Notes on using WEPP Tile Drainage

September 18, 2012

The WEPP drainage code in the subroutine drain.for was corrected to better represent tile drainage. This was during the spring of 2010, after the WEPP 2010.1 release which was in January. The following is a list of the changes:

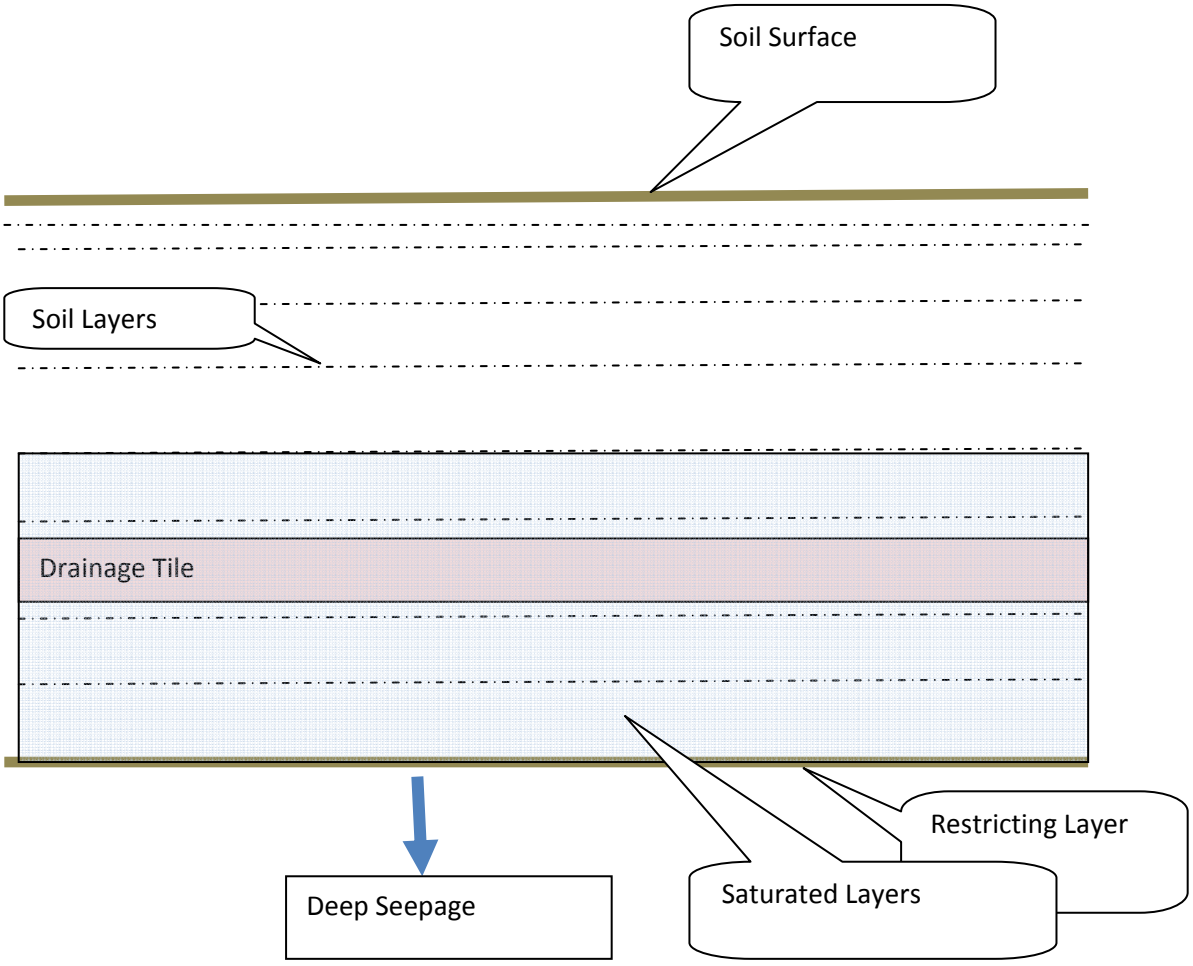
1. Drainage flux variable represents the amount of water leaving through tile drains. The old code misused this variable and it was reporting the amount of potential water left over after the tile drainage occurred.
2. Drainage flux equation was using pipe diameter instead of radius. Equation as written was also not evaluating correctly based on operator precedence. Rewrote equation with correct units.
3. Water was removed from the soil profile starting from the first layer and working down until the potential drainage limit was reached or until the end of the soil profile. This was changed to start at the soil layer containing the tile and continue towards the top soil layer until the potential drainage limit was reached or the time it would take for water to flow from a layer to the drain is greater than 24 hours.
4. The unsaturated depth calculation at the end of the routine was rewritten to use the same code as the water balance routine.

