THESIS

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NUMERICAL SIMULATION FOR CONVECTION OF CONTAMINANTS IN GROUNDWATER

Submitted by

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ABSTRACT

A numerical model which simulates the convective transport of conservative ions through groundwater aquifers is presented and discussed. The model uses the fully implicit, central finite difference technique to predict transient, two-dimensional areal groundwater level or piezometric head fluctuations, the corresponding flows, and the convective transport of conservative ions. The model uses the fully explicit finite difference technique to calculate the contaminant concentrations. The model neglects the dispersion portion of the convective-dispersion equation. Either square or rectangular grids which remain constant throughout the study period may be used.

Simple longitudinal and radial flow problems are solved. In addition, criteria to assure convergence and stability of the model are developed theoretically and empirically. The sensitivity of the model to variations in grid size, time increment and seepage velocity are presented.

The study was limited to confined aquifers. However, the model has been developed to handle unconfined aquifers also. The study was also limited to homogeneous and isotropic porous media.

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CHAPTER^II INTRODUCTION

Water is the most abundant substance on earth. It is estimated that there is six times as much water on the earth as there is feldspar, the most abundant solid material. Of all the fresh water, approximately 97% -- about 8 trillion acre-feet -- is groundwater (Universal Oil Products, 1974).

Rapid population and industrial growth have led to extensive utilization of groundwater for municipal, agricultural, and industrial purposes. At the same time, improper disposal of human wastes, garbage and toxic chemicals, in addition to agricultural irrigation and fertilization, and a general unfamiliarity with groundwater hydrology have resulted in many instances of groundwater contamination.

These problems have finally begun to make officials aware of the potential for contamination of groundwater aquifers. The need for managing the quality of groundwater has also become apparent. In order to study and predict the areal distribution of contaminants in groundwater aquifers, it is necessary to understand the movement of the contaminants through the groundwater systems.

Groundwater Quality Modeling and its Limitations

As a means to study the movement of contaminants in groundwater aquifers, numerical models using digital computers have been developed.

These models simulate the movement of groundwater with additional provisions to simulate the transport and dispersion of contaminants.

Recent attempts at developing groundwater quality models have been limited primarily to conservative substances, principally the mineral salts. While this simplifies the development process, it is not undesirable since certain conservative parameters (e.g. total dissolved solids, chlorides, etc.) are of significant interest to water quality agencies.

These water quality models generally model only one contaminant at a time. The models are normally two-dimensional simulating areal or vertical distribution of the contaminant. While many models ignore the effects of soil chemistry, some models (Water Resources Engineers, Inc., 1969, and Perez et al, 1972) take the effects of the unsaturated soil zone into account.

Various numerical techniques have been used in the attempt to simulate the convective transport and dispersion of contaminants in groundwater aquifers. The finite difference technique has been adapted using the fully explicit, fully implicit (including forward, centered, and backward in time approaches), and the alternating-direction methods for solution. Previous research has indicated that, while these methods are valid, large amounts of computer time and storage usually limit their application.

The finite element technique has been studied more recently because it supposedly has advantages over the finite difference technique. However, some studies have shown that the Rayleigh-Ritz method exhibits convergence and stability problems and is not applicable to cases where

convection is the dominant transport mode. Another approach, the Galerkin method, requires large amounts of computer storage and time because small time steps and grid sizes must be used during the early calculations.

The method of characteristics is another numerical technique used to simulate convective transport and dispersion. Initial research where concentration values of the stationary grids were plotted indicated a significant amount of numerical dispersion. However, additional studies were made and accurate results obtained when the concentrations of the moving points were plotted.

Objectives of this Study

The previous discussion indicates that serious limitations are inherent in most numerical methods used to simulate convection and dispersion in groundwater aquifers. Most of the models require that the coefficient of dispersion be known and that the users have an extensive understanding of numerical methods, groundwater hydrology and the convection-dispersion process. In addition, these models often require extensive field data and very large amounts of computer time and storage.

Sunada (McWhorter et al, 1977) presented a finite difference numerical model called WTQUAL1 which simulates the convective transport of conservative ions. This model simplifies the simulation of contaminant movement through groundwater aquifers by neglecting the dispersion process. The model ignores the effects of the unsaturated soil

column and handles only one conservative parameter at a time. By using the fully explicit technique to calculate contaminant concentrations, the model minimizes the need for costly computer storage and time.

The objectives of this study are to:

- Briefly discuss WTQUALL, paying particular attention to the groundwater flow equation and the mass balance equation used to calculate the contaminant concentrations.
- Modify WTQUAL1 so that it is applicable to a wider variety of problems.
- Verify the numerical model by comparing numerical solutions to appropriate analytic solutions.
- 4. Develop criteria to assure convergence and stability of the model.
- 5. Perform a sensitivity analysis of the model, specifically evaluating those terms which appear in the stability criteria.

A review of literature dealing with numerical simulation of convection and dispersion in groundwater aquifers will be made. The problems encountered in these approaches will be noted and the effort of this study directed toward minimization or elimination of these problems. The existing numerical model will be modified and a hypothetical aquifer developed for which both numerical and analytic solutions for convection problems will be made. Computer runs will be made primarily on the HP 9830A desk-top computer with verification of these runs being made on the CDC 6400. Theoretical and empirical approaches will be used to develop criteria to assure convergence and stability of the model. Analyses will be performed to determine the sensitivity of the model to changes in grid size, length of time increment and seepage velocity. In addition, runs will be made to verify that the model produces accurate results for the two-dimensional convection process resulting from radial flow from a recharge well.

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CHAPTER II

CONVECTION AND DISPERSION IN POROUS MEDIA

The first recorded study of dispersion in porous media was done inadvertently by Slichter (1905). In attempting to determine the rate of movement of groundwater, he injected a salt solution into a well and observed the time of arrival at an observation well down-gradient. He noted that the salt did not arrive at the observation well as a slug, but that the salt concentration gradually increased to some maximum value and then decreased. Since that time, much work has been done on the properties of dispersion and molecular diffusion of contaminants in groundwater.

Variation of concentration of contaminants in groundwaters is caused by three processes: convection, dispersion and molecular diffusion. Convection is the transportation of contaminants associated with groundwater flow and is based on the average seepage velocity. Dispersion in a porous media is associated with the convection process and results from a mechanical mixing caused by the individual fluid particles traveling at variable velocities through the pore spaces of the media and along microscopic path lines. Molecular diffusion results directly from the thermal motion of the individual fluid molecules and takes place under the influence of a concentration gradient. A detailed discussion of convection and dispersion is contained in Bear (1972).

Due to the difficulty encountered in trying to describe the boundary conditions on a microscopic scale (i.e. diffusion), the system is usually described on a macroscopic scale (i.e. convection and dispersion). Dispersion is a function of three physical properties: the fluid, the porous media, and fluid flow. Fluid properties of concern are density, viscosity, contaminant concentration, and miscibility of fluids in systems containing two or more fluid types. Media properties affecting dispersion are permeability, pore geometry, and pore space dimensions. Velocity is the major flow property.

According to Scheidegger (1961), and deJosselin deJong and Bossen (1961), the convection and dispersion of a contaminant in fluid flow through a saturated homogeneous porous medium is described by the differential equation:

$$\frac{\partial C}{\partial t} = \frac{\partial}{\partial x_{i}} \left[D_{ij} \frac{\partial C}{\partial x_{j}} - v_{i}C \right]$$
(2-1)

where D_{ij} = coefficient of dispersion

C = the contaminant concentration

- t = time

 x_i (i=1,2,3) = the cartesian space coordinates.

The double subscripting of D_{ij} and x_i, x_j represent the tensorial nature of the dispersion process. The first term in brackets represents the dispersion process while the second term represents convection.

Analytic Solution of Longitudinal Convection and Dispersion

For longitudinal convection and dispersion in a homogeneous and isotropic porous medium with a plane source at $x_3=0$ (see Figure 2-1), Equation 2-1 becomes:

$$\frac{\partial C}{\partial t} = D_L \frac{\partial^2 C}{\partial x_3^2} - v_3 \frac{\partial C}{\partial x_3}$$
(2-2)

where D_L is the longitudinal dispersion coefficient neglecting molecular diffusion. The initial and boundary conditions needed for the schematic in Figure 2-1 to apply for steady state flow in the direction of the velocity vector are as follows: the concentration $C=C_0$ of the contaminant source is constant for all times; the concentration in the porous media is initially zero for all values of x_3 ; the concentration at x_3 equal infinity is always zero. Mathematically, these initial and boundary conditions are given by:

$$C(0,t) = C_0 ; t \ge 0$$

$$C(x_3,0) = 0 ; x_3 \ge 0$$

$$C(\infty,t) = 0 ; t > 0.$$
(2-3)

Ogata and Banks (1961) used Laplace transforms to obtain the following solution to Equations 2-2 and 2-3:

$$\frac{C}{C_0} = \frac{1}{2} \left[\operatorname{erfc} \left(\frac{x_3 - v_3 t}{2\sqrt{D_L t}} \right) + \exp \left(\frac{v_3 x_3}{D_L} \right) \operatorname{erfc} \left(\frac{x_3 + v_3 t}{2\sqrt{D_L t}} \right) \right] \quad (2-4)$$

where erfc=1-erf. For areas not close to the source and where $x_3 > v_3 t$, the second term in Equation 2-4 can be omitted and the equation simplified to:



Figure 2-1. Schematic of longitudinal dispersion.

$$\frac{C}{C_0} = \frac{1}{2} \left[1 - \operatorname{erf} \left(\frac{x_3 - v_3 t}{2 \sqrt{D_L t}} \right) \right]$$
(2-5)

Where $x_3 < v_3 t$, the applicable equation is:

b

$$\frac{C}{C_0} = \frac{1}{2} \left[1 + \operatorname{erf} \left(\frac{x_3 - v_3 t}{2\sqrt{D_L t}} \right) \right]$$
(2-6)

Equations 2-5 and 2-6 assume that the dispersion is symmetric about the point $C/C_0=0.50$ and assume steady state flow but non-steady state dispersion.

Analytic Solution of Longitudinal and Lateral Dispersion and Longitudinal Convection

If the source area is less than the area through which flow is occuring, longitudinal and lateral dispersion and longitudinal convection will occur. A schematic of this condition is shown in Figure 2-2(a).

For a homogeneous and isotropic media with one dimensional flow in the x_3 direction only, the governing equation is:

$$\frac{\partial C}{\partial t} = D_L \quad \frac{\partial^2 C}{\partial x_3^2} + D_T \frac{\partial^2 C}{\partial x_3^2} - v_3 \quad \frac{\partial C}{\partial x_3}$$
(2-7)

where D_T is the lateral (transverse) dispersion coefficient. For steady state conditions and with flow in the direction of the velocity vector, the initial and boundary conditions for this equation are:

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$$C(x_{2},0,t) = C_{0} ; 0 \le x_{2} \le b ; t \ge 0$$

$$C(x_{2},0,t) = 0 ; b \le x_{2} \le k_{2} ; t \ge 0$$

$$\frac{\partial C(0,x_{3},t)}{\partial x_{2}} = 0 ; t > 0$$

$$\frac{\partial C(k_{2},x_{3},t)}{\partial x_{2}} = 0 ; t > 0$$

$$C(x_{2},\infty,t) = \text{bounded}$$

$$C(x_{2},x_{3},0) = 0 ; 0 \le x_{2} \le k_{2} ; x_{3} > 0$$

$$(2-8)$$

The actual dispersion process is graphically shown in Figure 2-2(b). Harleman and Rumer (1963) gave the following approximate steady state



Figure 2-2. Schematic of longitudinal and lateral dispersion.

solution to Equations 2-7 and 2-8:

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$$\frac{C}{C_0} = \frac{1}{2} \left[1 - \operatorname{erf} \left(\frac{x_3 - b}{2 \sqrt{D_T \frac{x_3}{v_3}}} \right) \right]$$
(2-9)

Analytic Solution for Radial Convection and Dispersion

The partial differential equation governing radially symmetric diverging flow and the associated convection and dispersion from a well is (Bear, 1972):

$$\frac{\partial C}{\partial t} = va_{I} \frac{\partial^{2} C}{\partial r^{2}} - v \frac{\partial C}{\partial r}$$
(2-10)

where r is the radial distance from the recharging well and a_I is the longitudinal dispersivity of the porous media expressed as the coefficient of dispersion D_I divided by the seepage velocity v. For a well of radius r_w injecting a fluid at a constant rate into a confined aquifer, the initial and boundary conditions for Equation 2-10 are:

$$C(\mathbf{r}, \mathbf{t}) = C_0 ; \mathbf{t} > 0 ; \mathbf{r} = \mathbf{r}_2$$

$$C(\mathbf{r}, 0) = 0 ; \mathbf{r} > \mathbf{r}_w$$

$$C(\infty, \mathbf{t}) = 0 ; \mathbf{t} > 0$$
(2-11)

Because of the nonlinearity of Equation 2-10 (resulting from the fact that v is a function of r), exact analytic solutions are difficult to obtain. However, deJosselin deJong (Lau et al, 1959) obtained the following approximate analytic solution to Equation 2-10

$$\frac{C}{C_0} = \frac{1}{2} \left[1 - \operatorname{erf} \left(\frac{\mathbf{r} - \overline{\mathbf{r}}}{\sqrt{\frac{4}{3} \mathbf{a}_{\mathrm{I}} \overline{\mathbf{r}}}} \right) \right]$$
(2-12)

where \overline{r} is the average radius of the body of injected water.

Raimondi et al (1959) suggested an approximate solution to Equation 2-10 based on the assumption that the influence of dispersion becomes small in comparison to the local convective effect as the contaminant moves away from the source. They assumed that the influence of dispersion and diffusion on the concentration distribution as the contaminant moves past any point becomes small as compared to the accumulated effect of dispersion and diffusion that has taken place up to that point. For the case of a well continuously injecting a contaminant of constant concentration they derived the equation:

$$\frac{C}{C_0} = \frac{1}{2} \left[1 - \operatorname{erf} \left(\frac{r^2/2 - Gt}{\sqrt{\frac{4}{3} a_I \overline{r^3}}} \right) \right]$$
(2-13)

where G is obtained from the relationship

$$G = \frac{Q}{2\pi h\phi} = vr$$
 (2-14)

where h is the saturated thickness of a confined aquifer, v is the seepage velocity and ϕ is the porosity.

Dispersion Coefficients

Ebach and White (1958) developed the following empirical relationship for the longitudinal dispersion coefficient based on experiments over a wide range of particle sizes and shapes and where the Reynolds numbers (\mathbb{R}) were less than 100:

$$\frac{D_L}{v} = \alpha_1 \left(\frac{vd}{v}\right)^{\beta_1}$$
(2-15)

where $\left(\frac{vd}{v}\right)$ = the Reynold's number \mathbb{R}

v = the fluid velocity

d = the particle size of the porous media

v = the kinematic viscosity of the fluid

 α_1 and β_1 = porous medium coefficients.

They found that α_1 is strongly dependent on the porous medium while β_1 is a function of the flow regime and the porous medium. Various experimental values for α_1 and β_1 have been obtained and are listed in Table 2-1.

| Reference | °1 | β1 |
|----------------------------|------|------|
| Harleman and Rumer (1963) | 0.66 | 1.2 |
| Hoopes and Harleman (1965) | 1.70 | 1.2 |
| Ebach and White (1958) | 1.92 | 1.06 |

TABLE 2-1. Experimentally Determined Values for α_1 and β_1

Harleman et al (1963) also correlated the longitudinal dispersion coefficient with intrinsic permeability and obtained the following empirical relationship:

$$\frac{D_{\rm L}}{v} = \alpha_2 \left(\frac{v\sqrt{k}}{v}\right)^{\beta_2}$$
(2-16)

where k is the intrinsic permeability. They found $\alpha_2=54$ for spheres and 88 for sand with $\beta_2=1.2$ for both media.

Attempts to fit the lateral dispersion coefficient into a form similar to Equation 2-15 led to the following equation:

$$\frac{D_{T}}{v} = \alpha_{3} \left(\frac{vd}{v}\right)^{\beta_{3}}$$
(2-17)

Experimental values for α_3 range from 0.036 (Harleman and Rumer, 1963) to 0.11 (Hoopes and Harleman, 1965). Both studies estimated β_3 to be 0.7.

Review of Finite Difference Simulation Techniques

Numerical methods approximate the governing differential equations, allowing for high speed solution of a set of equations. While the use of analytic solutions is limited to simplistic problems, the numerical models can be applied to problems involving many source or sink terms and a variety of boundary conditions. To verify the validity of a numerical scheme, it is necessary to compare numerical and analytic solutions for the same problems. A discussion of numerical methods is contained in Conte (1965).

Douglas, Peaceman and Rachford (1959) solved the problem of miscible displacement in a two-dimensional flow field using an alternating-direction implicit scheme. This work was expanded on by Peaceman and Rachford (1962) and by Blair and Peaceman (1963). Two significant problems were often encountered: either the results were effected by numerical dispersion or the solution developed severe oscillations, especially in the regions where the concentration changed rapidly. Numerical dispersion is the error associated with the numerical approximation of the governing differential equation.

In an effort to overcome the problems of instability and numerical dispersion, Stone and Brian (1963) developed a method which consisted of writing a general finite difference equation for the one-dimensional convective-dispersion equation. Their method contained arbitrary weighting coefficients for approximations to the space and time derivatives of the contaminant concentration. With proper choice of weighting coefficients, the model did reduce oscillations and numerical dispersion but could not handle two- and three-dimensional problems. Shamir and Harleman (1966) took advantage of the Stone and Brian scheme by transforming the two-dimensional dispersion equation into a potential flow coordinate system (i.e., equipotential and streamlines). In this case, the velocity is everywhere tangential to the streamlines and the equation becomes one-dimensional in the convective term. They observed that C/C_0 values greater than 1.0 occurred behind the dispersion front. While the method did exhibit this oscillation, the solution was considered stable since the magnitude of the oscillation was constant with time.

Shamir and Harleman also discussed several basic finite difference approaches of simulating the movement of contaminants in groundwater aquifers. They stated that the fully explicit method of calculating the contaminant concentrations was impractical due to the large amounts of computer time required to solve even very simple problems. They determined that the grid size in the direction of flow must be on the order of a single grain size. They also concluded that the maximum admissible time increment was of the order required for the mean velocity to cover a distance equal to a fraction of the grain size. This particular numerical scheme required that the coefficient of dispersion be known to solve the dispersion equation.

Review of Finite Element Simulation Techniques

The finite element technique supposedly has several advantages over the finite difference technique. Chief among these are the use of smaller amounts of computer time and less storage, additional flexibility available to model irrigular shaped basins by using triangular grids as

opposed to square or rectangular grids, and a minimizing of numerical dispersion. Whereas the finite difference technique solves the dispersion equation directly, the finite element technique uses a functional which is minimized for each triangular element. The resulting set of equations is then solved.

Price, Cavendish and Varga (1968) used the Galerkin method for solution of the one-dimensional diffusion-convection equation. They obtained more accurate results while requiring less computer time than central or non-central finite difference approximations and the method of characteristics.

Guyman (1970a) applied the Rayleigh-Ritz finite element technique to the solution of the nonsteady state one-dimensional diffusionconvection equation and later extended it to the two-dimensional case (1970b). The method was not applicable to problems defined by mixed partial differential equations. Later, Guyman (1972) suggested an improvement to his previous solution of the convective dispersion equation but that method displayed numerical dispersion and gave erratic results for small values of the dispersion parameters. It was concluded that the method was not applicable to convection dominated mass transport.

The efforts by Guyman and additional work by Nalluswami (1971) suggested that the method could not be applied to convection dominated transport which is the case for a majority of field situations. In addition, the time domain solution was comprised of inherently explicit schemes and so exhibited convergence and stability problems.

Prakash (1974) applied the Galerkin method to the flow of salt water towards partially penetrating wells located in homogeneous and isotropic aquifers consisting of a fresh water layer overlying a salt water layer. He found that in order to prevent oscillations in the solution of the flow equation, small initial time steps must be followed by gradually increasing time step size. He also found that the number of elements required for reasonably accurate results with a linear interpolation function has to be very large, necessitating huge amounts of computer storage. Due to the combined effect of small initial time steps and the large number of elements, the number of iterations to be performed becomes very large.

Review of Method of Characteristics Simulation Technique

Garder, Peaceman and Pozzi (1964) used the method of characteristics to solve the problem of miscible displacement of an oil-solvent system in order to reduce numerical dispersion. The method gave good results for low oil-solvent viscosity ratios but ignored the tensorial nature of dispersion. However, the method required large amounts of computer time and storage while giving results slightly more accurate than previous, cheaper methods.

Reddell and Sunada (1970) developed flow and convective dispersion equations for non-homogeneous, unsteady flow fields. The flow equation was solved using an implicit numerical technique and the convective dispersion equation was solved using the method of characteristics. This technique required so much excessive storage to catalog information on each moving point that auxilliary storage was required. They observed that the magnitude of error did not converge to a minimum value

regardless of the number of points used per grid in the simple onedimensional case. They also observed that the concentration profile lagged the actual frontal movement when the moving points remained inside a grid throughout a time step. Use of a weighted-average in the concentration calculations and taking the tensorial nature of dispersion into account allowed for more accurate calculations.

Kraeger (1972) applied the method of characteristics as developed by Reddell and Sunada to a field problem. She observed numerical dispersion inherent in the method of characteristics which did not show up in Reddell and Sunada's study. She attributed this to the grid size used. Reddell and Sunada used grids on the order of fractions of centimeters in size, allowing the actual physical dispersion to partially absorb the numerical smear. Kraeger used grids approximately one-half mile square which clearly indicated the numerical dispersion. She also encountered difficulty in trying a trial-and-error process to arrive at a time increment which produced a concentration distribution resembing the data collected in the field.

Shariatmadar Taleghani (1974) used the method of characteristics to solve the convective-dispersion equation for the case of partially penetrating wells pumping from an aquifer consisting of a fresh water layer underlain by salt water. He obtained accurate results when the concentrations of the moving points were plotted. Kraeger had plotted the concentrations of the stationary grids while neglecting the dispersion process. Therefore, she whould have obtained a vertical front regardless of the value of the dispersion coefficient. Shariatmadar Taleghani concluded that the numerical dispersion which Kraeger noted

was a result of the manner in which she plotted the concentration distribution curves and not the grid size used.

Summary of Previous Research

The development of the analytic solutions for dispersion in porous media were major accomplishments. However, their applicability to physical situations is severely restricted. The effect of boundary conditions and inability to handle more than one contaminant source are serious limitations.

The numerical methods which have been developed offer a significant improvement over the analytic solutions but have their own limitations. These methods often require large amounts of costly computer time and storage. Many of the models are affected by instability. In addition, some models require extensive physical data such as longitudinal and lateral dispersion coefficients which are often economically impossible to obtain or which simply are unavailable.

CHAPTER III THE GROUNDWATER QUALITY MODEL

The groundwater staff of the Civil Engineering Department at Colorado State University recognized the need to develop a numerical approach to simulate two-dimensional flow in aquifers consisting of multiple sources and sinks. The basic philosophy of the model was presented in Bittinger et al (1967). Eckhardt (1976) modified the model to handle confined and unconfined leaky aquifers. Sunada (McWhorter et al, 1977) added provisions to simulate the convection of conservative water quality parameters and called the model WTQUAL1.

Groundwater Flow Equation

The basic non-linear partial differential equation describing twodimensional transient flow in a saturated porous medium may be derived from the mass continuity equation and Darcy's Law and written as (Jacob, 1950):

$$\frac{\partial}{\partial x} (K_x h \Delta y \frac{\partial H}{\partial x}) \Delta x + \frac{\partial}{\partial y} (K_y h \Delta x \frac{\partial H}{\partial y}) \Delta y = S \frac{\partial h}{\partial t} \Delta x \Delta y + Q$$
(3-1)

where h =saturated thickness of aquifer (L)

- H = water table elevation above datum (L)
- K = hydraulic conductivity (L/T)
- S = storage coefficient (dimensionless)
- Q = net groundwater withdrawal (L^3/T)

x,y = space dimensions (L)

t = time dimension (T).

Equation 3-1 has no general solution. However, by making use of the grid system shown in Figure 3-1, a finite difference approximation of this equation will allow a numerical solution. Equation 3-1 written in implicit, central finite difference form is as follows:

$$\begin{bmatrix} AH_{i,j-1} + BH_{i,j+1} + CH_{i-1,j} + DH_{i+1,j} - (A+B+C+D+E)H_{i,j} \end{bmatrix}^{t+\Delta t}$$

= Q - EH_{i,j}^{t} (3-2)



Figure 3-1. Finite difference grid notation (adapted from Bittinger, et al).

where,

$$A = \frac{2K_{i,j} \cdot K_{i,j-1} \cdot \Delta y_{i,j} \cdot \Delta y_{i,j-1} \cdot h_{i,j-1/2}}{\Delta y_{i,j} \cdot K_{i,j} \cdot \Delta x_{i,j-1} + \Delta y_{i,j-1} \cdot K_{i,j-1} \cdot \Delta x_{i,j}}$$

$$B = \frac{2K_{i,j} \cdot K_{i,j+1} \cdot \Delta y_{i,j} \cdot \Delta y_{i,j+1} \cdot h_{i,j+1/2}}{\Delta x_{i,j} \cdot K_{i,j+1} \cdot \Delta y_{i,j+1} + \Delta x_{i,j+1} \cdot K_{i,j} \cdot \Delta y_{i,j}}$$

$$C = \frac{2K_{i,j} \cdot K_{i-1,j} \cdot \Delta x_{i,j} \cdot \Delta x_{i-1,j} \cdot h_{i-1/2,j}}{\Delta y_{i,j} \cdot K_{i-1,j} \cdot \Delta x_{i-1,j} + \Delta y_{i-1,j} \cdot K_{i,j} \cdot \Delta x_{i,j}}$$

$$D = \frac{2K_{i,j} \cdot K_{i+1,j} \cdot \Delta x_{i,j} \cdot \Delta x_{i+1,j} \cdot h_{i+1/2,j}}{\Delta y_{i,j} \cdot K_{i+1,j} \cdot \Delta x_{i+1,j} + \Delta y_{i+1,j} \cdot K_{i,j} \cdot \Delta x_{i,j}}$$

$$E = \frac{S_{i,j} \cdot \Delta x_{i,j} \cdot \Delta y_{i,j}}{\Delta t}$$

Equations 3-1 and 3-2 are subject to the Dupuit-Forchheimer assumptions and also assume that the fluid and porous medium are incompressible.

The subscript notation refers to particular grid blocks in a fivegrid system as indicated in Figure 3-1. The superscript t refers to the starting time or previous time level, Δt is the time increment and t+ Δt is the current time level. Equation 3-2 is written for each grid in the study area for each designated time increment. The system of equations for the first time increment is solved simultaneously for the values of $H_{i,j}$ at the end of the time increment. These computed values of $H_{i,j}$ are then used as initial values in the system of equations representing the next time increment.

The coefficients A, B, C, and D are computed for each grid at the beginning of each time increment and are held constant during the time increment. The term $(h_{i,j-1/2})$ in the equation for coefficient A is the effective saturated thickness between grids (i,j-1) and (i,j) calculated by the following approximation:

$$h_{i,j-1/2} = MAX(H_{i,j}, H_{i,j-1}) - MAX(Z_{i,j}, Z_{i,j-1})$$
 (3-3)

where Z equals the bedrock elevation above a datum. A similar expression may be written for the h term in the equations for the coefficients B, C, and D. The value for the storage coefficient, S, included in coefficient E, various spatially but remains constant in time. If the time increment is also constant, coefficient E will remain constant in time for each grid.

The rate of net groundwater withdrawal, Q, represents the deep percolation of precipitation and applied surface water, and the rate of net withdrawal by pumping. The extraction of water by phreatophytes or the addition of water by artificial recharge could also be included in the value of Q. It is necessary to calculate an average value of Q for each grid for each time increment.

Water Quality Aspects of WTQUAL1

WTQUAL1 was developed primarily to model the convection of contaminants which are picked up when water flows through strip mine tailings. The model allows for a continuous contaminant source in those cases where the contaminants go into solution over a long period of time. The model considers as slug sources those cases where the contaminants go into solution in a relatively short period of time.

WTQUAL1 uses the fully explicit method to determine relative contaminant concentrations during each time increment. However, the model only allows consideration of water quality parameters within the aquifer itself. Other contaminant sources such as rivers, lakes, irrigated land and artificial recharge areas cannot be considered when using WTQUAL1. The fully explicit method, which assumes complete and instantaneous mixing of the waters in the aquifer, satisfies the objective of a simplistic convective transport simulator. In addition, the fully explicit method as utilized in WTQUAL1 provides results of sufficient accuracy to render the numerical simulator a valid approach.

Since it was desirable to develop a simplistic simulator of convection in groundwater aquifers, it was felt that WTQUAL1 offered an excellent starting point. Because WTQUAL1 was based on a groundwater flow model, all the required inputs and outputs of the groundwater system, the geologic parameters and a provision for either slug or continuous contaminant injection were available. The primary modification required was to make provisions for including and varying input contaminant concentrations for each source variable for each desired time increment to be studied. This involves estimating relative concentrations of contaminants in rainfall, water applied as irrigation, constant head sources (e.g., lakes, rivers, ponds), artificial recharge areas, and the underflow into the aquifer from outside the area being studied.

Modifications to WTQUAL1

The first modification to WTQUAL1 involved providing for the input of initial contaminant concentrations for all source waters. This was accomplished by expanding Subroutine READPH (see Appendix B for a flowchart of the computer program and Appendix C for a description of all subroutines). Provisions were made for reading in, as either slug or continuous sources, initial contaminant concentrations for precipitation, water applied as irrigation, water

artificially recharged to the aquifer, and constant head sources such as rivers, lakes and ponds. These initial concentrations can be input as a constant throughout the study area or can be varied from grid to grid.

The second modification, which is actually an extension of the previous one, involved providing for the change of the contaminant concentrations of all the source waters at each time increment of analysis. This was accomplished by adding Subroutine READC to the program. A controlling variable, AGGIE, is included in the initial data input to the numerical model. Depending on the value of AGGIE, the model either uses the initial contaminant concentrations for each time increment of analysis or control is transferred to READC at the beginning of each time increment and new relative concentration values are read in. Concentrations for flows through boundary grids into the study area are included in this data input.

The next modification occurred in Subroutine QFIX. In order for the relative contaminant concentration calculation to be made later in the program, it was necessary to convert all flows to a consistent volumetric unit and to identify and store this volume for each source and sink for each grid in the study area. These terms are then retrieved by Subroutine BYFLØW where the actual concentration calcuations are made.

Due to the structure of Subroutine BYFLØW, the concentration calculation process was broken into two steps. First, an intermediate change in contaminant mass for the current time level was computed based on all source and sink terms except constant head grids. This step includes the actual flow of groundwater within the aquifer. Then, all constant head

contributions to each grid were calculated. A new total change in contaminant mass was computed, converted to a relative concentration value and combined with the relative concentration value at the previous time step to give the new relative concentration value for each grid.

For confined aquifers, the model automatically excludes contaminants resulting from precipitation, water applied as irrigation, water artificially recharged to the aquifer, and phreatophyte consumption. However, contaminants removed by pumping and added by constant head sources in direct contact with the aquifer are included.

These modifications make the numerical model suitable for application to many problems involving either confined or unconfined aquifers. This modified version of WTQUAL1 is called WTQUAL2.

Explicit Contaminant Mass Balance Equation

The fully explicit mass balance equation used in calculating the contaminant concentrations is very similar to that used in the development of the basic groundwater flow equation. In general terms, the mass balance equation can be written as:

| RATE OF CHANGE OF CONTAMINANT IN THE AQUIFER | = | RATE OF CONTAMINANT INFLOW TO THE AQUIFER | - | RATE OF CONTAMINANT OUTFLOW FROM THE AQUIFER |
|--|---|---|---|--|
| L _ | | | | |

(3-4)

where the assumption is made that the rate of contaminant removal within the aquifer is zero (i.e. we are modeling a conservative substance).

The grid system used is identical to that shown in Figure 3-1. However, for more detailed illustration, a typical grid is shown in Figure 3-2 indicating the various parameters which effect the mass
balance calculation. Neglecting the dispersion process, the applicable explicit mass balance equation in finite difference form is:

$$C_{i,j}^{t+\Delta t} = C_{i,j}^{t} + [(V^{t+\Delta t} \cdot C^{t})_{i,j-1} + (V^{t+\Delta t} \cdot C^{t})_{i-1,j} - V_{i+1,j}^{t+\Delta t} \cdot C_{i,j}^{t}]$$

- $V_{i,j+1}^{t+\Delta t} \cdot C_{i,j}^{t} + (W \cdot C)_{i,j}^{t+\Delta t} - V LEAK_{i,j}^{t+\Delta t} \cdot C_{i,j}^{t}] / [U_{i,j}^{t+\Delta t}]$ (3-5)

where $C_{i,j}$ = relative contaminant concentration in the grid i,j $V_{i,j-1}$ = volume of flow from grid i,j-1 to grid i,j $C_{i,j-1}$ = relative contaminant concentration corresponding to $V_{i,j-1}$ $V_{i-1,j}$ = volume of flow from grid i-1,j to grid i,j



Figure 3-2. Typical aquifer grid illustrating parameters which influence a change in concentration.

