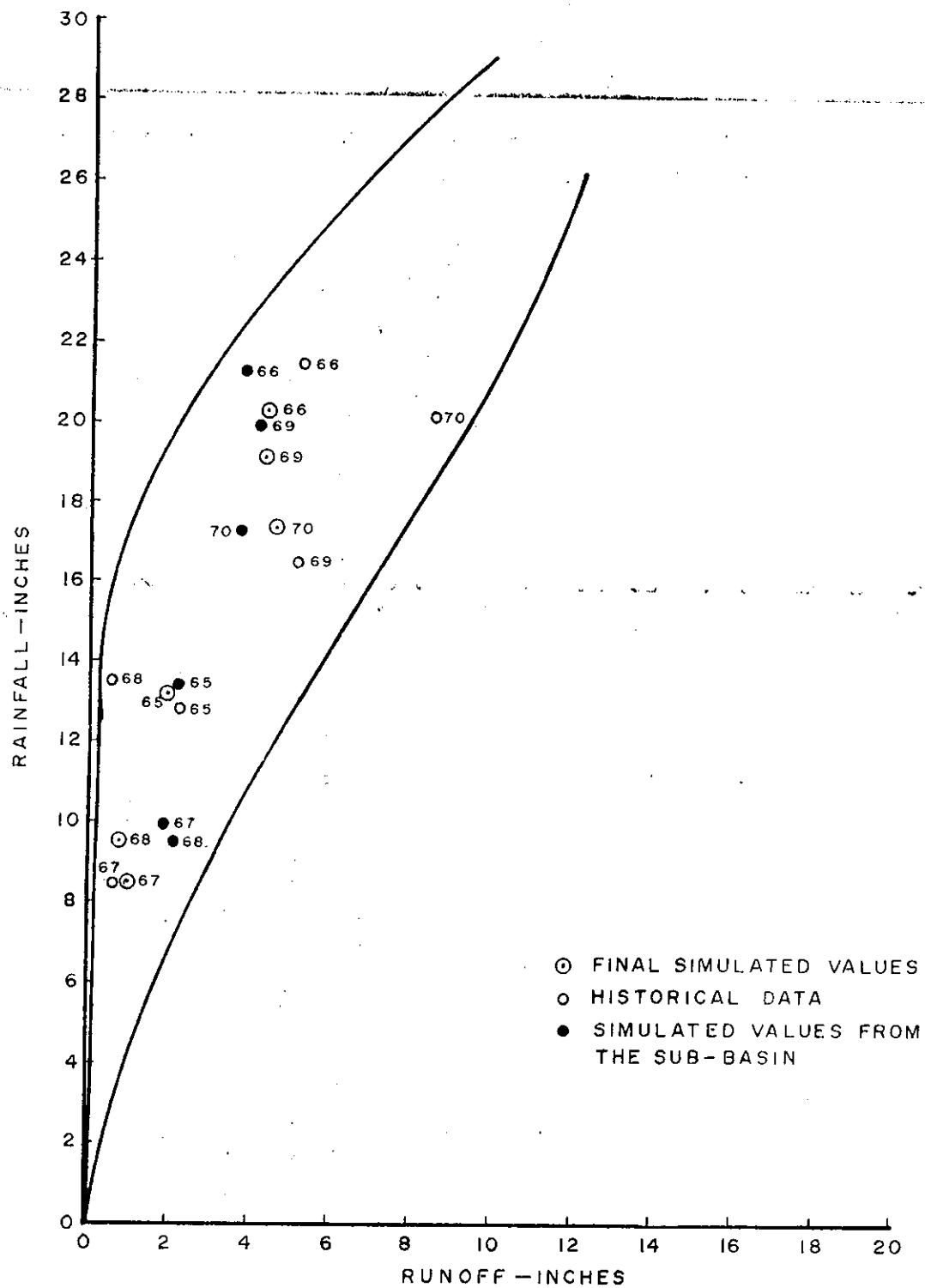
COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON ENTIRE KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 32



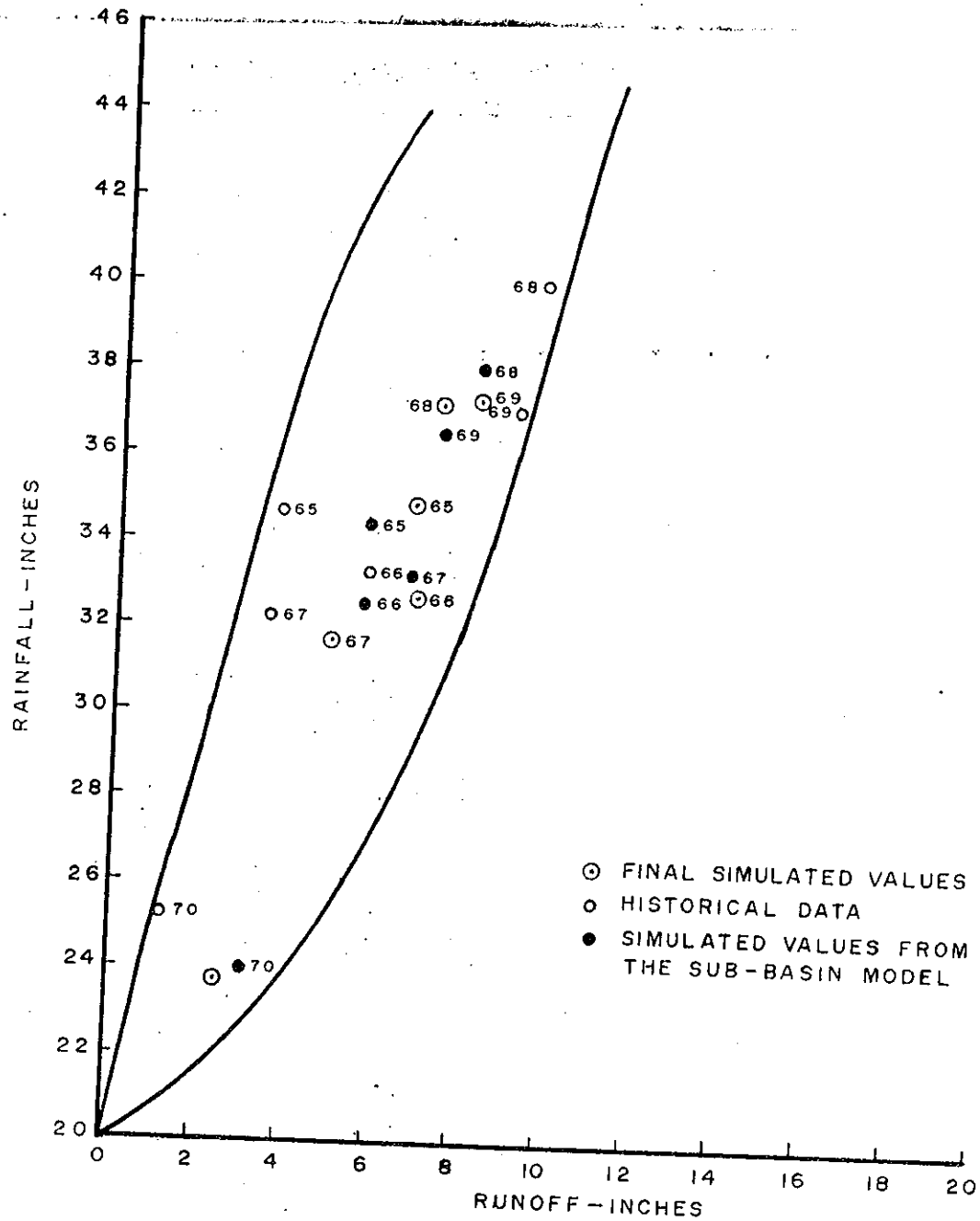
COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON ENTIRE KISSIMMEE BASIN FOR THE PERIOD 1942-64

FIGURE 33



COMPARISON OF DRY SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON ENTIRE KISSIMMEE BASIN FOR THE PERIOD 1965-70

FIGURE 34



COMPARISON OF WET SEASONAL RAINFALL RUNOFF RELATIONSHIPS ON ENTIRE KISSIMMEE BASIN FOR THE PERIOD 1965-70

2.5 ROUTING METHODOLOGY

2.5.1 GENERAL

In technical terms, routing is defined as a procedure to determine the time and spatial distribution of streamflow or a flood wave at a point in a water system by considering the hydraulic and hydrologic data at one or more points upstream (9). In our specific investigations, the basic purposes of developing routing methodology are:

1. To distribute sub-basin model output through the lake, channel and controlling structures system,

2. To combine stage-storage fluctuations of the lake with the stage discharge characteristics of the channel sections for developing a joint methodology of reservoir and channel routing,

3. To include operational characteristics of the controlling gates coupled with the routed simulated stages for estimating discharges through various controlling structures,

4. To improve sub-basin model output by including the key process (if any) of the lake or channel which might be excluded from the assumed conceptual physical system,

5. To provide the basis for examining the effects of changing operational parameters on the hydrologic characteristics of the Kissimmee water system with complete independence from the analysis of the historical data.

Since the basic principles of the available routing techniques are more or less similar with minor variations in the algebraic manipulation or in the graphical modifications or in the framework of assumptions (9), they are discussed briefly to provide some comparative basis for our methodology.

2.5.2 CURRENTLY AVAILABLE METHODS:

Fundamentally, there are four basic routing methods widely used in channel and reservoir routing. They are given below (9):

1. The puls method of invariable discharge-storage relationship,

2. The muskingum method with variable discharge-storage relationships,

3. Tatum routing using successive average lag,

4. Straddle-stagger routing based on progressive average lag method, and

5. Mathematical methods.

1. The puls method: This method is found to be more applicable to the reservoir routing than to the channel routing. To apply this method to a reservoir, a storage and outflow relationship for that particular reservoir should be known. With the known initial storage (S_1) and assuming initial outflow (O_1), the left hand side of the following equation is obtained (8,9).

$$\left(\frac{I_1+I_2}{2}\right) \Delta t + S_1 - \frac{O_1}{2} \Delta t = S_2 + \frac{O_2}{2} \Delta t$$

where

I_1 = inflows at the beginning of routing period,

I_2 = inflows at the end of routing period,

O_1 = outflow at the end of routing period,

O_2 = outflow at the end of routing period,

S_2 = storage at the end of routing period,

S_1 = storage at the beginning of routing period,

Δt = time step

Using the known storage outflow relationship, the values of S_2 and O_2 are obtained by a simple trial and error procedure.

2. A Muskingum Method: This is another very popular method for routing the flows in the channel systems. Considering the total storage as a sum of wedge storage and prismatic storage, the following muskingum equation is the basis of this method (9):

$$S = KO + KX\ (I-O)$$

where

S = total storage,

K = storage constant reflecting ratio of storage to discharge,

O = outflow,

X = parameter based on relative effect of inflow and outflow,

I = inflow

Converting this equation into inflows and outflows at the beginning and end of the routing period, we get

$$O_2 = C_0 I_2 + C_1 I_1 + C_2 O_1$$

where

$$C_0 = \frac{KX + 0.5t}{K-KX + 0.5t}$$

$$C_1 = \frac{KX + 0.5t}{K-KX + 0.5t}$$

$$C_2 = \frac{K-KX - 0.5t}{K-KX + 0.5t}$$

where

t = time step

I_1, I_2, O_1 and O_2 have usual meaning.

From these equations it can be clearly seen that the Muskingum method is largely geared to the determination of coefficients X and K. By plotting accumulated discharge and accumulated storage for various values of X, the shape of the curve decides the value of X (9). After having the value of X, K is calculated as

$$K = \frac{0.5t\ \Delta t\ [(I_2+I_1) - (O_2-O_1)]}{X(I_2-I_1) + (1-X)\ (O_2-O_1)}$$

Thus, knowing K, X and t, values of C_0, C_1 and C_2 are obtained to get routed flows through the channel sections. It is also to be noted here that there also exists other graphical and analytical methods for computing the routing coefficients.

3. Tatum routing method using successive average lag: This is essentially an empirical method. Assuming that the change in the shape of the hydrograph between two consecutive points (one upstream and other downstream) is due to the cumulative effect of all storage characteristics of the channel reach, for a subreach, the routed flow is given by

$$O_2 = \frac{1}{2}(I_1 + I_2),$$

Similarly for two reaches,

$$O_2 = \frac{1}{2}\left(\frac{I_1 + I_2}{2}\right) + \left(\frac{I_2 + I_3}{}\right)$$

$$= \frac{1}{4}(I_1 + 2I_2 + I_3)$$

Generalizing this concept to n subreaches, we get

$$O_{n+1} = C_1I_1 + C_2I_2 + C_3I_3 - C_{n+1}\ I'_{n+1}$$

where

$$C_1 = \frac{1}{2^n}$$

$$C_2 = \frac{n}{2^n}$$

$$C_3 = \frac{(n)(n-1)}{2^n 2!}$$

$$C_n = \frac{(n)(n-1)\ (2)}{2^n n!}$$

and

$$C_{n+1} = \frac{n!}{2^n n!} = \frac{1}{2^n}$$

where

n = number of subreaches

$= \frac{2 \times (\text{travel time})}{\text{Routing Interval}}$

$I_1, I_2 \ldots, I_n+1$ = inflows at time $t_1, t_2 \ldots t_{n+1}$

$C_1, C_2, \ldots, C_{n+1}$ = routed coefficients

O_{n+1} = routed outflow at subreach n+1

4. Straddle-stagger routing based on progressive average lag method: In this method, again routed outflows are empirically obtained by simple averaging of two or more inflows with the lag time computed as a function of time of travel of the flood wave. The length of inflow period is estimated by trial and error procedure and the range of this period is generally observed to be in a range of three quarters twice the travel time (9).

5. Mathematical methods: Instead of using historical data to tune up the routing coefficients, the hydrodynamics of the streamflows of floods can be expressed in terms of partial differential equations which are based on the principles of conservation of energy and conservation of matter for unsteady or steady flows. The methodologies of various investigators differ primarily in their technique for obtaining the solution of these partial differential equations (1,7,12,27,28,31,41). Finite difference techniques have been used in terms of fixed mesh finite difference method and the method of characteristics. In fixed mesh finite difference method, solutions are obtained at fixed predetermined points in a rectangular mesh of time and distance. Whereas solutions in the method of characteristics are obtained generally along

curvilinear characteristics curves on the time and distance plane (1). In addition, some efforts are also made to simplify these equations with known hydraulic characteristics of the channel section to express these equations in terms of various coefficients which are determined either by laboratory experiments or by field measurements (7,8,9,27,31,41). Since the mathematical solutions are obtained with the unique framework of assumptions and simplifications (suitable for specific cases), they should be applied with great caution.

Although all these methods describe different routing procedures, none of these methods can be applied directly to our typical controlled water system of the Kissimmee basin. Considering the framework of our investigations, there are many key factors which create a need for modifying existing methodologies for the Kissimmee water system under investigation. Such factors are discussed below.

2.5.3 FACTORS FOR THE SELECTION OF OUR ROUTING METHODOLOGY

It has been emphasized repeatedly in many places in this report that the conventional techniques are mostly developed for a natural system with historical data to refine the model. Therefore, when operational characteristics of the controlled system are to be incorporated into the overall methodology, a different routing procedure is warranted because the coefficients or parameters used in the conventional methods may vary substantially with the different gate operations. As a result, routing procedure is to be designed to include directly or indirectly the operational data coupled with simulated stages rather than the historical data. In other words, due to our specific requirement of developing an operational watershed model, it seems necessary to modify the existing routing procedures.

Another factor for developing a modified routing methodology relates to the controlled nature of the Kissimmee basin. Again, since our task is to distribute sub-basin model outputs through lakes, channels and controlling structures, it is essential to design a routing methodology to link these component parts together in some fashion using the operating schedule (if necessary).

While routing the streamflows through the controlled Kissimmee water system, the concept of "time lag" is an important factor to be considered in the routing techniques. In conventional methods, as discussed earlier, the estimated time lag is based on the travel time of the water system. However, for the water system of the Kissimmee with typical lakes, channels and controlling points, it may not be possible to compute the travel time since it will vary considerably as a function of gate openings. This again looks forward to a routing methodology (an entirely different or modified form of conventional routing methods) for including the possible time-lag in streamflows as they move through lake, channel and controlling structures.

Another key factor in any routing methodology is the routing period. If the routing period is sufficiently short, then hydrographs will be represented more adequately. However, by decreasing routing period, data collection steps

become more laborious because of the increased sample size. As a general rule, it is recommended that the routing period should be equal to somewhat shorter than the travel time of the flow through the reach and, as a lower bound, it should be short enough so that the hydrograph during that period approximates a straight line (9). Considering these points, it was decided to select a 3 hour period as a routing period in our routing methodology. To keep data collection steps manageable, it was also decided to demonstrate the routing procedure for a period of 1 year, specifically 1970.

2.5.4 INPUT INFORMATION AND ESSENTIAL FORMULATIONS

2.5.4.1 INPUT INFORMATION

Since we are trying to demonstrate the routing model for a one year period of 1970, it is necessary to obtain hydrologic base-line information just before this period in upper and lower Kissimmee lake, channel and controlling structures. Based on the requirements of our routing procedure, the initial recorded stages of all the lakes of the upper Kissimmee and discharges with tailwater, headwater elevations at all the structures of the Kissimmee basin should be adequate to start the routing model. Such information (also known as initial conditions) is compiled in Tables 11, 12, 13. Based on Table 11, weighing factors are further computed using maximum storage, average surface area of the lake and maximum surface area for each of the lakes contained in a particular planning unit. Such proportioning factors are given in Table 14. These factors are used in distributing local inflows (sub-basin model output) in the corresponding lakes of a particular planning unit. Three sets of these proportioning factors are intentionally prepared with a view to perform sensitivity analysis in the later stage (if necessary).

As a result of the comparisons of sub-basin output with historical data, it is concluded that evaporation values in the upper Kissimmee lakes should be included in the routing procedure to improve the sub-basin outputs and thus their subsequent spatial and time distribution. With this intention, monthly pan evaporation values recorded at the Orlando Weather Bureau station are taken and various constants to convert these monthly values to 3 hour lake evaporation values are computed. Since lake evaporation is a function of stage, final equations to estimate 3 hour evaporation values for the lake chain of the upper Kissimmee are given in Table 15.

2.5.4.2 ESSENTIAL FORMULATIONS

As an essential part of the simulation procedure, our methodology also heavily depends on the formulations of various water systems. Basic forms of the equations which are used in our analysis are summarized in Table 16. As shown in this table, formulations are classified according to the type of the system (i.e., lake, channel or controlling structures). They are described as follows:

2.5.4.2.1 FORMULATIONS OF LAKE SYSTEM

Essentially, the parameters which are of interest to our simulation analysis are stages, storages, inflows and outflows for various lakes. The first two equations of the lake system given in Table 16 tie together change in storage (ΔS) and changes in stage to the characteristics of inflow, outflow and initial stages. These equations are simple forms of mass-balance equations.

Table 11. Surface Areas at Maximum Stages of Different Lakes

LAKE	AVERAGE SURFACE AREA IN ACRES	CAPACITY IN ACRE-FT	MAXIMUM AREA IN ACRES
Pierce	2,251	3,514	3,592
East L. Toho.	12,300	250,000	19,980
Allig. & Brick	3,750	79,500	11,260
Tohopekaliga	21,200	420,000	30,700 at stage 61
Mary Jane	725	16,700	3,100
Hart	253	16,700	7,069 at stage 58
Trout	197	7,215	750 at stage 65
Coon	65	3,663	225 at stage 64
Myrtle	365	5,750	1,290
Lizzie	240	18,870	1,220 at stage 65
Preston	515	7,990	1,455
Cypress	2,600	55,000	4,011
Gentry	1,730	48,300	9,600
Kissimmee	33,500	716,000	100,000
Rosalie	5,540	100,000	9,130
Tiger	3,060	42,800	4,400
Weohyakapka	7,280	95,000	11,000
Alligator	1,350	80,500	9,170
Hatchineha	4,000	43,396	9,439
Joel	124.6	2,716 at stage 65	219.4 at stage 60
Center	365	19,200	4,975

Table 12. Recorded stages of upper Kissimmee Lakes on December 31, 1969.

LAKES	STAGES
Pierce	77.54
Tohopekaliga	55.05
East Tohopekaliga	57.98
Alligator and Brick	63.92
Mary Jane	60.93
Coon	63.92
Hart	60.92
Cypress	52.54
Kissimmee	52.25
Gentry	61.78
Tiger	52.28
Hatchineha	52.25
Myrtle	63.40
Preston	63.40
Trout	63.92
Weohyakapka	62.18
Joel	63.40
Lizzie	63.92
Center	63.92

Table 13. A set of initial stages at structures of the upper and lower Kissimmee basin.

Structure	Discharge**	TWE*	HWE*
S-57	48	60.99***	63.36
S-58	0	63.34	63.94
S-59	594	55.79	57.66
S-60	150	61.98	63.96
S-61	727	52.30	54.51
S-62	145	58.00	61.00
S-63	209.33	56.63	59.87
S-63A	0	51.83	56.40
Recording Station near Lake Wales	309.2	-	-
S-65	3400	46.60	52.34
S-65A	67	40.68	46.45
S-65B	75	33.96	40.62
S-65C	36.13	27.03	34.00
S-65D	34.0	20.86	26.92
S-65E	2660	13.27	20.79

* These tailwater and headwater elevation (TWE and HWE) values are at the end of December 31, 1969 which is the last previous day of the time period (January 1, 1970 to December 1970) considered in our routing model.

** These values are for the first 3 hour period of January 1, 1970.

*** These stages have been modified to include datum correction provided by the Hydrology Division of FCD.

Table 14. Proportioning Factors for the Lakes of the Upper Kissimmee to Distribute the Local Inflows from Appropriate Planning Units

Lake	Max. Storage in acre/ft.	Proportioning Factors Based on: Surface Area at Max. Stage	Avg. Surface Area	Manual Assessment of Drainage Area	Planning Units
*Alligator & Brick	0.52	0.610960	0.812216	0.80	1
Lizzie	0.08	0.066196	0.051982	0.05	1
Coon	0.31	0.012208	0.014078	0.01	1
Trout	0.09	0.040695	0.042668	0.04	1
Joel	0.09	0.074012	0.124029	0.09	2
Myrtle	0.91	0.435164	0.363329	0.91	2
Mary Jane	0.500000	0.304848	0.722112	0.70	3
Hart	0.500000	0.695152	0.258691	0.30	3
East Toho.	1.000000	1.000000	1.000000	1	4,5
Tohopekaliga	1.000000	1.000000	1.000000	1	6,7
*Cypress	0.342485	0.298216	0.363636	-	8,10,11
*Hatchineha	0.657515	0.701784	0.606061	-	8,10,11
Gentry	1.000000	1.000000	1.000000	0.5	9
Kissimmee	1.000000	1.000000	1.000000	1	12,13,14

*Based on the manual assessment of drainage areas of Cypress and Hatchineha, the following proportioning factors are estimated for these lakes:

Cypress	-	-	-	0.34	10
Cypress	-	-	-	0.40	8
Cypress	-	-	-	0.40	9
Hatch.	-	-	-	1.00	11
Hatch.	-	-	-	0.66	10
Hatch.	-	-	-	0.60	8
Alligator &	-	-	-	0.10	9

Table 15. Pan Evaporation Values and Associated Equations with Coefficients for Estimating Evaporation of Lakes of Upper Kissimmee Basin.

Month	Pan Evaporation* in Inches (A)	Coefficients (K) for Converting to 3 hr. values (B)	Equations for Estimating Lake Evaporation in Acre-ft.
January	2.636250	0.0002688	$(A)\cdot(B)\cdot(X_{i1})$**
February	3.400000	0.0002976	$(A)\cdot(B)\cdot(X_{i2})$
March	4.925000	0.0002688	$(A)\cdot(B)\cdot(X_{i3})$
April	6.188750	0.0002778	$(A)\cdot(B)\cdot(X_{i4})$
May	7.292500	0.0002688	$(A)\cdot(B)\cdot(X_{i5})$
June	6.741429	0.0002778	$(A)\cdot(B)\cdot(X_{i6})$
July	6.573333	0.0002688	$(A)\cdot(B)\cdot(X_{i7})$
August	6.298750	0.0002688	$(A)\cdot(B)\cdot(X_{i8})$
September	5.337500	0.0002778	$(A)\cdot(B)\cdot(X_{i9})$
October	4.270000	0.0002688	$(A)\cdot(B)\cdot(X_{i10})$
November	3.047778	0.0002778	$(A)\cdot(B)\cdot(X_{i11})$
December	2.276667	0.0002688	$(A)\cdot(B)\cdot(X_{i12})$

* Data from Orlando Station compiled by Khanal and Hamrick (reference no.23)

**X_{ij} = Lake surface in acres for ith lake in jth month, (i = 1, ...14 and j = 1, ...12)

Table 16. Basic Forms of Equations Useful in the Model *

System	Formulations	
Lake System	1. $(\text{stage})_{t+1} = (\text{stage})_t + (\Delta S)_{t+1}$	(A)
	2. $(\Delta S)_{t+1} = I_{t+1} - O_{t+1}$	(B)
	3. $WSE = a\ (S)^b$	(C)
	4. polynomial equations $\text{stage} = A_0 + A_1(S) + A_2(S)^2 + A_3(S)^3 + A_4(S)^4$	(D)
Channel System	1. $\frac{dy}{dx} = \frac{SO - SE}{1 - \frac{\alpha Q^2 T}{gA3}} = \dot{y}$	(E)
	2. $SE = \frac{(n)^2 V2}{2.22\ (H.R)^{4/3}}$ $SE = \frac{n^2 Q^2 P^{4/3}}{2.2\ A^{10/3}}$	(F)
	3. $Y_{i+1} = Y_i + \left[\frac{\dot{Y}_{i+1} + \dot{Y}_i}{2}\right] DX$	(G)
Structure Operations	1. $Q(N) = P(GO)^r\ (EH)^S$	(H)

*Notations are defined in the beginning of the report.

In addition it is also necessary to know the stage-storage relationships for all the lakes of the upper Kissimmee. These relationships can be in either tabular form or in the form of nonlinear equations developed basically from the tabular form. Although it is clear that the use of tabular form is the most accurate way of converting back and forth the stages and storages of the lake, the tabulated values may consume more memory of the computer. Among the nonlinear exponential functions and polynomial equations the exponential functions can be selected due to the high correlation coefficients associated with them and their use by the previous investigators. However, it is to be noted that if at the later stage they are found to be inadequate in simulating stages within the accepted accuracies, then we will still have the option to use tabulated values directly as shown in Tables 17, 18, 19, 20 and 21.

2.5.4.2.2 FORMULATIONS OF CONTROLLING STRUCTURES

The operational characteristics of the Kissimmee water systems are reflected in the formulations of the controlling structures. Variables considered in these formulations are gate openings (GO), headwater elevation (HWE) and tailwater elevation (TWE) with discharge as a dependent variable as shown by equation 1 for structure operations in Table 16. In our routing methodology these equations are used to compute the discharge through the structure knowing the simulated tailwater and headwater stages for a given set of gate openings. Such available formulations for all the controlling structures for our study are depicted in Tables 22, 23 and 24. As an example, a typical 3 hour gate operational data set that goes with these formulations is presented in Appendix I. It is to be noted that with structure S-65E being one of the five check points, the data set given in Appendix I also has recorded tailwater and headwater elevations which will be used to compare our simulated stages at this controlling structure.

2.5.4.2.3 CHANNEL FORMULATIONS

The development of channel formulations and using them in a convenient fashion in routing methodology are some of the steps that make our procedure different than previously attempted techniques. Essentially, the hydraulic formulations given in Table 16 for the channel system relate to:

1. A differential equation representing gradual varied flow with slope of energy line, channel bottom slope, discharges, cross-sectional area, top width of the channel and velocity head coefficients as variables and rate of change of depth (with distance) as a dependent variable (equation 1 of Table 16).

2. Manning's equation combining hydraulic characteristics of the flow (i.e., velocity, Manning's coefficients, slope of the energy line) with the physical characteristics of the channel cross-sections such as cross-sectional area (A) and Perimeter (P). (Equation 2 of Table 16 of channel system).

3. An iterative equation based on a numerical integration technique of trapezoidal rule developed by Prasad (29,30) to estimate the water depth (and then water surface elevation) at the end of the channel section (equation 3 of Table 16 of the channel system).

Table 17. The available stage-storage values for the lakes of the upper Kissimmee basin.

Stage ft. m.s.l.	Storage Acre-ft	Stage ft.m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft
Alligator - Brick		Lake Lizzie		Lake Coon	
54	10,800	41	0	49	5
55	12,600	42	30	50	13
56	14,800	43	50	51	27
57	17,400	44	100	52	45
58	20,300	45	170	53	134
59	23,500	46	250	54	254
60	27,000	47	340	55	415
61	30,600	48	425	56	660
62	34,500	49	560	57	947
63	38,400	50	665	58	1310
64	43,300	51	800	59	1670
65	50,200	52	990	60	2120
66	59,000	53	1,210	61	2548
67	68,700	54	1,475	62	3055
68	79,500	55	1,760	63	3685
		56	2,135	64	4440
		57	2,500	65	5576
		58	2,950	66	7425
		59	3,435	67	10485
		60	4,150	68	14763
		61	4,950		
		62	5,700		
		63	6,500		
		64	7,350		
		65	8,350		
		66	10,450		
		67	16,085		
		68	18,870		

Table 18. The available stage-storage values for the lakes of upper Kissimmee basin.

Stage ft. m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft
Lake Trout		Lake Joel		Lake MaryJane	
51	12	51	30	49	16
52	30	52	100	50	100
53	60	53	187	51	250
54	130	54	287	52	585
55	235	55	304	53	1,100
56	375	56	436	54	1,500
57	540	57	586	55	2,075
58	736	58	756	56	2,800
59	940	59	946	57	3,600
60	1,170	60	1,155	58	4,500
61	1,420	61	1,327	59	5,600
62	1,695	62	1,632	60	6,770
63	1,970	63	1,921	61	7,080
64	2,340	64	2,261	62	9,500
65	2,840	65	2,716	63	11,400
66	3,750			64	13,600
67	5,460			65	16,700
68	7,215				

Table 19. The available stage-storage values for the lakes of the upper Kissimmee basin.

Stage ft. m.s.l.	Storage Acre-ft	Stage ft.m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft.
Lake Myrtle		E. Lake Tohopekaliga		Lake Tohopekaliga	
52	65	40	0	48	26,000
53	415	48	24,900	49	40,500
54	850	49	33,400	50	55,300
55	1,375	50	42,400	51	69,000
56	2,000	51	51,900	52	84,000
57	2,710	52	61,800	53	101,200
58	3,530	53	71,800	54	122,600
59	4,500	54	82,700	55	144,800
60	5,650	55	94,200	56	170,500
61	6,700	56	106,000	57	194,700
62	8,000	57	118,300	58	222,600
63	9,500	58	130,000	59	250,000
64	11,350	59	143,700	60	280,500
65	13,740	60	158,600	61	306,000
		61	176,400	62	335,000
		62	194,300	63	360,000
		63	210,500	64	390,000
		64	227,500	65	420,000
		65	250,000		

Table 20. The available stage-storage values for the lakes of the upper Kissimmee basin.

Stage ft. m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft.	Stage ft. m.s.l.	Storage Acre-ft
Lake Cypress		Lake Kissimmee		Lake Hart	
41	0	42	50,000	39	1
42	23	43	66,000	40	13
43	427	44	85,000	41	39
44	1,614	45	108,000	42	72
45	3,429	46	135,000	43	111
46	5,783	47	162,000	44	160
47	8,573	48	190,000	45	226
48	11,671	49	221,000	46	318
49	15,039	50	256,000	47	444
50	18,699	51	292,000	48	653
51	22,604	52	330,000	49	939
52	26,500	53	370,000	50	1,281
53	30,500	54	418,000	51	1,739
54	35,000	55	475,000	52	2,305
55	40,000	56	544,000	53	2,932
56	45,000	57	623,000	54	3,651
57	50,000	58	716,000	55	4,495
58	55,000			56	5,305
				57	6,227
				58	1,239
				59	8,900
				60	9,475
				61	10,400
				62	11,400
				63	12,540
				64	13,600
				65	16,700

Table 21. The available stage-storage values for the lakes of the upper Kissimmee basin.

Stage ft. m.s.l.	Storage Acre-ft	Stage ft. m.s.l.	Storage Acre-ft
Lake Gentry		Lake Hatchineha	
54	5,600	41	0
55	6,700	42	13,977
56	8,000	45	14,571
57	9,300	47	17,427
58	10,800	48	22,329
59	12,300	49	27,961
60	13,900	50	34,301
61	15,500	51	43,396
62	17,200	52	51,000
63	20,000	53	60,000
64	23,700	54	70,000
65	29,000	55	80,000
66	35,600	56	90,000
67	42,000	57	100,000
68	48,300	58	110,000

Table 22. Nonlinear Rating Curves for Various Controlling Structures of Upper and Lower Kissimmee basin.

Structure Number	Type of Equation	Constants
S-57	$Q = C_1(GO)(HW-TW)^{C_2}$	$C_1 = 15.55936109$ $C_2 = 0.49629271$
S-58	$Q = C_1(GO)(HW-TW)^{C_2}$	$C_1 = 15.55936109$ $C_2 = 0.49629271$
S-59	$Q = C_1AL(GO)(HW-TW)^{C_2} - C_3(HW-TW)^{C_2}$ for $GO<1.0'$	$C_1 = 8.2933$ $C_2 = 0.2295$ $C_3 = 17.28$ $C_4 = 0.2295$
	$Q = C_1AL(GO)^{C_2}(HW-TW)^{C_3}$ for $GO \geq 1.0$	$C_1 = 7.2444$ $C_2 = 1.07$ $C_3 = 0.2295$ $AL = 18.0$
S-60	$Q = C_1AL(GO)(HW-TW)^{C_2}$	$C_1 = 5.8587061$ $C_2 = 0.5230012361$ $AL = 12.0'$
S-61	$Q = C_1AL(GO)(HW-TW)^{C_2} - C_3(HW-TW)^{C_4}$ for $GO<1.0$	$C_1 = 4.9583$ $C_2 = 1.175$ $C_3 = 0.484$ $AL = 27$
	$Q = C_1AL(GO)^{C_2}(HW-TW)^{C_3}$ for $GO \geq 1.0$	$C_1 = 4.27$ $C_2 = 1.175$ $C_3 = 0.484$ $AL = 27$
S-62	$Q = C_1AL(GO)^{C_2}(HW-TW)^{C_3}$	$C_1 = 7.214$ $C_2 = 1.08$ $C_3 = 0.492$ $AL = 14.0$

Table 22. (continued)

Structure Number	Type of Equation	Constants
S-63	$Q = C_1 AL(GO)(HW-TW)^{C_2}$	$C_1 = 6.00$ $C_2 = 1.00$ $C_3 = 0.500$ $AL = 15.00$
S-63A	$Q = C_1 AL(GO)(HW-TW)^{C_2}$	$C_1 = 6.0$ $C_2 = 0.5$ $AL = 15.0$
S-65** S-65A S-65B S-65C S-65D S-65E	$Q = 0.40237(HW-TW)^{0.43357} \frac{(G\phi - 0.666)}{0.001666}$ for $G\phi > 2.8'$ $Q = 0.40237(HW-TW)^{0.43357} \frac{(G\phi)}{0.002236}$ for $G\phi \leq 2.8'$	

GO = Gate opening,

HW = Headwater elevation,

TW = Tailwater elevation,

AL = Length of the weir

** For six structures of the lower Kissimmee, the equation form is the same.

Reference: Data from the files of the Hydrology Division of the Central and Southern Florida Flood Control District.

Table 23. Second Set of Rating Curves for Six Controlling Structures of Lower Kissimmee Basin.

Structure Number	Type of Equation	Constants
S-65	$Q = C_1 \cdot AL \cdot (G\phi)(HW-TW)^{C_2}$	$C_1 = 6.0642$ $C_2 = .49345$ $AL = 27$
*S-65A	$Q = 0.45\ (HW-TW)^{0.346787\ \frac{(G\phi\ -\ .666)}{.001666}}$	$G\phi \geq 2.8$
	$Q = 0.45\ (HW-TW)^{.346787\ \frac{(G\phi)}{.002236}}$	$G\phi < 2.8$
*S-65B	Same as S-65A	
*S-65C	Same as S-65A	
*S-65D	Same as S-65A	
*S-65E	Same as S-65A	

* According to the Hydrology Division's files, these equations are derived from USGS' original theoretical curve.

Table 24. Third Set of Rating Curves for Six Controlling Structures of Lower Kissimmee Basin

Structure Number	Type of Equation	Constants
S-65	Same as given in Table 23	
S-65A	$Q = 235.3336\ (G\phi)^{.70331}(HW-TW)^{.346787}$	$0 < G\phi < 2$
	$Q = 94.5\ (G\phi)^{1.42}(HW-TW)^{.346787} + 300$	$2 \leq G\phi < 4$
	$Q = 96.5\ (G\phi)^{1.42}(HW-TW)^{.346787} + 300$	$G\phi \geq 4$
S-65B	Same as equation for S-65B used in Table 23	
*S-65C	Same as S-65A	
*S-65D	Same as S-65A	
S-65E	Same as S-65B	

* These equations are based on the FCD-USGS composite curve.

In other words, for channel routing, we are using Manning's equation as against different existing routing methods that are presented in the earlier section. The obvious reasons for such selection are as follows:

1. Unlike other methods, Manning's equation does not depend heavily on many coefficients which are mostly determined from the historical data,

2. The channel cross-sections are built into that equation to represent realistic flow conditions,

3. An adequate sensitivity analysis has been previously done to get realistic values for Manning's coefficients n for upper as well as lower Kissimmee basin (28,40,41),

4. A numerical technique is readily available to use iterative procedure for computing water stages,

5. It is also possible to include marsh area of the lower Kissimmee with a different formulation for Manning's coefficient in some part of the cross-sectional channel data.

Originally, we had planned to use Manning's equation with Prasad's iterative procedure as an intermediate step in our overall routing methodology. However, realizing the computer time involved in the synthesis of channel data, subsequent iteration procedure and their hold-up effects on other steps of the routing procedure, it was decided to use the existing FCD backwater program separately and then transfer the results independently to the required point in the main program. This task can be achieved in two ways. In the first method, the main program can specify the values of Q and their distribution pattern with other essential computational parameters and then the FCD backwater program can be called in as a subroutine. The output of the subroutine can then be transferred to the main program where it will be processed further as required by the logic of the main program. In the second approach, for a given set of discharges and stages, the FCD backwater computations for all the channel sections of the Kissimmee using the available channel cross-sectional data. For a given channel section, this program can generate a set of upstream, downstream stages along with discharges and storages. Using this data set, empirical relationships based on statistical principles can be derived for these variables. These established mathematical relationships (also known as backwater functions) are then used in the main program directly to replace the backwater computational steps. Between these two approaches, the second approach seems to be more convenient in the short term as well as long term basis and thus, it is used in our routing methodology.

As a first step toward developing these backwater functions, the ranges of discharge and stage are to be decided for each of the channel sections. After reviewing the general design memorandums for the channel systems of the Kissimmee, the upper and lower limits of discharge and stage are selected. Such ranges are given in Table 25. For each channel section, the corresponding discharge and stage ranges are divided into about ten equal parts and for each set of discharge and stage, backwater program provides the upstream stage after cross-sectional data is arranged from downstream to the upstream side. A stepwise procedure for arriving at backwater functions

Table 25. Ranges of Discharge and Stage Used in FCD Backwater Program for Different Channel Sections

Channel Section	Ranges of Discharge in cfs	Ranges of Stage in ft. msl
C-38 between S-65 and S-65A	0 - 13000	44 - 55
C-38 between S-65A and S-65B	10 - 18000	35 - 45
C-38 between S-65B and S-65C	0 - 20000	25 - 36
C-38 between S-65C and S-65D	0 - 25000	25 - 30
C-38 between S-65D and S-65E	0 - 30000	18 - 23
C-37	0 - 7000	45 - 60
C-36	0 - 4000	45 - 60
C-35	0 - 3000	45 - 60
C-34	0 - 2000	45 - 65
C-33	0 - 400	55 - 70
C-32	0 - 200	55 - 75
C-31 below S-59	0 - 700	45 - 65
C-30 below S-57	0 - 300	50 - 70
C-30 above S-57	0 - 300	50 - 70
C-29 above S-62	0 - 250	55 - 70
C-29 below S-62	0 - 600	50 - 65

(as shown in Figure 36) include:

1. Processing of existing cross-sectional data for all the channels of the Kissimmee (a typical cross-sectional data set is given in Appendix IV),

2. Arranging the cross-sectional data to the correct input format specified for the existing FCD program of E070A for channel section analysis,

3. Using E081A program for backwater computations subsequent to the E070A program,

4. Getting punched output from the E081A program relating downstream stage, upstream stage, average discharge through the channel section and computed storage. (A typical set of punched data for five pools of the lower Kissimmee is shown in Appendix V),

5. Using such punched output in the "multivariate regression analysis" subroutine (E069) for developing backwater functions for three or four variables of the channel section.

The results from the FCD backwater program (a combination of E070A and E081A) for all the channel sections of the upper and lower Kissimmee are given in data generation files of the Resource Planning Department. These files, constituting several hundred pages, contain:

1. Cross-sectional data used in the backwater program,

2. Water stages, water depth, top width, conveyance, accumulated surface area, accumulated volume, right and left intercepts of channel cross-sections and the alpha value for each of the stations considered in a particular channel section.

Although the existing backwater program is primarily based on the basic formulations given in Table 16, and since it has been refined and re-examined by many previous investigators, it is used in our study as a black box. Therefore, to examine the net effect of various parameter coefficients and assumptions involved in this blackbox, Table 26 is prepared. As depicted in this table, the output of the backwater program is compared with the recorded values for pool A of the lower Kissimmee between S-65 and S-65A. Such comparison indicates the adequacy of the output of the backwater program in estimating the stage at the one end of the channel section knowing the mean discharge through the channel and stage at the other end. It is also to be noted that for the upper Kissimmee channel sections n is assumed to be 0.018 and for the lower Kissimmee it is taken as 0.025 although for any other value of n, our results can be modified by simply multiplying them by the ratio of squares of the new value and the selected values of n. To develop the mathematical relationships between upstream stage, downstream stage, storage and discharges, it is necessary to first look into the nature of the functional relationships to be attempted. To proceed in this direction, the

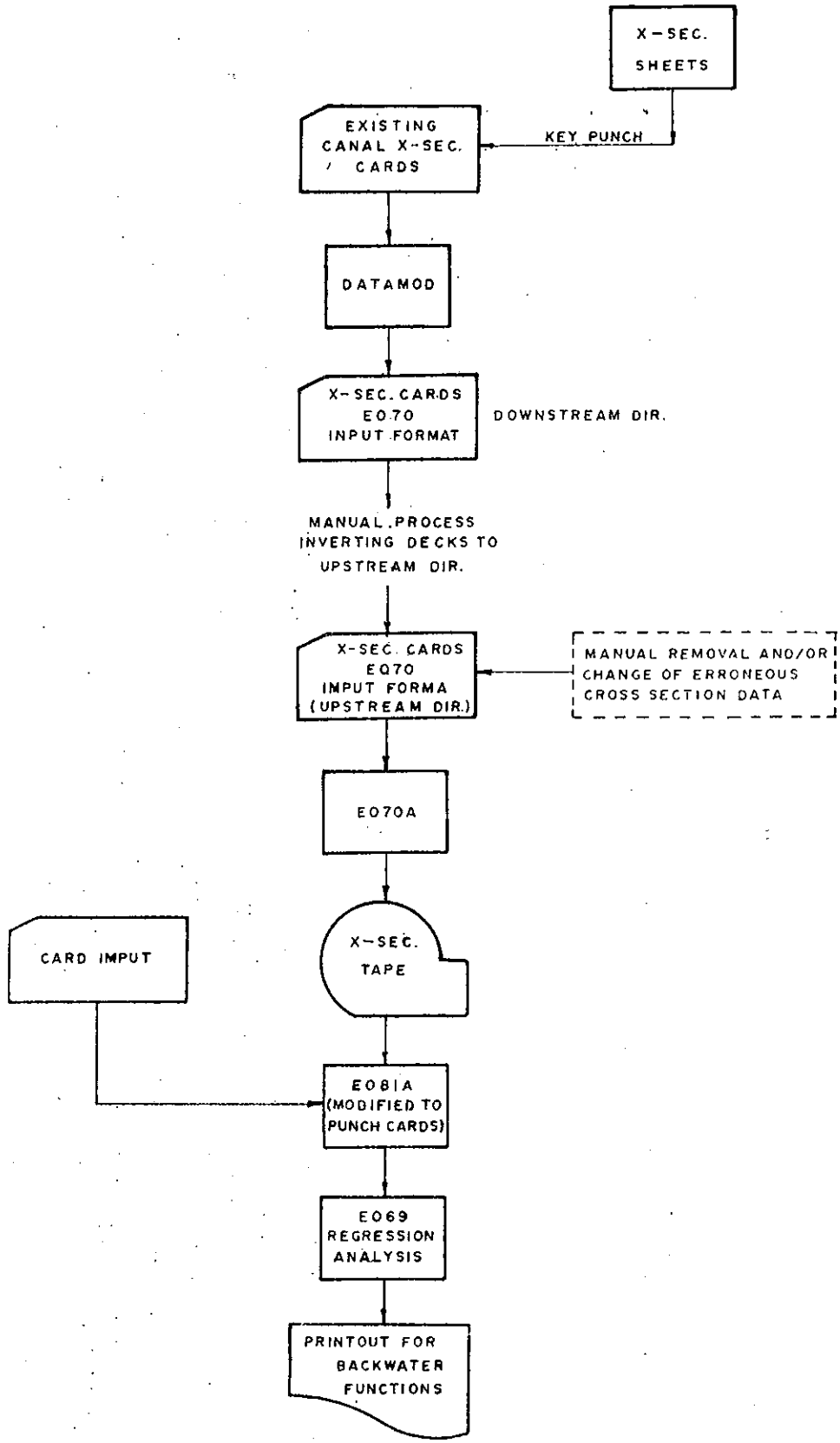


Figure 36. A FLOW CHART OF THE PROCEDURE FOR ARRIVING AT BACKWATER FUNCTIONS

Table 26. Comparisons of Recorded Stages With Simulated Stages of the FCD Backwater Program for the Channel Section Between S-65 and S-65A.

Discharge Through S-65A	Recorded Downstream Stages at S-65	Recorded Upstream Stages at S-65A	Recorded Stage Difference	Simulated Stage at S-65	Simulated Stage at S-65A	Simulated Stage Difference
2165	46.27[a]	46.15[a]	0.12	46.07	46.00	0.07
2986	46.23[b]	46.07[b]	0.16	46.14	46.00	0.14
3993	46.60[c]	46.35[c]	0.25	46.25	46.00	0.25
4400	46.61[d]	46.24[d]	0.37	46.31	46.00	0.31
2952	46.21[e]	46.04[e]	0.17	46.14	46.00	0.14
3844	46.38[f]	46.16[f]	0.22	46.23	46.00	0.23

a. Sept. 20, 1973

b. Oct. 1, 1973

c. Sept. 28, 1973

d. March 28, 1970

e. Sept. 17, 1973

f. Sept. 30, 1973

discharge values, the difference between upstream and downstream stages (ΔH) and downstream stages are plotted for C-38A (C-38 between S-65 and S-65A), C-38E (C-38 between S-65D and S-65E), C-35 below S-61 and C-29A above S-62 as shown in Figures 37 to 40. These graphs, coupled with the requirements of the existing regression program (E069), suggest that the nonlinear relationships between ΔH, Q and D.S.S. apply more conveniently to the channel sections of the lower Kissimmee than for the upper Kissimmee channels. As a result, the existing E069 computer subroutine is extensively used to try different combinations of four variables (U.S.S., D.S.S., discharge and storage) for the lower Kissimmee sections and different combinations of three variables (U.S.S., D.S.S. and discharge) for the upper Kissimmee channels. Empirical relationships developed by the E069 program are depicted in Tables 27 to 31. Associated with these tables, the following pertinent points are to be noted:

Since the storage characteristics of the upper Kissimmee units are largely related to the lake storage with relatively insignificant storage in the channel sections of the upper Kissimmee basin, linear and nonlinear relationships are developed for these channels with three variables of upstream, downstream stages and discharges. Whereas for five pools of the lower Kissimmee, channel storage being significant, storage parameter is included as the fourth variable as can be seen from Tables 27 to 31.

Among these various empirical formulations developed, nonlinear equations of the upper Kissimmee channel sections (as given in Tables 27 and 28) are finally used in our routing methodology. Similarly, three nonlinear relationships given in Tables 29, 30 and 31 are simultaneously used to estimate the upstream stage taking into account storage, discharge, D.S.S. and more importantly the cross-sectional data of the channel sections. The selection of these equations should be made largely by examining the comparative tables given in the output of the E069 program. More refinement and discussions on these formulations are expected after routed values are examined in the later stages.

These formulations are further stored in two subroutines which are called in the main program whenever necessary. In this fashion, the tedious and time consuming step of backwater computations is indirectly avoided.

In addition to the formulations presented above, various other convenient mathematical forms are also considered. Statistical coefficients of these equations are also included in the files prepared by the authors (49,50).

2.5.5 COMPUTATIONAL METHODOLOGY

After developing and refining various pieces presented earlier, the next important step is to link them together to distribute the sub-basin flows through the lake, channel and controlling structures of the Kissimmee basin. Considering the interactions between local inflows, discharge through the connecting channels of two lakes due to the fluctuations in lake stages, and discharge through the controlling structures as a function of gate operations, there can be varieties of iterative routing procedures that can be developed to achieve the same objective. As a matter of fact, the authors themselves have outlined and analyzed the routing procedure in three different

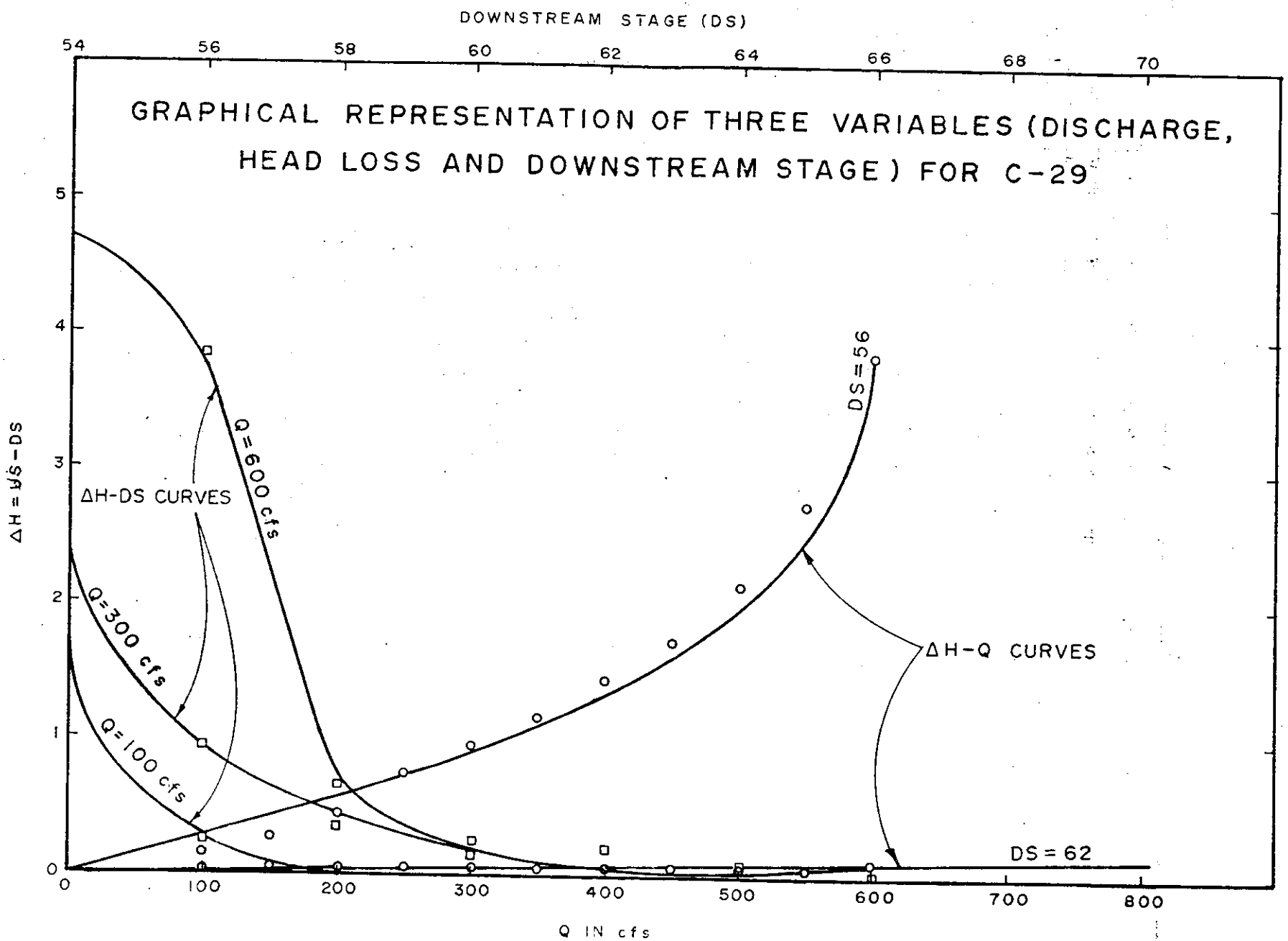

GRAPHICAL REPRESENTATION OF THREE VARIABLES (DISCHARGE, HEAD LOSS AND DOWNSTREAM STAGE) FOR C-29
DOWNSTREAM STAGE (DS)
54
56
58
60
62
64
66
68
70
ΔH = US − DS
0
1
2
3
4
5
Q IN cfs
0
100
200
300
400
500
600
700
800
ΔH-DS CURVES
Q=600 cfs
Q=300 cfs
Q=100 cfs
DS=56
ΔH-Q CURVES
DS = 62

FIGURE 37

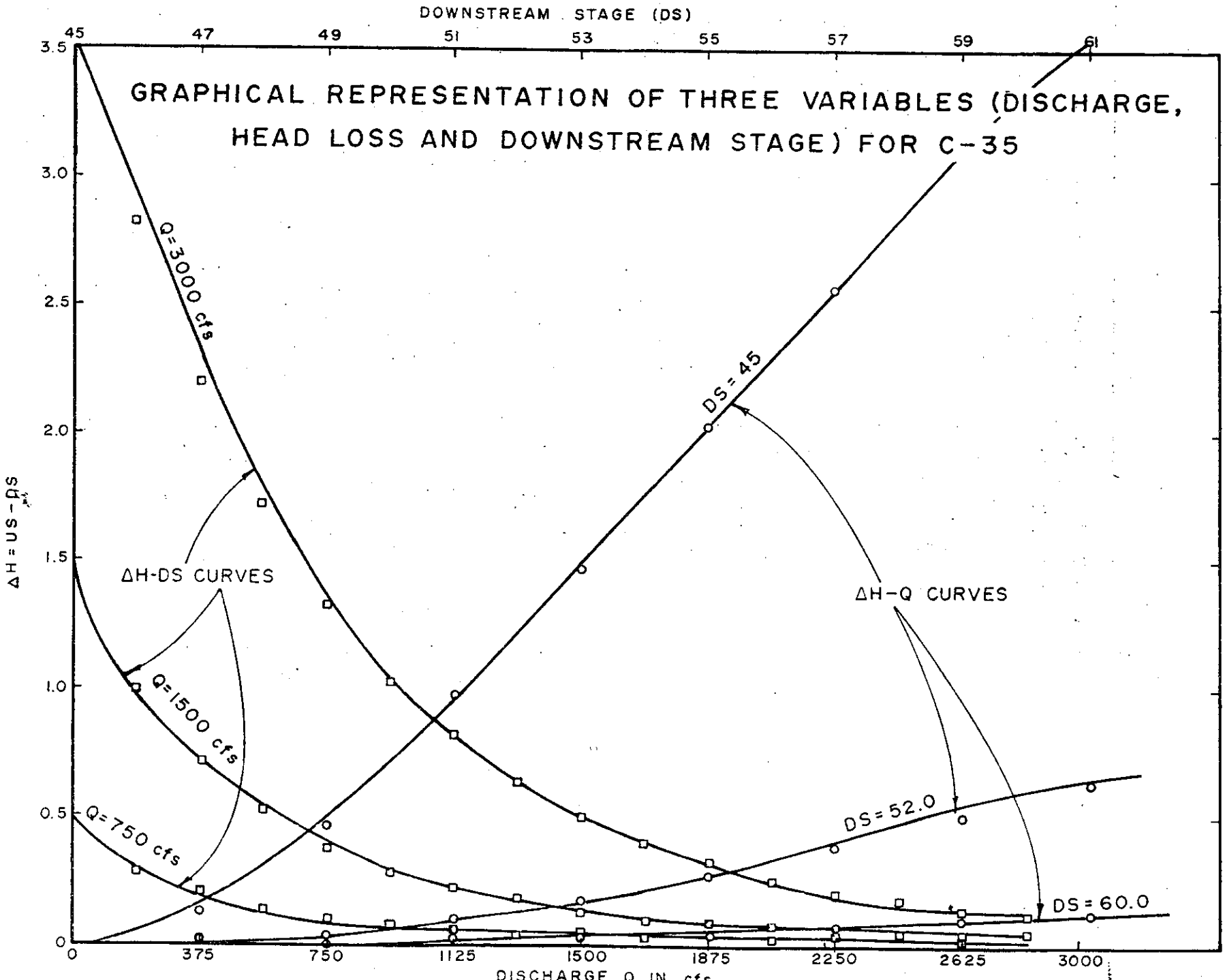

GRAPHICAL REPRESENTATION OF THREE VARIABLES (DISCHARGE, HEAD LOSS AND DOWNSTREAM STAGE) FOR C-35
DOWNSTREAM STAGE (DS)
45
47
49
51
53
55
57
59
61
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
ΔH = US - DS
Q=3000 cfs
Q=1500 cfs
Q=750 cfs
ΔH-DS CURVES
DS=45
DS=52.0
DS=60.0
ΔH-Q CURVES
0
375
750
1125
1500
1875
2250
2625
3000
DISCHARGE Q IN cfs

FIGURE 38

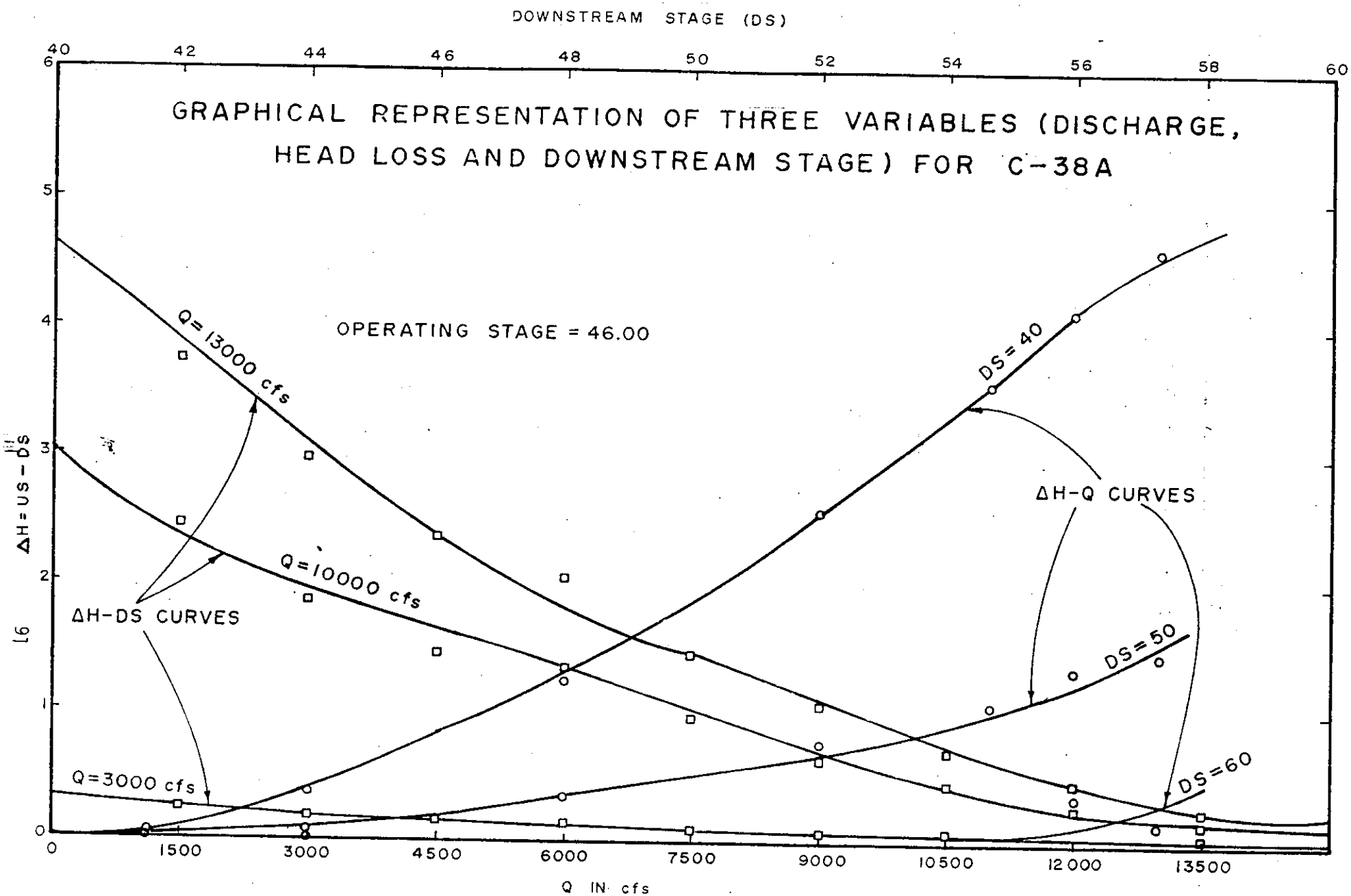

GRAPHICAL REPRESENTATION OF THREE VARIABLES (DISCHARGE, HEAD LOSS AND DOWNSTREAM STAGE) FOR C-38A
DOWNSTREAM STAGE (DS)
40
42
44
46
48
50
52
54
56
58
60
OPERATING STAGE = 46.00
Q=13000 cfs
Q=10000 cfs
Q=3000 cfs
ΔH-DS CURVES
DS=40
DS=50
DS=60
ΔH-Q CURVES
ΔH = US - DS
0
1
2
3
4
5
6
0
1500
3000
4500
6000
7500
9000
10500
12000
13500
Q IN cfs

FIGURE 39

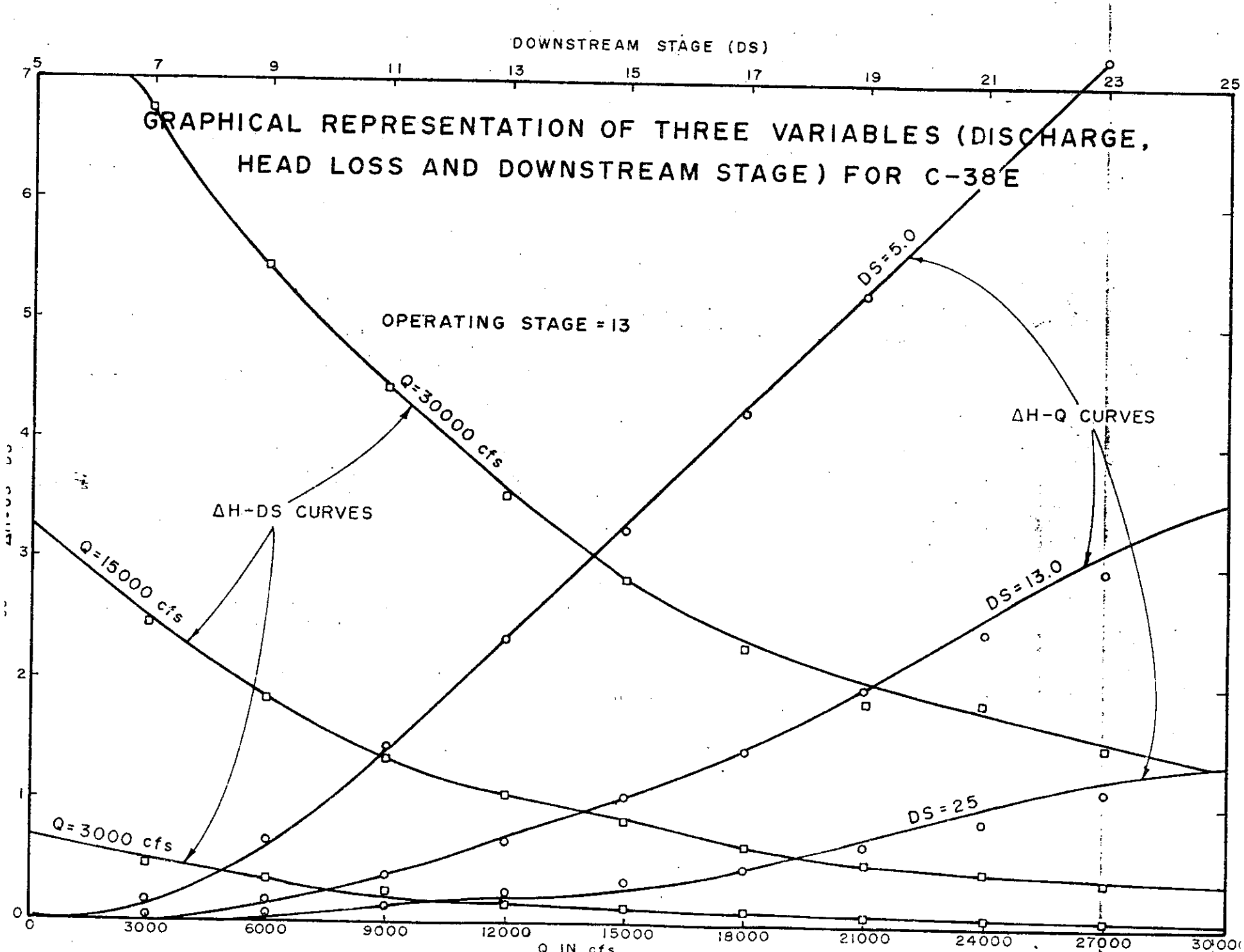

GRAPHICAL REPRESENTATION OF THREE VARIABLES (DISCHARGE, HEAD LOSS AND DOWNSTREAM STAGE) FOR C-38E
DOWNSTREAM STAGE (DS)
OPERATING STAGE = 13
ΔH-DS CURVES
ΔH-Q CURVES
Q=30000 cfs
Q=15000 cfs
Q=3000 cfs
DS=5.0
DS=13.0
DS=25
Q IN cfs
0
3000
6000
9000
12000
15000
18000
21000
24000
27000
30000
5
7
9
11
13
15
17
19
21
23
25
1
2
3
4
5
6
7

FIGURE 40

Table 27. Nonlinear formulations of discharges for the typical seven channel sections of the upper Kissimmee basin.

Channel Section	Nonlinear Relationship $Q = (US-DS)^A (DS)^B$		
	A	B	r^2
C-32G	0.19562817	1.37327452	0.99036109
C-32B	0.12933563	1.31192007	0.99028838
C-32D	0.11312801	1.28232715	0.98835559
C-32F	0.02812316	1.14778715	0.98488793
C-29	0.23189354	1.53817995	0.99206125
C-37	0.44362025	2.25302023	0.99901088
C-36	0.40565648	2.17679705	0.99862609

r = correlation coefficient,

Q = mean discharge,

US = upstream stage,

DS = downstream stage

Table 28. Nonlinear formulations for the channel sections of upper Kissimmee basin.

Channel Section	Nonlinear Relationship $U.S.S. = (Q)^A (D.S.S.)^B$		
	A	B	r^2
C-29	0.005731	0.993423	0.999993
C-29A above S-62	0.000190	0.999820	1.000000
C-29A below S-62	0.002290	0.997502	0.999999
C-29B	0.005924	0.992899	0.999976
C-30 above S-57	0.00037	0.99969	1.000000
C-30 below S-57	0.000792	0.999316	1.000000
C-31 above S-59	0.007304	0.990799	0.999986
C-31 below S-59	0.00763087	0.99079201	0.999991
C-32B	0.000350	0.999690	1.000000
C-32C above S-58	0.000696	0.999392	1.000000
C-32C below S-58	0.00001	1.000050	1.000000
C-32D	0.00014	0.99988	1.000000
C-32F	0.006202	0.994513	0.999973
C-32G	0.000077	0.999936	1.000000
C-33 above S-60	0.000916	0.999313	0.999999
C-33 below S-60	0.002472	0.997548	0.999998
C-34 between S-63 and S-63A	0.007898	0.992503	0.999944
C-34 between S-63A and Lake Cypress	0.004327	0.993701	0.999997
C-35	0.006335	0.989862	0.999998
C-36	0.003194	0.994645	0.999999
C-37	0.007644	0.986547	0.999995

r = correlation coefficient,

Q = mean discharge,

U.S.S. = upstream stage,

D.S.S. = downstream stage,

$Q > 0$

Table 29. Stage-storage-discharge relationships for the lower Kissimmee basin.

Channel Section *	Nonlinear Relationship $US = (DS)^A(\log Q)^B$		
	A	B	r^2
C-38A	0.93525909	0.12357836	0.99999427
C-38B	0.80300638	0.34915258	0.99997801
C-38C	0.72539726	0.45337676	0.99993335
C-38D	0.72979747	0.42254163	0.99995117
C-38E	0.84436366	0.22342889	0.99995183

r = correlation coefficient,

US = upstream stage,

DS = downstream stage,

Q = mean discharge,

$Q > 0$

* C-38A = channel section of C-38 between structures S-65 and S-65A
C-38B = " " " " " " S-65A and S-65B
C-38C = " " " " " " S-65B and S-65C
C-38D = " " " " " " S-65C and S-65D
C-38E = " " " " " " S-65D and S-65E

Table 30. Stage-storage-discharge relationships for the lower Kissimmee basin.

Channel Section	Nonlinear Relationship $DS = (\log Q)^A(\log ST)^B$		
	A	B	r^2
C-38A	0.46661167	1.29225620	0.9974083
C-38B	0.06123664	1.59817418	0.99994493
C-38C	-0.11387716	1.70097296	0.99985066
C-38D	-0.32464046	1.79672855	0.99987939
C-38E	-0.31844141	1.68094907	0.99921370

r = correlation coefficient,

DS = downstream stage,

Q = discharge,

ST = storage in acre ft.,

$Q > 0$

Table 31. Stage-storage-discharge relationships for the lower Kissimmee basin.

Channel Section	Nonlinear Relationship $\text{Storage} = e^{(\log DS)^A (\log Q)^B}$		
	A	B	r^2
C-38A	1.94349507	-0.18936090	0.99940581
C-38B	1.75866251	-0.03262747	0.99987813
C-38C	1.65939267	0.05420344	0.99998;24
C-38D	1.54070909	0.17934023	0.99995894
C-38E	1.21042069	0.39086445	0.99968979

r = correlation coefficient,

DS = stage,

Q = discharge,

e = 2.718281828,

Q > 0

ways. Having gone through the brain-twisting experience of the "cat chasing its tail" situation regarding the logic of these iterative procedures, the authors have indeed become aware of the difference between a conceptual methodology and its conversion into computer logic. As a result, it was decided to present only the basic computational methodology step by step (even if conceptually these steps are similar and repetitive) by excluding complicated technicalities involved with these selected steps.

At the outset, the three lakes system is considered with emphasis on the middle lake and the associated two channel sections (i.e., one on each side of the middle lake). Using the recorded initial stage of the middle lake, its initial storage is computed from a stage-storage Table 17. From the initial recorded stages of three lakes, the initial discharges are estimated by channel formulations given in Table 27. If a controlling structure is located in one or both channel sections, the initial discharges are computed from the discharge rating curves for controlling structures (as given in Tables 22, 23 and 24) knowing the recorded tailwater, headwater elevations (TWE and HWE) and the 3 hour gate opening data. Using these initial estimates of discharges flowing into or away from the middle lake and the local inflow generated by the sub-basin model, the change in storage (ΔS) in the middle lake is estimated from the simple mass-balance equation. Knowing the initial storage and the computed change in storage, a new storage and new stage is obtained for a prescribed time step. If the new discharges corresponding to the new stage make the change in storage (ΔS) in the middle lake significantly different than the previously estimated ΔS, then ΔS is again computed using the average values of the new and previous discharges through two channel sections. This iterative procedure is continued until the difference between previous and new estimates of ΔS arewithin the prescribed limit. At the end of the iteration, final estimates of discharges through the channels, and the lake stage of the middle are obtained. Two illustrations to explain the selected methodology (one for Alligator-Brick system in the upper Kissimmee and the other for Pool A in the lower Kissimmee) are presented with associated routing steps. For a better understanding of the following steps, the reader is advised to refer simultaneously to Figures 1 and 2.

Consider the first three lakes systems with Lakes Alligator and Brick in the middle and Lakes Gentry and Lizzie on each side. Channel sections associated with this system are:

1. C-32G between Lakes Alligator and Lizzie.

2. C-33 between Lakes Gentry and Alligator.

With the initial stage recorded on December 31, 1969 for the Alligator-Brick system, initial storage is computed from the stage-storage tables for the Alligator-Brick lake.

Using initial recorded stages at Lake Lizzie and at Alligator, the initial discharge is estimated by channel formulations given in Table 27 (I_1).

Since, for channel section C-33, there is a structure (S-60) located between Gentry and Alligator, the initial discharge through the structure is

estimated from the recorded tailwater and headwater elevations (TWE and HWE) and the first 3 hour gate opening data using the discharge curves of controlling structures.

Now by considering the first 3 hour local inflow of January 1, 1970, (which is assumed to be the same as the discharge through S-60) and initial estimates of the discharge through C-32G, the change in storage (ΔS) in Lake Alligator-Brick system is computed as follows:

$$\Delta S = I_1 \pm I_2 \pm O_1$$

where

I_1 = a proportion of 3 hour simulated streamflow from the FCD sub-basin model for planning unit 1,

I_2 = initial estimate of flow between Lakes Alligator and Lizzie,

O_1 = initial estimate of flow between S-60 and Lake Alligator-Brick system through C-33.

After converting this ΔS value to acre-ft., new storage is obtained by adding ΔS to the initial storage. Corresponding to this new storage for the first 3 hour period, new stage is computed from the corresponding stage-storage Table 17.

Using this new stage at the end of the 3 hours and using initial stages at Lake Lizzie and headwater elevation at S-60, new discharges through C-33 and C-32G are estimated.

Using these new discharges and the same value of local inflow into Lake Alligator, the ΔS is again computed. If the absolute difference between new and previous estimates of ΔS is within the storage error margin, then iteration is stopped for Lake Alligator and new stages and new estimates of discharges through C-33 and C-32G become final estimates which are subsequently used in the next step for Lake Lizzie.

If the new estimate of ΔS is significantly different than its previous values, then that means that estimated discharge values are to be modified. This is done by taking averages of the new and previous values of discharges through C-33 and C-32G. With these average values of discharges, ΔS is again computed for the Alligator and Brick system. This procedure is continued until the difference between previous and new estimates of ΔS are within the prescribed limit.

From the final estimate of discharge through C-33 and final 3 hour stage of Alligator Lake, headwater elevation (HWE) at S-60 is computed using the equations of Table 28. This stage is the simulated headwater stage which, in turn, is used to estimate discharge in the next time step.

The final outcome of the iterative procedure for this three lake system gives us:

1. Final estimate of stage in the Lake Alligator-Brick system at the end of the particular 3 hour period considered.

2. Final values of discharges through C-33 and C-32G at the end of the 3 hour period.

3. Simulated headwater stage at S-60.

The procedure that is described for the first three lakes system is repeated for next chain of three lakes. Likewise, the analysis is completed for lakes Lizzie, Coon, Trout, Joel, Myrtle, Mary Jane, Hart, East Tohopekaliga and Tohopekaliga in that sequence with associated channel sections and controlling structures. Although the next logical step is to include three lake system of Tohopekaliga, Cypress and Hatchineha, it is essential to consider Lake Gentry next because Lake Cypress is associated with three channel sections; one channel being linked to Lake Gentry through controlling structures. Thus, in the next three lakes system, lakes to be considered are:

1. Lake Gentry

2. Lake Alligator

Associated controlling structures are:

1. S-60 on C-33

2. S-63 below Lake Gentry and

3. S-63A

Channels to be included in this analysis for this lake system are:

1. C-33 and

2. C-34 between S-63A and S-63

With the initial stage recorded on December 31, 1969 for Lake Gentry, initial storage is computed using nonlinear stage-storage relationships given in Tables 17 through 21.

Using the initial estimates of discharge through S-60 and S-63 coupled with 3 hour local inflow, the change in storage during the 3 hour period is computed as

$$\Delta S = I_1 \pm I_2 \pm O_1$$

where

I_1 = 3 hour sub-basin model output for planning unit 9,

I_2 = initial estimates of discharge through S-60

O_1 = initial estimates of discharge through S-63

A new storage is thus obtained by adding ΔS to the initial storage. This new storage is converted back to the stage from the developed relationship for Lake Gentry given in Tables 17 through 21.

Considering this new stage as headwater elevation at S-63 and computed tailwater stage (i.e., this stage is computed by using downstream stage as 56.5 and initial estimate of discharge through S-63 in the formulations for C-34 as given in Table 28) in rating equations of S-63, a new value of discharge through S-63 is estimated.

Using this new estimate of discharge, previously used value of discharge through S-63 and local inflow of planning unit 9, change in storage (ΔS) is again estimated and iteration is continued or stopped depending on the difference in the previously estimated and newly estimated storages for Lake Gentry.

At the end of this iterative procedure, the following values are finally estimated

1. New simulated 3 hour stage in Lake Gentry,

2. Discharge through C-34

After the analysis of Lake Gentry, the next three lake system with Lake Cypress in the middle, and Lakes Tohopekaliga and Hatchineha on each side is considered. Channel sections considered in this system are

1. C-35 between Lakes Tohopekaliga and Cypress

2. C-36 between Lakes Cypress and Hatchineha

With the initial stage recorded on December 31, 1969 for the Cypress system, initial storage is computed by using nonlinear stage-storage relationships given in Tables 17 through 21.

Using initial recorded stages at Lakes Cypress and Hatchineha, the initial discharge is estimated by channel formulations given in Table 28.

Since for channel section C-35 there is a structure S-61 located between Lakes Cypress and Tohopekaliga, the final discharge through the structure is obtained from the previous step.

Now by considering the first 3 hour local inflow of January 1, 1970, (which is a fraction of the corresponding sub-basin model output according to Table 14), final estimates of the discharges through C-35 (which is assumed

to be the same as the discharge through S-61) and initial estimate of the discharge through C-36, the change in storage (ΔS) in Lake Cypress system is computed as follows:

$$S = I_1 \pm I_2 \pm I_3 \pm O_1$$

where

I_1 = a proportion of 3 hour simulated streamflows from the FCD sub-basin model for planning units 8, 10 and 11

I_2 = final estimate of flow between Lakes Tohopekaliga and Cypress

I_3 = final estimate of discharge through C-34 (this is obtained from the previous step).

O_1 = initial estimate of flow between Lakes Cypress and Hatchineha

After converting this ΔS value to acre-ft., new storage in Lake Cypress is obtained by adding ΔS to the initial storage. Corresponding to this new storage for the first 3 hour period, new stage of Cypress is computed from the nonlinear relationships of Tables 17 through 21.

Using this new stage at the end of the 3 hours and using initial stages at Lake Hatchineha, new discharge through C-36 is estimated.

Using this new discharge and the same values of local inflow into Lake Cypress and other inputs, the ΔS is again computed. If the absolute difference between new and previous estimates of ΔS is within storage error margin, then iteration is stopped for Lake Cypress and new stage and new estimate of discharges through C-36 become final estimates which are subsequently used in the next step for Lake Hatchineha.

If the new estimate of ΔS is significantly different than its previous value, then that means that estimated discharge values are to be modified. This is done by taking averages of the new and previous values of discharges through C-36. With this average value of discharge ΔS is again computed for Lake Cypress. This procedure is continued until the difference between previous and new estimates of ΔS is within the prescribed limit.

From the final estimate of discharge through C-34 and through C-35 and 3 hour stage of Cypress Lake, tailwater elevation (TWE) at S-63A and headwater elevation (HWE) are computed at S-61 using the equations of Table 28. This stage is the simulated headwater stage which, in turn, is used to estimate discharge in the next time step.

The final outcome of the iterative procedure for this three lake system gives us:

1. Final estimate of stage in the Lake Cypress system at the end of the particular 3 hour period considered.

2. Final values of discharges through C-36 at the end of the 3 hour period.

3. Simulated tailwater stage at S-63A

4. Simulated headwater stage at S-61

Thus, after completing the iterative procedure of this three lake system, the same procedure is repeated for the next three lake system with Lake Hatchineha in the middle and Lakes Cypress and Kissimmee on each side. After completing the analysis for Lake Hatchineha, the last lake system of the upper Kissimmee basin is considered.

In this system, the channel section is C-37, the lake is Kissimmee and there is a controlling structure (S-65) at the other side of Lake Kissimmee.

As usual, initial storage in Lake Kissimmee is computed from the recorded initial stage given in Table 12.

For the first 3 hours of January 1, 1970, the change in storage (ΔS) in Lake Kissimmee is estimated as follows:

$$\Delta S = I_1 + I_2 - O_1$$

where

I_1 = final estimate of discharge through C-37 for the first 3 hours of January 1, 1970. (This is computed by the iterative procedure of the previous step).

I_2 = a proportion of 3 hours simulated streamflows from the FCD sub-basin model.

O_1 = initial estimate of discharge through S-65 (This estimate is based on the initial recorded tailwater and headwater elevations on December 31, 1969 and the observed gate operations for the first 3 hours of January 1, 1970).

After computing ΔS, the new storage and thus new stage of Lake Kissimmee at the end of the 3 hour period are obtained using initial storage, ΔS and relationships given in Tables 17 through 21.

Using this new stage as the new headwater elevation at S-65 coupled with the same value of tailwater elevation and set of gate operations, new discharge through S-65 is estimated.

For this new discharge, if the value of the new ΔS in Lake Kissimmee is not significantly different than the previously computed value of ΔS, then the iteration is stopped right here and then computed lake stage and discharge through S-65 are final estimates for that 3 hour period.

If, on the other hand, the new value of ΔS is significantly different than the previously computed value of ΔS, then the average value of new and previous values of discharges through S-65 is used to compute again the latest value of ΔS. Likewise, the iteration is continued until the difference between the new estimate and the previous estimate of ΔS lie within the prescribed storage error margin.

At the end of the iteration procedure applied to the Kissimmee lake system, we get

1. Final stage in Lake Kissimmee at the end of 3 hours and

2. 3 hour simulated headwater elevation (HWE) at S-65.

After completing the iterative steps of the upper Kissimmee for a given time step of 3 hours, five pools of the lower Kissimmee are then considered. Due to the storage in the channel as well as in the surrounding vegetative marsh areas, the iterative procedure for these pools is different than the lake-channel system of the upper Kissimmee. Such procedure is illustrated step by step for Pool A (which is basically C-38 between S-65 and S-65A with the contributing area of planning unit 15).

Using initial tailwater and headwater (TWE and HWE) stages at S-65 and S-65A with the corresponding first 3 hour gate operations at these structures, initial discharges through S-65 and S-65A are estimated from the given rating curves.

Taking the average value of these two initial discharges through S-65 and S-65A and recorded initial HWE at S-65A, initial storage is estimated for Pool A from the equation in Table 31.

Now for the first 3 hour period of January 1, 1970, the change in storage for Pool A is estimated by

$$\Delta S = I_1 + I_2 - O_1$$

where

I_1 = final estimate of discharge through S-65 (This is obtained from the application of the same procedure to Lake Kissimmee).

I_2 = 3 hour streamflow values for planning unit 15 obtained from the sub-basin model,

O_1 = discharge through S-65A (This can be estimated from the rating curve).

Using this new storage (i.e., initial storage + ΔS) and average discharge (i.e., $Q = \frac{I_1 + O_1}{2}$) upstream and downstream stages in C-38A are estimated from the equations given in Tables 29 and 30.

Thus, when tailwater elevation at S-65 and headwater elevation at S-65A are estimated, a new discharge corresponding to these new simulated stages is then obtained. Using these values, the change in storage is recomputed. If the new value of the storage is not significantly different than the previous value, then iteration is stopped.

If the new value of the storage is significantly different than the previous value, then averages of new and previous discharges at S-65 and S-65A are taken and iteration is continued until the new value of storage is similar to the previous estimate within the prescribed error margin.

Thus, the outcome of this iteration procedure as applied to Pool A give us:

1. 3 hour simulated headwater elevation at S-65A and

2. 3 hour simulated tailwater elevation At S-65.

This procedure is continued for the other four channel sections and similar analysis is performed for the next time step using simulated discharges and stages of the previous time step.

2.5.6 SPECIAL CHARACTERISTICS OF OUR ROUTING METHODOLOGY

After examining all the previously reported efforts on the hydrologic modelling procedure for the Kissimmee basin, it is seen very clearly that our effort to develop a routing framework and thus complete the overall development of operational watershed models is unique in many respects.

First of all, through this report an effort is made for the first time to tie together the sub-basin model and the routing procedure for the entire Kissimmee basin, including the upper chain of lakes and the peculiar types of the five pools of the lower Kissimmee.

Although the routing methodology is demonstrated only for one year of 1970 on a 3 hour basis, it is designed to take into account:

1. The change in the flow direction due to the prevailing operating rules at controlling structures,

2. Indirectly the possible time lag between the streamflows of the sub-basin model, and more importantly

3. The interactions of stage-storage and discharge characteristics of lakes and channels of the controlled water system of the upper and lower Kissimmee basin.

While designing and developing different steps of our methodology many simplifications in the form of assumptions, approximations and speculations were made. They are as follows:

1. Lakes Brick and Alligator are considered as one combined lake,

2. Lake Ajay is again treated in combination with East Lake Tohopekaliga,

3. Since the water level in Lakes Myrtle and Preston is the same, Lake Preston is not included in the analysis although its share in storages and in distributing sub-basin model output are indirectly accounted for,

4. Similarly, offline Lake Center is not directly included in the analysis since the water level of Lake Coon and Lake Center is the same although its storage is accounted for,

5. Because of the short and straightforward nature of channels C-29B, C-34 above S-63, C-35 above S-61, they are not included in the backwater computational methodology. For these channel sections it is assumed that the water level of the nearest lake is equal to either the headwater or tailwater elevation at the structure of these channels,

6. For channel sections of upper and lower Kissimmee the backwater functions are developed with backwater computations carried out from downstream to upstream. It is assumed that the pattern of backwater values remains the same when backwater functions are used from upstream to downstream direction.

Since the routing methodology and associated computer design is intended to be general with the operational characteristics of the controlled system of the Kissimmee adequately built into the steps of our routing procedure, the procedure is susceptible to the parametric sensitivity analysis. Therefore, it is possible to examine the effect of changed conditions on the different parameters under investigation.

As far as the specific investigations for the Kissimmee basin are concerned, Kiker and Sinha have attempted to generate the simulated stages based on hydraulic simulation (23, 29). The basic difference in our methodology and these two previous investigators are as follows:

1. Although Sinha has discussed the various pieces of the operational watershed model, his investigations are limited to the East Lake Tohopekaliga basin and furthermore, the outputs from the sub-basin model were not used in his computations.

2. While performing the operational analysis of a flood in the lower Kissimmee River basin, the staff of the Engineering Department of the FCD has applied hydraulic principles to investigate the damages caused to the channel rip-rap of control structures. However, such investigations are specifically for analyzing the flood events for the whole month of October of 1969 on an hourly basis. Again, in this study, discharge rating equations of the control structures, backwater formulations with Manning equation and gate operations data are used (without sub-basin model output) to analyze the flood event.

3. Professor Kiker has attempted to combine the sub-basin model output with the routing steps for the upper Kissimmee water system only. His simulated values are on a daily basis using the average daily gate opening data with backwater computations associated with iterative procedure done in every time step. Since certain lakes are treated as one, some of the channel sections between these

individual lakes are not analyzed. In addition, the cross-sectional data of the channel sections are related to the side slope, bottom width, trapezoidal cross section and bed slope; whereas, in our methodology, the elevations at various points in the cross section (obtained by the survey crew) are used to first carry out backwater computations and then develop the backwater functions interconnecting upstream, downstream stages and discharge for the full channel section.

4. For the first time, our study attempts to unify hydrologic and hydraulic pecularities of the upper and lower Kissimmee in one computer program.

In a nutshell, the consideration of three lake systems in the routing methodology, the use of the developed backwater formulations, parametric sensitivity analysis to calibrate the model and use of practical assumptions are main factors responsible for making our methodology different and perhaps unique.

2.6 COMPUTER PROGRAM TO COMBINE SUB-BASIN MODEL AND ROUTING MODEL:

After generating, developing and refining pieces of the operational watershed models, it is a separate task to design a computer program for carrying out the steps of different types efficiently. Such a planned computer program is expected to

1. Make available the complete input data set of recorded 3 hour stages for selected controlling structures and gate openings for all the structures of the upper and lower Kissimmee basin,

2. Provide sub-basin output to be included in the routing steps,

3. Perform the iterative procedure of the routing model using all the developed formulations, input data set, sub-basin output and initial conditions.

In simple terms it means that such a computer program should handle the following three steps separately:

1. Input data synthesis,

2. Sub-basin model, and

3. Routing procedure.

The computer steps in processing the input data set are depicted in Figure 6. As shown in this figure, the recorded break-point stages and gate operations (which are either on paper tapes or on punched cards) are processed through E040 and E049 programs to

1. Verify the input data and deliver proofed output, and

2. Generate stages and gate operations at 12 minute intervals from the break-point recorded data.

Since in our methodology, the data computational steps require 3 hour data, a program SDATA is provided to convert the output of E040 into 3 hour data set. This process is repeated for gate operations of all the structures and for recorded stages of selected controlling structures. As a result, a huge data base of these parameters is generated for only 1 year of 1970. To adequately use such data on a random access basis, the data sets of various structures are arranged in order and are stored on a tape through a program called MERGE.

In summary, this piece of the computer program processes the break-point historical data into 3 hour values of stages and gate operational data which can be conveniently used in the routing steps.

To bring together the sub-basin model output for the one year of 1970 for the 19 planning units, discharge data of 10 years located in the disk is further processed through a DISCHEXT program as shown in the last two steps of Figure 6. In this way, discharge values on a 3 hour basis for 19 planning units for our selected routing period of 1970 are stored on a file from which they can be transferred to the routing program whenever necessary.

The third part of the computer program deals primarily with the iterative procedure of the routing model which is described previously. It is to be noted that the computer logic is developed around a map which is designed to include the three lake system with computational steps related to the central lake and two links connecting two side lakes to this central lake; these two links may be either channel controlled or structure controlled.

These computerized steps essentially

1. Start with the 5 x 34 matrix map of the upper Kissimmee basin with three lake systems considered at a time,

2. Check for the channel section with either lake controlled or structure controlled,

3. Estimate initial, final and average discharges through the channel sections, initial and final storages in lakes,

4. Use stage-storage relationships for all the lakes and stage-storage discharge relationships for the channel sections with FUNCTIONS, BACKWTR1 and BACKWTR2,

5. Take into account the correct direction of the flow,

6. Compute discharges through the controlling structures using gate operations,

7. Carry out the iterative procedure by using a criteria of error stage margin, and finally

8. Provide final estimates of simulated stages in all the lakes of the upper Kissimmee with the corresponding final estimates of discharges through the channel sections.

Thus, it can be summarized that using input tapes containing the sub-basin model output and operational data, the computer program with its various steps is designed to combine sub-basin model and routing procedures together. For more clarity, the system chart of the overall operational watershed model is depicted in Figure 6.

CHAPTER 3

3.1 NATURE OF THE OUTPUT

After refining all the previously described pieces of the operational watershed model, the output is essentially the net result of the interactions of various subcomponents of our hydraulic simulation procedure. Since, as per our final goal, we are able to develop a broader operational water quantity model for combining sub-basin models with routing models for the entire Kissimmee Basin, the primary output from such methodology consists of:

1. Three hours of simulated discharges through all the channel sections of the upper and lower Kissimmee for the year 1970.

2. Three hours of simulated mean discharges through all the control structures for the full year of 1970

3. Three hours simulated stages for all the major 14 lakes of the upper Kissimmee Basin.

4. Three hours simulated tailwater and headwater stages at all the control structures of the upper and lower Kissimmee Basin.

5. Storages in all the major lakes and storages for five sections of the lower Kissimmee at the end of every three hours for the entire year of 1970.

6. Comparative tables for assessing the adequacy of the output by comparing recorded TWE and HWE with simulated values at selected control structures.

7. Graphical comparisons of simulated stages and recorded stages of eight lakes of the upper Kissimmee Basin.

8. Graphical comparisons of the simulated and recorded daily discharges through S-59, S-63, S-57, S-62, S-60 and S-65.

Excluding the time required for preparing manually the comparative graphs, it takes about 5 hours on the CDC 3100 computer to obtain the above required output. Further breakdown of these 5 hours is as follows:

1. Sub-basin output (139 minutes)

   a. state conditions program (2 minutes)
   b. BASIN parameters (2 minutes)
   c. rainfall synthesis (20 minutes)
   d. BASIN model (100 minutes)
   e. printing the result (15 minutes)

2. Routing model output (150 minutes)

   a. DISCHEXT program (15 minutes)
   b. ROUTING program (120 minutes)
   c. GRAPH program (15 minutes)

In addition to the above primary output, a tremendous amount of secondary output is also generated. Categorically, such secondary output consists of

1. A complete set of cross-sectional data of all the channel sections of the upper and lower Kissimmee Basin in computer usable form.

2. The backwater computations at every available cross-section of all the channel sections of the upper and lower Kissimmee for different ranges of discharge and stage as shown in Table 25.

3. Various types of backwater functions correlating the downstream stage, upstream stage and discharge for the channel sections of the upper Kissimmee and correlating four variables (US, DS, Q and storage) for the five sections of the lower Kissimmee.

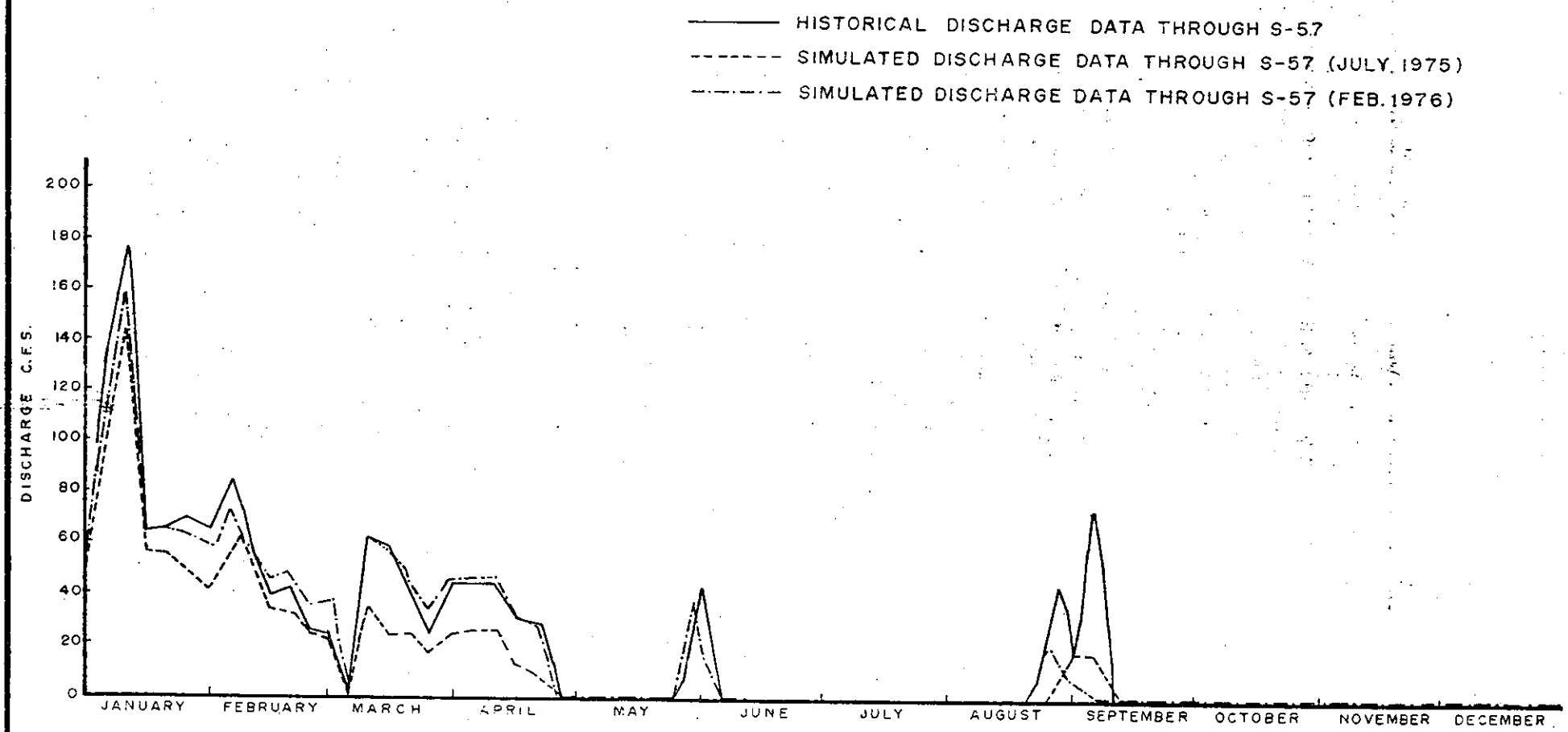
4. Linear-nonlinear stage-storage functional relationships for all the 14 lakes of the upper Kissimmee.

5. Operational data such as gate openings and the corresponding headwater, tailwater elevations at all the 14 control structures of the upper and lower Kissimmee Basin on a 3 hour basis.

Considering the fact that we are for the first time, trying to incorporate collectively huge sets of input data, various types of coefficients, numerous mathematical formulations, complexities in computer logic and iterative procedures in developing an operational framework for the hydraulic simulation of the entire Kissimmee Basin, the results are indeed encouraging. The success of our methodology can be viewed in terms of the various comparisons of simulated stages and discharges with the corresponding recorded values. Because of the inter-dependence between and within the various component parts of the overall operational watershed model, it is to be noted that a particular set of simulated stages and discharges correspond to the specific set of the combinations of coefficients, mathematical formulations and input data. Even if one coefficient is changed arbitrarily or systematically, the output of simulated stages and discharges corresponding to that change can be significantly different from the previous set. In addition there are numerous key coefficients, rate constants and numerical multipliers that can be changed. As a result, it is better to first obtain an output based on realistic and well documented input data set and then a further tuning-up of the proper coefficients in the right direction is recommended after comparing the simulated values with the recorded values.

