



# Techniques of Water-Resources Investigations of the United States Geological Survey



# COMPUTER MODEL OF TWO-DIMENSIONAL SOLUTE TRANSPORT AND DISPERSION IN GROUND WATER

By L. F. Konikow and J. D. Bredehoeft

Book 7

AUTOMATED DATA PROCESSING AND COMPUTATIONS

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# PREFACE

The series of manuals on techniques describes procedures for planning and executing specialized work in water-resources investigations. The material is grouped under major headings called books and further subdivided into sections and chapters; section C of Book 7 is on computer programs.

This chapter presents a digital computer model for calculating changes in the concentration of a dissolved chemical species in flowing ground water. The computer program represents a basic and general model that may have to be modified by the user for efficient application to his specific field problem. Although this model will produce reliable calculations for a wide variety of field problems, the user is cautioned that in some cases the accuracy and efficiency of the model can be affected significantly by his selection of values for certain user-specified options.

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### COMPUTER MODEL OF TWO-DIMENSIONAL SOLUTE TRANSPORT AND DISPERSION IN GROUND WATER

#### By L. F. Konikow and J. D. Bredehoeft

#### Abstract

This report presents a model that simulates solute transport in flowing ground water. The model is both general and flexible in that it can be applied to a wide range of problem types. It is applicable to one- or two-dimensional problems involving steady-state or transient flow. The model computes changes in concentration over time caused by the processes of convective transport, hydrodynamic dispersion, and mixing (or dilution) from fluid sources. The model assumes that the solute is nonreactive and that gradients of fluid density, viscosity, and temperature do not affect the velocity distribution. However, the aquifer may be heterogeneous and (or) anisotropic.

The model couples the ground-water flow equation with the solute-transport equation. The digital computer program uses an alternating-direction implicit procedure to solve a finite-difference approximation to the ground-water flow equation, and it uses the method of characteristics to solve the solute-transport equation. The latter uses a particletracking procedure to represent convective transport and a two-step explicit procedure to solve a finitedifference equation that describes the effects of hydrodynamic dispersion, fluid sources and sinks, and divergence of velocity. This explicit procedure has several stability criteria, but the consequent timestep limitations are automatically determined by the program.

The report includes a listing of the computer program, which is written in FORTRAN IV and contains about 2,000 lines. The model is based on a rectangular, block-centered, finite-difference grid. It allows the specification of any number of injection or withdrawal wells and of spatially varying diffuse recharge or discharge, saturated thickness, transmissivity, boundary conditions, and initial heads and concentrations. The program also permits the designation of up to five nodes as observation points, for which a summary table of head and concentrations. The data input formats for the model require three data cards and from seven to nine data sets to describe the aquifer properties, boundaries, and stresses.

The accuracy of the model was evaluated for two idealized problems for which analytical solutions could be obtained. In the case of one-dimensional flow the agreement was nearly exact, but in the case of plane radial flow a small amount of numerical dispersion occurred. An analysis of several test problems indicates that the error in the mass balance will be generally less than 10 percent. The test problems demonstrated that the accuracy and precision of the numerical solution is sensitive to the initial number of particles placed in each cell and to the size of the time increment, as determined by the stability criteria. Mass balance errors are commonly the greatest during the first several time increments, but tend to decrease and stabilize with time.

# Introduction

This report describes and documents a computer model for calculating transient changes in the concentration of a nonreactive solute in flowing ground water. The computer program solves two simultaneous partial differential equations. One equation is the ground-water flow equation, which describes the head distribution in the aquifer. The second is the solute-transport equation, which describes the chemical concentration in the system. By coupling the flow equation with the solute-transport equation, the model can be applied to both steady-state and transient flow problems.

The purpose of the simulation model is to compute the concentration of a dissolved chemical species in an aquifer at any specified place and time. Changes in chemical concentration occur within a dynamic ground-water system primarily due to four distinct processes: (1) convective transport, in which dissolved chemicals are moving with the flowing ground water; (2) hydrodynamic dispersion, in which molecular and ionic diffusion and small-scale variations in the velocity of flow through the porous media cause the paths of dissolved molecules and ions to diverge or spread from the average direction of ground-water flow; (3) fluid sources, where water of one composition is introduced into water of a different composition; and (4) reactions, in which some amount of a particular dissolved chemical species may be added to or removed from the ground water due to chemical and physical reactions in the water or between the water and the solid aquifer materials. The model presented in this report assumes (1) that no reactions occur that affect the concentration of the species of interest, and (2) that gradients of fluid density, viscosity, and temperature do not affect the velocity distribution.

This model can be applied to a wide variety of field problems. However, the user should first become aware of the assumptions and limitations inherent in the model, as described in this report. The computer program presented in this report is offered as a basic working tool that may have to be modified by the user for efficient application to specific field problems. The program is written in FORTRAN IV and is compatible with most high-speed computers. The data requirements, input format specifications, program options, and output formats are all structured in a general manner that should be readily adaptable to many field problems.

This report includes a detailed description of the numerical method used to solve the solute-transport equation. The reader is assumed to have (or can obtain elsewhere) a moderate familiarity with finite-difference methods and ground-water flow models.

# **Theoretical Background**

### Flow equation

By following the derivation of Pinder and Bredehoeft (1968), the equation describing the transient two-dimensional areal flow of a homogeneous compressible fluid through a nonhomogeneous anisotropic aquifer can be written in Cartesian tensor notation as

$$\frac{\partial}{\partial x_i} \left( T_{ij} \frac{\partial h}{\partial x_j} \right) = S \frac{\partial h}{\partial t} + W \qquad i,j = 1,2 \qquad (1)$$

where

$T_{ij}$	is the transmissivity ten- sor, $L^2/T$ ;
h	is the hydraulic head, $L$ ;
S	is the storage coefficient,
	(dimensionless);
t	is the time, $T$ ;
W = W(x,y,t)	is the volume flux per unit area (positive sign for outflow and negative for inflow), $L/T$ ; and
$x_i$ and $x_j$	are the Cartesian coordi- nates, L.

If we only consider fluxes of (1) direct withdrawal or recharge, such as well pumpage, well injection, or evapotranspiration, and (2) steady leakage into or out of the aquifer through a confining layer, streambed, or lakebed, then W(x,y,t) may be expressed as

$$W(x,y,t) = Q(x,y,t) - \frac{K_z}{m} (H_s - h)$$
 (2)

where

- Q is the rate of withdrawal (positive sign) or recharge (negative sign), L/T;
- $K_z$  is the vertical hydraulic conductivity of the confining layer, streambed, or lakebed, L/T;
- *m* is the thickness of the confining layer, streambed, or lakebed, *L*; and
- $H_s$  is the hydraulic head in the source bed, stream, or lake, L.

Lohman (1972) shows that an expression for the average seepage velocity of ground water can be derived from Darcy's law. This expression can be written in Cartesian tensor notation as

$$V_i = -\frac{K_{ij}}{\epsilon} \frac{\partial h}{\partial x_j} \tag{3}$$

where

- $V_i$  is the seepage velocity in the direction of  $x_i$ , L/T;
- $K_{ij}$  is the hydraulic conductivity tensor, L/T; and
- ε is the effective porosity of the aquifer, (dimensionless).

### **Transport** equation

The equation used to describe the two-dimensional areal transport and dispersion of a given nonreactive dissolved chemical species in flowing ground water was derived by Reddell and Sunada (1970), Bear (1972), Bredehoeft and Pinder (1973), and Konikow and Grove (1977). The equation may be written as

$$\frac{\partial (Cb)}{\partial t} = \frac{\partial}{\partial x_i} (bD_{ij} \frac{\partial C}{\partial x_j}) - \frac{\partial}{\partial x_i} (bCV_i) - \frac{C'W}{\epsilon}$$
  
$$i,j = 1,2 \quad (4)$$

where

- C is the concentration of the dissolved chemical species,  $M/L^3$ ;
- $D_{ij}$  is the coefficient of hydrodynamic dispersion (a second-order tensor),  $L^2/T$ ;
- b is the saturated thickness of the aquifer, L; and
- C' is the concentration of the dissolved chemical in a source or sink fluid,  $M/L^3$ .

The first term on the right side of equation 4 represents the change in concentration due to hydrodynamic dispersion. The second term describes the effects of convective transport, while the third term represents a fluid source or sink.

### **Dispersion coefficient**

Bear (1972, p. 580-581) states that hydrodynamic dispersion is the macroscopic outcome of the actual movements of individual tracer particles through the pores and that it includes two processes. One process is mechanical dispersion, which depends upon both the flow of the fluid and the nature of the pore system through which the flow takes place. The second process is molecular and ionic diffusion, which because it depends on time, is more significant at low flow velocities. Bear (1972) further states that the separation between the two processes is artificial. In developing our model we assume for flowing ground-water systems that the definable contribution of molecular and ionic diffusion to hydrodynamic dispersion is negligible.

The dispersion coefficient may be related to the velocity of ground-water flow and to the nature of the aquifer using Scheidegger's (1961) equation:

$$D_{ij} = \alpha_{ijmn} \frac{V_m V_n}{|V|} \tag{5}$$

where

$$\alpha_{ijmn}$$
 is the dispersivity of the aquifer, L;

- $V_m$  and  $V_n$  are components of velocity in the *m* and *n* directions, respectively, L/T; and
- |V| is the magnitude of the velocity, L/T.

Scheidegger (1961) further shows that for an isotropic aquifer the dispersivity tensor can be defined in terms of two constants. These are the longitudinal and transverse dispersivities of the aquifer ( $\alpha_L$  and  $\alpha_T$ , respectively). These are related to the longitudinal and transverse dispersion coefficients by

 $D_L = \alpha_L |V|$ 

and

$$D_T = \alpha_T |V|. \tag{7}$$

(6)

After expanding equation 5, substituting Scheidegger's identities, and eliminating terms with coefficients that equal zero, the components of the dispersion coefficient for two-dimensional flow in an isotropic aquifer may be stated explicitly as

$$D_{\sigma x} = D_L \frac{(V_{\sigma})^2}{|V|^2} + D_T \frac{(V_y)^2}{|V|^2}; \qquad (8)$$

$$D_{yy} = D_T \frac{(V_x)^2}{|V|^2} + D_L \frac{(V_y)^2}{|V|^2}; \qquad (9)$$

$$D_{xy} = D_{yx} = (D_L - D_T) \frac{V_x V_y}{|V|^2}.$$
 (10)

Note that while  $D_{xx}$  and  $D_{yy}$  must have positive values, it is possible for the crossproduct terms (eq 10) to have negative values if  $V_x$  and  $V_y$  have opposite signs.

### **Review of assumptions**

A number of assumptions have been made in the development of the previous equations. Following is a list of the main assumptions that must be carefully evaluated before applying the model to a field problem.

- 1. Darcy's law is valid and hydraulic-head gradients are the only significant driving mechanism for fluid flow.
- 2. The porosity and hydraulic conductivity of the aquifer are constant with time, and porosity is uniform in space.
- 3. Gradients of fluid density, viscosity, and temperature do not affect the velocity distribution.
- 4. No chemical reactions occur that affect the concentration of the solute, the fluid properties, or the aquifer properties.
- 5. Ionic and molecular diffusion are negligible contributors to the total dispersive flux.
- 6. Vertical variations in head and concentration are negligible.
- 7. The aquifer is homogeneous and isotropic with respect to the coefficients of longitudinal and transverse dispersivity.

The nature of a specific field problem may be such that not all of these underlying assumptions are completely valid. The degree to which field conditions deviate from these assumptions will affect the applicability and reliability of the model for that problem. If the deviation from a particular assumption is significant, the governing equations will have to be modified to account for the appropriate processes or factors.

# **Numerical Methods**

Because aquifers have variable properties and complex boundary conditions, exact analytical solutions to the partial differential equations of flow (eq 1) and solute transport (eq 4) cannot be obtained directly. Therefore, approximate numerical methods must be employed.

The numerical methods require that the area of interest be subdivided by a grid into a number of smaller subareas. The model developed here utilizes a rectangular, uniformly spaced, block-centered, finite-difference grid, in which nodes are defined at the centers of the rectangular cells.

# Flow equation

Pinder and Bredehoeft (1968) show that if the coordinate axes are alined with the principal directions of the transmissivity tensor, equation 1 may be approximated by the following implicit finite-difference equation:

$$T_{xx[i-\frac{1}{2},j]}\left[\frac{h_{i-1,j,k}-h_{i,j,k}}{(\Delta x)^{2}}\right] + T_{xx[i+\frac{1}{2},j]}\left[\frac{h_{i+1,j,k}-h_{i,j,k}}{(\Delta x)^{2}}\right] + T_{yy[i,j-\frac{1}{2}]}\left[\frac{h_{i,j-1,k}-h_{i,j,k}}{(\Delta y)^{2}}\right] + T_{yy[i,j+\frac{1}{2}]}\left[\frac{h_{i,j+1,k}-h_{i,j,k}}{(\Delta y)^{2}}\right] = S\left[\frac{h_{i,j,k}-h_{i,j,k-1}}{\Delta t}\right] + \frac{q_{w(i,j)}}{\Delta x \Delta y} \frac{K_{z}}{m}[H_{s(i,j)}-h_{i,j,k}]$$
(11)

where

- *i,j,k* are indices in the *x*, *y*, and time dimensions, respectively;
- $\Delta x, \Delta y, \Delta t$  are increments in the x, y,and time dimensions, respectively; and
- $q_w$  is the volumetric rate of withdrawal or recharge at the (i,j) node,  $L^3/T$ .

Note that k represents the new time level and k-1 represents the previous time level. To avoid confusion between tensor subscripts and nodal indices, the latter are separated by commas.

The finite-difference equation (eq 11) is solved numerically for each node in the grid using an iterative alternating-direction implicit (ADI) procedure. The derivation and solution of the finite-difference equation and the use of the iterative ADI procedure have been previously discussed in detail in the literature. Some of the more relevant references include Pinder and Bredehoeft (1968), Prickett and Lonnquist (1971), and Trescott, Pinder, and Larson (1976).

After the head distribution has been computed for a given time step, the velocity of ground-water flow is computed at each node using an explicit finite-difference form of equation 3. For example, the velocity in the x direction at node (i,j) would be computed as

$$V_{x(i,j)} = \frac{K_{xx(i,j)}}{\epsilon} \frac{(h_{i-1,j,k} - h_{i+1,j,k})}{2\Delta x}.$$
 (12)

The velocity in the x direction can also be computed on the boundary between node (i,j) and node (i+1,j) using the following equation:

$$V_{x(i+\frac{1}{2},j)} = \frac{K_{xx(i+\frac{1}{2},j)}}{\epsilon} \frac{(h_{i,j,k} - h_{i+1,j,k})}{\Delta x}$$
(13)

where the hydraulic conductivity on the boundary is computed as the harmonic mean of the hydraulic conductivities at the two adjacent nodes.

Expressions similar to equations 12 and 13 are used to compute the velocities in the y direction at (i,j) and (i,j+1/2) respectively. Note that equation 13, which computes the head difference over a distance  $\Delta x$ , is more accurate than equation 12, which computes the head difference over  $2\Delta x$ .

### **Transport** equation

#### Method of characteristics

The method of characteristics is used in this model to solve the solute-transport equation. This method was developed to solve hyperbolic differential equations. If solute transport is dominated by convective transport, as is common in many field problems. then equation 4 may closely approximate a hyperbolic partial differential equation and be highly compatible with the method of characteristics. Although it is difficult to present a rigorous mathematical proof for this numerical scheme, it has been successfully applied to a variety of field problems. The development of this technique for problems of flow through porous media has been presented by Garder, Peaceman, and Pozzi (1964), Pinder and Cooper (1970), Reddell and Sunada (1970), and Bredehoeft and Pinder (1973). Garder. Peaceman. and Pozzi (1964) state that this technique does not introduce numerical dispersion (artificial dispersion resulting from the numerical calculation process). They and Reddell and Sunada (1970) also compared solutions obtained using the method of characteristics with those derived by analytical methods and found good agreement for the cases investigated. Applications of the method to field problems have been documented by Bredehoeft and Pinder (1973), Konikow and Bredehoeft (1974), Robertson (1974), Robson (1974), and Konikow (1977).

The approach taken by the method of characteristics is not to solve equation 4 directly, but rather to solve an equivalent system of ordinary differential equations. Konikow and Grove (1977, eq 61) show that by considering saturated thickness as a variable and by expanding the convective transport term, equation 4 may be rewritten as

$$\frac{\partial C}{\partial t} = \frac{1}{b} \frac{\partial}{\partial x_i} \left( bD_i \frac{\partial C}{\partial x_j} \right) - V_i \frac{\partial C}{\partial x_i} + \frac{C(S \frac{\partial h}{\partial t} + W - \epsilon \frac{\partial b}{\partial t}) - C'W}{\epsilon b}$$
(14)

Equation 14 is the form of the solute-transport equation that is solved in the computer program presented in this report. For convenience we may also write equation 14 as

$$\frac{\partial C}{\partial t} = \frac{1}{b} \frac{\partial}{\partial x_i} \left( b D_{ij} \frac{\partial C}{\partial x_j} \right) - V_x \frac{\partial C}{\partial x} - V_y \frac{\partial C}{\partial y} + F$$
(15)

where

$$F = \frac{C(S\frac{\partial h}{\partial t} + W - \epsilon \frac{\partial b}{\partial t}) - C'W}{\epsilon b}.$$
 (16)

Next consider representative fluid particles that are convected with flowing ground water. Note that changes with time in properties of the fluid, such as concentration, may be described either for fixed points within a stationary coordinate system as successive fluid particles pass the reference points, or for reference fluid particles as they move along their respective paths past fixed points in space. Aris (1962, p. 78) states that "associated with these two descriptions are two derivatives with respect to time." Thus  $\partial C/\partial t$  is the rate of change of concentration as observed from a fixed point, whereas dC/dt is the rate of change as observed when moving with the fluid particle. Aris (1962) calls the latter the material derivative.

The material derivative of concentration may be defined as

$$\frac{dC}{dt} = \frac{\partial C}{\partial t} + \frac{\partial C}{\partial x} \frac{dx}{dt} + \frac{\partial C}{\partial y} \frac{dy}{dt}.$$
 (17)

Note the correspondence of the second and third terms on the right side of equation 15 with the second and third terms on the right side of equation 17. The latter includes the material derivatives of position, which are defined by velocity. Thus for the x and ycomponents, respectively, of position and velocity we have

$$\frac{dx}{dt} = V_x \tag{18}$$

and

$$\frac{dy}{dt} = V_y. \tag{19}$$

If we next substitute the right sides of equations 15, 18, and 19 for the corresponding terms in equation 17, we obtain

$$\frac{dC}{dt} = \frac{1}{b} \frac{\partial}{\partial x_i} (bD_{ij} \frac{\partial C}{\partial x_j}) + F.$$
(20)

The solutions of the system of equations comprising equations 18-20 may be given as

$$x = x(t); y = y(t); \text{ and } C = C(t)$$
 (21)

and are called the characteristic curves of equation 15.

Given solutions to equations 18-20, a solution to the partial differential equation (eq 15) may be obtained by following the characteristic curves. This is accomplished numerically by introducing a set of moving points (or reference particles) that can be traced within the stationary coordinates of the finite-difference grid. Garder, Peaceman, and Pozzi (1964, p. 27) state, "Each point corresponds to one characteristic curve, and values of x, y, and C are obtained as functions of t for each characteristic." Each point has a concentration and position associated with it and is moved through the flow field in proportion to the flow velocity at its location. Intuitively, the method may be visualized as tracing a number of fluid particles through a flow field and observing changes in chemical concentration in the fluid particles as they move.

#### **Particle tracking**

The first step in the method of characteristics involves placing a number of traceable particles or points in each cell of the finite-difference grid to form a set of points that are distributed in a geometrically uniform pattern throughout the area of interest. It was found that placing from four to nine points per cell provided satisfactory results for most two-dimensional problems. The location or position of each particle is specified by its x- and y- coordinates in the finite-difference grid. The initial concentration assigned to each point is the initial concentration associated with the node of the cell containing the point.

For each time step every point is moved a distance proportional to the length of the time increment and the velocity at the location of the point. (See fig. 1.) The new position of a point is thus computed with the following finite-difference forms of equations 18 and 19:

$$x_{p,k} = x_{p,k-1} + \delta x_p = x_{p,k-1} + \Delta t V_{x[x_{(p,k)}, y_{(p,k)}]}$$
(22)

and





--- Computed path of particle

Figure 1.—Part of hypothetical finitedifference grid showing relation of flow field to movement of points.

$$y_{p,k} = y_{p,k-1} + \delta y_p = y_{p,k-1} + \Delta t V_{y[x_{(p,k)}, y_{(p,k)}]}$$
(23)

where

p is the index number for point identification; and  $\delta x_p$  and  $\delta y_p$  are the distances moved in the x and y directions, respectively.

The x and y velocities at the position of any particular point p, indicated as  $V_{i[x_{(p,k)},y_{(p,k)}]}$ , for time k are calculated through bilinear interpolation over the area of half of a cell using the x and y velocities computed at adjacent nodes and cell boundaries. For example, figure 2 illustrates that the velocity in the x direction of point p, located in the southeast quadrant of cell (i,j), would be computed using bilinear interpolation between the x velocities computed with equations 12 and 13 at (i,j), (i,j+1),  $(i+\frac{1}{2},j)$ , and  $(i+\frac{1}{2},j+1)$ . Similarly, the velocity in the y direction of point p would be based on the y velocities computed at (i,j), (i+1,j), (i,j+1/2) and (i+1,j+1/2).

After all points have been moved, the concentration at each node is temporarily assigned the average of the concentrations of





all points then located within the area of that cell; this average concentration is denoted as  $C_{i,j,k^*}$ . The time index is distinguished with an asterisk here because this temporarily assigned average concentration represents the new time level only with respect to convective transport. The moving points simulate convective transport because the concentration at each node of the grid will change with each time step as different points having different concentrations enter and leave the area of that cell.

#### **Finite-difference approximations**

The total change in concentration in an aquifer may be computed by solving equations 18–20. Equations 18 and 19, which are related to changes in concentration caused

by convective transport alone, are solved by the movement of points as described previously. The changes in concentration caused by hydrodynamic dispersion, fluid sources, divergence of velocity, and changes in saturated thickness are calculated using an explicit finite-difference approximation to equation 20, which can be expressed as

$$\Delta C_{i,j,k} = \Delta t \left[ \frac{1}{b} \frac{\partial}{\partial x_i} (bD_{ij} \frac{\partial C}{\partial x_j}) + F \right]. \quad (24)$$

Note that a solution to equation 20 requires the computation of the change in concentration at the tracer particles. However, primarily because of the difficulty in computing the concentration gradient at a large number of moving points, the change in concentration represented by equation 20 is solved at each node of the grid rather than directly at the location of each point. The material derivative of concentration on any characteristic curve (or for any tracer particle) is then related to the change in concentration for a node during one time step, which was computed with the solution to equation 24.

The right side of equation 24 can be considered as the sum of two separate terms, as follows:

 $\Delta C_{i,j,k} = (\Delta C_{i,j,k})_{\mathrm{I}} + (\Delta C_{i,j,k})_{\mathrm{II}}$ 

where

 $(\Delta C_{i,j,k})_{I}$  is the change in concentration caused by hydrodynamic dispersion, and is defined as

$$(\Delta C_{i,j,k})_{I} = \frac{\Delta t}{b} \left[ \frac{\partial}{\partial x_{i}} (b D_{ij} \frac{\partial C}{\partial x_{j}}) \right] \qquad (26)$$

and

 $(\Delta C_{i,j,k})_{II}$  is the change in concentration resulting from an external fluid source and changes in saturated thickness, and from equation 16 is defined as

$$(\Delta C_{i,j,k})_{II} = \Delta t F$$
  
=  $\Delta t \left[ \frac{C(S \frac{\partial h}{\partial t} + W - \epsilon \frac{\partial b}{\partial t}) - C'W}{\epsilon b} \right].$  (27)

First we will examine the change in concentration due to dispersion, partly following the development of Reddell and Sunada (1970). The right side of equation 26 can be expanded according to the summation convention of tensor notation to obtain

$$(\Delta C_{i,j,k})_{I} = \frac{\Delta t}{b} \left[ \frac{\partial}{\partial x} (b D_{xx} \frac{\partial C}{\partial x} + b D_{xy} \frac{\partial C}{\partial y}) + \frac{\partial}{\partial y} (b D_{yy} \frac{\partial C}{\partial y} + b D_{yx} \frac{\partial C}{\partial x}) \right].$$
(28)

A finite-difference approximation for the derivative in the x direction at (i,j) may be written as

$$\frac{\frac{\partial}{\partial x}(bD_{xx}\frac{\partial C}{\partial x}+bD_{xy}\frac{\partial C}{\partial y})}{=\frac{\partial}{\partial x}(bD_{xx}\frac{\partial C}{\partial x})+\frac{\partial}{\partial x}(bD_{xy}\frac{\partial C}{\partial y})}{=\frac{\left(bD_{xx}\frac{\partial C}{\partial x}\right)_{i+\frac{1}{2},j}-\left(bD_{xx}\frac{\partial C}{\partial x}\right)_{i-\frac{1}{2},j}}{\Delta x}}{\left(bD_{xy}\frac{\partial C}{\partial y}\right)_{i+\frac{1}{2},j}-\left(bD_{xy}\frac{\partial C}{\partial y}\right)_{i-\frac{1}{2},j}}}{\Delta x}.$$
(29)

In the following expansion of equation 29 it is implied that concentrations (C) are known from the previous (k-1) time level; hence, equation 29 is an explicit finite-difference equation. The spatial derivatives of concentration at (i+1/2,j) may be approximated by

$$\left(\frac{\partial C}{\partial x}\right)_{i+\frac{1}{2},j} = \frac{C_{i+1,j} - C_{i,j}}{\Delta x}$$
(30)

and

(25)

$$\left(\frac{\partial C}{\partial y}\right)_{i+\frac{1}{2},j} = \frac{C_{i+\frac{1}{2},j+1} - C_{i+\frac{1}{2},j-1}}{2\Delta y}.$$
(31)

Because concentrations are defined only at nodes, we must express the right side of equation 31 in terms of concentrations at nodes. Assuming that the concentration at a

cell boundary is approximately equal to the average (arithmetic mean) of the concentrations at adjacent nodes, we have

$$C_{i+\frac{1}{2},j+1} = \frac{C_{i,j+1} + C_{i+1,j+1}}{2}$$
(32)

and

$$C_{i+\frac{1}{2},j-1} = \frac{C_{i,j-1} + C_{i+1,j-1}}{2}.$$
 (33)

$$\left(\frac{\partial C}{\partial y}\right)_{i+\frac{1}{2},j} = \frac{C_{i,j+1} + C_{i+1,j+1} - C_{i,j-1} - C_{i+1,j-1}}{4\Delta y}.$$
(34)

Similarly, the spatial derivatives of concentration at  $(i-\frac{1}{2},j)$  are

$$\left(\frac{\partial C}{\partial x}\right)_{i-\frac{1}{2},j} = \frac{C_{i,j} - C_{i-1}}{\Delta x}$$
(35)  
and

$$\left(\frac{\partial C}{\partial y}\right)_{i-\frac{1}{2},j} = \frac{C_{i-1,j+1} + C_{i,j+1} - C_{i-1,j-1} - C_{i,j-1}}{4\Delta y}.$$
(36)

Substitution of equations 32 and 33 into equation 31 results in:

After substituting equations 30, 34, 35, and 36 into equation 29, we have

$$\frac{\partial}{\partial x} (bD_{xx} \frac{\partial C}{\partial x} + bD_{xy} \frac{\partial C}{\partial y}) = \frac{bD_{xx[i+\frac{1}{2},j]}(C_{i+1,j} - C_{i,j})}{(\Delta x)^{2}} - \frac{bD_{xx[i-\frac{1}{2},j]}(C_{i,j} - C_{i-1,j})}{(\Delta x)^{2}} + \frac{bD_{xy[i+\frac{1}{2},j]}(C_{i,j+1} + C_{i+1,j+1} - C_{i,j-1} - C_{i+1,j-1})}{4\Delta x \Delta y} - \frac{bD_{xy[i-\frac{1}{2},j]}(C_{i-1,j+1} + C_{i,j+1} - C_{i-1,j-1} - C_{i,j-1})}{4\Delta x \Delta y}.$$
(37)

A finite-difference approximation for the derivative in the y direction in equation 28

may be developed for node (i,j) in an analogous manner to equation 37 to produce

$$\frac{\partial}{\partial y} (bD_{yy} \frac{\partial C}{\partial y} + bD_{yx} \frac{\partial C}{\partial x}) = \frac{\left(bD_{yy} \frac{\partial C}{\partial y}\right)_{i,j+\frac{1}{2}} - \left(bD_{yy} \frac{\partial C}{\partial y}\right)_{i,j-\frac{1}{2}}}{\Delta y} + \frac{\left(bD_{yx} \frac{\partial C}{\partial x}\right)_{i,j+\frac{1}{2}} - \left(bD_{yx} \frac{\partial C}{\partial x}\right)_{i,j-\frac{1}{2}}}{\Delta y} = \frac{bD_{yy[i,j+\frac{1}{2}]} (C_{i,j+1} - C_{i,j})}{(\Delta y)^{2}} - \frac{bD_{yy[i,j-\frac{1}{2}]} (C_{i,j} - C_{i,j-1})}{(\Delta y)^{2}} + \frac{bD_{yx[i,j+\frac{1}{2}]} (C_{i+1,j} + C_{i+1,j+1} - C_{i-1,j} - C_{i-1,j+1})}{4\Delta x \Delta y} - \frac{bD_{yx[i,j-\frac{1}{2}]} (C_{i+1,j-1} + C_{i+1,j-1} - C_{i-1,j-1} - C_{i-1,j-1})}{4\Delta x \Delta y}.$$
(38)

Equation 28 may then be solved explicitly by substituting the relationships expressed | brackets on the right side of equation 28.

by equations 37 and 38 for the terms within

Next we will examine the change in concentration denoted by equation 27. Substituting explicit finite-difference approximations for the terms in equation 27, we have

$$(\Delta C_{i,j,k})_{\mathrm{II}} = \frac{\Delta t}{\epsilon b_{i,j,k}} \left[ C_{i,j,k-1} \left( S \left[ \frac{h_{i,j,k} - h_{i,j,k-1}}{\Delta t} \right] + W_{i,j,k} - \epsilon \left[ \frac{b_{i,j,k} - b_{i,j,k-1}}{\Delta t} \right] \right) - C'_{i,j,k} W_{i,j,k} \right].$$
(39)

Equations 28, 37, 38, and 39 together provide a solution to equation 24, which in turn allows us to solve equation 20 and complete the definition of the characteristic curves of equation 15.

Because the processes of convective transport, hydrodynamic dispersion, and mixing are occurring continuously and simultaneously, equations 18, 19, and 20 should be solved simultaneously. However, equations 18 and 19 are solved by particle movement based on implicitly computed heads while equation 20 is solved explicitly with respect to concentrations. Because the change in concentration at a source node due to mixing is proportional to the difference in concentration between the node and the source fluid (see eq 27), the accuracy of estimating the concentration at the node during a time increment will clearly affect the computed change. Similarly, because the change in concentration due to dispersion is proportional to the concentration gradient at a point, the accuracy of estimating the concentration gradient will clearly affect the accuracy of the numerical results. As the position of a front or breakthrough curve advances with time, say from the k-1 to k time level, the concentration gradient at any fixed reference point and the concentration differences at sources are continuosly changing. The consequent limitations imposed by estimating nodal concentrations in a strict explicit manner can be minimized by using a two-step explicit procedure in which equation 24 is solved at each node by giving equal weight to concentration gradients computed from the concentrations at the previous time level (k-1) and to concentration gradients computed from concentrations at time level  $(k^*)$ , which represents the convected position of the front at the new time level (k) prior to adjustments of concentration for dispersion and mixing. Figure 3 illustrates the sequence of calculations to solve equations 18-20 over a given time increment. First the concentration gradients at the previous time level (k-1) are determined at each node. Then the front is convected to a new position for time level  $k^*$  based on the velocity of flow and length of the time increment. Next the concentration gradients at each node are recomputed for the new position of the front. The concentration distribution for the new frontal position is then adjusted at each node in two steps: first based on concentration gradients at k-1 and second based on concentration gradients at  $k^*$ .

The finite-difference approximation to equation 24 may thus be expressed as

$$\Delta C_{i,j,k} = \frac{0.5 \Delta t}{b} \left[ \frac{\partial}{\partial x_i} (bD_{ij} \frac{\partial C_{(k-1)}}{\partial x_j}) + \frac{C_{(k-1)} (S \frac{\partial h}{\partial t} + W - \epsilon \frac{\partial b}{\partial t}) - C'W}{\epsilon} \right] + \frac{0.5 \Delta t}{b} \left[ \frac{\partial}{\partial x_i} (bD_{ij} \frac{\partial C_{(k^*)}}{\partial x_j}) + \frac{C_{(k^*)} (S \frac{\partial h}{\partial t} + W - \epsilon \frac{\partial b}{\partial t}) - C'W}{\epsilon} \right]$$
(40)

in which the appropriate finite-difference approximations for the terms within brackets are indicated by equations 37, 38, and 39.

The new nodal concentrations at the end of time increment k are computed as

$$C_{i,j,k} = C_{i,j,k} + \Delta C_{i,j,k} \tag{41}$$



Figure 3.—Representative change in breakthrough curve from time level k-1 to k. Note that concentration changes are exaggerated to help illustrate the sequence of calculations.

where  $C_{i,j,k}$  is the average of the concentrations of all points in cell (i,j) after equations 22 and 23 were solved for all points for time step k, and  $\Delta C_{i,j,k}$  is the change in concentration caused by hydrodynamic dispersion, sources, and sinks, as calculated in equation 40.

Because the concentrations of points in a cell vary about the concentration of the node, the change in concentration computed at a node using equation 40 cannot be applied directly in all cases to the concentrations of the points. If the change in concentration at the node  $(\Delta C_{i,j,k})$  is positive, the increase is simply added to the point concentrations. But if the concentration change is negative, it is applied to points in that cell as a percentage decrease in concentration at each point that is equal to the percentage decrease

at the node. This technique preserves a mass balance within each cell, but when a decrease in concentration is computed for a node, it will also prevent a possible but erroneous computation of negative concentrations at those points that had a concentration less than that at the node.

#### **Stability criteria**

The explicit numerical solution of the solute-transport equation has a number of stability criteria associated with it. These may require that the time step used to solve the flow equation be subdivided into a number of smaller time increments to accurately solve the solute-transport equation.

First, Reddell and Sunada (1970, p. 62) show that for an explicit finite-difference solution of equation 26 to be stable,

$$\frac{D_{xx}\Delta t}{(\Delta x)^2} + \frac{D_{yy}\Delta t}{(\Delta y)^2} \leq \frac{1}{2}.$$
 (42)

Solving equation 42 for  $\Delta t$ , we see that

$$\Delta t \leq \min_{\text{(over grid)}} \left[ \frac{0.5}{\frac{D_{xx}}{(\Delta x)^2} + \frac{D_{yy}}{(\Delta y)^2}} \right]. (43)$$

Because the solution to equation 26 is actually written as a set of N equations for N nodes, the maximum permissible time increment is the smallest  $\Delta t$  computed for any individual node in the entire grid. The smallest  $\Delta t$  will then occur at the node having the largest value of

$$\frac{D_{xx}}{(\Delta x)^2} + \frac{D_{yy}}{(\Delta y)^2}.$$

Next consider the effects of mixing ground water of one concentration with injected or recharged water of a different concentration, as represented by the source terms in equation 39. The change in concentration in a source node cannot exceed the difference between the source concentration  $(C'_{i,j})$  and the concentration in the aquifer  $(C_{i,j})$ , and the maximum possible change occurs when a source completely flushes out the volume of water in an aquifer cell at the start of a time step. Therefore

$$\Delta C_{i,j,k} \leq C_{i,j,k-1} - C'_{i,j,k} .$$

$$(44)$$

After rearranging terms in equation 44, we have

$$\frac{\Delta C_{i,j,k}}{(C_{i,j,k-1} - C'_{i,j,k})} \leq 1.0.$$
(45)

We may isolate the effects of mixing represented in equation 39 by assuming steadystate flow in which  $\partial h/\partial t = 0$  and  $\partial b/\partial t = 0$ . Then we can rewrite equation 39 as

$$(\Delta C_{i,j,k})_{II} = \frac{\Delta t \ W_{i,j,k} \ (C_{i,j,k-1} - C'_{i,j,k})}{\epsilon b_{i,j,k}}.$$
(46)

After rearranging terms in equation 46, we have

$$\frac{(\Delta C_{i,j,k})_{II}}{(C_{i,j,k-1} - C'_{i,j,k})} = \frac{\Delta t W_{i,j,k}}{\epsilon b_{i,j,k}}.$$
 (47)

Substituting equation 47 into equation 45 results in

$$\frac{\Delta t W_{i,j,k}}{\epsilon b_{i,j,k}} \leq 1.0.$$
(48)

Solving equation 48 for  $\Delta t$  at all nodes yields the following criterion:

$$\Delta t \leq \frac{\mathrm{Min}}{(\mathrm{over grid})} \left[ \frac{\epsilon b_{i,j,k}}{W_{i,j,k}} \right]. \quad (49)$$

A third type of stability check involves the movement of points computed by equations 22 and 23 to simulate convective transport. The distance a particle moves is defined as

$$\delta x = \Delta t \ V_{x[x_{(p,k)},y_{(p,k)}]} \tag{50}$$

and

$$\delta y = \Delta t \ V_{y[x_{(p,k)},y_{(p,k)}]} . \tag{51}$$

In effect, this constitutes a linear spatial extrapolation of the position of a particle from one time step to the next. Where streamlines are curvilinear, the extrapolated position of a particle will deviate from the streamline on which it was previously located. This deviation introduces an error into the numerical solution that is proportional to  $\Delta t$ . Thus, it is thought that an accurate computation of concentration changes caused by convective transport requires the maintenance of a relatively uniformly spaced field of marker particles that are moving along relatively smooth and continuous pathlines. Also, if  $\delta x$  is greater than  $\Delta x$ , or  $\delta y$  is greater than  $\Delta y$ , it might be possible for particles to move beyond the boundaries of the grid during one time increment. Thus, for a given velocity field and grid, some restriction must be placed on the size of the time increment to assure that neither  $\delta x$  nor  $\delta y$ exceed some critical distances, called  $\delta x^*$  and  $\delta y^*$ . Therefore

(52)

$$\delta y \leq \delta y^*$$
. (53)

These critical distances can be related to the dimensions of the finite-difference grid by

 $\delta x \leq \delta x^*$ 

$$\delta x^* = \gamma \Delta x \tag{54}$$

and

and

(56)

(58)

$$\delta y^* = \gamma \Delta y \tag{55}$$

where  $\gamma$  is the fraction of the grid dimensions that particles will be allowed to move  $(0 < \gamma \leq 1)$ .

If we replace the terms in equations 52 and 53 with the corresponding terms from equations 50, 51, 54, and 55, we have

 $\Delta t \, V_{x[x_{(n,k)},y_{(n,k)}]} \leq \gamma \Delta x$ 

and

$$\Delta t V_{y[x_{(p,k)},y_{(p,k)}]} \leq \gamma \Delta y.$$
 (57)

Because these criteria are governed by the maximum velocities in the system, and since the computed velocity of a tracer particle will always be less than or equal to the maximum velocity computed at a node or cell boundary, we have to check only the latter. Substituting the grid velocities and solving equations 56 and 57 for  $\Delta t$  results in

 $\Delta t \leq \frac{\gamma \Delta x}{(V_z)_{\max}}$ 

and

$$\Delta t \leq \frac{\gamma \Delta y}{(V_y)_{\max}}.$$
 (59)

If the time step used to solve the flow equation exceeds the smallest of the time limits determined by equations 43, 49, 58, or 59, then the time step will be subdivided into the appropriate number of smaller time increments required for solving the solutetransport equation.

#### Boundary and initial conditions

Obtaining a solution to the equations that describe ground-water flow and solute transport requires the specification of boundary and initial conditions for the domain of the problem. Specifications for solving the flow equation must be compatible with the solution of the solute-transport equation. Several different types of boundary conditions can be incorporated into the solute-transport model. Two general types are incorporated in this model; these are constant-flux and constant-head conditions. These can be used to represent the real boundaries of an aquifer as well as to represent artificial boundaries for the model. The use of the latter can help to minimize data requirements and the areal extent of the modeled part of the aquifer.

A constant-flux boundary can be used to represent aquifer underflow, well withdrawals, or well injection. A finite flux is designated by specifying the flux rate as a well discharge or injection rate for the appropriate nodes. A no-flow boundary is a special case of a constant-flux boundary. The numerical procedure used in this model requires that the area of interest be surrounded by a no-flow boundary. Thus the model will automatically specify the outer rows and columns of the finite-difference grid as no-flow boundaries. No-flow boundaries can also be located elsewhere in the grid to simulate natural limits or barriers to ground-water flow. No-flow boundaries are designated by setting the transmissivity equal to zero at appropriate nodes, thereby precluding the flow of water or dissolved chemicals across the boundaries of the cell containing that node.

A constant-head boundary in the model can represent parts of the aquifer where the head will not change with time, such as recharge boundaries or areas beyond the influence of hydraulic stresses. In this model constant-head boundaries are simulated by adjusting the leakage term (the last term on the right side of equation 11) at the appropriate nodes. This is accomplished by setting the leakance coefficient  $(K_z/m)$  to a sufficiently high value (such as  $1.0 \ s^{-1}$ ) to allow the head in the aquifer at a node to be implicitly computed as a value that is essentially equal to the value of  $H_s$ , which in this case would be specified as the desired constant-head altitude. The resulting rate of leakage into or out of the designated constant-head cell would equal the flux required to maintain the head in the aquifer at the specified constant-head altitude.

If a constant-flux or constant-head boundary represents a fluid source, then the chemical concentration in the source fluid (C')must also be specified. If the boundary represents a fluid sink, then the concentration of the produced fluid will equal the concentration in the aquifer at the location of the sink.

Because solute transport directly depends upon hydraulic and concentration gradients, the head and concentration in the aquifer at the start of the simulation period must be specified. The initial conditions can be determined from field data and (or) from previous simulations. It is important to note that the simulation results may be sensitive to variations or errors in the initial conditions. In discussing computed heads, Trescott, Pinder, and Larson (1976, p. 30) state:

If initial conditions are specified so that transient flow is occurring in the system at the start of the simulation, it should be recognized that water levels will change during the simulation, not only in response to the new pumping stress, but also due to the initial conditions. This may or may not be the intent of the user.

#### **Mass balance**

Mass balance calculations are performed after specified time increments to help check the numerical accuracy and precision of the solution. The principle of conservation of mass requires that the cumulative sums of mass inflows and outflows (or net flux) must equal the accumulation of mass (or change in mass stored). The difference between the net flux and the mass accumulation is the mass residual  $(R_m)$  and is one measure of the numerical accuracy of the solution. Although a small residual does not prove that the numerical solution is accurate, a large error in the mass balance is undesirable and may indicate the presence of a significant error in the numerical solution.

The model uses two methods to estimate the error in the mass balance. Both are based on the magnitude of the mass residual,  $R_m$ , which is computed from

$$R_m = \Delta M_s - M_f \tag{60}$$

where

- $\Delta M_s$  is the change in mass stored in the aquifer, M; and
- $M_f$  is the net mass flux, M.

The two mass terms,  $\Delta M_s$  and  $M_f$ , are evaluated using the following equations:

$$\Delta M_s = \sum_{\substack{i,j \\ i,j \\ i \neq j}} \sum_{k,j \in \Delta x \Delta y} \left( C_{i,j,k} - C_{i,j,o} \right) \quad (61a)$$

where  $C_{i,j,o}$  is the initial concentration at node (i,j),  $M/L^3$ ; and

$$M_f = \sum_{\substack{i \ j \ k}} W_{i,j,k} \Delta x \Delta y \Delta t_k C'_{i,j,k} . \quad (61b)$$

The percent error (E) in the mass balance is computed first by comparing the residual with the average of the net flux and net accumulation, as

$$E_{1} = \frac{100.0 \left(M_{f} - \Delta M_{s}\right)}{0.5 \left(M_{f} + \Delta M_{s}\right)}.$$
 (62)

This is a good measure of the accuracy of the numerical solution when the flux and the change in mass stored are relatively large. However, equation 62 does not account for the initial mass of solute in the aquifer. If total fluxes are very small compared to the initial mass of solute in the aquifer, then equation 62 might indicate a relatively large error when the numerical solution is actually quite accurate. Therefore, the error may also be computed a second way by comparing the residual with the initial mass of solute  $(M_0)$  present in the aquifer, as

$$E_{2} = \frac{100.0 (M_{f} - \Delta M_{s})}{M_{o}}.$$
 (63)

Equation 63 provides a good measure of the accuracy of the numerical solution when fluxes are zero or relatively small. But when  $M_0$  is zero or very small in comparison to  $\Delta M_s$ , then  $E_2$  becomes meaningless. This problem can be overcome by correcting  $M_0$  in the denominator of equation 63 for the net mass flux, resulting in

$$E_{s} = \frac{100.0 \left(M_{f} - \Delta M_{s}\right)}{M_{o} - M_{f}}.$$
 (64)

Note that as  $M_f$  becomes very small, equation 64 approaches equation 63, and as  $M_0$ becomes very small,  $E_3$  becomes just a comparison of the residual with the net flux. In the latter case  $E_3$  is a mass balance indicator similar to  $E_1$  in equation 62. Thus,  $E_3$  is considered a more reliable and versatile indicator of numerical accuracy than is  $E_2$ . Either one or both of  $E_1$  and  $E_3$  are computed by the model, as appropriate.

#### Special problems

There are a number of special problems associated with the use of the method of characteristics to solve the solute-transport equation. Some of these problems are associated with the movement and tracking of particles, while other problems are related to the computational transition between the concentrations of particles within a cell and the average concentration at that node. We will next describe the more significant problems and the procedures used to minimize errors that might result from them.

One possible problem is related to no-flow boundaries. Neither water nor dissolved chemicals can be allowed to cross a no-flow boundary. However, under certain conditions it might be possible for the interpolated velocity at the location of a particle near a no-flow boundary to be such that the particle will be convected across the boundary during one time increment. Figure 4 illustrates such a possible situation, which arises from the deviation between the curvilinear flow line and the linearly projected particle path. If a particle is convected across a no-flow boundary, then it is relocated within the aquifer by reflection across the boundary, as also shown in figure 4. This correction thus will tend to relocate the particle closer to the true flow line.

