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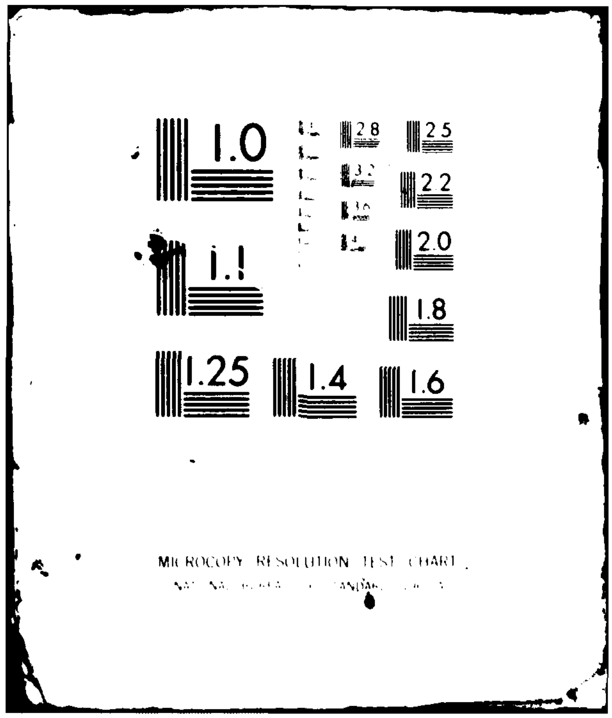
DAILY FLOW MODEL OF THE DELAWARE RIVER BASIN. USER'S MANUAL AND--ETC(U)

SEP 81 DACW61-78-C-0127

UNCLASSIFIED DAEN/NAP-51850/DFM03-81/09 NL

1 of 2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LEVEL III

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DAILY FLOW MODEL OF THE DELAWARE RIVER BASIN

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USER'S MANUAL AND DOCUMENTATION

September 1981

REPORT NO: DAEN/NAP-51850/DFM03-81/09

KEY FOR
SERIES OF DOCUMENTATION

MAIN REPORT (Book 1 of 2)

VOLUME 1 - Phase I Report for Development of a Daily Flow Model of the Delaware River.

VOLUME 2 - Phase II Report for Development of a Daily Flow Model of the Delaware River which Incorporates Reservoir Systems Analysis

APPENDICES (Book 2 of 2)

APPENDIX A - Natural Daily Flows Duration and Frequency Analysis for Phase I

APPENDIX B - Regulated Daily Flows Duration and Frequency Analysis for Phase I

APPENDIX C - Base Run Daily Flows Duration and Frequency Analysis For Phase II

APPENDIX D - Combination one Daily Flows Duration and Frequency Analysis for Phase II

APPENDIX E - Combination 17 Daily Flows Duration and Frequency Analysis For Phase II

USER'S MANUAL AND DOCUMENTATION

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This effort was conducted by Camp Dresser and McKee (CDM) under contract to the Philadelphia District, Corps of Engineers (PDO) with direction from a committee representing two states and four agencies. The principal engineers for CDM were Robert Taylor, Thomas George and Sue Hanson-Walton. Paul Gaudini of the Corps was responsible for the conduct of the work with technical support from Dave Erickson and Vince Hill. Members of the committee included John McSparran and Steve Runkle of the Pennsylvania Department of Environmental Resources, William Lee and Chin Liu from the New York Deoartment of Environmental Conservation, Robert Goodell of the Delaware River Basin Committee, and James Shearman from the U.S. Geological Survey. In addition, assistance was received throughout the study from George Mekenian and Raphael Hurwitz from New York City Department of Environmental Protection.

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A specialized daily flow model was developed for the Delaware River Basin to be used to determine the resulting discharges in the Basin for proposed operating policies for the future and existing reservoirs. This report is a combination of a user's manual and a model documentation. An overview of the program, description of pertinent program features, theoretical limitations, presentation of necessary data requirements and an example input deck are provided within this document.

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NOTICE

Daily Flow Model
of the
Delaware River Basin

US Army Corps of Engineers
Philadelphia District

September 1981

USER'S MANUAL AND DOCUMENTATION

PREPARED BY:

Camp Dressler & McKee, Inc.
Annondale, Va.

PREPARED FOR:

U.S. Army Corps of Engineers
Philadelphia, Pa.

IN COOPERATION WITH:

Pennsylvania Department of Environmental Resources
Harrisburg, Pa.

New York Department of Environmental Conservation
Albany, N.Y.

Delaware River Basin Commission
West Trenton, N.J.

U.S. Geological Survey
Harrisburg, Pa.

REPORT NO: DAEN/NAP-51850/DFM03-81/09

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I. INTRODUCTION

BACKGROUND

This documentation is the result of a study authorized by Section 22 of the Water Resources Development Act (P.L. 93-251) and Section 214 of the Rivers and Harbors Act of 1965 (P.L. 89-298). The study was requested by the Pennsylvania Department of Environmental Resources (DER) and the State of New York Department of Environmental Conservation (DEC). The Philadelphia District office of the Corps of Engineers is responsible for the conduct of the work and the study is being directed by a group consisting of staff from the Corps of Engineers, the Pennsylvania DER, the New York DEC, the Delaware River Basin Commission (DRBC), and the United States Geological Survey (USGS). The Philadelphia District Office contracted with Water Resources Engineers (WRE) an operating unit of Camp Dresser & McKee Inc. and the firm is performing work under contract number DACW61-78-C-0127.

A specialized daily flow model was developed specifically for the Delaware River Basin. This model is to be used to determine the resulting discharges in the Basin for proposed operating policies for future and existing reservoirs. It has in it the option of testing modifications to existing reservoirs such as changing the operating rules or increasing the available storage. Proposed reservoirs can also be simulated with the Daily Model.

This report is a combination of a User's Manual and a Model Documentation. For those wishing to understand fully and/or modify the program, Chapter II entitled Program Descriptions should be examined thoroughly. Those wanting only guidelines to run the model are directed to Chapter III, Input Descriptions, and Chapter IV, Output Description.

MODEL REPRESENTATION

The Daily Model consists of a branching network of nodes which are linked together. The nodes represent points of headwater and incremental inflows, river confluences, reservoirs, and points where specific low flow objectives are to be met. The flow regime throughout the basin is determined by accumulating flows, from node to node, in an upstream to downstream manner accounting for headwater and incremental inflows, reservoir releases, withdrawals and consumptive losses from the system. Lag or route times have been established for each pair of nodes, upstream to downstream. Being a daily representation, the maximum time between two nodes is 24 hours. A more detailed discussion of the development of the route times can be found in the Delaware River Daily Flow Model Report[1].

The model is driven by a set of daily incremental inflows at each node. It incorporates the simulation of reservoir water supply diversion schemes and release rules for basic conservation at the reservoir site and for flow augmentation to meet critical low flow objectives at Montague and Trenton, New Jersey. These are variable and can be changed in the input deck.

In the following paragraphs, a description of the various elements of the simulation program is given.

Flow Objectives

The Daily Model can currently simulate flow objectives at any two locations. These objectives govern the release schedule of the corresponding reservoirs. Presently, the two objectives in operation are Montague and Trenton, New

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[1]Development of a Daily Flow Model of the Delaware River which Incorporates Reservoir Systems Analysis, Volume I, Camp Dresser & McKee, March 1981

Jersey. Montague's flow governs the release from the three New York City reservoirs, Pepacton, Cannonsville and Neversink. Trenton's flow governs the releases from any other additional reservoir(s). The Daily Model is capable of operating up to seven more reservoirs for Trenton's objective. If either objective, Montague or Trenton, is not met by natural inflows and conservation releases from the reservoirs, additional releases from the appropriate reservoirs are made to meet the objectives.

The New York City reservoirs' operations are based on the daily flow at Montague. If the target is not met, the model "backs-up" three days, re-initializes the storage and the flows, and makes a release from the fullest reservoir. Because of attenuation, not all of the release is seen at Montague. Therefore, an input option that specifies a multiplication factor to increase the release is available.

The reservoirs used to meet the Trenton objective operate in a much simpler fashion. Yesterday's Trenton flow operates today's reservoir releases. This eliminates any overlapping of "back-ups" that could occur with two backup schemes. The attenuation problem is also handled differently. Because of the next day release and a possible maximum two-day lag, the release made three days ago is subtracted from today's Trenton flow to better estimate the natural Trenton flow.

Throughout the years of simulation, the model can simulate dry weather periods. During these dry periods, flow objectives and diversions are reduced. Therefore, the model has been set up to acknowledge three different system conditions: Normal, Drought Warning and Drought. These conditions are governed by the total storage level of the three New York City reservoirs, Pepacton, Cannonsville and Neversink. Figure I-1 gives the current storage scheme. This scheme is a modification of the Drought Emergency Operating Rules - Model #2 for

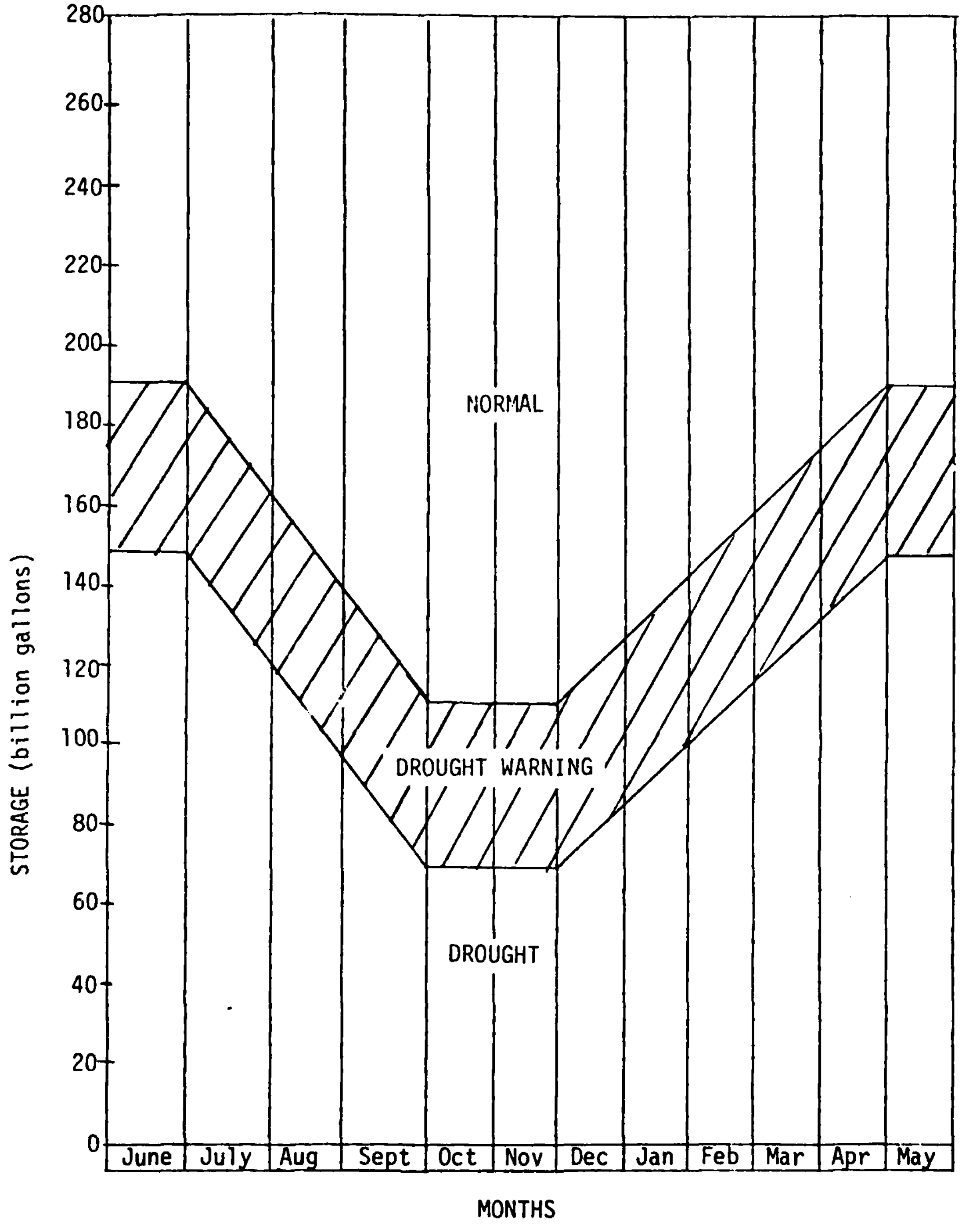

Figure I-1. NYC Reservoir System Conditions the New York-Delaware System presented in the Task Group Report, DRBC Docket No. D-77-20[1]. The natural hydrology of the area is reflected in Figure I-1. For example, during the late winter/early spring months, there is rainfall activity causing the entire basin to gain water. During the summer/early fall months, there is much less rainfall and the basin loses water. Therefore, a Normal Condition in October and November would be a Drought Condition for April through July, as is represented in Figure I-1.

The storage level is the total storage of all three New York City reservoirs. The upper part of the graph is the Normal regime. The hatched middle part is the Drought Warning area. The lower part of the graph is the Drought Condition. Table I-1 shows the effect of each of the three conditions on the Montague objective and the allowable diversions from the reservoirs to New York City for use as water supply. While currently only used for the Montague objective, the Trenton objective can also be linked to these System Conditions. Both Table I-1 and Figure I-1 contain information that are input options and can therefore be changed.

TABLE I-1

FLOW OBJECTIVE AND DIVERSION SCHEDULE

Montague	Normal	Drought Warning	Drought
Objective (cfs)	1750	1750	1525
NYC Diversion (mgd)	800	600	430

[1] Task Group Report DRBC Docket No. D-77-20, Appraisal of Upper Basin Reservoir Systems, Drought Emergency Criteria and Conservation Measures, DRBC, March 1979.

Diversions

The diversions to New York City come from only Pepacton, Cannonsville and Neversink. Any other reservoir is used only for the Trenton flow objective with no diversion. Three diversions are specified in Table I-1 one for each of the System Conditions. These three diversions, like the Montague objectives, are options and can be changed for each simulation.

Reservoirs

The reservoirs are operated to meet the various flow objectives and diversion schedules. Currently, only the three New York City reservoirs can be used to meet the Montague objective. Any additional reservoirs are used for the Trenton objective. These reservoirs can be incorporated into the model by merely being specified in the input data.

All reservoirs are located at headwaters. They are each set up with three major components: a continuous storage, a special release node and an incremental inflow node. When the reservoir is not used, the incremental inflow is equal to the flow at the node. When in operation, the reservoir's normal spills and releases will also be located at the incremental inflow node. If for some reason the special releases made to augment the flows at the objective nodes should not be released with the normal releases conservation, the special release node is specified as something different from the incremental inflow node. Such is the case at Neversink Reservoir. Being much closer to Montague than Pepacton and Cannonsville, its releases to augment Montague's flow arrive a full day earlier than releases from Pepacton and Cannonsville. Therefore, a special release node has been specified that will hold Neversink's releases for one day before allowing them to be routed naturally down to Montague. While this option can be used for any reservoir, it is not advised to do so. The Special release node is then usually equal to the inflow node. The storage node is always specified as 1000 plus the node number linked to the incremental inflow to the reservoir. This is essential to keep the natural inflows and the new reservoir releases occurring at the same location.

ASSUMPTIONS AND LIMITATIONS

The Daily Model has been operated on only two systems, a CDC CYBER 176 at United Computing Services (UCS) in Dallas, Texas, and a CDC CYBER 750 at Sun Information Services in Dallas, Texas. The entire 50-year simulation requires 70 CPU seconds at UCS and 160 CPU seconds at Sun Oil. This will vary slightly reservoir can be designated in the input deck without changing the program. While it is not difficult to change these, it does require knowledge of the program and FORTRAN.

Chapter II contains a description of the pertinent program features, theoretical limitations and assumptions. A detailed description of the data requirements is provided along with necessary format descriptions in Chapter III. An example input deck is given and described at the end of the Chapter. Chapter IV provides a discussion of the output for the example input deck.

II. PROGRAM DESCRIPTION

MODEL STRUCTURE

This chapter gives an overview of the Daily Model program. Figure II-1 represents the main program and the order of calling the nine subroutines. The main program and each subroutine is described in detail. Included in the description is a flow chart and the computer listing.

The controlling parameters (number of years in simulation, monthly counter, inflow tape number, etc.) are initialized and read-in (INDATA), the nodes are ordered from upstream to downstream and then linked to their incremental inflow (ORDER and LINKER), all before RGFL (main program) enters the daily and yearly loops. The System Condition storage levels are also calculated (INTRPL) before entering the loop. The incremental inflows are read for the current day (INFLOW). The upstream flows are added to the downstream incremental inflows (ROUTE) once the reservoirs have been operated (RESOP). If Montague needs more water, the simulation backs up three days (NEWFLO). After each day which is not in the back up procedure, all the flows are written on a special tape, later to be reduced into tabular form (OUTPUT or MONTH).

RGFL Program

The main program of the Daily Flow Model is called RGFL, an acronym for the Regulated Flow model. It calls most of the subroutines and keeps track of the daily and yearly counters, as well as the backup procedure. Figure II-1 gives a general flow chart for the RGFL program. Parameters are initialized and variables are read in (INDATA) before the model begins the daily loop. The subroutine LINKER connects the model nodes to the incremental inflow nodes on the tape.

Once inside the daily loop, RGFL calls INFLOW which reads the incremental inflows and ROUTE which moves the water through the basin with lag functions and various reservoir operations. The past three days' flows, storages and counters are then set to be used if and when backup occurs.

The main purpose of RGFL is to check whether or not the model needs to make a release to augment the Montague flow. If a release is required, RGFL calls NEWFLO which backs up the simulation three days. A flag is set in NEWFLO such that the model can never backup to that particular day again. This flag is checked in RGFL after the past three days' flow values have been set. In the flowchart, this check occurs in two places. The question "Is the Model in Backup?" directly checks the flag. The next one "Should the Model Backup?" in actuality is two questions. First, it asks if the Montague flow is lower than the objective. If it is, it asks if the model just finished backing up. In other words, whether the simulation is at the point where it was required to backup before. If so, the model will not backup due to the check on the backup flag and instead writes on a scratch tape all the flows, storages and special outputs from three days ago. By writing the information from three days ago, there is no possible way to rewrite days due to the backup procedure.

If the model beginning the backup procedure, it goes back to INFLOW in order to set the inflows for the current day. This is done without incrementing the daily, monthly or yearly counters. It then calls ROUTE which makes the release from the fullest NYC reservoir on the first day only.

RGFL performs two additional calculations. The first calculation is the release needed to maintain the Trenton flow objective. The second calculation, when appropriate, is Merrill Creek's operation. Designed in reality to release whenever the Trenton flow is less than 3100 cfs, RGFL will increase Merrill Creek's target of 3100 cfs if the Trenton objective is greater than 3100 cfs. This is discussed in much greater detail in the Delaware River Daily Flow Model Report[1].

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[1] Development of a Daily Flow Model of the Delaware River which Incorporates Reservoir Systems Analysis, Volume I, Camp Dresser & McKee, March 1981

The daily and yearly loops are continued until the number of years in the simulation have been completed or the end of the inflow tape has been reached. At this point, either MONTH or OUTPUT is called to create the tabular output. MONTH produces the monthly average values while OUTPUT produces the daily values for each year.

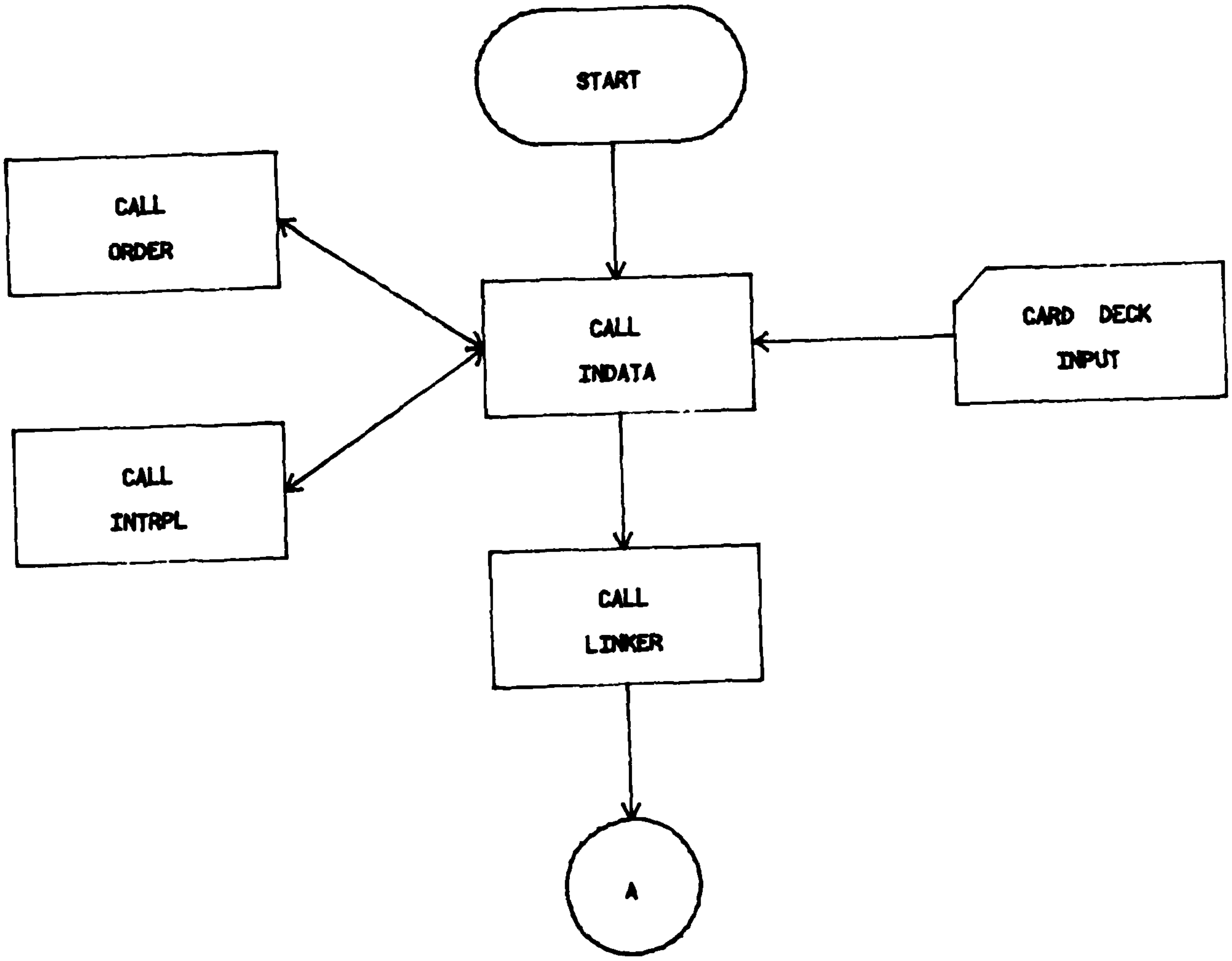

Figure II-1. Flowchart for Main Program RGFL.

