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AGTEHM: Documentation of Modifications to the Terrestrial Ecosystem Hydrology Model (TEHM) for Agricultural Applications

D. M. Hetrick
J. T. Holdeman
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ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1770

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ABSTRACT

HETRICK, D. M., J. T. HOLDEMAN, and R. J. LUXMOORE. 1982. AGTEHM: Documentation of modifications to the terrestrial ecosystem hydrology model (TEHM) for agricultural applications. ORNL/TM-7856. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 124 pp.

AGTEHM, an agricultural application version of TEHM, the Terrestrial Ecosystem Hydrology Model (Huff et al., 1977), is the outgrowth of over a decade of effort to realize a model of the complex interrelations of air, water, land, and vegetation. TEHM combines mechanistic algorithms for climatic and hydrologic processes with vegetation properties to explicitly simulate interception, throughfall, infiltration, root zone evaporation, transpiration, drainage, plant and soil water potential, unsaturated and saturated subsurface flow, surface runoff, and open channel flow. AGTEHM was developed from TEHM and several innovations have been added for agricultural applications. These include changes in the input data options, algorithms for sprinkler and flood irrigation, an alternative surface resistance-water potential relationship, a variable-contributing-area function, and the coupling of a model for soil macropore effects on water flow. Several internal changes to the original code have been made to increase calculation efficiency. This report is intended as a companion to the TEHM report and describes those features not previously documented.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. Introduction and Rationale

The Terrestrial Ecosystem Hydrology Model (TEHM) documented by Huff et al. (1977) is a simulation code for the hydrologic processes of vegetated land in which the physical processes and physiological mechanisms of water and vapor transport are represented by deterministic equations. TEHM has been chiefly applied to forest watershed studies; however, it can also be applied to agricultural watersheds. In extending the range of TEHM applications to more diverse agricultural situations, a series of modifications have been introduced that are documented in this report as a model called AGTEHM. These changes involve (1) additional input data options, (2) irrigation algorithms, (3) an alternative leaf physiological algorithm, (4) a variable-contributing-area algorithm, and, (5) algorithms for water flow in soil macropores.

The TEHM code has an hourly time step (15 minute step during periods with rainfall or rapid soil water flow). Computation of hourly meterological conditions from daily input data is conducted with simple algorithms for diurnal changes. In recent years some experiments have been performed for selected periods to measure plant variables while simultaneously measuring meteorological conditions at intervals of approximately an hour. Data with this detailed time resolution has become more common with the development of automated data sampling equipment. Provision needs to be made for entering such hourly data for detailed simulation of these experiments. While simulation for a period of one year may require as many as 8784 hourly values of each variable, the measured values are rarely available for such extensive periods. Facility has been provided in AGTEHM for combining periods with hourly records with the standard daily data inputs of the TEHM code. In addition, algorithms have been added to AGTEHM to simulate daily averages for applications where daily data are incomplete or missing entirely. These changes in input data options greatly expand the types of applications that can be attempted, although care must be taken in the interpretation of simulations generated with default meterological data.

Irrigation is an ancient agricultural practice that continues as a well established and important technology in current times. Sprinkler and flood irrigation systems have greatly improved agricultural productivity. Some problems in irrigation practice remain, however, especially water-borne pollutants originating from agricultural ecosystems. Incorporation of irrigation algorithms into the hydrology model will be useful for addressing these problems.

One of the most important relationships in the hydrologic model is between stomatal resistance and leaf-water potential. This function determines the partitioning of water between the liquid and vapor phases. An exponential function is used in TEHM and is not suitable for some agricultural crops. A hyperbolic function has been shown to be more appropriate in some cases (Reicosky and Lambert, 1978) and AGTEHM provides this function as an alternative to the original exponential form.

Two additional developments in the model concerning variable-contributing areas and soil macropores have been undertaken to simulate two hydrologic processes that are important during storm events or excessive irrigation. Hewlett and Nutter (1970), Freeze (1972), and Bevan and Kirby (1979), among others, have investigated the role of variable-contributing areas through which the majority of watershed runoff passes during storm events. Soil macropores due to root channels, wormholes, and cracks between aggregates also have an important role in channeling water downslope during and after storm events. Thomas and Phillips (1979) have reviewed the hydrologic role of macropores, and simple algorithms have been included in AGTEHM for representation of channel-water flow through soil profiles. These various changes greatly extend the range of applications. Both the TEHM and AGTEHM are designed to be coupled with soil chemistry models. The improved treatment of soil-water-flow behavior will greatly improve the analysis of pollutant transport in forestry and agricultural ecosystems. The alternative input data options, irrigation algorithms, and the other code developments are documented in the following sections.

II. Documentation of Modifications to TEHM

This section describes ten sets of programming changes that have been introduced in AGTEHM. Other minor modifications are discussed in the subroutine descriptions of Section III.

A. Hourly Data Input and Default Algorithms

The format for the input of daily meteorological data is described in the documentation of TEHM (Huff et al., 1977; see pp. 85-91). Included here is a brief review and a description of the format for entering hourly data.

As in TEHM, each set of meteorological data (air temperature, dew point, solar radiation, and wind speed) is preceeded by a data card which has an integer specifying a data type and a title or name of the type of data. This latter identification is used to make the listing of the data more readable and serves no other purpose. This data-type card is followed by an arbitrary number of data cards. The last data card is followed by a card with a dollar sign ($) in column 1 which signals the end of this set of data.

Each data card begins with a seven-column field (see field F1 on hypothetical card given on page 6) which may be used to identify the data. Any descriptor not beginning with a dollar sign ($) in column 1 may be used. The descriptor is not used internally in TEHM or AGTEHM. The descriptor is followed in columns 8-11 by two-digits signifying the year and two digits signifying the month of the subsequent data items (F2). Column 12 contains a single digit (F3) which, if 1, 2, or 3, indicates that the data items are for the first, second, or third 11 d of the month. In AGTEHM an additional option is provided. If the digit is 4 it signals that hourly data follows.

Each string of hourly data is preceeded by a two-digit integer day, two-digit integer starting hour, and a two-digit integer indicating the number of consecutive hourly data items to follow (F4, F6, F8). If the number of data items is zero the remainder of the card is ignored. If the number is nonzero, the string of data (F5, F7) may be followed by additional day-hour-number designators and data. A string of data cannot be continued from one data card to the next. The items in the data string are entered in groups of six columns (two groups of three columns in the case of temperature data) in FORTRAN F6.0 (or 2F3.0) format.

For example, to input hourly solar radiation data, the format would be as follows (see p. 90 of Huff et al., 1977):

For NBZ, BZ = 3 SOLAR RADIATION, the cards required for hourly data are:

Subroutine	Card number	Columns	Description of Input Data
ENTRY DAYIN (alternate entry to subroutine BIMON)	3.38 to ...		FORMAT (A1, 6X, 2I2, I1, 11F6.0)
	3.38	1-7	X. May be used for identification purposes. The character $ in column 1 signals that all daily radiation data have been read and control should return to subroutine GETSET.
		8-9	Y, a two-digit integer signifying the year of input.
		10-11	M, a two-digit integer signifying the month of input.
		12	K, = 4, signifying hourly input.

13-14	A two-digit integer signifying the day of month M.
15-16	A two-digit integer signifying the starting hour of the day that hourly input is available (the ordinal number of the hour - see below).
17-18	IN, a two-digit integer signifying the number of data items to follow (must be ≤ 10).
19-24	Hourly radiation for the first hour (cal $cm^{-2}h^{-1}$).
25-30	Hourly radiation for the second hour if IN > 1 (cal $cm^{-2}h^{-1}$). There will be IN data items. For example, if IN = 3, then input the third data item in columns 31-36. The user can input another string of data as follows.
⋮	
37-38	See columns 13-14 above.
39-40	See columns 15-16 above.
41-42	See columns 17-18 above, but now IN ≤ 6 (if IN = 3 the first time).
⋮	
etc.	

Additional data cards 3.39, 3.40, etc. have the same format as card 3.38. The last card in this section of data will have a $ in column 1.

To illustrate further, consider the card (^ signifies blank),

^OR^TN^	7807	4	130704	^^1.02^^0.76^^1.15^^1.09	131401	^^ 2.45	
F1	F2	F3	F4	F5	F6	F7	F8

The fields on the card signify as follows: F1 - Oak Ridge, Tennessee, F2 - July 1978; F3 - hourly data follows; F4 - July 13, begin with the hour ending at 7:00 AM, find 4 h of data; F5 - four data items; F6 - continue July 13 at 1:00 PM (14th h) find one data item; F7 - data item; F8 - end of data (number of following data items is zero). Observe that the number of the starting hour is the ordinal number of the hour.

To avoid the necessity of providing complete hourly data, or even hourly data for a full day, a hierarchical set of algorithms is used to enter data not otherwise specified. It is not necessary that daily data be chronologically ordered. However, for each set of meteorological data (i.e., air temperature, dew point, solar radiation, and wind speed), all daily data must be entered before any hourly data. These daily quantities are used to compute hourly values. The computed hourly values are then overwritten by the subsequent hourly data input. In other words, the code will not function properly if only hourly data are read.

It is stressed here that the daily data are read or computed for 11-d intervals. That is, if available, the daily data for the first 11 d of a month are read in on one card, the second 11 d on a second card, and the data for the remaining days of the month on a third card (Huff et al., 1977; see pp. 89-90). Therefore, daily data cannot be read in for only part of an 11-d interval; the code assumes the data for this interval are complete and will not calculate the missing data. Hence, if the data for any interval are incomplete, do not read any data at all for that interval, and AGTEHM will compute the data for the 11 d (or less if the last third of the month) using the appropriate internal algorithm (see below). AGTEHM calculates the hourly values from the computed daily values during simulation.

B. Algorithm for Average Daily Temperature

The average daily temperature at a site varies with the slope of the land, soil type, vegetation, nearness to bodies of water, and air drainage as well as with season, latitude, and altitude. The equation used includes only the three latter effects.

The equation was developed from charts of normal average daily temperature by month in North America published in the "Weather Atlas of the United States" (1968). Use of the function should be limited to the range from 25° to 55° North latitude on the North American continent. The mean daily temperature T (in Fahrenheit degrees) is given by

$$T = 117 - 1.60L + (12.2 - .925L) \cos (.0172(D-20)) - .0015A \quad , \quad (1)$$

where L is the North latitude in degrees, D is the Julian date, and A is the altitude above mean sea level in feet. Of the constants, ".0015" is the average lapse rate in °F/foot, ".0172" is $2\pi/365.25$ and "20" represents a lag of about one month from the winter solstice. The remaining constants are empirical, derived from an analysis of the weather charts. The mean daily temperature variation has a small seasonal variation and varies with terrain slope and elevation as well as other factors mentioned previously. Away from bodies of water the mean daily temperature variation (°F) can be taken to be

$$\Delta T = 20 + .0013\ A \quad °F \quad , \qquad (2)$$

where A is again the altitude in feet. This estimate also came from an analysis of the weather maps. The mean temperature and its variation allows calculation of the maximum and minimum temperatures which are actually needed in AGTEHM.

The hourly variation of temperature is described in TEHM (Huff et al., 1977; see pp. 8-9), and follows an empirical curve. In qualitative terms, the temperature rises sinusoidally from a minimum at sunrise with a 1-h lag behind that of incident solar radiation. The deviation from sinusoidal behavior increases in the afternoon, and after sunset the temperature decays approximately exponentially to the minimum value of the following morning.

C. Algorithm for Humidity

While the relative humidity may vary considerably during a typical day, the absolute humidity expressed as a dew point temperature is relatively constant. Daily average dew point temperature is approximately equal to the minimum daily temperature with a daily variation of about 3°F. In the absence of any humidity data, the average dew point is taken to be equal to the minimum temperature for the day.

When the average dew point is 3°F or more below the minimum temperature for the day, an hourly dew point equal to the average is assigned. When the average dew point is higher than this a different procedure is used. If the temperature falls below the dew point, moisture will ordinarily condense as fog or dew lowering the dew point. Thus, the hourly dew point is assigned a value lower than the hourly temperature. To preserve the definition of the average, a "dew-point-hour" total is defined for the day equal to the average dew point times 24 h. Starting with the hour with minimum temperature, a dew point is assigned equal to the smaller of (1) the air temperature values less 3°F or (2) the number of dew point hours divided by the number of hours with as yet unassigned dew points. This dew point times 1 h is subtracted from the total number of dew point hours, and the remaining hour with the lowest temperature is chosen to repeat the process.

D. Algorithm for Incident Solar Radiation

From purely geometric considerations, one can calculate the potential solar radiation incident on an area above the earth's surface as in the algorithm of Swift (1973) used in TEHM. A simplified model of the transmission of the earth's atmosphere in the absence of clouds uses the transmission factor $T = e^{\alpha \ell}$, where α is an attenuation coefficient and ℓ is an appropriate optical path length. The attenuation coefficient α is determined from the relation,

$$\alpha h = \log T_0, \qquad (3)$$

where T_0 is the fraction of the direct potential solar radiation reaching the earth's surface on a clear day when the sun is at the zenith with an optical path length (or atmospheric thickness) h. The value $T_0 \approx 0.90$ was found for one set of measured data from which $\alpha h \approx -0.106$. Assuming a flat earth with the sun at an angle Ψ (radians) from the zenith, then $\ell = h \sec \Psi$. Including the earth's curvature,

$$\frac{\ell}{h} = \frac{2 + h/R}{\cos \Psi + \sqrt{\cos^2\Psi + (h/R)(2+h/R)}} \quad , \qquad (4)$$

where the law of cosines was applied to the triangle as seen in Fig. 1 (ℓ/h is dimensionless). R is the earth radius and h the atmospheric thickness; variation of density of the air with altitude can be neglected when $h << R$.

The mean daily atmospheric transmission is approximated by

$$I = I_0 e^{\alpha \ell} = I_0 e^{(\alpha h \ell/h)} = I_0 \; T_0 \; ^{(\ell/h)} \qquad (5)$$

using the previous expression for ℓ/h and approximating Ψ by the angle of the sun from the zenith at local solar noon. Here, I_0 is the daily potential radiation above the atmosphere.

The effects of cloud cover are calculated by the expression

$$S = S_i \; [(1 - C) + kC] \qquad (6)$$

from Sikov (1971) using sky cover estimates from local climatological data. S_i is the solar radiation incident on the clouds, C is the fraction of the sky covered with clouds, and k is the transmission through clouds. Sikov suggests the value $k \approx .32$ for 25° to 35° North latitude.

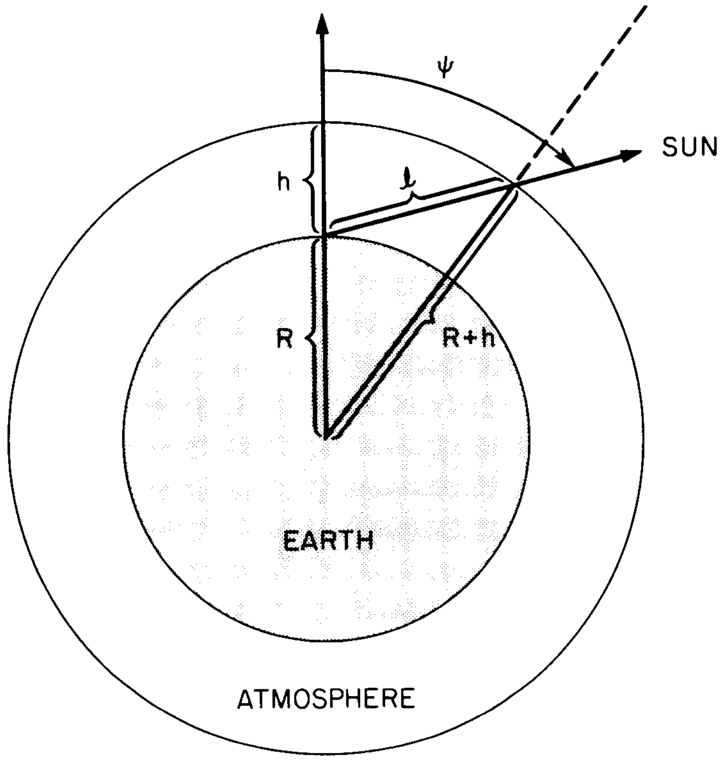


Fig. 1. Variables used in calculations with the incident solar radiation algorithm. R is the earth's radius, h the atmospheric thickness, ℓ the optical path length, and Ψ the angle of the sun from the zenith.

When no solar radiation data are available, the total daily radiation on a horizontal slope is calculated assuming a nominal 10% of the sky is covered with clouds (C = 0.10) and the cloud transmission is 32%. While solar radiation data are not usually available, average daily cloud cover at 3-h intervals is available from most weather stations. A program which reads average daytime cloud cover and computes average daily radiation is given in appendix A.

E. Algorithm for Average Daily Wind Speed

Annual average wind speeds vary considerably across the North American continent. The average wind speed is highest in the spring when temperatures are increasing rapidly. Examination of average climatological data shows that the annual variation is approximately 40% of the annual average wind speed. The algorithm for wind speed used is

$$V_w = V_a \; (1 + .2 \cos \; (.172 \; (D - 70))) \quad , \tag{7}$$

where D is the Julian date and V_a is the annual average wind speed (mph). V_a varies typically between 6 and 16 km/h (4 and 10 mph). A value of 9.7 km/h (6 mph) is used in AGTEHM, in the model above, in the absence of input wind speed data.

F. Data Input for Sprinkler and Flood Irrigation

For agricultural applications a natural and necessary extension of the TEHM model is to include provisions for irrigation. A feature of irrigation in non-arid areas is that the time during which irrigation is actually in use is a small fraction of the total growing period. This fact is reflected in the way in which the irrigation data is managed in the AGTEHM program. The irrigation data is stored by month in a compact form. At the start of the simulation of each day the irrigation data for that month is checked and any data pertinent to that day is copied into an array of hourly values.

Irrigation data are entered along with the climatic variables for a given land segment; see the description of the TEHM input data (Huff et al., 1977; see pp. 85-107). The irrigation data are preceeded by a data-type card, 17 IRRIGATION, read with format (2I, 1X, A4). The next card reads a parameter called FIRRG in F6.0 format. FIRRG is the effective fraction of the segment surface that is being irrigated. For example, FIRRG would be less than 1.0 if the land is furrow irrigated (flooded irrigation). Set FIRRG equal to 1.0 if sprinkler irrigation is used. These cards are followed by any number of data cards and the set of irrigation data is terminated by a card with a dollar sign ($) in column 1. The format is as follows:

Subroutine	Card number	Columns	Description of Input Data
RDIRIG	17.1 to ...		FORMAT (A1, 6X, 2I2, I1, 11F6.0)
	17.1	1-7	X. May be used for identification purposes. The character $ in column 1 signals that all irrigation data have been read and control should return to subroutine GETSET.
		8-9	Y, a two-digit integer signifying the year of input.
		10-11	M, a two-digit integer signifying the month of input.
		12	K, a one-digit integer signifying the type of irrigation used. K can be equal to 1 (sprinkler), 2 (flood), or 3 (flood) as explained below.

13-14	A two-digit integer signifying the day of month M.
15-16	A two-digit integer signifying the starting hour of the day with available hourly input. (This is the ordinal hour number - see example below).
17-18	N, a two-digit integer signifying the number of data items to follow if K = 1 or 2 ($N \leq 10$). If K = 3, N is the number of hours that water stands on the surface (see below).
19-24	If K = 1 or 2, the input is the irrigation amount (inches) for the first hour (see explanation of K below). If K = 3, these columns would be like columns 13-18 above if data are available, or blank.
25-30	If K = 1 or 2 (and N > 1) the input is the irrigation amount (inches) for the second hour. There will be N data items. For example, if N = 3, then input the third data item in columns 31-36. The user can input another string of data as follows. (If K = 3, these columns would be like columns 13-18 above if data are available, or blank.)
⋮	
37-38	See columns 13-14 above.
39-40	See columns 15-16 above.
41-42	See columns 17-18 above, only now $N \leq 6$ (if N = 3 the first time).
⋮	
etc.	

Additional data cards 17.2, 17.3, etc. have the same format as card 17.1. The last card in this section of data will have a $ in column 1.

To explain further, the first seven columns (see field F1 of the hypothetical card below) are not used by the program and may be used for identification purposes but must not contain a $ character in column 1. The next four columns (F2) identify the year (76) and month (06), and the following column (F3) is the type of irrigation used (described below via the variable K).

The next six columns (F4) are interpreted as three two-digit numbers (15, 09, 02 in example below) and (when K = 1 or 2; see below) identify the string of actual irrigation data (F5) which follows. In the example below, 15 identifies the day, 09 the starting hour, and 02 the number of hourly irrigation amounts to follow. After the 02 hourly amounts (inches of water) are read, the next six columns are treated as a new identifier (F6). Here, 17 identifies the day, 09 the starting hour, and 02 the number of hourly irrigation amounts to follow. If these columns are blank, zero, or an invalid identifier (F8), the remainder of the card is ignored. Data on each card must be in chronological order.

Three types of irrigation are recognized, but all data on a given card are treated as the same data type. When K = 1 (see F1) the data are taken to be sprinkler irrigation and are treated like precipitation. When K = 2 the data represent irrigation by flooding with the application amount specified. This water is routed directly to the land surface, bypassing interception storage and impervious areas. When K = 3 flooding is again assumed; however, in this case infiltration is determined by specifying the number of hours N (the last 2 columns of field F4) with water standing on the surface. The amount of infiltration is then determined internally by AGTEHM. In this case hourly identifiers (F4) follow one after another with no intervening data.

Consider the following example. If on June 15 and 17 of 1976 a field of corn near Florence, South Carolina was irrigated by sprinklers starting at 8:00 AM for two hours each day at a rate of 0.254 cm (0.10 inches) of water per hour, this might be specified on a data card by:

(^ signifies blank)

FSC-CRN	7606	1	150902	^0.10^^0.10^	170902	^0.10^^0.10	
F1	F2	F3	F4	F5	F6	F7	F8

The similarity to the hourly data format is so obvious that the differences should be made clear. All irrigation data are hourly so the variable K in column 12 is interpreted as irrigation type. When K = 3, the value N (columns 17-18) is the datum (i.e., number of hours that surface is flooded) rather than delimiting the data as in the cases where K = 1 or 2.

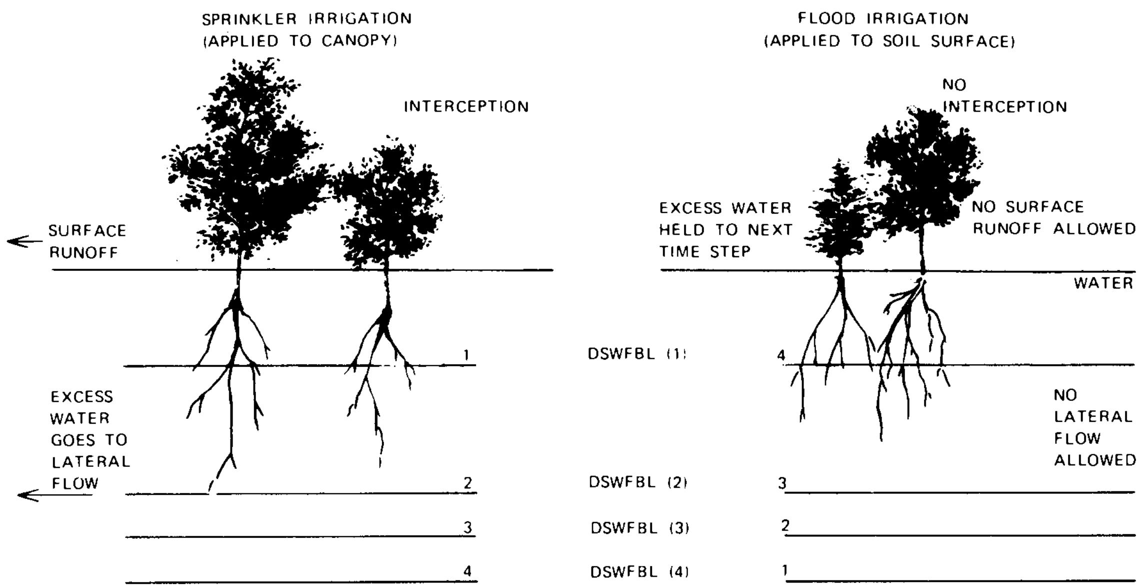
G. PROSPR Subroutine Modifications for Flood Irrigation

When there is flood irrigation (K = 2 or 3), no lateral flow or surface runoff is allowed in subroutine PROSPR. The soil layers are allowed to become saturated, but any excess water will remain on the surface at each time step. Within PROSPR, a check is made for the presence of irrigation water (by flooding) on the surface. If there is surface water, the normal top to bottom calculations for the volumetric water content of each of the soil layers, surface runoff, lateral flow, and drainage to the groundwater are bypassed (Huff et al., 1977; see pp. 24-33), and PROSPR computes the soil water properties starting with the deepest soil layer. This was introduced to prevent lateral flow during flood irrigation. The first step in this reverse sequence is the calculation of drainage to the groundwater from the bottom layer. The volumetric water content of the deepest layer is calculated as usual. If the layer becomes saturated, the soil water entering the bottom layer from the layer above is limited to the amount that can drain out of the bottom layer. Thus, no lateral flow is allowed. Each soil layer is treated in the same way, i.e., when a layer becomes saturated, the amount entering from above is limited to the water that can drain into the soil layer below. At the surface no runoff is allowed and any excess irrigation water on the surface is saved for the next time step. When flood irrigation ceases ($K \leq 1$) and all remaining irrigation water on the surface is zero, PROSPR proceeds as before (from top to bottom) allowing lateral flow and surface runoff.

Sprinkler irrigation follows the normal series of calculations (i.e., the same as for precipitation). See Fig. 2 for comparison between sprinkler and flood irrigation calculations by the PROSPR routine.

H. Algorithm for Stomatal Resistance vs Leaf-Water Potential

One of the most important factors influencing transpiration rates is the leaf stomatal resistance. Two important environmental factors



COMPARISON

1. SURFACE RUNOFF IS ALLOWED
2. SOIL WATER FLOW CALCULATIONS START WITH TOP LAYER AND PROCEED TO BOTTOM LAYER
3. THE SOIL WATER FLUX BETWEEN THE LAYERS (DSWFBL(I)) IS CALCULATED IN THE NORMAL MANNER (HUFF, et al, 1977), AND EXCESS WATER GOES TO LATERAL FLOW

1. NO SURFACE RUNOFF IS ALLOWED. EXCESS WATER IS HELD TO NEXT TIME STEP
2. FLOW IS CALCULATED FROM BOTTOM LAYER FIRST AND SEQUENTIALLY UP TO THE TOP LAYER
3. THE SOIL WATER FLUX BETWEEN LAYER (DSWFBL (I)) IS CALCULATED IN THE NORMAL MANNER; HOWEVER, IF A LAYER BECOMES SATURATED THEN DSWFBL (I-1) IS LIMITED TO DSWFBL (I), i.e., NO LATERAL FLOW IS ALLOWED

Fig. 2. Comparison of sprinkler and flood irrigation calculation sequences within subroutine PROSPR.

affecting the stomatal resistance during the growing season are the leaf-water potential and sunlight. The functional relation used in TEHM between the stomatal resistance and leaf-water potential is given by

$$r_s = \begin{cases} r_s(\min), & \Psi_\ell > 0.0 \ , \\ r_s(\min) + (r_s(\max) - r_s(\min)) \exp(\alpha(\Psi_\ell + \Psi_\ell(\max))), & -\Psi_\ell(\max) < \Psi_\ell < 0.0 \ , \\ r_s(\max), & \Psi_\ell < -\Psi_\ell(\max) \ . \end{cases} \tag{8}$$

These symbols (with their FORTRAN names given in parentheses) are: r_s (RRR) is leaf stomatal resistance, $r_s(\min)$ (TM) is a minimum stomatal resistance, $r_s(\max)$ (RESMAX) is a maximum stomatal resistance, Ψ_ℓ (LWPA) is the leaf-water potential and is negative, $\Psi_\ell(\max)$ (PWPMAX) is the leaf-water potential at which the maximum resistance is obtained (input as absolute value), and α (POWER) is a negative number. Under dark conditions r_s is set equal to $r_s(\max)$. Figure 3a shows the relation among these variables.

Field data for corn stomatal resistance obtained for a range of leaf-water potentials were fitted to a hyperbolic function (Reicosky and Lambert, 1978) with the following form,

$$r_s = \begin{cases} \dfrac{r_s(\min)}{1 + \Psi_\ell/\Psi_\ell(\max)} \ , & \Psi_\ell > \tilde{\Psi}_\ell(\max) \ , \\ r_s(\max) \ , & \Psi_\ell < \tilde{\Psi}_\ell(\max) \ , \end{cases} \tag{9}$$

where

$$\tilde{\Psi}_\ell(\max) = \Psi_\ell(\max) \left(\frac{r_s(\min)}{r_s(\max)} - 1 \right) . \tag{10}$$

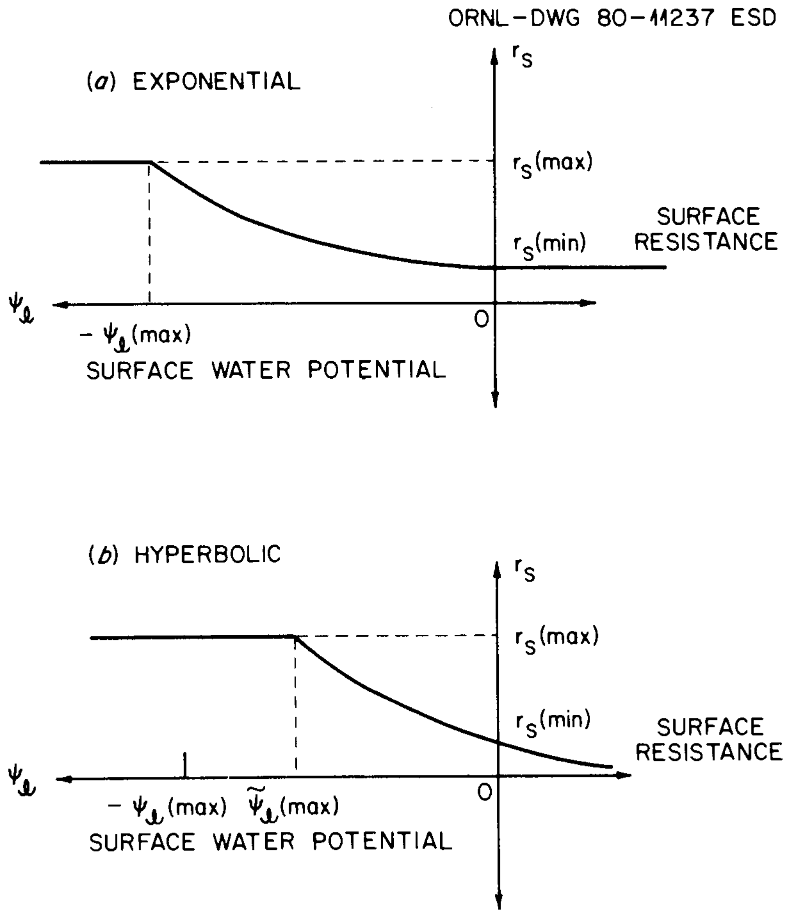


Fig. 3. Exponential (a) and hyperbolic (b) relationships between stomatal resistance (r_S) and surface-water potential (Ψ_ℓ).

Figure 3b shows a graph of the function. As with the first model, under dark conditions the resistance is set to $r_s(max)$ (RESMAX). The values of $r_s(max)$, $r_s(min)$, and $\Psi_\ell(max)$ vary seasonally between values specified on data cards which are part of the input data block beginning "07 READIN." Formats are as described in the documentation of TEHM except that a new variable, LRMODL, is read in I5 format from columns 61 - 65 on card number 7.12 (Huff et al., 1977; see p. 99). A blank or "0" in column 65 selects the original "exponential model" while a "1" in column 65 selects the "hyperbolic model" for the stomatal resistance.

I. Algorithm for Variable Contributing Areas

The original version of TEHM (Huff et al., 1977; see pp. 34-37) contains an algorithm to account for lateral diversion of soil drainage to represent the subsurface runoff (interflow) contributions to stream flow during storm events. This algorithm (found in subroutine PROSPER) caused an increasing proportion of vertical soil drainage to be diverted to the stream with increase in soil drainage rate. This lateral diversion is represented by a ramp function (Fig. 4a). A similar function is used in AGTEHM to represent variable contributing areas with direct surface runoff during storm events. The size of the contributing areas is determined by the same subsurface drainage rate used in TEHM for interflow. To ensure a smooth change in the area size during rain storms, a moving average of the contributing area parameter over three time steps is computed. The net effect is that an increasing proportion of infiltration is diverted directly to the stream as

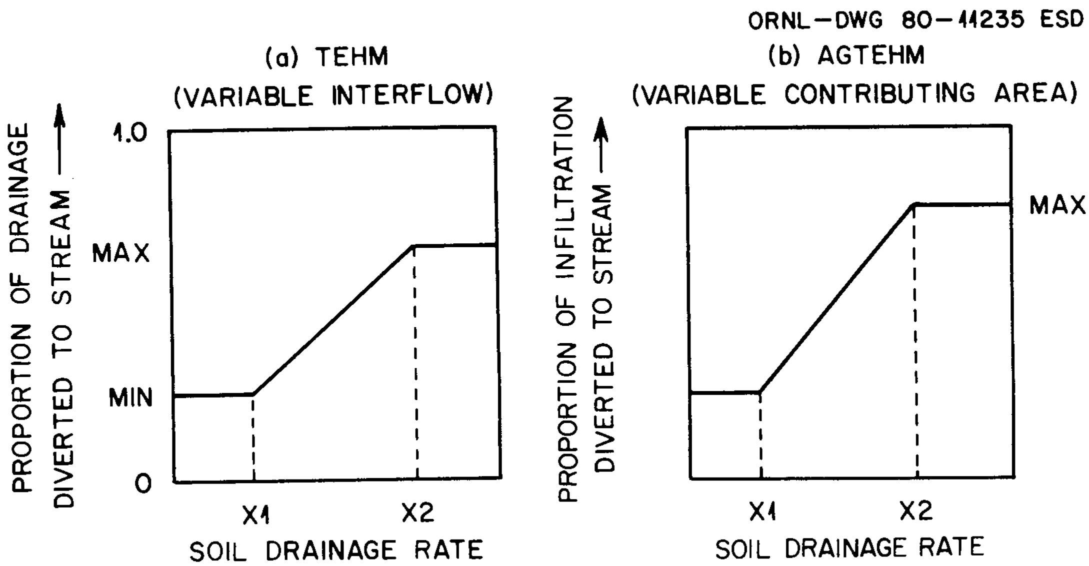


Fig. 4. Comparison of the TEHM and AGTEHM runoff algorithms.

COMPARISON

1. Constant impervious area with direct surface runoff to stream.	1. Constant impervious area with direct surface runoff to stream.
2. Infiltration enters whole watershed segment area.	2. Variable proportion of infiltration diverted to stream during storms. The remaining infiltration enters whole segment area.*
3. A variable proportion of drainage between the A and B horizons is diverted to stream during storms. The remaining drainage enters whole segment area B horizon.*	3. All soil drainage percolates to groundwater.
4. Additional subsurface lateral flow is generated from drainage into saturated soil layers.	4. Subsurface lateral flow to stream is generated from drainage to saturated soil layers.

