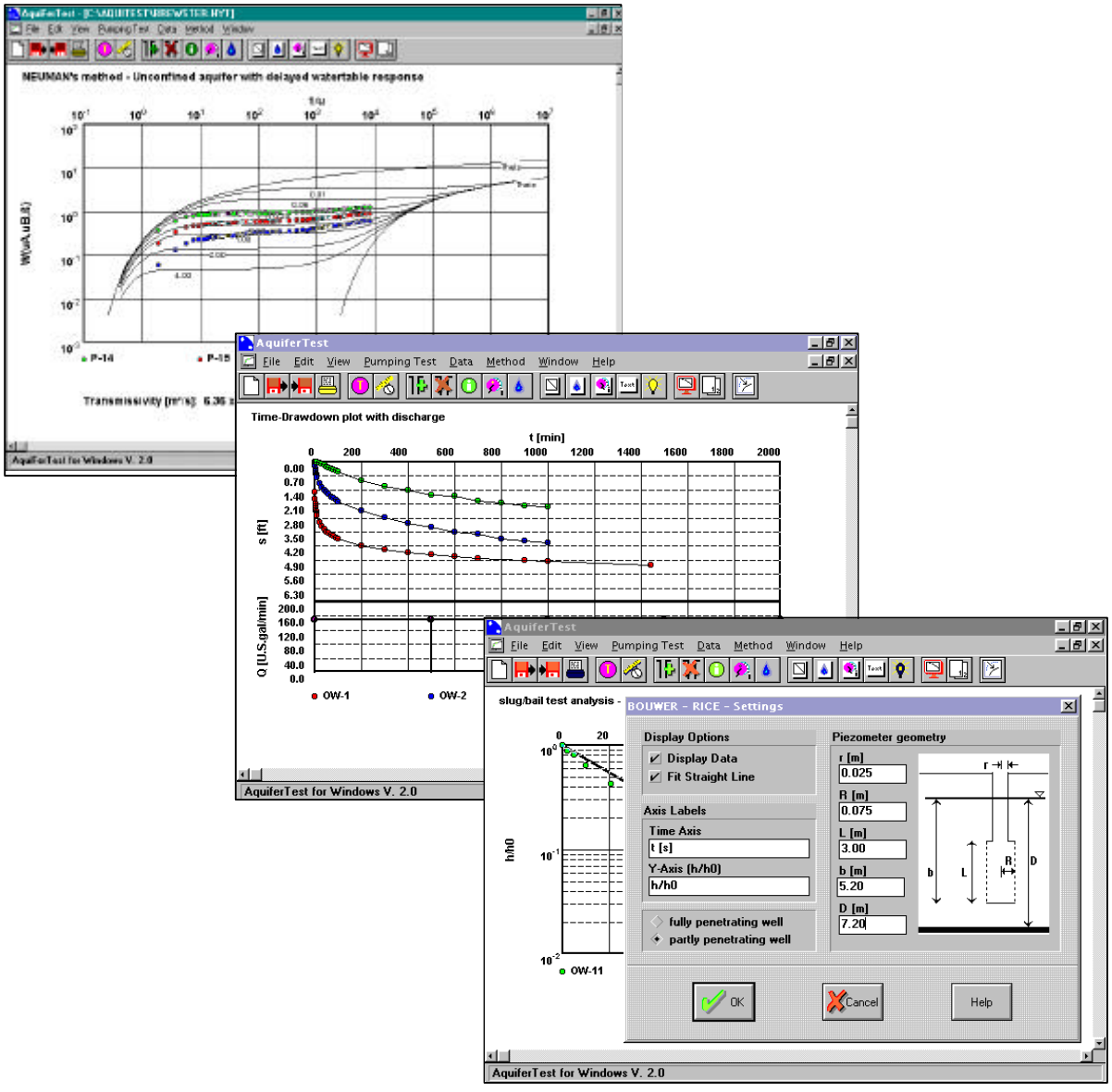
AquiferTest
Student Version Tutorial

The intuitive aquifer test analysis package.



Co-developed by: Thomas R hrich and Waterloo Hydrogeologic Inc.

Introduction

About AquiferTest for Windows

AquiferTest for Windows is a fast and efficient tool for the analysis and plotting of pumping test and slug test data. It contains a comprehensive set of analytical methods for estimating the hydraulic conductivity, transmissivity and storativity of confined, unconfined, leaky and fractured rock aquifers.

AquiferTest provides a flexible, user-friendly graphical environment for entering data via keyboarding, cut-and-paste or importing from a data logger ASCII file. Once the pumping test or slug test data is entered, AquiferTest allows you to easily switch between the various analysis methods for determining the aquifer hydraulic properties. Automatic or manual curve matching capabilities are also provided which allow you to find the best-fit solution for all data points or to use your own judgement to manually fit the data to your satisfaction.

About the Student Version of AquiferTest for Windows

The student version of AquiferTest for Windows is a fully functional version that includes the three most commonly used pumping test analysis methods (Theis, Cooper-Jacob and Neuman) and allows a maximum of 25 data points. The student version of AquiferTest allows the user to create new files, save all files and print all data and results to any printer or plotter supported by Windows. If the analysis methods or functionality provided by this version of AquiferTest does not meet the needs of your specific application, please contact Waterloo Hydrogeologic, Inc. to inquire about purchasing a professional version of AquiferTest for Windows.

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Terms and Conditions of Use

The student version of AquiferTest for Windows can be installed on any number of computers and can be applied by any number of users at licensed educational institutions. This version of AquiferTest is to be used exclusively for educational purposes and is not to be used for any type of professional consulting application or sold for proprietary gain.

Getting Started

Hardware Requirements

To run **AquiferTest** you need the following system configuration:

- A floppy drive (3 1/2-inch diskettes) for software installation
- A hard drive, with at least 5 Mb free
- A 386 processor or better
- Windows 3.x, Windows 95, or Windows NT
- A math coprocessor
- A microsoft mouse or compatible

If you have any problems with your particular system configuration, please ensure that you have closely followed the installation instructions. If the problem is still not resolved after consulting your systems experts, contact us at Waterloo Hydrogeologic Inc.

Installing AquiferTest

AquiferTest is distributed on one 3.5" 1.44 MB diskette formatted for standard IBM PCs and compatible running MS-DOS or PC-DOS.

AquiferTest must only be installed using the **original installation diskettes**. Any attempt to run the program if it was installed using a duplicate of the original disks will fail. Therefore, there is no point in making a backup copy of the installation disk.

AquiferTest must be installed on your hard disk in order to run. The installation procedure outlined here assumes that **AquiferTest** will be installed from drive A: (use cdrom drive if installing from cdrom) to drive C: (destination drive). The default installation directory is \AQUITEST, but may be modified.

[1] Enter your Windows "Program Manager"

type "**win**" at the DOS Prompt (unless already in windows)

[2] Run the Install Program:

For Windows 3.x / Windows NT 3.x:

Click on "File" (top left hand corner of the Program Manager Window)

Click on "Run"

type "A:\Install" (or use your cdrom drive letter)

For Windows 95 / Windows NT 4.0:

Click on "Start" (bottom left hand corner of the screen)

Click on "Run"

type "**A:\Install**" (or use your cdrom drive letter)

[3] Click on "**OK**" to start the installation process

[4] Enter the path to install **AquiferTest** to and

Click on "**OK**" to start copying files to the specified path

[5] After the installation is complete,

Click on "**OK**" to complete the window's set-up.

You should now see a program group called "**WHI Software**" on your screen with the **AquiferTest** icon inside this window. You are now ready to start working with **AquiferTest**.

Running AquiferTest For The First Time

To run **AquiferTest** for the first time:

[1] Double click on the **AquiferTest** icon to enter the menu environment

[2] Select [**Preferences...**]

[3] Enter your working directory ("**c:\aquitest**" generally) and your name and address. The program now creates the new file **AQUITEST.INI** in your windows directory, wherein your selected preferences are saved.

[4] Next you can initialize a new data file, [**File**] [**New**], and a new data set, [**Data**] [**Create**], and proceed with entering your data, performing the appropriate analysis, and obtaining report quality output which is customized for your company.

Online Help

AquiferTest includes a comprehensive on-line Help feature, which can be accessed from most dialogue windows as well as from the "Help" menu item along the top menu bar. The on-line help feature includes "Help" on how to get your data into **AquiferTest**, choose the appropriate analysis method, and preview and print the output. The Help feature contains a detailed description of all menu items and some trouble shooting tips as

well. The Help feature is designed for standard Windows and has a table of contents and a comprehensive, easy to follow menu structure.

On-Line Help Contents

The table of contents for the on-line Help feature of AqufierTest contains the following options:

Program Preferences	- describes the available customizations for **AquiferTest**, including the output header, logo, display and analysis options.
Title Block	- describes the title block feature of **AquiferTest** which allows you to customize the output for every pumping / slug test.
Analysis Units	- describes how to set the units for your analysis and how to use the convert feature to obtain the desired units.
Display	- explains the display features of **AquiferTest** and how to customize your output further.
Data Input	- describes the different method for getting your data into **AquiferTest** as well as some tips on the most effective ways.
Data Analysis Method	- describes each of the available analysis methods in **AquiferTest** as well as their governing equations, data requirements, and available analysis options.
Data Analysis Settings	- describes the available settings (options) for each of the analysis methods, including the option to set the time limits for the analysis.
Data Output	- describes how to use the various features of **AquiferTest** to customize and preview your output.

Demonstration Exercises

The following demonstration exercises will introduce you to some of the many features and analysis capabilities of **AquiferTest**. The two exercises involve evaluation of pumping tests in a confined aquifer using the Theis and Cooper-Jacob methods. The Neuman analysis method is not covered in these tutorials, but the steps and methods involved inusing the Neuman methods are very similar. If you need additional instructions, you will find that the on-line help can be very useful.