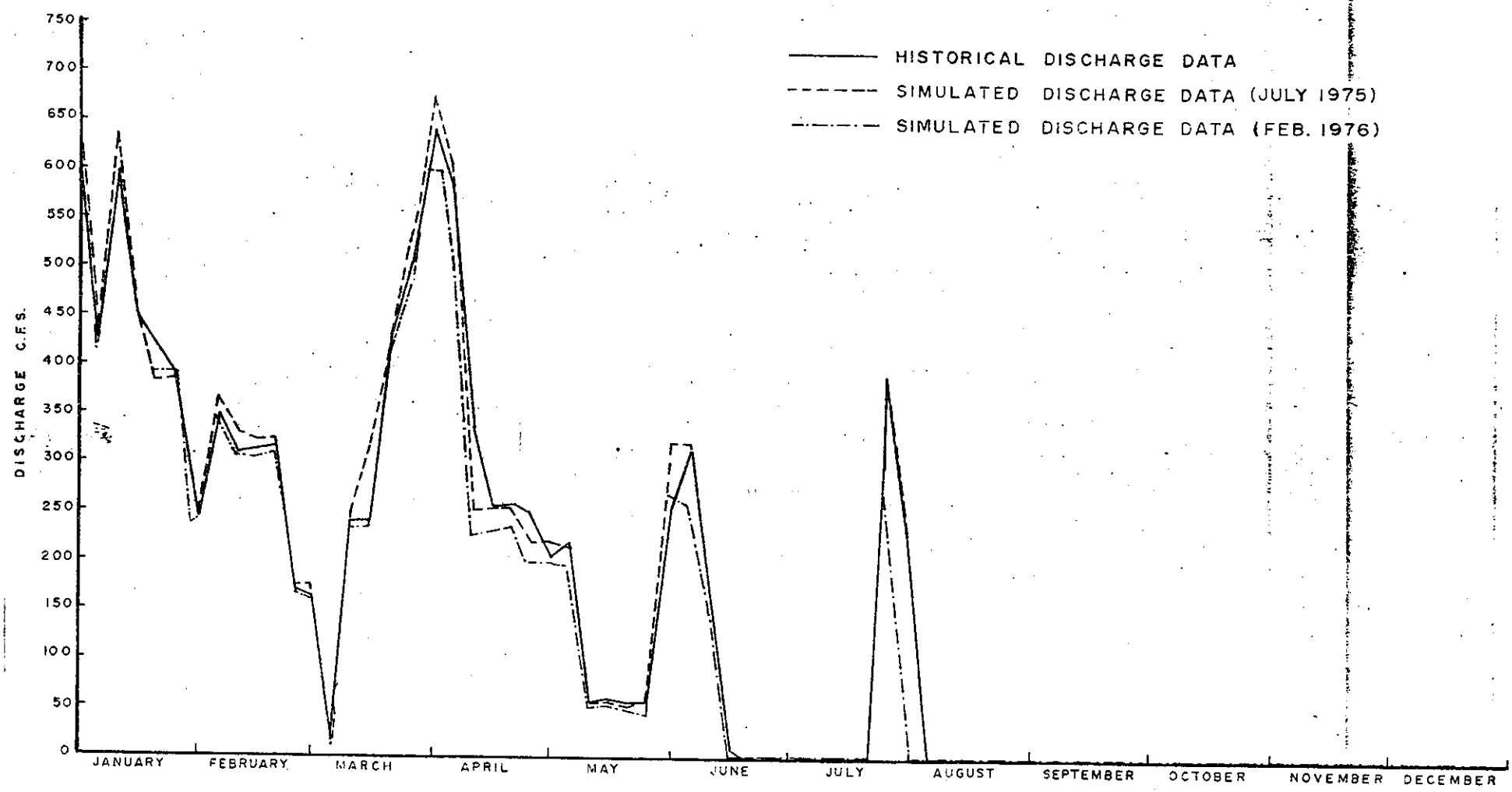
For example, the results of our routing methodology for the upper Kissimmee Basin gave us comparative discharge graphs shown in Figures 41-48 for a particular set of state conditions, basin parameters of sub-basin models coupled with another specific set of proportioning factors, tabular values and mathematical formulations of the routing model. Although the correlations depicted in Figures 41-48 for discharges are excellent, the comparative graphs of simulated and recorded stages of some of the lakes of the upper Kissimmee show some differences in graphical comparisons for Lakes Cypress, Kissimmee and Tohopekaliga which are depicted in Figures 49 and 50. A comparative table of simulated stages at three illustrative points are shown in Table 32. These comparisons indicate clearly:

1. The capability of the operational water quantity model to combine the sub-basin model with the routing methodology and to generate the wanted simulated information,



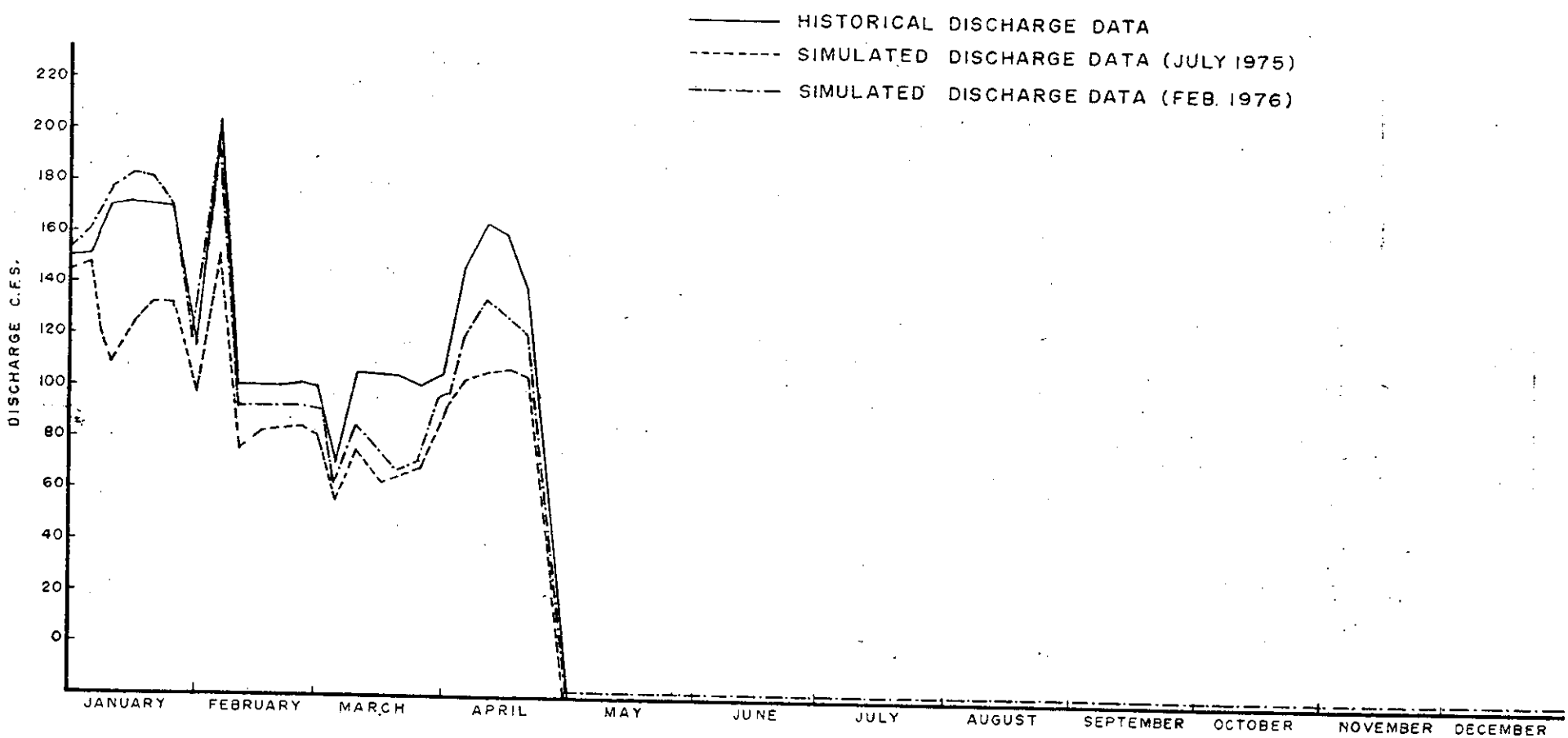
COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-57 FOR THE FULL YEAR OF 1970

FIGURE 41



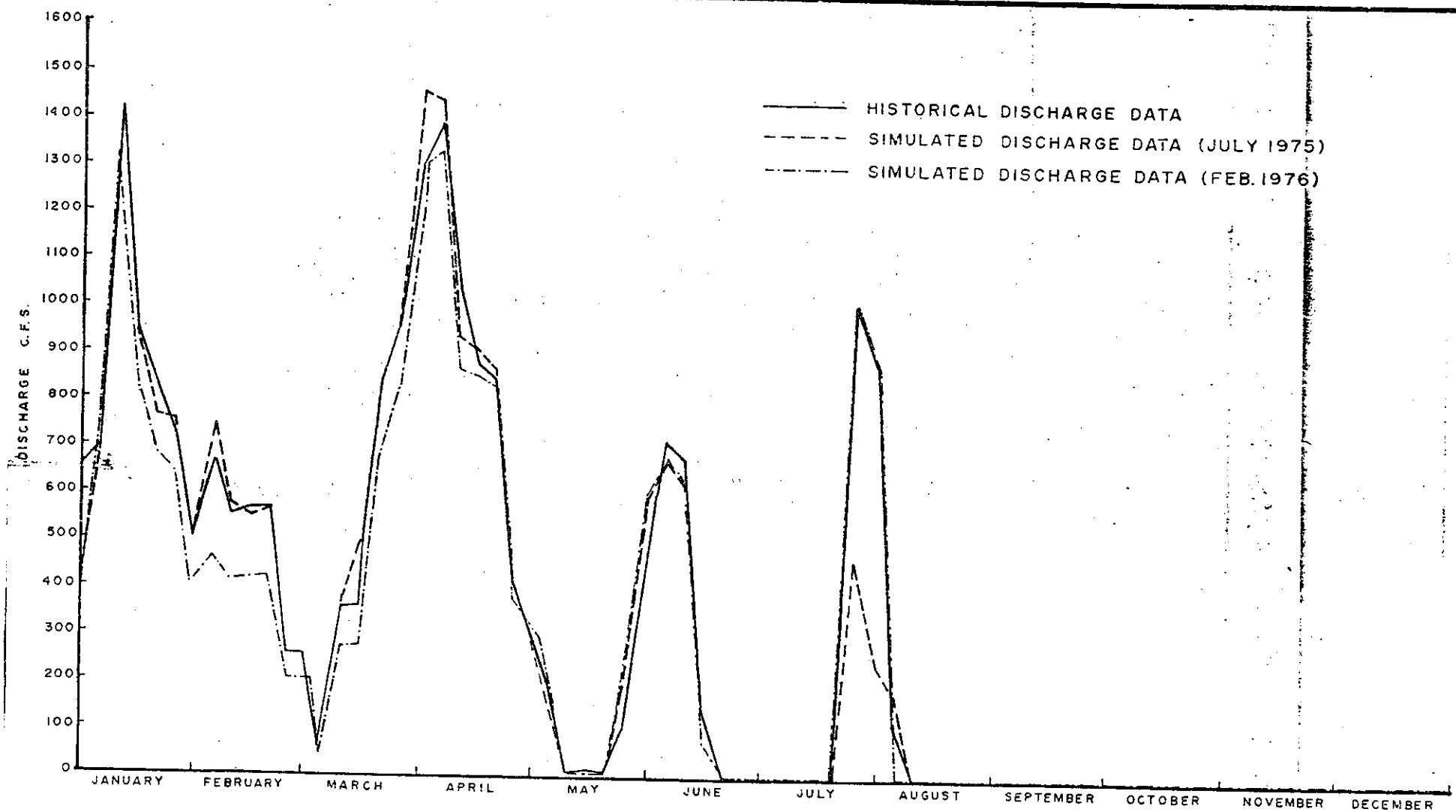
COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-59 FOR THE FULL YEAR OF 1970

FIGURE 42



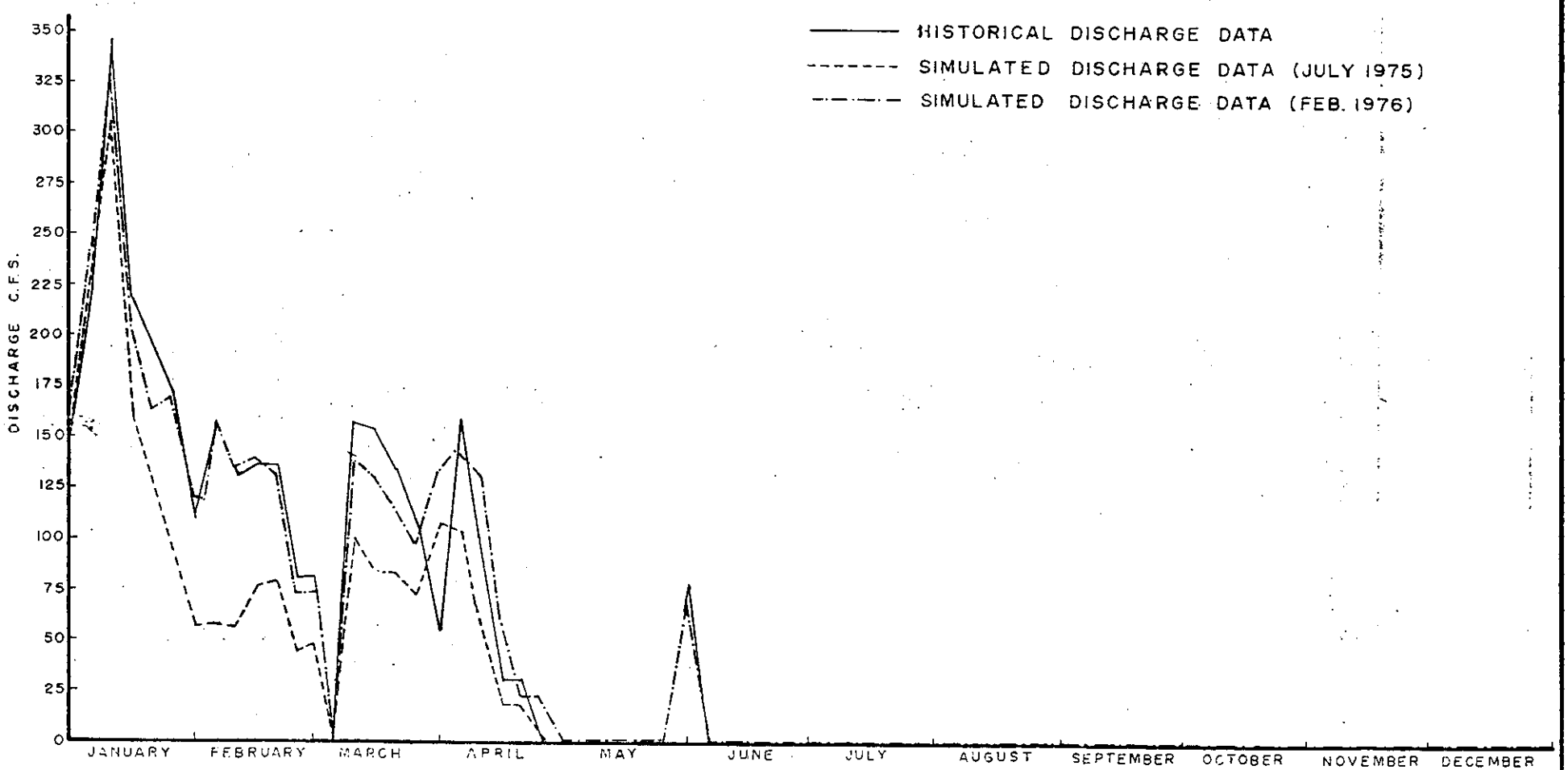
COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-60 FOR THE FULL YEAR OF 1970

FIGURE 43



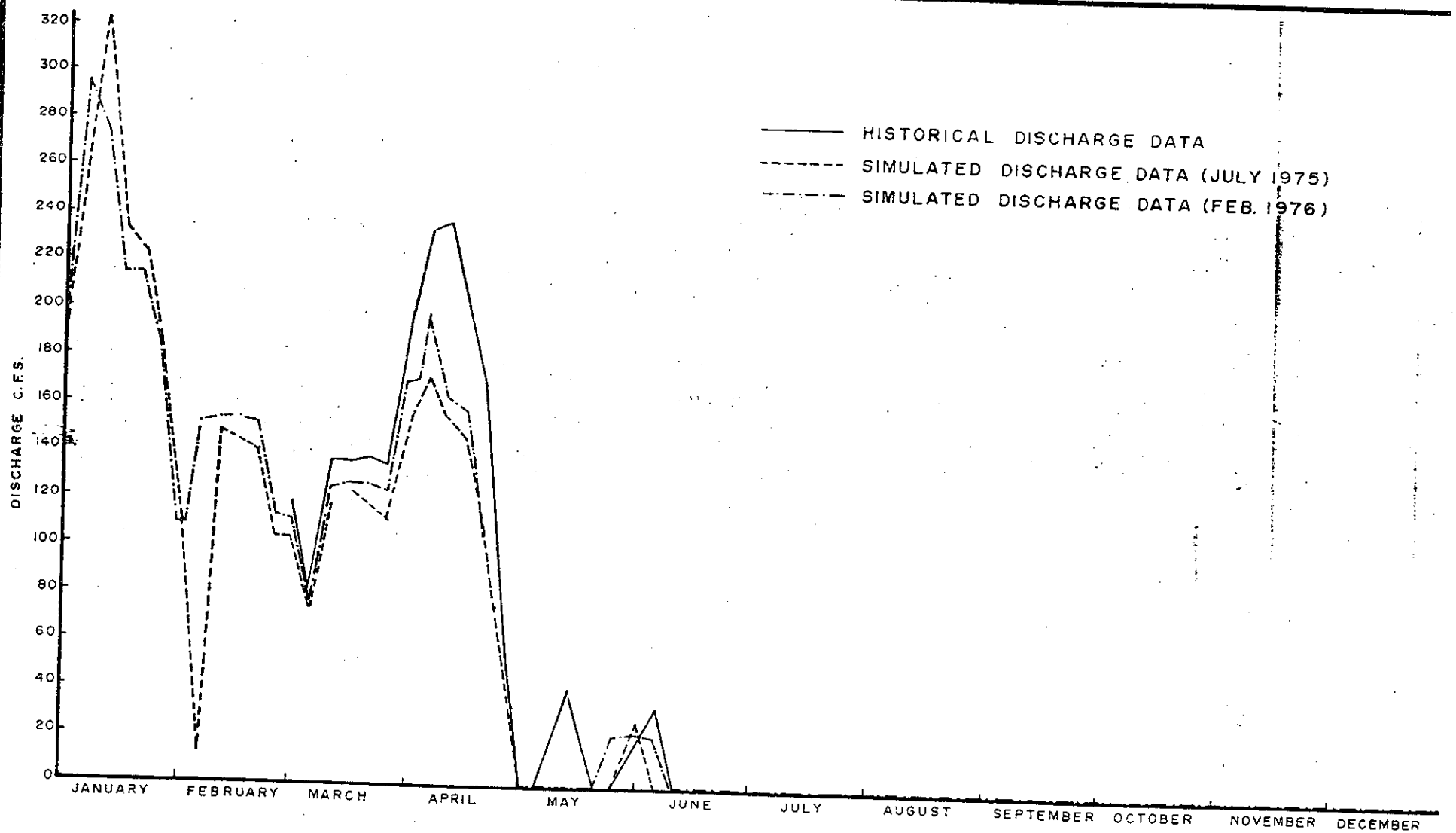
COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-61 FOR THE FULL YEAR OF 1970

FIGURE 44



COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-62 FOR THE FULL YEAR OF 1970

FIGURE 45



COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-63 FOR THE FULL YEAR OF 1970

FIGURE 46

C38A

US	CUS	UFACT	DS	CDS	DFACT	STOR	CSTOR	SFACT	Q
44.020	43.730	1.0066390	44.000	38.393	1.146	4329.18	10015.75	.43	1000.00
46.020	45.586	1.0095202	46.000	39.637	1.161	5336.83	12374.38	.43	1000.00
48.010	47.437	1.0120765	48.000	42.023	1.142	7938.45	15184.57	.52	1000.00
50.010	49.283	1.0147464	50.000	45.627	1.096	14325.95	18514.99	.77	1000.00
52.010	51.125	1.0173185	52.000	49.091	1.059	25015.72	22442.37	1.11	1000.00
54.010	52.961	1.0198000	54.000	51.762	1.043	38223.28	27052.22	1.41	1000.00
44.080	44.249	.9961696	44.000	40.159	1.096	4339.10	8489.74	.51	2000.00
46.060	46.184	.9973117	46.060	41.461	1.111	5349.40	10513.48	.51	2000.00
48.060	48.001	1.0012290	48.000	43.961	1.092	7963.84	12775.29	.62	2000.00
50.040	49.869	1.0034275	50.000	47.731	1.048	14375.42	15521.95	.93	2000.00
52.030	51.732	1.0057544	52.000	51.343	1.013	25062.23	18749.62	1.34	2000.00
54.020	53.591	1.0080067	54.000	54.131	.998	38261.26	22525.30	1.70	2000.00
44.190	44.535	.9922623	44.000	41.169	1.069	4355.63	7769.97	.56	3000.00
46.140	46.425	.9938590	46.000	42.504	1.082	5370.51	9543.95	.56	3000.00
48.130	48.310	.9962683	48.000	45.074	1.065	8006.34	11645.49	.69	3000.00
50.090	50.190	.9979999	50.000	48.941	1.022	14457.92	14122.28	1.02	3000.00
52.060	52.066	.9998920	52.000	52.624	.988	25139.91	17027.37	1.48	3000.00
54.040	53.936	1.0019245	54.000	55.471	.973	38324.53	20419.52	1.88	3000.00
44.330	44.729	.9910730	44.000	41.887	1.050	4378.78	7319.81	.60	4000.00
46.250	46.628	.9918919	46.000	43.246	1.064	5400.38	8978.71	.60	4000.00
48.220	48.521	.9937864	48.000	45.872	1.046	8066.45	10941.26	.74	4000.00
50.150	50.410	.9948459	50.000	49.807	1.004	14573.50	13251.25	1.10	4000.00
52.110	52.293	.9964956	52.000	53.527	.971	25248.44	15957.26	1.58	4000.00
54.070	54.172	.9981169	54.000	56.408	.957	38413.00	19113.07	2.01	4000.00
44.510	44.876	.9918378	44.000	42.453	1.036	4408.56	7000.37	.63	5000.00
46.390	46.781	.9916357	46.000	43.832	1.049	5439.30	8578.08	.63	5000.00
48.350	48.681	.9932018	48.000	46.509	1.032	8144.85	10442.70	.78	5000.00
50.240	50.575	.9933669	50.000	50.497	.990	14722.23	12635.29	1.17	5000.00
52.160	52.465	.9941847	52.000	54.232	.959	25387.78	15201.34	1.67	5000.00
54.110	54.350	.9955836	54.000	57.132	.945	38526.61	18191.19	2.12	5000.00
44.720	44.994	.9939124	44.000	42.929	1.025	4444.95	6756.63	.66	6000.00
46.560	46.904	.9926680	46.000	44.326	1.038	5487.64	8272.67	.66	6000.00
48.500	48.809	.9936788	48.000	47.051	1.020	8243.01	10062.98	.82	6000.00
50.340	50.708	.9927423	50.000	51.083	.979	14905.42	12166.56	1.23	6000.00
52.230	52.603	.9929166	52.000	54.817	.949	25557.67	14626.59	1.75	6000.00
54.160	54.492	.9938987	54.000	57.724	.935	38665.22	17490.82	2.21	6000.00
44.970	45.092	.9973017	44.000	43.347	1.015	4487.96	6561.66	.68	7000.00
46.750	47.006	.9945577	46.000	44.762	1.028	5545.84	8028.56	.69	7000.00
48.670	48.915	.9949997	48.000	47.536	1.010	8362.52	9759.69	.86	7000.00
50.460	50.818	.9929512	50.000	51.605	.969	15125.37	11792.42	1.28	7000.00
52.320	52.717	.9924710	52.000	55.324	.940	25757.87	14168.14	1.82	7000.00
54.210	54.611	.9926593	54.000	58.229	.927	38828.71	16932.54	2.29	7000.00
45.240	45.175	1.0014352	44.000	43.724	1.006	4537.61	6400.43	.71	8000.00
46.970	47.093	.9973912	46.000	45.159	1.019	5614.67	7826.81	.72	8000.00
48.870	49.005	.9972420	48.000	47.986	1.000	8506.24	9509.19	.89	8000.00
50.600	50.912	.9938658	50.000	52.085	.960	15382.45	11483.60	1.34	8000.00
52.410	52.815	.9923408	52.000	55.774	.932	25988.07	13789.93	1.88	8000.00
54.280	54.712	.9921041	54.000	58.672	.920	39017.28	16472.22	2.37	8000.00
45.550	45.248	1.0066763	44.000	44.077	.998	4596.14	6263.77	.73	9000.00
47.210	47.169	1.0008757	46.000	45.532	1.010	5695.80	7655.91	.74	9000.00
49.080	49.084	.9999170	48.000	48.420	.991	8681.89	9297.09	.93	9000.00
50.740	50.994	.9950133	50.000	52.534	.952	15674.48	11222.25	1.40	9000.00
52.510	52.900	.9926357	52.000	56.185	.926	26247.93	13470.02	1.95	9000.00
54.330	54.800	.9914214	54.000	59.069	.914	39231.74	16083.05	2.44	9000.00
45.870	45.312	1.0123081	44.000	44.415	.991	4664.27	6145.72	.76	10000.00
47.470	47.236	1.0049580	46.000	45.891	1.002	5792.04	7508.34	.77	10000.00
49.310	49.154	1.0031755	48.000	48.847	.983	8893.26	9114.04	.98	10000.00
50.910	51.067	.9969286	50.000	52.962	.944	16000.58	10996.78	1.46	10000.00
52.630	52.975	.9934906	52.000	56.566	.919	26537.02	13194.15	2.01	10000.00
54.420	54.878	.9916528	54.000	59.432	.909	39472.68	15747.59	2.51	10000.00
46.220	45.370	1.0187354	44.000	44.740	.983	4741.12	6042.19	.78	11000.00
47.760	47.296	1.0098119	46.000	46.242	.995	5901.90	7378.98	.80	11000.00
49.550	49.216	1.0067765	48.000	49.283	.974	9152.17	8953.63	1.02	11000.00
51.080	51.132	.9989858	50.000	53.375	.937	16360.17	10799.29	1.51	11000.00
52.750	53.042	.9944898	52.000	56.925	.913	26854.89	12952.60	2.07	11000.00
54.510	54.948	.9920299	54.000	59.767	.904	39740.54	15453.96	2.57	11000.00
46.600	45.422	1.0259303	44.000	44.086	.998	4188.33	5950.27	.70	12000.00
48.060	47.350	1.0149869	46.000	44.676	1.030	4565.42	7264.16	.63	12000.00
49.820	49.273	1.0110989	48.000	45.406	1.057	5078.23	8811.30	.58	12000.00
51.320	51.191	1.0025258	50.000	46.080	1.085	5599.89	10624.12	.53	12000.00
52.980	53.103	.9976778	52.000	46.729	1.113	6151.33	12738.42	.48	12000.00
54.750	55.011	.9952524	54.000	47.341	1.141	6719.00	15193.70	.44	12000.00
46.970	45.470	1.0329923	44.000	45.375	.970	4924.72	5867.81	.84	13000.00
48.370	47.400	1.0204631	46.000	46.932	.980	6166.82	7161.20	.86	13000.00
50.060	49.325	1.0149048	48.000	50.172	.957	9795.38	8683.73	1.13	13000.00
51.460	51.244	1.0042071	50.000	54.171	.923	17180.19	10467.15	1.64	13000.00
53.020	53.159	.9973846	52.000	57.592	.903	27574.81	12546.56	2.20	13000.00
54.010	55.069	.9807715	54.000	60.379	.894	40358.21	14960.62	2.70	13000.00

C388

US	CUS	UFACT	DS	CDS	DFACT	STOR	CSTOR	SFACT	Q
36.100	36.081	1.0005298	36.000	35.180	1.023	5355.76	6856.14	.78	2000.00
38.070	37.682	1.0102997	38.000	36.228	1.049	6279.57	8678.58	.72	2000.00
40.060	39.266	1.0202115	40.000	38.195	1.047	8427.62	10880.26	.77	2000.00
42.050	40.835	1.0297460	42.000	41.413	1.014	13473.25	13520.86	1.00	2000.00
44.040	42.390	1.0389341	44.000	44.680	.985	21400.69	16666.85	1.28	2000.00
36.380	37.197	.9780299	36.000	35.412	1.017	5391.28	6686.09	.81	4000.00
38.280	38.848	.9853849	38.000	36.461	1.042	6316.39	8457.66	.75	4000.00
40.230	40.481	.9937929	40.000	38.450	1.040	8490.07	10596.48	.80	4000.00
42.190	42.099	1.0021673	42.000	41.680	1.008	13561.75	13160.08	1.03	4000.00
44.140	43.701	1.0100424	44.000	44.966	.979	21539.60	16212.47	1.33	4000.00
36.820	37.822	.9734997	36.000	35.587	1.012	5449.66	6595.08	.83	6000.00
38.620	39.501	.9777073	38.000	36.632	1.037	6378.08	8339.49	.76	6000.00
40.520	41.162	.9844143	40.000	38.648	1.035	8596.58	10444.75	.82	6000.00
42.420	42.806	.9909780	42.000	41.881	1.003	13713.99	12967.27	1.06	6000.00
44.320	44.436	.9974007	44.000	45.176	.974	21774.91	15969.76	1.36	6000.00
37.400	38.254	.9776657	36.000	35.755	1.007	5530.38	6533.83	.85	8000.00
39.070	39.952	.9779277	38.000	36.796	1.033	6464.84	8259.98	.78	8000.00
40.910	41.632	.9826633	40.000	38.846	1.030	8750.53	10342.71	.85	8000.00
42.750	43.295	.9874070	42.000	42.078	.998	13937.42	12837.64	1.09	8000.00
44.560	44.943	.9914751	44.000	45.377	.970	22111.19	15806.62	1.40	8000.00
38.090	38.583	.9872128	36.000	35.931	1.002	5632.87	6488.08	.87	10000.00
39.610	40.295	.9829902	38.000	36.967	1.028	6577.29	8200.61	.80	10000.00
41.390	41.990	.9857157	40.000	39.064	1.024	8956.12	10266.52	.87	10000.00
43.160	43.668	.9883768	42.000	42.297	.993	14248.89	12740.86	1.12	10000.00
44.850	45.330	.9894187	44.000	45.589	.965	22553.73	15684.85	1.44	10000.00
38.850	38.848	1.0000426	36.000	36.121	.997	5758.15	6451.77	.89	12000.00
40.230	40.572	.9915670	38.000	37.154	1.023	6718.08	8153.49	.82	12000.00
41.940	42.278	.9920015	40.000	39.322	1.017	9236.22	10206.07	.90	12000.00
43.630	43.967	.9923251	42.000	42.545	.987	14649.42	12664.09	1.16	12000.00
45.200	45.641	.9903387	44.000	45.824	.960	23116.79	15588.27	1.48	12000.00
39.670	39.070	1.0153629	36.000	36.333	.991	5912.24	6421.79	.92	14000.00
40.920	40.803	1.0028575	38.000	37.365	1.017	6892.87	8114.60	.85	14000.00
42.570	42.519	1.0011961	40.000	39.637	1.009	9612.47	10156.17	.95	14000.00
44.150	44.218	.9984609	42.000	42.831	.981	15162.22	12600.73	1.20	14000.00
45.580	45.901	.9930046	44.000	46.094	.955	23838.80	15508.57	1.54	14000.00
40.520	39.260	1.0321012	36.000	36.573	.984	6099.75	6396.33	.95	16000.00
41.660	41.002	1.0160537	38.000	37.602	1.011	7105.68	8081.57	.88	16000.00
43.260	42.726	1.0125019	40.000	40.004	1.000	10086.81	10113.80	1.00	16000.00
44.710	44.433	1.0062336	42.000	43.185	.973	15851.48	12546.94	1.26	16000.00
45.990	46.124	.9970894	44.000	46.407	.948	24747.04	15440.91	1.60	16000.00
41.390	39.426	1.0498190	36.000	36.834	.977	6315.48	6374.25	.99	18000.00
42.230	41.175	1.0256156	38.000	37.873	1.003	7364.72	8052.93	.91	18000.00
44.120	42.907	1.0282790	40.000	40.449	.989	10708.09	10077.07	1.06	18000.00
45.290	44.621	1.0149920	42.000	43.601	.963	16726.87	12500.31	1.34	18000.00
46.440	46.319	1.0026032	44.000	46.758	.941	25837.24	15382.27	1.68	18000.00

C38C

US	CUS	UFACT	DS	CDS	DFACT	STOR	CSTOR	SFACT	Q
26.110	26.655	.9795470	26.000	27.709	.938	3209.89	2763.31	1.16	2000.00
28.080	28.127	.9983179	28.000	28.428	.985	3628.12	3735.04	.97	2000.00
30.060	29.571	1.0165423	30.000	29.244	1.026	4163.11	4964.39	.84	2000.00
32.050	30.988	1.0342668	32.000	30.383	1.053	5030.95	6500.78	.77	2000.00
34.030	32.381	1.0509149	34.000	33.302	1.021	8067.81	8400.05	.96	2000.00
36.030	33.752	1.0674878	36.000	37.635	.957	15776.05	10724.96	1.47	2000.00
26.420	27.731	.9527251	26.000	27.481	.946	3235.72	2869.11	1.13	4000.00
28.310	29.263	.9674487	28.000	28.182	.994	3650.27	3883.59	.94	4000.00
30.240	30.764	.9829573	30.000	28.985	1.035	4184.22	5168.81	.81	4000.00
32.180	32.239	.9981756	32.000	30.117	1.063	5059.57	6777.12	.75	4000.00
34.140	33.688	1.0134107	34.000	33.020	1.030	8129.59	8767.77	.93	4000.00
36.110	35.114	1.0283536	36.000	37.306	.965	15880.69	11207.44	1.42	4000.00
26.910	28.338	.9496218	26.000	27.407	.949	3277.85	2928.90	1.12	6000.00
28.690	29.903	.9594467	28.000	28.088	.997	3686.89	3967.63	.93	6000.00
30.530	31.437	.9711401	30.000	28.877	1.039	4219.40	5284.57	.80	6000.00
32.410	32.944	.9837894	32.000	30.011	1.066	5108.12	6933.76	.74	6000.00
34.310	34.425	.9966551	34.000	32.921	1.033	8234.21	8976.41	.92	6000.00
36.240	35.883	1.0099629	36.000	37.176	.968	16058.03	11481.44	1.40	6000.00
27.540	28.759	.9576241	26.000	27.405	.949	3335.21	2970.45	1.12	8000.00
29.180	30.347	.9615453	28.000	28.063	.998	3737.68	4026.08	.93	8000.00
30.910	31.904	.9688314	30.000	28.839	1.040	4269.22	5365.13	.80	8000.00
32.720	33.434	.9786571	32.000	29.981	1.067	5178.32	7042.85	.74	8000.00
34.540	34.937	.9886456	34.000	32.911	1.033	8384.11	9121.79	.92	8000.00
36.420	36.416	1.0001181	36.000	37.141	.969	16312.29	11672.45	1.40	8000.00
28.290	29.080	.9728256	26.000	27.450	.947	3406.73	3002.22	1.13	10000.00
29.770	30.686	.9701395	28.000	28.084	.997	3802.26	4070.78	.93	10000.00
31.390	32.261	.9729968	30.000	28.847	1.040	4334.12	5426.78	.80	10000.00
33.100	33.807	.9790754	32.000	30.007	1.066	5274.23	7126.35	.74	10000.00
34.830	35.327	.9859223	34.000	32.964	1.031	8582.44	9233.11	.93	10000.00
36.650	36.823	.9953051	36.000	37.170	.969	16648.80	11818.78	1.41	10000.00
29.100	29.340	.9918258	26.000	27.530	.944	3491.70	3027.89	1.15	12000.00
30.440	30.960	.9831967	28.000	28.139	.995	3880.60	4106.91	.94	12000.00
31.940	32.549	.9812856	30.000	28.891	1.038	4415.10	5476.61	.81	12000.00
33.540	34.109	.9833126	32.000	30.079	1.064	5399.13	7193.87	.75	12000.00
35.160	35.643	.9864577	34.000	33.069	1.028	8834.44	9323.16	.95	12000.00
36.920	37.152	.9937665	36.000	37.253	.966	17078.31	11937.19	1.43	12000.00
29.970	29.557	1.0139672	26.000	27.638	.941	3589.69	3049.39	1.18	14000.00
31.170	31.190	.9993723	28.000	28.224	.992	3973.21	4137.18	.96	14000.00
32.550	32.790	.9926731	30.000	28.969	1.036	4515.63	5518.39	.82	14000.00
34.040	34.362	.9906331	32.000	30.195	1.060	5557.56	7250.49	.77	14000.00
35.550	35.907	.9900656	34.000	33.229	1.023	9155.62	9398.69	.97	14000.00
37.240	37.427	.9950092	36.000	37.388	.963	17624.85	12036.52	1.46	14000.00
30.870	29.744	1.0378602	26.000	27.770	.936	3701.03	3067.87	1.21	16000.00
31.950	31.387	1.0179499	28.000	28.337	.988	4083.26	4163.22	.98	16000.00
33.210	32.997	1.0064430	30.000	29.084	1.031	4641.25	5554.31	.84	16000.00
34.580	34.579	1.0000307	32.000	30.356	1.054	5755.60	7299.20	.79	16000.00
35.980	36.134	.9957506	34.000	33.438	1.017	9551.24	9463.68	1.01	16000.00
37.590	37.663	.9980557	36.000	37.587	.958	18336.97	12122.00	1.51	16000.00
31.780	29.907	1.0626124	26.000	27.925	.931	3827.35	3084.06	1.24	18000.00
32.750	31.559	1.0377329	28.000	28.479	.983	4212.33	4186.03	1.01	18000.00
33.910	33.179	1.0220375	30.000	29.236	1.026	4795.83	5585.81	.86	18000.00
35.150	34.769	1.0109564	32.000	30.563	1.047	6000.28	7341.90	.82	18000.00
36.440	36.332	1.0029667	34.000	33.693	1.009	10025.23	9520.66	1.05	18000.00
37.970	37.870	1.0026325	36.000	37.838	.951	19209.33	12196.97	1.57	18000.00
32.700	30.053	1.0880848	26.000	28.103	.925	3971.28	3098.46	1.28	20000.00
33.570	31.713	1.0585702	28.000	28.646	.977	4361.25	4206.32	1.04	20000.00
34.640	33.340	1.0389890	30.000	29.423	1.020	4981.74	5613.82	.89	20000.00
35.740	34.938	1.0229530	32.000	30.814	1.038	6297.19	7379.89	.85	20000.00
36.940	36.509	1.0118102	34.000	34.000	1.000	10601.32	9571.38	1.11	20000.00
38.370	38.054	1.0082936	36.000	38.133	.944	20239.75	12263.70	1.65	20000.00

C38D

US	CUS	UFACT	DS	CDS	DFACT	STOR	CSTOR	SFACT	Q
24.070	24.254	.9924062	24.000	26.266	.914	7643.26	5369.05	1.42	2500.00
26.050	25.713	1.0130988	26.000	27.118	.959	8972.30	7509.58	1.19	2500.00
28.040	27.142	1.0330796	28.000	28.338	.988	11244.06	10286.50	1.09	2500.00
30.030	28.544	1.0520685	30.000	30.237	.992	15841.72	13834.84	1.15	2500.00
24.290	25.140	.9661929	24.000	25.602	.937	7718.94	6125.10	1.26	5000.00
26.200	26.652	.9830335	26.000	26.415	.984	9032.07	8611.26	1.05	5000.00
28.140	28.133	1.0002368	28.000	27.610	1.014	11333.55	11852.64	.96	5000.00
30.100	29.586	1.0173682	30.000	29.457	1.018	15963.98	16013.84	1.00	5000.00
24.620	25.639	.9602625	24.000	25.299	.949	7841.86	6589.19	1.19	7500.00
26.440	27.181	.9727340	26.000	26.075	.997	9130.71	9290.20	.98	7500.00
28.320	28.692	.9870464	28.000	27.266	1.027	11485.44	12821.39	.90	7500.00
30.240	30.173	1.0022107	30.000	29.086	1.031	16174.68	17366.42	.93	7500.00
25.060	25.985	.9644057	24.000	25.144	.954	8007.51	6928.31	1.16	10000.00
26.760	27.548	.9713942	26.000	25.883	1.005	9266.14	9787.49	.95	10000.00
28.560	29.079	.9821534	28.000	27.083	1.034	11701.38	13532.56	.86	10000.00
30.430	30.581	.9950754	30.000	28.887	1.039	16477.39	18361.46	.90	10000.00
25.580	26.249	.9745101	24.000	25.075	.957	8210.49	7196.99	1.14	12500.00
27.150	27.828	.9756326	26.000	25.774	1.009	9434.82	10182.18	.93	12500.00
28.850	29.375	.9821414	28.000	26.996	1.037	11981.74	14097.91	.85	12500.00
30.660	30.891	.9925063	30.000	28.792	1.042	16882.50	19153.68	.88	12500.00
26.160	26.462	.9885775	24.000	25.061	.958	8446.75	7420.20	1.14	15000.00
27.590	28.054	.9834570	26.000	25.724	1.011	9642.75	10510.50	.92	15000.00
29.190	29.613	.9857107	28.000	26.979	1.038	12339.23	14568.79	.85	15000.00
30.920	31.142	.9928594	30.000	28.774	1.043	17400.39	19814.29	.88	15000.00
26.770	26.641	1.0048538	24.000	25.088	.957	8716.61	7611.50	1.15	17500.00
28.090	28.243	.9945736	26.000	25.760	1.009	9972.49	10792.21	.92	17500.00
29.570	29.813	.9918551	28.000	27.028	1.036	12798.57	14973.22	.85	17500.00
31.220	31.352	.9957784	30.000	28.812	1.041	18027.70	20382.24	.88	17500.00
27.410	26.794	1.0229924	24.000	25.143	.955	9014.04	7779.14	1.16	20000.00
28.620	28.406	1.0075433	26.000	25.842	1.006	10368.98	11039.29	.94	20000.00
29.990	29.984	1.0001894	28.000	27.133	1.032	13370.23	15328.25	.87	20000.00
31.550	31.533	1.0005483	30.000	28.893	1.038	18750.23	20881.21	.90	20000.00
28.070	26.928	1.0424043	24.000	25.222	.952	9338.85	7928.49	1.18	22500.00
29.160	28.548	1.0214380	26.000	25.976	1.001	10861.22	11259.59	.96	22500.00
30.540	30.134	1.0134567	28.000	27.294	1.026	14081.48	15645.04	.90	22500.00
31.900	31.691	1.0066066	30.000	29.011	1.034	19582.91	21326.75	.92	22500.00
28.730	27.047	1.0622094	24.000	25.352	.947	9753.66	8063.26	1.21	25000.00
29.730	28.674	1.0368123	26.000	26.168	.994	11484.79	11458.53	1.00	25000.00
31.010	30.268	1.0245158	28.000	27.509	1.018	14950.01	15931.31	.94	25000.00
32.260	31.831	1.0134777	30.000	29.157	1.029	20512.67	21729.62	.94	25000.00

C38E

US	CUS	UFACT	DS	CDS	DFACT	STOR	CSTOR	SFACT	Q
17.026	17.410	.9779411	17.000	20.105	.846	6910.29	2846.08	2.43	3000.00
19.020	19.124	.9945436	19.000	20.540	.925	7738.45	4159.66	1.86	3000.00
21.019	20.811	1.0100073	21.000	21.091	.996	8920.85	5867.93	1.52	3000.00
23.016	22.472	1.0241952	23.000	21.900	1.050	10960.00	8039.11	1.36	3000.00
17.104	17.736	.9643640	17.000	19.588	.868	6923.33	3699.88	1.87	6000.00
19.081	19.482	.9793947	19.000	20.010	.950	7751.68	5475.65	1.42	6000.00
21.078	21.200	.9942261	21.000	20.549	1.022	8939.58	7812.53	1.14	6000.00
23.064	22.893	1.0074669	23.000	21.336	1.078	10983.64	10814.96	1.02	6000.00
17.232	17.917	.9617422	17.000	19.317	.880	6945.08	4288.35	1.62	9000.00
19.182	19.682	.9746085	19.000	19.733	.963	7773.83	6391.41	1.22	9000.00
21.174	21.417	.9886404	21.000	20.266	1.036	8970.98	9177.52	.98	9000.00
23.144	23.127	1.0007239	23.000	21.043	1.093	11023.12	12778.98	.86	9000.00
17.408	18.042	.9648358	17.000	19.143	.888	6976.13	4750.33	1.47	12000.00
19.321	19.819	.9748716	19.000	19.553	.972	7804.99	7114.60	1.10	12000.00
21.309	21.567	.9880526	21.000	20.084	1.046	9015.37	10261.27	.88	12000.00
23.255	23.289	.9985590	23.000	20.854	1.103	11078.59	14345.99	.77	12000.00
17.629	18.137	.9719724	17.000	19.021	.894	7016.20	5135.96	1.37	15000.00
19.498	19.923	.9786550	19.000	19.426	.978	7845.22	7720.85	1.02	15000.00
21.481	21.680	.9908164	21.000	19.958	1.052	9073.18	11173.33	.81	15000.00
23.395	23.411	.9993144	23.000	20.723	1.110	11150.29	15669.45	.71	15000.00
17.894	18.214	.9824514	17.000	18.933	.898	7065.41	5469.70	1.29	18000.00
19.711	20.007	.9852027	19.000	19.333	.983	7894.52	8247.31	.96	18000.00
21.689	21.771	.9962208	21.000	19.868	1.057	9144.94	11967.74	.76	18000.00
23.563	23.510	1.0022754	23.000	20.629	1.115	11238.54	16825.41	.67	18000.00
18.197	18.277	.9956088	17.000	18.868	.901	7123.84	5765.55	1.24	21000.00
19.957	20.077	.9940254	19.000	19.263	.986	7952.97	8715.26	.91	21000.00
21.935	21.847	1.0040122	21.000	19.804	1.060	9232.01	12675.65	.73	21000.00
23.758	23.592	1.0070515	23.000	20.561	1.119	11343.68	17857.84	.64	21000.00
18.535	18.332	1.0110864	17.000	18.822	.903	7191.59	6032.31	1.19	24000.00
20.234	20.137	1.0048256	19.000	19.212	.989	8020.62	9138.20	.88	24000.00
22.218	21.912	1.0139419	21.000	19.761	1.063	9336.37	13316.80	.70	24000.00
23.979	23.662	1.0133969	23.000	20.514	1.121	11466.31	18794.74	.61	24000.00
18.906	18.379	1.0286526	17.000	18.791	.905	7269.47	6275.94	1.16	27000.00
20.540	20.189	1.0173790	19.000	19.176	.991	8097.54	9525.25	.85	27000.00
22.528	21.969	1.0254255	21.000	19.734	1.064	9455.37	13904.63	.68	27000.00
24.226	23.723	1.0211831	23.000	20.483	1.123	11607.97	19655.16	.59	27000.00
19.304	18.422	1.0478993	17.000	18.772	.906	7357.99	6500.67	1.13	30000.00
20.873	20.236	1.0315028	19.000	19.151	.992	8183.73	9882.91	.83	30000.00
22.882	22.020	1.0391510	21.000	19.725	1.065	9601.94	14448.71	.66	30000.00
24.504	23.778	1.0305334	23.000	20.469	1.124	11775.68	20452.71	.58	30000.00

COMPUTER PROGRAMS DEVELOPED FOR THE OPERATIONAL WATER QUANTITY MODEL

by

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February 1976

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INTRODUCTION

As a result of increasing use of complex models for simulating the interactions within a water system and then utilizing the simulated results for developing planning policies, it is vitally important for the decision makers to clearly understand the computational steps involved in the simulation procedure. Since almost all model simulation procedures are carried out on high speed computers, the theoretical development of the simulation procedure (also called model) should accompany documentation of the computer programs used in the procedure. This is particularly beneficial when the developmental procedure is carried out by many investigators in cronological sequence. It is also common experience that the more complexities the model attempts to include, the more it depends on the rate coefficients, characteristic parameters and large set of input information. Although there has been increasing tendency to look at the model as a "black box" emphasizing the input-output values without getting into the internal computational steps of the model, it is not advisable to structure the planning policies based on this "black box" approach. To avoid a "garbage in-garbage out" situation, it is necessary to describe the computer programs for supplementing the theoretical and practical development procedure of the model.

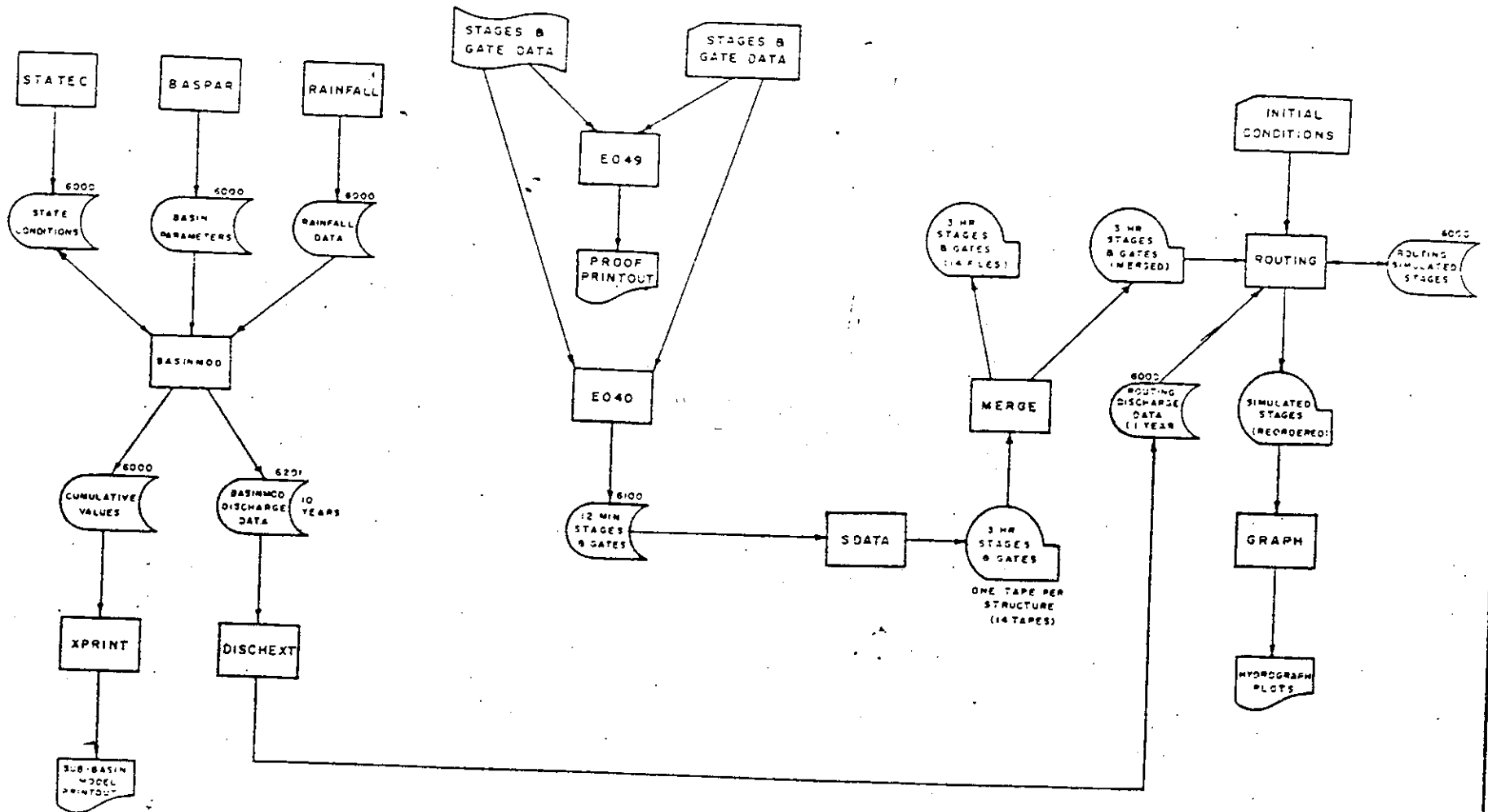
Another motivation of documenting the developed computer program is related to the increased efficiency for further refining and modifying the model within its capacity regarding what it can do and what it cannot do etc., etc. In other words, with careful study of the computer programs it is easier to decide whether a specific question can be answered by the model at other

similar locations. Conversely, it is very frustrating when a systems analyst or an engineer is given the task of making sense out of a complex computer program without any written program documentation. While developing some parts of the operational water quantity model and tieing together previously developed formulations with these parts, the authors have experienced the foregoing points. This has encouraged the authors to document all the ten computer programs encompassing the broad structure of the operational water quantity model as outlined in Figure 1.

PURPOSES

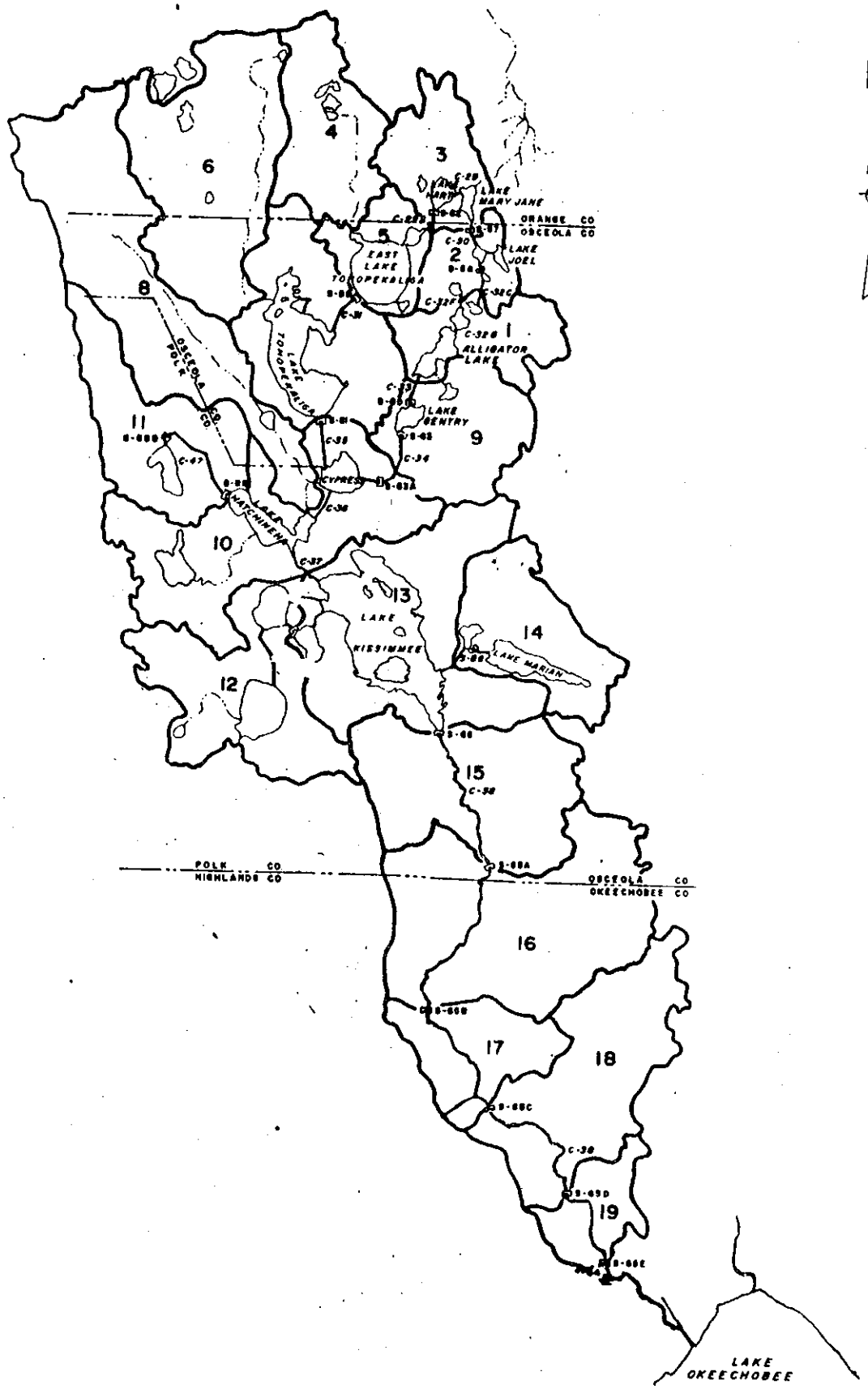
In addition to the previously mentioned rationale for attempting to document the computer programs, the following are specific purposes of documenting the recently developed computer programs for the 19 planning units of the Kissimmee River Basin (Figure 2).

1. To supplement the theoretical and practical development of the model described in a separate report (i.e., reference #8),
2. To present all the coefficients, constants and formulations as were actually used in the computations,
3. To provide the equipment description to run the program,
4. To explain in detail the manner in which input-output data and the program are written on cards, tapes and disks,
5. To present updated program listings for better understanding of the computer logic and computational sequence.
6. To present the system limitations of the program,
7. To give information on the total number of memory locations and the time used by the program. Such information can be useful in cases where any additions or modifications are warranted.



SYSTEM CHART OF THE OVERALL WATER QUANITY MODEL

FIGURE 1



MAP SHOWING APPROXIMATE LOCATION OF THE 19 PLANNING UNITS

FIGURE 2

8. To examine wide spectrums of variations of different parameters, coefficients and formulations either to refine the model output or to perform various sensitivity tests.
9. To become familiar with the operating instructions to request the programs to be run on the FCD computer facility (if required).
10. To present sequentially all pieces of the overall operational water quantity model as outlined in Figure 1.

A BRIEF DISCUSSION

It is to be noted that the development of the ten computer programs for bringing the FCD operational water quantity model to its current level occurred in three sequential steps. The initial efforts were made by Lindahl, Storch, Hamrick and Sinha during the period of 1967 to 1972 (1,2,3,4). As a result of their investigations, the sub-basin model was formulated and tested for the Taylor Creek basin. After obtaining adequate correlation between the simulated sub-basin output and the recorded discharges, the principles of the sub-basin model were applied to the 19 planning units of the Kissimmee River basin by Sinha, Hamrick, Khanal and Kiker (5,6). Several modifications were made at that point in time to the original program. Since the middle of 1974, the authors have been trying to complete the operational water quantity model by developing the routing model, by modifying the previously developed sub-basin model and tieing together the sub-basin model and routing model (7,8).

As can be seen from the ten program listings, the model has attempted to include real world complexities in light of several practical assumptions approximations and simplifications. Although great care is instituted to check the accuracies of all pieces of the model to every extent possible, it is advisable for the users (outside the FCD) to fully understand the various

rationale behind the FCD operational water quantity model before any attempts are made to apply or modify the model for other cases. Considering the nature and complicated procedure incorporated in the model, the FCD does not guarantee the workability of the model to other drainage basins. It is to be fully realized that the authors in their capacity are willing to extend their fullest cooperation for modifying or applying their methodology to suit a specific situation; however, the systems analyst in charge of developing a model for his own specific area is soley responsible for the outcome. In other words, although the model covers extensive aspects of watershed engineering, like any other problem it is not a cure for all problems. It is hoped that descriptions given in the following pages provide a balanced commentary about computerized steps of the operational water quantity model so that blind application of this methodology to any other areas can be avoided.

Effort was made to describe the computer programs in terms of program description, format of input cards, tapes and disk files, sample data, machine configuration, program limitations, operating instructions and program listing. It is to be noted that each program is stored in the FCD computer system by the name and number associated with it. For example, DISCHEXT program was given a number of E096; STATEC program was given a number of E091 etc.,etc. With this numbering system, it is possible to use the program by specifying the number on the requisition and by following the operating instructions for that program.

Since it is the first time the authors were able to piece together all the operational water quantity model for the Kissimmee River basin, there is indeed a need to critically examine the computer programs and theoretical development of the model by other professionals. Any constructive comments and suggestions are welcomed.

PROGRAM DESCRIPTION FOR THE STATEC PROGRAM (E091)

PROGRAM DESCRIPTION

This program is part of a system of programs (Figure 1) which deal with water quantity in the Kissimmee River Basin. The purpose of this program is to build a disk file of state conditions for each of 19 distinct planning units (Figure 2). The state conditions are a set of parameters which specify for a particular point in time water quantity conditions such as available storage in the soil (SA(1), SA(2), SA(3)), volume of water in surface depressions (VD), infiltration rate (FRI), and discharge rates for surface flow and runoff through various soil layers (END(1,1) ---------END(4,6)).

The disk file generated by this program is utilized by program BASINMOD (E094). BASINMOD uses these values as initial conditions and periodically updates this file to reflect conditions at some later point in time.

INPUT CARDS

1. Card 1

Columns 1-5	Number of planning units - right adjusted
Columns 6-80	Unused

2. Card 2

Among the values punched on this card, the value of day number requires some explanation. Since the program assumes 31 days for each month (totalling 372 days for the year), the value of day number lies between 0 and 371, day 0 being equivalent to December 31, 1 is Jan. 1 and 371 is Dec. 30. Depending upon the leap and non-leap year, there are 6 or 7 days that do not exist. This is important especially for choosing some intermediate day as a starting point. Furthermore, it is to be noted that the value of IT in this program has to match the

	value of ISDAY in BASINMOD program (E094).
Columns 1-3	Day number - right adjusted
* Columns 4-15	Unused
* Columns 16-24	Available storage in layer 1 in inches
* Columns 25-33	Available storage in layer 2 in inches
* Columns 34-42	Available storage in layer 3 in inches,
* Columns 43-47	Infiltration rate in inches per 12 minutes
* Columns 48-56	Volume in surface depressions in inches

* Value must include a decimal point.

3. Card 3 and 4	These two cards contain twenty-four routed discharges for planning unit 1.
**Columns 1-6	END(1,1): routed discharge value for the first reservoir of layer 1.
**Columns 7-12	END(2,1): routed discharge value for the first reservoir of layer 2.
**Columns 13-18	END(3,1): routed discharge value for the first reservoir of layer 3.
**Columns 19-24	END(4,1): routed discharge value for the first reservoir of overland flow; however, since the overland flow does not pass through a three layered soil system, it is not cascaded. Therefore, all the initial routed discharge values for overland flow are zero. i.e. END(4,1), END(4,2), END(4,3), END(4,4), END(4,5) and END(4,6) are all zero.
**Columns 25-48	END(1,2), END(2,2), END(3,2), END(4,2): Four routed discharges for four types of layers (as described above)from their <u>second</u> reservoir

**Columns 49-72	Four routed discharges for four types of layers from their <u>third</u> reservoir

Card 4

Columns 1-24	END(1,4), END(2,4), END(3,4), END(4,4): Four routed discharges for four types of layers from their <u>fourth</u> reservoir
Columns 25-48	END(1,5), END(2,5), END(3,5), END(4,5): Four routed discharges for four types of layers from their <u>fifth</u> reservoir
Columns 49-72	END(1,6), END(2,6), END(3,6), END(4,6): Four routed discharges for four types of layers from their <u>sixth</u> reservoir

4.	Cards 5-7	These three cards contain values for the above parameters for planning unit 2
5.	Cards 8-10	Values for planning unit 3
6.	Cards 11-13	Values for planning unit 4
7.	Cards 14-16	" " " " 5
8.	Cards 17-19	" " " " 6
9.	Cards 20-22	" " " " 7
10.	Cards 23-25	" " " " 8
11.	Cards 26-28	" " " " 9
12.	Cards 29-31	" " " " 10
13.	Cards 32-34	" " " " 11
14.	Cards 35-37	" " " " 12
15.	Cards 38-40	" " " " 13
16.	Cards 41-43	" " " " 14

17.	Cards 44-46	Values	for	planning	unit	15
18.	Cards 47-49	"	"	"	"	16
19.	Cards 50-52	"	"	"	"	17
20.	Cards 53-55	"	"	"	"	18
21.	Cards 56-58	"	"	"	"	19

Please note that cards 5-58 have the same format and same number of parameters that are described for card numbers 2, 3 and 4 for planning unit 1. This point can be seen from the sample data section.

FILE FORMAT

The STATEC program requires one disk file with the following details:

File Description: STATE CONDITIONS

Logical Unit: 22

Record Length: 59 words

Blocking factor: 2

Disk File Formats:

Each record of disk file 22 has the following format:

Word 1:	Day number from input card 2 (integer)
Words 2 and 3	Corresponds to SA(1)*,
Words 4 and 5	Corresponds to SA(2) (real)
Words 6 and 7	Corresponds to SA(3) (real)
Words 8 and 9	Corresponds to FR1 (real)
Words 10 and 11	Corresponds to VD (real)
Words 12 to 59	(total 48 words): corresponds to 24 routed discharges for one planning unit i.e. END(1,1) through END (4,6)*

It is to be noted that the program writes five records with exactly the same values of SA, FR1, VD and END for each planning unit. This duplication of the record is an initialization process which allows the BASINMOD program (E094) to save the updated state conditions for up to five selected days of the year.

The order of records in this file is as follows:

5 records for planning unit 1

5 " " " " 2

.

.

.

5 records for planning unit 19

MACHINE CONFIGURATION

The following equipment is required to run this program:

CDC 3100 computer (program requires 5K+ operating system).

1 405 ASCII card reader

2 854 Disk Drives (including the system disk)

1 line printer

PROGRAM LIMITATIONS

1. This program is designed to handle state conditions for the 19 planning units of the Kissimmee basin.

2. The state conditions that are read in are estimated for a three layer soil system and it is assumed that water movement through each layer occurs in six cascades.

OPERATING INSTRUCTIONS

Program Number: E091

Programmer: Paul Berger
Ashok N. Shahane

Purpose: To generate a disk file of state conditions to be used in sub-basin model for the Kissimmee River Basin.

DISK Required: 6000

Control Cards:

```
$JOB, 8430-305, E091, 2
$RONL, 854/6000
$FET, E091, STATEC, 960
$OPEN, 25
$FET, WATERPLN, STATE CONDITIONS, 512
$OPEN, 22
$LOAD, 25
$RUN
Insert card input here
```

Card Input: 1 card with total number of planning units punched in first five columns
57 cards (3 cards for each of the 19 planning units: first card has ten values, second and third cards have twelve values each)

Operating Instructions:
No input tape and no output tape, the generated disk-file is stored on disk 6000.

Error Stops: None

Timing: 2 minutes

```
                 00000000011111111112222222222333333333344444444445555555555666666666677777777778
                 12345678901234567890123456789012345678901234567890123456789012345678901234567890

CARD   1           19
CARD   2         0  3  5  7  9 0.        0.       4.846682 2.855 0.
CARD   3        .0012 .0012 .00234 0.   .0012 .0012 .00242 0.   .0012 .0012 .00248 0.    P.U. #1
CARD   4        .0012 .0012 .00250 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD   5         0  3  5  7  9 0.        0.       1.803683 .7154 0.
CARD   6        .0012 .0012 .00607 0.   .0012 .0012 .00613 0.   .0012 .0012 .00618 0.    P.U. #2
CARD   7        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD   8         0  3  5  7  9 0.        0.       1.226239 .4168 0.
CARD   9        .0012 .0012 .00454 0.   .0012 .0012 .00454 0.   .0012 .0012 .00454 0.    P.U. #3
CARD  10        .0012 .0012 .00456 0.   .0012 .0012 .00456 0.   .0012 .0012 .0012  0.
CARD  11         0  3  5  7  9 0.        0.       1.339978 .4720 0.
CARD  12        .0012 .0012 .00232 0.   .0012 .0012 .00233 0.   .0012 .0012 .00235 0.    P.U. #4
CARD  13        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  14         0  3  5  7  9 0.        0.       1.629825 .6208 0.
CARD  15        .0012 .0012 .00307 0.   .0012 .0012 .00311 0.   .0012 .0012 .00314 0.    P.U. #5
CARD  16        .0012 .0012 .00317 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD  17         0  3  5  7  9 0.        0.       1.535357 .5711 0.
CARD  18        .0012 .0012 .00284 0.   .0012 .0012 .00289.00001.0012 .0012 .00294.00007 P.U. #6
CARD  19        .0012 .0012 .00297 0.   .0012 .0012 .00296 0.   .0012 .0012 .0012  0.
CARD  20         0  3  5  7  9 0.        0.       1.683665 .6498 0.
CARD  21        .0012 .0012 .00294 0.   .0012 .0012 .00297 0.   .0012 .0012 .00300 0.    P.U. #7
CARD  22        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  23         0  3  5  7  9 0.0     0.000000 37.63458 5.005 0.0
CARD  24        0.0012.00975.000280.00000.0012.01029.000280.00000.0012.009470.00120.0000 P.U. #8
CARD  25        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  26         0  3  5  7  9 0.        0.       1.027431 .3255 0.
CARD  27        .0012 .0012 .00202 0.   .0012 .0012 .00204 0.   .0012 .0012 .00207 0.    P.U. #9
CARD  28        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  29         0  3  5  7  9 0.        0.       5.834111 3.702 0.
CARD  30        .0012 .0012 .00583 0.   .0012 .0012 .00576 0.   .0012 .0012 .0012  0.    P.U. #10
CARD  31        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  32         0  3  5  7  9 0.       0.000000 26.7560377.067 0.
CARD  33        .0012 .00902.00028 0.   .0012 .00998.00028 0.   .0012 .00992.0012  0.    P.U. #11
CARD  34        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  35         0  3  5  7  9 0.        0.       5.875636 3.739 0.
CARD  36        .0012 .0012 .00579 0.   .0012 .0012 .00572 0.   .0012 .0012 .0012  0.    P.U. #12
CARD  37        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  38         0  3  5  7  9 0.        0.       1.494655 .5500 0.
CARD  39        .0012 .0012 .00268 0.   .0012 .0012 .00271 0.   .0012 .0012 .0012  0.    P.U. #13
CARD  40        0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
```

SAMPLE DATA (continued)

```
                 00000000011111111112222222222333333333344444444445555555555666666666677777777778
                 12345678901234567890123456789012345678901234567890123456789012345678901234567890

CARD  41           0  3  5  7  9 0.        0.       1.300394 .4525 0.
CARD  42         .0012 .0012 .00400 0.   .0012 .0012 .00403 0.   .0012 .0012 .0012  0.      P.U. #14
CARD  43         0.00120.00120.00120.00000.00120.00120.00120.00000.00120.00120.00120.0000
CARD  44           0  3  5  7  9 0.        0.       1.180560 .3953 0.
CARD  45         .0012 .0012 .00282 0.   .0012 .0012 .00282 0.   .0012 .0012 .00283 0.      P.U. #15
CARD  46         .0012 .0012 .00282 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD  47           0  3  5  7  9 0.        0.       1.859370 .7466 0.
CARD  48         .0012 .0012 .00383 0.   .0012 .0012 .00391 0.   .0012 .0012 .0040  0.      P.U. #16
CARD  49         .0012 .0012 .00397 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD  50           0  3  5  7  9 0.        0.       1.973083 .8114 0.
CARD  51         .0012 .0012 .00336 0.   .0012 .0012 .00342 0.   .0012 .0012 .00347 0.      P.U. #17
CARD  52         .0012 .0012 .00349 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD  53           0  3  5  7  9 0.        0.       3.335825 1.692 0.
CARD  54         .0012 .0012 .00204 0.   .0012 .0012 .00213 0.   .0012 .0012 .00220 0.      P.U. #18
CARD  55         .0012 .0012 .00223 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
CARD  56           0  3  5  7  9 0.        0.       2.542978 1.158 0.
CARD  57         .0012 .0012 .00272 0.   .0012 .0012 .00278 0.   .0012 .0012 .00283 0.      P.U. #19
CARD  58         .0012 .0012 .00285 0.   .0012 .0012 .0012  0.   .0012 .0012 .0012  0.
```

PROGRAM LISTING

```
COSY V3.3      - MSOS V5.0     09/17/75
 STATEC    DECK/      I=01,L
        PROGRAM STATEC
        DIMENSION        SA(3), END(4,6), IA(59), IBUF(123)
        EQUIVALENCE (IT,IA(1)), (SA(1),IA(2)), (FR1,IA(8)), (VD,IA(10)),
       $(END,IA(12))
        READ (60,30) NSUB
        CALL FOPEN (IBUF,-22,59,2)
        DO 20 K=1,NSUB
        READ (60,40) IT,SA,FR1,VD,END
        DO 20 I=1,5
        IK = 5*(K-1)+I

        CALL FPUT (IBUF,IA,IK)
  20    CONTINUE
        CALL FCLOSE (IBUF)
        CALL EXIT
C
  30    FORMAT (I5)
  40    FORMAT I3,12X,3F9.0,F5.0,F9.0/12F6.0/12F6.0)
        END
```

PROGRAM DESCRIPTION FOR THE BASPAR PROGRAM (E092)

PROGRAM DESCRIPTION

This program is part of an overall water quantity model developed for the Kissimmee River system as shown in figure 1. The basic purpose of the program is to build a disk file of basin parameters for each of 19 planning units which are depicted in Figure 2. Essentially the basin parameters represent the agricultural - related water characterstics of the basins and are related to

a. Total available storage in three soil layers (i.e. TAS(1), TAS(2) and TAS(3)).

b. Constant rates of infiltration in three layered soil systems from one layer to another (designated as F(1), F(2) and F(3)).

c. Total amount of gravitational water (G) in these three layers (i.e. G(1), G(2) and G(3)).

d. Portion of G that can be drawn into surface water (i.e. GD(1), GD(2) and GD(3)).

e. Total depth of the soil profile (D) in inches.

f. Depth of water table at which evaporative water loss is considered significant (DWTM).

g. Maximum volume of surface storage (VDM).

h. Sub-surface discharges through three soil layers (Q(1), Q(2) and Q(3)).

i. Corresponding storages in three soil reservoirs (SG(1), SG(2) and SG(3)).

j. Routing coefficients to combine flows from three sub-surface layers with the overland flow (TK(1), TK(2), TK(3), TK(4)),

k. Number of cascades in layer i (CNR(i))

These parameters are estimated primarily from the available research publications of the Agricultural Research Service.

The disk file generated by this program is utilized by program BASINMOD (E094) as shown in Figure 1.

INPUT CARDS

1. Card 1

Columns	1-5	Number of planning units - right adjusted
Columns	6-80	Unused

2. Card 2

Columns	1-5	TAS(1)*	
Columns	6-10	F(1)	for planning unit 1
Columns	11-15	G(1)	for planning unit 1
Columns	16-20	GD(1)	for planning unit 1
Columns	21-25	Q(1)	for planning unit 1
Columns	26-30	TAS(2)	for planning unit 1
Columns	31-35	F(2)	for planning unit 1
Columns	36-40	G(2)	for planning unit 1
Columns	41-45	GD(2)	for planning unit 1
Columns	46-50	Q(2)	for planning unit 1
Columns	51-55	TAS(3)	for planning unit 1
Columns	56-60	F(3)	for planning unit 1
Columns	61-65	G(3)	for planning unit 1
Columns	66-70	GD(3)	for planning unit 1
Columns	71-75	Q(3)	for planning unit 1
Columns	76-80	D	for planning unit 1

3. Card 3

Columns	1-5	SG(1)	for planning unit 1
Columns	6-10	SG(2)	for planning unit 1
Columns	11-15	SG(3)	for planning unit 1
Columns	16-20	DWTM	for planning unit 1
Columns	21-25	VDM	for planning unit 1
Columns	26-30	CNR(1)	for planning unit 1
Columns	31-35	TK(1)	for planning unit 1
Columns	36-40	CNR(2)	for planning unit 1
Columns	41-45	TK(2)	for planning unit 1
Columns	46-50	CNR(3)	for planning unit 1
Columns	51-55	TK(3)	for planning unit 1
Columns	56-60	CNR(4)	for planning unit 1
Columns	61-65	TK(4)	for planning unit 1

* Notations are defined earlier.

4. Cards 4-5 These two cards contain values for the above parameters for planning unit 2.

5. Cards 6-7 Values for planning unit 3

6. Cards 8-9 Values for planning unit 4

7. Cards 10-11 Values for planning unit 5

8. Cards 12-13 Values for planning unit 6

9. Cards 14-15 Values for planning unit 7

10. Cards 16-17 Values for planning unit 8

11.	Cards 18-19	Values for planning unit 9
12.	Cards 20-21	Values for planning unit 10
13.	Cards 22-23	Values for planning unit 11
14.	Cards 24-25	Values for planning unit 12
15.	Cards 26-27	Values for planning unit 13
16.	Cards 28-29	Values for planning unit 14
17.	Cards 30-31	Values for planning unit 15
18.	Cards 32-33	Values for planning unit 16
19.	Cards 34-35	Values for planning unit 17
20.	Cards 36-37	Values for planning unit 18
21.	Cards 38-39	Values for planning unit 19

It is to be noted that the same format and same number of parameters that are described for card numbers 2 and 3 of planning unit 1 are valid for the other 18 planning units. This point can be further seen from the sample data section.

FILE FORMAT

The BASPAR program requires one disk file with the following details:

File description : BASIN PARAMETERS
Logical unit : 23
Record length : 58
Blocking Factor : 2

Disk File Formats (all parameters are double word real)

Words 1 and 2 corresponds to TAS(1)
Words 3 and 4 corresponds to TAS(2)
Words 5 and 6 corresponds to TAS(3)
Words 7 and 8 corresponds to F(1)
Words 9 and 10 corresponds to F(2)
Words 11 and 12 corresponds to F(3)
Words 13 and 14 corresponds to G(1)
Words 15 and 16 corresponds to G(2)
Words 17 and 18 corresponds to G(3)
Words 19 and 20 corresponds to GD(1)
Words 21 and 22 corresponds to GD(2)
Words 23 and 24 corresponds to GD(3)
Words 25 and 26 corresponds to Q(1)
Words 27 and 28 corresponds to Q(2)
Words 29 and 30 corresponds to Q(3)

Words 31 and 32 corresponds to SG(1)
Words 33 and 34 corresponds to SG(2)
Words 35 and 36 corresponds to SG(3)
Words 37 and 38 corresponds to D
Words 39 and 40 corresponds to DWTM
Words 41 and 42 corresponds to VDM
Words 43 and 44 corresponds to CNR(1)
Words 45 and 46 corresponds to CNR(2)
Words 47 and 48 corresponds to CNR(3)
Words 49 and 50 corresponds to CNR(4)
Words 51 and 52 corresponds to TK(1)
Words 53 and 54 corresponds to TK(2)
Words 55 and 56 corresponds to TK(3)
Words 57 and 58 corresponds to TK(4)

Next record with 58 words relates to the planning unit 2. Thus, there are 19 records (with 58 words in each record) for each of 19 planning units.

MACHINE CONFIGURATION

The following equipment is required to run this program.

CDC 3100 computer (program requires 5K plus the operating system)

1 405 ASCII card reader
2 854 disk drives (including the system disk)

PROGRAM LIMITATIONS

1. This program is based on the derived basin-parameters for the 19 planning units of the Kissimmee basin. The applicability of these parameters to the other water systems with no available data is limited.

2. Although basin-parameters are originally obtained for three layers soil system, the program considers the soil profile as a one layer and thus the basin-parameters are accordingly modified for one layer soil system.

PROGRAM E092

PROGRAMMER: Paul Berger
Ashok N. Shahane

PURPOSE: To generate a disk file of basin parameters to be used for the Kissimmee River Basin.

DISK: 6000

CONTROL CARDS:

```
$JOB,8430-305,E092,2,,,                    E092
$RONL,854/6000
$FET,E092,BASPAR,960
$OPEN,25
$FET,WATERPLN,BASIN PARAMETERS,512
$OPEN,23
$LOAD,25
$RUN
Insert card input here
```

CARD INPUT: 1 card with total number of planning units punched in first five columns. 38 cards (2 cards for each of the 19 planning units; First card has sixteen values and second card has thirteen values)

OPERATING INSTRUCTIONS: No input tape and no output tape, the generated disk file is stored on disk 6000.

ERROR STOPS: None

TIMING: 2 minutes.

PROGRAM LISTING

```
COSY V3.3      - MSOS V5.0     09/17/75
 BASPAR    DECK/      I=01,L
        PROGRAM BASPAR
        DIMENSION TAS(3), F(3), G(3), GD(3), Q(3), SG(3), CNR(4), TK(4)
        DIMENSION IBUF(121), IA(58)
        EQUIVALENCE (TAS(1),IA(1)), (F(1),IA(7)), (G(1),IA(13)), (GD(1),IA
       $(19)), (Q(1),IA(25)), (SG(1),IA(31)), (D,IA(37)), (DWTM,IA(39)),
       $(VDM,IA(41)), (CNR(1),IA(43)), (TK(1),IA(51))
        READ (60,20) NSUB
        CALL FOPEN (IBUF,-23,58,2)
        DO 10 K=1,NSUB
        READ (60,30) (TAS(I),F(I),G(I),GD(I),Q(I),I=1,3),D
        READ (60,30) SG,DWTM,VDM,(CNR(I),TK(I),I=1,4)
        CALL FPUT (IBUF,IA,K)
  10    CONTINUE
        CALL FCLOSE (IBUF)
        CALL EXIT
 C
  20    FORMAT (I5)
  30    FORMAT (16F5.0)
        END
```

SAMPLE DATA

```
                 00000000011111111112222222222333333333344444444445555555555666666666677777777778
                 12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD   1           19
CARD   2         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 20.8 .0003 8.1  6.48.016 48.0  P.U
CARD   3         0.0  0.0 5.35 27.00.20 0.0   0.0  0.0  0.0  4.0 50.0  2.0 25.0
CARD   4         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 22.5 .0003 8.3  5.8 .012 42.0  P.U
CARD   5         0.0  0.0  5.8 27.00.15 0.0   0.0  0.0  0.0  3.0 45.0  3.0 13.0
CARD   6         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 18.5 0000. 6.8  5.5 .021846.0  P.U
CARD   7         0.0  0.0  5.5 27.00.15 0.0   0.0  0.0  0.0  5.0 27.0  3.0 14.0
CARD   8         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 18.6 .0005 7.2  5.1 .012 42.0  P.U
CARD   9         0.0  0.0  5.1 27.00.15 0.0   0.0  0.0  0.0  3.0 40.0  3.0 13.0
CARD  10         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 21.5 0.00  7.8  5.2 .014540.0  P.U
CARD  11         0.0  0.0  5.2 27.00.10 0.0   0.0  0.0  0.0  4.0 30.0  3.0 15.0
CARD  12         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 22.0 0.001 9.0  7.5 .01  50.0  P.U
CARD  13         0.0  0.0  7.5 30.00.20 0.0   0.0  0.0  0.0  5.0 50.0  3.0 30.0
CARD  14         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 19.5 0.0   7.8  4.9 .01  41.0  P.U
CARD  15         0.0  0.0  5.2 27.00.10 0.0   0.0  0.0  0.0  3.0 54.0  3.0 15.0
CARD  16         0.0  0.0  0.0  0.0  0.0 0.0  .0000 0.0  0.0 .008439.4 0.00121.8 12.9 .001862.0  P.U
CARD  17         0.0  0.0 12.9 30.00.15 0.0   0.0  3.0 100.0 2.0 360.0 4.0 24.0
CARD  18         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 14.8 0.0   5.0  4.0 .017940.0  P.U
CARD  19         0.0  0.0  4.0 27.00.1250.0   0.0  0.0   0.0 3.0 44.0  4.0 14.0
CARD  20         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 37.0 0.00127.0 20.6 .025 57.0  P.U
CARD  21         0.0  0.0 20.6 30.00.10 0.0   0.0  0.0   0.0 2.0 144.0 3.0 30.0
CARD  22         0.0  0.0  0.0  0.0  0.0 00.0  .000 0.0  0.0 .00  29.5 .001 20.0 15.0 .002 60.0  P.U
CARD  23         0.0  0.0 15.0 30.00.30 0.0   0.0  3.0  95.0 2.0 390.0 4.0 23.0
CARD  24         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 37.0 .001 27.0 20.6 .025 57.0  P.U
CARD  25         0.0 00.0 20.6 30.00.10  0.0   0.0  0.0  0.0  2.0 144.0 3.0 30.0
CARD  26         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 23.0 .0005 9.1  7.1 .004 52.0  P.U
CARD  27         0.0  0.0  7.1 27.00.25  0.0   0.0  0.0  0.0  2.0 080.0 3.0 14.0
CARD  28         0.0  0.0  0.0  0.0  0.0 0.0   0.0  0.0  0.0  0.0 23.0 .0005 9.1  7.1 .004 52.0  P.U
CARD  29         0.0  0.0  7.1 27.00.25  0.0   0.0  0.0  0.0  2.0  80.0 3.0 14.0
CARD  30          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  24. .0005  9.   7.2 .01  50.  P.U
CARD  31          0.   0.   7.2 27.    .2  0.   0.   0.   0.   4.  55.  2.   14.
CARD  32          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  24. .0005  9.   7.2 .01  50.  P.U
CARD  33          0.   0.   7.2 27.    .2  0.   0.   0.   0.   4.  55.  2.   14.
CARD  34          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  24. .0005  9.   7.2 .01  50.  P.U
CARD  35          0.   0.   7.2 27.    .2  0.   0.   0.   0.   4.  55.  2.   14.
CARD  36          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  24. .0005  9.   7.2 .01  50.  P.U
CARD  37          0.   0.   7.2 27.    .2  0.   0.   0.   0.   4.  55.  2.   14.
CARD  38          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  24. .0005  9.   7.2 .01  50.  P.U
CARD  39          0.   0.   7.2 27.    .2  0.   0.   0.   0.   4.  55.  2.   14.
```

PROGRAM DESCRIPTION FOR THE RAINFALL PROGRAM (E093)

PROGRAM DESCRIPTION

The relative position of the rainfall program in the overall water quantity model is depicted in Figure 1. The main purposes of the program are:

1. To convert daily values of rainfall for a one year period to the hourly values using the appropriate probability theory, and

2. To generate a disk file of rainfall at every 12 minutes for each of the 19 planning units of the Kissimmee basin as shown in Figure 2.

The computational procedure first deals with the processing of the "read in" daily rainfall values in terms of their amounts and persistency classes. The corresponding regression coefficients and random numbers are then used to convert daily values into the hourly values. These hourly values are stored in the disk file which is subseqently utilized by the program BASINMOD (E094).

MACHINE CONFIGURATION

The following equipment is required to run the program:

1. CDC 3100 computer (program requires 8 K plus the operating system).
   1 405 ASCII card reader
   2 854 disk drives (including the system disk)
   1 line printer

PROGRAM LIMITATIONS

1. This program is largely geared to the conditional probabilities which are estimated using four persistency classes and ten rainfall amount classifications as reported in reference No. 14.

2. Regression cofficients that are used in the stochastic rainfall synthesis are derived by analyzing 18 years historical hourly rainfall data recorded at Kissimmee II raingaging station.

3. The stochastic methodology of decomposing the daily values into hourly values uses gaussian distribution for generating random numbers and the program is designed to decompose daily rainfall values to hourly values only.

INPUT CARDS

1. Card 1

Columns	1-5	IX	Number used in generating random number - right adjusted.
Columns	6-10	IST	Number of planning units to be processed- right adjusted.
Columns	11-15	IYR	Year of rainfall data - 4 digits - right adjusted.
Columns	16-79		Unused
Columns	80	IBUG	An identifier (with a value of either one or blank) to print-out intermediate results (if required).

2. Card 2 — There are 16 values of conditional probabilities with five columns allocated for each value (values must contain a decimal point).

3. Cards 3-60 — These cards have the remaining (960-16) values of conditional probabilities with exactly the same format as Card 2.

   * It is to be noted that the first 24 values are hourly probabilities for persistence of Class 1 and for rainfall amount classification 1; next 24 values represent hourly probabilities for persistence Class 1 and for rainfall classification 2 and so on. Thus, the first 240 values are hourly probabilities for the first persistence class and for ten rainfall amount classifications. Similarly, 240 values for each of the next three persistence classes are read in making total values to 960. For a more detailed explanation of persistency class and rainfall amount classification, the reader is advised to refer to reference No. 14.

4. Card 61 — This card has 20 values of daily rainfall with 4 columns for each value (values must contain a decimal point). The values correspond to dates Jan. 1 to Jan. 20.

5. Cards 62-79 — These cards contain daily values of rainfall from January 21 to December 31 totaling 346 values. These values have the same format as the values on Card 61. Please note that the values on cards 61-79 have daily rainfall values for planning unit 1.

6. Cards 80-98 — Daily rainfall values for planning unit 2

7. Cards 99-117 — Daily rainfall values for planning unit 3

8. Cards 118-136 — Daily rainfall values for planning unit 4

9. Cards 137-155 — Daily rainfall values for planning unit 5

10. Cards 156-174 — Daily rainfall values for planning unit 6

11. Cards 175-193 — Daily rainfall values for planning unit 7

12.	Cards 194-212	Daily rainfall values for planning unit 8
13.	Cards 213-231	Daily rainfall values for planning unit 9
14.	Cards 232-250	Daily rainfall values for planning unit 10
15.	Cards 251-269	Daily rainfall values for planning unit 11
16.	Cards 270-288	Daily rainfall values for planning unit 12
17.	Cards 289-307	Daily rainfall values for planning unit 13
18.	Cards 308-326	Daily rainfall values for planning unit 14
19.	Cards 327-345	Daily rainfall values for planning unit 15
20.	Cards 346-364	Daily rainfall values for planning unit 16
21.	Cards 365-383	Daily rainfall values for planning unit 17
22.	Cards 384-402	Daily rainfall values for planning unit 18
23.	Cards 403-421	Daily rainfall values for planning unit 19

FILE FORMAT

Each record of disk file 21 has 24 words with each word representing an integer value of hourly rainfall in inches scaled up by 10^4. There are 366 records per sub-basin (one record per day) totalling 6,954 records for 19 planning units.

The order of records is as follows:

Hourly rainfall record per day 1 for sub-basin 1

Hourly " " " " 2 " " 1

" " " " " 3 " " 1

- -

Hourly rainfall value of day 366 for sub-basin 1

Hourly rainfall value of day 1 for sub-basin 2

- -

Hourly rainfall value of day 366 for sub-basin 2

Order is continued likewise for all the 19 planning units.

Records are located on disk according to the following formula:
Record number = 366 (planning unit 1) + Day Number
where planning unit = 1 to 19
day number = 1 to 366.

SAMPLE DATA
(960 values of conditional probabilities)

101 19 1970

.006	.022	.038	.064	.073	.089	.115	.147	.173	.205	.264	.333	.382	.460	.515	.60
.698	.786	.841	.900	.929	.952	.965	1.000	.005	.006	.007	.008	.010	.020	.050	.08
.125	.170	.205	.261	.296	.367	.443	.539	.666	.737	.798	.854	.894	.934	.974	1.00
.0	.0	.030	.060	.090	.112	.149	.171	.208	.275	.335	.402	.469	.521	.603	.68
.745	.820	.872	.932	.962	.984	1.000	1.000	.0	.008	.016	.033	.050	.067	.084	.10
.127	.161	.187	.213	.265	.360	.499	.612	.707	.785	.832	.875	.909	.952	.978	1.00
.010	.030	.031	.033	.035	.037	.039	.040	.050	.060	.070	.151	.202	.283	.344	.43
.537	.669	.781	.893	.944	.974	.984	1.000	.025	.046	.067	.088	.100	.125	.159	.18
.201	.222	.256	.367	.363	.423	.503	.604	.686	.785	.845	.896	.921	.959	.980	1.00
.0	.0	.0	.007	.028	.056	.077	.105	.140	.175	.210	.267	.331	.388	.452	.53
.617	.696	.775	.845	.896	.931	.959	1.000	.005	.015	.025	.041	.068	.095	.132	.16
.201	.244	.287	.351	.432	.507	.571	.630	.705	.775	.829	.888	.920	.947	.963	1.00
.012	.035	.072	.108	.144	.180	.228	.264	.312	.348	.384	.420	.444	.468	.504	.57
.637	.697	.770	.818	.866	.902	.938	1.000	.015	.044	.085	.124	.139	.154	.177	.21
.237	.276	.307	.354	.401	.464	.527	.590	.669	.748	.803	.858	.889	.928	.959	1.00
.079	.142	.193	.244	.258	.269	.288	.339	.410	.485	.515	.598	.638	.697	.760	.79
.838	.876	.906	.936	.976	.983	.997	1.000	.057	.121	.172	.223	.242	.254	.273	.31
.349	.425	.476	.508	.552	.616	.686	.762	.819	.889	.921	.940	.959	.978	1.000	1.00
.021	.042	.078	.099	.113	.134	.170	.206	.213	.249	.300	.351	.409	.481	.561	.63
.727	.807	.858	.887	.938	.981	1.000	1.000	.051	.102	.147	.179	.211	.243	.281	.30
.318	.343	.388	.420	.484	.561	.619	.702	.785	.843	.875	.907	.939	.964	.970	1.00
.021	.056	.099	.142	.170	.191	.205	.240	.268	.303	.324	.359	.423	.487	.587	.65
.754	.818	.882	.910	.938	.966	.987	1.000	.040	.080	.126	.152	.185	.211	.231	.27
.297	.323	.356	.402	.442	.488	.561	.674	.767	.833	.879	.912	.952	.978	.984	1.000
.034	.047	.060	.080	.100	.127	.140	.167	.194	.228	.276	.324	.407	.504	.566	.65
.746	.815	.877	.911	.931	.958	.971	1.000	.022	.048	.070	.100	.130	.169	.204	.24
.296	.335	.374	.426	.492	.553	.632	.711	.777	.843	.900	.948	.961	.969	.982	1.000
.037	.074	.092	.110	.147	.184	.221	.258	.295	.332	.369	.424	.498	.590	.682	.79
.867	.922	.940	.960	.977	1.000	1.0	1.0	.048	.096	.152	.216	.280	.328	.360	.39
.432	.472	.512	.552	.608	.664	.728	.792	.848	.880	.896	.920	.936	.960	.984	1.000
.004	.009	.013	.014	.015	.017	.026	.040	.058	.081	.095	.113	.159	.220	.295	.360
.453	.589	.682	.766	.822	.868	.910	1.0	.012	.031	.034	.037	.043	.075	.087	.112
.131	.143	.162	.194	.219	.283	.366	.482	.552	.610	.661	.744	.821	.891	.942	1.000
.007	.022	.037	.044	.051	.055	.058	.065	.080	.095	.125	.170	.231	.292	.353	.421
.504	.641	.717	.785	.861	.906	.959	1.000	.0	.018	.036	.054	.057	.060	.063	.081
.090	.103	.117	.153	.198	.243	.315	.414	.513	.585	.657	.747	.828	.873	.936	1.0
.0	.0	.0	.0	.0	.0	.012	.024	.030	.036	.048	.097	.158	.256	.367	.441
.564	.699	.760	.809	.833	.894	.943	1.0	.004	.008	.010	.012	.016	.030	.044	.058
.077	.111	.150	.219	.283	.362	.442	.531	.605	.674	.743	.822	.906	.955	.990	1.0
.0	.007	.014	.028	.049	.070	.091	.119	.162	.212	.240	.283	.319	.391	.466	.542
.621	.715	.794	.851	.887	.930	.966	1.000	.006	.012	.024	.036	.048	.060	.085	.110
.141	.178	.203	.247	.278	.353	.434	.515	.603	.684	.772	.847	.909	.959	.980	1.0
.021	.042	.063	.084	.105	.115	.125	.146	.167	.188	.209	.230	.251	.294	.359	.456
.564	.640	.748	.813	.834	.888	.931	1.0	.017	.034	.051	.077	.111	.145	.179	.213
.247	.290	.342	.482	.490	.540	.609	.678	.738	.781	.841	.884	.910	.944	.970	1.0
.037	.058	.074	.084	.087	.090	.094	.131	.168	.216	.264	.328	.392	.456	.531	.617
.692	.761	.841	.921	.937	.947	.957	1.0	.005	.010	.015	.026	.031	.048	.077	.118
.171	.188	.217	.270	.317	.382	.477	.578	.655	.780	.869	.928	.963	.968	.973	1.000
.018	.045	.072	.081	.090	.099	.104	.108	.135	.162	.180	.207	.243	.306	.396	.477
.567	.703	.812	.866	.893	.920	.956	1.0	.043	.074	.105	.136	.167	.204	.235	.260
.272	.290	.308	.345	.376	.432	.519	.600	.662	.749	.811	.861	.949	.976	.985	1.0
.011	.022	.025	.028	.031	.033	.044	.055	.066	.077	.111	.156	.190	.258	.348	.450
.597	.733	.835	.903	.937	.971	.982	1.0	.021	.037	.053	.069	.079	.095	.111	.127
.148	.180	.206	.270	.334	.414	.489	.558	.633	.697	.766	.846	.883	.926	.963	1.000
.025	.050	.068	.086	.111	.123	.141	.159	.184	.215	.252	.308	.364	.401	.470	.571
.665	.785	.848	.885	.922	.953	.965	1.0	.016	.037	.047	.057	.062	.067	.072	.088
.104	.125	.141	.173	.227	.303	.390	.494	.598	.713	.789	.843	.886	.918	.945	1.0
.021	.056	.084	.112	.133	.154	.189	.217	.259	.294	.315	.343	.364	.399	.434	.511

Sample Data (continued)

Daily rainfall values for two illustrative planning units

```
0.050.800.120.000.000.500.600.000.000.000.000.000.000.000.500.500.000.000.
0.000.000.000.000.000.000.000.000.000.000.000.001.900.150.050.000.000.000.
0.000.000.000.000.000.000.500.000.000.000.000.000.000.000.000.000.250.000.
0.000.000.000.530.550.000.000.000.001.100.000.000.000.000.000.000.000.000.
0.100.000.001.000.700.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.300.000.000.000.000.000.000.000.000.000.000.500.100.000.000.000.000.
0.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.000.040.070.000.000.001.001.100.000.000.000.000.000.000.600.000.000.
0.000.000.000.000.000.000.000.000.000.000.000.001.201.000.001.000.501.201.
0.000.000.000.000.000.000.000.000.000.001.000.500.501.350.000.000.000.000.
0.000.000.000.500.000.000.000.000.000.000.000.000.000.000.001.320.000.000.
0.000.000.000.000.000.000.000.600.000.000.000.000.000.000.100.000.000.000.
0.000.000.000.000.000.000.000.330.000.000.000.100.000.000.000.900.000.000.
0.000.000.000.000.000.000.000.320.000.350.000.450.000.001.100.000.000.000.
0.550.000.500.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.000.000.000.000.000.000.100.000.000.000.000.000.000.000.000.000.000.
0.000.000.000.000.000.000.000.000.000.000.300.000.000.000.000.000.000.000.
0.000.000.000.000.760.00
0.050.201.590.000.001.540.000.000.000.000.000.000.000.000.500.120.000.000.
0.000.000.000.000.000.000.050.000.000.000.000.001.363.550.000.000.110.090.
0.000.000.000.000.000.070.950.220.000.000.000.000.000.000.230.000.000.000.
0.000.000.001.000.000.330.270.000.000.940.000.010.000.000.000.000.000.000.
0.060.000.000.400.550.020.000.000.000.000.000.000.470.000.040.060.000.000.
0.000.050.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.000.001.200.200.000.001.760.980.000.000.250.000.000.730.000.000.520.
0.000.000.000.000.390.000.000.020.000.000.000.000.000.090.091.000.180.081.
0.000.000.000.010.000.360.000.000.310.000.120.001.550.360.520.170.000.000.
0.160.520.400.040.000.000.000.001.070.000.000.000.000.000.000.001.300.000.
0.000.240.000.430.810.000.000.000.100.240.000.000.540.000.320.000.000.211.
0.000.000.000.000.000.011.010.000.000.000.000.000.310.000.000.200.010.200.
0.000.000.000.070.000.000.360.790.000.000.140.100.000.000.000.000.000.000.
0.010.070.500.000.000.000.000.010.000.000.000.130.371.540.000.000.000.000.
0.330.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.000.
0.000.000.000.000.000.000.070.000.000.000.000.000.000.000.000.000.040.130.
0.000.000.000.000.000.000.000.000.000.380.000.000.000.000.000.000.000.000.
0.000.000.020.000.900.00
```

PROGRAM E093

PROGRAMMER: Paul Berger
Ashok N. Shahane

PURPOSE: To generate a disk file of hourly rainfall for 19 planning units of the Kissimmee basin to be used in the subsequent sub-basin model (E094).

DISK: 6000

CONTROL CARDS:

```
$JOB, 8430-305, E093, 20
$RONL, 854/6000
$FET, E093, RAINFALL, 960
$OPEN, 3
$FET, WATERPLN, RAINFALL DATA, 1024
$OPEN, 21
$FET, RLS, AUX
$OPEN, 35, I
$AUX, 35
$LOAD, 3, M
$RUN
Insert card input here
```

CARD INPUT:

1 card with four values of IX, IST, IYR, IBUG (IBUG optional)
60 cards with 16 additional probabilities per card totalling 960 values
361 cards - every card has 20 values of daily rainfall, i.e., first 19 cards have 365 daily values of rainfall for a specific planning unit. Thus for 19 planning units there are 361 cards with daily values for a one year period.

OPERATING INSTRUCTIONS: No input tape and no output tape, the generated disk file is stored on disk 6000. Aux. library to use subroutine RANDU and GAUSS.

ERROR STOPS: Any error generates an appropriate message and the program terminates.

TIMING: 20 minutes to process one year data for 19 planning units.

```
      PROGRAM RAINFALL
C GLOSSARY OF SYMBOLS
C
C   FREQ...HISTORICAL RAINFALL FREQUENCY DATA FOR 24 HOURS, 10 RAINFALL
C          AMOUNT CLASSIFICATIONS, AND 4 PERSISTENCY CLASSES.
C   HREAL..COMPUTED HOURLY RAINFALL
C   IREAL..COMPUTED HOURLY RAINFALL * 10000
C   J......RAINFALL PERSISTENCY CLASS
C   K......RAINFALL AMOUNT CLASS
C   REALL..DAILY RAINFALL VALUES
C   SUM....SUM OF COMPUTED HOURLY RAINFALL FOR ONE DAY
C
      DIMENSION FREQ(960), DST(10), REALL(367), C1(10), C2(10), HREAL(2
     $)
      DIMENSION C3(10), IREAL(24), IMO(12), IDATA(20,24)
      DIMENSION NBUF(245)
      DATA ((IMO(I),I=1,12)=31,28,31,30,31,30,31,31,30,31,30,31)
      DATA ((DST(I),I=1,10)=0.1,0.2,0.3,0.4,0.5,0.75,1.0,1.5,2.0,9.0)
      DATA ((C1(I),I=1,10)=.0264,.0486,.0667,.0803,.1177,.1255,.1465,.
     $1682,.2005,.2489)
      DATA ((C2(I),I=1,10)=-.2820,-.2648,-.1938,-.2139,-.2340,-.0940,-.
     $0701,-.0318,-.0647,.1619)
      DATA ((C3(I),I=1,10)=.0256,.0673,.0679,.0964,.1163,.1554,.1923,.
     $2431,.3053,.4922)
      READ (60,300) IX,IST,IYR,IBUG
      IF (IYR-IYR/4*4) 20,10,20
10    NDAY = 366+1
      IMO(2) = 29
      GO TO 30
20    NDAY = 365+1
30    READ (60,310) (FREQ(L),L=1,960)
      CALL FOPEN(NBUF,21,24,10)
      DO 280 JKL=1,IST
      WRITE (61,320) JKL
      REALL(1) = 0.00
      READ (60,330) (REALL(IDAY),IDAY=2,NDAY)
      DO 270 IDAY=2,NDAY
      SUM = 0.0
      IF (REALL(IDAY)) 290,40,60
40    DO 50 LBC=2,25
50    HREAL(LBC) = 0.00
60    DO 70 K=1,10
      IF (REALL(IDAY)-DST(K)) 80,80,70
70    CONTINUE
      K = 10
80    IF (REALL(IDAY-1)) 90,90,120
90    IF (REALL(IDAY+1)) 100,100,110
100   J = 1
      GO TO 150
110   J = 3
      GO TO 150
120   IF (REALL(IDAY+1)) 130,130,140
130   J = 2
      GO TO 150
140   J = 4
150   CALL RANDU (IX,IY,GFREQ)
      IX = IY
      DO 160 JHR=1,25
160   HREAL(JHR) = 0.0
      L = (J-1)*240+(K-1)*24-1
```

```
      DO 170 IHR=2,25
      M = L+IHR
      IF (GFREQ-FREQ(M)) 180,180,170
170   CONTINUE
      IHR = 25
180   DO 210 JHR=IHR,25
      CALL GAUSS (IX,1.0,0.0,YFL)
      HRFAL(JHR) = C1(K)+C2(K)*HRFAL(JHR-1)+YFL*C3(K)*0.50+0.005
      IF (HRFAL(JHR)) 190,200,200
190   HRFAL(JHR) = 0.00
200   SUM = SUM+HRFAL(JHR)
      IF (SUM-RFALL(IDAY)) 210,230,220
210   CONTINUE
      JHR = 25
      HRFAL(JHR) = HRFAL(JHR)+(RFALL(IDAY)-SUM)
      SUM = RFALL(IDAY)
      GO TO 230
220   HRFAL(JHR) = HRFAL(JHR)-(SUM-RFALL(IDAY))
      SUM = RFALL(IDAY)
230   IF (SUM-0.0) 250,250,240
240   IF (IBUG.NE.1) GO TO 250
      WRITE (61,340) IDAY,(HRFAL(IHR),IHR=2,25),SUM,RFALL(IDAY)
250   DO 260 IHR=2,25
      IRFAL(IHR-1) = HRFAL(IHR)*10000.0
260   CONTINUE
      CALL FPUT (NBUF,IRFAL,366*(JKL-1)+IDAY-1)
270   CONTINUE
      CALL FCLOSE (NBUF)
280   CONTINUE
      CALL EXIT
290   WRITE (61,350) JKL,(RFALL(I),I=2,NDAY)
      CALL EXIT
C
300   FORMAT (3I5,64X,I1)
310   FORMAT (16F5.4)
320   FORMAT (1H1,7HBASIN =,I3)
330   FORMAT (20F4.3)
340   FORMAT (2X,I4,2X,24F4.2,2X,F5.2,2X,F5.2)
350   FORMAT (34HNEGATIVE RAINFALL VALUE FOR BASIN,I3//(1X,20F5.3))
      END
```

PROGRAM DESCRIPTION FOR THE BASINMOD PROGRAM (E094)

PROGRAM DESCRIPTION

This program is the heart of the sub-basin model where most of the hydrologic computations are performed for 19 planning units of the Kissimmee River basin. The relative position of the program is depicted in Figure 1. Figure 2 shows 19 planning units considered in the program.

The purpose of this program is to simulate hydrologic components such as surface flows, subsurface flows, evaporative losses, storages in soils, depression storages and watershed streamflows for each of the 19 planning units using rainfall, state conditions and basin parameters as input.

The main program uses only one subroutine GIEP which computes the growth index and pan evaporation using the developed trigonometric functions.

The output of the program is stored on two disks. As shown in Figure 1, the disk 6000 stores cumulative values of generated hydrologic components which are used subsequently to obtain printouts. The disk 6201 stores only streamflows generated by the program and these streamflows are subsequently used in the routing program.

INPUT CARDS

1. Card 1

Columns	1-4	IYR	(simulation year)
Columns	5-79		Unused
Column	80	IBUG	(with value of either 1 or blank) to print the intermediate results (if required).

2. Card 2 (Values must contain a decimal point).

Columns	1-8	Area of planning unit 1 in sq. miles.
Columns	9-16	" " " " 2 in sq. miles.
Columns	17-24	" " " " 3 " " "
Columns	25-32	" " " " 4 " " "
Columns	33-40	" " " " 5 " " "
Columns	41-48	" " " " 6 " " "
Columns	49-56	" " " " 7 " " "
Columns	57-64	" " " " 8 " " "
Columns	65-72	" " " " 9 " " "
Columns	73-80	" " " " 10 " " "

3. Card 3 (Values must contain a decimal point).

Columns	1-8	Area of planning unit 11 in sq. miles.
Columns	9-16	" " " " 12 " " "
Columns	17-24	" " " " 13 " " "
Columns	25-32	" " " " 14 " " "
Columns	33-40	" " " " 15 " " "
Columns	41-48	" " " " 16 " " "
Columns	49-56	" " " " 17 " " "
Columns	57-64	" " " " 18 " " "
Columns	65-72	" " " " 19 " " "

4. Card 4 (All values are right adjusted)

Columns	1-4	ISAV(1) = 1
Columns	5-8	ISAVC(2)* = 90
Columns	9-12	ISAV(3)* = 182
Columns	13-16	ISAV(4)* = 274
Columns	17-20	ISAV(5)* = 365

*Five days for which state conditions are saved and printed as an intermediate output.

Columns	21-24	ISDAY: Day number corresponding to day numbers of saved state conditions from a previous run of E094, or from the initial generation run of program E091. When state conditions are from an E091 run, this parameter should = 0.
Columns	25-28	NOD: Number of days for which simulation is to be performed (normally = 372, one year assuming 31 days per month).

Columns	29-32	NSUB: Sub-basin (or planning unit number) 1 to 19
Columns	33-36	IDAY: Starting day number of simulation based on a 372 day year (31 days per month), normally = 1.
Columns	37-40	LDAY: Ending day number of simulation based on a 372 day year (31 days per month), normally = 372.

One card type 4 must be present for each planning unit to be processed.

The last card type 4 must be followed by a blank card.

FILE FORMAT

The BASINMOD program requires three input disk files (i.e., state conditions, basin parameters and rainfall) which are described in the documentations for E091, E092 and E093. It is to be noted that among these three disk files, only the state conditions file is updated in this program.

The program generates the following two disk files to store the output:

First Disk File:

File description:	Cumulative values
Logical Unit:	24
Record Length:	20 words
Blocking factor:	12

Disk File Format:
Each record of disk file 24 has the following format:

Word 1:	Cumulative daily rainfall in inches (NPR) - integer x100,
Word 2 and 3:	Cumulative daily value of water recovered from soil reservoirs (FQ1) - real,
Word 4 and 5:	Cumulative daily value of water in overland reservoir (FQ2) - real,
Word 6 and 7:	Cumulative daily value of evaporation loss (TLOS1),
Word 8 and 9:	Cumulative daily value of transpiration loss (TLOS2)- real,
Word 10 and 11:	Currently available storage at the end of the day (SA5) - real,
Word 12 and 13:	Cumulative daily value of deep percolation loss (TFC) - real,
Word 14 and 15:	Depth of water in surface depression (VDDD) - real,
Word 16:	Sub-basin number - Integer,
Word 17:	Day number (MP) - integer,
Word 18 and 19:	Cumulative daily values of discharges in inches (QFINCH)
Word 20:	Year of simulation - integer.

Record Number = NOD X(NSUB-1) + day number

Where NOD = total number of days from input card #4
NSUB = sub-basin number
day number = 1 to 366

Second Disk File:

File Description: DISCHARGE DATA
Logical Unit: 20
Record Length: 20 words
Blocking Factor: 12

Disk File Format:

Word 1:	Month number (IMO) - integer,
Word 2:	Day number (IDY) - integer,
Word 3:	Last 2 digits of simulation year (year-1900) - integer,
Word 4-11:	Eight integer values of 3 hr. discharges in inches (IQFIN)
Word 12:	NPR*
Word 13:	NUSUB*
Word 14:	FQ1* scaled up by 10^4 - integer,
Word 15:	FQ2* " " " " "
Word 16:	TLOS1* " " " " "
Word 17:	TLOS2* " " " " "
Word 18:	SA5* " " " " "
Word 19:	TFC* " " " " "
Word 20:	VDDD* " " " " "

* Notations are defined earlier

The order of the record is given by the following formula

Record Number = (IYEAR-1)* 7068 + (NSUB-1)* 372 + MP

Where IYEAR: year of simulation - 1960
NSUB: planning unit (or sub-basin) number (1 to 19)
MP: day number (1-372)

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 computer (program requires 14K plus operating system),
1 405 ASCII card reader,
2 854 disk drives (disk 6000 and disk 6201),
1 line printer

PROGRAM LIMITATIONS

1. The current program is designed to handle 19 planning units only.
2. The time step used in the program is 12 minutes. This means that all the hydrologic components are generated at every 12 minutes.
3. The final steps of the programs convert 12 minute values to hourly and then to 3 hourly values which are used in the routing model.
4. The generated output of BASINMOD is largely based on the particular set of coefficients, known basin characteristics and the processed rainfall inputs. It is to be noted that the application of the BASINMOD program to an unknown drainage basin can be erroneous unless there is sufficient data to estimate adequately the required parameters.

SAMPLE DATA

```
$RUN
1970
60.5046 37.9062 57.6843 89.6703 52.9312 185.6640132.7718198.754689.2265 119.639
109.8500197.7885197.789094.7046 150.80  229.76  70.36   163.44  56.68   0.0
   1  90 182 274 365  0 372  1  1 372
   1  90 182 274 365  0 372  2  1 372
   1  90 182 274 365  0 372  3  1 372
   1  90 182 274 365  0 372  4  1 372
   1  90 182 274 365  0 372  5  1 372
   1  90 182 274 365  0 372  6  1 372
   1  90 182 274 365  0 372  7  1 372
   1  90 182 274 365  0 372  8  1 372
   1  90 182 274 365  0 372  9  1 372
   1  90 182 274 365  0 372 10  1 372
   1  90 182 274 365  0 372 11  1 372
   1  90 182 274 365  0 372 12  1 372
   1  90 182 274 365  0 372 13  1 372
   1  90 182 274 365  0 372 14  1 372
   1  90 182 274 365  0 372 15  1 372
   1  90 182 274 365  0 372 16  1 372
   1  90 182 274 365  0 372 17  1 372
   1  90 182 274 365  0 372 18  1 372
   1  90 182 274 365  0 372 19  1 372
```

PROGRAM E094

PROGRAMMER: Paul Berger
Ashok N. Shahane

PURPOSE:

1. To simulate hydrologic components for 19 planning units from 1 to 10 years (1 year per run).
2. To generate two disk files with two types of simulated values

DISK: 6000, 6201

CONTROL CARDS:

```
$JOB, 8430-305, E094, 120
$DUMP
$RONL, 854/6000
$FET, WATERPLN, RAINFALL DATA, 1024
$OPEN, 21
$FET, WATERPLN, STATE CONDITIONS, 512
$OPEN, 22
$FET, WATERPLN, BASIN PARAMETERS, 512
$OPEN, 23
$MSUTIL, 60
PURGE
SCOPE
$RRAT, 854/6000
$FET, WATERPLN, CUMULATIVE VALUES, 1024
$RELEASE, ALL
$ALLOCATE, 200, 991231
$OPEN, 24
$RAT, 854/6000
$FET, BASINMOD, DISCHARGEDATA
$ALLOCATE, 1500, 991231
$OPEN, 20
$LOAD, 56, M
$RUN
Insert card input here
$EQUIP, 10 = MT
$MSUTIL
DUMP, 10, 20
END
```

CARD INPUT: One card indicating year and IBUG (optional), 2 cards with areas of 19 planning units, 1 to 19 cards (each card giving 10 values for each of up to 19 planning units).

OPERATING INSTRUCTIONS: Tape Output: LUN 10 (Dump of BASINMOD, DISCHARGE DATA) Disk file 24 is stored on disk 6000. Program E095 uses this file and then releases it. Disk file 20 is stored on disk 3001 and dumped to tape 10. Program E096 uses tape 10 as input.

ERROR STOPS: 6 (five "error messages" and one "call-abnormal"statement).

TIMING: 2 hours.