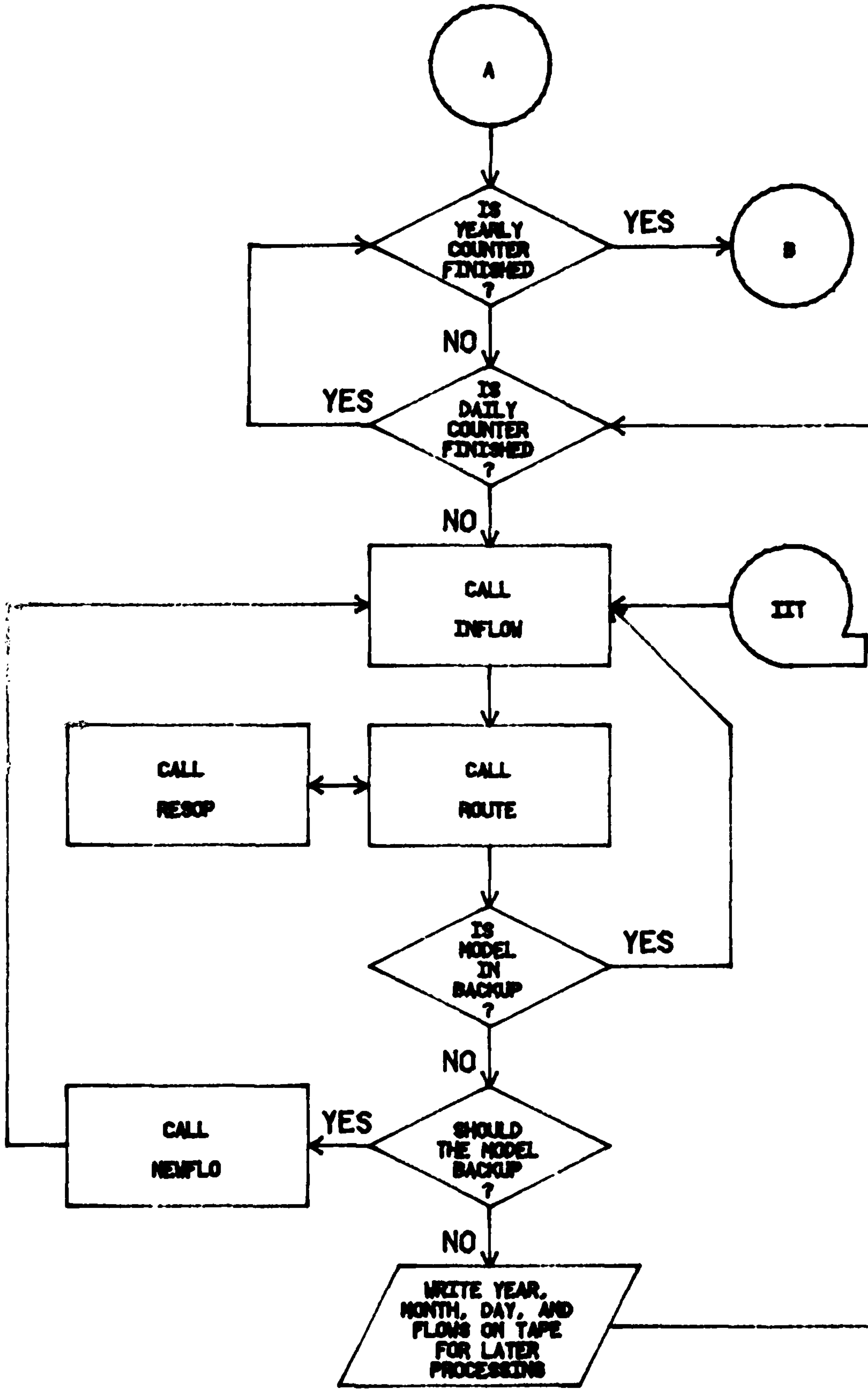

Figure II-1. Flowchart for Main Program RGFL.
(Continued)

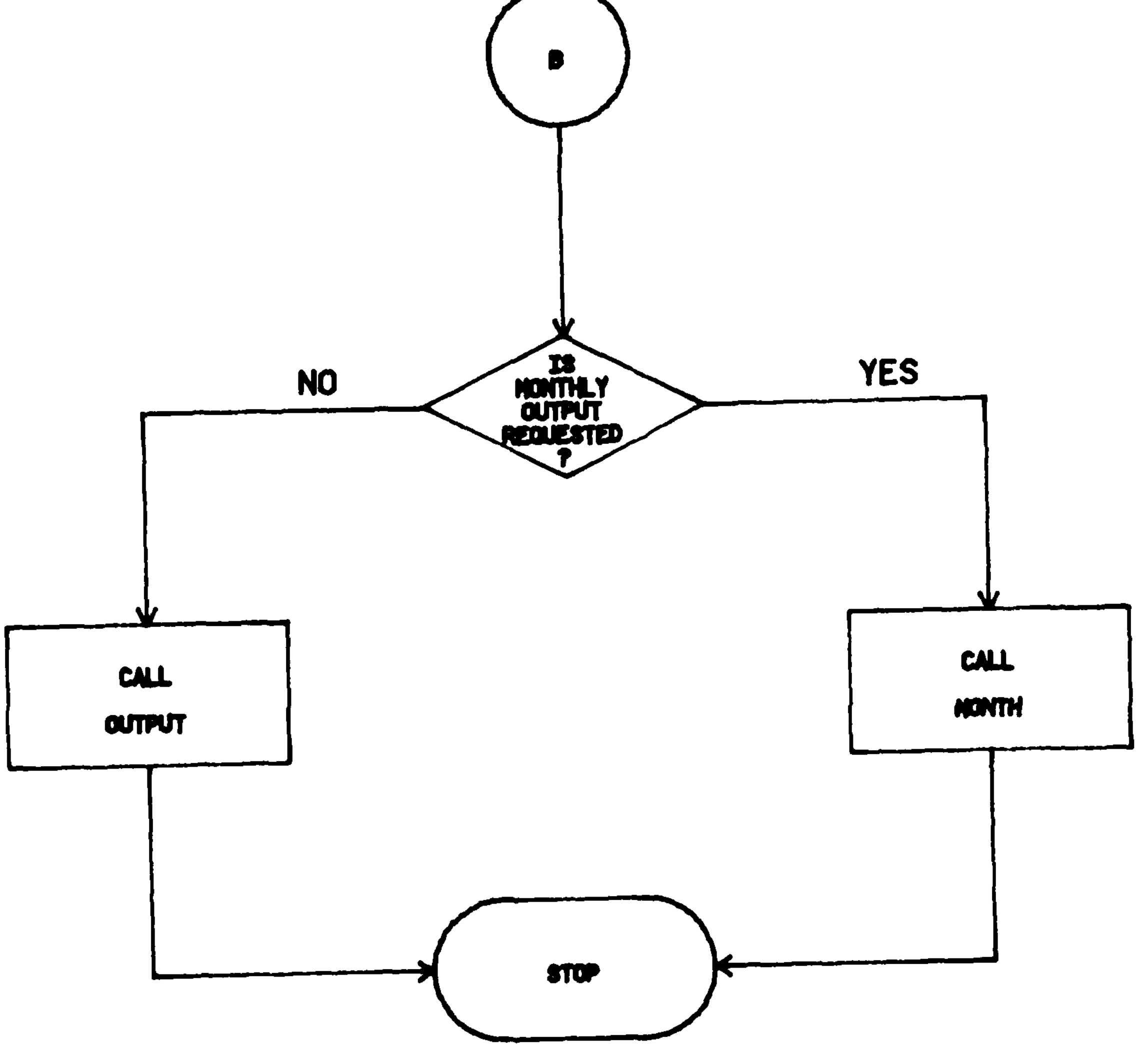

Figure II-1. Flowchart for Main Program RGFL.
(Continued)

```
C ********************************************************************
C
C     REGULATED FLOW MODEL
C     DAILY FLOW MODEL OF THE DELAWARE RIVER BASIN
C
C     WRITTEN BY J.W.RIDGWAY
C     REVISED BY K.E.ZIMMERMAN      DECEMBER 1979
C     REVISED BY S.A.HANSON         FEBRUARY 1981
C
C *********************************************************************
      PROGRAM RGFL(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE10,TAPE20,
     .                 TAPE30,TAPE99)
C *********************************************************************
C       TAPE CLARIFICATION:
C                      TAPE10: BINARY OUTPUT OF SIMULATION
C                      TAPE20: EXTRA TAPE - NOT CURRENTLY USED
C                      TAPE30: INCREMENTAL INFLOW TAPE - REQUIRED
C                      TAPE99: EXTRA TAPE - NOT CURRENTLY USED
C *********************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /STOR/    STORE1(10),STORE2(10),STORE3(10),STORE4(10)
      COMMON /LAG/     QOUT(100),XM(100),B(100)
      COMMON /DATE/    IYR3,IMO3,IDY3,IYR2,IMO2,IDY2,IYR1,IMO1,IDY1,
     .                 Q1(100),Q2(100)
      COMMON /PHAS2/   NYCRES,ICHK,STOREN(31,12),STORED(31,12),
     .                 DIVERS(3),OBJECT(3),EVP(12,10),IEVP,DFLOW(3),
     .                 TARG(3)
      COMMON /PADER/   ACONS(12,10),TRENT,YFLOW,REL(10),NSTEP,MDATE
      COMMON /FLAGS/   NTR,NDR,MER,MPR,NTG,MRES,NBEL,MBL
      COMMON /CAL/     CALIB1,JOUT,JMIN
      COMMON /OUTS/    NSPO
      COMMON /MOMIN/   QMM(12,50,10),QMIN(10)
      COMMON /BACKUP/  YF5,YF4,YF3,YF2,YF1
      DATA QMIN/10*999999./
C ***** INITIALIZE PARAMETERS
      IFLAG=2
      IEVP=1
      ICHK=1
      FLOWL=0.
      XFLOW=0.
      YFLOW=0.
      ZFLOW=0.
      NSTEP=0
      MDATE=0
C ***** CALL INDATA (READS INPUT DATA)
      CALL INDATA
      IMO=1
```

```
      IDY=31
C ***** CALL LINKER (ASSIGNS INCREMENTAL INFLOWS TO NODES)
      CALL LINKER
      NOGG=NOG
      NOG=NOG+NRES+NSPO
C ***** NTAPE IS AN UNFORMATTED OUTPUT TAPE
      WRITE(NTAPE)NOG
      WRITE(NTAPE)(NAMEG(I),I=1,NOG)
C ***** ENTER DAILY LOOP FOR NYEAR YEARS
      DO 1000 I=1,NYEAR
      DO 800 II=1,366
C ***** CALL INFLOW (READS INFLOWS AT NODES AND RESERVOIRS, CALCULATES
C              RESERVOIR LEVELS)
   10 CALL INFLOW
C ***** CALL ROUTE (SETS TARGETS, OPERATES RESERVOIRS AND ROUTES FLOWS
C              DOWNSTREAM)
      CALL ROUTE
C ***** SAVE THE PAST THREE DAYS DATES
      IYR3=IYR2
      IYR2=IYR1
      IYR1=IYR
      IMO3=IMO2
      IMO2=IMO1
      IMO1=IMO
      IDY3=IDY2
      IDY2=IDY1
      IDY1=IDY
      IF(NRES.EQ.0) GO TO 610
C ***** SAVE THE PAST THREE DAYS STORAGE LEVELS
      DO 600 N=1,NRES
      STORE4(N)=STORE3(N)
      STORE3(N)=STORE2(N)
      STORE2(N)=STORE1(N)
      STORE1(N)=STORE(N)
  600 CONTINUE
  610 CONTINUE
C ***** SAVE THE PAST THREE DAYS FLOWS
      DO 700 N=1,NOG
      Q02(N)=Q01(N)
      Q01(N)=Q2(N)
      Q2(N)=Q1(N)
      Q1(N)=Q(N)
  700 CONTINUE
C ***********************************************************************
C                           LOWER BASIN TARGET IS AT NODE ICK1
C                     TRENT IS THE TARGET AT 2ND TARGET NODE (ORIG. TRENTON)
C                     YFLOW IS THE AMOUNT THE 2ND TARGET NODE MISSED ITS FLOW
C                     ZFLOW IS FOR THE MERRILL CREEK OPTION
C ***********************************************************************
      YF6=YF5
      YF5=YF4
      YF4=YF3
      YF3=YF2
      YF2=YF1
```

```
      YF1=YFLOW
      YFLOW=(TRENT-Q1(NTR))+YF3
      IF(YFLOW) 701,701,702
701   YFLOW=0.
702   CONTINUE
C ***** CHECK IF TARGET FLOW IS ACHIEVED AND IF BACKUP HASNT OCCURRED
C ***** NOTE : THIS OCCURS ONLY WHEN NYC RESERVOIRS ARE INCLUDED
      IF(Q(ICK).LT.FLOWL.AND.IFLAG.LT.0)CALL NEWFLO
      IF(IFLAG.GT.0) GO TO 695
      WRITE(NTAPE) IYR3,IMO3,IDY3,(QO1(N),N=1,NOG)
  695 CONTINUE
C ***** IFLAG KEEPS TRACK OF THE NUMBER OF DAYS SINCE THE
C ***** LAST BACKUP OCCURRED
      IFLAG=IFLAG-1
      ZFLOW=Q1(NTR)-3100
C ***** NEXT STATEMENT ALLOWS FOR A VARIABLE MERRILL CREEK OPTION
      IF(TRENT.GT.3100) ZFLOW =Q1(NTR)-TRENT
      IF(IFLAG)800,10,10
  800 CONTINUE
 1000 CONTINUE
      IF(JOUT)1100,1200,1300
1100  CALL OUTPUT
      GO TO 1400
1200  CALL MONTH
      GO TO 1400
1300  CALL MONTH
      CALL OUTPUT
1400  CONTINUE
      STOP
       END
```

Subroutine INDATA

The main function of INDATA is to read and write all of the card input variables as seen in Figure II-2. If INDATA detects any inconsistencies in card order, an error message is printed and execution is immediately terminated. It is therefore very important to put in the flags specified in the various data series. INDATA calls the subroutine ORDER which connects the upstream to downstream nodes. The reservoir evaporation is changed from inches/month to cfs-days (a volume) right after the reservoir information is read in. INDATA also calls INTRPL which calculates the reservoir levels for the System Conditions. INDATA returns to RGFL.

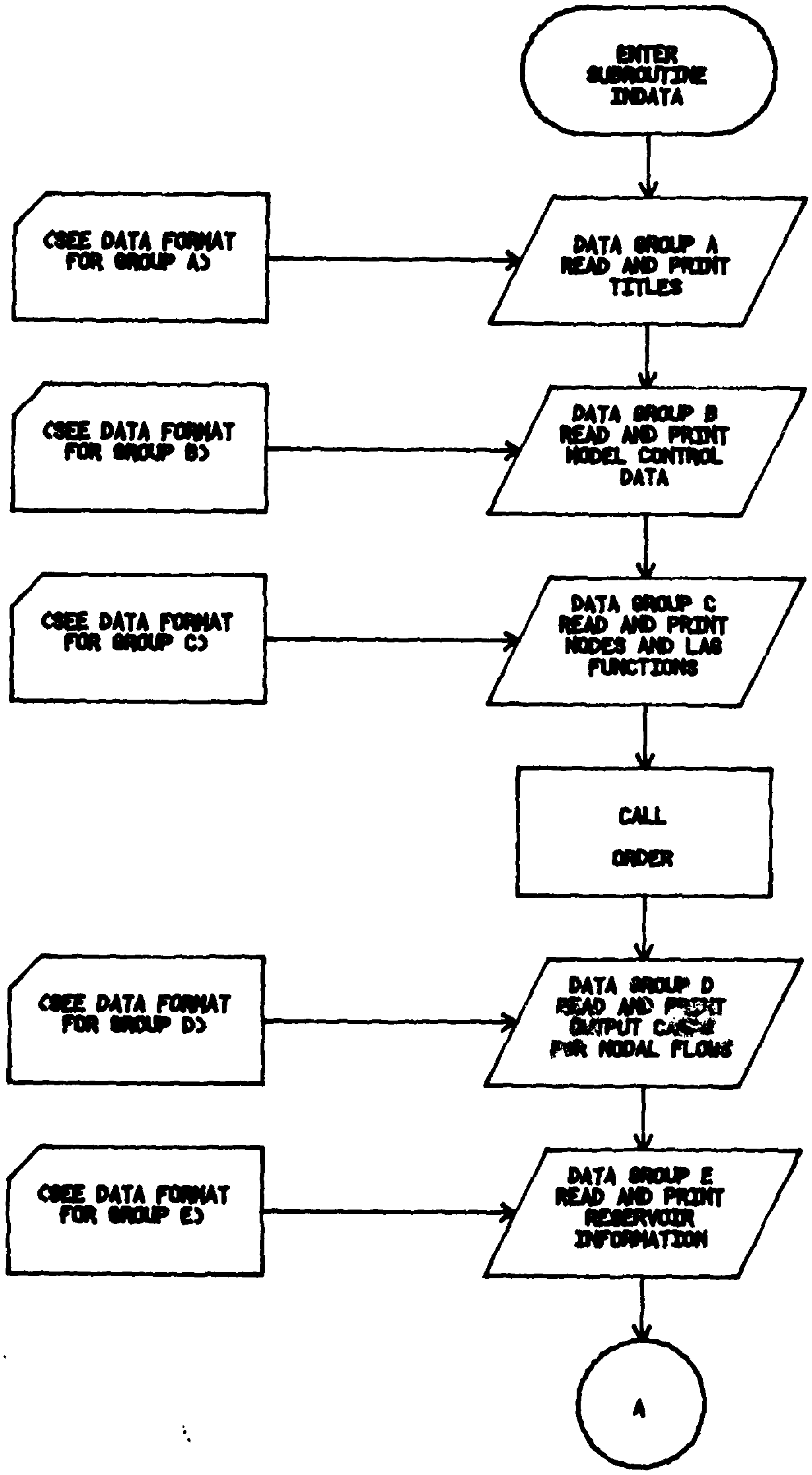

Figure II-2. Flowchart for Subroutine INDATA

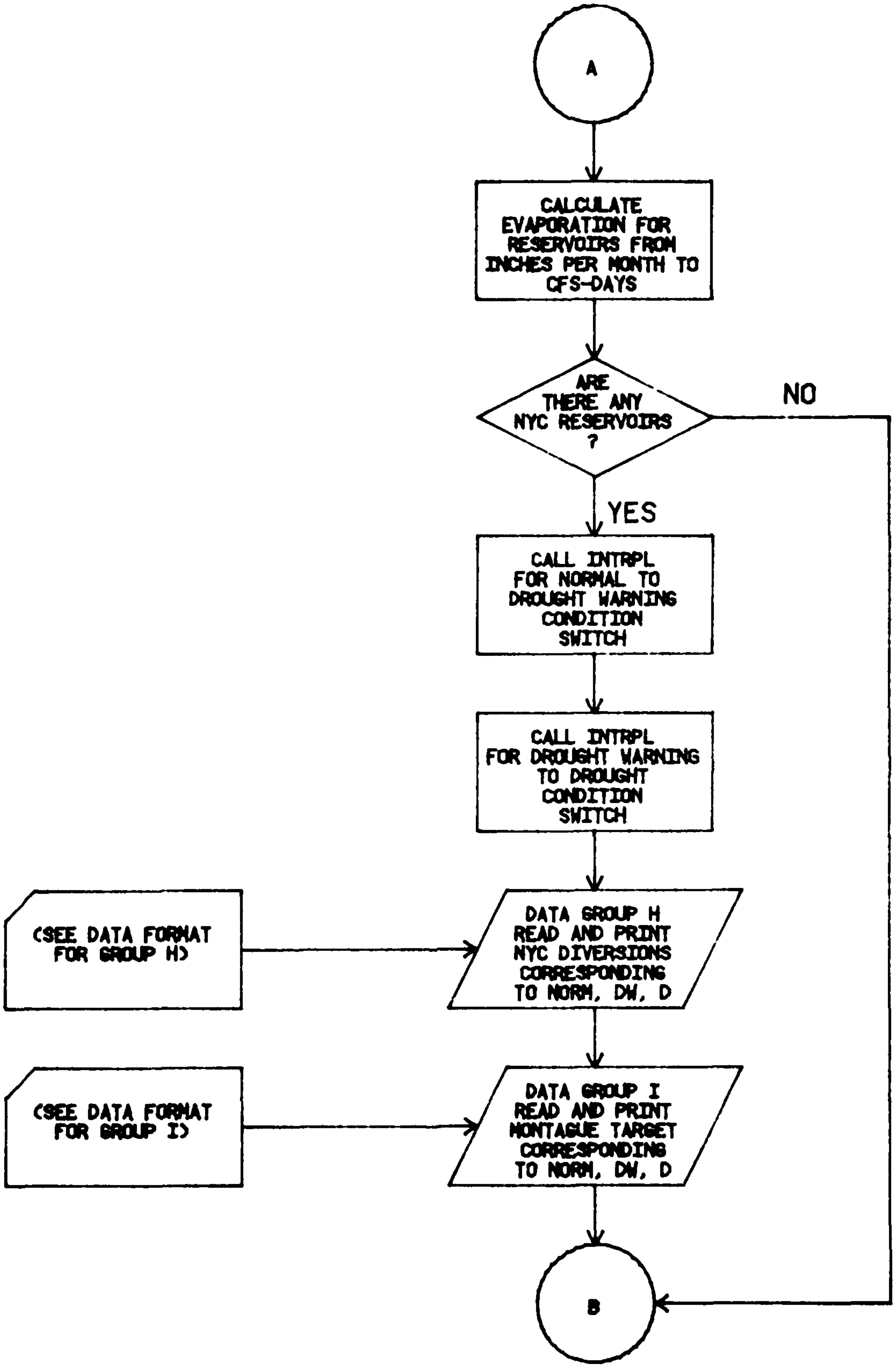

Figure II-2. Flowchart for Subroutine INDATA (Continued)