 $U_{i,j}$ = total volume of water stored in grid i,j. The term $(W \cdot C)_{i,j}^{t+\Delta t}$ is determined from the following relationship:

$$(W \cdot C)_{i,j}^{t+\Delta t} = [(V \cdot C)_{PPT} + (V \cdot C)_{RCHR} + (V \cdot C)_{APW} + (V \cdot C)_{SQR}$$
$$- (V \cdot C)_{PHR} - (V \cdot C)_{PUM}]_{i,j}^{t+\Delta t}$$
(3-6)

where the volumes, V, and relative contaminant concentrations, C, apply to precipitation (PPT), artificial recharge (RCHR), water applied as irrigation (APW), recharge from constant head sources such as rivers, lakes and ponds (SQR), phreatophyte consumption (PHR), and pumping from wells (PUM). This equation encompasses the modifications made to WTQUALL allowing the contaminant concentrations of all source and sink waters to be taken into account.

Description of the Numerical Model

WTQUAL2 uses the fully implicit, central difference technique to predict transient, two-dimensional areal groundwater level (or piezometric head) fluctuations and the corresponding flows. Based upon these flows, the model uses the fully explicit mass balance technique to simulate the convection of contaminants through the aquifer. The study area is overlain with a grid system. The selection of grid dimensions are dependent upon the stability criteria of the concentration calculation (see Chapter IV). The rectangular grid system is oriented to allow for easy boundary approximation, provide for easy adaption of hydrologic and geologic data, and to meet the required stability criteria.

The program reads in the number of rows and columns for the entire grid system, including those of the buffer zones which are built into the program (Olson, 1973). The desired time increment of analysis, total time of analysis, and time increment printout are also input to the program.

The dimensions of each grid and values for hydraulic conductivity, bedrock elevation, ground surface elevation, storage coefficient or specific yield, coefficient for the fraction of each grid that is irrigated, initial relative concentrations for all source waters, and initial relative concntrations for each of the grids in the aquifer are read as input data. All values are held constant throughout the time of analysis except for source water concentrations which may be changed at the beginning of each time step. New values of the aquifer concentrations are calculated for each time increment based on the previous concentration of each grid and the addition or loss of contaminant during the time period Δt .

Contaminant concentrations are read in and calculated as relative concentrations ranging from 0.0 to 1.0. Normally, a source concentration is considered to have a value of 1.0. However, if concentrations are anticipated which might exceed a source concentration, then an arbitrary

value can be assigned to the relative concentration value of 1.0 and all other values will be referenced to it.

The initial water table (or piezometric head) elevations are also read in for each grid. Impermeable boundary grids, constant head boundary grids, and grids with horizontal underflow are identified by coding the initial water table elevations. For boundary grids having underflow, the difference in water elevation between the outermost boundary grid and the next inner grid is held constant throughout the total time of the analysis (i.e., a constant hydraulic gradient is maintained).

The program also reads in hydrologic data for annual precipitation (the model assumes a uniform depth of precipitation over the entire study area), annual water applied as irrigation (the model assumes a uniform application of the water over the irrigated portion of the grid in question), annual phreatophyte extraction, gross annual pumping withdrawal, and annual application of water to recharge pits. The annual precipitation, irrigation, phreatophyte, pumping, and recharge values are read in for each grid of the study area for the year to be analyzed. One set of annual distribution coefficients is read in for each of the five types of hydrologic data. The coefficients represent the percentage of annual precipitation, irrigation, phreatophyte consumption, pumping, and recharge that occurs during each of the time increments. The coefficients are read in initially and remain constant throughout one year of analysis but may be changed at the beginning of each additional year of analysis.

The program also reads in coefficients that represent the percentage of precipitation, applied water, and recharge water that percolates to the water table. Another coefficient is read in to represent the percentage of the gross pumping withdrawal that does not return to the water table.

The program uses the Gauss elimination method to solve the system of equations for each time step. The program output at desired time steps includes the following:

- Matrix of net vertical withdrawal of water from each grid including precipitation, applied water, pumping, artificial recharge, phreatophyte consumption and leakage.
- 2. List of overdrawn or flooded grids.
- List of grids, if any, which change from confined to unconfined or unconfined to confined.
- 4. Matrix of discharge between grids in the i-directions. Flow down is considered positive and flow upward is negative. Discharge in the first row of the matrix is the flow between grids in row 1 and 2, and so on for the remainder of the grids. Therefore, the value in the last row is always zero.
- 5. Matrix of discharge between grids in the j-direction. Flow right is positive and flow left is negative. Discharge in the first column of the matrix is the flow between grids in column 1 and 2 and so on for the remainder of the grids. Therefore, the value in the last column is always zero.
- 6. Matrix of net flow from constant head grids.

- 7. Table of water balance computations.
- 8. Matrix of water table or piezometric head elevations.
- 9. Matrix of relative contaminant concentrations.

CHAPTER IV

NUMERICAL SIMULATION OF CONVECTIVE TRANSPORT

As mentioned in the introduction, a major purpose of this research was to study a simplistic numerical technique to simulate convection of contaminants in groundwater aquifers. This attempt at a simplistic model is based on the fully explicit method of calculating contaminant concentrations. In order to compare numerical and analytic results, the aquifer studied must have both numerical and analytic solutions.

A hypothetical one-dimensional, homogeneous and isotropic, steady state situation was developed using representative values of aquifer properties for a coarse sand commonly encountered in actual physical situations (McWhorter and Sunada, 1977). The assumptions and calculations associated with the development of the hypothetical situation are discussed in Appendix A and a schematic of the layout is shown in Figure 4-1. In order to assure that flow was steady state, the saturated thickness of the aquifer was held constant and a constant hydraulic gradient was maintained.

Verification of the Longitudinal Convection Case

The longitudinal convection case was verified using a onedimensional, steady state flow situation with a constant contaminant source located along the inflow boundary of the model. Hydraulic conductivity was uniform throughout the model and the piezometric head was oriented to provide a constant gradient in the direction of flow



Figure 4-1. Schematic of the hypothetical aquifer with constant contaminant source.

and zero gradient perpendicular to the direction of flow. Boundaries parallel to the direction of flow were considered impermeable. This results in a constant seepage velocity v being maintained throughout the aquifer in the direction of flow.

The numerical results were compared with those derived from Equations 2-5 and 2-6. The results for time equal 90, 180, 270, and 360 days and grid size equals 115 feet for a time increment of 30 days and grid size equals 40 feet for a time increment of 10 days are shown graphically in Figures 4-2 and 4-3, respectively.

The analytic solution is at all times located a distance equal to the product of the seepage velocity and the elapsed time from the contaminant source. The numerical solution satisfies this condition for the case where C/C_0 has a value of approximately 0.5.

The numerical model yielded relative concentration values which decreased gradually with increasing distance from the contaminant source. The shape of the numerically determined curve can be attributed to the numerical dispersion inherent in the model. This numerical dispersion is a result of the error which occurs from numerically approximating the governing differential equation. It is a function of the numerical model and is independent of the aquifer properties.

The abrupt change of the analytic solutions shown in Figures 4-2 and 4-3 is a result of neglecting the dispersion process. Therefore, the curves shown are actually vertical lines. The analytic solutions including the dispersion process were calculated but not plotted. The shape of these curves could not be distinguished from the curves neglecting the dispersion process.



Figure 4-2. Numerical versus analytic solutions for $\Delta x/v\Delta t=1$ and $\Delta t=30$ days.



Figure 4-3. Numerical versus analytic solution for $\Delta x/v\Delta t=1$ and $\Delta t=10$ days.

Previous research indicates that analytic solutions are usually S-shaped curves similar to the numerical solutions shown. The seepage velocities and the associated dispersion coefficients for the analytic solutions used in this study are typical for actual physical situations and are low relative to those used by many previous researchers. As a result, the analytic solutions take on essentially vertical profiles.

The results shown in Figures 4-2 and 4-3 indicate that the method used to calculate the relative concentrations of the contaminant is a valid method, especially in the region near the point where $C/C_0=0.5$. For the particular cases illustrated, the method gives results to within approximately ±10 percent for all relative concentration values $0 \le C/C_0 \le 1.0$ at time equal 360 days.

In addition, Figures 4-2 and 4-3 indicate that the results are stable for all times. Thus, the accuracy of the solution does not decrease with time. If the initial error which is introduced during the very early time steps when large concentration gradients are present can be minimized, then a high degree of accuracy can be maintained throughout the period of study.

Verification of the Radial Convection Case

To show that the numerical model is applicable to problems other than simple one-dimensional flow, the model was run for a simplistic twodimensional case. This involved simulating the injection of a contaminant into a confined aquifer through a recharge well. A constant rate of flow containing a conservative contaminant was injected into a homogeneous and isotropic confined aquifer and the convection of the contaminant was radially symmetric about the location of the well.

The model was first run for a square grid network where all grids were of a uniform size. The center grid of the system was used to simulate a recharge well by maintaining a constant head throughout the period of analysis. This resulted in radial, diverging flow into the aquifer from the recharge grid. The flow rate from the recharge grid into the aquifer remained constant for all time. The piezometric head of all grids surrounding the recharge grid were initially level and a uniform constant head was maintained on all boundary grids.

The concentration distribution curves for various times and the associated analytic solutions for Equation 2-13 neglecting dispersion are shown in Figure 4-4. It can be seen that the numerical solutions lag the analytic solutions by a large but relatively constant value. This can be attributed to the fact that the numerical model (using a rectangular coordinate system) is trying to simulate purely radial, diverging flow. The fact that the model only approximates this condition results in the errors shown.

In order to minimize this problem, a run was made for an almost identical hypothetical situation except the grid sizes were varied radially, from small dimensions near the recharge grid to larger grids on the edge of the grid network. The results for this condition are plotted in Figure 4-5. These results are better with regard to the location of the point where $C/C_0=0.5$, improving on the results shown in Figure 4-4.

Semi-logarithmic plots were made of piezometric head versus radial distance at time equal 270 days for both the uniform and variable grid size problems. While the results showed that neither solution was



DISTANCE (ft)

Figure 4-4. Concentration distribution curves for radial flow in a uniform size grid network.



DISTANCE (ft)

Figure 4-5. Concentration distribution curves for radial flow in a variable size grid network.

exact with regard to the radial flow case, both numerical solutions gave good approximations at points located away from the recharge grid. The curve for the variable grid size problem became linear at a radial distance of approximately 200 feet while the uniform grid size problem did not become linear until a radial distance of approximately 500 feet had been reached. The fact that the variable grid size problem gives a better approximation of the radial flow case nearer the recharge grid explains the reason for the improved accuracy over the uniform grid size problem.

The concentration distribution curves in Figures 4-4 and 4-5 exhibit significant amounts of numerical dispersion. As time increases the magnitude of the numerical dispersion increases. However, the error in distance between the numerical and analytic solutions at the point where $C/C_0=0.5$ remains constant with increasing time.

For radially symmetric, diverging flow with a constant flow rate, the velocity of the fluid decreases with increasing distance from the recharge grid. It will be shown in Chapter V that the degree of numerical dispersion is a function of the grid size, time increment and seepage velocity.

Stability Criteria

The general equation governing longitudinal convection and dispersion, which was discussed previously, is

$$\frac{\partial C}{\partial t} = D_L \frac{\partial^2 C}{\partial x^2} - v \frac{\partial C}{\partial x}$$
(2-2)

For the purpose of developing the simplistic model, the term $D_L \frac{\partial^2 C}{\partial x^2}$ was assumed to be zero. This reduced Equation 2-2 to

$$\frac{\partial C}{\partial t} = -v \frac{\partial C}{\partial x}$$
(4-1)

Using the backward finite difference expansion, Equation 4-1 becomes

$$\frac{C_{i}^{t} - C_{i}^{t+\Delta t}}{\Delta t} = -\nu \frac{C_{i}^{t} - C_{i-1}^{t}}{\Delta x}$$
(4-2)

Rearranging Equation 4-2 and solving for $C_i^{t+\Delta t}$ yields

$$C_{i}^{t+\Delta t} = \frac{\mathbf{v} \cdot \Delta t}{\Delta \mathbf{x}} \left[C_{i-1}^{t} - C_{i}^{t} \right] + C_{i}^{t}$$

$$(4-3)$$

Noting that contaminant concentrations are at all times between zero and one, and that the worst condition is given by $C_i^t=0$, $C_{i-1}^t=1.0$ and $C_{i-1}^{t+\Delta t}=1.0$, Equation 4-3 reduces to

$$1 = \frac{v \cdot \Delta t}{\Delta x} [1 - 0] + 0 \tag{4-4}$$

Simplifying this equation leads to the stability criteria

$$\frac{\Delta x}{v \cdot \Delta t} \ge 1.0 \tag{4-5}$$

An identical criteria was developed empirically and is discussed below.

Upon examining the runs made using the numerical model, it was noted that the volume of water flowing through a finite difference grid during each time increment must not exceed the volume of water stored in the grid during the time increment under study or severe oscillation and instability of the solution would occur. Mathematically, this necessary condition for the one-dimensional flow case may be expressed as

$$Q \leq \Delta x \cdot \Delta y \cdot h \cdot \phi \tag{4-6}$$

where Q = volume of flow through the grid

 Δx , Δy = grid dimensions

h = saturated thickness

\$\phi\$ = porosity.

Noting that the volume of flow through the grid may be expressed using Darcy's law, the grid dimensions and the time increment, Equation 4-6 may also be written as

 $\mathbf{v} \cdot \Delta \mathbf{y} \cdot \Delta \mathbf{t} \cdot \mathbf{h} \cdot \phi \leq \Delta \mathbf{x} \cdot \Delta \mathbf{y} \cdot \mathbf{h} \cdot \phi \tag{4-7}$

where v is the seepage velocity and Δt is the time increment. Cancelling like terms and rearranging this equation, we get

$$\frac{\Delta x}{v \cdot \Delta t} \ge 1.0 \tag{4-8}$$

This relationship (which is identical to that developed by expanding the governing partial differential equation) indicates that the grid dimension in the direction of flow must at all times be greater than or equal to the seepage velocity times the time increment. If this criteria is not met, severe oscillations and instability, as shown in Figures 4-6 and 4-7, will occur. It can also be shown that the greates accuracy of the model occurs when $\frac{\Delta x}{v \cdot \Delta t} = 1.0$. Figures 4-2 and 4-3, discussed earlier, are plots of two specific instances where this stability criteria has a value of unity.

Conservation of Contaminant Mass

Contaminant mass within the groundwater system is conserved at all times. This is a result of using the fully explicit method to calculate relative contaminant concentrations (i.e. mass of contaminant within each









grid). Chapter III contains a detailed discussion of the concentration calculation process.

All C/C_0 values range between 0.0 and 1.0. Since concentrations beyond the third significant figure are not normally of interest, the model only prints out concentrations to three decimal places. Many computers carry numbers to 10 or 15 significant figures. Therefore, grids with a printed concentration of 0.000 often have small contaminant concentrations. In order for a total conservation of contaminant mass to occur, these small concentrations must always be taken into account.

CHAPTER V

SENSITIVITY ANALYSIS OF THE NUMERICAL MODEL

The response behavior of the groundwater system to the convection of a contaminant may be influenced by many input variables and the interaction of many system parameters. The number of possible combinations of these factors is infinite -- not only in terms of magnitude of the factors, but also variations in time and space. It is seldom economically feasible to quantitatively evaluate all or most of the input variables and system parameters with precision. It is, however, very important that the effect of these variables on the accuracy of the model be known.

While most aquifers are not homogeneous and isotropic, these basic assumptions were made in order to simplify the development of the numerical model. As such, sensitivity of the numerical model to variations in the aquifer properties (i.e., permeability, stratification, porosity, storage coefficient, etc.) will not be discussed here. The parameters grid size, time increment and seepage velocity are the primary components of the stability criteria. The effects of these properties on the accuracy of the numerical model should be studied prior to the effects of the aquifer properties.

Grid Size

For the purpose of analyzing the model's sensitivity to grid size, time increments of 10, 30 and 45 days were chosen. Previous work with the basic groundwater flow model indicated that these time increments yield results of sufficient accuracy for the groundwater flow. Also, a total model time of 360 days was chosen to compare the results of the various grid sizes.

Figure 5-1 shows the concentration distribution curves for grid sizes 115, 300, 500 and 1000 feet when the time increment is 30 days. It can be seen that the numerical dispersion increases with increasing grid size. As grid size increases, the numerical solution, as evidenced by the point where $C/C_0=0.5$, lags the analytic solution by an increasing amount. However, the calculated distance where $C/C_0=0.5$ for the 1000 foot grid size only lags the analytic solution by approximately 10 percent. Table 5-1 illustrates the percent error of distance for each grid size at various C/C_0 values.

| c/c ₀ | PERCENT DISTANCE ERROR | | | | |
|------------------|------------------------|--------|------|-------|--|
| | 115' | 300' | 500' | 1000 | |
| 0 | 3.6 | 82.9 | | | |
| 0.2 | 1.4 | 30.2 | | | |
| 0.4 | 0 | 7.2 | | | |
| 0.5 | 0 | - 1.4 | -3.6 | -11.0 | |
| 0.6 | 0 | - 9.3 | | | |
| 0.8 | - 1.4 | - 31.0 | | | |
| 1.0 . | -11.5 | -100.0 | | | |

TABLE 5-1. Value of C/C₀ Versus Percent Error in Calculated Distance



Figure 5-1. Concentration distribution curves for various grid sizes with $\Delta t=30$ days.

The data in Table 5-1 indicates that if a value of $\frac{\Delta x}{v \cdot \Delta t} = 1$ is chosen (in this instance this corresponds to a grid size of 115 feet), then accuracy within ±10 percent can be obtained for the entire concentration distribution curve while accuracy to within ±2% can be obtained for all values $0.2 \leq C/C_0 \leq 0.8$. Thus, the model has the capability of giving very accurate results. For $\frac{\Delta x}{v \cdot \Delta t} = 2.6$ (a grid size of 300 feet), accuracy to less than ±10 percent can be obtained for all values $0.4 \leq C/C_0 \leq 0.6$. As grid size increases, the model does lose accuracy. Yet, very good results are obtained for the location of the point where $C/C_0=0.5$ for all grid sizes. Figures 5-2 and 5-3 show the concentration distribution curves for various grid sizes when the time increment equals 10 days and 45 days, respectively. These figures confirm the conclusions drawn with respect to the 30 day time increment.

The data for grid sizes 115 feet and 300 feet in Table 5-1 also indicate that the numerical model does not produce a symmetric numerical dispersion pattern. This can be attributed to the fully explicit mass balance technique which is used to calculate the relative contaminant concentrations. Regardless of the speed at which the contaminant front moves, the numerical model advances the contaminant concentrations one grid with each calculation. As the time of analysis increases, so does the numerical dispersion and non-symmetry of the concentration distribution curve. Figures 5-1, 5-2, and 5-3 all indicate this pattern. However, by keeping the value of $\frac{\Delta x}{v\cdot\Delta t}$ as close to 1.0 as possible, this numerical dispersion and non-symmetric pattern is kept at a minimum, and in the case where $\frac{\Delta x}{v\cdot\Delta t} = 1$ actually stabilizes.







Figure 5-3. Concentration distribution curves for various grid sizes with $\Delta t=45$ days.

Time Increment

Figure 5-4 shows the relationship of the concentration distribution curves for time increments of 10, 30 and 45 days with a constant grid size of 300 feet at time equal 360 days. This illustrates that the use of a small time increment actually leads to an increase in numerical dispersion. This is due to the use of the fully explicit mass balance technique to calculate the relative concentration values. If a time increment of 10 days is used, three calculations are made over a thirtyday period as opposed to one for a thirty-day time increment. Since each calculation moves the contaminant down-gradient one grid, the model has a tendency to smear the front with each mass balance calculation. The use of as large a time increment as possible while meeting the stability criteria will keep this numerical smear to a minimum.

From Figure 5-4, it can be seen that each time increment gives approximately the same distance for a C/C_0 value of 0.5. Therefore, it can be concluded that while the time increment does have some effect on the accuracy of the numerical model, the effect is not as severe as that caused by variation in grid size.

The maximum value which can be chosen will be dictated by the hydrologic accuracy of the numerical model and the stability criteria. Figures 5-5 and 5-6 show the concentration distribution curves for various times when the grid size equals 500 feet and 115 feet, respectively. These figures confirm the conclusions drawn with respect to the 300 foot grid size. It should be noted that the larger variation



Figure 5-4. Concentration distribution curves for various time increments with $\Delta x=300$ feet.



DISTANCE (ft)

Figure 5-5. Concentration distribution curves for various time increments with $\Delta x=500$ feet.



Figure 5-6. Concentration distribution curves for various time increments with $\Delta x=115$ feet.

indicated by Figure 5-6 is due to the fact that the $\frac{\Delta x}{v \cdot \Delta t}$ value for the 30 day time increment is 1.0, resulting in a very accurate approximation to the analytic solution which somewhat distorts the comparison with the 10 day time increment.

Seepage Velocity

As indicated by Equation 2-16, the dispersion coefficient is directly related to the seepage velocity. The analytic results presented previously are all related to one hypothetical case where the coefficient of longitudinal dispersion was calculated to be 1.44×10^{-3} ft²/day. It should be noted that the coefficient of dispersion was estimated based on Equation 2-16 (Harleman, et al, 1963). While there is a small loss of accuracy in estimating the coefficient in this manner, the research by Harleman, et al, indicated that this is a valid relationship which gives accurate results. The results of this study tend to indicate that this estimation is very accurate and that confidence can be expressed in the results obtained based upon this empirical relationship.

To verify the validity of the numerical model for general use, the model was run for hypothetical cases using various values of seepage velocity. Table 5-2 lists the particular cases studied. As with the original hypothetical case, McWhorter and Sunada (1977) was used as a reference to obtain typical values of porosity and hydraulic conductivity for groundwater aquifers. The concentration distribution curves for the medium sand and medium gravel are shown in Figures 5-7 and 5-8, respectively. It is apparent that the numerical model is valid for these different values of the seepage velocity and the associated dispersion coefficients. As discussed in the previous section, when $\frac{\Delta x}{v \cdot \Delta t} = 1$ the numerical model produces a close approximation to the analytic solution. As the value of $\frac{\Delta x}{v \cdot \Delta t}$ increases, numerical dispersion increases. However, the model continues to produce accurate results with respect to the location of the point where $C/C_0=0.5$ for all values of the seepage velocity. From this analysis, it can be concluded that while the numerical model neglects the dispersion process, the effect of dispersion for typical aquifer properties is very small relative to convection over the time periods used and thus the model is valid for the range of seepage velocities studied.

| CASE | TYPE OF MATERIAL | POROSITY ¢ | HYDRAULIC CONDUCTIVITY K ft/day | SEEPAGE VELOCITY v ft/day | DISPERSION COEFFICIENT $\frac{D_L}{ft^2/day}$ |
|------|---------------------|---------------|--|------------------------------------|---|
| 1 | Medium Sand | 0.41 | 40 | 0.975 | 1.26×10^{-4} |
| 2 | Coarse Sand | 0.39 | 150 | 3.846 | 1.44×10^{-3} |
| 3 | Medium Gravel | 0.31 | 1140 | 36.84 | 7.32×10^{-2} |

TABLE 5-2. Data for Cases Tested



Figure 5-7. Concentration distribution curves for a medium sand.



Figure 5-8. Concentration distribution curves for a medium gravel.

Summary of the Sensitivity Analysis

Results of the sensitivity analysis produce three independent conclusions. First, the grid size has a very large effect on the accuracy of the numerical model. For a constant time increment, the larger the grid size, the larger the numerical dispersion. Second, the value of the time increment chosen has little effect on the accuracy of the model. However, the larger the time increment, the greater the accuracy. Finally, the model is valid for a relatively wide range of seepage velocities commonly encountered in groundwater systems.

Collectively, additional conclusions can be drawn. Since the best numerical solutions occur when $\frac{\Delta x}{v \cdot \Delta t}$ =1 and when large time increments are used, this forces the use of large grid sizes which reduce computer time and storage requirements. So long as the value of $\frac{\Delta x}{v \cdot \Delta t}$ remains close to 1.0, the use of larger grid sizes does not significantly effect the accuracy of the model. In addition, the accuracy of the model for cases where $\frac{\Delta x}{v \cdot \Delta t}$ =1 is so good that results for all values $0 \le C/C_0 \le 1$ can be used with confidence. However, as the value of $\frac{\Delta x}{v \cdot \Delta t}$ increases, the range over which the C/C_0 values are acceptible decreases. Regardless, for all grid sizes the model produces very accurate locations of the point where $C/C_0 = 0.5$.
CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

From the results of this study, it can be concluded that the numerical model is a valid numerical approach for simulating convection in confined groundwater aquifers. The accuracy of the model is strongly dependent on the value of the function $\frac{\Delta x}{v \cdot \Delta t}$. If the value of this function can be maintained near unity, very good accuracy of the dispersion process can be obtained. While larger values of the function result in increasing amounts of numerical dispersion, the model at all times locates the point where $C/C_0=0.5$ with good accuracy.

With regard to the sensitivity of the model, conclusions can be drawn about each of the terms which appear in the function $\frac{\Delta x}{v \cdot \Delta t}$. With v and Δt held constant, increased numerical dispersion results with larger grid sizes. With Δx and v held constant, varying Δt has a much smaller effect on model accuracy than varying Δx . However, as Δt is increased, numerical dispersion is minimized and the accuracy of the model increases. The model is valid for a wide range of seepage velocities subject to the limitations imposed by varying Δx and Δt . It is shown that, for a given seepage velocity, the best results are obtained by maximizing Δt within the limits of the accuracy of the groundwater flow portion of the model and minimizing Δx so that the

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value of $\frac{\Delta t}{\mathbf{v} \cdot \Delta t}$ approaches 1.0. While this criteria does somewhat limit grid size, grid sizes on the order of hundreds of feet should be possible for most cases.

While the majority of work done as a part of this study was based on the one-dimensional, steady state flow condition, the model was developed to simulate two-dimensional, areal distribution of contaminants. For the radially symetric, diverging flow situation, the model produced relatively good results as the numerical approximation of the groundwater flow equation approached the solution for pure radial flow. The numerical dispersion increased with increasing distance from the contaminant source and is attributable to the increase in the value of the function $\frac{\Delta x}{v \cdot \Delta t}$ as the radial distance increases.

Several runs were made in which various numbers of recharge pits, pumping wells, constant head sources and phreatophyte sources were used. These indicated that the programming modifications made are correct insofar as computer language is concerned. However, no hypothetical cases were run to determine the accuracy and sensitivity of these contaminant sources.

In general, the numerical model minimizes many of the problems encountered with the development of previous numerical models. The model does not require prohibitive amounts of computer time or storage. It has the capability of handling impermeable, constant head and constant gradient boundaries. When the stability criteria is followed, the model is stable and converges to a reasonably accurate solution.

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It is recommended that the following areas be studied with regard to the fully explicit mass balance approach of simulating convection in groundwater aquifers:

- The validity of the model should be verified for non-homogeneous confined aquifers.
- 2. The validity of the model for both homogeneous and non-homogeneous unconfined aquifers should be established.
- 3. The model should be applied to an actual field problem.

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DETERMINATION OF HYPOTHETICAL AQUIFER PROPERTIES

APPENDIX A

DETERMINATION OF HYPOTHETICAL AQUIFER PROPERTIES

In order to show that WTQUAL2 is a valid dispersion simulator, it was felt that the data used in the comparison of the analytic and numerical solutions should be representative of values commonly encountered in actual physical situations. Therefore, typical values of hydraulic conductivity and porosity were chosen from a table in McWhorter and Sunada (1977) containing maximum, minimum and arithmetic mean values for soils ranging from the finest silts and clays to coarse gravels. The values K=150 ft/day and ϕ =0.39 were chosen for the sensitivity analysis of grid size and time increment and are representative of a typical coarse sand.

Once these values were chosen, it was then necessary to choose a value for the hydraulic gradient. Review of several actual physical situations indicated that a gradient of 0.01 (10 feet change in vertical elevation per 1000 feet change in horizontal distance) is typical and so this value was chosen.

Assuming that the flow regime would be laminar (this will be checked later), Darcy's law was applied. The version used in this situation was

$$q = K \cdot \frac{dh}{d1}$$
(A-1)

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where q is the Darcy velocity, K is hydraulic conductivity, and $\frac{dh}{dl}$ is the hydraulic gradient. Using the previously chosen values for K and $\frac{dh}{dl}$, a Darcy velocity q of 1.50 ft/day was obtained. Dividing this value by the porosity gave a seepage velocity v of 3.846 ft/day.

At this point in the analysis an additional assumption had to be made. For the purpose of this study, a groundwater temperature of 50°F was chosen. The groundwater system was then assumed to be isothermal throughout the period of study. The appropriate fluid properties of water at this temperature are

| dynamic viscosity | $\mu = 2.735 \times 10^{-5} \text{ lb-sec/ft}^2$ |
|-------------------------|--|
| kinematic viscosity | $v = 1.410 \times 10^{-5} \text{ ft}^2/\text{sec}$ |
| density | $\rho = 1.94 \text{ slugs/ft}^3$ |
| acceleration of gravity | $g = 32.2 \text{ ft/sec}^2$ |
| specific weight | $\gamma = 62.4 \ 1b/ft^3$. |

Applying the relationship between hydraulic conductivity and intrinsic permeability k

$$k = \frac{K^* \mu}{\rho g} = \frac{K^* \mu}{\gamma}$$
(A-2)

yielded a permeability of 7.609 x 10^{-10} ft².

At this point, Equation 2-16 as developed by Harleman et al (1963) was applied and a longitudinal dispersion coefficient value $D_L=1.439 \times 10^{-3} \text{ ft}^2/\text{day}$ was obtained. This value was then used in Equation 2-5 to obtain the analytic solution values of the concentration distribution curve. To verify that the flow regime was laminar, the Reynold's number **R** was calculated from the following equation:

$$\mathbb{R} = \frac{\nu\sqrt{k}}{\nu} \tag{A-3}$$

This calculation yielded $\mathbb{R} = 8.708 \times 10^{-5}$. Since this value is less than 0.01, the flow regime can be characterized as laminar and Darcy's law applies.

To determine the storage coefficient, it was necessary to estimate values for the pore volume compressibility and the compressibility of water due to the formation lying above the confined aquifer. Pore volume compressibility α_p was assumed to be 3×10^{-5} psi⁻¹ and compressibility of water β was assumed to be 3.3×10^{-6} psi⁻¹. These values are relatively constant for most problems commonly encountered in groundwater hydrology and are therefore assumed to be representative for the condition being studied.

A specific storage S_s of 5.68×10^{-5} ft⁻¹ was obtained by applying the formula

$$S_{s} = \rho \cdot g \cdot \phi \cdot (\alpha_{p} + \beta)$$
(A-4)

With a confined aquifer thickness set at 60 feet, a storage coefficient S of 0.0034 was obtained.

APPENDIX B

PROGRAM FLOW CHART

















APPENDIX C

DESCRIPTION OF SUBPROGRAMS

APPENDIX C

DESCRIPTION OF SUBPROGRAMS

Subroutine READPH

This subroutine reads and writes the physical data describing the study area. The following variables are read and printed: DX, DY, FK, Z, CS, CPPT, CAPW, CRCHR, CSQR, G, PHI, and PHIC. CA is also read but printed later. Coded values of CS are printed. Only one data card is required if all variables are uniform for each grid, otherwise each parameter that is variable must be read in matrix form. Variables DX and DY require only NC and NR values, respectively.

CALLED FROM: Main Program SUBPROGRAMS USED: MATRØP IMPORTANT VARIABLES: DX, DY, FK, Z, G, PHI, PHIC, CA, CS, CPPT, CAPW,

CRCHR, CSQR

Subroutine READH

This subroutine reads the initial coded water level or piezometric head elevations. H is decoded and set equal to HT and HP. One data card is required if the initial water level is horizontal, otherwise the entire H-matrix must be read.

CALLED FROM: Main Program SUBPROGRAMS USED: None IMPORTANT VARIABLES: H, HT, HP

Subroutine LEKAQF

This subroutine reads and writes the leaky aquifer parameters. The following variables are read and printed: HL, TL, and FKL. One data card is required if these variables are uniform, otherwise each matrix that is variable must be read.

| CALLED FROM: | Main Program |
|----------------------|--------------|
| SUBPROGRAMS USED: | MATRØP |
| IMPORTANT VARIABLES: | HL, TL, FKL |

Subroutine CSET

This subroutine initializes the relative concentration throughout the aquifer.

| CALLED FROM: | Main Program |
|----------------------|------------------|
| SUBPROGRAMS USED: | None |
| IMPORTANT VARIABLES: | CØ, CT, H, G, CS |

Subroutine STØRAG

This subroutine computes the initial storage and increase or decrease of storage. Total area and between station (between buffer zone boundaries) storage is calculated. Also storage of overlap areas is computed.

| CALLED FROM: | Main | Prog | ram | | | |
|----------------------|------|------|-------|----|-----|---|
| SUBROUTINES USED: | None | | | | | |
| IMPORTANT VARIABLES: | STA, | STT, | STØL, | Н, | HT, | Z |

Subroutine QFIX

This subroutine reads and writes the hydrologic parameters. The hydrologic and artificial inputs are then calculated for each grid. A value of zero on the input card indicates a particular parameter is not used. The exception to this is the number of grids with phreatophyte use, NGPU. If NGPU is blank, the entire PHR matrix must be read, otherwise the number of grids specified is read. NGPU equal to zero indicates no phreatophyte use.

