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Management, Protection and Sustainable Use of

Groundwater and Soil Resources in the Arab Region

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Technical Paper on

Groundwater Recharge/ Surface Runoff Entry Options in WEAP

by

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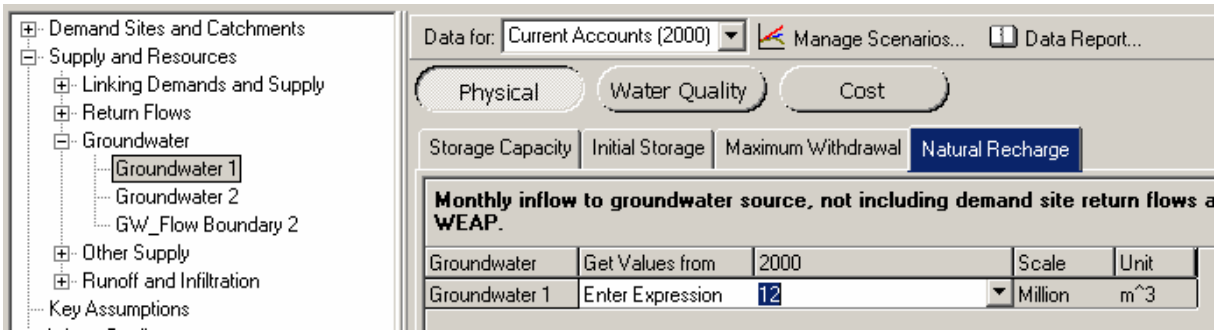
1. Groundwater Recharge/ Surface Runoff Entry Options in WEAP

The following sections describe different options on entering/ calculating groundwater recharge in WEAP.

1.1. Enter "Natural Recharge" to the groundwater node.

The simplest options is by entering the recharge directly to the groundwater node. Through this option the entered value will be evenly distributed to the respective catchment/ groundwater (cells) area. This value can be also entered as a function of precipitation, area and infiltration coefficient if the parameters are known for the respective catchment.

