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User's manual for groundwater model SIMGRO

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Version no	publication date	description of modifications
1.1	Nov '86	original programme
1.2	Feb '88	channel system, common, warnings and minor modifications
1.3	Oct '88	sprinkling period per technology, target levels, grass-reference evap., fallow soil and PC version

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1. INTRODUCTION

The computerprogramme FEMSAT (Finite Element Model for Saturated Groundwater Flow) is a groundwater flow model to simulate hydraulic heads and flows in a region. The need to include the unsaturated zone and surface water system in this model has led to the extended version FEMSATP. The P stands for the Southern Peel region, because it was developed for the ICW project "Optimization of Regional Water Management in Areas with Conflicting Interests" (IIASA, 1986). The Southern Peel region was the pilot area.
For general applications the model FEMSATP was given the name SIMGRO (Simulation of groundwater flow and surface water levels). A structure of the comprehensive groundwater model is shown in figure 1. The model simulates groundwater movements, evapotranspiration, sprinkling, water supply, surface water levels,etc. The various water movements allowed for within the schematization of a subregion is shown in figure 2.

The calculation method for the saturated zone is described by QUERNER. (1984a). The adopted calculation scheme, the derivation of the general equation of motion for groundwater flow, and the boundary conditions are dealt with. The method described in that paper was used for the steady and unsteady flow model FEMSATS and FEMSAT. For these models a user's manual was compiled (QUERNER, 1984b). A detailed description of the model SIMGRO is described by QUERNER and VAN BAKEL (1988).
This working paper will discuss in detail how to use the programme, the required input, its possibilities and limitations. For using the programme one requires a schematization of the groundwater and surface water system and the land use. The agricultural activity in growing and processing a certain crop or livestock is here called a technology. Not only agricultural technologies can be simulated, also urban areas, nature reserves and forests are incorporated in the model.

In Chapter 2 the calculation method is summarized, as a guide when collecting the input data for the programme. All the possibilities of the programme can be selected by setting certain option parameters. These are discussed in Chapter 3 together with the restrictions of the programme. Also in Chapter 3 the printed output of data and results is discussed and the possibility to limit this output. All the checks which are performed by the programme on the input data and during the running are also given in Chapter 3.
In Chapter 4 the required data to run the programme are given. Per record the variables, the format, and its function is discussed.
An example of a groundwater flow problem and the way to analyse this with SIMGRO is given in Chapter 5. The required input of data and the results are given in Appendix A and B.

Calculated results of the model can be used to estimate crop production and income on a regional level (QUERNER and FEDDES, 1985). For those cases evapotranspiration rates and sprinkling quantities are given as output. Subsequent the programme SIMCROP (Simulation of Crop production and income) requires this information together with other input data.

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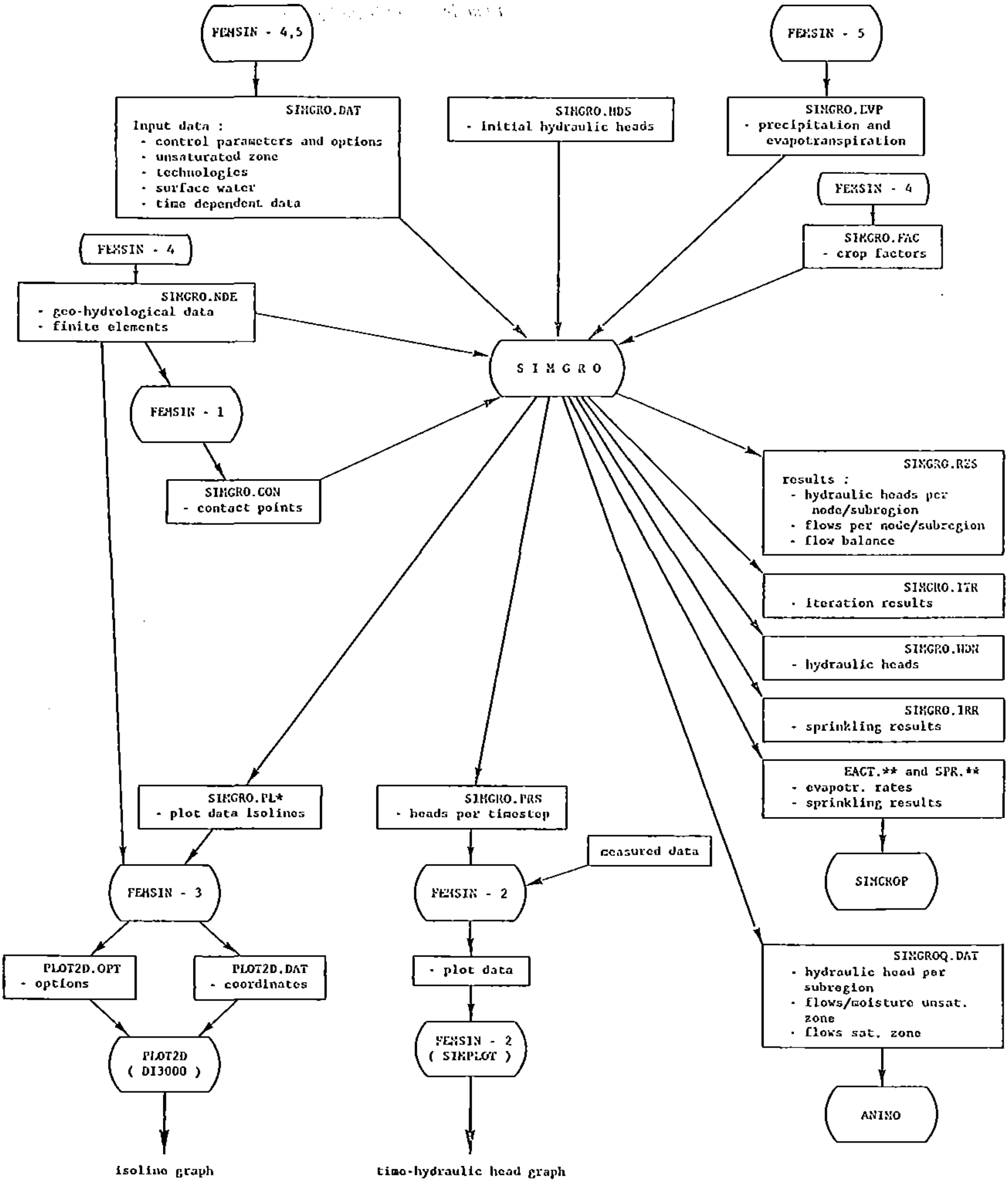

Figure 1 - Structure of groundwater simulation model with files and relevant data management modules

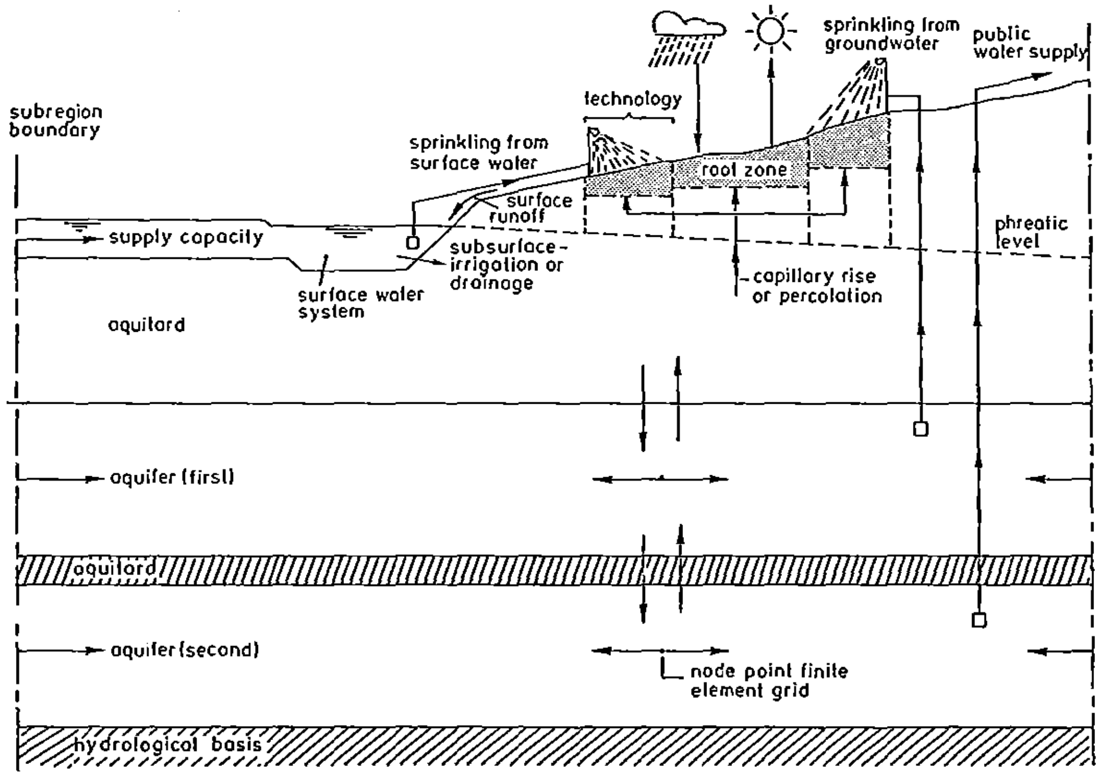

Figure 2 - Schematization of water movements within a subregion

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2. CALCULATION METHOD

2.1 Saturated zone

For the derivation of the equation of motion the solution domain is divided into a finite number of elements. Each element can have a triangular or quadrilateral shape. The nodes are representative for a certain area surrounded by it.
The method assumes that groundwater is flowing in water bearing layers in horizontal directions and vertical in less-permeable layers. The finite element network is taken identical for each layer to be modelled. The nodes in each layer are positioned in the middle of it.

The equation of motion can be obtained by considering an aquifer layer with a node i and applying the principle of conservation of mass. Unsteady flow conditions will indicate that during a time interval from t to t + Δt a quantity of water will flow to or from node i. The amount of water involved will result in a rise or fall of the hydraulic head. Therefore one can write the continuity equation per layer as :

$$\mu \frac{\Delta h}{\Delta t} = W \left| \sum_j Q_{ji} + Q \right|^{t+\Delta t} + (1-W) \left| \sum_j Q_{ji} + Q \right|^{t} \qquad (1)$$

where W is a weighting parameter between the time levels t and t + Δ t and μ is the storage factor for node i. The term Q_{ji} is flow from node j to node i and Q are all fluxes from adjacent layers, the unsaturated zone, interactions with the surface water and extractions. Equation (1) can be rewritten as :

$$\mu \frac{\Delta h}{\Delta t} = \sum_j Q_{ji}^{t} + Q_e^{t} + W \left| \sum_j \Delta Q_{ji} + \frac{dQ_e}{dh} \Delta h \right| + Q_{\ell} \qquad (2)$$

where Q_e is the boundary flow dependent on the groundwater level (leakage and drainage channel system) and Q_{ℓ} are constant fluxes such as drainage (2nd+ 3rd), capillary rise and extrations for water supply and sprinkling. The first two terms on the right hand side of equation (2) represents the flows to or from node i at time t and the third and fourth term are the actual change in flow over the considered timestep. The assumptions is a linear relation between hydraulic heads and the various flux terms.
The flow between node i and adjacent nodes j in the same layer, can be written as :

$$Q_{ji} = A_{ij} (h_j - h_i) \qquad (3)$$

where the matrix A_{ij} contains the conductivity parameters for horizontal flow in a water bearing layer. Between two nodes the flow is linear related to the difference in hydraulic head. Equation (3) can therefore also be used to define a change in flow given the changes in hydraulic head between two adjacent nodes. The flow towards a node is assumed as positive and from a node as negative.
The external flow is composed of the following flux terms :

$$Q_e = A_i \ (\ q_s + q_l \ ) \qquad (4)$$

In which A_i is the area of the node, q_s is the flow to the channel system and q_l is the leakage.

If we consider a water bearing layer that is enclosed between two less-permeable layers, then the vertical flux for layer L can be written as :

$$q_l = \frac{h_{i,L+1} - h_i}{.5 \ c_{i,L+1}} + \frac{h_{i,L-1} - h_i}{.5 \ c_{i,L-1}} \qquad (5)$$

where c is the hydraulic (vertical) resistance of the less-permeable layer defined as :

$$c_i = \frac{d_i}{k_i} \qquad (6)$$

where d is the vertical thickness of the layer and k the hydraulic conductivity. If the top layer is a c-layer, then the vertical resistance is corrected for the groundwaterdepth. The resistance is only taken for the waterbearing part of the c-layer. When this part becomes too small (less than 1.0 m) a warning in this respect is given by the programme and no further reduction is done.
If between two aquifers the aquitard is missing, then equation (6) cannot be used two calculate the flux between the two aquifers. These two layers at node i will then be considered as one layer with adjacent nodes in the two separate layers. The programme assumes that the c-layer is not present when the hydraulic conductivity is less than 10. This situation may only occur for a few nodes in the c-layer.

2.2. Unsaturated zone

The unsaturated zone is modelled as a reservoir. Water is considered to be stored in the root zone until a certain equilibrium is reached.

If the equilibrium is exceeded, excess water will percolate to the unsaturated zone between root zone and phreatic surface. If the moisture content in the root zone is below its equilibrium, capillary flux from the phreatic surface will take place. The height of the phreatic surface is calculated by means of a storage coefficient which is dependent on the groundwater depth (figure 3). The model is described in detail elsewhere (QUERNER and VAN BAKEL, 1988). The major functions are summarized below.

The change of moisture content ΔV_w over a timestep Δt due to rainfall P_n, sprinkling P_s and evapotranspiration E is :

$$\Delta V_w = (P_n + 0.9 * P_s - E) * \Delta t \qquad (7)$$

Evapotranspiration is a function of the crop and of the moisture content in the root zone. Without considering percolation or capillary rise the moisture content for the next timestep would be :

$$V = V_w^t + \Delta V_w \qquad (8)$$

The equilibrium moisture content in the root zone is a function of the soil physical properties, s, the groundwater depth h^* and the thickness of the root zone, rz. If the moisture content V is above equilibrium, percolation occurs, otherwise capillary rise is effective. Therefore the capillary rise is calculated as :

$$q_c = f (s , h^* , rz) \qquad V < V_{eq} \quad \text{(capillary rise)} \qquad (9)$$

or

$$q = \frac{V_{eq} - V}{\Delta t} \qquad V > V_{eq} \quad \text{(percolation)} \qquad (10)$$

The moisture content for the next timestep can now be calculated as :

$$V_w^{t+\Delta t} = V + \Delta t * q_c \qquad (11)$$

This model concept was verified with results from a more accurate model SWATRE (BELMANS et al, 1983). For a sandy soil evapotranspiration and capillary rise in winter did not differ, but for the summer half year the above described model gave 3 - 8 % lower actual evapotranspiration, so it underestimated capillary rise.

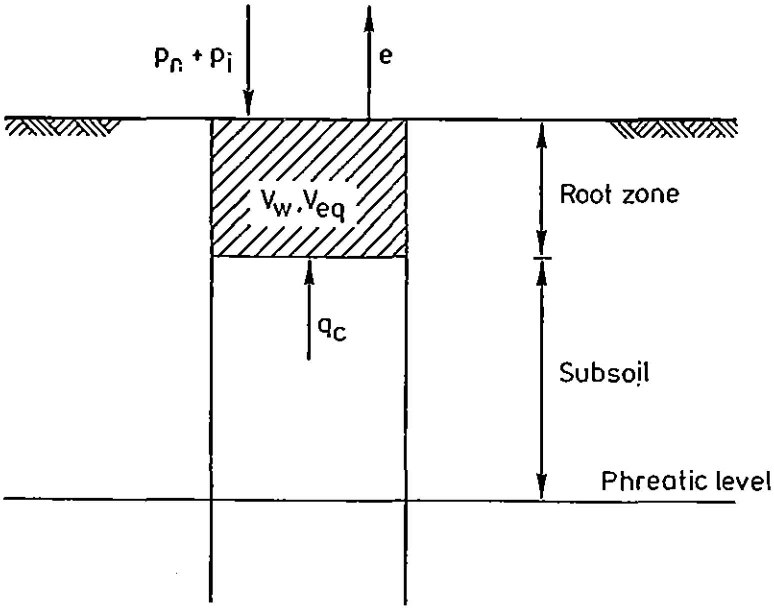

Figure 3 - Schematization of unsaturated zone

The actual evapotranspiration per technology is calculated as :

$$E = \alpha E_p \qquad (12)$$

with :

$$\alpha = f\ (V_w \ / \ V^o_{eq}) \qquad (13)$$

The potential evapotranspiration is calculated from the reference grass evapotranspiration (see Nota 1903) and multiplied with a factor dependent on the land use j. The relative evapotranspiration α is given by equation (13). The dry up factor is defined as the actual moisture content V_w of the root zone divided by the equilibrium moisture content for zero groundwater depth. The relationship between relative evapotranspiration and the dry up factor is given in Report ??. Water-logging reduces the evapotranspiration for agricultural technologies and urban area. This is only done for the summer period. Crops sensitive for water-logging can be differentiated from the others, the evapotranspiration is then reduced at an earlier stage.

2.3. Sprinkling

The sprinkling irrigation is started when the relative moisture content is below a certain value. The relative moisture content is defined here as the present moisture content divided by the equilibrium moisture content for a groundwater depth of 1.0 m ($V_w/V_{eq}^{1.0}$). This threshold value depends on the production level of a technology (crop). The sprinkling is continued as long as the moisture content is below a certain level. A rotation scheme of say 7 or 14 days can be selected by the user. This means that in 7 or 14 days the total area of the specific land use is sprinkled with 25 mm. A loss of 5 % is taken into account and 10 % of the water is not stored in the root zone but percolates directly to the saturated zone, due to irregularities in the distribution of the sprinkling (equation 7). The period in which sprinkling is applied varies per technology. Therefore this period must be specified. The maximum period can be the entire summer period (1st april-1st oct).

In general the extraction for sprinkling from surface water is the preferred source in the model. But due to restrictions or no surface water available nearby the extraction from groundwater is considered as well.
The extraction from groundwater for sprinkling is calculated first. This is for the area where no surface water is available (land more than say 150-250 m from the water courses). The rest of the required amount will be extracted from surface water subject to the maximum allowed for by either the maximum capacity or a restricted capacity. If the required amount from surface water is not enough, the rest is added to the amount extracted from groundwater.
The maximum extraction from surface water is allowed when the supply is enough to maintain the summer target level. When the supply is not enough the water level becomes lower than the target level. If the water level is below a certain value, then the extraction for sprinkling is reduced. The reduced capacity available for sprinkling is then the supply minus the subsurface irrigation.

2.4. Drainage

The ditches that actually are involved in the interaction between surface and groundwater are commonly the combined secondary and tertiary water courses, together with the flow to trenches. Additional to this a so-called channel system can be present (see figure 4). The secondary system consists of the larger water courses that always contain water. The tertiary system consists of shallow ditches which are intermittently filled with water. These secondary and tertiary systems together form the schematisation of the surface water system on a subregional level. It is assumed that these ditches are spread evenly over the area and are present in all nodes. The interaction between surface water and groundwater is only possible with the top layer.
The channel system can be present as well, but in specific nodes. It should represent the larger channels having its own special influence, often locally, on the groundwater system. It is not related to the area of a node, but the length of channels must be given. An interaction with all layers defined in the model is possible.

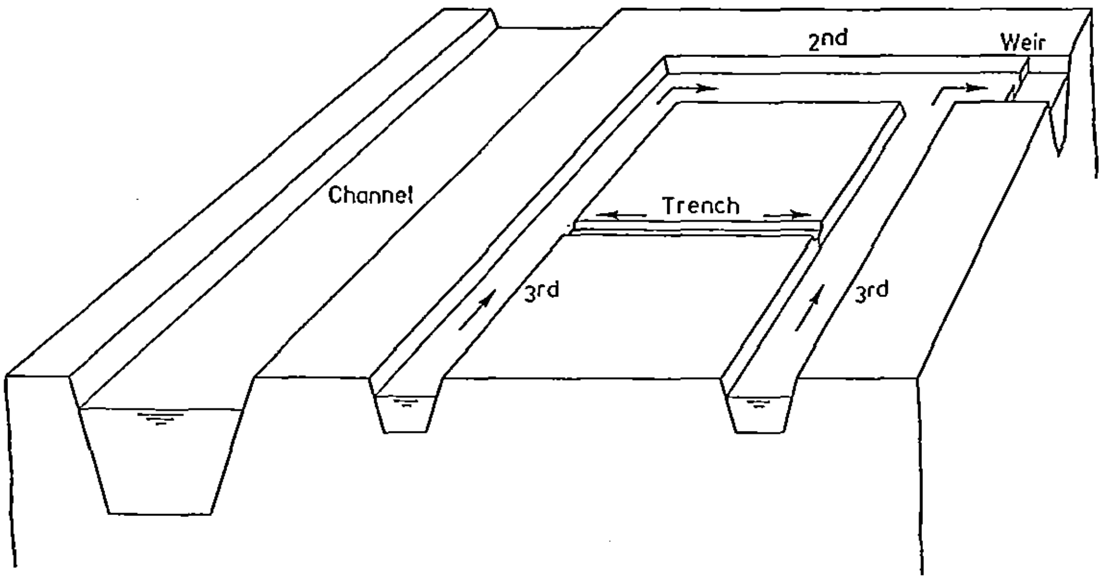

Figure 4 - Schematization of interaction groundwater surface water in four different categories

2nd + 3rd system

The interaction between the three subsystems (2nd, 3rd and trenches) and the groundwater system can be described as :

$$Q_w = \sum_{n=1-3} \frac{(h_w - h_i)}{\alpha_s \, \gamma_s} \, A_i \qquad (14)$$

where h_w is the water level or invert level of a subsystem, α_s is a geometry factor, γ_s is the so-called drainage resistance and A_i is the area of the node. Here is h_w the highest value of either the invert level or the water level. The geometry factor α_s is necessary to convert the head midway between two parallel ditches to the average hydraulic head used in equation (14). The drainage resistance is either kept constant or used as a function of the groundwater depth, dependent on the number of ditches per unit area and the geo-hydrological properties of the soil. The drainage resistance can then be written as :

$$\gamma = a \exp (b * h_{min}) \qquad (15)$$

with :

$$h_{min} = \min \{ gl - h_i , gl - h_w \}$$

where a and b are constants, h_{min} is the minimum of the distance between ground level gl and the phreatic level h_i or surface water level h_w.

Channel system

For the channel system the equation per unit length of ditch is :

$$q_s = \beta (h_c - h_i) \qquad (16)$$

with

$$\beta = - \frac{1}{R_r + R_e / P} \qquad (17)$$

The radial resistance R_r can be calculated with the equation :

$$R_r = \frac{1}{\pi k} \ln \frac{\alpha_c d}{\pi P} \qquad (18)$$

in which k is the hydraulic conductivity, d is the thickness of the saturated layer, P is the wetted perimeter of the channel and α_c is a coefficient depending on size of the channel. If the channel is small (depth less than 2.50 m), then α_c is 4.0 - 5.0, and for larger channels α_c is 6.0 - 7.0. The upper limit can be selected for empty stage and the lower limit for bankfull channels.
The entry resistance R_e is strongly dependent on local conditions and cannot be calculated explicitly, but must be measured on site and is required as input. In the programme the entry resistance (dimension days) is divided by the wetted perimeter, only for the part exposed to the layer considered. This part is calculated by the programme from the information on layer thickness in relation to the ground, water and invert level.

2.5. Water management

The surface water system is often a very quick responding system with rapid water level fluctuations. Therefore the timestep of this system must be very small, say between 0.2 and 1.0 day. For the groundwater system the timestep can be much larger, say between 1 and 7 days. Therefore the surface water system has its own timestep. In between two timesteps of the groundwater module a number of timesteps of the surface water module are executed. The groundwater level remains constant during that time and the interaction groundwater surface water is added up. The next time the groundwater module is called, then this amount of drainage or subsurface irrigation is used in the calculation of a new groundwater level.

The surface water system in a subregion is modelled as one reservoir with a weir situated at the outlet. In reality a number of weirs may be present. But under the assumption that the weir levels are a constant distance below ground level (see figure 5). Then the schematization of the surface water system as one reservoir is justified. For a subregion it is possible that in the higher parts subsurface irrigation occurs and in the lower parts drainage. This drainage water cannot be fully reused in the same subregion. Using the concept of one reservoir it would mean lifting it up from the lower parts, to the higher parts of the subregion. Therefore the fraction of drainage water that can be reused in the same subregion is an input variable (see factor-record).

The water level is calculated from the stage discharge relation given as input data. Included in this relation are the flow resistance within the system, they are also dependent on the drainage rate. When subsurface irrigation is taken place the storage capacity of the system is taken into account. With the supply, subsurface irrigation, extractions (sprinkling) and the stage-storage relation a new water level is calculated. This water level for a subregion is in the programme considered as a distance below ground level. From this distance the actual water level for all nodal points is calculated.