Coding PHR less than one indicates that phreatophyte use should be calculated every time increment from the previous time step water level elevation. The ET subprogram is used for this.

The factors considered in QFIX are (1) precipitation, (2) applied water as irrigation, (3) phreatophyte use, (4) wells, (5) recharge areas or lines, and (6) leaky aquifer conditions.

CALLED FROM: Main Program

SUBPROGRAMS USED: ET

IMPORTANT VARIABLES: PPT, CPT, YPT, APW, CAW, YAW, NGPU, PHR, YPR, WELL, RPUM, YPM, PIT, RCHR, YRC, Q, SQT, SQA, REPEAT, CPM

Function ET

This subprogram computes the phreatophyte use for each grid using the water level elevations from the previous time step. If the depth of water table DTWT is negative, an error message is printed. It is anticipated this program, if used, will change with each study area.

| CALLED FROM: | QFI | X |
|----------------------|------|------|
| SUBPROGRAMS USED: | None | e |
| IMPORTANT VARIABLES: | ET, | DTWT |

Subroutine MATSØL

This subroutine sets up the coefficient matrix, CMATRX, and the right hand side vector matrix, CR. CMATRX is a reduced matrix containing only the band of known values in the left side of the difference equations and is written vertically rather than diagonally. Its dimensions are (NR-2)*(NC-2) by 2*NR-3. The coefficients are computed using Function PARAM and checked for adjacent boundary values of H in subroutine NSCØNT. MATSØL treats known grid values of H. BSØLVE is used to solve the matrix equation set up.

CALLED FROM: Main Program SUBPROGRAMS USED: PARAM, NSCØNT, BSØLVE IMPORTANT VARIABLES: CMATRX, CR

Function PARAM

This subprogram computes the coefficients in the left side of the finite difference equation. For confined aquifer analysis, saturated thickness is compared to aquifer thickness and the smallest of the two is used to calculate the coefficient.

CALLED FROM: MATSØL, BYFLØW SUBPROGRAMS USED: None IMPORTANT VARIABLES: PARAM

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Subroutine NSCØNT

This subroutine transfers the coefficients, in CMATRX, multiplied by their respective H-value, to the right hand side vector matrix in case of adjacent head or known boundary conditions. It also sets coefficients equal to zero in case of adjacent impermeable grids.

CALLED FROM: MATSØL SUBPROGRAMS USED: None IMPORTANT VARIABLES: None

Subroutine BSØLVE

This subroutine solves the matrix equation set up in MATSØL by Gauss Elimination. BSØLVE is designed specifically for a diagonal matrix that results from analysis of groundwater systems.

CALLED FROM: MATSØL SUBPROGRAMS USED: None IMPORTANT VARIABLES: None

Subroutine BJUST

This subroutine adjusts the underflow boundary water level elevations. Gradients are calculated three grids in from the exterior boundary grids and the gradients are projected back to the exterior boundary grids to obtain new water level elevations. This calculation is performed at even time steps. At odd time steps the water level elevations are held constant and the exterior boundary grids are treated as constant head grids.

CALLED FROM: Main Program SUBPROGRAMS USED: None IMPORTANT VARIABLES: H, HT

Subroutine ØDFLØD

This subroutine checks for overdrawn or flooded grids. If either should occur, a message is printed indicating such. For confined aquifer analysis the flooded grid computations are bypassed. Total flooded and overdraw amounts are computed for the total area and between stations. CALLED FROM: Main Program SUBPROGRAMS USED: None IMPORTANT VARIABLES: ØACFTT=ØVT, ØACFTA=ØVA, FACFTT=FVT, FACFTA=FVA

Subroutine BYFLØW

This subroutine computes flows for each grid. Total flow through model boundaries and buffer zone boundaries is calculated as well as flow into the system from constant head grids. The flow equation used is developed from the finite difference equations and uses particular values of the CMATRX. These values are transferred from MATSØL except for boundary values which are calculated in BYFLØW using Function PARAM. Flow is not allowed to or from an impermeable grid and between any two adjacent underflow grids. I-direction and J-direction flows are printed and flows from constant head grids are interpreted and printed as flow from river grids. Relative concentration calculations are made using the flow between grids.

CALLED FROM: Main Program

SUBPROGRAMS USED: PARAM, MATRØP

IMPORTANT VARIABLES: SQGGI, SQGGJ, SQBT, SQBA, SQR, SQRT, SQRA, CS,

CPPT, CAPW, CRCHR, CSQR

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Subroutine BALCØP

This subroutine writes the balance computations at the desired time steps specified by FWTØP. Mass balance for the entire area cannot always be obtained, due to accounting procedures used to compute mass flow at exterior boundary grids. However, for between stations, which refers to the area between the buffer zone boundaries, mass balance must always be satisfied except for the case when a confined grid becomes unconfined. This error should be small and is indicated by the "TOTALS" in the mass balance output being different than zero. To reduce this error, decrease the value of Δt . For confined aquifer analysis, a message is printed indicating if a grid becomes unconfined.

CALLED FROM: Main Program SUBPROGRAMS USED: None IMPORTANT VARIABLES: SQA, SQT, SQRA, SQRT, SQBA, SQBT, STT, STTTEM, STA, STATEM, STØL, ØVA, ØVT

Subroutine MATRØP

This subroutine organizes data or results into a suitable form for printing and then prints.

CALLED FROM: READPH, LEKAQF, QFIX, BYFLØW SUBPROGRAMS USED: None IMPORTANT VARIABLES: NR=NØRØW, NC=NØCØL

Subroutine READC

This subroutine reads in new relative concentration values for all source waters and the boundary grids for each time increment of analysis. Execution of this subroutine is controlled by the value AGGIE. If AGGIE is less than or equal to zero, only new concentrations for the boundary grids will be read in. If AGGIE is greater than zero, new values for each source water throughout the grid network can be read in as a single value. Variable concentrations must be read in matrix form. Boundary grid concentrations are read in one value per card for each grid other than impermeable boundaries.

CALLED FROM: Main Program SUBPROGRAMS USED: None IMPORTANT VARIABLES: CPPT, CAPW, CRCHR, CSQR, CØ, AGGIE

APPENDIX D

PROGRAM LISTING

PROGRAM WTQUAL2

PROGRAM WTQUAL2

C

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| | 20 |
|---|---|
| PROGRAM TO COMPUTE ARTIFICIAL AND HYDROLCCIC INFLUENCE CN GRCUND WATER LEVEL. | 30 40 50 |
| BASIC PROGRAM DEVELOPED BY THE GROUNDWATER STAFF AT C.S.U. | 6L 70 |
| MODIFIED FOR UNCONFINED AND CONFINED LEAKY AQUIFERS, CYNAMIC COFE Allocation and Strïp Mine Water Guality by D.K. Sunaca 1976. Modified as a groundwater quality management mocel by L.W. Pittman 1977. | 100 |
| SEE USERS MANUAL FOR DATA INFUT. | 110 |
| PROGRAM USES BUFFER ZONES. IT SHOULD BE NOTED THAT MASS BALANCE OCCURS FOR THE CASE OF CONSTANT HEAD OR IMPERMEABLE ROUNDAFIES. FOR THE CASE OF UNDERFLOW BOUNDARIES, ONLY MASS BALANCE BETWEEN BUFFER ZONES SHOULD BE EXPECTED. BUFFER ZONES ARE SET IN PROGRAM AND FOR EFFECTIVE USE, NR.GT.7 AND NC.GT.7. LOIW=LEFT (J) BUFFER ZONE | 130 140 150 160 170 180 |
| LCJH=TOP (I) BUFFER ZONE | 210 |
| LCJE=BOTTOM (I) BUFFER ZONE | 230 |
| FOR EXPLINATION OF VARIABLES AND SUBROUTINES, SEE SUBROUTINES. | 240 |
| CONTROL VARIABLES NR=NUMBER OF ROWS NC=NUMBER OF COLUMNS NR SHOULD ALWAYS BE LESS THAN OF EQUAL TO NC NH=MAXIMUM NUMBER OF WELLS NP=MAXIMUM NUMBER OF RECHIRGE PITS ICFA0=1 FOR CONFINED AGUIFER ANALYSIS, CTHERWISE BLANK ILKAQ=1 FOR LEAKY AQUIFER CONDITIONS, CTHERWISE BLANK OT=TIME INCREMENT (DAYS) ST=TOTAL TIME OF ANALYSIS (CAYS) FWTOP=DESIRED TIME OF OUTPUT (MULTIFLE OF CT) NA=NUMBER OF ROWS IN REDUCED BAND MATRIX NB=NUMBER OF TIME INCREMENTS FER YEAR IFK, IPHI ETC.=FIRST WORD ADDRESS OF FK, PHI ETC. AFRAYS | 2500 2700 2800 2900 31200 31200 3340 3400 3400 3400 3400 3400 3400 3 |
| DIMENSION TITLE(8) | 446 |
| COMMON /BLK1/ DT.ST.ICFAG,ILKAG,LCIE,LCIW,LCJE,LCJW,FWTOP COMMON /BLK2/ STA,STOL,STT,SGA,SGT,SGFA,SGBA,SGRT,SGBT,CVA,OVT COMMON C(2) | 460 470 480 |
| READ (5,200) TITLE | 500 |
| READ (5,270) AGGIE | 910 |
| IF AGGIE EQUALS 1, NEW GONGENTRATIONS MUST BE READ IN FCR EACH SOURCE WATER AT THE BEGINNING OF EACH TIME INCREMENT. IF AGGIE FOUAL 0, NEW CONCENTRATIONS MUST BE READ IN ONLY FOR CONSTANT HEAD AND CONSTANT GRADIENT BOUNDAFY GRIDS AT THE BEGINNING OF EACH TIM INCREMENT. IF AGGIE IS LESS THAN 0, OLD CONCENTRATION VALUES WILL BE USED FOR ALL SOURCE WATERS AND BOUNDARY GRIDS. | E |

| c | | | | 520 |
|------|-----|----------------------------|---------------------------|------|
| c | | NA=(NP=2) * (NC=2) | | 536 |
| | | N8=2*NR-3 | | 540 |
| C | | | | 551 |
| c | | INTR=350.0701 | | 570 |
| v | | IDC=NR*NC | | 580 |
| | | IFK=1 | | 590 |
| | | IPHI=IDC+1 | | 600 |
| | | I7=2*IDC+1 | | 610 |
| | | | | 63. |
| | | 10X=4*10C+1 | | 641 |
| | | ICA=6*IOC+1 | | 650 |
| | | IH=7*IOC+1 | | 660 |
| | | IHT=8*IDC+1 | | 67. |
| | | IHP=9*INC+1 | | 600 |
| | | | | 700 |
| | | 1017=12#100+1 | | 71 |
| | | IPHR=13*IDC+1 | | 720 |
| | | IS066I=14*IDC+1 | | 731 |
| | | ISQGGJ=15*IDC+1 | | 740 |
| | | ISOR=16*IDC+1 | | 75 |
| | | IA=17*IDC+1 | | 760 |
| | | | | 780 |
| | | THE=20*TDC+1 | | 79: |
| | | 100=21*100+1 | | |
| | | ICT=22*IDC+1 | | |
| | | ICS=23*I0C+1 | | |
| | | IAREA=24*IDC+1 | | |
| | | IOPPT=25*IDC+1 | | |
| | | 104PW=26*100+1 | | |
| | | TOPHR=28*TOC+1 | | |
| | | IOPUM=29# IDC+1 | | |
| | | IQLEAK=30*IDC+1 | | |
| | | ICPPT=31*IOC+1 | | |
| | | ICAPH=32*IDC+1 | | |
| | | ICRCHR=33*IDC+1 | | |
| | | ICP49=34*IDC+1 | | |
| | | 10PUM=35*10C+1 | | |
| | | ICSOR=37*IDC+1 | | |
| | | IPHIC=ICS+ICFAQ*IDC | | |
| | | IHL = IPHIC + ILKAQ * IDC | | 810 |
| | | ITL = IHL + ILKAQ * ICC | | 82: |
| | | IFKL=ITL+ILKAO*IOC | | 830 |
| 223 | | IEND1=38*IDC+ICFAQ*IDC+ILK | AQ+3+IDC | |
| C | | TYRT-TENDING | | 850 |
| | | TYPR=TYPT+TNY2 | | 87 0 |
| | | TYAW=TYPR+TNYP | | 685 |
| | | IYPM=IYAH+INYR | | 890 |
| | | ICPM=IYPM+NW*INYR | | 90. |
| | | IRPUM=ICPM+NW | | 91. |
| | | IYRC=IRPUM+NW | | 920 |
| | | TENCA-TENDIATOTNYPANWETNYD | 1 2 * NUAND# T . VD+ ND+1 | 94 |
| C | | TENCE-TENDITS TNIKTNA TNIK | T2 MATHE SALE OF T | 95) |
| | | TOWATRY-TEND241 | | 961 |
| | | TCR=TEND2+(NA*NA)+1 | | 970 |
| | | TENDS=TEND2+NA+ (NA*NB) | | 985 |
| C | | | | 99(|
| 1.00 | | LWA=LOCF(C(IEND3)) | | 1000 |
| | | WRITE (6, 230) LWA | | 1010 |
| | | DO 100 LT=1. TENDS | | 1020 |
| | | | | |
| | 100 | CONTINUE | | |
| C | | | | 1030 |
| | | LCIW=3 | | 1040 |
| | | LCIE=NC-2 | | 1050 |
| | | LCJW=3 | | 1060 |
| • | | LCJE=NR-2 | | 108. |
| C | | NETTE (6.210) STTLE | | 1690 |
| | | IF (ILKAQ.LE.0) GO TO 110 | | 1105 |
| | | | | |