The use of **AquiferTest** is quite simple and follows the Windows conventions for saving, printing, and moving between menus. The sequence of a typical session is:

1. Open or create a file
2. Enter/Import data
3. Select analysis method
4. Fit type curve
5. Print output

If not already installed, follow the instructions provided in the previous section to install Aquifertest.

To Start AquiferTest

- Find the "**WHI**" program group and ☞☞ on the "**AquiferTest**" icon; the program now starts up and the main screen menu is displayed.☞
- Maximize the **AquiferTest** window.

  Windows 3.x:

  ☞ on the up-arrow in the upper right hand corner of the new window.

  Windows 95/Windows NT:

  ☞ on the full screen button in the upper right hand corner of the new window.

Conventions**:** In these lab exercises, the following abbreviations are used:

The "**ENTER**" key is abbreviated by ↵.

Clicking the left mouse button is abbreviated by ☞.

Double Clicking the left mouse button is abbreviated by ☞☞.

To move from one data entry box to the next, use the **<TAB**> key following the standard Windows protocol. Alternatively, if selected in program preferences, the <**Enter**> key can be used to move from one data entry field to the next within each data entry window.

EXERCISE 1: THEIS ANALYSIS: CONFINED AQUIFER PUMPING TEST

Data Input

Create a data set from scratch.

[1] ☞ on "**File**".

[2] ☞ on "**New**"**;** a dialogue window will show a blank graph of "**Time - Drawdown plot with Discharge**".

[3] Maximize the new data window.

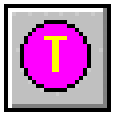
- **Windows 3.x:**

  ☞ on the up-arrow in the upper right hand corner of the new window.

- **Windows 95/Windows NT:**

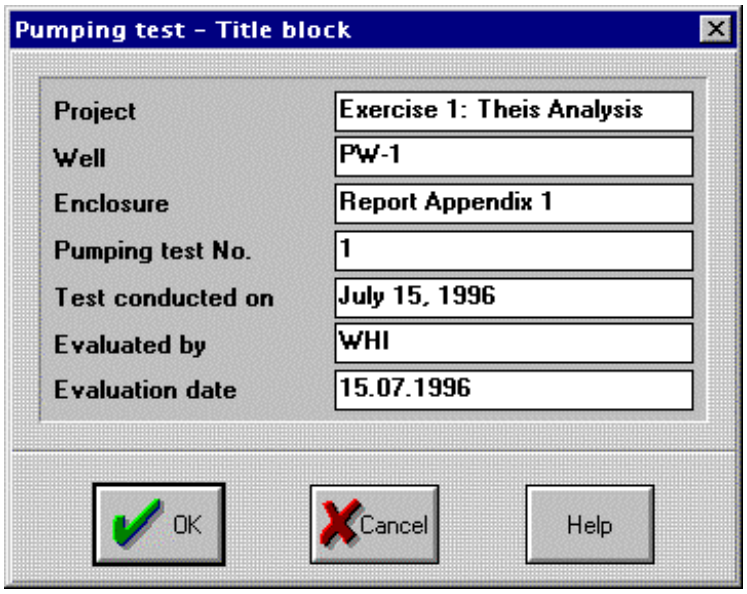
  ☞ on the full screen button in the upper right hand corner of the new window.

[4] ☞ on "**Pumping Test**".



[5] ☞ on "**Title Block**".

[6] Fill the dialogue box as follows:

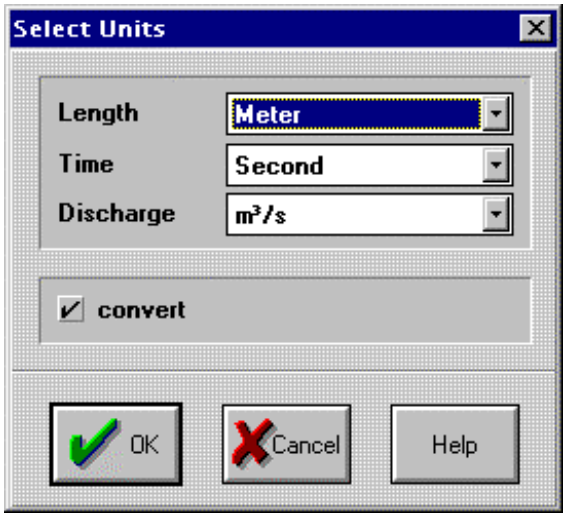


[7] **AquiferTest** reads the date from the computer's calendar and fills in the "**Evaluation Date**" automatically, using the windows settings for the date format.

[8] ☞ on "**OK**".



[9] ☞ on the **Units Icon** to set the units for the input data. (**AquiferTest** can also convert the input data at a later time, or change to a different set of units if you forgot to select the proper units before entering the data)



[10] ☞ on the down arrow beside the length input box and then ☞ on "**Meter**".

[11] ☞ on the down arrow beside the time input box and then ☞ on "**Second**".

[12] ☞ on the down arrow beside the discharge input box, scroll down in the window and then ☞ on "**m^3/s**".

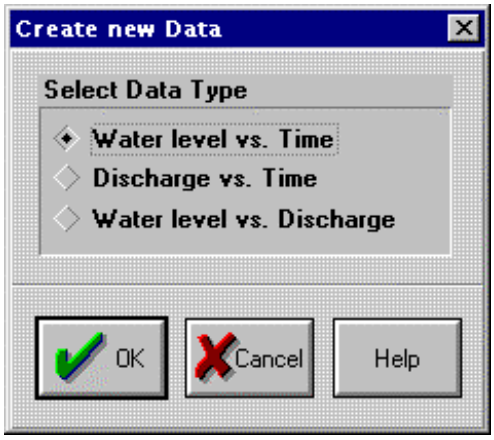
[13] ☞ on "**OK**".

[14] ☞ on "**Data**".

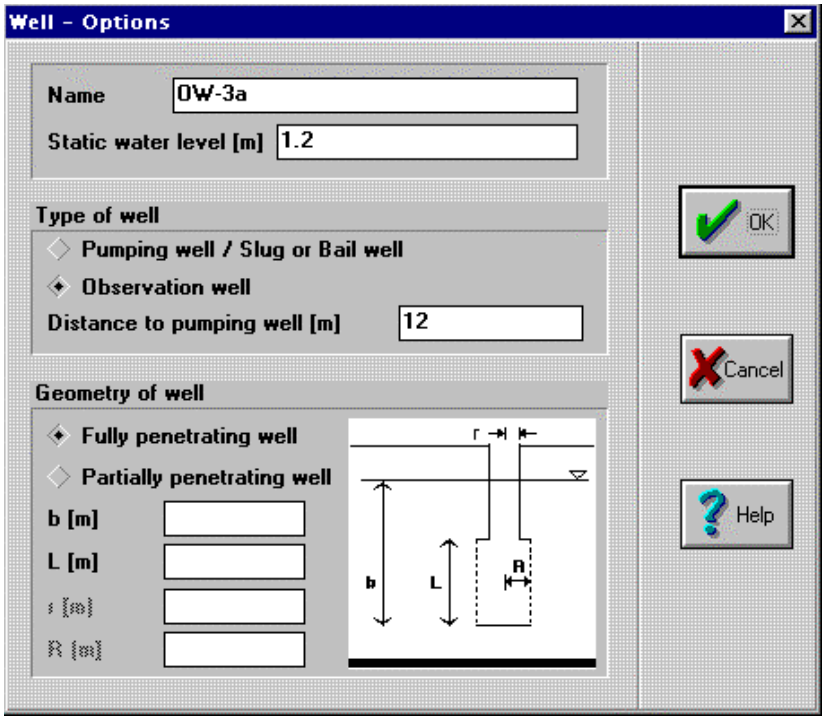


[15] ☞ on "**Create**"; a dialogue box will appear as follows:

Note : By default, the model assumes that you are entering water level vs time (time-drawdown) data. You could also enter discharge (flow rate) vs time or water level vs discharge data, depending on the type of analysis being conducted.



[16] ☞ on "**OK**"; another dialogue box will appear, entitled "**Well - Options**".

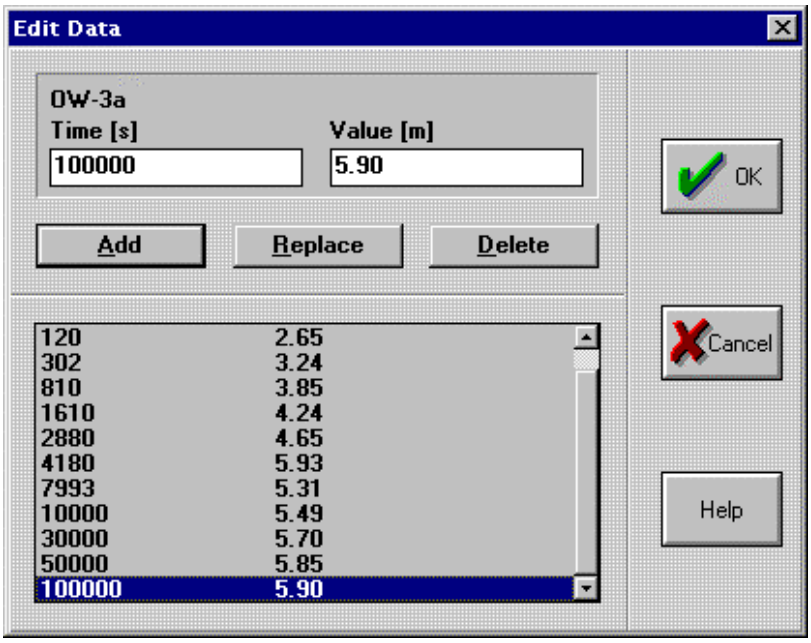


[17] Fill in the box as shown above. You do not need to put in well geometry since we are going to be using the Theis method of analysis which is assumed to be fully penetrating.

