CHAPTER 19

SWAT INPUT DATA: .HRU

The HRU general input file contains information related to a diversity of features within the HRU. Data contained in the HRU input file can be grouped into the following categories: topographic characteristics, water flow, erosion, land cover, and depressional storage areas.

Following is a brief description of the variables in the HRU general input file. They are listed in the order they appear within the file.

19.1 TITLE

Variable name	Definition
TITLE	The first line of the .hru file is reserved for user comments. The comments may take up to 80 spaces. The title line is not processed by the model and may be left blank. Optional.

19.2 TOPOGRAPHIC CHARACTERISTICS

Variable name	Definition
HRU_FR	Fraction of subbasin area contained in HRU (km^2/km^2). If no value for HRU_FR is entered, the model will set HRU_FR = 0.0000001. Required.
SLSUBBSN	Average slope length (m). This is the distance that sheet flow is the dominant surface runoff flow process. Slope length should be measured to the point that flow begins to concentrate. This length is easily observable after a heavy rain on a fallow field when the rills are well developed. In this situation, the slope length is the distance from the microwatershed divide to the origin of the rill. This value can also be determined from topographic maps. Terraces divide the slope of the hill into segments equal to the horizontal terrace interval. With terracing, the slope length is the terrace interval. For broadbase terraces, the horizontal terrace interval is the distance from the center of the ridge to the center of the channel for the terrace below. The horizontal terrace interval for steep backslope terraces is the distance from the point where cultivation begins at the base of the ridge to the base of the frontslope of the terrace below.

Variable name	Definition
SLSUBBSN, cont.	Slope length is a parameter that is commonly overestimated. As a rule of thumb, 90 meters (300 ft) is considered to be a very long slope length. If no value for SLSUBBSN is entered, the model will set SLSUBBSN = 50. The GIS interfaces will assign the same value to this variable for all HRUs within a subbasin. However, some users like to vary this value by soil type and land cover. Required.
SLSOIL	Slope length for lateral subsurface flow (m). If no value is entered for SLSOIL, the model sets SLSOIL = SLSUBBSN. The GIS interfaces will assign the same value to this variable for all HRUs within a subbasin. However, some users like to vary this value by soil type and land cover. Required.
HRU_SLP	Average slope steepness (m/m). The GIS interfaces will assign the same value to this variable for all HRUs within a subbasin. However, some users like to vary this value by soil type and land cover. Required.

19.3 LAND COVER CHARACTERISTICS

Variable name	Definition
CANMX	Maximum canopy storage (mm H_2O). The plant canopy can significantly affect infiltration, surface runoff and evapotranspiration. As rain falls, canopy interception reduces the erosive energy of droplets and traps a portion of the rainfall within the canopy. The influence the canopy exerts on these processes is a function of the density of plant cover and the morphology of the plant species.

Variable name	**Definition**
CANMX, cont.	When calculating surface runoff, the SCS curve number method lumps canopy interception in the term for initial abstractions. This variable also includes surface storage and infiltration prior to runoff and is estimated as 20% of the retention parameter value for a given day (see Chapter 2:1). When the Green and Ampt infiltration equation is used to calculate infiltration, the interception of rainfall by the canopy must be calculated separately. SWAT allows the maximum amount of water that can be held in canopy storage to vary from day to day as a function of the leaf area index. CANMX is the maximum amount of water that can be trapped in the canopy when the canopy is fully developed (mm H_2O). Required.
RSDIN	Initial residue cover (kg/ha). Optional.
OV_N	Manning's "n" value for overland flow. Required.

Table 19-1: Values of Manning's roughness coefficient, *n*, for overland flow (Engman, 1983).

Characteristics of Land Surface	**Median**	**Range**
Fallow, no residue	0.010	0.008-0.012
Conventional tillage, no residue	0.090	0.060-0.120
Conventional tillage, residue	0.190	0.160-0.220
Chisel plow, no residue	0.090	0.060-0.120
Chisel plow, residue	0.130	0.100-0.160
Fall disking, residue	0.400	0.300-0.500
No till, no residue	0.070	0.040-0.100
No till, 0.5-1 t/ha residue	0.120	0.070-0.170
No till, 2-9 t/ha residue	0.300	0.170-0.470
Rangeland, 20% cover	0.600	
Short grass prairie	0.150	0.100-0.200
Dense grass	0.240	0.170-0.300
Bermudagrass	0.410	0.300-0.480

