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Land Use Simulation Model of the Subalpine Coniferous Forest Zone

Charles F. Leaf and Glen E. Brink

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Abstract

A dynamic model simulates the short- and long-term hydrologic impacts of combinations of timber harvesting and weather modification to develop management strategies for planning intervals which can vary from a few years to the rotation age of subalpine forests (120 years and longer). Management strategies may subdivide a given "planning unit," defined by environmental characteristics, into as many as eight distinct "response units," which may be managed independently. Different cutting practices may be imposed on the response units, and any number of cuttings can be made at specified years during the planning interval. All interactions between the various response units are accounted for in both time and space. Moreover, the model contains time trend functions which compute changes in evapotranspiration, soil water, forest cover density, reflectivity, interception, snow redistribution, and sediment yield as the forest stands respond to timber harvesting.

Keywords: Computer models, coniferous forest, forest management, land use planning, simulation analysis, subalpine hydrology, watershed management.

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**Land Use Simulation Model of the Subalpine
Coniferous Forest Zone //**

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Land Use Simulation Model of the Subalpine Coniferous Forest Zone

Charles F. Leaf and Glen E. Brink

Introduction

Conflicts between interest groups over land-use impacts on the environment in the subalpine zone cannot be resolved without objective multi-resource analyses. These analyses must account for both primary resource responses and their interactions. Dynamic simulation models are one way of providing the framework for comprehensive land-use planning in ecologically complex forests. The output from such models should help planners to better understand how various land-use practices influence productivity and environmental quality. Moreover, multi-resource simulation models should help to achieve the most desirable balance of uses and products from the subalpine coniferous forest zone.

Some progress has been made in the development of simulation models that predict the short-term effects of timber harvesting on snowmelt and water yield (Leaf and Brink 1972, 1973a, 1973b, Leaf 1975). This work has been expanded to determine the long-term interactions between the water and timber resources in old-growth subalpine forests subjected to partial cutting and regeneration practices. The effects of logging and road construction on erosion and sediment yields are also considered.

The objective has been to design a model that: (1) is formulated in terms of the diverse form, structure, and arrangement of natural forest stands; and (2) at least qualitatively accounts for the response of these stands to management, based on the best information available.

Theory

Comparison of Subalpine Water Balance Model and Land Use Model

Leaf and Brink (1973a,b) have previously described a water balance model for simulating runoff from subalpine watersheds. This model is now being used in representative areas throughout the Rocky Mountain region for simulating watershed management practices and their resultant effects on hydrologic system behavior.

The Land Use Model has greatly expanded capabilities in that it utilizes the output from the Subalpine Water Balance Model (Leaf and Brink 1973b) to simulate both immediate and long-term effects of forest and watershed management on the water resource. Considerable flexibility is provided for simulating alternative silvicultural systems.

All but two of the subroutines in the core of the Subalpine Water Balance Model are used by the Land Use Model without significant changes; they are not discussed here, therefore, but are listed in Appendix II. Complete descriptions of the un-revised routines are also given in Leaf and Brink (1973a,b). Two subroutines, EVTRAN and CANVAP, were extensively revised as discussed later in this report. A "time-trend package" has been developed which simulates the long-term changes in the primary hydrologic variables. These variables are expressed in terms of accepted silvicultural concepts as described in this report.

In developing the Land Use Model, it was necessary to restructure the Subalpine Water Balance Model to make it the core system of a more versatile planning tool. The analytical framework of the Water Balance Model is a watershed divided into subunits defined by homogeneous environmental characteristics (slope, aspect, elevation, and forest cover composition and density). Hydrologic responses are computed for each subunit, then weighted according to their respective areas and combined to produce an overview of hydrologic system behavior on a watershed basis.

In the Land Use Model, the emphasis is shifted from the watershed to a "planning unit" of any size, which has all of the inherent characteristics of the hydrologic subunits discussed above, but which also accommodates the objectives of management. The Land Use Model is designed to simulate the effects of combinations of timber harvesting and weather modification in order to develop management strategies for planning intervals. These planning intervals can vary from a few years to the rotation age of subalpine forests (120 years and longer).

Management strategies may subdivide a given planning unit into as many as eight distinct areas or "response units" of any size, which may be man-

aged independently at varying points in time during the planning interval. Provision is also made so that different cutting practices may be imposed on the response units, and finally, any number of cuttings may be made on a given response unit at specified years during the planning interval.

Hydrologic integrity is maintained as management strategies are formulated, since all interactions between the various response units are accounted for in both time and space. Moreover, the overall hydrologic effects resulting from each management decision on the planning unit are projected to the end of the planning interval as though that decision were the final one in the strategy. Thus, the singular effects of each decision can be evaluated.

Table 1 compares the capabilities of the Subalpine Water Balance Model described by Leaf and Brink (1973a,b) and the Land Use Model described in this report.

Table 1.—Comparison of Subalpine Water Balance Model with Land Use Model

Factor	WBMODEL	LUMOD
Desired output	Watershed	Planning Unit
Secondary output	Subunit	Region
Method of computation	Subunits combined to yield watershed response	Response units combined to yield response for planning unit
Time trends	None	Yes
Erosion and sediment yield	None	Yes
Multiple treatments	Limited	Full range

Detailed flow chart descriptions and pertinent theory follow.

Land Use Model Configuration (Program LUMOD)

Program LUMOD is the controlling routine for a series of five relatively independent steps in the Land Use Model. The Control Data Corporation's 6400 FORTRAN Extended² provides Overlay capabilities which are ideally suited to the operation of the model. If such capabilities are not available, however, the five steps could be performed in a series of computer runs with communication among them through the use of magnetic tape files:

Procedural Differences from Subalpine Water Balance Model (fig. 1)

Step 1 (and to some extent, step 3) corresponds to the Water Balance Model described by Leaf and Brink (1973b). Both models utilize the Water Balance routines as their core.

Since climatological observations are rarely available for the long periods of time simulated by the Land Use Model, step 2 extends the data base by a randomized selection of water years until the planning interval is completed.

Both models contain peripheral routines which handle input/output and supply the continuous and static conditions to the core. It is the peripheral routines which embody the different objectives of each model.

The Water Balance Model was designed to simulate the effects of management strategies on an entire watershed over relatively short periods of time. Thus, computer memory was used extensively

Figure 1.—General flow of Land Use Model.

for retaining simulated results until a composite overview was produced. Little use was made of online storage. In the Land Use Model, however, the objective has been to extend the capabilities of the Water Balance Model across a much longer time frame, with the added ability of introducing new management decisions at various points during the planning interval. Not only did we want the capacity to simulate each management decision independently, but we wanted to be able to view the interactive effects of a new decision on ones previously implemented. Moreover, an added objective was to simulate the effects of time, as demonstrated through reforestation, on each response unit at each point in the planning interval. It was therefore necessary to develop peripheral routines which were concerned with only one planning unit at one time. Use of computer memory was diminished as use of online storage increased to facilitate retention of: (1) input data for "multiple-passes"; and (2) voluminous output data which are summarized for the planning unit, watershed, and perhaps for a region comprising several watersheds.

Time Trends.—With the Water Balance routines collectively defined as the "core system" of the Land Use Model, it is useful to identify the time trends routines as "satellite" to the model, since they are accessed only once each water year as opposed to daily utilization of the "core system." Imposition of time trends on the simulation also required one additional means of communication (common block/TIME/) between routines.

Response Units

A planning unit of any desired size is subdivided in the management strategy into as many as eight distinct management areas, called "response units", seven of which may be subjected to timber harvesting practices during a planning interval. It should be emphasized that a response unit need not be made up of a single forest area, but represents a percentage of the area of the entire planning unit. For example, consider a response unit that is 40 percent of the planning unit and subjected to patch-cutting. Such a unit is not considered as one very large forest opening, but rather as an array of small openings distributed over the entire planning unit and occupying 40 percent of its area. One response unit out of the eight is retained in the "natural" state to aid in simulating the redistribution of precipitation or weather modification. If the entire

planning unit is managed, however, the area-weighting factor for the "natural" response unit is set to zero and it no longer affects the results. It is retained in the simulation, regardless of its weight, since the time trend functions cause the managed response unit to approach the same state as the natural response unit. All of the time functions are defined for each managed response unit, and are totally independent of the functions for other response units.

Model Subroutines

The routines discussed below are time trend routines that compute changes in evapotranspiration, soil water, forest cover density, reflectivity, interception, snow redistribution, and erosion and sediment yield. Peripheral routines, which are meaningful only in implementing the hydrologic and silvicultural concepts on a computer, are not discussed in detail here, but can be found in the FORTRAN listings in Appendix II. The remainder of the Water Balance routines that comprise the core system of the Land Use Model are also described in Leaf and Brink (1973b).

Evapotranspiration.—Subroutines EVTRAN and CANVAP, as described by Leaf and Brink (1973b), have been extensively revised to account for the regrowth of forest stands after harvest cutting. In computing evapotranspiration, there is some evidence that water use during the growing season proceeds at rates limited only by available energy until the soil water is depleted to 50 percent of the maximum "available" for transpiration (field capacity index). Thereafter, transpiration is decreased in proportion to the amount of soil water below one-half of the field capacity index. In open or cutover areas, it was reasoned that the absence of dense vegetation and a highly developed root system reduces evapotranspiration below maximum rates unless the soil mantle is completely recharged. Thereafter, evapotranspiration is linearly decreased to zero at three-fourths of the field capacity index (fig. 2a). As forest vegetation is established on cutover areas and consumptive use increases, the relationship in fig. 2a changes until ultimately, as the forest cover is reestablished, it approaches the old-growth forest curve (fig. 2b). It is this phenomenon which is primarily responsible for diminishing water yield increases from timber harvesting. The rate at which this transition takes place depends upon forest species, climate, stand conditions, and the objectives of management.

Figure 2.—Relationships showing evapotranspiration as a function of available soil water for: (a) old-growth forest and open conditions, and (b) old-growth forest and some intermediate forest cover condition several years after timber harvesting.

A general expression for the relations shown in figure 2 can be written as follows:

$$\Theta = \Delta \left[\beta - \left(\tau - \frac{1}{\Delta} \right) \right] = \Delta(\beta - \tau) + 1$$

$$\beta \geq \tau, \Theta = 1$$

$$\tau - \frac{1}{\Delta} < \beta < \tau \quad [1]$$

$$\beta < \tau - \frac{1}{\Delta}, \Theta = 0$$

where $\theta = \frac{E_a}{E_s}$, E_a is the actual evapotranspiration rate and E_s is computed in this model by a modified version of the Hamon equation (Leaf and Brink 1973b).
 β = the available soil water at any time, can vary between 0 and M , where M is the "field capacity index."
 τ = the critical point at which available soil water begins to limit evapotranspiration. can vary between $M/2$ and M .
 Δ = the slope of the relationship between $E_a/E_s = 0$ and 1.

In addition to complex factors such as ecological habitat and stand condition, the rate at which a forest reestablishes itself varies according to species. Discussions and background literature for the three major forest types of the subalpine zone are summarized by Alexander (1974). Of the three types, spruce-fir forests are the most difficult to regenerate, and therefore require the longest time for regrowth. Due to its seed production and growth habits, lodgepole pine does not require as much time to reestablish itself. Finally, since aspen normally regenerates from root suckers, a new stand promptly occupies the site, and on many sites growth exceeds that of associated conifers for decades.

Hydrologic changes resulting from timber harvest in the subalpine zone persist for many years. The Fool Creek watershed study in central Colorado (Hoover and Leaf 1967, Leaf 1975) resulted in water yield increases which did not show a significant decline more than 15 years after treatment. These results and results from timber management research were used to develop the time-trend relationships discussed below.

The procedure used in deriving the assumed time-trend equations was to: (1) establish plateaus, and maximum and minimum values for each hydrologic parameter; (2) establish critical values at which a transition takes place (that is, "when things begin to happen"); and (3) assume a functional relationship for each process which determines all intermediate values with respect to time.

Although the time-trend relationships may not be inherently correct, they are certainly plausible in light of our present understanding of long-term hydrologic phenomena. The validity of the equation should be determined by additional research.

Soil Water.—The critical point at which available soil water begins to limit evapotranspiration (τ) was assumed to vary with time and species (fig. 3):

Figure 3.—Variation of τ with time and vegetation type.

$$\tau = M e^{-k(t - t_{c_1})} \quad \tau = M, t < t_{c_1} \quad [2]$$

$$\tau = M/2, t > t_r$$

where k = an index of the rate of decline of τ .

t_{c_1} = the time at which available soil water begins to limit evapotranspiration in years.

t_r = the time at which the hydrologic effect of timber harvesting becomes insignificant.

The parameters, k and t_{c_1} , vary according to forest species. When $t \leq t_{c_1}$, no adjustments are

made in the soil water correction, since watershed experiments indicate that a correction is not warranted for a number of years after timber harvest. Assumed values of t_{c_1} , t_r , and k for the three species are:

Forest type	t_{c_1}	t_r	k
aspen	7 years	60 years	0.01
lodgepole pine	15 years	80 years	.01
spruce-fir	30 years	100 years	.01

The assumed relationship between Δ and τ is given by:

$$\Delta = \frac{4\tau}{M^2} \quad [3]$$

Substituting equation [2] and [3] into equation [1] yields

$$\Theta = 4e^{-k(t - t_{c_1})} \left[\beta/M - e^{-k(t - t_{c_1})} \right] + 1 \quad [4]$$

which is a general equation for θ as a function of forest cover type, field capacity index, and time.

Forest Cover Density.—Forest cover density plays an important role in the simulation model. It is the major descriptive parameter of the form, structure, and arrangement of forest stands, and therefore controls the energy balance, interception, and evapotranspiration. Forest cover density as used in the Land Use Model is not defined as "canopy" or "crown closure," but rather as a parameter that describes the net effects of the vegetation on the transmission of solar radiation to the forest floor. Forest cover density varies according to crown closure, the vertical foliage distribution, species, season, and stocking (Reifsnyder and Lull 1965). Empirical relationships between various timber stand variables and percent radiation beneath the forest canopy (transmissivity coefficient) have been determined from field measurements (Miller 1959, Muller 1971). A similar relationship was derived for the three major subalpine forest species in the process of calibrating the model against observed snowmelt rates (Leaf and Brink 1973a) and from solar radiation transmission studies in central Colorado. The resulting equation from this work is given by

$$T = 0.19 C_{dmx}^{-0.6} \quad [5]$$

where T = the transmissivity of the forest canopy expressed as a decimal fraction of the amount of solar radiation available above the forest canopy.

C_{dmx} = the natural old-growth forest cover density (expressed as a decimal).

Combinations of C_{dmx} and T that were found

acceptable during calibration of the model for lodgepole pine, aspen, and spruce-fir in central Colorado are summarized below:

Forest type	C_{dmx}	T
lodgepole pine	0.25-0.45	0.40-0.30
spruce-fir	0.50-0.65	0.30-0.25
aspen		
foliated	0.35	0.35
defoliated	0.20	0.50

Figure 4.—Assumed variation of Δ as a function of τ .

As vegetation reoccupies cutover areas, forest cover density (C_d) increases with time until it reaches a maximum. Research has shown that the rate at which canopy development reaches this plateau depends on environmental conditions, stocking levels, and species. In coniferous forests, it can vary from 30 to more than 80 years; in aspen, growth and resultant canopy development is normally much more rapid due to the presence of an extensive root system at the time of stand regeneration (Pollard 1972). Accordingly, the following assumed relationship for C_d as a function of time was developed:

$$C_d = \frac{C_{dmx}}{\Phi^2} (t - t_{c_2})^2 \quad t_{c_2} \leq t \leq \Phi \quad [6]$$

where C_d = intermediate forest cover density expressed as a decimal.

Φ = the time in years from t_{c_2} at which maximum forest cover density is reached. This parameter was assumed to vary according to vegetation type as follows:

Forest type	Φ
lodgepole pine	40 years
spruce-fir	80 years
aspen	20 years and

t_{c_2} = critical time at which regeneration is sufficient to, reestablish the stand when $t < t_{c_2}$, $C_d = 0$.

Reflectivity.—The relationship between reflectivity and forest cover density derived by Leaf and Brink (1973b) was modified as follows:

$$R_f = R_{fo} \exp \left[\frac{\omega C_{dmx} (t - t_{c_2})^2}{\Phi^2} \right] \quad [7]$$

R_f = the reflectivity of the forest stand.

R_{fo} = the reflectivity of a forest opening (assumed herein as 0.5). When $t < t_{c_2}$,

$$R_f = 0.5.$$

$$\omega = 1.609 C_{dmx}^{-1}$$

Subroutine EVTRAN as used in the Land Use Model incorporates the effects of natural regeneration discussed above. As explained in the discussion for Subroutine TRENDS, the final computations of the adjustment factor for available soil water (equation 4) are performed in Subroutine EVTRAN, since they are dependent on the dynamic state of the soil mantle storage. The simulated potential evapotranspiration E_s is then adjusted for both available soil water and canopy reflectivity (equation 7) to produce the actual evapotranspiration E_a . It should be noted that equation 7 is constant over a water year and is recomputed after each growing season. Subroutine EVTRAN also alters the soil mantle storage according to the calculated evapotranspiration.

Figure 5.—Subroutine EVTRAN.

Interception.—Subroutine CANVAP (Leaf and Brink 1973b) is essentially unchanged except that allowance is made for snow interception as the forest regrows after harvest cutting, by weighting the effects of both snow evaporation from areas not occupied by trees (SNOWVAP in Leaf and Brink 1973b) and evaporation from intercepted snow. In the Land Use Model, evaporation from the snow surface and from intercepted snow is computed by the following rational relationships:

$$V_s = (1 - C_d)E_s \text{ and} \quad [8]$$

$$V_c = (1/C_d)E_s \quad [9]$$

where V_s = evaporation from the snow surface.

V_c = intercepted snow evaporation.

C_d = intermediate forest cover density expressed as a decimal, where $C_d < C_{dmx}$.

E_s = potential evapotranspiration as defined in equation [1].

When $C_d \geq \frac{C_{dmx}}{2}$, and snow rests on the canopy, evaporation is computed by equation [9]; when the canopy is free of snow, evaporation takes place according to equation [8]. However, when $0 < C_d < \frac{C_{dmx}}{2}$, both equations [8] and [9] are used as follows:

$$V_t = E_s \left[\frac{2}{C_{dmx}} + \left(1 - \frac{2C_d}{C_{dmx}} \right) (1 - C_d) \right] \quad [10]$$

V_t = combined evaporation from snow surface and intercepted snow in cut-over areas.

We believe that equation [10] more realistically represents the evaporation from cutover areas that are not completely occupied by forest vegetation. When $C_d = 0$, $V_t = V_s$. By substituting equation [6] into equation [10], the following relationship is obtained:

$$V_t = E_s \left[\frac{2}{C_{dmx}} + \left(1 - \frac{2(t - t_c)^2}{\Phi^2} \right) \left(1 - \frac{C_{dmx}}{\Phi^2} \{t - t_c\}^2 \right) \right] \quad [11]$$

which expresses V_t as a function of C_{dmx} and time.

Snow Redistribution.—Redistribution of snow as a result of patch-cutting is a significant factor

influencing runoff. In lodgepole pine, this phenomenon is not diminished more than 30 years after timber harvest in spite of regrowth of trees and increased forest cover density (Hoover and Leaf 1967). Changes in natural snow accumulation patterns produced by patch-cutting will likely persist until the new crop of trees approaches the height of the surrounding forest. Accordingly, the following relationships were developed for simulating snow redistribution effects with time and forest species:

$$\rho = \rho_{mx} \exp [-k_1(t - t_{c_3})] \quad \begin{matrix} t \leq t_{c_3}, \rho = \rho_{mx} \\ t \leq t_{r_1}, \rho = 1 \end{matrix} \quad [12]$$

where ρ = snow redistribution factor in the cut-over area, which varies according to the silvicultural system used. For example, when 40 percent of the area is occupied by small openings 5 tree-heights in diameter, the winter snow-pack is increased by 30 percent in the open and decreased 20 percent in the uncut forest.

ρ_{mx} = the redistribution factor immediately after timber harvesting.

k_1 = an index of the rate of decline of ρ .

t_{c_3} = the time at which forest regrowth begins to reduce snow redistribution in years.

t_{r_1} = the time at which forest regrowth causes snow redistribution to become insignificant.

The parameters k_1 , t_{r_1} , and t_{c_3} vary according to forest species. When $t \leq t_{c_3}$, no adjustments are made in the redistribution, since field studies indicate that a correction is not warranted for several years after harvest cutting. Assumed values of t_{c_3} , t_{r_1} , and k_1 for the three subalpine types are summarized below:

Forest type	t_{c_3}	t_{r_1}	k_1
aspen	20 years	80 years	0.57
lodgepole pine	40 years	120 years	.04
spruce-fir	80 years	160 years	.04

It should be emphasized that redistribution is optimum only when timber is harvested in small patches (5-8 tree heights in diameter) that occupy less than 50 percent of a given planning unit. For other combinations of opening size and area, the

redistribution factor should be reduced in proportion to the size of openings above and below 5 to 8 tree heights.

Individual-tree Selection Cutting.—In the Land Use Model, selection cutting corresponds to a reduction of the forest cover density (C_d). The degree that C_d is reduced depends on the characteristics of the stand and the volume of timber removed. If C_d is reduced by 50 percent or less from C_{dmx} , it is assumed that forest canopy density does not increase subsequent to cutting. However, if C_d is reduced more than 50 percent from C_{dmx} , equation [6] is used to simulate redevelopment of the canopy with time. Solving equation [6] for time yields:

$$t_\eta = \left(\frac{\Phi^2 C_d}{C_{dmx}} \right)^{1/2} + t_{c2} \quad [13]$$

If the degree to which thinning reduces C_{dmx} is given by η , then C_d is given by

$$C_d = C_{dmx} (1 - \eta)$$

Hence, equation [13] can be written as:

$$t_\eta = \Phi [(1 - \eta)]^{1/2} + t_{c2} \quad [14]$$

t = the time required to reach the reduced forest cover density as if the stand were initially patch-cut.

η = the degree that C_d is reduced from C_{dmx} (expressed as a decimal).

All of the time trend relationships are then initialized at t_η to simulate the hydrologic effects of selection cutting.

Subroutine TRENDS (Fig. 6).—This routine initially defines the time functions discussed above in terms of the boundary conditions supplied by Subroutine GBOUND. After each growing season, Subroutine TRENDS redefines the functions whenever necessary to incorporate the effects of time.

Subroutine GBOUND (Fig. 7).—Subroutine GBOUND is used to initialize the basic functions which comprise the time trends concept. These functions are expressed in terms of a wide variety

Figure 6.—Subroutine TRENDS.

of management practices. As trees regrow after cutting, the impact of the original removal is diminished until the hydrologic changes are no longer significant. Therefore, all parameters are specified in terms of the number of years following treatment (t_{cn}) when the effect of timber harvesting

begins to diminish, and in terms of the number of years following treatment when hydrologic changes become negligible. If the parameters are not specified, the model assumes the values indicated in table 2, which vary according to vegetation type.

Subroutine GBOUND converts the boundary years into "real time" based on the year of treatment, and calculates the required parameters that are dependent solely on the boundary conditions.

Erosion and Sediment Yield

One of the environmental impacts associated with land use in the subalpine zone is erosion resulting from road construction. Accordingly, indices of onsite erosion and sediment yield downstream are

Figure 7.—Subroutine GBOUND.

computed by the Land Use Model. The erosion indices are computed from a system of empirical equations developed by Leaf (1974), based on field measurements of sediment yields in central Colorado (Leaf 1966, 1970, 1971), and a time trend equation proposed by Megahan (1974).

The model is based on measurements of accumulated sediment below a 1-square-mile experimental watershed. The sediment contained enough leaf litter and related organic debris so that the dry volumes of mineral soil occupied approximately 75 percent of the total volume of debris (dry unit weight approximately 85 lb/ft³). Moreover, the data were obtained from a stable watershed (26 percent average slope) and a road system that was carefully constructed with a high standard of followup maintenance. Thus, although the equations may not be generally applicable throughout the Rocky Mountain Region, we believe they will serve as good first approximations of total sediment yield until more data become available.

Table 2.—Assumed boundary years for the time trend functions

Factor	Years before effect begins to diminish	Years until effect becomes negligible
Lodgepole pine		
Available soil water	15	80
Canopy reflectivity	0	40
Precipitation redistribution	40	120
Spruce-fir		
Available soil water	30	100
Canopy reflectivity	0	80
Precipitation redistribution	80	160
Aspen		
Available soil water	7	60
Canopy reflectivity	0	20
Precipitation redistribution	20	80

Sediment yields are expressed in terms of watershed characteristics, engineering design variables, and time. The equation for predicting cumulative onsite erosion is:

$$S = 0.12 D E n \quad [15]$$

where S = the total cumulative onsite erosion at time (t) after disturbance in ft³.

D = the projected length of the disturbed area perpendicular to the road centerline in ft.

E = the unit cumulative onsite erosion at time (t) after disturbance in ft³/acre.

n = the number of miles of road system.

$$0.12 = 5,280 \frac{\text{ft}}{\text{mi}} \div 43,560 \frac{\text{ft}^2}{\text{acre}}$$

The projected length (D) is given by the equation

$$D = W \frac{W/2 \tan \nu}{\tan \Theta - \tan \nu} \quad [16]$$

where W = the "effective" width of road in ft.

ν = steepness of the watershed side slope in degrees.

$\Theta = \Theta_C = \Theta_F$ = the average angle of the cut and fill slopes in degrees.

The unit cumulative erosion (E) describes the erosion time trend, and can be expressed as

$$E = \epsilon_{nt} - S_o (e^{-k_2 t} - 1) \quad [17]$$

where ϵ_n = an estimate of the long-term "normal" erosion rate on the undisturbed area in ft³/acre. For central Colorado, (ϵ_n) is equal to 0.28 ft³/acre

based on 15 years of data collected from undisturbed watersheds.

S_0 = an index of the amount of soil available for erosion. This index is 201.3, based on statistical fitting to field measurements.

k_2 = an index of the rate of decline of erosion following disturbance, defined to be 0.085 by statistical fitting methods.

Sediment yields downstream expressed on a watershed basis are given by the equation

$$Q_s = \frac{S}{A} \quad [18]$$

Equation [16] assumes balanced cut and fill (i.e., that the centerline bisects the road width). This is not usually the case, since the cross-section can vary from total cut to total fill in actual practice. However, we believe that a sufficiently accurate index of the total area disturbed can be obtained by estimating an "effective" width and average cut and fill slopes for the proposed road system. Such estimates require considerable judgment and a knowledge of the topography.

Three additional assumptions are behind equations [15] - [17]. First, it was assumed that the equations provide a better index of erosion than equations based on rainfall-derived erodibility indices. Such equations may be grossly in error, since they do not predict time trends, nor do they account for the effects of melting snow, which is responsible for much of the sediment yield from the subalpine zone in central Colorado. The second assumption was that onsite erosion is proportional to the area disturbed. Finally, it was assumed that the delivery ratio is constant for a given watershed size, regardless of the amount of area disturbed. These assumptions involve complex interactions between the hydrology, geology, and soil, which need to be verified by additional study.

Equation [18] is valid provided that the upstream drainage area does not exceed 1 square mile. Sediment yields at downstream points would be less, since delivery ratios are inversely related to watershed area. It should be noted that the model has not been programmed to compute delivery ratios for upstream areas greater than 1 square mile.

Because equations [15] - [18] describe sediment yields in terms of watershed slope and engineering design parameters, the land use planner has at least some latitude, subject to the limitations discussed

above, in evaluating the potential short- and long-term impacts of alternative road systems required for various timber harvesting practices.

Subroutine SEDMOD (Fig. 8).—Equations [15] - [18] are appended to the Land Use Model as Subroutine SEDMOD. Program LUMOD provides the road design and sediment model parameters.

Applications

We have used the Land Use Model to simulate the long-term effects of forest and watershed management on the South Tongue River in the Bighorn National Forest (fig. 9). Elevations on the timbered portions of this drainage basin vary from approximately 8,000 to 8,900 ft. msl. Soils are derived from granitic rocks; virtually all of the forest cover is lodgepole pine. To illustrate how the model has been used, results from the analysis of

Figure 8. —Subroutine SEDMOD.

Figure 9.—Location map for South Tongue River, Bighorn National Forest.

one planning unit will be summarized here. Average values for pertinent geographic and hydrologic characteristics of a typical forested watershed in the South Tongue River drainage basin are:³ area, 640 acres; elevation, 8,480 ft.; aspect, WSW; slope, 17%; C_{dmx} , 40%; peak snowpack water equivalent, 15.5 in.; annual precipitation, 29.6 in.; evapotranspiration, 15.8 in.; annual runoff, 13.8 in.

In addition to improving water yield, the management strategy selected for this example is compatible with wildlife habitat improvement and timber production. Under this strategy, the old-growth timber would be harvested so that approximately 40 percent of the planning unit area would be occupied by small openings — five to eight times tree height. Forest openings would be constructed in a balanced and unified pattern that is visually compatible with the natural landscape. The openings would be permanently maintained by clearing the natural reproduction at 30-year intervals after the initial patch-cut.

The remaining 60 percent of the planning unit area would be retained in continuous forest cover. However, trees would also be removed from this area on an individual tree basis at 30-year intervals

³Based on hydrologic simulation analyses of the effects of timber harvesting on Prune Creek, a 2,461-acre tributary of the South Tongue River (see fig. 9.).

Table 3.—Projected changes in water yield resulting from timber harvesting, South Tongue River Planning Unit, Bighorn National Forest

Interval (Years)	Water yield increase, by treatment			
	I	II	III	IV
	<i>Inches</i>			
0-10	+1.58			
11-20	+1.87			
21-30	+1.15			
31-40	+ .85	+1.59		
41-50	+ .71	+1.78		
51-60	+ .60	+1.54		
61-70	+ .38		+2.97	
71-80	+ .10		+2.41	
81-90	+ .04		+1.93	
91-100	- .05			+2.92
101-110	- .02			+2.75
111-120	- .01			+1.79

so that the old-growth is gradually converted into a broad-aged stand.

The simulated management strategy essentially follows the recommendations published by Alexander (1972), which are keyed to stand descriptions, insect and disease problems, and windfall risk situations.

The management strategy would maintain a vigorous and productive forest cover throughout the planning interval.

Runoff Increases

The diagram below illustrates the management strategy selected for this example:

Management strategy	Response unit (percent of planning unit area)		
	1 (40%)	2 (30%)	3 (30%)
Patch 1st yr. ¹	X		
Select 31st yr. ²		X	
Clear ³	X		
Select 61st yr. ²		X	X
Clear ³	X		
Clear 91st yr. ³	X		
Select ²			X

¹Forty percent of planning unit area occupied by openings 5 to 8 tree-heights in diameter.

²Individual-tree selection cut so that forest cover density (C_d) is reduced 50 percent.

³Clear regrowth from permanent openings.

Projected 10-year mean runoff increases under this management strategy are summarized in table 3. The increases above the heavy diagonal line at any given time represent the overall response resulting from preceding management decisions. The data below the line reflect the singular effects of the initial patch-cut on 40 percent of the planning unit, as if it were the final decision in the strategy.

Water yields are improved throughout the planning interval, with the highest increases occurring after Treatment III. The projected runoff increases during each treatment interval are:

Treatment	Runoff increase Percent
I	11.1
II	11.9
III	17.7
IV	18.0

Apparently, the effect of the initial patch-cut persists for at least 60 and perhaps 70 years. Thereafter, the effect on water yield becomes negligible for all practical purposes.

Seasonal Distribution of Water Yields

The projected effects of the management strategy on distribution of water available for streamflow are summarized in table 4. These values represent increments of generated runoff, not routed streamflow. Hence, the effects of watershed storage must be considered in interpreting the data.

As seen in table 4, inputs from snowmelt are significantly increased during the April 16-30 and May 1-15 intervals, and decreased in June. Minor inputs to streamflow also occur in July, as compared to no input in the natural state, due to the less favorable hydrologic condition of the watershed.

Peak Flows

The hydrologic analysis in this example indicates that peak flows will be changed little if at all under the proposed management strategy. However, seasonal peaks would occur approximately 9 days earlier:

Treatment	Change in peak 7-day generated runoff <i>Inches</i>	Change in timing <i>Days</i>
I	-0.2	-9
II	0	-9
III	+ .3	-9
IV	+ .4	-10

The projected overall effect of the proposed management strategy on runoff timing and peak flows would be to increase snowmelt and resultant streamflow in April and May. This accelerated input would enlarge early spring flows and cause the hydrograph to peak approximately 1 week earlier throughout the planning interval. Annual peak flows would not be increased, however, and runoff on the recession side of the hydrograph during the summer months may be slightly diminished.

Erosion and Sediment Yield

It is assumed that the proposed logging operation on the planning unit would require the equivalent of approximately 12 miles of road system, including all spur roads and landings. Because most of the disturbed area would be occupied by roads, it can be described in terms of road design variables, which have the following characteristics based on watershed side slopes averaging 17 percent:

"effective width" = 14 feet
 average cut and fill slopes = 1½:1
 width of disturbed area = 19 feet (from
 equation [16])
 area disturbed per mile = 2.3 acres

The total area disturbed on the 1-square-mile planning unit is approximately 28 acres. For the purposes of this example, it is assumed that the entire road system would be constructed before logging operations on the planning unit. Thus most of the impact from road construction would take place during the first 30-year treatment interval.

The projected 10-year mean erosion increases produced by the proposed road system are summarized in table 5. Erosion on the 28 acres disturbed would increase 631 ft³ above the untreated norm of 3.8 ft³ immediately after the road construction, then decrease to less than 1 ft³ above the norm after

Table 4.—Projected changes in distribution of water available for streamflow resulting from timber harvesting. South Tongue River Planning Unit, Bighorn National Forest

Runoff interval	Natural generated runoff	Average change in generated runoff, by treatment			
		I	II	III	IV
		<i>Inches</i>			
April 16-30	0.1	+0.9	+0.7	+1.2	+0.5
May 1-15	1.7	+2.1	+2.5	+2.2	+3.1
May 16-31	5.9	+ .6	+ .3	+ .5	+1.3
June 1-15	5.6	-3.0	-2.7	-2.5	-3.1
June 16-30	.7	- .4	- .3	- .5	- .5
July 1-15	0	+ .1	+ .1	+ .1	+ .1

90 years. It is expected that after the first 30 years, increased erosion would be one-fifth of that immediately after road construction. By 60 years, it would be one-seventieth. Ratios of increased erosion on the disturbed area to the norm before road construction for each 30-year treatment interval are tabulated below.

<u>Treatment</u>	<u>Ratio</u> (Increase/undisturbed norm)
I	43.4
II	3.4
III	.3
IV	.1

Although a 40-fold increase in on-site erosion appears high at first, it must be weighed against the typically minimal erosion on subalpine watersheds. Whether or not the increased erosion and sediment yield are excessive would depend on local requirements for water quality and fisheries. On Fool Creek, in central Colorado, no detrimental effects on the land resource or water quality were observed in spite of the fact that on-site erosion was increased by approximately a factor of 60 immediately after road construction. This empirical model is based on data obtained from a carefully constructed road system and a high standard of followup maintenance, however. Any application of the model in its present form should presume similar standards of construction and maintenance.

Conclusion

Validation of the Subalpine Land Use Model will require additional data on long-term responses. In the meantime, we believe that the output from the model will produce the type of information land use

Table 5.—Projected increases¹ in on-site erosion resulting from road construction. South Tongue River Planning Unit, Bighorn National Forest

Interval (years)	Average erosion increase, ² by treatment			
	I	II	III	IV
	<i>Cubic feet</i>			
1-10	631			
11-20	270			
21-30	115			
31-40		49		
41-50		21		
51-60		9		
61-70			4	
71-80			2	
81-90			1	
91-100				<1
101-110				
111-120				

¹Assumptions:

1. Area disturbed by road system = 28 acres.
2. Approximate unit weight of sediment = 85 lb/ft.³.

²Untreated norm = 3.8 ft³.

planners need in order to make difficult management decisions. The ability of the Subalpine Land Use Model and other similar models to integrate complex forest and water systems makes them unique and powerful tools for evaluating the hydrologic effects of a broad array of land-use schemes in the subalpine zone. A user's guide for the model follows in Appendix I. A complete listing of the model is summarized in Appendix II.

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APPENDIX I: USER'S GUIDE FOR SUBALPINE LAND USE MODEL

INTRODUCTION

This brief user's guide describes the input parameters necessary for the operation of the Subalpine Land Use Model (LUMOD). The parameter cards are discussed in the same order as that of the parameter card deck; thus, by preparing the cards in this step-by-step method, the deck will be in the proper order. The guide provides the card columns in which the parameter value is to be punched, as well as the format by which it is read. This guide is intended for use by those primarily concerned with application of the model; it does not provide any computer systems information and, therefore, is of limited value to programmers or others who are computer-oriented.

The general flow of the model is as follows:

- Step 1. Proofread the parameter card deck.
- Step 2. Simulate the natural conditions from the climatological data (original data base.)
- Step 3. Extend the original data base by randomly selecting years until the desired planning interval is reached.
- Step 4. Simulate the management strategy from the extended data base.
- Step 5. Repeat steps 2-4 for all planning units.
- Step 6. Combine the planning units into a regional summary.

The following optional recovery procedures are provided:

1. The extended data base may be saved on a magnetic tape named "SAVNEW."
2. The results of the management strategy which are used in the regional summary are punched on cards in the event of abnormal termination. Thus, if one planning unit simulation had been successfully completed and the job aborted during the next planning unit, the RECOVERY DECK could replace the planning unit deck for the completed unit on the next run. This avoids recomputing an entire planning unit, but still provides results for use in the regional summary.