| <pre>110 [] 10 []</pre> | | 50 TO 13C | |
|--|-------|---|--|
| <pre>Control 10 120 wFife (6.500) 130 wFife (6.500) 130 wFife (6.500) 130 wFife (6.500) 130 wFife (6.500) 140 (Fife) (CICPP): CICPCHA: CICSCR: CICSC: CICR: CICCA 1.C(TPHCD) - CICCPPH: CICCACH, CICSCR: CICSC: CICCACHER, CICSCR: CICCACHER, CICC</pre> | 110 | IF (ICFAQ.LE.D) GO TO 120 | |
| <pre>120 wFITE (6.300) 130 wFITE (6.300) 130 wFITE (6.300) 140 cfile (6.100) WR.NC.CIFK).CIEDCHK).CIEDS.CIEDS.CIEDS.CIEDS. CALL READPH (NR.NC.CIHH).CIEDFN.CIEDCHK).CIEDS.CIEDS.CIEDS.CIEDS. CALL READH (NR.NC.CIH).CIEDFN.CIEDCHK).CIEDS.CIEDS.CIEDS.CIEDS. CALL READH (NR.NC.CIH).CIEDFN.CIEDFN.CIEDFN.CIEDS. CALL STOPAG (NR.NC.CIH).CIEDS.CIEDT.CIEDFN.CIEDF</pre> | | 50 TC 130 | |
| <pre>130 wFite (6.100) NR.NC.DT.ST CALL READEN (NR.NC.CGIFK).G(IFNI).G(II).G(IGX).G(IGX).G(IGX).G(IGA) 1.G(IPHIG).G(IGPT).G(IGA).G(IHP).G(IHT).G(IFF).BC.RBG.TBC.BBG) IF (ILKAQLE.D) GO TO 140 CALL STOPAG (NR.NC.G(IH).G(IF).G(IT).G(IFF).BC.RBG.TBC.BBG) IF (ILKAQLE.D) GO TO 140 CALL STOPAG (NR.NC.G(IH).G(IF).G(IZ).G(IDX).G(IDY).G(IPHI).C(IG). IG(IPHG)) GALL STOPAG (NR.NC.G(IC).G(IGT).G(IA).G(IDX).G(IDY).G(IPHI).C(IG). IG(IPHG)) GALL OSET (NR.NC.G(ICO).G(IGT).G(IA).G(IDX).G(ID).G(IF).I.G(IG). IGOPUL=ST/DT INDX=1 DC 170 I=1.LOOPUL IDT=0T 1.100+01 CALL ANDSC (NR.NC.G(IF).G(IDF).G(IDF).G(ID).G(IDF).G(IG).G(IPHID). GALL ANJSCL (NR.NC.G(IH).C(IF).G(ID).G(ID).G(IG).G(IPHID).G(IG).G(ID). GALL ANJSCL (NR.NC.G(IH).C(IF).G(ID).G(ID).G(IG).G(IPHID).G(ID).G(I 1.100+0.000.G(ICMATRX).G(ICC).G(ID).G(ID).G(IG).G(IPHID).G(ID).</pre> | 120 1 | WRITE (6,260) | |
| CALL READPH (NR.NC.C(IFK).C(IFK).C(IF).C(IG).C(IDX).C(IDY).C(ICA) 1(C)TPHIC).C(ICPP).C(ICAPH).C(IHF).C(IHF).LBC.RBC.C(IDX).TAR ZEAD CALL READH (NR.NC.C(IH).C(IHF).C(IHF).LBC.RBC.TBC.RBC) IF (ILKAOLF.D) GG TO 140 CALL STOPAG (NR.NC.C(IH).C(IF).C(IFKL)) 140 CALL STOPAG (NR.NC.C(IHO).C(IF).C(IF).C(IDY).C(IDY).C(IPHI).C(IG). 16(IFMIC)) CALL CSET (NR.NC.C(ICO).C(ICT).C(IH).C(IG).C(ICS)) LOOPUL=ST/DT INDX=1 DC 170 I=11. J=TOT*II J=TOT*II 151 T1=J1 12=J2 CALL OFIX (NF.NC.C(IDX).C(IDY).C(ICA).C(IF).C(IZ).C(IHT).I.C(IC 1 .N.NP.C(IPHR).C(ITWELL).C(IFT).C(IFM.C(IH).C(IFA).C(IFF). CALL OFIX (NF.NC.C(IDX).C(IDY).C(ICA).C(IF).C(IZ).C(IDF).C(IFF). CALL OFIX (NF.NC.C(IH).C(IFT).C(IFF).C(ITAM.C(IHF).C(IFF).C(IFF). CALL MAND.C(IPHR).C(ITWELL).C(IFT).C(ITMA.C(IHF).C(IFF).C(IFF). CALL MAND.C(IPHR).C(ITWELL).C(IFF).TN.NC.C(IHF).C(IFF).C(IFF).C(IFF). CALL MAND.C(IPHR).C(ITWELL).C(IFF).TN.NC.C(IHF).C(IFF).C(IFF). CALL HATSOL (NF.NC.NC.NA.NS).C(IFF).C(IA).C(IF).C(IG).C(IFF).C(IZ).C(ID 1 X).C(IDV).C(IQ).C(ICMATRX).C(IFF).C(IZ).C(ID).C(IDV).C(IDF).C(IZ).C(ID).C(IDV).C(IDF).C(IZ).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(IDX).C(ID).C(IDX).C(ID).C(IDX).C(ID).C(ID).C(IDX).C(ID).C(IDX) | 130 1 | FITE (6.190) NR.NC.DT.ST | |
| <pre>1.SCTEPHTD://SCTEGAPHY.SCTEGAPHY.C</pre> | | CALL READER (NR. NC. CLIEVA CLIEVA) CLITAL CLITAL CLICAL CLIDAL CLICAL | |
| CALL READM (NR.NC.C(IH).C(IHP).C(IHT).C(IHF).LBC.RBC.RBC.BC) IF (ILKAG.LF.0) GO TO 140 CALL LEKADY (NR.NC.C(IH).C(IF).C(IT).C(IDX).C(IDY).C(IPHI).C(IG). 1C(IPHIC)) CALL SET (NR.NC.C(IC).C(IF).C(IT).C(IDX).C(IDY).C(IPHI).C(IG). 1C(IPHIC)) CALL OSET (NR.NC.C(IC).C(IC).C(IDY).C(IDX).C(IDY).C(IPHI).C(IG). 1C(IPHIC)) CALL OSET (NR.NC.C(IDX).C(IDY).C(ICA).C(IH).C(IZ).C(IHT).I.C(IC 1DT=DT J=TDT*(I=1) J2=TDT*I FIT FIT FIT 71=J1 2 .C(IFRUM.C(IPHR).C(IHFL).C(IT).C(ITAM).C(IYPR.C(IFK). 3 C(IC).C(IPHRTHP).C(IDAPH).C(ICACHT).C(ICAM).C(IYPR.C(IFK). 3 C(IC).C(IPHRTHP).C(IDAPH).C(ICACHT).C(ICACHT).C(IDPHR).C(IC). 4 C(IC).C(IPHRTHP).C(IC).C(ITCCHT).TN *R.C(IHL).C(IT).C(IE).C(ID). 5 CALL MATSOL (NR.NC.NC.NA.NS.C(IF*).C(IPHI).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(ID).C(IC).C(IC).C(IC).C(IPHIC).C(ID).C(IC).C(IC).C(IC).C(ID | 1. | C(IPHIC), C(ICPPT), C(ICAPW), C(ICRCHR), C(ICSGR), C(ICS), C(IAREA), TAR | |
| <pre>F (ILKAD.LF.D) GO TO 140 GALL LEKAOF (NR,NC,G(IHL),G(ITL),C(IFKL)) (A40 CALL STOPAG (NR,NC,G(IHL),G(IFT),G(IZ),G(IDX),G(IDY),G(IPHI),C(IG), iG(IPHI),C(IG)) GALL CSET (NR,NC,G(ICO), G(ICT), G(IH), G(IG),G(ICS)) LOOPUL=ST/OT INOV=1 DO 170 T=1,LOOPUL IOT=0T J=:IOT=T FI=1 T=2-J2 GALL OFIX (NF,NC,G(IDX),C(IDY),G(ICA),G(IH),C(IZ),G(IHT),I,G(IG 1,NH,NP,G(IPHR),G(IYFL),C(IPTI),C(ITAH),G(IYFR),G(IYFR), C(IGPHR),G(ICFR),C(IOY),C(IOY),IN,NC(IHL),G(ITL),G(IFKL), 3 C(IG),G(IPHRTNP,G(IOPF),C(IOAPH),IN,NC(IHL),G(ITL),G(IFKL), 3 C(IG),G(IPHRTNP,G(IGPF),C(IGAPH),IN,NC(IHL),G(ITL),G(IGPHI),C(IDPHR),C(IOPHR),C(IDPHI),C(IH),C(IH),C(IHF),C(IZ),C(ID),C(I</pre> | : | CALL DEADY (NO. NO. CITH) CITHEN CITHEN CITHEN 18C. DBC. TRC. BBC) | |
| <pre>Ff (TLKAG.E.G) GO TO 140 GALL EKAOF (NR.NG.G(INL),C(ITL),C(ITFKL)) 140 CALL STOPAG (NR.NG.G(INL),C(ITL),C(ITFKL)) 141 CALL STOPAG (NR.NG.G(ICO), C(ICT), C(IT), C(IG),C(IGS)) COPULEST/OT INDX=1 DC 170 F=1,LOOPUL TDT=0T J2=TOT*(T=1) J2=TOT*(T=1) J2=TOT*(T=1) TT=-J T2=J2 CALL OFIX (NP.NG.C(IDX),C(IDY),C(ICA),C(IN),C(II),C(ITT),.I.G(IC CALL OFIX (NP.NG.C(IDX),C(IDY),C(ICA),C(INAM),C(ITPR),C(ITT), C(ICA),C(IAPEA),TAFEA) CALL OFIX (NP.NG.C(IDX),C(IDY),C(ICA),C(INAM),C(ITPR),C(ITT), C(ICA),C(IAPEA),TAFEA) CALL AFISUL (NP.NG.C(IDX),C(IDY),C(ICA),C(INAM),C(ITPR),C(ID),C(ICA),C(ID),C(ICA),C(ID),C(ICA),C(ID),</pre> | ; ' | CALL READE (NR, NC, C(IE), C(IE), C(IE), C(IE), CC, RCC, CC, CC) | |
| <pre>CALL LEXAOF (NR,NC,C(IHL),C(ITL),C(IFKL)) 140 CALL STOPAG (NR,NC,C(IH),C(IH),C(IF),C(ID),C(ID),C(ID)),C(IPHI),C(IG), 16(IPHID) CALL CSET (NR,NC,C(ICO), C(ICT), C(IH), C(IG),C(ICS)) 100701 100841 D0 170 I=1,L00PUL T0T=01 J1=T01*(I=1) J2=T01*I FI=1 T1=4 T2=42 CALL OFIX (NF,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I.C(IC 1),NN,NP,C(IPHR),C(IMELL),C(IPTI),C(ITAH),C(ITAH),C(ITFR),C(ICH), 2),C(IAPHN),C(IC(ICH),C(ITC),C(ICH),C(IH),C(IHL),C(ITFL),C(ICH), 4 (CIOLAX,C(IAPEA),TAREA) CALL MATSOL (NF,NC,AC(IH),C(IFK),C(IH),C(IG),C(ID),C(ID),C(ID),C(ID),C(ICH),C(ITH),C(IC),C(ID),C(ID),C(ID),C(IC),C(ID),C(ICH),C(IH),C(IH),C(IH),C(ID),</pre> | | IF (ILKAQ.LE.0) GO TO 140 | |
| <pre>140 CALL STOPAG (NR,NG,C(IH),C(IFI),C(IZ),C(IDX),C(IDY),G(IPHI),C(IG), 16(IPHIG)) GALL CSET (NR,NG,G(ICO), C(ICT), C(IH), C(IG),C(ICS)) LOOPUL=ST/OT INDX=1 DC 170 I=1,LOOPUL TDT=DT JZ=TDT*I FI=1 T1=J1 ZZ=ZDT CALL OFIX (NF,NG,C(IDX),C(IDY),G(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1).NN,NP,C(IPHR),C(IYC),C(ICAPH,I,NY,C(IHL),C(ITYR),C(IYR),C(IYR),C(IYR),C(IYR),C(ICR),C(ICAPHI),C(ITYR),C(ICR),C(ICAPHI),C(IDPH),C(ICR),C(ICAPHI),C(ICF),C(ICR),C(ICD),C(IDPHR),C(IOPHI),C(ICR),C(ICA),C(IG),C(IDPHR),C(ICPHI),C(IT),C(IZ),C(ID),C(ID),C(ID),C(ID),C(ID),C(ID),C(ID),C(ICA),C(ICA),C(ID),</pre> | | CALL LEKAOF (NR, NC, C(IHL), C(ITL), C(IFKL)) | |
| <pre>140 CALL SIDEAG (NR.NG.G(ID), G(IF), G(IF), G(ID), G(ID), G(ID), G(ID), G(IG), 16(IPHID) GALL CSET (NR,NG,G(ICO), G(ICT), G(IH), G(IG), G(IG), G(IGS)) LOOPUL=ST/OT INDX=1 DC 17C I=1,LOOPUL IDT=0T J=TOT*II=1 TI=J TI=J CALL OFIX (NF,NG,G(IDX), G(IDY), G(ICA), G(IH), G(IZ), G(IHT), I, G(IC 1, N,N,PD,G(IPHR), G(ICY), G(ICY), G(ICA), G(IH), G(IT), I, G(ICK), 2, GALL OFIX (NF,NG,G(ITX), G(IDY), G(ICA), G(IH), G(IT), I, G(IFK), 3, G(ICPN), G(IDF), G(ICYG), G(ICGNH, I, NY, G(IH), G(IT), G(IFK), 4, G(IGE), G(ICPN, G(ICY), G(IGPK), I, G(IG), G(ID), G(IGPH), G(IGPH), 4, G(IGE), G(IPHR), G(IGPFA), TAFEA) CALL MATSOL (NF,NG,NA,NSG(IFK), C(IPH), G(IG), G(IPHIC), G(I 1, X), G(IDY), G(IG), G(ICMATRX), C(ICR), G(IG), G(IB), G(IG), G(IPHIG), G(I 2, IHP), G(IHF)) CALL GJUST (NR,NG, G(IH), G(IHT), G(IF), G(IG), G(IDY), I) CALL GJUST (NR,NG, G(IH), C(IHT), G(IF), G(IG), G(IDY), G(IDX), G(ID 1, Y), G(IPHIG)) STITEMESTA CALL STORAG (NR,NG, G(IH), C(IHT), C(IZ), C(IDX), C(IDX), C(IDX), G(ID 1, Y), G(IPHIG)) STITEMESTA CALL STORAG (NR,NG, C(IH), C(IHT), C(IZ), C(IDX), C(IDY), C(IPHI), C(I 1, G), G(IPHIG)) PCNT=TNOX IF ((FITO)).NC.(PONT*EWTOP)) GC TO 150 INOX=INOX-1 CALL STORAG (NR,NG, C(IH), C(IHT), C(IF), C(IZ), C(IDX), C(IDY), C(IPHI), C(I 1, G), G(IG), G(IGPHI), G(IDFHI), G(ITF), G(IG), G(IAPF), G(IAFF), G(I</pre> | | | |
| <pre>CALL CSET (NR,NG,G(IGO), C(IGT), C(IH), C(IG),C(IGS)) LCOPUL=ST/OT INDX=1 DC 176 I=1,LOOPUL IDT=OT JI=T0!(I=1) J2=T0!*I FII T1=J1 CALL GET (NF,NG,C(IDX),C(IDY),G(IGA),G(IH),C(IZ),C(IH),ILG(IG (ITFR),G(IFR),G(ITFR),G(I</pre> | 140 0 | CALL STORAG (NR + NG + G(IH) + G(IFT) + G(IZ) + G(IDX) + G(IDT) + G(IPHI) + G(IG) + | |
| LOOPUL=ST/DT INDX=1 DC 170 I=1.LOOPUL IDT=0T J=IDT+0T J=IDT+0T FI=1 T1=2 CALL OFIX (NP,NC.C(IDX).C(IDY).C(ICA).C(IT).C(IZ).C(INT).I.C(IC 1).NN.NP.C(IPHR).C(IMELL).C(IPT).C(IYT).C(IYAN).C(IYPR).C(IYPM 2).C(IRPUN).C(IDPT).C(IDPT).C(IDY).C(ICA).C(IT).C(IT).C(IZ).C(IPM 3 C(ID).C(IPHTMP).C(IDPT).C(IDPN).C(IDCHN).C(ICA).C(IT).C(IZ).C(ID 1 x).C(IDY).C(IQ).C(ICA).C(ICR).C(IPHI).C(ID).C(ID).C(IZ).C(ID 1 x).C(IDY).C(IQ).C(ICA).C(IT).C(IP).C(IDX).C(IG).C(IDY).I) CALL NAISOL (NR.NC.C(IH).C(IHI).C(IF).C(IDX).C(IDY).I) CALL SIGNER (NR.NC.C(IH).C(IHI).C(IZ).C(IDX).C(IDX).C(ID).C(ID 1 x).C(IPHIC)) SITEM=SIT SITEM=SIT SITEM=SIT CALL STORAG (NR.NC.C(IH).C(IHI).C(IDX).C(IDY).C(IDX).C(IDY).C(ID).C(ID 1 C).C(IPHIC)) PCNT=INDX PCNT=INDX IF (IF1*OT).NC.(IDX).C(ICA).C(IDX).C(IDX).C(IDY).C(IPHI).C(I 2 G).C(ICH).C(ISOGG).C(ICM).C(IHI).C(IHF).C(IZ).C(IDX).C(IDY).C(IPHI).C(I 2 G).C(ICO).C(ICT).C(IFHI).C(IFHIC).C(IDX).C(IDY).C(IPHI).C(I 2 G).C(ICO).C(ICT).C(IFHIC).C(ICA).C(IDY).C(IDF).C(IDAFN).C(I 2 G).T.C(ISOGG).C(ICD).C(ICCH).C(IFHIC).C(ICA).C(ID).C(IDF).C(IDAFN).C(I 3 IDRCHM.C(IDPH).C(IDQUM).C(IDCHAT.C(ICA).C(IDF).C(ICAFN).C(IDAFN).C(IDAFN).C(ICAFN). | - | CALL CSET (NR.NC.C(ICO), C(ICT), C(IH), C(IG), C(ICS)) | |
| LOOPUL-ST/OT INDX*1 DC 170 I=1,LOOPUL IDT=0T JI=TOT*(I=1) J2=ZDT*1 GALL OFIX (NF,NC,C(IDX),C(IDY),C(ICA),C(IT),C(IZ),C(IHT),I.C(IC I),NH,NP,C(IPHR),C(IWELL),C(IPT),C(IYFT),C(IYAM),C(IYPR),C(IYPM 2),C(IPUM),C(IPHR),C(IYCF),C(ICAPH),IVR,C(IHL),C(ITL),C(IFKL), 3 C(IG),C(IPHRTMP),C(ICPT),C(ICAPH),IVR,C(IHL),C(ITL),C(IFKL), 4 C(IQLEAK),C(IAPEA),TAFEA) CALL MATSOL (NP.NC.NA.N9.C(IFK),C(IPHI).C(IA),C(IG),C(IPHIC),C(2 IMP),C(ID),C(ICATRX),C(ICR),((IA),C(IG),C(IDY),I) CALL MJUST (NR,NC,C(IH),C(IHT),C(IF),C(IOX),C(IOY),I) CALL DFLOD (NP.NC,C(IH),C(IHT),C(IZ),C(IOX),C(IDY),C(ID),C(ID) STIFM=SIT STATEMESIT STATEMESIT STATEMESIT CALL STORAG (NN,NC,C(IH),C(IHT),C(II),C(IDX),C(IDY),C(IPHI),C(I 1 Y),C(IPHIC)) PCNTEINOX IC (IFFIC)) PCNTEINOX IC (ISOGCI),C(ISOGC),C(ICCM),C(ICM),C(IAP),C(ID),C(IDY | | | |
| <pre>INDX=1 OC 170 I=1,LOOPUL IDT=0T II=0T*(I=1) J=IDT*(I=1) J=IDT*(I=1) J=2=10T*(I=1) J=2=10T*(I=1) I=2=10T*(I=1) I=2=10T*(I=1)</pre> | I | COPUL=ST/DT | |
| <pre>DG 170 I=1,LOOPUL IOT=OT JI=TOT*(I=1) J2=IDT*I FI=I TI=J T2=J2 GALL OFIX (NF,NC,C(IDX),C(IDY),C(ICA),C(IT),C(IZ),C(INT),I,C(IC I),NN,NP,C(IPHR),C(IPHL),C(IPT),C(IYFT),C(IYAM),C(IYPR),C(IYPM 2),C(IPHM),C(ICPH),C(IYRC),C(IRCHF),INYR,C(IHL),C(ITL),C(IFKL), 3 C(IG),C(IPHTMP),C(IOPT),C(IOAPM),C(IORCHR),C(IOPHR),C(IOPUP), 4 C(IQLEAK),C(IAPEA),TAFEA) CALL HATSOL (NP,NC,NA,NS,C(IFK),C(IPHI),C(IA),C(IG),C(IPHIC),C(I 1 X),C(IOY),C(IQ),C(ICMATRX),C(ICR),((IA),C(IG),C(IPHI),C(IZ),C(ID 1 X),C(IOY),C(IQ),C(ICMATRX),C(ICT),C(ID),C(IOX),C(IOY),I) CALL BJUST (NR,NC,C(IH),C(IHT),C(IZ),C(IOX),C(IOY),I) CALL ODFLON (NR,NC,C(IH),C(IHT),C(IZ),C(IOX),C(IOY),C(IPHI),C(I 1 Y),C(IPHIC)) SITTEM=SIT SIATEM=SIA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IOX),C(IDY),C(IPHI),C(I 1 G),C(IFMIC) PCNT=INOX IF ((FI*OT),NCL(PCNT*FWIOP)) GC TO 150 INDX=INOX+1 CALL BJYLOW (NR,NC,NA,NS,C(IFK),C(IH),C(IFF),C(IZ),C(IDX),C(IDY) 1 ,C(ISOGGI),C(ISOGJ),C(ISOP),C(ICMATRX),C(IA),C(IB),C(IAF),C(I 2 G),L(ICO),C(ICT),C(IFHI),C(IFHI),C(ICFF),C(ICF),C(IDX),C(IOY) 1 ,C(ISOGGI),C(ISOGJ),C(ISOP),C(ICMATRX),C(IA),C(IB),C(IAF),C(I 2 G),L(ICO),C(ICT),C(IFHI),C(IFHI),C(ICFF),C(ICFF),C(ICAFM),C(ICRFR),C(I 3 IDRCMA,(CIC),C(ICT),C(IFHI),C(ICLEAK),C(ICFFF)) CALL BALCOP (J1,J2,I,STTTEF,STATEM) WRITE (6,1A0) T2 CALL MATROP (NF,NC,C(IHT)) 150 NCT=0 DO 160 L=1,NC DO 160 L=1,NC C(IMP+NCT)=C(IMT+NCT) NCT=NCT+1 160 CONTINUE IF (I,FO,LOOPUL) GO YO 170 CALL PFADC (NF,NC,C(ICAFN),C(ICSOF),C(ICC),LBC,RBC,TFC, 1970 CONTINUE 170 CONTINUE 170</pre> | | INDX=1 | |
| <pre>IDT=DI JI=JOIT*I J=IDT*I FI=I TI=J GALL OFIX (NF,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC I),NH,NP,C(IPHR),C(IWELL),C(IPT)),C(IYPT),C(IYAH),C(ITH),C(ITP),C(IPH 2),C(IPHH),C(ITPR),C(IYCC),C(ICRCHP,I,NR,C(IHL),C(ITL),C(IFK), 3 CIGO,C(IPHRTHP),C(IYCC),C(IGCHPH),C(IDRCHR),C(IDPHR),C(IDPU), 4 CIIOLEAX,C(IAPEA),TAEEA CALL MATSOL (NR,NC,NA,NS,C(IFK),C(IPHI),C(IA),C(IG),C(IPHIC),C(2 IHP),C(ITH)) GALL RJUST (NR,NC,C(IH),C(ITHI),C(IZ),C(IDX),C(IDY),T) CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IDX),C(ID 1 Y),C(IPHIC)) STITEM=SIT STATEM=SIT STATEM=SIT CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCMT=INOX IF ((F1*DI),NE,(PCNT*FWTOP)) GC TO 150 INOX=INOX+1 CALL BYFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IIF),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 2 G,I,C(ICO),C(ICT),C(IPHI),C(ICATEX),C(IA),C(ICA,C(IDA),C(IDY),C(IDY),C(IDA),C(ICAEA),C(IDA),C(ICAEAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAA),C(ICAEAAAAA),C(ICAEAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA</pre> | | DC 170 T=1.LOOPUL | |
| <pre>IDT=DT JI=IDT*(I=1) J2=IDT*I FI=I FI=I T2=J2 CALL OFIX (NP,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1),NH,NP,C(IPPH),C(ITVC),C(IRCHP),INTR;C(IHL),C(ITL),C(IPPH) 2),C(IPPH),C(IPPH),C(ITOPT),C(IDAPH),C(IDPH),C(IDPH),C(IDPH), 3 C(IG),C(IPPHTHP),C(IDPT),C(IDAPH),C(IDPH),C(IDPH),C(IDPH), 4 C(IQLEAK),C(IAPEA),TAREA) CALL MATSOL (NP,NG,NA,NB,C(IFK),C(IPHI),C(IH),C(IH),C(IZ),C(ID 1 X),C(IDY),C(IQ),C(ICMATRX),C(ICR),((IA),C(IB),C(IG),C(IPHIG),C(2 IHP),C(IHF)) CALL DFLOD (NP,NG,C(IH),C(IHT),C(IF),C(IDX),C(IOY),I) CALL OFLOD (NP,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),I) CALL OFLOD (NP,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IDX),C(ID 1 Y),C(IPHIG)) SITFEM=STA CALL STORAG (NR,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G).C(IFPHIC)) PCNT=INDX IF ((FT*DT).NC.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOM (NR,NG,NA,NB,C(IFK),C(IH),C(IF),C(IZ),C(IDX),C(IDF),C(I 1).C(ISOGGI),C(ISOGGJ),C(ICGNATRX),C(IC),C(IDY),C(IPHI),C(I 2 G),IC(ICO),C(ICT),C(IPHI),C(ICLS),C(IDPT),C(ICAFF),C(I 2 G),IC(ICO),C(ICT),C(IFHI),C(IFHIC),C(ICS),C(IDPT),C(IAFF),C(I 3 IDRCMR),C(ICPUH),C(IDCUAX),C(ICCPT),C(ICAFF),C(IAFF),C(I 3 IDRCMR),C(ICPUH),C(ICLEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICLEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICCEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICLEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICCEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICCEAK),C(ICPFT),C(ICAFFM),C(ICRCMR) 5 NCT=MCT+M 5 NCT=MC 5 NCT=M 5 NCT=MC 5 NCT=MC</pre> | | VV ALV ATAVAVVA | |
| J1=TOT*(I=1) J2=TOT*I FI=I T1=J T2=J2 CALL OFIX (NP,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1),NH,NP,C(IPHR),C(IWELL),C(IPT),C(IYCH),C(IYAN),C(IYPH),C(IYPH) 2),C(IPPHR),C(IYPC),C(IYCC),C(IYCC),C(IYCC),C(IYAN),C(IIPH),C(IYPH) 2),C(ICP),C(IPHR)HP,C(IYCC),C(ICRCHR),C(IDCHR),C(IDPHR),C(IPHI),C(IIP) 3 CIG1,C(IDPHR)HP,C(IYPC),C(IDAPH),C(IDRCHR),C(IDPHR),C(IDPU), 4 CIG1QLAX),C(IDY),C(IID,C(ICHATRX),C(ICR),C(IA),C(IG),C(IPHI),C(IZ),C(ID) 1 X),C(IDY),C(IID),C(ICHATRX),C(ICR),C(IA),C(IDX),C(IDY),C(ID),C(I 2 IHP),C(IHF)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(ID),C(ID) 1 Y),C(IPHIC)) SITIEM=SIT SITIEM=SIT SITIEM=SIT SITIEM=SIT CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PONT=INDX IC (IFTOT).NC.(PONT*FWTOP)) GC TO 150 INDX=INDX+NC.(CICHT),C(IFHI),C(IFF),C(IZ),C(IDX),C(IDF),C(IDY),C(IPHI),C(I 2 G),C(ICF),C(ISGGGJ),C(ISGR),C(ICMATRX),C(IA),C(IR),C(IHF),C(II),C(IA),C(IDY),C(IDF),C(ICA),C(IDY),C(IDF),C(ICA),C(IDY),C(ICA),C(IDY),C(ICA),C(ICT),C(ICA),C(ICT),C(ICA),C(ICF),C(ICA),C(ICF),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICT),C(ICA),C(ICF),C(ICA),C(ICF),C(ICA),C(ICF),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C(ICA),C(ICC),C | | 101=01 | |
| Jd=101*1 FIEI TI=J T2=J2 GALL OFIX (NP,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1).NH,NP,C(IPHR),C(IYCC),C(ICCHA),YR,C(IHL),C(ITL),C(ITP),C(IYPH 2).C(ICP)HC,C(IYCC),C(ICCHA),YR,C(IHL),C(IID),C(IID),C(IGP), 3 C(IG),C(IAPEA),TAFEA) CALL MATSOL (NR,NC,NA,NB,C(IFK),C(IPHI),C(IA),C(IG),C(IPHI),C(IZ),C(ID 1 X),C(IOY),C(IQ),C(ICMATX),C(ICR),((IA),C(IA),C(IG),C(IPHI),C(IZ),C(ID 1 X),C(IOY),C(IQ),C(ICMATX),C(ICR),C(IA),C(IA),C(IOY),I) CALL BJUST (NR,NC,C(IH),C(IHT),C(IF),C(IG),C(IDY),I) CALL OFLOD (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(ID) 1 Y),C(IPHIC)) STITEM=SIT STATEMESIT STATEMESIT CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF ((Ff*OT)-NE.(PCNT*FWTOP)) GC TO 150 INOXEINDX+1 CALL BYFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IF),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 2 GALL BYFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IA),C(IA),C(IA),C(IAF),C(IAF),C(I 3 IDROHA,C(IGPHB,C(IDPH),C(ICDEAK),C(ICPF),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 4 ,C(ISOGI),C(ISOGG),C(ISOR),C(ICCMATRX),C(IA),C(IA),C(IAF),C(IAF),C(I 5 IDROHA,C(IGPHB,C(IDPH),C(IDEAK),C(ICPFI),C(ICAFH),C(ICRCHR)) 4 ,C(ISORI,C(ID),T2 CALL BALCOP (JI,JZ,I,STITEF,STATEH) WATIE (6,1A0) T2 CALL MATROP (NF,NC,C(IHT)) 150 NCT=0 160 CONTINUE 170 CONTINUE 171 CONTINUE 174 CONTINUE 175 ACT=0 CONTINUE 176 CONTINUE 177 CONTINUE 177 CONTINUE 178 CONTINUE 179 CONTINUE 170 CONTINUE | | J1=I0T*(I-1) | |
| <pre>T1=J1 T2=J2 CALL OFIX (NP,NC,C(IDX),C(IDY).C(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1),NN,NP,C(IPHR),C(IYCC),C(IPHT),C(IYPT),C(IYAN),C(IYPR),C(IYPR),C(IYPR) 2),C(IRPUM),C(IOPH),C(IYCC),C(IRCHP),TNYR,C(IHL),C(ITL),C(IFKL), 3) C(IG),C(IAPRAYNP),C(IO(IOPHT),C(IOAPH),C(IOPHR),C(IOPHR),C(IGPUM), 4) C(IOLE AK),C(IAPEA),TAKEA) CALL MATSOL (NR,NC,NA,NS,C(IFK),C(IPHI),C(IH),C(IG),C(IPHIC),C(I 1) X),C(IDY),C(IQ),C(ICMATXX),C(ICR),((IA),C(IR),C(IG),C(IPHIC),C(I 2) IHP),C(IHF)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IFY),C(IG),C(IDY),I) CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IZ),C(IGX),C(IDX),C(IDX),C(ID 1) Y),C(IPHIC)) STITEMESTI STATEMESTA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1) G),C(IPHIC)) PCNT=INDX IF (IFIOTI,NC,(PCNT*FWTOP)) GC TO 150 INOX=INDX+1 CALL STORAG (NR,NC,NA,NS,C(IFK),C(IH),C(IIFF),C(IZ),C(IDX),C(IDF),C(I 1) ,C(ISOGG),C(ISOG),C(ISOG),C(ICOFT,N,C(IAF,C(IIP,C(IIPHI),C(I 2) G),C(ICPHEC)) CALL BYFLOW (NR,NC,NA,NS,C(IFK),C(IH),C(IFF),C(IZ),C(IDX),C(IDF),C(I 1) ,C(ISOGG),C(ISOG),C(ISOG),C(ICCPHTX),C(IAF,C(IAF,C(IIFF),C(II 2) G),C(ICPHEC)) CALL BYFLOW (NR,NC,NA,NS,C(IFK),C(IHF),C(ICS),C(IDPF1),C(IGAFH),C(I 2) IDROHN,C(IICPHH),C(IDPHIC),C(ICS),C(IOPF1),C(IGAFH),C(I 2) G),IC(ICO),C(ICT),C(IFHT),C(IPHIC),C(ICS),C(IOPF1),C(IGAFH),C(I 2) IDROHN,C(IICPHH),C(IDPUM),C(IOLEAX),C(ICPF1),C(IGAFH),C(IICRHR) GALL BALCOP (JI,J2,I,STITEP,STATEM) WRITE (6,1A0) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCI=NCT+1 160 CONTINUE IF (I,FO,LOOPUL) GO YO 170 CALL PFAOC (NR,NC,C(ICAPH),C(ICCCGR),C(ICC),LBC,RBC,TEC, IPRC,AGGIE) 170 CONTINUE SIOP AND PONANT (HH1,HAY, 22HURAD MAP AT THE IEUEL FIA 2, 4H, F2Y, IBHEEC</pre> | | JZ=101+1 FT=T | |
| <pre>T2=J2 CALL OFIX (NP,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC),NN,NP,C(IPHR,C(IWELL),C(IPTI),C(IYPT),C(IIXN),C(IYPR),C(IYPH) 2),C(IRCUM),C(IYPR),C(IYCH),C(IYRCH),INN,C(IHL),C(IIPR),C(IOPUH), C(IGL,C(IPHRTMP),C(IOPT),C(IACMA),UNX,C(IHL),C(IDP),C(IOPUH), C(IGL,C(IAPEA),TAFEA) CALL HATSOL (NR,NC,NA,NS,C(IFK),C(IPHI),C(IA),C(IG),C(IPHIC),C(I 1 X),C(IDY),C(IQ),C(ICMATRX),C(ICR),((IA),C(IG),C(IDY),C(IZ),C(ID 1 X),C(IDY),C(IQ),C(ICMATRX),C(IFK),C(IPHI),C(IGX),C(IG),C(IPHIC),C(I 2 IMF),C(IPHIC)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IFP),C(IDX),C(IDY),I) CALL OFLOO (NR,NC,C(IH),C(IHT),C(IZ),C(IOX),C(IDY),I) CALL OFLOO (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 Y),C(IPHIC)) SITIEMESTI STATEMESTA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF (IFI*DT)_*NE.(PCNT*FWTOP)) GC TO 150 INOX=INOX+1 CALL BYLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IFF),C(IZ),C(IDX),C(IDY) 1,C(ISOGGI),C(ISOGGJ,C(ISOR),C(ICMATRX),C(IA),C(IDY),C(IDPH),C(I 2 G),IC(ICO),C(ICT),C(IFHI),C(IPHI),C(IIFF),C(IIZ),C(IOX),C(IDY) 1,C(ISOGGI),C(ISOGGJ,C(ISOR),C(ICMATRX),C(IAP),C(IAFW),C(IOX),C(IDY) 4,C(ISOGGI),C(ISOGGJ,C(ISOR),C(ICMATRX),C(IA),C(IAFW),C(ICMAFW),C(I 3 IQMCHP),C(ICI)PHH),C(IFHI),C(IFF),C(ICAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCAFW),C(ICCCAFW),C(ICCAFW),C(ICCAFWC,FEC, IFF(C,AGGIE) IF (I, FO,LOOPUL) GO YO 170 CALL BFADC (NR,NC,C(ICAFW),C(ICCAFF),C(ICCOFF),C(ICC),LBC,RBC,TEC, IFF(C,AGGIE) IF (I, FO,LOOPUL) GO YO 170 CALL FFADC (NR,NC,C(ICAFW),C(ICCAFF),C(ICCSF),C(ICC),LBC,RBC,TEC, IFF(C,AGGIE) IF (I, FO,LOOPUL) GO YO 170 CALL FFADC (NR,NC,C(ICAFW),C(ICCCAFF),C(ICCSF),C(ICC),LBC,RBC,TEC, IFF(C,AGGIE) IF (OCNTINUE SIOP</pre> | | T1=J1 | |
| <pre>CALL OFIX (NP,NC,C(IDX),C(IDY),C(ICA),C(IH),C(IZ),C(IHT),I,C(IC 1).NH,NP,C(IPHR),C(IYEL),C(IPTI),C(IYFI),C(ITAH),C(IYPR),C(IYPH) 2).C(IEQUAN,C(IYPR),C(IYCH),C(IYFI),C(IYAH),C(ITAL),C(IFKL), 3 C(IG),C(IPHRTMP),C(IOPTI),C(IYCH),C(IGCHR),C(IOPHR),C(IOPHP), 4 C(IGLE AK),C(IAPEA),TAFEA) CALL MATSOL (NR,NC,NA,NS,C(IFK),C(IA),C(IA),C(IG),C(IPHI),C(IZ),C(ID) 1 X),C(IDY),G(IG),C(ICMATRX),C(ICC),C(IA),C(IG),C(IDY),I) CALL BJUST (NR,NG,C(IH),C(IHT),C(IFP),C(IG),C(IDY),I) CALL ODFLOD (NR,NG,C(IH),C(IHT),C(IF),C(IG),C(IDY),I) CALL ODFLOD (NR,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IDX),C(ID) 1 Y),C(IPHIC)) STITEMESTI STATEMESTA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PGNT=INDX IF ((FI*DI).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IAF),C(IZ),C(IDY),C(IDY),C(IOY) 1 (CIISOGGI,C(ISGGJ),C(ISOR),C(ICMATRX),C(IA),C(IDY),C(IDAK),C(I 2 G),I,C(ICO),C(ICT),C(IFHI),C(IHF),C(IZ),C(IOPT),C(IGAFA),C(I 3 (OICSOR),C(ISOR),C(ISOR),C(ICMATRX),C(IA),C(ICPT),C(IGAFA),C(I 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPFF),C(IGAFA),C(IGAFA),C(ICCCHA),C(ICCCCHA),C(ICCC),LBC,RBC,TBC, 160 CONTINUE 161 (I,FO,LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPH),C(ICCCGF),C(ICC),LBC,RBC,TBC, 170 CONTINUE 170 CONTINUE</pre> | | T2=J2 | |
| <pre>CALL WITA (WF, NGLOCIDAT, CCLDAT, CCLDAT,</pre> | | | |
| <pre>1</pre> | | I NW.NP.C(TPHR).C(TWELL).C(TPLT).C(TYPT).C(TYAW).C(TYPR).C(TYPM | |
| <pre>3 C(IG),C(IPHRTHP),C(IDAPH),C(IDAPH),C(IDPHR),C(IDPHR),C(IDPHR), 4 C(IQLEAK),C(IAPEA),TAFEA) CALL MATSOL (NR,NC,C(IAA,NS,C(IFK),C(IPHI),C(IH),C(IH),C(IZ),C(ID 1 x),C(IQ),C(IQ),C(ICMATRX),C(ICR),C(IA),C(IH),C(IG),C(IPHIC),C(I 2 IHP),C(IHF)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IF)),C(IDX),C(IDV),I) CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IT),C(IG),C(IPHI),C(IDX),C(ID 1 Y),C(IPHIC)) SITTEM-SIT STATEM-SIA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDV),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF ((FI+OT)-NC.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IF),C(IZ),C(IDX),C(IOY 1),C(ISOGGI),C(ISOGGJ),C(ISOR),C(ICMATRX),C(IAP,C(IH),C(IHF),C(I 2 G),I,C(ICO),C(ICT),C(IFH),C(ICS),C(ICPPT),C(ICAFK),C(I 3 IDRCMR),C(ICO),C(ICT),C(IF),C(ICAFK),C(ICAFK),C(ICAFK),C(I 4 ,C(ICSOR),C(ID),C(ICT),C(ICF),C(ICPFT),C(ICAFK),C(ICAFK),C(I 5 IDRCMR),C(IGPUH),C(ICLEAK),C(ICPPT),C(ICAFK),C(ICAFK),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(ICT),C(IFH),C(ICF),C(ICF),C(ICF),C(ICCCHR) CALL BALCOP (J1,J2,I.STITEP,STATEM) WRITE (6,1A0) TZ CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 DO 160 K=1,NC DO 160 K=1,NC DO 160 K=1,NC DO 160 K=1,NC IF (I.FCO,LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAFW),C(ICCGF),C(ICC),LBC,RBC,TBC, IMBC,AGGIE) 170 CONTINUE IF (I.FCO,LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAFW),C(ICCCF),C(ICC),LBC,RBC,TBC, IMBC,AGGIE) 170 CONTINUE STOP 170 CONTINUE</pre> | 2 |),C(IRPUH),C(ICPM),C(IYRC),C(IRCHR),INYR,C(IHL),C(ITL),C(IFKL), | |
| <pre>4 C(IQLE AK),C(IAPEA),TAKEA) CALL MATSOL (NR+NG,NA,NB,C(IFK),C(IPHI),C(IH),C(IHI),C(IZ),C(ID 1 X),C(IQ),C(IQ),C(ICMATRX),C(ICR),C(IA),C(IB),C(IG),C(IPHIG),C(2 IHP),C(IPHIG) CALL BJUST (NR,NG,C(IH),C(IHT),C(IFP),C(IDX),C(IDY),I) CALL ODFLOD (NR,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IDX),C(ID 1 Y),C(IPHIG) STYTEM=SIT STATEM=SIT CALL STORAG (NR,NG,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC) PCNT=INDX IF ((FI*OT),NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOM (NR,NG,NA,NB,C(IFK),C(IH),C(IFF),C(IZ),C(IDX),C(IDY) 1),C(ISOGG),C(ISOG),C(ISOR),C(ICMATEX),C(IA),C(IAP),C(IAP),C(I 2 G),I,C(IGO),C(ICT),C(IPHI),C(IPHIC),C(ICP),C(ICPPT),C(IAAPA),C(I 3 IORCMR,C(IGP),C(ICD)UM),C(IOLEAK),C(ICPPT),C(ICAPM),C(ICRCHR) 4 ,C(ISOGR),C(ISOR),C(ICLEAK),C(ICPPT),C(ICAPM),C(ICRCHR) CALL BALCOP (J1,J2,I,STTTEP,STATEM) WRITE (6,1A0) T2 CALL MATROP (NN*,NG,C(IHT)) 150 NCT=0 DO 160 L=1,NC 00 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT*1 160 CONTINUE IF (I.FO.LOOPUL) GO YO 170 CALL PEADC (NR,NC,C(ICAPM),C(ICSOR),C(ICC),LBC,RBC,TBC, IRBC,AGGIE) 70 CONTINUE 170 CONTINUE STOP 170 CONTINUE 170 CONT</pre> | 3 | C(IG),C(IPHRTMP),C(IOPPT),C(IOAPW),C(IORCHR),C(IOPHR),C(IOPUP), | |
| CALL MATSOL (NR,NG,NA,NB,C(IFK),C(IPHI).C(IH),C(IH),C(IZ),C(ID 1 X),C(IDY),C(IQ),C(ICMATRX),C(ICR),((IA),C(IA),C(IG),C(IDHIC),C(2 IHP),C(IHF)) CALL BJUST (NR,NG,C(IH),C(IHT),C(IFP),C(IDX),C(IDY),I) CALL ODFLON (NR,NG,C(IH),C(IHT),C(IT),C(IG),C(IDHI).C(IDX),C(ID 1 Y),C(IPHIC)) STYTEM=STT STATEM=STA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI).C(I 1 G),C(IPHIC)) PCNT=INDX IF ((FI*DI).NC.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NG,NA,NB,C(IFK),C(IH),C(IFF),C(IZ),C(IDX),C(IDY) 1 ,C(ISOGGI),C(ISOGGJ),C(ISOR),C(ICMATRX),C(IA),C(IE),C(IHF),C(I 2 G),(C(ICO),C(ICT),C(IFHI),C(IPHIC),C(ICS),C(ICPPT),C(IDAFN),C(3 IORCHM,C(ISOF),C(ICOUM),C(ICLEAK),C(ICPFI),C(ICAFW),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPHF),C(ICAFW),C(ICRCHR) CALL BALCOP (J1,J2,I.STTTEP,STATEM) WRITE (6,1A0) T2 CALL MATRJP (NP,NC,C(IHT)) 150 NCT=0 DO 160 L=1,NC DO 160 CONTINUE IF (I .FC.LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAFW),C(ICCGF),C(ICC),LBC,RBC,TEC, 1RRC,AGGIE) 70 CONTINUE STOP 100 PADAT (1H1,44Y, 22HH4AD MAP AT THE IEVEL F10,2,2/1H _F2Y, 1H/F5E | 4 | C(IQLEAK), C(IAPEA), TAREA) | |
| <pre>x),C(IDY),C(IQ),C(ICMATRX),C(ICR),C(IA),C(IB),C(IG),C(IPHIC),C(IHP),C(IHF)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IF),C(IDX),C(IDY),T) CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IZ),C(ID),C(IDY),C(IDX),C(ID 1 Y),C(IPHIC)) SITTEMESTI STATEMESTA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF ((F1*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY 1),C(ISOGGI),C(ISOGGJ),C(ISOR),C(ICMATRX),C(IA),C(IDPT),C(IDAFN),C(I 2 G),T,C(ICO),C(ICT),C(IPHI),C(IPHIC),C(ICS),C(ICOPT),C(IDAFN),C(I 3 IDCMR),C(IJD)HF),C(IDCUM),C(ICLEAK),C(ICPHI),C(IICAFW),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPHE)) CALL BALCOP (J1+J2,I,STTTEF,STATEM) WRITE (6,1A0) T2 CALL MATRDP (NF,NC,C(IHT)) 150 NCT=0 DO 160 L=1,NC DO 160 L=1,NC DO 160 L=1,NC C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I.FCO.LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAFW),C(ICCCFR),C(ICC),LBC,RBC,TBC, IHRC,AGGIE) 70 CONTINUE STOP 170 CONTINUE STOP 174 DOMAT (1H1,44Y, 22HHEAD MAP AT THE IEVEL F10.2,2/14 _F2Y, 144/F5F</pre> | | CALL MATSOL (NR.NC.NA.NR.C (TEK).C (TPHT).C (TH).C (THT).C (TZ).C (TD | |
| <pre>2 IHP),C(IHF)) CALL BJUST (NR,NC,C(IH),C(IHT),C(IPP),C(IDX),C(IDY),I) CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IDX),C(ID Y),C(IPHIC)) STTTEM=STT STATEM=STA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF ((FI*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY) 1 ,C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(IE),C(IHF),C(I 2 G),I,C(IGO),C(ICT),C(IFHI),C(IFHIC),C(ICC),C(IOPPT),C(IOAFH),C(I 3 IDRCHR),C(IGPHP),C(IOPUH),C(IOLEAK),C(ICPPT),C(ICAFH),C(I 3 IDRCHR),C(IGPHP),C(IOPUH),C(IOLEAK),C(ICPPT),C(ICAFH),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(IPUH),C(IOLEAK),C(ICPPT),C(ICAFH),C(ICRCHR) CALL BALCOP (J1,J2,I,STTTEP,STATEM) WRITE (6,1A0) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCI=0 D0 160 L=1,NC D0 160 L=1,NC O0 160 L=1,NC IF (I +FO. LOOPUL) GO YO 170 CALL FADC(IM,NC,C(ICAPH),C(ICSOF),C(ICC),LBC,RBC,TEC, IBRC,AGGIE) 170 CONTINUE STOP 170 CONTINUE STOP</pre> | 1 | x).C(IDY).C(IQ).C(ICMATRX).C(ICR).C(IA).C(IA).C(IG).C(IPHIC).C(| |
| <pre>GALL BJUST (NR,NG,C(IH),C(IHT),C(IPP),C(IOX),C(IOY),I) GALL ODFLOD (NR,NG,C(IH),C(IHT),C(IZ),C(IG),C(IDHI),C(IDX),C(ID 1 Y),G(IPHIC)) STYTEM=STT STATEM=STA GALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IPHIC)) PCNT=INDX IF ((F1*0T).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 GALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IOY 1),C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(ID),C(IOY 1),C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(ID),C(IOY 1),C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(ID),C(IOY 1),C(ISOGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(ID),C(IOY 1),C(ISOR),C(IOPUH),C(IOLEAK),C(ICPPT),C(ICAFW),C(ICRCHR),C(ICCC),LBC,RBC,TBC, IBRC,AGGIE) 170 CONTINUE IF (I,H1,LAAY, 22HHEAD HAD AT THE LEVEL,FIG.2,/IH, 52Y, IAH/EEF</pre> | 2 | IHP),C(IHF)) | |
| <pre>GALL BASST (BRENCECLERFECTERFEC</pre> | | CALL BUILT IND NO CITED CITED CITED CITED CITED T | |
| <pre>CALL ODFLOD (NR,NC,C(IH),C(IHT),C(IJ),C(IG),C(IPHI),C(IDX),C(ID 1 Y),C(IPHIC)) STITEM=STT STATEM=STA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G),C(IFHIC)) PCNT=INDX IF ((F1*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOM (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IOY 1),C(ISOGGI),C(ISOGGJ),C(ISOR),C(ICMATRX),C(IA),C(IDK),C(IOY 1),C(ISOGGI),C(ICT),C(IPHI),C(IPHIC),C(ICS),C(ICPPT),C(IDAPH),C(I 2 G),I,C(ICO),C(ICT),C(IPHI),C(IPHIC),C(ICS),C(ICPPT),C(IDAPH),C(I 3 IDRCHR),C(IDPUM),C(IDELAK),C(ICPPT),C(ICAPH),C(ICRCHR)) 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR)) CALL BALCOP (J1+J2,I,STTTEM,STATEM) WRITE (6,1A0) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=J DO 160 L=1,NC OD 160 L=1,NC OD 160 L=1,NC IF (I .EO. LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPM),C(ICSOF),C(ICC),LBC,RBC,TEC, 1APC,AGGIE) 170 CONTINUE STOP 1AD EDMAT (1H1-ACY, 22MHEAD MAP AT THE LEVEL SIA 2, (1H .E2Y, 1MHEE)</pre> | | UNCE 0.0031 (00,0000000000000000000000000000000000 | |
| <pre>1 Y).C(IPHIC)) SITTEM=SIT STATEM=SIA CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I 1 G).C(IPHIC)) PCNT=INDX IF ((F+ICT).NC.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,N9,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY) 1).C(ISQGGI),C(ISQGJ),C(ISOR),C(ICMATRX),C(IA),C(IA),C(IDY),C(IDY) 1).C(ISQGGI),C(ICT),C(IPHI),C(ICHIC),C(ICPT),C(IDAPH),C(I 2 G).I.C(ICO),C(ICT),C(IPHI),C(ICHIC),C(ICPT),C(ICAPH),C(I 2 G).I.C(ICO),C(ICT),C(IPHI),C(ICHEAK),C(ICPPT),C(ICAPH),C(ICRCHR)) 4 ,C(ICSQR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR)) CALL HALCOP (J1,J2,I,STTTEM,STATEM) WRITE (6,180) T2 CALL HATROP (NP,NC,C(IHT)) 150 NCT=0 D0 16C L=1,NC D0 163 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FC. LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPH),C(ICSCF),C(ICC),LBC,RBC,TEC, 1ARC,AGGIE) 170 CONTINUE STOP 180 FORMAT (1H1,AAY, 22HHAD HAD AT TIME LEVEL F10,2,/1H, F2Y, 1HHEEF</pre> | | CALL ODFLOD (NR,NC,C(IH),C(IH),C(I7),C(IG),C(IPHI),C(IDX),C(ID | |
| <pre>SITTEM=SIT STATEM=SIT CALL STORAG (NR,NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I G),C(IPHIC)) PCNT=INDX IF ((FI*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,N9,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY) 1).C(ISQGGI),C(ISQGJ),C(ISOR),C(ICMATK),C(IA),C(IA),C(IDF),C(IOX),C(IOY) 2 G).1,C(ICO),C(ICT),C(IPHI),C(ICHHIC),C(ICS),C(IOPT),C(IDAFW),C(I 3 IQRCHR),C(IGPHA),C(IOPUM),C(IOLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) 4 ,C(ICSQR),C(IQ),C(ICPUM),C(IOLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) 4 ,C(ICSQR),C(IQ),C(ICPUM),C(IOLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) CALL BALCOP (J1,J2,I,STTTEF,STATEM) WRITE (6,1A0) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 DO 160 L=1,NC OD 160 L=1,NC OD 160 L=1,NC IF (I .FCO.LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPW),C(ICRCHR),C(ICSGF),C(ICC),L9C,R8C,TEC, IARC,AGGIE) 170 CONTINUE STOP 180 FORMAT (1H1,AKY, 22HHCAD MAP AT TIME LEVEL_F10,2,/14, 52Y, 14H/EEF</pre> | 1 | Y).C(IPHIC)) | |
| <pre>SITIEM=SIT STATEH=SIT STATEH=SIT CALL STORAG (NR+NC,C(IH),C(IHT),C(IZ),C(IDX),C(IDY),C(IPHI),C(I G),C(IPHIC)) PCNT=INDX IF ((FI*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR+NC,NA+NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY) 1),C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(IHF),C(IIF),C(I 2 G),I,C(ICO),C(ICT),C(IPHI),C(IPHIC),C(ICA),C(ICPPT),C(IDAPH),C(I 3 IORCHR),C(IDPHN),C(IOPUN),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR) 4 ,C(ICSOR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT)) CALL BALCOP (J1+J2,I,STTTEM,STATEM) WRITE (6,1A0) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 L=1.NC D0 160 L=1.NC CONTINUE IF (I .FO, LOOPUL) GO YO 170 CALL PFADC (NR+NC,C(ICAPH),C(ICSGR),C(ICC),LBC,RBC,TEC, IARC,AGGIE) 170 CONTINUE STOP 1AD BODMAT (IH1-AGY, 22HHEAD MAP AT THE LEVEL FIG. 2.71H .527 18H/FFF</pre> | | | |
| CALL STORAG (NR, NC, C(IH), C(IHT), C(IZ), C(IDX), C(IDY), C(IPHI), C(I G), C(IPHIC)) PCNT=TNDX IF ((FI*DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOH (NR, NC, NA, NB, C(IFK), C(IH), C(IHF), C(IZ), C(IDX), C(IDY) 1), C(ISOGGI), C(ISOGGJ), C(ISOR), C(ICMATRX), C(IA), C(IB), C(IHF), C(I 2 G), I, C(ICO), C(ICT), C(IPHI), C(IPHIC), C(ICS), C(IOPPT), C(IOAPH), C(I 3 IORCHAP, C(IDPUH), C(IOPUM), C(IOLEAK), C(ICPPT), C(ICAPH), C(ICRCHR) 4 , C(ICSOR), C(ID), C(ICPUM), C(ICLEAK), C(ICPPT), C(ICAPH), C(ICRCHR) 5 CALL BALCOP (J1, J2, I, STTTEM, STATEM) WRITE (6, 1A0) T2 CALL MATROP (NP, NC, C(IHT)) 150 NCT=0 DO 160 L=1,NC OO 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO, LOOPUL) GO YO 170 CALL RFADC (NR, NC, C(ICAPH), C(ICSGR), C(ICC), LBC, RBC, TEC, 1APC, AGGIE) 170 CONTINUE STOP | | STATEM=STA | |
| <pre>1 G),C(IPHIC)) PCNT=INDX IF ((FI+DT).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY) 1),C(ISQGGI),C(ISQGJ),C(ISQR),C(ICMATRX),C(IA),C(IHF),C(I 2 G),I,C(ICO),C(ICT),C(IPHI),C(IPHIC),C(ICS),C(IOPPT),C(IQAFW),C(I 3 IQRCHR),C(IGPHR),C(IOPUM),C(IGLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) 4 ,C(ICSQR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) 4 ,C(ICSQR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPT),C(ICAFW),C(ICRCHR) 4 ,C(ICSQR),C(ID),C(ICPUM),C(ICLEAK),C(ICPPHF)) CALL BALCOP (J1,J2,I,STTTEM,STATEM) WRITE (6,1A0) T2 CALL BALCOP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 L=1,NC D0 160 L=1,NC IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPW),C(ICCCHR),C(ICSCR),C(ICC),LBC,RBC,TEC, 1BRC,AGGIE) 170 CONTINUE STOP 1A0 BOPMAT (1H1,444, 22MHEAD MAP AT TIME LEVEL,ETA,2,44H,E24, 1AM/EEF </pre> | | CALL STORAG (NR.NC.C(IH),C(IHT).C(IZ).C(IDX).C(IDY).C(IPHI).C(I | |
| <pre>PCNT=INDX IF ((FI*DI).NE.(PCNT*FWTOP)) GC TO 150 INDX=INDX+1 CALL BYFLOW (NR,NC,NA,NB,C(IFK).C(IH).C(IHF).C(IZ).C(IDX).C(IDY) 1).C(ISQGGI).C(ISQGJ).C(ISOR).C(ICMATRX).C(IA).C(IA).C(IDX).C(IDY) 2 G).L.C(ICO).C(ICT).C(IPHI).C(IPHIC).C(ICS).C(IQPT).C(IGAPW).C(I 3 IQRCHR).C(IGPHR).C(IQPUM).C(IOLEAK).C(ICPPT).C(ICAPW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(IOLEAK).C(ICPPT).C(ICAPW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(IOLEAK).C(ICPPT).C(ICAPW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(IOLEAK).C(ICPPT).C(ICAPW).C(ICRCHR) 5 CALL BALCOP (J1.J2.I.STITEM.STATEM) WRITE (6.1A0) T2 CALL MATROP (NP.NC.C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 L=1.NC D0 160 K=1.NR C(IHP.NCT)=C(IHT.NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR.NC.C(ICAPW).C(ICRCHR).C(ICSGF).C(ICC).LBC.RBC.TEC. 1BBC.AGGIE) 170 CONTINUE STOP 180 BORMAT (1H1.AMY. 22HHEAD MAP AT TIME LEVEL.F10.2.74H .52Y. 18H/FEE</pre> | 1 | G),C(IPHIC)) | |
| <pre>PGNIEINUX IF ((FI*DT).NE.(PGNT*FWTOP)) GC TO 150 INDX=INDX+1 GALL BYFLOW (NR,NC,NA,NB,C(IFK).C(IH).C(IHF).C(IZ).C(IDX).C(IDY)).C(ISQGGI).C(ISQGJ).C(ISQR).C(ICMATRX).C(IA).C(IA).C(IHF).C(I 2 G).I.C(ICO).C(ICT).C(IFHI).C(IFHIC).C(ICS).C(IOPT).C(IGAFH).C(3 IQRCHR).C(IGDPH).C(IOPUM).C(IOLEAK).C(ICPT).C(ICAFW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(ICLEAK).C(ICPT).C(ICAFW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(ICLEAK).C(ICPT).C(ICAFW).C(ICRCHR) 4 .C(ICSQR).C(ID).C(ICPUM).C(ICLEAK).C(ICPT).C(ICAFW).C(ICRCHR) 6 .C(ICSQR).C(ID).C(ICPUM).C(ICLEAK).C(ICPT).C(ICAFW).C(ICRCHR) 6 .C(IHP.NCC.C(IHT)) 150 NCT=0 DO 160 L=1.NC DO 160 L=1.NC DO 160 L=1.NC OD 160 K=1.NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL #FADC (NR,NC.C(ICAPW).C(ICSCF).C(ICC).LBC.RBC.TEC. IBRC.AGGIE) 170 CONTINUE STOP 180 BORMAT (1H1-AAY. 22HHEAD MAP AT THE LEVEL.F10.2.74H .52Y. 18H/FEE</pre> | | | |
| <pre>INDX=INDX+1 CALL BYFLOW (NR,NC,NA,NB,C(IFK).C(IH).C(IHF).C(IZ).C(IDX).C(IDY 1).C(ISQGGI).C(ISQGJ).C(ISQR).C(ICMATRX).C(IA).C(IB).C(IHF).C(I 2 G).I.C(ICO).C(ICT).C(IPHT).C(IPHT).C(ICA).C(IQPT).C(IQAFK).C(I 3 IQRCHR).C(IGPHR).C(IQPUM).C(IQLEAK).C(ICPPT).C(ICAPW).C(ICRCHR) 4 ,C(ICSQR).C(IQ).C(ICPUM).C(ICLEAK).C(ICPHT). CALL BALCOP (J1.J2.I.STTTEM.STATEM) WRITE (6.180) T2 CALL MATROP (NP.NC.C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 L=1.NC D0 160 L=1.NC D0 160 L=1.NC IF (I .EO. LOOPUL) GO YO 170 CALL PFADC (NR.NC.C(ICAPW).C(ICCGR).C(ICC).LBC.RBC.TEC. IFRC.AGGIE) 170 CONTINUE STOP 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 22HHFAD MAP AT TIME LEVEL.EIG.2.(1H .E2Y. 1HHFEE) 180 POPNAT (1H1.444, 2HHFEE) 180 POPNAT (1H1.4444</pre> | | TE ((ET+DT), NE, (PCNT+EWTOP)) GC TO 150 | |
| CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IDX),C(IDY 1),C(ISQGGI),C(ISQGJ),C(ISQR),C(ICMTX),C(IA),C(IB),C(IDF),C(I 2 G),I,C(ICO),C(ICT),C(IPHT),C(IPHT),C(ICA),C(IQPT),C(IQAPK),C(3 IQRCHR),C(IGPHR),C(IQPUM),C(IQLEAK),C(ICPPT),C(ICAPH),C(ICRCHR) 4 ,C(ICSQR),C(IQ),C(ICPUH),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR) 4 ,C(ICSQR),C(IQ),C(ICPUH),C(ICLEAK),C(ICPPT),C(ICAPH),C(ICRCHR) 5 CALL BALCOP (J1,J2,I,STTTEM,STATEM) WRITE (6,180) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 L=1,NC D0 160 L=1,NC D0 163 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL FFADC (NR,NC,C(ICAPW),C(ICCGR),C(ICC),LBC,RBC,TEC, 1RBC,AGGIE) 170 CONTINUE STOP 180 BORMAT (1H1,44Y, 22HHEAD MAP AT TIME LEVEL ETA 2, (1H, E2Y, 1H)/EEE | | INDX=INDX+1 | |
| CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(IOX),C(IOY 1),C(ISOGGI),C(ISOGJ),C(ISOR),C(ICMATRX),C(IA),C(IB),C(IHF),C(I 2 G),I,C(ICO),C(ICT),C(IPHT),C(IPHT),C(ICA),C(IOPPT),C(IOAPK),C(3 IORCHR),C(IGPHR),C(IOPUM),C(IOLEAK),C(ICPPT),C(ICAPW),C(IORCHR) 4 ,C(ICSOR),C(IO),C(ICPUH),C(ICLEAK),C(ICPPT),C(ICAPW),C(ICRCHR) 5 CALL BALCOP (J1,J2,I,STITEM,STATEM) WRITE (6,180) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 L=1,NC D0 160 L=1,NC D0 160 L=1,NC IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPW),C(ICSOR),C(ICC),LBC,RBC,TEC, 1RBC,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1,44Y, 22HHEAD MAP AT TIME LEVEL F10,2, (1H, F2Y, 1H)/FEF | | | |
| <pre>1).C(ISQGGI).C(ISQGJ).C(ISQR).C(ICMATX).C(ID).C(ID).C(ID).C(IDAP).C(I 2 G).I.C(ICO).C(ICT).C(IPHI).C(ICHATX).C(IC).C(IQAP).C(IQAP).C(3 IQQCHR).C(IGPHR).C(IQPHI).C(IQLAX).C(ICPPT).C(IQAP).C(IQAP).C(4 .C(ICSQR).C(IQ).C(ICPUM).C(ICLEAX).C(ICPPT).C(ICAPH).C(ICRCHR) 4 .C(ICSQR).C(IQ).C(ICPUM).C(ICLEAX).C(ICPHR)) CALL BALCOP (J1.J2.I.STITEM.STATEM) WRITE (6.180) T2 CALL MATROP (NF.NC.C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 L=1.NC D0 160 L=1.NC D0 160 K=1.NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL FFADC (NR.NC.C(ICAPH).C(ICSQF).C(ICC).LBC.RBC.TEC. 1880.AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1.44Y. 22HHFAD MAP AT TIME LEVEL.F10.2.(1H .F2Y. 18H/FEF</pre> | | CALL BYFLOW (NR,NC,NA,NB,C(IFK),C(IH),C(IHF),C(IZ),C(ICX),C(IOY | |
| 3 IORCHAP., C(IGPHR), C(IOPUM), C(IOLEAK), C(ICPPT), C(IGAPH), C(ICRCHR) 4 , C(ICSOR), C(IG), C(ICPUM), C(IOLEAK), C(ICPPT), C(ICAPH), C(ICRCHR) CALL BALCOP (J1.J2.I.STITEP.STATEM) WRITE (6.180) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 L=1.NC D0 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL PEACC (NR,NC,C(ICAPW),C(ICCGR),C(ICC),LBC,RBC,TEC, IBBC,AGGIE) 170 CONTINUE STOP 180 POPNAT (1H1.44Y, 22HHEAD MAP AT TIME LEVEL ET0.2.114 .E2Y, 18H/EEE | 1 |),C(ISQGGI),C(ISQGGJ),C(ISQR),C(ICMATRX),C(IA),C(IA),C(IHF),C(I | |
| 4 ,C(ICSOR),C(ID),C(ICPUH),C(ICLEAK),C(ICPHR)) CALL BALCOP (J1,J2,I,STITEM,STATEM) WRITE (6,140) T2 CALL MATROP (NR,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 L=1,NC D0 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL PEADC (NR,NC,C(ICAPH),C(ICSOR),C(ICC),LBC,RBC,TEC, 1BBC,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1,44Y, 22HHEAD MAP AT TIME LEVEL ET0, 2, (1H, EDY, 1H)/EEF | 3 | IQRCHR) . C(IGPHR) . C(IQPUM) . C(IGLEAK) . C(ICPPT) . C(ICAFW) . C(ICRCHR) | |
| CALL BALCOP (J1.J2.I.STTTEP.STATEM) WRITE (6.180) T2 CALL MATROP (NR,NC.C(IHT)) 150 NCT=0 D0 160 L=1.NC D0 160 K=1.NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR.NC.C(ICAPH).C(ICSGR).C(ICC).LBC.RBC.TEC. 1880.AGGIE) 170 CONTINUE STOP | 4 | ,C(ICSQR),C(IQ),C(ICPUM),C(ICLEAK),C(ICPHR)) | |
| WRITE (6,180) T2 GALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PEADC (NR,NC,C(ICAPW),C(ICSGR),C(ICC),LBC,RBC,TEC, 1880,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1,44Y, 22HHEAD MAP AT TIME LEVEL F10,2, (1H, F2Y, 1H)/FEF | | CALL DALCOD CIA 12 T STATEN STATEN | |
| WRITE (6,140) T2 CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 D0 160 L=1,NC D0 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR,NC,C(ICAPH),C(ICSGR),C(ICC),LBC,RBC,TEC, 188C,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1-44Y, 22HHFAD MAP AT TTHE LEVEL F10-2, (1H .F2Y, 1H)/FEF | | UNLE DALOUP IJ14024143111EP431A1ERI | |
| CALL MATROP (NP,NC,C(IHT)) 150 NCT=0 DO 160 L=1,NC DO 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL RFADC (NR,NC,C(ICAPH),C(ICSGR),C(ICC),LBC,RBC,TEC, 180, AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1-44Y, 22HHEAD MAP AT TIME LEVEL E10.2.11H .E2Y, 18H/EEE | | WRITE (6,180) T2 | |
| <pre>150 NCT=0 D0 160 L=1,NC D0 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR+NC,C(ICAPH),C(ICSCR),C(ICC),LBC,RBC,TBC, 18RC,AGGIE) 170 CONTINUE STOP 180 PORMAT (1H1-44Y, 22HHEAD MAP AT TIME LEVEL F10.2.71H .F2Y, 18H/FFF</pre> | | CALL MATROP (NP,NC,C(IHT)) | |
| 150 NCI=U D0 160 L=1,NC 00 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .FO. LOOPUL) GO YO 170 CALL PFADC (NR+NC,C(ICAPH),C(ICRCHR),C(ICSCR),C(ICC),LBC,RBC,TBC, 18RC,AGGIE) 170 CONTINUE STOP | | 107-0 | |
| DO 160 K=1,NR C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I =FO. LOOPUL) GO YO 170 CALL PFADC (NR+NC,C(ICAPH),C(ICCCR),C(ICC),LBC,RBC,TBC, 180, AGGIE) 170 CONTINUE STOP 140 BORNAT (1H1-44Y, 22HHFAD MAP AT TIME LEVEL E10.2.71H .52Y, 18H/FEF | 150 | D0 160 L=1.NC | |
| C(IHP+NCT)=C(IHT+NCT) NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL READC (NR,NC,C(ICAPH),C(ICCGR),C(ICC),LBC,RBC,TBC, 18BC,AGGIE) 170 CONTINUE STOP | | 00 160 K=1,NR | |
| NCT=NCT+1 160 CONTINUE IF (I .EO. LOOPUL) GO YO 170 CALL READC (NR,NC,C(ICAPH),C(ICRCHR),C(ICSGR),C(ICC),LBC,RBC,TBC, 180,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1,444, 22HHEAD MAP AT TIME LEVEL E10,2, (1H, E2), 184/EEE | | C(IHP+NCT)=C(IHT+NCT) | |
| <pre>IDU CUNTINUE IF (I .EO. LOOPUL) GO YO 170 CALL RFADC (NR,NC,C(ICAPH),C(ICRCHR),C(ICSGR),C(ICC),LBC,RBC,TBC, 18BC,AGGIE) 170 CONTINUE STOP 180 BORNAT (1H1,444, 22HHEAD HAP AT TIME LEVEL E10,2, (1H, E2), 18H/EEE</pre> | | NCT=NCT+1 | |
| CALL PEAC (NR,NC,C(ICAPH),C(ICRCHR),C(ICSGR),C(IGC),LBC,RBC,TBC, 1880,AGGIE) 170 CONTINUE STOP 180 PORMAT (1H1,444, 22HHEAD MAP AT TIME LEVEL E10,2, (1H, 52Y, 18H/55E) | 160 | | |
| 1880, AGGIE) 170 CONTINUE STOP 180 BORNAT (101-464), 2200500 MAD AT TIME LEVEL 510-2-210 -527 1005555 | | CALL READC (NR.NC.C(ICAPH).C(ICRCHR).C(ICSCR).C(ICC).LBC.RBC.TPC. | |
| 170 CONTINUE STOP 180 BORNAT (111,444), 2200FAD MAD AT TIME LEVEL E10,2,710 .529, 100/EEE | 11 | ARC, AGGIE) | |
| STOP | 170 (| CONTINUE | |
| 180 BORNAT (1H1.444, 22HHEAD HAP AT TIME LEVEL .510. 2. /14 .524. 184/555 | | STOP | |
| AND A DESIGN A A DESIGN AND A | 180 1 | ORMAT (1H1.44X. 22HHEAD HAP AT TTHE LEVEL | |