The characteristics from the surface water system must be given in the form of a stage-storage-discharge relation. For the summer and winter period a target level must be specified. In the summer period from 1st of April until a specified time (IDWL in criteria-record) water level control is possible (weir level). Water level control in the region can be differentiated in three categories, each having its own criteria of weir level manipulation in relation to the groundwater depth (see level control-record).
The storage capacity is important for the summer period when there is a supply. When the supply is smaller than the subsurface irrigation plus the extraction for sprinkling, the storage in the system is used to calculate the lowering of the water level. For drainage situations the storage capacity is very small and plays a minor role. Often the storage of the system is equal to amount of drainage for one to three days. For drainage situations the discharge curve is important, because the water level is calculated from it (only winter period). Drainage situations in summer does not effect the water level. It is assumed that automatically the weirs are lowered to maintain the same level.

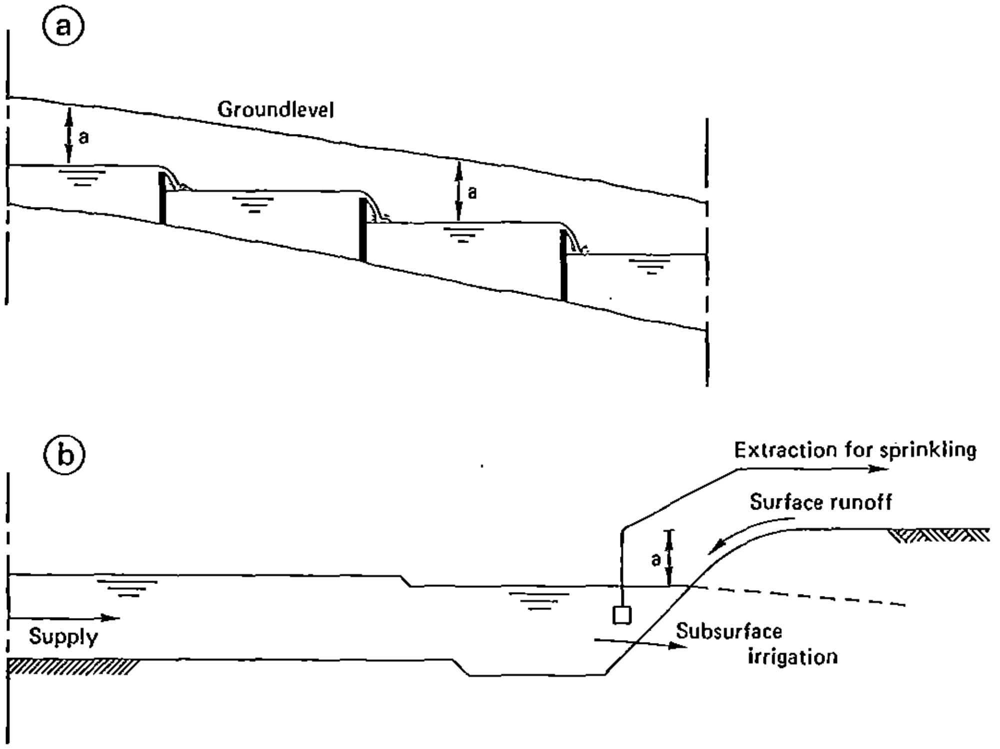

Figure 5 - Schematization of surface water system per subregion
a - in reality with a number of weirs; b - schematisation as one reservoir per subregion

2.6. Schematization

Using the programme one requires a schematization of the groundwater system in a number of layers. For each layer geo-hydrological information is required such as hydraulic conductivity, vertical resistance, layer thickness, specific storage, etc. On the boundary of the system a flux or hydraulic head must be specified. The region to be modelled is subdivided into finite elements. For the calculation of water movements in the unsaturated zone the region is subdivided in subregions and per subregion in different areas characterized by its land use.

To construct a finite element model for a specific problem, we must draw to scale a plan of the area to be analysed. After the geometry has been sketched, we define the points along the boundary and in the interior. Nodes should be more closely spaced in regions where the hydraulic head is expected to change much. All elements should have angles less than ninety degrees.
With the use of a digitizer one can determine the coordinates of each

nodal point. Also the plotting of the digitized map can be of use in tracing errors and compiling additional information such as ground levels and geo-hydrological data.

For the spacing and positioning of nodes one should bear in mind that a nodal point is representative for a certain area surrounded by it (half way to next nodal point). The results in the form of heads and flows are average values for the representative area of the node. The spacing of points is also very important for the correct simulation of the groundwater levels and fluxes. For a good representation of reality one requires a fair number of points. On the other hand the limitation on the number of points can be in conflict with this (accuracy and amount of input data; capacity computer system). For each nodal point a certain amount of information is required (eg kD or c) which is often not available on such a detailed scale. All these aspects taken into account, in general the maximum number of nodes should be less than 1000.

Another important criteria is the schematization in a number of layers. For example the top layer is often assumed to be an aquitard, which means that the water flow in horizontal direction is assumed to be negligeble. Depending on the hydraulic resistances of the aquitard and the underlaying aquifer this assumption is often justified.

The unsaturated zone is modelled per land use on a subregional level. This means that the division of the region in a number of subregions is very important. Therefore within subregions homogeneous conditions must be present in respect of soil type, groundwater depth class and characteristics surface water system. From the soil type capillary rise and moisture content root zone are the important factors. Only one soil type per subregion is possible. The groundwater depth class as minimum and maximum groundwater levels over the years should not vary considerable within a subregion. The average groundwater depth is used for the unsaturated zone (capillary rise, storage coefficient and equilibrium moisture coefficient). The surface water system is a reservoir per subregion. The water management is another important factor to select subregions (water supply, water level control, target levels, etc.).

The agricultural activity in growing and processing a certain crop or livestock is here called a technology. Not only agricultural technologies can be simulated, also urban areas, nature reserves and forests. Similar criteria as for the agricultural technologies are defined for these areas, so that they could be incorporated in the computer model.

3. DISCUSSION OF PROGRAMME FEATURES

3.1. Calculation and print options

Different options can be selected by the user to define certain types of conditions, calculations, or output. They are discussed here in the same sequence as required to be given as input in the option-record.

Over-relaxation

The over-relaxation factor is important for the rate of convergence. With an optimum value of the over-relaxation factor the programme requires on average less than half the number of iterations, when using no over-relaxation factor. The two methods of over-relaxation are discussed in chapter 6 of Nota 1557. One can chose between the use of the constant factor or the use of the ratio factor.

Save results for time graphs

Results of certain nodes or subregions can be made visible as time-hydraulic head graphs. In the programme the results are written to file. With seperate programmemes, as discussed in Chapter 5, these results can be plotted or made visible on a grafical display unit.

Printed output

The way to control the amount of printed output of data and results is discussed in detail in paragraph 3.5.

Output for other models

Calculated results can be saved to serve as input data for other models. The results can be used in a water quality model ANIMO and a crop production model SIMCROP.

Results per node or subregion

If one wants the results of hydraulic heads and flows per node or per subregion it can be set by this option parameter. For a full description on the way to control the printed output see paragraph 3.5.

Anisotropy

The properties of the soil, anisotropy, must be defined here. If isotropic layers are present, one must give the conductivity, that is valid in all directions (conductivity-record). If anisotropic layers are present, then the first and second principal conductivity must be given. The angle between the first principal conductivity and the X-coordinates is also required.

Also one can set this option, indicating that the soil properties are the same for an entire layer or the same per subregion and layer.

Surface water system

The characteristics of the surface water system in its form as secondary and tertiary system is given by invert levels and storage capacities. The invert levels of both systems can be given per nodal point or per subregion (as depth below ground level). The storage capacity is always part of the input per subregion.

The drainage resistance required for equation (14) can be given as input data in two ways. First as an exponential relation dependent on the groundwater depth or surface water level whichever is the highest. Then the input data are the two constants for equation (15). Secondly the drainage resistance can be constant, one for the secondary and one for the tertiary system.

Channel system

The inclusion of a channel system can be set by this option. The data is required only for those nodes where it is present. The channel system can have an interaction with all layers defined in the model. This system is used often for those channels which are not evenly distributed over the region. They play only at specific locations a role. The channel system is not part of the surface water system, has no storage and the water level specified remains constant, but it can be changed in time (time-record).

The option parameters are summarised below and the values to be given in the option-record.

ICON - 1 = over-relaxation factor constant for all nodes
2 = over-relaxation factor per node as ratio old/new hydraulic head

IPLR - 1 = write hydraulic heads to file for specified nodes (see plot-record)
2 = write hydraulic heads to file for specified subregions
3 = write groundwater depth to file for specified nodes
4 = write groundwater depth to file for specified subregions
5 = write groundwater level, surface water level and drainage flux (tr.+3rd+2nd in mm/d) to file for specified nodes
6 = write groundwater level, surface water level and drainage flux (tr.+3rd+2nd in mm/d) to file for specified subregions
7 = write groundwater depth and flux from 1st to 2nd layer to file for specified nodes (mm/d)
8 = write groundwater depth and flux from 1st to 2nd layer to file for specified subregions (mm/d)

IPRI - 1 = only general input data is printed
2 = limited output of the input is printed
3 = output of all input data and certain calculated main (initial) variables

IPRQ - 0 = no results are saved
1 = results of all flows in unsaturated zone are saved for water quality model ANIMO
2 = actual evapotranspiration rates are saved for crop production model SIMCROP
3 = flows between subregions in a water bearing layer are saved

IRES - 1 = output results per node (for optional interval see the criteria-record)
2 = output results per subregion

IANS - 1 = isotropic and data per layer
2 = anisotropic and data per layer
3 = isotropic and data per subregion and per layer
4 = anisotropic and data per subregion and per layer
5 = isotropic and data per node and per layer
6 = anisotropic and data per node and per layer

ISURF - 1 = input per subregion - depth of system and constants a and b for equation (15) - both drainage-record
2 = input per subregion - depth of system and constant drainage resistance tertiary and secondary system (drainage-record)
3 = input per node - invert level of system and constant drainage resistance tertiary and secondary system (surface water-record)
4 = input per node - invert level of system and per subregion the constants a and b for equation (15) (surface water-record and drainage-record)

ISEC - 0 = no channel system
1 = channel system present (specific nodes)

3.2. Time dependent variables

The time dependent input must be given in sequential order of time. From that particular time the new data will be effective. One has to fit these times in such a way that they coincide with the calculation time controlled by the timestep. If it is found by the programme that the time for new input does not fit the calculation time, then the time for new input is advanced or delayed to fit the calculation time. The closest calculation time is then selected, and a note concerning this is printed on the output.

For the selection of day numbers in the year in relation to the first day of the month is given in the table below :

first day of month	day no	first day of month	day no
February	32	August	213
March	60	September	244
April	91	October	274
May	121	November	305
June	152	December	335
July	182		

Hydraulic head

One can set the hydraulic head to a preset value or cancel a previous set value. If one sets the hydraulic head, the value should not be to much different from the value it has at that particular moment. Otherwise instability may occur if the value is changed to a great extend. The programme checks the difference and accepts a difference of 1.50 m or less. If this situation is expected to occur, then one should change the hydraulic head over more than one timestep to the new prescribed value. If the hydraulic head for a node is kept constant, then the interaction with the surface water system is the rest term of the water balance. The drainage or subsurface irrigation is calculated directly from the other terms (capillary rise, leakage and lateral flow).

External discharge

The discharge or recharge at an internal node point or on the boundary can be prescribed or a previous set value can be cancelled.

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Constant water level in surface water system

The water level for a subregion can be fixed to a prescribed level, this means also that no storage is considered and the supply must be enough.

New timestep

The changing of the timestep is an important factor on the modelling of the groundwater flow over a long period. To start the calculation one can better begin with a small timestep in order to let the initial heads (SIMGRO.HDS) to be adjusted, dependent on the prescribed boundary conditions. The maximum time that has been tested and uses not to much iterations per timestep is ten days. But the number of iterations depends on the type of problem, the changes in hydraulic head over a timestep, and the number of nodes in the solution domain. The table below gives an advised start up of the timestep, but check the number of iterations in the start up procedure if the increase in the timestep is moderate or too fast. The iteration file gives the maximum change in head over a timestep (PMAX), this can be checked if it is acceptable.
A timestep of 7 days is possible, but depending on geohydrological parameters and the surface water system this may be too large. If the value of PMAX is greater than 0.30 m, reduce the timestep to e.g. 3 days.

Table 1 - Advised timestep to be used

day number for input (d)	new timestep (d)	
-	.4	criteria-record
0.4	.6	time-record
1.0	1.0	,,
2.0	2.0	,,
4.0	3.0	,,
7.0	7.0	,,

Plot of results

For the time given a plotfile will be created with the name SIMGRO.PLn (n is number in order 1, 2, ..), to which the results will be written. One can select the actual hydraulic heads or the change from the beginning. The present programme can create a maximum of nine files for results to be stored.

Printing hydrological results per subregion in mm

The hydrological results can be printed for a specific time in mm. These results are accumulations from another specified time. The results per subregion are from the unsaturated zone and the top (first) layer of the saturated zone.

New season

For the calculation of evapotranspiration, allocation of sprinkling and water level control the differentiation between summer and winter half year is required. The programme changes at day number 91 over from winter to summer half year and at day number 274 over from summer to winter period.

Sprinkling

The sprinkling can be applied in the summer period dependent on production level and relative water content in the root zone (production level-record and factor-record). Per technology the period in which sprinkling may be applied must be specified.

Water level control

The water level is in general raised during the summer period to a specified target level. From the first of april the target levels can be raised to the target level in summer. This depends on the groundwater depth and weir regime (level control-record and management-record). At the end of the summer the water level is lowered to the target level for the winter period. The end of the period with high levels can be given as input data in the criteria-record (say late august to beginning of september, but not later than 1st october).

3.4. Restrictions on use computerprogramme

There are certain restrictions on the use of the programme. For most of these restrictions checks have been included in the programme which give a warning or stops the programme. These restrictions are summarised below.

Number of nodes	<=	600
Number of subregions	<=	50
Number of elements	<=	900
Number of layers	<=	5
Bandwidth	<=	15
Time interval for printing results (days)	<	500
Nodes skipped while printing node results	<	75
Number of discharges (incl prescribed inflow on boundary	<=	500
Maximum number of iterations per timestep	<	40
Number of technologies	<=	18
Number of soil physical units	<=	6
Different regimes for water level control	=	3
Values for relations of equilibrium moisture content and capillary rise	=	33
Values for storage coefficient	=	11

The above values are default in the programme, but the user may change these to suit them for his specific case. It should be noted however, that certain changes may change input or output formats.

The same sequence of node numbers as given in the node-records must be preserved for the head-records, the conductivity-records and for the contact points.

The same sequence as used for the subregions must be kept for the conductivity-record if so required (IANS = 3 or 4).

Two water bearing layers must be separated by a less-permeable layer. For certain nodes a window in the less-permeable layer can be present.

No boundary flux can be prescribed for an aquitard.

The unsaturated zone per technology (land use) is modelled per subregion and therefore all information for the unsaturated zone must be compiled on a subregional level.

3.5. Printing of input data and results

The printed output of data is controlled by the option IPRI. There are three different stages each giving an amount of information. A low value of the parameter gives little information.
Which information is included where, is given in the table below. The items under A are input data and under B are calculated variables from the input data.

For the interpretation of the results one should bear in mind that the calculated heads are average values representative for the area of a nodal point. It is therefore no point value but an average head. The

area of a nodal point goes as far as half way the surrounding points. The results of the calculations (m^{-3} and m^{-3}/d) can be given per node or per subregion. For both ways one can set an interval between results (days). Only for those times corresponding to the time interval, results will be printed. If one sets the interval smaller than the initial timestep, then for all timesteps the results will be printed. For the printed output per node one can skip a certain number of nodes. For those nodes only, the results will be printed.
The quantities for the unsaturated zone and the top layer can be printed in mm per subregion. This can be done for specific times and can be results accumulated from either beginning or another specified time (time-record).

Table 2 - Printed data and results

	Type of data or results	Value of IPRI 1	2	3
A	General data	x	x	x
	Unsaturated zone data	x	x	x
	Water level control	x	x	x
	Node point data	-	x	x
	Conductivity param.	-	x	x
	Subregion numbers	-	x	x
	Area per technology	x	x	x
	Surface water and sprinkling	-	x	x
	Node numbers per element	-	-	x
	Time dependent data	-	x	x
B	Conductivity matrix	-	-	x
	Storage vector per node	-	-	x
	Area vector	-	-	x
C	results per node or subregion (m^{-3})			
	head and fluxes saturated zone	x	x	x
	fluxes unsaturated zone	x	x	x
	flows and level surface water	x	x	x
	flows to channel system	x	x	x
	moisture content root zone	-	x	x
	change in head over timestep	-	x	x
D	results per subregion (mm)			
	terms unsaturated zone and top-layer sat. zone	x	x	x
	actual evapotr. per technology	x	x	x
	sprinkling per technology	x	x	x

3.6. Warnings and error messages

The warnings given by the programme are:

1 - For c-layer waterbearing part top layer less than 1.0 m

2 - Top layer for aquifer becomes less than 0.5 m for element no ....
prog. assumes min of 0.5 m

3 - Vertical resistance quite low (between 50 and 10)

4 - Channel system - length side slope <= -0.5 m

5 - Flow balance in layer .... out by .... (>55 %)

6 - Change in phreatic level of more than .... (>0.40 m)

7 - Water level more than 5 cm above ground level

subroutine SURFW
Day .... water level fluctuations in subregion .... too much
last time step .... now .... (depth below groundlevel)

Day number : .... subregion : .... with fixed water level,
supply : ...... exceeds maximum : .....
increase max. supply or lower water level

maximum supply capacity exceeded
day .... year .... SUPM = ... factor = ...

subroutine SPRINK
More groundwater extracted than maximum - day = ...
subregion : .... GIRR = ... GMAX = ... ??

The actual error messages given by the programme are given below (number between brackets refers to the error number used in the programme).

OPEN - ALL FILES COULD NOT BE OPENED - IOS = .. PROG. STOPS (1)
The parameter IOS gives an indication on the type of error (file locked by other user or file could not be found). Refer to your reference manual for the interpretation of this value.

READ DATA - TYPE OF DATA RECORD INCORRECT, IT IS : *...., IT REQUIRES TO BE : *.... RECORD (22)
In the input files records are missing or too much. Also possible is an option parameter requiring data which is not given or a wrong value for the option.

READ DATA - OPTION PARAMETER NO : .. HAS INVALID VALUE OF : .. (17)
Value given is out of range (for parameter number see option-record.

READ DATA - BOTTOM LAYER MAY NOT BE A C-LAYER (24)

READ DATA - NUMBER OF NODES GIVEN IN SUBREGION-RECORDS = ..
TOTAL NUMBER OF NODES = .. ? (5)
In the subregion-records the nodes are given. The total number of these nodes is not the same as given in the number-record.

READ DATA - SUBREGION NUMBER GIVEN IS OUT OF SEQUENCE, IT IS : ..
IT SHOULD BE : .. (23)
Sequence of subregion numbers used in subregion-record should also be used in conductivity-record.

READ DATA - SUBREGION NUMBER ... NOT FOUND IN ARRAY WITH SUBREGION NUMBERS - SEE PLOT-RECORDS (26)

READ DATA - NODE : ... THE INVERT OF SURFACE WATER SYSTEM (2ND OR 3RD) HIGHER AS GROUND LEVEL (18)

READ DATA - NODE : ... LAYER .. HAS THICHNESS OF ... CM
THIS DATA IS REQUIRED FOR CHANNEL SYSTEM (31)

READ DATA - THE BANDWITH OF : .. IS NOT LESS OR EQUAL 15 (9)
To many adjacent nodes or error in elemental network (element-record)

READ DATA - ANISOTROPY , NODE NUMBER : ... NOT IN CONSECUTIVE ORDER WITH EXTERNAL NUMBER : ... (7)
Use in conductivity-record the same node number sequence as used in node-record.

READ DATA - CONTACT POINTS , NODE NUMBER : ... NOT IN CONSECUTIVE ORDER WITH EXTERNAL NUMBER : ... (10)
Use for contact point records the same node number sequence as used in node-record.

READ DATA - INITIAL HEADS, NODE NUMBER : ... NOT IN CONSECUTIVE ORDER WITH EXTERNAL NUMBER : ... (12)
Use for initial heads records the same node number sequence as used in node-record.

READ DATA - TECHNOLOGY NUMBER IN NUMBER-RECORD FOR URBAN AREA OR FOREST NOT FOUND IN ARRAY WITH TECHNOLOGY NUMBERS - NUMBER GIVEN IS : .. (27)

READ DATA - POINTER INDEX FOR URBAN AREA OR FOREST FALLS WITHIN THE AGRICULTURAL TECHNOLOGIES - CHECK NUMBER-RECORD (28)
Number first the agricultural technologies and then the others.

READ DATA - TECHNOLOGY NUMBER IN ROOT ZONE-RECORD .... DOES NOT

CORRESPOND TO TECHNOLOGY NUMBER FROM TECHNOLOGY-RECORD ... (32)

READ DATA - SUBREGION : .. TOTAL PERCENTAGE OF LAND USE NOT EQUAL 100 % - IT IS : ... % ! (8)
See area-record, the summation of percentages is not equal to 100 %.

UNSTEADY DATA - NODE : ... NOT FOUND IN ARRAY WITH EXTERNAL NODE NUMBERS (TIME-RECORD) (16)
In time-record B a node number is given which is not used in node-record.

UNSTEADY DATA - START OUTPUT RESULTS FOR OTHER MODELS, BUT OPTION IPRQ IS ZERO ? (6)
In the time-record B the results for other models is started, but the option IPRQ is not given a value of 1 to 3.

UNSTEADY DATA - NODE ... NEW WATER LEVEL IN CHANNEL SYSTEM ABOVE GROUND LEVEL OR BELOW INVERT. GROUND LEVEL IS .... AND INVERT LEVEL IS .... ? (29)

UNSTEADY DATA - SUBREGION : .. NOT FOUND IN ARRAY WITH SUBREGION NUMBERS - SEE PLOT RECORDS (4)
In time-record B a subregion number is given which is not used in subregion-record.

UNSTEADY DATA - LAYER : .. NODE : ... NO BOUNDARY FLUX IN C-LAYER POSSIBLE (25)

UNSTEADY DATA - DAY ... INPUT DAY NUMBER OF ... WITH YEAR .... EXCEEDS DAY 365 ? (30)

RUN TIME ERROR - ELEMENT NO : ... , CORNER NODE : ... NOT FOUND IN ARRAY WITH EXTERNAL NODE NUMBERS (13)
In element-record a corner node is given which is not specified in node-record.

RUN TIME ERROR - CONTACT POINT : ... NOT FOUND IN ARRAY WITH EXTERNAL NODE NUMBERS (14)
In contact point-record a corner node is given which is not specified in node-record.

RUN TIME ERROR - SUBREGION NO : .. , NODE .. NOT FOUND IN ARRAY WITH SUBREGION NUMBERS (RECORDS : PLOT; SUBREGION OR CHANNEL) (15)

RUN TIME ERROR - FOR NODE : 27 THE AREA IS : -10 (NOT ACCEPTABLE) (11)
Check the numbering in the element-records of nodes in the vicinity of the specified node. Node numbering must be anti-clockwise or elements may be present with angles greater then ninety degrees.

RUN TIME ERROR - IT IS BETTER TO STOP NOW BECAUSE OF NO CONVERGENCE (2)
After three iterations the difference in hydraulic head between two iterations is more than four meters. This often means no solution possible (error in boundary conditions).

RUN TIME ERROR - MAX. NUMBER OF ITERATIONS PASSED (3)

RUN TIME ERROR - DAY ... , SUBREGION .. , TECHNOLOGY .. , MOISTURE IN ROOT ZONE <= 0.0 ? (19)

RUN TIME ERROR - DAY ... ELEMENT NO ... , WATERBEARING PART OF TOP LAYER LESS THAN ZERO (= .... CM !) (20)
The water bearing part of the top layer becomes zero. The programme cannot handle these situations. Check thickness of top layer.

RUN TIME ERROR - NODE ... LAYER .. BOTTOM OF CHANNEL HIGHER AS TOP OF LAYER. CALCULATED DISTANCE IS .... CM (21)
For channel system the invert level is higher than the top of the layer, where you indicate that an interaction is possible.

Main programme
READ DATA - IN TOP LAYER IS NODE .... WITH VERTICAL RESISTANCE OF .... MIN IS 10. FOR TOP LAYER

Subroutine READN
NODE ... CHANNEL SYSTEM NOT FOR BOUNDARY NODE OR INTERNAL NODE WITH PRESCRIBED HEAD

Subroutine READO
READING END OF FILE FROM FILE WITH HEADS FOR INITIAL TIME (SIMGRO.HDS)

Subroutine SURFW
READ DATA - SUBREGION : ... FOR WINTER WEIR LEVEL : .... THE DISCHARGE IS .... (NOT ZERO). IT IS INTERPOLATED FROM TWO VALUES : .... FOR TOTAL SUBREGION
For the winter weir level (management-record) the discharge must be zero (discharge-record).

