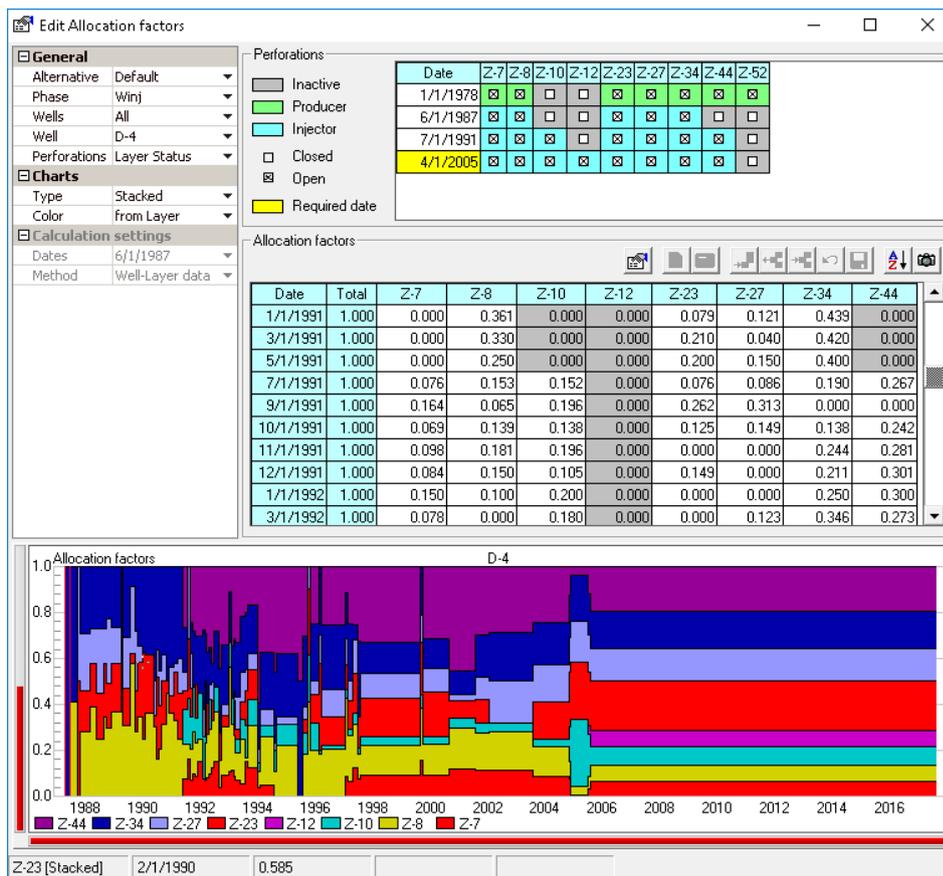


PRODUCTION ALLOCATION

Sahara provides several convenient tools when it comes to allocating production, from the well to the productive layers or from a well to its sidetracks. If, for example, during the analysis of a reservoir, there is a need to calculate the recovery factors per layer, a distribution of the production per layer will be necessary.

Allocation factors can be calculated with data obtained from fluid transit logs, which measure for production or injection per layer. Since these logs are not always available, Sahara provides different options to calculate production or injection allocation factors using petrophysical data.

In addition, it is possible to work with multiple allocation factor alternatives to compare different value sets.



Production allocation factors can be imported or calculated within Sahara using different methods.

Allocation factors can be applied to distribute both monthly and daily productions. Depending on the level of allocation desired, different types of alternative factors are available:

- Well to Sidetrack
- Well/Sidetrack to Formation
- Well/Sidetrack to Layer
- Well/Sidetrack to Zone
- Completion to Layer
- Formation to Layer

Of course, in order to carry out the production allocation, it is necessary to know in advance which sidetracks, formations, layers or zones are open in each well, for the different dates. This is why Sahara provides the possibility of performing the calculation of layer status with different methods, depending on the information available. The status indicates whether a well is open or closed in a layer or formation, and whether it is a producer or injector. This information is the fundamental basis for generating allocation factors that can reflect the changes over time.

The most widely used method for calculating layer status is to have into account the wellworks data imported into the wells, such as perforations, squeezes, or plugs. As an additional option, a direct import of the status can be performed or they can be calculated using the previously allocated production data.