Fluid sources and sinks also require special treatment. Because they tend to represent, singularities in the velocity field, the use of a central difference formulation (eq 12) to compute the velocity at a node may indicate zero or very small velocities at the nodes. Therefore, the velocity components at a source or sink node cannot be used for interpolation of the velocity at a point within or adjacent to that cell. To help maintain radial flow to or from a sink or source, respectively, the velocities computed on the boundaries of source or sink cells are assigned to that node. The appropriate boundary velocities are determined on the basis of the quadrant of interest. This can be illustrated by referring again to figure 2. If a point is located in the southeast quadrant of cell (i,j), the x velocity at node (i,j) would



Figure 4.—Possible movement of particles near an impermeable (no-flow) boundary.

be set equal to  $V_{x(i+\frac{1}{2},j)}$  and the y velocity to  $V_{y(i,j+\frac{1}{2})}$ . Corresponding adjustments are made for points in other quadrants, so that the magnitude and direction of velocity at the node are not fixed for a given time increment, but depend on the relative location of the point of interest within the cell. A similar approximation is made when a point of interest is located in a cell adjacent to a source or sink. Thus, if the same point, p. in figure 2 were located in an unstressed cell but the adjacent cell (i+1,j) represented a source or sink, then the y velocity at node (i+1,j) would be approximated by  $V_{y(i+1,j+\frac{1}{2})}$  in order to estimate the y velocity at point p. A corresponding approximation for the x velocity at node (i,j+1) would be made using  $V_{x(i+\frac{1}{2},j+1)}$  if a source or sink were located at (i,j+1).

The maintenance of a reasonably uniform and continuous spacing of points requires special treatment in areas where sources and sinks dominate the flow field. Points will continually move out of a cell that represents a source, but few or none will move in to replace them and thereby maintain a continuous stream of points. Thus, whenever a point that originated in a source cell moves out of that source cell, a new point is introduced into the source cell to replace it. Placement of new points in a source cell is compatible with and analogous to the generation of fluid and solute mass at the source.

The procedure used to replace points in source cells that are adjacent to no-flow boundaries is illustrated in figure 5. Here a steady, uniformly spaced stream of points is maintained by generating a new point at the same relative position in the source cell as the new position in the adjacent cell of the point that left the source cell. As an example, point 7 was convected from cell (i-1,j) to cell (i,j). So the replacement point (22) was placed at a location within cell (i-1,j) that is identical to the new location of point 7 within cell (i,j).

The procedure used to replace points in source cells that lie within the aquifer and not adjacent to a no-flow boundary is illustrated in figure 6. Here a steady, uniformly spaced stream of particles is maintained by generating a new point in the source cell at the original location of the point that left the source cell. When a relatively strong source is imposed on a relatively weak regional flow field, as illustrated in figure 6a. then radial flow will be maintained in the area of the source, and all initial and replacement points will move symmetrically away from node (i,j). For example, after point 7 moves from cell (i,j) to (i+1, j-1), the replacement point (18) is positioned at time k in cell (i,j) at the same location as the initial position of point 7. Although the replacement procedure illustrated earlier by figure 5 would work just as well for the case illustrated in figure 6a, it would not be satisfactory for the situation presented in figure 6b, which illustrates the imposition of a relatively weak source in a relatively strong regional flow field. In this case the velocity distribution within the source cell does not possess radial symmetry, and the velocity within the upgradient part of the source cell is much lower than the velocity within the downgradient part of the source cell. Replacement of points at original locations in source cells, as illustrated in figure 6b, will maintain a steady stream of points leaving the source cell in proportion to the velocity field. However, the use of the procedure illustrated in figure 5 for the case presented in figure 6b would result in the accumulation of



Figure 5.---Replacement of points in source cells adjacent to a no-flow boundary.





#### **EXPLANATION**



Figure 6.—Replacement of points in source cells not adjacent to a no-flow boundary for negligible regional flow (a) and for relatively strong regional flow (b).

points in the low-velocity area of the source cell (i,j), with few points being replaced into the high-velocity area, where convective transport is the greatest.

Although we normally expect points to be convected out of source cells, figure 6b also demonstrates the possibility that points may sometimes enter a source cell. This can also occur when two or more source cells of different strengths are adjacent to each other. An erroneous multiplication of points might then result if points that did not originate in a particular source cell are replaced when they in turn are convected out of that source cell. Therefore, points leaving a source cell are replaced only if they had originated in that source cell.

Hydraulic sinks also require some special treatment. Points will continually move into a cell representing a strong sink, but few or none will move out. To avoid the resultant crowding and stagnation of tracer points, any point moving into a sink cell is removed from the flow field after the calculations for that time increment have been completed. The numerical removal of points which enter sink cells is analogous to the withdrawal of fluid and solute mass through the hydraulic sink. The combination of creating new points at sources and destroying old points at sinks will tend to maintain the total number of points in the flow field at a nearly constant value.

Both the flow model and the transport model assume that sources and sinks act over the entire cell area surrounding a source or sink node. Thus, in effect, heads and concentrations computed at source or sink nodes represent average values over the area of the cell. Part of the total concentration change computed at a source node represents mixing between the source water at one concentration and the ground water at a different concentration (eq 39). It can be shown from the relationship between the source concentration  $(C'_{i,j,k})$  and the aquifer concentration  $(C_{i,j,k-1})$ , as indicated by equation 44, that the following constraints generally must be met in a source cell:

 $C_{i,j,k} \leq C'_{i,j,k}$  for  $C'_{i,j,k} > C_{i,j,k-1}$  (65a) and

 $C_{i,j,k} \ge C'_{i,j,k}$  for  $C'_{i,j,k} < C_{i,j,k-1}$  (65b) If it is assumed that the sources act over

the area of the source cell and that there is complete vertical mixing, then these same constraints should also apply to all points within the cell. Because of the possible deviation of the concentrations of individual points within a source cell from the average concentration, the change in concentration computed at a source node  $(\Delta C_{i,i,k})$  should not be applied directly to each of the points in the cell. Rather, at the end of each time increment the concentration of each point in a source cell is updated by setting it equal to the final nodal concentration. Although this may introduce a small amount of numerical dispersion by eliminating possible concentration variations within the area of a source cell, it prevents the adjustment of the concentration at any point in the source cell to a value that would violate the constraints indicated by equation 65.

In areas of divergent flow there may be a problem because some cells can become void of points where pathlines become spaced widely apart. This would result in a calculation of zero change in concentration at a node due to convective transport, although the nodal concentration would still be adjusted for changes caused by hydrodynamic dispersion (eq 28). Also, some numerical dispersion is generated at nodes in and adjacent to the cells into which the convective transport of solute was underestimated because of the resulting error in the concentration gradient. This might not cause a serious problem if only a few cells in a large grid became void or if the voiding were transitory (that is, if upgradient points were convected into void cells during later or subsequent time increments). Figure 6a illustrates radial flow, which represents the most severe case of divergent flow. Here it can be seen that when four points per cell are used to simulate convective transport, then in the numerical procedure four of the eight surrounding cells would erroneously not receive any solute by convection from the adjacent source. If eight points per cell were used initially, then at a distance of two rows or columns from the source only 8 of 16 cells would be on pathlines originating in the source cell. So, while increasing the initial number of points per cell would help, it is obvious that for purely radial flow, an impractically large initial number of points per cell would be required to be certain that at least one particle pathline passes from the source through every cell in the grid.

The problem of cells becoming void of particles can be minimized by limiting the number of void cells to a small percentage of the total number of cells that represent the aquifer. If the limit is exceeded, the numerical solution to the solute-transport equation is terminated at the end of that time increment and the "final" concentrations at that time are saved. Next the problem is reinitialized at the time of termination by regenerating the initial particle distribution throughout the grid and assigning the "final" concentrations at the time of termination as new "initial" concentrations for nodes and particles. The solution to the solute-transport equation is then simply continued in time from this new set of "initial" conditions until the total simulation period has elapsed. This procedure preserves the mass balance within each cell but also introduces a small amount of numerical dispersion by eliminating variations in concentration within individual cells.

To help minimize the amount of numerical dispersion resulting from the regeneration of points, the program also includes an optimization routine that attempts to maintain an approximation of the previous concentration gradient within a cell. The optimization routine aims to meet the following constraints:

$$\frac{\sum_{n=1}^{N_{p}} C_{n}^{*}}{N_{p}} = C_{i,j} \qquad (66a)$$

$$C_{i,j} \leq C_{n}^{*} \leq C_{l,m} \quad \text{for} \quad C_{i,j} \leq C_{l,m} \quad (66b)$$

and

 $C_{l,m} \leq C_n^* \leq C_{i,j}$  for  $C_{i,j} \geq C_{l,m}$  (66c)

where

- $C_n^*$  is the concentration of the *n*th point in cell  $(i,j), M/L^3$ ;
- $N_p$  is the total number of points initially placed in a cell; and
- $C_{l,m}$  is the concentration at node (l,m), which represents a cell adjacent to (i,j) and on a line that starts at (i,j) and extends through the coordinates of the point (n) of interest, as illustrated in figure 7,  $M/L^3$ .

Note that equation 66a simply indicates that a mass balance must be preserved in a cell regardless of the range in variation of point concentrations within the cell. Equations 66b and c indicate that the concentration of any point must lie between  $C_{i,j}$  and the concentration at the node adjacent to particle *n*. The coordinates of the adjacent node would take on values of l=i or  $l=i\pm 1$ and m=j or  $m=j\pm 1$ . For example, figure 7 shows that for point 2, the coordinates (l,m)would equal (i,j-1), while for point 3, (l,m)



Figure 7.—Relation between possible initial locations of points and indices of adjacent nodes.

routine is written so that if equations 66a-c cannot be satisfied simultaneously for node (i,j) within two iterations, then to avoid further computational delay all  $C_n^*$  are simply set equal to  $C_{i,j}$ .

# **Computer Program**

The computer program serves as a means of translating the numerical algorithm into machine executable instructions. The purpose of this chapter is to describe the overall structure of the program and to present a detailed description of its key elements. thereby providing a link between the numerical methods and the computer code. We hope that this link will make it easier for the model user to understand and, if necessary, modify the program. The FORTRAN IV source program developed for this model is listed in attachment I and includes almost 2,000 lines. For reference purposes columns 73-80 of each line contain a label that is numbered sequentially within each subroutine. The definition of selected variables used in the program is presented in attachment II; this glossary therefore also serves as a key for relating the program variables to their corresponding mathematical terms. The computer program is compatible with many scientific computers; it has been successfully run on Honeywell, IBM, DEC, and CDC computers.

# General program features

The program is segmented into a main routine and eight subroutines. The name and primary purpose of each segment are listed in Table 1. Each program segment will be described in more detail in later sections of this chapter.

Table 1.-List of subroutines for solute-transport model

Name	Purpose
MAIN	Control execution.
PARLOD	Data input and initialization.
ITERAT _	Compute head distribution.
GENPT	Generate or reposition particles.
VELO	Compute hydraulic gradients, velocities, dispersion equation coefficients, and time increment for stable solution to transport equation.
MOVE	Move particles.
CNCON _	Compute change in chemical concentra- tions and compute mass balance for transport model.
OUTPT	Print head distribution and compute mass balance for flow model.
CHMOT _	Print concentrations, chemical mass balance, and observation well data.

The major steps in the calculation procedures are summarized in figure 8, which presents a simplified flow chart of the overall structure of the computer program. The flow chart illustrates that the tracer particles may have to be moved more than once to complete a given time step. In other words, the time step used to implicitly solve the flow equation may have to be subdivided into a number of smaller time increments for the explicit solution of the solute-transport equation. The maximum time increments allowable for the explicit calculations are computed automatically by the model. Thus, the model user cannot specify an erroneously large increment or an inefficiently small increment for solving the solute-transport equation. For transient flow problems, some discretion is still required in the specification of the initial time step and of the timestep multiplier, as discussed by Trescott, Pinder, and Larson (1976, p. 38-40).

The general program presented here is written to allow a grid having up to 20 rows and 20 columns. Because the numerical procedure requires that the outer rows and columns represent no-flow boundaries, the aquifer itself is then limited to maximum dimensions of 18 rows and 18 columns. If a problem requires a larger grid, then the appropriate arrays must be redimensioned accordingly. These arrays are contained in COMMON statements PRMK, HEDA, HEDB, CHMA, CHMC, and DIFUS, and in DIMENSION statements on lines C170, G200, H140, and I160.

The program allows the specification of one pumping well per node. The wells can represent injection (recharge) or withdrawal (discharge). If more than one well exists within the area of a cell, then the flux specified for that node should represent the net rate of injection or withdrawal of all wells in that cell. The model assumes that stresses are constant with time during each pumping period (NPMP). But the total number of wells, as well as their locations, flux rates, and source concentrations, may be changed for successive pumping periods. The program also allows the specification of observation wells at as many as five nodes in the grid. For nodes that are designated as observation wells, at the end of the simulation period or after every 50 time increments the model will print a summary table of the head and concentration at the previous time increments.

The program also includes a node identification array (NODEID), which allows certain nodes or zones to be identified by a unique code number. This feature can save much time in the preparation of input data by easily equating each code number with a desired boundary condition, flux, or source concentration.



Figure 8.—Simplified flow chart Illustrating the major steps in the calculation procedure.

### **Program segments**

#### MAIN

The primary purpose of the MAIN routine is to control the overall execution sequence of the program. Subroutines for input, execution, and output are called from MAIN and the elapsed time simulated is compared with the desired total simulation period. Also, lines A500-A580 serve to store (or record) observation well data for transient flow problems.

#### Subroutine PARLOD

All input data are read through subroutine PARLOD. These data define the properties, boundaries, initial conditions, and stresses for the aquifer, as well as spatial grid and time-step factors. The values of many variables are also initialized here. After the data are read, some preliminary calculations are made, such as (1) determining time increments for the flow model (lines B780-B890), (2) computing the harmonic mean transmissivities in the x and y directions (B1670– B1800), (3) adjusting transmissivity for anisotropy (B1810-B1820), (4) computing iteration parameters (B1840-B1910 and B2880-B2980), and (5) checking for possible inconsistencies among the input data (B3140-B3290). A printout is also provided of all input data so that the data may be rechecked and each run identified.

#### Subroutine ITERAT

This subroutine solves a finite-difference approximation of the flow equation (eq 11) using an iterative ADI procedure. The matrix generated by the finite-difference approximation is solved using the Thomas algorithm, as described by von Rosenberg (1964, p. 113). Row calculations are made in lines C270–C610, and column calculations are made in lines C630-C970. The calculations are assumed to have converged on a solution if the maximum difference at all nodes between heads computed along rows and heads computed along columns is less than the specified tolerance. Convergence is checked on lines C940-C950. Note that here (for example, lines C380, C700, C930, and C1150) and in other subroutines the thickness array (THCK) is used to check whether a node is in the aquifer.

It should also be noted here that the flow model, as written, assumes that the transmissivity of the aquifer is independent of the head (or saturated thickness) and remains constant with time. If this assumption is not appropriate to the particular aquifer system being modeled, then the solution algorithm presented in this subroutine should be modified accordingly. For example, flow models published by Prickett and Lonnquist (1971, p. 43-45) and Trescott, Pinder, and Larson (1976) include such a modification.

All parameters involved in the calculation of heads are defined as double precision variables and all calculations involving these parameters are performed in double precision. The number of double precision variables and operations can be reduced significantly if the program is to be executed on a high-precision scientific computer, thereby improving the efficiency of the model by reducing computer storage requirements and execution time.

The iterative ADI procedure used to solve the finite-difference equations is not necessarily the best possible solution technique for all problems. For example, it may be difficult to obtain a solution using the iterative ADI procedure for cases of steady-state flow when internal nodes in the grid have zero transmissivity and for cases in which the transmissivity is highly anisotropic. In such cases, a strongly implicit procedure, such as the one documented by Trescott, Pinder, and Larson (1976), should be substituted for the solution algorithm contained in subroutine ITERAT.

#### Subroutine GENPT

The primary purpose of subroutine GENPT is to generate a uniform initial distribution of tracer particles throughout the finite-difference grid. This is done either at the start of a simulation period or at an intermediate time when too many cells have become void of particles. In the latter case, the program attempts to preserve an approximation of the previous concentration gradient within each cell (lines D1420– D2040).

The placement of particles is accomplished in lines D510-D1410. The program allows the placement of either four, five, eight, or nine particles per cell. Of course each option will result in a slightly different geometry



Figure 9.—Parts of finite-difference grids showing the initial geometry of particle distribution for the specification of four (A), five (B), eight (C), and nine (D) particles per cell.

and density of points, as illustrated by figure 9. The most regular or uniform patterns are produced when four or nine particles per cell are specified. If a different number of particles per cell or a different placement geometry are desired, this subroutine could be modified accordingly.

As particles are moved or convected through the grid during the calculation procedure, there is a need to remove particles at fluid sinks and create particles at fluid sources. A buffer array (called LIMBO) is created on lines D430–D480 that contains particles that can be added later to the grid at sources and that also contains space to store particles removed at sinks or discharge boundaries.

#### **Subroutine VELO**

Subroutine VELO accomplishes three objectives. First, it computes the flow velocities at nodes and on cell boundaries by solving equations having the form of equations 12 and 13. The velocities are computed on lines E420-E680. Second, the dispersion equation coefficients are calculated. These coefficients represent terms factored out of equations 37 and 38, as follows:

DISP(IX,IY,1) = 
$$(bD_{xx})_{[i+\frac{1}{2},j]}/(\Delta x)^2$$
 (67a)

DISP(IX,IY,2) = 
$$(bD_{yy})_{[i,j+\frac{1}{2}]}/(\Delta y)^2$$
 (67b)

DISP(IX,IY,3) = 
$$(bD_{xy})_{(i+\frac{1}{2},j)}/4\Delta x \Delta y$$
 (67c)

DISP(IX,IY,4) = 
$$(bD_{yx})_{[i,j+\frac{1}{2}]}/4\Delta x \Delta y.$$
 (67d)

Note that each dispersion coefficient  $(D_{xx}, D_{yy}, D_{xy}, D_{yx})$  is computed on cell boundaries using the relationships expressed in equations 8–10. Therefore, the equation coefficients computed by equation 67 are stored as forward values from the indicated node in the DISP array. Third, this subroutine computes (on lines E1050–E1240 and E1800– E1930) the minimum number of particle moves (NMOV) required to solve the transport equation for the given time step so that the maximum time increment for the transport equation solution will not exceed any of the criteria indicated by equations 43, 49, 58, and 59.

#### Subroutine MOVE

Although this subroutine has only one main function, which is to move the tracer particles in accordance with equations 22 and 23, it is the longest and perhaps the most complex segment of the program. The complexities are mainly introduced by the treatment of particles at the various types of boundary conditions. To help illustrate the calculation procedure followed within subroutine MOVE, a flow chart is presented in figure 10. The numbers in the flow chart indicate the corresponding lines in subroutine MOVE where the indicated operation is executed.

If a node represents a fluid source or sink, then particles must be respectively created or destroyed in these cells. If the value of pumpage (REC) at a node does not equal zero, then the node is assumed to represent either a fluid source (for REC<0) or a fluid sink (for REC>0). Recharge or discharge can also be represented by the RECH array. But it is assumed that this type of flux is sufficiently diffuse so that it does not induce areas or points of strongly divergent or convergent flow and therefore particles need not be created or destroyed at these nodes. Note that here and in other subroutines the presence of a constant-head boundary is tested by checking the value of leakance (VPRM)





at each node. If VPRM exceeds 0.09, it is assumed that the node represents a constanthead boundary condition and is treated as a fluid source or sink accordingly. At a constant-head node the difference in head between the aquifer and the source bed is used to determine whether the node represents a fluid source or sink (for example, lines F2500-F2520).

#### Subroutine CNCON

This subroutine computes the change in concentration at each node and at each particle for the given time increment. Equation 39, which denotes the change in concentration resulting from sources, divergence of velocity, and changes in saturated thickness, is solved on lines G350-G610. On the G520 the value of the storage coefficient is checked to determine whether the aquifer is confined or unconfined. It assumes that if S < 0.005. then the aquifer is confined and  $\partial b/\partial t = 0$ . If  $S \ge 0.005$ , the model assumes that  $\partial b / \partial t$  $=\partial h/\partial t$ . If this criterion is not appropriate to a particular aquifer system, then line G520 should be modified accordingly. The change in concentration caused by hydrodynamic dispersion is computed on lines G640-G770 as indicated by equations 37 and 38.

The nodal changes in concentration caused by convective transport are computed on lines G850-G940. The number of cells that are void of particles at the new time level are also counted in this set of statements on lines G880-G910, and then compared with the critical number of void cells (NZCRIT) to determine if particles should be regenerated at initial positions before the next time level is started (lines G960-G1020).

The new (time level k) concentrations at nodes are computed on the basis of the previous concentration at time k-1 and the change during k-1 to k. The adjustment at nodes is accomplished on lines G1060-G1180, while the concentration of particles is adjusted on lines G1210-G1360.

A mass balance for the solute is next computed (lines G1400-G1730) at the end of each time increment. In computing the mass of solute withdrawn or leaking out of the aquifer at fluid sinks, the concentration at the sink node is assumed to equal the nodal concentration computed at time level k-1.

#### Subroutine OUTPT

This subroutine prints the results of the flow model calculations. When invoked, the subroutine prints (1) the new hydraulic head matrix (lines H190-H260), (2) a numeric map of head values (H300-H390), and (3) a drawdown map (H510-H710). This subroutine also computes a mass balance for the flow model and estimates its accuracy (H420-H820). A mass balance is performed both for cumulative volumes since the initial time and for flow rates during the present time step. The mass balance results are printed on lines H840-H930.

#### Subroutine CHMOT

This subroutine prints (1) maps of concentration (lines I250-I380), (2) change in concentration from initial conditions (I440-1580), and (3) the results of the cumulative mass balance for the solute (1670-1860). The accuracy of the chemical mass balance is estimated on lines I610-I660 using equations 62 and 64. The former is not computed if there was no change in the total mass of solute stored in the aquifer. The latter is not computed if the initial concentrations were zero everywhere. Lines 1890-11140 serve to print the head and concentration data recorded at observation wells. These data are recorded after each time step for a transient flow problem and after each particle movement for a steady-state flow problem. The data are printed after every 50 time increments and at the end of the simulation period.

# **Evaluation of Model**

# Comparison with analytical solutions

The accuracy of the numerical solution to the solute-transport equation can be evaluated in part by analyzing relatively simple problems for which analytical solutions are available and then comparing the numerical calculations with the analytical solution. Figure 11 presents such a comparison for a problem of one-dimensional steady-state flow through a homogeneous isotropic porous medium. The analytical solution is obtained with the following equation presented by Bear (1972, p. 627):

$$\frac{C(x,t)-C_0}{C_1-C_0} = \frac{1}{2} \operatorname{erfc} \left\{ -\frac{x-qt/\epsilon}{\sqrt{4D_L t}} \right\} (68)$$

where

- erfc is the complimentary error function, and
- $q = \epsilon V$  is the specific discharge,  $LT^{-1}$ .

Bear (1972, p. 627) shows that equation 68 is subject to the following initial conditions:

$$t \leq 0, \quad -\infty < x < 0, \quad C = C_0$$
$$0 \leq x < +\infty, \quad C = C_1$$

and to the following boundary conditions:

$$t>0, \quad x=\pm\infty, \quad \partial C/\partial x=0$$
$$x=+\infty, \quad C=C_1$$
$$x=-\infty, \quad C=C_0.$$

The general computer program presented in this report was modified in three simple ways for application to a problem equivalent to the one for which the analytical solution was derived. First, the program's arrays were redimensioned to 3 by 50 rather than 20 by 20. The aquifer (or column of porous medium) was thus represented by a 1-by-48 array of nodes. A grid spacing of 10 ft (3.05 m) was used. Second, the flow velocity was specified as a constant value, rather than being computed implicitly on the basis of hydraulic gradients and hydraulic conductivity. Third, the first (upstream) node of the aquifer was specified as a constant-concentration boundary, so that the concentration at node (2,2) was always equal to  $C_0$  of



Figure 11.—Comparison between analytical and numerical solutions for dispersion in one-dimensional, steady-state flow.

equation 68. In the analysis of one-dimensional test problems, it was assumed that porosity equals 0.35, velocity equals  $3.0 \times 10^{-4}$  ft/s ( $9.1 \times 10^{-5}$  m/s), and time equals 10.0 days.

As shown in figure 11, comparisons between the analytical and numerical solutions were made for two different values of dispersivity. For the higher dispersion there was essentially an exact agreement between the two curves. In the case of low dispersion, there is a very small difference at some nodes between the concentrations computed analytically and those computed numerically. This difference is caused primarily by the error in computing the concentration at a node as the arithmetic average of the concentrations of all particles located in that cell. This is not considered to be a serious problem since this error is not cumulative. Also note in the case of low dispersion that the grid spacing (10 ft or 3.05 m) was coarse relative to the width of the breakthrough curve between concentrations of 0.05 and 0.95. Nevertheless, the numerical model still accurately computed the shape and position of the front.

In computing the numerical solutions shown in figure 11 the program was executed using nine particles per cell and with CELDIS=0.50 ( $\gamma$  in equations 54-55). The 10-day simulation required 52 time increments and used about 40 seconds of cpu on a Honeywell 60/68 computer.

An analytical solution is also available for the problem of plane radial flow in which a well continuously injects a tracer at constant rate  $q_w$  and constant concentration  $C_0$ . Bear (1972, p. 638) indicates that the following equation is appropriate for this problem (although there are some limitations discussed by Bear):

$$\frac{C}{C_0} = \frac{1}{2} \operatorname{erfc} \left\{ \frac{r^2/2 - Gt}{\sqrt{4/3\alpha_1 \overline{r}^3}} \right\}$$
(69)

is the radial distance from

the center of the well,

 $=\frac{q_w}{2\pi\epsilon b}=Vr;$ 

L; and

where

G r

$$\overline{r} = (2Gt)^{\frac{1}{2}}$$
 is the average radius of the  
body of injected water,

Again, the general computer program had to be somewhat modified to permit a suitable comparison to be made between the analytical solution and the numerical model. One change involved the direct calculation of velocity at any point based on its distance from the well using the following equation:

$$V = \frac{q_w}{2\pi r_{\epsilon} b}.$$
 (70)

The other significant change was made in subroutine GENPT to allow the initial placement of 16 particles per cell, rather than the present maximum of 9. In the analysis of test problems for radial flow, it was assumed that porosity equals 0.35, the injection rate  $(q_w)$  equals 1.0 ft<sup>3</sup>/s (0.028 m<sup>3</sup>/s), saturated thickness equals 10.0 ft (3.05 m), and longitudinal dispersivity equals 10.0 ft (3.05 m).

The application of the method of characteristics, which was written for two-dimensional Cartesian coordinates, to a problem involving radially symmetric divergent flow represents a severe test of the model. Nevertheless, it can be seen in figure 12 that there is good agreement between the analytical and numerical solutions after both relatively short and long times. However, the presence of some numerical dispersion is evident, particularly for the longer time. The numerical dispersion is introduced in part during the regeneration of particles after the number of cells void of particles has exceeded the critical number. The geometry of initial particle placement minimized this problem in cells that lay in the same row or column of the grid as the injection well. The circles in figure 12, which indicate concentration values computed at these nodes, agree closely with the analytical solution. The greatest errors occur at nodes on radii from the injection well that are neither parallel to nor 45° from the main axes of the grid. These results indicate that this Cartesian coordinate model is not best suited for application to purely radial flow problems. However, if radially divergent flow is limited to areas of several



Figure 12.-Comparison between analytical and numerical solutions for dispersion in plane radial steady-state flow.

rows and columns within a more uniform regional flow field, the model will accurately compute concentration distributions. To apply the method of characteristics to a problem of plane radial flow, it would be best to rewrite the program in a system of radial coordinates, which should improve the accuracy for those problems to the same order shown in figure 11 for the analysis of onedimensional flow.

### Mass balance tests

The accuracy and precision of the numerical solution can also be partly evaluated by computing the magnitude of the error in the mass balance. The mass balance error will depend on the nature of the problem and will vary from one time step to the next. During the development of the program, the model was applied to a variety of hypothetical solute-transport problems to assure its flexibility, transferability, and accuracy under a wide range of conditions. To illustrate the range in mass balance errors that might be expected and some of the factors that affect it, several of these problems are presented here.

#### Test problem 1—spreading of a tracer slug

The first test described here was designed to evaluate the accuracy of simulating the processes of convective transport and dispersion independent of the effects of chemical sources. Thus, a slug of tracer was initially placed in four cells of a grid whose boundary conditions generated a steady-state flow field that was moderately divergent in some places and moderately convergent in other places, as illustrated in figure 13. The aquifer was assumed to be homogeneous and isotropic. Because flow was assumed to be in steady state, the storage coefficient was set equal to 0.0. The parameters used to define problem



Figure 13.-Grid, boundary conditions, and flow field for test problem 1.

1 are listed in table 2. The slug of known mass was then allowed to spread downgradient for a period of 2.0 years.

	Table 2M	odel paramet	ters for te	st problem
--	----------	--------------	-------------	------------

Aquifer properties	Numerical parameters	
K=0.005 ft/s	$\Delta x = 900 \text{ ft}$	
(1.5×10 <sup>-3</sup> m/s)	(274 m)	
b=20.0 ft	$\Delta y = 900 \text{ ft}$	
(6.1 m)	(274 m)	
S=0.0	CELDIS=0.49	
ε <u>=0.30</u>	NPTPND=9	
$a_L = 0.30$		

The model first computed a steady-state head distribution, shown in figure 13, and velocity field. The model required 12 time increments (or particle movements) to simulate a 2.0-year period. The model was run to simulate conditions of no dispersion ( $\alpha_L = 0.0$ ft) as well as moderate dispersion ( $\alpha_L = 100$ ft or 30.5 m). The mass balance error computed using equation 64 is shown in figure 14 for both conditions. In these tests the error averages 1.9 percent and is always within a range of  $\pm 8$  percent. Much of the error is related to the calculation of nodal concentrations based on the arithmetic mean of particle concentrations in each cell. When a particle moves across a cell boundary, its area of influence shifts entirely from the first node to the second. Thus, depending on the local density of points and local concentration gradients, the use of an arithmetic mean to compute nodal concentrations may give too much weight to some particles and too little weight to others. The use of a weighted mean, in which the weighting factor is a function of the distance between a node and a particle, reduced the error to some degree. But the improvement in precision was small compared with the increase in computational requirements, so this algorithm was not included in the general program. Because the error caused by using an arithmetic mean is not cumulative, it is not considered a serious



Figure 14.—Mass balance errors for test problem 1.



Figure 15.—Grid, boundary conditions, and flow field for test problem 2.

problem. Furthermore, figure 14 shows that the error decreases for a higher dispersivity because dispersion smooths out sharp fronts and minimizes strong concentration gradients.

#### Test problem 2-effects of wells

The second problem was designed to evaluate the application of the model to problems in which the flow field is strongly influenced by wells. The grid and boundary conditions used to define this problem are illustrated in figure 15. The problem consists of one injection well and one withdrawal well, whose effects are superimposed on a regional flow field controlled by two constant-head boundaries. The parameters for problem 2 are defined in table 3. The aquifer was also assumed to be homogeneous and isotropic. The model simulated a period of 2.4 years and assumed steady-state flow.

The model required 18 time increments (or particle movements) to simulate a 2.4year period of solute transport. Problem 2 was also evaluated for conditions of no dispersion ( $\alpha_L = 0.0$  ft) as well as moderate dispersion ( $\alpha_L = 100$  ft or 30.5 m). The mass balance error was computed using equation 62 and is shown in figure 16 for both conditions. The average of the 36 values shown in figure 16 is -0.06 percent; the error always falls within the range of  $\pm 8$  percent. It can be

Table 3.-Model parameters for test problems 2 and 3

Aquifer properties and stresses	Numerical parameters
K = 0.005  ft/s	$\Delta x = 900 \text{ ft}$
$(1.5 \times 10^{-3} \text{ m/s})$	(274 m)
<i>b</i> =20.0 ft	$\Delta y = 900 \text{ ft}$
(6.1 m)	(274 m)
S = 0.0	CELDIS = 0.50
€ <u>=0.30</u>	NPTPND=9
$a_T/a_L = 0.30$	
C'=100.0	
$C_{0} = 0.0$	
$q_w = 1.0  \text{ft}^3/\text{s}$	
$(0.028 \text{ m}^3/\text{s})$	

seen that in this case the errors are essentially coincident for almost 1 year, after which the error appears to be dependent on the magnitude of dispersion. However, the model output showed that when  $\alpha_L = 100$  ft (30.5 m), the leading edge of the breakthrough curve (or chemical front) reaches the constant-head sink just prior to 1.0 year. When  $\alpha_L = 0.0$  ft, the leading edge of the breakthrough curve still had not entered the constant-head sink after 2.4 years. Because the two curves in figure 16 are essentially coincident prior to 1.0 year, it thus appears that the divergence of the two curves is not caused directly by the difference in dispersivity. Rather, it is related to the difference in arrival times at the hydraulic sinks and is a direct effect of the manner in which con-



Figure 16.—Mass balance errors for test problem 2.
centrations are computed at sink nodes and (or) the method of estimating the mass of solute removed from the aquifer at sink nodes during each time increment.

#### Test problem 3—effects of user options

In addition to the input options that control the form or frequency of the output, there are two execution parameters that must be specified by the user and influence the accuracy, precision, and efficiency (or computational cost) of the solution to a particular problem. These execution parameters are the initial number of particles per node (NPTPND) and the maximum fraction of the grid dimensions that particles are allowed to move ( $\gamma$  in equations 54–55 or CELDIS in the program). The third test problem was designed to allow an evaluation of both of these parameters. As illustrated in figure 17, this problem consists of one withdrawal well located in a regional flow field that is controlled by two constant-head boundaries. The contamination sources are three central nodes along the upgradient constant-head boundary. The model parameters for test problem 3 are the same as for test problem 2, as listed in table 3. However, for test problem 3 solutions were obtained using a range in values for CELDIS and NPTPND.

The solution to this problem was found to be sensitive to the density of tracer particles used in the simulation. Figure 18 shows how the error in the mass balance varied with time for cases of NPTPND equal to 4, 5, 8, and 9. Table 4 lists the execution time and the mean and standard deviation of the mass balance error for each case. These data clearly indicate that the accuracy and precision



Figure 17.--Grid, boundary conditions, and flow field for test problem 3.



Figure 18.-Effect of NPTPND on mass balance error for test problem 3; CELDIS=0.50 in all cases.

Table 4.—Effect of NPTPND on accuracy, precision, and efficiency of solution to test problem 3

		Mass balance error (percent)		
NPTPND	cpu-seconds 1	Mean	Standard deviation	
4	12.8	1.49	5.33	
5	14.0	.90	2.29	
8	17.9	.48	1.53	
9	19.2	.26	.69	

<sup>1</sup> The program was executed on a Honeywell 60/68 computer; CELDIS = 0.50.

of the solution are directly proportional to particle density, while the efficiency of the solution is inversely related to NPTPND. In other words, a better solution will cost more. It is important to note that the oscillations or scatter shown in figure 18 decrease with time and that there is essentially no difference among the solutions and among the mass balance errors for times greater than about 1.5 years.

Next the effect of CELDIS (or  $\gamma$ ) was evaluated for test problem 3 by setting NPTPND=9 and running the model with several possible values of CELDIS. Figure 19 shows how the error in the mass balance varied with time for cases of CELDIS equal to 0.25, 0.50, 0.75, and 1.00. Table 5 lists the

Table 5.—Effect of CELDIS on accuracy, precision, and efficiency of solution to test problem 3

		Mass balance error (percent)		
CELDIS	cpu-seconds <sup>1</sup>	Mean	Standard deviation	
0.25	34.6	1.50	2.99	
.50	19.2	.26	.69	
.75	14.4	.56	.69	
1.00	12.1	.25	1.48	

<sup>1</sup> The program was executed on a Honeywell 60/68 computer; NPTPND=9.

execution time and the mean and standard deviation of the mass balance error for each case. These data indicate that the relationship between CELDIS and the mass balance error is not as simple and straightforward as for NPTPND. It is apparent that the results for 0.50, 0.75, and 1.00 are similar, and of these, the results for CELDIS = 0.50 ap-



Figure 19.-Effect of CELDIS on mass balance error for test problem 3; NPTPND=9 in all cases.

pear to be the best. However, when CELDIS was reduced to 0.25. the error oscillated strongly for about 1.5 years before apparently converging to a small error within the range of the other curves. This oscillation occurred because the maximum distance a particle could move (25 percent of the grid dimensions) was less than the spacing between particles (33 percent of the grid dimensions for NPTPND=9). Thus, convective transport across the boundaries of cells could not be adequately represented for any single time step in those parts of the grid where the concentration was changing significantly with time. But over two successive time increments the error would average out to a minimum. As the contaminated area increases in size over time, the error in computed concentrations at cells near the front (that is, in areas of steep concentration gradient) becomes an increasingly smaller percentage of the total mass of solute present in the aquifer. Hence, the mass balance error generally tends to approach a minimal range with time for these types of problems.

The effects of NPTPND and CELDIS on the mass balance error are problem dependent. In problems for which CELDIS is not the limiting stability criterion, varying CELDIS will have no effect on the solution. Because of the possible tradeoff between accuracy and efficiency, it is recommended in general that the model user specify NPTPND as 4 or 5 and CELDIS as 0.75 to 1.0 for runs made during the early stages of model calibration when frequent runs are made and maximum efficiency is desired. For final runs when maximum accuracy is desired, set NPTPND equal to 9 and CELDIS equal to 0.50.

## Possible program modifications

The program presented here represents a basic and general solute-transport model. Some program modifications may be desirable or even necessary to allow the model to be applied efficiently to a particular field problem. Some changes might require only minor adjustments, while others might involve major rewriting of the program. The purpose of this section is to discuss some of the modifications that might commonly be considered, and that might be incorporated into the present basic model, rather than using an entirely different solution technique.

### Coordinate system and boundary conditions

After the finite-difference grid is designed, the first program modification that should be made is to modify the array dimensions for the specific grid used. This will permit the most efficient use of computer storage. The array sizes should be set equal to NX, NY, and NPMAX, which are specified on Input Card 2. The maximum number of particles, NPMAX, may be computed from the following equation:

 $NPMAX \approx (NX-2) (NY-2) (NPTPND)$  $+ (N_s) (NPTPND) + 250 (71)$ 

where

 $N_s$  is the number of nodes that represent fluid sources, either at wells or at constant-head cells.

The values of NX and NY should be substituted for the 20-by-20 arrays contained in COMMON statements PRMK, HEDA, HEDB, CHMA, CHMC, and DIFUS, and in DIMENSION statements on lines C170, G200, H140, and I160. The value of NPMAX should replace 3200 in the PART array in all the CHMA COMMON statements.

Although this program is designed for application to two-dimensional areal flow problems, it can be applied directly to two-dimensional cross sections. In this case the zcoordinate would replace the y-coordinate. Then the user would have to assume and specify unit width (THCK array) for  $\Delta y$ and substitute hydraulic conductivity for transmissivity in data set 3 of attachment III. If the problem involves transient flow, then specific storage  $(S_s)$  should be substituted for the storage coefficient. Also, if recharge or discharge is to be specified through the RECH array (data set 5), values should be divided by the thickness of the layer  $(\Delta z)$ to reduce the dimensionality of the stress rate to  $(T^{-1})$  rather than  $(LT^{-1})$  as indicated in the documentation. In applying the cross-sectional model to a field problem it is important that conditions meet the inherent assumption that there exist no significant components of flow into or out of the plane of the section. Because this assumption would probably be impossible to meet in the vicinity of a pumping well, the use of the REC array (data set 2) should usually be limited to representing special or known-flux boundary conditions.

The program can also be applied directly and simply to one-dimensional problems. In this case one of the dimensions (NX or NY) should be reduced to a value of 3, of which the outer two are used to represent the noflow boundaries around the one-dimensional row or column.

The most complex type of change would involve rewriting the program for application to other than a two-dimensional rectangular grid. One possibility includes problems of flow to or from wells in which radial symmetry can be assumed. This would allow variables to be expressed in terms of r-z coordinates. Another possibility is to simulate three-dimensional flow in x-y-z coordinates. A three-dimensional finite-difference flow model is available (Trescott, 1975) and would be compatible with the method-of-characteristics solution to the solute-transport equation.

It is sometimes convenient to separately associate certain parts of the grid or certain boundary conditions with corresponding field conditions or hydrologic units. The analysis of flow patterns and water-quality changes may then be aided by performing separate mass balances (or budgets) for each characteristic type of node. The nodal types or zones can be conveniently identified through the NODEID array. Then the mass balance routines in subroutines CNCON and (or) OUTPT would have to be modified to tally fluxes separately for each NODEID; for an example, see Konikow (1977). Similarly, if a coupled stream-aquifer system is being considered, a separate subroutine may be added to route streamflow downstream and progressively account for ground-water gains and losses and for tributary inflow or diversions. An example of such a modification is discussed by Konikow and Bredehoeft (1974).

For certain types of problems it may be desirable to be able to specify a constantconcentration boundary condition. The program could be modified to allow this by using a predetermined value or range in values of NODEID to identify this type of boundary. Then a statement could be added between lines G1090 and G1100 to reset the concentration at the node equal to the constant concentration where this condition is specified. The value of the constant concentration can be stored in the CNRECH array. Note that the mass balance calculation as presently written will not account for the mass of solute added or removed at a constant-concentration boundary.

#### **Basic equations**

The basic equations that are solved by this model were derived under a number of limiting assumptions. Some of these assumptions can be overcome through modifications of the basic equations and corresponding changes in the program.

The program assumes that molecular diffusion is negligible. But if it is necessary to consider the process of molecular diffusion in a particular problem, the coefficient of hydrodynamic dispersion  $(D_{ij})$  can be redefined as the sum of the coefficient of mechanical dispersion, which is defined by the right side of equation 5, and a coefficient of molecular diffusion. The consequent program modification would have to be made only in subroutine VELO (lines E1280-E1680).

The solute-transport equation can also be modified to include the effects of first-order chemical reactions, as was done by Robertson (1974). The reaction term could be included in the right side of equation 39. The corresponding program modification would be required in subroutine CNCON.

In certain problems the range in concentrations may be so great that the dependence of fluid properties, such as density and viscosity, on the concentration may have to be considered because of the dependence of fluid flow on variations in fluid properties. In this case the flow equation (eq 1) would have to be rewritten in terms of fluid pressure, rather than hydraulic head, such as equation 15 of Bredehoeft and Pinder (1973, p. 197). Then the program can be modified to iterate between the solutions to the flow and solutetransport equations if the change in fluid properties at any node exceeds some criterion during one time increment.

The flow equation can also be modified for application to unconfined aquifers in which the saturated thickness is a direct function of water-table elevation. This would require the inclusion of steps in subroutine ITERAT to correct the transmissivity for changes in saturated thickness. Such a feature is included in the two-dimensional flow model documented by Trescott, Pinder, and Larson (1976).

#### Input and output

The input and output formats have been designed for flexibility of use and general compatibility with the analysis of a variety of types of flow problems. If any of the formats are not suitable for use with a particular problem, they should be modified accordingly. All input formats are described in attachment III and contained in subroutine PARLOD in the program.

It has been assumed that several aquifer parameters are constant and uniform in space, such as storage coefficient, effective porosity, and dispersivity. If any of these are known to vary in space, they should be redefined as two-dimensional arrays. Then statements to allow these arrays to be read into the program should be added to subroutine PARLOD. Similarly, values of leakance and source concentrations (CNRECH) are only read in data set 7, where values can be associated only with a limited number of unique node identification codes. If the variations of these parameters are known on a more detailed scale, then they too can be read as additional data sets by adding appropriate statements to subroutine PARLOD. For example, a typical sequence of statements for reading one data set is represented by lines B2650-B2750, where the initial water-table elevations (data set 8) are read. This sequence of statements can then be replicated for reading in a different data set and inserted into subroutine PARLOD.

A labeled listing of the input data deck for test problem 3 is provided in attachment IV. This example illustrates the use of the data input formats specified in attachment III and shows that only a few data cards are required by the model to simulate a relatively simple problem. This example will also allow the user to verify that his program deck and computer yield essentially the same results as obtained by the documented program. Thus, selected parts of the output for test problem 3 are included in attachment V. Not all of the printed output from test problem 3 has been duplicated in attachment III. Instead, it contains only a sufficient selection to illustrate the type and form of output provided by the model, as well as to allow the user to compare his calculated values of critical parameters, such as head, velocity, and concentration, with the values computed by the documented model.

## Conclusions

The model presented in this report can simulate the two-dimensional transport and dispersion of a nonreactive solute in either steady-state or transient ground-water flow. The program is general and flexible in that it can be readily and directly applied to a wide range of types of problems, as defined by aquifer properties, boundary conditions, and stresses. However, some program modifications may be required for application to specialized problems or conditions not included in the general model.

The accuracy of the numerical results can be evaluated by comparison with analytical solutions only for relatively simple and idealized problems; in these cases there was good agreement between the numerical and analytical results. Mass balance tests also help to evaluate the accuracy and precision of the model results. The error in the mass balance is generally less than 10 percent. The range in mass balance errors is commonly the greatest during the first few time increments, but tends to decrease and stabilize with time. For some problems the accuracy and precision of the numerical results may be sensitive to the initial number of particles placed in each cell and to the size of the time increments, as determined by the stability criteria for the solute-transport equation. The results of several numerical experiments suggest that the accuracy and precision of the results are essentially independent of the magnitude of the dispersion coefficient, and comparable accuracies are attained for high, low, or zero dispersivities.

## **References Cited**

- Aris, Rutherford, 1962, Vectors, tensors, and the basic equations of fluid mechanics: Englewood Cliffs, N. J., Prentice-Hall, 286 p.
- Bear, Jacob, 1972, Dynamics of fluids in porous media: New York, Am. Elsevier Publishing Co., 764 p.
- Bredehoeft, J. D., and Pinder, G. F., 1973, Mass transport in flowing groundwater: Water Resources Research, v. 9, no. 1, p. 194-210.
- Garder, A. O., Peaceman, D. W., and Pozzi, A. L., Jr., 1964, Numerical calculation of multidimensional miscible displacement by the method of characteristics: Soc. Petroleum Engineers Jour., v. 4, no. 1, p. 26-36.
- Konikow, L. F., 1977, Modeling chloride movement in the alluvial aquifer at the Rocky Mountain Arsenal, Colorado: U.S. Geol. Survey Water-Supply Paper 2044, 43 p.
- Konikow, L. F., and Bredehoeft, J. D., 1974, Modeling flow and chemical quality changes in an irrigated stream-aquifer system: Water Resources Research, v. 10, no. 3, p. 546-562.
- Konikow, L. F., and Grove, D. B., 1977, Derivation of equations describing solute transport in ground water: U.S. Geol. Survey Water-Resources Investigatons 77-19, 30 p.
- Lohman, S. W., 1972, Ground-water hydraulics: U.S. Geol. Survey Prof. Paper 708, 70 p.
- Pinder, G. F., and Bredehoeft, J. D., 1968, Application of the digital computer for aquifer evaluation: Water Resources Research, v. 4, no. 5, p. 1069-1093.
- Pinder, G. F., and Cooper, H. H., Jr., 1970, A numerical technique for calculating the transient position of the saltwater front: Water Resources Research, v. 6, no. 3, p. 875-882.
- Prickett, T. A., and Lonnquist, C. G., 1971, Selected digital computer techniques for groundwater resource evaluation: Illinois Water Survey Bull. 55, 62 p.

- Reddell, D. L., and Sunada, D. K., 1970, Numerical simulation of dispersion in groundwater aquifers: Colorado State Univ. Hydrology Paper 41, 79 p.
- Robertson, J. B., 1974, Digital modeling of radioactive and chemical waste transport in the Snake River Plain aquifer at the National Reactor Testing Station, Idaho: U.S. Geol. Survey Open-File Rept. IDO-22054, 41 p.
- Robson, S. G., 1974, Feasibility of digital waterquality modeling illustrated by application at Barstow, California: U.S. Geol. Survey Water-Resources Investigations 46-73, 66 p.
- Scheidegger, A. E., 1961, General theory of dispersion in porous media: Jour. Geophys. Research, v. 66, no. 10, p. 3273-3278.