ERROR IN SUBR. SURFW - IDN, NR, TARL ... ... STORAGE FOR TARGET LEVEL SUMMER OR WINTER WEIR LEVEL NOT FOUND

4. DESCRIPTION OF INPUT DATA

For the internal operation of the programme, four fundamental sets of data are required in addition to control parameters.
These are :

- node and element characteristics
- boundary conditions
- unsaturated zone
- time dependent data

In paragraph 4.1. to 4.9. the required data for the programme SIMGRO is given. The data for running the programme must be placed in six different files. The results are written to a maximum of ten files depending on the required output (see paragraph 4.10 for a description of the output files). The file names for the input with a description of the content is given below. The input data in file SIMGRO.DAT must be given in the order as shown.

Input files

description	file name	paragraph
General data	SIMGRO.DAT	4.1.
Unsaturated zone	SIMGRO.DAT	4.2
Subregional data	SIMGRO.DAT	4.3
Time dependent data	SIMGRO.DAT	4.5.
Geo-hydrological data saturated zone	SIMGRO.NDE	4.4.
Initial heads	SIMGRO.HDS	4.6.
Contact points	SIMGRO.CON	4.7.
Meteorological data	SIMGRO.EVP	Nota 1903
Crop evapotranspiration factors	SIMGRO.FAC	Nota 1903

The records for file SIMGRO.DAT are :

4.1 Heading-record
Number-record
Criteria-record
Option-record
Layer-record
Plot-record (optional)

4.2 Technology-record
Infiltration-record
Root zone-record
Factor-record
Index-record
Water logging-record
Sprinkling-record
Production level-record
Level control-record
Moisture-record
Capillary rise-record
Storage-record

4.3 Subregion-record
Area-record
Drainage-record (optional ISURF)
Management-record
Discharge-record

4.5 Time-record

The records for file SIMGRO.NDE are :

4.4 Node-record
Surface water-record (optional ISURF)
Conductivity-record
Channel-record (optional ISEC)
Element-record

4.1. General data

Heading-record

Record to give project name and other text to distinguish the calculation results from each other. Two records are required.

column	format	name	description
1- 5	A5	TEXT	name of record - *HEAD
11-80	A70	HEAD()	title for calculation results

Remark

1 - There must be always two records even if not required.

Number-record

Record to input the number of nodes, elements, layers, subregions, the node interval while printing results, the maximum number of iteration per timestep and general information for the unsaturated zone.

column	format	name	description
1- 5	A5	TEXT	name of record - *GNRL
11-15	I5	NUMNP	number of nodes
16-20	I5	NUMEL	number of elements
21-25	I5	NUMLAY	number of layers
26-30	I5	NUMSB	number of subregions
31-35	I5	INTND	interval between nodes for printing results
36-40	I5	MAXIT	maximum number of iterations per timestep (def. 40)
41-45	I5	NUMNS	number of soil physical units
46-50	I5	NUMTCH	number of technologies
51-55	I5	NUMBD	number of subregions with boundary nodes
56-60	I5	NUMTA	number of agricultural technologies
61-65	I5	NPTT	pointer index for urban area
66-70	I5	NPTF	pointer index for pine forest
71-75	I5	NPTF	pointer index for deciduous forest

Remarks

1 - The agricultural technologies must be given first and then others such as urban area, forest, nature area, etc (see technology-record).
2 - The pointer index means the sequential number of that technology as listed in the technology-record (eg 4th technology listed).
3 - The boundary nodes must be placed in one or more subregions and these must be the last subregions-records.

Criteria-record

Record with time criteria, timesteps and tolerance in head per timestep.

column	format	name	description	
1- 5	A5	TEXT	name of record - *GNRL	
11-15	I5	IDNB	day number to start calculations	
16-20	I5	IYRB	year to start calculations	
21-25	I5	IDM	day number to stop calculations	
26-30	I5	IYM	year to stop calculations	
31-35	F5.0	TDEL	initial time interval	(d)
36-45	F10.0	TPRI	time interval for printing results (m^{-3})	(d)
46-55	F10.0	TOLP	maximum tolerance in head per node (def. 0.001)	(m)
56-60	F5.0	TETA	weighting parameter (def. 0.55)	
61-65	F5.0	PERT	percentage of urban area has impermeable surface	(%)
66-70	I5	IDWL	day number to stop water level control at end of summer	
71-75	F5.0	TSURF	timestep for calculations surface water system	(d)

Remarks

1 - The time to start execution must be choosen such, that it corresponds to the day number in a year (91 = 1st April).
2 - Time to start must be between 1st oct until 1st april (otherwise file with crop factors does not correspond).
3 - For the discussion on the advised timestep to be used, see paragraph 3.3.
4 - For the tolerance a value between 0.01 and 0.001 is common. Use the first value in the case of testing the programme and for final accurate results use the second value.
5 - For the value of the weighting parameter see Nota 1557 (in general use 0.55).
6 - The percentage impermeable surface in urban area often lies between 25 and 45 %.

Option-record

Record with options to control various activities of the programme, such as over-relaxation, printing output, surface water system, etc.

column	format	name	description
1- 5	A5	TEXT	name of record - *GNRL
11-10	I5	ICON	1 - over-relaxation
16-20	I5	IPLR	2 - save results for time-head graphs
21-25	I5	IPRI	3 - amount of output - data and results
26-30	I5	IPRQ	4 - output results for other models
31-35	I5	IRES	5 - output of results (m^{-3}) per node or subregion
36-40	I5	IANS	6 - isotropic or anisotropic layers
41-45	I5	ISURF	7 - surface water system
46-50	I5	ISEC	8 - channel system
51-55	I5	-	9 -
56-60	I5	-	10 -

Remarks

1 - The error messages of the option refer to the numbers given in the description.
2 - A full description of the option parameters and their meaning is given in paragraph 3.1.
3 - The amount of printed data and results is described in paragraph 3.5.
4 - To start printing results for other models (IPRQ > 0) see time-record.
5 - If the position for a parameter is left blank in your data deck, the programme takes the default value.
6 - The default values for the options are :

ICON = 1	IANS = 1
IPLR = 0	ISURF = 1
IPRI = 1	ISEC = 0
IPRQ = 0	
IRES = 2	

Layer-record

Record to give information on type of layer (aquifer or aquitard).

column	format	name	description
1- 5	A5	TEXT	name of record - *GNRL
11-15	I5	NCLY(1)	code for top layer
16-20	I5	NCLY(2)	code for second layer
21-25	I5	NCLY(3)	code for third layer
26-30	I5	NCLY(4)	code for fourth layer
31-35	I5	NCLY(5)	code for fifth layer

Remarks

1 - Code to define type of layer :
0 = aquifer
1 = aquitard (c-layer)
2 - Two aquifer layers must be separated by an aquitard.
3 - The last layer must be always an aquifer.

Plot-record (IPLR ≠ 0)

Record to give number of nodes or subregions, the actual nodes or subregions and the layer numbers from which the results must be written to file. Subsequent these results can be plotted with programmes as discussed in Nota 1903.

Record A

column	format	name	description
1- 5	A5	TEXT	name of record - *PLOT
11-15	I5	NUMP	total number of nodes or subregions for plotting results
21-25	I5	NUMPR()	node or subregion number
~	~	~	~
66-70	I5	NUMPR()	10th node or subregion number

Record B

column	format	name	description
1- 5	A5	TEXT	name of record - *PLOT
21-25	I5	NUMPL()	layer number for node or subregion from record A
~	~	~	~
66-70	I5	NUMPL()	layer number for 10th node/subregion

Remarks

1 - The maximum number of nodes or subregions (NUMP) for writing results is 35.
2 - Per record A and B ten node-, subregion-, or layer numbers can be given. Use as many records A as required, the first record requires the total number of nodes or subregions.
3 - First give all records A, then the records B.
4 - The type of output is dependent on the value of IPLR in the option-record.

4.2. Unsaturated zone

Technology-record

Record to give names of land usage in the form of technologies.

column	format	name	description
1- 5	A5	TEXT	name of record - *TECH
13-15	I3	NRTECH()	technology number
16-30	A15	TECHN()	name of 1st technology
33-35	I3	NRTECH()	technology number
36-50	A15	TECHN()	name of 2nd technology
53-55	I3	NRTECH()	technology number
56-70	A15	TECHN()	name of 3rd technology

Remarks

1 - The maximum number of technologies is 18.
2 - Use second or more records if more than 4 technologies are present.
3 - First the agricultural technologies must be given and then the others such as urban area, forest, etc. (see also number-record).

Infiltration-record

Record to give maximum infiltration rate per soil physical unit.

column	format	name	description
1- 5	A5	TEXT	name of record - *INFL
11-20	F10.0	ERES()	infiltration capacity for 1st soil physical unit (mm/d)
~	~	~	~
61-70	F10.0	ERES()	infiltration capacity for 6th soil physical unit (mm/d)

Remark

1 - If precipitation for a day exceeds the infiltration capacity, then the excess is treated as surface runoff.

Root zone-record

Record to give per soil physical unit and per technology the root zone depth.

column	format	name	description	
1- 5	A5	TEXT	name of record - *ROOT	
6-10	I5	NTT	technology number	
16-20	F5.0	RZD()	root zone depth of 1st soil physical unit	(m)
~	~	~	~	
41-45	F5.0	RZD()	root zone depth of 6th soil physical unit	(m)

Remarks

1 - The maximum number of soil physical units is 6.
2 - Use as many root zone-records as there are technologies.
3 - Use the same sequence of technology numbers as given in the technology-record.
4 - The root zone is assumed to be of constant thickness in time.
5 - The minimum thickness of the root zone is 0.25 m.

Factor-record

Record to give per production level the threshold for sprinkling in terms of the relative water content of the root zone ($V_w/V_{eq}^{1.0}$), the timestep for the meteorological data and general information for the surface water system.

column	format	name	description
1- 5	A5	TEXT	name of record - *SFAC
11-15	F5.0	FIRR()	zero production level - threshold for sprinking as $V_w/V_{eq}^{1.0}$.
16-20	F5.0	FIRR()	1st production level - threshold for sprinking
21-25	F5.0	FIRR()	2nd production level - threshold for sprinking
26-30	F5.0	FIRR()	3rd production level - threshold for sprinking
31-35	F5.0	TRDP	timestep for rainfall and evapotr. (d)
36-45	F10.0	STMAX	maximum surface water supply entire region (m^3/s)
46-50	F5.0	DHSW	lowering of summer target level before sprinkling is prohibited
51-55	F5.0	FDR	percentage of drainage water to be reused in subregion (minimum is 5 %)

Remarks

1 - In general the criterium for sprinkling are :

production level	$V_w / V_{eq}^{1.0}$
0	0.5
1	0.6
2	0.7
3	0.8

2 - A production level zero indicates in general no sprinkling, but in rare occasions (extremely dry periods) it can be sprinkled.

3 - See Report ?? for full description of theory on sprinkling in the model.

4 - The maximum surface water supply is for all subregions together. If the total requirement exceeds this maximum, then the supply to all subregions is reduced.

5 - The maximum supply isn't necessary the sum of all maximum supplies to the individual subregions, this can be less.

6 - A certain lowering of surface water level is allowed before sprinkling from it is reduced or stopped. Sprinkling from groundwater is taken instead if this is possible (extraction less then maximum)

Index-record

Per technology the pointer index for the evapotranspiration factor must be given. This is the link with the crop factors in file SIMGRO.FAC.

column	format	name	description
1- 5	A5	TEXT	name of record - *INDX
11-15	I5	NF()	pointer index of 1st techn.
~	~	~	~
55-60	I5	NF()	pointer index of 10th techn.

Remarks

1 - Use second record if more than 10 technologies are present.
2 - The evapotranspiration factors and the corresponding pointer indices are discussed in paragraph 4.9.
3 - If the pointer index is given a negative sign, it means that the technology is grassland and/or natural vegetation. It is not considered as fallow soil in winter.

Interception-record

Per technology the rainfall and sprinkling to reach the root zone is reduced by the amount of intercepted water as input in this record.

column	format	name	description	
1- 5	A5	TEXT	name of record - *INTC	
11-15	F5.0	FINT()	interception of 1st technology	(%)
~	~	~	~	
55-60	F5.0	FINT()	interception of 10th technology	(%)

Remarks

1 - Use second record if more than 10 technologies are present.
2 - No interception for forest must be given here, this is taken into account by the calculation of potential evapotranspiration (see paragraph 4.8.).

Water logging-record

Record to input code for presence of water logging effect on evapotranspiration. The evapotranspiration is reduced when the water content of the root zone reaches the equilibrium content.

column	format	name	description
1- 5	A5	TEXT	name of record - *WLOG
11-15	I5	NRED()	code - sensitivity for water logging of 1st technology
~	~	~	~
55-60	I5	NRED()	code - sensitivity for water logging of 10th technology

Remarks

1 - Use second record if more than 10 technologies are present.
2 - Code for expressing sensitivity for water logging is :
NRED() = 0 - no sensitivity for water logging
1 - sensitive for water logging (see Report ??)

Sprinkling-record

Record A to give per technology the length of the rotational scheme. Within this rotational period all land from a certain technology is sprinkled once. The average amount of sprinkling per day is then the standard application of 25 mm divided by the length of rotational scheme. Sprinkling can only be applied within the period specified in record B and C.

Record A

column	format	name	description
1- 5	A5	TEXT	name of record - *SPRD
11-15	F5.0	DAYI()	1st techn. - length of rotational scheme (d)
~	~	~	~
55-60	F5.0	DAYI()	10th techn. - length of rotational scheme (d)

Record B

column	format	name	description
1- 5	A5	TEXT	name of record - *BEG
11-15	I5	IBEG()	1st techn. - day no sprinkling can start
~	~	~	~
55-60	I5	IBEG()	10th techn. - day no sprinkling can start

Record C

column	format	name	description
1- 5	A5	TEXT	name of record - *END
11-15	I5	IEND()	1st techn. - day no sprinkling stops
~	~	~	~
55-60	I5	IEND()	10th techn. - day no sprinkling stops

Remarks

1 - Use second record if more than 10 technologies are present.
2 - A common length of rotational scheme is 0 (no sprinkling), 7 or 14 days. Take into account the production level as well.
3 - A sprinkling gift of 25 mm is given per land use and averaged out over the length of a rotational scheme.
4 - Sprinkling can only start after the day number given in record B and no sprinkling is applied after the day no. given in record C.
5 - The maximum period of sprinkling is from 1st April until 1st Oct.

Production level-record

Record to give per technology the production level.

column	format	name	description
1- 5	A5	TEXT	name of record - *PROD
11-15	F5.0	PROD()	1st techn. - production level
~	~	~	~
55-60	F5.0	PROD()	10th techn. - production level

Remarks

1 - Use second record if more than 10 technologies are present.
2 - The production level is a criterium for frequent or less sprinkling of that crop.
3 - The criteria for sprinkling per production level are given in the factor-record.
4 - The production level must be greater or equal zero and less or equal 3.0.
5 - Take length of rotational scheme (sprinkling-record) into account for establishing the production levels per technology.

Level control-record

Record to enter water level control information in the form of water level lowerings in summer in relation to the groundwater depth.

Record A

column	format	name	description	
1- 5	A5	TEXT	name of record - *WLEV	
11-20	F10.0	WLM(,1)	1st groundwater depth	(m)
~	~	~	~	
51-60	F10.0	WLM(,1)	5th groundwater depth	(m)

Record B

column	format	name	description	
1- 5	A5	TEXT	name of record - *WLEV	
11-20	F10.0	WLM(,2)	lowering target level for 1st groundwater depth in summer	(m)
~	~	~	~	
51-60	F10.0	WLM(,2)	lowering target level for 5th groundwater depth in summer	(m)

Remarks

1 - The target level (weir level) for the summer period can be lowered by a certain distance dependent on the groundwater depth.
2 - The maximum lowering (1st groundwater depth) should be equal or less than the difference in summer water level and winter weir level (see for these values the management-record).
3 - The groundwater depth must have increasing values (say from 0.80 - 2.00 m)
4 - Actual groundwater depth lower than value given in record A, lower the summer target level by the value given in record B.
5 - The water level control for three type of regimes are required, so three sets of records A and B must be entered even if not required.
6 - In the management-record the regime number (1 - 3) is the link with the level control-records.
7 - The water level control is performed during summer up till the time (IDWL) specified in the criteria-record.

Moisture-record

Input per soil physical unit the equilibrium moisture content of a root zone with depth of 0.25, 0.50 and 1.00 m. For specific groundwater depths the content must be given.

column	format	name	description
1- 5	A5	TEXT	name of record - *V25/*V50/*V100
6-10	I5	....	root zone depth (m)
11-20	F10.0	VEQ()	1st s.p.u. - equilibrium moisture content for zero groundwater depth (mm)
~	~	~	~
61-70	F10.0	VEQ()	6th s.p.u. - equilibrium moisture content for zero groundwater depth (mm)

Remarks

1 - Use 2nd to 11th record for groundwater depth of 0.20, 0.40, etc. to a depth of 2.00 m for each root zone.
2 - Give per rootzone depth of 0.25 (record *V25), 0.50 (record *V50) and 1.00 m (record *V100) the equilibrium moisture content (thus always 33 records).
3 - The way to calculate this input data with FEMSIN is given in Nota 1903.

Capillary rise-record

Records to give per soil physical unit the capillary rise flux. For specific groundwater depths the fluxes must be given.

column	format	name	description
1- 5	A5	TEXT	name of record - *C25
11-20	F10.0	VZH()	1st s.p.u. - capillary rise flux for zero groundwater depth (mm/d)
~	~	~	~
61-70	F10.0	VZH()	6th s.p.u. - capillary rise flux for zero groundwater depth (mm/d)

Remarks

1 - Use 2nd to 11th record for groundwater depth of 0.20, 0.40, etc. to a depth of 2.00 m (only for root zone depth of 0.25 m)
2 - The way to calculate this input data is given in Nota 1903.

Storage-record

Records to give per soil physical unit the storage coefficient for the phreatic surface. For specific groundwater depths the values must be given.

column	format	name	description
1- 5	A5	TEXT	name of record - *U25
11-20	F10.0	BC()	1st s.p.u. - storage coefficient for zero groundwater depth
~	~	~	~
61-70	F10.0	BC()	6th s.p.u. - storage coefficient for zero groundwater depth

Remarks

1 - Use 2nd to 11th record for groundwater depth of 0.20, 0.40, etc. to a depth of 2.00 m (only for root zone depth of 0.25 m)
2 - The way to calculate this input data is given in Nota 1903.

4.3. Subregional data

Subregion-record

Records to include the subregion numbers and the actual node numbers per subregion.

Record A

column	format	name	description
1- 5	A5	TEXT	name of record - *SREG
6-10	I5	NPSUB()	subregion number
11-15	I5	NTOT	total number of nodes in subregion

Record B

column	format	name	description
1- 5	A5	TEXT	name of record - *SREG
11-15	I5	NRSUB()	1st node number
16-20	I5	NRSUB()	2nd node number
~	~	~	~
66-70	I5	NRSUB()	12th node number

Remarks

1 - Per record B, twelve node numbers can be given. Use as many records as required.
2 - Records A and B must be repeated for every subregion (total number equal to NUMSB in number-record).
3 - The boundary nodes must be placed in the last subregions (NUMBD is number of boundary subregions in number-record).

Area-record

Record to give per technology the area as percentage of the subregional area.

column	format	name	description	
1- 5	A5	TEXT	name of record - *AREA	
6-10	I5	NR	subregion number	
11-15	F5.0	PTN()	1st techn. - area	(%)
~	~	~	~	
55-60	F5.0	PTN()	10th techn. - area	(%)

Remarks

1 - Use second record if more than 10 technologies are present.
2 - Use the same sequence of subregion numbers as used in the subregion-record.

Drainage-record (ISURF = 1, 2 and 4)

Record to give per subregion the depth of the surface water below ground level and the drainage resistance.

column	format	name	description
1- 5	A5	TEXT	name of record - *DRES
6-10	I5	NR	subregion number
11-20	F10.0	HBTR(,1)	depth of secondary system below ground level (m)
21-30	F10.0	HBTR(,2)	depth of tertiary system below ground level (m)
31-40	F10.0	SWSA()	parameter a
41-50	F10.0	SWSB()	parameter b

Remarks

1 - Dependent on the value of ISURF the following data must be given :
  ISURF = 1 - depth and parameters a and b for equation (15)
  2 - depth, drainage resistance secondary system (a) and drainage resistance tertiary system (b)
  3 - no data, see only surface water-record
  4 - parameters a and b for equation (15), see also surface water-record
2 - The depth of trenches is constant (0.20 m) in the programme, but can be changed.
3 - The drainage resistance for trenches is 0.75 times the resistance for the tertiary system (ISURF = 2).

Management-record

Record to give per subregion the soil physical unit and the criteria for water levels, sprinkling capacities, etc.

column	format	name	description
1- 5	A5	TEXT	name of record - *MSUB
6-10	I5	NR	subregion number
11-15	I5	NBT()	soil physical unit
16-20	F5.0	TAR(,1)	target level for summer period (distance below ground level)
21-25	I5	NWLM()	water level control - regime number
26-30	F5.0	TAR(,2)	weir level for winter period (distance below ground level)
31-40	F10.0	UMAX()	max supply capacity surface water (m^3/d)
41-50	F10.0	SMAX()	max extraction for sprinkling from surface water (m^3/d)
51-60	F10.0	GMAX()	max extraction from groundwater (m^3/d)
61-70	F10.0	PERC()	percentage of sprinkling always from groundwater
71-75	I5	NDLY()	layer number extraction for sprinkling

Remarks

1 - For soil physical unit enter index number (1 to 6). For instance 2nd soil physical unit for which root zone depth, capillary rise, etc. are given.
2 - For water level control the number of the level control-record (1-3) must be given here.
3 - The weir level for winter period must also be given in the discharge-record, array SWHS(,1).
4 - Water level control and supply is from 1st of april until the day number given in the criteria-record (IDWL).
5 - The maximum supply capacity is the supply only to the subregion considered. The supply must be more than the extraction for sprinkling from surface water, otherwise the sprinkling from surface water is reduced.
6 - An area not situated close to the surface water uses groundwater for sprinkling. This area, as a percentage of the total area for the subregion, must be given here.

Discharge-record

Record to give per subregion the storage and discharge characteristics.

column	format	name	description	
1- 5	A5	TEXT	name of record - *DISH	
6-10	I5	NR	subregion number	
21-30	F10.0	SWHS(,1)	distance below ground level	(m)
31-40	F10.0	SWHS(,2)	storage capacity of all ditches	(m^{-3}/ha)
41-50	F10.0	SWHS(,3)	discharge capacity	(m^{-3}/s/km^{-2})

Remarks

1 - The characteristics per subregion must be always in 10 records.
2 - The distance below ground level must be entered as negative values, say from +0.20m (above ground level !) to -3.00m.
3 - For a level the storage capacity is the volume of water present in the system.
4 - The discharge characteristics can be seen as a weir with a certain width, give for such a situation per level the discharge rate.
5 - The discharge rate must be zero for the weir level given in the management-record.

4.4. Geo-hydrological data of saturated zone

Node-record

Record to give per node the geometry of the nodal points.

column	format	name	description	
1- 5	A5	TEXT	name of record - *NODE	
6-10	I5	NUMEX()	node number	
16-20	5A1	KODE()	code to define type of node, per layer one character (see remarks)	
21-30	F10.0	HGL()	ground level above datum	(m)
31-40	F10.0	X()	X-coordinate	(m)
41-50	F10.0	Y()	Y-coordinate	(m)

Remarks

1 - The node numbers can be at random numbers, not explicitly from one to the total number and in consequetive order. All numbers are converted to internal numbers by the programme.
2 - Code to define the node :
 0 = internal node (or may be blank)
 1 = node on boundary
3 - The nodes on the boundary as defined here can have a prescribed head or flux. For the prescribed head the appropriate values must be given in the file with heads. For a prescribed flux include also time-records. In the programme the code is then changed from 1 to 2 automatically.
4 - For constant heads inside the region the amount of inflow will be shown under the heading surface water (constant head is set in time-record).

Surface water-record (ISURF = 3 or 4)

Record to give characteristics of surface water system in the form of invert levels and drainage resistance per nodal point.

column	format	name	description	
1- 5	A5	TEXT	name of record - *DRNG	
6-10	I5	N	node number	
11-20	F10.0	HBSS()	invert level of 2nd system	(m)
21-30	F10.0	HBTS()	invert level of 3rd system	(m)
31-40	F10.0	DRN(,1)	drainage resistance of 2nd syst.	(d)
41-50	F10.0	DRN(,2)	drainage resistance of 3rd syst.	(d)

Remarks

1 - When ISURF is 3 give invert levels and drainage resistance, when ISURF is 4 give invert levels only (see also drainage-record).
2 - For surface water-record the same sequence of node numbers apply as given in node-record.
3 - The depth for the trenches are standard in the programme 0.20 m deep and have a drainage resistance of 0.75 times the resistance for the 3rd system.
4 - When a system is not present in nodes, use a very high drainage resistance to simulate this.

Conductivity-record

Record to give the geo-hydrological data per node, subregion or layer.

Isotropic layers

column	format	name	description
1- 5	A5	TEXT	name of record - *CDCT
6-10	I5	IDUM	node number or subregion number
11-20	F10.0	C1	transmissivity (kD), only for aquifer (m^2/d)
21-30	F10.0	THI	thickness of layer (m)
31-40	F10.0	VERRES	vertical resistance - only for c-layer (d)
41-50	F10.0	SS	specific storage (m^{-1})

Remarks

1 - Depending on the value of the parameter IANS :
- IANS = 1 - above data required only per layer (starting with top-layer)
- IANS = 3 - above data required per subregion and per layer (subregions in the same sequence as subregion-record).
- IANS = 5 - above data required per node and per layer

2 - Node numbers must be given in the same sequence as in the node-records.