PROGRAM LISTING

```
      PROGRAM BASINMOD
C GLOSSARY OF SYMBOLS
C     A----VEGETAL COVER INDEX
C     A1-----A9 CONSTANTS FOR CONVEYING STORAGE INTO STAGE
C     AREA--AREA FOR NTH SUB-BASIN(SQUARE MILES)
C     B0 B1...B6 CONSTANTS FOR CONVEYANCE AS A FUNCTION OF WATER SURF. I
C     CNR-- TOTAL NUMBER OF CASCADES IN ANY OF THE 4 RESERVOIRS
C     CONST AN INTEGER USED TO DIVIDE STORAGE VALUE TO MAKE IT SMALL
C     D-- TOTAL DEPTH OF SUB-SURFACE PROFILE
C     DIS  LENGTH OF CANAL REACH(FT)
C     DPE-- EXCESS PRECIPITATION FOR DELTAT
C     DWTM--- DEPTH TO FREE WATER WHERE EVAPORATION FROM THE SOIL SEASE
C     DX-- LENGTH OF SUB-REACH
C     END   ROUTED VALUES OF DISCHARGE
C     EP-- PAN EVAPORATION, WEEKLY VALUES
C     F-- MOVEMENT OF WATER BETWEEN LAYERS
C     FQ-- ARRAY CONTAINING ALL VALUES OF QVOL
C     FQ1--- CUMULATIVE DAILY VALUE OF WATER RECOVERED FROM SOIL
C     RESERVOIR UP TO THE DAY,MP
C     FQ2--- CUMULATIVE DAILY VALUE OF WATER IN OVERLAND RESERVOIR
C    IEXPRESSED IN INCHES OVER THE ENTIRE WATERSHED
C     VDM  MAX. AMOUNT OF WATER THAT CAN BE STORED IN SURFACE DEPRESSIO
C     VD  DEPTH OF WATER IN SURFACE DEPRESSION IN INCHES OVER THE WHOLE
C     TK  TIME CONSTANT CORRESPONDING TO EACH OF THE 4 RESERVOIRS USED I
C     TLOS2  CUM VALUE OF TRANSPIRATION LOSS UP TO THE DAY, MP
C     TLOS1  CUM. DAILY VALUE OF EVAPORATION LOSS UP TO THE DAY,MP
C     TFC  CUMULATIVE DAILY VALUE OF DEEP PERCOLATION LOSS UP TO THE DAY
C     TAS  TOT. AVAIL. STORAGE IN A LAYER OF SOIL, INCHES OF WATER
C     SURO  STREAMFLOW CONTRIBUTING TO ANY STRUCTURE AT 6 HR INTERVALS
C     SG  STORAGE, INCHES, IN PROFILE THAT CORRESPONDS TO SELECTED Q,S
C     SA5  CURRENTLY AVAILABLE STORAGE IN SOIL PROFILE AT THE END OF DAY
C     SA  AVAILABLE STORAGEIN SOIL, INCHES OF WATER
C     QFTI  EIGHT VALUES OF ROUTED RUNOFF EACH AT 3 HR INTERVALS FOR THE
C     Q--- PROFILE DISCHARGE, IN/HR
C     PPAN-- RATIO OF EPMAX/ ET MAX
C     PC  +-1 DEPENDING ON WHETHER THE COMPUTATION PROCEEDS UP OR DOWN
C     NSUB--- SUN-BASIN ID NUMBER=1,2,---19
C     NPR--- CUMULATIVE RAINFALL TO THE DAY,MP
C     NOD   TOTAL NUMBER OF DAYS FOR WHICH RUN IS TO BE MADE
C     NEL-----TOT. NUMBER OF DAYS TO BE SKIPPED FROM THE RUN
C     LDAY-- ENDING DATE OF EXECUTION(JULIAN)
C     MP---JULIAN DAY NUMBER
C     IT-- DAYS ON WHICH STATE CONDITIONS ARE SAVED
C     ISAV   DAYS FOR WHICH 2400 HOUR VALUES WILL BE RETAIMED ON FILE(JU
C     IPR$PR -- PRECIPITATION VALUES
C     IDAY-- BEGINING DATE OF EXECUTION
C     GD-- THAT PORTION OF G WHICH WILL DRAIN TO A SURFACE WATER BODY.
C     GI-- GROUTH INDEX, WEEKLY VALUES
C     G--- AMOUNT OF FREE WATER IN A LAYER WHEN SATURATED
C    1UP TO THE DAY,MP
      REAL LOS1,LOS2,LOS1T,LOS2T,LOST1,LOST2
      DIMENSION LOS1(3), LOS2(3), IBAS(30), TAS(3), F(3), G(3), GD(3), C
     $(3)
      DIMENSION SG(3), CNR(4), TK(4), SA(3), END(9,4,6), ISAV(5), IPR(32
     $)
      DIMENSION PR(120), FPF(3), S(3), SLOP(3), QVOL(3), FQ(120,4), DIS
     $(3,4)
      DIMENSION QFIN(8), IQFIN(8), ISA(5), AREA(20), NEL(7)
      DIMENSION IBUF(121), IA(58), JBUF(123), JA(59), NBUF(245), KBUF
     $(245)
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D.S.S.	U.S.S.	DISCHARGE	STORAGE
14.000	26.580	25000.000	7409.580
16.000	26.730	25000.000	7612.526
18.000	26.990	25000.000	7908.491
20.000	27.380	25000.000	8329.935
22.000	27.950	25000.000	8907.916
24.000	28.730	25000.000	9753.664
26.000	29.730	25000.000	11484.790
28.000	31.010	25000.000	14950.010
30.000	32.260	25000.000	20512.670

FOJ. END OF JOB

I SYS 400 00/00/50 ASHOK4 L= 182 C= 0

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STAGE-DISCHARGE-STORAGE VALUES FOR :
C-38E

D.S.S.	U.S.S.	DISCHARGE	STORAGE
5.000	5.000	50.000	8072.955
7.000	7.000	50.000	9223.668
9.000	9.000	50.000	10405.670
11.000	11.000	50.000	11620.900
13.000	13.000	50.000	12876.260
15.000	15.000	50.000	14188.210
17.000	17.000	50.000	15592.780
19.000	19.000	50.000	17173.970
21.000	21.000	50.000	19125.340
23.000	23.000	50.000	21974.570
25.000	25.000	50.000	26487.430
5.000	5.420	3000.000	8191.553
7.000	7.290	3000.000	9305.787
9.000	9.200	3000.000	10464.590
11.000	11.150	3000.000	11664.450
13.000	13.110	3000.000	12909.360
15.000	15.080	3000.000	14214.090
17.000	17.060	3000.000	15614.420
19.000	19.050	3000.000	17193.350
21.000	21.040	3000.000	19145.640
23.000	23.030	3000.000	21995.470
25.000	25.030	3000.000	26519.410
5.000	6.510	6000.000	8513.819
7.000	8.070	6000.000	9537.423
9.000	9.770	6000.000	10634.490
11.000	11.560	6000.000	11791.770
13.000	13.420	6000.000	13006.940
15.000	15.320	6000.000	14290.890
17.000	17.250	6000.000	15679.180
19.000	19.200	6000.000	17251.430
21.000	21.170	6000.000	19206.470
23.000	23.140	6000.000	22058.170
25.000	25.130	6000.000	26622.620
5.000	7.930	9000.000	8971.652
7.000	9.170	9000.000	9884.311
9.000	10.610	9000.000	10897.980
11.000	12.210	9000.000	11993.810
13.000	13.920	9000.000	13164.300
15.000	15.710	9000.000	14416.630
17.000	17.550	9000.000	15786.920
19.000	19.440	9000.000	17347.800
21.000	21.380	9000.000	19307.620
23.000	23.310	9000.000	22162.710
25.000	25.310	9000.000	26821.120
5.000	9.470	12000.000	9506.568
7.000	10.440	12000.000	10310.310
9.000	11.630	12000.000	11233.950
11.000	13.020	12000.000	12258.500
13.000	14.560	12000.000	13374.760
15.000	16.220	12000.000	14588.380
17.000	17.960	12000.000	15935.890
19.000	19.760	12000.000	17481.410
21.000	21.660	12000.000	19448.850
23.000	23.540	12000.000	22310.460
25.000	25.610	12000.000	27160.340
5.000	11.000	15000.000	10080.950

D.S.S.	U.S.S.	DISCHARGE	STORAGE
7.000	11.770	15000.000	10786.760
9.000	12.750	15000.000	11622.800
11.000	13.940	15000.000	12573.480
13.000	15.310	15000.000	13630.990
15.000	16.830	15000.000	14807.290
17.000	18.460	15000.000	16124.450
19.000	20.170	15000.000	17650.920
21.000	22.020	15000.000	19629.780
23.000	23.840	15000.000	22504.530
25.000	26.070	15000.000	27714.350
5.000	12.490	18000.000	10672.920
7.000	13.100	18000.000	11293.690
9.000	13.920	18000.000	12049.930
11.000	14.940	18000.000	12928.130
13.000	16.150	18000.000	13927.800
15.000	17.530	18000.000	15063.520
17.000	19.030	18000.000	16352.270
19.000	20.640	18000.000	17854.770
21.000	22.440	18000.000	19849.910
23.000	24.200	18000.000	22755.530
25.000	26.670	18000.000	28564.430
5.000	13.920	21000.000	11270.260
7.000	14.410	21000.000	11818.400
9.000	15.090	21000.000	12501.460
11.000	15.970	21000.000	13314.860
13.000	17.030	21000.000	14261.010
15.000	18.280	21000.000	15358.750
17.000	19.660	21000.000	16617.810
19.000	21.170	21000.000	18091.160
21.000	22.920	21000.000	20110.100
23.000	24.630	21000.000	23084.660
25.000	27.390	21000.000	29795.550
5.000	15.280	24000.000	11867.030
7.000	15.690	24000.000	12353.970
9.000	16.260	24000.000	12975.010
11.000	17.010	24000.000	13731.190
13.000	17.950	24000.000	14629.260
15.000	19.080	24000.000	15690.270
17.000	20.340	24000.000	16916.250
19.000	21.740	24000.000	18358.550
21.000	23.450	24000.000	20411.930
23.000	25.110	24000.000	23499.400
25.000	28.130	24000.000	31638.580
5.000	16.580	27000.000	12464.530
7.000	16.920	27000.000	12901.570
9.000	17.410	27000.000	13469.260
11.000	18.060	27000.000	14176.580
13.000	18.890	27000.000	15030.800
15.000	19.900	27000.000	16056.820
17.000	21.050	27000.000	17244.470
19.000	22.360	27000.000	18655.690
21.000	24.020	27000.000	20756.470
23.000	25.670	27000.000	24036.790
25.000	28.800	27000.000	33938.070
5.000	17.830	30000.000	13069.350
7.000	18.110	30000.000	13454.210

STAGE-DISCHARGE-STORAGE VALUES FOR
C-38E

D.S.S.	U.S.S.	DISCHARGE	STORAGE
9.000	18.530	30000.000	13987.560
11.000	19.100	30000.000	14650.850
13.000	19.830	30000.000	15465.230
15.000	20.740	30000.000	16451.100
17.000	21.790	30000.000	17600.220
19.000	23.000	30000.000	18980.860
21.000	24.710	30000.000	21223.290
23.000	26.600	30000.000	24999.870
25.000	29.390	30000.000	36596.330
-0	-0	-0	-0

EOJ. END OF JOB

I SYS 400 00/00/50 ASHOK5 L= 184 C= 0

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APPENDIX IV

Tables for Computing Correction Factors for Upstream and Downstream Stages for 13 Channel Sections of the Upper Kissimmee River

C29AAS62 = C-29 above S-62
C29ABS62 = C-29 below S-62
C30AS57 = C-30 above S-57
C30BS57 = C-30 below S-57
C31BS59 = C-31 below S-59
C31AS59 = C-31 above S-59
C32CBS58 = C-32C below S-58
C32CAS58 = C-32C above S-58
C33BS60 = C-33 below S-60
C33AS60 = C-33 above S-60

US	CUS	DFACTOR	DS	CDS	DFACTOR	Q	DH
55.001	54.994	1.00012792	55.000	55.007	.99987207	25.000	.001
57.000	56.993	1.00011617	57.000	57.007	.99988382	25.000	0
59.000	58.993	1.00012238	59.000	59.007	.99987762	25.000	0
61.000	60.992	1.00012838	61.000	61.008	.99987161	25.000	0
63.000	62.992	1.00013419	63.000	63.008	.99986581	25.000	0
65.000	64.991	1.00013981	65.000	65.009	.99986018	25.000	0
67.000	66.990	1.00014527	67.000	67.010	.99985473	25.000	0
69.000	68.990	1.00015056	69.000	69.010	.99984943	25.000	0
71.000	70.989	1.00015571	71.000	71.011	.99984429	25.000	0
55.006	55.001	1.00008712	55.000	55.005	.99991287	50.000	.006
57.001	57.001	1.00000201	57.000	57.000	.99999799	50.000	.001
59.001	59.001	1.00000762	59.000	59.000	.99999238	50.000	.001
61.000	61.000	.99999667	61.000	61.000	1.00000333	50.000	0
63.000	63.000	1.00000248	63.000	63.000	.99999752	50.000	0
65.000	64.999	1.00000811	65.000	65.001	.99999189	50.000	0
67.000	66.999	1.00001356	67.000	67.001	.99998644	50.000	0
69.000	68.999	1.00001885	69.000	69.001	.99998114	50.000	0
71.000	70.998	1.00002400	71.000	71.002	.99997600	50.000	0
55.013	55.005	1.00013734	55.000	55.008	.99986265	75.000	.013
57.003	57.005	.99996996	57.000	56.998	1.00003995	75.000	.003
59.001	59.005	.99993059	59.000	58.996	1.00006943	75.000	.001
61.000	61.005	.99991364	61.000	60.995	1.00008038	75.000	0
63.000	63.005	.99992544	63.000	62.995	1.00007457	75.000	0
65.000	65.004	.99993107	65.000	64.996	1.00006895	75.000	0
67.000	67.004	.99993652	67.000	66.996	1.00006349	75.000	0
69.000	69.004	.99994182	69.000	68.996	1.00005820	75.000	0
71.000	71.004	.99994696	71.000	70.996	1.00005305	75.000	0
55.023	55.008	1.00026447	55.000	55.015	.99973556	100.000	.023
57.005	57.008	.99994048	57.000	56.997	1.00005953	100.000	.005
59.002	59.008	.99989288	59.000	58.994	1.00010715	100.000	.002
61.001	61.008	.99988138	61.000	60.993	1.00011866	100.000	.001
63.000	63.008	.99987079	63.000	62.992	1.00012925	100.000	0
65.000	65.008	.99987642	65.000	64.992	1.00012362	100.000	0
67.000	67.008	.99988187	67.000	66.992	1.00011817	100.000	0
69.000	69.008	.99988716	69.000	68.992	1.00011287	100.000	0
71.000	71.008	.99989231	71.000	70.992	1.00010773	100.000	0
55.035	55.011	1.00044029	55.000	55.024	.99955992	125.000	.035
57.003	57.011	.99995071	57.000	56.997	1.00004930	125.000	.009
59.002	59.011	.99985049	59.000	58.991	1.00014956	125.000	.002
61.001	61.011	.99983898	61.000	60.990	1.00016107	125.000	.001
63.001	63.011	.99984427	63.000	62.990	1.00015578	125.000	.001
65.000	65.011	.99983402	65.000	64.989	1.00016603	125.000	0
67.000	67.011	.99983948	67.000	66.989	1.00016058	125.000	0
69.000	69.011	.99984477	69.000	68.989	1.00015528	125.000	0
71.000	71.011	.99984991	71.000	70.989	1.00015014	125.000	0
55.054	55.013	1.00067421	55.000	55.037	.99932213	150.000	.050
57.011	57.013	.99996369	57.000	56.998	1.00003131	150.000	.011
59.004	59.013	.99984974	59.000	58.991	1.00015031	150.000	.004
61.002	61.013	.99982974	61.000	60.989	1.00017933	150.000	.002
63.001	63.013	.99980963	63.000	62.988	1.00019044	150.000	.001
65.000	65.013	.99979939	65.000	64.987	1.00020069	150.000	0
67.000	67.013	.99980484	67.000	66.987	1.00019523	150.000	0
69.000	69.013	.99981014	69.000	68.987	1.00018993	150.000	0
71.000	71.013	.99981528	71.000	70.987	1.00018479	150.000	0
55.068	55.014	1.00097609	55.000	55.054	.99902469	175.000	.068
57.015	57.014	1.00000956	57.000	57.001	.99999044	175.000	.015
59.005	59.015	.99983740	59.000	58.990	1.00016265	175.000	.005
61.002	61.015	.99979146	61.000	60.987	1.00020863	175.000	.002
63.001	63.015	.99978035	63.000	62.986	1.00021974	175.000	.001
65.001	65.015	.99978549	65.000	64.986	1.00021460	175.000	.001
67.000	67.015	.99977556	67.000	66.985	1.00022453	175.000	0
69.000	69.015	.99978085	69.000	68.985	1.00021923	175.000	0
71.000	71.015	.99978600	71.000	70.985	1.00021409	175.000	0
55.089	55.016	1.00133240	55.000	55.073	.99866913	200.000	.089
57.020	57.016	1.00007189	57.000	57.004	.99992811	200.000	.020
59.006	59.016	.99982898	59.000	58.990	1.00017108	200.000	.006

61.003	61.016	.99978248	61.000	60.987	1.00021761	200.000	.003
63.002	63.016	.99977086	63.000	62.986	1.00022924	200.000	.002
65.001	65.017	.99976012	65.000	64.984	1.00023998	200.000	.001
67.000	67.017	.99975020	67.000	66.983	1.00024991	200.000	0
69.000	69.017	.99975549	69.000	68.983	1.00024462	200.000	0
71.000	71.017	.99976063	71.000	70.983	1.00023947	200.000	0
55.112	55.017	1.00172805	55.000	55.095	.99827463	225.000	.112
57.025	57.017	1.00013720	57.000	57.008	.99986279	225.000	.025
59.008	59.017	.99984049	59.000	58.991	1.00015956	225.000	.008
61.003	61.018	.99976011	61.000	60.985	1.00023999	225.000	.003
63.002	63.018	.99974848	63.000	62.984	1.00025163	225.000	.002
65.001	65.018	.99973775	65.000	64.983	1.00026237	225.000	.001
67.001	67.018	.99974274	67.000	66.983	1.00025737	225.000	.001
69.000	69.018	.99973312	69.000	68.982	1.00026700	225.000	0
71.000	71.019	.99973826	71.000	70.981	1.00026186	225.000	0
55.140	55.018	1.00221692	55.000	55.122	.99778759	250.000	.140
57.031	57.018	1.00022241	57.000	57.013	.99977760	250.000	.031
59.010	59.019	.99985437	59.000	58.991	1.00014568	250.000	.010
61.004	61.019	.99975648	61.000	60.985	1.00024362	250.000	.004
63.002	63.019	.99972847	63.000	62.983	1.00027165	250.000	.002
65.001	65.019	.99971774	65.000	64.982	1.00028239	250.000	.001
67.001	67.020	.99972273	67.000	66.981	1.00027740	250.000	.001
69.000	69.020	.99971310	69.000	68.980	1.00028703	250.000	0
71.000	71.020	.99971824	71.000	70.980	1.00028189	250.000	0

US	COS	DFACTOR	DS	COS	DFACTOR	Q	DH
52.264	51.953	1.00608989	52.000	52.317	.99393187	50.000	.269
54.121	53.946	1.00139574	54.000	54.076	.99860272	50.000	.021
56.006	55.939	1.00120466	56.000	56.068	.99879378	50.000	.006
58.002	57.931	1.00121968	58.000	58.071	.99877876	50.000	.002
60.001	59.924	1.00128663	60.000	60.077	.99871180	50.000	.001
62.004	61.916	1.00135196	62.000	62.084	.99864648	50.000	0
64.000	63.909	1.00143138	64.000	64.092	.99856709	50.000	0
66.000	65.901	1.00150836	66.000	66.100	.99849014	50.000	0
54.177	54.031	1.00084391	54.000	54.045	.99915469	100.000	.077
56.021	56.027	.99988443	56.000	55.994	1.00011588	100.000	.021
58.003	58.023	.99973510	58.000	57.995	1.00026563	100.000	.008
60.004	60.019	.99974853	60.000	59.985	1.00025216	100.000	.004
62.002	62.015	.99979602	62.000	61.987	1.00020453	100.000	.002
64.001	64.014	.99985869	64.000	63.991	1.00014169	100.000	.001
66.001	66.005	.99993507	66.000	65.996	1.00006510	100.000	.001
54.167	54.082	1.00157919	54.000	54.085	.99841935	150.000	.167
56.046	56.043	.99940224	56.000	55.966	1.00059961	150.000	.046
58.018	58.077	.99897945	58.000	57.941	1.00102415	150.000	.018
60.008	60.075	.99888726	60.000	59.933	1.00111677	150.000	.008
62.004	62.072	.99890135	62.000	61.932	1.00110362	150.000	.004
64.002	64.070	.99894674	64.000	63.932	1.00105741	150.000	.002
66.001	66.067	.99900705	66.000	65.934	1.00099643	150.000	.001
54.289	54.117	1.00317394	54.000	54.172	.99682819	200.000	.289
56.077	56.116	.99929648	56.000	55.961	1.00070577	200.000	.077
58.031	58.116	.99854524	58.000	57.915	1.00146053	200.000	.031
60.014	60.114	.99832423	60.000	59.900	1.00167776	200.000	.014
62.008	62.113	.99830689	62.000	61.895	1.00170023	200.000	.008
64.004	64.112	.99831965	64.000	63.892	1.00168739	200.000	.004
66.002	66.110	.99836425	66.000	65.892	1.00164253	200.000	.002
54.440	54.145	1.00545027	54.000	54.295	.99456574	250.000	.440
56.118	56.145	.99951623	56.000	55.973	1.00048522	250.000	.118
58.047	58.145	.99831029	58.000	57.902	1.00169682	250.000	.047
60.022	60.145	.99795223	60.000	59.877	1.00205712	250.000	.022
62.011	62.145	.99784516	62.000	61.866	1.00216490	250.000	.011
64.007	64.144	.99785641	64.000	63.862	1.00215358	250.000	.007
66.004	66.144	.99788446	66.000	65.860	1.00212534	250.000	.004
54.616	54.168	1.00827974	54.000	54.448	.99176777	300.000	.616
56.168	56.169	.99999918	56.000	55.999	1.00001085	300.000	.168
58.065	58.170	.99820319	58.000	57.896	1.00180474	300.000	.065
60.031	60.170	.99768523	60.000	59.861	1.00232596	300.000	.031
62.016	62.171	.99750996	62.000	61.845	1.00250342	300.000	.016
64.009	64.171	.99747195	64.000	63.838	1.00254172	300.000	.009
66.006	66.172	.99749814	66.000	65.834	1.00251443	300.000	.006
54.811	54.187	1.01152255	54.000	54.424	.98858034	350.000	.811
56.224	56.189	1.00063288	56.000	56.036	.99936593	350.000	.224
58.086	58.190	.99821158	58.000	57.896	1.00179611	350.000	.086
60.041	60.192	.99749924	60.000	59.850	1.00251332	350.000	.041
62.022	62.193	.99725347	62.000	61.829	1.00276100	350.000	.022
64.012	64.194	.99716573	64.000	63.818	1.00284945	350.000	.012
66.004	66.195	.99717629	66.000	65.813	1.00283881	350.000	.008
55.019	54.233	1.01505070	54.000	54.815	.98513561	400.000	1.019
56.289	56.236	1.00148342	56.000	56.083	.99851507	400.000	.289
58.111	58.268	.99933584	58.000	57.903	1.00167107	400.000	.111
60.052	60.219	.99737696	60.000	59.942	1.00263654	400.000	.052
62.028	62.212	.99704601	62.000	61.916	1.00297118	400.000	.028
64.016	64.214	.99692315	64.000	63.903	1.00309409	400.000	.016
66.010	66.215	.99690162	66.000	65.795	1.00311581	400.000	.010
55.236	54.218	1.01977933	54.000	55.017	.98152110	450.000	1.236
56.362	56.221	1.00251178	56.000	56.141	.99748824	450.000	.362
58.139	58.224	.99854755	58.000	57.916	1.00145821	450.000	.139
60.065	60.226	.99732393	60.000	59.839	1.00269008	450.000	.065

62.035	62.229	.99688861	62.000	61.807	1.00312893	450.000	.035
64.029	64.231	.99671657	64.000	63.789	1.00330251	450.000	.020
66.012	66.233	.99666296	66.000	65.779	1.00335661	450.000	.012
55.456	54.231	1.02259028	54.000	55.223	.97785406	500.000	1.456
56.441	56.234	1.00367477	56.000	56.205	.99632954	500.000	.441
58.171	58.238	.99885613	58.000	57.933	1.00114805	500.000	.171
60.079	60.241	.99731563	60.000	59.839	1.00269834	500.000	.079
62.042	62.244	.99676058	62.000	61.799	1.00325810	500.000	.042
64.025	64.246	.99655394	64.000	63.779	1.00346665	500.000	.025
66.015	66.249	.99646780	66.000	65.766	1.00355361	500.000	.015
56.526	56.247	1.00496693	56.000	56.279	.99504527	550.000	.526
58.205	58.250	.99922183	58.000	57.955	1.00078073	550.000	.205
60.094	60.254	.99734693	60.000	59.840	1.00266680	550.000	.094
62.050	62.257	.99667155	62.000	61.793	1.00334795	550.000	.050
64.030	64.260	.99641426	64.000	63.770	1.00360767	550.000	.030
66.018	66.263	.99629561	66.000	65.755	1.00372749	550.000	.018
56.618	56.258	1.00640203	56.000	56.359	.99362282	600.000	.618
58.242	58.262	.99965781	58.000	57.980	1.00034316	600.000	.242
60.111	60.266	.99743030	60.000	59.845	1.00259278	600.000	.111
62.059	62.270	.99661751	62.000	61.790	1.00340249	600.000	.059
64.035	64.273	.99629353	64.000	63.762	1.00372959	600.000	.035
66.021	66.277	.99614238	66.000	65.745	1.00388228	600.000	.021

US	CDS	DFACTOR	DS	CDS	DFACTOR	Q	DH
60.014	59.990	1.00039421	60.000	60.024	.99960582	20.000	.014
61.004	60.990	1.00023155	61.000	61.014	.99976843	20.000	.004
62.002	61.989	1.00020327	62.000	62.013	.99979671	20.000	.002
63.001	62.989	1.00019134	63.000	63.012	.99980814	20.000	.001
64.001	63.988	1.00019649	64.000	64.013	.99980350	20.000	.001
65.000	64.988	1.00018566	65.000	65.012	.99981432	20.000	0
66.000	65.987	1.00019039	66.000	66.013	.99980959	20.000	0
67.000	66.987	1.00019505	67.000	67.013	.99980492	20.000	0
68.000	67.986	1.00019965	68.000	68.014	.99980033	20.000	0
69.000	68.986	1.00020417	69.000	69.014	.99979581	20.000	0
70.000	69.985	1.00020863	71.000	70.015	.99979134	20.000	0
60.153	60.106	1.00078761	60.000	60.047	.99921276	40.000	.053
61.115	61.056	1.00015537	61.000	61.009	.99984461	40.000	.015
62.056	62.065	1.00001130	62.000	62.001	.99998870	40.000	.006
63.003	63.005	.99996710	63.000	62.998	1.00003291	40.000	.003
64.002	64.005	.99995562	64.000	63.997	1.00004440	40.000	.002
65.001	65.005	.99994456	65.000	64.996	1.00005546	40.000	.001
66.001	66.004	.99994906	66.000	65.997	1.00005096	40.000	.001
67.001	67.004	.99995350	67.000	66.997	1.00004652	40.000	.001
68.000	68.004	.99994316	68.000	67.996	1.00005686	40.000	0
69.000	69.004	.99994769	69.000	68.996	1.00005233	40.000	0
70.000	70.003	.99995215	70.000	69.997	1.00004797	40.000	0
60.114	60.015	1.00165390	60.000	60.099	.99834832	60.000	.114
61.033	61.015	1.00030935	61.000	61.018	.99969965	60.000	.033
62.013	62.015	.99997416	62.000	61.998	1.00002585	60.000	.013
63.006	63.015	.99986471	63.000	62.991	1.00013535	60.000	.006
64.004	64.014	.99983686	64.000	63.993	1.00016322	60.000	.004
65.003	65.014	.99982532	65.000	64.989	1.00017476	60.000	.003
66.002	66.014	.99981421	66.000	65.988	1.00018589	60.000	.002
67.001	67.014	.99980349	67.000	66.987	1.00019661	60.000	.001
68.001	68.014	.99980786	68.000	67.987	1.00019223	60.000	.001
69.001	69.014	.99981218	69.000	68.987	1.00018792	60.000	.001
70.001	70.014	.99980215	70.000	69.986	1.00019796	60.000	0
61.057	61.021	1.00058718	61.000	61.036	.99941298	80.000	.057
62.023	62.021	1.00002896	62.000	62.002	.99997103	80.000	.023
63.011	63.021	.99983762	63.000	62.990	1.00016245	80.000	.011
64.005	64.021	.99976168	64.000	63.985	1.00023845	80.000	.006
65.004	65.021	.99973428	65.000	64.983	1.00026587	80.000	.004
66.003	66.021	.99972293	66.000	65.982	1.00027723	80.000	.003
67.002	67.021	.99971290	67.000	66.981	1.00028818	80.000	.002
68.001	68.021	.99970145	68.000	67.980	1.00029873	80.000	.001
69.001	69.021	.99970576	69.000	68.980	1.00029442	80.000	.001
70.001	70.021	.99971001	70.000	69.980	1.00029016	80.000	.001
61.087	61.026	1.00099617	61.000	61.061	.99900452	100.000	.087
62.035	62.026	1.00013997	62.000	62.009	.99986011	100.000	.035
63.016	63.026	.99983441	63.000	62.993	1.00016567	100.000	.016
64.009	64.027	.99972599	64.000	63.982	1.00027417	100.000	.009
65.006	65.027	.99968253	65.000	64.979	1.00031770	100.000	.006
66.004	66.027	.99965554	66.000	65.977	1.00034468	100.000	.004
67.003	67.027	.99964438	67.000	66.976	1.00035586	100.000	.003
68.002	68.027	.99963361	68.000	67.975	1.00036664	100.000	.002
69.002	69.027	.99963771	69.000	68.975	1.00036253	100.000	.002
70.001	70.027	.99962748	70.000	69.974	1.00037278	100.000	.001
61.123	61.031	1.00151851	61.000	61.093	.99848332	120.000	.123
62.049	62.031	1.00029809	62.000	62.018	.99970190	120.000	.049
63.023	63.031	.99987202	63.000	62.992	1.00012203	120.000	.023
64.012	64.031	.99970541	64.000	63.981	1.00029477	120.000	.012
65.004	65.031	.99964542	65.000	64.977	1.00035442	120.000	.008
66.006	66.031	.99960325	66.000	65.974	1.00039703	120.000	.005
67.004	67.031	.99959197	67.000	66.973	1.00040843	120.000	.004
68.003	68.032	.99958088	68.000	67.971	1.00041943	120.000	.003
69.002	69.032	.99957028	69.000	68.970	1.00043004	120.000	.002
70.002	70.032	.99957432	70.000	69.970	1.00042599	120.000	.002
61.166	61.034	1.00216592	61.000	61.132	.99783809	140.000	.166
62.066	62.034	1.00051500	62.000	62.032	.99948502	140.000	.066
63.030	63.034	.99993204	63.000	62.996	1.00006798	140.000	.030
64.015	64.035	.99971186	64.000	63.981	1.00028932	140.000	.016
65.010	65.035	.99961456	65.000	64.975	1.00038070	140.000	.010
66.007	66.035	.99957653	66.000	65.972	1.00042378	140.000	.007
67.005	67.035	.99954977	67.000	66.970	1.00045057	140.000	.005

68.004	68.035	.99953857	68.000	67.969	1.00046179	140.000	.004
69.003	69.036	.99952775	69.000	68.967	1.00047262	140.000	.003
70.002	70.036	.99951731	70.000	69.966	1.00048307	140.000	.002
62.087	62.037	1.00080416	62.000	62.050	.99919623	160.000	.087
63.040	63.037	1.00004128	63.000	63.003	.99995871	160.000	.040
64.021	64.038	.99973954	64.000	63.983	1.00026060	160.000	.021
65.013	65.038	.99961630	65.000	64.975	1.00038397	160.000	.013
66.009	66.038	.99955743	66.000	65.971	1.00044290	160.000	.009
67.006	67.038	.99951531	67.000	66.968	1.00048508	160.000	.006
68.005	68.039	.99950388	68.000	67.966	1.00049652	160.000	.005
69.004	69.039	.99949286	69.000	68.965	1.00050756	160.000	.004
70.003	70.039	.99948221	70.000	69.964	1.00051822	160.000	.003
62.109	62.040	1.00111516	62.000	62.069	.99888574	180.000	.109
63.050	63.040	1.00015633	63.000	63.010	.99984365	180.000	.050
64.026	64.040	.99977405	64.000	63.986	1.00022607	180.000	.026
65.016	65.041	.99961886	65.000	64.975	1.00038140	180.000	.016
66.010	66.041	.99952901	66.000	65.969	1.00047135	180.000	.010
67.008	67.041	.99950158	67.000	66.967	1.00049882	180.000	.008
68.005	68.042	.99946033	68.000	67.963	1.00054013	180.000	.005
69.004	69.042	.99944930	69.000	68.962	1.00055117	180.000	.004
70.004	70.042	.99945293	70.000	69.962	1.00054754	180.000	.004
62.133	62.042	1.00146297	62.000	62.091	.99853872	200.000	.133
63.061	63.043	1.00029182	63.000	63.018	.99970817	200.000	.061
64.032	64.043	.99982877	64.000	63.989	1.00017132	200.000	.032
65.020	65.043	.99964139	65.000	64.977	1.00035885	200.000	.020
66.013	66.044	.99953547	66.000	65.969	1.00046489	200.000	.013
67.009	67.044	.99947753	67.000	66.965	1.00052290	200.000	.009
68.007	68.044	.99945076	68.000	67.963	1.00054972	200.000	.007
69.005	69.045	.99942482	69.000	68.960	1.00057569	200.000	.005
70.004	70.045	.99941397	70.000	69.959	1.00058656	200.000	.004
62.159	62.044	1.00184671	62.000	62.115	.99815613	220.000	.159
63.074	63.045	1.00046275	63.000	63.029	.99953732	220.000	.074
64.038	64.045	.99988719	64.000	63.993	1.00011286	220.000	.038
65.023	65.046	.99965226	65.000	64.977	1.00034797	220.000	.023
66.015	66.046	.99953051	66.000	65.969	1.00046986	220.000	.015
67.010	67.046	.99945723	67.000	66.964	1.00054326	220.000	.010
68.008	68.047	.99943021	68.000	67.961	1.00057029	220.000	.008
69.006	69.047	.99940406	69.000	68.959	1.00059648	220.000	.006
70.004	70.048	.99937873	70.000	69.956	1.00062185	220.000	.004
62.188	62.046	1.00228184	62.000	62.142	.99772265	240.000	.188
63.087	63.047	1.00063674	63.000	63.040	.99936347	240.000	.087
64.045	64.047	.99996430	64.000	63.998	1.00003572	240.000	.045
65.027	65.048	.99968157	65.000	64.979	1.00031863	240.000	.027
66.018	66.048	.99954375	66.000	65.970	1.00045660	240.000	.018
67.012	67.049	.99945486	67.000	66.963	1.00054561	240.000	.012
68.009	68.049	.99941273	68.000	67.960	1.00058780	240.000	.009
69.007	69.049	.99938637	69.000	68.958	1.00061420	240.000	.007
70.005	70.050	.99936083	70.000	69.955	1.00063978	240.000	.005
62.218	62.048	1.00273566	62.000	62.170	.99727096	260.000	.218

63.101	63.049	1.00082915	63.000	63.052	.99917128	260.000	.101
64.053	64.049	1.00005959	64.000	64.004	.99994040	260.000	.053
65.032	65.050	.99972883	65.000	64.982	1.00027133	260.000	.032
66.020	66.050	.99954443	66.000	65.970	1.00045592	260.000	.020
67.015	67.051	.99947000	67.000	66.964	1.00053045	260.000	.015
68.010	68.051	.99939782	68.000	67.959	1.00060273	260.000	.010
69.008	69.051	.99937125	69.000	68.957	1.00062934	260.000	.008
70.006	70.052	.99934551	70.000	69.954	1.00065513	260.000	.006
62.252	62.050	1.00325611	62.000	62.202	.99675346	280.000	.252
63.117	63.050	1.00105548	63.000	63.067	.99894531	280.000	.117
64.062	64.051	1.00017268	64.000	64.011	.99982730	280.000	.062
65.037	65.051	.99977828	65.000	64.986	1.00022184	280.000	.037
66.024	66.052	.99957758	66.000	65.972	1.00042273	280.000	.024
67.017	67.052	.99947242	67.000	66.965	1.00052802	280.000	.017
68.012	68.053	.99939981	68.000	67.959	1.00060074	280.000	.012
69.009	69.053	.99935833	69.000	68.956	1.00064228	280.000	.009
70.007	70.054	.99933238	70.000	69.953	1.00066827	280.000	.007
62.287	62.052	1.00379454	62.000	62.235	.99621863	300.000	.287
63.134	63.052	1.00129954	63.000	63.082	.99870174	300.000	.134
64.071	64.053	1.00028766	64.000	64.018	.99971234	300.000	.071
65.042	65.053	.99982962	65.000	64.989	1.00017046	300.000	.042
66.027	66.054	.99959748	66.000	65.973	1.00040281	300.000	.027
67.019	67.054	.99947673	67.000	66.965	1.00052370	300.000	.019
68.013	68.055	.99938899	68.000	67.958	1.00061157	300.000	.013
69.010	69.055	.99934730	69.000	68.955	1.00065333	300.000	.010
70.008	70.056	.99932114	70.000	69.952	1.00067953	300.000	.008

DS	CDS	DFACTOR	DS	CDS	DFACTOR	Q	DH
54.477	53.981	1.00019239	54.000	54.497	.99088514	20.000	.477
55.016	54.980	1.00006948	55.000	55.036	.99934050	20.000	.016
56.006	55.979	1.00048798	56.000	56.027	.99951193	20.000	.006
57.003	56.978	1.00044556	57.000	57.025	.99955434	20.000	.003
58.001	57.977	1.00042205	58.000	58.024	.99957784	20.000	.001
59.001	58.975	1.00043346	59.000	59.026	.99956643	20.000	.001
60.001	59.974	1.00044468	60.000	60.027	.99955522	20.000	.001
61.000	60.973	1.00043931	61.000	61.027	.99956058	20.000	0
62.000	61.972	1.00045844	62.000	62.028	.99954945	20.000	0
63.000	62.971	1.00046139	63.000	63.029	.99953851	20.000	0
64.000	63.970	1.00047217	64.000	64.030	.99952773	20.000	0
65.000	64.969	1.00048278	65.000	65.031	.99951713	20.000	0
66.000	65.967	1.00049323	66.000	66.033	.99950668	20.000	0
67.000	66.966	1.00050352	67.000	67.034	.99949639	20.000	0
68.000	67.965	1.00051366	68.000	68.035	.99948626	20.000	0
69.000	68.964	1.00052365	69.000	69.036	.99947627	20.000	0
70.000	69.963	1.00053349	70.000	70.037	.99946643	20.000	0
55.060	55.010	1.00091015	55.000	55.050	.99909005	40.000	.060
56.020	56.009	1.00018884	56.000	56.011	.99981106	40.000	.020
57.011	57.009	1.00003682	57.000	57.002	.99996316	40.000	.011
58.006	58.008	.99995919	58.000	57.998	1.00004084	40.000	.006
59.003	59.008	.99991829	59.000	58.995	1.00008177	40.000	.003
60.002	60.007	.99991228	60.000	59.995	1.00008779	40.000	.002
61.001	61.007	.99990664	61.000	60.994	1.00009343	40.000	.001
62.001	62.006	.99991753	62.000	61.995	1.00008256	40.000	.001
63.001	63.006	.99992819	63.000	62.995	1.00007187	40.000	.001
64.000	64.005	.99992309	64.000	63.995	1.00007697	40.000	0
65.000	65.004	.99993369	65.000	64.996	1.00006636	40.000	0
66.000	66.004	.99994413	66.000	65.996	1.00005591	40.000	0
67.000	67.003	.99995442	67.000	66.997	1.00004562	40.000	0
68.000	68.002	.99996455	68.000	67.998	1.00003547	40.000	0
69.000	69.002	.99997454	69.000	68.998	1.00002548	40.000	0
70.000	70.001	.99998438	70.000	69.999	1.00001563	40.000	0
55.131	55.128	1.00187904	55.000	55.103	.99812320	60.000	.131
56.043	56.027	1.00027822	56.000	56.016	.99972167	60.000	.043
57.021	57.027	.99989179	57.000	56.994	1.00010900	60.000	.021
58.012	58.027	.99974153	58.000	57.985	1.00025871	60.000	.012
59.007	59.027	.99966501	59.000	58.980	1.00033533	60.000	.007
60.005	60.027	.99964121	60.000	59.978	1.00035917	60.000	.005
61.003	61.026	.99961837	61.000	60.977	1.00038204	60.000	.003
62.002	62.026	.99961257	62.000	61.976	1.00038784	60.000	.002
63.001	63.026	.99960713	63.000	62.975	1.00039329	60.000	.001
64.001	64.025	.99961765	64.000	63.976	1.00038276	60.000	.001
65.001	65.025	.99962801	65.000	64.976	1.00037238	60.000	.001
66.001	66.025	.99963822	66.000	65.976	1.00036216	60.000	.001
67.000	67.025	.99963336	67.000	66.975	1.00036703	60.000	0
68.000	68.024	.99964349	68.000	67.976	1.00035689	60.000	0
69.000	69.024	.99965347	69.000	68.976	1.00034689	60.000	0
70.000	70.024	.99966331	70.000	69.976	1.00033704	60.000	0
55.229	55.040	1.00341315	55.000	55.189	.99659614	80.000	.229
56.074	56.040	1.00060351	56.000	56.034	.99939644	80.000	.074
57.037	57.040	.99994380	57.000	56.997	1.00005625	80.000	.037
58.020	58.040	.99965161	58.000	57.980	1.00034875	80.000	.020
59.013	59.040	.99953899	59.000	58.973	1.00046164	80.000	.013
60.008	60.040	.99946343	60.000	59.968	1.00053722	80.000	.008
61.005	61.040	.99942340	61.000	60.965	1.00057733	80.000	.005
62.004	62.040	.99941708	62.000	61.964	1.00058366	80.000	.004
63.003	63.040	.99941113	63.000	62.963	1.00058962	80.000	.003
64.002	64.040	.99940554	64.000	63.962	1.00059522	80.000	.002
65.001	65.040	.99940028	65.000	64.961	1.00060049	80.000	.001
66.001	66.040	.99941048	66.000	65.961	1.00059027	80.000	.001
67.001	67.040	.99942054	67.000	66.961	1.00058020	80.000	.001
68.001	68.040	.99943045	68.000	67.961	1.00057027	80.000	.001
69.000	69.040	.99942573	69.000	68.960	1.00057499	80.000	0
70.000	70.040	.99943558	70.000	69.960	1.00056514	80.000	0
55.344	55.050	1.00534301	55.000	55.294	.99468176	100.000	.344
56.115	56.050	1.00115818	56.000	56.065	.99884237	100.000	.115
57.057	57.050	1.00011766	57.000	57.007	.99988227	100.000	.057
58.031	58.050	.99966444	58.000	57.981	1.00033590	100.000	.031

59.020	59.051	.99948090	59.000	58.969	1.00051982	100.000	.020
60.013	60.051	.99937008	60.000	59.962	1.00063075	100.000	.013
61.008	61.051	.99924593	61.000	60.957	1.00070505	100.000	.008
62.006	62.051	.99927270	62.000	61.955	1.00072833	100.000	.006
63.004	63.051	.99925038	63.000	62.953	1.00075070	100.000	.004
64.003	64.051	.99924454	64.000	63.952	1.00075655	100.000	.003
65.002	65.052	.99923904	65.000	64.951	1.00076206	100.000	.002
66.002	66.052	.99924901	66.000	65.950	1.00075207	100.000	.002
67.001	67.052	.99924393	67.000	66.949	1.00075716	100.000	.001
68.001	68.052	.99925383	68.000	67.949	1.00074724	100.000	.001
69.001	69.052	.99926360	69.000	68.949	1.00073745	100.000	.001
70.001	70.052	.99927323	70.000	69.949	1.00072780	100.000	.001
55.488	55.158	1.00781328	55.000	55.430	.99224200	120.000	.488
56.162	56.158	1.00185294	56.000	56.104	.99815012	120.000	.162
57.081	57.159	1.00039387	57.000	57.022	.99960601	120.000	.081
58.044	58.159	.99974402	58.000	57.985	1.00025623	120.000	.044
59.027	59.159	.99945501	59.000	58.968	1.00054566	120.000	.027
60.018	60.159	.99930903	60.000	59.959	1.00069192	120.000	.018
61.012	61.160	.99921715	61.000	60.952	1.00078400	120.000	.012
62.008	62.160	.99916564	62.000	61.948	1.00084064	120.000	.009
63.006	63.160	.99913782	63.000	62.946	1.00086352	120.000	.006
64.004	64.161	.99911587	64.000	63.943	1.00088552	120.000	.004
65.003	65.161	.99911014	65.000	64.942	1.00089127	120.000	.003
66.002	66.161	.99910473	66.000	65.941	1.00089668	120.000	.002
67.002	67.161	.99911456	67.000	66.941	1.00088683	120.000	.002
68.001	68.162	.99910955	68.000	67.939	1.00089185	120.000	.001
69.001	69.162	.99911932	69.000	68.939	1.00088206	120.000	.001
70.001	70.162	.99912894	70.000	69.939	1.00087241	120.000	.001
55.663	55.165	1.01186834	55.000	55.598	.98924119	140.000	.663
56.215	56.165	1.00267507	56.000	56.150	.99733025	140.000	.215
57.109	57.165	1.00076241	57.000	57.043	.99923765	140.000	.109
58.059	58.166	.99988029	58.000	57.993	1.00011980	140.000	.059
59.037	59.166	.99950230	59.000	58.971	1.00049829	140.000	.037
60.024	60.167	.99928693	60.000	59.957	1.00071407	140.000	.024
61.016	61.167	.99916067	61.000	60.949	1.00084061	140.000	.016
62.011	62.168	.99908700	62.000	61.943	1.00091446	140.000	.011
63.008	63.168	.99904755	63.000	62.940	1.00095401	140.000	.008
64.006	64.168	.99902512	64.000	63.938	1.00097650	140.000	.006
65.004	65.169	.99900353	65.000	64.935	1.00099814	140.000	.004
66.003	66.169	.99899790	66.000	65.934	1.00100379	140.000	.003
67.002	67.170	.99899259	67.000	66.932	1.00100912	140.000	.002
68.002	68.170	.99900227	68.000	67.932	1.00099941	140.000	.002
69.001	69.170	.99899734	69.000	68.931	1.00100435	140.000	.001
70.001	70.171	.99900697	70.000	69.930	1.00099470	140.000	.001
56.277	56.171	1.00367477	56.000	56.206	.99633618	160.000	.277
57.141	57.172	1.00121728	57.000	57.069	.99878337	160.000	.141
58.077	58.172	1.00008451	58.000	58.005	.99991543	160.000	.077
59.047	59.173	.99956589	59.000	58.974	1.00043460	160.000	.047
60.030	60.173	.99928113	60.000	59.957	1.00071988	160.000	.030
61.021	61.174	.99913688	61.000	60.947	1.00086446	160.000	.021
62.014	62.174	.99902967	62.000	61.940	1.00097193	160.000	.014
63.010	63.175	.99897361	63.000	62.935	1.00102815	160.000	.010
64.007	64.175	.99893507	64.000	63.932	1.00106679	160.000	.007
65.005	65.176	.99891325	65.000	64.929	1.00108867	160.000	.005
66.004	66.176	.99890739	66.000	65.928	1.00109456	160.000	.004
67.003	67.177	.99890185	67.000	66.926	1.00110011	160.000	.003
68.002	68.177	.99889663	68.000	67.925	1.00110535	160.000	.002
69.002	69.178	.99890617	69.000	68.924	1.00109577	160.000	.002
70.001	70.178	.99890132	70.000	69.923	1.00110064	160.000	.001
56.343	56.176	1.00475812	56.000	56.267	.99526118	180.000	.343
57.175	57.177	1.00171957	57.000	57.098	.99828220	180.000	.175
58.097	58.178	1.00033559	58.000	58.019	.99966429	180.000	.097
59.059	59.178	.99967577	59.000	58.981	1.00032456	180.000	.059
60.038	60.179	.99932107	60.000	59.959	1.00067985	180.000	.038
61.026	61.179	.99912554	61.000	60.947	1.00087583	180.000	.026
62.018	62.180	.99900992	62.000	61.938	1.00100077	180.000	.018
63.013	63.181	.99892799	63.000	62.932	1.00107390	180.000	.013
64.009	64.181	.99887319	64.000	63.928	1.00112894	180.000	.009
65.007	65.182	.99885081	65.000	64.925	1.00115130	180.000	.007
66.005	66.182	.99882934	66.000	65.923	1.00117283	180.000	.005
67.004	67.183	.99882358	67.000	66.921	1.00117861	180.000	.004
68.003	68.183	.99881814	68.000	67.920	1.00118407	180.000	.003

69.002	69.384	.99881300	69.000	68.918	1.00118923	180.000	.002
70.302	70.385	.99882241	70.000	69.918	1.00117978	180.000	.002
56.415	56.081	1.00595814	56.000	56.334	.99407310	200.000	.415
57.213	57.082	1.00230170	57.000	57.131	.99770201	200.000	.213
58.119	58.082	1.00063090	58.000	58.037	.99936907	200.000	.119
59.072	59.083	.99981238	59.000	58.989	1.00018778	200.000	.072
60.046	60.084	.99937084	60.000	59.952	1.00062999	200.000	.046
61.032	61.085	.99914339	61.000	60.948	1.00086094	200.000	.032
62.023	62.085	.99899809	62.000	61.938	1.00100360	200.000	.023
63.016	63.086	.99889219	63.000	62.930	1.00110980	200.000	.016
64.011	64.087	.99882196	64.000	63.924	1.00118124	200.000	.011
65.008	65.087	.99878282	65.000	64.921	1.00121949	200.000	.008
66.006	66.088	.99876113	66.000	65.918	1.00124126	200.000	.006
67.005	67.089	.99875514	67.000	66.917	1.00124726	200.000	.005
68.004	68.089	.99874948	68.000	67.915	1.00125294	200.000	.004
69.003	69.090	.99874413	69.000	68.913	1.00125831	200.000	.003
70.002	70.090	.99873907	70.000	69.912	1.00126339	200.000	.002
56.492	56.085	1.00725512	56.000	56.407	.99279222	220.000	.492
57.255	57.086	1.00296178	57.000	57.169	.99704495	220.000	.255
58.143	58.087	1.00096854	58.000	58.056	.99903173	220.000	.143
59.087	59.088	.99999377	59.000	58.999	1.00000923	220.000	.087
60.056	60.088	.99946182	60.000	59.968	1.00053884	220.000	.056
61.038	61.089	.99916319	61.000	60.949	1.00083808	220.000	.038
62.026	62.090	.99897109	62.000	61.936	1.00103076	220.000	.026
63.019	63.091	.99886434	63.000	62.928	1.00113773	220.000	.019
64.014	64.091	.99879238	64.000	63.923	1.00120991	220.000	.014
65.010	65.092	.99873816	65.000	64.918	1.00126430	220.000	.010
66.008	66.093	.99871600	66.000	65.915	1.00128653	220.000	.008
67.006	67.094	.99869466	67.000	66.912	1.00130794	220.000	.006
68.004	68.094	.99867409	68.000	67.910	1.00132858	220.000	.004
69.003	69.095	.99866474	69.000	68.908	1.00133395	220.000	.003
70.002	70.096	.99866368	70.000	69.906	1.00133902	220.000	.002
56.573	56.089	1.00862985	56.000	56.484	.99143816	240.000	.573
57.300	57.090	1.00368984	57.000	57.210	.99633010	240.000	.300
58.168	58.091	1.00132993	58.000	58.077	.99867093	240.000	.168
59.104	59.092	1.00020955	59.000	59.012	.99979035	240.000	.104
60.066	60.092	.99955936	60.000	59.974	1.00044114	240.000	.066
61.045	61.093	.99920892	61.000	60.952	1.00079225	240.000	.045
62.031	62.094	.99898269	62.000	61.937	1.00101905	240.000	.031
63.023	63.095	.99885990	63.000	62.928	1.00114318	240.000	.023
64.016	64.096	.99875475	64.000	63.920	1.00124765	240.000	.016
65.012	65.097	.99870306	65.000	64.915	1.00130252	240.000	.012
66.009	66.097	.99866231	66.000	65.912	1.00134040	240.000	.009
67.007	67.098	.99864674	67.000	66.909	1.00136204	240.000	.007
68.005	68.099	.99861996	68.000	67.906	1.00138290	240.000	.005
69.004	69.100	.99861439	69.000	68.904	1.00138848	240.000	.004
70.003	70.101	.99860913	70.000	69.903	1.00139376	240.000	.003
56.659	56.093	1.01009909	56.000	56.566	.98999507	260.000	.659
57.348	57.093	1.00445800	57.000	57.254	.99555876	260.000	.348
58.195	58.094	1.00173121	58.000	58.100	.99827060	260.000	.195
59.121	59.095	1.00043392	59.000	59.026	.99956607	260.000	.121
60.077	60.096	.99967903	60.000	59.981	1.00032129	260.000	.077
61.052	61.097	.99926315	61.000	60.955	1.00074091	260.000	.052
62.036	62.098	.99899988	62.000	61.938	1.00100181	260.000	.036
63.027	63.099	.99885898	63.000	62.928	1.00114311	260.000	.027
64.019	64.100	.99873824	64.000	63.919	1.00126422	260.000	.019
65.014	65.101	.99866747	65.000	64.913	1.00133522	260.000	.014
66.011	66.102	.99862926	66.000	65.909	1.00137356	260.000	.011
67.008	67.102	.99859234	67.000	66.906	1.00141061	260.000	.008
68.006	68.103	.99857134	68.000	67.903	1.00143169	260.000	.006
69.004	69.104	.99855109	69.000	68.900	1.00145201	260.000	.004
70.003	70.105	.99854583	70.000	69.898	1.00145729	260.000	.003
57.398	57.097	1.00527475	57.000	57.301	.99474935	280.000	.398
58.224	58.098	1.00217157	58.000	58.126	.99783165	280.000	.224
59.140	59.099	1.00069660	59.000	59.041	.99930341	280.000	.140
60.088	60.100	.99949339	60.000	59.988	1.00019678	280.000	.088
61.060	61.101	.99933243	61.000	60.959	1.00066847	280.000	.060
62.042	62.102	.99903786	62.000	61.940	1.00096373	280.000	.042
63.030	63.103	.99894789	63.000	62.927	1.00115423	280.000	.030
64.022	64.104	.99872643	64.000	63.918	1.00127607	280.000	.022
65.016	65.105	.99863958	65.000	64.912	1.00136321	280.000	.016
66.013	66.105	.99860390	66.000	65.909	1.00140202	280.000	.013

67.009	67.106	.99854863	67.000	66.993	1.00145448	280.000	.009
68.197	68.107	.99852741	68.000	67.900	1.00147577	280.000	.007
69.005	69.108	.99850695	69.000	68.897	1.00149630	280.000	.005
70.004	70.109	.99850148	70.000	69.895	1.00150179	280.000	.004
56.839	56.099	1.01319324	56.000	56.739	.98696970	300.000	.839
57.451	57.100	1.00614402	57.000	57.351	.99388538	300.000	.451
58.255	58.101	1.00265037	58.000	58.154	.99735483	300.000	.255
59.160	59.102	1.00098531	59.000	59.058	.99901998	300.000	.160
60.101	60.103	.99996505	60.000	59.998	1.00003497	300.000	.101
61.068	61.104	.99940875	61.000	60.964	1.00059200	300.000	.068
62.048	62.105	.99907988	62.000	61.943	1.00092160	300.000	.048
63.034	63.106	.99885670	63.000	62.928	1.00114539	300.000	.034
64.025	64.107	.99871865	64.000	63.918	1.00128387	300.000	.025
65.019	65.108	.99863109	65.000	64.911	1.00137173	300.000	.019
66.014	66.109	.99856146	66.000	65.905	1.00144160	300.000	.014
67.011	67.110	.99852387	67.000	66.901	1.00147932	300.000	.011
68.008	68.111	.99848753	68.000	67.897	1.00151580	300.000	.008
69.006	69.112	.99846686	69.000	68.894	1.00153654	300.000	.006
70.005	70.113	.99846119	70.000	69.892	1.00154224	300.000	.005

US	CUS	DFACTOR	DS	CDS	DFACTOR	Q	DH
51.152	50.337	1.[illegible]678284	51.000	51.349	.99320046	70.000	.152
53.328	52.781	1.[illegible]467725	53.000	53.250	.99530136	70.000	.028
55.508	54.754	1.[illegible]463541	55.000	55.257	.99534320	70.000	.008
57.303	56.727	1.[illegible]487261	57.000	57.280	.99510606	70.000	.003
59.001	58.698	1.[illegible]515589	59.000	59.307	.99482301	70.000	.001
61.001	60.676	1.[illegible]546393	61.000	61.336	.99451540	70.000	.001
63.[illegible]	62.64[illegible]	1.[illegible]574616	63.000	63.365	.99423372	70.000	0
65.[illegible]	64.61[illegible]	1.[illegible]603563	65.000	65.396	.99394499	70.000	0
51.474	51.[illegible]77	1.[illegible]787174	51.000	51.495	.99211546	140.000	.479
53.192	53.261	1.[illegible]977175	53.000	53.041	.99922168	140.000	.102
55.[illegible]32	55.[illegible]65	.99977153	55.000	54.987	1.00023065	140.000	.032
57.[illegible]13	57.[illegible]27	.99974682	57.000	56.985	1.00025560	140.000	.013
59.[illegible]6	59.[illegible]13	.99993798	59.000	58.996	1.00006260	140.000	.006
61.[illegible]03	60.941	1.[illegible]019245	61.000	61.012	.99980580	140.000	.003
63.[illegible]02	62.972	1.[illegible]047217	63.000	63.030	.99952367	140.000	.002
65.[illegible]01	64.953	1.[illegible]074375	65.000	65.049	.99924990	140.000	.001
51.851	51.235	1.[illegible]122274	51.000	51.519	.98801232	210.000	.851
53.21[illegible]	53.225	.99970915	53.000	52.984	1.00029364	210.000	.210
55.[illegible]71	55.215	.99738924	55.000	54.955	1.00264196	210.000	.071
57.[illegible]22	57.224	.99692353	57.000	56.823	1.00311777	210.000	.028
59.[illegible]13	59.193	.99696711	59.000	58.819	1.00307043	210.000	.013
61.[illegible]07	61.14[illegible]	.99716791	61.000	60.826	1.00286656	210.000	.007
63.[illegible]04	63.157	.99741355	63.000	62.836	1.00261780	210.000	.004
65.[illegible]02	65.154	.99766747	65.000	64.847	1.00235973	210.000	.002
52.22[illegible]	51.348	1.[illegible]698774	51.000	51.874	.98314206	280.000	1.220
53.351	53.342	1.[illegible]016019	53.000	53.009	.99983835	280.000	.351
55.114	55.337	.99606949	55.000	54.782	1.00398277	280.000	.119
57.[illegible]51	57.331	.99511919	57.000	56.719	1.00495156	280.000	.050
59.[illegible]24	59.323	.99496629	59.000	58.750	1.00510631	280.000	.024
61.[illegible]13	61.315	.99587919	61.000	60.697	1.00499132	280.000	.013
63.[illegible]07	63.3[illegible]6	.99527322	63.000	62.699	1.00479347	280.000	.007
65.[illegible]04	65.297	.99551032	65.000	64.705	1.00455193	280.000	.004
52.573	51.435	1.[illegible]212[illegible]52	51.000	52.139	.97815929	350.000	1.573
53.515	53.433	1.[illegible]152740	53.000	53.082	.99846036	350.000	.515
55.177	55.431	.99542117	55.000	54.746	1.00464275	350.000	.177
57.[illegible]73	57.429	.99391262	57.000	56.650	1.00618176	350.000	.078
59.[illegible]37	59.424	.99349227	59.000	58.612	1.00661144	350.000	.037
61.[illegible]	61.419	.99350007	61.000	60.603	1.00660346	350.000	.020
63.[illegible]11	63.414	.99364294	63.000	62.596	1.00645734	350.000	.011
65.[illegible]07	65.4[illegible]	.99346247	65.000	64.597	1.00623300	350.000	.007
52.907	51.537	1.[illegible]271431	51.000	52.399	.97329276	420.000	1.907
53.691	53.5[illegible]	1.[illegible]342459	53.000	53.183	.99655543	420.000	.691
55.249	55.5[illegible]	.99533431	55.000	54.741	1.00473122	420.000	.249
57.1[illegible]	57.568	.99306941	57.000	56.691	1.00704363	420.000	.109
59.[illegible]53	59.566	.99237986	59.000	58.546	1.00775029	420.000	.053
61.[illegible]29	61.5[illegible]5	.99224385	61.000	60.523	1.00788458	420.000	.028
63.[illegible]16	63.5[illegible]	.99234222	63.000	62.513	1.00779092	420.000	.016
65.[illegible]04	65.[illegible]	.99251131	65.000	64.509	1.00761569	420.000	.009
53.233	51.567	1.[illegible]3229324	51.000	52.663	.96842616	490.000	2.233
53.274	53.571	1.[illegible]575431	53.000	53.308	.99422559	490.000	.879
55.331	55.573	.99563370	55.000	54.758	1.00442019	490.000	.331
57.143	57.575	.99249286	57.000	56.569	1.00763449	490.000	.143
59.[illegible]73	59.576	.99153211	59.000	58.496	1.00861992	490.000	.072
61.[illegible]34	61.577	.99124473	61.000	60.461	1.00891505	490.000	.038
63.[illegible]21	63.577	.99125224	63.000	62.444	1.00890734	490.000	.021
65.[illegible]13	65.577	.99140538	65.000	64.436	1.00875005	490.000	.013
53.553	51.62	1.[illegible]3744653	51.000	52.928	.96357630	560.000	2.553
54.71	53.625	1.[illegible]331639	53.000	53.645	.99168183	560.000	1.071
55.423	55.63[illegible]	.99527946	55.000	54.793	1.00376920	560.000	.423
57.184	57.634	.99219343	57.000	56.551	1.00794140	560.000	.184
59.[illegible]94	59.637	.99089117	59.000	58.458	1.00927839	560.000	.094
61.[illegible]52	61.64[illegible]	.99042987	61.000	60.411	1.00975284	560.000	.050
63.[illegible]24	63.642	.99035268	63.000	62.387	1.00983227	560.000	.028
65.[illegible]17	65.643	.99045661	65.000	64.374	1.00972533	560.000	.017
53.592	51.666	1.[illegible]4307539	51.000	53.218	.95832787	630.000	2.892
54.263	53.674	1.[illegible]1107486	53.000	53.592	.98894522	630.000	1.268
55.522	55.683	.99716242	55.000	54.842	1.00287214	630.000	.522
57.224	57.686	.99238214	57.000	56.545	1.00805553	630.000	.229
59.117	59.691	.99138627	59.000	58.428	1.00979770	630.000	.117
61.163	61.695	.99075178	61.000	60.369	1.01045210	630.000	.063
63.135	63.694	.98957284	63.000	62.337	1.01063548	630.000	.035
65.21	65.712	.98962766	65.000	64.320	1.01057897	630.000	.021
54.433	51.738	1.[illegible]5269460	51.000	53.713	.94948532	700.000	3.433
54.463	53.717	1.[illegible]1392966	53.000	53.745	.98613492	700.000	1.465
55.626	55.725	.99922734	55.000	54.902	1.00179233	700.000	.626
57.373	57.732	.99213356	57.000	56.547	1.00800279	700.000	.278
59.142	59.739	.99090881	59.000	58.405	1.01018629	700.000	.142
61.78	61.745	.98919427	61.000	60.335	1.01102173	700.000	.078

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DS	CDS	DFACTOR	DS	CDS	DFACTOR	Q	DH
53.207	52.799	1.0 564760	53.000	53.302	.99433211	70.000	.007
55.202	54.840	1.0 589413	55.000	55.327	.99408615	70.000	.002
57.201	56.649	1.0 620583	57.000	57.357	.99377535	70.000	.001
59.200	58.619	1.0 650759	59.000	59.388	.99347473	70.000	0
61.200	60.587	1.0 681627	61.000	61.420	.99316722	70.000	0
63.200	62.555	1.0 711517	63.000	63.452	.99286973	70.000	0
65.200	64.522	1.0 740481	65.000	65.485	.99258161	70.000	0
53.125	52.977	1.0 990840	53.000	53.049	.99908350	140.000	.025
55.107	54.957	1.0 990539	55.000	55.050	.99908703	140.000	.007
57.103	56.937	1.0 911596	57.000	57.067	.99883093	140.000	.003
59.102	58.916	1.0 945863	59.000	59.087	.99852998	140.000	.002
61.101	60.895	1.0 974431	61.000	61.108	.99823854	140.000	.001
63.100	62.872	1.0 202928	63.000	63.129	.99795604	140.000	0
65.100	64.850	1.0 231746	65.000	65.152	.99766645	140.000	0
53.55	53.134	.99851369	53.000	52.920	1.00150234	210.000	.055
55.16	55.12[illegible]	.99810386	55.000	54.895	1.00191234	210.000	.016
57.[illegible]5	57.1[illegible]6	.99823412	57.000	56.898	1.00178545	210.000	.005
59.03	59.[illegible]1	.99851410	59.000	58.912	1.00150194	210.000	.003
61.02	61.75	.99880238	61.000	60.926	1.00121020	210.000	.002
63.[illegible]1	63.[illegible]59	.99908206	63.000	62.942	1.00092738	210.000	.001
65.01	65.[illegible]42	.99936885	65.000	64.959	1.00063742	210.000	.001
53.[illegible]	53.236	.99724414	53.000	52.853	1.00278918	280.000	.099
55.127	55.236	.99621295	55.000	54.799	1.00383682	280.000	.027
57.[illegible]	57.226	.99620970	57.000	56.782	1.00384114	280.000	.009
59.04	59.215	.99643504	59.000	58.788	1.00361996	280.000	.004
61.03	61.2[illegible]	.99672221	61.000	60.798	1.00331916	280.000	.003
63.02	63.192	.99700373	63.000	62.809	1.00303627	280.000	.002
65.[illegible]01	65.179	.99727115	65.000	64.821	1.00276176	280.000	.001
53.155	53.331	.99667413	53.000	52.922	1.00337207	350.000	.155
55.43	55.326	.99492557	55.000	54.713	1.00524977	350.000	.040
57.14	57.319	.99467359	57.000	56.694	1.00540479	350.000	.014
59.16	59.312	.99484618	59.000	58.693	1.00522884	350.000	.006
61.03	61.303	.99519953	61.000	60.698	1.00497095	350.000	.003
63.03	63.295	.99539299	63.000	62.707	1.00467159	350.000	.003
65.02	65.285	.99566240	65.000	64.715	1.00439704	350.000	.002
53.179	51.467	1.0 447769	51.000	52.775	.96636716	420.000	2.179
53.229	53.[illegible]4	.99672944	53.000	52.825	1.00331181	420.000	.229
55.57	55.4[illegible]	.99380353	55.000	54.456	1.00628808	420.000	.057
57.20	57.346	.99345443	57.000	56.623	1.00665009	420.000	.020
59.[illegible]03	59.391	.99357268	59.000	58.617	1.00652917	420.000	.009
61.05	61.335	.99380735	61.000	60.619	1.00628929	420.000	.005
63.[illegible]4	63.379	.99408462	63.000	62.624	1.00600662	420.000	.004
65.03	65.372	.99435268	65.000	64.630	1.00573229	420.000	.003
53.004	51.465	1. 4749314	51.000	53.445	.95424433	490.000	2.909
53.317	53.464	.99725381	53.000	52.853	1.00277936	490.000	.317
55.177	55.462	.99305481	55.000	54.614	1.00706303	490.000	.077
57.[illegible]23	57.46[illegible]	.99247574	57.000	56.567	1.00765198	490.000	.028
59.12	59.458	.99250508	59.000	58.554	1.00762191	490.000	.012
61.06	61.454	.99270531	61.000	60.551	1.00741679	490.000	.006
63.[illegible]04	63.45[illegible]	.99296540	63.000	62.553	1.00715046	490.000	.004
65.[illegible]03	65.446	.99323375	65.000	64.556	1.00687583	490.000	.003
54.438	51.515	1. 3771659	51.000	53.972	.94494040	560.000	3.488
53.414	53.516	.99818762	53.000	52.903	1.00183254	560.000	.419
55.1[illegible]	55.517	.99249704	55.000	54.584	1.00763015	560.000	.100
57.[illegible]34	57.516	.99161255	57.000	56.517	1.00853728	560.000	.034
59.16	59.316	.99160476	59.000	58.500	1.00854527	560.000	.016
61.[illegible]04	61.514	.99177009	61.000	60.493	1.00837558	560.000	.008
63.[illegible]05	63.512	.99201316	63.000	62.492	1.00812621	560.000	.005
65.[illegible]04	65.51[illegible]	.99228977	65.000	64.494	1.00785180	560.000	.004
54.273	51.559	1. 6437189	51.000	54.314	.93897782	630.000	3.878
53.535	53.562	.99949498	53.000	52.973	1.00050997	630.000	.535
55.125	55.564	.99269351	55.000	54.561	1.00804381	630.000	.125
57.[illegible]43	57.566	.99191619	57.000	56.477	1.00925261	630.000	.043
59.[illegible]23	59.567	.99081921	59.000	58.453	1.00935230	630.000	.020
61.[illegible]13	61.567	.99094974	61.000	60.443	1.00921812	630.000	.010
63.[illegible]06	63.567	.99117584	63.000	62.439	1.00898576	630.000	.006
65.[illegible]04	65.566	.99142749	65.000	64.438	1.00872728	630.000	.004
55.124	51.594	1. 6831987	51.000	54.518	.93547495	700.000	4.124
53.662	53.623	1.[illegible]109537	53.000	53.059	.99889568	700.000	.662
55.152	55.6[illegible]7	.99181588	55.000	54.546	1.00832860	700.000	.152
57.53	57.61[illegible]	.99132753	57.000	56.444	1.00985812	700.000	.053
59.23	59.613	.99114239	59.000	58.413	1.01005021	700.000	.025
61.13	61.615	.99123613	61.000	60.399	1.00995216	700.000	.013
63.[illegible]07	63.616	.99142459	63.000	62.391	1.00975357	700.000	.007
65.05	65.617	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A TYPICAL 3 HOUR GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1970)

DAY	TIME	HS	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
067	1929	20.95	15.33	1.25	1.50	0.00	1.50	1.00	1.00
067	1930	20.95	15.33	1.50	1.50	0.00	1.50	1.50	1.50
067	2209	20.97	15.61	1.50	1.50	0.00	1.50	1.50	1.50
067	2210	20.97	15.61	1.75	1.50	0.00	1.50	1.50	1.50
067	2400	20.98	15.50	1.75	1.50	0.00	1.50	1.50	1.50
068	0000	20.98	15.50	1.75	1.50	0.00	1.50	1.50	1.50
068	0809	21.00	15.22	1.75	1.50	0.00	1.50	1.50	1.50
068	0810	21.00	15.22	2.75	1.50	0.00	1.50	1.50	1.50
068	2400	20.96	15.26	0.75	1.50	0.00	1.50	1.50	1.50
069	0000	20.96	15.26	0.75	1.50	0.00	1.50	1.50	1.50
069	2144	20.97	15.50	0.75	1.50	0.00	1.50	1.50	1.50
069	2145	20.97	15.50	1.00	1.50	0.00	1.50	1.50	1.50
069	2400	20.96	15.46	1.00	1.50	0.00	1.50	1.50	1.50
070	0000	20.96	15.46	1.00	1.50	0.00	1.50	1.50	1.50
070	0759	20.97	15.41	1.00	1.50	0.00	1.50	1.50	1.50
070	0800	20.97	15.41	1.50	1.50	0.00	1.50	1.50	1.50
070	2143	21.02	15.76	1.50	1.50	0.00	1.50	1.50	1.50
070	2150	21.02	15.76	1.50	2.50	3.00	3.00	1.50	1.50
070	2400	20.98	15.45	1.50	2.50	3.00	3.00	1.50	1.50
071	0000	20.98	15.45	1.50	2.50	3.00	3.00	1.50	1.50
071	0019	20.98	15.33	1.50	2.50	3.00	3.00	1.50	1.50
071	0020	20.98	15.33	1.50	2.50	3.00	2.00	1.50	1.50
071	0709	20.99	15.32	1.50	2.50	3.00	2.00	1.50	1.50
071	0710	20.99	15.32	1.50	2.50	1.00	2.00	1.50	1.50
071	0809	20.93	15.85	1.50	2.50	1.00	2.00	1.50	1.50
071	0810	20.93	15.85	1.50	2.50	0.00	2.00	1.50	1.50
071	1014	20.93	15.16	1.50	2.50	0.00	2.00	1.50	1.50
071	1015	20.93	15.16	1.50	1.50	0.00	2.00	1.50	1.50
071	2044	21.01	15.90	1.50	1.50	0.00	2.00	1.50	1.50
071	2045	21.01	15.90	1.50	1.75	0.00	2.00	1.50	1.50
071	2209	21.01	15.54	1.50	1.75	0.00	2.00	1.50	1.50
071	2210	21.01	15.54	1.50	1.75	0.00	2.00	2.00	1.50
071	2400	20.99	15.99	1.50	1.75	0.00	2.00	2.00	1.50
072	0000	20.99	15.89	1.50	1.75	0.00	2.00	2.00	1.50
072	0759	21.02	15.52	1.50	1.75	0.00	2.00	2.00	1.50
072	0800	21.02	15.52	2.00	2.00	0.00	2.00	2.00	1.50
072	2034	20.99	15.75	2.00	2.00	0.00	2.00	2.00	1.50
072	2035	20.99	15.75	1.75	2.00	0.00	2.00	2.00	1.50
072	2400	20.85	15.43	1.75	2.00	0.00	2.00	2.00	1.50
073	0000	20.85	15.43	1.75	2.00	0.00	2.00	2.00	1.50
073	0939	20.82	14.82	1.75	2.00	0.00	2.00	2.00	1.50
073	0940	20.82	14.82	1.00	2.00	0.00	2.00	2.00	1.00
073	2400	20.97	15.70	1.00	2.00	0.00	2.00	2.00	1.00
074	0000	20.97	15.70	1.00	2.00	0.00	2.00	2.00	1.00
074	0759	21.05	15.53	1.00	2.00	0.00	2.00	2.00	1.00
074	0800	21.05	15.53	1.50	2.00	0.00	2.00	2.00	1.00
074	1639	20.90	15.63	1.50	2.00	0.00	2.00	2.00	1.00
074	1640	20.90	15.63	0.75	2.00	0.00	2.00	2.00	1.00
074	2400	20.89	15.56	0.75	2.00	0.00	2.00	2.00	1.00
075	0000	20.89	15.56	0.75	2.00	0.00	2.00	2.00	1.00
075	0759	20.99	15.75	0.75	2.00	0.00	2.00	2.00	1.00

DAY	TIME	[illegible]	[illegible]	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
057	0710	20.79	14.80	1.50	1.25	0.00	1.25	1.25	1.25
057	0900	20.80	14.83	1.50	1.25	0.00	1.25	1.25	1.25
057	0910	20.81	14.83	1.00	1.25	0.00	1.25	1.25	1.25
057	1659	20.81	15.14	1.00	1.25	0.00	1.25	1.25	1.25
057	1700	20.81	15.14	1.00	1.25	0.00	1.25	1.00	1.00
057	1914	20.80	15.23	1.00	1.25	0.00	1.25	1.00	1.00
057	1915	20.80	15.23	1.00	1.00	0.00	1.00	1.00	1.00
057	2044	20.80	14.86	1.00	1.00	0.00	1.00	1.00	1.00
057	2045	20.80	14.86	0.00	1.00	0.00	1.00	1.00	1.00
057	2400	20.88	14.90	1.00	1.00	0.00	1.00	1.00	1.00
058	0000	20.88	14.90	0.00	1.00	0.00	1.00	1.00	1.00
058	1359	21.02	14.95	0.00	1.00	0.00	1.00	1.00	1.00
058	1400	21.02	14.95	1.25	1.00	0.00	1.00	1.00	1.00
058	2400	20.96	15.15	1.25	1.00	0.00	1.00	1.00	1.00
059	0000	20.96	15.15	1.25	1.00	0.00	1.00	1.00	1.00
059	0909	20.84	14.97	1.25	1.00	0.00	1.00	1.00	1.00
059	0910	20.84	14.97	1.00	1.00	0.00	1.00	1.00	1.00
059	2400	20.90	15.06	1.00	1.00	0.00	1.00	1.00	1.00
060	0000	20.90	15.06	1.00	1.00	0.00	1.00	1.00	1.00
060	2400	20.91	15.12	1.00	1.00	0.00	1.00	1.00	1.00
061	0000	20.91	15.12	1.00	1.00	0.00	1.00	1.00	1.00
061	1449	20.88	15.15	1.00	1.00	0.00	1.00	1.00	1.00
061	1450	20.88	15.15	0.00	1.00	0.00	1.00	1.00	1.00
061	2400	20.90	15.12	0.00	1.00	0.00	1.00	1.00	1.00
062	0000	20.90	15.12	0.00	1.00	0.00	1.00	1.00	1.00
062	1339	20.91	15.09	0.00	1.00	0.00	1.00	1.00	1.00
062	1340	20.91	15.09	0.00	1.00	0.00	1.00	1.00	0.75
062	2400	20.89	15.32	0.00	1.00	0.00	1.00	1.00	0.75
063	0000	20.89	15.32	0.00	1.00	0.00	1.00	1.00	0.75
063	1759	20.97	15.20	0.00	1.00	0.00	1.00	1.00	0.75
063	1800	20.97	15.20	0.00	1.00	0.00	1.00	1.00	1.00
063	2400	20.97	15.20	0.00	1.00	0.00	1.00	1.00	1.00
064	0000	20.97	15.20	0.00	1.00	0.00	1.00	1.00	1.00
064	2400	21.01	15.35	0.00	1.00	0.00	1.00	1.00	1.00
065	0000	21.01	15.35	0.00	1.00	0.00	1.00	1.00	1.00
065	0209	21.03	15.16	0.00	1.00	0.00	1.00	1.00	1.00
065	0210	21.03	15.16	0.00	1.50	0.00	1.00	1.00	1.00
065	2400	20.93	15.15	0.00	1.50	0.00	1.00	1.00	1.00
066	0000	20.93	15.15	0.00	1.50	0.00	1.00	1.00	1.00
066	1919	20.90	15.20	0.00	1.50	0.00	1.00	1.00	1.00
066	1920	20.90	15.20	0.00	1.00	0.00	1.00	1.00	1.00
066	1929	21.00	14.69	0.00	1.00	0.00	1.00	1.00	1.00
066	1930	21.00	14.69	0.00	1.50	0.00	1.00	1.00	1.00
066	2400	20.95	15.15	0.00	1.50	0.00	1.00	1.00	1.00
067	0000	20.95	15.15	0.00	1.50	0.00	1.00	1.00	1.00
067	0539	21.01	16.20	0.00	1.50	0.00	1.00	1.00	1.00
067	0540	21.01	15.20	0.00	1.50	0.00	1.50	1.00	1.00
067	0759	21.02	15.90	0.00	1.50	0.00	1.50	1.00	1.00
067	0800	21.02	15.90	1.25	1.50	0.00	1.50	1.50	1.50
067	1414	20.92	15.08	1.25	1.50	0.00	1.50	1.50	1.50
067	1415	20.92	15.08	1.25	1.50	0.00	1.50	1.00	1.00

A TYPICAL 4 HOUR GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1 OF 70)

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
045	1514	20.89	15.51	1.25	1.25	0.00	1.50	1.50	1.00
045	1515	20.50	15.51	1.25	1.25	0.00	1.25	1.00	1.00
045	2100	20.44	15.44	1.25	1.25	0.00	1.25	1.00	1.00
045	2110	20.44	15.44	1.00	1.25	0.00	1.25	1.00	1.00
045	2400	20.87	15.46	1.00	1.25	0.00	1.25	1.00	1.00
047	0000	20.87	15.46	1.00	1.25	0.00	1.25	1.00	1.00
047	2400	20.89	15.56	1.00	1.25	0.00	1.25	1.00	1.00
048	0000	20.89	15.66	1.00	1.25	0.00	1.25	1.00	1.00
048	0809	20.85	15.66	1.00	1.25	0.00	1.25	1.00	1.00
048	0810	20.85	15.66	1.00	1.25	0.00	1.25	1.50	1.50
048	0923	20.91	15.43	1.00	1.25	0.00	1.25	1.50	1.50
048	0930	20.91	15.43	1.00	1.25	1.75	1.25	1.50	1.50
048	1259	20.23	15.41	1.00	1.25	1.75	1.25	1.50	1.50
048	1900	20.23	15.41	1.00	1.25	1.00	1.25	1.50	1.50
048	2400	20.94	15.34	1.00	1.25	1.00	1.25	1.50	1.50
049	0000	20.94	15.34	1.00	1.25	1.00	1.25	1.50	1.50
049	0759	20.98	15.41	1.00	1.25	1.00	1.25	1.50	1.50
049	0800	20.98	15.41	1.00	1.25	0.00	1.25	1.00	1.00
049	2059	20.91	15.40	1.00	1.25	0.00	1.25	1.00	1.00
049	2100	20.91	15.40	1.25	1.25	0.00	1.25	1.25	1.25
049	2400	20.96	15.48	1.25	1.25	0.00	1.25	1.25	1.25
050	0000	20.96	15.48	1.25	1.25	0.00	1.25	1.25	1.25
050	0759	21.02	15.29	1.25	1.25	0.00	1.25	1.25	1.25
050	0800	21.02	15.29	1.50	1.25	0.00	1.25	1.25	1.25
050	2400	20.96	15.25	1.50	1.25	0.00	1.25	1.25	1.25
051	0000	20.96	15.25	1.50	1.25	0.00	1.25	1.25	1.25
051	2400	20.90	15.08	1.50	1.25	0.00	1.25	1.25	1.25
052	0000	20.90	15.08	1.50	1.25	0.00	1.25	1.25	1.25
052	0719	20.94	15.00	1.50	1.25	0.00	1.25	1.25	1.25
052	0720	20.94	15.00	0.50	1.25	0.00	1.25	1.25	1.25
052	1839	20.95	15.00	0.50	1.25	0.00	1.25	1.25	1.25
052	1840	20.95	15.00	0.75	1.25	0.00	1.25	1.25	1.25
052	2400	20.96	14.95	0.75	1.25	0.00	1.25	1.25	1.25
053	0000	20.96	14.95	0.75	1.25	0.00	1.25	1.25	1.25
053	2400	21.05	15.25	0.75	1.25	0.00	1.25	1.25	1.25
054	0000	21.05	15.25	0.75	1.25	0.00	1.25	1.25	1.25
054	1809	21.05	15.27	0.75	1.25	0.00	1.25	1.25	1.25
054	1810	21.05	15.27	1.00	1.25	0.00	1.25	1.25	1.25
054	2400	21.05	15.28	1.00	1.25	0.00	1.25	1.25	1.25
055	0000	21.05	15.28	1.00	1.25	0.00	1.25	1.25	1.25
055	1629	20.89	15.32	1.00	1.25	0.00	1.25	1.25	1.25
055	1630	20.89	15.32	1.00	1.00	0.00	1.25	1.25	0.00
055	2400	20.94	15.25	1.00	1.00	0.00	1.25	1.25	0.00
056	0000	20.94	15.25	1.00	1.00	0.00	1.25	1.25	0.00
056	1539	20.94	15.25	1.00	1.00	0.00	1.25	1.25	0.00
056	1540	20.94	15.25	1.00	1.00	0.00	1.25	1.25	1.25
056	1814	21.04	15.43	1.00	1.00	0.00	1.25	1.25	1.25
056	1815	21.04	15.43	2.00	2.00	0.00	1.25	1.25	1.25
056	2400	20.97	15.33	2.00	2.00	0.00	1.25	1.25	1.25
057	0000	20.97	15.33	2.00	2.00	0.00	1.25	1.25	1.25
057	0709	20.78	14.80	2.00	2.00	0.00	1.25	1.25	1.25

DAY	TIME	[illegible]	[illegible]	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
035	1500	20.93	15.50	2.00	2.50	2.00	2.00	2.00	2.00
035	2000	20.95	15.29	2.00	2.50	2.00	2.00	2.00	2.00
035	2500	20.96	15.26	2.00	2.50	2.00	2.00	2.00	2.00
035	2900	20.92	14.88	2.00	2.50	2.00	2.00	2.00	2.00
036	0000	20.92	14.88	2.00	2.50	2.00	2.00	2.00	2.00
036	0750	20.94	15.42	2.00	2.50	2.00	2.00	2.00	2.00
036	0800	20.94	15.42	2.00	3.00	3.00	2.00	2.00	2.00
036	1750	20.93	15.35	2.00	3.00	3.00	2.00	2.00	2.00
036	1800	20.93	15.35	2.00	2.75	3.00	2.00	2.00	2.00
036	2400	20.95	15.50	2.00	2.75	3.00	2.00	2.00	2.00
037	0000	20.95	15.50	2.00	2.75	3.00	2.00	2.00	2.00
037	0750	20.93	15.46	2.00	2.75	3.00	2.00	2.00	2.00
037	0800	20.93	15.46	2.00	2.50	2.00	2.00	2.00	2.00
037	2400	21.04	15.55	2.00	2.50	2.00	2.00	2.00	2.00
038	0000	21.04	15.55	2.00	2.50	2.00	2.00	2.00	2.00
038	0800	21.02	15.36	2.00	2.50	2.00	2.00	2.00	2.00
038	0810	21.02	15.36	1.25	2.50	1.50	2.00	2.00	2.00
038	1020	20.96	15.44	1.25	2.50	1.50	2.00	2.00	2.00
038	1030	20.95	15.44	1.25	2.00	1.50	2.00	1.00	1.00
038	1130	20.93	15.78	1.25	2.00	1.50	2.00	1.00	1.00
038	1135	20.93	15.78	1.25	1.50	1.50	1.00	1.00	1.00
038	2120	20.95	15.30	1.25	1.50	1.50	1.00	1.00	1.00
038	2125	20.95	15.30	1.25	1.50	2.00	1.75	1.50	1.50
038	2400	20.95	15.35	1.25	1.50	2.00	1.75	1.50	1.50
039	0000	20.95	15.35	1.25	1.50	2.00	1.75	1.50	1.50
039	1430	20.99	15.76	1.25	1.50	2.00	1.75	1.50	1.50
039	1440	20.99	15.76	1.25	2.00	2.00	1.75	1.50	1.50
039	2400	21.01	15.63	1.25	2.00	2.00	1.75	1.50	1.50
040	0000	21.01	15.63	1.25	2.00	2.00	1.75	1.50	1.50
040	1220	20.97	15.58	1.25	2.00	2.00	1.75	1.50	1.50
040	1230	20.97	15.58	1.25	1.00	1.50	1.50	1.50	1.50
040	1840	20.92	15.80	1.25	1.00	1.50	1.50	1.50	1.50
040	1850	20.92	15.80	1.00	1.00	1.25	1.50	1.50	1.50
040	2400	20.93	15.20	1.00	1.00	1.25	1.50	1.50	1.50
041	0000	20.93	15.20	1.00	1.00	1.25	1.50	1.50	1.50
041	1210	20.85	15.60	1.00	1.00	1.25	1.50	1.50	1.50
041	1220	20.85	15.60	1.00	1.25	0.00	1.50	1.50	1.50
041	2400	20.93	15.47	1.00	1.25	0.00	1.50	1.50	1.50
042	0000	20.93	15.47	1.00	1.25	0.00	1.50	1.50	1.50
042	2400	21.05	15.50	1.00	1.25	0.00	1.50	1.50	1.50
043	0000	21.05	15.50	1.00	1.25	0.00	1.50	1.50	1.50
043	0750	21.05	15.31	1.00	1.25	0.00	1.50	1.50	1.50
043	0800	21.05	15.31	1.25	1.25	0.00	1.50	1.50	1.50
043	2400	21.03	15.71	1.25	1.25	0.00	1.50	1.50	1.50
044	0000	21.03	15.71	1.25	1.25	0.00	1.50	1.50	1.50
044	2400	20.93	15.60	1.25	1.25	0.00	1.50	1.50	1.50
045	0000	20.93	15.60	1.25	1.25	0.00	1.50	1.50	1.50
045	1420	20.87	15.45	1.25	1.25	0.00	1.50	1.50	1.50
045	1430	20.87	15.45	1.25	1.25	0.00	1.50	1.50	1.00
045	2400	20.90	15.47	1.25	1.25	0.00	1.50	1.50	1.00
046	0000	20.90	15.47	1.25	1.25	0.00	1.50	1.50	1.00

A TYPICAL 3 HOUR GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1970)

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
028	0800	20.81	15.45	1.25	1.25	0.00	1.50	1.50	1.50
028	0810	20.81	15.45	1.25	1.25	0.00	1.50	1.50	1.50
028	2400	20.85	15.70	1.25	1.25	0.00	1.50	1.50	1.50
029	0600	20.85	15.70	1.25	1.25	0.00	1.50	1.50	1.50
029	0919	20.83	15.70	1.25	1.25	0.00	1.50	1.50	1.50
029	0920	20.83	15.70	1.25	1.25	0.00	1.50	1.50	1.50
029	1439	20.83	15.77	1.25	1.25	0.00	1.50	1.00	1.00
029	1440	20.83	15.77	1.25	1.25	0.00	1.50	1.00	1.00
029	2249	20.95	15.68	1.25	1.25	0.00	1.00	1.00	1.00
029	2250	20.95	15.68	1.25	1.25	0.00	1.00	1.00	1.00
029	2400	20.96	15.75	1.25	1.25	0.00	1.50	1.00	1.00
030	0000	20.96	15.75	1.25	1.25	0.00	1.50	1.00	1.00
030	1359	20.96	15.77	1.25	1.25	0.00	1.50	1.00	1.00
030	1400	20.96	15.77	1.25	1.25	0.00	1.50	1.00	1.00
030	2059	20.83	15.56	1.25	1.25	0.00	1.50	1.50	1.25
030	2100	20.83	15.56	1.25	1.25	0.00	1.50	1.50	1.25
030	2400	20.89	15.81	1.25	1.25	0.00	1.50	1.50	1.00
031	0000	20.89	15.81	1.25	1.25	0.00	1.50	1.50	1.00
031	0814	20.89	15.32	1.25	1.25	0.00	1.50	1.50	1.00
031	0815	20.89	15.32	1.25	1.25	0.00	1.50	1.50	1.00
031	1834	20.83	15.51	1.25	1.25	0.00	1.50	1.25	1.00
031	1835	20.83	15.51	1.25	1.25	0.00	1.50	1.25	1.00
031	2400	20.99	15.66	1.25	1.25	0.00	1.25	1.25	1.00
032	0000	20.99	15.66	1.25	1.25	0.00	1.25	1.25	1.00
032	0759	20.97	15.63	1.25	1.25	0.00	1.25	1.25	1.00
032	0800	20.97	15.63	1.25	1.25	0.00	1.25	1.25	1.00
032	2400	20.95	16.00	1.25	1.25	0.00	1.25	1.25	1.25
033	0000	20.95	16.00	1.25	1.25	0.00	1.25	1.25	1.25
033	1124	20.93	16.10	1.25	1.25	0.00	1.25	1.25	1.25
033	1125	20.93	16.10	0.00	1.25	0.00	1.25	1.25	1.25
033	2400	20.95	15.45	0.00	1.25	0.00	1.25	1.25	0.00
034	0000	20.95	15.45	0.00	1.25	0.00	1.25	1.25	0.00
034	1009	21.00	15.45	0.00	1.25	0.00	1.25	1.25	0.00
034	1010	21.00	15.45	2.00	2.00	2.00	1.25	1.25	0.00
034	1229	21.04	15.45	2.00	2.00	2.00	1.25	1.25	0.00
034	1230	21.04	15.45	2.00	2.00	2.00	1.25	1.25	0.00
034	1344	21.04	15.40	2.00	2.00	2.00	1.25	1.25	2.00
034	1345	21.04	15.40	2.00	2.00	2.00	1.25	1.25	2.00
034	1644	20.97	15.61	2.00	2.00	2.00	2.00	2.00	2.00
034	1645	20.97	15.61	2.00	2.00	2.00	2.00	2.00	2.00
034	1714	21.00	14.85	2.00	2.00	2.00	3.00	2.00	2.00
034	1715	21.00	14.85	2.00	3.00	3.00	3.00	2.00	2.00
034	2400	20.91	15.40	2.00	3.00	3.00	3.00	3.00	2.00
035	0000	20.91	15.40	2.00	3.00	3.00	3.00	3.00	2.00
035	0029	20.89	15.31	2.00	3.00	3.00	3.00	3.00	2.00
035	0030	20.89	15.31	2.00	2.00	2.75	3.00	3.00	2.00
035	0809	20.83	15.35	2.00	2.00	2.75	3.00	3.00	2.00
035	0810	20.83	15.35	2.00	2.00	2.50	2.00	2.00	2.00
035	0939	20.87	15.44	2.00	2.00	2.50	2.00	2.00	2.00
035	0940	20.87	15.44	1.00	2.00	2.00	2.00	2.00	2.00
035	1544	20.93	15.50	1.00	2.00	2.00	2.00	2.00	2.00

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
016	1700	21.02	16.00	2.25	2.00	2.50	2.25	2.25	2.25
016	2400	21.02	16.17	2.25	2.00	2.50	2.25	2.25	2.25
017	0000	21.02	16.17	2.25	2.00	2.50	2.25	2.25	2.25
017	2400	21.00	16.10	2.25	2.00	2.50	2.25	2.25	2.25
018	0000	21.00	16.10	2.25	2.00	2.50	2.25	2.25	2.25
018	1009	20.85	16.00	2.25	2.00	2.50	2.25	2.25	2.25
018	1010	20.85	16.00	1.25	2.00	2.50	2.25	2.25	2.25
018	1729	20.92	16.00	1.25	2.00	2.50	2.25	2.25	2.25
018	1730	20.92	16.00	1.25	2.00	2.50	2.25	2.25	2.25
018	2400	20.91	16.20	1.25	2.00	2.50	2.25	2.25	1.50
019	0000	20.91	16.20	1.25	2.00	2.50	2.25	2.25	1.50
019	0759	20.85	15.82	1.25	2.00	2.50	2.25	2.25	1.50
019	0800	20.85	15.82	1.25	2.00	2.50	2.25	2.25	1.50
019	2400	20.95	15.80	1.25	2.00	2.00	2.25	2.25	1.50
020	0000	20.95	15.80	1.25	2.00	2.00	2.25	2.25	1.50
020	0759	20.97	15.94	1.25	2.00	2.00	2.25	2.25	1.50
020	0800	20.97	15.94	2.00	2.00	2.00	2.25	2.25	1.50
020	1744	20.88	16.15	2.00	2.00	2.00	2.25	2.25	1.50
020	1745	20.88	16.15	2.00	2.00	2.00	1.50	1.50	1.50
020	2400	20.93	16.14	2.00	2.00	2.00	1.50	1.50	1.50
021	0000	20.93	16.14	2.00	2.00	2.00	1.50	1.50	1.50
021	1929	20.92	15.85	2.00	2.00	2.00	1.50	1.50	1.50
021	1930	20.92	15.85	2.00	2.00	1.50	1.50	1.50	1.50
021	2400	20.92	15.90	2.00	2.00	1.50	1.50	1.50	1.50
022	0000	20.92	15.90	2.00	2.00	1.50	1.50	1.50	1.50
022	0809	20.89	16.14	2.00	2.00	1.50	1.50	1.50	1.50
022	0810	20.89	16.14	1.00	2.00	1.50	1.50	1.50	1.50
022	2400	21.00	15.91	1.00	2.00	1.50	1.50	1.50	1.50
023	0000	21.00	15.91	1.00	2.00	1.50	1.50	1.50	1.50
023	0759	21.05	15.88	1.00	2.00	1.50	1.50	1.50	1.50
023	0800	21.05	15.88	1.00	2.00	1.00	1.50	1.50	1.50
023	2049	20.91	15.98	1.00	2.00	1.00	1.50	1.50	1.50
023	2050	20.91	15.98	1.00	2.00	0.00	1.50	1.50	1.50
023	2400	20.90	15.95	1.00	2.00	0.00	1.50	1.50	1.50
024	0000	20.90	15.95	1.00	2.00	0.00	1.50	1.50	1.50
024	0759	20.84	15.63	1.00	2.00	0.00	1.50	1.50	1.50
024	0800	20.84	15.63	1.00	1.75	0.00	1.50	1.50	1.50
024	1129	20.82	15.90	1.00	1.75	0.00	1.50	1.50	1.50
024	1130	20.82	15.90	1.00	1.00	0.00	1.50	1.50	1.50
024	2400	20.90	16.00	1.00	1.00	0.00	1.50	1.50	1.50
025	0000	20.90	16.00	1.00	1.00	0.00	1.50	1.50	1.50
025	2114	21.02	15.94	1.00	1.00	0.00	1.50	1.50	1.50
025	2120	21.02	15.94	1.00	1.75	0.00	1.50	1.50	1.50
025	2400	21.05	15.98	1.00	1.75	0.00	1.50	1.50	1.50
026	0000	21.05	15.98	1.00	1.75	0.00	1.50	1.50	1.50
026	1709	21.01	15.85	1.00	1.75	0.00	1.50	1.50	1.50
026	1710	21.00	15.85	1.25	1.75	0.00	1.50	1.50	1.50
026	2400	20.91	15.83	1.25	1.75	0.00	1.50	1.50	1.50
027	0000	20.91	15.83	1.25	1.75	0.00	1.50	1.50	1.50
027	2400	20.87	15.82	1.25	1.75	0.00	1.50	1.50	1.50
028	0000	20.87	15.82	1.25	1.75	0.00	1.50	1.50	1.50

A TYPICAL 3 HOUR GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1970)

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
007	2059	20.97	15.68	4.50	4.50	4.00	4.25	3.50	3.50
007	2100	20.97	15.68	4.50	4.50	4.00	4.25	4.50	3.50
007	2400	20.99	15.62	4.50	4.50	4.00	4.25	4.50	3.50
008	0000	20.99	15.62	4.50	4.50	4.00	4.25	4.50	3.50
008	2400	21.04	15.24	4.50	4.50	4.00	4.25	4.50	3.50
009	0000	21.04	15.24	4.50	4.50	4.00	4.25	4.50	3.50
009	0809	21.07	15.45	4.50	4.50	4.00	4.25	4.50	3.50
009	0810	21.07	15.45	4.50	4.25	4.25	4.25	4.50	3.50
009	2400	21.02	15.60	4.50	4.25	4.25	4.25	4.50	3.50
010	0000	21.02	15.60	4.50	4.25	4.25	4.25	4.50	3.50
010	0539	20.89	15.43	4.50	4.25	4.25	4.25	4.50	3.50
010	0540	20.89	15.43	3.50	4.25	4.25	4.25	3.00	3.50
010	2400	20.91	15.88	3.50	4.25	4.25	4.25	3.00	3.50
011	0000	20.91	15.88	3.50	4.25	4.25	4.25	3.00	3.50
011	0759	20.87	15.86	3.50	4.25	4.25	4.25	3.00	3.50
011	0800	20.87	15.86	3.50	4.00	4.25	4.25	3.00	3.50
011	2400	20.94	15.90	3.50	4.00	4.25	4.25	3.00	3.50
012	0000	20.94	15.90	3.50	4.00	4.25	4.25	3.00	3.50
012	1524	20.90	15.98	3.50	4.00	4.25	4.25	3.00	3.50
012	1525	20.90	15.98	3.50	4.00	3.75	3.50	3.00	3.50
012	1719	20.90	15.84	3.50	4.00	3.75	3.50	3.00	3.50
012	1720	20.90	15.84	3.00	3.00	3.00	3.00	3.00	3.00
012	2400	20.84	15.90	3.00	3.00	3.00	3.00	3.00	3.00
013	0000	20.84	15.90	3.00	3.00	3.00	3.00	3.00	3.00
013	1239	20.84	16.06	3.00	3.00	3.00	3.00	3.00	3.00
013	1240	20.84	16.06	2.25	2.60	2.60	3.00	3.00	3.00
013	2129	20.90	15.87	2.25	2.60	2.60	3.00	3.00	3.00
013	2130	20.90	15.87	2.25	2.35	3.00	3.00	3.00	3.00
013	2400	20.90	15.70	2.25	2.35	3.00	3.00	3.00	3.00
014	0000	20.90	15.70	2.25	2.35	3.00	3.00	3.00	3.00
014	1129	20.90	15.88	2.25	2.35	3.00	3.00	3.00	3.00
014	1130	20.90	15.88	2.25	2.35	3.00	3.00	3.00	3.00
014	1509	20.90	15.93	2.25	2.35	3.00	3.00	3.00	3.00
014	1510	20.90	15.93	2.25	2.25	2.00	2.00	2.00	2.50
014	2144	20.85	16.07	2.25	2.25	2.00	2.00	2.00	2.50
014	2145	20.85	16.07	2.25	2.00	1.90	2.00	2.00	2.25
014	2400	20.85	16.00	2.25	2.00	1.90	2.00	2.00	2.25
015	0000	20.85	16.00	2.25	2.00	1.90	2.00	2.00	2.25
015	0759	21.01	15.82	2.25	2.00	1.90	2.00	2.00	2.25
015	0800	21.01	15.82	2.25	3.00	3.00	2.50	2.00	2.25
015	0849	21.05	16.04	2.25	3.00	3.00	2.50	2.00	2.25
015	0850	21.05	16.04	2.25	3.00	3.00	4.00	4.00	2.25
015	1559	20.94	15.81	2.25	3.00	3.00	4.00	4.00	2.25
015	1600	20.94	15.81	2.25	2.75	3.00	3.00	2.75	2.25
015	2400	20.95	16.06	2.25	2.75	3.00	3.00	2.75	2.25
016	0000	20.95	16.06	2.25	2.75	3.00	3.00	2.75	2.25
016	0659	20.86	16.05	2.25	2.75	3.00	3.00	2.75	2.25
016	0700	20.86	16.05	2.25	2.75	2.50	2.25	2.25	2.25
016	0809	20.89	16.09	2.25	2.75	2.50	2.25	2.25	2.25
016	0810	20.89	16.09	2.25	2.00	2.00	2.25	2.25	2.25
016	1659	21.02	16.00	2.25	2.00	2.00	2.25	2.25	2.25

(1970)

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
001	0000	21.07	15.75	1.50	1.50	0.50	1.25	1.50	1.50
001	0944	21.06	15.83	1.50	1.50	0.50	1.25	1.50	1.50
001	0945	21.06	15.83	1.50	1.50	0.00	2.00	1.50	1.50
001	2400	20.94	15.44	1.50	1.50	0.00	2.00	1.50	1.50
002	0000	20.94	15.44	1.50	1.50	0.00	2.00	1.50	1.50
002	0759	20.90	15.55	1.50	1.50	0.00	2.00	1.50	1.50
002	0800	20.90	15.55	1.50	1.50	0.00	2.00	1.50	1.75
002	1759	20.28	15.40	1.50	1.50	0.00	2.00	1.50	1.75
002	1800	20.38	15.40	1.50	1.50	0.00	2.00	1.50	1.25
002	2400	20.93	15.65	1.50	1.50	0.00	2.00	1.50	1.25
003	0000	20.93	15.65	1.50	1.50	0.00	2.00	1.50	1.25
003	0814	20.98	15.46	1.50	1.50	0.00	2.00	1.50	1.25
003	0815	20.98	15.46	2.00	1.50	0.00	2.00	2.00	1.25
003	1239	21.02	15.97	2.00	1.50	0.00	2.00	2.00	1.25
003	1240	21.02	15.97	2.00	1.50	0.00	2.00	2.00	2.00
003	1749	20.97	15.85	2.00	1.50	0.00	2.00	2.00	2.00
003	1759	20.97	15.85	2.00	2.50	0.00	2.00	2.00	2.00
003	2400	20.98	15.30	2.00	2.50	0.00	2.00	2.00	2.00
004	0000	20.98	15.30	2.00	2.50	0.00	2.00	2.00	2.00
004	0209	20.90	15.23	2.00	2.50	0.00	2.00	2.00	2.00
004	0210	20.90	15.23	2.00	2.00	0.00	2.00	2.00	2.00
004	2229	20.89	15.45	2.00	2.00	0.00	2.00	2.00	2.00
004	2230	20.89	15.45	2.00	2.00	0.00	2.00	2.00	1.50
004	2400	20.92	15.60	2.00	2.00	0.00	2.00	2.00	1.50
005	0000	20.92	15.60	2.00	2.00	0.00	2.00	2.00	1.50
005	1914	20.91	15.20	2.00	2.00	0.00	2.00	2.00	1.50
005	1915	20.91	15.20	1.50	1.50	0.00	2.00	1.50	1.50
005	2400	20.93	15.75	1.50	1.50	0.00	2.00	1.50	1.50
006	0000	20.93	15.75	1.50	1.50	0.00	2.00	1.50	1.50
006	1244	21.01	15.82	1.50	1.50	0.00	2.00	1.50	1.50
006	1245	21.01	15.82	1.50	1.50	2.25	2.00	1.50	1.50
006	1319	21.10	16.10	1.50	1.50	2.25	2.00	1.50	1.50
006	1320	21.10	16.10	2.50	2.50	2.25	2.00	2.50	2.00
006	1639	21.15	16.30	2.50	2.50	2.25	2.00	2.50	2.00
006	1640	21.15	16.30	2.50	2.50	3.00	3.00	2.50	2.00
006	1849	21.15	15.83	2.50	2.50	3.00	3.00	2.50	2.00
006	1850	21.15	15.83	3.50	3.50	3.00	3.00	3.50	3.50
006	2009	21.14	15.22	3.50	3.50	3.00	3.00	3.50	3.50
006	2010	21.14	15.22	3.50	3.50	5.00	5.00	3.50	3.50
006	2309	20.90	15.92	3.50	3.50	5.00	5.00	3.50	3.50
006	2310	20.90	15.92	3.50	3.50	3.50	3.50	3.50	3.50
006	2400	20.92	15.55	3.50	3.50	3.50	3.50	3.50	3.50
007	0000	20.92	15.55	3.50	3.50	3.50	3.50	3.50	3.50
007	0239	21.07	15.55	3.50	3.50	3.50	3.50	3.50	3.50
007	0240	21.07	15.55	3.50	4.50	5.00	3.50	3.50	3.50
007	0759	20.87	15.50	3.50	4.50	5.00	3.50	3.50	3.50
007	0800	20.87	15.50	3.50	4.50	4.00	3.50	3.50	3.50
007	1314	20.93	15.65	3.50	4.50	4.00	3.50	3.50	3.50
007	1315	20.93	15.65	3.50	3.50	4.00	3.50	3.50	3.50
007	1529	20.95	15.50	3.50	3.50	4.00	3.50	3.50	3.50
007	1530	20.95	15.50	4.50	4.50	4.00	4.25	3.50	3.50

APPENDIX I

A Typical 3 Hour Gate Operation and Stage Data for Structure S-65E

(Note: Considering the illustrative nature of the appendix, the data presented for the first 119 days seems to serve the purpose).

HW = Headwater elevation
TW = Tailwater elevation
GT1 = Gate No. 1
GT2 = Gate No. 2
GT3 = Gate No. 3
GT4 = Gate No. 4
GT5 = Gate No. 5
GT6 = Gate No. 6

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D.S.S.	U.S.S.	DISCHARGE	STORAGE
12.000	20.840	12500.000	4833.221
14.000	21.090	12500.000	5065.922
16.000	21.500	12500.000	5388.007
18.000	22.140	12500.000	5835.744
20.000	23.040	12500.000	6444.795
22.000	24.200	12500.000	7229.348
24.000	25.580	12500.000	8210.494
26.000	27.150	12500.000	9434.816
28.000	28.850	12500.000	11981.740
30.000	30.660	12500.000	16882.500
10.000	22.040	15000.000	5191.769
12.000	22.160	15000.000	5332.568
14.000	22.350	15000.000	5532.810
16.000	22.680	15000.000	5818.189
18.000	23.200	15000.000	6222.503
20.000	23.940	15000.000	6730.183
22.000	24.930	15000.000	7516.734
24.000	26.160	15000.000	8446.749
26.000	27.590	15000.000	9642.748
28.000	29.190	15000.000	12339.230
30.000	30.920	15000.000	17400.390
10.000	23.280	17500.000	5700.870
12.000	23.370	17500.000	5821.747
14.000	23.540	17500.000	6001.977
16.000	23.800	17500.000	6260.850
18.000	24.210	17500.000	6624.013
20.000	24.830	17500.000	7141.084
22.000	25.680	17500.000	7830.280
24.000	26.770	17500.000	8716.606
26.000	28.090	17500.000	9972.493
28.000	29.570	17500.000	12798.570
30.000	31.220	17500.000	18027.700
10.000	24.440	20000.000	6206.221
12.000	24.490	20000.000	6307.216
14.000	24.610	20000.000	6462.852
16.000	24.830	20000.000	6700.627
18.000	25.180	20000.000	7041.587
20.000	25.710	20000.000	7522.760
22.000	26.440	20000.000	8166.818
24.000	27.410	20000.000	9014.038
26.000	28.620	20000.000	10368.980
28.000	29.990	20000.000	13370.230
30.000	31.550	20000.000	18750.230
10.000	25.470	22500.000	6689.560
12.000	25.520	22500.000	6785.852
14.000	25.630	22500.000	6934.408
16.000	25.810	22500.000	7154.839
18.000	26.110	22500.000	7470.585
20.000	26.550	22500.000	7916.828
22.000	27.200	22500.000	8527.691
24.000	28.070	22500.000	9338.848
26.000	29.160	22500.000	10861.220
28.000	30.540	22500.000	14081.480
30.000	31.900	22500.000	19582.910
10.000	26.440	25000.000	7187.980
12.000	26.490	25000.000	7273.433

D.S.S.	U.S.S.	DISCHARGE	STORAGE
10.000	10.000	50.000	1622.731
12.000	12.000	50.000	2310.630
14.000	14.000	50.000	3027.155
16.000	16.000	50.000	3793.909
18.000	18.000	50.000	4611.489
20.000	20.000	50.000	5497.437
22.000	22.000	50.000	6483.116
24.000	24.000	50.000	7617.684
26.000	26.000	50.000	8952.298
28.000	28.000	50.000	11214.720
30.000	30.000	50.000	15801.220
10.000	12.650	2500.000	2072.833
12.000	13.420	2500.000	2557.535
14.000	14.840	2500.000	3200.340
16.000	16.500	2500.000	3908.823
18.000	18.280	2500.000	4681.218
20.000	20.170	2500.000	5543.507
22.000	22.110	2500.000	6516.474
24.000	24.070	2500.000	7643.258
26.000	26.050	2500.000	8972.304
28.000	28.040	2500.000	1124.406
30.000	30.030	2500.000	1584.172
10.000	14.990	5000.000	2594.738
12.000	15.560	5000.000	3056.788
14.000	16.620	5000.000	3633.754
16.000	17.640	5000.000	4194.006
18.000	19.020	5000.000	4872.391
20.000	20.650	5000.000	5675.920
22.000	22.420	5000.000	6614.490
24.000	24.290	5000.000	7718.945
26.000	26.200	5000.000	9032.066
28.000	28.140	5000.000	11333.550
30.000	30.100	5000.000	15963.980
10.000	17.240	7500.000	3225.748
12.000	17.710	7500.000	3718.300
14.000	18.230	7500.000	4108.777
16.000	18.950	7500.000	4563.717
18.000	19.990	7500.000	5147.075
20.000	21.340	7500.000	5879.509
22.000	22.910	7500.000	6771.009
24.000	24.620	7500.000	7841.864
26.000	26.440	7500.000	9130.713
28.000	28.320	7500.000	11485.440
30.000	30.240	7500.000	16174.680
10.000	19.030	10000.000	4004.665
12.000	19.370	10000.000	4301.440
14.000	19.720	10000.000	4592.313
16.000	20.250	10000.000	4968.359
18.000	21.060	10000.000	5474.731
20.000	22.160	10000.000	6139.813
22.000	23.510	10000.000	6978.411
24.000	25.060	10000.000	8007.506
26.000	26.760	10000.000	9266.141
28.000	28.560	10000.000	11701.380
30.000	30.430	10000.000	16477.390
10.000	20.670	12500.000	4651.685

D.S.S.	U.S.S.	DISCHARGE	STORAGE
24.000	32.000	20000.000	3686.467
26.000	32.700	20000.000	3971.278
28.000	33.570	20000.000	4361.247
30.000	34.640	20000.000	4981.738
32.000	35.740	20000.000	6297.189
34.000	36.940	20000.000	10601.320
36.000	38.370	20000.000	20239.750
38.000	39.760	20000.000	33849.960
40.000	41.230	20000.000	49818.620

EOJ. END OF JOB

I SYS 400 00/00/50 ASHOK3 L= 182 C= 0

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D.S.S.	U.S.S.	DISCHARGE	STORAGE
22.000	25.810	10000.000	2802.722
24.000	26.950	10000.000	3080.075
26.000	28.290	10000.000	3406.732
28.000	29.770	10000.000	3802.256
30.000	31.390	10000.000	4334.115
32.000	33.100	10000.000	5274.232
34.000	34.830	10000.000	8582.443
36.000	36.650	10000.000	16648.800
38.000	38.490	10000.000	29925.270
40.000	40.340	10000.000	46830.190
20.000	26.210	12000.000	2699.237
22.000	26.970	12000.000	2915.044
24.000	27.930	12000.000	3177.404
26.000	29.100	12000.000	3491.698
28.000	30.440	12000.000	3880.599
30.000	31.940	12000.000	44151.030
32.000	33.540	12000.000	53991.300
34.000	35.160	12000.000	8834.441
36.000	36.920	12000.000	17078.310
38.000	38.690	12000.000	30436.990
40.000	40.480	12000.000	47299.000
20.000	27.490	14000.000	2838.975
22.000	28.120	14000.000	3038.249
24.000	28.950	14000.000	3286.592
26.000	29.970	14000.000	3589.690
28.000	31.170	14000.000	3973.205
30.000	32.550	14000.000	4515.634
32.000	34.040	14000.000	5557.562
34.000	35.550	14000.000	9155.620
36.000	37.240	14000.000	17624.850
38.000	38.920	14000.000	31164.540
40.000	40.640	14000.000	47821.810
20.000	28.740	16000.000	2986.748
22.000	29.270	16000.000	3171.761
24.000	29.970	16000.000	3407.810
26.000	30.870	16000.000	3701.028
28.000	31.950	16000.000	4083.256
30.000	33.210	16000.000	4641.247
32.000	34.580	16000.000	5755.598
34.000	35.980	16000.000	9551.242
36.000	37.590	16000.000	18336.970
38.000	39.180	16000.000	31956.690
40.000	40.820	16000.000	48424.270
20.000	29.920	18000.000	3142.439
22.000	30.390	18000.000	3316.742
24.000	30.990	18000.000	3540.699
26.000	31.780	18000.000	3827.350
28.000	32.750	18000.000	4212.327
30.000	33.910	18000.000	4795.828
32.000	35.150	18000.000	6000.280
34.000	36.440	18000.000	10025.230
36.000	37.970	18000.000	19209.330
38.000	39.460	18000.000	32854.070
40.000	41.020	18000.000	49091.580
20.000	31.100	20000.000	3309.173
22.000	31.480	20000.000	3472.561

D.S.S.	U.S.S.	DISCHARGE	STORAGE
20.000	20.000	50.000	2183.333
22.000	22.000	50.000	2497.629
24.000	24.000	50.000	2834.006
26.000	26.000	50.000	3201.189
28.000	28.000	50.000	3620.699
30.000	30.000	50.000	4156.082
32.000	32.000	50.000	5021.496
34.000	34.000	50.000	8047.393
36.000	36.000	50.000	1574.149
38.000	38.000	50.000	2868.130
40.000	40.000	50.000	4575.938
20.000	20.310	2000.000	2203.124
22.000	22.210	2000.000	2511.936
24.000	24.150	2000.000	2844.872
26.000	26.110	2000.000	3209.891
28.000	28.080	2000.000	3628.116
30.000	30.060	2000.000	4163.113
32.000	32.050	2000.000	5030.946
34.000	34.030	2000.000	8067.807
36.000	36.030	2000.000	15776.050
38.000	38.020	2000.000	28730.430
40.000	40.010	2000.000	45802.950
20.000	21.130	4000.000	2259.114
22.000	22.800	4000.000	2553.367
24.000	24.570	4000.000	2876.848
26.000	26.420	4000.000	3235.720
28.000	28.310	4000.000	3650.269
30.000	30.240	4000.000	4184.215
32.000	32.180	4000.000	5059.571
34.000	34.140	4000.000	8129.588
36.000	36.110	4000.000	15880.690
38.000	38.080	4000.000	28878.140
40.000	40.060	4000.000	45933.360
20.000	22.270	6000.000	2343.461
22.000	23.660	6000.000	2618.309
24.000	25.220	6000.000	2928.187
26.000	26.910	6000.000	3277.847
28.000	28.690	6000.000	3686.895
30.000	30.530	6000.000	4219.400
32.000	32.410	6000.000	5108.124
34.000	34.310	6000.000	8234.212
36.000	36.240	6000.000	16058.030
38.000	38.180	6000.000	29125.090
40.000	40.120	6000.000	46149.420
20.000	23.560	8000.000	2448.157
22.000	24.690	8000.000	2702.778
24.000	26.030	8000.000	2996.575
26.000	27.540	8000.000	3335.210
28.000	29.180	8000.000	3737.680
30.000	30.910	8000.000	4269.216
32.000	32.720	8000.000	5178.317
34.000	34.540	8000.000	8384.105
36.000	36.420	8000.000	16312.290
38.000	38.310	8000.000	29472.920
40.000	40.220	8000.000	46449.240
20.000	24.890	10000.000	2568.117

D.S.S.	U.S.S.	DISCHARGE	STORAGE
34.000	36.680	10000.000	4982.805
36.000	38.090	10000.000	5632.873
38.000	39.610	10000.000	6577.293
40.000	41.390	10000.000	8956.119
42.000	43.160	10000.000	14248.890
44.000	44.850	10000.000	22553.730
46.000	46.600	10000.000	34469.150
48.000	48.420	10000.000	48927.570
50.000	50.290	10000.000	6556.350
30.000	35.640	12000.000	4221.647
32.000	36.530	12000.000	4617.823
34.000	37.610	12000.000	5115.214
36.000	38.850	12000.000	5758.152
38.000	40.230	12000.000	6718.080
40.000	41.940	12000.000	9236.218
42.000	43.630	12000.000	14649.420
44.000	45.200	12000.000	23116.790
46.000	46.850	12000.000	35073.400
48.000	48.600	12000.000	49408.040
50.000	50.410	12000.000	65923.290
30.000	36.880	14000.000	4402.204
32.000	37.640	14000.000	4781.926
34.000	38.570	14000.000	5266.272
36.000	39.670	14000.000	5912.242
38.000	40.920	14000.000	6892.871
40.000	42.570	14000.000	9612.469
42.000	44.150	14000.000	15162.220
44.000	45.580	14000.000	23838.800
46.000	47.130	14000.000	35782.070
48.000	48.800	14000.000	49970.090
50.000	50.550	14000.000	66349.730
30.000	38.100	16000.000	4596.626
32.000	38.740	16000.000	4962.844
34.000	39.550	16000.000	5439.573
36.000	40.520	16000.000	6099.746
38.000	41.660	16000.000	7105.685
40.000	43.260	16000.000	10086.810
42.000	44.710	16000.000	15851.480
44.000	45.990	16000.000	24747.040
46.000	47.440	16000.000	36590.400
48.000	49.020	16000.000	50610.750
50.000	50.700	16000.000	66832.440
30.000	39.290	18000.000	4807.155
32.000	39.830	18000.000	5165.734
34.000	40.540	18000.000	5638.061
36.000	41.390	18000.000	6315.482
38.000	42.230	18000.000	7364.722
40.000	44.120	18000.000	10708.090
42.000	45.290	18000.000	16726.870
44.000	46.440	18000.000	25837.240
46.000	47.770	18000.000	37493.170
48.000	49.260	18000.000	51326.320
50.000	50.870	18000.000	67367.950

EOJ. END OF JOB

I SYS 400 00/ 1/14 ASHOK2 L= 206 C= 0

STAGE-DISCHARGE-STORAGE VALUES FOR

C-38B

U.S.S.	U.S.G.	DISCHARGE	STORAGE
32.000	32.000	50.000	4100.591
34.000	34.000	50.000	4659.202
36.000	36.000	50.000	5343.842
38.000	38.000	50.000	6267.292
40.000	40.000	50.000	8407.058
42.000	42.000	50.000	13444.230
44.000	44.000	50.000	21354.820
46.000	46.000	50.000	33078.050
48.000	48.000	50.000	47819.390
50.000	50.000	50.000	64706.750
30.000	30.060	2000.000	3631.675
32.000	32.180	2000.000	4117.185
34.000	34.130	2000.000	4672.978
36.000	36.100	2000.000	5355.759
38.000	38.070	2000.000	6279.569
40.000	40.060	2000.000	8427.623
42.000	42.050	2000.000	13473.250
44.000	44.040	2000.000	21400.690
46.000	46.020	2000.000	33134.190
48.000	48.020	2000.000	47864.120
50.000	50.010	2000.000	64735.550
30.000	30.960	4000.000	3694.157
32.000	32.690	4000.000	4165.806
34.000	34.510	4000.000	4713.806
36.000	36.380	4000.000	5391.276
38.000	38.280	4000.000	6316.391
40.000	40.230	4000.000	8496.072
42.000	42.190	4000.000	13561.750
44.000	44.140	4000.000	21539.600
46.000	46.100	4000.000	33302.400
48.000	48.070	4000.000	47998.180
50.000	50.060	4000.000	64839.710
30.000	31.960	6000.000	3790.885
32.000	33.460	6000.000	4243.331
34.000	35.090	6000.000	4780.266
36.000	36.820	6000.000	5449.660
38.000	38.620	6000.000	6378.078
40.000	40.520	6000.000	8596.580
42.000	42.420	6000.000	13713.990
44.000	44.320	6000.000	21774.910
46.000	46.220	6000.000	33581.760
48.000	48.160	6000.000	48220.890
50.000	50.110	6000.000	65012.310
30.000	33.130	8000.000	3914.451
32.000	34.400	8000.000	4345.897
34.000	35.830	8000.000	4870.496
36.000	37.400	8000.000	5530.377
38.000	39.070	8000.000	6464.835
40.000	40.910	8000.000	8750.535
42.000	42.750	8000.000	13937.420
44.000	44.560	8000.000	22111.190
46.000	46.390	8000.000	33971.640
48.000	48.270	8000.000	48531.180
50.000	50.190	8000.000	65251.860
30.000	34.380	10000.000	4059.193
32.000	35.440	10000.000	4471.615

D.S.S.	U.S.S.	DISCHARGE	STORAGE
44.000	46.220	11000.000	4741.120
46.000	47.760	11000.000	5901.902
48.000	49.550	11000.000	9152.171
50.000	51.080	11000.000	16360.170
52.000	52.750	11000.000	26854.890
54.000	54.510	11000.000	39740.540
56.000	56.330	11000.000	55359.240
58.000	58.190	11000.000	71727.970
60.000	60.130	11000.000	88530.660
40.000	44.110	12000.000	3539.179
42.000	45.260	12000.000	3943.914
44.000	46.600	12000.000	4188.328
46.000	48.060	12000.000	4565.416
48.000	49.820	12000.000	5078.226
50.000	51.320	12000.000	5599.889
52.000	52.980	12000.000	6151.329
54.000	54.750	12000.000	6719.001
56.000	56.580	12000.000	7296.427
58.000	58.460	12000.000	7880.112
60.000	60.370	12000.000	8468.001
40.000	44.640	13000.000	3765.492
42.000	45.710	13000.000	4233.146
44.000	46.970	13000.000	4924.717
46.000	48.370	13000.000	6166.818
48.000	50.060	13000.000	9795.378
50.000	51.460	13000.000	17180.190
52.000	53.020	13000.000	27574.810
54.000	54.010	13000.000	40358.210
56.000	56.450	13000.000	55799.440
58.000	58.260	13000.000	71983.250
60.000	60.190	13000.000	88749.680

EOJ. END OF JOB

I SYS 400 00/00/55 ASHOK2 L= 204 C= 0

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D.S.S.	U.S.S.	DISCHARGE	STORAGE
42.000	42.950	6000.000	3781.734
44.000	44.720	6000.000	4444.955
46.000	46.560	6000.000	5487.637
48.000	48.500	6000.000	8243.013
50.000	50.340	6000.000	14905.420
52.000	52.230	6000.000	25557.670
54.000	54.160	6000.000	38665.220
56.000	56.100	6000.000	54557.060
58.000	58.060	6000.000	71267.460
60.000	60.040	6000.000	88143.750
40.000	41.680	7000.000	3353.555
42.000	43.270	7000.000	3825.137
44.000	44.970	7000.000	4487.962
46.000	46.750	7000.000	5545.840
48.000	48.670	7000.000	8362.516
50.000	50.460	7000.000	15125.370
52.000	52.320	7000.000	25757.870
54.000	54.210	7000.000	38828.710
56.000	56.140	7000.000	54681.650
58.000	58.080	7000.000	71338.610
60.000	60.050	7000.000	88202.860
40.000	42.120	8000.000	3405.869
42.000	43.620	8000.000	3875.320
44.000	45.240	8000.000	4537.612
46.000	46.970	8000.000	5614.671
48.000	48.870	8000.000	8506.243
50.000	50.600	8000.000	15382.450
52.000	52.410	8000.000	25988.070
54.000	54.280	8000.000	39017.280
56.000	56.180	8000.000	54824.530
58.000	58.100	8000.000	71420.380
60.000	60.070	8000.000	88271.090
40.000	42.590	9000.000	3464.291
42.000	44.000	9000.000	3932.431
44.000	45.550	9000.000	4596.137
46.000	47.210	9000.000	5695.796
48.000	49.080	9000.000	8681.888
50.000	50.740	9000.000	15674.480
52.000	52.510	8000.000	26247.930
54.000	54.330	9000.000	39231.740
56.000	56.220	9000.000	54985.340
58.000	58.130	9000.000	71512.630
60.000	60.090	9000.000	88348.460
40.000	43.080	10000.000	3529.297
42.000	44.400	10000.000	3996.503
44.000	45.870	10000.000	4664.274
46.000	47.470	10000.000	5792.036
48.000	49.310	10000.000	8893.257
50.000	50.910	10000.000	1600.058
52.000	52.630	10000.000	26537.020
54.000	54.420	10000.000	39472.680
56.000	56.270	10000.000	55163.750
58.000	58.160	10000.000	71615.220
60.000	60.110	10000.000	88434.970
40.000	43.590	11000.000	3600.724
42.000	44.820	11000.000	4067.525

D.S.S.	U.S.S.	DISCHARGE	STORAGE
40.000	40.040	1000.000	3182.784
42.000	42.030	1000.000	3665.012
44.000	44.020	1000.000	4329.180
46.000	46.020	1000.000	5336.826
48.000	48.010	1000.000	7938.453
50.000	50.010	1000.000	14325.950
52.000	52.010	1000.000	25015.720
54.000	54.010	1000.000	38223.280
56.000	56.010	1000.000	54218.150
58.000	58.010	1000.000	71074.580
60.000	60.010	1000.000	87984.690
40.000	40.150	2000.000	3193.745
42.000	42.110	2000.000	3674.983
44.000	44.080	2000.000	4339.097
46.000	46.070	2000.000	5349.402
48.000	48.060	2000.000	7963.835
50.000	50.040	2000.000	14375.420
52.000	52.030	2000.000	25062.230
54.000	54.020	2000.000	38261.260
56.000	56.010	2000.000	54247.400
58.000	58.010	2000.000	71091.180
60.000	60.010	2000.000	87998.320
40.000	40.340	3000.000	3211.902
42.000	42.250	3000.000	3691.578
44.000	44.190	3000.000	4355.630
46.000	46.140	3000.000	5370.513
48.000	48.130	3000.000	8006.340
50.000	50.090	3000.000	14457.920
52.000	52.060	3000.000	25139.910
54.000	54.040	3000.000	38324.530
56.000	56.030	3000.000	54296.050
58.000	58.010	3000.000	71118.830
60.000	60.010	3000.000	88021.040
40.000	40.600	4000.000	3237.105
42.000	42.440	4000.000	3714.885
44.000	44.330	4000.000	4378.782
46.000	46.250	4000.000	5400.381
48.000	48.220	4000.000	8066.451
50.000	50.150	4000.000	14573.500
52.000	52.110	4000.000	25248.440
54.000	54.070	4000.000	38413.000
56.000	56.040	4000.000	54364.010
58.000	58.030	4000.000	71157.480
60.000	60.020	4000.000	88052.840
40.000	40.910	5000.000	3269.189
42.000	42.670	5000.000	3744.973
44.000	44.510	5000.000	4408.556
46.000	46.390	5000.000	5439.301
48.000	48.350	5000.000	8144.848
50.000	50.240	5000.000	14722.230
52.000	52.160	5000.000	25387.780
54.000	54.110	5000.000	38526.610
56.000	56.070	5000.000	54451.090
58.000	58.040	5000.000	71207.040
60.000	60.070	5000.000	88093.750
40.000	41.270	6000.000	3307.971

APPENDIX III

Stage-Discharge-Storage Values for C-38A, C-38B, C-38C, C-38D and C-38E

CANAL ID.	STATION ID.	RANGE	ELEV
C-31	4+00	85.	49.7
C-31	4+00	90.	50.7
C-31	4+00	95.	53.8
C-31	4+00	97.	54.8
C-31	4+00	100.	56.8
C-31	4+00	105.	61.0
C-31	4+00	110.	63.3
C-31	2+00	24.	63.3
C-31	2+00	25.	62.8
C-31	2+00	30.	57.3
C-31	2+00	35.	55.6
C-31	2+00	38.	54.7
C-31	2+00	40.	53.6
C-31	2+00	45.	51.1
C-31	2+00	50.	49.3
C-31	2+00	55.	48.5
C-31	2+00	60.	48.4
C-31	2+00	65.	48.4
C-31	2+00	70.	48.3
C-31	2+00	75.	48.2
C-31	2+00	80.	48.3
C-31	2+00	85.	49.3
C-31	2+00	90.	50.9
C-31	2+00	95.	52.6
C-31	2+00	100.	54.7
C-31	2+00	105.	56.5
C-31	2+00	110.	59.6
C-31	2+00	115.	62.7
C-31	0+25	27.	62.4
C-31	0+25	30.	61.6
C-31	0+25	35.	57.8
C-31	0+25	40.	55.2
C-31	0+25	42.	54.7
C-31	0+25	45.	53.5
C-31	0+25	50.	51.3
C-31	0+25	55.	48.7
C-31	0+25	60.	48.4
C-31	0+25	65.	47.8
C-31	0+25	70.	47.0
C-31	0+25	75.	47.9
C-31	0+25	80.	51.0
C-31	0+25	85.	53.5
C-31	0+25	88.	54.7
C-31	0+25	95.	57.0
C-31	0+25	100.	59.0
C-31	0+25	105.	60.3
C-31	0+25	110.	65.1

CANAL NO.	STATION NO.	RANGE	ELEV
		ft	
C-31	3+00	55.	51.5
C-31	3+00	60.	49.3
C-31	3+00	65.	48.2
C-31	3+00	70.	48.3
C-31	3+00	75.	48.1
C-31	3+00	80.	48.0
C-31	3+00	85.	47.3
C-31	3+00	90.	47.8
C-31	3+00	95.	47.8
C-31	3+00	100.	49.3
C-31	3+00	105.	51.5
C-31	3+00	113.	54.8
C-31	3+00	120.	57.7
C-31	3+00	125.	58.9
C-31	3+00	130.	59.3
C-31	3+00	135.	60.1
C-31	3+00	145.	62.3
C-31	5+00	20.	54.7
C-31	5+00	25.	51.1
C-31	5+00	30.	57.4
C-31	5+00	35.	55.4
C-31	5+00	37.	55.0
C-31	5+00	40.	52.6
C-31	5+00	45.	47.3
C-31	5+00	50.	45.7
C-31	5+00	55.	42.9
C-31	5+00	60.	41.9
C-31	5+00	65.	42.4
C-31	5+00	70.	43.8
C-31	5+00	75.	44.2
C-31	5+00	80.	44.3
C-31	5+00	90.	45.2
C-31	5+00	95.	48.6
C-31	5+00	100.	51.7
C-31	5+00	105.	54.8
C-31	5+00	110.	58.4
C-31	5+00	115.	64.0
C-31	4+00	22.	64.3
C-31	4+00	25.	61.7
C-31	4+00	30.	57.2
C-31	4+00	35.	55.7
C-31	4+00	37.	54.7
C-31	4+00	40.	52.9
C-31	4+00	45.	50.9
C-31	4+00	50.	49.7
C-31	4+00	55.	48.6
C-31	4+00	60.	48.2
C-31	4+00	65.	48.2
C-31	4+00	70.	48.5
C-31	4+00	75.	48.7
C-31	4+00	80.	49.3

TYPICAL CROSS-SECTIONAL DATA FOR C-31 ABOVE S-30

CANAL NO.	STATION NO.	RANGE	ELEV
C-31	17+00	30.	54.3
C-31	17+00	35.	53.9
C-31	17+00	40.	54.3
C-31	17+00	45.	54.2
C-31	17+00	50.	54.3
C-31	17+00	53.	54.1
C-31	17+00	60.	52.7
C-31	17+00	65.	50.8
C-31	17+00	70.	49.2
C-31	17+00	75.	48.2
C-31	17+00	80.	48.5
C-31	17+00	85.	48.1
C-31	17+00	90.	47.9
C-31	17+00	95.	47.8
C-31	17+00	100.	48.0
C-31	17+00	105.	48.5
C-31	17+00	110.	50.0
C-31	17+00	115.	51.6
C-31	17+00	118.	53.7
C-31	17+00	120.	53.7
C-31	17+00	130.	54.0
C-31	17+00	140.	54.1
C-31	17+00	150.	54.3
C-31	17+00	160.	54.4
C-31	17+00	170.	54.5
C-31	17+00	179.	54.8
C-31	17+00	185.	55.3
C-31	17+00	190.	55.7
C-31	13+00	46.	56.8
C-31	13+00	48.	56.5
C-31	13+00	50.	54.8
C-31	13+00	55.	52.4
C-31	13+00	60.	50.5
C-31	13+00	65.	49.2
C-31	13+00	70.	48.9
C-31	13+00	75.	48.4
C-31	13+00	80.	47.8
C-31	13+00	85.	47.3
C-31	13+00	90.	47.0
C-31	13+00	95.	46.8
C-31	13+00	100.	47.5
C-31	13+00	105.	49.3
C-31	13+00	110.	51.8
C-31	13+00	115.	51.5
C-31	13+00	116.	54.8
C-31	13+00	121.	55.9
C-31	13+00	129.	59.1
C-31	8+00	35.	62.5
C-31	8+00	40.	61.3
C-31	8+00	45.	58.0
C-31	8+00	50.	54.8

CANAL NO.	STATION NO.	RANGE	ELEV
C-31	25+50	20.	50.9
C-31	25+50	30.	52.1
C-31	25+50	40.	52.0
C-31	25+50	50.	52.0
C-31	25+50	60.	52.0
C-31	25+50	70.	51.8
C-31	25+50	80.	51.7
C-31	25+50	90.	51.4
C-31	25+50	100.	50.9
C-31	25+50	110.	50.8
C-31	25+50	120.	51.2
C-31	25+50	130.	51.4
C-31	21+00	00.	54.8
C-31	21+00	50.	53.5
C-31	21+00	60.	53.3
C-31	21+00	70.	53.1
C-31	21+00	75.	52.3
C-31	21+00	80.	50.1
C-31	21+00	85.	48.7
C-31	21+00	90.	47.7
C-31	21+00	95.	47.4
C-31	21+00	100.	47.3
C-31	21+00	105.	48.7
C-31	21+00	110.	51.0
C-31	21+00	115.	52.6
C-31	21+00	118.	52.9
C-31	21+00	120.	53.0
C-31	21+00	125.	53.1
C-31	21+00	130.	53.2
C-31	21+00	135.	53.2
C-31	18+00	25.	55.4
C-31	18+00	33.	54.8
C-31	18+00	40.	54.2
C-31	18+00	50.	53.9
C-31	18+00	57.	54.0
C-31	18+00	60.	52.6
C-31	18+00	65.	50.6
C-31	18+00	70.	49.6
C-31	18+00	75.	48.5
C-31	18+00	85.	48.6
C-31	18+00	95.	48.1
C-31	18+00	105.	47.5
C-31	18+00	115.	50.2
C-31	18+00	120.	52.1
C-31	18+00	130.	52.7
C-31	18+00	140.	53.0
C-31	18+00	150.	53.4
C-31	18+00	160.	53.5
C-31	17+00	13.	57.4
C-31	17+00	18.	56.1
C-31	17+00	28.	54.8

APPENDIX II

A Typical Cross-Sectional Data for C-31 Above S-59

A TYPICAL 2 [illegible] GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1970)

DAY	TIME	HX	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
104	2400	20.97	15.36	1.00	2.00	0.00	2.00	1.25	1.00
105	0000	20.97	15.35	1.00	2.00	0.00	2.00	1.25	1.00
105	2400	20.93	16.00	1.00	2.00	0.00	2.00	1.25	1.00
106	0000	20.98	16.00	1.00	2.00	0.00	2.00	1.25	1.00
106	2400	20.93	15.73	1.00	2.00	0.00	2.00	1.25	1.00
107	0000	20.98	15.73	1.00	2.00	0.00	2.00	1.25	1.00
107	2400	20.95	15.33	1.00	2.00	0.00	2.00	1.25	1.00
108	0000	20.95	15.83	1.00	2.00	0.00	2.00	1.25	1.00
108	2400	20.95	15.35	1.00	2.00	0.00	2.00	1.25	1.00
109	0000	20.95	15.35	1.00	2.00	0.00	2.00	1.25	1.00
109	2400	20.92	15.75	1.00	2.00	0.00	2.00	1.25	1.00
110	0000	20.92	15.75	1.00	2.00	0.00	2.00	1.25	1.00
110	0759	20.82	15.49	1.00	2.00	0.00	2.00	1.25	1.00
110	0800	20.82	15.89	1.00	1.50	0.00	2.00	1.25	1.00
110	1224	20.86	15.52	1.00	1.50	0.00	2.00	1.25	1.00
110	1225	20.86	15.52	1.00	1.00	0.00	1.00	1.25	1.00
110	1654	20.87	15.58	1.00	1.00	0.00	1.00	1.25	1.00
110	1700	20.87	15.58	1.00	1.00	0.00	1.00	1.00	1.00
110	2400	20.91	15.52	1.00	1.00	0.00	1.00	1.00	1.00
111	0000	20.91	15.53	1.00	1.00	0.00	1.00	1.00	1.00
111	2514	20.88	15.53	1.00	1.00	0.00	1.00	1.00	1.00
111	2515	20.88	15.53	0.75	1.00	0.00	1.00	1.00	1.00
111	2400	20.89	15.40	0.75	1.00	0.00	1.00	1.00	1.00
112	0000	20.89	15.40	0.75	1.00	0.00	1.00	1.00	1.00
112	1029	20.93	15.40	0.75	1.00	0.00	1.00	1.00	1.00
112	1030	20.93	15.40	1.25	1.50	0.00	1.00	1.00	1.00
112	2400	20.92	15.44	1.25	1.50	0.00	1.00	1.00	1.00
113	0000	20.93	15.44	1.25	1.50	0.00	1.00	1.00	1.00
113	1014	20.88	15.47	1.25	1.50	0.00	1.00	1.00	1.00
113	1015	20.88	15.47	1.00	1.00	0.00	1.00	1.00	1.00
113	2400	20.91	15.33	1.00	1.00	0.00	1.00	1.00	1.00
114	0000	20.91	15.33	1.00	1.00	0.00	1.00	1.00	1.00
114	1244	20.87	15.27	1.00	1.00	0.00	1.00	1.00	1.00
114	1245	20.87	15.27	0.00	1.00	0.00	1.00	0.50	0.00
114	2400	20.91	15.30	0.00	1.00	0.00	1.00	0.50	0.00
115	0000	20.91	15.30	0.00	1.00	0.00	1.00	0.50	0.00
115	1249	20.95	15.15	0.00	1.00	0.00	1.00	0.50	0.00
115	1250	20.95	15.15	1.00	1.00	0.00	1.00	0.50	0.00
115	2400	20.95	15.20	1.00	1.00	0.00	1.00	0.50	0.00
116	0000	20.95	15.20	1.00	1.00	0.00	1.00	0.50	0.00
116	1229	20.87	15.30	1.00	1.00	0.00	1.00	0.50	0.00
116	1230	20.87	15.30	0.00	1.00	0.00	1.00	0.50	0.00
116	2400	20.93	15.23	0.00	1.00	0.00	1.00	0.50	0.00
117	0000	20.93	15.23	0.00	1.00	0.00	1.00	0.50	0.00
117	2400	20.90	15.19	0.00	1.00	0.00	1.00	0.50	0.00
118	0000	20.90	15.19	0.00	1.00	0.00	1.00	0.50	0.00
118	2109	20.87	15.08	0.00	1.00	0.00	1.00	0.50	0.00
118	2110	20.87	15.08	0.00	1.00	0.00	1.00	0.00	0.00
118	2400	20.88	14.97	0.00	1.00	0.00	1.00	0.00	0.00
119	0000	20.88	14.97	0.00	1.00	0.00	1.00	0.00	0.00
119	2400	20.95	14.95	0.00	1.00	0.00	1.00	0.00	0.00

DAY	TIME	Ha	Ta	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
092	1710	20.99	16.70	3.50	3.50	0.00	3.00	3.00	3.00
092	2000	20.99	16.59	3.50	3.50	0.00	3.00	3.00	3.00
092	2010	20.98	16.59	3.50	3.50	0.00	3.00	3.00	3.00
092	2400	20.89	16.85	3.00	3.50	0.00	3.00	3.00	3.00
093	0000	20.89	16.85	3.00	3.50	0.00	3.00	3.00	3.00
093	0640	20.81	16.66	3.00	3.50	0.00	3.00	3.00	3.00
093	0650	20.81	16.66	3.00	2.75	0.00	3.00	3.00	3.00
093	0740	20.83	16.59	3.00	2.75	0.00	3.00	3.00	3.00
093	0750	20.83	16.59	2.25	2.75	0.00	3.00	3.00	3.00
093	2400	20.96	16.73	2.25	2.75	0.00	3.00	3.00	3.00
094	0000	20.96	16.73	2.25	2.75	0.00	3.00	3.00	3.00
094	0750	21.00	16.59	2.25	2.75	0.00	3.00	3.00	3.00
094	0800	21.00	16.59	2.50	2.75	0.00	3.00	3.00	3.00
094	1839	21.00	16.58	2.50	2.75	0.00	3.00	3.00	3.00
094	1840	21.00	16.58	2.75	2.75	0.00	3.00	3.00	3.00
094	2400	20.95	16.35	2.75	2.75	0.00	3.00	3.00	3.00
095	0000	20.95	16.35	2.75	2.75	0.00	3.00	3.00	3.00
095	2400	20.94	16.45	2.75	2.75	0.00	3.00	3.00	3.00
096	0000	20.94	16.45	2.75	2.75	0.00	3.00	3.00	3.00
096	0849	20.23	16.23	2.75	2.75	0.00	3.00	3.00	3.00
096	0850	20.23	16.23	2.75	2.75	0.00	3.00	2.50	2.50
096	2400	20.98	16.53	2.75	2.75	0.00	3.00	2.50	2.50
097	0000	20.98	16.53	2.75	2.75	0.00	3.00	2.50	2.50
097	1709	20.87	16.34	2.75	2.75	0.00	3.00	2.50	2.50
097	1710	20.87	16.34	2.75	2.50	0.00	2.50	2.50	2.50
097	2400	20.33	16.19	2.75	2.50	0.00	2.50	2.50	2.50
098	0000	20.33	16.19	2.75	2.50	0.00	2.50	2.50	2.50
098	1659	20.95	16.49	2.75	2.50	0.00	2.50	2.50	2.50
098	1700	20.95	16.49	2.25	2.50	0.00	2.50	2.50	2.50
098	2400	20.93	16.30	2.25	2.50	0.00	2.50	2.50	2.50
099	0000	20.93	16.30	2.25	2.50	0.00	2.50	2.50	2.50
099	0809	20.87	16.31	2.25	2.50	0.00	2.50	2.50	2.50
099	0810	20.87	16.31	2.00	2.50	0.00	2.50	2.50	2.50
099	1339	20.86	16.30	2.00	2.50	0.00	2.50	2.50	2.50
099	1340	20.85	16.30	2.00	2.50	0.00	2.50	2.50	2.00
099	2400	20.94	16.44	2.00	2.50	0.00	2.50	2.50	2.00
100	0000	20.94	16.44	2.00	2.50	0.00	2.50	2.50	2.00
100	1359	20.97	16.26	2.00	2.50	0.00	2.50	2.50	2.00
100	1400	20.97	16.26	1.00	2.00	0.00	2.00	2.00	2.00
100	2400	21.05	16.43	1.00	2.00	0.00	2.00	2.00	2.00
101	0000	21.05	16.43	1.00	2.00	0.00	2.00	2.00	2.00
101	0914	20.87	16.31	1.00	2.00	0.00	2.00	2.00	2.00
101	0915	20.87	16.31	1.00	2.00	0.00	2.00	2.00	1.00
101	2400	20.90	16.15	1.00	2.00	0.00	2.00	2.00	1.00
102	0000	20.90	16.15	1.00	2.00	0.00	2.00	2.00	1.00
102	2400	20.93	16.05	1.00	2.00	0.00	2.00	2.00	1.00
103	0000	20.93	16.05	1.00	2.00	0.00	2.00	2.00	1.00
103	0809	20.25	16.14	1.00	2.00	0.00	2.00	2.00	1.00
103	0810	20.25	16.14	1.00	2.00	0.00	2.00	1.25	1.00
103	2400	20.94	16.45	1.00	2.00	0.00	2.00	1.25	1.00
104	0000	20.94	16.45	1.00	2.00	0.00	2.00	1.25	1.00

A TYPICAL 3 DAYS GATE OPERATIONS AND STAGES DATA FOR STRUCTURE S-65E
(1970)

DAY	TIME	HW	TW	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
085	1929	21.01	15.00	4.00	4.00	4.00	4.00	4.00	4.00
085	1933	21.01	15.10	4.00	4.50	4.75	4.00	4.00	4.00
085	2114	21.00	15.25	4.00	4.50	4.75	4.00	4.00	4.00
085	2115	21.00	15.25	4.00	4.50	4.00	4.00	4.00	4.00
085	2400	20.93	16.00	4.00	4.50	4.00	4.00	4.00	4.00
086	0000	20.93	16.00	4.00	4.50	4.00	4.00	4.00	4.00
086	0614	20.78	16.31	4.00	4.50	4.00	4.00	4.00	4.00
086	0615	20.78	16.31	2.50	4.00	4.00	4.00	4.00	2.50
086	1044	21.00	16.40	2.50	4.00	4.00	4.00	4.00	2.50
086	1045	21.01	16.40	3.50	4.00	4.00	4.00	4.00	2.50
086	1259	21.05	16.26	3.50	4.00	4.00	4.00	4.00	2.50
086	1300	21.05	16.26	3.50	4.00	4.50	4.00	4.00	4.00
086	1649	21.02	16.45	3.50	4.00	4.50	4.00	4.00	4.00
086	1650	21.02	16.45	4.00	5.00	4.50	5.00	5.00	4.00
086	1909	20.95	16.40	4.00	5.00	4.50	5.00	5.00	4.00
086	1910	20.95	16.40	4.00	4.50	4.50	5.00	5.00	4.00
086	2400	20.94	16.40	4.00	4.50	4.50	5.00	5.00	4.00
087	0000	20.94	16.40	4.00	4.50	4.50	5.00	5.00	4.00
087	0759	20.95	16.45	4.00	4.50	4.50	5.00	5.00	4.00
087	0800	20.95	16.45	4.00	4.50	4.50	4.50	4.00	4.00
087	2209	20.88	16.55	4.00	4.00	4.50	4.50	4.00	4.00
087	2210	20.88	16.55	4.00	4.00	4.00	4.00	4.00	4.00
087	2400	20.87	16.53	4.00	4.00	4.00	4.00	4.00	4.00
088	0000	20.87	16.53	4.00	4.00	4.00	4.00	4.00	4.00
088	0529	21.00	16.65	4.00	4.00	4.00	4.00	4.00	4.00
088	0530	21.00	16.65	4.00	4.00	4.25	4.00	4.00	4.00
088	0629	21.00	16.55	4.00	4.00	4.25	4.00	4.00	4.00
088	0630	21.00	16.65	3.00	4.00	4.25	4.00	4.00	3.00
088	1529	20.84	16.51	3.00	4.00	4.25	4.00	4.00	3.00
088	1530	20.84	16.51	3.00	4.00	3.75	4.00	4.00	3.00
088	2400	20.83	16.57	3.00	4.00	3.75	4.00	4.00	3.00
089	0000	20.83	16.57	3.00	4.00	3.75	4.00	4.00	3.00
089	0759	20.97	16.82	3.00	4.00	3.75	4.00	4.00	3.00
089	0800	20.97	16.82	3.00	4.00	3.00	4.00	4.00	3.00
089	2400	20.84	16.55	3.00	4.00	3.00	4.00	4.00	3.00
090	0000	20.84	16.55	3.00	4.00	3.00	4.00	4.00	3.00
090	0759	20.90	16.64	3.00	4.00	3.00	4.00	4.00	3.00
090	0800	20.90	16.64	3.00	4.00	1.50	4.00	3.50	3.00
090	2059	20.99	16.69	3.00	4.00	1.50	4.00	3.50	3.00
090	2100	20.99	16.69	3.00	4.00	1.50	4.00	4.00	3.00
090	2400	20.99	16.85	3.00	4.00	1.50	4.00	4.00	3.00
091	0000	20.99	16.85	3.00	4.00	1.50	4.00	4.00	3.00
091	0809	21.02	16.72	3.00	4.00	1.50	4.00	4.00	3.00
091	0810	21.02	16.72	4.00	4.00	0.00	4.00	4.00	3.50
091	1259	20.92	16.61	4.00	4.00	0.00	4.00	4.00	3.50
091	1300	20.92	16.61	4.00	4.00	0.00	3.50	3.50	3.50
091	1659	20.93	16.82	4.00	4.00	0.00	3.50	3.50	3.50
091	1700	20.93	16.82	3.50	3.50	0.00	3.50	3.50	3.50
091	2400	20.87	16.71	3.50	3.50	0.00	3.50	3.50	3.50
092	0000	20.87	16.71	3.50	3.50	0.00	3.50	3.50	3.50
092	1709	20.89	16.70	3.50	3.50	0.00	3.50	3.50	3.50

DAY	TIME	HS	TP	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6
075	0300	20.99	15.75	1.75	2.00	0.00	2.00	1.75	1.00
075	1730	20.96	15.85	1.75	2.00	0.00	2.00	1.75	1.00
075	1730	20.96	15.85	1.75	2.00	0.00	2.00	1.75	1.00
075	2400	20.88	15.50	1.75	2.00	0.00	2.00	1.75	1.00
076	0000	20.88	15.50	1.75	2.00	0.00	2.00	1.75	1.00
076	0759	20.85	15.76	1.75	2.00	0.00	2.00	1.75	1.00
076	0800	20.85	15.76	1.75	2.00	0.00	1.75	1.75	1.00
076	2214	20.83	15.92	1.75	2.00	0.00	1.75	1.75	1.00
076	2215	20.83	15.92	1.75	2.00	0.00	1.75	1.75	1.25
076	2400	20.89	15.50	1.75	2.00	0.00	1.75	1.75	1.25
077	0000	20.83	15.50	1.75	2.00	0.00	1.75	1.75	1.25
077	2109	21.02	15.53	1.75	2.00	0.00	1.75	1.75	1.25
077	2110	21.02	15.53	1.75	2.00	0.00	1.75	1.75	1.50
077	2400	21.03	15.93	1.75	2.00	0.00	1.75	1.75	1.50
078	0000	21.00	15.93	1.75	2.00	0.00	1.75	1.75	1.50
078	0809	21.00	15.68	1.75	2.00	0.00	1.75	1.75	1.50
078	0810	21.00	15.68	2.00	2.00	0.00	2.00	1.75	1.50
078	2400	20.95	15.60	2.00	2.00	0.00	2.00	1.75	1.50
079	0000	20.95	15.50	2.00	2.00	0.00	2.00	1.75	1.50
079	0809	20.94	15.66	2.00	2.00	0.00	2.00	1.75	1.50
079	0810	20.94	15.66	1.75	2.00	0.00	1.75	1.75	1.50
079	2400	20.95	15.70	1.75	2.00	0.00	1.75	1.75	1.50
080	0000	20.95	15.70	1.75	2.00	0.00	1.75	1.75	1.50
080	2400	20.94	15.52	1.75	2.00	0.00	1.75	1.75	1.50
081	0000	20.94	15.52	1.75	2.00	0.00	1.75	1.75	1.50
081	1139	20.97	15.58	1.75	2.00	0.00	1.75	1.75	1.50
081	1140	20.97	15.58	1.75	1.50	0.00	1.75	1.75	1.50
081	2400	20.97	15.23	1.75	1.50	0.00	1.75	1.75	1.50
082	0000	20.99	15.23	1.75	1.50	0.00	1.75	1.75	1.50
082	0809	20.91	15.31	1.75	1.50	0.00	1.75	1.75	1.50
082	0810	20.91	15.31	1.75	1.75	0.00	1.75	1.75	1.50
082	1309	20.93	15.45	1.75	1.75	0.00	1.75	1.75	1.50
082	1310	20.93	15.45	1.75	1.75	0.00	2.00	2.00	2.00
082	1644	20.94	15.39	1.75	1.75	0.00	2.00	2.00	2.00
082	1645	20.94	15.39	2.00	2.00	0.00	2.00	2.00	2.00
082	2400	20.94	15.17	2.00	2.00	0.00	2.00	2.00	2.00
083	0000	20.94	15.17	2.00	2.00	0.00	2.00	2.00	2.00
083	2400	21.01	15.44	2.00	2.00	0.00	2.00	2.00	2.00
084	0000	21.01	15.44	2.00	2.00	0.00	2.00	2.00	2.00
084	1509	21.07	15.55	2.00	2.00	0.00	2.00	2.00	2.00
084	1510	21.07	15.55	2.00	2.00	1.25	2.00	2.00	2.00
084	1724	21.08	15.63	2.00	2.00	1.25	2.00	2.00	2.00
084	1725	21.08	15.63	2.00	2.50	2.25	2.00	2.00	2.00
084	1859	21.05	15.30	2.00	2.50	2.25	2.00	2.00	2.00
084	1900	21.05	15.30	2.00	2.50	2.75	2.75	2.75	2.00
084	2029	21.08	15.52	2.00	2.50	2.75	2.75	2.75	2.00
084	2030	21.08	15.52	4.00	4.00	4.00	4.00	2.75	2.00
084	2400	20.94	15.58	4.00	4.00	4.00	4.00	2.75	2.00
085	0000	20.94	15.58	4.00	4.00	4.00	4.00	2.75	2.00
085	1359	20.95	15.88	4.00	4.00	4.00	4.00	2.75	2.00
085	1400	20.95	15.88	4.00	4.00	4.00	4.00	4.00	4.00

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FURTHER AREAS OF INVESTIGATION

Since it is demonstrated that the formulations, coefficients and parameters used in developing the operational water quantity model interact in a constructive manner to yield useful operational information, the following are further areas of investigation that can be evolved from the recently completed model and the associated data base:

1. Due to the tedious and laborious task of collecting 3 hour gate operations data for all the control structures of the Kissimmee Basin, our methodology is demonstrated for only one year, 1970. It is logical to extend this useful methodology (with necessary modifications to its pieces) for some other years for which the sub-basin output is already available and for which gate operation data will be generated.

2. At the current level of development, the model uses practical information (such as gate operations) as input and then generates an output of simulated discharges and stages at various points in the system. To use the model as an operational tool, it is necessary to modify the model in such a way that it provides an output of the essential gate openings at various controlling structures to maintain specified water levels and discharges in various sections of the Kissimmee water system.

3. Since some of the coefficients used in the model are related directly and indirectly to the land uses in the basin, it is possible to further examine the effects of land use changes on the hydrologic characteristics of the Kissimmee Basin. In such an endeavor, it may be necessary to re-examine the procedures used to estimate the values of the basin parameters. After achieving a good output on land use - water quantity interactions through the operational water quantity model, efforts may be made to tie it further to water quality aspects of water management in the Kissimmee Basin.

4. Since a large bank of data of hourly values for the ten year period is generated in this study, it is possible to apply currently available advanced data processing techniques to explore further characteristics of the hydrologic components. In addition, since extreme values of runoff coefficients are estimated in our study by a simple graphical method, more advanced probabilistic methods can be explored to acquire similar hydrologic information of exteme values.

CONCLUSIONS

After developing an adequate framework of the operational water quantity model and after obtaining encouraging results on a first pass basis in July 1975 (see reference No. 36), an extensive effort was made to further examine critical links of the model. As a result, the sub-basin model was first refined by conducting several computerized parametric sensitivity analyses on the key parameters of the hydrologic system considered in the sub-basin model. As a next step, a procedure of double interpolation was designed to use the developed formulations in conjunction with the correction factors for better accuracy. In addition, the coefficients, parameters and data base of the model had all been checked from previous available documents. When such refined pieces of the model were put together for the year of 1970, the results showed significant improvement in simulated lake stages, and excellent correlations between simulated and historical discharges through the controlling structures. It is hoped that such a recently completed water quantity model can be useful as an effective operational tool in managing the Kissimmee water system in the near future.

The nicety of the operational water quantity model lies in the fact that its strong data base can answer the following questions more accurately and more scientifically than ever before:

1. What is the storage in any pool of the lower Kissimmee Basin at a given stage and mean discharge through the primary conveyance canal of C-38?

2. What is the discharge in C-29 in the upper Kissimmee when lake stages of Lakes Hart and Mary Jane are known?

3. Can the maximum velocity in C-36 exceed the design velocity? If so, in which period of the year can it happen?

4. What is evapotranspiration loss in Boggy Creek drainage basin in the upper Kissimmee as against evepotranspiration loss in Pool A of the lower Kissimmee?

5. What is the relationship between the state conditions concerning the available storages in soil layers of planning units 8 and 11 in the sub-basin model on the final simulated stages of Lakes Cypress, Hatchineha and Kissimmee?

6. What are the hydrologic effects (in terms of velocities, additional area acreage and storages) in pool D (C-38 between S-65C and S-65D) if the water level is to be maintained 2 ft. higher than regulation stage of 27 ft.?

7. What are the relative stage increases in the upper Kissimmee lakes if X amount of inflows are added to each of them in 3 hourly periods?

8. How does the detention time of the water vary between different lakes of the upper Kissimmee?

9. What is the slope of the water surface in Pool B for given discharges through S-65A and S-65B with known storages?

10. What are the percentage differences using U.S.G.S. rating curves versus U.S.G.S. - F.C.D. composite curves for estimating discharges through controlling structures of the lower Kissimmee Basin?

It is to be noted that these are just a few questions that can be answered by the intermediate steps built into the operational water quantity model.

Most of the steps of the operational water quantity model are computerized. These developed computer programs (which take five hours to process one simulation year) are shown to be successful in performing the following operations:

a. Generating hydrologic parameters (such as sub-surface flow, surface flow, evaporation losses, deep seepage losses, available soil storage, storage in depression and finally streamflows) on a 3 hour basis for 19 planning units using rainfall, stage conditions and basin parameters as input data.

b. Routing these streamflows of the 19 planning units through the controlled systems of lakes, channels, and operating structures.

c. Simulating 3 hour lake stages, headwater and tailwater elevations of structures and discharges through the structures of the upper and lower Kissimmee using 3 hour gate operations data, rainfall values and various initial conditions as input data.

Table 38. Ranges for the extreme values of the coefficients of runoff $(\frac{R}{P})$ for upper, lower and entire Kissimmee basin.

Description	Upper	Lower	Entire
Dry Period			
Max. Values	$0.28 \leq \frac{R}{P} \leq 0.63$	$0.31 \leq \frac{R}{P} \leq 0.8$	$0.33 \leq \frac{R}{P} \leq 0.78$
	$0.44 \leq \frac{R}{P} \leq 0.47^*$	$0.49 \leq \frac{R}{P} \leq 0.5^*$	$0.46 \leq \frac{R}{P} \leq 0.49^*$
Min. Values	$0.03 \leq \frac{R}{P} \leq 0.27$	$0.03 \leq \frac{R}{P} \leq 0.25$	$0.03 \leq \frac{R}{P} \leq 0.26$
	$0.01 \leq \frac{R}{P} \leq 0.13^*$	$0.01 \leq \frac{R}{P} \leq 0.14^*$	$0.01 \leq \frac{R}{P} \leq 0.15^*$
Wet Period			
Max. Values	$0.13 \leq \frac{R}{P} \leq 0.46$	$0.16 \leq \frac{R}{P} \leq 0.51$	$0.10 \leq \frac{R}{P} \leq 0.52$
	$0.25 \leq \frac{R}{P} \leq 0.30^*$	$0.19 \leq \frac{R}{P} \leq 0.48^*$	$0.01 \leq \frac{R}{P} \leq 0.31^*$
Min. Values	$0.01 \leq \frac{R}{P} \leq 0.22$	$0.01 \leq \frac{R}{P} \leq 0.25$	$0.01 \leq \frac{R}{P} \leq 0.20$
	$0.01 \leq \frac{R}{P} \leq 0.09^*$	$0.01 \leq \frac{R}{P} \leq 0.13^*$	$0 \leq \frac{R}{P} \leq 0.13^*$
Cumulative Values			
Max. Values		$0.21 \leq \frac{R}{P} \leq 0.23$	
Min. Values		$0.04 \leq \frac{R}{P} \leq 0.14$	
Annual Values			
Max. Values	$0.13 \leq \frac{R}{P} \leq 0.25$	$0.09 \leq \frac{R}{P} \leq 0.34$	$0.01 \leq \frac{R}{P} \leq 0.30$
Min. Values	$0.01 \leq \frac{R}{P} \leq 0.09$	$0.01 \leq \frac{R}{P} \leq 0.08$	$0.01 \leq \frac{R}{P} \leq 0.06$

* These ranges are based on Tables compiled by the authors.

8 to 35. Based on simple subjective judgment, boundaries enclosing all these points as closely as possible are drawn. Using these boundaries, the maximum and minimum values of runoff to different values of precipitation are read from the corresponding graphs of the upper, lower and entire Kissimmee. Their ratios are depicted in tables compiled by the authors. Again, these tables can be further condensed into ranges of extreme values as shown in Table 38. From these tables, it is possible to observe the hydrologic characteristics regarding the maximum and minimum amount of runoff that can occur in the upper, lower and entire Kissimmee for a given rainfall value. It is also recognized by the authors that there exists more sophisticated probabilistic methods to estimate extreme values. However, for simplicity, a subjective judgment is used in drawing the envelop around the data points as shown in Figures 8 to 35.

2. Other specific hydrologic information:

For a given set of state conditions and basin parameters, the output from the sub-basin model compiled in references 45 and 61 provides useful information regarding the percent of rainfall that attributes to the

a. sub-surface flow,
b. surface flow,
c. total evaporation loss,
d. soil storage, and
e. streamflow.

This generated information is for ten years with "print-out" of the daily values for 19 planning units of the upper and lower Kissimmee.

Another useful hydraulic characteristic of the 21 channel sections of C-38 are compiled in reference 46. Such generated output gives

a. velocities,
b. storages,
c. surface areas,
d. hydraulic conveyance, and
e. water surface elevations

at various sections for a given mean discharge. With such information, it is possible to examine the effect of runoff, resulting from the given precipitation on the downstream and upstream water levels and velocities at different points in the channel.

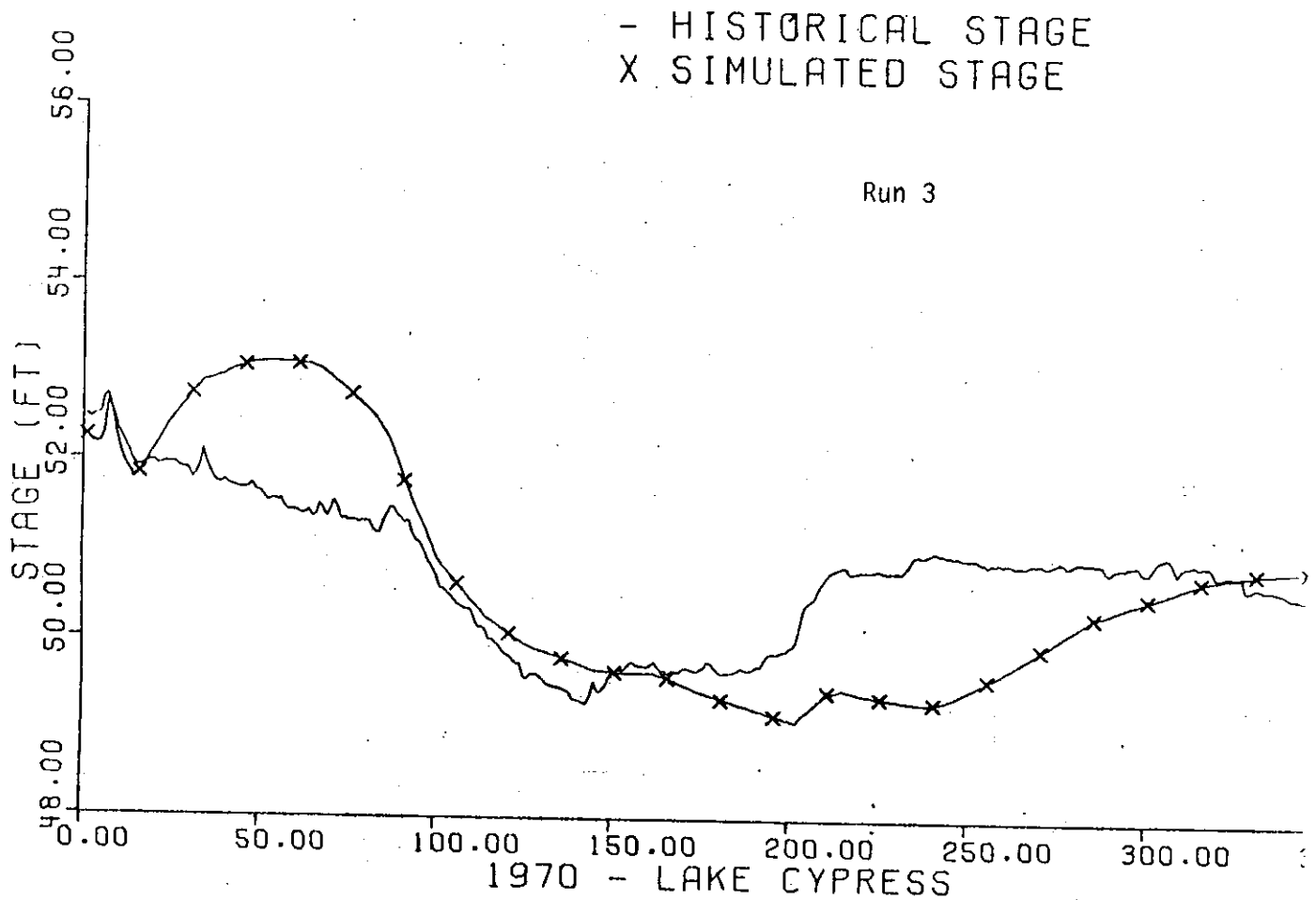
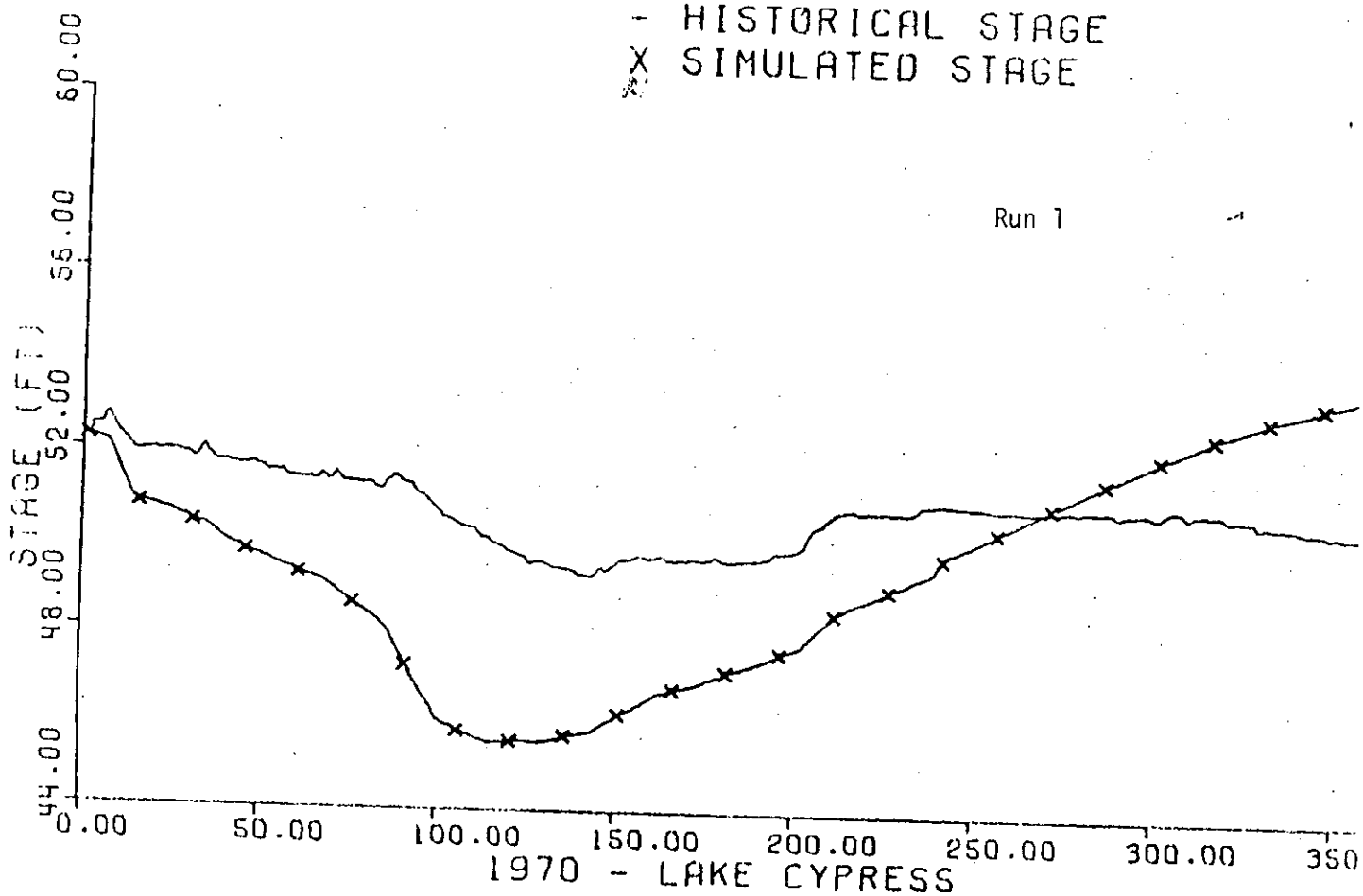


Figure 53. (continued)



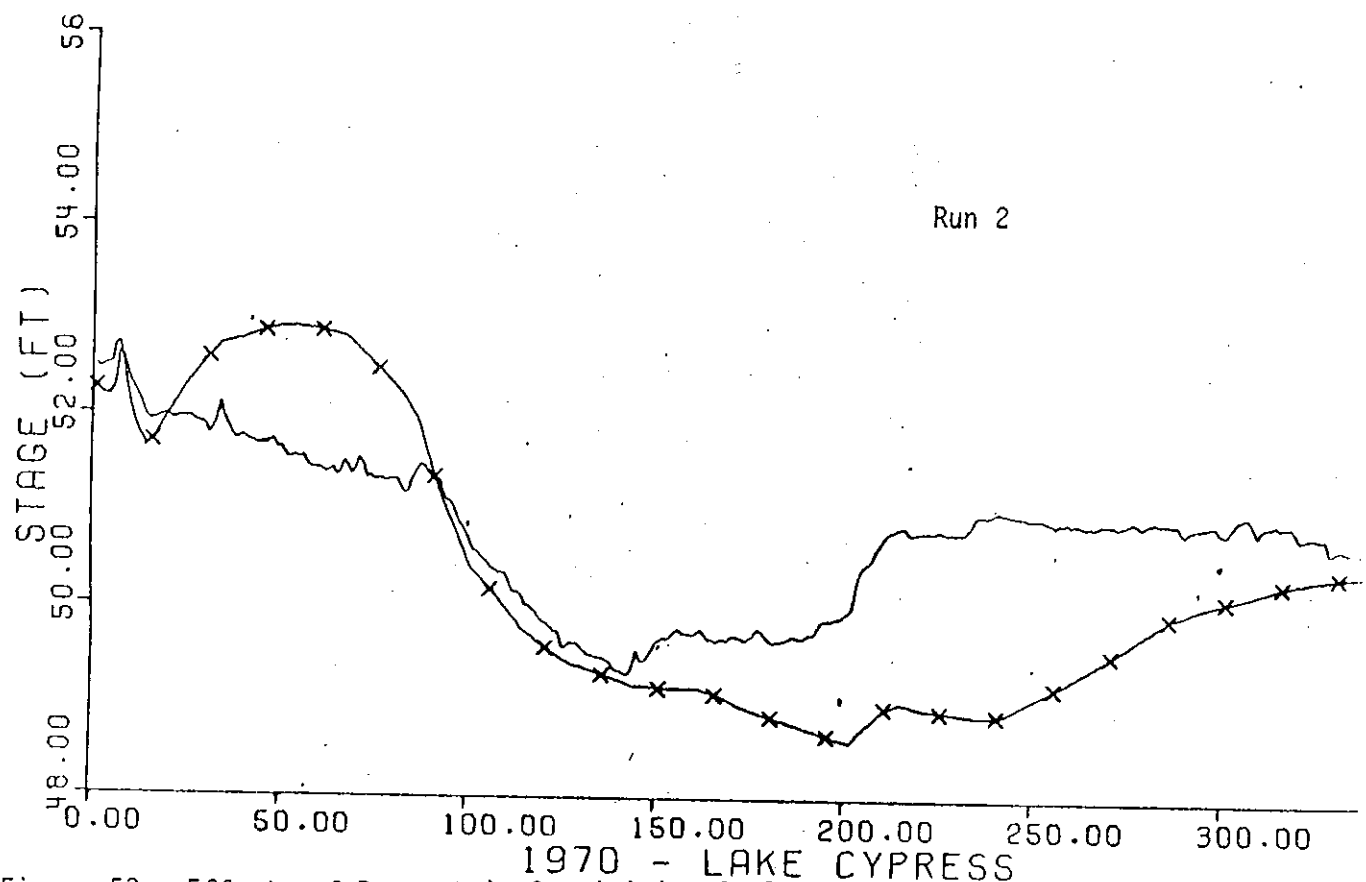


Figure 53. Effects of Parametric Sensitivity Analyses on the Refinement of Simulated Lake Stages for Lake Cypress

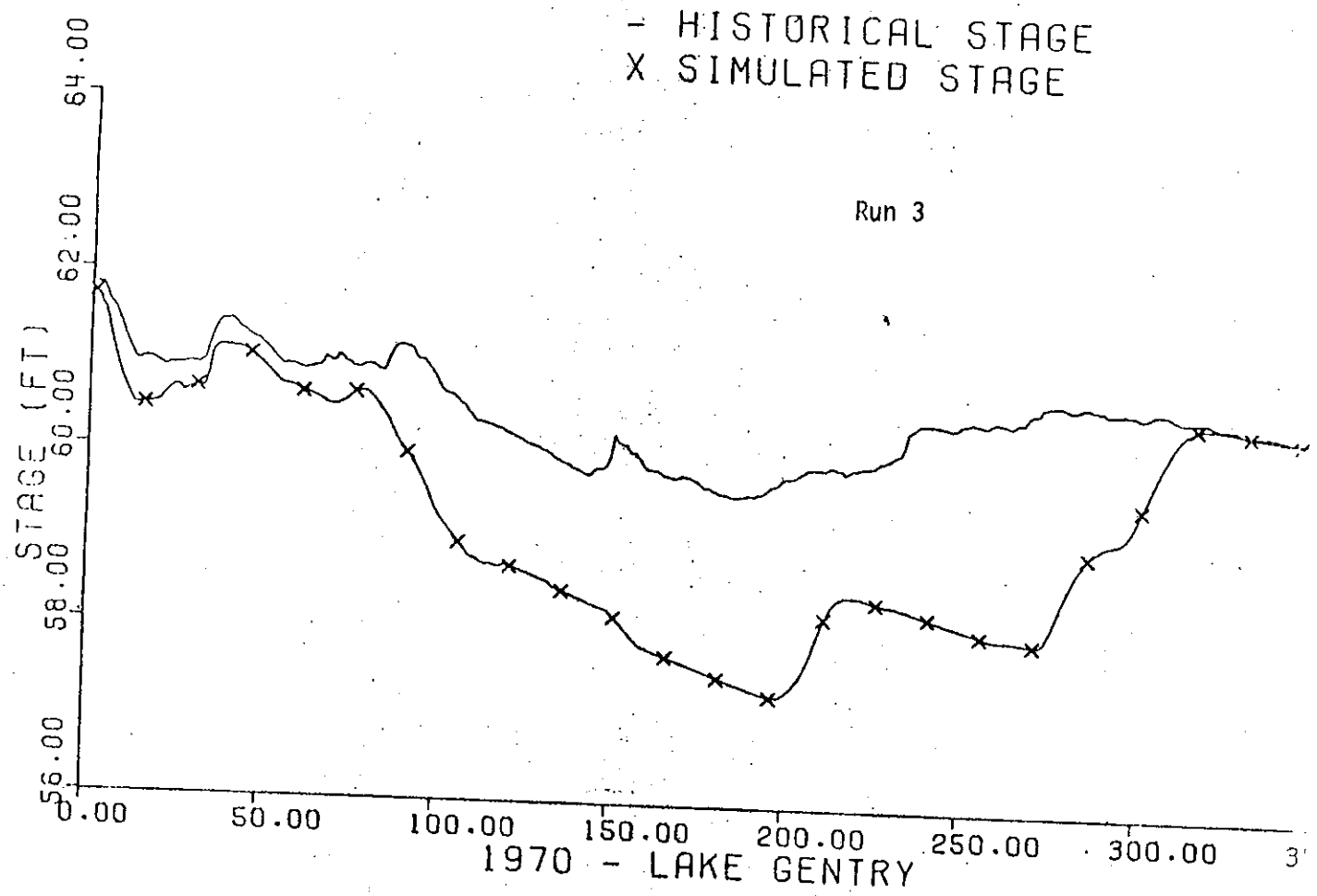
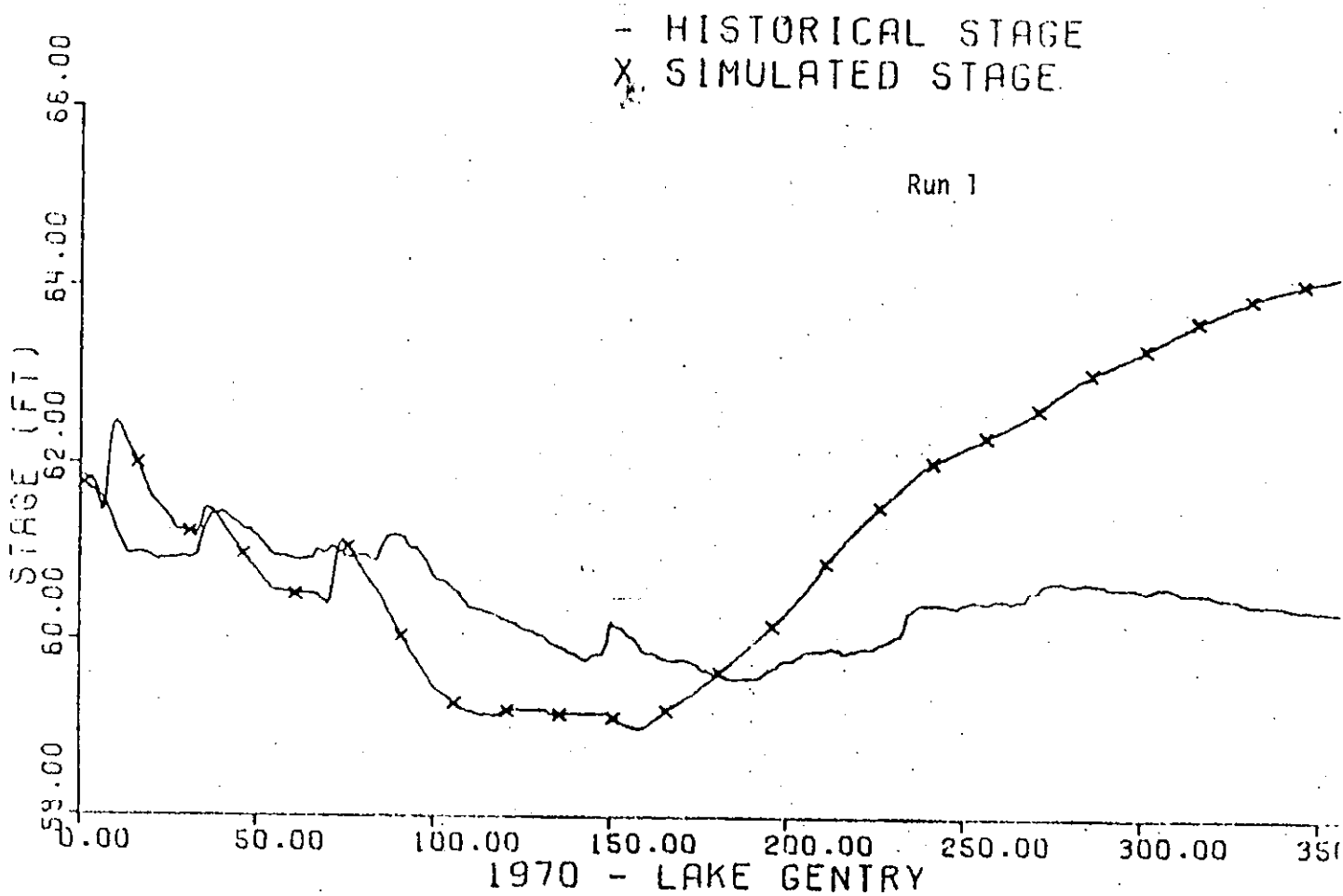


Figure 52. (continued)



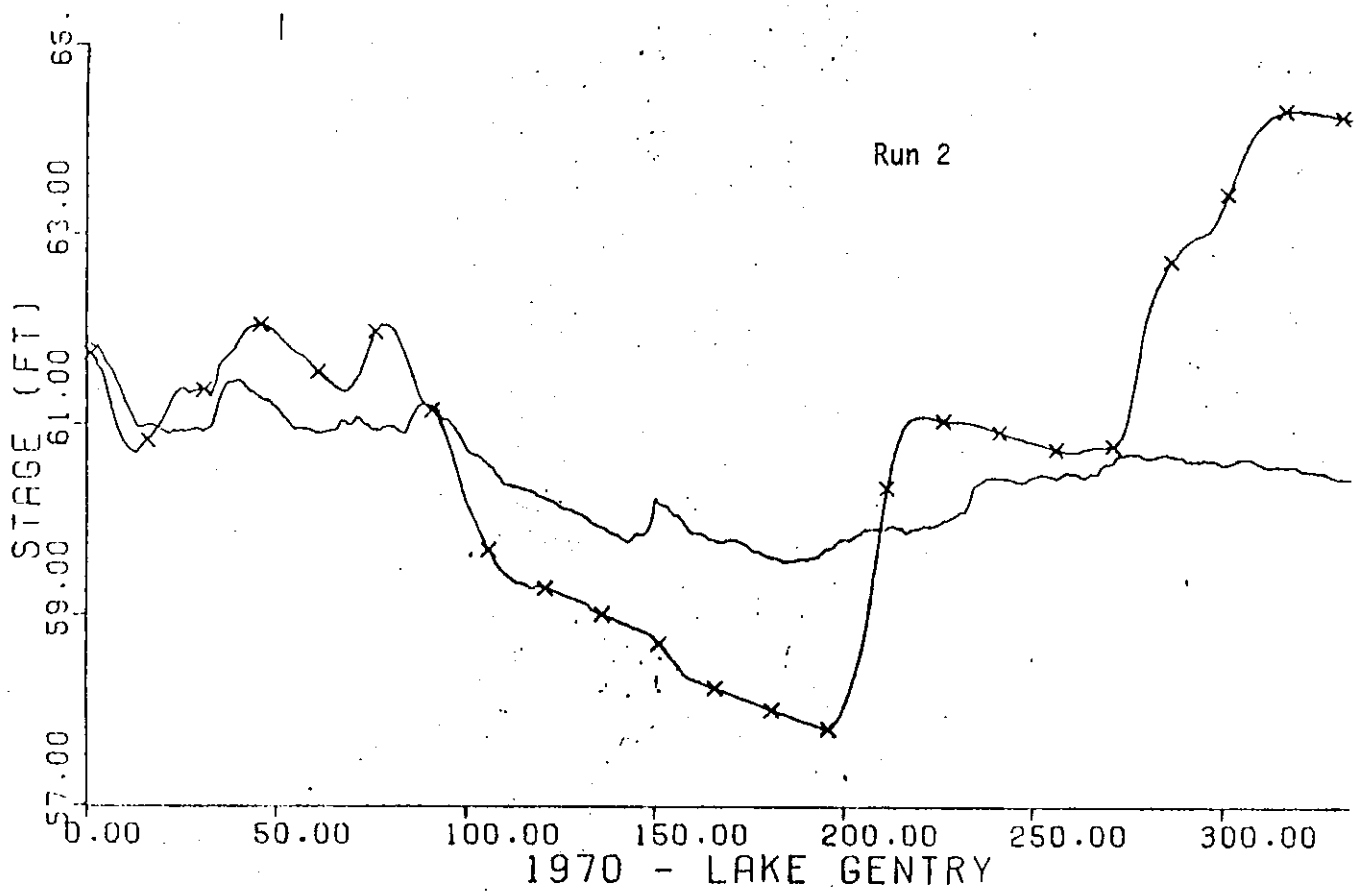


Figure 52. Effects of Parametric Sensitivity Analyses on the Refinement of

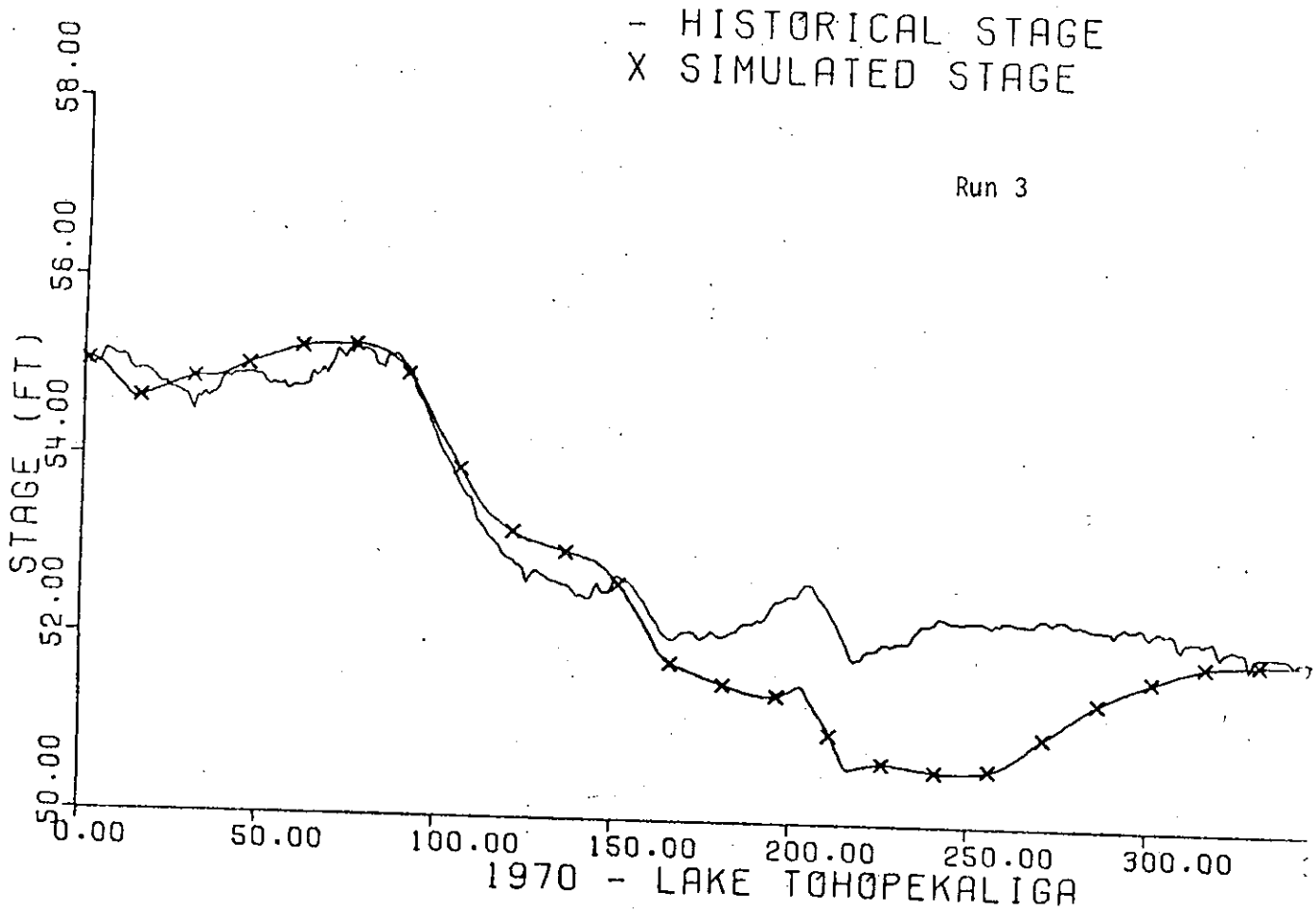
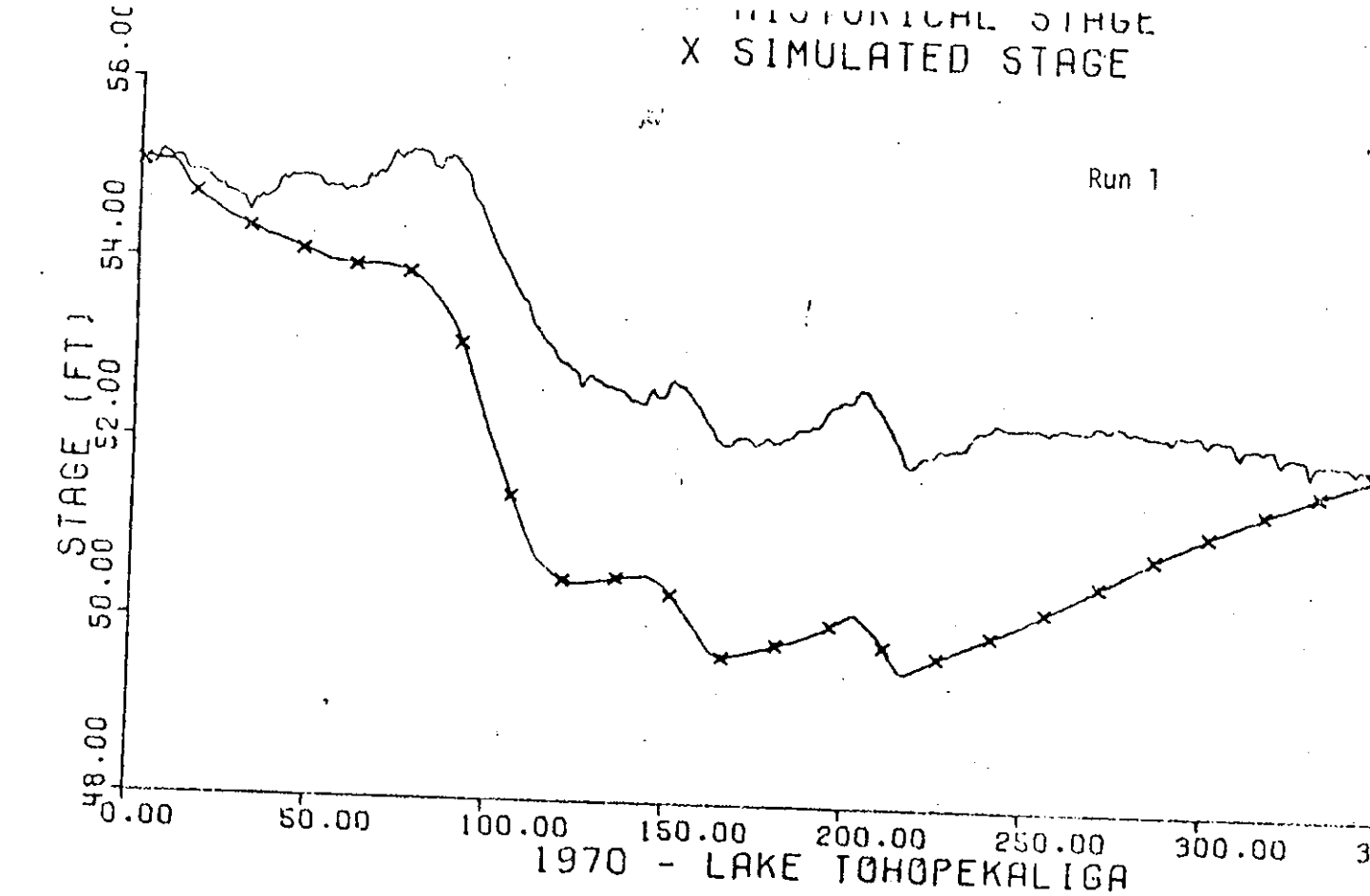


Figure 51. (Continued)



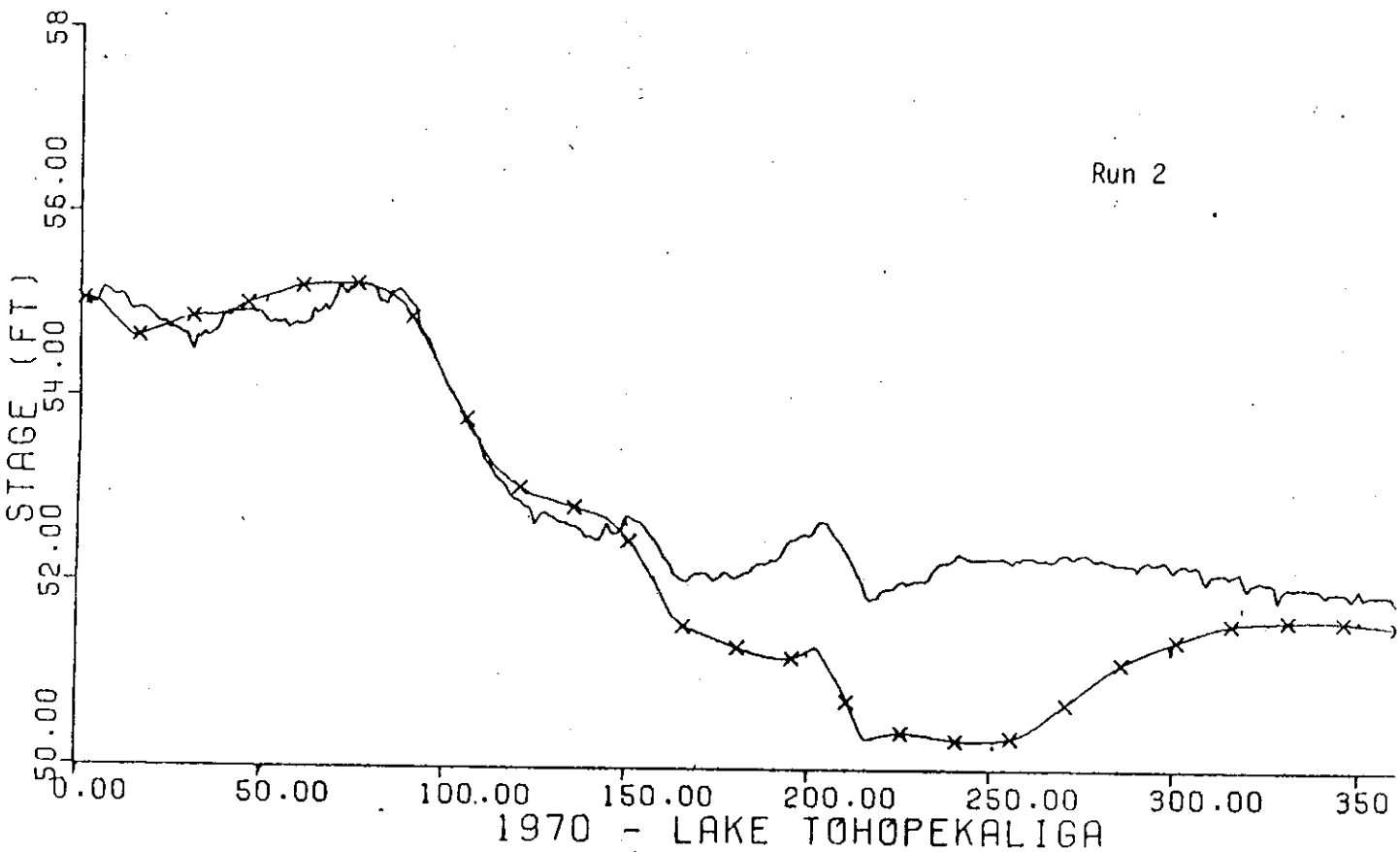


Figure 51. Effects of Parametric Sensitivity Analyses on the Refinement of Simulated Lake Stages for Lake Tohopekaliga

Table 37. Comparison of discharges computed by three different formulations for five pools of the Lower Kissimmee basin.

Structure	Equations Based on USGS Curve (Table No. 23)	FCD-USGS Equations (Table No. 24)	Equations Used In Our Study (Table No. 22)
S-65	2227.19	-	2303.28
S-65A	2160.72	2295.61	2311.95
S-65B	2230.804	2231.33	2354.27
S-65C	2078.17	2155.30	2082
S-65D	2546.87	2536.58	2652.86
S-65E	3170.60	-	3344.70

* This table was prepared as a result of discussions with the Hydrology Division

of sensitivity analyses Nos. 21 and 23. The output of the finally selected sub-basin model is compiled in reference No. 61. The values of the hydrologic components based on the final output are also shown in comparative Figures 9 to 35. As pointed out earlier, that since the streamflows generated by the sub-basin model are not conceptually the same as that of the discharges passing through the controlling structures, any positive conclusions based on these comparisons alone are not possible. However, since the simulated lake stages are significantly improved using the new set of sub-basin output, the selected combination among the other 23 parametric sensitivity analyses is fully justified.

Another step that is introduced in the process of developing a series of parametric sensitivity analyses is related to further refinement of discharge-stage relationships of the lakes and channels of the upper Kissimmee Basin. Such a refinement is achieved through correction factors. For each of the 20 channel sections of the upper Kissimmee, the estimated values of the discharges and stages are obtained using the equations of Tables 27 and 28. Knowing the computed values of these discharges and stages, the correction factors are computed. These correction factors along with their corresponding discharges and stages for each of the 20 channel sections are given in Appendix V and Appendix VI. The developed procedure to compute correction factors by double interpolation can be seen from the computer program given in Reference No. 37.

Since the iterative procedure of the lower Kissimmee Basin is geared to estimation of the discharges through controlling structures, and since there are three available sets of governing equations, an effort is made to examine the sensitivity of these formulations in terms of the variations in their discharge estimates. The results compiled in Table 37 indicate that all estimates are within the usual error limit of 10% suggesting equal rating for these three sets of equations. In spite of such a conclusion an effort is made in the final analysis to use these sets one at a time and to examine their sensitivity on the final simulated stages in the lower Kissimmee Basin.

Considering the important role of the parametric sensitivity analyses in refining the simulated values, it is essential to examine that role in our methodology. Using various parametric changes described earlier, many computer runs were made to generate simulated values. The improvements in subsequent runs for three illustrative lakes of the upper Kissimmee are shown in Figures 51, 52 and 53. These comparisons indicate positively the right direction given by the parametric sensitivity analyses in resolving the previous problems associated with lake stages.

3.3 OBSERVED HYROLOGIC CHARACTERISTICS OF THE KISSIMMEE BASIN

Since the pieces of sub-basin model and routing model have generated tremendous amounts of hydrologic information of various kinds, such information can be analyzed in many different ways to obtain the hydrologic characteristics of the Kissimmee Basin. Again, considering the fact that our efforts are toward completing the water quantity model and not towards applying advanced data processing techniques to the generated data, the detailed task of the hydrologic data analysis is out of scope for this study at this time. However, basic and useful hydrologic characteristics that can be observed through our generated data are briefly outlined below.

1. Range of maximum and minimum values of the coefficients of runoff:

The output of the sub-basin model on an annual, seasonal and cumulative basis is plotted along with the corresponding historical data as shown in Figures

Table 36. (continued)

Hydrologic Parameter	Sensitivity Analyses #	Planning Units 1	8	16
Annual Sub-surface Flow in inches	13	2.72	0.00	17.52
	14	2.72	0	17.74
	15	11.57	0	13.11
	16	11.59	0	13.85
	17	21.87	1.15	22.89
Annual SF in inches	13	0	0.00	0.12
	14	0	0	0.12
	15	0	0	0.02
	16	0	0	0.08
	17	0	0	0.11
Annual Total ET losses in inches	13	28.45	29.90	25.57
	14	38.45	30.77	25.35
	15	28.72	26.33	29.93
	16	28.69	26.33	29.11
	17	17.97	17.18	18.95
Annual Deep Seepage in inches	13	1.03	0.87	0.0
	14	1.03	0.43	0.0
	15	0.13	0	0.23
	16	0.13	0	0.25
	17	0.22	2.28	0.53
Annual Change in Available Storage in inches	13	-3.56	+18.15	5.43
	14	-3.56	+17.73	5.42
	15	-1.81	+22.73	5.464
	16	-1.81	+22.58	5.49
	17	-1.38	+28.298	4.710
Annual Change in Depression Storages	13	0	0	0
	14	0	0	0
	15	0	0	0
	16	0	0	0
	17	0	0	0
Annual Total Streamflows in inches	13	0.09	0.05	0.34
	14	2.88	0.07	18.15
	15	11.73	0.07	13.43
	16	11.76	0.07	14.22
	17	21.48	0.92	23.23

Table 36. (Continued)

Hydrologic Parameter	Sensitivity Analysis #	Planning Units 1	4	8	16
Annual Precipitation in inches	18	-	-	-	37.58
	19	38.48	44.10	48.90	37.58
	20	38.48	44.10	48.90	37.58
	21	38.48	44.10	48.90	37.58
Annual Sub-surface flow in inches	18	-	-	-	12.88
	19	11.57	1.65	0	13.11
	20	7.90	0.77	0	8.41
	21	7.43	0.62	6.11	6.62
Annual Surface flow in inches	18	-	-	-	0.01
	19	0	3.87	0	0.02
	20	0	1.76	0	0
	21	0	0.75	1.37	0
Annual Total ET losses in inches	18	-	-	-	29.87
	19	28.72	38.00	26.33	29.93
	20	32.92	42.94	26.51	35.40
	21	32.85	40.07	48.22	33.69
Annual Deep Seepages in inches	18	-	-	-	0.54
	19	0.13	2.68	0	0.23
	20	0.07	1.59	0	0.14
	21	0.06	1.56	1.55	0.09
Annual change in depression storage in inches	18	-	-	-	-5.46
	19	1.81	2.04	22.58	-5.46
	20	-2.27	-2.818	22.40	-6.044
	21	-1.76	+1.08478	-8.1525	-2.73
Annual change in depression storage in inches	18	-	-	-	0.00
	19	0	0	0	0.00
	20	0	0	0	0.00
	21	0	0	0	0
Annual Total Streamflow in inches	18	-	-	-	13.17
	19	11.73	5.56	0.07	13.43
	20	8.07	2.59	0.07	8.69
	21	7.52	1.40	7.35	6.72

Table 36. (Continued)

Hydrologic Parameter	Sensitivity Analysis #	Planning Units 1	8	16
Annual Total ET Losses in inches	7	34.38	35.59	34.15
	8	28.72	26.33	29.93
	9	28.69	35.39	29.02
	10	28.69	35.39	29.02
	11	28.72	26.33	29.93
	12	38.45	29.90	25.57
Annual Deep Seepage in inches	7	1.40	6.07	0.96
	8	0.13	0	0.23
	9	0.11	5.99	0.16
	10	0.11	5.99	0.16
	11	0.13	0.00	0.23
	12	1.03	0.87	0
Annual Change in Available Storage in inches	7	0.47	-4.84	-0.19
	8	-1.81	22.58	5.46
	9	-1.29	-4.91	-2.09
	10	-1.29	-4.91	-2.09
	11	-1.81	22.58	-5.46
	12	-3.56	18.15	-5.43
Annual Change in Depression Storages	7	0	0	0
	8	0	0	0
	9	0	0	0
	10	0	0	0
	11	0	0	0
	12	0	0	0
Annual Total Streamflow in inches	7	0.06	1.29	0.07
	8	0.22	0.05	0.26
	9	0.16	1.33	0.16
	10	0.16	1.33	0.16
	11	0.20	0.05	0.26
	12	0.09	0.05	0.34
Annual Precipitation in inches	13	38.48	48.90	37.58
	14	38.48	48.90	37.58
	15	38.48	48.90	37.58
	16	38.48	48.90	37.58
	17	38.48	48.90	37.58

Table 36. (Continued)

Hydrologic Parameter	Sensitivity Analysis #	Planning Units 1	8	16
Annual Change in Available Storage in inches	1	-3.77	-0.67	-6.87
	2	-0.54	+17.36	-4.15
	3	0.31	+19.7	-3.93
	4	-0.56	+24.17	2.76
	5	+4.54	+37.54	+1.14
	6	-0.08	22.58	3.66
Annual Change in Depression Storage in inches	1	0	0	0
	2	0	0	0
	3	0	0	0
	4	0	0	0
	5	0	0.02	0
	6	0	0	0
Annual Total Streamflows in inches	1	4.60	27.27	4.36
	2	4.58	13.40	5.81
	3	5.17	15.18	6.57
	4	2.82	18.31	4.57
	5	33.93	10.05	36.56
	6	0.09	0.05	0.23
Annual Precipitation in inches	7	38.48	48.90	37.58
	8	38.48	48.90	37.58
	9	38.48	48.90	37.58
	10	38.48	48.90	37.58
	11	38.48	48.90	37.58
	12	38.48	48.90	37.58
Annual Surface Flow in inches	7	2.25	10.39	2.68
	8	11.57	0	13.11
	9	11.06	10.80	10.58
	10	11.06	10.80	10.58
	11	11.57	0	13.11
	12	2.72	0	17.52
Annual SF in inches	7	0	1.81	0
	8	0	0	0.02
	9	0	1.77	0
	10	0	1.77	0
	11	0	0	0.02
	12	0	0	0.12

Table 36. A comparison of yearly hydrologic parameters generated by the sub-basin model for various parametric sensitivity runs.

Hydrologic Parameter	Sensitivity Analysis #	Planning Units 1	8	16
Annual Precipitation in inches	1	38.48	48.90	37.58
	2	33.86	43.03	37.58
	3	38.48	48.90	37.58
	4	38.48	48.90	37.58
	5	38.48	48.90	37.58
	6	38.48	48.90	37.58
Annual Sub-surface flow in inches	1	4.24	26.41	4.82
	2	4.52	15.02	5.25
	3	4.91	17.05	5.65
	4	2.72	20.61	3.58
	5	6.92	6.50	8.19
	6	2.32	0	3.08
Annual SF in inches	1	0.25	0	0.74
	2	0	0	0.39
	3	0.22	0	0.76
	4	0	0	0.76
	5	27.02	4.84	28.28
	6	0	0	0
Annual total ET losses in inches	1	36.68	24.33	37.38
	2	28.39	10.65	30.60
	3	32	12.17	34.10
	4	33.18	3.30	34.90
	5	0	0	0
	6	34.77	26.33	36.49
Annual Deep Seepages in inches	1	1.16	0	1.63
	2	1.50	0	1.04
	3	1.68	0	1.10
	4	2.01	0.83	1.16
	5	0	0	0
	6	1.50	0	0.99

Table 35. (continued)

Sensitivity Analysis #	Planning Unit #	Streamflows in inches			
		Feb-May	June-Sept	Oct-Nov	Dec-Jan
18	1	-	-	-	-
	4	-	-	-	-
	8	-	-	-	-
	16	4.50	1.89	2.78	4.0
19	1	2.37	5.12	1.64	2.60
	4	3.11	0.29	0.27	1.89
	8	0.02	0.00	0.00	0.05
	16	4.66	1.91	2.81	4.05
20	1	1.10	3.71	0.85	2.41
	4	1.39	0.11	0.08	1.01
	8	0.02	0.0	0.0	0.05
	16	2.61	0.99	1.53	3.56
21	1	1.02	3.71	0.85	1.94
	4	1.03	0.11	0.08	0.18
	8	2.86	1.03	1.05	2.41
	16	2.11	0.99	1.53	2.09
22	1	-	-	-	-
	4	1.04	0.11	.08	0.19
	8	-	-	-	-
	16	-	-	-	-
23	1	-	-	-	-
	4	3.12	1.14	0.68	1.65
	8	-	-	-	-
	16	-	-	-	-

Table 35. (Continued)

Sensitivity Analysis #	Planning Unit #	Streamflows in inches			
		Feb-May	June-Sept	Oct-Nov	Dec-Jan.
10	1	0.03	0.06	0.02	0.05
	8	0.45	0.35	0.22	0.31
	16	0.05	0.02	0.03	0.06
11	1	0.03	0.06	0.02	0.09
	8	0.01	0.00	0.00	0.04
	16	0.06	0.02	0.03	0.15
12	1	0	0	0	0
	8	0.01	0.00	0.00	0.04
	16	0.08	0.05	0.04	0.17
13	1	0	0	0	0.09
	8	0.01	0	0	0.04
	16	0.08	0.05	0.04	0.17
14	1	0.35	0.20	0	2.33
	8	0.02	0.00	0	0.05
	16	6.13	4.13	3.40	4.49
15	1	2.37	5.12	1.64	2.60
	4	3.11	0.29	0.27	1.89
	8	0.02	0.00	0.00	0.05
	16	4.66	1.91	2.81	4.05
16	1	2.38	5.12	1.64	2.62
	4	5.24	0.39	0.33	2.18
	8	0.02	0.00	0.00	0.05
	16	5.15	1.95	2.81	4.31
17	1	6.13	10.31	2.00	3.35
	4	7.31	0.87	0.40	2.47
	8	0.02	0.06	0.49	0.35
	16	8.65	6.49	3.33	4.76

Table 35. Comparison of streamflows for various parametric sensitivity runs for the year 1970.

Sensitivity Analysis #	Planning Unit #	Streamflows in inches			
		Feb-May	June-Sept	Oct-Nov	Dec-Jan
1	1	0.4	2.60	1.06	0.54
	8	5.87	16.54	2.56	2.30
	16	1.20	1.89	1.07	1.67
2	1	0.69	2.03	1.08	0.78
	8	2.19	5.45	3.81	1.95
	16	1.17	1.87	1.21	1.56
3	1	0.76	2.47	1.13	0.81
	8	2.48	6.18	4.32	2.20
	16	1.22	2.10	1.29	1.96
4	1	0.68	0.98	0.56	0.60
	8	2.64	7.71	5.29	2.67
	16	1.07	1.01	0.75	1.74
5	1	6.12	24.03	2.60	1.17
	8	0.02	4.57	4.17	1.29
	16	10.89	19.95	2.66	3.06
6	1	0.01	0.01	0.01	0.06
	8	0.01	0	0	0.04
	16	0.01	0.01	0.01	0.20
7	1	0.01	0.01	0.01	0.03
	8	0.44	0.34	0.21	0.30
	16	0.01	0.01	0.01	0.04
8	1	0.03	0.06	0.02	0.09
	8	0.01	0.00	0.00	0.04
	16	0.06	0.02	0.03	0.15
9	1	0.03	0.06	0.02	0.05
	8	0.45	0.35	0.22	0.31
	16	0.05	0.02	0.03	0.06

Table 34. (continued)

Sensitivity Analysis Number	Description
18	This run is exactly the same as #15 except that sensitivity of F(3) is examined for the planning units 16, 17, 18 and 19. The value of F(3)=0.0005 is used instead of 0.0002
19	In this run, all the conditions are the same as sensitivity analysis #15 except that number of cascades in overland flow is used as 1 instead of "read in" values.
20	In this run, a modified equation for estimating evapotranspiration loss is used.
21	This run is exactly the same as #20 except that state conditions at the end of 1960 are used instead of the conditions at the end of 1969.

Table 34. Descriptions of the sensitivity analyses performed on the sub-basin model

Sensitivity Analysis Number	Description
8	Two patch-up statements such as SG(3)=15 and Q(3) = 0.002 are removed; the updated state conditions at the end of 1969 are used, other conditions are the same as #7.
9	All conditions are the same as that of analysis #8 except state conditions at the end of 1960 are used.
10	Six statements after statement No. 680 are removed; two additional statements are added to estimate loss functions correctly, other conditions are the same as for analysis #9.
11	Everything is the same as sensitivity analysis #10 except that state conditions at the end of 1969 are used.
12	Two statements to improve loss functions and previously thought "patch-up" statements are again used; seasonality in PPA1 is introduced; state conditions at the end of 1969 are used.
13	Some more "patch-up" and "unnecessary" statements were removed. All other conditions are the same as for analysis #12.
14	Everything is the same as sensitivity analysis #12 except a. $C_1 = 2(DT_1)/ 2(TK(1)) + DT_1)$ is used. b. planning unit 4 was processed in addition to the units #1, 8 and 16.
15	Everything is the same as sensitivity analysis #14 except that the seasonal variation in PPA1 was removed.
16	This run is exactly the same as sensitivity analysis #14 except that few logical errors overlooked in analysis #14 were eliminated.
17	This run is exactly the same as sensitivity analysis #16 except that seasonality of PPA1 is introduced in LOS^2T.

Table 34. Descriptions of the sensitivity analyses performed on the sub-basin model

Sensitivity Analysis Number	Description
1	This is the original program given to us by the previous investigators. Using the original set of state conditions, basin parameters and rainfall inputs, this program generated streamflows for 19 planning units for ten years (1960-1970). It is to be noted that these simulated streamflows are used in comparative tables and graphs for verifying the sub-basin model output.
2	In this run, upper and lower bounds on the ET loss are removed and interception loss is included. Value of ppan is changed from 0.78 to 0.76. Sub-basin model output is compiled for 19 planning units.
3	This run is made only for three illustrative planning units #1, 8 and 16. The value of ppan = 0.78. Interception loss is not included but upper and lower limits on ET loss are removed.
4	In this run, "upper bound" is changed from 0.00142 to 0.0009 and "lower bound" is set to 0.0005.
5	Upper and lower bounds are removed, increment in GD is removed. Adjustment to LOS2T is removed.
6	Upper and lower bounds are removed; increment in GD is removed; in the right hand side of the equation for C1, 2ΔT, is replaced by 2; the original equation for adjusting LOS2T is replaced by the equation given in ARS publication.
7	Everything is exactly the same as sensitivity analysis #6 except that the original state conditions at the beginning of 1961 are used instead of the updated conditions at the end of the year 1969.

3.2.8 NATURE OF THE PARAMETRIC SENSITIVITY ANALYSIS

After successfully fitting together the sub-basin model with the routing model, the next important step is to improve and refine the final output by tuning up the model. This tune-up is generally done in terms of parametric sensitivity analysis. In simple terms, parametric sensitivity analysis is related to a systematic effort to determine the impact of change in one or more parameters on the final output. As a result, it is possible to identify the more sensitive or key parameters or coefficients used in the model. It is also to be noted that the purpose of parametric sensitivity analysis is to improve the correlation between simulated and recorded values on a rational basis.

As a first attempt, parametric sensitivity analysis is performed by

1. Converting the basin parameters of planning units 8 and 11 to one layered soil systems in the sub-basin model.

2. Changing the value of F(3) from 0.0003 to 0.0002 for the five planning units of the lower Kissimmee.

3. Increasing and decreasing the upper and lower limits of the total losses.

4. Using initial storage values instead of the developed formulations for the lower Kissimmee in the routing model.

5. Selecting another set of proportioning factors for distributing local inflows.

6. Introducing in the sub-basin model the interception loss which is less effective in dry periods and more effective in wet periods.

7. Changing the criteria of convergence and the limit of maximum number of iterations.

Since such a preliminary effort of one shot parametric changes was not successful in improving simulated lake stages, a detailed and systematic parametric analysis was planned to examine the critical parts of the model.

As a step in that direction, sub-basin model output is first generated with 23 different modifications in the sub-basin program for three illustrative planning units - 1, 8 and 16. The description of such changes (also called parametric sensitivity analyses) is given in Table 34. The effects of these changes on simulated hydrologic components and simulated streamflows in particular, are depicted in Tables 35 and 36. These comparative tables indicate clearly the net response of various parameters of the physical hydrologic system to state conditions, routing coefficients, seasonal variation of evaporation coefficient, use of modified equations for evapotranspiration and artificial patch-up coefficients used by the previous investigators. Among these 23 analyses, Nos. 15, 21 and 23 are the choices for many obvious reasons. Since Nos. 21 and 23 are the subsequent refinements of No. 15, the final selection of the parameters for the sub-basin model is based on the combination

Table 33. Initial storages for five channel sections of lower Kissimmee basin.

Channel Section	Initial Storage in Acre-ft.	Cubic Ft.
C-38A	5901.807693	2.570827431×10^8
C-38B	10003.447100	4.357501557×10^8
C-38C	8013.750286	3.490789625×10^8
C-38D	10017.3096	4.363540062×10^8
C-38E	8796.698	3.831841649×10^8

were associated with these formulations. Unfortunately, since these inaccuracies were accumulated in our iteration procedure, simulated values were different than recorded values. Furthermore, to increase the accuracies of these formulations, the use of tables was not a viable alternative because of the three variables system. Under these circumstances, it was decided to use correction factors to increase the accuracies of the backwater functions of the lower Kissimmee Basin. As a first step, new forms of equations, as shown in Tables 27,28,29,30 and 31, were formulated. Using these equations, computed upstream (CUS), downstream stages (CDS) and computed stages were estimated for five sections of the lower Kissimmee. These values were tabulated with their actual values and with their ratio such as

1. $Ufact = \frac{US}{CUS}$
2. $Dfact = \frac{DS}{CDS}$
3. $Sfact = \frac{STOR}{CSTOR}$

These tabulated values corresponding to particular mean discharges are depicted in Appendix VI. Based on the values given in these tables, correction factors for upstream stage (Ufact), downstream stage (Dfact) and storage (Sfact) are formulated. Although linear and nonlinear equations are tried for these correction factors, it is found more accurate to fit parabolic equations. Such developed equations of Ufact, Dfact and Sfact for five channel sections of the Kissimmee are given in Tables based on references 48 and 49. In the routing methodology, the computed upstream stage, downstream stage and storage values are multiplied by these correction factors to obtain final simulated stages and storages. After examining the effects of these formulations of correction factors, it was decided to use correction factors for downstream stage directly from the tables instead of the corresponding parabolic relationships.

3.2.7 COMPUTATIONS OF INITIAL STORAGES FOR FIVE SECTIONS OF THE LOWER KISSIMMEE BASIN

Based on experience with the first-cut results of the routing model for the lower Kissimmee, it is realized that the accuracy of the simulated values would be increased if we compute manually initial storages of the five sections of C-38 and if we feed them as input data to the routing model. In this fashion, the computation of storage in the beginning of each time step, using the relationships given in Table 31 can be eliminated and storage at the end of the time period is used as an initial storage in the next time period. Furthermore, it is very convenient to change the initial storages if required. Since initial storages play an important role in obtaining more accurate simulated values, they are computed as accurately as possible by the following steps:

1. For each channel section of C-38, discharges through the upstream and downstream control structures are estimated from the equations given in Table 22 using the initial stages of Table 13 and initial gate openings similar to those given in Appendix I.

2. For average values of these two discharges and for the given initial value of downstream storage is interpolated directly from the tables given in Appendix VI.

Such computed values are given in Table 33.

3. With a limit of 50 on the number of iterations in one time step, and with an allowable increment of 0.005 ft., an iteration procedure becomes flexible in changing the initial stage by as much as 0.25 ft. to obtain final convergent stage.

3.2.5 COMPUTATIONS OF ANNUAL EVAPORATION FOR THE UPPER, LOWER AND ENTIRE KISSIMMEE BASIN

In the process of verifying the sub-basin model output, it has been speculated previously that evaporation from the free water surface be included in the routing model to improve and refine the simulated streamflows of the sub-basin model. Accordingly, equations given in Table 15 are incorporated to account for evaporation from each lake on a 3 hour basis. To examine the impact of including evaporation on an annual and seasonal basis, however, the following values are obtained:

Kissimmee Area	Dry Period in Inches	Wet Period in Inches	Annual in Inches
Upper	0.96	1.16	2.12
Lower	0.37	0.45	0.82
Entire	0.79	0.95	1.74

It is to be emphasized here that the procedure to obtain such values includes:

1. Estimation of the total lake area of the upper Kissimmee,
2. Computations of water surface area of the lower Kissimmee,
3. Calculating the ratio of water surface area and total area of the upper, lower and entire Kissimmee, and
4. Multiplying lake evaporation values (which are converted from pan evaporation values of Table 15) by the ratio obtained in step 3.

It is to be noted that these evaporative values represent the water lost directly from the free water surface. Such a direct evaporative loss is insignificant as compared to the total water loss from the total area of the upper, lower and entire Kissimmee Basin. Since such water loss has an insignificant effect in improving lake stages and storages of the upper Kissimmee Basin, it is not included in the lower Kissimmee computations although it can easily be added if it becomes necessary.

3.2.6 USE OF CORRECTION FACTORS FOR THE BACKWATER FUNCTIONS OF THE LOWER KISSIMMEE

When the formulations relating upstream and downstream stages, discharges and storages were originally built into the routing model, the simulated stages were found to be inaccurate from an operational standpoint. Although the variables of these original formulations were principally based on the hydraulic characteristics depicted in Figures 37,38,39 and 40, mathematically, we were trying to simulate a small number (U.S.S.-D.S.S.) from two large numbers of D.S.S. and Q. Thus, in spite of a high correlation coefficient, inaccuracies

the lower Kissimmee, the total storage (i.e., storage in channel as well as in the storage outside the channel) of the planning unit is the key parameter to be iterated on. This iterative procedure of storage parameters was already described step by step in the previous chapter. Due, however, to the relatively small size of some of the upper lakes (i.e., Coon, Lizzie, Trout, Joel, etc., etc.) and due to the inherent inaccuracies in the backwater functions for some small channel sections between these small lakes, iterative procedure did not converge many times. To eliminate such a convergence problem, another iterative procedure is devised only for the upper Kissimmee. In this procedure, the change in the storage during a time step is broken down into two parts; the first part consists of fixed inflows and outflows for the time period and the second part is related to the variable outflows and inflows to contribute to the variable "change in storage." Since the first part is constant, an iterative procedure is developed based on the second part. It is observed that such procedure has completely eliminated the convergence problem and thus storage values converge within 20 to 30 iterations.

3.2.4 IMPORTANCE OF ERROR FUNCTION AND ITS COMPUTATION

To carry out an iterative procedure, a criteria of convergence needs to be specified. In other words, if the storage value obtained in the iteration step is very close to the storage value in the previous iteration, then iteration is stopped. To quantify such closeness of the two storage values, an error function is used. Error function is basically a number which can be compared against the difference between two consecutive storage values. If the difference is greater than this number, then iteration is continued, otherwise no. Normally, such a number is selected based on the required precision in the system parameters. In our case, however, that number is computed from the tabulated relationships of the stage-storages for the upper Kissimmee (given in Tables 17,18,19,20 and 21) and functional relationships of stage, storage and discharges for the lower Kissimmee Basin (shown in Table 31). This is the reason why we called it error function rather than error number. For any lake in the upper Kissimmee at the start of the specific time period, initial stage is either obtained from the previous time period or from the table of initial conditions. Corresponding to this stage, a storage is obtained by interpolating the tabulated stage-storage values. Now, stage is incremented by 0.0005 ft. and another storage is obtained corresponding to this increased stage. The difference between these two numbers is the criteria of convergence.

For the lower Kissimmee the same procedure is repeated with the mathematical function (given in Table 31) instead of interpolating tabulated values. The advantages of using such error functions are as follows:

1. Since error function is based on the stages, the value given by error function varies according to the period of the year with different values in dry and wet periods.

2. It is possible to increase or decrease the error function by using appropriate values of stage increments.

dependent variables by simply knowing the values of the independent variables without extrapolating or interpolating the values from the table every time. Thirdly, it is possible to examine directly the parametric change in one or more independent variables on the dependent variable. This is particularly useful in tuning up the model with the key parameters. The fourth advantage is that further modifications in the mathematical forms or availability of new sets of data can be easily incorporated in the simulation procedure. Lastly, it is also possible to select the final form of equations based on the criteria of correlation coefficients or sum of the squares of the deviations, etc., etc. In spite of all these advantages, one major drawback of using these formulations is that they are abstractions of reality and thus an error (maybe minor) is always associated with these formulations. This minor error can accumulate in an iterative simulation procedure like ours and can finally become very significant. To illustrate this important and critical point, one of the formulations which were developed on data is used as an example. For Lake Kissimmee, with the storage of 370,000 acre feet, the developed equation simulated a stage of 52.68, whereas actual stage is 53.00 showing a difference of 0.32 ft. (i.e., approximately 0.6% error). If this error is carred out in the same direction for every 3 hour computation, then, in a day we may have an error or more than 1 or 2 ft. in our simulated stages. This also indicates that statistically derived relationships with very high correlation coefficients are not always accurate enough for the operationally oriented controlled water system like the Kissimmee Basin. To increase the accuracy of these stage-storage relationships to some extent, different forms of equations can be used. Considering only two variables, stage-storage tables, it appears that the most accurate method is to use tables directly to convert back and forth stages and storages of the fourteen lakes of the upper Kissimmee Basin. Since our total input data set is well within our total computer memory allocation, it was decided to use directly tabulated values of stage-storages (given in Tables 17,18,19,20 and 21) with the necessary interpolation process instead of using the developed formulations. It is to be noted here that this decision is justified in our particular situation wherein there is availability of additional memory core and tables with only two variables required to be stored. For tables with more than two variables, however, use of formulations becomes more convenient. Thus, for two variable systems, tabular values are directly used whereas for more than two variable tables, formulations are used instead of tables.

3.2.3 CONVERGENCE ASPECT OF OUR ITERATIVE PROCEDURE

Basically, the convergent characteristics of the iterative procedure assures the right functioning of linear and nonlinear interactions. A final converged value of storage or stage of the lake after some iterations indicates clearly the stabilized situation in that lake during that time step. On the other hand, non-convergent nature of the system suggests the wrong functioning of one or more pieces of the designed iterative procedure. To increase confidence in the final routed values of discharges and corresponding stages of lakes, control structures and channel sections of the upper and lower Kissimmee Basin, it is essential to eliminate the non-convergent values.

In our hydraulic analysis of the three lake system of the upper Kissimmee and five channel sections of the lower Kissimmee Basin, iterative procedure is geared to the convergent process for storage parameter. In the case of the upper Kissimmee, storage of the middle lake is made to converge whereas for

4. While formulating generalized backwater functions, we have initially used full ranges of discharge and stage including unrealistic maximum-minimum values of stages. However, when it is consistently observed that the backwater functions derived by multivariate analysis yielded inaccurate results around operating conditions because of the unrealistic and unnecessary extreme values, the range is narrowed to realistic stages only as shown in Table 25. Thus, the backwater equations are restricted to these particular ranges. Furthermore, the increment of the stages is selected at two foot intervals to generate an optimum number of sample points for the subsequent multivariate analysis.

5. In developing the routing logic for the water systems of the upper Kissimmee, an assumption is required to be made to consider a peculiar situation in C-34 between S-63 and S-63A. By examining the recorded headwater stages at S-63A, it is assumed that HWE at S-63A remains constant at the 56.5 level. This particular assumption enables us to estimate tailwater stage at S-63 and then corresponding discharges through S-63A and S-63 for the next time step.

6. For the last section of the lower Kissimmee between S-65D and S-65E, the tailwater elevation at S-65E is first assumed to be constant. When this assumption is found to have significant harmful effects on the final simulated stages in the lower Kissimmee, then the assumed value is replaced with the recorded values of tailwater stages at S-65E.

7. As mentioned earlier, the routing methodology for the upper Kissimmee can be developed in many different ways. After examining various alternatives about the possible iterative procedure on either storage in the lakes or discharges in the channel sections, or discharges through structures or stages at structures, it was decided to consider three lakes at a time, keeping the storage and stage of the middle lake variable and the lake levels of the other two held constant. Using this assumption, coupled with a relatively small time step of 3 hours, we have tried to route the sub-basin model output through the controlled water system of the upper Kissimmee.

8. The sub-basin model program that we used in this study is set up to deal with the basin-parameter of a one layer soil system. Therefore, it is essential to convert basin parameters of a two layer system to a one layer system. In other words, the current sub-basin program takes only the basin parameters of the third layer, although the program can be modified to include more than a one layer system.

3.2.2. USE OF TABLES VERSUS MATHEMATICAL FORMULATIONS

Like any other simulation procedure, our hydraulic simulation methodology is heavily geared to the mathematical formulations based on the tabulated values of the key system parameters. In other words, the mathematical equations are developed to be used in place of tables. There are many advantages to doing this. First of all, using the formulations with their corresponding coefficients requires less computer memory. Secondly, it is possible to obtain the value of

2. The relative importance of gate openings as against the head difference across the structure in the discharge rating formulations for the control structures,

3. Effectiveness of the net refinements in the various parameters and formulations in the sub-basin model and the routing model. This is particularly encouraging because the inadequacies in the formulations and sub-basin model have caused significant differences in simulated and historical stages of Lakes Cypress and Kissimmee in the first pass attempt. Subsequent refinement in the sub-basin model and the development of a better procedure for correcting channel formulations have reduced the significant differences to a manageable level where further fine tune-up is possible if required.

Although the details of sub-basin modeling and routing methodology are separately described in the previous section, there are many salient points that come into the picture, especially when these two important pieces are combined to obtain the required routed discharges and simulated water levels in the Kissimmee Basin. Since it is essential to interpret the results of our methodology in proper perspective, these points are discussed in the following section.

3.2 DISCUSSIONS

While developing and refining the various procedures that are responsible for the effective functioning of the hydrologic and hydraulic simulation of the Kissimmee Basin, the following assumptions are made.

3.2.1 ASSUMPTIONS

1. The set of basin parameters that was prepared by Lindahl and Sinha (39,40) and subsequently used in the sub-basin model by Khanal and Kiker (23,42) is assumed to be realistic. Although it is possible to repeat the time consuming task of deriving and recomputing these basin parameters, these values are granted as "given" mainly because of the fact that our main emphasis of these efforts is on the completion of the development of the methodology of the operational watershed model and not on repeating the previous work of refining the sub-basin model. However, considerable effort is made to understand the physical meaning of these basin parameters and to perform sensitivity analysis on these given numbers.

2. The backwater output obtained from the program of E070 and E081 is checked for a section of C-38 between S-65 and S-65A. Therefore, for other channel sections it is assumed to be adequate for developing backwater functions.

3. The selection of the value of the Manning's coefficient n is made based on the previous parametric investigations (39) and thus the value of n is assumed to be 0.018 for channels of the upper Kissimmee and 0.025 for five channel sections of the lower Kissimmee. If, for some valid reasons these numbers are to be changed at a later date, it is possible to easily modify the developed program to incorporate such change.

Table 32. Distribution of Magnitudes of Absolute Differences Between Simulated and Recorded Values for Three Illustrative Points Including Tailwater Elevation at S-59, Tailwater Elevation at S-63 and Headwater Elevation at S-65

Absolute Difference (D) in. ft.	Tailwater Elevation at S-59	Tailwater Elevation at S-63	Headwater Elevation at S-65
$0 < D < 0.1$	349*	1025*	264*
$0.1 < D < 0.15$	233	350	131
$0.15 < D < 0.2$	338	311	92
$0.2 < D < 0.25$	256	457	121
$0.25 < D < 0.3$	243	279	165
$0.3 < D < 0.35$	214	182	210
$0.35 < D \leq 0.4$	242	122	218
$0.4 < D < 0.45$	333	46	175
$0.45 < D < 1$	521	52	593
$D > 1.0$	191	96	951

* Number of times in a year the absolute difference observed to be in the range of Column 1. Please note that there are 8 times in a day and 2920 times in a year considering the time step of 3 hours used in the model.

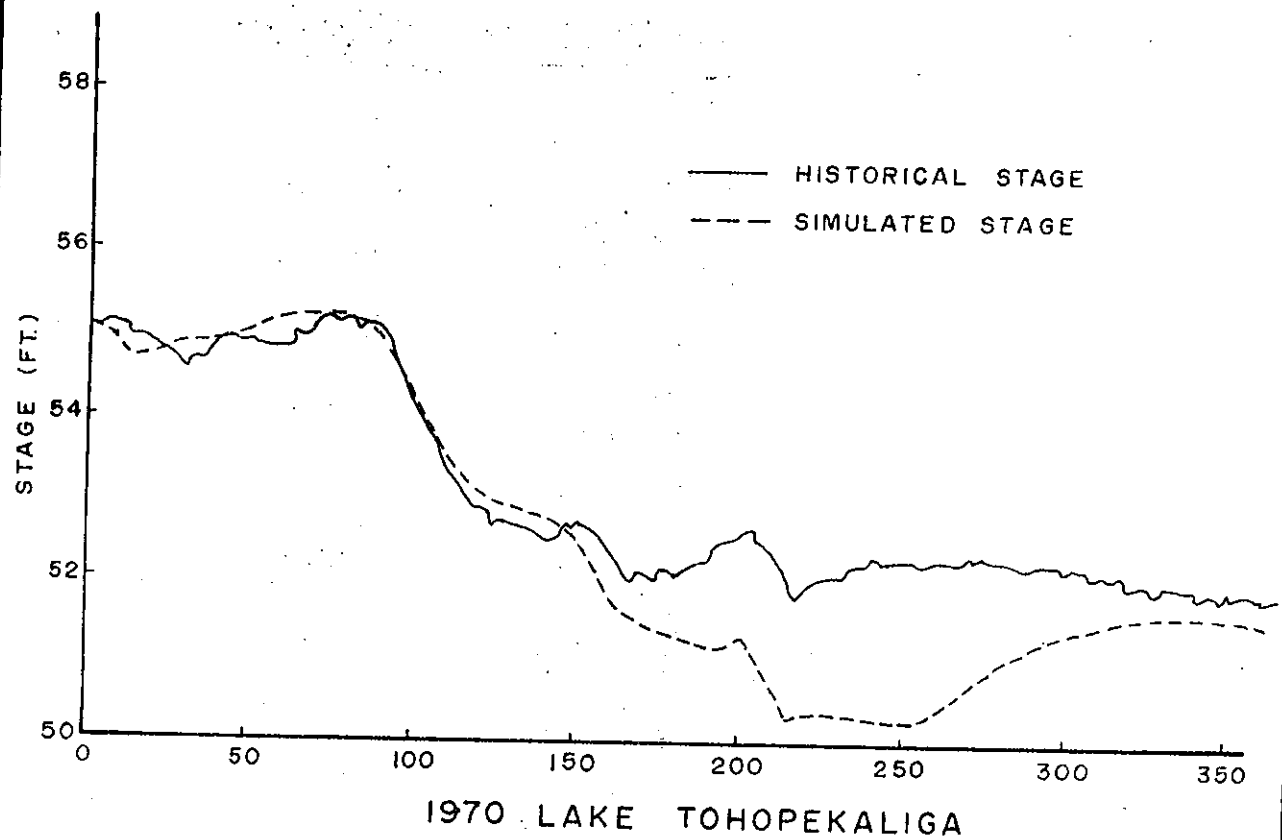
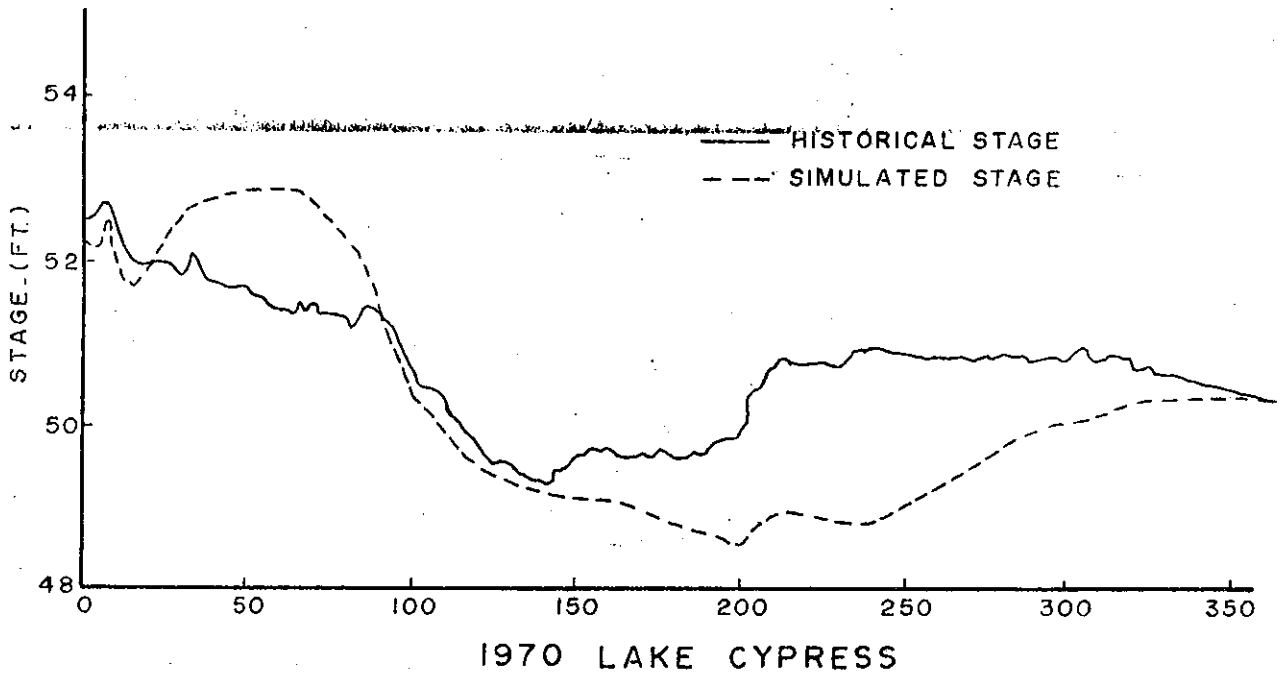


Figure 50 COMPARISON OF SIMULATED AND RECORDED STAGES FOR LAKE TOHOPEKALIGA FOR THE YEAR 1970



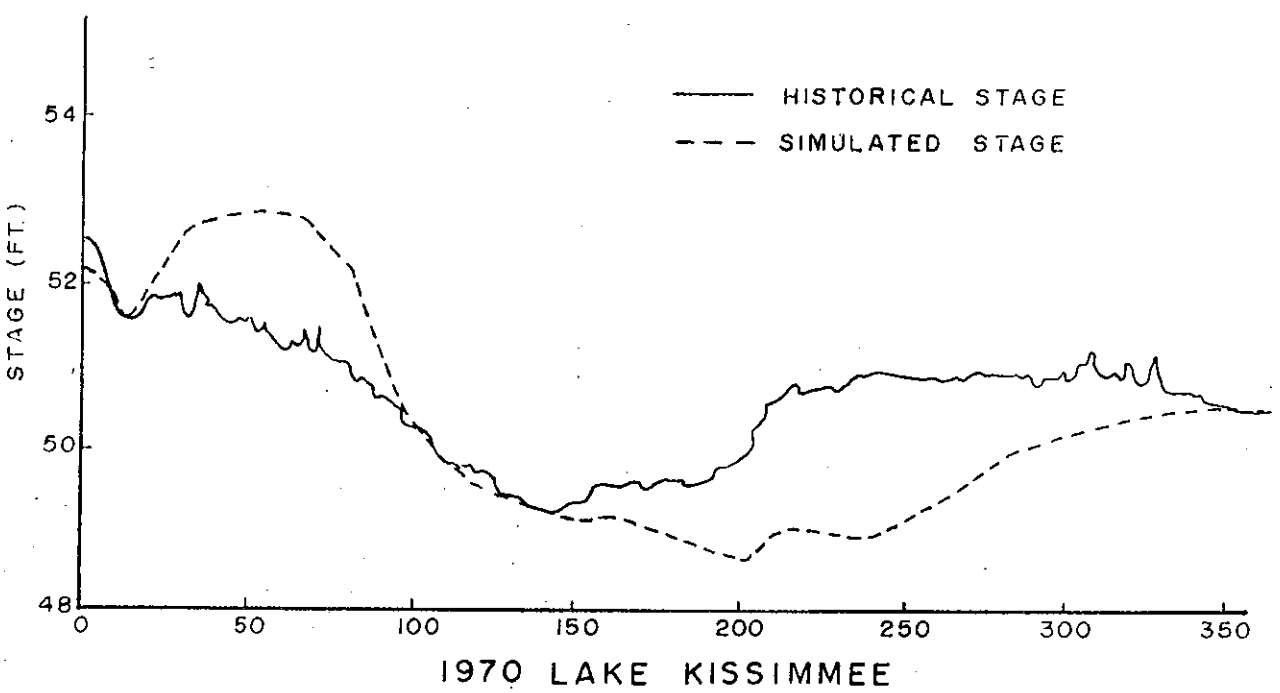
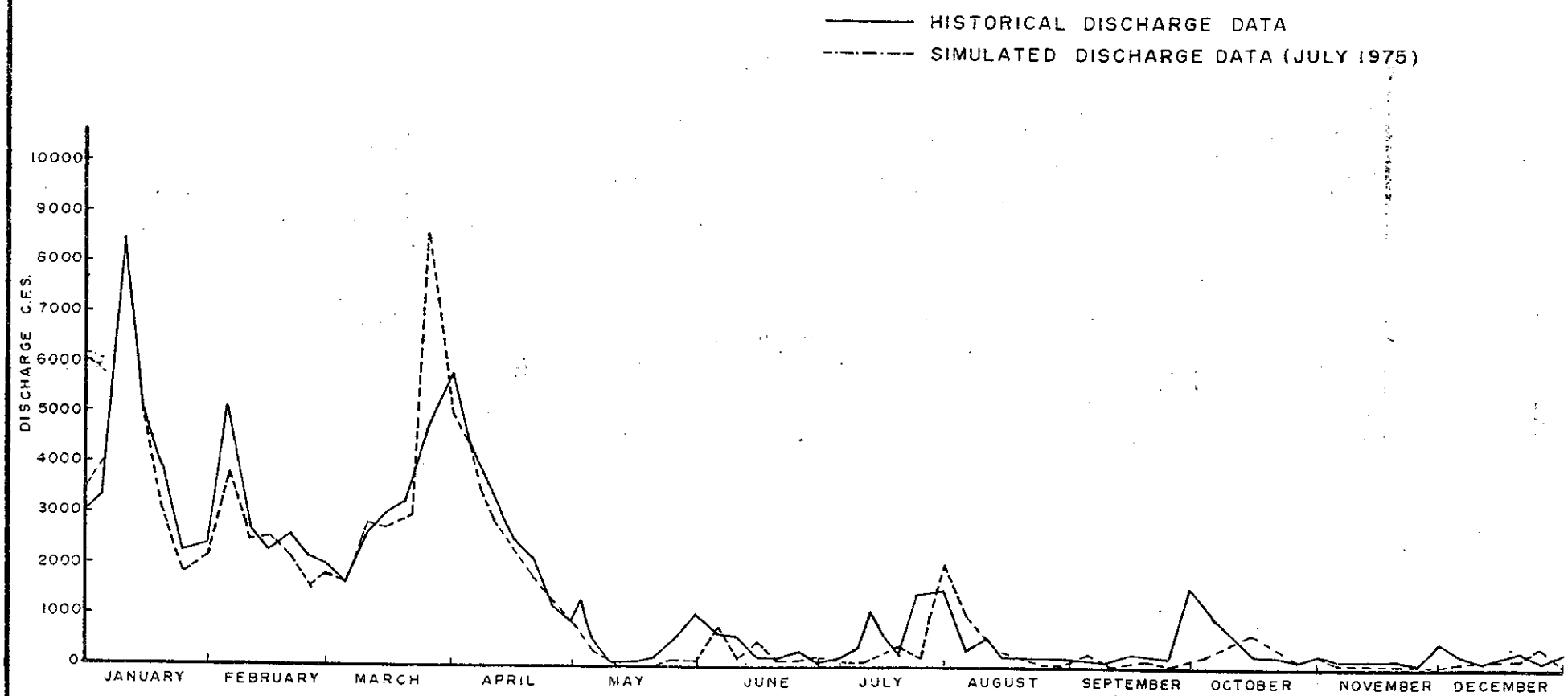
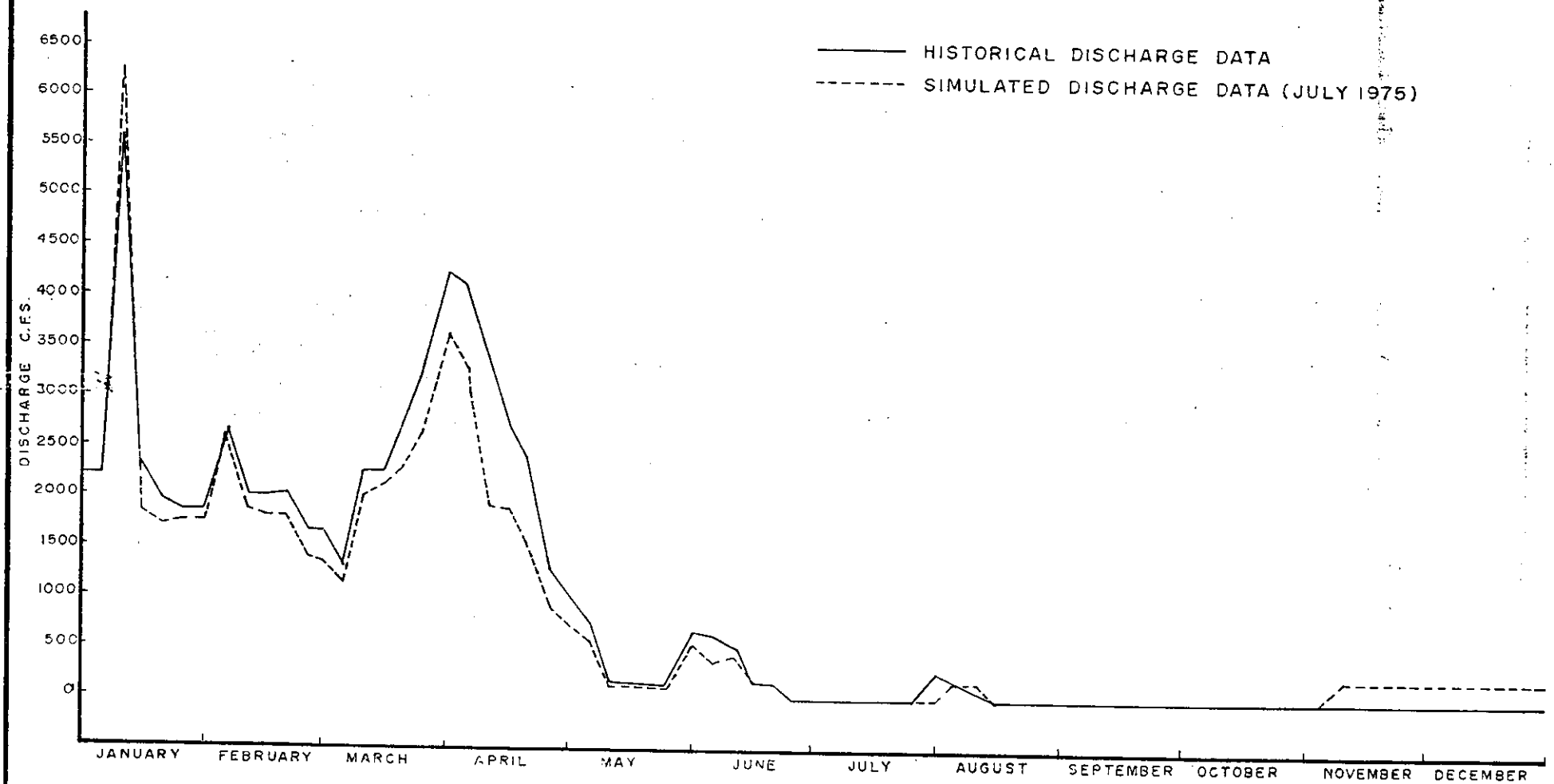


Figure 49 COMPARISON OF SIMULATED AND RECORDED STAGES FOR LAKE CYPRESS AND LAKE KISSIMMEE FOR THE YEAR 1970



COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-65E FOR THE FULL YEAR OF 1970

FIGURE 48



COMPARISON OF SIMULATED AND RECORDED DISCHARGES THROUGH S-65 FOR THE FULL YEAR OF 1970

FIGURE 47

APPENDIX VI

Tables for Computing Correction Factors for Downstream Stage, Upstream Stage and Storages for Five Pools of the Lower Kissimmee Basin

54.089	54.000	2500.000	2212.498	1.129945	.089
54.128	54.000	3000.000	2563.415	1.170086	.128
54.172	54.000	3500.000	2890.392	1.210908	.172
54.220	54.000	4000.000	3193.884	1.252394	.220
55.003	55.000	500.000	582.096	.858965	.003
55.012	55.000	1000.000	1021.466	.978965	.012
55.026	55.000	1500.000	1397.784	1.073127	.026
55.047	55.000	2000.000	1777.233	1.125345	.047
55.073	55.000	2500.000	2124.790	1.176567	.073
55.104	55.000	3000.000	2452.842	1.223071	.104
55.141	55.000	3500.000	2775.183	1.261178	.141
55.182	55.000	4000.000	3077.936	1.299572	.182
56.002	56.000	500.000	513.566	.973586	.002
56.010	56.000	1000.000	986.392	1.013590	.010
56.022	56.000	1500.000	1358.450	1.104200	.022
56.038	56.000	2000.000	1695.628	1.179504	.038
56.059	56.000	2500.000	2020.430	1.233393	.059
56.085	56.000	3000.000	2350.512	1.276318	.085
56.116	56.000	3500.000	2668.502	1.312581	.116
56.150	56.000	4000.000	2959.550	1.351554	.150
57.002	57.000	500.000	533.739	.936788	.002
57.008	57.000	1000.000	936.608	1.067682	.008
57.018	57.000	1500.000	1361.437	1.152572	.018
57.031	57.000	2000.000	1672.530	1.232638	.031
57.049	57.000	2500.000	1953.677	1.279638	.049
57.070	57.000	3000.000	2257.822	1.328714	.070
57.095	57.000	3500.000	2553.584	1.369550	.095
57.124	57.000	4000.000	2847.238	1.404870	.124
58.002	58.000	500.000	554.332	.901986	.002
58.006	58.000	1000.000	865.601	1.155267	.006
58.015	58.000	1500.000	1255.291	1.194942	.015
58.026	58.000	2000.000	1569.092	1.274622	.026
58.040	58.000	2500.000	1858.708	1.337823	.040
58.058	58.000	3000.000	2172.708	1.380765	.058
58.078	58.000	3500.000	2450.168	1.428474	.078
58.102	58.000	4000.000	2731.352	1.464208	.102
59.001	59.000	500.000	434.326	1.151208	.001
59.005	59.000	1000.000	834.368	1.198512	.005
59.012	59.000	1500.000	1190.125	1.260371	.012
59.022	59.000	2000.000	1521.873	1.314170	.022
59.034	59.000	2500.000	1815.810	1.376796	.034
59.048	59.000	3000.000	2078.442	1.436478	.048
59.066	59.000	3500.000	2376.434	1.472795	.066
59.085	59.000	4000.000	2633.281	1.519617	.085
60.001	60.000	500.000	456.511	1.109852	.001
60.005	60.000	1000.000	865.459	1.155456	.005
60.010	60.000	1500.000	1146.467	1.308368	.010
60.018	60.000	2000.000	1455.172	1.374408	.018
60.028	60.000	2500.000	1740.821	1.436164	.028
60.041	60.000	3000.000	2032.082	1.476319	.041
60.056	60.000	3500.000	2306.050	1.517747	.056
60.073	60.000	4000.000	2567.875	1.557708	.073

C-36

US	US	Q	CW	FACTORQ	QH
45.046	45.000	500.000	1138.275	.439261	.046
45.180	45.000	1000.000	1979.724	.505121	.180
45.393	45.000	1500.000	2717.508	.551976	.393
46.031	46.000	500.000	1017.413	.491442	.031
46.123	46.000	1000.000	1779.510	.561952	.123
46.272	46.000	1500.000	2455.362	.610908	.272
47.024	47.000	500.000	951.036	.526272	.024
47.090	47.000	1000.000	1642.856	.608696	.090
47.199	47.000	1500.000	2266.694	.661757	.199
47.345	47.000	2000.000	2833.551	.705828	.345
47.528	47.000	2500.000	3367.459	.742399	.528
47.991	47.000	3500.000	4347.353	.805088	.991
48.017	48.000	500.000	874.764	.571582	.017
48.062	48.000	1000.000	1478.587	.676321	.062
48.139	48.000	1500.000	2051.537	.731159	.139
48.242	48.000	2000.000	2568.986	.778517	.242
48.369	48.000	2500.000	3048.473	.820083	.369
48.521	48.000	3000.000	3506.343	.855592	.521
48.696	48.000	3500.000	3943.432	.887552	.696
49.012	49.000	500.000	794.367	.629432	.012
49.046	49.000	1000.000	1370.102	.729873	.046
49.102	49.000	1500.000	1892.544	.792584	.102
49.186	49.000	2000.000	2342.925	.839305	.180
49.275	49.000	2500.000	2829.929	.883414	.275
49.389	49.000	3000.000	3257.424	.920973	.389
49.521	49.000	3500.000	3667.307	.954379	.521
49.668	49.000	4000.000	4056.330	.986113	.668
50.009	50.000	500.000	738.649	.676912	.009
50.036	50.000	1000.000	1296.187	.771494	.036
50.079	50.000	1500.000	1782.905	.841324	.079
50.139	50.000	2000.000	2242.184	.891987	.139
50.214	50.000	2500.000	2671.105	.935942	.214
50.303	50.000	3000.000	3075.790	.975359	.303
50.407	50.000	3500.000	3466.968	1.009545	.407
50.522	50.000	4000.000	3835.165	1.042980	.522
51.007	51.000	500.000	696.440	.717937	.007
51.028	51.000	1000.000	1222.119	.818251	.028
51.063	51.000	1500.000	1698.159	.883309	.063
51.110	51.000	2000.000	2128.965	.939424	.110
51.170	51.000	2500.000	2540.156	.984192	.170
51.240	51.000	3000.000	2921.544	1.026854	.240
51.321	51.000	3500.000	3287.337	1.064691	.321
51.416	51.000	4000.000	3651.880	1.095326	.416
52.006	52.000	500.000	682.470	.732633	.006
52.023	52.000	1000.000	1177.105	.849542	.023
52.050	52.000	1500.000	1612.946	.929975	.050
52.088	52.000	2000.000	2028.680	.985863	.088
52.136	52.000	2500.000	2420.502	1.032844	.136
52.194	52.000	3000.000	2795.652	1.073095	.194
52.260	52.000	3500.000	3148.264	1.111724	.260
52.334	52.000	4000.000	3484.943	1.147795	.334
53.005	53.000	500.000	660.649	.756831	.005
53.018	53.000	1000.000	1110.807	.900246	.018
53.046	53.000	1500.000	1535.731	.976733	.046
53.071	53.000	2000.000	1938.225	1.031872	.071
53.110	53.000	2500.000	2314.906	1.079957	.110
53.157	53.000	3000.000	2674.300	1.121789	.157
53.209	53.000	3500.000	3003.389	1.165356	.209
53.270	53.000	4000.000	3332.174	1.200418	.270
54.004	54.000	500.000	628.535	.795500	.004
54.014	54.000	1000.000	1044.803	.957118	.014
54.033	54.000	1500.000	1479.433	1.013902	.033
54.057	54.000	2000.000	1846.640	1.083048	.057

53.003	53.000	500.000	582.946	.857712	.003
53.013	53.000	1000.000	1117.212	.895085	.013
53.053	53.000	2000.000	2043.969	.959707	.053
53.116	53.000	3000.000	2949.871	1.016994	.116
53.203	53.000	4000.000	3781.113	1.057890	.203
53.311	53.000	5000.000	4568.847	1.094368	.311
53.440	53.000	6000.000	5329.136	1.125486	.440
53.590	53.000	7000.000	5069.791	1.153252	.590
54.003	54.000	500.000	608.020	.822341	.003
54.011	54.000	1000.000	1082.033	.924187	.011
54.043	54.000	2000.000	1981.058	1.009562	.043
54.093	54.000	3000.000	2789.430	1.075486	.093
54.163	54.000	4000.000	3577.964	1.117973	.163
54.251	54.000	5000.000	4333.126	1.153901	.251
54.355	54.000	6000.000	5053.478	1.187301	.355
54.476	54.000	7000.000	5755.699	1.216186	.476
55.002	55.000	500.000	529.364	.944529	.002
55.009	55.000	1000.000	1031.651	.969320	.009
55.034	55.000	2000.000	1860.401	1.075037	.034
55.076	55.000	3000.000	2658.145	1.128607	.076
55.131	55.000	4000.000	3384.356	1.181909	.131
55.204	55.000	5000.000	4119.176	1.213835	.204
55.289	55.000	6000.000	4807.460	1.248060	.289
55.386	55.000	7000.000	5466.056	1.280631	.386
56.002	56.000	500.000	551.297	.906953	.002
56.007	56.000	1000.000	961.048	1.040531	.007
56.028	56.000	2000.000	1777.587	1.125121	.028
56.062	56.000	3000.000	2529.202	1.186145	.062
56.107	56.000	4000.000	3221.944	1.241487	.107
56.165	56.000	5000.000	3904.478	1.280581	.165
56.237	56.000	6000.000	4584.888	1.308647	.237
56.317	56.000	7000.000	5216.303	1.341947	.317
57.001	57.000	500.000	421.853	1.185248	.001
57.006	57.000	1000.000	934.038	1.070620	.006
57.023	57.000	2000.000	1695.317	1.179721	.023
57.051	57.000	3000.000	2413.646	1.242933	.051
57.089	57.000	4000.000	3089.938	1.294525	.089
57.135	57.000	5000.000	3717.235	1.345086	.135
57.194	57.000	6000.000	4365.922	1.374280	.194
57.262	57.000	7000.000	4988.480	1.403233	.262
58.001	58.000	500.000	438.711	1.139703	.001
58.005	58.000	1000.000	895.892	1.116206	.005
58.019	58.000	2000.000	1619.792	1.234727	.019
58.042	58.000	3000.000	2302.950	1.302677	.042
58.074	58.000	4000.000	2960.788	1.350992	.074
58.114	58.000	5000.000	3586.434	1.394142	.114
58.161	58.000	6000.000	4179.948	1.435425	.161
58.218	58.000	7000.000	4741.508	1.463973	.218
59.001	59.000	500.000	455.937	1.096643	.001
59.004	59.000	1000.000	843.317	1.185794	.004
59.015	59.000	2000.000	1515.802	1.319433	.015
59.035	59.000	3000.000	2207.418	1.359054	.035
59.062	59.000	4000.000	2844.762	1.406093	.062
59.096	59.000	5000.000	3453.666	1.447737	.096
59.136	59.000	6000.000	4030.749	1.488557	.136
59.183	59.000	7000.000	4598.051	1.522384	.183
60.001	60.000	500.000	473.533	1.055893	.001
60.003	60.000	1000.000	770.922	1.297147	.003
60.013	60.000	2000.000	1477.467	1.353668	.013
60.029	60.000	3000.000	2109.111	1.422400	.029
60.052	60.000	4000.000	2732.775	1.463714	.052
60.081	60.000	5000.000	3326.539	1.503064	.081
60.116	60.000	6000.000	3901.085	1.538034	.116
60.156	60.000	7000.000	4449.021	1.573380	.156

US	DS	Q	CQ	FACTORQ	DH
45.022	45.000	500.000	975.857	.512370	.022
45.083	45.000	1000.000	1758.743	.568588	.083
45.315	45.000	2000.000	3178.057	.629315	.315
45.682	45.000	3000.000	4476.975	.670095	.682
46.148	45.000	4000.000	5640.436	.709165	1.148
46.702	45.000	5000.000	6717.065	.744373	1.702
47.291	45.000	6000.000	7663.650	.782917	2.291
47.911	45.000	7000.000	8522.750	.821331	2.911
46.017	46.000	500.000	914.573	.546703	.017
46.062	46.000	1000.000	1623.707	.615875	.062
46.238	46.000	2000.000	2948.926	.678213	.238
46.515	46.000	3000.000	4153.162	.722341	.515
46.879	46.000	4000.000	5264.770	.759767	.879
47.314	46.000	5000.000	6292.719	.794569	1.314
47.805	46.000	6000.000	7244.452	.828220	1.805
48.333	46.000	7000.000	8117.858	.862296	2.333
47.012	47.000	500.000	822.538	.607874	.012
47.049	47.000	1000.000	1535.376	.651306	.049
47.180	47.000	2000.000	2734.602	.731368	.180
47.391	47.000	3000.000	3857.906	.777624	.391
47.673	47.000	4000.000	4908.788	.814865	.673
48.017	47.000	5000.000	5895.464	.848110	1.017
48.414	47.000	6000.000	6823.587	.879303	1.414
48.854	47.000	7000.000	7695.010	.909680	1.854
48.009	48.000	500.000	759.156	.658626	.009
48.037	48.000	1000.000	1421.333	.703565	.037
48.140	48.000	2000.000	2564.931	.779748	.140
48.304	48.000	3000.000	3617.952	.829198	.304
48.528	48.000	4000.000	4621.951	.865435	.528
48.804	48.000	5000.000	5569.807	.897697	.804
49.128	48.000	6000.000	6472.557	.926991	1.128
49.492	48.000	7000.000	7327.535	.955301	1.492
49.007	49.000	500.000	711.357	.702882	.007
49.029	49.000	1000.000	1336.394	.748282	.029
49.111	49.000	2000.000	2423.996	.825084	.111
49.244	49.000	3000.000	3437.793	.872653	.244
49.423	49.000	4000.000	4388.165	.911543	.423
49.647	49.000	5000.000	5298.577	.943650	.647
49.914	49.000	6000.000	6176.194	.971472	.914
50.213	49.000	7000.000	7002.422	.999654	1.213
50.006	50.000	500.000	695.275	.719146	.006
50.023	50.000	1000.000	1261.953	.792423	.023
50.090	50.000	2000.000	2311.504	.865238	.090
50.197	50.000	3000.000	3272.086	.916846	.197
50.343	50.000	4000.000	4184.666	.955871	.343
50.528	50.000	5000.000	5067.206	.986737	.528
50.751	50.000	6000.000	5924.411	1.012759	.751
51.007	50.000	7000.000	6747.730	1.037386	1.007
51.005	51.000	500.000	670.512	.745699	.005
51.019	51.000	1000.000	1212.301	.824478	.019
51.075	51.000	2000.000	2229.177	.897192	.075
51.165	51.000	3000.000	3162.643	.948574	.165
51.290	51.000	4000.000	4061.617	.984829	.290
51.446	51.000	5000.000	4916.182	1.017049	.446
51.636	51.000	6000.000	5754.396	1.042681	.636
51.862	51.000	7000.000	6585.365	1.062963	.862
52.004	52.000	500.000	634.476	.788051	.004
52.016	52.000	1000.000	1173.550	.852116	.016
52.065	52.000	2000.000	2185.620	.915072	.065
52.141	52.000	3000.000	3081.532	.973542	.141
52.249	52.000	4000.000	3965.811	1.008621	.249
52.381	52.000	5000.000	4789.389	1.043975	.381
52.541	52.000	6000.000	5595.400	1.072309	.541
52.724	52.000	7000.000	6367.478	1.099336	.724

US	DS	Q	CQ	FACTORQ	DH
56.034	56.000	50.000	223.094	.224121	.034
56.131	56.000	100.000	305.020	.327847	.131
56.283	56.000	150.000	364.670	.411330	.283
56.478	56.000	200.000	411.803	.485669	.478
56.701	56.000	250.000	450.040	.555507	.701
56.934	56.000	300.000	481.007	.623692	.934
57.169	56.000	350.000	506.703	.690740	1.169
57.423	56.000	400.000	530.341	.754232	1.423
57.731	56.000	450.000	554.993	.810821	1.731
58.148	56.000	500.000	583.478	.856931	2.148
58.766	56.000	550.000	618.715	.888940	2.766
59.837	56.000	600.000	667.501	.898876	3.837
58.007	58.000	50.000	163.216	.306343	.007
58.023	58.000	100.000	215.063	.464981	.023
58.050	58.000	150.000	257.495	.582535	.050
58.088	58.000	200.000	293.563	.681284	.088
58.136	58.000	250.000	324.745	.769834	.136
58.192	58.000	300.000	351.781	.852805	.192
58.257	58.000	350.000	376.389	.929889	.257
58.331	58.000	400.000	399.136	1.002165	.331
58.411	58.000	450.000	419.684	1.072236	.411
58.500	58.000	500.000	439.200	1.138433	.500
58.595	58.000	550.000	457.279	1.202765	.595
58.694	58.000	600.000	473.895	1.266104	.694
60.003	60.000	50.000	141.279	.353910	.003
60.009	60.000	100.000	182.271	.548632	.009
60.016	60.000	150.000	208.288	.720158	.016
60.028	60.000	200.000	237.150	.843349	.028
60.043	60.000	250.000	261.955	.954362	.043
60.062	60.000	300.000	285.154	1.052062	.062
60.084	60.000	350.000	305.959	1.143942	.084
60.108	60.000	400.000	324.320	1.233350	.108
60.135	60.000	450.000	341.544	1.317546	.135
60.166	60.000	500.000	358.315	1.395421	.166
60.199	60.000	550.000	373.702	1.471762	.199
60.234	60.000	600.000	388.009	1.546356	.234
62.001	62.000	50.000	115.170	.434140	.001
62.004	62.000	100.000	158.838	.629573	.004
62.008	62.000	150.000	186.535	.804137	.008
62.013	62.000	200.000	208.764	.958017	.013
62.018	62.000	250.000	225.128	1.110478	.018
62.025	62.000	300.000	242.948	1.234831	.025
62.035	62.000	350.000	262.664	1.332503	.035
62.045	62.000	400.000	278.426	1.436648	.045
62.056	62.000	450.000	292.910	1.536309	.056
62.069	62.000	500.000	307.438	1.626344	.069
62.083	62.000	550.000	320.894	1.713959	.083
62.099	62.000	600.000	334.284	1.794882	.099
64.002	64.000	100.000	142.022	.704115	.002
64.004	64.000	150.000	166.787	.899349	.004
64.007	64.000	200.000	189.899	1.053193	.007
64.010	64.000	250.000	206.273	1.211985	.010
64.014	64.000	300.000	223.012	1.345217	.014
64.017	64.000	350.000	233.283	1.500326	.017
64.022	64.000	400.000	247.656	1.615145	.022
64.027	64.000	450.000	259.701	1.732764	.027
64.033	64.000	500.000	272.071	1.837753	.033
64.040	64.000	550.000	284.483	1.933331	.040
64.048	64.000	600.000	296.769	2.021776	.048
66.001	66.000	100.000	126.796	.788608	.001
66.002	66.000	150.000	148.906	1.007347	.002
66.004	66.000	200.000	174.872	1.143696	.004
66.006	66.000	250.000	192.112	1.301327	.006
66.008	66.000	300.000	205.365	1.460815	.008
66.011	66.000	350.000	221.105	1.582962	.011
66.014	66.000	400.000	233.822	1.710704	.014
66.016	66.000	450.000	241.175	1.865862	.016
66.019	66.000	500.000	250.981	1.992186	.019
66.023	66.000	550.000	262.350	2.096435	.023
66.027	66.000	600.000	272.289	2.203545	.027

C32F

US	US	Q	CQ	FACTORQ	UH
59.076	59.000	20.000	100.250	.199500	.076
59.377	59.000	40.000	104.869	.381429	.377
61.222	59.000	60.000	110.233	.544303	2.222
59.321	59.000	80.000	104.396	.706315	.321
61.005	61.000	20.000	96.466	.207283	.005
61.016	61.000	40.000	99.695	.401224	.016
61.035	61.000	60.000	101.914	.588733	.035
61.060	61.000	80.000	103.470	.773168	.060
61.095	61.000	100.000	104.815	.954050	.095
61.138	61.000	120.000	105.923	1.132401	.138
61.190	61.000	140.000	106.880	1.309885	.190
61.253	61.000	160.000	107.744	1.485003	.253
61.328	61.000	180.000	108.533	1.658475	.328
61.419	61.000	200.000	109.283	1.830104	.419
63.001	63.000	20.000	95.695	.208997	.001
63.003	63.000	40.000	98.698	.405276	.003
63.008	63.000	60.000	101.458	.591375	.008
63.012	63.000	80.000	102.622	.779560	.012
63.019	63.000	100.000	103.957	.961938	.019
63.027	63.000	120.000	104.989	1.142474	.027
63.036	63.000	140.000	105.842	1.322725	.036
63.045	63.000	160.000	106.508	1.502228	.045
63.056	63.000	180.000	107.166	1.679645	.056
63.069	63.000	200.000	107.797	1.855348	.069
65.001	65.000	40.000	99.190	.403265	.001
65.002	65.000	60.000	101.143	.593221	.002
65.004	65.000	80.000	103.134	.775691	.004
65.006	65.000	100.000	104.317	.958621	.006
65.008	65.000	120.000	105.164	1.141075	.008
65.010	65.000	140.000	105.826	1.322926	.010
65.014	65.000	160.000	106.832	1.497677	.014
65.017	65.000	180.000	107.417	1.675711	.017
65.021	65.000	200.000	108.057	1.850870	.021
67.001	67.000	60.000	102.701	.584219	.001
67.001	67.000	80.000	102.701	.778958	.001
67.002	67.000	100.000	104.723	.954901	.002
67.003	67.000	120.000	105.924	1.132839	.003
67.004	67.000	140.000	106.784	1.311054	.004
67.005	67.000	160.000	107.457	1.488974	.005
67.007	67.000	180.000	108.478	1.659319	.007
67.008	67.000	200.000	108.886	1.836777	.008
69.001	69.000	80.000	106.228	.753099	.001
69.001	69.000	100.000	106.228	.941374	.001
69.001	69.000	120.000	106.228	1.129649	.001
69.002	69.000	140.000	108.319	1.292481	.002
69.002	69.000	160.000	108.319	1.477121	.002
69.003	69.000	180.000	109.561	1.642920	.003
69.003	69.000	200.000	109.561	1.825467	.003
71.001	71.000	120.000	109.769	1.093201	.001
71.001	71.000	140.000	109.769	1.275402	.001
71.001	71.000	160.000	109.769	1.457602	.001
71.001	71.000	180.000	109.769	1.639802	.001
71.002	71.000	200.000	111.930	1.786829	.002
73.001	73.000	160.000	113.326	1.411859	.001
73.001	73.000	180.000	113.326	1.588342	.001
73.001	73.000	200.000	113.326	1.764824	.001

US	DS	Q	CQ	FACTORQ	DH
57.003	57.000	20.000	92.512	.216188	.003
57.009	57.000	40.000	104.755	.381844	.009
57.020	57.000	60.000	114.658	.523295	.020
57.038	57.000	80.000	123.293	.648859	.038
57.069	57.000	100.000	131.901	.758146	.069
59.001	59.000	20.000	85.394	.234208	.001
59.005	59.000	40.000	102.447	.390445	.005
59.011	59.000	60.000	112.005	.535689	.011
59.018	59.000	80.000	118.422	.675548	.018
59.027	59.000	100.000	123.981	.806576	.027
59.039	59.000	120.000	129.247	.928452	.039
59.052	59.000	140.000	133.523	1.048510	.052
59.067	59.000	160.000	137.407	1.164427	.067
59.084	59.000	180.000	140.967	1.276895	.084
59.103	59.000	200.000	144.257	1.386418	.103
61.001	61.000	40.000	89.124	.448815	.001
61.003	61.000	60.000	100.918	.594542	.003
61.005	61.000	80.000	106.922	.748211	.005
61.008	61.000	100.000	112.761	.886834	.008
61.011	61.000	120.000	116.897	1.026544	.011
61.015	61.000	140.000	121.071	1.156342	.015
61.020	61.000	160.000	125.077	1.279217	.020
61.025	61.000	180.000	128.274	1.403245	.025
61.030	61.000	200.000	130.947	1.527332	.030
63.001	63.000	60.000	92.888	.645940	.001
63.002	63.000	80.000	100.465	.796298	.002
63.003	63.000	100.000	105.180	.950747	.003
63.004	63.000	120.000	108.660	1.104364	.004
63.006	63.000	140.000	113.760	1.230660	.006
63.008	63.000	160.000	117.523	1.361432	.008
63.009	63.000	180.000	119.100	1.511338	.009
63.011	63.000	200.000	121.834	1.641573	.011
65.001	65.000	80.000	96.686	.827420	.001
65.001	65.000	100.000	96.686	1.034275	.001
65.002	65.000	120.000	104.573	1.147525	.002
65.002	65.000	140.000	104.573	1.338780	.002
65.003	65.000	160.000	109.481	1.461437	.003
65.004	65.000	180.000	113.103	1.591471	.004
65.005	65.000	200.000	115.994	1.724221	.005
67.001	67.000	100.000	100.517	.994852	.001
67.001	67.000	120.000	100.517	1.193823	.001
67.001	67.000	140.000	100.517	1.392793	.001
67.001	67.000	160.000	100.517	1.591764	.001
67.002	67.000	180.000	108.717	1.655680	.002
67.002	67.000	200.000	108.717	1.839644	.002
69.001	69.000	140.000	104.381	1.341238	.001
69.001	69.000	160.000	104.381	1.532843	.001
69.001	69.000	180.000	104.381	1.724449	.001
69.001	69.000	200.000	104.381	1.916054	.001
71.001	71.000	200.000	108.277	1.847120	.001

C324

US	DS	Q	CQ	FACTORQ	DH
57.003	57.000	20.000	94.901	.210747	.003
57.012	57.000	40.000	113.537	.352308	.012
57.026	57.000	60.000	125.478	.478172	.026
57.046	57.000	80.000	135.087	.592210	.046
57.069	57.000	100.000	142.360	.702442	.069
57.099	57.000	120.000	149.165	.804478	.099
57.133	57.000	140.000	154.971	.903395	.133
57.172	57.000	160.000	160.212	.998679	.172
57.215	57.000	180.000	164.903	1.091552	.215
57.262	57.000	200.000	169.174	1.182216	.262
59.001	59.000	20.000	86.141	.232178	.001
59.003	59.000	40.000	99.293	.402449	.003
59.005	59.000	60.000	108.075	.565646	.005
59.010	59.000	80.000	116.023	.689517	.010
59.015	59.000	100.000	122.270	.817862	.015
59.021	59.000	120.000	127.768	.939641	.021
59.029	59.000	140.000	133.153	1.051425	.029
59.038	59.000	160.000	137.890	1.160348	.038
59.047	59.000	180.000	141.733	1.269993	.047
59.057	59.000	200.000	145.314	1.376333	.057
61.001	61.000	40.000	89.992	.444485	.001
61.002	61.000	60.000	98.432	.609557	.002
61.004	61.000	80.000	107.664	.743052	.004
61.006	61.000	100.000	113.461	.881362	.006
61.008	61.000	120.000	117.762	1.019005	.008
61.011	61.000	140.000	122.713	1.140869	.011
61.014	61.000	160.000	126.601	1.263810	.014
61.018	61.000	180.000	130.784	1.376315	.018
61.022	61.000	200.000	134.223	1.490060	.022
63.001	63.000	60.000	93.882	.639098	.001
63.002	63.000	80.000	102.688	.779062	.002
63.003	63.000	100.000	108.216	.924075	.003
63.004	63.000	120.000	112.319	1.068389	.004
63.006	63.000	140.000	118.366	1.182773	.006
63.007	63.000	160.000	120.750	1.325057	.007
63.009	63.000	180.000	124.739	1.443015	.009
63.011	63.000	200.000	128.019	1.562272	.011
65.001	65.000	60.000	97.812	.613424	.001
65.001	65.000	80.000	97.812	.817899	.001
65.002	65.000	100.000	106.985	.934707	.002
65.002	65.000	120.000	106.985	1.121649	.002
65.003	65.000	140.000	112.746	1.241734	.003
65.004	65.000	160.000	117.020	1.367293	.004
65.005	65.000	180.000	120.446	1.494446	.005
65.006	65.000	200.000	123.320	1.621798	.006
67.001	67.000	80.000	101.779	.786018	.001
67.001	67.000	100.000	101.779	.982523	.001
67.001	67.000	120.000	101.779	1.179027	.001
67.002	67.000	140.000	111.325	1.257583	.002
67.002	67.000	160.000	111.325	1.437238	.002
67.003	67.000	180.000	117.318	1.534286	.003
67.003	67.000	200.000	117.318	1.704763	.003
69.001	69.000	120.000	105.783	1.134397	.001
69.001	69.000	140.000	105.783	1.323463	.001
69.001	69.000	160.000	105.783	1.512529	.001
69.001	69.000	180.000	105.783	1.701595	.001
69.002	69.000	200.000	115.784	1.728542	.002
71.001	71.000	140.000	109.824	1.274770	.001
71.001	71.000	160.000	109.824	1.456880	.001
71.001	71.000	180.000	109.824	1.638990	.001
71.001	71.000	200.000	109.824	1.821100	.001
73.001	73.000	180.000	113.900	1.586333	.001
73.001	73.000	200.000	113.900	1.755926	.001

C326

US	US	Q	CQ	FACTORQ	DH
61.001	61.000	20.000	73.259	.273002	.001
61.005	61.000	40.000	100.369	.398527	.005
61.009	61.000	60.000	112.500	.532857	.009
61.014	61.000	80.000	122.766	.651646	.014
61.013	61.000	100.000	120.999	.826452	.013
63.001	63.000	20.000	76.578	.261172	.001
63.002	63.000	40.000	87.699	.456106	.002
63.004	63.000	60.000	100.435	.597403	.004
63.007	63.000	80.000	112.054	.713939	.007
63.012	63.000	100.000	124.515	.803115	.012
63.017	63.000	120.000	133.295	.900258	.017
63.023	63.000	140.000	141.415	.989992	.023
63.029	63.000	160.000	147.976	1.081259	.029
63.036	63.000	180.000	154.369	1.166036	.036
63.044	63.000	200.000	160.550	1.245720	.044
65.002	65.000	40.000	91.545	.436945	.002
65.002	65.000	60.000	91.545	.655418	.002
65.003	65.000	80.000	99.102	.807251	.003
65.005	65.000	100.000	109.517	.913100	.005
65.007	65.000	120.000	116.968	1.025919	.007
65.009	65.000	140.000	122.863	1.139484	.009
65.012	65.000	160.000	129.975	1.231001	.012
65.015	65.000	180.000	135.775	1.325723	.015
65.018	65.000	200.000	140.705	1.421412	.018
67.001	67.000	40.000	83.333	.480001	.001
67.002	67.000	60.000	95.435	.628700	.002
67.002	67.000	80.000	95.435	.838267	.002
67.003	67.000	100.000	103.313	.967931	.003
67.004	67.000	120.000	109.294	1.097953	.004
67.005	67.000	140.000	114.171	1.226231	.005
67.006	67.000	160.000	118.317	1.352304	.006
67.008	67.000	180.000	125.166	1.438087	.008
67.010	67.000	200.000	130.751	1.529623	.010
69.001	69.000	60.000	86.768	.691498	.001
69.001	69.000	80.000	86.768	.921997	.001
69.002	69.000	100.000	99.369	1.006352	.002
69.003	69.000	120.000	107.572	1.115534	.003
69.003	69.000	140.000	107.572	1.301456	.003
69.003	69.000	160.000	107.572	1.487379	.003
69.004	69.000	180.000	113.799	1.581731	.004
69.005	69.000	200.000	118.877	1.682409	.005
71.001	71.000	80.000	90.241	.886520	.001
71.001	71.000	100.000	90.241	1.108150	.001
71.002	71.000	120.000	103.345	1.161154	.002
71.002	71.000	140.000	103.345	1.354680	.002
71.003	71.000	160.000	111.877	1.430146	.003
71.004	71.000	180.000	118.354	1.520867	.004
71.004	71.000	200.000	118.354	1.649852	.004
73.001	73.000	100.000	93.750	1.066671	.001
73.001	73.000	120.000	93.750	1.280005	.001
73.001	73.000	140.000	93.750	1.493340	.001
73.002	73.000	160.000	107.364	1.490255	.002
73.002	73.000	180.000	107.364	1.676537	.002
73.003	73.000	200.000	116.227	1.720768	.003
75.001	75.000	120.000	97.295	1.233365	.001
75.001	75.000	140.000	97.295	1.438926	.001
75.001	75.000	160.000	97.295	1.644487	.001
75.001	75.000	180.000	97.295	1.850048	.001
75.002	75.000	200.000	111.424	1.794943	.002

APPENDIX V

Tables for Computing Correction Factors for Discharges for Seven Channel Sections of the Upper Kissimmee Basin.

69.004	69.226	.99679609	69.000	68.774	1.00322212	250.000	.004
70.103	70.227	.99681619	70.000	69.777	1.00320184	250.000	.003
60.536	60.231	1.00556111	60.000	60.334	.99495203	275.000	.536
61.250	61.233	1.00328523	61.000	61.017	.99971415	275.000	.250
62.123	62.234	.99821357	62.000	61.889	1.00178900	275.000	.123
63.066	63.235	.99732496	63.000	62.831	1.00268881	275.000	.066
64.038	64.236	.99691123	64.000	63.802	1.00310592	275.000	.038
65.023	65.238	.99671015	65.000	64.786	1.00330884	275.000	.023
66.015	65.239	.99662134	66.000	65.776	1.00339846	275.000	.015
67.010	67.240	.99658335	67.000	66.770	1.00343983	275.000	.010
68.007	68.241	.99657241	68.000	67.766	1.00344987	275.000	.007
69.005	69.242	.99657571	69.000	68.763	1.00344452	275.000	.005
70.003	70.243	.99658137	70.000	69.760	1.00343881	275.000	.003
60.625	60.244	1.00632227	60.000	60.380	.99370205	300.000	.625
61.294	61.246	1.00378352	61.000	61.048	.99921017	300.000	.294
62.145	62.247	.99835731	62.000	61.898	1.00164944	300.000	.145
63.077	63.249	.99728439	63.000	62.828	1.00272971	300.000	.077
64.046	64.250	.99682139	64.000	63.796	1.00319660	300.000	.046
65.028	65.252	.99657241	65.000	64.777	1.00344785	300.000	.028
66.013	66.253	.99645224	66.000	65.765	1.00356912	300.000	.018
67.012	67.254	.99639576	67.000	66.758	1.00362619	300.000	.012
68.008	68.256	.99637172	68.000	67.753	1.00365146	300.000	.008
69.006	69.257	.99637591	69.000	68.749	1.00364632	300.000	.006
70.004	70.258	.99638126	70.000	69.746	1.00364082	300.000	.004
60.720	60.256	1.00769979	60.000	60.463	.99234034	325.000	.720
61.343	61.258	1.00134144	61.000	61.082	.99865707	325.000	.340
62.163	62.260	.99852921	62.000	61.909	1.00147658	325.000	.168
63.090	63.261	.99729257	63.000	62.829	1.00272146	325.000	.090
64.054	64.263	.99674866	64.000	63.791	1.00326998	325.000	.054
65.032	65.265	.99643653	65.000	64.768	1.00358502	325.000	.032
66.021	66.266	.99630241	66.000	65.755	1.00372247	325.000	.021
67.014	67.268	.99622835	67.000	66.747	1.00379525	325.000	.014
68.010	68.269	.99620289	68.000	67.741	1.00382097	325.000	.010
69.007	69.271	.99619312	69.000	68.737	1.00383084	325.000	.007
70.005	70.272	.99619336	70.000	69.733	1.00382554	325.000	.005
60.808	60.267	1.00897536	60.000	60.540	.99108271	350.000	.808
61.387	61.269	1.00192512	61.000	61.118	.99807386	350.000	.387
62.192	62.271	.99373172	62.000	61.921	1.00127302	350.000	.192
63.104	63.273	.99733116	63.000	62.831	1.00268257	350.000	.104
64.062	64.275	.99669054	64.000	63.788	1.00332862	350.000	.062
65.038	65.277	.99634592	65.000	64.762	1.00367651	350.000	.038
66.024	66.278	.99616317	66.000	65.746	1.00386109	350.000	.024

67.016	67.281	.99607559	67.000	66.736	1.00394957	350.000	.016
68.011	68.282	.99603506	68.000	67.730	1.00399053	350.000	.011
69.008	69.283	.99602507	69.000	68.725	1.00400062	350.000	.008
70.006	70.285	.99603511	70.000	69.721	1.00399553	350.000	.006
60.892	60.277	1.00119685	60.000	60.613	.98988139	375.000	.892
61.437	61.279	1.00257019	61.000	61.157	.99743010	375.000	.437
62.219	62.282	.99899491	62.000	61.938	1.00100857	375.000	.219
63.119	63.284	.99739419	63.000	62.836	1.00261510	375.000	.119
64.068	64.286	.99661399	64.000	63.783	1.00340597	375.000	.068
65.043	65.288	.99625260	65.000	64.756	1.00377076	375.000	.043
66.028	66.290	.99605363	66.000	65.739	1.00397176	375.000	.028
67.019	67.292	.99595031	67.000	66.728	1.00407617	375.000	.019
68.013	68.293	.99589448	68.000	67.720	1.00413260	375.000	.013
69.009	69.295	.99586965	69.000	68.714	1.00415770	375.000	.009
70.006	70.297	.99586325	70.000	69.710	1.00416720	375.000	.006
60.976	60.287	1.01142933	60.000	60.697	.98867250	400.000	.976
61.488	61.289	1.00324238	61.000	61.198	.99676017	400.000	.488
62.247	62.292	.99928595	62.000	61.956	1.00071723	400.000	.247
63.135	63.294	.99749178	63.000	62.842	1.00252071	400.000	.135
64.078	64.296	.99661145	64.000	63.783	1.00340946	400.000	.078
65.049	65.298	.99618555	65.000	64.751	1.00383848	400.000	.049
66.032	66.300	.99595597	66.000	65.732	1.00407136	400.000	.032
67.021	67.302	.99582115	67.000	66.719	1.00420673	400.000	.021
68.015	68.304	.99576489	68.000	67.711	1.00426360	400.000	.015
69.010	69.306	.99572521	69.000	68.704	1.00430372	400.000	.010
70.007	70.308	.99571561	70.000	69.699	1.00431343	400.000	.007

59.382	59.114	1.00452645	59.000	59.268	.99548290	125.000	.382
60.131	60.114	1.00028474	60.000	60.017	.99971465	125.000	.131
61.058	61.113	.99999505	61.000	60.945	1.00090800	125.000	.058
62.027	62.113	.99862348	62.000	61.914	1.00138482	125.000	.027
63.014	63.112	.99844678	63.000	62.902	1.00155946	125.000	.014
64.008	64.111	.99838328	64.000	63.897	1.00161829	125.000	.008
65.005	65.111	.99837324	65.000	64.894	1.00162839	125.000	.005
66.003	66.110	.99838420	66.000	65.893	1.00162239	125.000	.003
67.002	67.109	.99840544	67.000	66.893	1.00160104	125.000	.002
68.001	68.108	.99842659	68.000	67.893	1.00157977	125.000	.001
69.001	69.107	.99846211	69.000	68.894	1.00154404	125.000	.001
70.001	70.106	.99849713	70.000	69.895	1.00150883	125.000	.001
59.505	59.141	1.00615359	59.000	59.364	.99386906	150.000	.505
60.185	60.141	1.00073190	60.000	60.044	.99926884	150.000	.185
61.081	61.141	.99902104	61.000	60.946	1.00098233	150.000	.081
62.039	62.141	.99836362	62.000	61.898	1.00164310	150.000	.039
63.020	63.140	.99809191	63.000	62.879	1.00191644	150.000	.020
64.011	64.140	.99798518	64.000	63.871	1.00202385	150.000	.011
65.007	65.140	.99795908	65.000	64.867	1.00205013	150.000	.007
66.004	66.140	.99794945	66.000	65.864	1.00205982	150.000	.004
67.003	67.139	.99797045	67.000	66.864	1.00203868	150.000	.003
68.002	68.139	.99799137	68.000	67.863	1.00201762	150.000	.002
69.001	69.138	.99801221	69.000	68.863	1.00199665	150.000	.001
70.001	70.138	.99804721	70.000	69.863	1.00196142	150.000	.001
59.632	59.164	1.00791684	59.000	59.468	.99212611	175.000	.632
60.245	60.164	1.00134791	60.000	60.081	.99865040	175.000	.245
61.108	61.164	.99998186	61.000	60.944	1.00092124	175.000	.108
62.053	62.164	.99920446	62.000	61.889	1.00179917	175.000	.053
63.027	63.165	.99792247	63.000	62.862	1.00218765	175.000	.027
64.016	64.165	.99768289	64.000	63.851	1.00232821	175.000	.016
65.009	65.165	.99760956	65.000	64.844	1.00240206	175.000	.009
66.006	66.165	.99759947	66.000	65.841	1.00241222	175.000	.006
67.004	67.165	.99760513	67.000	66.839	1.00240653	175.000	.004
68.003	68.165	.99762582	68.000	67.838	1.00238569	175.000	.003
69.002	69.165	.99764644	69.000	68.837	1.00236492	175.000	.002
70.001	70.165	.99766697	70.000	69.836	1.00234424	175.000	.001
59.760	59.183	1.00974697	59.000	59.576	.99032350	200.000	.760
60.310	60.184	1.00209745	60.000	60.126	.99790180	200.000	.310
59.760	59.183	1.00974697	59.000	59.576	.99032350	200.000	.760
60.310	60.184	1.00209745	60.000	60.126	.99790180	200.000	.310
61.139	61.184	.99925979	61.000	60.955	1.00074358	200.000	.139
62.067	62.185	.99810415	62.000	61.882	1.00190412	200.000	.067
63.036	63.185	.99763559	63.000	62.851	1.00237585	200.000	.036
64.020	64.186	.99741594	64.000	63.834	1.00259713	200.000	.020
65.012	65.186	.99732634	65.000	64.826	1.00268743	200.000	.012
66.008	66.187	.99730145	66.000	65.821	1.00271352	200.000	.008
67.005	67.187	.99729177	67.000	66.818	1.00272328	200.000	.005
68.004	68.187	.99731124	68.000	67.817	1.00270265	200.000	.004
69.003	69.188	.99733163	69.000	68.815	1.00268209	200.000	.003
70.002	70.188	.99735195	70.000	69.814	1.00266161	200.000	.002
59.887	59.200	1.01159828	59.000	59.686	.98850668	225.000	.887
60.381	60.201	1.00298510	60.000	60.180	.99701648	225.000	.381

61.173	61.202	.99952343	61.000	60.971	1.00047797	225.000	.173
62.083	62.203	.99837081	62.000	61.880	1.00193767	225.000	.083
63.045	63.204	.99748756	63.000	62.841	1.00252497	225.000	.045
64.026	64.205	.99721402	64.000	63.822	1.00279560	225.000	.026
65.016	65.205	.99709734	65.000	64.811	1.00291827	225.000	.016
66.010	66.206	.99704233	66.000	65.804	1.00297577	225.000	.010
67.007	67.207	.99703320	67.000	66.801	1.00298598	225.000	.007
68.005	68.207	.99703556	68.000	67.798	1.00298057	225.000	.005
69.003	69.208	.99704129	69.000	68.795	1.00297479	225.000	.003
70.002	70.208	.99706161	70.000	69.794	1.00295431	225.000	.002
60.012	59.216	1.01344576	59.000	59.745	.98670024	250.000	1.012
60.456	60.217	1.00396348	60.000	60.239	.99603650	250.000	.456
61.219	61.218	.99986753	61.000	60.992	1.00013281	250.000	.219
62.132	62.219	.99811627	62.000	61.893	1.00189193	250.000	.132
63.056	63.220	.99740179	63.000	62.836	1.00261139	250.000	.056
64.032	64.221	.99705276	64.000	63.811	1.00296323	250.000	.032
65.019	65.222	.99688368	65.000	64.797	1.00313376	250.000	.019
66.012	66.223	.99681088	66.000	65.789	1.00320720	250.000	.012
67.008	67.224	.99678543	67.000	66.784	1.00323288	250.000	.008
68.006	68.225	.99679257	68.000	67.781	1.00322769	250.000	.006

US	CUS	DFACTOR	DS	COS	DFACTOR	Q	DH
58.251	57.753	1.0015639	58.000	58.300	.99485749	10.000	.051
59.203	58.746	1.0043648	59.000	59.258	.99564184	10.000	.003
60.101	59.740	1.0043755	60.000	60.263	.99563482	10.000	.001
61.000	61.733	1.0043751	61.000	61.269	.99561100	10.000	0
62.000	61.726	1.0044356	62.000	62.276	.99557121	10.000	0
63.000	62.719	1.0044697	63.000	63.283	.99553206	10.000	0
64.000	63.712	1.0045576	64.000	64.290	.99549352	10.000	0
65.000	64.705	1.0045395	65.000	65.297	.99545558	10.000	0
66.001	65.698	1.0045155	66.000	66.304	.99541823	10.000	0
67.000	66.691	1.0046239	67.000	67.311	.99538143	10.000	0
68.000	67.684	1.0046659	68.000	68.318	.99534518	10.000	0
69.000	68.677	1.0047015	69.000	69.325	.99530947	10.000	0
70.000	69.670	1.0047355	70.000	70.332	.99527427	10.000	0
53.159	57.984	1.0047831	58.000	58.276	.99526284	25.000	.159
59.020	58.981	1.0023222	59.000	59.141	.99761701	25.000	.020
60.006	59.975	1.0021869	60.000	60.131	.99781476	25.000	.006
61.002	60.971	1.0021591	61.000	61.132	.99784145	25.000	.002
62.001	61.965	1.0021818	62.000	62.136	.99781823	25.000	.001
63.001	62.961	1.0022324	63.000	63.140	.99777924	25.000	.001
64.000	63.957	1.0022393	64.000	64.144	.99775649	25.000	0
65.000	64.952	1.0022813	65.000	65.149	.99771847	25.000	0
66.000	65.947	1.0023186	66.000	66.153	.99768103	25.000	0
67.000	66.943	1.0023562	67.000	67.158	.99764415	25.000	0
68.000	67.939	1.0023923	68.000	68.163	.99760782	25.000	0
69.000	68.933	1.0024279	69.000	69.168	.99757202	25.000	0
70.001	69.928	1.0024628	70.000	70.173	.99753674	25.000	0
52.274	57.193	1.0067384	58.000	58.392	.99329283	50.000	.374
59.076	58.191	1.0016121	59.000	59.096	.99838243	50.000	.076
60.023	59.178	1.0015235	60.000	60.045	.99924636	50.000	.023
61.009	60.175	1.0015533	61.000	61.034	.99944192	50.000	.009
62.004	61.172	1.0015386	62.000	62.032	.99948514	50.000	.004
61.004	62.175	1.0015553	61.000	61.034	.99944192	50.000	.009
62.004	61.172	1.0015386	62.000	62.032	.99948514	50.000	.004
63.002	62.169	1.0015233	63.000	63.033	.99947867	50.000	.002
64.001	63.166	1.0015428 3	64.000	64.035	.99945613	50.000	.001
65.001	64.163	1.0015863	65.000	65.038	.99941828	50.000	.001
66.000	65.160	1.0016269	66.000	66.040	.99939619	50.000	0
67.000	66.157	1.0016395 9	67.000	67.043	.99935925	50.000	0
68.000	67.154	1.0016759 4	68.000	68.046	.99932286	50.000	0
69.000	68.151	1.0017117 6	69.000	69.049	.99928700	50.000	0
70.000	69.148	1.0017475 7	70.000	70.052	.99925166	50.000	0
58.611	58.142	1.0098135 7	58.000	58.570	.99026098	75.000	.611
59.159	59.140	1.0020186 2	59.000	59.119	.99798050	75.000	.159
60.052	60.138	1.0022328 2	60.000	60.014	.99976666	75.000	.052
61.021	61.136	.99975127	61.000	60.985	1.00024941	75.000	.021
62.010	62.134	.99962826	62.000	61.976	1.00039286	75.000	.010
63.005	63.132	.99956559	63.000	62.973	1.00043567	75.000	.005
64.003	64.131	.99957172	64.000	63.973	1.00042952	75.000	.003
65.002	65.129	.99959362	65.000	64.974	1.00040755	75.000	.002
66.001	66.126	.99961543	66.000	65.975	1.00038567	75.000	.001
67.001	67.124	.99965236	67.000	66.977	1.00034892	75.000	.001
68.001	68.122	.99968216	68.000	67.979	1.00031271	75.000	.001
69.000	69.120	.99970924	69.000	68.980	1.00029156	75.000	0
70.000	70.118	.99974451	70.000	69.982	1.00025618	75.000	0
58.833	58.183	1.0129142	58.000	58.751	.98721870	100.000	.833
59.264	59.182	1.0038348	59.000	59.182	.99691845	100.000	.264
60.087	60.181	1.0010431	60.000	60.056	.99989545	100.000	.087
61.038	61.180	.99931887	61.000	60.958	1.00068327	100.000	.038
62.017	62.178	.99901343	62.000	61.938	1.00099302	100.000	.017
63.009	63.177	.99891942	63.000	62.932	1.00108542	100.000	.009
64.005	64.176	.99839234	64.000	63.929	1.00111162	100.000	.005
65.003	65.175	.99889838	65.000	64.928	1.00110555	100.000	.003
66.002	66.173	.99891994	66.000	65.929	1.00108389	100.000	.002
67.001	67.172	.99894141	67.000	66.929	1.00106232	100.000	.001
68.001	68.171	.99897748	68.000	67.930	1.00102608	100.000	.001
69.001	69.169	.99901333	69.000	68.932	1.00099038	100.000	.001
71.000	70.168	.99903320	70.000	69.932	1.00096952	100.000	0

65.022	65.140	.99818759	65.000	64.882	1.00181695	240.000	.022
67.011	67.143	.99803446	67.000	66.868	1.00197077	240.000	.011
69.006	69.146	.99797757	69.000	68.860	1.00202793	240.000	.006
71.003	71.149	.99795255	71.000	70.855	1.00205397	240.000	.003
58.117	57.134	1.01720266	57.000	57.981	.98307674	270.000	1.117
59.353	59.137	1.00364496	59.000	59.215	.99636578	270.000	.353
61.127	61.141	.99977584	61.000	60.986	1.00022436	270.000	.127
63.055	63.144	.99859181	63.000	62.911	1.00141115	270.000	.055
65.027	65.147	.99815665	65.000	64.880	1.00184803	270.000	.027
67.014	67.150	.99797146	67.000	66.864	1.00203406	270.000	.014
69.007	69.153	.99788436	69.000	68.854	1.00212158	270.000	.007
71.004	71.156	.99785994	71.000	70.848	1.00214713	270.000	.004
58.277	57.140	1.01990466	57.000	58.135	.98047052	300.000	1.277
59.426	59.143	1.00478240	59.000	59.282	.99523710	300.000	.426
61.153	61.147	1.00010457	61.000	61.096	.99989537	300.000	.153
63.067	63.150	.99868546	63.000	62.917	1.00131718	300.000	.067
65.032	65.153	.99813706	65.000	64.879	1.00186770	300.000	.032
67.017	67.157	.99791982	67.000	66.861	1.00208595	300.000	.017
69.009	69.160	.99781698	69.000	68.843	1.00218930	300.000	.009
71.005	71.163	.99777669	71.000	70.842	1.00222980	300.000	.005
59.502	59.148	1.00597959	59.000	59.353	.99405188	330.000	.502
61.183	61.152	1.00050784	61.000	61.031	.99949207	330.000	.183
63.081	63.156	.99881995	63.000	62.926	1.00118226	330.000	.081
65.038	65.159	.99814201	65.000	64.879	1.00186273	330.000	.038
67.020	67.163	.99787737	67.000	66.858	1.00212861	330.000	.020
69.011	69.166	.99775879	69.000	68.845	1.00224780	330.000	.011
71.006	71.169	.99770364	71.000	70.837	1.00230323	330.000	.006
58.643	55.145	1.06342667	55.000	58.491	.94031658	360.000	3.643
59.583	59.153	1.00726874	59.000	59.429	.99277877	360.000	.583
61.215	61.157	1.00095134	61.000	61.058	.99904891	360.000	.215
63.093	63.161	.99893034	63.000	62.933	1.00107155	360.000	.093
65.045	65.164	.99816988	65.000	64.881	1.00183474	360.000	.045
67.024	67.168	.99785740	67.000	66.856	1.00214868	360.000	.024
69.013	69.172	.99770818	69.000	68.842	1.00229867	360.000	.013
71.008	71.175	.99765222	71.000	70.833	1.00235492	360.000	.008
59.665	59.157	1.00858103	59.000	59.507	.99148616	390.000	.665
61.250	61.161	1.00145022	61.000	61.089	.99855089	390.000	.250
63.106	63.165	.99906291	63.000	62.941	1.00093862	390.000	.106
65.052	65.169	.99820411	65.000	64.883	1.00180036	390.000	.052
67.028	67.173	.99784378	67.000	66.855	1.00216236	390.000	.028
69.016	69.177	.99767840	69.000	68.840	1.00232861	390.000	.016
71.009	71.180	.99759312	71.000	70.829	1.00241434	390.000	.009
59.751	59.161	1.00996621	59.000	59.599	.99012538	420.000	.751
61.287	61.165	1.00198715	61.000	61.121	.99801543	420.000	.287
63.123	63.169	.99926421	63.000	62.954	1.00073684	420.000	.123
65.060	65.173	.99825910	65.000	64.887	1.00174514	420.000	.060
67.033	67.177	.99785044	67.000	66.856	1.00215563	420.000	.033
69.018	69.181	.99763958	69.000	68.837	1.00236763	420.000	.018
71.010	71.185	.99753946	71.000	70.825	1.00246831	420.000	.010

DS	COS	DFACTOR	DS	COS	DFACTOR	Q	DH
55.343	55.32[illegible]	1.[illegible]597171	55.300	55.323	.99415856	30.000	.343
57.[illegible]	57.[illegible]	1.[illegible]15323	57.000	57.009	.99984672	30.000	.028
59.[illegible]06	59.[illegible]19	.99973748	59.000	58.987	1.00021271	30.000	.006
61.[illegible]02	61.[illegible]18	.99974149	61.000	60.984	1.00025875	30.000	.002
63.[illegible]01	63.[illegible]17	.99974674	63.000	62.984	1.00025350	30.000	.001
65.[illegible]	65.[illegible]15	.99975234	65.000	64.984	1.00024789	30.000	0
67.[illegible]	67.315	.99977315	67.000	66.985	1.00022705	30.000	0
69.[illegible]	69.[illegible]14	.99979336	69.000	68.986	1.00020683	30.000	0
71.[illegible]	71.[illegible]13	.99981298	71.000	70.987	1.00018718	30.000	0
57.[illegible]94	57.[illegible]55	1.[illegible]67515	57.000	57.039	.99932484	60.000	.094
59.[illegible]23	59.[illegible]56	.99944576	59.000	58.967	1.00055994	60.000	.023
61.[illegible]68	61.[illegible]57	.99926521	61.000	60.951	1.00079597	60.000	.008
63.[illegible]3	63.[illegible]57	.99914397	63.000	62.946	1.00085742	60.000	.003
65.[illegible]21	65.[illegible]57	.99913314	65.000	64.944	1.00086820	60.000	.001
67.[illegible]01	67.[illegible]58	.99915349	67.000	66.943	1.00084781	60.000	.001
69.[illegible]	69.[illegible]58	.99915877	69.000	68.942	1.00084252	60.000	0
71.[illegible]	71.[illegible]58	.99917838	71.000	70.942	1.00082286	60.000	0
57.193	57.[illegible]77	1.[illegible]203427	57.000	57.116	.99796468	90.000	.193
59.[illegible]44	59.[illegible]78	.99949280	59.000	58.970	1.00050781	90.000	.048
61.[illegible]17	61.[illegible]79	.99898151	61.000	60.938	1.00102023	90.000	.017
63.[illegible]67	63.[illegible]86	.99883629	63.000	62.927	1.00116587	90.000	.007
65.[illegible]93	65.[illegible]82	.99879236	65.000	64.921	1.00120943	90.000	.003
67.[illegible]92	67.[illegible]83	.99879737	67.000	66.919	1.00120490	90.000	.002
69.[illegible]81	69.[illegible]84	.99880222	69.000	68.917	1.00120005	90.000	.001
71.[illegible]	71.[illegible]85	.99883735	71.000	70.915	1.00119490	90.000	0
57.321	57.[illegible]92	1.[illegible]491606	57.000	57.229	.99599726	120.000	.321
59.[illegible]42	59.[illegible]94	.99980481	59.000	58.988	1.00019536	120.000	.082
61.[illegible]24	61.[illegible]95	.99889835	61.000	60.933	1.00110363	120.000	.028
63.[illegible]12	63.[illegible]97	.99865236	63.000	62.915	1.00135039	120.000	.012
65.[illegible]25	65.[illegible]99	.99856042	65.000	64.906	1.00144265	120.000	.005
67.[illegible]03	67.[illegible]	.99854911	67.000	66.903	1.00145400	120.000	.003
69.[illegible]01	69.[illegible]02	.99853905	69.000	68.899	1.00146409	120.000	.001
71.[illegible]91	71.[illegible]04	.99855824	71.000	70.898	1.00144483	120.000	.001
57.467	57.[illegible]13	1.[illegible]636762	57.000	57.363	.99366833	150.000	.467
59.119	59.[illegible]06	1.[illegible]022647	59.000	59.013	.99977343	150.000	.119
61.[illegible]42	61.[illegible]08	.99892339	61.000	60.934	1.00107861	150.000	.042
63.[illegible]19	63.[illegible]11	.99855917	63.000	62.909	1.00144390	150.000	.019
65.[illegible]08	65.112	.99840241	65.000	64.896	1.00160125	150.000	.008
67.[illegible]04	67.114	.99835993	67.000	66.890	1.00164390	150.000	.004
69.[illegible]02	69.[illegible]	.99834944	69.000	68.886	1.00165443	150.000	.002
71.[illegible]01	71.118	.99835416	71.000	70.883	1.00164969	150.000	.001
57.625	57.113	1.[illegible]396602	57.000	57.511	.99110758	180.000	.625
59.167	59.115	1.[illegible]087141	59.000	59.051	.99912875	180.000	.167
61.[illegible]60	61.118	.99905100	61.000	60.942	1.00095056	180.000	.060
63.[illegible]26	63.120	.99850332	63.000	62.906	1.00149996	180.000	.026
65.[illegible]12	65.123	.99829711	65.000	64.889	1.00170697	180.000	.012
67.[illegible]06	67.125	.99822330	67.000	66.881	1.00178138	180.000	.006
69.[illegible]03	69.128	.99819719	69.000	68.876	1.00180731	180.000	.003
71.[illegible]02	71.130	.99820150	71.000	70.872	1.00180298	180.000	.002
57.788	57.121	1.[illegible]167715	57.000	57.666	.98844974	210.000	.788
59.223	59.124	1.[illegible]167726	59.000	59.099	.99832440	210.000	.223
61.[illegible]41	61.127	.99925349	61.000	60.954	1.00074758	210.000	.081
63.[illegible]35	63.129	.99850490	63.000	62.906	1.00149837	210.000	.035
65.[illegible]16	65.132	.99821757	65.000	64.884	1.00178684	210.000	.016
67.[illegible]08	67.135	.99811185	67.000	66.873	1.00189302	210.000	.008
69.[illegible]05	69.137	.99808518	69.000	68.868	1.00191982	210.000	.005
71.[illegible]03	71.140	.99807462	71.000	70.863	1.00193042	210.000	.003
57.952	57.128	1.[illegible]1442416	57.000	57.823	.98577123	240.000	.952
59.285	59.131	1.[illegible]260326	59.000	59.154	.99740171	240.000	.285
61.103	61.134	.99949114	61.000	60.969	1.00050947	240.000	.103
63.[illegible]43	63.137	.99850949	63.000	62.906	1.00149376	240.000	.043

73.000	73.061	.99916956	73.000	72.939	1.00083163	140.000	0
59.110	59.062	1.00080982	59.000	59.048	.99919034	160.000	.110
61.038	61.063	.99958993	61.000	60.975	1.00041049	160.000	.038
63.015	63.064	.99922507	63.000	62.951	1.00077600	160.000	.015
65.007	65.065	.99911379	65.000	64.942	1.00088754	160.000	.007
67.003	67.065	.99906934	67.000	66.938	1.00093209	160.000	.003
69.002	69.066	.99907143	69.000	68.936	1.00093000	160.000	.002
71.001	71.067	.99907390	71.000	70.934	1.00092752	160.000	.001
73.001	73.067	.99999039	73.000	72.934	1.00091099	160.000	.001
59.137	59.067	1.00118489	59.000	59.070	.99881579	180.000	.137
61.046	61.068	.99943899	61.000	60.978	1.00036136	180.000	.046
63.019	63.069	.99920658	63.000	62.950	1.00079453	180.000	.019
65.009	65.070	.99906262	65.000	64.939	1.00093883	180.000	.009
67.004	67.071	.99900235	67.000	66.933	1.00099925	180.000	.004
69.002	69.072	.99898953	69.000	68.930	1.00101210	180.000	.002
71.001	71.073	.99999200	71.000	70.928	1.00100963	180.000	.001
73.001	73.073	.99900849	73.000	72.928	1.00099310	180.000	.001
57.730	57.070	1.01156258	57.000	57.659	.98856267	200.000	.730
59.167	59.071	1.00161933	59.000	59.096	.99838230	200.000	.167
61.057	61.073	.99974580	61.000	60.984	1.00025441	200.000	.057
63.024	63.074	.99921259	63.000	62.950	1.00078851	200.000	.024
65.011	65.075	.99902010	65.000	64.936	1.00098146	200.000	.011
67.005	67.076	.99894401	67.000	66.929	1.00105775	200.000	.005
69.003	69.077	.99893076	69.000	68.926	1.00107104	200.000	.003
73.001	73.079	.99893524	73.000	72.922	1.00106655	200.000	.001

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US	CUS	UFACTOR	DS	CDS	DFACTOR	Q	DH
57.012	56.979	1.00058382	57.000	57.033	.99941617	20.000	.012
59.002	58.977	1.00042910	59.000	59.025	.99957182	20.000	.002
61.001	60.975	1.00043587	61.000	61.026	.99956906	20.000	.001
63.000	62.973	1.00043409	63.000	63.027	.99956583	20.000	0
65.000	64.971	1.00045310	65.000	65.029	.99954683	20.000	0
67.000	66.968	1.00047153	67.000	67.032	.99952840	20.000	0
69.000	68.966	1.00048943	69.000	69.034	.99951052	20.000	0
71.000	70.964	1.00050681	71.000	71.036	.99949314	20.000	0
73.000	72.962	1.00052371	73.000	73.038	.99947625	20.000	0
57.042	57.036	1.00062748	57.000	57.036	.99937253	40.000	.042
59.008	59.005	1.00004727	59.000	59.003	.99995271	40.000	.008
61.002	61.004	.99996474	61.000	60.998	1.00003528	40.000	.002
63.001	63.003	.99996744	63.000	62.998	1.00003258	40.000	.001
65.000	65.002	.99997557	65.000	64.998	1.00002945	40.000	0
67.000	67.001	.99998899	67.000	66.999	1.00001101	40.000	0
69.000	69.000	1.00000688	69.000	69.000	.99999312	40.000	0
71.000	70.998	1.00002425	71.000	71.002	.99997574	40.000	0
73.000	72.997	1.00004114	73.000	73.003	.99995884	40.000	0
57.088	57.022	1.00115184	57.000	57.066	.99884878	60.000	.088
59.018	59.022	.99993452	59.000	58.996	1.00006552	60.000	.018
61.006	61.021	.99974814	61.000	60.985	1.00025208	60.000	.006
63.002	63.021	.99970115	63.000	62.981	1.00029912	60.000	.002
65.001	65.020	.99970379	65.000	64.981	1.00029648	60.000	.001
67.000	67.020	.99970683	67.000	66.980	1.00029343	60.000	0
69.000	69.019	.99972471	69.000	68.981	1.00027553	60.000	0
71.000	71.018	.99974208	71.000	70.982	1.00025814	60.000	0
73.000	73.018	.99975896	73.000	72.982	1.00024124	60.000	0
57.150	57.034	1.00283848	57.000	57.116	.99796443	80.000	.150
59.031	59.034	.99995454	59.000	58.997	1.00004549	80.000	.031
61.010	61.034	.99961352	61.000	60.976	1.00038687	80.000	.010
63.004	63.033	.99953273	63.000	62.971	1.00046777	80.000	.004
65.002	65.033	.99951982	65.000	64.969	1.00048150	80.000	.002
67.001	67.033	.99952160	67.000	66.968	1.00047892	80.000	.001
69.000	69.033	.99952456	69.000	68.967	1.00047596	80.000	0
71.000	71.033	.99954192	71.000	70.967	1.00045857	80.000	0
73.000	73.032	.99955881	73.000	72.968	1.00044166	80.000	0
57.227	57.043	1.00323274	57.000	57.184	.99677572	100.000	.227
59.046	59.043	1.00005330	59.000	59.003	.99994667	100.000	.046
61.015	61.043	.99954619	61.000	60.972	1.00046030	100.000	.015
63.006	63.043	.99940924	63.000	62.963	1.00059147	100.000	.006
65.003	65.043	.99937917	65.000	64.960	1.00062159	100.000	.003
67.001	67.043	.99936638	67.000	66.958	1.00063441	100.000	.001
69.001	69.044	.99938382	69.000	68.957	1.00061693	100.000	.001
71.000	71.044	.99938670	71.000	70.956	1.00061405	100.000	0
73.000	73.044	.99940358	73.000	72.956	1.00059714	100.000	0
57.315	57.050	1.00464795	57.000	57.265	.99537074	120.000	.315
59.064	59.050	1.00023123	59.000	59.014	.99976868	120.000	.064
61.022	61.051	.99952802	61.000	60.971	1.00047249	120.000	.022
63.009	63.051	.99933000	63.000	62.958	1.00067085	120.000	.009
65.004	65.052	.99926774	65.000	64.952	1.00073324	120.000	.004
67.002	67.052	.99925449	67.000	66.950	1.00074652	120.000	.002
69.001	69.052	.99925701	69.000	68.949	1.00074399	120.000	.001
71.001	71.053	.99927396	71.000	70.948	1.00072701	120.000	.001
73.000	73.053	.99927677	73.000	72.947	1.00072420	120.000	0
57.409	57.056	1.00618767	57.000	57.353	.99384665	140.000	.409
59.086	59.057	1.00049645	59.000	59.029	.99950350	140.000	.086
61.030	61.057	.99955181	61.000	60.973	1.00044866	140.000	.030
63.012	63.058	.99927037	63.000	62.954	1.00073061	140.000	.012
65.005	65.059	.99917590	65.000	64.946	1.00082528	140.000	.005
67.003	67.059	.99916229	67.000	66.944	1.00083902	140.000	.003
69.001	69.060	.99914981	69.000	68.941	1.00085143	140.000	.001
71.001	71.060	.99916676	71.000	70.941	1.00083444	140.000	.001

63.329	63.016	1.00020232	63.000	63.013	.99979773	160.000	.029
65.314	65.017	.99995589	65.000	64.997	1.00004411	160.000	.014
67.307	67.017	.99984350	67.000	66.990	1.00015652	160.000	.007
69.303	69.018	.99978104	69.000	68.985	1.00021896	160.000	.003
71.302	71.019	.99976431	71.000	70.983	1.00023573	160.000	.002
73.301	73.019	.99974846	73.000	72.982	1.00025160	160.000	.001
75.301	75.020	.99974674	75.000	74.981	1.00025331	160.000	.001
61.297	61.016	1.00133231	61.000	61.081	.99866952	180.000	.097
63.336	63.016	1.00031223	63.000	63.020	.99968789	180.000	.036
65.317	65.017	1.00000286	65.000	65.009	.99999914	180.000	.017
67.308	67.018	.99985724	67.000	66.990	1.00014277	180.000	.008
69.304	69.018	.99979436	69.000	68.986	1.00020568	180.000	.004
71.302	71.019	.99976313	71.000	70.983	1.00023691	180.000	.002
73.301	73.019	.99974728	73.000	72.982	1.00025277	180.000	.001
75.301	75.020	.99974556	75.000	74.981	1.00025449	180.000	.001
61.118	61.016	1.00167543	61.000	61.172	.99832745	200.000	.118
63.043	63.016	1.00042226	63.000	63.027	.99957794	200.000	.043
65.020	65.017	1.00004594	65.000	65.003	.99995406	200.000	.020
67.010	67.018	.99998603	67.000	66.992	1.00011398	200.000	.010
69.005	69.018	.99989779	69.000	68.987	1.00019224	200.000	.005
71.002	71.019	.99976208	71.000	70.983	1.00023796	200.000	.002
73.001	73.020	.99974622	73.000	72.981	1.00025383	200.000	.001
75.001	75.020	.99974451	75.000	74.981	1.00025554	200.000	.001

C32CRS58

US	CUS	UFACTOR	DS	CDS	DFACTOR	D	DH
57.307	57.313	1.00015263	57.000	57.294	.99487404	20.000	.307
59.309	59.314	.99991870	59.000	58.995	1.00008130	20.000	.009
61.302	61.314	.99979731	61.000	60.988	1.00020273	20.000	.002
63.301	63.315	.99977878	63.000	62.986	1.00022125	20.000	.001
65.300	65.316	.99976135	65.000	64.984	1.00023869	20.000	0
67.300	67.316	.99975984	67.000	66.984	1.00024021	20.000	0
69.300	69.317	.99975837	69.000	68.983	1.00024168	20.000	0
71.300	71.317	.99975694	71.000	70.983	1.00024311	20.000	0
73.300	73.318	.99975555	73.000	72.982	1.00024450	20.000	0
75.300	75.318	.99975420	75.000	74.982	1.00024585	20.000	0
59.332	59.314	1.00030151	59.000	59.018	.99969860	40.000	.032
61.306	61.315	.99985593	61.000	60.991	1.00014408	40.000	.006
63.302	63.315	.99978772	63.000	62.987	1.00021231	40.000	.002
65.301	65.316	.99976980	65.000	64.985	1.00023024	40.000	.001
67.300	67.317	.99975291	67.000	66.983	1.00024714	40.000	0
69.300	69.317	.99975144	69.000	68.983	1.00024861	40.000	0
71.300	71.318	.99975001	71.000	70.982	1.00025004	40.000	0
73.300	73.318	.99974862	73.000	72.982	1.00025143	40.000	0
75.300	75.319	.99974727	75.000	74.981	1.00025278	40.000	0
59.370	59.314	1.00094136	59.000	59.056	.99905957	60.000	.070
61.313	61.315	.99996661	61.000	60.998	1.00003339	60.000	.013
63.305	63.316	.99983128	63.000	62.989	1.00016874	60.000	.005
65.302	65.316	.99978113	65.000	64.986	1.00021891	60.000	.002
67.301	67.317	.99976378	67.000	66.984	1.00023627	60.000	.001
69.300	69.317	.99974738	69.000	68.983	1.00025267	60.000	0
71.300	71.318	.99974595	71.000	70.982	1.00025410	60.000	0
73.300	73.319	.99974457	73.000	72.981	1.00025549	60.000	0
75.300	75.319	.99974322	75.000	74.981	1.00025684	60.000	0
59.122	59.315	1.00181962	59.000	59.107	.99818378	80.000	.122
61.322	61.315	1.00011123	61.000	61.007	.99988879	80.000	.022
63.308	63.316	.99987601	63.000	62.992	1.00012400	80.000	.008
65.304	65.316	.99980902	65.000	64.988	1.00019101	80.000	.004
67.302	67.317	.99977582	67.000	66.985	1.00022422	80.000	.002
69.301	69.318	.99975900	69.000	68.983	1.00024105	80.000	.001
71.300	71.318	.99974303	71.000	70.982	1.00025697	80.000	0
73.300	73.319	.99974164	73.000	72.981	1.00025836	80.000	0
75.300	75.319	.99974034	75.000	74.981	1.00025972	80.000	0
61.333	61.315	1.00028928	61.000	61.018	.99971081	100.000	.033
63.313	63.316	.99995312	63.000	62.997	1.00004688	100.000	.013
65.306	65.317	.99983755	65.000	64.989	1.00016247	100.000	.006
67.303	67.317	.99978851	67.000	66.986	1.00021152	100.000	.003
69.301	69.318	.99975677	69.000	68.983	1.00024328	100.000	.001
71.301	71.318	.99975493	71.000	70.983	1.00024512	100.000	.001
73.300	73.319	.99973946	73.000	72.981	1.00026060	100.000	0
75.300	75.320	.99973811	75.000	74.980	1.00026195	100.000	0
61.346	61.315	1.00050052	61.000	61.031	.99949975	120.000	.046
63.318	63.316	1.00003064	63.000	63.002	.99996936	120.000	.018
65.308	65.317	.99986648	65.000	64.991	1.00013353	120.000	.008
67.304	67.317	.99980161	67.000	66.987	1.00019842	120.000	.004
69.302	69.318	.99976943	69.000	68.984	1.00023061	120.000	.002
71.301	71.319	.99975311	71.000	70.982	1.00024694	120.000	.001
73.301	73.319	.99975133	73.000	72.982	1.00024872	120.000	.001
75.300	75.320	.99973629	75.000	74.981	1.00026377	120.000	0
61.369	61.316	1.00072843	61.000	61.044	.99927214	140.000	.060
63.323	63.316	1.00010345	63.000	63.007	.99989157	140.000	.023
65.311	65.317	.99991108	65.000	64.994	1.00008892	140.000	.011
67.305	67.317	.99981499	67.000	66.988	1.00018503	140.000	.005
69.302	69.319	.99976789	69.000	68.984	1.00023215	140.000	.002
71.301	71.319	.99975156	71.000	70.982	1.00024848	140.000	.001
73.301	73.319	.99974979	73.000	72.982	1.00025026	140.000	.001
75.300	75.320	.99973474	75.000	74.980	1.00026531	140.000	0
61.378	61.316	1.00102210	61.000	61.062	.99897900	160.000	.078