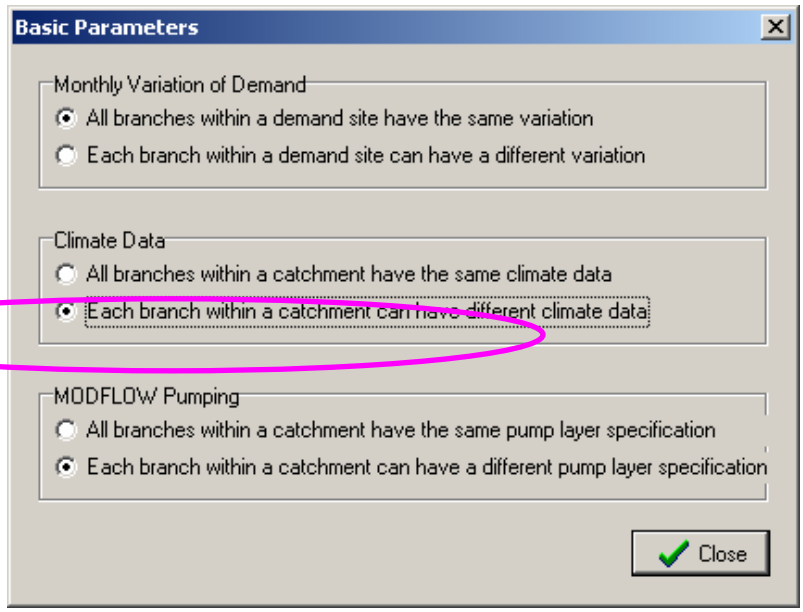


1.2. Enter Recharge directly to the land use class area

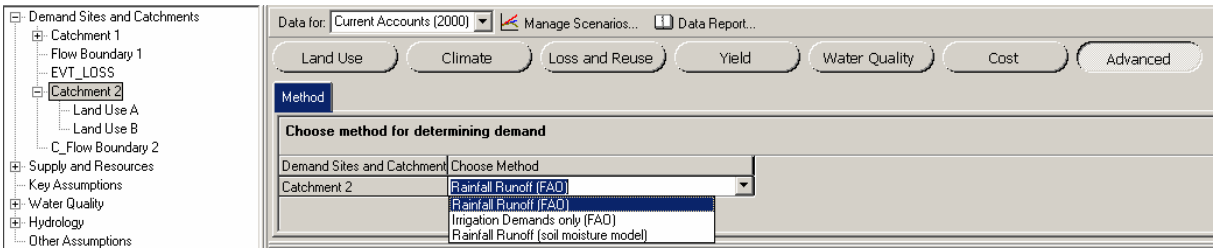
All the following methods can be only applied if **NO irrigation demand model is applied in WEAP (no irrigation is modelled)**.

First you have to activate under General - > Basic Parameters:

Each branch within a catchment can have different climate parameters

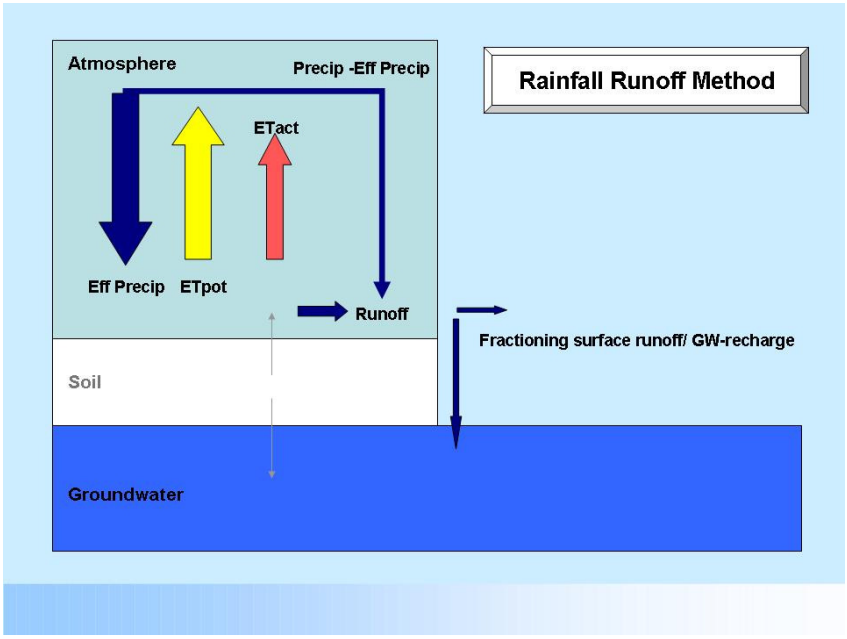


If not yet selected you must choose the FAO Rainfall Runoff Method:

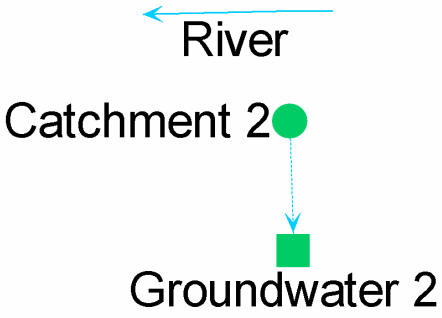


The figure below shows the main schema of the rainfall runoff method. Basically the water balance is:

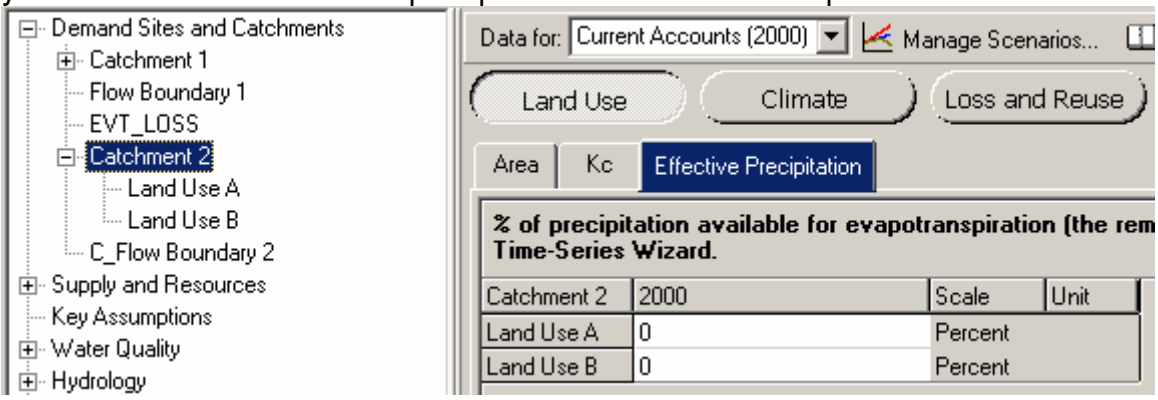
Runoff = Effective Precipitation – actual Evapotranspiration + “ineffective” Precipitaton



The effective/ ineffective precipitation fraction is a user entry variable as well as the fractioning between surface runoff and groundwater recharge. In our example we will not assign any runoff link from the catchment to the surface water (river), that means all “WEAP-runoff” is groundwater recharge.



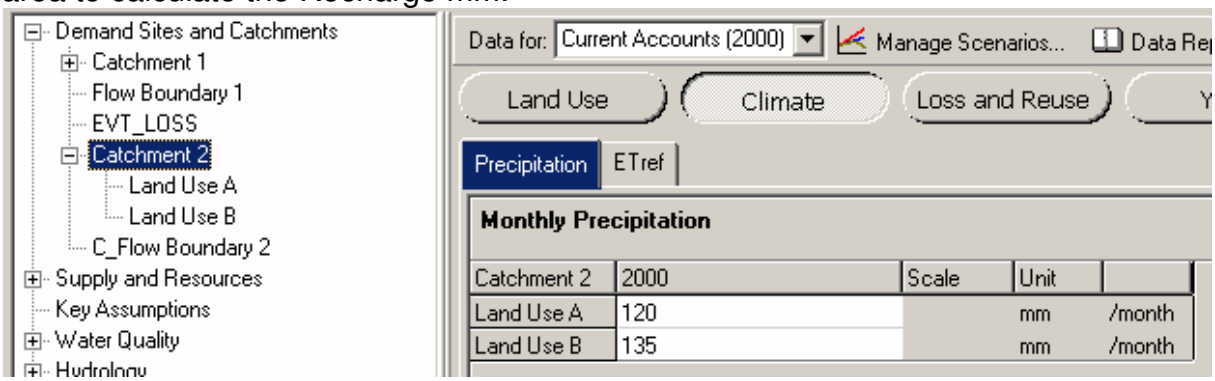
In this approach we want to enter directly recharge to the land use class, therefore you have to set the effective precipitation to 0% for the respective landuse classes.



This means that you neglect any calculation of Evapotranspiration and you use the precipitation value as a data entry for groundwater recharge.

Here: WEAP precipitation = groundwater recharge

Note: the unit is mm so if you have only volumes you must divide the volumes by the area to calculate the Recharge mm.