*NOTE: This provides a quasi-lateral redistribution of soil water.

additional surface runoff (i.e., in addition to that already calculated by the infiltration function in subroutine RAATS) with increase in soil drainage rate during storm events (Fig. 4b). Basically, AGTEHM partitions the incoming infiltration at an earlier stage than TEHM, i.e., at the soil surface rather than at the top of the B-soil horizon. The AGTEHM approach has conceptual similarities with variable-source-area behavior as described by Hewlett and Nutter (1970) and as simulated by Freeze (1972). Although both the TEHM and AGTEHM can be tuned to provide agreement between measured and simulated hydrographs, the difference in the water flow routing would show large differences when coupled with chemical transport simulation models.

The parameters defining the ramp function in AGTEHM have the same names and are read in the same sequence and format as the TEHM ramp function parameters (Huff et al., 1977; see p. 103). This format is repeated for convenience.

Subroutine	Card number	Columns	Description of Input Data
GETSET			FORMAT (10D8.0)
	8.1	1-8	AREA1; the minimum (fractional) size of contributing areas (suggested value = 0.01 if not known).
		9-16	CUT; the drainage rate (cm/day) from contributing areas when their maximum extent is reached.
		17-24	CUTL; the minimum drainage rate (cm/day) for contributing areas to contribute to streamflow.
		25-32	WUP; the maximum (fractional) size of contributing areas. AREA1 $\leq$ WUP $\leq$ 1.0..

33-40	RNTL; the number of soil-water transmission layers between the saturated zone and the region simulated by PROSPR ($\leq$ 5).

A printout of the contributing area dynamics during storm events can be obtained with an input data switch called ISWIWT. If ISWIWT is nonzero, and if the size of the contributing areas (parameter WT in code) is greater than AREA1 (see above), then the program will write out the value of WT along with the corresponding day, hour, and minute. The variable ISWIWT is read in I5 format from columns 26-30 on card number 6.1 (Huff et al., 1977; see pp. 92-93). If a "1" (or nonzero number) is typed in column 30, the code will print the information about the contributing area dynamics during storm events. This information will not be printed if a "0" is entered in column 30 or if columns 26-30 are left blank.

It is anticipated that alternatives to the ramp function could be used for the variable-contributing-area algorithm to represent differing hydrologic behavior of watersheds with differing slope complexity. Some conceptual functions (Fig. 5) for landscape segments of a watershed with differing permeability and slope complexity would be expected to show greatly different variable-contributing-area behavior during storm events. Recent work by Beven and Kirkby (1979) have shown that geometrical analysis of a watershed can provide a useful basis for prediction of variable-contributing-area behavior.

J. Macropore-Mesopore Soil Water Flow Option

Algorithms for describing the channeling flow of water through soil profiles have been coded into three subroutines (SWIFT, RSWIFT,

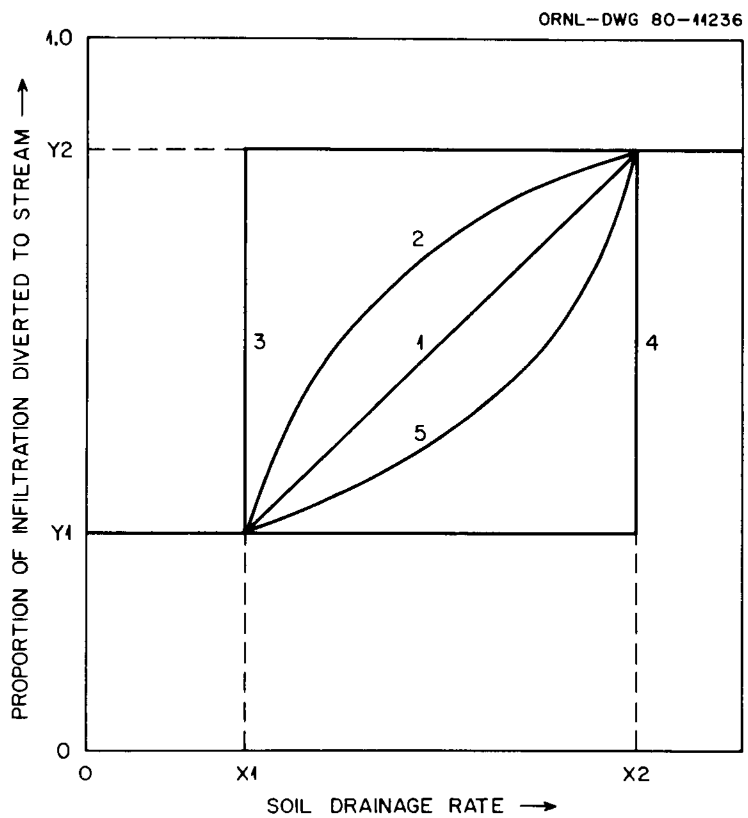


Fig. 5. Conceptual variable-contributing-area relationships for six landscape units where X1 is the soil drainage rate for minimum infiltration diversion (Y1) and X2 is the soil drainage rate for maximum infiltration diversion (Y2). The landscape units are (1) wedge (2D convergence), (2) piece of pie (3D convergence), (3) crusted surface, (4) sandhill, and (5) delta (3D divergence).

WSWIFT) and coupled to AGTEHM. The rationale and documentation of this development is given by Fong and Appelbaum (1980) and a brief outline is given here for user convenience.

Definitions are as follows:

(i) Macropores are large holes or cracks in soil that are water filled at suctions less than 0.3 kPa (3 cm of water, pore diam > 1 mm; crack width > 0.5 mm).

(ii) Mesopores are pores that are water filled at suctions between 0.3 and 30 kPa (3 and 300 cm of water).

(iii) Micropores are water filled pores at suctions greater than 30 kPa (field capacity).

The basic flows considered in the model (Fig. 6) include continuous and dead-end macropores. Continuous macropores pass between soil layers and dead-end macropores exist as reservoirs within a soil layer.

The following assumptions were made in the macropore-mesopore model:

1. Flow rate <u>within</u> macropores is rapid and not controlled by geometrical factors. At each time step, macropore flow between soil layers is the lesser of the macropore water content or the capacity to accept additional macropore water in the lower layer.
2. Flow from macropores to mesopores is controlled by the hydraulic properties of the mesopore matrix using cylindrical and linear flow equations for cylinders and cracks, respectively.

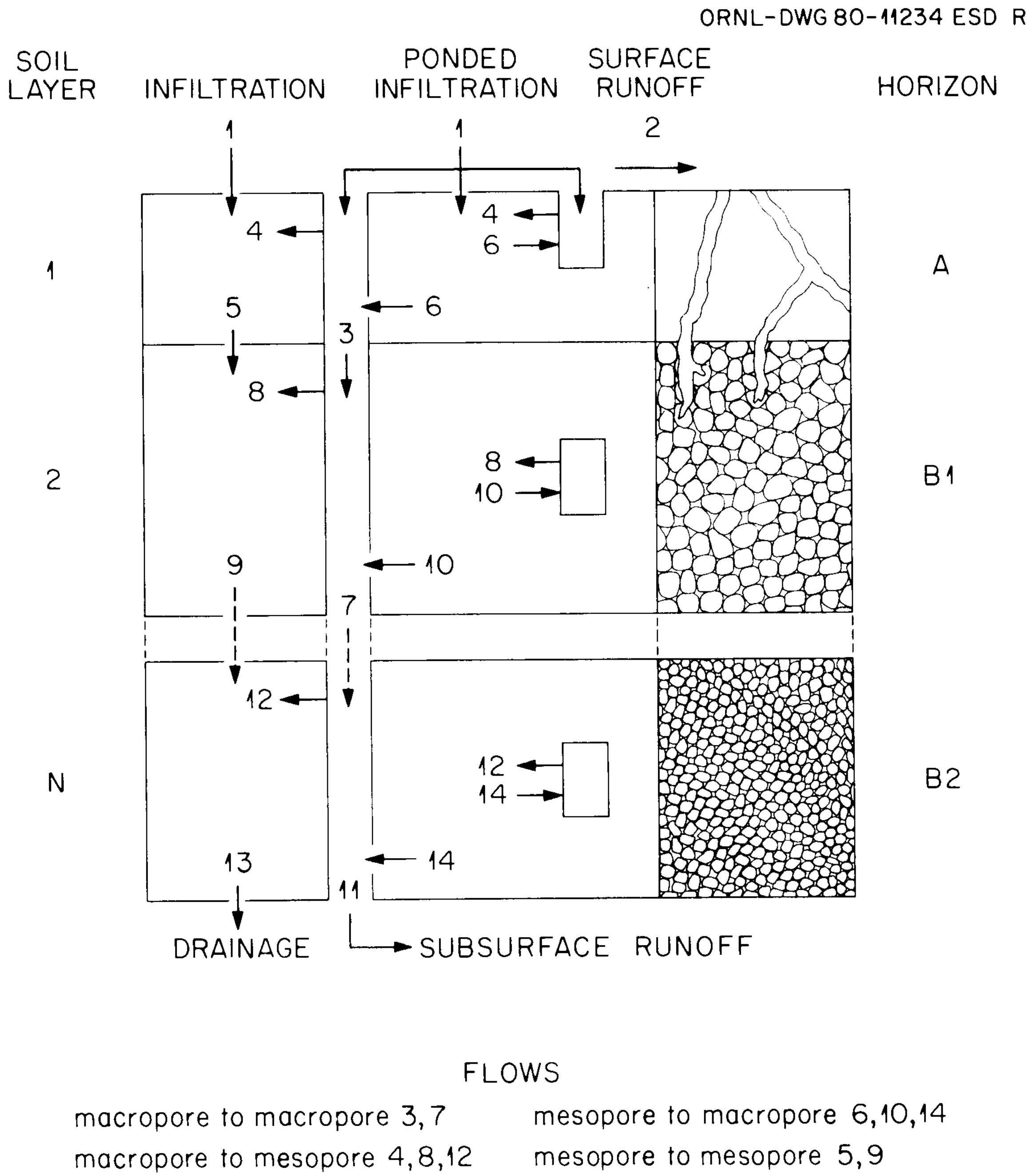


Fig. 6. Continuous and dead-end macropore components in a mesopore matrix showing sequence of flow calculations.

3. Flow from mesopores to macropores results from the excess water entering mesopores above the saturation value.

4. Excess water in the continuous macropore system becomes subsurface runoff (Whipkey, 1967) and enters the stream channel.

5. Drainage from the mesopores enters the deep soil transmission zones and eventually percolates into ground water.

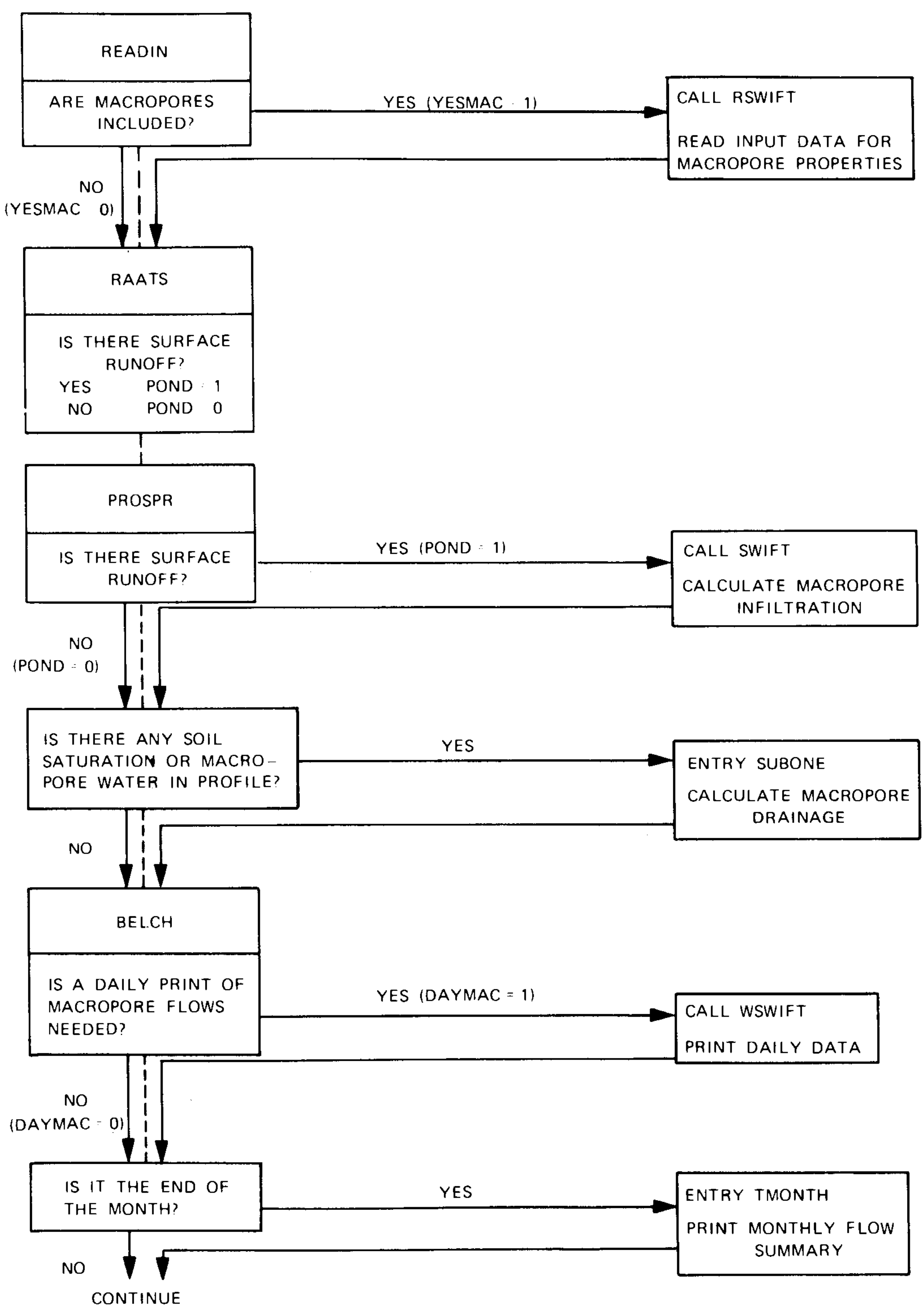
Subroutine RSWIFT is called in subroutine READIN if the macropore option is to be used. The input data for each soil layer are read by RSWIFT and some initial parameter values calculated. The flow calculations of macropore-mesopore drainage are conducted in SWIFT (including a subroutine entry, SUBONE) during periods of surface ponding and perched water tables (saturated zones) within the profile. Daily and monthly summaries of mesopore and macropore flow are printed from subroutine WSWIFT which is called from BELCH. The AGTEHM model can be executed with or without the macropore effects depending on the condition of a flag variable (YESMAC). A logic flow chart (Table 1) outlines the basic procedures involved.

The following give descriptions of the input data required for the macropore-mesopore option. The format here is the same as that used in the TEHM report (Huff, et al., 1977; see pp. 99, 103).

Subroutine	Card Number	Columns	Description of Input Data
READIN	7.11		FORMAT (2G10.3, 2I5, 2F10.0)
		31 - 40	YESMAC; flag for macropore flow effects. YESMAC = 0.0 for no macropore effects. YESMAC = 1.0 for macropore effects.

Table 1. Flow chart of the interrelations between the hydrologic model and the macropore subroutines.

ORNL-DWG 81-5893 ESD



		41 - 50	DAYMAC; flag for daily macropore flow print out. DAYMAC = 0.0 for no daily macropore flow print out. DAYMAC = 1.0 for daily macropore flow print out.
RSWIFT (Called from READIN)	7.33 to 7.32 + NSL		FORMAT (6F10.4); one card per soil layer for NSL soil layers.
		1 - 10	MCPOR; macroporosity of the layer (ml/ml).
		11 - 20	RP; radius of cylindrical pores if in A-horizon (cm) (put 0.0 for B-horizon).
		21 - 30	WP; width of cracks if in B-horizon (cm) (put 0.0 for A-horizon).
		31 - 40	PL; breadth of cracks if in B-horizon (cm) (put 0.0 for A-horizon).
		41 - 50	PERC; proportion of dead-end macropores.
		51 - 60	AGSIZE; average length of aggregate (cm).

III. Subroutines Modified or Added to TEHM to Obtain AGTEHM

The following gives a summary of the subroutines in TEHM that were modified and of those that were added. The reader is referred to Appendix B which contains a listing of the subroutines. The job control language (JCL) used to submit a job to the ORNL IBM computer is given in Appendix D.

A. Changes in Subroutine ANUDAY

Modifications were made in the calling sequence and in the common statements ANGLES and HRLYS to handle parameters for irrigation and hourly radiation on the slope. The hourly radiation on the slope is now determined by calling subroutine HRADSL and passing the result back to subroutine LAND in array HNRAD. Calculations of the cloud cover factors PERMAX, CLD, and STCLD were changed. The daily radiation is now compared with the potential radiation calculated by FUNCTION SOLRAD rather than the previous sinusoidal model. This allows correct variation with latitude. Irrigation data contained in array PKIRIG (see Subroutine RDIRIG below) are examined to see if irrigation water was added during the day. If so, the hourly irrigation values are returned in the array HIRIG.

B. Changes in Subroutine ANUMON

The AGTEHM version of ANUMON calls subroutine MONDAT to compute the hourly model climatological data for the entire month, whereas ANUMON in TEHM calculated these data itself.

C. Changes in Subroutine ANUSEG

The parameter SASTOR was initialized to 0.0D0 and added to the common SRFSUM. Several lines of code, an artifact from an earlier TEHM version, were commented out. These lines involved computation with some variables which are uninitialized and unused in the present version of AGTEHM.

D. Changes in Subroutine ASPECT

The two variables DGLAT and DLONG were added with common ANGLES. These variables are the latitude and longitude of the site, respectively, in decimal degrees and are calculated in subroutine GETSET (see below). Also, ASPECT has been changed from the TEHM version to make it more efficient.

E. Changes in Subroutine BELCH

Two common statements (PIECES and BOOKS) and two subroutine calls (WSWIFT and TMONTH) were introduced into BELCH for the macropore water flow option.

F. Subroutine CHKCIF

Subroutine CHKCIF was written and added to AGTEHM to check the "smoothness" of the cumulative infiltration curve. The cumulative infiltration curve is read in as input data by subroutine READIN (Huff et al., 1977; see p. 103) and READIN then calls CHKCIF. The smoothness of the curve must be checked since, during execution, Lagrangian interpolation is used to calculate the cumulative infiltration for a given simulation time (or the equivalent time for a given cumulative infiltration). The interpolation uses the three "closest" points from the cumulative infiltration curve. Thus, erroneous results could occur if this curve is not smooth (e.g., a parabola could be calculated). The algorithm used by CHKCIF takes the derivative of the Lagrangian polynomial through the first three points of the cumulative infiltration curve, sets it to 0.0, and solves the resulting equation to find the extrumum. If the extrumum lies outside the bounds of the three points, the test is satisfied, and CHKCIF continues by checking the second through fourth points of the curve. CHKCIF marches up the curve until the last three points are checked. If any three successive points fail the test, i.e., the interpolated curve is not monatonic within the bounds of the three points, then CHKCIF immediately stops execution and an error message is printed. For user convenience, the cumulative infiltration data can be checked separately using the utility program given in Appendix A.

G. Changes in Subroutines CLEAR0 and CLEAR2

CLEAR0 and CLEAR2 are used to load the labeled COMMON storage into regions of core that have been cleared to zero values (Patterson et al., 1974). Changes that were made to obtain AGTEHM enabled CLEAR0 and CLEAR2 to reduce the amount of storage that needed to be used.

H. Subroutine DEFER

DEFER is a subroutine that has been added and is called from subroutine MONDAT. It is used to write and retrieve a month's data from storage.

I. Changes in Subroutine EVAL

EVAL was modified to include the algorithm for the hyperbolic relationship between stomatal resistance and leaf-water potential (discussed in Chapter II). Originally, only an exponential model was allowed, which was not suitable for some agricultural crops. If the variable LRMODL is read in as "0" the exponential algorithm is used and if read in as "1" the hyperbolic model is used. Refer to Chapter II for the details.

J. Changes in Subroutine GETSET

The two variables DGLAT and DLONG were added to the common ANGLES. These variables, the latitude and longitude of the site in decimal degrees, are computed just prior to calling subroutine READIN from values which were entered with the precipitation data and were stored in LAT(3) and LONG(3) as integer degrees, minutes, and seconds. The TEHM version passes only the integer degrees to ASPECT in variable ELONG in common LOCATE.

Modifications were made to allow reading of irrigation data preceeded by a data type card, 17 IRRIGATION (refer to Chapter II). When NSD = 17 (see p. 87 of TEHM; Huff et al., 1977), GETSET calls RDIRIG to read the irrigation data.

The change was made to read the switch parameter ISWIWT in I5 format from columns 26 - 30 on card number 6.1 (Huff et al., 1977; see p. 93). If ISWIWT $\neq$ 0, then subroutine LAND will print the variable-contributing-area parameter WT that is calculated in PROSPR for each time step that it is nonzero. That is, WT is the proportion of infiltration that is diverted to the stream (see Fig. 5b). ISWIWT is passed to LAND via the common statement IMPAR.

A section of code executed at the end of subroutine GETSET was rearranged to allow for smoother program flow. Also, the two parameters SNOPAR and DUST were uninitialized in TEHM. In AGTEHM, these two variables are initialized to 0.0.

K. Subroutine HRADSL

Subroutine HRADSL takes the hourly solar radiation incident on a horizontal surface and computes the corresponding hourly solar radiation on a sloping surface. It is assumed that 5.6% of the hourly radiation on the horizontal is diffuse radiation from the sky. The slope is exposed to this diffuse radiation even if the sun has not risen on the slope. This diffuse radiation is, however, multiplied by the fraction of the whole sky visible from the slope. The remaining 94.4% of the incident radiation on the horizontal is assumed to be direct. When the sun is above the horizon on the slope this factor is multiplied by the ratio of the direct radiation on the slope, to the direct radiation on the horizontal and added to the diffuse radiation to give the total radiation for that hour. Correction is also made for map area. Multiple sunrises are considered.

A different formulation for the equation of time is used. The version used in subroutine EQUATI in TEHM has some undesirable numerical properties associated with the way the principal values of the arctangent function are handled.

HRADSL is called from ANUDAY.

L. Subroutine INDEX

This subroutine is called by subroutine MONDAT when calculating the hourly dew point for cases where the hourly dew point is not available. It takes the hourly temperatures for a day and indexes them in increasing order. This routine is used in the implementation of the hourly dew point algorithm explained in Chapter II.

M. Changes in Subroutine LAND

A dimension statement for the two arrays HNRAD and HIRIG was added in subroutine LAND. These arrays were included in the new calling sequence to ANUDAY which returns hourly values of solar radiation on the slope and hourly irrigation values for the day. Hourly sprinkler irrigation values were added to the precipitation values in the new call to subroutine XPREC and hourly flood irrigation conditions are passed to subroutine RAATS. The call to the PROSPR subroutine was modified to include irrigation parameters. The infiltration that is calculated by the RAATS subroutine is multiplied by the variable-source-area parameter (computer name WT) that was computed in subroutine PROSPR (see Chapter II). This result is added to the impervious area runoff, and the remaining water is passed to subroutine PROSPR. LAND prints the variable WT (along with the day, hour, and minute) if the switch parameter ISWIWT is not 0 and if WT > 0.

N. Subroutine MONDAT

Subroutine MONDAT is an added subroutine and is used to process a month's data. MONDAT will enter nominal or calculate daily meteorological data when input data are not available. When hourly input data are not available, MONDAT will enter nominal or calculate hourly meteorological data inferred from the daily data.

O. Subroutine NATEMP

NATEMP is an algorithm that calculates mean daily temperatures in North America (see Chapter II). This subroutine is called by MONDAT if temperature data are not available. The Julian date, the latitude, and the altitude above mean sea level are used in the equation, which is applicable between 25° and 55° North latitude.

P. Changes in Subroutine PEVSRF

In PEVSRF, the calling sequence was changed to remove unnecessary variables and some redundant common statements were deleted. Modifications were made within the routine to make it flow more smoothly.

Q. Changes in Subroutine PROSPR

A few changes were made to PROSPR to allow the routine to run more efficiently. The model calculating the soil moisture content of each layer during flood irrigation (see Chapter II) was added. The algorithm for variable-source-area as described in Chapter II was modified with the results (parameter WT) being passed by common IMPAR to subroutine LAND. If the macropore-mesopore option is needed, PROSPR calls subroutine SWIFT.

R. Changes in Subroutine RAATS

The calling sequence in RAATS was changed to include the irrigation variables IRT (signifies type of irrigation; = K in Chapter II), QHIRRG (quarter-hour irrigation), RIRRG (remaining irrigation), and FIRRG (fraction of the land surface that is flooded). If there is sprinkler irrigation or no flood irrigation (IRT < 2), RAATS proceeds as in the original version. When IRT $\geq$ 2, RAATS computes the infiltration depending on the type of flood irrigation. The corresponding infiltration takes FIRRG into account.

The occurrence of ponded water at the soil surface due to irrigation or excess rainfall results in a switch parameter POND to be set from 0.0 to 1.0. This switch then invokes the macropore algorithms if they are called for by the input data.

S. Subroutine RADIST

Subroutine RADIST uses daily solar radiation to estimate the hourly radiation on a horizontal surface. The hourly radiation, obtained by integrating the solar altitude equation, is reduced by the transmission factor $T_h = e^{\alpha \ell}$ where ℓ is substituted from equation (4) to give

$$T_h = \exp\ (\alpha h\ (2+r)/(\cos\phi + \sqrt{r(2+r) + \cos^2\phi}))\quad , \tag{11}$$

where

r = height of atmosphere/radius of earth $\approx$0.002 (dimensionless),

αh = attenuation coefficient = - 0.106, and

ϕ = solar altitude during the hour (radians).

This transmission factor gives slightly less radiation near sunrise and sunset than does the algorithm used by subroutine SRATIO in TEHM. Subroutine RADIST is called from subroutine MONDAT.

T. Subroutine RDIRIG

Subroutine RDIRIG reads hourly irrigation data. These data are preceeded by the card, 17 IRRIGATION, which signals subroutine GETSET to call RDIRIG (see Chapter II). The packed card images are stored by year and month with other hourly data and examined at daily intervals in subroutine ANUDAY.

U. Changes in Subroutine READIN

One modification made to subroutine READIN was to make the call to subroutine CHKCIF immediately after reading the cumulative infiltration curve (from the input data) in order to check the smoothness of the curve. Another change was that of reading the parameters LRMODL and YESMAC that were discussed in Chapter II. If YESMAC >0.0, subroutine RSWIFT is called from READIN.

V. Subroutine RSWIFT

The input data required for the macropore flow algoritms are read by RSWIFT. This subroutine is called from READIN.

W. Function SOLRAD

Function SOLRAD calculates the potential daily solar radiation at the earth's surface. The daily potential solar radiation on a horizontal surface is calculated from the date, latitude, and solar constant using the algorithm of Swift (1973). The atmospheric transmission factor is estimated from Eq. (11) where ϕ is now the solar altitude from zenith at solar noon (radians). This is the clear air transmission and does not include tropospheric attenuation by clouds.

Function SOLRAD is called from subroutines MONDAT and ANUDAY.

X. Entry SUBONE

The entry to SUBONE is coded in subroutine SWIFT and the call to SUBONE is made from subroutine PROSPR. This entry invokes the macropore flow calculations for soil profile layers below the first soil layer.

Y. Subroutine SWIFT

Macropore flow algorithms for ponded infiltration and perched water tables are conducted by this subroutine. The instruction CALL SWIFT is made from subroutine PROSPR.

Z. Entry TMONTH

Monthly totals of macropore flow results are printed as a result of the ENTRY TMONTH into subroutine WSWIFT. The CALL TMONTH statement is coded in subroutine BELCH.

A1. Subroutine WSWIFT

The daily simulation results of macropore flows are printed (if requested) by WSWIFT which is called from subroutine BELCH. Monthly results are also printed with the entry TMONTH into subroutine WSWIFT.

B1. Changes in Subroutine XPREC

Subroutine XPREC was modified to handle sprinkler irrigation data. The calling sequence was changed and a section of redundant and unnecessary code was removed.

IV. Discussion

All of the new input data options and algorithms documented in this report have been tested through preliminary application of AGTEHM to corn and soybean crop studies and a grassland watershed. These applications and results will be documented in subsequent reports. Advances in understanding and prediction occur through the cycles of model development and application. AGTEHM is best viewed as a research tool for addressing hydrologic hypotheses in agricultural and forestry research. This is a necessary and important step which provides the hydrologic framework for coupling material transport subroutines. There are many chemical pollutant problems resulting from agricultural and forestry practices (pesticides, nitrate) and conversely agricultural and forest ecosystems may be impacted by pollutants from external sources. Systematic analysis of these chemical transport problems can be aided by simulation modeling using AGTEHM as a component model.

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APPENDIX A
UTILITY PROGRAMS

This appendix includes two utility programs used in preparing data for AGTEHM. The first program reads average daytime cloud cover and generates average daily solar radiation data for AGTEHM. A description of the input data to the program is given below. An example input data set to the program is shown along with the corresponding output (Figs. A-1 - A-2). The second program reads the cumulative infiltration curve data and checks its "smoothness" (see Chapter III). This program allows the user to check these data before executing AGTEHM. Again, a description of the input data to the code is given along with a sample input data set (Fig. A-3).

Input Description for Daily Solar Radiation Program

Card	Columns	Description of Input Data
1		FORMAT (A4, A3, 2I2, I1, 22F3.0)
	1-7	T - A seven-character field used to identify the data.
	8-9	IY - A two-digit integer signifying the year of the input.
	10-11	IM - A two-digit integer signifying the month of the input.
	12	N - A single digit number: = 1 for days 1 through 11, = 2 for days 12 through 22, = 3 for days 23 through 31.
	13-15	S(1) - Fraction of possible sunshine for day 1 of month IM If N = 1, day 12 of month IM if N = 2, day 23 of month IM if N = 3. However, this entry is not used in the program.

16-18 C(1) - Fraction of sky covered with clouds for day 1 of month IM if N = 1, day 12 of month IM if N = 2, day 23 of month IM if N = 3 in tenths (e.g., if 4/10 of the sky is covered enter 4.0).

19-78 S(J), C(J), J=2,11 - Similar to columns 13-18 with J signifying days 2 to 11 of month IM if N = 1, days 13 to 22 of month IM if N = 2, days 24 to 31 of month IM if N = 3.

All cards of the input data for this program are similar to card 1. See the sample input data set in Fig. A-1 and the corresponding output in Fig. A-2. The program precedes these figures.

Input Description for the Cumulative Infiltration Check Program

Card	Columns	Description of Input Data
1		FORMAT (I3)
	1-3	NRAATS - The number of points to be included in the table of corresponding time and cumulative infiltration values.
2		FORMAT (16F5.2)
	1-5, 6-10 etc.	CIF(I), I=1, NRAATS - Cumulative infiltration amounts corresponding to the (following) times since the start of water input (cm).
3		FORMAT (16F5.2)
	1-5, 6-10 etc.	RTIM(I), I=1, NRAATS - Elapsed time from beginning point for the cumulative infiltration curve (min).