3 - The specific storage is required for all layers.

4 - For information per subregion take the same sequence of subregion numbers as used in the subregion-record.

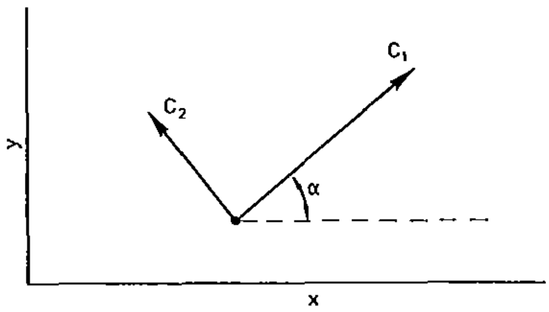

Figure 6 - Variables to define conductivity

Anisotropic layers

column	format	name	description	
1- 5	A5	TEXT	name of record - *CDCT	
6-10	I5	IDUM	node number or subregion number	
11-20	F10.0	SANG	angle between C1 and X-coordiate	(deg)
21-30	F10.0	C1	first principle conductivity	(m/d)
31-40	F10.0	C2	second principle conductivity	(m/d)
41-50	F10.0	THI	thickness of layer	(m)
51-60	F10.0	VERRES	vertical resistance (only c-layer)	(d)
61-70	F10.0	SS	specific storage	(m^{-1})

Remarks

1 - Depending on the value of the parameter IANS :
 IANS = 2 - above data required only per layer (starting with top-layer)
 IANS = 4 - above data required per subregion and per layer (subregions in same sequence as in subregion-record)
 IANS = 6 - above data required per node and per layer
2 - Node numbers must be given in the same sequence as in the node-records.
3 - The variables SANG, C1, and C2 are only required for aquifer layers (see layer-record).
4 - For the definition of SANG, C1, and C2 see figure 6.
5 - The specific storage is required for all layers.

Channel-record (ISEC = 1)

Record to give details on the channel system per nodal point.

Record A

column	format	name	description
1- 5	A5	TEXT	name of record - *CHAN
6-10	I5	NUMSS	number of nodes with channel system
21-30	F10.0	TAL	angle of side slope (degrees)
31-55	5F5.0	ENRES()	entry resistance per layer (d)

Record B

column	format	name	description
1- 5	A5	TEXT	name of record - *CHAN
6-10	I5	N1	node number
11-20	5I2	LY1()	layer affected (code per layer)
21-25	F5.0	WIDBSC()	bottom width at invert (m)
26-35	F10.0	LESC()	total length of channel in area represented by node (m)
36-45	F10.0	HBSEC()	invert level of channel (m)
46-55	F10.0	WTSS()	water level in channel (m)
56-80	5F5.0	RADRES()	radial resistance per layer (d/m)

Remarks

1 - Code to define interaction with channel system per layer as :
   0 = no interaction (or may be blank)
   1 = interaction with channel system
2 - The side slopes must be given in degrees (e.g. 26.5 ~ 1 : 2).
3 - For all layers a value for the entry resistance and radial resistance is required, even if not required for all of them.
4 - The entry resistance is divided in the programme by the wetted perimeter of the channel (only that part exposed to the layer considered).
5 - The wetted perimeter is calculated from the information on layer thickness in relation to the ground, water and invert levels. Include the thickness of layers for all relevant layers in the conductivity-records.
6 - The water level for a channel can be changed per node in time (see time-record).

Element-record

Record to give the node numbers per finite element in an counter clockwise direction.

column	format	name	description
1- 5	A5	TEXT	name of record - *ELEM
6-10	I5	NUMLEX()	element number
11-15	I5	KX()	node i
16-20	I5	KX()	node j
21-25	I5	KX()	node k
26-30	I5	KX()	node l (only for quadrilateral element)

Remarks

1 - Number the nodes per element always in an anti-clockwise direction (see figure 7).
2 - Triangular or quadrilateral elements can be used to subdivide the domain.
3 - The element numbers can be at random numbers, not explicitly starting from one.

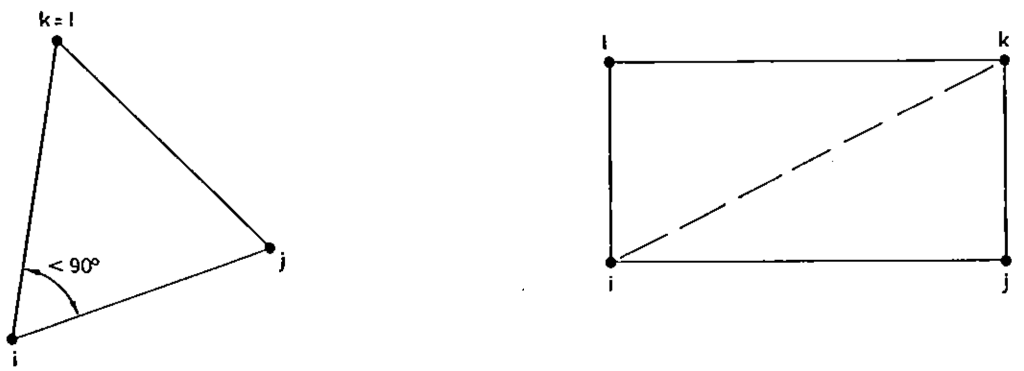

Figure 7 - Node numbering of the finite elements

4.5. Time dependent data

Time-record

Records to give time and information on data which changes in time.

Record A

column	format	name	description
1- 5	A5	TEXT	name of record - *TIME
11-20	F10.0	TDIN	day number for next input data
21-25	I5	IYIN	year for next input data

Remarks

1 - The day numbers to be used must be sequential.
2 - Time must coincide with calculation time (note in this respect the timestep).
3 - The last time-record must have a value, which is higher than the maximum calculation time (day and year) as given in the criteria-record.
4 - Day number for the first day of every month is given in paragraph 3.2.
5 - A day number given here means in the programme at the beginning of the day.

Record B

column	format	name	description
1- 5	A5	TEXT	name of record - *NONS
6-10	I5	KOD	code for type of input
11-15	I5	LY1	layer number
16-20	I5	N1	node or subregion number
21-30	F10.0	VAR	new value

Remarks

1 - Code to define the type of input :

```
    1 - Head    - LY1 = 0      all layers
                  N1  = node number
                  VAR = 0.0   cancel prescribed head
                  VAR ≠ 0.0   new prescribed head
    2 = New flux in M3/d ( internal or boundary node )
                  LY1 = 0      all layers
                  N1  = node number
                  VAR = 0.0   cancel prescribed flux
                  VAR ≠ 0.0   new prescribed flux ( in = positive )
    3 = New fixed water level in channel system of node
                  No layer number required
                  N1  = node number
                  VAR = new prescribed level
    4 - New fixed water level in surface water system of subregion
                  No layer number required
                  N1  = subregion number
                  VAR = 0.0 cancel prescribed level
                  VAR ≠ 0.0 new prescribed level ( as depth below
                            ground level, always neg. value )
    5 - New timestep ( no layer and node number )
    6 - Create plotfile with data for isolines
                  LY1 ≠ 0      layer number (one layer per time step)
                  LY1 = 0      all layers
                  VAR = 0.0    write heads
                  VAR = 1.0    write change in head from beginning
                  VAR = 2.0    write X-, Y-coord. and heads
                  VAR = 3.0    write X-, Y-coord. and change in head
                                from beginning
    7 - Results per subregion in mm
                  No layer and node number required
                  VAR = 1.0    print results and start accumulation
                  VAR = 2.0    print results only
    8 = printing output for other models
                  VAR = 1.0    start printing results ( IPRQ > 0 )
    9 = End of input for time under consideration
```

2 - For a prescribed flux or level of 0.00 use 0.01 instead because it means otherwise cancel flux or level).

3 - The maximum change of head for a node to a new prescribed value is 1.50 m.

4 - A prescribed head for a node inside the region can be for the top layer only, but not for nodes with the channel system present.

5 - A presribed flux for a node and layer can be changed from the old value direct to the new value.

6 - The maximum change in water level for a subregion to the new prescribed value is 0.50 m.

7 - Layer number, node number, and the new value must be given only when so required.

8 - Use as many records B as required, but close input always off with end of input code (KOD = 9).

4.6. Initial values for hydraulic heads

A separate file with the information on the initial heads must be compiled (see file-record and the example in Appendix A).

Groundwater depth-record

Record to give initial groundwater depth for all nodes and layers.

column	format	name	description	
1- 5	A5	TEXT	name of record - *H*	
11-20	F10.0	HST	groundwater depth	(m)

Remarks

1 - Enter only a positive value if no head-records are given.
2 - If zero groundwater depth is given, then the head-records must be present.
3 - The groundwater depth is translated to a hydraulic head per node and constant for all layers.

Head-record

Record to give per node the initial hydraulic heads for each layer.

column	format	name	description	
1- 5	A5	TEXT	name of record - *HEAD	
11-15	I5	IDUM	node number	
21-30	F10.0	PM()	head for 1st layer	(m)
31-40	F10.0	PM()	head for 2nd layer	(m)
41-50	F10.0	PM()	head for 3rd layer	(m)
51-60	F10.0	PM()	head for 4th layer	(m)
61-70	F10.0	PM()	head for 5th layer	(m)

Remarks

1 - Node numbers must be given in the same sequence as in the node-record
2 - If no heads are given the programme assumes the hydraulic heads to be zero.
3 - See paragraph 4.10 for an easy way to generate the heads per node and layer.

4.7. Description of output files

The output files created by the programme are :

Output files

file name	description	when
SIMGRO.RES	results	always
SIMGRO.ITR	iteration parameters	,,
SIMGRO.HDN	hydraulic heads at end of calculation	,,
SIMGRO.IRR	sprinkling gifts per subregion and technology	,,
SIMGRO.PL*	data for plotting isolines	time-record
SIMGRO.PRS	data for time-hydraulic head graphs	IPLT in option-record
SIMGRO.QUA	data for water quality model	IPRQ in option-record
EACT.**	evapotranspiration data for crop production model	,,
SPR.**	sprinkling quantities for crop production model	,,
SIMGRO.FLW	flows between subregions in a water bearing layer	,,

Note : The two files with results for crop production model (SIMCROP) will show the year for which the results apply as part of the file name (e.g. EACT.76).

SIMGRO.ITR
For each iteration some information is given. The node number and layer are given, where the largest difference in hydraulic head occurs. The over-relaxation value is given as well when ICON is 1. When the iteration stop criteria is reached, e.g. 0.001 m, then the maximum change in head PMAX over the timestep per layer is given. When the change is more then a specified value (default 0.40 m) a warning follows. Then the change in level over a timestep is too much and you should check the input data. Also the timestep can be too large. Next

the waterbalance per layer is given (PFLOW). Positive and negative flow values in relation to the change in storage is given as a percentage they differ. In general this is smaller than 1 %, but at the beginning of the calculation (first couple of days) this difference may be as high as 20 to 30 %.

SIMGRO.IRR

When sprinkling is applied for a technology it will be recorded in a file. Here the information of the moisture content in the root zone is given together with the start and stop criterium of sprinkling. The amount of water sprinkled is in general 25 mm per week. The total amount extracted is 5 % more than this to account for losses. The amount of sprinkling per day can vary according to the rotational time and can be reduced due to restrictions for using surface water. When the water level becomes a certain distance below target level, then the maximum extraction is limited to the supply minus the subsurface irrigation and 5 % for additional losses such as open water evaporation. This reduction factor is given also in the output file.

SIMGRO.HDN

Hydraulic heads per node and layer at end of the calculation period. This file can be used as initial heads in subsequent calculations (copy file SIMGRO.HDN to SIMGRO.HDS). Take into account that the results are for the same date within a year. Often the calculations start and stop the 1st april or the 1st october).

5. EXAMPLE

5.1. Input data

The finite element model requires a schematization into a number of layers with the same characteristics (aquifers and aquitards). Each layer is subdivided into a finite number of elements (see Report ??). For the calculations of certain actions such as groundwater extractions, sprinkling and water supply, the time period is very important. For certain actions it takes a long period to reach at a seasonal equilibrium state. Therefore the calculation period must be taken at least 2 or 3 years. In the example the calculation period is from the 1st october 1973 untill 31st december 1976.
The urban area present in the region has a percentage of impermeable surface. For these areas the infiltration is zero.
All the input data as present in the files SIMGRO.DAT and SIMGRO.NDE (geo-hydrological data) is given in Appendix A. The calculation of soil physical properties is shown in Nota 1903.

5.2. Results

The results of the programme SIMGRO is given in Appendix B. The iteration data which is written to file SIMGRO.ITR is also shown in this Appendix.
The calculation time which the programme requires depends on the geometry of the element network, the changes in hydraulic head over the timesteps and the number of nodes and layers. These are the primary factors which influence the calculation time. The calculation times given here are obtained from running the programme on a MICROVAX computer. Where the time is given in seconds CPU per node and per timestep (average 7 iterations per timestep) :

400 nodes : 0.02 - 0.04 sec CPU (per node per layer)

These figures should be seen as a rough indication and not as exact figures. The programme requires in general 4 - 8 iterations per timestep. For the calculation of one year for a network with 400 nodes, 18 technologies and a timestep of 7 days, one requires approximately 10 minutes CPU time.

5.3. Plotting of results

In figure 8 the isolines are plotted for a certain day number of the year. With these type of results one can easily verify the results with measured data.

The change in hydraulic head over the calculation period is plotted as time-hydraulic head graphs. An example is shown in figure 9. If one plots measured and calculated point values, one can check the adopted boundary conditions, such as drainage or capillary rise relations.

Nov 1988

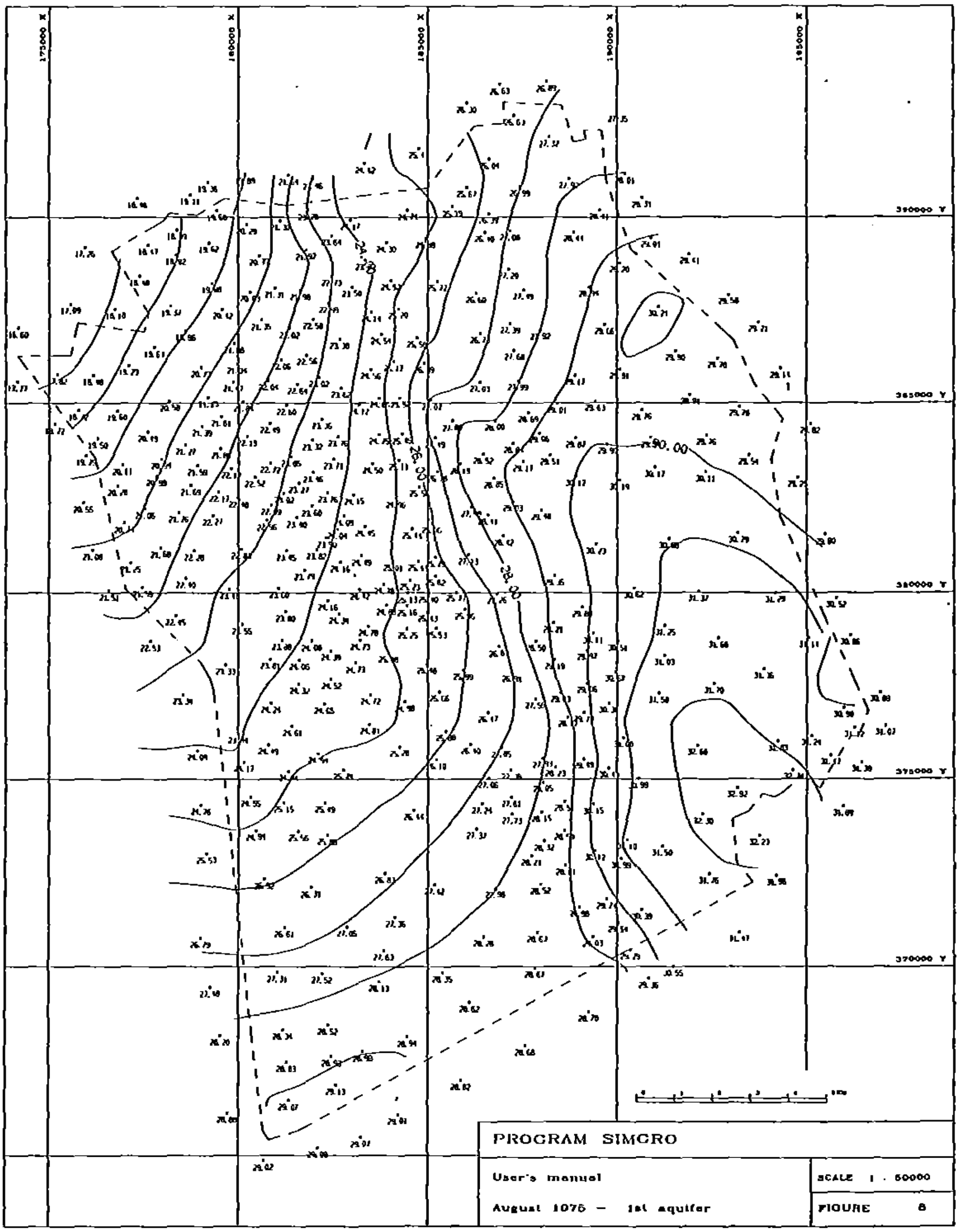

Figure 8 - Calculated isolines for day number

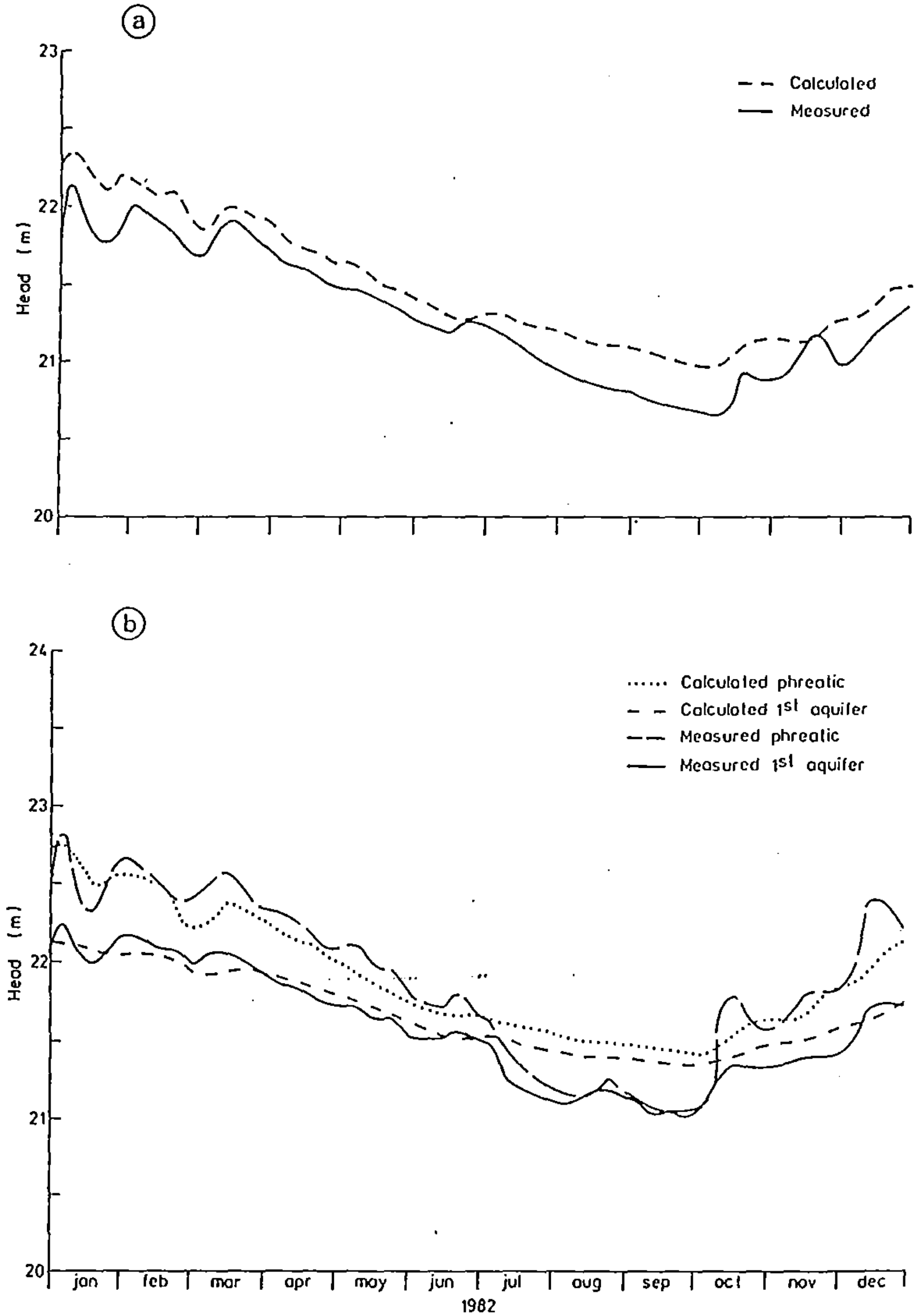

Figure 9 - Time-hydraulic head graphs for nodes 38 and 105

6. REFERENCES

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Appendix A - Input data for programme SIMGRO

File : SIMGRO.DAT

```
*HEAD      USER'S MANUAL   -  Example
*HEAD      From 1-oct-1973  till  31-dec-1976
*GNRL       404  748    4   33   10   25    6   18    2   15   16   18    0
*GNRL       271 1973  274 1974   .4       182.      .0005  .55  40.  240  1.0
*GNRL         1    2    1    2    2    5    4    1
*GNRL         1    0    1    0    0
*PLOT         3        10   16   27
*PLOT                   1    1    1
*TECH         1 GLASSH. HORT      2 SM HORT     NI     3 SM HORT     IRR
*TECH         4 LARGE HORT  NI    5 LARGE HORT IRR     6 CEREALS      NI
*TECH         7 CEREALS    IRR    8 ROW CROPS   NI     9 ROW CROPS   IRR
*TECH        10 MAIZE       NI   11 MAIZE      IRR    12 DAIRY CATT  NI
*TECH        13 DAIRY CAT. IRR   14 REAR CAT.   NI    15 REAR CAT.  IRR
*TECH        16 URBAN AREA       17 NATURE AREA       18 FOREST
*INFL          100.0     100.0     100.0     100.0     100.0     100.0
*ROOT    1       0.25 0.25 0.30 0.40 0.25 0.40
*ROOT    2       0.25 0.25 0.30 0.40 0.25 0.40
*ROOT    3       0.25 0.25 0.30 0.40 0.25 0.40
*ROOT    4       0.25 0.25 0.30 0.40 0.25 0.40
*ROOT    5       0.25 0.25 0.30 0.40 0.25 0.40
*ROOT    6       0.25 0.25 0.30 0.60 0.25 0.60
*ROOT    7       0.25 0.25 0.30 0.60 0.25 0.60
*ROOT    8       0.30 0.25 0.40 0.80 0.30 0.80
*ROOT    9       0.30 0.25 0.40 0.80 0.30 0.80
*ROOT   10       0.30 0.25 0.40 0.80 0.30 0.80
*ROOT   11       0.30 0.25 0.40 0.80 0.30 0.80
*ROOT   12       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   13       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   14       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   15       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   16       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   17       0.25 0.20 0.30 0.50 0.25 0.60
*ROOT   18       1.00 1.00 1.00 1.00 1.00 1.00
*SFAC      0.50 0.60 0.70 0.80  1.0       2.0 0.20  20.
*INDX         1    5    5    4    4    3    3    2    2    6
*INDX         6   -1   -1   -1   -1   -1   -1    0
*INTC        .0   .0   .0   .0   .0  10.  10.  10.  10.  10.
*INTC       10.   .0   .0   .0   .0   .0   .0   .0
*WLOG         0    0    0    0    0    0    0    1    1    0
*WLOG         0    0    0    0    0    0    0    0
*SPRD       0.0  0.0  7.0  0.0  7.0  0.0  7.0  0.0  7.0  0.0
*SPRD       7.0  0.0  7.0  0.0  7.0  0.0  0.0  0.0
*BEG                   90        90       150       150
*BEG        180        90        90
*END                  275       275       245       245
*END        245       275       275
*PROD       0.0  0.0  3.0  0.0  3.0  0.0  2.0  0.0  3.0  0.0
*PROD       2.0  0.0  3.0  0.0  3.0  0.0  0.0  0.0
```