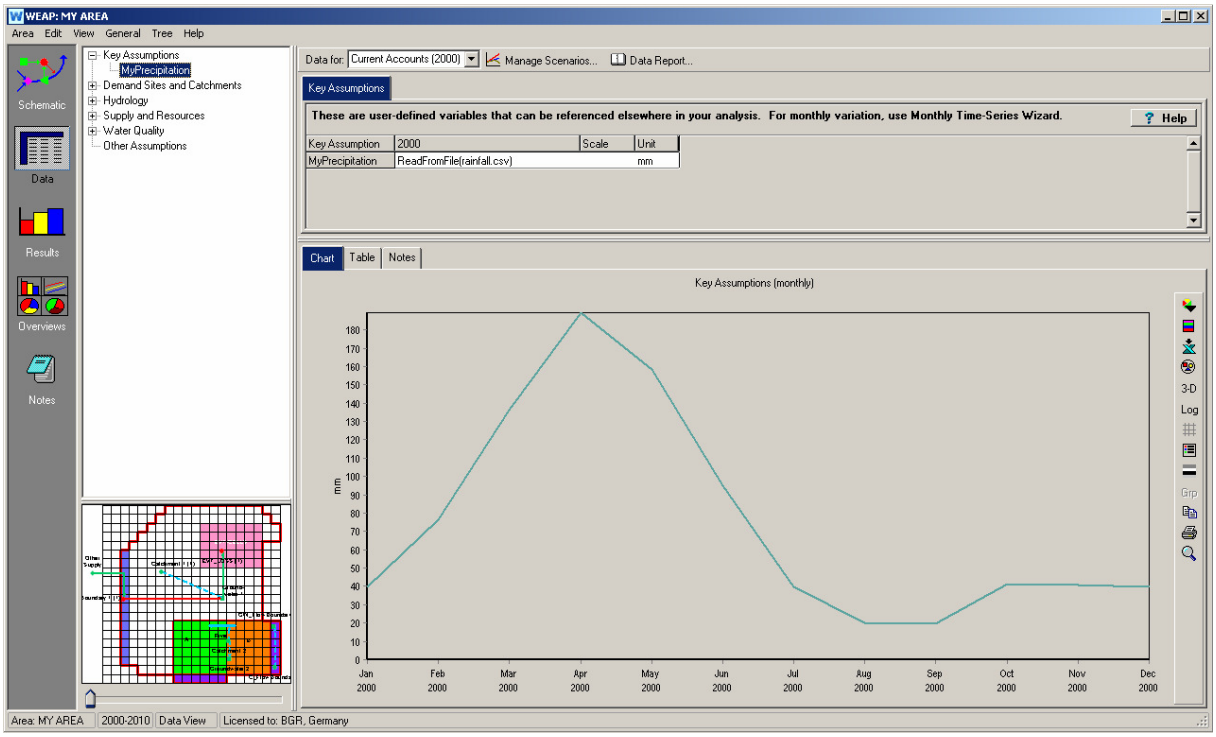


By this method you will transfer the recharge values evenly to the respective land use class (cells) within a catchment.

1.3. Using infiltration and runoff coefficients for the water balance calculation

In many regions monitoring data are not available and/or empirical approaches are well established by using coefficients (fractions of the precipitation) to calculate groundwater recharge and surface runoff respectively.
This method is a refinement of 1.2. The key to work with that is that the user has to specify the real precipitation as a new variable(s) under key assumptions.