The layer status can be viewed in the Map window over time, and also in tabular format in the Edit Allocation Factors window.

Edit Allocation Factors. This window displays the layer status together with the existing allocation factors for each well. The factors can be edited manually or using any of the methodologies available for calculation. The chart at the bottom of the window shows the weight each layer has on the well total production.

The Perforations panel, located at the top of the Allocation Factors window, shows useful information for the generation of allocation factors: evolution over time of the sidetrack, formation, layer or zone status (according to the type of the selected alternative). This information determines the dates on which there should be factors for each case. If there is no information for any dates, they will be highlighted to denote that there have been significant changes in the layer status but with no changes registered in the allocation factor table.

The main purpose of this tool is to assist the user in editing or creating allocation factors. There are three methodologies to generate them, each using different data:

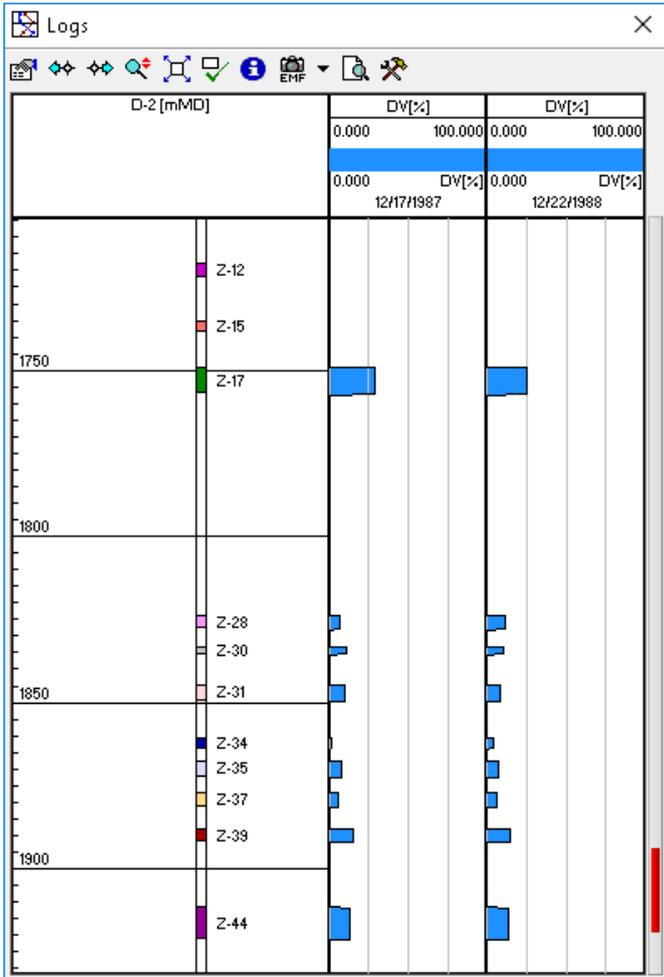
- Static petrophysical data
- Scattered petrophysical data
- Measured fluid transit logs

In this way, depending on the information available, it is possible to carry out a detailed study of each well.

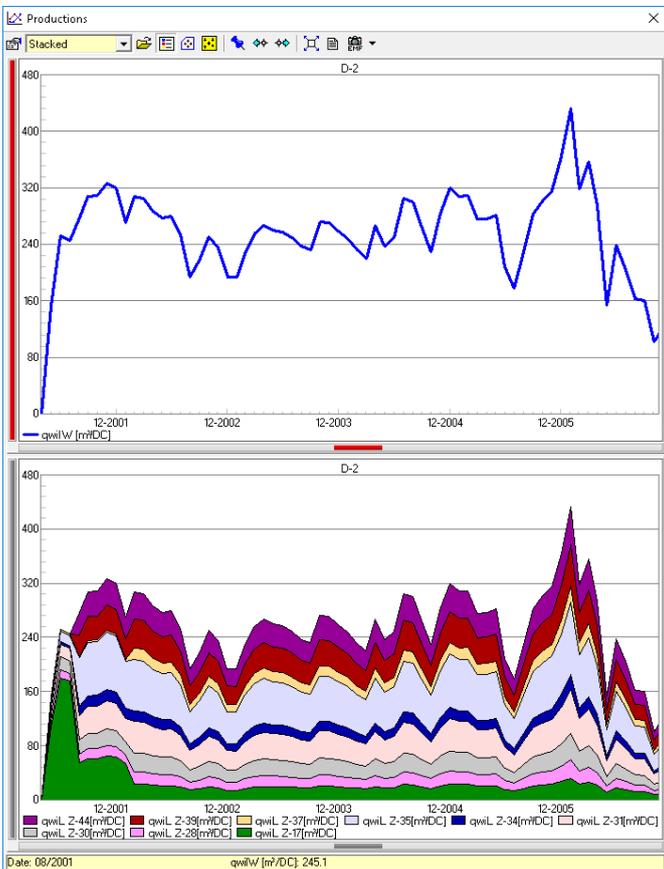
Allocation Factor Calculation with Static Petrophysical Data.