```
      DIMENSION KA(20), DUM(4,6)
      DIMENSION MBUF(245), MA(20)
      DIMENSION SINX(120), COSX(120), CF(9,2)
      COMMON K,GI,EP,SINX,COSX,SX,CX,IFIRST
      EQUIVALENCE (TAS(1),IA(1)), (F(1),IA(7)), (G(1),IA(13)), (GD(1),IA
     $(19)), (Q(1),IA(25)), (SG(1),IA(31)), (D,IA(37)), (DWTM,IA(39)),
     $(VDM,IA(41)), (CNR(1),IA(43)), (TK(1),IA(51))
      EQUIVALENCE (IT,JA(1)), (SA(1),JA(2)), (FR1,JA(8)), (VD,JA(10)),
     $(DUM,JA(12))
      EQUIVALENCE (NPR,KA(1)), (FQ1,KA(2)), (FQ2,KA(4)), (TLOS1,KA(6)),
     $(TLOS2,KA(8)), (SA5,KA(10)), (TFC,KA(12)), (VDDD,KA(14)), (NSUB,KA
     $(16)), (MP,KA(17)), (QFINCH,KA(18)), (IYR,KA(20))
      DATA ((IBAS(I),I=1,30)=30(0)),(IGAIN=1)
      DATA ((NEL(I),I=1,7)=60,61,62,124,186,279,341)
C
C IBUF IS BUFFER FOR BASIN PARAMETER FILE
C JBUF IS BUFFER FOR STATE CONDITIONS FILE
C NBUF IS BUFFER FOR RAINFALL DATA FILE
C KBUF IS BUFFER FOR CUMULATIVE VALUES FILE
C MBUF IS BUFFER FOR DISCHARGE DATA FILE
C
      CALL FOPEN (IBUF,23,58,2)
      CALL FOPEN (JBUF,22,59,2)
      CALL FOPEN (NBUF,21,24,10)
      CALL FOPEN (KBUF,-24,20,12)
      CALL FOPEN (MBUF,-20,20,12)
      READ (60,1160) IYR,IBUG
      IYEAR = IYR-1960
      NELI = 7
      IF (IYR-IYR/4*4) 10,20,10
 10   ILEAP = 0
      GO TO 30
 20   ILEAP = 1
 30   READ (60,1170) (AREA(I),I=1,20)
 40   READ (60,1180) (ISAV(I),I=1,5),ISDAY,NOD,NSUB,IDAY,LDAY
      IF (NSUB) 1050,1050,50
 50   I = NSUB
      IBAS(I) = NSUB
C     READ PARAMETER VALUES FOR THE SELECTED BASIN
      CALL FGET (IBUF,IA,NSUB)
      WRITE (61,1190) NSUB,(TAS(IV),F(IV),G(IV),GD(IV),Q(IV),IV=1,3),D,
     $SG,DWTM,VDM,(CNR(IV),TK(IV),IV=1,4)
C     ESTABLISH THE LAYERS THAT EXIST IN SELECTED SOIL PROFILE
      DO 60 I=1,3
      IF (TAS(I)) 70,60,80
 60   CONTINUE
 70   WRITE (61,1070) I,NSUB
      GO TO 1060
 80   NI = I
C     INITIALIZE THE SYSTEM FOR THE BASIN
C     READ STATE CONDITIONS FOR THE BASIN
      IJ = 5*(NSUB-1)+1
      IJ1 = IJ+4
      DO 100 I=IJ,IJ1
      CALL FGET (JBUF,JA,I)
      DO 90 J=1,6
      DO 90 L=1,4
 90   END(I,L,J) = DUM(L,J)
      WRITE (61,1200) IT,SA,FR1,VD,((END(I,LM,JM),LM=1,4),JM=1,6)
      [illegible]
 100  CONTINUE
      WRITE (61,1080) ISDAY,NSUB
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      GO TO 1060
  110 IF (IYR-1961) 120,120,130
  120 IN = ISDAY+1
      GO TO 140
  130 IN = 1
  140 NODAY = IN+(NOD-1)
      ISDAY = IN
C     IJS IS THE RECORD NUMBER ON FILE 500,WHICH CONTAINS THE PREDICTED
C     STREAMFLOW TO BE USED IN ROUTING MODEL
C     NOD IS SAME FOR ALL BASINS BUT WOULD LIKE IT TO BE DIFFERENT FOR
C     ALL BASINS
      IJS = NOD*(NSUB-1)+1
      DT = 0.2
      DT1 = 3.
      A = 1.00
      PPAN = 0.78
      TLOS1 = 0.
      TLOS2 = 0.
      TPF = 0.
      TFC = 0.
      TQ = 0.
      GT = G(1)+G(2)+G(3)
      TAST = TAS(1)+TAS(2)+TAS(3)
      JT = 1
      IC = 1
C     TAKE RAINFALL INPUT AT TWO-TENTH OF AN HOUR INTERVAL FOR ONE DAY
C     AT A TIME
      PR1 = 0.
      FO1 = 0.
      FO2 = 0.
      QQ = 0.
      QFT1 = 0.
      QFG1 = 0.
      QFG2 = 0.
      DF = 0.0
      DL = 0.0
      JDAY = IN
      IFIRST = 1
      PI = 2.*3.1416/(366.*120)
      DO 1040 MP=IN,NODAY
      NF1 = 1
      IF (ILEAP) 160,160,150
  150 NE1 = NF1+1
  160 DO 170 NE=NF1,NELI
      IF (IDAY-NFL(NE)) 170,1020,170
  170 CONTINUE
      NLOC = 366*(NSUB-1)+ IDAY
      CALL FGET (NBUF,IPR,NLOC)
      DO 180 K=1,24
      DO 180 IP=1,5
      KN = (K-1)*5+IP
      PR(KN) = IPR(K)/50000.
  180 CONTINUE
      DO 730 K=1,120
      IF (PR(K)) 190,200,200
  190 WRITE (61,1090) K,PR(K),NSUB
      CALL ABNORMAL
  200 PR1 = PR1+PR(K)
      IF (IFIRST.EQ.0) GO TO 210
      X = ((MP-1)*120)+K
      XX = PI*X
      SINX(K) = SIN(XX)
```