A sample input data set is shown in Fig. A-3 and the program precedes it. There is no output if the curve is "smooth." Otherwise, an error message is printed, and the user should alter the existing data or add more points or both so that the smoothness checks are satisfied.

```
C        MODEL DAILY RADIATION AT EARTHS SURFACE
      DIMENSION T(2),S(11),C(11),SA(11),NDY(12)
C        NUMBER OF DAYS IN EACH MONTH
      DATA NDY/31,28,31,30,31,30,31,31,30,31,30,31/
C        ALAT IS LATITUDE OF SITE
      DATA IN,IOUT/21,22/,AK/.35/,ALAT/35.3/
C        SEE SIKOV FOR AK PARAMETER
      AK1=1.-AK
C        READ SUNSHINE S (NOT USED HERE),
C        AND FRACTION CLOUD COVER C
   10 READ (IN,1000,END=60) T,IY,IM,N,(S(J),C(J),J=1,11)
      N2=MIN0(11,NDY(IM)-(N-1)*11)
C     WRITE (IOUT,1010) T,IY,IM,N,(C(J),J=1,N2)
 1000 FORMAT(A4,A3,2I2,I1,22F3.0)
      JDY=0
      IF(IM.EQ.1) GO TO 20
      IMM=IM-1
      DO 15 J=1,IMM
   15 JDY=JDY+NDY(J)
   20 JDY=JDY+(N-1)*11
      DO 30 J=1,N2
      JDY=JDY+1
C        GET POTENTIAL SOLAR RADIATION FOR DAY AND LATITUDE
      DY=JDY
      SP=SOLRAD(DY,ALAT)
C        CORRECT FOR CLOUD COVER
   30 SA(J)=SP*(1.-.1*C(J)*AK1)
      WRITE (IOUT,1010) T,IY,IM,N,(SA(J),J=1,N2)
 1010 FORMAT(A4,A3,2I2,I1,11F6.0)
      GO TO 10
   60 CONTINUE
      STOP
      END
      FUNCTION SOLRAD(DJULN,DGLAT)
C        CALCULATION OF DAILY POTENTIAL SOLAR RADIATION
C        ALGORITHM PREPARED BY LLOYD W. SWIFT JR. CHL
C       DJULN IS JULIAN DATE
C       DGLAT IS NORTH LATITUDE IN DEGREES
C       SOLRAD IS POTENTIAL DAILY DIRECT SOLAR RADIATION
C        SUNRN=SOLAR CONSTANT(CAL/CM**2/MIN)
C        AO=ATTENUATION OF RADIATION WHEN THE SUN IS AT ZENITH
C     ALFA=NATURAL LOGRITHM OF ATTENUATION AO
C        HA=EFFECTIVE HEIGHT OF THE ATMOSPHERE/EARTH RADIUS
      DATA SUNRN/1.95/,ALFA,HA/-.106,.002/
C       SOLAR DECLINATION
      SINDEC=.39785*SIN(4.868961+.0172024*DJULN+.033446*
     +       SIN(6.22411+.0172024*DJULN))
      COSDEC=SQRT(1.-SINDEC*SINDEC)
C       ECCENTRICITY CORRECTION TO EARTH ORBITAL RADIUS
      E=1.0-0.0167*COS((DJULN-3.)*0.0172)
C       HOURLY RADIATION INCIDENT ON UPPER ATMOSPHERE
      RI=60.*SUNRN/(E*E)
      RADLAT=DGLAT*.01745329
      SINLAT=SIN(RADLAT)
      COSLAT=COS(RADLAT)
      DAYL=A COS(-SINLAT/COSLAT*SINDEC/COSDEC)
C        DAILY RADIATION INCIDENT ON UPPER ATMOSPHERE
      SOLRAD=RI*7.64*(SINDEC*SINLAT*DAYL+COSDEC*COSLAT*SIN(DAYL))
C        ATTENUATION OF DIRECT RADIATION BY CLEAR ATMOSPHERE
      COSI=COSDEC*COSLAT+SINDEC*SINLAT
      ATTEN=EXP(ALFA*(2.+HA)/(COSI+SQRT(HA*(2.+HA)+COSI*COSI)))
C        POTENTIAL DIRECT RADIATION AT EARTHS SURFACE
      SOLRAD=SOLRAD*ATTEN
      RETURN
      END
```

```
S STUT 75011 80  6 44  8 20 10100  0 88  8100  2  9 10 54  5 64  5 20 10 78  4
S STUT 75012 32  6 96  2 87  6100  4 96  2 39 10 41  8  2 10 97  1 90  5 68  9
S STUT 75013 90  2 16 10 67  6100  1 77  4 52 10 64  8 45 10  0 10
S STUT 75021  0 10  2 10  9 10 14 10 39  9 42  9 98  1 76  9 90  3 45  8 31  8
S STUT 75022 35  8 84  5 80  6 38 10 27 10 64  8 48  8 67  6 96  0 92  2  9 10
S STUT 75023  6 10 56  8100  0 26 10 72  3 78  6
S STUT 75031 73  5 89  6 82  8 49  8100  6 36 10 89  4 98  2 14 10 36 10  6 10
S STUT 75032  6 10  6 10 86  3 42 10 40  9 48 10 42 10 92  1100  7 72  9 94  2
S STUT 75033 26 10 94  1100  0 72  5 20 10  4 10 17 10 90  6 28 10
S STUT 75041100  1 50  8 98  1100  2 98  6 96  4 66 10 13 10 66  9 72  6 82  4
S STUT 75042100  0 42  9 36 10100  2100  4 26 10 53 10 93  2100  0 97  1 80  4
S STUT 75043 74  8 47  8 77  6 72  8 78  8 40 10 58  8 57 10
S STUT 75051 80  4 56  8 72  8 95  0 86  4 78  8 66  6 58  9 63  8 76  6 58  9
S STUT 75052 98  2 97  7 50  9 43 10 44 10 61  4100  0 93  5 80  8 84  7 92  4
S STUT 75053 90  4 86  8 84  6 66  8 90  6 52  9 64 10 76  8 74  7
S STUT 75061 98  0 95  3 92  6 96  1 74  7 79  6 51 10 86 10 63 10 38 10 68  8
S STUT 75062100  0 96  0 62 10 73  6 82  7 66 10 94  4 80  6 96  3 77  6 86  6
S STUT 75063 88  5 95  2 92  3 89  4 70  5 85  2 82  4 86  2
S STUT 75071 83  3 77  8 74  3 86  3 87  4 70  7 58  6 79  6 84  4 70  7 93  2
S STUT 75072 94  2 96  4 98  1100  0 96  4 97  2 68  6 90  6 48  8 70 10 81  4
S STUT 75073 73  7 70 10 48 10 91  8 48  9 82  6 88  4 76  6 28 10
S STUT 75081 37 10 70  8 50 10 74  7 86  4 92  2 94  4 92  2 62  6 78  5 92  2
S STUT 75082 96  2 96  3 93  6 80  8 68 10 76  8 74  9 74  6 84  4 90  2 96  2
S STUT 75083 94  4 86  6 91  4 70  6 76  4 78  4 82  4 70  6 92  4
S STUT 75091 98  1100  0 96  1 97  1 34 10 66  6 97  2 94  3 54  8 64  9 96  6
S STUT 75092 22 10 45  8 57  9 18 10 45 10 42  8 80  4 49  9 96  1 72  8 45  8
S STUT 75093  8  4 49 10 90  2100  1100  0100  0 88  2 86  5
S STUT 75101 58  8100  0100  0 79  4 51  9 55  9 64  8 92  2100  0 99  0 96  2
S STUT 75102100  0100  1100  1 80  4  8 10 78  6 94  3100  0100  0100  0 93  2
S STUT 75103 64  6 52  8  1 10 94  0 30  9 50  8 42 10100  0 95  7
S STUT 75111 87  3 90  6 26 10 34 10 30  8 28  8 56  6 95  1 16  9 99  0 71  3
S STUT 75112100  0 69  4100  1100  0100  4100  0100  0 80  4 68  6  0 10  0 10
S STUT 75113  6  6 89  2 91  8  0 10 98  1  3  6 21 10 31  7
S STUT 75121 98  1100  0100  0 98  8 34  8  0 10  0 10  0 10  0 10100  0 97  2
S STUT 75122 91  8 34  8 10 10  0 10 36  8 32  6 95  2100  1 75  2 66  6 68  8
S STUT 75123 37  7 24 10  0 10  0 10  8 10 82  8 11 10  0 10 13  7
$

.
```

Fig. A-1. Sample input data set (Stuttgart, AK.) for the average daily solar radiation program.

```
S STUT 75 11  198.  156.  114.  328.  158.  288.  117.  226.  227.  119.  252.
S STUT 75 12  209.  301.  212.  260.  307.  125.  172.  127.  341.  248.  154.
S STUT 75 13  326.  132.  233.  360.  287.  137.  190.  140.  141.
S STUT 75 21  143.  144.  146.  147.  176.  178.  405.  182.  356.  214.  217.
S STUT 75 22  219.  311.  284.  165.  166.  230.  233.  299.  495.  435.  177.
S STUT 75 23  179.  247.  520.  184.  427.  327.
S STUT 75 31  365.  333.  265.  267.  343.  198.  423.  502.  204.  206.  208.
S STUT 75 32  209.  211.  490.  215.  257.  218.  220.  593.  348.  267.  565.
S STUT 75 33  229.  616.  664.  452.  236.  237.  239.  420.  242.
S STUT 75 41  652.  337.  661.  619.  437.  533.  254.  255.  304.  450.  549.
S STUT 75 42  746.  311.  264.  659.  564.  268.  269.  673.  777.  730.  580.
S STUT 75 43  378.  380.  485.  383.  385.  282.  388.  284.
S STUT 75 51  602.  392.  394.  823.  611.  398.  507.  346.  401.  512.  349.
S STUT 75 52  734.  461.  352.  298.  298.  633.  857.  580.  413.  470.  640.
S STUT 75 53  641.  416.  530.  418.  532.  363.  306.  421.  478.
S STUT 75 61  879.  708.  537.  825.  481.  539.  310.  310.  310.  310.  426.
S STUT 75 62  888.  888.  311.  542.  485.  311.  658.  543.  716.  543.  543.
S STUT 75 63  600.  774.  716.  658.  600.  772.  657.  772.
S STUT 75 71  713.  425.  712.  712.  654.  481.  538.  537.  651.  479.  763.
S STUT 75 72  762.  647.  817.  872.  644.  756.  529.  528.  415.  302.  637.
S STUT 75 73  468.  300.  299.  409.  353.  518.  626.  515.  295.
S STUT 75 81  294.  402.  292.  453.  614.  719.  610.  715.  499.  551.  707.
S STUT 75 82  704.  649.  490.  384.  279.  381.  328.  480.  580.  679.  676.
S STUT 75 83  572.  470.  567.  465.  561.  559.  556.  456.  550.
S STUT 75 91  691.  735.  683.  680.  253.  438.  621.  571.  339.  291.  425.
S STUT 75 92  242.  330.  283.  237.  236.  321.  492.  274.  612.  312.  310.
S STUT 75 93  474.  223.  549.  585.  621.  616.  532.  409.
S STUT 75101  289.  596.  591.  434.  241.  239.  274.  492.  561.  556.  479.
S STUT 75102  546.  506.  501.  393.  184.  318.  415.  511.  506.  501.  432.
S STUT 75103  300.  234.  169.  477.  196.  224.  162.  458.  247.
S STUT 75111  362.  271.  154.  153.  207.  205.  258.  392.  172.  411.  327.
S STUT 75112  403.  295.  370.  392.  287.  384.  381.  279.  228.  130.  129.
S STUT 75113  223.  315.  172.  125.  330.  214.  122.  189.
S STUT 75121  321.  341.  339.  162.  161.  117.  116.  116.  115.  327.  284.
S STUT 75122  156.  155.  113.  113.  154.  195.  278.  299.  278.  195.  153.
S STUT 75123  174.  112.  112.  112.  112.  154.  113.  113.  176.
$
```

Fig. A-2. Output data from the average daily solar radiation program using the input data from Fig. A-1. These data can then be read by AGTEHM.

```
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION RTIM(50),CIF(50)
      READ(60,50)NRAATS
 50   FORMAT(I3)
      READ(60,100)(CIF(I),I=1,NRAATS)
      READ(60,100)(RTIM(I),I=1,NRAATS)
 100  FORMAT(16F5.2)
      CALL CHKCIF(RTIM,CIF,NRAATS,1)
      CALL CHKCIF(CIF,RTIM,NRAATS,2)
      STOP
      END
      SUBROUTINE CHKCIF(X,Y,NR,IXY)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION X(1),Y(1)
      N=NR
      NM2=N-2
      DO 10 I=1,NM2
      TMDEN1=Y(I)*(X(I+1)-X(I+2))
      TMDEN2=-Y(I+1)*(X(I)-X(I+2))
      TMDEN3=Y(I+2)*(X(I)-X(I+1))
      TMNUM1=TMDEN1*(X(I+1)+X(I+2))
      TMNUM2=TMDEN2*(X(I)+X(I+2))
      TMNUM3=TMDEN3*(X(I)+X(I+1))
      DENOMR=TMDEN1+TMDEN2+TMDEN3
      IF(DENOMR.EQ.0.0)GO TO 10
      XX=0.5*(TMNUM1+TMNUM2+TMNUM3)/DENOMR
      IF(XX.GE.X(I+2).OR.XX.LE.X(I))GO TO 10
      GO TO 20
 10   CONTINUE
      RETURN
 20   IF(IXY.EQ.1)WRITE(61,30)X(I),X(I+2)
 30   FORMAT(1X,'ERROR IN CIF CURVE @ RTIM = ',E11.4,' TO ',E11.4,
     1' (NOT SMOOTH)')
      IF(IXY.EQ.2)WRITE(61,40)X(I),X(I+2)
 40   FORMAT(1X,'ERROR IN CIF CURVE @ CIF = ',E11.4,' TO ',E11.4,
     1' (NOT SMOOTH)')
      STOP
      END
```

```
 16
0.0000.4251.1751.8752.2302.6252.9253.1203.2053.2253.2403.2753.3103.3503.4003.450
   0.  10.  30.  50.  70. 120. 200. 300. 400. 450. 500. 700.1000.1300.1660.2000.
```

Fig. A-3. Sample input data for the cumulative infiltration check program.

APPENDIX B
AGTEHM SUBROUTINE LISTINGS

```
      SUBROUTINE ANUDAY(YEAR,MONTH,DAY,HNRAD,IP,IRT,HIRIG)
C       INITIALIZATION FOR START OF A NEW DAY
      COMMON/TIMES/T1,T2,T3,T4,TMS,TMW,SIGS,SIGW,ALBS,ALBW
      COMMON /RESIST/ R1,R2,R3,R4,R5,RR1,RRA,RRB,RRC,RRR,TM,RLIT
      COMMON/HUMID/FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/DRAG/SDRAG,WDRAG,REDUC
      COMMON /ANGLES/ FILL(6),DGLAT,DLONG
      COMMON/DAILY/DEW(12,31), RAD(12,31), EVAP(12,31), TEM (2,12,31),
     > WINDS(12,31), IFILL(144)
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART, NUMDYS,
     > HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),
     > IRIG,PKIRIG(87)
      COMMON/BLOCKE/RN,GND,TTT,EE,PWP,EV,VEL,JDATE
      COMMON/SHIFT1/ RADCON,CONMLT,SCF,ELDIF,IDNS,FCI,DGM,WC,MPACK, K1,
     > A, LG, SS, NN, K24L, EPXM,SUNCON,CLD,CLDFAC
      COMMON/THINGS/ALBVEG,CANON,CANOFF,SIMIN,SIMAX,ALMIN,ALMAX,SLOPE
      COMMON /SURF/ PWPS,PWPW,PWPMAX,RESS,RESW,RESMAX,POWS,POWW, POWER,
     > LRMODL
      COMMON /GET/ STCLD,MONTHP(12),EPXMIN, EPXMAX,RNON,SUNHR(24),
     > DUST(12),Y,M,T(744),JJ
      REAL*8 SDRAG,WDRAG,REDUC
      REAL*8 PWPS,PWPW,PWPMAX,RESS,RESW,RESMAX,POWS,POWW,POWER
      REAL*8 R1,R2,R3,R4,R5,RR1,RRA,RRB,RRC,RRR,TM,RLIT
      REAL*8 T1,T2,T3,T4,RB,XL,GND,STCLD,TDATE, FOLTYP,ALBVEG,TMS,
     > TMW,SIGS,SIGW, ALBS,ALBW,PAIR,CPO,RX,SIGMA,GM,GV,HT,ALEAF,RN,TTT,
     > EE,PWP,EV, VEL,CANON,CANOFF,SIMIN,SIMAX,ALMIN,ALMAX,SLOPE
      REAL IDNS,MPACK,K1,LG,K24L,NN
      INTEGER DAY,YEAR,Y
      DIMENSION HNRAD(24),HIRIG(24)
C
      JLAST=JSTART+NUMDYS
      JDATE=JSTART+DAY
      TDATE=JDATE
      XDATE=JDATE
C     SET DAILY VALUE OF EPXM (INTERCEPTION STORAGE),
C     ALEAF (LEAF AREA), ALBVEG (ALBEDO OF VEGETATION)
      IF (TDATE.LT.T4.AND.TDATE.GT.T1) GO TO 10
C       WINTER VALUES
      EPXM = EPXMIN
      ALEAF=ALMIN
      ALBVEG=ALBW
      SIGMA=SIGW
      PWPMAX=PWPW
      RESMAX=RESW
      POWER=POWW
      REDUC=WDRAG
      TM=TMW
      GO TO 50
C       SOME NON-WINTER VALUES
   10 SIGMA=SIGS
      PWPMAX=PWPS
      RESMAX=RESS
      POWER=POWS
      TM=TMS
      IF (TDATE.GT.T2) GO TO 20
C       COEFFICIENTS FOR SPRING VALUES
      FRS=(TDATE-T1)/(T2-T1)
      FRW=1.-FRS
      GO TO 40
   20 IF (TDATE.GT.T3) GO TO 30
C       SUMMER VALUES
```

APPENDIX B (continued)

```
      EPXM=EPXMAX
      ALEAF=ALMAX
      ALBVEG=ALBS
      REDUC=SDRAG
      GO TO 50
C        COEFFICIENTS FOR FALL VALUES
   30 FRW=(TDATE-T3)/(T4-T3)
      FRS=1.-FRW
   40 EPXM=FRS*EPXMAX+FRW*EPXMIN
      ALEAF=FRS*ALMAX+FRW*ALMIN
      ALBVEG=FRS*ALBS+FRW*ALBW
      REDUC=FRS*SDRAG+FRW*WDRAG
   50 CONTINUE
C        ESTIMATE CLOUD COVER, STATISITICAL CLOUD FACTOR
      PERMAX=AMIN1(RAD(MONTH,DAY)/SOLRAD(XDATE,DGLAT),1.)
      CLD=1.0-(PERMAX-0.1)/.9
      IF (PERMAX.LE.0.1) CLD=1.0
      STCLD = 0.9*CLD**2
C        HOURLY SOLAR RADIATION INCIDENT ON SLOPE
      CALL HRADSL(XDATE,HRAD(1,DAY),HNRAD)
      GND=GROUND(GM,GV,TDATE)
      RIF=1.-ALBVEG-GND/RAD(IMO,DAY)
      CLDFAC=1.-STCLD
      SR2=RAD(MONTH,DAY)
      CALL SUNMAP(XDATE,SR2)
      SOLNET=(SR2*(1.-ALBVEG))-GND
      SUNCON=SR2/SOLNET
C        CORRECT FOR ALBEDO TO GET NET RADIATION
      DO 60 IH=1,24
      HNRAD(IH)=HNRAD(IH)*RIF
   60 HIRIG(IH)=0.
      IRT=0
   70 IF(IP.GT.IRIG) GO TO 110
C        LOOK FOR IRRIGATION DATA
      K=PKIRIG(IP)
      ID=K/100000
      IF(ID.NE.DAY) GO TO 110
      K=K-100000*ID
      IH=K/1000
      K=K-IH*1000
      IH=IH-1
      IN=K/10
      IRT=K-10*IN
      IF(IRT.EQ.3) GO TO 90
      IPL=IP
      IP=IP+IN+1
      IF(IN.LE.0) GO TO 110
      DO 80 I=1,IN
   80 HIRIG(IH+I)=PKIRIG(IPL+I)
      GO TO 70
   90 DO 100 I=1,IN
  100 HIRIG(IH+I)=1.0
      IP=IP+1
      GO TO 70
  110 CONTINUE
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE ANUMON(TL,TE,HOUR,YEAR,MONTH,MIN,DAY,IDN)
C
C       PERFORM INITIALIZATIONS FOR START OF A NEW MONTH
      COMMON/UNITS/ DRUM, IDRUM, PDRUM, SDRUM, RDRUM, SCRACH
      COMMON/C/MONTHS(12)
      COMMON/E/ PREC, DEPS, SURF, RSRF, INV, MAXWYR, TAPESZ, DATE(4)
      COMMON/M30/DUMMY1,DUMMY2,RS30M(6,1488)
      COMMON/PDTEMP/IDUMMY(5),TEMPX(6,31,24)
      COMMON/TOTS/TOTALS(2,3)
C
      COMMON/INVGA/STANF,WB,NAME(6),ELEV,LAT(3),LONG(3),
     + GTYPE(2),INTRVL,ELEM(5),
     + INITP,DSNAME,STRTYR,ENDYR, INITS,RODSNA,ROSTYR,RENDYR,
     + INITD,DDSNAM,DSTYR,DENDYR, INITR,DSDSNA,DSSTYR,DSENDY,
     + FRADCN,FCNMLT,FSCF,FELDIF,FIDNS,FFCI,FDGM,FWC,FMPACK,
     + FK1,FA, FL, FSS, FNN, FK24L, FEPXM,
C      THE FOLLOWING 13 PARAMETERS TEMPORARILY REMOVED 12 19 75
C     + BARES, ANOTS, KDS, LFTOVS, OCRITS, ONCRTS, AZEROS, SDPMS, SEDMPS
C     + ,SONES, STWOS, STRES, SFORS,
     + SGWINV,LZSINV,LIQW,DEPTH,NEMELT,PACK,KEYTIM,
     + DUM1,DUM2,UNUSED(24)
C     CONTAMINANT TRANSPORT REMOVED TEMPORATILY 12-19-75-DDH
C     COMMON/SHIFT2/
C    + BARE, ANOT, KD, LFTOVR, OCRIT, ONCRIT, AZERO, SDPM, SEDMP,
C    + SONE, STWO, STRE, SFOR
      COMMON/SHIFT3/ SGW, LZS, WTRT, DEPTHT, COLDT, PACKT
      COMMON /SOISNO/ SG,LZ,WCON,SDE,COL,PAC
      DIMENSION SOIL(2),SNOW(4),SOILM(2),RLTEMP(13)
     +  ,RLNPAR(13),INVTMP(4),SNOPAK(9),IDN(12)
      EQUIVALENCE (SNOW(1),WCON),(SOIL(1),SG),
     + (SOILM(1),SGWINV),(RLTEMP(1),BARE),(RLNPAR(1),BARES),
     +(INVTMP(1),SGW),(SNOPAK(1),LIQW),(TOTALS(1,1),DUMTOT(1))
        COMMON/NMON/NOW,KEY,SEG,HRNI,TARGET,NXTF
      REAL  INVTMP,LZS,LZSINV,LIQW,NEMELT,LZ
C    + ,KD,LFTOVR,OCRIT,ONCRIT
      INTEGER DUMTOT(3),TL,TE,DAY,SEG,TARGET,SURF,
     +  TAPESZ,DSNAME,YEAR,HOUR,PREC,DSENDY,DUMMY1,DUMMY2,
     + STRTYR,ENDYR,RODSNA,ROSTYR,RENDYR,DSTYR,DENDYR,DSDSNA,
     +  DSSTYR,PDRUM,SCRACH,DRUM,RDRUM
      INTEGER*2 RS30M,TOTALS,TEMPX
      COMMON/DAILY/DEW(12,31), RAD(12,31), EVAP(12,31),
     & TEM (2,12,31),WINDS(12,31),IFILL(144)
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART,
     & NUMDYS,HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31)
     & ,IRIG,PKIRIG(87)
      DATA IDY/ 0/
C
       IF (TL.NE.TE) GO TO 32
C
C      FIRST TIME INTERVAL OF MONTH   ************************************
C
C     DO 773 L = 1, 13
C 773 RLNPAR(L) = RLTEMP(L)
      DO 774 L = 1, 2
      SOILM(L) = INVTMP(L)
      SOIL(L) = SOILM(L)
  774 SNOW(L) = SNOPAK(L)
C      KTIME = 1
   32 NOW = TL
      CALL DATIM(TL,YEAR,MONTH,DAY,HOUR,MIN)
      HOUR = 0
```

APPENDIX B (continued)

```
      MIN = 0
      IF(IDY.NE.0) GO TO 10
      MON=MONTH
      DO 15 J=1,12
      IDN(J)=MON
      MON=MON+1
      IF(MON.EQ.13) MON=1
   15 CONTINUE
      IDY=1
   10 TARGET = TE
      IF (NOW.GE.TARGET) GO TO 1000
      NXTF=1
      IF(MONTH.EQ.10) GO TO 4
      NX=MOD(MONTH+1,12)+1
      DO 5 I=1,NX
      II = MOD((I+8),12) + 1
  5   NXTF = NXTF + LASDAY(YEAR,II)
    4 NXTF=NXTF+NXTF
C        ZERO ARRAY TO RECEIVE RUNNOFF AND OUTFLOWS
      DO 200 NDEX = 1,6
      DO 200 INDEY = 1, 1488
  200 RS30M(NDEX,INDEY) = 0
C        LOAD MONTHS PRECIPITATION DATA FROM PRECIP FILE
      NREC = 12 * YEAR + MONTH + 3
      CALL TSEARC (PDRUM,PREC,DSNAME,NREC,RP,1493)
      CALL IN (PDRUM,RP,IDUMMY,1493)
      KEY = IDUMMY(2)
      DO 5555 II=1,3
5555  DUMTOT(II) = IDUMMY(II+2)
C       SEE EQUIVALENCE STATEMENT FOR DUMTOT ARRAY
      RP = RP + 1
      WRITE(6,2020)  MONTHS(MONTH), YEAR, SEG, DSNAME, NREC
 2020 FORMAT(1H1,
     +          ' SIMULATION OF ',A4,' 19',I2,' BEGINS FOR SEGMENT NO. ',
     +I3,'. PRECIP FILE KEY = ',I6,I4)
C
C        LOAD MONTH OF HOURLY METEOROLOGICAL DATA
      CALL MONDAT(YEAR,MONTH,1)
C
      PRINT 103
  103 FORMAT(T1,'0 DAY  INFILT   RUNOFF      DRAINAGE       ET
     +FLLAT     FLNET        SURF.CON   SURF.POT      THETA1      THETA2
     +THETAN')
      PRINT 104
  104 FORMAT(T7,' (CM)       ------------------(CM PER DAY)--------------
     +-------------        (CM/SEC)     (BAR)    -(CM PER CM)-')
1000     CONTINUE
         RETURN
         END
```

APPENDIX B (continued)

```
      SUBROUTINE ANUSEG(DCS,SINTC,BAL,IDX15,IDX30,SINT)
      DOUBLE PRECISION SSGT(10)
      COMMON/SATMP/SSGT/TLYR/NTL
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/SHIFT1/ RADCON,CONMLT,SCF,ELDIF,IDNS,FCI,DGM,WC,MPACK, K1,
     > A, LG, SS, NN, K24L, EPXM,SUNCON,CLD,CLDFAC
C      CONTAMINANT TRANSPORT IS REMOVED TEMPORARILY. 12 19 75-DDH.
C      COMMON/SHIFT2/
C     + BARE, ANOT, KD, LFTOVR, OCRIT, ONCRIT, AZERO, SDPM, SEDMP,
C     + SONE, STWO, STRE, SFOR
      COMMON/MISC/ SIMP,SSUR,SAR1,SAR2,SBAS,STOT,SRCH,SLTO,SRA,SIEN,
     > SPRS,SOILEV, TOTELH,SNEVAP,SNET,SPET,STSNO,SCEP,RES,STDEP,STUS,
     > STDS1,STDS2,STGW,STBT
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/SSF/SSG(5)/RKUTT/DEL,ACCURC,IMAX
      COMMON/SRFSUM/SFLO1,SFLO2,SFLO3,SGWIN,S2TO,S3TO,SASTOR
      COMMON/SHIFT3/ SGW, LZS, WTRT, DEPTHT, COLDT, PACKT
      COMMON/INVGA/STANF,WB,NAME(6),ELEV,LAT(3),LONG(3),GTYPE(2),INTRVL,
     >  ELEM(5), INITP,DSNAME,STRTYR,ENDYR, INITS,RODSNA,ROSTYR,RENDYR,
     > INITD,DDSNAM,DSTYR,DENDYR, INITR,DSDSNA,DSSTYR,DSENDY, FRADCN,
     > FCNMLT,FSCF,FELDIF,FIDNS,FFCI,FDGM,FWC,FMPACK, FK1,FA, FL, FSS,
     > FNN, FK24L, FEPXM,
C      THE FOLLOWING 13 PARAMETERS TEMPORARILY REMOVED 12 19 75
C     + BARES, ANOTS, KDS, LFTOVS, OCRITS, ONCRTS, AZEROS, SDPMS, SEDMPS
C     + ,SONES, STWOS, STRES, SFORS,
     +SGWINV,LZSINV,LIQW,DEPTH,NEMELT,PACK,KEYTIM, DUM1,DUM2,UNUSED(24)
      COMMON/SURFXP/RZ,PR,ORAIN,FF,FIXM,RGX,SHRD,A3,AUZS,ASDS,AINF
      COMMON/NSEG/ SRC,DEC,IDX,SSG1,RES1,SGW1,LZS1,ASPR,CKDH, SFILT,
     > LIQW1,PACK1,SSG2,SCEP1,SNOBAL,STRANS,SDDRAN,SINTFA
      COMMON/SNO/SSCEP,PCKRN,SMELT,MSRVAP,SUMSNO,SDEN,ALBEDO
      COMMON/AR/AREA1,AREA2,PA
      COMMON/PEV/CNPE,DSEQL,DSOLOS
      REAL NN,LZS1,LIQW1,INVTMP(2) ,IDNS,MPACK,K1,LG,K24L, LZSINV,
     > LIQW,NEMELT,LZS,MSRVAP
      INTEGER DSNAME,STRTYR,ENDYR,RODSNA,ROSTYR,RENDYR,DSTYR,DENDYR,
     > DSDSNA,DSSTYR,DSENDY,DCS(13)
      REAL*8 SSG,S2TO,S3TO,SFLO1,SFLO2,SFLO3,VP,F,S,SEV, ETGW,
     > DNFAC,WP1,WP2,SGWIN,DL,AT,ARAT,FC,THETA,SWT ,AREA1,AREA2,PA,
     > DEL,ACCURC,SASTOR
      DIMENSION SOILM(2),STRAYS(25),SLTEMP(16)
      EQUIVALENCE (INVTMP(1),SGW),(SOILM(1),SGWINV), (STRAYS(1),SIMP),
     > (SLTEMP(1),RADCON)
      SRC = 1020.*SQRT(SS)/(NN*LG)
      DEC = 0.00982*((NN*LG/SQRT(SS))**0.6)
C     PA = 1.0-A
      DO 10 L = 1, 18
   10 STRAYS(L) = 0.0
      SINT=0.
      DO 20 L = 1, 2
   20 INVTMP(L) = SOILM(L)
      IF (DCS(10).EQ.0) PACK=0.0
      BAL=0.0
      SNOBAL=0.0
      STRANS=0.0
      SDDRAN = 0.0
      SGWIN = 0.0
      SFLO1 = 0.0
      SFLO2 = 0.0
      SFLO3 = 0.0
      S2TO = 0.0
      S3TO = 0.0
```

APPENDIX B (continued)

```
      SASTOR=0.0D0
      DO 40 J=1,NTL
   40 SSGT(J)=SSG(J)
      RES1 = RES
      SINTFA = 0.0
      SFILT=0.0
      SINTC=0.0
      PCKRN=0.0
      SMELT=0.0
      LIQW1=LIQW
      CNPE=0.0
      PACK1=PACK
      SUMSNO=0.0
      MSRVAP=0.0
      SSCEP=0.0
C     SRGX1=0.0
      SGW1 = SGW
      LZS1 = LZSINV
      SCEP1=0.0
      IDX = 1
      IDX15 = 1
      IDX30 = 1
      ASPR =1.0
      CKDH = 1.
      RETURN
      END
```

```
      SUBROUTINE ASPECT
      COMMON/ANGLES/RADINC,RADLAT,DELONG,PI,D,EQLAT,DGLAT,DLONG
      REAL*8 RADINC
      PI=3.141592654D0
      FAC=PI/180.0
      READ(5,10100) DEGINC,AZIM,DGLAT
      RADINC=DEGINC*FAC
      RDAZ=AZIM*FAC
      RADLAT=DGLAT*FAC
      COSLAT=COS(RADLAT)
      SINLAT=SIN(RADLAT)
      RDINC=RADINC
      COSINC=COS(RDINC)
      SININC=SIN(RDINC)
      COSAZ=COS(RDAZ)
      SINAZ=SIN(RDAZ)
      EQLAT=ARSIN(COSINC*SINLAT+SININC*COSLAT *COSAZ)
      DENOM=COSINC*COSLAT-SININC*SINLAT *COSAZ
      DELONG=ATAN2(SININC*SINAZ,DENOM)
      DEQLAT=EQLAT/FAC
      WRITE(6,10000) DEGINC,AZIM,DGLAT,DLONG,DEQLAT,DELONG
      RETURN
10000 FORMAT(' DEGINC=',F7.2,5X,'AZIM=',F7.2,5X,'DGLAT=',
     & F7.2,5X,'DLONG=',F7.2,5X,'DEQLAT=',F7.2,5X,'DELONG=',
     & F7.2)
10100 FORMAT(3F10.5)
      END
```

APPENDIX B (continued)

```
      SUBROUTINE BELCH(JLAST)
      IMPLICIT REAL*8 (A-H,O-Z)
      REAL*8 MACEX
      DIMENSION FBETA(8),FDBET(8)
      COMMON/THINGS/ALEVEG,CANON,CANOFF,SIMIN,SIMAX,ALMIN,ALMAX,SLOPE
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/HUMID/FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/BLOCKE/RN,GND,TTT,EE,PWP,EV,VEL,JDATE
      COMMON/PLACE/ CASEID(20),LASTDY(12),MOBEG
      COMMON/SOLPOT/PSI(8)
      COMMON/TOTMON/ROFF,TDRN,PSEUDO,ETOT,PTOT,PRES,RF1MON,RF2MON
      COMMON/TOTDAY/DDRAIN,DET,FLLAT,FLNET,RUNO,DPTOT
      COMMON/DAYMID/RM,POT,SW1M,SW2M,SWNM
      COMMON/PIECES/TRUNO,ZS(8),PRE1,POND,TBET(8),YESMAC,PSM(8),REMAIN
      COMMON/BOOKS/DMEMA(8),DMAME(8),DMAMA(8),MACEX(8),BETA(8),DBET(8)
      DATA PTOTAL,ETOTAL/0.,0./,STMAC/0.0/
      DATA FBETA,FDBET/0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
     10.,0./
      SWAT1=SW1M/DL(1)
      SWAT2=SW2M/DL(2)
      SWATN=SWNM/DL(NSL)
      PSL=POT*9.81D-4
      CM=1./RM
      WRITE(6,10000) JDATE,DPTOT,RUNO,DDRAIN,DET,FLLAT,FLNET,CM,PSL,
     > SWAT1,SWAT2,SWATN
      IF(YESMAC.GT.0.) CALL WSWIFT
      IF(JDATE.NE.JLAST) GO TO 40
   10 PRINT 10100
      WINL=0.
      WFIN=0.
      DO 20 K=1,NSL
      WFIN=WFIN+THETA(K)
   20 WINL=WINL+SWT(K)
      SOILWT=WFIN-WINL
      IF(YESMAC.EQ.0.)GO TO 27
      SMINL=0.0
      SMFIN=0.0
      DO 25 K=1,NSL
      SMFIN=SMFIN+BETA(K)+DBET(K)
 25   SMINL=SMINL+FBETA(K)+FDBET(K)
      STMAC=SMFIN-SMINL
 27   CONTINUE
      BALANC=PTOT-ROFF-PSEUDO-TDRN-ETOT-SOILWT-STMAC
      PRINT 10200, PTOT,ETOT,ROFF,TDRN,PSEUDO,SOILWT,BALANC,RF1MON,
     > RF2MON
C
      IF(YESMAC.GT.0.)PRINT 10400, STMAC
C       DO 23 I=1,NSL
C   23 PRINT 10500, BETA(I),FBETA(I),DBET(I),FDBET(I)
      IF(BALANC.GT.0.5) CALL ERROR
      PTOTAL=PTOTAL+PTOT
      ETOTAL=ETOTAL+ETOT
      PTOT=0.
      ETOT=0.
      ROFF=0.
      TDRN=0.
      PSEUDO=0.
      RF1MON=0.
      RF2MON=0.
      IF(YESMAC.EQ.0.0)GO TO 29
```

APPENDIX B (continued)

```
      DO 28 K=1,NSL
      FBETA(K)=BETA(K)
 28   FDBET(K)=DBET(K)
 29   DO 30 K=1,NSL
   30 SWT(K)=THETA(K)
      IF (YESMAC.GT.0.) CALL TMONTH
      IF (JLAST.NE.273.OR.JAST.NE.274) GO TO 40
      PRINT 10300, PTOTAL,ETOTAL
      PTOTAL=0.
      ETOTAL=0.
   40 CONTINUE
      RETURN
10000 FORMAT(I5,2X,D8.2,2X,5(D10.4,1X),2X,2(D10.4,1X),2X,3D10.4)
10100 FORMAT('OMONTHLY WATER BUDGET (CM)')
10200 FORMAT(T1,'OTOTAL INFILTRATION, EVAPOTRANSPIRATION, RUNOFF, DRAINA
     >GE, LATERAL FLOW, SOIL WATER CHANGE AND BALANCE (CM)'/(T6,' ',7G15
     >.7)/1X,'ROOT WATER UPTAKE (CM) LAYER 1 ',G15.7,' LAYER 2 'G15.7)
10300 FORMAT('OANNUAL INFILT IS ',G15.7,'AND ANNUAL ET IS ',G15.7,'CM')
10400 FORMAT(' MONTHLY MACROPORE WATER STORAGE CHANGE (CM) ',G15.7)
C     >/'  MACROPORE WATER CONTENT - BETA,FBETA,DBET,FDBET')
C10500 FORMAT(10X,4G15.7)
      END
```

```
      SUBROUTINE CHKCIF(X,Y,NR,IXY)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION X(1),Y(1)
      N=NR
      NM2=N-2
      DO 10 I=1,NM2
      TMDEN1=Y(I)*(X(I+1)-X(I+2))
      TMDEN2=-Y(I+1)*(X(I)-X(I+2))
      TMDEN3=Y(I+2)*(X(I)-X(I+1))
      TMNUM1=TMDEN1*(X(I+1)+X(I+2))
      TMNUM2=TMDEN2*(X(I)+X(I+2))
      TMNUM3=TMDEN3*(X(I)+X(I+1))
      DENOMR=TMDEN1+TMDEN2+TMDEN3
      IF(DENOMR.EQ.0.0)GO TO 10
      XX=0.5*(TMNUM1+TMNUM2+TMNUM3)/DENOMR
      IF(XX.GE.X(I+2).OR.XX.LE.X(I))GO TO 10
      GO TO 20
 10   CONTINUE
      RETURN
 20   IF(IXY.EQ.1)WRITE(6,30)X(I),X(I+2)
 30   FORMAT(1X,'ERROR IN CIF CURVE @ RTIM = ',E11.4,' TO ',E11.4,
     1' (NOT SMOOTH)')
      IF(IXY.EQ.2)WRITE(6,40)X(I),X(I+2)
 40   FORMAT(1X,'ERROR IN CIF CURVE @ CIF = ',E11.4,' TO ',E11.4,
     1' (NOT SMOOTH)')
      STOP
      END
```

