

AQUIFER TEST INTERPRETATION BY GRAPHICAL METHODS

Introduction

This lesson will teach you to interpret the results of an aquifer test using graphical methods. This lesson is based on the data that were used to create the project in Lesson 2. Conceptual model and pumping test details are explained in the [Lesson 2 Tutorial](#). At the end of the tutorial, the project is created and saved. If you have not followed the tutorial and do not have a saved file, you can download the [Ansdimat project](#) file from Lesson 2 tutorial, un-archive it in your local drive and open Lesson2.oat from the project folder.

Open project

To start working, go to ANSDIMAT main menu “*Aquifer test analysis/Open project*” and open file “Lesson2.oat”. You will see plotted hydrographs for pumping and observation well. Let’s display the pumping well hydrograph in red colour. Clicking any measurement point of the hydrograph will open dialog window “Observation data symbol”. Change symbol colour to red, click “Ok” two times and your plot will look like Figure 1.

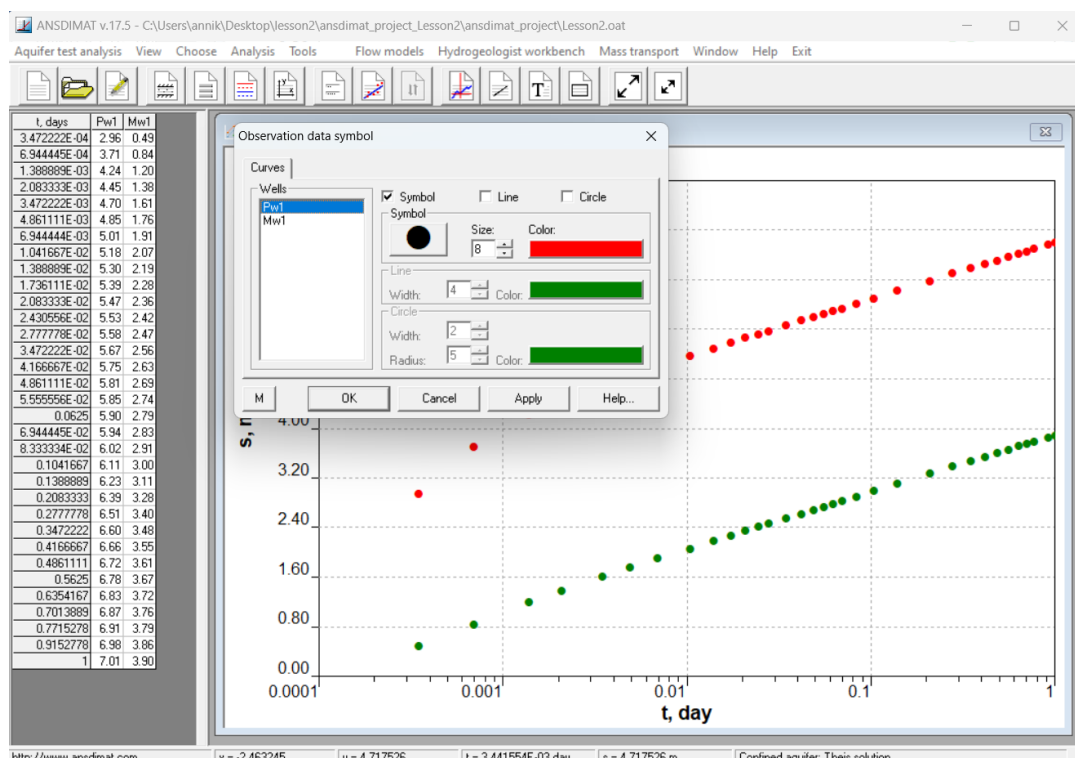


Figure 1. Plot window after opening file “Lesson2.oat and changing colour of PW1 hydrograph”

Plot window on Figure 1 shows drawdown measurements for pumping (red) and observation wells (green). On the left hand side of the Main window you can see a spreadsheet with drawdown

measurements. In this spreadsheet, individual measurements can be modified manually. These changes will remain effective during the interpretation process, while the file is opened, but *they won't be saved* after closing ANSDIMAT. To change the original measurements, you will have to open the Editor through the menu “Aquifer test analysis/Editor”. Alternatively, you can also use the “Open project” command in the “Aquifer test analysis” menu and select the file “Lesson2.eat”.