[18] ☞ on "**OK**".

AT THIS POINT YOU ARE PRESENTED WITH AN "EDIT DATA" WINDOW. If you plan on manually entering your data, use step [19]. If you plan on transferring your data in from a file (through windows clipboard) use the method outlined in step [20].

You only need to complete one of these two steps to get the pumping test data into **AquiferTest**.



[19] Enter data directly into **AquiferTest**.

Fill in the "**Edit Data**" dialogue box, similar to the screen capture, by typing in the following pumping test data (press **<Enter>** after every **time** or **water level** entry to add the data to the list):

time [s]	**waterlevel [m]**
0↵	1.20↵
40↵	1.95↵
120↵	2.65↵
302↵	3.24↵
810↵	3.85↵
1610↵	4.24↵
2880↵	4.65↵
4180↵	5.93↵

7993↵	5.31↵
10000↵	5.49↵
30000↵	5.70↵
50000↵	5.85↵
100000↵	5.90↵

You can enter the data in any sequence, **AquiferTest** will sort the data for increasing time

Once you're done,

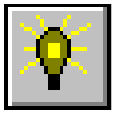
☞ on "**OK**". Now skip to step [21].

[20] Transferring data from another windows program

☞ on "**Cancel**" to exit the "**Edit Data**" window.

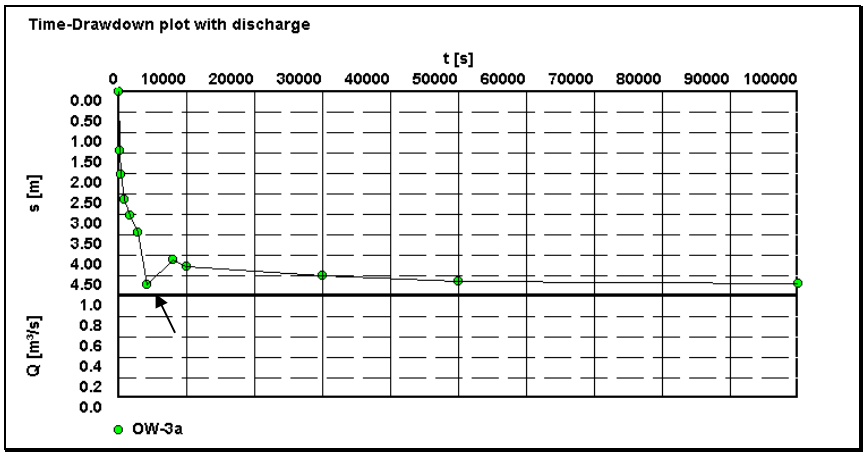
- **Windows 3.x:**
  - **<ALT><TAB>** Hold down the <ALT> key and press the <TAB> key to change to the Program Manager Window (you may have to do this a number of times to reach the Program Manager Window).
  - Go to the "**Accessories**" program group (or the group with "**Notepad**").
  - ☞☞ on the "**Notepad**" icon: **alternatively any windows spreadsheet could be used.**
- **Windows 95/WindowsNT:**
  - ☞ on "**Start**" at the bottom left hand corner of the screen.
  - ☞ on "**Programs**".
  - Go to the "**Accessories**" program group (or the group with "**Notepad**").
  - find and ☞ on the "**Notepad**" icon: **alternatively any windows spreadsheet could be used.**
- ☞ on "**File**".
- ☞ on "**Open**".
- ☞ on "**C:**" (or the drive you installed **AquiferTest**).
- ☞ on the "**Aquitest**" directory/folder (or your **AquiferTest** installation directory).
- ☞☞ on "**THEIS.TXT**".
- highlight the data by ☞ at the top left hand corner and, while holding down the left mouse button, drag the mouse to the right and down overtop of the entire data set and then release the left mouse button.

- ☞ on "**Edit**".
- ☞ on "**Copy**": this places the selected data onto the Windows "**clipboard**".
- **<ALT><TAB>** Hold down the <**ALT**> key and press the <**TAB**> key to change back to the **AquiferTest** window. (you may need to do this several times)
- ☞ on "**Edit**".
- ☞ on "**Paste**".



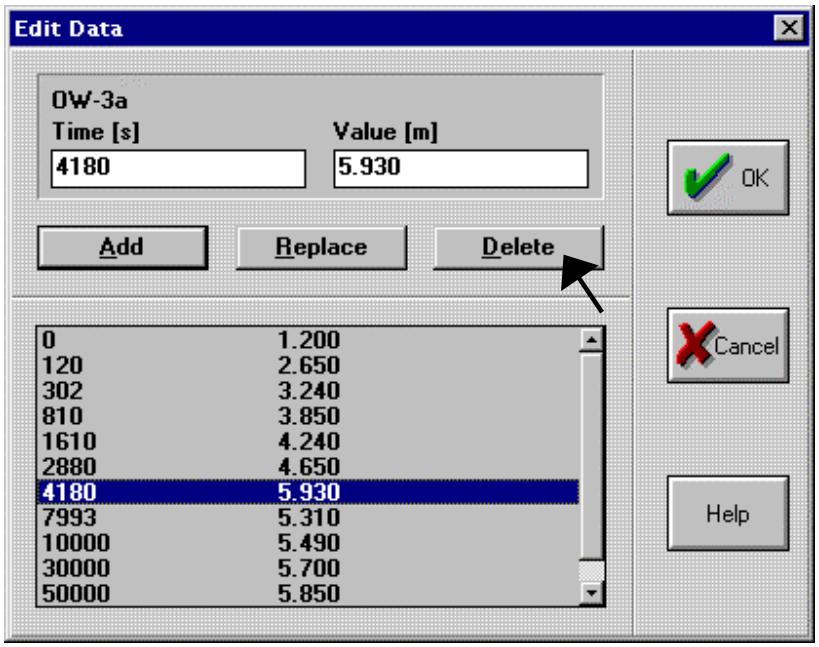
[21] ☞ on the **light bulb icon** to update the plot. Now the drawdown vs time curve will be displayed. As you may notice, one data point appears to be faulty. Let's remove it.

[22] ☞☞ on the data point at approximately 4,200 seconds.



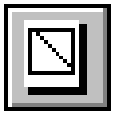
[23] The "**Edit Data**" window appears with the selected data point highlighted as follows.

Note: when the data point is removed from the list, the graph of drawdown vs. time is updated.



[24] ☞ on "**Delete**" and then ☞ on "**OK**".

Entering the Pumping Rate



[25] ☞ on "**Method**".

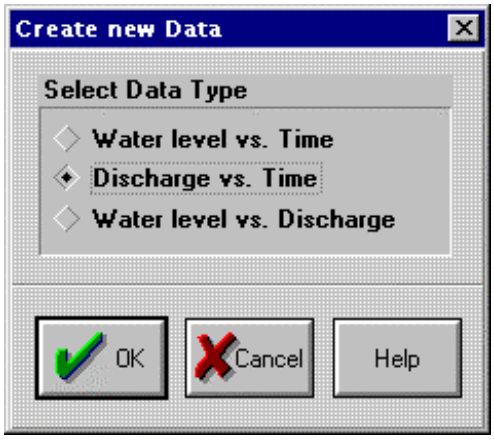
[26] ☞ on "**Select**"; make sure that "**Time/Drawdown with discharge**" is selected (if it isn't, ☞ on it).

[27] ☞ on "**OK**".

[28] ☞ on "**Data**".



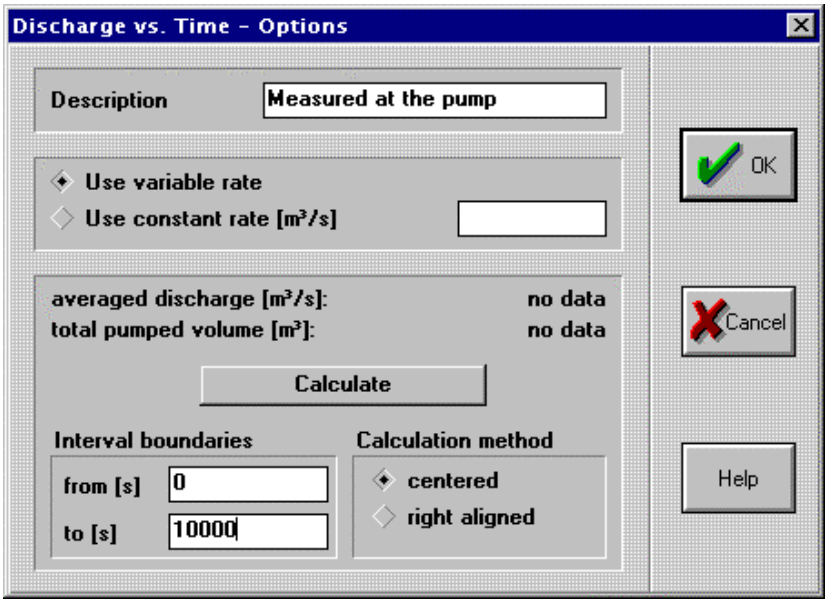
[29] ☞ on "**Create**": The following window appears.



[30] ☞ on "**Discharge vs Time**".