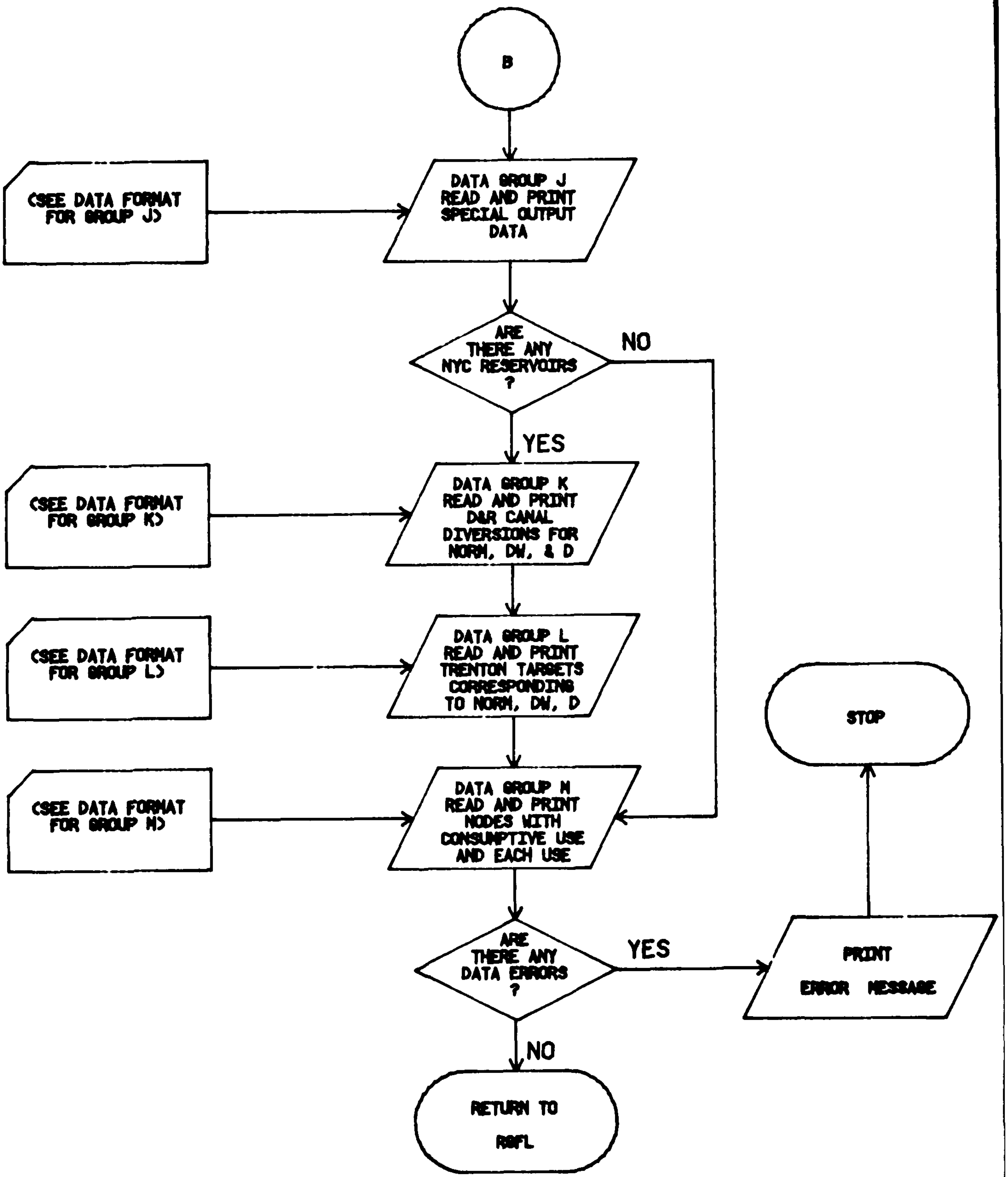

Figure II-2. Flowchart for Subroutine INDATA (Continued)

```
      SUBROUTINE INDATA
C ***********************************************************************
C                         INDATA READS THE INPUT DATA:
C           YEARS OF SIMULATION
C           NUMBER OF RESERVIORS
C           MODEL NODES AND LAG FUNCTION COEFFICIENTS
C           OUTPUT OPTIONS
C ***********************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /STOR/    STORE1(10),STORE2(10),STORE3(10),STORE4(10)
      COMMON /INOUT/   NTITLE1(10),NTITLE2(10),NTITLE3(10,100)
      COMMON /LAG/     QOUT(100),XM(100),B(100)
      COMMON /CAL/     CALIB1,JOUT,JMIN
      COMMON /PHAS2/   NYCRES,ICHK,STOREN(31,12),STORED(31,12),
     .                 DIVERS(3),OBJECT(3),EVP(12,10),IEVP,DFLOW(3),
     .                 TARG(3)
      COMMON /PADER/   ACONS(12,10),TRENT,YFLOW,REL(10),NSTEP,MDATE
      COMMON /CONSUM/  NCON,ICON(50),CLOSS(10,12)
      COMMON /OUTS/    NSPO
      COMMON /WALLIN/  MWL
      COMMON /FLAGS/   NTR,NDR,MER,MPR,MTG,MRES,NBEL,MBL
      DIMENSION MMON(12),NAMR(5)
      DATA MMON/31,28,31,30,31,30,31,31,30,31,30,31/
      WRITE(6,10)
10    FORMAT(1H1)
C ***** READ TWO TITLE CARDS                        A.K.A. 'A' CARDS
      READ(5,1300)AC,NTITLE1
      IF(AC.NE.1HA) GO TO 5100
      WRITE(6,1301)AC,NTITLE1
1300  FORMAT(A1,4X,10A4)
1301  FORMAT(1X,A1,4X,10A4)
      READ(5,1300) AC,NTITLE2
      IF(AC.NE.1HA) GO TO 5100
      WRITE(6,1301)AC,NTITLE2
      ICK=0
      ICK1=0
C ***** READ ONE CONTROL CARD                      A.K.A. 'B' CARD
      READ(5,1000)BC,ITAPE,NTAPE,NYEAR,CALIB1,NYCRES,JOUT,JMIN,MWL
      IF(BC.NE.1HB) GO TO 5200
      IF(CALIB1.EQ.0.) CALIB1=1.25
      IF(NYEAR.EQ.0) NYEAR=1
      WRITE(6,2998)BC,ITAPE,NTAPE,NYEAR,CALIB1,NYCRES,JOUT,JMIN,MWL
1000  FORMAT(A1,4X,3I5,F5.2,4I5)
2998  FORMAT(1X,A1,4X,3I5,F5.2,4I5)
C ***** READ UP TO 100 CHANNEL CARDS               A.K.A. 'C' CARDS
      DO 100 I=1,100
```

```
      READ(5,1100)CC,NAMEG(I),NGTO(I),XM(I),B(I),ICKK
      IF(CC.NE.1HC) GO TO 150
      WRITE(6,1101)CC,NAMEG(I),NGTO(I),XM(I),B(I),ICKK
      IF(NAMEG(I))5800,1120,1110
 1100 FORMAT(A1,4X,2I10,E10.4,F10.0,I10)
1101  FORMAT(1X,A1,4X,2I10,E10.4,F10.0,I10)
1110  IF(ICKK.EQ.2) ICK1=I
      IF(ICKK.EQ.1)ICK=I
      B(I)=B(I)/24.
      XM(I)=XM(I)/24.
  100 CONTINUE
  150 CONTINUE
1120  NOG=I-1
      CALL ORDER
      IF(ICK.EQ.0)ICK=NOG
      IF(ICK1.EQ.0)ICK1=NOG
      DO 2000 N=1,100
C ***** READ UP TO 100 CHANNEL OUTPUT CARDS      A.K.A.  'D' CARDS
C ***** NODES FOR WHICH YOU REQUEST OUTPUT
      READ(5,1200)DC,NOUTPT(N),(NTITLE3(NN,N),NN=1,10)
 1200 FORMAT(A1,4X,I5,10A4)
      IF(DC.NE.1HD) GO TO 5810
      WRITE(6,1201)DC,NOUTPT(N),(NTITLE3(NN,N),NN=1,10)
      IF(NOUTPT(N))5810,2100,2000
1201  FORMAT(1X,A1,4X,I5,10A4)
 2000 CONTINUE
 2100 CONTINUE
      NOUT=N-1
C ***** ENTER INFORMATION FOR UP TO 10 RESERVOIRS   A.K.A 'E' CARDS
      DO 3000 N=1,11
      NX=N+NOG
      READ(5,2200)E1C,IRES,VOLUME,LRES,AREA,(NAMR(IR),IR=1,5)
      IF(E1C.NE.2HE1) GO TO 5820
      WRITE(6,2201)E1C,IRES,VOLUME,LRES,AREA,(NAMR(IR),IR=1,5)
      IF(IRES) 5820,3500,2220
 2200 FORMAT(A2,3X,I5,E10.4,I10,F10.0,5A4)
2201  FORMAT(1X,A2,3X,I5,E10.4,I10,F10.0,5A4)
2220  IF(IRES.EQ.2155) MRES=N
C ***** FIND THE NODE WHERE THE REQUIRED RESERVOIR RELEASES ARE MADE
      DO 2210 NN=1,NOG
      IF(NAMEG(NN).EQ.LRES)GO TO 2215
 2210 CONTINUE
      WRITE(6,2211)LRES
 2211 FORMAT(19H NO MATCH FOR LRES   ,I5)
      STOP
 2215 LAGRES(N)=NN
      IF(LRES.EQ.1050)MPR=NN
      IF(LRES.EQ.1450)MBL=NN
      VOL(N)=VOLUME/86400.
      STORE(N)=VOL(N)
      STORE1(N)=STORE(N)
      STORE2(N)=STORE(N)
      STORE3(N)=STORE(N)
```

```
      STORE4(N)=STORE(N)
C ***** READ 3 OTHER RESERVOIR CARDS
C ***** FIRST IS THE BASIC CONSERVATION RELEASE
      READ(5,2250)(CONS(I,N),I=1,12)
      WRITE(6,2255)(CONS(I,N),I=1,12)
C ***** SECOND IS THE AUGMENTED CONSERVATION RELEASE
      READ(5,2250)(ACONS(I,N),I=1,12)
      WRITE(6,2255)(ACONS(I,N),I=1,12)
C ***** THIRD IS THE EVAPORATION IN INCHES PER MONTH
      READ(5,2250)(EVAP(I,N),I=1,12)
      WRITE(6,2255)(EVAP(I,N),I=1,12)
C ***** CHANGE EVAPORATION FROM INCHES/MONTH TO CFS-DAYS
C ***** 0.042=43560/(12*86400)
      DO 2260 I=1,12
      AMON=MMON(I)
 2260 EVAP(I,N)=EVAP(I,N)*AREA*0.042/AMON
      WRITE(6,2255)(EVAP(I,N),I=1,12)
C ***** STORE THE EVAPORATION VALUES TO BE USED WITH NYC INFLOWS
      DO 2245 IM=1,12
      EVP(IM,N)=EVAP(IM,N)
 2245 CONTINUE
 2250 FORMAT(5X,12F5.0)
 2255 FORMAT(12F10.2)
      IRES=IRES-1000
C ***** FIND THE NODE WHERE CONSERVATION RELEASES AND OVERFLOWS ARE MADE
      DO 2300 NN=1,NOG
      IF(NAMEG(NN).EQ.IRES)GO TO 2350
 2300 CONTINUE
      IRES=IRES+1000
      WRITE(6,2330)IRES
 2330 FORMAT(23H NO MATCH FOR RESERVOIR  ,I5)
      STOP
 2350 LNKRES(N)=NN
      NAMEG(NX)=IRES+1000
 3000 CONTINUE
      WRITE(6,3100)
 3100 FORMAT(21H TOO MANY RESERVOIRS    )
      STOP
 3500 CONTINUE
      NRES=N-1
      IF(NYCRES.LT.1) GO TO 3615
C ***** CALL INTRPL WHICH CALCULATES THE NORMAL AND DROUGHT CURVES
C ***** FOR THE NYC RESERVOIRS
      CALL INTRPL (STOREN)
      CALL INTRPL (STORED)
C ***** READ IN DIVERSION                         A.K.A. 'H' CARD
      READ(5,3600) CH,(DIVERS(I),I=1,3)
      IF(CH.NE.1HH) GO TO 5300
      WRITE(6,3601)CH,(DIVERS(I),I=1,3)
 3600 FORMAT(A1,4X,6F10.0)
3601  FORMAT(1X,A1,4X,6F10.0)
C ****** READ IN OBJECTIVE CARD                   A.K.A. 'I' CARD
      READ (5,3600)CI,(OBJECT(I),I=1,3)
```

```
      IF(CI.NE.1HI) GO TO 5400
      WRITE(6,3601)CI,(OBJECT(I),I=1,3)
      DO 3610 K=1,3
C ***** CONVERT DIVERSIONS  FROM MGD TO CFS
      DIVERS(K)=DIVERS(K)*1.5473
 3610 CONTINUE
3615  CONTINUE
C ***** READ THE SPECIAL OUTPUT SELECTIONS       A.K.A. 'J' CARDS
      READ(5,3999)CJ,NSPO
3999  FORMAT(A5,I5)
      WRITE(6,3979)CJ,NSPO
3979  FORMAT(1X,A5,I5)
      IF(CJ.NE.1HJ) GO TO 5900
      IF(NSPO)4011,4011,3989
3989  DO 4001 N=1,NSPO
      NNG=NOG+NRES+N
      NOUT=NOUT+1
      READ(5,1200) CJ,NOUTPT(NOUT),(NTITLE3(NN,NOUT),NN=1,10)
      WRITE(6,1201)CJ,NOUTPT(NOUT),(NTITLE3(NN,NOUT),NN=1,10)
      NAMEG(NNG)=NOUTPT(NOUT)
 4001 CONTINUE
C ***** READ D & R CANAL FLOW CHANGES            A.K.A 'K' CARD
4011  READ(5,1007)CK,(DFLOW(I),I=1,3)
      IF(CK.NE.1HK) GO TO 5500
      WRITE(6,1027)CK,(DFLOW(I),I=1,3)
1007  FORMAT(A1,4X,3F10.0)
1027  FORMAT(1X,A1,4X,3F10.0)
      IF(NYCRES) 5010,5010,5020
C ***** READ TRENTON TARGETS FOR OPERATING RULES   A.K.A. 'L' CARD
5020  READ(5,1007)CL,(TARG(I),I=1,3)
      IF(CL.NE.1HL) GO TO 5600
      WRITE(6,1027)CL,(TARG(I),I=1,3)
C ***********************************************************************
C       READ INPUT FOR CONSUMPTIVE LOSSES        A.K.A. 'M' CARDS
C       NCON = NUMBER OF NODES WITH CONSUMPTIVE LOSSES
C       ICON = NODE NUMBER
C       CLOSS = LOSSES SPECIFIED FOR EACH MONTH FOR EACH NODE
C ***********************************************************************
5010  READ(5,2001)CM,NCON
      IF(EOF(5))2003,1999
1999  CONTINUE
      IF(CM.NE.1HM) GO TO 5700
      WRITE(6,9999)CM,NCON
2001  FORMAT(A1,4X,I10)
9999  FORMAT(1X,A1,4X,I10)
      DO 6000 I=1,NCON
      READ(5,2002)ICON(I),(CLOSS(I,J),J=1,12)
6000  CONTINUE
2002  FORMAT(5X,I10,12F5.0)
C ***** FIND THE NODES WHERE THE CONSUMPTIVE LOSSES ARE MADE
      DO 6010 I=1,NOG
      DO 6010 K=1,NCON
      IF(ICON(K).EQ.NAMEG(I)) ICON(K)=I
```

```
 6010 CONTINUE
      DO 6020 I=1,NCON
      WRITE(6,2002)ICON(I),(CLOSS(I,J),J=1,12)
6020  CONTINUE
      RETURN
2003  NCON=0
      RETURN
 5000 CONTINUE
      RETURN
5100  WRITE(6,5101)
5101  FORMAT(54H  ERROR : TITLE 'A' CARD LEFT OUT : PROGRAM TERMINATED)
      STOP
5200  WRITE(6,5201)
5201  FORMAT(55H  ERROR : CONTROL CARD 'B' MISSING : PROGRAM TERMINATED)
      STOP
5300  WRITE(6,5301)
5301  FORMAT(59H  ERROR : NO DIVERSIONS-CHECK 'H' CARD : PROGRAM TERMINA
     .TED)
      STOP
5400  WRITE(6,5401)
5401  FORMAT(54H  ERROR : NO OBJECTIVE 'I' CARD : PROGRAM TERMINATED  )
      STOP
5500  WRITE(6,5501)
5501  FORMAT(57H  ERROR : NO DIVERSIONS TO D&R CANAL : PROGRAM TERMINATE
     .D )
      STOP
5600  WRITE(6,5601)
5601  FORMAT(68H  ERROR : NO 2ND TARGET FLOWS - CHECK 'L' CARD : PROGRAM
     .TERMINATED    )
      STOP
5700  WRITE(6,5701)
5701  FORMAT(69H  ERROR : INCORRECT INPUT FOR CONSUMPTIVE LOSSES : PROGR
     .AM TERMINATED)
      STOP
5800  WRITE(6,5801)
5801  FORMAT(57H  ERROR : NO 'ZERO' TO END 'C' CARDS : PROGRAM TERMINATE
     .D    )
      STOP
5810  WRITE(6,5811)
5811  FORMAT(63H  ERROR : INCORRECT FORMAT OF 'D' CARDS : PROGRAM TERMIN
     .ATED    )
      STOP
5820  WRITE(6,5821)
5821  FORMAT(77H  ERROR : INCORRECT FORMAT OF RESERVOIR INPUT 'E' CARD :
     . PROGRAM TERMINATED    )
      STOP
5900  WRITE(6,5901)
5901  FORMAT(53H  ERROR : SPECIAL OUTPUT MISSING : PROGRAM TERMINATED  )
      STOP
      END
@
```

Subroutine ORDER

Subroutine ORDER's flow chart is shown in Figure II-3. ORDER connects the upstream to downstream nodes by use of the order of the nodes, or "slots" that they fill. Specifically, a zero array is filled in such that all model nodes are connected to all those nodes flowing into them.

The process of filling in the array is geared to the downstream node. Each downstream node is checked against all the model nodes. When a match is made, the 2-dimensional zero array sets the appropriate element to a positive integer. The first subscript is the matched model node slot number. The second subscript is the counter of the upstream nodes. The element is equal to the slot number of the upstream node corresponding to that particular downstream node being checked. This results in a 2-dimensional array where the first subscript corresponds to a model node, the second subscript to the number of nodes flowing into it and the elements equaling those particular upstream nodes. Therefore, a headwater node would have only zeroes as its elements.

The following is a simplified example of the process of ORDER. Given a reach with six nodes as in the network shown in Figure II-3A, the upstream to downstream data would be input as in Table II-1.

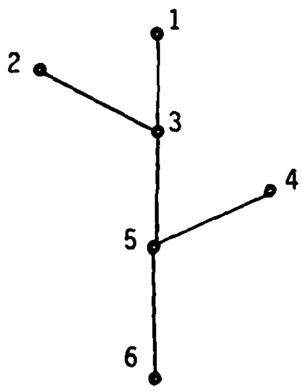

TABLE II-1
SAMPLE INPUT

Upstream	Downstream	Pair Number
1	3	(Pair 1)
2	3	(Pair 2)
3	5	(Pair 3)
4	5	(Pair 4)
5	6	(Pair 5)
6	0	(Pair 6)

Figure II-3A. Sample Network

When ordering the nodes, the process examines each pair of nodes. In the first pair, 1 is the upstream node and 3 is the downstream node. 3 is compared to all the model (upstream) nodes. It is equal to the upstream node in the 3rd pair in the list. The first element of the array to be filled in will be: (3,1)=1, which says that the first node to flow into 3 is 1. The second pair of nodes is then examined. Again the downstream node is 3 while the upstream node is now 2. 3 is again compared to all the model nodes. Again it matches the third pair. The next element to be filled in will be (3,2)=2. This says that the second node to flow into 3 is 2. The third pair is examined. The upstream node is now 3 and the downstream node is 5. 5 is compared to the model nodes and matches pair number 5. The third element to be filled in will be (5,1)=3. The first node to flow into 5 is 3. The fourth pair is examined, 5 is compared and matched to the fifth pair. The fourth element to be filled in is (5,2)=4. The second node to flow into 5 is 4. The last full pair is examined. The last element to be filled in is (6,1)=5. All elements not being set specifically to a positive value are equal to zero. The final array is given in Table II-2. ORDER returns to INDATA.

TABLE II-2

SAMPLE MATRIX

	Position of Nodes Flowing into Model Node				
Model Node	1	2	3	4	5
1	0	0	0	0	0
2	0	0	0	0	0
3	1	2	0	0	0
4	0	0	0	0	0
5	3	4	0	0	0
6	5	0	0	0	0

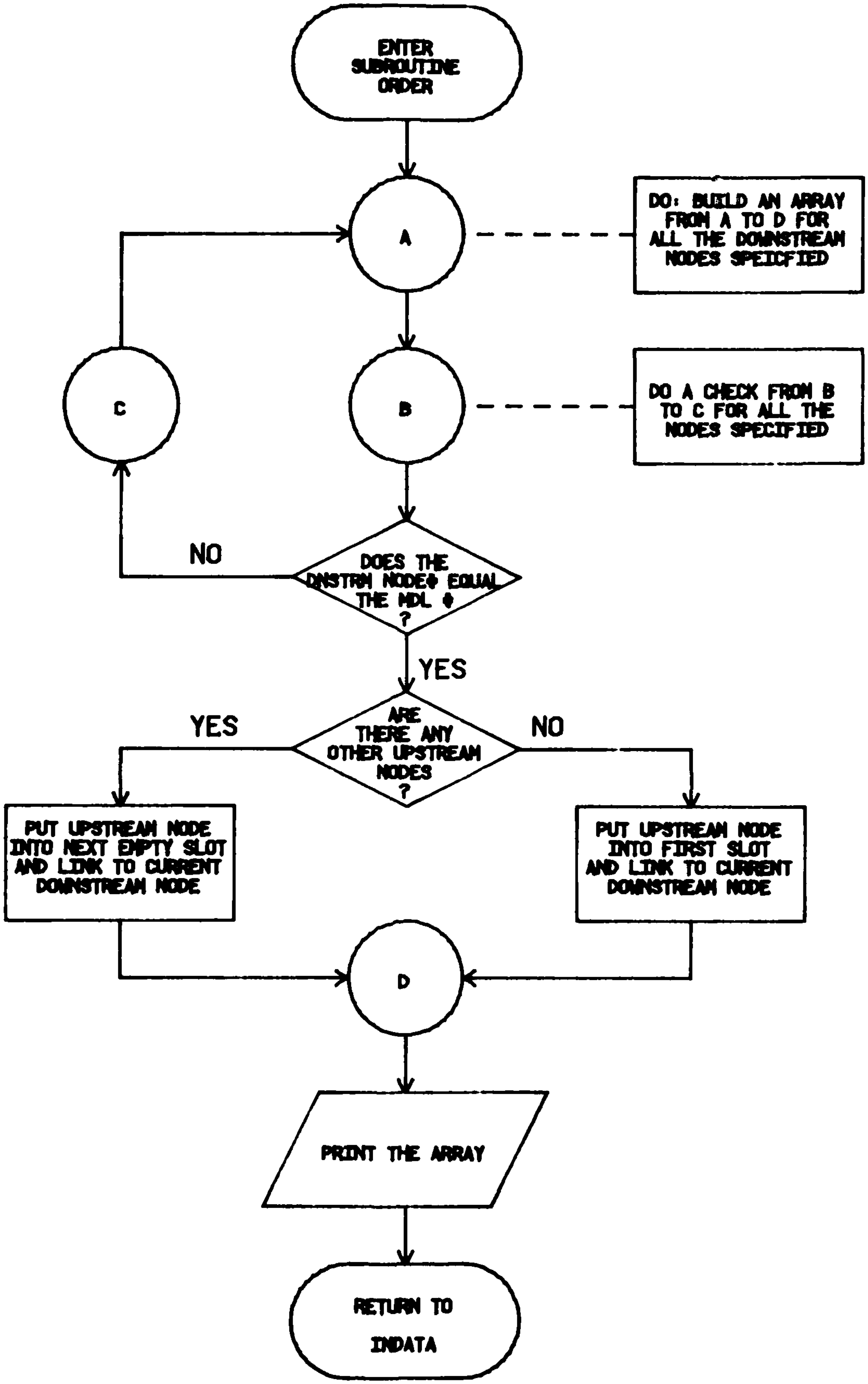

Figure II-3. Flowchart for Subroutine ORDER.

```
      SUBROUTINE ORDER
C ***********************************************************************
C               ORDER CREATES AN ARRAY THAT LINKS DOWNSTREAM NODES TO THE
C               UPSTREAM NODES FLOWING INTO IT.
C ***********************************************************************
C ***** ORDER CREATES AN ARRAY WITH THE NODES UPSTREAM OF EACH NODE
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      NG=100
      NLETS=0
      DO 750 N=1,NOG
      NN=NOG+NLETS
C ***** FIND WHICH NODE EACH NODE IS UPSTREAM OF AND
C ***** STORE IN THE NGTOG ARRAY
      DO 720 NGOTO=1,NN
      IF (NGTO(N).EQ.NAMEG(NGOTO)) GO TO 730
  720 CONTINUE
C ***** CREATE DUMMY GUTTERS AS NEEDED
C ***** NLETS  IS THE NUMBER OF END NODES IN THE MODEL RUN
      NLETS=NLETS+1
      NGOTO=NOG+NLETS
      NAMEG(NGOTO)=NGTO(N)
      IF (NGOTO.GT.NG) GO TO 760
  730 CONTINUE
      DO 740 J=1,10
C ***** BUILD THE NGTOG ARRAY
      IF(NGTOG(NGOTO,J).GT.0) GO TO 740
      NGTOG(NGOTO,J)=N
      GO TO 750
  740 CONTINUE
  750 CONTINUE
      NOG=NOG+NLETS
      GO TO 780
C ***** ERROR IN DATA
  760 WRITE(6,770) NGOTO,NG
  770 FORMAT(45H **** ERROR **** THE ASSIGNED CHANNEL NUMBERS  ,I5,
     1      24H WHICH INCLUDES DUMMIES,  ,
     2       33H EXCEEDS THE COMMON STORAGE BLOCK  ,I5)
      STOP
  780 CONTINUE
C ***** PRINT THE NGTOG ARRAY
      DO 1100 I=1,NOG
      WRITE(6,3000)I,NAMEG(I),NGTO(I),(NGTOG(I,J),J=1,10)
 3000 FORMAT(14I7)
 1100 CONTINUE
      RETURN
      END
```

Subroutine INTRPL

Subroutine INTRPL as shown in Figure II-4 is called from INDATA only if there are NYC reservoirs. It is called twice, the first time to define the storage level dividing line between Normal and Drought Warning conditions, the second time to define the storage level dividing line between Drought Warning and Drought conditions.

Each time it is called, it reads the beginning, ending and inflection points of the line between each set of conditions. It then determines for each day of the year the storage level that changes from Normal to Drought Warning and from Drought Warning to Drought and, of course, visa versa. INTRPL returns to INDATA.

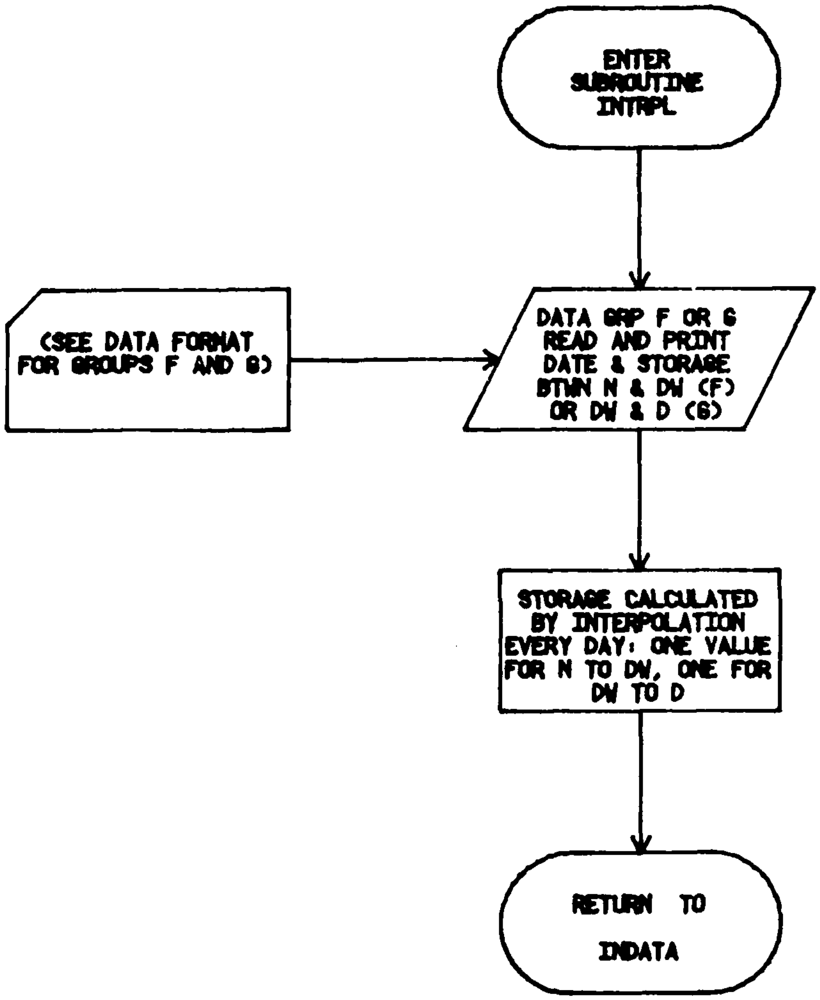

Figure II-4. Flowchart for Subroutine INTRPL.

```
      SUBROUTINE INTRPL(X)
C ***********************************************************************
C        THIS SUBROUTINE FIXES THE STORAGE LEVELS FOR DETERMINING THE
C        SYSTEM CONDITIONS, USED TO OPERATE THE NYC RESERVOIRS AND THE
C        D & R CANAL.
C ***********************************************************************
      DIMENSION X(31,12),FLOW(10),NDAY(10),MOKNT(13)
      DATA MOKNT /0,31,29,31,30,31,30,31,31,30,31,30,31/
      IMO11=1
      IMO1=2
      IDY1=1
      READ(5,100)FC,NCARDS
      IF(FC.NE.1HF.AND.FC.NE.1HG) GO TO 2100
      WRITE(6,101)FC,NCARDS
  100 FORMAT(A1,4X,I10)
101   FORMAT(1X,A1,4X,I10)
      READ(5,200) NMO,NDY,FLOW(1)
      WRITE(6,200) NMO,NDY,FLOW(1)
      FLOW(1)=FLOW(1)*1550.
      X(1,1)=FLOW(1)
      NDAY(1)=MOKNT(NMO)+NDY
  200 FORMAT(5X,2I5,F10.0)
      DO 1000 I=2,NCARDS
      READ(5,200) NMO,NDY,FLOW(I)
      WRITE(6,200) NMO,NDY,FLOW(I)
      FLOW(I)=FLOW(I)*1550.
      MONTHS=0
      DO 300 II=1,NMO
      MONTHS=MONTHS+MOKNT(II)
  300 CONTINUE
      NDAY(I)=MONTHS+NDY
      II=I-1
      DELDAY=NDAY(I)-NDAY(II)
      DELFLO=FLOW(I)-FLOW(II)
      SLOPE=DELFLO/DELDAY
      IIDY=DELDAY
      DO 500 IDY=1,IIDY
      IDY1=IDY1+1
      IF(IDY1.LE.MOKNT(IMO1))GO TO 400
      IMO1=IMO1+1
      IDY1=1
      IF(IMO1.GT.13)IMO1=2
      IMO11=IMO1-1
  400 CONTINUE
      X(IDY1,IMO11)=IDY*SLOPE+FLOW(II)
  500 CONTINUE
 1000 CONTINUE
      RETURN
2100  WRITE(6,2101)
2101  FORMAT(57H  ERROR : INCORRECT 'F' OR 'G' CARD : PROGRAM TERMINATED
     ,  )
      STOP
      END
```

Subroutine LINKER

Subroutine LINKER is called from RGFL to link the model nodes to the incremental inflow tape (IIT) nodes. Its flow chart is given in Figure II-5. It is essential that the model node numbers correspond to the tape node numbers that are given in Table III-2. The first block of information on the incremental inflow tape contains the node numbers. These are compared with all of the specified node numbers in the input data. If any do not match, a warning is printed, containing the node number of the unclaimed incremental inflow, on the tape.

Some model nodes are special and need to be flagged. They are Merrll Creek, a ficticious Belvidere where Merrill Creek skims and the D & R canal. Each of these has a special, hard-coded operation performed on it and therefore needs to be flagged. LINKER returns to RGFL.

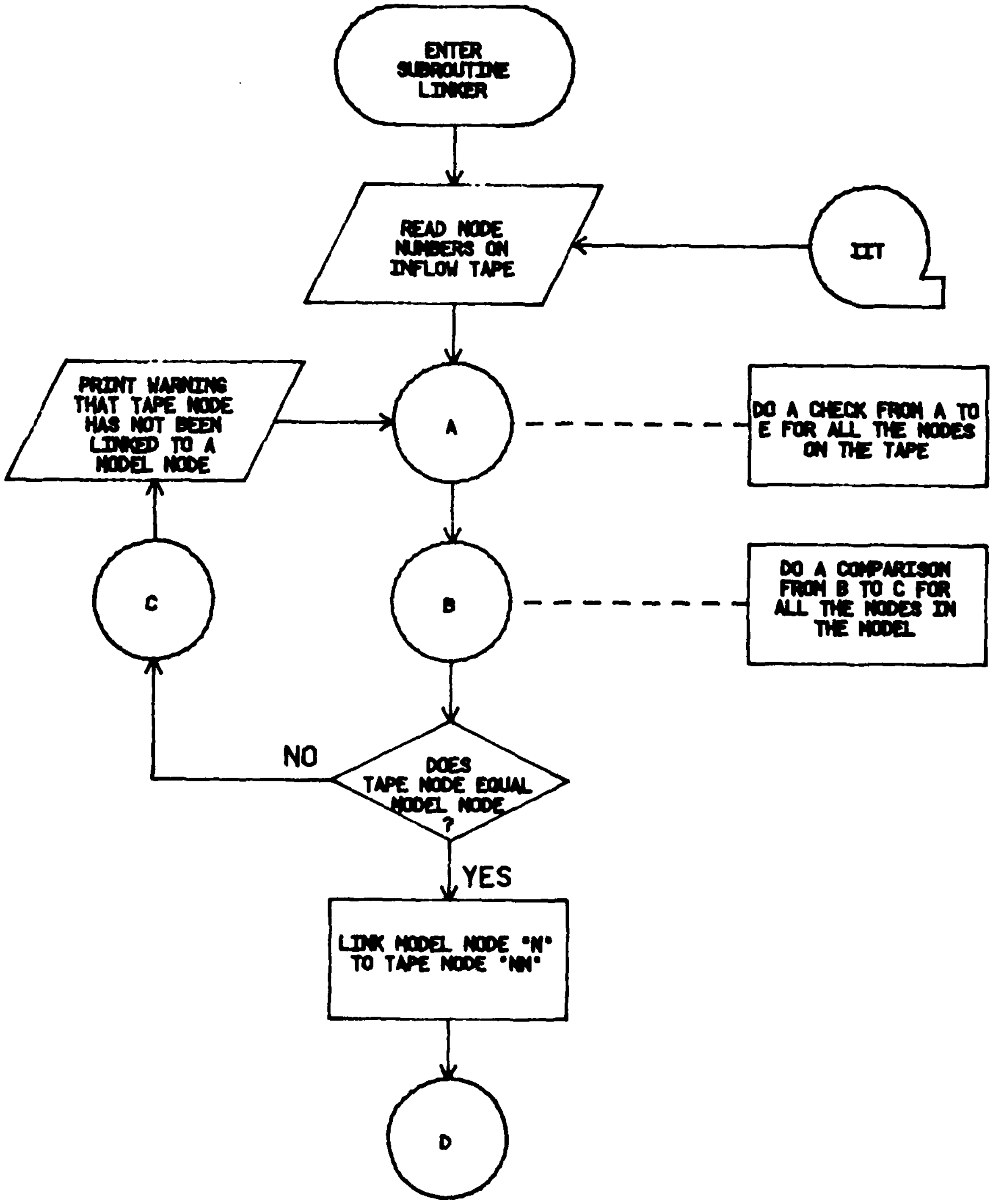

Figure II-5. Flowchart for Subroutine LINKER.