```
      SX = SINX(K)
      CX = COSX(K)
C     COMPUTE INFILTRATION TO FIND OUT THE CURRENT STATUS OF SA AND DF
C     IN TOP LAYER,VD,AND DPE
C SUBROUTINE GIEP CALCULATES GI AND EP
 210  CALL GIEP
      AF = GI*A
      F(3) = .0003
      FR1 = AF*SA(NI)**1.4+F(NI)
      IF (FR1*DT-(VD+PR(K))) 220,220,230
 220  DELF = FR1*DT
      GO TO 240
 230  DELF = VD+PR(K)
 240  SA2 = SA(NI)-DELF
      IF (SA2) 250,250,260
 250  SA2 = 0.
 260  FR2 = AF*SA2**1.4+F(NI)
      FAV = (FR1+FR2)/2.
      IF ((DELF/DT)-FAV) 280,280,270
 270  DELF = DELF-0.001
      GO TO 240
 280  IF (DELF-(PR(K)+VD)) 300,300,290
 290  WRITE (61,1100) DELF,PR,VD,K
      GO TO 1060
 300  VD = VD+PR(K)-DELF
      VDM = .2
      IF (VD-VDM) 310,320,320
 310  DPE = 0.
      GO TO 330
 320  DPE = VD-VDM
      VD = VDM
 330  SA(NI) = SA2
      TPE = TPE+DPE
      DF = DF+DELF
      TPF = TPE+DPE
C     COMPUTE LOSSES DUE TO EVAPN.,TRANSPN.,AND DPL,AND FIND OUT THE
C     CURRENT STATUS OF SA IN EXISTING LAYERS OF SOIL PROFILE
      SAT = SA(1)+SA(2)+SA(3)+(F(3)*DT)
      IF (SAT-TAST) 350,350,340
 340  IF (IBUG.EQ.1) WRITE (61,1210) SAT,TAST,NSUB,MP
      SAT = TAST
 350  LOS1T = (1.0-SAT*D/(DWTM*GT))*EP*PPAN*DT/24.
      LOS2T = GI*EP*PPAN*DT/24.0
      ZAST = 2.0*TAST
      LOS2T = LOS2T*(((ZAST-SAT)/TAST)-0.98)
      ZLOS2T = LOS1T+LOS2T
      IF (ZLOS2T-.00142) 370,370,360
 360  ZLOS2T = .00167
      LOS2T = ZLOS2T-LOS1T
      GO TO 390
 370  IF (ZLOS2T-.00044) 380,380,390
 380  LOS2T = .00067
 390  LOST1 = LOS1T
      LOST2 = LOS2T
C     APPORTION EVAPORATIVE LOSS, LOS1T
      XF = 0.
      DO 720 I=NI,3
      IF (LOST1) 400,400,410
 400  LOST1 = 0.0
      TLOS1 = TLOS1+LOST1
      F3DT = 0.
```