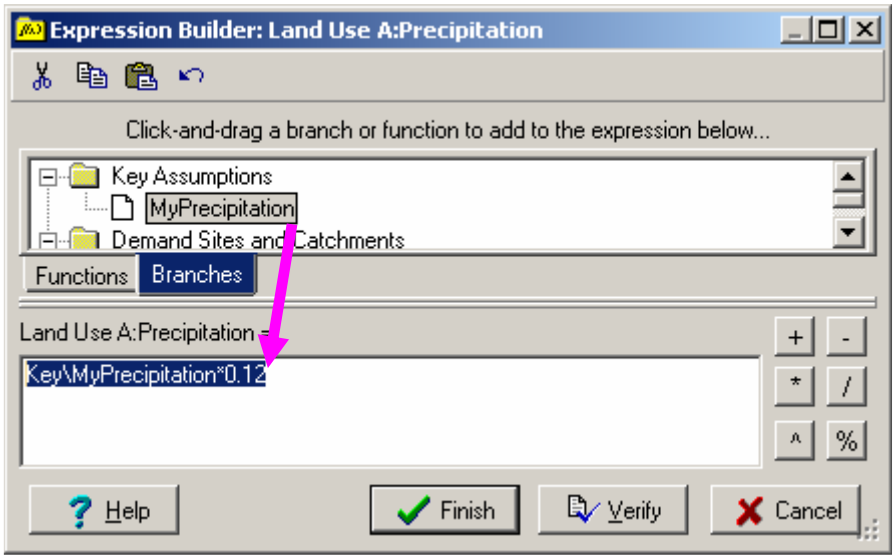
Here: MyPrecipitation

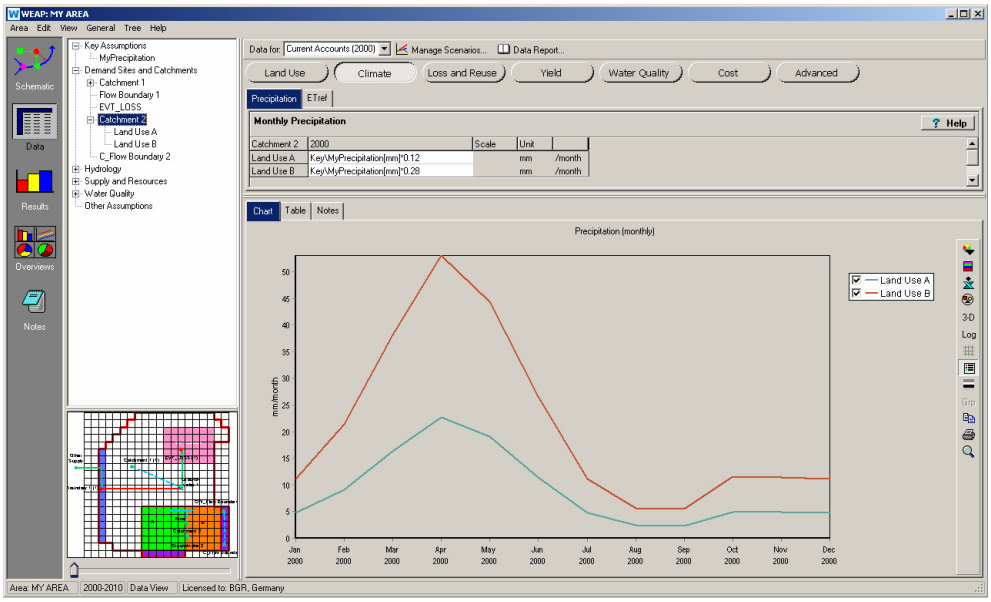


This variable is then used to calculate surface runoff and groundwater recharge respectively:

Lets assume that the infiltration coefficient for Land Use A is 12% and for Land Use B 28%. Then the groundwater recharge can be calculated under the respective land use clase precipitation tab:

You can use the expression builder (right click in the data field) by drag and drop your variable into the formula and complete the formula by typing “*0.12”:
Synthax: Key\MyPrecipitation*0.12