In [Lesson 1](#) you learned how to interpret aquifer tests using manual matching. In this Lesson we will explore graphical methods of interpretation, specifically straight-line methods.

Selection of Conceptual model

Open the “Conceptual model” dialog window (Menu “Choose/Model...”) and check that the “Confined aquifer: Theis solution” conceptual model is selected with boundary condition as “Unbounded”.

Interpretation data for the pumping period

This lesson contains data for both the pumping and recovery periods. Let's now interpret results for the pumping period. To do this, open the “test conditions” window (Menu “Choose/Test conditions...”) and select “Pumping/injection”.

The straight-line method is applicable for time-drawdown, distance-drawdown and time-distance drawdown plot analysis. To start time-drawdown plot interpretation, open the “Choose plot” dialog window (Menu “Choose/Plot...”) and select “s-log(t)” plot (Figure 2).

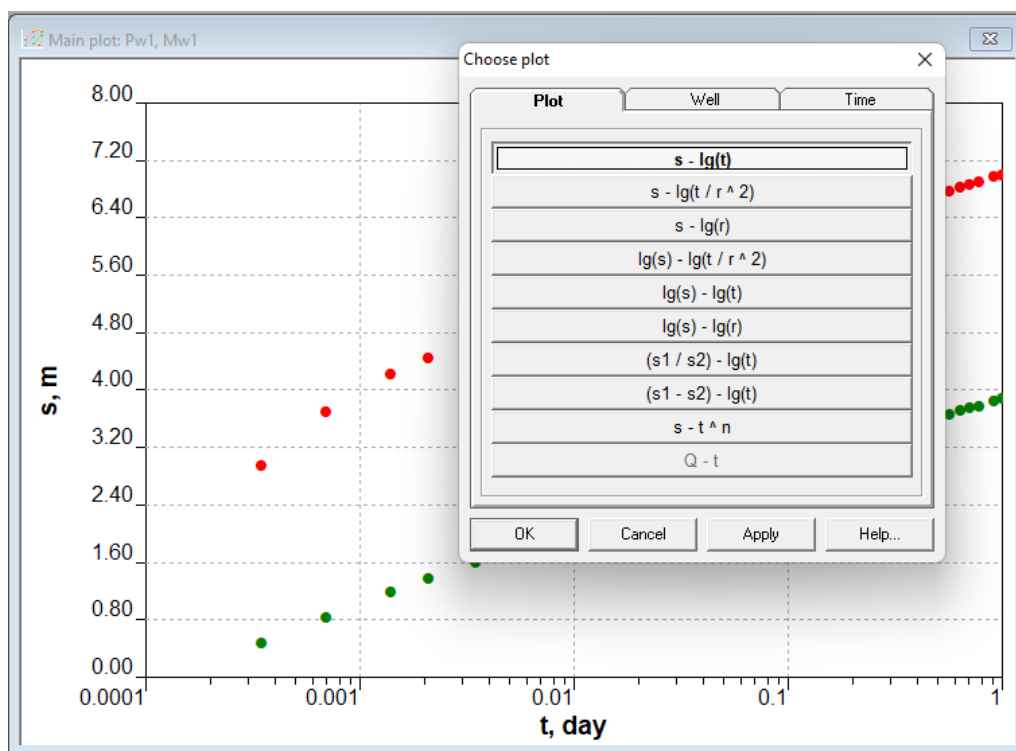



Figure 2. Selection of plot type for interpretation by the straight line method

Select “Graphical method” in the “Analysis” menu or click the icon “Graphical method”  on the toolbox panel. The dialog window “Value” pops up that allows you matching up your observations interactively with a straight line. The “Value” floating window displays two observation wells, Pw1 and

Mw1, together with parameters estimated by the straight-line method. A straight line for PW1 appears simultaneously with the floating window. The line is automatically calculated by minimizing the distance between observation points and the straight line. You can move this line or draw a new line to match PW1 observations using the left mouse button for the left end of the line and the right mouse button for the right end of the line. When you are satisfied with the matching result, press ENTER and move the cursor to MW1 in the floating window. When you are satisfied with the straight line matching for MW1, press ENTER and then ESC to close the floating window. The hotkeys list is displayed on the information panel that is opened after pressing “?” key on the value panel (Figure 3).

