# DOCUMENTATION OF A REGIONAL AQUIFER SIMULATION MODEL, RAQSIM, AND A DESCRIPTION OF SUPPORT PROGRAMS APPLIED IN THE TWIN PLATTE - MIDDLE REPUBLICAN STUDY AREA, NEBRASKA

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| Multiply | By | To obtain |
|---|---|---|
| acre | 0.0040 | square kilometer |
| acre-foot | 1,233 | cubic meter |
| inch | 25.4 | millimeter |
| foot | 0.3048 | meter |
| cubic foot | 0.02832 | cubic meter |
| square foot | 0.09294 | square meter |
| square mile | 2.509 | square kilometer |
| mile | 1.609 | kilometer |
| degree Fahrenheit | °C = 5/9(°F-32) | degree Celsius |

# DOCUMENTATION OF A REGIONAL AQUIFER SIMULATION MODEL, RAQSIM, AND A DESCRIPTION OF SUPPORT PROGRAMS APPLIED IN THE TWIN PLATTE-MIDDLE REPUBLICAN STUDY AREA, NEBRASKA

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## ABSTRACT

RAQSIM, a generalized flow model of a ground-water system using finite-element methods, is documented to explain how it works and to demonstrate that it gives valid results. Three support programs that are used to compute recharge and discharge data required as input to RAQSIM are described.

RAQSIM was developed to solve transient, two-dimensional, regional ground-water flow problems with isotropic or anisotropic conductance. The model can also simulate radially-symmetric flow to a well and steady-state flow. The mathematical basis, program structure, data input and output procedures, organization of data sets, and program features and options of RAQSIM are discussed. An example, containing listings of data and results and illustrating RAQSIM's capabilities, is discussed in detail. Two test problems also are discussed comparing RAQSIM's results with analytical procedures.

The first support program described, the PET Program, uses solar radiation and other climatic data in the Jensen-Haise method to compute potential evapotranspiration. The second support program, the Soil-Water Program, uses output from the PET Program, soil characteristics, and the ratio of potential to actual evapotranspiration for each crop to compute infiltration, storage, and removal of water from the soil zone. The third program, the Recharge-Discharge Program, uses output from the Soil-Water Program together with other data to compute recharge and discharge from the ground-water flow system.

For each support program, a program listing and examples of the data and results for the Twin Platte-Middle Republican study are provided. In addition, a brief discussion on how each program operates and on procedures for running and modifying these programs are presented.

# INTRODUCTION

"RAQSIM" is an acronym for the Regional Aquifer Simulation Model prepared for use in the Twin Platte-Middle Republican hydrogeologic study. The area of this study consists of about 2,970 square miles in southwest Nebraska, partly in the Twin Platte Natural Resources District and partly in the Middle Republican Natural Resources District (fig. 1). Because of the large area involved and a restricted computer memory, use of a traditional finite-difference ground-water flow model was impractical at the available computer facilities. The flexibility of a finite-element grid, however, allows boundaries and streams to be more closely approximated while maintaining coarser discretization outside the primary area of interest. Unfortunately, at the time this project began, no well documented finite-element program was available for simulation of ground-water systems involving large areas.

A finite-element program that had many features applicable to regional modeling and that offered advantages unavailable in other programs was discovered through a literature search. This program, called "FLUMP," is described in detail by Narasimhan and others (1978). Some aspects of FLUMP, however, are not particularly suited to use in simulation of large areas for lengthy water-management plans. RAQSIM, therefore, was written to add features designed to increase efficiency in handling problems specific to the Twin Platte-Middle Republican study area.

Values of recharge to and discharge from the major aquifer or aquifers of the ground-water system are required in order to operate a ground-water flow model such as RAQSIM. These data cannot be obtained by direct measurement but must be estimated through use of a variety of programs, which for this report will be referred to as "support programs." Output from these support programs provides input to the ground-water flow model that is applicable specifically to the study area. Support programs described in this report are pre-existing programs modified to meet the needs of the Twin Platte-Middle Republican study.

## Purpose and Scope

There are two purposes for this report. One purpose is to document RAQSIM. As RAQSIM is a generalized flow model of a ground-water system, it has potential for use in areas other than the Twin Platte-Middle Republican study. Documentation is necessary, therefore, not only to explain this model but also to demonstrate that it gives valid results.

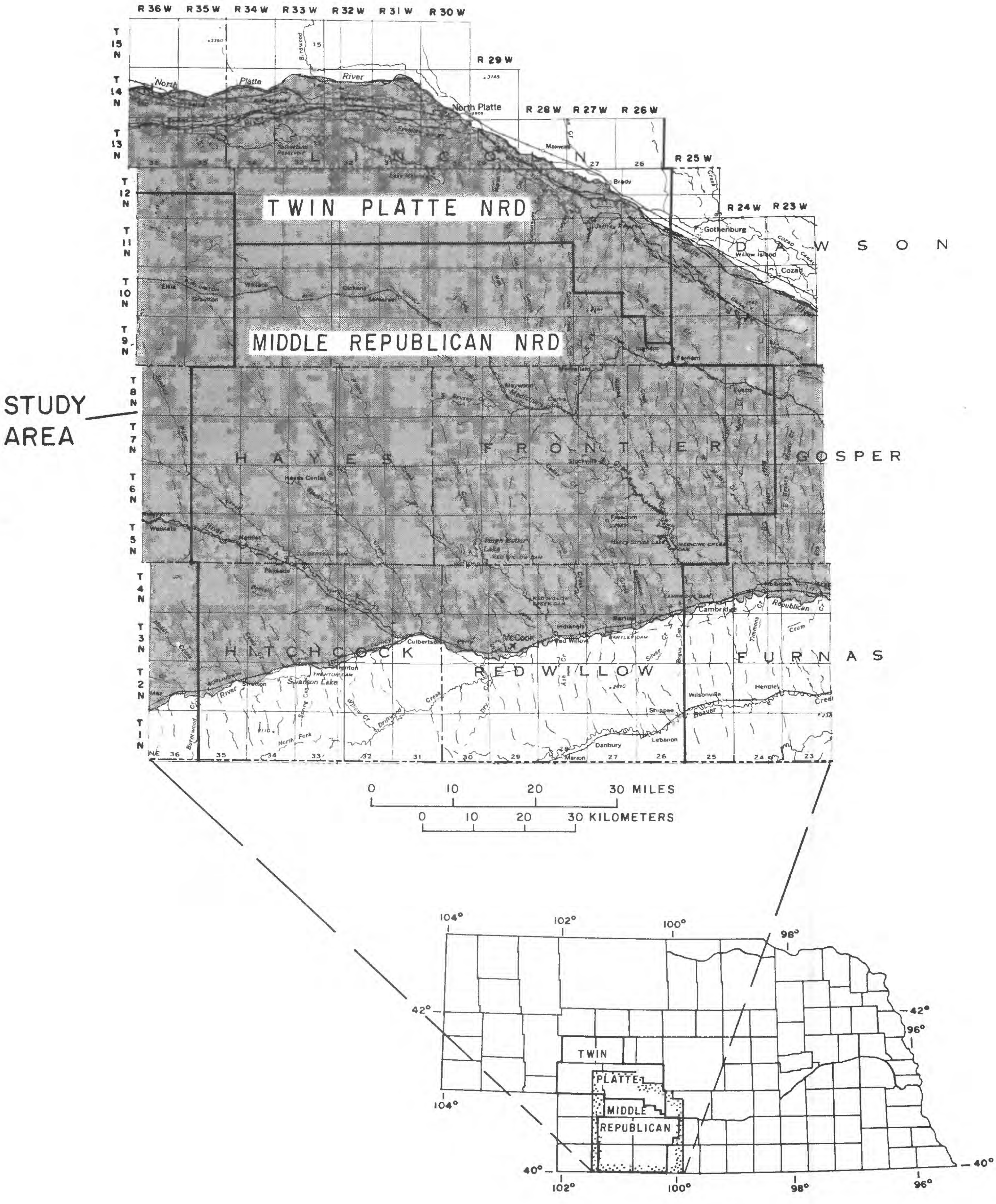



Figure 1.--Location of the Twin Platte-Middle Republican study area.

The second purpose of the report is to describe the support programs used with RAQSIM in the Twin Platte-Middle Republican study. These programs are modified from existing programs that have been tested and used previously. They are described in detail for the benefit of those who may wish to use RAQSIM together with the support programs in future studies of the Twin Platte-Middle Republican area.

The documentation and descriptions in this report are intended to be sufficiently detailed so that others might operate or revise the programs in the future. The basic mathematics and theoretical developments involved in RAQSIM will be summarized. However, the mathematics and theoretical basis for the support programs have been described by others and are not given in this report.

Three sample problems were run using RAQSIM. The first sample problem was run to show the versatility of this model in handling irregular boundaries. In addition, this example was run to show the input data and output. Two sample problems are compared with other procedures--test problem No. 1 using the Papadopulos and Cooper method (1967), and test problem No. 2 using an analytic solution presented by Chan and others (1976) to test the validity of RAQSIM.

## Treatment of Subject Matter

RAQSIM and the support programs are treated separately in this report. RAQSIM simulates the ground-water system or saturated zone and the surface-water system where the streams are connected with the ground-water system. The support programs simulate the soil zone and calculate recharge and discharge to the ground-water system. Values derived through the support programs may be input to RAQSIM without direct interaction between RAQSIM and the support programs. Consequently, operation of the support programs may proceed independently of RAQSIM and logically may be described separately.

## DOCUMENTATION OF RAQSIM

RAQSIM was written principally to solve time-dependent, two-dimensional, regional ground-water flow problems. The model also incorporates features that allow it to be applied to other problems such as radially-symmetric flow to a well and steady-state flow. It is designed to simulate two-dimensional problems or three-dimensional problems if radial symmetry about the vertical axis can be assumed. In two dimensions, the grid may be oriented either horizontally or vertically. RAQSIM has the capability of handling both isotropic and anisotropic conductance.

Two hydraulic properties of the ground-water flow system that are simulated by RAQSIM will vary, depending on the dimensionality and orientation of the finite-element grid. These hydraulic properties are referred to in RAQSIM as "conductance" and "capacitance." These terms may be used in place of analagous terms such as "transmissivity" and "storage coefficient" when dealing in a two-dimensional horizontal system, or "hydraulic conductivity" and "specific storage" when dealing with a saturated cross-sectional or three-dimensional, radially-symmetric flow system. Likewise, they may be used in place of "hydraulic conductivity" and "soil-water capacity" when dealing with an unsaturated cross-sectional or a three-dimensional, radially-symmetric flow system.

The model FLUMP, after which RAQSIM is patterned, is described by Neuman and Narasimhan (1977), Narasimhan and others (1977), and Narasimhan and others (1978). The reader interested in the primary mathematical foundation of FLUMP should consult these articles.

RAQSIM differs from FLUMP in a number of significant ways:

1. RAQSIM is written in IBM FORTRAN IV while FLUMP uses the conventions of CDC FORTRAN IV.

2. Input to RAQSIM is organized to utilize disk files arranged to minimize the amount of computer memory required during the simulation. In FLUMP, a single data set is used for all of input data and all data are read at the start of the simulation.

3. RAQSIM solves for hydraulic head, which hereafter will be referred to as head, at implicit nodes directly by using the Cholesky method (Pinder and Gray, 1977, p. 22-23). FLUMP uses an iterative scheme to solve for head at the implicit nodes.

4. In RAQSIM, head-dependent hydraulic properties are updated in response to a time-frequency parameter or an absolute head-change parameter. In FLUMP, these hydraulic properties are updated after every time step.

5. In RAQSIM, flux specification generally is implemented only as a tabulated function of time, while conductance and capacitance are implemented only as tabulated functions of head. Within RAQSIM, stream-aquifer flux and ground-water evapotranspiration may be simulated as simple functions of head. In FLUMP, the user is allowed to specify flux as a tabulated function of head or time and to specify conductance and capacitance as tabulated functions of head or time.

6. In RAQSIM, code is provided to simulate stream-aquifer flux if streams are connected to the ground-water system and to account for changes in quantity as flow moves downstream. Stream-aquifer flux is approximated as a linear function of the difference between the head in the stream and the head in the aquifer. The flux from the stream to the aquifer may be limited if there is insufficient flow in the stream. FLUMP has provisions to simulate flux only as a function of head or as a function of time, not as a function of flux at adjacent nodes.

7. Ground-water evapotranspiration (ET) is simulated within RAQSIM as a very simple function of depth to water below the land surface. The maximum rate of ET, which is uniform over the entire area but variable through time, will occur if the head is at the elevation of the land surface. ET will vary linearly from the maximum rate as head drops below the land surface, ceasing entirely once head falls below a specified depth (also uniform over the entire area). FLUMP is unable to simulate flux as time-varying function of head.

From the standpoint of flexibility, it is obvious that RAQSIM lacks some of the power offered by FLUMP (primarily related to the updating of hydraulic properties and the general specification of flux as functions of head or hydraulic properties as functions of time). The primary function of RAQSIM is to simulate efficiently regional ground-water systems and to incorporate some features beyond FLUMP's capabilities, while sacrificing some of FLUMP's features that generally are not applied to regional ground-water simulations.

## Mathematical Basis

A brief summary of the mathematical basis of RAQSIM is presented in this section. A uniform convention has been adopted pertaining to the sign of flux values throughout RAQSIM. Positive flux represents flow into the aquifer, while negative flux represents discharge from the aquifer.

### Flow Equation

Equation 3 of Neuman and Narasimhan (1977) describes the general form of parabolic equation that both FLUMP and RAQSIM solve:

$$[A]\{h(t)\} + [D]\{\dot{h}(t)\} = \{Q(t)\} \tag{1}$$

where

$[A]$ the conductance matrix, is dependent upon the geometry of the system and the conductance within the system;

$[D]$ the capacitance matrix, is dependent upon the geometry of the system and the capacitance within the system;

$\{h(t)\}$ the vector of the dependent variable, i.e., hydraulic head for a ground-water simulation;

$\{\dot{h}(t)\}$ the vector of the time derivative of the dependent variable (dh/dt);

$\{Q(t)\}$ the vector of sources, sinks, or boundary flux

The capacitance matrix $[D]$ is diagonalized following the suggestions and justification given by Neuman and Narasimhan (1977).

Individual terms of $[A]$ and $[D]$ are defined by Neuman and Narasimhan (1977, equations 4 and 5).

Finite differencing the time derivative and introducing an implicit weighting factor ($\theta$, i.e., THETA) leads to the discrete form:

$$[A]\left(\theta\left\{h^{k+1}\right\} + (1-\theta)\left\{h^{k}\right\}\right) + [D]\frac{\left\{h^{k+1}\right\} - \left\{h^{k}\right\}}{\Delta t} = \{Q\} \tag{2}$$

which is equivalent to equation 6 of Neuman and Narasimhan (1977) with the asterisk dropped from the symbol for the capacitance array $[D]$. Superscripts k+1 and k refer to time. Time level k+1 equals time k plus $\Delta t$.

Rearranging and combining terms in equation (2) yields

$$\left(\theta\,[A] + \frac{[D]}{\Delta t}\right)\left(\{h^{k+1}\} - \{h^{k}\}\right) = \{Q\} - [A]\{h^{k}\}\,. \tag{3}$$

For explicit nodes, $\theta$ is zero; the resulting equation for an explicit node contains a single unknown variable, the head ($h^{k+1}$). Implicit nodes generally have more than one unknown for each equation and must be solved simultaneously. RAQSIM uses the Cholesky method (Pinder and Gray, 1977, p. 22-23) to solve the resulting system of symmetric simultaneous equations directly.

## Automated Estimation of Time Step Size and Implicit Weighting Factor

Time derivatives of head are forecast for each time step and are used to help assure that the maximum head change during that time step does not exceed an allowed maximum. Choice of an optimal value for the implicit weighting factor, THETA, during the simulation also makes use of the forecast time derivative of head. Time derivatives of head at the start of a time step are approximated by the explicit form. By saving the time derivative at the beginning of a time step for the implicit node with the largest head change during a time step, it is possible to forecast a head change for that node during the subsequent time step.

Assume that DHAVG is the average deviation from the initial head during a time step, while DELH is the total head change during the time step. These can be described mathematically as:

$$\mathrm{DELH} = h(t_2) - h(t_1)$$

$$\mathrm{DHAVG} = \frac{1}{t_2 - t_1}\int_{t_1}^{t_2}\left[h(t) - h(t_1)\right] dt$$

The optimal value for THETA for that time step is estimated such that the forecast estimate of DHAVG equals the product of THETA with the forecast estimate of DELH.

The forecast values for DHAVG and DELH are derived by assuming one of the following functional relationships for head change with respect to time.

1. Head-change rate decreasing with time: If the magnitude of the head-change rate for the specified node decreases with time, the function is assumed to be an exponential decay of the form:

$$\dot{h}(t_1) = \dot{h}(t_0) * e^{ALPHA * (t_1-t_0)} \tag{4}$$

or

$$h(t_1) = h(t_0) - \frac{\dot{h}(t_0)}{ALPHA} * (1-e^{ALPHA * (t_1-t_0)}) \tag{5}$$

where

$\dot{h}(t)$ is the value of the time derivative of head at time t;

$h(t)$ is the value of head at time t;

$t_0$ is the value of time at the beginning of a time step;

$t_1$ is any time after t ; and

ALPHA is a negative constant controlling the decay rate.

ALPHA can be estimated if the head and time derivatives of head are known at two times for the node of interest by the relation

$$ALPHA = \frac{\dot{h}(t_1) - \dot{h}(t_0)}{h(t_1) - h(t_0)} \tag{6}$$

The forecast of the head change in a subsequent time step (from $t_1$ to $t_2$) can be estimated by the relation

$$DELH = - \frac{\dot{h}(t_1)}{ALPHA} * (1 - e^{ALPHA * (t_2-t_1)}) \tag{7}$$

The average head difference from $h(t_1)$ during the same time step may be forecast with the relationship

$$DHAVG = \frac{DELH}{ALPHA * (t_2-t_1)} - \frac{\dot{h}(t_1)}{ALPHA} \tag{8}$$

2. Head-change rate increasing with time: If the magnitude of the head-change rate increases with time, the functional relationship for the specified node is assumed to be quadratic growth of the form

$$\dot{h}(t_1) = \dot{h}(t_0) + 2 * BETA * (t_1 - t_0) \qquad (9)$$

or

$$h(t_1) = h(t_0) + \dot{h}(t_0) * (t_1 - t_0) + BETA * (t_1 - t_0)^2 \qquad (10)$$

where

BETA is the constant controlling the quadratic growth.

The value of BETA may be estimated for the specified node from the head change during the previous time step and the present value of the time derivative of head:

$$BETA = \frac{\dot{h}(t_1) - \dfrac{h(t_1) - h(t_0)}{t_1 - t_0}}{t_1 - t_0} \qquad (11)$$

The forecast head change in a subsequent time step (from $t_1$ to $t_2$) can be estimated by the relationship:

$$DELH = \dot{h}(t_1) * (t_2 - t_1) + BETA * (t_2 - t_1)^2 \qquad (12)$$

while the average head difference from $h(t_1)$ during any time step may be forecast with the relationship:

$$DHAVG = \frac{\dot{h}(t_1) * (t_2 - t_1)}{2} + \frac{BETA * (t_2 - t_1)^2}{3} \qquad (13)$$

## Program Structure

The program RAQSIM consists of a short dimensioning procedure and 22 subroutines. A listing of the program is given in Attachment A. Comments in the first program segment give a listing of the subroutines and a brief description of the task performed by each. The overall structure of the program is shown by a flow chart (fig. 2) and a brief description of each subroutine is given in table 1. This program uses IBM double precision, half-word integers, and single-byte logical variables and therefore may require some re-coding before it will run on other computers. All of the variable dimensioning is accomplished in the first program segment by partitioning four vectors. If there is insufficient room within these vectors to store the dimensioned variables, the user must change the dimensions only of these four vectors (lines 85-94 of Attachment A). Comments in the first program segment guide the initial selection of dimensions for the vectors. Required dimensions are printed in the normal output to allow the user to adjust the dimensions to suit a specific problem.

Terms of the A and D matrices of equation 1 are incorporated into the ANM vector within the program. The LAMBDA vector in the program holds the coefficients of the set of simultaneous equations for the implicit nodes.

Table 1.--Brief description of RAQSIM subroutines

| | |
|---|---|
| INPUTS: | Performs input of initial and constant data. |
| BOUNDS: | Checks for proper range of certain integer data. |
| CONTRL: | Subroutine to control the progress of the simulation and keep tabs on remaining computer time to allow a restart. |
| REFORM: | Generates the ANM array. Checks stability criteria. Reclassifies and resequences implicit nodes if needed. |
| SMULAT: | Routine to simulate and perform mass balance calculations for each time period having constant hydraulic parameters and specified boundary conditions. |
| FLUXES: | Consolidates various flux components and updates known heads, streamflow variables, and time parameters. |

TSMASS: Calculates capacitance and conductance as a function of saturated thickness from tabulated input and determines the amount of fluid in each nodal subdomain at the start of the simulation and at the end of the simulation for use in mass balance.

SHAPE: Determines basis function integrals and element areas.

STFLOW: Simulates streamflow components.

INTABL: Reads tabulated values of capacitance and conductance versus "saturated thickness" from device INTS.

DAYS: Determines number of days between dates. Inputs are integer values for month, day, and year; output is number of days.

NEWDAT: Determines the new month, day, and year given the old month, day, and year and the number of days added.

ACCUM: Subroutine which forms space and time derivative matrices.

SETANM: Subroutine to form the linked list structure of ANM array.

FACTOR: Subroutine for Cholesky factorization of matrix LAMBDA.

SOLVE: Subroutine solving factored LAMBDA matrix for unknowns.

OPTNUM: Scheme to renumber implicit nodes to minimize the left horizontal profile of the symmetric matrix.

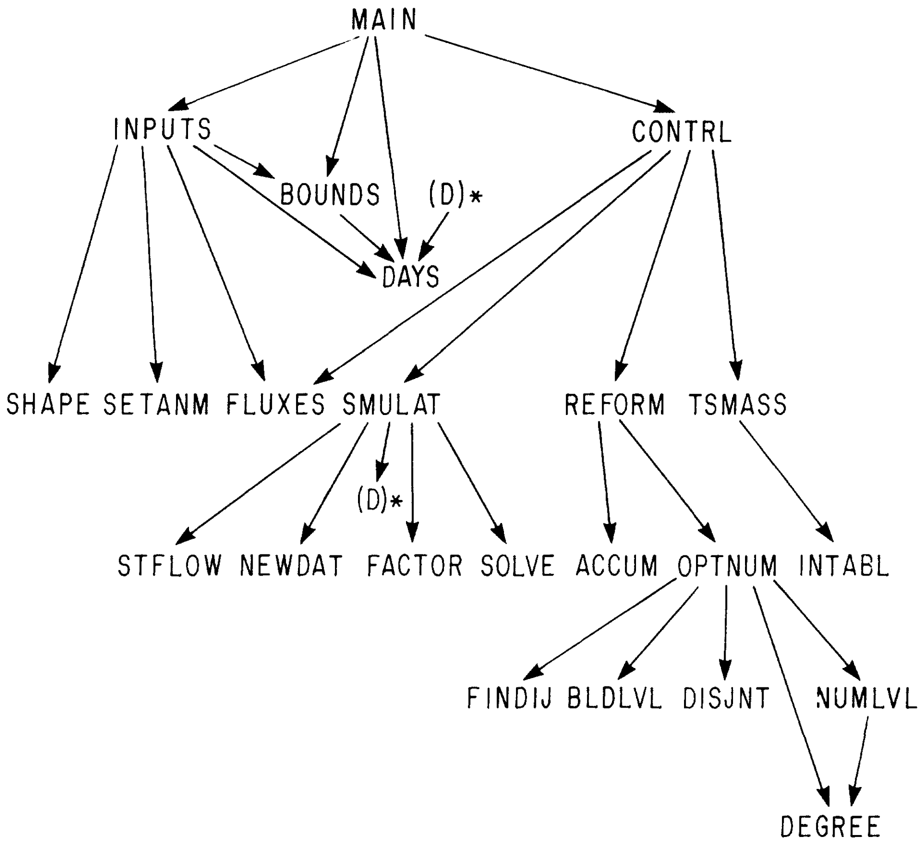
NUMLVL: Subroutine that renumbers nodes within a particular level structure.

DISJNT: Subroutine to determine which level structure is to be used for a particular disjoint connected component during renumbering.

BLDLVL: Subroutine to build level structure during renumbering.

DEGREE: Subrouting to determine degrees in a level structure during renumbering.

FINDIJ: Subroutine to form the linked list I-J connection during renumbering.




Subroutines referred to in this figure are described in table 1.

*Note: (D) is a feature of the flow chart used to avoid crossing flow paths. (D) merely serves to connect subroutine SMULAT with subroutine DAYS.

Figure 2.--Generalized flow chart depicting overall structure of RAQSIM.

## Overview of Data Input and Output

To allow RAQSIM to simulate a wide range of problems, input and output was designed for maximum flexibility. A complex simulation might require up to nine input data sets and produce up to six output data sets. Device numbers for these files are specified by an integer greater than zero within the job-file data set (the record number refers to the record sequence within the job-file described in Attachment B).

### Input Data

Data are input as a number of separate data sets in order to minimize the computer memory requirements. Data used more than once but only a limited number of times during execution of the program are re-read when needed. For example, tabulated values of conductance or capacitance versus saturated thickness, needed to update values used during simulation, are read each time they are needed rather than continually stored in locations in computer memory.

Some data, such as recharge or discharge at any node, or head at "prescribed head" nodes, may be time dependent. Files containing these data are accessed as often as needed during simulation to insure that the proper time-dependent values are used.

Files containing separate data sets can also facilitate the use of programs other than the simulation program. For example, programs to "contour" simulated head values may use the RAQSIM data set that contains the coordinate locations of all the node points.

The data set accompanying the job includes data necessary to title the particular run, to set the duration of the simulation, to specify the input and output device numbers, and to select the available options for the run. As a matter of convenience, generally there is one data value or option value specified per record. This allows liberal room for annotation of the corresponding input variable. A description of the contents of the job input data set (or data deck) is included in Attachment B.

In addition to the job-file data set, the program allows up to ten additional input data sets:

1. Restart data set (record 6).
2. Initial heads at all nodes (record 7).
3. Tabulated hydraulic properties (record 17).

4. Evapotranspiration data set (record 21).
5. Stream systems (record 22).
6. Node definition (record 28).
7. Element definition (record 29).
8. Nodal recharges or discharges (record 31).
9. Known-flux boundary conditions (record 33).
10. Known-head boundary conditions (record 34).

A number of the input data sets use variable formats; that is, a format is read in by the program from the data file and subsequently used as the format for reading the data.

The node definition data set, the element definition data set, and the job-file data set are the only data sets that are required (initial heads normally are included in the node definition data set and boundary conditions automatically default to no-flow boundaries). The structure of the input data sets is described in Attachment B.

Sources or sinks may be incorporated by using either the known-flux boundary condition, the nodal recharge-discharge data sets, or both. The known-flux boundary data set may include any flux boundary (top, bottom, or lateral) of the system. It is of greatest use in problems with sources or sinks at a limited number of nodes. In the event that there are sources or sinks at the majority of nodes, it may be advantageous to use the nodal recharge-discharge data set (record 31, Attachment B).

The first record encountered in these data sets consists of a value that specifies the dimensions of the arrays. For example, the node definition data set starts with a record that specifies the total number of nodes in this problem. Likewise, the element definition data set starts with the total number of elements in this problem.

Most data within these data sets conform to formats determined by the user and are entered as a record within the data set. Date and time parameters are entered in a fixed format. Month, day, year, and hours into the day are input according to the following format:

(I2, 1X, I2, 1X, I4, F10.0)

For those data sets that contain time-dependent data, the values of the time-dependent data are preceded by the relevant date and time. For example, time varying boundary heads are defined by first designating the time followed by the boundary heads at that time. For transient solutions, the boundary heads at intermediate times are estimated as a simple linear interpolation between the heads at specified times. For steady-state solutions, known heads are held constant until the time of the next given known-head boundary condition.

## Output Data

The program handles output in a variety of ways. Two forms of output are available, one in printed copy and the other as output to a file. Options are available to control the amount and type of output. Head data may be written to files in two ways--either as head values for all nodes at particular times or as head values at particular nodes for all simulated times. The first allows "contour" plots of head to be drawn from the output values, and the second allows hydrographs of head versus time at particular nodes to be plotted. Printout contents can range from a brief listing of job-file input, fatal errors, and final mass balance to a complete "dump" of intermediate results, by selecting the appropriate value for the printout code (PCODE) in the job-file input data set(Attachment C).

In addition to the printed file (record 37), the program allows up to five other output data sets. The device numbers of these files are specified by an integer greater than zero within the job-file data set. The following output data sets can be generated by RAQSIM (the record number refers to the record sequence within the job-file described in Attachment B):

1. Final time, nodal heads, and the amount of fluid associated with each nodal subdomain (subsequently referred to as nodal mass) (record 8).

2. Estimate of stream baseflows (record 26).

3. Reaches where streams begin to flow (record 27).

4. Water levels or heads stored at selected nodes for all times (record 38).

5. Water levels or heads stored for all nodes at selected times (record 42).

Attachment D provides additional information on input and output data sets. Types of data contained within each data set, data format, and other useful information are contained in this attachment.

## Program Features and Options

1. Time variables.--Internally, time variables are handled in units of days. Some of the input data are time parameters and are read under one of two separate input formats. If the parameter consists of an absolute time reference (a date), the parameter is input by specifying the month, day, year, and time of day in decimal hours conforming to the format specified as number 3 in the job-file format section (Attachment B). If the parameter refers to a frequency or time-step duration parameter, it is input in decimal days, conforming to the format specified as number 2 in the job-file format section.

The starting date is the date associated with the initial conditions of the simulation. In the event of a restart from a particular point after simulation has been halted, the starting date is not changed. All references of time in decimal days are related to the starting date. In similar fashion, the ending date is the end point of the present simulation, and simulation is halted upon reaching that date.

2. Radial symmetry.--Three-dimensional problems may be solved if the problem is radially symmetric about the vertical axis (record 4 of Attachment B).

3. Discharge limitation.--For some problems, it may be unreasonable to continue discharge once head falls below a certain level. An option is provided (record 5 of Attachment B) that temporarily disregards discharge at a node if the head at that node is at or below the level specified by the reference datum for the node.

4. Restart of a simulation.--In the event of a restart, the date and time at which the simulation resumes are read in from a file denoted by CONTNU (record 6 of Attachment B) along with the nodal head array and nodal mass array that represent that point in the simulation. Initial heads are those that are consistent with the starting date and are read in only if the simulation is not a restart.

5. Output of final head and mass.--At the end of the simulation, the ending date, nodal heads, and nodal mass may be transferred to a file denoted by OUTM (record 8 of Attachment B) in order to allow the simulation to be restarted from this time.

6. Steady-state simulation.--A steady-state simulation solves for heads at equilibrium with the flux (analogous to heads that would occur after an infinite period maintaining constant boundary conditions and fixed recharge or discharge). This program may be used to solve for one or many steady states by activating the steady-state option (record 9 of Attachment B). During a steady-state simulation, known-head boundaries are considered to be set to constant values read in at the previous head boundary condition change rather than interpolating head between specified times as is done during normal transient simulation. When streams are simulated during a steady-state simulation, the storage at all nodes except the stream nodes is set to zero. This minimizes the possibility of extreme oscillation that might occur because stream-to-aquifer flux is not being handled implicitly.

7. Implicit weighting factor.--The program gives the user the option of specifying a constant value for the implicit weighting factor THETA (record 11 of Attachment B) or allowing the program to vary the weighting factor during the course of simulation (record 10 of Attachment B). A value of 1.00 for THETA is equivalent to a fully implicit formulation. With THETA equal to 0.00, the solution is explicit and THETA equal to 0.50 commonly is known as the Crank-Nicholson formulation. With a variable THETA specified, THETA will be maintained between the range from 0.57 to 1.00 in order to avoid oscillations and increase the accuracy of the solution (see Narasimhan and others, 1977).

8. Equilibrium head-change rate.--To avoid simulating through a period during which all heads are at or near equilibrium, the program allows the user to specify the largest magnitude head-change rate that will be considered to define equilibrium (record 12 of Attachment B). Once this condition is satisfied, time will be updated to the next change of boundary condition or change of flux conditions.

9. Maximum time-step duration.--The maximum duration for any time step (record 13 of Attachment B) determines the classification of a node as explicit or implicit and, in general, restricts the size of time steps.

10. Minimum time-step duration.--Allowing conductance or capacitance to vary during a simulation will cause variation in the stability of individual nodes. If, during simulation, the smallest stable time step for any explicit node falls below the value specified in record 14 of Attachment B, all nodes will be reclassified as explicit or implicit depending on present stability conditions relative to the maximum time step duration. Since reclassifying nodes may be somewhat time consuming, a trade-off must be made between continuously reclassifying on one hand and simulating progressively smaller and smaller time steps on the other.

11. Maximum head-change per time step.--The duration of time steps may be controlled by specifying a maximum head change allowed over any time step (record 15 of Attachment B). It is activated by input of a non-zero value. The program will reduce the length of the time step a maximum of ITMAX times (record 16 of Attachment B) if the maximum head change per step is exceeded. The program forecasts the maximum head change expected during a step by assuming either an exponential decay or a quadratic growth of the head-change rate depending on past history. Generally, only a few iterations are necessary. To vary the maximum number of iterations allowed, adjust the input value of ITMAX.

12. Hydraulic properties for an element.--An element may have constant hydraulic properties or may have them determined as a function of the average head within an element. Record 17 of Attachment B may designate a file that contains tabulated hydraulic properties (also refer to part 5 of Attachment D). A constant value of isotropic conductance for an element may be specified by including the value in the element definition (record 29 of Attachment B and part 4 of Attachment D). These values take precedence over any values determined from functional relationships if control variables in the element definition are set less than or equal zero (see part 4 of Attachment D). Thus, certain areas within the simulated region may have varying hydraulic properties while other areas may have constant hydraulic properties. Also, for any element, one hydraulic property may be constant while the other is variable. In the event that record 17 of Attachment B (the device number of the tabulated hydraulic properties) does not refer to a valid file, the hydraulic properties are constant for each element and are those values input as part of the element definition. Anisotropic conductance may be interpolated from tabulated conductance relationships if record 18 of Attachment B is an integer other than zero.

Selection of a specific tabulated functional relationship for hydraulic properties of a particular element is governed by a material number that is input as part of the element data set (Attachment D, part 4). The reference datum used to determine the mass associated with each node and used during any estimation of hydraulic properties from the functional relationship is input as a variable within the node data set (Attachment D, part 2). For example, in modeling two-dimensional horizontal flow, the reference datum most often would be the base of the aquifer, and thus hydraulic properties would be tabulated with respect to saturated thickness or elevation of the piezometric surface above the base of the aquifer. Hydraulic properties derived from tabulated functional relationships may be re-evaluated during a simulation if at least one of two criteria is active. TSFREQ (record 19 of Attachment B) representing a time frequency and DHFREQ (record 20 of Attachment B) representing an absolute head-change frequency may be enabled by coding with non-zero values.

13. Evapotranspiration may be simulated in RAQSIM by designating INET (record 21 of Attachment B) as the input file for the evapotranspiration data set (see part 9 of Attachment D).

14. Simulation of stream systems.--The program has the capability of simulating stream systems as a network of reaches that may leak water to or from the aquifer depending on the head in the stream, the head in the aquifer, and the amount of water available in the stream (Rushton and Tomlinson, 1979). Associated with each stream reach is a leakance parameter that essentially is the volume of water that would be transferred from the stream to the aquifer per unit length of stream reach due to a unit difference in head between the stream and the aquifer. In the program, the leakance parameter is constant over time for each stream reach. Two variables for each stream reach may be time dependent: (1) the average head in the stream for that reach, and (2) any inflow (or diversion) to the stream associated with that reach, such as overland runoff. Defining the stream network requires creation of a tree-structure for each stream system within the network. This will be explained further during the documentation of a test problem.

15. Maximum stream-to-aquifer head gradient.--For many stream-aquifer systems, a gradient between stream and aquifer (resulting in flow from the stream to the aquifer) that exceeds 1.0 may be unrealistic. The user may limit the maximum stream-to-aquifer gradient to 1.0 by coding SGCODE to a non-zero value in record 23 of the job-file (Attachment B).

16. Prediction and correction of stream-to-aquifer flux.--Due to the non-linear nature of flow in ephemeral streams (negative flow is not allowed) and because the maximum stream-to-aquifer head gradient may be limited to 1.0, the stream-to-aquifer linkage cannot be implicitly formulated as a function of the unknown head in the aquifer. The initial estimate of stream-aquifer flux for a time step is calculated by using the stream-aquifer flux at the beginning of the time step. The average stream-aquifer flux during a time step may be estimated using a predictor-corrector step by coding PCCODE to a value greater than zero in record 24 of the job-file (Attachment B).

17. Forcing implicit solution of all stream nodes.--The user may choose to solve all stream nodes implicitly by coding ISCODE in record 25 (Attachment B) with a non-zero value.

18. Output of streamflow variables.--Baseflow estimates may be written to an output file by coding the output file number for OUTS in

record 26 (Attachment B). Similarly, the approximate locations where the streams begin to flow, may be written to an output file designated by OUTH in record 27 (Attachment B).

19. Temporary storage outside of computer memory.--Data describing elements (nodes acting as element vertices, material number, element areas, etc.) are only occasionally needed during execution of the program and, therefore, may be suited to storage in a temporary file designated by IOSH in record 30 (Attachment B). Additional memory may be conserved by storing the array containing any current nodal flux values in another temporary file designated by IONQ in record 32 (Attachment B). These options are recommended only for very large problems.

20. Reordering of unknowns.--In order to implement a direct solution for implicit nodes, unknown nodes must be reordered so that implicit nodes begin the sequence. This may be accomplished within the program by two methods; implicit nodes may keep the same sequence relative to the other implicit nodes, or, implicit nodes may be totally resequenced for a more optimal ordering. Resequencing minimizes the size of the array and the number of operations for direct solution of the set of simultaneous equations for implicit nodes. The program normally will attempt the first method, and will attempt the second method only if there is insufficient space available to store the resulting matrix (called LAMBDA within the program). If desired, the second method may be forced by setting SQCODE (record 35, Attachment B) equal to 1. The second method uses an algorithm described by Gibbs, Poole, and Stockmeyer (1976). The final six subroutines of the program (OPTNUM through FINDIJ) perform this numbering algorithim.

21. Amount of printout.--The complexity, size, and duration of a simulation affects the amount of printout that may be produced. An input variable, PCODE, (record 36 of Attachment B) is included that allows the user to vary the amount of printout to suit the problem. During initial runs, the greatest amount normally will be desired as a means of checking the data and fully defining the problem. During subsequent runs, duplication normally will be omitted. The present range of valid values for the variable PCODE is zero to six; zero generates the least amount of printout, and six generates the greatest.

22. Mass balance.--A mass balance is performed during every time step for every node. Mass balance results may be printed if desired. At known-head nodes, estimates of net flux required to maintain the known head are computed by assuming mass balance at those nodes. At the conclusion of a simulation, a comparison is made between the cumulative

mass associated with a node and the mass associated with the final head at the node. Under certain circumstances, these two measures may conflict. If capacitance is a function of head, the capacitance approximated for a time period is the capacitance determined during an update of the hydraulic properties beginning that time period. Errors will arise if the head varies such that the "true" capacitance varies during a time step. In other words, if the capacitance of a node starts a time step as the capacitance of a confined system and the system changes from confined to unconfined during a time step, the "true" capacitance changes during the time step from a confined value to an unconfined value. The program considers capacitance to be constant and equal to the confined value throughout the time step. The cumulative result of these individual errors in mass balance is reported in the "ERROR" column in the final output of the simulation.

## Example of Problem Setup

The following example will be used to explain the various data sets required to solve a problem that utilizes the main features of RAQSIM. Attachment E contains listings of the input for this problem.

This sample problem incorporates a stream system with an aquifer system and demonstrates the use of time-dependent boundary conditions, time-dependent nodal flux conditions, simplified time-dependent groundwater evapotranspiration, and tabulated hydraulic properties (storage coefficient and anisotropic transmissivity). The job-file input is listed in part 1 of Attachment E.

A stream drainage basin as illustrated in figure 3 is assumed to have aquifer boundaries coincident with the surface drainage boundary. Element grid and boundaries corresponding to the discretized version of this problem are shown in figure 4 and node locations are shown in figure 5.

Nodes are defined by a unique number, two cartesian coordinates (recall that all length units must be consistent throughout the program), and a reference datum for the node. This datum is subtracted from the head value prior to determining the mass of water associated with each node or estimating the conductance and capacitance for each element.

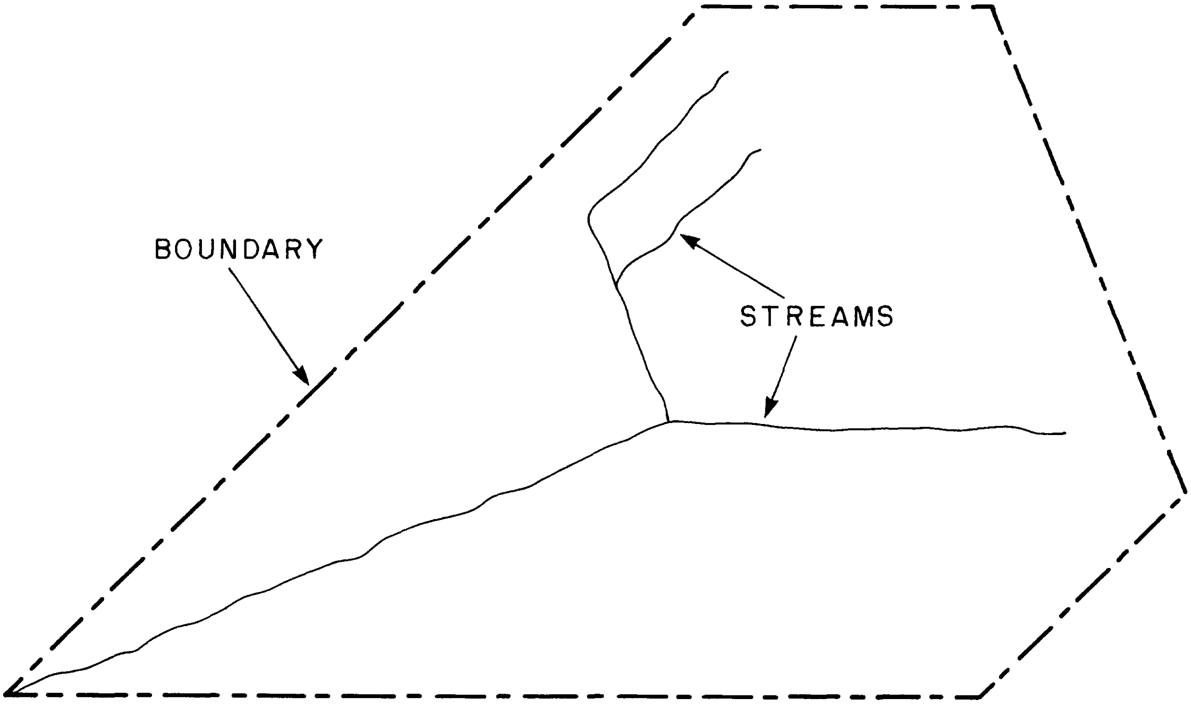



Figure 3.--Generalized drainage basin.

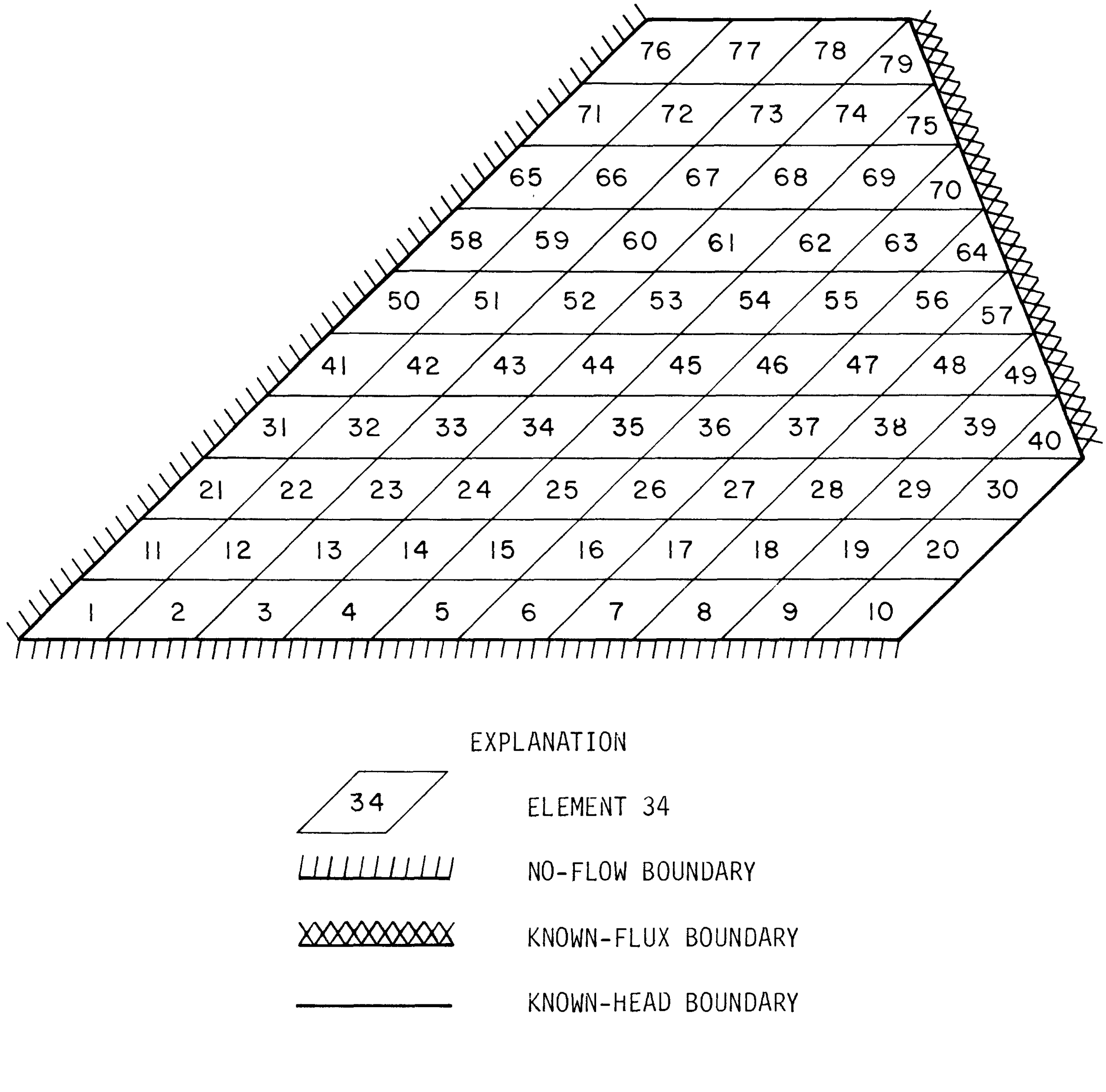



Figure 4.--Element grid and boundary conditions.

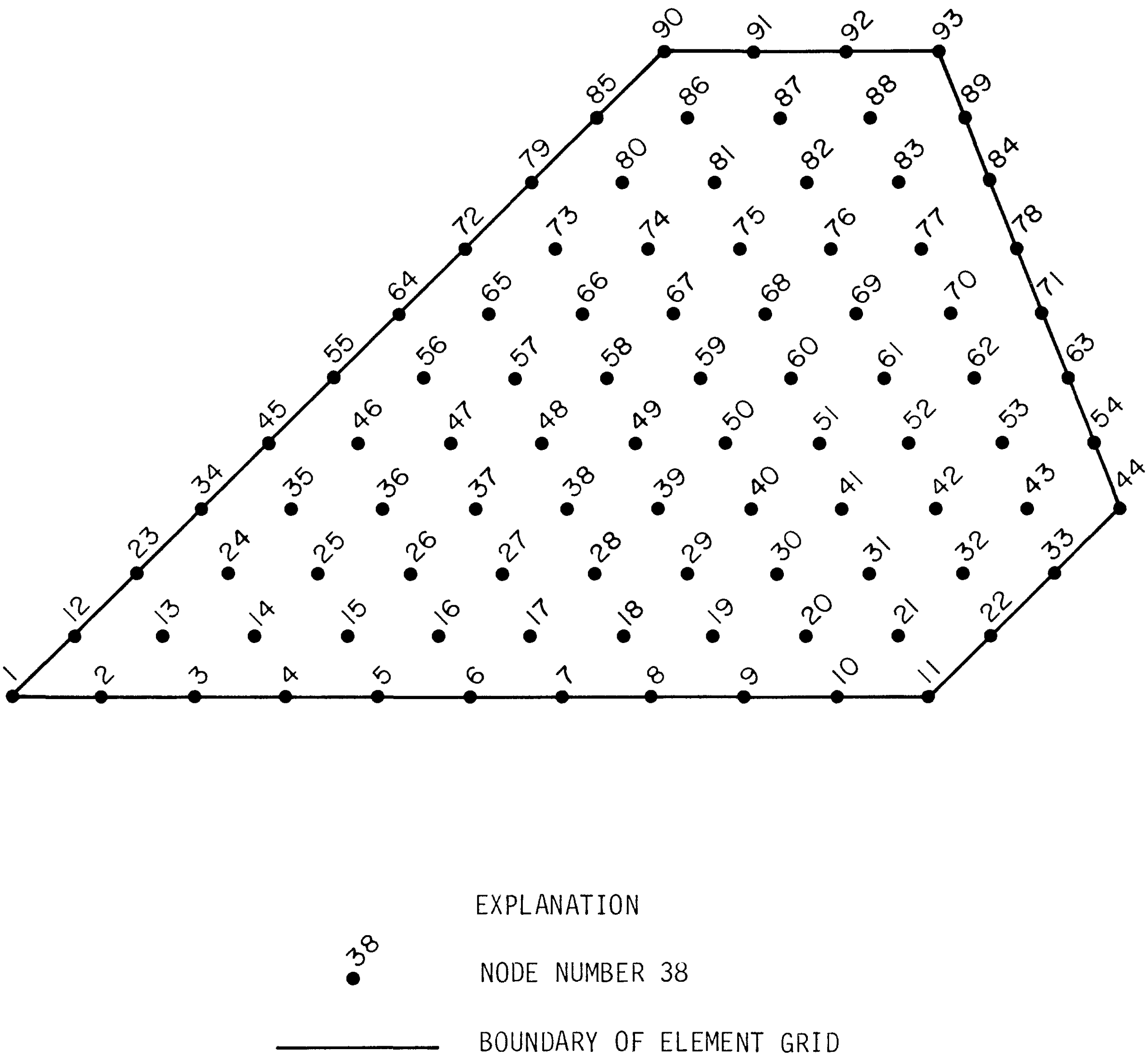



Figure 5.--Node locations.

The hydraulic properties, storage coefficient and transmissivity, are tabulated with respect to saturated thickness; therefore, the reference datum is the base of the aquifer. In most instances, initial heads are included along with the node definition and reference datum in the node-definition data set (INNS). The program reads only the coordinates, the reference datum, and the initial head from the node data set. Therefore, the number of nodes must reflect the maximum node number and data must be included for every node even if a number within the sequence is not used. The node data set for this problem is listed as part 2 of Attachment E.

Elements are defined geometrically by the nodes that form the vertices of either one triangle or of two adjoining triangles. Associated with each element are conductance and capacitance values, a material number, and codes to indicate whether the conductance or capacitance values are to be determined from the input value or determined by interpolation from hydraulic properties associated with the material number. Vertices are input in counter-clockwise order following the boundary of the element. If the element consists of two adjoining triangles, the common side connects the first vertex with the third vertex. For example, referring to the element data set (part 3 of Attachment E), element 39 has four vertices: 53, 42, 43, and 54. These four nodes make two triangles: 53, 42, 43, and 53, 43, 54. On the other hand, element 40 is a single triangle since it has only three vertices: 43, 44, and 54.

Elements must not overlap! If possible, obtuse angles should be avoided and greatest accuracy is generally achieved if all angles are less than 90 degrees. Narasimhan and others (1977) discuss how anisotropic conductance influences this general consideration. Unlike the node data sets, the elements are associated with an identification number that is part of the element input data set and is used immediately for reference to the element; however, the maximum identification number has no relevance to the total number of elements. The element data set is part 3 of Attachment E.

Hydraulic properties are considered constant within individual elements and options within the program allow hydraulic properties to be handled in various ways. Capacitance and isotropic conductance may be specified as constant values for the duration of the simulation. These values are entered in the element definition data set (INES). Tabulated functional relationships also may be used to calculate capacitance, isotropic conductance, or anisotropic conductance for an element or elements. Hydraulic properties determined from tabulated functional relationships may be updated during simulation based upon two criteria: a maximum-head-change criterion, a time-frequency criterion, or both.

The problem simulates a single lithologic sequence over the entire area. Table 2 describes the lithologic sequence and includes values of hydraulic conductivity and specific yield for each layer.

Table 2.--Hydraulic conductivity and specific yield for lithologic sequence in sample problem

| Depth below land surface (feet) | Height above bedrock (feet) | Lithologic description | Hydraulic conductivity (feet/day) | Specific yield |
|---|---|---|---|---|
| 0-50 | 75-125 | Uniform medium sand | 85.0 | 0.26 |
| 50-75 | 50- 75 | Very silty medium sand | 40.0 | .18 |
| 75-125 | 0- 50 | Coarse sand to fine gravel | 150 | .22 |
| >125 | | Impermeable bedrock | 0 | 0 |

Transmissivity and storage coefficient, for this sample problem, are estimated from a single pair of functional relationships for the entire modeled area. These functional relationships are shown in figures 6 and 7 for the lithologic sequence given by table 2. The reference datum used for this problem is the elevation of the base of the aquifer. In the general case, many lithologic sequences and a corresponding number of functional relationships may occur between hydraulic properties and the height of the piezometric surface above the reference datum. The functional relationships are discretized and tabulated within the tabulated hydraulic properties data set (part 4 of Attachment E). To refer the proper functional relationship to an element, a number is associated with each element to specify which functional relationships apply for the determination of hydraulic properties. This number is referred to as the "material" number associated with an element and is the last variable of each element record in the element data set. For a model of a cross section, a different set of hydraulic properties would be specified for each lithologic unit within the cross section.

Hydraulic properties for this problem are tabulated in part 4 of Attachment E. When more than one lithologic sequence occurs within a problem, a "table" for each sequence ("material") is required. If

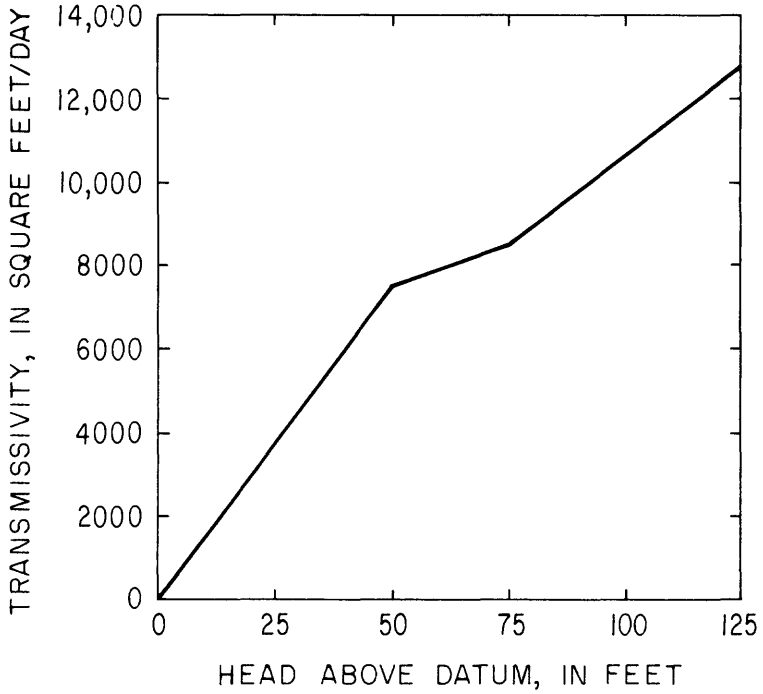



Figure 6.--Transmissivity as a function of head.

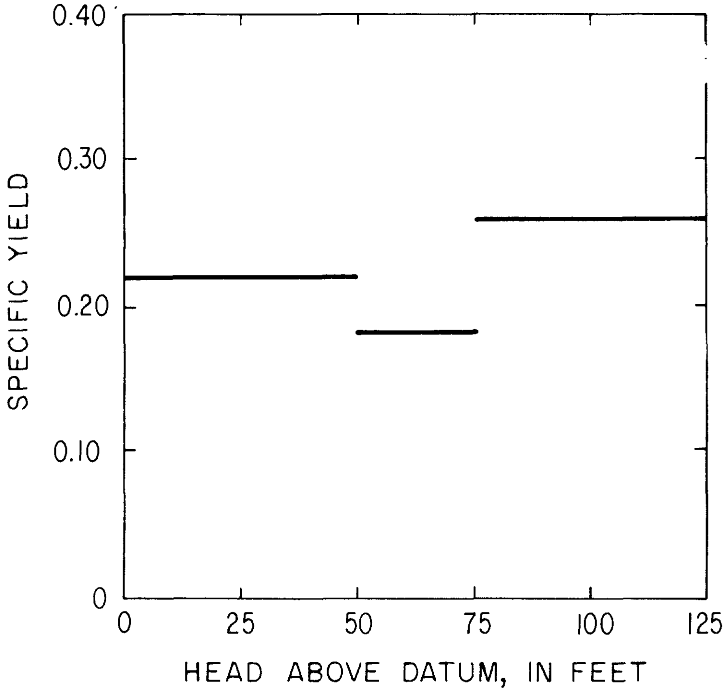



Figure 7.--Specific yield as a function of head.

anisotropic conductance is simulated for any "material," the format must be specified to include the additional two terms: minor axis of conductance and angle between x-axis and major axis of conductance. Anisotropy has been incorporated into the tabulated transmissivity values of this problem for illustrative purposes. Each line of the "table" in part 4 consists of the elevation of the top of an interval above the base of the aquifer, storage coefficient, value of the major axis of the transmissivity ellipse, value of the minor axis of the transmissivity ellipse and the angle between the x-axis and the major axis of the transmissivity ellipse. The data must be arranged by increasing head above datum; thus, the "table" in part 4 of Attachment E appears in reverse order of the lithology listed in table 2. For isotropic transmissivity (or conductance), the single isotropic value is input instead of the three values required for anisotropic conductance.

Storage coefficient (or capacitance) may be handled two ways, either as a constant throughout an interval or interpolated linearly across an interval. The choice depends upon the value given for the degree for capacitance interpolation; zero specifies that the value given for capacitance will apply to the entire previous interval while 1.0 specifies that capacitance will be computed as a linear interpolation between values for the endpoints of the interval. If the conductance of a "material" is isotropic, the last value on the record preceding the "table" must be coded zero. Otherwise conductance is assumed to be anisotropic if anisotropy is enabled by DAN in the job file (record 18 of Attachment B. Conductance always is estimated by linear interpolation over an interval.

The line prior to each "table" contains: (1) the "material" number that relates the tabulated properties to the "material" number given with each element; (2) the number of lines in the table; (3) the degree to be used when interpolating capacitance over an interval; and (4) a code indicating whether the tabulated conductance is isotropic or anisotropic.

The boundary of the basin consists of segments that may be classified by one of three general boundary conditions: no flow, known flux, and known head. No special treatment is required to treat a no-flow boundary; the finite-element method treats boundaries as no-flow boundaries unless specified otherwise. Known-flux boundaries require that the flux entering the system across the boundary be specified. Similarly, known-head boundaries require that the head be specified for nodes along the boundary. The known-flux data set (record 33 of Attachment B and part 6 of Attachment D) incorporates known-flux boundary conditions and the aquifer stresses (well discharge) and is listed as part 5 of Attachment E. The known-head data set (record 34 of Attachment B and part 7 of Attachment D) is listed as part 6 of Attachment E. Boundary values of flux or head may vary with time throughout a simulation. Known head at a node is interpolated linearly through time between the values specified for a transient simulation. For a steady-state simulation (record 9 of Attachment B), the known head is held constant until it is updated to a new value.

A distribution of recharge or discharge may be assigned over the entire grid by including a value for each node in the network either in the known-flux data set or in the recharge-discharge data set. In this example, a uniform areal recharge is imposed over the entire area in the recharge-discharge data set (record 31 of Attachment B and part 8 of Attachment D) and the system is stressed by the addition of stress nodes and stress amounts to the known-flux data set. Uniform areal recharge is incorporated into part 7 of Attachment E as the product of the recharge rate and the area associated with each node. One-third of the area of each triangular element is associated with each node in the element. The fraction of area of quadrilateral elements associated with each node is computed from the areas of the two triangles that comprise the quadrilateral.

Simulation of ground-water evapotranspiration requires an independent data set (record 21 of Attachment B and part 9 of Attachment D). The simplified functional relationship between discharge from the ground-water system and the hydraulic head in the aquifer is identical to that modeled by Prickett and Lonnquist (1971) and Trescott, Pinder, and Larson (1976) with an extension to a time-varying maximum evapotranspiration rate. This relationship approximates ground-water evapotranspiration as a linear function of depth to water below the land surface. Below a specified depth ground-water evapotranspiration ceases. In addition to land-surface elevation, two variables must be specified: maximum ground-water evapotranspiration rate and the depth below the land surface that designates the depth below which there will be no evapotranspiration from the ground-water system. Simplified ground-water evapotranspiration is incorporated into this simulation by part 8 of Attachment E.

Streams essentially are accounting units for reporting baseflow at particular locations during the simulation. Streams may be tributary to one another, and any particular stream may, in turn, contain tributary segments of any rank. A tributary segment is a branch whose baseflow is not tabulated.

The basic unit for a stream is a "reach" connecting adjacent nodes along the stream. Each reach has a constant leakance parameter, a time-dependent average stream head and a time-dependent inflow or diversion associated with it. Inflow or diversion is water that enters or leaves the reach by means other than flow from the upstream reach, flow to the downstream reach, or flow from or to the ground-water system. For example, overland flow entering the stream along that reach would be included in the inflow-diversion quantity. Reaches and associated nodes are labeled in figure 8.

Within the simulation, flow is reported by stream or, if desired, by reach. The stream system in this example is defined by two streams, one called stream A and another called stream B, with its tributary segment B'. Flow at the confluence of stream A and stream B is required output from the simulation but not the flow at the confluence of B and B'. To define the stream system correctly, the tributary streams must be defined prior to defining the receiving streams. Therefore, the first stream to be defined is stream B and B', and the last to be defined is stream A. To define a stream, specify the most upstream reach number and the most downstream reach number. For stream B and B', the most upstream reach is number 1 and the most downstream reach is number 7. Likewise, for stream A, the most upstream reach is number 8 and the most downstream reach is number 15. To set up the stream system, the following items for each reach must be listed:

1. The node number that represents the upstream end of the reach.
2. The number of the most upstream reach of any tributary segment joining that reach (zero if no tributary segment).
3. The number of the next reach downstream.
4. The leakance for the reach in units of volume per day per unit gradient per unit length of reach in consistent length units.

B' is the only tributary segment in this example. The flow of stream B is added automatically to the flow of A at their juncture by numbering B before A in the stream numbering sequence.

Because the specification of a reach requires definition of an upstream and a downstream node, a null (or imaginary) reach must be included to define the most downstream node along a stream system that exits the modeled area (node number 1 in this example). Null reaches do not enter into calculations, but must have data records included for proper alignment of the input data.

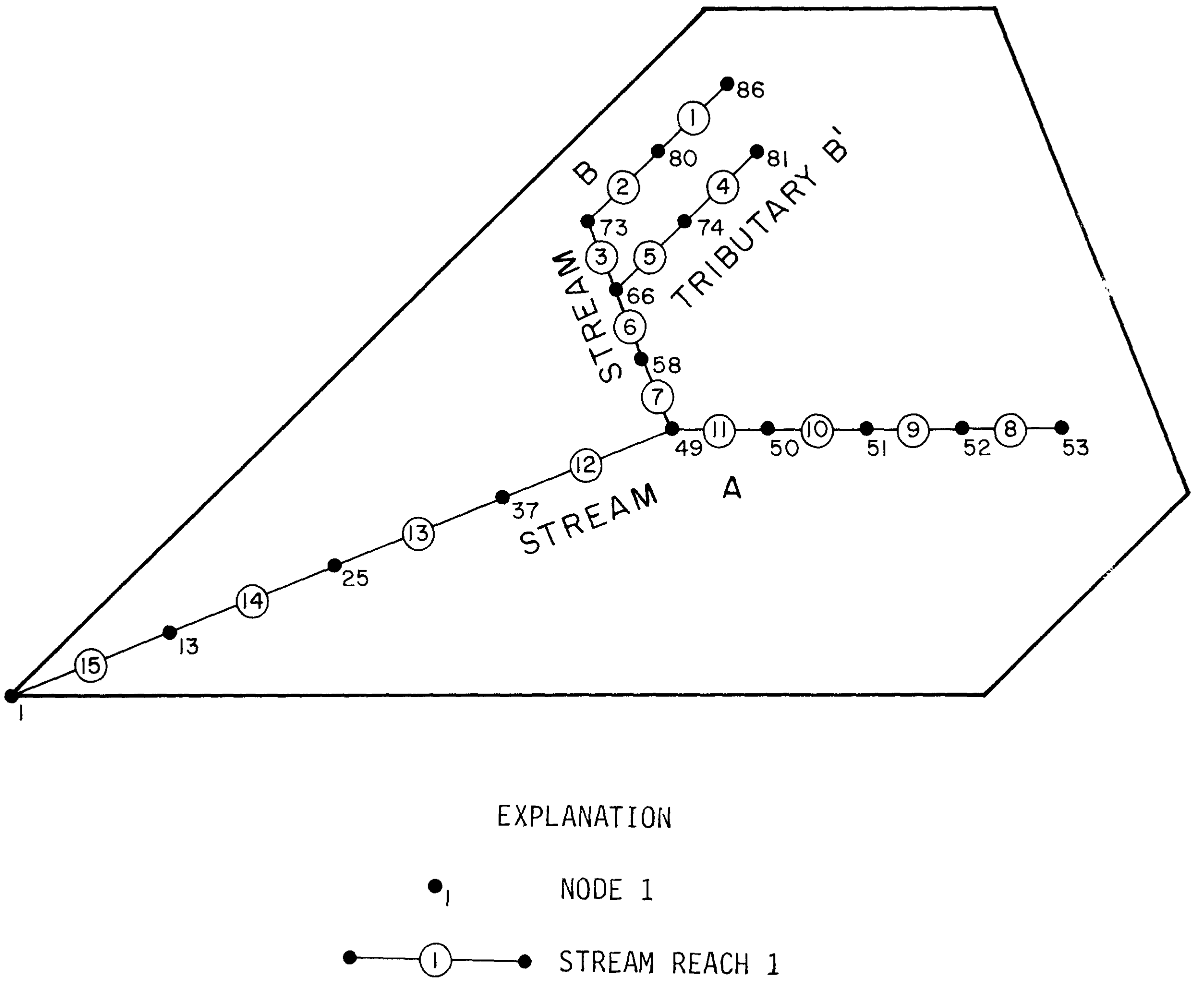



Figure 8.--Stream system and associated nodes for the drainage basin.

Following the same basic form for time-dependent input data, values are specified corresponding to the time-dependent average head in the stream for each stream reach (including a record for any null reaches) and for time-dependent inflow or diversion from each stream reach (an inflow is a positive value while a diversion is a negative value). The stream system data set for this problem is in part 9 of Attachment E.

Printed output for this sample problem is listed in Attachment F. This level of printout results from a PCODE value of 5 (Attachment C and record 36 of Attachment B). Solution arrays are listed if PCODE is set to 6. Because this generates considerable output, a value of 6 is recommended only if it is necessary to examine the contents of the solution arrays.

The listing begins with a summary of the job-file (Attachment B) and initial array dimensioning requirements. The program is designed to stop if the required dimensions exceed the space provided by dimensions within the program. The absolute double precision (REAL*8) array and the half-word integer (INTEGER*2) array dimension requirements are determined later in the program and are listed when the determination has been made. The minimum dimension for the half-word integer array is printed following the listing of the element data and the minimum dimension for the double precision array is printed a few lines following the listing of the "EXTERNAL TO INTERNAL NODE NUMBERINGS," (p.165).

The printout continues with a listing of input and occasional values derived from the data (such as element areas and stream reach leakage factors). The leakage factor printed for the stream reaches is the product of the input value for stream-reach leakance and the length of the stream reach. Starting values for hydraulic properties for each element are calculated from the average head in each element and the tabulated hydraulic properties applicable for that element. The initial mass for each node is calculated by integrating the capacitance between the reference datum for the node and the initial head for the node for each sub-element area corresponding to the node. If capacitance is constant for an element, the initial mass is the capacitance times one-third the element area times the head minus the reference datum. Variable capacitance involves a more complex integration.

Because the program may solve for some nodes explicitly and others implicitly, it first assumes all nodes will be solved explicitly and determines the maximum time step that will be stable for all nodes. This time step then is compared with the minimum time step allowed (record 14 of Attachment B). If the explicitly stable time step is greater than or equal to the minimum time step, the program will proceed to solve all nodes explicitly. If the explicitly stable time step is less than the minimum time step, some nodes must be solved implicitly. The criterion for selecting the implicit nodes is the stability of nodes relative to the size of the maximum time step allowed (record 13 of Attachment B).

A solution array named LAMBDA is required if there are any implicit nodes. Two numbering schemes are available to relate the node number (external number) to an unknown (internal number) in the solution process for implicit nodes. One involves numbering sequentially all implicit unknowns in the same sequence as they are found in the node numbering. The other involves a much more complex and time-consuming procedure that orders the unknowns to reduce the size of the LAMBDA array. This second procedure generally is used only if the double precision array is not sufficient to hold the LAMBDA array using the first procedure. The variable SQCODE is available in the job-file (record 35 of Attachment B) to force use of the second numbering procedure. The number of an implicit unknown (internal number) is output only when listing the "ORIGINAL LAMBDA MATRIX," "FACTORED LAMBDA MATRIX" or printing a message to indicate that factorization of the LAMBDA matrix failed in subroutine number 15 (FACTOR). All other output is in the node numbering (external number) system. Once the implicit unknowns are numbered, the minimum dimension of the double precision (REAL*8) array is known and is printed.

For each time step during the simulation, the listing includes the stream baseflows at the start of the time step, summary of the streamflow components by stream reach, mass balance for known (or prescribed) head nodes, a general mass balance for each node and a summary of the time step.

The "PRESCRIBED-HEAD BOUNDARY" mass balance is included to give the user additional information about those nodes that have the head variation prescribed. Because the head at these nodes may change over time, DELTA HEAD is the amount of head change prescribed for this time step. Similarly, the DELTA STORAGE term represents the volume of water reflected by this head change. SRCS-SINKS is the volume of water added to the nodal subdomain as a result of the nodal sources or sinks (excludes ground-water evapotranspiration and stream-aquifer flux). BNDFLX IN represents the quantity of water required to balance the change in storage with all of the inflows and outflows. GRADIENT INDUCED is the volume of water that flowed into the nodal subdomain due to the ground-water head gradient during the time step. The final column is a character string that indicates the presence of ground-water evapotranspiration and/or stream-aquifer flux associated with the node. The sum of DELTA STOR, SRCS-SINKS, BNDFLX IN, and GRADIENT INDUCED will be zero for a node unless ground-water evapotranspiration and/or stream-aquifer flux are present.

Terms of the nodal mass balance require further explanation (Attachment F, p. 166). FLUX IN represents the net volume of water that flowed into a node during the time step. DELTA STORAGE indicates the volume of water added to the volume of water associated with the node during the time step. ERROR is the difference between FLUX IN and DELTA STORAGE. CUMULATIVE MASS is a sum of the initial volume of water associated with a node and the DELTA STORAGE terms. DRY-WET STATUS indicates if the head is above (WET) or below (DRY) the reference datum for that node.

The final page of the output contains a check of the nodal mass by comparing the CUMULATIVE MASS with the mass determined using the head at the end of the simulation (Attachment F, p. 179). ERROR represents the difference between these two. For a more thorough discussion, refer to the section on mass balance in the discussion of Program Features and Options.

## Test Problems

In order to demonstrate that the program can be used to accurately simulate various problems in hydrogeology, two test problems have been evaluated using RAQSIM. The first test compares the results from RAQSIM with an analytic solution for a simple problem of radial flow to a fully penetrating well pumping from a confined aquifer. The second test compares the results from RAQSIM with an analytic solution for a simple areal-flow problem. Both tests approximate the corresponding analytic solutions quite well, suggesting that RAQSIM may be a useful tool for simulating complex problems that are not readily approximated by an analytic solution.

### Test No. 1

This problem simulates the water-level response in a fully penetrating well pumping from a homogeneous and isotropic confined aquifer. The RAQSIM option of radial symmetry about the vertical axis is used to allow simulation of radial flow. The hydraulic material properties analogous to conductance and capacitance are hydraulic conductivity and specific storage, respectively. A well is represented by a single element with a very high hydraulic conductivity, and the product of specific storage and thickness equals unity. The aquifer is assumed to be 50 feet thick, to have a hydraulic conductivity of 125 feet per day, and to have a specific storage of 0.002 (transmissivity equals 6,250 square feet per day and storage coefficient equals 0.10). The radius of the well is 0.5 feet, and the well is pumping at a rate of about 78,540 cubic feet per day (in order to make water-level decline equal to the "well function" or dimensionless drawdown). Nodes are spaced such that the distance between nodes increases with distance from the well to improve resolution of the drawdown cone. For this example, the equivalent hydraulic properties, specific storage, and hydraulic conductivity are constant. Head at a radius of 1,000 feet is maintained constant throughout the simulation of this problem by applying a known-head boundary condition to the two nodes at a radius of 1,000 feet from the well. The well discharge is simulated by using the known-flux boundary condition to extract 78,540 cubic feet per day from node 1.

Time steps were constrained by requiring that the maximum change in head per time step (DHMAX; record 15 of Attachment B) was less than or equal to 0.5 feet. Three adjustments of time-step duration were generally required to satisfy the head-change constraint during early simulated time. Time steps vary from initial values less than 1 second early in the simulation to the maximum allowed time step of one-tenth of a day near the end of the simulation. THETA, the explicit-implicit weighting factor was allowed to vary throughout the course of the simulation (record 10 of Attachment B) and varied from near 1.0 during early simulated time to 0.57 toward the end of simulated time.

Papadopulos and Cooper (1967) analytically solved this problem for an aquifer that is infinite in areal extent. Their solution for dimensionless drawdown in the pumping well for an alpha of 0.1 is depicted relative to dimensionless time by the continuous curve in figure 9. The alpha value of Papadopulos and Cooper equals the product of storage coefficient (0.10) and the ratio of the square of the well screen radius to the square of the well casing radius (1.0).

Drawdown in the well computed by RAQSIM is plotted against dimensionless time as the discrete points (crosses) in figure 9. Because discharge and transmissivity were selected so that drawdown equals dimensionless drawdown, a direct correspondence with the analytic solution's dimensionless drawdown versus dimensionless time curve should exist if the simulated drawdown is plotted against the time in days multiplied by 1 million. Although the distant boundary conditions differ between the numerical and analytic solution, there should be little influence at early times. The results from RAQSIM correspond well with the analytic solution (fig. 9). The simulated drawdown may differ from the equivalent drawdown for the analytic solution, in part, due to the boundary condition at a finite distance.

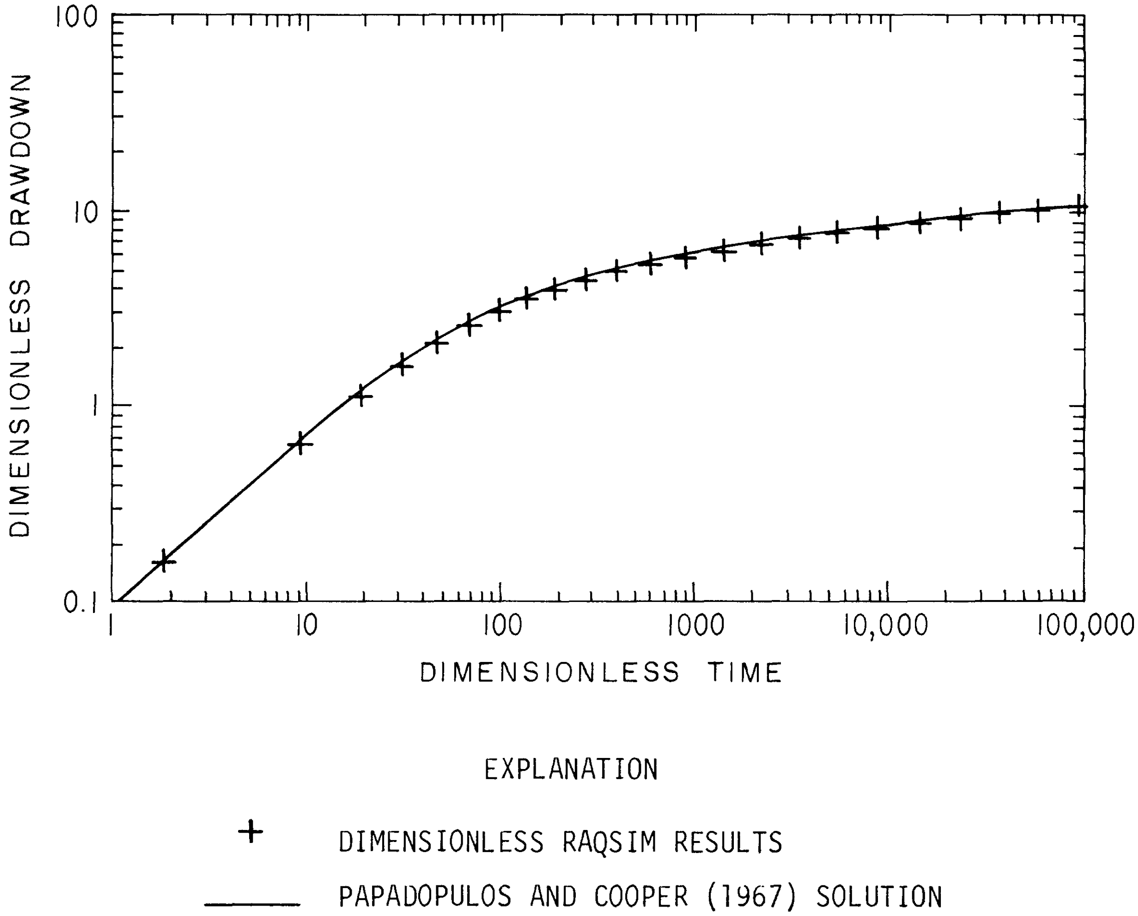
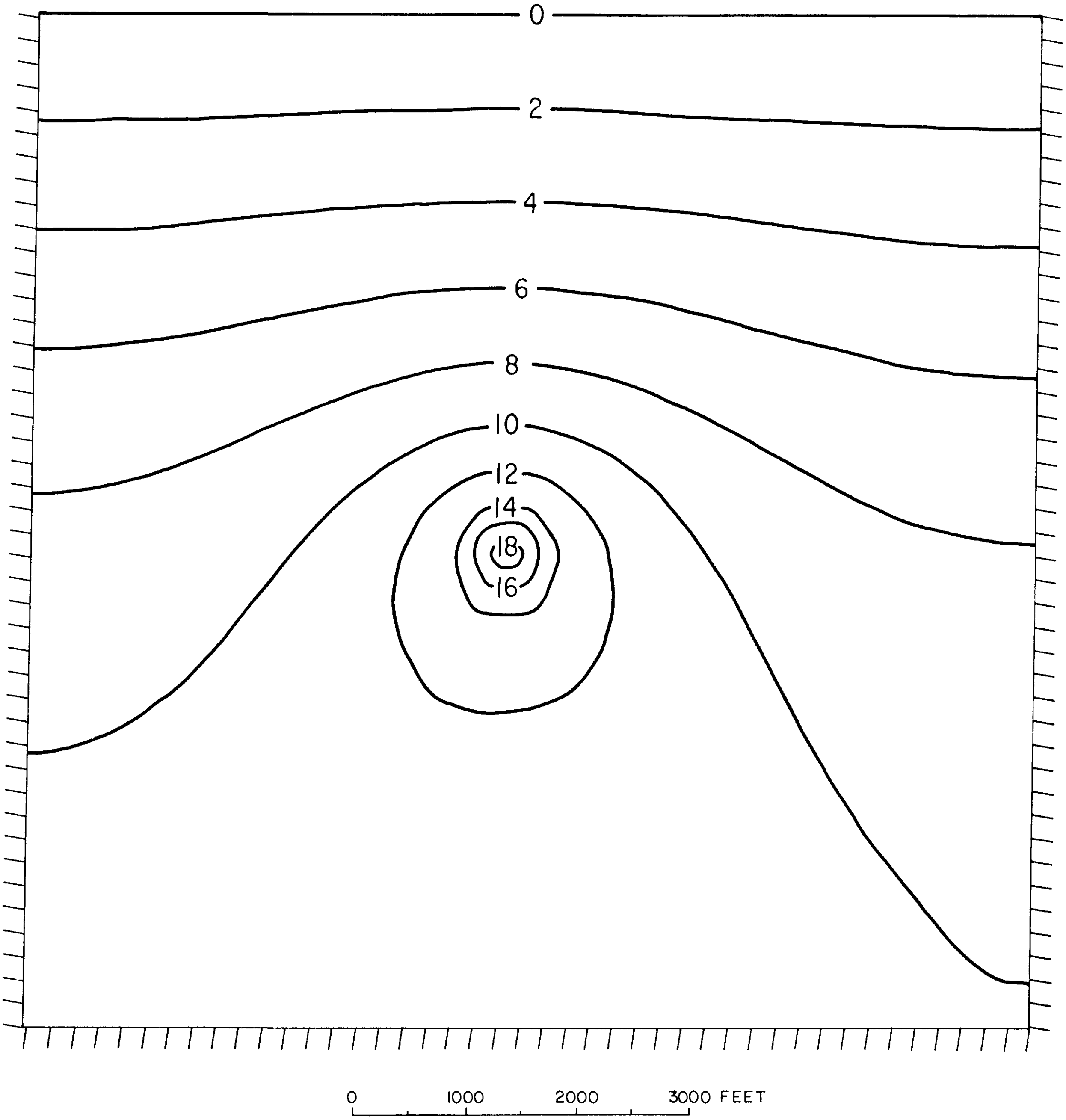



Figure 9.--Dimensionless drawdowns versus dimensionless time for Test No. 1.

Test No. 2

This test compares RAQSIM results with an analytic solution to a simple areal-flow problem. Chan and others (1976) report a solution for the steady-state drawdown due to constant withdrawal from a point within a homogeneous isotropic rectangular aquifer surrounded by impermeable boundaries on three sides and a constant head boundary along the remaining side. The aquifer of this specific problem is characterized as a square 90,000 feet on a side with a transmissivity of 0.1 square feet per second. The southern, eastern, and western boundaries are no-flow boundaries. The northern boundary is a constant-head boundary. The withdrawal point (or well) is located 42,500 feet east of the western boundary and 42,500 feet north of the southern boundary and is discharging at a rate of 2 cubic feet per second. The finite-element grid includes 371 nodes and 324 elements arranged such that most triangles are essentially equilateral.

RAQSIM simulated 19.64 feet of drawdown at the node that represents the pumping well, whereas drawdown for the analytic solution is 24.88 feet. Figures 10 and 11 depict the steady-state head configuration for the finite-element simulation from RAQSIM and for the analytic solution, respectively. The finite-element solution could be improved by increasing the number of nodes near the well. Away from the well, the finite-element results are indistinguishable from the analytic solution.