```
      GO TO 680
  410 IF (I-1) 420,440,430
  420 WRITE (61,1110) DT
      GO TO 1060
  430 XF = F(I-1)
  440 FRF(I) = G(I)-SA(I)
      IF (FRF(I)) 590,590,450
  450 IF (I-3) 460,480,430
  460 IF (FRF(I)-((F(I)-XF)*DT)) 470,470,530
  470 SA(I) = SA(I)+FRF(I)
      F1 = FRF(I)
      SA(I+1) = SA(I+1)-F1
      GO TO 510
  480 IF (FRF(I)-F(I)*DT) 490,490,500
  490 SA(I) = SA(I)+FRF(I)
      GO TO 510
  500 SA(I) = SA(I)+F(I)*DT
      TFC = TFC+(F(I)*DT)
      DL = DL+(F(I)*DT)
      FRF(I) = FRF(I)-F(I)*DT
      GO TO 540
  510 IF (I-2) 580,580,520
  520 TFC = TFC+FRF(I)
      DL = DL+FRF(I)
      GO TO 580
  530 SA(I) = SA(I)+((F(I)-XF)*DT)
      F1 = F(I)*DT
      SA(I+1) = SA(I+1)-F1
      FRF(I) = FRF(I)-((F(I)-XF)*DT)
  540 IF (FRF(I)-LOST1) 550,550,560
  550 LOS1(I) = FRF(I)
      GO TO 570
  560 LOS1(I) = LOST1
  570 LOST1 = LOST1-LOS1(I)
      SA(I) = SA(I)+LOS1(I)
      TLOS1 = TLOS1+LOS1(I)
      DL = DL+LOS1(I)
C     APPORTION LOS2T, TRANSPIRATION LOSS
  580 S(I) = TAS(I)-SA(I)
      IF (S(I)) 590,590,600
  590 SA(I) = TAS(I)
      GO TO 640
  600 IF (S(I)-LOST2) 610,610,620
  610 LOS2(I) = S(I)
      GO TO 630
  620 LOS2(I) = LOST2
  630 LOST2 = LOST2-LOS2(I)
      SA(I) = SA(I)+LOS2(I)
      DL = DL+LOS2(I)
      TLOS2 = TLOS2+LOS2(I)
C     COMPUTE RECOVERY OF WATER INTO STREAM CHANNEL FROM EACH OF THE
C     EXISTING LAYERS IN THE SOIL PROFILE AND FIND OUT THE CURRENT
C     STATUS OF SA IN EACH OF THE EXISTING LAYERS
  640 SG(3) = 15.00
      Q(3) = .002
      SLOP(I) = Q(I)/SG(I)
  650 FRED = GD(I)-SA(I)
      IF (FRED) 660,660,670
  660 GD(I) = GD(I)+1.0
      GO TO 650
  670 FRED1 = FRED
      II = 1
```

```
      FR = FRED-QV*DT
      IF (ABS(FR-FRED1)-.002) 710,710,690
  690 FRED1 = FR
      II = II+1
      IF (II-100) 680,680,700
  700 WRITE (61,1120) FR,FRED1
      GO TO 1060
  710 QVOL(I) = QV*DT
      FQ(K,I) = QVOL(I)
      FQ1 = FQ1+FQ(K,I)
      SA(I) = SA(I)+QVOL(I)
      DL = DL+QVOL(I)
      TQ = TQ+QVOL(I)
  720 CONTINUE
      FQ(K,4) = DPF
      FQ2 = FQ2+FQ(K,4)
  730 CONTINUE
      IFIRST = 0
      SA5 = SA(3)+SA(2)+SA(1)
      IF (IBUG.NE.1) GO TO 735
      WRITE (61,1220) PR1,FQ1,FQ2,TLOS1,TLOS2,SA5,TFC,VD,DF,DL
C     ROUTE WATER FROM EACH OF THE FOUR RESERVOIRS BY SAME ROUTING .
C     FUNCTION BUT WITH DIFFERENT TIME CONSTANTS AND DIFFERENT NUMBER
C     OF CASCADES
  735 DO 740 I=1,8
  740 QFIN(I) = 0.
      DO 920 I=NI,4
      QFF = 0.
      N1 = 1
      N2 = 15
      DO 760 J=1,8
      DIS(J,I) = 0.
      DO 750 N=N1,N2
  750 DIS(J,I) = DIS(J,I)+FQ(N,I)
      N1 = N2+1
      N2 = N1+14
  760 CONTINUE
      IF (NSUB-4) 800,770,800
  770 C1 = 0.02
      C2 = 0.98
      IF (I-4) 780,790,800
  780 NUM = CNR(I)
      C1 = 0.12
      C2 = 0.88
      GO TO 810
  790 NUM = 1
      C1 = 0.15
      C2 = 0.85
      GO TO 810
  800 C1 = 2.*DT1/((2.*TK(I))+DT1)
      C2 = ((2.*TK(I))-DT1)/((2.*TK(I))+DT1)
      NUM = CNR(I)
  810 DO 860 L=2,9
      DO 850 M=1,NUM
      IF (M-1) 820,820,830
  820 END(L,I,M) = C1*DIS(L-1,I)+C2*END(L-1,I,M)
      GO TO 840
  830 END(L,I,M) = C1*((END(L,I,M-1)+END(L-1,I,M-1))/2.)+C2*END(L-1,I,
  840 IF(END(L,I,M).LT.1.0E-50)END(L,I,M) = 0.0
  850 CONTINUE
      QFIN(L-1) = QFIN(L-1)+END(L,I,NUM)
```

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  860  CONTINUE
       DO 870 I1=1,8
  870  QFF = QFF+QFIN(I1)
       IF (I-4) 890,880,890
  880  QFG = (QFF/8.)-QFG
       QFG2 = QFG2+QFG
       QFG4 = QFG2*8.
       GO TO 900
  890  QFG = QFF/8.
       QFG1 = QFG1+QFG
       QFG3 = QFG1*8.
  900  DO 910 M=1,NUM
  910  END(1,I,M) = END(9,I,M)
  920  CONTINUE
       QFINCH = 0.0
       DO 930 I=1,8
       QFINCH = QFINCH+QFIN(I)
       IF (QFIN(I).GE.15.0) CALL ABNORMAL
  930  IQFIN(I) = QFIN(I)*10000.
       DO 940 I=JI,5
       IF (MP-ISAV(I)) 940,950,940
  940  CONTINUE
       GO TO 970
  950  JI = I
       IT = MP
       DO 960 J=1,6
       DO 960 I=1,4
  960  DUM(I,J) = END(1,I,J)
C UPDATE STATE CONDITIONS FILE
       CALL FPUT (JBUF,JA,IJ)
       WRITE (61,1230) IJ,IT,(SA(I),I=1,3),FR1,VD,((END(1,I,J),I=1,4),J=1
      $,6)
       IJ = IJ+1
       ISA(IC) = IT
       IC = IC+1
  970  IQFI = 0
       DO 980 I=1,8
  980  IQFI = IQFI+IQFIN(I)
       QQ = QQ+IQFI/80000
       QFI = (IQFI/10000.)*26.9*AREA(NSUB)
       QFII = QFII+QFI
       NPR = PR1*100.+.5
       VDDD = VD
C WRITE OUT CUMULATIVE VALUES RECORD
       CALL FPUT (KBUF,KA,IJ5)
       IMO = MP/31+1
       IDY = MP-((IMO-1)*31)
       IF (IDY) 990,990,1000
  990  IDY = 31
       IMO = IMO-1
 1000  MA(1) = IMO
       MA(2) = IDY
       MA(3) = IYR-1900
       DO 1010 MNA=1,8
       MA(MNA+3) = IQFIN(MNA)
 1010  CONTINUE
       MA(12) = NPP
       MA(13) = NSUB
       MA(14) = FQ1*10000.0
       MA(15) = FQ2*10000.0
       MA(16) = TLOS1*10000.0
       MA(17) = TLOS2*10000.0
```

```
      MA(20) = VDDD*10000.0
C WRITE OUT DISCHARGE DATA RECORD
      CALL FPUT (MBUF,MA,(IYEAR-1)*7068+(NSUB-1)*372+MP)
      IJ5 = IJ5+1
      IDAY = IDAY+1
      JDAY = JDAY+1
      GO TO 1040
 1020 IDAY = IDAY+1
C UPDATE SINX AND COSX ARRAYS FOR DAY NOT PROCESSED
      DO 1030 K=1,120
      CALL GIEP
 1030 CONTINUE
 1040 CONTINUE
      WRITE (61,1130) ISDAY,NOD,NSUB
      WRITE (61,1140) ISA,NSUB
      NSUB = NSUB+1
      IF (NSUB-30) 40,40,1050
 1050 WRITE (61,1150) IBAS
 1060 CALL FCLOSE (JBUF)
      CALL FCLOSE (KBUF)
      CALL FCLOSE (MBUF)
      CALL EXIT
C
 1070 FORMAT (33H ERROR...TAS IS NEGATIVE IN LAYER,I2,38H OR TAS IS ZER(
     $ IN ALL LAYERS OF BASIN,I3)
 1080 FORMAT (14H ERROR...ISDAY,I5,34H DOES NOT MATCH IT VALUES FOR NSUI
     $,I2)
 1090 FORMAT (4H K =,I3,5X,8H PR(K) =,F10.5,5X,7H NSUB =,I3)
 1100 FORMAT (16H ERROR...DELF IS,F8.4,27H GREATER THAN THE SUM OF PR,F8
     $.4,7H AND VD,F8.4,10H ON DAY MP,I4,20H AND TIME INTERVAL K,I3)
 1110 FORMAT (14H ERROR...NI IS,I3,8HNEGATIVE)
 1120 FORMAT (56H ERROR... FR AND FREDI ARE NOT WITHIN THE LIMIT OF 0.0(
     $5)
 1130 FORMAT (17H RUN BEGAN ON THE,I3,16H DAY AND RAN FOR,I3,26H DAYS FC
     $R THE BASIN NUMBER,I2)
 1140 FORMAT (35H STATE SAVED ON THE FOLLOWING DAYS-,5(I3,2X),17H FOR BA
     $SIN NUMBER,I3/1H1)
 1150 FORMAT (32H BASINS THAT WERE PROCESSED ARE-,30(1X,I2))
 1160 FORMAT (I4,75X,I1)
 1170 FORMAT (10F8.0)
 1180 FORMAT (20I4)
 1190 FORMAT (1H1,5HBASIN,I2,13H PARAMETERS =//1H ,16F7.0//1H ,16F7.0)
 1200 FORMAT (1H0,18HSTATE CONDITIONS =/1H ,I5,3F9.0,F5.0,F9.0/1H0,12F10
     $.0/1H0,12F10.0)
 1210 FORMAT (1H0,5HSAT =,F10.5,3X,6HTAST =,F10.5,3X,6HNSUB =,I3,3X,
     $4HMP =,I6)
 1220 FORMAT (1H ,4HPRI=,F6.3,2X,4HF01=,F6.3,2X,4HF02=,F6.3,2X,6HTLOS1=,
     $F7.4,2X,6HTLOS2=,F7.4,2X,4HSA5=,F6.3,2X,4HTFC=,F5.3,2X,3HVD=,F6.3,
     $2X,3HDF=,F6.3,1X,3HDL=,F6.3)
 1230 FORMAT (2I7,5F10.6/12F10.6/12F10.6)
      END
      SUBROUTINE GIEP
C THIS ROUTINE COMPUTES THE VARIABLES GI AND EP USING A SIGNIFICANTLY
C MORE EFFICIENT TRIGONOMETRIC FORM.   THE ORIGINAL FORM IS SHOWN IN
C THE FOLLOWING COMMENT STATEMENTS.
C
C     GI=0.5915+(0.1607*SIN(PI*X))-(0.2571*COS(PI*X))-(0.0698*SIN(PI*X*2
C    1))-(0.0214*COS(PI*X*2))-(0.0036*SIN(PI*X*3))+(0.0122*COS(PI*X*3))-
C    2(0.0008*SIN(PI*X*4))-(0.0117*COS(PI*X*4))
C
```

```
C      EP=0.1639+(0.023*SIN(PI*X))-(0.0575*COS(PI*X))-(0.0032*SIN(PI*X*2)
C     1)-(0.0123*COS(PI*X*2))-(0.0025*SIN(PI*X*3))-(0.0014*COS(PI*X*3))+(
C     20.0008*SIN(PI*X*4))-(0.0012*COS(PI*X*4))
C
C INITIALLY, 120 VALUES OF SINX AND COSX ARE COMPUTED IN THE MAIN
C PROGRAM FOR K=1,120.  THEN GI AND EP ARE COMPUTED IN TERMS OF
C SINGLE ANGLE FUNCTIONS.
C
C THEN (WHEN IFIRST.NE.1), SINE AND COSINE VALUES ARE COMPUTED AS A
C FUNCTION OF THE PREVIOUS ANGLE'S SINE AND COSINE.   GI AND EP ARE
C THEN COMPUTED IN TERMS OF SINGLE ANGLE FUNCTIONS.
C .9998526477 IS COS(6.2831853/366)
C .01716632975 IS SIN(6.2831853/366)
C AN ASSUMPTION IS.... MP IN MAIN PROGRAM ALWAYS INCREMENTS IN STEPS
C OF 1.
      DIMENSION SINX(120), COSX(120), CF(9,2)
      COMMON K,GI,EP,SINX,COSX,SX,CX,IFIRST
      DATA ((CF(I,1),I=1,9)=.5915,.1607,-.2571,-.1376,-.0214,-.0036,.
     $0122,-.0008,-.0936)
      DATA ((CF(I,2),I=1,9)=.1639,.023,-.0575,-.0064,-.0123,-.0025,-.
     $0014,.0008,-.0096)
      IF (IFIRST.EQ.1) GO TO 10
      SX = .9998526477*SINX(K)+.01716632975*COSX(K)
      CX = .9998526477*COSX(K)-.01716632975*SINX(K)
10    SCOSX = SX*CX
      COSQRX = CX*CX
      COSCBX = COSQRX*CX
      CS4THX = COSCBX*CX
      SINCBX = SX*SX*SX
      I = 1
20    V = CF(1,I)+CF(2,I)*SX+CF(3,I)*CX+CF(4,I)*SCOSX+CF(5,I)*(2.0*
     $COSQRX-1.0)+CF(6,I)*(3.0*SX-4.0*SINCBX)+CF(7,I)*(4.0*COSCBX-3.0*CX
     $)+CF(8,I)*(8.0*COSCBX*SX-4.0*SCOSX)+CF(9,I)*(CS4THX-COSQRX+.125)
      GO TO (30,40), I
30    GI = V
      I = 2
      GO TO 20
40    EP = V
      SINX(K) = SX
      COSX(K) = CX
      RETURN
      END
```

PROGRAM DESCRIPTION FOR THE XPRINT PROGRAM (E095)

PROGRAM DESCRIPTION

This is the last step in the sub-basin model as can be seen from Figure 1. The sole purpose of XPRINT is to print the hydrologic components on a daily and seasonal basis for all 19 planning units which are shown in Figure 2. The daily and seasonal values are computed simply by averaging the 3 hour estimates generated by the BASINMOD program (E094).

INPUT CARDS

1. Card 1

Columns	1-4	IYR	(year of simulation)
Columns	5-80		Unused

2. Card 2 (All values must include a decimal point)

Columns	1-8	Area of Planning Unit 1 in square miles.
Columns	9-16	" " " " 2 " " "
Columns	17-24	" " " " 3 " " "
Columns	25-32	" " " " 4 " " "
Columns	33-40	" " " " 5 " " "
Columns	41-48	" " " " 6 " " "
Columns	49-56	" " " " 7 " " "
Columns	57-64	" " " " 8 " " "
Columns	65-72	" " " " 9 " " "
Columns	73-80	" " " " 10 " " "

3. Card 3 (All values must include a decimal point)

Columns	1-8	Area of Planning Unit 11 in square miles.
Columns	9-16	" " " " 12 " " "
Columns	17-24	" " " " 13 " " "
Columns	25-32	" " " " 14 " " "
Columns	33-40	" " " " 15 " " "
Columns	41-48	" " " " 16 " " "
Columns	49-56	" " " " 17 " " "
Columns	57-64	" " " " 18 " " "
Columns	65-72	" " " " 19 " " "

4. Card 4

Columns	1-19	IBAS: These columns specify which planning units are to be processed. Each column corresponds to a planning unit (1-19). A 1 in a column causes that planning unit to be processed. For planning units that are not to be processed, the corresponding columns must be left blank.

FILE FORMAT

The XPRINT program requires one input disk file with the following details:

File description:	Cumulative values
Logical Unit:	24
Record length:	20 words
Blocking factor:	12

Disk File Format

Each record of disk file 24 has the following format:

Word 1:	NPR (cumulative rainfall value - integer x100)
Words 2 and 3:	FQ1 (cumulative daily value of water received from soil reservoir) - real
Words 4 and 5:	FQ2 (cumulative daily value of water in an overland reservoir) - real
Words 6 and 7:	TLOS1 (cumulative daily value of evaporation loss) - real
Words 8 and 9:	TLOS2 (cumulative daily value of transpiration) - real
Words 10 and 11:	SA5 (currently available storage in soil profile at the end of the day) - real
Words 12 and 13:	TFC (cumulative daily value of deep percolation) - real
Words 14 and 15:	VD (depth of water in surface depressions expressed in inches) - real
Word 16:	NSUB (Sub-basin number)- integer
Word 17:	MP = day number - integer
Words 18 and 19:	QFII = 3 hourly routed runoff in inches - real
Word 20:	IYR = simulation year - integer

MACHINE CONFIGURATION

The following equipment is required to run this program:

CDC 3100 computer (program requires 6Kplus the operating system)
1 405 ASCII card reader
2 854 Disk drives (including the system disk)
1 line printer

PROGRAM LIMITATIONS

1. The XPRINT program provides a print-out of daily values, monthly averages and seasonal averages. It does not print out hourly or 3 hourly values.
2. This program is currently designed to handle 19 planning units for a one year period.
3. It prints out the values for total evaporative losses and it does not print out evaporation and evapotranspiration separately.

SAMPLE DATA

```
1970
60.5046 37.9062 57.6843 89.6703 52.9312 185.6640132.7718198.754689.2265 119.639
109.8500197.7885197.789094.7046 150.80  229.76  70.36  163.44  56.68   0.0
1111111111111111111
```

PROGRAM E095

PROGRAMMER: Paul Berger
Ashok N. Shahane

PURPOSE: To print out the daily values, monthly averages and seasonal averages for hydrologic estimates of 19 planning units of the Kissimmee River Basin.

DISK: 6000

CONTROL CARDS:

```
$JOB, 8430-305, E095
$RONL, 854/6000
$FET, WATERPLN, XPRINT, 960
$OPEN, 25
$FET, WATERPLN, CUMULATIVE VALUES, 1024
$OPEN, 24
$LOAD, 25
$RUN
Insert card input here
$CLOSE, 24
$RELEASE, ALL
```

CARD INPUT: 1 card with the year identity,
2 cards with areas of 19 planning units,
1 card with ones or blanks in the first 19 columns - at least one column must contain a one.

OPERATING INSTRUCTIONS: No input tape, no output tape

ERROR STOPS: None

TIMING: About 1 minute per planning unit, maximum of 20 minutes total.

```
      PROGRAM XPRINT
      COMMON PR(12,31),FO(12,31),FOO(12,31),TLOS(12,31),TF(12,31)
      COMMON QFI(12,31),SA(12,31),VDD(12,31),AREA(20),QFIN(12,31)
      COMMON QFIA(12,31),RAIN(12),SURF(12),SUBF(12),ET(12),DEEP(12)
      COMMON STMF(12),STMF2(12),STMF1(12),IBAS(20)
      DIMENSION KBUF(245), KA(20)
      EQUIVALENCE (NPR,KA(1)), (FO1,KA(2)), (FO2,KA(4)), (TLOS1,KA(6)),
     $(TLOS2,KA(8)), (SA5,KA(10)), (TFC,KA(12)), (VD,KA(14)), (NSUB,KA
     $(16)), (MP,KA(17)), (QFII,KA(18)), (IYR,KA(20))
      CALL FOPEN (KBUF,24,20,12)
      READ (60,470) IYEAR
      IF (IYEAR-IYEAR/4*4) 10,20,10
 10   NDAY = 364
      GO TO 30
 20   NDAY = 365
 30   DO 40 J=1,31
      DO 40 I=1,12
      PR(I,J) = 9999.0E+30
      FO(I,J) = 9999.0E+30
      FOO(I,J) = 9999.0E+30
      TLOS(I,J) = 9999.0E+30
      TF(I,J) = 9999.0E+30
      QFI(I,J) = 9999.0E+30
      SA(I,J) = 9999.0E+30
      QFIN(I,J) = 9999.0E+30
      QFIA(I,J) = 9999.0E+30
      VDD(I,J) = 9999.0E+30
 40   CONTINUE
      READ (60,480) AREA
      READ (60,490) IBAS
      K = 1
 50   IF (IBAS(K)) 240,240,60
 60   NSUB = K
      DO 70 IMO=1,12
      RAIN(IMO) = 0.
      SURF(IMO) = 0.
      SUBF(IMO) = 0.
      ET(IMO) = 0.
      DEEP(IMO) = 0.
      STMF(IMO) = 0.
      STMF1(IMO) = 0.
 70   STMF2(IMO) = 0.
      IJ5 = 372*(NSUB-1)+1
      IJ6 = IJ5+NDAY
      DO 130 I=IJ5,IJ6
      CALL FGET (KBUF,KA,I)
      PR1 = NPR/100.
      IMO = MP/31+1
      ID = MP-((IMO-1)*31)
      IF (ID) 80,80,90
 80   ID = 31
      IMO = IMO-1
 90   IF (I-IJ5) 100,100,110
 100  PR(IMO,ID) = PR1
      FO(IMO,ID) = FO1
      FOO(IMO,ID) = FO2
      TLOS(IMO,ID) = TLOS1+TLOS2
      TF(IMO,ID) = TFC
      QFI(IMO,ID) = QFII*26.9*AREA(NSUB)
      QFIN(IMO,ID) = QFII
```

```
      QFIA(IMO,ID) = QFI(IMO,ID)*1.9835
      GO TO 120
  110 PR(IMO,ID) = PR1-PR2
      FQ(IMO,ID) = FQ1-FQI
      FQQ(IMO,ID) = FQ2-FQQ2
      TLOS(IMO,ID) = (TLOS1+TLOS2)-TLO
      TF(IMO,ID) = TFC-TFC1
      QFI(IMO,ID) = QFII*26.9*AREA(NSUB)
      QFIN(IMO,ID) = QFII
      QFIA(IMO,ID) = QFI(IMO,ID)*1.9835
  120 SA(IMO,ID) = SA5
      VDD(IMO,ID) = VD
      PR2 = PR1
      FQI = FQ1
      FQQ2 = FQ2
      TLO = TLOS1+TLOS2
      TFC1 = TFC
      QFIII = QFII
      RAIN(IMO) = RAIN(IMO)+PR(IMO,ID)
      SURF(IMO) = SURF(IMO)+FQQ(IMO,ID)
      SUBF(IMO) = SUBF(IMO)+FQ(IMO,ID)
      ET(IMO) = ET(IMO)+TLOS(IMO,ID)
      DEEP(IMO) = DEEP(IMO)+TF(IMO,ID)
      STMF(IMO) = STMF(IMO)+QFI(IMO,ID)
      STMF1(IMO) = STMF1(IMO)+QFIN(IMO,ID)
      STMF2(IMO) = STMF2(IMO)+QFIA(IMO,ID)
  130 CONTINUE
      WRITE (61,260) NSUB,IYR
      WRITE (61,270)
      WRITE (61,280)
      DO 140 ID=1,31
  140 WRITE (61,500) ID,(PR(IMO,ID),IMO=1,12)
      WRITE (61,290)
      WRITE (61,300) RAIN
      WRITE (61,290)
      P1 = RAIN(2)+RAIN(3)+RAIN(4)+RAIN(5)
      P2 = RAIN(6)+RAIN(7)+RAIN(8)+RAIN(9)
      P3 = RAIN(10)+RAIN(11)
      P4 = RAIN(1)+RAIN(12)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,320) NSUB,IYR
      WRITE (61,270)
      WRITE (61,330)
      DO 150 ID=1,31
  150 WRITE (61,510) ID,(FQ(IMO,ID),IMO=1,12)
      WRITE (61,340)
      WRITE (61,300) SUBF
      WRITE (61,340)
      P1 = SUBF(2)+SUBF(3)+SUBF(4)+SUBF(5)
      P2 = SUBF(6)+SUBF(7)+SUBF(8)+SUBF(9)
      P3 = SUBF(10)+SUBF(11)
      P4 = SUBF(12)+SUBF(1)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,350) NSUB,IYR
      WRITE (61,270)
      WRITE (61,330)
      DO 160 ID=1,31
  160 WRITE (61,510) ID,(FQQ(IMO,ID),IMO=1,12)
      WRITE (61,340)
      WRITE (61,300) SURF
      WRITE (61,340)
      P1 = SURF(2)+SURF(3)+SURF(4)+SURF(5)
```

```
      P4 = SUPF(12)+SUPF(1)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,360) NSUB,IYR
      WRITE (61,270)
      WRITE (61,330)
      DO 170 ID=1,31
  170 WRITE (61,510) ID,(TLOS(IMO,ID),IMO=1,12)
      WRITE (61,340)
      WRITE (61,300) ET
      WRITE (61,340)
      P1 = ET(2)+ET(3)+ET(4)+ET(5)
      P2 = ET(6)+ET(7)+ET(8)+ET(9)
      P3 = ET(10)+ET(11)
      P4 = ET(12)+ET(1)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,370) NSUB,IYR
      WRITE (61,270)
      WRITE (61,330)
      DO 180 ID=1,31
  180 WRITE (61,510) ID,(TF(IMO,ID),IMO=1,12)
      WRITE (61,340)
      WRITE (61,300) DEEP
      WRITE (61,340)
      P1 = DEEP(2)+DEEP(3)+DEEP(4)+DEEP(5)
      P2 = DEEP(6)+DEEP(7)+DEEP(8)+DEEP(9)
      P3 = DEEP(10)+DEEP(11)
      P4 = DEEP(12)+DEEP(1)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,380) NSUB,IYR
      WRITE (61,270)
      WRITE (61,390)
      DO 190 ID=1,31
  190 WRITE (61,520) ID,(SA(IMO,ID),IMO=1,12)
      WRITE (61,400) NSUB,IYR
      WRITE (61,270)
      WRITE (61,390)
      DO 200 ID=1,31
  200 WRITE (61,520) ID,(VDD(IMO,ID),IMO=1,12)
      WRITE (61,410) NSUB,IYR
      WRITE (61,270)
      WRITE (61,420)
      DO 210 ID=1,31
  210 WRITE (61,530) ID,(OFI(IMO,ID),IMO=1,12)
      WRITE (61,430)
      WRITE (61,440) STMF
      WRITE (61,430)
      P1 = STMF(2)+STMF(3)+STMF(4)+STMF(5)
      P2 = STMF(6)+STMF(7)+STMF(8)+STMF(9)
      P3 = STMF(10)+STMF(11)
      P4 = STMF(12)+STMF(1)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,450) NSUB,IYR
      WRITE (61,270)
      WRITE (61,420)
      DO 220 ID=1,31
  220 WRITE (61,540) ID,(OFIN(IMO,ID),IMO=1,12)
      WRITE (61,430)
      WRITE (61,300) STMF1
      P1 = STMF1(2)+STMF1(3)+STMF1(4)+STMF1(5)
      P2 = STMF1(6)+STMF1(7)+STMF1(8)+STMF1(9)
```

```
      P3 = STMF1(10)+STMF1(11)
      P4 = STMF1(12)+STMF1(1)
      WRITE (61,430)
      WRITE (61,310) P1,P2,P3,P4
      WRITE (61,460) NSUB,IYR
      WRITE (61,270)
      WRITE (61,420)
      DO 230 ID=1,31
  230 WRITE (61,550) ID,(OFIA(IMO,ID),IMO=1,12)
      WRITE (61,430)
      WRITE (61,560) STMF2
      WRITE (61,430)
      P1 = STMF2(2)+STMF2(3)+STMF2(4)+STMF2(5)
      P2 = STMF2(6)+STMF2(7)+STMF2(8)+STMF2(9)
      P3 = STMF2(10)+STMF2(11)
      P4 = STMF2(12)+STMF2(1)
      WRITE (61,570) P1,P2,P3,P4
  240 K = K+1
      IF (K-20) 50,250,250
  250 CALL EXIT
C
  260 FORMAT (1H1////////30X,34HRAINFALL(INCH) FOR THE SUB-BASIN =,I3,
     $11H AND YEAR =,I5//)
  270 FORMAT (6X,3HDAY,6X,3HJAN,6X,3HFEB,6X,3HMAR,6X,3HAPR,6X,3HMAY,6X,
     $3HJUN,6X,3HJUL,6X,3HAUG,6X,3HSEP,6X,3HOCT,6X,3HNOV,6X,3HDEC)
  280 FORMAT (6X,3H---,5X,5H-----,11(4X,5H-----)/)
  290 FORMAT (9X,5X,5H-----,11(4X,5H-----)//)
  300 FORMAT (4X,5HTOTAL,5X,F5.2,11(4X,F5.2))
  310 FORMAT (4X,12HPERIOD TOTAL,3X,2H**,11X,F8.2,11X,2H**,16X,F8.2,13X,
     $2H**,F9.2,7X,2H**,F9.2)
  320 FORMAT (1H1////////30X,41HSUBSURFACE FLOW(INCH) FOR THE SUB-BASIN
     $=,I3,11H AND YEAR =,I5//)
  330 FORMAT (6X,3H---,4X,7H-------,11(2X,7H-------)/)
  340 FORMAT (13X,7H-------,11(2X,7H-------)//)
  350 FORMAT (1H1////////30X,38HSURFACE FLOW(INCH) FOR THE SUB-BASIN =,
     $I3,11H AND YEAR =,I5//)
  360 FORMAT (1H1////////30X,33HET LOSS(INCH) FOR THE SUB-BASIN =,I3,
     $11H AND YEAR =,I5//)
  370 FORMAT (1H1////////30X,43HDEEP SEEPAGE LOSS(INCH) FOR THE SUB-BASI
     $N =,I3,11H AND YEAR =,I5//)
  380 FORMAT (1H1////////20X,62HEND OF DAY AVAILABLE STORAGE IN SOIL(INC
     $H) FOR THE SUB-BASIN =,I3,11H AND YEAR =,I5//)
  390 FORMAT (6X,3H---,3X,8H--------,11(1X,8H--------)/)
  400 FORMAT (1H1////////20X,58HEND OF DAY STORAGE IN DEPRESSION(INCH) F
     $OR THE SUB-BASIN =,I3,11H AND YEAR =,I5//)
  410 FORMAT (1H1////////20X,52HMEAN STREAMFLOW FOR THE DAY(CFS) FOR THE
     $ SUB-BASIN =,I3,11H AND YEAR =,I5//)
  420 FORMAT (6X,3H---,4X,7H-------,11(2X,7H-------)/)
  430 FORMAT (9X,4X,7H-------,11(2X,7H-------)//)
  440 FORMAT (4X,5HTOTAL,F13.2,11(F9.2))
  450 FORMAT (1H1////////20X,54H MEAN STREAMFLOW FOR THE DAY(INCH) FOR T
     $HE SUB-BASIN =,I3,11H AND YEAR =,I5//)
  460 FORMAT (1H1////////20X,55H MEAN STREAMFLOW FOR THE DAY(AC-FT) FOR
     $THE SUB-BASIN =,I3,11H AND YEAR =,I5//)
  470 FORMAT (I4)
  480 FORMAT (10F8.0)
  490 FORMAT (20I1)
  500 FORMAT (6X,I3,5X,F5.2,11(4X,F5.2))
  510 FORMAT (6X,I3,4X,F7.5,11(2X,F7.5))
  520 FORMAT (6X,I3,3X,F8.5,11(1X,F8.5))
  530 FORMAT (6X,I3,4X,F7.2,11(2X,F7.2))
  540 FORMAT (6X,I3,4X,F7.5,11(2X,F7.5))
```

```
570  FORMAT (1H ,3X,12HPERIOD TOTAL,3X,2H**,11X,F8.0,11X,2H**,16X,F8.0
    $13X,2H**,F9.0,7X,2H**,F9.0)
     END
```

PROGRAM DESCRIPTION FOR THE DISCHEXT PROGRAM (E096)

PROGRAM DESCRIPTION

This program is part of a system of programs (Figure 1) which deals with water quantity in the Kissimmee River Basin. The purpose of this program is to extract one year of surface flow data for 19 sub-basins from a disk file generated by program E094 and store the data on another disk file to be used by the Routing Program (E097). The first 11 values of each record of the output file are printed along with the record number.

INPUT CARDS

This program requires one input card to specify which of the 10 years of data is to be extracted from the input file.

Col. 1-2 Year number 1 to 10 (right adjusted)

FILE FORMATS

1. Input File - Discharge Data (Surface Flow) for 19 sub-basins for a 10 year period (logical unit 20).

There is one record per day, 372 records per year assuming 31 days per month. The non-existent days have missing records, however space is provided for them. There can be up to 10 years of data for 19 sub-basins for a total of 70680 records (372 x 19 x 10).

Record Format: 20 words per record, packed 12 per block.

Word	Content
1	Month 1 to 12 (integer)
2	Day 1 to 31 (integer)
3	Last two digits of year (integer)
4	Surface Flow for time 0000 to 0300 (inches x 10^4-integer)
5	Surface Flow for time 0300 to 0600 (inches x 10^4-integer)
6	Surface Flow for time 0600 to 0900 (inches x 10^4-integer)
7	Surface Flow for time 0900 to 1200 (inches x 10^4-ingeter)
8	Surface Flow for time 1200 to 1500 (inches x 10^4-integer)
9	Surface Flow for time 1500 to 1800 (inches x 10^4-integer)
10	Surface Flow for time 1800 to 2100 (inches x 10^4-integer)
11	Surface Flow for time 2100 to 2400 (inches x 10^4-integer
12	Cumulative daily rainfall (inches x 100-integer)
13	Sub-basin number 1 to 19 (integer)
14	Cumulative daily value of water recovered from soil reservoir (inches x 10^4-integer)
15	Cumulative daily value of water in overland reservoir (inches x 10^4-integer)
16	Cumulative daily value of evaporation loss (inches x 10^4-integer)
17	Cumulative daily value of transpiration loss (inches x 10^4-integer)
18	Currently available storage in soil profile (inches x 10^4-integer)
19	Cumulative daily value of deep percolation loss (inches x 10^4-integer)
20	Depth of water in surface depressions over entire watershed (inches x 10^4-integer)

Record Number = 7068 x (year number -1)+
372 x (sub-basin number -1) + day number

Where = year number = 1 to 10
sub-basin number = 1 to 19
day number = 1 to 372

2. Output File - Discharge Data (Surface Flow) for 19 sub-basins for 1 year (logical unit 40).

There is one record per day, 372 records per year assuming 31 days per month. The non-existent days have missing records, however space is provided for them. Record format is the same as the input file.

Record Number = 372 x (sub-basin number -1)+ day number
Where = sub-basin number = 1 to 19
day number = 1 to 372

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 computer (Program requires 5K + operating system).
1 405 ASCII card reader.
3 854 disk drives (including the system disk).
1 line printer

PROGRAM E096

PROGRAMMER: Paul Berger
Ashok Shahane

PURPOSE: Routing Interface Program for the Kissimmee River Basin.

DISKS: 6000 & 6201

CONTROL CARDS:

```
$JOB,8430-305,E096,15,15000,,          E096
$RONL,854/6000,854/6201
$FET,E096,DISCHEXT,960
$OPEN,25
$FET,BASINMOD,DISCHARGEDATA,1024
$OPEN,20
$FET,ROUTING,DISCHARGEDATA,1024
$OPEN,40
$LOAD,25
$RUN
Insert card input here
```

CARD INPUT: Year number (1 to 10) right adjusted in columns 1-2.

ERROR STOPS: If year number is not 1 to 10, the program will branch to ABNORMAL.

TIMING: 10 to 15 minutes.

```
      PROGRAM DISCHEXT
C
C ROUTING INTERFACE PROGRAM - EXTRACTS ONE YEAR OF DISCHARGE DATA FROM
C LU 20 AND STORES ON LU 40.  THE YEAR EXTRACTED IS DETERMINED BY THE
C YEAR NUMBER ON THE INPUT CARD.
C PROGRAM DEVELOPED BY PAUL BERGER AND ASHOK SHAHANE.
C
      DIMENSION MBUF(245), MA(20), IBUF(245)
      DIMENSION NEL(7)
      DATA (NEL=60,61,62,124,186,279,341)
C
C OPEN DISK FILES
C
      CALL FOPEN (MBUF,20,20,12)
      CALL FOPEN (IBUF,-40,20,12)
C
C READ YEAR NUMBER
C
      READ (60,3) IYN
 3    FORMAT (I2)
      IF (IYN.LT.1 .OR. IYN.GT.10) CALL ABNORMAL
C
C LOOP ON 19 SUB-BASINS
C
      DO 100 NSUB = 1,19
      WRITE (61,2) NSUB
 2    FORMAT (10H1SUB-BASIN,I3)
C
C LOOP ON 372 DAYS PER YEAR
C
      DO 100 I = 1,372
C
C ELIMINATE NON-EXISTENT DAYS
C
      DO 5 N = 1,7
      IF (I.EQ.NEL(N)) GO TO 100
 5    CONTINUE
C
C COMPUTE RECORD NUMBER IN THE OUTPUT FILE FOR THIS DAY FOR THIS SUB-
C BASIN
C
      K = (NSUB-1)*372 + I
C
C COMPUTE RECORD NUMBER IN THE INPUT FILE FOR THIS DAY FOR THIS SUB-
C BASIN
C
      L = 7068 * (IYN-1) + K
C
C COPY RECORD FROM INPUT FILE TO OUTPUT FILE AND PRINT RECORD CONTENT
C
      CALL FGET (MBUF,MA,L)
      CALL FPUT (IBUF,MA,K)
      WRITE (61,1) (MA(L),L=1,11),K
 1    FORMAT (1X,12I9)
 100  CONTINUE
C
C CLOSE FILES AND EXIT
C
      CALL FCLOSE (MBUF)
      CALL FCLOSE (IBUF)
      CALL EXIT
```

```
END
   FINIS
```

PROGRAM DESCRIPTION FOR THE ROUTING PROGRAM (E097)

PROGRAM DESCRIPTION

This program is part of a system of programs (Figure 1) which deal with water quantity in the Kissimmee River Basin. The purpose of this program (called the Routing Model) is to route the water stored in the lakes, canals, and river sections along with local inflows from each of 19 distinct planning units or sub-basins (Figure 2) and in so doing to simulate the stages and discharges in the system.

The simulation is for a one year period with a time increment of every 3 hours. The Routing Model consists of 14 lakes, 14 controlling structures, and 25 canals and river sections (Figure 3). It is comprised of a mainline program ROUTING and 8 subroutines:

ROUTING - Performs housekeeping and data file handling, controls logic, and generates printed output.

LAKEFLOW - Simulates flow between the 14 lakes of the upper Kissimmee River.

RIVER - Simulates flow in the 5 river sections of the lower Kissimmee River.

BACKWATR - Backwater function for the canals of the upper Kissimmee River.

BACKWTR2 - Backwater subroutine for the 5 river sections of the lower Kissimmee River.

FACTOR - Computes correction factors for upstream and downstream stages and for storage to correct for inaccuracies in the formulas used by BACKWTR2.

DISCHRGE - Computes discharges for the 14 structures.

STORGF - Converts stage to storage and storage to stage for the 14 lakes.

INTERP - Linear interpolation routine.

Printed output generated by this program consists of simulated stages in the 14 lakes and at the controlling structures and simulated discharges in the canal and river sections. Also a convenient table is printed which shows the distribution of absolute differences between simulated and recorded stages.

An output tape is generated, which can be processed by another program E098 to produce CALCOMP plots of the simulated stages in the 14 lakes together with plots of historical stages when available.

INPUT CARDS

1. Card 1 — Debug card.

   Column 1 — Normally blank. If intermediate results are desired, this column = '1'.

   Columns 2-80 — Unused.

2. Cards 2-35 — Map of Kissimmee River (34 cards). Numbers are right adjusted with no decimal point. The six fields are defined separately for the lakes and canals of the Upper Kissimmee River (UKR) and for the river sections of the Lower Kissimmee River (LKR).

   Lakes, canals, structures and links are all prenumbered in Figure 3. For the UKR, a link is defined as the canal section between 2 lakes regardless of the presence of structures. For the LKR, a link is defined as the river section between 2 structures.

   Columns 1-5 — UKR: A positive number specifying the number of a lake (range 1 to 14).

   LKR: A negative number specifying the number of a river section (range -1 to -5).

   Columns 6-10 — UKR: The number of a lake adjacent to the one specified in columns 1-5. (Zero for the link downstream from L. Kissimmee).

   LKR: The number of the upstream structure.

   Columns 11-15 — UKR: The number of the structure between the lakes specified by the first two fields, or 0 if no structure is present.

	LKR:	The number of the downstream structure.
Columns 16-20	UKR:	The number of the canal between the 2 lakes if no structure is present, or the number of the canal on the side of the structure nearest the lake specified in columns 1-5 when a structure is present.
	LKR:	The number of the river section between the upstream and downstream structures.
Columns 21-25	UKR:	0 if no structure is present in the canal between the 2 lakes, or the number of the canal on the side of the structure furthest from the lake specified in columns 1-5 when a structure is present.
	LKR:	The number of the river section below the downstream structure. (zero if the map terminates at the downstream structure).
Columns 26-30	UKR:	The number of the link between the 2 lakes. (15 for the link downstream from Lake Kissimmee).
	LKR:	The number of the link between the upstream and downstream structures.
Columns 31-80	Unused.	

3. Card 36 — End of map card.

   Columns 1-5 — The number '99' right adjusted.

   Columns 6-80 — Unused.

4. Card 37 — Routing order card. This card controls the order in which the stream-flows are routed. The Upper Kissimmee stream-flows must be routed before routing the Lower

Kissimmee stream-flows, however, partial routing is possible with this card. All numbers are right adjusted.

Columns 1-3	Number of lakes and river sections for which routing is to be performed. (19 to route the entire basin).
Columns 4-6 Columns 7-9 Columns 10-12 Columns 13-15 Columns 16-18 Columns 19-21 Columns 22-24 Columns 25-27 Columns 28-30 Columns 31-33 Columns 34-36 Columns 37-39 Columns 40-42 Columns 43-45 Columns 46-48 Columns 49-51 Columns 52-54 Columns 55-57 Columns 58-60	For the Upper Kissimmee River, the order is specified by positive lake numbers (1 to 14). For the Lower Kissimmee River, the order is specified by negative river section numbers (-1 to -5). Order numbers from left to right must agree with the direction of flow. Where more than one channel empties into the same lake, the routing order may be designated in a non-contiguous fashion in order to route the other stream-flows emptying into the lake (See Sample Data routing order card).
Columns 61-80	Unused.

5. Cards 38-39 — Initial lake stages. Stages are in feet and must contain a decimal point. Each stage occupies 10 columns. The stages of lakes 1-8 occupy 8 respective positions on card 38, and the stages of lakes 9-14 occupy 6 respective positions on card 39. Columns 61-80 of card 39 are unused.

6. Cards 40-43 — Initial structure stages. Stages are in feet and must contain a decimal point. Each stage occupies 10 columns. The headwater stage for structure 1 is followed by the tailwater stage for structure 1 followed by the headwater stage for structure 2, etc.

Card 43 contains the headwater and tailwater stages for structures 13 and 14. Columns 41-80 of card 43 are unused.

7. Cards 44-45 Sub-basin areas. Areas are in square miles and must contain a decimal point. Each area occupies 8 columns. The areas of sub-basins 1-10 occupy 10 respective positions on card 44, and the areas of sub-basins 11-19 occupy 9 respective positions on card 45. Columns 73-80 of card 45 are unused.

8. Card 46 Initial storages for river sections of the Lower Kissimmee. Storages are in cubic feet and must contain a decimal point. Fortran E format constants may be used. Each storage occupies 16 columns. If E format is used the values must be right justified in the field. The storages of river sections 1 to 5 occupy 5 respective fields on the card.

9. Stage/storage tables for the 14 lakes.

One set of cards is required for each of the 14 lakes which defines stage/storage tables for the lakes. The first card of each set is a header card which contains the value -1.0 in columns 1-4, blank in columns 5-20, and any desired identification characters in columns 21-80. Each of the remaining cards of the set contains a stage and the corresponding storage for the lake.

Columns 1-10	Stage in feet (including decimal point).
Columns 11-20	Storage in acre-feet (including decimal point).
Columns 21-80	Unused.

The header card for the next lake serves as a trailer card for the previous lake. The sets of cards must be in order of lake number (1 to 14). The stage/storage cards for lake 14 are followed by an end card which must contain the value -99.0 in columns 1-5, blank in columns 6-20, and any desired comments in columns 21-80.

FILE FORMATS

This program requires two tape files and two disk files as described in the following chart:

FILE DESCRIPTION	LOGICAL UNIT	TYPE	PARITY	DENSITY	RECORD LENGTH	BLOCKING FACTOR
Input Stages & Gate	01	Tape	Binary	800	12 words	10
Simulated Stages	04	Tape	Binary	800	5 words	25
Simulated Stages	03	Disk	-	-	5 words.	25
Discharge Data	02	Disk	-	-	20 words	12

1. Tape File Formats.

A. Tape 01 is an input tape generated by programs E049, E040, E099, and E100 in that sequence. It contains historical stages and gate openings for 14 structures for a period of one year. This data is originally in the form of breakpoint data stored both on paper tape and on punch cards. E049 is used to check the data for errors and missing data. E040 distributes the data over 12 minute time periods. E099 re-distributes the data over 3 hour time periods and generates a magnetic tape for each of the 14 structures. E100 merges the 14 tapes into a single magnetic tape which is tape 01.

Tape 01 contains one data file consisting of 40880 logical records. These records are generated using the FCD 'T' routines. There are 14 records (one for each structure) for each of 8 three hour time periods per day for each of 365 days. The first 14 records are for day 1, time 0300 for the 14 structures in the following order:

S-57
S-62
S-59
S-61
S-63A
S-65
S-60
S-63
S-58
S-65A
S-65B
S-65C
S-65D
S-65E

Each record contains 12 words in the following format:

Word 1	Structure ID (4 characters).
Word 2	Day number (1 to 372 - integer with days 60, 61, 62, 124, 186, 279 and 341 missing).
Word 3	Time 300-2400 (integer).
Word 4	Number of gates or barrels (integer).
*Word 5	Headwater stage in feet above MSL (integer x 100).
*Word 6	Tailwater stage in feet above MSL (integer x 100).
Word 7	Gate opening for gate 1 in feet (integer x 100).
Word 8	Gate opening for gate 2 in feet (integer x 100).
Word 9	Gate opening for gate 3 in feet (integer x 100).
Word 10	Gate opening for gate 4 in feet (integer x 100).
Word 11	Gate opening for gate 5 in feet (integer x 100).
Word 12	Gate opening for gate 6 in feet (integer x 100).

* Note: -9999 is used where data is not available.

The remaining records are in ascending time sequence, 14 records per time period.

B. Tape 04 is an output tape generated by this program. It contains simulated stages for each of the 14 lakes for a period of one year. The tape contains one data file consisting of 1022 logical records. These records are generated using the FCD 'T' routines. There are

73 records for each of the 14 lakes (1 to 14 in that order). Each of the 73 records contains 5 words for a total of 365 words per lake. The simulated stages stored in these words are end of the day values. They are rounded and stored x 100 as integers.

2. Disk File Formats.

A. Disk file 03 is used to store simulated stages for each of the 14 lakes for a period of one year. Since the order required for plotting is not the same as the order generated by this program, the stages are stored in the proper position on disk. Then after all the values are generated, this file is copied to tape 04.

B. Disk file 02 is an input file generated by programs E091, E092, E093 E094 and E096 in that sequence. It contains stream-flows for the 19 planning units of the Kissimmee River Basin for a period of one year. Program E094 generates the data for a ten year period. Program E096 extracts only one year of test data.

This file contains 6935 records, one record for each of 365 days for each of 19 planning units. The records are located on disk according to the following formula:

Record number = (planning unit -1) x 372 + day number

where day number is defined the same as word 2 of the tape 01 format.

Each record contains 20 words in the following format:

Word 1	Month 1 to 12 (integer).
Word 2	Day of month (integer).
Word 3	Last 2 digits of year (integer).
Words 4-11	Stream-flow for 8 three hour time periods in inches (integer x 10^4)
Words 12-20	Not used by this program.

SAMPLE DATA

```
                    00000000011111111112222222222333333333344444444445555555555666666666677777777778
                    12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD   1            1
CARD   2                1    2    0    2    0    2
CARD   3                1   12    8    1   16    1
CARD   4                2    1    0    2    0    2
CARD   5                2    3    0    3    0    3
CARD   6                3    2    0    3    0    3
CARD   7                3    4    0    4    0    4
CARD   8                4    3    0    4    0    4
CARD   9                4    5    1    5    6    5
CARD  10                5    4    1    6    5    5
CARD  11                5    6    0    7    0    6
CARD  12                6    5    0    7    0    6
CARD  13                6    7    2    8    9    7
CARD  14                7    6    2    9    8    7
CARD  15                7    8    0   10    0    8
CARD  16                8    7    0   10    0    8
CARD  17                8    9    3   11   12    9
CARD  18                9    8    3   12   11    9
CARD  19                9   10    4   13   14   10
CARD  20               10    9    4   14   13   10
CARD  21               10   11    5   26   15   11
CARD  22               11   10    5   15   26   11
CARD  23               11   12    7   17   26   12
CARD  24               11   13    0   19    0   13
CARD  25               12    1    8   16    1    1
CARD  26               12   11    7   26   17   12
CARD  27               13   11    0   19    0   13
CARD  28               13   14    0   20    0   14
CARD  29               14   13    0   20    0   14
CARD  30               14    0    9   26   26   15
CARD  31               -1    9   10   21   22   15
CARD  32               -2   10   11   22   23   16
CARD  33               -3   11   12   23   24   17
CARD  34               -4   12   13   24   25   18
CARD  35               -5   13   14   25    0   19
CARD  36               99
CARD  37             19  1  2  3  4  5  6  7  8  9 10 12 11 13 14 -1 -2 -3 -4 -5
CARD  38            63.92      63.92      63.92      63.92      63.40      63.40      60.93      60.92
CARD  39            57.98      55.05      52.54      61.78      52.25      52.25
CARD  40            63.89      63.29      63.40      61.01      61.13      58.12      57.58      55.70
```

```
                 00000000011111111112222222222333333333344444444445555555555666666666677777777778
                 12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD  41         54.71      52.56      56.49      51.83      62.00      56.75      63.80      61.90
CARD  42         52.34      46.60      46.45      40.66      40.62      33.96      33.96      27.03
CARD  43         26.92      20.86      20.79      13.27
CARD  44         60.5046 37.9062 57.6843 89.6703 52.9312 185.6640132.7718198.754689.2265 119.6395
CARD  45         109.8500197.7885197.789094.7046 150.80  229.76  70.36   163.44  56.68
CARD  46           2.570827431E+8  4.357501557E+8  3.490789625E+8  4.363540062E+8  3.831841649E+8
CARD  47         -1.0                                HEADER CARD FOR LAKE ALLIGATOR AND BRICK
CARD  48         54.0       10800.0
CARD  49         55.0       12600.0
CARD  50         56.0       14800.0
CARD  51         57.0       17400.0
CARD  52         58.0       20300.0
CARD  53         59.0       23500.0
CARD  54         60.0       27000.0
CARD  55         61.0       30600.0
CARD  56         62.0       34500.0
CARD  57         63.0       38400.0
CARD  58         64.0       43300.0
CARD  59         65.0       50200.0
CARD  60         66.0       59000.0
CARD  61         67.0       68700.0
CARD  62         68.0       79500.0
CARD  63         -1.0                                HEADER CARD FOR LAKE LIZZIE
CARD  64         42.0       30.0
CARD  65         43.0       50.0
CARD  66         44.0       100.0
CARD  67         45.0       170.0
CARD  68         46.0       250.0
CARD  69         47.0       340.0
CARD  70         48.0       425.0
CARD  71         49.0       560.0
CARD  72         50.0       665.0
CARD  73         51.0       800.0
CARD  74         52.0       990.0
CARD  75         53.0       1210.0
CARD  76         54.0       1475.0
CARD  77         55.0       1760.0
CARD  78         56.0       2135.0
CARD  79         57.0       2500.0
CARD  80         58.0       2950.0
```

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD  81    59.0      3435.0
CARD  82    60.0      4150.0
CARD  83    61.0      4950.0
CARD  84    62.0      5700.0
CARD  85    63.0      6500.0
CARD  86    64.0      7350.0
CARD  87    65.0      8350.0
CARD  88    66.0      10450.0
CARD  89    67.0      16085.0
CARD  90    68.0      18870.0
CARD  91    -1.0                        HEADER CARD FOR LAKE COON
CARD  92    49.0      5.0
CARD  93    50.0      13.0
CARD  94    51.0      27.0
CARD  95    52.0      45.0
CARD  96    53.0      70.0
CARD  97    54.0      104.0
CARD  98    55.0      150.0
CARD  99    56.0      210.0
CARD 100    57.0      282.0
CARD 101    58.0      370.0
CARD 102    59.0      470.0
CARD 103    60.0      570.0
CARD 104    61.0      698.0
CARD 105    62.0      830.0
CARD 106    63.0      985.0
CARD 107    64.0      1140.0
CARD 108    65.0      1476.0
CARD 109    66.0      1925.0
CARD 110    67.0      2660.0
CARD 111    68.0      3663.0
CARD 112    -1.0                        HEADER CARD FOR LAKE TROUT
CARD 113    51.0      12.0
CARD 114    52.0      30.0
CARD 115    53.0      60.0
CARD 116    54.0      130.0
CARD 117    55.0      235.0
CARD 118    56.0      375.0
CARD 119    57.0      540.0
CARD 120    58.0      736.0
```

```
                00000000011111111112222222222333333333344444444445555555555666666666677777777778
                12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD 121        59.0        940.0
CARD 122        60.0        1170.0
CARD 123        61.0        1420.0
CARD 124        62.0        1695.0
CARD 125        63.0        1970.0
CARD 126        64.0        2340.0
CARD 127        65.0        2840.0
CARD 128        66.0        3750.0
CARD 129        67.0        5460.0
CARD 130        68.0        7215.0
CARD 131        -1.0                          HEADER CARD FOR LAKE JOEL
CARD 132        51.0        30.0
CARD 133        52.0        100.0
CARD 134        53.0        187.0
CARD 135        54.0        287.0
CARD 136        55.00       304.0
CARD 137        56.0        436.0
CARD 138        57.0        586.0
CARD 139        58.0        756.0
CARD 140        59.0        946.0
CARD 141        60.0        1155.0
CARD 142        61.0        1327.0
CARD 143        62.0        1632.0
CARD 144        63.0        1921.0
CARD 145        64.0        2261.0
CARD 146        65.0        2716.0
CARD 147        -1.0                          HEADER CARD FOR LAKE MYRTLE
CARD 148        52.0        15.0
CARD 149        53.0        140.0
CARD 150        54.0        300.0
CARD 151        55.0        475.0
CARD 152        56.0        700.0
CARD 153        57.0        960.0
CARD 154        58.0        1300.0
CARD 155        59.0        1700.0
CARD 156        60.0        2250.0
CARD 157        61.0        2650.0
CARD 158        62.0        3200.0
CARD 159        63.0        3850.0
CARD 160        64.0        4700.0
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00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD 161    65.0      5750.0
CARD 162    -1.0                          HEADER CARD FOR LAKE MARY JANE
CARD 163    49.0      16.0
CARD 164    50.0      100.0
CARD 165    51.0      250.0
CARD 166    52.0      585.0
CARD 167    53.0      1100.0
CARD 168    54.0      1500.0
CARD 169    55.0      2075.0
CARD 170    56.0      2800.0
CARD 171    57.0      3600.0
CARD 172    58.0      4500.0
CARD 173    59.0      5600.0
CARD 174    60.0      6770.0
CARD 175    61.0      7080.0
CARD 176    62.0      9500.0
CARD 177    63.0      11400.0
CARD 178    64.0      13600.0
CARD 179    65.0      16700.0
CARD 180    -1.0                          HEADER CARD FOR LAKE HART
CARD 181    39.0      1.0
CARD 182    40.0      13.0
CARD 183    41.0      39.0
CARD 184    42.0      72.0
CARD 185    43.0      111.0
CARD 186    44.0      160.0
CARD 187    45.0      226.0
CARD 188    46.0      318.0
CARD 189    47.0      444.0
CARD 190    48.0      653.0
CARD 191    49.0      939.0
CARD 192    50.0      1281.0
CARD 193    51.0      1739.0
CARD 194    52.0      2305.0
CARD 195    53.0      2932.0
CARD 196    54.0      3651.0
CARD 197    55.0      4495.0
CARD 198    56.0      5305.0
CARD 199    57.0      6227.0
CARD 200    58.0      7239.0
```

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                00000000011111111112222222222333333333344444444445555555555666666666677777777778
                12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD 201        59.0        8900.0
CARD 202        60.0        9475.0
CARD 203        61.0        10400.0
CARD 204        62.0        11400.0
CARD 205        63.0        12540.0
CARD 206        64.0        13600.0
CARD 207        65.0        16700.0
CARD 208        -1.0                          HEADER CARD FOR LAKE EAST TOHOPEKALIGA
CARD 209        48.0        24900.0
CARD 210        49.0        33400.0
CARD 211        50.0        42400.0
CARD 212        51.0        51900.0
CARD 213        52.0        61800.0
CARD 214        53.0        71800.0
CARD 215        54.0        82700.0
CARD 216        55.0        94200.0
CARD 217        56.0        106000.0
CARD 218        57.0        118300.0
CARD 219        58.0        130000.0
CARD 220        59.0        143700.0
CARD 221        60.0        158600.0
CARD 222        61.0        176400.0
CARD 223        62.0        194300.0
CARD 224        63.0        210500.0
CARD 225        64.0        227500.0
CARD 226        65.0        250000.0
CARD 227        -1.0                          HEADER CARD FOR LAKE TOHOPEKALIGA
CARD 228        46.0        8000.0
CARD 229        47.0        17000.0
CARD 230        48.0        26000.0
CARD 231        49.0        40500.0
CARD 232        50.0        55300.0
CARD 233        51.0        69000.0
CARD 234        52.0        84000.0
CARD 235        53.0        101200.0
CARD 236        54.0        122600.0
CARD 237        55.0        144200.0
CARD 238        56.0        170500.0
CARD 239        57.0        194700.0
CARD 240        58.0        222600.0
```

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00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD 241    59.0      250000.0
CARD 242    60.0      280500.0
CARD 243    61.0      306000.0
CARD 244    62.0      335000.0
CARD 245    63.0      360000.0
CARD 246    64.0      390000.0
CARD 247    65.0      420000.0
CARD 248    -1.0                        HEADER CARD FOR LAKE CYPRESS
CARD 249    42.0      23.0
CARD 250    43.0      427.0
CARD 251    44.0      1614.0
CARD 252    45.0      3429.0
CARD 253    46.0      5783.0
CARD 254    47.0      8573.0
CARD 255    48.0      11671.0
CARD 256    49.0      15039.0
CARD 257    50.0      18699.0
CARD 258    51.0      22604.0
CARD 259    52.0      26500.0
CARD 260    53.0      30500.0
CARD 261    54.0      35000.0
CARD 262    55.0      40000.0
CARD 263    56.0      45000.0
CARD 264    57.0      50000.0
CARD 265    58.0      55000.0
CARD 266    -1.0                        HEADER CARD FOR LAKE GENTRY
CARD 267    54.0      5600.0
CARD 268    55.0      6700.0
CARD 269    56.0      8000.0
CARD 270    57.0      9300.0
CARD 271    58.0      10800.0
CARD 272    59.0      12300.0
CARD 273    60.0      13900.0
CARD 274    61.0      15500.0
CARD 275    62.0      17200.0
CARD 276    63.0      20000.0
CARD 277    64.0      23700.0
CARD 278    65.0      29000.0
CARD 279    66.0      35600.0
CARD 280    67.0      42000.0
```

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                00000000011111111112222222222333333333344444444445555555555666666666677777777778
                12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD 281        68.0        48300.0
CARD 282        -1.0                                HEADER CARD FOR LAKE HATCH
CARD 283        42.0        13977.0
CARD 284        45.0        14571.0
CARD 285        47.0        17427.0
CARD 286        48.0        22329.0
CARD 287        49.0        27961.0
CARD 288        50.0        34301.0
CARD 289        51.0        43396.0
CARD 290        52.0        51000.0
CARD 291        53.0        60000.0
CARD 292        54.0        70000.0
CARD 293        55.0        80000.0
CARD 294        56.0        90000.0
CARD 295        57.0        100000.0
CARD 296        58.0        110000.0
CARD 297        -1.0                                HEADER CARD FOR LAKE KISSIMMEE
CARD 298        42.0        50000.0
CARD 299        43.0        66000.0
CARD 300        44.0        85000.0
CARD 301        45.0        108000.0
CARD 302        46.0        135000.0
CARD 303        47.0        162000.0
CARD 304        48.0        190000.0
CARD 305        49.0        221000.0
CARD 306        50.0        256000.0
CARD 307        51.0        292000.0
CARD 308        52.0        330000.0
CARD 309        53.0        370000.0
CARD 310        54.0        418000.0
CARD 311        55.0        475000.0
CARD 312        56.0        544000.0
CARD 313        57.0        623000.0
CARD 314        58.0        716000.0
CARD 315        -99.                                TRAILER CARD FOR LAST LAKE
CARD 316        15.62 15.59 15.58 15.45 15.72 15.88 15.58 15.53 15.63 15.68
CARD 317        15.89 15.91 15.84 15.90 16.01 16.08 16.14 16.13 16.06 16.05
CARD 318        15.95 15.91 15.98 15.85 15.88 15.87 15.82 15.80 15.77 15.60 15.35
CARD 319        15.72 15.83 15.67 15.41 15.42 15.60 15.47 15.58 15.63 15.44
CARD 320        15.60 15.62 15.57 15.52 15.52 15.51 15.40 15.39 15.38 15.20
```

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                00000000011111111112222222222333333333344444444445555555555666666666677777777778
                12345678901234567890123456789012345678901234567890123456789012345678901234567890

CARD 321        15.00 15.26 15.21 15.24 15.20 15.07 15.05 15.15
CARD 322        15.15 15.17 15.20 15.20 15.26 15.15 15.22 15.50 15.28 15.45
CARD 323        15.63 15.80 15.64 15.45 15.70 15.65 15.75 15.65 15.65 15.65
CARD 324        15.60 15.52 15.30 15.40 15.45 16.05 16.25 16.50 16.60 16.70 16.70
CARD 325        16.80 16.80 16.55 16.58 16.63 16.50 16.34 16.40 16.37 16.30
CARD 326        16.27 16.24 16.09 16.00 15.90 15.85 15.79 15.76 15.84 15.69
CARD 327        15.55 15.49 15.44 15.30 15.23 15.18 15.11 14.98 14.89 14.74
CARD 328        14.64 14.53 14.48 14.43 14.10 14.03 14.25 14.28 14.22 14.20
CARD 329        14.07 14.02 13.99 13.97 13.94 13.92 13.89 13.81 13.76 13.76
CARD 330        13.75 13.70 13.70 13.92 14.03 13.93 14.00 14.06 14.08 14.28 14.25
CARD 331        14.33 14.27 14.30 14.26 14.22 14.20 14.16 14.13 14.07 14.10
CARD 332        14.14 14.24 14.20 14.18 14.18 14.15 14.11 14.06 14.03 14.06
CARD 333        14.03 14.02 14.00 14.01 14.07 14.03 14.00 13.94 13.96 13.98
CARD 334        13.82 13.90 13.95 13.88 14.09 13.99 13.94 13.96 14.12 14.10
CARD 335        14.18 14.20 14.23 14.25 14.16 14.15 14.12 14.10 14.08 14.06
CARD 336        14.09 14.22 14.24 14.21 14.19 14.16 14.19 14.20 14.18 14.14 14.17
CARD 337        14.14 14.10 14.04 13.92 13.79 13.87 13.92 13.98 14.00 14.06
CARD 338        14.04 14.08 14.06 14.04 14.00 13.99 14.01 13.98 13.95 13.94
CARD 339        13.94 14.00 14.11 14.17 14.18 14.23 14.21 14.26 14.25 14.22 14.17
CARD 340        14.15 14.15 14.15 14.15 14.12 14.14 14.12 14.18 14.21 14.16
CARD 341        14.12 14.08 14.07 14.13 14.05 14.16 14.05 14.07 14.07 14.10
CARD 342        13.99 14.05 14.06 14.05 14.12 14.17 14.30 14.18 14.08 14.09
CARD 343        14.11 14.11 14.14 14.08 14.08 14.13 14.18 14.17 14.14 14.13
CARD 344        14.13 14.14 14.13 14.10 14.08 14.12 13.99 14.13 14.16 14.24
CARD 345        14.13 14.10 14.11 14.16 14.15 13.98 13.87 14.02 14.07 14.06 14.06
CARD 346        14.02 14.10 14.07 13.76 13.67 13.90 13.93 13.90 13.90 13.90
CARD 347        13.90 13.88 13.90 13.90 13.70 13.59 13.54 13.63 13.67 13.70
CARD 348        13.68 13.65 13.65 12.91 13.28 13.45 13.50 13.42 13.43 13.45
CARD 349        13.45 13.40 13.43 13.40 13.37 13.34 13.25 13.32 13.34 13.30
CARD 350        13.34 13.35 13.25 13.13 13.22 13.30 13.20 13.15 13.20 13.17
CARD 351        13.18 13.20 13.15 13.14 13.07 12.85 12.80 12.90 13.00 13.00 13.00
```

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 computer (Program requires 14K + operating system).

2 604 magnetic tape drives (7 track).

1 405 ASCII card reader.

2 854 disk drives (including the system disk).

1 501 line printer.

PROGRAM LIMITATIONS

1. A maximum of 34 map cards is allowed.
2. This program is designed to handle no more than 3 canals connecting into a single lake.
3. This program was developed specifically for the Kissimmee River Basin. The backwater routines BACKWATR, BACKWTR2, and FACTOR use equations and coefficients specifically designed for this basin, and must be changed to handle another area. Similarly the DISCHRGE routine computes discharges for the structures of the Kissimmee Basin only. Other program changes are required to process a different basin.
4. A maximum of 14 lakes and 5 river sections are allowed.
5. A maximum of 19 planning units are allowed.
6. This program has a limited capability to handle two lakes connected by a canal containing 2 structures, specifically, the canal connecting Lakes Cypress and Gentry in the Kissimmee Basin. Since the headwater stage at structure S63A is maintained at a reasonably constant stage (about 56.5 feet above MSL), the canal section between S63A and Lake Cypress is ignored in this model. The discharge into Lake Cypress through this canal is assumed to be the same as the discharge through structure S-63.

OPERATING INSTRUCTIONS

Program Number: E-097 Programmer: Paul Berger
Ashok Shahane

Purpose: FCD Hydrologic Routing Model of the Kissimmee River Basin.

Disks Required: 6000

Control Cards:

```
$JOB,8430-305,E097,120,50000
$DUMP
$EQUIP,01=MT,04=MT
$FET,E097,ROUTING,960
$OPEN,25
$FET,ROUTING,DISCHARGEDATA,1024
$OPEN,02
$MSUTIL,60
PURGE
SCOPE
$RAT,854/6000
$FET,ROUTING,SIMULATEDSTAGES,512
$ALLOCATE,50
$OPEN,03
$LOAD,25,M
$RUN
Insert card input here.
```

Card Input:

Blank card (may have a 1 in column 1)
34 map cards (6 values per card)
99 card
Routing order card (contains + and - numbers)
2 lake stage cards (14 values)
4 structure stage cards (28 values)
2 area cards (19 values)
1 storage card (5 values)
-1.0 header card
Set of stage/storage cards (2 values each)
Repeat above 2 items with different values 14 times
-99. trailer card

Operating Instructions:

Tape 01 is an input tape.

Tape 04 is an output tape if user specifies, or a scratch tape if user specifies; otherwise please call user.

Error Stops: Any errors will cause the program to branch to ABNORMAL. Please allow dump to print.

Timing: 2 hours.

```
      PROGRAM ROUTING
C
C                    GLOSSARY
C-----------------------------------------------------------------------
C
C LN........LAKE NUMBER FOR UPPER KISSIMMEE
C           LINK NUMBER FOR LOWER KISSIMMEE
C NEL.......DAY NUMBERS OF NON EXISTING DAYS, ASSUMING A 372 DAY YEAR
C           WITH 31 DAYS IN EACH MONTH
C LPU.......LAKE/PLANNING UNIT TABLE. THE PAIRS OF NUMBERS SHOW WHICH
C           LAKES RECEIVE LOCAL INFLOW FROM WHICH PLANNING UNITS.
C           FOR EXAMPLE, THE 1ST 4 NUMBER PAIRS INDICATE THAT LAKES 1,
C           2, 3 AND 4 ALL RECEIVE LOCAL INFLOW FROM PLANNING UNIT 1.
C PROPORTN...FOR EACH NUMBER PAIR IN ARRAY LPU, THIS ARRAY GIVES THE
C           PROPORTION OF LOCAL INFLOW FROM THAT PLANNING UNIT.
C IROUT.....ROUTING ORDER WHICH CONTROLS THE ORDER IN WHICH THE LAKES
C           AND RIVER SECTIONS ARE ROUTED. THESE NUMBERS ARE POSITIVE
C           FOR LAKES AND NEGATIVE FOR RIVER SECTIONS OF THE LOWER
C           KISSIMMEE.
C NROUT.....NUMBER OF ENTRIES IN ARRAY IROUT.
C STGLKIN...INITIAL STAGES IN THE 14 LAKES OF THE UPPER KISSIMMEE.
C STGSTRIN..INITIAL HW/TW STAGES AT THE 14 STRUCTURES.
C AREA......AREA IN SQUARE MILES OF THE 19 PLANNING UNITS.
C KNT.......ARRAY OF COUNTS OF THE NUMBER OF OCCURRENCES OF ABSOLUTE
C           DIFFERENCE BETWEEN SIMULATED AND HISTORICAL STAGES LE.10,
C           LE .15, LE .20, LE .25, LE .30, LE .35, LE .40, LE .45,
C           LE 1.0, AND ABOVE 1.0 FEET FOR HW AND TW AT EACH OF THE 14
C           STRUCTURES.
C TKSONSTR..365 DAILY VALUES OF TAILWATER STAGE AT FARTHEST DOWNSTREAM
C           STRUCTURE (S65E), PLUS ZERO FILL VALUES FOR 7 MISSING
C           DAYS (ASSUMING 31 DAYS PER MONTH)
C
C-----------------------------------------------------------------------
C
      COMMON MAP(6,35), STGSTRUC(2,14), QLINK(19), LLINK(19),
     1 STGLAKES(14), LAKES(4), LINKS(3), STAGE(4), QTNEL, NGATES(3),
     2 GO(6,3), STAGET, QCHAN(3), IDEBUG, HWS, TWS, T(2,268), LI(15),
     3 MONTH, QFIN, STORCHAN(5), US, DS
C
C
      DIMENSION JRUE(245), JREC(20), NEL(7), IRUE(130), IREC(12)
      DIMENSION IROUT(20), IS(12,14), STGLKIN(14), STGSTRIN(2,14)
      DIMENSION CNAME(25), ISNAME(14), ALNAME(14)
      DIMENSION LPU(2,28), PROPORTN(28),AREA(19)
      DIMENSION KRUE(130), KREC(5), LRUE(135), ISTAGE(5,14)
      DIMENSION THIST(2,14), KNT(10,2,14), SDELT(9), IKNT(12)
      DIMENSION IRNG(3,10)
      DIMENSION TKSONSTR(372)
C
C
C
C
C ARRAY MAP(6,35) IS USED TO DESCRIBE THE INTERCONNECTING LAKES,
C CHANNELS, AND RIVER SECTIONS AND THE STRUCTURES CONTROLLING FLOW
C THROUGH THE CHANNELS AND RIVER SECTIONS.  THERE ARE 6 ENTRIES PER LINE
C AND 35 LINES.  LINE 35 IS NOT PART OF THE MAP BUT IS USED BY THE
```

```
C PROGRAM WHEN READING THE MAP INTO MEMORY.
C
C FOR LAKE AND CHANNEL DEFINITION, THE 1ST ENTRY IS A POSITIVE NUMBER
C SPECIFYING THE NUMBER OF LAKES(4).  THE 2ND ENTRY IS THE NUMBER OF
C ONE OF THE OTHER THREE LAKES. ONE LINE IS REQUIRED FOR EACH LAKE
C CONNECTING DIRECTLY TO LAKES(4).  THE 3RD ENTRY IS ZERO IF THERE IS N
C STRUCTURE IN THE CHANNEL CONNECTING THE TWO LAKES OR IS THE STRUCTURE
C NUMBER IF ONE IS PRESENT.  THE 4TH ENTRY IS THE NUMBER OF THE CANAL
C BETWEEN THE TWO LAKES IF NO STRUCTURE IS PRESENT, OR IS THE NUMBER OF
C THE CANAL ON THE SIDE OF THE STRUCTURE NEAREST LAKES(4) WHEN A
C STRUCTURE IS PRESENT.  THE 5TH ENTRY IS ZERO WHEN NO STRUCTURE IS
C PRESENT, OR THE NUMBER OF THE CANAL ON THE SIDE OF THE STRUCTURE
C FURTHEST FROM LAKES(4) WHEN A STRUCTURE IS PRESENT.  THE 6TH ENTRY IS
C THE LINK NUMBER OF THE LINK BETWEEN THE TWO LAKES REGARDLESS OF
C WHETHER A STRUCTURE IS PRESENT OR NOT.
C
C FOR RIVER DEFINITION, THE 1ST ENTRY IS THE RIVER SECTION NUMBER.  THI
C NUMBER MUST BE A NEGATIVE NUMBER SO AS TO DISTINGUISH IT FROM A LAKE
C AND CHANNEL DEFINITION.  THE 2ND ENTRY IS THE NUMBER OF THE UPSTREAM
C STRUCTURE AND THE 3RD ENTRY THAT OF THE DOWNSTREAM STRUCTURE.  THE 4T
C ENTRY IS THE NUMBER OF THE CHANNEL BETWEEN THE TWO STRUCTURES.  THE
C 5TH ENTRY IS THE NUMBER OF THE CHANNEL BELOW THE DOWNSTREAM STRUCTURE
C THE 6TH ENTRY IS THE LINK NUMBER OF THE RIVER SECTION.
C
C ALTHOUGH THE MAP IS READ FROM DATA CARDS, THE MAP USED TO DEFINE THE
C KISSIMMEE RIVER BASIN IS SHOWN BELOW.
C
C
C     1     2     0     2     0     2
C     1    12     8     1    16     1
C     2     1     0     2     0     2
C     2     3     0     3     0     3
C     3     2     0     3     0     3
C     3     4     0     4     0     4
C     4     3     0     4     0     4
C     4     5     1     5     6     5
C     5     4     1     6     5     5
C     5     6     0     7     0     6
C     6     5     0     7     0     6
C     6     7     3     8     8     7
C     7     6     3     8     8     7
C     7     8     0    10     0     8
C     8     7     0    10     0     8
C     8     9     3    11    12     9
C     9     8     3    12    11     9
C     9    10     4    13    14    10
C    10     9     4    14    13    10
C    10    11     5    26    15    11
C    11    10     5    15    26    11
C    11    12     7    17    26    12
C    11    13     0    19     0    13
C    12     1     8    16     1     1
C    12    11     7    26    17    12
C    13    11     0    19     0    13
C    13    14     0    20     0    14
C    14    13     0    20     0    14
```

```
C   14     0     9    26    26    15
C   -1     9    10    21    22    15
C   -2    10    11    22    23    16
C   -3    11    12    23    24    17
C   -4    12    13    24    25    18
C   -5    13    14    25     0    19
C
C
      DATA (ISNAME=56HS-54S-57S-62S-59S-61S63AS-63S-60S-65S65AS65BS65CS6
     45DS65E)
C
      DATA (LPU=1,1  1,9,  2,1,   3,1,   4,1,   5,2,   6,2,
     1              7,3,     8,3,     9,4,     9,5,    10,6,    10,7,
     2             11,8,    11,10,   11,9,    12,9,    13,8,    13,10,
     3             13,11,   14,12,   14,13,   14,14,   15,15,   16,16,
     4             17,17,   18,18,   19,19 )
      DATA (PROPORTN= .91,.1,.05,.09,.04, .12, .88, .70, .30, 1.0, 1.0,
     1                1.0, 1.0, .40, .34, .60, .30, .60, .66, 1.0, 1.0,
     2                1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0 )
C
      DATA (NEL=60,61,62,124,186,279,341)
C
      DATA (SDELT=.10,.15,.20,.25,.30,.35,.40,.45,1.0)
      DATA (IRNG = 9H.10:D:0  ,          9H.15:D<.10,
     1             9H.20:D<.15,          9H.25:D<.20,
     2             9H.30:D<.25,          9H.35:D<.30,
     3             9H.40:D<.35,          9H.45:D<.40,
     4             9H1.0:D<.45,          9HABOVE 1.0 )
C
C INITIALIZE KNT ARRAY TO ZERO
C
      DO 50 I = 1,14
      DO 40 J = 1,2
      DO 30 K = 1,10
      KNT(K,J,I) = 0
 30   CONTINUE
 40   CONTINUE
 50   CONTINUE
C
      READ (60,9) IDEBUG
 9    FORMAT (I1)
C
C READ IN MAP OF KISSIMMEE RIVER BASIN
C
      I = 1
 100  READ (60,1) (MAP(J,I),J=1,6)
 1    FORMAT (6I5)
      IF (MAP(1,I).EQ.99) GO TO 110
      I = I + 1
      GO TO 100
 110  NMAP = I - 1
C
C READ IN ROUTING ORDER CARD - ORDER IN WHICH LAKES ARE TO BE CONSIDERED
C
      READ (60,2) NROUT, IROUT
 2    FORMAT (26I3)
```

```
C
C READ IN INITIAL LAKE STAGES AND STRUCTURE STAGES
      READ (60,3) STGLKIN
 3    FORMAT (8F10.2)
      READ (60,3) STGSTRIN
C
C USE INITIAL STAGES AS CURRENT VALUES FOR ARRAYS STGLAKES AND STGSTRUC
C
      DO 160 I = 1,14
      STGLAKES(I) = STGLKIN(I)
      DO 150 J = 1,2
      STGSTRUC(J,I) = STGSTRIN(J,I)
 150  CONTINUE
 160  CONTINUE
C
C READ IN AREAS OF THE 19 PLANNING UNITS IN SQUARE MILES
C
      READ (60,4) AREA
 4    FORMAT (10F8.4)
C
C READ IN INITIAL STORAGES FOR 5 SECTIONS OF LOWER KISSIMMEE RIVER IN
C CUBIC FEET
C
      READ (60,7) STORCHAN
 7    FORMAT (5F16.0)
C
C READ IN STAGE/STORAGE TABLES FOR THE 14 LAKES
C
      I = 0
      J = 1
      LL(1) = 1
C                    READ NEGATIVE HEADER CARD FOR FIRST LAKE
      READ (60,5)
 5    FORMAT (1X)
 165  READ (60,6) ST,STR
 6    FORMAT (2F10.1)
      IF (ST.LT.0.) GO TO 166
      I = I+1
      T(1,I) = ST
      T(2,I) = STR
      GO TO 165
C                    NEG HEADER FOR NEXT LAKE OR -99 TRAILER FOR LAST LAKE
 166  J = J+1
      LL(J) = I+1
      IF (ST.NE.-99.) GO TO 165
C
C     READ DAILY VALUES OF TAILWATER STAGE AT FURTHEST DOWNSTREAM STRU.
C
      READ(60,8)TWSDNSTR
 8    FORMAT(10F6.2/10F6.2/11F6.2)
C
C OPEN TAPE FILE CONTAINING THE 3 HOUR GATE OPENINGS AND HISTORICAL
C STAGES FOR THE 14 STRUCTURES
C
      CALL TOPEN (TRUE,1,25,10,12)
C
```

```
C OPEN DISK FILE CONTAINING THE 3 HOUR ECD STREAMFLOW VALUES FOR 19
C PLANNING UNITS IN CFS
C
      CALL FOPEN (JBUF,2,20,12)
C
C
C OPEN OUTPUT DISK FILE CONTAINING SIMULATED STAGES
C
      CALL FOPEN (KBUF,3,5,25)
C ***** LOOP ON DAYS *****
C
      JK = 1
      NL = 0
      DO 800 I = 1,372
C
C SKIP MISSING DAYS
C
      DO 170 K = 1,7
      IF (I.EQ.NEL(K)) GO TO 800
  170 CONTINUE
      MONTH = (I-1) / 31 + 1
      STGSTRUC(2,14)=TWSDNSTR(I)
C
C ***** LOOP ON TIME OF DAY *****
C
      DO 700 L = 1,8
C
C INITIALIZE LLINK ARRAY TO -1 (INDICATES NO DISCHARGES HAVE BEEN
C COMPUTED FOR THIS TIME PERIOD)
C
      DO 200 K = 1,19
      LLINK(K) = -1
  200 CONTINUE
C
C READ GATE OPENING AND STAGE DATA FROM TAPE FOR 14 STRUCTURES INTO
C ARRAY IS
C
      DO 240 K = 1,14
      CALL TREAD (IBUF,IREC,IEOF)
      IF (IEOF.EQ.1) CALL ABNORMAL
      DO 210 L = 1,14
      IF (IREC(1).EQ.ISNAME(L)) GO TO 220
  210 CONTINUE
      CALL ABNORMAL
  220 DO 230 N = 1,12
      IS(N,L) = IREC(N)
  230 CONTINUE
      THIST(1,L) = IREC(5)
      THIST(2,L) = IREC(6)
  240 CONTINUE
C
C ***** LOOP ON ROUTING ORDER - FROM ARRAY IROUT *****
C
      DO 600 K = 1,NROUT
      IF (IROUT(K).LT.0) GO TO 250
      LAKES(4) = IROUT(K)
```

```
      LN = LAKES(4)
C
C SET UP LINK LINE NUMBERS FROM ARRAY MAP
C
      N = LAKES(4)
      STAGE(4) = STGLAKES(N)
 250  TT = 0
      DO 300 L = 1,NMAP
      IF (MAP(1,L).NE.ICOUT(K)) GO TO 300
      TT = TT + 1
      IF (TT.GT.3) CALL ABNORMAL
      LINKS(TT) = L
      IF (ICOUT(K).LT.0) GO TO 280
      LAKES(TT) = MAP(2,L)
      N = MAP(2,L)
      STAGE(TT) = STGLAKES(N)
      IF (MAP(1,L).EQ.12 .AND. MAP(2,L).EQ.11) STAGE(TT) = 56.5
      N = MAP(3,L)
      IF (MAP(2,L).EQ.0) STAGE(TT) = STGSTRUC(2,N)
      IF (N.EQ.0) GO TO 300
      NGATES(TT) = IS(4,N)
      DO 270 M = 1,6
      GO(M,TT) = IS(M+6,N)/ 100.
 270  CONTINUE
      GO TO 300
C
C OBTAIN STRUCTURE GATE OPENINGS FOR RIVER SUBROUTINE
C
 280  N = MAP(2,L)
      NGATES(1) = IS(4,N)
      DO 285 M = 1,6
      GO(M,1) = IS(M+6,N) / 100.
 285  CONTINUE
      N = MAP(3,L)
      NGATES(2) = IS(4,N)
      DO 290 M = 1,6
      GO(M,2) = IS(M+6,N) / 100.
 290  CONTINUE
      LN = MAP(6,L)
      GO TO 310
 300  CONTINUE
C
C OBTAIN LOCAL INFLOWS TO LAKE A
C
C .0215111 IS CONVERSION FACTOR FROM INCHES*10**4 TO CFS
C
C INCHES     FT          HR        (5280)**2 SQ FT      1
C ------ * ----- * -------- * --------------- * ----- * SQ MILES
C 3 HRS     12 IN    3600 SEC      SQ MILE          10**4
C
 310  QINFL = 0.
      DO 350 L=1,28
      IF (LN.GT.LPU(1,L)) GO TO 350
      IF (LN.LT.LPU(1,L)) GO TO 355
      M = (LPU(2,L)-1) * 372 + 1
      CALL FGET (JRUF,JPFC,M)
```

```
      IA = LPH(2,L)
      QINFL = QINFL + JSEC(J+3) * PROPORTN(L) * .02151111 * AREA(IA)
 350  CONTINUE
 355  IF (IROUT(K).LT.0) GO TO 500
C
C COMPUTE A NEW STAGE IN LAKE(4) AT TIME J (STAGET) AND THE DISCHARGE
C (QCHAN) IN CFS IN THE CHANNELS ADJACENT TO LAKE(4)
C..... + FLOW INTO LAKE(4)
C..... - FLOW OUT OF LAKE(4)
C
      CALL LAKEFLOW
      IF (J.NE.8) GO TO 600
C
C PRINT ROUTED STAGES AND DISCHARGES
C
      WRITE (61,11) LAKES,LINKS,STAGE,STAGET,QCHAN,I,J,IROUT(K)
 11   FORMAT (1X5HLAKES,4I3,2X5HLINKS,3I3,1X5HSTAGE,4F8.4,2X7HSTAGET=
     1 F8.4,1X6HQCHAN=3F10.4,I4,I3,I2)
      IF (J.NE.8) GO TO 600
C
C MOVE STAGET TO OUTPUT ARRAY (ISTAGE)
C
      IK = LAKES(4)
      ISTAGE(JK,IK) = (STAGET+.005) * 100.
      GO TO 600
C
C
C
 500  CALL RIVER
      IF (J.NE.8) GO TO 590
      L = LINKS(1)
      WRITE (61,501) MAP(1,L), MAP(2,L), MAP(3,L), QCHAN(1), US, DS, I,
     1 J, IROUT(K)
 501  FORMAT (1X9HRIVER SEC,I3,2X10HSTRUCTURES,2I3,2X6HQCHAN=F10.4,
     1 2X2HUS=F5.2,2X3HDS=F5.2,57X,I4,I3,I2)
 590  IF (K.NE.NROUT) GO TO 600
      JS = MAP(3,L)
      SIGSTRUC(1,JS) = HWS
C
 600  CONTINUE
      DO 670 L = 1,14
      DO 660 M = 1,2
      HIST = THIST(M,L)/100.
      IF (HIST.LT.0.) GO TO 658
      DIFF = ABS(SIGSTRUC(M,L)-HIST)
      DO 650 N = 1,9
      IF (DIFF.GT.SDELT(N)) GO TO 650
      KNT(N,M,L) = KNT(N,M,L) + 1
      GO TO 660
 650  CONTINUE
      KNT(10,M,L) = KNT(10,M,L) + 1
      GO TO 660
 658  KNT(1,M,L) = -9999
 660  CONTINUE
 670  CONTINUE
 700  CONTINUE
```

```
C
C WRITE LAKE STAGES FROM ISTAGE WHEN ARRAY IS FULL
C
      JK = JK+1
      IF (JK.LE.5) GO TO 800
      JK = 1
      NN = NN+1
      DO 750 K = 1,14
      KK = (K-1) * 73 + NN
      DO 730 L = 1,5
      KREC(L) = ISTAGE(L,K)
 730  CONTINUE
      CALL EPUT (KBUF,KREC,KK)
      WRITE (61,900) KK,KREC
 900  FORMAT (1X6I6)
 750  CONTINUE
 800  CONTINUE
      CALL ECLOSE (KBUF)
C
C COPY LAKE STAGES FROM DISK FILE TO TAPE FILE
C
      CALL TOPEN (LBUF,4,25,25,5)
      CALL EOPEN (KBUF,2,5,25)
      KA = 1
      DO 780 L = 1,14
      DO 770 K = 1,73
      CALL EGET (KBUF,KREC,KA)
      KA = KA+1
      CALL TWRITE (LBUF,KREC,IEOT)
 770  CONTINUE
 780  CONTINUE
      CALL TCLOSE (LBUF,-1)
      WRITE (61,991) (ISNAME(I),I=1,5),(ISNAME(I),I=7,9),ISNAME(14)
 991  FORMAT (1H1,36X,26HDISTRIBUTION OF MAGNITUDES/20X,60HOF ABSOLUTE D
     1IFFERENCE BETWEEN SIMULATED AND RECORDED STAGES/35X,28HFOR THE KT
     2SINKEE RIVER BASIN/36X,27H(NUMBER OF TIMES IN A YEAR)//9H ABSOLUTE
     3,5X,9(A4,6X)/13H DIFF D (FT) ,9(10HHW    TW    )//)
      DO 950 I = 1,10
      II = -1
      DO 910 J = 1,14
      IF (KNT(I,1,J).LT.0) GO TO 910
      II = II + 2
      IKNT(II) = KNT(I,1,J)
      IKNT(II+1) = KNT(I,2,J)
 910  CONTINUE
      WRITE (61,992) (IBNG(K,I),K=1,3), (IKNT(K),K=1,17)
 992  FORMAT (1X,2A4,A1,2X,17(I4,1X),2H -)
 950  CONTINUE
      CALL EXIT
      END
```

PROGRAM VARIABLES

01565 R	ALNAME	02573 I	IHIST	04734 I	J	022
02001 R	AREA	05000 I	II	00207 I	JBUF	047
01465 R	CNAME	05014 I	IK	04767 I	JK	022
05022 R	DIFF	03301 I	IKNT	00574 I	JREC	047
05020 I	HIST	01031 I	IREC	05017 I	JS	01
04731 I	I	03323 I	IRNG	04736 I	K	05
05010 I	IA	01045 I	IROUT	05023 I	KA	047

```
00627 I    IDUE      01071 I    IS        02047 I    KBUF      00[illegible]
04774 I    IDOE      01547 I    ISNAME    05025 I    KK        04[illegible]
05030 I    IEOT      02465 I    ISTAGE    02627 I    KNT

     COMMON VARIABLES

02762 R    DS        00542 I    LINKS     00560 I    NGATES    00[illegible]
00563 R    GO        02724 I    LL        00631 R    QCHAN     00[illegible]
00640 R    HMS       00460 I    LLINK     02744 R    QFIN      00[illegible]
00637 I    IDEBUG    00000 I    MAP       00554 R    QINEL     00[illegible]
00537 I    LAKES     02743 I    MONTH     00412 R    QLINK

     STATEMENT NUMBERS

     1 00001        11 00024       166 05653       280 06270
     2 00002        30 05403       170 05746       285 06307
     3 00005        40 05413       200 05774       290 06336
     4 00007        50 05423       210 06035       300 06352
     5 00013       100 05444       220 06047       310 06362
     6 00014       110 05500       230 06055       350 06436
     7 00011       150 05547       240 06075       355 06446
     8 00016       160 05557       250 06126       500 06542
     9 00000       165 05623       270 06257       501 00052

     EXTERNAL REFERENCES

          ABNORMAL              ECLOSE              FRUT
          ABS                   EGET                LAKEFLOW
          EXIT                  EOPEN               RIVER

                    FORTRAN DIAGNOSTIC RESULTS  FOR    ROUTING

   COMPILED LENGTHS OF ROUTING  - P   07323   C   02764   D   00000
NO ERRORS
```

```
      SUBROUTINE LAKEFLOW
C
C GIVEN THE STAGES OF UP TO FOUR LAKES AT TIME T, AND RUNOFF STREAMFLOW
C INTO ONE OF THE FOUR  LAKES, LAKE 4, THIS ROUTINE COMPUTES A NEW STAGE
C FOR LAKE 4 AND THE DISCHARGES IN THE CHANNELS CONNECTING THE FOUR
C LAKES AT TIME T + 1 (A PERIOD OF 3 HOURS).
C
C
C
C                                  >>
C                                  >> QINFL
C                                  >>
C        ******                 ******                 ******
C       *      *               *      *               *      *
C      * STAGE  *             * STAGE  *             * STAGE  *
C      *  (1)   *-----------*  (4)    *----][----*  (2)    *    GIVEN AT
C      *        *             *        *   GATE    *        *     TIME T
C       *      *               *      *  OPENINGS  *      *
C        ******                 ******                 ******
C                                  1
C                                  1
C                                  1
C                                  1
C                                  1
C                                  1
C                                  1
C                                 ******
C                                *      *
C                               * STAGE  *
C                               *  (3)   *
C                               *        *
C                                *      *
C                                 ******
C
C
C
C
C
C        ******                 ******                 ******
C       *      *               *      *               *      *
C      *        *  -     +    *        *  +     -    *        *    COMPUTED AT
C      *        *-----------* STAGET   *----][----*        *      TIME T
C      *        *  >----<    *        *  >----<    *        *     PLUS 3 HRS
C       *      *  QCHAN(1)    *      *  QCHAN(2)    *      *
C        ******                 ******                 ******
C                                 +1
C                                  1 v
C                                  1 1
C                                  1 1  QCHAN(3)
C                                  1 1
C                                  1 -
C                                 -1
C                                ******
C                               *      *
C                              *        *
C                              *        *
```

```
C                                  *        *
C                                 *       *
C                                  ******
C
C
C
C                              GLOSSARY
C-----------------------------------------------------------------------
C LAKES......LAKE NUMBERS OF THE 4 LAKES
C LINKS......LINK(1) = LINK NUMBER OF LAKE 4 TO LAKE 1
C            LINK(2) = LINK NUMBER OF LAKE 4 TO LAKE 2
C            LINK(3) = LINK NUMBER OF LAKE 4 TO LAKE 3
C            THESE NUMBERS ARE THE LINE NUMBERS OF ARRAY MAP.
C STAGE......STAGE(1) = STAGE OF LAKE 1 AT SOME TIME T
C            STAGE(2) = STAGE OF LAKE 2 AT SOME TIME T
C            STAGE(3) = STAGE OF LAKE 3 AT SOME TIME T
C            STAGE(4) = STAGE OF LAKE 4 AT SOME TIME T
C QINFL......LOCAL INFLOW INTO LAKE 4 IN CFS
C STAGET.....NEW STAGE OF LAKE 4 AT TIME T + 3 HRS
C QCHAN......DISCHARGE IN CFS IN THE 3 LINKS AT TIME T + 3 HRS
C NGATES(1)..NUMBER OF GATES IN STRUCTURE BETWEEN LAKE 4 AND LAKE 1 IF
C            PRESENT
C NGATES(2)..NUMBER OF GATES IN STRUCTURE BETWEEN LAKE 4 AND LAKE 2 IF
C            PRESENT
C NGATES(3)..NUMBER OF GATES IN STRUCTURE BETWEEN LAKE 4 AND LAKE 3 IF
C            PRESENT
C (GO(I,1),I=1,6)...GATE OPENINGS OF 1ST STRUCTURE IF PRESENT
C (GO(I,2),I=1,6)...GATE OPENINGS OF 2ND STRUCTURE IF PRESENT
C (GO(I,3),I=1,6)...GATE OPENINGS OF 3RD STRUCTURE IF PRESENT
C MAP........MAP GIVING LAKE, STRUCTURE AND CANAL LINKAGE
C Q..........INITIAL ESTIMATE OF DISCHARGE IN THE 3 LINKS IN CFS
C QLEW.......NEWEST ESTIMATE OF DISCHARGE IN THE 3 LINKS IN CFS
C QBAR.......CURRENT AVERAGE DISCHARGE IN THE 3 LINKS IN CFS
C SIOP.......INITIAL STORAGE IN LAKE 4
C SIOPE......NEWEST ESTIMATE OF STORAGE IN LAKE 4 AT TIME T + 3 HRS
C SIOPT......PREVIOUS ESTIMATE OF STORAGE IN LAKE 4 AT TIME T + 3 HRS
C FR.........DIFFERENCE IN STORAGE IN LAKE 4 CORRESPONDING TO .001 FEET
C            STAGE ABOVE INITIAL STAGE
C IGO........INDICATOR FOR EACH LINK = 1 IF CHANNEL CONTROL
C                                    = 2 IF STRUCTURE CONTROL
C JS.........STRUCTURE NUMBER FOR EACH LINK, = 0 IF NO STRUCTURE
C STAGENR....STRUCTURE STAGE AT SIDE NEAREST LAKE 4
C STAGEFAR...STRUCTURE STAGE AT SIDE FURTHEST FROM LAKE 4
C SIGLAKES...ARRAY OF CURRENT STAGES IN THE 14 LAKES
C NEAREST....ARRAY OF POINTERS TO THE STRUCTURE STAGES NEAREST AND
C            FURTHEST FROM EACH LAKE
C SIGSTRUC...ARRAY OF CURRENT STAGES AT THE 14 STRUCTURES
C QLINK......ARRAY OF CURRENT DISCHARGES IN THE 12 CHANNELS
C LLINK......ARRAY OF LAKE NUMBERS TO WHICH QLINK REFERS.
C            +Q, LAKE 5 MEANS FLOW INTO LAKE 5
C            -Q, LAKE 5 MEANS FLOW OUT OF LAKE 5
C QA.........ARRAY OF AVERAGE DISCHARGES IN THE 12 CHANNELS
C HWS........HEADWATER STAGE AT S-65 AT THE END OF 3 HOURS
C TWS........TAILWATER STAGE AT S-65 AT THE END OF 3 HOURS
C ET.........EVAPOTRANSPIRATION LOSS FROM LAKE 4
C EIKON......COEFFICIENTS FOR COMPUTING ET LOSS
```

```
C-----------------------------------------------------------------------
C
C
      COMMON MAP(6,25), STGSTRUC(2,14), QLINK(19), LLINK(19),
     1 STCLAKES(14), LAKES(4), LINKS(3), STAGE(4), QINFL, NGATES(3),
     2 GO(4,3), STAGET, QCHAN(3), IDEBUG, HWS, TWS, T(2,268), LL(15),
     3 MONTH, QFIN, STORCHAN(5), HS, DS
C
C
      DIMENSION QBAR(3), IGO(3), Q(3), QNEW(3), JS(3), NEAREST(2,14)
      DIMENSION QA(19), FTKON(12)
      DIMENSION QLIM1(3), QLIM2(3), QLIM3(3)
C
C
      DATA (NEAREST=4,5,6,7,8,9,10,10,11,0,11,13,0,1,12,14,0)
      DATA (FTKON= 8.8579E-4,      1.2648E-3,      1.6548E-3,
     1             2.1490435E-3,  2.45028E-3,     2.3409588E-3,
     2             2.2086399E-3,  2.11638E-3,     1.8534469E-3,
     3             1.43472E-3,    1.0583409E-3,   7.6496011E-4   )
C
C
C COMPUTE INITIAL STORAGE OF LAKE 4 AT TIME T (STOR) AND
C ERROR MARGIN (ER) BASED ON A .001 FT HIGHER STAGE
C
      IF (IDEBUG.NE.1) GO TO 10
      WRITE (61,501) NGATES,(GO(1,I),I=1,2)
  501 FORMAT (1X6HNGATES,3I3,2X2HGO,2F7.2)
   10 STOR = STORGE (STAGE(4),LAKES(4))
      ER = STORGE (STAGE(4)+.001,LAKES(4)) - STOR
      ITER = 0
C
C DETERMINE FOR EACH LINK IF CHANNEL CONTROL OR STRUCTURE CONTROL
C
      STOR1 = 0.
      STOR2 = 0.
      NL = 2
      IF (LAKES(4).EQ.11) NL = 3
      DO 50 I = 1,NL
      J = LINKS(I)
      JS(I) = MAP(3,J)
      IF (JS(I).NE.0) GO TO 30
C
C NO STRUCTURE PRESENT IN LINK I - CHANNEL CONTROL
C
      IGO(I) = 1
C
C COMPUTE INITIAL Q IN CFS FOR CHANNEL I AND USE AS INITIAL ESTIMATE
C OF QBAR
C
      JL = MAP(6,J)
      IF (LLINK(JL).GE.0) GO TO 20
      JC = MAP(4,J)
      Q(I) = QRACK(STAGE(4),STAGE(I),JC)
      GO TO 40
C
C DISCHARGE FOR THIS CHANNEL HAS ALREADY BEEN COMPUTED
```

```
C
 20     QRAD(I) = -QA(JL)
        GO TO 40
C
C STRUCTURE PRESENT IN LINK I - STRUCTURE CONTROL
C
 30     IGO(I) = 2
        J = LINKS(I)
        IF (MAP(2,J).EQ.0) GO TO 32
        JL = MAP(4,J)
        IF (LINK(JL).GE.0) GO TO 20
C
C COMPUTE INITIAL Q IN CFS THROUGH STRUCTURE AND USE AS INITIAL ESTIMATE
C OF QRAD
C
 32     J = JS(I)
        IF (NEAREST(1,J).NE.LAKES(4)) GO TO 35
        STAGENR = STGSTRUC(1,J)
        STAGEFAR = STGSTRUC(2,J)
        GO TO 40
 35     STAGENR = STGSTRUC(2,J)
        STAGEFAR = STGSTRUC(1,J)
 40     JJ = NGATES(I)
        Q(I) = 0.
        DO 45 J = 1,JJ
        Q(I) = Q(I) + DISCHRGE(JS(I),STAGEFAR,STAGENR,GO(J,I))
 45     CONTINUE
 48     QRAD(I) = Q(I)
        STOR1 = STOR1 + QRAD(I) * 10800.
        QNEW(I) = Q(I)
        GO TO 50
 49     STORE = STORE + QRAD(I) * 10800.
 50     CONTINUE
C
C COMPUTE ET FOR LAKE 4
C
        ET = ETKON(MONTH) * EP / .001 * .8
C
C COMPUTE NEW STORAGE (STORT) AT TIME T + 3 HRS FOR LAKE 4
C
        STORE = STORE + QINFL*10800. - ET
        STORT = STOR + STORE + STOR1
C
C COMPUTE NEW STAGE (STAGET) AT TIME T + 3 HRS FOR LAKE 4
C
 70     STOR2 = 0.
        STAGET = STAGEE (STORT,LAKES(4))
        IF (IDEBUG.NE.1) GO TO 75
        WRITE (61,502) QRAD,QINFL,STOR,STORT,STAGET
 502    FORMAT (5X5HQRAD=3F8.2,2X4HQINFL=F8.2,2X5HSTOR=F14.6,2X6HSTORT=
     * F14.6,2X7HSTAGET=F7.2)
 75     DO 200 I = 1,NI
        GO TO (80,90), IGO(I)
C
C                                  *** CHANNEL CONTROL ***
C COMPUTE NEW ESTIMATE OF DISCHARGE(QNEW) IN CFS
```