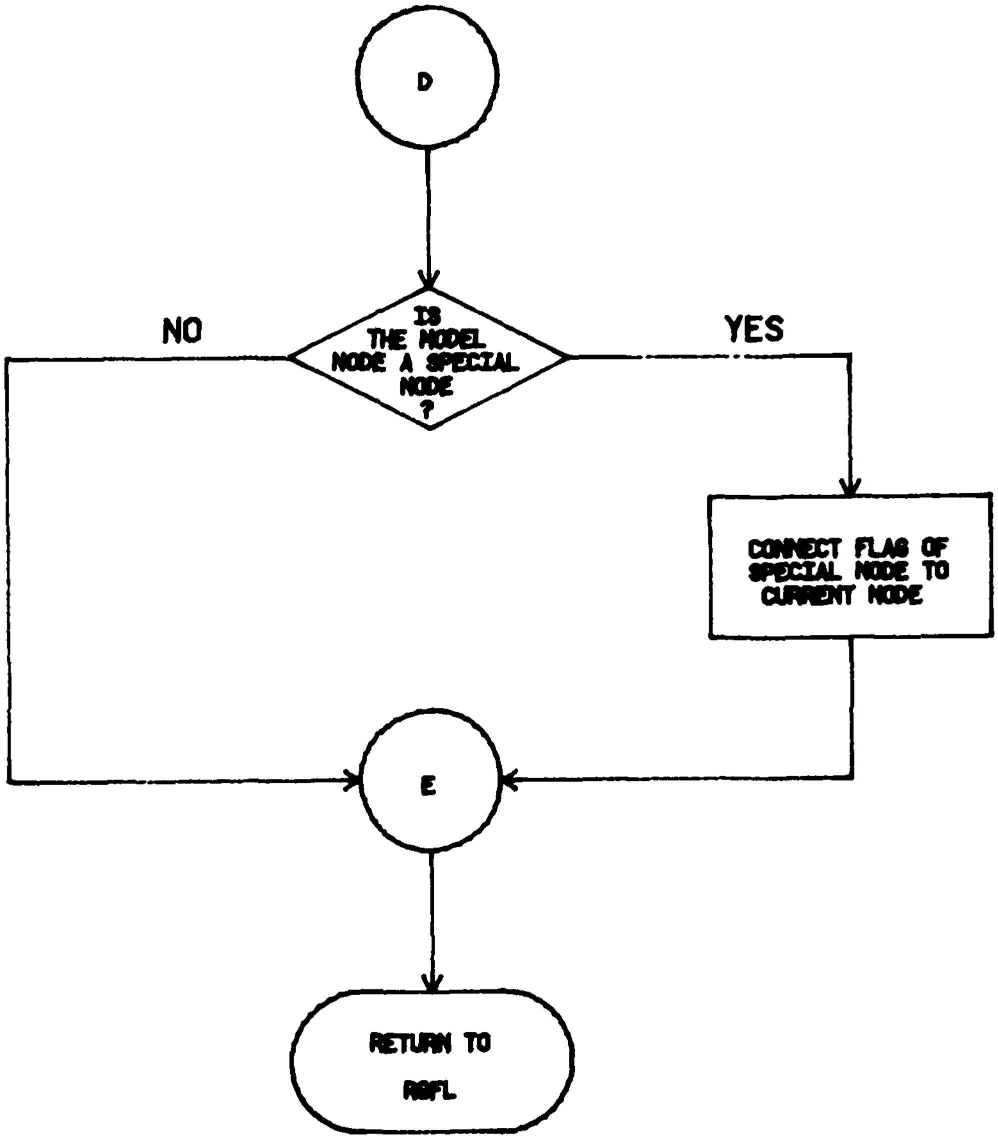

Figure II-5. Flowchart for Subroutine LINKER.
(Continued)

```
      SUBROUTINE LINKER
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /FLAGS/   NTR,NDR,MER,MPR,MTG,MRES,NBEL,MBL
      DIMENSION NODE(100)
C ***********************************************************************
C     THIS SUBROUTINE SORTS THE INFLOW INFORMATION, ASSIGNS IT TO THE
C     APPROPRIATE CHANNEL AND PRESERVES THE ORDER FOR REFERENCE
C     IN  SUBROUTINE INFLOW.
C ***********************************************************************
      NTR=0
      NDR=0
      MTG=0
      MER=0
      NBEL=0
      READ(ITAPE,50)NNODE
      READ(ITAPE,50)(NODE(N),N=1,NNODE)
   50 FORMAT(I5)
      DO 100 N=1,NNODE
      DO 200 NN=1,NOG
      IF (NODE(N).EQ.NAMEG(NN))GO TO 90
      IF(NAMEG(NN).EQ.1155) MER=NN
      IF(NAMEG(NN).EQ.1151) NBEL=NN
  200 CONTINUE
      WRITE(6,2000)NODE(N)
 2000 FORMAT(30H WARNING: NO MATCH FOR NODE   ,I4)
      GO TO 100
   90 LINK(NN)=N
      IF(NODE(N).EQ.1310)NTR=NN
      IF(NODE(N).EQ.1300)NDR=NN
      IF(NODE(N).EQ.1130)MTG=NN
  100 CONTINUE
      WRITE(6,150) NTR,NDR,MER,MPR,MTG,NBEL,MBL
150   FORMAT(///,1X,27HTHE TRENTON SLOT NUMBER IS ,I4,
     .         /,1X,29HTHE D&R CANAL SLOT NUMBER IS ,I4,
     .         /,1X,29HTHE MERRILL CR SLOT NUMBER IS,I4,
     .         /,1X,29HTHE PROMPTON SLOT NUMBER IS  ,I4,
     .         /,1X,29HTHE MONTAGUE SLOT NUMBER IS  ,I4,
     .         /,1X,29HTHE BELVIDERE SLOT NUMBER IS ,I4,
     .         /,1X,29HTHE BLUE MARSH SLOT NUMBER IS,I4)
      RETURN
      END
```

Subroutine INFLOW

Subroutine INFLOW is the first subroutine called within the daily loop. Its purpose is to link today's incremental inflows to the proper model nodes. Because the incremental inflows are input in the USGS format (station number followed by eight daily flows), a special routine is required. Figure II-6 shows the basic flowchart for INFLOW.

An 8-day counter is checked to see whether the next 8 days of inflows should be read. Once read in, today's inflows are set and linked to the proper node. If the counter is not at 8, there are three possibilities. One, if it is during the midweek then simply today's inflows are set. Two, if it is the last day of the month, the daily, monthly and yearly counters must be incremented properly and then today's inflows are set. Three, if the model is in backup, the counter will not be 8. However, backup is not checked unless it is the last day of the month. If both backup is occurring and it is the last day of the month, the next 8 days of inflows are read in without incrementing the daily, monthly and yearly counters.

It is possible, during a 50-year simulation to come to the end of the Incremental Inflow Tape (IIT) before the daily and yearly counters are finished. If this is the case, the simulation is ended with the message - END OF INPUT ENCOUNTERED IN INFLOW - and the output subroutines are called. Otherwise, INFLOW returns to RGFL.

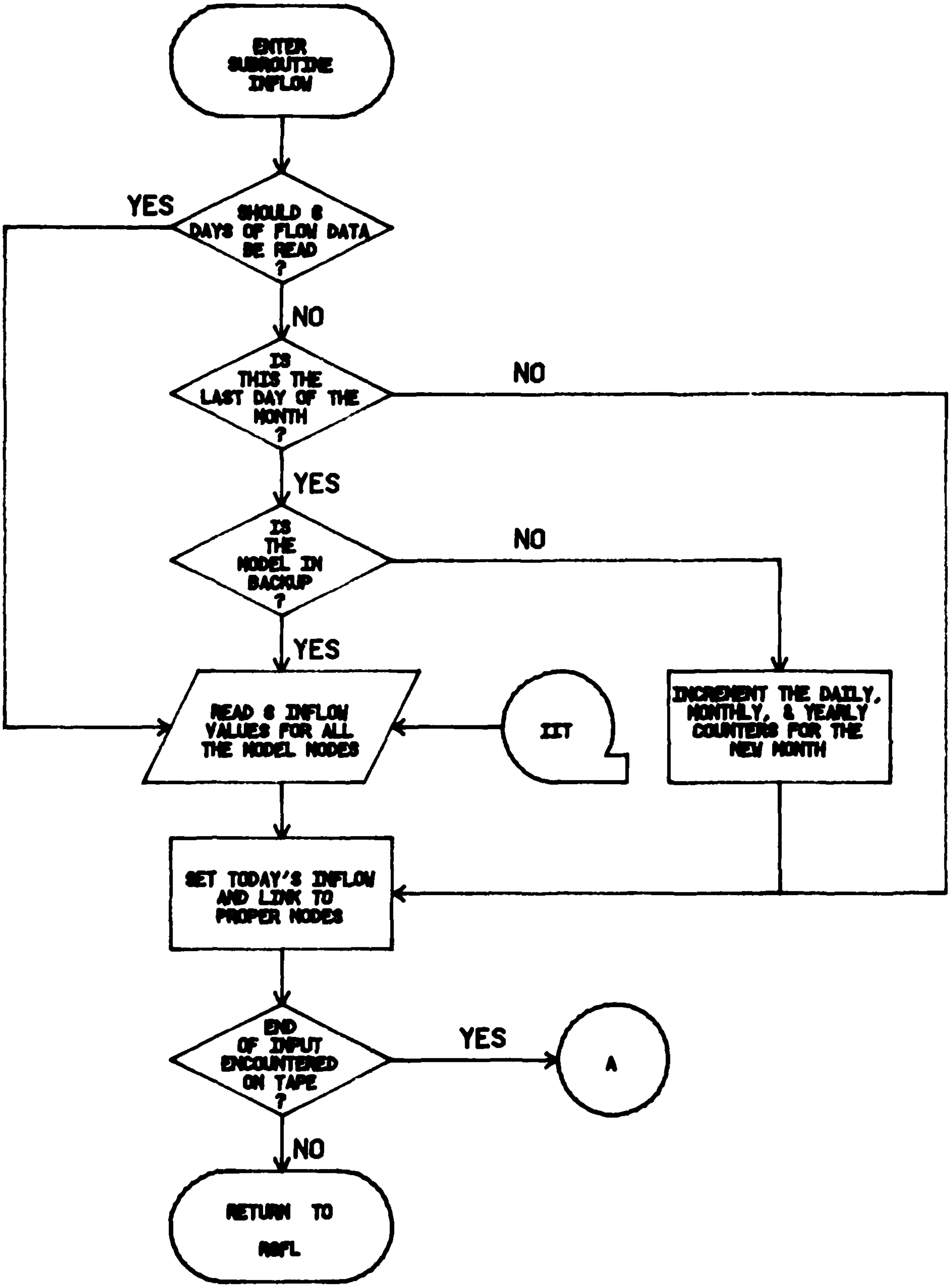

Figure II-6. Flowchart for Subroutine INFLOW.

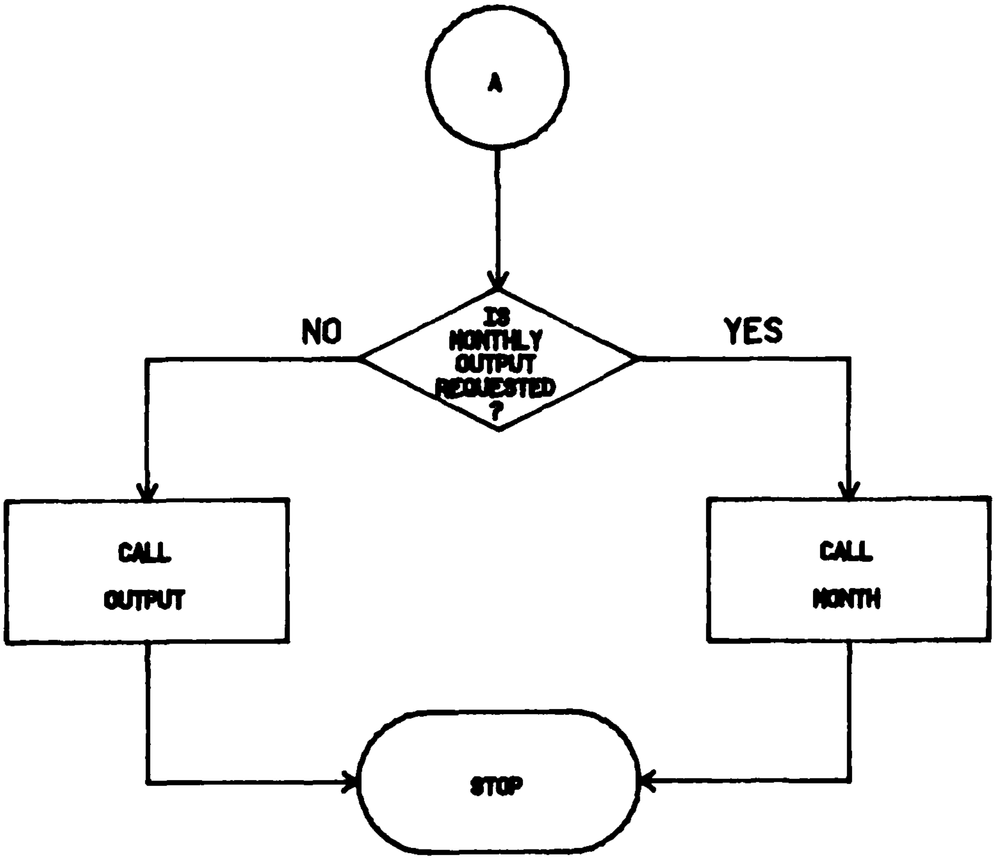

Figure II-6. Flowchart for Subroutine INFLOW.
(Continued)

```
      SUBROUTINE INFLOW
C ************************************************************************
C        INFLOW PROVIDES DAILY INCREMENTAL INFLOW TO ALL MODEL NODES
C        AND OPERATES WALLENPAUPACK WHEN SPECIFIED TO DO SO
C ************************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /CAL/     CALIB1,JOUT,JMIN
      COMMON /LAG/     QOUT(100),XM(100),B(100)
      COMMON /STOR/    STORE1(10),STORE2(10),STORE3(10),STORE4(10)
      COMMON /DATE/    IYR3,IMO3,IDY3,IYR2,IMO2,IDY2,IYR1,IMO1,IDY1,
     .                 Q1(100),Q2(100)
      COMMON /PADER/   ACONS(12,10),TRENT,YFLOW,REL(10),NSTEP,MDATE
      COMMON /BACKUP/  YF5,YF4,YF3,YF2,YF1
      COMMON /WALLIN/  MWL
      DIMENSION WALL(60)
      DIMENSION FLOW(10,65),KNT(12)
C ***** WALL CONTAINS THE STEPPED UP RELEASES FROM WALLENPAUPACK
C        DURING THE 1960'S DROUGHT
      DATA WALL/39.4,355.,291.,424.,549.,741.,70.,70.,70.,70.,  0.,18.4,
     1          365.,404.,243.,407.,346.,299.,70.,70.,70.,70.,415.,484.,
     2          302.,382.,236.,384.,470.,198.,70.,70.,70.,70.,  0.,  0.,
     3            0.,145.,320.,460.,494.,313.,70.,70.,70.,70.,  0.,8.36,
     4          390.,357.,277.,433.,422.,570.,70.,70.,70.,70.,357.,564./
      DATA KNT/7,4,7,6,7,6,7,7,6,7,6,7/
C ***** INCREMENT THE DAY OF THE WEEK BEING PROCESSED
      KOUNT=KOUNT+1
C ***** IF KOUNT = 8   A NEW WEEKS CARDS MUST BE READ
      IF(KOUNT-8)4,5,5
    4 CONTINUE
      IDAY=IDY-24
C ***** CHECK FOR THE LAST DAY OF THE MONTH AND FOR BACKUP OCCURRANCE
      IF(IDAY-KNT(IMO))30,1,3
    1 IF(IMO-2) 3,2,3
    2 IF(MOD(IYR,4).EQ.0)GO TO 30
    3 IF(IFLAG)5,21,6
    6 IF(IFLAG-1) 5,21,5
    5 CONTINUE
C ***** READ INFLOWS FOR THE NEXT WEEK AND SAVE THE INFLOWS OF THE
C ***** LAST 2 DAYS OF THE PREVIOUS WEEK
      DO 10 J=1,NNODE
      K9=KOUNT+1
      K10=KOUNT+2
C ***** SAVE THE LAST 2 DAYS VALUES IN THE FLOW ARRAY
      FLOW(1,J)=FLOW(K9,J)
      FLOW(2,J)=FLOW(K10,J)
   10 CONTINUE
   11 CONTINUE
C ***** READ ANOTHER WEEKS FLOWS
```

```
      DO 20 J=1,NNODE
      READ(ITAPE,15)IYR,IMO ,IDY,(FLOW(I,J),I=3,10)
      IF(EOF(ITAPE))2000,20
   15 FORMAT(18X,3I2,8F7.0)
   20 CONTINUE
      IF(MWL)23,23,223
C ***** FIX TO REPLACE WALLENPAUPACK RELEASES FROM JUNE'62 THROUGH MAY'67
223   NDATE=IYR*100+IMO
      IF(NDATE.LT.6206.OR.NDATE.GT.6705) GO TO 23
C ***** INCREMENT THE MONTHLY REPLACEMENTS
      IF(NDATE.NE.MDATE) NSTEP=NSTEP+1
      DO 201 I=3,10
      FLOW(I,11)=WALL(NSTEP)
  201 CONTINUE
      MDATE=NDATE
      GO TO 23
   21 CONTINUE
C ***** INCREMENT THE MONTHS DURING THE BACKUP PROCEDURE
      IMO=IMO+1
      IDY=1
      IF(IMO-13)23,22,23
   22 CONTINUE
      IMO=1
      IYR=IYR+1
   23 CONTINUE
C ***** RESET THE COUNTER AFTER READING A NEW WEEKS FLOWS
      KOUNT=0
      IDY=(IDY-1)*8
      GO TO 30
C ***** ENTRY POINT FOR BACKUP PROCEDURE
      ENTRY NEWFLO
      IF(NRES.EQ.0)RETURN
      WRITE(6,3000)IYR,IMO,IDY
 3000 FORMAT(22H LOW FLOW AT MONTAGUE   ,3I2)
C ***** RESET THE DATE TO THREE DAYS AGO
      IDY=IDY3-1
      IDY1=IDY3
      IMO1=IMO3
      IYR1=IYR3
      IMO=IMO3
      IYR=IYR3
      KOUNT=KOUNT-3
C ***** RESET TRENTON TARGET TO THREE DAYS AGO
      YFLOW=YF3
      YF1=YF4
      YF2=YF5
      YF3=YF6
C ***** CALCULATE XFLOW---THE RELEASE TO MONTAGUE
      XFLOW=CALIB1*(FLOWL-Q(ICK))
C ***** SET IFLAG TO COUNT THE DAYS UNTIL THE BACKUP IS OVER
      IFLAG=3
C ***** RESET THE FLOWS TO THREE DAYS AGO
      DO 25 K=1,NOGG
      Q1(K)=Q02(K)
```

```
      QOUT(K)=QO2(K)
   25 CONTINUE
C ***** RESET THE RESERVOIR LEVELS TO THREE DAYS AGO
      DO 27 K=1,NRES
      STORE1(K)=STORE4(K)
      STORE(K)=STORE4(K)
   27 CONTINUE
C ***** SET BLUE MARSH MAXIMUM VOLUME TO THE CORRECT LEVEI
C     IF(IMO.EQ.9) VOL(NRES)=11545.
C     IF(IMO.EQ.3) VOL(NRES)=8873.
      RETURN
   30 CONTINUE
C ***** INCREMENT FOR THE NEXT DAYS INFLOW
      IDY=IDY+1
      IPOINT=KOUNT+3
      DO 40 J=1,NNODE
      QIN(J)=FLOW(IPOINT,J)
   40 CONTINUE
 1001 CONTINUE
C ***** LINK THE NEW INFLOWS TO THE PROPER NODE
      DO 100 I=1,NOGG
      Q(I)=0.
      N=LINK(I)
      Q(I)=QIN(N)
  100 CONTINUE
      RETURN
 2000 WRITE(6,2100)
 2100 FORMAT(35H END OF INPUT ENCOUNTERED IN INFLOW       )
      IF(JOUT)2200,2300,2400
2200  CALL OUTPUT
      GO TO 2500
2300  CALL MONTH
      GO TO 2500
2400  CALL MONTH
      CALL OUTPUT
2500  CONTINUE
      STOP
      END
```

Subroutine ROUTE

Before all of the flows can be routed, the reservoir releases must be calculated. As shown in Figure II-7, ROUTE calls RESOP immediately after defining the lag functions. Next, any consumptive losses are subtracted from the appropriate node. Finally, the flows are lagged and added from upstream to downstream and at each downstream node, the incremental inflows are added in. ROUTE returns to RGFL. Immediately upon return, the flows are written on an output tape, providing the model is not backing up.

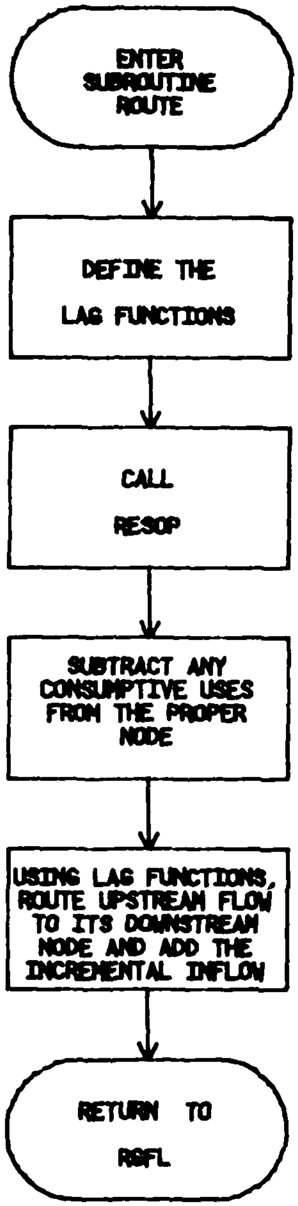

Figure II-7. Flowchart for Subroutine ROUTE.

```
      SUBROUTINE ROUTE
C ***********************************************************************
C       SUBROUTINE ROUTE LAGS THE FLOWS FROM UPSTREAM TO DOWNSTREAM
C       AND ADDS IN THE PROPER INCREMENTAL INFLOWS.  ROUTE CALLS RESOP
C       TO OPERATE THE RESERVOIRS IN ORDER TO DETERMINE THEIR DOWNSTREAM
C       FLOWS
C ***********************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /LAG/     QOUT(100),XM(100),B(100)
      COMMON /CONSUM/  NCON,ICON(50),CLOSS(10,12)
C ***** DEFINE THE LAG FUNCTIONS
      XLAG(I)=Q(I)*XM(I)+B(I)
      YLAG(I)=QOUT(I)*XM(I)+B(I)
C ***** CALL RESOP---OPERATE THE RESERVOIRS
      CALL RESOP
C ***** SUBTRACT THE CONSUMPTIVE LOSSES FROM SELECTED NODES
      IF(NCON.EQ.0) GO TO 951
      DO 950 I=1,NCON
      II=ICON(I)
      Q(II)=Q(II)-CLOSS(I,IMO)
950   CONTINUE
951   CONTINUE
C ***** FIND THE UPSTREAM NODES FOR EACH NODE AND LAG AND
C ***** ADD THE FLOWS FROM THE UPSTREAM NODES
      DO 900 I=1,NOGG
      DO 100 II=1,10
      IF(NGTOG(I,II).EQ.0)GO TO 101
      III=NGTOG(I,II)
      Q(I)=Q(I)+QOUT(III)*YLAG(III)+Q(III)*(1.0-XLAG(III))
  100 CONTINUE
  101 CONTINUE
  900 CONTINUE
      DO 1000 I=1,NOGG
C ***** Q(I) IS THE DAILY FLOW AT EACH NODE
C ***** QOUT(I) SAVES THE DAILY FLOW ARRAY FOR THE NEXT DAYS PROCESSING
      QOUT(I)=Q(I)
 1000 CONTINUE
      RETURN
      END
```

Subroutine RESOP

Subroutine RESOP whose flowchart is given in Figure II-8 operates the reservoirs and makes releases to augment both the Montague and Trenton flows.

Upon entering RESOP, the beginning of the month is checked. If it is the first day of the month, three things occur: 1) If Blue Marsh is included, its maximum storage is changed because a higher reservoir level is maintained during the summer months for recreation purposes; 2) The Special Outputs that require the beginning storage levels are set for all reservoirs to the current storage and; 3) The previous month's minimum storage is saved for output purposes.

On every new day, the System Condition is determined using the total beginning NYC reservoir storage. The condition will not be changed during backup. The System Condition then specifies the amount of the diversions and the objectives.

The next logical step is to calculate new storages using inflow, conservation releases and evaporation factors. Before this can be done the NYC evaporation needs to be set. Because the net inflow values are available for the NYC reservoirs after they are put on line, evaporation must be set to zero for that particular reservoir at the appropriate date. Once this is done, the new storages for all the reservoirs are calculated.

First the NYC diversion is taken from the fullest NYC reservoir and its new storage calculated. Then any release needed to maintain the Montague flow is taken from the fullest NYC reservoir, using the new storage just calculated. Next, any release needed to augment Trenton is taken from the fullest lower basin reservoir.

Merrill Creek is an optional reservoir. If it is online, the Trenton flow is checked: if the flow is less than 3100 cfs, Merrill Creek releases 126.9 cfs to Riegelsville. If the flow is greater than 3200 cfs, Merrill Creek skims from Belvidere to replenish its storage.