EXPLANATION

LINE OF EQUAL DRAWDOWN, IN FEET -- Contour interval 2 feet

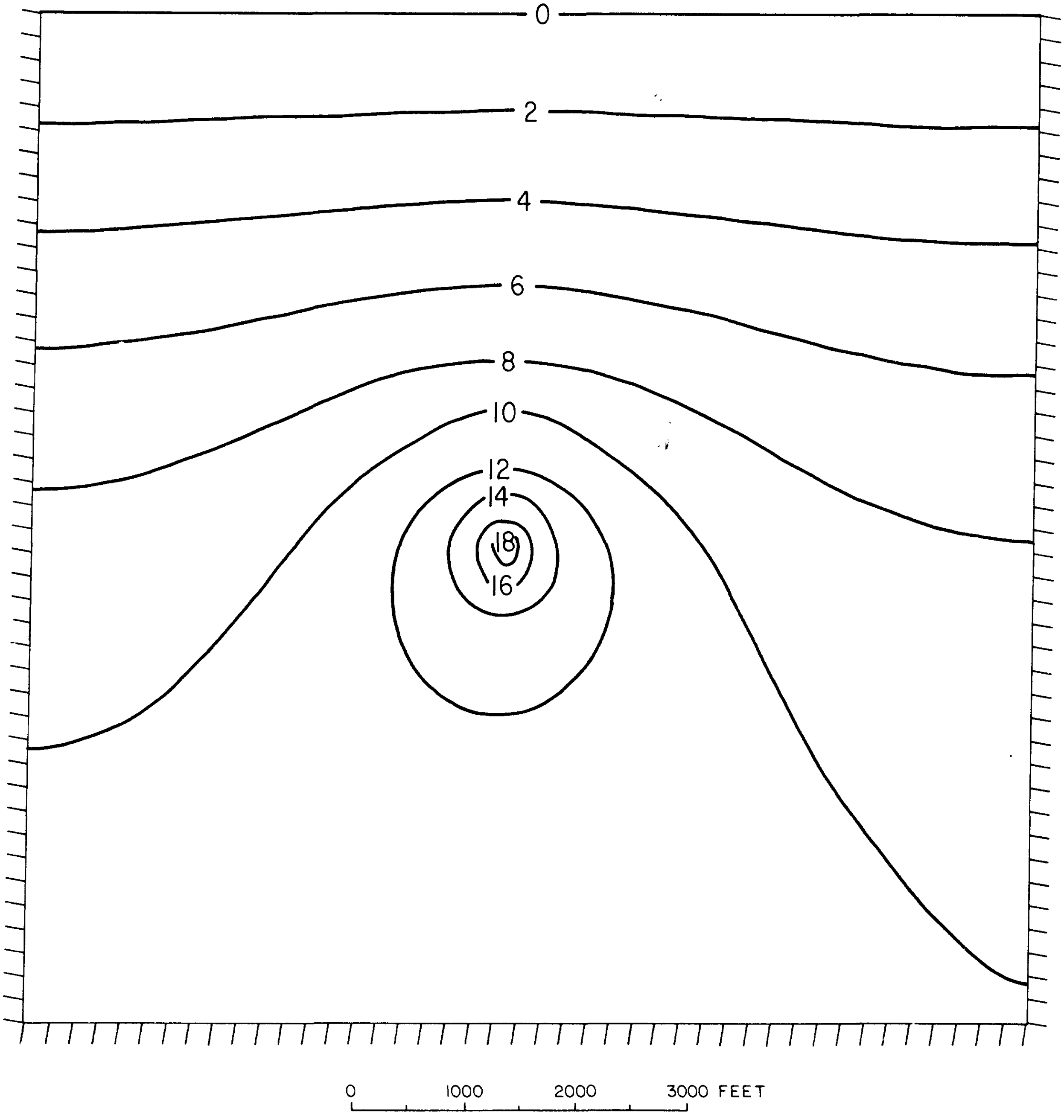


NO-FLOW BOUNDARY



KNOWN-HEAD BOUNDARY

Figure 10.--Drawdown computed by RAQSIM simulation of Test No. 2.




EXPLANATION

| | |
|---|---|
| —— 10 —— | LINE OF EQUAL DRAWDOWN, IN FEET -- Contour interval 2 feet |
| ⊥⊥⊥⊥⊥⊥⊥ | NO-FLOW BOUNDARY |
| ———— | KNOWN-HEAD BOUNDARY |

Figure 11.--Drawdown computed from analytic solution of Test No. 2.

## DESCRIPTION OF SUPPORT PROGRAMS

Three support programs are used to compute recharge and discharge data required as input by RAQSIM for the Twin Platte-Middle Republican study. These programs are interdependent, in that the first generates data needed as input to the second, the second generates data needed as input to the third, and the third generates the data needed by RAQSIM. The first program, called the Potential Evapotranspiration (PET) Program, uses solar radiation and other climatic data to compute potential evapotranspiration. The second program, the Soil-Water Program, uses output from the PET Program, soil characteristics, and the ratio of potential to actual evapotranspiration for crop types to compute infiltration, storage, and removal of water from the soil zone. This program and the preceding program were based on a program developed by Otradovsky (1980). The third program, called the Recharge-Discharge Program, uses output from the Soil-Water Program together with other data to compute recharge to and discharge from the ground-water system.

### PET Program

The PET Program computes potential evapotranspiration using the Jensen-Haise method (Jensen and others, 1969) for each weather station. First, it computes total solar radiation by a regression equation using percent possible sunshine and maximum solar radiation for each month. Next it calculates monthly potential evapotranspiration using temperature and total solar radiation. Output from this program, in addition to the monthly values of potential evapotranspiration for each weather station, are monthly precipitation and average monthly temperature at each weather station. However, the output is not specific to any area or element; thus, this program can be applied to a variety of areal or grid schemes.

#### Main Features in the Program

The PET Program consists of a main program that computes monthly potential evapotranspiration (ET) values and a subroutine, SRAD, which is used to compute monthly total solar radiation. The program (Attachment G, Part 1) begins by reading both the first and last years of the period of interest and the number and description of the weather station for which percent possible sunshine data is provided. The SRAD subroutine reads the mean daily solar radiation on cloudless days for each month, RSO(I), in units of langleys per day and percent possible sunshine, X(I), for each month. The total solar radiation, R(K,I), in inches of water evaporation equivalent by year (K) and month (I) is computed using an empirical relationship developed by Fritz and MacDonald (1949):

R(K,I) = RSO(I)*(.35 + .61*X(I))*DAMO(I)*0.000673

In this equation, RSO(I), X(I), and DAMO(I), the number of days per month, are multiplied by 0.000673, the conversion factor to convert langleys to inches of water evaporation equivalent. The computed R(K,I) values are returned to the main program.

Within the main program, control cards for the precipitation station, temperature station, and elevation of temperature station are read. Next, monthly precipitation and temperature data for each weather station are read. The potential evapotranspiration values S(I,J), in inches by year (I) and month (J), are calculated using lines 128 through 141, Attachment G, Part 1.

Jensen and Haise used these techniques (Jensen and Haise, 1963, and Jensen and others, 1969) to compute potential ET. The equation S(I,J) = R(I,J)*CX*(T(I,J) - TP), on line 139, Attachment G, Part 1 is a variation of the Penman equation with the wind velocity term omitted. The variables in this equation are as follows:

S(I,J) is the monthly potential evapotranspiration, in inches.

R(I,J) is the total monthly solar radiation computed in subroutine SRAD and expressed as inches of water evaporation equivalent.

CX is the quantity 1./(C1 + 13.*CH);

where C1 = 68. - 3.6 (ELEV/1000.),

ELEV is elevation of weather station, in feet,

CH = 50./DELE,

DELE = E2 - E1,

E2 is saturation vapor pressure of water at mean maximum air temperature for warmest month of year in units of millibars, and

E1 is saturation vapor pressure of water at mean minimum air temperature for warmest month of year in units of millibars.

T(I,J) is mean monthly air temperature in units of °F.

TP is the quantity 27.5 - 0.25*DELE - (ELEV/1000.).

After the potential ET values are computed for one weather station for the period of interest, monthly precipitation, temperature, and potential ET values are written to file 11 and file 6, the output listing devices. Then the program computes potential ET for another weather station until all the weather stations have been used.

## Input Data

Because of the sparseness of climatic data, all U.S. Weather Bureau stations within and near the study area usually are used if the appropriate climatic measurements have been obtained for the period of interest. Even if some measurements are missing, estimates can be generated by using linear regression on two or three nearby weather stations. The question of how many weather stations are needed to provide enough input data can be answered only after a thorough examination of the study area. If precipitation varies widely over the area, then several weather stations appropriately located will usually be necessary to adequately represent the precipitation events. If, however, precipitation is fairly similar throughout the study area, then fewer weather stations will be needed.

The types of input data for the PET Program are illustrated in Attachment G, Part 2 by using the Twin Platte-Middle Republican study as an example. One type of input data, the mean daily solar radiation on cloudless days for each month is read from file 3 (line 167 in Attachment G, Part 1) in one 80-character record (line 8, Attachment G, Part 2). These values are applied to the entire study area.

The second type of input data for this program are referred to as control cards and they are read from file 5 (lines 86 and 93, Attachment G, Part 1) for items 1, 2, and 3 explained below. The different types of control cards are as follows:

(1) First and last years of the simulation with a format of (2I4) (line 10, Attachment G, Part 2);

(2) the U.S. Weather Bureau's (USWB) stations with their identification numbers and descriptions with a format of (2A3, 18A4), used for the percent possible sunshine (line 11); and

(3) three cards for each weather station where card 1 contains the USWB's identification number and description for the monthly precipitation with a format of (2A3, 18A4) (line 12), card 2 contains the same information for mean monthly air temperature (line 13), and card 3 contains the altitude of the temperature stations, in feet, with a format of (F5.0) (line 14).

The three input items listed under item (3) are repeated for each weather (precipitation) station (lines 15 through 68).

The final type of input data for this program is the climatic data file (file 8). This 80-character file contains the USWB's identification number (2A3), the year of the data, (I4), and one of the following:

(1) Twelve values of monthly precipitation, in inches;

(2) twelve values of monthly mean air temperature, in °F;

(3) twelve values of monthly percent possible sunshine; or

(4) two values of maximum and minimum mean daily air temperatures, in °F, of the warmest month of each year (usually July).

The format for these last four items is (12F5.0), and all of these items have a card indicator type in columns 79 and 80 for each card. The card indicators are defined in the program (Attachment G, Part 1). Examples of the climatic data file are listed in Attachment G, Part 2. These data are read from file 8 at lines 99 and 172 in the program.

## Output from Program

The output from the PET Program is printed using file 6 (line 1, Attachment G, Part 2) and stored as a permanent data set, file 11, on a magnetic tape or disc system (lines 4 through 6, Attachment G, Part 2). The variables written on these two files are listed in the "write" statements on lines 143, 148, and 149 in the program (Attachment G, Part 1). The format statements for these files are found on lines 144, 150, and 151 in the program.

A sample listing of file 6, which is identical to the permanent data set, file 11, except for spacing between variables, is found in Attachment G, Part 3. The first line contains the six-character USWB station identification number and the name of the weather station. Each additional line contains the following variables or items: the six-character USWB station identification number, the year, the month, the total monthly precipitation in inches, the mean monthly temperature in degree Fahrenheit, and the monthly potential evapotranspiration in inches. After the specified number of years of data are listed for this weather station, data from other weather stations are listed.

## Soil-Water Program

The Soil-Water Program simulates the infiltration, storage, and removal of water from the soil on a monthly basis in order to compute the amount of water that passes through the soil eventually to become recharge to the underlying ground-water flow system. This program also has been described by Lappala (1978). A listing of the main program, of typical input to the program and typical output from the program are presented in Attachment H, Parts 1, 2, and 3, respectively.

The volume of water that passes through the soil to become recharge is dependent largely on weather, nature of the soils, and crops grown. The soil groups, crop types, and weather stations will be discussed in an interpretive report on the Twin Platte-Middle Republican study area (James W. Goeke, written commun., 1984).

A schematic showing the major factors involved in water balance within the soil is given in figure 12. Water is added to the soil by precipitation and by irrigation. It remains in storage in the soil zone until it is removed either upward through evapotranspiration or downward through deep percolation to the ground-water system. In this program, water movement through the soil is assumed to be in a vertical direction. Deep percolation occurs when the water in the soil exceeds the water-holding capacity of the soil.

It should be noted that infiltration and surface runoff are computed without considering the antecedent moisture conditions. Infiltration and surface runoff are determined from the empirical relationships discussed below.

The amount of infiltration through the soil surface is dependent on the amount and intensity of precipitation, topography of the land surface, soil lithology, and vegetative cover. Infiltration is computed by utilizing infiltration-curve numbers and infiltration-curve coefficients. Surface runoff is the difference between precipitation and infiltration. The curve numbers are selected after considering soil lithology, vegetation or crop type, and topography as indicated in figure 13. These precipitation-infiltration curves were derived from empirical monthly precipitation-runoff curves for varying soils, land use, and topography (Lappala, 1978). The infiltration-curve coefficients are simply the ratios of monthly infiltration to monthly precipitation taken from the appropriate curves (see example on fig. 13).

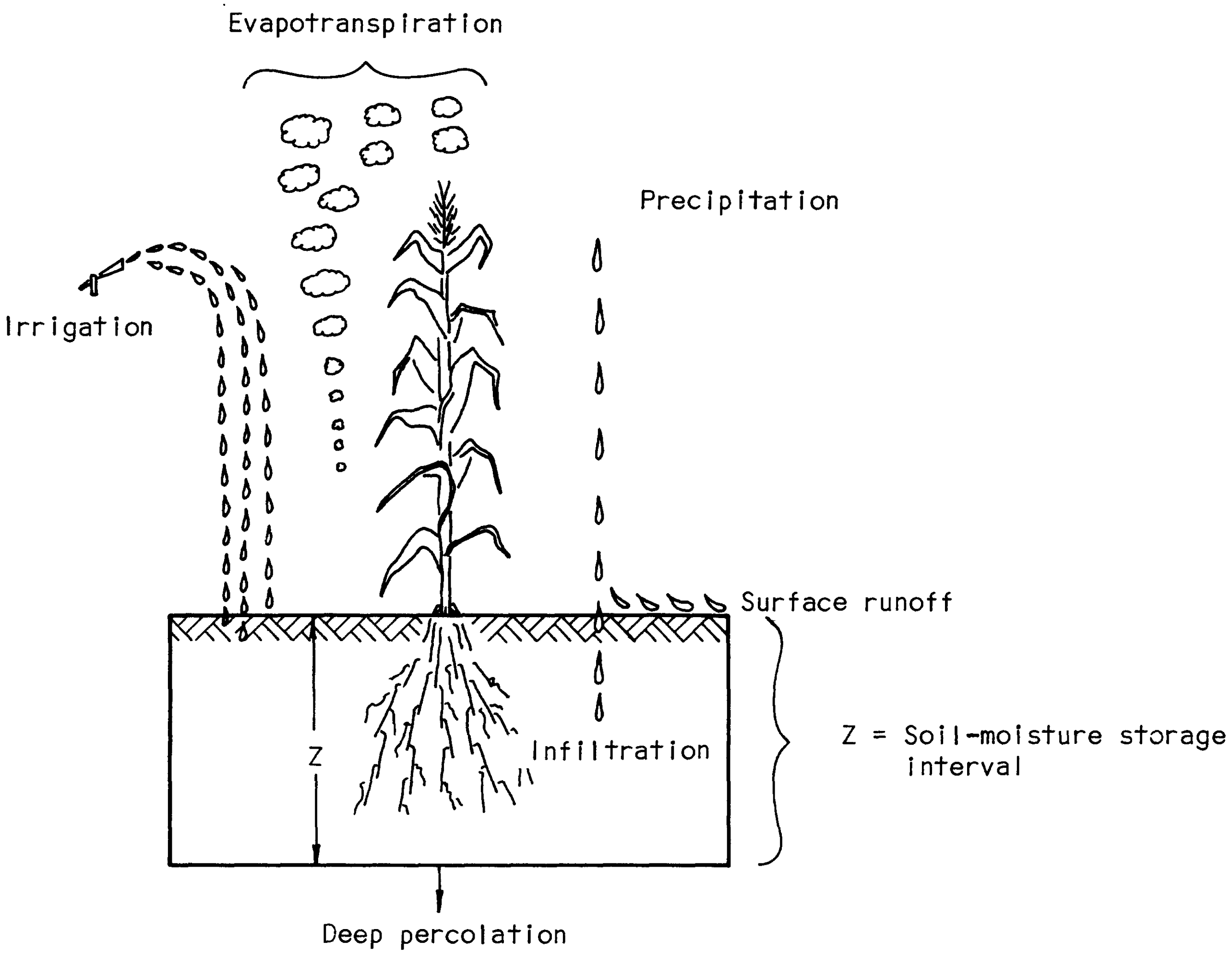
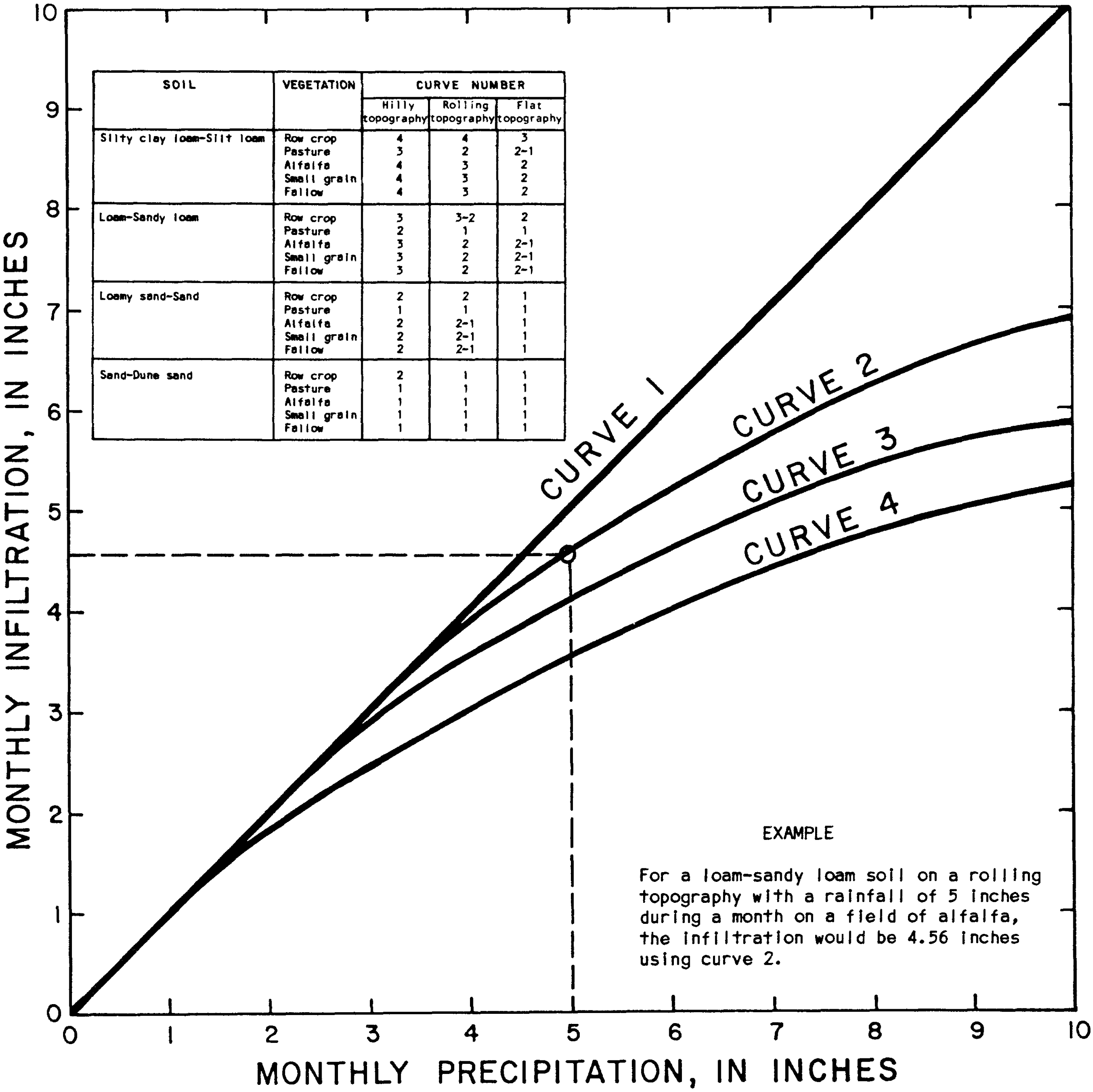



Figure 12.--Factors involved in water balance within the soil.




| SOIL | VEGETATION | CURVE NUMBER | | |
|---|---|---|---|---|
| | | Hilly topography | Rolling topography | Flat topography |
| Silty clay loam-Silt loam | Row crop | 4 | 4 | 3 |
| | Pasture | 3 | 2 | 2-1 |
| | Alfalfa | 4 | 3 | 2 |
| | Small grain | 4 | 3 | 2 |
| | Fallow | 4 | 3 | 2 |
| Loam-Sandy loam | Row crop | 3 | 3-2 | 2 |
| | Pasture | 2 | 1 | 1 |
| | Alfalfa | 3 | 2 | 2-1 |
| | Small grain | 3 | 2 | 2-1 |
| | Fallow | 3 | 2 | 2-1 |
| Loamy sand-Sand | Row crop | 2 | 2 | 1 |
| | Pasture | 1 | 1 | 1 |
| | Alfalfa | 2 | 2-1 | 1 |
| | Small grain | 2 | 2-1 | 1 |
| | Fallow | 2 | 2-1 | 1 |
| Sand-Dune sand | Row crop | 2 | 1 | 1 |
| | Pasture | 1 | 1 | 1 |
| | Alfalfa | 1 | 1 | 1 |
| | Small grain | 1 | 1 | 1 |
| | Fallow | 1 | 1 | 1 |

Figure 13.--Monthly precipitation-infiltration for different soils, land use, and topography.

This program provides for a delay of infiltration from the date of precipitation, if precipitation falls as snow and if average monthly air temperatures are below a specified level. For this study, the maximum number of days that snow storage can occur (SNDAY) was selected as 40; and the minimum temperature at which precipitation does not go into snow storage (TMIN) was selected as 27° F. Both of these values were based on the climatic records in Nebraska.

The amounts of water used by different crops are indicated by crop coefficients, which are monthly ratios of actual evapotranspiration and potential evapotranspiration. The crop coefficients used in this study were obtained from the curves shown on figure 14. These curves were derived from field experiments by the U.S. Bureau of Reclamation (Lappala, 1978). Modifications were made in the crop coefficients for row crops and for pasture and range to reflect conditions in the study area. A larger crop coefficient of 1.0 was used for row crops during July, and lower crop coefficients were used for pasture and range from July through October when the grasses are frequently dormant. These crop coefficients are used to compute actual evapotranspiration from the potential evapotranspiration calculated in the PET Program.

The ranges in the water-holding capacity of the soil were obtained from soil-series data (U.S. Soil Conservation Service, 1978). The water-holding capacity of the soil is the difference between the quantity of water in the soil at field capacity (the quantity of water held in the soil after gravitational water or deep percolation has drained) and the quantity of water in the soil at wilting point (the moisture content in the soil resulting in permanent wilting of plants). The water-holding capacities of the soils sometimes were adjusted after the Soil-Water Program was run so that the computed deep percolation, surface runoff, and consumptive-irrigation requirement (CIR) values corresponded with estimated and measured values.

The Soil-Water Program generates data on CIR, dryland water shortage, and deep percolation for both dryland and irrigated land using crop type, soil group, and weather station data. This program assumes that plants withdraw water at a rate independent of the available soil moisture until the water is depleted. At this time, evapotranspiration is reduced to zero. For dryland conditions, the available soil moisture may fall below the wilting point. When this occurs, the remaining soil moisture cannot be used for evapotranspiration. Thus, when evapotranspiration demands exceed stored available soil moisture plus infiltration during a month, the excess ET demands are reported as dryland water shortage. This shortage is for reference only; the dryland water shortage is not

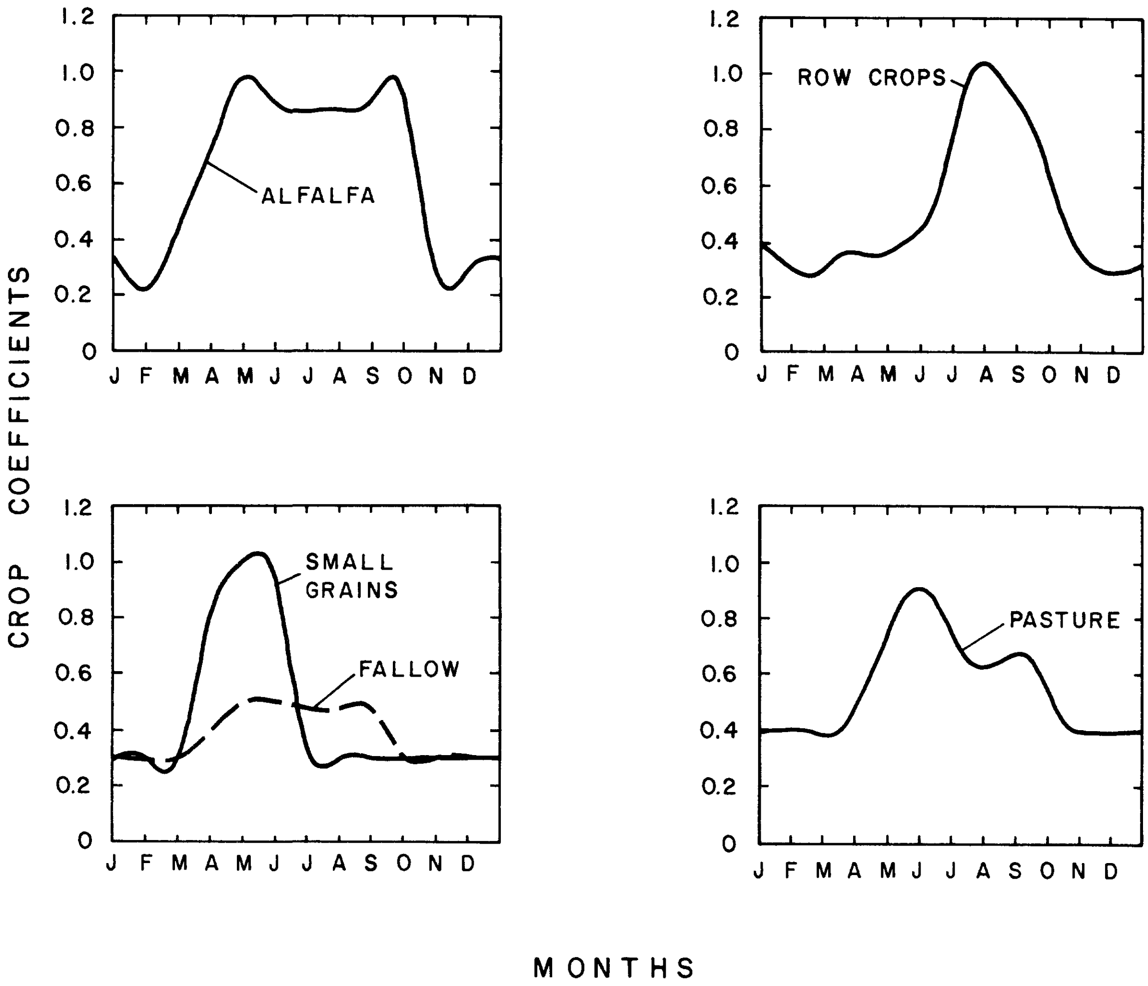



Figure 14.--Crop coefficients for four crop types and fallow.

replenished. For irrigated conditions, CIR is computed as the amount of water required to maintain soil moisture at 50 percent of the water-holding capacity. Deep percolation occurs under irrigated and dryland conditions when the available soil moisture exceeds the field capacity ($F_c * \Delta Z$ on fig. 15).

The CIR, deep percolation, and other values computed by the Soil-Water Program were determined for an irrigation pumping period from June through August and for a nonirrigation pumping period from September through May for this study. However, the length and number of the pumping periods can be varied.

The previous soil moistures for irrigated and dryland crops are not initially known. They are set within the program as follows. The previous soil moistures for irrigated crops (SMIP) and for dryland crops (SMDP) are initialized at one-half and one-fourth of the available soil moisture, plus the wilting point for the root zone depth, respectively.

Modifications in the Soil-Water Program from an earlier version (Lappala, 1978) include procedures for handling nonuniform distribution of rainfall with respect to time, for reducing the initial surface runoff by using a "seep" term, and for alternating small grain and fallow land uses. Modifications for nonuniform distribution of rainfall are included because without them, precipitation is input as monthly values that eliminate the temporal features of daily data on rainfall. The U.S. Bureau of Reclamation ran a daily soil-water program, which is similar to the one described in this report, using climatic data for Nebraska (Fred J. Otradovsky, written commun., 1979; and Otradovsky, 1980). With multiple regression techniques, they developed the nonuniform distribution of rainfall procedure. The result of this procedure is an increase in deep percolation.

The second modification in the program, the addition of a "seep" term, was needed to account for recharge that seeps from road ditches, ponds, low areas, and intermittent drains. The rainfall-runoff curves in the Soil-Water Program were developed from data collected on 4-acre watersheds, and they represent only initial surface runoff. When larger areas are considered, much of the original surface runoff reaches road ditches, ponds, swales, etc., from which water percolates downward to become recharge to the aquifer. The fraction of the initial surface runoff that is subsequently retained and percolates downward to become recharge is referred to as "seep" and is treated as additional deep percolation in this program (Fred J. Otradovsky, U.S. Bureau of Reclamation, written commun., 1979; Otradovsky, 1980). The "seep" values used in this study are estimates that are based on surface runoff from large watersheds in Nebraska that have these soils or similar soils. Attachment H, Part 2 contains the "seep" values used for this study.

The final modification in the program, alternating the small grain and fallow land uses, was necessary to account for the farming practices in this area. Wheat is grown the first year on lands that are initially delineated as small grain, and the land is left fallow the next year. Alternatively, lands left fallow the first year, are planted to wheat the following year. This cycle is repeated throughout the time period of the study.

This program, like the PET Program, produces results that are not discretized; that is, output from the Soil-Water Program represents a particular weather station, soil group, and crop type or land use and not a specific area or element.

## General Format of the Program

The major components of the Soil-Water Program are listed below. Figure 15, which is a flow chart illustrating the major steps in the program, provides a summary of the general format of this program.

1. Read and write program options and soil, crop, and infiltration parameters (lines 151 through 242, Attachment H, Part 1).
2. Start the weather station loop (line 248).
3. Read and store for the simulation period the monthly values of precipitation, mean temperature, and potential evapotranspiration for one weather station (lines 273 and 274).
4. Start the soils and crops loops (lines 306 and 312).
5. Initialize soil moisture for dryland and irrigated land and other soil parameters for all soils (lines 323 through 342).
6. Start loop on monthly time increments (line 348).
7. Perform procedures for handling snow storage and snow melt (lines 375 through 397).
8. Compute infiltration (I) and surface runoff (RO) (lines 398 through 404).

9. Compute maximum evapotranspiration (lines 406 through 413). This includes procedures for alternating between small grain and fallow land uses.

10. Compute current soil moisture (Si), deep percolation for dryland and irrigated land, dryland water shortage, and consumptive irrigation requirements (lines 418 through 455). The deep percolation contains procedures for nonuniform distribution of rainfall.

11. If desired, write to printer and (or) disc monthly values of precipitation, temperature, potential evapotranspiration, evapotranspiration, deep percolation, snow storage, surface runoff, and soil moisture (lines 454 through 463).

12. Summarize precipitation, snow, infiltration, surface runoff, ET, deep percolation for irrigated and dry lands, dryland water shortage, and soil moisture for drylands and irrigated lands for irrigation and nonirrigation season (lines 468 through 547).

13. Determine whether to compute and print seasonal and (or) yearly summaries. If the logical variable, SMRY, is true, only yearly summaries are computed and printed; however, if it is false, both seasonal and yearly summaries are computed and printed (lines 482 and 522).

14. End of monthly time loop (line 547).

15. Compute average of each value listed in item (11) above for the entire time period for each soil, crop, and weather station (lines 550 through 562).

16. Compute average recharge or discharge for each soil, crop, and weather station (lines 572 through 589).

17. Write outputs to printers and (or) disc (lines 600 through 634).

18. End soils and crops loops (line 635).

19. End weather station loop (line 641).

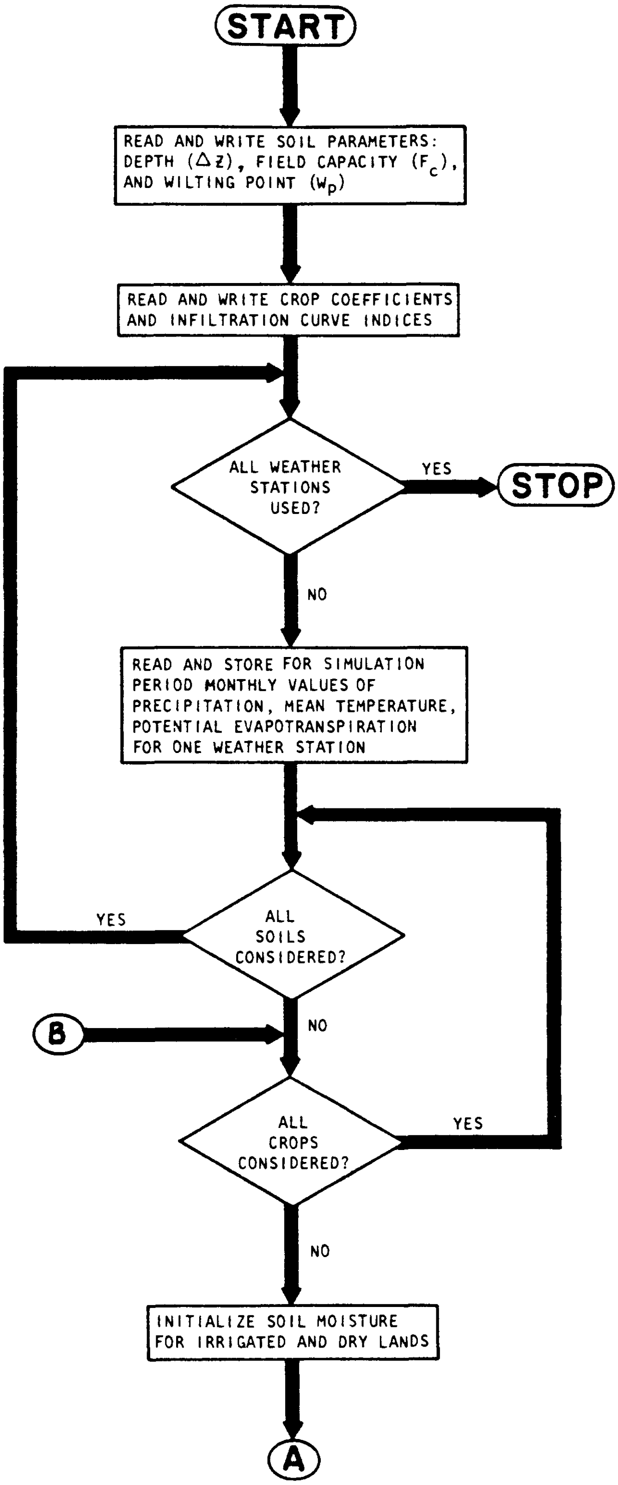



Figure 15.--Flow chart of Soil-Water Program.

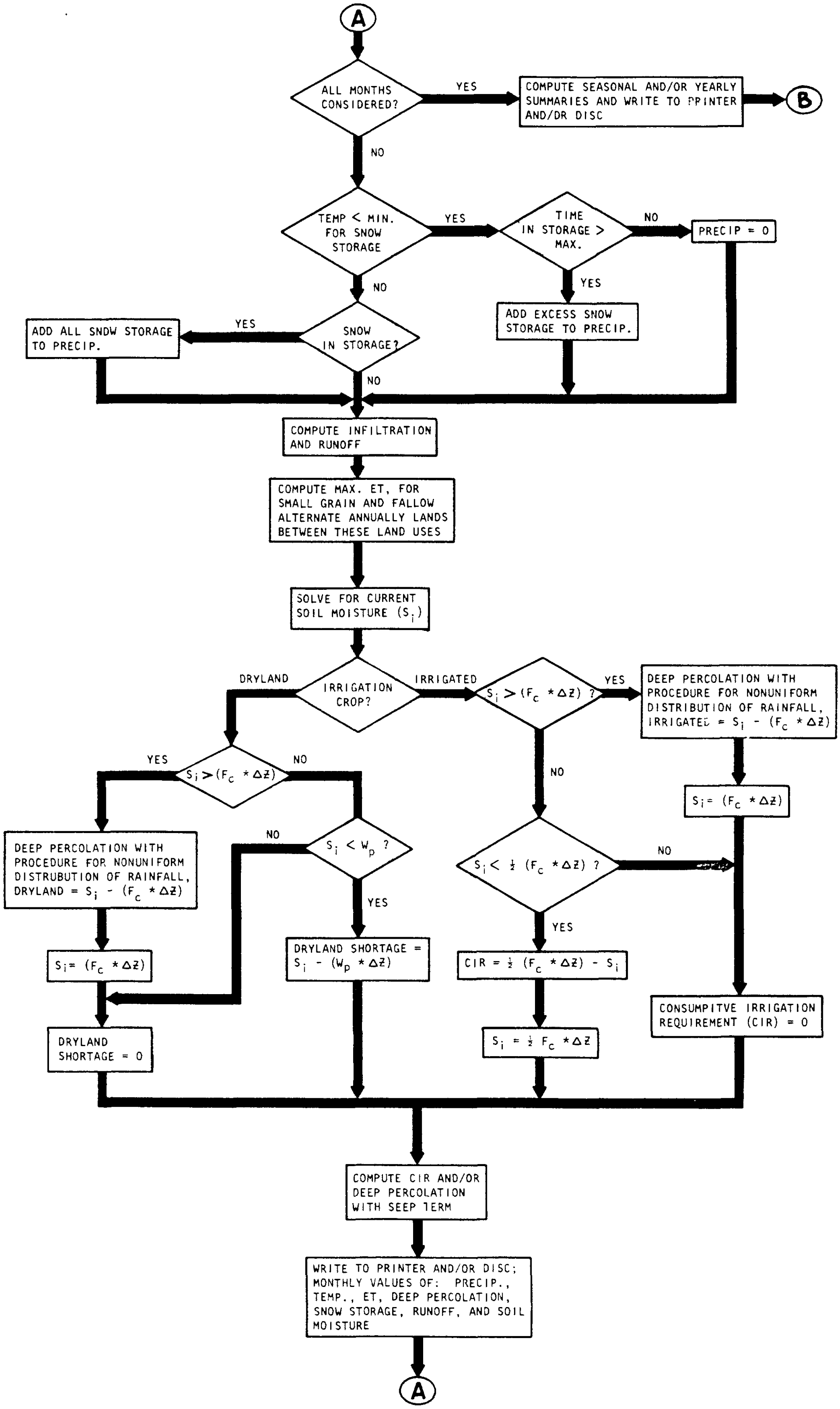



Figure 15.--(Continued).

## Input Data

Input data for the Soil-Water Program consist of four types. First, the program options are read (lines 154 through 156, Attachment H, Part 1) in the following order:

1. Title of the soil-water run (ITL);
2. number of weather stations (NUMSTA);
3. logical variables for monthly summary (if MOPRI = T) and yearly summary (if SMRY = T) of inputs, outputs, and changes in soil-moisture storage and logical variables for seasonal listings (if F13P = T) and average (for the entire time period) listings (if F14P = T) of recharge and CIR;
4. minimum temperature at which precipitation does not go into snow storage (TMIN);
5. maximum number of days that snow storage can occur (SNDAY);
6. number of crops (NCR);
7. number of soils (NSC);
8. last year in the simulation or number of years from the first year to be used in computing averages (LYR);
9. first month of irrigation season (MFST); and
10. last month of irrigation season (MLST).

Examples of this input are listed in Attachment H, Part 1, file 8, lines 8 through 11.

The second type of input is crop, soil, and infiltration data. These data are read from file 8, lines 159 through 187, Attachment H, Part 1. The items read are the following: (1) crops or land uses; (2) soil group; (3) infiltration-curve coefficients; (4) monthly crop coefficients for each crop and the root-zone depth of each crop in inches; and (5) field capacity, wilting point, infiltration-curve number, seep term, farm efficiency, and field losses for each soil. Examples of this input are listed in Attachment H, Part 2, on lines 12 through 39. Farm efficiencies and field losses may be set to 1.0 and 0.0, respectively, to eliminate their effects in this program. These items will, however, be used in the Recharge-Discharge Program.

The third type of data read from file 8 is the U.S. Weather Bureau's six-digit weather station number and weather station name. These are read from lines 236 and 237 of the program. Examples of these data are found on lines 40 through 58 of the input data.

The final type of data read is the output from the PET Program, which includes data on total monthly precipitation, in inches; mean monthly temperature, in degrees Fahrenheit; and the monthly potential evapotranspiration, in inches, for each weather station. These data are read from lines 273 and 274 of the program. Examples of this input are provided in Attachment G, Part 3.

## Output from Program

The output from the Soil-Water Program is printed using file 6 (line 1, Attachment H, Part 2) and stored as permanent data sets, files 13 and 14, on a magnetic tape or disc system (lines 5 through 7 and line 2). However, for this example, file 14 was not used. The variables written onto these files can be grouped into three types: data checks; echo or listing of input data and program options; and results generated by the program.

The output for the data checks listed on file 6 indicate whether specific problems occur with the input data. There are data checks for crop numbers (lines 166 and 167 of Attachment H, Part 1); soil numbers (lines 169 and 170 of the program); relationship between the first and last month of the irrigation season (lines 239 through 241); the number of months of data read from the PET data set that exceeds the selected limit (lines 281 through 284 of the program); and weather station numbers that do not match between files 1 and 8 (lines 295 through 298 of the program).

The echo or printing of the program options and input data using file 6 is a listing of the types 1 and 2 input data discussed in the previous section. Lines 189 through 234, Attachment H, Part 1, contain the write and format statements for this output. Examples of the output listings are found in Attachment H, Part 3.

The final type of output, results generated by the program, can be in several forms depending on the program options specified. Monthly values of the precipitation, mean temperature, snow storage, infiltration, surface runoff, evapotranspiration, deep percolation for irrigated lands, consumptive irrigation requirements, soil moisture for irrigated lands, deep percolation for drylands, water shortage for drylands, and soil moisture for drylands may be listed on file 6 (lines 460 through 463, Attachment H, Part 1 and footnote 3, Attachment H, Part 3).

Seasonal values for both the irrigation and nonirrigation pumping periods also may be listed on file 6 (lines 483 through 485 of the program for the irrigation pumping period and lines 523 through 525 of the program for the nonirrigation pumping period). All monthly values are printed in their appropriate seasonal sums except mean temperature. It should also be noted that the seasonal values are not listed unless the logical variable, SMRY, is false (lines 482 and 522 in the program).

The average monthly values for all parameters except mean temperature for the entire simulation period are printed using file 6 (lines 561 and 562 of the program). An example of this is illustrated in Attachment H, Part 3. Output listings for the monthly and seasonal values have not been included in Attachment H, Part 3.

Simulation totals and average values for deep percolation (recharge) or CIR are printed using file 6 (lines 600 through 603 for the write statements, and lines 617 through 628 for the format statements in the program) for the following conditions: Irrigated lands during the nonirrigation pumping period (NPP), drylands during the NPP, irrigated lands during the irrigation pumping period (IPP), and drylands during the IPP by weather station, soil group, and crop. Positive totals or averages represent recharge for all the conditions, negative values represent the CIR on irrigated lands during the IPP, and zero values represent no recharge and water shortages on drylands during NPP and IPP and no recharge on irrigated lands during the NPP. An example of the listing is shown in Attachment H, Part 3. If the logical variable, F14P is true (line 604), then the average values for the simulation period of recharge or CIR for the four conditions are written onto permanent file 14 (lines 604 through 606 in the program).

The seasonal values for recharge or CIR by weather station, soil group, and crop for the four conditions are listed on file 6 (lines 630 through 634 in the program). The lines following footnote 4 in Attachment H, Part 3, illustrate this output. If the logical variable, F13P, is true (line 610), then the seasonal values for recharge or CIR by weather station, soil group, and crop for the above four conditions are written onto permanent file 13 (lines 610 through 616 in the program).

## Procedures for Running the Program

By changing the program options discussed in the section on Input Data, different types of output from the Soil-Water Program can be obtained. The values for the four logical variables, MOPRI, SMRY, F13P, and F14P (line 154, Attachment H, Part 1) determine the amounts and types of data listed on file 6 or stored on permanent files. For additional information on these items, the reader should review the previous three sections.

Pumping periods may be modified by changing the MFST and MLST variables in the program options (line 154 in Attachment H, Part 1) and by changing lines 264 through 267 in Attachment H, Part 1. Two pumping periods can be developed. If more than two pumping periods per year are needed, additional changes especially in the write statements will be necessary.

## Recharge-Discharge Program

The Recharge-Discharge Program, using output from the Soil-Water Program and information on irrigation and land use, computes net recharge to, or discharge from the ground-water flow system for each element of the RAQSIM ground-water flow model for a given time period. The development of the Recharge-Discharge Program, including the major assumptions in the input data, will be discussed in an interpretive report for the Twin Platte-Middle Republican study area (James W. Goeke, written commun., 1984). The information that follows describes two versions of the program and how they operate.

The calibration version of the Recharge-Discharge Program (PUMP) used for the Twin Platte-Middle Republican study called TPMRPUMP computes recharge and CIR data for the calibration period from 1935 through 1978. The predictive version (PRED), called TPMRPRED, computes recharge and pumpage data for a specified time period, 1981-2020, rate of ground-water irrigation development, and irrigation application rate.

### PUMP Program

The calibration version of the Recharge-Discharge Program, PUMP Program (the TPMRPUMP Program for the Twin Platte-Middle Republican study will be used as an example) uses different deep percolation and

CIR data for each pumping period. Figure 16, a generalized flow chart of the PUMP Program, illustrates the structure within this program. A listing of the program, of typical input, and typical output are presented in Attachment I, Parts 1, 2, and 3, respectively.

Program

The major components of the PUMP Program (Attachment I, Part 1) are listed below.

1. Read and write annual canal diversions; compute and write annual amounts of surface water applied per acre; and read and write area of elements, land use by county and year, and annual seepage rates from canals and lakes (lines 113 through 157).

2. Start "years" loop (lines 161 through 516) where everything within the loop is processed each year.

3. Read wells per element and recharge and CIR data by soil, weather station, and crop (lines 170 through 229).

4. Start element loop (lines 233 through 475) where everything within the loop is processed for each element within the study. Read soils and land use data (lines 233, 234, and 262).

5. Compute seepage values for canals and lakes (lines 241 through 260) and compute land uses, including the acres of dryland and irrigated row crops, alfalfa, small grain, pasture and range, and fallow (lines 279 through 314).

6. Compute net recharge and CIR for each pumping period based on soil group, land use, and weather station data for each element for the following situations (lines 318 through 446):

a. Only ground-water irrigation occurs.

b. Only surface-water irrigation occurs.

c. Both surface- and ground-water irrigation occurs. Surface-water supply is adequate without supplement for surface-water irrigated acres, and ground water is used for irrigation of additional acres.

d. Available surface water is not adequate to irrigate surface-water irrigated acres; allow 50 percent of ground water to be used as supplemental water on surface-water acres.

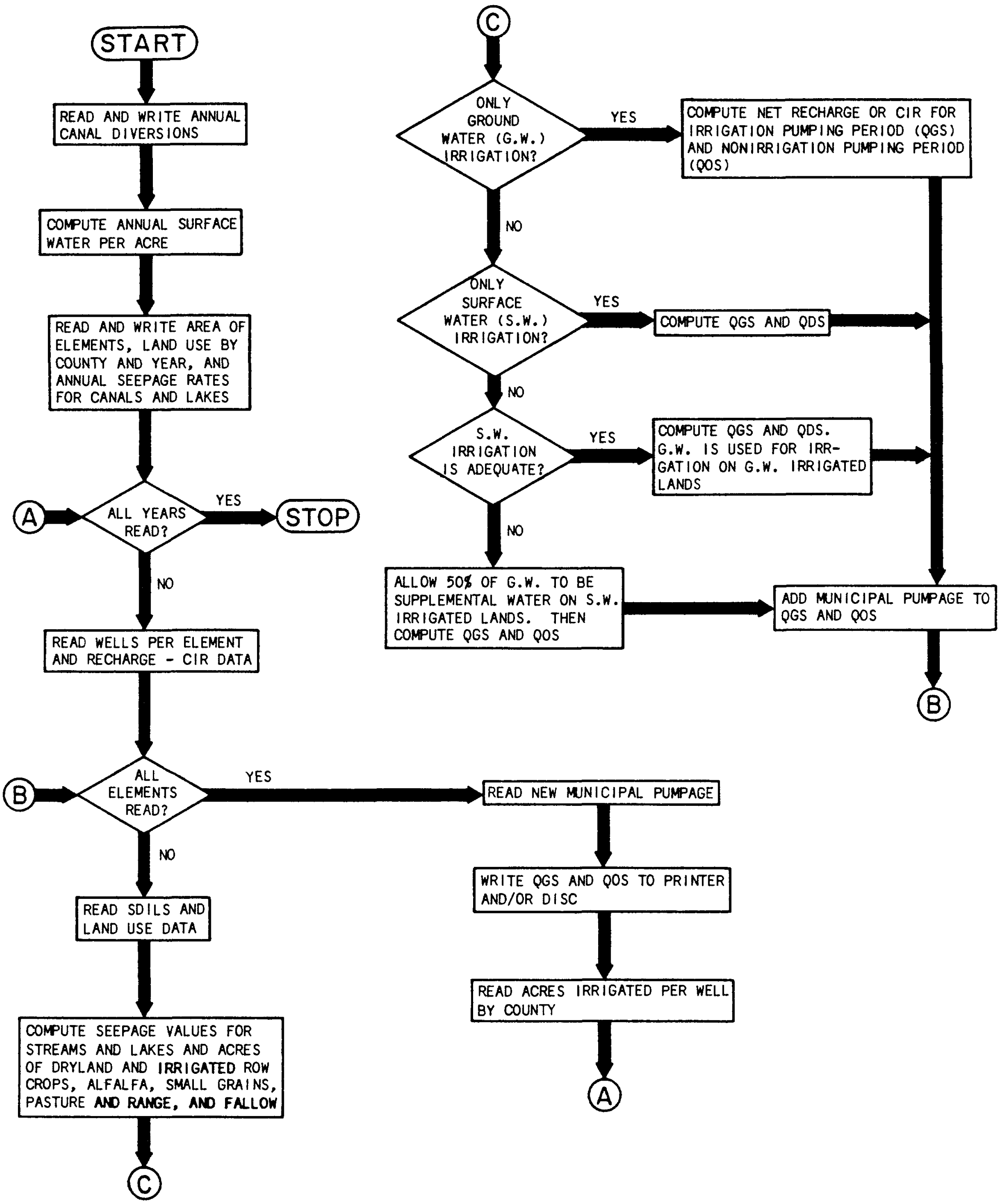



Figure 16.--Generalized flow chart of the PUMP Program.

7. Add municipal pumpage to the net recharge and CIR values (lines 449 through 466).

8. End of the element loop (line 475).

9. Check to determine if new municipal pumpage should be read (lines 476 through 481).

10. Write net recharge or CIR values (QGS and QOS) by element and pumping period to file 6, the printer, and to permanent file 8 (lines 483 through 498).

11. Check to determine if new acres per well values should be read (lines 508 through 515).

12. End of the yearly time loop (line 516).

## Input Data

Input data for the PUMP Program is read from nine files. Attachment I, Part 2, contains listings of all or parts of each file using input data for TPMRPUMP as an example. A brief description of the data that each file contains is listed below in the order that they are read from the program.

1. File 5, annual canal diversions (lines 116 and 117, Attachment I, Part 1). Values read are annual diversions for 9 canals, in acre-feet, and annual proportions of surface-water irrigated acres used for 4 canals.

2. File 11, area of elements (lines 130 and 133). Values read are element number and area of element in acres.

3. File 10, agricultural statistics on crops harvested (lines 138 through 140). Ten different land-use categories for dryland and irrigated land are read by county and year.

4. File 12, annual seepage from streams and lakes (lines 148 through 151). Values read are seepage from 9 streams and 4 lakes, in feet per mile and feet per acre, respectively.

5. File 13, wells per element by year (lines 176 through 178 and line 182).

6. File 14, seasonal recharge and CIR data (lines 195 through 219). This is output file 13 of the Soil-Water Program Attachment H, Part 3).

7. File 9, soils and land use information by element (lines 233, 234, and 262). Items read are element number, proportions of seven soil groups and water in each element (each value must be multiplied by 0.01 to obtain proportion), weather station number, county number, proportions of three land-use categories in each element (croplands, pasture and range, and water), canal index, surface-water irrigated acres, land surface elevation in feet, canal lengths, lake index, lake area in acres, and ground-water irrigation factors.

8. File 15, municipal pumpage (lines 476 through 481). Values read are pumpage, in units of square feet per second, for different time periods and elements.

9. File 16, acres irrigated per well by county, usually averaged for 5-year periods (lines 508 through 513 and line 515).

## Output from Program

The output from the PUMP Program is printed using file 6 (line 9, Attachment I, Part 2) and stored using file 8 as a permanent data set (lines 12 through 14, Attachment I, Part 2). Output to these files may be grouped into three types: data checks, echo or listing of input data, and results generated by the program. Output from TPMRPUMP (Attachment I, Part 3) are typical examples of the output for the PUMP Program.

The output for data checks, which are listed on file 6, indicate either a specific problem with the input data or a computational problem. The data check for weather stations and county numbers (lines 269 through 274, Attachment I, Part 1) determines if these data fall within the correct ranges. The data check for surface-water irrigated acres, irrigated acres, dryland acres, surface-water shortage, surface-water shortage after supplemental ground water, and net recharge or CIR for the irrigation and nonirrigation pumping periods (lines 440 and 441) is used to check land use, recharge, and CIR calculations. When computations for these parameters are being performed correctly, these data check lines are not used but are made comment statements (a "C" in column 1).

The echo or listing of the input data using file 6 is performed to check that the input data have been correctly read. Items checked by this procedure are annual canal diversions (lines 118 and 119, Attachment I, Part 1), area of elements (lines 131 and 132), agricultural statistics on crops harvested (lines 141 through 144), annual seepage from canals and lakes (lines 152 through 154), recharge or CIR from the Soil-Water Program (lines 220, 221, and 223), and the number of wells per element (lines 183 and 184). The last two listings have been changed to comment statements; they are used when the program or input data is being initially checked.

The final type of output is the net recharge or CIR data by element for the irrigation and nonirrigation pumping periods. These data are printed on file 6 (lines 491 through 493 and 496 through 498, Attachment I, Part 1) and stored on file 8 (lines 489, 495, and 514). File 8 then is used as input to the RAQSIM ground-water flow model.

Procedures for Running and Modifying the Program

Some modifications in the PUMP Program can be made very simply. For example, the number of years in the "years" loop on line 161 of the program (Attachment I, Part 1) can be changed. Thus, net recharge and CIR data can be computed for any desired time period if the necessary input data are available. When steady-state results from this program are desired, the years loop is read for only 1 year or for some time period that is believed to be representative of steady-state conditions. For this latter case, the net recharge and CIR data are averaged at individual elements based on length of the time period.

If information indicates that the recharge or pumpage should be substantially different from that generated by the Soil-Water Program for certain soil groups, crops, or weather stations, adjustments can be made in the statements on lines 224 through 227, Attachment I, Part 1. Additional modifications probably will require some changes in the program or the input data.

## PRED Program

The predictive version of the Recharge-Discharge Program, PRED Program, is a modification of the PUMP Program. The PRED Program (the TPMRPRED Program for the Twin Platte-Middle Republican study will be used as an example) calculates the net recharge or discharge for different ground-water irrigation development rates and for different irrigation-application rates.

## Program

Figure 17, a generalized flow chart of the PRED Program, illustrates the structure of the PRED Program. Listings of the main program, of typical input, and of typical output from the PRED Program are presented in Attachment J, Parts 1, 2, and 3, respectively.

Comparisons between figures 16 and 17 show the principal differences between the PRED and PUMP Programs. The major differences are:

1. The PRED Program has one additional loop more than the PUMP Program, the "soil and land-use" loop (lines 174 through 233, Attachment J, Part 1). In this loop, using the TPMRPRED Program as an example, the soil groups and land uses are read for each element, the 1980 irrigated acres file is read for each element, and average seepage values are calculated for canals and lakes.

2. The PRED Program contains procedures (lines 254 through 263) for adding more ground-water irrigated acres if more than 10.0 acres are irrigable but not irrigated. Any ground-water irrigation-development rate may be selected.

3. The computations of net recharge or discharge in the PUMP and PRED Programs are similar. However, for the PRED Program there is no need to supplement surface water with ground water for irrigating lands with deficient surface-water supplies because these deficiences are taken into account in the 1980 irrigated-acres file (item (1) above).

Two major differences in the TPMRPRED and TPMRPUMP Programs are related to this study. First, the time periods used in the "years" loop are different--1981 to 2020 (TPMRPRED) instead of 1935 to 1978 (TPMRPUMP). (The RAQSIM model was extended to 1980 before any predictive model runs were performed.) Also, annual canal diversions, seepage rates from canals and lakes, and agricultural statistics on the proportion of dryland and irrigated row crops, alfalfa, small grain, pasture and range, and fallow, by county, for the TPMRPRED Program are computed for a shorter time period (1963 to 1978) compared to the TPMRPUMP Program (1935 to 1978).

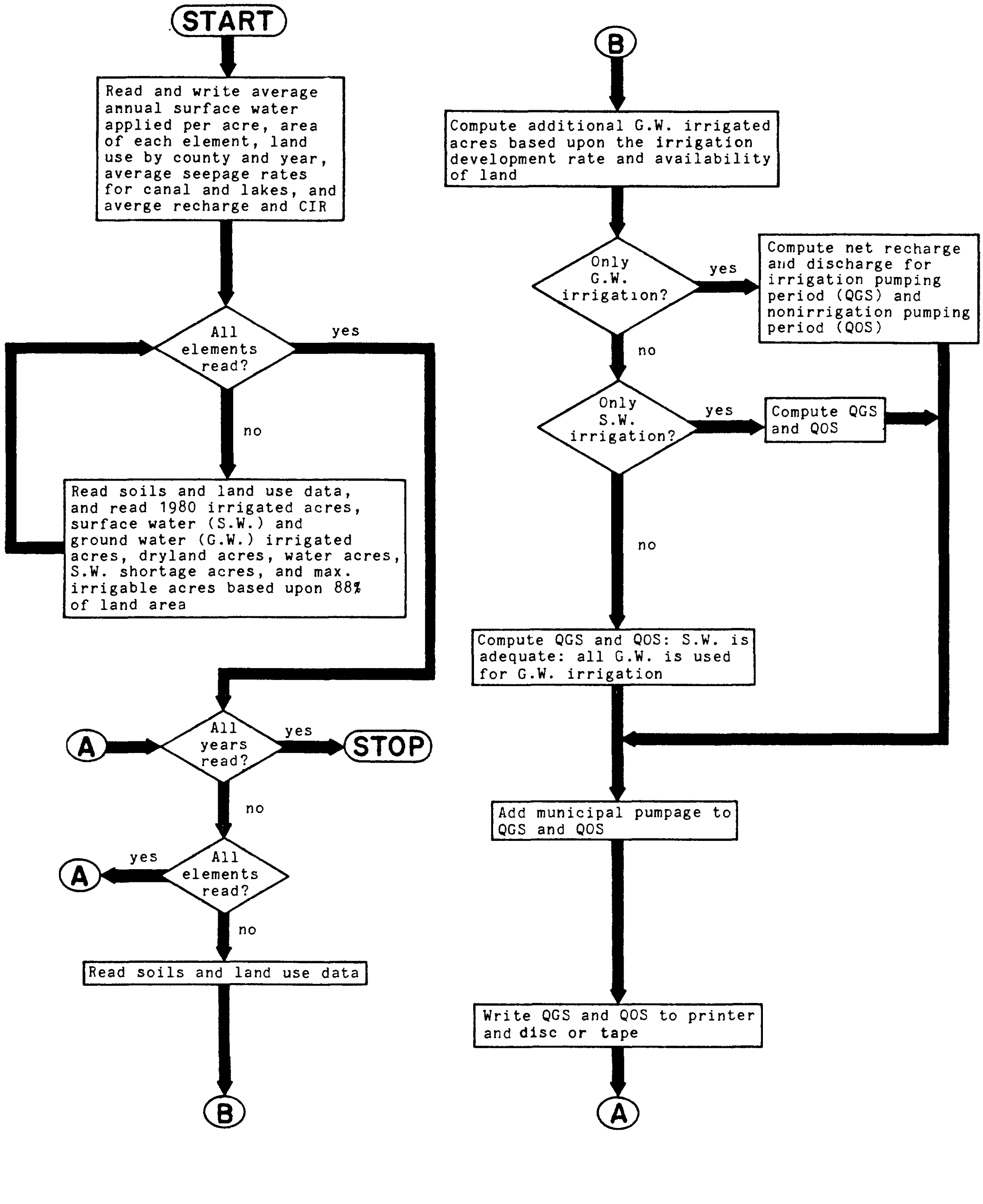



Figure 17.--Generalized flow chart of the PRED Program.

Input Data

Input data for the PRED Program is similar to the input data for the PUMP Program with a few important differences; much of the input data for PRED Program are averaged for a "selected" time period.

Attachment J, Part 2, contains typical listings (based on TPMRPRED Program) of all or parts of six input files for the PRED Program. Brief descriptions of the data within each file are listed below in the order they are read:

1. File 5, average annual canal diversions for the 1963-78 time period (lines 131 and 132, Attachment J, Part 1). Values read are diversions for 9 canals, in acre-feet.

2. File 11, area of elements (lines 137 and 140). Values read are element number and area of element, in acres.

3. File 10, agricultural statistics on crops harvested (lines 145 through 147). Values read are agricultural statistics on crops harvested for ten different land-use categories for dryland and irrigated land. They are read by county and year.

4. File 5, average annual seepage from streams and lakes for the 1963-78 time period (lines 154 through 157). Values read are seepage from 9 streams and 4 lakes, in feet per mile and feet per acre, respectively.

5. File 14, value of average seasonal recharge and CIR data are read by weather station, soil, and crop for the four conditions mentioned in the section on Soil-Water Program from the 1963-78 time period (lines 163, 164, and 168).

6. File 9, soils and land-use information by elements (lines 174, 175, and 223). This file is read again later in the program (lines 248, 249, and 223). Items read are element number, proportions of seven soil groups and water in each element (each value must be multiplied by 0.01), weather station number, county number, proportions of three land-use categories in each element (croplands, pasture and range, and water), canal index, surface-water irrigated acres, land surface elevation, canal lengths, lake index, lake area, and ground-water irrigation factors.

7. File 12, 1980 irrigated acres file (lines 181 through 183). Values read for each element based on 1980 conditions are element number, total surface- and ground-water irrigated acres, surface-water irrigated acres, ground-water irrigated acres, dryland acres, water acres, surface-water shortage acres, and maximum irrigable acres with an upper limit of 88 percent of the land area.

Output from Program

The output from the PRED Program is listed in Attachment J, Part 3. It should be noted that not all the output is listed, but only examples from the TPMRPRED Program are presented. Two output files, the printer file 6 (line 1, Attachment J, Part 2) and a permanent dataset file 8 (lines 15 through 17) are used in this program. These files can be divided into three types of output: data checks, echo or listings of input data, and results computed by the program.

A data check for weather stations and county numbers (lines 229 through 231, Attachment J, Part 1) is used to determine if these items fall within the correct ranges. If either of these items falls outside the given range, information indicating the problem is printed using file 6.

The echo or listing of input data using file 6 is done to check that the input data has been correctly read. Items checked by this procedure are the average annual canal diversions (lines 133 and 134, Attachment J, Part 1), area of elements (lines 138 and 139), agricultural statistics on crops harvested (lines 148 through 151), average annual seepage from streams and lakes (lines 158 through 160), and average seasonal recharge and CIR data (lines 165, 166, and 168). The last listing has been changed to comment statements, and it is used only when the program or input data is being initially checked.

The third type of output, the results computed by the program, are the net seasonal recharge and pumpage for each year in the predictive period (file 6, lines 424 through 426 and lines 429 through 431, Attachment J, Part 1, and file 8, lines 422, 428, and 438) and the average total and elemental recharge and discharge (file 6, lines 435 through 437). File 8 is then used as input to the RAQSIM ground-water flow model.

Procedures for Running the Program

Minor adjustments in the PRED Program (examples from the TPMRPRED Program will be used) may yield significantly different net recharge and pumpage values. By changing the irrigation-development rate (0.025, which means that the irrigated acres are 1.025 times the acreage in the preceding year) on line 255 of Attachment J, Part 1, different net recharge and pumpage values can be generated for a variety of irrigation development rates. In the Twin Platte-Middle Republican study, irrigation development rates of 0.00, 0.025, and 0.100 were used, which resulted in significantly different net recharge and pumpage values.

Modifications in the irrigation-application rates (line 167, Attachment J, Part 1) also may produce significant changes in the net recharge and pumpage values. In the equation

QIRGS (IS,IW,IL) = (-15.0*4.0)/12.0,

QIRGS (IS, IW, IL) is the recharge or CIR during the irrigation pumping period for a specified soil group (IS), weather station (IW), and land use (IL); and the -15.0 value represents 15 inches of pumpage. Thus, if a different pumpage value is required,change the -15.0 value to the negative of the new pumpage value.

In the above equation, 4.0 is the volume rate factor, which must be modified if the irrigation pumping period is changed from the June through August time period (92 days or approximately 0.25 of a year), presently used in TPMRPRED. The volume rate factor is the reciprocal of the length of the pumping period in years. For this case, the irrigation pumping period is 0.25 of a year; therefore, the reciprocal of 0.25 is 4.0. Finally, the 12.0 value in the above equation converts the pumpage from inches to feet.

A variety of time periods may be computed by adjusting the "years" loop (fig. 13 and line 239, Attachment J, Part 1). This change may require additional changes in the input data so that time periods correspond.

## SUMMARY AND CONCLUSIONS

RAQSIM is a generalized flow model of a ground-water system using finite-element methods, which has potential uses in areas other than the Twin Platte-Middle Republican study. Within this report, RAQSIM was documented to explain how it works and to demonstrate that it gives valid results. The three support programs that are used to compute recharge and discharge data required as input to RAQSIM also were described in this report.

RAQSIM was developed to solve large-scale, transient, two-dimensional, regional ground-water flow problems with isotropic or anisotropic conductance. It also has features that handle radial flow to a well and steady-state flow. The items discussed are the mathematical basis, program structure, data input and output procedures, data set organization, and program features and options. An example with listings of input data and output results was presented to illustrate RAQSIM's capabilities. Two test problems, comparing RAQSIM with analytical procedures, were presented and discussed. The results of these comparisons clearly show that RAQSIM adequately simulates the physical system.

The first support program discussed, PET Program, uses solar radiation and other climatic data along with the Jensen-Haise method to compute potential evapotranspiration. The second support program, the Soil-Water Program, uses output from the PET Program, soil characteristics, and the ratio of potential to actual evapotranspiration for each crop to compute infiltration, storage, and removal of water from the soil zone. The third program, Recharge-Discharge Program, uses output from the Soil-Water Program together with other data to compute recharge and discharge from the ground-water flow system for both the calibration and predictive periods.

For each support program, a program listing and examples of the input data and output results were provided. Also, a brief discussion on how each program operates and on procedures for running and modifying these programs were presented.

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ATTACHMENT A - Listing of RAQSIM

```
C*** RAQSIM: REGIONAL AQUIFER SIMULATION ***********************************
C*    MIXED EXPLICIT-IMPLICIT PROGRAM TO SIMULATE 2-DIMENSIONAL TRANSIENT
C*    AREAL GROUND-WATER FLOW OR 2-DIMENSIONAL TRANSIENT FLOW WITH RADIAL
C*    SYMMETRY ABOUT THE Y-AXIS.  DOUBLE PRECISION VERSION.
C*                   REVISED: SEPTEMBER 1982
C*    ANISOTROPIC CONDUCTANCE AND LINEAR GROUNDWATER EVAPOTRANSPIRATION
C*    ADDED AS OPTIONS:     OCTOBER  1983
C**************************************************************************
C-DEFINITION OF SUBROUTINES:
C SBR01 INPUTS: PERFORMS INPUT OF INITIAL AND CONSTANT DATA.
C SBR02 BOUNDS: CHECKS FOR PROPER RANGE OF CERTAIN INTEGER DATA.
C SBR03 CONTRL: SUBROUTINE TO CONTROL THE PROGRESS OF THE SIMULATION AND
C               KEEP TABS ON REMAINING COMPUTER TIME TO ALLOW A RESTART.
C SBR04 REFORM: GENERATES THE ANM ARRAY, CHECKS STABILITY CRITERIA,
C               RECLASSIFIES AND RESEQUENCES IMPLICIT NODES IF NEEDED.
C SBR05 SMULAT: ROUTINE TO SIMULATE AND PERFORM MASS BALANCE
C               CALCULATIONS FOR TIME PERIOD WITH CONSTANT HYDRAULIC
C               PARAMETERS AND SPECIFIED BOUNDARY CONDITIONS.
C SBR06 FLUXES: CONSOLIDATES VARIOUS FLUX COMPONENTS AND RETURNS THEM AS
C               DH ARRAY.  ALSO UPDATES KNOWN HEADS AND TIME PARAMETERS.
C SBR07 TSMASS: CALCULATES CAPACITANCE AND CONDUCTANCE AS A
C               FUNCTION OF SATURATED THICKNESS FROM TABLUATED INPUT
C               AND DETERMINES THE AMOUNT OF FLUID IN EACH NODAL
C               SUBDOMAIN AT THE START OF SIMULATION AND AT THE
C               END OF SIMULATION FOR USE IN MASS BALANCE.
C SBR08 SHAPE : DETERMINES BASIS FUNCTION INTEGRALS AND ELEMENT AREAS.
C SBR09 STFLOW: CALCULATES NODAL FLUX TO STREAM. STREAM BASEFLOWS AND
C               DETERMINES WHETHER STREAM IS 'DRY' OR 'WET'.
C SBR10 INTABL: READS TABULATED VALUES OF CAPACITANCE AND CONDUCTANCE
C               VERSUS "SATURATED THICKNESS" FROM DEVICE INTS.
C SBR11 DAYS  : DETERMINES NUMBER OF DAYS BETWEEN DATES.  INPUT INTEGER
C               VALUES FOR MONTH, DAY AND YEAR; OUTPUT IS NUMBER OF DAYS
C SBR12 NEWDAT: DETERMINES THE NEW MONTH, DAY AND YEAR GIVEN THE OLD
C               MONTH, DAY AND YEAR AND THE NUMBER OF DAYS ADDED.
C SBR13 ACCUM : SUBROUTINE WHICH FORMS SPACE AND TIME DERIVATIVE MATRICES.
C SBR14 SETANM: SUBROUTINE TO FORM THE LINKED LIST STRUCTURE OF ANM ARRAY
C SBR15 FACTOR: SUBROUTINE FOR CHOLESKY FACTORIZATION OF MATRIX LAMDA.
C SBR16 SOLVE : SUBROUTINE SOLVING FACTORED LAMDA MATRIX FOR UNKNOWNS.
C SBR17 OPTNUM: SCHEME TO RENUMBER IMPLICIT NODES TO MINIMIZE THE LEFT
C               HORIZONTAL PROFILE OF THE SYMMETRIC MATRIX.
C SBR18 NUMLVL: SUBROUTINE WHICH RENUMBERS NODES WITHIN A PARTICULAR
C               LEVEL STRUCTURE.
C SBR19 DISJNT: SUBROUTINE TO DETERMINE WHICH LEVEL STRUCTURE IS TO BE
C               USED FOR A PARTICULAR DISJOINT CONNECTED COMPONENT.
C SBR20 BLDLVL: BUILD LEVEL STRUCTURE.
C SBR21 DEGREE: DETERMINE DEGREES.
C SBR22 FINDIJ: FORM THE LINKED LIST I-J CONNECTION.
C**************************************************************************
C**************************************************************************
C* VARIABLE DEFINITIONS NECESSARY FOR DETERMINING DIMENSIONS:             *
```

```
C* NN     : NUMBER OF NODES.                                                *
C* NBH    : NUMBER OF NODES WITH KNOWN HISTORY OF HEAD.                     *
C* DFX    : EQUAL TO NN IF INTERMEDIATE FLUX VALUES ARE TO BE STORED        *
C*          IN CORE, OTHERWISE EQUAL TO 1.                                  *
C* MAXT   : MAXIMUM HYDRAULIC PROPERTY  VS.  SAT. THICKNESS TABLE LENGTH.   *
C* NBF    : NUMBER OF NODES WITH KNOWN BOUNDARY FLUX.                       *
C* NSS    : NUMBER OF STREAM SYSTEMS.                                       *
C* NSN    : NUMBER OF STREAM NODES.                                         *
C* NHD    : NUMBER OF NODES TO HAVE HEAD HYDROGRAPHS OUTPUT.                 *
C* NE     : NUMBER OF ELEMENTS.                                             *
C* DNE    : EQUAL TO NE IF ELEMENT DATA STORED IN CORE: OTHERWISE 1.        *
C* DAN    : DIMENSION OF CONDUCTANCE TENSOR (1:ISOTROPIC, 3:ANSIOTROPIC).   *
C* DET    : NN IF SIMULATING SIMPLIFIED GROUNDWATER ET; OTHERWISE 1.        *
C*                                                                          *
C* MINIMUM REQUIRED DIMENSIONS:                                             *
C*   REAL*8      DR8=9*NN+MAX(1,NBH)+DFX+ROOM FOR IMPLICIT VECTOR (LAMDA)   *
C*   REAL*4      DR4=(2+DAN)*MAXT+MAX(1,NBF)+5*MAX(1,NSN)+NN                *
C*                   +(3+6*DAN)*DNE+2*DET                                   *
C*   INTEGER*2   DI2=2*MAX(1,NSS)+3*MAX(1,NSN)+MAX(1,NBF)+MAX(1,NBH)        *
C*                   +MAX(1,NHD)+7*DNE+2*(NN-NBH+1)+ROOM FOR MANM ARRAY     *
C*   LOGICAL*1   DLG=MAX(1,NSN)                                             *
C*                                                                          *
C*  IF ARRAY STORAGE IS INSUFFICIENT, THE PROGRAM WILL STOP PRIOR TO        *
C*  ATTEMPTING FURTHER EXECUTION.                                           *
C*                                                                          *
C*--------------------------------------------------------------------------*
      INTEGER*4 DR8,DR4,DI2,DLG,DE2,DEQ
C*--------------------------------------------------------------------------*
C*  THE VE2 VECTOR IS DIMENSIONED TO USE STORAGE PARTITIONED BY THE         *
C*  VR8 VECTOR.  DIMENSION IT NO MORE THAN 4 TIMES THE VR8 VECTOR SIZE.     *
C*                                                                          *
C*  THE FOLLOWING DIMENSIONS AND ASSIGNMENTS MUST BE ADJUSTED IF MORE       *
C*  ARRAY STORAGE IS NECESSARY:                                             *
C*--------------------------------------------------------------------------*
      DOUBLE PRECISION  VR8(30000)
      DATA              DR8/30000/
      INTEGER*2         VE2(120000)
      DATA              DEQ/120000/
      REAL*4            VR4(13400)
      DATA              DR4/13400/
      INTEGER*2         VI2(12800)
      DATA              DI2/12800/
      LOGICAL*1         VLG(00300)
      DATA              DLG/00300/
C***************************************************************************
      EQUIVALENCE (VR8(1),VE2(1))
C***************************************************************************
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
```

```
     &                    DNE,DFX,NUK,NK1,NAA,NLM,NUI,NUE,DAN,TABW,DET
      COMMON /TIMES/  MS,DS,YS,TS,MF,DF,YF,TF,M,DD,Y,IDAY,TIME,TTOTL,
     &                NDAYO,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,TFLUX,
     &                DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ,ITMAX
      REAL*4    DD,TF,TIME,TS,TTOTL,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,
     &                TFLUX,DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ
      INTEGER*4 MS,DS,YS,MF,DF,YF,M,Y,IDAY,NDAYO,ITMAX
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4          FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &                FNXY(20),FNBS(20),FNQS(20)
      COMMON /SUMFLX/  BALCUM,QBDS,QBDF,QBDH,SUMNQ
      DOUBLE PRECISION BALCUM,QBDS,QBDF,QBDH,SUMNQ
      COMMON /GWET/     ZDEPTH,TGWET,ETMAX,SUMET,FETX,INET
      REAL*4            ZDEPTH,TGWET,ETMAX,SUMET,FETX(20)
      INTEGER*4         INET
C
C.....LIST OF ARGUMENTS NOT PREVIOUSLY SPECIFIED:
      INTEGER*4 CONTNU,KTABS,PCODE,DRBX,DI2X,KODE,RADIAL,QCODE,THCODE
      LOGICAL*1 CODEPC,CODEBP,CODEIS,CODERL,CODEQP,CODETH,CODESQ,CODESG,
     &          CODESS
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION NSET(2),ESET(2),NUMN(2),NUME(2),NUMH(2),NUMQ(2).
     &                 NUMS(2),NUMR(2),NUMBF(2).NUMBH(2),NUMHD(2),
     &                 NUMET(2),NUMTS(2)
      REAL*4    MIXED,TITLE(20),FMT(20)
      INTEGER*4 OUTD,DRL8,DRL4,DIN2,A8A,A8B,A8C,A8D,A8E,A8F,A8G,A8X,
     &          A4A,A4B,A4C,A4D,A4E,A4F,A4G,A4H,A4I,A4J,A4K,A4L,A4M.A4N,
     &          A2A,A2B.A2C,A2D,A2E,A2F,A2G,A2H,A2I,
     &          SQCODE,SGCODE.STEADY,PCCODE,ISCODE,I,ENT
      INTEGER*4 INFIN,ONE
      INTEGER*2 NUM
      LOGICAL FAILED,TABLD
      DATA MIXED/4HMIXE/,INFIN/9999999/,FAILED/.FALSE./,
     &     NSET/8HNODAL DE,8HVICE    /,NUMN/8HNUMBER O,8HF NODES /,
     &     ESET/8HELEMENT ,8HDEVICE  /,NUME/8HNUMBER O,8HF ELMNTS/,
     &     NUMH/8HINITIAL ,8HHEADS   /,NUMQ/8HNODAL RE,8HCHARGES /,
     &     NUMS/8HNUM. OF ,8HSTREAMS /,NUMR/8HNUM. OF ,8HREACHES /,
     &     NUMBF/8HNUM OF B,8HNDY FLUX/,NUMBH/8HNUM OF B,8HNDY HEAD/,
     &     NUMHD/8HNUM OF H,8HYDROGRAP/,NUMET/8HNUM OF G,8H.W. ET. /,
     &     NUMTS/8HMAX TABL,8HE LENGTH/,ONE/1/,TABLD/.FALSE./
C...........................................................................
      DE2=DEQ
      ININ=5
      OUTD=6
C...........................................................................
   10 READ (ININ,1000,END=60) TITLE
      IF(TITLE(1).EQ.MIXED) GO TO 20
      WRITE(OUTD,2000) TITLE
      GO TO 10
C
C.....READ BULK OF JOB-FILE INPUT DATASET:
   20 READ (ININ,1000,END=60) TITLE
      READ (ININ,1010) MS,DS,YS,TS,MF,DF,YF,TF
```

```
      CALL DAYS (MS,DS,YS,0,NDAYO)
      CALL DAYS (MF,DF,YF,NDAYO,NDAYS)
      TTOTL=NDAYS+TF/24.0
      TIME=TS/24.
      READ (ININ,1020) RADIAL,QCODE
      READ (ININ,1020) CONTNU,INHS,OUTM,STEADY,THCODE
      READ (ININ,1030) THETA,DHSTDY,DTMAX,DTMIN,DHMAX
      READ (ININ,1020) ITMAX,INTS,DAN
      READ (ININ,1030) TSFREQ,DHFREQ
      READ (ININ,1020) INET,INSS,SGCODE,PCCODE,ISCODE,OUTS,OUTH,INNS,
     &                 INES,IOSH,INQS,IONQ,INBF,INBH,SQCODE,PCODE,OUTP,
     &                 OUTN
      IF(DHMAX.LT.0.0) DHMAX=-DHMAX
      IF(DHMAX.EQ.0.0) ITMAX=1
      IF(ITMAX.LT.1)   ITMAX=10
      KTABS=1
      IF(INTS.LE.0) KTABS=0
      IF(KTABS.EQ.1) TABLD=.TRUE.
      IF(.NOT.TABLD) DAN=0
      IF(DAN.GT.0)   DAN=3
      IF(DAN.LE.0)   DAN=1
      TABW=2+DAN
      IF(.NOT.TABLD .OR. TSFREQ.LE.0.0) TSFREQ=2.0*TTOTL
      IF(.NOT.TABLD .OR. DHFREQ.LT.0.0) DHFREQ=0.0
      MAXT=0
      IF(DHFREQ.GT.0.0 .AND. DHMAX.GT.DHFREQ) DHMAX=DHFREQ
C
C.....CHECK BOUNDS ON DEVICE NUMBERS. READ DIMENSIONING PARAMETERS.
C     AND CHECK BOUNDS ON DIMENSIONS:
      NUM=INNS
      CALL BOUNDS (NUM,ONE,ONE,INFIN,NSET,FAILED)
      NUM=INES
      CALL BOUNDS (NUM,ONE,ONE,INFIN,ESET,FAILED)
      READ(INNS,1020) NN
      NUM=NN
      CALL BOUNDS (NUM,ONE,ONE,INFIN,NUMN,FAILED)
      READ(INES,1020) NE
      NUM=NE
      CALL BOUNDS (NUM,ONE,ONE,INFIN,NUME,FAILED)
      IF(INHS.LE.0) INHS=INNS
      IF(INHS.NE.INNS) READ(INHS,1020) NUM
      IF(INHS.NE.INNS) CALL BOUNDS (NUM,ONE,NN,NN,NUMH,FAILED)
      IF(INQS.GT.0)    READ(INQS,1020) NUM
      IF(INQS.GT.0)    CALL BOUNDS (NUM,ONE,NN,NN,NUMQ,FAILED)
      IF(TABLD) READ(INTS,1020) MAXT
      NUM=MAXT
      IF(TABLD) CALL BOUNDS (NUM,ONE,ONE,INFIN,NUMTS,FAILED)
      NSS=0
      NSN=0
      IF(INSS.GT.0) READ(INSS,1020) NSS,NSN
      NUM=NSS
      IF(INSS.GT.0) CALL BOUNDS (NUM,ONE,ONE,NN,NUMS,FAILED)
      NUM=NSN
      IF(INSS.GT.0) CALL BOUNDS (NUM,ONE,ONE,NN,NUMR,FAILED)
```

```
      NBF=0
      IF(INBF.GT.0) READ(INBF,1020) NBF
      NUM=NBF
      IF(INBF.GT.0) CALL BOUNDS (NUM,ONE,ONE,NN,NUMBF,FAILED)
      NBH=0
      IF(INBH.GT.0) READ(INBH,1020) NBH
      NUM=NBH
      IF(INBH.GT.0) CALL BOUNDS (NUM,ONE,ONE,NN,NUMBH,FAILED)
      IF(INET.GT.0) READ(INET,1020) NUM
      IF(INET.GT.0) CALL BOUNDS (NUM,ONE,NN,NN,NUMET,FAILED)
      DET=1
      IF(INET.GT.0) DET=NN
      READ(ININ,1020) NHD
      IF(NHD.EQ.0) OUTN=0
      NUM=NHD
      IF(OUTN.GT.0) CALL BOUNDS (NUM,ONE,ONE,NN,NUMHD,FAILED)
C
C.....SET STATE OF OPTION FLAGS:
      CODEPC=.FALSE.
      CODEBP=.FALSE.
      CODEIS=.FALSE.
      CODERL=.FALSE.
      CODEQP=.FALSE.
      CODETH=.FALSE.
      CODESG=.FALSE.
      CODESQ=.FALSE.
      CODESS=.FALSE.
      IF(PCCODE.GT.0 .AND. INET.GT.0)   CODEPC=.TRUE.
      IF(PCCODE.GT.0 .AND. NSS.GT.0)    CODEPC=.TRUE.
      IF(PCCODE.GT.1 .AND. NSS.GT.0)    CODEBP=.TRUE.
      IF(ISCODE.NE.0 .AND. NSS.GT.0)    CODEIS=.TRUE.
      IF(RADIAL.NE.0)                   CODERL=.TRUE.
      IF(QCODE.NE.0)                    CODEQP=.TRUE.
      IF(SGCODE.NE.0)                   CODESG=.TRUE.
      IF(SQCODE.NE.0)                   CODESQ=.TRUE.
      IF(THCODE.NE.0 .AND. STEADY.EQ.0) CODETH=.TRUE.
      IF(STEADY.NE.0)                   CODESS=.TRUE.
      IF(CODESS)                        THETA=1.0
      NUK=NN-NBH
      NK1=NUK+1
      IF(OUTM.GT.0) GO TO 30
      IF(IOSH.GT.0) WRITE (OUTD.2210) IOSH,OUTM
      IOSH=0
   30 WRITE(OUTD,2010) TITLE
      IF(CODERL)        WRITE(OUTD,2090)
      IF(.NOT.CODERL)   WRITE(OUTD,2100)
      IF(CODETH)        THETA=0.57
      IF(CODEQP)        WRITE(OUTD,2110)
      IF(.NOT.CODEQP)   WRITE(OUTD,2120)
      WRITE(OUTD,2020) MS,DS,YS,TS,TIME,MF,DF,YF,TF,TTOTL,CONTNU,
     &                 INHS,OUTM,CODESS,THETA
      IF(CODETH)        WRITE(OUTD,2130)
      IF(.NOT.CODETH)   WRITE(OUTD,2140)
      WRITE(OUTD,2030) DHSTDY,DTMAX,DTMIN,DHMAX,ITMAX,TABLD,MAXT,INTS
```

```
      IF(DAN.EQ.1)            WRITE(OUTD,2180)
      IF(DAN.EQ.3)            WRITE(OUTD,2190)
      IF(TSFREQ.LT.2.0*TTOTL) WRITE(OUTD,2150) TSFREQ
      IF(DHFREQ.GT.0.0)       WRITE(OUTD,2160) DHFREQ
      IF(INET.GT.0)           WRITE(OUTD,2200) INET
      WRITE(OUTD,2040) NSS,NSN,INSS,CODESG,CODEPC,CODEBP,CODEIS,OUTS,
     &                 OUTH
      WRITE(OUTD,2050) NN,INNS,NE,INES,IOSH,INQS,IONQ
      WRITE(OUTD,2060) NBF,INBF,NBH,INBH,NUK
      WRITE(OUTD,2070) CODESQ,PCODE,OUTP,NHD,OUTN
      IF(FAILED)       GO TO 60
      IF(OUTP.EQ.OUTD) GO TO 40
      OUTD=OUTP
      GO TO 30
   40 DNE=NE
      DFX=NN
      IF(IOSH.GT.0) DNE=1
      IF(INQS.EQ.0) IONQ=0
      IF(IONQ.NE.0.OR.INQS.LE.0) DFX=1
      DSS=NSS
      IF(DSS.LE.0) DSS=1
      IF(NSS.LE.0) NSN=1
      DBF=NBF
      IF(DBF.LE.0) DBF=1
      DBH=NBH
      IF(DBH.LE.0) DBH=1
      DHD=NHD
      IF(DHD.LE.0) DHD=1
      IF(KTABS.EQ.0) MAXT=1
      DRL8=5*NN+DBH+DFX
      DR8X=DR8-DRL8
C
C.....SUBDIVIDE DOUBLE PRECISION VECTOR:
      A8A =  1+DR8X
      A8B =A8A+NN
      A8C =A8B+NN
      A8D =A8C+NN
      A8E =A8D+NN
      A8F =A8E+NN
      A8G =A8F+DBH
C
C.....SUBDIVIDE SINGLE PRECISION VECTOR:
      A4A =1+MAXT*TABW
      A4B =A4A+DSS
      A4C =A4B+NSN
      A4D =A4C+NSN
      A4E =A4D+NSN
      A4F =A4E+DBF
      A4G =A4F+NSN
      A4H =A4G+NSN
      A4I =A4H+NN
      A4J =A4I+5*DAN*DNE
      A4K =A4J+2*DNE
      A4L =A4K+DNE
```

```
      A4M =A4L+DAN*DNE
      A4N =A4M+DET
      DRL4=A4N+DET-1
C
C.....SUBDIVIDE HALF-WORD INTEGER VECTOR:
      A2A =  1+DSS
      A2B =A2A+DSS
      A2C =A2B+NSN*3
      A2D =A2C+DBF
      A2E =A2D+DBH
      A2F =A2E+DHD
      A2G =A2F+DNE*7
      A2H =A2G+NK1
      A2I =A2H+NN
      DIN2=A2I-1
      DI2X=(DI2-DIN2)/2
      IF(NHD.LT.1) GO TO 50
C
C.....A2E MARKS START OF POINTER FOR NODAL HYDROGRAPH NODES; READ THEM
C     NOW:
      END=A2E+NHD-1
      READ(ININ,1000) FMT
      READ(ININ,FMT) (VI2(I),I=A2E,END)
C
C.....READ OUTPUT DEVICE NUMBER FOR HEAD ARRAY OUTPUT:
   50 READ(ININ,1020) OUTC
      WRITE(OUTP,2170) OUTC
      WRITE(OUTP,2080) DRL8,DR8,DRL4,DR4,DIN2,DI2,NSN,DLG
      IF(DRL8.GT.DR8.OR.DRL4.GT.DR4.OR.DIN2.GT.DI2.OR.NSN.GT.DLG) STOP
      CALL INPUTS (VR8(1),VR8(A8A),VR8(A8B),VR8(A8C),VR8(A8D),VR8(A8E),
     &             VR8(A8F),VR8(A8G), VR4(1),VR4(A4A),VR4(A4B),VR4(A4C),
     &             VR4(A4D),VR4(A4E),VR4(A4H),VR4(A4I),VR4(A4J),
     &             VR4(A4K),VR4(A4L),VR4(A4M),VR4(A4N),    KTABS,CONTNU,
     &             PCODE,KODE,DR8X,DRL8,DR8,DI2X,DIN2,DI2,A8X,   VI2(1),
     &             VI2(A2A),VI2(A2B),VI2(A2C),VI2(A2D),VI2(A2E),
     &             VI2(A2F),VI2(A2G),VI2(A2H),VI2(A2I),VE2,
     &             VLG,CODERL,CODESS)
      CALL CONTRL (VR8(1),VR8(A8X),VR8(A8A),VR8(A8B),VR8(A8C),VR8(A8D),
     &             VR8(A8E),VR8(A8F),VR8(A8G), VR4(1),VR4(A4A),VR4(A4B),
     &             VR4(A4C),VR4(A4D),VR4(A4E),VR4(A4F),VR4(A4G),
     &             VR4(A4H),VR4(A4I),VR4(A4J),VR4(A4K),VR4(A4L),
     &             VR4(A4M),VR4(A4N),         KTABS,PCODE,KODE,DR8,DRL8,
     &             VI2(1),VI2(A2A),VI2(A2B),VI2(A2C),VI2(A2D),VI2(A2E),
     &             VI2(A2F),VI2(A2G),VI2(A2H),VI2(A2I),VE2,  VLG,CODEPC,
     &             CODEBP,CODEIS,CODEOP,CODETH,CODESG,CODESQ,CODESS)
   60 STOP
C
C........................................................................
C.....INPUT FORMATS:
 1000 FORMAT(20A4)
 1010 FORMAT(60X,I2,1X,I2,1X,I4,F10.0)
 1020 FORMAT(60X,I10)
 1030 FORMAT(60X,F10.0)
C
```