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- Trescott, P. C., 1975, Documentation of finite-difference model for simulation of three-dimensional ground-water flow: U.S. Geol. Survey Open-File Rept. 75-438, 32 p.
- Trescott, P. C., Pinder, G. F., and Larson, S. P., 1976, Finite-difference model for aquifer simulation in two dimensions with results of numerical experiments: U.S. Geol. Survey Techniques of Water-Resources Investigations, Book 7, Chap. C1, 116 p.
- von Rosenberg, D. U., 1969, Methods for the numerical solution of partial differential equations: New York, Am. Elsevier Publishing Co., 128 p.

# COMPUTER PROGRAM AND RELATED DATA

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# Attachment I

## FORTRAN IV Program Listing

C	*****	A	10
C	* *		N 20
C	* SOLUTE TRANSPORT AND DISPERSION IN A POROUS MEDIUM *		<b>\</b> 30
C	* NUMERICAL SOLUTION METHOD OF CHARACTERISTICS *	ļ ļ	<b>40</b>
C	* PROGRAMMED BY J. D. BREDEHOEFT AND L. F. KONIKOW *		<b>\</b> 50
C	* *		60
С	*****	, A	70
	DOUBLE PRECISION DMIN1, DEXP, DLOG, DABS	, A	80
	REAL +8TMRX/VPRM/HI/HR/HC/HK/WT/REC/RECH/TIM/AOPT/TITLE	P	<b>90</b>
	REAL + BXDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR		100
	REAL +BTINT/ALPHA1/ANITP	A	110
	COMMON /PRMI/ NTIM/NPMP/NPNT/NITP/N/NX/NY/NP/NREC/INT/NNX/NNY/NU	10 A	120
	1BS/NMOV/IMOV/NPMAX/ITMAX/NZCRIT/IPRNT/NPTPND/NPNTMV/NPNTVL/NPNTD	PN A	130
	2PNCHV>NPDELC	A	140
	COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IY	)8 🖡	150
	15(5)	A	160
	COMMON /HEDA/ THCK(20/20)/PERM(20/20)/TMWL(5/50)/TMOBS(50)/ANFCT	8 A	170
	COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20	), A	180
	120)+HK (20+20)+HT (20+20)+REC (20+20)+RECH (20+20)+TIM (100)+AOPT (20)	FT A	190
	2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR	A	200
	COMMON_/CHMA/_PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY(2	), A	210
	120), CONINT (20,20), CNRECH (20,20), POROS, SUMTCH, BETA, TIMV, STORM, STO	em M	220
	2I, CMSIN, CMSOUT, FLMIN, FLMOT, SUMIO, CELDIS, DLTRAT, CSTORM	A	230
C	***************************************	/	1 240
С	LOAD DATA	,	250
	INT=0		260
	CALL PARLOD	P	270
	CALL GENPT	A	280
C	***************************************	P	290
C	START COMPUTATIONS	A	300
C	COMPUTE ONE PUMPING PERIOD	A	310
	DO 150 INT=1,NPMP	A	320
	IF (INT.GT.1) CALL PARLOD	A	330
C	COMPUTE ONE TIME STEP		340
	DO 130 N=1.NTIM	A	350
	IPRNT=0	A	360
С	LOAD NEW DELTA T	A	370
	TINT=SUMT-PYR*(INT-1)	A	380
	TDEL=DMIN1(TIM(N), PYR-TINT)	A	390
	SUMT=SUMT+TDEL		400
	TIM(N)=TDEL	A	410
_	REMN=MOD(N_NPNT)	A	420
C	***************************************	A .	4 50
	CALL ITERAT	A	440
	IF (REMN.EQ.U.U.OR.N.EQ.NIIM) CALL OUTPI		450
	CALL VELO		460
•	CALL MOVE		470
C		A .	480
C	STORE OBS. WELL DATA FOR TRANSIENT FLOW PROBLEMS	A	490
	IF (S.EQ.D.0) GO TO 120	A	500
	IF (NUMUDS.LE.U) 60 10 120		510
	J-MUU(N/JU) TE (  EQ Q) (-EQ		520
	17 (J. CW.U) J <sup>2</sup> )U TMADO(/)-CUMT		530
	100 J J + 5UMI	A	240
	UU 11U 1=1/NUMUUS TMUU (T.,)+UV/1V/06(T),IV/06(T))		640
	INWL(1/J/~NK(1/UD3(1)/1/UD3(1))		500
110			500
			1 200

C		*****	A	590
C		OUTPUT ROUTINES	A	600
	120	) IF (REMN_EQ.0.0.OR_N_EQ.NTIM_OR_MOD(N/50)_EQ.0) CALL CHMOT	A	610
		TE (SUMT GE ( $PVP+TNT$ ) GO TO 140		620
	130		Â	630
r	100	·	Δ	620
ř				450
Ľ	1/0			441
	140			000
			A .	401
	4 6 0		~	400
~	150		A	090
¢		*****	A	700
-		STOP	A	710
C		***************************************	. <u>^</u>	120
		END	A	130
		SUBROUTINE PARLOD	8	10
		DOUBLE PRECISION DMINT/DEXP/DLOG/DABS	8	20
		REAL *8TMRX,VPRM,HI,HR,HC,HK,WI,REC,RECH,TIM,AOPT,TITLE	8	- 30
		REAL +8XDEL/YDEL/S/AREA/SUMT/RHO/PARAM/TEST/TOL/PINT/HMIN/PYR	B	4(
		REAL *8FCTR/TIMX/TINIT/PIES/YNS/XNS/RAT/HMX/HMY	В	50
		REAL +8TINT/ALPHA1/ANITP	B	60
		COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO	8	70
		1BS,NMOV,IMOV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPNTMV,NPNTVL,NPNTD,N	B	80
		2PNCHV/NPDELC	8	90
		COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB	B	100
		15(5)	8	110
		COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR	В	120
		COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,	8	13(
		120),HK(20,20),WT(20,20),REC(20,20),RECH(20,20),TIM(100),A0PT(20),T	8	14(
		2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR	Ð	150
		COMMON /CHMA/ PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY(20,	B	160
		120), CONINT (20,20), CNRECH (20,20), POROS, SUMTCH, BETA, TIMV, STORM, STORM	B	170
		21, CMSIN, CMSOUT, FLMIN, FLMOT, SUMIO, CELDIS, DLTRAT, CSTORM	B	180
		COMMON /BALM/ TOTLQ	8	190
		COMMON /XINV/ DXINV/DYINV/ARINV/PORINV	8	200
		COMMON /CHMC/ SUMC(20,20),VXBDY(20,20),VYBDY(20,20)	в	210
С		*******	8	220
		IF (INT.GT.1) GO TO 10	8	230
		WRITE (6,750)	B	240
		READ (S.720) TITLE	8	250
			A	260
r		****	B	270
ř			R	280
•			Ř	290
			R	300
			6	110
			0	200
			0	320
			0	330
			b	340
			0	240
			0	770
		υ−υ Ω+υΩ1	0	310
			ц Ц	200
r		NMUV=U	5	390
C A			0	400
Ç			ß	410
		READ (5//4U) NTIM/NPMP/NX/NY/NPMAX/NPNT/NITP/NUMOBS/ITMAX/NREC/NPT	9	420
		TPND, NC ODES, NPNTMV, NPNTVL, NPNTD, NPDELC, NPNCHV	6	450
		READ ()/8UU) PINT/TOL/POROS/BETA/S/TIMX/TINIT/XDEL/YDEL/DLTRAT/CEL	8	440
		TDIS/ANFCIK	B	4 > 0
		PYR≠PINT*86400₀0*365₀25	B	460
		N N X = N X - 1	В	470

.

		8	480
	NP=NPMAX	в	490
	DXINV=1.0/XDEL	R	500
	DYINV=1.0/YDEL	õ	510
	ARINV=DXINV+DYINV	0	520
			220
~		8	530
ι		в	540
	WRITE (6//6U)	в	550
	WRITE (6,770) NX/NY/XDEL/YDEL	8	560
	WRITE (6,780) NTIM,NPMP,PINT,TIMX,TINIT	8	570
	WRITE (6,790) SAPOROSA BETAADI TRATANECTR	0	590
			500
	IS (NOTONNIT ( OR NOTONNICT O ON NOTONNITAND	8	390
	IF (NFIFND-LI-4-UR-NFIFND-GI-9-UR-NFIFND-EQ.O.UR-NFIFND-EQ.7) WRIT	8	600
	TE (0/880)	8	610
	WRITE (6,890) NPNT,NPNTMV,NPNTVL,NPNTD,NUMOBS,NREC,NCODES,NPNCHV,N	В	620
	1PDELC	B	630
	IF (NPNTMV.EQ.D) NPNTMV=999	P	640
	60 10 20	5	450
r		D	0.50
~		В	660
Ľ	READ DATA TO REVISE TIME STEPS AND STRESSES FOR SUBSEQUENT	8	670
C	PUMPING PERIODS	θ	680
	10 READ (5,1060) ICHK	8	690
	IF (ICHK_LE_O) RETURN	P	700
	READ (5,1070) NTIMANENTANTEATTMAY NEED NEWTWY NEWTYL NEWTY NEWTYL	5	710
			7 7 0
			720
		в	7 30
	WRITE (6,1090) NTIM, NPNT, NITP, ITMAX, NREC, NPNTMV, NPNTVL, NPNTD, NPDEL	В	740
	1C/NPNCHV/PINT/TIMX/TINIT	8	750
С	*****************	8	760
С	LIST TIME INCREMENTS	B	770
	0 0 J = 1 • 100	õ	780
	TIM(1) = 0		700
		8	790
		в	800
		8	810
	IF (S.EQ.0.0) GO TO 50	B	820
	DO 40 K=2/NTIM	8	830
	40 TIM(K)=TIMX*TIM(K-1)	8	840
	WRITE (6,470)	5	850
		В	800
		8	870
	SU IIM(I)=PYR	B	880
	WRITE (6,480) TIM(1)	8	890
С	******	B	900
С	INITIALIZE MATRICES	P I	91n
	60 LF (INT-6L-1) 60 TO 100	6 6	220
			720
		8	930
		B	940
	VPRM(IX,IY)=0.0	В (	950
	PERM(IX,IY)=0.0	8 9	960
	THCK(IX IY)=0.0	R (	970
	$RECH(IX \neq IY) = 0.0$		n a c
		· ت م	200
		0	770
		810	100
		B10	)10
	TMRX(IX/IY/7)=0.0	B1(	020
	TMRX(IX,IY,2)=0.0	B10	030
	HI(IX,IY)=0.0	810	<b>34</b> 0
	$HR(IX_{\bullet}IY)=0.0$	B10	ารก
	$HC(IX \bullet IY) = 0.0$	644	140
			100
		81(	010
		B1(	080
	VX(IX¢IY)=U•U	B1(	090



FORTRAN	' IV	program	listing	Continued
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		$v_{1}(1x,1y) = 0.0$	B1100
		VXBDY(IX,IY)=0.0	B1110
		VYBDY(IX,IY)=0.0	B1120
		CONC(IX,IY)=0.0	B1130
		CONINT(IX,IY) = 0.0	B1140
		SUMC(IX/IY)=0.0	B1150
	70	CONTINUE	B1160
C		***************************************	B1170
C		READ OBSERVATION WELL LOCATIONS	B1180
		IF (NUMOBS.LE.O) GO TO 100	81190
		WRITE (6/900)	B1200
		$DU = 0$ $J = 1 \rho N m 0 D S$ D = A h - (S - 700), $T = T V$	81270
		READ (J)/00/ 18/11 WRITE (6.810) 1.17.17	B1230
			B1240
	80	I YOBS(J) = I Y	81250
		DO 90 I=1, NUMOBS	B1260
		DO 90 J=1,50	B1270
		TMWL(I>J)=0.0	B1280
	90	TMCN(I,J)=0.0	B1290
C		***************************************	B1300
C		READ PUMPAGE DATA (X-Y COORDINATES AND RATE IN (FS)	01310
L C			81330
Č	100	TE (NEC.) 60 TO 120	B1340
		WRITE (6/210)	B1350
		DO 110 I=1,NREC	B1360
		READ (5,710) IX,IY,FCTR,CNREC	B1370
		IF (FCTR.LT.O.O) CNRECH(IX,IY)=CNREC	B1380
		REC(IX,IY)=FCTR	81390
~	110	WRITE (0,82U) IX, IY, REC(IX, IY), UNKECH(IX, IY)	* 81400 81410
C	120	TE (INT.GT 1) PETHON	B1470
		AREA=XDEL +YDEL	81430
		WRITE (6,690) AREA	B1440
		WRITE (6,600)	B1450
		WRITE (6,610) XDEL	B1460
~		WRITE (6,610) YDEL	81470
C C			B1400
c c			B1500
C		WRITE (6,530)	B1510
		READ (5,550) INPUT/FCTR	B1520
		DO 160 IY=1,NY	81530
		IF (INPUT.EQ.1) READ (5,560) (VPRM(IX,IY),IX=1,NX)	B1540
		DO 150 IX=1.NX	81550
		IF (INPUT.NE.1) GO TO 130	81560
		VPKM(IX/IT)=VPKM(IX/IT)*F(IK	81570
	130	VPPM(IX_IX)=FCTP	B1590
	140	$IF (IX_EQ_1.0R_IX_EQ_NX) VPRM(IX_IY)=0.0$	B1600
		IF (IY.EQ.1.OR.IY.EQ.NY) VPRM(IX/IY)=0.0	B1610
	150	CONTINUE	B1620
_	160	WRITE (6,520) (VPRM(IX,IY),IX=1,NX)	B1630
C			81640
C		SEI UP COEFFICIENI MAIKIX BLOCK-CENIEKED GRID	0107U
C		TE (ANECTRANSMISSIVII) MARMUNIC MEANT	B1670
		WRITE (6,1050)	B1680
		ANFCTR=1.0	B1690
	170	PIES=3.1415927*3.1415927/2.0	81700
		YNS=NY *NY	B1710

		X N S = N X * N X	B1720
		HMIN=2.0	B1730
			017/0
			D1/40
		DO ISU IX = 2  inv	81750
		IF (VPRM(IX/IY)_EQ.0.0) GO TO 180	81760
		$TMRX(IX_{I}Y_{I})=2.0 + VPRM(IX_{I}Y) + VPRM(IX+1_{I}Y)/(VPRM(IX_{I}Y) + XDFI + VPRM)$	81770
			01110
			81780
		TMRX(IX/IY/2)=2.0*VPRM(IX/IY)*VPRM(IX/IY+1)/(VPRM(IX/IY)*YDEL+VPRM	B1790
		1(IX/IY+1)+YDEL)	B1800
C		AD HIST COFFFICIENT FOR ANISOTROPY	D1910
			01010
		IMRX(IX/IT/2)=IMRX(IX/IT/2)+ANFCIR	81820
C		COMPUTE MINIMUM ITERATION PARAMETER (HMIN)	B1830
		IF (TMRX(IX,IY,1),EQ,0,0) GO TO 180	81840
		I = (T M P V (T V - T V - 2)) = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 =	01040
		IF (IMRA(IA)II)2).EQ.0.07 GO TO 180	81920
		RAT=TMRX(IX,IY,1)+YDEL/(TMRX(IX,IY,2)+XDEL)	B1860
		HMX=PIES/(XNS±(1_0+RAT))	61870
		HMY = DTECZZYNCZZZTDZZTDZDZTDZDZDZDZDZDZDZDZDZDDZDDZDDZDDDDDDDDDD	01990
			01000
		IF (HMX.LT.HMIN) HMIN=HMX	B1890
		IF (HMY_LT_HMIN) HMIN=HMY	B1900
	180	CONTINUE	e1010
•	100		01770
Ľ		** *** * * * * * * * * * * * * * * * * *	81920
C		READ AQUIFER THICKNESS	B1930
		WRITE (6,510)	B1940
			01050
		READ (J/JJU) INPUT/FCTR	B1930
		DO 210 IY=1,NY	81960
		IF (INPUT.EQ.1) READ (5,540) (THCK(IX,IY),IX=1,NX)	B1970
			P1080
			01700
		TE (TUPUL NE. 1) 60 10 140	81330
		THCK(IX/IY)=THCK(IX/IY)+FCTR	B2000
		GO TO 200	B2010
	100	I = (V P P M (I Y I Y) N = D D) I U C V (I Y I Y) = C T P	82020
			02020
	200	CONTINUE	B2030
	210	WRITE (6,500) (THCK(IX,IY),IX=1,NX)	B2040
C		*********	B2050
-			02030
L		READ DIFFUSE RECHARGE AND DISCHARGE	82000
		WRITE (6,830) <sup>.</sup>	B2070
		READ (5,550) INPUT,FCTR	B2080
			B 2 0 0 0
			02070
		IF (INPUI-EW.)) READ (SASOU) (RECH(IXAIY)AIX=IANX)	82100
		DO 230 IX=1>NX	B2110
		IF (INPUT_NE_1) GO TO 220	B2120
			02170
			02130
		GO TO 230	B2140
	220	IF (THCK(IX/IY).NE.O.O) RECH(IX/IY)=FCTR	B2150
	230	CONTINUE	B2160
	2.50		02100
	240	WRITE (0/84U) (RECH(IX/IY)/IX=T/NX)	82170
C		* * * * * * * * * * * * * * * * * * * *	82180
C		COMPUTE PERMEABILITY FROM TRANSMISSIVITY	82190
ř		COUNT NO OF CELLS IN AQUIFER	82200
2			02200
ι		SET NZCRIT = 2% OF THE NO. OF CELLS IN THE AQUIFER	82210
		DO 250 IX=1,NX	B2220
		DO 250 IY=1.NY	B2230
		TE (THERE IN TO D 0) GO TO 250	62270
			02240
		rckw(1%)11)=Akw(1%)11)/ HCK(1%)11)	85520
		N C A = N C A + 1	B2260
	250	VPRM(IX_IY)=0.0	82270
~		- · · · · · · · · · · · · · · · · · · ·	02210
ι			82280
		A A Q = NC A * A R E A	BZ290
		NZCRIT=(NCA+25)/50	82300
			97210
			02310
		DU 26U IY=1,NY	85250
	260	WRITE (6,650) (PERM(IX,IY),IX=1,NX)	B2330

				B2340
	~			B2350
	ç			B2360
	۲ د		READ NUDE IDENTIFICATION CARDS	B2370
	C C		SET VERT. FERM. & SUDRE CONC. VID NETTOSE RECORDE	B2380
	ι		HOLTE (4 S70)	82300
			WRITE (07)/U/ Dran /s Esca indut scie	B2400
				B2400
			DU ZOU IT = 1 MT	62470
			IF (INPUL-EW-I) READ ()/04U) (NUDEID(IX/IT//IX-I/WA/	02420
			DO $\mathcal{L}(U   X = 1 \text{ NX})$	B2430
		270	$\frac{1}{1} = \frac{1}{1} = \frac{1}$	B2450
		200	write (0) = (0,0) (0,0	82460
			$\frac{1}{10}$	82470
				82480
				82400
			DU JUU IJ HINKUUES DEAN /E GEN ICANE ECTD1.ECTD2.ECTD3.AVEDDN	B2500
			READ (JACOU) ILODE/FLIKI/FLIKZ/FLIKZ/VVERKU	82510
				B2520
			$U_{U}$ $Z_{U}$ $U_{U}$ $U_{U$	82530
			$\frac{1}{1} (NODEID(1x) IT) = NE (IODE) GO IO 290$	B2560
				82550
			CNRECH(IX)IY = FURZ	82560
		200		B2570
		290		D2580
		300	WRITE (0,800) ICODEFFERIATING	82500
		300	IF (OVERRD_NE_U) WRITE (OFTIOU) FORS	82600
		510	WRITE (07)707	B2610
		120	$\frac{1}{2} \int \frac{1}{2} \int \frac{1}$	82620
	~	260		82630
	r r			82640
	C			82650
				B2660
				82670
			IF (INPUT FQ.1) READ ( $5_{0}660$ ) ( $\forall T(IX_{0}IY)_{0}IX=1_{0}NX$ )	82680
				B2690
			$IE (INPUT_NE_1) = 0.0030$	B2700
			$\mathbf{H} \mathbf{T} (1 \mathbf{X}_{\mathbf{r}} 1 \mathbf{Y}) = \mathbf{H} \mathbf{T} (1 \mathbf{X}_{\mathbf{r}} 1 \mathbf{Y}) + \mathbf{F} \mathbf{C} \mathbf{T} \mathbf{R}$	B2710
			GO TO 340	<b>B27</b> 20
		330	IF (THCK(IX,IY).NE.O.O) WT(IX,IY)=FCTR	82730
		340	CONTINUE	B2740
		350	WRITE (6,680) (WT(IX,IY),IX=1,NX)	82750
	С	570	****************	B2760
	ċ		SET INITIAL HEADS	82770
	-		DO 360 IX=1/NX	B2780
			DO 360 IY=1/NY	B2790
			HI(IX,IY) = WI(IX,IY)	<b>B280</b> 0
			HC(IX + IY) = HI(IX + IY)	B2810
			HR(IX,IY) = HI(IX,IY)	<b>B282</b> 0
		360	HK(IX,IY) = HI(IX,IY)	82830
	С			B2840
• * *	-		CALL OUTPT	B2850
	C		***************	B2860
	C		COMPUTE ITERATION PARAMETERS	82870
			DO 370 ID=1,20	B2880
			AOPT(10)=0.0	B2890
		370	CONTINUE	<b>B29</b> 00
			ANITP=NITP-1	B2910
			ALPHA1=DEXP(DLOG(1.0/HMIN)/ANITP)	B2920
			AOPT(1)=HMIN	B2930
			DO 380 IP=2,NITP	B2940
		380	AOPT(IP)=AOPT(IP-1)*ALPHA1	B2950

-

С			B2960
		WRITE (6,450)	82970
		WRITE (6,460) AOPT	B5380
C		************	B2990
C		READ INITIAL CONCENTRATIONS AND COMPUTE INITIAL MASS STORED	83000
		READ (5,550) INPUT,FCTR	83010
		DO 420 IY=1/NY	B3020
		IF (INPUT_EQ.1) READ (5,660) (CONC(IX,IY),IX=1,NX)	B3030
		DO 410 IX=1-NX	83040
		IF (INPUT.NE.1) GO TO 390	B3050
		CONC(IX + IY) = CONC(IX + IY) + FCTR	B3060
		60 TO 400	83070
	390	IF (THCK(IX,IY), NF, 0, 0) (ONC(IX,IY)=FCTR	B 3080
	400	CONINT (IX + IY) = CONC (IX + IY)	83090
	410	STORMI = STORMI+CONINT(IX+IY)+THCK(IX+IY)+ARFA+POROS	B3100
	420		83110
c	420		83120
r			03120
•			B 11/0
			07150
		DU 44U IT = I M T	03130
		$\frac{1}{1} \left( \frac{1}{1} + 1$	07170
		$\frac{1}{1} \left( \frac{1}{1} \frac$	83170
		IF (IMRX(IX)IY) O O WRITE (O) O I X II C	83180
		IF (NODEID(IX,IY).G1.U) WRITE (8,980) IX,IY	83190
		IF (WI(IX,IY),NE,U,U) WRITE (0,97U) IX,IY	83200
		IF (RECH(IX,IY).NE.U.U) WRITE (8,98U) IX,IY	83210
		IF (REC(IX,IY).NE.U.U) WRITE (6,990) IX,IY	B 32 20
	430	IF (PERM(IX,IY).GT.0.0) GO TO 440	83230
		IF (NODEID(IX,IY).GT.0.0) WRITE (6,1000) IX,IY	B3240
		IF (WT(IX,IY).NE.0.0) WRITE (6,1010) IX,IY	83250
		IF (RECH(IX,IY).NE.O.O) WRITE (6,1020) IX,IY	B3260
		IF (REC(IX,IY),NE.O.O) WRITE (6,1030) IX,IY	83270
		IF (THCK(IX,IY).GT.O.O) WRITE (6,1040) IX,IY	B3280
	440	CONTINUE	83290
C		***************************************	в3300
		RETURN	83310
C		***************************************	B3320
C			в3330
C			в 3 3 4 0
C			83350
	450	FORMAT (1H1,20HITERATION PARAMETERS)	B3360
	460	FORMAT (3H ,1G20.6)	B3370
	470	FORMAT (1H1,27HTIME INTERVALS (IN SECONDS))	B3380
	480	FORMAT (1H1,15x,17HSTEADY-STATE FLOW//5x,57HTIME INTERVAL (IN SEC)	83390
	•	1 FOR SOLUTE-TRANSPORT SIMULATION = $\rho$ G12,5)	B3400
	490	FORMAT (3H ,10G12.5)	83410
	500	FORMAT (3H 20F5-1)	в 3420
	510	FORMAT (1H1,22HAQUIFER THICKNESS (FT))	83430
	520	FORMAT (3H 20F5_2)	83440
	530	FORMAT (1H1,30HTRANSMISSIVITY MAP (FT+FT/SEC))	83450
	540	FORMAT (2063-0)	B3460
	550		83470
	560	FORMAT (2064-1)	R3480
	570	FORMAT (141,234NONE IDENTIFICATION MAP//)	B3400
	580	FORMAT (14 -2015)	0 7 4 7 U
	500	CARAT (14).CUVEDITAL DEDMEADILITY/TUTEVNESS (FT/STASSALL)	0 J J UU 0 Z C 1 A
	570	FORMAT (INT/45074ERIICAE FERMERBILIT/INT/ERNESS (FI/(FI*SE()))	03710
	410	$\frac{1}{2} \frac{1}{2} \frac{1}$	03520
	010	FURMAL (IN PICAPIUSIC.),	82220
	020	FURMAL CHIZCHPERMEABLEIT MAP (FT/SEC))	83540
	030	FORMAL CHUS////TUX/44MNU, OF FINITE-DIFFERENCE CELLS IN AQUIFER	83220
	1	1 14// 1UX/28HAREA OF AQUIFER IN MODEL = /G12.5/10H SQ. FT.///1	83560
		CUX#47HNZURII (MAX. NU. OF LELLS THAT CAN BE VOID OF/20X#56HPARTI	85570

3CLES; IF EXCEEDED, PARTICLES ARE REGENERATED) = ,14/) 64D FORMAT (2011)	
64D FORMAT (2011)	83280
	B3590
450 FORMAT (34 -2065 3)	B3600
	07/10
660 FORMAI (2064.0)	82010
670 FORMAT (1H1,11HWATER TABLE)	B3620
680 FORMAT (1H #20F5.0)	B3630
$c_{00}$ comment (in February 10 March of one cell $= c_{12}$ ()	034/0
OU FORMAL (THU) UX) TY HAREA OF ONE CELL = $JG(2,4)$	83040
700 FORMAT (212)	<b>B365</b> 0
710 FORMAT (212+268+2)	83660
	93670
720 FORMAL (TUR8)	63010
730 FORMAT (1H0/10A8)	83680
740 FORMAT (1714)	83690
750 FARMAT (141-774) C.C. METHON-AF-CHARAFTERISTICS MONEL FOR SALITE	
TO FURMAL CHAINTHUSSESS METHOD-UF-CHARACTERISTICS MODEL FUR SOLUTION	
1 TRANSPORT IN GROUND WATER)	83710
760 FORMAT (1H0,21X,21HIN PUT DATA)	83720
770 FORMAT (140-239-1646PTD DESCRIPTORS//139-304NY (NUMBER OF COLUE	93730
The Format (These Sartoneric Descriptors//15//500max (Nonber Of Coed)	
1NS) = ,14/13X,28HNY (NUMBER OF ROWS) =,16/13X,29HXDEL ()	B3740
2-DISTANCE IN FEET) = $\rho F_1/13X_29HYDEL$ (Y-DISTANCE IN FEET) = $\rho F_1$	в 3750
3 1)	B3740
780 FORMAT (1HU/23X/16HTIME PARAMETERS//13X/4UHNTIM (MAX. NO. OF I	83//0
$1ME STEPS) = 16/13X_40HNPMP$ (NO, OF PUMPING PERIODS)	B 3780
$2 = 16/13 \times 30 \text{ MDINT}$ (DIMDING DEDIAD IN VEADE) = 510 3/12 × 30	B1700
$2 = j10j13\lambda j3jnp1ni$ (pumping period in terms) = $jr_10.2j_13\lambda j_3$	03170
3HTIMX (TIME INCREMENT MULTIPLIER) =+F10.2/13X+39HTINIT (INI)	63800
4IAL TIME STEP IN SEC.) =/F8.0)	в3810
700 FORMAT (400.1/Y 3/UUVNDOLOCTE AND CUENTCAL DADAMETEDC//13Y.105.7Y	07820
TYU FURMAL CHUPI4X334HATURULUGIC AND CHEMICAL PARAMETERS//13A/183/A	03020
129H(STORAGE COEFFICIENT) =/5X/F9.6/13X/28HPOROS (EFFECIIVE	83830
2 POROSITY),8X,3H= ,F8,2/13X,39HBETA (CHARACTERISTIC LENGTH)	в3840
3	P 3850
	03010
4NAL DISPERSIVITY) = $F9.2/13X_39$ HANFCTR (RATIO OF T-YY TO T-XX)	83800
5 = r f 12.6	83870
800 FORMAT (1265 0)	83880
	0,0000
810 FORMAT (1H /16X/12/5X/12/4X/12)	83890
820 FORMAT (1H ,7X,2I4,3X,F7.2,5X,F7.1)	B3900
830 FORMAT (1H1,39HDIFFUSE RECHARGE AND DISCHARGE (FT/SEC))	83910
all remain the second of the second of the second of the second	-7020
84U FURMAT (TH JIPIUEIU.2)	82450
850 FORMAT (12,3G10.2,12)	в 39 30
	83940
840 ENDMAT (140.77.17.77.610 3.57.69 2)	03740
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)	07050
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,2DHEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE	B3950
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI	83950 83960
860 FORMAT $(1+0,7x,12,7x,e10.3,5x,f9.2)$ 870 FORMAT $(1+0,21x,20+execution parameters//13x,39+nitp)$ (NO. OF ITE 1RATION PARAMETERS) = $,14/13x,39+t0L$ (CONVERGENCE CRITERIA - ADI 2P) = $,F9,6/13x,39+tmax$ (MAX,NO,OF ITERATIONS - ADIP) = $,14/13x,39$	B3950 B3960 B3970
860 FORMAT $(1+0,7x,12,7x,e10.3,5x,f9.2)$ 870 FORMAT $(1+0,21x,20+execution parameters//13x,39+nitp)$ (no. of ite 1RATION PARAMETERS) = $,14/13x,39+tol$ (CONVERGENCE CRITERIA - ADI 2P) = $,F9.4/13x,39+itmax$ (MAX.NO.OF ITERATIONS - ADIP) = $,14/13x,33$ 37(4) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	B3950 B3960 B3970 B3970
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.)	B3950 B3960 B3970 B3980
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,3	B 3950 B 3960 B 3970 B 3980 B 3980 B 3990
<pre>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</pre>	B3950 B3960 B3970 B3980 B3980 B3990 B4000
<pre>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14) 800 FORMAT (1H0,5Y,6Y,4HAPAINC AAAA NDTRNA MUST FOUND (A.5,8,00,0) 910 FORMAT (1H0,5Y,6Y,4HAPAINC AAAA NDTRNA MUST FOUND (A.5,8,00,0) 920 FORMAT (1H0,5Y,6Y,4HAPAINC AAAA NDTRNA MUST FOUND (A.5,8,00,0) 930 FORMAT (1H0,5Y,6Y,4HAPAINC AAAA NDTRNA MUST FOUND (A.5,8,00,0) 940 FORMAT (1H0,5Y,6Y,4HAPAINC AAAAA NDTRNA MUST FOUND (A.5,8,00,0) 940 FORMAT (1H0,5Y,6Y,4HAPAINC AAAAA NDTRNA MUST FOUND (A.5,8,00,0) 940 FORMAT (HAPAINC AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA</pre>	B3950 B3960 B3970 B3980 B3980 B3990 B4000 B4010
<pre>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14) 880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</pre>	83950 83960 83970 83980 83980 83990 84000 84010
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14) 880 FORMAT (1H0,5X,47H+** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER	B3950 B3960 B3970 B3980 B3990 B4000 B4010 B4020
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE</li> </ul>	B3950 B3960 B3970 B3980 B3990 B4000 B4010 B4020 B4030
860 FORMAT $(1+0,7x,12,7x,e10.3,5x,F9.2)$ 870 FORMAT $(1+0,21x,20+Execution Parameters//13x,39+nitp)$ (NO. OF ITER 1RATION PARAMETERS) = ,14/13x,39+tol (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13x,39+ITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13x,3 34+CELDIS (MAX.CELL DISTANCE PER MOVE/24x,28+OF PARTICLES - M.O.C.) 4 = ,F8.3/13x,30+NPMAX (MAX. NO. OF PARTICLES),7x,2+= ,14/12x,3 52+ NPTPND (NO. PARTICLES PER NODE),6x,3+= ,14) 880 FORMAT (1+0,5x,47++*+ WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1+0,23x,15+PROGRAM OPTIONS//13x,30+NPNT (TIME STEP INTER 1VAL FOR/21x,18+HCOMPLETE PRINTOUT),7x,3+= ,14/13x,31+NPNTMV (MOVE	83950 83960 83970 83980 83990 84000 84010 84020 84030 84040
860 FORMAT $(1+0,7x,12,7x,e10.3,5x,F9.2)$ 870 FORMAT $(1+0,21x,20+Execution Parameters//13x,39+nitp)$ (NO. OF ITER 1RATION PARAMETERS) = $,14/13x,39+tol$ (CONVERGENCE CRITERIA - ADI 2P) = $,F9.4/13x,39+itmax$ (MAX.NO.OF ITERATIONS - ADIP) = $,14/13x,33$ 34+CeLDIS (MAX.CELL DISTANCE PER MOVE/24x,28+OF PARTICLES - M.O.C.) 4 = $,F8.3/13x,30+npmax$ (MAX.NO. OF PARTICLES),7x,2+= $,14/12x,33$ 52+ NPTPND (NO. PARTICLES PER NODE),6x,3+= $,14$ ) 880 FORMAT (1+0,5x,47++++ WARNING +++ NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1+0,23x,15+PROGRAM OPTIONS//13x,30+NPNT (TIME STEP INTER 1VAL FOR/21x,18+COMPLETE PRINTOUT),7x,3+= $,14/13x,31+npntmy$ (MOVE 2INTERVAL FOR CHEM./21x,28+CONCENTRATION PRINTOUT) = $,14/13x,29+n$	B3950 B3960 B3970 B3980 B3990 B4000 B4010 B4020 B4030 B4040 B4040
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,1</li> </ul>	B3950 B3960 B3970 B3980 B3990 B4000 B4010 B4020 B4020 B4030 B4040 B4050
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HM 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=FIRST TIME STEP;/21X,14 47H2=ALL TIME STEP),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.0</li> </ul>	83950 83960 83970 83980 83990 84000 84010 84020 84030 84030 84050 84060
860 FORMAT $(1+0,7x,12,7x,e10.3,5x,F9.2)$ 870 FORMAT $(1+0,21x,20+Execution Parameters//13x,39+nitp)$ (NO. OF ITER 1RATION PARAMETERS) = ,14/13x,39+tol (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13x,39+ITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13x,3 34+CELDIS (MAX.CELL DISTANCE PER MOVE/24x,28+OF PARTICLES - M.O.C.) 4 = ,F8.3/13x,30+NPMAX (MAX.NO. OF PARTICLES),7X,2+= ,14/12x,3 52+ NPTPND (NO. PARTICLES PER NODE),6x,3+= ,14) 880 FORMAT (1+0,5x,47++++ WARNING +++ NPTPND MUST EQUAL 4,5,8, OR 9.) 880 FORMAT (1+0,23x,15+PROGRAM OPTIONS//13x,30+NPNT (TIME STEP INTER 1VAL FOR/21x,18+COMPLETE PRINTOUT),7X,3+= ,14/13x,31+NPNTMV (MOVE 2INTERVAL FOR CHEM./21x,28+CONCENTRATION PRINTOUT) = ,14/13x,29+N 3PNTVL (PRINT OPTION-VELOCITY/21x,24+D=NO; 1=FIRST TIME STEP;/21x,1 47+2=ALL TIME STEPS),8x,3+= ,14/13x,31+NPNTD (PRINT OPTION-DISP.C	83950 83960 83970 83980 84000 84000 84010 84020 84030 84030 84040 84050 84050 84060
860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2) 870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = $,14/13X,39HTOL$ (CONVERGENCE CRITERIA - ADI 2P) = $,F9.4/13X,39HITMAX$ (MAX.NO.OF ITERATIONS - ADIP) = $,14/13X,33$ 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = $,F8.3/13X,30HNPMAX$ (MAX.NO. OF PARTICLES),7X,2H= $,14/12X,33$ 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= $,14$ ) 880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= $,14/13X,31HNPNTMV$ (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = $,14/13X,29HN$ 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,14 47H2=ALL TIME STEPS),8X,3H= $,14/13X,31HNPNTD$ (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3	83950 83960 83970 83980 84000 84000 84010 84020 84030 84030 84040 84050 84060 84060 84070
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,36H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGRAM</li> </ul>	B3950 B3960 B3980 B3980 B4000 B4010 B4020 B4020 B4020 B4050 B4050 B4050 B4060 B4080
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,147H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H= ,14/13X,33HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H= ,14/13X,33HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H= ,14/13X,33HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST STEPS),8X,3H= ,14/13X,33HNPNT (NO WELS/21X,28HFOR HYDROGR TAPH PRINT</li></ul>	B3950 B3960 B3970 B3980 B4000 B4010 B4020 B4020 B4020 B4030 B4050 B4050 B4060 B4070 B4080 B4090
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,147H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H</li> <li>6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGRAM FEDERAL AND AND AND AND AND AND AND AND AND AND</li></ul>	B3950 B3960 B3970 B3980 B4000 B4010 B4020 B4020 B4030 B4040 B4050 B4060 B4060 B4080 B4080 B4090 B4090
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24HO=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3H= ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V</li> </ul>	B 3950 B 3960 B 3970 B 3980 B 4000 B 4000 B 4020 B 4020 B 4020 B 4020 B 4050 B 4050 B 4060 B 4070 B 4080 B 4090 B 4100
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.)</li> <li>4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,147H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,36H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15/13X,22HNNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = ,15/13X,26HNPOELC (PRINT OPTCONC. CHANGE) = ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = ,15/13X,26HNPAL (PRINT OPTCONC. CHANGE) = ,15/13X,26</li></ul>	B3950 B3960 B3980 B3980 B4000 B4010 B4020 B4020 B4030 B4050 B4050 B4060 B4070 B4080 B4090 B4100 B4110
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,352H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,147H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEPS),8X,3H= ,14/13X,32HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24HOCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = ,514)</li> </ul>	83950 83960 83970 83980 83990 84000 84010 84020 84030 84030 84050 84050 84060 84060 84060 84080 84090 84110 84110 84120
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,334HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.)</li> <li>4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,35H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=FIRST TIME STEP;/21X,147H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 5OEF./21X,24HO=NO; 1=FIRST TIME STEPS),8X,36H= ,14/13X,22HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = ,14/1</li> </ul>	B3950 B3960 B3970 B3980 B3990 B4000 B4010 B4020 B4020 B4030 B4040 B4050 B4060 B4060 B4070 B4080 B4090 B4100 B4110 B4120
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - AD I 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HM 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/1X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = ,14/1 900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX</li> </ul>	B3950 B3960 B3980 B3980 B4000 B4010 B4020 B4020 B4020 B4030 B4050 B4060 B4060 B4060 B4060 B4060 B4070 B4100 B4110 B4120 B4130
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - AD I 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=FIRST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24HO=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 514)</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> </ul>	B3950 B3960 B3970 B3980 B4000 B4000 B4020 B4020 B4020 B4020 B4050 B4050 B4060 B4070 B4080 B4090 B4100 B4120 B4120 B4130 B4140
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,2DHEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE IRATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTWV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HK 3PNTVL (PRINT OPTION-VELOCITY/21X,24HO=NO; 1=F1RST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24HO=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 514)</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA</li> </ul>	83950 83960 83970 83980 83990 84000 84000 84020 84030 84030 84040 84050 84060 84060 84060 84090 84090 84100 84110 84120 84130 84140 84150
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITE 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX.NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS/13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , \$14)</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA 115(IN (CFS)) (ONC /)</li> </ul>	B3950 B3960 B3980 B3980 B4000 B4010 B4020 B4020 B4020 B4020 B4020 B4050 B4050 B4060 B4050 B4060 B4060 B4100 B4120 B4120 B4130 B4140 B4150 B4150
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H+** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTWV (MOVE 21NTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,14 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C SOEF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , \$14]</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA 1TE(IN CFS) CONC./)</li> </ul>	B 3950 B 3960 B 3970 B 3980 B 3980 B 4000 B 4000 B 4020 B 4020 B 4020 B 4030 B 4050 B 4050 B 4050 B 4060 B 4070 B 4120 B 4120 B 4150 B 4160
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 890 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.) 11VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTWV (MOVE 21NTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,14 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDROGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 514)</li> <li>900 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,5X,37HNO. OF NODE IDENT. CODES SPECIFIED = ,12)</li> </ul>	83950 83960 83970 83980 83990 84000 84000 84020 84020 84030 84030 84050 84050 84060 84070 84080 84090 84100 84110 84120 84130 84140 84150 84160 84170
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.)</li> <li>890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/21X,28HFOR HYDOGR 7APH PRINTOUT) = ,14/13X,35HNREC (NO. OF PUMPING WELLS) = ,15 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H= ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 514)</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA 1TE(IN CFS) CONC./)</li> <li>920 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA 1TE(IN CFS) CONC./)</li> <li>920 FORMAT (1H0,10X,41HTHE FOLLOWING ASSIGNMENTS HAVE BEEN MADE:/5X,51</li> </ul>	B 3950 B 3960 B 3970 B 3980 B 4000 B 4000 B 4020 B 4020 B 4020 B 4020 B 4020 B 4020 B 4020 B 4050 B 4050 B 4050 B 4050 B 4050 B 4100 B 4120 B 4120 B 4130 B 4150 B 4180
<ul> <li>860 FORMAT (1H0,7X,12,7X,E10.3,5X,F9.2)</li> <li>870 FORMAT (1H0,21X,20HEXECUTION PARAMETERS//13X,39HNITP (NO. OF ITER 1RATION PARAMETERS) = ,14/13X,39HTOL (CONVERGENCE CRITERIA - ADI 2P) = ,F9.4/13X,39HITMAX (MAX.NO.OF ITERATIONS - ADIP) = ,14/13X,3 34HCELDIS (MAX.CELL DISTANCE PER MOVE/24X,28HOF PARTICLES - M.O.C.) 4 = ,F8.3/13X,30HNPMAX (MAX. NO. OF PARTICLES),7X,2H= ,14/12X,3 52H NPTPND (NO. PARTICLES PER NODE),6X,3H= ,14)</li> <li>880 FORMAT (1H0,5X,47H*** WARNING *** NPTPND MUST EQUAL 4,5,8, OR 9.1 890 FORMAT (1H0,23X,15HPROGRAM OPTIONS//13X,30HNPNT (TIME STEP INTER 1VAL FOR/21X,18HCOMPLETE PRINTOUT),7X,3H= ,14/13X,31HNPNTMV (MOVE 2INTERVAL FOR CHEM./21X,28HCONCENTRATION PRINTOUT) = ,14/13X,29HN 3PNTVL (PRINT OPTION-VELOCITY/21X,24H0=NO; 1=FIRST TIME STEP;/21X,1 47H2=ALL TIME STEPS),8X,3H= ,14/13X,31HNPNTD (PRINT OPTION-DISP.C 50EF./21X,24H0=NO; 1=FIRST TIME STEP;/21X,17H2=ALL TIME STEPS),8X,3 6H= ,14/13X,32HNUMOBS (NO. OF OBSERVATION WELLS/1X,28HFOR HYDROGR 7APH PRINTOUT) = ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 8/13X,24HNCODES (FOR NODE IDENT.),9X,2H# ,15/13X,25HNPNCHV (PUNCH V 9ELOCITIES),8X,2H= ,15/13X,36HNPDELC (PRINT OPTCONC. CHANGE) = , 514)</li> <li>900 FORMAT (1H0,10X,29HLOCATION OF OBSERVATION WELLS//17X,3HNO.,5X,1HX 1,5X,1HY/)</li> <li>910 FORMAT (1H0,10X,28HLOCATION OF PUMPING WELLS//11X,28HX Y RA 1TE(IN CFS) CONC./)</li> <li>920 FORMAT (1H0,10X,41HTHE FOLLOWING ASSIGNMENTS HAVE BEEN MADE:/5X,51 1HCOF NO.</li> </ul>	B 3950 B 3960 B 3970 B 3980 B 3980 B 4000 B 4000 B 4020 B 4020 B 4020 B 4030 B 4050 B 4050 B 4050 B 4050 B 4060 B 4100 B 4120 B 4120 B 4150 B 4160 B 4170 B 4180 B 4180

