CHAPTER 32

SWAT OUTPUT DATA: PRIMARY OUTPUT FILES

A number of output files are generated in every SWAT simulation. These files are: the summary input file (input.std), the summary output file (output.std), the HRU output file (output.hru), the subbasin output file (output.sub), and the main channel or reach output file (output.rch).

The detail of the data printed out in each file is controlled by the print codes in the master watershed file (Chapter 3). Average daily values are always printed in the HRU, subbasin and reach files, but the time period they are summarized over will vary. Depending on the print code selected, the output files may include all daily values, daily amounts averaged over the month, daily amounts averaged over the year, or daily amounts averaged over the entire simulation period.

32.1 INPUT SUMMARY FILE (INPUT.STD)

The input summary file prints summary tables of important input values. This file provides the user with a mechanism to spot-check input values. All model inputs are not printed, but the file does contain some of the most important.

32.2 OUTPUT SUMMARY FILE (OUTPUT.STD)

The standard output summary file provides watershed average annual, monthly or daily loadings from the HRU's to the streams. It si the first file a user should examine to obtain a basic understanding of the watershed's water, sediment, nutrient and pesticide balances. Average watershed or basin values are the weighted sum of HRU loadings before any channel or reservoir routing is simulated. It does not account for channel routing losses (ie. Water transmission losses, sediment deposition, and nutrient transformations) and does not account for reservoir losses. Following is a brief description of the output variables in the output summary file.

Variable name	Definition
UNIT TIME	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step:
PREC	Average amount of precipitation in watershed for the day, month or year (mm)
SURQ	Surface runoff in watershed for the day, month or year (mm)
LATQ	Lateral flow contribution to streamflow in watershed for the day, month or year (mm)
GWQ	Groundwater contribution to stream in watershed on day, month or year (mm)
PERCO LATE	Water percolation past bottom of soil profile in watershed for the day, month or year (mm)
TILE Q	Drainage tile flow contribution to stream in watershed on the day, month or year (mm)
SW	Amount of water stored in soil profile in watershed for the day, month or year (mm)

ET	Actual evapotranspiration in watershed for the day, month or year (mm)
Variable name	**Definition**
PET	Potential evapotranspiration in watershed on the day, month or year (mm)
WATER YIELD	Water yield to streamflow from HRUs in watershed for the day, month or year (mm)
SED YIELD	Sediment yield from HRUs in watershed for the day, month or year (metric tons/ha)
NO3 SURQ	Nitrate loading to stream in surface runoff in watershed for the day, month or year (kg N/ha)
NO3 LATQ	Nitrate loading to stream in lateral flow for the day, month or year (kg N/ha)
NO3 PERC	Nitrate percolation past bottom of soil profile in watershed for the day, month or year (kg N/ha)
NO3CROP	Plant uptake of N in watershed for the day, month or year (kg N/ha)
N ORGANIC	Organic N loading to stream in watershed for the day, month or year (kg N/ha)
P SOLUBLE	Soluble P loading to stream in watershed for the day, month or year (kg P/ha)
P ORGANIC	Organic P loading to stream in watershed for the day, month or year (kg P/ha)

Tables are also included that present average annual HRU and subbasin values for a few parameters. The "Average Crop Values" table provides the crop name for each HRU and the corresponding yield (kg/ha) and biomass (kg/ha) averages.

The "AVE ANNUAL VALUES" table provides the average annual parameter values for each HRU. Following is a brief description of the output variables in the "AVE ANNUAL VALUES" table.

Variable name	Definition
HRU	Hydrologic Response Unit number.
SUB	Subbasin in which HRU is located
CPMN	Crop name
SOIL	Soil series name
AREA	Are of HRU (km^2)
CN	SCS runoff curve number for moisture condition II
SWC	Amount of water held in the soil profile at field capacity (mm)
USLE_LS	USLE equation length slope (LS) factor
IRR	Amount of irrigation water applied to HRU during simulation (mm)
AUTON	Average annual amount of N (organic and mineral) auto-applied in HRU (kg N/ha)
AUTOP	Average annual amount of P (organic and mineral) auto-applied in HRU (kg P/ha)
MIXEF	Sum of mixing efficiencies in HRU
PREC	Precipitation in HRU during simulation (mm)
SURQ	Amount of surface runoff to main channel from HRU during simulation (ignores impact of transmission losses) (mm)
GWQ	Amount of lateral flow and ground water flow contribution to main channel from HRU during simulation (mm)
ET	Actual evapotranspiration in HRU during simulation (mm)
SED	Sediment Yield from HRU for simulation (metric tons/ha)
NO3	Nitrate in surface runoff and lateral flow in HRU during simulation (hg N/ha)
ORGN	Organic N in surface runoff in HRU during simulation (kg N/ha)
BIOM	Average annual biomass (dry weight) in HRU (metric tons/ha)
Variable name	**Definition**

YLD	Average annual yield (dry weight) in HRU (metric tons/ha)

The "AVE MONTHLY BASIN VALUES" displays the average annual watershed monthly values. A brief description of the output variables are listed below.

Variable name	Definition
RAIN	Average annual precipitation in watershed falling during month (mm)
SNOW FALL	Average annual freezing rain in watershed falling during month (mm)
SURF Q	Average annual surface runoff in watershed during month (mm)
LAT Q	Average annual lateral flow in watershed during month (mm)
WATER YIELD	Average annual water yield in watershed during month (mm)
ET	Average annual actual evapotranspiration in watershed during month (mm)
SED YIELD	Average annual sediment yield in watershed during month (metric tons)
PET	Average annual potential evapotranspiration in watershed during month (mm)

Water balance and nutrient balance are displayed in the "AVE ANNUAL BASIN VLUES" tables. The following is a brief description of the output variables for the water balance narrative.

Variable name	Definition
PRECIP	Average amount of precipitation in watershed for the simulation (mm)
SNOW FALL	Freezing rain/snow fall is watershed for the simulation (mm)
SNOW MELT	Snow melt in watershed for the simulation (mm)
SUBLIMATION	Water that changes directly to a gaseous state in the watershed for the simulation (mm)
SURFACE RUNOFF Q	Surface runoff in the watershed for the simulation (mm)
LATERAL SOIL Q	Lateral flow contribution to streamflow in watershed for simulation (mm)
TILE Q	Drainage tile flow contribution to stream in watershed for the simulation (mm)
GROUNDWATER (SHAL AQ) Q	Groundwater contribution to stream in watershed for the simulation (mm)
REVAP (SHAL AQ => SOIL/PLANTS)	Amount of water moving from shallow aquifer to plants/soil profile in watershed during simulation (mm)
DEEP AQ RECHARGE	Deep aquifer recharge in watershed during simulation (mm)
TOTAL AQ RECHARGE	Total amount of water entering both aquifers in watershed during simulation (mm)
TOTAL WATER YLD	Water yield to streamflow from HRUs in watershed for simulation (mm)
PERCOALTION OUT OF OSIL	Water percolation pat bottom of soil profile in watershed for simulation (mm)
ET	Actual evapotranspiration in watershed for simulation (mm)
PET	Potential evapotranspiration in watershed during simulation (mm)
TRANSMISSION LOSSES	Average amount of tributary channel transmission losses in watershed during simulation (mm)
TOTAL SEDIMENT LOADING	Sediment yield from HRUs in watershed for the simulation (metric tons/ha)
Variable name	**Definition**

POND BUDGET	
EVAPORATION	Evaporation from ponds in watershed during simulation (mm)
SEEPAGE	Seepage from ponds in watershed during simulation (mm)
RAINFALL ON POOL	Precipitation on ponds in watershed during simulation (mm)
INFLOW WATER	Volume of water entering ponds in watershed during simulation (mm)
INFLOW SEDIMENT	Sediment loading to ponds in watershed during simulation (metric tons/ha)
OUTFLOW WATER	Volume of water leaving ponds in watershed during simulation (mm)
OUTFLOW SEDIMENT	Sediment loading from ponds in watershed during simulation (metric tons/ha)
RESERVIOR BUDGET	
EVAPORATION	Average annual evaporation from reservoirs in watershed (mm)
SEEPAGE	Average annual seepage from reservoirs in watershed (mm)
RAINFALL ON RESERVOIR	Average annual precipitation on reservoirs in watershed (mm)
INFLOW WATER	Average annual amount of water transported into reservoirs in watershed (mm)
INFLOW SEDIMENT	Average annual amount of sediment transported into reservoirs in watershed (metric tons/ha)
OUTFLOW WATER	Average annual amount of water transported out of reservoirs in watershed (mm)
OUTFLOW SEDIMENT	Average annual amount of sediment transported out of reservoirs in watershed (metric tons/ha)

Variable name	Definition
YIELD LOSS FROM PONDS	
WATER	Net change in water volume of ponds in watershed during simulation (mm)
SEDIMENT	Net change in sediment level in ponds in watershed during simulation (metric tons/ha)
YIELD LOSS FROM RESERVOIRS	
WATER	Net change in water volume of reservoirs in watershed during simulation (mm)
SEDIMENT	Net change in sediment level in reservoirs in watershed during simulation (metric tons/ha)

The following is a brief description of the output variables for the nutrient balance narrative.