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C.....OUTPUT FORMATS:
 2000 FORMAT(1X,20A4)
 2010 FORMAT(1H1,20A4,//,41H TIME AND DATE OF EXECUTION :___________)
 2020 FORMAT(/11X,14HSTARTING DATE:,2(I2,1H/),I4,F5.2,8H HOURS (,
     &       1PE10.3,6H DAYS),/11X,14HENDING DATE  :,2(I2,1H/),I4,
     &       0PF5.2,8H HOURS (,1PE10.3,6H DAYS),
     &      //11X,39HCONTINUATION? (0=NO OR INPUT DEVICE #):,T60,I10,
     &       /11X,31HINPUT DEVICE FOR INITIAL HEADS:,T60,I10,
     &       /11X,37HOUTPUT DEVICE FOR FINAL HEADS & MASS:,T60,I10,
     &       /11X,40HSOLVE FOR THE STEADY STATE (T:YES F:NO):,T69,L1,
     &       /11X,35HTHETA (1.0:IMPLICIT, 0.0:EXPLICIT):,T60,1PE10.3)
 2030 FORMAT(11X,44HEQUILIBRIUM HEAD-CHANGE CRITERIA (L**1/DAY):,T60,
     &       1PE10.3,/11X,35HMAXIMUM ALLOWABLE TIME STEP (DAYS):,T60,
     &       E10.3,/11X,35HMINIMUM ALLOWABLE TIME STEP (DAYS):,T60,E10.3,
     &       /11X,42HMAXIMUM ALLOWABLE HEAD-CHANGE/STEP (L**1):,T60,
     &       E10.3,/16X,29H(ACTIVE IF GREATER THAN ZERO),/11X,
     &       30HMAX. ITERATIONS TO MEET DHMAX:,T60,I10,//11X,
     &       47HTABULATED CONDUCTANCE-CAPACITANCE (T:YES F:NO):,T69,L1,
     &       /11X,21HMAXIMUM TABLE LENGTH:,T60,I10,
     &       /11X,48HINPUT DEVICE FOR CONDUCTANCE-CAPACITANCE TABLES:,
     &       T60,I10)
 2040 FORMAT(/11X,25HNUMBER OF STREAM SYSTEMS:,T60,I10,/11X,
     &       25HNUMBER OF STREAM REACHES:,T60,I10,/11X,
     &       29HINPUT DEVICE FOR STREAM DATA:,T60,I10,/11X,10HMAX STREAM,
     &       39H-AQUIFER GRADIENT CONTROL (T:YES F:NO):,T69,L1,/11X,
     &       51HPREDICT & CORRECT STREAM-AQUIFER FLUX (T:YES F:NO):,T69,
     &       L1,/11X,46HPRINT PREDICTED STREAM BASEFLOWS (T:YES F:NO):,
     &       T69,L1,/11X,36HNODES ON STREAMS TREATED IMPLICITLY ,
     &       13H(T:YES F:NO):,T69,L1,/11X,
     &       42HOUTPUT DEVICE FOR STREAM-FLOW HYDROGRAPHS:,T60,I10,/17X,
     &       29H(SET TO ZERO IF NONE DESIRED),/11X,
     &       41HOUTPUT DEVICE FOR STREAM-HEADING RESULTS:,T60,I10,/17X,
     &       29H(SET TO ZERO IF NONE DESIRED))
 2050 FORMAT(/11X,16HNUMBER OF NODES:,T60,I10,/11X,17HINPUT DEVICE FOR ,
     &       26HNODE DATA (X,Y,BASE,HEAD):,T60,I10,/11X,10HNUMBER OF ,
     &       9HELEMENTS:,T60,I10,/11X,27HINPUT DEVICE FOR ELEMENTS (,
     &       15HINDICES, ETC.):,T60,I10,/11X,21HTEMPORARY DEVICE FOR ,
     &       23HELEMENT STIFFNESS, ETC:,T60,I10,/17X,13H(SET TO 0 IF ,
     &       30HSTIFFNESS, ETC STORED IN CORE),/11X,17HINPUT DEVICE FOR ,
     &       25HNODAL RECHARGE-DISCHARGE:,T60,I10,/17X,13H(SET TO 0 IF ,
     &       16HFLUXES ARE ZERO),/11X,31HTEMPORARY I-O DEVICE FOR NODAL ,
     &       12HFLUX VALUES:,T60,I10,/17X,26H(SET TO 0 IF VALUES TO BE ,
     &       15HSTORED IN CORE))
 2060 FORMAT(/11X,36HNUMBER OF KNOWN-FLUX BOUNDARY NODES:,T60,I10,/11X,
     &       42HINPUT DEVICE FOR KNOWN-FLUX BOUNDARY DATA:,T60,I10,/11X,
     &       36HNUMBER OF KNOWN-HEAD BOUNDARY NODES:,T60,I10,/11X,
     &       42HINPUT DEVICE FOR KNOWN-HEAD BOUNDARY DATA:,T60,I10,/11X,
     &       35HTOTAL NUMBER OF UNKNOWN-HEAD NODES:,T60,I10)
 2070 FORMAT(11X,37HFORCE NODE RESEQUENCING (T:YES F:NO):,T69,L1,//11X,
     &       37HPRINTOUT CODE VARIES BETWEEN 0 AND 6:,/11X,
     &       50H0-FATAL ERRORS, BASIC INPUT DATA AND FINAL OUTPUT.,/11X,
     &       50H1-INCLUDES STREAM BASEFLOWS AND CUM. MASS BALANCE.,/11X,
     &       30H2-INCLUDES NODAL MASS BALANCE.,/11X,
     &       50H3-INCLUDES HEADS, BOUNDARY CONDITIONS & NODE FLUX.,/11X,
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     &       33H4-INCLUDES STREAM-AQUIFER FLUXES.,/11X,
     &       49H5-INCLUDES STREAMS, BOUNDARIES AND INITIAL HEADS.,/11X,
     &       47H6-INCLUDES DIAGONAL DOMINANCE WARNING MESSAGES.,/11X
     &       36HPRINTOUT CODE (0=MINIMUM,6=MAXIMUM):,T60,I10,/11X,
     &       32HOUTPUT DEVICE FOR PRINTOUT FILE:,T60,I10,//11X,
     &       43HNUMBER OF NODES FOR WATERLEVEL HYDROGRAPHS:,T60,I10,/11X,
     &       41HOUTPUT DEVICE FOR WATERLEVEL HYDROGRAPHS:,T60,I10)
 2080 FORMAT(/11X,29HINITIAL  REAL*8    DIMENSION=,I5,14H WITH REAL*8  ,
     &       23H  VECTOR DIMENSIONED TO,I6,/11X,19HREQUIRED REAL*4     ,
     &       10HDIMENSION=,I5,37H WITH REAL*4    VECTOR DIMENSIONED TO,
     &       I6,/11X,29HINITIAL  INTEGER*2 DIMENSION=,I5,12H WITH INTEGE,
     &       26HR*2 VECTOR DIMENSIONED TO ,I5,/11X,18HREQUIRED LOGICAL*1,
     &       11H DIMENSION=,I5,37H WITH LOGICAL*1 VECTOR DIMENSIONED TO,
     &       I6)
 2090 FORMAT(11X,42HPROBLEM IS RADIALLY SYMMETRIC ABOUT Y AXIS)
 2100 FORMAT(11X,32HPROBLEM HAS NO RADIAL SYMMETRY  )
 2110 FORMAT(11X,43HDISCHARGE CONTROLLED IF HEAD LESS THAN BASE)
 2120 FORMAT(11X,33HNO DISCHARGE LIMITATION IN EFFECT)
 2130 FORMAT(11X,33HVARIABLE THETA FOR IMPLICIT NODES)
 2140 FORMAT(11X,24HCONSTANT VALUE FOR THETA)
 2150 FORMAT(11X,41HCONDUCTANCE AND CAPACITANCE UPDATED EVERY,T60,
     &        1PE10.3,6H DAYS.)
 2160 FORMAT(11X,41HCONDUCTANCE AND CAPACITANCE UPDATED EVERY,T60,
     &        1PE10.3,22H UNITS OF HEAD CHANGE.)
 2170 FORMAT(/11X,30HOUTPUT DEVICE FOR HEAD ARRAYS:,T60,I10,
     &        /17X,31H(SET TO 0 IF NO OUTPUT DESIRED))
 2180 FORMAT(11X,27HCONDUCTANCE ONLY ISOTROPIC.)
 2190 FORMAT(11X,51HCONDUCTANCE MAY BE ANSIOTROPIC IF TENSOR TABULATED.)
 2200 FORMAT(11X,45HSIMULATE SIMPLE GW. ET. WITH INPUT FROM UNIT:,
     &        T60,I10)
 2210 FORMAT(/11X,' TEMPORARY DEVICE FOR STIFFNESS, ETC. CANNOT=',I5,
     &        /11X,' UNLESS OUTPUT DEVICE FOR FINAL MASS (OUTM) IS > 0,',
     &        ' OUTM=',I5,/11X,'IOSH SET TO ZERO!',/)
      END
C-SBR01
C-INPUTS:  PERFORMS THE INPUT OF INITIAL AND CONSTANT DATA.
C ---------------------------------------------------------------------------
      SUBROUTINE INPUTS (VR8,H,DH,MASS,RHS,NET,HBND,FLUX,    TABL,BFLOW,
     &                  INF,QLK,HS,QBND,BASE,STIFF,AREAS,CPCT,CNDT,
     &                  LAND,NAREA,  KTABS,CONTNU,PCODE,KODE,DR8X,DRL8,
     &                  DR8,DI2X,DIN2,DI2,A8X,MOUTH,ITP,NSTP,PBDF,PBDH,
     &                  PHYD,IN,MV,LR,MANM,VE2,LSN,CODERL,CODESS)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INOS,INSS,INTS,
     &               IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INOS,INSS,INTS,IONQ,IOSH,
     &               OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &               DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &               DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /TIMES/  MS,DS,YS,TS,MF,DF,YF,TF,M,DD,Y,IDAY,TIME,TTOTL,
     &               NDAY0,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,TFLUX,
     &               DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ,ITMAX
      REAL*4    DD,TF,TIME,TS,TTOTL,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,
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     &          TFLUX,DTMAX,DTMIN,DHMAX,THETA,DHSTDV,DHFREQ
      INTEGER*4 MS,DS,YS,MF,DF,YF,M,Y,IDAY,NDAYO,ITMAX
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &       FNXY(20),FNBS(20),FNQS(20)
      COMMON /SUMFLX/ BALCUM,QBDS,QBDF,QBDH,SUMNQ
      DOUBLE PRECISION BALCUM,QBDS,QBDF,QBDH,SUMNQ
      COMMON /GWET/    ZDEPTH,TGWET,ETMAX,SUMET,FETX,INET
      REAL*4           ZDEPTH,TGWET,ETMAX,SUMET,FETX(20)
      INTEGER*4        INET
      COMMON /TRAVER/  NTRAV
      INTEGER*4        NTRAV
      INTEGER*4 KTABS,CONTNU,PCODE,KODE,DR8X,DRL8,DR8,DI2X,DIN2,DI2,A8X
      DOUBLE PRECISION H(NN),DH(NN),HBND(DBH),MASS(NN),FLUX(DFX),
     &                 RHS(NN),NET(NN),VR8(DR8X)
      REAL*4 TABL(TABW,MAXT),BFLOW(DSS),INF(NSN),QLK(NSN),HS(NSN),
     &       QBND(DBF),STIFF(DAN,5,DNE),AREAS(2,DNE),CPCT(DNE),
     &       CNDT(DAN,DNE),BASE(NN),LAND(DET),NAREA(DET)
      INTEGER*2 MOUTH(DSS),ITP(DSS),NSTP(3,NSN),PBDF(DBF),PBDH(DBH),
     &          PHYD(DHD),IN(7,DNE),MV(NK1),LR(NN),
     &          MANM(2,DI2X),VE2(DE2)
      LOGICAL*1 LSN(NSN),CODERL,CODESS
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION DTIP(2),DMTH(2),DUP(2),DDWN(2),DNODE(2),DDAT(2),
     &                 DVRT(2),DMAT(2),DBDF(2),DBDH(2),DHYD(2),
     &                 DEGREE,LINEAR,CONST,DIST,DELX,DELY
      REAL*4    FMT(20),FMTT(20),T,LSTIFF(3,5),AREA(02),STRGE,CONDCT,
     &          ISOTRO,ANISOT
      INTEGER*4 DIN,NDAYS,I,J,J1,J2,K,MIN,YIN,LD,L,LL,JD(04),IVOID,
     &          ZERO,ONE,MATNUM,LTABL,TBCODE,IDUM,ICLS,CODEAN,FOUR
      INTEGER*2 JJ
      LOGICAL FAILED,SKIPST,ANCODE
      DATA LINEAR/8H LINEAR /,CONST/8HCONSTANT/,ZERO/0/,ONE/1/,
     &     DTIP/8HSTREAM H,8HEADINGS /,DMTH/8HSTREAM M,8HOUTHS   /,
     &     DUP/8HUP-STREA,8HM BRANCH/,DDWN/8HDOWN STR,8HEAM     /,
     &     DNODE/8HSTREAM N,8HODE #   /,DVRT/8HELEMENT ,8HVERTICES/,
     &     DMAT/8HMATERIAL,8H NUMBER /,DBDF/8HBOUNDARY,8H FLUX   /,
     &     DBDH/8HBOUNDARY,8H HEAD   /,DHYD/8HHYDROGRA,8HPH NODE /,
     &     DDAT/8HSTREAM D,8HATA CARD/,FAILED/.FALSE./,
     &     ISOTRO/4H    /,ANISOT/4H  AN/,FOUR/4/
C.........................................................................
      BALCUM=0.0
      M=MS
      DD=DS+TIME
      Y=YS
      TSTRM=TTOTL*2
      TBNDH=TTOTL*2
      TBNDF=TTOTL*2
      TFLUX=TTOTL*2
      TGWET=TTOTL*2
C
C.....CHECK BOUNDS ON NODES FOR WATERLEVEL HYDROGRAPHS.
      IF(NHD.GT.0) CALL BOUNDS (PHYD,NHD,ONE,NN,DHYD,FAILED)
```

```
C
C.....IF PROBLEM IS A RESTART, READ DATE AND TIME AT RESTART.
C     BALANCE FOR EACH NODAL SUBDOMAIN AT RESTART TIME.
      IF(CONTNU.GT.0) READ (CONTNU) M,DD,Y,TIME
C
C.....INITIALIZE ALL NODES AS EXPLICIT.
      DO 10 I=1,NN
      MANM(1,I)=I
   10 LR(I)=0
C
C.....READ INPUT FORMATS FOR INITIAL NODAL DATASET:  HEADS, X & Y, BASE.
      READ(INNS,1000)     FMT,FNXY,FNBS
C
C.....READ X AND Y ARRAYS AS H AND DH.
      READ(INNS,FNXY)   (H(I),DH(I),I=1,NN)
C
C.....READ BASE ARRAY.
      REWIND INNS
      READ(INNS,1000) FMT,FMT,FNXY,FNBS
      READ(INNS,FNBS) BASE
C
C.....IF SIMULATING GROUNDWATER E.T., READ DEPTH WHEN ET IS ZERO, AND
C     NODAL LAND SURFACE ELEVATION AND INITIAL MAXIMUM ET RATE.
      IF(INET.LE.0) GO TO 20
      DO 13 I=1,NN
   13 NAREA(I)=0.0
      READ(INET,1000) FMT
      READ(INET,FMT)  ZDEPTH
      READ(INET,1000) FMT
      READ(INET,FMT)  LAND
      READ(INET,1000) FETX
      ETMAX=0.0
      READ(INET,1010,END=14) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TGWET=NDAYS+TIN/24.0
      GO TO 20
   14 TGWET=2*TTOTL
C
C.....READ AND SET UP STREAM SYSTEMS.
   20 IF(NSS.EQ.0) GO TO 110
      READ (INSS,1000) FMT
      READ (INSS,FMT) (J,ITP(J),MOUTH(J),I=1,NSS)
      CALL BOUNDS (ITP,NSS,ONE,NSN,DTIP,FAILED)
      CALL BOUNDS (MOUTH,NSS,ONE,NSN,DMTH,FAILED)
      READ (INSS,1000) FMT
      DO 30 I=1,NSN
      READ (INSS,FMT) J,(NSTP(K,J),K=1,3),QLK(J)
      CALL BOUNDS (NSTP(1,J),ONE,ONE,NN,DNODE,FAILED)
      CALL BOUNDS (NSTP(2,J),ONE,ZERO,NSN,DUP,FAILED)
      CALL BOUNDS (NSTP(3,J),ONE,ZERO,NSN,DDWN,FAILED)
      IF(NSTP(3,J).EQ.0) QLK(J)=0.0
   30 CONTINUE
      READ (INSS,1000) FSTM
      SKIPST=.FALSE.
```

```
      READ(INSS,1010,END=60) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TSTRM=NDAYS+TIN/24.0
      IF(TSTRM.GT.TIME) SKIPST=.TRUE.
      GO TO 70
   60 TSTRM=TTOTL*2
   70 IF(SKIPST) FAILED=.TRUE.
      IF(SKIPST) WRITE(OUTP,2240)
      NTRAV=0
      DO 90 I=1,NSN
      NDN=NSTP(3,I)
      IF(NDN.EQ.0) GO TO 90
      NTRAV=NTRAV+1
      IF(NSTP(2,I).GT.0) NTRAV=NTRAV+1
      J1=NSTP(1,I)
      J2=NSTP(1,NDN)
      DELX=H(J1)-H(J2)
      DELY=DH(J1)-DH(J2)
      DIST=DSQRT(DELX**2+DELY**2)
      QLK(I)=QLK(I)*DIST
   90 CONTINUE
  110 REWIND INNS
      READ(INNS,1000)
C
C.....READ THE KNOWN-FLUX BOUNDARY NODES.
      IF(NBF.EQ.0) GO TO 120
      READ(INBF,1000) FMT
      READ (INBF,FMT) PBDF
      CALL BOUNDS (PBDF,NBF,ONE,NN,DBDF,FAILED)
      READ(INBF,1000) FBDF
      READ(INBF,1010) MIN,DIN,YIN,T
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TBNDF=NDAYS+T/24
C
C.....READ KNOWN-HEAD BOUNDARY NODES.
  120 IF(NBH.EQ.0) GO TO 140
      READ(INBH,1000) FMT
      READ (INBH,FMT) PBDH
      CALL BOUNDS (PBDH.NBH,ONE,NN,DBDH,FAILED)
      DO 130 I=1,NBH
      J=PBDH(I)
  130 LR(J)=-1
      READ(INBH,1000) FBDH
      TBNDH=-1.0
C
C.....READ THE INPUT FORMAT FOR FILE CONTAINING NODAL TIME-DISCHARGE
C     VALUES.
  140 IF(INQS.EQ.0) GO TO 150
      READ(INQS,1000) FNQS
      READ(INQS,1010) MIN,DIN,YIN,T
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TFLUX=NDAYS+T/24
C
C.....READ SPECIFICS FOR OUTPUT OF HEAD ARRAY.
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  150 TPLOT=0.0
      IF(OUTC.LE.0) GO TO 170
  160 IF(TPLOT.GT.TIME) GO TO 180
      READ(ININ,1010,END=170) MIN,DIN,YIN,T
      CALL DAYS (MIN,DIN,YIN,NDAYO,NDAYS)
      TPLOT=NDAYS+T/24
      GO TO 160
  170 TPLOT=TTOTL*2
C
C.....CREATE THE FILE CONTAINING THE SHAPE-FUNCTION INTEGRALS
C     AND SET UP THE LINKED LIST FOR THE "ANM" ARRAY.
  180 DO 190 I=1,NN
      MANM(2,I)=0
  190 CONTINUE
      READ(INES,1000) FMT
      IVOID=NN+1
      IF(PCODE.GE.5) WRITE(OUTP,2040)
      DO 250 LL=1,NE
      L=LL
      IF(DNE.NE.NE) L=1
      READ(INES,FMT) LD,(IN(I,L),I=1,6),CNDT(1,L),CPCT(L),IN(7,L)
      IF(DAN.GT.1) CNDT(2,L)=CNDT(1,L)
      IF(DAN.GT.1) CNDT(3,L)=0.0
      IF(IN(4,L).EQ.0)        IN(4,L)=IN(3,L)
      CALL BOUNDS (IN(1,L),FOUR,ONE,NN,DVRT,FAILED)
      IF(IN(4,L).EQ.IN(3,L)) IN(4,L)=0
      IF(IN(5,L).LT.0)        IN(5,L)=0
      IF(IN(6,L).LT.0)        IN(6,L)=0
      IN(5,L)=IN(5,L)*KTABS
      IN(6,L)=IN(6,L)*KTABS
      IF(IN(5,L).GT.0 .OR. IN(6,L).GT.0)
     &           CALL BOUNDS (IN(7,L),ONE,ONE,NE,DMAT,FAILED)
      DO 220 I=1,4
      JD(I)=IN(I,L)
  220 CONTINUE
      CALL SETANM (JD(1),JD(2),IVOID,MANM,DI2X,OUTP)
      CALL SETANM (JD(2),JD(3),IVOID,MANM,DI2X,OUTP)
      CALL SETANM (JD(3),JD(1),IVOID,MANM,DI2X,OUTP)
      IF(JD(4).EQ.0) GO TO 230
      CALL SETANM (JD(3),JD(4),IVOID,MANM,DI2X,OUTP)
      CALL SETANM (JD(4),JD(1),IVOID,MANM,DI2X,OUTP)
  230 CALL SHAPE (H,DH,LSTIFF,AREA,LD,JD,NN,NE,PCODE,OUTP,FAILED,CODERL)
      DO 240 I=1,5
      IF(DAN.EQ.1) LSTIFF(1,I)=LSTIFF(1,I)+LSTIFF(2,I)
      DO 240 J=1,DAN
      STIFF(J,I,L)=LSTIFF(J,I)
  240 CONTINUE
      AREAS(1,L)=AREA(1)
      AREAS(2,L)=AREA(2)
      IF(DET.LT.NN) GO TO 245
      II=IN(1,L)
      NAREA(II)=NAREA(II)+AREA(1)+AREA(2)
      II=IN(2,L)
      NAREA(II)=NAREA(II)+AREA(1)
```

```
      II=IN(3,L)
      NAREA(II)=NAREA(II)+AREA(1)+AREA(2)
      II=IN(4,L)
      IF(II.GT.0) NAREA(II)=NAREA(II)+AREA(2)
  245 IF(DNE.NE.NE) WRITE(IOSH) IN,STIFF,AREAS,CPCT,CNDT
      IF(PCODE.LT.5) GO TO 250
      IF(IN(5,L).EQ.0 .AND. IN(6,L).EQ.0)
     &          WRITE(OUTP,2050) LD,(IN(I,L),I=1,4),CNDT(1,L),CPCT(L),
     &                           IN(7,L),AREAS(1,L),AREAS(2,L)
      IF(IN(5,L).GT.0 .AND. IN(6,L).GT.0)
     &          WRITE(OUTP,2060) LD,(IN(I,L),I=1,4),
     &                           IN(7,L),AREAS(1,L),AREAS(2,L)
      IF(IN(5,L).EQ.0 .AND. IN(6,L).GT.0)
     &          WRITE(OUTP,2070) LD,(IN(I,L),I=1,4),CNDT(1,L),
     &                           IN(7,L),AREAS(1,L),AREAS(2,L)
      IF(IN(5,L).GT.0 .AND. IN(6,L).EQ.0)
     &          WRITE(OUTP,2080) LD,(IN(I,L),I=1,4),CPCT(L),
     &                           IN(7,L),AREAS(1,L),AREAS(2,L)
  250 CONTINUE
      ENDFILE INES
      IF(DNE.NE.NE) REWIND IOSH
      NAA=IVOID-1
      DIN2=DIN2+2*NAA
      NLM=DR8-DRL8-NAA
      ABX=1+NLM
      DRL8=DRL8+NAA
      WRITE(OUTP,2090) DIN2,DI2
      WRITE(OUTP,2100) NAA
      IF(NLM.LT.1.OR.DIN2.GT.DI2) STOP
C
C.....PRINT NODAL VALUES FOR X AND Y COORDINATES, BASE AND LAND SURFACE.
      IF (PCODE.LT.5) GO TO 255
      WRITE(OUTP,2000) (I,H(I),DH(I),I=1,NN)
      WRITE(OUTP,2010) (I,BASE(I),I=1,NN)
      IF( INET.LE.0) GO TO 255
      WRITE(OUTP,2250) (I,LAND(I),I=1,NN)
      WRITE(OUTP,2260) (I,NAREA(I),I=1,NN)
C
C.....READ INPUT HEAD DATA.  IF PROBLEM IS A RESTART, READ TIME AND MASS
C     BALANCE FOR EACH NODAL SUBDOMAIN AT RESTART TIME.
  255 IF(CONTNU.LE.0) GO TO 260
      DIN=DD
      WRITE(OUTP,2110) M,DIN,Y,TIME
      READ (CONTNU) BALCUM,H,MASS
      REWIND OUTM
      KODE=0
      GO TO 270
  260 READ(INHS,1000) FMT
      IF(INNS.EQ.INHS) READ(INHS,1000) FNXY,FNBS
      READ (INHS,FMT) H
      REWIND INHS
      KODE=-1
  270 IF(NBF.GT.0 .AND. PCODE.GE.5) WRITE(OUTP,2120) (I,PBDF(I),I=1,NBF)
      IF(NBH.GT.0 .AND. PCODE.GE.5) WRITE(OUTP,2130) (I,PBDH(I),I=1,NBH)
```

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C
C.....INPUT STARTING VALUES FOR BOUNDARY CONTIONS.
      IF(DFX.NE.NN) CALL FLUXES (H,NET,RHS,HBND,QBND,LAND,NAREA,HS,INF,
     &                           PCODE,PBDF,PBDH,PHYD,CODESS)
      IF(DFX.EQ.NN) CALL FLUXES (H,NET,FLUX,HBND,QBND,LAND,NAREA,HS,INF,
     &                           PCODE,PBDF,PBDH,PHYD,CODESS)
C
C.....ECHO INPUTS IF THE PRINT CODE WARRANTS.
      IF(PCODE.LT.5) GO TO 310
      WRITE(OUTP,2140) TIME,(I,H(I),I=1,NN)
      IF(NHD.GT.0) WRITE(OUTP,2150) (I,PHYD(I),I=1,NHD)
      IF(NSS.LE.0) GO TO 290
      WRITE(OUTP,2160) (I,ITP(I),MOUTH(I),I=1,NSS)
      WRITE(OUTP,2170)
      DO 280 I=1,NSN
      J=NSTP(1,I)
      K=NSTP(3,I)
      IF(K.NE.0) J2=NSTP(1,K)
      IF(K.NE.0) WRITE(OUTP,2180) I,J,NSTP(2,I),K,QLK(I),J,J2
      IF(K.EQ.0) WRITE(OUTP,2180) I,J,NSTP(2,I),K
  280 CONTINUE
  290 IF(KTABS.EQ.0) GO TO 310
      WRITE(OUTP,2190)
      IF(TSFREQ.LT.2.0*TTOTL) WRITE(OUTP,2200) TSFREQ
      IF(DHFREQ.GT.0.0)       WRITE(OUTP,2210) DHFREQ
C
C.....READ THE FORMAT FOR THE MATERIAL #, TABLE LENGTH AND CODE FOR
C     CONSTANT OR LINEAR VARIATION OF CAPACITANCE AND ANISOTROPHY CODE.
      READ(INTS,1000) FMT
C
C.....READ THE FORMAT FOR THE TABULATED 'SATURATED THICKNESS' AND
C     CORRESPONDING VALUES FOR 'CAPACITANCE' AND 'CONDUCTANCE':
      READ(INTS,1000) FMTT
C
C.....MATERIAL PROPERTIES:  MATERIAL NUMBER, TABLE LENGTH, AND WHETHER
C     CAPACITANCE IS CONSTANT THROUGHOUT "BLOCKS" OR VARIES LINEARLY.
C     LINEAR IF TBCODE IS NOT ZERO.  CODEAN INDICATES THE PRESENCE OF
C     ANISOTROPIC CONDUCTANCE IF CODEAN IS NON-ZERO.
  300 READ(INTS,FMT,END=310) MATNUM,LTABL,TBCODE,CODEAN
C
C.....IF ANISOTROPIC, CONDUCTANCE WILL CONSIST OF MAJOR AXIS VALUE,
C     MINOR AXIS VALUE, AND ANGLE OF MAJOR AXIS WITH X-AXIS IN DEGREES.
      IF(DAN.EQ.1) CODEAN=0
      IF(MATNUM.EQ.0) GO TO 310
      ANCODE=.FALSE.
      IF(CODEAN.NE.0) ANCODE=.TRUE.
      CONDCT=ISOTRO
      IF(ANCODE)      CONDCT=ANISOT
      ICLS=3
      IF(ANCODE)      ICLS=2+DAN
      DEGREE=CONST
      IF(TBCODE.NE.0) DEGREE=LINEAR
      WRITE(OUTP,2220) MATNUM,DEGREE,CONDCT
C
```

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C.....SATURATED THICKNESS, CONDUCTANCE, AND CAPACITANCE.
      DO 309 J=1,LTABL
      READ(INTS,FMTT) (TABL(I,J),I=1,ICLS)
  309 WRITE(OUTP,2230)(TABL(I,J),I=1,ICLS)
      GO TO 300
  310 IF(FAILED) STOP
      RETURN
C.......................................................................
C.....INPUT FORMATS:
 1000 FORMAT(20A4)
 1010 FORMAT(I2,1X,I2,1X,I4,F10.0)
C
C.....OUTPUT FORMATS:
 2000 FORMAT(//11X,25HNODE X AND Y COORDINATES:,/11X,24(1H-),
     &       //11X,3(4HNODE,3X,7HX-VALUE,5X,7HY-VALUE,5X),
     &       /(11X,3(I4,2X,1PE10.3,2X,E10.3,3X)))
 2010 FORMAT(//11X,16HBASE OF AQUIFER:,/11X,16(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
 2040 FORMAT(//10X,46HELEMENT  /------INDICES-------/    CONDUCTANCE,
     &             46H   CAPACITANCE   MATERIAL #     TRIANGLE AREAS)
 2050 FORMAT(11X,5I6,5X,1PE10.3,4X,E10.3,I8,4X,2(2X,E10.3))
 2060 FORMAT(11X,5I6,5X,9HTABULATED,5X,9HTABULATED,I9,4X,2(2X,1PE10.3))
 2070 FORMAT(11X,5I6,5X,1PE10.3,4X,9HTABULATED,I9,4X,2(2X,E10.3))
 2080 FORMAT(11X,5I6,5X,9HTABULATED,5X,1PE10.3,I8,4X,2(2X,E10.3))
 2090 FORMAT(/11X,29HREQUIRED INTEGER*2 DIMENSION=,I5,
     &              38H WITH INTEGER*2 VECTOR DIMENSIONED TO ,I5)
 2100 FORMAT(11X,23HANM VECTOR   DIMENSION=,I5)
 2110 FORMAT(/11X,21HRESTARTING FROM DATE:,2(I2,1H/),I4,
     &       /11X,8H(TIME = ,1PE10.3,2H).)
 2120 FORMAT(//11X,26HKNOWN-FLUX BOUNDARY NODES:,/11X,25(1H-),
     &       //11X,6(20HSEQ.-#   NODE-#     ),/,(11X,6(I5,I10,5X)))
 2130 FORMAT(//11X,26HKNOWN-HEAD BOUNDARY NODES:,/11X,25(1H-),
     &       //11X,6(20HSEQ.-#   NODE-#     ),/,(11X,6(I5,I10,5X)))
 2140 FORMAT(//11X,14HHEADS AT TIME=,1PE10.3,6H DAYS.,/11X,30(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,E10.3,3X)))
 2150 FORMAT(//11X,30HNODAL WATER-LEVEL HYDROGRAPHS:,/11X,29(1H-),
     &       //11X,6(20HSEQ.-#   NODE-#     ),/,(11X,6(I5,I10,5X)))
 2160 FORMAT(//11X,15HSTREAM SYSTEMS:,/11X,14(1H-),//11X,
     &              25HSTREAM  HEAD-WATER  MOUTH,/11X,
     &              27HNUMBER   REACH #    REACH #,/,(11X,I4,I9,I11))
 2170 FORMAT(//11X,26HDEPLETABLE STREAM REACHES:,/11X,25(1H-),/,
     &      /11X,50HREACH  UPPER  BRANCH   NEXT   LEAKAGE    FROM   TO,
     &      /11X,51HNUMBER NODE  TO REACH REACH    FACTOR    NODE  NODE,
     &      /40X,12H(L**3/DAY/L))
 2180 FORMAT(9X,I5,I8,2I7,3X,1PE10.3,2I6)
 2190 FORMAT(//11X,34HTABULATED CONDUCTANCE-CAPACITANCE:,/11X,33(1H-),
     &     //11X,49HCAPACITANCE EITHER LINEAR OR STEPPED WITHIN TABLE,/)
 2200 FORMAT(/11X,43HVARIABLE MATERIAL PROPERTIES UPDATED EVERY ,
     &       1PE10.3,6H DAYS.)
 2210 FORMAT(/11X,43HVARIABLE MATERIAL PROPERTIES UPDATED EVERY ,
     &       1PE10.3,22H UNITS OF HEAD CHANGE.)
 2220 FORMAT(/11X,16HMATERIAL NUMBER ,I3,6H WITH ,A8,13H CAPACITANCE.,
     &              4HAND ,A4,22HISOTROPIC CONDUCTANCE.,
     &       /11X,49H"SATURATED THICKNESS"   CAPACITANCE   MAJOR COND.,
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     &        4X,20HMINOR COND.    ANGLE)
 2230 FORMAT(16X,1PE10.3,9X,E10.3,4X,E10.3,4X,E10.3,4X,E10.3)
 2240 FORMAT(/11X,49H**** ERROR: STREAM HEADS NOT INITIALIZED; STOP***)
 2250 FORMAT(//11X,28HNODE LAND SURFACE ELEVATION:,/11X,27(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
 2260 FORMAT(//11X,24HNODAL AREAS FOR GW. ET.:,/11X,23(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
      END
C-SBR02
C-BOUNDS: SUBROUTINE TO DETERMINE IF INPUT DATA IS WITHIN THE REQUIRED
C         BOUNDS.  INPUT VECTOR IS INTEGER*2.
C ----------------------------------------------------------------------
      SUBROUTINE BOUNDS (INPUT,DIMN,LOWER,UPPER,MESSGE,FAILED)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      REAL*8 MESSGE(2)
      INTEGER*4 DIMN,LOWER,UPPER
      INTEGER*2 INPUT(DIMN)
      LOGICAL FAILED
C.......................................................................
      DO 10 I=1,DIMN
      IF (INPUT(I).GE.LOWER .AND. INPUT(I).LE.UPPER) GO TO 10
      WRITE(OUTP,2000) I,MESSGE,INPUT(I),LOWER,UPPER
      FAILED=.TRUE.
   10 CONTINUE
      RETURN
C.......................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(11X,18H** WARNING, VALUE ,I5,4H OF ,2A8,8H EQUALS ,I9,
     &       28H AND FALLS OUTSIDE RANGE OF ,I9,9H THROUGH ,I9,3H **)
      END
C-SBR03
C-CONTRL:  SUBROUTINE TO CONTROL THE PROGRESS OF THE SIMULATION AND KEEP
C          TABS ON THE REMAINING COMPUTER TIME TO ALLOW FOR A RESTART.
C ----------------------------------------------------------------------
      SUBROUTINE CONTRL (LAMDA,ANM,H,DH,MASS,RHS,NET,HBND,FLUX,    TABL,
     &                   BFLOW,INF,QLK,HS,QBND,STFX,STFW,BASE,STIFF,
     &                   AREAS,CPCT,CNDT,LAND,NAREA,KTABS,PCODE,KODE,
     &                   DRB,DRLB,  MOUTH,ITP,NSTP,PBDF,PBDH,PHYD,IN,MV,
     &                   LR,MANM,VE2,          LSN,CODEPC,CODEBP,CODEIS,
     &                   CODEQP,CODETH,CODESG,CODESQ,CODESS)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /TIMES/  MS,DS,YS,TS,MF,DF,YF,TF,M,DD,Y,IDAY,TIME,TTOTL,
     &                NDAYO,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,TFLUX,
     &                DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ,ITMAX
```

```
      REAL*4    DD,TF,TIME,TS,TTOTL,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,
     &          TFLUX,DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ
      INTEGER*4 MS,DS,YS,MF,DF,YF,M,Y,IDAY,NDAY0,ITMAX
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &       FNXY(20),FNBS(20),FNQS(20)
      COMMON /SUMFLX/ BALCUM,QBDS,QBDF,QBDH,SUMNQ
      DOUBLE PRECISION BALCUM,QBDS,QBDF,QBDH,SUMNQ
      COMMON /GWET/    ZDEPTH,TGWET,ETMAX,SUMET,FETX,INET
      REAL*4           ZDEPTH,TGWET,ETMAX,SUMET,FETX(20)
      INTEGER*4        INET
      DOUBLE PRECISION H(NN),DH(NN),HBND(DBH),MASS(NN),FLUX(DFX),
     &                 RHS(NN),NET(NN),ANM(NAA),LAMDA(NLM)
      REAL*4 TABL(TABW,MAXT),BFLOW(DSS),INF(NSN),QLK(NSN),HS(NSN),
     &       QBND(DBF),STIFF(DAN,5,DNE),AREAS(2,DNE),CPCT(DNE),BASE(NN),
     &       CNDT(DAN,DNE),STFX(NSN),STFW(NSN),LAND(DET),NAREA(DET)
      INTEGER*4 KTABS,PCODE,KODE,IO(2),DR8,DRL8
      INTEGER*2 MOUTH(DSS),ITP(DSS),NSTP(3,NSN),PBDF(DBF),PBDH(DBH),
     &          PHYD(DHD),IN(7,DNE),MV(NK1),LR(NN),MANM(2,NAA),VE2(DE2)
      LOGICAL*1 LSN(NSN),CODEPC,CODEBP,CODEIS,CODEQP,CODETH,CODESG,
     &          CODESQ,CODESS
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION WTOT,SUM,TOTAL
      REAL*4 DUM,HRS,DELTS,DELTP,TTIME,TSTIME,DHSUM,DHP,DHM,
     &       CPT,CPRE,CPMAX
      INTEGER*4 I,K,LMN
      DATA K/1/,CPMAX/0.0/
C.......................................................................
      DELTP=0.0
      IO(1)=IOSH
      IO(2)=OUTM
      TSTIME=TIME+TSFREQ
      DHP=0.0
      DHM=0.0
C
C.....IN THE EVENT OF A RESTART AND NO TABULATED CONDUCTANCE-CAPACITANCE,
C     TSMASS NEED NOT BE CALLED:
      IF(KODE.NE.0 .OR. KTABS.EQ.1)
     &           CALL TSMASS (H,MASS,WTOT,TABL,BASE,STIFF,AREAS,CPCT,
     &                        CNDT,KODE,KTABS,PCODE,IO,IN)
      IF(KODE.EQ.-1) WRITE(OUTP,2040) WTOT,(I,MASS(I),I=1,NN)
      KODE=0
      CALL REFORM (ANM,DH,QLK,STIFF,AREAS,CPCT,CNDT,DTMIN,DTMAX,DELTS,
     &            THETA,PCODE,IO,LMN,NSTP,MANM,MV,VE2,IN,LR,CODEIS,
     &            CODESQ,CODESS)
      DRL8=DRL8+LMN
      WRITE(OUTP,2050) DRL8,DR8
C
C.....THE FUNCTION "CPTIME" IS A LOCAL ROUTINE THAT DETERMINES THE
C     AMOUNT OF TIME AVAILABLE BEFORE A JOB IS CANCELLED.
C     CALL CPTIME (K)
      CPRE=FLOAT(K)*0.00002604
      CPMAX=0.0
```

```
C.......................................................................
   10 TTIME=AMIN1(TSTRM,TBNDH,TBNDF,TFLUX,TSTIME,T6WET,TTOTL)
      CALL SMULAT (H,DH,RHS,NET,HBND,WTOT,MASS,ANM,LAMDA,
     &             TTIME,DELTS,DELTP,STFX,STFW,BFLOW,INF,QLK,HS,BASE,
     &             LAND,NAREA,DHP,DHM,PCODE,
     &             PBDH,PHYD,MV,MANM,LR,NSTP,MOUTH,ITP,
     &             LSN,CODEPC,CODEBP,CODEQP,CODETH,CODESG,CODESS)
      IF(TIME.GE.TTOTL) GO TO 40
      IF(KTABS.NE.1) GO TO 30
      IF(TIME.GE.TSTIME) GO TO 20
      DHSUM=DHP
      IF(-DHM.GT.DHSUM) DHSUM=-DHM
      IF(DHFREQ.EQ.0.0 .OR. DHSUM.LT.DHFREQ) GO TO 30
   20 CALL TSMASS (H,MASS,WTOT,TABL,BASE,STIFF,AREAS,CPCT,CNDT,KODE,
     &             KTABS,PCODE,IO,IN)
      CALL REFORM (ANM,DH,QLK,STIFF,AREAS,CPCT,CNDT,DTMIN,DTMAX,DELTS,
     &             THETA,PCODE,IO,LMN,NSTP,MANM,MV,VE2,IN,LR,CODEIS,
     &             CODESQ,CODESS)
      TSTIME=TIME+TSFREQ
      DHP=0.0
      DHM=0.0
      DELTP=0.0
   30 CONTINUE
C
C.....UPDATE BOUNDARY CONDITIONS AND NODE FLUX IF APPROPRIATE:
      IF(DFX.NE.NN) CALL FLUXES (H,NET,RHS,HBND,QBND,LAND,NAREA,HS,INF,
     &                           PCODE,PBDF,PBDH,PHYD,CODESS)
      IF(DFX.EQ.NN) CALL FLUXES (H,NET,FLUX,HBND,QBND,LAND,NAREA,HS,INF,
     &                           PCODE,PBDF,PBDH,PHYD,CODESS)
C
C.....CHECK REMAINING CPU-TIME; IF SUFFICIENT TO COMPLETE ANOTHER TIME
C     STEP CONTINUE; OTHERWISE, DUMP TIME. HEADS AND CUMULATIVE MASS
C     TO  DATASET OUTM FOR SUBSEQUENT RESTART.
C
C.....THE FUNCTION "CPTIME" IS A LOCAL ROUTINE THAT DETERMINES THE
C     AMOUNT OF TIME AVAILABLE BEFORE A JOB IS CANCELLED.
C     CALL CPTIME (K)
      CPT=FLOAT(K)*0.00002604
      DUM=CPRE-CPT
      CPRE=CPT
      IF(CPMAX.LT.DUM) CPMAX=DUM
      IF(CPT.GT.CPMAX) GO TO 10
      WRITE(OUTP,2030) M,IDAY,Y
      GO TO 60
C
C.....INTEGRATE STORAGE OVER SATURATED THICKNESS (STORE AS RHS ARRAY).
   40 KODE=1
      CALL TSMASS (H,RHS,SUM,TABL,BASE,STIFF,AREAS,
     &             CPCT,CNDT,KODE,KTABS,PCODE,IO,IN)
C
C.....DETERMINE THE DIFFERENCE BETWEEN THE TWO.
      TOTAL=0.0
      HRS=(DD-IDAY)*24
      WRITE(OUTP,2000) M,IDAY,Y,HRS
```

```
      DO 50 I=1,NN
      NET(I)=RHS(I)-MASS(I)
   50 TOTAL=TOTAL+NET(I)
      WRITE(OUTP,2010) (I,MASS(I),RHS(I),NET(I),I=1,NN)
      WRITE(OUTP,2020) WTOT,SUM,TOTAL
C
C.....FINAL OUTPUT:
   60 IF (OUTM.LE.0) RETURN
      WRITE(OUTM) M,DD,Y,TIME
      WRITE(OUTM) BALCUM,H,MASS
      RETURN
C
C.............................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(1H1,10X,20HFINAL OUTPUT (DATE: ,2(I2,1H/),I4,6H TIME:,
     &       F6.2,8H HOURS).,/11X,29HCHECK OF NODAL SUBDOMAIN MASS,
     &       /11X,46HNODE  CUMULATIVE MASS  INTEGRATED MASS  ERROR.,
     &        14X,46HNODE  CUMULATIVE MASS  INTEGRATED MASS  ERROR.)
 2010 FORMAT(2(10X,I5,3X,1PD10.3,7X,D10.3,5X,D10.3))
 2020 FORMAT(//9X,9HTOTALS:  ,1PD10.3,7X,D10.3,5X,D10.3)
 2030 FORMAT(//11X,47HSIMULATION HALTED DUE TO INSUFFICIENT CPU TIME.,
     &        /11X,18HRESTART FROM DATE:,I4,1H/,I2,1H/,I4,
     &             48H BY SETTING CONTNU TO DEVICE # AND RESUBMITTING.)
 2040 FORMAT(//11X,20HINITIAL TOTAL MASS =,1PD10.3,7H (L**3),/11X,
     &       37(1H-),//11X,35HINITIAL NODAL SUBDOMAIN MASS (L**3),/11X,
     &       35(1H-),//11X,6(4HNODE,5X,5HVALUE,5X),
     &              /(11X,6(I4,2X,E10.3,3X)))
 2050 FORMAT(/11X,29HREQUIRED REAL*8    DIMENSION=,I5,12H WITH REAL*8,
     &         4X,22HVECTOR DIMENSIONED TO ,I5)
      END
C-SBR04
C-REFORM: GENERATES THE ANM ARRAY, CHECKS STABILITY CRITERIA, RECLASSIFIES
C        NODES IF NECESSARY AND RESEQUENCES IMPLICIT NODES IF NEEDED.
C ---------------------------------------------------------------------------
      SUBROUTINE REFORM (ANM,DH,QLK,STIFF,AREAS,CPCT,CNDT,DTMIN,DTMAX,
     &                   DELT,THETA,PCODE,IO,SUM,NSTP,MANM,MV,VE2,IN,LR,
     &                   CODEIS,CODESQ,CODESS)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 PCODE,IO(2),SUM
      DOUBLE PRECISION ANM(NAA),DH(NN)
      REAL*4    DTMIN,DTMAX,DELT,QLK(NSN),STIFF(DAN,5,DNE),AREAS(2,DNE),
     &          CPCT(DNE),CNDT(DAN,DNE),THETA
      INTEGER*2 IN(7,DNE),MANM(2,NAA),VE2(DE2),MV(NK1),LR(NN),
     &          NSTP(3,NSN)
      LOGICAL*1 CODEIS,CODESQ,CODESS
C
C.....LOCAL VARIABLES:
```

```
      DOUBLE PRECISION NAME(4),VALUE(6)
      REAL*4    ASUM
      INTEGER*4 A2A,A2B,A2C,A2D,A2E,A2F,A2G,A2H,A2I,DAR,ML,
     &          L,LD,I,J,II,JJ,IS,INIT,TEMP,DSKI,NBHO,JS(6)
      LOGICAL FIRST,NEXT,FAILED
      DATA NAME/8H   KNOWN,8HEXPLICIT,8HIMPLICIT,8H  ERSATZ/
C.........................................................................
      DSKI=IO(1)
      FAILED=.FALSE.
      SUM=1
      NUE=0
      NBHO=0
      NUM=0
      DO 10 I=1,NAA
   10 ANM(I)=0.0
      DO 20 I=1,NN
   20 DH(I)=0.0
      DO 30 LD=1,NE
      L=LD
      IF(DNE .NE. NE) L=1
      IF(DNE .NE. NE) READ (DSKI) IN,STIFF,AREAS,CPCT,CNDT
      CALL ACCUM (ANM,STIFF(1,1,L),AREAS(1,L),CNDT(1,L),CPCT(L),DAN,NAA,
     &            OUTP,IN(2,L),IN(3,L),MANM)
      CALL ACCUM (ANM,STIFF(1,2,L),AREAS(1,L),CNDT(1,L),CPCT(L),DAN,NAA,
     &            OUTP,IN(1,L),IN(2,L),MANM)
      ASUM=AREAS(1,L)+AREAS(2,L)
      CALL ACCUM (ANM,STIFF(1,5,L),ASUM,      CNDT(1,L),CPCT(L),DAN,NAA,
     &            OUTP,IN(3,L),IN(1,L),MANM)
      IF(IN(4,L).EQ.0) GO TO 30
      CALL ACCUM (ANM,STIFF(1,3,L),AREAS(2,L),CNDT(1,L),CPCT(L),DAN,NAA,
     &            OUTP,IN(1,L),IN(4,L),MANM)
      CALL ACCUM (ANM,STIFF(1,4,L),AREAS(2,L),CNDT(1,L),CPCT(L),DAN,NAA,
     &            OUTP,IN(4,L),IN(3,L),MANM)
   30 CONTINUE
      IF(DNE .NE. NE) REWIND DSKI
      IF(NSN.LT.1) GO TO 50
C
C.....ADJUST FOR LEAKAGE AT STREAM NODES; TIME STEP MUST BE SHORT ENOUGH
C     THAT LEAKAGE DOES NOT CAUSE INSTABILITY.  DISTRIBUTE QLK TO
C     UPSTREAM AND DOWNSTREAM NODES.
      DO 40 J=1,NSN
      I=NSTP(1,J)
C
C.....FLAG STREAM NODES IF STEADY-STATE SIMULATION
      IF(CODESS) LR(I)=LR(I)+5
      NDN=NSTP(3,J)
      IF(NDN.LE.0) GO TO 40
      K=NSTP(1,NDN)
      DH(I)=DH(I)+0.50*QLK(J)
      DH(K)=DH(K)+0.50*QLK(J)
   40 CONTINUE
   50 IF(PCODE.GE.6) WRITE(OUTP,2080)
      DO 80 I=1,NN
C
```

```
C.....IF STEADY-STATE AND NON-STREAM NODE, SET STORAGE TO ZERO:
      IF(CODESS .AND. LR(I).LE.1) ANM(I)=0.0
C
C.....RESET FLAGGED STREAM NODES:
      IF(LR(I).GT.3) LR(I)=LR(I)-5
      IS=I
   60 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 70
      J=MANM(1,IS)
C
C.....ACCUMULATE FLUX PART OF STABILITY CRITERIA AS DH VECTOR:
      DH(I)=DH(I)-ANM(IS)
      DH(J)=DH(J)-ANM(IS)
      IF(PCODE.LT.6) GO TO 60
      NUM=NUM+1
      JS(NUM)=J
      VALUE(NUM)=ANM(IS)
      IF(NUM.LT.6) GO TO 60
   70 IF(NUM.EQ.0) GO TO 80
      WRITE(OUTP,2090) I,(JS(K),VALUE(K),K=1,NUM)
      NUM=0
      IF(IS.NE.0) GO TO 60
   80 CONTINUE
      IF(PCODE.GE.6) WRITE(OUTP,2070) (I,ANM(I),I=1,NN)
      DELT=1.5*DTMAX
C
C.....DETERMINE LARGEST TIME STEP THAT WILL NOT VIOLATE STABILITY OF
C     CURRENT EXPLICIT NODES:
      DO  90 I=1,NN
      IF(LR(I).LT.0) NBHO=NBHO+1
      IF(LR(I).LT.0)   GO TO 90
      IF(DH(I).EQ.0.0) GO TO 85
      DH(I)=ANM(I)/DH(I)
      IF(LR(I).NE.0)   GO TO 90
      NUE=NUE+1
      IF(DH(I).LT.DELT) DELT=DH(I)
      GO TO 90
   85 WRITE(OUTP,2110) I,DH(I),ANM(I)
      FAILED=.TRUE.
   90 CONTINUE
      IF (FAILED) STOP
      NUI=NN-NUE-NBHO
C
C.....FOR SAFETY SAKE, REDUCE DURATION OF STABLE TIME STEP:
      DELT=0.666667*DELT
      WRITE(OUTP,2050) DELT
C
C.....RETURN IF THE STABILITY OF EXPLICIT NODES WILL NOT BE VIOLATED
C     BY ALLOWING A TIME STEP OF AT LEAST DTMIN:
      IF(DELT.GT.DTMIN) GO TO 270
      WRITE(OUTP,2060) DTMIN
C
C.....CONSIDER NODES EXPLICIT IF STABILITY IS GREATER THAN 1.5*DTMAX.
C     FORCE STREAM NODES IMPLICIT IF CODEIS IS TRUE.
```

```
      DELT=1.5*DTMAX
      IF(.NOT.CODEIS) GO TO 110
      DO 100 J=1,NSN
      I=NSTP(1,J)
      DH(I)=0.0
  100 CONTINUE
  110 DO 130 I=1,NN
      IF(LR(I).LT.0) GO TO 130
      LR(I)=0
      IF(DH(I).LT.DELT .AND. THETA.NE.0.0) LR(I)=1
      IS=I
  120 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 130
      J=MANM(1,IS)
      IF(LR(I).EQ.0 .AND. LR(J).EQ.1) LR(I)=2
      IF(LR(I).EQ.1 .AND. LR(J).EQ.0) LR(J)=2
      GO TO 120
  130 CONTINUE
C
C.....LR=-1   KNOWN HEAD NODE.
C       = 0   EXPLICIT NODE.
C       = 1   IMPLICIT NODE.
C       = 2   EXPLICIT NODE THAT HAS AN IMPLICIT CONNECTION AND IS
C             HENCEFORTH CONSIDERED IMPLICIT (LR WILL BE SET TO 1)
C
C.....NUMBER IMPLICIT NODES FROM 1 UP TO NUK AND EXPLICIT OR KNOWN NODES
C     FROM NN DOWN.
      INIT=1
      NUI=NN
      DO 150 I=1,NN
      IF(LR(I).GT.0) GO TO 140
      MANM(1,I)=NUI
      NUI=NUI-1
      GO TO 150
  140 MANM(1,I)=INIT
      LR(I)=1
      INIT=INIT+1
  150 CONTINUE
      DELT=DTMAX
      NUE=NN-NUI-NBHO
      IF(NUI.EQ.0) GO TO 240
      FIRST=.NOT.CODESQ
      IF(FIRST)    GO TO 190
C
C.....IN ORDER FOR SOLUTION MATRIX TO FIT WITHIN LAMDA VECTOR, THE
C     IMPLICIT NODES MUST BE RENUMBERED TO MINIMIZE THE LOWER HORIZONTAL
C     PROFILE.  THE PHILOSOPHY BEHIND THE RENUMBERING ROUTINE REPRESENTED
C     BY SUBROUTINES SBR18 THROUGH SBR23 (OPTNUM, NUMLVL, DISJNT,
C     BLDLVL, DEGREE AND FINDIJ) IS BASED UPON AN ARTICLE WRITTEN BY
C     NORMAN E. GIBBS, WILLIAM G. POOLE, JR. AND PAUL K. STOCKMEYER
C     OF THE DEPARTMENT OF MATHEMATICS, COLLEGE OF WILLIAM AND MARY,
C     WILLIAMSBURG, VIRGINIA, 23185.  ARTICLE REFERENCE:
C ***********************************************************************
C *       'AN ALGORITHM FOR REDUCING THE BANDWIDTH AND PROFILE          *
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C *        OF A SPARSE MATRIX', SOCIETY FOR INDUSTRIAL AND APPLIED     *
C *        MATHEMATICS JOURNAL ON NUMERICAL ANALYSIS, VOLUME 13,       *
C *        NUMBER 2, APRIL 1976, PAGES 236-250.                        *
C ********************************************************************
C
  160 DAR=NUI
      DO 180 I=1,NN
      IF(LR(I).LT.1) GO TO 180
      IS=I
  170 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 180
      J=MANM(1,IS)
      IF(LR(J).EQ.1) DAR=DAR+2
      GO TO 170
  180 CONTINUE
      ML=(NLM*4-5*NUI-2*DAR)/3
      IF(ML.GT.NUI) ML=NUI
      A2A =  1+NUI
      A2B =A2A+NUI
      A2C =A2B+NUI
      A2D =A2C+NUI
      A2E =A2D+NUI
      A2F =A2E+DAR
      A2G =A2F+DAR
      A2H =A2G+ML
      A2I =A2H+ML
      WRITE(OUTP,2010) NUI,DAR,ML
      IF(ML.LE.0) STOP
      CALL OPTNUM (NAA,NN,NUI,DAR,ML,OUTP,VE2(1),VE2(A2A),VE2(A2B),
     &             VE2(A2C),VE2(A2D),VE2(A2E),VE2(A2F),VE2(A2G),
     &             VE2(A2H),VE2(A2I),MANM,LR)
      WRITE(OUTP,2030)
C
C.....PARTITION THE LAMDA VECTOR INTO LOWER TRIANGULAR ROW SEGMENTS
C     BASED UPON THE TRANSFORMED NODE NUMBERING.
  190 DO 200 I=1,NUI
  200 MV(I)=I
      DO 220 I=1,NN
      IF(LR(I).LT.1) GO TO 220
      II=MANM(1,I)
      IS=I
  210 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 220
      J=MANM(1,IS)
      IF(LR(J).LT.1) GO TO 210
      JJ=MANM(1,J)
      IF(II.LT.MV(JJ)) MV(JJ)=II
      IF(JJ.LT.MV(II)) MV(II)=JJ
      GO TO 210
  220 CONTINUE
      SUM=0
      DO 230 I=1,NUI
      TEMP=I-MV(I)
      MV(I)=SUM+1
```

```
  230 SUM=MV(I)+TEMP
      MV(NUI+1)=SUM+1
  240 WRITE(OUTP,2040) SUM
      IF(PCODE.LT.3) GO TO 260
      DO 250 I=1,NN
      L=LR(I)+2
      IF(L.LT.1.OR.L.GT.3) L=4
  250 DH(I)=NAME(L)
      WRITE(OUTP,2020) (I,DH(I),MANM(1,I),I=1,NN)
  260 IF(NLM.GE.SUM) GO TO 270
      NEXT=FIRST
      FIRST=.NOT.NEXT
      IF(NEXT) GO TO 160
      WRITE(OUTP,2000) NLM,SUM
      STOP
  270 WRITE(OUTP,2100) NUI,NUE,NBHO
      WRITE(OUTP,2050) DELT
      RETURN
C.........................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(11X,33HSPACE FOR LAMDA ARRAY=            ,I10,
     &           33H IS INSUFFICIENT; REQUIRED SPACE=,I10)
 2010 FORMAT(11X,33HNUMBER OF IMPLICIT NODES=        ,I10,
     &      /11X,33HTOTAL IMPLICIT LINKAGES=         ,I10,
     &      /11X,33HAND MAXIMUM ALLOWED DEPTH=       ,I10)
 2020 FORMAT(//11X,36HEXTERNAL TO INTERNAL NODE NUMBERING:,
     &        /11X,35(1H-),//11X,4(23HNODE NODE-TYPE INTERNAL,4X),
     &       /(11X,4(I4,2X,A8,3X,I4,6X)))
 2030 FORMAT(11X,21HRENUMBERING COMPLETE.)
 2040 FORMAT(11X,33HLAMDA VECTOR DIMENSION=          ,I10)
 2050 FORMAT(/11X,34HEXPLICIT STABILITY WITH TIME STEP=,1PE10.3,5H DAYS)
 2060 FORMAT(11X,34HMINIMUM TIME STEP=                 ,1PE10.3,5H DAYS,
     &           41H THEREFORE RECLASSIFY AND RENUMBER NODES.)
 2070 FORMAT(//11X,18HCAPACITANCE TERMS:,/11X,17(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PD10.3,3X)))
 2080 FORMAT(//11X,18HCONDUCTANCE TERMS:,/11X,17(1H-),
     &        //1X,10H NODE  TO:,6(4HNODE,5X,5HVALUE,5X))
 2090 FORMAT(1X,I5,5X,6(I4,2X,1PD10.3,3X))
 2100 FORMAT(/11X,33HNUMBER OF IMPLICIT NODES=        ,I10,
     &       /11X,33HNUMBER OF EXPLICIT NODES=        ,I10,
     &       /11X,33HNUMBER OF KNOWN-HEAD NODES=      ,I10)
 2110 FORMAT(//11X,30HFAILURE FOR UNKNOWN-HEAD NODE=,I10,5X,
     &       25HSUM OF CONDUCTANCE TERMS=,1PE10.3,/16X,
     &       17HCAPACITANCE TERM=,E10.3,/11X,
     &       48HPERHAPS NODE IS NOT INCLUDED IN ELEMENT NETWORK!,//)
      END
C
C-SBR05
C-SMULAT: ROUTINE TO SIMULATE AND PERFORM MASS BALANCE CALCULATIONS
C        FOR A TIME PERIOD WITH CONSTANT HYDRAULIC PARAMETERS AND
C        PRE-DEFINED BOUNDARY CONDITIONS.
C ----------------------------------------------------------------------
      SUBROUTINE SMULAT (H,DH,RHS,NET,HBND,WTOT,MASS,ANM,LAMDA,
     &                   TTIME,DELTS,DELTP,STFX,STFW,BFLOW,INF,QLK,HS,
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```
     &                      BASE,LAND,NAREA,DHP,DHM,
     &                      PCODE,PBDH,PHYD,MV,MANM,LR,NSTP,MOUTH,ITP,
     &                      LSN,CODEPC,CODEBP,CODEQP,CODETH,CODESG,CODESS)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /TIMES/  MS,DS,YS,TS,MF,DF,YF,TF,M,DD,Y,IDAY,TIME,TTOTL,
     &                NDAY0,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,TFLUX,
     &                DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ,ITMAX
      REAL*4    DD,TF,TIME,TS,TTOTL,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,
     &          TFLUX,DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ
      INTEGER*4 MS,DS,YS,MF,DF,YF,M,Y,IDAY,NDAY0,ITMAX
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &       FNXY(20),FNBS(20),FNQS(20)
      COMMON /SUMFLX/ BALCUM,QBDS,QBDF,QBDH,SUMNQ
      DOUBLE PRECISION BALCUM,QBDS,QBDF,QBDH,SUMNQ
      COMMON /GWET/   ZDEPTH,TGWET,ETMAX,SUMET,FETX,INET
      REAL*4          ZDEPTH,TGWET,ETMAX,SUMET,FETX(20)
      INTEGER         INET
      DOUBLE PRECISION H(NN),DH(NN),RHS(NN),NET(NN),HBND(DBH),MASS(NN),
     &                 ANM(NAA),LAMDA(NLM),WTOT
      REAL*4    TTIME,DELTS,DELTP,STFX(NSN),STFW(NSN),BFLOW(DSS),
     &          INF(NSN),QLK(NSN),HS(NSN),BASE(NN),LAND(DET),NAREA(DET),
     &          DHP,DHM
      INTEGER*4 PCODE
      INTEGER*2 PBDH(DBH),PHYD(DHD),MV(NK1),MANM(2,NAA),LR(NN),
     &          NSTP(3,NSN),MOUTH(DSS),ITP(DSS)
      LOGICAL*1 LSN(NSN),CODEPC,CODEBP,CODEQP,CODETH,CODESG,CODESS
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION BALI,BALT,DELF,DELS,DFI,DSI,TERM,SRSK,HRS,GFLX,
     &       MXDHDT,NOTE,BLANK,STREAM,DHDT,DH1,DH2,DH3,DHMORE,DHLESS,
     &       DHDT2,ALPHA,BETA,DHAVG,DHEST,DTINV,VBFX,VNFX,DEL,
     &       ETNOTE,STRMET
      REAL*4 MAXDH,MINDH,WET,DRY,DRYWET,DT,TIME0,TIN,THPRE,DT1,DT2,MULT,
     &       RATIO,DTMORE,DTLESS,DTSTEP,DTINIT,DTSTD,D(2),ET(2),PREDET,
     &       DELT
      INTEGER*4 I,J,JJ,NDRY,MIN,DIN,YIN,NDAYS,NSTEP,NODE,HH,MM,SS,K,IT
      LOGICAL*1 BFCODE,NUIS,INITL,EXTRP,LAST,REDO
      DATA WET/4H WET/,DRY/4H DRY/,BLANK/8H        /,STREAM/8HSTREAM  /,
     &    MULT/0.67/,PREDET/0.0/,ETNOTE/8HGW E.T. /,STRMET/8HSTRFW+ET /
C......................................................................
      DT1=0.0
      DT2=0.0
      DH2=0.0
      DHDT2=0.0
      EXTRP=.FALSE.
      INITL=.FALSE.
```

```
      NUIS=.FALSE.
      LAST=.FALSE.
C.......................................................................
C
C.....THE LR VECTOR DEFINES THE TYPE OF NODE:
C     LR=-2   KNOWN HEAD NODE WITH ACTIVE STREAM-AQUIFER CONNECTION.
C       =-1   KNOWN HEAD NODE.
C       = 0   EXPLICIT NODE.
C       = 1   IMPLICIT NODE.
C
C.....CALCULATE THE STANDARD TIME STEP TO EVENLY DIVIDE "DELT":
      DTINIT=0.01*DELTS
      DELT=TTIME-TIME
      DEL=DELT
      IF(DELT.LT.DELTS) DTINIT=0.01*DELT
      IF(DHMAX.NE.0.0 .OR. CODETH  ) EXTRP=.TRUE.
      IF(CODESS .OR. NUI.EQ.0) EXTRP=.FALSE.
      IF(EXTRP) DEL=DELT-2*DTINIT
      NSTEP=DEL/DELTS
      IF(NSTEP*DELTS.LT.DEL) NSTEP=NSTEP+1
      DTSTD=DEL/NSTEP
      DTSTEP=DTSTD
      IF(EXTRP) DTSTEP=DTINIT
      IF(EXTRP) INITL=.TRUE.
C
C.....READ NEXT TIME FOR OUTPUT OF HEAD ARRAY.
   10 IF(TPLOT.GT.TIME) GO TO 30
      READ(ININ,1000,END=20) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TPLOT=NDAYS+TIN/24.0
      GO TO 10
   20 TPLOT=TTOTL*2
   30 IT=0
   35 TIME0=TPLOT
      IF(TTIME.LT.TIME0) TIME0=TTIME
      DELT=TIME0-TIME
C
C.....DETERMINE STREAM-AQUIFER FLUX AT BEGINNING OF TIME STEP:
      IF(NSS.GT.0) CALL STFLOW (H,DH,STFX,STFW,BFLOW,INF,QLK,HS,
     &                          0.0,0.0,TIME,TTOTL,TSTRM,DD,
     &                          PCODE,NDAY0,M,Y,
     &                          MOUTH,ITP,NSTP,LSN,CODEPC,CODEBP,CODESG)
      BFCODE=.NOT.CODEPC
C
C.....INITIALIZE RHS VECTOR:
      DO 40 I=1,NN
   40 RHS(I)=0.0
      QBDS=0.0
      IF(NSS.LE.0) GO TO 60
      DO 50 J=1,NSN
      I=NSTP(1,J)
      IF(LR(I).LT.0) LR(I)=-1
      IF(STFX(J).EQ.0.0) GO TO 50
      QBDS=QBDS+STFX(J)
```

```
      II=MANM(1,I)
      RHS(II)=STFX(J)
      IF(LR(I).LT.0) LR(I)=-2
C
C.....ADJUST TIME STEP IF STREAM-AQUIFER FLUX MAY CAUSE INSTABILITY
C     BECAUSE IT IS HANDLED EXPLICITLY.  STFW(J) CONTAINS QLK FOR REACHES
C     ADJACENT TO NODE I OR NSTP(1,J).
      IF(LR(I).LT.1 .OR. STFW(J).LE.0.0 .OR. CODEPC) GO TO 50
      TERM=ANM(I)/STFW(J)
      IF(MULT*TERM .LT.DTSTEP) DTSTEP=MULT*TERM
   50 CONTINUE
C
C.....MODIFY RHS VECTOR TO ALSO INCLUDE NET FLUX:
   60 SUMET=0.0
      IF(INET.GT.0) RATIO=ETMAX/ZDEPTH
      DO 90 I=1,NN
      ET(1)=0.0
      IF(INET.LE.0) GO TO 70
      D(1)=LAND(I)-H(I)
      IF(D(1).GE.ZDEPTH) GO TO 70
      IF(D(1).LT.0.0) D(1)=0.0
      ET(1)=RATIO*(ZDEPTH-D(1))*NAREA(I)
      SUMET=SUMET+ET(1)
   70 IS=I
      II=MANM(1,I)
      RHS(II)=RHS(II)+NET(I)+ET(1)
      IF(.NOT.CODEOP .OR. H(I).GT.BASE(I) .OR. NET(I).GE.0.0) GO TO 80
      RHS(II)=RHS(II)-NET(I)
   80 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 90
      J=MANM(1,IS)
      JJ=MANM(1,J)
      RHS(II)=RHS(II)+ANM(IS)*(H(I)-H(J))
      RHS(JJ)=RHS(JJ)+ANM(IS)*(H(J)-H(I))
      GO TO 80
   90 CONTINUE
      MXDHDT=0.0
C
C.....DETERMINE DH/DT FOR KNOWN HEAD NODES.
      IF(NBH.LT.1) GO TO 110
      DO 100 I=1,NBH
      JJ=PBDH(I)
      DH(JJ)=(HBND(I)-H(JJ))/(TBNDH-TIME)
      IF(CODESS) DH(JJ)=0.0
      IF(DABS(DH(JJ)).GT.MXDHDT) MXDHDT=DABS(DH(JJ))
  100 CONTINUE
  110 IF(CODESS .OR. NUE.EQ.0) GO TO 130
C
C.....DETERMINE DH/DT THROUGHOUT TIME STEP FOR EXPLICIT NODES:
      DO 120 I=1,NN
      IF(LR(I).NE.0) GO TO 120
      II=MANM(1,I)
      DH(I)=RHS(II)/ANM(I)
      IF(DABS(DH(I)).GT.MXDHDT) MXDHDT=DABS(DH(I))
```

```
  120 CONTINUE
C
C.....ESTIMATE MAXIMUM TIME STEP FOR ANY EXPLICIT OR KNOWN-HEAD NODES TO
C     KEEP HEAD CHANGE LESS THAN DHMAX:
  130 DT=DTSTEP
      IF(DELT.LT.DTSTEP) DT=DELT
      IF(.NOT.INITL .AND. DELT.LE.DELTS) DT=DELT
      IF(MXDHDT*DT.GT.DHMAX .AND. DHMAX.NE.0.0) DT=DHMAX/MXDHDT
      IF(NUI.LE.0 .OR. CODESS) GO TO 180
C
C.....ESTIMATE THE MAXIMUM HEAD CHANGE TO CONTROL TIME STEP IF
C     DHMAX IS ACTIVE (I.E. NOT EQUAL 0.0) AND CALCULATE THETA IF
C     CODETH IS "TRUE" ONLY AFTER SIMULATING WITH TWO SHORT TIME STEPS:
      IF(CODETH) THETA=1.00
      IF(.NOT.EXTRP .OR. INITL) GO TO 180
      II=MANM(1,NODE)
      DHDT=DHDT2
      IF(ANM(NODE).GT.0.0) DHDT=RHS(II)/ANM(NODE)
      ALPHA=0.0
      BETA=0.0
      IF(DABS(DHDT).GT.DABS(DHDT2) .OR. DH2.EQ.0.0) GO TO 140
C
C.....ASSUME EXPONENTIAL DECAY; DHDT(T)=DHDT(0)*EXP(ALPHA*T) BASED UPON
C     DELTA HEAD/DELTA TIME  FOR PREVIOUS TIME STEP AND DH/DT FOR
C     BEGINNING OF CURRENT TIME STEP AND ESTIMATE THE CHANGE IN HEAD
C     FOR TIME STEP OF LENGTH DT:
      ALPHA=(DHDT-DHDT2)/DH2
      IF(ALPHA.GE.0.0) GO TO 140
C
C.....IF THE PRODUCT OF ALPHA AND TIME STEP IS LESS THAN -100, ADJUST
C     TIME STEP TO KEEP PRODUCT WITHIN REASON:
      IF(ALPHA*DT.LT.-100.0) DT=-100.0/ALPHA
      DH3=DHDT*(DEXP(ALPHA*DT)-1.0)/ALPHA
      DTLESS=DHMAX/DABS(DHDT2)
      DHLESS=DHDT*(DEXP(ALPHA*DTLESS)-1.0)/ALPHA
      DHAVG=(DH3/DT-DHDT)/ALPHA
      GO TO 150
C
C.....ASSUME QUADRATIC VARIATION; H(T)=H(0)+DHDT(0)*T+BETA*T**2
  140 BETA=(DHDT-DH2/DT2)/DT2
      DH3=(DHDT+BETA*DT)*DT
      DTLESS=DHMAX/DABS(DHDT+2*BETA*DT)
      DHLESS=(DHDT+BETA*DTLESS)*DTLESS
      DHAVG=(0.5*DHDT+BETA*DT/3)*DT
  150 DHEST=DH3
      IF(PCODE.GT.2) WRITE(OUTP,2100) DHDT2,DHDT,DHEST,NODE,ALPHA,BETA
C
C.....INCREASE ESTIMATED HEAD CHANGE BY 10% THEN COMPARE WITH DHMAX
C     IF DHMAX IS ACTIVE.  IF GREATER THAN DHMAX, DT MUST BE REDUCED:
  160 DH3=1.10*DABS(DH3)
      IF(DH3.LT.DHMAX .OR. DHMAX.EQ.0.0) GO TO 170
      DHLESS=DABS(DHLESS)
      DHMORE=DH3
      DTMORE=DT
```

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      RATIO=(DHMORE-DHLESS)/(DTMORE-DTLESS)
      DT=(DHMAX-DHLESS+DTLESS*RATIO)/RATIO
C
C.....ESTIMATE VALUE OF THETA IF THETA IS CONSIDERED VARIABLE:
  170 IF(.NOT.CODETH .OR. DHEST.EQ.0.0) GO TO 180
      THETA=DHAVG/DHEST
      IF(THETA.LT.0.57) THETA=0.57
      IF(THETA.GT.1.00) THETA=1.00
C
C.....SOLVE FOR CHANGE IN HEAD FOR KNOWN HEAD NODES AND EXPLICIT NODES
C     OVER TIME STEP OF DT:
  180 DTINV=1./DT
      IF(NUI.EQ.NN) GO TO 200
      DO 190 I=1,NN
      IF(LR(I).LE.0) DH(I)=DH(I)*DT
  190 CONTINUE
      IF(NUI.EQ.0) GO TO 290
C
C.....IF THETA, DT OR HYDRAULIC PROPERTIES HAVE CHANGED SINCE LAST
C     TIME STEP, REFORM LAMBDA MATRIX AND FACTOR LAMBDA MATRIX.
  200 IF(THETA.EQ.THPRE .AND. DT.EQ.DELTP) GO TO 240
      DO 210 I=1,NLM
  210 LAMDA(I)=0.0
      DELTP=DT
      THPRE=THETA
      DO 230 I=1,NN
      IF(LR(I).EQ.0) GO TO 230
      II=MANM(1,I)
      KI=MV(II)
      IF(LR(I).EQ.1) LAMDA(KI)=LAMDA(KI)+ANM(I)*DTINV
      IS=I
  220 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 230
      J=MANM(1,IS)
      IF(LR(J).EQ.0) GO TO 220
      JJ=MANM(1,J)
      TERM=ANM(IS)*THETA
      KJ=MV(JJ)
      IF(LR(I).EQ.1) LAMDA(KI)=LAMDA(KI)-TERM
      IF(LR(J).EQ.1) LAMDA(KJ)=LAMDA(KJ)-TERM
      IF(LR(I).LT.1.OR.LR(J).LT.1) GO TO 220
      K=KI+II-JJ
      IF(II.LT.JJ) K=KJ+JJ-II
      LAMDA(K)=TERM
      GO TO 220
  230 CONTINUE
      CALL FACTOR (LAMDA,NLM,NUI,NK1,PCODE,OUTP,MV)
C
C.....TEMPORARILY STORE RHS VALUES FOR IMPLICIT NODES IN DH VECTOR.
  240 IF(NUI.EQ.0) GO TO 290
      DO 250 I=1,NN
      IF(LR(I).LT.1) GO TO 250
      II=MANM(1,I)
      DH(I)=RHS(II)
```

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  250 CONTINUE
C
C.....COMPLETE THE RIGHT-HAND-SIDE VECTOR.
      DO 270 I=1,NN
      IF(LR(I).EQ.0) GO TO 270
      II=MANM(1,I)
      IS=I
  260 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 270
      J=MANM(1,IS)
      IF(LR(J).EQ.0) GO TO 260
      JJ=MANM(1,J)
      TERM=THETA*ANM(IS)
      IF(LR(J).LT.0) RHS(II)=RHS(II)-TERM*DH(J)
      IF(LR(I).LT.0) RHS(JJ)=RHS(JJ)-TERM*DH(I)
      IF(LR(I).LT.0) RHS(II)=RHS(II)+TERM*DH(I)
      IF(LR(J).LT.0) RHS(JJ)=RHS(JJ)+TERM*DH(J)
      GO TO 260
  270 CONTINUE
C
C.....SOLVE FOR CHANGES IN HEAD, RETURNED IN TRANSFORMED SEQUENCE AS
C     "RHS" VECTOR.
      CALL SOLVE (LAMDA,RHS,NLM,NUI,NK1,MV)
C
C.....TRANSFORM HEAD CHANGE TO "DH" VECTOR & DETERMINE MAX HEAD CHANGE.
      TERM=0.0
      J=0
      DO 280 I=1,NN
      IF(LR(I).LT.1) GO TO 280
      II=MANM(1,I)
      DEL=RHS(II)
      RHS(II)=DH(I)
      DH(I)=DEL
      IF(DABS(TERM).GT.DABS(DEL)) GO TO 280
      TERM=DEL
      J=I
  280 CONTINUE
      IT=IT+1
C
C.....IF HEAD CHANGE IS GREATER THAN DHMAX AND DHMAX IS ACTIVE, REDUCE
C     TIME STEP BUT TRY NO MORE THAN "ITMAX" TIMES:
      IF(DABS(TERM).LE.DHMAX .OR. IT.GE.ITMAX) GO TO 290
C
C.....RETURN DH VALUES FOR NON-IMPLICIT NODES TO DHDT ESTIMATES:
      IF(NUI.EQ.NN) GO TO 360
      DO 350 I=1,NN
      IF(LR(I).LE.0) DH(I)=DH(I)*DTINV
  350 CONTINUE
  360 IF(CODEPC .AND. BFCODE) GO TO 285
C
C.....IF THERE IS NO PREDICTOR-CORRECTOR USED OR THIS IS A "PREDICTOR" STEP,
C     THE TIME STEP CAN BE FREELY CHANGED BECAUSE "RHS" HAS NOT BEEN ALTERED.
      DH3=TERM
      IF(.NOT.INITL) GO TO 160
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      DTSTEP=DHMAX*DT/DABS(TERM)
      IF(DTSTEP.GT.0.1*DT) DTSTEP=0.1*DT
      GO TO 130
C
C.....IF GROUNDWATER ET OR STREAMFLOW WERE "CORRECTED" AND DHMAX WAS
C     VIOLATED, "RHS" MUST BE RE-INITIALIZED.
  285 DTSTEP=DHMAX*DT/DABS(TERM)
      GO TO 35
C
C.....EITHER DHMAX WAS NOT VIOLATED, OR THE MAXIMUM NUMBER OF ITERATIONS
C     (ITMAX) HAS BEEN EXCEEDED.
  290 IF(BFCODE)   GO TO 339
C
C...."PREDICTION" CYCLE: BFCODE IS FALSE ONLY FOR THE PREDICTION STEP
C     OF A STREAM-AQUIFER FLUX OR ET FLUX PREDICTOR-CORRECTOR SEQUENCE.
      IF(NSS.LE.0) GO TO 320
C
C.....REMOVE OLD STREAM-AQUIFER FLUX VALUE FROM "RHS":
      DO 300 J=1,NSN
      I=NSTP(1,J)
      II=MANM(1,I)
      RHS(II)=RHS(II)-STFX(J)
  300 CONTINUE
      CALL STFLOW (H,DH,STFX,STFW,BFLOW,INF,QLK,HS,
     &             DT,THETA,TIME,TTOTL,TSTRM,DD,
     &             PCODE,NDAYO,M,Y,
     &             MOUTH,ITP,NSTP,LSN,CODEPC,CODEBP,CODES6)
      BFCODE=.TRUE.
C
C.....ADJUST  "RHS" FOR STREAM-AQUIFER FLUX:
      QBDS=0.0
      DO 310 J=1,NSN
      I=NSTP(1,J)
      IF(LR(I).LT.0) LR(I)=-1
      IF(LR(I).GT.0) NUIS=.TRUE.
      II=MANM(1,I)
      QBDS=QBDS+STFX(J)
      RHS(II)=RHS(II)+STFX(J)
      IF(LR(I).LT.0) LR(I)=-2
C
C.....RE-ESTIMATE HEAD-CHANGE FOR EXPLICIT STREAM NODES:
      IF(LR(I).EQ.0) DH(I)=DT*RHS(II)/ANM(I)
  310 CONTINUE
  320 IF(INET.LE.0) GO TO 338
      PREDET=0.0
      RATIO=ETMAX/ZDEPTH
      REDO=.FALSE.
C
C.....ADJUST NET AND RHS FOR GROUNDWATER ET PREDICTION:
      DO 337 I=1,NN
C
C.....D(1)  IS OLD DEPTH TO WATER,   D(2)  IS NEW DEPTH TO WATER:
C     ET(1) IS OLD GW. ET. ESTIMATE, ET(2) IS NEW GW. ET. ESTIMATE.
      D(1)=LAND(I)-H(I)
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      D(2)=D(1)-DH(I)*THETA
      IF(D(1).GE.ZDEPTH .AND. D(2).GE.ZDEPTH) GO TO 337
      II=MANM(1,I)
      DO 330 J=1,2
      ET(J)=0.0
      IF(D(J).GT.ZDEPTH) GO TO 330
      IF(D(J).LT.0.0) D(J)=0.0
      ET(J)=RATIO*(ZDEPTH-D(J))*NAREA(I)
  330 CONTINUE
      PREDET=PREDET+ET(2)
      RHS(II)=RHS(II)-ET(1)+ET(2)
      IF(LR(I).EQ.1 .AND. ET(1).NE.ET(2)) REDO=.TRUE.
C
C.....RE-ESTIMATE HEAD-CHANGE FOR EXPLICIT NODES:
      IF(LR(I).EQ.0) DH(I)=DT*RHS(II)/ANM(I)
  337 CONTINUE
C
C.....RE-ESTIMATE HEAD-CHANGE FOR IMPLICIT NODES WITH ALTERED GW. ET. IF ANY:
      IF(REDO) GO TO 240
C
C.....RE-ESTIMATE HEAD-CHANGE FOR IMPLICIT STREAM NODES IF ANY:
  338 IF(NUIS) GO TO 240
  339 IF(NUI.EQ.0) GO TO 410
      NODE=J
      DH1=DH2
      DH2=DH(NODE)
      II=MANM(1.NODE)
C
C.....DH/DT AT BEGINNING OF STEP IS DESIRED IF NODE HAS NON-ZERO VOLUME:
      DHDT2=DH2/DT
      IF(ANM(NODE).GT.0.0) DHDT2=RHS(II)/ANM(NODE)
C
C.....DETERMINE MASS BALANCE:
C    "NET" WILL REPRESENT THE GRADIENT INDUCED FLUX INTO THE SUBDOMAIN.
C    "RHS" REPRESENTS THE TOTAL NET FLUX INTO THE NODAL SUBDOMAIN.
      DO 400 I=1,NN
      IF(LR(I).EQ.0) GO TO 400
      II=MANM(1,I)
      IS=I
  390 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 400
      J=MANM(1,IS)
      IF(LR(J).EQ.0) GO TO 390
      JJ=MANM(1,J)
      TERM=THETA*ANM(IS)
      RHS(II)=RHS(II)+TERM*DH(I)
      RHS(JJ)=RHS(JJ)+TERM*DH(J)
      RHS(II)=RHS(II)-TERM*DH(J)
      RHS(JJ)=RHS(JJ)-TERM*DH(I)
      GO TO 390
  400 CONTINUE
C
C.....DETERMINE MASS BALANCE FOR PRESCRIBED-HEAD NODES. (L**3)
  410 IF(NBH.LT.1) GO TO 430
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      IF(PCODE.GE.2) WRITE(OUTP,2000)
      QBDH=0.0
      DO 420 J=1,NBH
      I=PBDH(J)
      II=MANM(1,I)
      SRSK=NET(I)*DT
      DSI=DH(I)*ANM(I)
      DFI=DSI-RHS(II)*DT
      GFLX=(RHS(II)-NET(I))*DT
      RHS(II)=DSI/DT
      QBDH=QBDH+DFI
      NOTE=BLANK
      IF(LR(I).LT.-1) NOTE=STREAM
      IF(INET.LE.0) GO TO 415
      IF(LAND(I)-H(I) .LT.ZDEPTH .AND. NOTE.EQ.BLANK)  NOTE=ETNOTE
      IF(LAND(I)-H(I) .LT.ZDEPTH .AND. NOTE.EQ.STREAM) NOTE=STRMET
  415 IF(LR(I).LT.-1) LR(I)=-1
      IF(PCODE.GE.2) WRITE(OUTP,2010) I,DH(I),DSI,SRSK,DFI,GFLX,NOTE
  420 CONTINUE
C
C.....ADJUST THE AMOUNT OF FLUID STORED IN EACH SUBDOMAIN. (L**3)
  430 BALT=0.0
      WTOT=0.0
      DELF=0.0
      DELS=0.0
      MAXDH=DH(1)
      MINDH=DH(1)
      NDRY=0
      IF(PCODE.GE.2) WRITE(OUTP,2060)
      DO 440 I=1,NN
      IF(DH(I).LT.MINDH) MINDH=DH(I)
      IF(DH(I).GT.MAXDH) MAXDH=DH(I)
      II=MANM(1,I)
      DFI=RHS(II)*DT
      DSI=ANM(I)*DH(I)
      DELF=DELF+DFI
      DELS=DELS+DSI
      BALI=DFI-DSI
      MASS(I)=MASS(I)+DSI
      WTOT=WTOT+MASS(I)
      BALT=BALT+BALI
      DRYWET=WET
      IF(H(I).LE.BASE(I)) DRYWET=DRY
      IF(H(I).LE.BASE(I)) NDRY=NDRY+1
      IF(PCODE.GE.2) WRITE(OUTP,2070) I,DFI,DSI,BALI,MASS(I),DRYWET
  440 CONTINUE
      BALCUM=BALCUM+BALT
      VBFX=QBDF*DT
      QBDS=QBDS*DT
      VNFX=SUMNQ*DT
      SUMET=SUMET*DT
      PREDET=PREDET*DT
C
C.....UPDATE THE DATE AND THE TOTAL SIMULATION TIME.
```