940       FORMAT (11 - 5% - 61 + 14 - 40, 17 14)       THCK.EG.D.O AND TMRX(X).GT.D. 0       8220         950       FORMAT (11 - 5% - 61 + 4ARIING + 14)       THCK.EG.D.O AND TMRX(Y).GT.D. 0       8223         960       FORMAT (11 - 5% - 61 + 4ARIING + 14)       THCK.EG.D.O AND NODEID.GT.D. 0       8220         970       FORMAT (11 - 5% - 61 + 4ARIING +				
<pre>1 AT NODE IX =,16,40, IY =,16) 950 FORMAT (11, %,16). MARNING *** TH(K,EQ.O.O AND TMRX(Y),GT.O.O B4220 1 AT NODE IX =,16,40, IY =,16 900 FORMAT (11, %,16). MARNING *** TH(K,EQ.O.O AND NODEID,GT.O.O B4220 1 AT NODE IX =,16,40, IY =,16 900 FORMAT (11, %,15,501+** WARNING *** TH(K,EQ.O.O AND NT,E,O.O AT N 8220 900 FORMAT (11, %,15,501+** WARNING *** TH(K,EQ.O.O AND RECH,ME.O.O AT 8220 900 FORMAT (11, %,15,501+** WARNING *** TH(K,EQ.O.O AND RECH,ME.O.O AT 8220 900 FORMAT (11, %,15,501+** WARNING *** TH(K,EQ.O.O AND RECH,ME.O.O AT 8220 900 FORMAT (11, %,16,301) Y =,163 1000 FORMAT (11, %,16,301) Y =,163 1000 FORMAT (11, %,16,301) Y =,164 1000 FORMAT (11, %,17,301) Y =,164 1000 FORMAT (11, 104,502,501) Y =,164 1000 FORMAT (11, 104</pre>	940	FORMAT (1H >5X>61H*** WARNING ***	THCK.EQ.O.O AND TMRX(X).GT.O.O	B4200
950 FORMAT (1H >5X-51H**** WARNING ***       THCK_EG.Q.O AND TMRX(Y)_GT_Q.O 84200         940 FORMAT (1H >5X-51H**** WARNING ***       THCK_EG.Q.O AND NDDEID.GT.Q.O 84200         970 FORMAT (1H >5X-51H**** WARNING ***       THCK_EG.Q.O AND NDEID.GT.Q.O 84200         980 FORMAT (1H >5X-53H**** WARNING ***       THCK_EG.Q.O AND NDE.LO.O AT 84200         980 FORMAT (1H >5X-53H**** WARNING ***       THCK_EG.Q.O AND RECH.ME.Q.O AT 86200         980 FORMAT (1H >5X-53H**** WARNING ***       THCK_EG.Q.O AND RECH.ME.Q.O AT 86200         1 NODE IX =-14.64H, IY =-143       THCK_EG.Q.O AND NDEELD.GT.Q.O 84200         990 FORMAT (1H >5X-53H**** WARNING ****       PERM.EG.Q.O AND NDEELD.GT.Q.O 84300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND NDEELD.GT.Q.O AN 84300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND NDEELD.GT.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND ND.EC.ME.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND RECL.ME.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND RECL.ME.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND RECL.ME.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND THCK.GT.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND THCK.GT.Q.O AT 86300         1000 E IX =-14.64H, IY =-143       PERM.EG.Q.O AND THCK.GT.Q.O AT 86400		1 AT NODE IX =,14,6H, IY =,14)		84210
1 AT NODE IX = 14,64H, IY = 143       THCK.EQ.0.0 AND NODEID.GT.0.0       B4240         940 FORMAT (HH, SX,56H+*, UY =,143)       THCK.EQ.0.0 AND WT.NE.0.0 AT N       B4240         100E IX =,14,64H, IY =,143       THCK.EQ.0.0 AND WT.NE.0.0 AT N       B4240         940 FORMAT (HH, SX,58H+** WARNING ***       THCK.EQ.0.0 AND WT.NE.0.0 AT N       B4240         940 FORMAT (HH, SX,58H+** WARNING ***       THCK.EQ.0.0 AND RECH.MC.0.0 AT B4280       B4280         940 FORMAT (HH, SX,58H+** WARNING ***       THCK.EQ.0.0 AND RECH.MC.0.0 AT B4320       B4320         1000 FORMAT (HH, SX,58H+** WARNING ***       PERM.EQ.0.0 AND WT.NE.0.0 AT B4320       B4320         1010 FORMAT (HH, SX,58H+** WARNING ***       PERM.EQ.0.0 AND WT.NE.0.0 AT B4320       B4330         1010 FORMAT (HH, SX,58H+** WARNING ***       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4330       B4330         1020 FORMAT (HH, SX,58H+** WARNING ***       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4330       B4330         1030 FORMAT (HH, SX,58H+** WARNING ***       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4330       B4330         1040 FORMAT (HH, SX,58H+** WARNING ****       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4330       B4330         1040 FORMAT (HH, SX,58H+** WARNING ****       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4330       B4330         1040 FORMAT (HH, SX,58H+** WARNING ****       PERM.EQ.0.0 AND RECH.WE.0.0 AT B4340       B4430         105 FORMAT (HH, SX,5	950	FORMAT (1H \$5X\$61H*** WARNING ***	THCK, FQ.O.O AND TMRX(Y) GT.O.O	84220
960 00 AND 11 - 5X,50 + + + WARING ++ THCK_EQ.O. 0 AND NODEID.GT.O. 0 970 FORMAT (11 - 5X,550 ++ WARING ++ THCK_EQ.O. 0 AND WT_NE.O.0 AT N 970 FORMAT (11 - 5X,550 ++ WARING ++ THCK_EQ.O. 0 AND RECH,NE.O.0 AT N 970 FORMAT (11 - 5X,550 ++ WARING ++ THCK_EQ.O. 0 AND RECH,NE.O.0 AT N 970 FORMAT (11 - 5X,550 ++ WARING ++ THCK_EQ.O. 0 AND RECH,NE.O.0 AT N 970 FORMAT (11 - 5X,550 ++ WARING ++ THCK_EQ.O. 0 AND RECH,NE.O.0 AT N 970 FORMAT (11 - 5X,550 ++ WARING ++ PERM_EQ.O.0 AND NODEID.GT.O.0 B 9510 FORMAT (11 - 5X,550 ++ WARING ++ PERM_EQ.O.0 AND NODEID.GT.O.0 B 9530 FORMAT (11 - 5X,550 ++ WARING +++ PERM_EQ.O.0 AND NODEID.GT.O.0 AT N 9530 FORMAT (11 - 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT N 9530 FORMAT (11 - 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT N 9530 FORMAT (11 - 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT N 9530 FORMAT (11 - 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 85300 100 E 1X = 914.640 + 1Y = 140 1030 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84300 100 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84300 100 FORMAT (10 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 100 FORMAT (10 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1030 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1040 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1050 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1050 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1050 FORMAT (11 + 5X,550 +++ WARING +++ PERM_EQ.O.0 AND RECH,NE.O.0 AT 84400 1050 FORMAT (11 + 5X,550 +AREA,NE + KH,FTR WARS SPECIFIED AS 0.0/23 1000 FORMAT (11 + 5X,550 +AREA,NE + KH,FTR HARFTR		1  AT NONE TY = 16.64 - TY = 16		0/070
900 FORMAI (1H, JX, JANNA, WARNING ***         THCK, EQ. D. O AND NODEID, GT. O. D         B4250           970 FORMAT (1H, JX, JSH*** WARNING ***         THCK, EQ. D. O AND WT, N. O. O AT N         B4250           980 FORMAT (1H, JX, JSH*** WARNING ***         THCK, EQ. D. O AND WELD, D. O AT N         B4250           980 FORMAT (1H, JX, JSH*** WARNING ***         THCK, EQ. D. O AND RECH, NE, D.O AT N         B4270           970 FORMAT (1H, JX, JSH*** WARNING ***         THCK, EQ. D. O AND RECH, NE, D.O AT N         B4270           970 FORMAT (1H, JX, JSH*** WARNING ***         PERM, EQ. O. O AND NODEID, GT. D.O AK         B4300           1000 FIX = JL4, GH, IY = JL4)         PERM, EQ. D.O AND NODEID, GT. D.O AK         B4330           1010 FORMAT (1H, JX, JSH*** WARNING ***         PERM, EQ. D.O AND RECH, NE, D.O AT N         B4330           1020 FORMAT (1H, JX, JSH*** WARNING ***         PERM, EQ. D.O AND RECH, NE, D.O AT N         B4330           1030 FORMAT (1H, JX, JSH*** WARNING ***         PERM, EQ. D.O AND RECH, NE, D.O AT B         B4330           1030 FORMAT (1H, JX, JSH*** WARNING ***         PERM, EQ. D.O AND RECH, NE, D.O AT B         B4330           1006 FIX = JL4, GH, IY = JL4)         SAND THCK, GT, D.O AND RECH, NE, D.O AT B         B4330           1030 FORMAT (1H, JX, JSKSH*** WARNING ***         PERM, EQ. D.O AND RECH, NE, D.O AT B         B4330           1040 FORMAT (1H, JSK, SH*** WARNING ***         <	0.40			84230
1 AT NODE IX = 14,64, IY = 14) 970 FORMAT (14,5X;564+**) WARNING *** THCK_EQ.O.D AND WT_NE_O.D AT 86260 100E IX = 14,64, IY = 14) 980 FORMAT (14,5X;584+**) WARNING *** THCK_EQ.O.D AND RECH_NE_O.D AT 86280 1 NODE IX = 14,64, IY = 14) 970 FORMAT (14,5X;584+**) WARNING *** THCK_EQ.O.D AND RECH_NE_O.D AT 86320 1 NODE IX = 14,64, IY = 14) 1000 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND NODEID.GT_O.D 84320 1010 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND NODEID.GT_O.D 84320 1010 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND NOLELD.GT_O.D AT 86350 1020 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND RECH_NE_O.D AT 86350 1020 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND RECH_NE_O.D AT 86350 1030 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND RECH_NE_O.D AT 86350 1 NODE IX = 14,64, IY = 14) 1030 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND RECH_NE_O.D AT 86350 1 NODE IX = 14,64, IY = 140 1050 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND RECH_NE_O.D AT 86450 1 NODE IX = 14,64, IY = 140 1050 FORMAT (14,5X;584+**) WARNING *** PERM_EQ.O.D AND THCK_GT_O.D AT 86450 1070 FORMAT (114,5X;584+**) WARNING *** PERM_EQ.O.D AND THCK_GT_O.D AT 86450 1070 FORMAT (114,5X;584+**) WARNING *** PICH_VARS SPECIFIED AS 0.0/23 108450 1070 FORMAT (114,5X;584+**) WARNING *** PICH_VARS SPECIFIED AS 0.0/23 108450 1070 FORMAT (114,5X;584+**) WARNING *** 14/15X;94444 1070 FORMAT (114,5X;584+**) WARNING *** 14/15X;94444 108450 1080 FORMAT (114,5X;584+**) WARNING *** 14175X;94444 1090 FORMAT (114,5X;584+**) WARNING **** ANFCTR WAS SPECIFIED AS 0.0/23 1000 FORMAT (114,5X;584+**) WARNING **** 14175X;9444+*** 1000 FORMAT (114,5X;584+**) WARNING **** 14175X;9444+*** 1000 FORMAT (114,5X;584+**) WARNING **** 14175X;9444+*** 1000 FORMAT (114,5X;584+***) WARNING **** 14175X;9444+**** 14175X;9444+**** 1000 FORMAT (114,5X;584+**** WARNING **** 14175X;9444+***** 14175X;9444+**********************************	960	FORMAL (TH #DX#OTH*** WARNING ***	THCK_EQ.U.U AND NODEID.GT.O.O	B4240
970 FORMAT (1H ,5X,56H*** WARNING ***       THCK_EG.Q.D AND WT_NE.Q.D AT N 84200         980 FORMAT (1H ,5X,58H*** WARNING ***       THCK_EG.Q.D AND RECH.NE.Q.D AT 84200         970 FORMAT (1H ,5X,58H*** WARNING ***       THCK_EG.Q.D AND RECH.NE.Q.D AT 84200         970 FORMAT (1H ,5X,58H*** WARNING ***       THCK_EG.Q.D AND NODEID.GT.Q.D AT 84300         1000 FIX ==1/4,6/H, IY ==1/4)       PERM.EG.Q.D AND NODEID.GT.Q.D AT 86300         1010 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND NODEID.GT.Q.D AT 86300         1020 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 86300         1020 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 86300         1030 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 86300         1040 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 86300         1050 FORMAT (1H ,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 86300         1050 FORMAT (1H,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 864300         1050 FORMAT (1H,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 864300         1050 FORMAT (1H,5X,58H*** WARNING ***       PERM.EG.Q.D AND RECH.NE.Q.D AT 864300         1050 FORMAT (1H,5X,58H*** WARNING ***       PERM.EG.Q.D AND THCK.GT.Q.D AT 864300         1050 FORMAT (1H,5X,58H*** WARNING ***       PERM.EG.Q.D AND THCK.GT.Q.D AT 864300         1050 FORMAT (1H,5X,5		1 AT NODE IX =,I4,6H, IY =,I4)		B4250
10DE IX =,14,6W, IY =,14) 980 FORMAT (1H, 5X,58H-XWARNING +** THCK,EQ.O.,D AND RECH.NE.O.D AT 990 FORMAT (1H, 5X,58H-XWARNING +** THCK,EQ.O.,D AND RECH.NE.O.D AT 8220 990 FORMAT (1H, 5X,58H-XWARNING +** THCK,EQ.O.,D AND NODEID.GT.O.D 1000 FORMAT (1H, 5X,56H-XWARNING +** PERM.EQ.O.D AND NODEID.GT.O.D 8330 1000 FORMAT (1H, 5X,56H-XWARNING +** PERM.EQ.O.D AND MT.NE.O.D AT 8350 1020 FORMAT (1H, 5X,56H-XWARNING +** PERM.EQ.O.D AND MT.NE.O.D AT 8350 1020 FORMAT (1H, 5X,56H-XWARNING +** PERM.EQ.O.D AND RECH.NE.O.D AT 8350 1030 FORMAT (1H, 5X,58H-XWARNING +** PERM.EQ.O.D AND RECH.NE.O.D AT 8350 1040 FORMAT (1H, 5X,58H-XWARNING +** PERM.EQ.O.D AND RECH.NE.O.D AT 8350 1050 FORMAT (1H, 5X,58H-XWARNING +** PERM.EQ.O.D AND RECH.NE.O.D AT 8450 1040 FORMAT (1H, 5X,58H-XWARNING +** PERM.EQ.O.D AND THCK.GT.O.D AT 8450 1050 FORMAT (1H, 5X,58H-XWARNING +** PARINC +** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1150 FORMAT (1H, 5X,58H-XWARNING +** PARINC *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1050 FORMAT (1H, 5X,59H-XWARNING +** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1050 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1050 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 1060 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 1060 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 1060 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 1060 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 200 FORMAT (1H, 5X,59H-XWARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 8450 200 FORMAT (1H, 5X,59H-XWARNING *** PERM.EQ.20,1/3X,59H-1HW ** 5/4/15X,59H-1HW 201 FIGNARA (1H, 5X,59H-XWARNING *** PERM.EQ.20,1/3X,59H-1HW ** 5/4/15X,59H-1HW 201 FIGNARA (1H, 5X,59H-XWARNING *** PERM.EQ.20,1/3	970	FORMAT (1H \$5X\$56H*** WARNING ***	THCK_EQ.O.O AND WT_NE.O.O AT N	B4260
980 FORMAT (11.50.50) 1000 FIX=,14.640, IY =,14.) 1000 FORMAT (11.50.50) 1000 FORMAT (11.50.640, IY =,14.) 1000 FORMAT (11.50.640, IY =,14.) 1000 FORMAT (11.50.640, IY =,14.) 1000 FORMAT (11.50.640, IY =,14.) 1010 FORMAT (11.50.640, IY =,14.) 1020 FORMAT (11.50.640, IY =,14.) 1020 FORMAT (11.50.560, IY =,14.) 1030 FORMAT (11.50.560, IY =,14.) 1030 FORMAT (11.50.560, IY =,14.) 1040 FORMAT (11.50.560, IY =,14.) 1050 FORMAT (11.50.560, IY =,14.) 1050 FORMAT (11.50.560, IY =,14.) 1050 FORMAT (11.50.560, IY =,14.) 1060 FORMAT (11.50.250, IY =,14.) 1060 FORMAT (11.50.250, IY =,14.) 1070 FORMA		10DE TY = T4.6H. TY = T4)		B/270
Value       Value <td< td=""><td>000</td><td></td><td></td><td>54270</td></td<>	000			54270
T NODE IX =,14,6M, IY =,143 90 FORMAT (IH ,5X,53H=*** WARNING *** THCK.EQ.O.O AND REC.N.E.O.O AT NODE IX =,14,6M, IY =,143 1000 FORMAT (IH ,5X,64H=** WARNING *** PERM.EQ.O.O AND NODEID.GT.O.O B4320 1 AT NODE IX =,14,6M, IY =,143 1010 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND WT.M.E.O.O AT N 8430 1020 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1020 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1030 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1040 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1040 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1040 FORMAT (IH ,5X,54H=** WARNING *** PERM.EQ.O.O AND RECH.N.E.O.O AT 8430 1040 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1050 FORMAT (IH ,5X,55H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1060 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1070 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1080 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1090 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 1000 FORMAT (IH ,5X,54H=** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 84420 116 TIME STEP, PUMPAGE, AND PRINT PARAMETERS HAVE BEEN REDEFINED:/) 84400 107 FORMAT (IH ,5X,54H=** JA(15X,9MH)TM = ,14(15X,9MH)TM = ,14(15X,9MH) 1080 SUBROUTINE ITERAT 000 DUBLE PRECISION DMINI,DEXP,DLOG,DABS 1100 FORMAT (IH ,46X,E10.3) END 1000 FORMAT (IH ,46X,E10.3)	980	FURMAL (TH >>X>>8H*** WARNING ***	THCK.EQ.U.U AND RECH.NE.U.U AT	B4280
990 FORMAT (11 + 5x,588+** WARNING *** THCK,EG,D,D AND REC,NE,D,D AT B4300 1000 FORMAT (11 + 5x,614*** WARNING *** PERM,EG,D,D AND NDEID,GT,D,D 1 AT NODE IX =,14,64N, IY =,14) 1010 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND MT,NE,D,D AT N 4330 1020 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT N 4330 1030 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT N 4330 1040 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT A 4330 1000 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT A 4330 1000 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT A 4330 1000 FORMAT (11 + 5x,584*** WARNING *** PERM,EG,D,D AND RECH,NE,D,D AT A 4400 1000 FORMAT (11 + 5x,584*** WARNING *** ANFCIR WAS SPECIFIED AS 0.0/23 84420 1007 FORMAT (11 + 5x,584*** WARNING *** ANFCIR *** SPECIFIED AS 0.0/23 84420 1006 FORMAT (11 + 5x,584*** WARNING *** ANFCIR *** SPECIFIED AS 0.0/23 84420 1007 FORMAT (11 + 5x,554*** WARNING *** ANFCIR *** SPECIFIED AS 0.0/23 84420 1007 FORMAT (11 + 5x,554*** WARNING *** ANFCIR *** SPECIFIED AS 0.0/23 84420 1007 FORMAT (11 + 5x,545*** WARNING *** ANFCIR *** ANFCIR *** SPECIFIED AS 0.0/23 84420 1008 FORMAT (11 + 5x,545*** WARNING *** ANFCIR *** ANFCIR *** ANFCIR *** SPECIFIED *** 114/15x,9447404 *** 14/15x,944474 *** ANFCIR *** ANFCIR *** ANFCIR *** 2114/15x,9447404 *** 14/15x,944474 *** ANFCIR *** ANFCIR *** ANFCIR *** 84500 514(13) 1100 FORMAT (11 + 46x,e10.3) END 500 5000 SUBROUTINE ITERAT 5000 SUBROUTINE ITERAT,NDF,PARC,HAR,MTEST,TOL,PINT,MIN,PYR 5000 SUBROUTINE ITERAT 5000 SUBROUTINE ITERAT,NDF,PARC,HAR,MTEST,TOL,PINT,MIN,PYR 5000 SUBROUTINE ITERAT 5000 SUBROUTINE ITERAT,NDF,PARC,HAR,MTEST,TOL,PINT,MIN,PYR 5000 SUBROUTINE ITERAT,NDF,PARA,MECR,FARA,SUMT,RH		T NODE IX =/I4/6H/ IY =/I4)		84290
1 NODE IX =,14,64, IY =,14) 1000 FORMAT (1H, 5X,54H+** WARNING *** PERM.EQ.O.O AND NODEID.GT.O.D 63300 1010 FORMAT (1H, 5X,54H+** WARNING *** PERM.EQ.O.O AND WINE.O.O AT N 63300 1020 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND RECH.NE.O.O AT 63500 1030 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND RECH.NE.O.O AT 64500 1000 FIX =,14,64, IY =,14) 1000 FIX =,14,64, IY =,14) 1000 FIX =,14,64, IY =,14) 1000 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND RECH.NE.O.O AT 64500 1000 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND THCK.GT.O.O AT 64500 1000 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND THCK.GT.O.O AT 64500 1000 FORMAT (1H, 5X,58H+** WARNING *** PERM.EQ.O.O AND THCK.GT.O.O AT 64500 1000 FORMAT (1014,525,50) 1030 FORMAT (1014,525,0) 1030 FORMAT (1014,565,0) 1060 FORMAT (1014,565,0) 1070 FORMAT (1014,565,0) 1080 FORMAT (1014,565,0) 1080 FORMAT (1014,525,51AT PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84400 1014 (1H,5X,94HPNTIM = ,14/15X,94HPNTC = ,14/15X,94HPNTNV = ,14/15X,94H 14/15X,94HPNTIM = ,14/15X,94HPNTC = ,14/15X,94HPNTNV = ,14/15X,94HPNTNV = ,14/15X,94H 1000 FORMAT (11H,54,52H) 1000 FORMAT (11H,46X,510.3) END 1100 FORMAT (11H,46X,510.3) END 1100 FORMAT (11H,46X,510.3) END 1100 FORMAT (11H,46X,510.3) END 1100 FORMAT (11H,46X,20,72H,74H,74H,74H,74H,74H,74H,74H,74H,74H,74	990	FORMAT (1H >5X>58H+++ WARNING +++	THCK.EQ.O.O AND REC.NE.O.O AT	B4300
1000 FORMAT (1H - SS, SG1W.++ WARNING +++ PERM.EQ.O.O AND NODEID.GT.D.O 1 NODE IX = -14.6H, IY = IA 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND WT.NE.O.O AT N 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND RECH.NE.O.O AT N 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND RECH.NE.O.O AT N 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND RECH.NE.O.O AT N 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND RECH.NE.O.O AT A 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND THCK.GT.O.O AT A 1000 FORMAT (1H - SX, S6H*++ WARNING +++ PERM.EQ.O.O AND THCK.GT.O.O AT A 1000 FORMAT (1H - SX, S6H*++ WARNING +++ ANFCTR WAS SPECIFIED AS 0.0/23 1000 FORMAT (1H) - SX, S6H*++ WARNING +++ ANFCTR WAS SPECIFIED AS 0.0/23 1000 FORMAT (11) 1000 FORMAT (11) - SX, S5H S1ART PUMPING PERIOD NO. , 12//2X, 75HTHE FOLLOWIN 164400 1000 FORMAT (11) - SX, S5H S1ART PUMPING PERIOD NO. , 12//2X, 75HTHE FOLLOWIN 164500 1000 FORMAT (1H) - SX, S4HSTART PUMPING PERIOD NO. , 12//15X, 9HTHPARAMETERS HAVE BEEN REDEFINED:/) 84470 1000 FORMAT (1H) - SX, S4HSTART PUMPING PERIOD NO. , 12//15X, 9HTHPARAMETERS HAVE BEEN REDEFINED:/) 84470 1000 FORMAT (1H) - SX, S4HSTART PUMPING PERIOD NO. , 12//15X, 9HTHPARAMETERS HAVE BEEN REDEFINED:/) 84500 1011/15X, 9HTHPARE, ALA/15X, 9HNPATC = , 14/15X, 9HNPATW = , 14/15X, 9H 11/15X, 9HTHPARE, ALA/15X, 9HNPATC = , 14/15X, 9HNPATW = , 14/15X, 9H 11/15X, 9HTHPARE, ALA/15X, 9HNPATC = , 14/15X, 9HNPATW		1 NODE IX =/14/6H/ IY =/14)		84310
1000 FORMAT (1H, 2,14,6H, IY =,14)       FERM_EQ.JO.O AND WT.NE.JO.O AT N       B4330         1010 FORMAT (1H, 2,14,6H, IY =,14)       B4330         1020 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO. AND RECH.NE.JO.O AT M       B4330         1030 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO. AND RECH.NE.JO.O AT M       B4330         1030 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO. AND RECH.NE.JO.O AT B4360       1000 IX =,14,64H, IY =,143         1040 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4300       1030         1050 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4400       1000 IX =,14,64H, IY =,143         1050 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4400       1000 IX =,14,64H, IY =,143         1050 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4400       1000 IX =,14,64H, IY =,143         1050 FORMAT (1H, 5X,58H*** WARNING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4400       1000 FORMAT (1H, 5X,25HTART PUMPING *** PERM_EQ.JO.O AND THCK.GT.JO.O AT B4400         1080 FORMAT (1H, 5X,25HSTART PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84400       104420         1090 FORMAT (1H, 5X,25HSTART PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84400       84540         1090 FORMAT (1H, 46X,4E10.3)       84500         200 FORMAT (1H, 46X,4E10.3)       84500         2114/15X,9HPINT = ,410/15X,9HNPNT =	1000	CODMAT /10 -5V-610444 HADNING 444		0/720
1 AL NUDE IX =:14:56H IV =:14: 1010 FORMAT (1H ::5X:56H :: WARNING *** PERM.EQ.D.O AND WT.NE.D.O AT N B4330 1020 FORMAT (1H ::5X:56H :: Y =:14: 1030 FORMAT (1H ::5X:56H :: Y =:14: 1030 FORMAT (1H ::5X:56H :: Y =:14: 1030 FORMAT (1H ::5X:56H :: Y =:14: 1050 FORMAT (1H ::5X:56H :: Y =:14:) 1050 FORMAT (1H ::5X:56H :: Y =:14: 1050 FORMAT (1H ::5X:56H :: Y =:14:) 1060 FORMAT (1H ::5X:56H :: Y =:14:) 1070 FORMAT (1H ::5X:56H :: Y =:14:) 1071 FORMAT (1H ::5X:56H :: Y =: Y =:14:) 1071 FORMAT (1H :: Y =:	1000	FURMAL (IN PJAPOINANA WARNING ***	PERM.EW.U.U AND NUDEID.GI.U.U	84320
1010       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND WINE.0.0 AT ME330         1020       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND RECH.NE.0.0 AT 6430         1030       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND RECH.NE.0.0 AT 6430         1040       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND RECH.NE.0.0 AT 6430         1040       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND THCK.GT.0.0 AT 6430         1040       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND THCK.GT.0.0 AT 6430         1050       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND THCK.GT.0.0 AT 6430         1050       FORMAT (1H ->SX,SSH+** WARNING *** PERM_EQ.0.0 AND THCK.GT.0.0 AT 6430         1050       FORMAT (1H ->SX,SSH+** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23         1070       FORMAT (11)       B4450         1080       FORMAT (1H ->SX,SSHTART PUMPING FERIOD NO., J2//2X,7SHTHE FOLLOWIN 84460         1080       FORMAT (1H ->SX,SSHTART PUMPING FERIOD NO., J2//2X,7SHTHE FOLLOWIN 84460         1080       FORMAT (1H ->SX,SSHTART PUMPING FERIOD NO., J2//2X,7SHTHE FOLLOWIN 84460         1080       FORMAT (1H ->SX,SSHTART PUMPING FERIOD NO., J2//2X,7SHTHE FOLLOWIN 84460         1080       FORMAT (1H) -SX,2SHTART PUMPING FERIOD NO., J2//1SX,9HNPTMY = , 64430         114/15X,9HIPMIN = , F10.5/15X,9HNPTM = , J4/15X,9HNPTMY = , J4/1		7 AI NUDE 1X =/14/0H/ 1Y =/14)		84330
10DE IX =,14,6H, IY =,14) 1020 FORMAT (IH ,5Xx5BH++* WARNING ++* PERM.EQ.O.D AND RECH.NE.O.D AT 1030 FORMAT (IH ,5Xx5BH+** WARNING ++* PERM.EQ.O.O AND REC.NE.O.D AT 1040 FORMAT (IH ,5Xx5BH+** WARNING ++* PERM.EQ.O.O AND THCK.GT.O.D AT 100DE IX =,14,6H, IY =,14) 1040 FORMAT (IH ,5Xx5BH+** WARNING ++* PERM.EQ.O.O AND THCK.GT.O.D AT 84300 100DE IX =,14,6H, IY =,14) 1050 FORMAT (IH ,5Xx5BH+** WARNING ++* PERM.EQ.O.O AND THCK.GT.O.D AT 84410 1050 FORMAT (IH ,5Xx5BH+** WARNING ++* ANFCTR WAS SPECIFIED AS 0.0/23 84420 1070 FORMAT (ID/4,355.0) 1080 FORMAT (II) 1060 FORMAT (II) 1070 FORMAT (IH ,5Xx5BTART PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84430 1070 FORMAT (IH ,5Xx5HTART PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84450 1161 FORMAT (IH ,5Xx5HNFH = ,14/15X,9HNPNT = ,14/15X,9HNPNT = , 84450 114/15X,9HITMAX = ,14/15X,9HNPNT = ,14/15X,9HNPNT = ,14/15X,9HNPNCHV = , 84500 2NPHVL = ,14/15X,9HNPNT = ,14/15X,9HNPNT = ,14/15X,9HNPNCHV = , 84500 1000 FORMAT (IH ,46X,EIO.3) END SUBROUTINE ITERAT DOUBLE PRECISION DMIN1,0EXP,DLOG,DABS REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,PARM.TEST,TOL,PINT,HMIN,PYR C 400 CMMON /PRM1/ NTM,MPNPNPNT,MITP,NNR,ORAM,TEST,TOL,PINT,HMIN,NNY,NUMO C 2PNCHV,NPELC C 0MMON /PRM1/ NTM,NPNPNPNT,MITP,NNX,NY,NPNRCC,ITN,NNX,NY,NUMO C 500 C 0MMON /PRM1/ NTM,NPNPNPNT,NITP,NNX,NY,NPNRCC,ITN,NNX,NY,NUMO C 500 C 0MMON /PEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(5),IVOB C 0MMON /PEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(5),IVOB C 0MMON /HEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(5),IVOB C 0MMON /HEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(5),IVOB C 0MMON /HEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(5),IVOB C 0MMON /HEDA/ THCK (20,20),PECEL(20,20),TMWL(5,50),TMOBS(5),IVOF C 0MMON /HEDA/ THCK (20,20),PECEL(20,20),TMWL(5,50),TMOBS(5),IVFT C 0MMON /HEDA/ THCK (20,20),PECEC C 130 C 0MMON /HEDA/ THCK (20,20),PECEC (20,20),TMWL(5,50),TMOBS(5),IVFT C 0MMON /HEDA/ THCK (20,20),PECEC (20,20),RECH(20,20),TIMUL(5,50),TMOBS(5),TON C 0MMON /HEDA/ THCK (20,20),FC	1010	FORMAT (1H >5X>56H*** WARNING ***	PERM.EQ.0.0 AND WT.NE.0.0 AT N	B4340
1020 FORMAT (1H >5X>5BH++* WARNING *** PERM.EQ.O.O AND RECH.NE.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** PERM.EQ.O.O AND RECH.NE.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** PERM.EQ.O.O AND REC.NE.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** PERM.EQ.O.O AND REC.NE.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** PERM.EQ.O.O AND TH(K.GT.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** PERM.EQ.O.O AND TH(K.GT.O.O AT 1020 FORMAT (1H >5X>5BH+** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 1020 FORMAT (110) 1050 FORMAT (1016>5X>5BH+** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 1020 FORMAT (110) 1050 FORMAT (110) 1050 FORMAT (111) 1050 FORMAT (111) 1050 FORMAT (111) 1050 FORMAT (111) 1050 FORMAT (111) 1050 FORMAT (111,5X>5HTAT PUMPING PERIOD NO12//2X,75HTHE FOLLOWIN 84400 10 TIME STEP, PUMPAGE, AND PRINT PARAMETERS HAVE BEEN REDEFINED;/) 10470 FORMAT (111,5X>5HNARC = .14/15X,9HNPTMV =		10DE IX =,I4,6H, IY =,I4)		B4350
1       NODE IX =,14,60, IY =,14)       Status       PERM.EQ.D.O AND REC.NE.O.D AT         1030 FORMAT (1H ,5X,58H+** WARNING ***)       PERM.EQ.D.O AND REC.NE.O.D AT       B4300         1040 FORMAT (1H ,5X,58H+** WARNING ***)       PERM.EQ.D.O AND THCK.GT.O.D AT       B44300         1050 FORMAT (1H ,5X,58H+** WARNING ***)       PERM.EQ.O.O AND THCK.GT.O.D AT       B44300         1050 FORMAT (1H ,5X,58H+** WARNING ***)       PERM.EQ.O.O AND THCK.GT.O.D AT       B44300         1050 FORMAT (1H ,5X,58H+** WARNING ***)       ANFCTR WAS SPECIFIED AS 0.0/23       B4430         1050 FORMAT (1H ,5X,55BH5TART PUMPING PERIDD NO., 12//2X,75HTHE FOLLOWIN B4430       B4430         1070 FORMAT (1H ,15X,55LSTART PUMPING PERIDD NO., 12//2X,75HTHE FOLLOWIN B4430       B4430         1070 FORMAT (1H ,15X,25HSTART PUMPING PERIDD NO., 12//2X,75HTHE FOLLOWIN B4430       B4430         1080 FORMAT (1H ,15X,25HSTART PUMPING PERIDD NO., 12//2X,75HTHE FOLLOWIN B4430       B4430         1090 FORMAT (1H ,15X,25HSTART PUMPING = ,14/15X,9HNPNTW = ,14/15X,9HNP	1020	FORMAT (1H .5Y .58H+++ WARNING +++	DEDM EQ O O ANN DECH NE O O AT	P4360
1030 FORMAT (1H + 5Xx5BH+** WARNING *** PERM.EQ.O.O AND REC.NE.O.O AT 1000 FORMAT (1H + 5Xx5BH+** WARNING *** PERM.EQ.O.O AND REC.NE.O.O AT 1000 FORMAT (1H + 5Xx5BH+** WARNING *** PERM.EQ.O.O AND THCK.GT.O.O AT 1000 FORMAT (1H + 5Xx5BH+** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 1050 FORMAT (1O16,5Xx5H+** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 1060 FORMAT (11) 1050 FORMAT (1014,365.O) 1060 FORMAT (1014,365.O) 1060 FORMAT (1014,365.O) 1070 FORMAT (1014,365.O) 1080 FORMAT (1014,365.O) 1090 FORMAT (11,5X,9HNFTM = ,14/15X,9HNPTMY = ,14/15X,9HNPTMY = , 14/15X,9HNPTMY = ,14/15X,9HNPTMY = ,11/15X,9HNPTMY = ,11/15X,		$1 \text{ NONE } 1Y = 14.4H \cdot 1Y = 14.$		04300
<pre>1030 F0RMAT (1H ,&gt;X&gt;S0H*** WARNING *** PERM_EG.U.O AND REC.WE.U.O AT B4380 11060 F0RMAT (1H ,&gt;X&gt;S0H*** WARNING *** PERM_EG.U.O AND REC.WE.U.O AT B4400 11050 F0RMAT (1H0,5X,45H*** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 B4420 11050 F0RMAT (1H1,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN B4460 11000 F0RMAT (111) B4400 11070 F0RMAT (111,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN B4460 11070 F0RMAT (111,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN B4460 11070 F0RMAT (111,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN B4460 11080 F0RMAT (111,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN B4460 11000 F0RMAT (111,5X,29HNTM = ,14/15X,9HNPNTW = ,14/15X,9HNPN</pre>		I NUVE IA =/14/08/ 11 =/14/		84370
1 NODE IX =,14,0H, IY =,14) 1040 FORMAT (1H -5X,58H*** WARNING *** PERM.EQ.0.0 AND THCK.GT.0.0 AT B4400 1 NODE IX =,14,0H, IY =,14) 1050 FORMAT (1H0,5X,45H*** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 B4420 11x,34HDEFAULT ACTION: RESET ANFCTR = 1.0) 1040 FORMAT (11) 1050 FORMAT (11,1,5X,25HSTART PUMPING PERIOD NO.,12//2X,75HTHE FOLLOWIN B4450 1060 FORMAT (1H0,14X,9HNTIM =,14/15X,9HNPNTT =,14/15X,9HNTIP =, 84480 114/15X,9HITMAX =,14/15X,9HNPNTC =,14/15X,9HNTNTW =,14/15X,9H B4450 200 FORMAT (1H-0.14X,9HNTIM =,14/15X,9HTIMX =,14/15X,9HNTINT =,14/15X,9H B4450 2114/15X,9HITMAX =,14/15X,9HNPNTD =,14/15X,9HTIMX =,14/15X,9HNTINT =,14 114/15X,9HITMAX =,14/15X,9HNPNTD =,14/15X,9HTIMX =,14/15X,9HNTNTW =,14/15X,9H 1100 FORMAT (1H ,46X,E10.3) END SUBROUTINE ITERAT DOUBLE PRECISION DMIN1,9EXP,0L0G,DABS C 100 REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR C 400 REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR C 400 COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO C 600 15S,MOV,IMCV,NPMAX,ITMAX,NXCRIT,PRNT,NPTMA,NPNTVL,NPNTVL,NPNTVL,MC C 0MMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO C 600 15S,MOV,IMCV,NPMAX,ITMAX,NXCRIT,PRNT,NPTMA,NPNTVL,NPNTVL,NNT,NUMO C 600 15S,MOV,IMCV,NPMAX,ITMAX,NXCRIT,PRNT,NPTMA,PNTV,NNTVL,NNTVL,NC C 0MMON /HEDA/ THCK (20,20),PERM(20,20),TIM(50,20),HIC(20),C ( 120) C 0MMON /HEDA/ THCK (20,20),PERM(20,20),TIM(50,20),JNFCTR C 0MMON /HEDA/ THCK (20,20),PERM(20,20),HIC(20,20),HIMOS(50),ANFCTR C 0MMON /HEDA/ THCK (20,20),PERM(20,20),HIC(20,20),HINT,MDS(50),TING C 0MMON /HEDA/ THCK (20,20),PERM(20,20),HINC(20,20),HINT,MD,POR C 0MMON /ALM/ TOTLQ C 0MON /ALM HE NFERATION PARAMETER C 200 C 0MMON /ALM HE ALTION PARAMETER	1030	FURMAL (TH JOXJOBH*** WARNING ***	PERM.EQ.U.U AND REC.NE.U.U AT	84380
1040 FORMAT (1H ,5X,58H*** WARNING *** PERM.EQ.0.0 AND THCK.GT.0.0 AT 1 NODE IX = 714.64M. IY = 714) 1050 FORMAT (1H0,5X,45H*** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 B4420 1X,34HDEFAULT ACTION: RESET ANFCTR = 1.0) 1060 FORMAT (11) 1070 FORMAT (111,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN 84400 1080 FORMAT (1H1,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN 84400 1080 FORMAT (1H1,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN 84400 1090 FORMAT (1H1,5X,25HSTART PUMPING PERIOD NO. ,12//2X,75HTHE FOLLOWIN 84400 114/15X,9HITMAX = ,14/15X,9HNPENT = ,14/15X,9HNPITMY = ,44450 2NPNTVL = ,14/15X,9HNPITD = ,14/15X,9HNPDELC = ,14/15X,9HNPITMY = ,44500 20,3/) 1100 FORMAT (1H ,46X,E10.3) END END END SUBROUTINE ITERAT C 100 COMMON /PRMI/ NIM,PMP,NPAT,MC,MK,WT,REC,RECH,TIM,AOPT,TITLE C 200 COMMON /PRMI/ NIM,PMP,NPAT,MC,MK,WT,REC,RECH,TIM,AOPT,TITLE C 200 COMMON /PRMI/ NIM,PMP,NPAT,MITP,NNX,NY,NPANE,CHK,QL,BRH C 000 C 0MMON /PRMI/ NIM,PMMX,NITAR,NX,NY,NPANE,RES,TOL,PINT,MMIN,PVR C 400 C 2PNCHY,NPDELC S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,MMIN,PVR C 400 C 0MMON /PRMI/ NIM,PMP,NPAT,NITP,NNX,NY,NPANE,CHK,QL,BRH C 0000 /PRMI/ NIM,NPMP,NPAT,NITP,NNX,NY,NPANE,CHK,QL,BRH C 0000 /PRMI/ NIM,NPMP,NPAT,NITP,NNX,NY,NPANE,CHK,QL,BRH C 0000 /PRMI/ NIM,NPMP,NPAT,NITP,NNX,NY,NPANE,CHK,QL,DRH C 0000 /PRMI/ NIM,NPMP,NPAT,NITP,NNX,NY,NPANE,CHK,QL,DRH C 100 C 0000 /PRMI/ NIM,NPMP,NPAT,NITP,NT,NT,NT,NNX,NNY,NNMO C 100 C 00000 /PRMI/ NIM,NY,NY,NNA C 100 C 00000 /PRMI/ NIM,NY,NY,NNA C 100 C 00000 /PRMI/ NIM,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,		1 NODE IX =,I4,6H, IY =,I4)		B4390
1 NODE IX = 14,640, IY = 14) 1050 FORMAT (1H0,5X,45H*** WARNING *** ANFCTR WAS SPECIFIED AS 0.0/23 B4430 11,34HDEFAULT ACTION: RESET ANFCTR = 1.D) 1060 FORMAT (11) 1070 FORMAT (11) 1070 FORMAT (11) 1080 FORMAT (11) 1080 FORMAT (11),5X,25HSTART PUMPING PERIOD NO.,12//2X,75HTHE FOLLOWIN 84450 1080 FORMAT (1H1,5X,25HSTART PUMPING PERIOD NO.,12//2X,75HTHE FOLLOWIN 84460 1090 FORMAT (1H1,5X,25HSTART PUMPING PERIOD NO.,12//2X,75HTHE FOLLOWIN 84460 1090 FORMAT (1H1,5X,29HNFNT = ,14/15X,9HNPNT = ,14/15X,9HNP1HE = , 84470 114/15X,9HITMAX = ,14/15X,9HNFNT = ,14/15X,9HNFNTN = ,14/15X,9HNFNH = , 114/15X,9HFINT = ,14/15X,9HNFNT = ,14/15X,9HNFNTN = ,14/15X,9HNFNH = , 114/15X,9HFINT = ,14/15X,9HNFNT = ,14/15X,9HNFNTN = ,14/15X,9HNFNH = , 1100 FORMAT (1H ,46X,E10.3) END SUBROUTINE ITERAT DOUBLE PRECISION DMIN1,DEXP,0LOG,DABS C 100 REAL *8XDEL,YDELS,AREA,SUMT,RHO,PARAM,TEST,TOL,PTINT,HMIN,PYR C 200 COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,NNX,NY,NP,NREC,INT,HMIN,PYR C 400 REAL *8XDEL,YDELS,AREA,SUMT,RHO,PARAM,TEST,TOL,PTINT,HMIN,PYR C 700 COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,NNX,NY,NP,NREC,INT,NNX,NNY,NUMO C 00MON /PRRK/ NODEID(20,20),PERM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /HEDB/ TMRX (20,20,2),YPRM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /HEDB/ TMRX (20,20,2),YPRM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /HEDB/ TMRX (20,20,2),YPRM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /ALM/ TOLQ C 0MMON /XINV/ DXINV,DYINV,ARINV,PORINV D IMENSION W(20),ZO,WINV,ARINV,PORINV C 100 C 0MMON /XINV/ DXINV,DYINV,ARINV,PORINV C 100 C 0MMON /XINV/ DXINV,DYINV,ARINV,PORINV C 100 C 0MMON /XINV/ DXINV,DYINV,ARINV,PORINV C 100 C 0MMON /XINV/ DXINV,DYINV,ARINV,PORINV C 100 C 0MMON /XINV DXINV,DYINV,ARINV,PORINV C 100 C 0MMON /XINV DXINV,DYINV,AREC	1040	FORMAT (1H \$5x\$58H*** WARNING ***	PERM. FQ.O.O AND THCK.GT.O.O AT	B4400
1050 FORMAT (1H0.5X.45H+** WARRING *** ANFCTR WAS SPECIFIED AS 0.0/23 B4420 17.34HDEFAULT ACTION: RESET ANFCTR = 1.0) B4430 1000 FORMAT (11) B4440 1070 FORMAT (111,5X,55,0) B4450 1080 FORMAT (114,5X,25HSTART PUMPING PERIOD NO. ,12//2X.75HTHE FOLLOWIN B4460 1070 FORMAT (1H.5X,25HSTART PUMPING PERIOD NO. ,12//2X.75HTHE FOLLOWIN B4460 1070 FORMAT (1H.5X,25HSTART PUMPING PERIOD NO. ,12//2X.75HTHE FOLLOWIN B4460 1070 FORMAT (1H.5X,25HSTART PUMPING PERIOD NO. ,12//2X.75HTHE FOLLOWIN B4460 1070 FORMAT (1H.5X.9HNPHTM = ,14/15X.9HNPNTM = ,14/15X.9HNPTM = ,14/15X.9		1 NODE IX $\pm 14.6H$ , IY $= 14$ )		B4410
1000       1001       1000       1001       1000       1001       1000       1001       1000       1001       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       1000       10000       1000	1050	$\begin{bmatrix} 1 & -2142002 & 11 & -2142 \\ \hline 1 & -2142002 & 11 & -2142 \\ \hline 1 & -2142002 & 11 & -2142 \\ \hline 1 & -2142002 & -214200 \\ \hline 1 & -2142000 & -214000 \\ \hline 1 & -214000 & -214000 \\ \hline 1 & -2140000 & -214000 \\ \hline 1 & -2140000 & -214000 \\ \hline 1 & -2140000 & -2140000 \\ \hline 1 & -2140000 & -2140000 \\ \hline 1 & -2140000 & -2140000 \\ \hline 1 & -21400000 & -2140000 \\ \hline 1 & -2140000 \\ \hline 1 & -2140000 & -2140000 \\ \hline 1 & -2$		04410
1x.34MDEFAULT ACTION: RESET ANFCTR = 1.0) 1000 FORMAT (11) 1000 FORMAT (1014,365.0) 1080 FORMAT (1014,365.0) 1080 FORMAT (111,5X,25MSTART PUMPING PERIOD NO., 12//2X,75HTHE FOLLOWIN 84400 10 THE STEP, PUMPAGE, AND PRINT PARAMETERS HAVE BEEN REDEFINED:/) 1090 FORMAT (1HC,14X,9HNTIM = ,14/15X,9HNPNT = ,14/15X,9HNPNTW = ,14/15X,9HNPTW = ,14/15X,9HNP	1030	FURMAI (IMU/DX/40H*** WARNING ***	ANFLIR WAS SPELIFIED AS U.U/25	84420
1060 FORMAT (11)       84440         1070 FORMAT (1014,365.0)       84450         1080 FORMAT (114,352,25NSTART PUMPING PERIOD NO.,12//22,75NTHE FOLLOWIN       84450         11000 FORMAT (114,352,25NSTART PUMPING PERIOD NO.,12//22,75NTHE FOLLOWIN       84460         11000 FORMAT (114,352,25NSTART PUMPING PERIOD NO.,12//22,75NTHE FOLLOWIN       84450         11001 FORMAT (114,352,25NSTART PUMPING PERIOD NO.,12//22,75NTHE FOLLOWIN       84450         11001 FORMAT (114,352,25NSTART PUMPING PERIOD NO.,12//22,75NTHE FOLLOWIN       84450         2NPNTVL = ,14/15X,94NTIM = ,14/15X,94NPNT = ,14/15X,94NPNCHV =       84500         2NPNTVL = ,14/15X,94NPINT = ,14/15X,94NPNCHV = ,14/15X,94NPNCHV =       84500         40,37)       84500       84500         1100 FORMAT (11 + ,46X,E10.3)       84530         80BROUTINE ITERAT       C 100         DUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C 100         REAL * 850EL,YDELS, SAREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 400         COMMON /PRMI/ NIM,NPPNPNT,NITP,N,NX,NY,NP,NBREC,INT,NNX,NNY,NUMO       C 600         105,NMOV,IMCV,MPMAX,ITMAX,NICRIT,PRN,NPTPND,NPNTVL,NPNTV,NNNN C 600       105,NMOV,INCV,MPAX,ITMAX,NICRIT,PRNT,NPTPND,NPNTVL,NPNTVL,NPNTV,NPNTVL,NPNTV,NUMO         C 0MMON /PRMI/ NIM,NPPNPNY,NITP,N,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,NY,N		1x,34HDEFAULT ACTION: RESET ANFCTR =	= 1.0)	B4430
1070       FORMAT       (1014,365.0)       64450         1080       FORMAT       (1014,365.0)       64460         10       TIME       FORMAT       (1014,365.0)       84400         1090       FORMAT       (114,37,254,54,74,04,04,07)       =,11/15X,94,04,04       84400         11090       FORMAT       (114,34,394,04,04,07)       =,11/15X,94,04,04       =,14/15X,94,04,04       84400         200       FORMAT       (114,35X,94,04,04,02)       =,14/15X,94,04,04       =,44/15X,94,04,04       84400         3,14/15X,94,04,04       =,14/15X,94,04,04       =,14/15X,94,04,04       =,44/15X,94,04       84500         3,14/15X,94,04,04       =,14/15X,94,04,04       =,14/15X,94,04       =,44/15X,94,04       84500         400,3/0       SUBROUTINE       ITERAT       C       1000       60450       84540         SUBROUTINE       ITERAT       C       20       84540       20       84540       20       20       84540       20       20       84540       20       20       84540       20       20       84540       20       20       20       20       84540       20       20       20       20       20       20       20       20       20       20	1060	FORMAT (11)		84440
1080       FORMAT       (1H1>5X,25HSTART       PUMPING       PERIOD       NO. ,12//2X,75HTHE       FOLLOWIN       B4460         10       16 TIME       STEP, PUMPAGE, AND PRINT       PARAMETERS       HAVE       B4480         1090       FORMAT       (1Hc,14X,94NTIM       = ,14/15X,94NPT       = ,14/15X,94NPNT       = ,14/15X,94NPNTW       ,14/15X,94NPNTW       = ,14/15X,94	1070	FORMAT (1014,365.0)		84450
1000       FORMAT       CHURAGE, AND PRINT PARAMETERS       HAVE BEEN REDEFINED;)       B4430         1090       FORMAT       CHURAGE, AND PRINT       PARAMETERS       HAVE BEEN REDEFINED;)       B4430         114/15X,9HITMAX       = J14/15X,9HNPNT       = J14/15X,9HNPNTW	1080	ENDMAT (191.57.2545TADT DUMDING DE		84440
16 TIME STEP, PUMPAGE, AND PRINT PARMETERS HAVE BEEN REDEFINED;) 84400 1090 FORMAT (1HC,14X,9HNTIM = ,14/15X,9HNPNT = ,14/15X,9HNPNTW = ,14/15X,9H 114/15X,9HITMAX = ,14/15X,9HNPNT = ,14/15X,9HNPNTW = ,14/15X,9HNPNCHV = 84500 2NPNTVL = ,14/15X,9HNPNT = ,110.3/15X,9HTIMX = ,F10.3/15X,9HTINIT = ,F1 84510 40.3/) 1100 FORMAT (1H ,46X,e10.3) END SUBROUTINE ITERAT DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE C 100 REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE C 300 REAL *8DEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HNIN,PYR C 400 1BS,NMOV,IMCV,NPMAX,ITMAX,PIC,TIT,IPN,NX,NY,NP,NREC,INT,NNX,NY,NUMO C 600 1BS,NMOV,PRM// NDEID(20,20),PERM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /PRMK/ NODEID(20,20),PERM(20,20),LIMBO(500),IXOBS(5),IYOB C 0MMON /PRMK/ NODEID(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /PRMK/ NODEID(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20),PERM(20,20),LIMBO(500,ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20),PERM(20,20),HI(20,20),HR(20,20),HC(20,C) C 120),HK(20,20),WIC(20,20),PERM(20,20),HI(20,20),HR(20,20),HC(20,C) C 120),HK(20,20),WIC(20,20),PERM(20,20),HI(20,20),HR(20,20),HC(20,C) C 1420),HK(20,20),WICV,NV,ARINV,PORINV C 150 C 0MMON /BALM/ TOTLQ CCOMPUTE ROW AND COLUMN CCOMPUTE ROW AND COLUMN C 220 C +ROW COMPU	1000	FURMAT (THTPSA/25HSTART FUMPING PER	RIUD NU. DIZTIZADIJNIHE FULLUWIN	D4400
1090 FORMAT (1HC,14X,9HNTIM = ,14/15X,9HNPNT = ,14/15X,9HNPNT = ,14/15X,9HNPNT = ,14/15X,9HNPNTW = ,14/15X,9HNPNTWL = ,14/15X,9HNPNTWL = ,14/15X,9HNPNTWL = ,14/15X,9HNPNTW = ,14/15X,9HNPNTWL = ,14/15X,9HNPTWL = ,110,100,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00PT,100,00,00PT,100,00PT,100,00PT,100,00PT,100,00P		TG TIME STEPP PUMPAGEP AND PRINT PA	RAMETERS HAVE BEEN REDEFINED://	B447U
<pre>114/15X,9H1TMAX = ,14/15X,9HNPREC = ,14/15X,9HNPNTW = ,14/15X,9H PNTWL = ,14/15X,9HNPNCHV = B4500 2NPNTVL = ,14/15X,9HNPNTD = ,14/15X,9HNPDELC = ,14/15X,9HNPNCHV = B4500 3,14/15X,9HPINT = ,F10.3/15X,9HTIMX = ,F10.3/15X,9HTINT = ,F1 B4510 40.3/) 1100 FORMAT (1H ,46X,E10.3) END SUBROUTINE ITERAT C 100 DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS C 100 REAL *8TMEX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE C 30 REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR C 40 REAL *8B,G,W,A,C,F,F,DR,DC,TBAR,TMK,COFF,BLH,BRK,CHK,QL,BRH C 0MMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,MP,NRC,INT,NNX,NNY,NUMO C 60 18S,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPTNU,NPNTVL,NPNTD,N C 70 2PNCHV,NPDELC C 0MMON /PRKK/ NODEID(20,20),PERM(20,20),TIMUL(5,50),TMOBS(50),ANFCTR C 110 C 0MMON /HEDA/ THCK(20,20,20,20),PERM(20,20),HI(20,20),HR(20,20),HC(20, C 120 120),HK(20,20),WT(20,20),REC(20,20),RECH(20,20),TIM(100),AOPT(20),T C 130 2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR C 140 C 0MMON /ALM/ TOTLQ CCOMPUTE ROW AND COLUMN CCALL NEW ITERATION PARAMETER 10 REMN=MOD(KOUNT,NITP) IF (REMN,EQ.0) NTH=0 NTH=NTH1 PARAM=AOPT(NTH) C 2770 C ++++++++++++++++++++++++++++++++++++</pre>	1090	FORMAT (1HC,14X,9HNTIM = ,14/15X	,9HNPNT = ,14/15X,9HNITP = ,	84480
2NPNTVL = ,14/15X,9HNPNTD = ,14/15X,9HNPDELC = ,14/15X,9HNPNCHV =       B4500         3,14/15X,9HPINT = ,F10.3/15X,9HTIMX = ,F10.5/15X,9HTINIT = ,F1       B4510         40,3/)       B4520         1100 FORMAT (1H ,46X,E10.3)       B4530         END       C 10         DUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C 20         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,A0PT,TITLE       C 30         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,A0PT,TITLE       C 30         REAL *8DEL,YDEL,S,AREA,SUMT,RH0,PARM,TEST,TOL,PINT,HMIN,PYR       C 40         REAL *8B,G,W,A,C,E,F,DR,DC,TBAR,TMK,COEF,BLH,BRX,CHK,QLSRH       C 50         COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO       C 60         1BS,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,FIPNT,NPTPND,NPNTV,NPNTV,NPNTV,NPNTV,NC       C 70         2PNCHV,NPDELC       C 60         COMMON /PRMK/ NOEID(20,20),PERM(20,20),TIMUL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TMUL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDB/ TMRX(20,20,20),PERM(20,20),TIMUL(5,50),TMOBS(50),ANFCTR       C 110		114/15X,9HITMAX = ,14/15X,9HNREC	$= 14/15 \times 9HNPNTMV = 14/15 \times 9H$	B4490
3/14/15 X,9HPINT = /FI0.3/15 X,9HTIMX = /FI0.3/15 X,9HTINIT = /FI       B4510         40.3/)       B4520         1100 FORMAT (1H /46 X,E10.3)       B4520         END       C10         DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C100         REAL *8TMRX,VPRM,H1,HR,HC,HK,WT,REC,RECH,TIM,A0PT,TITLE       C30         REAL *8SDEL,YDEL,S,AREA,SUMT,RH0,PARAMATEST,TOL,PINT,HMIN,PYR       C40         C0MMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO       C60         1105,NMOV,IMGV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPNREC/INT,NNX,NNY,NUMO       C60         1106,NMOV,PMK/ NODEID(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C100         C0MMON /PRKK/ NODEID(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C100         C1100, COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C110         C0MMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C1100         C1100, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C150         C1100, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C150         C1110, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C150         C1100, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C150         C1100, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C150         C1100, XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,		2NPNTVI = . 14/158.9HNPNTD = . 14/15	$x_0$ HNPDELC = .T4/15x_0 HNPNCHV =	84500
3/14/17/3/9/11/11       2       2       2       3		$z_{11} (1) (z_{12} - y_{13} (1) (y_{13} $	$\mathbf{N} = \mathbf{F} 1 0 1 1 5 \mathbf{V} 0 0 1 1 1 1 1 1 1 1$	04500
40.37)       B4520         1100 FORMAT (1H ,46X,E10.3)       B4530         END       SUBROUTINE ITERAT       C 10         DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C 20         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C 30         REAL *8D,G,W,A,C,C,F,DR,DC,TBAR,IMK,COEF,BUH,BRK/CKK,QL,BRH       C 50         COMMON /PRMI/ NTM,NPMP,NNT,NITP,N,NX,NY,NVP,NVEC/INT,NXX,NY,NUMO       C 60         1BS,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NREC/INT,NXX,NY,NVMON       C 60         COMMON /PRMK/ NODEID(20,20),PRCELL(20,20),LIMBO(500),IXOBS(5),IYOB       C 90         1S(5)       C 00MON /PRMK/ NODEID(20,20),PRM (20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 100         COMMON /HEDA/ THCK (20,20),PRCELL(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 100         COMMON /HEDA/ THCK (20,20),PRM (20,20),TMWL (5,50),TMOBS(50),ANFCTR       C 100         COMMON /HEDA/ THCK (20,20),REC(20,20),TMUL (5,50),TMOBS(50),ANFCTR       C 100         COMMON /HEDA/ THCK (20,20),REC(20,20),TMUL (5,50),TMOBS(50),ANFCTR       C 100         COMMON /HEDA/ THCK (20,20),REC(20,20),TMUL (20,20),TM(100),AOPT(20),T       C 130		5/14/15////PINI = ///0.5/15////11	MX = Priu + 27 i 2X P + M + 1 N + 1 = Pri	84510
1100 FORMAT (1H ,46x,E10.3)       B4530         END       B4540         SUBROUTINE ITERAT       C 100         DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C 200         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C 300         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C 300         REAL *8B,G,W,A,C,E,F,DR,DC,TBAR,TMK,COEF,BLH,BRK,CHK,QL,BRH       C 500         COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO       C 600         18S,NMOV,INCV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPNTWV,NPNTVL,NPNTD,N       C 700         2PNCHV,NPDELC       C 800         COMMON /PRMK/ NODEID(20,20),PCELL(20,20),LIMB0(500),IX0BS(5),IY0B       C 900         1S(S)       C 1000         COMMON /HEDA/ THCK (20,20),PERM (20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 1000         COMMON /HEDB/ TMRX (20,20),PERM (20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 1000         COMMON /HEDB/ TMRX (20,20),PERM (20,20),TIM(100),AOPT (20),T       C 1300         211LE(10),XDEL,YDEL,SAREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 420         C 0MMON /ABLM/ TOTLQ       C 1500         C 0MMON /ALM/ TOTLQ       C 1500         C 0MMON /ALM/ TOTLQ       C 1500         C 11L(10),XDEL,YDEL,SAREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 1400         C 0MMON /ALM/ TOTLQ       C 150		40.3/)		B4520
END       B4540         SUBROUTINE ITERAT       C         DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C         REAL *8SDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C         COMMON /RMI/ NTIM,NPPN,NTTP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO       C         COMMON /RMK/ NTIM,NPPN,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO       C         COMMON /RMK/ NODEID(20,20),NPCELL(20,20),LIMB0(500),IXOBS(5),IYOB       C         COMMON /PRKK/ NODEID(20,20),PERM (20,20),TMUL(5,50),TMOBS(50),ANFCTR       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20, C       C         COMMON /HEDA/ THCK (20,20),PERM (20,20),HI (20,20),HI (20,20),HC (20,C)       C         COMMON /HEDA/ THCK (20,20),PEC (20,20),PEC (20,20),HI (20,20),HI (20,20),HC (20,C)       C         COMMON /HEDA/ T	1100	FORMAT (1H #46X#E10_3)		B4530
SUBROUTINE ITERAT       C 10         DOUBLE PRECISION DMIN1,DEXP,DLOG,DABS       C 20         REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE       C 30         REAL *8DEL,SYAEA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 40         REAL *8B,G,W,A,C,E,F,DR,DC,TBAR,TMK,COEF,BLH,BRK,CHK,QL,BRH       C 50         COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NVMO       C 60         1BS,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,IPRNT,NTPPND,NPNTWV,NPNTVL,NPNTD,N       C 70         2PNCHV,NPDELC       C 80         COMMON /PRMK/ NODEID(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TIMUL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TIMUL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TIMUL(5,50),TIMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TIMUL(5,50),TIMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PERM(20,20),TIMUL(5,50),TIMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PECL(20,20),TIMUL(5,50),TIMOBS(50),ANFCTR       C 110         COMMON /HEDA/ THCK (20,20),PECL(20,20),FECH (20,20),FIN(100),AOPT(20),T       C 130         CITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 1400		END		B4540-
SUBNOUTINE TIERAT       C 100         DOUBLE PRECISION DMIN1>DEXP>DLOG>DABS       C 200         REAL *8TMRX>VPRM>HI>HR,HC>HK>WT>REC>RECH>TIM_AOPT>TITLE       C 300         REAL *8XDEL>YDEL>S>AREA>SUMT>RHOPARAM>TEST>TOL>PINT>HMIN>PYR       C 400         REAL *8B>G,W,A>C,F,F,DR>DC>TBAR>TMK>COEF,BLH>BRK>CHK>QL>RINT>HMIN,PYR       C 400         REAL *8B>G,W,A>C,F,F,DR>DC>TBAR>TMK>COEF,BLH>BRK>CHK>QL>RINT>NNY>NUMO       C 600         1BS>NMOV,IMCV>NPMAX>ITMAX>NZCRIT>IPRNT>NPTPN>NX>NY>NPN RECLINT>NNX>NNY>NUMO       C 600         1BS>NMOV,IMCV>NPMAX>ITMAX>NZCRIT>IPRNT>NPTPND>NPTMV>NPNTVL>NPNTD>N       C 700         2PNCHW>NPDELC       C 800         COMMON /PRMK/ NODEID(20,20)>NPCELL(20,20)>LIMB0(500)>IXOBS(5)>IYOB       C 900         1S(5)       C 1000         COMMON /HEDA/ THCK(20,20)>PERM(20,20)>TMWL(5,50)>TMOBS(50)>ANFCTR       C 1100         COMMON /HEDA/ TMRX(20,20)>REC(20,20)>HI(20,20)>HI(20,20)>HC(20)       C 120)         120)>HK (20,20)>WT(20,20)>REC(20,20)>RECH(20,20)>HI(20,20)>HC(20)>T       C 1300         21TLE(10)>XDEL>YDEL>SAREA>SUMT>RHO,PARAM,TEST>TOL>PINT>HMIN>PYR       C 1400         COMMON /BALM/ TOTLQ       C 1500       C 1500         COMMON /XINV/ DXINV>DYINV>ARINV>PORINV       C 1600       C 1500         DIMENSION W(20)> B (20)> G (20)       C 1400       C 1500         CCALL NEW ITERATION PARAMETER       C		SUDDALLTING TEDAT		c 10
DOUBLE PRECISION DMINT, DEAP, DLOG, DABS       C 200         REAL +8TMRX, VPRM, HI, HR, HC, HK, WT, REC, RECH, TIM, AOPT, TITLE       C 30         REAL +8TMRX, VPRM, HI, HR, HC, HK, WT, REC, RECH, TIM, AOPT, TITLE       C 30         REAL +8DDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR       C 40         REAL +8B, G, W, A, C, E, F, DR, DC, TBAR, TMK, COEF, BLH, BRK, CHK, QL, BRH       C 50         COMMON /PRMI/ NTIM, NPMP, NPNT, NITP, N, NY, NP, NREC, INT, NNX, NNY, NUMO       C 60         1BS, NOV, IMCV, NPMAX, ITMAX, NZCRIT, IPRNT, NPTPND, NPNTW, NPNTVL, NPNTD, N       C 70         2PNCHV, NPDELC       C 00MMON /PRMK/ NODEID(20, 20), NPCELL(20, 20), LIMBO(500), IXOBS(5), IYOB       C 90         1S(S)       C 00MMON /HEDA/ THCK (20, 20), PERM (20, 20), TMWL(5, 50), TMOBS (50), ANFCTR       C 110         C 0MMON /HEDB/ TMRX (20, 20, 2), VPRM (20, 20), HI (20, 20), HR (20, 20), HC (20, C 120       C 120         120) +K (20, 20), JUT (20, 20), REC (20, 20), HI (20, 20), HR (20, 20), HC (20), T (20), T (20), T (20), Z       C 140         C 0MMON /XINV/ DXINV, DYINV, ARINV, PORINV       C 140         C 0MMON /XINV/ DXINV, DYINV, ARINV, PORINV       C 140         C 100       CUMMON /XINV, DXINV, DYINV, ARINV, PORINV       C 140         C 100       CUMMON /XINV, DXINV, DYINV, ARINV, PORINV       C 140         C 100       COMMON /XINV, DYINV, ARINV, PORINV       C 140 <td< td=""><td></td><td>SUDRUCTING TIERAT</td><td></td><td>0 10</td></td<>		SUDRUCTING TIERAT		0 10
REAL *8TMRX.VVPRM.HI,H, #, HC, HK, WT, REC, RECH, TIM.A0PT, TITLE       C 30         REAL *8XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR       C 40         REAL *8B, G, W, A, C, E, F, DR, POC, TBARA, TMK, COEF, BLH, BRK, CHK, GL, BRH       C 50         COMMON /PRMI/ NTIM, NPMP, NPNT, NITP, N, NX, NY, NP, NREC, INT, NNX, NNY, NUMO       C 60         1BS, NMOV, IMGY, NPMAX, ITMAX, NICRIT, IPRNT, NPTPND, NPNTWV, NPNTVL, NPNTD, N       C 70         2PNCHV, NPDELC       C 80         COMMON /PRMK/ NODE ID (20, 20), NPCELL (20, 20), LIMBO (500), IXOBS (5), IYOB       C 100         1S (S)       C 1000         C 0MMON /HEDA/ THCK (20, 20, 20), PERM (20, 20), TMWL (5, 50), TMOBS (50), ANFCTR       C 110         C 0MMON /HEDA/ THCK (20, 20, 20, VPRM (20, 20), HI (20, 20), HR (20, 20), HC (20), C 120       C 120         12D) + K (20, 20), WT (2D, 20), PEC (20, 20), PEC (120, 20), TIM (10D), AOPT (20), T 130       C 130         2ITLE (10), XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR       C 1400         C 0MMON /BALM/ TOTLQ       C 150       C 170         C 0MMON /BALM/ TOTLQ       C 160         C 0COMPUTE ROW AND COLUMN       C 200		DOUBLE PRECISION DMINT, DEXP, DLOG, D	ABS	C 20
REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 40         REAL *8B,G,M,A,C,E,F,DD,DC,TBAR,TMK,COEF,BLH,BRK,CHK,QL,BRH       C 50         COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,X,NY,NP,NREC,INT,NNX,NNY,NUMO       C 60         1BS,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPNTWL,NPNTVL,NPNTD,N       C 70         2PNCHV,NPDELC       C 80         COMMON /PRKK/ NODEID(20,20),NPCELL(20,20),LIMB0(500),IX0BS(5),IY0B       C 90         1S(S)       C 100         COMMON /HEDA/ THCK (20,20),PERM (20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 1100         COMMON /HEDB/ TMRX (20,20,2),VPRM (20,20),HI (20,20),HI (20,20),HC (20),C 1 20       C 100         2D),HK (20,20),WT (20,20),REC (20,20),FECH (20,20),TIM (100),AOPT (20),T C 130       C 150         2ITLE (10),XDEL,YDEL,SAREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 1400         COMMON /BALM/ TOTLQ       C 150         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C 160         DIMENSION W(20), B (20), G (20)       C 1700         C      COMPUTE ROW AND COLUMN       C 200         C      COMPUTE ROW AND COLUMN       C 210         C      COMPUTE ROW AND COLUMN       C 220         IF (REMN_EQ.0) NTH=0       C 230         IF (REMN_EQ.0) NTH=0       C 230         IF (REMN_EQ.0) NTH=0       C 240		REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,RE	C,RECH,TIM,AOPT,TITLE	<b>c</b> 30
REAL *8B,G,W,A,C,E,F,DR,DC,TBAR,TMK,COEF,BLH,BRK,CHK,QL,BRH       C 50         COMMON /PRMI/ NTIM,PMPP,PNT,NITP,A,NX,NY,PN,REC,INT,NNX,NNY,NUMO       C 60         1BS,NMOV,IMCV,NPMAX,ITMAX,NICRIT,IPRNT,NPTPND,NPNTCL,NNX,NNY,NUMO       C 60         2PNCHV,NPDELC       C 80         COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMB0(500),IXOBS(5),IYOB       C 90         1S(5)       C 100         COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 1100         COMMON /HEDA/ THCK(20,20),REC(20,20),FM(20,20),HR(20,20),HC(20,C)       C 120         120),HK(20,20),WI(20,20),REC(20,20),REC(120,20),TIM0D),AOPT(20),T       C 130         21TLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 1400         COMMON /BALM/ TOTLQ       C 150         COMMON /SALM/ TOTLQ       C 1700         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C 1600         DIMENSION W(20), B (20), G (20)       C 1700         C      COMPUTE ROW AND COLUMN       C 200         C      CALL NEW ITERATION PARAMETER       C 2100         10 REMN=MOD(KOUNT,NITP)       C 2200       C 2200         IF (REMN.EQ.0) NTH=0       C 2200         NTH=NTH+1       C 2400         PARAM=AOPT(NTH)       C 2400         CROW COMPUTATIONS       C 2400 </td <td></td> <td>REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,P</td> <td>ARAM, TEST, TOL, PINT, HMIN, PYR</td> <td>C 40</td>		REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,P	ARAM, TEST, TOL, PINT, HMIN, PYR	C 40
COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,M,XX,NY,NP,NREC,INT,NNX,NNY,NUMO C 60 1BS,NMOV,IMCV,NPMAX,ITMAX,NZCRIT,IPRNT,NPTPND,NPNTWV,NPNTVL,NPNTD,N C 70 2PNCHV,NPDELC C C 80 COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB C 90 1S(5) C 100 COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR C 110 COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HC(20,C 120) 120),HK(20,20),WT(20,20),REC(20,20),FECH(20,20),HR(20,20),HC(20,C 120) 120),HK(20,20),WT(20,20),REC(20,20),FECH(20,20),TIM(100),AOPT(20),T C 130 2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR C 140 COMMON /BALM/ TOTLQ COMMON /BALM/ TOTLQ COMMON /KALM/ TOTLQ C ************************************		REAL +8B+G+W+A+C+F+F+DR+DC+TBAR+TM	KACOEFABLHABRKACHKAQLABRH	C 50
1BS,NOV,JNC,NPMAX,JITMAX,NZCRIT,JPPNT,NPTPND,NPNTWV,NPNTVL,NPNTD,N       C         2PNCHV,NPDELC       C         COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMB0(500),IX0BS(5),IY0B       C         1S(5)       C         COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C         COMMON /HEDA/ THCK(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,C)       C         12D),HK(20,20),WT(20,20),REC(20,20),HR(20,20),HR(20,20),HC(20,C)       C         12D),HK(20,20),WT(20,20),REC(20,20),HR(20,20),HR(20,20),HC(20,C)       C         2ITLE(10),XDEL,YDEL,SAREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C         COMMON /BALM/ TOTLQ       C       140         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C       160         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C       160         C ************************************		COMMON / DOMT / NITTH NOMO NONT NITTO		6 60
1057NH0V/INGV/NPMAX/IIMAX/NLLKII/IPRNI/NPIPND/NPNIHV/NPNIVL/NPNTVL/NPNTD/N       C 70         2PNCHV/NPDELC       C         COMMON /PRMK/ NODEID(20,20),NPCELL(20,20)/LIMB0(500)/IX0BS(5)/IY0B       G 90         1S(5)       C         COMMON /HEDA/ THCK (20,20)/PERM (20,20)/TMWL(5,50)/TM0BS(50)/ANFCTR       C 110         COMMON /HEDA/ TMCX (20,20)/PERM (20,20)/HI (20,20)/HR (20,20)/HC (20, C 120)       120         120)/HK (20,20)/WT (20,20)/REC (20,20)/FI (20,20)/TIM (100)/A0PT (20)/T       C 130         21TLE (10)/XDEL/SAREA/SUMT/RH0/PARAM/TEST,TOL/PINT/HMIN/PYR       C 140         COMMON /HEDA/ TOTLQ       C 150         COMMON /XINV/ DXINV/DYINV/ARINV/PORINV       C 160         COMMON /XINV/ DXINV/DYINV/ARINV/PORINV       C 160         C +************************************		A C MACH TRANSPORT TO THE PREMIUNITY AND A STATE TO		
2PNCHV,NPDELC       C 80         COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IX0BS(5),IY0B       C 90         1S(5)       (100         COMMON /HEDA/ THCK (20,20),PERM (20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDB/ TMRX(20,20,2),VPRM (20,20),HI(20,20),HR(20,20),HC(20, C 120       (20,20),WT(20,20),WT(20,20),FEC(20,20),FEC(20,20),FIM(100),AOPT(20),T       C 130         217LE(10),XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR       C 140         COMMON /BALM/ TOTLQ       C 150         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C 160         DIMENSION W(20), B (20), G (20)       C 170         C      COMPUTE ROW AND COLUMN       C 200         C      CALL NEW ITERATION PARAMETER       C 210         10       REMN=MOD (KOUNT,NITP)       C 220         IF (REMN,EQ.0) NTH=0       C 230         NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 250         C      ROW COMPUTATIONS       C 250		TBS/NMOV/IMCV/NPMAX/IIMAX/NZCRII/IP	RNT/NPTPND/NPNIMV/NPNTVL/NPNTD/N	C /U
COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMB0(500),IXOBS(5),IYOB       C 90         1S(5)       C 100         COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR       C 110         COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20, C 120       120),HK(20,20),WT(20,20),REC(20,20),REC(H(20,20),TIM(100),AOPT(20),T C 130         21TLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 140         COMMON /BALM/ TOTLQ       C 150         COMMON /BALM/ TOTLQ       C 160         COMMON /BLM/ TOTLQ       C 160         COMMON /BALM/ TOTLQ       C 200         C      COMPUTE ROW AND COLUMN       C 200         C      COMPUTE ROW AND COLUMN       C 210         C      CALL NEW ITERATION PARAMETER       C 210         If (REMN.EQ.0) NTH=0       C 240         NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 240		ZPNCHV, NPDELC		C 80
1S(5)       C 100         COMMON /HEDA/ THCK (20,20), PERM (20,20), TMWL (5,50), TMOBS (50), ANFCTR       C 110         COMMON /HEDB/ TMRX (20,20,2), VPRM (20,20), HI (20,20), HR (20,20), HC (20, C 120       120)         120), HK (20,20), WT (20,20), REC (20,20), REC (120,20), TIM (100), AOPT (20), T C 130       130         21TLE (10), XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR       C 140         COMMON /BALM/ TOTLQ       C 150         COMMON /BALM/ TOTLQ       C 150         COMMON /SALM/ TOTLQ       C 160         COMMON /SUNV/ DXINV/DXINV/PORINV       C 160         DIMENSION W(20), B (20), G (20)       C 170         C      COMPUTE ROW AND COLUMN       C 200         C      CALL NEW ITERATION PARAMETER       C 210         IF (REMN.EQ.0) NTH=0       C 230         NTH=NTH+1       C 240         PARAM=AOPT (NTH)       C 240		COMMON /PRMK/ NODEID(20,20),NPCELL	(20,20),LIMBO(500),IXOBS(5),IYOB	C 90
COMMON /HEDA/ THCK (20,20), PERM (20,20), TMWL (5,50), TMOBS (50), ANFCTR C 110 COMMON /HEDB/ TMRX (20,20,2), VPRM (20,20), HI (20,20), HR (20,20), HC (20, C 120 120), HK (20,20), WT (20,20), REC (20,20), RECH (20,20), TIM (100), AOPT (20), T C 130 2ITLE (10), XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR C 140 COMMON /BALM/ TOTLQ C 150 COMMON /KALM/ TOTLQ C 150 COMMON /XINV/ DXINV, DYINV, ARINV, PORINV C 160 COMMON /XINV/ DXINV, DY INV, ARINV, PORINV C 160 C ************************************		15(5)		1 100
COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20, C 120) 120),HK(20,20),WT(20,20),REC(20,20),RECH(20,20),TIM(100),A0PT(20),T C 130 2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RH0,PARAM,TEST,TOL,PINT,HMIN,PYR C 140 COMMON /BALM/ TOTLQ C 150 COMMON /XINV/ DXINV,DYINV,ARINV,PORINV C 160 COMMON /XINV/ DXINV,DYINV,ARINV,PORINV C 160 C ************************************		CONMON /HEDA/ THERIDA - 201 - PERMISO	20). THUI (5.50) - THORE (50) ANECTO	c 110
COMMON /HEDB/ IMEX(20,20,20,20,20,20,20,20,20,20,20,20,20,2		COMMON /NEVA/ INCK(20/20//FERM(20/)	EU/FINWES/JJJU/FINUD3SJJU/FANFUIK	6 4 3 0
12D)+HK (2D,2D), WT (2D,2D), REC (20,2D), RECH (20,2D), TIM (10D), AOPT (20), T       C       130         2ITLE(10), XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR       C       140         COMMON /BALM/ TOTLQ       C       150         COMMON /BALM/ TOTLQ       C       150         COMMON /BALM/ TOTLQ       C       160         COMMON /XINV/ DXINV, DYINV, ARINV, PORINV       C       160         DIMENSION W(20), B(20), G(20)       C       170         C       ************************************		COMMON THEDET IMEX(20,20,2),VPRM(2)	U = C U = H = (C U = C U = H R (C U = C U = H C (C U = C U = C U = H C (C U = C U = C U = H C (C U = C U = C U = C U = H C (C U = C U =	C 120
2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR       C 140         COMMON /BALM/ TOTLQ       C 150         COMMON /XINV/ DXINV,DYINV,ARINV,PORINV       C 160         DIMENSION w(20), B(20), G(20)       C 170         C       ************************************		120)/HK(20,20)/WT(20,20)/REC(20,20)	<pre>/RECH(20/20)/TIM(100)/AOPT(20)/T</pre>	C 130
COMMON /BALM/ TOTLQ       C 150         COMMON /XINV/ DXINV/DYINV/ARINV/PORINV       C 160         DIMENSION w(20), B(20), G(20)       C 170         C       ************************************		2ITLE(10), XDEL, YDEL, SAREA, SUMTARHO	PARAM, TEST, TOL, PINT, HMIN, PYR	C 140
COMMON /XINV/ DXINV/DYINV/ARINV/PORINV       C 160         DIMENSION w(20), B(20), G(20)       C 170         C       ************************************		COMMON /BALM/ TOTLA		C 150
Common / XINV/ DXINV/DTINV/ARINV/PORINV       C 180         DIMENSION w(20), B(20), G(20)       C 170         C       ************************************		COMMON /VINU/ NVINU-NVINU-ADINU DO	DTMV	6 140
DIMENSION W(20), B(20), G(20) C ************************************		COMMON FAINAS AND	KT MA	C 100
C       ************************************		DIMENSION w(20), B(20), G(20)		C 170
KOUNT=0       C 190         C      COMPUTE ROW AND COLUMN       C 200         C      CALL NEW ITERATION PARAMETER       C 210         10       REMN=MOD(KOUNT,NITP)       C 220         IF (REMN.EQ.O) NTH=0       C 230         NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 250         C      ROW COMPUTATIONS       C 270	С	*****	******	C 180
C      COMPUTE ROW AND COLUMN       C       200         C      CALL NEW ITERATION PARAMETER       C       210         10       REMN=MOD (KOUNT,NITP)       C       220         If (REMN.EG.O) NTH=0       C       230         NTH=NTH+1       C       240         PARAM=AOPT(NTH)       C       250         C      ROW COMPUTATIONS       C		KOUNT=0		C 190
C      CALL NEW ITERATION PARAMETER       C       210         10       REMN=MOD(KOUNT,NITP)       C       220         IF       (REMN.EQ.O) NTH=0       C       230         NTH=NTH+1       C       240         PARAM=AOPT(NTH)       C       250         C      ROW COMPUTATIONS       C       260	r			c 200
C      CALL NEW TIERATION PARAMETER       C 210         10       REMN=MOD(KOUNT,NITP)       C 220         IF (REMN.EQ.0) NTH=0       C 230         NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 250         C       ************************************		CALL NEW TRECTION CALCURATE		
10       REMN=MOD(KOUNT,NITP)       C       220         IF       (REMN.EQ.0) NTH=0       C       230         NTH=NTH+1       C       240         PARAM=AOPT(NTH)       C       250         C       ************************************	L	LALL NEW TIERATION PARAMETER		C 210
IF (REMN.EQ.O) NTH=0       C 230         NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 250         C       ************************************	10	REMN=MOD(KOUNT,NITP)		C 220
NTH=NTH+1       C 240         PARAM=AOPT(NTH)       C 250         C       ************************************		IF (REMN_EQ.O) NTH=O		C 230
PARAM=AOPT(NTH)       C 250         C       ************************************		NTH=NTH+1		c 240
C +************************************		PARAM=AOPT(NTH)		r 250
CROW COMPUTATIONS C 270	~		******	C 200
CROW COMPUTATIONS C 270	L		~~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	L 20U
	С	ROW COMPUTATIONS		C 270