Variable name	Definition
ORGANIC N	Organic N loading to stream in water shed for the simulation (kg N/ha)
ORGANIC P	Organic P loading to stream in water shed for the simulation (kg P/ha)
NO3 YIELD (SQ)	Nitrate loading to stream in surface runoff in watershed for the simulation (kg N/ha)
NO3 YIELD (SSQ)	Nitrate loading to stream in lateral flow in watershed for the simulation (kg N/ha)
SOL P YIELD	Soluble P loading to stream in watershed for the simulation (kg P/ha)
NO3 LEACHED	Nitrate percolation past bottom of soil profile in watershed for the simulation (kg N/ha)_
P LEACHED	Average annual amount of P leached into second soil layer (kg P/ha)
N UPTAKE	Plant uptake of N in watershed for the simulation (kg N/ha)
Variable name	**Definition**

P UPTAKE	Average annual amount of plant uptake of P (kg P/ha)
NO3 YIELD (GWQ)	Nitrate loading to groundwater in watershed for the simulation (kg N/ha)
ACTIVE TO SOLUTION P FLOW	Average annual amount of P moving from labile mineral to active mineral pool in watershed (kg P/ha)
ACTIVE TO STABLE P FLOW	Average annual amount of P moving from active mineral to stable mineral pool in watershed (kg P/ha)
N FERTILIZER APPLIED	Average annual amount of N (mineral and organic) applied in watershed (kg N/ha)
P FERTILIZER APPLIED	Average annual amount of P (mineral and organic) applied in watershed (kg P/ha)
N FIXATION	Average annual amount of N added t the plant biomass via fixation (kg N/ha)
DETRIFICATION	Average annual amount of N lost from nitrate pool due to denitrification in watershed (kg N/ha)
HUMUS MIN ON ACTIVE ORG N	Average annual amount of N moving from active organic to nitrate pool in watershed (kg N/ha)
ACTIVE TO STABLE ORG N	Average annual amount of N moving from stable active N pool to stable organic N pool (kg N/ha)
HUMUS MIN ON ACTIVE ORG P	Average annual amount of P moving from active organic to nitrate pool in watershed (kg P/ha)
MIN FROM FRESH ORG N	Average annual amount of N moving from fresh organic (residue) to nitrate and active organic pools in watershed (kg N/ha)
MIN FROM FRESH ORG P	Average annual amount of P moving from fresh organic (residue) to labile and organic pools in watershed (kg P/ha)
NO3 IN RAINFALL	Average annual amount of NO_3 added to soil by rainfall in watershed (kg N/ha)
INITIAL NO3 IN SOIL	Initial average amount of N in the nitrate pool in watershed soil (kg N/ha)

Variable name	Definition
FINAL NO3 IN SOIL	Final average amount of N in the nitrate pool in watershed soil (kg N/ha)
INITIAL ORG N IN SOIL	Initial average amount of N in the organic N pool in watershed soil (kg N/ha)
FINAL ORG N IN SOIL	Final average amount of N in the organic N pool in watershed soil (kg N/ha)
INITIAL MIN P IN SOIL	Initial average amount of P in the mineral P pool in watershed soil (kg P/ha)
FINAL MIN P IN SOIL	Final average amount of P in the mineral P pool in watershed soil (kg P/ha)
INITIAL ORG P IN SOIL	Initial average amount of P in the organic P pool in watershed soil (kg P/ha)
FINAL ORG P IN SOIL	Final average amount of P in the organic P pool in watershed soil (kg P/ha)
NO3 IN FERT	Average annual amount of NO3-N applied in watershed (kg N/ha)
AMMONIA IN FERT	Average annual amount of NH3-N applied in watershed (kg N/ha)
ORG N IN FERT	Average annual amount of organic N applied in watershed (kg N/ha)
MINERAL P IN FERT	Average annual amount of mineral P applied in watershed (kg P/ha)
ORG P IN FERT	Average annual amount of mineral P applied in watershed (kg P/ha)
N REMOVED IN YIELD	Amount of N removed in watershed in yield (kg N/ha)
P REMOVED IN YIELD	Amount of P removed in watershed in yield (kg P/ha)
AMMONIA VOLATILIZATIO N	Average annual amount of N lost by ammonia volatilization in watershed (kg N/ha)
AMMONIA NITRIFICATION	Average annual amount of N moving fro mthe NH_3 to the NO_3 pool by nitrification in the watershed (kg N/ha)
NO3 EVAP-LAYER 2 TO 1	Amount of nitrate moving upwards in the soi profile in watershed (kgN/ha)

Directly below the nutrient summary narrative is the bacteria summary table. The following is a brief description of the variables included in this table. All variable units are number of colonies/ha.

Variable name	Definition
DIE-GRO P Q	Average annual change in the number of persistent bacteria colonies in soil solution in watershed
DIE-GRO LP Q	Average annual change in the number of less persistent bacteria colonies in soil solution in watershed
DIE-GRO P SED	Average annual change in the number of persistent bacteria colonies on soil particles in watershed
DIE-GRO LP SED	Average annual change in the number of less persistent bacteria colonies on soil particles in watershed
BACT P RUNOFF	Average annual number of persistent bacteria transported to main channel with surface runoff in solution
BACT LP RUNOFF	Average annual number of less persistent bacteria transported to main channel with surface runoff in solution
BACT P SEDIMENT	Average annual number of persistent bacteria transported with sediment in surface runoff
BACT LP SEDIMENT	Average annual number of less persistent bacteria transported with sediment in surface runoff
BACT P INCORP	Average annual number of persistent bacteria lost from soil surface layer by percolation
BACT LP INCORP	Average annual number of less persistent bacteria lost from soil surface layer by percolation

If pesticides were applied during the simulation, then a pesticide narrative will be displayed after the bacteria table. The pesticide narrative includes the amount of applied and decayed pesticide, the amount of dissolved and sorbed

pesticide in surface runoff enter stream, the amount of pesticide leached out of soil profile, and the amount of pesticide in lateral flow entering stream. In addition, the final amounts of pesticide on the plants and in the ground will be displayed.

32.3 HRU OUTPUT FILE (OUTPUT.HRU)

The HRU output file contains summary information for each of the hydrologic response units in the watershed. The file is written in spreadsheet format.

Following is a brief description of the output variables in the HRU output file.

Variable name	Definition
LULC	Four letter character code for the cover/plant on the HRU. (code from crop.dat file)
HRU	Hydrologic response unit number
GIS	GIS code reprinted from watershed configuration file (.fig). See explanation of subbasin command (Chapter 2).
SUB	Topographically-defined subbasin to which the HRU belongs.
MGT	Management number. This is pulled from the management (.mgt) file. Used by the SWAT/GRASS interface to allow development of output maps by landuse/management type.

Variable name	Definition
MON	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step: four-digit year Average annual summary lines: total number of years averaged together
AREA	Drainage area of the HRU (km^2).
PRECIP	Total amount of precipitation falling on the HRU during time step (mm H_2O).
SNOFALL	Amount of precipitation falling as snow, sleet or freezing rain during time step (water-equivalent mm H_2O).
SNOMELT	Amount of snow or ice melting during time step (water-equivalent mm H_2O).
IRR	Irrigation (mm H_2O). Amount of irrigation water applied to HRU during the time step.
PET	Potential evapotranspiration (mm H_2O). Potential evapotranspiration from the HRU during the time step.
ET	Actual evapotranspiration (soil evaporation and plant transpiration) from the HRU during the time step (mm H_2O).
SW_INIT	Soil water content (mm H_2O). For daily output, this column provides the amount of water in soil profile at beginning of day. For monthly and annual output, this is the average soil water content for the time period. The amount of water in the soil profile at the beginning of the day is used to calculate daily curve number values.
SW_END	Soil water content (mm H_2O). Amount of water in the soil profile at the end of the time period (day, month or year).
PERC	Water that percolates past the root zone during the time step (mm H_2O). There is usually a lag between the time the water leaves the bottom of the root zone and reaches the shallow aquifer. Over a long period of time, this variable should equal groundwater recharge (PERC = GW_RCHG as time $\rightarrow \infty$).
GW_RCHG	Recharge entering aquifers during time step (total amount of water entering shallow and deep aquifers during time step) (mm H_2O).
DA_RCHG	Deep aquifer recharge (mm H_2O). The amount of water from the root zone that recharges the deep aquifer during the time step. (shallow aquifer recharge = GW_RCHG - DA_RCHG)