WEPP moves water between the soil layers at the end of each day, starting from the bottom layer and working towards the surface. Any water that leaves the last layer is attributed to deep seepage. If not enough water can move to deep seepage then the last layer becomes saturated, exceeding its upper limit. The excess water is moved to the soil layer above.

A water table depth is estimated starting from the bottom layer and ending at the first soil layer that is below field capacity. If the depth to the water table from the surface is less than the depth of the drainage tile the drainage routine is called. The drainage routine calculates a potential amount that can be drained from saturated layers at the tile level and above. The actual amount of water removed is taken from the layer containing the tile to bring it back down to field capacity. Since this only happens once a day so all layers with excess water above the tile are also brought down to field capacity. This continues until the potential drainage limit is reached for the day. The limit is based on the drainage coefficient or the amount of water that can travel down to the tile in 24 hours – whichever is less.

Adding Drainage to a WEPP Run

To setup drainage include a restricting layer in the soil file, also change the default anisotropy ratio to be a small value to not allow horizontal subsurface flow. In the management inputs the depth to the drain tile should be set less than the depth of the soil restricting layer. The maximum plant root depth in the plant management inputs can have a large effect on the drainage amounts during a growing season.


Soil Surface
Soil Layers
Drainage Tile
Deep Seepage
Saturated Layers
Restricting Layer

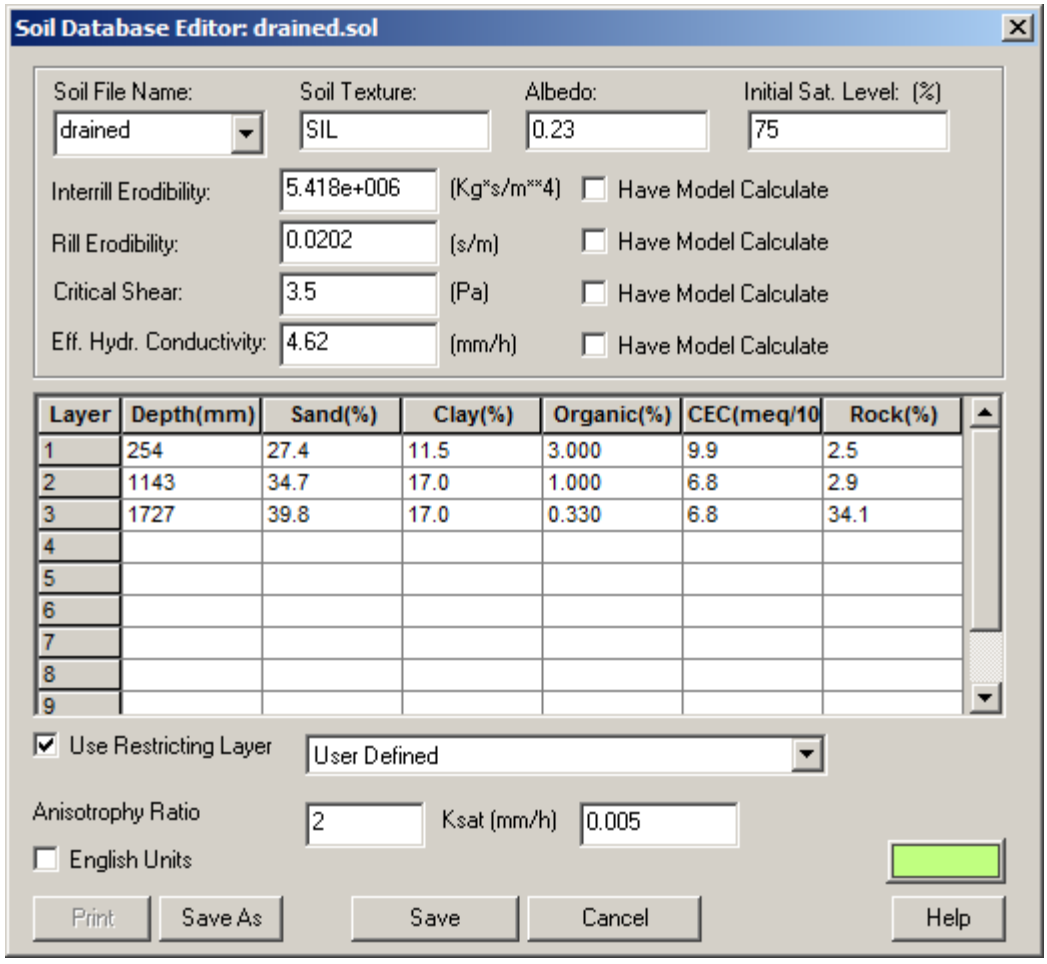


Figure 1 Example Soil input for drainage with restricting layer and small anisotrophy ratio to limit horizontal flow.