Allocation Factor Calculation with Scattered Petrophysical Data.

Allocation Factor Calculation with Fluid Transit Logs.



Fluid Transit Logs. The Logs window displays the fluid transit logs measured at different dates.

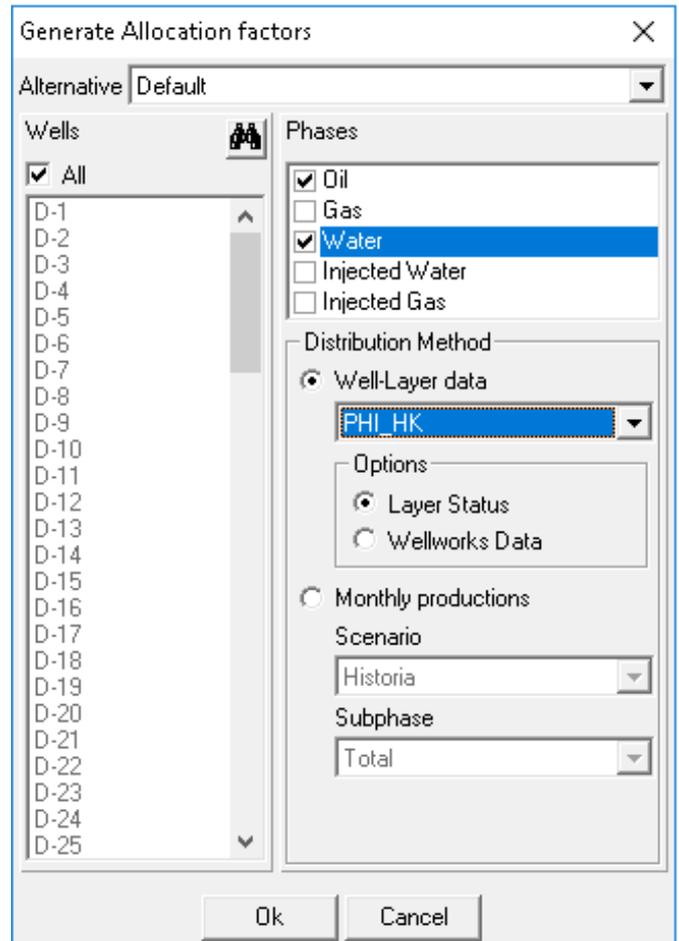


Productions Window. Upper chart: shows injection at well level. Lower chart: shows the injection allocated to the different layers in stacked format.

In addition to the detailed Calculation window, Sahara provides another tool in the Generate Allocation Factors window, which allows a massive calculation of factors for a group of wells taking into account the layer status and using a static well-layer petrophysical variable. Another feature of this tool is to calculate the factors in the opposite way. That is to say, instead of calculating the factors to allocate the production, productions allocated at layer level are used to reconstruct the factors.

As a final step of the workflow, the Apply Allocation Factors window can be used to apply the factors to different scenarios of monthly or daily productions. The interface allows the user to choose the alternative containing the factors he/she wants to apply, the objects for which the allocation is to be performed, the production scenario where it will be done and the phases for which to perform the calculation.