FORTRAN	IV	program	listing-	Continued
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			-	
		TEST=0.0	Ç	280
		RHO=S/TIM(N)	С	290
		88K=-8H0	С	300
			ř	310
			ž	320
			Ľ	220
			C	330
		B(M)=0_0	С	340
		G(M)=0_0	C	350
	20	CONTINUE	Ċ	360
	20		č	220
			L	570
		IF (THCK(IX,IY)_EQ.U.U) GO TO 30	C	380
		COEF=VPRM(IX/IY)	C	390
		QL=-COEF+WT(IX/IY)	C	400
			ř	410
			ž	100
			L	420
		E=TMRX(IX,IY-1,2)+DYINV	C	430
		F=TMRX(IX,IY,2)+DYINV	C	440
		TBAR=A+C+E+F	C	450
			r	4 4 0
			2	170
			L	470
		BRH=E+F-TMK	С	480
		DR=BRH*HC(IX,IY)+BRK*HK(IX,IY)-E*HC(IX,IY-1)-F*HC(IX,IY+1)+QL+RECH	С	490
		1(IX/IY)+REC(IX/IY)*ARINV	C	500
		$  (1\mathbf{Y}) = \mathbf{P}       \mathbf{A} + \mathbf{P}( 1\mathbf{Y}  \mathbf{A}  A$	Ċ	510
			ž	520
			ι.	520
		G(IX)=(DR-A+G(IX-1))/W(IX)	С	530
	30	CONTINUE	C	540
C			C	\$50
č			č	560
C			č	570
		00 40 J=22NX	L	570
		I J = J - 1	С	580
		I S = NX ~ I J	С	590
	40	HR(15, 1Y) = G(15) - B(15) + HR(15+1, 1Y)	С	600
	50		č	610
-	20	CONTINUE	5	4.20
¢		***************************************	ι	620
С		COLUMN COMPUTATIONS	С	630
		DO 90 IX=1,NX	С	640
		DO 60 M=1.0NY	C	650
			ċ	660
			~	4.70
		B(M)=0_0	L	070
	60	G(M)=0.0	С	680
		DO 70 IY=1,NY	С	690
		$1 = (THCK(TX_{0}TX)_{0} = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, $	C	700
			ř	710
			2	710
		WL=-UUEr=WI(LX/IT)	Ĺ	120
		A=TMRX(IX,IY-1,2) * DYINV	С	730
		C=TMRX(IX,IY,2)*DYINV	С	740
		ESTMPY (TY-1,TY-1)+DYINV	c	750
			č	740
				700
		I BANFA TUTETE	ç	110
		TMK=TBAR*PARAM	C	780
		BLH=-A-C~RHO-COEF-TMK	C	790
		BRH=E+F-TMK	C	800
		$DC = BBH + HB(IX_IY) + BBK + HK(IX_IY) - F + HB(IX_I_IY) - F + HB(IX+I_IY) + OI + PECH$	č	810
		$\mathcal{L}$ is a set of the two set of t	~	820
			L A	020
		W(IY) = BLH - A + B(IY - 1)	C	830
		B(IY)=C/W(IY)	С	840
		G(IY)=(DC-A*G(IY-1))/W(IY)	C	850
	70	CONTINUE	C	860
r			ř	870
L A			2	990
C		BALK SUBSTITUTION	C	000
		DO 8U J=2/NY	C	890

-

		I – L – L – L	C 900
		I B=NY-I J	C 910
		HC(IX,IB)=G(IB)-B(IB)+HC(IX,IB+1)	C 920
		IF (THCK(IX,IB).EQ.0.0) GO TO 80	C 930
		CHK=DABS(HC(IX,IB)-HR(IX,IB))	C 940
		IF (CHK.GT.TOL) TEST=1.0	C 950
	80	CONTINUE	C 960
	90	CONTINUE	C 970
С		***************************************	C 980
		KOUNT=KOUNT+1	C 990
		IF (TEST.EQ.0) GO TO 120	C1000
		IF (KOUNT.GE.ITMAX) GO TO 100	C1010
		GO TO 10	C1020
C		******************	C1030
С		TERMINATE PROGRAM ITMAX EXCEEDED	C1040
	100	WRITE (6,160)	C1050
		DO 110 IX=1,NX	C1060
		DO 110 IY=1,NY	C 1070
	110	HK(IX/IY)=HC(IX/IY)	C1080
		CALL OUTPT	C1090
		STOP	C1100
C		***************	C1110
C		SET NEW HEAD (HK)	C1120
	120	DO 130 IY=1>NY	C1130
		DO 130 IX=1,NX	C1140
		IF (THCK(IX,IY).EQ.0.0) GO TO 130	C1150
		HR(IX,IY)=HK(IX,IY)	C1160
		HK(IX,IY)=HC(IX,IY)	C1170
С			C1180
C		COMPUTE LEAKAGE FOR MASS BALANCE	C1190
		IF (VPRM(IX,IY).EQ.0.0) GO TO 130	C1200
		DELQ=VPRM(IX,IY)+AREA+(WT(IX,IY)-HK(IX,IY))	C1210
		TOTLQ=TOTLQ+DELQ+TIM(N)	L1220
_	1 3 0	CONTINUE	C1230
¢			C1240
		WRITE (6,740) N	C1250
			C1270
L			C1290
•		RETURN	C1200
C C		*****	C1300
C c			C1310
C C			c1320
Ľ	1/0		C1330
	150	FURMAL (INU/JA/400 - $p$ 114) FORMAT (10 -29, 23UNUMBED OF ITEDATIONS - (17/)	(13/0
	160	FORMAL (IN PERFECTION TERMINATED = $p(14)$ FORMAL (IN SY 464++ FEFENTION TERMINATED = MAY NO ITEDATION	C1340
		(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,	c1340
			c1370-
			N 10
		300x0011xe	D 20
		REAL STARAWS REPRESENTATION PROVINCE AND A DAMA TEST TO A DINT WITH DYD	D 30
			0 10
		1RS_NMOV_IMOV_NPMAX_IIMAX_N7CRIT_IPPNT_NPIPNN_NPNTW_NPNTWI_NPNTN_N	D 50
	;	2PNCHV,NPDELC	D 60
	•	COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB	D 70
	•	15(5)	D 80
		COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR	D 90
		COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,	D 100
	4	120), HK (20,20), WT (20,20), REC (20,20), RECH (20,20), TIM (100), AOPT (20), T	D 110
	ä	2ITLE(10),XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR	D 120
		COMMON /CHMA/ PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY(20,	D 130
	1	120),CONINT(20,20),CNRECH(20,20),POROS,SUMTCH,BETA,TIMV,STORM,STORM	D 140

	2I,CMSIN,CMSOUT,FLMIN,FLMOT,SUMIO,CELDIS,DLTRAT,CSTORM	D	150
	DIMENSION RP(8), RN(8), IPT(8)	D	160
C	*****	D	170
•	F1=0_30	D	180
	F2=1-0/3-0	D	190
		Ň	200
	$\frac{1}{10} \frac{1}{100} \frac{1}{$		210
	IF (NPIPND, E4, 9) F = 1, 0/3, 0		210
	IF (NPTPND.EQ.8) F2=0.25	U	220
	NCHK=NPTPND	D	230
	IF (NPTPND.EQ.5.0R.NPTPND.EQ.9) NCHK=NPTPND-1	D	240
	IF (TEST.GT.98.) GO TO 10	D	250
C	*****	D	260
Ċ	INITIALIZE VALUES	D	270
•	STORM=0.0	D	280
	CMSIN=0.0	ĥ	290
		5	300
		~	310
		~	320
		U	320
	SUMIO=0.0	D	330
С	****************	D	340
	10 DO 20 ID=1/3	D	350
	DO 20 IN=1,NPMAX	D	360
	20 PART(ID/IN)=0.0	D	370
	DQ 30 IA=1,8	D	380
	RP(IA)=0_0	D	390
	RN(IA) = 0	D	400
	30 IPT(IA)=0	D	410
r	SET HP I TMRO ARRAY	D	420
Č		ň	430
		5	440
			440
		<b>v</b>	4 30
			400
	LIMBO(IL)=IND	D	470
	SU IND=IND+1	D	460
C	***************************************	D	490
C	INSERT PARTICLES	D	500
	DO 410 IX=1/NX	D	510
	DO 410 IY=1,NY	D	520
	IF (THCK(IX,IY).EQ.0.0) GO TO 410	D	530
	KR=0	D	540
	TEST2=0.0	D	550
	METHal	D	560
	NPCELL( $1x$ , $1y$ )=0	D	570
		0	580
	r = r = r = r = r = r = r = r = r = r =	ň	590
		~	600
			000
	IF (RE((IX)IT).NE.U.U) IESIZ=1.U	D D	610
	IF (THCK(IX+1,IY+1).EQ.U.U.OR.THCK(IX+1,IY-1).EQ.U.U.OR.THCK(IX-1,	D	020
	11Y+1).EQ.0.0.0R.THCK(IX-1,IY-1).EQ.0.0) TEST2=1.0	D	630
	IF ((THCK(IX,IY+1),EQ.0.0.0R,THCK(IX,IY+1),EQ.0.0.0R,THCK(IX+1,IY)	D	640
	1.EQ.0.0.0R.THCK(IX-1,IY).EQ.0.0).AND.NPTPND.GT.5) TEST2=1.0	D	650
	CNODE#CI+(I.U-FI)	D	660
	IF (TEST.LT.98.0.0R.TEST2.6T.0.0) GO TO 70	D	670
	SUMC=CONC(IX+1,IY)+CONC(IX-1,IY)+CONC(IX,IY+1)+CONC(IX,IY-1)	D	<b>68</b> 0
	IF (NCHK.EQ.4) GO TO 60	D	690
	SUMC=SUMC+CONC(IX+1,IY+1)+CONC(IX+1,IY-1)+CONC(IX-1,IY+1)+CONC(IX-	D	700
	11,17-1)	Ð	710
	60 AVC≠SUMC/NCHK	D	720
	IF (AVC.GT.C1) METH=2	D	730
с		Ď	740
č	PUT & PARTICLES ON CELL DIAGONALS	Ď	750
•		ĥ	760

		EVET=(-1.0)**IT	D 770
		DO 140 IS=1,2	D 780
		EVES=(-1.0)**IS	D 790
		PART(1,IND)=IX+F1+EVET	008 đ
		PART(2,IND)=IY+F1*EVES	D 810
		PART(2,IND)=-PART(2,IND)	D 820
		PART(3,IND)=C1	D 830
		IF (TEST.LT.98.0.0R.TEST2.GT.0.0) GO TO 130	D 840
		IXD=IX+EVET	D 850
		IYD=1Y+EVES	D 860
		K R≖K R + 1	D 870
		IPT(KR)=IND	088 d
		IF (METH.EQ.2) GO TO 80	D 890
		PART(3,IND)=CNODE+CONC(IXD,IYD)*F1	D 900
		GO TO 90	D 910
	80	PART(3,IND)=2.0*C1*CONC(IXD,IYD)/(C1+CONC(IXD,IYD))	D 920
	90	IF (C1-CONC(IXD,IYD)) 100,110,120	D 930
	100	RP(KR)=CONC(IXD,IYD)-PART(3,IND)	D 940
		RN(KR)=C1-PART(3,IND)	D 950
		GO TO 130	D 960
	110	RP(KR)=0.0	Þ 970
		RN(KR)=0.0	P 980
		GO TO 130	D 990
	120	RP(KR) = C1 - PART(3, IND)	p1000
		$RN(KR) = CONC(IXD_IYD) - PART(3_IND)$	D1010
	130	IND=IND+1	p1020
	140	CONTINUE	p1030
C			D1040
		IF (NPTPND.EQ.5.0R.NPTPND.EQ.9) GO TO 150	D1050
		GO TO 160	01060
C		PUT ONE PARTICLE AT CENTER OF CELL	D1070
	150	PART(1,IND)=-IX	D1080
		PART(2,IND)=-IY	D1090
		PART(3,IND)=C1	D1100
		IND=IND+1	D1110
C		PLACE NORTH, SOUTH, EAST, AND WEST PARTICLES	D1120
	160	IF (NPTPND.LT.8) GO TO 290	D1130
		CNODE=C1+(1.0-F2)	D1140
		00 280 IT=1,2	D1150
		EVET=(-1.0)**IT	D1160
		PART(1,IND)=IX+F2*EVET	D1170
		PART(2,IND)=-IY	01180
		PART(3,IND)=C1	D1190
		IF (TEST.LT.98.0.0R.TEST2.GT.0.0) GO TO 220	01200
		IXD=IX+EVET	D1210
		KR=KR+1	D1220
		IPT(KR)=IND	D1230
		IF (METH.EG.2) GO TO 170	D1240
		PART(3,IND)=CNODE+CONC(IXD,IY)+F2	01250
		GO TO 180	D1260
	170	PART(3,IND)=2.0*C1*CONC(IXD,IY)/(C1+CONC(IXD,IY))	D1270
	180	IF (C1-CONC(IXD,IY)) 190,200,210	D1280
	190	RP(KR)=CONC(IXD,IY)-PART(3,IND)	D1290
		RN(KR) = C1 - PART(3, IND)	D1300
		GO TO 220	D1310
	200	RP(KR) =0.0	D1320
		RN(KR)=0.0	01330
		GO TO 220	D1340
	210	RP(KR) = C1 - PART(3, IND)	D1350
		RN(KR) = CONC(IXD,IY) - PART(3,IND)	D1360
	220	IND=IND+T	01370
		PART(7/IND)=IX	D1380