Prompton reservoir being located above Montague will change the NYC reservoirs' releases if the Montague objective does not also change. At this point in RESOP, this is done. The natural inflow to Prompton is routed down to Montague without taking into account any incremental inflows from further down the basin using the actual route times. The total releases from Prompton reservoir are then also routed in the same manner. The difference is determined and then added to the Montague target. A positive change indicates that the Prompton reservoir releases are greater than the natural Prompton flow. The objective increases so that these releases move on down to Trenton and are not used to augment Montague's flow. A negative change indicates the opposite: Prompton's natural flow was greater than the reservoir releases and therefore the model reduces the Montague target objective to keep the reservoirs from releasing more than they should under conditions when Prompton was not included.

The final function of RESOP is to save the Special Outputs. These Special Outputs are different from the flows at any particular node. They consist of total storages, releases neded to maintain Montague or Trenton, minimum monthly storages and other various requests. They are hard-coded into the program but can be changed easily. RESOP returns to ROUTE.

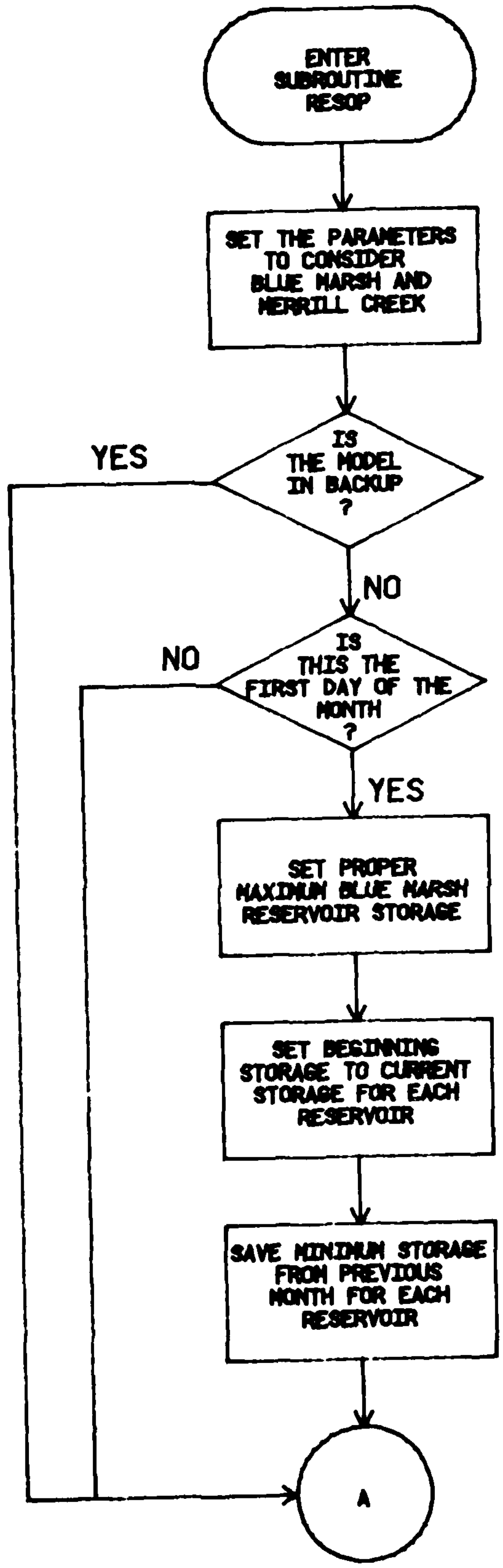

Figure II-8. Flowchart for Subroutine RESOP.

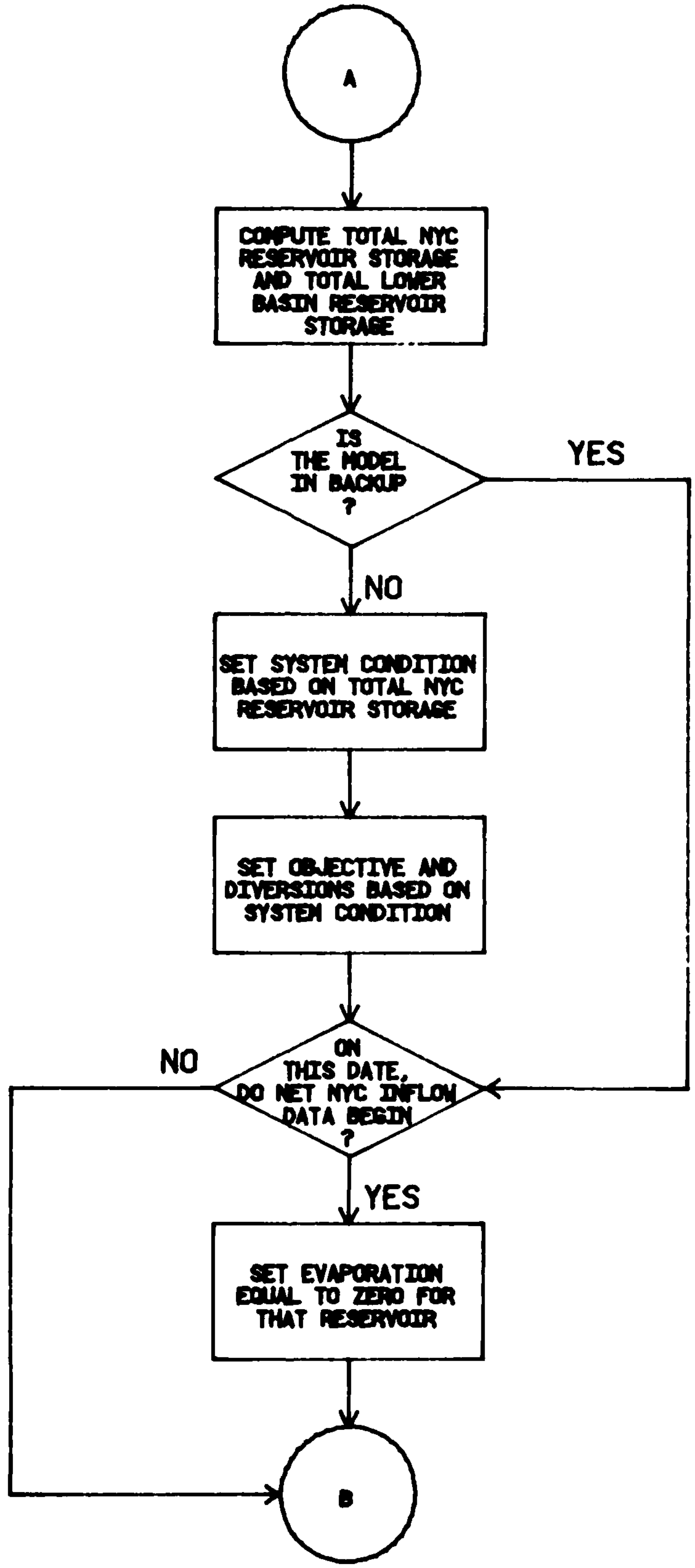

Figure II-8. Flowchart for Subroutine RESOP. (Continued)

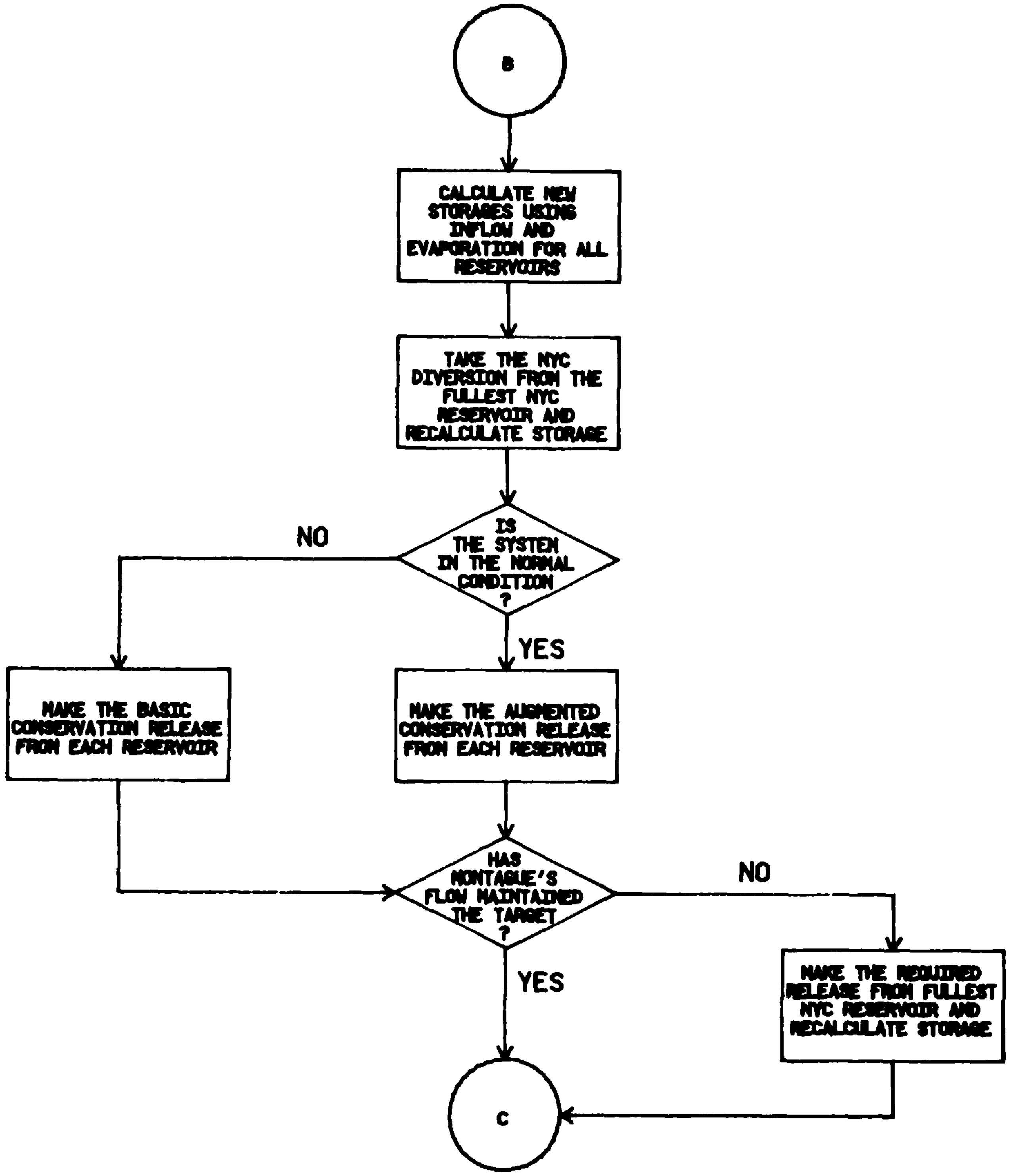

Figure II-8. Flowchart for Subroutine RESOP. (Continued)

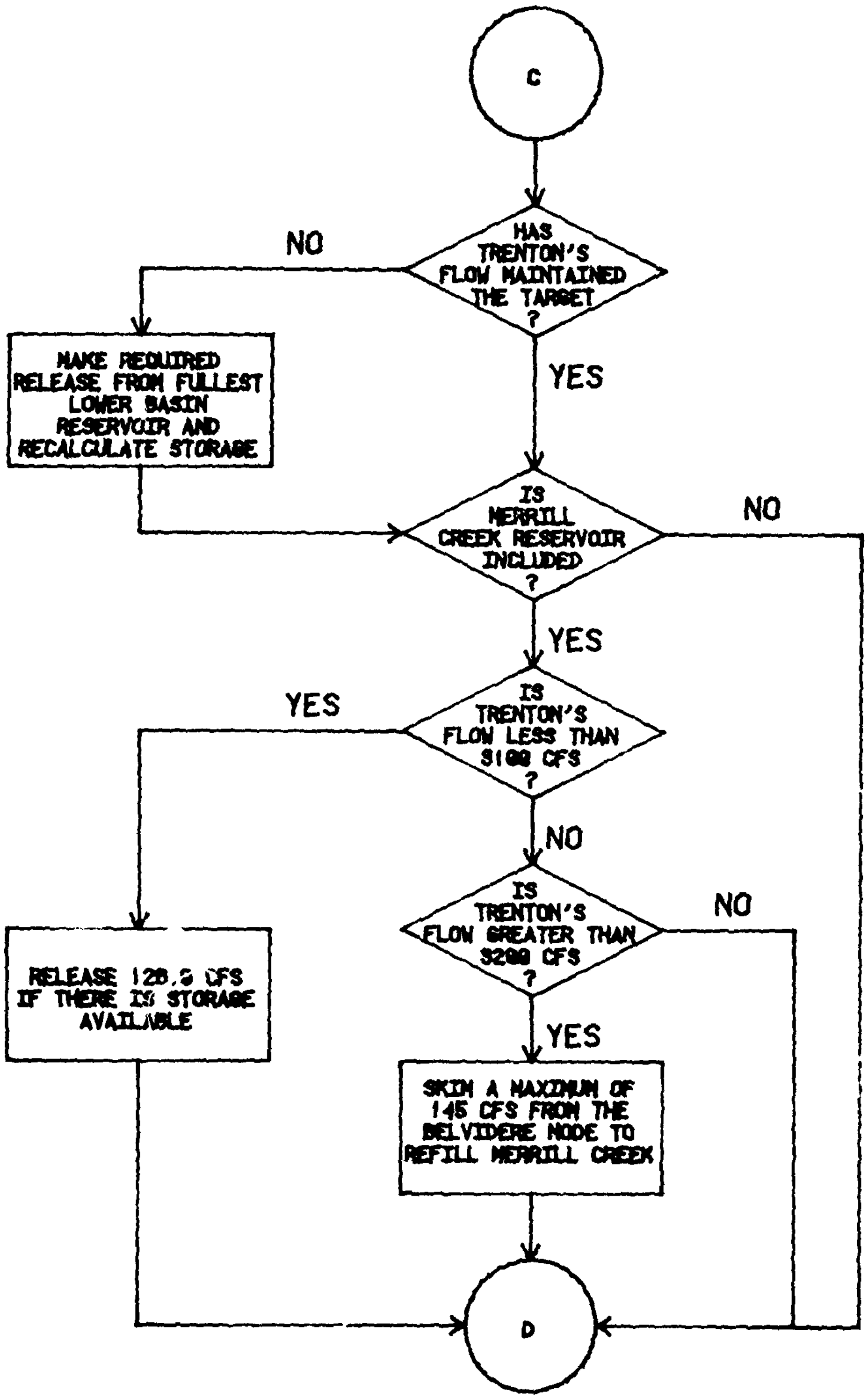

Figure II-8. Flowchart for Subroutine RESOP.
(Continued)

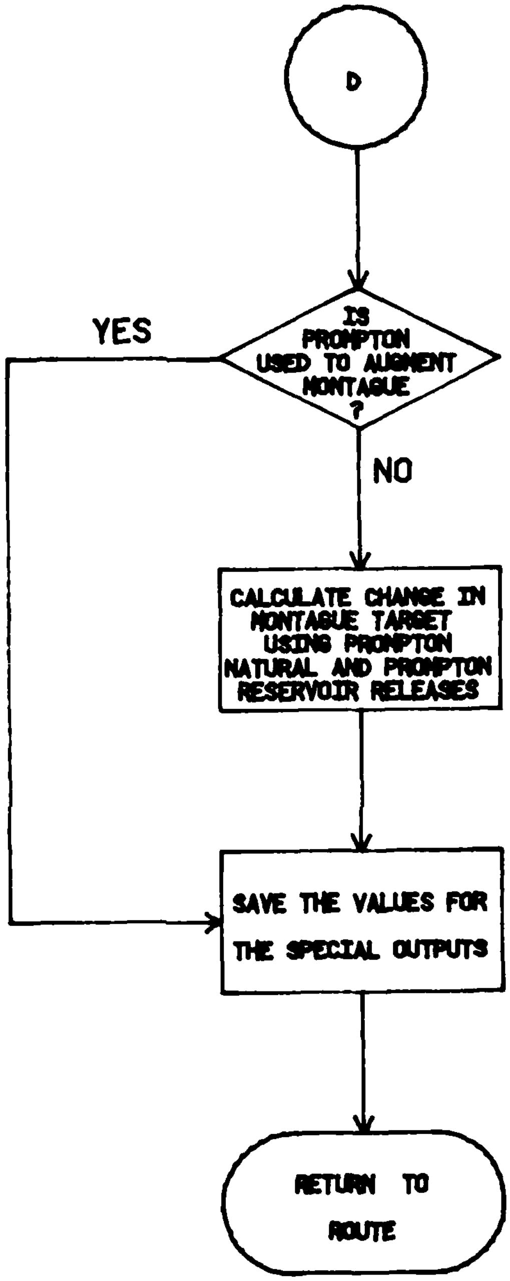

Figure II-8. Flowchart for Subroutine RESOP. (Continued)

```
      SUBROUTINE RESOP
C ***********************************************************************
C        RESOP OPERATES THE RESERVOIRS IN THE MODEL
C        1) CONSERVATION RELEASES ARE MADE---BASIC OR AUGMENTED
C        2) RELEASES ARE MADE AND DIVERSIONS AND EVAPORATION
C           ARE SUBTRACTED EACH DAY
C ***********************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /PHAS2/   NYCRES,ICHK,STOREN(31,12),STORED(31,12),
     .                 DIVERS(3),OBJECT(3),EVP(12,10),IEVP,DFLOW(3),
     .                 TARG(3)
      COMMON /PADER/   ACONS(12,10),TRENT,YFLOW,REL(10),NSTEP,MDATE
      COMMON /FLAGS/   NTR,NDR,MER,MPR,MTG,MRES,NBEL,MBL
      COMMON /DATE/    IYR3,IMO3,IDY3,IYR2,IMO2,IDY2,IYR1,IMO1,IDY1,
     .                 Q1(100),Q2(100)
      COMMON /MOMIN/   QMM(12,50,10),QMIN(10)
      DIMENSION WIT(10),IDATE(10),QBS(10)
      DIMENSION FXM(3),FB(3),SPL(10)
      DATA FXM/-1.4221E-05,-6.7208E-06,-4.8167E-06/
      DATA FB/.0833,.2083,.4583/
C ***** IDATE CONTAINS THE SWITCH DATES FOR TURNING ON AND OFF
C        NYC RESERVOIR EVAPORATION WITH THE NYC INFLOW DATA
      DATA IDATE/530701,540101,540201,540917,550601,550701,
     .           590801,600101,631001,771001/
C ***** SET LAG FUNCTIONS FOR DTARG CALCULATIONS
      FKLX(I)=QFK(I)*FXM(I)+FB(I)
      FKLR(I)=QPR(I)*FXM(I)+FB(I)
      FKLY(I)=QFKO(I)*FXM(I)+FB(I)
      FKRY(I)=QPRO(I)*FXM(I)+FB(I)
C ***** IF THERE ARE NO RESERVOIRS, RETURN TO MAIN PROGRAM
      IF (NRES.EQ.0) RETURN
      NRES1=NRES
C ***** FOR BLUE MARCH INCLUSION, MUST NOT USE IT TO MEET TRENTON FLOW
      IF(MBL)2,2,1
1     NRES1=NRES-1
C ***** IF IN BACKUP, SKIP THE RESETTING OF QMIN AND BLUE MARSH
2     IF(IFLAG.GT.0) GO TO 10
C ***** FIND THE BEGINNING MONTH STORAGE AND START SEARCHING FOR MINIMUM
      IF(IDY-1) 10,20,10
C ***** CHANGE BLUE MARSH STORAGE LEVEL FROM SUMMER TO WINTER
20    IF(MBL)45,45,21
21    IF(IMO.LT.4.OR.IMO.GT.9) GO TO 40
      VOL(NRES)=11545.
      GO TO 45
40    VOL(NRES)=8873.
45    DO 25 I=1,NRES
      QBS(I)=STORE(I)
      IF(IMO-11)50,55,55
```

```
50     IMF=IMO+2
       IYF=IYR-27
       GO TO 35
55     IMF=IMO-10
       IYF=IYR-26
35     IF(IMF)10,10,36
36     QMM(IMF,IYF,I)=QMIN(I)*0.00064627
25     QMIN(I)=9999999.
10     CONTINUE
       DO 30 I=1,NRES
       SPL(I)=0.
30     QMIN(I)=AMIN1(QMIN(I),STORE(I))
       XNYC=0.
       QTOT=0.
       QVOL=0.
       QTOTA=0.
       PRIN=Q(MPR)
       IF(NYCRES.LT.1) GO TO 101
C ***** COMPUTE TOTAL STORAGE AVAILABLE IN THE NYC RESERVOIRS
       DO 100 N=1,NYCRES
  100  QTOT=QTOT+STORE(N)
101    CONTINUE
       IF(NRES.EQ.NYCRES) GO TO 104
C ***** COMPUTE TOTAL STORAGE AVAILABLE FOR ALL OTHER RESERVOIRS
       KRES=NYCRES+1
       IF(MER.NE.0) KRES=KRES+1
       DO 103 N=KRES,NRES1
       QTOTA=QTOTA+STORE(N)
       QVOL=VOL(N)+QVOL
103    CONTINUE
104    CONTINUE
       IF(IFLAG.GE.0)GO TO 205
       IOLD=ICHK
       ICHK=2
       IF(NYCRES.LT.1) GO TO 1001
       IF(QTOT.GT.STOREN(IDY,IMO)) ICHK=1
       IF(QTOT.LT.STORED(IDY,IMO)) ICHK=3
  205  CONTINUE
       FLOWL=OBJECT(ICHK)
       WITHH=DIVERS(ICHK)
       TRENT=TARG(ICHK)
       Q(NDR)=-DFLOW(ICHK)
C ***** SKIP SWITCHING EVAPORATION ON AND OFF IF NYCRES DOES NOT EQUAL 3
       IF(NYCRES.NE.3) GO TO 420
       IF(IYR.LT.53.OR.IYR.GT.63) GO TO 420
       NDATE=IYR*10000+IMO*100+IDY
       IF(NDATE.EQ.IDATE(IEVP)) GO TO (310,330,310,350,370,350,
     .                                 330,310,390,420),IEVP
       GO TO 420
C ***** EVAPORATION SWITCH FOR NEVERSINK
  310  DO 320 IM=1,12
       EVAP(IM,3)=0.
       EVAP(IM,1)=0.
  320  CONTINUE
```

```
      GO TO 410
  330 DO 340 IM=1,12
      EVAP(IM,3)=EVP(IM,3)
  340 CONTINUE
      GO TO 410
C ***** EVAPORATION SWITCH FOR PEPACTON
  350 DO 360 IM=1,12
      EVAP(IM,1)=0.
  360 CONTINUE
      GO TO 410
  370 DO 380 IM=1,12
      EVAP(IM,1)=EVP(IM,1)
  380 CONTINUE
      GO TO 410
C ***** EVAPORATION SWITCH FOR CANNONSVILLE
  390 DO 400 IM=1,12
      EVAP(IM,2)=0.
  400 CONTINUE
  410 CONTINUE
      IF(IFLAG.GE.0) GO TO 420
      WRITE(6,411) IEVP,NDATE
  411 FORMAT(24H EVAPORATION SWITCH NO. ,I2,11H THROWN ON ,I6)
      IEVP=IEVP+1
  420 CONTINUE
      DO 430 I=1,NRES
  430 WIT(I)=0.
      QSAV=-300.
      DO 1000 II=1,NYCRES
      IX=NOGG+II
      IF(Q(IX).LT.QSAV) GO TO 1000
      QSAV=Q(IX)
      NSAV=II
 1000 CONTINUE
1001  CONTINUE
      WIT(NSAV)=WITHH
      DO 2000 N=1,NRES
      NN=LNKRES(N)
      STORE(N)=STORE(N)+Q(NN)
      STORE(N)=STORE(N)-EVAP(IMO,N)-WIT(N)
 2000 CONTINUE
      IF(ICHK.EQ.1) GO TO 3001
C ***** MAKE BASIC CONSERVATION RELEASES
      DO 3000 N=1,NRES
      NN=LNKRES(N)
      IN=NOGG+N
      Q(NN)=STORE(N)-VOL(N)
      IF(Q(NN)-CONS(IMO,N)) 2100,2400,2300
2100  Q(NN)=CONS(IMO,N)
      GO TO 2400
C ***** OPTIONAL OUTPUT : SPILLS ARE COMPUTED FOR EVERY RESERVOIR
2300  SPL(N)=Q(NN)-CONS(IMO,N)
2400  STORE(N)=STORE(N)-Q(NN)
      Q(IN)=STORE(N)/VOL(N)*100.
 3000 CONTINUE
```

```
      GO TO 121
 3001 CONTINUE
C ***** MAKE AUGMENTED RELEASES
      DO 3002 N=1,NRES
      NN=LNKRES(N)
      IN=NOGG+N
      Q(NN)=STORE(N)-VOL(N)
      IF(Q(NN)-ACONS(IMO,N)) 2500,2800,2700
2500  Q(NN)=ACONS(IMO,N)
      GO TO 2800
2700  SPL(N)=Q(NN)-ACONS(IMO,N)
2800  STORE(N)=STORE(N)-Q(NN)
      Q(IN)=STORE(N)/VOL(N)*100.
 3002 CONTINUE
  121 CONTINUE
      DO 3004 I=1,NRES
 3004 REL(I)=0.
C ***** BEGIN CALCULATION OF RELEASE REQUIRED TO MAINTAIN
C ***** 2ND TARGET'S FLOW
      IF(YFLOW) 3008,3008,3005
 3005 CONTINUE
      QSAV=-300.
      DO 3006 N=KRES,NRES1
      NT=NOGG+N
      IF(Q(NT).LT.QSAV) GO TO 3006
      NFULL=N
      QSAV=Q(NT)
3006  CONTINUE
      REL(NFULL)=YFLOW
      NN=LAGRES(NFULL)
      IN=NOGG+NFULL
      STORE(NFULL)=STORE(NFULL)-REL(NFULL)
      Q(NN)=Q(NN)+REL(NFULL)
      Q(IN)=STORE(NFULL)/VOL(NFULL)*100.
 3007 CONTINUE
 3008 CONTINUE
C ***** BEGIN TO COMPUTE RELEASE REQUIRED TO MAINTAIN 1ST TARGET'S FLOW
      IF(XFLOW)5000,5000,4100
4100  QSAV=-300.
      DO 4000 II=1,NYCRES
      IX=NOGG+II
      IF(Q(IX).LT.QSAV)GO TO 4000
      QSAV=Q(IX)
      ISAV=II
 4000 CONTINUE
      REL(ISAV)=XFLOW
      NN=LAGRES(ISAV)
      IN=NOGG+ISAV
      Q(NN)=XFLOW+Q(NN)
      STORE(ISAV)=STORE(ISAV)-XFLOW
      Q(IN)=STORE(ISAV)/VOL(ISAV)*100.
 5000 CONTINUE
C ***** MERRILL CREEK OPTION
      IF(MER.EQ.0) GO TO 5500
```

```
      IF(ZFLOW)5510,5520,5520
5510  IN=NOGG+MRES
      IF(Q(IN).LE.0) GO TO 5500
      NN=LNKRES(MRES)
      Q(NN)=126.9+Q(NN)
      STORE(MRES)=STORE(MRES)-Q(NN)
      Q(IN)=STORE(MRES)/VOL(MRES)*100.
      GO TO 5500
5520  IN=NOGG+MRES
      IF(Q(IN).GE.100.) GO TO 5500
      ZFLOW=ZFLOW-100.
      IF(ZFLOW)5500,5500,5525
5525  ZF1=VOL(MRES)-STORE(MRES)
      ZFLOW=AMIN1(ZFLOW,ZF1)
      ZFLOW=AMIN1(ZFLOW,145.)
      STORE(MRES)=STORE(MRES)+ZFLOW
      Q(IN)=STORE(MRES)/VOL(MRES)*100.
      Q(NBEL)=Q(NBEL)-ZFLOW
5500  CONTINUE
C ***** END OF MERRILL CREEK OPTION
C ***** BEGIN PROMPTON OPTION
C ***** FIRST ROUTE DOWN THE NATURAL PROMPTON FLOW
      IF(MPR)5200,5200,5100
5100  CONTINUE
      QFK(1)=PRIN
      DO 180 JK=1,3
      KJ=JK+1
      QFK(KJ)=QFK(JK)*(1-FKLX(JK))+QFKO(JK)*FKLY(JK)
 180  QFKO(JK)=QFK(JK)
C ***** NOW ROUTE THE ACTUAL RELEASES FROM PROMPTON
      QPR(1)=Q(MPR)
      DO 181 JK=1,3
      KJ=JK+1
      QPR(KJ)=QPR(JK)*(1-FKLR(JK))+QPRO(JK)*FKRY(JK)
 181  QPRO(JK)=QPR(JK)
C ***** SUBTRACT NATURAL FLOW FROM ACTUAL RELEASES
      DTARG=QPR(4)-QFK(4)
      FLOWL=FLOWL+DTARG
5200  CONTINUE
C ***** END OF PROMPTON OPTION
C ***** BLUE MARSH OPTION : 9 CFS WATER SUPPLY WITHDRAWAL
      IF(NBL)5300,5300,5250
5250  IN=NOGG+NRES
      IF(Q(IN).LE.0) GO TO 5300
      STORE(NRES)=STORE(NRES)-9.0
      Q(IN)=STORE(NRES)/VOL(NRES)*100.
5300  CONTINUE
C ***** END BLUE MARSH OPERATION
C ***** SPECIAL OUTPUTS
      NZ=NOGG+NRES+1
C ***** MONTAGUE TARGET
C     Q(NZ)=FLOWL
C     NZ=NZ+1
C ***** RELEASES TO MAINTAIN 1ST TARGET NODE'S FLOW
```

```
      Q(NZ)=XFLOW
      NZ=NZ+1
C ***** RELEASES TO MAINTAIN 2ND TARGET NODE'S FLOW
      Q(NZ)=YFLOW
      NZ=NZ+1
C ***** DIVERSIONS TO NYC RESERVOIR SYSTEM IN MGD
      Q(NZ)=WITHH/1.5473
      NZ=NZ+1
C ***** NYC RESERVOIRS' TOTAL STORAGE IN BILLION GALLONS
      IF(NYCRES) 5320,5320,5310
5310  Q(NZ)=QTOT*0.00064627
      NZ=NZ+1
C ***** LOWER BASIN RESERVOIRS' TOTAL STORAGE:NOT INCLUDING MERRILL CREEK
C ***** OR BLUE MARSH
5320  Q(NZ)=QTOTA*0.00064627
C ***** SPILLS FROM EACH AND ALL RESERVOIRS
C     DO 70 I=1,NRES
C     NZ=NZ+1
C     Q(NZ)=SPL(I)-REL(I)
C70   IF(Q(NZ).LT.0.) Q(NZ)=0.
C ***** BEGINNING STORAGES FOR EACH AND ALL RESERVOIRS
C     DO 60 I=1,NRES
C     NZ=NZ+1
C60   Q(NZ)=QBS(I)*0.00064627
C ***** RELEASES MADE FROM EACH RESERVOIR TO MAINTAIN TARGETS
C     DO 4010 I=1,NRES
C     NZ=NZ+1
C     Q(NZ)=REL(I)
C4010 CONTINUE
C ***** NYC DIVERSIONS FROM EACH OF THE NYC RESERVOIRS
C     DO 4020 I=1,3
C     NZ=NZ+1
C     Q(NZ)=WIT(I)/1.5473
C4020 CONTINUE
      XFLOW=0.
      ZFLOW=0.
      RETURN
      END
```