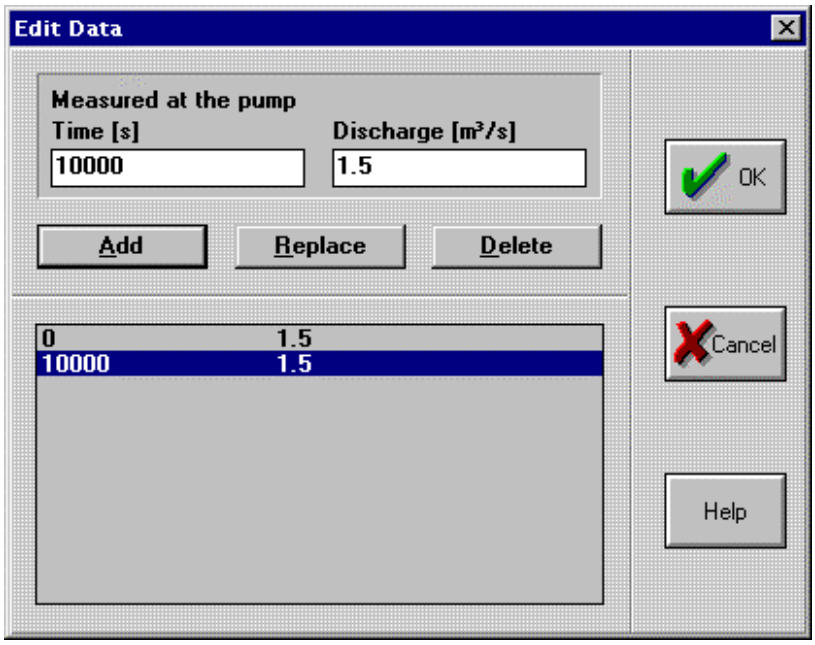
[31] ☞ on "**OK**"; a dialogue box will appear (**Discharge vs Time - Options**).

[32] fill out the dialogue box as follows:



☞ on "**OK**".

[33] another "**Edit Data**" window will appear; specify the pumping rates as follows:



AquiferTest allows you to quickly enter the data by jumping to the next prompt automatically every time the **<enter>** key is pressed.

0↵ 1.5↵

10000↵ 1.5↵

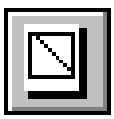
[34] ☞ on "**OK**".

Note: The plotted data now appear in a purple(red) colour to indicate that this water level vs. time data set is not the current data set. The pumping history is displayed, in green, in the bottom portion of the graph indicating that it is the current data set. In **AquiferTest**, if you have multiple sets of data for a pumping test (i.e. pumping rate and several observation wells) the current data set is always the one displayed in green. You can set the active data set as follows:



[35] ☞ on any measured data point on the screen to make that data set the current data set (alternatively you can do this through the "**Data**" "**List**" pull-down menu options or by ☞ on the information icon). In this case, we will select one of the data points for the Water level vs. Time data set to make this data set current (it should now be displayed in green).

Theis Analysis

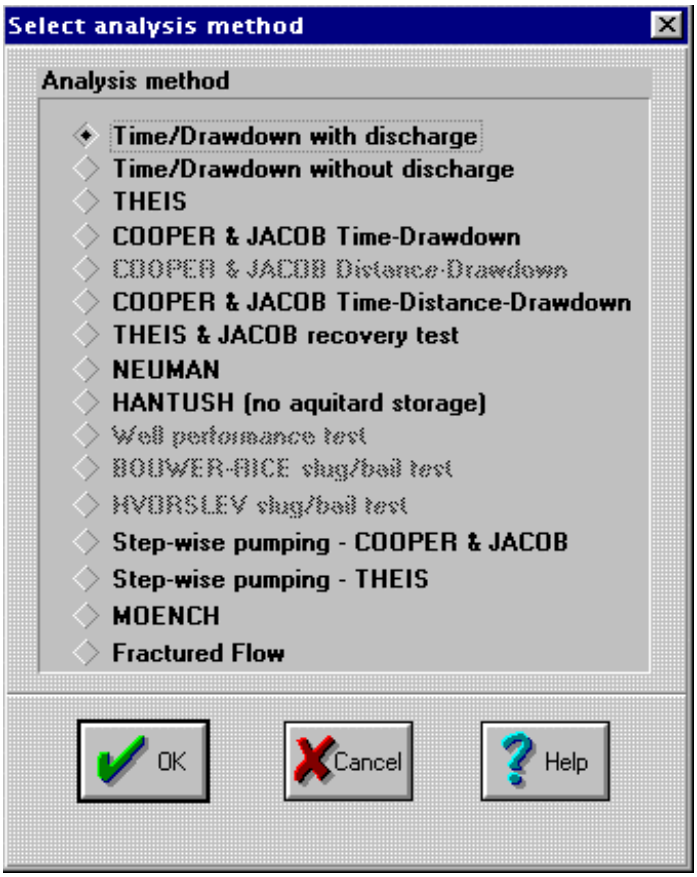


[25] ☞ on "**Method**".

[26] ☞ on "**Select**".

[27] ☞ on "**Theis**" as follows:

Note: In the screen capture, some methods are "greyed-out" because the "smart" interface only allows the options which are most appropriate for the type of input data.



[28] ☞ on "**OK**".

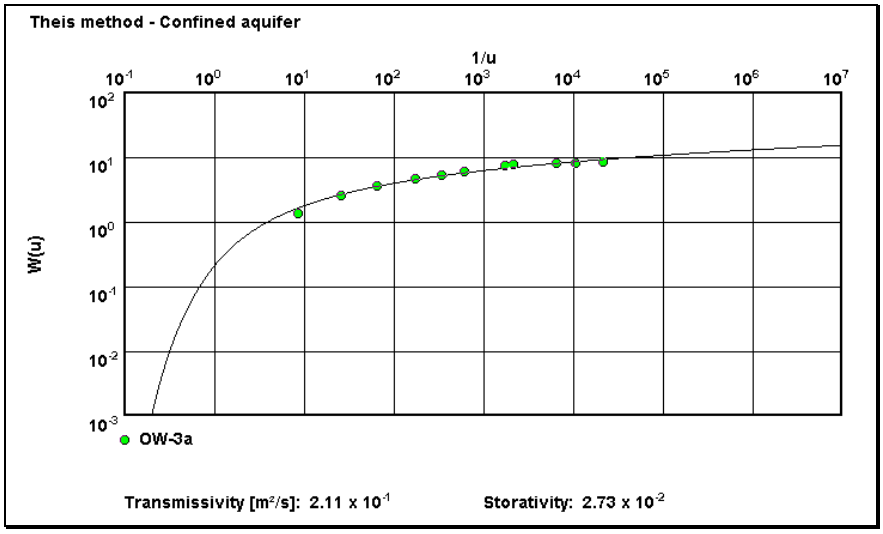


[29] ☞ on the Automatic Curve Fit button. At this point the data are automatically moved to overlay the Theis curve and obtain a least-squares fit.

The estimated parameters with this fit are:

Transmissivity **≈ 2.1 x 10^{-1} m^2/s,**

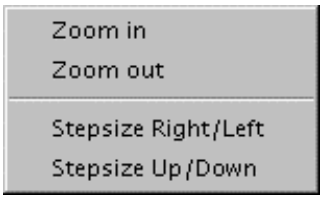
Storativity **≈ 2.7 x 10^{-2}.**



[30] Let's take a closer look at the fit obtained automatically by zooming in.



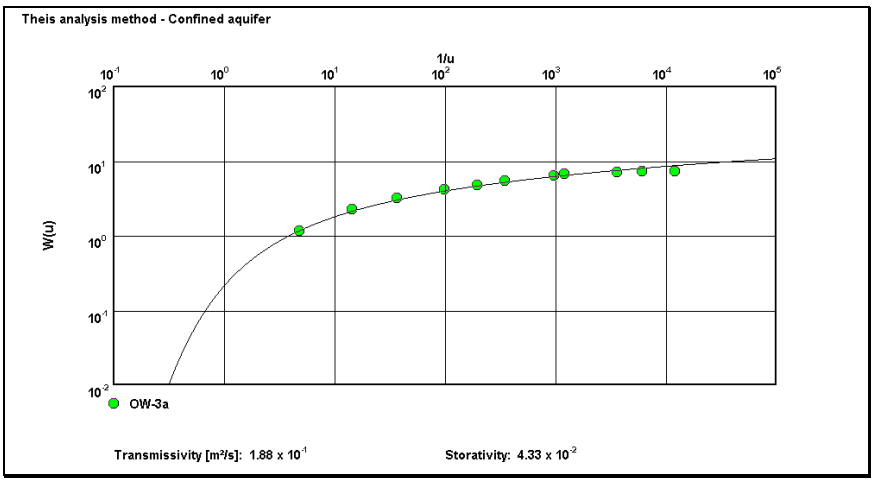
[31] Click on the right mouse button to obtain the zoom menu; you can do this at any time, or you could access this option through the "**View**" pull-down menu.



[32] ☞ on "**Zoom In**".

[33] ☞ at the top left corner of the zoom area (W(u) ≈10^{1}, 1/u ≈10^{0}) and drag a window over the data (to approx.W(u) ≈10^{-2}, 1/u ≈ 10^{4}). ☞ again to anchor the final corner.

[34] Now you can use your professional judgement to adjust the curve as you see fit. For example, you may wish to place more emphasis on the early time data if you suspect that the aquifer is either leaky, or if you suspect that some other boundary feature may be affecting your results. To do this, use the arrow keys to move the data points onto the Theis type curve (similar to the figure below); as you move the data curve, the transmissivity value is continuously updated.