APPENDIX B (continued)

```
      SUBROUTINE CLEAR0                                                 CLE0  10
C       NEW DIMENSIONS 5/10/77 - JTH                                    CLE0  20
      DIMENSION L(87000)                                                CLE0  30
      CALL CLEAR(L,87000,0.0)                                           CLE0  40
      RETURN                                                            CLE0  50
      END                                                               CLE0  60
      SUBROUTINE CLEAR2                                                 CLE2  10
C       NEW DIMENSIONS 5/10/77 - JTH                                    CLE2  20
      DIMENSION L(70000)                                                CLE2  30
      CALL CLEAR(L,70000,0.0)                                           CLE2  40
      RETURN                                                            CLE2  50
      END                                                               CLE2  60
```

```
      ENTRY OFFER                                                       DEFE1230
C      WRITE REMAINING DATA ON FILE FOR POSSIBLE SAVING                 DEFE1240
      IBB=2                                                             DEFE1250
      IF(IWRT.EQ.1) GO TO 40                                            DEFE1260
  200 WRITE (10'1) JAM                                                  DEFE1270
      PRINT 1310,MREC,LREC,NREC                                         DEFE1280
 1310 FORMAT(////1X,'MREC =',I4,5X,'LREC =',I4,5X,'NREC ='I4//)         DEFE1290
      PRINT 1320                                                        DEFE1300
 1320 FORMAT(4X,'NTRY',5X,'LOCREC',4X,'LOCREF'/)                        DEFE1310
      DO 210 I=1,NREC                                                   DEFE1320
  210 PRINT 1300,NTRY(I),LOCREC(I),LOCREF(I)                            DEFE1330
 1300 FORMAT(1X,3I10)                                                   DEFE1340
      IF(ISTOP.NE.0) STOP 10                                            DEFE1350
      RETURN                                                            DEFE1360
      END                                                               DEFE1370
```

APPENDIX B (continued)

```
      SUBROUTINE DEFER
C
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART,
     & NUMDYS,HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),
     & IRIG,PKIRIG(87)
      DIMENSION BUFFER(3072),JAM(154),NTRY(50),LOCREC(50),
     & LOCREF(50)
      EQUIVALENCE (IYR,BUFFER(1)), (MDUMY,JAM(1)),(MREC,JAM(2)),
     & (LREC,JAM(3)),(NREC,JAM(4)),(NTRY(1),JAM(5)),
     & (LOCREC(1),JAM(55)),(LOCREF(1),JAM(105))
      DATA MXREC/16/, MDUMY/0/, ISTOP/0/
C
C       DEFINE RANDOM ACCESS FILE ON UNIT 10 WITH A MAXIMUM OF
C       MXREC RECORDS EACH OF LENGTH 3072 WORDS AND UNFORMATTED
C       ACCESS WITH ASSOCIATED VARIABLE IVAR
C       MXREC MAY BE MADE AS LARGE AS 50 WITHOUT CHANGING THE
C       EQUIVALENCE STATEMENT ABOVE, BUT CHANGE DEFINE FILE TOO
C
C     DEFINE FILE 10(MXREC,3072,U,IVAR)
C
      DEFINE FILE 10(16,3072,U,IVAR)
C       ASK IBM WHY THIS WRITE IS NECESSARY!!!
      WRITE (10'1) MDUMY
      MUREC=MXREC-1
      READ (10'1) JAM
      IF(LREC.EQ.3072) RETURN
C       THIS IS A NEW FILE SO SET UP REFERENCE INFORMATION
      DO 30 I=1,154
   30 JAM(I)=0
      MREC=MXREC
      LREC=3000
      RETURN
C
C       THE ARRAYS NTRY, LOCREC, AND LOCREF ALLOW INDEXING OF
C       RECORDS BY YEAR AND MONTH OR RECORD NUMBER WITH CROSS
C       REFERENCES FOR VALIDITY CHECKS WHEN WRITING RECORDS
C
      ENTRY PROFER
      IBB=1
C       WRITE OUT RECORD IN BUFFER
   40 INTRY=IYR*12+IMO
      IF(IREC.GE.MUREC) GO TO 90
      IBR=1
C       GO FIND PROPER POSITION IN STACK IF NEW ENTRY
      IF(IREC.EQ.NREC+1) GO TO 140
C       CHECK RECORD CROSS REFERENCES BEFORE STORING
      INDX=LOCREF(IREC)
      IF(NTRY(INDX).NE.INTRY) GO TO 95
      IF(LOCREC(INDX).NE.IREC) GO TO 95
      GO TO 80
C       RETURN TO HERE FROM TABLE SEARCH (STATEMENT 140)
   60 IF(IPLACE.GT.NREC) GO TO 75
C       PUSH PART OF STACK DOWN
      K=NREC
      DO 70 I=IPLACE,NREC
      NTRY(K+1)=NTRY(K)
      LOCREC(K+1)=LOCREC(K)
      INDX=LOCREC(K+1)
      LOCREF(INDX)=LOCREF(INDX)+1
   70 K=K-1
   75 NTRY(IPLACE)=INTRY
```

APPENDIX B (continued)

```
      NREC=NREC+1
      LOCREC(IPLACE)=NREC
      LOCREF(NREC)=IPLACE
C      WRITE OUT RECORD
   80 KREC=IREC+1
      WRITE (10'KREC) BUFFER
      GO TO (85,200),IBB
   85 RETURN
C      ERROR MESSAGES
   90 PRINT 1100,IREC,INTRY,IYR,IMO,LOKN,MUREC
 1100 FORMAT('0PROFER - DATA FILE OVERFLOW ON RECORD',I3,
     & ' => ',I8,' (',I2,1H.,I2,A5,')'/'  ONLY',I3,
     & 'MONTHS DATA CAN BE STORED')
      RETURN
   95 PRINT 1101,INTRY,IYR,IMO,LOKN
 1101 FORMAT('0PROFER - FILE ENTRY FOR RECORD',I8,'  (',I2,
     & 1H.,I2,A5,')  NOT CONSISTANT')
      ISTOP=1
      GO TO 200
C
      ENTRY GOFER(IYEAR,MONTH,NXREC)
C
C      RETRIEVE DATA FOR YEAR "IYEAR" AND MONTH "MONTH"
C      IF IT IS ON FILE IN WHICH EVENT NXREC=0.
C      OTHERWISE SET NXREC=NREC+1, THE NEXT AVAILABLE
C      RECORD.
C
      INTRY=IYEAR*12+MONTH
      NXREC=NREC+1
      IF(NREC.EQ.0) GOTO 110
      IBR=2
C      BRANCH TO SEARCH PROCEDURE FOR ENTRY IN TABLE
      GO TO 140
C      RETURN FROM SEARCH FOR ENTRY IN TABLE
  100 IF(IPLACE.GT.NREC) GO TO 110
      IF(NTRY(IPLACE).NE.INTRY) GO TO 110
C      FOUND RECORD REFERENCE, NOW READ RECORD
      KREC=LOCREC(IPLACE)+1
      READ(10'KREC,ERR=120) BUFFER
      NXREC=0
  110 RETURN
  120 PRINT 1200,INTRY,IYR,IMO,LOKN
 1200 FORMAT('0GOFER - FILE ENTRY FOR RECORD',I8,'  (',I2,
     & 1H.,I2,A5,') IN ERROR')
      ISTOP=1
      GO TO 200
C
C     * BEGIN PROCEDURE TO FIND DESIRED ENTRY IN TABLE *
C
  140 IF(NREC.EQ.0) GO TO 155
C 140 IF(NTRY.GE.8) GO TO 160
C      USE SIMPLE SEQUENTIAL SEARCH IF LESS THAN 8 ENTRIES
      DO 150 I=1,NREC
      IPLACE=I
      IF(NTRY(I).GE.INTRY) GO TO 160
  150 CONTINUE
  155 IPLACE=NREC+1
  160 GO TO (60,100), IBR
C      USE BINARY SEARCH
C      END SEARCH PROCEDURE
C
```

APPENDIX B (continued)

```
      SUBROUTINE EVAL(Y,P)
      IMPLICIT REAL*8 (A-H,O-Z)
      REAL*8 LWPB,LLWP,LWPA
      COMMON/RESIST/R1,R2,R3,R4,R5,RR1,RRA,RRB,RRC,RRR,TM,RLIT
      COMMON/SURF/PWPS,PWPW,PWPMAX,RESS,RESW,RESMAX,POWS,POWW,POWER ,
     > LRMODL
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/HUMID/FOLTYP,PAIR,CPO,RA,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON /BLOCKE/ RN,GND,TTT,EE,PWP,EV,VEL,JDATE
      COMMON/SOLPOT/PSI(8)
C       DETERMINE ELECTRICAL ANALOG PARAMETERS
      RR=R4+RR1
      D=R1+R2+R5
      RT1=R1*R5/D
      RT2=R1*R2/D
      RT3=R2*R5/D+RR
      D=RT1+RT3+R3+RLIT
      RRA=RT2+RT1*RT3/D
      RRB=(R3+RLIT)*RT3/D
      RRC=(R3+RLIT)*RT1/D
      D=RRA+RRC
C       MODEL OF LEAF RESISTANCE VS LEAF WATER POTENTIAL
C       Y IS LEAF WATER POTENTIAL IN MILLIBARS AND IS NEGATIVE
      IF (TM.GE.RESMAX) GO TO 30
      IF (LRMODL.EQ.0) GO TO 10
C       HYPERBOLIC RELATION
      LWPB=1.0D-3*Y
C       LWPB IS LEAF WATER POTENTIAL IN BARS
      LLWP=PWPMAX*(TM/RESMAX-1)
      IF (LWPB.LE.LLWP) GO TO 30
      RRR=TM/(1.+LWPB/PWPMAX)
      GO TO 40
C       EXPONENTIAL RELATION
   10 LWPA=9.81D-4*Y
C       LWPA IS LEAF WATER POTENTIAL IN ATMOSPHERES
      IF (LWPA.LT.0) GO TO 20
      RRR=TM
      GO TO 40
   20 IF (LWPA.LT.-PWPMAX) GO TO 30
      RRR=TM+(RESMAX-TM)*DEXP(POWER*(LWPA+PWPMAX))
      GO TO 40
   30 RRR=RESMAX
   40 RX=RRR
C       DETERMINE EVAPOTRANSPIRATION
      CALL EVAPOR(EV,RN,GND,TTT,EE,ETGW)
      P=-(Y-(RRA*PSI(1)/D+RRC*PSI(2)/D))/(RRB+RRA*RRC/D)-EE
      RETURN
C       ENTRY POINT GOES HERE
C       COMPUTE SURFACE RESISTANCE
      ENTRY FEVAL(Y,P)
      PPP=9.81D-4*Y+PWPMAX
      IF (PPP.LT.0.D0) GO TO 50
      IF (PPP.GT.PWPMAX) GO TO 60
      RRR=TM+(RESMAX-TM)*DEXP(POWER*PPP )
      GO TO 70
   50 RRR = RESMAX
      GO TO 70
   60 RRR=TM
   70 RX=RRR
C       DETERMINE EVAPOTRANSPIRATION
      CALL FEVAPO(EE,ETGW)
      P=-(Y-(RRA*PSI(1)/D+RRC*PSI(2)/D))/(RRB+RRA*RRC/D)-EE
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE GETSET(GA,DCS,TE,TS,YR1,YR2)
C
      COMMON/DAILY/DEW(12,31), RAD(12,31), EVAP(12,31), TEM (2,12,31),
     > WINDS(12,31),IDEW(36),IRAD(36),ITEM(36),IWND(36)
      INTEGER*2 IDEW,IRAD,ITEM,IWND
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART, NUMDYS,
     > HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),
     > IRIG,PKIRIG(87)
      COMMON /ANGLES/ FILL(6),DGLAT,DLONG
      COMMON/SSRF/PORE,SBD(5),KSAT(5),SA(5),KSGW,CUT,CUTL,WUP
      COMMON/TLYR/NTL
      COMMON/SSF/SSG(5)
      COMMON/THSRF/WCK1,WCK2
      COMMON/FLAGS/KTEMP,KDEW,KRAD,KWIND,KSNOW,KLAND,KSOILM,KPE
      COMMON/AR/AREA1,AREA2,PA
      COMMON/AWYPLC/NU1(10),NU2(10),NU3(10),TITL(10,6),NPLTS,NAWPLT
      COMMON/CM/CMMO,CMYR
      INTEGER CMMO,CMYR
      COMMON/PRSPLC/NPRPLT,NMPLT,NSPLTS,NMSPLT,MONSPL(12),MONPLT(12),
     > PORPLT(36),NBEG(12),NEND(12),MACHIN
      COMMON/PLTALL/XMIN,XMAX,INC1,ISTRA,NQUES
      REAL MACHIN
      INTEGER*2 MONSPL,MONPLT,PORPLT,NBEG,NEND
      COMMON/SHIFT1/ RADCON,CONMLT,SCF,ELDIF,IDNS,FCI,DGM,WC, MPACK, K1,
     >  A, LG, SS, NN, K24L, EPXM,SUNCON,CLD,CLDFAC
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/SURFXP/RZ,PR,ORAIN,FF,FIXM,RGX,SHRD,A3,AUZS,ASDS,AINF
      COMMON/INVGA/STANF,WB,NAME(6),ELEV,LAT(3),LONG(3), GTYPE(2),
     > INTRVL,ELEM(5), INITP,DSNAME,STRTYR,ENDYR, INITS,RODSNA,ROSTYR,
     > RENDYR, INITD,DDSNAM,DSTYR,DENDYR, INITR,DSDSNA,DSSTYR,DSENDY,
     > FRADCN,FCNMLT,FSCF,FELDIF,FIDNS,FFCI,FDGM,FWC,FMPACK, FK1,FA, FL,
     >  FSS, FNN, FK24L, FEPXM,
C      THE FOLLOWING 13 PARAMETERS TEMPORARILY REMOVED 12 19 75
C     + BARES, ANOTS, KDS, LFTOVS, OCRITS, ONCRTS, AZEROS, SDPMS, SEDMPS
C     + ,SONES, STWOS, STRES, SFORS,
     +SGWINV,LZSINV,LIQW,DEPTH,NEMELT,PACK,KEYTIM, DUM1,DUM2,UNUSED(24)
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/LOCATE/ELONG
      COMMON/OPTS/CHMOPT,CEROPT,DRYOPT
      LOGICAL CHMOPT,CEROPT,DRYOPT
      COMMON/GET/STCLD,MONTHP(12),EPXMIN, EPXMAX,RNON,SUNHR(24),DUST(12)
     > ,Y,M,T(744),JJ
      COMMON/IMPAR/WT,WT1,WT2,ISWIWT
      DIMENSION SNOPAK(4),SOILM(4),SNOPAR(9), SLTEMP(16),
     > SEGMNT(49),DCS(13), INDATA(8),ID(12)
      REAL*8 SLBL(4),SA,RLNLBL(10),AREA1,AREA2,THETA ,SBD,SSG,CUT,WUP,
     > PORE,CUTL,KSAT,KSGW, PA,DL,AT,ARAT,FC,SWT,VP,F,S,SEV,ETGW,STCLD,
     > DNFAC,WP1,WP2,TLBL(6),WCK1,WCK2,RNTL,WT,WT1,WT2
      INTEGER Y,BZ,GA,TS,ENDYR,STRTYR,DCS,TEM , YR1,YR2,RODSNA,
     > ROSTYR,RENDYR,DSTYR,DENDYR,DSDSNA,DSSTYR, DSNAME,DSENDY
      REAL K24L,NN,LANPAR(7),LZSINV,MPACK,K1,LG,IDNS,LIQW,NEMELT
      INTEGER DSNAME,DSENDY
      EQUIVALENCE (SOILM(1),SGWINV),(INDATA(1),KTEMP), (SEGMNT(1),
     > SNOPAR(1),FRADCN),(SNOPAK(1),LIQW), (LANPAR(1),FK1), (SLTEMP(1),
     > RADCON)
C
      DATA SLBL/'SGW=    ','LZS=    ','FIXM=   ','FF=     '/
C     DATA RLNLBL/'BARE=','ANOT=','KD=','LFTOV=','OCRIT=','ONCRT=',
C    > 'AZERO=','SDPM=','SEDMP=','SONE='/
      DATA TLBL/'K1=','A=','LG=','SS=','NN=','K24L='/
      DATA KPLUS/'+'/
```

APPENDIX B (continued)

```
C
      NBZ = 8
   10 INDATA(NBZ) = 1
C
      ENTRY ONMARK(GA,DCS,TE,TS,YR1,YR2)
      CALL DATIM(TS,IY,MO,ID,IH,IMN)
      LM=MO-1
      IF (LM.EQ.0) LM=12
      READ 10000, NBZ,NSCL, BZ
      WRITE(6,10100) NBZ,BZ
      GO TO (30,40,60,50,100,110,180,120,140,150,160,80,70,90,170,200,
     > 165,20),NBZ
   20 PRINT 10200
      STOP 3004
   30 SFAC=1.
      IF (NSCL.EQ.KPLUS) SFAC=.1
      READ 10300,DCS(13)
      CALL DAYTEM(BZ,TEM,HTEM,ITEM,SFAC,DCS(13),&10)
C        TEM(1,M,D)=DAILY MAXIMUM TEMPERATURE, TEM(2,M,D)=MIN
   40 CALL DAYIN(BZ,DEW,HDEW,IDEW,&10)
   50 CALL DAYIN(BZ,WINDS,HWND,IWND,&10)
   60 CALL DAYIN(BZ,RAD,HRAD,IRAD,&10)
   70 NBZ = 3
      CALL BIMON(BZ,RAD,HRAD,IRAD,&10)
   80 NBZ = 2
      CALL BIMON(BZ,DEW,HDEW,IDEW,&10)
   90 NBZ = 4
      CALL BIMON (BZ,RAD,HRAD,IRAD,&10)
  100 READ 10400,SNOPAR, SNOPAK
      DCS(10)=1
      GO TO 10
  110 READ 10500, (LANPAR(I),I=1,5),ISWIWT
      INC1=0
      READ(5,10600)EPXMAX,EPXMIN,RNON,CMMO,CMYR,NAWPLT,NPRPLT,NSPLTS
      WRITE(6,11000) EPXMAX,EPXMIN,RNON,CMMO,CMYR,NAWPLT, NPRPLT,NSPLTS
      EPXMAX=EPXMAX/2.54
      EPXMIN=EPXMIN/2.54
      IF (NAWPLT.NE.0) READ(5,10900) NPLTS,(NU1(I),NU2(I),NU3(I),
     > (TITL(I,J),J=1,6),I=1,NPLTS)
      IF (NPRPLT.NE.0) READ(5,10700) NMPLT,(MONPLT(I),(PORPLT(J+(I-1)*3)
     >  ,J=1,3),I=1,NMPLT)
      IF (NSPLTS.NE.0) READ(5,10800) NMSPLT,MACHIN,(MONSPL(I),NBEG(I) ,
     > NEND(I),I=1,NMSPLT)
      GO TO 10
  120 READ 11200,AREA1,CUT,CUTL,WUP,RNTL
C     AREA1 IS THE MINIMUM EXTENT OF SOURCE AREAS
C       CUTL IS THE DRAIN RATE WHEN DEEP SOILS BEGIN TO DRAIN TO CHANNEL
C       CUT IS THE DRAIN RATE WHEN MAX. FRACTION OF DEEP SOILS
C         DRAINING TO CHANNEL (WUP) IS REACHED.
C       RNTL IS THE NUMBER OF SOIL TRANSMISSION LAYERS CONSIDERED.
      AREA2= 1.0 - AREA1
      NTL= IFIX(SNGL(RNTL))
      READ 11200,(SBD(I),I=1,NTL)
C       SBD IS THE LAYER THICKNESS OF TRANSMISSION LAYERS (CM).
      READ 11200,(SSG(I),I=1,NTL)
C       SSG IS THE VOLUMETRIC WATER CONTENT -- CONVERTED TO INCHES BELOW.
      DO 130 K=1,NTL
  130 SSG(K)=SSG(K)*SBD(K)
      READ 11200,PORE,((KSAT(I),SA(I)),I=1,3),WCK1,WCK2
C       PORE IS THE FRACTIONAL PORE SPACE FOR ALL TRANSMISSION LAYERS
C       KSAT AND SA CHARACTERIZE 3 LIMBS OF THE K VS. THETA CURVE,
```

APPENDIX B (continued)

```
C         FROM LOW TO HIGH K VALUES.
C       WCK1 AND WCK2 ARE BREAKPOINTS (THETAS) BETWEEN LIMBS (1&2)
C         AND (2&3).
      READ 11100,KSGW,SGW,K24L
      SGW=SGW/2.54D0
      KSOILM=1
      SGWINV=SGW
      LANPAR(6)=K24L
C       KSGW IS THE CONSTANT THAT RELATES GW FLOW TO GW STORAGE, I.E.
C         GWF=KSGW*SGW, AND HAS UNITS 1/HOUR.
C       SGW IS THE GW STORAGE (CM)
C       K24L IS THE FRACTION OF GW LOST TO DEEP SEEPAGE ACROSS THE
C           WATERSHED DIVIDE.
      KSSRF = 1
      WRITE(6,11300) AREA1,CUT,CUTL,WUP,RNTL
      WRITE(6,11400) (SBD(I),I=1,NTL)
      WRITE(6,11500) (SSG(I),I=1,NTL)
      WRITE(6,11600) PORE,((KSAT(I),SA(I)),I=1,3),WCK1,WCK2
      WRITE(6,11700) KSGW,SGW,K24L
      GO TO 10
  140 CALL RDCHM
      GO TO 10
  150 CALL RDCER
      GO TO 10
  160 CALL RDDRY
      GO TO 10
  165 CONTINUE
      CALL RDIRIG
      GO TO 10
  170 NBZ=8
      CALL EVAPO (YR1,YR2,BZ,&10)
  180 DGLAT=LAT(1)+LAT(2)/60.+LAT(3)/3600.
      DLONG=LONG(1)+LONG(2)/60.+LONG(3)/3600.
      CALL READIN
      LZSINV=0.
      DO 190 K=1,NSL
  190 LZSINV=LZSINV + THETA(K)/2.54
      GO TO 10
  200 WRITE(6,11800) NAME,STANF,WB,TS,TE
      IF (KLAND.EQ.0) WRITE(6,11900)
C     THE FOLLOWING OPTION IS NOT APPLICABLE IN THE TEHM AT PRESENT
C     HOWEVER, IT MAY BE ADDED BACK INTO THE CODE WHEN APPROPRIATE.
C      READ 79, (MONTHP(I),I=1,12), NOPOS
C79    FORMAT (13I5)
      IF (KPE.EQ.0) WRITE(6,12000)
      IF (KSOILM.EQ.0) WRITE(6,12100)
      IF (KTEMP.EQ.0) GO TO 250
      IF ((DCS(10).GT.0).AND.(KSNOW.GT.0)) GO TO 240
      WRITE(6,12200)
      DO 230 I = 1, 4
  230 SNOPAK(I) = 0.0
      DO 235 L=1,9
  235 SNOPAR(L)=0.
  240 IF (KRAD.EQ.0) WRITE(6,12300)
  250 DO 260 L = 1, 16
  260 SLTEMP(L) = SEGMNT(L)
      IF (A.LE.1.0.AND.K24L.LE.1.0.AND.NN.LE.1.0) GO TO 270
      PRINT 12400,((TLBL(I),SLTEMP(I+9)),I=1,6)
      STOP 3005
  270 WRITE(6,12500) STRTYR,ENDYR,LAT,LONG,ELEV,GTYPE
      WRITE(6,12600) ((TLBL(I),SLTEMP(I+9)),I=1,6)
```

APPENDIX B (continued)

```
C      EROSION REMOVED UNTIL IT CAN BE UPDATED FOR SOURCE AREAS.          GETS1840
      IF (KLAND.EQ.1) LANPAR(3)=LANPAR(3)*3.28084                         GETS1850
      FIXM=1.0                                                            GETS1860
      FF=1.0                                                              GETS1870
      DO 272 I=1,12                                                       GETS1880
  272 DUST(I)=0.                                                          GETS1890
C      WRITE(6,2017)  (RLNLBL(I),RLNPAR(I),I=1,10)                        GETS1900
CC2017 FORMAT ('OBASIN RADIOAEROSOL INVENTORY AND STARTING PARAMETERS'//GETS1910
C     + 2(3X,A6,F7.2,4(',  ',A6,F7.2)//))                                 GETS1920
      WRITE(6,12700) (SLBL(I),SOILM(I),I=1,2),SLBL(3),FIXM,SLBL(4),FF     GETS1930
      IF (KSSRF.EQ.1) GO TO 280                                           GETS1940
      WRITE(6,13100) GA                                                   GETS1950
      PORE = .304D0                                                       GETS1960
      DO 275 J=1,5                                                        GETS1970
      SBD(J) = 9.0D01                                                     GETS1980
  275 SSG(J) = 2.07D01                                                    GETS1990
      AREA1 = 0.05D0                                                      GETS2000
      AREA2 = 0.95D0                                                      GETS2010
      KSAT(1)=39.63586D0                                                  GETS2020
      SA(1)=95.56D0                                                       GETS2030
      KSAT(2)=1.19606D02                                                  GETS2040
      SA(2)=1.422D02                                                      GETS2050
      KSAT(3)=2.505879D02                                                 GETS2060
      SA(3)=5.12D02                                                       GETS2070
      KSGW=1.0D-03                                                        GETS2080
  280 WRITE(6,12800) NTL                                                  GETS2090
      WRITE(6,12900) (I,SBD(I),SSG(I),I=1,NTL)                            GETS2100
      WRITE(6,13000) (I,KSAT(I),SA(I),I=1,3),WCK1,WCK2,AREA1,WUP,         GETS2110
     > CUTL,CUT                                                           GETS2120
      DO 290 K=1,NTL                                                      GETS2130
      SBD(K)=SBD(K)/2.54                                                  GETS2140
      SSG(K)=SSG(K)/2.54                                                  GETS2150
  290 CONTINUE                                                            GETS2160
      IF (KSNOW.GT.0) WRITE(6,13200) SNOPAR,SNOPAK                        GETS2170
      PRINT 13300, DCS(10),DCS(13)                                        GETS2180
      ELONG=LONG(1)                                                       GETS2190
      IF (LONG(2).GE.30.) ELONG=LONG(1)+1.                                GETS2200
      RETURN                                                              GETS2210
10000 FORMAT (I2,A1,A4)                                                   GETS2220
10100 FORMAT (/1X,I2,2X,A4)                                               GETS2230
10200 FORMAT('OERROR, UNKNOWN CONTROL LABEL IN LAND SURFACE SIMULATION')GETS2240
10300 FORMAT(I1)                                                          GETS2250
10400 FORMAT( 9F6.2,4F5.2)                                                GETS2260
10500 FORMAT (5F5.1,I5)                                                   GETS2270
10600 FORMAT(3F10.4,10X,5I1)                                              GETS2280
10700 FORMAT(I5,(4I2))                                                    GETS2290
10800 FORMAT(I5,A4,(3I2))                                                 GETS2300
10900 FORMAT(I2,(3I2,6A4))                                                GETS2310
11000 FORMAT(5X,'EPXMAX=',F8.4,' EPXMIN=',F8.4,' RNON=',F8.4, ' CMMO=', GETS2320
     > I2, 'CMYR=',I2,'NAWPLT=',I2,' NPRPLT=',I2 ,'NSPLTS=',I2)           GETS2330
11100 FORMAT(D10.5,2F10.5)                                                GETS2340
11200 FORMAT(10D8.0)                                                      GETS2350
11300 FORMAT(1X,'AREA1,CUT,CUTL,WUP,RNTL= ',5G12.6)                       GETS2360
11400 FORMAT(1X,'SBD(I)= ',5(1X,G12.6))                                   GETS2370
11500 FORMAT(1X,'SSG(I)= ',5(1X,G12.6))                                   GETS2380
11600 FORMAT(1X,'PORE,KSAT&SA,WCK1,WCK2= ',7(1X,G12.6)/2(1X,G12.6))       GETS2390
11700 FORMAT(1X,'KSGW,SGW,K24L= ',3(1X,G12.6))                            GETS2400
11800 FORMAT ('1LAND SURFACE SIMULATION FOR SEGMENT AT ',6A4,             GETS2410
     > 'STANFORD NO= ',I3, 5X,'WEATHER BUREAU NO= ',I6/10X,'PERIOD = ', GETS2420
     > Z8,' TO ', Z8,' (HEX)')                                            GETS2430
11900 FORMAT ('OLAND SURFACE PARAMETERS WERE ASSIGNED FROM FILE')         GETS2440
```

APPENDIX B (continued)

```
12000 FORMAT ('OWARNING, POTENTIAL EVAPOTRANSPIRATION HAS BEEN CARRIED FGETS2450
     >ROM THE PREVIOUS SEGMENT')                                        GETS2460
12100 FORMAT ('OWARNING, INITIAL SOIL MOISTURES WERE ASSIGNED BY DEFAULTGETS2470
     >; STARTING DATE NOT ON FILE')                                     GETS2480
12200 FORMAT ('OWARNING, INITIAL SNOWPACK CONDITIONS WERE ASSIGNED BY DEGETS2490
     >FAULT; STARTING DATE NOT ON FILE')                                GETS2500
12300 FORMAT ('OWARNING, RADIATION HAS BEEN CARRIED FROM THE PREVIOUS SEGETS2510
     >GMENT')                                                           GETS2520
12400 FORMAT ('OEXECUTION DELETED DUE TO UNREASONABLE LAND SURFACE PARAMGETS2530
     >ETERS '//10X,6(A6,F6.3,3X))                                       GETS2540
12500 FORMAT ('ORAINGAGE RECORDS START AT WY',I3,', END AT WY',I3/      GETS2550
     > ' LOCATION=',1X,3(1X,I2),' LATITUDE,  ',I3,2(1X,I2),' LONGITUDE'/GETS2560
     >  ' ELEVATION=',I5,' FEET'/' EQUIPMENT= ',A4,A4/)                 GETS2570
12600 FORMAT ('OLAND SURFACE PARAMETERS'//(3X,A6,F7.2,5(',  ',A6,F7.2) /GETS2580
     > /))                                                              GETS2590
12700 FORMAT ('OSOIL MOISTURE PARAMETERS'//3X, A6,F7.2,3(',  ', A6,F7.2)GETS2600
     > /)                                                               GETS2610
12800 FORMAT(1X,'SUBSURFACE AND SOURCE AREA PARAMETERS: '//4X,          GETS2620
     > 'THERE ARE ',I1,' SOIL WATER TRANSMISSION LAYERS AS FOLLOWS:'//) GETS2630
12900 FORMAT(8X,'LAYER',4X,'THICKNESS (CM)',4X,'WATER CONTENT (CM)'/    GETS2640
     >  (10X,I1,7X,G12.6,8X,G12.6/))                                    GETS2650
13000 FORMAT(/4X,'CONDUCTIVITY CURVE PARAMETERS: '//8X,'INDEX',8X,      GETS2660
     > 'KSAT(INDEX)',8X,'SA(INDEX)'//3(10X,I1,10X,G12.6,9X,G12.6/),/    GETS2670
     > 4X,'BREAKPOINTS (THETA VALUES) IN CONDUCTIVITY CURVES:',         GETS2680
     > 2(3X,G12.6)//4X,'MINIMUM AND MAXIMUM EXTENT OF SOURCE AREAS (DE',GETS2690
     > 'CIMAL):',2(3X,G12.6)//4X,'DRAINAGE RATES (CM/DAY) AT LOWER AND 'GETS2700
     > ,'UPPER SOURCE AREA EXTENTS:',2(3X,G12.6)/)                      GETS2710
13100 FORMAT(5X,'SUBSRF PARAMETERS ASSIGNED BY DEFAULT FOR',            GETS2720
     > ' SEGMENT =',I4)                                                 GETS2730
13200 FORMAT('OSNOWPACK PARAMETERS'/3X,'RADCON',3X,'CONMLT',4X,'SCF',5X,GETS2740
     > 'ELDIF',5X,'INDS',6X,'FCI',6X, 'DGM',6X,'WC',5X,'MPACK',5X,      GETS2750
     > 'LIQW',5X,'DEPTH',3X,'NEMELT',4X,'PACK'/13(F8.3,1X))             GETS2760
13300 FORMAT(' DCS(10)= ',I2,' DCS(13)= ',I2/)                          GETS2770
      END                                                               GETS2780
```

APPENDIX B (continued)

```
      SUBROUTINE HRADSL(DY,HRAD,HNRAD)
C
C       MODEL THE DIURNAL VARIATION OF THE SOLAR
C       RADIATION INCIDENT ON A SLOPE
C
      COMMON /ANGLES/ RADINC,RADLAT,DELONG,PI,D,EQLAT,DLAT,DLONG
      REAL*8 RADINC
      DIMENSION HRAD(24),HNRAD(24)
C
      DAYL(SINL,COSL)=ARCOS(AMAX1(-1.,AMIN1(1.,-SINL/COSL*TANDEC)))
C
      TH=RADINC
      SECINC=1./COS(TH)
C       DIFUSE RADIATION FROM THE SKY
C       ASSUME TO BE 5% OF POTENTIAL SOLAR RADIATION
      RDIFUS=.056*(1.-RADINC/3.1415926)*SECINC
      DO 10 IH=1,24
   10 HNRAD(IH)=RDIFUS*HRAD(IH)
C       DIRECT RADIATION FROM THE SUN
      AT=.01720242*DY-1.41430
      BT=.033446*SIN(.01720242*DY-.059075)
      SINET=SIN(AT+BT)
      SINDEC=.39785*SINET
      COSDEC=SQRT(1.-SINDEC*SINDEC)
      TANDEC=SINDEC/COSDEC
C       SUNRISE AND SUNSET ON THE SLOPE
      SINEQ=SIN(EQLAT)
      COSEQ=COS(EQLAT)
C       SKIP IF SUN DOES NOT RISE ON SLOPE
      IF(COSEQ.LE.-SINEQ*TANDEC) GO TO 70
      TS=DAYL(SINEQ,COSEQ)
      TS1=(-TS-DELONG)/.2617994
      TS2=(TS-DELONG)/.2617994
C       EQUATION OF TIME IN UNITS OF HOURS
      EQUATI=3.819718*ATAN2(SIN(BT)-.082549*SINET*COS(AT),
     & COS(BT)-.082549*SINET*SIN(AT))
      SNOON=12.-(AINT(DLONG/15.+.5)-DLONG/15.)+EQUATI
      IF(TS1.LT.-SNOON) TS1=TS1+24.
      IF(TS2-24.0.GT.-SNOON) TS2=TS2-24.0
C       SUNRISE AND SUNSET ON THE HORIZONTAL
      RLAT=.01745329*DLAT
      SINLAT=SIN(RLAT)
      COSLAT=COS(RLAT)
C       SKIP IF SUN DOES NOT RISE ON HORIZONTAL
      IF(COSLAT.LE.-SINLAT*TANDEC) GO TO 70
      TH2=DAYL(SINLAT,COSLAT)/.2617994
      TH1=-TH2
C       NUMBER OF SUNRISES ON SLOPE MAY BE 0, 1, OR 2
      NUMSR=1
      IF(TS1.GT.TS2) GO TO 20
      TS1=AMAX1(TS1,TH1)
      TS2=AMIN1(TS2,TH2)
      GO TO 40
   20 IF(TH2.GT.TS1) GO TO 30
      TS1=TH1
      GO TO 40
   30 IF(TS2.GT.TH1) GO TO 35
      TS2=TH2
      GO TO 40
   35 TS4=TH2
      TS3=TS1
```