| Variable name | Definition |

REVAP	Water in the shallow aquifer returning to the root zone in response to a moisture deficit during the time step (mm H_2O). The variable also includes water uptake directly from the shallow aquifer by deep tree and shrub roots.
SA_IRR	Irrigation from shallow aquifer (mm H_2O). Amount of water removed from the shallow aquifer for irrigation during the time step.
DA_IRR	Irrigation from deep aquifer (mm H_2O). Amount of water removed from the deep aquifer for irrigation during the time step.
SA_ST	Shallow aquifer storage (mm H_2O). Amount of water in the shallow aquifer at the end of the time period.
DA_ST	Deep aquifer storage (mm H_2O). Amount of water in the deep aquifer at the end of the time period.
SURQ_GEN	Surface runoff generated in HRU during time step (mm H_2O).
SURQ_CNT	Surface runoff contribution to streamflow in the main channel during time step (mm H_2O).
TLOSS	Transmission losses (mm H_2O). Water lost from tributary channels in the HRU via transmission through the bed. This water becomes recharge for the shallow aquifer during the time step. Net surface runoff contribution to the main channel streamflow is calculated by subtracting TLOSS from SURQ.
LATQ	Lateral flow contribution to streamflow (mm H_2O). Water flowing laterally within the soil profile that enters the main channel during time step.
GW_Q	Groundwater contribution to streamflow (mm H_2O). Water from the shallow aquifer that enters the main channel during the time step. Groundwater flow is also referred to as baseflow.
WYLD	Water yield (mm H_2O). Total amount of water leaving the HRU and entering main channel during the time step. (WYLD = SURQ + LATQ + GWQ – TLOSS – pond abstractions)
DAILYCN	Average curve number for time period. The curve number adjusted for soil moisture content.
TMP_AV	Average daily air temperature (°C). Average of mean daily air temperature for time period.

Variable name	Definition
TMP_MX	Average maximum air temperature (°C). Average of maximum daily air temperatures for time period.
TMP_MN	Average minimum air temperature (°C). Average of minimum daily air temperatures for time period.
SOL_TMP	Soil temperature (°C). Average soil temperature of first soil layer for time period.
SOLAR	Average daily solar radiation (MJ/m^2). Average of daily solar radiation values for time period.
SYLD	Sediment yield (metric tons/ha). Sediment from the HRU that is transported into the main channel during the time step.
USLE	Soil loss during the time step calculated with the USLE equation (metric tons/ha). This value is reported for comparison purposes only.
N_APP	Nitrogen fertilizer applied (kg N/ha). Total amount of nitrogen (mineral and organic) applied in regular fertilizer operations during the time step.
P_APP	Phosphorus fertilizer applied (kg P/ha). Total amount of phosphorus (mineral and organic) applied in regular fertilizer operations during the time step.
NAUTO	Nitrogen fertilizer auto-applied (kg N/ha). Total amount of nitrogen (mineral and organic) auto-applied during the time step.
PAUTO	Phosphorus fertilizer auto-applied (kg P/ha). Total amount of phosphorus (mineral and organic) auto-applied during the time step.
NGRZ	Nitrogen applied during grazing operation (kg N/ha). Total amount of nitrogen (mineral and organic) added to soil by grazing operation during the time step.
PGRZ	Phosphorus applied during grazing operation (kg P/ha). Total amount of phosphorus (mineral and organic) added to soil by grazing operation during the time step.
CFERTN	Nitrogen applied during continuous fertilizer operation (kg N/ha). Total amount of nitrogen (mineral and organic) added to soil by continuous fertilizer operation during time step.
CFERTP	Phosphorus applied during continuous fertilizer operation (kg P/ha). Total amount of phosphorus (mineral and organic) added to soil by continuous fertilizer operation during time step.

Variable name	Definition
NRAIN	Nitrate added to soil profile by rain (kg N/ha).
NFIX	Nitrogen fixation (kg N/ha). Amount of nitrogen fixed by legumes during the time step.
F-MN	Fresh organic to mineral N (kg N/ha). Mineralization of nitrogen from the fresh residue pool to the nitrate (80%) pool and active organic nitrogen (20%) pool during the time step. A positive value denotes a net gain in the nitrate and active organic pools from the fresh organic pool while a negative value denotes a net gain in the fresh organic pool from the nitrate and active organic pools.
A-MN	Active organic to mineral N (kg N/ha). Movement of nitrogen from the active organic pool to the nitrate pool during the time step.
A-SN	Active organic to stable organic N (kg N/ha). Movement of nitrogen from the active organic pool to the stable organic pool during the time step.
F-MP	Fresh organic to mineral P (kg P/ha). Mineralization of phosphorus from the fresh residue pool to the labile (80%) pool (P in solution) and the active organic (20%) pool. A positive value denotes a net gain in solution and active organic pools from the fresh organic pool while a negative value denotes a net gain in the fresh organic pool from the labile and active organic pools.
AO-LP	Organic to labile mineral P (kg P/ha). Movement of phosphorus between the organic pool and the labile mineral pool during the time step. A positive value denotes a net gain in the labile pool from the organic pool while a negative value denotes a net gain in the organic pool from the labile pool.
L-AP	Labile to active mineral P (kg P/ha). Movement or transformation of phosphorus between the "labile" mineral pool (P in solution) and the "active" mineral pool (P sorbed to the surface of soil particles) during the time step. A positive value denotes a net gain in the active pool from the labile pool while a negative value denotes a net gain in the labile pool from the active pool.

Variable name	Definition
A-SP	Active to stable P (kg P/ha). Movement or transformation of phosphorus between the "active" mineral pool (P sorbed to the surface of soil particles) and the "stable" mineral pool (P fixed in soil) during the time step. A positive value denotes a net gain in the stable pool from the active pool while a negative value denotes a net gain in the active pool from the stable pool.
DNIT	Denitrification (kg N/ha). Transformation of nitrate to gaseous compounds during the time step.
NUP	Plant uptake of nitrogen (kg N/ha). Nitrogen removed from soil by plants during the time step.
PUP	Plant uptake of phosphorus (kg P/ha). Phosphorus removed from soil by plants during the time step.
ORGN	Organic N yield (kg N/ha). Organic nitrogen transported out of the HRU and into the reach during the time step.
ORGP	Organic P yield (kg P/ha). Organic phosphorus transported with sediment into the reach during the time step.
SEDP	Sediment P yield (kg P/ha). Mineral phosphorus sorbed to sediment transported into the reach during the time step.
NSURQ	NO_3 in surface runoff (kg N/ha). Nitrate transported with surface runoff into the reach during the time step.
NLATQ	NO_3 in lateral flow (kg N/ha). Nitrate transported by lateral flow into the reach during the time step.
NO3L	NO_3 leached from the soil profile (kg N/ha). Nitrate that leaches past the bottom of the soil profile during the time step. *The nitrate is not tracked through the shallow aquifer.*
NO3GW	NO_3 transported into main channel in the groundwater loading from the HRU (kg N/ha).
SOLP	Soluble P yield (kg P/ha). Soluble mineral forms of phosphorus transported by surface runoff into the reach during the time step.
P_GW	Soluble phosphorus transported by groundwater flow into main channel during the time step (kg P/ha).
W_STRS	Water stress days during the time step (days).
TMP_STRS	Temperature stress days during the time step (days).
N_STRS	Nitrogen stress days during the time step (days).

Variable name	Definition
P_STRS	Phosphorus stress days during the time step (days).
BIOM	Biomass. Total biomass, i.e. aboveground and roots at the end of the time period reported as dry weight. Daily biomass is reported in kg ha^{-1}, monthly in tons ha^{-1} and yearly in tons ha^{-1}.
LAI	Leaf area index at the end of the time period.
YLD	Harvested yield (metric tons/ha). The model partitions yield from the total biomass on a daily basis (and reports it). However, the actual yield is not known until it is harvested. The harvested yield is reported as dry weight.
BACTP	Number of persistent bacteria in surface runoff entering reach (# cfu/100 mL).
BACTLP	Number of less persistent bacteria in surface runoff entering reach (#cfu/100 mL).
WTAB	Water table from above the soil profile (mm). (Written only in daily output file. This is not used in the tile flow equations).
WAT_TBL	Water table based on depth from soil surface (mm)
SNO_HRU	Current snow content in the hru (mm). (Not summed)
CMUP_KGH	Current soil carbon for first soil layer (kg/ha)
CMTOT_KGH	Current soil carbon integrated – aggregating all soil layers (kg/ha)
QTILE	Drainage tile flow total (mm H2O)
TILENO3	NO3 in tile flow (kg N/ha)
LATNO3	NO3-N in lateral flow (kg N/ha)
GW_QDEEP	Groundwater contribution to streamflow from deep aquifer (mm H2O)
LATQCNT	Lateral flow contributed after pond and wetland losses and after lagging (mm)
VAP_TILE	Soluble phosphorus leached through the soil profile through cracks (kg P/ha)