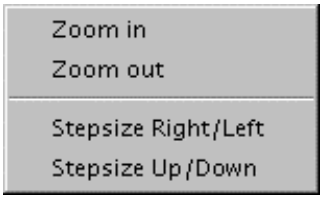
The estimated parameters with this fit are:

Transmissivity **≈ 1.9 x 10^{-1} m^2/s,**

Storativity **≈ 4.3 x 10^{-2}.**

Notice that the difference between the two estimated sets of parameters is relatively minor for this example. Nevertheless, the least squares fit curve may not always be the most appropriate curve; professional judgement is essential for the proper assessment of **AquiferTest** data.





[35] To "**Zoom Out**":

Click on the right mouse button to obtain the zoom menu)

☞ on "**Zoom Out**".

This takes you back to the previous zoomed area. If you zoomed in more than once, "zoom out" again until you return to the original axis limits.

Save

[36] ☞ on "**File**".

[37] ☞ on "**Save As**".

[38] type "**Theis**"; **AquiferTest** will supply the extension ".hyt" automatically.

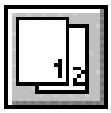
[39] ☞ on "**OK**" (if the file exists, replace it).

Print Preview of Output



[40] ☞ on the "Display Mode" icon. **AquiferTest** switches to the WYSIWYG (What You See Is What You Get) preview-mode.

[41] Using the scroll bar on the right of the screen, you can preview the entire plot.



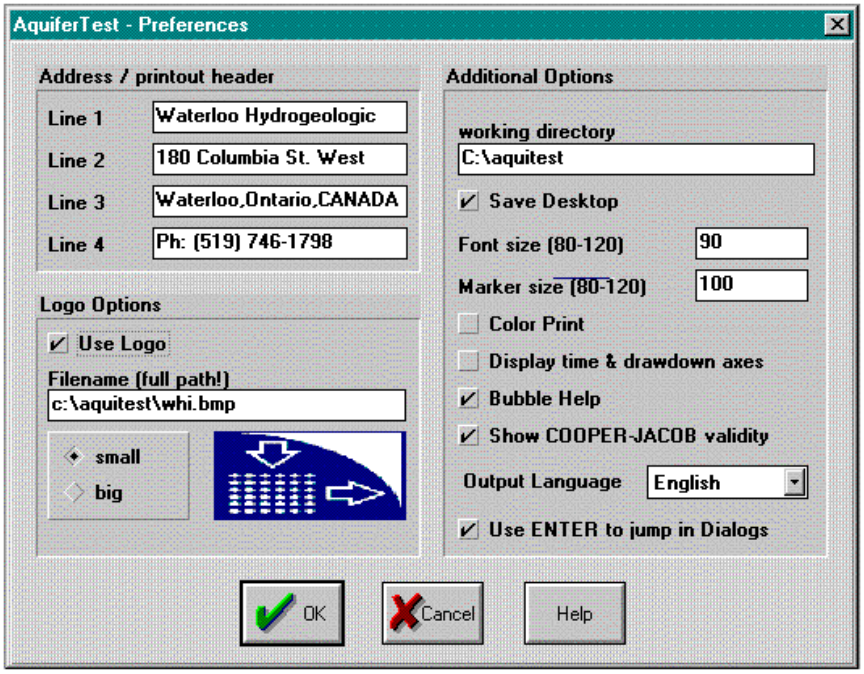
[42] ☞ on the "Next Page" icon.

[43] You should now see a table with your input data.

Let's look at some plotting/printing features:

[44] ☞ on "**File**".

[45] ☞ on "**Preferences**".



[46] Fill out the dialogue box with your company's name and address, similar to the following:

Line 1 **your company name**
Line 2 **street address**
Line 3 **city, state**
Line 4 **phone or fax No.**

☞ on "**Use Logo**" you could scan in your logo (what **AquiferTest** needs is a bitmap, i.e., a "*.bmp file"). The default is the Waterloo Hydrogeologic Logo.

☞ on "**Bubble Help**" (this will display a brief description of each icon as you move the mouse over the icons; try it by pointing at some of the icons once you're back at the main screen).

You may also wish to change the working directory to **C:\AQUITEST**.

[47] ☞ on "**OK**"; you should now see the Waterloo Hydrogeologic logo displayed along with your company name and address.

END OF EXERCISE 1.

TO QUIT AquiferTest:

[48] ☞ on "**File**".

[49] ☞ on "**Exit**".

EXERCISE 2: COOPER & JACOB ANALYSIS CONFINED AQUIFER PUMPING TEST

Data Input

The data for this example is the same as for Exercise 1. If you have saved Exercise 1, you can open Theis.hyt, change the "**Pumping Test**" title box (step [6]) and then proceed to step [36]. If you are still in Exercise 1 you can change the "**Pumping Title**" title box and continue directly to [36]. Lastly if you want to create a data set from scratch start at step [1].

[1] ☞ on "**File**".

[2] ☞ on "**New**"**;** a dialogue window will show a blank graph of drawdown vs. time.

[3] Maximize the new data window .

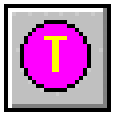
- **Windows 3.x:**

  ☞ on the up-arrow in the upper right hand corner of the new window.

- **Windows 95/Windows NT:**

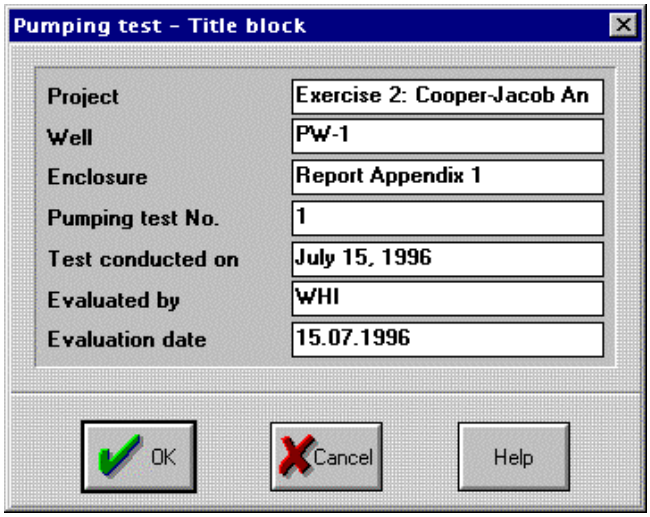
  ☞ on the full screen button in the upper right hand corner of the new window.

[4] ☞ on "**Pumping Test**".



[5] ☞ on "**Title Block**".

[6] Fill the dialogue box as follows:

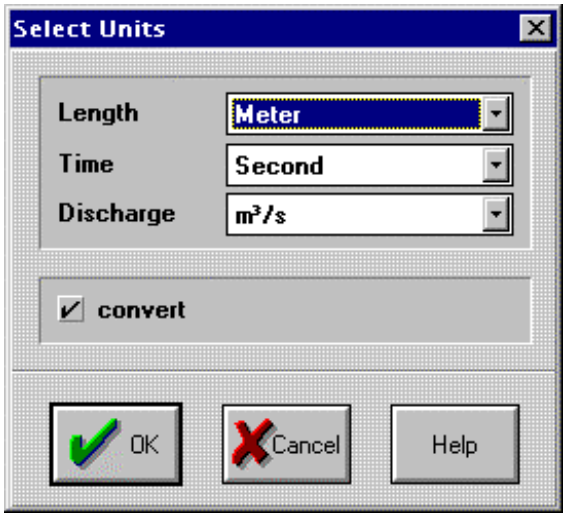


[7] **AquiferTest** reads the date from the computer's calendar and fills the in "**Evaluation Date**" automatically, using the windows settings for the date format.

[8] ☞ on "**OK**".



[9] ☞ on the **Units Icon** to set the units for the input data. (**AquiferTest** can also convert the input data at a later time, or change to a different set of units if you forgot to select the proper units before entering the data.)



[10] ☞ on the down arrow beside the length input box and then ☞ on "**Meter**".

[11] ☞ on the down arrow beside the time input box and then ☞ on "**Second**".

[12] ☞ on the down arrow beside the discharge input box, scroll down in the window and then ☞ on "**m^3/s**".

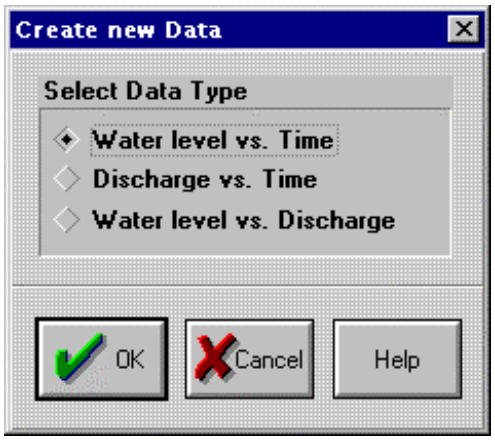
[13] ☞ on "**OK**".

[14] ☞ on "**Data**".