You can display aquifer parameters using hotkeys Alt+1, Alt+2 or menu “Tools/Show parameters”. Your interpretation plots will look similar to Figure 3.

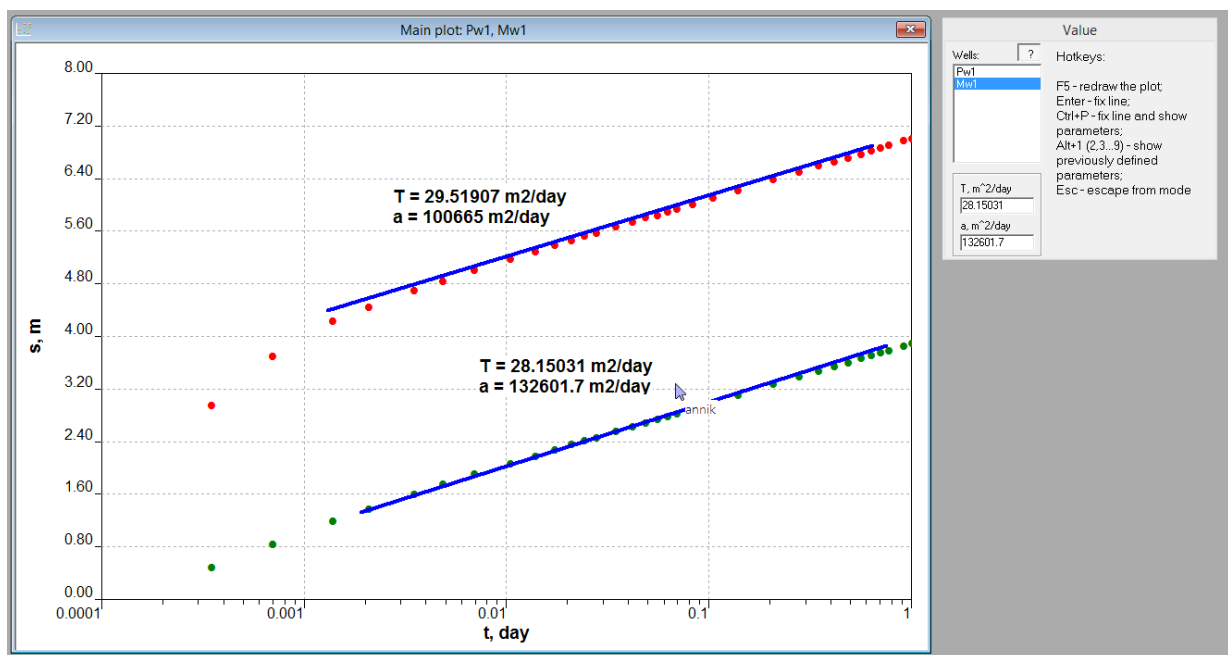


Figure 3. Straight line method - Interpretation plot for the pumping period.

Once you are satisfied with the interpretation, you can save your plot using “*Aquifer test analysis/save plot...*”. This function will save a plot in an internal format and can be later opened from the ANSDIMAT Aquifer test interpretation module that you are currently using. With a plot, the program also saves added text, interpretation settings such as the conceptual model, matched aquifer parameters and interpretation curve. You can save every interpretation as a separated plot. To open previously saved plot, use menu “*Aquifer test analysis/Load plot*”.

Alternatively, you can export the observation data plots, the straight lines or the type curves (when interpreting by the type-curve method) in EXCEL using the menu “Tools/Create Excel plot”.