The file format for the HRU output file (output.hru) is:

Variable name	Line #	Position	Format	F90 Format
LULC	All	space 1-4	character	a4
HRU	All	space 5-8	4-digit integer	i4
GIS	All	space 10-17	8-digit integer	i8
SUB	All	space 19-22	4-digit integer	i4
MGT	All	space 24-27	4-digit integer	i4
MON	All	space 29-32	4-digit integer	i4
AREA	All	space 33-42	decimal(xxxxxx.xxx)	f10.3
PRECIP	All	space 43-52	decimal(xxxxxx.xxx)	f10.3
SNOFALL	All	space 53-62	decimal(xxxxxx.xxx)	f10.3
SNOMELT	All	space 63-72	decimal(xxxxxx.xxx)	f10.3
IRR	All	space 73-82	decimal(xxxxxx.xxx)	f10.3
PET	All	space 83-92	decimal(xxxxxx.xxx)	f10.3
ET	All	space 93-102	decimal(xxxxxx.xxx)	f10.3
SW_INIT	All	space 103-112	decimal(xxxxxx.xxx)	f10.3
SW_END	All	space 113-122	decimal(xxxxxx.xxx)	f10.3
PERC	All	space 123-132	decimal(xxxxxx.xxx)	f10.3
GW_RCHG	All	space 133-142	decimal(xxxxxx.xxx)	f10.3
DA_RCHG	All	space 143-152	decimal(xxxxxx.xxx)	f10.3
REVAP	All	space 153-162	decimal(xxxxxx.xxx)	f10.3
SA_IRR	All	space 163-172	decimal(xxxxxx.xxx)	f10.3
DA_IRR	All	space 173-182	decimal(xxxxxx.xxx)	f10.3
SA_ST	All	space 183-192	decimal(xxxxxx.xxx)	f10.3
DA_ST	All	space 193-202	decimal(xxxxxx.xxx)	f10.3
SURQ_GEN	All	space 203-212	decimal(xxxxxx.xxx)	f10.3
SURQ_CNT	All	space 213-222	decimal(xxxxxx.xxx)	f10.3
TLOSS	All	space 223-232	decimal(xxxxxx.xxx)	f10.3
LATQ	All	space 233-242	decimal(xxxxxx.xxx)	f10.3
GW_Q	All	space 243-252	decimal(xxxxxx.xxx)	f10.3
WYLD	All	space 253-262	decimal(xxxxxx.xxx)	f10.3
DAILYCN	All	space 263-272	decimal(xxxxxx.xxx)	f10.3
TMP_AV	All	space 273-282	decimal(xxxxxx.xxx)	f10.3
TMP_MX	All	space 283-292	decimal(xxxxxx.xxx)	f10.3
TMP_MN	All	space 293-302	decimal(xxxxxx.xxx)	f10.3
SOL_TMP	All	space 303-312	decimal(xxxxxx.xxx)	f10.3
Variable name	**Line #**	**Position**	**Format**	**F90 Format**

SOLAR	All	space 313-322	decimal(xxxxxx.xxx)	f10.3
SYLD	All	space 323-332	decimal(xxxxxx.xxx)	f10.3
USLE	All	space 333-342	decimal(xxxxxx.xxx)	f10.3
N_APP	All	space 343-352	decimal(xxxxxx.xxx)	f10.3
P_APP	All	space 353-362	decimal(xxxxxx.xxx)	f10.3
NAUTO	All	space 363-372	decimal(xxxxxx.xxx)	f10.3
PAUTO	All	space 373-382	decimal(xxxxxx.xxx)	f10.3
NGRZ	All	space 383-392	decimal(xxxxxx.xxx)	f10.3
PGRZ	All	space 393-402	decimal(xxxxxx.xxx)	f10.3
CFERTN	All	space 403-412	decimal(xxxxxx.xxx)	f10.3
CFERTP	All	space 413-422	decimal(xxxxxx.xxx)	f10.3
NRAIN	All	space 423-432	decimal(xxxxxx.xxx)	f10.3
NFIX	All	space 433-442	decimal(xxxxxx.xxx)	f10.3
F-MN	All	space 443-452	decimal(xxxxxx.xxx)	f10.3
A-MN	All	space 453-462	decimal(xxxxxx.xxx)	f10.3
A-SN	All	space 463-472	decimal(xxxxxx.xxx)	f10.3
F-MP	All	space 473-482	decimal(xxxxxx.xxx)	f10.3
AO-LP	All	space 483-492	decimal(xxxxxx.xxx)	f10.3
L-AP	All	space 493-502	decimal(xxxxxx.xxx)	f10.3
A-SP	All	space 503-512	decimal(xxxxxx.xxx)	f10.3
DNIT	All	space 513-522	decimal(xxxxxx.xxx)	f10.3
NUP	All	space 523-532	decimal(xxxxxx.xxx)	f10.3
PUP	All	space 533-542	decimal(xxxxxx.xxx)	f10.3
ORGN	All	space 543-552	decimal(xxxxxx.xxx)	f10.3
ORGP	All	space 553-562	decimal(xxxxxx.xxx)	f10.3
SEDP	All	space 563-572	decimal(xxxxxx.xxx)	f10.3
NSURQ	All	space 573-582	decimal(xxxxxx.xxx)	f10.3
NLATQ	All	space 583-592	decimal(xxxxxx.xxx)	f10.3
NO3L	All	space 593-602	decimal(xxxxxx.xxx)	f10.3
NO3GW	All	space 603-612	decimal(xxxxxx.xxx)	f10.3
SOLP	All	space 613-622	decimal(xxxxxx.xxx)	f10.3
P_GW	All	space 623-632	decimal(xxxxxx.xxx)	f10.3
W_STRS	All	space 633-642	decimal(xxxxxx.xxx)	f10.3
TMP_STRS	All	space 643-652	decimal(xxxxxx.xxx)	f10.3
N_STRS	All	space 653-662	decimal(xxxxxx.xxx)	f10.3
Variable name	**Line #**	**Position**	**Format**	**F90 Format**

P_STRS	All	space 663-672	decimal(xxxxxx.xxx)	f10.3
BIOM	All	space 673-682	decimal(xxxxxx.xxx)	f10.3
LAI	All	space 683-692	decimal(xxxxxx.xxx)	f10.3
YLD	All	space 693-702	decimal(xxxxxx.xxx)	f10.3
BACTP	All	space 703-712	decimal(xxxxxx.xxx)	f10.3
BACTLP	All	space 713-722	decimal(xxxxxx.xxx)	f10.3
WTAB	All	space 723-732	decimal(xxxxxx.xxx)	f10.3
WAT_TAB	All	space 733-742	decimal(xxxxxx.xxx)	f10.3
SNO_HRU	All	space 743-752	decimal(xxxxxx.xxx)	f10.3
CMUP_KGH	All	space 753-762	decimal(xxxxxx.xxx)	f10.3
CMTOT_KGH	All	space 763-772	decimal(xxxxxx.xxx)	f10.3
QTILE	All	space 773-782	decimal(xxxxxx.xxx)	f10.3
TILENO3	All	space 783-792	decimal(xxxxxx.xxx)	f10.3
LATNO3	All	space 793-802	decimal(xxxxxx.xxx)	f10.3
GW_QDEEP	All	space 803-812	decimal(xxxxxx.xxx)	f10.3
LATQCNT	All	space 813-822	decimal(xxxxxx.xxx)	f10.3
VAP_TILE	All	space 823-823	decimal(xxxxxx.xxx)	f10.3

32.4 SUBBASIN OUTPUT FILE (OUTPUT.SUB)

The subbasin output file contains summary information for each of the subbasins in the watershed. The reported values for the different variables are the total amount or weighted average of all HRUs within the subbasin. The subbasin output file is written in spreadsheet format.

Following is a brief description of the output variables in the subbasin output file.

Variable name	Definition
SUB	Subbasin number.
GIS	GIS code reprinted from watershed configuration file (.fig). See explanation of subbasin command.
MON	Daily time step: julian date Monthly time step: the month (1-12) Annual time step: four-digit year Average annual summary lines: total number of years averaged together
AREA	Area of the subbasin (km^2).
PRECIP	Total amount of precipitation falling on the subbasin during time step (mm H_2O).
SNOMELT	Amount of snow or ice melting during time step (water-equivalent mm H_2O).
PET	Potential evapotranspiration from the subbasin during the time step (mm H_2O).
ET	Actual evapotranspiration from the subbasin during the time step (mm).
SW	Soil water content (mm). Amount of water in the soil profile at the end of the time period.