```
      TIME=TIME+DT
      IF(DT.GE.DELT) TIME=TIME0
      IF(TIME.GE.TTIME) LAST=.TRUE.
      CALL NEWDAT (M,DD,Y,DT,IDAY)
      HRS=(DD-IDAY)*24.0
      HH=HRS
      MM=(HRS-HH)*60.0
      SS=((HRS-HH)*60.0-MM)*60.0
      DT1=DT2
      DT2=DT
      IF(DT1.EQ.0.0) GO TO 450
      INITL=.FALSE.
      DTSTEP=DTSTD
C
C.....PRINT SUMMARY OF MASS BALANCE IN VOLUME UNITS.
  450 IF(PCODE.LT.1) GO TO 455
      WRITE(OUTP,2080) M,IDAY,Y,HH,MM,SS,TIME,DT,IT,THETA,DELF,DELS,
     &                 BALT,BALCUM,WTOT,VNFX,QBDS,VBFX,QBDH,MINDH,MAXDH,
     &                 NDRY
      IF(INET.LE.0) GO TO 455
                 WRITE(OUTP,2110) SUMET
      IF(CODEPC) WRITE(OUTP,2120) PREDET
C
C.....UPDATE AND OUTPUT HEAD ARRAY.
  455 DO 460 I=1,NN
      H(I)=H(I)+DH(I)
  460 CONTINUE
      IF(PCODE.GE.3) WRITE(OUTP,2020) TIME,DT,(I,H(I),I,DH(I),I=1,NN)
      IF(OUTN.LT.1) GO TO 480
      WRITE(OUTN,2040) M,IDAY,Y,HH,MM,SS
      DO 470 I=1,NHD
      J=PHYD(I)
      WRITE(OUTN,2050) J,H(J)
  470 CONTINUE
  480 IF(TIME.GE.TPLOT) WRITE(OUTC,2030)  M,IDAY,Y,HH,MM,SS,TIME,H
C
C.....ACCUMULATE MAXIMUM POSITIVE HEAD CHANGE AND MAXIMUM NEGATIVE HEAD
C     CHANGE AND COMPARE WITH CONDUCTANCE-CAPACITANCE UPDATE FREQUENCY:
      DHP=DHP+MAXDH
      DHM=DHM+MINDH
      IF(DHFREQ.GT.0.0 .AND.  DHP.GE.DHFREQ) GO TO 500
      IF(DHFREQ.GT.0.0 .AND. -DHM.GE.DHFREQ) GO TO 500
C
C.....IF EQUILIBRIUM HEAD CHANGE CRITERIA IS MET, WRITE MESSAGE AND
C     UPDATE TIME TO NEXT BOUNDARY CONDITION CHANGE.
      IF(MINDH.LT.0.0) MINDH=-MINDH
      IF(MAXDH.LT.0.0) MAXDH=-MAXDH
      IF(MINDH.GT.MAXDH) MAXDH=MINDH
      IF(MAXDH.GT.DHSTDY*DT) GO TO 490
      DT=TTIME-TIME
      IF(DT.LE.0.0) GO TO 490
C
C.....UPDATE THE DATE AND THE TOTAL SIMULATION TIME.
      CALL NEWDAT (M,DD,Y,DT,IDAY)
```

```
      HRS=(DD-IDAY)*24.0
      HH=HRS
      MM=(HRS-HH)*60.0
      SS=((HRS-HH)*60.0-MM)*60.0
      WRITE(OUTP,2090) MAXDH,DHSTDY,M,IDAY,Y,HRS,TTIME,DT
      IF(TTIME.GE.TPLOT .AND. TIME.LT.TPLOT)
     &                  WRITE(OUTC,2030)  M,IDAY,Y,HH,MM,SS,TTIME,H
      LAST=.TRUE.
C
C.....TIME TO CHANGE BOUNDARY CONDITIONS, HYDRAULIC PROPERTIES,
C     FLUX PARAMETERS?
  490 IF(.NOT.LAST) GO TO 10
      TIME=TTIME
  500 RETURN
C***************************************************************************
C***************************************************************************
C***************************************************************************
C***************************************************************************
C.....INPUT FORMATS:
 1000 FORMAT(I2,1X,I2,1X,I4,F10.0)
C
C..........................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(//11X,48HMASS BALANCE: PRESCRIBED-HEAD BOUNDARY (L,L**3):,
     &       /11X,47(1H-),//11X,34HNODE      DELTA HEAD  DELTA STOR  ,
     &       40HSRCS-SINKS   BNDFLX IN  GRADIENT INDUCED)
 2010 FORMAT(10X,I5,4X,1P5E12.3,5X,A8)
 2020 FORMAT(//11X,21HHEAD AND HEAD CHANGE:,/11X,20(1H-),/11X,6HTOTAL ,
     &     15HSIMULATED TIME=,1PE10.3,17H DAYS; TIME STEP=,E10.3,5H DAYS,
     &     //11X,3(4HNODE,5X,4HHEAD,6X,4HNODE,4X,6HCHANGE,5X),
     &     /(11X,6(I4,2X,D10.3,3X)))
 2030 FORMAT(I2,1H/,I2,1H/,I4,/I2,1H:,I2,1H:,I2,/1PE10.3,/(0PF10.2))
 2040 FORMAT(I2,1H/,I2,1H/,I4,/I2,1H:,I2,1H:,I2)
 2050 FORMAT(I5,F10.2)
 2060 FORMAT(//11X,36HNODAL SUBDOMAIN MASS BALANCE (L**3):,
     &       /11X,35(1H-),/11X,33HNODE   FLUX IN      DELTA STORAGE,
     &       6X,5HERROR,6X,32HCUMULATIVE MASS   DRY-WET STATUS)
 2070 FORMAT(10X,I5,4(3X,1PD10.3,2X),8X,A4)
 2080 FORMAT(/2X,34HMASS BALANCE SUMMARY (L**3). DATE ,I2,1H/,I2,1H/,I4,
     &       10H HH:MM:SS=,I2,1H:,I2,1H:,I2,6H TIME=,1PE10.3,8H DAYS.  ,
     &       6H(STEP=,D10.3,6H DAYS),I3,9H ATTEMPTS./2X,6HTHETA=,0PF5.2,
     &       12H TOTAL FLUX=,1PD10.3,22H TOTAL STORAGE CHANGE=,D10.3,
     &       18H TOTAL STEP ERROR=,D10.3,18H CUMULATIVE ERROR=,D10.3,
     &       /2X,13HTOTAL VOLUME=,D10.3,20H, NODAL RECHARGES & ,
     &       12HWITHDRAWALS=,D10.3,15H, STREAM INPUT=,D10.3,6H, FLUX
     &       16H BOUNDARY INPUT=,D10.3,/2X,20HHEAD BOUNDARY INPUT=,
     &       D10.3,17H, MIN DELTA HEAD=,E10.3,13H (L**1), MAX ,
     &       11HDELTA HEAD=,E10.3,13H (L**1), AND ,I4,13H "DRY" NODES.)
 2090 FORMAT(//11X,46HEQUILIBRIUM CONDITION SATISFIED: MAXIMUM HEAD ,
     &       26HCHANGE FOR THIS TIME STEP=,1PE10.3,8H (L**1),,/11X,
     &       27HWHILE EQUILIBRIUM CRITERIA=,E10.3,12H (L**1/DAY).,/11X,
     &       15HUPDATE TO DATE ,I2,1H/,I2,1H/,I4,0PF5.1,7H HOURS.,/11X,
     &       5HTIME=,1PE10.3,19H DAYS.  ADDED STEP=,E10.3,6H DAYS.)
 2100 FORMAT(/2X,10HLAST DHDT=,1PD10.3,11H THIS DHDT=,D10.3,7H DHEST=,
```

```
     &       D10.3,9H FOR NODE,I5,12H WITH ALPHA=,D10.3,9H OR BETA=,
     &       D10.3)
 2110 FORMAT(2X,26HPREDICTED GROUNDWATER ET =,1PE10.3)
 2120 FORMAT(2X,26HCORRECTED GROUNDWATER ET =,1PE10.3)
      END
C-SBR06
C-FLUXES: CONSOLIDATES THE VARIOUS FLUX COMPONENTS AND RETURNS THEM AS
C         THE DH ARRAY.  ALSO UPDATES KNOWN HEADS AND TIME PARAMETERS.
C ---------------------------------------------------------------------------
      SUBROUTINE FLUXES (H,NET,FLUX,HBND,QBND,LAND,NAREA,HS,INF,
     &                   PCODE,PBDF,PBDH,PHYD,CODESS)
       COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                 IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                 OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
     COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                 DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                 DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /TIMES/  MS,DS,YS,TS,MF,DF,YF,TF,M,DD,Y,IDAY,TIME,TTOTL,
     &                 NDAYO,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,TFLUX,
     &                 DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ,ITMAX
      REAL*4    DD,TF,TIME,TS,TTOTL,TSFREQ,TSTRM,TBNDH,TBNDF,TPLOT,
     &                 TFLUX,DTMAX,DTMIN,DHMAX,THETA,DHSTDY,DHFREQ
      INTEGER*4 MS,DS,YS,MF,DF,YF,M,Y,IDAY,NDAYO,ITMAX
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &       FNXY(20),FNBS(20),FNQS(20)
      COMMON /SUMFLX/ BALCUM,QBDS,QBDF,QBDH,SUMNQ
      DOUBLE PRECISION BALCUM,QBDS,QBDF,QBDH,SUMNQ
      COMMON /GWET/   ZDEPTH,TGWET,ETMAX,SUMET,FETX,INET
      REAL*4          ZDEPTH,TGWET,ETMAX,SUMET,FETX(20)
      INTEGER*4       INET
      DOUBLE PRECISION H(NN),NET(NN),FLUX(NN),HBND(DBH)
      REAL*4 QBND(DBF),LAND(DET),NAREA(DET),HS(NSN),INF(NSN)
      INTEGER*4 PCODE
      INTEGER*2 PBDF(DBF),PBDH(DBH),PHYD(DHD)
      LOGICAL*1 CODESS
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION DDAT(2)
      REAL*4           TIN,TEMP
      INTEGER*4        DIN,I,J,MIN,NDAYS,YIN,ONE
      INTEGER*2        JJ
      LOGICAL          FAILED
      DATA DDAT/8HSTREAM D,8HATA CARD/,FAILED/.FALSE./,ONE/1/
C...........................................................................
      DO 10 I=1,NN
   10 NET(I)=0.0
C
C.....KNOWN-FLUX BOUNDARIES.
      QBDF=0.0
      IF(NBF.EQ.0) GO TO 60
      IF(TBNDF.GT.TIME) GO TO 40
```

```
   20 READ(INBF,FBDF) QBND
      TEMP=TBNDF
      READ(INBF,1000,END=30) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAYO,NDAYS)
      TBNDF=NDAYS+TIN/24.0
      IF(TBNDF.LE.TIME) GO TO 20
      IF(TBNDF.NE.2*TTOTL) WRITE(OUTP,2030) MIN,DIN,YIN,TIN,TBNDF
      IF(PCODE.GE.3) WRITE(OUTP,2000) TEMP,(PBDF(I),QBND(I),I=1,NBF)
      GO TO 40
   30 TBNDF=TTOTL*2
   40 DO 50 I=1,NBF
      J=PBDF(I)
      NET(J)=NET(J)+QBND(I)
   50 QBDF=QBDF+QBND(I)
C
C.....DETERMINE NODAL RECHARGES-DISCHARGES.
   60 SUMNQ=0.0
      IF(INQS.EQ.0) GO TO 130
      IF(TFLUX.GT.TIME) GO TO 100
   70 READ(INQS,FNQS) FLUX
      READ(INQS,1000,END=80) MIN,DIN,YIN,TIN
      TEMP=TFLUX
      CALL DAYS (MIN,DIN,YIN,NDAYO,NDAYS)
      TFLUX=NDAYS+TIN/24.0
      IF(TFLUX.LE.TIME) GO TO 70
      GO TO 90
   80 TFLUX=TTOTL*2
   90 IF(DFX.NE.NN) WRITE(IONQ) FLUX
      IF(PCODE.GE.3) WRITE(OUTP,2010) TEMP,(I,FLUX(I),I=1,NN)
      IF(TFLUX.LE.TTOTL) WRITE(OUTP,2040) MIN,DIN,YIN,TIN,TFLUX
      GO TO 110
  100 IF(DFX.NE.NN) READ (IONQ) FLUX
  110 DO 120 I=1,NN
      SUMNQ=SUMNQ+FLUX(I)
      NET(I)=NET(I)+FLUX(I)
  120 CONTINUE
      IF(DFX.NE.NN) REWIND IONQ
C
C.....INPUT KNOWN HEAD VALUES IF NEEDED.
  130 IF(TBNDH.GT.TIME) GO TO 170
      IF(.NOT.CODESS)   GO TO 150
      DO 140 J=1,NBH
      I=PBDH(J)
      H(I)=HBND(J)
  140 CONTINUE
  150 READ(INBH,1000,END=160) MIN,DIN,YIN,TIN
      READ(INBH,FBDH) HBND
      CALL DAYS (MIN,DIN,YIN,NDAYO,NDAYS)
      TBNDH=NDAYS+TIN/24.0
      IF(TBNDH.LE.TIME) GO TO 130
      WRITE(OUTP,2050) MIN,DIN,YIN,TIN,TBNDH
      IF(PCODE.GE.3) WRITE(OUTP,2020) (PBDH(I),HBND(I),I=1,NBH)
      GO TO 170
  160 TBNDH=TTOTL*2
```

```
      WRITE(OUTP,2060)
C
C.....INPUT NEW VALUE FOR ETMAX IF NECESSARY:
  170 IF(TGWET.GT.TIME) GO TO 200
      READ(INET,FETX) ETMAX
      READ(INET,1000,END=180) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TGWET=NDAYS+TIN/24.0
      IF(TGWET.LE.TIME) GO TO 170
      WRITE(OUTP,2070) MIN,DIN,YIN,TIN,TGWET,ETMAX,ZDEPTH
      GO TO 200
  180 TGWET=TTOTL*2
C
C.....INPUT STREAM REACH VARIABLES IF NECESSARY:
  200 IF(TSTRM.GT.TIME) GO TO 230
      DO 210 I=1,NSN
      READ(INSS,FSTM) JJ,HS(JJ),INF(JJ)
  210 CALL BOUNDS (JJ,ONE,ONE,NSN,DDAT,FAILED)
      IF (FAILED) STOP
      READ(INSS,1000,END=220) MIN,DIN,YIN,TIN
      CALL DAYS (MIN,DIN,YIN,NDAY0,NDAYS)
      TSTRM=NDAYS+TIN/24.0
      GO TO 200
  220 TSTRM=TTOTL*2
  230 RETURN
C*****************************************************************************
C.....INPUT FORMATS:
 1000 FORMAT(I2,1X,I2,1X,I4,F10.0)
C
C.....OUTPUT FORMATS:
 2000 FORMAT(/11X,47HKNOWN NODAL BOUNDARY FLUX (L**3/DAY) AT TIME = ,
     &       1PE10.3,6H DAYS:,/11X,62(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
 2010 FORMAT(/11X,46HNODAL RECHARGE-DISCHARGE (L**3/DAY) AT TIME = ,
     &       1PE10.3,6H DAYS:,/11X,61(1H-),
     &       //11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
 2020 FORMAT(/11X,6(4HNODE,5X,5HVALUE,5X),/(11X,6(I4,2X,1PE10.3,3X)))
 2030 FORMAT(/11X,32HBOUNDARY FLUX TO CHANGE ON DATE ,2(I2,1H/),I4,
     &       6H TIME=,F5.1,7H HOURS:,/11X,7H(TBNDF=,1PE10.3,7H DAYS).)
 2040 FORMAT(/11X,37HRECHARGE-DISCHARGE TO CHANGE ON DATE ,2(I2,1H/),
     &       I4,6H TIME=,F5.1,7H HOURS:,/11X,7H(TFLUX=,1PE10.3,6H DAYS))
 2050 FORMAT(/11X,39HKNOWN BOUNDARY HEADS TO CHANGE ON DATE ,2(I2,1H/),
     &       I4,6H TIME=,F5.1,7H HOURS:,/11X,7H(TBNDH=,1PE10.3,6H DAYS))
 2060 FORMAT(/11X,45H****** WARNING, END OF DATASET ON UNIT INBH, ,
     &            46HKNOWN HEADS SET EQUAL TO PREVIOUS VALUES *****)
 2070 FORMAT(/11X,35HMAXIMUM ET RATE TO CHANGE ON DATE ,2(I2,1H/),I4,
     &       6H TIME=,F5.1,8H HOURS; ,7H(TGWET=,1PE10.3,6H DAYS,
     &       /11X,7H ETMAX=,E10.3,21H, WITH MAXIMUM DEPTH=,E10.3)
      END
C-SBR07
C-TSMASS:CALCULATES THE CONDUCTANCE AND CAPACITANCE AS A FUNCTION
C        OF "SATURATED THICKNESS" FROM TABULATED INPUT AND
C        DETERMINES THE AMOUNT OF FLUID IN EACH NODAL SUBDOMAIN AT
C        THE START OF SIMULATION AND AT THE END OF SIMULATION FOR USE
```

```
C        IN MASS BALANCE.
C ----------------------------------------------------------------------
      SUBROUTINE TSMASS (H,MASS,WTOT,TABL,BASE,STIFF,AREAS,CPCT,CNDT,
     &                   KODE,KTABS,PCODE,IO,IN)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &                OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &      FNXY(20),FNBS(20),FNQS(20)
      DOUBLE PRECISION H(NN),MASS(NN),WTOT
      REAL*4    TABL(TABW,MAXT),STIFF(DAN,5,DNE),AREAS(2,DNE),BASE(NN),
     &          CPCT(DNE),CNDT(DAN,DNE)
      INTEGER*4 KODE,IO(2),KTABS,PCODE
      INTEGER*2 IN(7,DNE)
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION A(4),PSUM,SATT(4),SAVG,RATIO,THCK
      REAL*4    SS,T11,T22,ANG,FMT(20),FMTT(20),DTOR
      INTEGER*4 I,J,KODS,KODT,KSUM,KTAB,KUPD,L,LAST,LD,MATL,NV,
     &          DSKI,DSKO,KALL,DEGREE,LTABL
      LOGICAL   ANCODE
      DATA DTOR/0.0174533/
C.........................................................................
      WTOT=0.0
      DSKI=IO(1)
      DSKO=IO(2)
C
C.....THE VALUE OF KODE CONTROLS THIS SUBROUTINE.
C     UPON INITITATION:
C       1). IF THE PROGRAM IS A RESTART, KODE=0: I.E. DETERMINE
C           CAPACITANCE AND CONDUCTANCE ONLY SINCE MASS IS READ IN.
C       2). IF THE PROGRAM IS NOT A RESTART, KODE=-1: I.E. DETERMINE
C           CAPACITANCE, CONDUCTANCE, AND THE INITIAL MASS.
C     DURING SIMULATION, TO UPDATE CAPACITANCE & CONDUCTANCE, KODE=0.
C     END OF SIMULATION DUE TO REACHING THE FINAL TIME, DETERMINATION
C     OF THE FINAL MASS IS ACHIEVED BY CALLING TSMASS WITH KODE SET TO 1.
C
      KUPD=1
      KSUM=0
      IF(KODE) 20,40,10
   10 KUPD=0
   20 KSUM=1
      DO 30 I=1,NN
   30 MASS(I)=0.0
   40 LAST=0
C
C.....IF CAPACITANCE AND CONDUCTANCE ARE TABULATED, REWIND FILE AND
C     READ FORMATS:
```

```
      IF(INTS.LE.0) GO TO 50
      REWIND INTS
      READ(INTS,1000)
      READ(INTS,1000) FMT,FMTT
   50 IF(KUPD.EQ.1 .AND. KTABS.NE.0 .AND. PCODE.GE.5) WRITE(OUTP,2000)
      IF(KUPD.EQ.1 .AND. KTABS.NE.0 .AND. PCODE.GE.5 .AND. DAN.GT.1)
     &                                                WRITE(OUTP,2020)
      DO 170 LD=1,NE
      L=LD
      IF(DNE.NE.NE) L=1
      IF(DNE.NE.NE) READ (DSKI) IN,STIFF,AREAS,CPCT,CNDT
      KODT=IN(5,L)
      KODS=IN(6,L)
      MATL=IN(7,L)
      NV=4
      IF(IN(4,L).EQ.0) NV=3
      KTAB=KODT+KODS
      KALL=KTAB*KUPD+KSUM*KODS
C
C.....DETERMINE SATURATED THICKNESS AT ELEMENT CORNERS AND AVERAGE
C     SATURATED THICKNESS FOR ELEMENT:
      SAVG=0.0
      DO 60 I=1,NV
      J=IN(I,L)
      SATT(I)=H(J)-BASE(J)
   60 SAVG=SAVG+SATT(I)/NV
C
C.....IF NECESSARY, READ TABULATED MATERIAL PROPERTIES:
      IF (KALL.GT.0 .AND. MATL.NE.LAST) CALL INTABL (FMT,FMTT,TABL,
     &             INTS,LAST,MATL,LTABL,MAXT,DAN,TABW,DEGREE,OUTP,ANCODE)
C
C.....IF THIS IS NOT A CONDUCTANCE-CAPACITANCE UPDATE, SKIP TO
C     MASS DETERMINATION:
      IF (KUPD.EQ.0) GO TO 120
C
C.....IF THIS NODE DOESN'T HAVE TABULATED PROPERTIES, SKIP IT:
      IF (KTAB.EQ.0) GO TO 110
C
C.....DETERMINE TABULATED ELEMENT CAPACITANCE AND CONDUCTANCE FOR
C     SATURATED THICKNESS OVER THE ELEMENT:
      LS=LTABL
      IF(SAVG.GE.TABL(1,LS)) GO TO 90
      LS=1
      IF(SAVG.LE.TABL(1,LS)) GO TO 90
   70 IF(SAVG.EQ.TABL(1,LS)) GO TO 90
      LF=LS+1
      IF(SAVG.LT.TABL(1,LF)) GO TO 80
      LS=LF
      GO TO 70
   80 RATIO=(SAVG-TABL(1,LS))/(TABL(1,LF)-TABL(1,LS))
C
C.....INTERPOLATE CAPACITANCE WITHIN INTERVAL:
      SS=TABL(2,LS)+RATIO*(TABL(2,LF)-TABL(2,LS))
C
```

```
C.....IF CAPACITANCE HOLDS THROUGHOUT PREVIOUS BLOCK:
      IF(DEGREE.EQ.0) SS=TABL(2,LF)
C
C.....INTERPOLATE CONDUCTANCE WITHIN INTERVAL:
      T11=TABL(3,LS)+RATIO*(TABL(3,LF)-TABL(3,LS))
      IF(ANCODE) T22=TABL(4,LS)+RATIO*(TABL(4,LF)-TABL(4,LS))
      IF(ANCODE) ANG=TABL(5,LS)+RATIO*(TABL(5,LF)-TABL(5,LS))
      GO TO 100
   90 SS=TABL(2,LS)
      T11=TABL(3,LS)
      IF(ANCODE) T22=TABL(4,LS)
      IF(ANCODE) ANG=TABL(5,LS)
  100 IF(KODS.EQ.1) CPCT(L)=SS
      IF(KODT.NE.1) GO TO 105
      IF(.NOT.ANCODE) GO TO 104
      ANG=ANG*DTOR
      SINA=SIN(ANG)
      COSA=COS(ANG)
      CNDT(1,L)=T11*COSA*COSA+T22*SINA*SINA
      CNDT(2,L)=T22*COSA*COSA+T11*SINA*SINA
      CNDT(3,L)=(T11-T22)*SINA*COSA
      GO TO 105
  104 CNDT(1,L)=T11
  105 IF(PCODE.GE.5) WRITE(OUTP,2010) LD,SAVG,CPCT(L),
     &                                 (CNDT(J,L),J=1,DAN)
  110 IF(DNE.NE.NE)  WRITE(DSKO) IN,STIFF,AREAS,CPCT,CNDT
C
C.....IF THIS PASS IS NOT FOR MASS DETERMINATION, SKIP TO END OF LOOP:
  120 IF(KSUM.EQ.0) GO TO 170
C
C.....DETERMINE THE MASS ASSOCIATED WITH EACH NODE:
C     ESTIMATE SUB-ELEMENT AREAS:
      A(2)=AREAS(1,L)
      A(4)=AREAS(2,L)
      A(1)=A(2)+A(4)
      A(3)=A(1)
      DO 160 I=1,NV
      J=IN(I,L)
C
C.....IF CAPACITANCE IS CONSTANT, I.E. NOT TABULATED, MASS ESTIMATE IS
C     TRIVIAL:
      IF(KODS.EQ.0) GO TO 150
C
C.....IF CAPACITANCE IS TABULATED, SUM THE MASS STORED IN EACH BLOCK
C     USING APPROPRIATE EQUATION DEPENDING UPON DEGREE OF VARIATION
C     OF CAPACITANCE WITHIN EACH BLOCK:
      LS=1
      THCK=TABL(1,1)
      IF(SATT(I).LT.THCK) THCK=SATT(I)
C
C.....IN FIRST BLOCK, CAPACITANCE IS ALWAYS CONSIDERED CONSTANT:
      PSUM=THCK*TABL(2,1)
  130 IF(SATT(I).LE.TABL(1,LS)) GO TO 160
      LF=LS+1
```

```
      IF(LF.LE.LTABL) GO TO 140
      THCK=SATT(I)-TABL(1,LS)
C
C.....IF SATURATED THICKNESS IS GREATER THAN TABULATED RANGE, CAPACITANCE
C     IS CONSIDERED CONSTANT AND EQUAL TO LAST TABULATED VALUE:
      PSUM=PSUM+THCK*TABL(2,LS)
      GO TO 160
  140 THCK=TABL(1,LF)-TABL(1,LS)
      IF(SATT(I).LT.TABL(1,LF)) THCK=SATT(I)-TABL(1,LS)
      RATIO=THCK/(TABL(1,LF)-TABL(1,LS))
C
C.....DETERMINE AVERAGE CAPACITANCE WITHIN BLOCK DEPENDING UPON DEGREE:
      SS=TABL(2,LS)+0.5*RATIO*(TABL(2,LF)-TABL(2,LS))
      IF(DEGREE.EQ.0) SS=TABL(2,LF)
      PSUM=PSUM+THCK*SS
      LS=LF
      GO TO 130
C
C.....ONLY IF CAPACITANCE IS NOT TABULATED:
  150 IF(KODS.EQ.0) PSUM=SATT(I)*CPCT(L)
C
C.....INCREMENT ADDED TO MASS OF NODE J:
  160 MASS(J)=MASS(J)+PSUM*A(I)
  170 CONTINUE
      DO 180 I=1,NN
  180 WTOT=WTOT+MASS(I)
      IF(DNE.EQ.NE) RETURN
      REWIND DSKI
      IF(KUPD.EQ.0) RETURN
      REWIND DSKO
      IO(1)=DSKO
      IO(2)=DSKI
      RETURN
C.........................................................................
C.....INPUT FORMAT:
 1000 FORMAT(20A4)
C.....OUTPUT FORMATS:
 2000 FORMAT(/11X,29HUPDATED HYDRAULIC PROPERTIES:,/11X,29(1H-),/11X,
     &     57HELEMENT  "SATURATED THICKNESS"   CAPACITANCE  CONDUCTANCE)
 2010 FORMAT(11X,I7,8X,1PE10.3,9X,E10.3,3X,E10.3,3X,E10.3,3X,E10.3)
 2020 FORMAT(61X,29HKXX           KYY           KXY)
      END
C-SBR08
C-SHAPE: DETERMINES BASIS FUNCTION INTEGRALS AND ELEMENT AREAS.
C -----------------------------------------------------------------------
      SUBROUTINE SHAPE (X,Y,STIFF,AREA,LL,JD,NN,NE,PCODE,OUTP,FAILED,
     &                 CODERL)
      INTEGER*4 LL,JD(04),NE,NN,PCODE,OUTP
      DOUBLE PRECISION X(NN),Y(NN)
      REAL*4 STIFF(3,5),AREA(2)
      LOGICAL   FAILED
      LOGICAL*1 CODERL
C
C.....LOCAL VARIABLES:
```

```
      DOUBLE PRECISION B(3,2),C(3,2),GEOM,XMUL(2),XSUM,STSUM,FACTOR
      INTEGER*4 I,I1,I2,IV(5,2),J,L,NL
C
C.....GEOM IS THE CONSTANT USED IN A RADIALLY SYMMETRIC PROBLEM AND IS
C     SET EQUAL TO 2*PI/3    XMUL IS THE COEFFICIENT RESULTING FROM
C     SYMMETRY: 2*PI*RADIUS TO CENTROID OR 1.0 IF NO SYMMETRY SIMULATED
      DATA GEOM/2.0943951/,XMUL/1.0,1.0/
C.......................................................................
C.......................................................................
      AREA(2)=0.0
      NL=2
      IF(JD(4).EQ.0) NL=1
      IV(1,1)=JD(2)
      IV(2,1)=JD(3)
      IV(3,1)=JD(1)
      IV(4,1)=JD(2)
      IV(5,1)=JD(3)
      IF(NL.EQ.1) GO TO 10
      IV(1,2)=JD(4)
      IV(2,2)=JD(1)
      IV(3,2)=JD(3)
      IV(4,2)=JD(4)
      IV(5,2)=JD(1)
   10 DO 40 L=1,NL
      XSUM=0.0
      DO 20 I=1,3
      I1=IV(I+1,L)
      I2=IV(I+2,L)
      B(I,L)=Y(I1)-Y(I2)
      C(I,L)=X(I2)-X(I1)
      XSUM=XSUM+X(I2)
   20 CONTINUE
      IF(CODERL) XMUL(L)=GEOM*XSUM
      AREA(L)=0.5*(B(1,L)*C(2,L)-C(1,L)*B(2,L))
      IF(AREA(L).GT.0.0) GO TO 25
      WRITE(OUTP,2000) LL,AREA(L)
      FAILED=.TRUE.
   25 DO 30 J=2,3
      I1=(L-1)*2+J-1
      FACTOR=XMUL(L)/(4*AREA(L))
      STIFF(1,I1)=FACTOR*B(1,L)*B(J,L)
      STIFF(2,I1)=FACTOR*C(1,L)*C(J,L)
      STIFF(3,I1)=FACTOR*(B(1,L)*C(J,L)+C(1,L)*B(J,L))
      STSUM=STIFF(1,I1)+STIFF(2,I1)
      IF(STSUM.LE.0.0) GO TO 30
      IF(PCODE.GT.5) WRITE(OUTP,2010) LL,IV(1,L),IV(J,L),STSUM
   30 CONTINUE
   40 CONTINUE
      STIFF(1,5)=0.0
      STIFF(2,5)=0.0
      STIFF(3,5)=0.0
      STSUM     =0.0
      DO 50 L=1,NL
      FACTOR=XMUL(L)/(4*AREA(L))
```

```
      STIFF(1,5)=STIFF(1,5)+FACTOR*B(2,L)*B(3,L)
      STIFF(2,5)=STIFF(2,5)+FACTOR*C(2,L)*C(3,L)
      STIFF(3,5)=STIFF(3,5)+FACTOR*(B(2,L)*C(3,L)+C(2,L)*B(3,L))
      STSUM=STSUM+STIFF(1,5)+STIFF(2,5)
      AREA(L)=XMUL(L)*AREA(L)/3.0
   50 CONTINUE
      IF(STSUM.LE.0.0) RETURN
      IF(PCODE.GT.5) WRITE(OUTP,2010) LL,JD(1),JD(3),STSUM
      RETURN
C.......................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT (11X,17HFAILURE: ELEMENT ,I5,7H AREA =,1PD10.3)
 2010 FORMAT (11X,17HWARNING: ELEMENT ,I5,25H NOT DIAGONALLY DOMINANT ,
     &        14HBETWEEN NODES ,I5,5H AND ,I5,8H (STIFF=,1PD10.3,2H).)
      END
C-SBR09
C-STFLOW: CALCULATES NODAL FLUX TO STREAM, STREAM BASEFLOWS AND
C        DETERMINES WHETHER STREAM IS 'DRY' OR 'WET'.
C -----------------------------------------------------------------------
      SUBROUTINE STFLOW (H,DH,STFX,STFW,BFLOW,INF,QLK,HS,
     &                   DELT,THETA,TIME,TTOTL,TSTRM,DECDAY,
     &                   PCODE,NDAYO,MONTH,YEAR,
     &                   MOUTH,ITP,NSTP,LSN,CODEPC,CODEBP,CODESG)
      COMMON /DEVICE/ INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,
     &                IONQ,IOSH,OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      INTEGER*4 INBF,INBH,INES,INHS,INNS,INQS,INSS,INTS,IONQ,IOSH,
     &          OUTC,OUTN,OUTP,OUTS,OUTM,OUTH,ININ
      COMMON /DIMENS/ NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      INTEGER*4 NN,NE,NSS,DSS,NSN,NBF,DBF,NBH,DBH,NHD,DHD,MAXT,
     &                DNE,DFX,NUK,NK1,NAA,NLM,DE2,NUI,NUE,DAN,TABW,DET
      COMMON /FORMTS/ FSTM,FSTS,FBDF,FBDH,FNXY,FNBS,FNQS
      REAL*4 FSTM(20),FSTS(20),FBDF(20),FBDH(20),
     &       FNXY(20),FNBS(20),FNQS(20)
      COMMON /TRAVER/ NTRAV
      INTEGER*4       NTRAV
      DOUBLE PRECISION H(NN),DH(NN)
      REAL*4    HS(NSN),QLK(NSN),BFLOW(DSS),INF(NSN),STFW(NSN),DELT,
     &          STFX(NSN),TIME,TTOTL,TSTRM,DECDAY
      INTEGER*4 PCODE,NDAYO,MONTH,YEAR
      INTEGER*2 ITP(DSS),MOUTH(DSS),NSTP(3,NSN)
      LOGICAL*1 LSN(NSN),CODEPC,CODEBP,CODESG
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION DDAT(2),PRED,CALC,MSSG,HRS
      REAL*4    BFSUM,DU,TIN,TFLOW,HA,CFS,NDRY,NWET,DD,MINS,DTHALF
      INTEGER*4 DIN,I,J,K,M,MIN,NUP,NDN,NOS,YIN,NDAYS,KK,MS,YS,
     *          IDAY,HH,MM,SS,STRAV
      LOGICAL FAILED,OUTPUT
      LOGICAL*1 DRY
      DATA FAILED/.FALSE./,
     &     PRED/7H PREDIC/,CALC/7HCALCULA/,NDRY/4HDRIE/,NWET/4HHEAD/
C.......................................................................
C.....STREAM NETWORK IS DIVIDED INTO ANY NUMBER OF STREAMS CONTAINING
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C     ANY NUMBER OF REACHES.  STREAMS MAY OR MAY NOT BE CONNECTED BUT
C     IF THEY JOIN, THE DOWNSTREAM ONE MUST BE A HIGHER NUMBER IN THE
C     NUMBERING SEQUENCE.  ONE STREAM MAY CONSIST OF A MAIN STEM AND
C     A NUMBER OF TRIBUTARY BRANCHES BY PROPER SELECTION OF THE "NUP"
C     VARIABLE FOR A REACH.  "NUP" OR NSTP(2,I) REFERS TO THE REACH NUMBER
C     BEGINNING THE TRIBUTARY THAT EVENTUALLY JOINS THE STREAM AT THE
C     TOP OF THE CURRENT REACH.  "NDN" OR NSTP(3,I) REFERS TO THE REACH
C     NUMBER JUST DOWNSTREAM OF THE CURRENT REACH.  NSTP(1,I) IS THE
C     REFERENCE TO THE NODAL NUMBER OF THE NODE AT THE TOP OF THE 'I'TH
C     REACH.  IN ORDER TO DEFINE ALL OF THE NODES IN A NETWORK, AT LEAST
C     ONE REACH WITH A "NDN" VALUE OF ZERO WILL BE NEEDED TO REFERENCE
C     THE MOST DOWNSTREAM NODE OR NODES IN THE SYSTEM.
C.......................................................................
      CFS=1./(1440.0*60.0)
      DTHALF=0.5*DELT
      DD=DECDAY
      MS=MONTH
      YS=YEAR
      IF(OUTS.LE.0 .AND. OUTH.LE.0) GO TO 40
      IDAY=DD
      IF(DTHALF.GT.0.0) CALL NEWDAT (MS,DD,YS,DTHALF,IDAY)
      HRS=(DD-IDAY)*24.0
      HH=HRS
      MINS=(HRS-HH)*60.0
      MM=MINS
      SS=(MINS-MM)*60.0
   40 DO 50 J=1,NSN
      STFX(J)=0.0
      IF(QLK(J).LE.0.0) GO TO 50
      JJ=NSTP(1,J)
      K=NSTP(3,J)
      KK=NSTP(1,K)
      DU=HS(J) - 0.5*(H(JJ)+H(KK)+THETA*(DH(JJ)+DH(KK)))
      IF(CODESG .AND. DU.GT.1.0) DU=1.0
      STFX(J)=QLK(J)*DU
   50 STFW(J)=INF(J)-STFX(J)
C
C.....IN ORDER TO CATCH INFINITE LOOPS IN THE STREAM-REACH NETWORK,
C     KEEP TRACK OF THE NUMBER OF REACHES TRAVERSED (STRAV) AND STOP
C     IF THIS EXCEEDS THE NUMBER REQUIRED (NTRAV).
      STRAV=0
      DO 130 NOS=1,NSS
      I=ITP(NOS)
   60 BFSUM=0.0
   70 IF(I.EQ.0) GO TO 120
      K=NSTP(1,I)
      NUP=NSTP(2,I)
      NDN=NSTP(3,I)
      STFW(I)=STFW(I)+BFSUM
      STRAV=STRAV+1
      IF (STRAV .GT. NTRAV) GO TO 300
      BFSUM=STFW(I)
      IF(NUP) 90,100,80
   80 NSTP(2,I)=-NUP
```

```
      I=NUP
      GO TO 60
   90 NSTP(2,I)=-NUP
  100 LSN(I)=.TRUE.
      IF(BFSUM.GT.0.0) GO TO 110
      LSN(I)=.FALSE.
      STFW(I)=0.0
      BFSUM=0.0
  110 IF(I.EQ.MOUTH(NOS)) GO TO 120
      I=NDN
      GO TO 70
  120 BFLOW(NOS)=BFSUM*CFS
C
C.....IF STREAM JOINS ANOTHER, I.E. NDN NOT ZERO, ADD BASEFLOW TO
C     ADJOINING REACH:
      IF(NDN.GT.0) STFW(NDN)=STFW(NDN)+BFSUM
  130 CONTINUE
      TFLOW=TIME+DTHALF
      IF(OUTS.GT.0)   WRITE(OUTS,2030) MS,IDAY,YS,HH,MM,SS,
     &                                 (NOS,BFLOW(NOS),NOS=1,NSS)
      IF(OUTH.LE.0)   GO TO 190
      IF((.NOT.CODEBP).AND.(THETA.NE.0.0)) GO TO 190
      WRITE(OUTH,2050) MS,IDAY,YS,HH,MM,SS,TFLOW
C
C.....PRINT REACHES WHERE STREAMS BECOME LIVE OR DRY UP TO DEVICE OUTH.
      DO 180 NOS=1,NSS
      DRY=.TRUE.
      I=ITP(NOS)
      M=MOUTH(NOS)
  140 IF(I.EQ.0 .OR. I.EQ.M) GO TO 180
      NUP=NSTP(2,I)
      NDN=NSTP(3,I)
      IF(NDN.EQ.0) GO TO 180
      IF(NUP) 160,170,150
C
C.....BRANCH UP TO TRIBUTARY; FLAG CONFLUENCE REACH IF MAINSTEM IS WET:
  150 NSTP(2,I)=-NUP
      IF(.NOT.DRY) NSTP(3,I)=-NDN
      DRY=.TRUE.
      I=NUP
      GO TO 140
C
C.....AT CONFLUENCE ONCE AGAIN; TAKE INTO ACCOUNT STATUS OF MAINSTEM:
  160 NSTP(2,I)=-NUP
      IF(NDN.GT.0) GO TO 170
      DRY=.FALSE.
      NSTP(3,I)=-NDN
      NDN=-NDN
C
C.....OUTPUT IF TRANSITION FROM WET TO DRY OR DRY TO WET IN REACH:
  170 JJ=NSTP(1,I)
      KK=NSTP(1,NDN)
      HA=0.5*(H(JJ)+H(KK)+THETA*(DH(JJ)+DH(KK)))
C
```

```
C.....STREAMS HEADS IN REACH "I" IF UPSTREAM DRY AND "I" WET.  WRITE OUT
C     STREAM #, REACH #, NODE NUMBERS ,BASEFLOW, HEADS AND TIME:
      IF(DRY .AND. LSN(I))
     &         WRITE(OUTH,2040) NOS,NWET,I,JJ,KK,STFW(I),HS(I),HA
C
C.....STREAMS DRIES IN REACH "I" IF UPSTREAM WET AND "I" DRY.  WRITE OUT
C     STREAM #, REACH #, NODE NUMBERS ,BASEFLOW, HEADS AND TIME:
      IF((.NOT.DRY) .AND. .NOT.LSN(I))
     &         WRITE(OUTH,2040) NOS,NDRY,I,JJ,KK,STFW(I),HS(I),HA
      DRY=.NOT.LSN(I)
      I=NDN
      GO TO 140
  180 CONTINUE
  190 OUTPUT=.FALSE.
      IF(PCODE.GE.1) OUTPUT=.TRUE.
      IF(THETA.NE.0.0 .AND. .NOT.CODEBP) OUTPUT=.FALSE.
      MSSG=CALC
      IF(THETA.NE.0.0) MSSG=PRED
      IF(OUTPUT) WRITE(OUTP,2020) MSSG,(NOS,BFLOW(NOS),NOS=1,NSS)
      IF(PCODE.LT.4) OUTPUT=.FALSE.
      IF(OUTPUT) WRITE(OUTP,2000)
C
C.....PARTITION THE STREAM-AQUIFER FLUX FOR A REACH INTO A CONTRIBUTION
C     FOR THE UPSTREAM NODE AND THE DOWNSTREAM NODE.
      DO 210 J=1,NSN
      I=NSTP(1,J)
      IF(.NOT.LSN(J)) STFX(J)=0.0
      NUP=NSTP(2,J)
      NDN=NSTP(3,J)
      IF(NDN.LE.0) GO TO 200
      K=NSTP(1,NDN)
      HA=0.5*(H(I)+H(K)+THETA*(DH(I)+DH(K)))
      IF(OUTPUT) WRITE(OUTP,2010) J,STFW(J),STFX(J),HS(J),HA,INF(J)
  200 STFW(J)=0.5*STFX(J)
      STFX(J)=STFW(J)
C
C.....CHECK CLOSURE OF STREAM NETWORK UPSTREAM BRANCHING IF ANY:
      IF(NUP.GE.0 .AND. NDN.GE.0) GO TO 210
      FAILED=.TRUE.
      WRITE(OUTP,2060) J,NUP,NDN
  210 CONTINUE
C
C.....ACCUMULATE STFX FOR REACHES UPSTREAM AND DOWNSTREAM OF NODE WITH
C     STFX INDEX REFERRING TO UPSTREAM NODE OF REACH.
      DO 220 J=1,NSN
      NDN=NSTP(3,J)
      IF(NDN.LE.0) GO TO 220
      STFX(NDN)=STFX(NDN)+STFW(J)
      STFW(J)=0.5*QLK(J)
  220 CONTINUE
C
C.....STFW TO REPRESENT EQUIVALENT LEAKAGE AT NODE WITH STFW INDEX
C     REFERRING TO UPSTREAM NODE OF REACH.
      DO 230 J=1,NSN
```

```
      NDN=NSTP(3,J)
      IF(NDN.LE.0) GO TO 230
      STFW(J)=STFW(J)+0.5*QLK(NDN)
  230 CONTINUE
C
C.....STOP IF A PROBLEM WITH UPSTREAM BRANCHING EXISTS:
      IF(FAILED) STOP
      RETURN
C
C.....STOP, THERE IS PROBABLY A PROBLEM IN THE DEFINITION OF THE
C     STREAM-REACH NETWORK FOR STREAM # "NOS" IN THE VICINITY OF
C     REACH NUMBER "I":
  300 WRITE(OUTP,2070) NOS,I
      STOP
C.......................................................................
C.....INPUT FORMAT:
 1000 FORMAT(I2,1X,I2,1X,I4,F10.0)
C
C.....OUTPUT FORMATS:
 2000 FORMAT(//11X,15HSTREAM REACHES:,/11X,14(1H-),/32X,9HSTREAM TO,33X,
     &       9HINFLOW(+),/11X,33HREACH STREAMFLOW   AQUIFER FLUX   ,
     &      39HSTREAM HEAD  AQUIFER HEAD  DIVERSION(-))
 2010 FORMAT(11X,I4,2X,1PE10.3,3(4X,E10.3),7X,E10.3)
 2020 FORMAT(/11X,A7,32HTED STREAM BASEFLOWS (L**3/SEC):,
     &       /11X,39(1H-),/11X,7(6HSTREAM,2X,5HVALUE,4X),
     &       /(11X,7(I4,1X,1PE10.3,2X)))
 2030 FORMAT(I2,1H/,I2,1H/,I4,/I2,1H:,I2,1H:,I2,(/I5,F10.2))
 2040 FORMAT(I6,3X,A4,'S',I7,I8,1H-,I5,3(1X,1PE10.3))
 2050 FORMAT(26HSTREAM BASEFLOWS FOR DATE:,I2,1H/,I2,1H/,I4,8H  TIME: ,
     &       I2,1H:,I2,1H:,I2,13H  TOTAL DAYS=,1PE10.3,/8HSTREAM  ,
     &       50HSTATUS  REACH NODES FROM-TO  FLOW(CFS)   STREAM & ,
     &       13HAQUIFER HEADS)
 2060 FORMAT(54H STOP: SERIOUS PROBLEM WITH STREAM NETWORK CLOSURE AT ,
     &        6HREACH ,I5,10H UPSTREAM=,I5,12H DOWNSTREAM=,I5,/,
     &       50H CHECK THAT REACH BRANCHING UPSTREAM IS TRAVERSED,
     &       32HAGAIN WHEN RETURNING DOWNSTREAM.)
 2070 FORMAT(49H STOP: SUBROUTINE STFLOW APPEARS STUCK IN A LOOP.,
     &       49H CHECK DEFINITION OF THE STREAM-REACH NETWORK FOR,
     &       15H      STREAM #,I5,25H IN THE VICINITY OF REACH,I5)
      END
C-SBR10
C-INTABL: READS THE TABULATED VALUES OF CONDUCTANCE AND CAPACITANCE VERSUS
C         VERSUS SATURATED THICKNESS FROM DEVICE INTS.
C -----------------------------------------------------------------------
      SUBROUTINE INTABL (FMT,FMTT,TABL,INTS,LAST,MATL,LTABL,MAXT,DAN,
     &                   TABW,CPCDEG,OUTP,ANCODE)
      INTEGER*4 INTS,LAST,MATL,LTABL,MAXT,DAN,TABW,CPCDEG,OUTP
      REAL*4    TABL(TABW,MAXT),FMT(20),FMTT(20)
      LOGICAL   ANCODE
C.....LOCAL VARIABLES:
      REAL*4    RATIO,DUMMY
      INTEGER*4 I,J,LS,LF,MATNUM,ACCESS,CODEAN,WIDTH
      LOGICAL   WARN1,WARN2
      DATA WARN1/.TRUE./,WARN2/.TRUE./
```

```
C.........................................................................
      ACCESS=0
   10 IF(LAST.EQ.MATL) RETURN
C
C.....MATERIAL PROPERTIES:  MATERIAL NUMBER, TABLE LENGTH, WHETHER
C     CAPACITANCE IS CONSTANT THROUGHOUT "BLOCKS" OR VARIES LINEARLY
C     (LINEAR IF DEGREE IS ONE, CONSTANT IF DEGREE IS ZERO) & PRESENCE
C     OF ANISOTROPIC CONDUCTANCE (INDICATED BY NON-ZERO CODE).
      READ(INTS,FMT,END=70) MATNUM,LTABL,CPCDEG,CODEAN
      IF(MATNUM.EQ.0) GO TO 20
      ANCODE=.FALSE.
      IF(DAN.EQ.3 .AND. CODEAN.NE.0) ANCODE=.TRUE.
      WIDTH=3
      IF(ANCODE) WIDTH=5
C
C.....READ SATURATED THICKNESS, CONDUCTANCE, AND CAPACITANCE.
      DO 15 J=1,LTABL
   15 READ(INTS,FMTT) (TABL(I,J),I=1,WIDTH)
      LAST=MATNUM
      GO TO 10
   20 REWIND INTS
C
C.....SKIP THE FIRST THREE RECORDS CONTAINING MAXIMUM TABLE LENGTH
C     AND DATA FORMATS:
      READ(INTS,FMT)
      READ(INTS,FMT)
      READ(INTS,FMT)
      IF(WARN1) WRITE(OUTP,2000)
      WARN1=.FALSE.
      IF(ACCESS.EQ.1) GO TO 80
      ACCESS=ACCESS+1
      GO TO 10
   70 IF(WARN2) WRITE(OUTP,2010) INTS
      WARN2=.FALSE.
      GO TO 20
   80 WRITE(OUTP,2020) MATL
      STOP
C.........................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(1X,45H*** WARNING: ELEMENTS NOT IN MATERIAL NUMBER ,
     &          41HSEQUENCE, EXECUTION TIME IS INCREASED ***)
 2010 FORMAT(1X,40H*** WARNING: END-OF-FILE REACHED ON UNIT,I5,
     &       55H WITHOUT BLANK; ERROR MAY RESULT AT SOME FACILITIES ***)
 2020 FORMAT(11X,27H***** STOP: MATERIAL NUMBER,I5,
     &           37H NOT FOUND WITHIN TABLE DATASET *****)
      END
C-SBR11
C-DAYS: DETERMINES THE NUMBER OF DAYS BETWEEN DATES.  INPUT THE INTEGER
C       VALUES FOR MONTH, DAY AND YEAR; OUTPUT IS NUMBER OF DAYS.
C -----------------------------------------------------------------------
      SUBROUTINE DAYS (M,D,Y,NDAY0,NDAYS)
      INTEGER*4 D,M,NDAY0,NDAYS,Y
C
C.....LOCAL VARIABLES:
```

```
      DOUBLE PRECISION DDAYS(2),DMNTH(2)
      INTEGER*4 NCOM,Y1,N31,N12,ONE
      INTEGER*2 D2,M2
      LOGICAL FAILED
      DATA DDAYS/8HDAYS IN ,8HA MONTH /,DMNTH/8HMONTHS I,8HN A YEAR/,
     &    N31/31/,N12/12/,ONE/1/,FAILED/.FALSE./
C.......................................................................
      D2=D
      M2=M
      CALL BOUNDS (D2,ONE,ONE,N31,DDAYS,FAILED)
      CALL BOUNDS (M2,ONE,ONE,N12,DMNTH,FAILED)
      IF (FAILED) STOP
      Y1=Y
      IF(M.LT.3) Y1=Y-1
      NDAYS=365*Y+31*(M-1)+D+INT(Y1/4.)-INT(0.75*(INT(Y1/100.)+1))
      IF(M.GT.2) NDAYS=NDAYS-INT(.4*M+2.3)
      NDAYS=NDAYS-NDAY0
      RETURN
      END
C-SBR12
C-NEWDAT:  DETERMINES THE NEW MONTH, DAY AND YEAR GIVEN THE OLD MONTH,
C          DAY AND YEAR AND THE NUMBER OF DAYS ADDED.
C ----------------------------------------------------------------------
      SUBROUTINE NEWDAT (M,DD,Y,DELD,D)
      REAL*4    DD,DELD
      INTEGER*4 D,M,Y
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION DUM
      INTEGER*4 DM(12),DELM,DELY,DM1,Y4
      DATA DM/31,28,31,30,31,30,31,31,30,31,30,31/
C.......................................................................
      DUM=DD+DELD
      D=IDINT(DUM)
      DUM=DUM-D
   10 DELM=DM(M)
      IF(M.NE.2) GO TO 20
      Y4=4*INT(Y/4.)
      DELY=Y-Y4
      IF(DELY.EQ.0) DELM=DELM+1
   20 DM1=DELM+1
      IF(D.LT.DM1) GO TO 30
      D=D-DELM
      M=M+1
      IF(M.LT.13) GO TO 10
      Y=Y+1
      M=1
      GO TO 10
   30 DD=DUM+D
      RETURN
      END
C-SBR13
C-ACCUM:SUBROUTINE TO ACCUMULATE THE SPACE AND TIME DERIVATIVE MATRICES.
C ----------------------------------------------------------------------
```

```
      SUBROUTINE ACCUM(ANM,STIFF,AREA,COND,CPTC,DAN,NAA,OUTP,IN,IM,MANM)
      INTEGER*4 NAA,OUTP,DAN
      INTEGER*2 IN,IM,MANM(2,NAA)
      DOUBLE PRECISION ANM(NAA)
      REAL*4    STIFF(DAN),AREA,COND(DAN),CPTC
C
C.....LOCAL VARIABLES:
      INTEGER*4 DNM,IS,JF,I
C.......................................................................
C     FORM CAPACITY TERM; NOTE THE ORDER IN WHICH THE ELEMENT INDICES ARE
C     PASSED TO THIS SUBROUTINE FROM SUBROUTINE REFORM (SBR04).
      ANM(IN)=ANM(IN)+CPTC*AREA
C
C.....FIND THE LOCATION OF THE IN:IM COMPONENT IN THE ANM LINKED LIST
      DNM=IN-IM
      IF(DNM.GT.0) DNM=0
      IS=IN-DNM
      JF=IM+DNM
   10 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 30
      IF(MANM(1,IS).NE.JF) GO TO 10
C
C.....ADD IN THE STIFFNESS MATRIX COMPONENT.
      DO 20 I=1,DAN
   20 ANM(IS)=ANM(IS)+COND(I)*STIFF(I)
      RETURN
   30 WRITE(OUTP,2000) IN,IM
      STOP
C.......................................................................
C.....OUTPUT FORMAT:
 2000 FORMAT (11X,34HSTOP EXECUTION: LINK BETWEEN NODES,I5,
     &             4H AND,I5,30H NOT FOUND IN ANM LINKED LIST.)
      END
C-SBR14
C-SETANM:SUBROUTINE TO FORM THE LINKED LIST STRUCTURE.
C -----------------------------------------------------------------------
      SUBROUTINE SETANM (I,J,IVOID,MANM,NAA,OUTP)
      INTEGER*4 I,J,IVOID,NAA,OUTP
      INTEGER*2 MANM(2,NAA)
C
C.....LOCAL VARIABLES:
      INTEGER*4 DIJ,IS,JF,PRE
C.......................................................................
      DIJ=I-J
      IF(DIJ.GT.0) DIJ=0
      IS=I-DIJ
      JF=J+DIJ
   10 PRE=IS
      IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 20
      IF(MANM(1,IS).EQ.JF) RETURN
      GO TO 10
   20 MANM(2,PRE)=IVOID
      MANM(1,IVOID)=JF
```

```
      MANM(2,IVOID)=0
      IVOID=IVOID+1
      IF(IVOID.LE.NAA) RETURN
      WRITE(OUTP,2000) NAA
      STOP
C.......................................................................
C.....OUTPUT FORMAT:
 2000 FORMAT(//11X,28HSTOP: ARRAY SPACE FOR MANM (,I5,11H) EXCEEDED:,
     &       /11X,49HINCREASE DIMENSION OF VI2 ARRAY IN INITIALIZATION,
     &       /11X,37HROUTINE. (LINE NUMBERS 0086 AND 0087))
      END
C-SBR15
C-FACTOR: SUBROUTINE FOR CHOLESKY FACTORIZATION OF MATRIX LAMDA.
C -----------------------------------------------------------------------
      SUBROUTINE FACTOR (LAMDA,NLM,NUK,NK1,PCODE,OUTP,MV)
      INTEGER*4 NLM,NUK,NK1,PCODE,OUTP
      INTEGER*2 MV(NK1)
      DOUBLE PRECISION LAMDA(NLM)
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION SUM,TEMP
      INTEGER*4 I,II,J,JJ,KID,KIJ,KIS,KJD,KJS
C.......................................................................
      IF(PCODE.LT.6) GO TO 30
C
C.....PRINT GLOBAL COEFFICIENT MATRIX PRIOR TO FACTORIZATION:
      WRITE(OUTP,2000)
      DO 20 I=1,NUK
      WRITE(OUTP,2020) I
      KIS=MV(I)
      KID=MV(I+1)-1-KIS
      II=I-KID
      J=KIS+I
   10 JJ=II+8
      IF(JJ.GT.I) JJ=I
      WRITE(OUTP,2030) (K,LAMDA(J-K),K=II,JJ)
      II=JJ+1
      IF(II.LE.I) GO TO  10
   20 CONTINUE
      WRITE(OUTP,2010)
C
C.....CHOLESKY FACTORIZATION OF MATRIX LAMDA.
   30 DO 100 I=1,NUK
      KIS=MV(I)
      KID=MV(I+1)-1-KIS
      KR=KID
      SUM=LAMDA(KIS)
   40 IF(KR.LE.0) GO TO 70
      J=I-KR
      KL=KID-KR
      KIJ=KIS+KR
      TEMP=LAMDA(KIJ)
      KJS=MV(J)
      KJD=MV(J+1)-1-KJS
```

```
      IF(KJD.LT.KL) KL=KJD
      IF(KL.LE.0) GO TO 60
      DO 50 K=1,KL
   50 TEMP=TEMP-LAMDA(KIJ+K)*LAMDA(KJS+K)
   60 LAMDA(KIJ)=TEMP*LAMDA(KJS)
      SUM=SUM-(TEMP*LAMDA(KJS))**2
      KR=KR-1
      GO TO 40
   70 IF(SUM.LE.0.0) GO TO 80
      LAMDA(KIS)=DSQRT(1./SUM)
      IF(PCODE.LT.6) GO TO 100
C
C.....PRINT GLOBAL COEFFICIENT MATRIX.
   80 WRITE(OUTP,2020) I
      II=I-KID
      J=KIS+I
   90 JJ=II+8
      IF(JJ.GT.I) JJ=I
      WRITE(OUTP,2030) (K,LAMDA(J-K),K=II,JJ)
      II=JJ+1
      IF(II.LE.I) GO TO 90
      IF(SUM.LE.0.0) GO TO 110
  100 CONTINUE
      RETURN
  110 WRITE(OUTP,2040) I,SUM
      STOP
C.........................................................................
C.....OUTPUT FORMATS:
 2000 FORMAT(//1X,23HORIGINAL LAMBDA MATRIX:,/1X,23(1H-))
 2010 FORMAT(//1X,23HFACTORED LAMBDA MATRIX:,/1X,23(1H-))
 2020 FORMAT(1X,9HEQUATION ,I5)
 2030 FORMAT(9(I4,1PE10.2))
 2040 FORMAT(//11X,32HFACTORIZATION FAILS ON EQUATION ,I5,
     &              12H WITH SUM = ,1PE15.6)
      END
C-SBR16
C-SOLVE: SUBROUTINE SOLVING FACTORED LAMDA MATRIX FOR UNKNOWNS.
C ------------------------------------------------------------------------
      SUBROUTINE SOLVE (LAMDA,RHS,NLM,NUK,NK1,MV)
      INTEGER*4 NLM,NUK,NK1
      INTEGER*2 MV(NK1)
      DOUBLE PRECISION LAMDA(NLM),RHS(NUK)
C
C.....LOCAL VARIABLES:
      DOUBLE PRECISION SUM
      INTEGER*4 I,II,K,KD,KF,KI,KS
C.........................................................................
C.....FOWARD SUBSTITUTION FOR INTERMEDIATE SOLUTION AND STORE AS RHS.
      DO 20 I=1,NUK
      SUM=RHS(I)
      KI=MV(I)
      KS=KI+1
      KF=MV(I+1)-1
      KD=KI+I
```

```
      IF(KI.EQ.KF) GO TO 20
      DO 10 K=KS,KF
   10 SUM=SUM-LAMDA(K)*RHS(KD-K)
   20 RHS(I)=SUM*LAMDA(KI)
C
C.....BACK SUBSTITUTION AND STORE SOLUTION IN VECTOR RHS.
      DO 40 II=1,NUK
      I=NUK+1-II
      KI=MV(I)
      KD=KI+I
      KS=KI+1
      KF=MV(I+1)-1
      RHS(I)=RHS(I)*LAMDA(KI)
      IF(KF.EQ.KI) GO TO 40
      DO 30 K=KS,KF
   30 RHS(KD-K)=RHS(KD-K)-LAMDA(K)*RHS(I)
   40 CONTINUE
      RETURN
      END
C-SBR17
C-OPTNUM: SCHEME TO RENUMBER IMPLICIT NODES TO MINIMIZE THE LEFT
C         HORIZONTAL PROFILE OF THE SYMMETRIC MATRIX.
C ----------------------------------------------------------------------
      SUBROUTINE OPTNUM (NAA,NA,NN,DAR,ML,OUTP,LR,LRC,LEVV,LEVU,NUM,
     &                   LL,PNT,NO,NH,NL,MANM,LO)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 ONE,ZERO,NA,NAA,NN,DAR,ML,IVOID,OUTP
      COMMON /DEGRE/ DMAX,DMIN,LMAX,LMIN
      DIMENSION LR(NN),LRC(NN),LEVV(NN),LEVU(NN),NUM(NN),LL(DAR),
     &          PNT(DAR),NO(ML),NH(ML),NL(ML),MANM(2,NAA),LO(NA)
      DATA ONE/1/,ZERO/0/
C.......................................................................
      IVOID=NN+1
      NS=NN+1
      DO 10 I=1,NN
      PNT(I)=0
   10 NUM(I)=0
      DO 30 I=1,NA
      IF(LO(I).LT.1) GO TO 30
      II=MANM(1,I)
      IS=I
   20 IS=MANM(2,IS)
      IF(IS.EQ.0) GO TO 30
      J=MANM(1,IS)
      IF(LO(J).LT.1) GO TO 20
      JJ=MANM(1.J)
      CALL FINDIJ (DAR,IVOID,OUTP,LL,PNT,JJ,II)
      CALL FINDIJ (DAR,IVOID,OUTP,LL,PNT,II,JJ)
      GO TO 20
   30 CONTINUE
      IVOID=IVOID-1
C
C.....ELIMINATE AND NUMBER UNCONNECTED NODES.
      DO 40 I=1,NN
```

```
      IF(NUM(I).NE.0.OR.PNT(I).NE.0) GO TO 40
      NS=NS-1
      NUM(I)=NS
   40 CONTINUE
      IF(NS.EQ.1) GO TO 320
C
C.....DETERMINE DEGREE OF UNNUMBERED NODES AND STORE AS LL(NODE).
C     RETURN MINIMUM DEGREE UNNUMBERED NODE.
   50 CALL DEGREE (NN,DAR,ONE,ZERO,ZERO,NUM,LEVU,LL,PNT)
C
C.....SET 'IV' TO NODE WITH MINIMUM DEGREE AND CREATE 'IV' LEVEL
C     STRUCTURE.
      IV=LMIN
      CALL BLDLVL (NN,DAR,LEVV,LL,PNT,IV,LMXV,WMXV,SIZE)
C
C.....CHECK FOR 'IU' WITHIN HIGHEST LEVEL OF 'IV' STRUCTURE STARTING
C     WITH LOWEST DEGREE.
   60 KODW=0
      DM2=DMIN
   70 DO 80 I=1,NN
      IF(NUM(I).NE.0.OR.LEVV(I).NE.LMXV) GO TO 80
      IF(LL(I).GT.DM2) GO TO 80
      IU=I
      LEVV(I)=-LEVV(I)
      DM2=LL(I)
      GO TO 90
   80 CONTINUE
      DM2=DM2+1
      IF(DM2.GT.DMAX) GO TO 150
      GO TO 70
   90 CALL BLDLVL (NN,DAR,LEVU,LL,PNT,IU,LMXU,WMXU,SIZE)
C
C.....CHECK LEVEL STRUCTURE OF 'IU'.
      IF(KODW.EQ.1) GO TO 100
      IMNU=IU
      WMN=WMXU
      KODW=1
C
C.....IF DEPTH OF 'IU' IS GREATER THAN DEPTH OF 'IV' LEVEL STRUCTURE,
C     SET 'IV' TO 'IU' AND REGENERATE 'IU' LEVELS.
  100 IF(LMXU-LMXV) 140,110,120
  110 IF(WMXU.GE.WMXV) GO TO 140
  120 WMXV=WMXU
      LMXV=LMXU
      DO 130 I=1,NN
  130 LEVV(I)=LEVU(I)
      IV=IU
      GO TO 60
C
C......SELECT 'IU' AS ENDPOINT WITH MINIMUM WIDTH LEVEL STRUCTURE.
  140 IF(WMXU.GE.WMN) GO TO 70
      IMNU=IU
      WMN=WMXU
      GO TO 70
```

```
C
C.....PSEUDO-DIAGONAL IV-IU DETERMINED.
  150 IF(LMXV.GT.ML) WRITE(6,2000) LMXV,ML
      DO 160 I=1,NN
      IF(LEVV(I).LT.0) LEVV(I)=-LEVV(I)
  160 CONTINUE
      IU=IMNU
      CALL BLDLVL (NN,DAR,LEVU,LL,PNT,IU,LMXU,WMXU,SIZE)
C
C.....SET UP 'IU' LEVEL STRUCTURE.
      DO 170 I=1,NN
      IF(LEVU(I).EQ.0) GO TO 170
      LEVU(I)=LMXU-LEVU(I)+1
  170 CONTINUE
      KODICH=0
      IF(LL(IU).LT.LL(IV)) KODICH=1
C
C.....DELETE NODES WITH LEVU EQUAL TO LEVV.
      NELM=0
      DO 180 I=1,NN
      IF(LEVV(I).NE.LEVU(I)) GO TO 180
      NELM=NELM+1
      LL(I)=0
  180 CONTINUE
C
C.....LOCATE DISJOINT CONNECTED COMPONENTS.
      SUM=0
      DO 190 I=1,NN
      IF(LEVV(I).EQ.0.OR.LL(I).EQ.0) GO TO 190
      SUM=SUM+1
      LL(I)=1
  190 CONTINUE
      IF(SUM.EQ.0) GO TO 330
C
C.....RANK DISJOINT CONNECTED COMPONENTS.
      II=1
      IF(II.GT.NN) GO TO 270
  200 DO 210 I=II,NN
      IS=I
      IF(LL(I).EQ.1) GO TO 220
  210 CONTINUE
      GO TO 270
  220 IC=1
      ISTART=IS
  230 IC=IC+1
      LL(IS)=-1
  240 IS=PNT(IS)
      IF(IS.EQ.0) GO TO 250
      LIS=LL(IS)
      IF(LL(LIS).NE.1) GO TO 240
      LL(LIS)=2
      GO TO 240
  250 DO 260 I=1,NN
      IS=I
```

```
      IF(LL(IS).EQ.2) GO TO 230
  260 CONTINUE
      II=ISTART+1
      LL(ISTART)=IC
      GO TO 200
C
C.....FORM THE NO VECTOR (NUMBER OF NODES ASSIGNED TO EACH LEVEL).
  270 DO 280 I=1,LMXV
  280 NO(I)=0
      DO 290 I=1,NN
      IF(LL(I).NE.0.OR.LEVV(I).EQ.0) GO TO 290
      L1=LEVV(I)
      NO(L1)=NO(L1)+1
  290 CONTINUE
C
C.....SETTLE DISJOINT CONNECTED COMPONENTS IN ORDER OF DECREASING SIZE.
      IDCC=0
  300 ICMAX=0
      DO 310 I=1,NN
      IF(LL(I).LE.ICMAX) GO TO 310
      ICMAX=LL(I)-1
      ISTART=I
  310 CONTINUE
  320 IDCC=IDCC+1
      IF(ICMAX.EQ.0) GO TO 330
C
C.....DETERMINE WHICH LEVEL STRUCTURE SHOULD BE SELECTED FOR THIS
C     DISJOINT CONNECTED COMPONENT.
      CALL DISJNT (NN,DAR,ML,ISTART,IDCC,NELM,KODREV,KODICH,WMXV,WMXU,
     &             LMXV,PNT,LL,LEVV,LEVU,NO,NH,NL)
      GO TO 300
C
C.....FINAL LEVEL STRUCTURE HAS BEEN FORMED.  RENUMBER THIS STRUCTURE.
  330 NSF=NS
      CALL DEGREE (NN,DAR,ZERO,ZERO,ZERO,NUM,LEVU,LL,PNT)
      CALL NUMLVL (NN,DAR,NSF,SIZE,KODREV,KODICH,IU,IV,LMXV,
     &             LR,LRC,LEVV,LEVU,NUM,LL,PNT)
      NS=NSF-SIZE
C
C.....IF ALL NODES HAVE NOT BEEN RENUMBERED, FORM ANY REMAINING
C     LEVEL STRUCTURE.
      IF(NS.GT.1) GO TO 50
C
C.....SET MANM ARRAY TO INTERNAL NUMBERING.
      DO 340 I=1,NA
      IF(LO(I).LT.1) GO TO 340
      J=MANM(1,I)
      MANM(1,I)=NUM(J)
  340 CONTINUE
      RETURN
C......................................................................
C.....OUTPUT FORMAT:
 2000 FORMAT(6X,14H***** WARNING:,I5,25H LEVELS EXCEED DIMENSION=,I5)
      END
```

```
C-SBR18
C-NUMLVL: SUBROUTINE WHICH RENUMBERS NODES WITHIN A PARTICULAR LEVEL
C          STRUCTURE.
C -----------------------------------------------------------------------
      SUBROUTINE NUMLVL (NN,DAR,NSF,SIZE,KODREV,KODICH,IU,IV,LMXV,
     &                    LR,LRC,LEVV,LEVU,NUM,LL,PNT)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 NN,DAR,W,ONE,ZERO
      COMMON /DEGRE/ DMAX,DMIN,LMAX,LMIN
      DIMENSION LR(NN),LRC(NN),LEVV(NN),LEVU(NN),NUM(NN),LL(DAR),
     &          PNT(DAR)
      DATA ONE/1/,ZERO/0/
C.......................................................................
C.....RENUMBER NODES STARTING WITH 'IV' AFTER CONSIDERING DEGREES OF
C     BOTH 'IU' AND 'IV'.  WORK INCREASING LEVELS: SELECT A NODE 'W'
C     WITH MINIMUM NUMBER AND ADJACENT UNNUMBERED NODES OF SAME LEVEL.
C     NUMBER THESE BY INCREASING MODIFIED DEGREE.  IF THERE ARE ANY
C     UNNUMBERED NODES REMAINING ON THIS LEVEL, NUMBER THESE BY
C     INCREASING MODIFIED DEGREE.  SELECT A NODE 'W' WITH MINIMUM
C     NUMBER AND UNNUMBERED ADJACENT NODES ON NEXT LEVEL.  NUMBER
C     THESE BY INCREASING MODIFIED DEGREE AND SO ON.
      IF(KODICH.EQ.0) GO TO 20
      DO 10 I=1,NN
      IF(LEVV(I).EQ.0) GO TO 10
      LEVV(I)=LMXV-LEVV(I)+1
   10 CONTINUE
      ITEMP=IV
      IV=IU
      IU=ITEMP
   20 DO 30 I=1,NN
      LRC(I)=0
      IF(LEVU(I).EQ.0) GO TO 30
      LEVU(I)=-1
      LR(I)=0
   30 CONTINUE
      LR(1)=IV
      LRC(IV)=1
      LEVU(IV)=0
      NUMC=1
      NUMX=1
      LEVEL=1
      LEVEF=1
      NUMS=1
      NULS=1
      NULF=1
      W=IV
      CALL DEGREE (NN,DAR,ZERO,ONE,W,NUM,LEVU,LL,PNT)
   40 DO 80 I=NUMS,NUMX
      JJ=LR(I)
      IF(LEVV(JJ).NE.LEVEL) GO TO 80
   50 IDEG=DMAX+1
      J=JJ
   60 J=PNT(J)
      IF(J.EQ.0) GO TO 70
```

```
      II=LL(J)
      IF(LEVU(II).EQ.0.OR.LEVV(II).NE.LEVEF) GO TO 60
      ISUM=LL(II)
      IF(ISUM.GT.IDEG) GO TO 60
      IDEG=ISUM
      W=II
      GO TO 60
   70 IF(IDEG.GT.DMAX) GO TO 80
      NUMC=NUMC+1
      LR(NUMC)=W
      LEVU(W)=0
      LRC(W)=NUMC
      CALL DEGREE (NN,DAR,ZERO,ONE,W,NUM,LEVU,LL,PNT)
      GO TO 50
   80 CONTINUE
      IF(NUMC.EQ.SIZE)   GO TO 130
      IF(LEVEL.EQ.LEVEF) GO TO 90
      LEVEL=LEVEF
      NULS=NULF+1
      NULF=NUMC
      NUMS=NULS
      NUMX=NULF
      GO TO 40
   90 IF(NUMC.NE.NUMX) GO TO 110
      IDEG=DMAX+1
      DO 100 I=1,NN
      IF(LEVV(I).NE.LEVEL.OR.LEVU(I).EQ.0) GO TO 100
      IF(LL(I).GE.IDEG) GO TO 100
      IDEG=LL(I)
      W=I
  100 CONTINUE
      IF(IDEG.GT.DMAX) GO TO 120
      NUMC=NUMC+1
      LR(NUMC)=W
      LEVU(W)=0
      LRC(W)=NUMC
      CALL DEGREE (NN,DAR,ZERO,ONE,W,NUM,LEVU,LL,PNT)
  110 NUMS=NUMX+1
      NUMX=NUMC
      GO TO 40
  120 LEVEF=LEVEF+1
      NULF=NUMC
      NUMS=NULS
      NUMX=NULF
      GO TO 40
  130 IF(KODREV) 160,160,140
  140 DO 150 I=1,NN
      IF(LRC(I).NE.0) NUM(I)=NSF-LRC(I)
  150 CONTINUE
      RETURN
  160 DO 170 I=1,NN
      IF(LRC(I).NE.0) NUM(I)=NSF-SIZE-1+LRC(I)
  170 CONTINUE
      RETURN
```

```
      END
C-SBR19
C-DISJNT: SUBROUTINE TO DETERMINE WHICH LEVEL STRUCTURE IS TO BE USED
C         FOR A PARTICULAR DISJOINT CONNECTED COMPONENT.
C ----------------------------------------------------------------------
      SUBROUTINE DISJNT (NN,DAR,ML,ISTART,IDCC,NELM,KODREV,KODICH,WMXV,
     &                   WMXU,LMXV,PNT,LL,LEVV,LEVU,NO,NH,NL)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 NN,DAR,ML
      DIMENSION PNT(DAR),LL(DAR),LEVV(NN),LEVU(NN),NO(ML),NH(ML),NL(ML)
C.......................................................................
C.....'NO','NH','NL' ARRAYS WILL CONTAIN THE NUMBER OF NODES ON EACH LEVEL.
C     'NO' CONSISTS ONLY OF NODES WITH DETERMINED LEVEL (LEVV=LEVU).
C     'NH' CONSISTS OF 'NO' PLUS NODES OF DISJOINT CONNECTED COMPONENT
C     USING LEVV LEVELS.
C     'NL' CONSISTS OF 'NO' PLUS NODES OF DISJOINT CONNECTED COMPONENT
C     USING LEVU LEVELS.
      DO 10 I=1,LMXV
      NH(I)=NO(I)
   10 NL(I)=NO(I)
C
C.....FLAG ELEMENTS OF DISJOINT CONNECTED COMPONENT BY SETTING LL=1.
      IS=ISTART
   20 LL(IS)=1
   30 IS=PNT(IS)
      IF(IS.EQ.0) GO TO 40
      LIS=LL(IS)
      IF(LL(LIS).NE.-1) GO TO 30
      LL(LIS)=2
      GO TO 30
   40 DO 50 I=1,NN
      IS=I
      IF(LL(IS).EQ.2) GO TO 20
   50 CONTINUE
C
C.....FORM NH,NL,NO ARRAYS
      DO 60 I=1,NN
      IF(LL(I).LE.0.OR.LEVU(I).EQ.0)GO TO 60
      L1=LEVV(I)
      L2=LEVU(I)
      NH(L1)=NH(L1)+1
      NL(L2)=NL(L2)+1
   60 CONTINUE
      LLM=0
      LHM=0
C
C.....DETERMINE MAXIMUM WIDTH OF 'NH' AND 'NL', CONSIDERING LEVELS
C     WHICH WOULD BE CONTRIBUTED TO BY SELECTING ONE OF THE TWO
C     OF THE TWO LEVEL STRUCTURES.
      DO 70 I=1,LMXV
      IF(NH(I).GT.LHM.AND.NH(I).GT.NO(I)) LHM=NH(I)
      IF(NL(I).GT.LLM.AND.NL(I).GT.NO(I)) LLM=NL(I)
   70 CONTINUE
      IF(LHM-LLM) 90,80,120
```

```
   80 IF(WMXV.GT.WMXU) GO TO 120
   90 IF(IDCC.EQ.1) KODREV=1-KODICH
      DO 100 I=1,NN
      IF(LL(I).LE.0) GO TO 100
      LEVU(I)=LEVV(I)
      LL(I)=0
      NELM=NELM+1
  100 CONTINUE
      DO 110 I=1,LMXV
  110 NO(I)=NH(I)
      RETURN
  120 IF(IDCC.EQ.1) KODREV=KODICH
      DO 130 I=1,NN
      IF(LL(I).LE.0) GO TO 130
      LEVV(I)=LEVU(I)
      LL(I)=0
      NELM=NELM+1
  130 CONTINUE
      DO 140 I=1,LMXV
  140 NO(I)=NL(I)
      RETURN
      END
C-SBR20
C-BLDLVL: BUILD LEVEL STRUCTURE.
C -----------------------------------------------------------------------
      SUBROUTINE BLDLVL(NN,DAR,LEVEL,LL,PNT,IV,LEV,WMX,SIZE)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 NN,DAR
      DIMENSION LEVEL(NN),LL(DAR),PNT(DAR)
C.......................................................................
      SIZE=1
      DO 10 I=1,NN
   10 LEVEL(I)=0
      LEV=0
      LEVEL(IV)=1
      WMX=1
   20 LEV=LEV+1
      WIDTH=0
      DO 40 I=1,NN
      IF(LEVEL(I).NE.LEV) GO TO 40
      IS=I
   30 IS=PNT(IS)
      IF(IS.EQ.0) GO TO 40
      LIS=LL(IS)
      IF(LEVEL(LIS).NE.0) GO TO 30
      WIDTH=WIDTH+1
      LEVEL(LIS)=LEV+1
      GO TO 30
   40 CONTINUE
      SIZE=SIZE+WIDTH
      IF(WIDTH.EQ.0) RETURN
      IF(WIDTH.GT.WMX) WMX=WIDTH
      GO TO 20
      END
```

```
C-SBR21
C-DEGREE: DETERMINE DEGREES.
C ----------------------------------------------------------------------
      SUBROUTINE DEGREE (NN,DAR,KSTAT,MOD,IN,NUM,LEVU,LL,PNT)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 NN,DAR,KSTAT,MOD,IN
      COMMON /DEGRE/ DMAX,DMIN,LMAX,LMIN
      DIMENSION NUM(NN),LEVU(NN),PNT(DAR),LL(DAR)
C.......................................................................
      IF(MOD.EQ.1) GO TO 70
C
C.....DETERMINE DEGREE OF NODE AND STORE AS LL(NODE).
      DO 20 I=1,NN
      ISUM=0
      IF(NUM(I).NE.0) GO TO 20
      IP=I
   10 IP=PNT(IP)
      IF(IP.EQ.0) GO TO 20
      ISUM=ISUM+1
      GO TO 10
   20 LL(I)=ISUM
      IF(KSTAT.EQ.0) RETURN
      DO 30 I=1,NN
      II=I
      IF(NUM(I).EQ.0) GO TO 40
   30 CONTINUE
      STOP
   40 DMAX=LL(II)
      DMIN=LL(II)
      LMIN=II
      LMAX=II
C
C.....DETERMINE MAXIMUM DEGREE (DMAX) AND MINIMUM DEGREE (DMIN).
      DO 60 I=1,NN
      IF(NUM(I).NE.0) GO TO 60
      IF(LL(I).GE.DMIN) GO TO 50
      LMIN=I
      DMIN=LL(I)
      GO TO 60
   50 IF(LL(I).LE.DMAX) GO TO 60
      DMAX=LL(I)
      LMAX=I
   60 CONTINUE
      RETURN
   70 J=IN
   80 J=PNT(J)
      IF(J.EQ.0) GO TO 90
      JJ=LL(J)
      IF(LEVU(JJ).EQ.-1) LEVU(JJ)=1
      GO TO 80
   90 J=IN
  100 J=PNT(J)
      IF(J.EQ.0) RETURN
      K=LL(J)
```