REGION CARDS

REGIONAL PARAMETERS

Card		Columns	Contents	Format
1	Identified by the word REGION.	1-6	"REGION"	A6
	The number of years to be simulated is generally the rotation cycle for a species; the original data base will be extended to the specified number by randomly selecting and repeating original years.	11-15	Number of years ($1 \leq n \leq 165$)	I5
	Initialize the random number generator with a positive number.	16-20	Seed for random number generator	I5
	If a magnetic tape is provided under the name SAVNEW, the extended data base is captured and saved for either recovery purposes or for use with other management strategies.	21-25	Save the extended data base? (0 = NO, 1 = YES, 2 = copy SAVOLD to SAVNEW before adding new files)	I5
	As the management strategy for a planning unit is completed, the information for the composite regional output is stored on the recovery deck in case the run terminates abnormally. Under normal termination, the recovery deck is not punched, but if specified, it may be punched regardless of the mode of termination.	26-30	Punch the recovery deck even under normal termination? (0 = NO, 1 = YES)	I5
	The five principal hydrologic components may be independently selected for regional summary output.	31 32 33 34 35	Print generated runoff? (0 = NO, 1 = YES) " precipitation? " " " evapotranspiration? " " " change in storage? " " " change in W. E.? " "	I1 " " " "
2	The region ID may contain 80 characters of information.	1-80	Region identification	8A10

PLANNING UNIT DECK

PLANNING UNIT ID

Card		Columns	Contents	Format
3	The planning unit ID may contain 60 characters of descriptive information.	1-60	Planning unit identification	6A10
	A two-digit number may be included to identify the recovery files. (It is always appended to the year as a decimal on the files.)	61-62	Optional identification number	I2
	If the driving variable data are on magnetic tape SAVOLD (saved on a previous run), specify 14. Otherwise, specify 10. (Note: if a tape of card images is used rather than a DATA DECK, the tape ID must be UNEDIT). With a 14, the remaining cards for NATURAL CONDITIONS must be omitted, since only the management strategy simulation is to be done.	64-65	Input file (10 or 14)	I2
	Indicate the percent of the total region area represented by this planning unit. (.15 = 15%)	66-68	Area Weight	F3.2
	If results are wanted at the planning unit level, specify the types of output. The codes are as follows (note 1,2&3 are available only as indicated):	69	Print detailed natural conditions? (0,1)	I1
		70	" list of years in extended data base? (0,1)	"
		71	" detailed managed conditions? (0,1)	"
		72	" list of time variant conditions? (0,1)	"
		73	" generated runoff? (0,1,2,3)	"
		74	" precipitation?	"
	0 - Not wanted	75	" evapotranspiration?	"
	1 - Print the results	76	" change in storage?	"
	2 - Print and plot only the differences attributable to the management strategy	77	" change in W. E.	"
		78	" Bimonthly generated runoff? (0,2)	"
	3 - Both 1 and 2.	79	" Peak W. E. and date? (0,2)	"
		80	" 7-day peak R.O. and starting date? (0,2)	"

NATURAL CONDITIONS

4	Identified by the words: SUBSTATION CONSTANTS	1-20	"SUBSTATION CONSTANTS"	2A10
	Transmissivity Coefficient: (If left blank, the model will supply a value as a function of the forest canopy density.)	21-25	Transmissivity Coefficient	F5.2
	Estimate the decimal percent of the solar radiation reaching the canopy which is transmitted (allowed to pass through) to the snowpack and/or understory. The following table summarizes combinations of cover densities and transmissivity coefficients which were found acceptable during the calibration of the model in lodgepole pine and spruce-fir forest in central Colorado:			
	COVER DENSITY	TRANSMISSIVITY COEFF		
	0.00 (open)	1.00		
	.25	.45		
	.30, .35	.40		
	.40	.35		
	.45	.30		
	.55, .65	.25		
	Cover Density: Using the above table as a guide, estimate the forest canopy density as a decimal percent. (In the table, the values below 50 were for lodgepole pine, with those above 50 for spruce-fir.)	26-30	Cover Density	F5.2
	Maximum Cover Density: Normally, this value is the same as number 5. But if a reduction in cover density is desired, this variable will allow adjustments to be made in the evapotranspiration and energy balance to compensate for that reduction.	31-35	Maximum Cover Density	F5.2
	Vegetation Type - Indicate the forest canopy composition as lodgepole pine, spruce-fir, or deciduous.	40	1 = lodgepole, 2 = spruce-fir, 3 = deciduous	I1
	Reflectivity Threshold Temperature: The model assumes that fresh snowfall increases the snowpack reflectivity according to internally controlled functions. However, field experience has shown that it is not necessarily increased during snow events where the daily maximum temperature varies according to aspect and elevation. The table below indicates some station characteristics and corresponding reflectivity threshold temperatures.	41-45	Reflectivity Threshold	F5.0

Card		Columns	Contents	Format
4	<p>Relative Elevation Aspect °F.</p> <p>High North, East 32</p> <p>Low-Middle East 40</p> <p>Low-Middle North 45</p> <p>All ranges West 45</p> <p>Low South 60</p> <p>Middle-High South 70</p> <p>Melt Threshold Temperature - During initial snowpack accumulation, the model relies on a base temperature to stop melt when the mean daily temperature is below that base. A knowledge of the typical pattern of fall snow accumulation will guide the user in selecting a threshold temperature. Areas where the snowpack accumulates and melts frequently might indicate a low threshold (32°F.). High thresholds (40°-45°F.) may be assumed where the snowpack may yield some melt, but generally continues to build once started.</p> <p>Available Soil Water - Estimate the soil mantle recharge requirement at which water is no longer available for transpiration. Examples: -5.3; -7.8; -10.6 inches.</p> <p>Deciduous Winter Values - The values defined in items 4, 5, and 6 represent the foliated conditions of a deciduous forest. Corresponding values must be supplied for the defoliated state and must represent the reduction in cover density between the seasons. The values used most frequently for cover density and maximum cover density on aspen stands in the central Rockies were .35 and .20 for the foliated and defoliated states, respectively. The model was allowed to generate the transmissivity coefficients as a function of those cover densities.</p> <p>Latitude - Select 38°, 40°, 42°, or 44°</p> <p>Aspect - Leave blank for a horizontal surface, or select N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, OR NNW</p> <p>Slope - Leave blank for a horizontal surface, or select 10%, 20%, 30%, or 40%</p>	<p>46-50</p> <p>51-55</p> <p>56-60 61-65 66-70</p> <p>72-73</p> <p>75-77</p> <p>79-80</p>	<p>Melt Threshold</p> <p>Available Soil Water</p> <p>Deciduous Winter trans. coeff " " cov. den. " " max. cov. den.</p> <p>Latitude (38,40,42, or 44)</p> <p>Aspect (Left-justified)</p> <p>Slope (10,20,30, or 40)</p>	<p>F5.0</p> <p>F5.2</p> <p>F5.2 F5.2 F5.2</p> <p>I2</p> <p>A3</p> <p>I2</p>
5	<p>Identified by the words INITIAL CONDITIONS, this card provides these conditions on Oct 1 of the first water year:</p> <p>Initial Snowpack Temperature, °C.</p> <p>Initial Snowpack Water Equivalent, inches</p> <p>Initial Recharge Requirement, inches</p>	<p>1-20</p> <p>21-25</p> <p>26-30</p> <p>31-35</p>	<p>"INITIAL CONDITIONS"</p> <p>Snowpack Temperature</p> <p>Snowpack Water Equivalent</p> <p>Recharge Requirement</p>	<p>2A10</p> <p>F5.2</p> <p>F5.2</p> <p>F5.2</p>
6	<p>Identified by the words: DAILY ET</p> <p>Average Daily Evapotranspiration - Obtain estimates of the average daily potential evapotranspiration in inches for each month.</p>	<p>1-10</p> <p>21-25 26-30 31-35 ° ° 76-80</p>	<p>"DAILY ET"</p> <p>Average daily ET for Jan " " " " Feb " " " " Mar " " " " Dec</p>	<p>A10</p> <p>F5.2 " " "</p>
7	<p>Identified by the words AIR TEMP COEFF + ADJ</p> <p>Air Temperature Correlation Coefficients - Supply the correlation coefficients for predicting the daily extreme temperatures in °F. from a base station, where the coefficients A and B are of the form,</p> $T_{\text{subunit}} = A + B(T_{\text{base}})$ <p>If the entire basin is being considered as a unit with observed extremes available, the coefficients would be 0.0 and 1.0, respectively. Examples:</p> <p>Maximum A = 4.779 B = 0.907 Minimum A = 0.698 B = 1.023</p> <p>Specify a post-peak precip adjustment, if desired. Example 1.15 = 15% increase.</p>	<p>1-20</p> <p>21-25 26-30 31-35 36-40</p>	<p>"AIR TEMP COEFF + ADJ"</p> <p>A_{MAX} B_{MAX} A_{MIN} B_{MIN}</p> <p>Post-peak precip adjustment</p>	<p>2A10</p> <p>F5.3 " " "</p>

Card		Columns	Contents	Format
8	Identified by the word: FORMAT	1-6	"FORMAT"	A6
	Specify the format for reading a data card. All six input items (month, day, year, max temp, min temp, and precip.) <u>must</u> be read by F formats. Read the date variables by F2.0	7-70	Variable Format (include parenthesis)	6A10,A4
	Specify the file number (or data deck number) if more than one set of data is included.	72-73	File number on "UNEDIT"	I2
	Specify the relative order on the card for the month.	75	Relative order for month	I1
	" " " " " " " " " " day.	76	" " " " day	"
	" " " " " " " " " " year.	77	" " " " year	"
	" " " " " " " " " " max temp.	78	" " " " max temp	"
	" " " " " " " " " " min temp.	79	" " " " min temp	"
	" " " " " " " " " " precip.	80	" " " " precip	"
	Example: If the items were ordered year, month, day, precip, temp max, and temp min, the relative order would be 231564.			
9	Identified by the words: SPECIFIED CONDITIONS. Include one card for each water year to be simulated.	1-20	"SPECIFIED CONDITIONS"	2A10
	Specify the observed peak water equivalent.	21-25	Observed peak water equivalent	F5.2
	Specify the date of the observed peak W.E.	32-37	Date of peak W.E. (MMDDYY)	3I2
	Specify the date by which the pack <u>must</u> be isothermal.	39-44	Isothermal date (MMDDYY)	3I2
10	Identified by the words: END OF NATURAL COND.	1-20	"END OF NATURAL COND."	2A10

MANAGEMENT STRATEGY

Note: The results from simulating natural conditions prescribed by the above cards are used repeatedly in simulating each of the management plans which make up the management strategy. Thus, the above cards are included only once, and each step (management plan) in the management strategy is described on a card as explained below. The cards which comprise the strategy are collectively termed the management strategy deck.

11a	Timber harvesting, Identified by the words: MANAGEMENT PLAN	1-20	"MANAGEMENT PLAN"	2A10
	A 1-5 digit non-zero response unit (managed area) number must be supplied. If more than one area is to be managed, unique numbers (not necessarily sequential) must be assigned to each of them.	21-25	Response unit number	I5
	Specify the year of initial timber harvest	28-30	Year of cut	I3
	Specify the percent of the total planning unit area represented by this response unit. (.15 = 15%)	31-35	Area weight	F5.0
	Specify the percent of the area of the response unit which is subjected to timber harvesting. 1.00 implies a complete removal of forest cover and the canopy will be reestablished with time; .99-.51 implies a partial removal of forest cover with the canopy being reestablished with time; and .50-.01 implies a reduction in the forest cover which does not permit an increase in canopy density subsequent to the initial cut.	36-40	Percent cut	F5.0
	Note: If <u>all</u> of the boundary conditions below are left blank, the assumed values for each of the hydrologic functions will be used. The boundaries are expressed in terms of the number of years since the initial cut. The lower boundary is the number of years that the cut area retains the characteristics of an opening if patch-cut, and the upper boundary is the required number of years before the cut area reacts as it did under natural conditions.			

Card		Assumed Years			Columns	Contents	Format
		lodge- pole	spruce- fir	aspen			
	Soil Water, Lower	15	30	7	43-45	Lower boundary, soil water function	I3
	Upper	80	100	60	48-50	Upper " , " " "	I3
	Cover Density, Lower	0	0	0	53-55	Lower " , cover density function	I3
	Upper	40	80	20	58-60	Upper " , " " "	I3
	Precip Redist, Lower	40	80	20	63-65	Lower " , precip redist. "	I3
	Upper	120	160	80	68-70	Upper " , " " "	I3
	Max increase due to precip redist.	0.0	0.0	0.0	71-75	Max increase due to precip redist.	F5.0
	(An increase in precipitation of .30 would correspond to 5-8H patches which occupy 40% of the planning unit. In this situation, the snowpack is increased 30% in the openings and decreased 20% in the uncut forest. For other combinations of opening size and area, the redistribution factor should be adjusted accordingly.)						
	If a desired cover density is known, rather than a percent cut (col 36-40), specify the desired cover density and the model will calculate the percent cut.				76-80	Desired cover density (col 36-40 must be blank if this is included)	F5.0
11b	Weather modification, Identified by the words: MANAGEMENT PLAN				1-20	"MANAGEMENT PLAN"	2A10
	There is no response unit number since cloud seeding affects the entire planning unit.				21-25	<u>Must</u> be blank	
	Specify the year cloud seeding begins.				28-30	Year cloud seeding begins	I3
	Specify the year cloud seeding ends.				33-35	Year cloud seeding ends	I3
	Specify the month and day that cloud seeding starts in a given year.				37-40	Date seeding starts (MMDD)	2I2
	Specify the month and day that cloud seeding ends in a given year.				42-45	Date seeding ends (MMDD)	2I2
	Specify the percent increase in precip due to cloud seeding				46-47	Percent increase	F5.0
ROAD CONSTRUCTION							
12	Identified by the words: ROAD CONSTRUCTION Note: The road construction card should contain the same year as a management plan.				1-20	"ROAD CONSTRUCTION"	2A10
	If a road construction card (or more than one) is included, the sediment yield model will execute. There are no options on its output, so if it is not wanted, exclude road construction cards.						
	Specify the year of construction.				28-30	Year of construction	I3
	Specify the	1) number of miles of road system			31-35	Miles of road	F5.0
		2) "effective" width of the road			36-40	Effective width of road	"
		3) index of the normal rate of erosion			41-45	Index, normal rate	"
		4) index of the soil available for erosion			46-50	Index, available soil	"
		5) index of the rate of decline of erosion			51-55	Index, rate of decline (positive number)	"
		6) average slope of the cut expressed as $\tan \theta_c$ (.20 = 20%)			56-60	Slope of cut	"
		7) average slope of the fill expressed as $\tan \theta_f$ (.20 = 20%)			61-65	Slope of fill	"
		8) average watershed sideslope on which the road is constructed			66-70	Slope of planning unit	"
13	Identified by the words: END OF STRATEGY Note: The following are the limitations of the management strategy deck: 1. The cards must all be in order by the year specified in col 28-30. There may be more than one card for any given year, and within that year, no particular order is mandatory. For example, in year 75, the management strategy may require road construction (1 card) and two response units (2 cards). All 3 cards would have year 75.				1-15	"END OF STRATEGY"	A210

2. A maximum of 7 separate response units may be designated. However, an existing response unit may be reentered any number of times, within a limit of 11 individual managerial strategies.
3. A maximum of 11 separate roads may be constructed.

DATA DECK

The climatological data may be read from cards, if the card is preceded by a card containing the words: "DATA DECK" in columns 1-9, and terminated by a card containing the words: "END OF DATA DECK" in columns 1-16. This deck may appear anywhere in the parameter deck following the region cards (cards 1 & 2).

RECOVERY DECK

In the event that a recovery deck is to be run, the recovery deck for any given planning unit may be identified from the punched output by one of the following methods:

1. Columns 5 and 6 contain the optional 2-digit ID discussed on the planning unit ID, or if not specified,
2. Column 37 will contain a 1, 2, 3, 4, or 5. There will be one card for each year in group 1, group 2, etc. Therefore, the end of the recovery deck in question will be the last card in the 5 group.

The deck must be preceded by a card containing the words: "RECOVERY DECK" in columns 1-13 and terminated by a card containing the words: "END OF RECOVERY DECK" in columns 1-20. (If the area weight is to be changed, punch the new weight in cols. 66-68 of the RECOVERY DECK card; otherwise, leave those columns blank.) The recovery deck replaces all cards pertaining to the planning unit in the parameter card deck (Planning unit deck.)

APPENDIX II: COMPLETE LISTING FOR SUBALPINE LAND USE MODEL

Program LUMOD

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OVERLAY (MAYS,C,S)
PROGRAM LUMOD (INPUT=512,OUTPUT=512,DATFIL=65,PLNFIL=65,
1 PLNLST=512,PRODFD=65, PUNCH=512,SAVNEW=513,SAVOLD=513,SCRFIL=65,
2 TIMFIL=512,UNEDIT=512,TAPE5=INPUT,TAPE6=OUTPUT,TAPE10=UNEDIT,
3 TAPE11=DATFIL,TAPE12=PLNFIL,TAPE13= PUNCH,TAPE14=SAVOLD,
4 TAPE15=SAVNEW,TAPE16=SCRFIL,TAPE17=TIMFIL,TAPE18=PLNLST,
5 TAPE19=PRODFD)
C-----THIS IS THE CONTROLLING ROUTINE OF THE LAND USE PLANNING MODEL FOR
C----- THE SUBALPINE ZONE (WATER, TIMBER, SOIL)
C-----
C-----THE FILE BUFFER SIZES ARE LIMITED ABOVE TO SAVE MEMORY. THOSE
C----- WHICH HANDLE FORMATTED READS AND WRITES ARE ALLOWED ABOUT HALF OF
C----- THEIR NORMAL BUFFER, BUT THOSE WHICH ARE ACCESSED ONLY BY BUFFER
C----- IN AND BUFFER OUT ARE LIMITED TO THE MINIMUM BUFFER SIZE
C-----
C-----THE REGION FILE (-RNGFIL-) WAS CHANGED TO THE PUNCH FILE I(-PUNCH-)
C----- TO PROVIDE RECOVERY DECKS IN CASE OF ABNORMAL TERMINATION. BY
C----- OPTION, THE USER MAY CAUSE THE DECK TO BE PUNCHED EVEN UNDER
C----- NORMAL TERMINATION, BUT IF THE OPTION IS NOT SPECIFIED, THE FILE
C----- IS REMOVED AND AN END OF FILE IS WRITTEN WHEN TERMINATING
C----- NORMALLY
C-----
C-----SEDIMENT YIELD, AN INDEPENDENT SIMULATION MODEL, HAS BEEN INCLUDED
C----- WITHIN THE GENERAL FLOW OF THE LAND USE MODEL. HOWEVER, THE ONLY
C----- FUNCTION THAT IS PERFORMED BY THE LAND USE MODEL FOR SEDIMENT
C----- MODELING IS THAT OF PROOFREADING AND INPUT OF PARAMETERS. ALL
C----- ROUTINES OF THE LAND USE MODEL WHICH WERE MODIFIED CONTAIN THE
C----- COMMON BLOCK /S/ (EXCEPT THIS MAIN PROGRAM WHICH CONTAINS THE
C----- DICTIONARY DEFINITIONS OF THE VARIABLES LISTED IN COMMON BLOCK
C----- /S/). THE SEDIMENT MODEL ITSELF IS A SECONDARY OVERLAY WHICH IS
C----- LOADED AND EXECUTED BETWEEN THE EXECUTION OF THE MANAGEMENT
C----- SIMULATION AND THE PRINTING OF THE COMPOSITE PLANNING UNIT OUTPUT
C-----
C-----DICTIONARY
C AIRTMC - THE MEAN AIRTEMPERATURE IN DEGREES CENTIGRADE
C ALLOW = 0, DO NOT ALLOW ANY INTERCEPTION
C         = 1, INTERCEPTION ALLOWED
C ALTYR - YEAR OF MANAGEMENT PLAN ON GIVEN RESPONSE UNIT
C AVSOIL - SEDIMENT MODEL, AN INDEX OF THE AMOUNT OF SOIL AVAILABLE
C         FOR EROSION
C B1MNTN - ARRAY FOR ACCUMULATING 8MONTHLY TOTALS FOR GENERATED
C         RUNOFF DURING THE SNOWMELT SEASON
C BLOCK = DATA ARRAY FOR TRANSFER OF ONE ENTIRE YEAR TO AND/OR FROM
C         TAPE FILES
C         (1) - YEAR AND IO, YY,IO
C         (2) - 13731 - MAXIMUM TEMPERATURE
C         (374) - 17451 - MINIMUM TEMPERATURE
C         (746) - 11171 - ACCUMULATED PRECIPITATION
C         (1118) - 114891 - INCIDENT SHORTWAVE RADIATION
C         (1490) - 18611 - ENERGY ADJUSTED EVAPOTRANSPIRATION
C         (1862) - TRANSMISSIVITY COEFFICIENT
C         (1863) - COVER DENSITY
C         (1864) - MAXIMUM COVER DENSITY
C         (1865) - VEGETATION TYPE
C         (1866) - REFLECTIVITY THRESHOLD
C         (1867) - MELT THRESHOLD
C         (1868) - WILTING POINT
C         (1869) - DECIDUOUS WINTER TRANSMISSIVITY COEFFICIENT
C         (1870) - DECIDUOUS WINTER COVER DENSITY
C         (1871) - DECIDUOUS WINTER MAXIMUM COVER DENSITY
C         (1872) - SPECIFIED ISOTHERMAL DATE (PSEUDO-JULIAN)
C         (1873) - SPECIFIED PEAK WATER EQUIVALENT DATE (PSEUDO-
C         JULIAN)
C         (1874) - INITIAL WATER EQUIVALENT
C         (1875) - INITIAL RECHARGE REQUIREMENT
C         (1876) - YEARLY TOTAL GENERATED RUNOFF
C         (1877) - YEARLY TOTAL EVAPOTRANSPIRATION
C         (1878) - CHANGE IN RECHARGE REQUIREMENT OVER THE
C         WATER YEAR
C         (1879) - CHANGE IN THE SNOWPACK WATER EQUIVALENT OVER
C         THE WATER YEAR
C         (1880) - APRIL 16-30 GENERATED RUNOFF
C         (1881) - MAY 1-15 GENERATED RUNOFF
C         (1882) - MAY 16-31 GENERATED RUNOFF
C         (1883) - JUNE 1-15 GENERATED RUNOFF
C         (1884) - JUNE 16-30 GENERATED RUNOFF
C         (1885) - JULY 1-15 GENERATED RUNOFF
C         (1886) - ACTUAL PEAK WATER EQUIVALENT
C         (1887) - ACTUAL PEAK WATER EQUIVALENT DATE (PSEUDO-
C         JULIAN)
C         (1888) - PEAK 7-DAY GENERATED RUNOFF
C         (1889) - DATE OF FIRST DAY OF PEAK 7-DAY GENERATED
C         RUNOFF
C ROUND - THE BOUNDARIES ON THE TIME FUNCTIONS
C         (1) - NUMBER OF YEARS BEFORE REGROWTH BEGINS TO
C         INCREASE SOIL WATER USE
C         (2) NUMBER OF YEARS WHEN REGROWTH IS COMPLETE AS FAR
C         AS SOIL WATER USE IS CONCERNED
C         (3) - NUMBER OF YEARS BEFORE REGROWTH BEGINS TO ALTER
C         THE COVER DENSITY AND CANOPY REFLECTIVITY
C         (4) - NUMBER OF YEARS WHEN REGROWTH IS COMPLETE AS
C         FAR AS CANOPY REFLECTIVITY IS CONCERNED
C         (4) - NUMBER OF YEARS BEFORE REGROWTH BEGINS TO ALTER
C         THE PRECIP REDISTRIBUTION FACTORS
C         (6) - NUMBER OF YEARS WHEN REGROWTH IS COMPLETE AS
C         FAR AS PRECIP REDISTRIBUTION IS CONCERNED
C CALDEF - THE CALORIE DEFICIT IS THE NUMBER OF CALORIES NEEDED
C         TO BRING THE SNOWPACK TEMPERATURE TO ZERO DEGREES
C         CENTIGRADE (NOTE SHOULD BE MADE THAT IS IS A POSITIVE
C         QUANTITY)
C CANREF - THE FACTOR FOR ADJUSTING THE EVAPOTRANSPIRATION FOR
C         CANOPY DENSITY (RECOMPUTED EACH YEAR UNDER THE
C         MANAGEMENT STRATEGY TO INCORPORATE THE EFFECTS OF
C         REGROWTH)
C COMAX - MAXIMUM COVER DENSITY ON THE PLANNING UNIT
C
C COMAX2 - HALF OF -COMAX-, USED AS THE CRITICAL POINT IN SELECTION
C         CUTTING TO DETERMINE WHETHER OR NOT THE WATER BALANCE
C         ROUTINES ARE TO BE ALTERED BY THE TIME TRENDS
C CHAYGR - CHANGE IN THE RECHARGE REQUIREMENT OVER THE WATER YEAR
C CHANGW - CHANGE IN THE SNOWPACK WATER EQUIVALENT OVER THE WATER
C         YEAR
C CONAV - THE TIME DEPENDENT CONSTANT FOR ADJUSTING EVAPOTRANSPIRA-
C         TION FOR AVAILABLE SOIL WATER (RECOMPUTED EACH YEAR
C         UNDER THE MANAGEMENT SIMULATION TO INCORPORATE THE
C         EFFECTS OF REGROWTH)
C COVDEN - THE COVER DENSITY IS THE FRACTION OF THE GROUND OR SNOW
C         SURFACE SHADED FROM DIRECT SUNLIGHT OR RADIATION
C CUT - THE PERCENT OF THE COVER DENSITY REMOVED (0.0 THROUGH 1.0).
C         SEE -SPECCO-
C DATE - MONTH, DAY
C DATES - SAME AS -DATE- BUT FOR TWO DATES
C DATIME - DATE AND TIME OF RUN IN ALPHANUMERIC FORMAT AS FOLLOWS
C         MM.DD.YY HH.MM.SS.
C DCDMAX - THE WINTER VALUE FOR -COMAX- ON DECIDUOUS FORESTS
C DECIDS - AN ARRAY USED IN WORKING WITH DECIDUOUS FORESTS FOR
C         RETAINING THE COVER DENSITY, MAXIMUM COVER DENSITY
C         AND TRANSMISSIVITY COEFFICIENT FOR ONE SEASON WHILE
C         THE OTHER IS BEING PROCESSED. (IN OTHER WORDS, WHILE
C         OPERATING DURING THE SUMMER, THE WINTER VALUES ARE
C         STORED. LIKEWISE, IN THE WINTER, THE SUMMER VALUES
C         ARE STORED. LOCATION 1 IS FOR THE TRANSMISSIVITY
C         COEFFICIENT, 2 IS FOR THE COVER DENSITY AND 3 IS FOR
C         THE MAXIMUM COVER DENSITY)
C DECLIN - SEDIMENT MODEL, AN INDEX OF DECLINE OF EROSION FOLLOWING
C         DISTURBANCE
C DECMAL - OPTIONAL TWO DIGIT INTEGER WHICH IDENTIFIES THE FILES ON
C         WHICH IS THEN APPENDED AS A DECIMAL TO THE YEAR IN
C         EACH BLOCK OF THE FILE. THE NUMERIC VALUE THUS
C         BECOMES YY.IO
C DREADY = 0, DIFFUSION MODEL (SUBROUTINE DIFMOD) NOT INITIALIZED
C         = 1, DIFFUSION MODEL INITIALIZED AND READY FOR SNOWPACK
C         TEMPERATURE SIMULATION
C         = -1, DIFFUSION MODEL MAY NOT BE USED
C ETDALY - ARRAY OF DAILY AVERAGE EVAPOTRANSPIRATION FOR EACH MONTH
C ETRFDM = 1, EVAPORATION IS FROM THE CANOPY
C         = 2, EVAPORATION IS FROM THE SURFACE OF THE SNOWPACK
C         = 3, BOTH 1 AND 2
C         = 4, EVAPOTRANSPIRATION IS FROM SNOWMELT, RAIN OR THE
C         SOIL MANTLE STORAGE
C ETO - ARRAY OF POTENTIAL EVAPOTRANSPIRATION VALUES (ALREADY
C         ADJUSTED FOR SLOPE, ASPECT, ETC) FOR AN ENTIRE YEAR
C EVAPTR - WHEN FIRST RECEIVED, THIS VARIABLE IS THE POTENTIAL
C         EVAPOTRANSPIRATION AS COMPUTED BY THE HAMON METHOD
C         AND ADJUSTED FOR AVAILABLE RADIATION. AFTER ACTION
C         IS TAKEN BY THE WATER BALANCE ROUTINES, THE ORIGINAL
C         VALUE HAS BEEN ADJUSTED FURTHER BY THE METHODS
C         DISCUSSED IN SUBROUTINES CANVAP, EVTRAN, AND SNOWVAP.
C         IT THEN REPRESENTS THE EVAPOTRANSPIRATION DURING THIS
C         INTERVAL
C EXPK - THE -K- FROM THE TIME FUNCTION FOR COMPUTING THE AVAILABLE
C         SOIL WATER ADJUSTMENT FACTOR
C EXPK1 - THE -K1- FROM THE TIME FUNCTION FOR COMPUTING THE PRECIP
C         REDISTRIBUTION FACTOR
C FORNXT - A UTILITY ARRAY WHOSE ONLY PURPOSE IS FOR READING AND
C         WRITING CURRENT MODEL CONDITIONS ON THE SCRATCH
C         FILE. IT IS EQUIVALENT WITH THE ENTIRE COMMON
C         BLOCK /M/. SEE -L4NXT-
C FRACTN - THE FRACTIONAL PART NEEDED IN THE INTERPOLATION BETWEEN
C         TABLE VALUES IN THE COMPUTATION OF THE RADIATION
C GENRO - DAILY GENERATED RUNOFF
C INFIL = 10, DATA IS ON FILE -UNEDIT-. SEE -NFILE-
C         = 14, DATA IS ON FILE -SAVOLD- IN STANDARD MODEL FORMAT
C ISOTRM - THE MANOATORY ISOTHERMAL DATE (NOTE, MUST BE IN THE
C         CALENDAR YEAR WHICH CORRESPONDS TO THE WATER YEAR.
C         THAT IS, IT MUST BE BETWEEN JAN 1 AND SEP 30)
C LASTI - RETAINS THE OLD VALUE OF -NEXTYR- WHEN A NEW ONE IS READ
C LCOPY - ARRAY FOR COPYING LINES FROM ONE FILE TO ANOTHER
C LINES - LINE COUNTER
C NAME - AN ALPHANUMERIC IDENTIFIER USED PRIMARILY TO VERIFY THE
C         PARAMETER CARD ORDER, ALSO USED IN ARRAY FORM AS
C         IDENTIFIERS FOR THE PRINTOUTS DURING THE PLANNING
C         UNIT AND REGION PHASES
C NDAY - THE PSEUDO JULIAN WATER YEAR DATE (1 = OCT 1)
C NEXTYR - THE YEAR ON THE NEXT MANAGEMENT PLAN
C NFILE - THE NUMBER OF THE FILE ON -UNEDIT- WHICH CONTAINS THE DATA
C         FOR THIS PLANNING UNIT
C NPLAN - THE NUMBER OF THIS PLAN IN THE SEQUENCE MAKING UP THE
C         MANAGEMENT STRATEGY
C NRMANG - A SWITCH INDICATING THE MODE OF OPERATION (0 OR 1 IS FOR
C         THE NORMAL SIMULATION, 2 FOR MANAGEMENT)
C NROADS - SEDIMENT MODEL, THE NUMBER OF TIMES ROADS WERE
C         CONSTRUCTED DURING A MANAGEMENT STRATEGY PERIOD
C NSAVED - NUMBER OF FILES WRITTEN ON -SAVNEW- DURING THE RUN
C NUM - THE RESPONSE UNIT CODE ON THE NEXT MANAGEMENT PLAN
C NUNIT - THE NUMBER OF RESPONSE UNITS AT ANY GIVEN POINT IN TIME
C NYEARS - NUMBER OF YEARS FOR MANAGEMENT STRATEGY (IF THE ORIGINAL
C         DATA BASE DOES NOT HAVE THIS NUMBER OF YEARS, IT WILL
C         BE EXPANDED OR CONTRACTED AS NEEDED)
C PARAM - AN ARRAY OF PARAMETERS READ FROM THE MANAGEMENT PLAN CARD
C         (1) - RESPONSE UNIT WEIGHT
C         (2) - PERCENT CUT
C         (3) (8) - CORRESPONDS TO -ROUND11 - (6) -
C         (9) - MAXIMUM INCREASE IN PPT DUE TO REDISTRIBUTION
C PEAKED = 0, THE PEAK WATER EQUIVALENT HAS NOT BEEN REACHED
C         = 1, THE PEAK WATER EQUIVALENT HAS BEEN REACHED
C PEAKRO - THE YEARLY T OAY PEAK RUNOFF
C PEAKWE - THE YEARLY PEAK WATER EQUIVALENT
C PEKDAT - THE SPECIFIED PEAK WATER EQUIVALENT DATE
C PEKPT - THE OBSERVED ACCUMULATED PRECIPITATION ON THE SPECIFIED
C         PEAK WATER EQUIVALENT DATE
C PHISO - PHI SQUARED, USED IN THE TIME FUNCTIONS FOR COVER DENSITY