Variable name	Definition
PERC	Water that percolates past the root zone during the time step (mm). There is potentially a lag between the time the water leaves the bottom of the root zone and reaches the shallow aquifer. Over a long period of time, this variable should equal groundwater percolation.
SURQ	Surface runoff contribution to streamflow during time step (mm H_2O).
GW_Q	Groundwater contribution to streamflow (mm). Water from the shallow aquifer that returns to the reach during the time step.
WYLD	Water yield (mm H_2O). The net amount of water that leaves the subbasin and contributes to streamflow in the reach during the time step. (WYLD = SURQ + LATQ + GWQ – TLOSS – pond abstractions)
SYLD	Sediment yield (metric tons/ha). Sediment from the subbasin that is transported into the reach during the time step.
ORGN	Organic N yield (kg N/ha). Organic nitrogen transported out of the subbasin and into the reach during the time step.
ORGP	Organic P yield (kg P/ha). Organic phosphorus transported with sediment into the reach during the time step.
NSURQ	NO_3 in surface runoff (kg N/ha). Nitrate transported by the surface runoff into the reach during the time step.
SOLP	Soluble P yield (kg P/ha). Phosphorus that is transported by surface runoff into the reach during the time step.
SEDP	Mineral P yield (kg P/ha). Mineral phosphorus attached to sediment that is transported by surface runoff into the reach during the time step.

The format of the subbasin output file (output.sub) is:

Variable name	Line #	Position	Format	F90 Format
SUB	All	space 7-10	4-digit integer	i4
GIS	All	space 12-19	8-digit integer	i8
MON	All	space 21-24	4-digit integer	i4
AREA	All	space 25-34	decimal(xxxxxx.xxx)	f10.3
PRECIP	All	space 35-44	decimal(xxxxxx.xxx)	f10.3
SNOMELT	All	space 45-54	decimal(xxxxxx.xxx)	f10.3
PET	All	space 55-64	decimal(xxxxxx.xxx)	f10.3
ET	All	space 65-74	decimal(xxxxxx.xxx)	f10.3
SW	All	space 75-84	decimal(xxxxxx.xxx)	f10.3
PERC	All	space 85-94	decimal(xxxxxx.xxx)	f10.3
SURQ	All	space 95-104	decimal(xxxxxx.xxx)	f10.3
GW_Q	All	space 105-114	decimal(xxxxxx.xxx)	f10.3
WYLD	All	space 115-124	decimal(xxxxxx.xxx)	f10.3
SYLD	All	space 125-134	decimal(xxxxxx.xxx)	f10.3
ORGN	All	space 135-144	decimal(xxxxxx.xxx)	f10.3
ORGP	All	space 145-154	decimal(xxxxxx.xxx)	f10.3
NSURQ	All	space 155-164	decimal(xxxxxx.xxx)	f10.3
SOLP	All	space 165-174	decimal(xxxxxx.xxx)	f10.3
SEDP	All	space 175-184	decimal(xxxxxx.xxx)	f10.3

32.5 MAIN CHANNEL OUTPUT FILE (OUTPUT.RCH)

The main channel output file contains summary information for each routing reach in the watershed. The file is written in spreadsheet format.

Following is a brief description of the output variables in the output.rch file.

Variable name	Definition
RCH	Reach number.
GIS	GIS number reprinted from watershed configuration (.fig) file.
MON	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step: 4-digit year Average annual summary lines: number of years averaged together
AREA	Area drained by reach (km^2).
FLOW_IN	Average daily streamflow into reach during time step (m^3/s).
FLOW_OUT	Average daily streamflow out of reach during time step (m^3/s).
EVAP	Average daily rate of water loss from reach by evaporation during time step (m^3/s).
TLOSS	Average daily rate of water loss from reach by transmission through the streambed during time step (m^3/s).
SED_IN	Sediment transported with water into reach during time step (metric tons).
SED_OUT	Sediment transported with water out of reach during time step (metric tons).
SEDCONC	Concentration of sediment in reach during time step (mg/L).
ORGN_IN	Organic nitrogen transported with water into reach during time step (kg N).
ORGN_OUT	Organic nitrogen transported with water out of reach during time step (kg N).
ORGP_IN	Organic phosphorus transported with water into reach during time step (kg P).

Variable name	Definition
ORGP_OUT	Organic phosphorus transported with water out of reach during time step (kg P).
NO3_IN	Nitrate transported with water into reach during time step (kg N).
NO3_OUT	Nitrate transported with water out of reach during time step (kg N).
NH4_IN	Ammonium transported with water into reach during time step (kg N).
NH4_OUT	Ammonium transported with water out of reach during time step (kg N).
NO2_IN	Nitrite transported with water into reach during time step (kg N).
NO2_OUT	Nitrite transported with water out of reach during time step (kg N).
MINP_IN	Mineral phosphorus transported with water into reach during time step (kg P).
MINP_OUT	Mineral phosphorus transported with water out of reach during time step (kg P).
ALGAE_IN	Algal biomass transported with water into reach during time step (kg chl-a).
ALGAE_OUT	Algal biomass transported with water out of reach during time step (kg chl-a).
CBOD_IN	Carbonaceous biochemical oxygen demand of material transported into reach during time step (kg O_2).
CBOD_OUT	Carbonaceous biochemical oxygen demand of material transported out of reach during time step (kg O_2).
DISOX_IN	Amount of dissolved oxygen transported into reach during time step (kg O_2).
DISOX_OUT	Amount of dissolved oxygen transported out of reach during time step (kg O_2).
While more than one pesticide may be applied to the HRUs, due to the complexity of the pesticide equations only the pesticide listed in .bsn (Chapter 4) is routed through the stream network.	
SOLPST_IN	Soluble pesticide transported with water into reach during time step (mg active ingredient)

Variable name	Definition
SOLPST_OUT	Soluble pesticide transported with water out of reach during time step (mg active ingredient).
SORPST_IN	Pesticide sorbed to sediment transported with water into reach during time step (mg active ingredient).
SORPST_OUT	Pesticide sorbed to sediment transported with water out of reach during time step (mg active ingredient).
REACTPST	Loss of pesticide from water by reaction during time step (mg active ingredient).
VOLPST	Loss of pesticide from water by volatilization during time step (mg active ingredient).
SETTLPST	Transfer of pesticide from water to river bed sediment by settling during time step (mg active ingredient).
RESUSP_PST	Transfer of pesticide from river bed sediment to water by resuspension during time step (mg active ingredient).
DIFFUSEPST	Transfer of pesticide from water to river bed sediment by diffusion during time step (mg active ingredient).
REACBEDPST	Loss of pesticide from river bed sediment by reaction during time step (mg active ingredient).
BURYPST	Loss of pesticide from river bed sediment by burial during time step (mg active ingredient).
BED_PST	Pesticide in river bed sediment during time step (mg active ingredient).
BACTP_OUT	Number of persistent bacteria transported out of reach during time step (# cfu/100 mL).
BACTLP_OUT	Number of less persistent bacteria transported out of reach during time step (# cfu/100 mL).
CMETAL#1	Conservative metal #1 transported out of reach (kg).
CMETAL#2	Conservative metal #2 transported out of reach (kg).
CMETAL#3	Conservative metal #3 transported out of reach (kg).

The format of the main channel output file (output.rch) is:

Variable name	Line #	Position	Format	F90 Format
RCH	All	space 7-10	4-digit integer	i4
GIS	All	space 12-19	8-digit integer	i8
MON	All	space 21-25	5-digit integer	i5
AREA	All	space 26-37	exponential	e12.4
FLOW_IN	All	space 38-49	exponential	e12.4
FLOW_OUT	All	space 50-61	exponential	e12.4
EVAP	All	space 62-73	exponential	e12.4
TLOSS	All	space 74-85	exponential	e12.4
SED_IN	All	space 86-97	exponential	e12.4
SED_OUT	All	space 98-109	exponential	e12.4
SEDCONC	All	space 110-121	exponential	e12.4
ORGN_IN	All	space 122-133	exponential	e12.4
ORGN_OUT	All	space 134-145	exponential	e12.4
ORGP_IN	All	space 146-157	exponential	e12.4
ORGP_OUT	All	space 158-169	exponential	e12.4
NO3_IN	All	space 170-181	exponential	e12.4
NO3_OUT	All	space 182-193	exponential	e12.4
NH4_IN	All	space 194-205	exponential	e12.4
NH4_OUT	All	space 206-217	exponential	e12.4
NO2_IN	All	space 218-229	exponential	e12.4
NO2_OUT	All	space 230-241	exponential	e12.4
MINP_IN	All	space 242-253	exponential	e12.4
MINP_OUT	All	space 254-265	exponential	e12.4
CHLA_IN	All	space 266-277	exponential	e12.4
CHLA_OUT	All	space 278-289	exponential	e12.4
CBOD_IN	All	space 290-301	exponential	e12.4
CBOD_OUT	All	space 302-313	exponential	e12.4
DISOX_IN	All	space 314-325	exponential	e12.4
DISOX_OUT	All	space 326-337	exponential	e12.4
SOLPST_IN	All	space 338-349	exponential	e12.4
SOLPST_OUT	All	space 350-361	exponential	e12.4
SORPST_IN	All	space 362-373	exponential	e12.4
SORPST_OUT	All	space 374-385	exponential	e12.4
REACTPST	All	space 386-397	exponential	e12.4