```
C
 80     J = LINKS(I)
        JL = MAP(6,J)
        IF (QLINK(JL).GE.0) GO TO 85
        JC = MAP(4,J)
        QNEW(I) = QBACK(STAGET,STAGE(I),JC)
        IF (ITER.GT.2) GO TO 81
        IF (ITER.EQ.2) GO TO 811
        IF (ITER.EQ.0) QLIM1(I) = QNEW(I)
        IF (ITER.EQ.1) QLIM2(I) = QNEW(I)
        GO TO 110
 81     IF (QLIM1(I).LT.QLIM2(I) .AND. QNEW(I).LT.QLIM3(I)) GO TO 810
        IF (QLIM1(I).GT.QLIM2(I) .AND. QNEW(I).GT.QLIM3(I)) GO TO 810
        QLIM1(I) = QLIM2(I)
        QLIM2(I) = QLIM3(I)
        GO TO 811
 810    QLIM2(I) = QLIM3(I)
 811    QLIM3(I) = (QLIM1(I)+QLIM2(I)) / 2.0
        QNEW(I) = QLIM3(I)
        GO TO 110
C
C DISCHARGE FOR THIS CHANNEL HAS ALREADY BEEN COMPUTED
C
 85     QNEW(I) = -QLINK(JL)
        GO TO 200
C
C                                   *** STRUCTURE CONTROL ***
C USE BACKWATER FUNCTIONS TO OBTAIN STAGES ON BOTH SIDES OF THE STRUCTU
C
 90     J = LINKS(I)
        IF (MAP(2,J).EQ.0) GO TO 905
        JL = MAP(6,J)
        IF (QLINK(JL).GE.0) GO TO 85
 905    IF (Q(I).EQ.0.) GO TO 91
        IF (STAGET.LT.STAGE(I)) GO TO 92
        IF (STAGET.GT.STAGE(I)) GO TO 94
 91     QNEW(I) = 0.
        STAGENR = STAGET
        STAGEFAR = STAGE(I)
        GO TO 110
 92     JC = MAP(4,J)
        STAGENR = QBACK(STAGET,QNEW(I),JC)
        IF (IDEBUG.EQ.1)
     1 WRITE (61,8001) STAGET,STAGE(I),QNEW(I),JC,I,STAGENR,J
8001 FORMAT (22H *** QBACK *** STAGET=F12.6,2X9HSTAGE(I)=F12.6,2X
     1 8HQNEW(I)=F12.6,2X3HJC=I3,2X2HI=I3,2X8HSTAGENR= F12.6,2X2HJ=I3)
        JC = MAP(5,J)
        STAGEFAR = QBACK(STAGE(I),QNEW(I),JC)
        IF (IDEBUG.EQ.1)
     1 WRITE (61,8004) STAGET,STAGE(I),QNEW(I),JC,I,STAGEFAR,J
8004 FORMAT (22H *** QBACK *** STAGET=F12.6,2X9HSTAGE(I)=F12.6,2X
     1 8HQNEW(I)=F12.6,2X3HJC=I3,2X2HI=I3,2X9HSTAGEFAR=F12.6,2X2HJ=I3)
        IF (STAGENR.GT.STAGEFAR) STAGENR = STAGET
        IF (STAGENR.GT.STAGEFAR) STAGEFAR = STAGE(I)
        GO TO 94
 94     JC = MAP(4,J)
```

```
      STAGENR = DBACK(STAGET,QNEW(I),JC)
      IF (IDEBUG.EQ.1)
     1WRITE (61,8003) STAGET,STAGE(I),QNEW(I),JC,I,STAGENR,J
 8003 FORMAT (22H *** DBACK *** STAGET=F12.6,2X9HSTAGE(I)=F12.6,2X
     1 8HQNEW(I)=F12.6,2X3HJC=I3,2X2HI=I3,2X8HSTAGENR= F12.6,2X2HJ=I3)
      JC = MAP(5,J)
      STAGEEAR = DBACK(STAGE(I),QNEW(I),JC)
      IF (IDEBUG.EQ.1)
     1WRITE (61,8002) STAGET,STAGE(I),QNEW(I),JC,I,STAGEEAR,J
 8002 FORMAT (22H *** DBACK *** STAGET=F12.6,2X9HSTAGE(I)=F12.6,2X
     1 8HQNEW(I)=F12.6,2X3HJC=I3,2X2HI=I3,2X9HSTAGEEAR=F12.6,2X2HJ=I3)
      IF (STAGENR.LT.STAGEEAR) STAGENR = STAGET
      IF (STAGENR.LT.STAGEEAR) STAGEEAR = STAGE(I)
      IF (MAP(2,J).EQ.0) GO TO 100
C
C UPDATE ARRAY STGSTRUC WITH THESE NEW STRUCTURE STAGES
C
 96   J = JS(I)
      IF (NEADEST(1,J).NE.LAKES(4)) GO TO 98
      STGSTRUC(1,J) = STAGENR
      STGSTRUC(2,J) = STAGEEAR
      GO TO 100
 98   STGSTRUC(2,J) = STAGENR
      STGSTRUC(1,J) = STAGEEAR
C
C COMPUTE NEW ESTIMATE OF DISCHARGE (QNEW) IN CFS AND NEW AVERAGE
C DISCHARGE (QBAR)
C
 100  JJ = NGATES(I)
      QNEW(I) = 0.
      DO 105 J = 1,JJ
      QNEW(I) = QNEW(I) + DISCHRGE(JS(I),STAGEEAR,STAGENR,GO(J,I))
 105  CONTINUE
 110  QBAR(I) = (Q(I) + QNEW(I)) / 2.0
      STOR2 = STOR2 + QBAR(I) * 10800.
 200  CONTINUE
C
C COMPUTE NEW ESTIMATE OF STORAGE IN LAKE 4 (STORE) IN CU FT
C
      STORE = STOR + STORE + STOR2
C
C COMPARE THE DIFFERENCE BETWEEN THE NEW ESTIMATE AND PREVIOUS ESTIMATE
C OF STORAGE.  IF SMALL DIFFERENCE, USE THE NEWEST ESTIMATES OF QNEW AN
C STAGET FOR FINAL VALUES.  IF LARGER DIFFERENCE, REPLACE PREVIOUS
C STORAGE ESTIMATE WITH NEW ESTIMATE AND REPEAT THE PROCEDURE.
C
      IF (IDEBUG.EQ.1)
     1WRITE (61,503) ITER,STORE,STORT,ER,QNEW,QBAR
 503  FORMAT (10X5HITER=I2,2X6HSTORE=E14.6,2X6HSTORT=E14.6,2X3HER=E14.6,
     1 1X5HQNEW=3E7.2,2X5HQBAR=3E7.2)
      IF (ABS(STORE-STORT) .LE. ER) GO TO 250
      ITER = ITER + 1
      IF(ITER.GT.20) GO TO 230
      STORT = STORE
      GO TO 70
 230  WRITE (61,235) LAKES(4)
```

```
235   FORMAT(26HCOULD NOT CONVERGE FOR LAKE,I3)
250   QCHAN(1) = QNEW(1)
      QCHAN(2) = QNEW(2)
      QCHAN(3) = QNEW(3)
C
C UPDATE ARRAY STGLAKES WITH THE NEW LAKE 4 STAGE
C
      J = LAKES(4)
      STGLAKES(J) = STAGET
C
C UPDATE ARRAYS QLTNK AND LLTNK WITH NEWLY COMPUTED DISCHARGE DATA
C
      I = LTNKS(1)
      J = LTNKS(2)
      K = MAP(6,I)
      L = MAP(6,J)
      QLTNK(K) = QCHAN(1)
      QLTNK(L) = QCHAN(2)
      LLTNK(K) = MAP(1,I)
      LLTNK(L) = MAP(1,J)
C
C UPDATE ARRAY QA WITH NEWLEY COMPUTED AVERAGE DISCHARGE VALUES
C
      QA(K) = QBAR(1)
      QA(L) = QBAR(2)
C
C SAVE S-65 STRUCTURE STAGES FOR TIME T + 3 HOURS
C
      IF (MAP(2,J).NE.0) GO TO 300
      HWS = STAGEUP
      QFTN = ABS(QCHAN(2))
300   IF (LAKES(4).NE.11) RETURN
C
C UPDATE ARRAYS FOR LINK 3
C
      I = LTNKS(3)
      J = MAP(6,I)
      QLTNK(J) = QCHAN(3)
      LLTNK(J) = MAP(1,I)
      QA(J) = QBAR(3)
      RETURN
      END
```

PROGRAM VARIABLES

00475	R	FP	00512	I	J	00545	I	I	0
00531	R	FT	00514	I	JC	00310	I	NEAREST	0
00412	R	FTKOU	00524	I	JJ	00505	I	NL	0
00466	I	T	00514	I	JL	00271	R	Q	0
00246	I	TGO	00305	I	JS	00344	R	QA	0
00477	I	ITED	00544	I	K	00260	R	QBAR	0

COMMON VARIABLES

02762	R	DS	00542	I	LTNKS	00560	I	NGATES	0
00563	R	GC	02724	I	LL	00631	R	QCHAN	0
00640	R	HWS	00460	I	LLTNK	02744	R	QFTN	0
00637	I	IDEBUG	00000	I	MAP	00556	R	QINFL	0
00537	I	LAKES	02763	I	MONTH	00412	R	QLTNK	

```
      SUBROUTINE RIVER
C
C
C                                  >>
C                                  >> QINFL
C                                  >>
C
C                 [-----------------------]          TIME T
C           Q(1)---<                      ---<Q(2)
C
C
C
C          Q1BAR---<        ---<          ---<Q2BAR
C                        Q12BAR
C
C
C                 [-----------------------]          TIME T + 3 HRS
C        QNEW(1)---<                      ---<QNEW(2)
C
C
C                         -------<
C                        DOWNSTREAM
C
C
C
C                           GLOSSARY
C-----------------------------------------------------------------------
C LINKS(1)...LINK NUMBER OF RIVER SECTION
C            THIS IS THE LINE NUMBER OF ARRAY MAP
C JS(1)......STRUCTURE NUMBER OF THE UPSTREAM STRUCTURE
C JS(2)......STRUCTURE NUMBER OF THE DOWNSTREAM STRUCTURE
C Q(1)........INITIAL DISCHARGE THROUGH UPSTREAM STRUCTURE IN CFS
C Q(2)........INITIAL DISCHARGE THROUGH DOWNSTREAM STRUCTURE IN CFS
C QNEW(1)....DISCHARGE THROUGH THE UPSTREAM STRUCTURE AT TIME T + 3 HRS
C            IN CFS
C QNEW(2)....DISCHARGE THROUGH THE DOWNSTREAM STRUCTURE AT TIME T + 3
C            HRS IN CFS
C STOR.......INITIAL STORAGE IN THE RIVER SECTION IN CUBIC FEET
C Q1BAR......AVERAGE DISCHARGE THROUGH UPSTREAM STRUCTURE FOR 3 HOURS
C Q2BAR......AVERAGE DISCHARGE THROUGH DOWNSTREAM STRUCTURE FOR 3 HOURS
C Q12BAR.....AVERAGE DISCHARGE IN THE RIVER SECTION FOR 3 HOUR PERIOD
C STORE......NEWEST ESTIMATE OF STORAGE IN RIVER SECTION IN CUBIC FT AT
C            TIME T + 3 HRS
C STORT......PREVIOUS ESTIMATE OF STORAGE IN RIVER SECTION IN CUBIC FT
C            AT TIME T + 3 HRS
C STORX......STORAGE CORRESPONDING TO .005 FT STAGE HIGHER THAN DS STAGE
C STORCHAN...ARRAY OF CURRENT STORAGES IN THE 5 RIVER SECTIONS IN CU FT.
C FR.........DIFFERENCE IN STORAGE BETWEEN STORE AND STORX
C US.........COMPUTED UPSTREAM STAGE GOR A GIVEN STORAGE AND DISCHARGE
C DS.........COMPUTED DOWNSTREAM STAGE FOR A GIVEN STORAGE AND DISCHARGE
C-----------------------------------------------------------------------
C
      COMMON MAP(6,35), STGSTRUC(2,14), QLINK(19), LLINK(19),
     1 STCLAKES(14), LAKES(4), LINKS(3), STAGE(4), QINFL, NGATES(3),
     2 GO(6,3), STAGET, QCHAN(3), IDEBUG, HWS, TWS, T(2,268), LL(15),
     3 MONTH, QFIN, STORCHAN(5), US, DS
```

```
      DIMENSION Q(2), QNEW(2), JS(2)
      TIME = 0
C
C STORE UPPER AND LOWER STRUCTURE NUMBERS IN ARRAY JS
C
      II = LINKS(I)
      JS(1) = MAP(2,II)
      JS(2) = MAP(3,II)
C
C COMPUTE INITIAL DISCHARGE (Q) THROUGH BOTH STRUCTURES
C
      DO 200 I = 1,2
      Q(I) = 0.
      JJ = NGATES(I)
      K = JS(I)
      DO 100 J = 1,JJ
      Q(I) = Q(I) + DISCHRGE(K,STGSTRUC(1,K),STGSTRUC(2,K),GO(J,I))
 100  CONTINUE
 200  CONTINUE
C
C EXTRACT INITIAL STORAGE FROM ARRAY STORCHAN
C
      N = IABS(MAP(1,II))
      STOR = STORCHAN(N)
C
C USE PREVIOUSLY COMPUTED DISCHARGE AT UPPER STRUCTURE (QFIN) AS VALUE
C OF DISCHARGE AT THE END OF THE TIME PERIOD (QNEW(I))
C
      QNEW(1) = QFIN
C
C USE INITIAL DISCHARGE AT LOWER STRUCTURE (Q(2)) AS 1ST ESTIMATE OF
C DISCHARGE AT THE END OF THE TIME PERIOD (QNEW(2))
C
      QNEW(2) = Q(2)
C
C COMPUTE AVERAGE DISCHARGE AT UPPER STRUCTURE (Q1BAR), AT LOWER
C STRUCTURE (Q2BAR), AND FOR THE ENTIRE RIVER SECTION (Q12BAR)
C
      Q1BAR = (Q(1) + QNEW(1)) / 2.0
      Q2BAR = (Q(2) + QNEW(2)) / 2.0
      Q12BAR = (Q1BAR + Q2BAR) / 2.0
C
C COMPUTE ESTIMATE OF STORAGE AT THE END OF THE TIME PERIOD (STORT)
C
      STORT = STOR + (Q1BAR - Q2BAR + QINFL) * 10800.
C
C FROM THIS STORAGE AND AVERAGE DISCHARGE, COMPUT NEW STAGES (DS AND US
C AT EXTREMITIES OF RIVER SECTION
C
 300  CALL USDSRACK (STORT,Q12BAR,MAP(4,II)-20,DS,US)
      IF (US.LT.10.0.OR.DS.LT.10.0) CALL ABNORMAL
      IF (US.GT.80.0.OR.DS.GT.80.0) CALL ABNORMAL
C
C USING THIS NEW DS STAGE (HW AT LOWER STRUCTURE), COMPUTE NEW
C DISCHARGE (QNEW(2))
C
```

```
      QNEW(2) = 0.
      DO 400 I = 1,JI
      QNEW(2) = QNEW(2) + DISCHRGE(K,DS,STGSTRUC(2,K),GO(I,2))
 400  CONTINUE
      QNEW(2) = ABS(QNEW(2))
C
C COMPUTE NEW Q12BAR USING NEW ESTIMATE OF QNEW(2)
C
      Q2BAR = (Q(2) + QNEW(2)) / 2.0
      Q12BAR = (Q1BAR + Q2BAR) / 2.0
C
C COMPUTE NEW ESTIMATE OF STORAGE AT END OF TIME PERIOD (STORE)
C AND ERROR TERM (ER) BASED ON DS STAGE + .040
C
      STORE = STOR + (Q1BAR-Q2BAR+QINFL) * 10800.
      CALL STORBACK (DS,Q12BAR,MAP(4,IT)-20,STORXX,-1.0)
      CALL STORBACK (DS+.040,Q12BAR,MAP(4,IT)-20,STORX,-1.0)
      ER = STORX - STORXX
      IF(IDEBUG.NE.1)
     1WRITE (61,901) ITER,STORE,STORT,ER,QNEW,Q1BAR,Q2BAR,Q12BAR,US,DS
 901  FORMAT (1X5HITER=I2,1X6HSTORE=F12.6,1X6HSTORT=F12.6,1X3HER=F12.6,
     1 1X6HQNEW=2F7.0,5HQ1BR=F7.0,1X5HQ2BR=F7.0,1X6HQ12BR=F7.0,2F7.2)
C
C COMPARE THE DIFFERENCE BETWEEN THE NEW ESTIMATE AND PREVIOUS ESTIMATE
C OF STORAGE.  IF SMALL DIFFERENCE, USE THE NEWEST ESTIMATE OF
C DOWNSTREAM DISCHARGE (QNEW(2)) AS DISCHARGE AT END OF TIME PERIOD AT
C THE DOWNSTREAM STRUCTURE, AND USE DS AND US AS THE FINAL DOWNSTREAM
C AND UPSTREAM STAGES IN THE RIVER SECTION.  IF LARGER DIFFERENCE,
C REPLACE PREVIOUS STORAGE ESTIMATE WITH NEW ESTIMATE AND REPEAT THE
C PROCEDURE.
C
      IF (ABS(STORT-STORE).LE.ER) GO TO 500
      ITER = ITER + 1
      IF (ITER.GT.80) CALL ABNORMAL
      STORT = STORE
      GO TO 300
 500  QCHAN(1) = QNEW(2)
      QETH = QNEW(2)
C
C UPDATE ARRAY STORCHAN WITH FINAL STORAGE (STORE)
C
      N = IABS(MAP(1,IT))
      STORCHAN(N) = STORE
C
C UPDATE ARRAY STGSTRUC WITH FINAL UPSTREAM STAGES
C
      N = JS(1)
      STGSTRUC(1,N) = HWS
      STGSTRUC(2,N) = US
C
C SAVE DOWNSTREAM STAGE FOR FINAL HEADWATER STAGE AT UPPER STRUCTURE OF
C NEXT RIVER SECTION
C
      HWS = DS
      RETURN
      END
```

PROGRAM VARIABLES

00129 R ER 00063 I J 00066 I N 00

```
      FUNCTION RACKWATR(V1,V2,N)
C
C     SUBROUTINE TO COMPUTE DISCHARGE OR UPSTEAM STAGE OR DOWNSTREAM
C     STAGE BY KNOWING OTHER TWO VARIABLES.
C     DISCHARGE IS IN CUFT. PER SEC.
C     USS AND DSS ARE IN FT ABOVE MSL
C     THIS SUBROUTINE IS FOR CHANNELS OF UPPER KISSIMMEE BASIN.
C
C     CHANNEL(N)....=    C-33 ABOVE S-60
C                        C-33G
C                        C-33F
C                        C-33D
C                        C-33C ABOVE S-58
C                        C-33C BELOW S-58
C                        C-33B
C                        C-30 ABOVE S-57
C                        C-30 BELOW S-57
C                        C-29
C                        C-29A ABOVE S-62
C                        C-29A BELOW S-62
C                        C-31 ABOVE S-59
C                        C-31 BELOW S-59
C                        C-35
C                        C-33 BELOW S-60
C                        C-344 BET. S-63 AND S-63A
C                        C-34 BET. S-63A AND LAKE CYPRESS
C                        C-36
C                        C-37
C     A AND C ARE COEFFICIENTS FOR NONLINEAR FORMULATIONS OF UPPER
C     KISSIMMEE CHANNELS.
C
      DIMENSION A(2,20), C(2,20)
C
      DATA (A= 0.,              0.,
     1        0.19562817,       1.37327452,
     2        0.04781795,       1.17262063,
     3        0.11312801,       1.28232715,
     4        0.,               0.,
     5        0.,               0.,
     6        0.12033563,       1.31192007,
     7        0.,               0.,
     8        0.,               0.,
     9        0.23188354,       1.53817995,
     A        0.,               0.,
     B        0.,               0.,
     C        0.,               0.,
     D        0.,               0.,
     E        0.,               0.,
     F        0.,               0.,
     G        0.,               0.,
     H        0.,               0.,
     I        0.40565648,       2.17679705,
     K        0.44352025,       2.25302023 )
C
      DATA(C=0.000916, 0.999313,
     1       0.000077, 0.999936,
```

```
      2          0.006202, 0.094513,
      3          0.000140, 0.099860,
      4          0.000696, 0.099392,
      5          0.00001,  1.000050,
      6          0.000350, 0.099690,
      7          0.000370, 0.099690,
      8          0.000792, 0.099316,
      9          0.005731, 0.093423,
      A          0.000180, 0.099820,
      B          0.002290, 0.097502,
      C          0.007304, 0.090799,
      D          0.007631, 0.090792,
      E          0.006335, 0.089862,
      F          0.002472, 0.097548,
      G          0.007898, 0.092503,
      H          0.004327, 0.093701,
      I          0.003194, 0.094645,
      K          0.007644, 0.086547)
C
C
      ENTRY QBACK
C     V1=DS
C     V2=HS
      IF (V1.EQ.V2) GO TO 20
      X1 = V1
      X2 = V2
      IF (X1.LT.X2) GO TO 5
      TEMP = X1
      X1 = X2
      X2 = TEMP
    5 Q = (X2-X1)**A(1,N) * X1**A(2,N)
      QFACT = FACTORA (V1,Q,N)
      Q = Q * QFACT
      IF(V2-V1) 10,11,11
   10 SIGN=-1.0
      GO TO 12
   11 SIGN=+1.0
   12 BACKWATR=Q*SIGN
      RETURN
   20 BACKWATR = 0.
      RETURN
C
C
      ENTRY DBACK
C     FOR DBACK V1=HS AND V2=Q
      IF(N.EQ.26) GO TO 50
      Q=ABS(V2)
      IF (Q.EQ.0.) GO TO 50
      BW = (V1 / Q**C(1,N)) ** (1.0 / C(2,N))
      DSDFAC = FACTORAB (BW,Q,N,1)
      BACKWATR = BW * DSDFAC
      IF (BACKWATR.GT.V1) GO TO 50
      RETURN
   50 BACKWATR=V1
      RETURN
C
```

```
C
      ENTRY UBACK
C     UBACK    V1=DS AND  V2=Q
      IF(N.EQ.26) GO TO 50
      Q=ABS(V2)
      IF (Q.EQ.0.) GO TO 50
      BW = ((Q)**(C(1,N)))*(V1**(C(2,N)))
      USUFAC = FACTORAB (BW,Q,N,2)
      BACKWATR = BW * USUFAC
      IF (BACKWATR.LT.V1) GO TO 50
      END
```

PROGRAM VARIABLES

00002	W	A	00266	R	DSDFAC	00255	R	DFACT	00
00264	W	BW	00252	R	Q	00261	R	SIGN	00
00122	W	C							

STATEMENT NUMBERS

9	00342	10	00372	11	00375	12	00377

EXTERNAL REFERENCES

ABS FACTORA FACTORAB

FORTRAN DIAGNOSTIC RESULTS FOR BACKWATR

COMPILED LENGTHS OF BACKWATR - P 00621 C 00000 D 00000
NO ERRORS

```
      SUBROUTINE BACKWTR2 (V1,V2,N,V3,V4)
C
C SUBROUTINE TO COMPUTE DOWNSTREAM STAGE AND INITIAL STORAGE BY KNOWING
C     DISCHARGE, INITIAL UPSTREAM STAGE,INITIAL  DOWNSTREAM STAGE AND
C     STORAGE AT TIME T
C     DISCHARGES IS IN CUFT PER SEC.
C     USS AND DSS ARE IN FT ABOVE M.S.L
C     THIS SUBROUTINE IS FOR CANALS OF LOWER KISSIMMEE BASIN
C     CHANNEL(N)=C-39A
C                C-39B
C                C-39C
C                C-39D
C                C-39E
C A,B,C COEFFICIENTS FOR NONLINEAR FORMULATIONS OF LOWER KISSIMMEE CHAN
C     ELS.
C
      DIMENSION A(2,5),B(2,5),C(2,5), QDELT(5)
C
      DATA (A=1.94349507, -0.18936090,
     1        1.75866251, -0.03262747,
     2        1.65939267,  0.05420344,
     3        1.54070909,  0.17934023,
     4        1.21042069, 0.39086445 )
C
      DATA (B=0.46661167, 1.29225620,
     1        0.06123664, 1.59817410,
     2       -0.11387716, 1.70097296,
     3       -0.32464046, 1.79672855,
     4       -0.31844141, 1.68094907 )
C
      DATA (C=0.93525809, 0.12357836,
     1        0.80300638, 0.34915250,
     2        0.72539726, 0.45337676,
     3        0.72979747, 0.42254163,
     4        0.84436366, 0.22342889 )
C
      DATA (QDELT=1000.,2000.,2000.,2500.,3000.)
C
      ENTRY STORBACK
C     FOR STORBACK,  V1=DS, V2=Q, V3=STORAGE, V4 IS + IF CORRECTION
C                    FACTOR IS TO BE APPLIED, OTHERWISE -
      QH=V2
      IF(QH.LT.QDELT(N))QH=QDELT(N)
      V3 = 2.71828182**(ALOG(V1)**A(1,N)*ALOG(QH)**A(2,N)).
      IF (V4.LT.0.) GO TO 50
      SFACT = FACTOR (V1,V2,N,2)
      V3 = V3 * SFACT
50    V3 = V3 * 43560.
      RETURN
C
C
      ENTRY USDSBACK
C     FOR USDSBACK,  V1=STORAGE, V2=Q, V3=DS, V4=US
      VV = V1 / 43560.
      QQ = V2
      IF (QQ.LT.QDELT(N)) QQ = QDELT(N)
```

```
            DEACT=FACTOR(VV,30,N,3)
            V3=DEACT
            V4 = V3*C(1,U) * ALOG(QQ)**C(2,N)
            DEACT = FACTOR (V3,V2,N,1)
            V4 = V4 * DEACT
            RETURN
            END
```

PROGRAM VARIABLES

00040 R	A	00050 R	C	00074 R	DDELT	0(
00024 R	U	00126 R	DEACT	00106 R	OH	0(

STATEMENT NUMBERS

50 00232

EXTERNAL REFERENCES

ALOG FACTOR

FORTRAN DIAGNOSTIC RESULTS FOR BACKWTR2

COMPILED LENGTHS OF BACKWTR2 - P 00376 C 00000 D 00000
NO ERRORS

```
      FUNCTION FACTOR (X,Q,N,M)
C
C FACTOR COMPUTES A CORRECTION FACTOR FOR US, DS, OR STORAGE AS COMPUTE
C BY SUBROUTINE BACKWTR2 TO CORRECT FOR INACCURACIES IN THE FORMULAS
C USED BY BACKWTR2.  FOR A GIVEN DISCHARGE (Q) AND FOR CANAL (N) AND
C GIVEN X . A MULTIPLIER IS COMPUTED TO OBTAIN A BETTER VALUE OF US, DS
C OR STORAGE.
C
C M = 1 WHEN COMPUTING FACTOR FOR US
C M = 2 WHEN COMPUTING FACTOR FOR STORAGE
C M = 3 WHEN COMPUTING FACTOR FOR DS
C
C GENERAL FORM OF THE CORRECTION FACTOR EQUATION FOR US AND STORAGE IS
C      CA + CB*X + CC*X**2
C      WHERE X IS DOWNSTREAM WHEN COMPUTING THE FACTORS FOR US AND STOR.
C      AND X IS STORAGE WHEN COMPUTING THE FACTOR FOR DS.
C
C A TABLE LOOKUP IS USED FOR COMPUTING THE DS CORRECTION FACTOR
C
      DIMENSION CA(13,2,5), CB(13,2,5), CC(13,2,5)
      DIMENSION QDELT(5), FACT(2), NQ(5)
      DIMENSION KK(526), ISTART(5), NENT(5)
C 13 A COEFFICIENTS FOR C3BA UPSTREAM
C 13 A COEFFICIENTS FOR C3BA STORAGE
      DATA(((CA(I,J,1),I=1,13),J=1,2)=
     1   0.283932167E-1,      0.348462497E-1,      0.504818335E-1,
     2   0.917052835E-1,      1.028172267,         1.076544217,
     3   1.133237117,         1.185715167,         1.255998733,
     4   1.324489450,         1.416981367,         1.570956233,
     5   0.754680333E-1,
     1   2.241200002E+1,      2.685650460E+1,      2.966199997E+1,
     2   3.130000000E+1,      3.242800002E+1,      3.311399997E+1,
     3   3.328800002E+1,      3.414399998E+1,      3.346999998E+1,
     4   3.290000000E+1,      3.229000000E+1,      3.420000000,
     5   2.985399998E+1)
C 13 A COEFFICIENTS FOR C3BB UPSTREAM
C 13 A COEFFICIENTS FOR C3BB STORAGE
      DATA(((CA(I,J,2),I=1,13),J=1,2)=
     1   7.836402058E-1,      9.288159290E-1,      0.845278858E-1,
     2   1.125871489,         1.264636826,         1.396359023,
     3   1.476670729,         1.487756197,         1.452675160,
     4   0.,                  0.,                  0.,
     5   0.,
     1   2.270857144E+1,      2.388971430E+1,      2.440020574E+1,
     2   2.461257144E+1,      2.539142856E+1,      2.530142856E+1,
     3   2.540771430E+1,      2.506942856E+1,      2.515171430E+1,
     4   0.,                  0.,                  0.,
     5   0.)
C 13 A COEFFICIENTS FOR C3BC UPSTREAM
C 13 A COEFFICIENTS FOR C3BC STORAGE
      DATA(((CA(I,J,3),I=1,13),J=1,2)=
     1   6.787595165E-1,      7.552501465E-1,      8.834655120E-1,
     2   1.043280591,         1.229322386,         1.400559514,
     3   1.533484098,         1.723101450,         1.857819972,
     4   1.977117159,         0.,                  0.,
     5   0.,
```

```
     1    2.264428570E+1,        2.005914287E+1,        1.985771429E+1,
     2    1.985771429E+1,        2.023005712E+1,        2.061400002E+1,
     3    2.120457145E+1,        2.194657143E+1,        2.266028570E+1,
     4    2.372116288E+1,        0.,                    0.,
     5    0.)
C 13 A COEFFICIENTS FOR C380 UPSTREAM
C 13 A COEFFICIENTS FOR C380 STORAGE
      DATA(((CA(I,J,4),I=1,13),J=1,2)=
     1    6.762531425E-1,        7.743821300E-1,        9.132097000E-1,
     2    1.102014239,           1.317753760,           1.522426766,
     3    1.636107332,           1.823960114,           1.854932984,
     4    1.897938454,           0.,                    0.,
     5    0.,
     1    1.556350000E+1,        1.355450000E+1,        1.302100000E+1,
     2    1.34545E+1,            1.2971E+1,             1.34075E+1,
     3    1.390300E+1,           1.34275E+1,            1.298400E+1,
     4    1.16995E+1,            0.,                    0.,
     5    0.)
C 13 A COEFFICIENTS FOR C38E UPSTREAM
C 13 A COEFFICIENTS FOR C38E STORAGE
      DATA(((CA(I,J,5),I=1,13),J=1,2)=
     1    7.876378313E-1,        7.980352860E-1,        8.311276095E-1,
     2    8.780446188E-1,        9.358233063E-1,        1.002599545,
     3    1.060987,              1.135872,              1.211106,
     4    1.273768,              0.,                    0.,
     5    0.,
     1    1.5444375E+1,          1.2339375E+1,          1.06025E+1,
     2    0.79375,               9.3393735,             2.1409375E+1,
     3    8.78500,               8.19625,               8.13125,
     4    8.05125,               0.,                    0.,
     5    0.)
C 13 B COEFFICIENTS FOR C38A UPSTREAM
C 13 B COEFFICIENTS FOR C38A STORAGE
      DATA(((CB(I,J,1),I=1,13),J=1,2)=
     1    2.150316815E-3,        1.499924978E-3,        9.264211310E-4,
     2   -6.133348217E-4,       -1.813098289E-3,       -3.410460193E-3,
     3   -5.249777233E-3,       -6.852089538E-3,       -9.064356771E-3,
     4   -1.151579732E-2,       -1.425874286E-2,       -2.000820186E-2,
     5    4.272476595E-2,
     1   -9.910357148E-1,       -1.189629976,          -1.314071428,
     2   -1.307767857,          -1.440303572,          -1.472964285,
     3   -1.494321429,          -1.522785714,          -1.499285714,
     4   -1.491975000,          -1.455714286,          -9.133928571E-2,
     5   -1.369928571)
C 13 B COEFFICIENTS FOR C38B UPSTREAM
C 13 B COEFFICIENTS FOR C38B STORAGE
      DATA(((CB(I,J,2),I=1,13),J=1,2)=
     1    7.013459285E-3,       -9.277118750E-4,       -3.070650715E-3,
     2   -9.031523357E-3,       -1.445936571E-2,       -1.931462786E-2,
     3   -2.106208857E-2,       -1.993504215E-2,       -1.622276000E-2,
     4    0.,                    0.,                    0.,
     5    0.,
     1   -1.164571429,          -1.219714286,          -1.246285715,
     2   -1.258071429,          -1.298428571,          -1.295428571,
     3   -1.306214286,          -1.287428571,          -1.295214286,
     4    0.,                    0.0,                   0.,
```

```
     5    0.)
C 13 B COEFFICIENTS FOR C3BC UPSTREAM
C 13 B COEFFICIENTS FOR C3BC STORAGE
      DATA(((CB(I,J,3),I=1,13),J=1,2)=
     1    1.257592813E-2,      7.588929093E-3,      -3.257366190E-5,
     2   -9.105904907E-3,     -1.875079732E-2,      -2.734750133E-2,
     3   -3.379393319E-2,     -4.263279271E-2,      -4.843265998E-2,
     4   -5.300830081E-2,      0.,                  0.,
     5    0.,
     1   -1.302321429,        -1.264857143,         -1.251732143,
     2   -1.251732143,        -1.276214285,         -1.300696429,
     3   -1.339303572,        -1.386839286,         -1.433946428,
     4   -1.504535715,        0.,                   0.,
     5    0.)
C 13 B COEFFICIENTS FOR C3BD UPSTREAM
C 13 B COEFFICIENTS FOR C3BD STORAGE
      DATA(((CB(I,J,4),I=1,13),J=1,2)=
     1    1.560921625E-2,      7.55501E-3,          -2.081025E-3,
     2   -1.408740063E-2,     -2.816890500E-2,      -4.065197688E-2,
     3   -4.556012344E-2,     -5.708656313E-2,      -5.341114813E-2,
     4   -5.638443313E-2,      0.,                  0.,
     5    0.,
     1   -1.03425,            -0.88725,             -0.853,
     2   -0.88725,            -0.853,               -0.88625,
     3   -0.9215,             -0.88625,             -0.852,
     4   -0.76225,            0.,                   0.,
     5    0.)
C 13 B COEFFICIENTS FOR C3BE UPSTREAM
C 13 B COEFFICIENTS FOR C3BE STORAGE
      DATA(((CB(I,J,5),I=1,13),J=1,2)=
     1    1.374755E-2,         1.16816925E-2,       8.505725E-3,
     2    4.54128E-3,          1.7062E-4,           -4.7339325E-3,
     3   -0.009341,            -0.013487,           -0.018296,
     4   -0.02167,             0.,                  0.,
     5    0.,
     1   -1.2225,              -9.665E-1,           -8.36E-1,
     2   -7.66E-1,             -7.345E-1,           -2.0425,
     3   -6.22E-1,             -6.46E-1,            -6.44E-1,
     4   -6.41E-1,             0.,                  0.,
     5    0.)
C 13 C COEFFICIENTS FOR C3BA UPSTREAM
C 13 C COEFFICIENTS FOR C3BA STORAGE
      DATA(((CC(I,J,1),I=1,13),J=1,2)=
     1   -8.641141471E-6,     -2.641057517E-6,      4.795107143E-7,
     2    1.356026786E-5,      2.236997768E-5,      3.476283482E-5,
     3    4.897433036E-5,      6.641741071E-5,      7.705636161E-5,
     4    9.344651786E-5,      1.181964286E-4,      1.729860491E-4,
     5   -1.137187500E-4,
     1    1.116071429E-2,      1.341462145E-2,      1.482142857E-2,
     2    1.564964286E-2,      1.629464286E-2,      1.669642857E-2,
     3    1.687500000E-2,      1.732142857E-2,      1.714285714E-2,
     4    1.700892857E-2,      1.678571429E-2,      6.696428571E-4,
     5    1.580285714E-2)
C 13 C COEFFICIENTS FOR C3BB UPSTREAM
C 13 C COEFFICIENTS FOR C3BB STORAGE
      DATA(((CC(I,J,2),I=1,13),J=1,2)=
```

```
     1    -2.750892857E-5,      6.370156250E-5,      7.655357143E-5,
     2    1.260803571E-4,       1.869660714E-4,      2.297767857E-4,
     3    2.325803571E-4,       1.980357143E-4,      1.37125E-4,
     4    0.,                   0.,                  0.,
     5    0.,
     1    1.535714286E-2,       1.607142857E-2,      1.642857143E-2,
     2    1.660714286E-2,       1.714285714E-2,      1.714285714E-2,
     3    1.732142857E-2,       1.714285714E-2,      1.732142857E-2,
     4    0.,                   0.,                  0.,
     5    0.)
C 13 C COEFFICIENTS FOR C38C UPSTREAM
C 13 C COEFFICIENTS FOR C38C STORAGE
      DATA(((CC(I,J,3),I=1,13),J=1,2)=
     1    -7.721093750E-5,      5.022321429E-9,      9.867745536E-5,
     2    2.160225446E-4,       3.406406250E-4,      4.460457589E-4,
     3    5.202488839E-4,       6.249453125E-4,      6.854854911E-4,
     4    7.301774554E-4,       0.,                  0.,
     5    0.,
     1    2.133928571E-2,       2.071428571E-2,      2.049107143E-2,
     2    2.049107142E-2,       2.089285714E-2,      2.129464286E-2,
     3    2.191964286E-2,       2.272321429E-2,      2.352678571E-2,
     4    2.472214286E-2,       0.,                  0.,
     5    0.)
C 13 C COEFFICIENTS FOR C38D UPSTREAM
C 13 C COEFFICIENTS FOR C38D STORAGE
      DATA(((CC(I,J,4),I=1,13),J=1,2)=
     1    -1.06496875E-4,       1.817500E-5,         1.683125E-4,
     2    3.702484375E-4,       5.776625000E-4,      7.667953125E-4,
     3    2.126445313E-4,       9.880046875E-4,      8.822671875E-4,
     4    8.974046875E-4,       0.,                  0.,
     5    0.,
     1    1.812500000E-2,       1.56250000E-2,       1.500000E-2,
     2    1.5625E-2,            1.500000E-2,         1.562500E-2,
     3    1.625000E-2,          1.562500E-2,         1.500000E-2,
     4    1.312500E-2,          0.,                  0.,
     5    0.)
C 13 C COEFFICIENTS FOR C38E UPSTREAM
C 13 C COEFFICIENTS FOR C38E STORAGE
      DATA(((CC(I,J,5),I=1,13),J=1,2)=
     1    -1.5090625E-4,        -1.118671875E-4,     -4.8921875E-5,
     2    2.940625E-5,          1.1346875E-4,        2.064609375E-4,
     3    0.000289,             0.000357,            0.000439,
     4    0.000486,             0.,                  0.,
     5    0.,
     1    2.5625E-2,            2.0625E-2,           1.75E-2,
     2    1.625E-2,             1.5625E-2,           5.0625E-2,
     3    1.50E-2,              1.375E-2,            1.375E-2,
     4    1.375E-2,             0.,                  0.,
     5    0.)
      DATA (ODELT=1000.,2000.,2000.,2500.,3000.)
      DATA (NO=13,9,10,10,10)
      DATA (ISTART=0,156,246,366,446)
      DATA (NCNT=6,5,6,4,4)
C
C KN IS TABLE OF STORAGE.DS CORRECTION FACTORS FOR EACH OF THE 5
C CHANNELS OF THE LOWER KISSIMMEE
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C
      DATA((KK(I),I=1,156)=
     1   366501,42,      432918,44,      533683,46,
     2   793845,48,      1432595,50,     2501572,52,
     3   367408,42,      433910,44,      534940,46,
     4   796394,48,      1437542,50,     2506223,52,
     4   369157,42,      435563,44,      537051,46,
     5   800634,48,      1445792,50,     2513991,52,
     6   371409,42,      437878,44,      540038,46,
     7   806645,48,      1457350,50,     2524844,52,
     8   374407,42,      440856,44,      543930,46,
     9   814485,48,      1472223,50,     2538778,52,
     1   378173,42,      444495,44,      548764,46,
     2   824301,48,      1490542,50,     2555767,52,
     3   382514,42,      448796,44,      554584,46,
     4   836252,48,      1512537,50,     2575787,52,
     4   387532,42,      453761,44,      561467,46,
     5   850624,48,      1538245,50,     2598807,52,
     6   393243,42,      459614,44,      569580,46,
     7   868189,48,      1567448,50,     2624793,52,
     8   399650,42,      466427,44,      579204,46,
     1   889326,48,      1600058,50,     2653702,52,
     2   406753,42,      474112,44,      590190,46,
     3   915217,48,      1636017,50,     2685489,52,
     4   384301,42,      418833,44,      456542,46,
     5   507823,48,      559989,50,      615133,52,
     6   423315,42,      402472,44,      616682,46,
     7   879538,48,      1718019,50,     2757481,52)
      DATA((KK(I),I=157,246)=
     1   535576,36,      627957,38,      842762,40,
     2   1347325,42,     2140069,44,     539128,36,
     3   631639,38,      849007,40,      1356175,42,
     4   2153960,44,     544966,36,      637808,38,
     5   859658,40,      1371399,42,     2177491,44,
     6   553038,36,      646484,38,      875053,40,
     6   1393742,42,     2211119,44,     563287,36,
     7   657709,38,      895612,40,      1424889,42,
     8   2255373,44,     575815,36,      671808,38,
     9   923622,40,      1464942,42,     2311679,44,
     1   591224,36,      689287,38,      961247,40,
     2   1516222,42,     2383880,44,     609975,36,
     4   710568,38,      1008681,40,     1585148,42,
     5   2474704,44,     631548,36,      736472,38,
     6   1070809,40,     1672687,42,     2583724,44)
      DATA((KK(I),I=247,366)=
     1   362812,28,      416311,30,      503095,32,
     2   806781,34,      1577605,36,     2873004,38,
     3   365027,28,      418422,30,      505957,32,
     4   812959,34,      1588069,36,     2887814,38,
     6   368689,28,      421940,30,      510812,32,
     7   823421,34,      1605803,36,     2912509,38,
     8   373768,28,      426922,30,      517832,32,
     1   838411,34,      1631229,36,     2947292,38,
     3   380226,28,      433412,30,      527423,32,
     3   858244,34,      1664880,36,     2992527,38,
     5   388060,28,      441510,30,      539913,32,
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     4    383444.34,        1707831.36,       3048699.38,
     5    397321.28,        451563.30,        555756.32,
     6    915562.34,        1762485.36,       3116454.38,
     7    408326.28,        464125.30,        575560.32,
     8    955154.34,        1833697.36,       3195669.38,
     9    421233.28,        479583.30,        600028.32,
     1    1002523.34,       1820933.36,       3285407.38,
     2    436125.28,        408174.30,        629719.32,
     3    1060132.34,       2023975.36,       3384094.38)
      DATA((KK(I),I=367,446)=
     1    764326.24,        897230.26,        1124406.28,
     2    1584172.30,       771894.24,        903207.26,
     3    1133355.28,       1596398.30,       784186.24,
     5    913071.26,        1148544.28,       1617468.30,
     5    8000751.24,       936614.26,        1170138.28,
     6    1647739.30,       831049.24,        943482.26,
     7    1198174.28,       1488250.30,       844675.24,
     8    964275.26,        1233923.28,       1740039.30,
     9    871661.24,        997249.26,        1279857.28,
     1    1802770.30,       901404.24,        1036898.26,
     2    1337023.28,       1975023.30,       933885.24,
     3    1086122.26,       1408148.28,       1958291.30,
     4    975366.24,        1148479.26,       1495001.28,
     5    2051267.30)
      DATA((KK(I),I=447,526)=
     1    691059.17,        773845.19,        892085.21,
     2    1096000.23,       692333.17,        775148.19,
     3    893958.21,        1098364.23,       694508.17,
     4    777393.19,        897098.21,        1102312.23,
     5    697613.17,        780499.19,        901537.21,
     6    1107059.23,       701620.17,        784522.19,
     7    907318.21,        1115029.23,       706541.17,
     8    789462.19,        914494.21,        1123854.23,
     1    712384.17,        795297.19,        923201.21,
     3    1134368.23,       719159.17,        802062.19,
     5    933637.21,        1146631.23,       726947.17,
     5    809764.19,        945537.21,        1160797.23,
     6    735709.17,        918373.19,        960194.21,
     7    1177568.23)
C
      I = Q/QDELT(N)
      J = I + 1
      IF (I.NE.0) GO TO 30
      I = 1
      J = 1
      GO TO 60
30    IF (J.LE.NQ(N)) GO TO 50
      I = NQ(N)
      J = NQ(N)
      GO TO 60
50    Q1 = I * QDELT(N)
      Q2 = (I+1) * QDELT(N)
60    L = 1
      DO 100 IJ = I,J
      IF (M.EQ.3) GO TO 65
      FACT(L) = CA(IJ,M,N) + CB(IJ,M,N)*X + CC(IJ,M,N)*X**2
```

```
      GO TO 99
   1  K = ISTART(N) + 2*NENT(N)*(IJ-1) + 1
      NN = NENT(N)
      DO 70 NT = 1,NN
      IF (KX.GT.KK(K)) GO TO 69
      IF (NT.EQ.1) GO TO 68
   65 KK=Y*100.+.5
      X1=KK(K-2)/100.
      X2=KK(K)/100.
      Y1=KK(K-1)
      Y2=KK(K+1)
      CALL INTERP (X,X1,X2,Y1,Y2,FACT(I))
      GO TO 99
   68 FACT(I)=KK(K+1)
      GO TO 99
   69 K = K+2
   70 CONTINUE
   99 I = 2
  100 CONTINUE
      IF (I.EQ.J) GO TO 200
      CALL INTERP (Q,Q1,Q2,FACT(1),FACT(2),Y)
      FACTOR = Y
      RETURN
  200 FACTOR = FACT(1)
      RETURN
      END
```

PROGRAM VARIABLES

00002 R	CA	02503 I	IJ	02512 I	KX	02
00406 R	CB	02457 I	ISTART	02501 I	L	02
01012 R	CC	02473 I	J	02464 I	NENT	02
01430 R	FACT	02507 I	K	02510 I	NN	01
02471 I	I	01441 I	KK	01434 I	NQ	02

STATEMENT NUMBERS

30	02634	60	02663	68	03006	70	03016
50	02651	65	02745	69	03013	99	03025

EXTERNAL REFERENCES

INTERP

FORTRAN DIAGNOSTIC RESULTS FOR FACTOR

```
I FTNC 3509 DETECTED AT      5 STATEMENTS BEYOND STATEMENT NO.     60
 STATEMENT NOT LABELED AND IS PRECEDED BY A NON-RETURN TRANSFER. STATEMENT C
   COMPILED LENGTHS OF FACTOR    = B   03130    C    00000    D    00000
```

```
      FUNCTION FACTORAB(X,Q,N,M)
C  FACTORAB COMPUTES THE CORRECTION FACTORS FOR US AND DS..
C  FOR A GIVEN DISCHARGE(Q),CANAL(N) ANDY,A MULTIPLIER IS COMPUTED TO G
C  A BETTER VALUE OF US AND DS..
C  A IS FIGHTER A COMPUTED US OR A COMPUTED DS..
C  M=1 WHEN COMPUTING FACTOR FOR DS
C   M=2 WHEN COMPUTING FACTOR FOR US
      DIMENSION KK(2956),KY(2956)
      DIMENSION DELT(13),NO(13),ISTART(17,13),DRASE(13)
      DIMENSION NTAB(13)
      DIMENSION FACT(2)
      DIMENSION KZ(2956,2)
      COMMON/DATA/KK,KY
      EQUIVALENCE(KZ,KK)
      DATA(NTAB=11,12,9,8,13,14,6,5,1,16,17,18,15)
      DATA(ISTART=1,10,19,28,37,46,55,64,73,82,91,6(0),
     1            91,99,106,113,120,127,134,141,148,155,162,168,167,4(0),
     2             174,185,196,207,217,227,237,247,256,265,274,283,292
     1,301,310,319,0,
     3             319,336,352,368,384,400,416,432,447,462,477,492,507,
     1522,536,551,0,
     4             551,558,565,572,579,586,594,602,610,618,626,6(0),
     5             626,634,642,650,658,666,674,682,690,698,706,6(0),
     6             706,715,724,733,742,751,760,769,777,785,793,6(0),
     7             793,803,812,821,830,838,846,854,862,870,878,6(0),
     8             878,891,906,919,932,944,956,968,982,994,1006,1017,
     11029,1039,1050,1061,1072,
     9             1072,1081,1089,1097,1105,1113,1121,1129,1137,1145,1153
     1,1160,1168,1175,1182,2(0),
     A   1182,1191,1200,1208,1216,1224,1232,1240,1248,1256,1263,6(0),
     B   1263,1274,1285,1295,1305,1315,1325,1335,1344,1353,1363,6(0),
     C   1363,1379,1395,1411,1425,1439,1453,1466,1479,8(0))
      DATA(DELT=25.,50.,20.,20.,70.,70.,20.,20.,25.,30.,200.,200.,375.)
      DATA(NO=10,12,15,15,10,10,10,10,16,14,10,10,8)
      DATA(DRASE=25.,50.,20.,20.,70.,70.,20.,20.,25.,30.,200.,200.,375.)
      DATA((KY(I),I=1,180)=
     1   0054994,1000127  ,  0056993,1000116  ,  0058993,1000122  ,
     2   0060992,1000128  ,  0062992,1000134  ,  0064991,1000139  ,
     3   0066990,1000145  ,  0068990,1000150  ,  0070989,1000155  ,
     4   0055001,1000087  ,  0057001,1000002  ,  0059001,1000007  ,
     5   0061000,0999996  ,  0063000,1000002  ,  0064999,1000008  ,
     6   0066999,1000013  ,  0068999,1000018  ,  0070998,1000024  ,
     7   0055005,1000137  ,  0057005,0999960  ,  0059005,0999930  ,
     8   0061005,0999919  ,  0063005,0999925  ,  0065004,0999931  ,
     9   0067004,0999936  ,  0069004,0999941  ,  0071004,0999946  ,
     A   0055008,1000264  ,  0057008,0999940  ,  0059008,0999892  ,
     B   0061008,0999881  ,  0063008,0999870  ,  0065008,0999876  ,
     C   0067008,0999881  ,  0069008,0999887  ,  0071008,0999892  ,
     D   0055011,1000440  ,  0057011,0999950  ,  0059011,0999850  ,
     E   0061011,0999838  ,  0063011,0999844  ,  0065011,0999834  ,
     F   0067011,0999839  ,  0069011,0999844  ,  0071011,0999849  ,
     G   0055013,1000678  ,  0057013,0999968  ,  0059013,0999849  ,
     H   0061013,0999820  ,  0063013,0999809  ,  0065013,0999799  ,
     I   0067013,0999804  ,  0069013,0999810  ,  0071013,0999815  ,
     J   0055014,1000976  ,  0057014,1000009  ,  0059015,0999837  ,
     K   0061015,0999791  ,  0063015,0999780  ,  0065015,0999785  ,
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L    0067015.0999775  ,  0069015.0999780  ,  0071015.0999786  ,
M    0055016.1001332  ,  0057016.1000071  ,  0059016.0999828  ,
N    0061016.0999782  ,  0063016.0999770  ,  0065017.0999760  ,
O    0067017.0999750  ,  0069017.0999755  ,  0071017.0999760  ,
P    0055017.1001728  ,  0057017.1000137  ,  0059017.0999840  ,
Q    0061018.0999760  ,  0063018.0999748  ,  0065018.0999737  ,
R    0067018.0999742  ,  0069018.0999733  ,  0071019.0999738  ,
S    0055018.1002216  ,  0057018.1000222  ,  0059019.0999854  ,
T    0061019.0999756  ,  0063019.0999728  ,  0065019.0999717  ,
U    0067020.0999722  ,  0069020.0999713  ,  0071020.0999718  )
 DATA((KY(I),I=181,346)=
1    0051053.1006089  ,  0053946.1001395  ,  0055939.1001204  ,
2    0057031.1001219  ,  0059924.1001286  ,  0061916.1001351  ,
3    0063009.1001431  ,  0065901.1001508  ,  0054031.1000843  ,
4    0056027.0999884  ,  0058023.0999735  ,  0060019.0999748  ,
5    0062015.0999796  ,  0064010.0999858  ,  0066005.0999935  ,
6    0054082.1001579  ,  0056080.0999402  ,  0058077.0998979  ,
7    0060075.0998887  ,  0062072.0998900  ,  0064070.0998946  ,
8    0066067.0999007  ,  0054117.1003173  ,  0056116.0999296  ,
9    0058116.0998545  ,  0060114.0998329  ,  0062113.0998306  ,
A    0064112.0998319  ,  0066110.0998364  ,  0054145.1005450  ,
B    0056145.0999516  ,  0058145.0998310  ,  0060145.0997952  ,
C    0062145.0997845  ,  0064144.0997856  ,  0066144.0997884  ,
D    0054169.1008279  ,  0056169.0999989  ,  0058170.0998203  ,
E    0060170.0997685  ,  0062171.0997509  ,  0064171.0997471  ,
F    0066172.0997498  ,  0054187.1011522  ,  0056188.1000632  ,
G    0058190.0998211  ,  0060192.0997499  ,  0062193.0997253  ,
H    0064194.0997165  ,  0066195.0997176  ,  0054203.1015050  ,
I    0056206.1001483  ,  0058208.0998335  ,  0060210.0997376  ,
J    0062212.0997045  ,  0064214.0996923  ,  0066215.0996901  ,
K    0054218.1018779  ,  0056221.1002511  ,  0058224.0998547  ,
L    0060226.0997323  ,  0062229.0996888  ,  0064231.0996716  ,
M    0066233.0996662  ,  0054231.1022590  ,  0056234.1003674  ,
N    0058238.0998856  ,  0060241.0997315  ,  0062244.0996760  ,
O    0064246.0996553  ,  0066249.0996467  ,  0056247.1004966  ,
P    0058250.0999221  ,  0060254.0997346  ,  0062257.0996671  ,
Q    0064260.0996414  ,  0066263.0996295  ,  0056258.1006402  ,
R    0058262.0999657  ,  0060266.0997430  ,  0062270.0996617  ,
S    0064273.0996293  ,  0066277.0996142  )
 DATA((KY(I),I=347,400)=
1    0059090.1000394  ,  0060990.1000231  ,  0061989.1000203  ,
2    0062089.1000191  ,  0063988.1000196  ,  0064988.1000185  ,
3    0065087.1000190  ,  0066987.1000195  ,  0067986.1000199  ,
4    0068086.1000204  ,  0069985.1000208  ,  0060006.1000787  ,
5    0061006.1000155  ,  0062005.1000011  ,  0063005.0999967  ,
6    0064005.0999955  ,  0065005.0999944  ,  0066004.0999949  ,
7    0067004.0999953  ,  0068004.0999943  ,  0069004.0999947  ,
8    0070003.0999952  ,  0060015.1001653  ,  0061015.1000300  ,
9    0062015.0999974  ,  0063015.0999864  ,  0064014.0999836  ,
A    0065014.0999825  ,  0066014.0999814  ,  0067014.0999803  ,
B    0068014.0999807  ,  0069014.0999812  ,  0070014.0999802  ,
C    0061021.1000587  ,  0062021.1000028  ,  0063021.0999837  ,
D    0064021.0999761  ,  0065021.0999734  ,  0066021.0999722  ,
E    0067021.0999712  ,  0068021.0999701  ,  0069021.0999705  ,
F    0070021.0999710  ,  0061026.1000996  ,  0062026.1000139  ,
G    0063026.0999834  ,  0064027.0999725  ,  0065027.0999682  ,
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U    0066027.0999655  ,  0067027.0999644  ,  0068027.0999633  ,
T    0069027.0999637  ,  0070027.0999627  ,  0061030.1001518  ,
I    0062031.1000298  ,  0063031.0999878  ,  0064031.0999705  ,
K    0065031.0999645  ,  0066031.0999603  ,  0067031.0999591  ,
I    0068032.0999580  ,  0069032.0999570  ,  0070032.0999574  ,
U    0061034.1002165  ,  0062034.1000515  ,  0063034.0999932  ,
N    0064035.0999710  ,  0065035.0999619  ,  0066035.0999576  ,
O    0067035.0999549  ,  0068035.0999538  ,  0069036.0999527  )
 DATA((KY(I),I=491,636)=
D    0070036.0999517  ,  0062037.1000804  ,  0063037.1000041  ,
O    0064038.0999739  ,  0065038.0999616  ,  0066038.0999557  ,
U    0067038.0999515  ,  0068039.0999503  ,  0069039.0999492  ,
S    0070039.0999482  ,  0062040.1001115  ,  0063040.1000156  ,
T    0064040.0999774  ,  0065041.0999618  ,  0066041.0999529  ,
U    0067041.0999501  ,  0068042.0999460  ,  0069042.0999449  ,
V    0070042.0999452  ,  0062042.1001462  ,  0063043.1000291  ,
W    0064043.0999828  ,  0065043.0999641  ,  0066044.0999535  ,
X    0067044.0999477  ,  0068044.0999450  ,  0069045.0999424  ,
Y    0070045.0999413  ,  0062044.1001846  ,  0063045.1000462  ,
Z    0064045.0999887  ,  0065046.0999652  ,  0066046.0999530  ,
1    0067046.0999457  ,  0068047.0999430  ,  0069047.0999404  ,
2    0070048.0999378  ,  0062046.1002281  ,  0063047.1000636  ,
3    0064047.0999964  ,  0065048.0999681  ,  0066048.0999543  ,
4    0067049.0999454  ,  0068049.0999412  ,  0069049.0999386  ,
5    0070050.0999360  ,  0062048.1002735  ,  0063049.1000829  ,
6    0064049.1000059  ,  0065050.0999728  ,  0066050.0999544  ,
7    0067051.0999470  ,  0068051.0999397  ,  0069051.0999371  ,
8    0070052.0999345  ,  0062050.1003256  ,  0063050.1001055  ,
9    0064051.1000172  ,  0065051.0999778  ,  0066052.0999577  ,
A    0067052.0999472  ,  0068053.0999399  ,  0069053.0999358  ,
B    0070054.0999332  ,  0062052.1003794  ,  0063052.1001299  ,
C    0064053.1000287  ,  0065053.0999829  ,  0066054.0999597  ,
D    0067054.0999476  ,  0068055.0999388  ,  0069055.0999347  ,
E    0070056.0999321  )
 DATA((KY(I),I=637,914)=
F                       0053981.1000192  ,  0054980.1000659  ,
G    0055979.1000487  ,  0056978.1000445  ,  0057977.1000422  ,
H    0058975.1000433  ,  0059974.1000444  ,  0060973.1000439  ,
U    0061972.1000450  ,  0062971.1000461  ,  0063970.1000472  ,
T    0064969.1000482  ,  0065967.1000493  ,  0086966.1000503  ,
I    0067965.1000513  ,  0068964.1000523  ,  0069963.1000533  ,
K    0055010.1000910  ,  0056009.1000188  ,  0057009.1000036  ,
L    0058008.0999959  ,  0059008.0999918  ,  0060007.0999912  ,
M    0061007.0999906  ,  0062006.0999917  ,  0063006.0999928  ,
N    0064005.0999923  ,  0065004.0999933  ,  0066004.0999944  ,
O    0067003.0999954  ,  0068002.0999964  ,  0069002.0999974  ,
P    0070001.0999984  ,  0055028.1001879  ,  0056027.1000278  ,
Q    0057027.0999891  ,  0058027.0999741  ,  0059027.0999665  ,
R    0060027.0999641  ,  0061026.0999618  ,  0062026.0999612  ,
S    0063026.0999607  ,  0064025.0999617  ,  0065025.0999628  ,
T    0066025.0999638  ,  0067025.0999633  ,  0068024.0999643  ,
U    0069024.0999653  ,  0070024.0999663  ,  0055040.1003413  ,
V    0056040.1000603  ,  0057040.0999943  ,  0058040.0999651  ,
W    0059040.0999539  ,  0060040.0999463  ,  0061040.0999423  ,
X    0062040.0999417  ,  0063040.0999411  ,  0064040.0999405  ,
Y    0065040.0999400  ,  0066040.0999410  ,  0067040.0999420  ,
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7    0068040,0999431  ,  0069040,0999425  ,  0070040,0999435  ,
1    0055050,1005343  ,  0056050,1001158  ,  0057050,1000117  ,
2    0058050,0999664  ,  0059051,0999480  ,  0060051,0999370  ,
3    0061051,0999295  ,  0062051,0999272  ,  0063051,0999250  ,
4    0064051,0999244  ,  0065052,0999239  ,  0066052,0999249  ,
5    0067052,0999243  ,  0068052,0999253  ,  0069052,0999263  ,
6    0070052,0999273  ,  0055058,1007813  ,  0056058,1001852  ,
7    0057059,1000393  ,  0058059,0999744  ,  0059059,0999455  ,
8    0060059,0999300  ,  0061060,0999217  ,  0062060,0999160  )
 DATA((Ky(I),I=815,994)=
9    0063060,0999137  ,  0064061,0999115  ,  0065061,0999110  ,
A    0066061,0999104  ,  0067061,0999114  ,  0068062,0999109  ,
B    0069062,0999119  ,  0070062,0999128  ,  0055065,1010868  ,
C    0056065,1002675  ,  0057065,1000762  ,  0058066,0999880  ,
D    0059066,0999503  ,  0060067,0999286  ,  0061067,0999160  ,
E    0062068,0999087  ,  0063068,0999047  ,  0064068,0999025  ,
F    0065069,0999003  ,  0066069,0998997  ,  0067070,0998992  ,
G    0068070,0999002  ,  0069070,0998997  ,  0070071,0999006  ,
H    0056071,1003674  ,  0057072,1001217  ,  0058072,1000084  ,
I    0059073,0999565  ,  0060073,0999281  ,  0061074,0999136  ,
K    0062074,0999029  ,  0063075,0998973  ,  0064075,0998935  ,
L    0065076,0998913  ,  0066076,0998907  ,  0067077,0998901  ,
M    0068077,0998896  ,  0069078,0998906  ,  0070078,0998901  ,
N    0056076,1004758  ,  0057077,1001719  ,  0058078,1000335  ,
O    0059078,0999675  ,  0060079,0999321  ,  0061079,0999125  ,
P    0062080,0999000  ,  0063081,0998927  ,  0064081,0998873  ,
Q    0065082,0998850  ,  0066082,0998829  ,  0067083,0998823  ,
R    0068083,0998810  ,  0069084,0998813  ,  0070085,0998822  ,
S    0056081,1005958  ,  0057082,1002301  ,  0058082,1000630  ,
T    0059083,0999812  ,  0060084,0999370  ,  0061085,0999140  ,
U    0062085,0998998  ,  0063086,0998892  ,  0064087,0998820  ,
V    0065087,0998782  ,  0066088,0998761  ,  0067089,0998755  ,
W    0068089,0998749  ,  0069090,0998744  ,  0070090,0998739  ,
X    0056085,1007255  ,  0057086,1002961  ,  0058087,1000968  ,
Y    0059088,0999990  ,  0060088,0999461  ,  0061089,0999163  ,
Y    0062090,0998971  ,  0063091,0998864  ,  0064091,0998792  ,
Z    0065092,0998738  ,  0066093,0998716  ,  0067094,0998694  ,
1    0068094,0998674  ,  0069095,0998668  ,  0070096,0998663  ,
2    0056089,1008629  ,  0057090,1003680  ,  0058091,1001329  ,
3    0059092,1000209  ,  0060092,0999559  ,  0061093,0999208  )
 DATA((KY(I),I=995,1100)=
4    0063094,0998982  ,  0063095,0998858  ,  0064096,0998754  ,
5    0065097,0998700  ,  0066097,0998662  ,  0067098,0998640  ,
6    0068099,0998619  ,  0069100,0998614  ,  0070101,0998609  ,
7    0056093,1010099  ,  0057093,1004458  ,  0058094,1001731  ,
8    0059095,1000433  ,  0060096,0999679  ,  0061097,0999260  ,
9    0062098,0998999  ,  0063099,0998858  ,  0064100,0998738  ,
A    0065101,0998667  ,  0066102,0998629  ,  0067102,0998592  ,
B    0068103,0998571  ,  0069104,0998551  ,  0070105,0998545  ,
C    0057097,1005274  ,  0058098,1002171  ,  0059099,1000696  ,
D    0060100,0999803  ,  0061101,0999332  ,  0062102,0999037  ,
E    0063103,0998847  ,  0064104,0998726  ,  0065105,0998639  ,
F    0066105,0998600  ,  0067106,0998548  ,  0068107,0998527  ,
G    0069108,0998506  ,  0070109,0998501  ,  0056099,1013193  ,
H    0057100,1006148  ,  0058101,1002650  ,  0059102,1000980  ,
I    0060103,0999965  ,  0061104,0999408  ,  0062105,0999079  ,
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I    0063106.0998856  ,  0064107.0998718  ,  0065108.0998631  ,
K    0066109.0998561  ,  0067110.0998523  ,  0068111.0998487  ,
L    0069112.0998466  ,  0070113.0998461  )
 DATA((KY(I),I=1101,1250)=
1    0052709.1005647  ,  0054680.1005894  ,  0056649.1006205  ,
2    0058619.1006507  ,  0060587.1006816  ,  0062555.1007115  ,
3    0064522.1007404  ,  0052977.1000908  ,  0054957.1000905  ,
4    0056937.1001159  ,  0058916.1001458  ,  0060895.1001748  ,
5    0052972.1002029  ,  0064850.1002317  ,  0053134.0998513  ,
6    0055120.0998108  ,  0057106.0998234  ,  0059091.0998514  ,
7    0061075.0998802  ,  0063059.0999082  ,  0065042.0999368  ,
8    0053246.0997244  ,  0055236.0996212  ,  0057226.0996208  ,
9    0059215.0996435  ,  0061204.0996722  ,  0063192.0997000  ,
A    0065179.0997271  ,  0053333.0996670  ,  0055326.0994825  ,
B    0057319.0994673  ,  0059312.0994846  ,  0061303.0995099  ,
C    0063295.0995392  ,  0065285.0995662  ,  0051407.1034477  ,
D    0053404.0996729  ,  0055400.0993808  ,  0057396.0993454  ,
E    0059391.0993572  ,  0061385.0993807  ,  0063379.0994084  ,
F    0065372.0994352  ,  0051465.1047498  ,  0053464.0997253  ,
G    0055462.0993050  ,  0057460.0992475  ,  0059458.0992505  ,
H    0061454.0992705  ,  0063450.0992965  ,  0065446.0993233  ,
I    0051515.1057716  ,  0053516.0998187  ,  0055517.0992497  ,
J    0057516.0991612  ,  0059516.0991604  ,  0061514.0991770  ,
K    0063512.0992013  ,  0065510.0992280  ,  0051559.1064371  ,
L    0053562.0990494  ,  0055564.0992093  ,  0057566.0990916  ,
M    0059567.0990819  ,  0061567.0990949  ,  0063567.0991175  ,
N    0065566.0991427  ,  0051599.1068319  ,  0053603.1001095  ,
O    0055607.0991815  ,  0057610.0991327  ,  0059613.0990140  ,
P    0061615.0990236  ,  0063616.0990429  ,  0065617.0990680  )
 DATA((KY(I),I=1251,1410)=
1    0050907.1006782  ,  0052781.1004677  ,  0054754.1004635  ,
2    0056727.1004872  ,  0058698.1005155  ,  0060670.1005463  ,
3    0062640.1005746  ,  0064610.1006035  ,  0051077.1007873  ,
4    0053061.1000771  ,  0055045.0999771  ,  0057027.0999746  ,
5    0059010.0999937  ,  0060991.1000192  ,  0062972.1000472  ,
6    0064953.1000743  ,  0051235.1012020  ,  0053225.0999709  ,
7    0055215.0997389  ,  0057204.0996920  ,  0059193.0996967  ,
8    0061190.0997167  ,  0063167.0997413  ,  0065154.0997667  ,
9    0051248.1016987  ,  0053342.1000160  ,  0055337.0996069  ,
A    0057330.0995119  ,  0059323.0994966  ,  0061315.0995079  ,
B    0063306.0995273  ,  0065297.0995510  ,  0051435.1022120  ,
C    0053433.1001527  ,  0055431.0995421  ,  0057428.0993912  ,
D    0059424.0993492  ,  0061419.0993500  ,  0063414.0993642  ,
E    0065408.0993862  ,  0051507.1027184  ,  0053508.1003424  ,
F    0055508.0995334  ,  0057508.0993069  ,  0059506.0992379  ,
G    0061505.0992248  ,  0063502.0992340  ,  0065500.0992511  ,
H    0051567.1032298  ,  0053571.1005754  ,  0055573.0995639  ,
I    0057575.0992492  ,  0059576.0991532  ,  0061577.0991244  ,
J    0063577.0991252  ,  0065577.0991405  ,  0051620.1037446  ,
K    0053625.1008310  ,  0055630.0996279  ,  0057634.0992193  ,
L    0059637.0990891  ,  0061640.0990429  ,  0063642.0990352  ,
M    0065643.0990456  ,  0051666.1043075  ,  0053674.1011074  ,
N    0055680.0997162  ,  0057684.0992082  ,  0059691.0990386  ,
O    0061695.0989750  ,  0063698.0989572  ,  0065702.0989627  ,
P    0051708.1052699  ,  0053717.1013929  ,  0055725.0998227  ,
Q    0057732.0992133  ,  0059739.0990008  ,  0061745.0989198  ,
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D     0063750.0988918  ,  0065755.0988908  )
 DATA((KV(I),I=1411,1584)=
1     0056079.1000589  ,  0058977.1000428  ,  0060975.1000430  ,
2     0062973.1000434  ,  0064971.1000453  ,  0066969.1000471  ,
3     0068966.1000489  ,  0070964.1000506  ,  0072962.1000523  ,
4     0057006.1000627  ,  0059005.1000047  ,  0061004.0999964  ,
5     0063003.0999967  ,  0065002.0999970  ,  0067001.0999988  ,
6     0069000.1000006  ,  0070998.1000024  ,  0072997.1000041  ,
7     0057022.1001151  ,  0059022.0999934  ,  0061021.0999748  ,
8     0063021.0999701  ,  0065020.0999703  ,  0067020.0999706  ,
9     0069019.0999724  ,  0071018.0999742  ,  0073018.0999758  ,
A     0057034.1002038  ,  0059034.0999954  ,  0061034.0999613  ,
B     0063033.0999532  ,  0065033.0999519  ,  0067033.0999521  ,
C     0069033.0999524  ,  0071033.0999541  ,  0073032.0999558  ,
D     0057043.1003232  ,  0059043.1000053  ,  0061043.0999540  ,
E     0063043.0999409  ,  0065043.0999379  ,  0067043.0999366  ,
F     0069044.0999383  ,  0071044.0999386  ,  0073044.0999403  ,
G     0057050.1004647  ,  0059050.1000231  ,  0061051.0999528  ,
H     0063051.0999330  ,  0065052.0999267  ,  0067052.0999254  ,
I     0069052.0999257  ,  0071053.0999273  ,  0073053.0999276  ,
J     0057056.1006187  ,  0059057.1000496  ,  0061057.0999551  ,
K     0063058.0999270  ,  0065059.0999175  ,  0067059.0999162  ,
L     0069060.0999149  ,  0071060.0999166  ,  0073061.0999169  ,
M     0059062.1000809  ,  0061063.0999589  ,  0063064.0999225  ,
N     0065065.0999589  ,  0067065.0999069  ,  0069066.0999071  ,
O     0071067.0999073  ,  0073067.0999090  ,  0059067.1001184  ,
P     0061068.0999633  ,  0063069.0999206  ,  0065070.0999062  ,
Q     0067071.0999002  ,  0069072.0999989  ,  0071073.0998992  ,
R     0073073.0999009  ,  0057070.1011562  ,  0059071.1001619  ,
S     0061073.0999745  ,  1063074.0999212  ,  0065075.0999020  ,
T     0067076.0999944  ,  0069077.0999930  ,  0073079.0998935  )
 DATA((KV(I),I=1585,1754)=
1     0057013.1005152  ,  0059014.0999918  ,  0061014.0999797  ,
2     0063015.0999779  ,  0065016.0999761  ,  0067016.0999759  ,
3     0069017.0999758  ,  0071017.0999756  ,  0073018.0999755  ,
4     0075018.0999754  ,  0059014.1000301  ,  0061015.0999855  ,
5     0063015.0999797  ,  0065016.0999769  ,  0067017.0999752  ,
6     0069017.0999751  ,  0071018.0999750  ,  0073018.0999748  ,
7     0075019.0999747  ,  0059014.1000941  ,  0061015.0999966  ,
8     0063016.0999831  ,  0065016.0999781  ,  0067017.0999763  ,
9     0069017.0999747  ,  0071018.0999745  ,  0073018.0999744  ,
A     0075019.0999743  ,  0059015.1001813  ,  0061015.1000111  ,
B     0063016.0999876  ,  0065016.0999809  ,  0067017.0999775  ,
C     0069018.0999759  ,  0071018.0999743  ,  0073019.0999741  ,
D     0075019.0999740  ,  0061015.1000289  ,  0063016.0999953  ,
E     0065017.0999837  ,  0067017.0999788  ,  0069018.0999756  ,
F     0071018.0999754  ,  0073019.0999739  ,  0075020.0999738  ,
G     0061015.1000500  ,  0063016.1000030  ,  0065017.0999966  ,
H     0067017.0999801  ,  0069018.0999769  ,  0071019.0999753  ,
I     0073019.0999751  ,  0075020.0999736  ,  0061016.1000728  ,
J     0063016.1000108  ,  0065017.0999911  ,  0067017.0999814  ,
K     0069018.0999767  ,  0071019.0999751  ,  0073019.0999749  ,
L     0075020.0999734  ,  0061016.1001022  ,  0063016.1000202  ,
M     0065017.0999955  ,  0067017.0999843  ,  0069018.0999781  ,
N     0071019.0999764  ,  0073019.0999748  ,  0075020.0999746  ,
O     0061016.1001332  ,  0063016.1000312  ,  0065017.1000000  ,
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B    0067018.0999857  ,  0069018.0999794  ,  0071019.0999763
C    0073019.0999747  ,  0075020.0999745  ,  0061016.1001675
D    0063016.1000422  ,  0065017.1000045  ,  0067018.0999886
E    0069018.0999807  ,  0071019.0999762  ,  0073020.0999746
T    0075020.0999744  )
 DATA((KY(I),I=1755,1934)=
1    0057084.1004748  ,  0058880.1002382  ,  0059875.1002184  ,
2    0060871.1002157  ,  0061866.1002181  ,  0062861.1002220  ,
3    0063857.1002243  ,  0064852.1002281  ,  0065847.1002318  ,
4    0066843.1002355  ,  0067838.1002392  ,  0068833.1002427  ,
5    0069828.1002463  ,  0057983.1006735  ,  0058981.1001616  ,
6    0059978.1000752  ,  0060975.1000557  ,  0061972.1000513  ,
7    0062975.1000557  ,  0061972.1000513  ,  0062969.1000520  ,
8    0063966.1000542  ,  0064963.1000580  ,  0065960.1000602  ,
9    0066957.1000639  ,  0067954.1000675  ,  0068951.1000711  ,
A    0069948.1000747  ,  0058042.1009810  ,  0059040.1002018  ,
B    0060038.1000232  ,  0061036.0999751  ,  0062034.0999608  ,
C    0063032.0999565  ,  0064030.0999571  ,  0065028.0999593  ,
D    0066026.0999615  ,  0067024.0999652  ,  0068022.0999688  ,
E    0069020.0999709  ,  0070018.0999744  ,  0058083.1012914  ,
F    0059082.1003083  ,  0060081.1000104  ,  0061080.0999318  ,
G    0062078.0999010  ,  0063077.0998918  ,  0064076.0998892  ,
H    0065075.0998898  ,  0066073.0998919  ,  0067072.0998941  ,
I    0068071.0998977  ,  0069069.0999013  ,  0070068.0999033  ,
J    0059114.1004526  ,  0060114.1000284  ,  0061113.0999095  ,
K    0062113.0998620  ,  0063112.0998446  ,  0064111.0998388  ,
L    0065111.0998378  ,  0066110.0998384  ,  0067109.0998405  ,
M    0068108.0998426  ,  0069107.0998462  ,  0070106.0998497  ,
N    0059141.1004153  ,  0060141.1000731  ,  0061141.0999021  ,
O    0062141.0999367  ,  0063140.0998091  ,  0064140.0997985  ,
P    0065140.0997950  ,  0066140.0997949  ,  0067139.0997970  ,
Q    0068139.0997991  ,  0069138.0998012  ,  0070138.0998047  ,
R    0059164.1007916  ,  0060164.1001347  ,  0061164.0999081  ,
S    0062164.0998208  ,  0063165.0997822  ,  0064165.0997682  ,
T    0065165.0997609  ,  0066165.0997599  ,  0067165.0997605  ,
U    0068165.0997625  ,  0069165.0997646  ,  0070165.0997666  )
 DATA((KY(I),I=1935,2024)=
V    0059183.1009746  ,  0060184.1002097  ,  0059183.1009746  ,
W    0060184.1002097  ,  0061184.0999258  ,  0062185.0998104  ,
X    0063185.0997535  ,  0064186.0997415  ,  0065186.0997326  ,
Y    0066187.0997300  ,  0067187.0997290  ,  0068187.0997311  ,
Z    0069188.0997331  ,  0070188.0997351  ,  0059200.1011598  ,
1    0060201.1002985  ,  0061202.0999523  ,  0062203.0998070  ,
2    0063204.0997487  ,  0064205.0997219  ,  0065205.0997097  ,
3    0066206.0997040  ,  0067207.0997030  ,  0068207.0997035  ,
4    0069208.0997041  ,  0070208.0997061  ,  0059216.1013445  ,
5    0060217.1003960  ,  0061218.0999867  ,  0062219.0998116  ,
6    0063220.0997401  ,  0064221.0997052  ,  0065222.0996883  ,
7    0066223.0996810  ,  0067224.0996785  ,  0068225.0996790  ,
8    0069226.0996796  ,  0070227.0996816  ,  0060231.1005061  ,
9    0061233.1000285  ,  0062234.0998218  ,  0063235.0997324  ,
A    0064236.0996911  ,  0065238.0996710  ,  0066239.0996621  )
 DATA((KY(I),I=2025,2142)=
B    0067240.0996580  ,  0068241.0996570  ,  0069242.0996575  ,
C    0070243.0996581  ,  0060244.1006322  ,  0061246.1000788  ,
D    0062247.0998357  ,  0063249.0997284  ,  0064250.0995821  ,
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E   0065252.0996572  ,  0066253.0996452  ,  0067254.0996395  ,
F   0068256.0996370  ,  0069257.0996375  ,  0070258.0996381  ,
G   0060256.1007699  ,  0061258.1001341  ,  0062260.0998529  ,
H   0063261.0997292  ,  0064263.0996748  ,  0065265.0996436  ,
I   0066266.0996300  ,  0067268.0996228  ,  0068269.0996202  ,
J   0069271.0996193  ,  0070272.0996198  ,  0060267.1008975  ,
K   0061269.1001925  ,  0062271.0998731  ,  0063273.0997331  ,
L   0064275.0996690  ,  0065277.0996345  ,  0066278.0996163  ,
M   0067280.0996075  ,  0068282.0996035  ,  0069283.0996025  ,
N   0070285.0996030  ,  0060277.1010196  ,  0061279.1002570  ,
O   0062282.0998994  ,  0063284.0997398  ,  0064286.0996613  ,
P   0065288.0996252  ,  0066290.0996053  ,  0067292.0995950  ,
Q   0068293.0995994  ,  0069295.0995869  ,  0070297.0995860  ,
R   0060287.1011429  ,  0061289.1003242  ,  0062292.0999285  ,
S   0063294.0997491  ,  0064296.0996610  ,  0065298.0996185  ,
T   0066300.0995955  ,  0067302.0995821  ,  0068304.0995764  ,
U   0069306.0995725  ,  0070308.0995715  )
 DATA((Kv(I),I=2143,2250)=
1   0055020.1005871  ,  0057019.1000153  ,  0059019.0999787  ,
2   0061018.0999741  ,  0063017.0999746  ,  0065016.0999752  ,
3   0067015.0999773  ,  0069014.0999793  ,  0071013.0999812  ,
4   0057055.1000675  ,  0059056.0999440  ,  0061057.0999205  ,
5   0063057.0999143  ,  0065057.0999133  ,  0067058.0999153  ,
6   0069058.0999158  ,  0071058.0999178  ,  0057077.1002038  ,
7   0059078.0999492  ,  0061079.0998981  ,  0063080.0998836  ,
8   0065082.0998792  ,  0067083.0998797  ,  0069084.0998802  ,
9   0071085.0998807  ,  0057092.1004016  ,  0059094.0999804  ,
A   0061095.0998898  ,  0063097.0998652  ,  0065099.0998560  ,
B   0067100.0998549  ,  0069102.0998539  ,  0071104.0998558  ,
C   0057103.1006367  ,  0059106.1000226  ,  0061108.0998923  ,
D   0063110.0998559  ,  0065112.0998402  ,  0067114.0998359  ,
E   0069116.0998349  ,  0071118.0998354  ,  0057113.1008966  ,
F   0059115.1000871  ,  0061119.0999051  ,  0063120.0998503  ,
G   0065123.0998297  ,  0067125.0998223  ,  0069128.0998197  ,
H   0071130.0998201  ,  0057121.1011677  ,  0059124.1001677  ,
I   0061127.0999253  ,  0063129.0998504  ,  0065132.0998217  )
 DATA((Kv(I),I=2251,2362)=
J   0067135.0998111  ,  0069137.0998085  ,  0071140.0998074  ,
K   0057128.1014424  ,  0059131.1002603  ,  0061134.0999491  ,
L   0063137.0998509  ,  0065140.0998187  ,  0067143.0998034  ,
M   0069146.0997977  ,  0071149.0997952  ,  0057134.1017202  ,
N   0059137.1003644  ,  0061141.0999775  ,  0063144.0998591  ,
O   0065147.0998156  ,  0067150.0997971  ,  0069153.0997884  ,
P   0071156.0997858  ,  0057140.1019904  ,  0059143.1004782  ,
Q   0061147.1000104  ,  0063150.0998685  ,  0065153.0998137  ,
R   0067157.0997919  ,  0069160.0997816  ,  0071163.0997776  ,
S   0059148.1005979  ,  0061152.1000507  ,  0063156.0998819  ,
T   0065159.0998142  ,  0067162.0997877  ,  0069166.0997758  ,
U   0071169.0997703  ,  0055145.1063426  ,  0059153.1007268  ,
V   0061157.1000951  ,  0063161.0998930  ,  0065164.0998169  ,
W   0067168.0997857  ,  0069172.0997708  ,  0071175.0997652  ,
X   0059157.1008581  ,  0061161.1001450  ,  0063165.0999062  ,
Y   0065169.0998204  ,  0067173.0997843  ,  0069177.0997678  ,
Z   0071180.0997593  ,  0059161.1009966  ,  0061165.1001987  ,
1   0063169.0999264  ,  0065173.0998259  ,  0067177.0997850  ,
2   0069181.0997639  ,  0071185.0997539  )
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DATA((KY(I),I=2363,2524)=
1    0047614.1048533  ,  0049625.1006816  ,  0051635.0991696  ,
2    0053644.0989147  ,  0055653.0988661  ,  0057661.0988687  ,
3    0059669.0988870  ,  0061676.0989082  ,  0063683.0989288  ,
4    0047075.1071174  ,  0049897.1022202  ,  0051918.0995469  ,
5    0053939.0986936  ,  0055959.0984389  ,  0057978.0983772  ,
6    0059997.0983688  ,  0062015.0983795  ,  0064033.0983965  ,
7    0050057.1035515  ,  0052085.1003307  ,  0054112.0988456  ,
8    0056138.0983023  ,  0058164.0981388  ,  0060189.0980925  ,
9    0062214.0980842  ,  0064238.0980928  ,  0050171.1047735  ,
A    0052203.1012734  ,  0054235.0991762  ,  0056266.0983103  ,
B    0058296.0980202  ,  0060326.0979196  ,  0062355.0978889  ,
C    0064384.0978857  ,  0050260.1059320  ,  0052295.1021487  ,
D    0054330.0996072  ,  0056365.0984193  ,  0058399.0979760  ,
E    0060432.0978117  ,  0062465.0977517  ,  0064498.0977335  ,
F    0050332.1068644  ,  0052371.1029164  ,  0054409.1000777  ,
G    0056446.0985001  ,  0058483.0979872  ,  0060519.0977486  ,
H    0062555.0976526  ,  0064591.0976161  ,  0050393.1077722  ,
I    0052434.1036341  ,  0054475.1005782  ,  0056515.0988340  ,
J    0058554.0980422  ,  0060593.0977188  ,  0062632.0975833  ,
K    0064669.0975252  ,  0050446.1090046  ,  0052490.1043041  ,
L    0054532.1010865  ,  0056575.0991045  ,  0058616.0981299  ,
M    0060657.0977164  ,  0062698.0975363  ,  0064738.0974548  ,
N    0050493.1142861  ,  0052539.1049342  ,  0054583.1015953  ,
O    0056627.0994027  ,  0058671.0982517  ,  0060714.0977375  ,
P    0062756.0975093  ,  0064798.0974012  ,  0052582.1055411  ,
Q    0054629.1021020  ,  0056674.0997205  ,  0058720.0983982  ,
R    0060764.0977780  ,  0062808.0974967  ,  0064852.0973618  )
DATA((KY(I),I=2525,2614)=
1    0044053.1005924  ,  0046939.1002413  ,  0049922.1001957  ,
2    0050006.1001999  ,  0052890.1002160  ,  0054873.1002355  ,
3    0056855.1002562  ,  0058837.1002779  ,  0060819.1002989  ,
4    0062800.1003176  ,  0064781.1003374  ,  0045088.1013336  ,
5    0047079.1002385  ,  0049069.0999996  ,  0051059.0999449  ,
6    0053049.0999366  ,  0055038.0999462  ,  0057026.0999629  ,
7    0059014.0999810  ,  0061002.1000002  ,  0062989.1000188  ,
8    0064976.1000384  ,  0047161.1005017  ,  0049155.0999932  ,
9    0051149.0999420  ,  0053142.0997972  ,  0055134.0997910  ,
A    0057126.0997982  ,  0059118.0998125  ,  0061109.0998298  ,
B    0063100.0998466  ,  0045090.0998646  ,  0047220.1009103  ,
C    0049217.1000903  ,  0051212.0998194  ,  0053208.0997238  ,
D    0055203.0996940  ,  0057197.0996898  ,  0059191.0996968  ,
E    0061185.0997105  ,  0063178.0997272  ,  0065171.0997434  ,
F    0047266.1014117  ,  0049264.1002616  ,  0051262.0998450  )
DATA((KY(I),I=2615,2724)=
G    0053259.0996877  ,  0055256.0996304  ,  0057253.0996128  ,
H    0059249.0996124  ,  0061244.0996224  ,  0063239.0996357  ,
I    0065234.0996503  ,  0047303.1019681  ,  0049303.1004949  ,
J    0051302.0999173  ,  0053301.0996841  ,  0055300.0995934  ,
K    0057298.0995587  ,  0059295.0995490  ,  0061293.0995520  ,
L    0063289.0995634  ,  0065286.0995763  ,  0047335.1025508  ,
M    0049336.1007564  ,  0051337.1000201  ,  0053337.0997057  ,
N    0055337.0995740  ,  0057336.0995202  ,  0059335.0994995  ,
O    0061333.0994971  ,  0063332.0995034  ,  0065329.0995145  ,
P    0049364.1010748  ,  0051366.1001492  ,  0053368.0997456  ,
Q    0055369.0995724  ,  0057369.0994924  ,  0059369.0994605  ,
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     P   0061369.0994510  ,  0063369.0994538  ,  0065367.0994631  ,
     S   0049390.1014121  ,  0051393.1003084  ,  0053395.0998053  ,
     T   0055397.0995831  ,  0057398.0994782  ,  0059400.0994317  ,
     U   0061400.0994150  ,  0063400.0994126  ,  0065400.0994185  ,
     V   0047408.1043395  ,  0049412.1017747  ,  0051416.1004863  ,
     W   0053419.0998796  ,  0055422.0996045  ,  0057425.0994730  ,
     X   0059427.0994116  ,  0061428.0993859  ,  0063429.0993783  ,
     Y   0065430.0993809  )
      DATA((KY(I),I=2725,2844)=
     1   0044053.1004004  ,  0045942.1002988  ,  0046930.1002594  ,
     2   0047919.1002472  ,  0048907.1002462  ,  0049894.1002516  ,
     3   0050882.1002611  ,  0051870.1002725  ,  0052857.1002877  ,
     4   0053344.1003027  ,  0054831.1003175  ,  0055818.1003338  ,
     5   0056804.1003500  ,  0057791.1003676  ,  0058777.1003832  ,
     6   0059763.1004002  ,  0045151.1007201  ,  0046144.1003252  ,
     7   0047137.1001278  ,  0048129.1000178  ,  0049122.0999596  ,
     8   0050114.0999261  ,  0051106.0999079  ,  0052098.0998985  ,
     9   0053090.0998954  ,  0054081.0998984  ,  0055072.0999070  ,
     A   0056063.0999156  ,  0057054.0999278  ,  0058045.0999416  ,
     B   0059035.0999552  ,  0060026.0999687  ,  0045267.1015067  ,
     C   0046263.1007596  ,  0047258.1003428  ,  0048253.1000949  ,
     D   0049248.0999469  ,  0050243.0998508  ,  0051237.0997863  ,
     E   0052232.0997456  ,  0053226.0997199  ,  0054220.0997029  ,
     F   0055214.0996960  ,  0056207.0996967  ,  0057201.0996994  ,
     G   0058194.0997075  ,  0059187.0997157  ,  0060180.0997272  ,
     H   0047344.1007642  ,  0048341.1003533  ,  0049338.1000932  ,
     I   0050335.0999134  ,  0051331.0997916  ,  0052327.0997054  ,
     J   0053323.0996434  ,  0054319.0996042  ,  0055315.0995795  ,
     K   0056310.0995649  ,  0057305.0995580  ,  0058300.0995569  )
      DATA((KY(I),I=2845,2956)=
     L   0059295.0995594  ,  0060290.0995655  ,  0047411.1013263  ,
     M   0048410.1007362  ,  0049408.1003505  ,  0050406.1000738  ,
     N   0051404.0998802  ,  0052401.0997401  ,  0053399.0996393  ,
     O   0054396.0995665  ,  0055393.0995201  ,  0056390.0994898  ,
     P   0057386.0994679  ,  0058383.0994573  ,  0059379.0994525  ,
     Q   0060375.0994513  ,  0047466.1019783  ,  0048466.1012162  ,
     R   0049465.1006936  ,  0050464.1003110  ,  0051463.1000369  ,
     S   0052462.0998365  ,  0053460.0996852  ,  0054459.0995764  ,
     T   0055457.0995026  ,  0056455.0994512  ,  0057453.0994158  ,
     U   0058450.0993922  ,  0059448.0993763  ,  0060445.0993696  ,
     V   0048513.1017750  ,  0049513.1011063  ,  0050513.1006110  ,
     W   0051513.1002460  ,  0052513.0999752  ,  0053513.0997710  ,
     X   0054512.0996242  ,  0055511.0995172  ,  0056510.0994426  ,
     Y   0057509.0993883  ,  0058507.0993515  ,  0059506.0993264  ,
     Z   0060504.0993106  ,  0048554.1023971  ,  0049555.1015737  ,
     1   0050556.1009631  ,  0051557.1005026  ,  0052557.1001590  ,
     2   0053558.0998958  ,  0054558.0997012  ,  0055558.0995626  ,
     3   0056558.0994610  ,  0057557.0993859  ,  0058557.0993324  ,
     4   0059556.0992961  ,  0060555.0992696  )
      DO 10 I=1,13
      IF(N.NE.NTAB(I)) GO TO 10
      MM=I
      GO TO 20
   10 CONTINUE
      CALL ABNORMAL
   20 I=OXODELT(MM)
```

```
      J=I+1
      IF(I.NE.2) GO TO 10
      I=1
      J=1
      GO TO 60
   10 IF(I.LE.NQ(MM)) GO TO 50
      I=NQ(1)
      J=NQ(1)
      GO TO 60
   50 Q1=I*QDELT(MM)
      Q2=(I+1)*QDELT(MM)
   60 L=1
      DO 100 IJ=I,J
      KY=Y*1000.+0.5
      K=(ISTART(IJ,MM))*2-1
      NN=ISTART(IJ+1,MM)-ISTART(IJ,MM)
      DO 70 NT=1,NN
      IF(KY.GT.KZ(K,M)) GO TO 69
      IF(NT.EQ.1) GO TO 68
      X1=KZ(K-2,M)/1000.
      X2=KZ(K,M)/1000.
      Y1=KZ(K-1,M)/1000000.
      Y2=KZ(K+1,M)/1000000.
      CALL INTERP(X,X1,X2,Y1,Y2,FACT(L))
      GO TO 90
   68 FACT(L)=KZ(K+1,M)/1000000.
      GO TO 90
   69 K=K+2
   70 CONTINUE
      FACT(L)=KZ(K-1,M)/1000000.
   90 L=2
  100 CONTINUE
      IF(I.EQ.J) GO TO 200
      CALL INTERP(Q,Q1,Q2,FACT(1),FACT(2),Y)
      FACTORAD=Y
      RETURN
  200 FACTORAD=FACT(1)
      RETURN
      END
```

PROGRAM VARIABLES

00455 R	FACT	00502 I	K	00034 I	NQ		
00461 I	I	00501 I	KX	00506 I	NT		
00474 I	IJ	00473 I	L	00440 I	NTAR		
00451 I	ISTART	00464 I	MM	00467 R	Q1		
00465 I	J	00505 I	NN				

DATA VARIABLES

00000 I	KK	05614 I	KY	00000 I	KZ

STATEMENT NUMBERS

10	00631	30	00665	60	00715	69	01024
20	00642	50	00703	68	01015	70	01030

EXTERNAL REFERENCES

APPROXIMAT INTERP

```
      SUBROUTINE ABDATA
      DIMENSION KK(2956),KY(2956)
      COMMON/DATA/KK,KY
      DATA((KK(I),I=1,170)=
     1  0055007,0999873  ,  0057007,0999883  ,  0059007,0999877  ,
     2  0061008,0999871  ,  0063008,0999865  ,  0065009,0999860  ,
     3  0067010,0999854  ,  0069010,0999849  ,  0071011,0999844  ,
     4  0055008,0999912  ,  0057000,0999997  ,  0059000,0999992  ,
     5  0061000,1000003  ,  0063000,0999997  ,  0065001,0999991  ,
     6  0067001,0999986  ,  0069001,0999981  ,  0071002,0999976  ,
     7  0055008,0999863  ,  0056998,1000039  ,  0058996,1000069  ,
     8  0060995,1000080  ,  0062995,1000074  ,  0064996,1000068  ,
     9  0066996,1000063  ,  0068996,1000058  ,  0070996,1000053  ,
     A  0055015,0999735  ,  0056997,1000059  ,  0058994,1000107  ,
     B  0060993,1000119  ,  0062992,1000129  ,  0064992,1000123  ,
     C  0066992,1000119  ,  0068992,1000112  ,  0070992,1000107  ,
     D  0055024,0999559  ,  0056997,1000049  ,  0058991,1000149  ,
     E  0060990,1000161  ,  0062990,1000155  ,  0064989,1000166  ,
     F  0066989,1000160  ,  0068989,1000155  ,  0070989,1000150  ,
     G  0055037,0999322  ,  0056998,1000031  ,  0058991,1000150  ,
     H  0060989,1000179  ,  0062988,1000190  ,  0064987,1000200  ,
     I  0066987,1000196  ,  0068987,1000189  ,  0070987,1000184  ,
     K  0055054,0999024  ,  0057001,0999990  ,  0058990,1000162  ,
     L  0060987,1000208  ,  0062986,1000219  ,  0064986,1000214  ,
     M  0066985,1000224  ,  0068985,1000219  ,  0070985,1000214  ,
     N  0055073,0998669  ,  0057004,0999928  ,  0058990,1000171  ,
     O  0060987,1000217  ,  0062986,1000229  ,  0064984,1000239  ,
     P  0066983,1000249  ,  0068983,1000244  ,  0070983,1000239  ,
     Q  0055095,0998274  ,  0057008,0999862  ,  0058991,1000159  ,
     R  0060985,1000239  ,  0062984,1000251  ,  0064983,1000262  ,
     S  0066983,1000257  ,  0068982,1000267  ,  0070981,1000261  ,
     T  0060985,1000243  ,  0062983,1000271  ,  0064982,1000282  ,
     U  0066981,1000277  ,  0068980,1000287  ,  0070980,1000281  )
      DATA((KK(I),I=171,346)=
     1  0052317,0993931  ,  0054074,0998602  ,  0056068,0998793  ,
     2  0058071,0998778  ,  0060077,0998711  ,  0062084,0998646  ,
     3  0064092,0998567  ,  0066100,0998490  ,  0054046,0999154  ,
     4  0055994,1000115  ,  0057985,1000265  ,  0059985,1000252  ,
     5  0061987,1000204  ,  0063991,1000141  ,  0065996,1000065  ,
     6  0054085,0998410  ,  0055966,1000599  ,  0057941,1001024  ,
     7  0059933,1001116  ,  0061932,1001103  ,  0063932,1001057  ,
     8  0065934,1000996  ,  0054172,0996828  ,  0055961,1000705  ,
     9  0057015,1001460  ,  0059900,1001677  ,  0061895,1001700  ,
     A  0063892,1001687  ,  0065892,1001642  ,  0054295,0994565  ,
     B  0055973,1000485  ,  0057903,1001696  ,  0059877,1002057  ,
     C  0061866,1002164  ,  0063862,1002153  ,  0065860,1002125  ,
     D  0054448,0991767  ,  0055990,1000010  ,  0057896,1001804  ,
     E  0059861,1002325  ,  0061845,1002503  ,  0063838,1002541  ,
     F  0065834,1002514  ,  0054624,0988580  ,  0056036,0999365  ,
     G  0057896,1001796  ,  0059850,1002513  ,  0061829,1002761  ,
     H  0063819,1002849  ,  0065813,1002838  ,  0054815,0985135  ,
     I  0056083,0998515  ,  0057903,1001671  ,  0059842,1002636  ,
     K  0061816,1002971  ,  0063803,1003094  ,  0065795,1003115  ,
     L  0055017,0981521  ,  0056141,0997488  ,  0057916,1001458  ,
     M  0059039,1002590  ,  0061807,1003128  ,  0053789,1003302  ,
```

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M    0065779.1003356  ,  0055223.0977854  ,  0056206.0996329  ,
N    0057033.1001149  ,  0059830.1002698  ,  0061799.1003258  ,
O    0063779.1003466  ,  0065766.1003553  ,  0056279.0995045  ,
P    0057055.1000780  ,  0059840.1002666  ,  0061793.1003347  ,
Q    0063770.1003607  ,  0065755.1003727  ,  0056359.0993622  ,
R    0057090.1000343  ,  0059845.1002582  ,  0061790.1003402  ,
S    0063762.1003720  ,  0065745.1003882  )
 DATA((KK(I),I=347,496)=
1    0060024.0999605  ,  0061014.0999768  ,  0062013.0999796  ,
2    0063012.0999809  ,  0064011.0999803  ,  0065012.0999814  ,
3    0066013.0999809  ,  0067013.0999804  ,  0068014.0999800  ,
4    0069014.0999795  ,  0070015.0999791  ,  0060047.0999212  ,
5    0061009.0999844  ,  0062001.0999988  ,  0062998.1000032  ,
6    0063997.1000044  ,  0064996.1000055  ,  0065997.1000050  ,
7    0066997.1000046  ,  0067996.1000056  ,  0068996.1000052  ,
8    0069997.1000047  ,  0060099.0998348  ,  0061018.0999699  ,
9    0061990.1000025  ,  0062991.1000135  ,  0063990.1000163  ,
A    0064989.1000174  ,  0065988.1000185  ,  0066987.1000196  ,
B    0067987.1000192  ,  0068987.1000187  ,  0069986.1000197  ,
C    0061036.0999412  ,  0062002.0999971  ,  0062990.1000162  ,
D    0063985.1000239  ,  0064983.1000265  ,  0065982.1000277  ,
E    0066981.1000288  ,  0067980.1000298  ,  0068980.1000294  ,
F    0069980.1000290  ,  0061061.0999004  ,  0062009.0999860  ,
G    0062990.1000165  ,  0063982.1000274  ,  0064979.1000317  ,
H    0065977.1000344  ,  0066976.1000355  ,  0067975.1000366  ,
E    0068975.1000362  ,  0069974.1000372  ,  0061093.0998483  ,
I    0062018.0999701  ,  0062992.1000122  ,  0063981.1000294  ,
K    0064977.1000354  ,  0065974.1000397  ,  0066973.1000408  ,
L    0067971.1000419  ,  0068970.1000430  ,  0069970.1000425  ,
M    0061132.0997838  ,  0062032.0999485  ,  0062996.1000067  ,
N    0063981.1000289  ,  0064975.1000380  ,  0065972.1000423  ,
O    0066970.1000450  ,  0067969.1000461  ,  0068967.1000472  ,
P    0069966.1000483  ,  0062050.0999196  ,  0063003.0999958  )
 DATA((KK(I),I=497,636)=
Q    0063983.1000260  ,  0064975.1000383  ,  0065971.1000442  ,
R    0066968.1000485  ,  0067966.1000496  ,  0068965.1000507  ,
S    0069964.1000510  ,  0062069.0998885  ,  0063010.0999843  ,
T    0063986.1000226  ,  0064975.1000381  ,  0065969.1000471  ,
U    0066967.1000498  ,  0067963.1000540  ,  0068962.1000551  ,
V    0069962.1000547  ,  0062091.0998538  ,  0063018.0999708  ,
W    0063989.1000171  ,  0064977.1000358  ,  0065969.1000464  ,
X    0066965.1000522  ,  0067963.1000549  ,  0068960.1000575  ,
Y    0069959.1000596  ,  0062115.0998156  ,  0063029.0999537  ,
Z    0063993.1000112  ,  0064977.1000347  ,  0065969.1000469  ,
1    0066964.1000543  ,  0067961.1000570  ,  0068959.1000596  ,
2    0069956.1000621  ,  0062142.0997722  ,  0063040.0999363  ,
3    0063998.1000035  ,  0064979.1000318  ,  0065970.1000456  ,
4    0066963.1000545  ,  0067960.1000587  ,  0068958.1000614  ,
5    0069955.1000639  ,  0062170.0997270  ,  0063052.0999171  ,
6    0064004.0999940  ,  0064982.1000271  ,  0065970.1000455  ,
7    0066964.1000530  ,  0067959.1000602  ,  0068957.1000629  ,
8    0069954.1000655  ,  0062202.0996753  ,  0063067.0998945  ,
9    0064011.0999327  ,  0064986.1000221  ,  0065972.1000422  ,
A    0066965.1000528  ,  0067959.1000600  ,  0068956.1000642  ,
B    0069953.1000668  ,  0062235.0996218  ,  0063082.0998701  ,
C    0064018.0999712  ,  0064989.1000170  ,  0065973.1000402  ,
```