APPENDIX B (continued)

```
      TS1=TH1
      NUMSR=2
   40 IF(TS1.GE.TS2) GO TO 70
      TH1=TS1
      I1=TH1+SNOON+1.
      TH2=I1-SNOON
      I2=TS2+SNOON+1.
C
      DO 60 IH=I1,I2
      RATIO=1.
      IF(RADINC.EQ.0.) GO TO 50
      T1=.2617994*TH1
      T2=.2617994*TH2
      PRAD=SINDEC*SINLAT*(T2-T1)+COSDEC*COSLAT*(SIN(T2)-SIN(T1))
      SRAD=SINDEC*SINEQ*(T2-T1)+COSDEC*COSEQ*
     & (SIN(T2+DELONG)-SIN(T1+DELONG))
      RATIO=SRAD/PRAD
   50 HNRAD(IH)=HNRAD(IH)+.944*HRAD(IH)*RATIO*SECINC
      TH1=TH2
   60 TH2=AMIN1(TH2+1.,TS2)
      IF(NUMSR.EQ.1) GO TO 70
      NUMSR=1
      TS1=TS3
      TS2=TS4
      GO TO 40
   70 RETURN
      END
```

```
      SUBROUTINE INDEX (L,Y,N)
C     INDEX ELEMENTS OF Y IN INCREASING ORDER
      DIMENSION L(1),Y(1)
      M=N
   10 M=M/2
      IF(M.EQ.0) RETURN
      K=N-M
      J=1
   20 I=J
   30 IM=I+M
      IF(Y(L(I)).LE.Y(L(IM))) GO TO 40
      LL=L(I)
      L(I)=L(IM)
      L(IM)=LL
      I=I-M
      IF(I.GE.1) GO TO 30
   40 J=J+1
      IF(J.GT.K) GO TO 10
      GO TO 20
      END
```

APPENDIX B (continued)

```
      SUBROUTINE LAND (NSEG,*)
C
C     HOURLY VERSION OF LAND MODIFIED BY J. HOLDEMAN AND
C     R. LUXMOORE TO ACCEPT HOURLY DATA -  3/2/76.
C     THIS IS SUBROUTINE LAND, CONTAINING AN N-LAYER VERSION OF
C     PROSPR THAT WAS ASSEMBLED BY R J LUXMOORE, BASED ON WORK BY
C     R A GOLDSTEIN AND J B MANKIN.  THE LAND VERSION THAT FOLLOWS HERE
C     WAS ASSEMBLED ON 12 17 75 BY D. D. HUFF, BASED UPON THE HYDROLOGIC
C     TRANSPORT MODEL AND AN EARLIER VERSION OF THE STANFORD
C     WATERSHED MODEL (VERSION V) BY CRAWFORD AND LINSLEY. THIS VERSION
C     MODIFIED TO INCLUDE IRRIGATION BY D.M. HETRICK AND J.T. HOLDEMAN.
C
      IMPLICIT INTEGER (T)
      COMMON/TLYR/NTL
      COMMON/SSF/SSG(5)
      COMMON/SSRF/PORE,SBD(5),KSAT(5),SA(5),KSGW,CUT,CUTL,WUP
      DOUBLE PRECISION PORE,SBD,KSAT,SA,KSGW,CUT,CUTL,WUP,AAMAX,WT,WT1,
     1 WT2
      COMMON/OPTS/CHMOPT,CEROPT,DRYOPT
      LOGICAL CHMOPT,CEROPT,DRYOPT,CLDRY
      COMMON /HOLNAM/ IBATCH,LENDRU,LPRECI,LDISTR,LANDS, LCHANN, NEMPTY,
     > EMPTY, IHOLNO,OPEN,HINPUT,HOUTPT,DDOL, RAING, UPRECI,READH,READM,
     > UPDATE,HDEPOS,PRECI,READS, IHOLBL, SDOL,HOLBL4,HOLBL3,NSDOL,
     > WEATHE,STANFO,ERNATE, HOLZRO, HOLMB2,HOLMB1,HOL999,HOL998,IHRLY,
     > HOLC,H3BZRO,HBMBB, H4000,HMBBB,HBBBO,HZZZM,HZZMB,HB998,IDAILY,
     > STORAG, RECORD,SINITL,SGETH,HDAM,HOLBL,DIVIN,DIOUT
      DOUBLE PRECISION ALEAF,PAIR,CPO,XL,THETA,DL,AT, ARAT,FC, GM,GV,RB,
     > RX,HT,SIGMA ,TSTEP,CIFLAS,P4,RRX,CIF, RTIM,STCLD,RNLW,VAPMB ,
     > FILT, TMP,SOLAR,VAPOR,ET,DDRAIN, RNXS,SW,ETGW,TTE ,TIMST,SWT,VP,
     > F,S,FOLTYP, SEV,DNFAC, WP1,WP2,ROFF,TDRN,PSEUDO,ETOT,PTOT,U,
     > RASOL,QFILT,QET, QDRAIN,QRNXS,HDRAIN,HRNXS,HET,DELINF,PRES ,
     > AREA1,AREA2, SSG,TST,PDRN,FLO1, FLO2,FLO3,PA, RF1MON,RF2MON,
     > SDRAG,WDRAG,REDUC,SSGCM(5),SBDCM(5),QFILTW
      COMMON/ DRAG /SDRAG,WDRAG,REDUC
      COMMON/AR/AREA1,AREA2,PA
      COMMON/HUMID/FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/PETRUS/TSTEP,TIMST,CIFLAS,CIF(50),RTIM(50),NRAATS
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL, NS
      COMMON/TOTMON/ROFF,TDRN,PSEUDO,ETOT,PTOT,PRES,RF1MON, RF2MON
      COMMON/TOTS/TOTALS(2,3)
      INTEGER*2 RS30M,SU30M,RAC30M, TOTALS,PRC,DEPOS
      REAL LAPSE,LAPS,TMPX,MSRVAP,TOTCMC,TBALWB, LZSOUT,MONCEM(13,25),
     > MELT,NEMELT,LIQW,LIQW1
      DIMENSION CMC(12),BALWB(12),ID(12)
      DIMENSION DCS(13),SUMCM(16),INCH(25),CM(25)
      INTEGER CMYR,CMMO
      COMMON/CM/CMMO,CMYR
      COMMON/AWYPLC/NU1(10),NU2(10),NU3(10),TITL(10,6),NPLTS, NAWPLT
      INTEGER RR,RS, SEG,STANFD, YRTE, DCS, FLAG, YR1, YR2, YEAR, HOUR ,
     >  Y, DAY
      REAL T, MONSUM,TOTAL,IMPV,LZSMO,IDNS, MPACK,K1, K24L,LG,NN,LZS,
     > LZSINV,LANPAR, LZ,INFQ,LOUT, LQO,INTF,TOTELH, LOS,INVTMP
      INTEGER DSTYR, DSDSNA, DSENDY, DSNAME, ENDYR, STRTYR, DENDYR,
     > DSSTYR, RENDYR, RODSNA, STAN, ROSTYR, DRUM, PDRUM, SDRUM, RDRUM,
     > SCRACH, SURF, PREC, NEMPTY
      COMMON/UNITS/ DRUM, IDRUM, PDRUM, SDRUM, RDRUM, SCRACH
      COMMON/C/MONTHS(12)
      COMMON/E/ PREC, DEPS, SURF, RSRF, INV, MAXWYR, TAPESZ, DATE(4)
      COMMON/S/STAN(200), WATSHD(7)
      COMMON/INVGA/STANF,WB,NAME(6),ELEV,LAT(3),LONG(3),GTYPE(2) ,
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APPENDIX B (continued)

```
     > INTRVL, ELEM(5), INITP,DSNAME,STRTYR,ENDYR, INITS, RODSNA,ROSTYR,LAND 620
     > RENDYR, INITD,DDSNAM,DSTYR,DENDYR, INITR, DSDSNA,DSSTYR,DSENDY,  LAND 630
     > FRADCN,FCNMLT,FSCF,FELDIF,FIDNS, FFCI,FDGM,FWC,FMPACK, FK1,FA,   LAND 640
     > FL, FSS, FNN, FK24L, FEPXM,                                      LAND 650
C      THE FOLLOWING 13 PARAMETERS TEMPORARILY REMOVED 12 19 75         LAND 660
C     + BARES, ANOTS, KDS, LFTOVS, OCRITS, ONCRTS, AZEROS,              LAND 670
C     + SDPMS, SEDMPS ,SONES, STWOS, STRES, SFORS,                      LAND 680
     >SGWINV,LZSINV,LIQW,DEPTH,NEMELT,PACK,KEYTIM, DUM1,DUM2, UNUSED(24)LAND 690
      DIMENSION SEGMNT(49), SNOPAR(9), LANPAR(7), SOILM(2), SNOPAK(4),  LAND 700
     > INVENT(88)                                                       LAND 710
      EQUIVALENCE (SEGMNT(1),SNOPAR(1),FRADCN), (LANPAR(1),FK1),        LAND 720
     > (SOILM(1),SGWINV), (SNOPAK(1),LIQW), (INVENT(1),STANF)           LAND 730
      COMMON/FLAGS/KTEMP,KDEW,KRAD,KWIND,KSNOW,KLAND,KSOILM,KPE         LAND 740
      COMMON /SOISNO/ SG,LZ,WCON,SDE,COL,PAC                            LAND 750
      COMMON/MOSUMS/ IMPV(13),SURFCE(13),SFL1MO(13),SFL2MO(13),         LAND 760
     > BASTRM(13),TOTAL(13), RECHGE(13),SLTOMO(13),RNFALL(13),          LAND 770
     > SIENMO(13),SPRSMO(13),SOILMO(13),TEHLMO(13),SVAPMO(13),          LAND 780
     > POTENT(13),SPETMO(13),STSNMO(13),SCEPMO(13),RESMO(13), UZSMO(13),LAND 790
     > LZSMO(13),STD1MO(13),STD2MO(13),SGWMO(13), STBTMO(13)            LAND 800
      COMMON/SHIFT1/ RADCON,CONMLT,SCF,ELDIF,IDNS,FCI,DGM,WC, MPACK, K1,LAND 810
     >  A, LG, SS, NN, K24L, EPXM,SUNCON,CLD,CLDFAC                     LAND 820
C      CONTAMINANT TRANSPORT IS REMOVED TEMPORARILY. 12 19 75-DDH.      LAND 830
C      COMMON/SHIFT2/                                                   LAND 840
C     + BARE, ANOT, KD, LFTOVR, OCRIT, ONCRIT, AZERO, SDPM, SEDMP,      LAND 850
C     + SONE, STWO, STRE, SFOR                                          LAND 860
      COMMON/SHIFT3/ SGW, LZS, WTRT, DEPTHT, COLDT, PACKT               LAND 870
      DIMENSION SLTEMP(16), INVTMP(2), INDATA(8), SOIL(2), SNOW(4),     LAND 880
     > STRAYS(25), MONSUM(13,25), MONVEC(325), SUM(20)                  LAND 890
      EQUIVALENCE (SLTEMP(1),RADCON), (INVTMP(1),SGW), (INDATA(1),KTEMP)LAND 900
     > ,(SOIL(1),SG),(SNOW(1),WCON), (MONSUM(1) ,MONVEC(1),IMPV(1)),    LAND 910
     > (STRAYS(1),SIMP)                                                 LAND 920
      COMMON/MISC/ SIMP,SSUR,SAR1,SAR2,SBAS,STOT,SRCH,SLTO,SRA, SIEN,   LAND 930
     > SPRS,SOILEV, TOTELH,SNEVAP,SNET,SPET,STSNO,SCEP,RES, STDEP,STUS, LAND 940
     > STDS1,STDS2,STGW,STBT                                            LAND 950
      COMMON/LOCALS/RU,SCI,F1,F1A,GWF,LOS,EP,RECE,ROS,HRLYRN, EPHRLI,   LAND 960
     > AETR                                                             LAND 970
      COMMON/SURFXP/RZ,PR,ORAIN,FF,FIXM,RGX,SHRD,A3,AUZS,ASDS, AINF     LAND 980
      COMMON/DAILY/DEW(12,31), RAD(12,31), EVAP(12,31), TEM (2,12,31),  LAND 990
     > WINDS(12,31),IFILL(144)                                          LAND1000
      REAL TEM                                                          LAND1010
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART, NUMDYS,      LAND1020
     > HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),IRIG,PKIRIG(87)  LAND1030
      COMMON/T/TWORD(3), RUNSCL, AERSCL                                 LAND1040
      COMMON/GET/STCLD,MONTHP(12),EPXMIN, EPXMAX,RNON,SUNHR(24),        LAND1050
     > DUST(12),Y,M,T(744),JJ                                           LAND1060
      COMMON/NMON/NOW,KEY,SEG,HRNI,TARGET,NXTF                          LAND1070
      COMMON/XPRE/DEP,SEP,INDRTS                                        LAND1080
      COMMON/SNO/SSCEP,PCKRN,SMELT,MSRVAP,SUMSNO,SDEN,ALBEDO            LAND1090
      COMMON/STOSNO/NDASTO,ISTDAY(31),STOPAC(31),STODEP(31),STOSDE(31), LAND1100
     > STOALB(31),STONEM(31),STOLIQ(31),STOSRA(31),STOMSR(31),          LAND1110
     > STORAD(31),STOCON(31)                                            LAND1120
      COMMON/NSEG/ SRC,DEC,IDX,SSG1,RES1,SGW1,LZS1,ASPR,CKDH, SFILT,    LAND1130
     > LIQW1,PACK1,SSG2,SCEP1,SNOBAL,STRANS,SDDRAN,SINTFA               LAND1140
      COMMON/PEV/CNPE,DSEQL,DSOLOS                                      LAND1150
      COMMON/IMPAR/WT,WT1,WT2,ISWIWT                                    LAND1160
      EQUIVALENCE (TWORD(1),TSL), (TWORD(2),TEL), (TWORD(3),TKL)        LAND1170
      INTEGER DUMTOT(3)                                                 LAND1180
      EQUIVALENCE (TOTALS(1,1),DUMTOT(1))                               LAND1190
      REAL*8 SET,QSET,WETDEP(5), LAB(2,25),THOUT(8),SGOUT(5)            LAND1200
      DIMENSION HNRAD(24),LAPSE(24),RADIST(24),HIRIG(24)                LAND1210
C                                                                       LAND1220
```

APPENDIX B (continued)

```
      DATA LAPSE /0.6,5*0.0,1.0,2.0,3.0,11*4.0,3.2,2.6,2.0,1.2/
      DATA RADIST/6*0.0,0.019,0.041,0.067,0.088,0.102,3*0.11, 0.105,
     > 0.095,0.081,0.055,0.017,5*0.0/
      DATA INCH/25*4H IN./,CM/25*4H CM./,C254/2.54/
      DATA LAB/ 'IMPERV R','UNOFF   ','SURFACE ','RUNOFF  ', 'SOURCE A',
     > 'REA1 RO ','SOURCE A','REA2 RO ','BASE FLO', 'W       ',
     > 'TOTAL ST','REAMFLOW','UNMSRD S','EEPAGE  ', 'TOTAL OU',
     > 'TFLOW   ','TOTAL PR','ECIP    ','INTRCEP ', 'EVAP    ',
     > 'PROSPR T','RANSP   ','SOIL EVA','POR     ', 'G.W.TRAN',
     > 'SP      ','SNOW EVA','POR     ','TOTAL ET', '        ',
     > 'POTENTIA','L ET    ','SNOWPACK',' TOTAL  ', 'INTERCEP',
     > 'TED STOR','DETENTIO','N STOR  ','DEPRESSI', 'ON STOR ',
     > 'UPPER SO','ILS     ','DEEP SOI','L 1     ', 'DEEP SOI',
     > 'L 2     ','GROUNDWA','TER     ','TOTAL CO', 'NTENT   '/
      DATA CLDRY/.FALSE./
C
C
      RUSCAL = RUNSCL
      SCSCAL = AERSCL
      WRITE(6,10000)
      TMP = 50.0
      BAL = 0.0
      FCI = 0.0
      DCS(10)=0
      DCS(13)=1
      RES = 0.0
      SRGX = 0.0
      SCEP = 0.0
      AUZS = 0
      ASDS = 0
      ALZS = 0
      DSOLOS=0.
      INDRTS=0
      RIRRG=0.
      CALL TIMEWD
      TS = TSL
   10 CALL PERIOD (TS, TE)
      IF (TE.NE.TEL) TE = TEL
C
C     START NEW SEGMENT FOR THE GIVEN WATER YEAR  **********
C
      DO 500 NG = 1,NSEG
      TSTEP=15.
      CIFLAS=0.
      TIMST=0.
      DDRAIN=0.
C     INITIALIZE MONTHLY WATER TERMS FOR PROSPR-BELCH
      CLDRY=.FALSE.
      ROFF=0.
      TDRN=0.
      RF1MON=0.0D0
      RF2MON=0.0D0
      PSEUDO=0.
      ETOT=0.
      PTOT=0.
      FILT=0.
      RNXS=0.
      SRCH=0.
      SNET=0.
      SOILET=0.0
      SPET=0.
```

APPENDIX B (continued)

```
      ELH=0.
      TOTELH = 0.0
      P4=0.
      HRNI=0.
      SDEN=.6
      ALBEDO=.8
      NEMELT=0
      PACK=0.0
      NDASTO=0
      READ 10100,IDOL,SEG,STANFD,YR1,YR2
C     INPUT SEG. NO. AND CORRESPONDING STANFORD NO. USE STANFORD
C     NO. TO FILE. SEVERAL SEGMENT NO. CAN GO INTO ONE STANFORD
C     NO.  I.E. SAME SEGMENT NO. CAN NOT APPEAR MORE THAN ONCE.
      IF (IDOL.EQ.NSDOL) GO TO 500
C       IF (YR(TE).EQ.YR2) GO TO 11
      CALL DATIM(TE,YRTE,MODUM,DADUM,HRDUM,MINDUM)
      IF (YRTE.EQ.YR2) GO TO 20
      PRINT 10200,SEG
      STOP 3001
   20 TL = TS
      DO 30 N = 1,NSEG
      IF (STANFD.EQ.STAN(N)) GO TO 40
   30 CONTINUE
      PRINT 10300,STANFD
      STOP 3002
   40 CALL TSEARC ( DRUM,INV,STANFD,0,RR,86)
      CALL IN ( DRUM,RR,INVENT,88)
      IF (NAME(1).NE.NEMPTY) GO TO 50
      PRINT 10400,SEG
      STOP 3003
   50 CALL CLEAR (INDATA, 8, 0)
      CALL CLEAR (MONVEC, 325, 0)
      IF (KEYTIM.EQ.TS) GO TO 60
      CALL ONMARK(NSEG,DCS,TE,TS,YR1,YR2)
      GO TO 70
   60 CALL GETSET(NSEG,DCS,TE,TS,YR1,YR2)
   70 CALL ANUSEG(DCS,SINTC,BAL,IDX15,IDX30,SINT)
      PA=1.0
      A=0.0
      WT=AREA1
      WT1=WT
      WT2=WT
      MONSUM(13,17)=LIQW+PACK
      MONSUM(13,18)=SCEP
      MONSUM(13,19)=RES
      MONSUM(13,20)=0.0
      MONSUM(13,21)=LZS*PA
      MONSUM(13,22)=SSG(1)*PA
      SUMS=0.
      IF (NTL.LT.2) GO TO 90
      DO 80 JC=2,NTL
   80 SUMS=SUMS+SSG(JC)*PA
   90 MONSUM(13,23)=SUMS
      MONSUM(13,24)=SGW
      MONSUM(13,25)=0.
      DO 100 K=17,24
  100 MONSUM(13,25)=MONSUM(13,25)+MONSUM(13,K)
C
C         START OF MONTH LOOP
C
  110 CALL ANUMON(TL,TE,HOUR,YEAR,MONTH,MIN,DAY,ID)
```

APPENDIX B (continued)

```
      AAMAX=0.0
      IF (NOW.GE.TARGET) GO TO 360
      IDX=(DAY-1)*24+1
      IDX30=IDX+IDX-1
      IDX15=IDX30+IDX30-1
      DLYDST=DUST(MONTH)/NUMDYS
      JLAST=JSTART+NUMDYS
      FLAG=0
      IP=1
C
C       START OF DAY LOOP
C
  120 CALL ANUDAY(YEAR,MONTH,DAY,HNRAD,IP,IRT,HIRIG)
      EP=EVAP(MONTH,DAY)
C
C       START OF HOUR LOOP
C
  130 HET=0.
      SET=0.
      HDRAIN=0.
      HRNXS=0.
      HRLYRN = .01*K1*PRC(DAY,HOUR+1)
      PR = 0.25*HRLYRN
      HRNI=HRNI+100.*HRLYRN
      SRA=SRA + HRLYRN
      DO 140 K=1,4
  140 WETDEP(K)=0.01*DEPOS(DAY,HOUR+1,K)
      IF (HRNI.GT.0.) GO TO 150
      DEP=.25*DLYDST
      GO TO 170
  150 HRNI = 0.0
  160 DEP = 0.0025*DEPOS(DAY,HOUR+1,1)
C       HOURLY WINDSPEED IN CM/SEC CORRECTED FOR CANOPY DRAG
  170 REDU=REDUC
      U=AMAX1(50.,HWND(HOUR+1,DAY)*44.704*REDU)
      HIR=HIRIG(HOUR+1)
      IF(IRT.EQ.1) PR=PR+HIR*.25
      HTMP=HTEM(HOUR+1,DAY)
      HT=607.25-.311*TMP
      TTE=(HTMP-32.)*0.5555556+273.16
      VAPOR=217060.*EXP(-7482.6/(AMIN1(HTMP,HDEW(HOUR+1,DAY))+ 398.36))
      VAPMB=1000.*VAPOR
      TMP=HTMP
      SOLHR=HNRAD(HOUR+1)
      RASOL = SOLHR
      IF (RNON.LT.1.) GO TO 190
      IF (RASOL.LE.0.) GO TO 180
C     CALCULATE LONG WAVE BALANCE FOR VEGETATION
      RNLW = RNLONG(STCLD,RASOL,VAPMB,TTE)
      RASOL=RASOL-RNLW
  180 IF (RASOL.LT.0.0) RASOL=0.0
      SOLHR=RASOL
      IF (DAY.EQ.2) PRINT 10500,STCLD,RASOL,VAPMB,TMP,RNLW
  190 IF (FOLTYP.GT.0) GO TO 200
C       FOLTYP.GT.0 INDICATES NEEDLE TYPE CANOPY, NOT LEAVES
      RB=1.3*DSQRT(XL/U)
      GO TO 210
  200 RB=3.3*XL**.3/DSQRT(U)
  210 CONTINUE
      IF (HOUR.NE.6) GO TO 220
      CHAN=(HTEM(17,DAY)-HTEM(7,DAY))/27.
```

APPENDIX B (continued)

```
      IF (CHAN.GT.1.0) CHAN=1.0
      RADFAC = RADCON*CHAN*RAD(MONTH,DAY)
C     THE ABOVE COMPUTATATIONS ARE ALWAYS NECESSARY IF SNOW IS POSSIBLE
C     TEMP IN ZONES
  220 LAPS=LAPSE(HOUR + 1)
      IF (HRLYRN.GT.0.05) LAPS = .75*LAPS
      TMPX = TMP-LAPS*ELDIF
      TMPXR =0.557*(TMPX -32.0)+273.0
      IF (DCS(10).EQ.0) GO TO 230
C      SKIP SNOWMELT DURING THE SUMMER MONTHS
C
      IF((TMPX-0.75*LAPS).LT.32..OR.PACK.GT.0.001)CALL SNOMLT(T,DCS,
     > TMPX,TMPXR,HRLYRN,FLAG,RADIST,RADFAC, DAY ,HOUR,
     > MONTH,TMP,LAPS,SOLHR)
  230 PRES=PR+RES+RIRRG
C
C      START 15 MINUTE LOOP   ************
C
C       ROUTE PRECIPITATION THRU INTERCEPTION STORAGE AND
C       THRUFALL
C
 235  CALL XPREC(PR,PACK,IDSID,SINTC,P3,P4)
      IF(ISWIWT.EQ.0)GO TO 234
C     PRINT OUT VARIABLE SOURCE AREA PARAMETER WT, (CALC. IN PROSPR)
      IF(WT.GT.AREA1)WRITE(6,236)DAY,HOUR,MIN,WT
 236  FORMAT(1X,'DAY = ',I3,' HOUR = ',I2,' MIN = ',I2,' WT = ',E11.4)
 234  QFILT=0.
      IF(RIRRG.GT.0) GO TO 237
      IRIRRG=0
      GO TO 239
 237  IRIRRG=IRIRRG+1
      IF(HIR.LE.0.0)GO TO 238
      IRIRRG=0
      GO TO 240
 238  IF(IRIRRG.LT.96)GO TO 240
      RIRRG=0.
      IRIRRG=0
 239  IF (IDSID.EQ.1 .AND. IRT.LE.1) GO TO 260
C LOWER ZONE AND GRNDWATER INFLTR
      IF (INDRTS.LT.96) GO TO 240
      TIMST=0.
      CIFLAS=0.
  240 INDRTS=0
      QHIR=HIR*.25
C       ROUTE THRUFALL PRECIP TO INFILTRATION AND RUNNOFF
C
      IF(IRT.EQ.2 .OR. IRT.EQ.3.AND.QHIR.GT.0.0) PRES=PRES+.01
      CALL RAATS(TSTEP,TIMST,CIFLAS,IRT,QHIR,RIRRG,P4,RRX,
     > QFILT,CIF,RTIM,NRAATS)
C     WT IS VARIABLE SOURCE AREA PARAMETER CALC IN PROSPR
      QFILTW=QFILT*WT
      RU=RU+QFILTW
      SIMP=SIMP+QFILTW
      QFILT=QFILT-QFILTW
      IF (RRX.LE.0) RES=0.0
      FILT=FILT+QFILT
      IF (RRX.LE.0.) GO TO 260
C      25 LINES REMOVED
C     THE VARIABLE RX HAS BEEN CHANGED TO RZ TO AVOID PROSPER CONFLICT
      RZ = RRX
C RZ IS THE VOL TO OVLAND FLOW SURF DETENT
```

APPENDIX B (continued)

```
      DE = (RES+RZ)/2.0
      X = DE
      IF (RZ.GT.RES) X = DEC*((RZ-RES)**0.6)
      IF (X.GT.DE) DE = X
      ROS = 0.0
      IF (RES+RZ.GT.0.0008) ROS=0.25*SRC*(((RES+RZ)/2.0)**1.67)* ((1.0+
     > 0.6*((RES+RZ)/(2.0*DE))**3.0)**1.67)
      IF (ROS.GT.0.75*RZ) ROS = 0.75*RZ
      R = PA * ROS
      IF (R.LT.0) WRITE(6,10600) TL,R,RES,RZ,ROS,DE,P4
      SSUR =SSUR + R
      RU = RU + R
C    THE FOLLOWING SECTION HAS BEEN REMOVED BECAUSE THE
C     TRANSPORT IS INCOMPATIBLE WITH SOURCE AREAS CONCEPT
      RES = RZ - ROS
      IF (RES.GE.0.0008) GO TO 260
      FILT = FILT + RES
      RES = 0.0
  260 CONTINUE
      WT=AREA1
      IF (PRES.LE.0.) GO TO 290
C
      CALL PROSPR(QFILT,TMP,RASOL,VAPOR,U,QET,QDRAIN,QRNXS,SW, SCEP,
     > MONTH,DAY,HOUR,YEAR,MIN,QSET,IRT,QHIR,RIRRG)
C
      IF (CHMOPT) CALL SCEHM(QDRAIN,QFILT,YEAR,MONTH,DAY,HOUR, MIN,
     > WETDEP,ROS)
C
      IF (DRYOPT.AND.CLDRY) CALL DRYADS(PRES,HOUR,MIN,MONTH, YEAR ,DAY)
      HET=HET+QET
      SET=SET+QSET
      HDRAIN=HDRAIN+QDRAIN
      SINTFA=SINTFA+QRNXS*PA
      SRGX=SRGX+QRNXS*PA
      LZS=0.0
      DO 270 K=1,NSL
  270 LZS = LZS + THETA(K)/2.54
      TST = 15.0D0
      FLO1 = QRNXS
      PDRN = (QDRAIN )*6.0D01/TST
C
      CALL SUBSRF(TST,PDRN,FLO1,FLO2,FLO3,K24L,SRCH,SGW)
      INTF = FLO1 + FLO2
      GWF = FLO3
      R = INTF
      SINT = SINT + R
      RU = RU + R
      SBAS = SBAS + GWF
      RU = RU + GWF
      IRSTOR = IFIX(RU*RUSCAL+0.5) + SU30M(IDX30)
C      SU30M(IDX30) = IRSTOR
      CALL SU30MR(IDX30, IRSTOR)
      IOSTOR = IFIX(SCI*SCSCAL+0.5) + RAC30M(IDX30,1)
C      RAC30M (IDX30,1) = IOSTOR
      CALL RAC30R(IDX30,1,IOSTOR)
      IF (IDX.EQ.1) JFLG = 0
      IF (JFLG.GT.0) GO TO 280
      IF (IRSTOR.LE.30000.AND.IOSTOR.LE.30000.AND.RU.GE.0.0) GO TO 280
      PRINT 10700,IRSTOR,RU,IOSTOR,SCI,IDX30,TL
      JFLG = 1
  280 CONTINUE
```

APPENDIX B (continued)

```
      STOT = STOT + RU
      ATOT = ATOT + SCI
  290 CONTINUE
      IF (MIN.NE.45) GO TO 340
C
      CALL PEVSRF(SOLHR,TTE,VAPOR,ETCNPY,RASOL)
      DELINF=0.
      IF (PRES.GT.0.) GO TO 330
C      IF(DAY.EQ.1)  WRITE(6,612) DELINF,TMP,RASOL,VAPOR,U,HET,
C     + HDRAIN,HRNXS,SW,SCEP,MONTH,DAY,HOUR,YEAR,MIN,SET
C
      WT1=AREA1
      WT2=WT1
      CALL PROSPR(DELINF,TMP,RASOL,VAPOR,U,HET,HDRAIN,HRNXS,SW, SCEP,
     > MONTH,DAY,HOUR,YEAR,MIN,SET,IRT,QHIR,RIRRG)
C
      IF (CHMOPT) CALL SCEHM(HDRAIN,DELINF,YEAR,MONTH,DAY,HOUR, MIN ,
     > WETDEP,ROS)
C
      IF (DRYOPT.AND.CLDRY) CALL DRYADS(PRES,HOUR,MIN,MONTH, YEAR ,DAY)
C
C      IF(DAY.EQ.1)  WRITE(6,612) DELINF,TMP,RASOL,VAPOR,U,HET,
C     + HDRAIN,HRNXS,SW,SCEP,MONTH,DAY,HOUR,YEAR,MIN,SET
      LZS=0.0
      DO 300 K=1,NSL
  300 LZS = LZS + THETA(K)/2.54
      TST = 30.0D0
      PDRN = (HDRAIN )
      DO 320 ISS = 1,2
      FLO1=0.5*HRNXS
      CALL SUBSRF(TST,PDRN,FLO1,FLO2,FLO3,K24L,SRCH,SGW)
      INTF = FLO1 + FLO2
      GWF = FLO3
      R = INTF
      SINT = SINT + R
      RU = R
      SBAS = SBAS + GWF
      RU = RU + GWF
      IDSS = IDX30 +ISS - 2
      IRSTOR = IFIX(RU*RUSCAL+0.5)
      CALL SU30MR(IDSS, IRSTOR)
      IOSTOR = IFIX(SCI*SCSCAL+0.5)
      CALL RAC30R(IDSS,1,IOSTOR)
      IF (IDX.EQ.1) JFLG = 0
      IF (JFLG.GT.0) GO TO 310
      IF (IRSTOR.LE.30000.AND.IOSTOR.LE.30000.AND.RU.GE.0.0) GO TO 310
      PRINT 10700,IRSTOR,RU,IOSTOR,SCI,IDX30,TL
      JFLG = 1
  310 CONTINUE
      STOT = STOT + RU
  320 ATOT = ATOT + SCI
C
C      DLAYIN SUBROUTINE WILL START HERE  ****************
  330 CALL DLAYIN(DAY,HOUR,YEAR,MONTH,U,VAPOR,HDRAIN,JLAST,RNXS, FILT,
     > SOLAR,NSEG,ET,SW,HET,ELH,ALZS,HRNXS)
C
      IF (CEROPT) CALL CERES(SOLHR,TMP,HOUR,MONTH,DAY,YEAR)
      CLDRY=.TRUE.
      SOILET=SOILET+SET
      SET=0.0D0
C
```

APPENDIX B (continued)

```
  340 MIN = MIN + 15
      AAMAX=DMAX1(AAMAX,WT)
      TL = ITWRD(YEAR,MONTH,DAY,HOUR,MIN)
      IDX15=IDX15+1
      IDX30=IDX30+MOD(IDX15,2)
      IF (MIN.LT.60) GO TO 235
C
C       END OF 15 MINUTE LOOP
C
      IDX=IDX+1
      CALL TIMEIC(TL)
      CALL DATIM(TL,YEAR,MONTH,DAY,HOUR,MIN)
      IF (HOUR.GT.0) GO TO 130
C
C       END OF HOUR LOOP
C
C       PRINT DAILY WATER BUDGET AND MONTHLY SUMMARY
      CALL BELCH(JLAST)
      IF (DAY.GT.1) GO TO 120
C
C       END OF DAY LOOP
C
C       PREPARE FOR MONTH END
      PA=1.0
      A=0.
      CALL TSEARC (SDRUM,SURF,NEMPTY,0,RS,146)
      CALL PUTOUT(BAL,NOPOS,SINTC,RS,MONTH,MONSUM,SINT,SOILET)
      WRITE(6,11800)AAMAX
11800 FORMAT(1X,' MAXIMUM A = ',E11.4)
C
      GO TO 110
C
C      END OF MONTH LOOP   **********************
C
  360 LASTYR = YEAR - 1
      A=0.0
      PA=1.
      IF (NAWPLT.NE.0) CALL AWYPLT(MONSUM)
      WRITE(6,10800) WATSHD,SEG,DSNAME,LASTYR,YEAR
      CALL CLEAR (SUM, 20,0.0)
      DO 370 I = 1, 16
      DO 370 J = 1, 12
  370 SUM(I) = SUM(I) + MONSUM(J,I)
C MONCEM IS THE MONSUM ARRAY IN CENTIMETERS INSTEAD OF INCHES.
C IF CMYR IS ONE THE VALUES PRINTED OUT WILL BE IN CM. IF ZERO
C THE VALUES PRINTED OUT WILL BE IN INCHES.
      IF (CMYR.EQ.0) GO TO 430
      DO 390 J=1,16
      DO 380 I=1,12
      MONCEM(I,J)=MONSUM(I,J)*C254
  380 CONTINUE
      SUMCM(J)=SUM(J)*C254
  390 CONTINUE
      DO 400 I=1,13
      DO 400 J=17,25
      MONCEM(I,J)=MONSUM(I,J)*C254
  400 CONTINUE
      WRITE(6,10900)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11000) (LAB(1,I),LAB(2,I),(MONCEM(ID(J),I),J=1,12),
     > SUMCM(I),CM(I),I=1,8)
      WRITE(6,11100) (MONTHS(ID(J)),J=1,12)
```

APPENDIX B (continued)