```
      KJ=K
      ISUM=0
  110 KJ=PNT(KJ)
      IF(KJ.EQ.0) GO TO 120
      KK=LL(KJ)
      IF(LEVU(KK).EQ.-1) ISUM=ISUM+1
      GO TO 110
  120 LL(K)=ISUM
      GO TO 100
      END
C-SBR22
C-FINDIJ: FORM THE LINKED LIST I-J CONNECTION.
C ----------------------------------------------------------------------
      SUBROUTINE FINDIJ (DAR,IVOID,OUTP,LL,PNT,I,J)
      IMPLICIT INTEGER*2 (A-Z)
      INTEGER*4 DAR,IVOID,OUTP
      DIMENSION LL(DAR),PNT(DAR)
C.......................................................................
      IP=I
   10 PRE=IP
      IP=PNT(IP)
      IF(IP.EQ.0) GO TO 20
      IF(LL(IP).EQ.J) RETURN
      GO TO 10
   20 IF(IVOID.GT.DAR) GO TO 30
      PNT(PRE)=IVOID
      PNT(IVOID)=0
      LL(IVOID)=J
      IVOID=IVOID+1
      RETURN
   30 WRITE(OUTP,2000) DAR,IVOID
      STOP
C.......................................................................
C.....OUTPUT FORMAT:
 2000 FORMAT(11X,40HNUMBER OF LINKED-LIST UNITS DIMENSIONED=,I5,
     &            24H BUT REQUIRES MORE THAN ,I5)
      END
```

ATTACHMENT B. Definition of job-file input order and variables.

The sign convention used for flux in RAQSIM treats flux into the aquifer as being greater than zero, discharge from the aquifer is less than zero.

The input data set accompanying the job includes data necessary to title the particular run, set the duration of the simulation, specify the input and output device numbers and select various options for the run. This data set is read by the program from input device number 5. As a matter of convenience, there is generally one data or option value specified per record. This allows liberal room for annotation relating to the corresponding input variable rather than filling each record with as many variable values as can reasonably fit onto one record. Each record in the job-input data set generally conforms to one of three formats:

1. For comments, titles and variable formats: 20A4
2. For integer or floating point variables : 60X,G10.0
3. For input of date and time variables : 60X,I2,1X,I2,1X,I4,F10.0

The program begins by scanning the job-file input for the first record containing the four characters 'MIXE' in columns 1-4. We will refer to this record as Record 0 in subsequent discussion. Any records that are found before encountering the 'MIXE' are printed just as they are read on the standard output device (number 6). This allows any number of comment lines to be incorporated into the job-file so the subsequent printout may be identified. The records following the 'MIXE' record must be included and must adhere to the following order.

Record 0. 'MIXE' in columns 1-4 to begin the active job-file.
Record 1. Title card for this run
Record 2. Starting month, day, year and hours
Record 3. Ending month, day, year and hours
Record 4. RADIAL: radial option flag: radial symmetry about the "Y" axis if this is coded non-zero.
Record 5. QCODE: discharge limitation code: discharge will be set to zero if head is below or equal "reference datum" and this is coded non-zero.
Record 6. CONTNU: continuation code: this is used to indicate that this simulation is a restart of a previous simulation. If this is coded non-zero, the restart time, restart heads and restart mass will be read from the device defined by this number. This file must be an OUTM data set (see record 8) created by a previous simulation. Be aware that if this device number is the same as record 8 in this simulation run, the present contents will be destroyed upon the completion of this simulation.
Record 7. INHS: input device number for initial heads: this device may be the same number as record 28. INHS defaults to the value specified by INNS (record 28) if record 7 is zero. This device is ignored in the event of a restart (record 6 is non-zero).

Record 8. OUTM: output device number for final time, final heads and final mass.

Record 9. STEADY: code for solving for the steady-state head configuration by setting the storage coefficient to zero. A non-zero value will activate this option.

Record 10. THCODE: code controlling the determination of the explicit-implicit weighting factor (THETA). A zero value for this code will result in a constant value for theta determined by the value specified in record 11. A non-zero value will allow the program to determine the value for THETA.

Record 11. THETA: explicit-implicit weighting factor. If record 10 is zero, this value must be between 0.0 and 1.0 (0.0 is explicit while 1.0 is implicit). It is recommended that THETA be between 0.57 and 1.00 for stability.

Record 12. DHSTDY: maximum head change rate that will be considered "steady-state". If the maximum absolute value head-change rate is less than this amount, the solution is considered to have reached steady-state. The time is updated to the next change of boundary condition, flux update or parameter update and simulation resumes.

Record 13. DTMAX: maximum duration for a time step in days. This value is also used to initially determine which nodes will be treated explicitly and which nodes will be treated implicitly depending upon how their explicit stability compares with this value.

Record 14. DTMIN: minimum time step in days allowed before nodes are re-classified from explicit to implicit. As simulation proceeds, changes in parameter values can cause the "stability" of some explicit nodes to decrease. As this occurs, the stable time step may also decrease. Once the stable time step decreases below this minimum value, all nodes are re-classified such that the stable time step is once again equal to the value specified in record 13.

Record 15. DHMAX: maximum allowed absolute head-change per time step in length units. A value of 0.0 causes this control to be neglected. If the maximum absolute head change during a time step exceeds this value, the duration of the time step will be reduced and the step will be repeated.

Record 16. ITMAX: maximum number of attempts to meet the critia imposed by the maximum allowed absolute head-change per time step.

Record 17. INTS: input device number containing the tabulated conductance and capacitance (transmissivity and storage coefficient) as functions of head. A value of zero specifies that all elements have constant conductance and capacitance and these values are input with the element records.

Record 18. DAN: coded non-zero if anisotropic tabulated conductance is to be allowed. A zero would impose an isotropic conductance equal to the major anisotropic conductance if the tabulated properties include anisotropic conductance.

Record 19. TSFREQ: frequency that conductance and capacitance are updated in days. A value of zero indicates that there will be no update forced by elapsed time during this simulation.

Record 20. DHFREQ: if this value is non-zero, the conductance and capacitance will be updated if the maximum positive or negative head change in length units exceeds this amount in absolute value.

Record 21. INET: input device number for the ground-water evapotranspiration data set. Code this value with a zero if ground-water evapotranspiration is not to be simulated.

Record 22. INSS: input device number for stream network and data. If streams are not simulated, code this value equal to zero.

Record 23. SGCODE: if there are streams, this code allows the user to restrict the maximum flux from the stream to the aquifer along a reach. The maximum stream to aquifer flux is that value calculated for a stream-to-aquifer head difference of one. This feature is activated by a non-zero value of SGCODE.

Record 24. PCCODE: if you wish to apply a predictor-corrector routine to the stream-aquifer flux, code this value greater than zero. If you wish to print the predicted stream baseflows in addition to the corrected stream baseflows, code PCCODE greater than 1.

Record 25. ISCODE: if you wish to have all of the stream nodes solved implicitly, code this value non-zero.

Record 26. OUTS: output device number for estimates of stream baseflows. Code this to zero if this output is not desired.

Record 27. OUTH: output device number for a listing of the nodes where streams "head" i.e. begin to flow. Code this to zero if this output is not desired.

Record 28. INNS: input device number for data set containing the constant node data (coordinates of nodes, elevation of base of the aquifer at the node). This data set may also contain the initial head values if desired (see record 7).

Record 29. INES: input device number for the data set containing element definitions (vertices, material number, etc.).

Record 30. IOSH: temporary device number for storing the element configuration and shape-function variables. Code this zero if these are to be stored in memory.

Record 31. INQS: input device number for the data set containing nodal flux amounts. This would be used when the majority of nodes have a flux component, otherwise incorporate these nodes into the known-flux boundary condition data set (see record 33) and code INQS as zero.

Record 32. IONQ: temporary device number for storing current values of the nodal flux from unit designated by record 31. If you wish these to remain in memory, code this zero. This will be ignored if INQS is zero.

Record 33. INBF: input device number for the known-flux boundary condition data set. Code this zero if there is no known-flux boundary condition for this simulation.

Record 34. INBH: input device number for the known-head boundary condition data set. Code this zero if there is no known-head boundary condition for this simulation.

Record 35. SQCODE: code to force the re-sequencing of the implicit nodes regardless of the amount of memory available to store the combined global stiffness and capacitance matrix. To activate this option, code this to 1, otherwise set the value to zero.

Record 36. PCODE: printout code that controls the amount of the printed output: an integer value between zero and six. The amount of printout is least when PCODE is set to zero and greatest when set to 6. See attachment C for more information regarding PCODE.

Record 37. OUTP: output device number for the printout. At many installations, this will normally equal 6.

Record 38. OUTN: output device for any output-hydrograph data. As mentioned in the section on output, nodes may be selected to have all of the intermediate head values output for subsequent processing. If this is not desired, set this value to zero.

Record 39. NHD: number of nodes for which hydrograph data is to BE output.

Record 40. Format to be used while reading in the nodal numbers for which hydrograph data is to be output.

Record 41. Nodal number or numbers for which hydrograph data is to be output. If necessary, more "cards" may be used to specify the entire number of nodes indicated by record 39.

Record 42. OUTC: output device number for the output of head arrays. As indicated in the section on output, the entire array of head values may be written to a device at particular times (see record 43). If no output of this type is desired, code this zero.

Record 43. If necessary, the times for output of the head array are included here in the month, day, year and time format. If there are more than one, they are arranged sequentially from earliest to latest time.

This summarizes the entire job-file input deck. The remaining input data is read from the various input devices defined within the job file and specified within Job-Control-Language statements.

ATTACHMENT C. Summary of printed output associated with different user-supplied values of variable "PCODE".

| Value of PCODE | Output related to the value of PCODE |
|---|---|
| any value | Fatal errors, summary of input job-file, computer memory requirements and final cumulative mass balance. |
| >0 | Mass balance summary for each time step and stream baseflows. |
| >1 | Known-head node mass balance and nodal mass balance for each time step. |
| >2 | Boundary conditions, nodal recharge or discharge, and simulated heads and head change for each time step. |
| >3 | Simulated stream-aquifer flux. |
| >4 | Echo of remainder of input data. |
| >5 | "Conductance" and "capacitance" terms, "LAMBDA" array before and after factorization and warning of obtuse angles (diagonal dominance warning) within elements. |

## ATTACHMENT D. Summary of input and output data files.

Part 1.
Input device CONTNU: restart data set that was created previously as an unformatted OUTM output data set.

Part 2.
Input device INNS: nodal data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of nodes (NN) | (60X,I10) |
| 2 | initial head format | (20A4) |
| 3 | nodal coordinate format | (20A4) |
| 4 | reference datum format | (20A4) |
| 5-(NN+4) | nodal data records; one record per node. | formats specified by records 2-3. |

Part 3.
Input device INHS: initial head data set.
If this data set is the same as INNS, the contents are specified according to that data set definition. If INHS is not the same as INNS use the following setup.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of nodes | (60X,I10) |
| 2 | format for nodal heads | (20A4) |
| 3 | nodal initial heads | format specified by record 2. |

Part 4.
Input device INES: element data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of elements (NE) | (60X,I10) |
| 2 | format for element number, element corner node numbers, code for tabulated conductance (tabulated if greater than zero and tabulated relationship is available), code for tabulated capacitance (tabulated if greater than zero and tabulated relationship is available), default conductance, default capacitance, and "material" number | (20A4) |
| 3-(NE+2) | element records; one record per element. | format specified by record 2. |

Part 5.
Input device INTS: tabulated capacitance-conductance data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | maximum length of table | (60X,I10) |
| 2 | format for material number, table length (LTABL), degree of capacitance (constant if degree=0, linear if degree=1), and code for anisotropy (anisotropic if code greater than zero) | (20A4) |
| 3 | format for table entries; head above datum, capacitance, conductance (or major axis of conductance, minor axis of | |

| | | |
|---|---|---|
| | conductance and and angle of major axis with the x-axis if conductance is anisotropic) | (20A4) |
| 4 | table identifiers | format specified by record 2. |
| 5-(4+LTABL) | table entries | format specified by record 3. |

these last two repeat for all tables; i.e. table identifier record followed by the table entries for all materials.

Part 6.
Input device INBF: known-flux data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of known-flux nodes (NBF) | (60X,I10) |
| 2 | format for known-flux nodes | (20A4) |
| 3 | known-flux nodes | format specified by record 2. |
| 4 | format for flux values at known-flux nodes | (20A4) |
| 5 | date and time for the known-flux values that follow. | (I2,1X,I2,1X,I4,F10.0) |
| 6 | NBF flux values for known-flux nodes. | format specified by record 4. |

These last two repeat for all times that flux is specified. Once data-set end is reached, it is assumed that flux remains fixed at last value.

Part 7.
Input device INBH: known-head data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of known-head nodes (NBH) | (60X,I10) |
| 2 | format for known-head nodes | (20A4) |
| 3 | known-head nodes | format specified by record 2. |
| 4 | format for head values at known-head nodes | (20A4) |
| 5 | date and time for the known-head values that follow | (I2,1X,I2,1X,I4,F10.0) |
| 6 | NBH head values for known-head nodes | format specified by record 4. |

These last two repeat for all times that heads are specified. Once data-set end is reached, it is assumed that heads remain fixed at last values.

Part 8.
Input device INQS: nodal-flux (recharge-discharge) data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of nodes | (60X,I10) |
| 2 | format for nodel recharge | (20A4) |
| 3 | time for following recharge values | (I2,1X,I2,1X,I4,F10.0) |
| 4 | nodal recharge | format specified by record 2. |

These last two repeat for all times that the recharge discharge is considered to vary. Once data-set end is encountered, recharge-discharge remains fixed at its last value.

Part 9.

Input device INET: ground-water evapotranspiration data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of nodes | (60X.I10) |
| 2 | format for depth below which ET ceases | (20A4) |
| 3 | depth below which ET ceases | format specified by record 2. |
| 4 | format for nodal land-surface elevations | (20A4) |
| 5 | nodal land-surface elevations | format specified by record 4. |
| 6 | format for maximum ET rate | (20A4) |
| 7 | date and time that the following maximum ET rate becomes active | (I2,1X,I2,1X,I4,F10.0) |
| 8 | maximum ET rate | format specified by record 6. |

These last two repeat every time the maximum ET rate varies. Once data-set end is reached, it is assumed that the maximum ET rate remains fixed at the last value.

Part 10.

Input device INSS: stream network data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | number of stream systems (NSS) | (60X,I10) |
| 2 | number of stream reaches (NSN) | (60X,I10) |
| 3 | format for stream system definition; stream number. head-water reach number and mouth reach number. | (20A4) |
| 4 | stream system definitions | format specified by record 3. |
| 5 | format for reach definitions; reach number, node at top of reach, most upstream reach number of branch, downstream reach number, leakance factor for reach | (20A4) |
| 6 | reach definitions | format specified by record 5. |
| 7 | format for reach number, stream head in reach and amount of "diversion from" or "return flow to" the reach during the specified time period | (20A4) |
| 8 | time for following known stream heads and diversions | (I2,1X,I2,1x,I4,F10.0) |
| 9 | reachs, heads in stream reaches and reach diversion or returnflow | format specified by record 7. |

These last two repeat for all times that the stream head and diversion-returnflow are specified.
Once data-set end is reached, it is assumed that the variables remain fixed at their last values.

Part 11.

Temporary device IOSH: temporary stiffness data set.

unformatted

Part 12.
Temporary device IONQ: temporary net flux data set.
unformatted

Part 13.
Output device OUTM: final heads and mass data set.
unformatted

Part 14.
Output device OUTS: streamflow hydrograph data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD | |
|---|---|---|---|
| 1 | month, day, year | (I2,1X,I2,1X,I4) | note: this entire |
| 2 | hours, minutes, seconds | (I2,1X,I2,1X,I2) | sequence defined by |
| 3-(2+NHD) | stream and baseflow (L**3/sec.) | (I5,F10.2) | format 2030 of SBR09. |
| | | line 2576 of Appendix 1. | |

This sequence repeats for every time step.

Part 15.
Output device OUTH: stream heading output.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | date and time | Note: these two records defined |
| 2 | column headings | by format 2050 of SBR09. |
| | | line 2578-2581 of Appendix 1. |
| 3-? | stream number, status (heading or dried), reach number, between node numbers, baseflow, stream head and aquifer head. | format 2040 of SBR09. line 2577 of Appendix 1. |

This sequence repeats for all times that the streamflow is calculated.

Part 16.
Output device OUTP: printout, 132 column records.
A summary of the job-file input is always printed to the standard output device number 6 along with any comment statements that appear before Record 0 of the job-file input (see table 2). If this device number is different from the standard output device, the job-file summary will also be included with this output; the only part that will not appear will be the comment statements.

Part 17.
Output device OUTN: nodal hydrograph data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | month, day, year | (I2,1X,I2,1X,I4) |
| 2 | hours, minutes, seconds | (I2,1X,I2,1X,I2) |
| 3-(2+NHD) | node & head for that node | (I5,F10.2) |

format 2050 of SBR05.
line 1898 of Appendix 1.

This sequence repeats for every time step.

Part 18.
Output device OUTC: output head array data set.

| RECORD # | CONTENTS OF RECORD | FORMAT OF RECORD |
|---|---|---|
| 1 | month, day, year | (I2,1X,I2,1X,I4) |
| 2 | hours, minutes, seconds | (I2,1X,I2,1X,I2) |
| 3 | total simulation time | (1PE10.3) |
| 4-(3+NN) | Head for all nodes | (F10.2) |

Note: all of these from format 2030 of SBR05. line 1896 of Appendix 1.

This sequence repeats for every time called for by input of specified times.

ATTACHMENT E. Input data for sample problem.

Part 1. Job-file input data set.

```
NOTES: TEST OF AREAL FLOW EXAMPLE.
      TABULATED CONDUCTANCE-CAPACITANCE VS. SATURATED THICKNESS

MIXED IMPLICIT-EXPLICIT PROGRAM DATA BEGINNING: (Record 0).
SAMPLE RADIAL PROGRAM RUN: AUGUST  4, 1983
STARTING DATE                                                :01/01/1900     0.0
ENDING DATE                                                  :03/06/1900     0.0
RADIAL SYMMETRY ABOUT Y-AXIS IF CODED NON-ZERO               :         0= RADIAL
DISCHARGE CONTROL FOR HEAD LESS THAN BASE IF CODED NON-ZERO:          0= QCODE
RESTART CODE (NO=0 OR DEVICE # FOR TIME, HEADS AND MASS)    :         0= CONTNU
INPUT DEVICE FOR INITIAL HEADS                              :        01= INHS
OUTPUT DEVICE FOR FINAL HEADS AND MASS              (NONE=0):        00= OUTM
SOLVE STEADY-STATE PROBLEM; STORAGE=0.0 IF CODED NON-ZERO   :         0= STEADY
VARIABLE IMPLICIT WEIGHTING FACTOR THETA IF CODED NON-ZERO  :         0= THCODE
IMPLICIT WEIGHTING FACTOR THETA(1.0-IMPLICIT; 0.0-EXPLICIT):       1.00= THETA
STEADY-STATE IF ALL HEAD-CHANGE-RATES LESS THAN THIS AMOUNT:     0.0001= DHSTDY
MAXIMUM DURATION FOR TIME STEP (DAYS)                       :     20.00= DTMAX
MINIMUM TIME STEP ALLOWED WITHOUT RECLASSIFICATION OF NODES:       5.00= DTMIN
MAXIMUM ALLOWED HEAD CHANGE/TIME STEP (L**1)(INACTIVE IF 0):          0= DHMAX
MAX. # OF ITERATIONS TO MEET DHMAX CRITERION (DEFAULT=10)   :        06= ITMAX
INPUT DEVICE FOR TABULATED TRANSMISSIVITY-STORAGE   (NONE=0):        11= INTS
IF CONDUCTANCE IS ANISOTROPIC, CODE THIS NON-ZERO           :         1= DAN
TRANS. AND STORAGE UPDATED AT LEAST EVERY(DAYS)     (NONE=0):         0= TSFREQ
TRANS. AND STORAGE UPDATED AT LEAST EVERY(L**1)     (NONE=0):         0= DHFREQ
INPUT DEVICE FOR GROUND-WATER E.T. DATA             (NONE=0):        12= INET
INPUT DEVICE FOR STREAM NETWORK AND DATA            (NONE=0):        15= INSS
LOSING STREAM GRADIENT CONTROL IF CODED NON-ZERO            :         0= SGCODE
PREDICT-CORRECT S-A FLUX (0:NO 1:YES 2:PRINT EST. BASEFLOW):          2= PCCODE
SOLVE ALL STREAM NODES IMPLICITLY IF CODED NON-ZERO         :         0= ISCODE
OUTPUT DEVICE FOR STREAM BASEFLOWS       (=0 IF NOT DESIRED):        00= OUTS
OUTPUT DEVICE FOR STREAM HEADING NODES   (=0 IF NOT DESIRED):        00= OUTH
INPUT DEVICE FOR NODAL DATA (COORDINATES, BASE, ETC.)       :        01= INNS
INPUT DEVICE FOR ELEMENT DATA SET (VERTICES, MATERIAL #)    :        03= INES
TEMP. DEVICE FOR ELEMENT SHAPE FUNCT., ETC.(IN MEMORY IF 0):         00= IOSH
INPUT DEVICE FOR NODAL FLUXES (RECHARGE>0)          (NONE=0):        02= INQS
TEMPORARY DEVICE FOR CURRENT NODAL FLUXES  (IN MEMORY IF 0):         00= IONQ
INPUT DEVICE OF KNOWN FLUX BOUNDARY DATA            (NONE=0):        14= INBF
INPUT DEVICE OF KNOWN HEAD BOUNDARY DATA            (NONE=0):        13= INBH
FORCE RESEQUENCING OF IMPLICIT NODES IF CODED NON-ZERO      :         1= SQCODE
PRINT CODE VALUE (CONTROLS AMOUNT OF OUTPUT)                :         5= PCODE
OUTPUT DEVICE FOR PRINTED OUTPUT                            :        06= OUTP
OUTPUT DEVICE FOR THE OUTPUT HYDROGRAPH DATA                :        17= OUTN
TOTAL NUMBER OF NODES WITH OUTPUT HYDROGRAPHS               :        03= NHD
(16I5)
    2    8   52
OUTPUT DEVICE FOR FILE CONTAINING HEAD ARRAY                :        16= OUTC
01/04/1901       0.0    :date and time when output of head arrav is desired
01/04/1902       0.0
```

```
01/04/1903       0.0
01/04/1904       0.0
01/04/1905       0.0
01/04/1906       0.0
```

Part 2. Nodal definition data set.

```
NODE DATA SET:   TOTAL NUMBER OF NODES                       :       93
(25X,E10.3)
(5X,2E10.3)
(35X,E10.3)
    1 0.0       0.0       1.000E+02 0.0        node #, x, y, init. head, datum
    2 1.000E+03 0.0       1.020E+02 2.000E+00
    3 2.000E+03 0.0       1.040E+02 4.000E+00
    4 3.000E+03 0.0       1.060E+02 6.000E+00
    5 4.000E+03 0.0       1.080E+02 8.000E+00
    6 5.000E+03 0.0       1.100E+02 1.000E+01
    7 6.000E+03 0.0       1.120E+02 1.200E+01
    8 7.000E+03 0.0       1.140E+02 1.400E+01
    9 8.000E+03 0.0       1.160E+02 1.600E+01
   10 9.000E+03 0.0       1.180E+02 1.800E+01
   11 1.000E+04 0.0       1.200E+02 2.000E+01
   12 7.070E+02 7.070E+02 1.020E+02 2.000E+00
   13 1.707E+03 7.070E+02 1.040E+02 4.000E+00
   14 2.707E+03 7.070E+02 1.060E+02 6.000E+00
   15 3.707E+03 7.070E+02 1.080E+02 8.000E+00
   16 4.707E+03 7.070E+02 1.100E+02 1.000E+01
   17 5.707E+03 7.070E+02 1.120E+02 1.200E+01
   18 6.707E+03 7.070E+02 1.140E+02 1.400E+01
   19 7.707E+03 7.070E+02 1.160E+02 1.600E+01
   20 8.707E+03 7.070E+02 1.180E+02 1.800E+01
   21 9.707E+03 7.070E+02 1.200E+02 2.000E+01
   22 1.071E+04 7.070E+02 1.220E+02 2.200E+01
   23 1.414E+03 1.414E+03 1.040E+02 4.000E+00
   24 2.414E+03 1.414E+03 1.060E+02 6.000E+00
   25 3.414E+03 1.414E+03 1.080E+02 8.000E+00
   26 4.414E+03 1.414E+03 1.100E+02 1.000E+01
   27 5.414E+03 1.414E+03 1.120E+02 1.200E+01
   28 6.414E+03 1.414E+03 1.140E+02 1.400E+01
   29 7.414E+03 1.414E+03 1.160E+02 1.600E+01
   30 8.414E+03 1.414E+03 1.180E+02 1.800E+01
   31 9.414E+03 1.414E+03 1.200E+02 2.000E+01
   32 1.041E+04 1.414E+03 1.220E+02 2.200E+01
   33 1.141E+04 1.414E+03 1.240E+02 2.400E+01
   34 2.121E+03 2.121E+03 1.060E+02 6.000E+00
   35 3.121E+03 2.121E+03 1.080E+02 8.000E+00
   36 4.121E+03 2.121E+03 1.100E+02 1.000E+01
   37 5.121E+03 2.121E+03 1.120E+02 1.200E+01
   38 6.121E+03 2.121E+03 1.140E+02 1.400E+01
   39 7.121E+03 2.121E+03 1.160E+02 1.600E+01
   40 8.121E+03 2.121E+03 1.180E+02 1.800E+01
   41 9.121E+03 2.121E+03 1.200E+02 2.000E+01
   42 1.012E+04 2.121E+03 1.220E+02 2.200E+01
```

| | | | | |
|---|---|---|---|---|
| 43 | 1.112E+04 | 2.121E+03 | 1.240E+02 | 2.400E+01 |
| 44 | 1.212E+04 | 2.121E+03 | 1.260E+02 | 2.600E+01 |
| 45 | 2.828E+03 | 2.828E+03 | 1.080E+02 | 8.000E+00 |
| 46 | 3.828E+03 | 2.828E+03 | 1.100E+02 | 1.000E+01 |
| 47 | 4.828E+03 | 2.828E+03 | 1.120E+02 | 1.200E+01 |
| 48 | 5.828E+03 | 2.828E+03 | 1.140E+02 | 1.400E+01 |
| 49 | 6.828E+03 | 2.828E+03 | 1.160E+02 | 1.600E+01 |
| 50 | 7.828E+03 | 2.828E+03 | 1.180E+02 | 1.800E+01 |
| 51 | 8.828E+03 | 2.828E+03 | 1.200E+02 | 2.000E+01 |
| 52 | 9.828E+03 | 2.828E+03 | 1.220E+02 | 2.200E+01 |
| 53 | 1.083E+04 | 2.828E+03 | 1.240E+02 | 2.400E+01 |
| 54 | 1.183E+04 | 2.828E+03 | 1.260E+02 | 2.600E+01 |
| 55 | 3.535E+03 | 3.535E+03 | 1.100E+02 | 1.000E+01 |
| 56 | 4.535E+03 | 3.535E+03 | 1.120E+02 | 1.200E+01 |
| 57 | 5.535E+03 | 3.535E+03 | 1.140E+02 | 1.400E+01 |
| 58 | 6.535E+03 | 3.535E+03 | 1.160E+02 | 1.600E+01 |
| 59 | 7.535E+03 | 3.535E+03 | 1.180E+02 | 1.800E+01 |
| 60 | 8.535E+03 | 3.535E+03 | 1.200E+02 | 2.000E+01 |
| 61 | 9.535E+03 | 3.535E+03 | 1.220E+02 | 2.200E+01 |
| 62 | 1.054E+04 | 3.535E+03 | 1.240E+02 | 2.400E+01 |
| 63 | 1.154E+04 | 3.535E+03 | 1.260E+02 | 2.600E+01 |
| 64 | 4.242E+03 | 4.242E+03 | 1.120E+02 | 1.200E+01 |
| 65 | 5.242E+03 | 4.242E+03 | 1.140E+02 | 1.400E+01 |
| 66 | 6.242E+03 | 4.242E+03 | 1.160E+02 | 1.600E+01 |
| 67 | 7.242E+03 | 4.242E+03 | 1.180E+02 | 1.800E+01 |
| 68 | 8.242E+03 | 4.242E+03 | 1.200E+02 | 2.000E+01 |
| 69 | 9.242E+03 | 4.242E+03 | 1.220E+02 | 2.200E+01 |
| 70 | 1.024E+04 | 4.242E+03 | 1.240E+02 | 2.400E+01 |
| 71 | 1.124E+04 | 4.242E+03 | 1.260E+02 | 2.600E+01 |
| 72 | 4.949E+03 | 4.949E+03 | 1.140E+02 | 1.400E+01 |
| 73 | 5.949E+03 | 4.949E+03 | 1.160E+02 | 1.600E+01 |
| 74 | 6.949E+03 | 4.949E+03 | 1.180E+02 | 1.800E+01 |
| 75 | 7.949E+03 | 4.949E+03 | 1.200E+02 | 2.000E+01 |
| 76 | 8.949E+03 | 4.949E+03 | 1.220E+02 | 2.200E+01 |
| 77 | 9.949E+03 | 4.949E+03 | 1.240E+02 | 2.400E+01 |
| 78 | 1.095E+04 | 4.949E+03 | 1.260E+02 | 2.600E+01 |
| 79 | 5.657E+03 | 5.657E+03 | 1.160E+02 | 1.600E+01 |
| 80 | 6.657E+03 | 5.657E+03 | 1.180E+02 | 1.800E+01 |
| 81 | 7.657E+03 | 5.657E+03 | 1.200E+02 | 2.000E+01 |
| 82 | 8.657E+03 | 5.657E+03 | 1.220E+02 | 2.200E+01 |
| 83 | 9.657E+03 | 5.657E+03 | 1.240E+02 | 2.400E+01 |
| 84 | 1.066E+04 | 5.657E+03 | 1.260E+02 | 2.600E+01 |
| 85 | 6.364E+03 | 6.364E+03 | 1.180E+02 | 1.800E+01 |
| 86 | 7.364E+03 | 6.364E+03 | 1.200E+02 | 2.000E+01 |
| 87 | 8.364E+03 | 6.364E+03 | 1.220E+02 | 2.200E+01 |
| 88 | 9.364E+03 | 6.364E+03 | 1.240E+02 | 2.400E+01 |
| 89 | 1.036E+04 | 6.364E+03 | 1.260E+02 | 2.600E+01 |
| 90 | 7.071E+03 | 7.071E+03 | 1.200E+02 | 2.000E+01 |
| 91 | 8.071E+03 | 7.071E+03 | 1.220E+02 | 2.200E+01 |
| 92 | 9.071E+03 | 7.071E+03 | 1.240E+02 | 2.400E+01 |
| 93 | 1.007E+04 | 7.071E+03 | 1.260E+02 | 2.600E+01 |

Part 3. Element definition data set.

ELEMENT DATA SET: TOTAL NUMBER OF ELEMENTS : 79
(I5,10X,6I5,2G10.0,I5)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 12 | 1 | 2 | 13 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 2 | 13 | 2 | 3 | 14 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 3 | 14 | 3 | 4 | 15 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 4 | 15 | 4 | 5 | 16 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 5 | 16 | 5 | 6 | 17 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 6 | 17 | 6 | 7 | 18 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 7 | 18 | 7 | 8 | 19 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 8 | 19 | 8 | 9 | 20 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 9 | 20 | 9 | 10 | 21 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 10 | 21 | 10 | 11 | 22 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 11 | 23 | 12 | 13 | 24 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 12 | 24 | 13 | 14 | 25 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 13 | 25 | 14 | 15 | 26 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 14 | 26 | 15 | 16 | 27 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 15 | 27 | 16 | 17 | 28 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 16 | 28 | 17 | 18 | 29 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 17 | 29 | 18 | 19 | 30 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 18 | 30 | 19 | 20 | 31 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 19 | 31 | 20 | 21 | 32 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 20 | 32 | 21 | 22 | 33 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 21 | 34 | 23 | 24 | 35 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 22 | 35 | 24 | 25 | 36 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 23 | 36 | 25 | 26 | 37 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 24 | 37 | 26 | 27 | 38 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 25 | 38 | 27 | 28 | 39 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 26 | 39 | 28 | 29 | 40 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 27 | 40 | 29 | 30 | 41 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 28 | 41 | 30 | 31 | 42 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 29 | 42 | 31 | 32 | 43 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 30 | 43 | 32 | 33 | 44 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 31 | 45 | 34 | 35 | 46 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 32 | 46 | 35 | 36 | 47 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 33 | 47 | 36 | 37 | 48 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 34 | 48 | 37 | 38 | 49 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 35 | 49 | 38 | 39 | 50 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 36 | 50 | 39 | 40 | 51 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 37 | 51 | 40 | 41 | 52 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 38 | 52 | 41 | 42 | 53 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 39 | 53 | 42 | 43 | 54 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 40 | 43 | 44 | 54 | 0 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 41 | 55 | 45 | 46 | 56 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 42 | 56 | 46 | 47 | 57 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 43 | 57 | 47 | 48 | 58 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 44 | 58 | 48 | 49 | 59 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 45 | 59 | 49 | 50 | 60 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 46 | 60 | 50 | 51 | 61 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 47 | 61 | 51 | 52 | 62 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 48 | 62 | 52 | 53 | 63 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 49 | 53 | 54 | 63 | 0 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 50 | 64 | 55 | 56 | 65 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |
| 51 | 65 | 56 | 57 | 66 | 1 | 1 | 1.000E+04 | 1.000E-01 | 1 |

```
  52            66   57   58   67    1     1 1.000E+04 1.000E-01     1
  53            67   58   59   68    1     1 1.000E+04 1.000E-01     1
  54            68   59   60   69    1     1 1.000E+04 1.000E-01     1
  55            69   60   61   70    1     1 1.000E+04 1.000E-01     1
  56            70   61   62   71    1     1 1.000E+04 1.000E-01     1
  57            62   63   71    0    1     1 1.000E+04 1.000E-01     1
  58            72   64   65   73    1     1 1.000E+04 1.000E-01     1
  59            73   65   66   74    1     1 1.000E+04 1.000E-01     1
  60            74   66   67   75    1     1 1.000E+04 1.000E-01     1
  61            75   67   68   76    1     1 1.000E+04 1.000E-01     1
  62            76   68   69   77    1     1 1.000E+04 1.000E-01     1
  63            77   69   70   78    1     1 1.000E+04 1.000E-01     1
  64            70   71   78    0    1     1 1.000E+04 1.000E-01     1
  65            79   72   73   80    1     1 1.000E+04 1.000E-01     1
  66            80   73   74   81    1     1 1.000E+04 1.000E-01     1
  67            81   74   75   82    1     1 1.000E+04 1.000E-01     1
  68            82   75   76   83    1     1 1.000E+04 1.000E-01     1
  69            83   76   77   84    1     1 1.000E+04 1.000E-01     1
  70            77   78   84    0    1     1 1.000E+04 1.000E-01     1
  71            85   79   80   86    1     1 1.000E+04 1.000E-01     1
  72            86   80   81   87    1     1 1.000E+04 1.000E-01     1
  73            87   81   82   88    1     1 1.000E+04 1.000E-01     1
  74            88   82   83   89    1     1 1.000E+04 1.000E-01     1
  75            83   84   89    0    1     1 1.000E+04 1.000E-01     1
  76            90   85   86   91    1     1 1.000E+04 1.000E-01     1
  77            91   86   87   92    1     1 1.000E+04 1.000E-01     1
  78            92   87   88   93    1     1 1.000E+04 1.000E-01     1
  79            88   89   93    0    1     1 1.000E+04 1.000E-01     1
```

Part 4. Tabulated hydraulic properties data set.

```
TABULATED STORAGE-ANISOTROPIC TRANS.:     MAX. TABLE LENGTH:         5
(10X,I5,10X,I5,14X,I1,27X,I1)
(5F10.0)
 MATERIAL(    1)  LENGTH(   05) DEGREE OF S(0) ANISOTROPIC IF NON-ZERO:(1)
      0.0      0.0100    1.0000     1.0000       0.0
     50.00     0.2600    7500.0     6900.0      45.0
     75.00     0.1800    8500.0     8100.0      50.0
    125.0      0.2200   12750.0    11000.0      55.0
    126.00     1.0000  1.00E+10   1.00E+10       0.0
```

Part 5. Known-flux data set.

```
KNOWN-FLUX DATA SET     NUMBER OF FLUX NODES IN COL 61-70  :         6
(6I5)
   54   63   71   78   84   89  nodes where following flux is given (in order)
(6F7.0)
01/01/1900   0.0        date and time when following flux values are given.
   0.00   0.00   0.00   0.00   0.00   0.00 known-flux values
06/01/1978   0.0
  10.00  10.00  10.00  10.00  10.00  10.00
06/01/2000   0.0
```

```
   0.00   0.00   0.00   0.00   0.00   0.00
```

Part 6.  Known-head data set.

```
KNOWN-HEAD DATA SET    NUMBER OF HEAD NODES IN COL 61-70  :         8
(8I5)
   11   22   33   44   90   91   92   93  nodes where following head is given
(8F7.0)
01/01/1900     0.0   date and time when following heads are known
 120.00 122.00 124.00 126.00 120.00 122.00 124.00 126.00  known-head values
01/02/1901   0.0                                          considered linear
 121.00 123.00 125.00 127.00 120.00 122.00 124.00 126.00  between known times
01/04/1901   0.0                                          if a transient
 120.00 122.00 124.00 126.00 120.00 122.00 124.00 126.00  simulation.
```

Part 7.  Nodal-flux data set.

```
NODAL-FLUX DATA SET: TOTAL NUMBER OF NODES IN COL 61-70    :        93
(11F7.0)
01/01/1900     0.0                                                     ALL NODES
  53.77 161.30 161.30 161.30 161.30 161.30 161.30 161.30 161.30 161.30 107.54
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 107.54
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30 161.30
 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61
 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61 322.61 322.61 322.61
 161.30 161.30 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61 322.61
 161.30 107.54 161.30 161.30 107.54
01/01/2100     0.0
  53.77 161.30 161.30 161.30 161.30 161.30 161.30 161.30 161.30 161.30 107.54
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 107.54
 161.30 322.61 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30 161.30
 322.61 322.61 322.61 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61
 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61 322.61 322.61 322.61
 161.30 161.30 322.61 322.61 322.61 322.61 161.30 161.30 322.61 322.61 322.61
 161.30 107.54 161.30 161.30 107.54
```

Part 8. Ground-water evapotranspiration data set.

```
GROUND-WATER E.T. DATA SET;   TOTAL # OF NODES IN COL 61-70:        93
(60X,F10.0)
DEPTH BELOW WHICH GROUND-WATER E.T. CEASES IN COL 61-70    :      12.0
(10F6.0)
 105.0 107.0 109.0 111.0 113.0 115.0 117.0 119.0 121.0 123.0   NODAL
 125.0 107.0 109.0 111.0 113.0 115.0 117.0 119.0 121.0 123.0   LAND
 125.0 127.0 109.0 111.0 113.0 115.0 117.0 119.0 121.0 123.0   SURFACE
 125.0 127.0 129.0 111.0 113.0 115.0 117.0 119.0 121.0 123.0   ELEVATIONS
 125.0 127.0 129.0 131.0 113.0 115.0 117.0 119.0 121.0 123.0
```

```
 125.0 127.0 129.0 131.0 115.0 117.0 119.0 121.0 123.0 125.0
 127.0 129.0 131.0 117.0 119.0 121.0 123.0 125.0 127.0 129.0
 131.0 119.0 121.0 123.0 125.0 127.0 129.0 131.0 121.0 123.0
 125.0 127.0 129.0 131.0 123.0 125.0 127.0 129.0 131.0 125.0
 127.0 129.0 131.0
(F10.0)
01/01/1900    0.0      : TIME THAT FOLLOWING MAXIMUM RATE BEGINS
-0.001                 : MAXIMUM RATE FOR EVAPOTRANSPIRATION (always < 0.0)
02/01/1900    0.0
-0.02
03/01/1900    0.0
 0.00
```

Part 9. Stream system data set.

```
STREAM-SYSTEM DATA SET:NUMBER OF STREAM SYSTEMS COLS 61-70 :         2
TOTAL NUMBER OF STREAM REACHES INCLUDING NULLS  COLS 61-70 :        16
(3I5)
    1    1    7   stream #, most upstream reach, most downstream reach
    2    8   15   stream 1 refers to B & B' while stream 2 refers to A.
(4I5,F10.2)
    1   86    0    2       0.5  reach #, upstream node number, number of the
    2   80    0    3       0.5            most upstream reach of any tributary
    3   73    0    6       0.5            segment joining that reach (zero if
    4   81    0    5       0.5            none), next downstream reach number,
    5   74    0    6       0.5            and leakance of reach [(L**3/T/L)/L].
    6   66    4    7       0.5
    7   58    0   12       0.5
    8   53    0    9       0.5
    9   52    0   10       0.5
   10   51    0   11       0.5
   11   50    0   12       0.5
   12   49    0   13       0.5
   13   37    0   14       0.5
   14   25    0   15       0.5
   15   13    0   16       0.5
   16    1    0    0       0.0  NULL reach (to define most downstream node #).
(I5,2F10.0)
 01/01/1900       0.0         date and time that the following becomes active
    1       119.0      0.50   reach #, average stream head, inflow-diversion
    2       117.0      0.20
    3       116.0      0.40
    4       119.0      0.35
    5       117.0      0.00
    6       116.0      1.00
    7       116.0      0.80
    8       123.0      0.00
    9       121.0      0.00
   10       119.0      0.00
   11       117.0      0.00
   12       114.0      0.00
   13       110.0      0.00
   14       106.0      0.00
   15       102.0      0.00
```

| | | | |
|---|---|---|---|
| 16 | | | the NULL reach |
| 06/01/2190 | | 0.0 | |
| 1 | 100.0 | 1.00 | |
| 2 | 100.0 | 2.00 | |
| 3 | 100.0 | 3.00 | |
| 4 | 100.0 | 4.00 | |
| 5 | 100.0 | 5.00 | |
| 6 | 100.0 | 6.00 | |
| 7 | 100.0 | 7.00 | |
| 8 | 100.0 | 1.00 | |
| 9 | 100.0 | 2.00 | |
| 10 | 100.0 | 3.00 | |
| 11 | 100.0 | 4.00 | |
| 12 | 100.0 | 5.00 | |
| 13 | 100.0 | 6.00 | |
| 14 | 100.0 | 7.00 | |
| 15 | 100.0 | 6.00 | |
| 16 | | | |
| 06/01/2190 | | 0.0 | |

ATTACHMENT F.  Listing of printed output from sample problem.

```
SAMPLE AREAL PROGRAM RUN: AUGUST  4, 1983

TIME AND DATE OF EXECUTION :____________
PROBLEM HAS NO RADIAL SYMMETRY
NO DISCHARGE LIMITATION IN EFFECT

STARTING DATE: 1/ 1/1900  .00 HOURS (  .000E+00 DAYS)
ENDING DATE  : 3/ 6/1900  .00 HOURS ( 6.400E+01 DAYS)

CONTINUATION? (0=NO OR INPUT DEVICE #):                     0
INPUT DEVICE FOR INITIAL HEADS:                             1
OUTPUT DEVICE FOR FINAL HEADS & MASS:                       0
SOLVE FOR THE STEADY STATE (T:YES F:NO):                    F
THETA (1.0:IMPLICIT, 0.0:EXPLICIT):                 1.000E+00
CONSTANT VALUE FOR THETA
EQUILIBRIUM HEAD-CHANGE CRITERIA (L**1/DAY):        1.000E-05
MAXIMUM ALLOWABLE TIME STEP (DAYS):                 2.000E+01
MINIMUM ALLOWABLE TIME STEP (DAYS):                 5.000E+00
MAXIMUM ALLOWABLE HEAD-CHANGE/STEP (L**1):           .000E-00
     (ACTIVE IF GREATER THAN ZERO)
MAX. ITERATIONS TO MEET DHMAX:                              1

TABULATED CONDUCTANCE-CAPACITANCE (T:YES F:NO):             T
MAXIMUM TABLE LENGTH:                                       5
INPUT DEVICE FOR CONDUCTANCE-CAPACITANCE TABLES:           11
CONDUCTANCE MAY BE ANSIOTROPIC IF TENSOR TABULATED.
SIMULATE SIMPLE GW. ET. WITH INPUT FROM UNIT:              12

NUMBER OF STREAM SYSTEMS:                                   2
NUMBER OF STREAM NODES:                                    16
INPUT DEVICE FOR STREAM DATA:                              15
MAX STREAM-AQUIFER GRADIENT CONTROL (T:YES F:NO):           F
PREDICT & CORRECT STREAM-AQUIFER FLUX (T:YES F:NO):         T
PRINT PREDICTED STREAM BASEFLOWS (T:YES F:NO):              F
STREAM NODES TREATED IMPLICITLY (T:YES F:NO):               F
OUTPUT DEVICE FOR STREAM-FLOW HYDROGRAPHS:                  0
      (SET TO ZERO IF NONE DESIRED)
OUTPUT DEVICE FOR STREAM-HEADING RESULTS:                   0
      (SET TO ZERO IF NONE DESIRED)

NUMBER OF NODES:                                           93
INPUT DEVICE FOR NODE DATA (X,Y,BASE,HEAD):                 1
NUMBER OF ELEMENTS:                                        79
INPUT DEVICE FOR ELEMENTS (INDICES, ETC.):                  3
TEMPORARY DEVICE FOR ELEMENT STIFFNESS, ETC:                0
      (SET TO 0 IF STIFFNESS, ETC STORED IN CORE)
INPUT DEVICE FOR NODAL RECHARGE-DISCHARGE:                  2
      (SET TO 0 IF FLUXES ARE ZERO)
TEMPORARY I-O DEVICE FOR NODAL FLUX VALUES:                 0
      (SET TO 0 IF VALUES TO BE STORED IN CORE)

NUMBER OF KNOWN-FLUX BOUNDARY NODES:                        6
INPUT DEVICE FOR KNOWN-FLUX BOUNDARY DATA:                 14
NUMBER OF KNOWN-HEAD BOUNDARY NODES:                        8
```

INPUT DEVICE FOR KNOWN-HEAD BOUNDARY DATA: 13
TOTAL NUMBER OF UNKNOWN-HEAD NODES: 85
FORCE NODE RESEQUENCING (T:YES F:NO): T

PRINTOUT CODE VARIES BETWEEN 0 AND 6:
0-FATAL ERRORS, BASIC INPUT DATA AND FINAL OUTPUT.
1-INCLUDES STREAM BASEFLOWS AND CUM. MASS BALANCE.
2-INCLUDES NODAL MASS BALANCE.
3-INCLUDES HEADS, BOUNDARY CONDITIONS & NODE FLUX.
4-INCLUDES STREAM-AQUIFER FLUXES.
5-INCLUDES STREAMS, BOUNDARIES AND INITIAL HEADS.
6-INCLUDES DIAGONAL DOMINANCE WARNING MESSAGES.
PRINTOUT CODE (0=MINIMUM,6=MAXIMUM): 5
OUTPUT DEVICE FOR PRINTOUT FILE: 6

NUMBER OF NODES FOR WATERLEVEL HYDROGRAPHS: 3
OUTPUT DEVICE FOR WATERLEVEL HYDROGRAPHS: 17

OUTPUT DEVICE FOR HEAD ARRAYS: 16
(SET TO 0 IF NO OUTPUT DESIRED)

INITIAL REAL*8 DIMENSION= 566 WITH REAL*8 VECTOR DIMENSIONED TO 30000
REQUIRED REAL*4 DIMENSION= 2051 WITH REAL*4 VECTOR DIMENSIONED TO 13400
INITIAL INTEGER*2 DIMENSION= 901 WITH INTEGER*2 VECTOR DIMENSIONED TO 12800
REQUIRED LOGICAL DIMENSION= 16 WITH LOGICAL VECTOR DIMENSIONED TO 300

| ELEMENT | /-------INDICES | | | -------/ | CONDUCTANCE | CAPACITANCE | MATERIAL # | TRIANGLE AREAS | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 12 | 1 | 2 | 13 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 2 | 13 | 2 | 3 | 14 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 3 | 14 | 3 | 4 | 15 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 4 | 15 | 4 | 5 | 16 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 5 | 16 | 5 | 6 | 17 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 6 | 17 | 6 | 7 | 18 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 7 | 18 | 7 | 8 | 19 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 8 | 19 | 8 | 9 | 20 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 9 | 20 | 9 | 10 | 21 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 10 | 21 | 10 | 11 | 22 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.182E+05 |
| 11 | 23 | 12 | 13 | 24 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 12 | 24 | 13 | 14 | 25 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 13 | 25 | 14 | 15 | 26 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 14 | 26 | 15 | 16 | 27 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 15 | 27 | 16 | 17 | 28 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 16 | 28 | 17 | 18 | 29 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 17 | 29 | 18 | 19 | 30 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 18 | 30 | 19 | 20 | 31 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 19 | 31 | 20 | 21 | 32 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.174E+05 |
| 20 | 32 | 21 | 22 | 33 | TABULATED | TABULATED | 1 | 1.182E+05 | 1.178E+05 |
| 21 | 34 | 23 | 24 | 35 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 22 | 35 | 24 | 25 | 36 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 23 | 36 | 25 | 26 | 37 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 24 | 37 | 26 | 27 | 38 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 25 | 38 | 27 | 28 | 39 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 26 | 39 | 28 | 29 | 40 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 27 | 40 | 29 | 30 | 41 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 28 | 41 | 30 | 31 | 42 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.177E+05 |
| 29 | 42 | 31 | 32 | 43 | TABULATED | TABULATED | 1 | 1.174E+05 | 1.178E+05 |
| 30 | 43 | 32 | 33 | 44 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 31 | 45 | 34 | 35 | 46 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 32 | 46 | 35 | 36 | 47 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 33 | 47 | 36 | 37 | 48 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 34 | 48 | 37 | 38 | 49 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 35 | 49 | 38 | 39 | 50 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 36 | 50 | 39 | 40 | 51 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 37 | 51 | 40 | 41 | 52 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 38 | 52 | 41 | 42 | 53 | TABULATED | TABULATED | 1 | 1.177E+05 | 1.181E+05 |
| 39 | 53 | 42 | 43 | 54 | TABULATED | TABULATED | 1 | 1.176E+05 | 1.178E+05 |
| 40 | 43 | 44 | 54 | 0 | TABULATED | TABULATED | 1 | 1.178E+05 | .000E+00 |
| 41 | 55 | 45 | 46 | 56 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 42 | 56 | 46 | 47 | 57 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 43 | 57 | 47 | 48 | 58 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 44 | 58 | 48 | 49 | 59 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 45 | 59 | 49 | 50 | 60 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 46 | 60 | 50 | 51 | 61 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 47 | 61 | 51 | 52 | 62 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.184E+05 |
| 48 | 62 | 52 | 53 | 63 | TABULATED | TABULATED | 1 | 1.181E+05 | 1.178E+05 |
| 49 | 53 | 54 | 63 | 0 | TABULATED | TABULATED | 1 | 1.178E+05 | .000E+00 |
| 50 | 64 | 55 | 56 | 65 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 51 | 65 | 56 | 57 | 66 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 52 | 66 | 57 | 58 | 67 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 53 | 67 | 58 | 59 | 68 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 54 | 68 | 59 | 60 | 69 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.176E+05 |
| 55 | 69 | 60 | 61 | 70 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.176E+05 |
| 56 | 70 | 61 | 62 | 71 | TABULATED | TABULATED | 1 | 1.184E+05 | 1.178E+05 |
| 57 | 62 | 63 | 71 | 0 | TABULATED | TABULATED | 1 | 1.178E+05 | .000E+00 |
| 58 | 72 | 64 | 65 | 73 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 59 | 73 | 65 | 66 | 74 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 60 | 74 | 66 | 67 | 75 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 61 | 75 | 67 | 68 | 76 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 62 | 76 | 68 | 69 | 77 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 63 | 77 | 69 | 70 | 78 | TABULATED | TABULATED | 1 | 1.176E+05 | 1.180E+05 |
| 64 | 70 | 71 | 78 | 0 | TABULATED | TABULATED | 1 | 1.178E+05 | .000E+00 |
| 65 | 79 | 72 | 73 | 80 | TABULATED | TABULATED | 1 | 1.180E+05 | 1.180E+05 |
| 66 | 80 | 73 | 74 | 81 | TABULATED | TABULATED | 1 | 1.180E+05 | 1.180E+05 |
| 67 | 81 | 74 | 75 | 82 | TABULATED | TABULATED | 1 | 1.180E+05 | 1.180E+05 |
| 68 | 82 | 75 | 76 | 83 | TABULATED | TABULATED | 1 | 1.180E+05 | 1.180E+05 |
| 69 | 83 | 76 | 77 | 84 | TABULATED | TABULATED | 1 | 1.180E+05 | 1.184E+05 |
| 70 | 77 | 78 | 84 | 0 | TABULATED | TABULATED | 1 | 1.181E+05 | .000E+00 |
| 71 | 85 | 79 | 80 | 86 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 72 | 86 | 80 | 81 | 87 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 73 | 87 | 81 | 82 | 88 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 74 | 88 | 92 | 83 | 89 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.174E+05 |
| 75 | 83 | 84 | 89 | 0 | TABULATED | TABULATED | 1 | 1.182E+05 | .000E+00 |
| 76 | 90 | 85 | 86 | 91 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 77 | 91 | 86 | 87 | 92 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.178E+05 |
| 78 | 92 | 87 | 88 | 93 | TABULATED | TABULATED | 1 | 1.178E+05 | 1.177E+05 |
| 79 | 88 | 89 | 93 | 0 | TABULATED | TABULATED | 1 | 1.174E+05 | .000E+00 |

REQUIRED REAL*8 DIMENSION= 902 WITH REAL*8 VECTOR DIMENSIONED TO 30000

REQUIRED INTEGER*2 DIMENSION= 1473 WITH INTEGER*2 VECTOR DIMENSIONED TO 12800
ANM VECTOR DIMENSION= 336

NODE X AND Y COORDINATES:
------------------------

| NODE | X-VALUE | Y-VALUE | NODE | X-VALUE | Y-VALUE | NODE | X-VALUE | Y-VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | .000E+00 | .000E+00 | 2 | 1.000E+03 | .000E+00 | 3 | 2.000E+03 | .000E+00 |
| 4 | 3.000E+03 | .000E+00 | 5 | 4.000E+03 | .000E+00 | 6 | 5.000E+03 | .000E+00 |
| 7 | 6.000E+03 | .000E+00 | 8 | 7.000E+03 | .000E+00 | 9 | 8.000E+03 | .000E+00 |
| 10 | 9.000E+03 | .000E+00 | 11 | 1.000E+04 | .000E+00 | 12 | 7.070E+02 | 7.070E+02 |
| 13 | 1.707E+03 | 7.070E+02 | 14 | 2.707E+03 | 7.070E+02 | 15 | 3.707E+03 | 7.070E+02 |
| 16 | 4.707E+03 | 7.070E+02 | 17 | 5.707E+03 | 7.070E+02 | 18 | 6.707E+03 | 7.070E+02 |
| 19 | 7.707E+03 | 7.070E+02 | 20 | 8.707E+03 | 7.070E+02 | 21 | 9.707E+03 | 7.070E+02 |
| 22 | 1.071E+04 | 7.070E+02 | 23 | 1.414E+03 | 1.414E+03 | 24 | 2.414E+03 | 1.414E+03 |
| 25 | 3.414E+03 | 1.414E+03 | 26 | 4.414E+03 | 1.414E+03 | 27 | 5.414E+03 | 1.414E+03 |
| 28 | 6.414E+03 | 1.414E+03 | 29 | 7.414E+03 | 1.414E+03 | 30 | 8.414E+03 | 1.414E+03 |
| 31 | 9.414E+03 | 1.414E+03 | 32 | 1.041E+04 | 1.414E+03 | 33 | 1.141E+04 | 1.414E+03 |
| 34 | 2.121E+03 | 2.121E+03 | 35 | 3.121E+03 | 2.121E+03 | 36 | 4.121E+03 | 2.121E+03 |
| 37 | 5.121E+03 | 2.121E+03 | 38 | 6.121E+03 | 2.121E+03 | 39 | 7.121E+03 | 2.121E+03 |
| 40 | 8.121E+03 | 2.121E+03 | 41 | 9.121E+03 | 2.121E+03 | 42 | 1.012E+04 | 2.121E+03 |
| 43 | 1.112E+04 | 2.121E+03 | 44 | 1.212E+04 | 2.121E+03 | 45 | 2.828E+03 | 2.828E+03 |
| 46 | 3.828E+03 | 2.828E+03 | 47 | 4.828E+03 | 2.828E+03 | 48 | 5.828E+03 | 2.828E+03 |
| 49 | 6.828E+03 | 2.828E+03 | 50 | 7.828E+03 | 2.828E+03 | 51 | 8.828E+03 | 2.828E+03 |
| 52 | 9.828E+03 | 2.828E+03 | 53 | 1.083E+04 | 2.828E+03 | 54 | 1.183E+04 | 2.828E+03 |
| 55 | 3.535E+03 | 3.535E+03 | 56 | 4.535E+03 | 3.535E+03 | 57 | 5.535E+03 | 3.535E+03 |
| 58 | 6.535E+03 | 3.535E+03 | 59 | 7.535E+03 | 3.535E+03 | 60 | 8.535E+03 | 3.535E+03 |
| 61 | 9.535E+03 | 3.535E+03 | 62 | 1.054E+04 | 3.535E+03 | 63 | 1.154E+04 | 3.535E+03 |
| 64 | 4.242E+03 | 4.242E+03 | 65 | 5.242E+03 | 4.242E+03 | 66 | 6.242E+03 | 4.242E+03 |
| 67 | 7.242E+03 | 4.242E+03 | 68 | 8.242E+03 | 4.242E+03 | 69 | 9.242E+03 | 4.242E+03 |
| 70 | 1.024E+04 | 4.242E+03 | 71 | 1.124E+04 | 4.242E+03 | 72 | 4.949E+03 | 4.949E+03 |
| 73 | 5.949E+03 | 4.949E+03 | 74 | 6.949E+03 | 4.949E+03 | 75 | 7.949E+03 | 4.949E+03 |
| 76 | 8.949E+03 | 4.949E+03 | 77 | 9.949E+03 | 4.949E+03 | 78 | 1.095E+04 | 4.949E+03 |
| 79 | 5.657E+03 | 5.657E+03 | 80 | 6.657E+03 | 5.657E+03 | 81 | 7.657E+03 | 5.657E+03 |
| 82 | 8.657E+03 | 5.657E+03 | 83 | 9.657E+03 | 5.657E+03 | 84 | 1.066E+04 | 5.657E+03 |
| 85 | 6.364E+03 | 6.364E+03 | 86 | 7.364E+03 | 6.364E+03 | 87 | 8.364E+03 | 6.364E+03 |
| 88 | 9.364E+03 | 6.364E+03 | 89 | 1.036E+04 | 6.364E+03 | 90 | 7.071E+03 | 7.071E+03 |
| 91 | 8.071E+03 | 7.071E+03 | 92 | 9.071E+03 | 7.071E+03 | 93 | 1.007E+04 | 7.071E+03 |

BASE OF AQUIFER:
----------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .000E+00 | 2 | 2.000E+00 | 3 | 4.000E+00 | 4 | 6.000E+00 | 5 | 8.000E+00 | 6 | 1.000E+01 |
| 7 | 1.200E+01 | 8 | 1.400E+01 | 9 | 1.600E+01 | 10 | 1.800E+01 | 11 | 2.000E+01 | 12 | 2.000E+00 |
| 13 | 4.000E+00 | 14 | 6.000E+00 | 15 | 8.000E+00 | 16 | 1.000E+01 | 17 | 1.200E+01 | 18 | 1.400E+01 |
| 19 | 1.600E+01 | 20 | 1.800E+01 | 21 | 2.000E+01 | 22 | 2.200E+01 | 23 | 4.000E+00 | 24 | 6.000E+00 |
| 25 | 8.000E+00 | 26 | 1.000E+01 | 27 | 1.200E+01 | 28 | 1.400E+01 | 29 | 1.600E+01 | 30 | 1.800E+01 |
| 31 | 2.000E+01 | 32 | 2.200E+01 | 33 | 2.400E+01 | 34 | 6.000E+00 | 35 | 8.000E+00 | 36 | 1.000E+01 |
| 37 | 1.200E+01 | 38 | 1.400E+01 | 39 | 1.600E+01 | 40 | 1.800E+01 | 41 | 2.000E+01 | 42 | 2.200E+01 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 43 | 2.400E+01 | 44 | 2.600E+01 | 45 | 8.000E+00 | 46 | 1.000E+01 | 47 | 1.200E+01 | 48 | 1.400E+01 |
| 49 | 1.600E+01 | 50 | 1.800E+01 | 51 | 2.000E+01 | 52 | 2.200E+01 | 53 | 2.400E+01 | 54 | 2.600E+01 |
| 55 | 1.000E+01 | 56 | 1.200E+01 | 57 | 1.400E+01 | 58 | 1.600E+01 | 59 | 1.800E+01 | 60 | 2.000E+01 |
| 61 | 2.200E+01 | 62 | 2.400E+01 | 63 | 2.600E+01 | 64 | 1.200E+01 | 65 | 1.400E+01 | 66 | 1.600E+01 |
| 67 | 1.800E+01 | 68 | 2.000E+01 | 69 | 2.200E+01 | 70 | 2.400E+01 | 71 | 2.600E+01 | 72 | 1.400E+01 |
| 73 | 1.600E+01 | 74 | 1.800E+01 | 75 | 2.000E+01 | 76 | 2.200E+01 | 77 | 2.400E+01 | 78 | 2.600E+01 |
| 79 | 1.600E+01 | 80 | 1.800E+01 | 81 | 2.000E+01 | 82 | 2.200E+01 | 83 | 2.400E+01 | 84 | 2.600E+01 |
| 85 | 1.800E+01 | 86 | 2.000E+01 | 87 | 2.200E+01 | 88 | 2.400E+01 | 89 | 2.600E+01 | 90 | 2.000E+01 |
| 91 | 2.200E+01 | 92 | 2.400E+01 | 93 | 2.600E+01 | | | | | | |

NODE LAND SURFACE ELEVATION:
---------------------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.050E+02 | 2 | 1.070E+02 | 3 | 1.090E+02 | 4 | 1.110E+02 | 5 | 1.130E+02 | 6 | 1.150E+02 |
| 7 | 1.170E+02 | 8 | 1.190E+02 | 9 | 1.210E+02 | 10 | 1.230E+02 | 11 | 1.250E+02 | 12 | 1.070E+02 |
| 13 | 1.090E+02 | 14 | 1.110E+02 | 15 | 1.130E+02 | 16 | 1.150E+02 | 17 | 1.170E+02 | 18 | 1.190E+02 |
| 19 | 1.210E+02 | 20 | 1.230E+02 | 21 | 1.250E+02 | 22 | 1.270E+02 | 23 | 1.090E+02 | 24 | 1.110E+02 |
| 25 | 1.130E+02 | 26 | 1.150E+02 | 27 | 1.170E+02 | 28 | 1.190E+02 | 29 | 1.210E+02 | 30 | 1.230E+02 |
| 31 | 1.250E+02 | 32 | 1.270E+02 | 33 | 1.290E+02 | 34 | 1.110E+02 | 35 | 1.130E+02 | 36 | 1.150E+02 |
| 37 | 1.170E+02 | 38 | 1.190E+02 | 39 | 1.210E+02 | 40 | 1.230E+02 | 41 | 1.250E+02 | 42 | 1.270E+02 |
| 43 | 1.290E+02 | 44 | 1.310E+02 | 45 | 1.130E+02 | 46 | 1.150E+02 | 47 | 1.170E+02 | 48 | 1.190E+02 |
| 49 | 1.210E+02 | 50 | 1.230E+02 | 51 | 1.250E+02 | 52 | 1.270E+02 | 53 | 1.290E+02 | 54 | 1.310E+02 |
| 55 | 1.150E+02 | 56 | 1.170E+02 | 57 | 1.190E+02 | 58 | 1.210E+02 | 59 | 1.230E+02 | 60 | 1.250E+02 |
| 61 | 1.270E+02 | 62 | 1.290E+02 | 63 | 1.310E+02 | 64 | 1.170E+02 | 65 | 1.190E+02 | 66 | 1.210E+02 |
| 67 | 1.230E+02 | 68 | 1.250E+02 | 69 | 1.270E+02 | 70 | 1.290E+02 | 71 | 1.310E+02 | 72 | 1.190E+02 |
| 73 | 1.210E+02 | 74 | 1.230E+02 | 75 | 1.250E+02 | 76 | 1.270E+02 | 77 | 1.290E+02 | 78 | 1.310E+02 |
| 79 | 1.210E+02 | 80 | 1.230E+02 | 81 | 1.250E+02 | 82 | 1.270E+02 | 83 | 1.290E+02 | 84 | 1.310E+02 |
| 85 | 1.230E+02 | 86 | 1.250E+02 | 87 | 1.270E+02 | 88 | 1.290E+02 | 89 | 1.310E+02 | 90 | 1.250E+02 |
| 91 | 1.270E+02 | 92 | 1.290E+02 | 93 | 1.310E+02 | | | | | | |

NODAL AREAS FOR G.W. ET. :
-------------------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.178E+05 | 2 | 3.535E+05 | 3 | 3.535E+05 | 4 | 3.535E+05 | 5 | 3.535E+05 | 6 | 3.535E+05 |
| 7 | 3.535E+05 | 8 | 3.535E+05 | 9 | 3.535E+05 | 10 | 3.535E+05 | 11 | 2.360E+05 | 12 | 3.535E+05 |
| 13 | 7.070E+05 | 14 | 7.070E+05 | 15 | 7.070E+05 | 16 | 7.070E+05 | 17 | 7.070E+05 | 18 | 7.070E+05 |
| 19 | 7.070E+05 | 20 | 7.070E+05 | 21 | 7.072E+05 | 22 | 3.542E+05 | 23 | 3.535E+05 | 24 | 7.070E+05 |
| 25 | 7.070E+05 | 26 | 7.070E+05 | 27 | 7.070E+05 | 28 | 7.070E+05 | 29 | 7.070E+05 | 30 | 7.070E+05 |
| 31 | 7.059E+05 | 32 | 7.064E+05 | 33 | 3.535E+05 | 34 | 3.535E+05 | 35 | 7.070E+05 | 36 | 7.070E+05 |
| 37 | 7.070E+05 | 38 | 7.070E+05 | 39 | 7.070E+05 | 40 | 7.070E+05 | 41 | 7.068E+05 | 42 | 7.065E+05 |
| 43 | 7.070E+05 | 44 | 2.357E+05 | 45 | 3.535E+05 | 46 | 7.070E+05 | 47 | 7.070E+05 | 48 | 7.070E+05 |
| 49 | 7.070E+05 | 50 | 7.070E+05 | 51 | 7.070E+05 | 52 | 7.079E+05 | 53 | 7.075E+05 | 54 | 3.535E+05 |
| 55 | 3.535E+05 | 56 | 7.070E+05 | 57 | 7.070E+05 | 58 | 7.070E+05 | 59 | 7.070E+05 | 60 | 7.070E+05 |
| 61 | 7.079E+05 | 62 | 7.084E+05 | 63 | 3.535E+05 | 64 | 3.535E+05 | 65 | 7.070E+05 | 66 | 7.070E+05 |
| 67 | 7.070E+05 | 68 | 7.070E+05 | 69 | 7.065E+05 | 70 | 7.072E+05 | 71 | 3.535E+05 | 72 | 3.537E+05 |
| 73 | 7.075E+05 | 74 | 7.075E+05 | 75 | 7.075E+05 | 76 | 7.075E+05 | 77 | 7.079E+05 | 78 | 3.539E+05 |
| 79 | 3.538E+05 | 80 | 7.075E+05 | 81 | 7.075E+05 | 82 | 7.075E+05 | 83 | 7.077E+05 | 84 | 3.547E+05 |
| 85 | 3.535E+05 | 86 | 7.070E+05 | 87 | 7.070E+05 | 88 | 7.059E+05 | 89 | 3.529E+05 | 90 | 2.357E+05 |
| 91 | 3.535E+05 | 92 | 3.534E+05 | 93 | 2.351E+05 | | | | | | |

KNOWN-FLUX BOUNDARY NODES:
-------------------------

| SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE- |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 54 | 2 | 63 | 3 | 71 | 4 | 78 | 5 | 84 | 6 | 8 |

KNOWN-HEAD BOUNDARY NODES:
-------------------------

| SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE- |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11 | 2 | 22 | 3 | 33 | 4 | 44 | 5 | 90 | 6 | 9 |
| 7 | 92 | 8 | 93 | | | | | | | | |

BOUNDARY FLUX TO CHANGE ON DATE 6/ 1/1978 TIME= .0 HOURS:
(TBNDF= 2.864E+04 DAYS).

KNOWN NODAL BOUNDARY FLUX (L**3/DAY) AT TIME = .000E+00 DAYS:
--------------------------------------------------------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | .000E+00 | 63 | .000E+00 | 71 | .000E+00 | 78 | .000E+00 | 84 | .000E+00 | 89 | .000E+00 |

NODAL RECHARGE-DISCHARGE (L**3/DAY) AT TIME = .000E+00 DAYS:
-------------------------------------------------------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.377E+01 | 2 | 1.613E+02 | 3 | 1.613E+02 | 4 | 1.613E+02 | 5 | 1.613E+02 | 6 | 1.613E+02 |
| 7 | 1.613E+02 | 8 | 1.613E+02 | 9 | 1.613E+02 | 10 | 1.613E+02 | 11 | 1.075E+02 | 12 | 1.613E+02 |
| 13 | 3.226E+02 | 14 | 3.226E+02 | 15 | 3.226E+02 | 16 | 3.226E+02 | 17 | 3.226E+02 | 18 | 3.226E+02 |
| 19 | 3.226E+02 | 20 | 3.226E+02 | 21 | 3.226E+02 | 22 | 1.613E+02 | 23 | 1.613E+02 | 24 | 3.226E+02 |
| 25 | 3.226E+02 | 26 | 3.226E+02 | 27 | 3.226E+02 | 28 | 3.226E+02 | 29 | 3.226E+02 | 30 | 3.226E+02 |
| 31 | 3.226E+02 | 32 | 3.226E+02 | 33 | 1.613E+02 | 34 | 1.613E+02 | 35 | 3.226E+02 | 36 | 3.226E+02 |
| 37 | 3.226E+02 | 38 | 3.226E+02 | 39 | 3.226E+02 | 40 | 3.226E+02 | 41 | 3.226E+02 | 42 | 3.226E+02 |
| 43 | 3.226E+02 | 44 | 1.075E+02 | 45 | 1.613E+02 | 46 | 3.226E+02 | 47 | 3.226E+02 | 48 | 3.226E+02 |
| 49 | 3.226E+02 | 50 | 3.226E+02 | 51 | 3.226E+02 | 52 | 3.226E+02 | 53 | 3.226E+02 | 54 | 1.613E+02 |
| 55 | 1.613E+02 | 56 | 3.226E+02 | 57 | 3.226E+02 | 58 | 3.226E+02 | 59 | 3.226E+02 | 60 | 3.226E+02 |
| 61 | 3.226E+02 | 62 | 3.226E+02 | 63 | 1.613E+02 | 64 | 1.613E+02 | 65 | 3.226E+02 | 66 | 3.226E+02 |
| 67 | 3.226E+02 | 68 | 3.226E+02 | 69 | 3.226E+02 | 70 | 3.226E+02 | 71 | 1.613E+02 | 72 | 1.613E+02 |
| 73 | 3.226E+02 | 74 | 3.226E+02 | 75 | 3.226E+02 | 76 | 3.226E+02 | 77 | 3.226E+02 | 78 | 1.613E+02 |
| 79 | 1.613E+02 | 80 | 3.226E+02 | 81 | 3.226E+02 | 82 | 3.226E+02 | 83 | 3.226E+02 | 84 | 1.613E+02 |
| 85 | 1.613E+02 | 86 | 3.226E+02 | 87 | 3.226E+02 | 88 | 3.226E+02 | 89 | 1.613E+02 | 90 | 1.075E+02 |
| 91 | 1.613E+02 | 92 | 1.613E+02 | 93 | 1.075E+02 | | | | | | |

KNOWN BOUNDARY HEADS TO CHANGE ON DATE 1/ 2/1901 TIME= .0 HOURS:
(TBNDH= 3.660E+02 DAYS)

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 1.210E+02 | 22 | 1.230E+02 | 33 | 1.250E+02 | 44 | 1.270E+02 | 90 | 1.200E+02 | 91 | 1.220E+02 |

| | | | |
|---|---|---|---|
| 92 | 1.240E+02 | 93 | 1.260E+02 |

MAXIMUM ET RATE TO CHANGE ON DATE , 2/ 1/1900 TIME= .0 HOURS: (TGWET= 3.100E+01 DAYS.
ETMAX=-1.000E-03, WITH MAXIMUM DEPTH= 1.200E+01

HEADS AT TIME= .000E+00 DAYS.
------------------------------

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.000E+02 | 2 | 1.020E+02 | 3 | 1.040E+02 | 4 | 1.060E+02 | 5 | 1.080E+02 | 6 | 1.100E+02 |
| 7 | 1.120E+02 | 8 | 1.140E+02 | 9 | 1.160E+02 | 10 | 1.180E+02 | 11 | 1.200E+02 | 12 | 1.020E+02 |
| 13 | 1.040E+02 | 14 | 1.060E+02 | 15 | 1.080E+02 | 16 | 1.100E+02 | 17 | 1.120E+02 | 18 | 1.140E+02 |
| 19 | 1.160E+02 | 20 | 1.180E+02 | 21 | 1.200E+02 | 22 | 1.220E+02 | 23 | 1.040E+02 | 24 | 1.060E+02 |
| 25 | 1.080E+02 | 26 | 1.100E+02 | 27 | 1.120E+02 | 28 | 1.140E+02 | 29 | 1.160E+02 | 30 | 1.180E+02 |
| 31 | 1.200E+02 | 32 | 1.220E+02 | 33 | 1.240E+02 | 34 | 1.060E+02 | 35 | 1.080E+02 | 36 | 1.100E+02 |
| 37 | 1.120E+02 | 38 | 1.140E+02 | 39 | 1.160E+02 | 40 | 1.180E+02 | 41 | 1.200E+02 | 42 | 1.220E+02 |
| 43 | 1.240E+02 | 44 | 1.260E+02 | 45 | 1.080E+02 | 46 | 1.100E+02 | 47 | 1.120E+02 | 48 | 1.140E+02 |
| 49 | 1.160E+02 | 50 | 1.180E+02 | 51 | 1.200E+02 | 52 | 1.220E+02 | 53 | 1.240E+02 | 54 | 1.260E+02 |
| 55 | 1.100E+02 | 56 | 1.120E+02 | 57 | 1.140E+02 | 58 | 1.160E+02 | 59 | 1.180E+02 | 60 | 1.200E+02 |
| 61 | 1.220E+02 | 62 | 1.240E+02 | 63 | 1.260E+02 | 64 | 1.120E+02 | 65 | 1.140E+02 | 66 | 1.160E+02 |
| 67 | 1.180E+02 | 68 | 1.200E+02 | 69 | 1.220E+02 | 70 | 1.240E+02 | 71 | 1.260E+02 | 72 | 1.140E+02 |
| 73 | 1.160E+02 | 74 | 1.180E+02 | 75 | 1.200E+02 | 76 | 1.220E+02 | 77 | 1.240E+02 | 78 | 1.260E+02 |
| 79 | 1.160E+02 | 80 | 1.180E+02 | 81 | 1.200E+02 | 82 | 1.220E+02 | 83 | 1.240E+02 | 84 | 1.260E+02 |
| 85 | 1.180E+02 | 86 | 1.200E+02 | 87 | 1.220E+02 | 88 | 1.240E+02 | 89 | 1.260E+02 | 90 | 1.200E+02 |
| 91 | 1.220E+02 | 92 | 1.240E+02 | 93 | 1.260E+02 | | | | | | |

NODAL WATER-LEVEL HYDROGRAPHS:
------------------------------

| SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# | SEQ.-# | NODE-# |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 8 | 3 | 52 | | | | | | |

STREAM SYSTEMS:
---------------

| STREAM NUMBER | HEAD-WATER REACH # | MOUTH REACH # |
|---|---|---|
| 1 | 1 | 7 |
| 2 | 8 | 15 |

DEPLETABLE STREAM REACHES:
--------------------------

| REACH NUMBER | UPPER NODE | BRANCH TO REACH | NEXT REACH | LEAKAGE FACTOR (L**3/DAY/L) | FROM NODE | TO NODE |
|---|---|---|---|---|---|---|
| 1 | 86 | 0 | 2 | 4.999E+02 | 86 | 80 |
| 2 | 80 | 0 | 3 | 5.006E+02 | 80 | 73 |
| 3 | 73 | 0 | 6 | 3.827E+02 | 73 | 66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 81 | 0 | 5 | 5.006E+02 | 81 | 74 |
| 5 | 74 | 0 | 6 | 4.999E+02 | 74 | 66 |
| 6 | 66 | 4 | 7 | 3.827E+02 | 66 | 58 |
| 7 | 58 | 0 | 12 | 3.827E+02 | 58 | 49 |
| 8 | 53 | 0 | 9 | 5.010E+02 | 53 | 52 |
| 9 | 52 | 0 | 10 | 5.000E+02 | 52 | 51 |
| 10 | 51 | 0 | 11 | 5.000E+02 | 51 | 50 |
| 11 | 50 | 0 | 12 | 5.000E+02 | 50 | 49 |
| 12 | 49 | 0 | 13 | 9.238E+02 | 49 | 37 |
| 13 | 37 | 0 | 14 | 9.238E+02 | 37 | 25 |
| 14 | 25 | 0 | 15 | 9.238E+02 | 25 | 13 |
| 15 | 13 | 0 | 16 | 9.238E+02 | 13 | 1 |
| 16 | 1 | 0 | 0 | | | |

TABULATED CONDUCTANCE-CAPACITANCE:

CAPACITANCE EITHER LINEAR OR STEPPED WITHIN TABLE

MATERIAL NUMBER 1 WITH CONSTANT CAPACITANCE AND ANISOTROPIC CONDUCTANCE.

| "SATURATED THICKNESS" | CAPACITANCE | MAJOR COND. | MINOR COND. | ANGLE |
|---|---|---|---|---|
| .000E+00 | 1.000E-04 | 1.000E-04 | 1.000E-04 | .000E+00 |
| 5.000E+01 | 2.600E-01 | 7.500E+03 | 6.900E+03 | 4.500E+01 |
| 7.500E+01 | 1.800E-01 | 8.500E+03 | 8.100E+03 | 5.000E+01 |
| 1.250E+02 | 2.200E-01 | 1.275E+04 | 1.100E+04 | 5.500E+01 |
| 1.260E+02 | 1.000E+00 | 1.000E+10 | 1.000E+10 | .000E+00 |

UPDATED HYDRAULIC PROPERTIES:

| ELEMENT | "SATURATED THICKNESS" | CAPACITANCE | CONDUCTANCE | | |
|---|---|---|---|---|---|
| | | | KXX | KYY | KXY |
| 1 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 2 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 3 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 4 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 5 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 6 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 7 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 8 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 9 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 10 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 11 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 12 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 13 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 14 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 15 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 16 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 17 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 18 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 19 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 20 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 21 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |

| | | | | | |
|---|---|---|---|---|---|
| 22 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 23 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 24 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 25 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 26 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 27 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 28 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 29 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 30 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 31 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 32 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 33 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 34 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 35 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 36 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 37 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 38 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 39 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 40 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 41 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 42 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 43 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 44 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 45 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 46 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 47 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 48 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 49 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 50 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 51 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 52 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 53 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 54 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 55 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 56 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 57 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 58 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 59 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 60 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 61 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 62 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 63 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 64 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 65 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 66 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 67 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 68 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 69 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 70 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 71 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 72 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 73 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 74 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 75 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |

| | | | | | |
|---|---|---|---|---|---|
| 76 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 77 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 78 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |
| 79 | 1.000E+02 | 2.200E-01 | 9.948E+03 | 1.023E+04 | 5.192E+02 |

INITIAL TOTAL MASS = 1.228D+09 (L**3)

INITIAL NODAL SUBDOMAIN MASS (L**3)

| NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE | NODE | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.710E+06 | 2 | 8.131E+06 | 3 | 8.131E+06 | 4 | 8.131E+06 | 5 | 8.131E+06 | 6 | 8.131E+06 |
| 7 | 8.131E+06 | 8 | 8.131E+06 | 9 | 8.131E+06 | 10 | 8.131E+06 | 11 | 5.428E+06 | 12 | 8.131E+06 |
| 13 | 1.626E+07 | 14 | 1.626E+07 | 15 | 1.626E+07 | 16 | 1.626E+07 | 17 | 1.626E+07 | 18 | 1.626E+07 |
| 19 | 1.626E+07 | 20 | 1.626E+07 | 21 | 1.627E+07 | 22 | 8.147E+06 | 23 | 8.131E+06 | 24 | 1.626E+07 |
| 25 | 1.626E+07 | 26 | 1.626E+07 | 27 | 1.626E+07 | 28 | 1.626E+07 | 29 | 1.626E+07 | 30 | 1.626E+07 |
| 31 | 1.624E+07 | 32 | 1.625E+07 | 33 | 8.131E+06 | 34 | 8.131E+06 | 35 | 1.626E+07 | 36 | 1.626E+07 |
| 37 | 1.626E+07 | 38 | 1.626E+07 | 39 | 1.626E+07 | 40 | 1.626E+07 | 41 | 1.626E+07 | 42 | 1.625E+07 |
| 43 | 1.626E+07 | 44 | 5.420E+06 | 45 | 8.131E+06 | 46 | 1.626E+07 | 47 | 1.626E+07 | 48 | 1.626E+07 |
| 49 | 1.626E+07 | 50 | 1.626E+07 | 51 | 1.626E+07 | 52 | 1.628E+07 | 53 | 1.627E+07 | 54 | 8.131E+06 |
| 55 | 8.131E+06 | 56 | 1.626E+07 | 57 | 1.626E+07 | 58 | 1.626E+07 | 59 | 1.626E+07 | 60 | 1.626E+07 |
| 61 | 1.628E+07 | 62 | 1.629E+07 | 63 | 8.131E+06 | 64 | 8.131E+06 | 65 | 1.626E+07 | 66 | 1.626E+07 |
| 67 | 1.626E+07 | 68 | 1.626E+07 | 69 | 1.625E+07 | 70 | 1.627E+07 | 71 | 8.131E+06 | 72 | 8.134E+06 |
| 73 | 1.627E+07 | 74 | 1.627E+07 | 75 | 1.627E+07 | 76 | 1.627E+07 | 77 | 1.628E+07 | 78 | 8.140E+06 |
| 79 | 8.138E+06 | 80 | 1.627E+07 | 81 | 1.627E+07 | 82 | 1.627E+07 | 83 | 1.628E+07 | 84 | 8.157E+06 |
| 85 | 8.131E+06 | 86 | 1.626E+07 | 87 | 1.626E+07 | 88 | 1.624E+07 | 89 | 8.117E+06 | 90 | 5.420E+06 |
| 91 | 8.131E+06 | 92 | 8.128E+06 | 93 | 5.407E+06 | | | | | | |

EXPLICIT STABILITY WITH TIME STEP= 2.765E+00 DAYS
MINIMUM TIME STEP= 5.000E+00 DAYS THEREFORE RECLASSIFY AND RENUMBER NODES.
NUMBER OF IMPLICIT NODES= 85
TOTAL IMPLICIT LINKAGES= 527
AND MAXIMUM ALLOWED DEPTH= 85
RENUMBERING COMPLETE.
LAMDA VECTOR DIMENSION= 710

EXTERNAL TO INTERNAL NODE NUMBERING:

| NODE | NODE-TYPE | INTERNAL | NODE | NODE-TYPE | INTERNAL | NODE | NODE-TYPE | INTERNAL | NODE | NODE-TYPE | INTERNAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | IMPLICIT | 85 | 2 | IMPLICIT | 83 | 3 | IMPLICIT | 80 | 4 | IMPLICIT | 76 |
| 5 | IMPLICIT | 71 | 6 | IMPLICIT | 65 | 7 | IMPLICIT | 58 | 8 | IMPLICIT | 50 |
| 9 | IMPLICIT | 41 | 10 | IMPLICIT | 31 | 11 | KNOWN | 93 | 12 | IMPLICIT | 84 |
| 13 | IMPLICIT | 81 | 14 | IMPLICIT | 77 | 15 | IMPLICIT | 72 | 16 | IMPLICIT | 66 |
| 17 | IMPLICIT | 59 | 18 | IMPLICIT | 51 | 19 | IMPLICIT | 42 | 20 | IMPLICIT | 32 |
| 21 | IMPLICIT | 22 | 22 | KNOWN | 92 | 23 | IMPLICIT | 82 | 24 | IMPLICIT | 78 |
| 25 | IMPLICIT | 73 | 26 | IMPLICIT | 67 | 27 | IMPLICIT | 60 | 28 | IMPLICIT | 52 |
| 29 | IMPLICIT | 43 | 30 | IMPLICIT | 33 | 31 | IMPLICIT | 23 | 32 | IMPLICIT | 14 |
| 33 | KNOWN | 91 | 34 | IMPLICIT | 79 | 35 | IMPLICIT | 74 | 36 | IMPLICIT | 68 |
| 37 | IMPLICIT | 61 | 38 | IMPLICIT | 53 | 39 | IMPLICIT | 44 | 40 | IMPLICIT | 34 |
| 41 | IMPLICIT | 24 | 42 | IMPLICIT | 15 | 43 | IMPLICIT | 7 | 44 | KNOWN | 90 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | IMPLICIT | 75 | 46 | IMPLICIT | 69 | 47 | IMPLICIT | 62 | 48 | IMPLICIT | 54 |
| 49 | IMPLICIT | 45 | 50 | IMPLICIT | 35 | 51 | IMPLICIT | 25 | 52 | IMPLICIT | 16 |
| 53 | IMPLICIT | 8 | 54 | IMPLICIT | 1 | 55 | IMPLICIT | 70 | 56 | IMPLICIT | 63 |
| 57 | IMPLICIT | 55 | 58 | IMPLICIT | 46 | 59 | IMPLICIT | 36 | 60 | IMPLICIT | 26 |
| 61 | IMPLICIT | 17 | 62 | IMPLICIT | 9 | 63 | IMPLICIT | 2 | 64 | IMPLICIT | 64 |
| 65 | IMPLICIT | 56 | 66 | IMPLICIT | 47 | 67 | IMPLICIT | 37 | 68 | IMPLICIT | 27 |
| 69 | IMPLICIT | 18 | 70 | IMPLICIT | 10 | 71 | IMPLICIT | 3 | 72 | IMPLICIT | 57 |
| 73 | IMPLICIT | 48 | 74 | IMPLICIT | 38 | 75 | IMPLICIT | 28 | 76 | IMPLICIT | 19 |
| 77 | IMPLICIT | 11 | 78 | IMPLICIT | 4 | 79 | IMPLICIT | 49 | 80 | IMPLICIT | 39 |
| 81 | IMPLICIT | 29 | 82 | IMPLICIT | 20 | 83 | IMPLICIT | 12 | 84 | IMPLICIT | 5 |
| 85 | IMPLICIT | 40 | 86 | IMPLICIT | 30 | 87 | IMPLICIT | 21 | 88 | IMPLICIT | 13 |
| 89 | IMPLICIT | 6 | 90 | KNOWN | 89 | 91 | KNOWN | 88 | 92 | KNOWN | 87 |
| 93 | KNOWN | 86 | | | | | | | | | |

NUMBER OF IMPLICIT NODES= 85
NUMBER OF EXPLICIT NODES= 0
NUMBER OF KNOWN-HEAD NODES= 8

EXPLICIT STABILITY WITH TIME STEP= 2.000E+01 DAYS

REQUIRED LAMBDA DIMENSION= 710 WITH LAMBDA VECTOR DIMENSIONED TO 8000

CALCULATED STREAM BASEFLOWS (L**3/SEC):

| STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.762E-05 | 2 | 3.762E-05 | | | | | | | | | | |

STREAM REACHES:

| REACH | STREAMFLOW | STREAM TO AQUIFER FLUX | STREAM HEAD | AQUIFER HEAD | INFLOW(+) DIVERSION(-) |
|---|---|---|---|---|---|
| 1 | 5.000E-01 | .000E+00 | 1.190E+02 | 1.190E+02 | 5.000E-01 |
| 2 | 7.000E-01 | .000E+00 | 1.170E+02 | 1.170E+02 | 2.000E-01 |
| 3 | 1.100E+00 | .000E+00 | 1.160E+02 | 1.160E+02 | 4.000E-01 |
| 4 | 3.500E-01 | .000E+00 | 1.190E+02 | 1.190E+02 | 3.500E-01 |
| 5 | 3.500E-01 | .000E+00 | 1.170E+02 | 1.170E+02 | .000E+00 |
| 6 | 2.450E+00 | .000E+00 | 1.160E+02 | 1.160E+02 | 1.000E+00 |
| 7 | 3.250E+00 | .000E+00 | 1.160E+02 | 1.160E+02 | 8.000E-01 |
| 8 | .000E+00 | .000E+00 | 1.230E+02 | 1.230E+02 | .000E+00 |
| 9 | .000E+00 | .000E+00 | 1.210E+02 | 1.210E+02 | .000E+00 |
| 10 | .000E+00 | .000E+00 | 1.190E+02 | 1.190E+02 | .000E+00 |
| 11 | .000E+00 | .000E+00 | 1.170E+02 | 1.170E+02 | .000E+00 |
| 12 | 3.250E+00 | .000E+00 | 1.140E+02 | 1.140E+02 | .000E+00 |
| 13 | 3.250E+00 | .000E+00 | 1.100E+02 | 1.100E+02 | .000E+00 |
| 14 | 3.250E+00 | .000E+00 | 1.060E+02 | 1.060E+02 | .000E+00 |
| 15 | 3.250E+00 | .000E+00 | 1.020E+02 | 1.020E+02 | .000E+00 |

MASS BALANCE: PRESCRIBED-HEAD BOUNDARY (L,L**3):

NODE DELTA HEAD DELTA STOR SRCS-SINKS BNDFLX IN GRADIENT INDUCED

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | 4.235E-02 | 2.199E+03 | 1.667E+03 | -2.083E+04 | 2.137E+04 | GW E.T. |
| 22 | 4.235E-02 | 3.300E+03 | 2.500E+03 | 1.437E+05 | -1.429E+05 | GW E.T. |
| 33 | 4.235E-02 | 3.294E+03 | 2.500E+03 | 1.827E+05 | -1.819E+05 | GW E.T. |
| 44 | 4.235E-02 | 2.196E+03 | 1.667E+03 | 3.098E+05 | -3.093E+05 | GW E.T. |
| 90 | .000E+00 | .000E+00 | 1.667E+03 | -1.069E+04 | 9.022E+03 | GW E.T. |
| 91 | .000E+00 | .000E+00 | 2.500E+03 | 1.487E+05 | -1.512E+05 | GW E.T. |
| 92 | .000E+00 | .000E+00 | 2.500E+03 | 1.795E+05 | -1.820E+05 | GW E.T. |
| 93 | .000E+00 | .000E+00 | 1.667E+03 | 3.082E+05 | -3.099E+05 | GW E.T. |

NODAL SUBDOMAIN MASS BALANCE (L**3):

| NODE | FLUX IN | DELTA STORAGE | ERROR | CUMULATIVE MASS | DRY-WET STATUS |
|---|---|---|---|---|---|
| 1 | 5.913D+04 | 5.913D+04 | -4.366D-11 | 2.769D+06 | WET |
| 2 | 1.066D+05 | 1.066D+05 | 7.276D-11 | 8.237D+06 | WET |
| 3 | 7.579D+04 | 7.579D+04 | 1.310D-10 | 8.206D+06 | WET |
| 4 | 6.408D+04 | 6.408D+04 | 3.638D-11 | 8.195D+06 | WET |
| 5 | 5.921D+04 | 5.921D+04 | 9.459D-11 | 8.190D+06 | WET |
| 6 | 5.717D+04 | 5.717D+04 | 6.548D-11 | 8.188D+06 | WET |
| 7 | 5.617D+04 | 5.617D+04 | .000D+00 | 8.187D+06 | WET |
| 8 | 5.529D+04 | 5.529D+04 | 1.237D-10 | 8.186D+06 | WET |
| 9 | 5.328D+04 | 5.328D+04 | -2.910D-11 | 8.184D+06 | WET |
| 10 | 4.570D+04 | 4.570D+04 | 4.366D-11 | 8.176D+06 | WET |
| 11 | 2.199D+03 | 2.199D+03 | .000D+00 | 5.431D+06 | WET |
| 12 | 1.038D+05 | 1.038D+05 | 5.821D-11 | 8.234D+06 | WET |
| 13 | 1.091D+05 | 1.091D+05 | 1.019D-10 | 1.637D+07 | WET |
| 14 | 7.420D+04 | 7.420D+04 | -1.455D-11 | 1.634D+07 | WET |
| 15 | 5.915D+04 | 5.915D+04 | -3.638D-11 | 1.632D+07 | WET |
| 16 | 5.305D+04 | 5.305D+04 | 1.455D-11 | 1.631D+07 | WET |
| 17 | 5.027D+04 | 5.027D+04 | 2.183D-11 | 1.631D+07 | WET |
| 18 | 4.851D+04 | 4.851D+04 | 8.731D-11 | 1.631D+07 | WET |
| 19 | 4.584D+04 | 4.584D+04 | -3.638D-11 | 1.631D+07 | WET |
| 20 | 3.833D+04 | 3.833D+04 | 2.183D-11 | 1.630D+07 | WET |
| 21 | 1.500D+04 | 1.500D+04 | 2.728D-11 | 1.628D+07 | WET |
| 22 | 3.300D+03 | 3.300D+03 | .000D+00 | 8.150D+06 | WET |
| 23 | 7.007D+04 | 7.007D+04 | -1.455D-11 | 8.201D+06 | WET |
| 24 | 6.980D+04 | 6.980D+04 | .000D+00 | 1.633D+07 | WET |
| 25 | 4.018D+04 | 4.018D+04 | 2.910D-11 | 1.630D+07 | WET |
| 26 | 2.920D+04 | 2.920D+04 | -2.547D-11 | 1.629D+07 | WET |
| 27 | 2.413D+04 | 2.413D+04 | -3.638D-12 | 1.629D+07 | WET |
| 28 | 2.164D+04 | 2.164D+04 | 3.638D-12 | 1.628D+07 | WET |
| 29 | 1.941D+04 | 1.941D+04 | 1.455D-11 | 1.628D+07 | WET |
| 30 | 1.523D+04 | 1.523D+04 | 7.276D-12 | 1.628D+07 | WET |
| 31 | 5.947D+03 | 5.947D+03 | 1.000D-11 | 1.624D+07 | WET |
| 32 | -3.473D+03 | -3.473D+03 | 2.274D-12 | 1.624D+07 | WET |
| 33 | 3.294D+03 | 3.294D+03 | .000D+00 | 8.134D+06 | WET |
| 34 | 5.640D+04 | 5.640D+04 | 5.821D-11 | 8.187D+06 | WET |
| 35 | 5.215D+04 | 5.215D+04 | -3.638D-11 | 1.631D+07 | WET |
| 36 | 2.680D+04 | 2.680D+04 | -3.638D-11 | 1.629D+07 | WET |
| 37 | 1.567D+04 | 1.567D+04 | 1.091D-11 | 1.628D+07 | WET |
| 38 | 1.115D+04 | 1.115D+04 | 7.276D-12 | 1.627D+07 | WET |
| 39 | 8.264D+03 | 8.264D+03 | -5.457D-12 | 1.627D+07 | WET |
| 40 | 4.832D+03 | 4.832D+03 | 6.366D-12 | 1.627D+07 | WET |
| 41 | -1.930D+03 | -1.930D+03 | -4.775D-12 | 1.625D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 42 | -1.438D+04 | -1.438D+04 | -2.547D-11 | 1.624D+07 | WET |
| 43 | -3.112D+04 | -3.112D+04 | -2.910D-11 | 1.623D+07 | WET |
| 44 | 2.196D+03 | 2.196D+03 | .000D+00 | 5.423D+06 | WET |
| 45 | 5.046D+04 | 5.046D+04 | 3.638D-11 | 8.181D+06 | WET |
| 46 | 4.464D+04 | 4.464D+04 | 2.183D-11 | 1.631D+07 | WET |
| 47 | 2.047D+04 | 2.047D+04 | -1.455D-11 | 1.628D+07 | WET |
| 48 | 9.904D+03 | 9.904D+03 | -1.819D-11 | 1.627D+07 | WET |
| 49 | 4.578D+03 | 4.578D+03 | 2.728D-12 | 1.627D+07 | WET |
| 50 | 5.739D+02 | 5.739D+02 | 2.160D-12 | 1.626D+07 | WET |
| 51 | -6.419D+03 | -6.419D+03 | -1.182D-11 | 1.625D+07 | WET |
| 52 | -2.289D+04 | -2.289D+04 | 3.638D-12 | 1.626D+07 | WET |
| 53 | -6.387D+04 | -6.387D+04 | 7.276D-12 | 1.621D+07 | WET |
| 54 | -8.854D+04 | -8.854D+04 | 4.366D-11 | 8.042D+06 | WET |
| 55 | 4.787D+04 | 4.787D+04 | -5.821D-11 | 8.178D+06 | WET |
| 56 | 4.110D+04 | 4.110D+04 | 4.366D-11 | 1.630D+07 | WET |
| 57 | 1.728D+04 | 1.728D+04 | -3.638D-12 | 1.628D+07 | WET |
| 58 | 6.289D+03 | 6.289D+03 | -1.819D-12 | 1.627D+07 | WET |
| 59 | 9.681D+00 | 9.681D+00 | -4.938D-13 | 1.626D+07 | WET |
| 60 | -7.950D+03 | -7.950D+03 | -7.276D-12 | 1.625D+07 | WET |
| 61 | -2.683D+04 | -2.683D+04 | 2.547D-11 | 1.626D+07 | WET |
| 62 | -7.801D+04 | -7.801D+04 | .000D+00 | 1.622D+07 | WET |
| 63 | -1.136D+05 | -1.136D+05 | -1.455D-11 | 8.017D+06 | WET |
| 64 | 4.658D+04 | 4.658D+04 | 4.366D-11 | 8.177D+06 | WET |
| 65 | 3.885D+04 | 3.885D+04 | 7.276D-12 | 1.630D+07 | WET |
| 66 | 1.442D+04 | 1.442D+04 | 1.637D-11 | 1.628D+07 | WET |
| 67 | 2.747D+03 | 2.747D+03 | -1.364D-12 | 1.626D+07 | WET |
| 68 | -6.987D+03 | -6.987D+03 | -4.547D-12 | 1.625D+07 | WET |
| 69 | -2.674D+04 | -2.674D+04 | -1.091D-11 | 1.622D+07 | WET |
| 70 | -8.285D+04 | -8.285D+04 | 1.455D-11 | 1.618D+07 | WET |
| 71 | -1.212D+05 | -1.212D+05 | -2.910D-11 | 8.009D+06 | WET |
| 72 | 4.551D+04 | 4.551D+04 | 5.093D-11 | 8.180D+06 | WET |
| 73 | 3.562D+04 | 3.562D+04 | 1.455D-11 | 1.631D+07 | WET |
| 74 | 1.038D+04 | 1.038D+04 | .000D+00 | 1.628D+07 | WET |
| 75 | -3.551D+03 | -3.551D+03 | -2.728D-12 | 1.627D+07 | WET |
| 76 | -2.288D+04 | -2.288D+04 | 1.819D-11 | 1.625D+07 | WET |
| 77 | -7.857D+04 | -7.857D+04 | 1.019D-10 | 1.620D+07 | WET |
| 78 | -1.212D+05 | -1.212D+05 | -7.276D-11 | 8.019D+06 | WET |
| 79 | 4.359D+04 | 4.359D+04 | 2.183D-11 | 8.182D+06 | WET |
| 80 | 2.875D+04 | 2.875D+04 | 2.910D-11 | 1.630D+07 | WET |
| 81 | 2.609D+03 | 2.609D+03 | -3.638D-12 | 1.628D+07 | WET |
| 82 | -1.435D+04 | -1.435D+04 | -3.638D-12 | 1.626D+07 | WET |
| 83 | -6.346D+04 | -6.346D+04 | 1.310D-10 | 1.621D+07 | WET |
| 84 | -1.146D+05 | -1.146D+05 | 7.276D-11 | 8.043D+06 | WET |
| 85 | 3.645D+04 | 3.645D+04 | -6.548D-11 | 8.167D+06 | WET |
| 86 | 8.649D+03 | 8.649D+03 | 5.457D-12 | 1.627D+07 | WET |
| 87 | -4.777D+03 | -4.777D+03 | 2.728D-12 | 1.626D+07 | WET |
| 88 | -3.011D+04 | -3.011D+04 | 2.910D-11 | 1.621D+07 | WET |
| 89 | -9.027D+04 | -9.027D+04 | -1.455D-10 | 8.027D+06 | WET |
| 90 | .000D+00 | .000D+00 | .000D+00 | 5.420D+06 | WET |
| 91 | .000D+00 | .000D+00 | .000D+00 | 8.131D+06 | WET |
| 92 | .000D+00 | .000D+00 | .000D+00 | 8.128D+06 | WET |
| 93 | .000D+00 | .000D+00 | .000D+00 | 5.407D+06 | WET |

MASS BALANCE SUMMARY (L##3). DATE 1/16/1900 HH:MM:SS=12: 0: 0 TIME= 1.550E+01 DAYS. (STEP= 1.550D+01 DAYS) 2 ATTEMPTS