Subroutine NEWFLO

Subroutine NEWFLO is called from RGFL only if the model is not already in backup and if Montague is below its objective. Figure II-9 shows the simple structure of NEWFLO.

NEWFLO backs the simulation up three days and reinitializes the storages, inflows and counters. It calculates the amount of release needed to maintain the objective. It then multiplies this release by the factor used to overcome attenuation. The simulation continues as before only no flows are written on tape until the three-day backup is completed. The model is set up such that it will never back up to a specific day more than once. This eliminates the possibility of releasing twice to maintain the flow on any particular day. NEWFLO returns to RGFL.

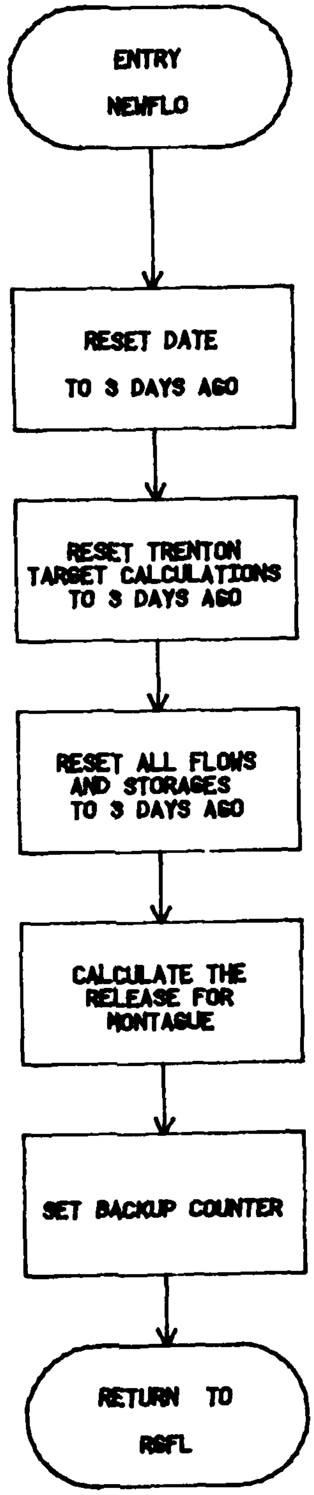

Figure II-9. Flowchart for Subroutine NEWFLO.

Subroutine MONTH

Figure II-10 shows the primary operation of Subroutine MONTH. The data for each requested output must be linked to the appropriate node or Special Output. If an output node, either flows and Special Outputs, cannot be linked to a node from the scratch tape, an error message will be printed ERROR IN OUTPUT: SELECTED OUTPUT NOT FOUND. This will result in a table of zeros but will not stop the printing of the rest of the tables. Subroutine MONTH reads all of the data for a single day from the scratch tape, connects the proper node to output request and begins building a monthly array. Each day, the values are properly connected and added to the previous sum. At the end of each month, the monthly average is calculated and stored.

Once all of the data has been read, the monthly tables are printed. Each node has its coresponding monthly average values printed by year in rows and by month in columns. The overall average value for each month is calculated. First, the flow values at the requested nodes are printed. Then come the Special Outputs, printed in the order specified in the input deck.

When the printing has finished, Subroutine MONTH prints - SIMULATION ENDED NORMALLY - and returns to RGFL.

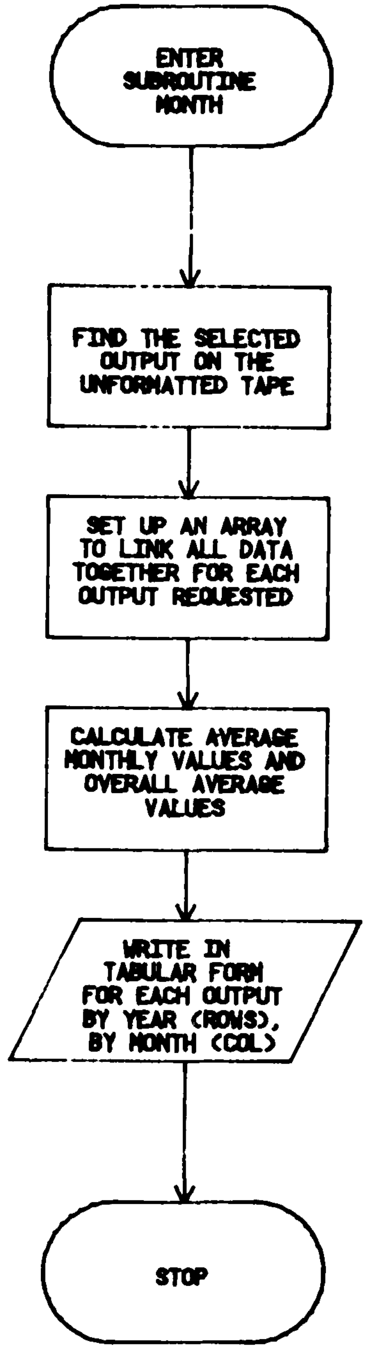

Figure II-10. Flowchart for Subroutine MONTH.

```
      SUBROUTINE MONTH
C ***************************************************************************
C        MONTHLY OUTPUT GENERATED USING DAILY VALUES AND AVERAGES
C **************************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /INOUT/   NTITLE1(10),NTITLE2(10),NTITLE3(10,100)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /DATE/    IYR3,IMO3,IDY3,IYR2,IMO2,IDY2,IYR1,IMO1,IDY1,
     .                 Q1(100),Q2(100)
      COMMON /MOMIN/   QMM(12,50,10)
      COMMON /CAL/     CALIB1,JOUT,JMIN
      DIMENSION FMAX(12,75),FMIN(12,75),FMEAN(12,75),ARRAY(12,50,75),
     .          NNSAV(75),SIG(12,75),MYEAR(50)
      DATA ARRAY/45000*0./
C ***** NEXT SECTION ALLOWS FOR MINIMUM MONTHLY STORAGES TO BE PRINTED OR
C ***** SKIPPED, DEPENDING ON THE CONTROL VARIABLE JMIN
      IF(JMIN-1) 510,500
500   NFK=NOUT
      GO TO 520
510   NFK=NOUT-NRES
520   CONTINUE
C ***** WRITE THE LAST TWO DAYS FLOW VALUES ON THE BINARY TAPE
      WRITE(NTAPE)IYR2,IMO2,IDY2,(Q2(N),N=1,NOG)
      WRITE(NTAPE)IYR1,IMO1,IDY1,(Q1(N),N=1,NOG)
      IF(NYEAR.EQ.51) NYEAR=50
C ***** FIND THE SLOT NUMBER OF THE SELECTED OUTPUTS ON THE BINARY TAPE
      DO 20 N=1,NOUT
      DO 10 NSAVE=1,NOG
      IF(NOUTPT(N).EQ.NAMEG(NSAVE)) GO TO 15
10    CONTINUE
      WRITE(6,12)
12    FORMAT(44H ERROR IN OUTPUT : SELECTED OUTPUT NOT FOUND    )
15    CONTINUE
      NNSAV(N)=NSAVE
20    CONTINUE
      REWIND NTAPE
      READ(NTAPE) NOG
      READ(NTAPE) (NAMEG(I),I=1,NOG)
   21 CONTINUE
      READ(NTAPE) IYR,IMO,IDY,(Q(II),II=1,NOG)
      IOLD=IMO
      IBEG=1901
      IF(IMO.EQ.1) IBEG=1900
C ***** BEGIN BUILDING THE MONTHLY OUTPUT ARRAY
      DO 60 K=1,NYEAR
```

```
      NYEAR(K)=IBEG+IYR
      DO 60 NMO=1,12
      DO 22 J=1,NOUT
      NX=NNSAV(J)
      ARRAY(NMO,K,J)=Q(NX)
   22 CONTINUE
      DO 30 I=2,32
      READ(NTAPE) IYR,IMO,IDY,(Q(II),II=1,NOG)
      IF(EOF(NTAPE))70,25
25    CONTINUE
C ***** CHECK TO SEE IF A NEW MONTHS RECORD HAS BEGUN
      IF(IMO.NE.IOLD) GO TO 40
C ***** FILL THE OUTPUT ARRAY WITH THE SUM OF DAILY VALUES
      DO 30 IN=1,NOUT
      NX=NNSAV(IN)
      ARRAY(NMO,K,IN)=ARRAY(NMO,K,IN)+Q(NX)
30    CONTINUE
40    CONTINUE
      DAY=I-1
C ***** DIVIDE THE SUM OF THE DAILY FLOWS BY THE NO. OF DAYS IN THE MONTH
      DO 50 IX=1,NOUT
      ARRAY(NMO,K,IX)=ARRAY(NMO,K,IX)/DAY
C ***** KEEP TRACK OF MONTHLY STATISTICS
      FMAX(NMO,IX)=AMAX1(ARRAY(NMO,K,IX),FMAX(NMO,IX))
      FMIN(NMO,IX)=AMIN1(ARRAY(NMO,K,IX),FMIN(NMO,IX))
      SIG(NMO,IX)=SIG(NMO,IX)+ARRAY(NMO,K,IX)*ARRAY(NMO,K,IX)
      FMEAN(NMO,IX)=FMEAN(NMO,IX)+ARRAY(NMO,K,IX)
50    CONTINUE
      IOLD=IMO
60    CONTINUE
C ***** FINISH CALCULATIONS FOR LAST DAY ON THE BINARY TAPE
70    CONTINUE
      YEAR=NYEAR
      DAY=I-1
      DO 80 IY=1,NOUT
      ARRAY(NMO,K,IY)=ARRAY(NMO,K,IY)/DAY
      FMAX(NMO,IY)=AMAX1(ARRAY(NMO,K,IY),FMAX(NMO,IY))
      FMIN(NMO,IY)=AMIN1(ARRAY(NMO,K,IY),FMIN(NMO,IY))
      SIG(NMO,IY)=SIG(NMO,IY)+ARRAY(NMO,K,IY)*ARRAY(NMO,K,IY)
      FMEAN(NMO,IY)=FMEAN(NMO,IY)+ARRAY(NMO,K,IY)
80    CONTINUE
C ***** DO THE STATISTICAL CALCULATIONS
      DO 90 J=1,NOUT
      DO 90 JJ=1,12
C ***** CALCULATE THE MONTHLY MEANS OF NYEAR MONTHS OF FLOW
      FMEAN(JJ,J)=FMEAN(JJ,J)/YEAR
      FM=FMEAN(JJ,J)*FMEAN(JJ,J)
C ***** CALCULATE THE STANDARD DEVIATIONS OF THE MONTHLY VALUES
      FS=SIG(JJ,J)/YEAR
      IF(FS-FM) 88,88,85
85    SIG(JJ,J)=SQRT(FS-FM)
```

```
      GO TO 90
88    SIG(JJ,J)=0.
90    CONTINUE
C ***** BEGIN OUTPUT OF TABLES
      DO 140 J=1,NOUT
C ***** WRITE HEADING OF OUTPUT TABLE
      WRITE(6,100)(NTITLE3(JJ,J),JJ=1,10)
100   FORMAT(1H1,3X,30HCDM / WATER RESOURCES DIVISION,19X,
     .      29H* * * * * F I N A L * * * * * ,20X,
     .      31HDELAWARE RIVER DAILY FLOW MODEL,/,4X,
     .  24HANNANDALE, VIRGINIA      ,64X,10A4)
      IF(IBEG.EQ.1901) GO TO 109
      WRITE(6,108)
  108 FORMAT(/,55X,23H AVERAGE MONTHLY VALUES,/,4X,8HCALENDAR,/,
     .       5X,4HYEAR,6X,3HJAN,7X,3HFEB,7X,3HMAR,7X,3HAPR,7X,3HMAY,
     .       6X,4HJUNE,6X,4HJULY,7X,3HAUG,7X,3HSEP,7X,3HOCT,7X,3HNOV,
     .       7X,3HDEC,/)
      GO TO 111
  109 CONTINUE
      WRITE(6,110)
110   FORMAT(/,55X,23H AVERAGE MONTHLY VALUES,/,4X,5HWATER,/,
     .         5X,4HYEAR,6X,3HOCT,7X,3HNOV,7X,3HDEC,7X,3HJAN,7X,3HFEB,
     .         7X,3HMAR,7X,3HAPR,7X,3HMAY,6X,4HJUNE,6X,4HJULY,7X,3HAUG,
     .         7X,3HSEP,/)
  111 CONTINUE
C ***** WRITE THE MONTHLY FLOW ARRAY
      DO 130 JX=1,NYEAR
      IF(J-NFK)320,320,330
330   IFK=J-NFK
      DO 340 NMO=1,12
340   ARRAY(NMO,JX,J)=QMM(NMO,JX,IFK)
320   CONTINUE
      WRITE(6,120)MYEAR(JX),(ARRAY(NMO,JX,J),NMO=1,12)
120   FORMAT(3X,I6,12F10.1)
125   FORMAT(/,6X,3HAVG,12F10.1)
130   CONTINUE
C ***** WRITE MONTHLY AVERAGE OF NYEAR VALUES
      WRITE(6,125)(FMEAN(NMO,J),NMO=1,12)
140   CONTINUE
      WRITE(6,150)
150   FORMAT(////,27H SIMULATION ENDED NORMALLY )
      RETURN
      END
```

Subroutine OUTPUT

Identical to Subroutine MONTH in the means of connecting nodes to output and error messages, Subroutine OUTPUT is different in that it will print out the daily values for each requested output. Figure II-11 shows the minor differences in the two flowcharts. The tables will appear beginning with the earliest year to the final year of simulation, completing an entire selected output's results before beginning the next. Each table is arranged in rows by the day of the month and in columns by month. Also calcualted for each month are the mean and standard deviation, minimum and maximum values, and the monthly total.

Subroutine OUTPUT ends the simulation in the same manner as MONTH: SIMULATION ENDED NORMALLY.

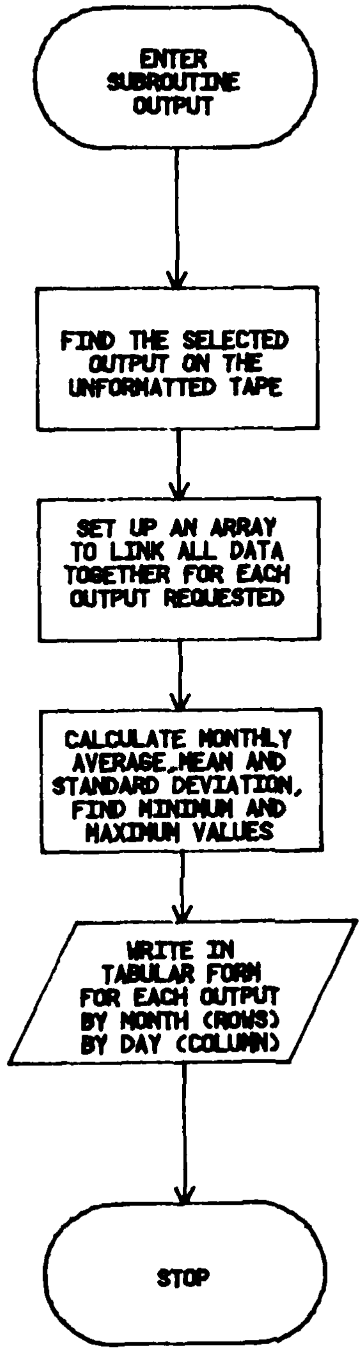

Figure II-11. Flowchart for Subroutine OUTPUT.

```
      SUBROUTINE OUTPUT
C ************************************************************************
C        THE OUTPUT ROUTINE PRODUCES YEARLY TABULATIONS OF DAILY FLOWS.
C        OUTPUT REQUIRES A REWIND OF THE UNFORMATTED OUTPUT TAPE.
C ************************************************************************
      COMMON /CONTROL/ NYEAR,NTAPE,NOUT,NOG,NNODE,ITAPE,IYR,IMO,IDY
      COMMON /CHANL/   NGTO(100),NAMEG(100),NGTOG(100,10),NOUTPT(100),
     .                 LINK(100),Q(100),QIN(100),QFK(4),QFKO(4),QPR(4),
     .                 QPRO(4)
      COMMON /INOUT/   NTITLE1(10),NTITLE2(10),NTITLE3(10,100)
      DIMENSION SIG(12),FMAX(12),FMIN(12),FDAY(12),FMEAN(12),
     .          FTOT(12),ARRAY(31,12),OUT(8,100),NNSAV(100)
      COMMON /RESERV/  NRES,XFLOW,IFLAG,VOL(10),LAGRES(10),LNKRES(10),
     .                 EVAP(12,10),STORE(10),CONS(12,10),QO1(100),
     .                 QO2(100),NOGG,ICK,FLOWL,ZFLOW,ICK1
      COMMON /DATE/    IYR3,IMO3,IDY3,IYR2,IMO2,IDY2,IYR1,IMO1,IDY1,
     .                 Q1(100),Q2(100)
      COMMON /CAL/     CALIB1,JOUT,JMIN
      DIMENSION KMO(12)
      DATA KMO /31,28,31,30,31,30,31,31,30,31,30,31/
      DO 9000 NO=1,NOUT
C ***** FIND THE LOCATION OF THE SELECTED OUTPUT ON THE UNFORMATTED TAPE
      DO 30 NSAVE=1,NOG
      IF (NOUTPT(NO).EQ.NAMEG(NSAVE)) GO TO 35
   30 CONTINUE
      WRITE(6,33)
   33 FORMAT(17H ERROR IN OUTPUT     )
   35 CONTINUE
      NNSAV(NO)=NSAVE
      REWIND NTAPE
      READ(NTAPE)NOG
      READ(NTAPE)(NAMEG(I),I=1,NOG)
      READ(NTAPE)IYR,IMO,IDY,(Q(II),II=1,NOG)
   37 CONTINUE
C ***** LOOP ON NUMBER OF YEARS OF THE RUN
      DO 8000 K=1,NYEAR
      ARRAY(29,2)=0.
      DO 50 J=1,12
      IF(J.NE.IMO)GO TO 45
      ARRAY(1,J)=Q(NSAVE)
      DO 40 I=2,32
      READ(NTAPE)IYR,IMO,IDY,(Q(II),II=1,NOG)
      IF (EOF(NTAPE)) 38,39
   38 IMO=13
      IYR=IYR+1
   39 CONTINUE
      IF (IMO.NE.J) GO TO 50
      ARRAY(I,J)=Q(NSAVE)
   40 CONTINUE
      GO TO 50
C ***** ZERO SUMMERS
   45 DO 47 I=1,31
      ARRAY(I,J)=0.
   47 CONTINUE
```

```
   50 CONTINUE
   55 CONTINUE
      DO 100 J=1,12
      FMIN(J)=1.E30
      FMEAN(J)=0.
      FTOT(J)=0.
      FMAX(J)=0.
      FDAY(J)=0.
      SIG(J)=0.
  100 CONTINUE
C ***** PERFORM STATISTICAL CALCULATIONS
      IIYR=IYR-1
      DO 200 J=1,12
      LL=KMO(J)
      IF(J.NE.2)GO TO 110
      IF(MOD(IIYR,4).EQ.0)LL=LL+1
  110 CONTINUE
      DO 150 I=1,LL
  120 FMEAN(J)=FMEAN(J)+ARRAY(I,J)
      SIG(J)=SIG(J)+ARRAY(I,J)*ARRAY(I,J)
      FMAX(J)=AMAX1(ARRAY(I,J),FMAX(J))
      FMIN(J)=AMIN1(ARRAY(I,J),FMIN(J))
      FDAY(J)=FDAY(J)+1.
  150 CONTINUE
  200 CONTINUE
      NNAME=NOUTPT(NO)
      WRITE(6,7280)NTITLE1,NTITLE2,NNAME,(NTITLE3(N,NO),N=1,10)
 7280 FORMAT(1H1,/,3X,30HCDM / WATER RESOURCES DIVISION,20X,
     *        29H* * * * * F I N A L * * * * *,9X,10A4,/,3X,
     *        21HANNANDALE, VIRGINIA  ,29X,
     *        29H*      DELAWARE  RIVER      *,9X,10A4,/3X,
     *        7HNODE   ,I5,38X,29H*     DAILY FLOW MODEL      * ,9X,
     *        10A4)
      MM=1900+IYR-1
      WRITE(6,7260) MM
 7260 FORMAT(///,24(2H--),35HAVERAGE DAILY VALUES SIMULATED FOR  ,I4,
     .                    23(2H--),/)
       WRITE(6,7310)
 7310 FORMAT(//,3X,3HDAY,6X,3HJAN,7X,3HFEB,7X,3HMAR,7X,3HAPR,7X,3HMAY,
     *        7X,3HJUN,7X,3HJUL,7X,3HAUG,7X,3HSEP,7X,3HOCT,7X,
     *        3HNOV,7X,3HDEC)
      WRITE(6,7300)(MDAY,(ARRAY(MDAY,MON),MON=1,12),MDAY=1,31)
 7300 FORMAT(I5,3X,12F10.2)
C
C          CALCULATE DEVIATIONS
C
      DO 400 J=1,12
      IF (FDAY(J).LE.0.0) GO TO 400
      FT=FMEAN(J)/FDAY(J)
      FTOT(J)=FMEAN(J)
      FMEAN(J)=FT
      FT=FT*FT
      FT1=SIG(J)/FDAY(J)
      IF (FT1-FT) 378,378,379
```

```
 379 SIG(J)=SQRT(FT1-FT)
     GO TO 400
 378 SIG(J)=0.
 400 CONTINUE
     DO 450 I=1,12
     IF (FMIN(I).GE.1.0E29) FMIN(I)=0.
 450 CONTINUE
     WRITE(6,7221)(FMIN(I),I=1,12),(FMAX(J),J=1,12),
    .     (FMEAN(KO),KO=1,12)
7221 FORMAT(/,5X,3HMIN,  12F10.2/,5X,3HMAX,  12F10.2,
    .      /4X,4HMEAN,12F10.2)
     WRITE(6,7222) (FTOT(N),N=1,12),(SIG(L),L=1,12)
7222 FORMAT(3X,5HTOTAL,12F10.2,/3X,5HS DEV,12F10.2)
 900 CONTINUE
8000 CONTINUE
9000 CONTINUE
     WRITE(6,9100)
9100 FORMAT(26H1SIMULATION ENDED NORMALLY)
     STOP
     END
```

III. INPUT DESCRIPTION

This chapter provides a detailed description of the card data requirements for the Daily Model along with an example. Table III-1 gives the individual card structure, including variable names and required format. This program does check for inclusion and order of the card groups. Therefore, an identifier, A through M, has been incorporated into each data block in the first column.