19.4 WATER CYCLING

Variable name	Definition
LAT_TTIME	Lateral flow travel time (days). Setting LAT_TTIME = 0.0 will allow the model to calculate the travel time based on soil hydraulic properties. This variable should be set to a specific value only by hydrologists familiar with the base flow characteristics of the watershed. Required.
POT_FR	Fraction of HRU area that drains into pothole. Required only if depressional storage area/pothole is defined in subbasin.
FLD_FR	Fraction of HRU area that drains into floodplain. Required only if floodplain is defined in subbasin.
RIP_FR	Fraction of HRU area that drains into riparian area. Required only if riparian area is defined in subbasin.
DEP_IMP	Depth to impervious layer in soil profile (mm). Perched water tables are created when water percolating through the soil profile reaches a layer of low hydraulic conductivity that causes water to pond at the upper boundary of the impervous layer. This variable defines the depth to the impervious layer in the soil profile and is required if perched water tables, depressional storage areas/potholes, or tile drainage is being modeled in the HRU (or subbasin for depressional storage areas). If perched water tables do not occur in the HRU leave this variable set to 0. If a generic depth is defined using DEPIMP_BSN (.bsn), set DEP_IMP = 0 to use the basin-level value.
EV_POT	Pothole evaporation coefficient. Default = 0.50.
DIS_STREAM	Average distance to the stream (m). Default = 35.0.
CF	This parameter controls the response of decomposition to the combined effect of soil temperature and moisture. You can get a more accurate definition and the range of values from the table below.
CFH	Maximum humification rate

Variable name	Definition
CFDEC	The undisturbed soil turnover rate under optimum soil water and temperature. Increasing it will increase carbon and organic N decomposition.

Upper and lower bounds of the parameters varied within the Monte Carlo framework

Parameter [unit]	Lower bound	Upper bound
Power controlling decomposition, f_p [dimensionless]	0.5	1.0
Maximum humification rate, h_R [day^{-1}]	x0.8	x1.2
Maximum decomposition rate, k_S [$year^{-1}$]	0.045	0.065

Unless the user has measured data and the model is decomposing soil carbon or organic N too fast or too slow, the user should simply leave these parameters set to the default values.

19.5 EROSION

Variable name	Definition
LAT_SED	Sediment concentration in lateral and groundwater flow (mg/L). Sediment concentration in lateral and groundwater flow is usually very low and does not contribute significantly to total sediment yields unless return flow is very high. Optional.
EPCO	Plant uptake compensation factor. The amount of water uptake that occurs on a given day is a function of the amount of water required by the plant for transpiration, E_t, and the amount of water available in the soil, *SW*. If upper layers in the soil profile do not contain enough water to meet the potential water uptake, users may allow lower layers to compensate. The plant uptake compensation factor can range from 0.01 to 1.00. As *epco* approaches 1.0, the model allows more of the water uptake demand to be met by lower layers in the soil. As *epco* approaches 0.0, the model allows less variation from the original depth distribution to take place.

Variable name	Definition
EPCO, cont.	If no value for EPCO is entered, the model will set EPCO = 1.0. The value for EPCO may be set at the watershed or HRU level (EPCO in .bsn, see Chapter 4). Required.
ESCO	Soil evaporation compensation factor. This coefficient has been incorporated to allow the user to modify the depth distribution used to meet the soil evaporative demand to account for the effect of capillary action, crusting and cracks. ESCO must be between 0.01 and 1.0. As the value for ESCO is reduced, the model is able to extract more of the evaporative demand from lower levels. The change in depth distribution resulting from different values of *esco* are graphed in Figure 19-1. If no value for ESCO is entered, the model will set ESCO = 0.95. The value for ESCO may be set at the watershed or HRU level (ESCO in .bsn, see Chapter 4). Required.