*WLEV	1	0.80	0.90	1.00	1.10	1.20	
*WLEV		0.0	0.0	0.0	0.0	0.0	
*WLEV	2	0.80	0.90	1.00	1.10	1.20	
*WLEV		0.20	0.15	0.10	0.05	0.00	
*WLEV	3	0.80	0.90	1.00	1.10	1.20	
*WLEV		0.30	0.25	0.20	0.15	0.10	
*V25		134.	136.	127.	155.	122.	134.
*V25		115.	120.	117.	141.	114.	120.
*V25		98.	106.	109.	130.	107.	110.
*V25		83.	95.	103.	123.	100.	104.
*V25		73.	87.	93.	117.	93.	97.
*V25		65.	80.	86.	112.	88.	90.
*V25		61.	76.	80.	108.	84.	84.
*V25		59.	73.	76.	104.	80.	80.
*V25		57.	71.	73.	100.	76.	77.
*V25		55.	69.	70.	98.	72.	74.
*V25		54.	67.	68.	95.	69.	72.
*V50		291.	313.	222.	278.	230.	250.
*V50		274.	298.	212.	265.	224.	242.
*V50		252.	279.	201.	247.	214.	228.
*V50		221.	256.	183.	229.	200.	212.
*V50		198.	238.	159.	216.	187.	198.
*V50		182.	225.	138.	202.	174.	184.
*V50		172.	215.	125.	191.	163.	172.
*V50		166.	208.	116.	182.	153.	162.
*V50		161.	203.	109.	175.	144.	155.
*V50		156.	198.	103.	168.	137.	149.
*V50		153.	194.	98.	163.	131.	143.
*V100		582.	587.	405.	467.	400.	460.
*V100		564.	572.	397.	454.	393.	450.
*V100		542.	553.	385.	436.	384.	436.
*V100		509.	527.	366.	416.	370.	418.
*V100		470.	492.	332.	391.	352.	394.
*V100		431.	451.	287.	359.	332.	361.
*V100		396.	414.	245.	329.	309.	334.
*V100		368.	388.	211.	300.	286.	313.
*V100		351.	372.	189.	276.	264.	297.
*V100		338.	360.	173.	257.	245.	284.
*V100		328.	351.	161.	242.	230.	271.
*C25		5.0	5.0	5.0	5.0	5.0	5.0
*C25		5.0	5.0	5.0	5.0	5.0	5.0
*C25		5.0	5.0	5.0	5.0	5.0	5.0
*C25		4.27	5.0	5.0	5.0	5.0	5.0
*C25		1.38	2.21	5.0	5.0	5.0	5.0
*C25		0.64	1.03	0.41	5.0	5.0	5.0
*C25		0.35	0.53	0.10	1.07	2.80	5.0
*C25		0.20	0.30	0.10	0.36	0.57	2.30
*C25		0.15	0.18	0.10	0.17	0.24	1.30
*C25		0.11	0.12	0.10	0.10	0.12	0.78
*C25		0.10	0.10	0.10	0.10	0.10	0.51
*U25	0.0	1.00	1.00	1.00	1.00	1.00	1.00
*U25	0.2	0.06	0.05	0.03	0.07	0.02	0.04
*U25	0.4	0.10	0.20	0.05	0.07	0.04	0.06
*U25	0.6	0.16	0.25	0.12	0.09	0.06	0.08
*U25	0.8	0.17	0.25	0.17	0.15	0.09	0.20

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```
*U25   1.0      0.20      0.25      0.23      0.17      0.40      0.32
*U25   1.2      0.24      0.25      0.28      0.21      0.11      0.13
*U25   1.4      0.22      0.30      0.28      0.24      0.16      0.15
*U25   1.6      0.26      0.30      0.11      0.26      0.13      0.13
*U25   1.8      0.25      0.30      0.46      0.26      0.21      0.18
*U25   2.0      0.21      0.25      0.34      0.30      0.18      0.17
*SREG    1    3
*SREG         1    2    3
*SREG    2   13
*SREG         4    5    6    7    8    9   10   11   12   13   14   15
*SREG        16
*SREG    3   10
*SREG        17   18   19   20   21   22   23   24   25   26


*SREG   31   10
*SREG       335  336  337  338  339  340  341  342  343  344
*SREG   32   30
*SREG       345  346  347  348  349  350  351  352  353  354  355  356
*SREG       357  358  359  360  361  362  363  364  365  366  367  368
*SREG       369  370  371  372  373  374
*SREG   33   30
*SREG       375  376  377  378  379  380  381  382  383  384  385  386
*SREG       387  388  389  390  391  392  393  394  395  396  397  398
*SREG       399  400  401  402  403  404
*AREA    1  0.0  4.4  4.8  1.8  0.0  0.7  0.0  4.4  0.0 42.2
            1.8 12.5 10.0  2.6  0.0 14.8  0.0  0.0
*AREA    2  0.1  0.2  2.3  0.2  0.7  0.7  0.0  1.0  1.0 15.0
            1.5 40.0 20.9 15.3  0.0  0.0  0.0  1.1
*AREA    3  0.3  2.0  1.1  0.3  0.3  0.3  0.0  0.8  0.0 15.4
            0.5 31.0  7.1 12.8  0.0 26.8  0.0  1.3


*AREA   31  0.5  5.9  0.9  1.3  0.0  3.3  0.0  3.1  0.7 18.6
            0.3 25.1  4.7 12.8  0.0  0.0  0.0 22.8
*AREA   32   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
*AREA        0.   0.   0.   0.   0.   0.   0.   0.
*AREA   33   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
*AREA        0.   0.   0.   0.   0.   0.   0.   0.
*DRES    1                           500.      1.20
*DRES    2                           165.      1.45
*DRES    3                            50.      1.94
*DRES    4                           500.      1.20


*DRES   31                           165.      1.45
*DRES   32                          2000.      1.00
*DRES   33                          2000.      1.00
*MSUB    1    4 1.10    2 1.40        0.      350.     1400.       70.     2
*MSUB    2    5 1.10    2 1.40     8800.     1310.     8195.       35.     2
*MSUB    3    1 1.10    2 1.40     5000.      415.     2275.       30.     2
*MSUB    4    3 1.10    2 1.50      860.        0.     1600.       80.     2


*MSUB   31    3 1.10    2 1.40    12500.      850.     3380.       55.     2
```

```
*MSUB   32     3 1.10     2 1.40         0.         0.         0.         0.    2
*MSUB   33     3 1.10     2 1.40         0.         0.         0.         0.    2
*DISH    1          0.50       105.       1.20
*DISH               0.00       105.       0.11
*DISH              -0.50        45.       0.05
*DISH              -1.00        16.       0.02
*DISH              -1.10        13.       0.01
*DISH              -1.40         8.        .0
*DISH              -1.50         6.        .0
*DISH              -2.00         .5        .0
*DISH              -2.50         .3        .0
*DISH              -3.00        0.0        .0
*DISH    2          0.50       250.       3.50
*DISH               0.00       245.       0.32
*DISH              -0.50        80.       0.18
*DISH              -1.00        30.       0.05
*DISH              -1.10        25.       0.03
*DISH              -1.40        10.        .0
*DISH              -1.50         6.        .0
*DISH              -2.00         .5        .0
*DISH              -2.50         .3        .0
*DISH              -3.00        0.0        .0

*DISH   33          0.50         0.        0.0
*DISH               0.00         0.        0.0
*DISH              -0.50         0.        0.0
*DISH              -1.00         0.        0.0
*DISH              -1.10         0.        0.0
*DISH              -1.40         0.         .0
*DISH              -1.50         0.         .0
*DISH              -2.00         0.         .0
*DISH              -2.50         0.         .0
*DISH              -3.00        0.0         .0
*TIME          271.0 1973
*NONS    2     2   75     -9630.
*NONS    2     4  203     -5900.
*NONS    2     2  345      -550.
*NONS    2     2  346      -550.

*NONS    2     4  375       -10.
*NONS    2     4  376       -10.
*NONS    2     4  379       -10.
*NONS    9
*TIME          271.4 1973
*NONS    5                  0.6
*NONS    9
*TIME          272.0 1973
*NONS    5                  1.0
*NONS    9
*TIME          273.0 1973
*NONS    5                  2.0
*NONS    9
*TIME          277.0 1973
```

```
*NONS     5               3.0
*NONS     9
*TIME          364.0 1973
*NONS     5               2.0
*NONS     9
*TIME            1.0 1974
*NONS     5               3.0
*NONS     8               1.0      !!  START PRINTING FOR SIMCROP
*NONS     9
*TIME            91. 1974
*NONS     2    2  351  -6200.
*NONS     2    2  356    550.

*NONS     2    2  396   -300.
*NONS     7                1.
*NONS     9
*TIME          271. 1974
*NONS     2    2  351  -7000.
*NONS     2    2  356   1000.

*NONS     2    2  396   -450.
*NONS     7                1.
*NONS     9
*TIME          364.0 1974
*NONS     5               2.0
*NONS     9
*TIME            1.0 1975
*NONS     5               3.0
*NONS     9
*TIME            91. 1975
*NONS     2    2  351  -6200.
*NONS     2    2  356    550.

*NONS     2    2  396   -300.
*NONS     7                1.
*NONS     9
*TIME          228. 1975
*NONS     6    2          0.0       !  save results for plot
*NONS     9
*TIME          271. 1975
*NONS     7                1.
*NONS     2    2  351  -7000.
*NONS     2    2  356   1000.

*NONS     2    2  396   -450.
*NONS     9
*TIME          364.0 1975
*NONS     5               2.0
*NONS     9
*TIME            1.0 1976
*NONS     5               3.0
```

```
*NONS     9
*TIME              91. 1976
*NONS     2     2   351     -6200.
*NONS     2     2   356       550.

*NONS     2     2   396      -300.
*NONS     7                     1.
*NONS     9
*TIME             273. 1976
*NONS     7                     1.
*NONS     2     2   351     -7000.
*NONS     2     2   356      1000.

*NONS     2     2   396      -450.
*NONS     9
*TIME            364.0 1976
*NONS     5                    2.0
*NONS     9
*TIME              1.0 1977
*NONS     5                    3.0
*NONS     9
```

File : SIMGRO.NDE

```
*NODE    1                18.80    178372.    389659.
*NODE    2                22.20    179438.    390180.
*NODE    3                21.70    179226.    389316.
*NODE    4                18.70    177620.    389254.
*NODE    5                18.40    178352.    388980.
*NODE    6                20.10    179299.    388230.
*NODE    7                21.20    180213.    389814.
*NODE    8                22.70    181096.    389914.
*NODE    9                21.80    180559.    388981.
*NODE   10                22.90    181780.    389119.
*NODE   11                22.80    181632.    388043.

*NODE  401      11111     27.50    184765.    391841.
*NODE  402      11111     26.50    183332.    391445.
*NODE  403      11111     24.50    181949.    391027.
*NODE  404      11111     24.00    181320.    391143.
*DRNG    1      16.80     17.80
*DRNG    2      20.20     21.20
*DRNG    3      19.70     20.70
*DRNG    4      16.70     17.70
*DRNG    5      16.40     17.40

*DRNG  401      25.50     26.50
*DRNG  402      24.50     25.50
*DRNG  403      22.50     23.50
*DRNG  404      22.00     23.00
```

```
*CDCT    1                25.     500.
         2                25.     500.
         3                25.     500.
         4                25.     500.
         5                25.     500.

       401                 5.     200.
       402                 5.     200.
       403                 5.     200.
*CDCT  404                 5.     200.
*CDCT    1    3500.       50.              .0006
         2    2500.       50.              .0006
         3    3500.       50.              .0006
         4    3500.       50.              .0006
         5    3500.       50.              .0006

       401    1000.       25.              .0006
       402    1000.       45.              .0006
       403    1500.       45.              .0006
*CDCT  404      10.       45.              .0006
*CDCT    1               110.   30000.     .0006
         2               110.   30000.     .0006
         3               110.   30000.     .0006
         4               110.   30000.     .0006
         5               110.   30000.     .0006

       401               110.   99999.     .0006
       402               110.   99999.     .0006
       403               110.   99999.     .0006
*CDCT  404               110.   99999.     .0006
*CDCT    1    5500.      160.              .0006
         2    5500.      160.              .0006
         3    5500.      160.              .0006
         4    5500.      160.              .0006
         5    5500.      160.              .0006

       401       9.      160.              .0006
       402       9.      160.              .0006
       403       9.      160.              .0006
*CDCT  404       9.      160.              .0006
*CHAN   12               26.5   5.    5.    5.    5.
*CHAN    4 1 0 0 0 0  5.0      500.    15.70    16.70   5.   5.   5.   5.
*CHAN    5 1 0 0 0 0  5.0      500.    15.40    16.40   5.   5.   5.   5.
*CHAN    6 1 0 0 0 0  5.0      500.    17.10    18.40   5.   5.   5.   5.
*CHAN    7 1 0 0 0 0  5.0      500.    18.20    19.20   5.   5.   5.   5.
*CHAN    8 1 0 0 0 0  5.0      500.    19.70    20.70   5.   5.   5.   5.
*CHAN    9 1 0 0 0 0  5.0      500.    18.80    19.80   5.   5.   5.   5.
*CHAN   10 1 0 0 0 0  5.0      500.    19.90    20.90   5.   5.   5.   5.
*CHAN   11 1 0 0 0 0  5.0      500.    19.80    20.80   5.   5.   5.   5.
*CHAN   12 1 0 0 0 0  5.0      500.    20.40    21.40   5.   5.   5.   5.
*CHAN   13 1 0 0 0 0  5.0      500.    21.10    22.10   5.   5.   5.   5.
*CHAN   14 1 0 0 0 0  5.0      500.    21.50    22.50   5.   5.   5.   5.
*CHAN   15 1 0 0 0 0  5.0      500.    21.50    22.50   5.   5.   5.   5.
*ELEM    1    1    2  347
*ELEM    2    1  347  348
```

*ELEM	3	1	348	4
*ELEM	4	1	4	5
*ELEM	5	1	5	3
*ELEM	6	1	3	2
*ELEM	7	2	3	7
*ELEM	8	2	7	345
*ELEM	744	344	380	379
*ELEM	745	349	351	350
*ELEM	746	374	376	375
*ELEM	747	375	376	377
*ELEM	748	379	380	381

File : SIMGRO.CON

10									
1	2	347	348	4	5	3	0	0	0
2	1	347	3	7	345	346	0	0	0
3	1	5	2	7	6	9	0	0	0
4	1	348	5	349	27	0	0	0	0
5	1	4	3	6	27	30	0	0	0
6	3	5	9	30	41	42	0	0	0
7	2	3	345	9	8	0	0	0	0
8	7	9	345	10	221	404	0	0	0
173	166	194	169	174	193	195	178	180	176
401	224	230	402	225	235	400	0	0	0
402	223	224	403	401	0	0	0	0	0
403	221	223	404	402	0	0	0	0	0
404	8	221	345	403	0	0	0	0	0

File : SIMGRO.HDS

H	0.00				
*HEAD	1	18.235	18.766	20.097	21.111
*HEAD	2	19.694	19.503	20.598	21.260
*HEAD	3	19.497	19.436	20.541	21.249
*HEAD	4	17.888	18.359	19.797	20.958
*HEAD	5	17.836	18.800	20.097	21.102
*HEAD	401	26.935	25.189	26.698	26.521
*HEAD	402	25.860	23.742	25.412	25.039
*HEAD	403	23.942	22.360	23.231	22.581
*HEAD	404	23.529	21.553	22.452	21.419

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File : SIMGRO.EVP

271	1973	3.90	1.49	2.97	2.29	1.00		
272	1973	6.00	0.79	2.36	1.61	1.00		
273	1973	8.20	0.61	2.09	1.32	1.00	! De Bilt	rainfall
274	1973	0.10	1.97	1.15	1.31	1.00		E grass
275	1973	0.00	2.03	1.03	1.24	1.00		E pine
276	1973	0.00	0.85	0.56	0.55	0.54		E decid
277	1973	0.00	1.77	0.95	0.93	0.42		F b. soil
278	1973	0.10	1.81	0.94	0.91	0.40		
279	1973	0.00	1.77	0.89	0.83	0.33		
280	1973	0.40	0.24	0.45	0.39	1.00		
281	1973	0.00	0.46	0.45	0.37	0.32		
282	1973	3.70	0.38	1.69	1.09	1.00		
283	1973	8.70	0.71	1.67	1.16	1.00		
284	1973	4.30	1.05	1.78	1.33	1.00		
285	1973	0.10	1.46	0.74	0.98	1.00		
286	1973	0.00	1.07	0.76	0.87	1.00		
287	1973	0.10	0.63	0.47	0.53	1.00		
288	1973	0.90	0.68	1.19	1.01	1.00		
289	1973	14.50	0.18	0.56	0.43	1.00		
290	1973	7.80	0.77	1.66	1.05	1.00		
291	1973	11.60	0.72	1.79	1.09	1.00		
292	1973	25.40	0.16	1.54	0.68	1.00		
293	1973	10.60	0.69	1.71	1.00	1.00		
294	1973	2.90	0.46	1.79	0.92	1.00		
295	1973	3.00	0.74	1.69	0.98	1.00		
296	1973	2.40	0.85	1.84	1.10	1.00		
297	1973	0.10	0.97	0.50	0.73	1.00		
298	1973	0.10	0.91	0.42	0.66	1.00		
299	1973	0.00	1.07	0.48	0.78	1.00		
300	1973	0.00	1.14	0.96	1.06	1.00		
301	1973	0.00	0.64	0.21	0.30	0.57		
302	1973	0.00	0.97	0.46	0.45	0.45		
303	1973	0.00	0.34	0.16	0.15	0.42		
304	1973	0.00	0.38	0.36	0.24	0.41		
305	1973	0.00	0.68	0.60	0.41	0.39		

File : SIMGRO.FAC

```
         1  -  mais
         2  -  gras
         3  -  gras
         4  -  gras
         5  -     not used
         6  -     not used
  91-0.01 1.00 1.00 1.00-0.01-0.01      !  first decade
  92-0.01 1.00 1.00 1.00-0.01-0.01      !  91 = day number
  93-0.01 1.00 1.00 1.00-0.01-0.01
  94-0.01 1.00 1.00 1.00-0.01-0.01
  95-0.01 1.00 1.00 1.00-0.01-0.01
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 96-0.01 1.00 1.00 1.00-0.01-0.01
 97-0.01 1.00 1.00 1.00-0.01-0.01
 98-0.01 1.00 1.00 1.00-0.01-0.01
 99-0.01 1.00 1.00 1.00-0.01-0.01
100-0.01 1.00 1.00 1.00-0.01-0.01
101-0.01 1.00 1.00 1.00-0.01-0.01        !  second decade
102-0.01 1.00 1.00 1.00-0.01-0.01
103-0.01 1.00 1.00 1.00-0.01-0.01


264 1.20 0.90 0.90 0.90-0.01-0.01
265 1.20 0.90 0.90 0.90-0.01-0.01
266 1.20 0.90 0.90 0.90-0.01-0.01
267 1.20 0.90 0.90 0.90-0.01-0.01
268 1.20 0.90 0.90 0.90-0.01-0.01
269 1.20 0.90 0.90 0.90-0.01-0.01
270 1.20 0.90 0.90 0.90-0.01-0.01
271 1.20 0.90 0.90 0.90-0.01-0.01
272 1.20 0.90 0.90 0.90-0.01-0.01
273 1.20 0.90 0.90 0.90-0.01-0.01
274 1.20 0.90 0.90 0.90-0.01-0.01
275 1.20 0.90 0.90 0.90-0.01-0.01
276 1.20 0.90 0.90 0.90-0.01-0.01
277 1.20 0.90 0.90 0.90-0.01-0.01
278 1.20 0.90 0.90 0.90-0.01-0.01
279 1.20 0.90 0.90 0.90-0.01-0.01
```

DATE : 4-NOV-88

PROGRAM SIMGRO

(VERSION : 1.3-88)

FINITE ELEMENT MODEL FOR UNSTEADY QUASI 3-DIM. GROUNDWATERFLOW

PROGRAM DEVELOPED BY :

THE INSTITUTE FOR LAND AND WATER MANAGEMENT RESEARCH
WAGENINGEN, THE NETHERLANDS

USER'S MANUAL - Example

From 1-oct-1973 till 31-dec-1976

NODAL POINTS	-	404	NO
ELEMENTS	-	748	NO
LAYERS	-	4	NO
SUBREGIONS	-	33	NO
TECHNOLOGIES	-	18	NO
NODES SKIPPED WHILE PRINTING RESULTS	-	10	NO
MAXIMUM ITERATIONS PER TIMESTEP	-	25	NO
DAY NUMBER TO START CALCULATIONS	-	271	
YEAR TO START CALCULATIONS	-	1973	
DAY NUMBER TO STOP CALCULATIONS	-	280	
YEAR TO STOP CALCULATIONS	-	1974	
DAY NUMBER TO STOP WATER LEVEL CONTROL	-	245	
INITIAL TIME INTERVAL	-	0.4	DAY
TIMESTEP FOR SURFACE WATER SYSTEM	-	1.0	DAY
TIME INTERVAL BETWEEN OUTPUT RESULTS	-	182.	DAY
WEIGHTING PARAMETER TETA (0.0 - 1.0)	-	0.55	
MAX. ALLOWABLE CHANGE IN H PER ITERATION	-	0.0005	M

OVERRELAXATION FACTOR CONSTANT FOR ALL NODES

OPTION PARAMETERS :

ICON = 1	IRES = 2
IPLR = 2	IANS = 5
IPRI = 1	ISURF = 4
IPRQ = 2	ISEC = 1

C - LAYERS   LAYER NO

1
3

SPRINKLING CRITERIA (V/V100) :
PRODUCTION LEVEL 0 = 0.50
PRODUCTION LEVEL 1 = 0.60
PRODUCTION LEVEL 2 = 0.70
PRODUCTION LEVEL 3 = 0.80

TIMESTEP READING EVAPOTRANSPIRATION DATA = 1.00 DAYS

DESCRIPTION OF TECHNOLOGY NUMBERS

1 -	GLASSH. HORT	2 -	SM HORT NI	3 -	SM HORT IRR
4 -	LARGE HORT NI	5 -	LARGE HORT IRR	6 -	CEREALS NI
7 -	CEREALS IRR	8 -	ROW CROPS NI	9 -	ROW CROPS IRR
10 -	MAIZE NI	11 -	MAIZE IRR	12 -	DAIRY CATT NI
13 -	DAIRY CAT. IRR	14 -	REAR CAT. NI	15 -	REAR CAT. IRR
16 -	URBAN AREA	17 -	NATURE AREA	18 -	FOREST

INFILTRATION CAPACITY OF SOIL (EXCESS RAINFALL IS SURFACE RUNOFF)

SOIL TYPE	INFIL. CAP (MM/D)
1	100.0
2	100.0
3	100.0
4	100.0
5	100.0
6	100.0

SOIL TYPE DEPENDABLE RELATIONS (FOR ROOT ZONE OF 0.25 m)

SOIL TYPE	GROUNDWATER DEPTH IN METERS 0.0	.20	.40	.60	.80	1.00	1.20	1.40	1.60	1.80	2.00
V-eq in mm											
1	134.	115.	98.	83.	73.	65.	61.	59.	57.	55.	54.
2	136.	120.	106.	95.	87.	80.	76.	73.	71.	69.	67.
3	127.	117.	109.	103.	93.	86.	80.	76.	73.	70.	68.
4	155.	141.	130.	123.	117.	112.	108.	104.	100.	98.	95.
5	122.	114.	107.	100.	93.	88.	84.	80.	76.	72.	69.
6	134.	120.	110.	104.	97.	90.	84.	80.	77.	74.	72.
capillary rise in mm/day											
1	5.00	5.00	5.00	4.27	1.38	0.64	0.35	0.20	0.15	0.11	0.10
2	5.00	5.00	5.00	5.00	2.21	1.03	0.53	0.30	0.18	0.12	0.10
3	5.00	5.00	5.00	5.00	5.00	0.41	0.10	0.10	0.10	0.10	0.10
4	5.00	5.00	5.00	5.00	5.00	5.00	1.07	0.36	0.17	0.10	0.10
5	5.00	5.00	5.00	5.00	5.00	5.00	2.80	0.57	0.24	0.12	0.10
6	5.00	5.00	5.00	5.00	5.00	5.00	5.00	2.30	1.30	0.78	0.51
storage coefficient											
1	1.000	0.060	0.100	0.160	0.170	0.200	0.240	0.220	0.260	0.250	0.210
2	1.000	0.050	0.200	0.250	0.250	0.250	0.250	0.300	0.300	0.300	0.250
3	1.000	0.030	0.050	0.120	0.170	0.230	0.280	0.280	0.110	0.460	0.340
4	1.000	0.070	0.070	0.090	0.150	0.170	0.210	0.240	0.260	0.260	0.300
5	1.000	0.020	0.040	0.060	0.090	0.400	0.110	0.160	0.130	0.210	0.180
6	1.000	0.040	0.060	0.080	0.200	0.320	0.130	0.150	0.130	0.180	0.170

MAXIMUM SURFACE WATER SUPPLY CAPACITY = 2.00 M**3/S

WATER LEVEL CONTROL IN SUMMER PERIOD (TARGET LEVEL DEPENDENT ON GROUNDWATER DEPTH)

CODE							
1	GROUNDWATER DEPTH SMALLER AS (m)	:	0.80	0.90	1.00	1.10	1.20
	LOWERING OF TARGET LEVEL (m)	:	0.00	0.00	0.00	0.00	0.00
2	GROUNDWATER DEPTH SMALLER AS (m)	:	0.80	0.90	1.00	1.10	1.20
	LOWERING OF TARGET LEVEL (m)	:	0.20	0.15	0.10	0.05	0.00
3	GROUNDWATER DEPTH SMALLER AS (m)	:	0.80	0.90	1.00	1.10	1.20
	LOWERING OF TARGET LEVEL (m)	:	0.30	0.25	0.20	0.15	0.10

INPUT DATA PER NODE OR SUBREGION

TOTAL AREA = 415590208.0 M**2

PER SUBREGION THE AREA, AVERAGE GROUND LEVEL, GROUNDWATER DEPTH AND DRAINAGE RESISTANCE

SUBR NO	AREA (ha) TOTAL	AGRIC.	AV. GL (m)	GROUNDW DEPTH	COEFFICIENTS FOR EQUATION(15) a	b
1	255.58	217.76	20.89	1.75	500.0	1.20
2	1038.07	1026.65	21.85	1.18	165.0	1.45
3	967.01	695.28	20.22	0.69	50.0	1.94
4	1261.51	485.68	21.27	1.30	500.0	1.20
5	1628.18	525.90	25.03	1.52	1000.0	1.20
6	350.09	329.09	23.89	1.16	325.0	1.20
7	1158.31	670.66	26.14	1.73	325.0	1.45
8	350.77	320.60	22.95	1.03	165.0	1.45
30	1351.34	1052.69	32.74	1.50	325.0	1.20
31	1484.50	1146.03	32.32	1.30	165.0	1.45

PER TECHNOLOGY THE PERCENTAGE OF THE SUBREGION AREA

SUBR	TECHNOLOGY																	
NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.0	4.4	4.8	1.8	0.0	0.7	0.0	4.4	0.0	42.2	1.8	12.5	10.0	2.6	0.0	14.8	0.0	0.0
2	0.1	0.2	2.3	0.2	0.7	0.7	0.0	1.0	1.0	15.0	1.5	40.0	20.9	15.3	0.0	0.0	0.0	1.1
3	0.3	2.0	1.1	0.3	0.3	0.3	0.0	0.8	0.0	15.4	0.5	31.0	7.1	12.8	0.0	26.8	0.0	1.3
4	0.3	0.0	0.1	0.7	0.0	0.2	0.0	0.3	0.0	17.4	0.2	12.2	3.2	3.9	0.0	5.3	0.0	56.2
29	1.2	7.3	2.8	0.0	0.0	6.3	0.0	2.2	0.2	17.5	0.4	4.3	6.3	4.7	0.0	38.7	8.1	0.0
30	0.7	7.9	4.0	0.6	0.0	3.1	0.0	2.2	1.6	21.1	0.4	18.2	7.2	10.9	0.0	3.0	0.0	19.1
31	0.5	5.9	0.9	1.3	0.0	3.3	0.0	3.1	0.7	18.6	0.3	25.1	4.7	12.8	0.0	0.0	0.0	22.8

SUBR NO	SOIL TYPE	WATER LEVEL MANAGEMENT SUMMER WATER L	CODE	WINTER WEIR L	MAXIMUM CAPACITY SUPPLY S M**3/D	IRR SURF M**3/D	IRR GR M**3/D	% ALLW. GRW	EXTRACT. LAYER
1	4	1.10	2	1.40	0.	350.	1400.	70.	2
2	5	1.10	2	1.40	8800.	1310.	8195.	35.	2
3	1	1.10	2	1.40	5000.	415.	2275.	30.	2
4	3	1.10	2	1.50	860.	0.	1600.	80.	2
28	3	1.10	2	1.50	18280.	11650.	22320.	50.	2
29	4	1.10	2	1.40	6500.	380.	1630.	75.	2
30	3	1.10	2	1.40	8400.	850.	3980.	60.	2
31	3	1.10	2	1.40	12500.	850.	3380.	55.	2