The input data to the program includes the card data deck and the Incremental Inflow Tape (IIT). The IIT contains the average daily incremental inflow to nodes in the entire Delaware River Basin. Table III-2 gives the location and model node numbers along with the corresponding USGS station number. Some of the model nodes do not have USGS stations and are represented by asterisks. These exact model node numbers must be used in the card input deck or LINKER will not be able to link the incremental inflows on tape to the specified model node. The IIT is the driving force of the model while the card input deck contains program control information.

Title Cards (A)

The first two cards in the data set are the title cards. They are printed in the heading of the daily output but not the monthly. They contain 40 alphanumeric characters, and can be used to describe the particulars of the simulation run.

TABLE III-1
INPUT DATA
CARD FORMAT

Card Group	Card No.	Format	Variable Name	Description
TITLE CARDS				
A	1	A1,4X	AC	Card Identifier (A)
		10A4	NTITLE1	Title Card
	2	A1,4X	AC	Card Identifier (A)
		10A4	NTITLE2	Title Card
CONTROL CARDS				
B	1	A1,4X	BC	Card Identifier (B)
		I5	ITAPE	Input Tape Number
		I5	NTAPE	Output Tape Number
		I5	NYEAR	Number of Years to be Simulated
		F5.2	CALIBI	Multiplication factor for the releases from NYC reservoirs
		I5	NYCRES	Number of New York City Reservoirs
		I5	JOUT	Specifies output option (-1 daily only, 0 monthly only, +1 both)
		I5	JMIN	Specifies option of minimum monthly reservoir storages: +1 no minimum storages, 0 minimum storages in special output
		I5	MWL	Wallenpaupack option: +1 use special releases, 0 use natural releases
CHANNEL CARDS				
C	1	A1,4X	CC	Card Identifier (C)
		I10	NAMEG(I)	Upstream Node Number
		I10	NGTO(I)	Downstream Node Number
		E10.4	XM(I)	Lag function coefficient defined in hours
		F10.0	B(I)	Maximum route time to next node in hours
		I10	ICKK	Flag for Objective Node. Equal to 1 if is 1st objective. Equal to 2 if is 2nd objective. Otherwise, blank.

Card 1 repeated for each node to be modeled.

To specify end to C Cards, one additional card with NAMEG(I) equal to zero is required.

TABLE III-1
INPUT DATA
CARD FORMAT
(Cont'd)

Card Group	Card No.	Format	Variable Name	Description
OUTPUT NODE CARDS				
D	1	A1,4X	DC	Card Identifier (D)
		I5	NOUTPT(I)	Output Node Number
		10A4	NTITLE3(N,I)	Title to be Printed

Card 1 repeated for each nodal output desired.

To specify end to D Cards, one additional card with NOUTPT(I) equal to zero is required.

Card Group	Card No.	Format	Variable Name	Description
RESERVOIR CARDS				
E	1	A2,3X	EC	Card Identifier (E1)
		I5	IRES	Reservoir Storage Node Number
		E10.4	VOL(I)	Maximum Volume (ft^3)
		I5	LRES	Node Number to Which IRES Releases
		F10.2	AREA	Surface Area Used to Calculate Evaporation from in/mo. to cfs-day (acres)
		5A4	NAMR(5)	Name of Reservoir - 20 Characters
	2	5X,12F5.0	CONS(N,I)	Conservation Release (cfs)
	3	5X,12F5.0	ACONS(N,I)	Monthly Augmented Conservation Release (cfs)
	4	5X,12F5.0	EVAP(N,I)	Evaporation Rate (in/mo)

Cards 1, 2, 3, 4 repeated for each reservoir.

To specify end to E cards, one additional card with IRES equal to zero is required.

If NYCRES equals zero, skip F, G, H, and I groups.

Card Group	Card No.	Format	Variable Name	Description
SYSTEM CONDITION CARDS				
F	1	A1,4X	FC	Card Identifier (F)
		I5	NCARDS	Number of Cards to Follow
	2	5X,I5	NMO	Month
		I5	NDY	Day
		F10.0	FLOW(I)	Storage Level (bg) that seperates Normal and Drought Warning Levels

Repeat Card 2 NCARDS times.

TABLE III-1
INPUT DATA
CARD FORMAT
(Cont'd)

Card Group	Card No.	Format	Variable Name	Description
G	1	A1,4X	GC	Card Identifier (G)
		I5	NCARDS	Number of Cards to Follow
	2	5X,I5	NMO	Month
		I5	NDY	Day
		F10.0	FLOW(I)	Storage Level (bg) that seperates Drought Warning and Drought Levels.
Repeat Card 2 NCARDS times.				
DIVERSION CARDS				
H	1	A1,4X	CH	Card Identifier (H)
		3F10.0	DIVERS(3)	New York City Diversions for 3 Conditions Normal, Drought Warning, Drought Respectively (mgd)
MONTAGUE OBJECTIVES CARD				
I	1	A1,4X	CI	Card Identifier (I)
		3F10.0	OBJECT(3)	Montague Flow Objectives for 3 Conditions Normal, Drought Warning, Drought Respectively (cfs)
SPECIAL OUTPUT CARDS				
J	1	A1,4X	CJ	Card Identifier (J)
		I5	NSPO	Number of Special Outputs
	2	A1,4X	CJ	Card Identifier (J)
		I5	NOUTPT(I)	Special Output Flag Number
		10A4	NTITLE3(N,I)	Description
Card 2 repeated for each special output.				
D & R CANAL DIVERSION CARD				
K	1	A1,4X	CK	Card Identifier (K)
		3F10.0	DFLOW(3)	D & R Canal Diversion (cfs) for Normal, Drought Warning and Drought conditions, Respectively

If NYCRES equals zero, skip L group.

TABLE III-1
INPUT DATA
CARD FORMAT
(Cont'd)

Card Group	Card No.	Format	Variable Name	Description
TRENTON OBJECTIVES CARD				
L	1	A1,4X	CL	Card Identifier (L)
		3F10.0	TARG(3)	Trenton flow objectives (cfs) for Normal, Drought Warning and Drought conditions, Respectively
CONSUMPTIVE USES CARDS				
M	1	A1,4X	CM	Card Identifier (M)
		I10	NCON	Number of nodes with consumptive uses (losses)
	2	A5	CM	Card Identifier (M)
		I10	ICON(I)	Node Number for subtraction of consumptive uses
		12F5.0	CLOSS(I,J)	Consumptive use for each ICON(I) node, one for each month (cfs)

Card 2 repeated for each node with consumptive use data

TABLE III-2

MODEL NODE NUMBER

AND

USGS STATION LOCATION

Model Node	USGS Number	Location
1600	01417000	E Branch Delaware River at Downsville, NY[1]
(1000)†		
1010	01421000	E Branch Delaware River at Fishs Eddy, NY
1610	01425000	W Branch Delaware River at Stilesville,NY[2]
(1020)†		
1030	01426500	W Branch Delaware River at Hale Eddy, NY
1035	01427405	Delaware River near Callicoon, NY
1040	01428500	Delaware River near Barryville, NY
1050	01429000	W Branch Lackawaxen River at Prompton, PA
1060	01429500	Dyberry Creek near Honesdale, PA
1070	01430000	Lackawaxen River near Honesdale, PA
1080	0143500	Lackawaxen River at Hawley, PA
1090	01432000	Wallenpaupack Creek at Wilsonville, PA
1100	01434000	Delaware River at Port Jervis, NY
1160	01436000	Neversink River at Neversink, NY[3]
(1110)†		
1120	01437000	Neversink River at Oakland Valley, NY
1130	01438500	Delaware River at Montague, NY
1140	01440200	Delaware River below Tacks Island Damsite
1150	01446500	Delaware River at Belvidere, NJ

[1]Pepacton Reservoir
[2]Cannonsville Reservoir
[3]Neversink Reservoir

†If the NYC Reservoirs are not to be used as reservoirs, then the node number in parenthesis must be used.

TABLE III-2
MODEL NODE NUMBER
AND
USGS STATION LOCATION
(Cont'd)

Model Node	USGS Number	Location
1160	01447800	Lehigh River near White Haven, PA
1170	01449800	Pohopoco Creek below Beltzville Damsite, PA
1180	*	Aquasicola Creek at Aquashicola Damsite, PA
1190	01450500	Aquashicola Creek at Palmerton, PA
1200	01451000	Lehigh River at Walnutport, PA
1210	01451800	Jordan Creek near Schnecksville, PA
1220	01452000	Jordan Creek at Allentown, PA
1230	01453000	Lehigh River at Bethlehem, PA
1240	01454700	Lehigh River at Glendon, PA
1250	01456000	Musconetcong River near Hackettstown, NJ
1260	01457500	Delaware River at Riegelsville, NJ
1280	01459500	Tohickon Creek near Pipersville, PA
1290	*	Delaware River near Point Pleasant
1300	01460500	D & R Canal at Kingston, NJ
1310	01463500	Delaware River at Trenton, NJ
1320	01464000	Assunpink Creek at Trenton, NJ
1330	01464500	Crosswicks Creek at Extonville, NJ
1340	01465500	Nashaminy Creek near Langhorne, PA
1350	01467000	N Branch Rancocas Creek at Pemberton, NJ
1360	*	Delaware River near Torresdale, PA
1370	*	Delaware River near Pier II North

*Not a USGS Station

TABLE III-2

MODEL NODE NUMBER

AND

USGS STATION LOCATION

(Cont'd)

Model Node	USGS Number	Location
1380	01467500	Schuylkill River at Pottsville, PA
1390	01467950	Schuylkill River at Cressona,PA
1400	01468500	Schuylkill River at Landingville, PA
1410	01469500	Lower Schuylkill River at Tamaqua, PA
1420	01470000	Lower Schuylkill River at Drehersville, PA
1430	01470500	Schuylkill River at Berne, PA
1440	01470756	Maiden Creek at Virginville, PA
1450	01470960	Tulpehocken Creek at Blue Marsh, PA
1460	01471000	Tulpehocken Creek near Reading, PA
1470	01471500	Schuylkill River near Reading, PA
1480	01472000	Schuylkill River at Pottstown, PA
1490	*	Schuylkill River near Limerick, PA
1500	014723000	Perkiomen Creek at Graterford, PA
1510	01474500	Schuylkill River at Philadelphia, PA
1520	*	Delaware River below Schuylkill Confluence
1530	01477000	Chester Creek near Chester, PA
1540	*	Delaware River near Chester, PA
1550	01479000	White Clay Creek near Newark, DE
1560	01480000	Red Clay Creek at Wooddale, DE
1570	01481000	Brandywine Creek at Chadds Ford, PA
1580	01481500	Brandywine Creek at Wilmington, DE
1590	*	Delaware River at Delaware Memorial Bridge

*Not a USGS Station

Control Card (B)

This third card contains the controlling variables; the input and output tape numbers, the numbers of years of simulation, the multiplication factor for the New York City reservoirs, the number of New York City reservoirs and, the option of monthly or daily final output. A negative one (-1) indicates daily output only, a zero (0) specifies monthly output only, and a positive (+1) gives both daily and monthly output. When only the monthly output has been specified, another output option is available. That is the inclusion of minimum monthly storages. A one (1) indicates no minimum storages are requested while a zero (0) indicates that the minimum monthly storages for every reservoir will be included in the Special Outputs. The final variable controls the operation of Wallenpaupack. Special releases, as described more fully in the Daily Flow Model Report[1], can be released from Wallenpaupack to help augment the Montague flow. If this variable is a one (1), the special releases will be made. A zero (0) indicates the natural releases from Wallenpaupack are desired.

Channel Cards (C)

These are the node input cards, specifying the channel between a pair of nodes, one upstream, one downstream. One card is required for each node. The user should note that each upstream node is connected to only one downstream node, i.e., NAMEG(I) is not duplicated. However, each downstream node can have multiple upstream nodes, i.e., NGTO(I) can be duplicated. When inputting the node numbers, it is essential that they be put in order from upstream to downstream. The first flow objective node connected with backup is flagged in this card series by putting a one (1) in column 35. The second flow objected node connected with the next day release scheme is flagged by putting a two (2) in column 35. A maximum number of 100 model nodes are possible. Of these 100 nodes, only 10 upstream nodes may be routed into any one downstream node.

---

[1]Development of A Daily Flow Model of the Delaware River Which Incorporates Reservoir Systems Analysis, Volume II, Camp Dresser & McKee, March 1981.

Output Nodes (D)

Two types of output tables can be generated. One is the actual flows at the system's nodes, which are specified by the D cards. The other is a special output described by the J cards. The D card contains the card identifier, the model node number where the flow is requested plus an alphanumeric description of the node. A maximum of 75 output tables can be generated. This includes both the Output Node tables plus the Special Output tables (D cards and J cards).

Reservoir Input (E)

This group contains a series of four cards for each reservoir. If no reservoirs are to be used, two items must be changed. Only one reservoir card is input: an "E" followed by a blank. Also, the NYC reservoirs' node numbers must be replaced by the node numbers in parentheses in Table III-2. When reservoirs are included, the first card contains the reservoir storage node number, the maximum volume in cubic feet, the node to where the release is made (usually the inflow node), and the surface area used to calculate the evaporation in cfs-day. The name of the reservoir is included to help with bookkeeping. It is essential to specify the reservoir storage node as 1000 plus the number of the node where the incremental inflow is associated. This inflow node is generally equal to the release node. A maximum of ten reservoirs can concurrently be used in the model. The second card contains the average daily basic conservation releases in cfs for each month. The third card contains the average daily augmented conservation release in cfs. The fourth card contains the average daily evaporation rates in inches/month for each month.

The first three reservoirs must always be the New York City reservoirs, Pepacton, Neversink and Cannonsville unless zero NYC reservoirs have been specified on the B Card. If more than three reservoirs are used in the simulation, the New York City reservoirs must be placed first.

The special cases of Merrill Creek and Blue Marsh are also coded on the E Cards. These two reservoirs are not operated to maintain any particular objective. They do, however, act as reservoirs and are therefore specified in this card series. If Merrill Creek is in operation, it must be placed before all other reservoirs used to maintain the Trenton objective and after any NYC reservoirs. If Blue Marsh is on line, it must be placed after all other reservoirs have been specified.

System Conditions: New York City Reservoir Storage Levels (F and G)

The F and G card series set the system's conditions by the New York City reservoir storage levels. If there are no NYC reservoirs, these two groups are skipped. The first (F series) designates the storage levels at which the system changes from Normal to Drought Warning conditions.

The second (G series) designates the storage levels at which the system changes from Drought Warning to Drought conditions. At the beginning of each day during simulation, the total New York City storage in the system is compared to the reservoir levels specified in the F and G cards for that particular day. The system condition is then set.

The first card in each set has the identifier and the number of cards to follow. The next n-cards give the storage levels at appropriate dates. The month, day and the total storage level in billion gallons are given. With a beginning point of January 1, the storage levels thereafter are specified at the inflection points seen in Figure I-1. December 31 is specified to end the year. The levels at each day are calculated by linear interpolation in the program. From these daily values, the System Conditions are set every day.

Diversions (H)

As part of the New York City reservoir operation matrix, the diversions to New York City are specified on this card. Three diversions for the three reservoir conditions, Normal, Drought Warning and Drought, are specified respectively. It should be noted that only Pepacton, Cannonsville and Neversink have diverisons taken from them. Any other reservoir contributes only to the Trenton flow objective. The diversions are the total taken from the system, not from each reservoir. The units are in mgd. If there are no NYC reservoirs, this card is eliminated.

Montague Objectives (I)

The Montague target flow objective (or the objective connected to backup) is specified on the I card. Three objectives are specified in cfs, again relating to the New York City System Conditions. This flow objective is used to determine the deficit of the Montague flow and thus the release needed to maintain the Montague objective. A card identifier followed by the three objectives are on this card. As with the H card, if there are no NYC reservoirs, this card is eliminated from the input deck.

Special Outputs (J)

The Special Outputs have been included in the model to give information additional to the flows generated by the model. Table III-3 lists the Special Outputs currently available along with their flag number. One card is required for each Special Output. The flag number must be specified higher than the reservoir storage numbers so as not to confuse them.

When setting these up in the input card deck, they must be in the same order as in Table III-3. This is due to the order of definition of each of the Special Outputs in RESOP. If any change is desired, the FORTRAN of the program would have to be altered.

The output from the D cards is in cfs. The Special Outputs are in several units: bg, cfs, and mgd. The user should take care when analyzing the results to remember the different units.

TABLE III-3

SPECIAL OUTPUTS

Flag	Description
6000	Releases to Maintain Montague Flow (cfs)
6010	Releases to Maintain Trenton Flow (cfs)
6020	Total Diversions to NYC (mgd)
6030	Combined NYC Reservoir Storage (bg)
6040	Combined Lower Basin Reservoir Storage (bg) (this includes Prompton and excludes Merrill Creek and Blue Marsh)

D & R Canal Diversions (K)

The Delaware and Raritan (D & R) Canal is now set to be operated by the same conditions as the New York City reservoirs. Therefore, three values are input corresponding to diversions during Normal, Drought Warning and Drought Conditions. These diversions are specified in cfs. If there are no NYC reservoirs, the K group is not included.

Trenton Objectives (L)

The Trenton, or second target flow objective is specified on the L card. Three objectives are specified, relating to the New York City System Conditions. However, because the Trenton objective is not governed by the New York City reservoirs, they are specified the same. The objectives are specified in cfs. Currently set at Trenton, this second objective node can be changed by setting ICKK in the C cards equal to two (2) for a different node.

Consumptive Uses (M)

As a prediction of future conditions, consumptive uses have been added to the simulation. The card identifier and the number of cards to follow is specified on the first card. The next n-cards contain the node number (taken from Table III-2) which is specified first, followed by average daily consumptive uses, from January to December, in cfs. Each day, these consumptive uses will be subtracted from the appropriate node.

Example Input

The example input deck which follows shows the data described in this chapter. The results are given in Chapter IV. The first two cards are the A Cards or title cards. The third card is the B Card or the control card. On this card is specified the number of years of the simulation as well as other flags and variables. In this example, there are four years in the simulation and all three NYC reservoirs are used. Monthly output only for the tabular results is flagged. The next card series is the C Cards which specify all of the nodes to be used in the network. Each card contains the upstream node, the downstream node and the two variables used in the routing function. In this case, all 62 nodes are being used. Also identified are the target nodes. Montague (node number 1130) is the first target node. Trenton (node number 1310) is the second target node. The C Cards are terminated by a blank C Card.

Only three nodes' flows (D Cards) are requested for tabular output: Montague, Trenton, and Delaware Memorial Bridge. The D Cards are terminated by a blank D Card. After the D Cards the reservoir information (E Cards) is specified. Each reservoir has four cards. The first contains the storage node number along with surface area and maximum volume. The second card gives the basic conservation releases for each month of the year. The third card gives the augmented conservation releases for each month of the year. The final card gives the evaporation of each reservoir in inches per month for each month of the year. After the reservoir information, six points are used to delineate each of the System Conditions (F and G Cards). The first two values give the month and day of the occurrence of the last value, the total NYC reservoir storage. The next two cards set the diversions to NYC (H Card) and the Montague objectives (I Card). Each of these is linked to the System Conditions and therefore all three values are different. The next card series is the special outputs (J Card). Six have been specified here to give a clear illustration of the different kinds of possible special outputs. The D&R Canal diversions (K Card) are specified next. These, too, are linked to the System Conditions and are therefore different. Trenton's objectives (L Card) on the other hand are identical, being independent of the System Conditions. Finally, consumptive uses (M Card) occur at seven nodes. The node number is followed by the consumptive use for each month of the year. Currently, these values are constant for each node.

```
A       DOCUMENTAION SIMULATION EXAMPLE
A       NYC RESERVOIRS PLUS BELTZVILLE
B        30    10      4 1.25     3     0      1      0
C            1600        1010-.6695E-03    16.
C            1010        1035-.3377E-03    24.
C            1610        1030-.3429E-03     6.
C            1030        1035-.6429E-03    24.
C            1035        1040
C            1040        1100-.5000E-04    10.
C            1050        1070-.3413E-03     2.
C            1060        1070-.6452E-04     1.
C            1070        1080-.1613E-03     5.
C            1080        1100-.1156E-03    11.
C            1090        1100-.3106E-03     4.
C            1100        1130
C            1105        1620              24.
C            1620        1120-.8072E-03    18.
C            1120        1130-.2667E-03    10.
C            1130        1140-.9600E-04    24.             1
C            1140        1150
C            1150        1270-.6241E-05     4.
C            1160        1200-.2030E-03    16.
C            1170        1200-.1132E-02     9.
C            1180        1190
C            1190        1200-.1786E-03     3.
C            1200        1230-.1542E-04    16.
C            1210        1220
C            1220        1230-.1852E-03     4.
C            1230        1240-.9783E-04    12.
C            1240        1270
C            1250        1260-.2304E-02     9.
C            1260        1270-.1437E-03     3.
C            1270        1290-.1764E-04    14.
C            1280        1290-.1875E-03     8.
C            1290        1310
C            1300        1310
C            1310        1360-.1216E-04     9.             2
C            1320        1360-.7339E-03     9.
C            1330        1360-.7722E-03    10.
C            1340        1360-.4057E-04     4.
C            1350        1360-.1734E-03     8.
C            1360        1370
C            1370        1520
C            1380        1400-.2431E-03     3.
C            1390        1400-.1818E-02     2.
C            1400        1430-.2917E-03     5.
C            1410        1420-.3851E-03     7.
C            1420        1430
C            1430        1470-.9346E-04     9.
C            1440        1470
```

```
C          1450      1460
C          1460      1470
C          1470      1480-.1827E-03    18.
C          1480      1490-.2559E-03    24.
C          1490      1510
C          1500      1510-.1504E-03    11.
C          1510      1520-.3119E-04     5.
C          1520      1540
C          1530      1540-.6944E-04     2.
C          1540      1590
C          1550      1590-.2326E-03     8.
C          1560      1590-.2528E-03     8.
C          1570      1580-.4167E-03     5.
C          1580      1590-.2366E-03     3.
C
D     1130    DELAWARE RIVER AT MONTAGUE  01438500
D     1310     DELAWARE RIVER AT TRENTON  01463500
D     1590 DELAWARE R AT MEMORIAL BRIDGE  01482100
D
E1    2600 .1874E+11     1600      5690   PEPACTON
E2   6.2  6.2  6.2  18.6 18.6 18.6 18.6 18.6 18.6 18.6 6.2  6.2
E3   50.  50.  50.  70.  70.  70.  70.  70.  70.  70.  50.  50.
E4   -0.19-0.17-0.41-0.591.55 1.63 1.55 1.62 1.83 2.07 -0.72-0.59
E1    2610 .1280E+11     1610      5150  CANNONSVILLE
E2   7.7  7.7  7.7  7.7  23.2 23.2 23.2 23.2 23.2 23.2 23.2 7.7
E3   33.  33.  33.  45.  45.  325. 325. 325. 45.  45.  33.  33.
E4   -0.19-0.17-0.41-0.591.55 1.63 1.55 1.62 1.83 2.07 -0.72-0.59
E1    2620 .4671E+10     1105      1523  NEVERSINK
E2   4.6  4.6  4.6  15.5 15.5 15.5 15.5 15.5 15.5 15.5 4.6  4.6
E3   25.  25.  25.  45.  45.  45.  45.  45.  45.  45.  25.  25.
E4   -0.19-0.17-0.41-0.591.55 1.63 1.55 1.62 1.83 2.07 -0.72-0.59
E1    2170 .1735E+10     1170       947  RELTZVILLE
E2   35.  35.  35.  35.  35.  35.  35.  35.  35.  35.  35.  35.
E3   35.  35.  35.  35.  35.  35.  35.  35.  35.  35.  35.  35.
E4   .0078.1267-.382-.4601.7922.2321.6832.0491.9082.340-.513-.343
E1
F              6
         1     1  127.
         5     1  190.
         7     1  190.
        10     1  110.
        12     1  110.
        12    31  127.
G              6
         1     1   87.
         5     1  150.
         7     1  150.
        10     1   70.
        12     1   70.
        12    31  87.
H    800.      600.      430.
```

AD-A110 111 CAMP DRESSLER AND MCKEE INC ANNANDALE VA F/G 13/2
DAILY FLOW MODEL OF THE DELAWARE RIVER BASIN. USER'S MANUAL AND--ETC(U)
SEP 81 DACW61-78-C-0127
UNCLASSIFIED DAEN/NAP-51850/DFM03-81/09 NL

2 of 2

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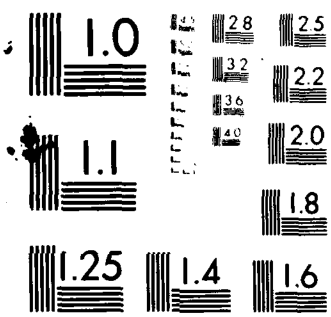

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963-A

```
I    1750.     1750.     1525.
J       5
J     6000RELEASES TO MAINTAIN MONTAGUE FLOW (CFS)
J     6010RELEASES TO MAINTAIN TRENTON FLOW  (CFS)
J     6020        DIVERSIONS TO NEW YORK CITY  (MGD)
J     6030   TOTAL STORAGE OF NYC RESERVOIRS  (BG)
J     6040                 BELTZVILLE STORAGE  (BG)
K    155.      124.      93.
L    2270.     2270.     2270.
M              7
          1100 2.  2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.
          1270 72. 72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.
          1290 71. 71.  71.  71.  71.  71.  71.  71.  71.  71.  71.  71.
          1310 30. 30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
          1520 187.187. 187. 187. 187. 187. 187. 187. 187. 187. 187. 187.
          1540 27. 27.  27.  27.  27.  27.  27.  27.  27.  27.  27.  27.
          1590 72. 72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.
```

IV. OUTPUT DESCRIPTION

The output for each simulation is divided into three major sections. The first is an echo of the input deck, interspersed with calculations done within the INDATA subroutine. The second reflects the simulation as it proceeds. In this second section, a message is printed every day the Montague flow was below the specified target. The third output section is the tabular results specified by the D and J Cards. This is printed after the entire simulation is finished.

INPUT ECHO

The subroutine INDATA echoes all input data. It also performs a few operations by data manipulation or by calling another subroutine. In the example output given at the end of this chapter, the A, B, and C Cards are quickly identified. Immediately following the C Cards are the results from the subroutine ORDER.

The purpose of this matrix is to present the slot numbers which flow into every node. The first column is the slot number associated with the node specified in the second column. The third column is the node into which the second column flows. The columns afterwards specify the slot numbers flowing into the second column node. For example, the 12th slot, node number 1100, has three nodes flowing into it, slot numbers 6, 10 and 11 (node numbers 1040, 1080 and 1090 respectively). After the matrix is printed, ORDER returns to INDATA, where the reading of the input data is resumed.