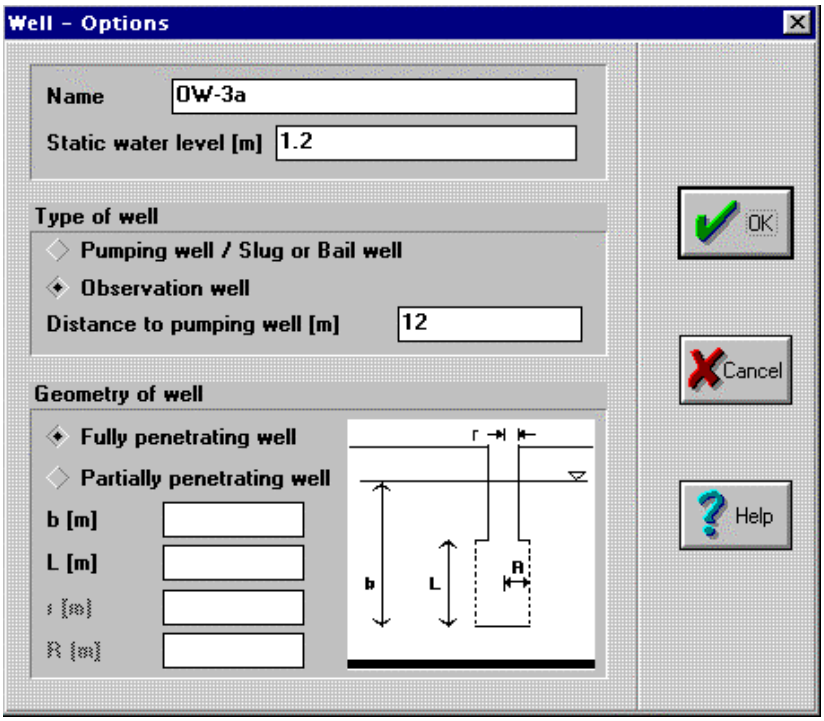


[15] ☞ on "**Create**"; a dialogue box will appear as follows:

Note : By default, the model assumes that you are entering water level vs time (time-drawdown) data. This is what we want for this exercise any way, but we could also enter discharge (flow rate) vs time or water level vs discharge data, depending on the type of analysis being conducted.



[16] ☞ on "**OK**"; another dialogue box will appear, entitled "**Well - Options**".

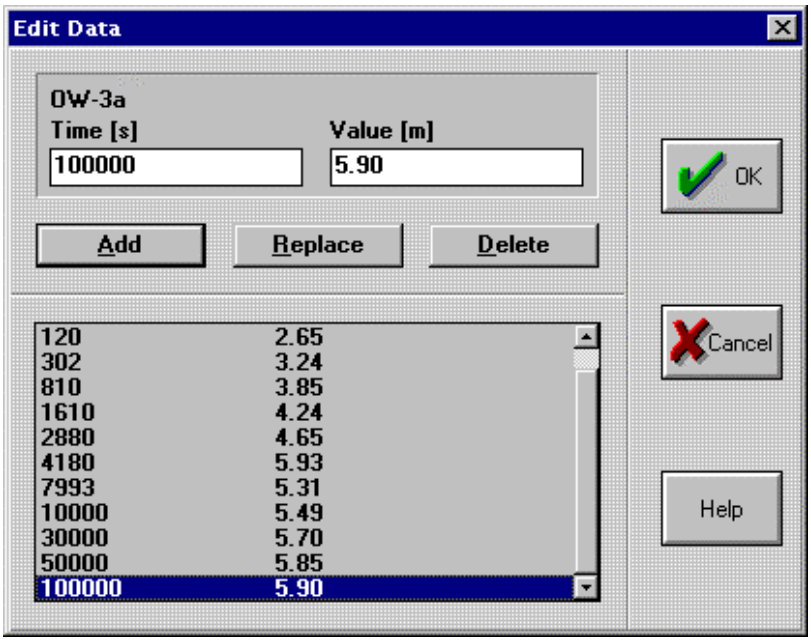


[17] Fill in the box as shown above. You do not need to enter the geometry of the well since we will be doing a Theis method analysis which assumes fully penetrating wells.

[18] ☞ on "**OK**".

AT THIS POINT YOU ARE PRESENTED WITH AN "EDIT DATA" WINDOW. If you plan on manually entering your data, use step [19]. If you plan on transferring your data in from a file (through windows clipboard) use the method outlined in step [20].

You only need to complete one of these two steps to get the pumping test data into **AquiferTest**.



[19] Enter data directly into **AquiferTest**.

Fill in the "**Edit Data**" dialogue box, similar to the screen capture, by typing in the following pumping test data (press **<Enter>** after every **time** or **water level** entry to add the data to the list):

time [s]	**waterlevel [m]**
0↵	1.20↵
40↵	1.95↵
120↵	2.65↵
302↵	3.24↵
810↵	3.85↵
1610↵	4.24↵
2880↵	4.65↵
4180↵	5.93↵
7993↵	5.31↵
10000↵	5.49↵
30000↵	5.70↵
50000↵	5.85↵
100000↵	5.90↵

You can enter the data in any sequence, **AquiferTest** will sort the data for increasing time.

Once you're done,

☞ on "**OK**". Now skip to step [21].

[20] Transferring data from another windows program.

☞ on "**Cancel**" to exit the "**Edit Data**" window.

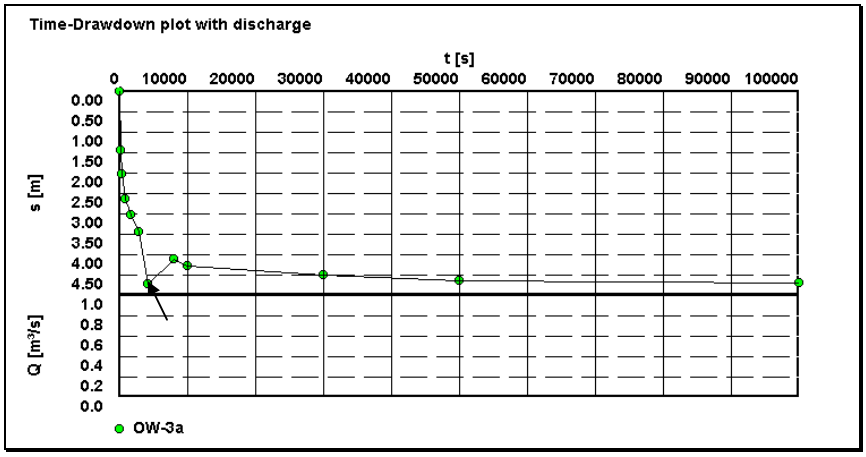
- **Windows 3.x:**
  - **<ALT><TAB>** Hold down the <ALT> key and press the <TAB> key to change to the Program Manager Window (you may have to do this a number of times to reach the Program Manager Window).
  - Go to the "**Accessories**" program group (or the group with "**Notepad**").
  - ☞☞ on the "**Notepad**" icon: **alternatively any windows spreadsheet could be used**.
- **Windows 95/WindowsNT:**
  - ☞ on "**Start**" at the bottom left hand corner of the screen.
  - ☞ on "**Programs**".
  - Go to the "**Accessories**" program group (or the group with "**Notepad**").
  - Find and ☞ on the "**Notepad**" icon: **alternatively any windows spreadsheet could be used**.
- ☞ on "**File**".
- ☞ on "**Open**".
- ☞ on "**C:**" (or the drive you installed **AquiferTest**).
- ☞ on the "**Aquitest**" directory/folder (or your **AquiferTest** installation directory).
- ☞☞ on "**THEIS.TXT.**"
- Highlight the data by ☞ at the top left hand corner and, while holding down the left mouse button, drag to the right and down overtop of the entire data set and then release the left mouse button.
- ☞ on "**Edit**".
- ☞ on "**Copy**": this places the selected data onto the Windows "**clipboard**".
- <**ALT**><**TAB**> Hold down the <**ALT**> key and press the <**TAB**> key to change back to the **AquiferTest** window. (you may need to do this several times).
- ☞ on "**Edit**".

- ☞ on "**Paste**".



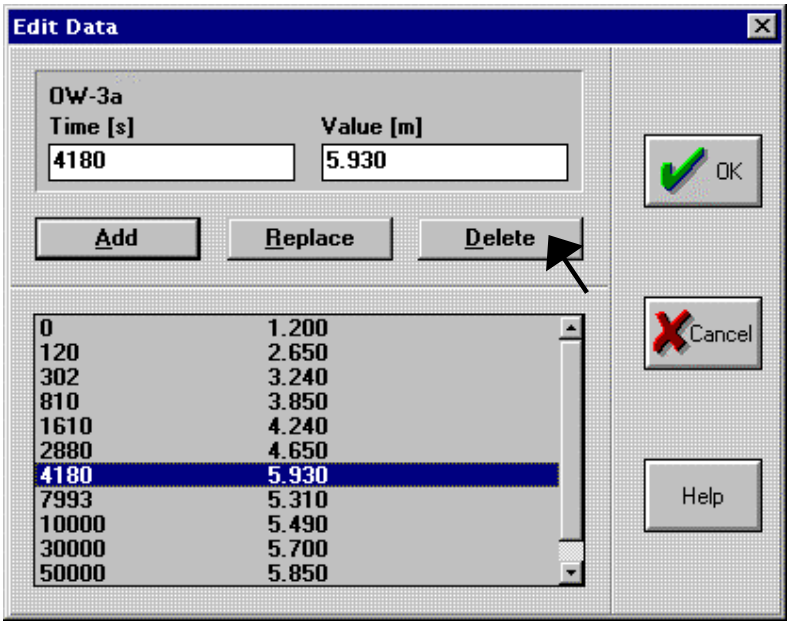
[21] ☞ on the **light bulb icon** to update the screen. Now the drawdown vs. time curve will be displayed. As you may notice, one data point appears to be faulty. Let's remove it.

[22] ☞☞ on the faulty data point as indicated.



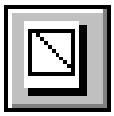
[23] The "**Edit Data**" window appears with the selected data point highlighted as follows:

Note: when the data point is removed from the list, the graph of drawdown vs. time is updated.



[24] ☞ on "**Delete**" and then ☞ on "**OK**".

Input of Pumping Rate



[25] ☞ on "**Method**".