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D     0066965.1000523  ,  0067958.1000611  ,  0068955.1000653  ,
E     0069952.1000679  )
 DATA((KK(I),I=637,754)=
F                        0054497.0990885  ,  0055036.0999340  ,
G     0056027.0999511  ,  0057025.0999554  ,  0058024.0999577  ,
H     0059026.0999566  ,  0060027.0999555  ,  0061027.0999560  ,
I     0062028.0999549  ,  0063029.0999538  ,  0064030.0999527  ,
J     0065031.0999517  ,  0066033.0999506  ,  0067034.0999496  ,
K     0068035.0999486  ,  0069036.0999476  ,  0070037.0999466  ,
L     0055050.0999090  ,  0056011.0999811  ,  0057002.0999963  ,
M     0057998.1000040  ,  0058995.1000081  ,  0059995.1000087  ,
N     0060994.1000093  ,  0061995.1000082  ,  0062995.1000071  ,
O     0063995.1000076  ,  0064996.1000066  ,  0065996.1000055  ,
P     0066997.1000045  ,  0067998.1000035  ,  0068998.1000025  ,
Q     0069999.1000015  ,  0055103.0998123  ,  0056016.0999721  ,
R     0056994.1000109  ,  0057985.1000258  ,  0058980.1000335  ,
S     0059978.1000359  ,  0060977.1000382  ,  0061976.1000387  ,
T     0062975.1000393  ,  0063976.1000382  ,  0064976.1000372  ,
U     0065976.1000362  ,  0066975.1000367  ,  0067976.1000356  ,
V     0068976.1000346  ,  0069974.1000337  ,  0055188.0996596  ,
W     0055934.0999396  ,  0056997.1000056  ,  0057980.1000348  ,
X     0058973.1000461  ,  0059968.1000537  ,  0060965.1000577  ,
Y     0061964.1000583  ,  0062963.1000589  ,  0063962.1000595  )
 DATA((KK(I),I=755,880)=
Z     0064961.1000600  ,  0065961.1000590  ,  0066961.1000580  ,
1     0067961.1000570  ,  0068960.1000574  ,  0069960.1000565  ,
2     0055294.0994681  ,  0056065.0998842  ,  0057007.0999882  ,
3     0057981.1000335  ,  0058969.1000519  ,  0059962.1000630  ,
4     0060957.1000705  ,  0061955.1000728  ,  0062953.1000750  ,
5     0063952.1000756  ,  0064951.1000762  ,  0065950.1000752  ,
6     0066949.1000757  ,  0067949.1000747  ,  0068949.1000737  ,
7     0069949.1000727  ,  0055430.0992242  ,  0056104.0998150  ,
8     0057022.0999606  ,  0057985.1000256  ,  0058968.1000545  ,
9     0059959.1000691  ,  0060952.1000784  ,  0061948.1000840  ,
A     0062946.1000863  ,  0063943.1000885  ,  0064942.1000891  ,
B     0065941.1000896  ,  0066941.1000886  ,  0067939.1000891  ,
C     0068939.1000882  ,  0069939.1000872  ,  0055598.0989241  ,
D     0056150.0997330  ,  0057043.0999237  ,  0057993.1000119  ,
E     0058971.1000498  ,  0059957.1000714  ,  0060949.1000840  ,
F     0061943.1000914  ,  0062940.1000954  ,  0063938.1000976  ,
G     0064935.1000990  ,  0065934.1001003  ,  0066932.1001009  ,
H     0067932.1000990  ,  0068931.1001004  ,  0069930.1000994  ,
I     0056206.0996336  ,  0057069.0998783  ,  0058005.0999915  ,
J     0058974.1000434  ,  0059957.1000719  ,  0060947.1000864  ,
K     0061949.1000971  ,  0062935.1001028  ,  0063932.1001066  )
 DATA((KK(I),I=881,970)=
L     0064929.1001088  ,  0065929.1001094  ,  0066926.1001100  ,
M     0067925.1001105  ,  0068924.1001095  ,  0069923.1001100  ,
N     0056267.0995261  ,  0057098.0998282  ,  0058019.0999664  ,
O     0058981.1000324  ,  0059959.1000679  ,  0060947.1000875  ,
P     0061938.1001000  ,  0062933.1001073  ,  0063928.1001128  ,
Q     0064925.1001151  ,  0065923.1001172  ,  0066921.1001178  ,
R     0067920.1001184  ,  0068918.1001189  ,  0069919.1001179  ,
S     0056334.0994073  ,  0057131.0997702  ,  0058037.0999369  ,
T     0058989.1000187  ,  0059962.1000629  ,  0060948.1000860  ,
U     0061938.1001003  ,  0062930.1001109  ,  0063924.1001181  ,
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     0064021.1001219  ,  0065918.1001241  ,  0066917.1001247  ,
     0067015.1001252  ,  0068013.1001258  ,  0069912.1001263  ,
     0056407.0993793  ,  0057169.0997044  ,  0058056.0999031  ,
     0058999.1000000  ,  0059968.1000538  ,  0060949.1000838  ,
     0061936.1001030  ,  0062928.1001137  ,  0063923.1001200  )
 DATA((KK(I),I=971,1100)=
     0064019.1001264  ,  0065915.1001286  ,  0066912.1001307  ,
     0067010.1001328  ,  0068908.1001333  ,  0069906.1001339  ,
     0056484.0991438  ,  0057310.0996310  ,  0058077.0998670  ,
     0059012.0999790  ,  0059974.1000441  ,  0060952.1000792  ,
     0061937.1001019  ,  0062928.1001143  ,  0063920.1001247  ,
     0064915.1001302  ,  0065912.1001340  ,  0066909.1001362  ,
     0067906.1001382  ,  0068904.1001388  ,  0069903.1001393  ,
     0056566.0989995  ,  0057254.0995558  ,  0058100.0998270  ,
     0059026.0999566  ,  0059981.1000321  ,  0060955.1000740  ,
     0061939.1001001  ,  0062928.1001143  ,  0063919.1001264  ,
     0064913.1001335  ,  0065909.1001373  ,  0066906.1001410  ,
     0067903.1001431  ,  0068900.1001452  ,  0069898.1001457  ,
     0057301.0994749  ,  0058126.0997831  ,  0059041.0999303  ,
     0059988.1000196  ,  0060959.1000669  ,  0061940.1000963  ,
     0062927.1001154  ,  0063918.1001276  ,  0064912.1001363  ,
     0065908.1001402  ,  0066903.1001454  ,  0067900.1001475  ,
     0068897.1001496  ,  0069895.1001501  ,  0056739.0986969  ,
     0057351.0993885  ,  0058154.0997354  ,  0059058.0999019  ,
     0059998.1000034  ,  0060964.1000592  ,  0061943.1000921  ,
     0062928.1001145  ,  0063918.1001283  ,  0064911.1001371  ,
     0065905.1001441  ,  0066901.1001479  ,  0067897.1001515  ,
     0068894.1001536  ,  0069892.1001542  )
 DATA((KK(I),I=1101,1250)=
     0053302.0994332  ,  0055327.0994086  ,  0057357.0993775  ,
     0059388.0993474  ,  0061420.0993167  ,  0063452.0992869  ,
     0065486.0992581  ,  0053049.0999083  ,  0055050.0999087  ,
     0057067.0998830  ,  0059087.0998529  ,  0061108.0998238  ,
     0063129.0997956  ,  0065152.0997666  ,  0052920.1001502  ,
     0054995.1001912  ,  0056898.1001785  ,  0058912.1001501  ,
     0060926.1001210  ,  0062942.1000927  ,  0064959.1000637  ,
     0052053.1002789  ,  0054790.1003836  ,  0056782.1003841  ,
     0058788.1003610  ,  0060798.1003319  ,  0062809.1003036  ,
     0064821.1002761  ,  0052822.1003372  ,  0054713.1005249  ,
     0056694.1005404  ,  0058693.1005228  ,  0060698.1004970  ,
     0062707.1004671  ,  0064715.1004397  ,  0052775.0966367  ,
     0052025.1003311  ,  0054656.1006288  ,  0056623.1006650  ,
     0058617.1006529  ,  0060619.1006289  ,  0062624.1006006  ,
     0064630.1005732  ,  0053445.0954244  ,  0052853.1002779  ,
     0054614.1007063  ,  0056567.1007651  ,  0058554.1007621  ,
     0060551.1007416  ,  0062553.1007150  ,  0064556.1006875  ,
     0053072.0944940  ,  0052903.1001832  ,  0054584.1007630  ,
     0056517.1008537  ,  0058500.1008545  ,  0060493.1008375  ,
     0062492.1008126  ,  0064494.1007851  ,  0054314.0938977  ,
     0052073.1000509  ,  0054561.1008043  ,  0056477.1009252  ,
     0058453.1009352  ,  0060443.1009218  ,  0062439.1008985  ,
     0064438.1008727  ,  0054518.0935474  ,  0053059.0998895  ,
     0054546.1008328  ,  0056444.1009858  ,  0058413.1010050  ,
     0060399.1009952  ,  0062391.1009753  ,  0064389.1009495  )
 DATA((KK(I),I=1251,1410)=
     0051349.0993290  ,  0053250.0995301  ,  0055257.0995343  ,
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2   0057280.0995106  ,  0059307.0994823  ,  0061336.0994515  ,
3   0063365.0994233  ,  0065396.0993944  ,  0051405.0992115  ,
4   0053041.0993221  ,  0054987.1000230  ,  0056985.1000255  ,
5   0058996.1000062  ,  0061012.0999805  ,  0063030.0999523  ,
6   0065049.0999249  ,  0051619.0988012  ,  0052984.1000293  ,
7   0054955.1002641  ,  0056823.1003117  ,  0058819.1003070  ,
8   0060826.1002866  ,  0062836.1002617  ,  0064847.1002359  ,
9   0051074.0983142  ,  0053009.0999838  ,  0054782.1003982  ,
A   0056719.1004951  ,  0058700.1005106  ,  0060697.1004991  ,
B   0062699.1004793  ,  0064705.1004551  ,  0052139.0978159  ,
C   0053082.0998460  ,  0054746.1004642  ,  0056650.1006181  ,
D   0058612.1006611  ,  0060600.1006603  ,  0062596.1006457  ,
E   0064597.1006233  ,  0052399.0973292  ,  0053183.0996555  ,
F   0054741.1004731  ,  0056601.1007043  ,  0058546.1007750  ,
G   0060523.1007884  ,  0062513.1007790  ,  0064509.1007615  ,
H   0052663.0968426  ,  0053308.0994225  ,  0054758.1004420  ,
I   0056568.1007634  ,  0058496.1008619  ,  0060461.1008915  ,
J   0062444.1008907  ,  0064436.1008750  ,  0052928.0963576  ,
K   0053445.0991681  ,  0054793.1003769  ,  0056551.1007941  ,
L   0058459.1009278  ,  0060411.1009752  ,  0062387.1009832  ,
M   0064374.1009725  ,  0053218.0958327  ,  0053592.0988945  ,
N   0054042.1002872  ,  0056545.1008055  ,  0058428.1009797  ,
O   0060369.1010452  ,  0062337.1010635  ,  0064320.1010578  ,
P   0053713.0949485  ,  0053745.0986134  ,  0054902.1001792  ,
Q   0056547.1008002  ,  0058405.1010186  ,  0060335.1011021  ,
R   0062295.1011310  ,  0064272.1011320  )
 DATA((KK(I),I=1411,1584)=
1   0057033.0999416  ,  0059025.0999571  ,  0061026.0999569  ,
2   0063027.0999565  ,  0065029.0999546  ,  0067032.0999528  ,
3   0069034.0999510  ,  0071036.0999493  ,  0073038.0999476  ,
4   0057036.0999372  ,  0059003.0999952  ,  0060998.1000035  ,
5   0062998.1000032  ,  0064998.1000029  ,  0066999.1000011  ,
6   0069000.0999993  ,  0071002.0999975  ,  0073003.0999958  ,
7   0057066.0998848  ,  0058996.1000065  ,  0060985.1000252  ,
8   0062981.1000299  ,  0064981.1000296  ,  0066980.1000293  ,
9   0068981.1000275  ,  0070982.1000259  ,  0072982.1000241  ,
A   0057116.0997964  ,  0058997.1000045  ,  0060976.1000386  ,
B   0062971.1000467  ,  0064969.1000481  ,  0066968.1000478  ,
C   0068967.1000475  ,  0070967.1000458  ,  0072968.1000441  ,
D   0057194.0996775  ,  0059003.0999946  ,  0060972.1000460  ,
E   0062963.1000591  ,  0064960.1000621  ,  0066958.1000634  ,
F   0068957.1000616  ,  0070956.1000614  ,  0072956.1000597  ,
G   0057265.0995370  ,  0059014.0999768  ,  0060971.1000472  ,
H   0062958.1000670  ,  0064952.1000733  ,  0066950.1000746  ,
I   0068949.1000743  ,  0070948.1000727  ,  0072947.1000724  ,
J   0057353.0993846  ,  0059029.0999503  ,  0060973.1000448  ,
K   0062954.1000730  ,  0064946.1000825  ,  0066944.1000839  ,
L   0068941.1000851  ,  0070941.1000834  ,  0072939.1000831  ,
M   0059048.0999190  ,  0060975.1000410  ,  0062951.1000776  ,
N   0064942.1000887  ,  0066938.1000932  ,  0068936.1000930  ,
O   0070934.1000927  ,  0072934.1000910  ,  0059070.0998815  ,
P   0060978.1000361  ,  0062950.1000794  ,  0064939.1000938  ,
Q   0066933.1000999  ,  0068930.1001012  ,  0070928.1001009  ,
R   0072928.1000993  ,  0057659.0988562  ,  0059096.0998382  ,
S   0060984.1000254  ,  0062950.1000788  ,  0064936.1000981  ,
T   0066929.1001057  ,  0068926.1001071  ,  0072922.1001066  )
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DATA((KK(I),I=1595,1754)=
1    0057294.0994874  ,  0058995.1000081  ,  0060988.1000202  ,
2    0062995.1000221  ,  0064984.1000238  ,  0066984.1000240  ,
3    0068983.1000241  ,  0070983.1000243  ,  0072982.1000244  ,
4    0074982.1000245  ,  0059018.0999698  ,  0060991.1000144  ,
5    0062987.1000212  ,  0064985.1000230  ,  0066983.1000247  ,
6    0068983.1000248  ,  0070982.1000250  ,  0072982.1000251  ,
7    0074981.1000252  ,  0059056.0999059  ,  0060998.1000033  ,
8    0062989.1000168  ,  0064986.1000218  ,  0066984.1000236  ,
9    0068983.1000252  ,  0070982.1000254  ,  0072981.1000255  ,
A    0074981.1000256  ,  0059107.0998183  ,  0061007.0998888  ,
B    0062992.1000124  ,  0064988.1000191  ,  0066985.1000224  ,
C    0068983.1000241  ,  0070982.1000256  ,  0072981.1000258  ,
D    0074981.1000259  ,  0061018.0999710  ,  0062997.1000046  ,
E    0064999.1000162  ,  0066986.1000211  ,  0068983.1000243  ,
F    0070983.1000245  ,  0072981.1000260  ,  0074980.1000261  ,
G    0061031.0999499  ,  0063002.0999969  ,  0064991.1000133  ,
H    0066987.1000198  ,  0068984.1000230  ,  0070982.1000246  ,
I    0072982.1000248  ,  0074980.1000263  ,  0061044.0999272  ,
J    0063007.0999891  ,  0064994.1000088  ,  0066988.1000185  ,
K    0068984.1000232  ,  0070982.1000249  ,  0072982.1000250  ,
L    0074980.1000265  ,  0061062.0998979  ,  0063013.0999797  ,
M    0064997.1000044  ,  0066990.1000156  ,  0068985.1000218  ,
N    0070983.1000235  ,  0072982.1000251  ,  0074981.1000253  ,
O    0061081.0998669  ,  0063020.0999687  ,  0065000.0999999  ,
P    0066990.1000142  ,  0068986.1000205  ,  0070983.1000236  ,
Q    0072982.1000252  ,  0074981.1000254  ,  0061102.0998327  ,
R    0063027.0999577  ,  0065003.0999954  ,  0066992.1000113  ,
S    0068987.1000192  ,  0070983.1000237  ,  0072981.1000253  ,
T    0074981.1000255  )
DATA((KK(I),I=1755,1994)=
1    0058976.0995262  ,  0059141.0997617  ,  0060131.0997814  ,
2    0061132.0997841  ,  0062136.0997818  ,  0063140.0997779  ,
3    0064144.0997756  ,  0065149.0997718  ,  0066153.0997681  ,
4    0067158.0997644  ,  0068163.0997607  ,  0069168.0997572  ,
5    0070173.0997536  ,  0058392.0993292  ,  0059096.0998382  ,
6    0060045.0999246  ,  0061034.0999441  ,  0062032.0999485  ,
7    0061034.0999441  ,  0062032.0999485  ,  0063033.0999478  ,
8    0064035.0999456  ,  0065038.0999418  ,  0066040.0999396  ,
9    0067043.0999359  ,  0068046.0999322  ,  0069049.0999287  ,
A    0070052.0999251  ,  0058570.0990260  ,  0059119.0997980  ,
B    0060014.0999766  ,  0060985.1000249  ,  0061976.1000392  ,
C    0062973.1000435  ,  0063973.1000429  ,  0064974.1000407  ,
D    0065975.1000385  ,  0066977.1000348  ,  0067979.1000312  ,
E    0068980.1000291  ,  0069982.1000256  ,  0058751.0987218  ,
F    0059182.0996918  ,  0060006.0999895  ,  0060958.1000683  ,
G    0061938.1000993  ,  0062932.1001085  ,  0063929.1001111  ,
H    0064928.1001105  ,  0065929.1001083  ,  0066929.1001062  ,
I    0067930.1001026  ,  0068932.1000990  ,  0069932.1000969  ,
J    0059368.0995482  ,  0060017.0999714  ,  0060945.1000908  ,
K    0061914.1001384  ,  0062903.1001559  ,  0063897.1001618  ,
L    0064894.1001628  ,  0065893.1001622  ,  0066893.1001601  ,
M    0067892.1001579  ,  0068894.1001544  ,  0069895.1001508  ,
N    0059764.0993869  ,  0060044.0999266  ,  0060940.1000982  ,
O    0061938.1001643  ,  0062879.1001916  ,  0063871.1002023  ,
P    0064867.1002050  ,  0065864.1002059  ,  0066864.1002038  ,
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0   0067063.1002017  ,  0068863.1001996  ,  0069863.1001961  ,
0   0059468.0992126  ,  0060081.0998650  ,  0060944.1000921  ,
0   0061039.1001799  ,  0062862.1002187  ,  0063851.1002328  ,
1   0064044.1002402  ,  0065841.1002412  ,  0066839.1002406  ,
U   0067038.1002385  ,  0068837.1002364  ,  0069836.1002344  ,
V   0059576.0990323  ,  0060126.0997901  ,  0059576.0990323  ,
    0060126.0997901  ,  0060955.1000743  ,  0061882.1001904  ,
X   0062051.1002375  ,  0063834.1002597  ,  0064826.1002687  ,
Y   0065021.1002713  ,  0066818.1002723  ,  0067817.1002702  ,
Z   0068015.1002682  ,  0069814.1002661  ,  0059686.0988506  ,
1   0060120.0997016  ,  0060971.1000477  ,  0061880.1001937  ,
2   0062041.1002524  ,  0063822.1002795  ,  0064811.1002918  ,
3   0065004.1002975  ,  0066801.1002985  ,  0067798.1002980  ,
4   0068795.1002974  ,  0069794.1002954  ,  0059795.0986700  ,
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 DATA((KK(I),I=1995,2142)=
6   0062036.1002611  ,  0063811.1002963  ,  0064797.1003133  ,
7   0065789.1003207  ,  0066784.1003232  ,  0067781.1003227  ,
8   0068778.1003222  ,  0069777.1003201  ,  0060304.0994952  ,
9   0061017.0999714  ,  0061889.1001789  ,  0062831.1002688  ,
A   0063802.1003105  ,  0064786.1003308  ,  0065776.1003398  ,
B   0066770.1003439  ,  0067766.1003449  ,  0068763.1003444  ,
C   0069760.1003438  ,  0060380.0993702  ,  0061048.0999210  ,
D   0061098.1001649  ,  0062828.1002729  ,  0063796.1003196  ,
E   0064777.1003447  ,  0065765.1003569  ,  0066758.1003626  ,
F   0067753.1003651  ,  0068749.1003646  ,  0069746.1003640  ,
G   0060463.0992340  ,  0061082.0998657  ,  0061909.1001476  ,
H   0062099.1002721  ,  0063791.1003269  ,  0064768.1003585  ,
I   0065755.1003722  ,  0066747.1003795  ,  0067741.1003820  ,
J   0068737.1003830  ,  0069733.1003825  ,  0060540.0991082  ,
K   0061118.0998073  ,  0061921.1001273  ,  0062831.1002682  ,
L   0063789.1003328  ,  0064762.1003676  ,  0065746.1003861  ,
M   0066736.1003949  ,  0067730.1003990  ,  0068725.1004000  ,
N   0069721.1003995  ,  0060613.0989881  ,  0061157.0997430  ,
O   0061039.1001008  ,  0062836.1002615  ,  0063783.1003405  ,
P   0064756.1003770  ,  0065739.1003971  ,  0066728.1004076  ,
Q   0067720.1004132  ,  0068714.1004157  ,  0069710.1004167  ,
R   0060687.0988672  ,  0061198.0996760  ,  0061956.1000717  ,
S   0062042.1002520  ,  0063783.1003409  ,  0064751.1003838  ,
T   0065732.1004071  ,  0066719.1004206  ,  0067711.1004263  ,
U   0068704.1004303  ,  0069699.1004313  )
 DATA((KK(I),I=2143,2352)=
1   0055323.0994158  ,  0057009.0999846  ,  0058987.1000212  ,
2   0060094.1000258  ,  0062984.1000253  ,  0064984.1000247  ,
3   0066095.1000227  ,  0068986.1000206  ,  0070987.1000187  ,
4   0057039.0999324  ,  0058967.1000559  ,  0060951.1000795  ,
5   0062046.1000857  ,  0064944.1000868  ,  0066943.1000847  ,
6   0068042.1000842  ,  0070942.1000822  ,  0057116.0997964  ,
7   0058070.1000507  ,  0060938.1001020  ,  0062927.1001165  ,
8   0064021.1001209  ,  0066919.1001204  ,  0068917.1001200  ,
9   0070015.1001194  ,  0057229.0995997  ,  0058988.1000195  ,
A   0060033.1001103  ,  0062915.1001350  ,  0064906.1001442  ,
B   0066003.1001454  ,  0068899.1001464  ,  0070898.1001444  ,
C   0057363.0993668  ,  0059013.0999773  ,  0060934.1001078  ,
D   0062009.1001443  ,  0064896.1001601  ,  0066890.1001643  ,
E   0068986.1001654  ,  0070883.1001649  ,  0057511.0991107  ,
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     0059051.0999128  ,  0060943.1000950  ,  0062906.1001499  ,
     0064899.1001706  ,  0066881.1001781  ,  0068876.1001807  ,
     0070872.1001802  ,  0057664.0988449  ,  0059099.0998324  ,
     0060054.1000747  ,  0062906.1001498  ,  0064884.1001786  ,
     0066871.1001893  ,  0068869.1001919  ,  0070863.1001930  ,
     0057623.0985771  ,  0059154.0997401  ,  0060969.1000509  ,
     0062906.1001493  ,  0064882.1001816  ,  0066868.1001970  ,
     0068860.1002027  ,  0070855.1002053  ,  0057981.0983076  ,
     0059315.0996365  ,  0060986.1000224  ,  0062911.1001411  ,
     0064890.1001848  ,  0066864.1002034  ,  0068854.1002121  ,
     0070849.1002147  ,  0058135.0980470  ,  0059282.0995237  ,
     0061006.0999895  ,  0062917.1001317  ,  0064879.1001867  ,
     0066861.1002085  ,  0068849.1002189  ,  0070842.1002229  ,
     0059253.0994051  ,  0061031.0999492  ,  0062926.1001182  ,
     0064879.1001862  ,  0066858.1002128  ,  0068845.1002247  ,
     0070837.1002303  ,  0058491.0940316  ,  0059429.0992778  ,
     0061658.0999048  ,  0062933.1001071  ,  0064881.1001834  ,
     0066856.1002140  ,  0068842.1002298  ,  0070833.1002354  ,
     0059507.0991486  ,  0061089.0998550  ,  0062941.1000938  ,
     0064883.1001800  ,  0066856.1002162  ,  0068840.1002328  ,
     0070829.1002414  ,  0059589.0990125  ,  0061121.0998015  ,
     0062954.1000736  ,  0064887.1001745  ,  0066856.1002155  ,
     0068837.1002367  ,  0070825.1002468  )
 DATA((KK(I),I=2363,2524)=
     0049590.0953371  ,  0049337.0993178  ,  0050573.1008436  ,
     0052421.1011054  ,  0054372.1011555  ,  0056350.1011529  ,
     0058338.1011340  ,  0060329.1011122  ,  0062320.1010909  ,
     0050371.0933070  ,  0050096.0978117  ,  0050767.1004585  ,
     0052302.1013337  ,  0054135.1015979  ,  0056068.1016621  ,
     0058030.1016708  ,  0060004.1016597  ,  0061982.1016419  ,
     0050754.0965448  ,  0051170.0996678  ,  0052384.1011767  ,
     0054359.1017400  ,  0055931.1019114  ,  0057866.1019593  ,
     0059823.1019680  ,  0061790.1019590  ,  0051357.0954103  ,
     0051654.0987330  ,  0052560.1008368  ,  0054064.1017318  ,
     0055963.1020351  ,  0057763.1021407  ,  0059703.1021730  ,
     0061658.1021763  ,  0051929.0943590  ,  0052104.0978806  ,
     0052790.1003973  ,  0054124.1016183  ,  0055838.1020815  ,
     0057699.1022542  ,  0059618.1023174  ,  0061561.1023367  ,
     0052390.0935295  ,  0052493.0971451  ,  0053042.0999217  ,
     0054224.1014305  ,  0055844.1020697  ,  0057662.1023207  ,
     0059657.1024221  ,  0061487.1024607  ,  0052838.0927358  ,
     0052868.0964672  ,  0053309.0994207  ,  0054354.1011886  ,
     0055076.1020120  ,  0057644.1023522  ,  0059515.1024954  ,
     0061429.1025569  ,  0053447.0916794  ,  0053212.0958429  ,
     0053680.0989170  ,  0054504.1009103  ,  0055926.1019201  ,
     0057643.1023548  ,  0059486.1025452  ,  0061385.1026315  ,
     0056057.0974114  ,  0053536.0952631  ,  0053852.0984179  ,
     0054669.1006054  ,  0055996.1017928  ,  0057655.1023325  ,
     0059469.1025737  ,  0061351.1026884  ,  0053848.0947112  ,
     0054123.0979257  ,  0054845.1002823  ,  0056080.1016402  ,
     0057679.1022838  ,  0059462.1025871  ,  0061326.1027303  )
 DATA((KK(I),I=2525,2614)=
     0045269.0994072  ,  0047114.0997576  ,  0049097.0998033  ,
     0051103.0997991  ,  0053115.0997830  ,  0055130.0997635  ,
     0057147.0997428  ,  0059165.0997210  ,  0061184.0997000  ,
     0063201.0996813  ,  0045221.0996615  ,  0045604.0986756  ,
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5    0047113.0997605  ,  0049000.1000003  ,  0050972.1000554  ,
6    0052066.1000637  ,  0054970.1000540  ,  0056979.1000372  ,
7    0058099.1000191  ,  0061000.0999997  ,  0063012.0999810  ,
8    0065025.0999612  ,  0047237.0994975  ,  0048997.1000068  ,
9    0050019.1001591  ,  0052892.1002044  ,  0054884.1002107  ,
A    0056094.1002034  ,  0058889.1001890  ,  0060896.1001715  ,
B    0062903.1001545  ,  0064911.1001363  ,  0047431.0990921  ,
C    0049045.0999092  ,  0050907.1001820  ,  0052853.1002786  ,
D    0054031.1003088  ,  0056822.1003130  ,  0058820.1003060  ,
E    0060022.1002921  ,  0062827.1002752  ,  0064832.1002587  ,
F    0047668.0985991  ,  0049120.0997373  ,  0050921.1001552  )
 DATA((KK(I),I=2615,2724)=
G    0052033.1003152  ,  0054795.1003733  ,  0056778.1003911  ,
H    0058770.1003915  ,  0060768.1003813  ,  0062769.1003679  ,
I    0064771.1003531  ,  0047931.0980577  ,  0049244.0995043  ,
J    0050058.1000832  ,  0052832.1003188  ,  0054775.1004108  ,
K    0056747.1004460  ,  0058732.1004558  ,  0060725.1004528  ,
L    0062723.1004412  ,  0064723.1004281  ,  0048207.0974970  ,
M    0049378.0992345  ,  0051010.0999797  ,  0052843.1002969  ,
N    0054764.1004305  ,  0056725.1004851  ,  0058703.1005062  ,
O    0060691.1005056  ,  0062695.1005022  ,  0064682.1004909  ,
P    0049530.0989298  ,  0051077.0998499  ,  0052864.1002566  ,
Q    0054763.1004320  ,  0056709.1005134  ,  0058680.1005458  ,
R    0060663.1005554  ,  0062654.1005526  ,  0064649.1005431  ,
S    0049696.0985987  ,  0051158.0996905  ,  0052896.1001963  ,
T    0054769.1004212  ,  0056701.1005277  ,  0058663.1005751  ,
U    0060641.1005921  ,  0062628.1005946  ,  0064620.1005885  ,
V    0049053.0958150  ,  0049875.0982452  ,  0051250.0995129  ,
W    0052036.1001212  ,  0054781.1003995  ,  0056698.1005331  ,
X    0058651.1005955  ,  0060623.1006217  ,  0062606.1006295  ,
Y    0064595.1006269  )
 DATA((KK(I),I=2725,2844)=
1    0045182.0995971  ,  0046139.0996990  ,  0047123.0997385  ,
2    0048120.0997500  ,  0049122.0997518  ,  0050127.0997464  ,
3    0051135.0997368  ,  0052143.0997253  ,  0053154.0997101  ,
4    0054165.0996950  ,  0055176.0996802  ,  0056189.0996638  ,
5    0057202.0996476  ,  0058215.0996299  ,  0059228.0996143  ,
6    0060243.0995972  ,  0045327.0992776  ,  0046151.0996724  ,
7    0047061.0998710  ,  0048009.0999819  ,  0048980.1000407  ,
8    0049963.1000747  ,  0050953.1000930  ,  0051947.1001026  ,
9    0052944.1001057  ,  0053945.1001027  ,  0054948.1000940  ,
A    0055952.1000852  ,  0056958.1000729  ,  0057966.1000589  ,
B    0058973.1000452  ,  0059981.1000316  ,  0045685.0985005  ,
C    0046353.0992384  ,  0047163.0996548  ,  0048046.0999041  ,
D    0048974.1000536  ,  0049925.1001508  ,  0050890.1002163  ,
E    0051866.1002576  ,  0052850.1002836  ,  0053838.1003009  ,
F    0054831.1003080  ,  0055828.1003073  ,  0056827.1003045  ,
G    0057829.1002962  ,  0058831.1002880  ,  0059835.1002763  ,
H    0047353.0992339  ,  0048171.0996443  ,  0049046.0999058  ,
I    0049956.1000875  ,  0050893.1002109  ,  0051845.1002984  ,
J    0052809.1003615  ,  0053784.1004013  ,  0054766.1004265  ,
K    0055754.1004414  ,  0056746.1004484  ,  0057740.1004496  )
 DATA((KK(I),I=2845,2956)=
L    0058737.1004470  ,  0059737.1004408  ,  0047630.0986776  ,
M    0048357.0992616  ,  0049174.0996470  ,  0050037.0999254  ,
N    0050938.1001211  ,  0051863.1002632  ,  0052807.1003656  ,
```

```
O    0053764.1004398  ,  0054733.1004871  ,  0055711.1005170  ,
P    0056694.1005403  ,  0057682.1005511  ,  0058674.1005561  ,
Q    0059667.1005573  ,  0047939.0980403  ,  0048590.0987860  ,
R    0049343.0993040  ,  0050157.0996867  ,  0051019.0999626  ,
S    0051914.1001653  ,  0052831.1003190  ,  0053769.1004296  ,
T    0054724.1005049  ,  0055690.1005574  ,  0056664.1005936  ,
U    0057644.1006177  ,  0058628.1006339  ,  0059618.1006408  ,
V    0048061.0982382  ,  0049548.0988946  ,  0050309.0993864  ,
W    0051127.0997520  ,  0051987.1000249  ,  0052877.1002318  ,
X    0053795.1003810  ,  0054732.1004901  ,  0055685.1005662  ,
Y    0056648.1006217  ,  0057620.1006593  ,  0058599.1006850  ,
Z    0059582.1007012  ,  0049158.0976448  ,  0049779.0984348  ,
1    0050487.0990363  ,  0051259.0994947  ,  0052084.0998396  ,
2    0053044.1001053  ,  0053837.1003027  ,  0054757.1004437  ,
3    0055695.1005473  ,  0056646.1006241  ,  0057609.1006789  ,
4    0058591.1007160  ,  0059557.1007432  )
 END

     DATA VARIABLES

  00000 I     KK              05614 I     KY

                    FORTRAN DIAGNOSTIC RESULTS  FOR    ABDATA

   COMPILED LENGTHS OF ABDATA   - P    00020    C    00000    D    13430
NO ERRORS
```

```
      FUNCTION FACTORA(DS,Q,N)
C FOR A GIVEN US AND DS,FACTORO IS ESTIMATED
      DIMENSION DDELT(7),NQ(7),ISTART(16,7),DBASE(7)
      DIMENSION KK(1084),FACT(2)
      DIMENSION NLTST(7)
      DATA(NLTST=2,7,4,3,10,20,19)
      DATA(DDELT=2.,2.,2.,2.,2.,1.,1.)
      DATA(NQ=8,9,8,8,6,16,15)
      DATA(ISTART=1,6,16,25,34,42,49,55,60,7(0),
     1            60,70,80,89,97,105,112,117,121,123,5(0),
     2            123,128,138,147,155,162,168,173,8(0),
     3            173,177,187,197,206,214,221,226,229,7(0),
     4            229,241,253,265,277,288,299,9(0),
     5            299,302,305,311,318,326,334,342,350,358,366,374,38
     1            390,398,406,414,
     6            414,422,430,438,446,454,462,470,478,486,494,502,51
     1            518,526,534,542)
      DATA(DBASE=61.,59.,57.,59.,56.,45.,45.)
      DATA((KK(I),I=1,118)=
     1   007325 .0273002,    010036 .0398527,    011260 .0532957,
     2   012276 .0651646,    012099 .0826452,    007657 .0261172,
     3   008769 .0456106,    010043 .0597403,    011205 .0713939,
     4   012451 .0803115,    013329 .0900258,    014141 .0989992,
     5   014737 .1081259,    015436 .1166030,    016055 .1245720,
     6   009154 .0436945,    009154 .0655418,    009910 .0807251,
     7   010861 .0913100,    011696 .1025919,    012286 .1139484,
     8   012907 .1231001,    013577 .1325723,    014070 .1421412,
     9   008333 .0480001,    009543 .0628700,    009543 .0838267,
     A   010331 .0967931,    010929 .1097953,    011417 .1226231,
     B   011831 .1352304,    012516 .1438087,    013075 .1529623,
     C   009676 .0691498,    008676 .0921997,    009936 .1006352,
     D   010757 .1115534,    010757 .1301456,    010757 .1487379,
     E   011379 .1581731,    011887 .1682409,    009024 .0886520,
     F   009024 .1108150,    010334 .1161154,    010334 .1354680,
     G   011137 .1430146,    011835 .1529867,    011835 .1689852,
     H   009375 .1066671,    009375 .1280005,    009375 .1493340,
     I   010736 .1490255,    010736 .1676537,    011622 .1720768,
     J   009729 .1233365,    009729 .1438926,    009729 .1644487,
     K   009729 .1850049,    011142 .1794943)
      DATA((KK(I),I=119,244)=
     1   009420 .0210747,    011353 .0352308,    012547 .0478172,
     2   013508 .0592210,    014236 .0702442,    014916 .0804478,
     3   015407 .0903395,    016021 .0998679,    016490 .1091552,
     4   016917 .1182216,    008614 .0232178,    009929 .0402849,
     5   010607 .0565640,    011602 .0689517,    012227 .0817862,
     6   012770 .0939641,    013315 .1051425,    013789 .1160348,
     7   014173 .1269993,    014531 .1376333,    008999 .0444485,
     8   009843 .0609557,    010766 .0743052,    011346 .0881362,
     9   011776 .1019005,    012271 .1140869,    012560 .1263810,
     A   013078 .1376315,    013422 .1490060,    009388 .0639098,
     B   010249 .0779062,    010821 .0924075,    011231 .1068389,
     C   011836 .1182773,    012075 .1325057,    012473 .1443015,
     D   012931 .1562272,    008781 .0613424,    008781 .0817899,
     E   010608 .0934707,    010698 .1121649,    011274 .1241734,
     F   011702 .1367293,    012044 .1494446,    012332 .1621798,
     G   010177 .0786018,    010177 .0982523,    010177 .1179027,
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H    011132 .1257583.    011132 .1437238.    011731 .1534286.
I    011731 .1704763.    010578 .1134397.    010578 .1323463.
J    010578 .1512529.    010578 .1701595.    011570 .1728542.
K    010982 .1274770.    010982 .1456880.    010982 .1638990.
L    010982 .1821100.    011390 .1500333.    011390 .1755926)
 DATA((KK(I),I=245,344)=
1    009251 .0216188.    010475 .0381844.    011465 .0523295.
2    012309 .0648850.    013190 .0758146.    008539 .0234208.
3    010244 .0390445.    011200 .0535680.    011842 .0675548.
4    012308 .0806576.    012924 .0928452.    013352 .1048510.
5    013740 .1164427.    014096 .1276895.    014425 .1386418.
6    008912 .0449815.    010091 .0594542.    010692 .0748211.
7    011276 .0886834.    011689 .1026544.    012107 .1156342.
8    012507 .1279217.    012827 .1403245.    013094 .1527332.
9    009238 .0645940.    010046 .0796298.    010518 .0950747.
A    010866 .1104364.    011376 .1230660.    011752 .1351432.
B    011910 .1511338.    012183 .1641573.    009668 .0827420.
C    009669 .1034275.    010457 .1147525.    010457 .1338780.
D    010969 .1461437.    011310 .1591471.    011599 .1724221.
E    010051 .0994852.    010051 .1193823.    010051 .1392793.
F    010051 .1591764.    010871 .1655680.    010871 .1839644.
G    010438 .1341238.    010438 .1532843.    010438 .1724449.
H    010439 .1916054.    010827 .1847120)
 DATA((KK(I),I=345,456)=
1    010025 .0199500.    010486 .0381429.    011023 .0544300.
2    010439 .0766315.    009648 .0207283.    009969 .0401224.
3    010101 .0588733.    010347 .0773169.    010481 .0954050.
4    010502 .1132901.    010688 .1309885.    010774 .1485003.
5    010853 .1658475.    010938 .1830104.    009569 .0208997.
6    009869 .0405276.    010145 .0591375.    010262 .0779660.
7    010305 .0961930.    010498 .1142974.    010584 .1322725.
8    010640 .1502228.    010716 .1679648.    010779 .1855348.
9    009919 .0403265.    010114 .0593221.    010313 .0775691.
A    010431 .0958621.    010516 .1141075.    010582 .1322926.
B    010603 .1497677.    010741 .1675711.    010905 .1850870.
C    010270 .0584219.    010270 .0778958.    010472 .0954901.
D    010502 .1132889.    010678 .1311054.    010745 .1488974.
E    010847 .1659319.    010898 .1836777.    010622 .0753099.
F    010622 .0941374.    010622 .1129649.    010831 .1292481.
G    010831 .1477121.    010956 .1642920.    010956 .1825467.
H    010976 .1093201.    010976 .1275402.    010976 .1457602.
I    010970 .1639802.    011193 .1786829.    011332 .1411859.
I    011332 .1588342.    011332 .1764824)
 DATA((KK(I),I=457,596)=
1    022309 .0224121.    030502 .0327847.    036467 .0411330.
2    041190 .0485669.    045004 .0555507.    048100 .0623692.
3    050670 .0690740.    053034 .0754232.    055499 .0810821.
4    058347 .0856931.    061871 .0888940.    066750 .0898876.
5    016351 .0306343.    021506 .0464981.    025749 .0582535.
6    029356 .0681284.    032474 .0769834.    035178 .0852805.
7    037638 .0929889.    039913 .1002165.    041968 .1072236.
8    043920 .1138433.    045727 .1202766.    047389 .1266104.
9    014157 .0353910.    018227 .0549632.    020828 .0720158.
A    023715 .0843349.    026195 .0954362.    028515 .1052062.
B    030505 .1143942.    032432 .1233350.    034154 .1317546.
C    035831 .1395421.    037370 .1471762.    038800 .1546356.
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D    011517 .0434140.    015883 .0629573.    018653 .0804137.
E    020876 .0950017.    022512 .1110478.    024294 .1234031.
F    025246 .1332509.    027842 .1436648.    029291 .1536309.
G    030743 .1626344.    032089 .1713959.    033428 .1794882.
H    014202 .0704115.    016678 .0899349.    018989 .1053193.
I    020537 .1211985.    022301 .1345217.    023328 .1500326.
J    024765 .1615145.    025970 .1732764.    027207 .1837753.
K    028448 .1933331.    029676 .2021776.    012679 .0788668.
L    014800 .1007347.    017487 .1143696.    019211 .1301327.
M    020536 .1460815.    022110 .1582962.    023382 .1710704.
N    024117 .1865862.    025098 .1992186.    026235 .2096435.
O    027228 .2203545)
 DATA((KK(I),I=597,896)=
1    113827 .0439261.    197972 .0505121.    271750 .0551976.
2    101741 .0491442.    177951 .0561952.    245536 .0610908.
3    096103 .0520272.    164285 .0608696.    226669 .0651757.
4    283355 .0705828.    336745 .0742399.    434735 .0805088.
5    087476 .0571592.    147858 .0676321.    205153 .0731159.
6    256809 .0778517.    304947 .0820083.    350634 .0855502.
7    204343 .0887552.    079436 .0629432.    137010 .0729873.
8    188254 .0792584.    230292 .0839305.    282992 .0883414.
9    325742 .0920973.    366730 .0954379.    405633 .0986113.
A    073964 .0676912.    120618 .0771494.    178290 .0841324.
B    224218 .0891987.    267110 .0935942.    307579 .0975159.
C    246600 .1009545.    383516 .1042980.    069644 .0717937.
D    122211 .0818251.    169815 .0883309.    212896 .0939424.
E    254015 .0984192.    292154 .1026854.    328733 .1064591.
F    365108 .1095326.    068247 .0732633.    117710 .0849542.
G    161204 .0920975.    209868 .0995963.    242050 .1032844.
H    279565 .1073095.    314826 .1111724.    348494 .1147795.
I    066064 .0756831.    111030 .0900246.    153573 .0976733.
J    193852 .1031872.    231490 .1079957.    267430 .1121789.
K    300338 .1165350.    333217 .1200418.    062853 .0795500.
L    104400 .0957118.    147943 .1013902.    184564 .1083048.
M    221240 .1129945.    256391 .1170086.    289039 .1210908.
N    319309 .1252394.    058209 .0858965.    102146 .0978985.
O    139778 .1073127.    177723 .1125345.    212479 .1176587.
P    245204 .1223071.    277518 .1261178.    307793 .1299572.
Q    051356 .0973586.    098659 .1013590.    135845 .1104200.
R    169542 .1179504.    209693 .1233393.    235051 .1276318.
S    266650 .1312581.    295955 .1351554.    053373 .0936788.
T    093660 .1067682.    136143 .1152572.    162253 .1232638.
U    195367 .1279638.    225782 .1328714.    255558 .1369550.
V    284793 .1404870.    055433 .0901986.    086560 .1155267.
W    125509 .1194942.    156909 .1274622.    186870 .1337823.
X    217270 .1380765.    245016 .1428474.    273185 .1464208.
Y    043432 .1151208.    083436 .1198512.    119012 .1260371.
Z    152187 .1314170.    181581 .1376796.    208844 .1436478.
1    237643 .1472795.    263328 .1519017.    045051 .1109852.
2    086545 .1155456.    114646 .1208368.    145517 .1374408.
3    174002 .1436104.    203208 .1476319.    230605 .1517747.
4    256787 .1557708)
 DATA((KK(I),I=897,964)=
1    097595 .0512370.    176874 .0568588.    317805 .0639315.
2    447607 .0670005.    564043 .0700165.    671706 .0744373.
3    766365 .0782917.    852275 .0831331.    091457 .0546703.
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     4    162320 .0615875,     294892 .0678213,     415316 .0722341,
     5    526477 .0759767,     620271 .0794569,     724445 .0828220,
     6    811795 .0862296,     883253 .0607874,     153537 .0651306,
     7    273460 .0731368,     385790 .0777624,     490878 .0814865,
     8    589546 .0848110,     682358 .0879303,     769501 .0909680,
     9    075915 .0650626,     142133 .0703565,     256493 .0779748,
     A    361705 .0829108,     462195 .0865435,     556980 .0897697,
     B    647255 .0926991,     732753 .0955301,     071135 .0792882,
     C    132639 .0748292,     242399 .0825084,     343779 .0872653,
     D    438816 .0911543,     520857 .0943650,     617619 .0971472,
     E    700242 .0999654,     060527 .0719140,     126195 .0792423,
     F    231150 .0865238,     327208 .0916846,     418456 .0955871,
     G    506750 .0986737,     592441 .1012759,     674773 .1037386,
     H    067051 .0745699,     121230 .0824878,     222917 .0897192,
     I    316244 .0948574,     406161 .0984829,     491618 .1017949,
     J    575479 .1042681,     658536 .1062963,     063447 .0788051,
     K    117355 .0852116,     210562 .0915072,     308153 .0973542,
     L    396501 .1008621,     479938 .1043975,     559540 .1072309,
     M    636747 .1099336,     050294 .0857712,     111721 .0895085,
     N    208306 .0950707,     294987 .1016994,     378111 .1057890)
      DATA((KK(I),I=965,1082)=
     O    456804 .1094369,     533913 .1125886,     606979 .1153252,
     P    060802 .0822341,     108203 .0924187,     198105 .1009562,
     Q    278943 .1075486,     357790 .1117973,     433312 .1153901,
     R    505347 .1187301,     575569 .1216186,     052936 .0944529,
     S    103145 .0969320,     186040 .1075037,     265814 .1128607,
     T    338435 .1181909,     411917 .1213835,     480746 .1248060,
     U    546605 .1280631,     055129 .0906953,     096104 .1040531,
     V    177758 .1125121,     252920 .1186145,     322194 .1241487,
     W    390447 .1280581,     450498 .1308647,     521630 .1341947,
     X    042195 .1185248,     093403 .1070620,     169531 .1179721,
     Y    241344 .1242933,     300993 .1294525,     371723 .1345086,
     Z    436502 .1374280,     498848 .1403233,     043871 .1139703,
     1    089509 .1116206,     161979 .1234727,     230295 .1302577,
     2    296079 .1350992,     358643 .1394142,     417994 .1435425,
     3    478160 .1463973,     045593 .1096643,     084331 .1185794,
     4    151500 .1319433,     220741 .1359054,     284476 .1406093,
     5    345366 .1447737,     403074 .1488557,     459805 .1522384,
     6    047353 .1055893,     077092 .1297147,     147746 .1353668,
     7    210911 .1422400,     273277 .1463714,     332653 .1503064,
     8    390108 .1538034,     444902 .1573380)
      DO 10 I=1,7
      IF(N.NE.NLIST(I)) GO TO 10
      M=I
      GO TO 20
   10 CONTINUE
      CALL ABNORMAL
   20 H=DPASE(M)-DDELT(M)
      T=(DS-H)/DDELT(M)
      J=T+1
      IF(T.NE.0) GO TO 30
      T=1
      J=1
      GO TO 60
   30 IF(J.LE.NO(M)) GO TO 50
      T=NO(M)
```

```
      J=NO(M)
      GO TO 50
   40 DS1=(I-1)*DDELT(M)+DBASE(M)
      DS2=(J-1)*DDELT(M)+DBASE(M)
   50 L=1
      DO 100 IJ=I,J
      KX=0*100.+0.5
      K=(ISTART(IJ,M))*2-1
      NN=(ISTART(IJ+1,M)-ISTART(IJ,M))
      DO 70 NT=1,NN
      IF(KX.GT.KK(K)) GO TO 69
      IF(NT.EQ.1) GO TO 68
      X1=KK(K-2)/100.
      X2=KK(K)/100.
      Y1=KK(K-1)/1000000.
      Y2=KK(K+1)/1000000.
      CALL INTERP(0,X1,X2,Y1,Y2,FACT(L))
      GO TO 90
   68 FACT(L)=KK(K+1)/1000000.
      GO TO 90
   69 K=K+2
   70 CONTINUE
      FACT(L)=KK(K-1)/1000000.
   90 L=2
  100 CONTINUE
      IF(I.EQ.J) GO TO 200
      CALL INTERP(DS,DS1,DS2,FACT(1),FACT(2),Y)
      FACTORA=Y
      RETURN
  200 FACTORA=FACT(1)
      RETURN
      END
```

PROGRAM VARIABLES

00207 R	DBASE	02340 R	H	02357 I	K		
00002	DDELT	02334 I	I	00225 I	KK		
02344 R	DS1	02351 I	IJ	02356 I	KX		
02346 R	DS2	00027 I	ISTART	02350 I	L		
02321 R	FACT	02342 I	J	02337 I	M		

STATEMENT NUMBERS

1 02462	30 02522	60 02556	69 02661
2 02473	50 02540	68 02654	70 02662

EXTERNAL REFERENCES

ABNORMAL INTERP

FORTRAN DIAGNOSTIC RESULTS FOR FACTORA

COMPILED LENGTHS OF FACTORA - R 02773 C 00000 D 00000
NO ERRORS

```
      FUNCTION DISCHRGE (JS,HWS,TWS,GO)
C
C*** SUBROUTINE TO COMPUTE DISCHARGE IN CFS OF STRUCTURE(JS) FOR
C*** SUBMERGED CONTROLLED FLOW ONLY
C
C JS...STRUCTURE CODE
C        JS=1...S-58
C        JS=2...S-57
C        JS=3...S-62
C        JS=4...S-59
C        JS=5...S-61
C        JS=6...S63A
C        JS=7...S-63
C        JS=8...S-66
C        JS=9...S-65
C        JS=10...S65A
C        JS=11...S65B
C        JS=12...S65C
C        JS=13...S65D
C        JS=14...S65E
C
C HWS..HEADWATER IN FT
C TWS..TAILWATER IN FT
C GO...GATE OPENING IN FT
C AL...GATE LENGTH IN FT
C DUNC..UNCORRECTED DISCHARGE FOR S-65 THRU S-65E
C
      DIMENSION C1(10), C2(10), C3(10), C4(10), C5(10), AL(10)
C
      DATA (C1=2(15.55936109),7.214,8.2933,4.9583,6.0,6.0,5.8587061,
     1 7.2444,4.27)
      DATA (C2=1.0,1.0,1.08,1.0,1.0,1.0,1.0,1.0,1.07,1.175)
      DATA (C3=2(.49629271),.492,.2295,.484,.5,.5,.5230012361,.2295,
     1 .494)
      DATA (C4=0.,0.,0.,17.28,18.585,0.,0.,0.,0.,0.)
      DATA (C5=0.,0.,0.,.2295,.484,0.,0.,0.,0.,0.)
      DATA (AL=1.,1.,14.,18.,27.,15.,15.,12.,18.,27.)
C
C
      IF (GO.LE.0) GO TO 800
      HW = HWS
      TW = TWS
      SIGN = +1.0
      IF (TW.LE.HW) GO TO 10
      TEMP = HW
      HW = TW
      TW = TEMP
      SIGN = -1.0
10    IS = JS
      DELTAH = HW - TW
      IF (IS.EQ.4.OR.IS.EQ.5) GO TO 500
      IF (IS.GE.9) GO TO 700
10    DISCHRGE = C1(IS) * AL(IS) * GO**C2(IS) * DELTAH**C3(IS)
      IF (C4(IS).EQ.0.) GO TO 750
      DISCHRGE = DISCHRGE - C4(IS) * DELTAH**C5(IS)
      GO TO 750
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```
 500  IF (GO.GE.1.0) IS = IS+5
      GO TO 100
C*** THE FOLLOWING COMPUTATION GIVES THE USGS CURVE FOR S-65 THRU S-
 700  IF (GO.LE.2.8) GO TO 710
      QUNC = (GO-0.666) / 0.001666
      GO TO 720
 710  QUNC = GO / 0.002236
 720  DISCHRGE = QUNC * 0.40237 * DELTAH**0.43357
 750  DISCHRGE = DISCHRGE * SIGN
      GO TO 900
 800  DISCHRGE = 0.
 900  RETURN
      END
```

PROGRAM VARIABLES

00146 R	A1	00052 R	C3	00210 R	DELTAH		
00002 R	C1	00076 R	C4	00177 R	HW		
00026 R	C2	00122 R	C5	00207 I	IS		

STATEMENT NUMBERS

10 00302	500 00363	710 00410	750 004
100 00327	700 00375	720 00413	

EXTERNAL REFERENCES

SYSTEM EXTERNALS ONLY

FORTRAN DIAGNOSTIC RESULTS FOR DISCHRGE

COMPILED LENGTHS OF DISCHRGE - R 00470 C 00000 D 00000
NO ERRORS

```
      FUNCTION STORGE (X,LAKE)
C
C FUNCTION STORGE COMPUTES LAKE STORAGE IN CUBIC FT FROM STAGE IN FE
C FUNCTION (ENTRY) STAGEE COMPUTES LAKE STAGE IN FT FROM STORAGE IN
C CUBIC FT.
C
      COMMON MAP(6,35), STGSTRUC(2,14), QLINK(19), LLINK(19),
     1 STGLAKES(14), LAKES(4), LINKS(3), STAGE(4), QINFL, NGATES(3),
     2 GO(6,3), STAGET, QCHAN(3), IDEBUG, HWS, TWS, T(2,260), LL(15)
     3 MONTH, QETN, STORCHAN(5), US, DS
C
      Y = X
      M = 1
      N = 2
50    J = LL(LAKE)
      K = LL(LAKE+1) - 1
      DO 100 I = J,K
      IF (Y.GE.T(M,I)) GO TO 100
      IF (I.EQ.J) CALL ABNORMAL
      CALL INTERP (Y,T(M,I-1),T(M,I),T(N,I-1),T(N,I),Z)
      GO TO (110,120), M
100   CONTINUE
      CALL ABNORMAL
110   STORGE = Z * 43560.
      RETURN
120   STORGE = Z
      RETURN
C
C
      ENTRY STAGEE
      Y = X / 43560.
      M = 2
      N = 1
      GO TO 50
      END
```

PROGRAM VARIABLES

00012 I	I	00011 I	K	00006 I	N		
00010 I	J	00004 I	M				

COMMON VARIABLES

02762 R	DS	00543 I	LINKS	00560 I	NGATES		
00563 R	GO	02724 I	LL	00631 R	QCHAN		
00640 R	HWS	00460 I	LLINK	02744 R	QETN		
00637 I	IDEBUG	00000 I	MAP	00556 R	QINFL		
00537 I	LAKES	02743 I	MONTH	00412 R	QLINK		

STATEMENT NUMBERS

50	00072	100	00152	110	00167	120	00170

EXTERNAL REFERENCES

ABNORMAL INTERP

FORTRAN DIAGNOSTIC RESULTS FOR STORGE

COMPILED LENGTHS OF STORGE - P 00235 C 02764 D 00000
```
```

```
USERCTRAN    (4,3) / MSOS 5.1                                    02/22/76          FA
      SUBROUTINE INTERP (X,X1,X2,Y1,Y2,Y)
C
C SUBROUTINE TO PERFORM LINEAR INTERPOLATION - GIVEN A VALUE X WHERE
C X1.LE.X AND X2.GE.X, A VALUE Y IS COMPUTED SUCH THAT Y.GE.Y1 AND Y.L
C
      DELX = X2 - X1
      DELY = Y2 - Y1
      PROP = (X-X1) / DELX
      Y = Y1 + PROP*DELY
      RETURN
      END

PROGRAM VARIABLES

00000 R    DELX          00002 R    DELY          00004 R    PROP

                 FORTRAN DIAGNOSTIC RESULTS  FOR    INTERP

  COMPILED LENGTHS OF INTERP   - P   00065   C   00000   D   00000
NO ERRORS
PAUS,**DISMOUNT MT 10 - MOUNT MT 0100**


EQUIP,01=MT
EQUIP,04=MT
FET,ROUTINES,DISCHARGEDATA,1024
OPEN,02
FET,ROUTINES,SIMULATEDSTAGES,512
ALLOCATE,5
OPEN,03
LOAD,25,M


 M 55          OVLAY  0     SEG   00     FILE  55

  SUBR
26317  CSPARES      26357  KEYBDC       26465  KEYBD        26545  RAAR
27150  FIXF         27210  FLOATF       27224  EXPF         27347  POWRF
30115  Q10ADRI      30302  CIO.MSIO     30663  CONTROL      32176  BCDINP
36477  TOPEN        36414  TREAD        36576  TRWE         37070  TCLOSE
37600  EXIT         37640  INTERP       37725  STORGE       40162  DISCHRGE
57315  FACTORAB     60456  FACTOR       63606  BACKWTR2     64203  BACKWATR
72315  ROUTING

  ENTR
43645  ABDATA       27137  ABSF         27137  ABS          27462  ALOG10
63761  BACKWTR2     33341  BCTARTON     33350  BCILJSON     30312  CIO.MSIO
26327  CSP.SW       64611  DBACK        40427  DISCHRGE     27075  ERRMES
27224  EXP          60127  FACTORAB     43315  FACTORA      63265  FACTOR
37405  FGET         27150  FIXF         37436  F.SPC        37440  F.USE
37225  FOPEN        37411  FPUT         27137  IABS         27150  IFIX
26361  KEYBDC       26465  KEYBD        26503  KEYBDS       66634  LAKEFLOW
27465  LOGF         33345  NORCTART     33353  NORCILJS     27347  POWRF
32367  RWRIRI       30203  Q10ADTR      30115  Q10ADRI      30147  Q10ADRX
30143  Q10DVRI      30177  Q10DVRX      30222  Q10DVXR      27670  Q10EXRI
30137  Q10MUDI      30173  Q10MUDX      30217  Q10MUXR      30214  Q10SBIR
30214  Q10SBXR      30225  Q10STIR      30236  Q10STRI      30253  Q10STRX
32211  QBQBCDMT     32001  QBQCONVT     31410  QBQEDBIN     31413  QBQEDITS
33663  QBQENTRY     30515  QBQEOERC     34176  QBQEOLST     26674  QBQERROR
3[illegible]  QBQFOTAB     33503  QBQTERMT     32055  QBQINEMS     32176  QBQINGIN
```

```
LAKES  2 12 13  1  LINKS   1   2 23 STAGE 63.8354 61.7686 52.2649 63.8907  STAGET= 63.8753 QCHAN= -160.4385 -145.9042 -650.5765  1 A
LAKES  1  3 13  2  LINKS   3   4 23 STAGE 63.8753 64.0028 52.2649 63.8354  STAGET= 63.9193 QCHAN=  160.4385  116.3450 -650.5765  1 A
LAKES  2  4 13  3  LINKS   5   6 23 STAGE 63.9193 63.9106 52.2649 64.0028  STAGET= 63.8290 QCHAN= -116.3450  155.9455 -650.5765  1 A
LAKES  3  5 13  4  LINKS   7   8 23 STAGE 63.8290 63.3971 52.2649 63.9106  STAGET= 63.9110 QCHAN= -155.9455         0 -650.5765  1 A
LAKES  4  6 13  5  LINKS   9  10 23 STAGE 63.9130 63.4001 52.2649 63.3971  STAGET= 63.4019 QCHAN=         -0 -102.0072 -650.5765  1 A
LAKES  5  7 13  6  LINKS  11  12 23 STAGE 63.4019 60.8404 52.2649 63.4001  STAGET= 63.3976 QCHAN=  102.0072  -49.3385 -650.5765  1 A
LAKES  6  8 13  7  LINKS  13  14 23 STAGE 63.3976 60.8276 52.2649 60.8404  STAGET= 60.8276 QCHAN=   49.3385   17.0837 -650.5765  1 A
LAKES  7  9 13  8  LINKS  15  16 23 STAGE 60.8276 57.9236 52.2649 60.8276  STAGET= 60.8154 QCHAN=  -17.0837 -145.4312 -650.5765  1 A
LAKES  8 10 13  9  LINKS  17  18 23 STAGE 60.8154 55.0600 52.2649 57.9236  STAGET= 57.9155 QCHAN=  165.4312 -621.3084 -650.5765  1 A
LAKES  9 11 13 10  LINKS  19  20 23 STAGE 57.9155 52.2711 52.2649 55.0600  STAGET= 55.0639 QCHAN=  621.3084 -390.4842 -650.5765  1 A
LAKES  1 11 13 12  LINKS  24  25 23 STAGE 63.8753 56.5000 52.2649 61.7686  STAGET= 61.7671 QCHAN=  145.9042 -193.5038 -650.5765  1 A
LAKES 10 12 13 11  LINKS  21  22 23 STAGE 55.0639 61.7671 52.2567 52.2711  STAGET= 52.2614 QCHAN=  390.4842  193.5038 -617.9054  1 A
LAKES 11 14 13 13  LINKS  26  27 23 STAGE 52.2614 52.2385 52.2567 52.2567  STAGET= 52.2505 QCHAN=  617.9054-1047.0869 -617.9054  1 A
LAKES 13  6 13 14  LINKS  28  29 23 STAGE 52.2505 46.6297 52.2567 52.2385  STAGET= 52.2341 QCHAN= 1047.0869-2279.5137 -617.9054  1 A
RIVER SEC -1  STRUCTURES  9 10  QCHAN= 2420.3769  US=46.62  DS=46.52  1 A
RIVER SEC -2  STRUCTURES 10 11  QCHAN= 2646.6609  US=40.97  DS=40.77  1 A
RIVER SEC -3  STRUCTURES 11 12  QCHAN= 2680.6448  US=34.19  DS=34.00  1 A
RIVER SEC -4  STRUCTURES 12 13  QCHAN= 3070.3031  US=24.46  DS=24.33  1 A
RIVER SEC -5  STRUCTURES 13 14  QCHAN= 3192.5255  US=19.58  DS=19.55  1 A
LAKES  2 12 13  1  LINKS   1   2 23 STAGE 63.8261 61.7420 52.2198 63.8475  STAGET= 63.8360 QCHAN= -122.1466  -99.1547 -657.9966  2 A
LAKES  1  3 13  2  LINKS   3   4 23 STAGE 63.8360 64.0036 52.2198 63.8261  STAGET= 63.9003 QCHAN=  122.1466  117.4976 -657.9966  2 A
LAKES  2  4 13  3  LINKS   5   6 23 STAGE 63.9003 63.9232 52.2198 64.0036  STAGET= 63.8334 QCHAN= -117.4976  158.1272 -657.9966  2 A
LAKES  3  5 13  4  LINKS   7   8 23 STAGE 63.8334 63.3885 52.2198 63.9232  STAGET= 63.9240 QCHAN= -158.1272         0 -657.9966  2 A
LAKES  4  6 13  5  LINKS   9  10 23 STAGE 63.9240 63.3838 52.2198 63.3885  STAGET= 63.3832 QCHAN=         -0  90.5949 -657.9966  2 A
LAKES  5  7 13  6  LINKS  11  12 23 STAGE 63.3832 60.7477 52.2198 63.3838  STAGET= 63.3779 QCHAN=  -90.5949  -74.6259 -657.9966  2 A
LAKES  6  8 13  7  LINKS  13  14 23 STAGE 63.3779 60.7400 52.2198 60.7477  STAGET= 60.7388 QCHAN=   74.6259  -44.0156 -657.9966  2 A
LAKES  7  9 13  8  LINKS  15  16 23 STAGE 60.7388 57.8658 52.2198 60.7400  STAGET= 60.7324 QCHAN=   44.0156 -166.4647 -657.9966  2 A
LAKES  8 10 13  9  LINKS  17  18 23 STAGE 60.7324 55.0850 52.2198 57.8658  STAGET= 57.8617 QCHAN=  166.4647 -425.7773 -657.9966  2 A
LAKES  9 11 13 10  LINKS  19  20 23 STAGE 57.8617 52.2260 52.2198 55.0850  STAGET= 55.0867 QCHAN=  425.7773 -435.4918 -657.9966  2 A
LAKES  1 11 13 12  LINKS  24  25 23 STAGE 63.8360 56.5000 52.2198 61.7420  STAGET= 61.7335 QCHAN=   99.1547 -192.8242 -657.9966  2 A
LAKES 10 12 13 11  LINKS  21  22 23 STAGE 55.0867 61.7335 52.2141 52.2260  STAGET= 52.2184 QCHAN=  435.4918  192.8242 -664.7850  2 A
LAKES 11 14 13 13  LINKS  26  27 23 STAGE 52.2184 52.1992 52.2141 52.2141  STAGET= 52.2097 QCHAN=  664.7850 -988.8710 -664.7850  2 A
LAKES 13  6 13 14  LINKS  28  29 23 STAGE 52.2097 46.5396 52.2141 52.1992  STAGET= 52.1941 QCHAN=  988.8710-2288.3522 -664.7850  2 A
RIVER SEC -1  STRUCTURES  9 10  QCHAN= 2409.2368  US=46.53  DS=46.44  2 A
RIVER SEC -2  STRUCTURES 10 11  QCHAN= 2542.7576  US=40.95  DS=40.76  2 A
RIVER SEC -3  STRUCTURES 11 12  QCHAN= 2590.6094  US=34.20  DS=34.02  2 A
RIVER SEC -4  STRUCTURES 12 13  QCHAN= 2964.8588  US=25.41  DS=25.49  2 A
RIVER SEC -5  STRUCTURES 13 14  QCHAN= 3030.6028  US=19.32  DS=19.30  2 A
LAKES  2 12 13  1  LINKS   1   2 23 STAGE 63.7874 61.6963 52.1836 63.8209  STAGET= 63.8063 QCHAN= -138.4099 -146.0368 -958.8340  3 A
LAKES  1  3 13  2  LINKS   3   4 23 STAGE 63.8063 63.9758 52.1836 63.7874  STAGET= 63.8659 QCHAN=  138.4099  117.7688 -958.8340  3 A
LAKES  2  4 13  3  LINKS   5   6 23 STAGE 63.8659 63.8978 52.1836 63.9758  STAGET= 63.8035 QCHAN= -117.7688  158.5537 -958.8340  3 A
LAKES  3  5 13  4  LINKS   7   8 23 STAGE 63.8035 63.3257 52.1836 63.8978  STAGET= 63.8982 QCHAN= -158.5537         0 -958.8340  3 A
LAKES  4  6 13  5  LINKS   9  10 23 STAGE 63.8982 63.3130 52.1836 63.3257  STAGET= 63.3109 QCHAN=         -0  85.9907 -958.8340  3 A
LAKES  5  7 13  6  LINKS  11  12 23 STAGE 63.3109 60.6525 52.1836 63.3130  STAGET= 63.3016 QCHAN=  -85.9907  -99.4663 -958.8340  3 A
LAKES  6  8 13  7  LINKS  13  14 23 STAGE 63.3016 60.6320 52.1836 60.6525  STAGET= 60.6312 QCHAN=   99.4663  -75.7903 -958.8340  3 A
LAKES  7  9 13  8  LINKS  15  16 23 STAGE 60.6312 57.8539 52.1836 60.6320  STAGET= 60.6115 QCHAN=   75.7903 -250.0628 -958.8340  3 A
LAKES  8 10 13  9  LINKS  17  18 23 STAGE 60.6115 55.0893 52.1836 57.8539  STAGET= 57.8612 QCHAN=  250.0628 -423.8727 -958.8340  3 A
LAKES  9 11 13 10  LINKS  19  20 23 STAGE 57.8612 52.1956 52.1836 55.0893  STAGET= 55.0884 QCHAN=  423.8727 -692.7263 -958.8340  3 A
LAKES  1 11 13 12  LINKS  24  25 23 STAGE 63.8063 56.5000 52.1836 61.6963  STAGET= 61.6945 QCHAN=  146.0368 -192.0483 -958.8340  3 A
LAKES 10 12 13 11  LINKS  21  22 23 STAGE 55.0884 61.6945 52.1811 52.1956  STAGET= 52.1941 QCHAN=  692.7263  192.0483 -955.7652  3 A
LAKES 11 14 13 13  LINKS  26  27 23 STAGE 52.1941 52.1608 52.1811 52.1811  STAGET= 52.1760 QCHAN=  955.7652-1149.3142 -955.7652  3 A
LAKES 13  6 13 14  LINKS  28  29 23 STAGE 52.1760 46.4331 52.1811 52.1608  STAGET= 52.1567 QCHAN= 1149.3142-2300.4288 -955.7652  3 A
RIVER SEC -1  STRUCTURES  9 10  QCHAN= 2601.5674  US=46.37  DS=46.26  3 A
RIVER SEC -2  STRUCTURES 10 11  QCHAN= 3057.6671  US=40.90  DS=40.66  3 A
RIVER SEC -3  STRUCTURES 11 12  QCHAN= 3439.4696  US=34.02  DS=33.80  3 A
RIVER SEC -4  STRUCTURES 12 13  QCHAN= 3672.2514  US=25.09  DS=24.86  3 A
RIVER SEC -5  STRUCTURES 13 14  QCHAN= 3852.4532  US=18.51  DS=18.44  3 A
LAKES  2 12 13  1  LINKS   1   2 23 STAGE 63.7488 61.6808 52.1513 63.7818  STAGET= 63.7672 QCHAN= -137.6193 -145.1294 -973.9106  4 A
LAKES  1  3 13  2  LINKS   3   4 23 STAGE 63.7672 63.9380 52.1513 63.7488  STAGET= 63.8270 QCHAN=  137.6193  117.7382 -973.9106  4 A
LAKES  2  4 13  3  LINKS   5   6 23 STAGE 63.8270 63.8627 52.1513 63.9380  STAGET= 63.7640 QCHAN= -117.7382  158.9758 -973.9106  4 A
LAKES  3  5 13  4  LINKS   7   8 23 STAGE 63.7640 63.2249 52.1513 63.8627  STAGET= 63.8627 QCHAN= -158.9758         0 -973.9106  4 A
LAKES  4  6 13  5  LINKS   9  10 23 STAGE 63.8627 63.2104 52.1513 63.2249  STAGET= 63.2090 QCHAN=         -0  85.6901 -973.9106  4 A
LAKES  5  7 13  6  LINKS  11  12 23 STAGE 63.2090 60.4921 52.1513 63.2104  STAGET= 63.1976 QCHAN=  -85.6901 -100.5293 -973.9106  4 A
LAKES  6  8 13  7  LINKS  13  14 23 STAGE 63.1976 60.4740 52.1513 60.4921  STAGET= 60.4726 QCHAN=  100.5293  -75.9276 -973.9106  4 A
LAKES  7  9 13  8  LINKS  15  16 23 STAGE 60.4726 57.8798 52.1513 60.4740  STAGET= 60.4568 QCHAN=   75.9276 -239.8083 -973.9106  4 A
LAKES  8 10 13  9  LINKS  17  18 23 STAGE 60.4568 55.0822 52.1513 57.8798  STAGET= 57.8796 QCHAN=  239.8083 -426.6085 -973.9106  4 A
LAKES  9 11 13 10  LINKS  19  20 23 STAGE 57.8796 52.1633 52.1513 55.0822  STAGET= 55.0813 QCHAN=  426.6085 -605.5256 -973.9106  4 A
LAKES  1 11 13 12  LINKS  24  25 23 STAGE 63.7672 56.5000 52.1513 61.6808  STAGET= 61.6784 QCHAN=  145.1294 -191.7254 -973.9106  4 A
LAKES 10 12 13 11  LINKS  21  22 23 STAGE 55.0813 61.6784 52.1487 52.1633  STAGET= 52.1618 QCHAN=  695.5256  191.7254 -959.5128  4 A
LAKES 11 14 13 13  LINKS  26  27 23 STAGE 52.1618 52.1269 52.1487 52.1487  STAGET= 52.1428 QCHAN=  959.5128-1171.1036 -959.5128  4 A
LAKES 13  6 13 14  LINKS  28  29 23 STAGE 52.1428 46.0137 52.1487 52.1269  STAGET= 52.1225 QCHAN= 1171.1036-2366.3070 -959.5128  4 A
RIVER SEC -1  STRUCTURES  9 10  QCHAN= 2570.6954  US=45.87  DS=45.86  4 A
RIVER SEC -2  STRUCTURES 10 11  QCHAN= 2973.5399  US=40.65  DS=40.41  4 A
RIVER SEC -3  STRUCTURES 11 12  QCHAN= 3206.6064  US=33.70  DS=33.47  4 A
RIVER SEC -4  STRUCTURES 12 13  QCHAN= 3511.2726  US=24.77  DS=24.55  4 A
RIVER SEC -5  STRUCTURES 13 14  QCHAN= 3483.8359  US=18.21  DS=18.16  4 A
LAKES  2 12 13  1  LINKS   1   2 23 STAGE 63.7156 61.5716 52.1230 63.7417  STAGET= 63.7273 QCHAN= -125.8149 -147.8254-1061.4986  5 A
LAKES  1  3 13  2  LINKS   3   4 23 STAGE 63.7273 63.9015 52.1230 63.7156  STAGET= 63.7910 QCHAN=  125.8149  117.6412-1061.4986  5 A
LAKES  2  4 13  3  LINKS   5   6 23 STAGE 63.7910 63.8247 52.1230 63.9015  STAGET= 63.7282 QCHAN= -117.6412  158.8198-1061.4986  5 A
LAKES  3  5 13  4  LINKS   7   8 23 STAGE 63.7282 63.1140 52.1230 63.8247  STAGET= 63.8247 QCHAN= -158.8198         0-1061.4986  5 A
LAKES  4  6 13  5  LINKS   9  10 23 STAGE 63.8247 63.0977 52.1230 63.1140  STAGET= 63.0969 QCHAN=         -0  85.3571-1061.4986  5 A
LAKES  5  7 13  6  LINKS  11  12 23 STAGE 63.0969 60.3425 52.1230 63.0977  STAGET= 63.0836 QCHAN=  -85.3571 -101.1919-1061.4986  5 A
LAKES  6  8 13  7  LINKS  13  14 23 STAGE 63.0836 60.3221 52.1230 60.3425  STAGET= 60.3238 QCHAN=  101.1919  -68.6535-1061.4986  5 A
LAKES  7  9 13  8  LINKS  15  16 23 STAGE 60.3238 57.8694 52.1230 60.3221  STAGET= 60.3036 QCHAN=   68.6535 -233.0382-1061.4986  5 A
LAKES  8 10 13  9  LINKS  17  18 23 STAGE 60.3036 55.0745 52.1230 57.8694  STAGET= 57.8671 QCHAN=  233.0382 -426.4181-1061.4986  5 A
LAKES  9 11 13 10  LINKS  19  20 23 STAGE 57.8671 52.1400 52.1230 55.0745  STAGET= 55.0735 QCHAN=  426.4181 -696.6301-1061.4986  5 A
LAKES  1 11 13 12  LINKS  24  25 23 STAGE 63.7273 56.5000 52.1230 61.5716  STAGET= 61.5568 QCHAN=  147.8254 -278.2293-1061.4986  5 A
LAKES 10 12 13 11  LINKS  21  22 23 STAGE 55.0735 61.5568 52.1191 52.1400  STAGET= 52.1351 QCHAN=  694.6301  278.2293-1050.1868  5 A
LAKES 11 14 13 13  LINKS  26  27 23 STAGE 52.1351 52.0946 52.1191 52.1191  STAGET= 52.1152 QCHAN= 1050.1868-1320.3949-1050.1868  5 A
LAKES 13  6 13 14  LINKS  28  29 23 STAGE 52.1152 45.9025 52.1191 52.0946  STAGET= 52.0907 QCHAN= 1320.3949-2379.6101-1050.1868  5 A
RIVER SEC -1  STRUCTURES  9 10  QCHAN= 2379.9589  US=45.93  DS=45.83  5 A
RIVER SEC -2  STRUCTURES 10 11  QCHAN= 2589.7861  US=40.49  DS=40.29  5 A
RIVER SEC -3  STRUCTURES 11 12  QCHAN= 2777.8586  US=33.42  DS=33.22  5 A
RIVER SEC -4  STRUCTURES 12 13  QCHAN= 2828.3182  US=24.38  DS=24.25  5 A
RIVER SEC -5  STRUCTURES 13 14  QCHAN= 2889.6875  US=18.28  DS=18.26  5 A
    1  6388  6384  6381  6377  6373
```

DISTRIBUTION OF M)ITTUDES
OF ABSOLUTE DIFFERENCE BETWEEN SIMULATED AND RECORDED STAGES
FOR THE KISSIMMEE RIVER BASIN
(NUMBER OF TIMES IN A YEAR)

JLUTE	S-58		S-57		S-62		S-59		S-61		S-63		S-60		S-65		S65E	
F D (FT)	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW
≥0≥0	120	56	18	4	0	146	146	0	0	3	65	601	17	95	54	93	3	-
≥0>.10	28	3	6	4	0	35	83	0	2	2	59	261	3	48	23	59	1	-
≥0>.15	9	3	3	6	0	41	70	24	15	14	27	230	20	43	24	44	2	-
≥0>.20	15	3	13	5	4	14	32	50	9	16	67	379	5	46	21	30	3	-
≥0>.25	11	3	2	3	4	44	84	32	19	4	29	235	4	53	32	29	10	-
≥0>.30	16	3	10	1	6	73	87	37	30	2	26	194	42	74	19	28	8	-
≥0>.35	26	3	11	4	3	107	31	13	27	3	35	151	21	100	29	22	2	-
≥0>.40	29	3	9	32	3	89	6	10	40	14	42	90	18	91	29	18	2	-
≥0>.45	530	224	34	714	26	590	123	403	233	65	669	615	253	950	299	246	24	-
VE 1.0	2135	2619	2814	2147	2874	1781	2256	2351	2545	2797	1902	164	2537	1420	2390	2351	2865	-

PROGRAM DESCRIPTION FOR THE GRAPH PROGRAM (E098)

PROGRAM DESCRIPTION

This program is designed to compare the output of the operational water quantity model with recorded information. Specifically, the simulated stages of the lakes of the upper Kissimmee are plotted along with available historical stages for one year, 1970. It is to be noted that the program is set up to compare only the stages of the 14 lakes of the upper Kissimmee. Comparative plots for the lower Kissimmee are separately prepared, although the program can be modified to include that aspect (if required).

INPUT CARDS

This program requires one input card:

Col. 1-4	Simulation Year - 4 digits

FILE FORMATS

There is one input tape to this program (logical unit 04) which is generated by program ROUTING (E097). The format of this input file is given in the E097 Program Documentation.

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 Computer (Program requires 10K + operating system).
1 405 ASCII card reader
1 854 disk drive (for the operating system)
1 line printer
1 CALCOMP 12" or 30" plotter
1 7 track magnetic tape drive

PROGRAM E098

PROGRAMMER: Paul Berger
Ashok Shahane

PURPOSE: Generate CALCOMP plots of simulated and historical stages for the Kissimmee River Basin.

DISKS: 3000

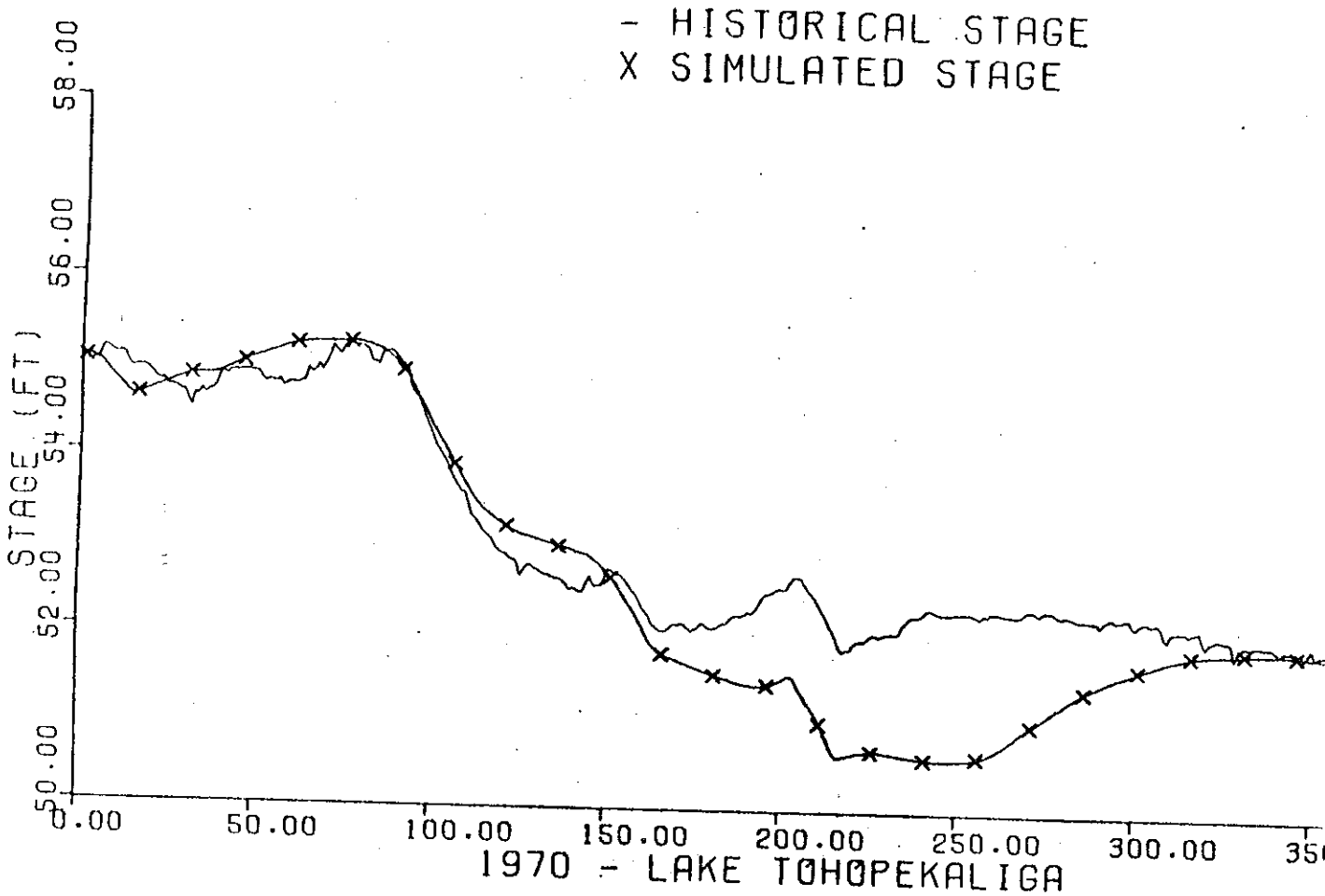
CONTROL CARDS:

```
$JOB, 8430-305, E098, 5
$EQUIP, 04 = MT
$RONL, 854/6000
$FET, E098, GRAPH, 960
$OPEN, 25
$LOAD, 25
$RUN
```

CARD INPUT: One card - year in columns 1-4.

ERROR STOPS: None

TIMING: 5 minutes


- HISTORICAL STAGE
X SIMULATED STAGE
STAGE (FT)
58.00
56.00
54.00
52.00
50.00
0.00
50.00
100.00
150.00
200.00
250.00
300.00
1970 - LAKE TOHOPEKALIGA

```
      PROGRAM GRAPH
C
C PROGRAM TO GENERATE CALCOMP PLOTS OF SIMULATED STAGES FOR LAKES OF
C THE KISSIMMEE RIVER BASIN AND HISTORICAL STAGES FOR THE ONE YEAR
C ROUTING PERIOD.  HISTORICAL STAGES ARE PLOTTED ONLY FOR THOSE LAKES
C WHERE DATA IS AVAILABLE - ALLIGATOR, MARY JANE, E.TOHOPEKALIGA,
C TOHOPEKALIGA, CYPRESS, GENTRY, AND KISSIMMEE.
C INPUT TAPE (LUN 4) IS TAPE 04 OUTPUT FROM PROGRAM E097.
C PROGRAM WAS DEVELOPED BY PAUL BERGER AND ASHOK SHAHANE.
C
      DIMENSION IBUF(135), IREC(5), SIM(367), HIST(367), IHIST(7)
      DIMENSION JREC(31), IDAYS(12), X(367), ITEXT(5), MTEXT(5)
      DIMENSION LABY(3)
      DIMENSION LAKES(3,14), LABX(6)
      DATA (IHIST=1,7,9,10,11,12,14)
      DATA (IDAYS=31,28,31,30,31,30,31,31,30,31,30,31)
      DATA (ITEXT=18H- HISTORICAL STAGE)
      DATA (MTEXT=17HX SIMULATED STAGE)
      DATA (LABX=12H**** - LAKE )
      DATA (LABY=10HSTAGE (FT))
      DATA (LAKES=12HALLIGATOR    ,
     1            12HLIZZIE       ,
     2            12HCOON         ,
     3            12HTROUT        ,
     4            12HJOEL         ,
     5            12HMYRTLE       ,
     6            12HMARY JANE    ,
     7            12HHART         ,
     8            12HE. TOHOPEK.  ,
     9            12HTOHOPEKALIGA,
     A            12HCYPRESS      ,
     B            12HGENTRY       ,
     C            12HHATCHINEHA   ,
     D            12HKISSIMMEE    )
C
C READ IN YEAR FOR WHICH STAGES ARE BEING PLOTTED
C
      READ (60,2) LABX(1)
 2    FORMAT (A4)
      CALL TOPEN (IBUF,4,25,25,5)
C
C INITIALIZE X ARRAY (TIME SCALE)
C
      DO 10 I = 1,365
      X(I) = I
 10   CONTINUE
      CALL PLOTS(0,0,0)
      CALL OFFSET (0.,1.,-5.5,1.)
C
C LOOP ON 14 LAKES OF THE UPPER KISSIMMEE RIVER BASIN
C
      DO 800 I = 1,14
C
C LOOP ON 73 RECORDS FOR EACH LAKE (5 WORDS PER RECORD FOR A TOTAL OF
C 365 DAILY STAGES)
C
```

```
      DO 100 J = 1,73
      CALL TREAD (IBUF,IREC,IEOF)
C
C UNSCALE STAGES AND STORE IN ARRAY SIM
C
      DO 50 K = 1,5
      L = 5*(J-1) + K
      SIM(L) = IREC(K) / 100.
 50   CONTINUE
 100  CONTINUE
      IFLAG = 0
C
C CHECK IF THERE IS HISTORICAL DATA FOR LAKE I
C
      DO 200 J = 1,7
      IF (IHIST(J).EQ.I) GO TO 300
 200  CONTINUE
      GO TO 500
C
C HISTORICAL DATA EXISTS FOR LAKE I, SET PLOT FLAG AND READ HISTORICAL
C STAGES INTO ARRAY HIST
C
 300  IH = 0
      IFLAG = 1
      DO 400 J = 1,12
      READ (60,1) JREC
 1    FORMAT (14X10I6/14X10I6/14X11I6)
      N = IDAYS(J)
      DO 320 K = 1,N
      IF (JREC(K).EQ.0) JREC(K) = JREC(K-1)
      IH = IH + 1
      HIST(IH) = JREC(K) / 100.
 320  CONTINUE
 400  CONTINUE
C
C SET UP SCALING PARAMETERS FOR TIME SCALE AND STAGE SCALE
C
 500  CALL SCALE (X,8.0,365,1)
      CALL SCALE (SIM,4.0,365,1)
      HIST(366) = SIM(366)
      HIST(367) = SIM(367)
C
C PLOT STAGE SCALE AXIS
C
      CALL AXIS (0.,0.,LABY,10,4.0,90.0,SIM(366),SIM(367))
C
C SET UP LAKE NAME FOR TIME SCALE AXIS AND PLOT AXIS
C
      LABX(4) = LAKES(1,I)
      LABX(5) = LAKES(2,I)
      LABX(6) = LAKES(3,I)
      CALL AXIS (0.,0.,LABX,-24,8.,0.,X(366),X(367))
C
C PLOT SIMULATED STAGES VS TIME
C
      CALL LINE (X,SIM,365,1,15,4)
```

```
C
C IF PLOT FLAG IS SET, PLOT HISTORICAL STAGES VS TIME AND IDENTIFY THE
C CURVE
C
      IF (IFLAG.EQ.1) CALL LINE (X,HIST,365,1,0,0)
      IF (IFLAG.EQ.1) CALL SYMBOL (3.0,4.4,.15,ITEXT,0.,18)
C
C IDENTIFY THE SIMULATED STAGES CURVE
C
      CALL SYMBOL (3.0,4.15,.15,MTEXT,0.,17)
C
C OFFSET EVEN NUMBERED PLOTS 5.5 INCHES IN THE Y PLOTTER DIRECTION
C
      CALL OFFSETRV
      IF ((I/2*2).EQ.I) CALL PLOT (11.,0.,-3)
  800 CONTINUE
      CALL PLOT (0.,0.,999)
      CALL TCLOSE (IBUF,-1)
      CALL EXIT
      END
```

PROGRAM VARIABLES

01562	R	HIST	04665	I	IFLAG	04540	I	ITEXT	04
04643	I	I	04667	I	IH	04656	I	J	04
00010	I	IBUF	03120	I	IHIST	03127	I	JREC	04
03166	I	IDAYS	00217	I	IREC	04661	I	K	04
04660	I	IEOF							

STATEMENT NUMBERS

1	00001	10	05010	100	05073	300	05125
2	00000	50	05064	200	05115	320	05174

EXTERNAL REFERENCES

AXIS	OFFSET	PLOTS
EXIT	OFFSETRV	SCALE
LINE	PLOT	

FORTRAN DIAGNOSTIC RESULTS FOR GRAPH

```
   COMPILED LENGTHS OF GRAPH    - P   05416   C   00000   D   00000
NO ERRORS


EQUIP,04=MT
LOAD,56,M


 M 55          OVLAY  0    SEG   00    FILE  55

   SUBR
55233  CSPARGS     55273  KEYBDC      55401  KEYBD       55461  RAAR
56160  ABSF        56171  FLOATF      56205  FIXF        56245  EXPF
56670  LOGF        57070  XTOI        57323  SINCOS      57632  CIO.MSIO
62451  FORMAT      63067  BCDINP      64474  TOPEN       65011  TREAD
65575  RSOC        65622  EQUIPIT     66355  FCDPLOT     67454  EXIT
70755  NUMBER      71355  AXIS        72222  GRAPH
```

PROGRAM DESCRIPTION FOR THE SDATA PROGRAM (E099)

PROGRAM DESCRIPTION

This program is part of a system of programs (Figure 1) which deals with water quantity in the Kissimmee River Basin. The purpose of this program is to generate a magnetic tape containing headwater and tailwater stages and up to 6 gate openings for a structure at 3 hour intervals for a period of one year.

In order to generate average values at every 3 hour time step, it would have been necessary to write a program to read paper tape and/or cards containing break point data, and convert this data to the 3 hour intervals. Since a program already existed (E040) which generates 12 minute interval data, the task of generating 3 hour interval data was considerably simplified. Program E049 (another existing program) is used to check paper tapes for errors. Then program E040 is run to generate 12 minute interval data. Finally E099 reads the disk files (created by E040) and generates 3 hour average values for a single structure.

The ROUTING program (E097) requires an ordered tape containing data for 14 structures. The procedure used was to run SDATA (E099) once for each of the 14 structures, and write another program MERGE (E100) to combine the 14 tapes output from SDATA into a single ordered tape.

INPUT CARDS

There is one input card required by this program:

Columns	1-4	Structure name
Columns	6-9	Data year (four digits)
Columns	11	Number of gates at this structure

FILE FORMATS

This program requires 2, 4, or 6 disk input files, depending on the number of gates at the structure. It generates one magnetic tape output file (logical unit 15).

The input files are generated by program E040. The two file names are called KOUNT (LUN20) and SDATA (LUN10).

File KOUNT consists of 4 binary records. Each record contains 372 words (corresponding to days of the year, assuming 31 days per month). Each word contains an integer 1 to indicate data is present in file SDATA for that day, or a 0 to indicate data is missing for that day. Record 1 contains indicators for tailwater stage, record 2 for headwater stage, record 3 for one gate opening, and record 4 for a second gate opening.

File SDATA consists of 4 binary records for each of 372 days. Each record contains 120 integer values scaled upward by a factor of 100. Each value covers a 12 minute time interval, thus 120 values cover 24 hours.
Record 1 contains tailwater stages for day 1 in feet.
Record 2 contains headwater stages for day 1 in feet.
Record 3 contains a gate opening for day 1 in feet.
Record 4 contains another gate opening for day 1 in feet.
Records 5 through 8 contain these same parameters for day 2, etc.

Since some of the structures have up to 6 gates, and the E040 program provides for only 2 gates, the following procedure was used:

1. Run E040 to obtain HW, TW, and 1st 2 gates. Save file 10 as SDATA1 and file 20 as KOUNT1.
2. Run E040 to obtain 2nd 2 gates (no HW or TW). Save file 10 as SDATA2 and file 20 as KOUNT2.
3. Run E040 to obtain 3rd 2 gates (no HW or TW). Save file 10 as SDATA 3 and file 20 as KOUNT3.
4. Run E099 using SDATA1 as LUN 10, SDATA2 as LUN 11, SDATA3 as LUN12, KOUNT1 as LUN 20, KOUNT2 as LUN 21, and KOUNT3 as LUN 22. Program E099 tests the number of gates to determine if it must read data from logical units 11, 12, 21 and 22.

The output file (Tape 15) consists of 365 binary records, one for each day of the year. The record format is:

Word	Content
1	Four character structure name
2	Day number integer 1 to 372 (There are no records for days 60, 61, 62, 124, 186, 279, or 341).
3	Time-integer 300, 600, 900, 1200, 1500, 1800, 2100, or 2400 (300 represents the time period from 0000 to 0300).
4	Number of gates at the structure-integer
5	Headwater stage-integer x 100
6	Tailwater stage-integer x 100
7-12	Six gate openings-integer x 100. If less than 6 gates, the values for the non-existent gates are zero filled.

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 computer (program requires 9K + operating system).
1 magnetic tape drive (7 track)
1 card reader
2 854 disk drives (including the system disk).
1 line printer.

JOB E099

PROGRAMMER: Paul Berger
Ashok Shahane

PURPOSE: Generate 3 hour stages and gate openings at a structure.

DISKS: 6000, 6100

CONTROL CARDS:

```
$JOB,8430-305,E099,20,,,          E099
$DUMP
$RONL,854/6000,854/6100
* $FET,E099,SDATA1,512
$OPEN,10
* $FET,E099,SDATA2,512
$OPEN,11
* $FET,E099,SDATA3,512
$OPEN,12
* $FET,E099,KOUNT1,512
$OPEN,20
* $FET,E099,KOUNT2,512
$OPEN,21
* $FET,E099,KOUNT3,512
$OPEN,22
$EQUIP,15=MT
$FET,E099,SDATA,960
$OPEN,25
$LOAD,25,M
$RUN
Insert card input here
```

*NOTE: It is the responsibility of the user to allocate these files prior to running program E040. It is also the user's responsibility to release these files when no longer needed. The E040 control card deck must be submitted with these file names replacing the ones used by E040. Number of tracks required on the 841 disk packs is 186 each for SDATA1, SDATA2, and SDATA3, and 2 tracks each for KOUNT1, KOUNT2, and KOUNT3.

CARD INPUT: One data card containing structure name, data year, and number of gates in columns 1-11.

TAPES: Tape 15 is an output tape. This tape is input tape 01 to program E097.

ERROR STOPS: None

TIMING: 15 to 20 minutes.

3/3/76:sop

SAMPLE OUTPUT

RUN
S-53 1973 1

```
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1

 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
```

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

S-60	1	300	1	6361	0192	150	0	0	0	0	0
S-60	1	600	1	6341	0190	150	0	0	0	0	0
S-60	1	900	1	6340	0166	150	0	0	0	0	0
S-60	1	1200	1	6360	0166	150	0	0	0	0	0
S-60	1	1500	1	6374	0165	150	0	0	0	0	0
S-60	1	1800	1	6379	0165	150	0	0	0	0	0
S-60	1	2100	1	6379	0166	150	0	0	0	0	0
S-60	1	2400	1	6374	0166	150	0	0	0	0	0
S-60	2	300	1	6374	0166	150	0	0	0	0	0
S-60	2	600	1	6374	0166	150	0	0	0	0	0
S-60	2	900	1	6380	0165	150	0	0	0	0	0
S-60	2	1200	1	6382	0165	150	0	0	0	0	0
S-60	2	1500	1	6384	0187	150	0	0	0	0	0
S-60	2	1800	1	6382	0193	160	0	0	0	0	0
S-60	2	2100	1	6383	0184	160	0	0	0	0	0
S-60	2	2400	1	6383	0184	160	0	0	0	0	0
S-60	3	300	1	6384	0184	160	0	0	0	0	0
S-60	3	600	1	6386	0190	160	0	0	0	0	0
S-60	3	900	1	6387	0192	160	0	0	0	0	0
S-60	3	1200	1	6383	0143	110	0	0	0	0	0
S-60	3	1500	1	6383	0193	150	0	0	0	0	0
S-60	3	1800	1	6387	0190	150	0	0	0	0	0
S-60	3	2100	1	6386	0188	150	0	0	0	0	0
S-60	3	2400	1	6385	0186	150	0	0	0	0	0
S-60	4	300	1	6385	0184	150	0	0	0	0	0
S-60	4	600	1	6386	0182	150	0	0	0	0	0
S-60	4	900	1	6387	0181	150	0	0	0	0	0
S-60	4	1200	1	6383	0179	150	0	0	0	0	0

```
      PROGRAM SDATA
C
C PROGRAM SDATA (F040) GENERATES STAGES AND GATE OPENINGS AT 3 HOUR
C INTERVALS FOR A PERIOD OF ONE YEAR FOR A SINGLE STRUCTURE.  THE INPUT
C DATA COMES FROM 2 DISK FILES FOR EACH PAIR OF GATES AT THE STRUCTURE.
C THESE 2 FILES ARE GENERATED BY PROGRAM F040.
C
C THE 3 HOUR STAGES AND GATE OPENINGS ARE OUTPUT TO A MAGNETIC TAPE
C (LUN 15) AND ARE ALSO PRINTED.
C
C SDATA WAS DEVELOPED BY PAUL BERGER AND ASHOK SHAHANE.
C
      DIMENSION TREC (120,8), KREC(372,8), LVAL (8), NODAYS(7)
      DATA (NODAYS = 0,31,62,124,186,279,341)
C
C READ IN STRUCTURE NAME, YEAR, AND NUMBER OF GATES.
C
      READ (60,1) NAME, IYEAR, NGATES
 1    FORMAT (A4,1XA4,1X,I1)
      WRITE (61,4) NAME, IYEAR, NGATES
 4    FORMAT (1XA4,1XA4,1X,I1)
      NEPT = NGATES + 2
      REWIND 15
C
C READ 4 INDICATOR RECORDS FROM LUN 20 (CORRESPONDING TO TAILWATER,
C HEADWATER, GATE 1, AND GATE 2.
C
      READ (20) (KREC(I,2),I=1,372)
      READ (20) (KREC(I,1),I=1,372)
      READ (20) (KREC(I,3),I=1,372)
      READ (20) (KREC(I,4),I=1,372)
C
C PRINT INDICATORS FOR VISUAL VERIFICATION.
C
      WRITE(61,6)(KREC(I,1),I=1,372),(KREC(I,2),I=1,372),
     1 (KREC(I,3),I=1,372), (KREC(I,4),I=1,372)
 6    FORMAT (12(1X31I3/)/)
C
C IF MORE THAN 2 GATES, READ INDICATORS FOR GATE 3 AND GATE 4.
C
      IF (NGATES.LE.2) GO TO 10
      READ (21) (IDUM,I=1,372)
      READ (21) (IDUM,I=1,372)
      READ (21) (KREC(I,5),I=1,372)
      READ (21) (KREC(I,6),I=1,372)
      WRITE (61,6) (KREC(I,5),I=1,372), (KREC(I,6),I=1,372)
C
C IF MORE THAN 4 GATES, READ INDICATORS FOR GATE 5 AND GATE 6.
C
      IF (NGATES.LE.4) GO TO 10
      READ (22) (IDUM,I=1,372)
      READ (22) (IDUM,I=1,372)
      READ (22) (KREC(I,7),I=1,372)
      READ (22) (KREC(I,8),I=1,372)
      WRITE (61,6) (KREC(I,7),I=1,372), (KREC(I,8),I=1,372)
C
C LOOP THRU 372 DAYS PER YEAR (ASSUMES 31 DAYS PER MONTH).
C
 10   DO 500 I = 1,372
      II = 48(I-1)
C
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C 10 (120 VALUES PER DAY...12 MINUTES BETWEEN VALUES).
C
      CALL LOCATE (10,LL+1,J)
      READ (10) (IREC(I,2),I=1,120)
      CALL LOCATE (10,LL+2,J)
      READ (10) (IREC(I,1),I=1,120)
      CALL LOCATE (10,LL+3,J)
      READ (10) (IREC(I,3),I=1,120)
      CALL LOCATE (10,LL+4,J)
      READ (10) (IREC(I,4),I=1,120)
C
C IF MORE THAN 2 GATES, READ 3RD AND 4TH GATE OPENINGS FROM LUN 11.
C
      IF (NGATES.LE.2) GO TO 20
      CALL LOCATE (11,LL+3,J)
      READ (11) (IREC(I,5),I=1,120)
      CALL LOCATE (11,LL+4,J)
      READ (11) (IREC(I,6),I=1,120)
C
C IF MORE THAN 4 GATES, READ 5TH AND 6TH GATE OPENINGS FROM LUN 12.
C
      IF (NGATES.LE.4) GO TO 20
      CALL LOCATE (12,LL+3,J)
      READ (12) (IREC(I,7),I=1,120)
      CALL LOCATE (12,LL+4,J)
      READ (12) (IREC(I,8),I=1,120)
C
C ELIMINATE NON-EXISTENT DAYS.
C
 20   DO 30 I = 1,7
      IF (L.EQ.NODAYS(I)) GO TO 500
 30   CONTINUE
C
C GENERATE 8 VALUES OF 3 HOUR AVERAGE STAGES AND GATE OPENINGS IN
C ARRAY LVAL.
C
      DO 300 IX = 1,120,15
      DO 40 I=1,8
 40   LVAL(I) = 0
      DO 200 N = 1,NENT
C
C FLAG MISSING VALUES WITH -9999.
C
      IF (KREC(L,N).EQ.0) GO TO 150
C
C SUM 15 TWELVE MINUTE VALUES AND DIVIDE BY 15 TO OBTAIN 3 HOUR AVERAGE
C
      DO 100 I = 1,15
      J = IX + I - 1
      LVAL(N) = LVAL(N) + IREC(J,N)
 100  CONTINUE
      XVAL = LVAL(N)
      LVAL(N) = XVAL/15.0 + 0.5
      GO TO 200
 150  LVAL(N) = -9999
 200  CONTINUE
C
C COMPUTE 3 HOUR MILITARY TIME.  PRINT AND OUTPUT TO TAPE 15 THE
C STRUCTURE NAME, DAY NUMBER, TIME, NUMBER OF GATES, AND THE 8 VALUES
C (HW, TW, AND STX GATE OPENINGS).
C
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      ITIME = (IX+14) * 20
      WRITE (15) NAME,L,ITIME,NGATES,LVAL
      WRITE (61,3) NAME,L,ITIME,NGATES,LVAL
3     FORMAT (1XA4,I1I6)
300   CONTINUE
500   CONTINUE
      ENDFILE 15
      REWIND 15
      CALL EXIT
      END
         FINIS
```

PROGRAM DESCRIPTION FOR THE MERGE PROGRAM (E100)

PROGRAM DESCRIPTION

This program is part of a system of programs (Figure 1) which deals with water quantity in the Kissimmee River basin. The purpose of this program is to merge stage and gate opening tapes generated by program E099 onto a single output tape and to arrange the records in an order suitable for processing by the FCD Hydrologic Routing Model (Program E097). The first 31 days of data is also printed. There are 14 input tapes (one tape per structure). There are 2 output tapes (the ordered output tape and a non-ordered tape which contains a blocked copy of the 14 input tapes in 14 separate files). The program does not require any input cards.

FILE FORMATS

The format of the input tape (logical unit 1) is described in the E099 Program Documentation. There are 14 input tapes, one tape per structure. The tapes are processed in order by structure number (See Program Listing). The tape containing data for structure 1 is first mounted on LUN 01. When the program is finished processing this tape, it types out a message to the operator to mount the next 01 tape. This procedure is repeated until all 14 input tapes have been processed.

There are two output tapes:

1. Sorted tape (logical unit 2) for input to the Routing Model (E097). The format of this tape is given with comment cards in the PROGRAM LISTING section of this document.

2. This tape (logical unit 3) contains 14 files of data, one file per structure. See additional format information in the PROGRAM LISTING section of this document. This tape was generated as a backup of the 14 input tapes. The 14 input tapes were than released.

The program also requires a scratch disk file (logical unit 20) which is used to re-order the records. The format and order of this file is the same as the sorted output tape.

MACHINE CONFIGURATION

The following equipment configuration is required to run this program:

CDC 3100 computer (program requires 5K+ operating system).
3 magnetic tape drives (7 track).
1 card reader
3 854 disk drives (including the system disk)
1 line printer.

OPERATING INSTRUCTIONS

PROGRAM E100

PROGRAMMER: Paul Berger
Ashok Shahane

PURPOSE: Merge and order stage and gate opening tapes.

DISKS: 6000, 3001

CONTROL CARDS:

```
$JOB,8430-305,E100,120
$DUMP
$RONL,854/6000
$RAT,854/3001
$FET,E100,SCRATCH,512
$ALLOCATE,600
$OPEN,20
$EQUIP,01=MT,02=MT,03=MT
$FET,E100,MERGE,960
$OPEN,25
$LOAD,25,M
$RUN
```

CARD INPUT: None

TAPES: There are 14 input tapes. These are mounted on LUN 01 in a user defined order.

There are two output tapes LUN 02 and LUN 03.

ERROR STOPS: None

PAUSES: 13- A pause after processing each of the first 13 tapes. Program exits after processing the 14th tape.

TIMING: About 1 hour, 40 minutes.

SAMPLE OUTPUT

```
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
A FTNO 0062 PAUSE 00000
S-57    1  300  2  6340  6100   100   100     0     0     0     0
S-62    1  300  1  6111  5805   100     0     0     0     0     0
S-59    1  300  1  5759  5569   361     0     0     0     0     0
S-61    1  300  1  5523  5252   351     0     0     0     0     0
S63A    1  300  2 -9999 -9999    48    48     0     0     0     0
S-65    1  300  3  5238  4668   200   200   200     0     0     0
S-60    1  300  1  6381  6192   150     0     0     0     0     0
S-63    1  300  1  6200  5675   100     0     0     0     0     0
S-58    1  300  2  6387  6330     0     0     0     0     0     0
S65A    1  300  3 -9999 -9999   200   200   200     0     0     0
S65B    1  300  3 -9999 -9999   175   200   200     0     0     0
S65C    1  300  4 -9999 -9999   100   150   150   150     0     0
S65D    1  300  4 -9999 -9999   150   175   200   150     0     0
S65F    1  300  6  2127  1577   150   150    50   125   150   150
S-57    1  600  2  6340  6100   100   100     0     0     0     0
S-62    1  600  1  6110  5804   100     0     0     0     0     0
S-59    1  600  1  5758  5569   361     0     0     0     0     0
S-61    1  600  1  5524  5252   351     0     0     0     0     0
S63A    1  600  2 -9999 -9999    39    39     0     0     0     0
S-65    1  600  3  5240  4667   200   200   200     0     0     0
S-60    1  600  1  6381  6190   150     0     0     0     0     0
S-63    1  600  1  [illegible]
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PROGRAM LISTING

```
      PROGRAM MERGE
C  PROGRAM TO MERGE STAGE AND GATE OPENING TAPES (TAPE 1) ONTO A SINGLE
C  TAPE (TAPE 3). AND TO SORT THE DATA INTO AN ORDER SUITABLE FOR
C  PROCESSING BY THE FCD ROUTING MODEL AND OUTPUT TO ANOTHER TAPE
C  (TAPE 2).
C MERGE WAS DEVELOPED BY PAUL BERGER AND ASHOK SHAHANE.
C
C  TAPE 1 ... 14 SEPARATE TAPES GENERATED BY PROGRAM SDATA.
C
C  TAPE 2 ... SORTED DATA TAPE FOR INPUT TO THE ROUTING MODEL. RECORD
C             NUMBER IS COMPUTED BY THE FOLLOWING FORMULA -
C              RECNO = (DAY-1)*112 + (TIME PERIOD - 1)*14 + STRUCTURE NO
C              WHERE DAY = 1...365
C                    TIME PERIOD = 1...8
C                    STRUCTURE NO = 1...14
C
C              STRUCTURE NO    STRUCTURE ID
C                   1              S-57
C                   2              S-62
C                   3              S-59
C                   4              S-61
C                   5              S63A
C                   6              S-65
C                   7              S-60
C                   8              S-63
C                   9              S-58
C                  10              S65A
C                  11              S65B
C                  12              S65C
C                  13              S65D
C                  14              S65E
C
C        EACH RECORD CONTAINS 12 WORDS (-9999 IS USED TO SIGNIFY
C                                                    MISSING DATA)
C
C              WORD 1     STRUCTURE ID (A4)
C              WORD 2     DAY 1-372 (INTEGER)
C              WORD 3     TIME 300-2400 (INTEGER)
C              WORD 4     NUMBER OF GATES OR BARRELS (INTEGER)
C              WORD 5     HW FEET ABOVE MSL (INTEGER * 100)
C              WORD 6     TW FEET ABOVE MSL (INTEGER * 100)
C              WORD 7     GATE OPENING FOR GATE 1 IN FEET (INTEGER * 100)
C              WORD 8     GATE OPENING FOR GATE 2 IN FEET (INTEGER * 100)
C              WORD 9     GATE OPENING FOR GATE 3 IN FEET (INTEGER * 100)
C              WORD 10    GATE OPENING FOR GATE 4 IN FEET (INTEGER * 100)
C              WORD 11    GATE OPENING FOR GATE 5 IN FEET (INTEGER * 100)
C              WORD 12    GATE OPENING FOR GATE 6 IN FEET (INTEGER * 100)
C
C  TAPE 3 ... 14 FILE TAPE. ONE FILE PER STRUCTUTE IN THE SAME ORDER AS
C             STRUCTURES 1-14 SPECIFIED ABOVE. (SEE NOTE BELOW)
C
C  NOTE.......TAPES 2 AND 3 ARE WRITTEN WITH THE T ROUTINES 10 RECORDS
C             PER BLOCK...800 BPI...BINARY MODE...UNLABELED.
C
      DIMENSION IREC(12), IBUF(125), JBUF(130), KBUF(130)
      DATA (NS=14)
      REWIND 1
      CALL TOPEN (KBUF,3,25,1 ,12)
      CALL FOPEN (IBUF, 23,12,10)
      DO 550 IS=1,14
      DO 520 IDAY = 1,365
```

```
      IREC = IREC
      CALL IWRITE (KBUF,IREC,IEOT)
      L = (IDAY-1)*112 + (ITIME-1)*14 + IS
      CALL FPUT (IBUF,IREC,L)
500   CONTINUE
      REWIND 1
      IF (IS.EQ.14) GO TO 600
      CALL FCLOSE (KBUF,0)
      WRITE (54,2)
2     FORMAT (33H MOUNT NEXT  1 TAPE-THEN CONTINUE)
      PAUSE
550   CONTINUE
600   CALL FCLOSE (IBUF)
      CALL TCLOSE (KBUF,-1)
      CALL FOPEN (IBUF,2H,12,1 )
      CALL TOPEN (JBUF,2H,2,1 ,12)
      N =
      DO 700 IDAY = 1,365
      DO 700 ITIME = 1,8
      DO 700 IS = 1,95
      N = N+1
      CALL FGET (IBUF,IREC,N)
      CALL IWRITE (JBUF,IREC,IEOT)
      IF (IDAY.EQ.32) WRITE(61,3) IREC
3     FORMAT (1XA4,I16)
700   CONTINUE
      CALL TCLOSE (JBUF,-1)
      CALL EXIT
      END
        FINIS
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REFERENCES

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4. Sinha, L. K., and Lindahl, L. E., "An Operational Watershed Model: General Purpose and Progress", transactions of ASAE, Vol. 14, No.4, 1971, pp. 688-691.

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