Interpretation data for the recovery period

Select the “Test conditions” command from the “*Choose/Test conditions...*” menu, then select the “Recovery (s – from start recovery)” option. For this interpretation, select the “*s-lg(t')*” plot through the menu option “*Choose/Plot*” (Figure 4).

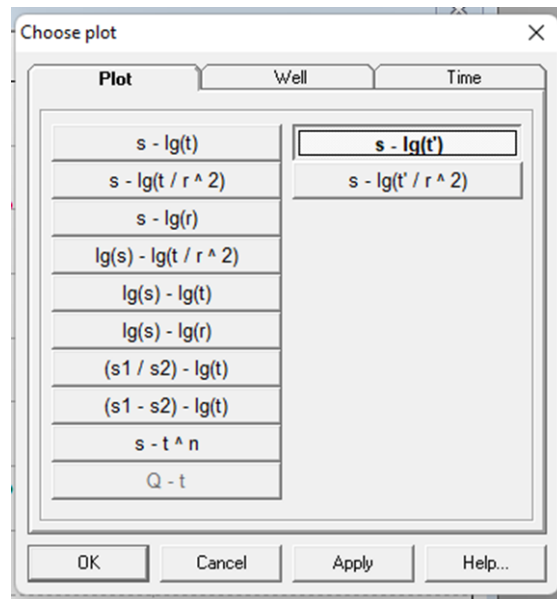


Figure 4. Selection of plot type for interpretation of the recovery test in $s\text{-lg}(t')$ coordinates



Select menu “*Analysis/Graphical method*” or click the icon “*Graphical method*” on the toolbox panel. Repeat the same steps as for the interpretation of the pumping period results and your interpreted parameters should be similar to the previous ones. Similarly to the previous exercise, you can display aquifer parameters, save the plot or export it to an Excel spreadsheet.

Recovery hydrographs for pumping and observation wells can also be plotted and interpreted in combined time and distance coordinates. Plot selection process is illustrated on Figure 5 (menu “*Choose/Plot*”).

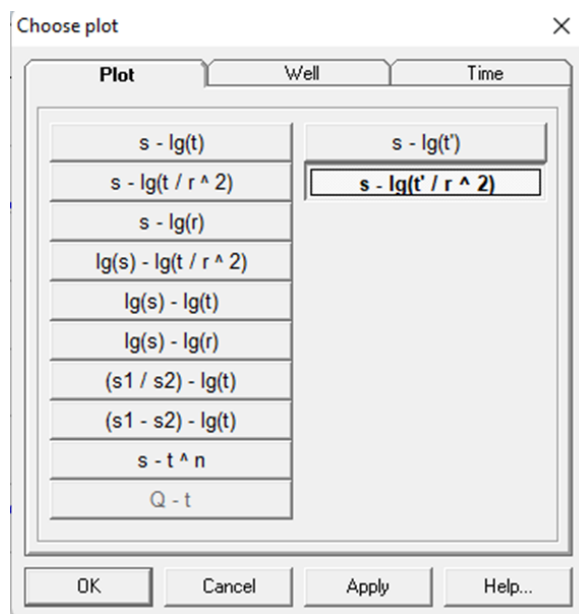



Figure 5. Selection of plot type for interpretation of the recovery test in combined time and distance coordinates.



After clicking the icon , the straight line will be matching the combined hydrographs of the pumping and the observation boreholes (Figure 6). You can manually move the straight line to achieve a better match. As previously, move the left end of the line with the left button of the mouse and the right end of the line with the right button of the mouse. When satisfied with your match, display aquifer parameters, exit graphical mode and save the plot.