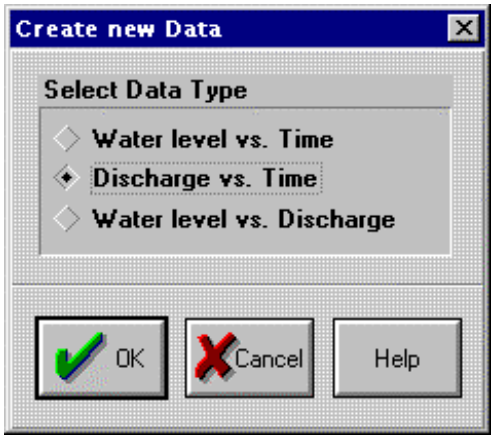
[26] ☞ on "**Select**"; make sure that "**Time/Drawdown with discharge**" is selected (if it isn't, ☞ on it).

[27] ☞ on "**OK**".

[28] ☞ on "**Data**"



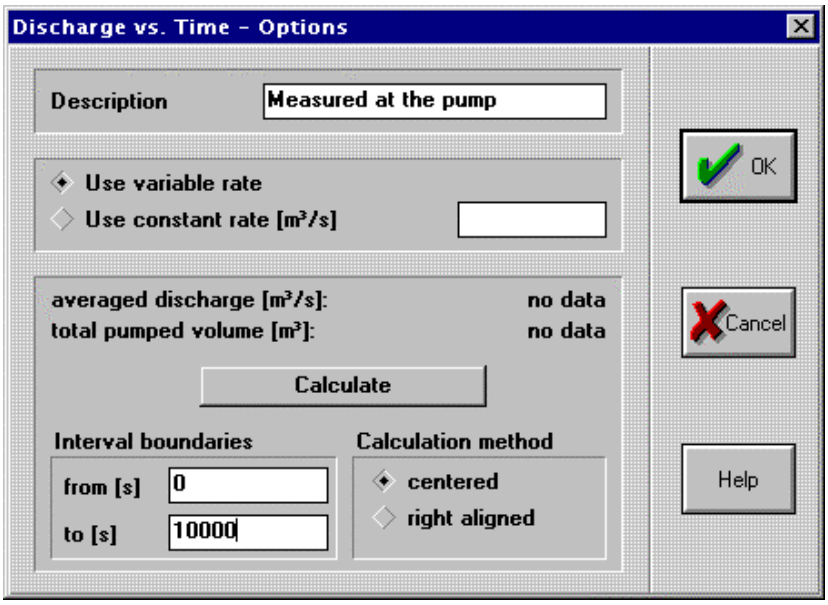
[29] ☞ on "**Create**": The following window appears



[30] ☞ on "**Discharge vs Time**".

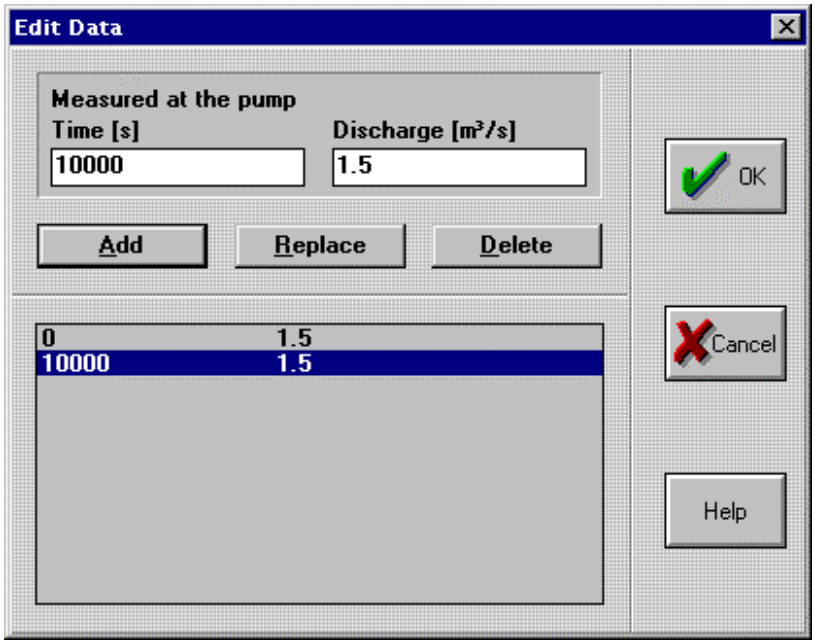
[31] ☞ on "**OK**"; a dialogue box will appear (**Discharge vs Time - Options**).

[32] fill out the dialogue box as follows:



☞ on "**OK**".

[33] another "**Edit Data**" window will appear; specify the pumping rates as follows:



AquiferTest allows you to quickly enter the data by jumping to the next prompt automatically every time the **<Enter>** key is pressed.

0↵ 1.5↵

10000↵ 1.5↵

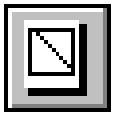
[34] ☞ on "**OK**".

Note: The plotted data now appear in a purple(red) colour to indicate that this water level vs. time data set is not the current data set. The pumping history is displayed, in green, in the bottom portion of the graph indicating that it is the current data set. In **AquiferTest**, if you have multiple sets of data for a pumping test (i.e. pumping rate and several observation wells) the current data set is always the one displayed in green. You can set the active data set as follows:



[35] ☞ on any measured drawdown data point on the screen to change the current data to the **Water Level vs. Time** data. (alternatively you can do this through the "**Data**" "**List**" pull-down menu options or by ☞ on the information icon)

Cooper & Jacob Analysis

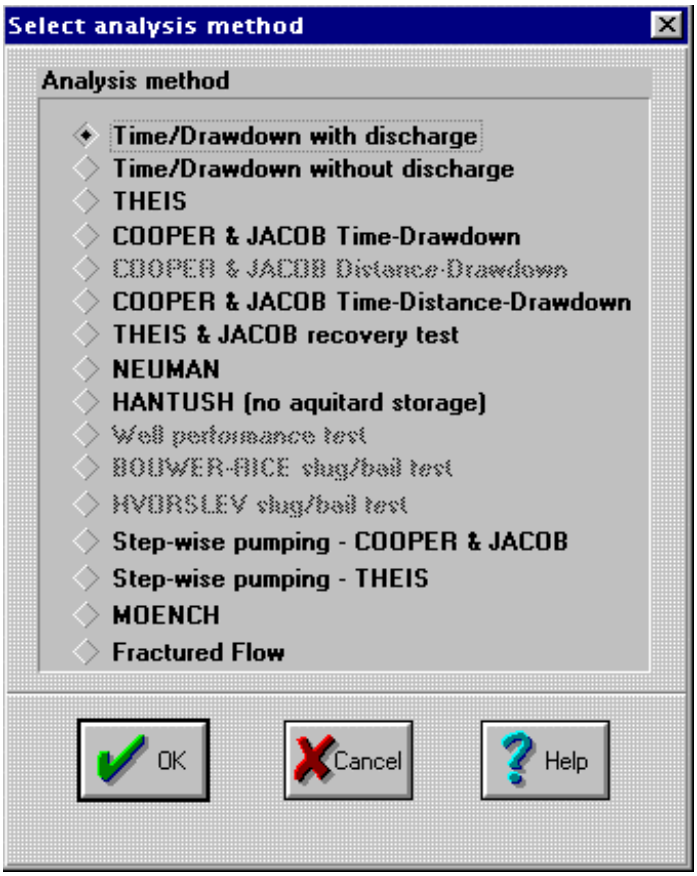


[36] ☞ on "**Method**".

[37] ☞ on "**Select**".

[38] ☞ on "**COOPER & JACOB, Time-Drawdown**" as shown:

Note: In the screen capture, some methods are "greyed-out" because the "smart" interface only allows the options which are most appropriate for the type of input data.



[39] ☞ on "**OK**"; the straight line fit should be displayed instantaneously together with T and S estimates.

Recall, there is a "**u**"-criterion for the Cooper & Jacob analysis. The analysis should be conducted for data points for which the criterion u > 0.02 is satisfied (Cooper & Jacob applies to the late time data from a pumping test). We can display this criterion as a straight line on the data plot by doing the following:

[40] ☞ on "**File**".

[41] ☞ on "**Preferences**".

[42] Select "**Show COOPER-JACOB validity**" (if the box beside it does not contain a check mark) to display the "**u**"-criterion (vertical line).

[43] ☞ on "**OK**".

Now you should see the data points on your screen with a straight line fit through them, and a vertical line displaying the "**u**"-criterion (as shown in the following figure). The data points to the left of the ″**u**″-criterion can be ignored for the analysis and it is more important to fit the data points to the right of this line.

To make this exercise more interesting, we have chosen a data set that shows a boundary effect. The Cooper-Jacob method is the most

appropriate analysis method to show the effect of nearby recharge boundaries or impermeable boundaries. The last few data points in this data set can be seen to deviate from the straight line; in this case drawdown does not increase as much as expected for late times. This is indicative of a nearby recharge boundary or a leaky aquifer (this could be analyzed using the Hantush method which is also available in **AquiferTest**). Note that this behaviour was not quite as obvious in the Theis analysis.