		PART(2/IND)=IY+F2*EVET	<b>D139</b> 0
		PART(2,IND)=-PART(2,IND)	D1400
		PAPT(3 + IND) = C1	p1410
		$\frac{1}{2} \frac{1}{2} \frac{1}$	N1/20
			01420
			01430
		KR=KR+1	01440
		IPT(KR)=IND	D1450
		IF (METH_EQ.2) GO TO 230	D1460
		PART(3,IND)=CNODE+CONC(IX,IYD) * F2	D1470
		60 10 240	<b>D148</b> 0
	230	PAPT(3,TND) = 2 (0+C1+CONC(1X,TYD)/(C1+CONC(1X,TYD))	h1490
	2/0	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i$	01500
	240	$\frac{1}{1} \left( \frac{1}{1} - \frac{1}{1} \right) = \frac{1}{1} \left( \frac{1}{1} - \frac{1}{1} \right) = \frac{1}{1} \left( \frac{1}{1} - \frac{1}{1} \right) = \frac{1}{1} \left( \frac{1}{1} - \frac{1}{1} \right)$	D1500
	230	RP(RR) = CONC(IX) ID PART(S) IND)	01510
		RN(KR) = CT - PART(3, IND)	01520
		GO TO 280	01530
	260	RP(KR)=0.0	D1540
		RN(KR)=0.0	D1550
		GO TO 280	D1560
	270	PP(KP) = r1 - PART(3, IND)	D1570
	270	$\frac{\partial r}{\partial r} = \frac{\partial r}{\partial r} + \frac{\partial r}{\partial r} + \frac{\partial r}{\partial r} + \frac{\partial r}{\partial r} = \frac{\partial r}{\partial r} + $	01580
	200		N1500
_	280		01390
С			01600
	290	IF (TEST.LT.98.0.0R.TEST2.GT.0.0) GO TO 410	D161U
		SUMPT=0.0	D1620
С		COMPUTE CONC. GRADIENT WITHIN CELL	D1630
-			D1640
			01650
	700		01050
	200		D1000
		(BAR=SUMPTINLIK	01070
С		CHECK MASS BALANCE WITHIN CELL AND ADJUST PI. CONCS	01000
		SUMPT=0.0	01690
		IF (CBAR-C1) 310,410,330	D1700
	310	CRCT=1.0-(CBAR/C1)	D1710
		IF (METH_EQ_1) CRCT=CBAR/C1	D1720
		DO 320 KPT=1 / NCHK	01730
			D1740
		DADT/3_1V/T=DADT/3_1V/+DD/VDT}+C0/T	D1750
	720		01760
	320		51770
		CBARN=SUMPI/NCHK	01770
		GO TO 350	D1/80
	330	CRCT=1.0-(C1/CBAR)	D1790
		IF (METH.EQ.1) CRCT=C1/CBAR	<b>D180</b> 0
		DO 340 KPT=1/NCHK	<b>D181</b> 0
		IK=IPT(KPT)	D1820
		PAPT(3,TK) = PART(3,TK) + RN(KPT) + CR(T)	01830
	7/0		01840
	340	SUMP I - SUMP I TPARI (SPIR)	51950
		CBARN#SUMPI/NCHK	1030
	350	IF (CBARN_EQ.C1) GO TO 410	01800
С		CORRECT FOR OVERCOMPENSATION	01870
		CRCT=C1/CBARN	<b>D188</b> 0
		DO 380 KPT=1/NCHK	D1890
		IK=IPT(KPT)	<b>D190</b> 0
		PART(3,IK) = PART(3,IK) + CRCT	D1910
ſ			b1920
			N1070
	7/0	17 VERVIJJIN/ELI/ JOUPJOUPJO	N10/0
	200	$\bigcup_{i=1}^{n} \sum_{j=1}^{n} \sum_{j$	U174U
		TH THANICSTRIFTIETHI GO TO SAO	01730
		GO TO 580	01960
	370	CLIM=C1+RP(KPT)-RN(KPT)	D1970
		IF (PART(3,IK).GT.CLIM) GO TO 390	D1980
	380	CONTINUE	D1990
		GO TO 410	D2000

54

	300	TEST2=1 0	
	570		D2010
			02020
	400	PAPT(3, tv) = r1	D2030
	400		02040
	410		02050
		NETING CONCALL CUMAT	D5090
r			D2070
Ľ		*****	D2080
~		KE TUKN	D5030
ι		***************************************	D2100
			D2110-
		SUBROUTINE VELO	E 10
		DOUBLE PRECISION DMINT, DEXP, DLOG, DABS	E 20
		REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE	E 30
		REAL * 8XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR	E 40
		REAL +8RATE,SLEAK,DIV	E 50
		COMMON /PRMI/ NTIMONPMPONPNTONITPONONXONYONPONRECOINTONNXONNYONUMO	E 60
		18S × NMOV × IMCV × NPMAX × ITMAX × NZCRIT × IPRNT × NPTPND × NPNTMV × NPNTVL × NPNTD × N	E 70
		2PNCHV,NPDELC	E 80
		COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB	E 90
		15(5)	E 100
		COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR	E 110
		COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,	E 120
		120),HK(20,20),WT(20,20),REC(20,20),RECH(20,20),TIM(100),AOPT(20),T	E 130
		2ITLE(10)/XDEL/YQEL/S/AREA/SUMT/RHO/PARAM/TEST/TOL/PINT/HMIN/PYR	E 140
		COMMON /XINV/ DXINV/DYINV/ARINV/PORINV	E 150
		COMMON /CHMA/ PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY(20,	E 160
	•	120) - CONINT (20,20) - CNRECH (20,20) - POROS - SUMTCH - BETA - TIMV - STORM - STORM	E 170
	i	21, CMSIN, CMSOUT, FLMIN, FLMOT, SUMIO, CELDIS, DL TRAT, CSTORM	E 180
		COMMON /CHMC/ SUMC(20,20),VXBDY(20,20),VYBDY(20,20)	E 190
		COMMON /DIFUS/ DISP(20,20,4)	F 200
C		*****	E 210
C		COMPUTE VELOCITIES AND STORE	F 220
		VMAX=1.0E-10	E 230
		VMAY=1.0E-10	E 240
		VMXBD=1.0E-10	E 250
		VMYBD=1.0E-10	E 240
		IMV=TIM(N)	E 200
			E 270
С			E 200
•		DO 20 FX=1-NX	E 290
			c 300
			E 310
	10		£ 320
r	10	₩131 \1 A#11#16/#UeU	E 330
C			E 340
		IF \INUN\IA/IT/+EW+U+U) &U  U 2U	E 350
		$RA \vdash TRE (IX) IY IX EA$	E 360
		SECAR=(MR(1X,1Y)-WI(1X,1Y))*VPRM(1X,1Y)	E 370
~		DIV-RAIETSLEAKTRECH(IX,IT)	E 380
Č			E 390
č			E 400
C			E 410
		URUA-VERVIIA-1/17/-HK(1X+1/17)/*DXINV*U.50	E 420
		IF () TUCK(IX-1/IX).EQ.U.U) GRDX=(HK(IX/IY)-HK(IX+T/IY))*DXINV	E 430
		IF (INCK(IX+1/17).EQ.U.U) GRDX#(HK(IX+1/IY)-HK(IX/IY))*DXINV	E 440
		IT (ITCK(IA-1/IT).EW.U.U.AND.IHCK(IX+1/IY).EQ.0.0) GRDX=0.0	E 450
		VALIA/II/="EKM(IX/IY)*GRDX*PORINV	E 460
			E 470
~		IF (ABVA.GI.VMAX) VMAX=ABVX	E 480
Ļ			E 490
		UKUI=(HK(1X)1T=I)=HK(1X)1T+T))*DY1NV*0.50	E 500
		IF (IHCK(IX>IY-1).EQ.O.O) GRDY=(HK(IX>IY)-HK(IX>IY+1))*DYINV	E 510

.

		IF (THCK(IX,IY+1).EQ.O.O) GRDY=(HK(IX,IY-1)-HK(IX,IY))*DYINV	E 520
		IF $(THCK(IX)T-1) = EQ_0Q_0AND_THCK(IX)T+1) = EQ_0Q_0 GRDY=0.0$	E 530
		$VV(TV, TV) = 0 \in DM(TV, TV) + CDV + DOD TNV + AN ECTD$	E 540
			5 5 5 6
		ABVY=ABS(VY(IX,IY))	E 550
		IF (ABVY.GT.VMAY) VMAY=ABVY	E 560
r			E 570
2			E 590
C		VELOCITIES AT CELL BOUNDARIES	E 300
		GRDX=(HK(IX/IY)-HK(IX+1/IY))*DXINV	E 590
		$DEDMY=2$ $\Pi + DEDM(TY,TY) + DEDM(TY+1,TY)/(DEDM(TY,TY) + DEDM(TY+1,TY))$	E 600
			F 410
		VXBDT(IX)IT)=PERMX*GRDX*PORINV	E 010
		GRDY=(HK(IX/IY)-HK(IX/IY+1))*DYINV	E 620
		PERMY=2.0+PERM(IX,IY)+PERM(IX,IY+1)/(PERM(IX,IY)+PERM(IX,IY+1))	E 630
			E 440
		VYBDY(IX;IY)=PERMY*GRDT*PORINV*ANFCIR	2 040
		ABVX=ABS(VXBDY(IX>IY))	£ 650
		ABVY=ABS(VYBDY(IX,IY))	E 660
		TE (ADVY CT VMYDD) VMYDD-ADVY	E 670
		IF CADAVAGI-AUXDU/ AUXDU-ADVA	C (010
		IF (ABVY.GT.VMYBD) VMYBD=ABVY	E 080
С			E 690
		τε (Ντν σε Ο Ο) σο το 20	E 700
			E 710
			E 710
		IF (TDIV.LT.TMV) TMV=TDIV	E 720
	20	CONTINUE	E 730
r			F 740
			E 740
С		PRINT VELOCITIES	E 750
		IF (NPNTVL.EQ.O) GO TO 80	E 760
		TE (NPNTVI EQ 2) GO TO 30	F 770
		$\frac{11}{1000000000000000000000000000000000$	E 780
		IF (NPRIVL.EW.I.AND.N.EW.I/ GO TO SU	2 700
		GO TO 80	E 790
	30	WRITE (6,320)	E 800
			F 810
			c 010
		DO 40 IY=1/NY	E 820
	40	WRITE (6,350) (VX(IX,IY),IX=1,NX)	E 830
		UPITE (6.340)	F 840
			C 950
		DO SU IY=1/NY	E 650
	50	WRITE (6,350) (VXBDY(IX,IY),IX=1,NX)	E 860
		WPITE (6.360)	E 870
			E 990
		WRITE (0,530)	E 000
		DO 60 IY=1/NY	E 890
	60	WRITE $(6,350)$ (VY(IX,IY),IX=1,NX)	E 900
	••		F 910
			5 000
			E 920
	70	WRITE (6,350) (VYBDY(IX,IY),IX=1,NX)	E 930
ſ		PUNCH VELOCITIES	E 940
	• •		E 050
	60	IF (NPNCHV.EW.D) GO TO TTO	E 930
		IF (NPNCHV.EQ.2) GO TO 90	E 960
		TE (NPNCHV-FQ-1-AND-N-FQ-1) GO TO 90	E 970
			E 080
			E 700
	90	WRITE (7,510) NX/NY/XDEL/YDEL/VMAX/VMAY	F AAN
		DO 100 IY=1/NY	E1000
		$\frac{1}{10} \frac{1}{10} \frac$	E1010
			c1070
	100	WRITE (//SZU) (VY(IX/IY)/IX=1/NX)	EIUZU
С		*****************	E1030
C		CONPUTE NEXT TIME STEP	E1040
•			E1050
	110		E1030
		WRITE (60400) VMAX/VMAY	E1000
		WRITE (6,410) VMXBD/VMYBD	E1070
		TDELX=CELDIS+XDEL/VMAX	E 1080
			£1000
		IDELT=LELDISTDEL/VMAT	E1070
		TDELXB=CELDIS+XDEL/VMXBD	E1100
		TDELYB=CELDIS+YDEL/VMYBD	E1110
		TTM ###TN1 (ThEI Y THEI Y THEI YR THEI YR)	F1120
		1177-ANINI (10ELA/10EL//10ELAD/10ELID/	54430
		WRITE (6,310) THV/TIMV	E1150

		IF (THV.LT.TIMV) GO TO 120	E1140
		LIM=-1	E1150
		GO TO 130	E1160
	120		E1170
	120	LIM=T NTTMV=TTM/N\/TTMV	E1180
	150	NIGV=   IG(N)/   IGV	E1190
			E1200
			E1210
		WRITE (6,370) TIM(N)	E1220
		WRITE (6,380) TIMV	F1240
C			F1250
		IF (BETA.EQ.0.0) GO TO 200	E1260
C		**********	E1270
C		COMPUTE DISPERSION COEFFICIENTS	E1280
		ALPHA=BETA	E1290
		ALNG=ALPHA	E1300
		TRAN=DLTRAT+ALPHA	E1310
		XX2=XDEL+XDEL	E1320
		YY2=YDEL+YDEL	E1330
		XYZ=4.UXXDELXYDEL	E1340
			E1350
		$\begin{array}{c} \mathbf{U} \in \mathbf{U} \\ \mathbf{U} \\ \mathbf{U} \in \mathbf{U} \\ \mathbf{U} \\ \mathbf{U} \in \mathbf{U} \\ \mathbf{U} \in \mathbf{U} \\ \mathbf{U} \in $	E1300
		VYFEV(IX/I//IX/IV)	E1390
		VYS=VYBDY(IX/IY)	E1300
		IF (THCK(IX+1/IY)_E9.0.0) GO TO 140	E1400
C		FORWARD COEFFICIENTS: X-DIRECTION	E1410
		VYE = (VYBDY(IX,IY-1)+VYBDY(IX+1,IY-1)+VYS+VYBDY(IX+1,IY))/4.0	E1420
		VXE2=VXE*VXE	E1430
		VYE2=VYE*VYE	E1440
		VMGE=SQRT(VXE2+VYE2)	E1450
		IF (VMGE_LT_1_0E-20) GO TO 140	E1460
		DALN=ALNG * VMGE	E1470
			E1480
~		VMGLZ=VMGL*VMGL	E1490
¢			E1500
r		DISF(IX, IT, I)=(DALN*VXE2+DIKN*VTE2)/(VMGE2*XX2)	E1510
•			E1520
C			E1520
•	140	IF (THCK(IX/IY+1), EQ. 0.0) GO TO 150	E1550
		$VXS = (VXBDY(IX-1,IY)+VXE+VXBDY(IX-1,IY+1)+VXBDY(IX,IY+1))/4_0$	E1560
		VYS2=VYS*VYS	E1570
		VXS2=VXS*VXS	E1580
		VMGS=SQRT (VXS2+VYS2)	E1590
		IF (VMGS.LT.1.0E-20) GO TO 150	E1600
		DALN=ALNG+VMGS	E1610
			E1620
r			E1630
¢			E104U
C			E 1030
Ť		DISP(IX,IY,4)=(DALN-DTRN) *VXS*VYS/(VMGS2*XY2)	E1670
	150	CONTINUE	E1680
С		************	E1690
C		ADJUST CROSS-PRODUCT TERMS FOR ZERO THICKNESS	E1700
		DO 160 IX=2,NNX	E1710
		DO 160 IY=2,NNY	E1720
	-	IF (THCK(IX,IY+1).EQ.0.0.OR.THCK(IX+1,IY+1).EQ.0.0.OR.THCK(IX,IY-1	E1730
	1	).EQ.U.U.OR.THCK(IX+1,IY-1).EQ.O.O) DISP(IX,IY,3)=0.0	E1740
		IF (IHUR(IX+1/IT).E4.U.U.OR.THCK(IX+1/IY+1).E4.0.0.OR.THCK(IX-1/IY	E1750

1400 CONVINUE       E17700         C      CHECK FOR STABILITY OF EXPLICIT METHOD       E17700         C      CHECK FOR STABILITY OF EXPLICIT METHOD       E17700         TIMDIS-0.0       D0 170 IX-2.MNY       E1810         D0 170 IX-2.MNY       E1810         TO CO-DISP(IX-IY,1)+DISP(IX,IY,2)       E1810         TIMDIC-D.STTIMDIS       THDISTICO         TIMDIC-D.STTIMDIS       E1830         WRITE (6,440) TIMOL       E1830         NIIMD-TIM (M)/TIMOC       E1830         NIIMD-TIM (M)/TIMOC       E1830         NOISP-MITIMOH       E1830         C      CASOD TIMV.NTIMD.NMOV       E1920         C      CASOD			1).EQ.0.0.0R.THCK(IX-1,IY+1).EQ.0.0) DISP(IX,IY,4)=0.0	E1760
CCPUECK FOR STABILLTY OF EXPLICIT METHOD E1780 CCPUECK FOR STABILLTY OF EXPLICIT METHOD E180 D 0 170 IX-2-MNX E180 D 0 170 IX-2-MNX E180 D 0 170 IX-2-MNX E180 T 100-0.57/IND15 IXD15F(IX,IY,2) E1830 T 100-0.57/IND15 IXD15F(IX,IY,2) E1830 WRITE (6,400) TIMD1S TIMD1S=TDC0 E1860 MRIVE (6,400) TIMDC E1860 MRIVE (6,400) TIMDC E1860 MRIVE (6,400) TIMDC E1860 MRIVE (6,400) TIMDC E1860 MOU-MD15P=NTIM0+1 IF (ND1SP_LELMNOV) CD 180 MOU-MD15P=NTIM0+1 E1860 MOU-MD15P=NTIM0+1 E1960 CADJUST D15P, EGUATION COEFFICIENTS FOR SATURATED THICKNESS E1960 D 190 IX-2-MNX E1960 CADJUST D15P, EGUATION COEFFICIENTS FOR SATURATED THICKNESS E1960 D 190 IX-2-MNX E1960 D 190 IX-2-MNY E20030 CPRINT D15P(IX,IY,-1)-AAWX E20010 D 15P(IX,IY,-1)-D15P(IX,IY,-1)-AAWX E20030 C 0PRINT D15P(IX,IY,-1)-AAWX E2003 C 0PRINT D15P(IX,IY,-1)-AAWX E20030 C 0PRINT D15P(IX,IY,-1)-AAWX E2003 C 0PRINT D15PF(IX,IY,-1)-AAWX E2003 C 0PRINT D15PF(IX,IY,-1)-AAWX E2003 C 0 TPRINT D15PF(IX,IY,-2)-AAWY E2030 C 0PRINT D15PF(IX,IY,-2)-AAWY E2030 C 0 TPRINT D15PF(IX,IY,-2)-AAWY E2030 C 0 TPRINT D15PF(IX,IY,-2)-AAWY E2030 C 0PRINT D15PF(IX,IY,-2)-AAWY E2030 C 0 TPRINT D15PF(IX,IY,-2)-AAWY E2030 C 0 0 20 1Y+1-AWY E		160	CONTINUE	E1770
CCMECK FOR STABILITY OF EXPLICIT METHOD TIMDIS=0.0 D0 170 IX=2.NNX D0 170 IX=2.NNX D0 170 IX=2.NNY TOCO=DISP(IX,IY,I)+01SP(IX,IY,2) TOCO=DISP(IX,IY,I)+01SP(IX,IY,2) TIMDETIN(N)/IMDIS WRITE (6,430) TIMDS IF (NDISP.LE.NMOV) GO TO 180 MIND=TIM(N)/IMDO LIM=0 180 WRITE (6,430) TIMV,NTIMD,NMOV CADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS D0 190 IX=2.NNX CADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS D0 190 IX=2.NNX D0 190 IX=2.NNX D0 190 IX=2.NNX D0 190 IX=2.NNX D0 190 IX=2.NNX D0 190 ISP(IX,IY,1)+MCK(IX,IY+1)) D1SP(IX,IY,2)=DISP(IX,IY,2)+BAVY D0 1SP(IX,IY,2)=DISP(IX,IY,4)+BAVX CADJUST DISP(IX,IY,4)+BAVX D0 1SP(IX,IY,4)=DISP(IX,IY,4)+BAVX D0 1SP(IX,IY,4)=DISP(IX,IY,4)+BAVX C	r		**************	E1780
TIMDIS=0.0       E1800         00 170 IX=2.NNX       E1810         00 170 IX=2.NNX       E1810         00 170 IX=2.NNX       E1830         170 IF (TDC0.GT.TIMDIS) TIMDIS=TDC0       E1840         110 CC0.S/TIMDIS       E1840         WRITE (6.440) TIM0C       E1840         WRITE (6.430) TIMV.NTIM0C       E1940         C      ADJUST DISP.EQUATION COEFFICIENTS FOR SATURATED THICKNESS         E1940       E1940         C      ADJUST DISP.EQUATION COEFFICIENTS FOR SATURATED THICKNESS         E1950       E1970         BAVX=0.S*(THCK(IX.1Y)+THICK(IX.1Y+1Y))       E1980         BAVX=0.S*(THCK(IX.1Y)+THICK(IX.1Y+1Y))       E1980         DISP(IX.1Y.3)=DISP(IX.1Y.3)+BAVX       E2000         DISP(IX.1Y.3)=DISP(IX.1Y.3)+BAVX       E2001         DISP(IX.1Y.3)=DISP(IX.1Y.3)+BAVX       E2003         C      PRINT DISPERSION COEFFICIENTS       E2030         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2100         C	č			E1790
D0 170 172_NNX         [1810           D0 170 172_NNY         [1820           T0 0 170 0.172_NNY         [1820           T0 0 170 0.171         [1800           T1 0 17 0 0.0, 0.171         [1800           W 110 - 114(N)/11M0C         [1800           M 110 - 114(N)/11M0C         [1900           1100 0 172_NAX         [1900           C        ADJUST 015P, EQUATION COEFFICIENTS FOR SATURATED THICKNESS           [1900         [1900 1172_NAX           D0 190 1172_NAX         [1900           D0 197 [1X,1Y,1]=D15P(1X,1Y,1)=HAX           D0 197 [1X,1Y,1]=D15P(1X,1Y,1)=AAX           D0 197 [1X,1Y,1]=D15P(1X,1Y,1)=AAX           D0 197 [1X,1Y,1]=D15P(1X,1Y,1)=AAX           D0 197 [1X,1Y,1]=D15P(1X,1Y,1)=AAX      <				E1800
0.170         170 </td <td></td> <td></td> <td>DO 170 IX=2-NNX</td> <td>E1810</td>			DO 170 IX=2-NNX	E1810
TOCO=DISP(TX,1Y,1)=01SP(IX,1Y,2)         FIRSD           170 IF (TOCO,GT,TIMDIS) TIMDIS=TDCO         FIRSD           180 URITE (6,440) TIMDC         FIRSD           WITHD=TIM(W)/TIMDC         FIRSD           WITHE         FIRSD           180 WITHE         FORMATINE           C        ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS           E1900         FOO 170 IT=2,WX           DO 190 IT=2,WX         E1900           DISP(IX,1Y,1)=DISP(IX,1Y,1)+THCK(IX,1Y+1))         E1900           DISP(IX,1Y,1)=DISP(IX,1Y,1)+THCK(IX,1Y+1))         E1900           DISP(IX,1Y,1)=DISP(IX,1Y,1)+THCK(IX,1Y+1))         E2000           DISP(IX,1Y,1)=DISP(IX,1Y,1)+THCK(IX,1Y+1))				E1820
170       IF (TIREC) GT.TIMDIS) TIMDISTOCO       E1850         170       INDCED.GT.TIMDIS)       E1850         171       INDCED.GT.TIMDIS)       E1850         172       INDCED.GT.TIMDIS)       E1850         173       INDCED.GT.TIMDIS)       E1850         174       INDISPENTINGS)       E1850         175       INDISPLICANNOV)       E1850         180       INTE (G.440) TIMUC       E1850         180       INDISPLICANNOV       E1950         180       INTE (G.430) TIMUNTIMD.NMOV       E1920         180       URITE (G.430) TIMUNTIMD.NMOV       E1920         190       INTE (G.430) TIMUNTIMD.NOV       E1920         190       INTE (G.430) TIMUNTIMO.NOV       E1920         190       INTE (G.430)       E1920         191       E192.117.1194840X       E2030				E1830
TIMD:=0.57TIMD:S       E1850         WITE (6,440) TIMD:       E1850         WITE (6,40) TIMD:       E1850         If (MDISP.LE.NNOV) GO TO 180       E1870         MOUPHOISP       E1900         TIMU-TIM(N)/TIMOV       E1900         LIMHO       E1900         TIMUTTM(N)/NMOV       E1910         LIMHO       E1900         TIMUTTM(N)/NMOV       E1910         C		170	IF (TDCO.GT.TIMDIS) TIMDIS=TDCO	E1840
WITE (6.40) TIMDC         E1850           NTIMD TIM (N) / TIMDC         E1850           NTIMD TIM (N) / TIMDC         E1850           NDISP=NTIMD'         E1850           TARUATION (NOV) GO TO 180         E1800           NMOV=NDISP         E1900           TIMU=TIM (N)/NMOV         E1910           LIM-0         E1920           180 WRITE (6.430) TIMU, NTIMD, NMOV         E1920           C        ADJUST DISP, EQUATION COEFFICIENTS FOR SATURATED THICKNESS           E1950         D0 190 I*=2.NNX           GAVY=0.5         SATURATE(IX, IY)+THCK(IX, I/Y+1))           DISP(IX, IY, J=01SP(IX, IY, J)+84VX         E2000           DISP(IX, IY, J=01SP(IX, IY, J)+84VX         E2020           DISP(IX, IY, J=01SP(IX, IY, J)+84VX         E2020           C			TIMDC=0.5/TIMDIS	E1850
WTIMG=TIN(W)/TING       E1870         WDISP=WTIM0H       E1880         IF (WDISP,LE.NMOV) GO TO 180       E1800         MMUV=NDISP       E1900         TIMU=TIM(W)/NMOV       E1900         LIM=0       E1900         180 WAITE (64/40) TIMV,NTIMD,NMOV       E1920         c      ADJUST DISP, EQUATION COEFFICIENTS FOR SATURATED THICKNESS         E1900       E1900         D0 190 I*=2,NNX       E1960         D0 190 I*=2,NNX       E1960         D0 190 I*=2,NNX       E1960         D190 I*=2,NNX       E1960         D197 (IX=17,4)=0158 (IX,1Y,4)+840X       E2000         D159 (IX,1Y,3)=D159 (IX,1Y,3)+840X       E2000         D20 IF (IX,1Y,3)=D158 (IX,1Y,4)+840Y       E2020         C      RINT D15PERSIN (IX,1Y,4)+840Y       E2050         C10 IF (IMP TE (6,530)       E2000       E2000         C      RINT D15PERSIN EQUATION COEFFICIENTS       E2100         220 WRITE (6,550)       E2100       E2100         C      RINT D15PERSION EQUATION COEFFICIENTS       E2			WRITE (6,440) TIMDC	E1860
NDISP=NIND.1       E1880         IF (NDISP.LE.NNOV) GO TO 180       E1890         IF (NDISP.LE.NNOV) GO TO 180       E1900         TIMU=TIN(N)/NHOV       E1920         LIM=0       E1920         180 WRITE (6,430) TIMV.NTIMD.NNOV       E1920         C      ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS       E1950         D0 190 Ix=2.NNX       E1960         BAVN=0.5<(THCK(IX,IY)+THCK(IX,IY+1))			NTIMD=TIM(N)/TIMDC	E1870
IF       TIMUSTIN(N)/NMOV       E1800         NMOVENDISP       E1900         TIMUSTIM(N)/NMOV       E1910         LIM=0       E1920         180       WHITE (6,430) TIMV,NTIMD,NMOV       E1920         C      ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS       E1950         D0 190       Ix=2,NNY       E1970         BAVX=0.5S(THCK(IX,IT)+THCK(IX+1,IY))       E1980         BAVX=0.5S(THCK(IX,IY)+THCK(IX,IY+1))       E1980         D1SP(IX,IY,2)=DISP(IX,IY,2)+BAVX       E2000         D1SP(IX,IY,2)=DISP(IX,IY,2)+BAVX       E2020         C      DFINT DISP(IX,IY,2)+BAVX       E2020         200 IF (LIM) 210,220,230       E2050         200 WRITE (6,550)       E2050         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2100         220 WRITE (6,550)       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2100         C<			NDISP=NTIMD+1	E1880
NMOVENDISP       E1900         TIMVETIM(N)/NMOV       E1910         LIM=0       E1920         180 WRITE (6,430) TIMV,NTIMD,NMOV       E1930         C      ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS       E1930         D0 190 IY=2,NNX       E1960         00 190 IY=2,NNX       E1960         01 700 IY=2,NNX       E1960         01 700 IY=2,NNX       E1960         01 700 IY=2,NNX       E1960         01 84V=0.55 (THCK(IX,IY)+THCK(IX,IY+1))       E1980         BAVX=0.55 (THCK(IX,IY,IY)+THCK(IX,IY+1))       E1980         01 SP(IX,IY,2)=DISP(IX,IY,2)+BAVX       E2000         01 SP(IX,IY,2)=DISP(IX,IY,2)+BAVX       E2020         200 IF (LIM) 210,220,230       E2050         210 UHTE (6,530)       E2050         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2100         220 UHTE (6,500)       E2100       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2130         240 IF (MPNTD.EQ.2) GO TO 300       E2100       E2100         1240 IF (MPNTD.EQ.2) GO TO 250       E2100       E2100         1250 WRITE (6,500)       (DISP(IX,IY,2),IX=1,NX)       E2200         250 WRITE (6,500)       (DISP(IX,IY,2),IX=1,NX)			IF (NDISP.LE.NMOV) GO TO 180	E1890
TIMV=TIM(N)/NMOV       E1910         180       WRITE (6,430)       TIMV,NTIMD,NMOV       E1930         C      ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS       E1930         D0       190       Ix=2,NNX       E1970         BAVX=0.5       (TKK(IX,IY)+THCK(IX,IY))       E1980         BAVX=0.5       S(TKK(IX,IY)+THCK(IX,IY))       E1980         D1SP(IX,IY,1)=DISP(IX,IY,1)+BAVX       E2000         D1SP(IX,IY,1)=DISP(IX,IY,1)+BAVX       E2000         D1SP(IX,IY,1)=DISP(IX,IY,3)+BAVX       E2020         190       DISP(IX,IY,4)=DISP(IX,IY,3)+BAVX       E2030         200       DISP(IX,IY,4)=DISP(IX,IY,4)+BAVX       E2030         210       WRITE (6,530)       E2060         200       IF (LIM) 210-220,230       E2080         201       FIC (APNTD,EQ.2) G0 TO 300       E2100         17       C      PRINT DISPERSION EQUATION COEFFICIENTS       E2100         201       IF (MPNTD,EQ.2) G0 TO 250       E2150         30       MRITE (6,450)       E2160         30       D270       IY-INY       E2200         300       MRITE (6,450)       E2170         300       MRITE (6,460)       E2180         300			NMOV=NDISP	E1900
LIM=0 180 WRITE (6.430) TIMV,NTIMD,NMOV E1930 CADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS E1950 D0 190 IX=2.NNX E1960 BAYY=0.5 E1960 E1950 E1960 BAYY=0.5 E1960 E1960 E1960 E1960 E1960 E2060 E2			TIMV=TIM(N)/NMOV	E1910
180 WRITE (6,6,430) TIMU, NITMD, NMOV       E1930         C      ADJUST DISP, EQUATION COEFFICIENTS FOR SATURATED THICKNESS       E1950         D0 190 IX=2, NNX       E1970         BAVX=0,5% (THCK(IX,1Y)+THCK(IX+1,1Y))       E1980         BAVX=0,5% (THCK(IX,1Y)+THCK(IX,1Y+1))       E1980         DISP(IX,1Y,2)=DISP(IX,1Y,2)*HCK(IX,1Y+1))       E1990         DISP(IX,1Y,2)=DISP(IX,1Y,2)*BAXY       E2010         DISP(IX,1Y,2)=DISP(IX,1Y,2)*BAXY       E2020         210 WRITE (6,530)       E2080         220 WRITE (6,550)       E2080         C      PRINT DISPERSION EGUATION COEFFICIENTS       E2130         240 IF (NPNTb,EQ.2) GO TO 250       E2140         C      PRINT DISPERSION EGUATION COEFFICIENTS       E2130         240 IF (NPNTb,EQ.2) GO TO 250       E2140         IF (NPNTb,EQ.2) GO TO 250       E2180         D0 260 IY=1,NY       E2200       E2180         D0 270 IY=1,NY       E2200 (D15P(IX,1Y,1),1X=1,NX)       E2200         WRITE (6,480)       E2180       E2180         D0 270 IY=1,NY       E2200 (D15P(IX,1Y,2),1X=1,NX)       E2230         WRITE (6,480)       E2230       E2230         D0 270 IY=1,NY       E2230       E2230         D0 270 IY=1,NY <t< td=""><td></td><td></td><td>LIM=0</td><td>E1920</td></t<>			LIM=0	E1920
C		180	WRITE (6,430) TIMV/NTIMD/NMOV	E 1930
CADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS DO 190 IX=2,NNX E1950 DO 190 IY=2,NNY E1960 BAVX=0.5*(THCK(IX,IY)+THCK(IX+1,IY)) E1980 DISP(IX,IY,1)=DISP(IX,IY,1)+THCK(IX+1,IY)) E1980 DISP(IX,IY,2)=DISP(IX,IY,1)+BAVX E2000 DISP(IX,IY,2)=DISP(IX,IY,1)+BAVX E2020 DISP(IX,IY,2)=DISP(IX,IY,4)+BAVX E2020 C ####################################	C		*************	E1940
D0 190 IX=2,NNX E1960 D0 190 IY=2,NNY E1960 BAVX=0,5*(THCK(IX,IY)+THCK(IX+1,IY)) E1980 BAVY=0,5*(THCK(IX,IY)+THCK(IX+1,IY)) E1990 D1SP(IX,IY,2)=D1SP(IX,IY,2)+BAVX E2010 D1SP(IX,IY,2)=D1SP(IX,IY,2)+BAVX E2030 190 D1SP(IX,IY,3)=D1SP(IX,IY,2)+BAVY E2030 200 IF(LIM) 210,220,230 E2050 210 WRITE (6,530) E2060 200 OF (LIM) 210,220,230 E2050 210 WRITE (6,540) E2080 60 TO 240 E2090 230 WRITE (6,550) E2010 CPRINT D1SPERSION EQUATION COEFFICIENTS E2100 CPRINT D1SPERSION EQUATION COEFFICIENTS E2100 E2100 CPRINT D1SPERSION EQUATION COEFFICIENTS E2200 CPRINT D1SPERSION EQUATION COEFFICIENTS E2200 E2100 E2100 E2100 E2100 E2100 E2100 E2200 E2100 E2200 E2100 E2200 E2100 E2200 E	C		ADJUST DISP. EQUATION COEFFICIENTS FOR SATURATED THICKNESS	E1950
00 190 1Y=2,NNY       E1970         BAVY=0.5:(THCK(IX,IY)+THCK(IX+1,IY))       E1980         BAVY=0.5:(THCK(IX,IY)+THCK(IX,IY+1))       E1980         DISP(IX,IY,1)=DISP(IX,IY,1)+BAVX       E2010         DISP(IX,IY,2)=DISP(IX,IY,7)+BAVX       E2020         190 DISP(IX,IY,2)=DISP(IX,IY,7)+BAVX       E2020         190 DISP(IX,IY,2)=DISP(IX,IY,7)+BAVX       E2030         200 IF (LIM) 210,220,230       E2050         210 WRITE (6,550)       E2060         60 TO 240       E2090         230 WRITE (6,550)       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         240 IF (NPNTD,EQ.0) GO TO 250       E2160         1F (NPNTD,EQ.2) GO TO 250       E2160         250 WRITE (6,450)       E2170         1F (NPNTD,EQ.2) GO TO 250       E2180         250 WRITE (6,450)       E2170         WRITE (6,460)       E2180         260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)       E2200         270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX)       E2200         290 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) <td></td> <td></td> <td>DO 190 IX=2,NNX</td> <td>E1960</td>			DO 190 IX=2,NNX	E1960
BAVX=0.5 (THCK(IX,IY)+THCK(IX+1,IY)) E1980 BAVY=0.5 (THCK(IX,IY)+THCK(IX,IY+1)) E1990 DISP(IX,IY,2)=DISP(IX,IY,2)+BAVX E2000 DISP(IX,IY,2)=DISP(IX,IY,2)+BAVY E2030 190 DISP(IX,IY,2)=DISP(IX,IY,2)+BAVY E2030 C ++++++++++++++++++++++++++++++++++++			DO 190 IY=2,NNY	E1970
BAVY=0.5 (TH(CK(1X,1Y)+THCK(1X,1Y+1)) DISP(IX,1Y,1)=DISP(IX,1Y,2)+BAVX DISP(IX,1Y,2)=DISP(IX,1Y,2)+BAVX E2010 DISP(IX,1Y,2)=DISP(IX,1Y,2)+BAVX E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+BAVY E2030 C 200 IF(IX,1Y,2)=DISP(IX,1Y,2)+IX=1,NX) IF(INPNTD,EQ,2) OISP(IX,1Y,2),IX=1,NX) IF(IX,1Y,2)=JIX=1,NX) E2130 D 200 Z00 IY=1,NY 200 IF(IX,1Y,2),IX=1,NX) E2130 D 200 Z00 IY=1,NY 200 IF(IX,640) D 200 Z00 IY=1,NY 200 IF(IX,640) D 200 Z00 IY=1,NY 200 IF(IX,640) D 200 Z00 IY=1,NY 200 IF(IX,640) E2240 D 200 Z00 IY=1,NY 200 IF(IX,640) E2250 S10 FORMAT (1H, 19H TMV (MAX. INJ.) = ,G12.5/20H TIMV (CELDIS) = ,G E2350			BAVX=0.5*(THCK(IX/IY)+THCK(IX+1/IY))	E1980
DISP(IX,IY,1)=DISP(IX,IY,1)+BAVX DISP(IX,IY,2)=DISP(IX,IY,2)+BAVX DISP(IX,IY,2)=DISP(IX,IY,3)+BAVX E2020 190 DISP(IX,IY,3)=DISP(IX,IY,3)+BAVX E2020 200 IF (LIM) 210-220-230 210 WRITE (6,530) G TO 240 220 WRITE (6,540) CPRINT DISPERSION EQUATION COEFFICIENTS 240 IF (MPNTD.EQ.2) GO TO 300 IF (MPNTD.EQ.2) GO TO 250 IF (MPNTD.EQ.2) GO TO 250 C +			BAVY=0.5*(THCK(IX,IY)+THCK(IX,IY+1))	E1990
DISP(1x,1Y,2)=DISP(1x,1Y,2)*BAVY DISP(1x,1Y,3)=DISP(1x,1Y,3)*BAVY E2020 190 DISP(1x,1Y,4)=DISP(1x,1Y,4)*BAVY E2030 C ************************************			DISP(IX,IY,1)=DISP(IX,IY,1)+BAVX	E2000
DISP(1x,1Y,3)=DISP(1x,1Y,3)+BAVX E2030 C ####################################			DISP(IX,IY,2)=DISP(IX,IY,2)+BAVY	E2010
190       DISP(IX,IY,4)=DISP(IX,IY,4)+BAVY       E2030         200       IF (LIM) 210,220,230       E2050         210       WRITE (6,530)       E2060         60       TO 240       E2080         230       WRITE (6,550)       E2070         240       IF (NPNTD,EQ.0) 60 TO 300       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         240       IF (NPNTD,EQ.0) 60 TO 300       E2130         1F (NPNTD,EQ.2) GO TO 250       E2140         1F (NPNTD,EQ.1) AND_N.EQ.1) GO TO 250       E2160         250       WRITE (6,450)       E2170         00       260 IY=1,NY       E2200         260       WRITE (6,460)       E2190         00       260 IY=1,NY       E2200         270       WRITE (6,460)       E2210         00       270 URITE (6,500) (DISP(IX,IY,2),IX=1,NX)       E2220         280       WRITE (6,460)       E2250         280       WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)       E2250         290       WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2260         WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2250         290       WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2260 <td< td=""><td></td><td></td><td>DISP(IX,IY,3)=DISP(IX,IY,3)+BAVX</td><td>E2020</td></td<>			DISP(IX,IY,3)=DISP(IX,IY,3)+BAVX	E2020
C ************************************		190	DISP(IX,IY,4)=DISP(IX,IY,4)*BAVY	E2030
210 IF (LIM) 210220,230       E2030         210 WRITE (6,530)       E2060         G0 TO 240       E2080         220 WRITE (6,540)       E2080         G0 TO 240       E2080         230 WRITE (6,550)       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2130         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2130         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2130         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2140         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2130         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2140         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2140         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2140         C	Ç		***************************************	E2040
210       WRITE       (6,550)       E2070         220       WRITE       (6,550)       E2080         C      PRINT       DISPERSION       E2100         C      PRINT       DISPERSION       E2110         C      PRINT       DISPERSION       E2110         C      PRINT       DISPERSION       EQ120         240       IF       (NPNTD.Eq.0)       GO TO 300       E2130         1F       (NPNTD.Eq.2)       GO TO 250       E2140         1F       (NPNTD.Eq.1)       GO TO 250       E2160         250       WRITE       (6,450)       E2170         wRITE       (6,460)       E2180       E2180         00       260       UISP(IX,IY,1),IX=1,NX)       E2200         wRITE       (6,500)       (DISP(IX,IY,2),IX=1,NX)       E2210         00       280       IY=1,NY       E2250         280       WRITE       (6,500)       (DISP(IX,IY,3),IX=1,NX)       E2250         280       WRITE       (6,500)       (DISP(IX,IY,4),IX=1,NX)       E2250         280       WRITE       (6,500)       (DISP(IX,IY,4),IX=1,NX)       E2250         290       WRITE       (6,500)		200		E2000
G0 10 240       E200         220 WRITE (6,550)       E2080         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         240 IF (NPNTD.EQ.2) G0 TO 300       E2140         IF (NPNTD.EQ.2) G0 TO 250       E2140         G0 TO 300       E2150         G0 TO 300       E2180         250 WRITE (6,450)       E2180         MRITE (6,460)       E2180         D0 260 IY=1,NY       E2200         WRITE (6,460)       E2180         D0 260 IY=1,NY       E2200         WRITE (6,460)       E22180         D0 260 IY=1,NY       E2200         WRITE (6,460)       E22180         D0 270 IY=1,NY       E2200         WRITE (6,460)       E2210         MRITE (6,460)       E2210         WRITE (6,460)       E2210         WRITE (6,460)       E2200         WRITE (6,460)      <		210		C2070
230 WRITE (6,550)       E2090         230 WRITE (6,550)       E2100         C      PRINT DISPERSION EQUATION COEFFICIENTS       E2120         240 IF (NPNTD.EQ.2) GO TO 300       E2130         IF (NPNTD.EQ.2) GO TO 250       E2160         250 WRITE (6,450)       E2170         WRITE (6,460)       E2180         260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)       E2200         WRITE (6,460)       E2180         270 WRITE (6,460)       E2200         WRITE (6,460)       E2200         WRITE (6,460)       E2200         WRITE (6,460)       E2200         WRITE (6,400)       E22		220		- E2070
230 WRITE (6,550) CPRINT DISPERSION EQUATION COEFFICIENTS 240 IF (NPNTD.EQ.2) GO TO 300 IF (NPNTD.EQ.2) GO TO 250 GO TO 300 250 WRITE (6,450) WRITE (6,460) DO 260 IY=1.NY 260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX) WRITE (6,470) DO 270 IY=1.NY 270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX) WRITE (6,480) DO 280 IY=1.NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2200 DO 290 IY=1.NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2250 280 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2250 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2250 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2250 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) E2250 200 RETURN C ++++++++++++++++++++++++++++++++++++		220	WRITE (07240) Co to 240	E2000
C + + + + + + + + + + + + + + + + + + +		230	UD IU 24U	E2100
CPRINT DISPERSION EQUATION COEFFICIENTS 240 IF (NPNTD.EQ.2) GO TO 300 IF (NPNTD.EQ.2) GO TO 250 E2130 C (NPNTD.EQ.1.AND.N.EQ.1) GO TO 250 C TO 300 250 WRITE (6.450) WRITE (6.450) WRITE (6.460) C 250 WRITE (6.500) (DISP(IX,IY,1),IX=1,NX) WRITE (6.470) DO 270 IY=1,NY 270 WRITE (6.480) WRITE (6.480) DO 280 IY=1,NY 280 WRITE (6.480) WRITE (6.480) DO 280 IY=1,NY 280 WRITE (6.500) (DISP(IX,IY,2),IX=1,NX) WRITE (6.490) DO 290 IY=1,NY 290 WRITE (6.500) (DISP(IX,IY,3),IX=1,NX) WRITE (6.490) C	~	230		E 2110
240       IF (NPNTD.EQ.0) GO TO 300       E2130         1F (NPNTD.EQ.2) GO TO 250       E2140         1F (NPNTD.EQ.1.AND.N.EQ.1) GO TO 250       E2160         250       WRITE (6,450)       E2170         WRITE (6,460)       E2170         0 260       IY=1,NY       E2200         260       WRITE (6,470)       E2210         0 270       IY=1,NY       E2220         270       WRITE (6,470)       E2220         0 0 280       IY=1,NY       E2220         270       WRITE (6,470)       E2220         0 0 280       IY=1,NY       E2220         270       WRITE (6,500)       (DISP(IX,IY,2),IX=1,NX)       E2220         WRITE (6,500)       (DISP(IX,IY,3),IX=1,NX)       E2250         280       WRITE (6,500)       (DISP(IX,IY,3),IX=1,NX)       E2260         WRITE (6,500)       (DISP(IX,IY,3),IX=1,NX)       E2260         0 0 290       IY=1,NY       E2280       E2280         290       WRITE (6,500)       (DISP(IX,IY,4),IX=1,NX)       E2280         290       WRITE (6,500)       (DISP(IX,IY,4),IX=1,NX)       E2280         290       WRITE (6,500)       (DISP(IX,IY,4),IX=1,NX)       E2280         290       WRIT	ř			F 2120
IF (NPNTD.EQ.2) GO TO 250       E2140         IF (NPNTD.EQ.1.AND.N.EQ.1) GO TO 250       E2150         GO TO 300       E2160         250 WRITE (6.450)       E2170         WRITE (6.460)       E2180         DO 260 IY=1.NY       E2200         WRITE (6.470)       E2210         DO 270 IY=1.NY       E2220         270 WRITE (6.480)       E2210         DO 280 IY=1.NY       E2220         280 WRITE (6.480)       E2240         DO 280 IY=1.NY       E2250         280 WRITE (6.490)       E2240         DO 280 IY=1.NY       E2250         280 WRITE (6.500) (DISP(IX,IY,3),IX=1,NX)       E2250         WRITE (6.490)       E2270         DO 290 IY=1.NY       E2280         290 WRITE (6.500) (DISP(IX,IY,3),IX=1,NX)       E2280         290 WRITE (6.500) (DISP(IX,IY,4),IX=1,NX)       E2280         300 RETURN       E2310         C       ************************************	C	240	IF (NPNTD_EQ.0) GO TO 300	E2130
IF (NPNTD.EQ.1.AND.N.EQ.1) GO TO 250       E2150         GO TO 300       E2160         250 WRITE (6.460)       E2170         wRITE (6.460)       E2180         DO 260 IY=1.NY       E2190         260 WRITE (6.500) (DISP(IX,IY,1),IX=1.NX)       E2200         WRITE (6.4670)       E2210         DO 270 IY=1.NY       E2220         270 WRITE (6.460)       E2210         DO 280 IY=1.NY       E2220         280 WRITE (6.480)       E2240         DO 280 IY=1.NY       E2250         280 WRITE (6.480)       E2270         WRITE (6.490)       E2270         DO 290 IY=1.NY       E2280         290 WRITE (6.500) (DISP(IX,IY,3),IX=1.NX)       E2280         290 WRITE (6.500) (DISP(IX,IY,4),IX=1.NX)       E2280         300 RETURN       E2310         C       ************************************			IF (NPNTD.EQ.2) GO TO 250	E2140
GO TO 300       E2160         250 WRITE (6,450)       E2170         WRITE (6,460)       E2180         DO 260 IY=1,NY       E2190         260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)       E2200         WRITE (6,470)       E2210         DO 270 IY=1,NY       E2220         270 WRITE (6,470)       E2210         DO 270 IY=1,NY       E2220         270 WRITE (6,470)       E2210         DO 270 IY=1,NY       E2220         270 WRITE (6,460)       E2230         WRITE (6,480)       E2240         DO 280 IY=1,NY       E2250         280 WRITE (6,400)       E2270         DO 290 IY=1,NY       E2260         290 WRITE (6,490)       E2270         DO 290 IY=1,NY       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2300         300 RETURN       E2310         C       ************************************			IF (NPNTD.EG.1.AND.N.EG.1) GO TO 250	E2150
250 WRITE (6,450) WRITE (6,460) D0 260 IY=1,NY 260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX) WRITE (6,470) D0 270 IY=1,NY 270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX) WRITE (6,480) D0 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) D0 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C **********************************			GO TO 300	E2160
WRITE (6,460)       E2180         D0 260 IY=1,NY       E2190         260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)       E2200         WRITE (6,470)       E2210         D0 270 IY=1,NY       E2220         270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX)       E2240         WRITE (6,480)       E2240         D0 280 IY=1,NY       E2250         280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)       E2260         WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)       E2260         00 290 IY=1,NY       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2280         300 RETURN       E2310         C       ************************************		250	WRITE (6,450)	E2170
D0 260 IY=1,NY       E2190         260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)       E2200         WRITE (6,470)       E2210         D0 270 IY=1,NY       E2220         270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX)       E2230         WRITE (6,480)       E2240         D0 280 IY=1,NY       E2250         280 WRITE (6,490)       E2270         D0 290 IY=1,NY       E2280         290 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2280         300 RETURN       E2310         C       ************************************			WRITE (6,460)	E2180
260 WRITE (6,500) (DISP(IX,IY,1),IX=1,NX) WRITE (6,470) D0 270 IY=1,NY 270 WRITE (6,500) (DISP(IX,IY,2),IX=1,NX) WRITE (6,480) D0 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) D0 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C **********************************			DO 260 IY=1,NY	E2190
WRITE (6,470) D0 270 IY=1,NY E2220 270 WRITE (6,5C0) (DISP(IX,IY,2),IX=1,NX) WRITE (6,480) D0 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) D0 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C ************************************		260	WRITE (6,500) (DISP(IX,IY,1),IX=1,NX)	E2200
D0 270 IY=1,NY       E2220         270 WRITE (6,5C0) (DISP(IX,IY,2),IX=1,NX)       E2230         WRITE (6,480)       E2240         D0 280 IY=1,NY       E2250         280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)       E2260         WRITE (6,490)       E2270         D0 290 IY=1,NY       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2290         300 RETURN       E2310         C       ************************************			WRITE (6,470)	E 2210
270 WRITE (6,5C0) (DISP(IX,IY,2),IX=1,NX) WRITE (6,480) DO 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) DO 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C **********************************			DO 270 IY=1,NY	E2220
WRITE (6,480) D0 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) D0 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C ************************************		270	write (6,5CO) (disp(ix,iy,2),ix=1,nx)	E Z 2 30
DO 280 IY=1,NY 280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) DO 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C ************************************			WRITE (6,480)	E2240
280 WRITE (6,500) (DISP(IX,IY,3),IX=1,NX) WRITE (6,490) DO 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C ************************************			DO 280 IY=1,NY	E2250
WRITE (6,490) D0 290 IY=1,NY 290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX) C ************************************		280	WRITE (6,500) (DISP(IX,IY,3),IX=1,NX)	E2260
D0 290 IY=T/NY       E2280         290 WRITE (6,500) (DISP(IX,IY,4),IX=1,NX)       E2290         300 RETURN       E2310         C       ************************************			WRITE (0,490)	E2270
2300       RETURN       E2300         300       RETURN       E2310         C       ************************************		200	DU 29U 1T=1/NT Hotze (4 500) (Diso(iv.iv.() iv=1 44)	C2200
300 RETURN C ************************************	~	2 90	WRITE (UPJUU) (VIJF(IAPI(P4)PIA= PNA)	62270
C ************************************	L	300		E2300
C E2320 C E2330 C E2340 C 310 FORMAT (1H ,19H TMV (MAX. INJ.) = ,G12.5/20H TIMV (CELDIS) = ,G E2360 112.5) = ,G12.5/20H TIMV (CELDIS) = ,G E2360 E2370	r	200	NE I VNH	E2120
C C C 310 FORMAT (1H /19H TMV (MAX. INJ.) = /G12.5/20H TIMV (CELDIS) = /G E2360 112.5) E2370	ř			F2220
C S10 FORMAT (1H /19H TMV (MAX. INJ.) = /G12.5/20H TIMV (CELDIS) = /G E2350 112.5) E2370	ř			E2340
310 FORMAT (1H ,19H TMV (MAX. INJ.) = ,G12.5/20H TIMV (CELDIS) = ,G E2360 112.5) E2370	č			E2350
112.5) E2370	-	310	FORMAT (1H $_{19H}$ TMV (MAX. INJ.) = $_{9G12.5/20H}$ TIMV (CELDIS) = $_{9G}$	E2360
			112.5)	E2370