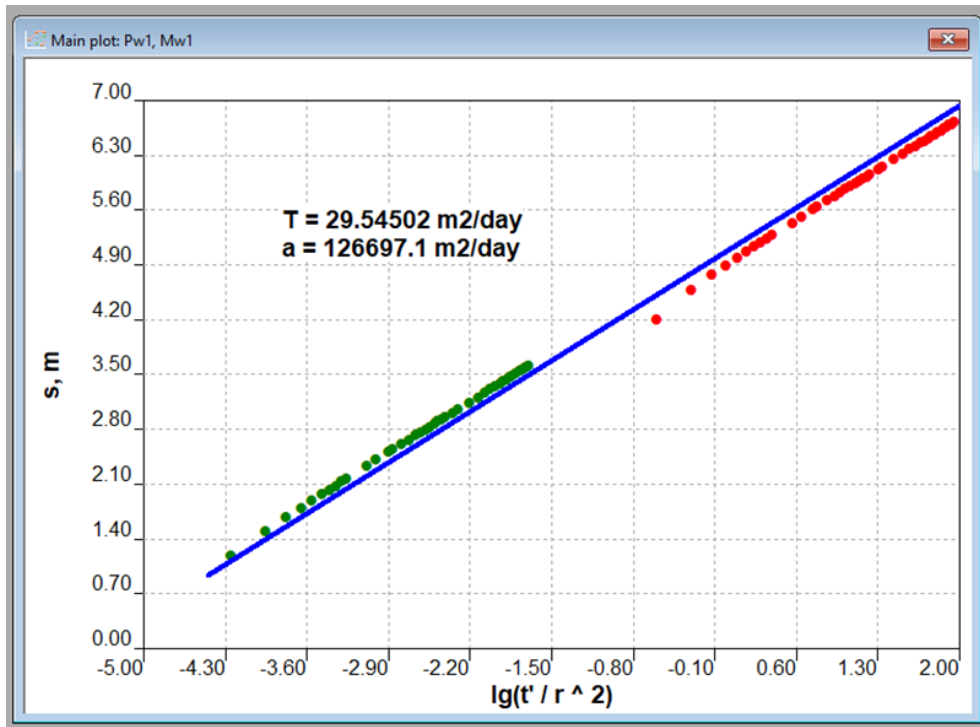


Figure 6. Interpretation by the straight line method. Combined plot for the pumping and the observation borehole for the recovery period.

Using menu “Choose/Plot” you can change plot coordinates and use other graphical interpretation methods, for example “type curve method”. To see available methods, go to help documentation using menu “Help/Contents...” and then in “Conceptual models” item. After selecting details of conceptual model (see Figure 7 as an example) and

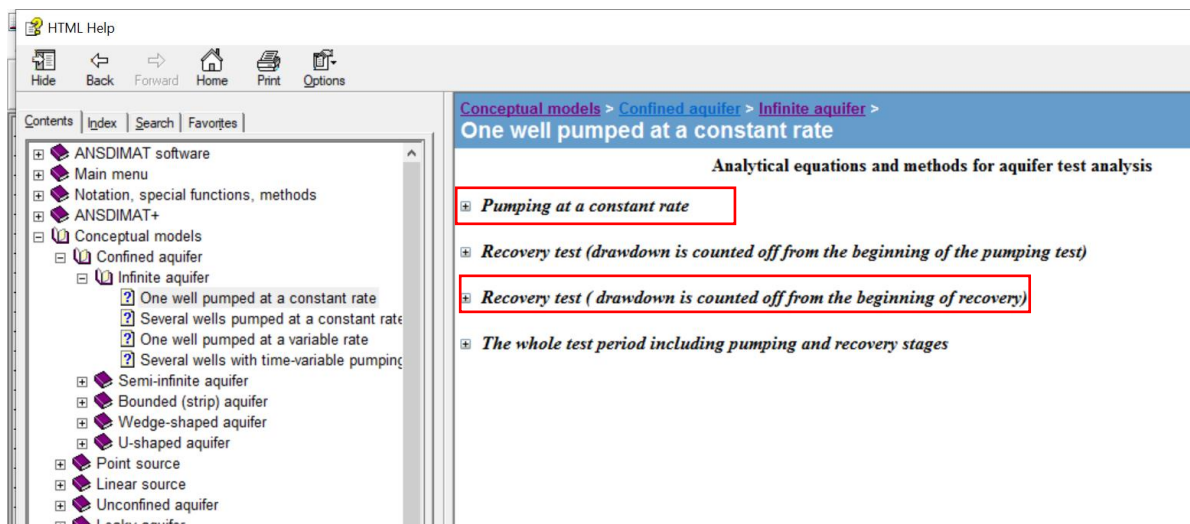


Figure 7. Example of conceptual model selection in help documentation: one constant-rate pumping well in a confined infinite aquifer.