```
      WRITE(6,11200) (LAB(1,I),LAB(2,I),(MONCEM(ID(J),I),J=1,12),
     > SUMCM(I),CM(I),I=9,16)
      WRITE(6,11300)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11400) (LAB(1,I),LAB(2,I),MONCEM(13,I), (MONCEM(ID(J),I),
     > J=1,12),CM(I),I=17,25)
      DO 410 J=2,12
      CMC(ID(J))=MONCEM(ID(J),25)-MONCEM(ID(J-1),25)
  410 CONTINUE
      CMC(ID(1))=MONCEM(ID(1),25)-MONCEM(13,25)
      DO 420 JJ=1,12
  420 BALWB(JJ)=MONCEM(JJ,8)+MONCEM(JJ,15)-MONCEM(JJ,9)+CMC(JJ)
      TOTCMC=MONCEM(ID(12),25)-MONCEM(13,25)
      TBALWB=SUMCM(8)+SUMCM(15)-SUMCM(9)+TOTCMC
      WRITE(6,11500)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11600)(MONCEM(ID(J),9),J=1,12),SUMCM(9), CM(1),
     > (MONCEM(ID(J),15),J=1,12),SUMCM(15),CM(1), (MONCEM(ID(J), 8),J=1,
     > 12),SUMCM(8),CM(1), (CMC(ID(J)),J=1,12),TOTCMC, CM(1),
     > (BALWB(ID(J)),J=1,12), TBALWB,CM(1)
      GO TO 460
  430 WRITE(6,10900)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11000) (LAB(1,I),LAB(2,I),(MONSUM(ID(J),I),J=1,12), SUM(I)
     > ,INCH(I),I=1,8)
      WRITE(6,11100) (MONTHS(ID(J)),J=1,12)
      WRITE(6,11200) (LAB(1,I),LAB(2,I),(MONSUM(ID(J),I),J=1,12), SUM(I)
     > ,INCH(I),I=9,16)
      WRITE(6,11300)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11400) (LAB(1,I),LAB(2,I),MONSUM(13,I), (MONSUM(ID(J),I),
     > J=1,12),INCH(I),I=17,25)
      TOTCMC=0.
      DO 440 J=2,12
      CMC(ID(J))=MONSUM(ID(J),25)-MONSUM(ID(J-1),25)
  440 CONTINUE
      CMC(ID(1))=MONSUM(ID(1),25)-MONSUM(13,25)
      DO 450 JJ=1,12
  450 BALWB(JJ)=MONSUM(JJ,8)+MONSUM(JJ,15)-MONSUM(JJ,9)+CMC(JJ)
      TOTCMC=MONSUM(ID(12),25)-MONSUM(13,24)
      TBALWB=SUM(8)+SUM(15)-SUM(9)+TOTCMC
      WRITE(6,11500)(MONTHS(ID(J)),J=1,12)
      WRITE(6,11600)(MONSUM(ID(J),9),J=1,12),SUM(9),INCH(1),
     > (MONSUM(ID(J),15),J=1,12),SUM(15),INCH(1) ,(MONSUM(ID(J), 8),J=1,
     > 12),SUM(8),INCH(1), (CMC(ID(J)),J=1,12),TOTCMC, INCH(1),
     > (BALWB(ID(J)),J=1,12) ,TBALWB,INCH(1)
  460 DO 461 ITH = 1,NSL
  461 THOUT(ITH) = THETA(ITH)/DL(ITH)
      DO 462 ISG = 1,NTL
      SSGCM(ISG) = 2.54 * SSG(ISG)
      SBDCM(ISG) = 2.54 * SBD(ISG)
  462 SGOUT(ISG) = SSG(ISG)/SBD(ISG)
      SGWOUT = 2.54*SGW
      WRITE(6,11601)
      WRITE(6,11602) NSL,(I,THETA(I),DL(I),THOUT(I),I=1,NSL)
      WRITE(6,11603) (I,SSGCM(I),SBDCM(I),SGOUT(I),I=1,NTL)
      WRITE(6,11604) SGWOUT
      WRITE(6,11605)
      CALL TSEARC (DRUM,INV,STANFD,0,RR,88)
      DO 470 I = 1, 5
      IF (ELEM(I).NE.HOLBL4) GO TO 480
  470 CONTINUE
      GO TO 490
  480 IF (YR1.LT.DSSTYR.OR.DSSTYR.EQ.0) DSSTYR = YR1
      IF (YR2.GT.DSENDY) DSENDY = YR2
```

APPENDIX B (continued)

```
  490 CONTINUE
      IF (YR1.LT.ROSTYR.OR.ROSTYR.EQ.0) ROSTYR = YR1
      IF (YR2.GT.RENDYR.OR.RENDYR.EQ.0) RENDYR = YR2
      CALL OUT (DRUM,RR,INVENT,88)
      CALL OUT (SDRUM,RS,NEMPTY,1)
  500 CONTINUE
      TS = TE
      NOW = TE
      TARGET = TEL
      IF (NOW.LT.TARGET) GO TO 10
C
C      END OF SEGMENT LOOP  ********************
C
      WRITE(6,11700)
      RETURN 1
10000 FORMAT ('0***  BEGIN LAND SURFACE SIMULATION ROUTINES  ***'//)
10100 FORMAT (A1,I2,1X,I3,1X,I2,1X,I2)
10200 FORMAT('0ERROR** INPUT OUT OF SEQUENCE FOR SEGMENT ',I3)
10300 FORMAT(' ERROR** UNKNOWN STANFORD NUMBER ',I3,
     > ' IN LAND SURFACE SIMULATION')
10400 FORMAT(' ERROR** NO INVENTORY INFO IS ON FILE FOR SEGMENT ',I3)
10500 FORMAT(1H ,'STCLD,RASOL,VAPMB,TMP,RNLW=',3X,5G15.7)
10600 FORMAT ('HEX=',Z9,5X,10E10.4)
10700 FORMAT ('0',10X,'IRSTOR=',I10,', RU=',E10.2,', IOSTOR=', I10,
     > ', SCI=',E10.2,', IDX30=',I5,', TL=',Z8)
10800 FORMAT (1H1,7A4,' SEGMENT ',I4,' GAGE ',I6,24X, ' WATER YEAR 19',
     > I 2,'-',I2//)
10900 FORMAT(' SEGMENT RUNOFF SUMMARY'/22X,12(A4,4X),'ANNUAL'//)
11000 FORMAT(8(1X,2A8,1X,13F8.2,A8/))
11100 FORMAT(' SEGMENT PRECIP/ET SUMMARY'/22X,12(A4,4X),4X, 'ANNUAL'//)
11200 FORMAT(8(1X,2A8,1X,13F8.2,A8/))
11300 FORMAT(' SEGMENT MOISTURE STATUS-BEGINNING OF THE MONTH VALUES'/
     > 22X,13(A4,4X)//)
11400 FORMAT(9(1X,2A8,1X,13F8.2,A8/))
11500 FORMAT(' SEGMENT WATER BUDGET SUMMARY'/22X,12(A4,4X),4X, 'ANNUAL'/
     > /)
11600 FORMAT(' PRECIPITATION',5X,13F8.2,A8/' INPUT'/
     > ' EVAPORANSPIRATION',1X,13F8.2, A8/' LOSS'/' OUTFLOW', 11X,
     > 13F8.2, A8/' TOTAL'/ ' CHANGE IN MOISTURE', 13F8.2,A8,/
     > ' CONTENT'/' BALANCE' 11X,13F8.2,A8)
C       THE FOLLOWING FIVE FORMATS OUTPUT NEXT YEAR START VALUES
11601 FORMAT(1H1,' THE END OF THE YEAR VALUES TO BE USED TO START NEXT',
     >' YEAR SIMULATIONS FOLLOW:'//)
11602 FORMAT(1X,'FOR THIS SEGMENT THERE ARE ',I3,' SOIL LAYERS SIMULAT',
     >'ED BY PROSPER'/1X,'THEY HAVE THE FOLLOWING PROPERTIES:'//1X,
     >'LAYER',3X,'WATER CONTENT (CM)',3X,'LAYER THICKNESS (CM)',
     >3X,'THETA VALUE'/(3X,I1,7X,G14.8,7X,G16.8,6X,G12.6/))
11603 FORMAT(/1X,'THE SOIL WATER TRANSMISSION LAYERS HAVE THE ',
     >'FOLLOWING PROPERTIES'//1X,'LAYER',3X,'WATER CONTENT (CM)',
     >3X,'LAYER THICKNESS (CM)',3X,'THETA VALUE'/(3X,I1,7X,G14.8,7X,
     >G16.8,6X,G12.6/))
11604 FORMAT(/1X,'THE GROUNDWATER STORAGE VALUE IS ',G12.6,' CM.')
11605 FORMAT(1H1)
11700 FORMAT ('0***  END OF LAND SIMULATION  ***')
      END
```

APPENDIX B (continued)

```
      SUBROUTINE MONDAT(YEAR,MONTH,IFFIN)
C
C     PROCESS A MONTH'S DATA
C
      COMMON /DAILY/ DEW(12,31),RAD(12,31),EVAP(12,31),
     & TEM(2,12,31), WINDS(12,31),IDEW(36),IRAD(36),ITEM(36),
     & IWND(36)
C       YEAR, MONTH, LOCATION, WRITE FLAG, COMPLETE FLAG, RECORD
C       NUMBER, JULIAN DATE MINUS ONE OF FIRST DAY OF MONTH,
C       NUMBER OF DAYS IN MONTH
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART,
     & NUMDYS,HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),
     & IRIG,PKIRIG(87)
      COMMON /ANGLES/ FILL(6),DGLAT,DLONG
      INTEGER*2 IDEW,IRAD,ITEM,IWND
      INTEGER YEAR
      DIMENSION ZERO(3064)
      EQUIVALENCE (ZERO(1),HDEW(1))
C       MODEL FOR HOURLY TEMPERATURES INFERED FROM DAILY HIGH
C       AND LOW TEMPERATURES
C         HOURLY TEMPERATURE VARIATION, TEMPF=(T-TMAX)/(TMAX-TMIN)
      DIMENSION TEMPF(24),LOC(24)
      DATA TEMPF/ .17,.13,.09,.06,.04,.02,.00,.02,.08,.22,
     & .40,.60,.77,.90,.96,.99,1.00,.95,.88,.78,.65,.50,.37,.25/
      DATA LOC/ 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,
     & 19,20,21,22,23,24/
      DATA IFDEFF/0/,IBLANK/'    '/,TWOPI/6.2832/
C     ANNUAL AVG. DAILY TEMPERATURE, SEASONAL VARIATION OF
C       ANNUAL AVERAGE WINDSPEED, AVERAGE CLOUD COVERAGE,
C       TRANSMISSION OF SOLAR RADIATION THROUGH CLOUDS.
      DATA AAWIND/ 4.5/, CLDF,CLDT/ .1,  .32/
C
      JRETRN=1
C       HAS DIRECT ACCESS FILE BEEN 'DEFINED'?
      IF(IFDEFF.NE.0) GO TO 10
C       IN NOT THEN 'DEFINE' IT
      CALL DEFER
      IFDEFF=1
      IWRT=0
      GO TO 20
C       IS NEW MONTH DATA ALREADY AVAILABLE?
   10 IF(YEAR.EQ.IYR .AND. MONTH.EQ.IMO) GO TO 60
C       NOT AVAILABLE, SEE IF OLD MONTHS DATA SHOULD BE WRITTEN
C       HAS OLD MONTHS HOURLY DATA BEEN COMPLETED?
      IF(IKMPLT.EQ.1) GO TO 18
C       NO, COMPLETE ANY POSSIBLE ENTRIES
      JRETRN=2
      GO TO 150
C       RETURN FROM POSSIBLE UPDATE
   16 JRETRN=1
C     SHOULD OLD DATA BE WRITTEN OUT?
   18 IF(IWRT.EQ.0) GO TO 20
C       WRITE OUT OLD MONTH'S DATA ON FILE
      IWRT=0
      CALL PROFER
C       GET RECORD NUMBER IF DATA AVALILABLE FOR NEW MONTH,
C       ELSE GET A RECORD NUMBER ASSIGNED TO NEW MONTH
   20 CALL GOFER(YEAR,MONTH,NXREC)
      IF(NXREC.EQ.0) GO TO 60
C       RECORD NOT FOUND SO CREATE A BLANK RECORD
   30 IYR=YEAR
```

APPENDIX B (continued)

```
      IMO=MONTH
      LOKN=IBLANK
      IWRT=0
      IKMPLT=0
      IREC=NXREC
      DO 40 I=1,3064
   40 ZERO(I)=0.
      NUMDYS=LASDAY(IYR,IMO)
      JSTART=0
      IF(IMO.EQ.1) GO TO 60
      IMM=IMO-1
      DO 50 I=1,IMM
   50 JSTART=JSTART+LASDAY(IYR,I)
C      END OF BLOCK TO INITIALIZE NEW HOURLY DATA
C
C      IS DATA COMPLETE?
   60 CONTINUE
C  60 IF(IKMPLT.EQ.1) GO TO 900
      II=(IMO-1)*3
C      ARE WE TO FORCE COMPLETION OF MONTH'S DATA?
      IF(IFFIN.EQ.0) GO TO 150
C
C      BEGIN BLOCK TO ENTER NOMINAL OR MODEL DAILY METEOROLOGICAL
C      DATA WHEN INPUT DATA IS NOT AVAILABLE
C
      DO 140 I=1,3
      IS=(I-1)*11+1
      IL=IS+10
      IF(I.EQ.3) IL=NUMDYS
      III=II+I
      IF(IWND(III).NE.0) GO TO 80
C      SET DAILY WINDSPEED TO NOMINAL VALUE
      DO 70 J=IS,IL
      DY=JSTART+J
   70 WINDS(IMO,J)=AAWIND*(1.+.2*SIN(.0172*DY-31.))
      IWND(III)=1
   80 IF(IRAD(III).NE.0) GO TO 100
C      SET DAILY INCIDENT RADIATION TO NOMINAL VALUES
      CLOUDS=1.0-CLDF+CLDT*CLDF
      DO 90 J=IS,IL
      DY=JSTART+J
   90 RAD(IMO,J)=SOLRAD(DY,DGLAT)*CLOUDS
      IRAD(III)=1
  100 IF (ITEM(III).NE.0) GO TO 120
      ALTUDE=0.
C      SET DAILY HIGH AND LOW TEMPERATURES TO NOMINAL VALUES
      DO 110 J=IS,IL
      DY=JSTART+J
      CALL NATEMP(ALTUDE,DGLAT,DY,TMPMD,TMPDV)
      TEM(1,IMO,J)=TMPMD+TMPDV
  110 TEM(2,IMO,J)=TMPMD-TMPDV
      ITEM(III)=1
  120 IF(IDEW(III).NE.0) GO TO 140
C      SET DAILY DEWPOINT TO NOMINAL VALUES (DAILY MIN TEMP)
      DO 130 J=IS,IL
  130 DEW(IMO,J)=TEM(2,IMO,J)
      IDEW(III)=1
  140 CONTINUE
C      END NOMINAL DAILY DATA BLOCK
C
C      ANY NEW HOURLY DATA TO BE ENTERED?
```

APPENDIX B (continued)

```
  150 DO 160 I=1,3
      III=II+I
      IF(IWND(III).EQ.1) GO TO 170
      IF(IRAD(III).EQ.1) GO TO 170
      IF(ITEM(III).EQ.1) GO TO 170
  160 IF(IDEW(III).EQ.1) GO TO 170
      GO TO (900,16), JRETRN
C
C      BEGIN BLOCK TO ENTER NOMINAL OR MODEL HOURLY
C      METEOROLOGICAL DATA INFERED FROM DAILY DATA WHEN
C      HOURLY INPUT DATA IS NOT AVAILABLE
C
  170 DO 260 I=1,3
      III=II+I
      IS=(I-1)*11+1
      IL=IS+10
      IF(I.EQ.3) IL=NUMDYS
C      DO WE HAVE NEW TEMPERATURE DATA?
      IF(ITEM(III).NE.1) GO TO 230
      THI=TEM(1,IMO,IS)
      TLO=TEM(2,IMO,IS)
      IF(I.GT.1) GO TO 190
      IYRR=IYR
      IIL=III-1
      IMM=MOD(IMO+10,12)+1
      IF(IIL.GT.0) GO TO 180
      IYRR=IYRR-1
      IMM=12
      IIL=36
  180 IF(ITEM(IIL).LE.0) GO TO 190
      LAS=LASDAY(IYRR,IMM)
      THI=TEM(1,IMM,LAS)
  190 TDIF=THI-TLO
      DO 228 ID=IS,IL
      DO 210 IH=1,7
  210 HTEM(IH,ID)=TLO+TEMPF(IH)*TDIF
      THI=TEM(1,IMO,ID)
      TDIF=THI-TLO
      DO 220 IH=8,17
  220 HTEM(IH,ID)=TLO+TEMPF(IH)*TDIF
      IF(ID.GE.IL) GO TO 222
      TLO=TEM(2,IMO,ID+1)
      GO TO 224
  222 IF(IMO.NE.12) TLO=TEM(2,IMO+1,1)
  224 TDIF=THI-TLO
      DO 226 IH=18,24
  226 HTEM(IH,ID)=TLO+TEMPF(IH)*TDIF
  228 CONTINUE
      ITEM(III)=2
C       HOURLY DEWPOINT; DAILY HIGH-LOW TEMPERATURE SHOULD BE
C      ENTERED BEFORE ENTERING HOURLY DEWPOINT
  230 IF(IDEW(III).NE.1) GO TO 240
      IF(ITEM(III).NE.2) GO TO 236
C       DISTRIBUTE HOURLY DEWPOINT (FOR VAPOR PRESSURE) WHILE PRESERVING
C       AVERAGE, I.E. ENFORCE "CONSERVATION" OF "DEGREE-HOURS"
      DO 235 ID=IS,IL
      CALL INDEX(LOC,HTEM(1,ID),24)
      DIV=24.
C       TOTAL NUMBER OF DEWPOINT "DEGREE-HOURS" LEFT IN THIS DAY
      TDH=DEW(IMO,ID)*DIV
      DO 234 J=1,24
```

APPENDIX B (continued)

```
      ADP=TDH/DIV
      DIV=DIV-1.
      IH=LOC(J)
      IF(HTEM(IH,ID).LT.ADP) GO TO 232
      HDEW(IH,ID)=ADP
      GO TO 234
  232 HDEW(IH,ID)=HTEM(IH,ID)
  234 TDH=TDH-HDEW(IH,ID)
  235 CONTINUE
      IDEW(III)=2
      GO TO 240
C       DONT HAVE HOURLY TEMPERATURES BUT ASSIGN HOURLY DEWPOINT
C       ANYWAY. MAY LEAD TO SUPERSATURATED CONDITIONS
  236 DO 238 ID=IS,IL
      ADEW=DEW(IMO,ID)
      DO 238 IH=1,24
  238 HDEW(IH,ID)=ADEW
      IDEW(III)=2
C        HOURLY WINDSPEED (CM/SEC)
  240 IF(IWND(III).NE.1) GO TO 250
      DO 246 ID=IS,IL
      WNDSPD=WINDS(IMO,ID)
      DO 246 IH=1,24
  246 HWND(IH,ID)=WNDSPD
      IWND(III)=2
C       HOURLY INCIDENT SOLAR RADIATION
  250 IF(IRAD(III).NE.1) GO TO 260
      DO 258 ID=IS,IL
      DY=JSTART+ID
C        HOURLY RADIATION INCIDENT ON HORIZONTAL SURFACE
      CALL RADIST(DY,RAD(IMO,ID),DGLAT,DLONG,HRAD(1,ID))
  258 CONTINUE
      IRAD(III)=2
  260 CONTINUE
      IWRT=1
C     IF(IFSAVE.NE.0) IWRT=1
C     IF(IFSAVE.EQ.1) IFSAVE=0
C       IS HOURLY UPDATE COMPLETE?
      DO 270 I=1,3
      III=II+I
      IF(IWND(III).NE.2) GO TO 280
      IF(IRAD(III).NE.2) GO TO 280
      IF(ITEM(III).NE.2) GO TO 280
  270 IF(IDEW(III).NE.2) GO TO 280
      IKMPLT=1
  280 CONTINUE
C       END OF BLOCK TO ENTER NOMINAL HOURLY METEOROLOGICAL DATA
C
      GO TO (900,16), JRETRN
  900 RETURN
      END
```

```
      SUBROUTINE NATEMP(ALTUDE,DGLAT,DAYJ,TMPMD,TMPDV)
C
C        MODEL FOR MEAN DAILY TEMPERATURES IN NORTH AMERICA.
C        DAYJ IS JULIAN DATE, DGLAT IS LATITUDE IN DEGREES,
C        ALTUDE IS ALTITUDE ABOVE MEAN SEA LEVEL IN FEET,
C        " .0035 " IS AVERAGE LAPSE RATE IN DEG. F/FOOT.
C        MODEL MAY BE USED BETWEEN 25N AND 55N LATITUDE.
C
      TMPMD=(12.2-.925*DGLAT)*COS(.0172*(DAYJ-21.))-1.8*DGLAT
     & +124.-.0035*ALTUDE
C     TMPDV=20.+.175*SQRT(ALTUDE)
      TMPDV=20.
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE PEVSRF(SOLHR,TTE,VAPOR,ETCNPY,RASOL)
      COMMON/HUMID/FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/MISC/ SIMP,SSUR,SAR1,SAR2,SBAS,STOT,SRCH,SLTO,SRA,SIEN,
     > SPRS,SOILEV, TOTELH,SNEVAP,SNET,SPET,STSNO,SCEP,RES,STDEP,STUS,
     > STDS1,STDS2,STGW,STBT
      COMMON/PEV/CNPE,DSEQL,DSOLOS
      COMMON/LOCALS/RU,SCI,F1,F1A,GWF,LOS,EP,RECE,ROS,HRLYRN,EPHRLI,
     > AETR
      REAL*8 TTE,DEDT,ESTAR,VAPOR, RASOL,
     > FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      REAL*4 LOS
C
C
C
      CALL SATVP(TTE,ESTAR,DEDT)
      ESTAR=ESTAR*1.0132
      DEDT=DEDT*1.0132
      DELTA=.1*DEDT/(0.461*TTE)
      IF (VAPOR.GT.ESTAR) VAPOR=ESTAR
C     WARNING--- THERE IS NO INDICATION IF ESTAR.LT.VAPOR
C
      REL=VAPOR*(PAIR-ESTAR)/(ESTAR*(PAIR-VAPOR))
      SATMR=0.622*ESTAR/(PAIR-ESTAR)
      RMR=REL*SATMR
      CP=CPO*(1.+.8*RMR)
      RHOAIR=.1*PAIR*(1.+RMR)/(287.D-3*(1.+1.61*RMR)*TTE)
      RHODIF=0.1*(ESTAR-VAPOR)/(.461*TTE)
      ECNP1 = SOLHR*DELTA/(2.*CP*RHOAIR)
      ECNP2 = 3.6D3*(RHODIF)/RB
      IF ((ECNP1+ECNP2).LE.0.) GO TO 20
      ETCNPY = (ECNP1+ECNP2)/(1.+HT*DELTA/(2.*CP*RHOAIR))
      ETCNPY=ETCNPY/2.54
      IF (ETCNPY.GE.0.) GO TO 30
   20 ETCNPY=0.
   30 EPHRLI=ETCNPY
      IF (EPHRLI.LE.0.000001) GO TO 60
      IF (SCEP.LE.0.0) GO TO 70
      IF (SCEP.LE.EPHRLI) GO TO 40
      SCEP = SCEP - EPHRLI
C     CNPE IS EVAPORATION FROM INTERCEPTION STORAGE
      CNPE=CNPE+EPHRLI
      SNET = SNET + EPHRLI
      SOLOS=SOLHR
      EPHRLI = 0.0
      GO TO 60
   40 EPHRLI = EPHRLI - SCEP
      CNPE=CNPE+SCEP
      SNET = SNET + SCEP
C     CONVERT ET LOSS TO REDUCED SOLAR RADIATION
      SOLOS = 0.0
      IF (ETCNPY.GT.0.) SOLOS=SOLHR*SCEP/ETCNPY
      SCEP = 0.0
      RASOL=SOLHR-SOLOS
      GO TO 70
   60 RASOL=0.0
   70 RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE PROSPR(FILT,TEMP,HSOLAR,VAPOR,V,TET,TDRAIN,TRNXS,SW,
     > SCEP,MONTH,DAY,HOUR,YEAR,MIN,SEVTOT,IRT,QHIRRG,RIRRG)
      IMPLICIT REAL*8 (A-H,O-Z)
      REAL*4 HSW(120,8),HTET(120),HTDRAN(120),HTFLNT(120), HCONL(120),
     > HPA,DIVP,HPBAR(120),HP(120), SCEP,XMIN,XMAX,QHIRRG,RIRRG
      REAL*8 LAI,LSTOR,LSPHLO,LSUGAR
      INTEGER DAY,MONTH,HOUR,YEAR
      COMMON/PLTALL/XMIN,XMAX,INC1,ISTRA,NQUES
      DIMENSION RS(8),RSBL(7)
      DOUBLE PRECISION SBD(5),KS(5),A(5)
      COMMON/SSRF/PORE,SID,SBD,KS,A,CUT,CUTL,WUP
      COMMON/AR/AREA1,AREA2,PA
      COMMON/RESIST/R1,R2,R3,R4,R5,RR1,RRA,RRB,RRC,RRR,TM,RLIT
      COMMON/HUMID/FOLTYP,PAIR,CPO,RA,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/THINGS/ALBVEG,CANON,CANOFF,SIMIN,SIMAX,ALMIN,ALMAX,SLOPE
      COMMON/SURF/PWPS,PWPW,PWPMAX,RESS,RESW,RESMAX,POWS,POWW,POWER
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON /BLOCKE/ RN,GND,TTT,EE,PWP,EV,VEL,JDATE
      COMMON/SOLPOT/PSI(8)
      COMMON/TIMES/T1,T2,T3,T4,TMS,TMW,SIGS,SIGW,ALBS,ALBW
      COMMON/TOTMON/ROFF,TDRN,PSEUDO,ETOT,PTOT,PRES,RF1MON,RF2MON
      COMMON/TOTDAY/DDRAIN,DET,FLLAT,FLNET,RUNO,DPTOT
      COMMON/DAYMID/ RM,POT,SW1M,SW2M,SWNM
      COMMON/OPTS/CHMOPT,CEROPT,DRYOPT
      LOGICAL CHMOPT,CEROPT,DRYOPT
      COMMON/TRUNK/LAI(3),LSTOR(3),SSTOR(3),RSTOR(3), LSPHLO(3),
     > SRPHLO(3),LSUGAR(3),SSUGAR(3),RSUGAR(3)
      COMMON/PRSPLC/NPRPLT,NMPLT,NSPLTS,NMSPLT,MONSPL(12),MONPLT(12),
     > PORPLT(36),NBEG(12),NEND(12),MACHIN
      COMMON/SULU/RTCON1,RTCON2,RSTEM,AGGIE
      COMMON/CHMMOS/SWFBL(8),CHETA(8),SWRF1,SWRF2,RLAT(8)
      COMMON/MESOP/DMEME(8)
      COMMON/PIECES/TRUNO,ZS(8),PRE1,POND,TBET(8),YESMAC,PSM(8),REMAIN
      COMMON/IMPAR/WT,WT1,WT2,ISWIWT
      DIMENSION SWFLUX(8),DSWFBL(8)
      INTEGER*2 MONSPL,MONPLT,PORPLT,NBEG,NEND
C NPRPLT IS THE INDICATOR OF ANY REGULAR PROSPR PLOTS ARE TO BE
C PLOTTED.  NSPLTS IS THE INDICATOR OF ANY SPECIAL PLOTS TO BE PLOTTED.
C
      DATA I96,NDRN,NB/96,0,0/
      DATA NT1/0/,NST/0/,HPA/0./,DIVP/0./,LMONTH/0/,NRQUES/1/
      DATA HTET/120*0./,HTDRAN/120*0./,HTFLNT/120*0./,HCONL/120*0./ ,
     > HPBAR/120*0./
      DATA FFF,DELPSI,SPIN/0.D0,1.2D4,2./
      DATA C254,C59/2.54001,0.5555555555/,PERHR/.0416667/
C
      NVPN=(S(NSL)-F)*10.
      NVP=VP(1)*100.
      DSWFBL(NSL)=0.
C     CONVERT TO METRIC UNITS
      P=FILT*C254
      ITER=4
      IF (PRES.GT.0.) ITER=1
      I96=I96+ITER
      IF(I96.LE.96) GO TO 20
C     IF(HOUR.NE.0 .OR. MIN.NE.0) GO TO 20
C       INITIALIZE DAILY CUMULATIVE FLOW, RUNOFF, E.T.,
C       LATERAL FLOW,DRAIN, AND PRECIPITATION
      I96=ITER
      FLNET=0.
```

APPENDIX B (continued)

```
      RUNO=0.
      DET=0.
      FLLAT=0.
      DDRAIN=0.
      DPTOT=0.
C       INITIALIZE HOURLY OR QUARTER HOURLY VARIABLES
   20 XDIS=96.
      IF (ITER.GT.1) XDIS=24.
      TE=(TEMP-32.)*C59
      TTT=TE
      DO 30 K=1,NSL
      RLAT(K)=0.0D0
   30 SWFBL(K)=0.
      EV=VAPOR
      VEL=V
      TRUNO=0.
      TDRAIN=0.
      WT=0.
      SWRF1=0.
      SWRF2=0.
      ETOTAL=0.
      TFLNET=0.
      SEVTOT=0.
      REMWAT=0.0
      WATOVR=0.0
      T=JDATE
      TM=TMW
      IF (T.LT.T4.AND.T.GT.T1) TM=TMS
      IF (.NOT.CEROPT) GO TO 60
      ALEAF=LAI(1)
      IF (ALEAF.GT.ALMIN) GO TO 60
      ALBVEG=ALBW
      SIGMA=SIGW
      PWPMAX=PWPW
      RESMAX=RESW
      POWER=POWW
      TM=TMW
   60 RN=24.*HSOLAR
      NRAD=0
      IF ((RN.LT.0.).OR.(SCEP.GT.0.)) NRAD=1
      IF (HSOLAR.LT.0.01) TM=RESMAX
      NT=1+NB
      NP=P*100.*SPIN
      IF (NP.GT.NVP) NT=NT+(NP/NVP)**2
      IF (NDRN.GT.NVPN) NT=NT+(NDRN/NVPN)**2
      NT=MIN0(NT,30)
      XNT=NT
      PRE=P/XNT
      DTIM=1./(XDIS*XNT)
      TCL=CUTL*PERHR
      TC=CUT*PERHR
      IF(NT.LT.3) GO TO 68
   68 CONTINUE
      DO 260 IDIS=1,NT
C     IF PONDING, CONSIDER MACROPORE FLOW EFFECTS ----------MIT
      THETA(1)=THETA(1)+PRE+REMWAT
      PRE1=PRE+REMWAT
      REMWAT=0.0
      IF (YESMAC.GT.0.)  GO TO 69
      GO TO 67
   69 IF (POND.EQ.0.0 .AND. TBET(1).LT.1.D-12)  GO TO 67
```

APPENDIX B (continued)

```
C       WRITE(6,111)POND,TBET(1)
C 111   FORMAT(' POND OR TBET >0.0: CALLED SWIFT',2D16.7)
      THETA(1)=THETA(1)-PRE1
      CALL SWIFT(1,DTIM)
   67 CONTINUE
      DO 70 K=1,NSL
   70 CHETA(K)=THETA(K)/DL(K)
      CALL TABLOK(CHETA,PSM,ZS)
C       PRINT 24, CHETA,DL,PSM,ZS
C    24 FORMAT(1H ,'CHETA,DL,PSM,ZS'/1X,8G15.7)
      XXX=0.
      DO 80 K=1,NSL
      PSI(K)=-PSM(K)-DL(K)/2.-XXX
   80 XXX=XXX+DL(K)
      DO 90 K=1,NSL
   90 RS(K)=DL(K)/(2.*ZS(K))
      ZR1=RTCON1*ZS(1)
      ZR2=RTCON2*ZS(2)
      RR1 = DL(1)/(AT(1)*ZR1)/2.
      RR2 = DL(2)/(AT(2)*ZR2)/2.
      RSR1 = DL(1)*AT(1)/(ZS(1)*ALEAF*ARAT(1))
      RSR2 = DL(2)*AT(2)/(ZS(2)*ALEAF*ARAT(2))
      RSBL(1) = RS(1)
      DO 218 K=2,NBL
      IF(PSI(K) .GT. PSI(K+1)) GO TO 2175
      RSBL(K)=RS(K+1) + RS(K)*ZS(K)/ZS(K+1)
      GO TO 218
 2175 RSBL(K)=RS(K)+RS(K+1)*ZS(K+1)/ZS(K)
  218 CONTINUE
      R1=RSBL(1)
      FAC=9.*(1.+ALEAF**2/3.8)/ALEAF**2
C     IF(AGGIE.EQ.1.) FAC=FAC/9.
      R2=(RSR2+(RR2+RR1/2.))*FAC
      R3=RS(1)
      R4=(RSTEM+RR1/2.)*FAC
      R5=RSR1*FAC
      CALL SOLVO1(Y)
      PWP=Y
      IF (NRAD.EQ.1) GO TO 140
      IF (PWP.GT.PSI(1)) GO TO 120
      CALL SUBEV(Y,B)
      ET=B
      GO TO 130
  120 PWP=PSI(1)-DELPSI
      CALL EVAPOR(EV,RN,GND,TTT,ET,ETGW)
  130 IF (ET.GT.0.D0) GO TO 150
  140 ET=0.D0
      SEV=0.D0
      ETGW=0.D0
      ETRF1=0.
      ETRF2=0.
      GO TO 160
  150 CONTINUE
      ET=ET*DTIM
      SEV=(PSI(1)-PWP)/(R3+RLIT)*DTIM
      ET=ET-SEV
      ETRF1=ET*R2/(R2+R5)
      ETRF2=ET-ETRF1
      SEVTOT=SEVTOT+SEV
      ETOTAL=ETOTAL+ET
      SWRF1=SWRF1+ETRF1
```

APPENDIX B (continued)