Variable name	Line #	Position	Format	F90 Format
VOLPST	All	space 398-409	exponential	e12.4
SETTLPST	All	space 410-421	exponential	e12.4
RESUSP_PST	All	space 422-433	exponential	e12.4
DIFFUSEPST	All	space 434-445	exponential	e12.4
REACBEDPST	All	space 446-457	exponential	e12.4
BURYPST	All	space 458-469	exponential	e12.4
BED_PST	All	space 470-481	exponential	e12.4
BACTP_OUT	All	space 482-493	exponential	e12.4
BACTLP_OUT	All	space 494-505	exponential	e12.4
CMETAL#1	All	space 506-517	exponential	e12.4
CMETAL#2	All	space 518-529	exponential	e12.4
CMETAL#3	All	space 530-541	exponential	e12.4

32.6 HRU IMPOUNDMENT OUTPUT FILE (OUTPUT.WTR)

The HRU impoundment output file contains summary information for ponds, wetlands and depressional/impounded areas in the HRUs. The file is written in spreadsheet format.

Following is a brief description of the output variables in the HRU impoundment output file.

Variable name	Definition
LULC	Four letter character code for the cover/plant on the HRU. (code from crop.dat file)
HRU	Hydrologic response unit number
GIS	GIS code reprinted from watershed configuration file (.fig). See explanation of subbasin command (Chapter 2).
SUB	Topographically-defined subbasin to which the HRU belongs.
MGT	Management number. This is pulled from the management (.mgt) file. Used by the SWAT/GRASS interface to allow development of output maps by landuse/management type.
MON	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step: year Average annual summary lines: total number of years averaged together
AREA	Drainage area of the HRU (km^2).
PNDPCP	Precipitation falling directly on the pond during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
PND_IN	Pond inflow (mm H_2O). Surface runoff entering the pond during the time step. The depth of water is the volume divided by the area of the HRU.
PSED_I	Pond sediment inflow (metric tons/ha). Sediment transported into the pond during the time step. The loading is the mass divided by the area of the HRU.
PNDEVP	Evaporation from the pond surface during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.

Variable name	Definition
PNDSEP	Water that seeps through the bottom of the pond and recharges the shallow aquifer during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
PND_OUT	Pond outflow (mm H_2O). Water leaving the pond and entering the reach during the time step. The depth of water is the volume divided by the area of the HRU.
PSED_O	Pond sediment outflow (metric tons/ha). Sediment transported out of the pond and entering the reach during the time step. . The loading is the mass divided by the area of the HRU.
PNDVOL	Volume of water in pond at end of time step (m^3 H_2O).
PNDORGN	Concentration of organic N in pond at end of time step (mg N/L or ppm).
PNDNO3	Concentration of nitrate in pond at end of time step (mg N/L or ppm).
PNDORGP	Concentration of organic P in pond at end of time step (mg P/L or ppm).
PNDMINP	Concentration of mineral P in pond at end of time step (mg P/L or ppm).
PNDCHLA	Concentration of chlorophyll-a in pond at end of time step (mg chl-a/L or ppm).
PNDSECI	Secchi-disk depth of pond at end of time step (m).
WETPCP	Precipitation falling directly on the wetland during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
WET_IN	Wetland inflow (mm H_2O). Surface runoff entering the wetland during the time step. The depth of water is the volume divided by the area of the HRU.
WSED_I	Wetland sediment inflow (metric tons/ha). Sediment transported into the wetland during the time step. The loading is the mass divided by the area of the HRU.
WETEVP	Evaporation from the wetland during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.

Variable name	Definition
WETSEP	Water that seeps through the bottom of the wetland and recharges the shallow aquifer during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
WET_OUT	Wetland outflow (mm H_2O). Water leaving the wetland and entering the reach during the time step. The depth of water is the volume divided by the area of the HRU.
WSED_O	Wetland sediment outflow (metric tons/ha). Sediment transported out of the wetland and entering the reach during the time step. . The loading is the mass divided by the area of the HRU.
WET_VOL	Volume of water in wetland at end of time step (m^3 H_2O).
WETORGN	Concentration of organic N in wetland at end of time step (mg N/L or ppm).
WETNO3	Concentration of nitrate in wetland at end of time step (mg N/L or ppm).
WETORGP	Concentration of organic P in wetland at end of time step (mg P/L or ppm).
WETMINP	Concentration of mineral P in wetland at end of time step (mg P/L or ppm).
WETCHLA	Concentration of chlorophyll-a in wetland at end of time step (mg chl-a/L or ppm).
WETSECI	Secchi-disk depth of wetland at end of time step (m).
POTPCP	Precipitation falling directly on the pothole during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
POT_IN	Pothole inflow (mm H_2O). Surface runoff entering the pothole during the time step. The depth of water is the volume divided by the area of the HRU.
OSED_I	Pothole sediment inflow (metric tons/ha). Sediment transported into the pothole during the time step. The loading is the mass divided by the area of the HRU.
POTEVP	Evaporation from the pothole during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.

Variable name	Definition
POTSEP	Water that seeps through the bottom of the pothole and enters the underlying soil during the time step (mm H_2O). The depth of water is the volume divided by the area of the HRU.
POT_OUT	Pothole outflow (mm H_2O). Water leaving the pothole and entering the reach during the time step. The depth of water is the volume divided by the area of the HRU.
OSED_O	Pothole sediment outflow (metric tons/ha). Sediment transported out of the pothole and entering the reach during the time step. . The loading is the mass divided by the area of the HRU.
POTVOL	Volume of water in pothole at end of time step (m^3 H_2O).
POT_SA	Surface area of pothole at end of time step (ha).
HRU_SURQ	Surface runoff contribution to streamflow in the main channel from entire HRU during the time step (mm H_2O).
PLANT_ET	Amount of water removed by transpiration from plants during the time step (mm H_2O).
SOIL_ET	Amount of water removed by evaporation from the soil during the time step (mm H_2O).

The format of the HRU impoundment output file (output.wtr) is:

Variable name	Line #	Position	Format	F90 Format
LULC	All	space 1-4	character	a4
HRU	All	space 5-8	4-digit integer	i4
GIS	All	space 10-17	8-digit integer	i8
SUB	All	space 19-22	4-digit integer	i4
MGT	All	space 24-27	4-digit integer	i4
MON	All	space 29-32	4-digit integer	i4
AREA	All	space 33-42	decimal(xxxxxx.xxx)	f10.3
PNDPCP	All	space 43-52	decimal(xxxxxx.xxx)	f10.3
PND_IN	All	space 53-62	decimal(xxxxxx.xxx)	f10.3
PSED_I	All	space 63-72	decimal(xxxxxx.xxx)	f10.3
PNDEVP	All	space 73-82	decimal(xxxxxx.xxx)	f10.3
PNDSEP	All	space 83-92	decimal(xxxxxx.xxx)	f10.3
PND_OUT	All	space 93-102	decimal(xxxxxx.xxx)	f10.3
PSED_O	All	space 103-112	decimal(xxxxxx.xxx)	f10.3

