Explanation of *output.std* Output File for SWAT-MODFLOW Simulations

Ryan Bailey, Colorado State University (rtbailey@engr.colostate.edu)
June 8, 2016

This document summarizes the new format of the *output.std* for SWAT-MODFLOW simulations. For standard SWAT model simulations, the *output.std* file contains daily-averaged depths for the principal water balance variables in the watershed (e.g. rainfall, surface runoff, groundwater flow to streams, etc.). The *output.std* file for the SWAT-MODFLOW simulations has the same general format as the original SWAT model, but with several key additions that provide more information regarding groundwater and groundwater-surface water interactions. These additions are summarized as follows:

Variables in original SWAT simulations

PREC:	Rainfall in the watershed
SURQ:	Surface runoff to streams
LATQ:	Lateral flow to streams
GWQ:	Groundwater flow to streams (using original SWAT groundwater module)
PERCO LATE:	Deep percolation (recharge) to groundwater
TILE Q:	Tile drain flow to streams
SW:	Total soil water contained in the watershed
WATER YIELD:	Total water added to streams (= SURQ + LATQ + GWQ + TILE Q)

New Variables (and changes to original variables) in SWAT-MODFLOW simulations

GWQ:	Groundwater flow to streams (as calculated by the River package in MODFLOW)
SWGW:	Seepage from streams to the aquifer (as calculated by the River package in MODFLOW)
GW:	Total groundwater contained in the watershed
WATER YIELD:	Total water added to streams (= SURQ + LATQ + GWQ – SWGW + TILE Q) (notice that this takes into account the water that leaves the stream and seeps into the aquifer)

Example output from a SWAT-MODFLOW simulation is shown in the following figure:

UNIT TIME	PREC (mm)	SURQ (mm)	LATQ (mm)	GWQ (mm)	SWGW (mm)	PERCO LATE (mm)	TILE Q (mm)	SW (mm)	GW (mm)	ET (mm)	PET (mm)	WATER YIELD (mm)	SED YIELD (mm)	NO3 SURQ (kg nutrient/ha)	NO3 LATQ (kg nutrient/ha)	NO3 PERC (kg nutrient/ha)	NO3 CROP (kg nutrient/ha)	N ORGANIC (kg nutrient/ha)	P SOLUBLE (kg nutrient/ha)	P ORGANIC (kg nutrient/ha)	TILENO3 (kg/ha)
1	0.00	0.00	0.00	0.67	0.06	0.00	0.00	174.55	464.15	0.51	1.40	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.66	0.06	0.00	0.00	173.59	463.56	1.02	3.32	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.66	0.06	0.00	0.00	173.12	462.97	0.53	1.91	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.65	0.06	0.00	0.00	172.71	462.39	0.46	1.79	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.64	0.06	0.00	0.00	172.25	461.82	0.51	2.07	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.64	0.06	0.00	0.00	171.87	461.26	0.42	1.74	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.63	0.07	0.00	0.00	171.60	461.04	0.32	1.33	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	60.70	27.93	0.29	2.90	0.00	14.55	0.00	186.57	472.34	0.78	0.88	28.85	0.57	0.18	0.00	0.75	0.00	0.64	0.01	0.10	0.00
9	21.10	4.40	0.40	1.87	0.22	13.97	0.00	187.56	484.83	0.56	0.63	8.11	0.00	0.06	0.01	0.80	0.00	0.10	0.00	0.02	0.00
10	0.00	0.00	0.29	1.14	0.10	1.98	0.00	184.11	486.03	1.52	2.29	1.86	0.00	0.01	0.01	0.05	0.00	0.01	0.00	0.00	0.00
11	0.00	0.00	0.21	1.08	0.04	0.78	0.00	181.92	485.92	1.47	2.99	1.31	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
12	28.20	7.67	0.36	3.19	0.00	13.54	0.00	187.17	496.37	0.28	0.32	10.61	0.09	0.03	0.01	0.82	0.00	0.10	0.00	0.02	0.00
13	49.50	22.82	0.58	4.61	0.01	21.95	0.00	189.24	513.92	0.36	0.41	26.72	0.36	0.02	0.01	1.37	0.00	0.48	0.01	0.08	0.00

Figure 1. Example output data in *output.std* file, as written by the SWAT-MODFLOW model. The variables bounded by a red rectangle are either new variables output by SWAT-MODFLOW (SWGW, GW) or variables that are modified from the original SWAT modeling code (GWQ, WATER YIELD).