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C AND CANOPY REFLECTIVITY
C PLNOPT = ARRAY OF OUTPUT OPTIONS FOR PLANNING UNIT PHASE 10 = NO
C OUTPUT, 1 = PRINT OUTPUT)
C (1) - DETAILED YEARLY OUTPUT FOR NORMAL SIMULATION
C (2) - LIST OF YEARS IN ORIGINAL DATA BASE AND THOSE
C GENERATED DURING EXTENSION OF THAT DATA BASE
C (3) - DETAILED YEARLY OUTPUT FOR MANAGEMENT
C SIMULATION
C (4) - LIST OF CHANGES MADE BY THE TIME TRENDS
C FUNCTIONS
C SUMMARIES FOR PLANNING UNIT 10=NO OUTPUT, 1=ACTUAL
C TOTALS, 2=DIFFERENCES AND PLOT OF DIFFERENCES,
C 3=BOTH 1 AND 2)
C (5) - GENERATED RUNOFF
C (6) - PRECIPITATION
C (7) - EVAPOTRANSPIRATION
C (8) - CHANGE IN RECHARGE REQUIREMENT
C (9) - CHANGE IN SNOWPACK WATER EQUIVALENT
C (10)-(15) - 31MONTHLY GENERATED RUNOFF DIFFERENCES
C AND PLOTS (0=NONE WANTED, 2 IN (10) IMPLIES ALL)
C (16)-(17) - SNOWPACK PEAK WATER EQUIVALENT AND OATE,
C DIFFERENCES AND PLOTS (0=NEITHER WANTED, 2 IN (16)
C IMPLIES BOTH)
C (18)-(19) - PEAK 7-DAY GENERATED RUNOFF AND STARTING
C DATE, DIFFERENCES AND PLOTS (0=NEITHER WANTED, 2
C IN (18) IMPLIES BOTH)
C PLUNIT = 00 CHARACTER NAME AND/OR DESCRIPTION OF THE PLANNING UNIT
C POTENT = ARRAY OF POTENTIAL INCIDENT SHORTWAVE RADIATION VALUES AT
C APPROXIMATELY TWO WEEK INTERVALS THROUGH THE YEAR
C POTRAD = THE INTERPOLATED VALUE SELECTED FROM -POTENT-
C PPT = ARRAY OF ACCUMULATED PRECIPITATION FOR THE ENTIRE YEAR
C PPTNOW = THE OBSERVED ACCUMULATED PRECIP UP TO THE DAY BEING
C PROCESSED
C PRECIP = DAILY PRECIPITATION AMOUNT
C PREVFC = PREDICTED SNOWPACK WATER EQUIVALENT
C RAD = ARRAY OF THE RADIATION (ALREADY ADJUSTED FOR SLOPE, ASPECT,
C ETC.) FOR THE ENTIRE YEAR
C RADIN = RADIATION IN IS THE TOTAL INCIDENT SHORT WAVE RADIATION
C RADLWN = NET LONG WAVE RADIATION IS THE ALGEBRAIC SUM OF THE LONG
C WAVE RADIATION FROM THE FOREST AND THE LONG WAVE
C RADIATION LOST BY THE SNOWPACK TO THE CANOPY
C RADSUB = SUBSCRIPT USED IN THE CALCULATION OF -POTRAD-
C RADSWN = THE CALORIC INPUT TO THE PACK BY THE NET SHORT WAVE
C RADIATION
C RATRNM = SEDIMENT MODEL, AN ESTIMATE OF THE LONG-TERM NORMAL
C EROSION RATE
C RCHRG = THE RECHARGE REQUIREMENT AT THE BEGINNING OF THE WATER
C YEAR
C ROIST = THE FACTOR FOR REDISTRIBUTING THE PRECIP
C ROMAX = THE MAXIMUM INCREASE IN PRECIP DUE TO REDISTRIBUTION
C RECHRG = RECHARGE REQUIREMENT OR SOIL MANTLE STORAGE DEFICIT
C RECDVR = 0, DO NOT PUNCH RECOVERY CHECKS UNDER NORMAL TERMINATION
C 1, PUNCH RECOVERY CHECKS EVEN UNDER NORMAL TERMINATION
C REGION = 00 CHARACTER NAME AND/OR DESCRIPTION OF REGION
C REGOPT = ARRAY OF OUTPUT OPTIONS FOR REGIONAL PHASE 10 = NO
C OUTPUT, 1 = PRINT OUTPUT)
C SUMMARIES FOR REGIONAL PHASE
C (1) - GENERATED RUNOFF
C (2) - PRECIPITATION
C (3) - EVAPOTRANSPIRATION
C (4) - CHANGE IN RECHARGE REQUIREMENT
C (5) - CHANGE IN SNOWPACK WATER EQUIVALENT
C REGROW(1,-) - SEE -CONAV-
C (2,-) - SEE -CANREF-
C RD = ARRAY OF DAILY GENERATED RUNOFF FOR AN ENTIRE YEAR
C ROADMI = SEDIMENT MODEL, THE NUMBER OF MILES OF ROAD CONSTRUCTED
C ROADW = SEDIMENT MODEL, THE EFFECTIVE WIDTH OF THE ROAD
C RUNUM = THE RESPONSE UNIT CODES
C RUNT = THE PERCENT OF THE PLANNING UNIT REPRESENTED BY EACH
C RESPONSE UNIT
C SAVE = 0, DO NOT SAVE THE EXTENDED DATA BASE
C = 1, SAVE THE EXTENDED DATA BASE ON -SAVEW-. (NOTE,
C -SAVEW- IS NOT POSITIONED FOR THE SAVING OF THE FILE
C WITHIN THE RUN - THE USER MUST REWIND OR POSITION IT
C BEFORE EXECUTION. THE LIST AT THE END OF THE RUN
C WILL INCLUDE ALL FILES CURRENTLY ON -SAVEW-)
C = 2, SAME AS 1 EXCEPT ALL OF THE FILES FROM -SAVOLO- ARE
C COPIED TO -SAVEW- AFTER THE PROOFREADING PHASE AND
C BEFORE THE EXECUTION PHASE
C SEDINC = THE PERCENT INCREASE IN PRECIP DUE TO CLOUD SEEDING
C SFDRN2 = SEED FOR RANDOM NUMBER GENERATOR, USED IN EXTENDING THE
C ORIGINAL DATA BASE TO A SPECIFIED NUMBER OF YEARS
C SEEDAT = THE DATES OF CLOUD SEEDING (MMDD THROUGH MMDD)
C SEEDYR = THE YEARS OF CLOUD SEED
C SEEDYR = THE YEARS OF CLOUD SEEDING (Y1 THROUGH Y2)
C SIMTMI = AN ARRAY USED PRIMARILY IN SUBROUTINE OIFMOO IN THE
C SIMULATION OF THE AVERAGE SNOWPACK TEMPERATURE
C SLPASP = THE SLOPE/ASPECT ADJUSTMENT FACTORS FOR TRANSLATING THE
C VALUES IN -POTENT- TO THE INDIVIDUAL STATION
C SPECCO = IF THE MANAGEMENT PLAN SPECIFIES A COVER DENSITY RATHER
C THAN A PERCENT CUT (SEE -CUT-), THE MODEL WILL
C CALCULATE THE PERCENT OF THE COVER DENSITY THAT MUST
C BE REMOVED TO ACHIEVE THE SPECIFIED COVER DENSITY
C SUMMER = THE POST-PEAK PRECIPITATION ADJUSTMENT FACTOR (EXPRESSED
C AS A DECIMAL PERCENT OF THE SUMMER BASE STATION
C PRECIP. EXAMPLE 1.05)
C TANCUT = SEDIMENT MODEL, THE SLOPE OF THE CUT IN ROAD CONSTRUCTION
C AS A PERCENT
C TANFIL = SEDIMENT MODEL, THE SLOPE OF THE FILL IN ROAD
C CONSTRUCTION AS A PERCENT
C TANRHO = SEDIMENT MODEL, THE AVERAGE SLOPE AS A PERCENT ON WHICH A
C ROAD IS CONSTRUCTED
C TCoeff = THE TRANSMISSIVITY COEFFICIENT USED TO ESTIMATE THE NET
C SHORT WAVE RADIATION REACHING THE SNOWPACK
C TMAX = ARRAY OF DAILY MAXIMUM TEMPERATURES FOR AN ENTIRE YEAR
C TMIN = ARRAY OF DAILY MINIMUM TEMPERATURES FOR AN ENTIRE YEAR
C TMPDAY = THE MAXIMUM TEMPERATURE DURING THE INTERVAL IN DEGREES
C FAHRENHEIT
C TMININ = THE MINIMUM TEMPERATURE DURING THE INTERVAL IN DEGREES
C FAHRENHEIT
C TMPXLT = THE TEMPERATURE BELOW WHICH THE FALL RADIATION ROUTINE
C MAY NOT BE RATE HELT OR FREE WATER
C TYPCUT = 0, THIS TYPE OF CUT DOES NOT HAVE REDISTRIBUTION
C ASSOCIATED WITH IT
C = 1, THIS TYPE OF CUT HAS REDISTRIBUTION ASSOCIATED WITH IT
C VERFMT = VARIABLE FORMAT FOR READING FROM FILE -UNEOIT-

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C VARIN = INPUT ARRAY TO BE READ BY -VARFMT- (ALLOWS THE VARIABLES
C TO BE IN ANY ORDER AT INPUT TIME)
C VEGTYP = 1, FOREST COVER PREDOMINATELY LODGEPOLE PINE
C = 2, FOREST COVER PREDOMINATELY SPRUCE-FIR
C = 3, FOREST COVER PREDOMINATELY ASPEN (DECIDUOUS)
C = 4, INITIAL USE ONLY TO SPECIFY DEFOLIATED DECIDUOUS
C FORESTS (DURING THE WINTER)
C WATRII = THE SUM OF ANY SNOWMELT AND ANY RAIN WHICH PROVIDES
C DIRECT INPUT TO THE WATER BALANCE
C W = ARRAY OF DAILY PACK WATER EQUIVALENTS FOR AN ENTIRE YEAR
C WEIGHT = THE PERCENT OF THE REGION AREA REPRESENTED BY THIS
C PLANNING UNIT 1A DECIMAL PERCENT BETWEEN C.O AND 1.0)
C WEG = THE SNOWPACK WATER EQUIVALENT AT THE BEGINNING OF A WATER
C YEAR
C WILTPY = THE WILTING POINT
C YEAR = CURRENT YEAR BEING PROCESSED
C YRCYST = SEDIMENT MODEL, YEAR OF ROAD CONSTRUCTION
C YRTOI = ARRAY OF THE YEARLY ACCUMULATED VALUES OF THE CONTINUITY
C EQUATION
C-----
C COMMON DATIME(2),DECMAL,NRMANG,NSAVEO,NYEARS,PLNOPT(19),PLUNIT(6),
C RECDVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
C INTEGER DATIME,PLNOPT,PLUNIT,RECDVR,REGION,REGOPT,SAVE,SEORN2
C-----PROOFREAD THE CARD DECK
C CALL OVERLAY (5HOLAYS,7,0)
C-----IF SPECIFIED, COPY -SAVOLO- TO -SAVEW-
C IF(SAVE,ED,2) CALL OVERLAY (5HOLAYS,3,0)
C-----READ A PLANNING UNIT CARD
C 20 READ (19) PLUNIT,DECMAL,INFILE,WEIGHT,PLNOPT
C-----AT THE END OF FILE, PROCESS THE REGIONAL FILE
C IF(EOF(19)) 80,30
C-----IF -INFILE- IS 14, THE NORMAL SIMULATION AND EXPANDED DATA FILE
C WERE SAVED FROM A PREVIOUS RUN. FIND THE FILE ON -SAVOLO- AND
C-----IF IT HAS THE SPECIFIED NUMBER OF YEARS, COPY IT TO -OATFIL- AND
C-----JUMP DIRECTLY TO THE MANAGEMENT PLANS SIMULATION. OTHERWISE,
C-----COPY IT TO -SCRFIL- AND JUMP TO CREATE THE SPECIFIED NUMBER OF
C-----YEARS
C 30 IF(INFILE - 14) 50,40
C 40 CALL OVERLAY (5HOLAYS,1,0)
C IF(NRMANG) 70,60
C-----PROCESS THE NORMAL SIMULATION AND GENERATE THE ORIGINAL DATA FILE
C 50 NRMANG = 1
C 60 CALL OVERLAY (5HOLAYS,2,0)
C-----PERFORM THE MANAGEMENT PLANS SIMULATION
C 70 NRMANG = 2
C CALL OVERLAY (5HOLAYS,2,0)
C-----SUMMARIZE THE RESULTS FOR THIS PLANNING UNIT AND GO ON TO THE NEXT
C CALL OVERLAY (5HOLAYS,4,0)
C GO TO 20
C-----REGIONAL SUMMARY
C 80 CALL OVERLAY (5HOLAYS,5,0)
C IF(RECDVR) 100,90
C 90 REMIND 13
C END FILE 13
C-----IF ANY FILES WERE SAVED, LIST THEM
C 100 IF(SAVE,NE,0) CALL OVERLAY (5HOLAYS,6,0)
C-----TERMINATE THE RUN
C END

```

Subroutine GDATE

```

C SUBROUTINE GDATE (NDAY,OATE)
C-----CONVERT THE PSEUDO-JULIAN DATE TO MONTH AND DAY
C INTEGER DATE(2),MONTHS(12)
C OATA MONTHS(10,11,12,1,2,3,4,5,6,7,8,9)
C OATE(2) = MOD(OATA,31)
C IF(OATE(2)) 10,20
C 10 DATE(1) = MONTHS((INDAY/31)+1)
C RETURN
C 20 OATE(2) = 31
C OATE(1) = MONTHS(INDAY/31)
C RETURN
C END

```

Subroutine GETREC

```

C SUBROUTINE GETREC (IFILE,ARRAY,N,IEND)
C-----READ A RECORD
C DIMENSION ARRAY(1)
C BUFFER IN (IFILE,1) (ARRAY(1),ARRAY(N))
C IF(UNIT(IFILE)) 10,20,30
C-----OK TO PROCEED
C 10 IEND = 0
C RETURN
C-----END OF FILE
C 20 IEND = 1
C RETURN
C-----PARITY ERROR
C 30 WRITE (6,91C) IFILE
C 910 FORMAT('PARITY ERROR ON FILE*13,* WHILE READING - JOB ABORTED*')
C CALL ABORT
C END

```

Subroutine PUTREC

```

C SUBROUTINE PUTREC (IFILE,ARRAY,N)
C-----WRITE A RECORD
C DIMENSION ARRAY(1)
C BUFFER OUT (IFILE,1) (ARRAY(1),ARRAY(N))
C IF(UNIT(IFILE)) 10,10,20
C 10 RETURN
C 20 WRITE (6,91C) IFILE
C 910 FORMAT('PARITY ERROR ON FILE*13,* WHILE WRITING - JOB ABORTED*')
C CALL ABORT
C END

```


Program GETOLD

```

OVERLAY (OLAYS,1,0)
PROGRAM GETOLD
C-----GET THE DATA FILE FROM -SAVOLD-
COMMON/ DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECDVR,RTSDON(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
1, TOSTER, DATIME, PLNOPT, PLUNIT, RECDVR, REGION, REGOPT, SAVE, SEDRN2
DIMENSION BLOCK(1889), ID(2)
CALL CORE (-1)
JEND = 1
C-----PREPARE THE DATA FILE AND GET AN IO RECORD
10 CALL GETREC (14,10,9,IEND)
C-----IF THE END OF FILE WAS READ, CHECK TO SEE IF A COMPLETE PASS HAS
C-----BEEN MADE OR IF THE FILE SHOULD BE REWOUND AND SEARCHED AGAIN
IF(IEND) 20,93
20 REWIND 14
IF(JEND) 30,80
30 WRITE (6,910) PLUNIT
910 FORMAT('THE PLANNING UNIT CARD ENTITLED *6A10/* INDICATES THE EX
PANDER DATA FILE HAS CREATED AND SAVED ON OLD RUN. HOWEVER, AS
2 THE LIST BELOW INDICATES,*/ NO SUCH FILE EXISTS ON -SAVOLD-*/)
IFILE = 0
40 CALL GETREC (14,10,9,IEND)
IF(IEND) 70,53
50 IFILE = IFILE + 1
WRITE (6,920) IFILE, ID(1), I=1,6
920 FORMAT(' SAVOLD FILE*(3,5X6A10)
C-----BYPASS THE DATA
60 CALL GETREC (14,BLOCK,1889,IEND)
IF(IEND) 40,60
70 WRITE (6,930)
930 FORMAT('JOB ABORTED*)
CALL ABORT
80 JEND = 1
GO TO 11
C-----IF THIS IS NOT THE DESIRED FILE, BYPASS THE DATA
90 DO 100 I = 1,6
IF(PLUNIT(I).NE.ID(1)) GO TO 110
100 CONTINUE
GO TO 120
110 CALL GETREC (14,BLOCK,1889,IEND)
IF(IEND) 10,110
C-----THIS IS THE FILE. IF IT HAS THE SAME NUMBER OF YEARS AS IS
C-----CURRENTLY BEING PROCESSED, JUST COPY IT TO THE EXPANDED DATA FILE
C-----AND RETURN. BUT IF IT HAS A DIFFERENT NUMBER OF YEARS, COPY IT
C-----TO THE SCRATCH FILE FOR EXPANSION OR CONTRACTION
120 IF(NYEARS - IO(7)) 130,140
130 NRMANG = 0
IFILE = 16
GO TO 150
140 NRMANG = 2
IFILE = 11
150 REWIND IFILE
GO TO 170
160 CALL PUTREC (IFILE,BLOCK,1889)
170 CALL GETREC (14,BLOCK,1889,IEND)
IF(IEND) 180,160
180 END FILE IFILE
CALL CORE (0)
C-----RETURN TO THE PRIMARY OVERLAY
END

```

Program LOADS

```

OVERLAY (OLAYS,2,0)
PROGRAM LOADS
C-----THIS OVERLAY CONTAINS THE WATER BALANCE AND UTILITY ROUTINES SO
C-----THEY ARE AVAILABLE FOR EITHER THE NORMAL OR THE MANAGEMENT
C-----SIMULATION AND IT CALLS FOR THE LOADING OF THE APPROPRIATE
C-----PERIPHERAL ROUTINES
COMMON/ DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECDVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
COMMON/ WTRAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RAOIWN,PAOSWN,TMPMAX,TMPMIN,WATRIN
COMMON/ S/AVSOIL(11),DECLIN(11),NROAS,RATNRM(11),RAOINI(11),
1 ROADW(11),TANCUL(11),TAYFIL(11),TANRHO(11),YRCNST(11)
INTEGER YPCNST
COMMON/ TIME/CANREF,COMAX2,CONAV
COMMON/ UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),OATES(4),LINES,
1 NAME,NDAV,RCHRG,RO(372),ME(372),WEQ,YEAR,YRTOT(3)
INTEGER DAT, OATES, YEAR
DIMENSION BIMNTH(6),ETC(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)), (BLOCK(374),TMIN(1)), (BLOCK(1746),
1 PPT(1)), (BLOCK(1118),RAO(1)), (BLOCK(1490),ETC(1)), (BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT, VEGTYP
NROADS = 0
N = IUPMNG
IF(N.EQ.0) N = 1
CALL OVERLAY (5HOLAYS,2,N)
IF(NROADS.NE.0) CALL OVERLAY (5HOLAYS,2,3)
C-----RETURN TO THE MAIN OVERLAY
END

```

Subroutine WATBAL

```

SUBROUTINE WATBAL (F1,F2,F3,I1,F4,F5,I2,I3,F6,I4,F7,F8,F9,F10,F11,
1 F12,F13,F14,I5,F15)
C-----THIS SUBROUTINE IS THE MAIN ROUTINE OF THE WATER BALANCE MODEL. IT
C-----RECEIVES THE DRIVING, STATIC AND CONTINUOUS VARIABLES FROM THE
C-----OPERATING ROUTINES, CONTROLS THE COMPUTATIONS ON THEM, AND
C-----RETURNS THE NEW VALUES FOR THE CONTINUOUS VARIABLES AND THE
C-----RESULTS OF THIS INTERVAL. SEE THE REPLACEMENT STATEMENTS BELOW
C-----FOR THE VARIABLE DEFINITIONS OF THE PARAMETERS

```

```

COMMON/ WTRAL/ AVETMC,BASTMF,CALOF,COMAX,COVON,ORFQY,ENGBL,
1 FNGRLO,FIFLOC,FPWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 *CHRG,SMTM(3),SMTM3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER DPEDY,PHASE,VEGTYP
COMMON/ WTRAL/ ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RAOIWN,PAOSWN,TMPMAX,TMPMIN,WATRIN
DATA AVETMC,BASTMF,ENGBL,SMTM3/D.0,35.0,-1.0,0.0/
C-----OBTAIN THE STATION DESCRIPTORS
COVON = F3
COMAX = F2
FIFLOC = -F15
TCDEF = F12
TMPMLT = F13
TRSHLO = F14
VEGTYP = I5
C-----RECALL THE CONTINUOUS VARIABLES NECESSARY FOR THE OPERATION OF THE
C-----MODEL DURING THIS INTERVAL
CALDF = F1
ORFQY = I1
ENGBL = F4
FPWT = F5
LSUSD = I2
NOSNO = I3 + 1
ONTRE = F6
PHASE = I4
PREWE = F7
RCHRG = F8
IF(ORFQY) 20,20,10
10 SMTM(1) = F9
SMTM(2) = F10
SMTM(3) = F11
C-----AVETMC = ((TMPMAX-32)+(TMPMIN-32))/2)*(5/9)
20 AVETMC = (TMPMAX + TMPMIN - 64.0) * D.277777778
C-----START THE ENERGY BALANCE AND THE INPUT AT ZERO FOR THIS INTERVAL
ENGBL = 0.0
WATRIN = 0.0
C-----IF THERE IS NO PRECIP. THERE IS NO NEED TO PASS THROUGH THE
C-----CLASSIFICATION STATEMENTS
IF(PRECIP) 90,90,30
C-----SEE IF THE PRECIP IS ALL SNOW
30 IF(TMPMIN.LE.32.0.OR.TMPMAX.LT.BASTMF) GO TO 80
C-----SEE IF ANY OF IT IS SNOW
IF(TMPMIN - BASTMF) 40,50,50
40 CALL MIXTUR
GO TO 90
C-----THIS IS A RAIN EVENT. IF THERE IS NO PACK, THE RAIN IS DIRECT
C-----INPUT TO THE WATER BALANCE. BUT IF THERE IS A PACK, DETERMINE
C-----THE EFFECTS OF THE RAIN
50 IF(PREWE) 60,60,70
60 WATRIN = PRECIP
GO TO 130
70 CALL RAINED (AVETMC,PRECIP)
GO TO 90
C-----THIS IS A SNOW EVENT
80 CALL SNOWED (AMINI (AVETMC,0.0),PRECIP)
C-----IF THERE IS SNOW ON THE TREES, EVAPORATE ONLY FROM THE CANOPY
90 IF(ONTRE) 130,130,100
100 CALL CANVAP
C-----ON THE FIRST DAY AFTER FRESH SNOW, ASSUME TURBULENCE HAS REMOVED
C-----ANY REMAINING INTERCEPTED SNOW AND ADD IT TO THE PACK
IF(INDSNO - 1) 120,110,110
110 PREWE = PREWE + ONTRE
ONTRE = 0.0
C-----IF THERE IS NO SNOWPACK, BYPASS THE RADIATION ROUTINES
120 IF(PREWE) 190,190,180
C-----DETERMINE THE FOREST TYPE - CONIFEROUS OR DECIDUOUS
130 IF(VEGTYP.NE.3.AND.VEGTYP.NE.4) GO TO 135
C-----DECIDUOUS
CALL DECID
GO TO 200
C-----CONIFEROUS - DETERMINE WHETHER TO SATISFY THE EVAPOTRANSPIRATION
C-----REQUIREMENTS UNDER GROWING SEASON OR WINTER CONDITIONS
135 IF(PREWE) 160,160,140
140 IF(PREWE - 5.0) 150,150,170
C-----USE THE GROWING SEASON ROUTINES TO INCLUDE TRANSPIRATION
150 CALL PADBAL
C-----DO -WATRIN- TO THE RECHARGE REQUIREMENTS SO THE ET ROUTINE CAN
C-----OPERATE ON THE INPUT AS WELL AS THE STORAGE
160 RCHRG = RCHRG + WATRIN
C-----0.22388 = 0.15/0.67 (SEE THE COMMENT IN SUBROUTINE EVTRAN FOR THE
C-----USE OF THE CONSTANT)
CALL EVTRAN (0.22388)
GO TO 200
C-----USE THE WINTER ROUTINES TO EVAPORATE FROM THE SNOWPACK SURFACE
170 CALL SNOWAP
180 CALL RAOBAL
C-----DO -WATRIN- TO THE RECHARGE/REQUIREMENTS
190 RCHRG = RCHRG + WATRIN
C-----IF THE RECHARGE REQUIREMENTS WERE SATISFIED, THE EXCESS IS
C-----CONSIDERED TO BE GENERATED RUNOFF
200 IF(RCHMG) 220,220,210
210 GENRO = RCHRG
F8 = 0.0
GO TO 230
220 GENRO = 0.0
F8 = RCHRG
230 I1 = DRDQY
F1 = CALOF
F4 = ENGBL
F5 = FPWT
I2 = LSUSD
I3 = NOSNO
F6 = ONTRE
F7 = PREWE
C-----WHEN THE PACK IS GONE, RESET THE PHASE INDICATOR
IF(PREWE) 240,240,250
240 I4 = 0
RETURN
250 I4 = PHASE
(F(ORFQY) 270,270,260
260 F9 = SMTM(1)
F10 = SVT(2)
F11 = SMTM(3)
270 RETURN
END

```

Subroutine CALIN

```

SUBROUTINE CALIN (CALIN)
C-----THIS SUBROUTINE COMPUTES THE EFFECTS OF THE CALORIC INPUT ON THE
C-----SNOWPACK
COMMON/ONLYCR/ AVETMC,BASTMF,CALOF,COMAX,COVON,OREOY,ENGBL,
1 ENGBLO,FIELOC,FREWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTH1(3),SMTH3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VEGTYP
COMMON/STRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----ADD THESE CALORIES INTO THE ENERGY BALANCE
ENGBL = ENGBL + CALIN
C-----SEE IF A CALORIE DEFICIT EXISTS IN THE PACK
COMPAR = CALIN - CALOF
IF (COMPAR) 1,20,30
C-----THERE IS A CALORIE DEFICIT, BUT THE INPUT DID NOT COMPLETELY
C-----WIPE IT OUT. ALL OTHER CONDITIONS ARE UNCHANGED
10 CALOF = - COMPAR
RETURN
C-----THE CALORIE DEFICIT WAS WIPE OUT, BUT ALL OTHER CONDITIONS ARE
C-----UNCHANGED
20 CALCF = C.0
RETURN
C-----ANY DEFICIT WHICH DID EXIST WAS WIPE OUT. COMPUTE THE POTENTIAL
C-----MELT FROM THE REMAINING CALORIES (CALORIES/(80.0 * 2.54))
30 ROTMELT = COMPAR/203.2
CALUF = C.0
C-----IF THE INPUT WAS ENOUGH TO MELT THE WHOLE PACK, CONTRIBUTE THE
C-----WATER EQUIVALENT TO THE SNOWMELT AND ZERO ALL CONDITIONS
IF (ROTMELT.LT.PREWE-FREWT) GO TO 40
WATRIN = WATRIN + PREWE
PREWE = C.0
FREWT = 0.0
RETURN
C-----DEplete THE ICE PACK BY THE AMOUNT MELTED AND CONTRIBUTE THAT
C-----AMOUNT TO THE FREE WATER
40 FREWT = FREWT + ROTMELT
C-----COMPUTE THE NEW HOLDING CAPACITY OF THE PACK AND COMPARE IT WITH
C-----THE FREE WATER TO SEE IF SNOWMELT IS PRODUCED
HOLDCP = 0.04 * (PREWE - FREWT)
COMPAR = FREWT - HOLDCP
IF (COMPAR.LE.0.0) RETURN
C-----THE SNOWMELT CONTRIBUTED IS IN -COMPAR-. REDUCE THE FREE WATER
C-----TO LEAVE A PRIMED PACK AND REDUCE THE PREDICTED WATER EQUIVALENT
PREWE = PREWE - COMPAR
WATRIN = WATRIN + COMPAR
FREWT = HOLDCP
RETURN
END

```

Subroutine CALOSS

```

SUBROUTINE CALOSS (CALOUT)
C-----THIS SUBROUTINE COMPUTES THE EFFECTS OF THE CALORIC LOSS ON THE
C-----SNOWPACK
COMMON/ONLYCR/ AVETMC,BASTMF,CALOF,COMAX,COVON,OREOY,ENGBL,
1 ENGBLO,FIELOC,FREWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTH1(3),SMTH3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VEGTYP
COMMON/STRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----ADD ALGEBRAICALLY THESE CALORIES INTO THE ENERGY BALANCE
ENGBL = ENGBL + CALOUT
C-----SEE IF THERE IS ANY FREE WATER IN THE PACK. IF NOT, THE LOSS IS
C-----JUST CONTRIBUTED TO THE CALORIC DEFICIT OF THE SNOWPACK.
C-----REMEMBER THAT -CALOUT- IS NEGATIVE
IF (FREWT.GT.0.0) GO TO 10
CALOF = CALOF - CALOUT
RETURN
C-----COMPUTE THE CALORIC LOSS NECESSARY TO FREEZE ALL OF THE FREE WATER
C----- (FREE WATER * 80.0 * 2.54)
10 CALNEO = FREWT * 203.2
C-----NOW COMPARE THAT NECESSARY LOSS WITH THE ACTUAL LOSS. IF THEY ARE
C-----THE SAME, THE FREE WATER IS WIPE OUT BUT NO OTHER CONDITIONS ARE
C-----ALTERED
COMPAR = CALOUT + CALNEO
IF (COMPAR) 20,30,40
C-----THE LOSS WAS MORE THAN ENOUGH TO FREEZE IT. THE BALANCE CREATES
C-----AN ENERGY DEFICIT IN THE PACK AND THE FREE WATER IS WIPE OUT
20 CALOF = - COMPAR
30 FREWT = 0.0
RETURN
C-----ONLY PART OF THE FREE WATER FROZE. COMPUTE THE BALANCE REMAINING
C-----BALANCE = EXISTING FREE WATER - AMOUNT FROZEN, WHERE
C-----AMOUNT FROZEN = CALORIES/(80.0 * 2.54)
40 FREWT = FREWT + (CALOUT/203.2)
RETURN
END

```

Subroutine CANVAP

```

SUBROUTINE CANVAP
C-----COMPUTE THE EVAPORATION FROM THE INTERCEPTED SNOW AS A FUNCTION OF
C-----THE CANOPY COVER DENSITY. NOTE - THIS VERSION REPLACED THE
C-----ORIGINAL SUBROUTINE CANVAP IN DECEMBER, 1973, TO INCORPORATE THE
C-----TIME TRENDS OF REGROWTH
COMMON/ONLYCR/ AVETMC,BASTMF,CALOF,COMAX,COVON,OREOY,ENGBL,
1 ENGBLO,FIELOC,FREWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTH1(3),SMTH3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VEGTYP
COMMON/STRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
COMMON/TIME/CANREF,COMAX2,CANAV
C-----IF THE COVER DENSITY IS GREATER THAN OR EQUAL TO HALF OF THE
C-----MAXIMUM COVER DENSITY (ASSUMES COMPLETE OR NEARLY COMPLETE
C-----CROWN) COVER AT COMAX/2), EVAPORATE ONLY FROM THE CANOPY
IF (COMAX2 - COVON) 10,10,40
10 ETFROM = 1.2

```

```

EVAPTR = EVAPTR/COVON
ONTRE = ONTRE - EVAPTR
IF (ONTRE) 20,30,30
20 EVAPTR = ONTRE + EVAPTR
ONTRE = 0.0
30 RETURN
C-----EVAPORATE FROM THE SNOWPACK SURFACE (USING THE PROCEDURES OF
C-----SUBROUTINE SNOVAR) AND FROM THE CANOPY, COMBINING THE RESULTS AS
C-----A FUNCTION OF THE PRESENT PERCENTAGE OF CROWN COVER
40 ETFROM = 3.0
PRCNTC = COVON/COMAX2
ETS = ((1.0 - COVON) * EVAPTR) * (1.0 - PRCNTC)
IF (PREWE - ETS) 50,50,60
50 ETS = PREWE
PREWE = 0.0
GO TO 70
60 PREWE = PREWE - ETS
70 ETC = (EVAPTR/COVON) * PRCNTC
ONTRE = ONTRE - ETC
IF (ONTRE) 80,90,90
80 ETC = ONTRE + ETC
ONTRE = 0.0
90 EVAPTR = ETC + ETS
RETURN
END

```

Subroutine DECID

```

SUBROUTINE DECID
C-----DECIDUOUS FOREST - DETERMINE THE SOURCE OF THE EVAPOTRANSPIRATION
COMMON/ONLYCR/ AVETMC,BASTMF,CALOF,COMAX,COVON,OREOY,ENGBL,
1 ENGBLO,FIELOC,FREWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTH1(3),SMTH3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VEGTYP
COMMON/STRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----IF FOLIAGE IS PRESENT, USE EVAPOTRANSPIRATION
IF (VEGTYP - 3) 40,10
C-----IF THERE IS NO PACK, BYPASS THE RADIATION ROUTINES
10 IF (PREWE) 20,30
20 CALL RADBAL
C-----ADD -WATRIN- TO THE RECHARGE REQUIREMENTS SO THE ET ROUTINE CAN
C-----OPERATE ON THE INPUT AS WELL AS THE STORAGE
30 RCHRG = RCHRG + WATRIN
C-----0.14925 = 0.10/0.67 (SEE THE COMMENT IN SUBROUTINE EVTRAN FOR THE
C-----USE OF THE CONSTANT)
CALL EVTRAN (0.14925)
RETURN
C-----SINCE FOLIAGE IS NOT PRESENT, EVAPORATE FROM THE PACK SURFACE IF A
C-----PACK EXISTS
40 IF (PREWE) 50,60
50 CALL SNOVAR
C-----ADD -WATRIN- TO THE RECHARGE REQUIREMENTS
RCHRG = RCHRG + WATRIN
RETURN
C-----NEITHER FOLIAGE NOR PACK ARE PRESENT. ADJUST THE EVAPORATION FOR
C-----AVAILABLE SOIL WATER BY THE SAME RELATIONSHIP USED IN EVTRAN FOR
C-----OPENINGS, THEN ADJUST FOR COVER DENSITY AS IN SNOVAR (USE ANY
C-----INPUT TO HELP SATISFY THE REQUIREMENTS)
60 ETFROM = 4.0
RCHRG = RCHRG + WATRIN
IF (RCHRG + (FIELOC/4.0)) 70,70,80
70 EVAPTR = 0.0
RETURN
80 AVABLE = ((4.0/FIELOC) * (FIELOC + RCHRG)) - 3.0
EVAPTR = EVAPTR + AVABLE * (1.0 - COVON)
IF (RCHRG - EVAPTR + FIELOC) 90,100,100
90 EVAPTR = RCHRG + FIELOC
RCHRG = - FIELOC
RETURN
100 RCHRG = RCHRG - EVAPTR
RETURN
END

```

Subroutine DIFMOD

```

SUBROUTINE DIFMOD
C-----THIS SUBROUTINE WAS DERIVED FROM PROGRAM SMTH, A SNOWPACK
C-----TEMPERATURE DIFFUSION MODEL DEVELOPED BY LEAF (1970 STUDY PLAN
C-----FS-RM-1662, NO. 224, RMF+RES). USING THE AVERAGE SURFACE TEMP
C-----AND THE GROUND TEMP AS BOUNDARY CONDITIONS, THE NEW AVERAGE
C-----SNOWPACK TEMPERATURE IS CALCULATED
COMMON/ONLYCR/ AVETMC,BASTMF,CALOF,COMAX,COVON,OREOY,ENGBL,
1 ENGBLO,FIELOC,FREWT,LSUSD,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTH1(3),SMTH3,TCDEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VEGTYP
COMMON/STRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----COMPUTE THE DENSITY OF THE SNOWPACK (THE FUNCTION WAS DERIVED FROM
C-----OBSERVED CONDITIONS ON THE FRASER EXPERIMENTAL FOREST)
DENSITY = (EXP((10.0179 * PREWE) + 3.02))/100.0
C-----COMPUTE THE DISTANCE BETWEEN THE TWO NODES IN CENTIMETERS
C-----DEPTH = PREWE/DENSITY
C-----H = (DEPTH/2)*2.54
H = (PREWE/DENSITY) * 1.27
C-----THE THERMAL DIFFUSIVITY IS CALCULATED FROM THE FUNCTION
C-----KV = 0.01/((2.751 - DENSITY)*0.48). MATHEMATICAL STABILITY
C-----REQUIRES THAT THE VALUE OF THE QUANTITY (INTERVAL IN SECONDS *
C-----KV/H**2) BE LESS THAN 0.5. WHEN A 24 HOUR INTERVAL IS USED, THE
C-----SNOW DEPTH MUST EXCEED 30 INCHES (20 PERCENT DENSITY) TO ACHIEVE
C-----STABILITY. IN ORDER TO INSURE STABILITY WITH SOMEWHAT SMALLER
C-----PACKS (ABOUT 18 INCHES), THE DAY IS DIVIDED INTO 2 TIME INTERVALS
C-----OF 12 HOURS (43200 SECONDS)
C-----CGNST1 = (43200 * 0.01/((2.751 - DENSITY) * 0.48))/H**2
CGNST1 = 900.0/((2.751 - DENSITY)*H**2)
C-----THE MINIMUM WATER EQUIVALENT WHICH WILL ACHIEVE STABILITY USING
C-----THE ABOVE DENSITY FUNCTION IS 4.7 INCHES
IF (CGNST1 - 0.5) 20,10,10

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C-----THE MODEL IS UNSTABLE - INDICATE THAT IT IS NOT READY FOR USE NOW.
C----- (IT MAY BE INITIALIZED AGAIN BY AN OBSERVED PACK TEMPERATURE CARD
C----- AND STABILITY WILL BE ASCERTAINED FROM THE WATER EQUIVALENT AT
C----- THAT TIME)
10 DREY = 0
RETURN
C-----GET THE SECOND CONSTANT
20 CONST2 = 1.0 - CONST1 - CONST1
C-----PERFORM THE SIMULATION IN TWO PARTS (ONE FOR EACH 12 HOUR PERIOD).
C-----SMTM1- HOLDS THE THREE TEMPERATURES FROM THE PREVIOUS INTERVAL
C----- THAT ARE NEEDED TO SIMULATE SMTM2, THE NODE AT THE CENTER OF
C----- THE PACK. SIMULATE THE FIRST 12 HOURS NOW
SMTM2 = (CONST1 * (SMTM1(1) + SMTM1(3))) + (CONST2 * SMTM1
1(2))
C-----THE AVERAGE SNOWPACK TEMPERATURE IS THE AVERAGE OF THE 2 NODES
C----- (MIDDLE AND GROUND) IN BOTH INTERVALS. GROUND TEMPERATURE IS
C----- CONSTANT, SO START THE AVERAGE NOW
SMTM3 = SMTM1(3) + SMTM1(3) + SMTM2
C-----RESET -SMTM1- TO THE TEMPERATURES OF THE INTERVAL JUST SIMULATED
C----- FOR USE IN THE SECOND 12 HOUR INTERVAL SIMULATION. THE SURFACE
C----- AIR TEMPERATURE IS SPLIT INTO A LOW AVERAGE ( (MEAN+MIN)/2 ) AND
C----- A HIGH AVERAGE ( (MEAN+MAX)/2 ) FOR USE WITH THE TWELVE HOUR
C----- INTERVALS. USE THE LOW AVERAGE NOW
SMTM1(1) = AMIN1 (D.0, ((1(TMPMIN-32.0)*0.555555556)+AVETMC)/
1 2.0)
SMTM1(2) = SMTM2
C-----SIMULATE THE SECOND 12 HOURS AND COMPUTE THE AVERAGE SNOWPACK
C----- TEMPERATURE
SMTM2 = (CONST1 * (SMTM1(1) + SMTM1(3))) + (CONST2 * SMTM1
1(2))
SMTM3 = (SMTM3 + SMTM2)/4.0
C-----RESET -SMTM1- USING THE HIGH AVERAGE FOR USE ON THE FIRST
C----- INTERVAL OF THE NEXT DAY
SMTM1(1) = AMIN1 (G.0, ((1(TMPMAX-32.0)*0.555555556)+AVETMC)/
1 2.0)
SMTM1(2) = SMTM2
C-----CHECK TO SEE IF THE GROUND TEMPERATURE SHOULD BE RAISED
IF(SMTM3 + 1.5) 60,40,30
30 IF(SMTM3 + 0.5) 40,50,50
40 IF(SMTM1(3).LT.-0.5) SMTM1(3) = -0.5
RETURN
50 SMTM1(3) = 0.0
60 RETURN
END