Variable name	Line #	Position	Format	F90 Format
PNDVOL	All	space 113-122	exponential	e10.4
PNDORGN	All	space 123-132	decimal(xxxxxx.xxx)	f10.3
PNDNO3	All	space 133-142	decimal(xxxxxx.xxx)	f10.3
PNDORGP	All	space 143-152	decimal(xxxxxx.xxx)	f10.3
PNDMINP	All	space 153-162	decimal(xxxxxx.xxx)	f10.3
PNDCHLA	All	space 163-172	decimal(xxxxxx.xxx)	f10.3
PNDSECI	All	space 173-182	decimal(xxxxxx.xxx)	f10.3
WETPCP	All	space 183-192	decimal(xxxxxx.xxx)	f10.3
WET_IN	All	space 193-202	decimal(xxxxxx.xxx)	f10.3
WSED_I	All	space 203-212	decimal(xxxxxx.xxx)	f10.3
WETEVP	All	space 213-222	decimal(xxxxxx.xxx)	f10.3
WETSEP	All	space 223-232	decimal(xxxxxx.xxx)	f10.3
WET_OUT	All	space 233-242	decimal(xxxxxx.xxx)	f10.3
WSED_O	All	space 243-252	decimal(xxxxxx.xxx)	f10.3
WET_VOL	All	space 253-262	exponential	e10.4
WETORGN	All	space 263-272	decimal(xxxxxx.xxx)	f10.3
WETNO3	All	space 273-282	decimal(xxxxxx.xxx)	f10.3
WETORGP	All	space 283-292	decimal(xxxxxx.xxx)	f10.3
WETMINP	All	space 293-302	decimal(xxxxxx.xxx)	f10.3
WETCHLA	All	space 303-312	decimal(xxxxxx.xxx)	f10.3
WETSECI	All	space 313-322	decimal(xxxxxx.xxx)	f10.3
POTPCP	All	space 323-332	decimal(xxxxxx.xxx)	f10.3
POT_IN	All	space 333-342	decimal(xxxxxx.xxx)	f10.3
OSED_I	All	space 343-352	decimal(xxxxxx.xxx)	f10.3
POTEVP	All	space 353-362	decimal(xxxxxx.xxx)	f10.3
POTSEP	All	space 363-372	decimal(xxxxxx.xxx)	f10.3
POT_OUT	All	space 373-382	decimal(xxxxxx.xxx)	f10.3
OSED_O	All	space 383-392	decimal(xxxxxx.xxx)	f10.3
POTVOL	All	space 393-402	exponential	e10.4
POT_SA	All	space 403-412	decimal(xxxxxx.xxx)	f10.3
HRU_SURQ	All	space 413-422	decimal(xxxxxx.xxx)	f10.3
PLANT_ET	All	space 423-432	decimal(xxxxxx.xxx)	f10.3
SOIL_ET	All	space 433-442	decimal(xxxxxx.xxx)	f10.3

32.7 RESERVOIR OUTPUT FILE (OUTPUT.RSV)

The reservoir output file contains summary information for reservoirs in the watershed. The file is written in spreadsheet format.

Following is a brief description of the output variables in the reservoir output file.

Variable name	Definition
RES	Reservoir number (assigned in .fig file, Chapter 2)
MON	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step: four-digit year
VOLUME	Volume of water in reservoir at end of time step (m^3 H_2O).
FLOW_IN	Average flow into reservoir during time step (m^3/s H_2O).
FLOW_OUT	Average flow out of reservoir during time step (m^3/s H_2O).
PRECIP	Precipitation falling directly on the reservoir during the time step (m^3 H_2O).
EVAP	Evaporation from the reservoir during the time step (m^3 H_2O).
SEEPAGE	Water that seeps through the bottom of the reservoir and enters the shallow aquifer during the time step (m^3 H_2O).
SED_IN	Reservoir sediment inflow (metric tons). Sediment transported into the reservoir during the time step.
SED_OUT	Reservoir sediment outflow (metric tons). Sediment transported out of the reservoir during the time step.
RES_SED	Sediment concentration (mg/L). Sediment concentration in reservoir water during the time step.
ORGN_IN	Amount of organic nitrogen transported into reservoir during the time step (kg N).
ORGN_OUT	Amount of organic nitrogen transported out of reservoir during the time step (kg N).
RES_ORGN	Organic nitrogen concentration in reservoir water during time step (mg N/L).
ORGP_IN	Amount of organic phosphorus transported into reservoir during the time step (kg P).

Variable name	Definition
ORGP_OUT	Amount of organic phosphorus transported out of reservoir during the time step (kg P).
RES_ORGP	Concentration of organic phosphorus in reservoir water during the time step (mg P/L).
ORGP_OUT	Amount of organic phosphorus transported out of reservoir during the time step (kg P).
RES_ORGP	Concentration of organic phosphorus in reservoir water during the time step (mg P/L).
NO3_IN	Amount of nitrate transported into reservoir during the time step (kg N).
NO3_OUT	Amount of nitrate transported out of reservoir during the time step (kg N).
RES_NO3	Concentration of nitrate in reservoir water during time step (mg N/L).
NO2_IN	Amount of nitrite transported into reservoir during the time step (kg N).
NO2_OUT	Amount of nitrite transported out of reservoir during the time step (kg N).
RES_NO2	Concentration of nitrite in reservoir water during time step (mg N/L).
NH3_IN	Amount of ammonia transported into reservoir during the time step (kg N).
NH3_OUT	Amount of ammonia transported out of reservoir during the time step (kg N).
RES_NH3	Concentration of ammonia in reservoir water during the time step (mg N/L).
MINP_IN	Amount of mineral phosphorus transported into reservoir during the time step (kg P).
MINP_OUT	Amount of mineral phosphorus transported out of reservoir during the time step (kg P).
RES_MINP	Concentration of mineral phosphorus in reservoir water during time step (mg P/L).
CHLA_IN	Amount of chlorophyll *a* transported into reservoir during the time step (kg chla).
CHLA_OUT	Amount of chlorophyll *a* transported out of reservoir during the time step (kg chla).

Variable name	Definition
SECCHIDEPTH	Secchi-disk depth of reservoir at end of time step (m).
PEST_IN	Amount of pesticide transported into reservoir during the time step (mg active ingredient).
REACTPST	Loss of pesticide from water by reaction during time step (mg active ingredient).
VOLPST	Loss of pesticide from water by volatilization during time step (mg active ingredient).
SETTLPST	Transfer of pesticide from water to reservoir bed sediment by settling during time step (mg active ingredient).
RESUSP_PST	Transfer of pesticide from reservoir bed sediment to water by resuspension during time step (mg active ingredient).
DIFFUSEPST	Transfer of pesticide from water to reservoir bed sediment by diffusion during time step (mg active ingredient).
REACBEDPST	Loss of pesticide from reservoir bed sediment by reaction during time step (mg active ingredient).
BURYPST	Loss of pesticide from reservoir sediment by burial during time step (mg active ingredient).
PEST_OUT	Amount of pesticide transported out of reservoir during the time step (mg pesticide active ingredient).
PSTCNCW	Average concentration of pesticide in reservoir water during time step (mg active ingredient/m^3 H_2O or ppb).
PSTCNCB	Average concentration of pesticide in reservoir bed sediment during time step (mg active ingredient/m^3 H_2O or ppb).

The format of the reservoir output file (output.rsv) is:

Variable name	Line #	Position	Format	F90 Format
RES	All	space 7-14	integer	i8
MON	All	space 16-19	integer	i4
VOLUME	All	space 20-31	exponential	e12.4
FLOW_IN	All	space 32-43	exponential	e12.4
FLOW_OUT	All	space 44-55	exponential	e12.4
PRECIP	All	space 56-67	exponential	e12.4
EVAP	All	space 68-79	exponential	e12.4
SEEPAGE	All	space 80-91	exponential	e12.4
SED_IN	All	space 92-103	exponential	e12.4
SED_OUT	All	space 104-115	exponential	e12.4

Variable name	Line #	Position	Format	F90 Format
RES_SED	All	space 116-127	exponential	e12.4
ORGN_IN	All	space 128-139	exponential	e12.4
ORGN_OUT	All	space 140-151	exponential	e12.4
RES_ORGN	All	space 152-163	exponential	e12.4
ORGP_IN	All	space 164-175	exponential	e12.4
ORGP_OUT	All	space 176-187	exponential	e12.4
RES_ORGP	All	space 188-199	exponential	e12.4
NO3_IN	All	space 200-211	exponential	e12.4
NO3_OUT	All	space 212-223	exponential	e12.4
RES_NO3	All	space 224-235	exponential	e12.4
NO2_IN	All	space 236-247	exponential	e12.4
NO2_OUT	All	space 248-259	exponential	e12.4
RES_NO2	All	space 260-271	exponential	e12.4
NH3_IN	All	space 272-283	exponential	e12.4
NH3_OUT	All	space 284-295	exponential	e12.4
RES_NH3	All	space 296-307	exponential	e12.4
MINP_IN	All	space 308-319	exponential	e12.4
MINP_OUT	All	space 320-331	exponential	e12.4
RES_MINP	All	space 332-343	exponential	e12.4
CHLA_IN	All	space 344-355	exponential	e12.4
CHLA_OUT	All	space 356-367	exponential	e12.4
SECCHIDEPTH	All	space 368-379	exponential	e12.4
PEST_IN	All	space 380-391	exponential	e12.4
REACTPST	All	space 392-403	exponential	e12.4
VOLPST	All	space 404-415	exponential	e12.4
SETTLPST	All	space 416-427	exponential	e12.4
RESUSP_PST	All	space 428-439	exponential	e12.4
DIFFUSEPST	All	space 440-451	exponential	e12.4
REACBEDPST	All	space 452-463	exponential	e12.4
BURYPST	All	space 464-475	exponential	e12.4
PEST_OUT	All	space 476-487	exponential	e12.4
PSTCNCW	All	space 488-499	exponential	e12.4
PSTCNCB	All	space 500-511	exponential	e12.4

32.8 SEDIMENT LOADS OUTPUT FILE (OUTPUT.SED)

The sediment loads output file contains summary information for reservoirs in the watershed. The file is written in spreadsheet format.