```
** WARNING *IWN7*  DAY NUMBER 298  NODE  225  WATER LEVEL BECOMES MORE THAN 5 CM ABOVE GROUND LEVEL !
** WARNING *IWN7*  DAY NUMBER 343  NODE  225  WATER LEVEL BECOMES MORE THAN 5 CM ABOVE GROUND LEVEL !
** WARNING *IWN7*  DAY NUMBER 349  NODE  225  WATER LEVEL BECOMES MORE THAN 5 CM ABOVE GROUND LEVEL !
** WARNING *IWN7*  DAY NUMBER 352  NODE  225  WATER LEVEL BECOMES MORE THAN 5 CM ABOVE GROUND LEVEL !
```

RESULTS FOR DAY = 88 YEAR = 1974

TIMESTEP = 3.00 DAY

NUMBER OF ITERATIONS = 5

RESULTS PER SUBREGION AND LAYER (M , 1000 M**3/DAY AND 1000 M**3)

FLOWS : TO SUBREGION = POS.
FROM SUBREGION = NEG.

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	TOTAL	LEAKAGE /DAY	TOTAL	DIS/RECHARGE /DAY	TOTAL	STORAGE LOSS /DAY	TOTAL	LATERAL FLOW /DAY	TOTAL
1	1	19.74	-1.93	-364.8	-0.84	-234.9	0.00	0.0	8.27	-153.8	0.00	0.0
	2	19.60			0.97	261.1	0.00	0.0	0.21	-27.8	-1.39	-234.1
	3	20.40			0.00	-1.5	0.00	0.0	0.00	1.6	0.00	0.0
	4	21.18			-0.13	-24.7	0.00	0.0	0.03	5.4	0.10	19.2
2	1	20.92	-14.22	-3224.4	6.23	606.7	0.00	0.0	20.63	-255.3	0.00	0.0
	2	21.21			-6.09	-577.4	0.00	0.0	1.18	-89.5	4.50	667.0
	3	21.41			-0.06	-14.5	0.00	0.0	0.06	14.9	0.00	0.0
	4	21.52			-0.08	-14.7	0.00	0.0	0.12	24.8	-0.05	-10.1
3	1	19.41	-40.24	-8264.8	34.60	5616.3	0.00	0.0	21.81	116.6	0.00	0.0
	2	20.10			-24.89	-3896.1	0.00	0.0	1.22	-7.0	22.50	3901.9
	3	20.85			-0.26	-2.6	0.00	0.0	0.19	3.1	0.00	0.0
	4	21.59			-9.45	-1717.6	0.00	0.0	0.08	29.4	9.36	1688.9
4	1	20.35	-9.99	-1745.1	-1.49	-627.5	0.00	0.0	40.01	-477.8	0.00	0.0
	2	20.30			4.97	1248.4	0.00	0.0	1.17	-91.0	-7.07	-1160.6
	3	20.81			-0.13	22.9	0.00	0.0	0.10	-22.3	0.00	0.0
	4	21.28			-3.35	-643.8	0.00	0.0	0.14	34.6	3.21	609.8
5	1	23.92	-4.20	-868.3	-10.67	-2343.2	0.00	0.0	26.76	-659.6	0.00	0.0
	2	23.61			9.96	2216.7	0.00	0.0	1.25	-134.5	-11.87	-2082.4
	3	22.95			-0.04	-7.7	0.00	0.0	0.03	8.2	0.00	0.0
	4	22.25			0.75	134.3	0.00	0.0	0.16	57.4	-0.92	-191.5
6	1	23.04	-4.57	-876.8	0.71	-9.5	0.00	0.0	11.54	-105.0	0.00	0.0
	2	23.14			-0.78	-2.1	0.00	0.0	0.31	-21.1	0.20	22.8
	3	22.86			-0.02	-3.3	0.00	0.0	0.02	3.4	0.00	0.0
	4	22.51			0.08	14.9	0.00	0.0	0.04	13.4	-0.12	-28.1
7	1	24.76	-2.32	-663.4	-11.04	-2437.0	0.00	0.0	15.84	-393.1	0.00	0.0
	2	24.31			9.00	2034.9	-9.63	-1752.7	1.09	-40.8	-0.79	-237.6
	3	23.78			-0.24	-3.6	0.00	0.0	0.21	4.9	0.00	0.0
	4	23.22			2.27	405.7	0.00	0.0	0.10	34.5	-2.38	-439.4

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	TOTAL	LEAKAGE /DAY	TOTAL	DIS/RECHARGE /DAY	TOTAL	STORAGE LOSS /DAY	TOTAL	LATERAL FLOW /DAY	TOTAL
28	1	30.92	-36.09	-8010.6	3.45	175.3	0.00	0.0	75.65	-671.9	0.00	0.0
	2	31.04			-3.43	-176.5	0.00	0.0	1.26	-42.4	1.42	214.9
	3	31.08			-0.01	5.1	0.00	0.0	0.00	-4.9	0.00	0.0
	4	31.11			-0.02	-3.9	0.00	0.0	0.02	3.3	0.00	0.5
29	1	30.97	-0.99	-231.9	-5.66	-1133.4	0.00	0.0	7.66	-339.3	0.00	0.0
	2	30.51			5.55	1113.6	0.00	0.0	0.29	-23.7	-5.81	-1095.5
	3	29.60			0.03	6.6	0.00	0.0	-0.03	-6.5	0.00	0.0
	4	28.97			0.07	13.2	0.00	0.0	0.01	2.2	-0.09	-15.4
30	1	31.71	-9.74	-1886.2	-2.18	-1288.9	0.00	0.0	40.53	-628.4	0.00	0.0
	2	31.69			2.07	1266.2	0.00	0.0	0.91	-40.0	-6.60	-1236.2
	3	31.29			0.04	10.6	0.00	0.0	-0.05	-10.4	0.00	0.0
	4	31.04			0.07	12.2	0.00	0.0	-0.01	-1.6	-0.06	-10.6
31	1	31.36	-19.35	-3684.1	4.17	129.3	0.00	0.0	49.28	-503.4	0.00	0.0
	2	31.42			-4.27	-150.5	0.00	0.0	0.74	-29.2	1.26	171.5
	3	31.09			0.02	7.0	0.00	0.0	-0.02	-6.9	0.00	0.0
	4	30.82			0.08	14.2	0.00	0.0	0.00	0.7	-0.08	-14.8
32	1	24.99	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	2	24.53			0.00	0.0	-14.49	-2637.2	0.72	-298.3	13.42	2936.3
	3	23.88			0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	4	23.76			0.00	0.0	-4.17	-758.9	0.99	170.4	3.18	586.8
33	1	29.92	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	2	29.49			0.00	0.0	-4.53	-825.4	0.51	-142.3	3.80	966.1
	3	29.84			0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	4	29.67			0.00	0.0	-0.03	-5.5	0.08	12.7	-0.05	-7.3
ALL	1		-374.67	-77131.9	33.09	-8647.4	0.00	0.0	938.28	-11779.2	0.00	0.0
	2				-36.43	7703.1	-28.65	-5215.2	36.54	-2608.2	0.00	0.0
	3				-1.61	283.3	0.00	0.0	1.14	-271.0	0.00	0.0
	4				4.95	661.0	-10.10	-1838.2	5.14	1183.2	0.00	0.0

UNSATURATED ZONE (1000 M**3/DAY AND 1000 M**3)

SUBR NO	CAPILLARY RISE /DAY	CAPILLARY RISE TOTAL	IRR. SURF. /DAY	IRR. SURF. TOTAL	IRR. GR. W. /DAY	IRR. GR. W. TOTAL	EVAPOTRANSPIRATION /DAY	EVAPOTRANSPIRATION TOTAL	RAINFALL /DAY	RAINFALL TOTAL	MOISTURE CONT.
1	5.29	-752.4	0.00	0.0	0.00	0.0	-2.26	-228.9	0.00	971.6	580.5
2	11.00	-3098.1	0.00	0.0	0.00	0.0	-14.42	-1052.5	0.00	4194.4	1007.4
3	14.85	-2537.3	0.00	0.0	0.00	0.0	-11.77	-872.0	0.00	3488.4	743.5
4	27.54	-2847.5	0.00	0.0	0.00	0.0	-13.35	-1798.2	0.00	4989.2	2915.1
5	11.28	-3869.4	0.00	0.0	0.00	0.0	-16.10	-1630.8	0.00	5402.5	1942.1
6	7.39	-991.0	0.00	0.0	0.00	0.0	-4.40	-351.6	0.00	1397.6	426.8
7	2.17	-3491.2	0.00	0.0	0.00	0.0	-12.12	-1398.6	0.00	4506.2	1468.8
8	4.36	-1010.0	0.00	0.0	0.00	0.0	-5.01	-376.5	0.00	1417.3	376.8
9	10.96	-4500.8	0.00	0.0	0.00	0.0	-16.16	-1722.2	0.00	6108.6	2037.0
10	1.96	-199.7	0.00	0.0	0.00	0.0	-1.30	-137.6	0.00	390.3	236.9
11	6.79	-1373.2	0.00	0.0	0.00	0.0	-5.86	-474.7	0.00	1873.7	528.4
12	9.81	-2267.5	0.00	0.0	0.00	0.0	-9.61	-1046.5	0.00	3255.6	1311.5
13	10.95	-2780.4	0.00	0.0	0.00	0.0	-12.01	-942.0	0.00	3733.1	948.7
14	0.42	-2302.0	0.00	0.0	0.00	0.0	-7.38	-735.5	0.00	2805.8	646.8
15	19.57	-2952.2	0.00	0.0	0.00	0.0	-14.54	-1040.5	0.00	4049.8	1116.0
16	68.92	-2507.0	0.00	0.0	0.00	0.0	-18.52	-1963.1	0.00	5570.0	4596.8
17	19.73	-2162.0	0.00	0.0	0.00	0.0	-8.22	-885.9	0.00	3025.5	1957.9
18	38.07	-11713.0	0.00	0.0	0.00	0.0	-50.47	-3891.8	0.00	15794.2	3790.3
19	6.02	-3392.3	0.00	0.0	0.00	0.0	-9.02	-916.4	0.00	3809.1	1821.4
20	15.81	-1456.3	0.00	0.0	0.00	0.0	-5.84	-480.7	0.00	1979.1	1233.8
21	11.66	-3203.0	0.00	0.0	0.00	0.0	-14.28	-1094.2	0.00	4365.4	1094.4
22	4.11	-551.4	0.00	0.0	0.00	0.0	-2.22	-237.6	0.00	806.7	318.8
23	8.28	-4163.4	0.00	0.0	0.00	0.0	-16.47	-1412.3	0.00	5514.3	1482.8
24	6.06	-7921.2	0.00	0.0	0.00	0.0	-28.42	-2711.5	0.00	10395.8	2856.2
25	12.05	-2181.4	0.00	0.0	0.00	0.0	-8.26	-752.9	0.00	3000.6	909.7
26	9.65	-1865.7	0.00	0.0	0.00	0.0	-8.42	-648.9	0.00	2525.6	690.5
27	121.82	-3689.5	0.00	0.0	0.00	0.0	-29.69	-4032.4	0.00	10202.4	11190.9
28	42.25	-8510.7	0.00	0.0	0.00	0.0	-33.85	-2925.5	0.00	11579.4	3275.2
29	1.01	-1709.1	0.00	0.0	0.00	0.0	-5.70	-483.7	0.00	2001.9	904.5
30	24.90	-3812.0	0.00	0.0	0.00	0.0	-14.19	-1508.2	0.00	5394.7	1909.3
31	31.81	-4067.8	0.00	0.0	0.00	0.0	-16.70	-1732.7	0.00	5998.3	2326.7
ALL	566.49	-97878.4	0.00	0.0	0.00	0.0	-416.56	-39485.6	0.00	140547.0	56645.4

SURFACE WATER (1000 M**3/DAY AND 1000 M**3)

SUBR NO	STORAGE CAP	WATER LEVEL	SUPPLY CAP /DAY	SUPPLY CAP TOTAL	DRAINAGE (2ND+3RD) /DAY	DRAINAGE (2ND+3RD) TOTAL	DRAINAGE (TRENCHES) /DAY	DRAINAGE (TRENCHES) TOTAL
1	2.15	-1.32	-2.01	-356.6	1.93	361.7	0.00	3.1
2	11.22	-1.36	-14.32	-3188.0	14.22	3224.4	0.00	0.0
3	18.37	-1.37	-40.20	-8231.7	40.24	8264.8	0.00	0.0
4	7.88	-1.46	-10.65	-1702.4	9.99	1745.1	0.00	0.0
5	13.18	-1.39	-4.19	-812.1	4.20	865.1	0.00	3.2
6	3.08	-1.32	-4.79	-864.9	4.57	876.8	0.00	0.0
7	8.54	-1.43	-2.43	-625.6	2.32	663.4	0.00	0.0
8	3.88	-1.36	-6.10	-1306.1	6.09	1318.7	0.00	0.0
9	9.64	-1.49	-7.97	-1810.8	7.79	1863.5	0.00	0.0
10	4.63	-0.82	-1.28	-219.2	1.31	217.7	0.00	0.0
11	5.27	-1.36	-7.16	-1479.1	7.04	1496.1	0.00	0.0
12	6.58	-1.35	-4.15	-785.6	3.96	812.2	0.00	0.6
13	19.60	-1.33	-25.87	-5958.6	25.84	5996.9	0.00	0.0
14	3.14	-1.64	-0.96	-213.4	0.89	233.3	0.00	0.0
15	19.27	-1.36	-28.55	-5575.1	27.02	5607.7	0.00	0.0
16	1030.62	-0.20	-10.82	-1873.7	3.62	295.9	9.91	1588.7
17	6.35	-1.39	-1.92	-332.8	1.95	358.9	0.00	0.4
18	24.88	-1.48	-44.34	-8345.9	41.57	8473.0	0.00	0.9
19	0.00	-1.90	-0.31	-54.3	0.22	31.4	0.00	0.0
20	4.23	-1.40	-2.48	-404.4	2.46	396.0	0.11	25.5
21	11.92	-1.36	-18.09	-3812.2	18.12	3849.9	0.00	0.0
22	1.73	-1.36	-0.69	-106.0	0.65	113.2	0.00	0.0
23	9.22	-1.47	-22.04	-5014.7	21.32	5059.8	0.00	0.0
24	16.56	-1.49	-18.14	-4330.9	17.03	4418.4	0.00	0.0
25	6.29	-1.33	-4.81	-779.0	4.58	803.3	0.00	0.0
26	6.57	-1.37	-6.43	-1380.6	6.24	1401.6	0.00	0.0
27	507.78	-0.30	-18.74	-2855.5	13.29	1387.7	10.02	1560.4
28	17.61	-1.47	-38.36	-7919.9	36.09	8010.6	0.00	0.0
29	1.81	-1.77	-1.07	-230.6	0.99	231.9	0.00	0.0
30	11.44	-1.33	-10.11	-1841.1	9.74	1886.2	0.00	0.0
31	12.66	-1.31	-20.37	-3634.6	19.35	3684.1	0.00	0.0
ALL	1806.12		-379.35	-76045.5	354.63	73949.1	20.04	3182.9

CHANNEL SYSTEM (1000 M**3/DAY AND 1000 M**3)

LAYER SUBR	1 /DAY	1 TOTAL	2 /DAY	2 TOTAL	3 /DAY	3 TOTAL	4 /DAY	4 TOTAL	/DAY	TOTAL
1	0.	0.	0.	0.	0.	0.	0.	0.		
2	1.	223.	0.	0.	0.	0.	0.	0.		
3	0.	0.	0.	0.	0.	0.	0.	0.		
4	0.	0.	0.	0.	0.	0.	0.	0.		
5	0.	0.	0.	0.	0.	0.	0.	0.		
6	0.	0.	0.	0.	0.	0.	0.	0.		
7	0.	0.	0.	0.	0.	0.	0.	0.		
8	0.	0.	0.	0.	0.	0.	0.	0.		
9	0.	0.	0.	0.	0.	0.	0.	0.		
10	0.	0.	0.	0.	0.	0.	0.	0.		

RESULTS FOR DAY = 91 YEAR = 1974

RESULTS IN MM ACCUMULATED FROM DAY = 271 YEAR = 1973

TO THE ZONE = POS.
FROM THE ZONE = NEG.

SUBR NO	DAY NO = 91 GR. W DEPTH	MOIST. CONT.	PRECIPITATION	UNSATURATED ZONE SPRINKLING IS	SPRINKLING IG	EVAPOTRANSPIR. E	EVAPOTRANSPIR. Ea	CAPIL. RISE	SATURATED ZONE (TOP LAYER) TRENCH	DRAINAGE 2ND+3RD	CHANNEL	LEAKAGE	STORAGE LOSS	LAT. FLOW	SUB-IR ONLY
1	1.14	220.2	380.1	0.0	0.0	-92.6	-97.3	-298.2	-1.2	-143.3	0.0	-93.0	-61.2	0.0	12.1
2	0.98	95.4	404.1	0.0	0.0	-106.5	-105.7	-295.0	0.0	-313.9	-21.8	60.5	-19.4	0.0	0.6
3	0.82	73.9	360.7	0.0	0.0	-94.7	-104.0	-260.8	0.0	-864.6	0.0	591.4	13.0	0.0	0.0
4	0.85	218.5	395.5	0.0	0.0	-146.2	-100.9	-234.7	0.0	-140.1	0.0	-50.6	-44.4	0.0	0.3
5	1.13	114.6	331.8	0.0	0.0	-103.7	-98.6	-238.8	-0.2	-53.8	0.0	-145.9	-39.1	0.0	4.8
6	0.87	115.9	399.2	0.0	0.0	-105.0	-103.7	-284.5	0.0	-253.3	0.0	-2.1	-29.1	0.0	0.6
7	1.41	122.2	389.0	0.0	0.0	-124.4	-100.1	-302.4	0.0	-57.8	0.0	-213.2	-31.6	0.0	9.5
8	0.93	103.6	404.1	0.0	0.0	-112.6	-105.8	-286.5	0.0	-380.2	0.0	104.5	-10.9	0.0	0.0
9	1.30	122.4	372.9	0.0	0.0	-108.6	-98.9	-273.2	0.0	-115.0	0.0	-124.5	-34.0	0.0	12.6
10	0.62	237.7	404.1	0.0	0.0	-147.2	0.0	-209.5	0.0	-227.6	0.0	64.4	-46.7	0.0	4.1
11	1.02	104.6	385.5	0.0	0.0	-102.1	-103.3	-282.2	0.0	-311.3	0.0	47.0	-17.6	0.0	1.7
12	1.11	154.9	404.1	0.0	0.0	-134.1	-103.9	-285.1	-0.1	-102.0	0.0	-150.5	-32.6	0.0	4.7
13	0.94	101.1	404.1	0.0	0.0	-106.7	-104.3	-297.8	0.0	-655.8	0.0	345.0	13.9	0.0	0.0
14	1.65	88.8	400.2	0.0	0.0	-108.6	-99.5	-328.1	0.0	-33.6	0.0	-268.3	-25.7	0.0	8.2
15	0.98	106.8	404.1	0.0	0.0	-109.2	-106.8	-293.7	0.0	-565.3	0.0	274.2	-1.7	0.0	0.1
16	0.21	319.3	404.1	0.0	0.0	-147.2	0.0	-191.2	-115.3	-20.4	0.0	-48.5	-6.9	0.0	16.7
17	1.12	240.8	386.0	0.0	0.0	-116.7	-100.4	-281.1	0.0	-46.3	0.0	-163.1	-72.0	0.0	4.7
18	0.96	94.9	402.3	0.0	0.0	-103.8	-104.0	-295.3	0.0	-218.5	0.0	-29.7	-46.8	0.0	1.2
19	1.98	180.4	381.4	0.0	0.0	-94.9	-97.5	-338.5	0.0	-3.2	0.0	-225.6	-109.9	0.0	7.2
20	1.00	228.6	382.2	0.0	0.0	-97.0	-99.4	-286.9	-4.9	-77.6	0.0	-93.3	-110.8	0.0	12.0
21	0.91	99.6	404.1	0.0	0.0	-106.1	-104.0	-293.3	0.0	-360.5	0.0	101.8	-33.6	0.0	0.3
22	0.99	141.6	378.0	0.0	0.0	-115.0	-100.1	-262.5	0.0	-53.7	0.0	-137.8	-71.2	0.0	1.7
23	1.12	104.3	404.1	0.0	0.0	-107.9	-102.9	-305.0	0.0	-374.5	0.0	79.8	-9.9	0.0	0.1
24	1.20	106.3	401.8	0.0	0.0	-108.7	-100.5	-306.4	0.0	-172.5	0.0	-108.4	-25.1	0.0	0.9
25	0.98	116.6	402.0	0.0	0.0	-104.8	-101.0	-293.5	0.0	-109.0	0.0	-110.1	-73.9	0.0	4.1
26	1.08	105.1	404.1	0.0	0.0	-108.8	-105.1	-298.9	0.0	-226.4	0.0	-44.8	-27.2	0.0	3.6
27	0.22	427.5	402.6	0.0	0.0	-163.2	-104.7	-155.7	-61.6	-54.7	0.0	-27.1	-12.3	0.0	4.8
28	1.03	109.7	404.1	0.0	0.0	-106.4	-102.0	-297.3	0.0	-282.4	0.0	6.4	-21.2	0.0	0.0
29	1.71	151.1	341.5	0.0	0.0	-86.0	-97.1	-291.3	0.0	-40.0	0.0	-196.2	-54.2	0.0	13.3
30	1.03	134.3	399.2	0.0	0.0	-115.3	-100.2	-285.4	0.0	-141.0	0.0	-97.3	-47.1	0.0	4.2
31	0.94	148.5	404.1	0.0	0.0	-120.7	-101.8	-278.2	0.0	-250.7	0.0	8.8	-36.0	0.0	0.0
-		153.1	393.6	0.0	0.0	-114.8	-102.2	-275.5	-8.9	-209.3	-0.6	-24.1	-32.3	0.0	3.7

NOTE :
PRECIPITATION - 40 % OF BUILT-UP AREA HAS IMPERMEABLE SURFACE
SPRINKLING - IN MM OF AGRICULTURAL AREA
EVAPOTRANSPIRATION - E IS TOTAL AND Ea IS FOR AGRICULTURAL AREA ONLY

EVAPOTRANSPIRATION PER TECHNOLOGY (MM)

SUBR NO	TECHNOLOGY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.0	92.7	92.7	92.7	0.0	92.7	0.0	92.7	0.0	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	0.0
2	92.7	92.7	92.7	92.7	92.7	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	0.0	185.9
3	92.1	92.1	92.1	92.1	92.1	92.1	0.0	92.7	0.0	92.7	92.7	109.5	109.5	109.5	0.0	109.5	0.0	185.9
4	92.7	0.0	92.7	92.7	0.0	92.7	0.0	92.7	0.0	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
5	0.0	92.6	92.6	92.6	0.0	92.6	0.0	92.6	92.6	92.6	92.6	110.2	110.2	110.2	0.0	110.2	0.0	185.8
6	0.0	92.7	0.0	0.0	0.0	0.0	0.0	92.7	0.0	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
7	0.0	92.4	92.4	92.4	92.4	92.4	0.0	92.0	92.0	92.0	92.0	109.8	109.8	109.8	0.0	109.8	0.0	185.1
8	0.0	0.0	0.0	0.0	91.5	0.0	0.0	0.0	0.0	92.3	92.3	108.7	108.7	108.7	0.0	0.0	0.0	185.9
9	92.7	92.7	92.7	92.7	0.0	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.3	185.9
11	92.7	92.7	92.7	92.7	92.7	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
12	92.7	92.7	92.7	92.7	92.7	0.0	0.0	92.6	92.6	92.6	92.6	110.2	110.2	110.2	0.0	0.0	0.0	185.9
13	92.7	92.7	92.7	0.0	0.0	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	0.0	185.9
14	91.9	91.9	91.9	0.0	91.9	91.9	0.0	91.2	91.2	91.2	91.2	109.1	109.1	109.1	0.0	109.1	0.0	182.3
15	92.7	0.0	92.7	0.0	0.0	92.7	0.0	0.0	0.0	92.7	92.7	110.3	110.3	110.3	0.0	0.0	0.0	185.9
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.3	185.9
17	92.7	92.7	92.7	0.0	0.0	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
18	92.7	92.7	92.7	92.7	92.7	92.7	0.0	92.7	0.0	92.7	92.7	110.3	110.3	110.3	0.0	110.3	0.0	185.9
19	92.2	92.2	92.2	92.2	92.2	92.5	0.0	92.6	0.0	92.6	0.0	110.1	110.1	110.1	0.0	110.1	0.0	185.8
20	0.0	0.0	0.0	92.7	92.7	0.0	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	110.3	110.3	0.0
21	92.7	92.7	92.7	92.7	92.7	0.0	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	110.3	185.9
22	92.6	0.0	92.6	92.6	0.0	0.0	0.0	92.5	0.0	92.5	92.5	110.1	110.1	110.1	0.0	110.1	0.0	185.8
23	92.7	92.7	92.7	92.7	92.7	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	0.0	185.9
24	0.0	92.6	92.6	92.6	92.6	92.6	0.0	92.6	92.6	92.6	92.6	110.2	110.2	110.2	0.0	110.2	110.2	185.9
25	0.0	92.6	92.6	92.6	92.6	0.0	0.0	92.5	92.5	92.5	92.5	110.1	110.1	110.1	0.0	110.1	0.0	185.8