```
THETA= 1.00 TOTAL FLUX= 1.028D+06 TOTAL STORAGE CHANGE= 1.028D+06 TOTAL STEP ERROR= 9.846D-10 CUMULATIVE ERROR= 9.846D-10
TOTAL VOLUME= 1.229D+09. NODAL RECHARGES & WITHDRAWALS= 3.775D+05. STREAM INPUT=-3.916D+04. FLUX BOUNDARY INPUT=  .000D+00
HEAD BOUNDARY INPUT= 1.241D+06. MIN DELTA HEAD=-1.558E+00 (L**1). MAX DELTA HEAD= 2.281E+00 (L**1). AND    0 "DRY" NODES.
PREDICTED GROUNDWATER ET =-4.827E+05
CORRECTED GROUNDWATER ET =-4.890E+05
```

HEAD AND HEAD CHANGE:

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TOTAL SIMULATED TIME= 1.550E+01 DAYS; TIME STEP= 1.550E+01 DAYS

| NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.023D+02 | 1 | 2.281D+00 | 2 | 1.034D+02 | 2 | 1.371D+00 | 3 | 1.050D+02 | 3 | 9.746D-01 |
| 4 | 1.068D+02 | 4 | 8.240D-01 | 5 | 1.088D+02 | 5 | 7.613D-01 | 6 | 1.107D+02 | 6 | 7.351D-01 |
| 7 | 1.127D+02 | 7 | 7.223D-01 | 8 | 1.147D+02 | 8 | 7.109D-01 | 9 | 1.167D+02 | 9 | 6.850D-01 |
| 10 | 1.186D+02 | 10 | 5.876D-01 | 11 | 1.200D+02 | 11 | 4.235D-02 | 12 | 1.033D+02 | 12 | 1.335D+00 |
| 13 | 1.047D+02 | 13 | 7.012D-01 | 14 | 1.065D+02 | 14 | 4.771D-01 | 15 | 1.084D+02 | 15 | 3.803D-01 |
| 16 | 1.103D+02 | 16 | 3.411D-01 | 17 | 1.123D+02 | 17 | 3.232D-01 | 18 | 1.143D+02 | 18 | 3.119D-01 |
| 19 | 1.163D+02 | 19 | 2.947D-01 | 20 | 1.182D+02 | 20 | 2.464D-01 | 21 | 1.201D+02 | 21 | 9.638D-02 |
| 22 | 1.220D+02 | 22 | 4.235D-02 | 23 | 1.049D+02 | 23 | 9.009D-01 | 24 | 1.064D+02 | 24 | 4.488D-01 |
| 25 | 1.083D+02 | 25 | 2.583D-01 | 26 | 1.102D+02 | 26 | 1.878D-01 | 27 | 1.122D+02 | 27 | 1.551D-01 |
| 28 | 1.141D+02 | 28 | 1.391D-01 | 29 | 1.161D+02 | 29 | 1.248D-01 | 30 | 1.181D+02 | 30 | 9.794D-02 |
| 31 | 1.200D+02 | 31 | 3.829D-02 | 32 | 1.220D+02 | 32 | -2.235D-02 | 33 | 1.240D+02 | 33 | 4.235D-02 |
| 34 | 1.067D+02 | 34 | 7.253D-01 | 35 | 1.083D+02 | 35 | 3.353D-01 | 36 | 1.102D+02 | 36 | 1.723D-01 |
| 37 | 1.121D+02 | 37 | 1.008D-01 | 38 | 1.141D+02 | 38 | 7.168D-02 | 39 | 1.161D+02 | 39 | 5.313D-02 |
| 40 | 1.180D+02 | 40 | 3.106D-02 | 41 | 1.200D+02 | 41 | -1.242D-02 | 42 | 1.219D+02 | 42 | -9.251D-02 |
| 43 | 1.238D+02 | 43 | -2.001D-01 | 44 | 1.260D+02 | 44 | 4.235D-02 | 45 | 1.086D+02 | 45 | 6.489D-01 |
| 46 | 1.103D+02 | 46 | 2.870D-01 | 47 | 1.121D+02 | 47 | 1.316D-01 | 48 | 1.141D+02 | 48 | 6.368D-02 |
| 49 | 1.160D+02 | 49 | 2.943D-02 | 50 | 1.180D+02 | 50 | 3.689D-03 | 51 | 1.200D+02 | 51 | -4.127D-02 |
| 52 | 1.219D+02 | 52 | -1.470D-01 | 53 | 1.236D+02 | 53 | -4.104D-01 | 54 | 1.249D+02 | 54 | -1.138D+00 |
| 55 | 1.106D+02 | 55 | 6.156D-01 | 56 | 1.123D+02 | 56 | 2.643D-01 | 57 | 1.141D+02 | 57 | 1.111D-01 |
| 58 | 1.160D+02 | 58 | 4.043D-02 | 59 | 1.180D+02 | 59 | 6.224D-05 | 60 | 1.199D+02 | 60 | -5.112D-02 |
| 61 | 1.218D+02 | 61 | -1.723D-01 | 62 | 1.235D+02 | 62 | -5.006D-01 | 63 | 1.245D+02 | 63 | -1.461D+00 |
| 64 | 1.126D+02 | 64 | 5.989D-01 | 65 | 1.142D+02 | 65 | 2.498D-01 | 66 | 1.161D+02 | 66 | 9.269D-02 |
| 67 | 1.180D+02 | 67 | 1.766D-02 | 68 | 1.200D+02 | 68 | -4.492D-02 | 69 | 1.218D+02 | 69 | -1.720D-01 |
| 70 | 1.235D+02 | 70 | -5.325D-01 | 71 | 1.244D+02 | 71 | -1.558D+00 | 72 | 1.146D+02 | 72 | 5.849D-01 |
| 73 | 1.162D+02 | 73 | 2.288D-01 | 74 | 1.181D+02 | 74 | 6.667D-02 | 75 | 1.200D+02 | 75 | -2.281D-02 |
| 76 | 1.219D+02 | 76 | -1.470D-01 | 77 | 1.235D+02 | 77 | -5.045D-01 | 78 | 1.244D+02 | 78 | -1.557D+00 |
| 79 | 1.166D+02 | 79 | 5.600D-01 | 80 | 1.182D+02 | 80 | 1.847D-01 | 81 | 1.200D+02 | 81 | 1.676D-02 |
| 82 | 1.219D+02 | 82 | -9.218D-02 | 83 | 1.236D+02 | 83 | -4.076D-01 | 84 | 1.245D+02 | 84 | -1.469D+00 |
| 85 | 1.185D+02 | 85 | 4.687D-01 | 86 | 1.201D+02 | 86 | 5.561D-02 | 87 | 1.220D+02 | 87 | -3.071D-02 |
| 88 | 1.238D+02 | 88 | -1.939D-01 | 89 | 1.248D+02 | 89 | -1.163D+00 | 90 | 1.200D+02 | 90 | .000D+00 |
| 91 | 1.220D+02 | 91 | .000D+00 | 92 | 1.240D+02 | 92 | .000D+00 | 93 | 1.260D+02 | 93 | .000D+00 |

CALCULATED STREAM BASEFLOWS (L**3/SEC):

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| STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.795E-03 | 2 | 2.758E-02 | | | | | | | | | | |

STREAM REACHES:

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STREAM TO INFLOW(+)

| REACH | STREAMFLOW | AQUIFER FLUX | STREAM HEAD | AQUIFER HEAD | DIVERSION(-) |
|---|---|---|---|---|---|
| 1 | 6.058E+01 | -6.008E+01 | 1.190E+02 | 1.191E+02 | 5.000E-01 |
| 2 | 1.643E+02 | -1.035E+02 | 1.170E+02 | 1.172E+02 | 2.000E-01 |
| 3 | 2.262E+02 | -6.151E+01 | 1.160E+02 | 1.162E+02 | 4.000E-01 |
| 4 | 2.123E+01 | -2.088E+01 | 1.190E+02 | 1.190E+02 | 3.500E-01 |
| 5 | 6.107E+01 | -3.983E+01 | 1.170E+02 | 1.171E+02 | .000E+00 |
| 6 | 3.137E+02 | -2.547E+01 | 1.160E+02 | 1.161E+02 | 1.000E+00 |
| 7 | 3.279E+02 | -1.337E+01 | 1.160E+02 | 1.160E+02 | 8.000E-01 |
| 8 | .000E+00 | .000E+00 | 1.230E+02 | 1.227E+02 | .000E+00 |
| 9 | .000E+00 | .000E+00 | 1.210E+02 | 1.209E+02 | .000E+00 |
| 10 | .000E+00 | .000E+00 | 1.190E+02 | 1.190E+02 | .000E+00 |
| 11 | 8.281E+00 | -8.281E+00 | 1.170E+02 | 1.170E+02 | .000E+00 |
| 12 | 3.963E+02 | -6.014E+01 | 1.140E+02 | 1.141E+02 | .000E+00 |
| 13 | 5.622E+02 | -1.659E+02 | 1.100E+02 | 1.102E+02 | .000E+00 |
| 14 | 1.005E+03 | -4.432E+02 | 1.060E+02 | 1.065E+02 | .000E+00 |
| 15 | 2.383E+03 | -1.378E+03 | 1.020E+02 | 1.035E+02 | .000E+00 |

MASS BALANCE: PRESCRIBED-HEAD BOUNDARY (L,L**3):
-----------------------------------------------

| NODE | DELTA HEAD | DELTA STOR | SRCS-SINKS | BNDFLX IN | GRADIENT INDUCED | |
|---|---|---|---|---|---|---|
| 11 | 4.235E-02 | 2.199E+03 | 1.667E+03 | -3.299E+04 | 3.353E+04 | GW E.T. |
| 22 | 4.235E-02 | 3.300E+03 | 2.500E+03 | 1.510E+05 | -1.502E+05 | GW E.T. |
| 33 | 4.235E-02 | 3.294E+03 | 2.500E+03 | 2.181E+05 | -2.173E+05 | GW E.T. |
| 44 | 4.235E-02 | 2.196E+03 | 1.667E+03 | 3.620E+05 | -3.615E+05 | GW E.T. |
| 90 | .000E+00 | .000E+00 | 1.667E+03 | -2.411E+04 | 2.244E+04 | GW E.T. |
| 91 | .000E+00 | .000E+00 | 2.500E+03 | 1.519E+05 | -1.544E+05 | GW E.T. |
| 92 | .000E+00 | .000E+00 | 2.500E+03 | 2.089E+05 | -2.114E+05 | GW E.T. |
| 93 | .000E+00 | .000E+00 | 1.667E+03 | 3.594E+05 | -3.610E+05 | GW E.T. |

NODAL SUBDOMAIN MASS BALANCE (L**3):
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| NODE | FLUX IN | DELTA STORAGE | ERROR | CUMULATIVE MASS | DRY-WET STATUS |
|---|---|---|---|---|---|
| 1 | 3.433D+04 | 3.433D+04 | -2.183D-11 | 2.604D+06 | WET |
| 2 | 8.257D+04 | 8.257D+04 | 8.731D-11 | 8.320D+06 | WET |
| 3 | 5.987D+04 | 5.987D+04 | 6.548D-11 | 8.266D+06 | WET |
| 4 | 4.652D+04 | 4.652D+04 | 7.276D-12 | 8.241D+06 | WET |
| 5 | 3.899D+04 | 3.899D+04 | 2.910D-11 | 8.229D+06 | WET |
| 6 | 3.500D+04 | 3.500D+04 | 2.183D-11 | 8.223D+06 | WET |
| 7 | 3.262D+04 | 3.262D+04 | 2.547D-11 | 8.219D+06 | WET |
| 8 | 3.052D+04 | 3.052D+04 | 3.638D-11 | 8.216D+06 | WET |
| 9 | 2.719D+04 | 2.719D+04 | 3.638D-12 | 8.211D+06 | WET |
| 10 | 2.000D+04 | 2.000D+04 | 1.819D-11 | 8.196D+06 | WET |
| 11 | 2.199D+03 | 2.199D+03 | .000D+00 | 5.433D+06 | WET |
| 12 | 8.276D+04 | 8.276D+04 | 8.731D-11 | 8.317D+06 | WET |
| 13 | 1.165D+05 | 1.165D+05 | 1.455D-11 | 1.649D+07 | WET |
| 14 | 8.586D+04 | 8.586D+04 | .000D+00 | 1.642D+07 | WET |
| 15 | 6.655D+04 | 6.655D+04 | .000D+00 | 1.639D+07 | WET |
| 16 | 5.627D+04 | 5.627D+04 | 7.276D-11 | 1.637D+07 | WET |
| 17 | 5.036D+04 | 5.036D+04 | -3.638D-11 | 1.636D+07 | WET |
| 18 | 4.608D+04 | 4.608D+04 | 1.455D-10 | 1.636D+07 | WET |
| 19 | 4.071D+04 | 4.071D+04 | -2.183D-11 | 1.635D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 20 | 3.073D+04 | 3.073D+04 | 4.002D-11 | 1.633D+07 | WET |
| 21 | 1.258D+04 | 1.258D+04 | 9.095D-12 | 1.629D+07 | WET |
| 22 | 3.300D+03 | 3.300D+03 | .000D+00 | 8.153D+06 | WET |
| 23 | 5.915D+04 | 5.915D+04 | 1.455D-11 | 8.260D+06 | WET |
| 24 | 8.399D+04 | 8.399D+04 | 2.910D-11 | 1.641D+07 | WET |
| 25 | 5.770D+04 | 5.770D+04 | -2.910D-11 | 1.636D+07 | WET |
| 26 | 4.402D+04 | 4.402D+04 | -2.183D-11 | 1.633D+07 | WET |
| 27 | 3.551D+04 | 3.551D+04 | 2.910D-11 | 1.632D+07 | WET |
| 28 | 3.020D+04 | 3.020D+04 | -3.274D-11 | 1.631D+07 | WET |
| 29 | 2.513D+04 | 2.513D+04 | 1.455D-11 | 1.631D+07 | WET |
| 30 | 1.764D+04 | 1.764D+04 | 2.910D-11 | 1.629D+07 | WET |
| 31 | 5.765D+03 | 5.765D+03 | -7.276D-12 | 1.625D+07 | WET |
| 32 | -3.320D+03 | -3.320D+03 | -5.912D-12 | 1.624D+07 | WET |
| 33 | 3.294D+03 | 3.294D+03 | .000D+00 | 8.137D+06 | WET |
| 34 | 4.437D+04 | 4.437D+04 | 7.276D-12 | 8.231D+06 | WET |
| 35 | 6.243D+04 | 6.243D+04 | 5.821D-11 | 1.638D+07 | WET |
| 36 | 4.195D+04 | 4.195D+04 | -3.638D-11 | 1.633D+07 | WET |
| 37 | 2.837D+04 | 2.837D+04 | -7.276D-12 | 1.631D+07 | WET |
| 38 | 2.092D+04 | 2.092D+04 | 4.002D-11 | 1.629D+07 | WET |
| 39 | 1.483D+04 | 1.483D+04 | -1.455D-11 | 1.628D+07 | WET |
| 40 | 7.748D+03 | 7.748D+03 | -9.095D-13 | 1.627D+07 | WET |
| 41 | -3.153D+03 | -3.153D+03 | 3.183D-12 | 1.625D+07 | WET |
| 42 | -1.738D+04 | -1.738D+04 | -4.002D-11 | 1.622D+07 | WET |
| 43 | -2.595D+04 | -2.595D+04 | -2.547D-11 | 1.620D+07 | WET |
| 44 | 2.196D+03 | 2.196D+03 | .000D+00 | 5.425D+06 | WET |
| 45 | 3.562D+04 | 3.562D+04 | 5.821D-11 | 8.217D+06 | WET |
| 46 | 5.033D+04 | 5.033D+04 | 7.276D-12 | 1.636D+07 | WET |
| 47 | 3.185D+04 | 3.185D+04 | -2.547D-11 | 1.631D+07 | WET |
| 48 | 1.934D+04 | 1.934D+04 | -1.819D-11 | 1.629D+07 | WET |
| 49 | 1.037D+04 | 1.037D+04 | 7.276D-12 | 1.628D+07 | WET |
| 50 | 2.369D+03 | 2.369D+03 | 3.638D-12 | 1.626D+07 | WET |
| 51 | -9.523D+03 | -9.523D+03 | -7.276D-12 | 1.625D+07 | WET |
| 52 | -2.914D+04 | -2.914D+04 | 1.091D-11 | 1.623D+07 | WET |
| 53 | -5.661D+04 | -5.661D+04 | 3.638D-11 | 1.615D+07 | WET |
| 54 | -3.768D+04 | -3.768D+04 | 2.183D-11 | 8.004D+06 | WET |
| 55 | 3.077D+04 | 3.077D+04 | -4.002D-11 | 8.209D+06 | WET |
| 56 | 4.316D+04 | 4.316D+04 | 8.004D-11 | 1.635D+07 | WET |
| 57 | 2.538D+04 | 2.538D+04 | -2.547D-11 | 1.630D+07 | WET |
| 58 | 1.208D+04 | 1.208D+04 | -1.273D-11 | 1.628D+07 | WET |
| 59 | 1.494D+03 | 1.494D+03 | 2.501D-12 | 1.626D+07 | WET |
| 60 | -1.199D+04 | -1.199D+04 | -1.455D-11 | 1.624D+07 | WET |
| 61 | -3.528D+04 | -3.528D+04 | 1.455D-11 | 1.622D+07 | WET |
| 62 | -7.402D+04 | -7.402D+04 | 1.455D-11 | 1.614D+07 | WET |
| 63 | -5.780D+04 | -5.780D+04 | 1.455D-11 | 7.959D+06 | WET |
| 64 | 2.783D+04 | 2.783D+04 | 2.183D-11 | 8.205D+06 | WET |
| 65 | 3.797D+04 | 3.797D+04 | 2.910D-11 | 1.634D+07 | WET |
| 66 | 1.931D+04 | 1.931D+04 | 1.091D-11 | 1.629D+07 | WET |
| 67 | 4.820D+03 | 4.820D+03 | -2.728D-12 | 1.627D+07 | WET |
| 68 | -1.047D+04 | -1.047D+04 | -5.457D-12 | 1.624D+07 | WET |
| 69 | -3.531D+04 | -3.531D+04 | -2.910D-11 | 1.619D+07 | WET |
| 70 | -7.923D+04 | -7.923D+04 | 1.455D-11 | 1.610D+07 | WET |
| 71 | -6.576D+04 | -6.576D+04 | 4.366D-11 | 7.944D+06 | WET |
| 72 | 2.538D+04 | 2.538D+04 | -3.638D-12 | 8.205D+06 | WET |
| 73 | 3.189D+04 | 3.189D+04 | -3.638D-12 | 1.634D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 74 | 1.210D+04 | 1.210D+04 | -1.819D-12 | 1.629D+07 | WET |
| 75 | -5.410D+03 | -5.410D+03 | 1.819D-12 | 1.626D+07 | WET |
| 76 | -2.949D+04 | -2.949D+04 | -1.091D-11 | 1.622D+07 | WET |
| 77 | -7.413D+04 | -7.413D+04 | 1.019D-10 | 1.613D+07 | WET |
| 78 | -6.622D+04 | -6.622D+04 | -5.821D-11 | 7.952D+06 | WET |
| 79 | 2.200D+04 | 2.200D+04 | 1.091D-11 | 8.204D+06 | WET |
| 80 | 2.247D+04 | 2.247D+04 | 3.638D-11 | 1.632D+07 | WET |
| 81 | 1.636D+03 | 1.636D+03 | -2.728D-12 | 1.628D+07 | WET |
| 82 | -1.843D+04 | -1.843D+04 | 2.183D-11 | 1.624D+07 | WET |
| 83 | -5.703D+04 | -5.703D+04 | 7.276D-11 | 1.616D+07 | WET |
| 84 | -5.913D+04 | -5.913D+04 | 5.093D-11 | 7.983D+06 | WET |
| 85 | 1.527D+04 | 1.527D+04 | -2.728D-11 | 8.182D+06 | WET |
| 86 | 6.390D+03 | 6.390D+03 | 6.366D-12 | 1.628D+07 | WET |
| 87 | -6.402D+03 | -6.402D+03 | -9.095D-12 | 1.625D+07 | WET |
| 88 | -2.723D+04 | -2.723D+04 | 3.638D-11 | 1.618D+07 | WET |
| 89 | -3.958D+04 | -3.958D+04 | 2.183D-11 | 7.987D+06 | WET |
| 90 | .000D+00 | .000D+00 | .000D+00 | 5.420D+06 | WET |
| 91 | .000D+00 | .000D+00 | .000D+00 | 8.131D+06 | WET |
| 92 | .000D+00 | .000D+00 | .000D+00 | 8.128D+06 | WET |
| 93 | .000D+00 | .000D+00 | .000D+00 | 5.407D+06 | WET |

MASS BALANCE SUMMARY (L**3). DATE 2/ 1/1900 HH:MM:SS= 0: 0: 0 TIME= 3.100E+01 DAYS. (STEP= 1.550D+01 DAYS) 2 ATTEMPTS
THETA= 1.00 TOTAL FLUX= 1.141D+06 TOTAL STORAGE CHANGE= 1.141D+06 TOTAL STEP ERROR= 1.042D-09 CUMULATIVE ERROR= 2.027D-09
TOTAL VOLUME= 1.230D+09. NODAL RECHARGES & WITHDRAWALS= 3.775D+05. STREAM INPUT=-7.291D+04. FLUX BOUNDARY INPUT= .000D+00
HEAD BOUNDARY INPUT= 1.394D+06. MIN DELTA HEAD=-8.505E-01 (L**1). MAX DELTA HEAD= 1.324E+00 (L**1). AND 0 "DRY" NODES.
PREDICTED GROUNDWATER ET =-4.887E+05
CORRECTED GROUNDWATER ET =-4.957E+05

HEAD AND HEAD CHANGE:
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TOTAL SIMULATED TIME= 3.100E+01 DAYS: TIME STEP= 1.550E+01 DAYS

| NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.036D+02 | 1 | 1.324D+00 | 2 | 1.044D+02 | 2 | 1.062D+00 | 3 | 1.057D+02 | 3 | 7.698D-01 |
| 4 | 1.074D+02 | 4 | 5.982D-01 | 5 | 1.093D+02 | 5 | 5.013D-01 | 6 | 1.112D+02 | 6 | 4.500D-01 |
| 7 | 1.131D+02 | 7 | 4.194D-01 | 8 | 1.151D+02 | 8 | 3.925D-01 | 9 | 1.170D+02 | 9 | 3.497D-01 |
| 10 | 1.188D+02 | 10 | 2.571D-01 | 11 | 1.201D+02 | 11 | 4.235D-02 | 12 | 1.044D+02 | 12 | 1.064D+00 |
| 13 | 1.055D+02 | 13 | 7.493D-01 | 14 | 1.070D+02 | 14 | 5.520D-01 | 15 | 1.088D+02 | 15 | 4.279D-01 |
| 16 | 1.107D+02 | 16 | 3.618D-01 | 17 | 1.126D+02 | 17 | 3.238D-01 | 18 | 1.146D+02 | 18 | 2.963D-01 |
| 19 | 1.166D+02 | 19 | 2.617D-01 | 20 | 1.184D+02 | 20 | 1.976D-01 | 21 | 1.202D+02 | 21 | 8.087D-02 |
| 22 | 1.221D+02 | 22 | 4.235D-02 | 23 | 1.057D+02 | 23 | 7.605D-01 | 24 | 1.070D+02 | 24 | 5.400D-01 |
| 25 | 1.086D+02 | 25 | 3.710D-01 | 26 | 1.105D+02 | 26 | 2.830D-01 | 27 | 1.124D+02 | 27 | 2.283D-01 |
| 28 | 1.143D+02 | 28 | 1.942D-01 | 29 | 1.163D+02 | 29 | 1.616D-01 | 30 | 1.182D+02 | 30 | 1.134D-01 |
| 31 | 1.201D+02 | 31 | 3.712D-02 | 32 | 1.220D+02 | 32 | -2.136D-02 | 33 | 1.241D+02 | 33 | 4.235D-02 |
| 34 | 1.073D+02 | 34 | 5.706D-01 | 35 | 1.087D+02 | 35 | 4.014D-01 | 36 | 1.104D+02 | 36 | 2.697D-01 |
| 37 | 1.123D+02 | 37 | 1.824D-01 | 38 | 1.142D+02 | 38 | 1.345D-01 | 39 | 1.161D+02 | 39 | 9.534D-02 |
| 40 | 1.181D+02 | 40 | 4.982D-02 | 41 | 1.200D+02 | 41 | -2.028D-02 | 42 | 1.218D+02 | 42 | -1.118D-01 |
| 43 | 1.236D+02 | 43 | -1.669D-01 | 44 | 1.261D+02 | 44 | 4.235D-02 | 45 | 1.091D+02 | 45 | 4.580D-01 |
| 46 | 1.106D+02 | 46 | 3.236D-01 | 47 | 1.123D+02 | 47 | 2.048D-01 | 48 | 1.142D+02 | 48 | 1.243D-01 |
| 49 | 1.161D+02 | 49 | 6.666D-02 | 50 | 1.180D+02 | 50 | 1.523D-02 | 51 | 1.199D+02 | 51 | -6.122D-02 |
| 52 | 1.217D+02 | 52 | -1.871D-01 | 53 | 1.232D+02 | 53 | -3.637D-01 | 54 | 1.244D+02 | 54 | -4.845D-01 |
| 55 | 1.110D+02 | 55 | 3.956D-01 | 56 | 1.125D+02 | 56 | 2.775D-01 | 57 | 1.143D+02 | 57 | 1.632D-01 |
| 58 | 1.161D+02 | 58 | 7.765D-02 | 59 | 1.180D+02 | 59 | 9.603D-03 | 60 | 1.199D+02 | 60 | -7.711D-02 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 1.216D+02 | 61 | -2.265D-01 | 62 | 1.230D+02 | 62 | -4.749D-01 | 63 | 1.238D+02 | 63 | -7.432D-01 |
| 64 | 1.130D+02 | 64 | 3.578D-01 | 65 | 1.145D+02 | 65 | 2.441D-01 | 66 | 1.162D+02 | 66 | 1.242D-01 |
| 67 | 1.180D+02 | 67 | 3.099D-02 | 68 | 1.199D+02 | 68 | -6.734D-02 | 69 | 1.216D+02 | 69 | -2.272D-01 |
| 70 | 1.230D+02 | 70 | -5.092D-01 | 71 | 1.236D+02 | 71 | -8.456D-01 | 72 | 1.149D+02 | 72 | 3.262D-01 |
| 73 | 1.164D+02 | 73 | 2.049D-01 | 74 | 1.181D+02 | 74 | 7.773D-02 | 75 | 1.199D+02 | 75 | -3.476D-02 |
| 76 | 1.217D+02 | 76 | -1.895D-01 | 77 | 1.230D+02 | 77 | -4.760D-01 | 78 | 1.236D+02 | 78 | -8.505D-01 |
| 79 | 1.168D+02 | 79 | 2.826D-01 | 80 | 1.183D+02 | 80 | 1.444D-01 | 81 | 1.200D+02 | 81 | 1.051D-02 |
| 82 | 1.218D+02 | 82 | -1.184D-01 | 83 | 1.232D+02 | 83 | -3.663D-01 | 84 | 1.238D+02 | 84 | -7.578D-01 |
| 85 | 1.187D+02 | 85 | 1.964D-01 | 86 | 1.201D+02 | 86 | 4.108D-02 | 87 | 1.219D+02 | 87 | -4.116D-02 |
| 88 | 1.236D+02 | 88 | -1.754D-01 | 89 | 1.243D+02 | 89 | -5.097D-01 | 90 | 1.200D+02 | 90 | .000D+00 |
| 91 | 1.220D+02 | 91 | .000D+00 | 92 | 1.240D+02 | 92 | .000D+00 | 93 | 1.260D+02 | 93 | .000D+00 |

MAXIMUM ET RATE TO CHANGE ON DATE . 3/ 1/1900 TIME= .0 HOURS; (TGWET= 5.900E+01 DAYS,
ETMAX=-2.000E-02, WITH MAXIMUM DEPTH= 1.200E+01

CALCULATED STREAM BASEFLOWS (L**3/SEC):

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| STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.679E-03 | 2 | 5.307E-02 | | | | | | | | | | |

STREAM REACHES:

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| REACH | STREAMFLOW | STREAM TO AQUIFER FLUX | STREAM HEAD | AQUIFER HEAD | INFLOW(+) DIVERSION(-) |
|---|---|---|---|---|---|
| 1 | 1.069E+02 | -1.064E+02 | 1.190E+02 | 1.192E+02 | 5.000E-01 |
| 2 | 2.981E+02 | -1.910E+02 | 1.170E+02 | 1.174E+02 | 2.000E-01 |
| 3 | 4.230E+02 | -1.245E+02 | 1.160E+02 | 1.163E+02 | 4.000E-01 |
| 4 | 4.332E+01 | -4.297E+01 | 1.190E+02 | 1.191E+02 | 3.500E-01 |
| 5 | 1.336E+02 | -9.030E+01 | 1.170E+02 | 1.172E+02 | .000E+00 |
| 6 | 6.217E+02 | -6.408E+01 | 1.160E+02 | 1.162E+02 | 1.000E+00 |
| 7 | 6.634E+02 | -4.098E+01 | 1.160E+02 | 1.161E+02 | 8.000E-01 |
| 8 | .000E+00 | .000E+00 | 1.230E+02 | 1.224E+02 | .000E+00 |
| 9 | .000E+00 | .000E+00 | 1.210E+02 | 1.208E+02 | .000E+00 |
| 10 | .000E+00 | .000E+00 | 1.190E+02 | 1.190E+02 | .000E+00 |
| 11 | 2.875E+01 | -2.375E+01 | 1.170E+02 | 1.171E+02 | .000E+00 |
| 12 | 6.674E+02 | -1.752E+02 | 1.140E+02 | 1.142E+02 | .000E+00 |
| 13 | 1.289E+03 | -4.214E+02 | 1.100E+02 | 1.105E+02 | .000E+00 |
| 14 | 2.249E+03 | -9.607E+02 | 1.060E+02 | 1.070E+02 | .000E+00 |
| 15 | 4.585E+03 | -2.335E+03 | 1.020E+02 | 1.045E+02 | .000E+00 |

MASS BALANCE: PRESCRIBED-HEAD BOUNDARY (L,L**3):

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| NODE | DELTA HEAD | DELTA STOR | SRCE-SINKS | BNDFLX IN | GRADIENT | INDUCED |
|---|---|---|---|---|---|---|
| 11 | 3.825E-02 | 1.986E+03 | 1.506E+03 | 7.230E+04 | -7.182E+04 | GW E.T. |
| 22 | 3.825E-02 | 2.981E+03 | 2.258E+03 | 2.697E+05 | -2.690E+05 | GW E.T. |
| 33 | 3.825E-02 | 2.975E+03 | 2.258E+03 | 3.418E+05 | -3.411E+05 | GW E.T. |
| 44 | 3.825E-02 | 1.983E+03 | 1.506E+03 | 4.319E+05 | -4.314E+05 | GW E.T. |
| 90 | .000E+00 | .000E+00 | 1.506E+03 | 7.983E+04 | -8.134E+04 | GW E.T. |
| 91 | .000E+00 | .000E+00 | 2.258E+03 | 2.716E+05 | -2.738E+05 | GW E.T. |
| 92 | .000E+00 | .000E+00 | 2.258E+03 | 3.337E+05 | -3.359E+05 | GW E.T. |

93 .000E+00 .000E+00 1.506E+03 4.330E+05 -4.345E+05 GW E.T.

NODAL SUBDOMAIN MASS BALANCE (L**3):

| NODE | FLUX IN | DELTA STORAGE | ERROR | CUMULATIVE MASS | DRY-WET STATUS |
|---|---|---|---|---|---|
| 1 | 8.925D+01 | 8.925D+01 | -2.842D-13 | 2.804D+06 | WET |
| 2 | -5.712D+03 | -5.712D+03 | -9.095D-13 | 8.314D+06 | WET |
| 3 | -1.494D+04 | -1.494D+04 | -2.547D-11 | 8.251D+06 | WET |
| 4 | -2.270D+04 | -2.270D+04 | 3.638D-12 | 8.218D+06 | WET |
| 5 | -2.802D+04 | -2.802D+04 | 7.276D-12 | 8.201D+06 | WET |
| 6 | -3.142D+04 | -3.142D+04 | 5.457D-11 | 8.191D+06 | WET |
| 7 | -3.363D+04 | -3.363D+04 | -1.455D-11 | 8.186D+06 | WET |
| 8 | -3.528D+04 | -3.528D+04 | 4.366D-11 | 8.181D+06 | WET |
| 9 | -3.623D+04 | -3.623D+04 | -5.093D-11 | 8.175D+06 | WET |
| 10 | -3.269D+04 | -3.269D+04 | 2.547D-11 | 8.164D+06 | WET |
| 11 | 1.986D+03 | 1.986D+03 | .000D+00 | 5.435D+06 | WET |
| 12 | -5.460D+03 | -5.460D+03 | 3.638D-12 | 8.312D+06 | WET |
| 13 | -2.662D+04 | -2.662D+04 | 3.638D-12 | 1.646D+07 | WET |
| 14 | -4.319D+04 | -4.319D+04 | -5.821D-11 | 1.638D+07 | WET |
| 15 | -5.528D+04 | -5.528D+04 | 2.183D-11 | 1.633D+07 | WET |
| 16 | -6.345D+04 | -6.345D+04 | -5.821D-11 | 1.631D+07 | WET |
| 17 | -6.871D+04 | -6.871D+04 | .000D+00 | 1.629D+07 | WET |
| 18 | -7.252D+04 | -7.252D+04 | 4.366D-11 | 1.628D+07 | WET |
| 19 | -7.546D+04 | -7.546D+04 | -1.455D-11 | 1.627D+07 | WET |
| 20 | -7.495D+04 | -7.495D+04 | 8.731D-11 | 1.626D+07 | WET |
| 21 | -5.561D+04 | -5.561D+04 | -2.910D-11 | 1.624D+07 | WET |
| 22 | 2.981D+03 | 2.981D+03 | .000D+00 | 8.156D+06 | WET |
| 23 | -1.467D+04 | -1.467D+04 | 1.273D-11 | 8.245D+06 | WET |
| 24 | -4.345D+04 | -4.345D+04 | -1.455D-11 | 1.637D+07 | WET |
| 25 | -5.538D+04 | -5.538D+04 | -1.455D-11 | 1.630D+07 | WET |
| 26 | -6.578D+04 | -6.578D+04 | 4.366D-11 | 1.627D+07 | WET |
| 27 | -7.235D+04 | -7.235D+04 | 1.455D-11 | 1.625D+07 | WET |
| 28 | -7.721D+04 | -7.721D+04 | 1.164D-10 | 1.624D+07 | WET |
| 29 | -8.115D+04 | -8.115D+04 | -8.731D-11 | 1.622D+07 | WET |
| 30 | -8.409D+04 | -8.409D+04 | 1.746D-10 | 1.621D+07 | WET |
| 31 | -8.130D+04 | -8.130D+04 | 5.821D-11 | 1.617D+07 | WET |
| 32 | -6.096D+04 | -6.096D+04 | 8.731D-11 | 1.618D+07 | WET |
| 33 | 2.975D+03 | 2.975D+03 | .000D+00 | 8.140D+06 | WET |
| 34 | -2.287D+04 | -2.287D+04 | 2.910D-11 | 8.208D+06 | WET |
| 35 | -5.641D+04 | -5.641D+04 | 8.004D-11 | 1.632D+07 | WET |
| 36 | -6.659D+04 | -6.659D+04 | -1.455D-11 | 1.626D+07 | WET |
| 37 | -7.385D+04 | -7.385D+04 | 7.276D-11 | 1.623D+07 | WET |
| 38 | -8.076D+04 | -8.076D+04 | 1.455D-11 | 1.621D+07 | WET |
| 39 | -8.586D+04 | -8.586D+04 | -1.455D-11 | 1.620D+07 | WET |
| 40 | -9.084D+04 | -9.084D+04 | -1.310D-10 | 1.618D+07 | WET |
| 41 | -9.487D+04 | -9.487D+04 | -2.910D-11 | 1.616D+07 | WET |
| 42 | -9.301D+04 | -9.301D+04 | 2.910D-11 | 1.613D+07 | WET |
| 43 | -7.101D+04 | -7.101D+04 | 2.910D-11 | 1.613D+07 | WET |
| 44 | 1.983D+03 | 1.983D+03 | .000D+00 | 5.427D+06 | WET |
| 45 | -2.879D+04 | -2.879D+04 | 4.002D-11 | 8.188D+06 | WET |
| 46 | -6.558D+04 | -6.558D+04 | 2.910D-11 | 1.629D+07 | WET |
| 47 | -7.401D+04 | -7.401D+04 | 7.276D-11 | 1.624D+07 | WET |
| 48 | -8.153D+04 | -8.153D+04 | -1.019D-10 | 1.621D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 49 | -8.769D+04 | -8.769D+04 | .000D+00 | 1.619D+07 | WET |
| 50 | -9.448D+04 | -9.448D+04 | -4.366D-11 | 1.617D+07 | WET |
| 51 | -1.020D+05 | -1.020D+05 | -5.821D-11 | 1.614D+07 | WET |
| 52 | -1.096D+05 | -1.096D+05 | -2.183D-10 | 1.612D+07 | WET |
| 53 | -1.104D+05 | -1.104D+05 | -8.731D-11 | 1.604D+07 | WET |
| 54 | -4.493D+04 | -4.493D+04 | 7.276D-12 | 7.959D+06 | WET |
| 55 | -3.273D+04 | -3.273D+04 | 4.002D-11 | 8.176D+06 | WET |
| 56 | -7.162D+04 | -7.162D+04 | 7.276D-11 | 1.627D+07 | WET |
| 57 | -7.942D+04 | -7.942D+04 | -1.455D-11 | 1.622D+07 | WET |
| 58 | -8.691D+04 | -8.691D+04 | -8.731D-11 | 1.619D+07 | WET |
| 59 | -9.494D+04 | -9.494D+04 | 4.366D-11 | 1.617D+07 | WET |
| 60 | -1.044D+05 | -1.044D+05 | -4.366D-11 | 1.614D+07 | WET |
| 61 | -1.167D+05 | -1.167D+05 | .000D+00 | 1.610D+07 | WET |
| 62 | -1.289D+05 | -1.289D+05 | .000D+00 | 1.601D+07 | WET |
| 63 | -6.421D+04 | -6.421D+04 | -5.093D-11 | 7.895D+06 | WET |
| 64 | -3.531D+04 | -3.531D+04 | 7.276D-12 | 8.170D+06 | WET |
| 65 | -7.577D+04 | -7.577D+04 | 7.276D-11 | 1.626D+07 | WET |
| 66 | -8.304D+04 | -8.304D+04 | -1.310D-10 | 1.621D+07 | WET |
| 67 | -9.207D+04 | -9.207D+04 | -8.731D-11 | 1.618D+07 | WET |
| 68 | -1.024D+05 | -1.024D+05 | 1.455D-11 | 1.614D+07 | WET |
| 69 | -1.166D+05 | -1.166D+05 | 2.910D-11 | 1.607D+07 | WET |
| 70 | -1.340D+05 | -1.340D+05 | 5.821D-11 | 1.597D+07 | WET |
| 71 | -7.157D+04 | -7.157D+04 | 2.910D-11 | 7.872D+06 | WET |
| 72 | -3.707D+04 | -3.707D+04 | 5.821D-11 | 8.168D+06 | WET |
| 73 | -7.814D+04 | -7.814D+04 | -4.366D-11 | 1.626D+07 | WET |
| 74 | -8.589D+04 | -8.589D+04 | 7.276D-11 | 1.621D+07 | WET |
| 75 | -9.581D+04 | -9.581D+04 | 1.310D-10 | 1.617D+07 | WET |
| 76 | -1.097D+05 | -1.097D+05 | -5.821D-11 | 1.611D+07 | WET |
| 77 | -1.291D+05 | -1.291D+05 | -8.731D-11 | 1.600D+07 | WET |
| 78 | -7.202D+04 | -7.202D+04 | 4.366D-11 | 7.880D+06 | WET |
| 79 | -3.782D+04 | -3.782D+04 | 7.276D-11 | 8.166D+06 | WET |
| 80 | -7.700D+04 | -7.700D+04 | 1.455D-11 | 1.625D+07 | WET |
| 81 | -8.279D+04 | -8.279D+04 | 4.366D-11 | 1.619D+07 | WET |
| 82 | -9.360D+04 | -9.360D+04 | .000D+00 | 1.615D+07 | WET |
| 83 | -1.111D+05 | -1.111D+05 | -1.019D-10 | 1.605D+07 | WET |
| 84 | -6.559D+04 | -6.559D+04 | 7.276D-11 | 7.918D+06 | WET |
| 85 | -3.392D+04 | -3.392D+04 | 1.455D-11 | 8.148D+06 | WET |
| 86 | -5.781D+04 | -5.781D+04 | -9.459D-11 | 1.622D+07 | WET |
| 87 | -6.271D+04 | -6.271D+04 | 5.093D-11 | 1.619D+07 | WET |
| 88 | -7.242D+04 | -7.242D+04 | -1.455D-10 | 1.611D+07 | WET |
| 89 | -4.691D+04 | -4.691D+04 | 7.276D-12 | 7.940D+06 | WET |
| 90 | .000D+00 | .000D+00 | .000D+00 | 5.420D+06 | WET |
| 91 | .000D+00 | .000D+00 | .000D+00 | 8.131D+06 | WET |
| 92 | .000D+00 | .000D+00 | .000D+00 | 8.128D+06 | WET |
| 93 | .000D+00 | .000D+00 | .000D+00 | 5.407D+06 | WET |

MASS BALANCE SUMMARY (L**3). DATE 2/15/1900 HH:MM:SS= 0: 0: 0 TIME= 4.500E+01 DAYS. (STEP= 1.400D+01 DAYS) 2 ATTEMPTS
THETA= 1.00 TOTAL FLUX=-5.783D+06 TOTAL STORAGE CHANGE=-5.783D+06 TOTAL STEP ERROR= 1.425D-10 CUMULATIVE ERROR= 2.169D-09
TOTAL VOLUME= 1.224D+09, NODAL RECHARGES & WITHDRAWALS= 3.410D+05, STREAM INPUT=-4.072D+04, FLUX BOUNDARY INPUT= .000D+00
HEAD BOUNDARY INPUT= 2.234D+06, MIN DELTA HEAD=-9.250E-01 (L**1), MAX DELTA HEAD= 3.825E-02 (L**1), AND 0 "DRY" NODES.
PREDICTED GROUNDWATER ET =-8.950E+06
CORRECTED GROUNDWATER ET =-8.267E+06

HEAD AND HEAD CHANGE:
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TOTAL SIMULATED TIME= 4.500E+01 DAYS; TIME STEP= 1.400E+01 DAYS

| NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.036D+02 | 1 | 3.443D-03 | 2 | 1.044D+02 | 2 | -7.345D-02 | 3 | 1.056D+02 | 3 | -1.921D-01 |
| 4 | 1.071D+02 | 4 | -2.919D-01 | 5 | 1.089D+02 | 5 | -3.603D-01 | 6 | 1.108D+02 | 6 | -4.040D-01 |
| 7 | 1.127D+02 | 7 | -4.325D-01 | 8 | 1.146D+02 | 8 | -4.537D-01 | 9 | 1.166D+02 | 9 | -4.659D-01 |
| 10 | 1.184D+02 | 10 | -4.204D-01 | 11 | 1.201D+02 | 11 | 3.825D-02 | 12 | 1.043D+02 | 12 | -7.021D-02 |
| 13 | 1.053D+02 | 13 | -1.712D-01 | 14 | 1.068D+02 | 14 | -2.777D-01 | 15 | 1.085D+02 | 15 | -3.554D-01 |
| 16 | 1.103D+02 | 16 | -4.080D-01 | 17 | 1.122D+02 | 17 | -4.418D-01 | 18 | 1.141D+02 | 18 | -4.662D-01 |
| 19 | 1.161D+02 | 19 | -4.852D-01 | 20 | 1.180D+02 | 20 | -4.819D-01 | 21 | 1.198D+02 | 21 | -3.574D-01 |
| 22 | 1.221D+02 | 22 | 3.825D-02 | 23 | 1.055D+02 | 23 | -1.886D-01 | 24 | 1.067D+02 | 24 | -2.794D-01 |
| 25 | 1.083D+02 | 25 | -3.561D-01 | 26 | 1.100D+02 | 26 | -4.229D-01 | 27 | 1.119D+02 | 27 | -4.652D-01 |
| 28 | 1.138D+02 | 28 | -4.964D-01 | 29 | 1.158D+02 | 29 | -5.217D-01 | 30 | 1.177D+02 | 30 | -5.406D-01 |
| 31 | 1.196D+02 | 31 | -5.235D-01 | 32 | 1.216D+02 | 32 | -3.922D-01 | 33 | 1.241D+02 | 33 | 3.825D-02 |
| 34 | 1.070D+02 | 34 | -2.941D-01 | 35 | 1.084D+02 | 35 | -3.627D-01 | 36 | 1.100D+02 | 36 | -4.281D-01 |
| 37 | 1.118D+02 | 37 | -4.748D-01 | 38 | 1.137D+02 | 38 | -5.192D-01 | 39 | 1.156D+02 | 39 | -5.520D-01 |
| 40 | 1.175D+02 | 40 | -5.840D-01 | 41 | 1.194D+02 | 41 | -6.101D-01 | 42 | 1.212D+02 | 42 | -5.984D-01 |
| 43 | 1.232D+02 | 43 | -4.565D-01 | 44 | 1.261D+02 | 44 | 3.825D-02 | 45 | 1.087D+02 | 45 | -3.702D-01 |
| 46 | 1.102D+02 | 46 | -4.216D-01 | 47 | 1.119D+02 | 47 | -4.758D-01 | 48 | 1.137D+02 | 48 | -5.242D-01 |
| 49 | 1.155D+02 | 49 | -5.638D-01 | 50 | 1.174D+02 | 50 | -6.074D-01 | 51 | 1.192D+02 | 51 | -6.558D-01 |
| 52 | 1.210D+02 | 52 | -7.039D-01 | 53 | 1.225D+02 | 53 | -7.095D-01 | 54 | 1.238D+02 | 54 | -5.778D-01 |
| 55 | 1.106D+02 | 55 | -4.208D-01 | 56 | 1.121D+02 | 56 | -4.605D-01 | 57 | 1.138D+02 | 57 | -5.106D-01 |
| 58 | 1.156D+02 | 58 | -5.588D-01 | 59 | 1.174D+02 | 59 | -6.104D-01 | 60 | 1.192D+02 | 60 | -6.711D-01 |
| 61 | 1.209D+02 | 61 | -7.495D-01 | 62 | 1.222D+02 | 62 | -8.272D-01 | 63 | 1.230D+02 | 63 | -8.256D-01 |
| 64 | 1.125D+02 | 64 | -4.540D-01 | 65 | 1.140D+02 | 65 | -4.871D-01 | 66 | 1.157D+02 | 66 | -5.339D-01 |
| 67 | 1.175D+02 | 67 | -5.920D-01 | 68 | 1.192D+02 | 68 | -6.585D-01 | 69 | 1.209D+02 | 69 | -7.498D-01 |
| 70 | 1.221D+02 | 70 | -8.615D-01 | 71 | 1.227D+02 | 71 | -9.203D-01 | 72 | 1.144D+02 | 72 | -4.764D-01 |
| 73 | 1.159D+02 | 73 | -5.020D-01 | 74 | 1.176D+02 | 74 | -5.518D-01 | 75 | 1.193D+02 | 75 | -6.156D-01 |
| 76 | 1.210D+02 | 76 | -7.049D-01 | 77 | 1.222D+02 | 77 | -8.290D-01 | 78 | 1.227D+02 | 78 | -9.250D-01 |
| 79 | 1.164D+02 | 79 | -4.859D-01 | 80 | 1.178D+02 | 80 | -4.947D-01 | 81 | 1.195D+02 | 81 | -5.319D-01 |
| 82 | 1.212D+02 | 82 | -6.014D-01 | 83 | 1.225D+02 | 83 | -7.138D-01 | 84 | 1.229D+02 | 84 | -8.407D-01 |
| 85 | 1.182D+02 | 85 | -4.362D-01 | 86 | 1.197D+02 | 86 | -3.717D-01 | 87 | 1.215D+02 | 87 | -4.032D-01 |
| 88 | 1.232D+02 | 88 | -4.663D-01 | 89 | 1.237D+02 | 89 | -6.042D-01 | 90 | 1.200D+02 | 90 | .000D+00 |
| 91 | 1.220D+02 | 91 | .000D+00 | 92 | 1.240D+02 | 92 | .000D+00 | 93 | 1.260D+02 | 93 | .000D+00 |

CALCULATED STREAM BASEFLOWS (L**3/SEC):
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| STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE | STREAM | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .000E+00 | 2 | 3.487E-02 | | | | | | | | | | |

STREAM REACHES:
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| REACH | STREAMFLOW | STREAM TO AQUIFER FLUX | STREAM HEAD | AQUIFER HEAD | INFLOW(+) DIVERSION(-) |
|---|---|---|---|---|---|
| 1 | .000E+00 | .000E+00 | 1.190E+02 | 1.188E+02 | 5.000E-01 |
| 2 | .000E+00 | .000E+00 | 1.170E+02 | 1.169E+02 | 2.000E-01 |
| 3 | .000E+00 | .000E+00 | 1.160E+02 | 1.158E+02 | 4.000E-01 |
| 4 | .000E+00 | .000E+00 | 1.190E+02 | 1.185E+02 | 3.500E-01 |
| 5 | .000E+00 | .000E+00 | 1.170E+02 | 1.166E+02 | .000E+00 |
| 6 | .000E+00 | .000E+00 | 1.160E+02 | 1.156E+02 | 1.000E+00 |

| | | | | | |
|---|---|---|---|---|---|
| 7 | .000E+00 | .000E+00 | 1.160E+02 | 1.155E+02 | 8.000E-01 |
| 8 | .000E+00 | .000E+00 | 1.230E+02 | 1.217E+02 | .000E+00 |
| 9 | .000E+00 | .000E+00 | 1.210E+02 | 1.201E+02 | .000E+00 |
| 10 | .000E+00 | .000E+00 | 1.190E+02 | 1.183E+02 | .000E+00 |
| 11 | .000E+00 | .000E+00 | 1.170E+02 | 1.165E+02 | .000E+00 |
| 12 | .000E+00 | .000E+00 | 1.140E+02 | 1.137E+02 | .000E+00 |
| 13 | 3.766E+01 | -3.766E+01 | 1.100E+02 | 1.100E+02 | .000E+00 |
| 14 | 7.548E+02 | -7.171E+02 | 1.060E+02 | 1.068E+02 | .000E+00 |
| 15 | 3.013E+03 | -2.258E+03 | 1.020E+02 | 1.044E+02 | .000E+00 |

MASS BALANCE: PRESCRIBED-HEAD BOUNDARY (L,L**3):

| NODE | DELTA HEAD | DELTA STOR | SRCS-SINKS | BNDFLX IN | GRADIENT INDUCED | |
|---|---|---|---|---|---|---|
| 11 | 1.428E-02 | 7.417E+02 | 5.377E+02 | 4.645E+03 | -4.441E+03 | GW E.T. |
| 22 | 1.428E-02 | 1.113E+03 | 8.065E+02 | 6.823E+04 | -6.793E+04 | GW E.T. |
| 33 | 1.428E-02 | 1.111E+03 | 8.065E+02 | 9.596E+04 | -9.566E+04 | GW E.T. |
| 44 | 1.428E-02 | 7.406E+02 | 5.377E+02 | 1.388E+05 | -1.386E+05 | GW E.T. |
| 90 | .000E+00 | .000E+00 | 5.377E+02 | 9.966E+03 | -1.050E+04 | GW E.T. |
| 91 | .000E+00 | .000E+00 | 8.065E+02 | 7.169E+04 | -7.250E+04 | GW E.T. |
| 92 | .000E+00 | .000E+00 | 8.065E+02 | 9.586E+04 | -9.667E+04 | GW E.T. |
| 93 | .000E+00 | .000E+00 | 5.377E+02 | 1.412E+05 | -1.417E+05 | GW E.T. |

NODAL SUBDOMAIN MASS BALANCE (L**3):

| NODE | FLUX IN | DELTA STORAGE | ERROR | CUMULATIVE MASS | DRY-WET STATUS |
|---|---|---|---|---|---|
| 1 | 8.883D+03 | 8.883D+03 | .000D+00 | 2.813D+06 | WET |
| 2 | 2.380D+04 | 2.380D+04 | 1.091D-11 | 8.338D+06 | WET |
| 3 | 1.885D+04 | 1.885D+04 | 7.276D-12 | 8.270D+06 | WET |
| 4 | 1.501D+04 | 1.501D+04 | 5.457D-12 | 8.233D+06 | WET |
| 5 | 1.234D+04 | 1.234D+04 | 1.819D-12 | 8.213D+06 | WET |
| 6 | 1.064D+04 | 1.064D+04 | -3.638D-12 | 8.202D+06 | WET |
| 7 | 9.513D+03 | 9.513D+03 | 3.638D-12 | 8.195D+06 | WET |
| 8 | 8.685D+03 | 8.685D+03 | 3.638D-12 | 8.190D+06 | WET |
| 9 | 8.112D+03 | 8.112D+03 | -6.185D-12 | 8.183D+06 | WET |
| 10 | 8.020D+03 | 8.020D+03 | -3.638D-12 | 8.172D+06 | WET |
| 11 | 7.417D+02 | 7.417D+02 | .000D+00 | 5.436D+06 | WET |
| 12 | 2.388D+04 | 2.388D+04 | -3.638D-12 | 8.336D+06 | WET |
| 13 | 3.803D+04 | 3.803D+04 | 2.183D-11 | 1.650D+07 | WET |
| 14 | 3.017D+04 | 3.017D+04 | -1.091D-11 | 1.641D+07 | WET |
| 15 | 2.405D+04 | 2.405D+04 | 1.091D-11 | 1.636D+07 | WET |
| 16 | 2.003D+04 | 2.003D+04 | .000D+00 | 1.633D+07 | WET |
| 17 | 1.737D+04 | 1.737D+04 | 7.276D-12 | 1.631D+07 | WET |
| 18 | 1.546D+04 | 1.546D+04 | -3.638D-12 | 1.630D+07 | WET |
| 19 | 1.397D+04 | 1.397D+04 | -1.819D-11 | 1.629D+07 | WET |
| 20 | 1.336D+04 | 1.336D+04 | 9.095D-12 | 1.627D+07 | WET |
| 21 | 1.361D+04 | 1.361D+04 | -2.001D-11 | 1.625D+07 | WET |
| 22 | 1.113D+03 | 1.113D+03 | .000D+00 | 8.157D+06 | WET |
| 23 | 1.889D+04 | 1.889D+04 | -1.091D-11 | 8.264D+06 | WET |
| 24 | 2.996D+04 | 2.996D+04 | -3.638D-12 | 1.640D+07 | WET |
| 25 | 2.295D+04 | 2.295D+04 | -3.638D-12 | 1.633D+07 | WET |
| 26 | 1.841D+04 | 1.841D+04 | -7.276D-12 | 1.629D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 27 | 1.510D+04 | 1.510D+04 | 1.091D-11 | 1.626D+07 | WET |
| 28 | 1.271D+04 | 1.271D+04 | .000D+00 | 1.625D+07 | WET |
| 29 | 1.076D+04 | 1.076D+04 | .000D+00 | 1.624D+07 | WET |
| 30 | 9.207D+03 | 9.207D+03 | -1.273D-11 | 1.622D+07 | WET |
| 31 | 8.960D+03 | 8.960D+03 | -1.819D-12 | 1.618D+07 | WET |
| 32 | 1.038D+04 | 1.038D+04 | -7.276D-12 | 1.619D+07 | WET |
| 33 | 1.111D+03 | 1.111D+03 | .000D+00 | 8.141D+06 | WET |
| 34 | 1.480D+04 | 1.480D+04 | 1.273D-11 | 8.223D+06 | WET |
| 35 | 2.339D+04 | 2.339D+04 | -1.455D-11 | 1.634D+07 | WET |
| 36 | 1.798D+04 | 1.798D+04 | -3.638D-12 | 1.628D+07 | WET |
| 37 | 1.383D+04 | 1.383D+04 | -7.276D-12 | 1.625D+07 | WET |
| 38 | 1.082D+04 | 1.082D+04 | -3.638D-12 | 1.622D+07 | WET |
| 39 | 8.288D+03 | 8.288D+03 | -7.276D-12 | 1.621D+07 | WET |
| 40 | 5.848D+03 | 5.848D+03 | -9.095D-13 | 1.619D+07 | WET |
| 41 | 3.683D+03 | 3.683D+03 | 5.912D-12 | 1.616D+07 | WET |
| 42 | 3.027D+03 | 3.027D+03 | .000D+00 | 1.613D+07 | WET |
| 43 | 5.166D+03 | 5.166D+03 | 6.366D-12 | 1.614D+07 | WET |
| 44 | 7.406D+02 | 7.406D+02 | .000D+00 | 5.427D+06 | WET |
| 45 | 1.184D+04 | 1.184D+04 | 1.819D-12 | 8.200D+06 | WET |
| 46 | 1.887D+04 | 1.887D+04 | -7.276D-12 | 1.631D+07 | WET |
| 47 | 1.426D+04 | 1.426D+04 | .000D+00 | 1.625D+07 | WET |
| 48 | 1.043D+04 | 1.043D+04 | 5.457D-12 | 1.622D+07 | WET |
| 49 | 7.238D+03 | 7.238D+03 | -1.182D-11 | 1.620D+07 | WET |
| 50 | 3.987D+03 | 3.987D+03 | .000D+00 | 1.617D+07 | WET |
| 51 | 3.041D+02 | 3.041D+02 | -2.842D-13 | 1.614D+07 | WET |
| 52 | -3.620D+03 | -3.620D+03 | 4.093D-12 | 1.612D+07 | WET |
| 53 | -5.985D+03 | -5.985D+03 | 1.819D-12 | 1.603D+07 | WET |
| 54 | -1.977D+03 | -1.977D+03 | -6.821D-13 | 7.957D+06 | WET |
| 55 | 9.869D+03 | 9.869D+03 | 7.276D-12 | 8.186D+06 | WET |
| 56 | 1.583D+04 | 1.583D+04 | 1.819D-11 | 1.629D+07 | WET |
| 57 | 1.158D+04 | 1.158D+04 | -1.091D-11 | 1.624D+07 | WET |
| 58 | 7.692D+03 | 7.692D+03 | 6.366D-12 | 1.620D+07 | WET |
| 59 | 3.770D+03 | 3.770D+03 | -2.728D-12 | 1.617D+07 | WET |
| 60 | -8.846D+02 | -8.846D+02 | -9.095D-13 | 1.614D+07 | WET |
| 61 | -6.988D+03 | -6.988D+03 | -9.095D-13 | 1.610D+07 | WET |
| 62 | -1.374D+04 | -1.374D+04 | -7.276D-12 | 1.600D+07 | WET |
| 63 | -8.421D+03 | -8.421D+03 | -1.819D-12 | 7.886D+06 | WET |
| 64 | 8.564D+03 | 8.564D+03 | .000D+00 | 8.178D+06 | WET |
| 65 | 1.372D+04 | 1.372D+04 | -1.819D-12 | 1.628D+07 | WET |
| 66 | 9.609D+03 | 9.609D+03 | -1.091D-11 | 1.622D+07 | WET |
| 67 | 5.207D+03 | 5.207D+03 | 5.457D-12 | 1.618D+07 | WET |
| 68 | 8.966D+01 | 8.966D+01 | -2.132D-13 | 1.614D+07 | WET |
| 69 | -7.005D+03 | -7.005D+03 | .000D+00 | 1.606D+07 | WET |
| 70 | -1.626D+04 | -1.626D+04 | 9.095D-12 | 1.595D+07 | WET |
| 71 | -1.167D+04 | -1.167D+04 | -3.638D-12 | 7.860D+06 | WET |
| 72 | 7.676D+03 | 7.676D+03 | -2.728D-12 | 8.176D+06 | WET |
| 73 | 1.234D+04 | 1.234D+04 | 3.638D-12 | 1.627D+07 | WET |
| 74 | 8.159D+03 | 8.159D+03 | 3.638D-12 | 1.622D+07 | WET |
| 75 | 3.205D+03 | 3.205D+03 | -9.095D-13 | 1.617D+07 | WET |
| 76 | -3.741D+03 | -3.741D+03 | 1.819D-12 | 1.611D+07 | WET |
| 77 | -1.391D+04 | -1.391D+04 | -1.819D-12 | 1.598D+07 | WET |
| 78 | -1.187D+04 | -1.187D+04 | -1.819D-12 | 7.868D+06 | WET |
| 79 | 7.155D+03 | 7.155D+03 | 4.547D-12 | 8.173D+06 | WET |
| 80 | 1.188D+04 | 1.188D+04 | -1.091D-11 | 1.626D+07 | WET |

| | | | | | |
|---|---|---|---|---|---|
| 81 | 8.068D+03 | 8.068D+03 | -4.547D-12 | 1.620D+07 | WET |
| 82 | 2.627D+03 | 2.627D+03 | .000D+00 | 1.615D+07 | WET |
| 83 | -6.425D+03 | -6.425D+03 | .000D+00 | 1.604D+07 | WET |
| 84 | -9.018D+03 | -9.018D+03 | .000D+00 | 7.909D+06 | WET |
| 85 | 7.034D+03 | 7.034D+03 | -9.095D-13 | 8.155D+06 | WET |
| 86 | 1.193D+04 | 1.193D+04 | -9.095D-12 | 1.623D+07 | WET |
| 87 | 9.133D+03 | 9.133D+03 | .000D+00 | 1.620D+07 | WET |
| 88 | 4.125D+03 | 4.125D+03 | .000D+00 | 1.611D+07 | WET |
| 89 | -2.881D+03 | -2.881D+03 | -1.819D-12 | 7.937D+06 | WET |
| 90 | .000D+00 | .000D+00 | .000D+00 | 5.420D+06 | WET |
| 91 | .000D+00 | .000D+00 | .000D+00 | 8.131D+06 | WET |
| 92 | .000D+00 | .000D+00 | .000D+00 | 8.128D+06 | WET |
| 93 | .000D+00 | .000D+00 | .000D+00 | 5.407D+06 | WET |

MASS BALANCE SUMMARY (L**3). DATE 2/20/1900 HH:MM:SS= 0: 0: 0 TIME= 6.400E+01 DAYS. (STEP= 5.000D+00 DAYS) 2 ATTEMPTS
THETA= 1.00 TOTAL FLUX= 7.234D+05 TOTAL STORAGE CHANGE= 7.234D+05 TOTAL STEP ERROR=-6.121D-11 CUMULATIVE ERROR= 2.108D-09
TOTAL VOLUME= 1.225D+09, NODAL RECHARGES & WITHDRAWALS= 1.218D+05, STREAM INPUT=-1.794D+04, FLUX BOUNDARY INPUT= .000D+00
HEAD BOUNDARY INPUT= 6.264D+05, MIN DELTA HEAD=-1.525E-01 (L**1), MAX DELTA HEAD= 3.427E-01 (L**1), AND 0 "DRY" NODES.
PREDICTED GROUNDWATER ET = .000E+00
CORRECTED GROUNDWATER ET = .000E+00

HEAD AND HEAD CHANGE:
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TOTAL SIMULATED TIME= 6.400E+01 DAYS; TIME STEP= 5.000E+00 DAYS

| NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE | NODE | HEAD | NODE | CHANGE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.040D+02 | 1 | 3.427D-01 | 2 | 1.047D+02 | 2 | 3.060D-01 | 3 | 1.058D+02 | 3 | 2.424D-01 |
| 4 | 1.073D+02 | 4 | 1.930D-01 | 5 | 1.091D+02 | 5 | 1.587D-01 | 6 | 1.109D+02 | 6 | 1.368D-01 |
| 7 | 1.128D+02 | 7 | 1.223D-01 | 8 | 1.148D+02 | 8 | 1.117D-01 | 9 | 1.167D+02 | 9 | 1.043D-01 |
| 10 | 1.185D+02 | 10 | 1.031D-01 | 11 | 1.201D+02 | 11 | 1.428D-02 | 12 | 1.046D+02 | 12 | 3.070D-01 |
| 13 | 1.055D+02 | 13 | 2.445D-01 | 14 | 1.069D+02 | 14 | 1.940D-01 | 15 | 1.086D+02 | 15 | 1.546D-01 |
| 16 | 1.104D+02 | 16 | 1.288D-01 | 17 | 1.123D+02 | 17 | 1.117D-01 | 18 | 1.142D+02 | 18 | 9.939D-02 |
| 19 | 1.162D+02 | 19 | 8.983D-02 | 20 | 1.180D+02 | 20 | 8.588D-02 | 21 | 1.199D+02 | 21 | 8.745D-02 |
| 22 | 1.221D+02 | 22 | 1.428D-02 | 23 | 1.057D+02 | 23 | 2.429D-01 | 24 | 1.069D+02 | 24 | 1.926D-01 |
| 25 | 1.084D+02 | 25 | 1.476D-01 | 26 | 1.102D+02 | 26 | 1.184D-01 | 27 | 1.120D+02 | 27 | 9.711D-02 |
| 28 | 1.139D+02 | 28 | 8.173D-02 | 29 | 1.158D+02 | 29 | 6.918D-02 | 30 | 1.177D+02 | 30 | 5.920D-02 |
| 31 | 1.196D+02 | 31 | 5.769D-02 | 32 | 1.216D+02 | 32 | 6.677D-02 | 33 | 1.241D+02 | 33 | 1.428D-02 |
| 34 | 1.072D+02 | 34 | 1.904D-01 | 35 | 1.085D+02 | 35 | 1.504D-01 | 36 | 1.101D+02 | 36 | 1.156D-01 |
| 37 | 1.119D+02 | 37 | 8.894D-02 | 38 | 1.138D+02 | 38 | 6.957D-02 | 39 | 1.156D+02 | 39 | 5.328D-02 |
| 40 | 1.175D+02 | 40 | 3.760D-02 | 41 | 1.194D+02 | 41 | 2.369D-02 | 42 | 1.212D+02 | 42 | 1.947D-02 |
| 43 | 1.232D+02 | 43 | 3.321D-02 | 44 | 1.261D+02 | 44 | 1.428D-02 | 45 | 1.089D+02 | 45 | 1.522D-01 |
| 46 | 1.103D+02 | 46 | 1.213D-01 | 47 | 1.120D+02 | 47 | 9.167D-02 | 48 | 1.137D+02 | 48 | 6.706D-02 |
| 49 | 1.156D+02 | 49 | 4.653D-02 | 50 | 1.174D+02 | 50 | 2.564D-02 | 51 | 1.192D+02 | 51 | 1.955D-03 |
| 52 | 1.209D+02 | 52 | -2.324D-02 | 53 | 1.225D+02 | 53 | -3.845D-02 | 54 | 1.238D+02 | 54 | -2.542D-02 |
| 55 | 1.107D+02 | 55 | 1.269D-01 | 56 | 1.122D+02 | 56 | 1.018D-01 | 57 | 1.138D+02 | 57 | 7.446D-02 |
| 58 | 1.156D+02 | 58 | 4.945D-02 | 59 | 1.174D+02 | 59 | 2.424D-02 | 60 | 1.192D+02 | 60 | -5.688D-03 |
| 61 | 1.208D+02 | 61 | -4.487D-02 | 62 | 1.221D+02 | 62 | -8.819D-02 | 63 | 1.229D+02 | 63 | -1.083D-01 |
| 64 | 1.126D+02 | 64 | 1.101D-01 | 65 | 1.141D+02 | 65 | 8.823D-02 | 66 | 1.157D+02 | 66 | 6.178D-02 |
| 67 | 1.175D+02 | 67 | 3.348D-02 | 68 | 1.192D+02 | 68 | 5.765D-04 | 69 | 1.208D+02 | 69 | -4.507D-02 |
| 70 | 1.220D+02 | 70 | -1.045D-01 | 71 | 1.225D+02 | 71 | -1.501D-01 | 72 | 1.145D+02 | 72 | 9.865D-02 |
| 73 | 1.160D+02 | 73 | 7.928D-02 | 74 | 1.176D+02 | 74 | 5.242D-02 | 75 | 1.193D+02 | 75 | 2.059D-02 |
| 76 | 1.209D+02 | 76 | -2.403D-02 | 77 | 1.221D+02 | 77 | -8.933D-02 | 78 | 1.225D+02 | 78 | -1.525D-01 |
| 79 | 1.164D+02 | 79 | 9.192D-02 | 80 | 1.179D+02 | 80 | 7.632D-02 | 81 | 1.195D+02 | 81 | 5.183D-02 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 82 | 1.212D+02 | 82 | 1.688D-02 | 83 | 1.225D+02 | 83 | -4.127D-02 | 84 | 1.228D+02 | 84 | -1.156D-01 |
| 85 | 1.183D+02 | 85 | 9.044D-02 | 86 | 1.198D+02 | 86 | 7.668D-02 | 87 | 1.216D+02 | 87 | 5.872D-02 |
| 88 | 1.232D+02 | 88 | 2.656D-02 | 89 | 1.237D+02 | 89 | -3.710D-02 | 90 | 1.200D+02 | 90 | .000D+00 |
| 91 | 1.220D+02 | 91 | .000D+00 | 92 | 1.240D+02 | 92 | .000D+00 | 93 | 1.260D+02 | 93 | .000D+00 |

FINAL OUTPUT (DATE: 2/20/1900 TIME: .00 HOURS).

CHECK OF NODAL SUBDOMAIN MASS

| NODE | CUMULATIVE MASS | INTEGRATED MASS | ERROR. | NODE | CUMULATIVE MASS | INTEGRATED MASS | ERROR. |
|---|---|---|---|---|---|---|---|
| 1 | 2.813D+06 | 2.813D+06 | .000D+00 | 2 | 8.338D+06 | 8.338D+06 | .000D+00 |
| 3 | 8.270D+06 | 8.270D+06 | -9.313D-10 | 4 | 8.233D+06 | 8.233D+06 | 9.313D-10 |
| 5 | 8.213D+06 | 8.213D+06 | -9.313D-10 | 6 | 8.202D+06 | 8.202D+06 | .000D+00 |
| 7 | 8.195D+06 | 8.195D+06 | -1.863D-09 | 8 | 8.190D+06 | 8.190D+06 | -9.313D-10 |
| 9 | 8.183D+06 | 8.183D+06 | 9.313D-10 | 10 | 8.172D+06 | 8.172D+06 | -9.313D-10 |
| 11 | 5.436D+06 | 5.436D+06 | -1.863D-09 | 12 | 8.336D+06 | 8.336D+06 | -9.313D-10 |
| 13 | 1.650D+07 | 1.650D+07 | -3.725D-09 | 14 | 1.641D+07 | 1.641D+07 | .000D+00 |
| 15 | 1.636D+07 | 1.636D+07 | 1.863D-09 | 16 | 1.633D+07 | 1.633D+07 | .000D+00 |
| 17 | 1.631D+07 | 1.631D+07 | .000D+00 | 18 | 1.630D+07 | 1.630D+07 | .000D+00 |
| 19 | 1.629D+07 | 1.629D+07 | .000D+00 | 20 | 1.627D+07 | 1.627D+07 | .000D+00 |
| 21 | 1.625D+07 | 1.625D+07 | 1.593D-04 | 22 | 8.157D+06 | 8.157D+06 | -9.313D-10 |
| 23 | 8.264D+06 | 8.264D+06 | -1.863D-09 | 24 | 1.640D+07 | 1.640D+07 | -1.863D-09 |
| 25 | 1.633D+07 | 1.633D+07 | -5.588D-09 | 26 | 1.629D+07 | 1.629D+07 | -3.725D-09 |
| 27 | 1.626D+07 | 1.626D+07 | 1.863D-09 | 28 | 1.625D+07 | 1.625D+07 | .000D+00 |
| 29 | 1.624D+07 | 1.624D+07 | .000D+00 | 30 | 1.622D+07 | 1.622D+07 | -1.863D-09 |
| 31 | 1.618D+07 | 1.618D+07 | 6.709D-04 | 32 | 1.619D+07 | 1.619D+07 | 6.345D-04 |
| 33 | 8.141D+06 | 8.141D+06 | -9.313D-10 | 34 | 8.223D+06 | 8.223D+06 | 9.313D-10 |
| 35 | 1.634D+07 | 1.634D+07 | .000D+00 | 36 | 1.628D+07 | 1.628D+07 | -5.588D-09 |
| 37 | 1.625D+07 | 1.625D+07 | -1.863D-09 | 38 | 1.622D+07 | 1.622D+07 | .000D+00 |
| 39 | 1.621D+07 | 1.621D+07 | .000D+00 | 40 | 1.619D+07 | 1.619D+07 | -1.863D-09 |
| 41 | 1.616D+07 | 1.616D+07 | -5.588D-09 | 42 | 1.613D+07 | 1.613D+07 | .000D+00 |
| 43 | 1.614D+07 | 1.614D+07 | -3.725D-09 | 44 | 5.427D+06 | 5.427D+06 | .000D+00 |
| 45 | 8.200D+06 | 8.200D+06 | -1.863D-09 | 46 | 1.631D+07 | 1.631D+07 | .000D+00 |
| 47 | 1.625D+07 | 1.625D+07 | -1.863D-09 | 48 | 1.622D+07 | 1.622D+07 | -3.725D-09 |
| 49 | 1.620D+07 | 1.620D+07 | .000D+00 | 50 | 1.617D+07 | 1.617D+07 | -3.725D-09 |
| 51 | 1.614D+07 | 1.614D+07 | 1.863D-09 | 52 | 1.612D+07 | 1.612D+07 | 1.824D-03 |
| 53 | 1.603D+07 | 1.603D+07 | 2.616D-03 | 54 | 7.957D+06 | 7.957D+06 | -9.313D-10 |
| 55 | 8.186D+06 | 8.186D+06 | -9.313D-10 | 56 | 1.629D+07 | 1.629D+07 | -1.863D-09 |
| 57 | 1.624D+07 | 1.624D+07 | -3.725D-09 | 58 | 1.620D+07 | 1.620D+07 | -5.588D-09 |
| 59 | 1.617D+07 | 1.617D+07 | -1.863D-09 | 60 | 1.614D+07 | 1.614D+07 | -3.725D-09 |
| 61 | 1.610D+07 | 1.610D+07 | 1.863D-09 | 62 | 1.600D+07 | 1.600D+07 | 3.250D-03 |
| 63 | 7.886D+06 | 7.886D+06 | .000D+00 | 64 | 8.178D+06 | 8.178D+06 | -9.313D-10 |
| 65 | 1.628D+07 | 1.628D+07 | -1.863D-09 | 66 | 1.622D+07 | 1.622D+07 | -1.863D-09 |
| 67 | 1.618D+07 | 1.618D+07 | -1.863D-09 | 68 | 1.614D+07 | 1.614D+07 | -1.863D-09 |
| 69 | 1.606D+07 | 1.606D+07 | .000D+00 | 70 | 1.595D+07 | 1.595D+07 | .000D+00 |
| 71 | 7.860D+06 | 7.860D+06 | .000D+00 | 72 | 8.176D+06 | 8.176D+06 | .000D+00 |
| 73 | 1.627D+07 | 1.627D+07 | 1.863D-09 | 74 | 1.622D+07 | 1.622D+07 | -1.863D-09 |
| 75 | 1.617D+07 | 1.617D+07 | 3.725D-09 | 76 | 1.611D+07 | 1.611D+07 | 3.725D-09 |
| 77 | 1.598D+07 | 1.598D+07 | 3.725D-09 | 78 | 7.868D+06 | 7.868D+06 | -9.313D-10 |
| 79 | 8.173D+06 | 8.173D+06 | -1.863D-09 | 80 | 1.626D+07 | 1.626D+07 | -1.863D-09 |
| 81 | 1.620D+07 | 1.620D+07 | .000D+00 | 82 | 1.615D+07 | 1.615D+07 | 3.725D-09 |
| 83 | 1.604D+07 | 1.604D+07 | 2.628D-03 | 84 | 7.909D+06 | 7.909D+06 | -9.313D-10 |
| 85 | 8.155D+06 | 8.155D+06 | 1.863D-09 | 86 | 1.623D+07 | 1.623D+07 | -1.863D-09 |
| 87 | 1.620D+07 | 1.620D+07 | .000D+00 | 88 | 1.611D+07 | 1.611D+07 | 1.390D-03 |
| 89 | 7.937D+06 | 7.937D+06 | .000D+00 | 90 | 5.420D+06 | 5.420D+06 | .000D+00 |
| 91 | 8.131D+06 | 8.131D+06 | .000D+00 | 92 | 8.128D+06 | 8.128D+06 | .000D+00 |
| 93 | 5.407D+06 | 5.407D+06 | .000D+00 | | | | |
| TOTALS: | 1.225D+09 | 1.225D+09 | 1.317D-02 | | | | |

ATTACHMENT G. Listing of PET Program

Part 1. Main Program