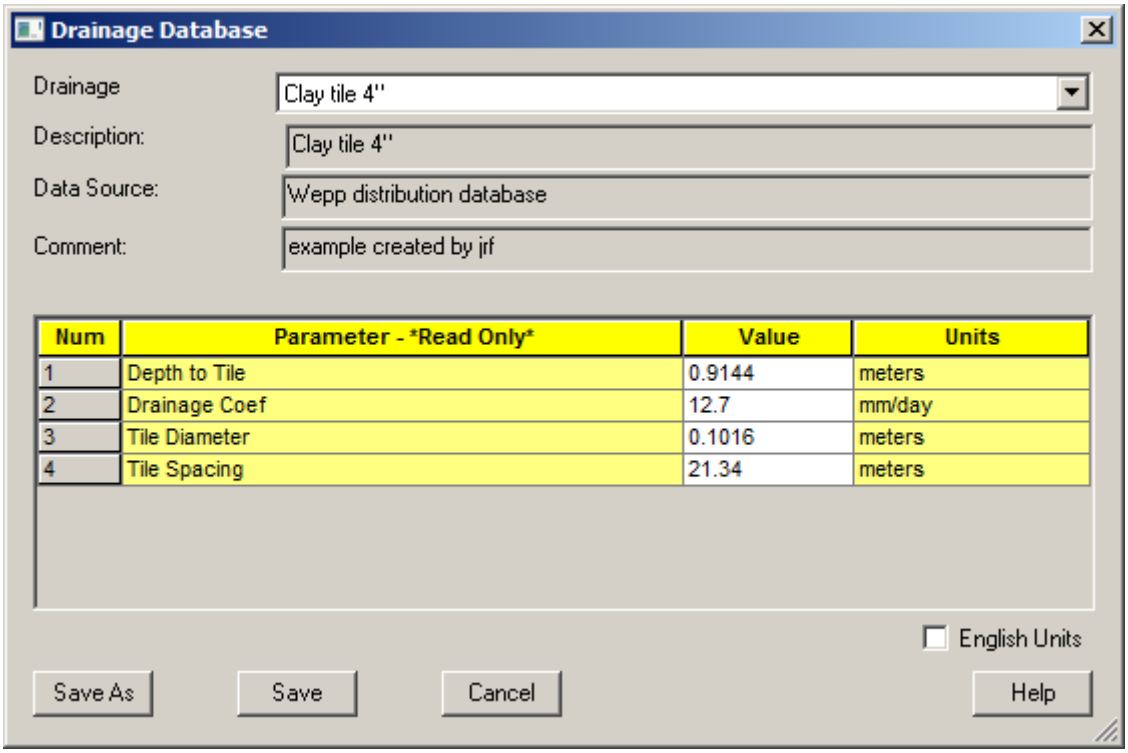


Figure 2 Drainage parameters, these are setup using the Drainage button at the bottom of the management window.

In the Run Options window select the Water Output file which will list the daily tile drainage prericted.