| 2 | 190 | FORMAT | (1 SH-ROW C | IMENSION=14,21H | COLUMN | DIMENSION | =14,24H | TIM | 1850 |
|---|-----|---------|-------------|--------------------|---------|-----------|---------|--------|------|
| | | 1E INCR | EMENTED BY | 69.2,5H DAYS,27H | TOTAL | TIME OF A | NALYSIS | 69.2.5 | 18 |
| | | 2H DAYS |) | | | | | | 1870 |
| | 200 | FORMAT | (8A10) | | | | | | 1880 |
| | 210 | FORMAT | (1H1.///// | ,27X,8A10) | | | | | 1890 |
| | 220 | FORMAT | (615,5F1C. | .1) | | | | | 1900 |
| | 230 | FCRMAT | (1H .///. | 20H FIFLD LENGTH | | 20) | | | 1910 |
| | 240 | FORMAT | (1H-,47X, | 25HCONFINED AQUIFE | P ANALY | SIS) | | | 1920 |
| | 250 | FORMAT | (1H48X. | 22HLEAKY AQUIFER | NALYSIS |) | | | 1933 |
| | 260 | FORMAT | (1H=,46X, | 27HUNCONFINEC AQUI | FER ANA | LYSISI | | | 1940 |
| | 270 | FCRMAT | (1F10.1) | | | | | | |
| C | | | | | | | | | 195. |
| | | END | | | | | | | 196. |

SUBROUTINE READPH

| | SUBROUTINE READPH (NR+NC+FK,PHI+Z+G+DX+DY+CA+PHIC+CFPT+CAPM+CRCHR+ | | |
|----|--|----|------|
| | 2CSQR +CS + AREA + TAREA) | | |
| C | | RP | 2 3 |
| C | | RP | 30 |
| C | THIS SUBROUTINE READS AND WRITES THE PHYSICAL DATA DESCRIBING | RP | 45 |
| c | EK-PERMEARTITTY (EFET/DAY) | PP | 6.5 |
| č | PHI=FFFFCTIVE POROSITY | RP | 70 |
| č | 7-BEDDOCK ELEVATION (FEET) | DD | 80 |
| č | GEODING SUPFACE ELEVATION. OF TOD OF CONFINED ADUITED (FEET) | 0D | 90 |
| č | OVER ANTIMAL ELEVATION OF THE COMMENT AND THE AND THE THEFT | 00 | 10. |
| č | OV=Y=OTHENSION OF GOTO (FEET) | DD | 110 |
| č | CA-EDACTION OF COTO THAT HATED IS ADDITED (DECTINAL) | 00 | 121 |
| č | DETERMENTED ADITED STADAGE COESTATENT | | 170 |
| č | DI X HINTEON DY | PP | 14 |
| č | | PP | 15. |
| č | EFK=UNTEGOM FK | PD | 16.1 |
| ř | | 00 | 170 |
| č | | DO | 100 |
| 2 | | DD | 100 |
| č | | 20 | 200 |
| č | | 00 | 540 |
| č | CONTRACTOR PALL | RP | 210 |
| č | CONTACTIVE CONCENTRATION OF CONTACTNENT IN PROFESS (DECIPAC) | | |
| č | CAPPI-RELATIVE CONCENTRATION OF CONTAMINANT IN PRECIPITATION | | |
| č | TADTAT ON | | |
| č | IRIGATION | | |
| č | CROBERLATIVE CONCENTRATION OF CURTAFINANT IN RECEARGE WHERS | | |
| č | SOURCE ATTVE CONCENTRATION OF CONTANTNANT FROF CONSTANT FEAC | | |
| č | | | |
| č | TAREA-TOTAL AREA COVERED BY THE SETD VETUCRY | | |
| č | TAXEA-TOTAL AREA GOVERED BY THE ORID RETROAK | DD | 225 |
| C. | DTHENSTON EVIND WCL. DHTING NCL. TIND NCL. TIND NCL. DYIND NCL. DY | DD | 230 |
| | 1(NP.NC), CA(NP.NC), CHIC(NP.NC), CS(NF.NC), AFFA(NP.NC), CPPT(NF. | ar | |
| | 2NGL CABULAN NOL COUNTRY CONTRACT CONTRACT | | |
| C | ENCY GAPHINKING, CRONKINKING, COURTHAINCE | RP | 250 |
| • | COMMON VELKIV DISSITCEACT, KACLEGE, CIR. LOF. C.H. ENTOP | RP | 260 |
| C | | PP | 276 |
| • | DO 110 J=1-NR | RP | 285 |
| | DO 110 K=1.NC | RP | 290 |
| | FK(J,K) = 0, 0 | RP | 300 |
| | $Z(J_{1},K) = 0 = 0$ | RP | 310 |
| | G(J-K)=0-0 | RP | 32: |
| | PHI(J,K)=0.0 | 35 | 330 |
| | CA(J+K)=0.0 | RP | 340 |
| | PHIC(J,K)=0.0 | RP | 350 |
| | CS(J,K)=0.0 | | |
| | CPPT(J,K)=0.0 | | |
| | CAPW(J+K)=0.0 | | |
| | CRCHR(J+K)=0.0 | | |
| | CSOP(1,K)-1.0 | | |
| | A A A A A A A A A A A A A A A A A A A | 20 | 76. |
| ~ | II CONTROL | 20 | 37. |
| C | READ (5-440) DIX-DIX-FEK.77-GG-PPHT-CCA PPHIC | RP | 380 |
| | | RP | 391 |
| ~ | TE (01X-1E-0-0) 60 TO 130 | RP | 460 |

| | | D0 120 J=1.NC | RP | 410 |
|---|---------|--|----------|-------|
| | 120 | | PP | 420 |
| | 100 | GO TO 150 | RP | 44 |
| | 130 | READ (5,440) (DX(1,J),J=1,NC) | RP | 450 |
| | | DO 146 I=2,NR | RP | 46. |
| | 140 | DX(T, J) = DX(1, J) | RP | 48 |
| | 150 | CONTINUE | (P) | 441 |
| 0 | ; | | 44 | 50. |
| | | IF (DLY.LF.D.D) GO TO 170 | RP | 510 |
| | | DO 160 J=1.NC | RP | 53 |
| | 160 | DY(I,J)=DLY | RP | 540 |
| | 10/2013 | GO TC 190 | RP | 550 |
| | 170 | FEAD (5,440) (DY(I,1),I=1,NR) | RP | 56. |
| | | DO 180 J=2,NC | RP | 583 |
| | 180 | DY(I, J) = OY(I, 1) | RP | 590 |
| | 190 | CONTINUE | RP | 60. |
| | | TAREA=0.0 | | |
| | | DO 195 I=1.NR | | |
| | | AREA(I,J)=DX(I,J)*DY(I,J) | | |
| | 105 | TAREA=TAREA+AREA(I,J) | | |
| c | 199 | CONTINUE | RP | 610 |
| | | IF (FFK.LE.0.0) GO TO 210 | RP | EZC |
| | | DO 200 J=1.NR | RP | 630 |
| | 200 | FK (J.K)=FFK | RP | 650 |
| | | GO TO 220 | RP | 661 |
| | 210 | READ (5,440) FK | RP | 670 |
| | 220 | TE (77.NE.0.0) 60 TO 230 | RP | 690 |
| | | IF (SIGN(1.0,ZZ).LT.0.0) GO TO 250 | RP | 700 |
| | 530 | DO 240 J=1.NR | RP | 710 |
| | 24.0 | DU 240 K=1.NC | NP NP | 71 |
| | | GO TO 260 | RP | 740 |
| | 250 | READ (5,440) 7 | RP | 751 |
| C | 260 | TE (66.NE.0.0) 60 TO 270 | RP | 760 |
| | | IF (SIGN(1.0,GG).LT.0.0) GO TO 290 | RP | 780 |
| | 270 | DO 280 J=1.NR | RP | 790 |
| | 280 | D0 280 K=1,NC | RP | 800 |
| | 200 | GO TO 3CO | RP | 820 |
| | 290 | READ (5,440) G | RP | 83. |
| 0 | | TE (BBHT 15 8 3) CO TO 733 | RP | 84. |
| | 300 | DC 310 J=1,NR | RP | 860 |
| | 20.20 | DO 316 K= 1, NC | RP | 870 |
| | 310 | PHI(J.K)=PPHI | RP | 880 |
| | 320 | READ (5.440) PHI | RP | 900 |
| 0 | : | | RP | 91 |
| | 330 | IF (CCA.NE.0.0) GO TO 340 | RP | 920 |
| | 340 | DO 350 J=1.NC | RP | 940 |
| | 1000 | DO 350 I=1,NR | RP | 950 |
| | 350 | CA(I,J)=CCA | RP | 961 |
| | 360 | | RP | 98. |
| 1 | 300 | KERG (STARD) OK | RP | 990 |
| | 370 | IF (ICFA0.LE.D) GO TO 400 | RP | 160 - |
| | | IF (PPHIC.LE.0.C) GO TO 390 DO 380 T=1.NP | RP | 101 |
| | | DC 380 J=1.NC | RP | 1030 |
| | 380 | PHIC(I,J)=PPHIC | RP | 104: |
| | 700 | GO TO 40C | RP | 105. |
| | 400 | READ (5.445) CSS | a. | |
| | | IF(CSS.LE.0.3) GO TO 610 | | |
| | | D0 600 J=1,NC | | |
| | 600 | CS(I,J)=CSS | | |
| | | GC TO 615 | | |
| | 610 | READ (5,440) CS | | |
| | 015 | TF (CCPPT-LT-0-C) GO TO 630 | | |
| | | また たちさんた の言語を使えるた たち はた (ちちち) し | | |

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DO 620 I=1,NR
  620 CPPT(I,J)=CCPPT
        GO TO 640
  630 READ (5,440) CPPT
C
  640 READ (5.445) CCAPH
        IF (CCAPH.LT.0.0) GO TO 650
        DO 660 J=1.NC
DO 660 I=1.NR
  660 CAPW(I, J) = CCAPW
  GO TO 670
650 RFAD (5,440) CAPW
C
  670 READ (5,445) CCRCHR
IF (CCRCHF.LT.0.0) GO TO 680
DO 690 J=1,NC
  D0 690 I=1.NR
690 CRCHR(I,J)=CCRCHR
  GO TO 700
680 READ (5,443) CRCHR
C
   700 READ (5.445) CCSOR
        IF (CCSQR.LT.0.6) GO TO 710
DO 720 J=1,NC
        DO 720 I=1.NR
   720 CSOR(I.J)=CCSOR
GO TO 730
   710 READ (5,440) CSOR
730 CONTINUE
                                                                                                         RP 1080
         WFITE (6,530)
         CALL MATROP (NR.NC.CS)
         WRITE (6.540)
         CALL MATPOP (NR . NC . CPPT)
        WEITE (6.550)
CALL MATROP (NR.NC.CAPW)
         WFITE (6,560)
         CALL MATPOP (NR, NC, CRCHR)
        WRITE (6,570)
CALL MATROP (NR.NC.CSOR)
        WRITE (6,450)
CALL MATROP (NR,NC,DX)
                                                                                                         RP 1090
                                                                                                         RP 1100
                                                                                                         RP 1110
         WRITE (6.460)
                                                                                                         RP 1120
        CALL MATROP (NR.NC.DY)
IF (ICFAQ.GT.0) GO TO 410
                                                                                                         RP 1130
                                                                                                         RP 1140
         WRITE (6,470)
                                                                                                         RP 1150
RP 1161
  GO TO 420
410 NPITE (6,510)
  420 CALL MATROP (NR, NC,G)
WRITE (6,480)
                                                                                                         RP 117:
                                                                                                         RP 118.
                                                                                                         RP 1190
        CALL MATROP (NR, NC, Z)
         WFITE (6,490)
                                                                                                         RP 1200
                                                                                                         RP 1210
        CALL MATROP (NR.NC.PHI)
IF (ICFAD.LE.D) GO TO 430
                                                                                                         RP 1220
        WFITE (6,520)
                                                                                                         RP 1230
        CALL MATROP (NR, NC, PHIC)
                                                                                                         RP 1240
   430 WRITE (6,500)
                                                                                                         RP 1250
        CALL MATROP (NR. NC. FK)
                                                                                                         RP 1260
                                                                                                         RP 1270
RP 1280
        RETURN
C
   440 FORMAT (8F13.1)
                                                                                                         RP 129:
  445 FORMAT (1F10.1)
450 FORMAT (1H1,40X, 50HDELTA=X MAP,SFACING ACROSS IN J-DIRECTION (FE RP 1200
                                                                                                         RP 1310
      1ET) ./)
   460 FORMAT (1H1,41X, 47HDELT-V MAP, SPACING COWN IN I-DIRECTION (FEET
                                                                                                         RP 1320
PP 1330
      1) ./)
  470 FORMAT (1H1,44X, 41HSURFACE ELEVATION MAP (FEET ABOVE DATUM),/)
480 FORMAT (1H1,44X, 41HBEDROCK ELEVATION MAP (FEET ABOVE DATUM),/)
490 FORMAT (1H1,55X, 18HSPECIFIC YIELC MAP,/)
500 FORMAT (1H1,46X, 28HPEPMEABILITY MAP (FEET/DAY),/)
                                                                                                         RP 1340
                                                                                                         RP 1350
                                                                                                         RP 136L
                                                                                                         RP 137:
   510 FORMAT (1H1,30X, 57HTOP OF CONFINED AQUIFER ELEVATION MAP (FEET A RP 1380
      1BOVE DATUMI ./)
                                                                                                         RP 1395
  520 FORMAT (1H1,39X, 4CHCONFINED AQUIFER STORAGE COEFFICIENT MAP,/)
530 FORMAT (1H1,51X, 33HINITIAL AQUIFER CONCENTRATION MAP,/)
540 FORMAT (1H1,49X, 39HINITIAL FRECIFITATION CONCENTRATICS MAP,/)
                                                                                                         RP 1400
  550 FORMAT (1H1,49X, 3CHINITIAL AFPLIED WATER CONCENTRATION MAP,/)
  560 FORMAT (1H1,52X, 34HINITIAL RECHARGE CONCENTRATION MAP./)
570 FORMAT (1H1,48X, 36HCONSTANT HEAD GRID CONCENTRATION MAP./)
C
                                                                                                         RP 1410
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END