clicking on the “+” symbol against a selected model, a table will be displayed showing available interpretation methods and types of plots. Figure 8 and Figure 9 present methods and plot types for this Lesson pumping and recovery periods. Highlighted in red are the plot types that are referred to in this Lesson.

Plot	Method	Parameter s	Comments
$s - \lg t$	straight line	T, a	$T = \frac{0.183Q}{C}; \lg a = \frac{A}{C} + \lg \frac{r^2}{2.25}$
	matching	T, a	
$s - \lg r$	straight line	T, a	$T = \frac{0.366Q}{C}; \lg a = 2 \frac{A}{C} - \lg(2.25 \cdot t)$
	matching	T, a	
$s - \lg \frac{t}{r^2}$	straight line	T, a	$T = \frac{0.183Q}{C}; \lg a = \frac{A}{C} - \lg(2.25)$
	matching	T, a	
$\lg s - \lg t$ $\lg W(u) - \lg \frac{1}{u}$	type line	T, a	$T = \frac{Q}{4\pi 10^D}; a = \frac{r^2 10^E}{4}$
	matching	T, a	
$\lg s - \lg \frac{t}{r^2}$ $\lg W(u) - \lg \frac{1}{u}$	type line	T, a	$T = \frac{Q}{4\pi 10^D}; a = \frac{10^E}{4}$
	matching	T, a	
$\lg s - \lg r$ $\lg W(u) - \lg \sqrt{u}$	type line	T, a	$T = \frac{Q}{4\pi 10^D}; a = \frac{10^{-2E}}{4t}$
	matching	T, a	
$s - t^n$	matching	T, a	
$(s_1 / s_2) - \lg t$	matching	a	
$(s_1 - s_2) - \lg t$	straight line	T	$T = \frac{Q}{2\pi \cdot A} \ln \frac{r_2}{r_1}$
	matching	T, a	
$(s_1 / s_2) - (f_1 / f_2)$	bisecting line	a	

Figure 8. Help documentation. A list of plots and interpretation methods for pumping period of a constant-rate pumping well in a confined infinite aquifer.

Plot	Method	Parameters	Comments
$s_r - \lg t_r$	matching	T, a	
$s_r - \lg r$	straight line	T, a	$T = \frac{0.366Q}{C}; \lg a = 2 \frac{A}{C} - \lg(2.25t')$
	matching	T, a	
$s_r - \lg \frac{t_r}{r^2}$	matching	T, a	
$s_r - \lg t'$	straight line	T, a	$T = \frac{0.183Q}{C}; \lg a = \frac{A}{C} + \lg \frac{r^2}{2.25}$
	matching	T, a	
$s_r - \lg \frac{t'}{r^2}$	straight line	T, a	$T = \frac{0.183Q}{C}; \lg a = \frac{A}{C} - \lg(2.25)$
	matching	T, a	
$\lg s_r - \lg t_r$	matching	T, a	
$\lg s_r - \lg \frac{t_r}{r^2}$	matching	T, a	
$\lg s_r - \lg r$	matching	T, a	
$s_r - t_r^n$	matching	T, a	
$(s_{r,1} / s_{r,2}) - \lg t_r$	matching	T, a	
$(s_{r,1} - s_{r,2}) - \lg t_r$	straight line	T	$T = \frac{Q}{2\pi \cdot A} \ln \frac{r_2}{r_1}$
	matching	T, a	
$(s_{r,1} / s_{r,2}) - (f_1 / f_2)$	bisecting line	a	

Figure 9. Help documentation. A list of plots and interpretation methods for recovery period of a constant-rate pumping well in a confined infinite aquifer.