```
//TPMRPET  JOB (                  ),'CALC-PET',MSGLEVEL=(1,1),
// PRTY=6,CLASS=U
/*JOBPARM TIME=(10,00),M=128,L=20
/*CONTROL  ACCT,PSWD=
/*OUTPUT FORM FORMS=0801,UCS=PN3,FCB=8801
//ST01 EXEC FORTGCLG,REGION.GO=128K,TIME.GO=10
//FORT.SYSIN DD *
C   PROGRAM TO CREATE POTENTIAL ET AND COMBINE WITH PRECIPITATION AND
C  TEMPERATURE.     POTENTIAL ET COMPUTED BY JENSEN-HAISE METHOD.
C
C     INPUT FILES NEEDED:
C                FT03F001 - ONE 80 CHARACTER RECORD WITH MONTHLY MEAN MAXIMUM
C                           SOLAR RADIATION ON CLOUDLESS DAYS, IN LANGLEYS
C                FT05F001 - CONTROL CARDS
C                           CARD 1 - FIRST AND LAST YEARS OF SIMULATION (2I4)
C                           CARD 2 - USWB STATE AND STATION NUMBER AND
C                                    DESCRIPTION FOR STATION USED FOR PERCENT
C                                    POSSIBLE SUNSHINE (2A3,18A4)
C                           CARD 3 - SETS OF 3 CARDS FOR EACH SET OF
C                                    CLIMATIC STATIONS (TEMP AND PRECIP)
C                            CARD 3A- USWB STATE & STA. NO. AND DESCRIPTION
C                                    FOR PRECIPITATION (2A3,18A4)
C                            CARD 3B- USWB STATE & STA. NO. AND DESCRIPTION
C                                    FOR AIR TEMPERATURE (2A3,18A4)
C                            CARD 3C- ALTITUDE OF TEMPERATURE STATION, IN FEET
C                                      (F5.0)
C        FILE FT08F001: FILE OF 80 CHARACTER RECORDS CONTAINING USWB STATE
C                       AND STA. NO.(2A3); YEAR (I4); 12 VALUES OF MONTHLY PRECIP
C                       IN INCHES, MEAN AIR TEMPERATURE IN DEG. F., PERCENT
C                       POSSIBLE SUNSHINE/100, OR 2 VALUES FOR MAXIMUM AND
C                       MINIMUM MEAN DAILY AIR TEMPERATURE IN WARMEST MONTH,
C                       (12F5.0); AND CARD TYPE INDICATOR (8X,A2)
C                           CARD TYPES:  PP = PRECIPITATION
C                                        TT = MEAN DAILY TEMPERATURE
C                                        SS = PERCENT POSSIBLE SUNSHINE/100
C                                        MM = MAXIMUM AND MINIMUM DAILY
C                                              AIR TEMPERATURES IN WARMEST MONTH
C
C     OUTPUT FILE : FT11F001 - 50 CHARACTER RECORD CONTAINING USWB STATE AND
C                              STATION NO., (2A3,2X),YEAR,(I4),MONTH,(I4),
C                              MONTHLY PRECIP, IN INCHES (F10.4),MEAN DAILY
C                              AIR TEMPERATURE, IN DEG. F.,(F10.4),POTENTIAL
C                              EVAPOTRANSPIRATION COMPUTED WITH JENSEN - HAISE
C                              METHOD, INCHES, (F10.4,4X)
C    ****************************************************************
C    **** DEFINITION OF VARIABLES  ********************************
C  CT = CARD TYPES:CTPL(1)=PP,MONTHLY PRECIPITATION DATA;CTP(2)=TT,MEAN MONTHLY
C     TEMPERATURE DATA;CTP(3)=MM,MAXIMUM AND MINIMUM DAILY AIR TEMPERATURE IN
C      WARMEST MONTH;CTS=SS,PERCENT POSSIBLE SUNSHINE;
C  DAMO = DAYS IN THE MONTH;
```

```
C  E1 = SATURATION VAPOR PRESSURE OF WATER AT MEAN MINIMUM AIR TEMPERATURE FOR
C  WARMEST MONTH OF YEAR IN MB;
C  E2 = SATURATION VAPOR PRESSURE OF WATER AT MEAN MAXIMUM AIR TEMPERATURE FOR
C  WARMEST MONTH OF YEAR IN MB;
C  ELEV = ELEVATION OF THE WEATHER (TEMPERATURE) STATION IN FEET;
C  IDP = PRECIPITATION STATION NUMBER AND DESCRIPTION;
C   IDT = TEMPERATURE STATION NUMBER AND DESCRIPTION;
C  IFYR = FIRST YEAR OF POTENTIAL EVAPOTRANSPIRATION (PET) DATA;
C  ILYR = LAST YEAR OF PET DATA;
C  ISRO = PERCENT POSSIBLE SUNSHINE STATION NUMBER AND DESCRIPTION;
C  IYR = YEAR OF CLIMATIC DATA;
C  JSTA OR ISTA = WEATHER STATION;
C  JYR = COUNTER FOR YEARS OF CLIMATIC DATA;
C  NYR = NUMBER OF YEARS IN THE CLIMATIC FILE;
C  P(I,J,K) = MONTHLY PRECIPITATION FOR EACH YEAR IN INCHES;
C  R(I,J) = MONTHLY SOLAR RADIATION FOR EACH YEAR (LANGLEYS);
C  RSO = MEAN MAXIMUM DAILY SOLAR RADIATION ON CLOUDLESS DAYS, IN LANGLEYS/DAY;
C  S(I,J) = MONTHLY POTENTIAL EVAPORATION (INCHES);
C  SRAD = SUBROUTINE THAT COMPUTES THE MONTHLY SOLAR RADIATION USING THE PERCENT
C  POSSIBLE SUNSHINE AND A REGRESSION EQUATION FROM FRITZ AND MCDONALD;
C  SUM = SUM OF THE MONTHLY PRECIPITATION;
C  T(JYR,K) =   MEAN MONTHLY AIR TEMPERATURE FOR EACH YEAR IN DEGREE FAHRENHEIT;
C  TMN = MINIMUM DAILY AIR TEMPERATURE IN THE WARMEST MONTH;
C  TMX = MAXIMUM DAILY AIR TEMPERATURE IN THE WARMEST MONTH;
C  TX = RECORDS 11 THROUGH 75 ON THE CLIMATIC DATA FILES;
C  X = RECORDS 11 THROUGH 70 ON THE CLIMATIC DATA FILE;
      DIMENSION S(50,12),IDT(20),IDP(20),JSTA(2),TX(13),T(50,12),
     *  TMX(50),TMN(50),WARM(50),P(50,12),CTP(3) ,R(50,12)
     *  ,ISRO(20)
      INTEGER*2 CTP,CT
      DATA CTP(1)/'PP'/,CTP(2)/'TT'/,CTP(3)/2HMM/
C
C  READ HEADER CARD FOR FIRST AND LAST YEAR AND PERCENT POSSIBLE
C       SUNSHINE STATION NUMBER AND DESCRIPTION
C
      READ(05,1999) IFYR,ILYR,ISRO
 1999 FORMAT(2I4/2A3,18A4)
      CALL SRAD(R,IFYR,ILYR,ISRO)
C
C    READ CONTROL CARDS FOR PRECIPITATION STATION,TEMPERATURE STATION,
C       AND ELEVATION OF TEMPERATURE STATION USED
C
   10 READ(05,1001,END=999)IDP,IDT,ELEV
 1001 FORMAT(2A3,18A4/2A3,18A4/F5.0)
C
C    READ AND STORE MONTHLY PRECIPITATION AND TEMPERATURE DATA
C
  336 REWIND 08
   36 READ(08,1000,END=998)JSTA,IYR,TX,CT
 1000 FORMAT(2A3,I4,13F5.0,3X,A2)
      IF(CT.EQ.CTP(1).AND.JSTA(1).EQ.IDP(1).AND.JSTA(2).EQ.IDP(2) )
     *    GO TO 30
      IF(CT.EQ.CTP(2).AND.JSTA(1).EQ.IDT(1).AND.JSTA(2).EQ.IDT(2))
     *   GO TO 31
```

```
      IF(CT.EQ.CTP(3).AND.JSTA(1).EQ.IDT(1).AND.JSTA(2).EQ.IDT(2))
     *   GO TO 32
      GO TO 36
   30 SUM=0.
      JYR=IYR-IFYR+1
      DO 45 K=1,12
      P(JYR,K)=TX(K)
      SUM=SUM+TX(K)
   45 CONTINUE
      GO TO 36
   31 SUM=0.
      JYR=IYR-IFYR+1
      DO 41 K=1,12
      T(JYR,K)=TX(K)
   41 CONTINUE
      GO TO 36
   32 JYR=IYR-IFYR+1
      TMX(JYR)=TX(1)
      TMN(JYR)=TX(2)
      GO TO 36
  998 CONTINUE
      NYR=ILYR-IFYR+1
C COMPUTE POTENTIAL ET
      DO 20 I=1,NYR
      E1=-5.530+.5234*TMN(I)-.0085*(TMN(I)*TMN(I))+
     *  1.04E-4*(TMN(I)*TMN(I)*TMN(I))
      E2=-5.53+.5234*TMX(I)-.0085*(TMX(I)*TMX(I))+
     *  1.04E-4*(TMX(I)*TMX(I)*TMX(I))
      DELE=E2-E1
      C1=68.-3.6*(ELEV/1000.)
      CH=50./DELE
      CX=1./(C1+13.*CH)
      TP=27.5-.25*DELE-(ELEV/1000.)
      DO 20 J=1,12
      S(I,J)=R(I,J)*CX*(T(I,J)-TP)
      IF(S(I,J).LT.0.)S(I,J)=0.
   20 CONTINUE
C WRITE PRECIP AND POTENTIAL ET
      WRITE(06,6001) IDP
 6001 FORMAT(1H ,5X,2A3,18A4)
      DO 40 I=1,NYR
      DO 40 J=1,12
      K=I+IFYR-1
      WRITE(11,5000) IDP(1),IDP(2),K,J,P(I,J),T(I,J),S(I,J)
      WRITE(06,5001) IDP(1),IDP(2),K,J,P(I,J),T(I,J),S(I,J)
 5000 FORMAT(2A3,2X,2I4,3F10.4)
 5001 FORMAT(1H ,5X,2A3,2X,2I4,3F10.4)
   40 CONTINUE
      GO TO 10
  999 CONTINUE
        END FILE 11
      STOP
      END
      SUBROUTINE SRAD(R,IFYR,ILYR,ISRO)
```

```
      DIMENSION RSO(12),R(50,12),X(12),DAMO(12)
     * ,ISRD(20),ISTA(2)
      DATA DAMO/31.,28.25,31.,30.,31.,30.,31.,31.,30.,31.,
     * 30.,31./,CTS/'SS'/
C
C  READ MEAN MAXIMUM DAILY SOLAR RADIATION ON CLOUDLESS DAYS, IN LANGLEYS
C           FOR EACH MONTH
C
      READ(03,1000) RSO
 1000 FORMAT(10X,12F5.0)
C
C    READ AND STORE MONTHLY PERCENT POSSIBLE SUNSHINE
C
   10 READ(08,1001,END=999) ISTA,IYR,X,CT
 1001 FORMAT(2A3,I4,12F5.2,8X,A2)
      IF(CT.NE.CTS) GO TO 10
      IF(IYR.LT.IFYR.AND.IYR.GT.ILYR) GO TO 10
      K=IYR-IFYR+1
C
C    COMPUTE MONTHLY TOTAL SOLAR RADIATION USING REGRESSION EQUATION
C         WITH PERCENT POSSIBLE SUNSHINE FROM FRITZ AND MCDONALD
C
      DO 11 I=1,12
   11 R(K,I)=RSO(I)*(.35+.61*X(I))*DAMO(I)*.000673
      GO TO 10
  999 CONTINUE
      RETURN
      END
/*
```

MENT G. Listing of PET Program--Continued
Part 2. Input Data

```
//GO.FT06F001 DD SYSOUT=(C,,FORM)
//GO.FT08F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//   DSN=A.    .AA      .TPMR.CLIM
//GO.FT11F001 DD UNIT=3330,VOL=SER=SYS345,SPACE=(TRK,(44,1),RLSE),
//   DISP=(NEW,KEEP),DSN=A.    .AA      .TPMR.PET,
//   DCB=(RECFM=FB,LRECL=50,BLKSIZE=13000)
//GO.FT03F001 DD *
137708    250. 365. 495. 635. 720. 740. 725. 640. 530. 410. 290. 230.         RR
//GO.SYSIN DD *
19311978
137708  NORTH PLATTE
258255  STRATTON
252065  CULBERTSON
2585.
259020  WAUNETA
253690  HAYES CENTER
3044.
255090  MADRID
253690  HAYES CENTER
3044.
256585  PAXTON
256065  NORTH PLATTE
2775.
258920  WALLACE
253690  HAYES CENTER
3044.
253690  HAYES CENTER
253690  HAYES CENTER
3044.
256480  PALISADE
253690  HAYES CENTER
3044.
258628  TRENTON
252065  CULBERTSON
2585.
252065  CULBERTSON
252065  CULBERTSON
2585.
257110  RED WILLOW
253690  HAYES CENTER
3044.
259115  WELLFLEET
253690  HAYES CENTER
3044.
256065  NORTH PLATTE
256065  NORTH PLATTE
2775.
253365  GOTHENBURG
256065  NORTH PLATTE
2775.
```

```
51.  252100  CURTIS
52.  253690  HAYES CENTER
53.  3044.
54.  251415  CAMBRIDGE
55.  252065  CULBERTSON
56.  2585.
57.  255310  MCCOOK
58.  252065  CULBERTSON
59.  2585.
60.  259325  WILSONVILE
61.  252065  CULBERTSON
62.  2585.
63.  252595  ELWOOD
64.  253690  HAYES CENTER
65.  3044.
66.  252790  EUSTIS
67.  256065  NORTH PLATTE
68.  2775.
69.  /*
```

File 8. Climatic Data[1/]

```
2590201931 0.00  .92 2.20  .91  .36 1.42 1.60 5.77  .78  .37  .70  .40          PP
2590201932  .20  .50  .41 3.48 1.43 3.66 3.88 1.14  .12  .55 0.0   .50          PP
2590201933  .05  .20  .79 2.84 2.84  .82 1.66 6.61 2.62  .00  .10  .91          PP
2590201934  .45 1.61  .38  .98  .61 5.44  .81 4.51 2.43  .14  .89  .52          PP
2590201935 0.0  1.03  .91 1.34 8.87 2.74  .15 1.08 1.59  .74  .79  .26          PP
   }    {                                                                       }
2590201975  .07  .44  .81 1.35 4.42 5.39 2.19  .44 1.22  .08 1.42  .09          PP
2590201976  .67  .16  .35 2.89 1.50 2.45 1.32 1.22  .49  .66  .12  .00          PP
2590201977  .17  .21 5.06 4.15 3.42 1.90 3.75 2.37  .42  .10  .37  .39          PP
2590201978  .33  .99  .77 1.91 4.53 1.16 3.42 1.60  .10  .60  .53  .50          PP

2536901931 35.2 39.2 35.5 49.6 59.1 75.0 78.6 73.2 72.2 56.6 39.4 30.8          TT
2563901932 24.8 35.4 3.33 53.5 63.8 69.4 79.4 76.7 66.0 52.0 41.0 23.3          TT
2536901933 35.0 27.5 41.0 50.0 57.8 77.8 78.0 72.4 69.2 55.4 44.4 36.6          TT
2536901934 35.2 34.6 43.0 53.9 70.5 76.2 84.2 77.4 59.3 58.6 46.2 30.8          TT
2536901935 33.2 36.6 44.3 46.5 53.0 66.6 81.8 76.4 65.5 51.8 35.6 32.4          TT
   {    }                                                                       }
2536901974 21.5 34.7 42.3 50.6 61.8 68.4 78.4 70.2 61.1 54.7 38.7 29.4          TT
2536901975 30.3 25.3 34.5 46.8 58.3 66.4 75.9 73.6 62.4 54.7 36.3 31.0          TT
2536901976 26.4 39.5 38.0 50.3 56.0 67.7 75.9 74.4 64.8 47.4 36.0 33.0          TT
2536901977 20.5 37.3 39.0 52.5 64.2 72.6 77.2 71.3 66.6 54.0 38.8 29.7          TT
2536901978 17.4 19.4 37.8 50.8 58.1 70.5 76.9 71.1 65.7 51.0 35.5 21.0          TT

1377081931  .68  .69  .49  .71  .69  .74  .81  .78  .69  .56  .42  .51          SS
1377081932  .47  .67  .64  .62  .69  .73  .74  .72  .79  .54  .54  .56          SS
1377081933  .58  .76  .61  .66  .62  .84  .82  .69  .70  .74  .53  .56          SS
1377081934  .48  .69  .65  .78  .88  .79  .76  .73  .66  .75  .46  .31          SS
1377081935  .51  .58  .68  .50  .33  .69  .88  .80  .74  .55  .40  .44          SS
   {    {                                                                       {
1377081974  .65  .53  .56  .67  .67  .84  .83  .71  .75  [illegible]  .50  .57          SS
1377081975  .44  .47  .54  .39  .69  .66  .86  .70  .67  64   .50  .40          SS
1377081976  .67  .63  .67  .53  .70  .78  .73  .77  .71  71   .71  .72          SS
1377081977  .64  .70  .64  .62  .63  .69  .70  .61  .67  .69  .70  .70          SS
1377081978  .50  .44  .70  .61  .72  .79  .83  .76  .80  .84  .50  .62          SS

2536901931 92.6 64.6                                                            MM
2536901932 93.4 65.4                                                            MM
2536901933 92.0 64.0                                                            MM
2536901934 98.2 70.2                                                            MM
2536901935 95.8 67.8                                                            MM
   {    }                                                                       }
2536901974 94.4 62.3                                                            MM
2536901975 90.8 62.0                                                            MM
2536901976 89.7 59.1                                                            MM
2536901977 91.6 62.7                                                            MM
2536901978 91.6 62.0                                                            MM
```

1/ First six characters are the U.S. Weather Bureau's identification number, and the next four characters are the years from 1931 to 1978. The last two columns are the card indicators, which are the following: PP, monthly precipitation, in inches; TT, monthly mean air temperature, in degree F; SS, monthly percent possible sunshine; and MM, maximum and minimum mean daily air temperatures, in degree F, of the warmest month of each year.

ATTACHMENT G. Listing of PET Program--Continued
Part 3. Output

U.S. Weather Bureau Station

Number (258255) Name (Stratton, NE)

| Weather Station Number | Year | Month | Precipitation in inches | Mean temperature in °F | Potential evapotranspiration in inches |
|---|---|---|---|---|---|
| 258255 | 1931 | 1 | 0.0 | 33.4000 | 0.8267 |
| 258255 | 1931 | 2 | 0.7300 | 38.6000 | 1.4600 |
| 258255 | 1931 | 3 | 1.8100 | 36.4000 | 1.6427 |
| 258255 | 1931 | 4 | 1.2900 | 51.6000 | 4.3882 |
| 258255 | 1931 | 5 | 0.3100 | 59.2000 | 6.1726 |
| 258255 | 1931 | 6 | 2.3500 | 75.1000 | 8.7863 |
| 258255 | 1931 | 7 | 0.7500 | 78.0000 | 9.8367 |
| 258255 | 1931 | 8 | 4.2800 | 72.7000 | 7.7572 |
| 258255 | 1931 | 9 | 0.4000 | 70.2000 | 5.5430 |
| 258255 | 1931 | 10 | 0.3800 | 55.8000 | 2.8994 |
| 258255 | 1931 | 11 | 0.7000 | 39.1000 | 0.9911 |
| 258255 | 1931 | 12 | 0.4000 | 30.4000 | 0.5373 |
| 258255 | 1932 | 1 | 0.3500 | 25.4000 | 0.4313 |
| 258255 | 1932 | 2 | 0.5000 | 36.8000 | 1.4735 |

(Note.--Output continues through December of 1978 for each of 19 weather stations.)

ATTACHMENT H. Listing of Soil-Water Program

Part 1. Main Program

```
//TPMRSOIL JOB (                ),'SOIL-PROGR',PRTY=2,CLASS=U,
//    MSGLEVEL=(1,1)
/*JOBPARM             TIME=(25,00),M=200,L=50
/*CONTROL  ACCT,PSWD=
/*OUTPUT FORM FORMS=0801,UCS=PN3,FCB=8801
//     EXEC FORTGCLG,REGION.GO=200K,TIME.GO=25
//FORT.SYSIN DD *
C
C  PROGRAM TO COMPUTE MONTHLY NET RECHARGE AND CONSUMPTIVE IRRIGATION
C          REQUIREMENTS AND SUMMARIZE INTO SEASONAL,ANNUAL, AND
C            PERIOD OF RECORD VALUES.
C         ---------------------------------------------
C            E. G. LAPPALA, USGS, WRD,LINCOLN, NEBRASKA  05/09/78 AND
C  SOME ADDITIONAL CHANGES MADE BY J. M. PECKENPAUGH 01/05/79
C           MODIFIED FROM ORIGINAL PROGRAM OF F.J. OTRADOVSKY,
C              USBR, GRAND ISLAND, NEBRASKA
C
C    ********** DEFINITION OF VARIABLES ****************
C     J = CROP INDEX;
C     I = SOIL - TOPOGRAPHIC COMPLEX;
C     AM = AVAILABLE SOIL MOISTURE FOR SOIL I AND ROOT ZONE DEPTH
C              FOR CROP J;
C     FC(I) = FIELD CAPACITY, IN INCHES/INCH, FOR SOIL I;
C     WP(I) = WILTING POINT, IN INCHES/INCH, FOR SOIL I;
C     EPCOEF(L,LL) = COEFFICIENTS FOR QUADRATIC EQUATIONS FOR MONTHLY
C                   INFILTRATION AS A FUNCTION OF PRECIPITATION;
C     CCOEF(J,MO) = CROP COEFFICIENTS TO APPLY TO MONTHLY POTENTIAL ET;
C     SMI = CURRENT SOIL MOISTURE, IRRIGATED CROP;
C     SMD = CURRENT SOIL MOISTURE, DRYLAND CROP;
C     SMIP = PREVIOUS SOIL MOISTURE, IRRIGATED CROP;
C     SMDP = PREVIOUS SOIL MOISTURE, DRYLAND CROP;
C     ITL(20) = PROBLEM TITLE
C     DEPTH(J) = ROOT ZONE DEPTH, IN INCHES, FOR CROP J;
C     STAID = 6 CHARACTER CLIMATIC STATION NUMBER ( STATE + NWS ID NO);
C     ICN(I,J)= INFILTRATION CURVE NUMBER (1,2,3,4) CORRESPONDING
C             TO SOIL I;
C     ET = ACTUAL MONTHLY EVAPOTRANSPIRATION (ET=ETP*CCOEF(J,MO));
C     ETP = MONTHLY POTENTIAL ET, IN INCHES;
C     RAIN = MONTHLY PRECIPITATION, IN INCHES;
C     TEMP = MEAN MONTHLY TEMPERATURE, IN DEGREES F;
C     SMC = CURRENT MONTHS SOIL MOISTURE, IN INCHES;
C     EP = MONTHLY INFILTRATION, IN INCHES;
C     RO = MONTHLY RUNOFF, IN INCHES;
C     HCAP = SOIL MOISTURE AT .5*( FC(I) - WP(I) );
C     MOPRI = IF T, PRINT MONTHLY SUMMARY OF WATER USE ITEMS;
C     SMRY = IF T, PRINT YEARLY SUMMARY OF WATER USE ITEMS;
C     F13P = IF T, STORE SEASONAL VALUES OF CIR AND
C     RECHARGE (VALUES ARE STORED FOR IRRIGATION AND NONIRRIGATION SEASON FOR IR
C     RIGATED LANDS AND DRYLANDS) ON FILE FT13;
C     F14P = IF T, STORE THE AVERAGE VALUES OF RECHARGE AND
```

```
 51.  C     CIR FOR A GIVEN TIME PERIOD ON FILE FT14;
 52.  C     TMIN = MINIMUM TEMPERATURE AT WHICH PRECIPITATION OCCURS AND IT DOESN'T GO
 53.  C     INTO SNOW STORAGE;
 54.  C     SNDAY = MAXIMUM NUMBER OF DAYS THAT SNOW STORAGE CAN OCCUR;
 55.  C     NCR = NUMBER OF CROPS;
 56.  C     NSC = NUMBER OF SOILS;
 57.  C     LYR = LAST YEAR IN THE RECORD OF INTEREST OR NUMBER OF YEARS FROM FIRST
 58.  C     YEAR TO BE USED IN COMPUTING AVERAGES;
 59.  C     MFST = FIRST MONTH OF IRRIGATION SEASON;
 60.  C     MLST = LAST MONTH OF IRRIGATION SEASON;
 61.  C     CNAM = CROP NAME, USED FOR ILLUSTRATIVE PURPOSES;
 62.  C     SOIL = SOIL NAME, USED FOR ILLUSTRATIVE PURPOSES;
 63.  C     IC = INFILTRATION CURVE NUMBERS FOR VARYING CONDITIONS OF SOILS,TOPOGRAPHY
 64.  C     , AND CROP TYPES;
 65.  C     ICC = COUNTER FOR CROP COEFFICIENTS;
 66.  C     ID = COUNTER FOR SOILS;
 67.  C     SEEP = FRACTION OF RUNOFF LOST LOCALLY TO SEEPAGE;
 68.  C     FEFF = FARM IRRIGATION EFFICIENCY;
 69.  C     FLOSS = PART OF GROSS PUMPAGE LOST TO ET AND RO;
 70.  C     NUMSTA = NUMBER OF WEATHER STATIONS;
 71.  C     QIROS = RECHARGE  (+) OR DISCHARGE (-) FOR IRRIGATED LANDS DURING THE NON-
 72.  C     IRRIGATION SEASON
 73.  C     QDYOS= RECHARGE OR DISCHARGE FOR DRYLANDS DURING THE NONIRRIGATION SEASON;
 74.  C     QIRGS = CONSUMPTIVE IRRIGATION REQUIREMENT (CIR) FOR IRRIGATED LANDS
 75.  C     DURING THE IRRIGATION SEASON;
 76.  C     QDYGS = RECHARGE OR DISCHARGE FOR DRYLANDS DURING THE IRRIGATION SEASON;
 77.  C     SLENTH = LENGTH OF THE IRRIGATION SEASON;
 78.  C     FGS = RATE OF THE RECHARGE OR DISCHARGE DURING THE IRRIGATION SEASON;
 79.  C     FOS = RATE OF THE RECHARGE OR DISCHARGE DURING THE NONIRRIGATION SEASON;
 80.  C     FFST = RATE ADJUSTMENT FOR RECHARGE OR DISCHARGE DURING THE NONIRRIGATION
 81.  C     SEASON FOR DATA AVAILABLE FOR THE LAST 5 MONTHS OF THE 9 MONTH SEASON;
 82.  C     STX = STATION NUMBER;
 83.  C     STNM = STATION NAME;
 84.  C     STAID = STATION NUMBER;
 85.  C     IYR = CURRENT YEAR (LINE 275); LATER IYR = JYR-1 (LINE 328);
 86.  C     MO = CURRENT MONTH;
 87.  C     RX OR RXXX = PRECIPITATION BY MONTH;
 88.  C     TPX OR TEMP = TEMPERATURE DATA BY MONTH;
 89.  C     ETX OR ETP = POTENTIAL EVAPOTRANSPIRATION DATA BY MONTH, GENERATED IN THE
 90.  C     PET PROGRAM;
 91.  C     ISNOW = NUMBER OF SNOW DAYS WHEN SNOW STORAGE OCCURS;
 92.  C     NMO = MAXIMUM NUMBER OF MONTHS FOR CALCULATED CIR AND RECHARGE;
 93.  C     JYR = FIRST YEAR IN THE PERIOD (LINE 292);
 94.  C     SNOW = CUMULATIVE AMOUNT OF SNOW IN INCHES;
 95.  C      SDAYS = NUMBER OF DAYS SNOW   STORAGE OCCURS, WHEN TEMPERATURE IS BELOW
 96.  C     27 DEGREES C;
 97.  C     WPX = DEPTH (J) * WP(I);
 98.  C     FCC = FC(I) * DEPTH (J);
 99.  C     DPI = DEEP PERCOLATION FOR IRRIGATED LANDS;
100.  C     DPD = DEEP PERCOLATION FOR DRYLANDS;
101.  C     SHT = WATER SHORTAGE FOR DRYLANDS;
102.  C     GS ( ) = IRRIGATION SEASON;
103.  C     OGS( ) = NONIRRIGATION SEASON;
104.  C     MOD = NOT A VARIABLE, A FORTRAN MATHEMATICAL FUNCTION;
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C     DAMO = DAYS PER MONTH;
C     TS( ) = TOTAL FOR TIME PERIOD;
C     FRAC = (SDAYS-SNDAYS)/DAMO (MO);
C     AS( ) = AVERAGE FOR TIME PERIOD;
C     THE VARIABLES GS(  ), OGS(  ), AS(  ), AND TS(  ) HAVE THE FOLLOWING MEAN
C     ING WHEN 1 THROUGH 12 ARE USED WITHIN (  );
C     --(1) = PRECIPITATION (RXXX) OR (RX);
C     --(2) = SNOW AMOUNTS (SNOW);
C     --(3) = INFILTRATION (EP);
C     --(4) = SURFACE RUNOFF (RO);
C     --(5) = EVAPOTRANSPIRATION (ET);
C     --(6) = DEEP PERCOLATION FOR IRRIGATED LANDS (DPI);
C     --(7) = COMSUMPTIVE IRRIGATION REQUIREMENT (CIR) FOR IRRIGATED LANDS;
C     --(8) = SOIL MOISTURE FOR IRRIGATED LANDS (SMI);
C     --(9) = DEEP PERCOLATION FOR DRYLANDS (SMD);
C     --(10) = SHORTAGE OF MOISTURE FOR DRYLANDS (SHT);
C     --(11) = SOIL MOISTURE FOR DRYLANDS (SMD);
C     SIRG = TOTAL CIR FOR ALL IRRIGATION SEASONS FOR IRRIGATED LANDS;
C     SDYG = TOTAL RECHARGE FOR ALL IRRIGATION SEASON FOR DRYLANDS;
C     SIRO = TOTAL RECHARGE (+) OR DISCHARGE (-) FOR ALL NONIRRIGATION SEASONS
C     FOR IRRIGATED LANDS;
C     SDYO = TOTAL RECHARGE FOR ALL NONIRRIGATION SEASONS FOR DRYLANDS;
C     AIRG = AVERAGE CIR FOR ALL IRRIGATION SEASONS FOR IRRIGATED LANDS;
C     ADYG = AVERAGE RECHARGE FOR ALL IRRIGATION SEASONS FOR DRYLANDS;
C     AIRO = AVERAGE RECHARGE (+) OR DISCHARGE (-) FOR ALL NONIRRIGATION
C     SEASONS FOR IRRIGATED LANDS;
C     ADYO = AVERAGE RECHARGE (+) FOR ALL NONIRRIGATION SEASONS FOR DRYLANDS.
C -------------------------------------------------------------------
C        CRITERIA FOR IRRIGATION REQUIREMENTS AND CROP SHORTAGES:
C             1) IRRIGATION REQUIRED TO MAINTAIN END OF MONTH
C                SOIL MOISTURE AT 1/2 OF AVAILABLE MOISTURE
C             2) CROP SHORTAGE IF END OF MONTH SOIL MOISTURE FALLS
C                  BELOW WILTING POINT
C ---------------------------------------------------------------------
C --------------------------------------------------------------------
      LOGICAL MOPRI,SMRY,F13P,F14P
      DIMENSION  FC(8),WP(8),EPCOEF(4,4),CCOEF(6,12),
     *   ITL(20),DEPTH(5),STAID(2),  ICN(8,5)
     * ,STX(30,2),STNM(30,4)
     * , DAMO(12)
     *  ,QIRGS(48),QDYGS(48),QIROS(48),QDYOS(48)
     * ,SOIL(8,19),CNAM(5,19),RXXX(1000),
     * TEMP(1000),ETP(1000),SEEP(8),FEFF(8),FLOSS(8)
      DATA DAMO/31.,28.25,31.,30.,31.,30.,31.,31.,30.,31.,30.,31./
      DIMENSION GS(11),OGS(11),TS(11),AS(11)
C --------------------------------------------------------------------
      DO 699 L=1,11
      TS(L)=0.0
  699 AS(L)=0.0
      READ(08,1002) ITL,NUMSTA,MOPRI,SMRY,F13P,F14P
     *,TMIN,SNDAY,NCR,NSC,LYR,MFST,MLST
 1002 FORMAT(20A4/I4,1X,4L1/2F10.0,5I4)
C  READ CROP AND SOIL DESCRIPTIONS
      IF(NCR.GT.5) GO TO 888
```

```
      DO 107 L=1,NCR
  107 READ(08,3214) LL,(CNAM(LL,K),K=1,19)
 3214 FORMAT(I4,19A4)
      IF(NSC.GT.7) GO TO 887
      DO 108 L=1,NSC
  108 READ(08,3214) LL,(SOIL(LL,K),K=1,19)
      GO TO 886
  888 WRITE(06,4556)
 4556 FORMAT(1H ,5X,'NUMBER OF CROPS LARGER THAN 5 PROGRAM STOP')
      GO TO 883
  887 WRITE(06,4557)
 4557 FORMAT(1H ,5X,'NUMBER OF SOILS LARGER THAN 7 PROGRAM STOP')
  883 STOP
C ----- READ INFILTRATION CURVE COEFFICIENTS
  886 DO 9 L=1,4
    9 READ(08,1000) IC, (EPCOEF(IC,LL),LL=1,4)
 1000 FORMAT(4X,I4,4F10.0)
C ----- READ CROP COEFFICIENTS AND ROOT ZONE DEPTHS
      DO 8 L=1,NCR
    8 READ(08,1001) ICC,(CCOEF(ICC,LL),LL=1,12),DEPTH(ICC)
 1001 FORMAT(4X,I4,13F5.0)
C ----- READ FIELD CAPACITY, WILTING POINT AND INFILTRATION CURVE NO.
      DO 6 L=1,NSC
    6 READ(08,1004) ID,FC(ID),WP(ID),(ICN(ID,J),J=1,5),
     1SEEP(ID),FEFF(ID),FLOSS(ID)
C  SEEP IS THE FRACTION OF RUNOFF LOST LOCALLY TO SEEPAGE.
C  FEFF IS THE FARM IRRIGATION EFFICIENCY.
C  FLOSS IS THAT PART OF THE GROSS PUMPAGE LOST TO ET AND RUNOFF.
 1004 FORMAT(4X,I4,2F5.0,5I5,3F5.2)
C ----- WRITE OUT INPUT DATA TO THIS POINT
      WRITE(06,7006) ITL
 7006 FORMAT(1H1,5X,20A4//)
      WRITE(06,7000)
 7000 FORMAT(1H0,50X,'INPUT DATA'//10X,'INFILTRATION CURVE COEFFICIENTS
     * (I = A1 + A2*RAIN + A3*RAIN**2  WHEN RAIN > A0 )'/5X,
     *  'CURVE NO.',5X,'A0',10X,'A1',10X,'A2',10X,'A3')
      DO 90 L=1,4
   90 WRITE(06,7001) L,(EPCOEF(L,LL),LL=1,4)
 7001 FORMAT(1H ,9X,I2,3X,4E12.4)
      WRITE(06,7010) TMIN,SNDAY
 7010 FORMAT(1H0,5X,'TEMPERATURE BELOW WHICH PRECIP IS PUT INTO SNOW STO
     *RAGE = ',F10.2/5X,'MAXIMUM NUMBER OF SNOW STORAGE DAYS = ',F10.0/)
      WRITE(06,7002)
 7002 FORMAT(1H0,10X,'CROP COEFFICIENTS ( ET/ETP) '
     * /10X,'INDEX',25X,'CROP IDENTIFICATION')
      DO 109 K=1,NCR
  109 WRITE(06,7025) K,(CNAM(K,L),L=1,19)
 7025 FORMAT(1H ,10X,I5,2X,19A4)
      WRITE(06,7023)
 7023 FORMAT(1H0,
     *  5X,'CROP NO.  ',' JAN   FEB   MAR   APR   MAY   JUNE  JULY  AUG
     *  SEPT  OCT   NOV   DEC')
      DO 91 L=1,NCR
   91 WRITE(06,7003) L,(CCOEF(L,LL),LL=1,12),DEPTH(L)
```

```
 7003 FORMAT(1H ,9X,I2,4X,12F6.3,5X,F10.0)
      WRITE(06,7035)
 7035 FORMAT(1H ,5X,'SOIL- TOPOGRAPHIC DESCRIPTIONS'//10X,
     *   'INDEX',25X,'SOIL IDENTIFICATION')
      DO 110 K=1,NSC
  110 WRITE(06,7025) K,(SOIL(K,L),L=1,19)
      WRITE(06,7004) (KK,KK=1,NCR)
 7004 FORMAT(1H0,10X,'SOIL MOISTURE PROPERTIES',30X,'INFILTRATION CURVE
     *FOR CROP NO'/5X,'SOIL NO.  ',5X,'FIELD CAP ',5X,'WILTING PT',
     * 5X,'EFF. DEPTH',
     *  4X,6I5)
      DO 92 L=1,NSC
   92 WRITE(06,7005) L,FC(L),WP(L),         (ICN(L,J),J=1,5)
 7005 FORMAT(1H ,9X,I2,9X,F10.4,5X,F10.4,        17X,5(3X,I2))
      N=0
      WRITE(06,8231) MOPRI,SMRY,LYR,MFST,MLST
 8231 FORMAT(1H0,5X,'PRINT MONTHLY VALUES?' ,1X,L1/
     *  5X,'TOTAL PERIOD OF RECORD SUMMARY PRINTED ONLY?',1X,L1/
     * 5X,' NUMBER OF YEARS FRO FIRST YEAR TO USE IN AVERAGES=',I5/
     * 5X,' FIRST MONTH OF IRRIGATION SEASON = ',I5/
     * 5X,' LAST MONTH OF IRRIGATION SEASON =',I5)
      IF(MLST.LE.MFST) GO TO 772
      DO 111 J=1,NUMSTA
  111 READ(08,1111) (STX(J,K),K=1,2),(STNM(J,KK),KK=1,4)
 1111 FORMAT(2A3,4A4)
      GO TO 10
  772 WRITE(06,8322)
 8322 FORMAT(1H ,5X,'ILLEGAL RELATION BETWEEN FIRST AND LAST MONTH OF I
     *RRIGATION SEASON, JOB TERMINATED')
      STOP
C
C******************
C              START OF LOOP ON NUMBER OF CLIMATIC STATION POLYGONS
C******************
C
   10 N=N+1
      REWIND 01
      IF(N.GT.NUMSTA) GO TO 999
      GO TO 11
  999 END FILE 13
      STOP
C
C ----- INITIALIZE
C
   11 CONTINUE
      DO 211 KK=1,48
      QIROS(KK)=0.
      QDYOS(KK)=0.
      QIRGS(KK)=0.
      QDYGS(KK)=0.
  211 CONTINUE
      SLENTH=MLST-MFST+1
      FGS=12./SLENTH
      FOS=12./(12.-SLENTH)
```

```
      FFST=(12.-SLENTH)/(MFST-1)
      K=0
      UNITS=1.
C
C   READ AND STOR  PRECIP, TEMP AND ETP FROM FILE FT01
C
   20 READ(01,1008,END=995) STAID,IYR,MO,RX,TPX,ETX
 1008 FORMAT(2A3,2X,2I4,3F10.0)
      IF(STAID(1).EQ.STX(N,1).AND.STAID(2).EQ.STX(N,2))GO TO 121
      GO TO 20
  121 IF(IYR.LT.1935) GO TO 20
      K=K+1
      IF(K.GT.1000) GO TO 23
      GO TO 24
   23 WRITE(06,6666) STAID
 6666 FORMAT(1H ,5X,'MORE THAN 1000 MONTHS OF DATA READ FOR STATION',
     *1X,2A3,' DATA IN EXCESS OF THIS NOT USED IN SUBSEQUENT',
     *' SIMULATION')
      K=1000
      GO TO 995
   24 RXXX(K)=RX*UNITS
      TEMP(K)=TPX*UNITS
      ETP(K)=ETX*UNITS
      IF(K.EQ.1)JYR=IYR
      GO TO 20
  995 CONTINUE
      IF(K.EQ.0) GO TO 972
      GO TO 973
  972 WRITE(06,9720) (STX(N,LL),LL=1,2)
 9720 FORMAT(1H0,5X,100(1H*)/5X,'NO STATION NUMBER MATCH FOUND FOR',
     *' STATION ',2A3,' COMPUTATIONS WERE NOT MADE FOR THIS STATION'/
     * 100(1H*))
      GO TO 10
  973 NMO=K
C
C*****************
C          START OF LOOP ON NUMBER OF SOIL TYPE SUBDIVISIONS USED
C*****************
C
      DO 30 I=1,NSC
C
C*****************
C          START OF LOOP ON NUMBER OF CROP TYPES USED
C*****************
C
      DO 30 J=1,NCR
 8000 FORMAT(1H1,5X,20A4//5X,'WEATHER STATION USED =',
     * 1X,2A3,1X,4A4/10X,'SOIL - TOPOGRAPHIC COMPLEX = ',19A4/
     * 10X,'CROP = ',19A4//80X,'IRRIGATED',16X,'DRYLAND'/73X,
     * '  DEEP    CONS     EOM    DEEP    CROP     EOM'/41X,
     * '  SNOW  ',24X,'  PERC     IRR    SOIL    PERC  ',
     * 1X,'SHORT    SOIL'/25X,' PRECIP   TEMP   STORED',
     * 2X,'INFIL   RUNOFF    ET     LOSS   RQRMT   MOIST',
     * 4X,'LOSS     AGE   MOIST'/18X,'YEAR MO  (IN)',
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```
     * 5X,'(F)',10('    (IN)'))
C
C    INITIALIZE SCALARS AND ARRAYS FOR THIS CLIMATIC STATION, SOIL,
C               AND CROP
C
      IYR=JYR-1
      MO=12
      KYR=0
      EP=0.
      RO=0.
      SNOW=0.
      SDAYS=0.
      ISNOW=0
      AM=DEPTH(J)*(FC(I)-WP(I))
      WPX=DEPTH(J)*WP(I)
      FCC=FC(I)*DEPTH(J)
      HCAP=.5*AM+WPX
      SMIP=HCAP
      SMDP=.25*AM+WPX
      DO 60 L=1,11
      GS(L)=0.
   60 OGS(L)=0.
C
C*** CHANGE CROP COEFFICIENTS FOR FALLOW AND SM GR (WHEAT).  ICKYR= 0
C     1 EVERY OTHER YEAR, THIS WILL HANDLE WHEAT-FALLOW-WHEAT-FALLOW...
C      START OF TIME LOOP USING MONTHLY TIME INCREMENTS*************
      ICKYR=0
      DO 992 K=1,NMO
      MO=MO+1
      IF(MO.GT.12) GO TO 991
      GO TO 993
  991 MO=1
      IF(ICKYR.EQ.1) GO TO 2033
      ICKYR=1
      GO TO 2034
 2033 ICKYR=0
 2034 IYR=IYR+1
      KYR=KYR+1
      IF(MOPRI) GO TO 88
      GO TO 89
   88 IF(MOD(KYR,2).EQ.0)GO TO 993
      GO TO 87
   89 IF(KYR.EQ.1) GO TO 87
      IF(MOD(KYR,LYR).EQ.0) GO TO 87
      GO TO 993
   87 IF(SMRY) GO TO 993
      WRITE(06,8000) ITL,(STX(N,KS),KS=1,2),
     *(STNM(N,KX),KX=1,4),(SOIL(I,M),M=1,19),
     * (CNAM(J,M),M=1,19)
  993 CONTINUE
C
C   COMPUTE INFILTRATION AND RUNOFF
C               COMPUTATION OF SNOW STORAGE FOR WINTER MONTHS
C
```

```
      RAIN=RXXX(K)
      IF(TEMP(K).LT.TMIN) GO TO 50
      GO TO 55
   50 KMM=MO-1
      IF(MO.EQ.1)KMM=12
      SDAYS=DAMO(MO)+DAMO(KMM)
      ISNOW=1
      IF(SDAYS.LT.SNDAY) GO TO 51
      GO TO 52
   51 RAIN=0.
      SNOW=SNOW+RXXX(K)
      GO TO 21
   52 FRAC=(SDAYS-SNDAY)/DAMO(MO)
      SNOW=SNOW+FRAC*RXXX(K)
      RAIN=(1.-FRAC)*RXXX(K)
      GO TO 21
   55 IF(ISNOW.EQ.1) GO TO 53
      GO TO 21
   53 RAIN=RAIN+SNOW
      SNOW=0.
      ISNOW=0
      SDAYS=0.
   21 CONTINUE
      IF(RAIN.GT.EPCOEF(ICN(I,J),1))GO TO 31
      EP= RAIN
      GO TO 32
   31 EP = EPCOEF(ICN(I,J),2)+EPCOEF(ICN(I,J),3)*RAIN+
     *     EPCOEF(ICN(I,J),4)*RAIN*RAIN
      IF(EP.GT.RAIN)EP=RAIN
   32 RO = RAIN-EP
C  ********** COMPUTE ACTUAL ET **********************
      ET=ETP(K)*CCOEF(J,MO)
C     COMPUTATION OF ET FOR SMALL GRAIN (3) AND FALLOW (5). WHEN ICKYR=0,SMGR IS
C SMGR AND FALLOW IS FALLOW. WHEN ICKYR=1,THESE LAND USES ARE REVERSED.
      IF(J.EQ.3.AND.ICKYR.EQ.0) ET=ETP(K)*CCOEF(3,MO)
      IF(J.EQ.3.AND.ICKYR.EQ.1) ET=ETP(K)*CCOEF(5,MO)
      IF(J.EQ.5.AND.ICKYR.EQ.0) ET=ETP(K)*CCOEF(5,MO)
      IF(J.EQ.5.AND.ICKYR.EQ.1) ET=ETP(K)*CCOEF(3,MO)
      IF(ET.LT.0.) ET = 0.
C
C ----- COMPUTE CURRENT MONTHS SOIL MOISTURE
C        FOR DRYLAND (SMD) AND IRRIGATED (SMI) CONDITIONS
C
      DPI=.1608+0.792*EP-0.552*(FCC-SMIP+ET)
      IF (DPI.LE.0.0) DPI=0.0
      IF (EP.LE.FCC-SMIP) DPI=0.0
      SMI=SMIP+EP-ET-DPI
      DPD=.1608 +0.792*EP-0.552*(FCC-SMDP+ET)
      IF(DPD.LE.0.0) DPD=0.0
      IF(EP.LE.FCC-SMDP) DPD=0.0
      SMD=SMDP+EP-ET-DPD
C
C  COMPUTE DEEP PERC , CIR, AND ADJUST SOIL MOISTURE
C
```

```
C      DPI=0.
       CIR=0.
       IF(SMI.GT.FCC) GO TO 33
       GO TO 34
    33 DPI=DPI+SMI-FCC
       SMI=FCC
       GO TO 35
    34 IF(SMI.GT.HCAP) GO TO 35
       IF(MO.LT.MFST.OR.MO.GT.MLST) GO TO 35
       CIR=HCAP-SMI
       SMI=HCAP
    35 IF(SMI.LT.0.)SMI=0.
       SMIP=SMI
    36 CONTINUE
       SHT=0.
       IF(SMD.GT.FCC) GO TO 43
       GO TO 44
    43 DPD=DPD +SMD-FCC
       SMD=FCC
       GO TO 45
    44 IF(SMD.GT.WPX) GO TO 45
       SHT=WPX-SMD
       IF(SMD.LT.0.)SMD=0.
    45 SMDP=SMD
    46 CONTINUE
       IF(MOPRI) GO TO 47
       GO TO 48
C
C        IF DESIRED, PRINT MONTHLY SUMMARY OF ALL INPUTS, OUTPUTS AND
C           CHANGES IN SOIL MOISTURE STORAGE
C
    47 WRITE(06,4000) IYR,MO,RAIN,TEMP(K),SNOW,EP,RO,ET,DPI,
      *  CIR,SMI,DPD,SHT,SMD
  4000 FORMAT(1H ,17X,I4,1X,I2,2X,F5.2,4X,F4.1,6(3X,F5.2)
      *  ,3X,F5.2,2(3X,F5.2),3X,F5.2)
C
C        SUMMATIZE INPUTS, OUTPUTS AND CHANGE IN STORAGE FOR IRRIGATION
C                    SEASON
C
    48 IF(MO.LT.MFST.OR.MO.GT.MLST) GO TO 70
       GS(1)=GS(1)+RXXX(K)
       GS(2)=GS(2)+SNOW
       GS(3)=GS(3)+EP
       GS(4)=GS(4)+RO
       GS(5)=GS(5)+ET
       GS(6)=GS(6)+DPI
       GS(7)=GS(7)+CIR
       GS(8)=SMI
       GS(11)=SMD
       GS(9)=GS(9)+DPD
       GS(10)=GS(10)+SHT
       IF(MO.EQ.8) GO TO 510
       GO TO 992
   510 IF(SMRY) GO TO 511
```

```
      WRITE(06,4001) IYR,MO,GS
 4001 FORMAT(1H ,5X,'GROWING',5X,I4,1X,I2,1X,F6.2,10X,F6.2,
     *  9(2X,F6.2))
C
C   STORE SEASONAL SUMARIES OF RECHARGE AND CIR FOR IRRIGATION SEASON
C
  511 QIRGS(KYR)=(GS(6)-GS(7)-GS(7)/FEFF(I)*FLOSS(I))*FGS
      QDYGS(KYR)=(GS(9)+SEEP(I)*GS(4))*FGS
C
C    SUMMARIZE INPUTS, OUTPUTS AND CHANGES IN STORAGE FOR
C              NON-IRRIGATION SEASON
C
      TS(1)=TS(1)+GS(1)
      TS(2)=TS(2)+GS(2)
      TS(3)=TS(3)+GS(3)
      TS(4)=TS(4)+GS(4)
      TS(5)=TS(5)+GS(5)
      TS(6)=TS(6)+GS(6)
      TS(7)=TS(7)+GS(7)
      TS(8)=TS(8)+GS(8)
      TS(9)=TS(9)+GS(9)
      TS(10)=TS(10)+GS(10)
      TS(11)=TS(11)+GS(11)
      DO 73 L=1,11
   73 GS(L)=0.
      GO TO 992
   70 OGS(1)=OGS(1)+RXXX(K)
      OGS(2)=OGS(2)+SNOW
      OGS(3)=OGS(3)+EP
      OGS(4)=OGS(4)+RO
      OGS(5)=OGS(5)+ET
      OGS(6)=OGS(6)+DPI
      OGS(7)=OGS(7)+CIR
      OGS(9)=OGS(9)+DPD
      OGS(10)=OGS(10)+SHT
      OGS(8)=SMI
      OGS(11)=SMD
      IF(MO.EQ.5) GO TO 61
      GO TO 992
   61 IF(SMRY)GO TO 512
      WRITE(06,4002) IYR,MO,OGS
 4002 FORMAT(1H ,5X,'NON-GROWING',1X,I4,1X,I2,1X,F6.2,10X,F6.2,
     *  9(2X,F6.2))
C     *****  STORE SEASONAL VALUES OF RECHARGE AND CIR FOR NORIRRIGATION SEASON*
C      *********     WHEN KYR=1, FIRST YEAR OF SIMULATION, THE FIRST 4 MONTHS
C   ****  OF NONIRRIGATION SEASON ARE MISSING; THEREFORE, QIROS(1) AND QDYOS(1)
C *** ARE MULTIPLED BY FFST=1.8 TO GENERATE MISSING DATA.   ********************
  512 QIROS(KYR)=(OGS(6)-OGS(7)-OGS(7)/FEFF(I)*FLOSS(I))*FOS
      QDYOS(KYR)=(OGS(9)+SEEP(I)*OGS(4))*FOS
      IF(KYR.EQ.1)QIROS(KYR)=QIROS(KYR)*FFST
      IF(KYR.EQ.1)QDYOS(KYR)=QDYOS(KYR)*FFST
      TS(1)=TS(1)+OGS(1)
      TS(2)=TS(2)+OGS(2)
      TS(3)=TS(3)+OGS(3)
```

```
      TS(4)=TS(4)+OGS(4)
      TS(5)=TS(5)+OGS(5)
      TS(6)=TS(6)+OGS(6)
      TS(7)=TS(7)+OGS(7)
      TS(8)=TS(8)+OGS(8)
      TS(9)=TS(9)+OGS(9)
      TS(10)=TS(10)+OGS(10)
      TS(11)=TS(11)+OGS(11)
      DO 63 L=1,11
   63 OGS(L)=0.
  992 CONTINUE
C     COMPUTE AVERAGE FOR THE TIME PERIOD (INCLUDES IRRIGATION AND NONIRRIGATION
C     SEASONS)
      AS(1)=TS(1)/LYR
      AS(2)=TS(2)/LYR
      AS(3)=TS(3)/LYR
      AS(4)=TS(4)/LYR
      AS(5)=TS(5)/LYR
      AS(6)=TS(6)/LYR
      AS(7)=TS(7)/LYR
      AS(8)=TS(8)/LYR
      AS(9)=TS(9)/LYR
      AS(10)=TS(10)/LYR
      AS(11)=TS(11)/LYR
      WRITE(06,4113) AS
 4113 FORMAT(1H ,5X,'AVERAGE FOR LYR YEARS',1X,F6.2,10X,F6.2,9(2X,F6.2))
      DO 698 L=1,11
      TS(L)=0.0
  698 AS(L)=0.0
C
C
C***************
C    END OF TIME LOOP
C***************
C
      SIRG=0.
      SDYG=0.
      SIRO=0.
      SDYO=0.
      DO 64 KK=1,LYR
      SIRG=SIRG+QIRGS(KK)
      SDYG=SDYG+QDYGS(KK)
      SIRO=SIRO+QIROS(KK)
      SDYO=SDYO+QDYOS(KK)
   64 CONTINUE
C
C   COMPUTE AVERAGE RECHARGE OR CIR VALUES FOR LYR YEARS FROM FIRST
C           YEAR OF RECORD
C
      AIRG=SIRG/LYR
      ADYG=SDYG/LYR
      AIRO=SIRO/LYR
      ADYO=SDYO/LYR
      K1=LYR+1
```

```
      IF(K1.GE.KYR) GO TO 803
      GO TO 804
  803 K1=1
      GO TO 806
  804 CONTINUE
C
C     WRITE AVERAGE VALUES OF RECHARGE AND CIR TO FILE FT14
C
  806 CONTINUE
      WRITE(06,6000) LYR,I,(SOIL(I,M),M=1,19),N,J,(CNAM(J,M),M=1,19),
     *  JYR,(STX(N,KS),KS=1,2),
     *(STNM(N,K),K=1,4),SIRO,AIRO,SDYO,ADYO,SIRG,AIRG,SDYG,
     * ADYG
      IF(F14P)WRITE(14,7778) I,N,J,(STX(N,KS),KS=1,2),JYR,AIRO,
     *  ADYO,AIRG,ADYG
 7778 FORMAT(3I2,2A3,I4,4F6.1)
C
C      WRITE SEASONAL VALUES FOR EACH YEAR OF RECORD TO FILE FT13
C
      IF(F13P) WRITE(13,7777)I,N,J,(STX(N,KS),KS=1,2),LYR,(QIROS(KK),
     *  QDYOS(KK),QIRGS(KK),QDYGS(KK),KK=K1,KYR)
C....
C NOTE THAT THE LRECL FOR FILE FT13F001 =
C 24*(KYR-LYR+1)+16
C....
 7777 FORMAT(3I2,2A3,I4,240F6.1)
 6000 FORMAT(1H0,5X//5X,'TOTAL AND AVG. RECHARGE(+) AND CIR RATES AT BAS
     *E OF ROOT ZONE, IN INPUT UNITS/YEAR'/5X,'YEARS OF RECORD =',
     * I5/5X,'SOIL INDEX NO.=',I5,5X,19A4/
     *  5X,'CLIMATE INDEX =',I5/
     *  5X,'CROP INDEX =',I5,5X,19A4/5X,'FIRST YEAR IS',I6/
     * 5X,'STATION NUMBER =',2A3,5X,4A4/5X,'NON-GROWING SEASON'/
     * 10X,'IRRIGATED SUM =',1PE10.3,2X,'IRRIGATED AVERAGE =',
     *  1PE10.3/10X,'DRYLAND SUM =',1PE10.3,2X,'DRYLAND AVERAGE ='
     *,1PE10.3/5X,'GROWING SEASON'/10X,'IRRIGATED SUM =',1PE10.3,
     * 2X,'IRRIGATED AVERAGE =',1PE10.3/10X,
     * 'DRYLAND SUM =',1PE10.3,
     *  2X,'DRYLAND AVERAGE =',1PE10.3)
      KXX=KYR-K1
      WRITE(06,5002) I,N,J,(STX(N,KS),KS=1,2),LYR,KXX
 5002 FORMAT(1H ,5X,3I2,2A3,2I4)
      WRITE(06,5001) (QIROS(KK),QDYOS(KK),
     * QIRGS(KK),QDYGS(KK),KK=K1,KYR)
 5001 FORMAT(1H ,16F6.1)
   30 CONTINUE
C
C***************
C    END OF LOOP ON SOILS AND CROPS
C***************
C
      GO TO 10
C
C***************
C    END OF LOOP ON NUMBER OF CLIMATIC STATION POLYGONS
```

```
C***************
C
      END
/*
```

ATTACHMENT H. Listing of Soil-Water Program--Continued
Part 2. Input Data

```
//GO.FT06F001 DD SYSOUT=(C,,FORM),DCB=RECFM=FA
//GO.FT14F001 DD DUMMY
//GO.FT01F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
// DSN=              TPMR.PET
//FT13F001 DD UNIT=3350,VOL=SER=SYS501,DISP=(OLD,KEEP),
//    DCB=(RECFM=FB,LRECL=1072,BLKSIZE=1072),
//    DSN=                  TPSOIL,SPACE=(TRK,(56,2),RLSE)
//FT08F001 DD *
```

JCL of input and output files.

```
AVERAGE 1935-78 RECHARGE, TWIN PLATTE & MIDDLE REP., 12/01/80]
```

ITL, title and data.

```
  19 FTTF ]
```

NUMSTA and logical variables, MOPRI,SMRY,F13P, and F14P.

```
      27.        40.   5   7  44   6   8 ]
```

TMIN,SNDAY,NCR,NSC,LYR,MFST, and MLST

```
   1 ROW CROP
   2 ALFALFA
   3 SMALL GRAIN
   4 PASTURE
   5 FALLOW
```

Crops or land uses.

```
   1 HOLDREGE-HALL-KEITH-GOSHEN;UPLANDS;SLIGHT SLOPES;SILTY
   2 COLBY-COLY-ULYSSES-ULY-ROSEBUD;DISSECTED UPLANDS;SEVERE SLOPES,SILTY
   3 MCCOOK-BRIDGEPORT-HORD-HOBBS-COZAD;TER.&HIGH FP,SL SLOPES,SILTY TO LOAMY
   4 ANSELMO-JAYEM-SARBEN-VETAL-TRIPP-ROSEBUD;UPL&HTER;SL-MOD SLOPE;SANDY LOAM
   5 VALENTINE;UPLANDS;SL TO SEVERE SLOPES;SANDY
   6 LAS-HAVERSON-PLATTE-RUSCO;BOTTOMLANDS;FLAT;SILTY
   7 LEX-GIBBON-LAWET-GLENBORG;BOTTOMLANDS;FLAT;SANDY TO SANDY LOAM
```

Soil groups, topographic position, and soil types.

```
      1 12.00     .0      1.0000     .0
      2  2.50   -.01987   1.1330   -.04394
      3  2.35    .3672     .9473   -.03920
      4  1.33    .2895     .8260   -.03345
```

Infiltration-curve coefficients.

```
      1 .345 .273 .353 .340 .396 .5801.000 .957 .775 .443 .296 .298  36.
      2 .338 .226 .446 .738 .981 .884 .861 .868 .894 .925 .290 .292  60.
      3 .300 .300 .300 .8001.000 .950 .350 .300 .300 .300 .300 .300  30.
      4 .400 .400 .400 .600 .870 .870 .652 .652 .652 .435 .400 .400  30.
      5 .300 .300 .300 .400 .500 .500 .475 .475 .475 .300 .300 .300  30.
```

Monthly crop coefficients from Januar through December for each crop and root-zone depth,in inches of each crop.

```
      1 .21    .0    2    2    2    1    2  .10 1.00  .00
      2 .16    .0    3    3    3    2    3  .10 1.00  .00
      3 .17    .0    2    2    2    1    2  .25 1.00  .00
      4 .13    .0    2    1    1    1    2  .50 1.00  .00
      5 .07    .0    2    1    1    1    2 1.00 1.00  .00
      6 .16    .0    2    2    2    1    2  .25 1.00  .00
      7 .13    .0    1    1    1    1    1  .50 1.00  .00
```

Values listed in order by column for each soil group (1-7): Field capacity, wiltir point, infiltration-curve number (for 5 land uses above) seep term, farm efficiency, and field losses.

| | |
|---|---|
| 40. 258255 STRATTON | U.S. Weather Bureau's station number and name. |
| 41. 259020 WAUNETA | |
| 42. 255090 MADRID | |
| 43. 256585 PAXTON | |
| 44. 258920 WALLACE | |
| 45. 253690 HAYES CENTER | |
| 46. 256480 PALISADE | |
| 47. 258628 TRENTON | |
| 48. 252065 CULBERTSON | |
| 49. 257110 RED WILLOW | |
| 50. 259115 WELLFLEET | |
| 51. 256065 NORTH PLATTE | |
| 52. 253365 GOTHENBERG | |
| 53. 252100 CURTIS | |
| 54. 251415 CAMBRIDGE | |
| 55. 255310 MCCOOK | |
| 56. 252595 ELWOOD | |
| 57. 252790 EUSTIS | |
| 58. 259325 WILSONVILLE | |
| 59. | |

ATTACHMENT H. Listing of Soil-Water Program--Continued

Part 3. Output

```
AVERAGE 1935-78 RECHARGE. TWIN PLATTE & MIDDLE REP.. 11/17/81 1/

                                   INPUT DATA

     INFILTRATION CURVE COEFFICIENTS  (I = A1 + A2*RAIN + A3*RAIN**2  WHEN RAIN > A0 )
 CURVE NO.     A0            A1           A2          A3
     1      0.1200E 02   0.0         0.1000E 01   0.0
     2      0.2500E 01  -0.1987E-01  0.1133E 01  -0.4394E-01
     3      0.2350E 01   0.3672E 00  0.9473E 00  -0.3920E-01
     4      0.1330E 01   0.2895E 00  0.8260E 00  -0.3345E-01

 TEMPERATURE BELOW WHICH PRECIP IS PUT INTO SNOW STORAGE =      27.00
 MAXIMUM NUMBER OF SNOW STORAGE DAYS =            40.

     CROP COEFFICIENTS ( ET/ETP)
     INDEX                              CROP IDENTIFICATION
          1    ROW CROP
          2    ALFALFA
          3    SMALL GRAIN
          4    PASTURE
          5    FALLOW
                                                                                     Root depth
 CROP NO.   JAN   FEB   MAR   APR   MAY   JUNE  JULY  AUG   SEPT  OCT   NOV   DEC      (inches)
     1     0.345 0.273 0.353 0.340 0.396 0.580 1.000 0.957 0.775 0.443 0.296 0.298       36.
     2     0.338 0.226 0.446 0.738 0.981 0.884 0.861 0.868 0.894 0.925 0.290 0.292       60.
     3     0.300 0.300 0.300 0.800 1.000 0.950 0.350 0.300 0.300 0.300 0.300 0.300       30.
     4     0.400 0.400 0.400 0.600 0.870 0.870 0.652 0.652 0.652 0.435 0.400 0.400       30.
     5     0.300 0.300 0.300 0.400 0.500 0.500 0.475 0.475 0.475 0.300 0.300 0.300       30.
 SOIL- TOPOGRAPHIC DESCRIPTIONS

     INDEX                             SOIL IDENTIFICATION
          1    HOLDREGE-HALL-KEITH-GOSHEN;UPLANDS;SLIGHT SLOPES;SILTY
          2    COLBY-CULY-ULYSSES-ULY-ROSEBUD;DISSECTED UPLANDS;SEVERE SLOPES.SILTY
          3    MCCOOK-BRIDGEPORT-HURD-HOBBS-COZAD;TER.&HIGH FP.SL SLOPES.SILTY TO LOAMY
          4    ANSELMO-JAYEM-SARBEN-VETAL-TRIPP-ROSEBUD;UPL&HTER;SL-MOD SLOPE;SANDY LOAM
          5    VALENTINE;UPLANDS;SL TO SEVERE SLOPES;SANDY
          6    LAS-HAVERSON-PLATTE-RUSCO;BOTTOMLANDS;FLAT;SILTY
          7    LEX-GIBBON-LAWET-GLENBORG;BOTTOMLANDS;FLAT;SANDY TO SANDY LOAM

     SOIL MOISTURE PROPERTIES                                 INFILTRATION CURVE FOR CROP NO
 SOIL NO.        FIELD CAP        WILTING PT      EFF. DEPTH      1    2    3    4    5
     1            0.2100            0.0                           2    2    2    1    2
     2            0.1600            0.0                           3    3    3    2    3
     3            0.1700            0.0                           2    2    2    1    2
     4            0.1300            0.0                           2    1    1    1    2
     5            0.0700            0.0                           2    1    1    1    2
     6            0.1600            0.0                           2    2    2    1    2
     7            0.1300            0.0                           1    1    1    1    1

  PRINT MONTHLY VALUES? F
 TOTAL PERIOD OF RECORD SUMMARY PRINTED ONLY? T
  NUMBER OF YEARS FRO FIRST YEAR TO USE IN AVERAGES=   44
  FIRST MONTH OF IRRIGATION SEASON =       6
  LAST MONTH OF IRRIGATION SEASON =     8
```

Input data listing

```
2/ AVERAGE FOR LYR YEARS  20.06              0.74   19.02   1.04   32.30    1.11   13.96    7.71    0.51   13.75   3.47

TOTAL AND AVG. RECHARGE(+) AND CIR RATES AT BASE OF ROOT ZONE. IN INPUT UNITS/YEAR
YEARS OF RECORD =    44
SOIL INDEX NO.=      1       HOLDREGE-HALL-KEITH-GOSHEN;UPLANDS;SLIGHT SLOPES;SILTY
CLIMATE INDEX =      1
CROP INDEX =      1       ROW CROP
FIRST YEAR IS  1935
STATION NUMBER =258255       STRATTON
NON-GROWING SEASON
     IRRIGATED SUM = 5.508E 01  IRRIGATED AVERAGE = 1.252E 00
     DRYLAND SUM = 2.624E 01   DRYLAND AVERAGE = 5.965E-01
GROWING SEASON
     IRRIGATED SUM =-2.420E 03  IRRIGATED AVERAGE =-5.500E 01
     DRYLAND SUM = 3.349E 01   DRYLAND AVERAGE = 7.612E-01
 3/1 1 1258255   44   43
4/5.3   3.3 -65.1   0.0   0.0   0.2-103.5   0.0   0.0   0.0 -78.9   0.3   0.0   0.1 -72.6   0.0
  0.0   0.0 -91.2   0.1   0.0   0.0 -86.9   0.0   0.0   0.0 -43.0   2.2   3.2   0.1 -61.3   0.2
  0.0   0.0 -89.6   0.0   4.5   3.7 -37.2   0.3   0.0   0.0 -52.8   0.0   0.0   0.0 -51.2   0.5
  0.5   0.0 -26.1   5.9   0.0   0.0 -57.0   0.1   2.6   2.8 -42.3   0.1   0.0   0.0 -43.3   0.3
  0.0   0.1 -22.0   0.2   5.4   0.9 -63.1   0.0   0.0   0.0 -77.5   0.0   0.0   0.0 -89.6   0.0
  0.0   0.0-100.1   0.0   0.0   0.0 -76.3   0.1   0.0   0.0 -47.4   0.1   2.0   1.7 -34.9   0.0
  0.0   0.0 -66.3   0.0   8.3   3.7 -43.3   0.5   0.0   0.0 -58.4   0.0   1.1   0.0   1.7  11.5
  0.0   0.0 -58.3   0.1   0.0   0.0 -46.0   0.1   0.0   0.0 -26.2   0.4   3.0   0.1 -43.1   0.2
  0.0   0.0 -30.6   0.8   0.0   0.0 -57.0   0.1   1.7   1.5 -41.2   0.0   0.0   0.1 -45.7   1.6
  6.0   4.1 -31.5   5.6   1.1   0.0 -18.3   0.2   4.0   1.6 -34.5   0.4   6.4   1.7 -52.0   0.9
  0.0   0.0 -64.2   0.1   0.0   0.0 -70.1   0.0   0.0   0.0 -42.6   0.1   0.0   0.0 -79.6   0.1
```

Simulation totals and average values for deep percolation and CIR on irrigated lands and drylands.

1/ Title of this run of Soil-Water Program

2/ This is the first line of the computed output for each combination of weather station, land use, and soil group. The numerical values along this line represent the average annual values in inches for the entire simulation period (1935-78) of the following items: Precipitation, snow in storage, infiltration, surface runoff, maximum evapotranspiration, deep percolation on irrigated lands, consumptive-irrigation requirements (CIR), soil moisture on irrigated lands, deep percolation on drylands, water shortage on drylands, and soil moisture on drylands.

3/ Values in this line represent: soil group number (1), climate index or weather station (1), land use (1), 6-digit U.S. Weather Bureau station No. (258255), number of year in the simulation period (44), and 1 year less than the number of years in the simulation period (43).

4/ Seasonal values, in inches, for recharge (positive numbers) or CIR (negative numbers) by weather station, soil group, and land use for irrigated lands during non-pumping period (NPP), for drylands during NPP, for irrigated lands during irrigation pumping period (IPP), and for drylands during IPP.

ATTACHMENT I. Listing of PUMP Program

Part 1. Main Program

```
//TPMRPUMP JOB (            ,L830),'TPMRPUMP1',PRTY=6,CLASS=U,
//  MSGLEVEL=(1,1)
/*JOBPARM TAPES=0,TIME=(30,00),M=256,L=60,EFFTIME=(60,00)
/*CONTROL  ACCT,PSWD=
/*OUTPUT FORM FORMS=0801,UCS=PN3,FCB=8801
//ST1 EXEC FORTGCLG,REGION.GO=256K,TIME.GO=30
//FORT.SYSIN DD *
C     PROGRAM TO COMPUTE AND STORE CALIBRATION PUMPAGE FOR TWIN PLATTE-
C    MIDDLE REPUBLICAN GROUND WATER STUDY.
C    BY JON PECKENPAUGH, OCT. 1980.
C        INPUT FILES:   FT09F001 SOIL-LAND USE FILE.
C                       FT13F001 NUMBER OF WELLS/ELEMENT/YEAR
C                       FT14F001 SEASONAL RECHARGE AND CIR FOR
C                                1935-1978 PERIOD FROM SOIL-WATER BALANCE MODEL
C                       FT07F001 ACRE PER WELL FILE, VARIES BY 5 YR PER.
C                       FT04F001 MUNICIPAL PUMPAGE DATA
C                       FT05F001 TOTAL DIVERSION/YEAR IN ACRE FEET FOR
C                                EACH OF 9 CANALS, 1 YEAR/CARD
C                       FT10F001 LANDUSE FILE GENERATED FROM COUNTY AG STATISTICS
C                       FT12F001 SEEPAGE DATE FILE.
C                       FT11F001 AREA OF THE ELEMENT.
C       OUTPUT FILE:    FT08F001 FILE8, CONTAINS 1 RECORD PER SEASON
C                       PER NODE; NON-IRRIG.SEASON FIRST (9 MOS.) THEN
C                       IRRIG. SEASON (3MOS.)
      DIMENSION      CF(9),Q1(1182),Q2(1182),AR(1182),NW(1182)
      REAL*4 ACPW(12)/48.,40.,40.,40.,41.,40.,58.,40.,35.,40.,30.,76./
      REAL*4 ACCAN(9)/27025.,3080.,1270.,1173.,3555.,9548.,11710.,4977.
     * ,16862./
      DIMENSION TOTDV(9,50),       MFMT(10)
      DIMENSION QIRGS(7,19,5),QDYGS(7,19,5),QIROS(7,19,5),
     *           QDYOS(7,19,5),KFMT(14),LFMT(24)
      REAL*4 TM(12)/30.,31.,35.,40.,45.,50.,55.,60.,65.,70.,71.,75./
      DIMENSION SC8(44),SL2(44),SC13L7(44),SC15(44),SC16(44),SC18(44),
     * SC19(44),SC2021(44),SC22L3(44),SL1(44),SL4(44),SL5(44),SL6(44)
      DIMENSION P1(12,44),P2(12,44),P3(12,44),P4(12,44),P5(12,44),
     *P6(12,44),P7(12,44),P8(12,44),P9(12,44),P10(12,44)
      DATA KFMT/'(3I2','    ','    ','   2','X,  ','   2','X,  ',
     *'   2','X,  ','   2','X,  ','   2','X,4F','6.1)'/
      DATA MFMT/'  26','  50','  74','  98',' 122',' 146',
     *' 170',' 194',' 218',' 242'/
      INTEGER*4 C(9),WS,S(8)
      REAL*4          TQIGS(3),TQIOS(3),TQDGS(5),TQDOS(5)
      DATA CF/9*1.0/, FLOSS/.10/, FEFF/.60/
C ****DEFINITION  OF PROGRAM VARIABLES**********
C FLOSS = FARM IRRIGATION EFFICIENCY;
C FEFF = TOTAL FARM PUMPAGE LOST TO RUNOCC AND EVAPORATION;
C C(II)=ANNUAL CANAL DIVERSIONS FOR 9 DIFFERENT CANALS;
C  CF(II)=FRACTION OF POSSIBLE IRRIGATED BY YEAR;
C  ACPW( )=ACRES IRRIGATED PER WELL;
C  ACCAN(  )=SURFACE WATER IRRIGATED ACRES, WATER DIVERTED FROM CANALS;
```

```
C  TOTDIV( , )=SURFACE WATER APPLIED PER ACRE IN AC-FT/YR FOR EACH CANAL;
C  NY = YEAR;
C MFMT, KFMT,AND LFMT=VARIABLES USED IN READING FILE 14, RECHARGE AND CIR DATA;
C  AR(IEM) = AREA OF ELEMENT, IEM COUNTER FROM 1 TO 1182;
C P1(  ,  ) THROUGH P10(  ,  )=COUNTY AGRICULTURAL STATISTICS DATA BY COUNTY(12)
C    AND YEAR(44);
C  SC8, SL2, SC13L7, SC15, SC16, SC18, SC19, SC2021, SC22L3, SL1, SL4, SL5, SL6
C  SEEPAGE RATES FOR CANALS AND LAKES;
C  Q1(  ), QOS = NET RECHARGE OR DISCHARGE FOR THE NONIRRIGATION SEASON;
C  Q2(  ), QGS = NET RECHARGE OR DISCHARGE FOR THE IRRIGATION SEASON;
C  ITWEL = COUNTER FOR IRRIGATION WELLS;
C  NW(  ) AND NWX = NUMBER OF IRRIGATION WELLS PER ELEMENT;
C  IS = SOIL GROUP;
C  IW = WEATHER STATION;
C  IL=CROP TYPE (ROW CROP, SMALL GRAIN, ALFALFA, PASTURE AND RANGE, AND FALLOW);
C  QIROS(    )  = RECHARGE OR CIR FOR IRRIGATED LANDS FOR NONIRRIGATION SEASONS;
C  QDYOS(    ) = RECHARGE OR WATER-SHORTAGE FOR DRYLANDS FOR NONIRRIGATION
C  SEASONS;  QIRGS(    )  = RECHARGE OR CIR FOR IRRIGATED LANDS FOR IRRIGATION
C  SEASONS;  QDYGS(    )  = RECHARGE OR WATER-SHORTAGE FOR DRYLANDS FOR
C  IRRIGATION SEASONS;
C  KR AND KRR = COUNTERS FOR READING RECHARGE AND CIR FROM FILE 14;
C  S(   ) = SOILS    PERCENT OF EIGHT DIFFERENT SOIL GROUPS THAT OCCUR IN EACH
C  ELEMENT;
C  LU1, LU2, AND LU3 = LAND USE    PERCENT OF 3 DIFFERENT LAND USE CATORIES THAT
C  MAY OCCUR IN EACH ELEMENT;
C  ICN = CANAL INDEX FOR EACH ELEMENT THAT HAS IRRIGATION FROM SURFACE-WATER
C  ACRES;
C  ICAN = AMOUNT OF SURFACE-WATER IRRIGATED ACRES IN EACH ELEMENT;
C  IGRD = ELEVATION OF LAND SURFACE BY ELEMENT, NOT USED IN THIS STUDY;
C  CLEN = CANAL LENGTHS BY ELEMENT;
C  LL = LAKE OR RESERVOIR       FOR ELEMENTS WITH LAKE OR RESERVOIR;
C LAREA = AMOUNT OF LAKE OR RESERVOIR IN ACRES THAT IS IN ELEMENT;
C  ILF = G.W. IRRIGATION FACTOR (1 OR 2) IF 1, ACPW =120.0 AND IF 2, ACPW= 50.0;
C  SEEP = SEEPAGE AMOUNTS FROM CANALS BY ELEMENT;
C  SEEPL = SEEPAGE AMOUNTS FROM LAKES BY ELEMENT;
C  ACIR = GROUND WATER IRRIGATED ACRES;
C  WATER, PAST, FAL, SMGNR, SMGIR, RCIR, RCNR, ALFNR, AND ALFIR ARE ACRES OF
C  THESE DIFFERENT LAND USES.  WHERE WATER=WATER AREA, PAST= PASTURE & RANGE,
C  FAL=FALLOW, SMGNR=SMALL GRAIN NONIRRIGATED,  SMGIR=SMALL GRAIN IRRIGATED,
C  RCIR=ROW CROP IRRIGATED, RCNR=ROW CROP NONIRRIGATED,  ALFNR=ALFALFA NON
C  IRRIGATED, ALFIR=ALFALFA IRRIGATED, CULT=CULTEVATED LANDS;
C  ARR =(CULT - FAL);
C  MAXSZ = MAX. ALLOWABLE IRRIGATED ACRES UP TO 88% OF AREA OF ELEMENT;
C  DIFF AND DIFF2 : DIFF=MAXSZ - ARR, DIFF2=MAXSZ - ACIR;
C  TQIGS(  ), TQIOS(  ), TQDGS(  ), TQDOS(  )=TOTAL RECH AND/OR CIR BASED UPON
C  QIROS(    ) VALUES AND SOILS GROUPS (S(1) THROUGH S(8);
C  SQIGS1,SQIGS2,SQIGS3,SQIOS1,SQIOS2,SQIOS3,SQDGS1,SQDGS2,SQDGS3,SQDGS4,SQDGS5,
C  SQDOS1,SQDOS2,SQDOS3,SQDOS4,SQDOS5 ARE INTERMEDIATE RECH  AND DISCHARGE
C  VALUES THAT ARE USED IN CALCULATING TQIGS(1),..., TQDOS(5);
C  CIR = CONSUMPTIVE IRRIGATION REQUIREMENT;
C  QIRGSP,QIROSP,QDYGSP,QDYOSP = TOTAL RECHARGE OR CIR ON IRRIGATED LANDS AND
C  DRYLANDS DURING IRRIGATION SEASON AND NONIRRIGATION SEASON;
C  RIRGS,RIROS,RDYOS,RDYGS = RECHARGE AND CIR OR WATER SHORTAGE PER ACRE;
C  ACNI = DRYLAND ACRES;
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C  FD = SURFACE WATER APPLIED/ACRE FOR A GIVEN CANAL & YEAR;
C  QNT =(FD + CIR) IF(QNT.LT.0.), S.W. IS NOT ADEQUATE TO IRRIGATE CROPS. IF(QNT
C  .GE.0.), S.W. IS ADEQUATE TO IRRIGATE CROPS;  ARRC = ARR-CANAC;
C  TRECH = TOTAL RECHARGE FOR ALL ELEMENTS;  TDISC = TOTAL DISCHARGE FOR ALL
C  ELEMENTS;  PUMPM (    ) = PUMPAGE FOR THE CITY OF NORTH PLATTE AT SELECTED
C  ELEMENTS;  RECHPN = RECHARGE PER ELEMENT, REGARDLESS OF ELEMENT SIZE;
C  DISCPN = DISCHARGE PER IRRIGATION WELL.
C  ***********************************************************************
C *** READ TOTAL DIVERSIONS FOR EACH OF 9 CANALS BY YEAR AND FRACTION
C IRRIGATED (CF) BY YEAR**************