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RP 1420

00 620 J=1.NC

SUBROUTINE READH

| | | SUBROUTINE READH (NR.NC.H.HP.HT.HF.LOC.RBC.TPC.BBC) | | |
|---|--------|--|----------|-----|
| C | | | RH | 2. |
| С | | | RH | 30 |
| C | | THIS SUPROUTINE READS IN AN INITIAL WATER TABLE ELEVATION OR | RH | 4. |
| C | | HEAD FOR COMPARING WATER LEVEL CHANGES. | RH | 5 |
| C | | H=INITAL WATER TABLE ELEVITION OR HEAD (FEET) | RH | 6 |
| C | | HT=PRESENT WATEP TABLE ELEVATION OR HEAD (FEET) | RH | |
| 5 | | HPEWATER TARLE ELEVATION OF HEAD AT PREVICUS TIME LEVEL (FEET) | RH DH | 01 |
| 5 | | IN-HORIZONIAL NATER LEVEL | PH | 100 |
| č | | PRC-PECHT BOUNDARY CODE | PH | 110 |
| č | | | RH | 12 |
| č | | BBC=BOTTOM BOUNDARY CODE | RH | 13 |
| C | | IDENTIFICATION OF BOUNDARY VALUES OF P. | RH | 140 |
| C | | H(I,J) LESS THAN 10,000 - WATER TABLE ELEVATION (NO BOUNDARY) | RH | 150 |
| С | | H(I,J) GREATER THAN 10000 BUT LESS THAN 20000 - IMPERMEABLE | PH | 160 |
| С | | H(I,J) GREATER THAN 200CO BUT LESS THAN 3C003 - UNDERFLOW | RH | 170 |
| C | | H(I,J) GREATER THAN 30000 BUT LESS THAN 40000 - CONSTANT HEAD | RH | 180 |
| C | | | RH | 190 |
| | | DIMENSION H(NR, NC), HT(NR, NC), HP(NR, NC), HF(NR, NC) | RH | 200 |
| | | REAL LBC | RH | 210 |
| C | | PFAD (5-220) HULLBC-PBC-TBC-BBC | DH | 23 |
| c | | | 2H | 241 |
| ۰ | | TE (HW-LE-0-0) 60 TO 140 | RH | 25 |
| | | DO 110 I=1.NR | RH | 26 |
| | | DO 110 J=1.NC | RH | 27 |
| | 110 | WH=(L,I)H | RH | 280 |
| | | 00 125 I=1.NR | RH | 29 |
| | | H(I,1)=LBC+HW | RH | 300 |
| | 122 | H(I.NC)=RBC+HW | RH | 313 |
| | 120 | CONTINUE | RH | 320 |
| | | | RH | 33. |
| | | | RH | 240 |
| | 4 3 0 | | PH PH | 360 |
| | 130 | | DH | 370 |
| C | | | RH | 38. |
| • | 140 | READ (5.220) H | RH | 39. |
| | 150 | DO 210 J=1.NC | RH | 400 |
| | | DO 210 I=1.NR | RH | 41: |
| | | KK=H(I,J)/10000.+1 | RH | 420 |
| | | GO TO (160,170,180,190), KK | RH | 43: |
| | 160 | HT(I,J)=H(I,J) | RH | 440 |
| | 312121 | GO TO 200 | RH | 45: |
| | 170 | HT(I,J) = H(I,J) - 10000. | 21 | 460 |
| | | 60 10 200 | RH | 41. |
| | 180 | $H_1(1, 3) = H(1, 3) - 20000$. | RH | 48. |
| | 190 | $HT(T_{-1}) = H(T_{-1}) = 30000$ | 2H | 50: |
| | 200 | HP(I.J)=HT(I.J) | PH | 51 |
| | | HF(I,J)=HT(I,J) | RH | 520 |
| | 210 | CONTINUE | RH | 530 |
| | | RETURN | RH | 540 |
| C | | | RH | 55 |
| | 220 | FORMAT (8510.1) | RH | 560 |
| С | | | RH | 570 |
| | | END | RH | 580 |

SUBROUTINE LEKAQF

| c | SUGRCUTINE LEKAOF (NR.NC.HL.TL.FKL) | LA | 10 |
|---|--|-----|-----|
| č | | LA | 20 |
| | | LA | 30 |
| С | THIS SUBROUTINE READS IN LEAKY AQUIFER PARAMETERS. | LA | 40 |
| C | HL=CONSTANT HEAD VALUE CAUSING LEAK (FEET) | LA | 50 |
| C | TL=THICKNESS OF LEAKY LAYER (FEET) | LA | 60 |
| C | FKL=PERMEABILITY OF LEAKY LAYER (FEET/DAY) | LA | 70 |
| C | | LA | 80 |
| | DIMENSION HL(NR,NC), TL(NR,NC), FKL(NR,NC) | LA | 90 |
| С | | 1.0 | 100 |

| | 00 110 I=1.NR | | | LA | 110 |
|-------|--------------------------------|---|-----|-----|------|
| | DO 110 J=1.NC | | | LA | 121 |
| | HL(T,J)=0.0 | | | LA | 130 |
| | TL(I,J)=G.0 | | | LA | 140 |
| | FKL(I.J)=0.0 | | | LA | 150 |
| 110 | CONTINUE | | | LA | 16. |
| | READ (5,210) HHL, TTL, FF | KL | | LA | 170 |
| | IF (HHL.LE.0.0) GO TO 1. | 30 | | LA | 180 |
| | 00 120 I=1.NR | | | LA | 190 |
| | DO 120 J=1.NC | | | LA | 20 ù |
| 120 | HL(I,J)=HHL | | | LA | 210 |
| | GO TO 140 | | | LA | 550 |
| 130 | RFAD (5,210) HL | 1380 (7.64) | | LA | 230 |
| 140 | IF (TTL.LE.0.0) GO TO 1 | 60 | | LA | 240 |
| | DO 150 I=1,NR | | | LA | 250 |
| | DO 150 J=1.NC | | | LA | Zeu |
| 150 | TL(I,J)=TTL | | | LA | 270 |
| | GO TO 170 | | | LA | 280 |
| 160 | READ (5,216) TL | | | LA | 290 |
| 170 | IF (FFKL.LE.0.0) GO TO | 190 . | | LA | 20. |
| | DO 180 I=1.NR | | | LA | 310 |
| | 00 180 J=1.NC | | | LA | 220 |
| 180 | FKL(1,J)=FFKL | | | LA | 330 |
| | | | | LA | 240 |
| 190 | CONTINUE | | | LA | 250 |
| 200 | CONTINUE | | | LA | 20. |
| | CALL MATEOR (NP. NC. HL) | | | LA | 38. |
| | HOTTE (6 370) | | | | 10. |
| | CALL MATRON (ND.NC.TL) | | | I A | 40 |
| | WRITE (6.240) | | | iA | 41 |
| | CALL MATROP (NR.NC.FKL) | | | LA | 420 |
| | RETURN | | | 1.0 | 431 |
| | NT TOWN | | | LA | 446 |
| 210 | FORMAT (8510 1) | | | IA | 451 |
| 221 | FORMAT (1 H1 . ////. 387. | ANNY FAR MATRY CAUSTNE LEAK LEFET AREVE | | I A | 460 |
| CCJ 1 | TUM) .//) | Addition universe chesting fear there would | - | LA | 470 |
| 230 | FORMAT (1H1./////.44%. | 32HTHTCKNESS OF LEAKY LAYER (FEFT) .//) | | LA | 480 |
| 240 | FORMAT (1H1 .////. 364. | ANNERTICAL PERMEABILITY OF LEAKY LAYER | (F | LA | 49 |
| 1 | EET/DAY) .//) | the second | 3.5 | LA | 500 |
| | ಾರ್ಷದ ನೀರುವಳಲ್ಲಿಗೆ ಸಂಶೇಶನ, ಕಾಲ | | | LA | 510 |
| | END | | | LA | 520 |
| | | | | | |

SUBROUTINE STORAG

| | SUBROUTINE STORAG (NR .NC .H. HT .Z. DX, DY, S. G. SC) | ST | 10 |
|---|--|----|-----|
| C | | ST | 20 |
| С | | ST | 30 |
| C | THIS SUBROUTINE COMPUTES THE INCREASE OR DECREASE IN STORAGE. | ST | 43 |
| C | STA=BETWEEN STATIONS STORAGE (AF) | ST | 5. |
| С | STT=TOTAL AREA STORAGE (AF) | ST | 6 G |
| C | STOL=OVEPLAP AREA STORAGE (AF) | ST | 76 |
| C | | ST | 80 |
| | DIMENSION H(NR, NC), HT(NR, NC), Z(NR, NC), DX(NR, NC), DY(NR, NC), S(N | ST | 90 |
| | 1R.NC). G(NP.NC). SC(NR.NC) | ST | 10. |
| C | | ST | 110 |
| | COMMCN /BLK1/ DT,S7,ICFAQ,ILKAQ,LCIE,LCIW,LCJE,LCJW,FKTOP | ST | 120 |
| | COMMON /BLK2/ STA, STOL, STT, SQA, SQT, SQFA, SQBA, SQFT, SQBT, OVA, OVT | ST | 130 |
| C | | ST | 140 |
| | NC1=NC-1 | ST | 156 |
| | NP1=NC-1 | ST | 160 |
| | STT=0.0 | ST | 170 |
| | STA=0.0 | ST | 180 |
| | D0 130 L=2.NC1 | ST | 190 |
| | DO 130 K=2, NR1 | ST | 200 |
| | IF (H(K,L).GT.1000C.) GO TO 130 | ST | 210 |
| | IF (ICFA0.LE.G) GO TO 110 | ST | 220 |
| | IF (HT(K,L).LE.G(K,L)) GO TO 150 | ST | 230 |
| | STP=((G(K,L)-Z(K,L))*S(K,L)+(HT(K,L)-G(K,L))*S(K,L))*D | ST | 340 |
| | 1 (K.L)/43560. | ST | 250 |
| | | 21 | 261 |
| | 10 SIP=(H1(K,L)=2(K,L)+UX(K,L)+UY(K,L)+S(K,L)/4356L. | 51 | 270 |
| | 160 211=211+216 | 21 | 281 |
| | | IF (L.LT.LCIW) GO TO 130 | ST | 290 |
|---|-----|--------------------------|----|-----|
| | | IF (L.GT.LCIE) GO TO 130 | ST | 300 |
| | 3 | IF (K.LT.LCJW) GO TO 130 | ST | 310 |
| | | IF (K.GT.LCJE) GO TO 130 | ST | 320 |
| | | STA=STA+STP | ST | 330 |
| | 130 | CONTINUE | ST | 340 |
| | | STOL = STT-STA | ST | 350 |
| C | ; | | ST | 360 |
| | | RETURN | ST | 370 |
| 0 | ; | | ST | 380 |
| | | END | ST | 141 |
| | | | | |

SUBROUTINE CSET

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SUBROUTINE CSET (NR.NC.CO.CT.H.G.CS)

| C | THIS SUBROUTINE SETS THE INITIAL RELATIVE CONCENTRATION IN EACH |
|--------|---|
| C | GRID OF THE AQUIFER. |
| С | |
| C | CS=INITIAL CODED AQUIFER CONCENTRATION |
| C | CO=INITIAL (OR CURRENT) UNCODED AGUIFER CONCENTRATION |
| C C | CT=NEW UNCODED AQUIFER CCNCENTRATION |
| | DIMENSION CO(NR,NC), CT(NR,NC),H(NR,NC),G(NR,KC),CS(NR,NC) DO 100 J=1.NC DO 100 J=1.NR CT(1,J)=0.0 |
| | IF(CS(I,J).GT.2.0) GO TO 10 CO(I,J)=CS(I,J) |
| | GO TO 100 |
| 1 | 0.5-(I,J)=CS(I,J)=2.0 |
| 10 | D CONTINUE |
| | RETURN |
| | END |
| | |

SUBROUTINE QFIX

SUBROUTINE OFIX (NR,NC,DX,DY,CA,H,Z,HT,I,Q,NW,NP,PHR,WELL,PIT,YPT, QF 1YAW,YPR,YPM,RPUM,CPM,YFC,GCHR,INYR,HL,TL,FKL,G,FHRTMP,CPPT,QAFW,QF 10 2CHR, OPHR, OPUM, OLEAK, AREA, TAFEA) QF 30 QF 40 THIS SUPPOUTINE COMPUTES THE HYCROLOGIC AND ARTIFICIAL INPUTS. QF 50 PPT=PRECIPITATION (INCHES/YEAR) QF 60 CPT=COEF. OF EFFECTIVE PRECIPITATION TO GROUNDWATER (DECIMAL) QF 76 YPT=DISTRIBUTION OF PRECIPITATION FOR EACH DT OF ONE YEAR OF 86 (DECIMAL) 90 QF APW=APPLIED WATER AS A RESULT OF SUFFACE IRRIGATION (FEET/YEAR) CAW=COEF. OF DEEP PERCOLATI(N OF APPLIED WATER (DECIMAL) QF 100 QF 110 YAW=DISTRIBUTION OF APPLIED WATER FOR EACH OT OF ONE YEAR QF 120 (DFCIMAL) OF 130 NGPU=NUMBER OF GRIDS WITH PHREATOPHYTE USE OF 140 PHR=WATER USED BY PHREATOPHYTES (AF/YEAR). THIS MAY BE QF 150 CALCULATED FROM THE ET SUBPROGRAM BY CCOING FHR VALUES OF 160 LESS THAN ZERO. YPR=DISTRIBUTION OF PHREATOPHYTE USE FOR EACH DT OF ONE YEAR QF 170 QF 184 (DECIMAL) QF 190 WELL=WELL NUMBER CODE QF 200 RFUM=AMOUNT EACH WELL PUMPS PER YEAR (AF/YEAR) CPM=COEF. OF GROUNDWATER REMOVED BY PUMPING (DECIMAL) OF 210 QF 223 YPM=DISTRIBUTION OF PUMPING FCR EACH DT CF ONE YEAR (DECIMAL) QF 230 PIT=RECHARGE PIT NUMBER CODE RCHR=AMOUNT EACH PIT RECHARGES FER YEAF (FEET) QF 240 QF 250 YRC=DISTRIBUTION OF PIT RECHARGE FOF EACH OT OF ONE YEAR QF 260 (DECIMAL) OF 27. D=NET VALUE OF HYDROLOGIC AND AFTIFICIAL INPUT PER GRID (AF/DAY) OF 280

| С | | SQT=TOTAL Q PER DT (AF) | QF | 290 |
|---|------|--|----|------|
| C | | SQA=TOTAL Q PER DT BETWEEN STATIONS (AF) | QF | 300 |
| C | | REFEAT=DATA INPUT CODE FOR PULTIPLE YEAR ANALYSIS | QF | 310 |
| С | | | QF | 320 |
| | | DIMENSION DX(NR,NG), DY(NR,NC), CA(NR,NC), H(NR,NC), 7(NR,NG), HT | QF | 230 |
| | | INK,NG), D(NK,NG), PHR(NK,NG), WELC(NK,NG), FIT(NK,NG), TPT(INTK), | OF | 340 |
| | | TARLINKI, TRUINKI, TRUNKI, KUTAKI, KUTAKI, GRUKAI, TRUKELIA | in | |
| | | SI, RGHRINPI, HEINMINGI, ILINMINGI, FRINKINCI, GUNKINCI, FHRIPFINK | ur | 200 |
| | | S.NC1. DDIM(ND.NC1. ADEA(ND.NC1) | | |
| c | | STRUTT GEOTINGING ASEATINGTOC | OF | 38. |
| • | | COMMON /BLK1/ DT.ST.ICFAD.ILKAD.LCIE.LCIW.LCJF.LCJW.FWTOP | QF | 290 |
| | | COMMON /BLK2/ STA, STOL, STT, SQA, SQT, SQFA, SQBA, SQRT, SQBT, CVA, OVT | QF | 400 |
| C | | | QF | 410 |
| | | IF (I.NE.1) GO TO 320 | QF | 420 |
| | | ICT=0 | QF | 430 |
| | | INDX=1 | QF | 440 |
| | 110 | DO 120 K=1.NR | QF | 450 |
| | | | OF | 401 |
| | | O(K-1) = 0.0 | OF | 480 |
| | | PHRTMP(K, I) = 0.0 | OF | 490 |
| | | WELL(K+L)=0.0 | QF | 50. |
| | | PIT(K+L)=0.0 | QF | 510 |
| | 120 | CONTINUE | QF | 520 |
| | | ETCNT=0.0 | QF | 530 |
| | | DO 130 K=1, INYR | QF | 540 |
| | | | QF | 550 |
| | | YPP(K) = 0.0 | DE | 570 |
| | 1 30 | CONTINUE | OF | 58 |
| | | FFT=HT(T, J)=G(T, J) | OF | 59 |
| | | READ (5.470) POT.CPT | QF | 60. |
| | | IF (PPT.LE.0.0) GO TO 140 | QF | 610 |
| | | PEAD (5,480) (YPT(K),K=1,INYR) | QF | 62. |
| | 140 | READ (5,470) APW.CAW | QF | 630 |
| | | IF (APW.LE.0.0) GO TO 150 | QF | 640 |
| | | READ (5,480) (YAW(K),K=1,INYR) | QF | 650 |
| | 150 | CONTINUE | QF | CC. |
| | | REAJ (5,490) NGPU | OF | 670 |
| | | | OF | 690 |
| | | PEAD (5.496) J.K.P | QF | 703 |
| | | $PHR(J \cdot K) = P$ | QF | 710 |
| | 160 | CONTINUE | QF | 720 |
| | | GO TO 180 | QF | 730 |
| | 170 | IF (SIGN(1.0.NGPU).GT.C.0) GC TO 21C | QF | 74 |
| | | READ (5,476) PHF | QF | 750 |
| | 180 | 00 190 KK=1,NR | OF | 700 |
| | | TF (PHR(KK))), 17,6,0) GO TO 210 | OF | 78 |
| | | IF (PHR(KK-LL)-GT-0-0) GO TO 200 | QF | 790 |
| | 190 | CONTINUE | QF | 800 |
| | 200 | READ (5,480) (YPR(K),K=1,INYR) | QF | 810 |
| | 210 | IF (NH.LE.0) GO TO 250 | QF | 821 |
| | | READ (5,490) NW | QF | 834 |
| | | DO 220 K=1.NW | UF | 840 |
| | | | OF | 85 |
| | 220 | | DF | 87. |
| | | D0 240 J=1,NW | QF | 880 |
| | | RFAD (5,500) IWNO,K,L,RPUM(J), (PM(J) | QF | 890 |
| | | WELL(K+L)=IWNO | QF | 900 |
| | | READ (5,480) (YPM(IWNO,K),K=1,INYR) | | |
| | | IF (YPM(J,1).NE.0.0) GO TO 240 | QF | 920 |
| | | IF (SIGN(1.0, YPM(J, 1)).GE.0.0) GO TO 240 | QF | 936 |
| | | DO 230 K=1,INYR | QF | 941 |
| | 240 | CONTINUE | OF | 95 |
| | 250 | IF (NP-LE-0) 60 TO 290 | QF | 976 |
| | | READ (5,490) NP | QF | 980 |
| | | DC 2FU K=1,NP | QF | 99. |
| | | DO 260 L=1, INYR | QF | 1000 |
| | | YRC(K,L)=0.0 | QF | 1010 |
| | 260 | CONTINUE | QF | 1020 |
| | | DU 280 J=1+NP READ (5.500) TRN0.K.I. RCHR(1) | QF | 1030 |
| | | PIT(K.L)=IPNO | OF | 1050 |
| | | PEAD (5,480) (YRC(IPNO,K),K=1,INYR) | | |
| | | IF (YRC(J.1).NE.0.6) GO TO 280 | QF | 107. |
| | | IF (SIGN(1.0, YPC(J,1)).GE.0.0: GO TO 280 | QF | 1080 |

| | 00 270 K=1.INYR | QF | 1090 |
|------|---|-----|------|
| 270 | Y9C(J,K)=Y8C(J-1,K) | QF | 110. |
| 280 | CONTINUE | or | 112 |
| 2 30 | | QF | 1130 |
| | CALL MATEOP (NR.NC.CA) | QF | 1140 |
| | WRITE (6,620) APW | QF | 1150 |
| | WRITE (6,630) (YAW(K),K=1,INYR) | QF | 1160 |
| | WRITE (6,560) | QF | 1170 |
| | CALL MATROP (NR, NC, PHF) | OF | 110. |
| | WEITE (6,640) PPT | QF | 1200 |
| | WRITE (6.630) (YPT(K).K=1.INYP) | QF | 1210 |
| | IF (NW.LE.0) GO TO 300 | QF | 1220 |
| | WRITE (6,520) | QF | 1236 |
| | CALL MATROP (NR, NC, WELL) | OF | 1240 |
| | NRIF (0,050) DC 295 J=1.NW | ur | 1690 |
| 295 | WRITE(6.660) J.RPUM(J). (YPM(J.K). K=1. INYR) | | |
| 300 | IF (NP.LE.0) GO TO 310 | QF | 1270 |
| | WRITE (6,530) | QF | 1280 |
| | CALL MATROP (NR, NC, PIT) | QF | 1295 |
| | WRITE (6,670) | Q.F | 1:00 |
| 305 | WEITE(6.680) J.RCHR(J). (YRC(J.K).K=1.INYR) | | |
| | | QF | 1320 |
| 310 | IF (I.NE.1) GO TO 320 | QF | 1330 |
| | WRITE (6,590) | QF | 1340 |
| | CALL MATROP (NR.NC.H) | QF | 1350 |
| | WEITE 10.0007 STA.STOL.STT | OF | 1370 |
| 320 | ICT=ICT+1 | QF | 1380 |
| | IF (ICT.LE.INYR) GO TO 330 | QF | 1390 |
| | ICT=ICT-INYR-1 | QF | 1461 |
| | READ (5,470) REPEAT | QF | 1410 |
| | IF (REFEAT-NE-0.07 50 TO 320 | OF | 1430 |
| | WEITE (6.610) KYEAR | QF | 1443 |
| | GO TO 110 | QF | 1450 |
| 330 | PCNT=INDX | QF | 1460 |
| | FIEI | QF | 1476 |
| | S07=0.0 | OF | 1400 |
| | S01-0.0 | QF | 1510 |
| | DO 440 K=1.NR | QF | 1520 |
| | D0 440 L=1.NC | QF | 1530 |
| | IF (H(K,L).GT.1.E4) GO TO 440 | QF | 1540 |
| | 1F (HI(K,L).GI.Z(K,L)) GO TO 350 | OF | 1550 |
| | IE (KCT.GT.0) GO TO 340 | QF | 1570 |
| | WRITE (6,580) I | QF | 1583 |
| | KCT=1 | QF | 1593 |
| 340 | WRITE (6,540) K.L | OF | 1600 |
| 750 | 4-1 0 | OF | 1610 |
| 360 | CONTINUE | QF | 1630 |
| | | QF | 1640 |
| | QPPT(K,L)=(PPT*CPT*YPT(ICT)*AREA(K,L)/TAREA)/(12.*43560.) | | |
| | OAPW(K,L)=(APW*CAW*CA(K,L)*YAW(ICT)*AFEA(K,L)/TAREA)/43560. | | |
| | | OF | 1683 |
| | DRCHR(K-L)=RCHR(JJJ)*YRC(JJJ,TCT)*APFA(X-L)/43560. | ar | 1000 |
| | GC TO 380 | QF | 1703 |
| 370 | QFCHR(K,L)=0.0 | | |
| 380 | CONTINUE | QF | 1720 |
| 1 | IF (PHR(K,L).GF.0.0) GO TO 390 | QF | 1730 |
| | DHDTHD (V, 1) = 0 HD (V, 1) | | |
| | ETCNT=1. | QF | 1760 |
| | GO TO 400 | QF | 1770 |
| 390 | QPHR(K,L)=PHR(K,L)*YPR(ICT) | - | |
| 400 | CONTINUE | QF | 1795 |
| | $J = WELL(K_{1}L)$ $TE (JJ_{1}LE_{2}) = 0 TO (410)$ | QF | 1810 |
| | OPUM(K,L) = RPUM(JJ) * YPM(JJ,ICT) * CPM(JJ) | | |
| | GO TO 420 | QF | 143: |
| 410 | OPUM(K+L)=0.0 | | |
| 420 | CONTINUE | QF | 1850 |
| | 1 - 11 - 11 | ur. | TOCC |
| i i | 160.) | | |
| | GO TO 431 | | |

C

C

C

| | 430 | ULEANIN, LIEU U | |
|---|---------|--|-----------|
| | 431 | | |
| | | 01 | 1920 |
| | | SQT=SQT+Q(K,L)+DT QF | 1933 |
| | | IF (L.LT.LCIW) GO TO 440 QF | 1940 |
| | | IF (L.GT.LCIE) GO TO 440 QF | 1951 |
| | | IF (K.LT.LCJW) GO TO 440 01 | F 1960 |
| | | IF (K.GT.LCJE) GO TO 440 (2) | 1970 |
| | | 50A=50A+0(K+L)+0T 01 | 1980 |
| | 440 | ONTINUE | F 1990 |
| | | F ((FI*DT).NE. (PCNT*FWTOP)) GO TO 460 QI | F 2000 |
| | | ND X=INO X+1 OF | 201. |
| | | F (ETCNT.LE.0.) GO TO 450 QI | F 2023 |
| | | RITE (6,570) QF | E 2035 |
| | | ALL MATPOP (NR, NC, PHRTMP) | = 2040 |
| | 450 | RITE (6,550) I QF | F 205) |
| | | ALL MATROP (NR,NC,Q) OF | 2061 |
| | 460 | OF JURN OF | E 2070 |
| 1 | 4.70 | | 2080 |
| | 4.80 | | 2095 |
| | 400 | ORMAT (215-7510-1) 0 | 2100 |
| | 500 | OPMAT (315,6510,1) | 5 2420 |
| | 510 | ORNAT (1H1.45%.40HCOFFETCIENT FOR PART OF BLOCK TRATED () | 2 2 4 3 6 |
| | 520 | ORMAT (1H1,57X,16HWELL NUMBER MAF./) | 214 |
| | 530 | ORMAT (1H1+53X+24HRECHARGE PIT NUMBER MAP+/) | F 2153 |
| | 540 | ORMAT (31H WITHDRAWAL RESTRICTED IN GRID 213) | F 2160 |
| | 550 | ORMAT (1H1,30X, 49HMATRIX OF O(I,J) (AC-FT/DAY) FOR INCREMENT NUM OF | 2170 |
| | 1225.04 | ER, 110) OF | 2180 |
| | 560 | ORMAT (1H1,2CX,60HMATRIX OF PHR(I,J) - (ACRE-FEET CF WATER USEC / OF | F 2190 |
| | | GRID / YEAR)) QF | E 5500 |
| | 570 | ORMAT (1H1,20X,60HMATRIX OF PHR(I,J) - (ACRE-FEET CF WATER USEC / OF | = 2210 |
| | | GRID / INYR)) QF | 2220 |
| | 580 | ORMAT (1H1,94H WATER TABLE AND BEDROCK ELEVATIONS FREVENT WITHDRAW OF | F 2230 |
| | | L FROM THE FOLLOWING GRIDS FCR TIME FFRICO, 15) OF | 2240 |
| | 540 | ORMAT (1H1.37X, 46HINITIAL HEAD ELEVATION PAP (FEET ABOVE GATUM) OF | 2250 |
| | | | 2260 |
| | 600 | URMAT (1H +/// 48x, 24HINITIAL STORAGE (AC-FT) // 10x, 5HSTA= , 0 | 2270 |
| | | 12 + 21 + 14 + 17 + 17 + 31 + 10 + 17 + 31 + 17 + 17 + 17 + 17 + 17 + 17 | 2200 |
| | 620 | URMAI (INI 4////92%) ANTEANAIXAISAA, IINUF ANALTSIS/ UPCCT/VE OC | 2290 |
| | 020 | DI | 2 2 3 4 1 |
| | 630 | 0RMAT (1H .//.5%, 12HDISTRIBUTION.3%,12F7,4) | 2320 |
| | 640 | ORMAT (1H1-///.37X, 21HYEAELY ERECTRITATION=.E10.3.5X, 11HINCHES/ OF | 2 2 3 3 |
| | | EAR) | 2340 |
| | 650 | ORMAT (1H1+/////,60%, 10HWELL TABLE) OF | 2350 |
| | 660 | ORMAT (1H .///.5%, BHWELL NC7%, I10.//.5%, 17 FRATE (AC-FT/YEAF OF | 2360 |
| | ALCONT. | .6X.F10.4.(/.5Y, 12HDISTRIBUTION.3X,12F7.4)) QF | F 237 |
| | 673 | ORMAT (1H1,////.53X, 14HRECHARGE TABLE) OF | 234: |
| | 680 | ORMAT (1H ,///,5X, 7HPIT NO.,8X,11C,//,5X, 16HRATE (FEET/YEAR), 0 | F 2390 |
| | | X,F10.4, (/,5X, 12HOISTRIBUTICN, 3X, 12F7.4)) | F 2400 |
| | | 01 | - 2410 |
| | | | |

FUNCTION ET

| | | FUNCTION ET (AHT, AG, K, L) | ET | 10 |
|---|-----|---|----|-----|
| C | | | ET | 20 |
| С | | | ET | 30 |
| C | | THIS SUBPROGRAM COMPUTES THE PHREATCPHYTE USE USING WATER TABLE | ET | 40 |
| С | • | ELEVATIONS. | ET | 50 |
| С | | ET=EVAPOTRANSPIRATION (FEET/INYR) | ET | 60 |
| C | | DTHT=DEPTH TO WATER TABLE FROM GROUND SURFACE (FEET) | ET | 70 |
| C | | | ET | 80 |
| | | DTWT=AG-AHT | ET | 90 |
| | | IF (DTHT.GE.0.0) GO TO 110 | ET | 100 |
| | | WRITE (6,120) K,L | ET | 110 |
| | 110 | CONTINUE | ET | 120 |
| | | ET==0.0 | FT | 130 |
| | | RFTURN | ET | 140 |
| С | | | ET | 150 |
| | 120 | FORMAT (1H1,////,45%, 37HET ERROR, DTWT LESS THAN ZERO IN GRID,21 | ET | 160 |
| | 6 | 15) | ET | 170 |
| C | | | ET | 180 |
| | | END | ET | 190 |