SZU FORMAT (1H1,12HX VELOCITIES)	E2380
330 FORMAT (1H ,25X,8HAT NODES/)	F 2 3 9 0
340 FORMAT (1H0,25%,13HON BOUNDAPIES/)	52/00
	E2400
JU FURMAT (IN FUGI2.3)	E 2 4 1 0
360 FORMAT (1H1,12HY VELOCITIES)	E2420
370 FORMAT (3H /11HTIM (N) = /1G12_5)	F2430
380  FORMAT (3H	52//0
$\frac{1}{200} = 0.000 \text{ mm} = 0.000 \text{ mm} = 0.0000 \text{ mm} = 0.0000 \text{ mm} = 0.0000000000000000000000000000000000$	E244U
STO FORMAT (THT/TUX/29HSTABILITY CRITERIA M.O.C.//)	E2450
400 FORMAT (1H0/8H VMAX = /1PE9.2/5X/7HVMAY = /1PE9.2)	E2460
410 FORMAT (1H ,8H VMXBD= ,1PE9_2,5X,7HVMYBD= ,1PE9_2)	F2470
420 FORMAT (1H0,8H TIMV = 1969 2,5Y,8HNTIMV = 15,5Y,7HNMOV + 15	1) 52/80
AS COMMAN (100.9) TIME = $10000$ S guarante - $1000000$	22400
450 FORMAL (INUSON IIMV = /IPE4.2/5X/6HNIIMD = /I5/5X//HNMOV = /I5	) E2490
440 FORMAL (SH $\rightarrow$ 1THLIMEDISP = $\rightarrow$ 1E12.5)	E2500
450 FORMAT (1H1,32HDISPERSION EQUATION COEFFICIENTS,10X,25H=(D-IJ)	*(B) E2510
1/(GRID FACTOR))	E 2520
460 FORMAT (1H -35%-14HYY COFFETCTENT/)	c 3 5 7 0
	E2330
470 FORMAT (TH JSSX/T4HTY COEFFICIENT/)	E2540
480 FORMAT (1H /35X/14HXY COEFFICIENT/)	E2550
490 FORMAT (1H /35X/14HYX COEFFICIENT/)	E2560
500 FORMAT (1H +1P10F8-1)	52570
510 FORMAT (21/ 2210 1.2010 2)	22570
	E2580
520 FORMAT (8F10.7)	E2590
530 FORMAT (1H0,10X,42HTHE LIMITING STABILITY CRITERION IS CELDIS)	E2600
540 FORMAT (1HC/10X/40HTHE LIMITING STABILITY (RITERION IS BETA)	E 2610
550 FORMAT (140-10V-SQUITE LIMITING STADILITY CONTENTON TO MAY MUM	
TECTON OFFICE CONTINUE STADIETTE CRITERIUN IS MAXIMUM	INJ E2020
TELITON RATES	E 2 6 3 U
END	E2640-
SUBROUTINE MOVE	F 10
REAL *8TMRX/VPRM/HI/HR/HC/HK/WT/REC/RECH/TIM/A0PT/TITIE	E 20
PEAL + SYNEL SYNEL S ADEA SIMT DUO DADAM TECT TOL DINI UMIN DVO	F 20
COMON (DONTO NTIN NOME NOOT AND TO THE STATUS AND TO THE STATUS	F 50
COMMON PRMIP NIMENPAPENPALENTIPENENXENTECEINTENXENYE	NUMO F 40
TBS>NMOV>IMOV>NPMAX>ITMAX>NZCRIT>IPRNT>NPTPND>NPNTMV>NPNTVL>NPN	TD, N F 50
2PNCHV,NPDELC	F 60
COMMON /PRMK/ NODEID(20,20), NPCELL(20,20), LIMBO(500), TYORS(5),	TYOP 5 70
	F 80
COMMON /HEDA/ IHCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANF	CTR F 90
COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC	(20, F 100
120) + HK (20, 20) + WT (20, 20) + REC (20, 20) + RECH (20, 20) + TIM (100) + AOPT (20)	0) T F 110
21TIF (10) + XDEL + YDEL + SAREA SUMT + BHO - PAPAM + TEST + TOL + PINT + HMIN - BY	
	R F 120
COMMON /XINV/ DXINV/DTINV/ARINV/PORINV	F 130
CUMMON /CHMA/ PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY	(20, F140
120),CONINT(20,20),CNRECH(20,20),POROS,SUMTCH,BETA,TIMV,STORM,S	TORM F 150
21, CMSIN, CMSOUT, FLMIN, FLMOT, SUMIO, CELDIS, DLTRAT, CSTORM	F 160
COMMON / CHMC/ SUMC(20,20) + VYBDY(20,20) + VYBDY(20,20)	£ 170
	F 170
DIMENSION XNEW(4), TNEW(4), DISI(4)	F 180
	* F 190
WRITE (6,680) NMOV	F 200
SUMTCH=SUMT+TIM(N)	F 210
F1=0,249	E 220
IF (NPTPND FO 5) F1=0 200	r 220
$\frac{1}{1} \left( \frac{1}{1} + 1$	+ 230
$\frac{1}{10000000000000000000000000000000000$	F 240
CONST1 = TIMV * DXINV	F 250
CONST2 = TIMV * DYINV	F 260
CMOVE PARTICLES 'NMOV' TIMES	£ 270
	r 210
	F 280
	F 290
CMOVE EACH PARTICLE	F 300
DO 590 IN=1,NP	F 310
IF (PART(1/IN).EQ.0.0) GO TO 590	F 320
KELAG=0	r 770
	r 330
· · · · · · · · · · · · · · · · · · ·	F 540
L +COMPULE OLD LOCATION	F 350

			c 7	40
		JFLAG=1	r 3	
		IF (PART(1,IN).GT.0.0) GO TO 20	F 3	
		JFLAG=-1	FS	580
		PART(1,IN)=-PART(1,IN)	+ 3	590
	20	XOLD=PART(1,IN)	F 4	+00
		I X = XOL D + O • 5	F 4	410
		IFLAG=1	F 4	420
		IF (PART(2,IN), GE, 0,0) GO TO 30	F 4	430
			F 4	440
		$\frac{1}{2} \frac{1}{2} \frac{1}$	F 4	450
	70		F 4	460
	30		F 4	470
				6.80
_		IF (IHCK(IX,IT).EW.0.0) GU IO 300		, on
С		******		47U 500
С		COMPUTE NEW LOCATION AND LOCATE CLOSEST NODE		500
C		LOCATE NORTHWEST CORNER	- r :	510
		IVX=XOLD	- <u>+</u>	520
		IVY=YOLD	F :	530
		I X E = I V X + 1	F S	540
		I Y S = I V Y + 1	F S	550
C		******	F 1	560
C		LOCATE QUADRANT, VEL. AT 4 CORNERS, CHECK FOR BOUNDARIES	F S	570
•		CFLDX=X0LD=IX	- F !	580
			F 5	590
		TE (CELDY EQ. $0.0$ AND (CELDY EQ. $0.0$ ) GO TO 280	F	600
		$f = (c_{E}) \times c_{E} = 0$ 0 0 0 (ELDY GE 0.0) 60 TO 70	F (	610
~			E /	620
ι				630
				6/0
		VXNE=VX(IXE/IVY)	- F (	460
		VXSW=VXBDY(IVX,IVS)	- r (	440
		VXSE=VX(IXE,IYS)	r e	
		VYNW=VYBDY(IVX/IVY)	FC	670
		VYNE=VYBDY(IXE,IVY)	FC	680
		VYSW=VY(IVX,IYS)	FC	690
		VYSE=VY(IXE,IYS)	F	700
		IF (THCK(IVX,IVY).EQ.0.0) GO TO 50	Fi	710
		IF (REC(IXE,IVY).EQ.O.O.AND.VPRM(IXE,IVY).LT.O.09) GO TO 40	F	720
		V X N E = V X N W	F 7	730
	40	IF (REC(IVX,IYS),EQ.O.O.AND.VPRM(IVX,IYS),LT.O.O9) GO TO 50	F	740
		V Y S W= V Y N W	F 7	750
	50	IF (REC(IXE,IYS).EQ.O.O.AND.VPRM(IXE,IYS).LT.O.09) GO TO 270	F	760
		IF (THCK(IVX,IVS), EQ.0.0) GO TO 60	F	770
			F	780
	60	IE (THCK(TXEATVY), EQ.0.0) GO TO 270	F	790
	00		E Å	800
			F	810
•		0 10 270	F	820
С		15 (15) N 15 0 0 00 15) N 15 0 0) 10 TO 130	5	830
	70			840
C	~ ~			960
	80	$\nabla X N W = \nabla X (1 \nabla X + 1 \nabla Y)$	- F - C	840
		VXNE=VXBDY(IVX;IVY)	- F (	000 970
		VXSW=VX(IVX,IYS)	- F (	000
		AX 2E = A XRD A (IAX + IA 2)		000
		VYNW=VYBDY(IVX/IVY)	- F -	040
		VYNE=VYBDY(IXE/IVY)	F	A00
		VYSW=VY(IVX,IYS)	F	97U
		VYSE=VY(IXE,IYS)	F	720
		IF (CELDX.EQ.0.0) GO TO 120	F	930
		IF (THCK(IXE,IVY).EQ.0.0) GO TO 100	Ē	940
		IF (REC(IVX/IVY).EQ.O.O.AND.VPRM(IVX/IVY).LT.O.O9) GO TO 90	F	950
		V X N ₩ = V X N E	F	960
	90	IF (REC(IXE,IYS).EQ.O.O.AND.VPRM(IXE,IYS).LT.O.09) GO TO 100	F	970

						F 980
	100	TE (DEC/INVITE) EO O O ANN NDOM/INVITES IT O OOS	<b>~</b> ^	<b>T</b> A	270	r 700
	100	IF (REL(IVA)IIS).EW.U.U.AND.VPRM(IVA)IIS).LI.U.U.)	60	10	270	F 790
		IF (IHCK(IXE/IYS).EQ.U.U) GO TO TTU				F1000
		VXSW=VXSE				F 1010
	110	IF (THCK(IVX,IVY),EQ.0.0) GO TO 270				F1020
		VYSW=VYNW				F1030
		GO TO 270				F1040
	120	TE (REC(TVX+TVS), EQ. $(0, AND, VPPM(TVX+TVS))$ (E ( (Q))	60	тο	270	F1050
		$T_{i} = (T_{i} \in V_{i} \cap V_{i}) = (T_{i} \cap$	00		270	E 1040
						F 1000
		V15W-V1NW				F1070
		60 10 270				F1080
С						F1090
	130	IF (CELDY.LE.O.O.OR.CELDX.GE.O.O) GO TO 190				F1100
C		PT。 IN SW QUADRANT				F1110
	140	VXNW=VXBDY(IVX,IVY)				F1120
		VXNE=VX(IXE/IVY)				F1130
		VXSH=VXRDY(IVX,IYS)				F1140
						E1150
						F1160
						r1170
						F 1 1 7 U
		VYSW=VYBDY(IVX,IVY)				F1180
		VYSE=VYBDY(IXE,IVY)				F1190
		IF (CELDY.EQ.0.0) GO TO 180				F1200
		IF (THCK(IVX,IYS).EQ.0.0) GO TO 160				F1210
		IF (REC(IVX,IVY).EQ.O.O.AND.VPRM(IVX,IVY).LT.0.09)	GO	ΤO	150	F1220
		VYNW=VYSW				F1230
	150	IF (REC(IXE,IYS), EQ.O.O.AND, VPRM(IXE,IYS), LT.O.09)	G 0	TO	160	F1240
		VXSE=VXSW				F1250
	160	IF $(REC(IXE_{A}IVY), EQ.0.0, AND, VPRM(IXE_{A}IVY), IT, 0.09)$	60	то	270	F1260
		IF $(THCK(IVX_IVY)_FQ_0_0)$ GO TO 170				F1270
		VXNF=VXNW				51280
	170	TE (THER/THE.THE) EO O O) CO TO 370				r1200
	170	1F ()HUK(1AE/1T3/0EW.0.0/ 00 TO 2/0				F1290
						F 1500
	1 0 0					F1310
	180	IF (REC(IXE/IVY).EQ.U.U.AND.VPRM(IXE/IVY).LE.U.U9)	GO	10	270	F1320
		IF (THCK(IVX,IVY).EQ.U.U) GO TO 27U				F 1 3 3 0
		VXNE=VXNW				F1340
		GO TO 270				F1350
C						F1360
	190	IF (CELDY.LE.O.O.OR.CELDX.LE.O.D) GO TO 260				F1370
C		PT. IN SE QUADRANT				F1380
	200	VXNW=VX(IVX,IVY)				F1390
		VXNE=VXBDY(IVX,IVY)				F1400
		VXSW=VX(IVX/IYS)				F1410
		VXSF=VXRDY(IVX.IVS)				F1470
						£1/30
						F1430
						F1440
		A L 2 M = A L R D A ( T A X \ T A X )				F1450
		VYSE=VYBDY(IXE,IVY)				F1460
		IF (CELDY.EQ.0.0) GO TO 240				F1470
		IF (CELDX.EQ.0.0) GO TO 250				F1480
		IF (THCK(IXE,IYS).EQ.0.0) GO TO 220				F1490
		IF (REC(IXE,IVY).EQ.O.O.AND.VPRM(IXE,IVY).LT.0.09)	GO	ΤO	210	F1500
		VYNE=VYSE				F1510
	210	IF (REC(IVX/IYS).EQ.O.O.AND.VPRM(IVX/IYS)_LT_0_09)	GO	TO	220	F1520
	-	VXSW=VXSE			•	\$1530
	220	TE (REC(TVX+TVY), EQ.O.O.AND VPRM(TVY-TVY) IT O OQ)	60	T٥	270	F1540
		IF (THCK(IXE $_1$ IV) $_{EQ_0}$ ) 60 TO 230	~~		210	F1550
		VYNW=VYNF				E1 540
	230	$IE (TH(K(TVX_TYS)) EQ (0, 0) EQ (70, 270)$				£1670
		VVNUEVVCU				r 1 J ( U E 1 E 0 A
		νιπτηστιώπ κα τα 270				r 1 3 8 U
						r 1 3 9 U

	240	IF (REC(IVX/IVY)_EQ.O.O.AND_VPRM(IVX/IVY).LE.O.O9) GO TO 270	F1600
		$T_{\rm r}$ (THCK(TYE-TWY) EQ 0.0) GO TO 270	F1610
			F1620
		VXNW=VXNE	51630
		60 10 270	61440
	250	IF (REC(IVX,IVY).EQ.U.U.AND.VPRM(IVX,IVY).LE.U.U9) GO TO 2/U	F1040
		IF (THCK(IVX,IYS).EQ.0.0) GO TO 270	F1650
		V Y N W = V Y S W	F1660
		60 10 270	F1670
~			F1680
r			£1400
	260	IF (CELDX.EQ.U.U.AND.CELDT.LI.U.U) GO TO 80	F1070
		IF (CELDX.LT.O.O.AND.CELDY.EQ.O.O) GO TO 140	F1700
		IF (CELDX.GT.D.O.AND.CELDY.EQ.O.O) GO TO 200	F1710
		IF (CELDX.EQ.O.O.AND.CELDY.GT.O.O) GO TO 200	F1720
		WRITE (6,690) INVIXIY	F 1 7 30
	270		F1740
~	270		F1750
L.		*****	E1760
C		BILINEAR INTERPOLATION	c 1 7 7 0
		CELXD=XOLD-IVX	F1770
		CELDXH=AMOD(CELXD,0.5)	F1/80
		CELDX=CELDXH*2.0	F1790
		CELDY=YOLD-IVY	F1800
r			F1810
2			F1820
C			c1930
		VXN=VXNW*(T.U-CELDX)+VXNE*CELDX	F1630
		IF (THCK(IVX/IVY).EQ.O.O.OR.THCK(IXE/IVY).EQ.O.O) VXN=VXNW+VXNE	F1840
		VXS=VXSW*(1.0-CELDX)+VXSE*CELDX	F1850
		IF (THCK(IVX,IYS), EQ.O.O.OR,THCK(IXE,IYS), EQ.O.O) VXS=VXSW+VXSE	F1860
		xy = xxy + (1, 0 - c = 0, y) + yx + c = 0, y	F1870
		$\frac{1}{100} = \frac{1}{100} = \frac{1}$	F1880
			£1900
_		IF (THER (IVX)ITS) EQ.U.U. AND THER (IXE)ITS) EQ.U.U. AVEL-VAN	F,1070
С		VELOCIIV	F 1 900
		CELDYH=AMOD(CELDY/0.5)	FIAIO
		CELDY=CELDYH+2.0	F1920
		VYW=VYNW*(1_0-CELDY)+VYSW*CELDY	F1930
		IF (THCK(IVX,IVY)_EQ.0.0.0R.THCK(IVX,IYS)_EQ.0.0) VYW=VYNW+VYSW	F1940
			F1950
		$\mathbf{v} = \mathbf{v} + \mathbf{v} = \mathbf{v} + \mathbf{v} = \mathbf{v} + \mathbf{v} + \mathbf{v} + \mathbf{v} + \mathbf{v} = \mathbf{v} + \mathbf{v} + \mathbf{v} + \mathbf{v} = \mathbf{v} + $	E1960
		IF (INCR(IAE)IVI).EQ.U.U.U.R.INCR(IAE)IV3/.EQ.U.U.V VIE-VINEVVISL	r 1070
		YVEL=VYW*(1.U-CELXD)+VYE*CELXD	F1770
		IF (THCK(IVX,IVY).EQ.O.U.AND.THCK(IVX,IYS).EQ.U.U) YVEL=VYE	F 1 9 6 U
		IF (THCK(IXE,IVY).EQ.O.O.AND.THCK(IXE,IYS).EQ.O.O) YVEL=VYW	F1990
C			F 2 0 0 0
		GO TO 290	F2010
	280		F 2 0 2 0
	200		F2030
	200		F 20 40
	290	DISIX=XVEL*CONSII	52040
		DISTY=YVEL*CONST2	12050
C		***************************************	F2000
C		BOUNDARY CONDITIONS	F2070
		TEMPX=XOLD+DISTX	F2080
		TEMPY=Y01 D+DISTY	F 2090
			F2100
			F2110
		$\frac{1}{10} = 1 = 1 = 1 = 1 = 0$	62120
		1F (IHCK(INX/INT).GI.U.U) GO IO 330	F 6 1 6U
C		****************	F2130
C		X BOUNDARY	F2140
		IF (THCK(INX/IY).EQ.0.0) GO TO 300	F2150
		PART(1/IN)=TEMPX	F2160
		60 10 310	F2170
	300		F2180
	200	DEIVN-TERFA-IA	F2190
		$\frac{1}{1} = \frac{1}{1} = \frac{1}$	F2200
		1   (BETUN, 61, 0, 0) BETUN=BETUN=0.)	53340
		PART(1,IN)=TEMPX-2.U+BEYON	12210

		INX=PART(1,IN)+0.5	F2220
		TEMPX=PART(1,IN)	F2230
С		* * * * * * * * * * * * * * * * * * * *	F2240
С		Y BOUNDARY	F2250
	310	IF (THCK(INX,INY).EQ.O.O) GO TO 320	F2260
		PART(2,IN)=TEMPY	F2270
		GO TO 340	F2280
C		******	F2290
	320	BEYON=TEMPY-IY	F2300
		IF (BEYON.LT.O.O) BEYON≃BEYON+0.5	F2310
		IF (BEYON.GT.O.O) BEYON=BEYON-0,5	F2320
		PART(2,IN)=TEMPY-2.0*BEYON	F 2 3 30
		INY=PART(2,IN)+0.5	F2340
		TEMPY=PART(2,IN)	F 2 3 5 0
		GO TO 340	F2360
	330	PART(1,IN)=TEMPX	F2370
		PART(2,IN)=TEMPY	F2380
	340	CONTINUE	F 2 390
С		***************	F2400
C		SUM CONCENTRATIONS AND COUNT PARTICLES	F2410
		SUMC(INX,INY)=SUMC(INX,INY)+PART(3,IN)	F2420
		NPCELL(INX/INY)=NPCELL(INX/INY)+1	F2430
C		***************	F2440
C		CHECK FOR CHANGE IN CELL LOCATION	F2450
		IF (IX.EQ.INX.AND.IY.EQ.INY) GO TO 580	F2460
C		CHECK FOR CONSTHEAD BDY. OR SOURCE AT OLD LOCATION	F2470
		IF (REC(IX,IY).LT.0.0) GO TO 350	F2480
		IF (REC(IX/IY).GT.O.O) GO TO 360	F2490
		IF (VPRM(IX,IY).LT.0.09) GO TO 540	F 2 500
		IF (WT(IX,IY).GT.HK(IX,IY)) GO TO 350	F2510
		IF (WT(IX,IY).LT.HK(IX,IY)) GO TO 360	F2520
		GO TO 540	F2530
С		***************************************	F2540
С		CREATE NEW PARTICLES AT BOUNDARIES	F2550
	350	IF (IFLAG.GT.O) GO TO 550	£5290
		KFLAG=1	F2570
	360	DO 370 IL=1,500	F2580
		IF (LIMBO(IL).EQ.D) GO TO 370	F2590
		IP=LIMBO(IL)	F2600
		IF (IP.LT.IN) GO TO 380	F2610 ·
-	370	CONTINUE	F 2620
C			F2630
C		GENERATE NEW PARTICLE	F264U
		IF (NPTM.EQ.NPMAX) GO TO 600	F2650
		NPTM=NPTM+1	F266U
			12070
			F2680
	380	LIMBO(IL)=U	F2690
Ç	700		12700
	390	IF (NFLAG, EW, U) GO IU 220 IE (THEVINA IN) EO O 20 AB THEVINA INV EO O O AB THEVINA INAL	52710
		1 = (1 + (1 + (1 + 1))) = (1 + (1 + (1 + (1 + (1 + (1 + (1 + (1	F2720
		$\frac{1}{10} \frac{1}{10} \frac$	F2730
		1 = (1 = (1 = (1 = 1) = 1) = (1 = (1 = 1) = (1 = 1) = (1 = 1) = (1 = (1	F2740
r		ULITIZAENAONAUNAUNUKAINUKAINITIZAENAUAUZ UU UU JU JU Vente (entersionaunukainukainukainukainukainukainukainu	F2740
•		IE (IELAG IT D) GO TO SOO	F2770
		st terenegelady do to you Haza	F2780
		AN=TEMPY-YOLD	F2790
			F2800
		DISTMV=SQRT((AD*AD)+(AN*AN))	F2810
		IF (AD, EQ. 0.0) GO TO 410	F 2820
		SLOPE=AN/AD	F2830

F2840 F2850 F2860 F2870 F2880 F2890 F 2 9 0 0 F2910 F 2920 F2930 F2940 F2950 F2960 F2970 F2980 F2990 F 3000 F3010 F 3020 F3030 F 3040 F3050 F 3060 F3070 F 3080 F3090 F 3100 F3110 F 3120 F 31 30 F3140 F 31 50 F 3160 F3170 F 3180 F3190 F 3200 F3210 F 32 20 F3230 F 3240 F 3250 F 3260 F3270 F 3280 F3290 F 3300 F3310 F 3320 F 3330 F3340 F3350 F 3360 F3370 F3380 F3390 F3400 F3410 F 3420 F3430 F3440 F3450

		AI=YOLD-SLOPE+XOLD
		XC2=1X+F1
		YC1=IY-F1
		VC 3= 1 V A C 1
-		
С		COMPUTE NEW COORDINATES AND VERIFY
		DO 400 IK=1,4
		YNEW(IK)=0.0
		XNEW(IK)=U.U
	400	DIST(IK)=0.0
		$YNEW(1) = (SI \cap PE + Y(1) + BI)$
		XNEW(1)=X(1)
		YNEW(2)=(SLOPE*XC2)+BI
		YNE4(2)=¥C2
		$\frac{1}{2} \int \frac{1}{2} \int \frac{1}$
		IF (SLOPE - EQ = 0 = 0) GO TO 420
		YNEW(3)=YC1
		XNFW(3)=(YC1-RI)/SLOPF
		TNEW(4)=+(2
		XNEW(4)=(YC2-BI)/SLOPE
		GO TO 430
	110	
	410	TNEW())=17-F)
		XNEW(1)=XOLD
		YNEW(2)=IY+F1
		XNEW(2)=X01 D
	120	
	420	J J = 2
	430	DO 440 II=1,JJ
	440	DIST(II)=SQRT((XNEW(II)-TEMPX)**2+(YNEW(II)-TEMPY)**2)*1.00001
		DISTCK=2.U
		DO 460 IG=1,JJ
		TE (DIST(IG) GE DISTMU AND DIST(IG) IT DIST(Y) GO TO 450
		60 10 480
	450	IXC=XNEW(IG)+0.50
		$\frac{1}{10} - \frac{1}{10} = \frac{1}{10} + \frac{1}{10} $
		IF (IXC.NE.IX.OR.ITC.NE.IT) GU TU 400
		IACC=IG
		DISTCK=DIST(IG)
	140	
	400	
		IF (IACC.LT.1.0R.IACC.6T.4) GO TO 510
		IF (XNEW(IACC).EQ.XC1.OR.XNEW(IACC).EQ.XC2) GO TO 470
		TE (YNEW(TACC), EQ. YC1, OP YNEW(TACC) EQ. YC2) GO TO 480
		2. THE EAC
		GO TO 510
	470	IF (YNEW(IACC).LT.YC1) YNEW(IACC)=YC1
		IF (YNEW(IACC)_GT_YC2) YNEW(IACC)=YC2
		GO TO 490
	480	IF (XNEW(IACC)_LT_XCT) XNEW(IACC)=XCT
		IF (XNEW(IACC).GT.XC2) XNEW(IACC)=XC2
	490	PART(1,IP)=XNFW(IACC)
		PARIL2/IP/=TNEW(IALL)
		GO TO 530
	500	PART(1,IP)=-IX
		PADT (2, TP)=TV
		60 10 550
	510	PART(1,IP)=XOLD
	_	PART(2,IP)=YOLD
		GO TO 530
_		
C		IF EDGE SOURCE OR SINK
C		X POSITION
	520	
C		Y POSITION

64

		PART(2/IP)=TEMPY-DLY	E 34 60
		1F (KELAG_GT_0) GO TO 530	57/70
r			F547U
C			F 3480
		SUMC(IX,IY)=SUMC(IX,IY)+CONC(IX,IY)	F 3490
		NPCELL(IX,IY)=NPCELL(IX,IY)+1	F 3 5 0 0
C			63510
•	530		
	550	PARI(2P)P = PAR(2P)P	F 3520
		PARI(S,IP)=CONC(IX,IY)	F 3 5 3 0
		IF (REC(IX,IY).EQ.0.0) GO TO 540	F 3 5 4 0
C		*****	E3550
r			63510
•	E / 0	TELACTOR FOR DISCHARGE BOONDART AT NEW LOCATION	1 2200
	240	IFLAG#1.U	F3570
	550	IF (VPRM(INX,INY).GT.O.09.AND.WT(INX,INY).LT.HK(INX,INY)) GO TO 56	F3580
		10	E3590
		IF (REC(INX (INX), GT, 0, 0) GO TO 560	E 7400
			P 3000
		60 10 390	F 3610
C		** * * * * * * * * * * * * * * * * * * *	F 3620
C		PUT PT. IN LIMBO	F 3630
	560	$PART(1 \wedge IN) = 0.0$	57440
			F 3040
			13020
		PART(S/IN)=U.U	F3660
		DO 570 ID=1,500	F 3670
		IF (LINBO(10)-6T-0) 60 TO 570	E 74 80
			1 3000
			F 3690
		GO TO 590	F 3700
	570	CONTINUE	F3710
C			F 3720
	580	TE (TELAG IT ()) PART(2,IN)=-TEMPY	63730
	200	$\frac{1}{15} + \frac{1}{15} $	F 37 30
		IF (JFLAG.LI.U) PARI(I/IN)=-IEMPX	F 5740
	240	CONTINUE	F 3750
C		END OF LOOP	F 37 60
C		*****	F3770
-		60 10 620	63790
r			13700
Ľ		RESTART MOVE IF FI. LIMIT EXCEEDED	13190
	000	WRITE (6//UU) IMOV/IN	F 3800
		TEST=100.0	F3810
		CALL GENPT	F 3820
		DO 610 IX=1.NX	63930
			r 3030
		DU GIU IT=INY	F 3840
		SUMC(IX,IY)=0.0	F 3850
	610	NPCELL(IX/IY)=0	F3860
			53870
			F 30/U
_			F 3880
C		*****************	F3890
	620	SUMTCH=SUMTCH+TIMV	F 3900
C		ADJUST NUMBER OF PARTICLES	F 1010
-			
			F 3920
		WRITE (6,670) NP/IMOV	F 3930
C		*************	F3940
		CALL CNCON	F3950
c		*****	F 7040
Ē			F 3700
L.			1 2410
		IF (S.GI.U.U) GO TO 64U	F3980
		IF (NUMOBS.LE.O) GO TO 640	F3990
		J = MOD(IMOV > 50)	F4000
		$IF (J_{+}FQ_{+}\Omega) J_{+}=50$	F & 010
			F4010
			+4020
		DU 65U 1=1,NUMOBS	F4030
		TMWL(I,J)=HK(IXOBS(I),IYOBS(I))	F4040
	630	TMCN(I,J) = CONC(IXOBS(I), IYOBS(I))	F4050
C	-	PRINT CHEMICAL OUTPUT	F4040
5	640		r / 0 0 0
	040	TE TERAPCENMUAL ON LO DON	r4U/U

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	20	DO	6	0	IX	= '	1,	NX	:																													G	350
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		DIV=RATE+SLEAK+RECH(IX,IY)	c	1.90
			6	400
			0	490
			6	500
		UI 4 - UI 4 3 - UE KH	G	510
~			G	520
L		NOTE: ABOVE STATEMENT ASSUMES THAT S=0.005 SEPARATES CONFINED	G	530
C		FROM UNCONFINED CONDITIONS; THIS CRITERION SHOULD BE	G	540
С		CHANGED IF FIELD CONDITIONS ARE DIFFERENT.	G	550
		DELC=EQFCT2*(C1*(DIV-POROS*DERH)-RATE*CNREC-SLEAK*CLKCN-RECH(IX/IY	G	560
		1) * CNRE CH(IX/IY))	G	570
		GO TO 40	G	580
	30	DELC=EQFCT2*(C1*DIV-RATE*CNREC-SLFAK*CLKCN-RECH(IX,IY)*CNRECH(IX,I	G	590
		1 ( ) )	ā	600
	۸۵		Ğ	£10
r	40	= - (A A A A A A A A A A A A A A A A A A	6	4 20
Č			6	620
Ľ		DISPERSION WITH TENSOR COEFFICIENTS	6	0.50
			G	640
		x1=DISP(IX,IY,1)+(CONC(IX+1,IY)-C1)	G	650
		x2=DISP(IX-1,IY,1)*(CONC(IX-1,IY)-C1)	G	660
		Y1=DISP(IX,IY,2)+(CONC(IX,IY+1)-C1)	G	670
		Y2=DISP(IX,IY-1,2)*(CONC(IX,IY-1)-C1)	G	680
		XX1=DISP(IX,IY,3)*(CONC(IX,IY+1)+CONC(IX+1,IY+1)-CONC(IX,IY-1)-CON	G	690
		1c(1x+1,IY-1))	G	700
		XX2=DISP(IX-1,IY,3)*(CONC(IX,IY+1)+CONC(IX-1,IY+1)-CONC(IX,IY-1)-C	G	710
		10NC(IX-1/IY-1))	G	720
		$YY1=DISP(IX \cdot IY \cdot 4) * (CONC(IX + 1 \cdot IY) + CONC(IX + 1 \cdot IY + 1) - CONC(IX - 1 \cdot IY) - CON$	G	7 30
		1((1x-1,(1y+1)))	Ğ	740
		YY2 = DISP(IX - 1 - 1 - 4) + (CONC(IX + 1 - IY) + CONC(IX + 1 - IY - 1) - CONC(IX - 1 - IY) - C	Ğ	750
		10NC(IX-1,IY-1))	Ğ	760
	50	CNCNC(IX,IY) = CNCNC(IX,IY) + EQECT1 + (X1 + X2 + Y1 + Y2 + XX1 - XX2 + YY1 - YY2)	Ğ	770
	60		Ğ	780
r		*****	ă	790
•		11207-1120741	č	000
		$\frac{1}{1} = \frac{1}{1} = \frac{1}$	6	000
			C C	010
~			6	820
L C			6	830
L			6	840
	70	DO 90 IX=1,NX	G	850
		DO 90 IY=1,NY	G	860
		IF (THCK(IX,IY).EQ.0.0) GO TO 90	G	870
		APC=NPCELL(IX,IY)	G	880
		IF (APC.GT.0.0) GO TO 80	G	890
		IF (REC(IX,IY).NE.O.O.OR.VPRM(IX,IY).GT.O.O9) GO TO 90	G	900
		NZERO=NZERO+1	G	910
		GO TO 90	G	920
	80	CONC(IX,IY)=SUMC(IX,IY)/APC	G	930
	90	CONTINUE	G	940
C		CHECK NUMBER OF CELLS VOID OF PTS	G	950
•		IF $(NZ FRO_GT_O)$ WRITE $(6/290)$ NZFRO/IMOV	Ğ	960
		IF (NZERO-LE-NZCRIT) GO TO 20	Ğ	970
		TESTER9.0	ñ	980
			ă	000
		WRITE (6.320)	61	000
			61	010
	100		6	010
	100	WRITE (0/330/ (NFLEEL(14/11//14=1/NA/	0	020
~			0	020
ر م			0	
C			61	0.00
	110		G 1	060
			G	1070
		1F (IH(K(17,1T),EW,U,U) GO IO 12U	G	080
		CONC(IX/IY)=CONC(IX/IY)+CNCNC(IX/IY)	G	0.40

		NPCFL ( ( X ~ I X )=0	61100
		SIM((1x+1y)=0.0)	G1110
		IF (CONC(IX, IY), LE, 0.0) GO TO 130	G1120
		$CNCPCT = CNCNC(IX \neq IY) / CONC(IX \neq IY)$	G1130
			G1140
		60 10 130	G1150
	120	IF (CONC(IX,IY),GT.D.D) WRITE (6,310) IX,IY,CONC(IX,IY)	G1160
		CONC(IX,IY)=0.0	61170
	130	CONTINUE	G1180
C		********	G1190
Č		CHANGE CONCENTRATION OF PARTICLES	G1200
		DO 180 IN=1,NP	G1210
		IF (PART(1,/IN)_EQ.0.0) GO TO 180	G1220
		INX=ABS(PART(1,IN))+0.5	G1230
		INY=ABS(PART(2,IN))+0.5	61240
C		UPDATE CONC. OF PTS. IN SINK/SOURCE CELLS	G 1 2 50
		IF (REC(INX,INY).NE.D.D) GO TO 14D	G1260
		IF (VPRM(INX,INY).LE.O.09) GO TO 150	61270
	140	PART(3,IN)=CONC(INX,INY)	G1280
		GO TO 180	G1290
	150	IF (CNCNC(INX,INY).LT.O.D) GO TO 170	G1300
	160	PART(3, IN) = PART(3, IN) + CNCNC(INX, INY)	61310
		G0 T0 180	61320
	170	$\begin{array}{c} \text{IF}  (\text{CONC(INX,INY)}, \text{Le.U.U)}  \text{GO IO ISO} \\ \end{array}$	61330
		IF (SUMC(INX,INY),LI, $-1.0$ ) GO IO IGU	61340
	4 0 0	PART(S/IN)=PART(S/IN)+PART(S/IN)+SUMC(INA/INT)	61360
	100	UNIINUE URIE (4.200) TIM/NI-TIMV-CUMTCH	61370
r		WRITE (0/2007) 11 M(N//// M/// United ( 1 + + + + + + + + + + + + + + + + + +	61380
~			61390
C		CSTORMED O	61400
			61410
		DO 270 IX=1-NX	G1420
		DO 270 IY=1,NY	61430
		IF (THCK(IX,IY).EQ.0.0) GO TO 270	G1440
		SUMC(IX/IY)=0.0	G 1 4 50
C		COMPUTE MASS OF SOLUTE IN STORAGE	G1460
		STORM=STORM+CONC(IX,IY)+THCK(IX,IY)+ARPOR	G1470
С		ACCOUNT FOR MASS PUMPED IN, OUT, RECHARGED, & DISCHARGED	61480
		IF (REC(IX,IY)) 200,210,190	61490
	190	CM SOUI=CM SOUI+RECCIX/ITJ*CNOLDCIX/ITJ*IIMV	61500
	200	00 10 210 CM CTN = CM CTN + DCC / TV - TV + CM DECN / TV - TV + TTMV	61520
	210	$T = (P \in P \in V \setminus V \setminus V) = 230, 240, 220$	61530
	220		61540
	220		61550
	230	CMSIN=CMSIN+RECH(IX,IY)+CNRECH(IX,IY)+TVA	61560
С		********	G1570
č		ACCOUNT FOR BOUNDARY FLOW	G1580
	240	IF (VPRM(IX,IY).EQ.D.0) GO TO 270	61590
		FLW=VPRM(IX,IY)+(WT(IX,IY)-HK(IX,IY))	G1600
		IF (FLW.GT.0.0) GO TO 250	61610
		IF (FLW.LT.0.D) GO TO 260	61620
~		GO TO 270	61650
C	250	+MASS IN BUUNDART DURING TIME STEP	61450
	230	LUNIN=LUNIN+LM*(NKECH(IX/IT)*/A	61440
~		SU IU CIU	61670
L	240	CIMOTACIMATACIMACNALACITATA	61680
	270	CONTINUE	61690
c			G1700
č		COMPUTE CHANGE IN MASS OF SOLUTE STORED	G1710
#### FORTRAN IV program listing-Continued

	CSTORM=STORM-STORMI	G1720
	SUMIO=FLMIN+FLMOT-CMSIN-CMSOUT	G1730
C	*****	61740
C	REGENERATE PARTICLES IF 'NZCRIT' EXCEEDED	61750
	IF (TEST.GT.98.0) CALL GENPT	61760
	TEST=0.0	61770
С	*****	61780
	RETURN	61790
C	****	61900
č		61800
č		61010
ř		61820
Ľ	200 EODMAT /74 114TTN/N) - 1012 E 102 144TTNN - 1012 E 404	61850
	10 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 +	61840
	$\frac{1}{2} = \frac{1}{2} = \frac{1}$	61850
	290 FORMAT (THUSSAUHNUMBER OF CELLS WITH ZERO PARTICLES = ,14,52,9	G1860
	1HIMOV = (147)	G1870
	SUD FORMAI (1HU, 5X, 44H*** NZCRIT EXCEEDED CALL GENPT ***/)	61880
	STU FORMAT (1H + 5X+ 37H * * CONC.GT. U. AND. THCK.EQ. U AT NODE = +214+4X+7HC	<b>G189</b> 0
	$10NC = c_{0}G10_{-}4c_{0}H + ***)$	G1900
	320 FORMAT (1H0,2X,6HNPCELL/)	G1910
	330 FORMAT (1H +4X+2013)	G1920
	END	61930 <del>-</del>
	SUBROUTINE OUTPT	н 10
	REAL *8TMRX,VPRM,HI,HR,HC,HK,WT,REC,RECH,TIM,AOPT,TITLE	H 20
	REAL *8XDEL,YDEL,S,AREA,SUMT,RHO,PARAM,TEST,TOL,PINT,HMIN,PYR	н 30
	COMMON /PRMI/ NTIM,NPMP,NPNT,NITP,N,NX,NY,NP,NREC,INT,NNX,NNY,NUMO	H 40
	1BS,NMOV,IMOV,NPMAX,ITMAX,NZCRIT,IPRNT,NPT,PND,NPNTMV,NPNTVL,NPNTD,N	H 50
	2PNCHV, NPDELC	н 60
	COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB	н 70
	1\$(5)	H 80
	COMMON /HEDA/ THCK(20,20),PERM(20,20),TMWL(5,50),TMOBS(50),ANFCTR	н 90
	COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,	н 100
	120),HK(20,20),WT(20,20),REC(20,20),RECH(20,20),TIM(100),AOPT(20),T	н 110
	2ITLE(10), XDEL, YDEL, S, AREA, SUMT, RHO, PARAM, TEST, TOL, PINT, HMIN, PYR	H 120
	COMMON /BALM/ TOTLQ	H 130
	DIMENSION IH(20)	H 140
С	*****	н 150
-	TIMD=SUMT/86400.	н 160
	TIMY=SUMT/(86400.0+365.25)	H 170
C		H 180
•		H 100
		u 200
		n 200
	WAIL (0/140/ JUNI)	H 210
	WRITE (6.160) TIMV	n 220
		n 200
		H 24U
		H 250
	$\begin{array}{c} 10  \text{write}  (0,180)  (\text{Hr}(1x,11),1x=1,\text{Nx}) \\ 15  (1,1,2,1,1)  (1,1,1)  (1,1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1)  (1,1,1) $	H 20U
~		H 270
Ľ	·····	H 280
L		H 290
	WRIIE (0/12U)	н 300
	WRITE (0,75U) N	H 310
	WKIIE (0/140) SUMI	н 320
	WRITE (6,150) TIMD	H 330
	WRITE (6,160) TIMY	н 340
	WRITE (6,170)	H 350
	DO 30 IY=1,NY	H 360
	DO 20 IX=1+NX	н 370
	20 IH(IX)=HK(IX,IY)+0.5	H 380
	30 WRITE (6,190) (IH(ID),ID=1,NX)	н 390
C	**************	н 400