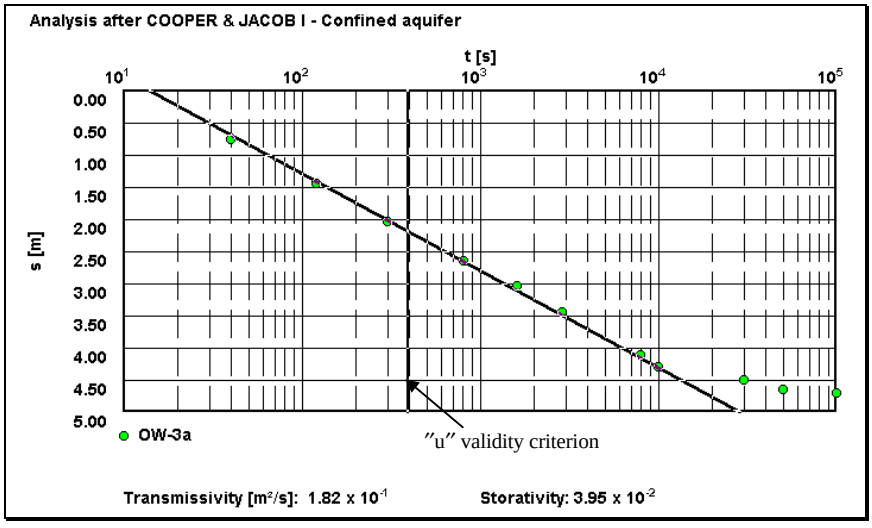
In order to analyze the data set, we ignore the last three data points, because the drawdown for late times has been influenced by this recharge condition. The straight line fit should therefore focus on the data points between the u-criterion and where the data start to deviate from the straight line. The straight line displayed on your screen may or may not fit the data well; therefore, let's try to achieve a better fit:

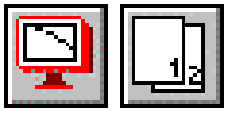


[44] ☞ on the "**light bulb icon**"; this will automatically fit the line to all data points.

We could now either exclude data points from being used, or manually adjust the fit. We'll do a manual fit:

[45] using the cursor keys, rotate and shift the line to achieve a good fit. The "**left**" and "**right**" cursor keys rotate the line, and the "**up**" and "**down**" keys shift the line. As you are rotating and moving the line, notice that the u-criterion is constantly being re-evaluated such that the vertical line also moves. An appropriate fit will be similar to the following:





[46] Again, you can preview the output plots by clicking on "**Display**" icon and the "**Next Page**" icon on the right of the menu bar at the top of the screen.

Correction for Unconfined Conditions

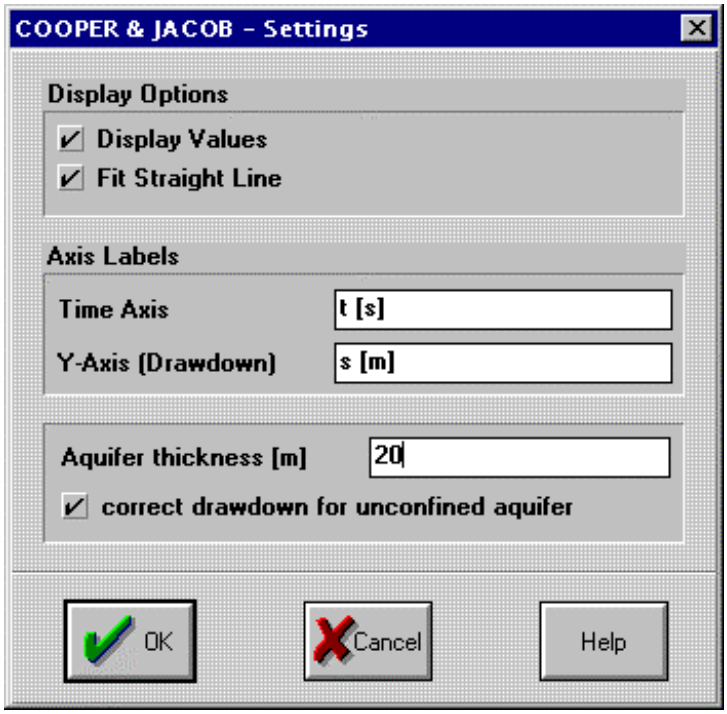
The evaluation of pumping test data from an unconfined aquifer is usually done using the Neuman method. However, simple correction terms have been introduced in easier analysis methods such as Theis and Cooper-Jacob. To see what happens if we change the aquifer from a confined to an unconfined aquifer.

[47] ☞ on "**Method**".



[48] ☞ on "**Settings**".

[49] A window will appear as follows:



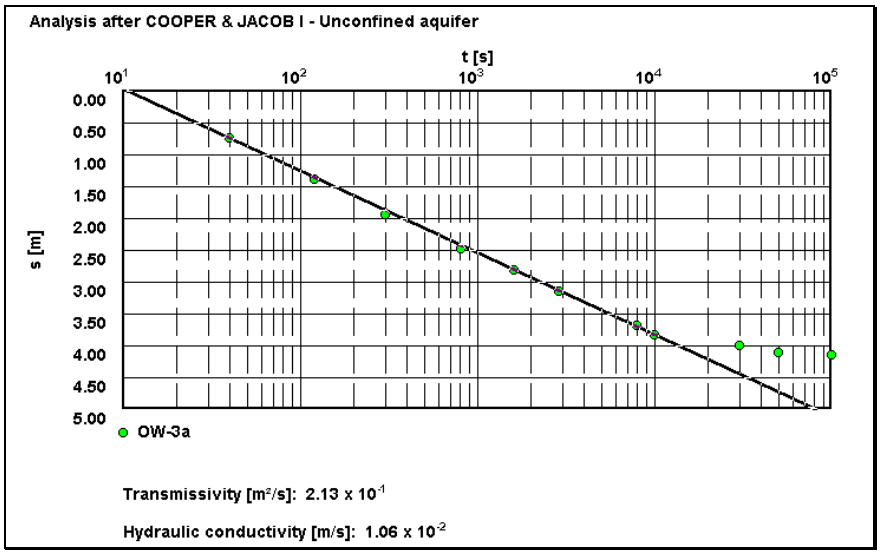
Enter an "**Aquifer thickness [m]**" of 20.

You could fill this box out for any type of analysis.

The program will then divide the transmissivity by this thickness and also display hydraulic conductivity (K = T/b).

[50] ☞ on "**correct drawdown for unconfined aquifer**".

[51] ☞ on "**OK**"; you may now have to re-fit your Cooper-Jacob line. Note that the model now cannot provide an estimate for storativity and that the u-criterion is not displayed (u is a function of S). If you want storativity and specific yield, you need to do a Neuman analysis (also available in **AquiferTest**). The results should be similar to those shown below:



Save

[52] ☞ on "**File**"

[53] ☞ on "**Save As**"

[54] Type "**Coop_Jac**"; **AquiferTest** will supply the extension ".hyt" automatically.

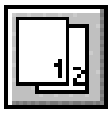
[55] ☞ on "**OK**" (if the file exists, replace it).

Print Preview of Output



[56] ☞ on the "**Display**" icon. **AquiferTest** switches to the WYSIWYG (What You See Is What You Get) preview-mode.

[57] Using the scroll bar on the right of the screen, you can preview the entire plot.



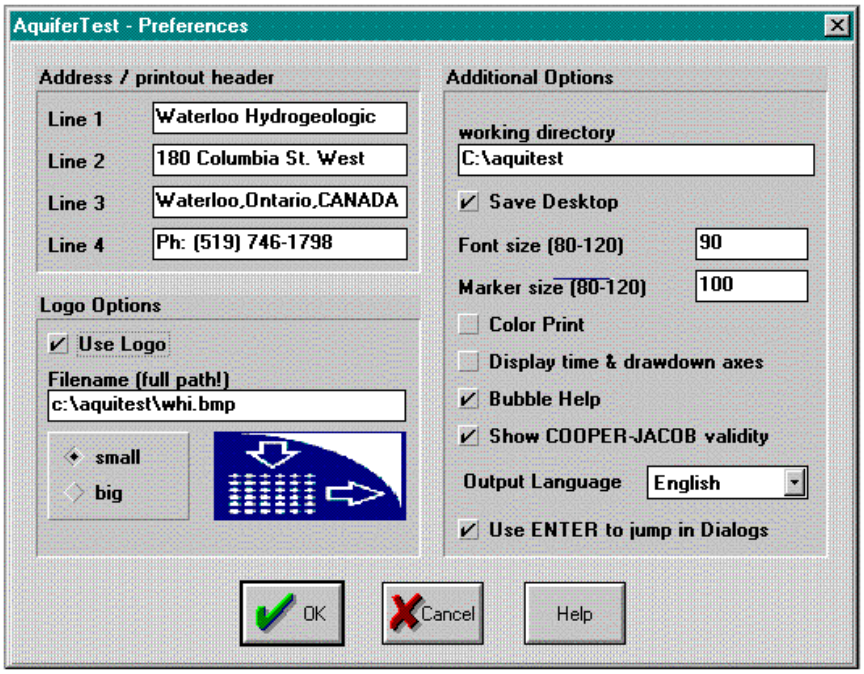
[58] ☞ on the "**Next Page**" icon.

[59] You should now see a table with your input data.

Let's look at some plotting/printing features:

[60] ☞ on "**File**".

[61] ☞ on "**Preferences**".



[62] Fill out the dialogue box with your company's name and address, similar to the following:

Line 1 **your company name**
Line 2 **street address**
Line 3 **city, state**
Line 4 **phone or fax No.**

☞ on "**Use Logo**" you could scan in your logo (what **AquiferTest** needs is a bitmap, ie., a "*.bmp file"). The default is the Waterloo Hydrogeologic Logo.

☞ on "**Bubble Help**" (this will display a brief description of each icon as you move the mouse over the icons; try it by pointing at some of the icons once you're back at the main screen).

You may also wish to change the working directory to **C:\AQUITEST.**

[63] ☞ on "**OK**"; you should now see the Waterloo Hydrogeologic logo displayed along with your company name and address.

END OF EXERCISE 2

TO QUIT AquiferTest:

[64] ☞ on "**File**".

[65] ☞ on "**Exit**".