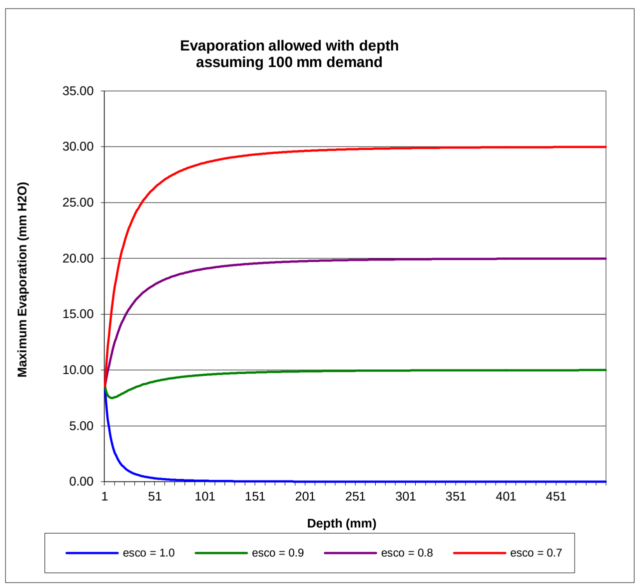

Figure 19-1: Soil evaporative demand distribution with depth

ERORGN	Organic N enrichment ratio for loading with sediment. As surface runoff flows over the soil surface, part of the water's energy is used to pick up and transport soil particles. The smaller particles weigh less and are more easily transported than coarser particles. When the particle size distribution of the transported sediment is compared to that of the soil surface layer, the sediment load to the main channel has a greater proportion of clay sized particles. In other words, the sediment load is enriched in clay particles. Organic nitrogen in the soil is attached primarily to colloidal (clay) particles, so the sediment load will also contain a greater proportion or concentration of organic N than that found in the soil surface layer. The enrichment ratio is defined as the ratio of the concentration of organic nitrogen transported with the sediment to the concentration in the soil surface layer. SWAT will calculate an enrichment ratio for each storm event, or allow the user to define a particular enrichment ratio for organic nitrogen that is used for all storms during the simulation. To calculate the enrichment ratio, the value for ERORGN is set to zero. The default option is to allow the model to calculate the enrichment ratio. Required.
ERORGP	Phosphorus enrichment ratio for loading with sediment. The enrichment ratio is defined as the ratio of the concentration of phosphorus transported with the sediment to the concentration of phosphorus in the soil surface layer. SWAT will calculate an enrichment ratio for each storm event, or allow the user to define a particular enrichment ratio for phosphorus attached to sediment that is used for all storms during the simulation. If the value for ERORGP is set to zero, the model will calculate an enrichment ratio for every storm event. The default option is to allow the model to calculate the enrichment ratio. Required.

19.6 DEPRESSIONAL STORAGE AREA/POTHOLE

Variable name	Definition
POT_TILE	Average daily outflow to main channel from tile flow if drainage tiles are installed in the pothole (mm) over the entire HRU (like the pond file). Required only for the HRU that is defined as a depressional storage area/pothole.
POT_VOLX	Maximum volume of water stored in the pothole (mm) over the entire HRU (like the pond file). Required only for the HRU that is defined as a depressional storage area/pothole.
POT_VOL	Initial volume of water stored in the pothole (mm) over the entire HRU (like the pond file). Required only for the HRU that is defined as a depressional storage area/pothole.
POT_NSED	Equilibrium sediment concentration in pothole (mg/L) over the entire HRU (like the pond file). Required only for the HRU that is defined as a depressional storage area/pothole.
POT_NO3L	*Not currently active*. Nitrate decay rate in pothole (1/day). Required only for the HRU that is defined as a depressional storage area/pothole.

19.7 URBAN BMP REDUCTIONS

Variable name	Definition
SED_CON	Sediment concentration in runoff, after urban BMP is applied (0-5,000 ppm)
ORGN_CON	Organic nitrogen concentration in runoff, after urban BMP is applied (0-100 ppm)
ORGP_CON	Organic phosphorus concentration in runoff, after urban BMP is applied (0-50 ppm)
SOLN_CON	Soluble nitrogen concentration in runoff, after urban BMP is applied (0-10 ppm)
SOLP_CON	Soluble phosphorus concentration in runoff, after urban BMP is applied (0-3 ppm)
POT_SOLP	Phosphorus decay rate in pothole (1/day). Required only for the HRU that is defined as a depressional storage area/pothole. (0-100)
POT_K	Saturated conductivity of soil surface under pothole (mm/h) (0-100)

The HRU general input file is a free format file. The variables may be placed in any position the user wishes on the line. Values for variables classified as integers *should not* include a decimal while values for variables classified as reals *must* contain a decimal. A blank space denotes the end of an input value and the beginning of the next value if there is another on the line. The format for the HRU general input file is:

Variable name	Line #	Format	F90 Format
TITLE	1	character	a80
HRU_FR	2	real	free
SLSUBBSN	3	real	free
HRU_SLP	4	real	free
OV_N	5	real	free

Variable name	**Line #**	**Format**	**F90 Format**
LAT_TTIME	6	Real	free
LAT_SED	7	real	free
SLSOIL	8	real	free
CANMX	9	real	free
ESCO	10	real	free
EPCO	11	real	free
RSDIN	12	real	free
ERORGN	13	real	free
ERORGP	14	real	free
POT_FR	15	real	free
FLD_FR	16	real	free
RIP_FR	17	real	free
Comment line	18	character	a80
POT_TILE	19	real	free
POT_VOLX	20	real	free
POT_VOL	21	real	free
POT_NSED	22	real	free
POT_NO3L	23	real	free
DEP_IMP	24	real	free
EVPOT	28	real	free
DIS_STREAM	29	real	free
CF	30	real	free
CFH	31	real	free
CFDEC	32	real	free
SED_CON	33	real	free
ORGN_CON	34	real	free
ORGP_CON	35	real	free
SOLN_CON	36	real	free
SOLP_CON	37	real	free
POT_SOLP	38	real	free
POT_K	39	real	free

REFERENCES

Engman, E.T. 1983. Roughness coefficients for routing surface runoff. Proc. Spec. Conf. Frontiers of Hydraulic Engineering.