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Subroutine EVTRAN

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SUBROUTINE EVTRAN
C-----COMPUTE THE EVAPORATION AND TRANSPIRATION DURING THE GROWING
C----- SEASON. NOTE - THIS VERSION REPLACED THE ORIGINAL SUBROUTINE
C----- EVTRAN IN DECEMBER, 1973, TO INCORPORATE THE TIME TRENDS OF
C----- REGROWTH
COMMON/DONLYCR/ AVETMC,BASTMF,CALDF,CDMAX,CVDN,DREY,ENGBL,
1 ENGBL,FIELDC,FREWT,LSUSD,NDSND,DNTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCDEF,TMPMLT,TRSHLD,VEGTYP
INTEGER DREY,PHASE,VEGTYP
COMMON/WTRBAL/ALLOD,ETFRDM,EVAPTR,GENRD,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
COMMON/TIME/CANREF,CDMAX2,CNAV
ETFRDM = 4.0
C-----GET THE ADJUSTMENT FACTOR FOR AVAILABLE SOIL WATER
C----- AVAIL = 4*EXP(-K*(T-TC))*(BETA/H - EXP(-K*(T-TC))) + 1.0, WHEN
C----- T (YEARS SINCE TREATMENT) IS GREATER THAN DR EQUAL TO TC (BASE
C----- YEAR OF FUNCTION). THE CONSTANT K IS CALCULATED WHEN THE
C----- MANAGEMENT PLAN CARD IS READ, AND THE CONSTANT -CNAV- IS
C----- COMPUTED AT THE BEGINNING OF EACH WATER YEAR BY THE TIME TRENDS
C----- ROUTINE. BETA IS THE AVAILABLE WATER
AVAIL = (4.0*CNAV*((RCHRG+FIELDC)/FIELDC)-CNAV) + 1.0
IF(AVAIL) 10,10,20
C-----THE WILTING POINT HAS BEEN REACHED
10 EVAPTR = 0.0
RETURN
20 IF(1.0 - AVAIL) 30,40,40
C-----THE FACTOR IS MAXIMIZED
30 AVAIL = 1.0
C-----THE ADJUSTMENT FOR CANOPY REFLECTIVITY IS RECOMPUTED EACH YEAR.
C----- PERFORM THE ADJUSTMENTS NOW
40 EVAPTR = EVAPTR * AVAIL * CANREF
C-----IF THE EVAPOTRANSPIRATION WILL DEplete THE MANTLE STORAGE BELOW
C----- THE WILTING POINT, ALTER THE EVAPOTRANSPIRATION
IF(RCHRG - EVAPTR + FIELDC) 50,60,60
50 EVAPTR = RCHRG + FIELDC
RCHRG = - FIELDC
RETURN
60 RCHRG = RCHRG - EVAPTR
RETURN
END

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Subroutine LINK

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SUBROUTINE LINK (CALAIR,CALRIE,IREFRN)
C-----THIS SUBROUTINE IS THE INTERFACE BETWEEN THE RADIATION BALANCE
C----- (SUBROUTINE RADBAL) AND THE DIFFUSION MODEL (SUBROUTINE OIFMOD)
COMMON/DONLYCR/ AVETMC,BASTMF,CALDF,CDMAX,CVDN,DREY,ENGBL,
1 ENGBL,FIELDC,FREWT,LSUSD,NDSND,DNTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCDEF,TMPMLT,TRSHLD,VEGTYP
INTEGER DREY,PHASE,VEGTYP
COMMON/WTRBAL/ALLOD,ETFRDM,EVAPTR,GENRD,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----SEE IF THE RADIATION BALANCE IS AN ENERGY LOSS OR GAIN
IF(CALDF) 10,10,90
C-----THERE WAS A LOSS. IF THIS IS STILL WINTER (NO FREE WATER), JUST
C----- GO AHEAD AND USE THE DIFFUSION MODEL
10 IF(FREWT) 20,20,50
C-----USE THE DIFFUSION MODEL TO SIMULATE THE CURRENT AVERAGE SNOWPACK
C-----TEMPERATURE
20 IF(DREY.NE.1) GO TO 140
CALL DIFMOD
IF(DREY) 40,40,30
C-----NOW MAKE ANY NECESSARY ADJUSTMENTS IN THE RADIATION BALANCE TO

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C----- CAUSE THE PACK TEMPERATURE TO BE THE SAME AS -SMTM3-. GET THE
C----- DIFFERENCE BETWEEN THE CALORIE DEFICITS AS COMPUTED BY THE
C----- DIFFERENT METHODS
30 CALDF = CALDF + (SMTM3 * PREWE * 1.27)
C-----ADJUST THE LONG WAVE PORTION OF THE RADIATION BALANCE BY THE
C----- DIFFERENCE BETWEEN THE CALORIES DERIVED FROM THE DIFFUSION MODEL
C----- AND THE ENERGY BALANCE
CALRIE = CALDF
RADLWN = CALRIE - RADSWN
40 IREFRN = 0
RETURN
C-----THE LOSS IS USED TO FREEZE PART OR ALL OF THE FREE WATER, BUT IT
C----- MAY NOT CREATE COLD CONTENT. IF IT WOULD CREATE COLD CONTENT,
C----- RE-INITIALIZE THE DIFFUSION MODEL TO 0 AND ADJUST THE ENERGY
C----- BALANCE ACCORDINGLY
50 CALL CALDS (CALRIE)
IF(FREWT - 0.35) 60,60,70
60 SMTM1(1) = AMIN1 (AVETMC,G.0)
SMTM1(2) = 0.0
SMTM1(3) = 0.0
DREY = 1
C-----MAKE ANY NECESSARY ADJUSTMENTS TO THE ENERGY BALANCE TO COMPENSATE
C----- FOR THE COLD CONTENT THAT WOULD HAVE BEEN GENERATED BY THIS LOSS
C----- AND ZERO THE COLD CONTENT
ENGBL = FIELDC + CALDF
RADLWN = RADLWN + CALDF
FREWT = 0.0
CALDF = 0.0
70 IREFRN = 1
RETURN
C-----THERE IS CALDIC INPUT TO THE PACK. CHECK TO SEE IF CONDITIONS
C----- INDICATE THAT THE DIFFUSION MODEL SHOULD BE TURNED OFF AND THE
C----- ENERGY BALANCE USED FOR SPRINGTIME SIMULATION. CONSIDER FIRST
C----- ANY COLD CONTENT INCLUDING THAT OF THE PREVIOUS DAY AND ANY
C----- CREATED BY A SNOW EVENT ON THIS DAY. IF THERE IS COLD CONTENT,
C----- CHECK THE AVERAGE AIR TEMPERATURE AND THE SNOWPACK TEMPERATURE
C----- FROM THE PREVIOUS DAY FOR ARBITRARILY CHOSEN SPRINGTIME
C----- CONDITIONS AND IF ALL ARE NOT SATISFIED, GO AHEAD AND USE THE
C----- DIFFUSION MODEL
80 IF(CALDF) 170,170,90
C-----0.889 = 1.27 * 0.7 DEGREES C (ARBITRARY TEMP)
90 IF(AVETMC.LE.0.0.DR.CALDF.GT.PREWE*0.889) GO TO 20
C-----SINCE SPRINGTIME CONDITIONS PREVAIL, RECOMPUTE THE BACK RADIATION
C----- AND THE NET RADIATION BALANCE (REMEMBER, IF THERE IS SNOW, THE
C----- LONGWAVE IS ASSUMED TO BE ZERO, SO THERE WOULD BE NO NEED TO MAKE
C----- ANY ADJUSTMENTS)
IF(NOSND) 140,140,100
100 USE = (TMPMIN - 32.0) * 0.555555556
IF(USE.GT.0.0) USE = 0.0
CALSD = 1.17E-7 * (USE + 273.16) ** 4)
IF(PRECIP) 110,110,120
110 RADLWN = ((1.0 - CVDN) * ((0.757 * CALAIR) - CALSD)) + ICDVDN
1 * (CALAIR - CALSD))
GO TO 130
120 RADLWN = CALAIR - CALSD
130 CALRIE = RADSWN + RADLWN
C-----RE-INITIALIZE THE DIFFUSION MODEL TO THESE CONDITIONS (BUT IF THE
C----- INPUT IS MORE THAN ENOUGH TO WIPE OUT THE CALORIE DEFICIT, JUST
C----- LET IT BRING THE PACK TO ISOTHERMAL. IN THIS WAY, TWO CONSECU-
C----- TIVE DAYS OF INPUT ARE REQUIRED TO GENERATE FREE WATER)
140 COMPAR = CALRIE - CALDF
IF(COMPAR) 160,150,150
C-----INITIALIZE THE DIFFUSION MODEL TO ISOTHERMAL CONDITIONS
150 SMTM1(1) = 0.0
SMTM1(2) = 0.0
SMTM1(3) = 0.0
SMTM3 = 0.0
DREY = 1
GO TO 30
C-----REDEFINE THE SURFACE TEMPERATURE AND COMPUTE THE NEW AVERAGE PACK
C----- TEMPERATURE. THEN COMPUTE THE MIDDLE NODE AS A FUNCTION OF THAT
C----- AVERAGE, THE SURFACE TEMPERATURE AND THE GROUND TEMPERATURE
C----- (WHICH REMAINED UNCHANGED)
160 SMTM1(1) = AMIN1 (0.0,AVETMC)
SMTM3 = COMPAR/(PREWE * 1.27)
SMTM1(2) = (3.0 * SMTM3) - SMTM1(1) - SMTM1(3)
SMTM1(3) = 0.0
DREY = 1
GO TO 30
C-----THERE IS INPUT TO THE PACK AND THE PACK IS ALREADY ISOTHERMAL. IF
C----- THIS ENERGY WILL CREATE AT LEAST 0.05 INCH (ARBITRARY AMOUNT) OF
C----- FREE WATER, SET THE DIFFUSION MODEL TO STANDBY STATUS AND LET THE
C----- ENERGY BALANCE TAKE ITS COURSE
170 IF(FREWT + (CALRIE/203.2) - 9.05) 150,180,180
180 DREY = 0
IREFRN = 0
RETURN
END

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Subroutine MIXTUR

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SUBROUTINE MIXTUR
C-----THIS SUBROUTINE CONTROLS THE COMPUTATIONS FOR A PRECIPITATION
C----- EVENT THAT IS A MIXTURE OF SNOW AND RAIN
COMMON/DONLYCR/ AVETMC,BASTMF,CALDF,CDMAX,CVDN,DREY,ENGBL,
1 ENGBL,FIELDC,FREWT,LSUSD,NDSND,DNTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCDEF,TMPMLT,TRSHLD,VEGTYP
INTEGER DREY,PHASE,VEGTYP
COMMON/WTRBAL/ALLOD,ETFRDM,EVAPTR,GENRD,PEAKED,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----COMPUTE THE AMOUNT OF PRECIPITATION OCCURRING AS RAIN
C----- AMOUNT RAIN = P * (B/A), WHERE
C----- P = PRECIPITATION IN INCHES
C----- B = DAILY MAXIMUM TEMPERATURE - BASE TEMPERATURE (DEGREES F)
C----- A = DAILY MAXIMUM TEMPERATURE - MINIMUM TEMPERATURE (DEGREES F)
0 = TMPMAX - BASTMF
A = TMPMAX - TMPMIN
AMTRAN = PRECIP * (B/A)
C-----NOW COMPUTE THE AVERAGE TEMPERATURES (DEGREES C) WHICH PRODUCE
C----- SNOW AND RAIN
TMSID = (TMPMIN + BASTMF - 64.0) * 0.2777777778
TMAIN = (TMPMAX + BASTMF - 64.0) * 0.2777777778
C-----COMPUTE THE EFFECT OF THE SNOW ON THE SNOWPACK

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CALL SNOWD (TMSNO,PRECIP-AMTRN)
C-----COMPUTE THE EFFECT OF THAT PORTION OF THE PRECIPITATION OCCURRING
C----- AS RAIN ON THE SNOWPACK
CALL RAINFD (TMAIV,AMTRN)
C-----
END

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Function PACKRF

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FUNCTION PACKRF (DUMMY)
C-----GET THE REFLECTIVITY OF THE SNOWPACK
COMMON/ONLYCR/ AVETMC,BASTMF,CALDF,COMAX,COVON,DREOY,ENGLB,
1 ENGBLO,FIELDC,FREWT,LSUSO,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCOEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VFGTYP
COMMON/WTBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
DIMENSION REFACM(15),REFMLT(15)
INTEGER PASINT
DATA REFACM/.80, .77, .75, .72, .70, .69, .68, .67, .66, .65,
1 .64, .63, .62, .61, .60/
DATA REFMLT/.72, .65, .60, .58, .56, .54, .52, .50, .48, .46,
1 .44, .43, .42, .41, .40/
PASINT = NOSNO
IF(NOSNO) 80,80,10
C-----USE THE SAME FUNCTION AS LAST TIME
10 (FILSUSO) 20,20,50
C-----ACCUMULATION PHASE - AFTER 15 DAYS, USE THE MELT FUNCTION
C----- STARTING AT THE FOURTH DAY
20 IF(PASINT - 15) 30,30,40
30 PACKRF = REFACM(PASINT)
RETURN
40 PASINT = PASINT - 11
C-----MELT FUNCTION - AFTER 15 DAYS, USE A CONSTANT 40 PERCENT
50 (F(PASINT - 15) 70,70,60
60 PASINT = 15
70 PACKRF = REFMLT(PASINT)
RETURN
C-----THERE IS NEW SNOW - DETERMINE IF THE FUNCTION IS TO BE RE-
C----- INITIALIZED
80 (IF(TMPMAX - TRSHLO) 90,90,10
C-----IT IS, SO SEE WHICH FUNCTION IS TO BE USED
90 (F(CALDF) 110,110,100
100 PACKRF = 0.91
LSUSO = 0
RETURN
C-----THE PACK IS ISOTHERMAL, BUT IF THE ENERGY BALANCE FROM THE
C----- PREVIOUS INTERVAL WAS NEGATIVE, USE THE ACCUMULATION PHASE
C----- FUNCTION ANYWAY
110 IF(ENGBLO) 100,120,120
120 PACKRF = 0.81
LSUSO = 1
RETURN
END

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Subroutine RADBAL

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SUBROUTINE RADBAL
C-----THIS SUBROUTINE COMPUTES THE RADIATION BALANCE AND TRANSFERS
C----- CONTROL TO THE DIFFUSION MODEL THROUGH SUBROUTINE LINK IF IT IS
C----- NEEDED
COMMON/ONLYCR/ AVETMC,BASTMF,CALDF,COMAX,COVON,DREOY,ENGLB,
1 ENGBLO,FIELDC,FREWT,LSUSO,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCOEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VFGTYP
COMMON/WTBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----COMPUTE THE CALORIC INPUT FROM NET SHORT WAVE RADIATION AS A
C----- FUNCTION OF THE SNOWPACK REFLECTIVITY
RADSWN = RADIN * (1.0 - PACKRF (0.0)) * TCOEF
C-----IF THE PACK IS ACCUMULATING, BUT IS NOT DEEP ENOUGH FOR STABILITY
C----- IN THE DIFFUSION MODEL, USE THE FOLLOWING SIMPLIFIED METHOD FOR
C----- DERIVING THE RADIATION BALANCE
IF(PHASE) 70,10,110
10 IF(PREWE - 4.7) 20,50,50
C-----USE ONLY THE SHORTWAVE INPUT (THIS IMPLIES THAT THE ONLY COLD
C----- CONTENT GENERATED IN THE ACCUMULATING PACK IS THAT OF NEW SNOW)
20 CALRIE = RADSWN
RADLWN = 0.0
CALL CALIN (CALRIE)
C-----MELT CAN OCCUR ONLY WHEN THE MEAN TEMPERATURE IS GREATER THAN THE
C----- SPECIFIED MINIMUM
IF(AVETMC - TMPMLT) 30,30,40
30 PREWE = PREWE + WATRIN
RADLWN = -ENGLR
ENGBL = 0.0
WATRIN = 0.0
FREWT = 0.0
CALDF = 0.0
40 RETURN
C-----THE PACK HAS JUST REACHED A SUFFICIENT DEPTH. INITIALIZE THE
C----- DIFFUSION MODEL, BUT RETAIN PSEUDO-CONTROL UNTIL THE DIFFUSION
C----- MODEL IS WELL ALONG INTO STABLE CONTROL
50 PHASE = -1
60 DREOY = 1
PREWE = PREWE + WATRIN
WATRIN = 0.0
RADLWN = -RADSWN
CALDF = 0.0
ENGBL = 0.0
SMTM1(1) = AMIN1 (AVETMC,0.0)
SMTM1(2) = 0.0
SMTM1(3) = 0.0
FRFMT = 0.0
RETURN
C-----THE DIFFUSION MODEL HAS BEEN INITIALIZED PREVIOUSLY. IF IT IS
C----- STILL STABLE AND IF THE PACK IS DEEP ENOUGH TO INSURE CONTINUED
C----- STABILITY UNTIL MELT, RELINQUISH CONTROL COMPLETELY TO THE
C----- NORMAL METHOD OF COMPUTING THE RADIATION BALANCE, INTERFACED WITH
C----- THE DIFFUSION MODEL

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70 IF(DREOY) 170,80,90
80 PHASE = 0
GO TO 10
90 CALRIE = RADSWN
CALAIR = 0.0
RADLWN = 0.0
IF(PREWE - 5.0) 230,230,100
100 PHASE = 1
C-----USE THE NORMAL METHOD OF COMPUTING THE RADIATION BALANCE. IF ANY
C----- OF THE PRECIP WAS SNOW, THE NET LONG WAVE RADIATION BALANCE IS
C----- ASSUMED TO BE ZERO
GO TO 170
C-----SEE IF THIS IS THE ACCUMULATION PHASE OR MELT PHASE
110 IF(PHASE - 2) 120,170
C-----ACCUMULATION - IF THE DIFFUSION MODEL IS STILL READY, GO ON TO THE
C----- NORMAL ROUTINE. BUT IF NOT, JUST USE THE SIMPLE ONE
120 IF(DREOY) 170,130,150
130 CALRIE = RADSWN
RADLWN = 0.0
CALL CALIN (CALRIE)
IF(AVETMC - TMPMLT) 140,40,40
140 IF(PREWE - 4.7) 30,60,60
C-----SEE IF THE PEAK WATER EQUIVALENT DATE HAS BEEN REACHED
150 IF(PEAKED) 160,170
160 PHASE = 2
170 IF(NOSNO) 180,180,190
180 RADLWN = 0.0
CALAIR = 0.0
GO TO 220
C-----TO COMPUTE THE LONG WAVE RADIATION COMPONENTS, CONVERT THE AIR
C----- AND SNOW TEMPERATURES TO POTENTIAL CALORIES BY THE STEFAN -
C----- BLTZMANN FUNCTION, CALORIES = S * (T ** 4), WHERE
C----- S = 1.17E-7 CAL/(CM**2)(DEGREES KELVIN)**4, AND
C----- T = ABSOLUTE TEMPERATURE (DEGREES KELVIN)
190 CALAIR = 1.17E-7 * ((AVETMC + 273.16) ** 4)
USE = AVETMC
C-----IF THE SNOWPACK IS ISOTHERMAL, USE THE MINIMUM TEMPERATURE FOR
C----- COMPUTING THE BACK RADIATION
IF(CALDF,0.0,0.0) USE = (TMPMIN - 32.0) * 0.5555555556
C-----UNDER NO CIRCUMSTANCES MAY THE TEMPERATURE FOR COMPUTING THE BACK
C----- RADIATION BE GREATER THAN ZERO
IF(USE,0.0,0.0) USE = 0.0
CALSN0 = 1.17E-7 * ((USE + 273.16) ** 4)
C-----COMPUTE THE LONG WAVE RADIATION COMPONENTS AS A FUNCTION OF THE
C----- FIRST, DETERMINE WHETHER THE SKIES ARE CLEAR OR CLOUDY
IF(PRECIPI) 200,200,210
C-----WITH CLEAR SKIES, THE DOWNWARD LONGWAVE RADIATION COEFFICIENT IS
C----- .757 (RUNOFF FROM SNOWMELT, EM110-2-1406, US ARMY CORPS OF
C----- ENGINEERS, 1960, PAGE 71)
200 SNOSKY = 1.10 COVON * ((0.757 * CALAIR) - CALSN0)
C-----THE DOWNWARD LONGWAVE RADIATION COEFFICIENT IS 1.0 BENEATH THE
C----- FOREST CANOPY (OR BENEATH CLOUDY SKIES)
SNOCAN = COVON * (CALAIR - CALSN0)
RADLWN = SNOCAN + SNOSKY
GO TO 220
C-----WITH CLOUDY SKIES, WHEN THE DOWNWARD LONGWAVE RADIATION COEFFI-
C----- CIENT IS 1.0 INSTEAD OF .757, THE ABOVE THREE EQUATIONS MAY BE
C----- REDUCED ALGEBRAICALLY TO THE FOLLOWING SINGLE EQUATION
210 RADLWN = CALAIR - CALSN0
C-----COMPUTE THE CALORIC INPUT OR LOSS FROM THE NET EFFECT OF SHORT
C----- WAVE AND LONG WAVE RADIATION
220 CALRIE = RADSWN + RADLWN
C-----THE SNOWPACK TEMPERATURE DIFFUSION MODEL (LEAF, 1970, STUDY PLAN
C----- FS-RM-1622, NO. 224, ROCKY MOUNTAIN FOREST AND RANGE EXP STA) IS
C----- INCORPORATED TO CONTROL THE SNOWPACK TEMPERATURE AND COLO CONTENT
C----- DURING NON-ISOTHERMAL CONDITIONS. SEE NOW IF THE DIFFUSION MODEL
C----- MAY BE USED (DREOY MAY NOT BE -1 AND PASS THROUGH LINK SINCE IT
C----- IS NOT DESIGNED TO WORK WITH IT. THE -1 IS USED TO INDICATE THAT
C----- THE RADIATION ROUTINES ARE TO BE USED EXCLUSIVELY. IF IT MAY BE
C----- USED, PASS THROUGH THE LINKING ROUTINE WHICH INTERFACES THE
C----- DIFFUSION MODEL AND THE RADIATION ROUTINES
IF(DREOY) 240,230,230
230 CALL LINK (CALAIR,CALRIE,IRETRN)
IF(IRETRN) 240,240,260
240 IF(CALRIE) 250,260,270
250 CALL CALOSS (CALRIE)
260 RETURN
270 CALL CALIN (CALRIE)
RETURN
END

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Subroutine RAINED

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SUBROUTINE RAINED (TRAIN,AMTRN)
C-----THIS SUBROUTINE COMPUTES THE EFFECT OF RAIN ON SNOW
COMMON/ONLYCR/ AVETMC,BASTMF,CALDF,COMAX,COVON,DREOY,ENGLB,
1 ENGBLO,FIELDC,FREWT,LSUSO,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCOEF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREOY,PHASE,VFGTYP
COMMON/WTBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
C-----ADD THIS AMOUNT OF PRECIPITATION TO THE PREDICTED WATER EQUIVALENT
PREWE = PREWE + AMTRN
C-----SEE IF THERE IS A CALORIC DEFICIT IN THE PACK
IF(CALDF) 50,50,10
C-----COMPUTE THE AMOUNT OF RAIN AT THIS TEMPERATURE THAT IS NEEDED TO
C----- WIPE OUT THE DEFICIT AND COMPARE IT WITH THE ACTUAL AMOUNT
10 CALRN = (80.0 + TRAIN) * 2.54
AMTND = CALDF/CALRN
COMPAR = AMTRN - AMTND
IF(COMPAR) 30,20,40
C-----THERE WAS JUST ENOUGH TO WIPE OUT THE DEFICIT
20 CALDF = 0.0
ENGBL = ENGL + CALRN
RETURN
C-----THERE WAS NOT ENOUGH TO WIPE IT OUT COMPLETELY. JUST DEplete
C----- THE DEFICIT
30 CALDF = CALDF - (CALRN * AMTRN)
ENGBL = ENGL + (CALRN * AMTRN)
RETURN
C-----THERE WAS MORE THAN ENOUGH TO WIPE OUT THE DEFICIT. THE AMOUNT
C----- OF RAIN NOT FROZEN IS FREE WATER
40 FREWT = COMPAR

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CALL CALIN (TRAIN * COMPAR * 2.54)
RETURN
C-----ALL OF THE RAIN IS ADDED TO THE FREE WATER AND CONTRIBUTES CALORIC
C----- INPUT TO THE PACK
50 FREAT = FREAT + AMTRAN
CALL CALIN (TRAIN * AMTRAN * 2.54)
RETURN
END

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Subroutine SNOWED

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SUBROUTINE SNOWED (TSNOWN,AMTSNO)
C-----THIS SUBROUTINE COMPUTES THE EFFECTS OF A SNOW EVENT ON THE
C----- SNOWPACK
COMMON/UTLTYR/ AVETMC,BASTMF,CALOF,COMAX,COVDN,OREGY,ENGBL,
1 ENGRLO,FIELOC,FREWAT,LASUSO,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCOFF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREGY,PHASE,VEGTYP
COMMON/WTRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
REAL INTCTP
C-----SEE IF INTERCEPTION IS ALLOWED NOW
IF(ALLOW) 10,30
C-----DETERMINE THE AMOUNT OF INTERCEPTED SNOW AS A FUNCTION OF COVER
C----- COMPOSITION AND COVER DENSITY (WATCH FOR OPENINGS AND DECIDUOUS
C----- FORESTS WITHOUT FOLIAGE)
10 IF(COMAX) 20,30
20 GO TO (40,50,40,30),VEGTYP
C-----NO INTERCEPTION
30 INTCTP = 0.0
GO TO 90
C-----LOOSEPOLE PINE AND FOLIATED DECIDUOUS FORESTS
40 PERCT = 0.10
GREAT = 0.20
GO TO 60
C-----SPRUCE FIR
50 PERCT = 0.15
GREAT = 0.30
60 INTCTP = AMTSNO * PERCT * (COVDN/COMAX)
IF(ONTRE + INTCTP - GREAT) 80,80,70
70 INTCTP = GREAT - ONTRE
80 ONTRE = ONTRE + INTCTP
90 NOSNO = 0
C-----ADD THIS AMOUNT OF PRECIPITATION TO THE PREDICTED WATER EQUIVALENT
PREWE = PREWE + AMTSNO - INTCTP
C----- THE SNOW FALLING WHEN THE TEMPERATURE IS BETWEEN 35 AND 32 DEGREES
C----- DOES NOT ALTER THE CALORIC DEFICIT
IF(TSNOWN,GE,3.0) RETURN
C-----COMPUTE THE CALORIC DEFICIT FOR THIS SNOW BY THE EQUATION
C----- CALORIC DEFICIT = S(I)*DELTA T*P, WHERE
C----- S(I) = SPECIFIC HEAT OF ICE (1.5 CAL/CM/DEGREES C),
C----- DELTA T = CHANGE IN TEMPERATURE WITH RESPECT TO FREEZING (0.0
C----- DEGREES CENTIGRADE), AND
C----- P = PRECIPITATION IN CM (CONVERSION FACTOR = 2.54 CM/IN).
C----- THEREFORE, CALORIC DEFICIT = 0.5 * (TFORSNO) * (AMTSNO * 2.54)
CALL CALOSS (TSNOWN * (AMTSNO - INTCTP) * 1.27)
RETURN
END

```

Subroutine SNOVAP

```

SUBROUTINE SNOVAP
C-----COMPUTE THE EVAPORATION FROM THE SURFACE OF THE SNOWPACK AS A
C----- FUNCTION OF THE COVER DENSITY AND REDUCE THE PACK ACCORDINGLY
COMMON/UTLTYR/ AVETMC,BASTMF,CALOF,COMAX,COVDN,OREGY,ENGBL,
1 ENGRLO,FIELOC,FREWAT,LASUSO,NOSNO,ONTRE,PHASE,PREWE,
2 RCHRG,SMTM1(3),SMTM3,TCOFF,TMPMLT,TRSHLO,VEGTYP
INTEGER OREGY,PHASE,VEGTYP
COMMON/WTRBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKED,PRECIP,RAOIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
ETFROM = 2.0
EVAPTR = (1.0 - COVDN) * EVAPTR
C-----SINCE DECIDUOUS FOREST AREAS MAY EVAPORATE FROM THE SNOWPACK WITH
C----- NO REGARD FOR PACK DEPTH, DO NOT ALLOW EVAPOTRANSPIRATION TO TAKE
C----- MORE THAN IS IN THE PACK
IF(PREWE - EVAPTR) 10,10,20
10 EVAPTR = PREWE
PREWE = 0.0
RETURN
20 PREWE = PREWE - EVAPTR
RETURN
END

```

Subroutine DECDUS

```

SUBROUTINE DECDUS
C-----CHECK FOR A CHANGE OF SEASON IN DECIDUOUS FORESTS
COMMON/UTLTYR/ BOUND(6,8),CALDEF(8),COVDEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK1(8),FREWAT(8),LAST1,
2 LASUSO(8),LCOPY(14),NOVSNO(8),NEXTN,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),RST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUIT(8),SEEDINC,SEEDAT(2),SEFDYR(2),
5 SINTH(13,8),TCOFF(8),TYPCUT(8)
INTEGER ALTYR,BOUND,OREGY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/UTLTYR/ BLOCK(1889),CHANGR,CHANGW,DATE(2),OATES(4),LINES,
1 NAME,NOAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRD)
INTEGER PEKDAT,VEGTYP
C-----CHECK THE DATE (BETWEEN APRIL 1 AND OCTOBER 15, IT IS POSSIBLE TO
C----- HAVE FOLIAGE. BUT DURING THE REMAINDER OF THE YEAR, IT IS

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```

C----- ASSUMED THAT THE TREES ARE LEAFLESS)
IF(NMAY,GE,1RT,OR,NDAY,LE,15) GO TO 30
C-----THE TREES SHOULD BE LEAFLESS. (IF THEY ARE NOT, SWITCH TO THE
C----- LOWER COVER DENSITY
10 IF(VEGTYP - 4) 20,80
20 VEGTYP = 4
GO TO 60
C-----THE FOLIAGE MAY BE PRESENT, BUT IF THE PACK WATER EQUIVALENT IS
C----- MORE THAN 5 INCHES, THE TREES ARE STILL ASSUMED TO BE LEAFLESS
30 DO 40 I = 1,NUNIT
IF(PREWEQ(I) - 5.0) 40,40,10
40 CONTINUE
C-----THE FOLIAGE SHOULD BE PRESENT. IF NOT, SWITCH TO THE HIGHER COVER
C----- DENSITY
IF(VEGTYP - 3) 50,80
50 VEGTYP = 3
60 DO 70 I = 1,NUNIT
TCOFF(I) = SWITCH (TCOFF(I),DECIOS(1,1))
COVDEN(I) = SWITCH (COVDEN(I),DECIOS(2,1))
COMAX = SWITCH (COMAX,DCOMAX)
70 CONTINUE
80 RETURN
END

```

Subroutine GBIMON

```

SUBROUTINE GBIMON
C-----GET THE BIMONTHLY RUNOFF
COMMON/UTLTYR/ BLOCK(1889),CHANGR,CHANGW,DATE(2),OATES(4),LINES,
1 NAME,NOAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRD)
INTEGER PEKDAT,VEGTYP
C-----APRIL 16 - APRIL 30
BIMNTH(1) = 0.0
DO 10 I = 202,216
10 BIMNTH(1) = BIMNTH(1) + RO(I)
C-----MAY 1 - MAY 15
BIMNTH(2) = 0.0
DO 20 I = 218,232
20 BIMNTH(2) = BIMNTH(2) + RO(I)
C-----MAY 16 - MAY 31
BIMNTH(3) = 0.0
DO 30 I = 233,248
30 BIMNTH(3) = BIMNTH(3) + RO(I)
C-----JUNE 1 - JUNE 15
BIMNTH(4) = 0.0
DO 40 I = 249,263
40 BIMNTH(4) = BIMNTH(4) + RO(I)
C-----JUNE 16 - JUNE 30
BIMNTH(5) = 0.0
DO 50 I = 264,278
50 BIMNTH(5) = BIMNTH(5) + RO(I)
C-----JULY 1 - JULY 15
BIMNTH(6) = 0.0
DO 60 I = 280,294
60 BIMNTH(6) = BIMNTH(6) + RO(I)
RETURN
END

```

Subroutine GPEAK

```

SUBROUTINE GPEAK (IOATE1)
C-----GET THE PEAK 7-DAY FLOW AND PEAK WATER EQUIVALENT
COMMON/UTLTYR/ BLOCK(1889),CHANGR,CHANGW,DATE(2),OATES(4),LINES,
1 NAME,NOAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRD)
INTEGER PEKDAT,VEGTYP
C-----PEAK WATER EQUIVALENT
PEAKWE = 0.0
PEKDAT = 1
DO 40 I = 1,372
IF(TMAX(I) + 1.E50) 10,40
10 IF(PEAKWE - WE(I)) 20,30,40
20 PEAKWE = WE(I)
30 PEKDAT = I
40 CONTINUE
CALL GOATE (PEKDAT,DATE)
C-----7-DAY PEAK FLOW
IOATE1 = 1
IOATE2 = 7
PEAKRD = 0.0
DO 100 I = 187,272
IF(TMAX(I) + 1.E50) 50,110
50 ACCUM = RO(I)
J = 6
K = I + 1
60 IF(TMAX(K) + 1.E50) 70,80
70 ACCUM = ACCUM + RO(K)
J = J - 1
IF(J) 80,90
80 K = K + 1
GO TO 60
90 IF(PEAKRD - ACCUM) 100,110,110
100 PEAKRD = ACCUM
IOATE1 = I
IOATE2 = K

```


Function JWYDAT

Subroutine OUTPT

Function SWITCH

Function TC

Program NORMAL

29

```

CALL GBMDN
ITEM = PKDAT
CALL GPEAK (IDATE1)
C-----STORE THE FINAL INFORMATION AND WRITE THE RECORD
BLOCK(1876) = YKTOT(1)
BLOCK(1877) = YRTOT(3)
BLOCK(1878) = RECHRG - RCHRG0
RCHRG0 = PECHRG
BLOCK(1879) = PKEWEO - WEO
WEO = PREWEO
C-----NOTE THAT -PEKDAT- WAS REDEFINED BY SUBROUTINE GPEAK, SO
C-----BLOCK(1887)- MAY OR MAY NOT BE THE SAME AS -BLOCK(1873)-
BLOCK(1887) = PKDAT
PEKDAT = ITEM
BLOCK(1889) = IDATE1
CALL PUTREC (16,BLOCK,1889)
C-----IF THE OUTPUT IS NOT TO BE PRINTED, GO ON TO THE NEXT YEAR. IF IT
C-----IS, OUTPUT THE COMPILED RESULTS
IF(PLNDPT(1),EQ,0) GO TO 40
YRTOT(2) = PPT(371)
CHANGR = BLOCK(1878)
CHANGW = BLOCK(1879)
CALL OUTPT
GO TO 40
C-----THE NORMAL SIMULATION IS COMPLETE, SO END -SCRFL-
90 END FILE 16
100 CALL EXTEND
CALL CORE (3)
C-----RETURN TO THE PRIMARY OVERLAY
END

```

Subroutine EXTEND

```

SUBROUTINE EXTEND
C-----EXTEND (OR CONTRACT) THE DATA BASE AND, IF SPECIFIED, SAVE IT
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,YEARS,PLNDPT(19),PLUNIT(6),
1 RECDVR,REGIDN(8),REGDPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNDPT,PLUNIT,RECDVR,REGIDN,REGDPT,SAVE,SEDRN2
COMMON/E/CDN,ID(9),NBLOCK,DRIGYR
INTEGER DRIGYR
COMMON/UTILITY/BLDCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG0,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TEMPLT),(BLOCK(1868),WILTPT),(BLOCK(1871),DCOMAX),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),B1MNT(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
CALL CORE (-1)
MYEARS = YEARS
LINES = 0
C-----IF THE FILE IS TO BE SAVED, WRITE THE ID RECORD
IF(SAVE) 10,30
10 NSAVED = NSAVED + 1
DO 20 I = 1,6
20 ID(I) = PLUNIT(I)
ID(7) = YEARS
ID(8) = DATIME(1)
ID(9) = DATIME(2)
CALL PUTREC (15,10,9)
C-----PREPARE THE FILES. IF OUTPUT IS WANTED, PRINT THE HEADING
30 REWIND 11
GO TO 60
C-----COPY THE ORIGINAL DATA
50 CALL PUTREC (11,BLOCK,1889)
IF(SAVE,NE,0) CALL PUTREC (15,BLOCK,1889)
YRNEXT = BLOCK(1)
MYEARS = MYEARS - 1
IF(MYEARS) 110,110,60
60 CALL GETREC (16,BLOCK,1889,1END)
IF(1END) 70,50
C-----EXTEND THE DATA BASE. START BY COMPUTING THE NUMBER OF YEARS IN
C-----THE ORIGINAL DATA BASE AND THE PRESENT POSITION OF THE SCRATCH
C-----FILE
70 DRIGYR = YEARS - MYEARS
NBLOCK = DRIGYR + 1
C-----DEFINE THE DEGREE OF THE CONSTANT TO BE USED IN THE SELECTION
C-----PROCESS
CDN = 10.
IF(DRIGYR,GE,10) CDN = CDN * 10.
IF(DRIGYR,GE,100) CDN = CDN * 10.
90 CALL RANSEL
YRNEXT = YRNEXT + 1.0
C-----SIMULATE THE NORMAL CONDITIONS
CALL SIMNRM
IF(PLNDPT(2),EQ,0) GO TO 100
YRTOT(2) = PPT(371)
CHANGR = BLOCK(1878)
CHANGW = BLOCK(1879)
YEAR = YRNEXT
CALL OUTPT1 (INT(BLOCK(1)))
100 TEMP = BLOCK(1)
TEMP = BLOCK(1)
BLOCK(1) = YRNEXT
CALL PUTREC (11,BLOCK,1889)
IF(SAVE,NE,0) CALL PUTREC (15,BLOCK,1889)
BLOCK(1) = TEMP
MYEARS = MYEARS - 1
IF(MYEARS) 110,110,90
110 IF(SAVE,NE,0) END FILE 15
CALL CORE (3)
C-----RETURN TO THE MAIN OVERLAY
END

```

Subroutine GENDAT

SUBROUTINE GENDAT