Finally, multiple Sahara windows can be used to visualize and validate the production allocation previously performed. For example, in the Productions window there are different options (stacked, overlay, normalized, among others) that make it possible to review the allocated production data.



Generate Allocation Factors. By selecting the alternative, wells, phases and distribution method, allocation factors can be calculated for a group of wells, and then other tools can be used to perform the detail analysis.

PATTERN PRODUCTION ALLOCATION

For secondary recovery projects, Sahara offers a tool to evaluate the injection and production balance in each injection pattern. In this way, it is possible to obtain information that will be useful for performing an analysis, before carrying out a simulation with the injection pattern model.

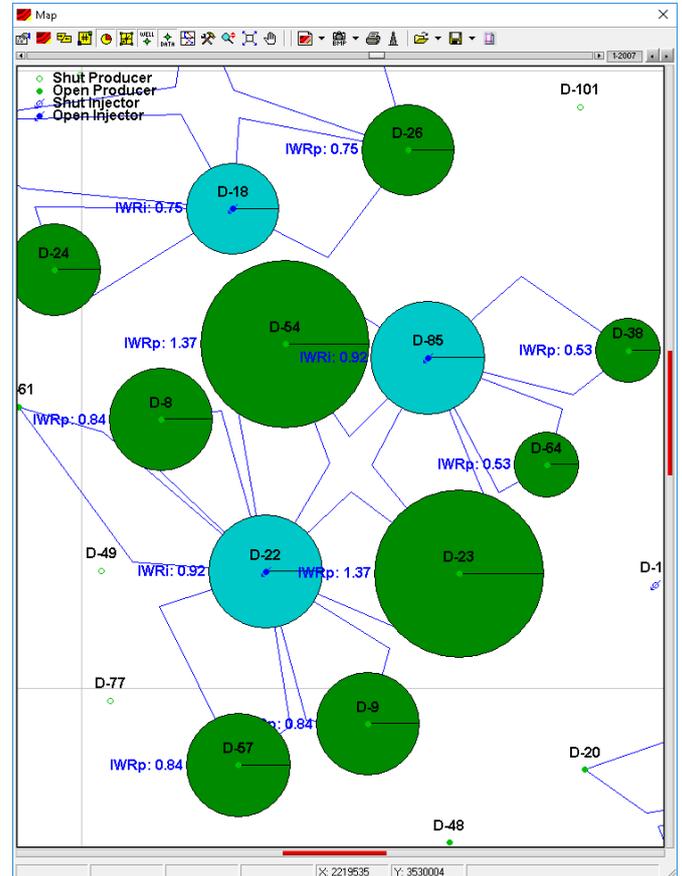
The Pattern Production Allocation tool provides a procedure for calculating the allocation of productions from each producer well to the neighboring injector wells. The calculation results will be saved as productions associated with the injector wells. So a ranking of injector wells may be obtained, based on their influence on the production of the neighboring producer wells. The distribution methods available include the following:

- Productions proportional to the angle of the flow elements reaching each producer well.
- Productions proportional to the pore volume of the elements reaching each producer well.
- Productions proportional to the pore volume of the flow elements reaching each producer well, normalized to the sum of the angles.
- Productions proportional to the total production of each injection pattern.

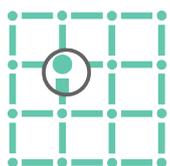
The latter is known as the IWR (Injection Withdrawal Ratio) Method, widely used in the oil and gas industry as a benchmark for the performance of secondary recovery projects. It is used to obtain associated productions, instead of being based on geometrical or petrophysical data.

The method consists in calculating the pattern production allocation according to the production and injection flow rates of all the wells in the pattern. After calculating these coefficients, they are used to generate the IWR (also known as VRR or FIFO) values for both producer wells (IWRp) and injector wells (IWRi). The formula used in the calculation is simple, dividing the injected water flow rate by the produced fluid flow rate, taking into account the production and injection flow rates of the wells and the previously calculated coefficients.

With the result of this calculation it is possible to analyze the performance of each well in the secondary recovery project, and optimize the injection distribution, maximizing the secondary production recovery.



IWR Factors. The calculated IWR values for producer and injector wells are displayed in bubbles and allow an areal analysis.



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