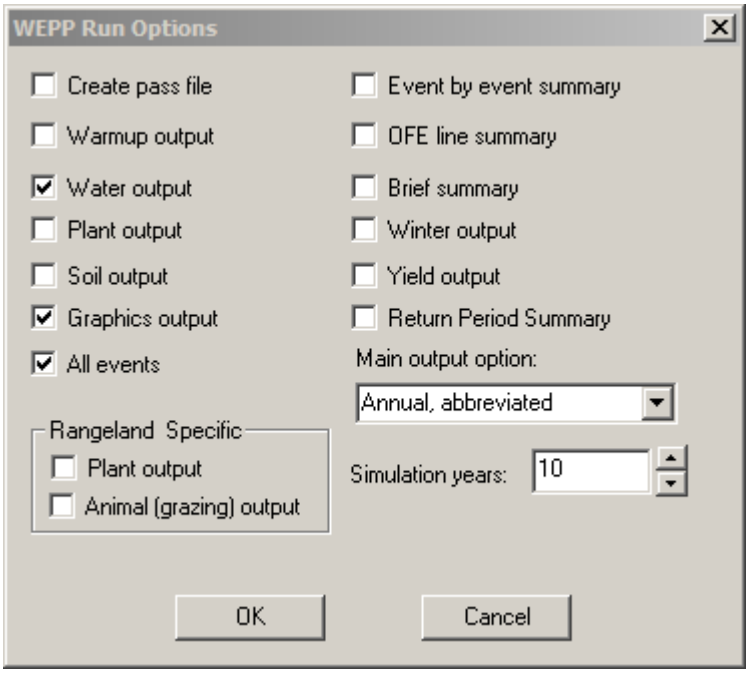


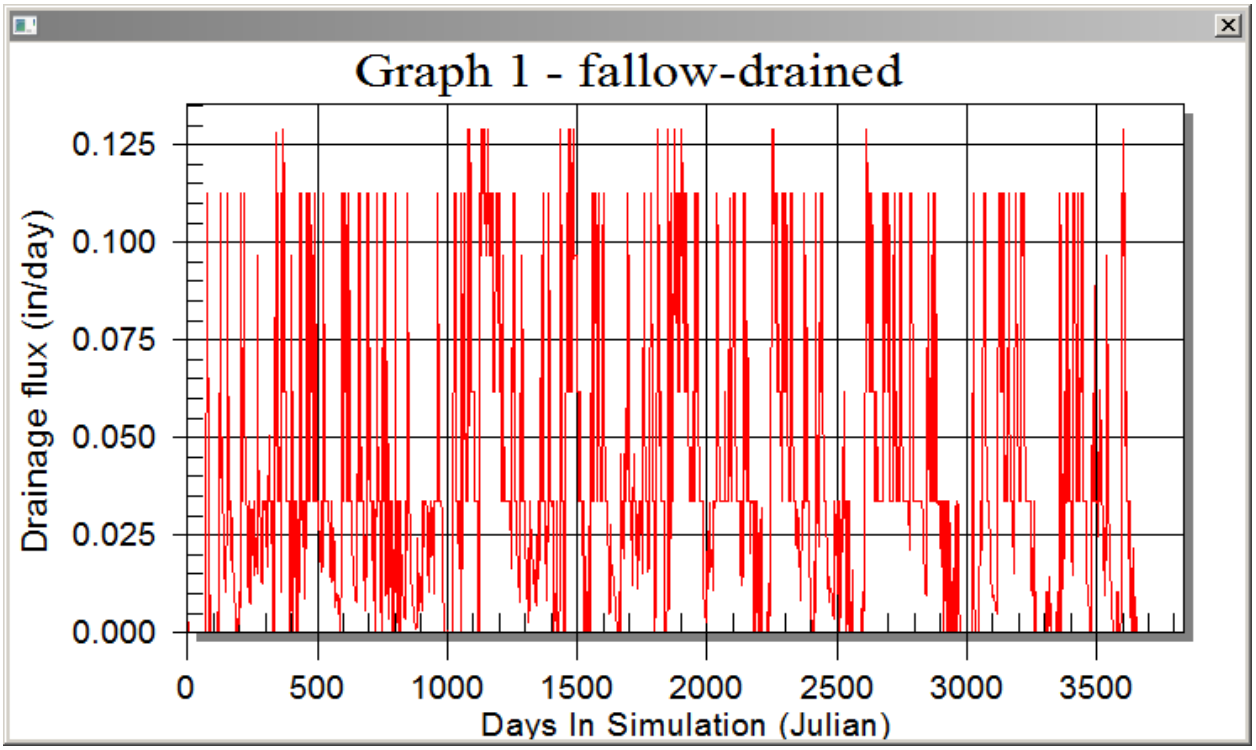
Figure 3 Set Water Output to get daily values for drainage and other water balance related outputs.

Drainage Outputs

There are 3 output files that show the tile drainage:

1. Graphics Output – Under the Drainage Flux variable, graphs daily tile flow. View by clicking the Graphical Output button.
2. Water Output – Listed under the Tile column, view file from list of text outputs from the model.
3. Water Balance Summary - A quick way to see how much water flowed from the tile choose the **Tools** menu item then **External Programs** then **Water Balance**.

Example from graphics output:



Example from Water Output File:

Snow-Water mm	QOFE mm	Tile mm	Irr mm	Area m^2
13.80	0.0000000E+00	0.06	0.00	457.20
13.80	0.0000000E+00	0.00	0.00	457.20
19.20	0.0000000E+00	0.00	0.00	457.20
19.20	0.0000000E+00	0.00	0.00	457.20
19.20	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.8885223E+01	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	0.00	0.00	457.20
0.00	0.0000000E+00	2.46	0.00	457.20
0.00	0.0000000E+00	1.57	0.00	457.20
0.00	0.0000000E+00	1.57	0.00	457.20
0.00	0.0000000E+00	0.17	0.00	457.20

Example from water balance summary tool:

+Precip(mm):	10887.10	4977.58 (m^3)	
-Runoff(mm):	1494.29	683.19 (m^3)	13.82%
-Soil Evap(mm):	4811.31	2199.73 (m^3)	44.51%
-Plant Evap(mm):	0.00	0.00 (m^3)	0.00%
-Residue Evap(mm):	0.00	0.00 (m^3)	0.00%
-Deep seep(mm):	871.09	398.26 (m^3)	8.06%
-Lat Flow(mm):	38.84	17.76 (m^3)	0.36%
-Tile Drainage(mm):	3584.70	1638.92 (m^3)	33.16%