_				140
C		COMPUTE WATER BALANCE AND DRAWDOWN	н	410
		QSTR≖O.O	н	4Z0
		PUMP=0_0	н	430
			н	440
				1 50
		QIN=0.0		4 30
		QOUT=0.0	н	460
		QNET=0.0	н	470
			н	480
				400
		JCK=0	н	490
		PCTERR=0.0	H	500
		WRITE (6,290)	н	510
r			н	520
•				520
				550
		DO 70 IX=1.NX	н	240
		IH(IX)=0.0	н	550
		IF $(THCK(IX_{I}IY)_{R} = 0.0)$ GO TO 70	н	560
		Thim = $\rho \in (TY, TY) + \rho \in (H(TY, TY) + \Delta \rho \in A + TP)$	н	570
				500
		IF (VPRM(IX,IT).EQ.0.0) 60 TO 60		100
		DELQ=VPRM(IX,IY)*AREA*(WT(IX,IY)-HK(IX,IY))	н	240
		IF (DELQ.GT.O.O) GO TO 40	н	600
			н	610
				620
			n 	020
	40	QIN=QIN+DELQ	н	030
	50	QNET=QNET+DELQ	н	640
	60	DDRW=HI(IX,IY)-HK(IX,IY)	н	650
	•••		н	660
				470
		QSTR=QSTR+DDRW*AREA*S	п	070
	70	CONTINUE	н	680
C		PRINT DRAWDOWN MAP	н	690
-		$PRITE \left( (A, 300) \right) \left( IH (IX) , IX = 1 , NX \right)$	н	700
			 L	710
	80	CONTINUE	n	710
		PUMP=TPUM*SUMT	н	720
		DELS=-QSTR/SUMT	н	730
		FRRMB=PUMP-TOTL Q-QSTR	н	740
			н	750
				740
		IF (ABS(DEN).EQ.ABS(ERRMB)) JUK=1	н	100
		IF (DEN.EQ.0.0) GO TO 100	н	770
		IF (JCK.EQ.1) GO TO 90	н	780
		PCTERR=ERRMR+200-0/DEN	н	790
				800
	~~		11	040
	90	$\mathbf{I} \in (\mathbf{QIN} \cdot \mathbf{E} \mathbf{Q}_{\bullet} \mathbf{U} \cdot \mathbf{U})  \mathbf{GO}  \mathbf{IO}  \mathbf{IO}$	н	010
		PCTERR=100.0*QNET/QIN	н	820
С		PRINT MASS BALANCE DATA FOR FLOW MODEL	н	830
-	100	WRITE (6.240)	н	840
				850
		WRITE (0/230) PUMP	п	010
		WRITE (6,230) QSTR	н	860
		WRITE (6,260) TOTLQ	н	870
			H	880
		$\mathbf{W}_{\mathbf{r}} = \mathbf{r}_{\mathbf{r}} \mathbf{r}} \mathbf{r}_{\mathbf{r}} \mathbf{r}_{$		800
		IT (JUN,EW,U) WAITE (0/200) FUTERR		070
		WRITE (6,200) GIN, GOUT, GNET	H	A00
		WRITE (6,210) TPUM	н	910
		WRITE (6,220) DELS	н	920
		TE (ICK EQ 1) WRITE (6.280) POTERP	н	930
~		II (JURGERGI) WRITE (UFCOU) IUTERN		010
C		***************************************	H	740
	110	RETURN	н	<b>72</b> 0
С		***************	н	960
с			н	970
ř				080
C .				200
C			н	770
	120	FORMAT (1H1,23HHEAD DISTRIBUTION - ROW)	H1	000
	130	FORMAT (1X,23HNUMBER OF TIME STEPS = ,115)	Н1	010
	1/0	= 1612  S	L I	020
	1 4 U	$\mathbf{v} \mathbf{v} \mathbf{v} \mathbf{v} \mathbf{v} \mathbf{v} \mathbf{v} \mathbf{v} $		

FORTRAN IV program listing—Continued

	150 FORMAT ( $8x_16$ HTIME(DAYS) = .1512 5)	H1030
		11000
	$\frac{1}{100} + \frac{1}{100} + \frac{1}$	H1040
	170 FORMAT (1H )	H1050
	180 FORMAT (140,10F12 7/10F12 7)	111040
		HIUOU
	TYU FORMAT (THU#2UI4)	H1070
	200 FORMAT (1H0,2X,33HRATE MASS BALANCE (IN $C_{1}F_{2}S_{1}$ ) //10X,8HRTN =	H1080
	$1 - c_{12} = c_{12} + c_{12}$	
	1 - 3 - 2 - 3 - 1 - 2 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3	H10A0
	210 FORMAT (1H >17X + 8HTPUM = ->G12.5)	H1100
	220  FORMAT (1H - 17X - 8HDFLS = -612 - 5/)	H111D
	230 FORMAT $(4y, 20)$ whated being set face from stopage - 1512 EV	111120
	COD FORMAT (44/27/WATER RECEASE FROM STORAGE - FIEL2.)	MIIZU
	240 FORMAT (1H0,2X,23HCUMULATIVE MASS BALANCE//)	H1130
	250  format (4X) - 29  formulative net pumpage = 1  f 12.5)	H1140
	240 FORMAT (AV. 2000) MULLATIVE NET LEAVAGE - 1512 EX	111150
	COD FORMAT (44727) CODULATIVE NET LEARAGE - FIET2.57	H1130
	2/U FORMAT (1HU//X/25HMASS BALANCE RESIDUAL = /G12.5)	H1160
	280 FORMAT (1H $r_7x_r_25$ HERROR (AS PERCENT) = $r_612_{-5}/$ )	H1170
	200 FORMAT (1H1-SHORAHOGHN)	H1180
		11100
	SUU FORMAI (SH /2013)	HIIYU
	END	H1200-
	SUBROUTINE CHMOT	T 10
	DEAL FORMAN VIDIA, UT UD UP, UV, UT DEC DECU TIM AODT TITLE	1 20
	REAL * OIMRASVPRMANIARANCANSWIZECZRECHZIIMZAUPIZIILE	1 20
	REAL *8XDEL/YDEL/S/AREA/SUMT/RHO/PARAM/TEST/TOL/PINT/HMIN/PYR	I 30
	COMMON /PRMI/ NTIMANPMPANPNTANITPANANXANYANPANRECAINTANNXANNYANNMO	I 40
	1DC NMAY ATMAY ATMAY ATTAXY ANTONY TOBAT ADTONY NOTTY NOTTY ADATA	1 60
	DO DATA VETRUEN NETRA ZITERA ZUCKI I ZIERNI ZNETENDZNEN I MVZNEN I VLZNEN UZNEN UZN	1 20
	2PNCHV,NPDELC	I 60
	COMMON /PRMK/ NODEID(20,20),NPCELL(20,20),LIMBO(500),IXOBS(5),IYOB	I 70
	15(5)	1 80
		1 00
	COMMON /HEDA/ IHCK(20/20)/PERM(20/20)/IMWL(5/50)/TMOBS(50)/ANFCTR	1 90
	COMMON /HEDB/ TMRX(20,20,2),VPRM(20,20),HI(20,20),HR(20,20),HC(20,	I 100
	120) + HK (20+20) + HT (20+20) + REC (20+20) + REC H (20+20) + T IM (100) + AOPT (20) + T	T 110
		1 1 20
	citle(tu), xbel/tbel/Syakea/SUMI/RHU/PARAM/TEST/TOL/PINT/HMIN/PTK	1 120
	COMMON /CHMA/ PART(3,3200),CONC(20,20),TMCN(5,50),VX(20,20),VY(20,	I 130
	120), CONINT(20,20), CNRECH(20,20), POROS, SUMTCH, BETA, TIMV, STORM, STORM	I 140
	21 - CHSTN - CHSOUT - ELMIN - ELMIN - CHMIN - CELNIS - NI TRAT - CSTORM	1 150
		1 1 50
	DIMENSION IC(20)	I 160
C	*****	I 170
-	TMEV=86400 0+365 25	T 180
		1 100
		1 190
	TCHD=SUMTCH/86400.0	I 200
		T 210
		1 220
	IF (IFRNI-GI-U) GO IU IUU	1 220
C	******************	1 230
C	PRINT CONCENTRATIONS	1 240
-		1 260
	WKIIC (0/100/	1 230
	WRITE (6,170) N	I 260
	IF (N.GT.O) WRITE (6,180) TIM(N)	I 270
	THUS (6-100) SHAT	1 280
	WRITE (6,450) SUMTCH	I 290
	WRITE (6,200) TCHD	I 300
	WRITE (6,210) TMYR	T 310
		1 3 20
	WRITE (0)4007 ICHTR	1 320
	WRITE (6,380) IMOV	I 330
	WRITE (6/20)	I 340
		1 360
		1 330
	U IX=I/NX	1 360
	10 IC(IX)=CONC(IX/IY)+0.5	1 370
	20 WRITE (6.240) (IC(IY), IV=1-NV)	1 380
~		7 700
C		T 2A0
	IF (N.EQ.O) GO TO 150	I 400
	IF (NPDELC.EQ.D) GO TO 50	I 410
r		1 420
L C		1 420
C	PRINI CHANGES IN CONCENIRATION	1 4 5 0
	WRITE (6,230)	I 440

FORTRAN IV program listing-Continued

				150
		WRITE (6,170) N	1	420
		URITE (6,180) TIM(N)	I	460
			T	470
			:	100
		WRITE (6,450) SUMTCH	1	480
		WRITE (6,200) TCHD	I	490
		WRITE (6,210) TMYR	I	500
			T	510
			÷	520
		WRITE (0,580) THOV		520
		WRITE (6,220)	1	530
		DO 40 IY=1/NY	I	540
		DO 30 IX=1+NX	I	550
			ī	560
	-		•	570
	30		1	570
	40	WRITE (6,240) (IC(IX),IX=1,NX)	I	580
С		** *** * * * * * * * * * * * * * * * * *	I	590
ŕ		PRINT MASS BALANCE DATA FOR SOLUTE	I	600
٠.	50		Ť	610
	50			400
		$1F (SUMI0_EQ_0_0) GO 10 OU $	Ł	020
		RESID=SUMIO-CSTORM	1	630
		ERR1=RESID+200.0/(SUMIO+CSTORM)	I	640
	60	IE (STORMI, EQ. 0.0) 60 TO 70	1	650
	00			660
				000
	70	WRITE (6,220)	1	670
		WRITE (6,250)	1	680
		WRITE (6/220)	I	690
		WRITE (6-260) FIMIN	T	700
			T	710
				7 30
		RECIN=-CMSIN		720
		RECOUT =- CMSOUT	1	750
		WRITE (6,290) RECIN	1	740
		WRITE (6/280) RECOUT	1	750
			ī	760
		WRITE (0/JUD/ STORIG		770
				700
		WRITE (6/32U) STORM	1	100
		WRITE (6,330) CSTORM	I	790
		IF (SUMID-EQ.0.0) GO TO 80	1	800
		WRITE (6,340)	I	810
			Ť	820
				9 20
		WRITE (0/50U) ERRI		0.00
	80	IF (STORMI.EQ.O.O) GO TO 90	I	840
		WRITE (6,370)	1	850
		WRITE (6+360) ERR3	I	860
~			T	870
			:	0.0
C	_	PRINI HYDROGRAPHS AFTER SU SIEPS OR END OF SIMULATION	Ĩ	000
	90	IF (MOD(IMOV,50).EQ.0.AND.S.EQ.0.0) GO TO 100	1	840
		IF (MOD(N,50)_EQ.0.AND.S.GT.0.0) GO TO 100	I	900
		60 10 150	1	910
				020
	100	WRITE (6/390) TILLE		720
		IF (NUMOBS_LE.O) GO TO 150	1	930
		WRITE (6,400) INT	I	940
		IF (S.GT.O.D) WRITE (6/410)	1	950
		IF (S. FQ.0.0) WRITE (6/420)	I	960
r			T	970
e.		HAT-A	Ť	0.80
			÷	000
		11 (5.61.0.0) 60 TO 110	T	770
		NT O=NM OV	I	1000
		IF (NMOV.GT.50) NTO=MOD(IMOV,50)	I	1010
		60 10 120	1	1020
	110		Ĩ	1030
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FORTRAN IV program listing—Continued

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	280	) F(	) R I	141	ſ	(8)	X,	• Z !	5H	MA	IS S	5	PU	MF	PE	D	00	IT					=	•1	E	12	2	5)										11	330
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	300	) F(	) R I	1 A P	Г	(8)	X,	2	5H	IN	IFL	- 0	W	M ]	[ N I	JS	0	U 1	FI	L 0'	4		=	,1	E	1 2	2	5)										11	350
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	330	F	R	1 A 1	r –	(8	X,	2	5 H (	СН	I A I	٩G	E	MA	S:	5 3	S T	OF	RE	D			=	,1	E	12		5)										11	380
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	390	FC	R	1 A 1	r	(1	н1	1	1 O /	A 8	11	1)																										11	460
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	440	FC	RM	141		(1	Н	1	58:	Χ,	12		6X.	, F	7.	.1.	.8	X,	F	7.		8 X	• F	7.	2	)												11	530
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		E٨	ID																																			11	560-

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## Attachment II Definition of Selected Program Variables

AAQ	area of aquifer in model	1
ALNG	BETA	
ANFCTR	anisotropy factor (ratio of $T_{yy}$ to $T_{zz}$ )	
AOPT	iteration parameters	
AREA	area of one cell in finite-difference grid	1
BETA	longitudinal dispersivity of porous medium	
CELDIS	maximum distance across one cell that a particle is permitted to move in one step (as fraction of width of	
at <b>1</b> at	cell)	
CLKCN	fining layer or streambed	
CMSIN	mass of solute recharged into aquifer	
CMSOUT	mass of solute discharged from aquifer	
CNCNC	change in concentration due to disper- sion and sources	
CNCPCT	change in concentration as percentage	
CNOLD	concentration at node at end of pre-	
UNULD	vious time increment	
CNREC	concentration of well withdrawal or injection	
CNRECH	concentration in fluid source	1
CONC	concentration in aquifer at node	
CONINT	concentration in aquifer at start of	
C1	CONC at node (IX.IY)	1
DALN	longitudinal dispersion coefficient	
DDRW	drawdown	
DELQ	volumetric rate of leakage across a	
DELS	rate of change in ground-water storage	
DEDS	abange in head with respect to time	
DEMI	disponsion equation coefficients	
DISTY	distance nerticle moves in <i>x</i> -direction	
	during time increment	
DISTY	distance particle moves in y-direction during time increment	
DLTRAT	ratio of transverse to longitudinal dispersivity	
DTRN	transverse dispersion coefficient	
FCTR	multiplication or conversion factor	
FLMIN	solute mass entering modeled area during time step	
FLMOT	solute mass leaving modeled area during time step	
GRDX	hydraulic gradient in x-direction	
GRDY	hydraulic gradient in $y$ -direction	
HC	head from column computation	1
HI	initial head in aquifer	
нк	computed head at end of time step	
HMIN	minimum iteration parameter	

HR	head from row computation in sub-
	routine ITERAT; elsewhere HR represents head from previous time
IMOV	step narticle movement sten number
INT	numping period number
IPRNT	print control index for hydrographs
ITMAX	maximum permitted number of iterations
IXOBS	x-coordinate of observation point
IYOBS	y-coordinate of observation point
KOUNT	iteration number for ADIP
LIMBO	array for temporary storage of particles
N	time step number
NCA	number of aquifer nodes in model
NCODES	number of node identification codes
NITP	number of iteration parameters
NMOV	number of particle movements (or time increments) required to complete
	time sten
NODEID	node identification code
NP	total number of active particles in grid
NPCELL	number of particles in a cell during time increment
NPMAX	maximum number of available particles
NPMP	number of pumping periods or simu- lation periods
NPNT	number of time steps between printouts
NPTPND	initial number of particles per node
NREC	number of pumping wells
NTIM	number of time steps
NUMOBS	number of observation wells
NX	number of nodes in <i>x</i> -direction
NY	number of nodes in $y$ -direction
NZCRIT	maximum number of cells that can be void of particles
NZERO	number of cells that are void of
	particles at the end of a time increment
PARAM	iteration parameter for current iteration
PART	1. x-coordinate of particle; 2. y-coordi- nate of particle; 3. concentration of particle. Also note that the signs of
	information on original location of particle.
PERM	hydraulic conductivity (in $LT^{-1}$ )
PINT	pumping period in years
POROS	effective porosity
PUMP	cumulative net pumpage
PYR	total duration of pumping period (in seconds)
ONET	net water flux (in $L^{*}T^{-1}$ )



### Definition of selected program variables—Continued

QSTR	cumulative change in volume of water	TMRX	transmissivity coefficients (harmonic
REC	noint source or sink: negative for in-		values are stored)
	jection positive for withdrawel	TW 337 1	computed heads at absorbation points
	$(in I^{3}T^{-1})$		computed neads at observation points
DECH	(III L I ') diffuno nochongo on dischonget nousting		convergence criteria (ADIP)
REON	uniuse recharge or discharge; negative	TOTLQ	cumulative net leakage through con-
	for recharge, positive for discharge	<b>mp</b> ( ) *	fining layer or streambed
RN	(in L1 <sup>-2</sup> ) range in concentration between regen-	TRAN	transverse dispersivity of porous medium
	erated particle and adjacent node	VMAX	maximum value of VX
	having lower concentration	VMAY	maximum value of VY
RP	range in concentration between regen-	VMGE	magnitude of velocity vector
	erated particle and adjacent node	VMXBD	maximum value of VXBDY
	having higher concentration	VMYRD	maximum value of VVBDV
S	storage coefficient (or specific yield)	VPPM	initially used to need transmissivity
SLEAK	rate of leakage through confining	V 1 10101	values at podes, then often line
	laver or streambed		P2270 VDDM equals lookenee fector
STORM	change in total solute mass in storage		for confining laws on streembod
	(by summation)		(ventice) hydroulic conductivity (
STORMI	initial mass of solute in storage		(vertical hydraulic conductivity) this $I_{\rm res}$ (vertical hydraulic conductivity)
SUMC	summation of concentrations of all		thickness). If VFAM=0.09, then the
00110	narticles in a cell		program assumes that the node is a
SUMIO	change in total solute mass in storage		constant-nead boundary and is hag-
Semi c	(from inflows_outflows)		ged for subsequent special treat-
SUMT	total elansed time (in seconds)		ment in calculating convective trans-
SUMTCH	cumulative elansed time during		port.
<b>NOMION</b>	particle moves (in seconds)	VX	velocity in x-direction at a node
тнск	saturated thickness of aquifer	VXBDY	velocity in x-direction on a boundary
TIM	length of specific time step		between nodes
	(in seconds)	VY	velocity in y-direction at a node
TIMD	elapsed time in days	VYBDY	velocity in y-direction on a boundary
TIMY	elapsed time in years	W.T	initial water table or notentiometric
TIMV	length of time increment for particle movement (in seconds)	WI	elevation, or constant head in
TIMX	time step multiplier for transient flow		stream or source bed
	problems	XDEL	grid spacing in x-direction
TINIT	size of initial time step for transient	XOLD	x-coordinate of particle at end of pre- vious time increment
TTTLE	nrohlem description	XVEL	velocity of particle in x-direction
TMCN	computed concentrations at observation	YDEL	grid spacing in <i>y</i> -direction
INCOM	noints	YOLD	u-coordinate of narticle at and of nre-
TMODS	alansed times for observation point		vious time increment
TWODS	records	VVEL.	velocity of narticle in <i>u</i> -direction
	1000100		verocity of particle in g-uncerion

			Alluchment	
		D	ata Input Fo	rmats
Card	Column	Format	Variable	Definition
1	1-80	10A8	TITLE	Description of problem
2	1-4	I4	NTIM	Maximum number of time steps in a pumping period (limit=100)*.
	5- 8	<b>I4</b>	NPMP	Number of pumping periods. Note that if NPMP>1, then data set 10 must be completed.
	9–12	<b>I4</b>	NX	Number of nodes in $x$ direction $(limit=20)^*$ .
	13–16	<b>I4</b>	NY	Number of nodes in $y$ direction $(limit=20)*$ .
	17-20	<b>I4</b>	NPMAX	Maximum number of particles (limit=3200)*. (See eq 71.)
	21–24	14	NPNT	Time-step interval for printing hydraulic and chemical output data.
	25–28	14	NITP	Number of iteration parameters (usually $4 \leq \text{NITP} \leq 7$ ).
	29–32	I4	NUMOBS	Number of observation points to be specified in a following data set (limit=5)*.
	83–36	I4	ITMAX	Maximum allowable number of iterations in ADIP (usually 100 $\leq$ ITMAX $\leq$ 200).
	37–40	I4	NREC	Number of pumping or injection wells to be specified in a following data set.
	41-44	<b>I4</b>	NPTPND	Initial number of particles per node (options=4, 5, 8, 9).
	4548	I4	NCODES	Number of node identification codes to be specified in a following data set (limit=10)*.
	<b>49</b> –52	<b>I4</b>	NPNTMV	Particle movement interval (IMOV) for printing chemical output data. (Specify 0 to print only at end of time steps.)
	53-56	I4	NPNTVL	Option for printing computed veloci- ties (0=do not print; 1=print for first time step; 2=print for all time steps).
	57–60	14	NPNTD	Option for printing computed dis- persion equation coefficients (op- tion definition same as for NPNTVL).
	61–64	14	NPDELC	Option for printing computed changes in concentration (0=do not print; 1=print).
	6568	<b>I4</b>	NPNCHV	Option to punch velocity data (op-

tion definition same as for

velocities at nodes.

NPNTVL). When specified, pro-gram will punch on unit 7 the

# Attachment III

See footnotes at end of table.

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### MODEL OF SOLUTE TRANSPORT IN GROUND WATER

Data input formats-Continued

Card	Column	Format	Variable	Definition
3	1-5	G5.0	PINT	Pumping period in years.
	6–10	G5.0	TOL	Convergence criteria in ADIP
				(usually TOL=0.01).
	11-15	G5.0	POROS	Effective porosity.
	16–20	G5.0	BETA	Characteristic length, in feet
	21–25	G5.0	S	Storage coefficient (set S=0 for steady flow problems)
	26–30	G5.0	TIMX	Time increment multiplier for trans- ient flow problems. TIMX is dis- regarded if $S=0$ .
	31–35	G5.0	TINIT	Size of initial time step in seconds.
	36-40	G5.0	XDEL	Width of finite-difference cell in
	41-45	G5.0	YDEL	Width in finite-difference cell in
	46-50	G5.0	DLTRAT	y direction, in feet. Ratio of transverse to longitudinal
	51–55	G5.0	CELDIS	dispersivity. Maximum cell distance per particle
	F.C. CO	05.0		move (value between 0 and 1.0).
	90-00	G5.0	ANFUTR	Ratio of $T_{yy}$ to $T_{zz}$ .
Data	Number	a 40 mar s		
set	of cards	Format	Variable	Definition
1	Value of NUMOBS (limit=5)*	212	IXOBS, IYOBS	x and y coordinates of observation points. This data set is eliminated if NUMOBS is specified as $=0$ .
2	Value of NREC	212, 2G8.2	IX, IY, REC, CNRECH	x and y coordinates of pumping $(+)$ or injection $(-)$ wells, rate in ft <sup>3</sup> /s, and if an injection well, the concentration of injected water. This data set is eliminated if NREC=0.
3	a. 1 b. Value of NY (limit=20)*	I1, G10.0 20G4.1	INPUT, FCTR VPRM	Parameter card $\dagger$ for transmissivity. Array for temporary storage of transmissivity data, in ft <sup>3</sup> /s. For an anisotropic aquifer, read in values of $T_{zz}$ and the program will adjust for anisotropy by multi- plying $T_{zz}$ by ANFCTR.
4	a. 1 b. Value of NY (limit=20)*	I1, G10.0 20G3.0	INPUT, FCTR THCK	Parameter card <sup>†</sup> for THCK. Saturated thickness of aquifer, in feet
5	a. 1	I1, G10.0	INPUT, FCTR	Parameter card <sup>†</sup> for RECH.
	b. Value of NY (limit=20)*	20G4.1	RECH	Diffuse recharge (-) or discharge (+), in ft/s.
6	a. 1	I1, G10.0	INPUT, FCTR	Parameter card <sup>†</sup> for NODEID.
	b. Value of NY (limit=20)*	2011	NODEID	Node identification matrix (used to define constant-head nodes or other boundary conditions and stresses).

See footnotes at end of table.

Data set	Number of cards	Format	Variable	Definition
7	Value of NCODES (limit=10)*	I2, 3G10.2, I2	ICODE, FCTR1, FCTR2, FCTR3, OVERRD	Instructions for using NODEID array. When NODEID=ICODE, program sets leakance=FCTR1, CNRECH=FCTR2, and if OVERRD is nonzero, RECH =FCTR3. Set OVERRD=0 to preserve values of RECH specified in data set 5.
8	a. 1 b. Value of NY (limit=20)*	I1, G10.0 20G4.0	INPUT, FCTR WT	Parameter card <sup>†</sup> for WT. Initial water-table or potentiometric elevation, or constant head in stream or source bed, in feet.
9	a. 1 b. Value of NY	I1, G10.0 20G4.0	INPUT, FCTR CONC	Parameter card† for CONC. Initial concentration in aquifer.
10	(111112-20)			This data set allows time step param- eters, print options, and pump- age data to be revised for each pumping period of the simulation. Data set 10 is only used if NPMP >1. The sequence of cards in data set 10 must be repeated (NPMP -1) times (that is, data set 10 is required for each pumping period after the first).
	a. 1	I1	ICHK	Parameter to check whether any re- visions are desired. Set ICHK=1 if data are to be revised, and then complete data set 10b and c. Set ICHK=0 if data are not to be re- vised for the next pumping period, and skip rest of data set 10.
	b. 1	10I4,3G5.0	NTIM, NPNT, NITP, ITMAX, NREC, NPNTMV, NPNTVL, NPNTD, NPDELC, NPNCHV, PINT, TIMX, TINIT	Thirteen parameters to be revised for next pumping period; the parameters were previously de- fined in the description of data cards 2 and 3. Only include this card if ICHK=1 in previous part a.
	c. Value of NREC	212, 2G8.2	IX, IY, REC, CNRECH	Revision of previously defined data set 2. Include part c only if ICHK=1 in previous part a and if NREC>0 in previous part b.

Data input formats-Continued

\* These limits can be modified if necessary by changing the corresponding array dimensions in the COMMON statements of the program.

<sup>†</sup>The parameter card must be the first card of the indicated data sets. It is used to specify whether the parameter is constant and uniform, and can be defined by one value, or whether it varies in space and must be defined at each node. If INPUT=0, the data set has a constant value, which is defined by FCTR. If INPUT=1, the data set is read from cards as described by part b. Then FCTR is a multiplication factor for the values read in the data set.



## Attachment IV Input Data for Test Problem 3

Card 1	TEST PROBLE	EM NO. 3 (S'	TEADY FLO	DW/ 1 WELL/	CONSTA	NT-HEAD I	BOUNDAR	IES)	
Card 2	1 1	9 103200	17	2 100 1	9	2 10	1 0	0	0
Card 3	2.5.0001	0.30 100.	0.0 0.0	0.0 900.	900.	0.3 0.50	1.0		
Data Set 1	54								
Data Set 2	47 1.0								
Data Set 3	0 0.1								
Data Set 4	0.05 0								
Data Set 5	0 0.0								
Data Set 6 <	1 1.0 000000000 022111220 000000000 00000000								
	000000000								
Data Set 7	2 1.0	0.0	υ.Ο	0					
	1 1.0	100.0	0.0	υ υ					
	1 1.0								
	0.0100.100	0.100.100.10	00.100.10	0.0.0					
Data Set 8									
	0.0 75. 75	5. 75. 75.	75.75.7	'5 <b>.</b> 0.0					
Data Set 9	0 0.0								

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## Attachment V Selected Output for Test Problem 3

U.S.G.S. METHOD-OF-CHARACTERISTICS MODEL FOR SOLUTE TRANSPORT IN GROUND WATER

TEST PROBLEM NO. 3 (STEADY FLOW, 1 WELL, CONSTANT-HEAD BOUNDARIES)

INPUT DATA

#### GRID DESCRIPTORS

NX	(NUNBER OF COLUMNS)	=	9
NY	(NUMBER OF ROWS)	=	10
XDEL	(X-DISTANCE IN FEET)	=	900.0
YDEL	(Y-DISTANCE IN FEET)	=	900.0

#### TIME PARAMETERS

NTIM	(MAX. NO. OF TIME STEPS)	=	1
NPMP	(NO. OF PUMPING PERIODS)	=	1
PINT	(PUMPING PERIOD IN YEARS)	=	2.50
TIMX	(TIME INCREMENT MULTIPLIER)	=	0.00
TINIT	(INITIAL TIME STEP IN SEC.)	=	0.

#### HYDROLOGIC AND CHEMICAL PARAMETERS

S	(STORAGE COEFFICIENT)	=	0.00000
POROS	(EFFECTIVE POROSITY)	=	0.30
BETA	(CHARACTERISTIC LENGIH)	I	100.0
DLTRAT	(RATIO OF TRANSVERSE TO		
	LONGITUDINAL DISPERSIVITY)	=	0.30
ANFCTR	(RATIO OF T-YY TO T-XX)	=	1.000000

#### EXECUTION PARAMETERS

NITP	(NO. OF ITERATION PARAMETERS)	=	7
TOL	(CONVERGENCE CRITERIA - ADIP)	=	0.0001
ITMAX	(MAX.NO.OF ITERATIONS - ADIP)	=	100
CELDIS	(MAX.CELL DISTANCE PER MOVE		
	OF PARTICLES - M.O.C.)	=	0.500
NPMAX	(MAX. NO. OF PARTICLES)	=	3200
NPTPND	(NO. PARTICLES PER NODE)	z	9

#### PROGRAM OPTIONS

NPNT	(TIME STEP INTERVAL FOR		
	COMPLETE PRINTOUT)	=	1
NPNTMV	(MOVE INTERVAL FOR CHEM.		
	CONCENTRATION PRINTOUT)	=	10
NPNTVL	(PRINT OPTION-VELOCITY		
	O=NO; 1=FIRST TIME STEP;		
	2≃ALL T'IME STEPS)	=	1
NPNTD	(PRINT OPTION-DISP.COEF.		
	O=NO; 1=FIRST TIME STEP;		
	2=ALL TIME STEPS)	=	0
NUMOBS	(NO. OF OBSERVATION WELLS		
	FOR HYDROGRAPH PRINTOUT)	=	2
NREC	(NO. OF PUMPING WELLS)	2	1
NCODES	(FOR NODE IDENT.)	=	2
NPNCHV	(PUNCH VELOCITIES)	=	0
NPDELC	(PRINT OPTCONC_ CHANGE)	=	0

#### STEADY-STATE FLOW TIME INTERVAL (IN SEC) FOR SOLUTE-TRANSPORT SIMULATION = 0.78894d+08 LOCATION OF OBSERVATION WELLS NO. х Y 1 5 4 2 5 7 LOCATION OF PUMPING WELLS X Y RATE(IN CFS) CONC. 7 1.00 4 0.0 AREA OF ONE CELL = 0.8100d+06 X-Y SPACING: 900.00 900.00

## TRANSMISSIVITY MAP (FT\*FT/SEC)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.16	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	<b>0.10</b>	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

#### AQUIFER THICKNESS (FT)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	20.0	20.C	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DIFFUSE RECHARGE AND	DISCHARGE	(FT/SEC)					
	01001.000						
0.00d+00 0.00a+00	) 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00+00
0.00d+00 0.00d+00	0.00d+00	0.00+00	0.00d+00	0.00d+00	0.U0d+00	0.00d+00	0.104+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.004+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.304+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00+00	0.00d+00	0.00+b00.0	0.00d+00	0.00d+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.J0d+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.30d+00
0.00d+00 0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.304+00
0.004+00 0.004+00	0.004+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.00d+00	0.004+00

> NO. OF FINITE-DIFFERENCE CELLS IN AQUIFER = 56 AREA OF AQUIFER IN MODEL = 0.45360e+08 SQ. FT.

NZCRIT (MAX. NO. OF CELLS THAT CAN BE VOID OF PARTICLES; IF EXCEEDED, PARTICLES ARE REGENERATED) = 1

#### NODE IDENTIFICATION MAP

0 0 0 0 0 0 0	0 0 0 0 0 0	0 2 0 0 0 0 0	0 1 0 0 0 0 0	0 1 0 0 0 0 0	0 1 0 0 0 0 0	0 2 0 0 0 0 0 0	0 2 0 0 0 0 0	0 0 0 0 0 0	
0	2	2	2	2	2	Z	2	0	
U	U	U	U	U	U	U	u	Û	
N0.	0 F	NODE	IDENT.	COD	ES SP	ECIFI	ED =	2	
CODE	T NO	HE FO	LOWING	S ASS ICE	I G N M E S O	NTS H URCE	AVE B CONC.	EEN	MADE: RECHARGE
	2		0.1000	e+(:1		0	.00		
	1		0.1006	+01		100	.00		

#### VERTICAL PERMEABILITY/THICKNESS (FT/(FT\*SEC))

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1.00	1.00	1.00	1,00	1.00	1.00	1.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WATER	TABL	E						
Ο.	Ο.	Ο.	Ο.	Ο.	Ο.	0.	0.	Ο.
Ο.	100.	100.	100.	100.	100.	100.	100.	Ο.
Ο.	ΰ.	Ο.	0.	0.	υ.	0.	Ο.	Ο.
0.	Ο.	Ο.	Ο.	Ο.	Ο.	0.	0.	Ο.
Ο.	Ο.	0.	0.	Ο.	Ο.	Ο.	0.	Ο.
Ο.	Ο.	Ο.	Ο.	Ο.	Ο.	0.	Ο.	Ο.
Ο.	Ο.	Ο.	0.	Ο.	Ο.	٥.	Ο.	Ο.
Ο.	Ο.	Ο.	Ο.	Ο.	Ο.	Ο.	Ο.	Ο.
0.	75.	75.	75.	75.	75.	75.	75.	Ο.
Ο.	Ο.	Ο.	ΰ.	0.	Ο.	Ο.	Ο.	ΰ.

ITERATION	PARAMETERS
	0.246740a-01
	0.457299d-01
	0.8475390-01
	.157080
	291125
	570540
	• 337300
	1.00000
	0.00000
	0.00000
	0.00000
	0.000000
	0.000000
	0.000000
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#### CONCENTRATION

NUMBER CHEM. CHEM. CHEM. NO. MO	OF TI TIME( TIME( TIME( TIME( TIME( VES C	ME ST SECON SECON DAYS) YEARS YEARS OMPLE	EPS DS) DS) ) TED	= 0. = 0. = 0. = 0.	0 00000 00000 00000 00000 00000 00000 0000	+00 +00 +00 +00		
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0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	U	0	0	0	0
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0	0	0	υ	0	0	0	0	0
0	0	0	0	Û	0	0	0	0

N = 1 NUMBER OF ITERATIONS = 20

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HEAD DISTRIBUTION - ROW NUMBER OF TIME STEPS = 1 TIME(SECONDS) = 0\_788944+08 TIME(DAYS) = 0\_91313e+03 TIME(DAYS) = 0\_25000e+01 TIME(YEARS) = 0\_25000e+01

0* 0000000	0.000000	0°00000	0.000000.0	0.000000.0	0.000000	0.000000	0•000000	0.00000.0
0 • 000 000 • 0	5666666*66	5666666*66	666666°66	69,999995	\$ 666666 * 66	5666666 * 66	66°,999995	0.00000.0
0000000	95.9387858	95.9346978	95.9468712	95.9958792	96.0611455	96.1171357	96.1482887	0.00000.0
0• 0000000	91.8816815	91.8531641	91.8569301	91.9755221	92.1315893	92.2591385	92.3277521	0.00000.0
0.000000	87.8530674	87.7393101	87.6521342	87.9176617	88.2305223	88.4600398	88.5758019	0-000000
0• 000 000 •0	83.9382225	83 . 5 988909	83.0946482	83.8124811	84.4128118	84.7747123	84.9396259	0000000000
0 • 000 000 • 0	80.3627221	79 .6233998	77.3151005	79.8248158	80.8335448	81.2863911	81.4683757	0.00000.0
0•000000	77.5265176	77.2168501	76.7175099	77.3381095	77.8101323	78.0688953	78.1790838	0000000000
0.000000	75.000003	75.000003	75.0000002	75.000003	75.0000003	25.000004	75.000004	00000000000
0•000000	0.000000	0.000000	0.0000000	0 • 0000000	0 • 00 0 000 0	0-000003	0.000000	0000000

04d+08 3e+03	0e+01
1 0.7885 0.9131	0.2500
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<b>Ö</b> ॥	17
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TION- ESTEF ECONDS AYS)	EARS)
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HEAD D Number	c

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c	2	100	96	92	80 80	85	81	78	75	0
c	2	100	96	92	88	84	81	78	75	0
c	2	100	96	92	88	84	80	77	75	0
¢	2	100	96	92	88	83	77	27	75	0
ç	2	100	96	92	88	84	80	17	75	0
c	>	100	96	92	88	84	80	78	75	0
c	2	0	0	0	0	0	0	0	0	0

								0.000 -0.712e-13 -0.577e-06 -0.127e-05 -0.214e-05 -0.337e-05 -0.337e-05 -0.204e-05 -0.252e-12 0.000		000 °0 000 °0 000 °0 000 °0 000 °0 000 °0 000 °0 000 °0 000 °0
								0.000 -0.996 e-13 -0.807 e-05 -0.182 e-05 -0.320 e-05 -0.328 e-05 -0.588 e-05 -0.588 e-05 -0.588 e-05 -0.588 e-05 -0.422 e-12 0.000		0.000 -0.712e-13 -0.577e-35 -0.1127e-35 -0.214e-35 -0.337e-35 -0.337e-35 -0.237e-15 -0.252e-12 0.000
								0.000 -0.139e-12 -0.112e-05 -0.263e-05 -0.502e-05 -0.502e-05 -0.135e-05 -0.835e-12 0.000		0,000 -0,128-12 -0,104-05 -0,236-05 -0,4256-05 -0,4256-05 -0,4256-05 -0,4256-05 -0,4796-05 -0,4796-05 -0,4796-05 -0,5926-12 0,000
								6.000 -0.131e-12 -0.131e-12 -0.106e-05 -0.536e-05 -0.536e-05 -0.122e-04 -0.122e-04 -0.125e-11		0.000 -0.1216-12 -0.1216-05 -0.2896-05 -0.5796-05 -0.1116-05 -0.1116-05 -0.1116-05 -0.1086-11 0.000
I			594e+68 300e+00 595e+08	00 19e-03				$\begin{array}{c} 0.000\\ -0.699e-13\\ -0.699e-06\\ -0.113e-05\\ -0.165e-05\\ -0.165e-05\\ -0.165e-05\\ -0.186e-05\\ -0.129e-12\\ -0.139e-12\\ 0.000\end{array}$		0.000 -0.112e-12 -0.112e-12 -0.908e-05 -0.220e-05 -0.492e-05 -0.455e-04 -0.455e-04 -0.455e-04 -0.115e-11 0.000
	00000000000000000000000000000000000000		E = 0.788 AGE = 0.000 E = 0.788	AL = -767. = -0.972	- C.F.S.)	1.U000 0.00000	T NODES	0.000 -0.924e-14 -0.729e-07 0.229e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05 0.281e-05	N BOUNDARIES	0.000 -0.278e-13 -0.225e-05 -0.697e-07 0.161e-05 0.934e-05 0.934e-05 0.925e-04 0.925e-04 0.925e-05 0.914e-11 0.000
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	C C C ASS BALANCE	NET PUMPAG Se From Stor Net Leakag	LANCE RESIDU (AS PERCENT)	LANCE (IN = 2.7857 = -1.7857 = 1.0000	TPUM = Dels =	A	0.000 0.9358-14 0.7578-07 0.5288-06 0.2118-05 0.1378-05 0.1378-05 0.5738-05 0.5738-12 0.000	0	0.000 0.935e-14 0.757e-07 0.528e-06 0.211e-05 0.528e-05 0.137e-05 0.573e-06 0.573e-02 0.573e-12 0.000
RAWDOWN	000000000000000000000000000000000000000	CUMULATIVE M	CUMULATIVE WATER RELEA CUMULATIVE	MASS BA Error	RATE MASS BA QIN QUT QNET QNET		VELOCITIES			

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Selected output for test problem 3-Continued

Y VELOCITIES

AT NODES

$\begin{array}{c} 0.000\\ 0.713 = -04\\ 0.713 = -04\\ 0.710 = -04\\ 0.688 = -04\\ 0.658 = -04\\ 0.658 = -04\\ 0.589 = -04\\ 0.589 = -04\\ 0.589 = -04\\ 0.000\\ 0.000\end{array}$	0.000 0.713e-04 0.713e-04 0.695e-04 0.673e-04 0.673e-04 0.693e-04 0.693e-04 0.589e-04 0.000
0.000 0.719e-J4 0.719e-J4 0.709e-J4 0.693e-J4 0.683e-J4 0.682e-J4 0.582e-D4 0.582e-D4	0.000 0.719=-04 0.714=-04 0.704=-04 0.648=-04 0.646=-04 0.568=-04 0.000
0.000 0.729-04 0.729-04 0.729-04 0.715-04 0.885-04 0.685-04 0.611-04 0.540-04 0.520-04 0.520-04	0.000 0.729-04 0.728-04 0.728-04 0.728-04 0.728-04 0.728-04 0.728-04 0.728-04 0.5608-04 0.5608-04 0.5208-04 0.000
0,000 0,742e-04 0,743e-04 0,748e-04 0,756e-04 0,759e-04 0,433e-04 0,433e-04 0,433e-04	0.000 0.742e-04 0.742e-04 0.745e-04 0.755e-04 0.756e-04 0.758e-04 0.738e-04 0.451e-04 0.451e-04 0.400
0.000 0.751e-04 0.754e-04 0.768e-04 0.811e-04 0.957e-04 0.590e-04 0.518e-04 0.318e-04	0.000 0.751e-04 0.779e-04 0.779e-04 0.844e-04 0.844e-04 0.111e-04 0.318e-04 0.000
0,000 0,753e-04 0,754e-04 0,754e-04 0,754e-04 0,751e-04 0,591e-04 0,411e-04 0,411e-04	N BOUNDARIES 0.753e-04 0.756e-04 0.756e-04 0.756e-04 0.756e-04 0.736e-04 0.416e-04 0.411e-04 0.000 0.000
0.000 0.752e-04 0.752e-04 0.752e-04 0.755e-04 0.756e-04 0.594e-04 0.594e-04 0.497e-04 0.497e-04 0.497e-04	0 0 00 0 752e - 04 0 752e - 04 0 751e - 04 0 755e - 04 0 755e - 04 0 525e - 04 0 525e - 04 0 682e - 04 0 682e - 04 0 000 0 000

STABILITY CRITERIA --- M.O.C.

VMAX = 3.26e-C5 VMAY = 9.57e-O5 VMXBD= 4.65e-O5 VMYBD= 1.07e-O4 TMV (MAX. INJ.) = 0.11955e+08 TIMV (CELDIS) = 0.42045e+07 TIMV = 4.20e+O6 NTIMV = 18 NMOV = 19 TIMV = 4.20e+O6 NTIMV = 18 NMOV = 19 TIM (N) = 0.78894d+08 TIM (N) = 0.78894d+08 TIM (N) = 0.78894d+08 TIM EVELO = 0.41523e+07 TIMEVELO = 0.30143e+08 NO. OF PARTICLE MOVES REQUIRED TO COMPLETE THIS TIME STEP =

THE LIMITING STABILITY CRITERION IS CELDIS

19

= YOWN

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TIMV = 4.15e+06 NTIMD =

19

#### CONCENTRATION

NUMBER CHEM. CHEM. CHEM. NO. MO	OF TI DELTA TIME( TIME( TIME( TIME( VES C	ME ST T SECON SECON DAYS) YEARS OMPLE	IEPS IDS) IDS) I I I I I I I I I I I I I I I I I I I	= 0.7 = 0.7 = 0.7 = 0.7 = 0.7 = 0.7 = 0.7	1 788940 788940 788940 788940 713130 250000 250000	d+08 d+08 e+08 e+03 e+03 e+01 e+01		
0	0	Û	0	0	0	0	0	0
0	0	2	98	100	98	2	0	0
0	0	4	96	100	96	4	0	0
0	0	7	92	99	93	7	0	0
0	0	9	89	96	88	9	0	0
0	1	10	81	89	80	10	1	0
0	1	8	56	73	46	8	1	0
0	0	Z	20	35	19	3	O	0
0	0	0	۱	5	3	0	0	0
0	0	0	0	0	0	0	0	O

#### CHEMICAL MASS BALANCE

MASS IN BOUNDARIES	= 0.94642e+10
MASS OUT BOUNDARIES	= -0.13340e+08
MASS PUMPED IN	= 0.00000e+00
MASS PUMPED OUT	= -0.96281e+09
INFLOW MINUS OUTFLOW	= 0.84881e+10
INITIAL MASS STORED	= 0.00000e+00
PRESENT MASS STORED	= 0.84631e+10
CHANGE MASS STORED	= 0.84631e+10
COMPARE RESIDUAL WITH NE	T FLUX AND MASS ACCUMULATION:
MASS BALANCE RESIDUAL	= 0.24910e+08
ERROR (AS PERCENT)	= 0.29390e+00

TEST PROBLEM NO. 3 (STEADY FLOW, 1 WELL, CONSTANT-HEAD BOUNDARIES)

TIME VERSUS HEAD AND CONCENTRATION AT SELECTED OBSERVATION POINTS\* -

PUMPING PERIOD NO.

STEADY-STATE SOLUTION

ME (YEARS)	0.00 0.13 0.53 0.53 0.53 0.53 0.53 0.53 0.53 0.5
C3VC. (46/L)	← M V Ø V Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø
HEAD (FT)	00000000000000000000000000000000000000
Z	0 - NW4N92 80 0 - NW4N92 80
≻ 4	
ХŅ	
OBS.WELL NO. 1	

#### MODEL OF SOLUTE TRANSPORT IN GROUND WATER

89

	TIME (YEARS)		00.0	0.13	0.26	0.39	0.53	0.66	0.79	0.92	1.05	1.18	1.32	1.45	1.58	1.71	1.84	1.97	2.11	2.24	2.37	2.50
inued	(7/94)-3403		0•0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.6	1.7	4.8	8 . 2	14.3	27.0	38.2	49.4	51.1	67.2	73.0
problem 3-Cont	HEAD (FT)		0.0	79.8	79.8	79.8	79.8	79.8	79.8	79.8	79.8	79.8	79.8	79.6	79.8	79.8	79.8	79.8	79.8	79.8	79.8	79.8
ected output for test	z		Э	-	2	r	4	ŝ	¢	~	30	٥	10	11	12	13	14	15	16	17	18	19
Sel	7	2																				
	×	5																				
	OBS.WELL NO.	~ .																				

☆U.S. GOVERNMENT PRINTING OFFICE: 1978 0-281-359/159