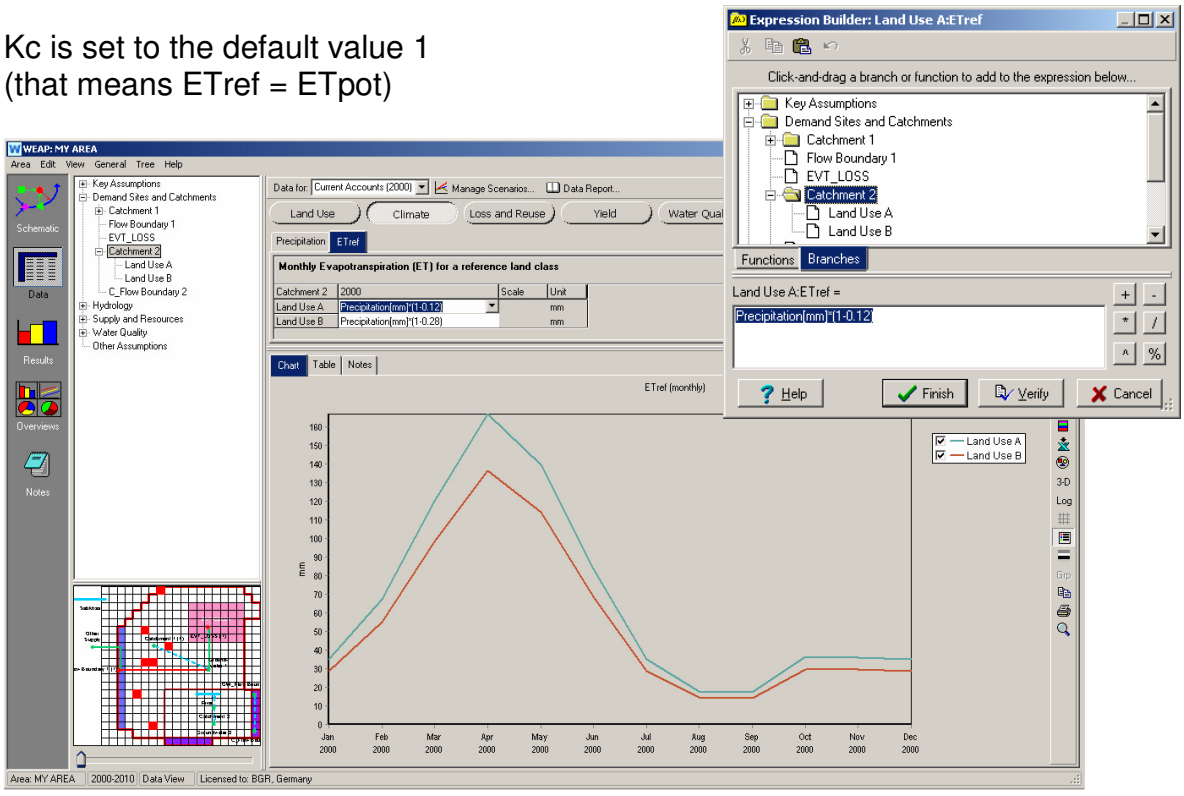


For the Land Use Class B you have to do it respectively. Now your groundwater recharge is always calculated according the monitored precipitation data and multiplied by the respective coefficient.

You can modify the formula as you want, for example you can classify your coefficients “if precipitation < 10mm then the coefficient is 0” from 10-30mm it should be 0.05,….
Alternatively you can also enter the real precipitation for each land use class level, set effective precipitation to 100% and simply enter the infiltration coefficient by the reference Evapotranspiration.

ETref = Land Use Class Precipitation x (1 – infiltration coefficient).

Kc is set to the default value 1
(that means ETref = ETpot)



Surface runoff: the surface runoff is calculated here as Surface Water Inflow. The runoff coefficient for catchment 2 is 0.16:

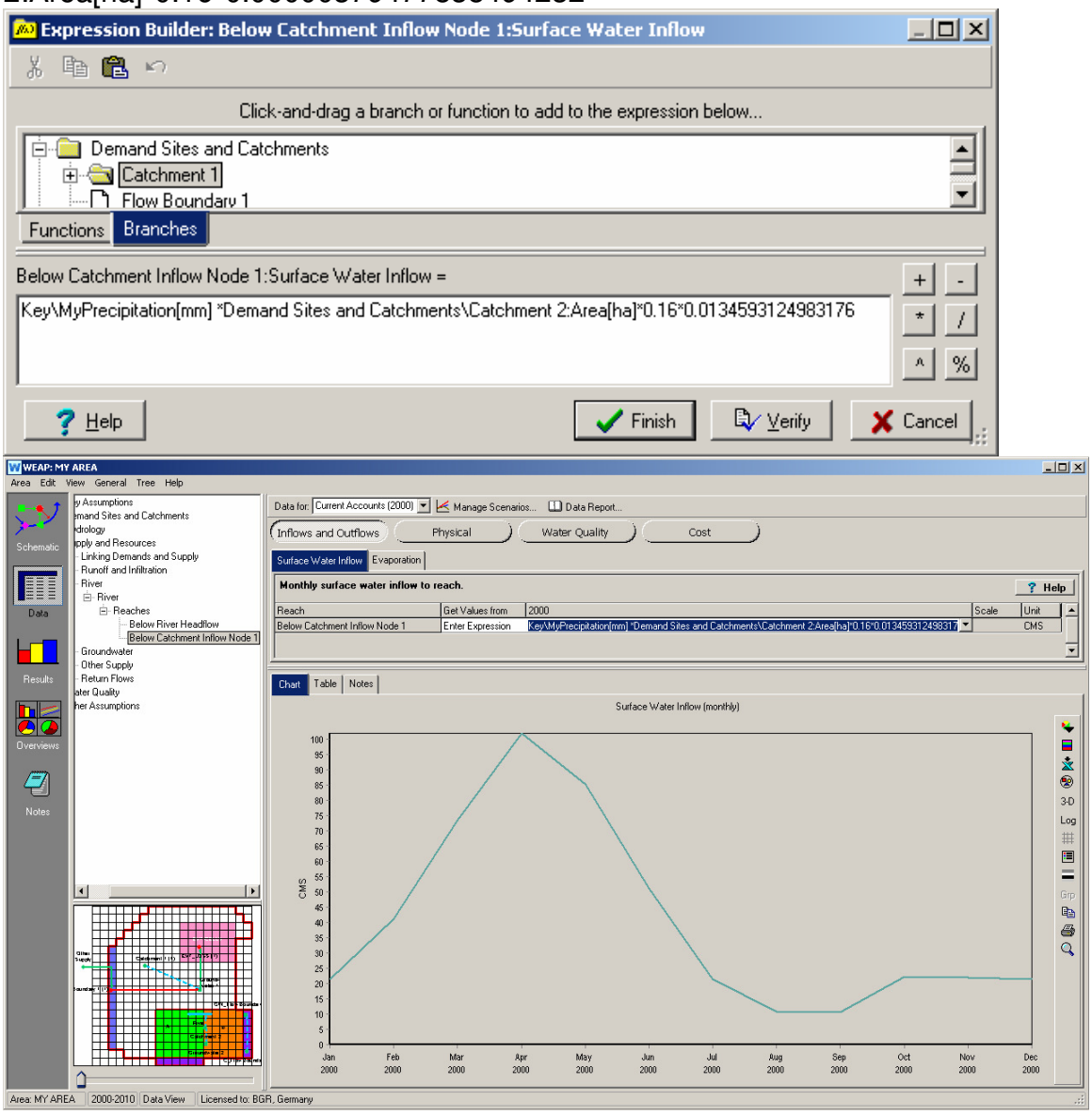
Precipitation * Area (catchment, landuse class, depending on data) * runoff coefficient * unit conversion factor

Units:

Precipitation [mm]	Area [ha]	Time [month]	Conversion factor mm*ha/month -> m^3/s
0.001m	10000 m^2	2635200s	0.00000379477838494232

Synthax in the expression builder:

Key\MyPrecipitation[mm] *Demand Sites and Catchments\Catchment 2:Area[ha]*0.16*0.00000379477838494232