```

C-----GENERATE THE DATA FOR THIS SUBSTATION
COMMON/ACCUM,AIRTM(4),ASPECT,CALDEF,CODVEN,DECIDS(3),DREADY,
1 ENGRAL,ETDLY(12),FRACTN,FREWAT,ID,IM,IMN,IMX,IP,IY,LASUD,LAT,
2 NDYSND,ONTRES,PEKPPT,PHASE,POTENT(24),POTRAD,PPTNDW,PREWEO,
3 RADSUB,RECHRG,SIMTM(3),SLOPE,SLPASP(24),SUMMER,TCOEFF,
4 VARFMT(7),VARIN(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT
COMMON/UTILITY/BLDCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG0,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TEMPLT),(BLOCK(1868),WILTPT),(BLOCK(1871),DCOMAX),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),B1MNT(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
COMMON/WTBAL/ALLOW,ETFROM,EVAPTR,GENRO,PEAKEO,PRECIP,RADIN,
1 RADLWN,RADSWN,TMPMAX,TMPMIN,WATRIN
EQUIVALENCE (DATE(1),MONTH)
DIMENSION DDOFACT(26)
DATA DDOFACT/.20,.35,.45,.51,.56,.59,.62,.64,.655,.67,
1 .682,.69,.70,.71,.715,.72,.722,.724,.726,.728,.73,
2 .734,.738,.742,.746,.75/
C-----DEFINE THE UNADJUSTED PRECIP
PPMSTR = PPT(NDAY) - PPTNDW
C-----ADJUST THE TEMPERATURES
TMPMAX = AIRTM(1) + (TMAX(NDAY) * AIRTM(2))
TMPMIN = AIRTM(3) + (TMIN(NDAY) * AIRTM(4))
IF(TMPMAX - TMPMIN) 10,20,20
10 TEMP = TMPMAX
TMPMAX = TMPMIN
TMPMIN = TEMP
C-----GET THE DATE AND POTENTIAL RADIATION
20 CALL GOATE (NDAY,DATE)
CALL RADCMP ((DATE(1)*100)+DATE(2))
C-----COMPUTE THE INCOMING RADIATION AT THE BASE STATION FROM THE
C-----POTENTIAL BY THE DEGREE-DAY METHOD
GO TO (50,50,50,50,60,70,70,70,60,50,50,50),MONTH
C-----OCTOBER - APRIL, DEGREE DAYS = .44 * TMPMAX - 15.9 (+1.0 FOR
C-----SUBSCRIPTING)
50 DD = (0.44 * TMPMAX) - 14.9
GO TO 100
C-----MAY AND SEPTEMBER, DEGREE DAYS = .53 * TMPMAX - 19.5 (+1.0 FOR
C-----SUBSCRIPTING)
60 DD = (0.53 * TMPMAX) - 18.5
GO TO 100
C-----JUNE, JULY AND AUGUST, DEGREE DAYS = .63 * TMPMAX - 24.1 (+1.0
C-----FOR SUBSCRIPTING), EXCEPT ON DAYS WITH PRECIP. DURING THESE
C-----MONTHS, USE A CONSTANT 44 PERCENT ON PRECIP DAYS
70 IF(PPMSTR) 90,90,80
80 RADHRZ = POTRAD * 0.44
GO TO 150
90 DD = (0.63 * TMPMAX) - 23.1
C-----WATCH FOR THE BOUNDARY VALUES, 0. AND 25. (WITH THE 1.0 ADDED
C-----ABOVE, THE SUBSCRIPTS FOR THE TABULAR VALUES VARY FROM 1 TO 26)
100 IF(DD - 1.0) 110,110,120
C-----USE THE FIRST TABLE VALUE (NO INTERPOLATION IS NECESSARY)
110 RADHRZ = POTRAD * DDOFACT(1)
GO TO 150
120 IF(DD - 26.0) 140,130,130
C-----USE THE LAST TABLE VALUE (NO INTERPOLATION IS NECESSARY)
130 RADHRZ = POTRAD * DDOFACT(26)
GO TO 150
C-----THE SUBSCRIPT IS IN THE PROPER RANGE. OBTAIN THE INTERPOLATION
C-----FRACTION AND SUBSCRIPTS THROUGH TRUNCATION OF -DD-
140 J1 = DD
DD1 = J1
J = J1 + 1
C-----THE TERM (DD-DD1)/1.0 IS THE INTERPOLATION FRACTION
RADHRZ = POTRAD * (DDOFACT(J1) + ((DDOFACT(J) - DDOFACT(J1)) * (DD -
1 DD1)))
C-----ADJUST THE POTENTIAL EVAPOTRANSPIRATION AS COMPUTED BY THE HAMON
C-----METHOD FOR AVAILABLE RADIATION AS A PERCENT OF POTENTIAL
150 EVAPTR = ETDALY(MDNT) * (RADHRZ/POTRAD)
C-----ADJUST THE RADIATION AT THE BASE STATION FOR SLOPE AND ASPECT
1 = RADSUB + 1
IF(.GT,24) I = 1
RADIN = RADHRZ * (SLPASP(RADSUB) + ((SLPASP(I) - SLPASP(RADSUB))
1 * FRACTN))
C-----ADJUST THE PRECIP TO ENSURE REACHING THE PEAK WATER EQUIVALENT
IF(PPMSTR) 160,160,170
160 PRECIP = 0.0
GO TO 200
170 IF(PEKPPT - PPTNDW) 190,190,180
180 PRECIP = PPMSTR * ((PEAKWE - PREWEO)/(PEKPPT - PPTNDW))
PEAKED = 0.0
GO TO 200
C-----AFTER THE PEAK, ADJUST THE BASE STATION PRECIP BY THE CONSTANT
C-----SUMMER FACTOR
190 PRECIP = PPMSTR * SUMMER
PEAKED = 1.0
C-----DO NOT ALLOW INTERCEPTION IN JULY AND AUGUST
ALLOW = 1.0
IF(NDAY,GE,280,AND,NDAY,LE,341) ALLOW = 0.0
200 IF(VEGTYP,NE,3,AND,VEGTYP,NE,4) GO TO 270
C-----CHECK THE DATE (BETWEEN APRIL 1 AND OCTOBER 15, IT IS POSSIBLE TO
C-----HAVE FOLIAGE. BUT DURING THE REMAINDER OF THE YEAR, IT IS
C-----ASSUMED THAT THE TREES ARE LEAFLESS)
IF(NDAY,GE,187,OR,NDAY,LE,15) GO TO 230
C-----THE TREES SHOULD BE LEAFLESS. IF THEY ARE NOT, SWITCH TO THE
C-----LOWER COVER DENSITY
210 IF(VEGTYP - 4) 220,270
220 VEGTYP = 4
GO TO 260
C-----THE FOLIAGE MAY BE PRESENT, BUT IF THE PEAK WATER EQUIVALENT IS
C-----MORE THAN 5 INCHES, THE TREES ARE STILL ASSUMED TO BE LEAFLESS
230 IF(PREWEO - 5.2) 240,240,210
C-----THE FOLIAGE SHOULD BE PRESENT. IF NOT, SWITCH TO THE HIGHER COVER
C-----DENSITY
240 IF(VEGTYP - 3) 250,270
250 VEGTYP = 3
260 TCOEFF = SWITCH (TCOEFF,DEC(0S(1)))
CODVEN = SWITCH (CODVEN,DEC(0S(2)))
CDMAX = SWITCH (CDMAX,DEC(0S(3)))

```


C-----STORE THESE VALUES FOR OUTPUT TO THE BASIC FILE

```

27C TMAX(NDAY) = TMAX
TMIN(NDAY) = TMIN
YRTOT(2) = YRTOT(2) + PRECIP
PPTNDW = PPT(NDAY)
PPT(NDAY) = YRTOT(2)
RAD(NDAY) = RADIN
ETG(NDAY) = EVAPTR
RETURN
END

```

Subroutine GETIYR

```

SUBROUTINE GETIYR (IEND)
C-----READ THE SPECIFIED CONDITIONS CARD AND THE DATA
COMMON DATIME(2),DECAL,NRMANG,NSAVED,YEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEDRN2
COMMON N/ACCUM,AIRTM(4),ASPECT,CALDEF,CVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDLY(12),FRACTN,FREMAT,ID,IM,IMN,IMX,IP,IY,LASUSO,LAT,
2 NDSND,DNTRES,PEKPPT,PHASE,POTENT(24),POTRAD,PPTNDW,PREWEQ,
3 RADSUB,RECHRG,SIMTM(13),SLOPE,SLPASP(24),SUMMER,TCOEFF,
4 VARFMT(7),VARINI(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRGD,ROI(372),WE(372),WEO,YEAR,YRTOT(13)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RADI(372),THAK(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RADI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TMPMLT),(BLOCK(1868),WILTP),(BLOCK(1871),DCDMAK),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
DIMENSION IDATES(6)
READ (19) NAME,PEAKWE,IDATES
IF(NAME,NE.IOHEND OF NAT) GO TO 10
IEND = 1
RETURN
10 IEND = D
C-----CONVERT THE DATES TO THE PSEUDO-JULIAN FORM AND STORE THE YEAR
C-----ALONG WITH THE DECIMAL ID
PEKDAT = JWDAT (IDATES(1),IDATES(2))
ISOTRM = JWDAT (IDATES(4),IDATES(5))
YEAR = IDATES(6)
BLOCK(1) = FLDAT(YEAR) + DECAL
C-----READ THE DATA AND COMPARE THE YEARS
CALL READAT
C-----DEFINE THE ACCUMULATED PRECIP UP TO THE DAY OF THE PEAK
2D IF(TMAX(PEKDAT-1) + 1.E501 40,3D
3D PEKDAT = PEKDAT - 1
GO TO 2D
4D PEKPT = PPT(PEKAT-1)
RETURN
END

```

Subroutine GPARAM

```

SUBROUTINE GPARAM
C-----READ THE STATION PARAMETERS FROM THE PRODFREAD FILE
COMMON DATIME(2),DECAL,NRMANG,NSAVED,YEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEDRN2
COMMON N/ACCUM,AIRTM(4),ASPECT,CALDEF,CVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDLY(12),FRACTN,FREMAT,ID,IM,IMN,IMX,IP,IY,LASUSO,LAT,
2 NDSND,DNTRES,PEKPPT,PHASE,POTENT(24),POTRAD,PPTNDW,PREWEQ,
3 RADSUB,RECHRG,SIMTM(13),SLOPE,SLPASP(24),SUMMER,TCOEFF,
4 VARFMT(7),VARINI(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRGD,ROI(372),WE(372),WEO,YEAR,YRTOT(13)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RADI(372),THAK(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RADI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TMPMLT),(BLOCK(1868),WILTP),(BLOCK(1871),DCDMAK),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
READ (19) TCOEFF,CVDEN,CDMAX,VEGTYP,TRSHLD,TMPMLT,WILTP,DECIDS,
1 LAT,ASPECT,SLOPE,SIMTM(2),PREWEQ,RECHRG,ETDLY,AIRTM,SUMMER
C-----IF THE TRANSMISSIVITY COEFFICIENTS ARE NOT SPECIFIED, COMPUTE THEM
IF(TCOEFF.LE.0.D) TCOEFF = TC (CVDEN)
C-----CONVERT THE PACK TEMPERATURE TO CALORIE DEFICIT (AS A POSITIVE
C-----QUANTITY), AND DEFINE THE GROUND TEMPERATURE FOR THE SIMULATION
CALDEF = -SIMTM(2) * PREWEQ * 1.27
SIMTM(1) = SIMTM(2)
SIMTM(3) = -1.5
C-----READ THE RADIATION, THEN THE VARIABLE FORMAT
READ (19) POTENT,SLPASP
READ (19) VARFMT,NFILE,IM,ID,IY,IMN,IMX,IP
C-----POSITION THE UNEDITED FILE AND READ THE FIRST CARD
CALL SKPFIL (NFILE)
READ (10,VARFMT) VARIN
RETURN
END

```

Subroutine OUTPTI

```

SUBROUTINE OUTPTI (YRFRM)
C-----OUTPUT THE COMPILED RESULTS AND WRITE THE BASIC DATA ON THE FILE
COMMON DATIME(2),DECAL,NRMANG,NSAVED,YEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEDRN2

```

```

COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRGD,ROI(372),WE(372),WEO,YEAR,YRTOT(13)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RADI(372),THAK(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RADI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TMPMLT),(BLOCK(1868),WILTP),(BLOCK(1871),DCDMAK),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
INTEGER YRFRM
C-----CHECK THE LINE COUNTER
IF(LINES) 10,1D,2D
10 WRITE (6,91D) REGION,DATIME,PLUNIT
91D FORMAT(1+8A1,32X2A1D,1X6A1D,45X*EXTENDED NATURAL CONDITIONS*/
1 *D *
1 *YEAR * - - - -81MONTHLY GENERATED RDIFF- - - - -
2YEARLY - - - - - 9/30 - - - - - PEAK - - - - - */
3 * *
3 * * APRIL MAY MAY JUNE JUNE JULY GEN
4 * CHANGE CHANGE RECH 7-DAY*/
5 * (FRDH)*
5 * 16-3D 1-15 16-31 1-15 16-3D 1-15 RD PPT
6 * ET RECH W.E. RED W.E. DATE GENRD DATES*/
LINES = 5D
C-----PRINT THE LINE
2D WRITE (6,92D) YRFRM,YEAR,BIMNTH,YRTOT,CHANGR,CHANGW,RCHRGD,
1 PEAKWE,DATIME,PEAKRO,DATES
92D FORMAT(1+13,*2X13,1X13F7.2,2K12,*/12,F7.2,2K12,*/12)
LINES = LINES - 1
RETURN
END

```

Subroutine RADCMP

```

SUBROUTINE RADCMP (MMDD)
C-----COMPUTE THE POTENTIAL RADIATION AT THE BASE STATION
COMMON N/ACCUM,AIRTM(4),ASPECT,CALDEF,CVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDLY(12),FRACTN,FREMAT,ID,IM,IMN,IMX,IP,IY,LASUSO,LAT,
2 NDSND,DNTRES,PEKPPT,PHASE,POTENT(24),POTRAD,PPTNDW,PREWEQ,
3 RADSUB,RECHRG,SIMTM(13),SLOPE,SLPASP(24),SUMMER,TCOEFF,
4 VARFMT(7),VARINI(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),OATES(4),LINES,
1 NAME,NDAY,RCHRGD,ROI(372),WE(372),WEO,YEAR,YRTOT(13)
INTEGER DATE,DATES,YEAR
DIMENSION BIMNTH(6),ETO(372),PPT(372),RADI(372),THAK(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RADI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX),(BLOCK(1865),VEGTYP),(BLOCK(1866),TRSHLD),(BLOCK(1867),
3 TMPMLT),(BLOCK(1868),WILTP),(BLOCK(1871),DCDMAK),(BLOCK(1872),
4 ISOTRM),(BLOCK(1873),PEKDAT),(BLOCK(1880),BIMNTH(1)),
5 (BLOCK(1886),PEAKWE),(BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
DIMENSION BETWEEN(24),NOATE(24)
DATA BETWEEN(13., 15., 13., 15., 14., 14., 15., 14., 15., 14.,
1 21., 20., 15., 14., 15., 15., 14., 15., 14., 14., 14., 19.,
2 19./
DATA NOATE/ 11D,123,207,22D,3D7,321,4D4,419,5D3,518,6D1,622,712,
1 727,81D,825,9D9,923,1D8B,1D22,11D5,1119,12D3,1222/
C-----PLACE THIS DATE WITH RESPECT TO THE TABLES
DD 1D = 1,24
IF(NDATE(1) - MMDD) 1D,8D,2D
10 CONTINUE
C-----A NORMAL TERMINATION OF THE DD LDDP MEANS THAT THIS DATE FALLS
C-----BETWEEN 12/23 AND 12/31, INCLUSIVE. USING THE ARRAY IN CIRCULAR
C-----FASHION, 1/10 (SUBSCRIPT 1) IS THE CONTROLLING DATE
1D = 1
GO TO 3D
C-----THIS DATE FALLS BETWEEN THE ONES AT LOCATIONS I AND I-1. IF I IS
C-----1, USE 24 FOR I-1 SINCE THE ARRAY IS CIRCULAR
2D RADSUB = 1 - 1
IF(RADSUB) 3D,3D,4D
3D RADSUB = 24
C-----OBTAIN THE INTERPOLATION FRACTDN. START BY DETERMINING IF
C-----THIS DATE FALLS IN THE SAME MONTH AS THAT AT LOCATION I OR I-1
4D IF(NDATE(1) - NOATE(RADSUB/10D)) 6D,5D,6D
C-----IT IS THE SAME AS I-1 AND IT IS LARGER, SO SUBTRACT THE I-1 DATE
C-----TO OBTAIN THE NUMBER OF DAYS TO BE USED FOR INTERPOLATING
5D DAYS = MMDD - NOATE(RADSUB)
GO TO 7D
C-----IT IS THE SAME AS I, BUT IT IS SMALLER, SO SUBTRACT IT FROM THE 1
C-----DATE. THEN SUBTRACT THE RESULT FROM THE DAYS BETWEEN I AND I-1
C-----TO OBTAIN THE NUMBER OF DAYS TO BE USED FOR INTERPOLATING
6D DAYS = NOATE(1) - MMDD
DAYS = BETWEEN(RADSUB) - DAYS
C-----COMPUTE THE INTERPOLATION FRACTION
7D FRACTN = DAYS/BETWEEN(RADSUB)
POTRAD = POTENT(RADSUB) + (POTENT(1) - POTENT(RADSUB)) * FRACTN
RETURN
C-----THIS DATE IS IN THE TABLE - NO INTERPOLATION IS NECESSARY
8D FRACTN = 0.0
RADSUB = 1
POTRAD = POTENT(1)
RETURN
END

```

Subroutine RANSEL

```

SUBROUTINE RANSEL
C-----RANDOMLY SELECT THE NEXT YEAR FROM THE ORIGINAL DATA BASE
COMMON DATIME(2),DECAL,NRMANG,NSAVED,YEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEDRN2
COMMON N/ACCUM,AIRTM(4),ASPECT,CALDEF,CVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDLY(12),FRACTN,FREMAT,ID,IM,IMN,IMX,IP,IY,LASUSO,LAT,
2 NDSND,DNTRES,PEKPPT,PHASE,POTENT(24),POTRAD,PPTNDW,PREWEQ,
3 RADSUB,RECHRG,SIMTM(13),SLOPE,SLPASP(24),SUMMER,TCOEFF,
4 VARFMT(7),VARINI(6)
INTEGER DATE,DATES,YEAR
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRGD,ROI(372),WE(372),WEO,YEAR,YRTOT(13)
INTEGER DATE,DATES,YEAR

```



```

DIMENSION BINMTH(6),ETD(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETD(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BINMTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
C-----GET A RANDOM NUMBER BETWEEN 1 AND -DRIGYR- (SUBROUTINE RM2
C----- RETURNS A REAL VALUE BETWEEN 0 AND 1)
10 CALL RN2 (SEDRN2,RANDOM)
N = RANDOM * CON
IF (1.GT.N.DR.NGT.DRIGYR) GO TO 10
C-----COMPARE THIS NUMBER WITH THE CURRENT BLOCK. IF THEY ARE THE SAME,
C----- NO FURTHER READING IS NECESSARY. IF THE CURRENT BLOCK NUMBER IS
C----- LARGER, THE FILE MUST BE REWOUND BEFORE THE SEARCH BEGINS
IF (N - NBLOCK) 20,4,30
20 REWIND 16
NBLOCK = J
C-----BYPASS THE BLOCKS UNTIL THE SPECIFIED NUMBER IS FOUND
30 CALL GETRC (16,BLOCK,1889,IEND)
NBLOCK = NBLOCK + 1
IF (N - NBLOCK) 30,40
40 RETURN
END

```

Subroutine READAT

```

SUBROUTINE READAT
C-----READ THE YEAR OF DATA AND STORE IT
COMMON/N/ACCUM,AIRTM(4),ASPECT,CALDEF,COVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDALY(12),FRACTM,FREWAT,IO,IN,IMM,IMX,IP,IY,LASUSO,LAT,
2 NDOYNO,DMTRES,PEKPT,PHASE,POTENT(24),POTRAD,PPTNOW,PREWEQ,
3 RADSUB,RECHRG,SIWTH(13),SLOPE,SLPASPI(24),SUMMER,TCOEFF,
4 VARFMT(7),VARIN(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEQ,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION BINMTH(6),ETD(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETD(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BINMTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
DATA MONTH/0/
IF (MONTH.EQ.-999999) GO TO 20
C-----FIND THE FIRST CARD FOR THIS YEAR
10 MONTH = VARIN(10)
IYEAR = VARIN(11)
IF (IYEAR+1.EQ.YEAR.AND.MONTH.GE.10).OR.(IYEAR.EQ.YEAR.AND.MONTH.
1 LE.9) GO TO 30
READ (10,VARFMT) VARIN
IF (EOF(10)) 20,10
20 WRITE (6,910) YEAR
910 FORMAT('UNABLE TO FIND YEAR*I4,* ON -UNEDIT-. JOB ABORTED*')
CALL ABORT
C-----STORE THE LARGE VALUE IN THE MAXIMUM TEMPERATURE SO MISSING OR
C----- NONEXISTENT DAYS (FEB 30) CAN BE DETECTED
30 DD 40 I = 1,372
40 THAX(1) = -1.E50
C-----CONVERT THE DATE TO THE PSEUDO-JULIAN FORM AND STORE THE DRIVING
C----- VARIABLES
50 IDAY = VARIN(10)
J = JYDAT(MONTH,IDAY)
TMAX(J) = VARIN(1MX)
TMIN(J) = VARIN(1MN)
PPT(J) = VARIN(1P)
C-----READ THE NEXT CARD AND IF THE WATER YEAR DOES NOT CHANGE, GO BACK
C----- TO STORE IT
READ (10,VARFMT) VARIN
IF (EOF(10)) 70,60
60 MONTH = VARIN(10)
IYEAR = VARIN(11)
IF (IYEAR+1.EQ.YEAR.AND.MONTH.GE.10).OR.(IYEAR.EQ.YEAR.AND.MONTH.
1 LE.9) GO TO 50
GO TO 80
70 MONTH = -999999
C-----THIS YEAR IS COMPLETE - ACCUMULATE THE PRECIP
80 ACCUM = 0.0
NDAY = 0
DD 100 I = 1,372
IF (TMAX(I) + 1.E50) 90,100
90 ACCUM = ACCUM + PPT(I)
PPT(I) = ACCUM
NDAY = NDAY + 1
100 CONTINUE
IF (NDAY.GE.364.AND.NDAY.LE.367) RETURN
WRITE (6,920) YEAR,NDAY
920 FORMAT('NOTE - YEAR*I4,* HAS*I4,* DAYS*')
RETURN
END

```

Subroutine SIMNRM

```

SUBROUTINE SIMNRM
C-----PERFORM THE NORMAL SIMULATION FOR A YEAR CREATED DURING THE
C----- EXTENSION OF THE DATA BASE
COMMON DATIME(2),DECMAL,NRRANG,NSAVED,MYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEDRN2
COMMON/N/ACCUM,AIRTM(4),ASPECT,CALDEF,COVDEN,DECIDS(3),DREADY,
1 ENGBAL,ETDALY(12),FRACTM,FREWAT,IO,IN,IPM,IMX,IP,IY,LASUSO,LAT,
2 NDOYNO,DMTRES,PEKPT,PHASE,POTENT(24),POTRAD,PPTNOW,PREWEQ,
3 RADSUB,RECHRG,SIWTH(13),SLOPE,SLPASPI(24),SUMMER,TCOEFF,
4 VARFMT(7),VARIN(6)
INTEGER ASPECT,DREADY,PHASE,RADSUB,SLOPE,VARFMT

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COMMON/TIME/CAMREF,CDMAX2,CONAV
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEQ,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION BINMTH(6),ETD(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETD(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),BINMTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
COMMON/MTRBAL/ALLOW,ETFROM,EVAPTR,GEWRO,PEAKED,PRECIP,RADIN,
1 RADLW,RADSHW,TMPMAX,TMPMIN,WATRIN
C-----STORE THE INITIAL CONDITIONS AND ZERO THE ACCUMULATORS
BLOCK(1874) = PREWEQ
BLOCK(1875) = RECHRG
YRTOT(1) = 0.0
YRTOT(3) = 0.0
DREADY = 0
PPTNOW = 0.0
PEAKED = 0.0
DD 30 WDAY = 1,372
IF (TMAX(WDAY) + 1.E50) 10,30
C-----DEFINE THE DRIVING VARIABLES
10 TMPMAX = TMAX(WDAY)
TMPMIN = TMIN(WDAY)
PRECIP = PPT(WDAY) - PPTNOW
PPTNOW = PPT(WDAY)
EVAPTR = ET(WDAY)
RADIN = RAD(WDAY)
C-----DO NOT ALLOW INTERCEPTION IN JULY AND AUGUST
ALLOW = 1.0
IF (NDAY.GE.200.AND.WDAY.LE.341) ALLOW = 0.0
IF (WDAY.EQ.PEKDAT) PEAKED = 1.0
C-----WATCH FOR DECIDUOUS FOREST AND THEIR CHANGE OF SEASONS
IF (VEGTYP.EQ.3.OR.VEGTYP.EQ.4) GO TO 40
15 CONTINUE
C-----NAKE THE PASS THROUGH THE WATER BALANCE ROUTINES
CALL MATBAL (CALDEF,CDMAX,COVDEN,DREADY,ENGBAL,FREWAT,LASUSO,
1 NDOYNO,DMTRES,PHASE,PREWEQ,RECHRG,SIWTH(1),SIWTH(2),SIWTH(3),
2 TCOEFF,TMPMLT,TRSHLD,VEGTYP,WILTPT)
C-----STORE THESE RESULTS
WE(WDAY) = PREWEQ
RO(WDAY) = GEWRO
YRTOT(1) = YRTOT(1) + GEWRO
YRTOT(3) = YRTOT(3) + EVAPTR
C-----WATCH FOR THE MANDATORY ISOTHERMAL DATE
IF (ISOTRM - NDAY) 30,20
20 DREADY = -1
CALDEF = 0.0
30 CONTINUE
C-----GET THE 81MONTHLY FLOWS AND THE PEAK INFORMATION
CALL GB1MON
ITEMP = PEKDAT
CALL GPEAK(IDATE1)
C-----STORE THE FINAL INFORMATION
BLOCK(1876) = YRTOT(1)
BLOCK(1877) = YRTOT(3)
BLOCK(1878) = RECHRG - RCHRG0
RCHRG0 = RECHRG
BLOCK(1879) = PREWEQ - WE0
WE0 = PREWEQ
C-----NOTE THAT -PEKDAT- WAS REDEFINED BY SUBROUTINE GPEAK, SO
C----- -BLOCK(1887)- MAY OR MAY NOT BE THE SAME AS -BLOCK(1873)-
BLOCK(1887) = PEKDAT
PEKDAT = ITEM
BLOCK(1889) = IDATE1
RETURN
C-----WATCH FOR THE CHANGE OF SEASONS FOR DECIDUOUS FORESTS
40 CONTINUE
C-----CHECK THE DATE (BETWEEN APRIL 1 AND OCTOBER 15, IT IS POSSIBLE TO
C----- HAVE FOLIAGE. BUT OURING THE REMAINDER OF THE YEAR, IT IS
C----- ASSUMED THAT THE TREES ARE LEAFLESS)
IF (NDAY.GE.187.OR.NDAY.LE.15) GO TO 230
C-----THE TREES SHOULD BE LEAFLESS. IF THEY ARE NOT, SWITCH TO THE
C----- LOWER COVER DENSITY
210 IF (VEGTYP - 4) 220,270
220 VEGTYP = 4
GO TO 260
C-----THE FOLIAGE MAY BE PRESENT, BUT IF THE PACK WATER EQUIVALENT IS
C----- MORE THAN 5 INCHES, THE TREES ARE STILL ASSUMED TO BE LEAFLESS
230 IF (PREWEQ - 5.0) 240,240,210
C-----THE FOLIAGE SHOULD BE PRESENT. IF NOT, SWITCH TO THE HIGHER COVER
C----- DENSITY
240 IF (VEGTYP - 3) 250,270
250 VEGTYP = 3
260 TCOEFF = SWITCH (TCOEFF,DECIDS(1))
COVDEN = SWITCH (COVDEN,DECIDS(2))
CDMAX = SWITCH (CDMAX,DECIDS(3))
270 CONTINUE
GO TO 15
END

```

Subroutine SKPFIL

```

SUBROUTINE SKPFIL (NFILE)
C-----SKIP FILES ON THE UNEDITED DATA FILE
REWIND 10
NFILE = NFILE - 1
IF (NFILE) 50,50,10
DD 40 I = 1,NFILE
READ (10,910)
910 FORMAT(1X)
C-----AN END OF FILE ON THE FIRST READ INDICATES AN END OF INFORMATION
IF (EOF(10)) 20,30
20 J = I - 1
WRITE (6,920) J,NFILE
920 FORMAT('OTHER ARE ONLY*I3,* FILES ON -UNEDIT- BUT ACCORDING TO TM
1E VARIABLE FORMAT CARD, THE DATA IS ON FILE*I3,* - JOB ABORTED*')
CALL ABORT
C-----BYPASS THE REMAINDER OF THE FILE
30 READ (10,910)

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      (FIEDF(10)) 40,30
40 CONTINUE
50 RETURN
END

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Subroutine TITLEN

```

SUBROUTINE TITLEN
C-----PRINT THE TITLE SHEET
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYFARS,PLNDPT(19),PLUNIT(6),
1 RECOVR,RGIDN(8),REGDPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNDPT,PLUNIT,RECOVR,REGION,REGDPT,SAVE,SEDRN2
COMMON//ACCUM,AIRTHC(4),ASPECT,CALDEF,COVEN,DECIDS(3),DREADY,
1 ENGBAL,ETOLBY(12),FRACTN,FREMAT,10,1M,1MX,1P,1Y,LASUS(8),LAT,
2 NDYSND,ONTRES,PEKPPF,PHASE,POTENT(24),POTRAD,POTNDW,PREWEQ,
3 RADSR,RECHRG,SIMTH(13),SLOPE,SLPASP(24),SUMMER,TCDEFF,
4 VARFMT(7),VARIN(6)
INTEGER ASPECT,DREADY,PHASE,RADSR,SLOPE,VARFMT
COMMON/UTILITY/8LOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION 81MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (8LOCK(2),TMAX(1)),(8LOCK(374),TMIN(1)),(8LOCK(746),
1 PPT(1)),(8LOCK(118),RAD(1)),(8LOCK(1490),ETO(1)),(8LOCK(1864),
2 COMAX),(8LOCK(1865),VEGTYP),(8LOCK(1866),TRSHLO),(8LOCK(1867),
3 THPMLT),(8LOCK(1868),WILTPT),(8LOCK(1871),DCOMAX),(8LOCK(1872),
4 ISOTRM),(8LOCK(1873),PEKDAT),(8LOCK(1880),81MNT(1)),
5 (8LOCK(1886),PEAKWE),(8LOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
INTEGER TABLE(13),TABLE2(13)
DATA TABLE/6HJUN 22,6HJUN 1,6HMAY 18,6HMAY 3,6HAPR 19,6HAPR 4,
1 6HMAR 21,6HMAR 7,6HFE8 20,6HFE8 7,6HJAN 23,6HJAN 10,6H /
DATA TABLE2/6H 6HJUL 12,6HJUL 27,6HAUG 10,6HAUG 25,6HSEP 9,
1 6HSEP 23,6HDEC 8,6HDEC 22,6HNOV 5,6HNOV 19,6HDEC 3,6HDEC 22/
WRITE (6,910) PLUNIT,DATIME
910 FORMAT('16A10,52X2A10/115X=NATURAL CONOITIONS*')
THPMLT = (THPMLT * 1.8) / 32
WRITE (6,920) TCDEFF,COVEN,COMAX,VEGTYP,TRSHLO,THPMLT,WILTPT
920 FORMAT('0SUBSTATION CONSTANTS*/ TRANSMISSIVITY COEFF=10XF10.2/
1 * COVER DENSITY *10XF10.2/* MAXIMUM COVER DEN *10XF10.2/
2 * VEGETATION TYPE *10X10 / * REFLECTIVITY THRSLO=10XF10.2/
3 * MELT THRESHOLD *10XF10.2/* WILTING POINT *10XF10.2)
IF(VEGTYP.EQ.3) WRITE (6,930) DECIDS
930 FORMAT(' * DECIDUOUS WINTER TC *10XF10.2/
1 * DECIDUOUS WINTER CD *10XF10.2/* DECIDUOUS WNTR COMAX*10XF10.2)
WRITE (6,940) SIMTH(12),PREWEQ,RECHRG
940 FORMAT('0INITIAL CONDITIONS*/
1 * AVERAGE PACK TEMP. *10XF10.2/* PACK WATER EQUIV. *10XF10.2/
2 * RECHARGE REQUIREMENT=10XF10.2)
WRITE (6,950) LAT,ASPECT,SLOPE,(TABLE(11-11),TABLE2(11-11),
1 POTENT(1),SLPASP(1),1=12,24)
950 FORMAT('0LATITUDE =13,*, ASPECT = *A3,*, SLOPE =13/
1 *0POTENTIAL RADIATION INCIDENT TO HORIZONTAL SURFACE AND ADJUSTME
INT FACTORS FOR ASPECT AND SLOPE*/22X*LY ADJUST*,13/1XA6,1XA6,
3 2F10.2))
RETURN
END

```

```

CALL NATURL
C-----DEFINE AN ALTERED RESPONSE UNIT
10 CALL DEFRU
C-----PRINT THE TITLE PAGE IF THE OUTPUT IS TO BE PRINTED
IF(PLNDPT(3).NE.C) CALL TITLEN
LINES = 0
C-----SIMULATE ONE YEAR
20 CALL SIMYR
C-----GET THE CHANGE IN THE RECHARGE REQUIREMENT AND IN THE PACK WATER
C-----EQUIVALENT AND WRITE THE INFORMATION ON THE PLANNING UNIT FILE
RCHRG = 0.0
DO 30 I = 1,NUNIT
30 RCHRG = RCHRG + (RECHRG(I) * RUWT(I))
CHANGR = RCHRG - RCHRG0
RCHRG0 = RCHRG
CHANGW = WE(371) - WEO
WEO = WE(371)
C-----GET THE 81MONTHLY FLOWS AND THE PEAK INFORMATION
CALL GRIMON
CALL GPEAK (IDATE1)
DATE1 = PEKDAT
DATE2 = IDATE1
WRITE (12,910) NPLAN,8LOCK(1),YRTOT,CHANGR,CHANGW,81MNT,PEAKWE,
1 DATE1,PEAKRO,DATE2
910 FORMAT(12,16F6.2)
C-----IF SPECIFIED, OUTPUT THE COMPILED RESULTS
IF(PLNDPT(3).EQ.0) GO TO 40
CALL DUTPT
C-----DETERMINE THE EFFECTS OF THE TIME TRENDS
40 CALL TRENDS
C-----IF THIS IS THE YEAR JUST BEFORE THE NEXT MANAGEMENT PLAN, STORE
C-----THE PRESENT MODEL CONDITIONS ON THE SCRATCH FILE TO PROVIDE THE
C-----STARTING POINT FOR THE NEXT PLAN
IF(YEAR + 1 - NEXTYR) 60,50
50 REWIND 16
CALL PUTREC (16,FORNXT,L4NXT)
C-----READ THE NEXT YEAR
60 CALL GETREC (11,8LOCK,1889,IEND)
IF(IEND.EQ.0) GO TO 20
C-----END OF FILE - 1 THERE IS ANOTHER MANAGEMENT PLAN, READ THE
C-----INITIAL CONDITIONS BACK FROM THE SCRATCH FILE, BYPASS THE DATA
C-----TAPE UP TO THE FIRST YEAR, AND GO ON TO THE NEXT MANAGEMENT PLAN
IF(NEXTYR - 9999) 70,80
70 CALL BYPASS
REWIND 16
CALL GETREC (16,FORNXT,L4NXT,IEND)
GO TO 10
C-----IF SPECIFIED, COPY THE TIME TRENDS FILE
80 IF(PLNDPT(4).EQ.0) GO TO 110
REWIND 17
GO TO 100
90 WRITE (6,990) LCOPY
990 FORMAT(13A10,A6)
100 READ (17,990) LCOPY
IF(EDF(17)) 110,90
C-----RETURN TO THE PRIMARY OVERLAY
110 CONTINUE
CALL CORE (0)
END