SUBROUTINE MATSOL

| | | SUBROUTINE MATSOL (NOROW, NOCCL. IP. IR. FK. FHI. H. HT. Z. DELY. OFLY. Q. CH | 1A M | \$ 11 |
|----|----|--|-------|--------|
| | | 1T + X + CR + A + R + G + PH 1 C + HP + HF) | M | \$ 21 |
| | | | M | 5 3. |
| | | THIS SUBDOUTTINE SETS UP THE COFFETCIENT WATDLY AND RIGHT HAND | N | 5 5 |
| : | | SIDE VECTOR MATRIX. | M | S 6 |
| : | | CMATRX=COEFFICIENT MATRIX | M | S 7 |
| : | | CR=FIGHT HAND SIDE VECTOR MATRIX | M | S 8 |
| ; | | | M | 5 9 |
| | | TROW NOCOLA, ZINOROW NOCOLA, DELYLNOECH NCCOLA, DELYLNOECH NCCOLA, DELYLNOECH NCCOLA, DELYLNOECH NCCOLA, | NU M | 5 10 |
| | | 2Q(NOROW,NOCOL), CMATRX(IP,IR), CR(IP), A(NOROW,NOCOL), B(NORCH,NO | ос м | S 12 |
| | | 30L), G(NOROW, NOCOL), PHIC(NORCH, NCCOL), HP(NCROW, NCCOL), HF(NCRC) | 4. M | S 13 |
| | | 4NOCOL) | M | S 14 |
| ; | | | H | S 15 |
| | | COMMON /BLK1/ DT.ST.ICFAO,ILKAO,LCIE.LCIW.LCJE.LCJW.FWTOP | M | S 16 |
| | | DELT=DT | M | S 18 |
| | | DO 110 J=1, IR | M | S 19 |
| | | DO 110 I=1.IP | м | S 20 |
| | | CPATRX(I,J)=0.0 | M | S 21 |
| | 10 | | M | 5 22 |
| | | 00 120 J=1,NOCOL | м | S 24 |
| | | A(I,J)=0.0 | M | S 25 |
| 02 | | 3(1, J)=0.0 | M | S 26 |
| 1 | 20 | | M | 5 27 |
| | | | M | S 28 |
| | | NR1=NOROW-1 | M | 5 30 |
| | | IB=NOROW-2 | M | S 31 |
| | | IM=[9+1 | M | 5 32 |
| | | IC=IM+1 | M | S 33 |
| | | ID=2*I9+1 | M | 5 34. |
| | | DO 160 J=2,NC1 | | 5 36 |
| | | NT=NT+1 | M | S 37 |
| | | CR(NT)=0.0 | м | 5 38 |
| | | IF (H(I, J).GE.10000.0) GO TO 150 | M | S 39 |
| | | JA=I | M | 5 40 |
| ; | | 56-1 | M | S 42 |
| ; | | LEFT(A) | м | S 43 |
| ; | | | M | 5 44 |
| | | GMATRX (NT, 1) = PARAM (FK(JA, J=1), FK(I, J), HT(JA, J=1), HT(I, J), Z(JA, | J M | 5 45 |
| | | 1 -1/,2(1,J),DELX(JA,J-1),DELX(1,J),DELY(JA,J-1),DELY(1,J),G(JA) | J H | 5 47 |
| 2 | | | M | S 48 |
| 5 | | TOP (B) | M | 5 49 |
| 3 | | | м | S 50 |
| | | CHATRX(NT, IB)=PARAP(FK(I=1, J), FK(I, J), HT(I=1, J), HT(I, J), Z(I=1, | JM | S 51 |
| | | 1) */(1*J) *DELY(1=1*J) *DELY(1*J) *DELX(1=1*J) *DELX(1*J)*G(1=1*J) | , U H | 5 51 |
| 2 | | | M | 5 54 |
| ; | | ROTTOM(C) | M | \$ 55 |
| ; | | | м | \$ 56 |
| | | CMATRX (NT, IC) = PARAM (FK(I+1, J), FK(I, J), HT (I+1, J), HT (I, J), Z(I+1, | JM | S 57 |
| | | 1).7(I, J).DELY(I+1, J).DFLY(I, J).DELX(I+1, J).DELX(I, J).G(I+1, J). | GM | 5 58 |
| | | A(I, I)=CHATRY(NT, IC) | M | 5 60 |
| ; | | | M | S 61 |
| ; | | RIGHT (D) | M | 5 62 |
| ; | | | м | S 63 |
| | | CMATRX (NT.ID) = PARAM(FK (JD.J+1) + FK (I.J) + FT (JD.J+1) + HT (I.J) + Z (JC | J, M | 5 64 |
| | | 2 J+1)+G (I+J) | N 1 | S 66 |
| | | 8(I,J)=CHATRX(NT,IO) | M | 5 67 |
| | | | M | S 68 |
| | | GALL NSCONT (H(JA, J=1), HT(JA, J=1), FT(I, J), Z(JA, J=1), Z(I, J), CH | AT M | 5 69 |
| | | 1 RAINI, 1), CMATRX (NT, IM), CR (NT)) CALL NSCONT (HAI-1, I), HTAT-1, I), HTAT, II, 247, II, 247, II, CHATES | M | 5 700 |
| | | 1 NT, IB), CMATRX (NT, IM), CR (NT)) | M | S 72 |
| | | CALL NSCONT (H(I+1,J), HT (I+1,J), HT (I,J), Z(I+1,J), Z(I,J), CMATE) | (M | S 73 |
| | | 1 NT.IC), CMATRX (NT.IM), CR (NT)) | M | S 74 |
| | | GALL NSCONT (H(JD,J+1),HT(JD,J+1),ST(I,J),Z(JD,J+1),Z(I,J),CM | AT MS | 5 750 |
| | | 1 RAINI & LUJ & GRAIKAINI & LEJ & GRINI)) | M | 5 77 |
| ; | | (E) | M | \$ 780 |
| | | | | |

| | | TF (ICFAQ.LE.0) GO TO 130 | 12 | 000 |
|---|--------|---|-----|-------|
| | | IF (HT(1.J).LE.G(1.J)) GO TO 130 | 12 | 110 |
| | | STCOLF=PHIC(1,J) | HS | 820 |
| | | GO TO 140 | MS | 430 |
| | 130 | STCOEF = PHI(I,J) | MS | 845 |
| | 140 | CONTINUE | MS | 850 |
| | | CMATRY (NT. TM) = CMATRX (NT. IM) = (CMATRX (NT. 1) + CMATRX (NT. IB) + CMATRX | MS | 860 |
| | | 1 NT.TC) + CMATRX (NT.ID) + (STCOFF*DELX(I,J)*DFLY(I,J))/CELT) | MS | 870 |
| | | CR(NT)=CR(NT)-(HT(I,J)*STCCFF*CELX(I,J)*CELY(I,J))/CELT=Q(I,J)* | MS | 88. |
| | | | MS | 896 |
| - | | 1 43990.0 | 45 | 900 |
| | | CO TO 160 | MS | 916 |
| | | GC 10 160 | MS | 920 |
| | 150 | | MS | 036 |
| | 120222 | | MC | 946 |
| | 160 | CONTINUE | MS | 054 |
| | | REWIND 7 | MC | 960 |
| | | WRITE (7) CHAIRX,CR | MS | 97. |
| | | CALL BSOLVE (CMATRX, IP, IR, CR) | 15 | 001 |
| | | NT=C | MS | 961 |
| | | D0 170 J=2,NC1 | MD | 990 |
| | | DO 170 I=2,NR1 | MS | 1000 |
| | | NT=NT+1 | MS | 1011 |
| | | HT(I,J)=CR(NT) | 42 | 1020 |
| | | HF(I,J)=CR(NT) | MS | 1030 |
| | 170 | CONTINUE | MS | 1040 |
| | 1.0 | IF (ICFA0.LE.0) GO TO 230 | MS | 1(5: |
| | | FEWIND 7 | MS | 106. |
| | | DEAD (7) CHATRY-CP | MS | 1070 |
| | | | MC | 1080 |
| | | | MC | 100 |
| | | N I = U | MC | 110 |
| | | 00 210 J=2.NC1 | 15 | 1105 |
| | | D0 210 1=2,NR1 | 113 | 1110 |
| | | NT=NT+1 | MS | 1120 |
| | | IF (HT(I.J).LE.G(I.J)) GO TO 180 | MS | 113. |
| | | IF $(HP(I,J)-G(I,J))$ 190,190,210 | MS | 114. |
| | 180 | IF $(HP(I,J)=G(I,J))$ 210,210,200 | MS | 1150 |
| | 190 | ERROR=(G(I,J)*(PHI(I,J)-PHIC(I,J)))*DELX(I,J)*DELY(I,J)/DELT | MS. | 1160 |
| | | CR(NT)=CR(NT)+ERROR | MS | 118. |
| | | CMATRX (NT,NR1)=CMATRX (NT,NR1)+(PHI(I,J)-PHIC(I,J))*OELX(I,J)*OE | MS | 1190 |
| | | 1 LY(I,J)/DELT | MS | 1200 |
| | | WRITE (6,240) I,J | MS | 1211 |
| | | ICAC=1 | MS | 1221 |
| | | 60 TO 210 | MS | 1236 |
| | 200 | ERROR= (G(1,J) * (PHI(1,J) - PHIC(1,J))) * DELX(1,J) * DELY(1,J) / DELT | MS | 1240 |
| | | CP(NT)=CP(NT)=+PPOP | MS | 1266 |
| | | CMATRX (NT, NR1) = CMATRX (NT, NR1) + (PHTC(T, J) = PHT(T, J)) * DELX(T, J) * DE | MS | 1270 |
| | | 1 LY(I,J)/DELT | MS | 1286 |
| | | WRITE (6-250) T-J | MS | 1290 |
| | | | MS | 1 300 |
| | 210 | | MS | 1 31 |
| | 510 | | HC | 172/ |
| | | IF (ICAC.E0.0) GO TO 233 | 15 | 1320 |
| | | CALL BSOLVE (CMATRX, IP, IR, GR) | ms | 1330 |
| | | N 1 = 0 | MS | 1340 |
| | | 00 220 J=2,NC1 | MS | 1350 |
| | | DO 220 I=2+NR1 | MS | 1360 |
| | | NT=NT+1 | MS | 1370 |
| | | HT(I,J)=CR(NT) | MS | 1380 |
| | | HF(I,J)=CR(NT) | MS | 1393 |
| | 220 | CONTINUE | MS | 1403 |
| | 230 | RETURN | MS | 1415 |
| C | | | MS | 1420 |
| | 240 | FORMAT (1H .43X. 4HGRID.215.5X. 22HUNCONFINED TC CONFINED) | MS | 1430 |
| | 250 | EDRMAT (1H -43Y - 4HG910.215.5Y - 22HCONETNED TO UNCONETNED) | MS | 1447 |
| c | 6 20 | FORMAT TEN FORT ANONIDIELITING EENCOM THED TO ONCONTINED | MS | 145 |
| U | | END | MS | 1660 |
| | | | | |

FUNCTION PARAM

| FUNCTION PARAM(AK1.AK2.AHT1.AHT2.A21.AZ2.AX1.AX2.AY1.AY2.AG1.AG2. | PR | 20 |
|---|----|----|
| | PR | 20 |
| | PR | 30 |
| THIS SUBPROGRAM COMPUTES THE COEFFICIENTS USED IN MATSCL AND | PR | 40 |
| BYFLOW. IT IS APPLICABLE TO CASES OF VARIABLE DX, CY, FK. | FR | 5. |
| AND SATURATED THICKNESS. | PR | 65 |
| | D9 | 7: |

| | | COMMON /BLK1/ DT.ST.ICFAD.ILKAD.LCIE.LCIN.LCJE.LCJN.FHTOP | PR | 8 |
|---|-----|---|----|-----|
| C | | | PR | 9. |
| | | IF (ICFAQ.LE.0) GO TO 110 | PR | 10 |
| | | A=AMIN1(AHT1,AG1) | PR | 110 |
| | | P=AMIN1(AHT2.AG2) | PR | 12: |
| | | SATHCK=AMAX1(A,B)-AMAX1(AZ1,AZ2) | PR | 13. |
| | | GO TO 120 | PR | 14. |
| | 110 | SATHCK=AMAX1(AHT1,AHT2)-AMAX1(AZ1,AZ2) | PR | 15: |
| | 120 | PARAM=(2.*AK1*AK2*AY1*AY2*SATHCK)/((AX1*AK2*AY2)+(AX2*AK1*AY1)) | PR | 16. |
| C | | | PR | 171 |
| | | RETURN | PR | 18: |
| C | | | PR | 190 |
| | | END | PR | 200 |

SUBROUTINE NSCONT

| | | SUBROUTINE NSCONT (HA, HTA, HTM, ZA, ZM, CRXA, CRXM, CRL) | NC | 1 |
|---|-----|---|----|-----|
| C | | | NC | 2 |
| С | | | NC | 31 |
| С | | THIS SUBROUTINE TRANSFERS THE CCEFFICIENTS, MULTIPLIED BY THEIR | NC | 41 |
| C | | RESPECTIVE H-VALUE, TO THE RIGHT HAND SIDE VECTOR MATRIX IN | NC | 51 |
| С | | CASE OF ADJACENT CONSTANT HEAD OR KNOWN BOUNDARY CONDITIONS. | NC | 61 |
| С | | IT ALSO SETS COFFFICIENTS EQUAL TO ZERC IN CASE OF ACJACENT | NC | 71 |
| C | | IMPERMEABLE BOUNDARIES. | NC | 8 |
| С | | | NC | 9. |
| | | IF (HA.LT.20000.0) GO TO 110 | NC | 103 |
| | | CRL=CRL=CRXA*HTA | NC | 111 |
| | | CRXM=CRXM-CRXA | NC | 120 |
| | | CFXA=0.0 | NC | 13: |
| | | GO TO 120 | NC | 141 |
| | 110 | IF (HA.GE.10000.0) GO TO 130 | NC | 15 |
| | 120 | IF ((HTM-ZM).LE.1.0.AND.HTM.GT.HTA) GO TO 130 | NC | 160 |
| | | IF ((HTA-ZA).GT.1.0.OR.HTA.LE.HTM) GC TO 140 | NC | 170 |
| | 130 | CRXA=C.0 | NC | 18 |
| С | | | NC | 190 |
| | 140 | RETURN | NC | 200 |
| С | | | NC | 21 |
| | | END | NC | 22 |
| | | | | |

SUBROUTINE BSOLVE

| | SUBROUTINE BSOLVE (0, N, M, V) | 85 | 10 |
|------|---|----|-----|
| C | | BS | 21 |
| С | | 85 | 30 |
| C | THIS SUBROUTINE SOLVES THE MATRIX, SET UP IN MATSOL, BY GAUSS | BS | 40 |
| C | FLIMINATION. | 95 | 50 |
| C | | 85 | 60 |
| | DIMENSION D(N.M), V(N) | BS | 7: |
| C | | BS | 80 |
| | LR = (M-1)/2 | 85 | 96 |
| | DO 120 L=1.LR | 85 | 100 |
| | IM=LR-L+1 | 85 | 110 |
| | DO 120 I=1,IM | 35 | 120 |
| | DO 110 J=2,M | 85 | 130 |
| 110 | D(L, J-1) = O(L, J) | 85 | 140 |
| | KN=N-L | BS | 150 |
| | KM=M-I | BS | 160 |
| 1.00 | D(L,M) = 0.0 | BS | 170 |
| 120 | D(KN+1,KM+1)=0.0 | BS | 180 |
| | LF=LP+1 | BS | 195 |
| | I M=N-1 | 85 | 200 |
| | DC 190 I=1,IM | 8S | 210 |
| | NPIV=I | BS | 220 |
| | L S=I+1 | 85 | 230 |
| | DO 13C L=LS,LR | 85 | 240 |
| | IF (ABS(0(L,1)).GT.A3S(0(NPIV,1))) NPIV=L | RS | 250 |
| 130 | CONTINUE | 85 | 260 |

| | IF (NPTV-LE-I) GO TO 150 | 85 | 270 |
|---------|-------------------------------------|-----|-----|
| | 00 140 J=1.M | 85 | 285 |
| | TEMP=D(T. I) | 85 | 290 |
| | D(I,J) = D(NPIV,J) | 85 | 300 |
| 140 | D(NPIV.J)=TEMP | 85 | 310 |
| | TEMP=V(T) | BS | 320 |
| | V(I)=V(NPIV) | 95 | 330 |
| | V(NPIV)=TEMP | 95 | 340 |
| 150 | $V(I) = V(I) / O(I \cdot 1)$ | BS | 35. |
| | 00 160 J=2,M | BS | 360 |
| 160 | D(I,J)=D(I,J)/D(I,1) | AS | 370 |
| | DO 180 L=LS.LR | A S | 380 |
| | TEMPTD(L.1) | BS | 390 |
| | V(L) = V(L) - TEMP*V(I) | 85 | 40 |
| | 00 170 J=2.M | ns | 410 |
| 170 | D(L, J=1) = D(L, J) = TEMP* D(I, J) | HS | 426 |
| 180 | D(L - M) = 0 - 0 | 35 | 436 |
| • • • • | TE (IP.LT.N) LP=LR+1 | 85 | 440 |
| 190 | CONTINUE | 95 | 450 |
| | V(N) = V(N) / D(N-1) | 85 | 460 |
| | IM=2 | 85 | 470 |
| | DO 210 I=1.IM | as | 480 |
| | L=N=T | BS | 490 |
| | D0 266 J=2.JM | 85 | 500 |
| | KM=L+J | BS | 510 |
| 203 | V(L) = V(L) = D(L,J) + V(KM-1) | 85 | 52: |
| | IF (JM+LT+M) JM=JM+1 | BS | 530 |
| 1210 | CONTINUE | 95 | 540 |
| C ` | | 85 | 550 |
| | RETURN | 85 | 560 |
| С | | BS | 57. |
| - | C 110 | 28 | 580 |

SUBROUTINE BJUST

| | SURROUTINE BJUST (NR+NC+H+HT+HP,DX+CV+I) | BJ | 10 |
|----|---|----------|------|
| C | | BJ | 23 |
| č | | BJ | 30 |
| c | THIS SUBROUTINE ADJUSTS THE UNDERFLOW BOUNDARY WATER TABLE OR | BJ | 40 |
| c | HEAD FLEVATIONS. BOUNDARY FLEVATIONS AFE HELD CONSTANT FOR | 8.1 | 5 |
| č | ODD TIME STEPS. GRADIENTS ARE COMPLIED THEFE GRIDS IN AND | BJ | 60 |
| č | PROJECTED BACK TO OBTATE NEW WATER LEVEL FLEVATIONS CR | BJ | 70 |
| ~ | LEAS CLEVENTIONS AT AGAINGAGING | RI | 8.1 |
| č | HEAD ELEVATIONS AT BOUNDARIES. | 9.1 | 9. |
| • | DIMENSION WIND NOT WITHIN NOT HOUSE DATAS NOT DATAS | 81 | 103 |
| ~ | DIMENSION HUNCHOF, HUNKING/, HEUNKING/, DAUNKING/, DUMAKING/ | 9.1 | 110 |
| U. | TE ((T/2+2) NE T) DETION | 91 | 120 |
| ~ | IF CUPE-EFORE-IF REFORM | | 131 |
| U | | 0. | 14.0 |
| | | 01 | 150 |
| ~ | NCI-NC-I | 0.1 | 150 |
| U | DO 120 72-2 NO1 | 0, | 170 |
| | | 0. | 10 |
| | | 35 | 105 |
| | | 0. | 250 |
| | UTIP=(H1(2,12)-H1(3,12))+(Ut(1,12)+Ut(2,12))/(Ut(2,12)+Ut(3,12)) | 50 | 210 |
| | | 0.1 | 220 |
| | $H^{(1,12)} = H^{(2,12)} + 0.110$ | 0.1 | 220 |
| | 110 IF (H(NR,12).6E.3600.0) GO TO 120 | DJ DJ | 230 |
| | | 0. | 250 |
| | 0101=(H(NR=2,12)=H(NR=3,12))*(U(NR,12)*U(NR=1,12))(U(NR=2 | | 250 |
| | 1 + 12 + 0 + (NR - 1, 12) | 81 | 201 |
| | HTTNR, 127=HTTNR 1,127=U181 | DJ. | 210 |
| | 120 CONTINUE | HJ | 280 |
| C | | BJ | 296 |
| | DO 140 I1=2,NR1 | BJ | 300 |
| | IF (H(II,1),GE.30000.0) GO TO 130 | 81 | 310 |
| | IF (H(I1.1).LT.2000C.0) GO TO 13C | BJ | 320 |
| | DIL I = (HI (I1, 2) - HI (I1, 3)) + (DX(I1, 1) + DX(I1, 2)) / (DX(I1, 2) + DX(I1, 3)) | BJ | 330 |
| | 1) | BJ | 340 |
| | HT(I1,1)=HT(I1,2)+OILT | BJ | 35 |
| | 130 IF (H(I1,NC).GE.30000.0) GO TO 140 | BJ | 360 |
| | IF (H(I1,NC).LT.20000.0) GC TO 140 . | 9J | 376 |
| | DIRT=(HT(I1,NG-2)-HT(I1,NC-1))*(DX(I1,NC)+DX(I1,NC-1))/(DX(I1,N | BJ | 386 |
| | 1 C-2)+DX(I1,NC-1)) | 81 | 391 |
| | HT(I1,NC)=HT(I1,NC1)-DIRT | BJ | 400 |
| 2 | 140 CONTINUE | 4J | 410 |
| С | | 8J | 420 |
| 2 | RETURN | BJ | 430 |
| С | | 4J | 443 |
| | ENU | 13 J | 456 |

SUBROUTINE ODFLOD

| C | | END | JF | 750 |
|---|------|--|-----|------|
| | 230 | FORMAT (12HOT O T A L S. 8X. 2(8X. F8. 2) . 2X. F8. 2. 4X. F8. 2//) | OF | 74: |
| | 550 | FORMAT (3H 214,9X,4F8.2) | OF | 736 |
| | 24.0 | 10 E D.5X. 8HAREA 00.,4X, 8HAREA FO.// | 0F | 710 |
| - | 200 | FORMAT (1H1,14H-ROW - COL NR., 6X, 15HO V E R C R A H, 2X, 13HF L O O | OF | 700 |
| С | | "LIVAN | OF | 680 |
| | | | OF | 673 |
| | 190 | OVA=CACFTA | OF | 66 L |
| | | WEITE (6,230) OACETT, FACETT, CACETA, FACETA | OF | 650 |
| | 100 | IF (04CFTT.EQ.0.0.4ND.FACFTT.E0.0.01 60 TO 190 | OF | 630 |
| | 170 | WFITE (6,220) I, J, ODFT, ODACFT, FFT, FACFT | OF | 62: |
| | | KCT=1 | OF | 610 |
| - | | WRITE (6.210) | OF | 600 |
| | 100 | WRITE (6,200) | OF | 591 |
| | 160 | FACFTA=FACFTA+SVOLF | OF | 570 |
| | | OACFTA=OACFTA+SVOLO | OF | 560 |
| | | IF (I.GT.LCJE) GO TO 160 | OF | 550 |
| | | TE (I_I_I_I_U) 60 TO 160 | OF | 54 |
| | | IF (J.LT.LCIW) GO TO 160 | OF | 520 |
| | 1 | FACFTT=FACFTT+SVOLF | OF | 510 |
| | 150 | OACFTT=OACFTT+SVOLO | OF | 500 |
| | 140 | HT(I,J)=G(I,J) | OF | 480 |
| | | GO TO 150 | OF | 470 |
| | | SVOLF=FACFT | OF | 465 |
| | | IF (H(I,J).GT.20000.0) GO TO 140 | OF | 450 |
| | | | OF | 430 |
| | | ODFT=C.0 | OF | 420 |
| | | FACFT=FFT*DX(I,J)*DY(I,J)*S(I,J)/43560. | OF | 410 |
| | | IF (HT (I, J). LE. G(I, J)) GO TO 180 | OF | 40: |
| | 130 | IF (ICFAQ.GT.C) GO TO 180 | OF | 390 |
| | 120 | $G_0 = T_0 = 2(1, 3)$ | OF | 38. |
| | | SVOLO=ODACFT | OF | 360 |
| | | IF (H(I,J).GE.20000.0) GO TO 120 | OF | 350 |
| | 110 | OCACFT=ODFT*DX(I,J)*DY(I,J)*SS/43560. | OF | 34. |
| | | IF (HT(I,J).LE.G(I,J)) SS=S(I,J) | OF | 330 |
| | | SS=SC(T.J) | OF | 120 |
| | | SS=S(1,J) | OF | 300 |
| | | FFT=0.0 | OF | 290 |
| | | FACFT=0.0 | OF | 285 |
| | | 00FT=7(I+J)=HT(I+J) | OF | 270 |
| | | IF (H(I,J).GE.10000.0) GO TO 180 | OF | 250 |
| | | DO 180 I=1.NR | OF | 240 |
| | | DO 180 J=1,NC | OF | 230 |
| | | SVOLF=0.0 | OF | 220 |
| | | SVOL 0=0.C | OF | 200 |
| | | FACFTA=0.0 | OF | 190 |
| | | DACFTA=0.0 | OF | 180 |
| | | FACETT=G_0 | OF | 170 |
| С | | CACETT-0 0 | OF | 15. |
| 1 | | COMMEN /ALK2/ STA, STOL, STT, SOA, SOT, SCFA, SQBA, SQRT, SQBT, CVA, OVT | OF | 140 |
| - | | COMMON /BLK1/ DT.ST.ICFAO.ILKAQ.LCIE.LCIW.LCJE.LCJW.FNTOP | OF | 130 |
| C | | LANDIA DILINKANULA SULIKANUL | OF | 120 |
| | | DIMENSION H(NR,NC), HT(NR,NC), Z(NR,NC), G(NR,NC), S(NR,NC), DX(NR | OF | 110 |
| C | | | OF | 96 |
| c | | FACETA= FVA= AMOUNT FLOODED EFTWEEN PUFFER ZONE BOUNDARIES (AF) | OF | NC |
| C | | OACFTA=OVA=OVERDRAW BETWEEN BUFFEK ZONE BOUNDARIES (AF) | OF | 73 |
| C | | OACFTT=OVT=TOTAL OVEPDRAW (AF) | OF | 50 |
| č | | THIS SURPOUTINE CHECKS FOR OVERDRAWN OR FLOODED AREAS. | OF | 40 |
| C | | | OF | 3. |
| | | SUBROUTINE ODFLOD (NR.NC.H.HT.Z.G.S.DX.DY.SC) | OF | 10 |
| | | | ~ - | |

SUBROUTINE BYFLOW

l

| | | SUI 1TR | BRC X,A | UT | IN,H | Ε Ρ, | BYI G, | FLO | W ME | (N | IR . | NC | , N. | A . | , FI | .FK | | 1.1 | IF . | Z . | .0 | X . 1 | PW. | SC | | I. | SO | GG HR | J.5 , QF | OR Pum | , CMA | BF | 16 |
|---|------|------------|------------|-----|-------|---------|-----------|-------|-------------|-------|-------|-----|------|------|-------|-------|------|------|------|-------|------|-------|------|------|-------|-----|------|----------|-------------|-----------|-------------|----------|------|
| | | ZAK | , CP | PT | , C | AP | ₩, | CRO | CHE | | SC | R, | Q | , C | PUI | ۹.(| LE | A | (.(| PH | R |) | | | | | | | | | | | |
| C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 81 | 30 |
| C | | | | | | | ** | | ~ | | | | | | | | 10 | | | | | | | | 0 | | | | C 11 | | | 0F | 4 |
| č | | In | 1.2 | ND | AP | TE | | | | 101 | M | 01 | NS | TA | NT. | in | A1 | 1 | 16 | 105 | i le | IC | · | | | | c n | uu | un | | | nr. | - 60 |
| č | | TH | 15 | SU | AP | ou | i I | NF | C | OMI | PUT | FS | N | FW | H | FL | 11 | I VI | . (| CON | (CI | FN | TRA | TI | ION | s | FC | 9 | FAC | H | GRIC | | |
| C | | PA | SED | 0 | N | AL | L | IN | PUT | 1 | AND | 0 | UT | PU | T | VAF | 11 | API | | 5 1 | 0 | E | ACH | + (| GRI | 0. | - 22 | | 9.0 | | 5 1945 1 | | |
| c | | | sag | GI | =F | LO | м | BEI | WE | EEN | V G | P.I | DS | I | N | 1-1 | | REC | : 11 | 101 | \$ | () | F) | | | | | | | | | BF | 76 |
| C | | | SQG | GJ | =F | LO | W | BE 1 | WE | EEN | 4 G | PI | ns | I | Ν. | J-1 | IF | REC | T | 101 | | (4 1 | F) | | | | | | | | | BF | 80 |
| С | | - | 509 | T = | TO | TA | L | IN | FL(| DM | TH | RO | UG | н | ec | UNI | A | RIE | 33 | (/ | F |) | | | | | | | | | | 9F | 9ú |
| C | | | SQR | = 4 | IN | FL | OW | TI | HRO | 000 | GH | BU | FF | ER | Z | ONE | | 3 CI | 141 | DAF | I | ES | () | AF |) | | | | | | | BF | 160 |
| C | | | SOR | = I | NF | LO | H | FRI | OW | CO | | TA | NT | H | EAI | 0 0 | SR. | 10: | 5 | | T | | | | | 0.0 | | | • | | | BF | 120 |
| č | | 1 | SUR | A = | TN | FI | ۲ ۵ | TUL | | 4 5 | | FO | 0 | D | | NST | 1 4 | . ОГ | H | | | | TO | | | HT | | RU | FFS | 2 | | BF | 130 |
| č | | | 5 0 1 | - | zo | NE | B | our | 101 | ARI | IES | (| AF | , | | | | ••• | | | | | | 1 | | | | | | | | BF | 14. |
| C | | - | 122 | - | | | | | | - | | | | | | | | | | | | | | | | | | | | | | BF | 150 |
| | | DI | MEN | SI | ON | F | K(| NR | NC | ;), | , н | (N | R, | NC |), | HF | . () | NR : | (| ; 1 , | | Z () | NR . | , N(| ;), | D | × (| NR | , NC | ;), | CYI | ØF | 160 |
| | | 1NR | .NC | 1. | S | QG | GI | INF | 1.5 | NC) | | SO | GG | 11 | NR | . NO | 2) | , : | SCI | 1) 5 | R | . 1 | C) . | | CMA | TR | × | NA | • N | 3), | 111 | BF | 170 |
| | | 2 R + | HTC | 11 | P. | K . | NG | 1.1 | | | un l | . 0 | 00 | | NR | , NC | | | | 111 | 10 | | | | PCL | DI | 1.0 | PH | 111 | CP | HEI | 134 | 10. |
| | | ANE | NC | 1. | OP | UM | 111 | R., | IC. | | DI F | AK | IN | P. | NC | 1.0 | 50 | VE. | N | | | FIL | MI | G. | NI | | CI | FA | KI | IR. | NCI. | | |
| | | 5CP | HR | NR | . N | C) | | PPI | 111 | IR | NC | 1. | CA | PW | 111 | R . 1 | IC | | F | HF | 1 | NF | .N | C). | CS | OR | IN | R. | NCI | | | | |
| C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 8F | 190 |
| | | CO | MMO | N | 18 | LK | 1/ | 0 | 1,5 | ST . | IC | FA | 0, | IL | KA | 0,1 | . C | IE . | L | I | 1,1 | LC | JE | . L | CJN | 1.F | WT | OP | | | | BF | 200 |
| | | CO | MMC | N | /e | LK | 21 | S | TA , | , 51 | TOL | • 5 | TT | • S | AD | , 50 | 11 | , 50 | 161 | 1.5 | 0 | P.A | • S(| R | , , , | GB | 1, | ov | Α,(| TVC | | 9F | 210 |
| C | | 15 | -1.0 | TE | | | | | | | | | | | | | | | | | | | | | | | | | | | | ISF OF | 221 |
| | | LN | =LC | TW | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | BE | 240 |
| | | NS | =LC | JE | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | BF | 250 |
| | | NN | =LC | JW | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | 9F | 260 |
| | | NE | 1 = N | F- | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | BF | 27 |
| | | NC | 1 = N | IC- | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | BF | 28. |
| | | SO | GIA | = 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | AF | 290 |
| | | 50 | 1 JA | = 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | ßF | 301 |
| | | TO | 3 1 A | - 0 | • 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | OF | 31. |
| C | | 10 | 3.3.4 | - 0 | • u | | | | | | | | | | | | | | | | | | | | | | | | | | | BF | 220 |
| c | | 00 | 20 | L | 00 | P | co | MPI | ITF | -s | FL | OW | Т | N | тн | F 1 | r i | ודר | F | | 10 | N | | | | | | | | | | RE | 340 |
| C | | ST | ATE | ME | NT | S | 10 | AI | ND | 12 | 2 F | OP | CE | s | CI | SCH | A | RGI | 5 | A | r | TH | EF | FIR | RSI | A | NO | L | AST | r | | BF | 350 |
| C | | GR | IDS | T | 0 | BE | C | 001 | NTE | ED | AS | e | 00 | NO | AF | Y (| SR | 101 | S | | | | | | | | | 1 | | | | BF | 360 |
| C | | ST | ATE | ME | NT | 1 | 4 | AN | 5 1 | 16 | CC | MP | UT | ES | R | IVE | R | FL | - CI | 15. | 2 | F | IVE | ER | M | IST | E | E | IN | TER | ICR | BF | 370 |
| C | | 10 | GR | 10 | S | 3 | AN | DI | NR1 | 1 0 | PC | IN | TE | RI | OR | T | ונ | -C: | IF | A | 0 | L | CIN | · • | | | | | | | | 9F | 380 |
| v | | 00 | 21 | n | 1= | | NC | | | | | | | | | | | | | | | | | | | | | | | | | BF | 390 |
| | | 00 | SO | GG | II | NR | |) = (| | 2 | | | | | | | | | | | | | | | | | | | | | | BE | 410 |
| | | DO | 21 | 0 | I= | 1, | NR | 1 | | 22 | | | | | | | | | | | | | | | | | | | | | | BF | 423 |
| C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | BF | 431 |
| C | | CH | ECK | F | OR | I | MP | ERI | HE A | ABL | E | BO | UN | DA | RY | | | | | | | | | | | | | | | | | BF | 44. |
| c | | CH | EUK | ۲ | UR | A | 0,1 | ACE | | | ON | 51 | AN | 1 | Hr. | AU | 01 | र (| C | VS1 | A | NT | G | RAI | CIE | NT | C | CN | OI | LIC | NS | BF | 450 |
| v | | | ĸĸ | = (| не | т. | | 111 | | 0. | | 4 | | | | | | | | | | | | | | | | | | | | SF OF | 460 |
| | | | KL | = (| HI | Î+ | 1, | Ji | 11 | 000 | bc. | î+ | 1 | | | | | | | | | | | | | | | | | | | BE | 48 |
| | | | 60 | T | 0 | (1 | 10 | ,16 | .0 | . 1 2 | 20 . | 13 | 3) | | кκ | | | | | | | | | | | | | | | | | BF | 490 |
| | 110 | | GO | T | 0 | (1 | 40 | ,16 | 50, | , 14 | +0, | 14 | 0) | | KL | | | | | | | | | | | | | | | | | BF | 500 |
| | 120 | | 60 | Ţ | 0 | 9 | 40 | ,11 | 50, | 10 | 50, | 16 | 0) | | KL | | | | | | | | | | | | | | | | | BF | 510 |
| C | 130 | | 60 | | U | (1 | 40 | ,10 | DU 1 | 1 1 1 | • (c | 14 | 0) | • | KL | | | | | | | | | | | | | | | | | BF | 52. |
| • | 140 | | IF | (| A (| Ι. | JI | • NE | . (| |)) | GO | T | 0 | 1 51 | 0 | | | | | | | | | | | | | | | | AF | 53. |
| | | | SO | GG | 1(| Ι. | JI | =PI | RA | M | FK | (1 | +1 | . J |) .! | FK | I | | | P | I | -1 | , J1 | | IP (| Ι, | J) | .7. | (1. | .1. | J) . Z | BF | 550 |
| | | 1 | (1 | , J | | DY | (1 | +1 . | . J) | .0 | Y (| Ι, | JI | ,0 | x () | I+1 | | , (נ | 0 | (1) | | 1) | G | 114 | 11. | JI | , G | (1 | , J) | 1)* | (HF (| BF | 56. |
| | | 2 | 1, | 1) | -H | F(| I+ | 1 | ") | *[| 110 | 43 | 56 | ٥. | | | | | | | | | | | | | | | | | | BF | 570 |
| | 150 | | 60 | CC | 0 | 17 | 0 | - ^ · | | | * / | | | | | | | | | | | | | | | | | | | | | BF | 580 |
| | 1.50 | | GO | T | 0 | 17 | 0 | - 4 | | 5) | | ar. | 11 | | , -1 | ir i | 1. | 11 | J | 13 | U | 1 | 10: | el | • | | | | | | | BE | 600 |
| | 160 | | SQ | GG | It | Ι. | J): | =0. | 0 | | | | | | | | | | | | | | | | | | | | | | | BF | 610 |
| | 170 | | IF | (| I . I | NE | .1 |) (| 0 | TO | 1 | 80 | | | | | | | | | | | | | | | | | | | | BF | 620 |
| | | | IF | () | KK. | E | 0.1 | 4) | GO |) T | 0 | 19 | 0 | | | | | | | | | | | | | | | | | | | BF | 630 |
| c | | | 20 | HI | =51 | 16 | ιI | 11, | 1) | | | | | | | | | | | | | | | | | | | | | | | BF | 640 |
| č | | SUM | 1 C | F | [-] | FLI | WO | TH | RO | UG | н | 80 | UNI | DAR | 11 | S | | | | | | | | | | | | | | | | BF | 660 |
| C | | 1009503 | | | | - | -2027 | | | | | | | -016 | - ' | | | | | | | | | | | | | | | | | 8F | 676 |
| | | | 50 | nI. | 4= 9 | SQU | IL | 4+5 | QB | I | | | | | | | | | | | | | | | | | | | | | | BF. | 680 |
| | 1.80 | | 100 | 10 | | 191 | | | | • | | | | | | | | | | | | | | | | | | | | | | ßF | 690 |
| | 1.00 | | IF | 0 | KK. | F | 2.4 | ., , | 60 | T | 0 | 19 | 0 | | | | | | | | | | | | | | | | | | | BF | 700 |
| | | | SC | 11: | - | :0: | G | | . 1 | 1 | | | - | | | | | | | | | | | | | | | | | | | 0.5 | 70.0 |