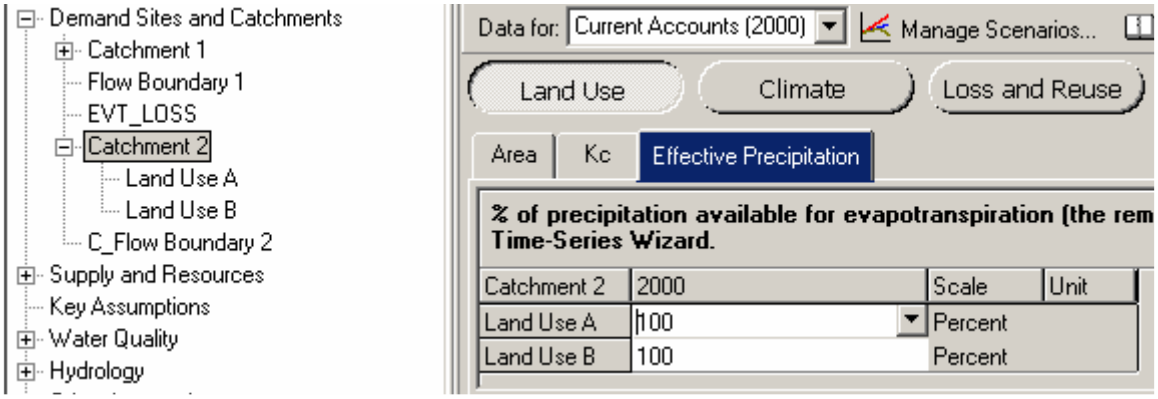


Also here you can aggregate your formula as you like or use other calculation methods to calculate the respective surface runoff flows.

1.4. Using rainfall data and a simple fractioning to calculate groundwater recharge and Surface runoff

In this approach we will partially use the “real Rainfall Runoff (FAO)” approach. That means we are using real precipitation and reference evapotranspiration data. This approach is reasonable if you have a yearly time step and you must somehow average the values of Evapotranspiration through the year or if you don’t have a lot monitoring data available

This time we will set the effective precipitation to 100% to use the WEAP calculations.



The simplified water balance is here:

Precipitation = ETref + groundwater recharge + surface runoff

Data sources:
Precipitation & ETref: meteorological stations (Etref can be calculated by Tmin/Tmax).

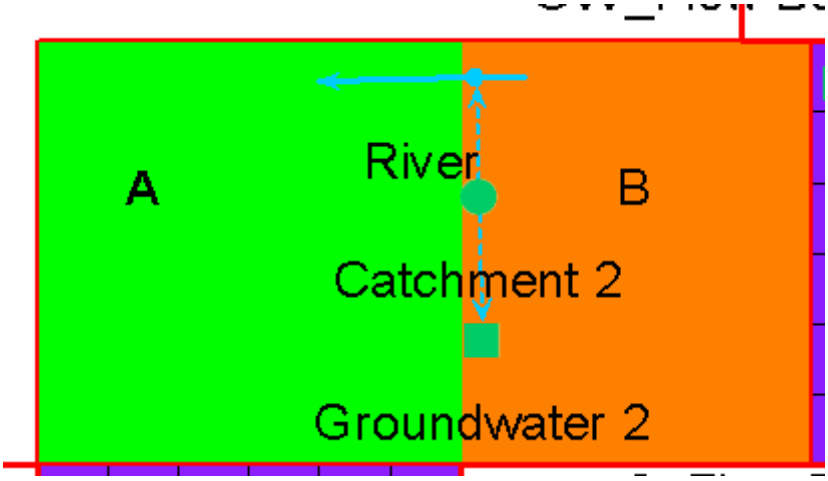
Surface runoff: river gages

Groundwater recharge: remainder

If surface runoff data are not available or if it doesn’t play a big role (low relief, high permable soil/rocks), you can specify respective fractions of the precipitation.

Note: in WEAP you define by adding a Runoff/Infiltration link from the catchment to the river/ groundwater if you have surface runoff and groundwater recharge existing or not.

Here: Catchment 2 has a runoff link to the River and an infiltration link to the groundwater 2



The Rainfall Runoff (FAO) method calculates first:

Precipitation – actual Evapotranspiration ETactual

Here we are neglecting the crop impact and keep the default Kc value of 1. That means that ETref = ETpot

The total “Runoff/Infiltration” is then Precipitation – ETref,

this volume you can fraction now between Runoff and Infiltration (uniformly for the whole catchment).