The D Cards are printed next. In this simple example there are only three nodes whose flows will be printed: Montague, Trenton and the Delaware Memorial Bridge.

The E Cards, reservoir input, show some minor data manipulation. The evaporation for each reservoir is changed from the input of inches/month to cfs-day using the surface area in acres. The final calculation in cfs-day is printed as the fifth cards in the E Card section of each reseroivr.

The next card sections F, G, H and I Cards, are simple input echoes. The J Cards, special outputs, are those described in Chapter III. Six are shown for this example simulation. The K and L Cards are simply input echoes also. Seven consumptive uses (M Cards) are specified in this example. Generated here are the slot numbers associated with the consumptive uses rather than the node number which was input.

The next three lines are warnings, specifying those nodes on the Incremental Inflow Tape which were not connected to any model node. These three "Warning" nodes are the naturalized flows for the NYC reservoirs. They do not include the special net inflow data for the reservoirs which are necessary when the reservoirs are in operation. Therefore, these three "Warning" nodes are specified whenever the NYC reservoirs are not in operation.

The next seven lines are the dividing line between the first section of data echo and the second section of actual simulation. These seven lines are generated in LINKER and merely reflect whether or not the special nodes have been specified. These special nodes are described fully in Chapter III.

ON-GOING SIMULATION OUTPUT

This next section of the example shows only a small portion of the actual output. Each time Montague's flow is less than the target and the model is required to backup, this flag is printed - LOW FLOW AT MONTAGUE - followed by the year, month and day. It is rather monotonous and time consuming and can be easily "switched off" within the program by simply deleting or commenting out the write statement.

TABULAR RESULTS

Two types of tables can be generated by the model. A monthly table which uses the daily results to calculate a monthly average is requested in the example problem presented in this report. A daily table can also be generated. Each table is generated for each output requested on the D and J Cards.

As described in the example input, only monthly average results for eight tables have been specified, three nodes' flows and five Special Outputs. Two have been put on a single page for ease of comparison. In reality, each is printed on a separate computer page.

Each monthly table title contains a brief description of the data being presented. The tables for flows will have the USGS station number and name printed. These are specified in the D Cards. The special outputs as specified by the J Cards will change as necessary. It is recommended to always specify the units.

The table is arranged by water year, from October to September. Each month in each year has the monthly average value printed. At the end of the table, the average value over all the years for each month is calculated.

An example of the daily output table is shown following the monthly example for a similar simulation. The tables are slightly different. The daily table's title contains the titles from the A Cards as well as those given on the output request cards, D and J. This table contains the results from a single year, this time organized by calendar year. For the daily output, the minimum, maximum, total and standard deviation are calculated along with the mean value. These are not included in the monthly tables in order to keep a 50-year simulation's results on a single page.

```
A       DOCUMENTATION SIMULATION EXAMPLE
A       NYC RESERVOIRS PLUS BELTZVILLE
B        30   10      4 1.25    3    1      1    0
C            1600          1010-.6695E-03        16.            0
C            1010          1035-.3377E-03        24.            0
C            1610          1030-.3429E-03         6.            0
C            1030          1035-.6429E-03        24.            0
C            1035          10400.                 0.            0
C            1040          1100-.5000E-04        10.            0
C            1050          1070-.3413E-03         2.            0
C            1060          1070-.6452E-04         1.            0
C            1070          1080-.1613E-03         5.            0
C            1060          1100-.1156E-03        11.            0
C            1090          1100-.3106E-03         4.            0
C            1100          11300.                 0.            0
C            1105          16200.                24.            0
C            1620          1120-.8072E-03        18.            0
C            1120          1130-.2667E-03        10.            0
C            1130          1140-.9600E-04        24.            1
C            1140          11500.                 0.            0
C            1150          1270-.6241E-05         4.            0
C            1160          1200-.2030E-03        16.            0
C            1170          1200-.1132E-02         9.            0
C            1180          11900.                 0.            0
C            1190          1200-.1786E-03         3.            0
C            1200          1230-.1542E-04        16.            0
C            1210          12200.                 0.            0
C            1220          1230-.1852E-03         4.            0
C            1230          1240-.9783E-04        12.            0
C            1240          12700.                 0.            0
C            1250          1260-.2304E-02         9.            0
C            1260          1270-.1437E-03         3.            0
C            1270          1290-.1764E-04        14.            0
C            1260          1290-.1875E-03         8.            0
C            1290          13100.                 0.            0
C            1300          13100.                 0.            0
C            1310          1360-.1216E-04         9.            2
C            1320          1360-.7339E-03         9.            0
C            1330          1360-.7722E-03        10.            0
C            1340          1360-.4057E-04         4.            0
C            1350          1360-.1734E-03         8.            0
C            1360          13700.                 0.            0
C            1370          15200.                 0.            0
C            1380          1400-.2431E-03         3.            0
C            1390          1400-.1818E-02         2.            0
C            1400          1430-.2917E-03         5.            0
C            1410          1420-.3851E-03         7.            0
C            1420          14300.                 0.            0
C            1430          1470-.9346E-04         9.            0
C            1440          14700.                 0.            0
C            1450          14600.                 0.            0
C            1460          14700.                 0.            0
C            1470          1480-.1827E-03        18.            0
C            1480          1490-.2559E-03        24.            0
C            1490          15100.                 0.            0
C            1500          1510-.1504E-03        11.            0
C            1510          1520-.3119E-04         5.            0
C            1520          15400.                 0.            0
C            1530          1540-.6944E-04         2.            0
C            1540          15900.                 0.            0
C            1550          1590-.2326E-03         8.            0
C            1560          1590-.2528E-03         8.            0
C            1570          1580-.4167E-03         5.            0
C            1560          1590-.2366E-03         3.            0
C               0            00.                  0.            0
```

1	1600	1010	0	0	0	0	0	0	0	0	0	0
2	1010	1035	1	0	0	0	0	0	0	0	0	0
3	1610	1030	0	0	0	0	0	0	0	0	0	0
4	1030	1035	3	0	0	0	0	0	0	0	0	0
5	1035	1040	2	4	0	0	0	0	0	0	0	0
6	1040	1100	5	0	0	0	0	0	0	0	0	0
7	1050	1070	0	0	0	0	0	0	0	0	0	0
8	1060	1070	0	0	0	0	0	0	0	0	0	0
9	1070	1080	7	8	0	0	0	0	0	0	0	0
10	1080	1100	9	0	0	0	0	0	0	0	0	0
11	1090	1100	0	0	0	0	0	0	0	0	0	0
12	1100	1130	6	10	11	0	0	0	0	0	0	0
13	1105	1620	0	0	0	0	0	0	0	0	0	0
14	1620	1120	13	0	0	0	0	0	0	0	0	0
15	1120	1130	14	0	0	0	0	0	0	0	0	0
16	1130	1140	12	15	0	0	0	0	0	0	0	0
17	1140	1150	16	0	0	0	0	0	0	0	0	0
18	1150	1270	17	0	0	0	0	0	0	0	0	0
19	1160	1200	0	0	0	0	0	0	0	0	0	0
20	1170	1200	0	0	0	0	0	0	0	0	0	0
21	1180	1190	0	0	0	0	0	0	0	0	0	0
22	1190	1200	21	0	0	0	0	0	0	0	0	0
23	1200	1230	19	20	22	0	0	0	0	0	0	0
24	1210	1220	0	0	0	0	0	0	0	0	0	0
25	1220	1230	24	0	0	0	0	0	0	0	0	0
26	1230	1240	23	25	0	0	0	0	0	0	0	0
27	1240	1270	26	0	0	0	0	0	0	0	0	0
28	1250	1260	0	0	0	0	0	0	0	0	0	0
29	1260	1270	28	0	0	0	0	0	0	0	0	0
30	1270	1290	18	27	29	0	0	0	0	0	0	0
31	1280	1290	0	0	0	0	0	0	0	0	0	0
32	1290	1310	30	31	0	0	0	0	0	0	0	0
33	1300	1310	0	0	0	0	0	0	0	0	0	0
34	1310	1360	32	33	0	0	0	0	0	0	0	0
35	1320	1360	0	0	0	0	0	0	0	0	0	0
36	1330	1360	0	0	0	0	0	0	0	0	0	0
37	1340	1360	0	0	0	0	0	0	0	0	0	0
38	1350	1360	0	0	0	0	0	0	0	0	0	0
39	1360	1370	34	35	36	37	38	0	0	0	0	0
40	1370	1520	39	0	0	0	0	0	0	0	0	0
41	1280	1400	0	0	0	0	0	0	0	0	0	0
42	1390	1400	0	0	0	0	0	0	0	0	0	0
43	1400	1430	41	42	0	0	0	0	0	0	0	0
44	1410	1420	0	0	0	0	0	0	0	0	0	0
45	1420	1430	44	0	0	0	0	0	0	0	0	0
46	1430	1470	43	45	0	0	0	0	0	0	0	0
47	1440	1470	0	0	0	0	0	0	0	0	0	0
48	1450	1460	0	0	0	0	0	0	0	0	0	0
49	1460	1470	48	0	0	0	0	0	0	0	0	0
50	1470	1480	46	47	49	0	0	0	0	0	0	0
51	1480	1490	50	0	0	0	0	0	0	0	0	0
52	1490	1510	51	0	0	0	0	0	0	0	0	0
53	1500	1510	0	0	0	0	0	0	0	0	0	0
54	1510	1520	52	53	0	0	0	0	0	0	0	0
55	1520	1540	40	54	0	0	0	0	0	0	0	0
56	1530	1540	0	0	0	0	0	0	0	0	0	0
57	1540	1590	55	56	0	0	0	0	0	0	0	0
58	1550	1590	0	0	0	0	0	0	0	0	0	0
59	1560	1590	0	0	0	0	0	0	0	0	0	0
60	1570	1580	0	0	0	0	0	0	0	0	0	0
61	1580	1590	60	0	0	0	0	0	0	0	0	0
62	1590	0	57	58	59	61	0	0	0	0	0	0

```
D     1130    DELAWARE RIVER AT MONTAGUE  01438500
D     1310      DELAWARE RIVER AT TRENTON  01463500
D     1590 DELAWARE R AT MEMORIAL BRIDGE  01482100
D        0
E1     2600 .1874E+11      1600      5690.   PEPACTON
     6.20      6.20      6.20     18.60     18.60     18.60     18.60     18.60     18.60     18.60      6.20      6.20
    50.00     50.00     50.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00     50.00     50.00
     -.19      -.17      -.41      -.59      1.55      1.63      1.55      1.62      1.83      2.07      -.72      -.59
    -1.46     -1.45     -3.16     -4.70     11.95     12.98     11.95     12.49     14.58     15.96     -5.74     -4.55
E1     2610 .1280E+11      1610      5150.  CANNONSVILLE
     7.70      7.70      7.70      7.70     23.20     23.20     23.20     23.20     23.20     23.20     23.20      7.70
    33.00     33.00     33.00     45.00     45.00    325.00    325.00    325.00     45.00     45.00     33.00     33.00
     -.19      -.17      -.41      -.59      1.55      1.63      1.55      1.62      1.83      2.07      -.72      -.59
    -1.33     -1.31     -2.86     -4.25     10.82     11.75     10.82     11.30     13.19     14.44     -5.19     -4.12
E1     2620 .4671E+10      1105      1523.  NEVERSINK
     4.60      4.60      4.60     15.50     15.50     15.50     15.50     15.50     15.50     15.50      4.60      4.60
    25.00     25.00     25.00     45.00     45.00     45.00     45.00     45.00     45.00     45.00     25.00     25.00
     -.19      -.17      -.41      -.59      1.55      1.63      1.55      1.62      1.83      2.07      -.72      -.59
     -.39      -.39      -.85     -1.26      3.20      3.48      3.20      3.34      3.90      4.27     -1.54     -1.22
E1     2170 .1735E+10      1170       947.  BELTZVILLE
    35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00
    35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00     35.00
      .01       .13      -.38      -.46      1.79      2.23      1.68      2.05      1.91      2.34      -.51      -.34
      .01       .13      -.49      -.61      2.30      2.96      2.16      2.63      2.53      3.00      -.68      -.44
E1        0C.               0         0.
F               6
        1    1       127.
        5    1       190.
        7    1       190.
       10    1       110.
       12    1       110.
       12   31       127.
G               6
        1    1        87.
        5    1       150.
        7    1       150.
       10    1        70.
       12    1        70.
       12   31        87.
H          800.       600.       430.
I         1750.      1750.      1525.
J        5
J     6000RELEASES TO MAINTAIN MONTAGUE FLOW (CFS)
J     6010RELEASES TO MAINTAIN TRENTON FLOW  (CFS)
J     6020       DIVERSIONS TO NEW YORK CITY  (MGD)
J     6030    TOTAL STORAGE OF NYC RESERVOIRS  (BG)
J     6040              BELTZVILLE STORAGE  (BG)
K          155.       124.        93.
L         2270.      2270.      2270.
M               7
             12   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.
             30  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.
             32  71.  71.  71.  71.  71.  71.  71.  71.  71.  71.  71.  71.
             34  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
             55 187. 187. 187. 187. 187. 187. 187. 187. 187. 187. 187. 187.
             57  27.  27.  27.  27.  27.  27.  27.  27.  27.  27.  27.  27.
             62  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.  72.
WARNING: NO MATCH FOR NODE   1000
WARNING: NO MATCH FOR NODE   1020
WARNING: NO MATCH FOR NODE   1110
```

```
THE TRENTON SLOT NUMBER IS   34
THE D&R CANAL SLOT NUMBER IS   33
THE MERRILL CR SLOT NUMBER IS    0
THE FROMPTON SLOT NUMBER IS      0
THE MONTAGUE SLOT NUMBER IS     16
THE BELVIDERE SLOT NUMBER IS     0
THE BLUE MARSH SLOT NUMBER IS    0
LOW FLOW AT MONTAGUE 281015
LOW FLOW AT MONTAGUE 281018
LOW FLOW AT MONTAGUE 281019
LOW FLOW AT MONTAGUE 281020
LOW FLOW AT MONTAGUE 281021
LOW FLOW AT MONTAGUE 281022
LOW FLOW AT MONTAGUE 281023
LOW FLOW AT MONTAGUE 281024
LOW FLOW AT MONTAGUE 281025
LOW FLOW AT MONTAGUE 281027
LOW FLOW AT MONTAGUE 281028
LOW FLOW AT MONTAGUE 281029
LOW FLOW AT MONTAGUE 2811 1
LOW FLOW AT MONTAGUE 2811 2
LOW FLOW AT MONTAGUE 2811 3
LOW FLOW AT MONTAGUE 2811 4
LOW FLOW AT MONTAGUE 2811 5
LOW FLOW AT MONTAGUE 2811 6
LOW FLOW AT MONTAGUE 2811 7
LOW FLOW AT MONTAGUE 2811 8
LOW FLOW AT MONTAGUE 2811 9
LOW FLOW AT MONTAGUE 281110
LOW FLOW AT MONTAGUE 281111
LOW FLOW AT MONTAGUE 281112
LOW FLOW AT MONTAGUE 281113
LOW FLOW AT MONTAGUE 281115
LOW FLOW AT MONTAGUE 281116
LOW FLOW AT MONTAGUE 281117
LOW FLOW AT MONTAGUE 281118
LOW FLOW AT MONTAGUE 281119
LOW FLOW AT MONTAGUE 281120
LOW FLOW AT MONTAGUE 281125
LOW FLOW AT MONTAGUE 281126
LOW FLOW AT MONTAGUE 281127
LOW FLOW AT MONTAGUE 281128
LOW FLOW AT MONTAGUE 281129
LOW FLOW AT MONTAGUE 281130
LOW FLOW AT MONTAGUE 2812 9
LOW FLOW AT MONTAGUE 281210
LOW FLOW AT MONTAGUE 281216
LOW FLOW AT MONTAGUE 281222
LOW FLOW AT MONTAGUE 281223
LOW FLOW AT MONTAGUE 281224
LOW FLOW AT MONTAGUE 281225
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Repeated to End of Simulation

CDM / WATER RESOURCES DIVISION
ANNANDALE, VIRGINIA

* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
DELAWARE RIVER AT MONTAGUE 01438500

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	13496.1	17390.7	16667.1	5105.9	7150.0	6741.6	14254.4	11877.1	12648.0	10719.7	5830.3	3856.2
1929	2020.0	1772.6	2292.4	2957.9	3240.6	12192.4	18862.1	9869.9	2788.5	2008.4	1812.5	1776.3
1930	2990.8	4593.7	5908.2	5493.5	5443.5	8056.8	5455.4	2947.0	4006.0	2243.3	1957.8	1867.4
1931	1731.6	1756.8	1672.4	1556.6	1975.6	7048.8	9714.8	8085.6	4288.5	6028.6	2231.3	1762.3
AVG	5059.6	6378.5	6635.0	3778.5	4452.4	8509.9	12071.7	8194.9	5932.8	5250.0	2958.0	2316.0

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DELAWARE RIVER DAILY FLOW MODEL
DELAWARE RIVER AT TRENTON 01463500

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	22831.7	25774.5	27296.3	15849.0	16177.0	12016.1	23197.3	17941.5	19073.1	24278.9	12026.5	8809.7
1929	3911.8	3344.3	3903.3	6713.3	7825.6	22141.9	27687.6	16865.0	5479.4	3389.1	3127.0	3626.5
1930	4717.0	9213.9	5647.6	10363.7	10772.7	15742.0	12349.3	6556.4	7642.1	3962.8	2565.5	2445.9
1931	2303.8	2677.5	2729.1	3631.1	4743.2	11128.4	15310.3	12618.4	7647.5	9215.2	3645.5	2695.3
AVG	8441.1	10252.5	[illegible]	7899.3	9879.6	15257.3	19636.1	13495.8	[illegible]	10211.5	5341.1	4394.4

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DELAWARE RIVER DAILY FLOW MODEL
DELAWARE R AT MEMORIAL BRIDGE 01482100

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	32299.2	33999.1	40317.1	16778.5	31022.1	19645.4	34438.0	26184.5	27350.8	35561.2	7735.3	13403.0
1929	6677.2	5698.6	6510.3	11708.5	15834.1	33178.4	38046.4	24380.8	8666.2	5137.1	5622.4	6043.7
1930	12655.8	15116.5	14361.7	15543.2	18866.6	23517.8	18177.6	9964.5	10278.3	5507.6	3419.1	3406.1
1931	2983.3	3747.0	4141.5	6301.2	7939.5	14861.1	19956.8	17455.3	11830.3	13622.1	6344.4	4343.2
AVG	13653.9	14640.3	16332.6	12582.8	18415.6	22800.7	27654.7	19496.3	14531.4	14957.0	8280.3	6799.0

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* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
RELEASES TO MAINTAIN MONTAGUE FLOW (CFS)

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1929	80.3	232.9	65.0	15.0	0.0	0.0	0.0	0.0	2.0	111.0	265.9	455.1
1930	79.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.3	171.4	314.7
1931	715.0	618.7	223.8	421.4	242.0	0.0	0.0	0.0	0.0	19.5	44.1	453.7
AVG	218.7	212.9	72.2	109.1	60.5	0.0	0.0	0.0	.5	41.4	120.3	305.9

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* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
RELEASES TO MAINTAIN TRENTON FLOW (CFS)

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1929	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1930	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.3	73.8
1931	151.9	33.2	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9
AVG	38.0	8.3	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	16.7

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* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
DIVERSIONS TO NEW YORK CITY (MGD)

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0
1929	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0
1930	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0
1931	741.9	600.0	479.4	430.0	430.0	430.0	430.0	606.5	706.7	787.1	800.0	800.0
AVG	785.5	750.0	719.8	707.5	707.5	707.5	707.5	751.6	776.7	796.8	800.0	800.0

COM / WATER RESOURCES DIVISION
ANNANDALE, VIRGINIA

* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
TOTAL STORAGE OF NYC RESERVOIRS (BG)

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	270.3	270.6	270.5	269.9	269.7	269.5	270.6	270.4	270.4	270.0	268.6	260.9
1929	241.1	216.3	200.6	191.2	185.8	219.4	269.2	270.5	262.0	241.6	209.2	175.9
1930	157.6	151.7	160.7	184.1	185.8	220.9	245.1	241.3	234.7	216.7	184.7	154.6
1931	120.5	87.8	72.2	58.7	43.4	46.4	119.1	169.7	190.4	196.8	197.5	170.6
AVG	197.4	181.6	176.0	176.0	171.2	189.1	226.0	238.0	239.4	231.3	215.0	190.5

COM / WATER RESOURCES DIVISION
ANNANDALE, VIRGINIA

* * * * * F I N A L * * * * *

DELAWARE RIVER DAILY FLOW MODEL
BELTZVILLE STORAGE (BG)

AVERAGE MONTHLY VALUES

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1928	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
1929	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
1930	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.3	11.0
1931	5.4	6.6	5.9	5.1	5.4	6.2	10.2	12.6	13.0	13.0	13.0	13.0
AVG	11.6	11.4	11.2	11.0	11.1	11.3	12.3	12.9	13.0	13.0	12.8	12.5

SIMULATION ENDED NORMALLY

COM / WATER RESOURCES DIVISION
ANNANDALE, VIRGINIA
NODE 1130

* * * * * F I N A L * * * * *
* DELAWARE RIVER *
* DAILY FLOW MODEL *

DOCUMENTAION SIMULATION EXAMPLE
NYC RESERVOIRS PLUS BELTZVILLE
DELAWARE RIVER AT MONTAGUE 01438500

----------AVERAGE DAILY VALUES SIMULATED FOR 1928----------

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	13797.65	2647.10	4969.80	9904.31	30565.98	5190.72	39763.88	4605.13	6625.80	2123.79	1794.55	2856.71
2	13211.80	3045.69	4457.16	8466.14	26906.96	4860.45	30257.98	4756.35	4328.21	2618.32	1749.27	4986.54
3	9585.54	3090.74	3386.79	7570.65	21058.41	4643.49	19550.12	5139.62	6297.64	2518.44	1760.83	4291.62
4	7607.34	2925.64	2540.22	7322.06	18104.47	4084.32	14978.34	3655.72	10755.31	2535.70	1829.73	3037.32
5	6393.36	2739.27	2620.62	6873.94	18247.85	8368.69	12451.57	3182.42	7602.13	2643.80	1632.16	2840.31
6	6670.56	2121.33	2494.01	8317.80	19387.51	19364.20	23338.02	4244.38	5490.63	2468.42	1750.54	2565.63
7	5497.62	1961.12	2298.09	10715.40	17785.25	36062.44	19367.97	6828.70	4802.51	1874.98	1650.95	2375.38
8	6913.53	2640.16	2076.52	12490.76	13123.68	24362.79	12472.90	7165.17	4451.25	1922.76	1769.93	2079.47
9	7585.34	9545.35	1986.92	11285.76	10337.47	17017.53	8555.47	5489.94	3869.66	2572.40	1692.79	1792.62
10	5901.67	7061.23	2653.87	10296.53	8533.78	16565.07	8158.49	5891.16	3924.85	2320.93	1779.42	1708.77
11	4803.32	5484.44	2694.12	9098.43	7281.52	17116.45	7573.03	5749.39	3699.57	1981.25	1712.42	1948.66
12	4073.67	4896.75	2978.16	13178.70	6816.87	12650.81	6385.53	7269.78	3096.29	2161.31	1759.03	1796.18
13	4431.67	4220.50	5452.51	13592.80	5634.86	9901.69	5691.16	6974.23	2847.27	2215.25	1641.11	2285.00
14	4021.56	3827.16	9465.36	12633.58	5541.18	8166.12	9607.53	5333.07	3166.58	1800.22	1832.43	2321.62
15	3854.32	16140.69	7449.32	12366.61	4614.41	7486.15	17545.33	4181.03	3292.07	1686.66	1757.44	2102.60
16	3789.15	22926.17	5751.47	12320.45	3848.66	6763.91	10151.17	3823.84	2775.60	2254.06	1844.51	1715.30
17	3500.38	16578.59	4578.82	11467.62	3758.06	5172.02	8640.33	3936.99	2691.54	2011.68	1724.92	1855.85
18	3526.09	8528.09	5271.28	9833.73	3496.34	4208.35	6261.65	5377.37	2940.08	1712.08	1695.94	2083.33
19	3278.15	8028.12	4919.23	6582.50	4588.57	5133.90	5460.31	5021.70	2972.30	1767.07	1656.54	2232.29
20	2637.45	6975.31	3884.24	8067.92	10818.71	10632.78	4667.04	4662.30	3101.27	1766.11	1727.84	3033.78
21	2537.14	4908.17	3319.26	7279.41	13814.91	8156.16	4273.08	3826.60	3162.87	1729.16	1978.64	2159.49
22	2115.16	3536.59	3565.11	7979.39	11930.96	9536.51	3671.87	3801.53	3167.33	1658.66	1967.67	1844.16
23	2245.07	7476.83	3901.91	21472.82	14424.75	11239.13	3615.41	4273.31	2460.10	1749.99	1893.09	1667.11
24	1988.22	12717.34	4227.89	36487.54	21943.62	8756.65	5982.55	4086.44	2364.48	1754.30	2094.50	1649.65
25	2741.74	15944.74	13962.33	32426.10	14311.79	9319.73	4694.97	3795.93	2677.18	1693.04	1708.62	1689.67
26	7654.38	9138.14	18537.33	22403.68	10869.84	14023.31	3549.13	4621.76	2747.39	1797.16	1757.49	2059.44
27	4210.22	6037.05	20254.73	16699.91	9042.06	15753.57	3668.70	18726.18	2713.44	1770.37	1813.46	1983.88
28	3140.91	5257.12	19213.94	15589.73	8161.95	14932.95	10574.22	12876.82	2720.38	1776.81	1823.17	2131.21
29	3409.15	4769.[illegible]	14333.57	25929.59	8111.15	11699.53	10940.28	8629.08	2724.40	1708.12	1683.21	1863.62
30	3791.59	0.00	12449.97	33677.25	6864.44	46572.76	6366.04	6243.22	2195.08	2113.72	1695.31	1935.65
31	2836.57	0.00	13312.63	0.00	6261.22	0.00	5283.82	6571.42	0.00	1911.87	0.00	2174.62
MIN	1988.22	1961.12	1988.92	6873.94	3496.34	4084.32	3549.13	3182.42	2195.08	1658.66	1632.16	1649.65
MAX	13797.65	22926.17	20254.73	36487.54	30565.98	48572.76	39763.88	18726.18	10755.31	2643.80	2094.50	4986.54
MEAN	5105.69	7150.02	6741.59	14254.38	11877.07	12648.05	10719.74	5830.33	3856.17	2019.95	1772.58	2292.44
TOTAL	158282.50	207350.71	208969.27	427631.34	368189.28	379441.44	332311.87	180740.28	115685.23	62618.45	53177.51	71065.65
S DEV	2926.47	5247.79	5421.65	9130.06	6959.80	9450.17	8272.65	3006.33	1833.61	318.92	113.39	730.73

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