   66 READ(05,1005,END=996)JYR,(C(II),II=1,9),CF(6),CF(7),CF(8),CF(9)
 1005 FORMAT(I2,I8,I5,I6,I5,5I6,4F3.2)
      WRITE(06,1001)JYR,(C(II),II=1,9),CF(6),CF(7),CF(8),CF(9)
 1001 FORMAT(1H ,2X,I2,9I6,  4F3.2)
      NY=JYR-34
C   CALCULATE WATER APPLIED PER ACRE
      DO 102 J=1,9
      IF(CF(J).EQ.0.0) CF(J)=1.00
      TOTDV(J,NY)=C(J)/(ACCAN(J)*CF(J))
  102 CONTINUE
      GO TO 66
  996 CONTINUE
C READ AND STORE AREA OF ELEMENT
      DO 115 IEL=1,1182
      READ(11,1151)IEM,AR(IEM)
      IF(IEL.LE.40.OR.IEL.GT.1160) WRITE(06,119) IEL,IEM,AR(IEM)
  119 FORMAT(1H ,1X,2I5,F10.2)
 1151 FORMAT(I5,F10.2)
  115 CONTINUE
C READ AND STORE LANDUSE FILE
      DO 1112 N1=1,12
      DO 1112 N2=1,44
      READ(10,1111) P1(N1,N2),P2(N1,N2),P3(N1,N2),P4(N1,N2),P5(N1,N2),
     *P6(N1,N2),P7(N1,N2),P8(N1,N2),P9(N1,N2),P10(N1,N2)
 1111 FORMAT(7X,10F5.3)
      IF(N1.EQ.12.AND.N2.EQ.44) WRITE(06,118) P1(N1,N2),P2(N1,N2),
     * P3(N1,N2),P4(N1,N2),P5(N1,N2),P6(N1,N2),P7(N1,N2),P8(N1,N2),
     * P9(N1,N2),P10(N1,N2)
  118 FORMAT(1H ,1X,10F5.3,2X,'TPMRCROP')
 1112 CONTINUE
C READ AND STORE SEEPAGE FILE
      J=1
  332 READ(12,1107,END=331)
     *              SC8(J),SL2(J),SC13L7(J),SC15(J),SC16(J),SC18(J),
     *SC19(J),SC2021(J),SC22L3(J),SL1(J),SL4(J),SL5(J),SL6(J)
 1107 FORMAT(3X,F6.1,6F5.1,F6.1,F5.1,4F4.1)
      WRITE(06,1106) SC8(J),SL2(J),SC13L7(J),SC15(J),SC16(J),SC18(J),
     * SC19(J),SC2021(J),SC22L3(J),SL1(J),SL4(J),SL5(J),SL6(J)
 1106 FORMAT(1H ,1X,13F6.1)
      J=J+1
      GO TO 332
  331 CONTINUE
C   *************************************************************************
```

```
C   START LOOP ON YEARS 1935 THROUGH 1978
C          **********************************************************************
      DO 100 NY=1,44
      REWIND 9
      DO 1101 K3=1,1182
      Q1(K3)=0.
      Q2(K3)=0.
 1101 CONTINUE
C
C   READ WELL COUNT/ELEMENT
C
      ITWEL=0
      DO 111 J=1,1182
  111 NW(J)=0
      KS=1
      KE=25
      DO 11 II=1,47
   15 FORMAT(I2,I3,7I3)
      READ(13,14)IYR,ISEQ,(NW(KK),KK=KS,KE)
   14 FORMAT(I2,I3,25I3)
      KS=KS+25
      KE=KE+25
   11 CONTINUE
      READ(13,15) IYR,ISEQ,(NW(KK),KK=1176,1182)
C     WRITE(06,82) (NW(KJ),KJ=1,1182)
C  82 FORMAT(1H ,1X,40I3)
C     ******************  START LOOP ON YEARS 1935 THRU 1978  *****
C
C     DO 100 NY=1,44
C     REWIND 9
C     DO 1101 K3=1,1182
C     Q1(K3)=0.
C     Q2(K3)=0.
C1101 CONTINUE
C    ***************************************************************
C    READ RECHARGE AND CIR FROM FILE 14 **************************************
      IF(NY.EQ.1) GO TO 22
      KR=MOD(NY,10)
      IF(KR.LT.2) GO TO 23
      GO TO 24
   23 IF(KR.EQ.0)KRR=9
      IF(KR.EQ.1)KRR=10
      GO TO 25
   24 KRR=KR-1
   25 IF(NY.GT.11) GO TO 50
      KFMT(4)=MFMT(KRR)
      GO TO 22
   50 IF(NY.GT.21) GO TO 51
      KFMT(6)=MFMT(KRR)
      GO TO 22
   51 IF(NY.GT.31) GO TO 52
      KFMT(8)=MFMT(KRR)
      GO TO 22
   52 IF(NY.GT.41) GO TO 53
```

```
      KFMT(10)=MFMT(KRR)
      GO TO 22
   53 IF(NY.GT.51) GO TO 100
      KFMT(12)=MFMT(KRR)
   22 REWIND 14
   20 READ(14,KFMT,END=998) IS,IW,IL,QIROS(IS,IW,IL),QDYOS(IS,IW,IL),
     *                      QIRGS(IS,IW,IL),QDYGS(IS,IW,IL)
C     WRITE(06,9112) IS,IW,IL,QIROS(IS,IW,IL),QDYOS(IS,IW,IL),
C    *  QIRGS(IS,IW,IL),QDYGS(IS,IW,IL)
C     IF(NY.LT.25) GO TO 100
C9112 FORMAT(1H ,1X,3I2,4F6.1)
      QIRGS(IS,IW,IL)=QIRGS(IS,IW,IL)/12.
      QIROS(IS,IW,IL)=(QIROS(IS,IW,IL)/12.)
      QDYGS(IS,IW,IL)=(QDYGS(IS,IW,IL)/12.)
      QDYOS(IS,IW,IL)=(QDYOS(IS,IW,IL)/12.)
      GO TO 20
  998 CONTINUE
C    *****************************************************************
C   READ SOIL AND LANDUSE DATA FOR EACH ELEMENT.  THIS FILE IS READ YEAR (NY).
C*****************************************************************
  301 READ(09,1022,END=30) I,S(1),S(2),S(3),S(4),S(5),S(6),S(7),S(8),
     * WS,ICT,LU1,LU2.LU3,ICN,ICAN,IGRND,CLEN,LL,LAREA,ILF
      CANAC=ICAN
      GRND=IGRND
      JW=WS
      IF(LL.GE.9) LL=9
C     CALCULATE SEEPAGE VALUES FOR CANALS AND LAKES. *************
C    *****************************************************************
      SEEP=0.0
      SEEPL=0.0
      IF(ICN.EQ.9) SEEP=CLEN * 1000.
      IF(ICN.EQ.8)SEEP=CLEN*SC8(NY)
      IF (ICN.EQ.13)SEEP=(CLEN*5280)*((SC13L7(NY)*110)/ 43560)
      IF (ICN.EQ.15)SEEP=CLEN*SC15(NY)
      IF(ICN.EQ.16)SEEP=CLEN*SC16(NY)
      IF(ICN.EQ.18)SEEP=CLEN*SC18(NY)
      IF(ICN.EQ.19)SEEP=CLEN*SC19(NY)
      IF(ICN.EQ.20)SEEP=CLEN*SC2021(NY)
      IF(ICN.EQ.21)SEEP=CLEN*SC2021(NY)
      IF(ICN.EQ.22)SEEP=(CLEN*5280)*((SC22L3(NY)*110) / 43560)
      IF(LL.EQ.1)SEEPL=LAREA*SL1(NY)
      IF(LL.EQ.4)SEEPL=LAREA*SL4(NY)
      IF(LL.EQ.5)SEEPL=LAREA*SL5(NY)
      IF(LL.EQ.6)SEEPL=LAREA*SL6(NY)
      IF(LL.EQ.2)SEEPL=LAREA*SL2(NY)
      IF(LL.EQ.7)SEEPL=LAREA*SC13L7(NY)
      IF(LL.EQ.3)SEEPL=LAREA*SC13L7(NY)
      IF(LL.EQ.9)SEEPL=LAREA*SC22L3(NY)
C      ***********************************************************
 1022 FORMAT(I4,8I3,2I2,3I3,I2.2I4,F5.2,I2,I4,I1)
      QGS=0.
      QOS=0.
C  COMPUTE NUMBER OF WELLS FOR THIS YEAR
C
```

```
      NWX=NW(I)
      ITWEL=ITWEL+NWX
      IF(JW.GT.19.OR.ICT.GT.12)  GO TO 311
      IF(JW.LT.01.OR.ICT.LT.01)  GO TO 311
      GO TO 312
  311 WRITE(06,3110) I,JW,ICT
 3110 FORMAT(1H ,5X,'**** ERROR FOR ELEMENT',I5,'  JW = ',I5,'  ICT=',
     * I5,'NO Q COMPUTED')
      GO TO 301
C  COMPUTE LANDUSES IN EACH ELEMENT.  LU1=CROPLAND,LU2=GRASSLAND
C  (PASTURE AND RANGE), LU3=WATER AREAS FOR EACH ELEMENT.  USE COUNTY
C   LANDUSES (P1(ICT,NY)--P10(ICT,NY)) AND ACIR TO CALCULATE LANDUSES.
  312 IF(NY.LT.36) GO TO 322
      IF(ILF.EQ.1) ACIR=NWX*120.0
      IF(ILF.EQ.2) ACIR=NWX*50.0
      GO TO 323
  322 ACIR=NWX*ACPW(ICT)
  323 WATER=0.0
      PAST=0.0
      FAL=0.0
      SMGNR=0.0
      SMGIR=0.0
      RCIR=0.0
      RCNR=0.0
      ALFNR=0.0
      ALFIR=0.0
      WATER=(LU3*.01)*AR(I)
      PAST=(LU2*.01)*AR(I)
      CULT=(LU1*.01)*AR(I)
      FAL=CULT*P8(ICT,NY)
      ARR=CULT-FAL
      DIFF=0.0
      DIFF2=0.0
      IF(NWX.LE.0.0)  GO TO 315
      MAXSZ=.88* (AR(I)-WATER)
      DIFF=MAXSZ-ARR
      IF(DIFF.GT.0.0)  MAXSZ=ARR
      DIFF2=MAXSZ-ACIR
      IF(DIFF2.LE.0.0) ACIR=MAXSZ
       RCIR=ACIR*P5(ICT,NY)
      ALFIR=ACIR*P7(ICT,NY)
      SMGIR=ACIR-RCIR-ALFIR
      GO TO 316
  315 ACIR=0.0
  316 ACDY=ARR-ACIR
      RCNR=ACDY*P2(ICT,NY)
      ALFNR=ACDY*P4(ICT,NY)
      SMGNR=ACDY-RCNR-ALFNR
C  COMPUTE RECHARGE AND CIR BASED UPON 8 POSSIBLE SOILS IN EACH ELEMENT.
C   8TH SOIL IS WATER.ITS RECH AND CIR IS 0.0,THUS IT IS NOT CALCULATED.
C  **************************************************************
      DO 709 JL=1,3
      TQIGS(JL)=0.0
  709 TQIDS(JL)=0.0
```

```
      DO 711 JM=1,5
      TQDGS(JM)=0.0
  711 TQDOS(JM)=0.0
      DO 7001 IS=1,7
      SQIGS1=QIRGS(IS,JW,1) * (S(IS)*.01)
      TQIGS(1)=TQIGS(1) + SQIGS1
      SQIGS2=QIRGS(IS,JW,2) * (S(IS)*.01)
      TQIGS(2)=TQIGS(2) + SQIGS2
      SQIGS3=QIRGS(IS,JW,3) * (S(IS)*.01)
      TQIGS(3)=TQIGS(3) + SQIGS3
      SQIOS1=QIROS(IS,JW,1) * (S(IS)*.01)
      TQIOS(1)=TQIOS(1) + SQIOS1
      SQIOS2=QIROS(IS,JW,2) * (S(IS)*.01)
      TQIOS(2)=TQIOS(2) + SQIOS2
      SQIOS3=QIROS(IS,JW,3) * (S(IS)*.01)
      TQIOS(3)=TQIOS(3) + SQIOS3
      SQDGS1=QDYGS(IS,JW,1) * (S(IS)*.01)
      TQDGS(1)= TQDGS(1) + SQDGS1
      SQDGS2=QDYGS(IS,JW,2) * (S(IS)*.01)
      TQDGS(2)= TQDGS(2) + SQDGS2
      SQDGS3=QDYGS(IS,JW,3) * (S(IS)*.01)
      TQDGS(3)= TQDGS(3) + SQDGS3
      SQDGS4=QDYGS(IS,JW,4) * (S(IS)*.01)
      TQDGS(4)= TQDGS(4) + SQDGS4
      SQDGS5=QDYGS(IS,JW,5) * (S(IS)*.01)
      TQDGS(5) = TQDGS(5) + SQDGS5
      SQDOS1=QDYOS(IS,JW,1) * (S(IS)*.01)
      TQDOS(1)= TQDOS(1) + SQDOS1
      SQDOS2=QDYOS(IS,JW,2) * (S(IS)*.01)
      TQDOS(2)= TQDOS(2) + SQDOS2
      SQDOS3=QDYOS(IS,JW,3) * (S(IS)*.01)
      TQDOS(3)= TQDOS(3)  + SQDOS3
      SQDOS4=QDYOS(IS,JW,4) * (S(IS)*.01)
      TQDOS(4)= TQDOS(4) + SQDOS4
      SQDOS5=QDYOS(IS,JW,5) * (S(IS)*.01)
 7001 TQDOS(5)= TQDOS(5) + SQDOS5
      IF(ALFIR.NE.0.0.OR.RCIR.NE.0.0.OR.SMGIR.NE.0.0) GO TO 318
      CIR=0.0
      GO TO 319
  318 CIR=((TQIGS(1) * RCIR + TQIGS(3) * SMGIR + TQIGS(2) *
     *ALFIR)/(RCIR+SMGIR+ALFIR))*.25
  319 RIRGS=0.0
      RIROS=0.0
      RDYGS=0.0
      RDYOS=0.0
      QIRGSP=TQIGS(1) * RCIR + TQIGS(2) * ALFIR + TQIGS(3) * SMGIR
      QIROSP=TQIOS(1) * RCIR + TQIOS(2) * ALFIR + TQIOS(3) * SMGIR
      QDYGSP=TQDGS(1) * RCNR + TQDGS(2) * ALFNR + TQDGS(3) * SMGNR +
     1 TQDGS(4) * PAST + TQDGS(5) * FAL
      QDYOSP=TQDOS(1) * RCNR + TQDOS(2) *ALFNR + TQDOS(3) * SMGNR +
     1 TQDOS(4) * PAST + TQDOS(5) * FAL
      IF(ACIR.LE.0.0) GO TO 71
      RIRGS=QIRGSP/ACIR
      RIROS=QIROSP/ACIR
```

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   71 ACNI=AR(I)-ACIR-WATER
      IF(ACNI.LE.0.0) GO TO 72
      RDYGS=QDYGSP/ACNI
      RDYOS= QDYOSP / ACNI
   72 CONTINUE
C      FOR ELEMENTS WITH NO SW AC.,CALC. GW RECH AND/OR DISCH.
      IF(ICN.EQ.0.OR.CANAC.EQ.0.) GO TO 42
      FD=TOTDV(ICN,NY)
      IF(CIR.LT.0.0) GO TO 77
C FOR ELEMENTS WITH CANALS BUT NO GW IRIG. AC  (ACIR).  ALSO DETERMINE
C SEEPAGE LOSSES AND RECHARGE. FOR CANALS W/O SEEP TERM SEEPAGE IS .5*SW
      ACIR=0.0
      MAXSZ=.88*(AR(I)-WATER)
      DIFF=MAXSZ-ARR
      IF(DIFF.GT.0.0) MAXSZ=ARR
      DIFF2=MAXSZ-CANAC
      IF(DIFF2.LE.0.0) CANAC=MAXSZ
      ACNI=AR(I)-CANAC
      IF (SEEP.GT.0.0) GO TO 83
C  NOT BUREAU OR RECLAMATION CANALS, CALCULATE SEEPAGE FROM CANALS.
      QGS=.00138*(.5*FD*CANAC+ACNI*RDYGS+SEEPL)
      QOS=.00138*((CANAC+ACNI)*RDYOS+SEEPL)
      GO TO 62
C    BUREAU OF RECLAMATION CANALS, SEEPAGE ALREADY COMPUTED.
   83 QGS=.00138*(SEEP+SEEPL+ACNI *RDYGS)
      QOS=.00138*(SEEP+SEEPL+ACNI*RDYOS)
      GO TO 62
C  *******  ELEMENTS WITH CANALS AND POTENTIAL SUPPLEMENTAL GW IRRIGATION  *****
   77 MAXSZ=.88*(AR(I)-WATER)
      DIFF=MAXSZ-ARR
      IF (DIFF.GT.0.0) MAXSZ=ARR
      DIFF2=MAXSZ-CANAC
      IF(DIFF2.LE.0.0) CANAC=MAXSZ
      QNT=FD+CIR
      ARRC=ARR-CANAC
      DIFF=ARRC-ACIR
      IF(DIFF.LE.0.0) ACIR=ARRC
      IF(QNT.LT.0.) GO TO 43
C SW IS ADEQUATE, ALL GW IS USED TO IRRIG. ADDITIONAL AREAS
C   CNPGW=CANAL AND GW IRRIGATION.
      IF(ACIR.GT.0.0) GO TO 39
      ACIR=0.0
   39 CNPGW=ACIR+CANAC
   38 ACNI=AR(I)-WATER-CNPGW
      IF (SEEP.GT.0.0) GO TO 84
      QGS=.00138*(ACIR *RIRGS+ACNI*RDYGS+CANAC*QNT+SEEPL)
      GO TO 85
   84 QGS=.00138*(ACIR*RIRGS+ACNI*RDYGS+SEEP+SEEPL)
   85 QOS=.00138*(CNPGW*RIROS+ACNI*RDYOS+SEEP+SEEPL)
      GO TO 62
C     SW IS NOT ADEQUATE TO IRRIG. CANAC. SUPPLEMENTAL IRRIG. IS NEEDED.
   43 CONTINUE
C   SUPPLEMENTAL GW IS USED: ACSHSW=SW SHORTAGE;ACSSW1=SW SHORTAGE AREA
C      AFTER GW SUPPLEMENT HAS BEEN ADDED.
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C ALLOW 50% OF GW IRRIGATION TO SUPPLEMENT SW LANDS.
      ACSHSW=(CANAC*QNT)/CIR
      ACSSW1=ACSHSW-(ACIR*.5)
      IF(ACSSW1.LE.0.0) ACSSW1=0.0
      CANAC=CANAC- ACSSW1
      IF(CANAC.LT.0.0) CANAC=0.0
      ACNI=AR(I)  -CANAC-(ACIR*.5)
      QGS=.00138*(ACIR*RIRGS +ACNI*RDYGS +                        SEEP+
     * SEEPL)
      QOS=.00138*( CANAC      *RIROS +ACNI*RDYOS +(ACIR*.5)      *RIROS
     *+SEEPL)
C     WRITE(06,3336) CANAC,ACIR,ACNI,ACSHSW,ACSSW1,QGS,QOS
C3336 FORMAT(1H ,5X,5F7.2,2E12.3,10X,'3')
      GO TO 62
C***ONLY GW IRRIG. COMPUTE QGS AND QOS USING FEFF AND FLOSS.
   42 QGS= .00138*(QIRGSP+QDYGSP+(QIRGSP/FEFF)   * FLOSS    +SEEP+SEEPL)
      QOS= .00138*(QIROSP+QDYOSP+SEEP+SEEPL)
   62 CONTINUE
 9333 FORMAT(9F7.3,17X)
C  ***********    MUNICIPAL PUMPAGE FOR CITY OF NORTH PLATTE,NE.   *************
      IF(IEL.EQ.754) QOS=QOS+PUMPM(1)
      IF(IEL.EQ.754) QGS=QGS+PUMPM(10)
      IF(IEL.EQ.760) QOS=QOS+PUMPM(02)
      IF(IEL.EQ.760) QGS=QGS+PUMPM(11)
      IF(IEL.EQ.764) QOS=QOS+PUMPM(03)
      IF(IEL.EQ.764) QGS=QGS+PUMPM(12)
      IF(IEL.EQ.771) QOS=QOS+PUMPM(04)
      IF(IEL.EQ.771) QGS=QGS+PUMPM(13)
      IF(IEL.EQ.785) QOS=QOS+PUMPM(05)
      IF(IEL.EQ.785) QGS=QGS+PUMPM(14)
      IF(IEL.EQ.791) QOS=QOS+PUMPM(06)
      IF(IEL.EQ.791) QGS=QGS+PUMPM(15)
      IF(IEL.EQ.797) QOS=QOS+PUMPM(07)
      IF(IEL.EQ.797) QGS=QGS+PUMPM(16)
      IF(IEL.EQ.799) QOS=QOS+PUMPM(08)
      IF(IEL.EQ.799) QGS=QGS+PUMPM(17)
      IF(IEL.EQ.805) QOS=QOS+PUMPM(09)
      IF(IEL.EQ.805) QGS=QGS+PUMPM(18)
      Q1(I)=QOS
      Q2(I)=QGS
      TRECH=TRECH + QOS
      TDISC=TDISC + QGS
      GO TO 301
C       ************************************************************************
C     ***************       END OF ELEMENT LOOP       *************************
C         **********************************************************************
   30 CONTINUE
      IF(NY.EQ.1.OR.NY.EQ.6.OR.NY.EQ.11) READ(15,9333)
     1 (PUMPM(IEE),IEE=1,18)
      IF(NY.EQ.16.OR.NY.EQ.21.OR.NY.EQ.26) READ(15,9333)
     1 (PUMPM(IEE),IEE=1,18)
      IF(NY.EQ.31.OR.NY.EQ.36.OR.NY.EQ.41) READ(15,9333)
     1 (PUMPM(IEE),IEE=1,18)
C
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```
C   WRITE NET PUMPAGE OR RECHARGE TO FILE 8;
C     ORDER OF RECORDS FOR EACH YEAR IS AS FOLLOWS:
C       FIRST NON-GROWING SEASON RECHARGE
C     SECOND - GROWING SEASON CONSUMPTINVE IRRIGATION RQMT OR RECHARGE
      KELEM=1182
      DO 261 K1=1,1182
  261 WRITE(8,2222) Q1(K1)
      NYY=NY+1934
      WRITE(06,7022) NYY,KELEM,(Q1(KT),KT=1,KELEM)
 7022 FORMAT(1H0,5X,'NON IRRIGATION SEASON PUMPAGE FOR YEAR',I5,
     *'NO ELEM  = ',I4/(1X,24(F5.2)))
      DO 262 K2=1,1182
  262 WRITE(8,2222) Q2(K2)
      WRITE(06,7023) NYY,KELEM,(Q2(KT),KT=1,KELEM)
 7023 FORMAT(1H0,5X,'IRRIGATION SEASON PUMPAGE FOR YEAR',I5,
     *'NO ELEM  = ',I4/(1X,24(F5.2)))
C
C   PRINT OUT TOTAL NUMBER OF WELLS FOR THIS YEAR AS A CHECK
C
      RECHPN=TRECH/1182.
      DISCPN=TDISC/ITWEL
      WRITE(06,2000) NY,ITWEL,TRECH,TDISC,RECHPN,DISCPN
 2000 FORMAT(1H ,5X,'YEAR =',I5,1X,'NO. OF WELLS =',I7//1X,'TRECH=',
     1 E20.3,1X,'TDISC=',E20.3,1X,'RECHPN=',E14.3,1X,'DISCPN=',E14.3)
C **********   READ NEW VALUES OF ACRES IRRIGATED PER WELL BY COUNTY  ********
      IF(NY.EQ.06.OR.NY.EQ.11.OR.NY.EQ.16) READ(16,3127)
     *(ACPW(ICO),ICO=1,12)
      IF(NY.EQ.21.OR.NY.EQ.26.OR.NY.EQ.31) READ(16,3127)
     *(ACPW(ICO),ICO=1,12)
      IF(NY.EQ.36.OR.NY.EQ.41) READ(16,3127)
     *(ACPW(ICO),ICO=1,12)
 2222 FORMAT(F7.3)
 3127 FORMAT(4X,12F5.1)
  100 CONTINUE
C
C     END OF TIME LOOP
C
C
      END FILE 8
      STOP
C********
      DEBUG SUBCHK
C
      END
/*
```

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

```
//DUM DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,DELETE),
//   DSN=A.    .AA      .TPMR.PUMP
//GO.FT10F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//     DSN=A.    .AA      .TPMR.CROP
//GO.FT11F001 DD UNIT=3330,VOL=SER=SYS345,DISP=SHR,
//   DSN=A.    .AA      .GOEKE.AREAS
//GO.FT12F001 DD UNIT=3330,VOL=SER=SYS345,DISP=SHR,
//   DSN=A.    .AA      .TPMR.SEEP
//GO.FT06F001 DD SYSOUT=(C,,FORM),DCB=RECFM=FA
//GO.FT09F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//   DSN=A.    .AA      .TPMR.WUD1
//GO.FT08F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(NEW,KEEP),
//     DCB=(RECFM=FB,LRECL=7,BLKSIZE=1001),SPACE=(TRK,(60,1),RLSE),
//  DSN=A.    .AA      .TPMR.PUMP
//GO.FT13F001 DD UNIT=3330,VOL=SER=SYS301,DISP=(OLD,KEEP),
// DSN=A.    .AA      .LOCDATA
//GO.FT14F001 DD UNIT=3350,VOL=SER=SYS501,DISP=(OLD,KEEP),
// DCB=(RECFM=FB,LRECL=1072,BLKSIZE=1072),DSN=A.    .AA      .TPSOIL
//GO.FT15F001 DD DDNAME=NPMUNP
//GO.SYSIN DD *
```

JCL for input and output files.

File 5. (GO.SYSIN) Canal diversions and factors from 1935 through 1978

```
Year    Canal diversions for nine canals in acre-feet       Factors1/

 35   88680 4160   6261  532 33412 20097   2/                .98  2/
 36   84290 7400   3033  384 18252 19832                     .98
 37  113110 5550  14275  575 36178 20421                     .98
 38   70720 4550   9938  652 49380 18547                     .98
 39  102680 7380   8660  521 59457 21257                     .98
 40   92260 9820  13072 2848 52684 22623                     .98
 {                                  }                         {
 74  124130 6820  10700 2650 44150 11102 12010  8146 26930.93.98.96.99
 75  121010 8760  10510 2540 38730 12220 12125  6721 23585.95.95.96.99
 76  122180 9000  11810 2050 37420 11024 11394  8337 32089.94.97.96.99
 77  100530 5800   9160 2340 35740  9454 10746  4631 19378.95.97.96.99
 78  123060 7860   9830 1720 43710  8070  8887  6863 22512.88.92.93.96
```

1/ These represent the fraction of canal acreage irrigated with surface water for four Bureau of Reclamation canals.

2/ Canals were not operating at this time.

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input data

File 11. Area of Elements

| Element | Area(acres) |
|---|---|
| 1 | 928.88 |
| 2 | 672.53 |
| 3 | 5625.06 |
| ⋮ | ⋮ |
| 1181 | 720.04 |
| 1182 | 643.48 |

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

File 10. Agricultural statistics for harvested dryland and irrigated crops

| County number | Year | Land use for drylands and irrigated lands[1/] (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 35 | .558 | .428 | .507 | .063 | .941 | .000 | .058 | .202 | .106 | .893 |
| 01 | 36 | .558 | .444 | .469 | .085 | .938 | .000 | .061 | .231 | .130 | .869 |
| 01 | 37 | .558 | .612 | .285 | .102 | .944 | .000 | .055 | .267 | .160 | .839 |
| 01 | 38 | .558 | .438 | .515 | .045 | .942 | .000 | .057 | .215 | .117 | .882 |
| ⋮ | | | | | ⋮ | | | | | | ⋮ |
| 12 | 75 | .431 | .117 | .081 | .801 | .857 | .011 | .131 | .020 | .656 | .343 |
| 12 | 76 | .431 | .087 | .103 | .808 | .855 | .001 | .143 | .015 | .657 | .342 |
| 12 | 77 | .431 | .090 | .062 | .847 | .920 | .005 | .073 | .010 | .679 | .320 |
| 12 | 78 | .431 | .020 | .066 | .913 | .910 | .007 | .081 | .010 | .724 | .275 |

1/ Land use values (dimensionless) by column are as follows: land area not cultivated (1); dryland row crop (2); dryland small grain (3); dryland alfalfa and tame hay (4); irrigated row crops (5); irrigated small grain (6); irrigated alfalfa (7); cultivated land in fallow (8); irrigated cropland (9); and dryland cropland (10). Column 1, whicn is pasture and range, subtracted from 1.0 yields the fraction of cultivated land by county. Columns 2, 3, 4, and 8 should total 1.0; these values represent the cultivated drylands. Columns 5, 6, and 7 should total 1.0; these values represent the cultivated irrigated lands. Columns 9 and 10 should also total 1.0; they represent the fraction of cultivated lands either irrigated or not irrigated.

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

File 12. Seepage from canals and lakes

```
                   Seepage for nine canals                  Seepage for four
Year                 (acre-feet/mile)                       lakes (feet/acre)

 35     0.0   0.0 1/  368.0   1/               98.9      5.3 1/
 36   176.2   6.7     356.0                   181.9      4.6
 37   253.5   8.3     370.0                   122.6     16.6
 38    44.4   1.1     337.0                   670.3     23.6
 39   733.6   8.4     385.0                   619.7     29.9

 76  1022.4  10.1 93.5225.0418.0116.3285.2 846.1100.618.9 1.6 9.6 3.8
 77  1413.3   8.9 96.7247.0429.0 93.9253.3 884.7120.622.7 2.9 7.0 7.7
 78  1453.2   9.3 95.3281.0424.0 78.9250.7 910.8120.425.9 0.5 8.0 1.0
```

1/ Canals and lakes were not operating at this time.

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

File 13. Wells per element by year from 1935 through 1978

| Year | ISEQ1/ | Wells by element | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 1 | 2/ 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | 46 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 35 | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 35 | 48 | 0 | 0 | 0 | 1 | 0 | 0 | 3/ 0 | | | | | | | | | | | | | | | | | | |
| 36 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 36 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 45 | 1 | 0 | 0 | 25 | 10 | 20 | 0 | 7 | 9 | 0 | 2 | 1 | 4 | 0 | 15 | 2 | 1 | 6 | 1 | 6 | 8 | 11 | 6 | 8 | 10 |
| 78 | 46 | 3 | 4 | 8 | 0 | 4 | 22 | 1 | 0 | 4 | 13 | 25 | 2 | 1 | 24 | 17 | 36 | 2 | 0 | 6 | 13 | 0 | 0 | 8 | 3 | 1 |
| 78 | 47 | 1 | 0 | 1 | 8 | 6 | 12 | 6 | 1 | 13 | 10 | 8 | 2 | 4 | 1 | 3 | 4 | 3 | 17 | 16 | 2 | 1 | 8 | 10 | 24 | 7 |
| 78 | 48 | 13 | 10 | 21 | 23 | 7 | 0 | 0 | | | | | | | | | | | | | | | | | | |

1/ ISEQ is a counter for the number of rows of elements. Each row can have a maximum of 25 elements.

2/ This is element number 1. Values are wells in each element.

3/ This is element number 1182. If maximum years have not been reached, the next element is number 1, with ISEQ equal to 1.

File 14. Seasonal recharge and CIR (File 13 of Appendix 8, Part B and output listed in Appendix 8, Part C under footnote 4).

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

File 9. Soils and land use

```
Ele-
ment
No.   1  2  3  4  5  6  7  8 910 11 12 1314 15 16  17 18 1920
-----------------------------------------------------------------
   1100  0  0  0  0  0  0  0 1 8100  0  0 0  0              1
   2  0 50 20  0  0 20 10  0 1 8    100                     2
   3  0 55 20  5  0  0 20  0 1 8 20 80                      2
   4  5 75 20  0  0  0  0  0 1 8 20 80                      1
   5 10 50 10 20  0  0 10  0 1 8 35 65                      2

1135 50 30  0  0  0  0  0 201912 50 30 2022       3.5212 3911
1136 90 10  0  0  0  0  0  01912 75 25   22        .22      1

1143  5 30 65  0  0  0  0  01811 80 20   19 208   1.21      1
1144       65         35  0  01811 80 20   191003    .80      2

1174 10 10 30 50  0  0  0  01912 90 10   12       7.49      1
1175 50 30  0  0  0  0  0 201912 70 30   10       3.1114 2231
1176  0 30 10 60  0  0  0  01912 60 40   10        .98      1
1177 75 20  0  0  0  0  0  51912 85 15   22       1.3514  461

1181100     0  0  0  0  0  01912 60 40                      1
1182 75 20  0  0  0  0  0  01912 50 50                      1
```

1/ Column variables are the following: 1 through 7 are fractions of soil groups (values must be multiplied by 0.01); 8 is the fraction of water (value must be multiplied by 0.01); 9 is the weather station number; 10 is the county number; 11 through 13 are land uses (11 is cropland, 12 is pasture and range, and 13 is water area); 14 is canal index; 15 is surface-water irrigated acres; 16 is land surface elevation; 17 is canal lengths; 18 is lake index; 19 is lake area; and 20 is ground-water factor (1 is upland and 2 is flood plain or terrace).

ATTACHMENT I. Listing of PUMP Program--Continued
Part 2. Input Data

File 15. North Platte municipal pumpage by elements and time periods

```
//GO.NPMUNP DD *
1/0.0    0.0    0.0    0.0    0.0    -0.576 -1.730  0.0    0.0
  0.0    0.0    0.0    0.0    0.0    -0.977 -2.931  0.0    0.0
  0.0    0.0    0.0    0.0    0.0    -0.621 -1.864  0.0    0.0

  0.445 -0.891  0.0   -0.445 -0.891 -0.891 -1.226 -0.445 -0.445
 -1.112 -2.225  0.0   -1.112 -2.225 -2.225 -3.337 -1.112 -1.112
 -0.388 -0.776 -0.388 -0.388 -1.164 -1.164 -1.664 -0.388 -0.388
 -1.156 -2.311 -1.156 -1.156 -3.467 -3.467 -3.467 -1.156 -1.156
```

1/ Each line represent a different time period and each column represents an element. Negative values represent pumpage.

File 16. Acres irrigated per well by county for 5-year periods

```
//GO.FT16F001 DD *
1/40   42.2 33.3 37.4 62.3 66.0 40.0 50.0 33.7 47.6 55.3 68.7 82.9
  45   15.0 38.6 30.0 30.5 25.0 36.7 45.3 35.0 20.6 27.0 43.9 37.4
  50   14.5 21.0 20.4 47.1 60.5 53.1 58.9 32.6 20.4 22.7 49.3 44.6
  55   46.5 84.1 28.6 71.9 54.6 80.9 62.3 71.7 34.5 35.9 43.6 52.3
  60   37.0 87.4 21.3 69.9 32.5 92.9 59.6 67.5 59.1 60.7 43.1 40.8
  65   36.1 93.3 22.4 92.0 44.6 86.1 58.0 92.6 37.8 87.2 41.6 31.8
  70   48.4124.9 41.0100.7 60.7102.7 75.8103.4 50.3 88.4 55.2 39.6
  75   57.0129.0 51.8 99.6 66.7 98.1 80.1 88.3 55.5 76.3 59.7 47.8
```

1/ Each line represents a different time priod from 1940 to 1975. The first column is years, with 40 representing 1940 and 75 representing 1975. Each additional column represents a different county (1 through 12).

Part 3. Output

Canal diversions and factors from 1935 through 1978

| Year | Canal diversions for 9 canals, in acre-feet | | | | | | | | | Factors 1/ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 88680 | 4160 | 6261 | 532 | 33412 | 20097 | 0 | 0 | 0 | 0.98 | .0 | .0 | .0 |
| 36 | 84290 | 7400 | 3033 | 384 | 18252 | 19821 | 0 | 0 | 0 | 0.98 | .0 | .0 | .0 |
| 37 | 113110 | 5550 | 14275 | 575 | 36178 | 20421 | 0 | 0 | 0 | 0.98 | .0 | .0 | .0 |
| 38 | 70720 | 4550 | 9938 | 652 | 49380 | 18547 | 0 | 0 | 0 | 0.98 | .0 | .0 | .0 |

1/ Fraction of canal acreage irrigated with surface water for four Bureau of Reclamation canals.

Element Data 1/

| Element number | | Element area (acres) |
|---|---|---|
| 1 | 1 | 982.88 |
| 2 | 2 | 672.93 |
| 3 | 3 | 5625.06 |

1/ Data continued through the last element, 1182.

Annual county land use values 1/

```
 1     2     3     4     5     6     7     8     9     10
0.4320.0200.0660.9130.9100.0070.0810.0200.7240.275  TPMRCROP
```

1/ This is a datacheck. Values printed are for county #12 and for 1978. Columns 1 through 10 are the fraction of land not cultivated, dryland row crop, dryland small grain, dryland alfalfa and tame hay, irrigated row crop, irrigated small grain, irrigated alfalfa, cultivated land under fallow, cropland under irrigation, and cropland not under irrigation, respectively.

ATTACHMENT I. Listing of PUMP Program--Continued
Part 3. Output

```
Seepage values for nine canals and four reservoirs for each year from 1935 through 1978
                                                               Seepage for four lakes
          Seepage for nine canals (acre-feet/mile)                (feet per acre)
  0.0     0.0    0.0 368.0    0.0    0.0    0.0  98.9    0.0    5.3    0.0    0.0    0.0
176.2     6.7    0.0 356.0    0.0    0.0    0.0 181.9    0.0    4.6    0.0    0.0    0.0
253.5     8.3    0.0 370.0    0.0    0.0    0.0 122.6    0.0   16.6    0.0    0.0    0.0


Recharge or discharge values for each element during non-irrigation season and irrigation season

   NON IRRIGATION SEASON PUMPING FOR YEAR 1935 NO.ELEM = 1182

1/0.33 0.35 3.02 1.60 2.20 1.00 0.15 1.47 0.83 1.47 0.35 1.55 1.50 1.90 2.70 2.64 2.59 0.43 2.16 0.42 2.94 1.92 0.89 1.83
  2.17 0.89 2.55 2.59 2.58 2.84 1.08 0.55 6.86 4.27 1.76 4.27 0.74 2.39 2.41 0.63 6.15 2.41 3.07 1.20 4.70 1.75 2.84 0.99

   IRRIGATION SEASON PUMPAGE FOR YEAR 1935 NO. ELEM  = 1182

  0.0  0.0  0.02 0.01 0.03 0.01 0.00 0.02 0.00 0.01 0.00 0.00 0.01 0.01 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0 -1.03 0.0
  0.0  0.0  0.0  0.0  0.0  0.00 0.00 0.0  0.05 0.02 0.0  0.02 0.0  0.0  0.0  0.0  0.04 0.0  0.01 0.11 0.49 0.30-1.81 0.01
```

1/ Positive values are recharge and negative values are discharge. Units are cubic feet per second. The value in the first column and row is for element number 1. There are a maximum of 24 elements for each row. Elements are listed sequentially from 1 to 1182.

# ATTACHMENT J. Listing of PRED program

## Part 1. Main Program

```
//TPMRPRED JOB (                    ),'TPMRPUMP1',PRTY=0,CLASS=U,
//  MSBLEVEL=(1,1)
/*JOBPARM TAPES=0,TIME=(31,00),M=256,L=60,EFFTIME=(60,00)
/**ONTROL  ACCT,PSWD=
/*OUTPUT FORM FORMS=0801,UCS=PN3,FCB=8801
//ST1 EXEC FORT6CLG,REGION.GO=256K,TIME.GO=31
//FORT.SYSIN DD *
C     PROGRAM TO COMPUTE AND STORE PREDICTIVE  PUMPAGE FOR TWIN PLATTE-
C   MIDDLE REPUBLICAN GROUND WATER STUDY.
C   BY JON PECKENPAUGH, MARCH 1982.
C        INPUT FILES:   FT09F001 SOIL-LAND USE FILE.
C                       FT13F001 NUMBER OF WELLS/ELEMENT/YEAR
C                       FT14F001 AVE. SEASONAL RECHARGE AND CIR FOR
C                                1963-1978 PERIOD FROM SOIL-WATER PROGRAM.
C                       FT05F001 AVE.  DIVERSION/YEAR IN ACRE-FEET FOR
C                                EACH OF 9 CANALS (1ST RECORD)
C                                AVERAGE SEEPAGE DATA FILE, (2ND RECORD).
C                       FT10F001 LANDUSE FILE GENERATED FROM COUNTY AG STATISTICS
C                       FT11F001 AREA OF THE ELEMENT.
C       OUTPUT FILE:    FT08F001 AVERAGE NET RECHARGE (+) OR DISCHARGE (-) FOR
C                       1963-1978 PERIOD FOR EACH ELEMENT FOR 2 PUMPING PERIODS;
C                       NON-IRRIG.SEASON FIRST (9MOS.) THEN IRRIG. SEASON (3MOS.)
C     ************************************************************************
      DIMENSION CANAC(1182),Q1(1182),Q2(1182),AR(1182),ACIR(1182),
     * ACDYB(1182),WATER(1182)
      REAL*4 IRSA(1182)/0.0/,SEEPLT(1182)/0.0/,SEEPT(1182)/0.0/,
     * ACDR(1182)/0.0/,IRSB(1182)/0.0/,IRSC(1182)/0.0/,
     * TADIAC(1182)/0.0/
      REAL*4 ACPW(12)/57.0,129.,51.8,99.6,66.7,98.1,80.1,88.3,55.5,76.3,
     *59.7,47.8/,IRRA(1182),IRS(7)/1.0,.25,1.0,.80,.60,.60,.60/,IRSU
      DIMENSION TDIV(9),            MFMT(10),PUMPM(18)
      DIMENSION QIRGS(7,19,5),QDYGS(7,19,5),QIROS(7,19,5),
     *          QDYOS(7,19,5),KFMT(14),LFMT(24)
      REAL*4 TM(12)/30.,31.,35.,40.,45.,50.,55.,60.,65.,70.,71.,75./
      DATA PUMPM/-0.388,-0.776,-0.388,-0.388,-1.164,-1.164,-1.164,
     * -0.388,-0.388,-1.156,-2.311,-1.156,-1.156,-3.467,-3.467,-3.467,
     * -1.156,-1.156/
      DIMENSION P1(12,44),P2(12,44),P3(12,44),P4(12,44),P5(12,44),
     *P6(12,44),P7(12,44),P8(12,44),P9(12,44),P10(12,44)
      DATA KFMT/'(3I2',',    ',',    ','   2','X,  ','  2','X,  ',
     *'   2','X,  ','   2','X,  ','   2','X,4F','6.1)'/
      DATA MFMT/'  26','  50','  74','  98',' 122',' 146',
     *' 170',' 194',' 218',' 242'/
      INTEGER*4 C(9),WS,S(8)
      REAL*4          TQIGS(3),TQIOS(3),TQDGS(5),TQDOS(5),MAXSZ(1182)
C***DEFINITION OF PROGRAM VARIABLES****
C     FEFF=.60, FARM IRRIGATION EFFICIENCY;
C     FLOSS=0.10, TOTAL FARM PUMPAGE LOST TO RUNOFF AND EVAPORATION;
C  TDIV AVE. SURFACE WATER APPLIED PER ACRE IN AC-FT/YR FROM '63-'78 FOR EACH OF
C  9 CANALS;
```

```
C  NY = YEAR;
C  MFMT, KFMT, AND LFMT : VARIABLES USED IN READING FILE 14, RECHARGE AND CIR
C  DATA;
C  AR(IEM)= AREA OF ELEMENT, IEM COUNTER FROM 1 TO 1182;
C  P1( , ) THROUGH P10( , ):COUNTY AGRICULTURAL STATISTICS DATA BY COUNTY(12)
C  AND YEAR (44);
C  SC8, SL2, SC13L7, SC15, SC16, SC18, SC19, SC2021, SC22L3, SL1, SL4, SL5, SL6=
C  AVE. SEEPAGE RATES FOR CANALS AND LAKES FROM 1963-1978;
C  IS = SOIL GROUP;
C  IW,WS = WEATHER STATION;
C  IL = CROP TYPE (ROW CROP, SMALL GRAIN, ALFALFA, AND PASTURE AND RANGE);
C  QIROS(   ) = AVE RECHARGE OR CIR FROM 1963-1978 FOR IRRIGATED LANDS NON
C  IRRIGATION SEASON;
C  QDYOS(   ) = AVE RECHARGE OR WATER-SHORTAGE FROM 1963-78 FOR DRYLANDS NON-
C  IRRIGATION SEASON;  QIRGS(   )=AVE RECHARGE OR CIR FROM 1963-78 FOR IRRIGATED
C  LANDS IRRIGATION SEASON;  QDYGS(   )=AVE RECHARGE OR WATER-SHORTAGE FROM 1963
C  -78 FOR DRYLANDS IRRIGATION SEASON;
C  ICT = COUNTY(12);
C  S(  ) = SOILS ( PERCENT OF EIGHT DIFFERENT SOIL GROUPS THAT OCCUR IN EACH
C  ELEMENT);
C  LU1,LU2,AND LU3 = PERCENT OF 3 DIFFERENT LAND USE CATORIES THAT MAY OCCUR IN
C  EACH ELEMENT;
C ICN= CANAL INDEX FOR EACH ELEMENT THAT HAS IRRIGATION FROM SURFACE WATER;
C  ICAN = AMOUNT OF SURFACE-WATER IRRIGATED ACRES IN EACH ELEMENT;
C  IGRND = ELEVATION OF LAND SURFACE BY ELEMENT, NOT USED IN THIS STUDY;
C  CLEN = CANAL LENGTHS BY ELEMENT;
C  LL = LAKE OR RESERVOIR INDEX FOR ELEMENTS WITH LAKE OR RESERVOIR;
C  LAREA = AMOUNT OF LAKE OR RESERVOIR IN ACRES THAT IS IN ELEMENT;
C  ILF = G.W. IRRIGATION FACTOR(1 OR 2) IF 1, ACPW=120.0 AND IF 2, ACPW=50.0;
C  SEEP AND SEEPT( ) = SEEPAGE AMOUNTS FROM CANALS BY ELEMENT;
C  SEEPL AND SEEPLT( ) = SEEPAGE AMOUNTS FROM LAKES BY ELEMENT;
C  ACIR( ) = GROUND-WATER IRRIGATED ACRES;
C  IRRA( ) = TOTAL SURFACE AND GROUND WATER IRRIGATED ACRES;
C  CANAC( ) = SURFACE WATER IRRIGATED ACRES;
C  ACDYB( ) = 1980 DRYLAND ACRES;
C  ACCSSW1 = SURFACE WATER SHORTAGE ACRES;
C  IRSA( ) = IRRIGABLE ACRES PER ELEMENT WITH MAXIMUM OF 88% OF AREA OF ELEMENT;
C  ACDY AND ACDR( ) = ACRES OF DRYLAND;
C  CHE = SUM OF ACIR AND ADIRAC;
C  IRS(1),...,IRS(7) = IRRIGATION POTENTIAL OF THE 7 SOIL GROUPS;
C  IRSU = IRRIGABLE ACRES FOR A GIVEN SOIL TYPE WITHIN A GIVEN ELEMENT;
C  IRSC( )  = POTENTIAL IRRIGABLE ACRES FOR A GIVEN YEAR THAT HAVE NOT BEEN
C  IRRIGATED;
C  IRSB( )  = SAME AS IRSC( ) EXCEPT VALUES CHANGE;
C  WATER, PAST, FAL, SMGNR, SMGIR, RCIR, RCNR, ALFNR, AND ALFIR ARE ACRES OF
C  THESE DIFFERENT LAND USES.  WHERE WATER=WATER AREA, PAST=PASTURE + RANGE, FAL
C =FALLOW, SMGNR=SMALL GRAIN NON IRRIGATED, SMGIR=SMALL GRAIN IRRIGATED, RCIR=
C  ROW CROPINIATED, RCNR=ROW CROP NON IRRIGATED, ALFNR=ALFALFA NON IRRIGATED,
C  ALFIR=ALFALFA IRRIGATED, CULT=CULTIVATED LANDS;
C  ARR=CULT-FAL;
C  MAXSZ( ) = MAXIMUM ALLOWABLE IRRIGATED ACRE, UP TO 88 PERCENT OF THE AREA OF
C  AN ELEMENT;
C  ADIRAC = ADDITIONAL IRRIGATED ACRES;
C  TADIAC( ) = TOTAL ADDITIONAL IRRIGATED ACRES;
```

```
C  AIRA = ACRES IRRIGATED (ACIR + TADIAC);
C  TQIGS( ), TQIOS( ), TQDGS( ), TQDOS( ), = TOTAL RECHARGE AND CIR BASED UPON
C  QIROS( , , ) VALUES AND SOILS GROUPS(S(1) THROUGH S(8));
C  SQIGS1, SQIGS2, SQIGS3, SQIOS1, SQIOS2, SQIOS3, SQDGS1, SQDGS2, SQDGS3,
C  SQDGS4, SQDGS5, SQDOS!, SQDOS2, SQDOS3, SQDOS4, SQDOS5,   : INTERMEDIATE
C  RECHARGE AND DISCHARGE VALUES THAT ARE USED IN CALCULATING TQIGS(1),...,
C  TQDOS(5) :THE TOTAL RECHARGE OR DISCHARGE BASED UPON 8 SOILS;
C  CIR = CONSUMPTIVE IRRIGATION REQUIREMENTS;
C  RIRGS, RIROS, RDYOS, RDYGS  = RECHARGE OR DISCHARGE VALUES PER ACRE,
C  CALCULATED FROM QIROSP, QIRGSP,QDYOSP, QDYGSP WHICH ARE TOTAL RECHARGE OR CIR
C  ON IRRIGATED LANDS AND DRYLANDS DURING IRRIGATION SEASON AND NONIRRIGATION
C  SEASON;
C  ACNI = DRYLAND ACRES;
C  FD = SURFACE WATER APPLIED/ACRE FOR A GIVEN CANAL AND YEAR;
C  QOS = Q1( )= NET RECHARGE OR DISCHARGE PER ELEMENT DURING NONIRRIGATION
C  SEASON;
C  QGS = Q2( )= NET RECHARGE OR DISCHARGE PER ELEMENT DURING IRRIGATION SEASON;
C  QNT = FD + CIR;
C  TRECH = TOTAL RECHARGE FOR ALL ELEMENTS;
C  TDISC = TOTAL DISCHARGE FOR ALL ELEMENTS;
C  PUMPM(  ) = PUMPAGE FOR THE CITY OF NORTH PLATTE AT SELECTED ELEMENTS;
C  RECHPN = RECHARGE PER ELEMENT, REGARDLESS OF ELEMENT SIZE;
C  DISCPN = DISCHARGE PER IRRIGATION WELL.
C     ***************************************************************************
C  ** READ AVE.WATER APPLIED PER ACRE FROM 1963-78 FOR EACH OF 9 CANALS. *****
C     ***********************************************************************
   66 READ(05,1005) (TDIV(I),I=1,9)
 1005 FORMAT(9F5.2)
      WRITE(06,1001)(TDIV(I),I=1,9)
 1001 FORMAT(1H ,2X,9F5.2)
C **************    READ AND STORE AREA OF ELEMENT   *************************
      DO 115 IEL=1,1182
      READ(11,1151)IEM,AR(IEM)
      IF(IEL.LE.40.OR.IEL.GT.1160) WRITE(06,119) IEL,IEM,AR(IEM)
  119 FORMAT(1H ,1X,2I5,F10.2)
 1151 FORMAT(I5,F10.2)
  115 CONTINUE
C READ AND STORE AG. STATISTICS FOR HARVESTED IRRIG. AND DRYLAND ACRES  ******
      DO 1112 N1=1,12
      DO 1112 N2=1,44
      READ(10,1111) P1(N1,N2),P2(N1,N2),P3(N1,N2),P4(N1,N2),P5(N1,N2),
     *P6(N1,N2),P7(N1,N2),P8(N1,N2),P9(N1,N2),P10(N1,N2)
 1111 FORMAT(7X,10F5.3)
      IF(N1.EQ.12.AND.N2.EQ.44) WRITE(06,118) P1(N1,N2),P2(N1,N2),
     * P3(N1,N2),P4(N1,N2),P5(N1,N2),P6(N1,N2),P7(N1,N2),P8(N1,N2),
     * P9(N1,N2),P10(N1,N2)
  118 FORMAT(1H ,1X,10F5.3,2X,'TPMRCROP')
 1112 CONTINUE
C READ AND STORE AVE.SEEPAGE VALUES FROM 1963-78
      READ(05,1107)
     *            SC8   ,SL2   ,SC13L7   ,SC15   ,SC16   ,SC18   ,
     *SC19   ,SC2021   ,SC22L3   ,SL1   ,SL4   ,SL5   ,SL6
 1107 FORMAT(13F6.1)
      WRITE(06,1106) SC8   ,SL2   ,SC13L7   ,SC15   ,SC16   ,SC18   ,
```

```
     * SC19   ,SC2021   ,SC22L3   ,SL1   ,SL4   ,SL5   ,SL6
 1106 FORMAT(1H ,1X,13F6.1)
C             ***********************************************
C    READ AVE. RECHARGE AND CIR FROM FILE 14   ***************
   20 READ(14,9112,END=998) IS,IW,IL,QIRGS(IS,IW,IL),QIROS(IS,IW,IL),
     *                      QDYGS(IS,IW,IL),QDYOS(IS,IW,IL)
C     WRITE(06,9112) IS,IW,IL,QIROS(IS,IW,IL),QDYOS(IS,IW,IL),
C    *  QIRGS(IS,IW,IL),QDYGS(IS,IW,IL)
      QIRGS(IS,IW,IL) =(-15.0*4.0)/12.0
 9112 FORMAT(3I2,4F7.2)
      GO TO 20
  998 CONTINUE
C   *****************************************************************
C   READ SOIL AND LANDUSE DATA.
C   *************************************************************
  302 READ(09,1022,END=29) I,S(1),S(2),S(3),S(4),S(5),S(6),S(7),S(8),
     * WS,ICT,LU1,LU2,LU3,ICN,ICAN,IGRND,CLEN,LL,LAREA,ILF
      JW=WS
      IF(LL.GE.9) LL=9
C    READ 1980 IRRIGATED ACRES,CANAC,GW IRRIG. AC.,DRYLAND AC,WATER AC,
C    SW SHORTAGE AC, MAX. IRRIGABLE AC BASED UPON 88% OF LAND AREA.
C    ****************************
  831 READ(12,337) I,IRRA(I),CANAC(I),ACIR(I),ACDYB(I),WATER(I),ACSSW1,
     * MAXSZ(I)
  337 FORMAT(I4,7F7.2,7X)
      IF(IRRA(I).GT.MAXSZ(I))IRRA(I)=MAXSZ(I)
      ACIR(I)=IRRA(I)-CANAC(I)
      DO 837 J=1,7
      IRSU=(.01*S(J))*IRS(J)*AR(I)
  837  IRSA(I)=IRSA(I) + IRSU
      IRSA(I)=IRSA(I)-WATER(I)
      IRSC(I)=IRSA(I)-ACIR(I)-CANAC(I)
       IF(IRSC(I).LE.0.0) IRSC(I)=0.0
      IF(IRSC(I).GT.MAXSZ(I)) IRSC(I)=MAXSZ(I)
      IRSB(I)=IRSC(I)
      ACDR(I)=ACDYB(I)
C   IRSA(I) AND IRSB(1182) ARE IRRIGABLE AC PER ELEMENT BASED UPON IRRIGATION
C  POTENTIAL OF SOILS AND ONLY 88% OF EACH NODE CAN BE IRRIGATED.
C   ACDY,ACDR(I),ACDYB(I) ARE DRYLAND ACRES--ACDYB(I) WILL BE 1980 DRYLAND AC
C    WHILE THE OTHER TWO VARIABLES WILL CHANGE DURING THE PREDICTIVE PERIOD.
C  ******************************
C    CALCULATE SEEPAGE VALUES FOR CANALS AND LAKES. *************
C   ****************************************************************
      SEEP=0.0
      SEEPL=0.0
      IF(ICN.EQ.9) SEEP=CLEN * 1000.
      IF(ICN.EQ.8)SEEP=CLEN*SC8
      IF (ICN.EQ.13)SEEP=(CLEN*5280)*((SC13L7    *110)/ 43560)
      IF (ICN.EQ.15)SEEP=CLEN*SC15
      IF(ICN.EQ.16)SEEP=CLEN*SC16
      IF(ICN.EQ.18)SEEP=CLEN*SC18
      IF(ICN.EQ.19)SEEP=CLEN*SC19
      IF(ICN.EQ.20)SEEP=CLEN*SC2021
      IF(ICN.EQ.21)SEEP=CLEN*SC2021
```

```
      IF(ICN.EQ.22)SEEP=(CLEN*5280)*((SC22L3    *110) / 43560)
      IF(LL.EQ.1)SEEPL=LAREA*SL1
      IF(LL.EQ.4)SEEPL=LAREA*SL4
      IF(LL.EQ.5)SEEPL=LAREA*SL5
      IF(LL.EQ.6)SEEPL=LAREA*SL6
      IF(LL.EQ.2)SEEPL=LAREA*SL2
      IF(LL.EQ.7)SEEPL=LAREA*SC13L7
      IF(LL.EQ.3)SEEPL=LAREA*SC13L7
      IF(LL.EQ.9)SEEPL=LAREA*SC22L3
C     ***********************************************************
 1022 FORMAT(I4,8I3,2I2,3I3,I2,2I4,F5.2,I2,I4,I1)
      SEEPLT(I) = SEEPL
      SEEPT(I) = SEEP
      IF(JW.GT.19.OR.ICT.GT.12)  GO TO 311
      IF(JW.LT.01.OR.ICT.LT.01)  GO TO 311
      GO TO 302
  311 WRITE(06,3110) I,JW,ICT
 3110 FORMAT(1H ,5X,'**** ERROR FOR ELEMENT',I5,'  JW = ',I5,'  ICT=',
     * I5,'NO Q COMPUTED')
      GO TO 302
   29 CONTINUE
C     ******************************************************************
C  ** START LOOP ON YEARS 1981-2020  ***********************************
C  COMPUTE LANDUSES IN EACH ELEMENT.  LU1=CROPLAND, LU2=GRASSLAND
C  (PASTURE AND RANGE), LU3=WATER AREAS FOR EACH ELEMENT.  USE COUNTY LANDUSES
C  (P1(ICT,NY)--P10(ICT,NY)) AND ACIR TO CALCULATE LANDUSES.
      DO 100 NY=1,40
      QGS=0.
      QOS=0.
      REWIND 9
      DO 1101 K3=1,1182
      Q1(K3)=0.
      Q2(K3)=0.
 1101 CONTINUE
C   READ SOIL AND AG. STASTICTICS DATA   ******************************
  301 READ(09,1022,END=100)I,S(1),S(2),S(3),S(4),S(5),S(6),S(7),S(8),
     * WS,ICT,LU1,LU2,LU3,ICN,ICAN,IGRND,CLEN,LL,LAREA,ILF
      JW=WS
      IF(LL.GE.9) LL=9
C   ************  CHECK FOR AVAILABLE LAND FOR MORE IRRIGATION.  IF LESS THAN
C   10.0, NO MORE LAND WILL BE IRRIGATED IN THIS ELEMENT.  *******************
      IF(IRSB(I).LE.10.0) GO TO 892
      ADIRAC=IRSB(I)*.025
      CHE=ACIR(I) + ADIRAC
      IF(CHE.GT.MAXSZ(I)) ADIRAC=MAXSZ(I)-TADIAC(I)-ACIR(I)
      IRSB(I)=IRSB(I) - ADIRAC
      TADIAC(I)=TADIAC(I) + ADIRAC
      ACDR(I)= ACDR(I)-ADIRAC
      GO TO 893
  892 ADIRAC=0.0
  893 ACDY=ACDR(I)
C   PASTURE IS PAST & RANGE (1980) - (TOTAL ADDITIONAL GW IRRIG. LAND SINCE
C   1980 * % OF PASTURE TO TOTAL LAND IN 1980)
C   CULT IS CROPLAND (1980) - (TOTAL ADDITIONAL GW IRRIG. LAND SINCE
```

```
C   1980 * % OF CROPLAND TO TOTAL LAND IN 1980)
      PAST=0.0
      FAL=0.0
      SMGNR=0.0
      SMGIR=0.0
      RCIR=0.0
      RCNR=0.0
      ALFNR=0.0
      ALFIR=0.0
      PAST=(LU2*.01)*(AR(I)-TADIAC(I))
      CULT=(LU1*.01)*(AR(I)-TADIAC(I))
      FAL=CULT*P8(ICT,44)
       RCIR=ACIR(I)*P5(ICT,44)
      ALFIR=ACIR(I)*P7(ICT,44)
      SMGIR=ACIR(I)-RCIR-ALFIR
      AIRA   =ACIR(I) + TADIAC(I)
      RCIR=RCIR + TADIAC(I)
      RCNR=ACDY*P2(ICT,44)
      ALFNR=ACDY*P4(ICT,44)
      SMGNR=ACDY-RCNR-ALFNR
C  COMPUTE RECHARGE AND CIR BASED UPON 8 POSSIBLE SOILS IN EACH ELEMENT.
C   8TH SOIL IS WATER.ITS RECH AND CIR IS 0.0,THUS IT IS NOT CALCULATED.
C  ***************************************************************
      DO 709 JL=1,3
      TQIGS(JL)=0.0
  709 TQIOS(JL)=0.0
      DO 711 JM=1,5
      TQDGS(JM)=0.0
  711 TQDOS(JM)=0.0
      DO 7001 IS=1,7
      SQIGS1=QIRGS(IS,JW,1) * (S(IS)*.01)
      TQIGS(1)=TQIGS(1) + SQIGS1
      SQIGS2=QIRGS(IS,JW,2) * (S(IS)*.01)
      TQIGS(2)=TQIGS(2) + SQIGS2
      SQIGS3=QIRGS(IS,JW,3) * (S(IS)*.01)
      TQIGS(3)=TQIGS(3) + SQIGS3
      SQIOS1=QIROS(IS,JW,1) * (S(IS)*.01)
      TQIOS(1)=TQIOS(1) + SQIOS1
      SQIOS2=QIROS(IS,JW,2) * (S(IS)*.01)
      TQIOS(2)=TQIOS(2) + SQIOS2
      SQIOS3=QIROS(IS,JW,3) * (S(IS)*.01)
      TQIOS(3)=TQIOS(3) + SQIOS3
      SQDGS1=QDYGS(IS,JW,1) * (S(IS)*.01)
      TQDGS(1)= TQDGS(1) + SQDGS1
      SQDGS2=QDYGS(IS,JW,2) * (S(IS)*.01)
      TQDGS(2)= TQDGS(2) + SQDGS2
      SQDGS3=QDYGS(IS,JW,3) * (S(IS)*.01)
      TQDGS(3)= TQDGS(3) + SQDGS3
      SQDGS4=QDYGS(IS,JW,4) * (S(IS)*.01)
      TQDGS(4)= TQDGS(4) + SQDGS4
      SQDGS5=QDYGS(IS,JW,5) * (S(IS)*.01)
      TQDGS(5) = TQDGS(5) + SQDGS5
      SQDOS1=QDYOS(IS,JW,1) * (S(IS)*.01)
      TQDOS(1)= TQDOS(1) + SQDOS1
```

```
      SQDOS2=QDYOS(IS,JW,2) * (S(IS)*.01)
      TQDOS(2)= TQDOS(2) + SQDOS2
      SQDOS3=QDYOS(IS,JW,3) * (S(IS)*.01)
      TQDOS(3)= TQDOS(3)  + SQDOS3
      SQDOS4=QDYOS(IS,JW,4) * (S(IS)*.01)
      TQDOS(4)= TQDOS(4) + SQDOS4
      SQDOS5=QDYOS(IS,JW,5) * (S(IS)*.01)
 7001 TQDOS(5)= TQDOS(5) + SQDOS5
      IF(ALFIR.NE.0.0.OR.RCIR.NE.0.0.OR.SMGIR.NE.0.0) GO TO 318
      CIR=0.0
      GO TO 319
  318 CIR=((TQIGS(1) * RCIR + TQIGS(3) * SMGIR + TQIGS(2) *
     *ALFIR)/(RCIR+SMGIR+ALFIR))*.25
  319 RIRGS=0.0
      RIROS=0.0
      RDYGS=0.0
      RDYOS=0.0
      QIRGSP=TQIGS(1) * RCIR + TQIGS(2) * ALFIR + TQIGS(3) * SMGIR
      QIROSP=TQIOS(1) * RCIR + TQIOS(2) * ALFIR + TQIOS(3) * SMGIR
      QDYGSP=TQDGS(1) * RCNR + TQDGS(2) * ALFNR + TQDGS(3) * SMGNR +
     1 TQDGS(4) * PAST + TQDGS(5) * FAL
      QDYOSP=TQDOS(1) * RCNR + TQDOS(2) *ALFNR + TQDOS(3) * SMGNR +
     1 TQDGS(4) * PAST + TQDGS(5) * FAL
      IF(AIRA.LE.0.0) GO TO 71
      RIRGS=QIRGSP/AIRA
      RIROS=QIROSP/AIRA
   71 ACNI=AR(I)-AIRA-WATER(I)
      IF(ACNI.LE.0.0) GO TO 72
      RDYGS=QDYGSP/ACNI
      RDYOS= QDYOSP / ACNI
   72 CONTINUE
C       FOR ELEMENTS WITH NO SW AC.,CALC. GW RECH AND/OR DISCH.
      ICNN=ICN
      IF(ICNN.GT.9) CANAC(I)=0.0
      IF(ICNN.GT.9) ICNN=0
      IF(ICN.EQ.0.OR.CANAC(I).EQ.0.) GO TO 42
      FD=TDIV(ICNN)
      IF(CIR.LT.0.0) GO TO 77
C FOR ELEMENTS WITH CANALS BUT NO GW IRIG. AC  (AIRA).  ALSO DETERMINE
C SEEPAGE LOSSES AND RECHARGE. FOR CANALS W/O SEEP TERM SEEPAGE IS .5*SW
      ACNI=AR(I)-CANAC(I)-WATER(I)
      IF (SEEPT(I).GT.0.0) GO TO 83
C  *** NOT BUREAU OF RECLAMATION CANALS, CALCULATE SEEPAGE FROM CANALS.  *******
      QGS=.00138*(.5*FD*CANAC(I)+ACNI*RDYGS+SEEPLT(I))
      QOS=.00138*((CANAC(I)+ACNI)*RDYOS+SEEPLT(I))
      GO TO 62
C  **  BUREAU OF RECLAMATION CANALS, SEEPAGE ALREADY COMPUTED.   **************
   83 QGS=.00138*(SEEPT(I)+SEEPLT(I)+ACNI*RDYGS)
      QOS=.00138*(SEEPT(I)+SEEPLT(I)+ACNI*RDYOS)
      GO TO 62
   77 QNT=FD+CIR
C SW IS ADEQUATE, ALL GW IS USED TO IRRIG. ADDITIONAL AREAS
C   CNPGW=CANAL AND GW IRRIGATION.
      IF(AIRA.GT.0.0) GO TO 39
```

```
      AIRA=0.0
   39 CNPGW=AIRA+CANAC(I)
   38 ACNI=AR(I)-WATER(I)-CNPGW
      IF (SEEPT(I).GT.0.0) GO TO 84
      QGS=.00138*(AIRA *RIRGS+ACNI*RDYGS+CANAC(I)*QNT+SEEPLT(I))
      GO TO 85
   84 QGS=.00138*(AIRA*RIRGS+ACNI*RDYGS+SEEPT(I)+SEEPLT(I))
   85 QOS=.00138*(CNPGW*RIROS+ACNI*RDYOS+SEEPT(I)+SEEPLT(I))
      GO TO 62
C  NO SW IRRIG. FEFF AND FLOSS ARE USED ONLY WHEN ELEMENT HAS ONLY GW IRRIG.
C  HOWEVER, WHEN APLLICATION RATES ARE READ AND NOT CIR, NO FEFF OR FLOSS.
   42 QGS= .00138*(QIRGSP+QDYGSP+SEEPT(I) + SEEPLT(I))
      QOS= .00138*(QIROSP+QDYOSP+SEEPT(I)+SEEPLT(I))
   62 CONTINUE
C ******   MUNICIPAL PUMPAGE FOR CITY OF NORTH PLATTE, NE.   *****************
      IF(IEL.EQ.754)  QOS=QOS+PUMPM(1)
      IF(IEL.EQ.754) QGS=QGS+PUMPM(10)
      IF(IEL.EQ.760) QOS=QOS+PUMPM(02)
      IF(IEL.EQ.760) QGS=QGS+PUMPM(11)
      IF(IEL.EQ.764) QOS=QOS+PUMPM(03)
      IF(IEL.EQ.764) QGS=QGS+PUMPM(12)
      IF(IEL.EQ.771) QOS=QOS+PUMPM(04)
      IF(IEL.EQ.771) QGS=QGS+PUMPM(13)
      IF(IEL.EQ.785) QOS=QOS+PUMPM(05)
      IF(IEL.EQ.785) QGS=QGS+PUMPM(14)
      IF(IEL.EQ.791) QOS=QOS+PUMPM(06)
      IF(IEL.EQ.791) QGS=QGS+PUMPM(15)
      IF(IEL.EQ.797) QOS=QOS+PUMPM(07)
      IF(IEL.EQ.797) QGS=QGS+PUMPM(16)
      IF(IEL.EQ.799) QOS=QOS+PUMPM(08)
      IF(IEL.EQ.799) QGS=QGS+PUMPM(17)
      IF(IEL.EQ.805) QOS=QOS+PUMPM(09)
      IF(IEL.EQ.805) QGS=QGS+PUMPM(18)
      Q1(I)=QOS
      Q2(I)=QGS
      TRECH=TRECH + QOS
      TDISC=TDISC + QGS
      GO TO 301
C   ******************   END OF ELEMENT LOOP   ********************************
   30 CONTINUE
C
C   WRITE NET PUMPAGE OR RECHARGE TO FILE 8;
C     ORDER OF RECORDS                IS AS FOLLOWS:
C       FIRST NON-GROWING SEASON RECHARGE
C     SECOND - GROWING SEASON CONSUMPTINVE IRRIGATION RQMT OR RECHARGE
      KELEM=1182
      DO 261 K1=1,1182
  261 WRITE(8,2222) Q1(K1)
      NYY=NY+1980
      WRITE(06,7022)NYY, KELEM,(Q1(KT),KT=1,KELEM)
 7022 FORMAT(1H0,5X,'NON IRRIGATION SEASON PUMPAGE',
     *'NO ELEM  = ',I4/(1X,24(F5.2)))
      DO 262 K2=1,1182
  262 WRITE(8,2222) Q2(K2)
```

```
      WRITE(06,7023) NYY,KELEM,(Q2(KT),KT=1,KELEM)
 7023 FORMAT(1H0,5X,'IRRIGATION SEASON PUMPAGE',
     *'NO ELEM  = ',I4/(1X,24(F5.2)))
C
      RECHPN=TRECH/1182.
      DISCPN=TDISC/1182.
      WRITE(06,2000)          TRECH,TDISC,RECHPN,DISCPN
 2000 FORMAT(1H ,5X,                                      'TRECH=',
     1 E20.3,1X,'TDISC=',E20.3,1X,'RECHPN=',E14.3,1X,'DISCPN=',E14.3)
 2222 FORMAT(F7.3)
C    **************************************************************************
C  ****************    END OF TIME LOOP  ************************************
  100 CONTINUE
C     END FILE 8
      STOP
C********
      DEBUG SUBCHK
      END
/*
```

ATTACHMENT J. Listing of PRED program--Continued
Part 2. Input Data

```
//GO.FT06F001 DD SYSOUT=(C,,FORM),DCB=RECFM=FA
//GO.FT10F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//    DSN=A.    .AA      .TPMR.CROP
//GO.FT11F001 DD UNIT=3330,VOL=SER=SYS345,DISP=SHR,
//   DSN=A.    .AA      .GOEKE.AREAS
//GO.FT09F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//   DSN=A.    .AA      .TPMR.WUD1
//GO.FT12F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
//  DCB=(RECFM=FB,LRECL=60,BLKSIZE=960),DSN=A.    .AA      .TPMR.IRBO
//GO.FT13F001 DD UNIT=3330,VOL=SER=SYS301,DISP=(OLD,KEEP),
// DSN=A.    .AA      .LOCDATA
//GO.FT14F001 DD UNIT=3330,VOL=SER=SYS345,DISP=(OLD,KEEP),
// DCB=(RECFM=FB,LRECL=0034,BLKSIZE=3060),
//     DSN=A.    .AA      .TPMR.PAVE
//GO.FT08F001 DD UNIT=3330,VOL=SER=SYS308,DISP=(OLD,KEEP),
//  DCB=(RECFM=FB,LRECL=07,BLKSIZE=1001),SPACE=(TRK,(40,5),RLSE),
//  DSN=A.    .AA      .TPMR.P306
//GO.SYSIN DD *  (File 5)
 4.43 2.71 7.26 1.8210.24 1.64 1.28 1.33 1.30 1/
1833.7   8.0  61.2 253.8 306.5  98.6 223.41093.6 111.2  25.2   3.0   9.7   4.1 2/
/*
```

(Lines 1–17: JCL for input and output files.)

1/ Average water applied per acre for 9 canals from 1963 through 1978.
2/ Average annual seepage from 9 canals in feet per mile and from four lakes, in feet per acre.

File 11. Area of Elements

Element Area (acres)

| Element | Area (acres) |
|---|---|
| 1 | 928.88 |
| 2 | 672.53 |
| 3 | 5625.06 |
| ⋮ | ⋮ |
| 1181 | 720.04 |
| 1182 | 643.48 |

File 10. Agricultural statistics for harvested dryland and irrigated crops

| County number | Year | Land use for dryland and irrigated lands[1/] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 01 | 35 | .558 | .428 | .507 | .063 | .941 | .000 | .058 | .202 | .106 | .893 |
| 01 | 36 | .558 | .444 | .469 | .085 | .938 | .000 | .061 | .231 | .130 | .869 |
| 01 | 37 | .558 | .612 | .385 | .102 | .944 | .000 | .055 | .367 | .160 | .839 |
| 01 | 38 | .558 | .438 | .515 | .045 | .942 | .000 | .057 | .215 | .117 | .882 |
| | | | | | | | | | | | |
| 12 | 75 | .431 | .117 | .081 | .801 | .857 | .011 | .131 | .020 | .656 | .343 |
| 12 | 76 | .431 | .087 | .102 | .808 | .855 | .001 | .143 | .015 | .657 | .342 |
| 12 | 77 | .431 | .090 | .062 | .847 | .920 | .005 | .073 | .010 | .679 | .320 |
| 12 | 78 | .431 | .020 | .066 | .913 | .910 | .007 | .081 | .010 | .724 | .275 |

1/ Land use values (dimensionless) by column are as follows: land area not cultivated (1); dryland row crop (2); dryland small grain (3); dryland alfalfa and tame hay (4); irrigated row crops (5); irrigated small grain (6); irrigated alfalfa (7); cultivated land in fallow (8); irrigated cropland (9); and dryland cropland (10). Column 1, which is pasture and range, subtracted from 1.0 yields the fraction of cultivated land by county. Columns 2, 3, 4, and 8 should total 1.0; these values represent the cultivated drylands. Columns 5, 6, and 7 should total 1.0; these values represent the cultivated irrigated lands. Columns 9 and 10 should also total 1.0; they represent the fraction of cultivated lands either irrigated or not irrigated.

ATTACHMENT J. Listing of PRED Program--Continued
Part 2. Input Data

File 14. Average seasonal recharge and CIR by weather station, soil group, and crop

| | | | Recharge or discharge[1/] | | | |
|---|---|---|---|---|---|---|
| | | | Irrigated land | | Dryland | |
| Soil group | Weather station | Crop | Irrigation season | Nonirriga-tion season | Irrigation season | Nonirriga-tion season |
| 1 | 1 | 1 | -3.86 | 0.12 | 0.06 | 0.05 |
| 1 | 1 | 2 | -5.72 | 0.0 | 0.02 | 0.00 |
| 1 | 1 | 3 | -1.59 | 0.24 | 0.10 | 0.13 |
| 1 | 1 | 4 | -3.44 | 0.11 | 0.0 | 0.05 |
| 1 | 1 | 5 | -1.50 | 0.22 | 0.08 | 0.13 |
| 1 | 2 | 1 | -3.77 | 0.04 | 0.02 | 0.01 |
| 1 | 2 | 2 | -5.72 | 0.0 | 0.02 | 0.00 |
| 7 | 18 | 1 | -3.88 | 0.25 | 0.28 | 0.17 |
| 7 | 18 | 2 | -4.24 | 0.04 | 0.04 | 0.01 |
| 7 | 18 | 3 | -0.87 | 0.39 | 0.45 | 0.30 |
| 7 | 18 | 4 | -2.61 | 0.20 | 0.15 | 0.13 |
| 7 | 18 | 5 | -0.79 | 0.34 | 0.24 | 0.26 |

1/ Negative values are discharge from the aquifer or CIR and positive values are recharge or deep percolation to the aquifer. Units are feet per year.

File 9. Soils and land use

| Element No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 100 | | | | | | | | | 1 |
| 2 | 0 | 50 | 20 | 0 | 0 | 20 | 10 | 0 | 1 | 8 | | 100 | | | | | | | | 2 |
| 3 | 0 | 55 | 20 | 5 | 0 | 0 | 20 | 0 | 1 | 8 | 20 | 80 | | | | | | | | 2 |
| 4 | 5 | 75 | 20 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 20 | 80 | | | | | | | | 1 |
| 5 | 10 | 50 | 10 | 20 | 0 | 0 | 10 | 0 | 1 | 8 | 35 | 65 | | | | | | | | 2 |
| 1135 | 50 | 30 | 0 | 0 | 0 | 0 | 0 | 20 | 19 | 12 | 50 | 30 | 20 | 22 | | | 3.52 | 12 | 391 | 1 |
| 1136 | 90 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 12 | 75 | 25 | | 22 | | | .22 | | | 1 |
| 1143 | 5 | 30 | 65 | 0 | 0 | 0 | 0 | 0 | 18 | 11 | 80 | 20 | | 19 | 208 | | 1.21 | | | 1 |
| 1144 | | | 65 | | | 35 | 0 | 0 | 18 | 11 | 80 | 20 | | 19 | 1003 | | .80 | | | 2 |
| 1174 | 10 | 10 | 30 | 50 | 0 | 0 | 0 | 0 | 19 | 12 | 90 | 10 | | 12 | | | 7.49 | | | 1 |
| 1175 | 50 | 30 | 0 | 0 | 0 | 0 | 0 | 20 | 19 | 12 | 70 | 30 | | 10 | | | 3.11 | 14 | 223 | 1 |
| 1176 | 0 | 30 | 10 | 60 | 0 | 0 | 0 | 0 | 19 | 12 | 60 | 40 | | 10 | | | .98 | | | 1 |
| 1177 | 75 | 20 | 0 | 0 | 0 | 0 | 0 | 5 | 19 | 12 | 85 | 15 | | 22 | | | 1.35 | 14 | 46 | 1 |
| 1181 | 100 | | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 12 | 60 | 40 | | | | | | | | 1 |
| 1182 | 75 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 12 | 50 | 50 | | | | | | | | 1 |

1/ Column variables are the following: 1 through 7 are fractions of soil groups (values must be multiplied by 0.01); 8 is the fraction of water (value must be multiplied by 0.01); 9 is the weather station number; 10 is the county number; 11 through 13 are land uses (11 is cropland, 12 is pasture and range, and 13 is water area); 14 is canal index; 15 is surface-water irrigated acres; 16 is land surface elevation; 17 is canal lengths; 18 is lake index; 19 is lake area; and 20 is ground-water factor (1 is upland and 2 is flood plain or terrace).

ATTACHMENT J. Listing of PRED Program--Continued
Part 2. Input Data

File 12. 1980 irrigated lands and other related land uses, in acres

| Element number | 1980 irrigated land | Surface water irrigated land | 1980 irrigated land | 1980 dryland | Water areas | SW shortage after supplemental GW | Maximum irrigable land | Areas of element |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | 982.88 | 0.0 | 0.0 | 0.0 | 982.88 |
| 2 | 0.0 | 0.0 | 0.0 | 672.53 | 0.0 | 0.0 | 0.0 | 672.53 |
| 3 | 400.0 | 0.0 | 400.00 | 5225.06 | 0.0 | 0.0 | 4950.05 | 5625.06 |
| 1180 | 500.00 | 0.0 | 500.00 | 3307.77 | 0.0 | 0.0 | 3350.84 | 3807.77 |
| 1181 | 0.0 | 0.0 | 0.0 | 720.04 | 0.0 | 0.0 | 3350.84 | 720.04 |
| 1182 | 0.0 | 0.0 | 0.0 | 643.48 | 0.0 | 0.0 | 3350.84 | 643.48 |

ATTACHMENT J. Listing of PRED Program--Continued
Part 3. Output

Average water applied per acre, in feet, for 9 canals
from 1963 through 1978

```
 4.43 2.71 7.26 1.8210.24 1.64 1.28 1.33 1.30
```

Element data[1/]

```
   Element# Element area(acres)
     1     1      982.88
     2     2      672.53
     3     3     5625.06
```

1/ Data continues through the last element, 1182.

Annual county land use values[1/]

```
   1     2     3     4     5     6     7     8     9    10
0.4310.0200.0660.9130.9100.0070.0810.0100.7240.275   TPMRCROP
```

1/ This is a data check. Values printed are for county #12 and for 1978. Columns 1 through 10 are the fraction of land not cultivated, dryland row crop, dryland small grain, dryland alfalfa and tame hay, irrigated row crop, irrigated small grain, irrigated alfalfa, cultivated land under fallow, cropland under irrigation, and cropland not under irrigation, respectively.

ATTACHMENT J. Listing of PRED Program--Continued
Part 3. Output

Average seepage values for 9 canals and 4 reservoirs from 1963 through 1978

```
1822.7    8.0  61.2 253.8 306.5  98.6 223.41093.6 111.2  25.2   3.0   9.7   4.1
```

Average recharge or discharge values for each element during the nonirrigation season and irrigation season from 1963 through 1978

NON IRRIGATION SEASON PUMPAGE NO ELEM = 1182

```
1/0.11 0.02 0.34 0.19 0.35 0.22 0.03 0.33 0.08 0.16 0.06 0.14 0.21 0.26 0.33 0.33 0.31 0.05 0.26 0.07 0.40 0.19 0.09 0.20
  0.22 0.09 0.31 0.28 0.32 0.36 0.15 0.07 1.20 0.69 0.23 0.65 0.07 0.30 0.41 0.08 1.09 0.13 0.46 0.20 0.82 0.23 0.39 0.19
```

IRRIGATION SEASON PUMPAGE NO ELEM = 1182

```
 0.10 0.02-3.62 0.17-7.06 0.19 0.02-0.90 0.07-2.21-3.48 0.13-0.99-2.12-4.27-7.77 0.37 0.97-0.84-1.09-4.22-4.51-1.87-3.28
-6.81-3.42-2.00 0.31 0.35-4.31 0.16-0.90-4.70-4.03 0.23-1.69-5.78*****-0.06 0.09-8.44-6.91-5.36-4.52***** 0.28-8.00-3.76
```

1/ Positive values are recharge and negative values are discharge. Units are cubic feet per second. The value in the first column and row is for element number 1. There are a maximum of 24 elements for each row. Elements are listed sequentially from 1 to 1182.