26	92.7	92.7	92.7	0.0	0.0	0.0	0.0	92.6	0.0	92.6	92.6	110.2	110.2	110.2	0.0	0.0	0.0	185.9
27	92.7	92.7	92.7	0.0	0.0	0.0	0.0	0.0	0.0	92.7	0.0	110.3	110.3	110.3	0.0	110.3	110.3	185.9
28	92.7	92.7	92.7	92.7	92.7	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	110.3	185.9
29	92.7	92.7	92.7	0.0	0.0	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	110.3	110.3	0.0
30	92.6	92.6	92.6	92.6	0.0	92.6	0.0	92.6	92.6	92.6	92.6	110.2	110.2	110.2	0.0	110.2	0.0	185.9
31	92.7	92.7	92.7	92.7	0.0	92.7	0.0	92.7	92.7	92.7	92.7	110.3	110.3	110.3	0.0	0.0	0.0	185.9
OPT	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	110.3	110.3	110.3	110.3	110.3	110.3	185.9

MORE GROUNDWATER EXTRACTED THAN MAXIMUM - DAY = 100 SUBREGION : 12 GIRR = 2756. GMAX = 950. ??

MORE GROUNDWATER EXTRACTED THAN MAXIMUM - DAY = 103 SUBREGION : 12 GIRR = 2756. GMAX = 950. ??

MORE GROUNDWATER EXTRACTED THAN MAXIMUM - DAY = 106 SUBREGION : 8 GIRR = 4045. GMAX = 3040. ??

RESULTS FOR DAY = 271 YEAR = 1974

TIMESTEP = 3.00 DAY

NUMBER OF ITERATIONS = 6

RESULTS PER SUBREGION AND LAYER (M , 1000 M**3/DAY AND 1000 M**3)

FLOWS : TO SUBREGION = POS.
FROM SUBREGION = NEG.

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	TOTAL	LEAKAGE /DAY	TOTAL	DIS/RECHARGE /DAY	TOTAL	STORAGE LOSS /DAY	TOTAL	LATERAL FLOW /DAY	TOTAL
1	1	19.37	-1.29	-544.1	-0.87	-287.4	0.00	0.0	-7.62	-58.2	0.00	0.0
	2	19.22			1.06	349.0	0.00	-54.2	-0.82	1.2	-0.16	-295.0
	3	20.34			-0.05	-12.1	0.00	0.0	0.06	12.1	0.00	0.0
	4	21.15			-0.14	-49.4	0.00	0.0	0.08	14.6	0.06	34.7
2	1	21.04	-14.74	-3633.0	-2.55	1341.8	0.00	0.0	-32.99	-387.9	0.00	0.0
	2	20.93			2.83	-1249.0	0.00	0.0	-3.29	-3.8	0.93	1259.7
	3	21.34			-0.19	-62.1	0.00	0.0	0.20	62.2	0.00	0.0
	4	21.48			-0.09	-30.7	0.00	0.0	0.36	66.5	-0.27	-36.3
3	1	19.58	-47.81	-13536.2	23.61	11025.2	0.00	0.0	-19.59	-49.5	0.00	0.0
	2	20.06			-14.62	-7448.1	0.00	-13.0	-2.23	5.3	17.45	7461.5
	3	20.75			0.53	-65.9	0.00	0.0	-0.42	67.3	0.00	0.0
	4	21.49			-9.52	-3511.2	0.00	0.0	0.40	118.1	9.13	3393.4
4	1	20.30	-4.72	-2028.5	-6.04	-971.8	0.00	0.0	-52.17	-403.3	0.00	0.0
	2	20.07			9.83	2385.1	0.00	-52.9	-2.58	-4.1	-6.14	-2323.9
	3	20.70			0.11	-65.8	0.00	0.0	-0.05	66.7	0.00	0.0
	4	21.20			-3.90	-1347.5	0.00	0.0	0.53	137.4	3.39	1210.2
5	1	23.50	-2.06	-670.1	-13.85	-4233.3	0.00	0.0	-43.95	8.8	0.00	0.0
	2	23.11			13.60	4051.4	-2.94	-229.9	-2.21	86.2	-7.23	-3900.5
	3	22.87			-0.48	-89.1	0.00	0.0	0.49	88.9	0.00	0.0
	4	22.19			0.74	270.9	0.00	0.0	0.79	157.2	-1.53	-428.8
6	1	23.01	-2.75	-1008.4	-1.99	-43.8	0.00	0.0	-10.80	-94.6	0.00	0.0
	2	22.73			2.00	34.7	0.00	-63.4	-0.66	17.4	-1.20	12.7
	3	22.78			-0.10	-21.4	0.00	0.0	0.10	21.4	0.00	0.0
	4	22.41			0.09	30.5	0.00	0.0	0.19	46.1	-0.28	-76.6
7	1	24.49	-2.00	-2.0	-14.73	-4568.0	0.00	0.0	-32.89	-82.4	0.00	0.0
	2	23.90			13.78	4082.9	-15.22	-4119.3	-1.97	84.8	3.42	-39.8
	3	23.59			-0.05	-148.1	0.00	0.0	0.12	149.7	0.00	0.0
	4	23.11			1.00	633.3	0.00	0.0	0.67	157.2	-1.65	-790.5

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	TOTAL	LEAKAGE /DAY	TOTAL	DIS/RECHARGE /DAY	TOTAL	STORAGE LOSS /DAY	TOTAL	LATERAL FLOW /DAY	TOTAL
8	1	22.20	-6.43	-1719.6	-0.30	642.9	0.00	0.0	-8.89	-100.1	0.00	0.0
	2	22.16			0.77	-450.0	0.00	-66.0	-0.68	20.0	0.03	498.6
	3	22.26			0.13	-55.0	0.00	0.0	-0.10	55.8	0.00	0.0
	4	22.39			-0.60	-137.9	0.00	0.0	0.18	57.9	0.43	80.1
9	1	23.05	-5.59	-1404.4	-11.21	-3230.5	0.00	0.0	-52.13	-388.5	0.00	0.0
	2	22.73			12.37	3821.9	0.00	-255.6	-3.70	12.7	-7.82	-3573.7
	3	22.79			0.86	-146.0	0.00	0.0	-0.67	148.9	0.00	0.0
	4	22.88			-2.03	-445.4	0.00	0.0	0.83	229.2	1.23	216.8
10	1	24.12	-0.48	-247.5	-0.36	95.1	0.00	0.0	-4.08	-53.5	0.00	0.0
	2	23.94			0.06	-204.9	0.00	0.0	-0.17	0.5	0.22	204.6
	3	23.70			0.04	-8.1	0.00	0.0	-0.03	8.3	0.00	0.0
	4	23.50			0.26	117.9	0.00	0.0	0.05	12.8	-0.31	-130.6
11	1	25.99	-5.72	-1850.5	-1.47	331.3	0.00	0.0	-13.53	-102.9	0.00	0.0
	2	25.91			0.57	-652.5	0.00	-47.6	-1.69	1.2	1.36	703.0
	3	25.27			-0.04	-47.0	0.00	0.0	0.07	47.4	0.00	0.0
	4	24.59			0.94	368.1	0.00	0.0	0.24	40.3	-1.18	-408.6
12	1	25.44	-2.17	-727.2	-8.60	-2019.8	0.00	0.0	-18.84	-158.8	0.00	0.0
	2	25.34			7.66	1697.8	0.00	-249.2	-3.50	-23.3	-3.52	-1423.7
	3	24.92			0.00	-53.0	0.00	0.0	0.05	53.6	0.00	0.0
	4	24.51			0.94	375.1	0.00	0.0	0.41	69.0	-1.35	-444.4
13	1	23.81	-34.44	-8416.0	9.30	5758.6	0.00	0.0	-20.67	-72.5	0.00	0.0
	2	24.10			-8.99	-5611.0	0.00	0.0	-2.83	-1.5	12.36	5616.3
	3	24.22			-0.05	-74.1	0.00	0.0	0.09	74.6	0.00	0.0
	4	24.31			-0.25	-73.4	0.00	0.0	0.50	98.7	-0.25	-25.5
14	1	24.89	-0.60	317.3	-12.98	-3399.1	0.00	0.0	-21.31	-81.6	0.00	0.0
	2	24.72			12.87	3347.6	-4.69	-706.2	-3.31	-0.9	-4.59	-2638.6
	3	24.66			-0.09	-62.5	0.00	0.0	0.13	62.8	0.00	0.0
	4	24.56			0.20	114.0	0.00	0.0	0.38	70.2	-0.58	-184.5
15	1	25.82	-27.89	-7512.8	2.68	4670.6	0.00	0.0	-25.11	-178.3	0.00	0.0
	2	25.85			-3.92	-5031.2	0.00	-42.1	-4.24	-26.3	9.27	5105.6
	3	25.41			0.13	-60.9	0.00	0.0	-0.07	61.7	0.00	0.0
	4	25.02			1.12	421.6	0.00	0.0	0.45	80.0	-1.57	-502.1
16	1	27.88	-0.55	-1412.5	-5.08	-1254.1	0.00	0.0	-61.18	-78.3	0.00	0.0
	2	26.99			2.17	142.2	0.00	0.0	-2.47	26.9	0.83	-164.0
	3	26.25			-0.38	-152.8	0.00	0.0	0.42	153.5	0.00	0.0
	4	25.41			3.30	1264.8	0.00	0.0	0.65	192.2	-3.95	-1457.8
17	1	28.71	-0.79	-166.3	-5.94	-2236.1	0.00	0.0	-22.27	-192.2	0.00	0.0
	2	28.01			5.36	1999.5	0.00	-40.6	-1.79	23.7	-3.27	-1975.8
	3	26.90			-0.17	-34.4	0.00	0.0	0.17	34.4	0.00	0.0
	4	25.48			0.74	271.0	0.00	0.0	0.31	56.3	-1.05	-327.9

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	DRAINAGE TOTAL	LEAKAGE /DAY	LEAKAGE TOTAL	DIS/RECHARGE /DAY	DIS/RECHARGE TOTAL	STORAGE LOSS /DAY	STORAGE LOSS TOTAL	LATERAL FLOW /DAY	LATERAL FLOW TOTAL
18	1	27.69	-18.17	-9821.2	-21.27	-680.2	0.00	0.0	-154.90	-1471.6	0.00	0.0
	2	27.43			17.46	-830.5	0.00	-82.1	-13.65	-52.2	-1.48	984.1
	3	26.55			-0.96	-284.0	0.00	0.0	1.07	285.2	0.00	0.0
	4	25.39			4.77	1794.7	-5.90	-2153.5	1.94	790.2	-0.81	-427.9
19	1	28.88	1.55	174.0	-10.62	-3498.4	0.00	0.0	-38.87	-171.1	0.00	0.0
	2	28.41			9.85	3089.6	-0.30	-44.1	-2.75	12.2	-6.20	-3054.5
	3	27.25			-0.41	-3.4	0.00	0.0	0.42	3.1	0.00	0.0
	4	25.48			1.18	412.2	0.00	0.0	0.53	221.5	-1.71	-634.4
20	1	24.58	-1.57	-495.3	-4.39	-680.8	0.00	0.0	-17.31	-431.2	0.00	0.0
	2	24.52			4.37	672.0	0.00	0.0	-2.53	-77.0	-1.44	-600.6
	3	24.30			0.02	7.1	0.00	0.0	-0.01	-7.0	0.00	0.0
	4	24.26			0.00	1.6	0.00	0.0	-0.01	-2.5	0.00	0.9
21	1	25.99	-19.47	-4626.5	-0.79	2027.2	0.00	0.0	-33.00	-577.3	0.00	0.0
	2	25.98			0.80	-2009.7	0.00	0.0	-4.09	-70.8	3.53	2075.0
	3	26.03			0.01	-12.0	0.00	0.0	0.00	12.1	0.00	0.0
	4	26.11			-0.02	-5.5	0.00	0.0	0.01	3.4	0.01	2.1
22	1	25.75	-0.22	-86.2	-1.92	-542.2	0.00	0.0	-5.27	-82.4	0.00	0.0
	2	25.68			1.91	537.1	-0.75	-67.5	-0.46	-7.8	-0.56	-462.2
	3	25.48			0.00	0.8	0.00	0.0	0.00	-0.7	0.00	0.0
	4	25.21			0.01	4.4	0.00	0.0	0.00	-1.0	-0.01	-3.4
23	1	27.29	-27.04	-5550.3	1.83	1343.4	0.00	0.0	-35.00	-405.2	0.00	0.0
	2	27.31			-1.86	-1342.5	0.00	-366.9	-2.33	-25.8	4.10	1735.3
	3	27.20			0.01	-8.7	0.00	0.0	0.00	8.8	0.00	0.0
	4	27.13			0.02	7.8	0.00	0.0	0.01	2.4	-0.03	-10.2
24	1	29.57	-9.70	-3339.6	-22.31	-8118.9	0.00	0.0	-68.34	-589.1	0.00	0.0
	2	29.38			22.32	8132.0	0.00	-3367.4	-8.08	-52.1	-13.72	-4706.4
	3	29.40			-0.04	-25.1	0.00	0.0	0.05	25.2	0.00	0.0
	4	29.35			0.03	12.0	0.00	0.0	0.01	1.8	-0.04	-13.9
25	1	28.29	-1.55	-709.4	-5.34	-1884.4	0.00	0.0	-19.65	-358.2	0.00	0.0
	2	28.15			5.23	1839.1	0.00	-400.7	-1.43	-31.7	-3.78	-1409.9
	3	27.43			0.03	16.9	0.00	0.0	-0.03	-16.9	0.00	0.0
	4	26.90			0.08	28.4	0.00	0.0	-0.02	-7.4	-0.06	-21.0
26	1	28.34	-4.76	-1364.4	-3.07	-736.9	0.00	0.0	-20.06	-221.2	0.00	0.0
	2	28.17			3.00	714.3	0.00	-168.9	-0.98	-14.0	-2.00	-532.7
	3	27.66			0.02	6.8	0.00	0.0	-0.02	-6.7	0.00	0.0
	4	27.32			0.04	15.8	0.00	0.0	-0.01	-5.9	-0.03	-9.9
27	1	30.92	-1.79	-2680.0	-5.70	-1355.7	0.00	0.0	-119.42	-190.3	0.00	0.0
	2	30.57			5.62	1326.3	0.00	0.0	-1.74	4.2	-3.16	-1327.2
	3	30.42			0.00	2.9	0.00	0.0	0.01	-2.9	0.00	0.0
	4	30.28			0.07	26.4	0.00	0.0	-0.02	-7.5	-0.05	-19.0

SUBR. NO	LAYER NO	HEAD AV-M	DRAINAGE(TR+2ND+3RD) /DAY	DRAINAGE TOTAL	LEAKAGE /DAY	LEAKAGE TOTAL	DIS/RECHARGE /DAY	DIS/RECHARGE TOTAL	STORAGE LOSS /DAY	STORAGE LOSS TOTAL	LATERAL FLOW /DAY	LATERAL FLOW TOTAL
28	1	31.06	-32.11	-8705.1	-3.09	-290.9	0.00	0.0	-90.84	-1068.5	0.00	0.0
	2	30.96			3.15	327.3	0.00	-729.2	-3.15	-26.3	0.36	431.5
	3	31.06			-0.03	-28.1	0.00	0.0	0.04	28.2	0.00	0.0
	4	31.11			-0.03	-8.4	0.00	0.0	0.03	7.2	0.00	1.1
29	1	30.66	0.38	530.0	-7.68	-2363.8	0.00	0.0	-17.78	-161.5	0.00	0.0
	2	30.11			7.62	2332.1	-2.01	-169.8	-0.14	-8.2	-5.19	-2157.6
	3	29.59			-0.01	4.9	0.00	0.0	0.01	-4.9	0.00	0.0
	4	28.96			0.07	26.7	0.00	0.0	0.01	4.6	-0.09	-31.3
30	1	31.55	-3.78	-1553.5	-7.56	-2738.3	0.00	0.0	-33.10	-414.9	0.00	0.0
	2	31.50			7.50	2711.4	0.00	-341.2	-1.83	-24.4	-5.80	-2347.3
	3	31.28			-0.01	2.4	0.00	0.0	0.01	-2.3	0.00	0.0
	4	31.04			0.07	24.5	0.00	0.0	-0.01	-3.0	-0.06	-21.4
31	1	31.43	-12.72	-3924.2	-2.89	103.9	0.00	0.0	-44.59	-606.7	0.00	0.0
	2	31.39			2.80	-131.7	0.00	-79.3	-1.72	-26.9	-0.65	235.4
	3	31.08			0.01	-0.7	0.00	0.0	-0.01	0.8	0.00	0.0
	4	30.82			0.08	28.4	0.00	0.0	0.00	1.3	-0.08	-29.8
32	1	24.99	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	2	24.06			0.00	0.0	-13.31	-5076.5	-3.00	63.4	17.01	5020.4
	3	23.88			0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	4	23.68			0.00	0.0	-4.17	-1522.1	1.40	406.9	2.78	1112.8
33	1	29.92	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	2	29.18			0.00	0.0	-3.93	-1547.2	-2.74	-38.2	7.05	1589.1
	3	29.84			0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
	4	29.67			0.00	0.0	-0.03	-10.9	0.10	28.8	-0.07	-17.9
ALL	1		-291.01	-86713.7	-145.19	-17794.7	0.00	0.0	-1146.12	-9223.1	0.00	0.0
	2				147.17	18632.2	-43.15	-18380.9	-88.76	-155.3	0.00	0.0
	3				-1.16	-1478.6	0.00	0.0	2.13	1491.6	0.00	0.0
	4				-0.82	641.0	-10.10	-3686.5	11.01	3044.4	0.00	0.0

UNSATURATED ZONE (1000 M**3/DAY AND 1000 M**3)

SUBR NO	CAPILLARY RISE /DAY	TOTAL	IRR. SURF. /DAY	TOTAL	IRR. GR. W. /DAY	TOTAL	EVAPOTRANSPIRATION /DAY	TOTAL	RAINFALL /DAY	TOTAL	MOISTURE CONT.
1	-9.65	-888.7	0.00	0.0	0.00	54.2	-1.99	-1245.3	16.56	1979.6	487.4
2	-50.79	-3049.5	0.00	0.0	0.00	0.0	-7.90	-5589.2	73.98	8697.6	1022.5
3	-42.91	-2551.3	0.00	2.5	0.00	13.0	-6.59	-4571.4	61.54	7234.3	790.6
4	-61.74	-3395.1	0.00	0.0	0.00	52.9	-17.38	-7142.3	88.07	10349.5	2434.0
5	-58.87	-4888.4	0.00	78.9	1.96	235.7	-13.93	-7104.6	95.29	11202.6	1548.2
6	-15.31	-1142.8	0.00	54.6	0.00	63.4	-2.80	-1840.8	24.37	2880.9	381.1
7	-48.94	-4644.9	0.00	177.8	5.59	621.1	-12.51	-5926.9	78.67	9294.8	1334.4
8	-15.44	-1172.5	0.00	58.9	0.00	66.0	-2.88	-1856.5	25.17	2949.2	384.7
9	-67.86	-5014.0	0.00	53.2	0.00	255.6	-15.46	-8098.2	105.81	12549.0	1881.5
10	-4.83	-204.5	0.00	0.0	0.00	0.0	-1.24	-564.1	7.02	817.6	232.9
11	-20.42	-1618.4	0.00	132.6	0.00	47.6	-3.76	-2428.4	32.78	3868.7	495.7
12	-28.80	-2901.8	0.00	97.5	0.00	249.2	-9.31	-4404.2	57.54	6758.1	1151.3
13	-45.31	-2724.9	0.00	0.0	0.00	0.0	-7.24	-4963.1	65.81	7738.7	988.6
14	-33.63	-3156.9	0.00	0.0	4.69	720.3	-6.30	-3489.4	48.50	5757.7	674.2
15	-48.99	-3009.2	0.00	53.3	0.00	42.1	-7.77	-5411.6	71.71	8414.6	1143.3
16	-66.55	-2743.6	0.00	0.0	0.00	0.0	-17.63	-8049.4	100.17	11667.0	4371.0
17	-28.79	-2592.1	0.00	18.1	0.00	40.6	-7.88	-4101.4	52.80	6239.6	1582.0
18	-191.51	-11943.9	0.00	0.0	0.00	82.1	-30.01	-20791.4	276.40	32617.8	3561.3
19	-47.16	-3492.0	0.00	0.0	0.26	44.9	-7.87	-4837.3	65.17	7775.5	1809.8
20	-22.77	-1610.6	0.00	0.0	0.00	0.0	-3.82	-2584.7	34.23	4062.9	1059.3
21	-52.90	-3179.2	0.00	0.0	0.00	0.0	-8.37	-5775.9	76.95	9049.3	1120.4
22	-7.30	-710.5	0.00	0.0	0.00	67.5	-2.10	-1068.9	14.06	1662.6	248.6
23	-60.27	-4612.2	0.00	27.1	0.00	366.9	-11.45	-7106.5	96.19	11369.3	1569.2
24	-99.71	-12041.1	0.00	258.0	0.00	3367.4	-22.22	-13186.4	181.34	21433.3	2743.0
25	-26.48	-2953.1	0.00	182.7	0.00	400.7	-6.25	-3840.5	51.77	6151.4	755.4
26	-27.81	-2322.8	0.00	206.4	0.00	168.9	-5.05	-3280.0	44.42	5229.1	662.3
27	-126.25	-4224.2	0.00	0.0	0.00	0.0	-38.94	-15126.4	183.37	21363.7	10723.6
28	-125.63	-10059.2	0.00	482.7	0.00	729.2	-23.43	-14928.4	203.08	23940.3	3236.0
29	-24.90	-1995.8	0.00	32.3	1.34	173.8	-3.80	-2541.5	34.87	4124.2	878.3
30	-44.50	-4708.0	0.00	66.3	0.00	341.2	-13.10	-7021.2	94.23	11130.2	1622.9
31	-59.66	-4428.2	0.00	35.6	0.00	79.3	-15.19	-8018.7	105.07	12393.5	2184.7
ALL	-1565.65	-113979.4	0.00	2018.6	13.84	8283.8	-334.16	-186894.6	2466.94	290702.5	53078.1

SURFACE WATER (1000 M**3/DAY AND 1000 M**3)

SUBR NO	STORAGE CAP	WATER LEVEL	SUPPLY CAP /DAY	SUPPLY CAP TOTAL	DRAINAGE (2ND+3RD) /DAY	DRAINAGE (2ND+3RD) TOTAL	DRAINAGE (TRENCHES) /DAY	DRAINAGE (TRENCHES) TOTAL
1	0.93	-1.72	-1.21	-536.9	1.29	541.0	0.00	3.1
2	10.38	-1.40	-14.74	-3591.9	14.74	3633.0	0.00	0.0
3	17.41	-1.40	-47.81	-13494.4	47.81	13536.2	0.00	0.0
4	7.57	-1.50	-4.72	-1984.5	4.72	2028.5	0.00	0.0
5	4.46	-1.80	-1.97	-543.7	2.06	667.0	0.00	3.2
6	2.80	-1.40	-2.75	-943.2	2.75	1008.4	0.00	0.0
7	2.65	-1.84	-1.90	207.7	2.00	2.0	0.00	0.0
8	3.51	-1.40	-6.43	-1649.7	6.43	1719.6	0.00	0.0
9	5.77	-1.73	-5.32	-1302.0	5.59	1404.4	0.00	0.0
10	4.83	-0.75	-0.48	-249.1	0.48	247.5	0.00	0.0
11	4.86	-1.40	-5.72	-1701.6	5.72	1850.5	0.00	0.0
12	4.98	-1.49	-2.05	-603.6	2.17	726.6	0.00	0.6
13	16.63	-1.40	-34.44	-8347.8	34.44	8416.0	0.00	0.0
14	0.00	-1.90	-0.69	331.1	0.60	-317.3	0.00	0.0
15	18.04	-1.40	-27.89	-7413.3	27.89	7512.8	0.00	0.0
16	554.52	-0.37	-0.53	-1877.7	0.55	-176.2	0.00	1588.7
17	1.50	-1.87	-0.74	-126.5	0.79	165.9	0.00	0.4
18	23.56	-1.50	-18.17	-9688.1	18.17	9820.3	0.00	0.9
19	0.00	-1.90	0.00	-59.9	-1.55	-174.0	0.00	0.0
20	2.42	-1.62	-1.48	-480.2	1.57	469.8	0.00	25.6
21	10.80	-1.40	-19.47	-4583.2	19.47	4626.5	0.00	0.0
22	0.94	-1.64	-0.21	-79.6	0.22	86.2	0.00	0.0
23	8.19	-1.50	-27.04	-5473.0	27.04	5550.3	0.00	0.0
24	15.52	-1.50	-9.70	-2993.6	9.70	3339.6	0.00	0.0
25	4.20	-1.53	-1.46	-504.5	1.55	709.4	0.00	0.0
26	6.25	-1.40	-4.76	-1136.9	4.76	1364.4	0.00	0.0
27	224.34	-0.42	-1.68	-2871.8	1.79	1119.0	0.00	1561.0
28	17.19	-1.50	-32.11	-8135.1	32.11	8705.1	0.00	0.0
29	0.00	-1.90	-0.28	543.6	-0.38	-530.0	0.00	0.0
30	9.17	-1.46	-3.47	-1443.1	3.78	1553.5	0.00	0.0
31	11.88	-1.40	-12.72	-3838.6	12.72	3924.2	0.00	0.0
ALL	995.29		-291.98	-84571.2	291.01	83530.2	0.00	3183.5

CHANNEL SYSTEM (1000 M**3/DAY AND 1000 M**3)