```

Subroutine BYPASS

```

SUBROUTINE BYPASS
C-----BYPASS THE DATA ON THE BASIC FILE UNTIL THE FIRST YEAR OF THE
C-----MANAGEMENT PLAN IS FOUND
COMMON//ALTYR(8),8OUND(6,8),CALDEF(8),COVEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK(8),FREWAT(8),LAST1,
2 LASUS(8),LCOPY(14),NDYSND(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),ROIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RWT(8),SEDINC,SEEDAT(2),SEEDYR(2),
5 SIMTH(13,8),TCDEFF(8),TYPCUT(8)
INTEGER ALTYR,8OUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/UTILITY/8LOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION 81MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (8LOCK(2),TMAX(1)),(8LOCK(374),TMIN(1)),(8LOCK(746),
1 PPT(1)),(8LOCK(118),RAD(1)),(8LOCK(1490),ETO(1)),(8LOCK(1864),
2 COMAX),(8LOCK(1865),VEGTYP),(8LOCK(1866),TRSHLO),(8LOCK(1867),
3 THPMLT),(8LOCK(1868),WILTPT),(8LOCK(1871),DCOMAX),(8LOCK(1872),
4 ISOTRM),(8LOCK(1873),PEKDAT),(8LOCK(1880),81MNT(1)),
5 (8LOCK(1886),PEAKWE),(8LOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
REWIND 11
C-----GET A YEAR
10 CALL GETREC (11,8LOCK,1889,IEND)
IF(IEND) 20,30
20 WRITE (6,910) NEXTYR
910 FORMAT('0THE EXTENDED DATA FILE ENDED BEFORE MANAGEMENT PLAN YEAR*
1 14,* WAS FOUND - JOB ABORTED*')
CALL ABORT
30 IF(NEXTYR - INT(8LOCK(1))) 40,50,10
40 JYEAR = INT(8LOCK(1))
WRITE (6,920) NEXTYR, JYEAR
920 FORMAT('0THE EXTENDED DATA FILE DOES NOT CONTAIN MANAGEMENT PLAN Y
1EAR=14,*. THE NEXT YEAR ON THE FILE IS=14,* - JOB ABORTED*')
CALL ABORT
50 JYEAR = 8LOCK(1)
RETURN
END

```

Subroutine DEFRU

```

SUBROUTINE DEFRU
C-----DEFINE A RESPONSE UNIT (OR REDEFINE ONE PREVIOUSLY DEFINED)
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYFARS,PLNDPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGDPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNDPT,PLUNIT,RECOVR,REGION,REGDPT,SAVE,SEDRN2
COMMON//ALTYR(8),8OUND(6,8),CALDEF(8),COVEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK(8),FREWAT(8),LAST1,

```

Program MANAGE

```

OVERLAY (OLAYS,2,2)
PROGRAM MANAGE
C-----PERFORM THE MANAGEMENT STRATEGY SIMULATION AND CREATE THE PLANNING
C-----UNIT FILE
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNDPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGDPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNDPT,PLUNIT,RECOVR,REGION,REGDPT,SAVE,SEDRN2
COMMON//ALTYR(8),8OUND(6,8),CALDEF(8),COVEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK(8),FREWAT(8),LAST1,
2 LASUS(8),LCOPY(14),NDYSND(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),ROIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RWT(8),SEDINC,SEEDAT(2),SEEDYR(2),
5 SIMTH(13,8),TCDEFF(8),TYPCUT(8)
INTEGER ALTYR,8OUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/TIME/CANREF,COMAX2,CNAV
COMMON/UTILITY/8LOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION 81MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (8LOCK(2),TMAX(1)),(8LOCK(374),TMIN(1)),(8LOCK(746),
1 PPT(1)),(8LOCK(118),RAD(1)),(8LOCK(1490),ETO(1)),(8LOCK(1864),
2 COMAX),(8LOCK(1865),VEGTYP),(8LOCK(1866),TRSHLO),(8LOCK(1867),
3 THPMLT),(8LOCK(1868),WILTPT),(8LOCK(1871),DCOMAX),(8LOCK(1872),
4 ISOTRM),(8LOCK(1873),PEKDAT),(8LOCK(1880),81MNT(1)),
5 (8LOCK(1886),PEAKWE),(8LOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
C-----NOTE - THE DIMENSION OF -FORNXT- MUST BE EQUAL TO THE LENGTH OF
C-----COMMON BLOCK /M/ AND THAT LENGTH MUST BE STORED IN -L4NXT-
DIMENSION FORNXT(1313)
EQUIVALENCE (ALTYR(1),FORNXT(1))
CALL CORE (1)
L4NXT = 313
REWIND 17
REWIND 18
WRITE (18,900) PLUNIT,DATIME
900 FORMAT('16A10,52X2A10/*OMANAGEMENT STRATEGY DESCRIPTION*')
LASTI = -1
SEEDYR(1) = 9999
C-----MAKE A LOSS THROUGH THE DATA TO TRANSFER THE YEARLY RESULTS OF THE
C-----NORMAL SIMULATION TO THE PLANNING UNIT FILE
CALL NORM
C-----READ THE FIRST MANAGEMENT PLAN CARD - IF THERE IS NONE, THIS UNIT
C-----IS NOT MANAGED, BUT WAS INCLUDED ONLY AS PART OF A REGION
NPLAN = 0
CALL RDPLAN
IF(NEXTYR.EQ.9999) GO TO 110
C-----BYPASS THE DATA ON THE BASIC FILE UNTIL THE FIRST YEAR OF THE
C-----MANAGEMENT PLAN IS FOUND
CALL BYPASS
C-----DEFINE THE NATURAL RESPONSE UNIT

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2 LASUSO(8),LCOPY(14),NDYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),RODIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RWMT(8),SEINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BOUNO,DREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
COMMON/S/AVSOIL(11),DECLIN(11),NROADS,RATNRM(11),ROADMI(11),
1 ROADW(11),TANCUT(11),TANFIL(11),TANRHO(11),YRCNST(11)
INTEGER YRCNST
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NOAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),OCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKOAT), (BLOCK(1880),81MTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKOAT,VEGTYP
INTEGER YRALT
YRALT = NEXTYR
C-----WATCH FOR ROAD CONSTRUCTION (SEDIIMENT MODELING)
IF(IROADS(N)-EO-1) GO TO 140
NPLAN = NPLAN + 1
C-----IF THE RESPONSE UNIT NUMBER IS ZERO, THIS IS WEATHER MODIFICATION
1 IF(NUM) 2C,10
2 SEEOYR(1) = NEXTYR
SEEOYR(2) = PARAM(1)
SEEOAT(1) = JWDAT (INT(PARAM(2)/100.),INT(AMOD(PARAM(2),100.)))
SEEOAT(2) = JWDAT (INT(PARAM(3)/100.),INT(AMOD(PARAM(3),100.)))
SEINC = 1.0 + PARAM(4)
GO TO 140
C-----IF THIS RESPONSE UNIT NUMBER IS ALREADY IN THE TABLE, THIS CARD IS
C----- REDEFINING THE UNIT
20 DO 30 I = 1,NUNIT
N = I
IF(RUNUM(N) - NUM) 30,80
30 CONTINUE
N = NUNIT + 1
IF(B - N) 40,50,50
40 WRITE (6,910) NUM
910 FORMAT('0A MAXIMUM OF 7 ALTERED RESPONSE UNITS IS ALLOWED DUE TO 1
INTERNAL PROGRAMMING REQUIREMENTS AND *16,* WILL BE NUMBER 8 - JOB
ABORTEO*)
CALL ABORT
C-----START THIS RESPONSE UNIT OUT UNDER THE PRESENT CONDITIONS OF THE
C----- NATURAL RESPONSE UNIT
50 NUNIT = N
RUNUM(NUNIT) = NUM
TCOEFF(NUNIT) = TCOEFF(1)
COVEN(NUNIT) = COVEN(1)
DECIO(1,NUNIT) = DECIO(1,1)
DECIO(2,NUNIT) = DECIO(2,1)
CALDEF(NUNIT) = CALDEF(1)
OREADY(NUNIT) = OREADY(1)
ENGBAL(NUNIT) = ENGBAL(1)
FREWAT(NUNIT) = FREWAT(1)
LASUSO(NUNIT) = LASUSO(1)
NDYSNO(NUNIT) = NDYSNO(1)
ONTRES(NUNIT) = ONTRES(1)
PHASE(NUNIT) = PHASE(1)
PREWEQ(NUNIT) = PREWEQ(1)
RECHRG(NUNIT) = RECHRG(1)
SIMTMI(1,NUNIT) = SIMTMI(1,1)
SIMTMI(2,NUNIT) = SIMTMI(2,1)
SIMTMI(3,NUNIT) = SIMTMI(3,1)
C-----DEFINE THE UNIT WEIGHT AND REDEFINE THE NATURAL RESPONSE UNIT
C----- WEIGHT
RWMT(NUNIT) = PARAM(1)
RWMT(1) = 1.0
DO 60 I = 2,NUNIT
60 RWMT(I) = RWMT(1) - RWMT(I)
IF(RWMT(1)) 70,75,75
70 WRITE (6,920)
920 FORMAT('0THE ALTERED RESPONSE UNITS ACCOUNT FOR MORE THAN 100 PER
CENT OF THE PLANNING UNIT - JOB ABORTEO*)
CALL ABORT
C-----IF THE NATURAL RESPONSE UNIT IS LESS THAN 1/2 OF ONE PERCENT, SET
C----- IT TO ZERO
75 IF(RWMT(1).LT.0.005) RWMT(1) = 0.0
C-----DEFINE (OR REDEFINE) THE PARAMETERS FOR THE RESPONSE UNIT
80 ALTYR(N) = NEXTYR
C-----IF THE COVER DENSITY WAS SPECIFIED (PARAM(2) WAS FLAGGED WITH A
C----- MINUS SIGN), GO DEFINE THE CORRESPONDING CUT
IF(PARAM(2).LT.0.0) GO TO 160
CUT(N) = PARAM(2)
C-----REDEFINE THE COVER DENSITY AND TRANSMISSIVITY COEFFICIENT
COVEN(N) = COVEN(N) * (1.0 - CUT(N))
90 TCOEFF(N) = TC (COVEN(N))
IF(COVEN(N).EQ.0.0) ONTRES(N) = 0.0
IF(VEGTYP.NE.3.AND.VEGTYP.NE.4) GO TO 100
DECIO(2,N) = DECIO(2,N) * (1.0 - CUT(N))
DECIO(1,N) = TC (DECIO(2,N))
C-----DEFINE THE BOUNDARIES FOR THE TIME TRENDS FUNCTIONS
100 CALL GBOUND (N)
C-----BALANCE THE REDISTRIBUTION FACTORS
CALL BALANC
C-----READ THE NEXT MANAGEMENT PLAN CARD AND IF IT IS FOR THE SAME YEAR,
C----- GO BACK TO DEFINE ANOTHER RESPONSE UNIT
140 CALL ROPLAN
IF(YRALT - NEXTYR) 150,145
145 IF(IROADS(N) - 1) 1,140
C-----DETERMINE THE INITIAL EFFECTS (IF ANY) OF THE TIME TRENDS
150 WRITE (17,940) PLUNIT,DATEIME
940 FORMAT('1*6A10,52X2A10/115X*ALTERED CONDITIONS*/OCHANGES IN PARAM
ETERS DUE TO THE EFFECTS OF THE TIME TRENDS*/)
CALL TRENDS
C-----ADD THIS INFORMATION TO THE STRATEGY LIST
CALL SLIST (YRALT)
RETURN
C-----USE THE SPECIFIED COVER DENSITY AND DEFINE THE CUT (REMEMBER,
C----- PARAM(2) IS NEGATIVE)
160 CUT(N) = 1.0 + (PARAM(2)/COVEN(N))
IF(CUT(N)) 180,170,170
170 COVEN(N) = - PARAM(2)
GO TO 93

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180 PARAM(2) = - PARAM(2)
WRITE (6,950) COVEN(N),PARAM(2)
950 FORMAT('0THE CURRENT COVER DENSITY IS ONLY*F5.2,*, BUT THE MANAGEM
ENT PLAN IS REQUESTING A CUT*/# WHICH WILL YIELD A SPECIFIED COVE
2R DENSITY OF*F5.2,* - JOB ABORTEO*)
CALL ABORT
END

```

Function IROADS

```

FUNCTION IROADS (OUMMY)
C-----CHECK FOR ROAD CONSTRUCTION (SEDIIMENT MODELING). SINCE THE
C----- SEDIMENT MODEL IS TOTALLY INDEPENDENT, MERELY STORE THE
C----- PARAMETERS NOW FOR MODELING AFTER THE MANAGEMENT PHASE IS
C----- COMPLETE
COMMON/M/ALTYR(8),BOUNO(6,8),CALDEF(8),COVEN(8),CUT(8),
1 DECIO(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK(8),FREWAT(8),LAST1,
2 LASUSO(8),LCOPY(14),NDYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),RODIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RWMT(8),SEINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BOUNO,DREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
COMMON/S/AVSOIL(11),DECLIN(11),NROADS,RATNRM(11),ROADMI(11),
1 ROADW(11),TANCUT(11),TANFIL(11),TANRHO(11),YRCNST(11)
INTEGER YRCNST
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NOAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),OCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKOAT), (BLOCK(1880),81MTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKOAT,VEGTYP
10 IFNAME.EQ.1DROAD CONST) GO TO 20
IROADS = 0
RETURN
20 IF(NROADS - 1) 40,40,30
30 WRITE (6,910) NEXTYR
910 FORMAT('0THERE ARE MORE THAN 11 ROAD CONSTRUCTION CARDS INCLUDED,
150 YEAR*14,* WAS IGNOREO*)
GO TO 50
C-----STORE THE PARAMETERS
40 NROADS = NROADS + 1
YRCNST(NROADS) = NEXTYR
ROADMI(NROADS) = PARAM(1)
ROADW(NROADS) = PARAM(2)
RATNRM(NROADS) = PARAM(3)
AVSOIL(NROADS) = PARAM(4)
DECLIN(NROADS) = PARAM(5)
TANCUT(NROADS) = PARAM(6)
TANFIL(NROADS) = PARAM(7)
TANRHO(NROADS) = PARAM(8)
50 IROADS = 1
RETURN
END

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Subroutine NATURL

```

SUBROUTINE NATURL
C-----DEFINE THE NATURAL RESPONSE UNIT
COMMON/M/ALTYR(8),BOUNO(6,8),CALDEF(8),COVEN(8),CUT(8),
1 DECIO(2,8),DREADY(8),ENGBAL(8),EXPK(8),EXPK(8),FREWAT(8),LAST1,
2 LASUSO(8),LCOPY(14),NDYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),RODIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RWMT(8),SEINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BOUNO,DREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NOAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MTH(6),ETO(372),PPT(372),RAO(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAO(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),OCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKOAT), (BLOCK(1880),81MTH(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKOAT,VEGTYP
C-----THE NATURAL RESPONSE UNIT STARTS AS 100 PERCENT OF THE PLANNING
C----- UNIT AND IS REDUCED AS MANAGEMENT PLANS ARE INTRODUCED
RWMT(1) = 1.0
RODIST(1) = 1.0
RUNUM(1) = D
C-----DEFINE THE COVER DENSITY, TRANSMISSIVITY COEFFICIENT, ETC., FROM
C----- THE BASIC FILE
TCOEFF(1) = BLOCK(1862)
COVEN(1) = BLOCK(1863)
DECIO(1,1) = BLOCK(1869)
DECIO(2,1) = BLOCK(1870)
PREWEQ(1) = BLOCK(1874)
RECHRG(1) = BLOCK(1875)
RCHRG = RECHRG(1)
WEO = PREWEQ(1)
C-----SEE SUBROUTINE TRENDS FOR DEVELOPMENT OF THE EQUATION BELOW
REGROW (2,1) = 1.0 - (0.5 * EXP (-1.609437912 * COVEN(1)/COMAX))
REGROW (1,1) = 0.5
CALDEF(1) = 0.0
OREADY(1) = 0.0
ENGBAL(1) = 0.0
FREWAT(1) = 0.0
LASUSO(1) = 0.0
NDYSNO(1) = 0.0
ONTRES(1) = 0.0
PHASE(1) = 0
SIMTMI(1,1) = 0.0
SIMTMI(2,1) = 0.0

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SIMTMI(3,1) = 1.5
TYPCUT(1) = 0
NUNIT = 1
RETURN
END

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Subroutine NORM

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SUBROUTINE NORM
C-----TRANSFER THE YEARLY RESULTS OF THE NORMAL SIMULATION TO THE
C-----PLANNING UNIT FILE
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNDPT(19),PLUNIT(6),
1 RECOVR,REGION(8),RECDDPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNDPT,PLUNIT,RECOVR,REGION,REGDPT,SAVE,SEDRN2
COMMON/UTILITY/BLCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),81MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
REWIND 11
REWIND 12
DO 30 I = 1,NYEARS
CALL GETREC (11,BLOCK,1889,IEND)
IF(IEND) 10,20
10 J = I - 1
WRITE (6,91D) NYEARS,J
91D FORMAT('OTHE REGION CARD SPECIFIES'14,* YEARS, BUT THERE ARE ONLY*
1 14,* ON -DATFIL-- JOB ADRTED*)
CALL ADRT
C-----BLCK(1116) = ACCUMULATED PRECIP ON 9/30
20 WRITE (12,92D) BLCK(1),BLCK(1876),BLCK(1116), (BLOCK(K),K=1877,
1 1889)
92D FORMAT(' 016F6.2)
30 CONTINUE
RETURN
END

```

Subroutine RDPLAN

```

SUBROUTINE RDPLAN
C-----READ A MANAGEMENT PLAN CARD
COMMON/M/ALTYR(8),BDUND(6,8),CALDEF(8),CDVDEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXP(8),EXPK(8),FREWAT(8),LASTI,
2 LASUSD(8),LCOPY(14),NDYSND(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWED(8),RDIST(8),RDMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEDINC,SEEDAT(2),SEEDYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BDUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/UTILITY/BLCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),81MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
C-----READ THE CARD
READ (19) NAME,NUM,NEXTYR,PARAM,SPECCD
IF(NAME,ED,10HEND OF STR) 10,20
10 NEXTYR = 9999
RETURN
20 LASTI = NEXTYR
C-----IF A SPECIFIED COVER DENSITY IS INCLUDED, FLAG IT WITH A MINUS
IF(SPECCD,NE,D,G) PARAM(2) = - SPECCD
RETURN
END

```

Subroutine SIM1YR

```

SUBROUTINE SIM1YR
C-----SIMULATE ONE YEAR
COMMON/M/ALTYR(8),BDUND(6,8),CALDEF(8),CDVDEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXP(8),EXPK(8),FREWAT(8),LASTI,
2 LASUSD(8),LCOPY(14),NDYSND(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWED(8),RDIST(8),RDMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEDINC,SEEDAT(2),SEEDYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BDUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/UTILITY/BLCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),81MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
COMMON/WTRAL/ALLOW,ETFRDM,EVAPTR,GENRO,PEAKEO,PRECIP,RADIN,
1 RADLWN,RDSDWN,TMPMAX,TMPMIN,WATRIN
YRTOT(1) = 0.0
YRTOT(2) = 0.0
YRTOT(3) = 0.0
YEAR = BLOCK(1)
DO 10 I = 1,NUNIT
10 DREADY(I) = 0

```

```

C-----PERFORM THE SIMULATION
PPTNOW = 0.0
PEAKEO = 0.0
DO 90 NDAY = 1,372
IF(TMAX(NDAY) + 1.50) 33,90
C-----DEFINE THE DRIVING VARIABLES
30 TMPMAX = TMAX(NDAY)
TMPMIN = TMIN(NDAY)
PPTNRM = PPT(NDAY) - PPTNOW
PPTNOW = PPT(NDAY)
RADIN = RAD(NDAY)
WE(NDAY) = 0.0
RO(NDAY) = 0.0
C-----DO NOT ALLOW INTERCEPTION IN JULY AND AUGUST
ALLOW = 1.0
IF(NDAY,GE,280,AND,NDAY,LE,341) ALLOW = 0.0
IF(NDAY,ED,PEKDAT) PEAKEO = 1.0
C-----WATCH FOR DECIDUOUS FORESTS AND THEIR CHANGE OF SEASONS
IF(VEGTYP,ED,3,OR,VEGTYP,ED,4) CALL DECDS
C-----MAKE A PASS THROUGH THE WATER BALANCE ROUTINES FOR EACH RESPONSE
C-----UNIT
DO 60 I = 1,NUNIT
PRECIP = PPTNRM
EVAPTR = ETO(NDAY)
C-----IF NECESSARY, ADJUST THE PRECIP
IF(SEEDYR(1) - YEAR) 40,40,50
40 IF(SEEDYR(2).LT.YEAR,OR,SEEDAT(1).GT.NDAY,OR,SEEDAT(2).LT.NDAY) GO
1 TO 50
PRECIP = PRECIP * SEDINC
50 PRECIP = PRECIP * RDIST(1)
CANREF = REGROW(2,I)
CONAV = REGROW(1,I)
CALL MATBAL (CALDEF(1),CDMAX,CDVDEN(1),DREADY(1),ENGBAL(1),
1 FREWAT(1),LASUSD(1),NDYSND(1),ONTRES(1),PHASE(1),PREWED(1),
2 RECHRG(1),SIMTMI(1,1),SIMTMI(2,1),SIMTMI(3,1),TCOEFF(1),
3 TMPMLT,TRSHLD,VEGTYP,WILTP)
C-----STORE THESE RESULTS
WE(NDAY) = WE(NDAY) + (PREWED(1) * RUWT(1))
RO(NDAY) = RO(NDAY) + (GENRO * RUWT(1))
YRTOT(2) = YRTOT(2) + (PRECIP * RUWT(1))
YRTOT(3) = YRTOT(3) + (EVAPTR * RUWT(1))
60 CONTINUE
YRTOT(1) = YRTOT(1) + RO(NDAY)
C-----WATCH FOR THE MANDATORY ISOTHERMAL DATE
IF(ISOTRM - NDAY) 90,70
70 DO 80 I = 1,NUNIT
DREADY(I) = -1
80 CALDEF(I) = 0.0
90 CONTINUE
RETURN
END

```

Subroutine SLIST

```

SUBROUTINE SLIST (YRALT)
C-----LIST THE MANAGEMENT STRATEGY
COMMON/M/ALTYR(8),BDUND(6,8),CALDEF(8),CDVDEN(8),CUT(8),
1 DECIDS(2,8),DREADY(8),ENGBAL(8),EXP(8),EXPK(8),FREWAT(8),LASTI,
2 LASUSD(8),LCOPY(14),NDYSND(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWED(8),RDIST(8),RDMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEDINC,SEEDAT(2),SEEDYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BDUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/S/ASDIL(1),DECLIN(1),NRADS,RATNRM(1),ROADM(1),
1 ROADW(1),TANCUT(1),TANFIL(1),TANRHO(1),YRCNST(1)
INTEGER YRCNST
COMMON/UTILITY/BLCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RO(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAD(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 CDMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLD), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTP), (BLOCK(1871),DCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKDAT), (BLOCK(1880),81MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKDAT,VEGTYP
INTEGER YRALT
IPRINT = 0
C-----CHECK FOR CLOUD SEEDING
IF(YRALT - SEEDYR(1)) 20,10
10 CALL GDATE (SEEDAT(1),DATES(1))
CALL GDATE (SEEDAT(2),DATES(3))
WRITE (18,91D) SEEDYR,SEDINC,DATES
91C FORMAT('01Y YEAR'14,* AND THROUGH YEAR'14,* CLOUD SEEDING MULTIPL
1IES PPT BY'F5.2,* BETWEEN'13,*'12,* AND'13,*'12,**)
IPRINT = 1
C-----CHECK THE YEAR OF THE MANAGED RESPONSE UNITS
20 IF(NUNIT - 2) 80,30,30
30 DO 70 I = 1,NUNIT
IF(YRALT - ALTYR(I)) 70,40
40 IPRCNT = (CUT(I) * 100.) / 0.5
IF(IPRINT) 50,60
50 WRITE (18,92D) RUNUM(1),RUWT(1),IPRCNT
92D FORMAT(13X'DN RESPONSE UNIT'16,* (AREA WEIGHT =F5.2,*)'14,* PERC
1ENT OF THE CURRENT COVER DENSITY WAS REMOVED,*)
GO TO 70
60 WRITE (18,93C) YPALT,RUNUM(1),RUWT(1),IPRCNT
93C FORMAT('01Y YEAR'14,* DN RESPONSE UNIT'16,* (AREA WEIGHT =F5.2,*)
1'14,* PERCENT OF THE CURRENT COVER DENSITY WAS REMOVED,*)
IPRINT = 1
70 CONTINUE
C-----CHECK FOR ROAD CONSTRUCTION
80 IF(NRADS) 90,150
90 DO 140 I = 1,NROADS
IF(YRALT - YRCNST(I)) 140,100
100 IPRCNT = (TANRHO(I) * 100.) / 0.5
IF(IPRINT) 120,110
110 WRITE (18,94C) YRALT,ROADW(1),ROADM(1),IPRCNT
94C FORMAT('01Y YEAR'14,* ROAD CONSTRUCTION CREATED'F6.1,* MILES OF RD
1AD AVERAGING'F5.1,* FEET WIDE THROUGH AN AVERAGE SIDESLOPE OF'13,
2 * PERCENT,*)
IPRINT = 1

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GO TO 130
120 WRITE (18,950) ROADMI(1),ROADW(1),IPRNT
950 FORMAT(13X,ROAD CONSTRUCTION CREATED*F6.1,* MILES OF ROAD AVERAGING
10F5.1,* FEET WIDE THROUGH AN AVERAGE SLOPE OF*13,* PERCENT.%)
130 IPRNT = (TANCL(1) * 100.1) + 0.5
JPRNT = (TANFL(1) * 100.1) + 0.5
WRITE (18,960) IPRNT,JPRNT,RATNR(1),AVSOIL(1),DECLIN(1)
960 FORMAT(14X,THE SLOPES OF CUT AND FILL AVERAGED*13,* ANO*13,* PERCE
INT, RESPECTIVELY. THE ESTIMATE OF THE LONG-TERM NORMAL*/14X*EROSI
20N RATE WAS*F7.2,*, THE INDEX OF THE AMOUNT OF SOIL AVAILABLE FOR
3EROSION WAS*F7.2,*, AND THE INDEX OF THE*/14X*RATE OF DECLINE OF E
4ROSION FOLLOWING DISTURBANCE WAS*F7.2,*,*)
140 CONTINUE
150 RETURN
END

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Subroutine TITLME

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SUBROUTINE TITLME
C-----PRINT THE TITLE SHEET
COMMON OATIME(2),OECMAL,NRMANG,NSAVEQ,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVER,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER OATIME,PLNOPT,PLUNIT,RECOVER,REGION,REGOPT,SAVE,SEORN2
COMMON/M/ALTYR(8),BOUND(6,8),CALOEF(8),COVOEN(8),CUT(8),
1 DECLOS(2,8),OREADY(8),ENGBAL(8),EXPK(8),EXPKI(8),FREWAT(8),LAST1,
2 LASUSD(8),LCOPY(14),NOYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),ROIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEQINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BOUND,OREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
COMMON/TIME/CANREF,COMAX2,CONAV
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAOI(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAOI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),OCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKAO), (BLOCK(1880),B1MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKAO,VEGTYP
WRITE (6,910) PLUNIT,OATIME
910 FORMAT(14,610,52X240/115X*ALTERED CONDITIONS*)
RUNUM(1) = 10H NATURAL
WRITE (6,920) (RUNUM(I),I=1,NUNIT)
920 FORMAT(*ORESPONSE UNIT NUMBER*10X10,710)
RUNUM(1) = 0
WRITE (6,921) (RUWT(I),I=1,NUNIT)
921 FORMAT(*PERCENT OF PLAN UNIT*10X8F10.2)
IF(NUNIT - 2) 20,10,10
10 WRITE (6,922) (ALTYR(I),I=2,NUNIT)
922 FORMAT(* YEAR OF CUT *20X7F10)
WRITE (6,923) (CUT(I),I=2,NUNIT)
923 FORMAT(* PERCENT OF CUT *20X7F10.2)
WRITE (6,924) (ROIST(I),I=1,NUNIT)
924 FORMAT(* PRECIP REOIST FACTOR*10X8F10.2)
WRITE (6,925) (BOUND(5,I),I=2,NUNIT)
925 FORMAT(* CHANGE STARTS IN *20X7F10)
WRITE (6,926) (BOUND(6,I),I=2,NUNIT)
926 FORMAT(* CHANGE ENDS IN *20X7F10)
WRITE (6,927) (REGROW(I),I=2,NUNIT)
927 FORMAT(* REGROWTH-AVAIL WATER*20X7F10.2)
WRITE (6,928) (BOUND(1,I),I=2,NUNIT)
WRITE (6,929) (BOUND(2,I),I=2,NUNIT)
WRITE (6,928) (REGROW(2,I),I=2,NUNIT)
928 FORMAT(* REGROWTH-REFLECTIVITY*20X7F10.2)
WRITE (6,925) (BOUND(3,I),I=2,NUNIT)
WRITE (6,926) (BOUND(4,I),I=2,NUNIT)
20 WRITE (6,930) (TCOEFF(I),I=1,NUNIT)
930 FORMAT(* TRANSMISSIVITY COEFF*10X8F10.2)
WRITE (6,931) (COVOEN(I),I=1,NUNIT)
931 FORMAT(* COVER DENSITY *10X8F10.2)
TMPMLT = (TMPMLT * 1.8) + 32.
WRITE (6,932) COMAX,VEGTYP,TRSHLO,TMPMLT,WILTPT
932 FORMAT(* MAXIMUM COVER DEN *10XF10.2/
1 * VEGETATION TYPE *10X10 / * REFLECTIVITY THRSLO*10XF10.2/
2 * MELT THRSLO *10XF10.2/ * WILTING POINT *10XF10.2)
IF(VEGTYP.NE.3) GO TO 30
WRITE (6,940) (DECLOS(I),I=1,NUNIT)
940 FORMAT(* DECIDUOUS WINTER TC *10X8F10.2)
WRITE (6,941) (DECLOS(2,I),I=1,NUNIT)
941 FORMAT(* DECIDUOUS WINTER CO *10X8F10.2)
WRITE (6,942) OCOMAX
942 FORMAT(* DECIDUOUS WNTN COMAX*10XF10.2)
30 WRITE (6,950) (SIMTMI(2,I),I=1,NUNIT)
950 FORMAT(*INITIAL CONDITIONS*/4 AVERAGE PACK TEMP. *10X8F10.2)
WRITE (6,951) (PREWEQ(I),I=1,NUNIT)
951 FORMAT(* PACK WATER EQUIV. *10X8F10.2)
WRITE (6,952) (RECHRG(I),I=1,NUNIT)
952 FORMAT(* RECHARGE REQUIREMENT*10X8F10.2)
IF(SEEOYR(1) - 9999) 40,50
40 CALL GOATE (SEEOAT(1),DATES(1))
CALL GOATE (SEEOAT(2),DATES(3))
WRITE (6,960) SEEOYR,DATES,SEQINC
960 FORMAT(*CLOUD SEEDING FROM *14,* TO *14,*, DAYS *12,*/*12,* TO *
1 12,*/*12,*, WITH A FACTOR OF *F6.2)
50 RETURN
END

```

Subroutine BALANC

```

SUBROUTINE BALANC
C-----BALANCE THE REDISTRIBUTION FACTORS
COMMON/M/ALTYR(8),BOUND(6,8),CALOEF(8),COVOEN(8),CUT(8),
1 DECLOS(2,8),OREADY(8),ENGBAL(8),EXPK(8),EXPKI(8),FREWAT(8),LAST1,
2 LASUSD(8),LCOPY(14),NOYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),ROIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEQINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)

```

```

INTEGER ALTYR,BOUND,OREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
IF(NUNIT - 2) 10,20,20
10 RETURN
C-----ACCUMULATE THE WEIGHTS FOR THE AREAS ON WHICH THERE IS
C----- REDISTRIBUTION WHILE CALCULATING THE REMAINING RORTION FOR THE
C----- OTHER AREAS
20 ROSTW = 1.0
REMAIN = 1.0
DO 40 N = 2,NUNIT
IF(TYPCUT(N)) 30,40
30 ROSTW = ROSTW + RUWT(N)
REMAIN = REMAIN - (ROIST(N) * RUWT(N))
40 CONTINUE
IF(ABS(REMAIN).LT.0.01) REMAIN = 0.0
IF(REMAIN) 50,60,60
50 WRITE (6,910)
910 FORMAT(*THE REDISTRIBUTION OF THE PRECIP TOTALS MORE THAN 100 PER
CENT - JOB ABORTED*)
CALL ABORT
C-----CALCULATE THE CORRESPONDING EFFECT ON PRECIP FOR THE NATURAL UNIT
C----- AND THOSE WHERE REDISTRIBUTION WAS NOT SPECIFIED
60 REST = 1.0
RSTWT = 1.0
IF(REST) 70,70,80
70 EFFECT = 0.0
GO TO 90
80 EFFECT = REMAIN/REST
C-----DEFINE THE REDISTRIBUTION FACTORS FOR THOSE AREAS
90 DO 110 N = 1,NUNIT
IF(TYPCUT(N)) 110,100
100 ROIST(N) = EFFECT
110 CONTINUE
RETURN
END

```

Subroutine GBOUND

```

SUBROUTINE GBOUND(N)
C-----GET THE BOUNDARY YEARS - IIF NOT SPECIFIED, USE THE ASSUMED
C----- VALUES)
COMMON/M/ALTYR(8),BOUND(6,8),CALOEF(8),COVOEN(8),CUT(8),
1 DECLOS(2,8),OREADY(8),ENGBAL(8),EXPK(8),EXPKI(8),FREWAT(8),LAST1,
2 LASUSD(8),LCOPY(14),NOYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEQ(8),ROIST(8),ROMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEQINC,SEEOAT(2),SEEOYR(2),
5 SIMTMI(3,8),TCOEFF(8),TYPCUT(8)
INTEGER ALTYR,BOUND,OREADY,PHASE,RUNUM,SEEOAT,SEEOYR,TYPCUT
COMMON/TIME/CANREF,COMAX2,CONAV
COMMON/UTILITY/BLOCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,ROI(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(6),ETO(372),PPT(372),RAOI(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLOCK(2),TMAX(1)),(BLOCK(374),TMIN(1)),(BLOCK(746),
1 PPT(1)),(BLOCK(1118),RAOI(1)),(BLOCK(1490),ETO(1)),(BLOCK(1864),
2 COMAX), (BLOCK(1865),VEGTYP), (BLOCK(1866),TRSHLO), (BLOCK(1867),
3 TMPMLT), (BLOCK(1868),WILTPT), (BLOCK(1871),OCOMAX), (BLOCK(1872),
4 ISOTRM), (BLOCK(1873),PEKAO), (BLOCK(1880),B1MNT(1)),
5 (BLOCK(1886),PEAKWE), (BLOCK(1888),PEAKRO)
INTEGER PEKAO,VEGTYP
INTEGER YRPAST
DIMENSION ASSUMO(7,3)
C-----LOGGEPLE PINE
DATA ASSUMO(1,1),ASSUMO(2,1),ASSUMO(3,1),ASSUMO(4,1),ASSUMO(5,1),
1 ASSUMO(6,1),ASSUMO(7,1)/15.,80.,0.,40.,40.,120.,0./
C-----SPRUCE-FIR
DATA ASSUMO(1,2),ASSUMO(2,2),ASSUMO(3,2),ASSUMO(4,2),ASSUMO(5,2),
1 ASSUMO(6,2),ASSUMO(7,2)/30.,100.,0.,80.,80.,160.,0./
C-----ASPEN
DATA ASSUMO(1,3),ASSUMO(2,3),ASSUMO(3,3),ASSUMO(4,3),ASSUMO(5,3),
1 ASSUMO(6,3),ASSUMO(7,3)/7.,60.,0.,20.,20.,80.,0./
COMAX2 = COMAX/2.0
C-----IF THE CUT IS LESS THAN 50 PERCENT, IT IS ASSUMED THAT THE
C----- PATCH CUT TRANSITION LEVEL OF THE FOREST IS ZERO
IF(COMAX2 - COVOEN(N)) 10,10,20
10 BOUND(1,N) = ALTYR(N) - 1
BOUND(2,N) = BOUND(1,N)
BOUND(3,N) = BOUND(1,N)
BOUND(4,N) = BOUND(1,N)
BOUND(5,N) = BOUND(1,N)
BOUND(6,N) = BOUND(1,N)
ROMAX(N) = 0.0
ROIST(N) = 1.0
TYPCUT(N) = 0
RETURN
C-----USE THE ASSUMED VALUES IF ALL PARAMETERS ARE BLANK
20 DO 40 I = 1,6
IF(PARAM(I+2)) 50,30
30 BOUND(I,N) = ASSUMO(I,VEGTYP)
40 CONTINUE
ROMAX(N) = ASSUMO(7,VEGTYP)
GO TO 70
C-----SINCE AT LEAST ONE OF THE PARAMETERS WAS SPECIFIED, USE THEM ALL
50 DO 60 I = 1,6
BOUND(I,N) = PARAM(I+2)
C-----CERTIFY THAT THE ENDING YEARS FOLLOW THE BEGINNING YEARS
IF(1.EQ.1.OR.1.EQ.3.OR.1.EQ.5) GO TO 60
IF(BOUND(I-1,N).LT.BOUND(I,N)) GO TO 60
WRITE (6,910) ALTYR(N),RUNUM(N),BOUND(I,N),BOUND(I-1,N)
910 FORMAT(*MANAGEMENT PLAN CARO ERROR - YEAR*14,*, RESPONSE UNIT*16,
1 *, ENDING YEAR*14,*, DOES NOT FOLLOW BEGINNING YEAR*14,* - JOB ABO
RTED*)
CALL ABORT
60 CONTINUE
ROMAX(N) = PARAM(9)
C-----DEFINE PHI SQUARED FOR THE REFLECTIVITY AND COVER DENSITY FUNCTION
70 PHISO(N) = (BOUND(4,N) - BOUND(3,N)) ** 2
C-----IF THIS IS A THINNING CUT RATHER THAN A PATCH CUT, ADJUST THE
C----- BOUNDARIES TO COMPENSATE (THIS ALLOWS THE REMOVAL OF THE
C----- OVERSTORY, BUT LEAVES A STAND WHICH, IN TERMS OF THE SIMULATION
C----- FUNCTIONS, IS ALREADY IN THE PROCESS OF REGROWTH)
IF(COVOEN(N)) 100,100,80
80 YRPAST = SORT ((COVOEN(N) * PHISO(N))/COMAX) + 0.5
DO 90 I = 1,6
90 BOUND(I,N) = BOUND(I,N) - YRPAST