Following is a brief description of the output variables in the sediment loads output file.

Variable name	Definition
RCH	Four letter character code for the reach number. The reach number is also the hydrograph number of the subbasin as defined in the .fig file.
GIS	GIS code reprinted from watershed configuration file (.fig).
MON	Daily time step: the julian date Monthly time step: the month (1-12) Annual time step: four-digit year Average annual summary lines: total number of years averaged together
AREA	Drainage area of the HRU ($km^{2)}$.
SED_IN	Total sediment transported into reach during time step (tons)
SED_OUT	Total sediment transported out of reach during time step (tons)
SAND_IN	Sand transported into reach during time step (tons)
SAND_OUT	Sand transported out of reach during time step (tons)
SILT_IN	Silt transported into reach during time step (tons)
SILT_OUT	Silt transported out of reach during time step (tons)
CLAY_IN	Clay transported into reach during time step (tons)
CLAY_OUT	Clay transported out of reach during time step (tons)
SMAG_IN	Small aggregates transported into reach during time step (tons)
SMAG_OUT	Small aggregates transported out of reach during time step (tons)
LAG_IN	Large aggregates transported into reach during time step (tons)

Variable name	Definition
LAG_OUT	Large aggregates transported out of reach during time step (tons)
GRA_IN	Gravel aggregates transported into reach during time step (tons)
GRA_OUT	Gravel aggregates transported out of reach during time step (tons)
CH_BNK	Bank erosion (tons)
CH_BED	Channel degradation (tons)
CH_DEP	Channel deposition (tons)
FP_DEP	Floodplain deposition (tons)
TSS	Total suspended sediments (mg/L)

The file format for the HRU output file (output.sed) is:

Variable name	Line #	Position	Format	F90 Format
RCH	All	Space 7-10	4-digit integer	i4
GIS	All	Space 12-19	8-digit integer	i8
MON	All	Space 21-25	5-digit integer	i5
AREA	All	Space 26-37	exponential	e12.4
SED_IN	All	Space 38-49	exponential	e12.4
SED_OUT	All	Space 50-61	exponential	e12.4
SAND_IN	All	Space 62-73	exponential	e12.4
SAND_OUT	All	Space 74-85	exponential	e12.4
SILT_IN	All	Space 86-97	exponential	e12.4
SILT_OUT	All	Space 98-109	exponential	e12.4
CLAY_IN	All	Space 110-121	exponential	e12.4
CLAY_OUT	All	Space 122-133	exponential	e12.4
SMAG_IN	All	Space 134-145	exponential	e12.4
SMAG_OUT	All	Space 146-157	exponential	e12.4
LAG_IN	All	Space 158-169	exponential	e12.4
LAG_OUT	All	Space 170-181	exponential	e12.4
GRA_IN	All	Space 170-181	exponential	e12.4
GRA_OUT	All	Space 182-193	exponential	e12.4
CH_BNK	All	Space 194-205	exponential	e12.4
CH_BED	All	Space 206-217	exponential	e12.4

Variable name	Line #	Position	Format	F90 Format
CH_DEP	All	Space 217-229	exponential	e12.4
FP_DEP	All	Space 230-241	exponential	e12.4
TSS	All	Space 242-253	exponential	e12.4

32.9 MANAGEMENT OUTPUT FILE (OUTPUT.MGT)

The management output file contains summary information for various management operations. Each time a scheduled operation occurs, the model prints to the OUTPUT.MGT file indicating the operation was simulated. These files can get very large. The user may indicate in file.cio if he/she would like to suppress the write statements (imgt = 0, do not write output.mgt file).

Following is a brief description of the output variables in the management output file.

Variable name	Definition
HRU	Hydrologic response unit number
YEAR	Current year of simulation (four digit)
DAY	Day being simulated (current Julian date)
MONTH	Monthly time step: (1-12)
OPERATION	Management operation being performed

Management operations addressed in the management output file.

Management name	Definition
PLANT	Plant/beginning of growing season, operation performed when no plant cover is growing.
IRRIGATE	Irrigation operation from shallow aquifer, deep aquifer and sources outside watershed
FERT APP	Fertilizer application
END GROW	Operation called at the end of the annual growing season as determined by length of day, dormant period for the plant and fraction of plant heat units.

HARV&KILL	Harvest and kill operation
HARVEST	Harvest operation, no kill
KILL	Kill operation
TILLAGE	Tillage operation, multiple tillage operation may be scheduled on same day
PEST APP	Pesticide application
RELEASE	Release/impound operation for rice fields

32.10 SOIL OUTPUT FILE (OUTPUT.SOL)

The soil output file contains summary information for nutrients in the soil profile. Following is a brief description of the output variables in the soil output file.

Variable name	Definition
DAY	Daily time step: the Julian date
HRU	Hydrologic response unit number
SURFACE SOL_RSD	Amount of organic matter in the soil classified as residue (kg/ha)
SOL_P	Soluble phosphorus in soil profile (kg P/ha)
NO3	Amount of nitrate in the soil profile (kg N/ha)
ORG_N	Amount of N stored in the stable organic N pool (kg N/ha)
ORG_P	Amount of P stored in the stable organic P pool (kg P/ha)
CN	Curve number for current day

32.11 SNOW AT ELEVATION BAND OUTPUT FILE (SNOWBAND.OUT)

The snowband output file contains summary information for the amount of moisture in snow at elevation bands.

Following is a brief description of the output variables in the snowband output file.

Variable name	Definition
DAY	Daily time step: the Julian date
HRU	Hydrologic response unit number
YR	Current year of simulation (four digit)
SNOW (1-7)	Snow water content in elevation band on current day (mm)

32.12 PESTICIDE OUTPUT FILE (OUTPUT.PST)

The pesticide output file contains summary information for the amount of pesticide that is sorbed to sediment and the amount that is soluble.

Following is a brief description of the output variables in the pesticide output file.

Variable name	Definition
PESTICIDE #	Pesticide number from the pesticide database
PESTICIDE NAME	Pesticide name from the database that was used in the simulation
HRU	Hydrologic response unit number
YEAR	Current year of simulation (four digit)
MON	Monthly time step: (1-12)
SOLUBLE	Amount of pesticide in solution in surface runoff (mg)
SORBED	Amount of pesticide sorbed to sediment in surface runoff (mg)

32.13 HOURLY OUTPUT FILE (HOURQ.OUT)

This output file contains summary information for the volume of water at a hydrograph storage location by year, day and hour.

Following is a brief description of the output variables in the hourly output file.

Variable name	Definition
YEAR	Current year of simulation (four digit)
DAY	Current day of simulation
HOUR	Current hour of simulation
HYD	The hydrograph storage location number for subbasin
TOTAL WATER YLD	Water yield (m^3) at the hydrograph storage location during hour

32.14 CHANNEL VELOCITY OUTPUT FILE (CHANVEL.OUT)

This output file contains summary information for the velocity of water at each reach by day and year. The user may input code (ITEMP) that is read from file.cio that controls the off/on (0=off/1=on) switch for writing output to this file.

Following is a brief description of the output variables in the channel velocity output file.

Variable name	Definition
YEAR	Current year of simulation (four digit)
DAY	Current day of simulation
CH_VEL	Velocity of water at each reach ($m\ s^{-1}$)

32.15 WATER DEPTH OUTPUT FILE (WATRDEP.OUT)

This output file contains summary information for the water depth at each reach by day and year. The user may input code (ITEMP) that is read from file.cio that controls the off/on (0=off/1=on) switch for writing output to this file.

Following is a brief description of the output variables in the channel velocity output file.

Variable name	Definition
YEAR	Current year of simulation (four digit)
DAY	Current day of simulation
AVE WATER DEPTH	Average water depth at each reach (m)

32.16 CARBON OUTPUT FILE (CSWAT_PROFILE.TXT)

This output file contains summary information for the mass of carbon in organic matter and manure for all soil layers as well as the mass of the residue in all soil layers for each HRU by day and year. The user may input code (CSWAT) that is read from .bsn that controls the off/on (0=off/1=on) switch for writing output to this file.

Following is a brief description of the output variables in carbon output file.

Variable name	Definition
IYR	Current year of simulation (four digit)
I	Current day of simulation
J	HRU number

CMASS_PRO	Mass of soil carbon in the soil organic matter in the entire profile or the sum of all layers, not including residue or manure (kg/ha)
SOL_RSD_	Sum of the mass of residue for all soil layers (kg/ha)
SOL_MC_PRO	Sum of the carbon in manure in all soil layers (kg/ha)