LAYER SUBR	1 /DAY	1 TOTAL	2 /DAY	2 TOTAL	3 /DAY	3 TOTAL	4 /DAY	4 TOTAL	/DAY	TOTAL
1	0.	0.	0.	0.	0.	0.	0.	0.		
2	1.	380.	0.	0.	0.	0.	0.	0.		
3	0.	0.	0.	0.	0.	0.	0.	0.		
4	0.	0.	0.	0.	0.	0.	0.	0.		
5	0.	0.	0.	0.	0.	0.	0.	0.		
6	0.	0.	0.	0.	0.	0.	0.	0.		
7	0.	0.	0.	0.	0.	0.	0.	0.		
8	0.	0.	0.	0.	0.	0.	0.	0.		
9	0.	0.	0.	0.	0.	0.	0.	0.		
10	0.	0.	0.	0.	0.	0.	0.	0.		

RESULTS FOR DAY = 274 YEAR = 1974

RESULTS IN MM ACCUMULATED FROM DAY = 91 YEAR = 1974

TO THE ZONE = POS.
FROM THE ZONE = NEG.

SUBR NO	DAY NO = 274 GR. W DEPTH	MOIST. CONT.	*	UNSATURATED ZONE PRECIPITATION	SPRINKLING IS	SPRINKLING IG	EVAPOTRANSPIR. E	EVAPOTRANSPIR. Ea	CAPIL. RISE	*	SATURATED ZONE (TOP LAYER) TRENCH	DRAINAGE 2ND+3RD	CHANNEL	LEAKAGE	STORAGE LOSS	LAT. FLOW	*	SUB-IR ONLY
1	1.50	195.2	*	406.6	0.0	24.9	-397.8	-421.0	-54.0	*	0.0	-70.1	0.0	-20.4	36.5	0.0	*	18.0
2	0.78	99.3	*	446.8	0.0	0.0	-435.3	-435.2	-7.6	*	0.0	-41.5	-15.1	68.1	-20.3	0.0	*	37.1
3	0.66	82.5	*	399.0	0.4	1.9	-381.1	-425.7	-10.9	*	0.0	-552.6	0.0	556.7	-16.1	0.0	*	0.0
4	1.06	206.6	*	437.6	0.0	10.9	-424.5	-423.3	-29.0	*	0.0	-22.3	0.0	-27.3	20.6	0.0	*	10.4
5	1.50	96.3	*	366.9	15.0	44.8	-335.8	-400.8	-67.6	*	0.0	12.4	0.0	-116.7	36.4	0.0	*	26.7
6	0.89	114.1	*	436.5	16.6	19.3	-424.2	-428.9	-46.2	*	0.0	-37.8	0.0	-11.9	2.5	0.0	*	18.0
7	1.63	116.8	*	425.9	26.5	92.6	-391.1	-399.2	-105.8	*	0.0	57.0	0.0	-184.9	21.8	0.0	*	68.4
8	0.76	113.5	*	449.7	18.4	20.6	-420.2	-418.2	-53.5	*	0.0	-116.7	0.0	78.7	-16.5	0.0	*	9.8
9	1.37	117.1	*	405.1	5.2	25.2	-389.2	-415.5	-39.2	*	0.0	28.0	0.0	-74.8	7.3	0.0	*	55.2
10	0.56	246.7	*	455.3	0.0	0.0	-441.1	0.0	-5.1	*	0.0	-33.0	0.0	33.3	-6.3	0.0	*	5.0
11	0.98	105.6	*	422.8	32.2	11.6	-400.8	-419.1	-56.2	*	0.0	-73.8	0.0	20.6	-4.0	0.0	*	53.6
12	1.23	146.8	*	447.7	19.3	49.4	-416.6	-407.0	-80.0	*	0.0	10.8	0.0	-102.6	11.6	0.0	*	39.3
13	0.73	107.4	*	446.5	0.0	0.0	-433.9	-433.7	-6.3	*	0.0	-268.4	0.0	281.7	-20.9	0.0	*	0.5
14	1.75	95.6	*	433.9	0.0	120.3	-392.6	-393.7	-132.1	*	0.0	78.5	0.0	-221.2	9.7	0.0	*	84.9
15	0.83	116.0	*	448.5	5.5	4.3	-434.2	-434.0	-14.2	*	0.0	-194.8	0.0	194.0	-14.8	0.0	*	15.7
16	0.26	325.8	*	455.3	0.0	0.0	-441.1	0.0	-7.7	*	-0.5	32.1	0.0	-43.5	4.1	0.0	*	33.6
17	1.58	206.1	*	422.4	3.5	8.0	-410.2	-425.3	-54.0	*	0.0	24.7	0.0	-124.3	45.7	0.0	*	31.4
18	1.01	91.5	*	441.4	0.0	2.1	-429.1	-430.9	-17.7	*	0.0	-33.7	0.0	10.8	4.3	0.0	*	7.5
19	2.81	178.2	*	409.5	0.0	5.4	-392.7	-413.8	-23.2	*	0.0	21.0	0.0	-128.2	83.6	0.0	*	21.6
20	1.27	210.3	*	414.7	0.0	0.0	-405.4	-423.1	-27.5	*	-0.1	-14.2	0.0	-39.2	27.0	0.0	*	21.0
21	0.69	105.1	*	446.5	0.0	0.0	-431.9	-430.6	-9.2	*	0.0	-74.5	0.0	86.6	-21.6	0.0	*	20.1
22	1.29	119.1	*	413.3	0.0	53.0	-389.5	-409.6	-76.3	*	0.0	13.0	0.0	-117.8	29.1	0.0	*	17.9
23	0.94	119.2	*	442.0	2.1	28.6	-416.4	-414.8	-38.2	*	0.0	-39.9	0.0	19.7	-18.2	0.0	*	27.2
24	1.19	107.9	*	439.5	11.9	154.8	-404.5	-404.5	-166.5	*	0.0	41.8	0.0	-207.7	-1.1	0.0	*	59.5
25	1.18	102.5	*	435.0	26.2	57.4	-413.1	-414.1	-110.3	*	0.0	13.2	0.0	-144.4	20.6	0.0	*	26.6
26	0.99	109.8	*	445.5	34.6	28.3	-419.5	-418.5	-78.4	*	0.0	4.8	0.0	-74.3	-9.3	0.0	*	41.2
27	0.30	431.6	*	453.4	0.0	0.0	-438.6	-433.3	-10.7	*	-0.8	9.1	0.0	-26.9	7.9	0.0	*	12.5
28	0.88	118.5	*	444.3	18.6	28.1	-418.0	-416.7	-57.7	*	0.0	-25.9	0.0	-16.7	-15.3	0.0	*	14.5
29	1.90	147.3	*	373.1	10.4	55.7	-350.4	-409.7	-59.9	*	0.0	130.4	0.0	-210.7	19.9	0.0	*	134.1
30	1.15	122.8	*	437.3	6.3	32.4	-408.0	-407.4	-69.4	*	0.0	25.0	0.0	-106.8	12.5	0.0	*	40.0
31	0.91	154.3	*	443.8	3.1	6.9	-423.3	-418.1	-22.1	*	0.0	-17.2	0.0	-1.7	-3.1	0.0	*	12.8
-		152.1	*	433.2	7.9	32.6	-412.3	-419.2	-49.3	*	-0.1	-27.9	-0.4	-26.6	5.3	0.0	*	28.9

NOTE :
PRECIPITATION - 40 % OF BUILT-UP AREA HAS IMPERMEABLE SURFACE
SPRINKLING - IN MM OF AGRICULTURAL AREA
EVAPOTRANSPIRATION - E IS TOTAL AND Ea IS FOR AGRICULTURAL AREA ONLY

EVAPOTRANSPIRATION PER TECHNOLOGY (MM)

SUBR NO	TECHNOLOGY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.0	405.2	408.1	364.6	0.0	394.2	0.0	394.2	0.0	418.4	418.6	440.0	440.9	440.0	0.0	440.0	0.0	0.0
2	441.4	408.8	408.8	366.4	366.4	395.2	0.0	396.0	396.0	420.8	420.8	441.4	441.4	441.4	0.0	0.0	0.0	440.8
3	431.0	400.9	400.9	359.5	359.5	386.3	0.0	393.2	0.0	417.8	417.8	430.9	432.7	430.9	0.0	430.9	0.0	440.8
4	434.4	0.0	406.2	361.8	0.0	385.3	0.0	390.1	0.0	413.6	414.8	434.4	439.2	434.4	0.0	434.4	0.0	440.7
5	0.0	394.0	402.7	354.6	0.0	355.4	0.0	377.3	387.5	397.8	408.3	402.2	434.6	402.2	0.0	402.2	0.0	428.4
6	0.0	402.2	0.0	0.0	0.0	0.0	0.0	392.5	0.0	416.4	416.5	433.9	438.8	433.9	0.0	433.9	0.0	440.8
7	0.0	390.2	401.7	349.6	360.0	342.2	0.0	374.2	386.2	392.7	405.9	386.8	433.8	386.8	0.0	386.8	0.0	421.9
8	0.0	0.0	0.0	0.0	353.7	0.0	0.0	0.0	0.0	408.5	408.8	415.4	425.5	415.4	0.0	0.0	0.0	440.8
9	425.1	400.4	407.6	361.3	0.0	375.7	0.0	387.1	395.1	410.6	417.1	424.9	440.4	424.9	0.0	424.9	0.0	440.8
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	441.4	440.8
11	421.6	400.3	406.2	360.3	364.4	372.6	0.0	386.3	392.1	410.0	413.2	421.5	438.5	421.5	0.0	421.5	0.0	440.8
12	410.2	395.3	403.6	355.6	362.4	0.0	0.0	378.4	388.7	399.5	409.4	402.6	435.7	402.6	0.0	0.0	0.0	432.7
13	441.4	408.8	408.8	0.0	0.0	395.2	0.0	396.0	396.0	420.8	420.8	441.4	441.4	441.4	0.0	0.0	0.0	440.8
14	390.7	388.1	400.9	0.0	359.4	336.6	0.0	371.7	384.1	389.4	403.7	381.1	432.3	381.1	0.0	381.1	0.0	416.8
15	436.3	0.0	408.0	0.0	0.0	390.3	0.0	0.0	0.0	420.8	420.8	436.3	440.1	436.3	0.0	0.0	0.0	440.8
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	441.4	440.8
17	438.8	404.4	408.1	0.0	0.0	393.1	0.0	393.5	394.7	417.7	418.0	439.6	440.9	439.6	0.0	439.6	0.0	438.0
18	440.1	406.6	408.3	365.3	366.0	394.0	0.0	394.9	0.0	418.9	419.4	440.1	441.1	440.1	0.0	440.1	0.0	440.8
19	426.1	400.6	405.7	360.2	363.6	386.1	0.0	390.9	0.0	415.5	0.0	432.2	439.5	432.2	0.0	432.2	0.0	438.5
20	0.0	0.0	0.0	366.4	366.4	0.0	0.0	396.0	396.0	420.8	420.8	441.4	441.4	441.4	0.0	441.4	441.4	0.0
21	441.4	408.8	408.8	366.4	366.4	0.0	0.0	396.0	396.0	420.8	420.8	441.4	441.4	441.4	0.0	0.0	441.4	440.8
22	418.0	0.0	404.4	356.7	0.0	0.0	0.0	378.8	0.0	400.1	409.8	417.9	436.6	417.9	0.0	417.9	0.0	432.3
23	419.6	401.8	406.1	360.5	364.2	369.0	0.0	392.9	393.8	416.9	416.9	413.4	437.8	413.4	0.0	0.0	0.0	440.8
24	0.0	394.1	403.3	354.3	362.1	352.8	0.0	377.0	387.7	397.3	408.3	398.7	435.1	398.7	0.0	398.7	398.7	430.6
25	0.0	396.9	405.4	357.7	363.2	0.0	0.0	380.2	390.0	402.4	410.9	420.7	437.5	420.7	0.0	420.7	0.0	435.4
26	415.4	398.5	405.6	0.0	0.0	0.0	0.0	384.2	0.0	407.5	412.7	413.5	437.6	413.5	0.0	0.0	0.0	440.0
27	441.4	408.8	408.8	0.0	0.0	0.0	0.0	0.0	0.0	420.8	0.0	441.4	441.4	441.4	0.0	441.4	441.4	440.8
28	421.0	400.8	406.4	360.4	364.5	371.1	0.0	388.7	392.5	413.5	414.2	420.9	439.1	420.9	0.0	0.0	420.9	440.8
29	421.6	400.7	407.4	0.0	0.0	380.7	0.0	385.6	390.5	409.3	413.0	422.7	439.4	422.7	0.0	422.7	422.7	0.0
30	416.2	396.8	405.2	357.2	0.0	362.8	0.0	379.9	389.7	401.9	410.5	415.9	437.1	415.9	0.0	415.9	0.0	435.2
31	427.9	401.7	406.0	361.7	0.0	379.4	0.0	390.7	392.6	415.0	415.6	427.9	438.7	427.9	0.0	0.0	0.0	440.8
OPT	441.4	408.8	408.8	366.4	366.4	395.2	395.2	396.0	396.0	420.8	420.8	441.4	441.4	441.4	441.4	441.4	441.4	440.8

SPRINKLING PER TECHNOLOGY (MM)

SUBR NO	TECHNOLOGY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.0	0.0	171.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.1	0.0	114.3	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	110.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	117.9	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	260.7	0.0	0.0	0.0	0.0	0.0	257.1	0.0	135.7	0.0	317.9	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	100.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	387.1	0.0	376.3	0.0	0.0	0.0	314.3	0.0	171.4	0.0	445.2	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	21.4	0.0	92.7	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	203.6	0.0	0.0	0.0	0.0	0.0	228.6	0.0	128.6	0.0	253.6	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	132.1	0.0	89.3	0.0	0.0	0.0	110.7	0.0	71.4	0.0	146.3	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	180.2	0.0	169.4	0.0	0.0	0.0	201.4	0.0	119.0	0.0	258.7	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	500.0	0.0	503.6	0.0	0.0	0.0	314.3	0.0	171.4	0.0	503.6	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	171.1	0.0	0.0	0.0	0.0	0.0	306.3	0.0	25.4	0.0	171.1	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	78.6	0.0	39.3	0.0	0.0	0.0	0.0	0.0	39.3	0.0	67.9	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	535.5	0.0	517.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542.6	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	203.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.9	0.0	282.1	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	117.9	0.0	78.6	0.0	0.0	0.0	57.1	0.0	0.0	0.0	142.9	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	215.4	0.0	204.1	0.0	0.0	0.0	199.9	0.0	106.9	0.0	272.5	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	192.9	0.0	164.3	0.0	0.0	0.0	221.4	0.0	128.6	0.0	232.1	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	139.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.6	0.0	192.9	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	121.4	0.0	89.3	0.0	0.0	0.0	96.4	0.0	42.9	0.0	153.6	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	314.0	0.0	0.0	0.0	0.0	0.0	313.5	0.0	170.6	0.0	370.1	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	188.9	0.0	0.0	0.0	0.0	0.0	183.3	0.0	112.8	0.0	246.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	89.3	0.0	0.0	0.0	0.0	0.0	78.6	0.0	42.9	0.0	125.0	0.0	0.0	0.0	0.0	0.0

F I N A L   R E S U L T S

TOTAL NUMBER OF ITERATIONS - 762

WARNINGS GIVEN

IWN1 =	0	IWN2 =	0	IWN3 =	0	IWN4 =	0
IWN5 =	0	IWN6 =	0	IWN7 =	5		

E N D   O F   S I M G R O

Nov 1988

File : SIMGRO.ITR

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   TIME       ITER    NODE    LAYER         DELTA P         OMEGA
271  1973       1      75       2            0.125           1.38
271  1973       2     319       2            0.005           1.38
271  1973       3     319       2            0.002           1.38
271  1973       4     325       2            0.001           1.38
271  1973       5     325       2            0.000           1.38
  PMAX(1-4)    (m) :      0.038    0.126    0.001    0.007
  PFLOW(1-4)   (%) :        0.6      4.3     12.3      0.3
272  1973       1      75       2            0.150           1.38
272  1973       2      75       2            0.010           1.38
272  1973       3      75       2            0.003           1.38
272  1973       4      75       2            0.001           1.38
272  1973       5      76       2            0.000           1.38
  PMAX(1-4)    (m) :      0.118    0.252    0.004    0.018
  PFLOW(1-4)   (%) :        0.0      0.1      0.0      0.0
273  1973       1      23       1            0.135           1.38
273  1973       2      75       2            0.019           1.38
273  1973       3      75       2            0.005           1.38
273  1973       4      97       2            0.001           1.38
273  1973       5      98       2            0.000           1.38
  PMAX(1-4)    (m) :      0.063    0.202    0.011    0.028
  PFLOW(1-4)   (%) :        0.0      0.1      0.0      0.0
275  1973       1     124       1            0.096           1.38
275  1973       2      75       2            0.019           1.38
275  1973       3     325       2            0.007           1.38
275  1973       4     292       2            0.002           1.38
275  1973       5     292       2            0.001           1.38
275  1973       6     325       2            0.000           1.38
  PMAX(1-4)    (m) :      0.100    0.149    0.027    0.047
  PFLOW(1-4)   (%) :        0.1      0.3      0.0      0.0
277  1973       1     123       1            0.090           1.38
277  1973       2      75       2            0.017           1.38
277  1973       3     326       2            0.004           1.38
277  1973       4     292       2            0.001           1.38
277  1973       5     292       2            0.001           1.38
277  1973       6      75       2            0.000           1.38
  PMAX(1-4)    (m) :      0.086    0.076    0.029    0.038
  PFLOW(1-4)   (%) :        0.1      0.2      0.0      0.0
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Nov 1988

File : SIMGRO.IRR

day	year	subr	tech	moisture contents VT1.0	start	stop	present	sprink. mm/d	ratio
94	1974	7	13	0.096	0.077	0.092	0.070	3.6	1.00
94	1974	14	3	0.096	0.077	0.092	0.075	3.6	1.00
94	1974	14	5	0.096	0.077	0.092	0.075	3.6	1.00
94	1974	14	13	0.096	0.077	0.092	0.065	3.6	1.00
94	1974	19	3	0.146	0.117	0.139	0.116	3.6	1.00
94	1974	19	5	0.146	0.117	0.139	0.116	3.6	1.00
94	1974	19	13	0.219	0.176	0.208	0.170	3.6	1.00
97	1974	24	13	0.096	0.077	0.092	0.075	3.6	1.00
97	1974	29	13	0.202	0.162	0.192	0.157	3.6	1.00
100	1974	5	13	0.096	0.077	0.092	0.070	3.6	1.00
100	1974	12	13	0.096	0.077	0.092	0.070	3.6	1.00
100	1974	23	13	0.096	0.077	0.092	0.071	3.6	1.00
103	1974	7	3	0.096	0.077	0.092	0.076	3.6	1.00
103	1974	7	5	0.096	0.077	0.092	0.076	3.6	1.00
103	1974	7	13	0.096	0.077	0.092	0.073	3.6	1.00
103	1974	8	13	0.065	0.052	0.062	0.051	3.6	1.00
103	1974	9	13	0.088	0.070	0.084	0.069	3.6	1.00
103	1974	14	13	0.096	0.077	0.092	0.068	3.6	1.00
103	1974	19	3	0.146	0.117	0.139	0.115	3.6	1.00
103	1974	19	5	0.146	0.117	0.139	0.115	3.6	1.00
103	1974	19	13	0.219	0.176	0.208	0.168	3.6	1.00
103	1974	26	13	0.096	0.077	0.092	0.070	3.6	1.00
103	1974	28	13	0.096	0.077	0.092	0.076	3.6	1.00
103	1974	30	13	0.096	0.077	0.092	0.075	3.6	1.00
106	1974	11	13	0.096	0.077	0.092	0.073	3.6	1.00
106	1974	14	5	0.096	0.077	0.092	0.076	3.6	1.00
106	1974	22	13	0.096	0.077	0.092	0.073	3.6	1.00
106	1974	29	13	0.202	0.162	0.192	0.161	3.6	1.00
109	1974	5	13	0.096	0.077	0.092	0.074	3.6	1.00
109	1974	12	13	0.096	0.077	0.092	0.073	1.9	0.53
109	1974	14	3	0.096	0.077	0.092	0.076	3.6	1.00
109	1974	23	13	0.096	0.077	0.092	0.075	3.6	1.00
109	1974	24	13	0.096	0.077	0.092	0.069	3.6	1.00
109	1974	25	13	0.096	0.077	0.092	0.070	3.6	1.00
109	1974	31	13	0.096	0.077	0.092	0.075	3.6	1.00
112	1974	3	13	0.065	0.052	0.062	0.049	3.6	1.00
112	1974	7	13	0.096	0.077	0.092	0.077	3.5	0.99
112	1974	14	13	0.096	0.077	0.092	0.072	3.6	1.00
112	1974	15	13	0.096	0.077	0.092	0.072	3.6	1.00
112	1974	19	3	0.146	0.117	0.139	0.115	3.6	1.00
112	1974	19	5	0.146	0.117	0.139	0.115	3.6	1.00
112	1974	19	13	0.219	0.176	0.208	0.168	3.6	1.00