RE 73: C C SUM OF I-FLOW THROUGH BOUNDARIES RE 740 BF. 750 SOBIA=SOBIA+SOBI RE 760 IF (I.NL.NN) GO TO 200 IF (J.LT.LGIW) GO TO 210 IF (J.GT.LCIE) GO TO 210 190 NF 71. NE 78 HF. 79. IF (KK.EQ.4) GO TO 210 TCBI=SQGGI(I,J) RE 800 BF 81 С BF 821 BE SUM OF I-FLOW THROUGH BUFFER ZONE BOUNDARIES C 83 BF 840 BF TOBIA= TOBIA+ TOBI 85 GO TO 210 IF (I.NE.NS) GO TO 210 BF 86 . 870 200 BF IF (J.LT.LCIW) GO TO 210 IF (J.GT.LCIE) GO TO 210 RF 880 BF 89. IF (KK.EQ.4) GO TO 210 BF 90: TOBI=-SOGGI(I,J) BF 910 С BF 92: Ċ SUM OF I-FLOW THROUGH BUFFER ZONE BOUNDAFIES 9F 935 BF 94: C RF 95: TOBIA= TOBIA+ TOBI 210 CONTINUE BF 960 BF WRITE (6,400) ITIME 970 CALL MATROP (NR, NC, SQGGI) BF 980 BF C 99. DO 40 LOOP COMPUTES FLOWS IN THE J-DIRECTION. BF 1000 С č BF 101u DO 320 I=1.NR BF 102. BF 103. SQGGJ(I,NC)=0.0 9F 1043 00 320 J=1,NC1 RF 1050 KK=(H(I,J)/10000.)+1 BF 106 KL=(H(I,J+1)/10000.)+1 GO TO (220,270,230,240), KK GO TO (250,270,250,250), KL BF 1075 3F 1080 220 BF 1090 230 GO TO (250,270,270,270), KL BF 1103 BF 1113 GC TO (250,270,270,250), KL 240 С BF 1120 250 IF (B(I,J).NE.0.0) GO TO 260 SNGGJ(I.J)=PARAM(FK(I,J+1),FK(I,J),HP(I,J+1),HP(I,J),Z(I,J+1),Z BF 1130 (I,J),DX(I,J+1),DX(I,J),CY(I,J+1),CY(I,J),G(I,J+1),G(I,J))*(HF(3F 1140 I,J)=HF(I,J+1))*DT/43560. BF 1150 1 2 8F 1160 8F 1170 G0 T0 280 S0GGJ(I,J)=B(I,J)*(HF(I,J)-HF(I,J+1))*DT/43560. 260 8F 1180 8F 1190 8F 1200 8F 1200 8F 1210 GC TO 280 SOGGJ(I,J)=0.0 IF (J.NE.1) GO TO 290 IF (KK.EQ.4) GO TO 300 270 280 BF 1221 BF 1231 SCBJ=SOGGJ(I,J) C 9F 1240 8F 125L SUM OF J-FLOW THROUGH BOUNDARIES C C SORJA=SORJA+SORJ BF 126. BF 127. GO TO 300 RF 1280 RF 1290 IF (J.NE.NC1) GO TO 300 IF (KK.EQ.4) GO TO 300 290 BF 130. SOAJ==SOGGJ(I,J) 8F 1313 C BF 1320 SUM OF J-FLOW THROUGH BOUNDARIES BF 1330 C BF 1340 SCRJA=SQBJA+SQBJ IF (J.NE.LN) GO TO 310 BF 1350 300 IF (I.LT.LCJW) GO TO 320 IF (I.GT.LCJE) GO TO 320 BF 1360 BF 1370 IF (KK.EQ.4) GO TO 320 BF 1380 BF 1390 TOBJ=SOGGJ(I.J) BF 1400 BF 1410 C č SUM OF J-FLOW THROUGH BUFFER ZONF BOUNDARIES C BF 142: 3F 143: BF 1440 TORJA=TOBJA+TOBJ GC TO 320 IF (J.NE.LS) GO TO 320 RF 1450 310 IF (I.LT.LCJW) GO TO 320 IF (I.GT.LCJE) GO TO 320 BF 1460 BF 1470 IF (KK.EQ.4) GO TO 320 BF 1480 BF 1490 TOBJ==SOGGJ(I.J) BF 1500 C BF 1510 SUM OF J-FLOW THROUGH BUFFER ZONE BOUNDARIES 6F 1520 С BF 1530 TOBJA=TOBJA+TOBJ 8F 1540 320 CONTINUE

WEITE (6,410) ITIME IF 155. CALL MATEOP (NR.NC.SOGGJ) BF 1560 9F 1570 C C RELATIVE CONCENTRATION CALCULATIONS CALCULATE CHANGE IN RELATIVE CONCENTRATICNS DUE TO ALL VARIABLES EXCEPT CONSTANT HEAD SOURCES INSICE THE BOUNDARY GRIDS. C С SOURCE GRIDS ARE TAKEN AS C=1.0 DO 10 J=1,NC 00 10 I=1,NR CPUM(I, J) = CO(I, J) CLEAK(I, J) = CO(I, J) CPHR(I.J) =0.0 10 CONTINUE DO 530 J=2.NC1 00 530 I=2,NR1 IF (CS(I,J) .GT. 2.0) GO TO 530 IF (HP(I,J) .GT. G(I,J)) GO TO 480 CT(I,J)=CO(I,J=1)*SOGGJ(I,J=1)+CO(I=1,J)*SOGGI(I=1,J)-CO(I,J)*(1SOGGI(I,J)+SQGGJ(I,J))+OPPT(I,J)*CPPT(I,J)+CRCHR(I,J)*CRCHR(I,J)+ 20APW(I,J)*CAPW(I,J)=OPUM(I,J)*CFUM(I,J)=CPHF(I,J)*CPHF(I,J)=CLEAK(3I, J) *CLEAK(I, J) GO TO 490 480 CT(I,J)=CO(I,J=1)*SQGGJ(I,J=1)+CO(I=1,J)*SQGGI(I=1,J)=CO(I,J)*(150GGI(I,J)+S0GGJ(I,J))-0PUM(I,J)*CPUM(I,J) 490 IF (SQGGI(I=1,J).GE.J.G) GC TC 500 CT(I,J)=CT(I,J)+(CO(I,J)-CO(I=1,J))*SQGGI(I=1,J) 500 IF (SOGGI (I.J).GF. 0.0) GO TO 510 CT(I,J)=CT(I,J)-(CO(I+1,J)-(C(I,J))*SOGGI(I,J) 510 IF(SOGGJ(I,J=1).GE.0.0) GO TC 520 CT(I,J)=CT(I,J)+(CO(I,J)=CO(I,J=1))*SOGGJ(I,J=1) 520 IF(SOGGJ(I,J).GF.0.0) GO TO 530 CT(I,J) = CT(I,J) = (CO(I,J+1) = CC(I,J)) * SCGGJ(I,J)530 CONTINUE BF 158. BF 159. C SORT=0.0 DC 330 J=1,NC SCGGI(1,J)=0.0 8F 1600 BF 161: BF 162. BF 1630 SQGGI(NR1,J)=0.0 330 CONTINUE 9F 1640 BF 1650 DC 340 I=1.NR SCGGJ(I,1)=0.0 SQGGJ(I.NC1)=0.0 BF 1660 9F 1670 340 CONTINUE DO 350 I=2,NR1 DC 350 J=2,NC1 BF 1680 BF 169. SOR(I, J)=0.0 HF 1760 KK=(H(I,J)/10000.)+1 3F 1710 IF (KK.NE.4) GO TO 350 8F 1720 SOR(I, J) = -SOGGI(I-1, J) + SOGGI(I, J) - SOGGJ(I, J-1) + SOGGJ(I, J)BF 1733 BF 174: SORL=SOR(I.J) BF 1750 C C TOTAL INFLOW FROM CONSTANT HEAD GRIDS 8F 1760 č BF 1770 BF 178. SORT=SORT+SORL 350 CONTINUE BF 1790 BF 1800 C C TOTAL INFLOW THROUGH BOUNDARIES 8F 1810 BF 182. BF 183 C SOBT=SQBJA+SQBIA IF (SORT.LE.0.0) GO TO 360 BF 1840 BF 1850 WRITE (6.420) ITIME CALL MATROP (NR . NC . SQR) 8F 1863 C BF 1870 C BF 1880 360 SORA=0.0 8F 1890 DO 370 J=LCIW.LCIE SOGGI(NN.J)=C.0 BF 190. BF 1910 9F 1926 SOGGI (NS, J)=0.0 370 CONTINUE BF 1930 1940 DO 386 I=LCJW,LCJE SOGGJ(I,LN)=0.0 BF BF BF 1960 SCGGJ(I,LS)=0.0 BF 1970 380 CONTINUE DO 390 I=LCJW.LCJE DO 390 J=LCIW.LCIE BF 1983 BF 1990 SOR(1, J)=0.0 BF 2000 KK=(H(I,J)/10000.)+1 BF 2010 IF (KK.NE.4) GO TO 390 8F 262. SQR(I, J) == SQGGI(I=1, J) + SQGGI(I, J) = SQGGJ(I, J=1) + SQGGJ(I, J) BF 2030 SOPL =SOR(T.J) BF 2040 BF 205. C TOTAL INFLOW FROM CONSTANT GRIDS WITHIN BUFFER ZONE BOUNDARIES BF 2060 BF 2070

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c
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SOLA=SOFA+SQLL
                                                                                                  IF ZURS
  390 CONTINUE
                                                                                                  BF 209:
C
                                                                                                  BF 210.
С
        TCTAL INFLOW THROUGH BUFFER ZONE BOUNCAPIES
                                                                                                  RF 211.
С
                                                                                                  BF 2120
BF 213.
        SOBA=TOBJA+TOBIA
CCC
        CALCULATE NEW RELATIVE CONCENTRATIONS FOR EACH GRID.
        DO 570 J=2,NC1
       DO 570 I=2,NR1
IF (CS(I,J) .GT. 2.0) GO TO 590
        IF (HP(I,J) .GT. G(I,J)) GO TO 580
       \begin{array}{l} CT(I,J) = CO(I,J) + (CT(I,J) + SQR(I,J) * CSQR(I,J)) * (43560./(DX(I,J) * DY(I 1,J) * PHI(I,J) * (HP(I,J) - 7(I,J)) + Q(I,J) * DT + SQR(I,J)) \end{array} 
        GO TO 570
  580 CT(I,J)=CO(I,J)+(CT(I,J)+SQR(I,J)*CSQF(I,J))*(43560./(CX(I,J)*DY(I
1,J)*(PHI(I,J)*(G(I,J)-Z(I,J))+PHIC(I,J)*(HP(I,J)-G(I,J))) -OPUM(I,
      2J) + SOR(1, J)))
  GO TO 570
590 CT(I,J)=CS(I,J)-2.
   570 CONTINUE
        TIME=ITIME*OT
WRITE(6,430) TIME
       CALL MATROP (NR.NC.CT)
DO 397 J=1.NC
DO 397 I=1.NR
        CO([.J)=(:T(I.J)
   397 CONTINUE
        RETURN
                                                                                                  8F 214C
  400 FORMAT (1H1,29X, 56HDISCHARGE IN I-DIFECTICN (AC-FT/DT) FOR INCREM BF 2160
1ENT NUMBER.16)
С
      1ENT NUMBER, 16)
   410 FORMAT (1H1,29X, 56HDISCHARGE IN J-DIRECTION (AC-FT/CT) FOR INCREM
                                                                                                  BF 2180
   1FNT NUMBER, 16)
420 FORMAT (1H1, 22X, 74HRIVER FLCW IN EACH GRID MINUS MEANS FLOW FRCM
                                                                                                  BF 2196
BF 2200
      1 AQUIFER
                                (AC-FT/OT),/,1H ,49x, 16HINCREMENT NUMBER,IE)
                                                                                                  BF 2216
C
                                                                                                  BF 2220
  430 FORMAT (1H1,3CX, 27HRFLATIVE CONCENTRATICA (CA),G10.2,4HDAYS)
        END
                                                                                                  BF 223:
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SUBROUTINE BALCOP

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CCC

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C

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| | SUBROUTINE BALCOP (J1, J2, I, STITEM, STATEM) | BC | 10 |
|---|--|----|-----|
| | | BC | 2: |
| | | BC | 30 |
| | THIS SUBROUTINE WRITES OUT THE BALANCE COMPUTATIONS FOR EACH | BC | 43 |
| | TIME INCREMENT. ALL UNITS ARE IN AC-FT PER TIME INCREMENT. | BC | 50 |
| | | BC | 60 |
| | SQA, SOT - APPLIED WATER, BETWEEN STATICNS, TOTAL AREA. | BC | 70 |
| | SQRA, SQRT - INFLOW FROM RIVER, NETKEEN STATICNS, TOTAL AREA. | 30 | 8 u |
| 1 | SOBA, SOBT - BOUNDARY INFLOW, BETHEEN STATICNS, TOTAL AREA. | BC | 91 |
| | STT.STTTEM - TOTAL ARFA STOFAGE AND DECREASE CF STOFAGE. | 90 | 100 |
| | STA. STATEM - BETWEEN STATICNS STOFAGE AND DECREASE OF STORAGE. | BC | 110 |
| | STOL - STORAGE OF OVERLAP AREAS. | BC | 12: |
| | OVA, OVI - ILLEGALLY WITHDRAWN. | BC | 130 |
| | ASTA,ASTT - TOTALS, BETWEEN STATIONS, TOTAL AREA. | RC | 140 |
| | | BC | 15 |
| | COMMEN /BLK2/ STA, STOL, STT, SQA, SQT, SQFA, SQBA, SQRT, SQBT, CVA, OVT | HC | 160 |
| | | BC | 170 |
| | WRITE (6,110) J1,J2,I | 90 | 18. |
| | WEITE (6,120) SOA,SOT | BC | 19. |
| | WRITE (6,130) SORA, SORT | BC | 20 |
| | WRITE (6,140) SOBA,SOBT | BC | 216 |
| | STTTFM=STTTEM=STT | 90 | 220 |
| | STATEM=STATEM=STA | BC | 23. |
| | WEITE (6,150) STT,STTTEM | BC | 240 |
| | WFITE (6,166) STA, STATEM | BC | 250 |
| | WRITE (6,170) STOL | BC | 260 |
| | WEITE (6,180) OVA.OVT | BC | 270 |
| | ASTA=SQA+SQRA+SQBA+STATEM+OVA | BC | 250 |
| | ASTT=SQT+SQRT+SQBT+STTTEM+OVT | BC | 290 |
| | WRITE (6,190) ASTA,ASTT | BC | 300 |
| | RETURN | BC | 310 |
| | | 80 | 320 |

110 FORMAT (1H1.13X, 55HMASS BALANCE COMPUTATIONS (AC-FT/DT) FOR SIMUL BC 330 AS AT THE END OF PERIOD, 13. ///) 1ATED TIME, 19, 1H-, 19, 26H 756 APPLIED WATER (BETWEEN STATIONS - TOTAL AREA),20%, BC 120 FORMAT (SOHO 360 90 12F15.2) INFLOW FROM RIVER (BETWEEN STATIONS - TOTAL AREA), BC 370 130 FORMAT (54H0 116X,2F15.2) 140 FORMAT (52H0 380 BC BOUNDARY INFLCW (BETWEEN STATIONS - TOTAL AREA),18 BC 396 1X,2F15.2) 90 400 150 FORMAT (47H0 TOTAL AREA STORAGE AND DECREASE OF STORAGE. 8X, F15. BC 410 12.15X.F15.2) 420 BC BETWEEN STATICNS STOPAGE AND DECREASE OF STORAGE,2 BC 160 FORMAT (53H0 430 1×,2F15.2) 90 440 170 FORMAT (29H0 STORAGE OF OVERLAF AREAS, 26X, F15.2/1 90 456 180 FORMAT (56H0 ILLEGALLY WITHDRAWN (BETHEEN STATIONS - TOTAL AREA BC 460 1).14X.2F15.2) 190 FORMAT (49H-476 30 T O T A L S (BETWEEN STATIONS - TOTAL AREA),21%,2 BC 486 1F15.21 BC 490 38 502 END BC 510

SUBROUTINE MATROP

C

| | | SUBRCUTINE MATROP (NOROW, NOCCL, 8) | MP | 16 |
|---|------|--|----|-----|
| С | | | MP | 25 |
| С | | | MP | 30 |
| С | | THIS SUBPOUTINE OFGANIZES DATA OF RESULTS INTO A SUITABLE FORM | MP | 40 |
| С | | FCR PRINTING AND PRINTS. | MP | 50 |
| С | | | MP | 60 |
| | | DIMENSION B(NOROW, NOCOL) | MP | 76 |
| С | | | MP | 80 |
| | | NOCOLM=NOCOL | MP | 90 |
| | | ICONT=1 | MP | 100 |
| | | NO1=NOCOLM | MP | 111 |
| | | IF (NOCOLM.GT.12) NO1=12 | MP | 12. |
| | 110 | NO2=NOCOLM-12 | MP | 130 |
| | | WRITE (6,140) (JJ,JJ=ICONT,NC1) | MP | 14. |
| | | D0 129 I=1,NOROW | MP | 150 |
| | 120 | WRITE (6,150) I, (B(I,J), J=ICCNT, NC1) | MP | 161 |
| | | IF (NO2.LE.G) RETURN | MP | 170 |
| | | NOCOLM=NOCOLM-12 | MP | 180 |
| | | ICONT=ICONT+12 | MP | 190 |
| | | IF (NOCOLM.LE.12) GO TO 130 | MP | 205 |
| | | NO1=ICONT+11 | MP | 210 |
| | | GO TO 110 | MP | 220 |
| | 130 | NO1=ICONT-1+NOCOLM | MP | 230 |
| | | GC TC 110 | MP | 240 |
| С | | | MP | 250 |
| | 140 | FORMAT (1H +//.3X.12(7X. 1HX.12)/) | MP | 261 |
| | 150 | FORMAT (1H . 1HY, 12, 12F10.3) | MP | 270 |
| С | 2.92 | | MP | 280 |
| | | END | MP | 290 |
| | | | | |

SUBROUTINE READC

DIMENSION CAPWINE, NC), COCHEINE, NC), CSOFINE, NC), COINE, NC) IF (AGGIE .EQ. C.C) GO TO 1 PC IF (AGGIE .LT. 0.0) GO TO 233 C NF1=NR=1 FEAD (5,500) CCAPH IF (CCAPH .LT. 0.0) GO TO 100 DO 110 J=1.NG DO 110 I=1.NR 110 CAPW(I, J)=CCAPW GO TO 120 100 READ (5,510) CAPH C 120 FLAD (5.500) CCFCHR IF (CCRCHF .LT. 0.6) GO TO 130 00 140 J=1.NC 00 140 I=1,NR 140 CHCHR(I,J)=CCRCHR GO TO 150 130 READ (5,510) CRCHR C 150 PFAD (5,500) CCSQR IF (CCSQR .LT. 0.0) GO TO 160 DO 170 J=1,NC DO 170 I=1,NR 170 CSOR(I.J)=CCSOR GO TO 180 160 REAC (5,510) CSOR С 180 IF (LBC .NE. 10000.) GO TO 190 280 IF (RBC .NF. 10000.) GO TO 200 290 IF (TBC .NE. 10000.) GO TO 200 300 IF (BBC .NE. 10000.) GO TO 210 GO TO 230 190 RFAD (5,510) (CO(I,1), I=2, NR1) GO TO 280 200 READ (5,510) (CO(I,NC), I=2,NR1) GO TO 290 210 READ (5,510) (CO(1,J), J=1,NC) GO TO 300 220 FLAD (5,510) (CO(NR,J), J=1,NC) 500 FORMAT (1F10.1) 510 FORMAT (8F10.1) 230 CONTINUE END

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APPENDIX E DATA CODING FORMAT

| PROG | ZAM | WT | OU. | ALS | 2 | | | - | | | 100 | - | 120 | - | | 1.00 | | | GRAPHI | c | 1 | | | | | | T | | PAGE 1 | Lor | 6 | |
|-------|--------|------|--------|-------|-----------|---------|----------|---------|---------|------------|-------|-------|-------|-------|-------|----------|------------------|-------|--------|-------|---------|----------|-------|----------|----------|-------|---------|---------|-----------|---------|---------------|--------|
| ROG | TANNER | LV | V. PI | TT | MAN | 1 | | | | DA | DE | CE | MB | ER | רל | INSTR | UCTION | 5 | PUNCH | - | | - | - | | + | | + | - | CARD ELEP | CIRO NU | IMBE 9" | |
| | | | | _ | | | | _ | | | | | | | | | | | | | | _ | | | _ | | _ | | | | | |
| ST ST | NUMBER | CONT | | | | | | | | | | | | FORT | RAN | STATE | MENT | | | | | | | | | | | | | | IDEN | QUENCE |
| 1 2 | 3 4 5 | 6 7 | 8 9 10 | 11 12 | 3 14 15 1 | 6 17 18 | 19 20 21 | 22 23 2 | 25 26 2 | 7 28 29 30 | 31 32 | 33 34 | 35 36 | 37 38 | 39 40 | 41 42 | 43 44 | 45 46 | 47 48 | 49 50 | 51 52 5 | 53 54 55 | 56 57 | 58 59 60 | 61 62 | 63 64 | 65 66 6 | 67 68 6 | 9 70 71 | 72 /3 | 74 25 | 76 77 |
| + | | - | | | | ++ | | +++ | | | ++ | ++ | T | IT | LE | | | | | | 11 | ++ | | ++ | + | +++ | ++ | ++ | ++ | ++- | ++ | +++ |
| + | | ++ | ++ | ++ | +++ | ++ | | +++ | +++ | | + | + | 1 | SA. | 10 | + | + | ++- | | - | | ++ | +++ | ++ | + | +++ | ++ | ++ | ++ | Ηł | ++ | |
| + | | - | | ++ | 11 | ++ | | 111 | | | + | | | + | | | ++ | | | | -1-1 | - | | ++ | 1 | +++ | + | ++ | ++- | | | |
| + | NR | - | NC | 44 | NW | ++ | NPI | CFA | QIL | KAQ | ++ | + | DT | | | | | ST | | | 4. | FW | TPP | ++ | | +++ | ++ | | ++- | +++ | | 11 |
| + | 15 | 1 | 15 | | IS | ++- | IS | 1 | 5 | IS | + | F1 | 9. | 1 | - | \vdash | F | 10. | 1 | - | | F10 | 1.1 | ++- | + | +++ | ++ | ++ | ++- | 4 | | +++ |
| + | | - | | + | +++ | ++ | | +++ | +++ | +++ | ++ | ++ | ++ | + | + | + | $\left \right $ | | | | ++ | ++ | +++ | ++ | + | +++ | ++ | ++ | ++ | +++ | \rightarrow | ++ |
| + | AG | GI | E | ++ | | ++ | | +++ | | +++ | ++ | + | + | + | + | | | | | + | | | | ++- | \vdash | | ++ | | ++- | +++ | H | |
| + | F1 | 1 | | ++ | +++ | ++- | | +++ | ++++ | +++ | + | + | | + | - | | | | | 1 | | ++ | +++ | ++- | | ++ | ++ | ++ | ++- | | H | |
| + | 115 | 1 | | 1 | - | | | +++ | | | + | ++ | | - | | | | | | + | 1.2 | 1.1. | | | | | + ' | 1 | | | | |
| + | DA | × - | 4.44 | 11 | D4 | Y | | | FFK | | ++ | | 2 Z | + | - | | | GG | | 1 | - | PF | HI | ++- | - | C | C A | 1 | 11 | P | PH | IC |
| + | F10 | 4 | | | F10. | 1 | ++ | F | 10.1 | | ++ | F1 | .q. 1 | - | - | | F | 10. | 1 | 1 | ++ | F1 | p. 1 | ++ | | F1 | .0.1 | L | ++ | ++-/ | FIO |).1 |
| + | 111 | | | | 11 | | | + | | | ++ | | | - | - | | | | | | | - | | ++ | | ++ | ++ | ++ | ++ | | + | |
| + | D | × | +++ | ++ | D> | < | | | | (NC | ¥ | F | 10. | 1) | - | | | | | - | ++ | | | ++- | | | ++ | ++ | ++ | | ++ | |
| ╀ | | ++ | 11 | | | ++ | | | +++ | | ++ | ++ | | - | - | | | | | + | - | +1. | +++ | ++ | | | ++ | | ++- | 44 | | |
| + | D | Y | - | 11 | DY | 1 | | 1 | | (NR | * | F | 10. | 1) | - | | - | | | - | 11 | 1. | 11 | 11 | 1 | | ++ | ++ | 11 | | | |
| + | | - | | | | - | | | | | ++ | | - | - | | | | | | 1 | | - t. | 11 | ++- | | 1++ | ++ | | 11 | | | 1 |
| 4 | F | ĸ | 11 | 11 | F | < | | | 7 | (NR | ¥ | N | c) | * | (F | 10 | 1) | 1 | R | FAD | IN | BY | CØL | UMN | 5 | | 11 | 1 | 1 | | | |
| 4 | | | 11 | 4 | 1 | 11 | | | | | | | | - | | 1 | | | | 1 | | 2.1 | | 11 | | 7 8 | M. | IT | IF | SP | ECI | FI |
| - | | Z | | | 2 | 2 | | ++++ | > | (NR | ¥ | N | c) | * | (F | 10. | 1) | | R | EAD | IN | BY | CØL | umn | 1 | 111 | 14 | EN | CA | RD | 3 | 44 |
| + | | ++ | | 1 | | | | 11. | | | ++ | | | - | | | | | | - | 11 | 11 | 11 | | | 11- | ++ | | 11 | 11 | 11 | |
| 1 | | G | | | G | | | 11 | 7 | INR | ¥ | N | c) | * | (F | 10 | 1) | | R | FAD | IN | 131 | cou | UMN | 15 | | 11 | 11 | 11 | | 1 | L |
| 1 | 110 | 1 | | 11 | 14.1 | 11 | | | | | | | | 1 | | | | | | | | | | | | | 44 | 11 | 11 | | | 1.1 |
| | PH | I | 11 | 11 | PH | I | | | > | (NR | × | N | c) | * | (F | 10 | 1) | - | R | EAD | IN | BI | CØ | LUMI | 11 | 1 | | 11 | | | | 1 |
| | 111 | | 1.1 | | 1.1 | 11 | | | | | | | | | | | | | | 1 | 1.10 | 11 | | | 1 | 111 | | | 11 | | 11 | |

| **C | CCPAN WTQU | ALZ | | | | MAGE Z OF 6 |
|--------|--|---|--|--|-------------------------------------|--|
| PRO | DGRAMMER L.W. | PITTMAN | DATE DECEMBER '77 | INSTRUCTIONS FUNCH | | CARD ELECTRO NUMBER |
| - | STATEMENI 2 | | FORTRAN | STATEMENT | | |
| Ť | 2 3 4 5 6 7 8 9 | 10 11 12 13 14 15 16 17 18 19 20 21 22 23 2 | 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 | 0 41 42 43 44 45 45 47 48 49 5 | 50 51 52 53 54 55 56 57 58 59 60 61 | 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 |
| - | CA | < A | > (NR ¥ NC) ¥ (F | 10.1) REA | D IN BY COLUMNS | |
| 4 | | | | | | Y OMIT IF SPECIFIED |
| | PHIC | PHIC / | 7 (NR * NC) * (F | F10.1) REF | AD IN BY COLUMNS |) IN CARD 3 |
| | | | | | | |
| I | css | SUNIFORM VALUE Ø | F INITIAL AQUIFER CON | KENTRATION , | OTHERWISE BLAN | IK CARD? |
| T | F 10.1 | C | | | | |
| T | | | | | | |
| T | CS | cs | (NR ¥ NC) ¥ (F | 10.1) REI | AD TN BY CHLUMN | OMIT IF SPECIFIED |
| 1 | | | USE CODED VALUE | | | S IN CARD 33 |
| 1 | | | | | | |
| † | Teess | SUNIEARM VALUE A | E INITIAL PRECIPITATION | A CANCENTRAT | IN ATHERWISE B | LANK CARD 3 |
| 1 | E101 | | | | | |
| 1 | | | **** | | | |
| $^{+}$ | CPPT | C.P.P.T. | | 101) 050 | DIN BY CALUMAN | |
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| Щ | ¢ | C | | HI | 2 | | 4 | U | NI | Fa | n | m | V | A | vé | | ØF | - | N | Eu | , | ¢ v | | 10 | EA | τ | RI | TI | 01 | N | 60 | - | w | AT | ER | | R | E | | AR | +E | D | | | L | 11 | YÞ | T | N | FEI | ED | 1 | F | | | |
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| | Î. | co | s | Q | 2 | N | | v | ~ | Fa | R | n | V | A | LVE | | OF | | N | eu | | cø | N | E | NT | n | 47 | 191 | ~ | | F | 1 | A | TE | e s | | on | 16 | IN | AT | IN | 6 | Į. | | | | | | | | 1 | | | | | |
| Π | i l | F | 10 | .1 | | | 5 | FI | 2 5 | m | | - | IN | ST | AN | T | 4 | EI | 40 | | 50 | iu n | 20 | ers. | T | ø | TH | ER | a | 115 | e | | SLA | N | ĸ | c | AR | | | | 11 | | | | | | | | | | | 1 | | | | Ĩ |
| Π | 1 | | | | | | T | T | | | | | | | T | | Т | | | | T | T | | T | T | T | | | T | 1 | | 1 | | | | | 1 | | | | 11 | | | | Г | | | T | | | | | | 1 | | 1 |
| Π | | cs | q | R | | | | 4 | s | 0 | R | T | | 4 | 7 | > | T | T | (| N | R | ¥ | | N | c |) | × | (| FI | 10. | 1) | 1 | 1 | R | E | AD | 1 | N. | BY | | - 0 | cu, | nn | | T | | T | | | 1 | | 1 | | | | |
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