```
      SWRF2=SWRF2+ETRF2
  160 CONTINUE
      DO 170 K=1,NBL
      SWFLUX(K)=(PSI(K)-PSI(K+1))/RSBL(K)*PERHR
  170 DSWFBL(K)=SWFLUX(K)*(DTIM/PERHR)
      FFF=ZS(NSL)*DTIM
      IF(RIRRG.GT.0.0)GO TO 175
      IF(IRT.GE.2.AND.QHIRRG.GT.0.0)GO TO 175
C     AREA1  IS THE LOWER LIMIT OF SOURCE AREA EXTENT (FRACTION)
C     CUTL   IS THE LOWER DRAINAGE THRESHOLD FOR EXPANSION OF SOURCE ARE
C     CUT    IS THE UPPER DRAINAGE LEVEL FOR MAXIMUM SOURCE AREA EXPANSI
C     W      IS THE FRACTION OF PERVIOUS AREAS ACTING AS SOURCE AREAS.
      SRCE1=0.
      W=AREA1
      IF (SWFLUX(1).LE.0.0D0) GO TO 190
C     W=AREA1
      IF (SWFLUX(1).GT.TCL) W=DMIN1(WUP,W+(WUP-W)*
     & (SWFLUX(1)-TCL)/(TC-TCL))
C     SIAV = (PSI(2)+PSI(3))/2.0
C     SIAV IS THE TOTAL POTENTIAL, AND INCLUDES DEPTH AND MATRIC POT.
C     IF(SIAV.GT.-320.) SRCE1 = W*DSWFBL(1)
      DSWFBL(1)=DSWFBL(1)-SRCE1
  190 THETA(1)=THETA(1)-DSWFBL(1)-ETRF1-SEV-SRCE1
      THETA(2)=THETA(2)+(DSWFBL(1)-DSWFBL(2))-ETRF2
      WT=WT+W
      IF (NSL.LT.3) GO TO 220
      DO 210 K=3,NSL
  210 THETA(K)=THETA(K)+(DSWFBL(K-1)-DSWFBL(K))
  220 IF ((THETA(1).GE.WP1).AND.(THETA(2).GE.WP2)) GO TO 230
      DIFF=THETA(1)+THETA(2)-WP1-WP2
      THETA(1)=WP1+DIFF*WP1/(WP1+WP2)
      THETA(2)=WP2+DIFF*WP2/(WP1+WP2)
  230 CONTINUE
      DO 232 K=1,NSL
  232 SWFBL(K)=DSWFBL(K)+SWFBL(K)
      TFLNET=TFLNET+DSWFBL(2)
      IF (THETA(1).LE.S(1)) GO TO 240
      TRUNO=TRUNO+THETA(1)-S(1)
      THETA(1)=S(1)
  240 IF(YESMAC.GT.0.)GO TO 245
      DO 250 K=2,NSL
      IF (THETA(K).LE.S(K)) GO TO 250
      RLAT(K)=RLAT(K)+THETA(K)-S(K)
      THETA(K)=S(K)
  250 CONTINUE
      GO TO 249
C     MACROPORE FLOW BETWEEN LAYERS ----------MIT
 245  DO 247 K=2,NSL
C     NOTE MACROPORES OF BOTTOM LAYER(NSL) LOOSE WATER
C     BY FLOW TO MESOPORES(NSL) ONLY
      DMEME(K-1)=DMEME(K-1)+DSWFBL(K-1)
      IF(K.LT.NSL)GO TO 246
      IF(REMAIN.GT.0.0) GO TO 248
      IF(TBET(NSL).GT.1.D-12)GO TO 248
      GO TO 247
  246 IF(REMAIN.GT.0.0) GO TO 248
      IF (THETA(K).GT.S(K) .OR. TBET(K-1).GT.1.D-12)GO TO 248
      GO TO 247
  248 CALL SUBONE(K,DTIM)
C      WRITE(6,2480) THETA(K),S(K),TBET(K-1),K
C 2480 FORMAT(' SUBONE CALLED - THETA,S,TBET,K',3D16.7,5X,I5)
```

APPENDIX B (continued)

```
  247 CONTINUE
  249 CONTINUE
C       THE SOURCE AREA RUNOFF IS ADDED TO EXCESS INPUT HERE.
      TRUNO=TRUNO+SRCE1
      RLAT(1)=RLAT(1)+TRUNO
      TDRAIN=TDRAIN+FFF
      THETA(NSL)=THETA(NSL)-FFF
      GO TO 260
 175  DSWFBL(NSL)=0.0
      TDRAIN=TDRAIN+FFF
      THETA(NSL)=THETA(NSL)-FFF
      IF(YESMAC.LT.1.) GO TO 181
      DO 182 IK=2,NSL
  182 CALL SUBONE(IK,DTIM)
      THETA(NSL)=THETA(NSL)+RLAT(NSL)
      RLAT(NSL)=0.
  181 IF(NSL.LT.3)GO TO 185
      DO 180 K=3,NSL
      NLYR=NSL-(K-3)
      DSWFBL(NLYR-1)=DMIN1(DSWFBL(NLYR-1),S(NLYR)-THETA(NLYR)+
     & DSWFBL(NLYR))
      IF(YESMAC.GT.0.0) DMEME(NLYR-1)=DMEME(NLYR-1)+DSWFBL(NLYR-1)
 180  THETA(NLYR)=THETA(NLYR)+DSWFBL(NLYR-1)-DSWFBL(NLYR)
 185  DSWFBL(1)=DMIN1(DSWFBL(1),S(2)-THETA(2)+DSWFBL(2)+ETRF2)
      IF(YESMAC.GT.0.0) DMEME(1)=DMEME(1)+DSWFBL(1)
      THETA(2)=THETA(2)+DSWFBL(1)-DSWFBL(2)-ETRF2
      THETA(1)=THETA(1)-DSWFBL(1)-SEV-ETRF1
      IF(THETA(1).LE.S(1))GO TO 260
      REMWAT=THETA(1)-S(1)
      THETA(1)=S(1)
      DO 255 K=1,NSL
 255  SWFBL(K)=DSWFBL(K)+SWFBL(K)
  260 CONTINUE
      WT=WT/XNT
      WT=(WT+WT1+WT2)/3.0
      WT2=WT1
      WT1=WT
      WATOVR=REMWAT
      IF(IRT.EQ.3)REMWAT=0.0
      RIRRG=RIRRG+REMWAT/C254
      IF(I96.NE.52) GO TO 270
C     IF(HOUR.NE.13 .OR. MIN.NE.0) GO TO 270
      RM=RX
      POT=PWP
      SW1M=THETA(1)
      SW2M=THETA(2)
      SWNM=THETA(NSL)
C     COMBINE PLANT AND SOIL ET
  270 TET=ETOTAL+SEVTOT
      IF (PSI(1).GT.PWP) DELPSI=PSI(1)-PWP
C     DETERMINE DAILY TOTALS
      NB=NT/2
      NDRN=TDRAIN*100.*SPIN
      DET=DET+TET
      FLNET=FLNET+TFLNET
      RUNO=RUNO+TRUNO
      DO 280 K=2,NSL
      FLLAT=FLLAT+RLAT(K)
  280 CONTINUE
      DDRAIN=DDRAIN+TDRAIN
      DPTOT=DPTOT+P
```

APPENDIX B (continued)

```
      DPTOT=DPTOT-WATOVR
C     DETERMINE MONTHLY TOTALS
      RF1MON=RF1MON+SWRF1
      RF2MON=RF2MON+SWRF2
      ROFF=ROFF+TRUNO
      TDRN=TDRN+TDRAIN
      DO 290 K=2,NSL
      PSEUDO=PSEUDO+RLAT(K)
  290 CONTINUE
      ETOT=ETOT+TET
      PTOT=PTOT+P
      PTOT=PTOT-WATOVR
      IF(RX.EQ.0.)RX=0.00001
      PCONL=1./RX
      PPBAR=PWP*9.81D-4
C***SPECIAL PRINT FOR FLORENCE CORN STUDY***
      IF(JDATE.EQ.137.OR.JDATE.EQ.140.OR.JDATE.EQ.153.OR.JDATE.EQ.158
     >.OR.JDATE.EQ.167.OR.JDATE.EQ.175) PRINT 700, JDATE,HOUR,MIN,PPBAR
     >,PCONL,SEVTOT,ETOTAL,SWRF1,SWRF2,TFLNET,TDRAIN
  700 FORMAT(' DHM-PCST12BD',3I4,8G13.4)
      IF (MONTH.EQ.LMONTH) GO TO 310
      I1=0
      I2=0
      LMONTH=MONTH
      NMONTH=1
      NSMONT=1
      NDAY=LASDAY(YEAR,MONTH)
C----THIS IS WHERE THE CALCULATIONS ARE DONE FOR PROSPER PLOTS FOR 1/3
C OF A MONTH.
  310 IF (NPRPLT.EQ.0.OR.NMONTH.EQ.0) GO TO 410
      IF (NT1.NE.0) GO TO 350
      IF (I1.NE.0) GO TO 340
      DO 320 I=1,NMPLT
      IF (MONTH.EQ.MONPLT(I)) GO TO 330
      I1=I
  320 CONTINUE
      NMONTH=0
      GO TO 410
  330 I1=I1*3+1
  340 IF (PORPLT(I1).EQ.0) PORPLT(I1)=4
      NDAY=LASDAY(YEAR,MONTH)
      INC2=PORPLT(I1)
  350 GO TO (360,370,380,390), INC2
C----FIRST THIRD OF THE MONTH
  360 IDAY=DAY
      IF (DAY.LT.10.OR.HOUR.NE.23) GO TO 400
      IF (MIN.NE.45) GO TO 400
      NQUES=1
      XMIN=1.
      XMAX=11.
      I1=I1+1
      GO TO 400
C----SECOND THIRD OF THE MONTH
  370 IDAY=DAY-10
      IF (DAY.LT.20.OR.HOUR.NE.23) GO TO 400
      IF (MIN.NE.45) GO TO 400
      NQUES=1
      XMIN=11.
      XMAX=21.
      I1=I1+1
      GO TO 400
```

APPENDIX B (continued)

```
C----LAST THIRD OF THE MONTH
  380 IDAY=DAY-20
      IF (DAY.LT.NDAY.OR.HOUR.NE.23) GO TO 400
      IF (MIN.NE.45) GO TO 400
      NQUES=1
      XMIN=21.
      XMAX=NDAY
      I1=I1+1
      GO TO 400
C----TO HERE IF NO PLOTS FOR THIS PORTION OF THE MONTH.
  390 IF (((DAY.EQ.10).OR.(DAY.EQ.20).OR.(DAY.EQ.NDAY))
     > .AND.HOUR.EQ.23.AND.MIN.EQ.45) I1=I1+1
      GO TO 500
  400 NT1=1
      CK=FLOAT(HOUR+1)/4.
      ID=(IDAY-1)*6
      INC1=0
      IF (CK.EQ.1.) INC1=ID+1
      IF (CK.EQ.2.) INC1=ID+2
      IF (CK.EQ.3.) INC1=ID+3
      IF (CK.EQ.4.) INC1=ID+4
      IF (CK.EQ.5.) INC1=ID+5
      IF (CK.EQ.6.) INC1=ID+6
      GO TO 460
C----THIS IS WHERE CALCULATIONS ARE DONE FOR SPECIAL PLOTS.
  410 IF (NSPLTS.EQ.0.OR.NSMONT.EQ.0) GO TO 500
      IF (NST.NE.0) GO TO 440
      IF (I2.NE.0) GO TO 440
      DO 420 I=1,NMSPLT
      IF (MONTH.EQ.MONSPL(I)) GO TO 430
      I2=I
  420 CONTINUE
      NSMONT=0
      GO TO 500
  430 I2=I2+1
  440 IF (DAY.LT.NBEG(I2).OR.DAY.GT.NEND(I2)) GO TO 500
      NST=1
      NDIFF=DAY-NBEG(I2)
      IF (NDIFF.NE.3.OR.HOUR.NE.23) GO TO 450
      IF (MIN.NE.45) GO TO 450
      XMIN=NBEG(I2)
      NBEG(I2)=NBEG(I2)+4
      XMAX=NBEG(I2)
      NQUES=1
  450 INC1=(NDIFF)*24+HOUR+1
  460 DIVP=DIVP+1.
      HPA=HPA+P
      HPA=HPA-WATOVR
      IF (INC1.EQ.0) GO TO 500
C----FILL THE 'HOLD' ARRAYS FOR PLOTTING.
      DO 470 J=1,NSL
      HSW(INC1,J)=THETA(J)/DL(J)
  470 CONTINUE
      HTET(INC1)=TET+HTET(INC1)
      HTDRAN(INC1)=TDRAIN+HTDRAN(INC1)
      HTFLNT(INC1)=TFLNET+HTFLNT(INC1)
      HCONL(INC1)=PCONL
      HPBAR(INC1)=PPBAR
      HP(INC1) = HPA/DIVP
      IF (MIN.EQ.45) HPA=0.0
      IF (HP(INC1).GT.1.E-6) IPLTP=1
```

APPENDIX B (continued)

```
C----CALL PRSPLT IF IT IS THE LAST LOOP THROUGH FOR THE PERIOD       PROS4280
C TO BE PLOTTED.                                                     PROS4290
      IF (NQUES.NE.1) GO TO 500                                      PROS4300
      CALL PRSPLT(HSW,HTET,HTDRAN,HTFLNT,HCONL,HPBAR,HP,IPLTP,INC1,  PROS4310
     > XMIN,XMAX,MONTH)                                              PROS4320
      IF (.NOT.DRYOPT) NQUES=0                                       PROS4330
      NT1=0                                                          PROS4340
      NST=0                                                          PROS4350
      HPA=0.                                                         PROS4360
      DIVP=0.                                                        PROS4370
      IPLTP=0                                                        PROS4380
      NRQUES=1                                                       PROS4390
      DO 490 JJ=1,120                                                PROS4400
      HCONL(JJ)=0.0                                                  PROS4410
      HTET(JJ)=0.0                                                   PROS4420
      HTDRAN(JJ)=0.0                                                 PROS4430
      HTFLNT(JJ)=0.0                                                 PROS4440
      HPBAR(JJ)=0.0                                                  PROS4450
  490 CONTINUE                                                       PROS4460
  500 CONTINUE                                                       PROS4470
C     TRNXS BECOMES INTERFLOW IN LAND                                PROS4480
      TRLAT=0.0D0                                                    PROS4490
      DO 510 K=2,NSL                                                 PROS4500
      TRLAT=TRLAT+RLAT(K)                                            PROS4510
  510 CONTINUE                                                       PROS4520
      TRNXS=TRUNO+TRLAT                                              PROS4530
C     CONVERT DATA TO INCHES FOR LAND                                PROS4540
      TDRAIN=TDRAIN/C254                                             PROS4550
      TRNXS=TRNXS/C254                                               PROS4560
      TET=TET/C254                                                   PROS4570
      SEVTOT=SEVTOT/C254                                             PROS4580
      RETURN                                                         PROS4590
      END                                                            PROS4600
```

APPENDIX B (continued)

```
      SUBROUTINE RAATS(TSTEP,TIMIN,CIFLAS,IRT,QHIRRG,RIRRG,
     > P4,RRX,DFILT,CIF,RTIM,NRAATS)
C       INFILTRATION BY TIME COMPRESSION APPROXIMATION
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/AREAIR/FIRRG
      REAL*4 QHIRRG,FIRRG,RIRRG,X,SPFILT
      DIMENSION CIF(1),RTIM(1)
      DATA IDQ,ITM/'DQ','TM'/
      M=3
      RCIF=CIFLAS
C       COMPUTE POTENTIAL INFILTRATION FOR TIME STEP TSTEP
      TM=TIMIN+TSTEP
      Q=YLAG(TM,RTIM,CIF,0,M,NRAATS,IEX)
      IF (IEX.NE.0) PRINT 10000, IEX,IDQ
      DQ=Q-RCIF
      IF(RIRRG.GT.0.0)GO TO 5
      IF(IRT.LT.2 .OR.(QHIRRG.EQ.0. .AND. RIRRG.EQ.0.)) GO TO 30
C       IRRIGATION BY FLOODING, A FRACTION FIRRG OF THE
C       LAND SURFACE IS FLOODED.
 5    X=DMIN1(DQ,P4)
      DFILT=X+FIRRG*(DQ-X)
      RRX=0.
      IF(IRT.EQ.2) GO TO 10
      IF(IRT.LE.1.AND.RIRRG.GT.0.0)GO TO 10
C       FLOOD IRRIGATION WHERE FLOODING TIME IS SPECIFIED
      CIFLAS=Q
      RIRRG=0.
      GO TO 60
C       FLOOD IRRIGATION WHERE AMOUNT OF WATER IS SPECIFIED.
   10 RIRRG=RIRRG+QHIRRG+P4
      SPFILT=DFILT
      DFILT=AMIN1(SPFILT,RIRRG)
      CIFLAS=AMIN1(RIRRG/FIRRG,DQ-X)+RCIF
      RIRRG=RIRRG-DFILT
      GO TO 50
C       FOLLOWING INCLUDES ANY SPRINKLER IRRIGATION
   30 IF (DQ.GE.P4) GO TO 40
C       THRUFALL EXCEEDS INFILTRATION, GENERATE RUNNOFF (RRX).
      RRX=P4-DQ
      CIFLAS=Q
      DFILT=DQ
      GO TO 60
C       POTENTIAL INFILTRATION EXCEEDS THRUFALL, NO RUNNOFF.
   40 DFILT=P4
      RRX=0.
      CIFLAS=RCIF+DFILT
   50 TM=YLAG(CIFLAS,CIF,RTIM,0,M,NRAATS,IEX)
      IF (IEX.NE.0) PRINT 10000, IEX,ITM
   60 TIMIN=TM
      RETURN
10000 FORMAT(' EXTRAPOLATION IN RAATS/YLAG, IEX = ',I3,' FOR ',A2)
      END
```

APPENDIX B (continued)

```
      SUBROUTINE RADIST(DY,DLYRAD,DLAT,DLONG,HRAD)
C
C       MODEL THE DIURNAL VARIATION OF THE SOLAR
C       RADIATION INCIDENT ON A HORIZONTAL SURFACE.
C
      DIMENSION HRAD(24)
      DATA ALFA,HA/-.106,.002/
C
C
      DO 10 IH=1,24
   10 HRAD(IH)=0.
C       EQUATION OF TIME
      AT=.01720242*DY-1.41430
      BT=.033446*SIN(.01720242*DY-.059075)
      SINET=SIN(AT+BT)
      EQUATI=229.1831*ATAN2(SIN(BT)-.082549*SINET*COS(AT),
     & COS(BT)-.082549*SINET*SIN(AT))
      SNOON=12.-(AINT(DLONG/15.+.5)-DLONG/15.)+EQUATI/60.
      SINDEC=.39785*SINET
      DEC=ARSIN(SINDEC)
      COSDEC=COS(DEC)
      RLAT=.01745329*DLAT
      SINLAT=SIN(RLAT)
      COSLAT=COS(RLAT)
      DAYL=ARCOS(AMAX1(-1.,AMIN1(1.,-SINLAT/COSLAT*SINDEC/COSDEC)))/.261
      TH1=-DAYL
      I1=-DAYL+SNOON+1.
      TH2=I1-SNOON
      TL=DAYL
      I2=SNOON+TL+2.
      SUM=0.
      DO 20 IH=I1,I2
      T1=.2617994*TH1
      T2=.2617994*TH2
      PRAD=SINDEC*SINLAT*(T2-T1)+COSDEC*COSLAT*(SIN(T2)-SIN(T1))
C       ATMOSPHERIC TRANSMISSION FACTOR
      TM=(T1+T2)*.5
      COSI=SINLAT*SINDEC+COSLAT*COSDEC*COS(TM)
      TRAD=EXP(ALFA*(2.+HA)/(COSI+SQRT(COSI**2+HA*(2.+HA))))
      HRAD(IH)=PRAD*TRAD
      SUM=SUM+HRAD(IH)
      TH1=TH2
   20 TH2=AMIN1(TH2+1.,TL)
      RNORM=DLYRAD/SUM
      DO 30 IH=I1,I2
   30 HRAD(IH)=HRAD(IH)*RNORM
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE RDIRIG
C       READ IRRIGATION DATA
      COMMON /HRLYS/ IYR,IMO,LOKN,IWRT,IKMPLT,IREC,JSTART,NUMDYS,
     > HDEW(24,31),HRAD(24,31),HWND(24,31),HTEM(24,31),
     > IRIG,PKIRIG(87)
      COMMON/AREAIR/FIRRG
      DIMENSION AH(11),EM(11)
      INTEGER X,Y,D
      DATA IDOL/'$'/,ER,BL/4H****,4H    /,EM/11*4H    /
C
      READ 1030,FIRRG
   10 READ 1000,X,Y,M,K,AH
      IF(X.EQ.IDOL) RETURN
      D=AH(1)/10000.
      PRINT 1010,M,D,Y,AH
      IF(Y.NE.IYR .OR. M.NE.IMO) CALL MONDAT(Y,M,0)
      IP=1
   20 IF(AH(IP).EQ.0.) GO TO 10
      IN=AH(IP)
      D=IN/10000
      IF(D.LT.1 .OR. D.GT.NUMDYS) GO TO 40
      IN=IN-10000*D
      IH=IN/100
      IF(IH.LT.1 .OR. IH.GT.24) GO TO 40
      IN=IN-100*IH
      IF(IN.EQ.0 .OR. IH+IN.GT.25) GO TO 40
      IL=1
      IF(K.EQ.3) GO TO 25
      IF(IP+IN.GT.11) GO TO 40
      IL=IN+1
   25 AH(IP)=10.*AH(IP)+K
      DO 30 I=1,IL
      IRIG=IRIG+1
      PKIRIG(IRIG)=AH(IP)
   30 IP=IP+1
      IWRT=1
      IF(IP.LE.10) GO TO 20
      GO TO 10
   40 EM(IP)=ER
      PRINT 1020,EM
      EM(IP)=BL
      GO TO 10
 1000 FORMAT(A1,6X,2I2,I1,11F6.0)
 1010 FORMAT(' IRRIGATION FOR ',I2,'/',I2,'/',I2,' -',11F8.0)
 1020 FORMAT(' *** ERROR ***',12X,11A8)
 1030 FORMAT(F6.0)
      END
```

APPENDIX B (continued)

```
      SUBROUTINE READIN
      IMPLICIT REAL*8 (A-H,O-Z)
      DIMENSION FILTID(20),ARBOR(20),HYCOND(8,8),SMPPAR(8,8)
      COMMON/THINGS/ALBVEG,CANON,CANOFF,SIMIN,SIMAX,ALMIN,ALMAX,SLOPE
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/HUMID/FOLTYP,PAIR,CPO,RB,RX,SIGMA,XL,GM,GV,HT,ALEAF
      COMMON/RESIST/R1,R2,R3,R4,R5,RR1,RRA,RRB,RRC,RRR,TM,RLIT
      COMMON/SURF/PWPS,PWPW,PWPMAX,RESS,RESW,RESMAX,POWS,POWW,POWER ,
     > LRMODL
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/TIMES/T1,T2,T3,T4,TMS,TMW,SIGS,SIGW,ALBS,ALBW
      COMMON/PLACE/ CASEID(19),LASTDY(12),MOBEG
      COMMON/PETRUS/TSTEP,TIMST,CIFLAS,CIF(50),RTIM(50),NRAATS
      COMMON/DRAG/SDRAG,WDRAG
      COMMON/PHOTO/CAIR,CCHL,P1,A1,B1,A2,B2,C2SEC,P3,F13
      COMMON/BIODAT/TL1,TL2,TL3,C6,P12,P13,PSMA,PSMB,PA,PB,PC,PD
      COMMON/SULU/RTCON1,RTCON2,RSTEM,AGGIE
      COMMON/FORMUL/HYCOND,SMPPAR,LFORM
      COMMON/PLTALL/XMIN,XMAX,INC1,ISTRA,NQUES
      COMMON/PIECES/TRUNO,ZS(8),PRE1,POND,TBET(8),YESMAC,PSM(8),REMAIN
      COMMON/FONG/DAYMAC
      DATA KFORM/'FORM'/
      REAL*4 CAIR,CCHL,P1,A1,B1,A2,B2,C2SEC, TL1,TL2,TL3,C6,P12,P13,
     > PSMA,PSMB,PA,PB,PC,PD,P3,F13
      READ(5,10000) NERR,CASEID
C     NERR=1 WHEN NEW SEGMENT PROPERTIES ARE READ, 0 OTHERWISE
      WRITE(6,10100) NERR, CASEID
      IF (NERR.LT.1) GO TO 100
      READ(5,10200) DL,THETA,F
      WRITE(6,10400) DL,THETA,F
      READ(5,10200) PAIR,CPO,XL,V,FOLTYP
      WRITE(6,10500) PAIR,CPO,XL,V,FOLTYP
      READ(5,10200) AT,ARAT,RTCON1,RTCON2,RSTEM
      WRITE(6,10600) AT,ARAT,RTCON1,RTCON2,RSTEM
      READ(5,10200) ALMIN,ALMAX,GM,GV
      WRITE(6,10700) ALMIN,ALMAX,GM,GV
      READ(5,10200) RLIT,WP1,WP2,AGGIE
      WRITE(6,10800) RLIT,WP1,WP2,AGGIE
      READ(5,10200) T1,T2,T3,T4
      PRINT 10900, T1,T2,T3,T4
      READ(5,10200) TMS,TMW,SIGS,SIGW,ALBS,ALBW
      PRINT 11000, TMS,TMW,SIGS,SIGW,ALBS,ALBW
      READ 10300, SDRAG,WDRAG,NSL,NS,YESMAC,DAYMAC
      PRINT 11100, SDRAG,WDRAG,NSL,NS,YESMAC,DAYMAC
      READ(5,11200) PWPS,PWPW,RESS,RESW,POWS,POWW,LRMODL
      PRINT 11300, PWPS,PWPW,RESS,RESW,POWS,POWW,LRMODL
      NBL=NSL-1
      DO 10 K=1,NSL
      THETA(K)=THETA(K)*DL(K)
   10 SWT(K)=THETA(K)
      CALL ASPECT
      READ 11400,LFORM
      IF (LFORM.NE.KFORM) GO TO 60
C     READ IN PARAMETERS IN ORDER TO USE FORMULAS FOR ZS & PSM INSTEAD
C     OF INTERPOLATION
C     TO CHANGE FORMULAS USED: CHANGE FORLOK
      DO 20 J=1,NS
      READ 11500,ST,ST1,ST2,ST3,ST4,ST5,ST6,ST7,ST8,ST9
      PRINT 11600,ST,ST1,ST2,ST3,ST4,ST5,ST6,ST7,ST8,ST9
      READ 11700,(HYCOND(J,JJ),JJ=1,8)
```

APPENDIX B (continued)

```
      PRINT 11800,(HYCOND(J,JJ),JJ=1,8)
      READ 11900,(SMPPAR(J,JJ),JJ=1,8)
      PRINT 12000,(SMPPAR(J,JJ),JJ=1,8)
      VP(J)=SMPPAR(J,2)
   20 CONTINUE
      IF (NS.GE.NSL) GO TO 70
      NN=NS+1
      DO 40 I=NN,NSL
      DO 30 JJ=1,8
      HYCOND(I,JJ)=HYCOND(NS,JJ)
      SMPPAR(I,JJ)=SMPPAR(NS,JJ)
   30 CONTINUE
   40 VP(I)=SMPPAR(NS,2)
      DO 50 I=1,NSL
      PRINT 11800,(HYCOND(I,JJ),JJ=1,8)
      PRINT 12000,(SMPPAR(I,JJ),JJ=1,8)
   50 CONTINUE
      GO TO 70
   60 CALL SOIL
   70 F=F*DL(NSL)
      DO 80 K=1,NSL
   80 S(K)=VP(K)*DL(K)
      WP1=WP1*DL(1)
      WP2=WP2*DL(2)
      READ(5,12400) FILTID
      READ(5,12100) TSTEP,TIMST,CIFLAS,NRAATS
      CIFLAS=CIFLAS/2.54
      READ(5,12200) (CIF(I),I=1,NRAATS)
      READ(5,12300) (RTIM(I),I=1,NRAATS)
      CALL CHKCIF(RTIM,CIF,NRAATS,1)
      CALL CHKCIF(CIF,RTIM,NRAATS,2)
      WRITE(6,12500) FILTID
      WRITE(6,12600)
      WRITE(6,12700) CIF
      DO 90 J=1,NRAATS
   90 CIF(J)=CIF(J)/2.54
      WRITE(6,12800) RTIM
  100 CONTINUE
      NQUES=0
      IF (YESMAC.EQ.1.0)  CALL RSWIFT
      RETURN
10000 FORMAT(I1,3X,19A4)
10100 FORMAT(T1,'0',I1,3X,19A4)
10200 FORMAT(8G10.3)
10300 FORMAT(2G10.3,2I5,2F10.0)
10400 FORMAT(T1,'0 DL ',8G10.3/' THETA ',8G10.3/' F ',G10.3)
10500 FORMAT(T1,'0  PAIR,CPO,XL,V AND FOLTYP'/(T1,' ',5G20.8))
10600 FORMAT(T1,'0  AT,ARAT,RTCON1,RTCON2,RSTEM'/(T1,' ',7G10.3))
10700 FORMAT(T1,'0  ALMIN,ALMAX,GM,GV'/(T1,' ',4G10.3))
10800 FORMAT(T1,'0 RLIT,WP1,WP2,AGGIE'/(T1,' ',4G20.4))
10900 FORMAT(1H ,'T1,T2,T3,T4 ',4G10.3)
11000 FORMAT(1H ,'TMS,TMW,SIGS,SIGW,ALBS,ALBW ',6G10.4)
11100 FORMAT(1H ,'SDRAG,WDRAG,NSL,NS,YESMAC,DAYMAC'
     +,1X,2G10.4,5X,2I5,2F10.0)
11200 FORMAT(6G10.3,I5)
11300 FORMAT(1H ,'PWPS,PWPW,RESS,RESW,POWS,POWW,LRMODL'/1X,6G15.2,I5)
11400 FORMAT(A4)
11500 FORMAT(10A4)
11600 FORMAT(40X,10A4)
11700 FORMAT(8G10.4)
11800 FORMAT(' HYDRAULIC CONDUCTIVITY PARAMETERS',/,8(2X,G10.4))
```

APPENDIX B (continued)

```
11900 FORMAT(8G10.4)
12000 FORMAT(' SOIL MATRIC POTENTIAL PARAMETERS',/,8(2X,G10.4))
12100 FORMAT(3F10.5,I5)
12200 FORMAT(16F5.2)
12300 FORMAT(16F5.0)
12400 FORMAT(20A4)
12500 FORMAT(1H ,20A4)
12600 FORMAT(T1,'0 CUMULATIVE INFILTRATION INPUT CURVE')
12700 FORMAT(T1,'0 CIF(CM)'/(T1,' ',20F5.2))
12800 FORMAT(T1,'0 RTIM(MINUTES)'/(T1,' ',20F5.0))
      END
```

```
      SUBROUTINE RSWIFT
C     THIS ROUTINE READS AND INITIALIZES FOR SWIFT
C     SWIFT ROUTINE ACCOUNTS FOR MACROPORE FLOW EFFECTS
      IMPLICIT REAL*8 (A-H,O-Z)
      REAL*8 MCPOR,NPOR,MFBL,MACEX,MMACEX,MMEME
      REAL*8 MMEMA,MMAME,MMAMA
      COMMON/INPTS/MCPOR(8),RP(8),WP(8),PL(8),PERC(8),AGSIZE(8)
      COMMON/BITS/ B(8),HWAT(8),FLOW(8),NPOR(8),DX(8)
     1,DFLOW(8),DHWAT(8),BD(8),IATOB
      COMMON/BOOKS/DMEMA(8),DMAME(8),DMAMA(8),MACEX(8),BETA(8),DBET(8)
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/CHMMOS/SWFBL(8),CHETA(8),SWRF1,SWRF2,RLAT(8)
      COMMON/PIECES/TRUNO,ZS(8),PRE1,POND,TBET(8),YESMAC,PSM(8),REMAIN
      COMMON/MONTHS/MMAME(8),MMEMA(8),MMAMA(8),MMACEX(8),MMEME(8)
      COMMON/MESOP/DMEME(8)
C     VARIABLES IN COMMONS BOOKS & MONTHS DEFINED IN WSWIFT
      DATA PI/3.14159265358979/
      DATA FRAC/1.414213562/
C     DATA INPUTS
C     VALUES ARE FOR A 1-CM**2 CROSS SECTION
C     FRAC=COSEC(ANGLE OF A PORE TO THE VERTICAL)
C     I REFERS TO A SOIL LAYER
C     MCPOR(I)=TOTAL MACROPOROSITY (ML/ML)
C     RP(I)=RADIUS OF CYLINDRICAL PORE (CM)
C     WP(I)=WIDTH OF RECTANGULAR CRACK (CM)
C     PL(I)=BREDTH OF RECTANGULAR CRACK (CM)
C     AGSIZE(I)=AVG LENGTH OF AGGREGATE (CM)
C     PERC(I)=FRACTION OF MACROPORES WHICH ARE DEAD END
C     BETA(I)=WATER CONTENT OF CONTINUOUS MACROPORES (CM/LAYER)
C     B(I)=MAX CAPACITY OF CONTINUOUS MACROPORES(SATURATED CM/LAYER)
C     DBET(I)=WATER CONTENT OF DEAD END MACROPORES (CM/LAYER)
C     BD(I)=MAX CAPACITY OF DEAD END MACROPORES (CM/LAYER)
C     HWAT(I)=HEAD OF WATER IN CONT. MACROPORES (CM OF WATER)
C     DHWAT(I)=HEAD OF WATER IN DEAD END MACROPORES (CM OF WATER)
C     NPOR(I)=TOTAL NUMBER OF MACROPORES (#/LAYER)
C     TBET(I)=TOTAL WATER CONTENT OF MACROPORES(CM/LAYER)
C     DX(I)=DISTANCE FROM MACROPORES TO MESOPORES (CM)
C     FOLLOWING VARIABLES ORIGINATE IN PROSPR
C     DL(I)=DEPTH OF SOIL LAYER (CM)
C     THETA(I)=WATER CONTENT OF MESOPORES (CM/LAYER)
C     S(I)=MAX CAPACITY OF MESOPORES (CM/LAYER)
C     NSL=NUMBER OF SOIL LAYERS
C     RLAT(I)=LATERAL FLOW (CM/TIME STEP)
C     TRUNO=SURFACE RUNOFF (CM/TIME STEP)
C     ZS(I)=HYDRAULIC CONDUCTIVITY (CM/DAY)
C     DTIM=TIME STEP (FRACTIONAL DAYS)
C     PRE=PRECIPITATION (CM/TIME STEP)
C     POND=SWITCH SET TO 1 IF THERE IS SURFACE PONDING
C     YESMAC=SWITCH SET TO 0 IF NEGLECTING MACROPORES
```

APPENDIX B (continued)

```
C     PSM(I)=MATRIC POTENTIAL IN MESOPORES (CM OF WATER)
C     IATOB=NUMBER OF SOIL LAYERS IN A HORIZON
C     NOMINAL VALUES ARE USED FOR ZERO INPUT DATA OF MCPOR,RP,WP,
C     PL,PERC AND AGSIZE
      IATOB=0
      POND=0.
      WRITE(6,100)
100   FORMAT(' LEVEL POROSITY  PORE RADIUS   WIDTH   LENGTH
     1PERCENTAGE   AGSIZE ')
      DO 170 I=1,NSL
      READ(5,150)MCPOR(I),RP(I),WP(I),PL(I),PERC(I),AGSIZE(I)
150   FORMAT(6F10.4)
C     IATOB=NUMBER OF LAYERS IN "A" HORIZON
      IF(PL(I).LE.1.0D-10) IATOB=IATOB+1
C     SET NOMINAL VALUES FOR ZERO INPUT DATA
      IF (MCPOR(I).EQ.0.)  MCPOR(I)=1.D-12
      IF (RP(I).EQ.0.)  RP(I)=1.D-12
      IF (WP(I).EQ.0.)  WP(I)=1.D-12
      IF (PL(I).EQ.0.)  PL(I)=1.D-12
      IF (PERC(I).EQ.0.)  PERC(I)=1.D-12
      IF (AGSIZE(I).EQ.0.)  AGSIZE(I)=1.D-12
      WRITE(6,160)I,MCPOR(I),RP(I),WP(I),PL(I),PERC(I),AGSIZE(I)
160   FORMAT(2X,I2,2X,6F10.4)
170   CONTINUE
      REMAIN=0.0
      DO 200 I=1,NSL
C     INITIALIZING WATER BUDGET ACCOUNTS
      BETA(I)=0.0
      DBET(I)=0.0
      TBET(I)=0.0
      DMEME(I)=0.0
      DMEMA(I)=0.0
      DMAME(I)=0.0
      DMAMA(I)=0.0
      MACEX(I)=0.0
      MMEME(I)=0.0
      MMEMA(I)=0.0
      MMAME(I)=0.0
      MMAMA(I)=0.0
      MMACEX(I)=0.0
      B(I)=MCPOR(I)*DL(I)*(1.-PERC(I))
      BD(I)=MCPOR(I)*DL(I)*PERC(I)
      IF(I.GT.IATOB)GO TO 190
C     NO. OF CYLINDERS IN "A" HORIZON LAYER
      NPOR(I)=MCPOR(I)/(PI*RP(I)**2.*FRAC)
C     ASSUMES MACROPORE LENGTH=FRAC*DL(I)
      DX(I)=DL(I)/(NPOR(I)*2.*FRAC)
      GO TO 200
C     NO. OF CRACKS IN "B" HORIZON LAYER
190   NPOR(I)=MCPOR(I)*DL(I)/(WP(I)*PL(I)*AGSIZE(I))
      DX(I)=(2.*PL(I)+AGSIZE(I))/6.
200   CONTINUE
      RETURN
      END
```

APPENDIX B (continued)