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C-----DEFINE THE BOUNDARIES IN TERMS OF THE YEAR OF TREATMENT
100 DD 110 I = 1+6
110 ROUNDI(1,N) = BOUND(1,N) + ALTYR(N)
C-----COMPUTE THE K FOR THE INVERSE EXPONENTIAL FUNCTION REPRESENTING
C-----THE AVAILABLE SOIL WATER FACTOR
C-----GIVEN THAT  $\tau = M \cdot \exp(-K \cdot (T-TC))$ , AT TIME T = FULL REGROWTH,  $\tau$ 
C-----BECOMES M/2. THUS,
C----- $M/2 = M \cdot \exp(-K \cdot (T-TC))$ , WHICH YIELDS
C----- $1/2 = \exp(-K \cdot (T-TC))$ , UPON TAKING THE NATURAL LOG,
C----- $\ln(1/2) = -K \cdot (T-TC)$ , OR
C----- $K = -\ln(1/2) / (T-TC)$ 
C----- $EXP(K) = 0.6931471905 / (T-TC)$ 
C-----COMPUTE THE K FOR THE INVERSE EXPONENTIAL FUNCTION REPRESENTING
C-----THE PRECIP REDISTRIBUTION
C-----GIVEN THAT  $RHD = RHD(MAX) \cdot \exp(-K1 \cdot (T-TC))$ , AT TIME T = FULL
C-----REGROWTH, RHD MUST APPROACH ZERO (ASSUME 1 PERCENT). HENCE,
C----- $0.01 = RHD(MAX) \cdot \exp(-K1 \cdot (T-TC))$ , UPON TAKING THE NATURAL LOG,
C----- $\ln(0.01/RHD(MAX)) = -K1 \cdot (T-TC)$ , OR
C----- $K1 = -\ln(0.01/RHD(MAX)) / (T-TC)$  (WATCH FOR RHD(MAX) = 0)
IF(RD(MAXIN)) 130,120,130
120 BOUND(5,N) = ALTYR(N) - 1
BOUND(4,N) = ALTYR(N) - 1
RETURN
130 EXPK1(N) = -ALOG(0.01/ABS(RD(MAXIN))) / (T-TC)
TYPCUT(N) = 1
RETURN
END

```

Subroutine TRENDS

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SUBROUTINE TRENDS
C-----DETERMINE THE EFFECTS OF THE TIME TRENDS
COMMON/H/ALTYR(18),BOUND(16,8),CALDEF(8),COVDEN(8),CUT(8),
1 DECIDS(2,8),OREADY(8),ENGBAL(8),EXPK(8),EXPK1(8),FREWAT(8),LASTI,
2 LASUD(8),LCOPY(14),NOYSNO(8),NEXTYR,NPLAN,NUM,NUNIT,ONTRES(8),
3 PARAM(9),PHASE(8),PHISO(8),PREWEO(8),RDIST(8),RDMAX(8),RECHRG(8),
4 REGROW(2,8),RUNUM(8),RUWT(8),SEINC,SEEDAT(2),SEEDYR(2),
5 SIMPL(3,8),TCOFF(8),TYPCUT(8)
INTEGER ALTYR,BOUND,DREADY,PHASE,RUNUM,SEEDAT,SEEDYR,TYPCUT
COMMON/TIME/CANREF,CDMAX2,CONAV
COMMON/UTILITY/BLDCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RD(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(16),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLDCK(2),THAX(1)),(BLDCK(374),TMIN(1)),(BLDCK(746),
1 PPT(1)),(BLDCK(1118),RAD(1)),(BLDCK(1490),ETO(1)),(BLDCK(1864),
2 COMAX), (BLDCK(1865),VEGTYP), (BLDCK(1866),TRSHLD), (BLDCK(1867),
3 TMPMLT), (BLDCK(1868),WILTP), (BLDCK(1871),DCOMAX), (BLDCK(1872),
4 ISDTRM), (BLDCK(1873),PEKAT), (BLDCK(1880),B1MNT(1)),
5 BLDCK(1886),PEAKWE), (BLDCK(1888),PEAKRD)
INTEGER PEKAT,VEGTYP
IF(NUNIT - 2) 10,20,20
10 RETURN
20 DD 170 N = 2,NUNIT
C-----AVAILABLE SOIL WATER ADJUSTMENT (ACCOUNTS FOR INCREASED CANOPY
C-----DENSITY AND ROOTING DEPTH)
C-----REGROW(1,N) WILL BE -CDNAV-
IF(YEAR - BOUND(1,N)) 30,30,40
C-----THE CUT AREA IS STILL TO BE CONSIDERED AS AN OPENING
30 REGROW(1,N) = 1.0
GO TO 70
40 IF(BOUND(2,N) - YEAR) 50,50,60
C-----REGROWTH IS COMPLETE AS FAR AS THIS FACTOR IS CONCERNED
50 REGROW(1,N) = 0.5
GO TO 70
C-----REGROWTH HAS OCCURRED, BUT IS NOT COMPLETE
60 REGROW(1,N) = EXP(-EXPK(N)) * (FLOAT(YEAR - BOUND(1,N)))
WRITE (17,910) YEAR,RUNUM(N),REGROW(1,N)
910 FORMAT(' AFTER THE GROWING SEASON OF WATER YEAR*14,* DN RESPONSE U
INIT*16,*, THE AVAILABLE WATER FACTOR IS*F5.2)
C-----CANOPY REFLECTIVITY ADJUSTMENT AND COVER DENSITY
C-----REGROW(2,N) WILL BE -CANREF-
70 IF(BOUND(4,N) - YEAR) 80,90,90
C-----REGROWTH IS COMPLETE AS FAR AS THE CANOPY REFLECTIVITY IS
C-----CONCERNED
80 REGROW(2,N) = 1.0 - (0.5 * EXP(-1.609437912 * COVDEN(N)/COMAX))
GO TO 120
C-----REGROWTH HAS OCCURRED, BUT IS NOT COMPLETE
C-----GIVEN THAT  $RF = RFO \cdot \exp(-DMEGA \cdot COMAX \cdot T^2 / PHISO^2)$ , AT TIME T =
C-----PHI,  $RF = RFO \cdot \exp(-DMEGA \cdot COMAX)$ , AT TIME PHI, THE MAXIMUM
C-----COVER DENSITY HAVE BEEN REACHED. HENCE,  $RF = 0.1$  (RFO IS A
C-----CONSTANT 0.5), WHICH YIELDS
C----- $0.1 = 0.5 \cdot \exp(-DMEGA \cdot COMAX)$ , OR
C----- $0.2 = \exp(-DMEGA \cdot COMAX)$ , UPON TAKING THE NATURAL LOG,
C----- $\ln(0.2) = -DMEGA \cdot COMAX$ , WHICH YIELDS
C----- $DMEGA = -\ln(0.2) / COMAX$ , SUBSTITUTION PRODUCES
C----- $RF = 0.5 \cdot \exp(-1.609437912 / PHISO^2)$ 
C-----THE VARIABLE -CANREF- IS DEFINED TO BE 1 - RF
90 IF(YEAR - BOUND(3,N)) 100,100,110
C-----THE CUT AREA IS STILL AN OPENING
100 REGROW(2,N) = 0.5
GO TO 120
110 TBYPHI = (FLOAT(YEAR - BOUND(3,N)) * 2) / PHISO(N)
REGROW(2,N) = 1.0 - (0.5 * EXP(-1.609437912 * TBYPHI))
COVDEN(N) = CDMAX * TBYPHI
TCOFF(N) = TC(COVDEN(N))
WRITE (17,920) YEAR,RUNUM(N),REGROW(2,N),COVDEN(N)
920 FORMAT(' AFTER THE GROWING SEASON OF WATER YEAR*14,* DN RESPONSE U
INIT*16,*, THE CANOPY REFLECTIVITY FACTOR IS*F5.2,*, COVER DENSITY
IS*F5.2)
IF(VEGTYP.NE.3.AND.VEGTYP.NE.4) GO TO 120
DECIDS(2,N) = CDMAX * TBYPHI
DECIDS(1,N) = TC(DECIDS(2,N))
WRITE (17,930) DECIDS(2,N)
930 FORMAT(' WITH A WINTER COVER DENSITY OF*F5.2)
C-----REDISTRIBUTION
120 IF(YEAR - BOUND(5,N)) 130,140,140
C-----MAXIMIZE REDISTRIBUTION
130 RDIST(N) = 1.0 + RDMAX(N)
GO TO 170
140 IF(BOUND(6,N) - YEAR) 150,150,160
C-----REGROWTH IS COMPLETE

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150 RDIST(N) = 1.0
TYPCUT(N) = 0
GO TO 170
C-----ADJUST THE REDISTRIBUTION
160 RDIST(N) = 1.0 + (RDMAX(N) * EXP(-EXPK1(N) * FLOAT(YEAR - BOUND(5,N)
1)))
WRITE (17,940) YEAR,RUNUM(N),RDIST(N)
940 FORMAT(' AFTER THE GROWING SEASON OF WATER YEAR*14,* DN RESPONSE U
INIT*16,*, THE PRECIP REDISTRIBUTION FACTOR IS*F5.2)
170 CONTINUE
C-----BALANCE THE REDISTRIBUTION FACTORS
CALL BALANC
RETURN
END

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Program SEDMOD

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OVERLAY (OLAYS,2,3)
PROGRAM SEDMOD
C-----SEDIMENT YIELD MODEL
COMMON/DATHE/DATE(2),DECAL,NRMANG,NSAVED,NYEARS,PLNDPT(19),PLUNIT(6),
1 RECOV,REGDIN(1),REGDPT(5),SAVE,SEDRN2,WFGHT
INTEGER DAT(HE,PLNDPT,PLUNIT,RECOV,REGION,REGDPT,SAVE,SEDRN2
COMMON/S/AVSDIL(11),DECL(N(11),NRDADS,RATNRM(11),RDADM(11),
1 RDADM(11),TANCUT(11),TANFIL(11),TANRHD(11),YRCNST(11)
INTEGER YRCNST
COMMON/UTILITY/BLDCK(1889),CHANGR,CHANGW,DATE(2),DATES(4),LINES,
1 NAME,NDAY,RCHRG,RD(372),WE(372),WEO,YEAR,YRTOT(3)
INTEGER DATE,DATES,YEAR
DIMENSION B1MNT(16),ETO(372),PPT(372),RAD(372),TMAX(372),TMIN(372)
EQUIVALENCE (BLDCK(2),THAX(1)),(BLDCK(374),TMIN(1)),(BLDCK(746),
1 PPT(1)),(BLDCK(1118),RAD(1)),(BLDCK(1490),ETO(1)),(BLDCK(1864),
2 COMAX), (BLDCK(1865),VEGTYP), (BLDCK(1866),TRSHLD), (BLDCK(1867),
3 TMPMLT), (BLDCK(1868),WILTP), (BLDCK(1871),DCOMAX), (BLDCK(1872),
4 ISDTRM), (BLDCK(1873),PEKAT), (BLDCK(1880),B1MNT(1)),
5 BLDCK(1886),PEAKWE), (BLDCK(1888),PEAKRD)
INTEGER PEKAT,VEGTYP
DIMENSION LCDPY(14),NCDL(165),DNELIN(11),SEONAT(165,11),
1 SEDINC(165,11)
INTEGER CODE(11),POINT(121),YEARS(165)
C-----EQUIVALENCE ARRAYS TO SAVE STORAGE REQUIREMENTS
EQUIVALENCE (BLDCK,SEONAT), (RD,NCDL), (WE,YEARS)
DATA CODE/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HA,1HB/
C-----COPY THE DESCRIPTION OF THE STRATEGY
REWIND 18
GO TO 3
1 WRITE (6,903) LCDPY
903 FORMAT(13A10,A6)
3 READ (18,903) LCDPY
IF(EOF(18)) 5,1
5 REWIND 18
END FILE 18
REWIND 12
C-----DEFINE THE COLUMN COUNTER AND THE YEARS
DD 10 I = 1,NYEARS
NCDL(I) = 0
10 READ (12,906) YEARS(I)
906 FORMAT(2X13)
C-----CALCULATE THE ACCUMULATED SEDIMENT FOR THE DISTURBED AREA AS
C-----THOUGH IT REMAINED IN ITS NATURAL STATE, THEN CALCULATE THE
C-----INCREASE
DO 50 J = 1,NRDADS
CDNST = (RDADM(I)/2.0) * TANRHD(I)
DISTRB = 0.121 * RDADM(I) * (RDADM(I) +
1 (CDNST/(TANFIL(I) - TANRHD(I))) +
2 (CDNST/(TANCUT(I) - TANRHD(I))))
C-----PLACE THIS YEAR IN THE TABLE
DD 20 J = 1,NYEARS
K = J
IF(YRCNST(I) - YEARS(J)) 20,30
20 CONTINUE
C-----CALCULATE THE VALUES FOR THE FIRST YEAR, THEN THE REMAINING YEARS
30 SEONAT(K,1) = DISTRB * RATNRM(I)
CDNST = DISTRB * AVSDIL(I)
SEINC(K,1) = CDNST * (1.0 - EXP(-DECLIN(I)))
NCDL(K) = 1
L = K + 1
IF(L.GT.NYEARS) GO TO 45
DECTIM = DECLIN(I)
RATTIM = SEONAT(K,I)
DD 40 J = L,NYEARS
SEONAT(J,1) = SEONAT(J-1,1) + RATTIM
DECTIM = DECTIM + DECLIN(I)
SEINC(J,1) = CDNST * (1.0 - EXP(-DECTIM))
NCDL(J) = 1
40 CONTINUE
45 IF(1.EQ.1) GO TO 50
L = L - 1
DD 46 J = K,NYEARS
SEONAT(J,1) = SEONAT(J,1) + SEONAT(J,L)
46 SEINC(J,1) = SEINC(J,1) + SEINC(J,L)
50 CONTINUE
60 IPASS = 1
NAMESD = IDHCUMULATIVE
C-----PRINT THE COMBINED AMOUNTS, THEN THE INCREASE OVER NATURAL
C-----CONDITIONS
70 DD 120 I = 1,NYEARS,55
WRITE (6,910) PLUNIT,DATE,NAMESD
910 FORMAT('1.6A1G,52X2A1G/113X10,* SED YIELD*/*C*/* YEAR*/*)
N1 = I
N2 = I + 54
IF(N2.GT.NYEARS) N2 = NYEARS
DD 110 Y = N1,N2
IF(NCDL(N)) 90,80
80 WRITE (6,920) YEARS(N)
920 FORMAT(1X15,15X11F10.3)
GO TO 110
90 J1 = NCNL(N)
DD 100 J = 1,J1
SEONAT(N,J) = SEONAT(N,J) + SEINC(N,J)
WRITE (6,920) YEARS(N),DNELIN(J),J=1,J1
110 CONTINUE
120 CONTINUE

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C-----PRINT THE INCREASE OVER NATURAL CONDITIONS
DO 160 I = 1,NYEARS,55
WRITE (6,930) PLUNIT,DATEIME,NAMSED
930 FORMAT(10A10,52X2A10,*) EFFECTS OF TREATMENT COMPARED WITH NATURAL
CONDITIONS (DECREASE INDICATED BY -)*33X10,* SED YIELD*/*0/*
2 * YEAR*/)
N1 = I
N2 = I + 54
IF(N2.GT.NYEARS) N2 = NYEARS
DO 150 N = N1,N2
IF(NCOL(N)) 140,130
130 WRITE (6,920) YEARS(N)
GO TO 150
140 J1 = NCOL(N)
WRITE (6,920) YEARS(N),(SEDCINC(N,J),J=1,J1)
150 CONTINUE
160 CONTINUE
C-----IF THE ANNUAL TOTALS HAVE PRINTED, GO ON TO THE PLOTS. IF NOT,
C-----SET THEM UP AND GO BACK TO PRINT THEM
IF(I.PASS) 170,210
170 IPASS = 0
NAMSED = 10H ANNUAL
C-----COMPUTE THE ANNUAL TOTALS
N2 = NYEARS
N1 = NYEARS - 1
DO 200 I = 2,NYEARS
IF(NCOL(N1)) 180,70
180 J1 = NCOL(N1)
IF(NCOL(N1),EO,NCOL(N2)) GO TO 185
J2 = J1 + 1
SEDNAT(N2,J2) = SEDNAT(N2,J2) - SEDNAT(N1,J1)
SEDCINC(N2,J2) = SEDCINC(N2,J2) - SEDCINC(N1,J1)
185 DO 190 J = 1,J1
SEDNAT(N2,J) = SEDNAT(N2,J) - SEDNAT(N1,J)
190 SEDCINC(N2,J) = SEDCINC(N2,J) - SEDCINC(N1,J)
N2 = N1
N1 = N1 - 1
200 CONTINUE
GO TO 70
C-----PLOT THE ANNUAL INCREASES
210 WRITE (6,930) PLUNIT,DATEIME,NAMSED
WRITE (6,940)
940 FORMAT(0*35X*INCREASE*/* YEAR 0*12(10H.....*))
DO 260 I = 1,NYEARS
DO 220 J = 2,121
220 POINT(I) = 1H
POINT(I) = 1H.
J1 = NCOL(I)
IF(J1 - 1) 250,230,230
230 DO 240 J = 1,J1
K = (SEDCINC(I,J)*0.1) + 1.5
IF(K.GE.1.AND.K.LE.121) POINT(K) = CDOE(J)
240 CONTINUE
C-----PRINT THE LINE OF PLOT
250 WRITE (6,950) YEARS(I),POINT
950 FORMAT(1X14,1X121A1)
260 CONTINUE
C-----RETURN TO THE MAIN OVERLAY
END

```

Program OLDNEW

```

OVERLAY (OLAYS,3,D)
PROGRAM OLDNEW
C-----COPY -SAVOLD- TO -SAVNEW-
COMMON DATEIME(2),DECMAL,NRMANG,NSAVEO,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECDVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER DATEIME,PLNOPT,PLUNIT,RECDVR,REGION,REGOPT,SAVE,SEORN2
DIMENSION BLOCK(1889),I(19)
CALL CORE (-1)
C-----WHEN AN END OF FILE IS SENSED ON AN IO READ, COPYING IS COMPLETE
REWIND 14
10 CALL GETREC (14,IO,9,IEND)
IF(IEND) 60,20
20 CALL PUTREC (15,IO,9)
C-----COPY ALL YEARS
30 CALL GETREC (14,BLOCK,1889,IEND)
IF(IEND) 50,40
40 CALL PUTREC (15,BLOCK,1889)
GO TO 30
50 END FILE 15
GO TO 10
60 CONTINUE
CALL CORE (3)
C-----RETURN TO THE MAIN OVERLAY
END

```

Program COMPLN

```

OVERLAY (OLAYS,4,0)
PROGRAM COMPLN
C-----COMBINE THE MANAGEMENT PLANS INTO ONE PRINTOUT FOR A PLANNING UNIT
C-----AND ADD THE DATA TO THE REGIONAL FILE
COMMON DATEIME(2),DECMAL,NRMANG,NSAVFO,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECDVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER DATEIME,PLNOPT,PLUNIT,RECDVR,REGION,REGOPT,SAVE,SEORN2
COMMON P/PNAME(2,15),NCOL(165),NPLAN,NUM(12),NVAR,OUT(165,12),
1 VAR(15),YEAR(165)
INTEGER YEAR
DIMENSION LCOPY(14)
INTEGER DATES(24)
DATA NAME(1,1),NAME(2,1)/10H GENERA,10HTEO RUNOFF/
DATA NAME(1,2),NAME(2,2)/10H PRE,10HCIPITATION/
DATA NAME(1,3),NAME(2,3)/10H EVAPOTRA,10HNSPIRATION/
DATA NAME(1,4),NAME(2,4)/10HCHANGE IN,10HRECH. REQ./
DATA NAME(1,5),NAME(2,5)/10HCHANGE IN,10H PACK W.E./
DATA NAME(1,6),NAME(2,6)/10H APR 16-,10H30 GEN R O/
DATA NAME(1,7),NAME(2,7)/10H MAY 1-,10H15 GEN R O/
DATA NAME(1,8),NAME(2,8)/10H MAY 16-,10H30 GEN R O/
DATA NAME(1,9),NAME(2,9)/10H JUNE 1-,10H15 GEN R O/

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DATA NAME(1,10),NAME(2,10)/10H JUNE 16-,10H30 GEN R O/
DATA NAME(1,11),NAME(2,11)/10H JULY 1-,10H15 GEN R O/
DATA NAME(1,12),NAME(2,12)/10H ,10H PEAK W E/
DATA NAME(1,13),NAME(2,13)/10H DATE D,10HF PEAK W E/
DATA NAME(1,14),NAME(2,14)/10H PEAK,10H 7-DAY R O/
DATA NAME(1,15),NAME(2,15)/10HDATE, PEAK,10H 7-DAY R O/
CALL CORE (-1)
C-----COPY THE MANAGEMENT STRATEGY DESCRIPTION
REWIND 18
IF(PLNOPT(5),FO,0.AND,PLNOPT(6),EO,0.AND,PLNOPT(7),EO,0.AND,
1 PLNOPT(8),EO,0.AND,PLNOPT(9),EO,C) GO TO 9
GO TO 6
3 WRITE (6,900) LCOPY
900 FORMAT(13A10,A6)
6 REAG (18,900) LCOPY
IF(EOF(18)) 9,3
9 CONTINUE
C-----PRINT THE INDICATED VARIABLES
DO 180 NVAR = 1,15
IF(NVAR.GT.5.AND,PLNOPT(NVAR+4),EO,0) GO TO 180
REWIND 12
C-----READ THE FIRST RECORD
READ (12,910) NUM(1),YEAR(1),VAR
910 FORMAT(12,13,3X15F6.2)
OUT(1,1) = VAR(NVAR)
NCOL(1) = 1
NPLAN = 1
C-----FILL THE FIRST COLUMN
DO 30 I = 2,NYEARS
READ (12,910) MPLAN,IYEAR,VAR
C-----IF THIS IS STILL THE SAME PLAN, STORE THE INFORMATION
10 IF(MPLAN - NUM(1)) 30,20
20 YEAR(I) = IYEAR
OUT(I,NPLAN) = VAR(NVAR)
NCOL(I) = 1
30 CONTINUE
C-----A MAXIMUM OF -NYEARS- YEARS MAY BE SUMMARIZED
READ (12,910) MPLAN,IYEAR,VAR
IF(EOF(12)) 150,40
40 IF(MPLAN - NUM(1)) 80,50
50 WRITE (6,920) YEARS
920 FORMAT(0A MAXIMUM OF 14,* YEARS MAY BE SUMMARIZED - THE BALANCE A
1RE IGNORED*)
60 READ (12,910) MPLAN,IYEAR,VAR
IF(EOF(12)) 150,70
70 IF(MPLAN - NUM(MPLAN)) 80,60
C-----FILL THE NEXT COLUMN (UP TO 12)
80 IF(MPLAN - 12) 100,90,90
90 WRITE (6,930)
930 FORMAT(0A MAXIMUM OF 12 PLANS MAY BE SUMMARIZED - THE BALANCE ARE
1 IGNORED*)
GO TO 150
100 NPLAN = NPLAN + 1
NUM(NPLAN) = MPLAN
C-----FIND THE FIRST YEAR AND STORE IT
DO 110 N = 1,NYEARS
IF(IYEAR - YEAR(N)) 110,120
110 CONTINUE
WRITE (6,940) MPLAN,IYEAR
940 FORMAT(0MANAGEMENT PLAN*14,* STARTS WITH YEAR*14,* WHICH WAS NOT
1PART OF THE ORIGINAL TIME SPAN - JOB ABORTED*)
CALL ABORT
OUT(N,NPLAN) = VAR(NVAR)
NCOL(N) = NCOL(N) + 1
C-----FILL THE REMAINDER OF THE COLUMN
N = N + 1
IF(N - NYEARS) 130,130,60
130 DO 140 I = N,NYEARS
READ (12,910) MPLAN,IYEAR,VAR
OUT(I,NPLAN) = VAR(NVAR)
NCOL(I) = NCOL(I) + 1
140 CONTINUE
C-----GO BACK TO READ THE NEXT PLAN
GO TO 60
C-----WRITE THE INFORMATION ON THE REGIONAL FILE
150 IF(NVAR.GT.5) GO TO 156
DO 155 I = 1,NYEARS
N = NCOL(I)
WRITE (13,945) YEAR(I),DECMAL,OUT(I,1),OUT(1,N),WEIGHT,NVAR
945 FORMAT(13,F3.2,3F10.5,11)
155 CONTINUE
C-----PRINT THE ARRAYS IF SPECIFIED
156 IF(PLNOPT(NVAR+4),EO,0) GO TO 180
IF(PLNOPT(NVAR+4),EO,2) GO TO 175
DO 170 I = 1,NYEARS,55
WRITE (6,950) PLUNIT,DATEIME,NAME(1,NVAR),NAME(2,NVAR)
950 FORMAT(1*6A10,52X2A10/113X2A10)
WRITE (6,960) (NUM(I),N=1,NPLAN)
960 FORMAT(0 PLAN NUMBER*15,11110)
WRITE (6,970)
970 FORMAT(* YEAR*/)
N1 = I
N2 = I + 54
IF(N2.GT.NYEARS) N2 = NYEARS
IF(NVAR.EQ.13,DR,NVAR.EQ.15) GO TO 165
DO 160 N = N1,N2
J1 = NCOL(N)
WRITE (6,980) YEAR(N),(OUT(N,J),J=1,J1)
980 FORMAT(1X15,5X12F10.2)
160 CONTINUE
GO TO 170
C-----CONVERT THE DATES FROM THE PSEUDO-JULIAN FORMAT
165 DO 167 N = N1,N2
J1 = NCOL(N)
J2 = 1
DO 166 J = 1,J1
K = OUT(N,J)
CALL GOATE (K,DATES(J2))
J2 = J2 + 2
166 CONTINUE
J2 = J2 - 1
WRITE (6,990) YEAR(N),(DATES(J),J=1,J2)
990 FORMAT(1X15,5X12(5X12,*/12))
167 CONTINUE
170 CONTINUE
IF(NVAR.LE.5.AND,PLNOPT(NVAR+4),EO,1) GO TO 180

```

```

C-----COMPUTE THE DIFFERENCES BETWEEN THE NATURAL AND TREATED CONDITIONS
175 CALL DIFFER
180 CONTINUE
CALL CORE (0)
C-----RETURN TO THE PRIMARY OVERLAY
END

```

Subroutine DIFFER

```

SUBROUTINE DIFFER
C-----COMPUTE AND PRINT THE DIFFERENCES CAUSED BY THE TREATMENTS
COMMON DATIME(2),DECHAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEORN2
COMMON P/NAME(2,15),NCOL(165),NPLAN,NUM(12),NVAR,OUT(165,12),
1 VAR(15),YFAR(165)
INTEGER YEAR
DIMENSION IOUT(12)
INTEGER ODO(6)
DO 110 I = 1,NYEARS,55
WRITE (6,910) PLUNIT,OATIME,NAME(1,NVAR),NAME(2,NVAR)
910 FORMAT('16A10,52X2A10// EFFECTS OF TREATMENT COMPARED WITH NATURA
1L CONDITIONS (DECREASE INDICATED BY -)*33X2A10)
WRITE (6,92C) (NUM(I),N=1,NPLAN)
920 FORMAT('0 PLAN NUMBER*15,11110)
WRITE (6,930)
930 FORMAT('0 YEAR*/)
N1 = 1
N2 = 1 + 54
IF(N2.GT.NYEARS) N2 = NYEARS
DO 100 N = N1,N2
J1 = NCOL(N)
IF(J1 - 1) 20,10
C-----NO TREATMENT
10 WRITE (6,940) YEAR(N)
940 FORMAT(1X15,15X11F10.2)
GO TO 100
C-----GET THE DIFFERENCES
20 IF(NVAR.EQ.13.OR.NVAR.EQ.15) GO TO 40
DO 30 J = 2,J1
30 OUT(N,J) = OUT(N,J) - OUT(N,1)
WRITE (6,940) YEAR(N),IOUT(N,J),J=2,J1)
GO TO 100
C-----DATES
40 I1 = OUT(N,1)
DO 90 J = 2,J1
I2 = OUT(N,J)
IOUT(J) = I2 - I1
C-----CHECK FOR 000 DAYS BETWEEN THEM
IF(IOUT(J)) 50,90,70
C-----I1 IS LARGER
50 DO 60 K = 1,6
IF(I12.LE.ODD(K).AND.ODD(K).LE.I1) IOUT(J) = IOUT(J) + 1
60 CONTINUE
GO TO 90
C-----I2 IS LARGER
70 DO 80 K = 1,6
IF(I12.LE.ODD(K).AND.ODD(K).LE.I2) IOUT(J) = IOUT(J) - 1
80 CONTINUE
90 OUT(N,J) = IOUT(J)
WRITE (6,950) YEAR(N),IOUT(J),J=2,J1)
950 FORMAT(1X15,15X11110)
100 CONTINUE
110 CONTINUE
C-----PLOT THE DIFFERENCES
WRITE (6,910) PLUNIT,OATIME,NAME(1,NVAR),NAME(2,NVAR)
IF(NVAR.EQ.13.OR.NVAR.EQ.15) GO TO 120
WRITE (6,960)
960 FORMAT('0*35X*DECREASE*52X*INCREASE*)
CALL PLOT(10.0)
RETURN
120 WRITE (6,970)
970 FORMAT('0*36X*EARLIER*52X*LATER*)
CALL PLOT(1.0)
RETURN
END

```

Subroutine PLOTD

```

SUBROUTINE PLOTD ISCALE)
C-----PLOT THE DIFFERENCES
COMMON DATIME(2),DECHAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEORN2
COMMON P/NAME(2,15),NCOL(165),NPLAN,NUM(12),NVAR,OUT(165,12),
1 VAR(15),YFAR(165)
INTEGER YFAR
INTEGER CODE(11),POINT(121)
DATA CODE/1M1,1M2,1M3,1M4,1M5,1M6,1M7,1M8,1M9,1MA,1MB/
WRITE (6,910)
910 FORMAT('0 YEAR *,6110H-----),1M0,6(10M-----+))
DO 50 I = 1,NYEARS
DO 10 J = 1,121
10 POINT(J) = 1M
POINT(61) = 1M
J1 = NCOL(I)
IF(J1 - 1) 20,40
C-----SCALE AND TRANSLATE THE DIFFERENCES, THEN STORE THE CODE
20 DO 30 J = 2,J1
K = IOUT(I,J)*SCALE + 61.5
IF(K.GE.1.AND.K.LE.121) POINT(K) = CODE(J-1)
30 CONTINUE
C-----WRITE THE LINE
40 WRITE (6,920) YEAR(I),POINT
920 FORMAT(1X15,121A1)
50 CONTINUE
END

```

Program COMRGN

```

OVERLAY (OLAYS,5,0)
PROGRAM COMRGN
C-----COMBINE THE PLANNING UNITS INTO A REGION
COMMON DATIME(2),DECHAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER OATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEORN2
DIMENSION OUT(165,10),WT(5)
INTEGER YEAR(165)
DIMENSION NAME(2,5)
DATA NAME(1,1),NAME(2,1)/10H CENERA,10HTE RUNOFF/
DATA NAME(1,2),NAME(2,2)/10H PRE,10HNCIPITATION/
DATA NAME(1,3),NAME(2,3)/10H EVAPOTRA,10HNSPIRATION/
DATA NAME(1,4),NAME(2,4)/10HCHANCE IN,10HRECH. REQ./
DATA NAME(1,5),NAME(2,5)/10H CHANCE IN,10M PACK N.E./
CALL CORE (-1)
REWIND 13
DO 5 I = 1,NYEARS
5 READ (13,910) YEAR(I)
REWIND 13
DO 10 I = 1,5
10 WT(I) = 0.0
DO 20 J = 1,10
DO 20 I = 1,165
20 OUT(I,J) = 0.0
C-----READ THE FIRST RECORD OF A VARIABLE FOR A PLANNING UNIT
30 READ (13,910) IYEAR,UNALT,ALT,WEIGHT,NVAR
910 FORMAT(13,3X10.5,11)
IF(EOF(13)) 60,40
C-----ACCUMULATE THE WEIGHT
40 WT(NVAR) = WT(NVAR) + WEIGHT
IF(IYEAR.NE.YEAR(1)) GO TO 150
C-----ACCUMULATE THE WEIGHTED VALUES
NVAR5 = NVAR + 5
OUT(I,NVAR) = OUT(I,NVAR) + (UNALT * WEIGHT)
OUT(I,NVAR5) = OUT(I,NVAR5) + (ALT * WEIGHT)
DO 50 I = 2,NYEARS
READ (13,910) IYEAR,UNALT,ALT
IF(IYEAR.NE.YEAR(1)) GO TO 150
OUT(I,NVAR) = OUT(I,NVAR) + (UNALT * WEIGHT)
OUT(I,NVAR5) = OUT(I,NVAR5) + (ALT * WEIGHT)
50 CONTINUE
GO TO 30
C-----PRINT EACH VARIABLE AS NEEDED
60 DO 140 NVAR = 1,5
IF(REGOPT(NVAR).EQ.0) GO TO 140
IF(WT(NVAR)) 70,140
70 WRITE (6,920) REGION,OATIME,NAME(1,NVAR),NAME(2,NVAR)
920 FORMAT('0*0A10,32X2A10// REGIONAL SUMMARY*96X2A10)
NVAR5 = NVAR + 5
IF(WT(NVAR).GE.0.99.AND.WT(NVAR).LE.1.01) GO TO 78
WRITE (6,930) WT(NVAR)
930 FORMAT('0-----N O T E----- THE COMBINED WEIGHTS OF THE PLANN
ING UNITS IS*F5.2* AS OPPOSED TO THE NORMAL 1.0-----N O T E-----
2-----*25X*THEFORE, ALL VALUES BELOW ARE ADJUSTED RESULTS, MAOE
3 TO CORRESPOND TO THE NORM*)
DO 74 I = 1,NYEARS
OUT(I,NVAR) = OUT(I,NVAR)/WT(NVAR)
74 OUT(I,NVAR5) = OUT(I,NVAR5)/WT(NVAR)
70 WRITE (6,940)
940 FORMAT('0*36X*YEAR NATURAL MANAGED*10X1//)
DO 130 I = 1,55
IF(I - NYEARS) 00,00,140
00 J = I + 55
IF(J - NYEARS) 100,100,90
90 WRITE (6,950) YEAR(I),OUT(I,NVAR),OUT(I,NVAR5)
950 FORMAT(1X3(110,2F10.2,10X))
GO TO 130
100 K = J + 55
IF(K - NYEARS) 120,120,110
110 WRITE (6,950) YEAR(I),OUT(I,NVAR),OUT(I,NVAR5),YEAR(J),
1 OUT(J,NVAR),OUT(J,NVAR5)
GO TO 130
120 WRITE (6,950) YEAR(I),OUT(I,NVAR),OUT(I,NVAR5),YEAR(J),
1 OUT(J,NVAR),OUT(J,NVAR5),YEAR(K),OUT(K,NVAR),OUT(K,NVAR5)
130 CONTINUE
140 CONTINUE
GO TO 160
C-----THE YEARS ON THE VARIOUS UNITS DO NOT MATCH
150 WRITE (6,960)
960 FORMAT('0THE YEARS PROCESSED ON THE VARIOUS UNITS WERE NOT CONSIST
ENT, SO THE REGIONAL SUMMARY IS BEING OMITTED*)
160 CALL CORE (0)
C-----RETURN TO THE PRIMARY OVERLAY
END

```

Program LSTSAV

```

OVERLAY (OLAYS,6,0)
PROGRAM LSTSAV
C-----LIST THE FILES ON -SAVNEW-
COMMON DATIME(2),DECHAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),
1 RECOVR,REGION(8),REGOPT(5),SAVE,SEORN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVR,REGION,REGOPT,SAVE,SEORN2
DIMENSION BLOCK(1889),ID(9)
CALL CORE (-1)
END FILE 15
REWIND 15
WRITE (6,910) DATIME
910 FORMAT('0LISTING OF FILES ON -SAVNEW- AS OF *2A10/
1 *2*6X*FILE NUMBER FIRST LAST*/
2 *X*NUMBR YEARS YEAR YEAR*10X*PLANNING UNIT 10*)
IFILF = C
C-----GET AN ID RECORD
10 CALL GETRFC (15,10,9,(END)
IF(1END) 50,20
C-----GET THE FIRST YEAR, THEN THE LAST
20 IFILF = IFILF + 1
CALL GETRFC (15,BLOCK,1889,1END)
FIRST = BLOCK(1)
30 PLAST = BLOCK(11)

```



```

CALL GETREC (15,BLOCK,1889,IEND)
IF(IEND) 40,30
40 WRITE (6,922) IFILE,ID17,FIRST,OLAST,IID(1),I=1,6)
920 FORMAT(10,2110,2F10.2,10X6A10)
GO TO 10
50 CONTINUE
C-----RETURN TO THE PRIMARY OVERLAY
END

```

Program PROOF

```

OVERLAY (OLAYS,7.0)
PROGRAM PROOF
C-----PROOFREAD THE PARAMETER DECK
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(1),
1 RECOVER,REGION(8),REGOPT(5),SAVE,SEDRN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVER,REGION,REGOPT,SAVE,SEDRN2
COMMON/5/AVS01(11),DECLIN(11),NRoads,RATNR(11),ROADM(11),
1 ROADW(11),TANCUT(11),TANFIL(11),TANRHO(11),YRCNST(11)
INTEGER YRCNST
DIMENSION CARD(5),DATCRD(8),IDATES(6),PARAM(9)
CALL CORE (-1)
C-----READ THE REGION CARDS
READ (5,910) NAME,NYEARS,SEDRN2,SAVE,RECOVER,REGOPT,REGION
910 FORMAT(16,4X15,5(1/8A10)
IF(NAME.EQ.6HREGION) GO TO 10
WRITE (6,920) NAME,REGION
920 FORMAT(10,THE FIRST INPUT CARD IS NOT THE REGION CARD*)
CALL PRABRT
10 IF(NYEARS.GT.D.AND.NYEARS.LE.165) GO TO 20
WRITE (6,930) NYEARS
930 FORMAT(10,THE NUMBER OF YEARS (*13,*) IS NOT BETWEEN 1 AND 165*)
CALL PRABRT
C-----READ A PLANNING UNIT CARD
20 READ (5,940) PLUNIT,DECMAL,INFILE,WEIGHT,(PLNOPT(I),I=1,10),
1 PLNOPT(11),PLNOPT(11)
940 FORMAT(16A10,F2.2,1X12,F3.2,12(11)
IF(EOF(5)) 120,30
C-----IF THIS IS A RECOVERY DECK, COPY IT TO THE REGION FILE
30 IF(PLUNIT(1).NE.10HRECOVERY D) GO TO 50
40 READ (5,950) CARD
950 FORMAT(2A10,A6,F10.5,A11)
IF(CARD(11).EQ.10HEND OF REC) GO TO 20
C-----IF A NEW WEIGHT WAS SPECIFIED, REPLACE THE ONE ON THE CARD
IF(WEIGHT.GT.0.0) CARD(4) = WEIGHT
WRITE (13,950) CARD
GO TO 40
C-----IF THIS IS A DATA DECK, COPY IT TO THE UNEDITED DATA FILE
50 IF(PLUNIT(1).NE.10HDATA DECK) GO TO 58
52 READ (5,955) DATCRD
955 FORMAT(8A10)
IF(DATCRD(11).EQ.10HEND OF DAT) GO TO 54
WRITE (10,955) DATCRD
GO TO 52
54 END FILE 10
GO TO 20
C-----DEFINE THE REMAINING OPTIONS
58 PLNOPT(11) = PLNOPT(10)
PLNOPT(12) = PLNOPT(10)
PLNOPT(13) = PLNOPT(10)
PLNOPT(14) = PLNOPT(10)
PLNOPT(15) = PLNOPT(10)
PLNOPT(16) = PLNOPT(10)
PLNOPT(17) = PLNOPT(10)
PLNOPT(18) = PLNOPT(10)
C-----WRITE THE RECORD
WRITE (19) PLUNIT,DECMAL,INFILE,WEIGHT,PLNOPT
LAST1 = 0
C-----IF THE INPUT UNIT IS 14, THE NORMAL SIMULATION WILL NOT BE
C-----PERFORMED, BUT IF IT IS NOT 14, READ THE STATION PARAMETERS
IF(INFILE - 4) 60,80
60 CALL PARAMS
C-----READ THE SPECIFIED CONDITIONS CARDS
70 READ (5,960) NAME,PEAKWE,IDATES
960 FORMAT(10,10X15,2,6X12,1X312)
WRITE (19) NAME,PEAKWE,IDATES
IF(NAME.EQ.10HSPESIFIED) GO TO 70
IF(NAME.EQ.10HEND OF NAT) GO TO 80
WRITE (6,970) NAME,PLUNIT
970 FORMAT(10,0A SPECIFIED CONDITIONS CARD WAS EXPECTED UNDER PLANNING U
INIT *6A10/* BUT COL 1-10 OF THE CARD READ CONTAIN *A10)
CALL PRABRT
C-----READ THE MANAGEMENT STRATEGY DECK
80 READ (5,980) NAME,NUM,NEXTYR,PARAM,SPECCD
980 FORMAT(10,10X215,10F5.0)
WRITE (119) NAME,NUM,NEXTYR,PARAM,SPECCD
IF(NAME.NE.10HMANAGEMENT.AND.NAME.NE.10HROAD CONST) GO TO 110
IF(LAST1 - NEXTYR) 90,80,100
90 LAST1 = NEXTYR
GO TO 80
100 WRITE (6,985) PLUNIT
985 FORMAT(10,0DN PLANNING UNIT *6A10/* THE MANAGEMENT PLAN CARDS ARE N
10T IN ORDER BY YEAR*)
CALL PRABRT
110 IF(NAME.EQ.10HEND OF STR) GO TO 20
WRITE (6,990) NAME
990 FORMAT(10,2A MANAGEMENT PLAN OR ROAD CONSTRUCTION CARD WAS EXPECTED
UNDER PLANNING UNIT*/2X6A10/* BUT COL 1-10 OF THE CARD READ CONTAIN
2IN *A10)
CALL PRABRT
C-----PROOFREADING COMPLETE
120 END FILE 19
REWIND 19
NSAVED = C
C-----GET THE DATE AND TIME OF THIS RUN
CALL DATE (DATIME(1))
CALL TIME (DATIME(2))
CALL CORE (3)
C-----RETURN TO THE MAIN OVERLAY
END

```

Subroutine GETFMT

```

SUBROUTINE GETFMT
C-----GET THE FORMAT-INDICES CARD AND CHECK FOR ERRORS
INTEGER VARFMT(7)
IERR = 1
C-----READ THE CARD
READ (5,910) NAME,VARFMT,NFILE,IM,IO,IY,IMX,IMN,IP
910 FORMAT(16,6A10,A4,1X(2,1X611)
IF(NAME.EQ.6HFORMAT) GO TO 10
WRITE (6,920) NAME
920 FORMAT(10,THE VARIABLE FORMAT CARD WAS EXPECTED, BUT COL 1-6 OF THE
1 CARD READ CONTAIN *A6)
CALL PRABRT
C-----CERTIFY THE VALIDITY OF THE INDICES - START WITH THE MONTH
10 NAME = 1CHMONTH 75
IF(IM.GT.D.AND.IM.LT.7) GO TO 20
WRITE (6,930) NAME,IM
930 FORMAT(1X10,I6,* FORMAT CARD, INVALID INDEX - MUST BE 1 TO 6 IN I
INDICATED COLUMN*)
IERR = 1
C-----DAY
20 NAME = 10HDAY 76
IF(IO.GT.C.AND.IO.LT.7) GO TO 30
WRITE (6,930) NAME,IO
IERR = 1
GO TO 50
30 IF(IO.NE.IM) GO TO 50
WRITE (6,950) NAME,IO
950 FORMAT(1X10,I6,* FORMAT CARD, THIS INDEX HAS BEEN USED PREVIOUSLY
14)
IERR = 1
C-----YEAR
50 NAME = 10HYEAR 77
IF(IY.GT.C.AND.IY.LT.7) GO TO 60
WRITE (6,930) NAME,IY
IERR = 1
GO TO 80
60 IF(IY.NE.IM.AND.IY.NE.ID) GO TO 80
WRITE (6,950) NAME,IY
IERR = 1
C-----MAXIMUM TEMPERATURE
80 NAME = 10HMAX TEM 78
IF(IMX.GT.D.AND(IMX.LT.7) GO TO 90
WRITE (6,930) NAME,IMX
IERR = 1
GO TO 110
90 IF(IMX.NE.IM.AND.IMX.NE.ID.AND.IMX.NE.IY) GO TO 110
WRITE (6,950) NAME,IMX
IERR = 1
C-----MINIMUM TEMPERATURE
110 NAME = 10HMIN TEM 79
IF(IMN.GT.C.AND.IMN.LT.7) GO TO 120
WRITE (6,930) NAME,IMN
IERR = 1
GO TO 140
120 IF(IMN.NE.IM.AND.IMN.NE.ID.AND.IMN.NE.IY.AND.IMN.NE.IMX) GO TO 140
WRITE (6,950) NAME,IMN
IERR = 1
C-----PRECIP
140 NAME = 10HPRECIP 80
IF(IP.GT.C.AND.IP.LT.7) GO TO 150
WRITE (6,930) NAME,IP
IERR = 1
GO TO 170
150 IF(IP.NE.IM.AND.IP.NE.ID.AND.IP.NE.IY.AND.IP.NE.IMX.AND.IP.NE.IMN)
1 GO TO 170
WRITE (6,950) NAME,IP
IERR = 1
C-----CHECK FOR ERRORS
170 IF(IERR) 190,180
180 WRITE (119) VARFMT,NFILE,IM,IO,IY,IMX,IMN,IP
RETURN
190 CALL PRABRT
END

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Subroutine GETPOT

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SUBROUTINE GETPOT (LAT,ASPECT,SLOPE)
C-----DEFINE THE POTENTIAL RADIATION VALUES AND THE SLOPE/ASPECT
C-----ADJUSTMENT FACTORS (THE TABLES ARE FROM -POTENTIAL SOLAR BEAM
C-----IRRADIATION ON SLOPES- BY FRANK AND LEE, 1966. ONLY THOSE
C-----PORTIONS OF THE TABLES PERTAINING TO THE CENTRAL ROCKY MOUNTAINS
C----- (LATITUDE 38 - 44) ARE INCLUDED. LIKEWISE, UNMANAGEABLE SLOPES
C----- (GREATER THAN 40 PERCENT) WERE ELIMINATED
DIMENSION L(1924)
DIMENSION POTENT(24),SLPASP(24)
INTEGER ASPECT,SLOPE
C****LATTITUDE 38
C-----HORIZONTAL SURFACE
DATA (L(I),I=1,131)/
1 102,104,974,930,872,802,722,639,558,485,425,383,359/
C-----N ASPECT
DATA (L(I),I=14,65)/
1 102,100,962,907,837,754,662,569,480,402,340,297,273,
2 1013, 987,942,877,794,700,597,495,401,319,257,214,190,
3 996, 965,913,839,746,641,530,420,322,240,178,138,115,
4 971, 937,879,797,695,581,461,346,246,165,107, 71, 53/
C-----S ASPECT
DATA (L(I),I=66,1171)/
1 1011, 999,977,944,898,842,775,703,630,563,507,467,443,
2 994, 986,972,949,916,873,819,758,695,634,582,545,522,
3 971, 967,960,947,925,895,854,805,751,697,650,614,593,
4 942, 943,942,938,927,909,880,843,798,751,708,675,655/
C-----NNE OR NNW ASPECT
DATA (L(I),I=118,1691)/
1 1021,1000,963,909,839,757,667,575,487,409,347,304,280,
2 1012, 987,943,879,799,707,608,508,415,335,272,229,205,
3 994, 965,915,843,754,651,547,442,346,264,202,161,138,
4 969, 937,881,802,705,598,486,377,281,200,141,102, 81/
C-----SSE OR SSW ASPECT
DATA (L(I),I=170,2211)/

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1 1010. 999.777.943.996.839.771.698.625.557.501.460.437.
2 996. 998.773.947.914.368.812.749.684.627.570.532.509.
3 976. 972.963.948.924.890.845.792.735.679.631.596.574.
4 954. 950.947.941.927.903.869.826.778.728.684.651.631/
C-----NE OR NW ASPECT
DATA (L(1),I=222,273)/
1 1010. 1000.965.913.866.768.680.590.504.428.366.324.299.
2 1011. 998.947.889.815.730.636.541.452.374.312.267.245.
3 993. 967.723.860.781.690.592.494.403.324.263.222.198.
4 960. 941.394.827.744.649.540.450.350.281.222.182.159/
C-----SE OR SW ASPECT
DATA (L(1),I=274,325)/
1 1010. 1000.976.947.891.830.760.684.609.540.483.442.418.
2 1011. 993.976.945.935.854.792.724.655.590.535.496.473.
3 990. 981.967.946.913.871.817.757.693.633.581.544.521.
4 969. 965.956.941.916.882.836.783.725.669.621.585.563/
C-----ENE OR ENW ASPECT
DATA (L(1),I=326,377)/
1 1010. 1001.968.920.857.783.700.613.529.454.394.352.327.
2 1011. 991.956.905.840.762.676.587.502.427.366.324.300.
3 997. 976.947.887.819.740.652.563.478.402.364.301.277.
4 978. 957.925.866.797.718.630.540.456.381.327.281.258/
C-----ESE OR ESW ASPECT
DATA (L(1),I=378,429)/
1 1016. 1001.975.935.882.817.743.664.586.515.457.415.391.
2 1008. 995.972.937.888.829.760.685.611.542.485.445.421.
3 997. 986.966.935.891.837.773.703.637.566.511.471.448.
4 983. 971.956.929.891.842.782.717.649.586.532.494.471/
C-----E OR W ASPECT
DATA (L(1),I=430,481)/
1 1010. 1001.972.928.870.801.722.639.558.485.426.384.359.
2 1011. 996.965.927.866.797.719.638.558.486.427.385.361.
3 1001. 984.956.914.859.792.716.636.557.486.428.387.363.
4 986. 970.944.903.850.785.711.633.556.486.429.389.366/
C-----LATITUDE 40
C-----HORIZONTAL SURFACE
DATA (L(1),I=482,494)/
1 1022. 1004.971.923.860.786.702.615.531.456.395.353.328/
C-----N ASPECT
DATA (L(1),I=495,546)/
1 1021. 998.957.898.823.735.640.543.452.373.310.267.243.
2 1017. 982.934.865.778.679.573.468.372.290.227.185.162.
3 991. 958.903.825.728.619.503.391.292.210.150.111.90.
4 964. 928.867.780.674.556.433.316.216.137.82.48.32/
C-----S ASPECT
DATA (L(1),I=547,598)/
1 1015. 1001.977.940.890.829.757.681.605.536.478.437.413.
2 1001. 992.975.948.911.863.804.739.662.608.555.495.472.
3 980. 975.965.949.923.888.842.788.730.673.623.586.564.
4 954. 953.952.942.927.904.871.828.779.729.683.648.627/
C-----NNE OR NNW ASPECT
DATA (L(1),I=599,650)/
1 1021. 998.958.899.825.739.645.549.459.380.317.274.250.
2 1017. 982.935.868.783.687.584.481.386.305.242.200.176.
3 992. 959.905.829.736.631.521.414.317.235.174.134.112.
4 963. 928.869.786.685.574.459.349.252.173.114.78.59/
C-----SSE OR SSW ASPECT
DATA (L(1),I=651,702)/
1 1016. 1002.977.939.888.826.753.676.600.529.472.431.407.
2 1003. 993.975.947.908.859.797.729.661.596.542.503.479.
3 985. 979.968.949.921.882.832.775.714.655.604.567.545.
4 961. 959.954.944.926.898.859.811.758.705.659.624.602/
C-----NE OR NW ASPECT
DATA (L(1),I=703,754)/
1 1022. 998.960.904.833.750.659.565.477.399.337.294.269.
2 1009. 984.941.879.801.711.613.515.424.345.283.240.216.
3 989. 962.915.848.764.669.568.468.375.296.235.194.171.
4 964. 935.884.814.726.628.525.423.332.254.195.156.135/
C-----SE OR SW ASPECT
DATA (L(1),I=755,806)/
1 1017. 1002.976.935.882.817.742.662.584.512.454.412.388.
2 1008. 997.976.943.898.842.775.703.631.563.507.467.443.
3 995. 987.971.945.909.861.803.738.671.608.554.515.492.
4 978. 972.961.943.914.875.824.766.705.645.595.557.535/
C-----ENE OR ENW ASPECT
DATA (L(1),I=807,858)/
1 1022. 1007.964.912.845.766.679.589.502.426.364.322.297.
2 1011. 989.951.897.827.745.655.563.475.398.337.295.271.
3 996. 973.934.878.806.723.631.538.451.375.314.273.249.
4 977. 954.914.857.784.700.609.516.430.354.295.255.231/
C-----ESE OR ESW ASPECT
DATA (L(1),I=859,910)/
1 1019. 1002.973.929.872.802.724.641.560.487.427.385.361.
2 1012. 997.971.932.880.816.742.663.586.515.457.416.391.
3 1002. 989.967.932.884.826.757.683.609.540.483.443.419.
4 989. 978.958.928.885.832.768.698.627.561.506.466.442/
C-----E OR W ASPECT
DATA (L(1),I=911,962)/
1 1022. 1001.969.921.859.785.702.615.532.457.396.354.329.
2 1013. 995.963.916.855.782.700.615.532.458.398.356.332.
3 1002. 984.954.908.849.778.697.614.532.459.400.359.335.
4 988. 972.942.898.841.772.694.612.532.460.402.361.338/
C-----LATITUDE 42
C-----HORIZONTAL SURFACE
DATA (L(1),I=963,975)/
1 1023. 1003.967.915.849.769.681.591.504.427.366.323.298/
C-----N ASPECT
DATA (L(1),I=976,1027)/
1 1022. 995.951.888.808.716.617.517.424.343.280.238.213.
2 1007. 977.925.852.760.657.547.440.342.260.198.157.134.
3 985. 951.922.816.708.595.476.362.262.181.122.85.65.
4 957. 919.854.763.653.531.404.286.186.109.57.28.14/
C-----S ASPECT
DATA (L(1),I=1028,1079)/
1 1018. 1003.976.935.880.815.739.659.580.508.449.407.383.
2 1007. 946.976.946.904.851.788.719.649.582.526.486.462.
3 989. 987.979.949.919.879.829.771.709.648.596.557.534.
4 965. 962.957.945.926.898.860.813.760.705.657.620.597/
C-----NNE OR NNW ASPECT
DATA (L(1),I=1080,1131)/
1 1022. 995.952.889.811.720.622.523.431.350.287.245.220.
2 1007. 977.927.855.766.666.559.454.357.276.213.172.148.
3 985. 952.895.815.717.608.495.385.288.206.146.107.86.
4 956. 927.857.773.664.549.432.320.224.145.89.55.38/
C-----SSE OR SSW ASPECT
DATA (L(1),I=1132,1183)/
1 1014. 1003.975.934.878.811.735.654.574.502.442.401.376.
2 1004. 997.977.945.901.846.781.709.637.570.513.473.449.
3 993. 983.971.949.917.873.818.756.692.630.577.538.515.
4 972. 968.961.947.925.892.848.795.738.682.633.596.573/
C-----NE OR NW ASPECT
DATA (L(1),I=1184,1235)/
1 1022. 976.955.895.819.732.636.540.449.369.307.264.240.
2 1007. 987.934.868.785.691.590.489.396.316.254.212.188.
3 986. 956.906.835.747.648.544.461.347.268.208.167.145.
4 950. 927.874.800.738.607.500.397.305.227.170.132.111/
C-----SE OR SW ASPECT
DATA (L(1),I=1236,1287)/
1 1022. 1003.976.935.872.802.722.639.558.484.424.382.358.
2 1013. 1000.976.939.890.829.758.682.606.536.478.437.413.
3 1012. 992.973.944.903.851.789.719.648.582.526.486.462.
4 986. 979.966.944.910.867.811.749.684.621.568.529.505/
C-----ENE OR ENW ASPECT
DATA (L(1),I=1288,1339)/
1 1022. 998.960.904.832.749.657.563.475.397.335.292.268.
2 1017. 987.946.887.813.727.633.538.448.370.308.266.242.
3 994. 970.928.868.792.704.609.514.425.347.286.245.221.
4 975. 957.908.847.770.682.587.492.404.328.268.228.205/
C-----ESE OR ESW ASPECT
DATA (L(1),I=1340,1391)/
1 1021. 1003.970.923.861.787.704.617.534.458.398.355.331.
2 1015. 999.970.927.870.802.723.641.561.487.428.386.362.
3 1006. 992.967.928.876.813.740.662.584.513.454.414.389.
4 995. 982.960.926.879.821.752.678.604.535.478.437.413/
C-----E OR W ASPECT
DATA (L(1),I=1392,1443)/
1 1021. 1001.965.914.847.768.681.591.505.428.367.324.299.
2 1014. 994.963.909.843.766.680.591.506.430.369.327.302.
3 1003. 984.951.902.838.762.678.591.507.432.372.330.306.
4 992. 972.940.892.831.758.675.590.508.434.375.334.310/
C-----LATITUDE 44
C-----HORIZONTAL SURFACE
DATA (L(1),I=1444,1456)/
1 1024. 1001.963.907.835.751.659.565.476.398.336.293.268/
C-----N ASPECT
DATA (L(1),I=1457,1508)/
1 1018. 991.944.877.792.696.593.490.395.314.251.208.184.
2 1003. 971.916.838.742.635.521.411.313.230.169.129.107.
3 980. 943.881.794.688.571.448.332.232.152.96.61.43.
4 940. 909.841.746.631.505.375.256.157.83.35.11.2/
C-----S ASPECT
DATA (L(1),I=1509,1560)/
1 1021. 1004.974.929.870.800.719.636.554.480.419.377.352.
2 1012. 999.977.943.897.833.741.698.624.555.497.456.431.
3 996. 988.973.949.914.870.815.752.686.622.568.527.503.
4 975. 971.963.948.924.892.849.797.739.661.630.591.567/
C-----NNE OR NNW ASPECT
DATA (L(1),I=1561,1612)/
1 1018. 991.945.878.795.700.598.496.402.321.258.215.191.
2 1003. 972.918.842.749.644.533.425.328.246.184.144.121.
3 980. 944.884.800.697.584.468.357.258.178.119.82.63.
4 940. 910.845.753.643.524.404.292.195.119.66.35.20/
C-----SSE OR SSW ASPECT
DATA (L(1),I=1613,1664)/
1 1021. 1004.973.928.868.796.715.630.548.473.413.371.346.
2 1013. 1002.977.942.893.834.763.688.612.542.485.443.418.
3 999. 991.974.948.911.863.804.737.669.604.549.509.484.
4 981. 976.966.949.922.885.836.778.717.657.606.567.543/
C-----NE OR NW ASPECT
DATA (L(1),I=1665,1716)/
1 1018. 993.948.885.804.712.613.513.420.340.277.235.211.
2 1004. 975.926.856.769.670.565.462.367.287.225.184.160.
3 982. 950.897.822.730.627.519.414.319.240.180.141.119.
4 953. 920.864.785.690.585.475.371.278.201.145.108.88/
C-----SE OR SW ASPECT
DATA (L(1),I=1717,1768)/
1 1022. 1004.971.923.861.786.702.615.531.456.395.352.327.
2 1017. 1002.975.934.881.815.740.660.581.509.449.407.382.
3 1007. 996.976.942.896.840.772.699.625.555.498.457.432.
4 994. 985.969.944.906.857.798.731.661.596.540.500.476/
C-----ENE OR ENW ASPECT
DATA (L(1),I=1769,1820)/
1 1022. 996.954.894.818.730.634.538.447.368.305.262.238.
2 1009. 983.940.877.798.708.610.512.420.341.279.237.213.
3 993. 966.922.857.777.685.587.488.398.319.258.217.194.
4 973. 946.901.836.755.664.565.468.378.301.242.202.180/
C-----ESE OR ESW ASPECT
DATA (L(1),I=1821,1872)/
1 1022. 1002.967.915.849.770.683.593.507.430.368.325.301.
2 1018. 1003.968.921.860.787.704.618.535.459.399.356.331.
3 1013. 994.966.924.868.800.722.640.560.486.426.384.359.
4 1002. 986.961.923.872.809.736.658.581.509.451.409.384/
C-----E OR W ASPECT
DATA (L(1),I=1873,1924)/
1 1021. 999.961.905.831.751.659.566.477.399.337.294.270.
2 1014. 993.955.901.831.749.659.566.479.401.340.297.273.
3 1004. 986.947.894.826.746.658.567.481.404.344.301.277.
4 992. 972.937.886.820.742.656.568.483.408.348.306.282/
C-----IF ALL ARE BLANK, READ THE INFORMATION FROM CARDS
IF(LAT.EO.C.ANO.ASPECT.EO.3H .AND.SLOPE.EO.0) GO TO 330
C-----FIND THE LATITUDE IN THE TABLE
IF(LAT - 38) 10,20,30
10 WRITE (6,91) LAT
910 FORMAT(0,LATITUDE*13,* NOT FOUND IN RADIATION TABLE ISUBROUTINE CE
1TP0T*)
CALL PRABST
C-----LATITUDE 38 (L(1) - L(481))
20 L1 = 1
GO TO 90
30 IF(LAT - 43) 10,40,50
C-----LATITUDE 40 (L(482) - L(1962))
40 L1 = 482
GO TO 90
50 IF(LAT - 42) 10,60,70
C-----LATITUDE 42 (L(1963) - L(1443))
60 L1 = 961
GO TO 70
70 IF(LAT - 44) 10,80,10
C-----LATITUDE 44 (L(1444) - L(1924))
80 L1 = 1444
C-----FIND THE ASPECT
90 IF(ASPECT.NE.3HN ) GO TO 100

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L2 = L1 + 13
GO TO 210
100 IF(ASPECT.NE.3MS ) GO TO 110
L2 = L1 + 65
GO TO 210
110 IF(ASPECT.NE.3HNE.AND.ASPECT.NE.3HNNW) GO TO 120
L2 = L1 + 117
GO TO 210
120 IF(ASPECT.NE.3HSE.AND.ASPECT.NE.3HSSW) GO TO 130
L2 = L1 + 169
GO TO 210
130 IF(ASPECT.NE.3HNE .AND.ASPECT.NE.3HNNW ) GO TO 140
L2 = L1 + 221
GO TO 210
140 IF(ASPECT.NE.3HSE .AND.ASPECT.NE.3HSSW ) GO TO 150
L2 = L1 + 273
GO TO 210
150 IF(ASPECT.NE.3HNE.AND.ASPECT.NE.3HNNW) GO TO 160
L2 = L1 + 325
GO TO 210
160 IF(ASPECT.NE.3HSE.AND.ASPECT.NE.3HSSW) GO TO 170
L2 = L1 + 377
GO TO 210
170 IF(ASPECT.NE.3HE .AND.ASPECT.NE.3HW ) GO TO 180
L2 = L1 + 429
GO TO 210
180 IF(ASPECT.EQ.3H ) GO TO 190
WRITE (6,920) ASPECT
920 FORMAT(*ASPECT *A3,* IS INVALID*)
CALL PRABRT
C-----NO ASPECT IMPLIES A HORIZONTAL SURFACE
190 IF(SLOPE.EQ.0) GO TO 200
WRITE (6,930) SLOPE
930 FORMAT(*WITH A SLOPE OF*13,*, AN ASPECT MUST BE SUPPLIED, BUT NON
1E WAS FOUND*)
CALL PRABRT
200 L2 = L1
GO TO 310
C-----FIND THE SLOPE WITHIN THE TABLE
210 IF(SLOPE) 230,220
220 WRITE (6,940) ASPECT
940 FORMAT(*WITH AN ASPECT OF *A3,*, A ZERO SLOPE IS INVALID*)
CALL PRABRT
230 IF(SLOPE - 10) 240,310,250
240 WRITE (6,950) SLOPE
950 FORMAT(*OSLOPE*13,* IS INVALID*)
CALL PRABRT
250 IF(SLOPE - 20) 240,260,270
260 L2 = L2 + 13
GO TO 310
270 IF(SLOPE - 30) 240,280,290
280 L2 = L2 + 26
GO TO 310
290 IF(SLOPE - 40) 240,300,240
300 L2 = L2 + 39
C-----STORE THE VALUES AT THE HORIZONTAL SURFACE AND COMPUTE THE
C----- PERCENTAGE WHICH IS INCIDENT TO THE SLOPE
310 L1 = L1 - 1
L2 = L2 - 1
DO 320 I = 1,13
J = I + 11
POTENT(J) = L(L1+I)
SLPASP(J) = FLDAT(L(L2+I))/POTENT(J)
320 CONTINUE
GO TO 340
C-----READ THE CARDS RATHER THAN USING THE TABLE
330 READ (5,960) NAME,(POTENT(I),I=12,24),NAME1,(SLPASP(I),I=12,24)
960 FORMAT(10,5X13F5.0/A10,5X13F5.2)
IF(NAME.EQ.10HPOTENTIAL .AND.NAME1.EQ.10HSLOPE/ASPE) GO TO 340
WRITE (6,970) NAME,NAME1
970 FORMAT(*OSINCE THE LATITUDE, ASPECT AND SLOPE WERE NOT SPECIFIED,
1THE -POTENTIAL RAD- AND -SLOPE/ASPECT- CARDS WERE EXPECTED.*/
2 *HOWEVER, COL 1-10 OF THE TWO CARDS CONTAIN -*A10,*- AND -*A10,
3 *-*)
CALL PRABRT
C-----FILL THE LOWER PORTION OF THE ARRAYS
340 DO 350 I = 1,11
POTENT(I) = POTENT(24-I)
SLPASP(I) = SLPASP(24-I)
350 CONTINUE
WRITE (19) POTENT,SLPASP
RETURN
END

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Subroutine PARAMS

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SUBROUTINE PARAMS
C-----READ THE PARAMETER DECK
COMMON DATIME(2),DECMAL,NRMANG,NSAVED,NYEARS,PLNOPT(19),PLUNIT(6),

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I RECOVER,REGION(8),REGOPT(15),SAVE,SEORN2,WEIGHT
INTEGER DATIME,PLNOPT,PLUNIT,RECOVER,REGION,REGOPT,SAVE,SEORN2
DIMENSION DECIDS(3),ETOALY(12),AIRTMC(4)
INTFGR ASPECT,SLOPE,VEGTYP
C-----READ THE SUBSTATION CONSTANTS
READ (5,920) NAME,TCOEFF,COVDEN,CDMAX,VEGTYP,TRSHLD,TMPMLT,WILTPPT,
1 DECIDS,LAT,ASPECT,SLOPE
920 FORMAT(A10,12X3F5.2,4X11,2F5.0,4F5.2,1X12,1X3,1X12)
IF(NAME.EQ.10HSUBSTATION) GO TO 20
WRITE (6,921) PLUNIT
921 FORMAT(*OTHE SUBSTATION CONSTANTS CARD DOES NOT FOLLOW THE SUBST
10DN ID CARD ENTITLED*/1X6A10)
CALL PRABRT
C-----ENSURE THAT THE WILTING POINT IS NEGATIVE
20 WILTPPT = -ABS(WILTPPT)
C-----CONVERT THE MELT THRESHOLD TO CENTIGRADE
TMPMLT = (TMPMLT - 32.0) * 0.5555555555555555
IF(CDMAX.GE.COVDEN.AND.COVDEN.GE.0.0) GO TO 30
WRITE (6,922) PLUNIT,COVDEN,CDMAX
922 FORMAT(*ODN THE SUBSTATION ID CARD ENTITLED *6A10/* THE COVER DENS
ITY SPECIFIED IN COLUMNS 26-30 (*F5.2,*) IS EITHER NEGATIVE OR IT
215 GREATER THAN THE MAXIMUM COVER DENSITY*/ IN COLUMNS 31-35 (*
3F5.2,*)*)
CALL PRABRT
30 IF(VEGTYP.EQ.1.OR.VEGTYP.EQ.2) GO TO 60
IF(VEGTYP.EQ.3) GO TO 40
IF(COVDEN.EQ.0.0.AND.VEGTYP.EQ.0.1) GO TO 60
WRITE (6,923) VEGTYP,PLUNIT
923 FORMAT(*0INVALID VEG TYPE (*11,*) IN COLUMN 40 OF SUBSTATION ID CA
RD ENTITLED *6A10/* VEGETATION TYPE = 1 (LODGEPOLE PINE), = 2 (SPR
2UCE FIR), = 3 (DECIDUOUS)*)
CALL PRABRT
C-----DECIDUOUS FOREST - CHECK THE WINTER VALUES FOR COVER DENSITY AND
C----- TRANSMISSIVITY COEFFICIENT
40 IF(DECIDS(3).GE.DECIDS(2).AND.DECIDS(2).GT.0.0) GO TO 60
WRITE (6,924) PLUNIT,DECIDS(2),DECIDS(3)
924 FORMAT(*ODN THE SUBSTATION ID CARD ENTITLED *6A10/* THE COVER DENS
ITY SPECIFIED IN COLUMNS 61-65 (*F5.2,*) IS EITHER NEGATIVE OR IT
215 GREATER THAN THE MAXIMUM COVER DENSITY*/ IN COLUMNS 66-70 (*
1F5.2,*)*)
CALL PRABRT
C-----READ THE INITIAL CONDITIONS CARD
60 READ (5,930) NAME,S1MTMI,PREWE0,RECHRG
930 FORMAT(A10,10X3F5.2)
IF(NAME.EQ.10HINITIAL CO) GO TO 70
WRITE (6,931) PLUNIT
931 FORMAT(*OTHE INITIAL CONDITONS CARD DOES NOT FOLLOW THE SUBSTANT
IN CONSTANTS CARD IN THE CARDS FOLLOWING THE SUBSTATION ID CARD ENTIT
21TED*/1X6A10)
CALL PRABRT
C-----READ THE DAILY ET VALUES
70 READ (5,940) NAME,ETOALY
940 FORMAT(A10,10X12F5.4)
IF(NAME.EQ.10HDAILY ET ) GO TO 80
WRITE (6,941) PLUNIT
941 FORMAT(*OTHE DAILY ET VALUES CARD DOES NOT FOLLOW THE INITIAL COND
ITIONS CARD IN THE CARDS FOLLOWING THE SUBSTATION ID CARD ENTITLED
2*/1X6A10)
CALL PRABRT
80 READ (5,950) NAME,AIRTMC,SUMMER
950 FORMAT(A10,10X5F5.3)
IF(NAME.EQ.10HAIR TEMP C) GO TO 90
WRITE (6,951) PLUNIT
951 FORMAT(*OTHE AIR TEMPERATURE COEFFICIENTS CARD DOES NOT FOLLOW THE
1 DAILY ET CARD IN THE CARDS FOLLOWING THE SUBSTATION ID CARD ENTIT
2LEO*/1X6A10)
CALL PRABRT
90 IF(SUMMER.LE.0.0) SUMMER = 1.0
WRITE (19) TCOEFF,COVDEN,CDMAX,VEGTYP,TRSHLD,TMPMLT,WILTPPT,DECIDS,
1 LAT,ASPECT,SLOPE,S1MTMI,PREWE0,RECHRG,ETOALY,AIRTMC,SUMMER
C-----GET THE POTENTIAL RADIATION AND THE ADJUSTMENT FACTORS
CALL GETPDT (LAT,ASPECT,SLOPE)
C-----READ THE FORMAT-INDICES CARD
CALL GETFMT
RETURN
END

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Subroutine PRABRT

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SUBROUTINE PRABRT
C-----PRE-ABORT THE RUN
WRITE (6,910)
910 FORMAT(*OJOB PRE-ABORTED BY A PARAMETER DECK PROOFREADING ROUTINE
1- NO SIMULATIONS WERE PERFORMED ON ANY OF THE PLANNING UNITS*)
REWIND 13
END FILE 13
CALL ABORT
END

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Leaf, Charles F., and Glen E. Brink.

1975. Land use simulation model of the subalpine coniferous forest zone. USDA For. Serv. Res. Pap. RM-135, 42 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

A dynamic model simulates the short- and long-term hydrologic impacts of combinations of timber harvesting and weather modification to develop management strategies for planning intervals which can vary from a few years to the rotation age of subalpine forests (120 years and longer). Management strategies may subdivide a given "planning unit," defined by environmental characteristics, into as many as eight distinct "response units," which may be managed independently. Different cutting practices may be imposed on the response units, and any number of cuttings can be made by specified years. The model contains time trend functions which compute changes in evapotranspiration, soil water, forest cover density, reflectivity, interception, snow redistribution, and sediment yield as the forest stands respond to timber harvesting.

Keywords: Computer models, coniferous forest, forest management, land use planning, simulation analysis, subalpine hydrology, watershed management.

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1975. Land use simulation model of the subalpine coniferous forest zone. USDA For. Serv. Res. Pap. RM-135, 42 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

A dynamic model simulates the short- and long-term hydrologic impacts of combinations of timber harvesting and weather modification to develop management strategies for planning intervals which can vary from a few years to the rotation age of subalpine forests (120 years and longer). Management strategies may subdivide a given "planning unit," defined by environmental characteristics, into as many as eight distinct "response units," which may be managed independently. Different cutting practices may be imposed on the response units, and any number of cuttings can be made at specified years. The model contains time trend functions which compute changes in evapotranspiration, soil water, forest cover density, reflectivity, interception, snow redistribution, and sediment yield as the forest stands respond to timber harvesting.

Keywords: Computer models, coniferous forest, forest management, land use planning, simulation analysis, subalpine hydrology, watershed management.