```
      FUNCTION SOLRAD(DJULN,DGLAT)
C       CALCULATION OF DAILY POTENTIAL SOLAR RADIATION
C       ALGORITHM PREPARED BY LLOYD W. SWIFT JR. CHL
C      DJULN IS JULIAN DATE
C      DGLAT IS NORTH LATITUDE IN DEGREES
C      SOLRAD IS POTENTIAL DAILY DIRECT SOLAR RADIATION
C       SUNRN=SOLAR CONSTANT(CAL/CM**2/MIN)
C       TO=TRANSMISSION OF RADIATION WHEN THE SUN IS AT ZENITH
C     ALFA=NATURAL LOGRITHM OF TRANSMISSION TO
C       HA=EFFECTIVE HEIGHT OF THE ATMOSPHERE/EARTH RADIUS
      DATA SUNRN/1.95/,ALFA,HA/-.106,.002/
C      SOLAR DECLINATION
      SINDEC=.39785*SIN(4.868961+.0172024*DJULN+.033446*
     +       SIN(6.22411+.0172024*DJULN))
      COSDEC=SQRT(1.-SINDEC*SINDEC)
C      ECCENTRICITY CORRECTION TO EARTH ORBITAL RADIUS
      E=1.0-0.0167*COS((DJULN-3.)*0.0172024)
C      HOURLY RADIATION INCIDENT ON UPPER ATMOSPHERE
      RI=60.*SUNRN/(E*E)
      RADLAT=DGLAT*.01745329
      SINLAT=SIN(RADLAT)
      COSLAT=COS(RADLAT)
      COSDYL=-SINLAT/COSLAT*SINDEC/COSDEC
      IF(COSDYL.GT.-1.0) GO TO 10
      DAYL=3.1415926
      GO TO 20
   10 DAYL=0.
      IF(COSDYL.LT.1.0) DAYL=ARCOS(COSDYL)
C       DAILY RADIATION INCIDENT ON UPPER ATMOSPHERE
   20 SOLRAD=RI*7.63944*(SINDEC*SINLAT*DAYL+COSDEC*COSLAT*SIN(DAYL))
C       TRANSMISSION OF DIRECT RADIATION BY CLEAR ATMOSPHERE
      COSI=COSDEC*COSLAT+SINDEC*SINLAT
      XMIT=EXP(ALFA*(2.+HA)/(COSI+SQRT(HA*(2.+HA)+COSI*COSI)))
C       POTENTIAL DIRECT RADIATION AT EARTHS SURFACE
      SOLRAD=SOLRAD*XMIT
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE SWIFT(K,DTIM)
C     THIS ROUTINE ACCOUNTS FOR MACROPORE FLOW EFFECTS
      IMPLICIT REAL*8 (A-H,O-Z)
      REAL*8 MCPOR,NPOR,MAFBL,MACEX
      COMMON/INPTS/MCPOR(8),RP(8),WP(8),PL(8),PERC(8),AGSIZE(8)
      COMMON/BITS/B(8),HWAT(8),FLOW(8),NPOR(8),DX(8)
     1,DFLOW(8),DHWAT(8),BD(8),IATOB
      COMMON/BOOKS/DMEMA(8),DMAME(8),DMAMA(8),MACEX(8),BETA(8),DBET(8)
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),FC(8),THETA(8),SWT(8)
      COMMON/PORES/VP(8),F,S(8),SEV,ETGW,DNFAC,WP1,WP2,NSL,NBL,NS
      COMMON/CHMMOS/SWFBL(8),CHETA(8),SWRF1,SWRF2,RLAT(8)
      COMMON/PIECES/TRUNO,ZS(8),PRE1,POND,TBET(8),YESMAC,PSM(8),REMAIN
      DATA TWOPI/6.28318531/,EXCESS/0.0/,FLXMAX/0.0/
      DATA BYPS/.5/,FRAC/1.414213562/
C     DTIM=TIME STEP IN FRACTIONAL DAYS
C     DATA, AS IN PROSPR, ARE PER CM**2 LAND AREA
C
C     FIRST LAYER MACROPORES
C     SURFACE INFILTRATION AND RUNOFF ACCOUNTED FOR
      RAIN=PRE1
C     FLXMAX=MAX INFILTRATION RATE (CM/TIME STEP)
      FLXMAX=12250.*RP(1)**2*MCPOR(1)*86400.*DTIM
      IF(POND.EQ.0.0)RAIN=0.0
C     IF FLXMAX EXCEEDED ALLOW RUNOFF
      IF(RAIN.LE.FLXMAX)GO TO 250
C     ASSUME ALL DEAD END MACROPORES IN FIRST LAYER OPEN TO SURFACE
      BETA(1)=BETA(1)+FLXMAX*(1.-PERC(1))
      DBET(1)=DBET(1)+FLXMAX*PERC(1)
      THETA(1)=THETA(1)+RAIN-FLXMAX
      GO TO 300
250   DBET(1)=DBET(1)+RAIN*PERC(1)
      BETA(1)=BETA(1)+RAIN*(1.-PERC(1))
300   HWAT(1)=BETA(1)/(MCPOR(1)*(1.-PERC(1)))
      DHWAT(1)=DBET(1)/(MCPOR(1)*PERC(1))
      HGRAD1=(PSM(1)+HWAT(1)/2.)/(RP(1)*DLOG(DX(1)/RP(1)))
      DHGRAD=(PSM(1)+DHWAT(1)/2.)/(RP(1)*DLOG(DX(1)/RP(1)))
C     DMEMA KEEPS TRACK OF DAILY MESO TO MACROPORE FLOW
      IF(THETA(1).LE.S(1))GO TO 302
      DMEMA(1)=DMEMA(1)+(THETA(1)-S(1))
      FLOW(1)=0.0
      DFLOW(1)=0.0
      GO TO 305
C     CALCULATE MACROPORE TO MESOPORE FLOW
302   FLOW(1)=TWOPI*RP(1)*FRAC*HWAT(1)*ZS(1)*DTIM*HGRAD1*NPOR(1)
     1*(1.-PERC(1))
      DFLOW(1)=TWOPI*RP(1)*FRAC*DHWAT(1)*ZS(1)*DTIM*DHGRAD*NPOR(1)
     1*PERC(1)
      IF(FLOW(1).GT.BETA(1))FLOW(1)=BETA(1)
      IF(DFLOW(1).GT.DBET(1))DFLOW(1)=DBET(1)
C     DMAME KEEPS TRACK OF DAILY MACRO TO MESOPORE FLOW
      DMAME(1)=DMAME(1)+FLOW(1)+DFLOW(1)
      THETA(1)=THETA(1)+FLOW(1)+DFLOW(1)
      BETA(1)=BETA(1)-FLOW(1)
      DBET(1)=DBET(1)-DFLOW(1)
      IF(THETA(1).LE.S(1))GO TO 310
      DMAME(1)=DMAME(1)-(THETA(1)-S(1))
C     FLOW FROM MESOPORE TO MACROPORE
305   BETA(1)=BETA(1)+(THETA(1)-S(1))*(1.-PERC(1))
      DBET(1)=DBET(1)+(THETA(1)-S(1))*PERC(1)
      THETA(1)=S(1)
310   CONTINUE
```

APPENDIX B (continued)

```
      IF(BETA(1).LE.B(1))GO TO 315
C     IF EXCEED CAPACITY ADD TO SECOND LAYER
      BETA(2)=BETA(2)+BETA(1)-B(1)
      DMAMA(2)=DMAMA(2)+(BETA(1)-B(1))
      BETA(1)=B(1)
315   IF(DBET(1).LE.BD(1))GO TO 320
C     IF EXCEED CAPACITY ALLOW RUNOFF
      THETA(1)=THETA(1)+DBET(1)-BD(1)
      DBET(1)=BD(1)
320   IF(BETA(2).LE.B(2))GO TO 350
      THETA(1)=THETA(1)+BETA(2)-B(2)
      BETA(2)=B(2)
  350 TBET(1)=BETA(1)+DBET(1)
      REMAIN=1.
      RETURN
      ENTRY SUBONE(K,DTIM)
C
C     MACROPORE FLOW BETWEEN LAYERS (K-1) AND (K)
      REMAIN=1.
      MAFBL=BETA(K-1)
      IF(MAFBL.LE.(B(K)-BETA(K)))GO TO 370
      MAFBL=B(K)-BETA(K)
      BETA(K-1)=BETA(K-1)-MAFBL
      BETA(K)=B(K)
      GO TO 380
370   BETA(K)=BETA(K)+MAFBL
      BETA(K-1)=0.0
380   CONTINUE
      DMAMA(K)=DMAMA(K)+MAFBL
C     ACCOUNTING FOR FLOW WITHIN LAYERS
C     FLOW(K)=FLOW FROM MACROPORES TO MESOPORES
      BETA(K)=BETA(K)+EXCESS
      EXCESS=0.0
      IF(BETA(K).LE.B(K))GO TO 400
      EXCESS=BETA(K)-B(K)
      BETA(K)=B(K)
400   HWAT(K)=BETA(K)/(MCPOR(K)*(1.-PERC(K)))
      DHWAT(K)=DBET(K)/(MCPOR(K)*PERC(K))
      DHGRAD=(PSM(K)+DHWAT(K)/2.)/DX(K)
      HGRAD=(PSM(K)+HWAT(K)/2.)/DX(K)
      IF(THETA(K).LE.S(K))GO TO 450
      FLOW(K)=0.0
      DFLOW(K)=0.0
      DMEMA(K)=DMEMA(K)+(THETA(K)-S(K))
      GO TO 570
450   IF(K.GT.IATOB) GO TO 500
      DHGRAD=(PSM(K)+DHWAT(K)/2.)/(RP(K)*DLOG(DX(K)/RP(K)))
       HGRAD=(PSM(K)+HWAT(K)/2.)/(RP(K)*DLOG(DX(K)/RP(K)))
C     FLOW FROM MACROPORE CYLINDERS
      FLOW(K)=TWOPI*RP(K)*FRAC*HWAT(K)*ZS(K)*DTIM*HGRAD*NPOR(K)*
     1(1.-PERC(K))
      DFLOW(K)=TWOPI*RP(K)*FRAC*DHWAT(K)*ZS(K)*DTIM*DHGRAD*NPOR(K)
     1*PERC(K)
      GO TO 550
500   X=BYPS*AGSIZE(K)
C     FLOW FROM MACROPORE CRACKS
      FLOW(K)=2.*(WP(K)+PL(K))*(X*FRAC+(1.-X))
     1*HWAT(K)*ZS(K)*DTIM*HGRAD*NPOR(K)*(1.-PERC(K))
      DFLOW(K)=2.*(WP(K)+PL(K))*(X*FRAC+1.-X)*NPOR(K)*PERC(K)
     1*DHWAT(K)*ZS(K)*DTIM*DHGRAD
550   IF(FLOW(K).GT.BETA(K))FLOW(K)=BETA(K)
```

APPENDIX B (continued)

```
      IF(DFLOW(K).GT.DBET(K))DFLOW(K)=DBET(K)                          SWIF1230
      DMAME(K)=DMAME(K)+FLOW(K)+DFLOW(K)                               SWIF1240
      THETA(K)=THETA(K)+FLOW(K)+DFLOW(K)                               SWIF1250
      IF(THETA(K).LT.0.0)CALL ERROR                                    SWIF1260
      BETA(K)=BETA(K)-FLOW(K)                                          SWIF1270
      DBET(K)=DBET(K)-DFLOW(K)                                         SWIF1280
      IF(THETA(K).LE.S(K)) GO TO 590                                   SWIF1290
      DMAME(K)=DMAME(K)-(THETA(K)-S(K))                                SWIF1300
C     FLOW FROM MESO TO MACROPORE (IF MESOPORES OVERFILLED)            SWIF1310
570   BETA(K)=BETA(K)+(THETA(K)-S(K))*(1.-PERC(K))                     SWIF1320
      DBET(K)=DBET(K)+(THETA(K)-S(K))*PERC(K)                          SWIF1330
C      WRITE(6,707)THETA(K),BETA(K),DBET(K),K                          SWIF1340
C707   FORMAT(' SWFT121 ',3G16.5,I3)                                   SWIF1350
      THETA(K)=S(K)                                                    SWIF1360
      IF(DBET(K).LE.BD(K))GO TO 580                                    SWIF1370
      EXCESS=EXCESS+DBET(K)-BD(K)                                      SWIF1380
C      WRITE(6,750)EXCESS,DBET(K),BD(K),K                              SWIF1390
C750   FORMAT(' SWFT122 ',3G16.5,I3)                                   SWIF1400
      DBET(K)=BD(K)                                                    SWIF1410
580   CONTINUE                                                         SWIF1420
      IF(BETA(K).LE.B(K))GO TO 590                                     SWIF1430
      EXCESS=EXCESS+BETA(K)-B(K)                                       SWIF1440
C      WRITE(6,775)EXCESS,BETA(K),B(K),K                               SWIF1450
C775   FORMAT(' SWFT134 ',3G16.5,I3)                                   SWIF1460
      BETA(K)=B(K)                                                     SWIF1470
C     BETA(NSL) ENTERS MESOPORES                                       SWIF1480
590   MACEX(K)=MACEX(K)+EXCESS                                         SWIF1490
C     IF(MACEX(K).GT.0.0) WRITE(6,777) K,MACEX(K),EXCESS,BETA(K),DBET(K)SWIF1500
C    1,THETA(K),FLOW(K),DFLOW(K),DMAMA(K),DMEMA(K),DMAME(K),           SWIF1510
C    2RLAT(K),TRUNO,FLXMAX                                             SWIF1520
C 777 FORMAT(' ',I1,13D10.3)                                           SWIF1530
      IF(MACEX(K).GT.100.) CALL ERROR                                  SWIF1540
      IF(K.NE.NSL)GO TO 600                                            SWIF1550
      RLAT(K)=RLAT(K)+EXCESS                                           SWIF1560
      EXCESS=0.0                                                       SWIF1570
      REMAIN=0.0                                                       SWIF1580
600   TBET(K)=BETA(K)+DBET(K)+EXCESS                                   SWIF1590
      RETURN                                                           SWIF1600
      END                                                              SWIF1610


      SUBROUTINE WSWIFT                                                WSWI  10
C     ROUTINE TO PRINT OUT DAILY/MONTHLY WATER STATUS                  WSWI  20
      IMPLICIT REAL*8 (A-H,O-Z)                                        WSWI  30
      REAL*8 MACEX,MMEMA,MMAME,MMAMA,MMACEX,MMEME                      WSWI  40
      DIMENSION DBETA(8),DDBET(8),DTHET(8)                             WSWI  50
      COMMON/MONTHS/MMAME(8),MMEMA(8),MMAMA(8),MMACEX(8),MMEME(8)      WSWI  60
      COMMON/MESOP/DMEME(8)                                            WSWI  70
      COMMON/GEOMET/DL(8),AT(2),ARAT(2),PC(8),THETA(8),SWT(8)          WSWI  80
      COMMON/PORES/VP(8),P,S(8),SEV,ETGW,DNPAC,WP1,WP2,NSL,NBL,NS      WSWI  90
      COMMON/BOOKS/DMEMA(8),DMAME(8),DMAMA(8),MACEX(8),BETA(8),DBET(8) WSWI 100
      COMMON/FONG/DAYMAC                                               WSWI 110
C     DMEMA(J)=DAILY MESOPORE TO MACROPORE FLOW                        WSWI 120
C     DMEME(J)=DAILY MESOPORE TO MESOPORE FLOW                         WSWI 130
C     DMAME(J)=DAILY MACROPORE TO MESOPORE FLOW                        WSWI 140
C     DMAMA(J)=DAILY MACROPORE TO MACROPORE FLOW                       WSWI 150
C     MACEX(J)=DAILY MACROPORE EXCESS                                  WSWI 160
C     MMAME(J)=MONTHLY MACROPORE TO MESOPORE FLOW                      WSWI 170
C     MMEMA(J)=MONTHLY MESOPORE TO MACROPORE FLOW                      WSWI 180
C     MMEME(J)=MONTHLY MESOPORE TO MESOPORE FLOW                       WSWI 190
C     MMAMA(J)=MONTHLY MACROPORE TO MACROPORE FLOW                     WSWI 200
C     MMACEX(J)=MONTHLY MACROPORE EXCESS                               WSWI 210
      DO 111 J=1,NSL                                                   WSWI 220
      DBETA(J)=BETA(J)/DL(J)                                           WSWI 230
      DDBET(J)=DBET(J)/DL(J)                                           WSWI 240
      DTHET(J)=THETA(J)/DL(J)                                          WSWI 250
```

APPENDIX B (continued)

```
C     DAILY WATER STATUS
111   CONTINUE
      IF(DAYMAC.EQ.0.0) GO TO 799
      WRITE(6,100)(DMAME(I),I=1,NSL)
100   FORMAT(' DMAME (CM/DAY) ',8(E12.4,2X))
      WRITE(6,200)(DMEMA(I),I=1,NSL)
200   FORMAT(' DMEMA (CM/DAY) ',8(E12.4,2X))
      WRITE(6,300)(DMAMA(I),I=1,NSL)
300   FORMAT(' DMAMA (CM/DAY) ',8(E12.4,2X))
      WRITE(6,400)(MACEX(I),I=1,NSL)
400   FORMAT(' MACEX (CM/DAY) ',8(E12.4,2X))
      WRITE(6,450)(DMEME(I),I=1,NSL)
450   FORMAT(' DMEME (CM/DAY) ',8(E12.4,2X))
      WRITE(6,500)(DBETA(I),I=1,NSL)
500   FORMAT(' BETA/DL(ML/ML) ',8(E12.4,2X))
      WRITE(6,600)(DDBET(I),I=1,NSL)
600   FORMAT(' DBET/DL(ML/ML) ',8(E12.4,2X))
      WRITE(6,700)(DTHET(I),I=1,NSL)
700   FORMAT(' THETA/DL(ML/ML)',8(E12.4,2X))
C     SET UP MONTHLY WATER ACCOUNTS
  799 CONTINUE
      DO 800 J=1,NSL
      MMAME(J)=MMAME(J)+DMAME(J)
      DMAME(J)=0.0
      MMEME(J)=MMEME(J)+DMEME(J)
      DMEME(J)=0.0
      MMEMA(J)=MMEMA(J)+DMEMA(J)
      DMEMA(J)=0.0
      MMAMA(J)=MMAMA(J)+DMAMA(J)
      DMAMA(J)=0.0
      MMACEX(J)=MMACEX(J)+MACEX(J)
      MACEX(J)=0.0
800   CONTINUE
      RETURN
C     MONTHLY WATER STATUS
      ENTRY TMONTH
      WRITE(6,105)
105   FORMAT(16X,'  MONTHLY WATER BUDGETS   ')
      WRITE(6,110)(MMAME(I),I=1,NSL)
110   FORMAT(' MMAME (CM/MTH) ',8(E12.4,2X))
      WRITE(6,210)(MMEMA(I),I=1,NSL)
210   FORMAT(' MMEMA (CM/MTH) ',8(E12.4,2X))
      WRITE(6,310)(MMAMA(I),I=1,NSL)
310   FORMAT(' MMAMA (CM/MTH) ',8(E12.4,2X))
      WRITE(6,410)(MMACEX(I),I=1,NSL)
410   FORMAT(' MMACEX(CM/MTH) ',8(E12.4,2X))
      WRITE(6,510)(MMEME(I),I=1,NSL)
510   FORMAT(' MMEME (CM/MTH) ',8(E12.4,2X))
      DO 900 J=1,NSL
      MMAME(J)=0.0
      MMEMA(J)=0.0
      MMEME(J)=0.0
      MMAMA(J)=0.0
      MMACEX(J)=0.0
900   CONTINUE
      RETURN
      END
```

APPENDIX B (continued)

```
      SUBROUTINE XPREC(PRT,PACK,IDSID,SINTC,P3,P4)
C       ROUTE PRECIPITATION THRU INTERCEPTION STORAGE TO LAND
C       SURFACE. PRT IS INCIDENT PRECIPITATION AND INCLUDES ANY
C       SPRINKLER TYPE IRRIGATION.
      COMMON/SHIFT1/ RADCON,CONMLT,SCF,ELDIF,IDNS,FCI,DGM,WC,MPACK, K1,
     > A, LG, SS, NN, K24L, EPXM,SUNCON,CLD,CLDFAC
C      CONTAMINANT TRANSPORT IS REMOVED TEMPORARILY. 12 19 75-DDH.
C      COMMON/SHIFT2/
C     + BARE, ANOT, KD, LFTOVR, OCRIT, ONCRIT, AZERO, SDPM, SEDMP,
C     + SONE, STWO, STRE, SFOR
      COMMON/MISC/ SIMP,SSUR,SAR1,SAR2,SBAS,STOT,SRCH,SLTO,SRA,SIEN,
     > SPRS,SOILEV, TOTELH,SNEVAP,SNET,SPET,STSNO,SCEP,RES,STDEP,STUS,
     > STDS1,STDS2,STGW,STBT
      COMMON/SURFXP/RZ,PR,ORAIN,FF,FIXM,RGX,SHRD,A3,AUZS,ASDS,AINF
      COMMON/LOCALS/RU,SCI,F1,F1A,GWF,LOS,EP,RECE,ROS,HRLYRN,EPHRLI,
     > AETR
      COMMON/XPRE/DEP,SEP,INDRTS
      COMMON/INVGA/STANF,WB,NAME(6),ELEV,LAT(3),LONG(3),GTYPE(2) ,
     > INTRVL, ELEM(5), INITP,DSNAME,STRTYR,ENDYR, INITS, RODSNA,ROSTYR,
     > RENDYR, INITD,DDSNAM,DSTYR,DENDYR, INITR, DSDSNA,DSSTYR,DSENDY,
     > FRADCN,FCNMLT,FSCF,FELDIF,FIDNS, FFCI,FDGM,FWC,FMPACK, FK1,FA,
     > FL, FSS, FNN, FK24L, FEPXM,
C      THE FOLLOWING 13 PARAMETERS TEMPORARILY REMOVED 12 19 75
C     + BARES, ANOTS, KDS, LFTOVS, OCRITS, ONCRTS, AZEROS,
C     + SDPMS, SEDMPS ,SONES, STWOS, STRES, SFORS,
     >SGWINV,LZSINV,LIQW,DEPTH,NEMELT,PCK,KEYTIM, DUM1,DUM2, UNUSED(24)
      COMMON/AR/AREA1,AREA2,PA
      REAL LG,IDNS,MPACK,K1,K24L,NN, LZSINV,LIQW,NEMELT,LOS
      INTEGER DSNAME,STRTYR,ENDYR,RODSNA,ROSTYR, RENDYR,
     > DSTYR,DENDYR,DSDSNA,DSSTYR,DSENDY
      REAL*8 P4,AREA1,AREA2,PA
      IDSID=0
      IF (PRT.LE.0.0) GO TO 20
      SEP=SEP+PRT
      IF(A.LT.FA)A=FA
      IF (PACK.GT.0.0) GO TO 40
      EPX=AMAX1(EPXM-SCEP,0.)
C       WILL PRECIPITATION EXCEED INTERCEPTION STORAGE ?
      IF (PRT.GT.EPX) GO TO 30
      SCEP = SCEP + PRT
      SINTC=SINTC + PRT
C       NO PRECIP OR PRECIP DOES NOT EXCEED INTERCEPTION STORAGE
   20 P3 = 0.0
      A3 = 0.0
      RU = 0.0
      SCI = 0.0
C      AZERO = AZERO + DEP
      IF (RES.GT.0.0) GO TO 50
      INDRTS=INDRTS+1
      P4=0.0
      ROS = 0.0
      IDSID=1
      GO TO 70
   30 P3 = PRT - EPX
C P3 IS RAIN REACHING THE LAND
      RU = P3 * A
      IF(A.EQ.1.0.AND.RES.EQ.0.0)IDSID=1
CRU IS IMPERVIOUS AREA RUNOFF
      SIMP = SIMP + RU
      SCEP = SCEP + EPX
      SINTC=SINTC + EPX
```

APPENDIX B (continued)

```
C     GDF = 1.0 - EXP(-1.0*P3/EPXM)
C      CONTAMINANT SIMULATION REMOVED TEMPORARILY---DDH 12 19 75.
      A3 = 0.0
C      A3 = AZERO*GDF+DEP*(1.0-EPXM*GDF/P3)
C      AZERO = AZERO +DEP - A3
C       ORAIN IS RAINFALL ENERGY CONTRIBUTION TO AVAILABLE
C       STREAMPOWER FOR PRODUCING EROSION.
      ORAIN=0.107*LG*PRT*(1.0-2.718**(-1.08*((4.0*PRT)**0.25)))**2.0
      SCI = A3*A
CIMPERVIOUS AREA CHANNEL INPUT
      GO TO 50
   40 P3=PRT
      RU=P3*A
      SIMP=SIMP+RU
   50 P4 = P3 + RES -RU
C
 70   A=0.
      PA=1.0
      RETURN
      END
```

APPENDIX C

Job Control Language for Submission of AGTEHM to IBM System 3033 Computer

```
//DMHMC001 JOB (18310),'XCSD-HETRICK-B216'
//*CLASS CPU91=300S,REGION=550,IO=9,L=45
/*ROUTE  PRINT LOCAL
/*ROUTE  PUNCH LOCAL
//STP1 EXEC FORTHCLG,REGION.GO=50K
//FORT.SYSIN DD *  FORTRAN SOURCE DECK FOLLOWS THIS CARD
      DIMENSION LIST(20)
  201 FORMAT (10X,20A4)
  100 READ (05,200,END=199) LIST
  200 FORMAT (20A4)
      PRINT 201, LIST
      WRITE(50,200) LIST
      GO TO 100
  199 END FILE 50
      STOP
      END
/*
//LKED.SYSIN DD *
/*
//GO.FT50F001 DD UNIT=SYSDA,DSNAME=&&TEMP,DISP=(NEW,PASS),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=7280),SPACE=(3200,(20),RLSE)
//GO.FT05F001 DD *  CARD DATA INPUT FOLLOWS THIS CARD
=CORNY1.AGR[6137,201]
/*
//STP2 EXEC FORTHCLG,PARM.FORT='XREF,XL,OPT=2,NODECK,SOURCE',
//     REGION.FORT=350K,PARM.LKED='OVLY,MAP,LIST,XREF,SIZE=(200K,36K)',
//     REGION.LKED=230K,
//     PARM.GO='EU=-1,SO=51,SI=50,TIME=5',REGION.GO=550K
//FORT.SYSIN DD *  FORTRAN SOURCE DECK FOLLOWS THIS CARD
=CHANGE.NEW
/*
//LKED.SYSLIB DD
// DD
// DD
//            DD DSN=ENVSCI.DDH14268.TEHM,DISP=SHR
//            DD DSN=ENVSCI.DDH14881.WHTM,DISP=SHR
//            DD DSNAME=Z.CWN10332.ORGRAPH,DISP=SHR
//LKED.PROSPER DD DSN=T.DMH18310.PROSPER,DISP=SHR
//LKED.SYSIN DD *
 INCLUDE PROSPER
 INSERT MAIN
 INSERT CLEAR
 OVERLAY ZERO
 INSERT CLEARO
 OVERLAY ZERO
 INSERT OLDMAI
```

APPENDIX C (continued)

```
INSERT CVBCBIDK
INSERT OPNDSK,RITE,READER
INSERT PRC
INSERT IDCODE
INSERT LASDAY
INSERT E
INSERT PARAM
INSERT HOLNAM
INSERT UNITS
INSERT A
INSERT B
INSERT C
INSERT D
INSERT F
INSERT FF
INSERT ITWRD
INSERT RAC30M
INSERT SU30M
INSERT SU30MR
INSERT PRCRV
INSERT TOTP
INSERT TOTPRV
INSERT IDAY
INSERT TIME
INSERT TOTD
INSERT LSRA
INSERT LSRNF
INSERT YLGINT
INSERT PDTEMP
INSERT TOTS
INSERT INVFIL
INSERT INVGA
INSERT FLAGS
INSERT SOISNO
INSERT SHIFT1
INSERT SHIFT3
INSERT MISC
INSERT T
INSERT JEJ1
INSERT CNTRL
INSERT ROUTS
INSERT T2
INSERT CHTMP
INSERT FLOTMP
INSERT DEPVAL
INSERT DAM1
INSERT SUMS
INSERT IH2P2
INSERT PRINT
INSERT DEPOS
INSERT BIMON
INSERT TIMEWD
```

APPENDIX C (continued)

```
INSERT DATIM
INSERT TAPEO
INSERT S
OVERLAY TWO
INSERT CLEAR2
OVERLAY TWO
INSERT PRECIP
INSERT OUTREC
INSERT ADDATA
INSERT OPNSET
INSERT RDHRLY
INSERT RDSTOR
INSERT MODEPS
INSERT INFILE
OVERLAY TWO
INSERT LAND
INSERT TLYR
INSERT SSF
INSERT DAILY
INSERT HRLYS
INSERT RAATS
INSERT YLAG
INSERT CM
INSERT AWYPLC
INSERT PRSPLC
INSERT INTL
INSERT QQCPA
INSERT FIXPLT
INSERT SETPLT
INSERT CRT
INSERT PLOTS
INSERT CRTNUM
INSERT CRTSYM
INSERT NUMBER
INSERT QQNEWS
INSERT QQPRIN
INSERT QQPRTS
INSERT QQROTE
INSERT QQINCH
INSERT QQICON
INSERT RNDPLT
INSERT AXIS
INSERT BOX
INSERT GRID
INSERT LABEL
INSERT QQQCPA
INSERT RANGE
INSERT SCALE
INSERT SIGN
INSERT SYMBOL
INSERT LINEUP
INSERT LINPLT
```

APPENDIX C (continued)

```
INSERT LABEL2
INSERT NUMBCD
INSERT QQEDIT
INSERT QQLINE
INSERT QQQFMT
INSERT LEGEND
INSERT ROUNDF
INSERT STEPF
INSERT PROSPR
INSERT TABLOK
INSERT FORLOK
INSERT EVAL
INSERT EVAPOR
INSERT GROUND
INSERT RNLONG
INSERT SATVP
INSERT SOLVO1
INSERT SUBEV
INSERT PHOTO
INSERT BIODAT
INSERT SULU
INSERT FORMUL
INSERT ANGLES
INSERT SUBSRF,EQS
INSERT THSET
INSERT EQUA
INSERT PMONTH
INSERT M30
INSERT MOSUMS
INSERT SOLPOT
INSERT SSRF
INSERT AR
INSERT SRFSUM
INSERT RAIN
INSERT HUMID
INSERT GEOMET
INSERT PIECES,BOOKS,INPTS,MONTHS
INSERT SWIFT,RSWIFT,WSWIFT,SUBONE,TMONTH
INSERT THINGS
INSERT BLOCKE
INSERT PETRUS
INSERT PORES
INSERT RESIST
INSERT TIMES
INSERT TOTMON
INSERT TOTDAY
INSERT DRAG
INSERT SURF
INSERT DAYMID
INSERT PLACE
INSERT HOOKUP
INSERT LOCALS
```

APPENDIX C (continued)

```
INSERT SURFXP
INSERT GET
INSERT NMON
INSERT XPRE
INSERT SNO
INSERT NSEG
INSERT PEV
INSERT MONDAT,DEFER,SOLRAD,RADIST
INSERT NATEMP,INDEX
INSERT XPREC
INSERT PEVSRF
INSERT DLAYIN
INSERT CERES
INSERT SCEHM
INSERT DRYADS
INSERT DIFMAS
INSERT CHMEX
INSERT FLO
INSERT RKUTT
INSERT KUTTA
INSERT ANUSEG
INSERT ANUMON
INSERT BELCH
INSERT ANUDAY,HRADSL
INSERT SNOMLT
OVERLAY THREE
INSERT GETSET,READIN,ASPECT,EVAPO,SOIL
INSERT RDCER,RDCHM,EXAMTS,OUTPT,RDDRY
INSERT RDIRIG
OVERLAY THREE
INSERT PUTOUT
INSERT AWYPLT
INSERT PRSPLT
INSERT CERPLT
INSERT DRYPLT
INSERT BUF
OVERLAY TWO
INSERT CHANL
INSERT CIRCRN
INSERT DAMRUN
INSERT SUM
INSERT INITCH
INSERT ITWRD
INSERT RAC30M
INSERT SU30M
INSERT SU30MR
INSERT PRCRV
INSERT TOTP
INSERT TOTPRV
INSERT IDAY
INSERT TIME
INSERT TOTD
```

APPENDIX C (continued)

```
INSERT LSRA
INSERT LSRNF
INSERT YLGINT
INSERT PDTEMP
INSERT TOTS
INSERT INVFIL
INSERT INVGA
INSERT FLAGS
INSERT SOISNO
INSERT SHIFT1
INSERT SHIFT3
INSERT MISC
INSERT T
INSERT JEJ1
INSERT CNTRL
INSERT ROUTS
INSERT T2
INSERT CHTMP
INSERT FLOTMP
INSERT DEPVAL
INSERT DAM1
INSERT SUMS
INSERT IH2P2
INSERT PRINT
INSERT DEPOS
INSERT BIMON
INSERT TIMEWD
INSERT DATIM
INSERT TAPEO
INSERT S
OVERLAY TWO
INSERT CLEAR2
OVERLAY TWO
INSERT PRECIP
INSERT OUTREC
INSERT ADDATA
INSERT OPNSET
INSERT RDHRLY
INSERT RDSTOR
INSERT MODEPS
INSERT INFILE
OVERLAY TWO
INSERT LAND
INSERT TLYR
INSERT SSF
INSERT DAILY
INSERT HRLYS
INSERT RAATS
INSERT YLAG
INSERT CM
INSERT AWYPLC
```

APPENDIX C (continued)

```
 INSERT INFLOS
 INSERT LAGRAN
 INSERT FLOWIN
 INSERT MEANDF
 INSERT MSPOL
 INSERT PRPLT
 INSERT REACHS
 INSERT SKIP
 INSERT INITIA
 INSERT SR25
 INSERT RNOFF
 INSERT JEJ
 INSERT CHANID
 INSERT MINI
 OVERLAY TWO
 INSERT DTRSTR
 INSERT CHANGE
/*
//GO.FT01F001 DD UNIT=SYSDA,DSNAME=&TEMP1,DISP=NEW,SPACE=(344,(100))
//GO.FT02F001 DD UNIT=SYSDA,DSNAME=&TEMP2,DISP=NEW,SPACE=(8948,(100)),
//    DCB=RECFM=FT
//GO.FT03F001 DD UNIT=SYSDA,DSNAME=&TEMP3,DISP=NEW,SPACE=(2424,(10))
//GO.FT04F001 DD UNIT=SYSDA,DSNAME=&TEMP4,DISP=NEW,SPACE=(584,(1200))
//GO.FT10F001 DD UNIT=SYSDA,SPACE=(12288,16),
// DCB=(RECFM=FT,BLKSIZE=12288)
//GO.SYSUDUMP DD SYSOUT=A
//GO.FT07F001 DD SYSOUT=B,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3520)
//GO.FT05F001 DD UNIT=SYSDA,DSNAME=&&TEMP,DISP=(OLD,DELETE)
//GO.FT50F001 DD *
/*
//
ENDINPUT
```

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