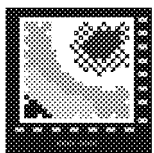

GROUND WATER FOR WINDOWS ... OVERVIEW



Ground Water for Windows is a relational data base and a Ground Water Information System (GWIS). The GWW combines the principles of Geographic Information Systems (GIS) with powerful dedicated ground water data processing and reporting modules:

- Master Data
- Chemical Data(including time and depth series)
- Pumping Test Processing and Aquifer Parameters
- Well Logs and Well Construction Data
- Lithologic, Hydrogeologic and Stratigraphic Cross Sections (in two and three dimensions)
- Mapping
- Step Drawdown Test Data
- Water Level Measurement Data
- Grain Size Distribution Curves and Calculations of Hydraulic Conductivity Using Empirical Formulas
- Various Hydrogeological Calculations, such as Well Functions, Drawdowns, and Miscellaneous Well Construction data.
- User-defined storage and retrieval applications.

MAPPING APPLICATION

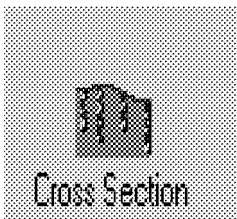


The GWW is capable of:

- Contouring any space-distributed parameter; such as any chemical constituent; interpolated water level or depth to water, transmissivity, hydraulic conductivity or any other hydrogeological parameter; stratigraphic contacts expressed as depth or absolute elevations; thicknesses of lithostratigraphic members; ground surface elevation; etc.

- Adding color regions to the map.
- Creating a gridded equidistant model from random values.
- Digitizing, on screen with a mouse, lines, areas, and points.
- Adding lines, areas, and text to the map.
- Importing AutoCad's .dxf files (data interchange files) and exporting grid models, lines, areas, text, points, and contours to .dxf format.
- Importing ASCII files containing the coordinates of points, lines, areas, grid models, and text.
- Saving various thematic maps as a part of the information system.
- Preparing various ASCII data files for direct input into the modeling software packages.
- Using maps to reduce a large data set to a smaller subset belonging to a free-hand drawn area, a rectangle, or simply selecting wells point by point.
- Using maps to select cross section lines and for selecting wells within a range from the cross section line to be plotted on the lithologic or stratigraphic cross section.

LITHOLOGIC CROSS SECTIONS



You may create lithologic cross sections directly from a map by using a mouse and selecting points one by one, by selecting a hand-drawn area and adding wells within a certain range from the cross section line, or by selecting a polygon area.

You may add various lines connecting wells:

- ground surface elevation
- static or dynamic water level lines

- lines separating stratigraphic units.

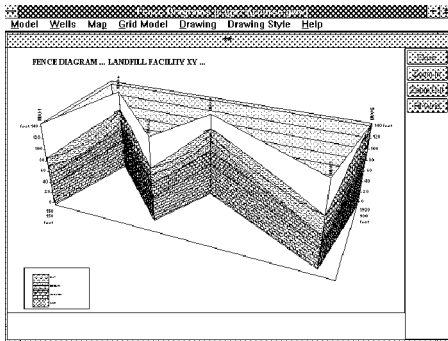
You may label these lines, and select any color, line pattern, font and typeface for drawing or labeling.

- You may create one or more legend blocks and position them at any place on the drawing.

You control the size of the cross section by selecting horizontal and vertical scales. You also define the width of lithologic columns. Symbols displayed on a cross section are the ones selected and/or created by you.

You may also add well construction details, such as casing diameters and position of well screens. Of an appeal in contaminant movement studies will be the option to add one or two graphs representing chemical constituents with depth of sampling.

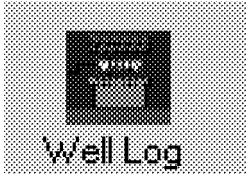
FENCE DIAGRAMS or THREE DIMENSIONAL MODELING OF LITHOLOGY



Using this application you may create one or more fence (block) diagrams. The features of this application are:

- Selecting wells for presentation on fence diagrams.
- Connecting layers and litho-stratigraphic units by free-hand drawing or as grid lines created using the Mapping application.
- Filling layers or closed polygons with lithologic symbols and pattern.
- Changing rotation and view angles to enhance a fence diagram.
- Making drawings with legend blocks, labels and headers.
- Saving drawings for printing.

WELL LOG AND WELL CONSTRUCTION



Using the Well Log application on the main menu bar of the GWW software you may do the following:

- Create a new well log by entering drilling data (depths and lithologic description of drilled layers) and construction data (hole and casing diameters, screen positions, materials filling annulus).
- Use the existing lithologic symbols for various lithologic members and/or materials filling the annulus.
- Create new symbols directly on the screen or using a text processor.
- Display a well log with its construction details on the screen.
- Create a lithologic data base which will be used by another application, the Cross Section, for creating lithologic cross sections, and by the Mapping application for creating various random models and contour maps.
- Print a well log, using a default reporting form or your own created forms.
- You may display static water levels on the log.
- You may write descriptions or characterizations of various lithologic members and layers.
- You may enlarge the well construction detail by expanding to other columns. By selecting a large vertical scale, the well log will continue to print on subsequent pages.
- You may design the screen pattern (bridges, holes, or slots) and display or print lines and backgrounds of every symbol in colors.
- You may customize the display and replace English words with equivalents in your native language.

**CHEMICAL DATA
APPLICATION**

With the Chemistry application of GWW you can do the following:

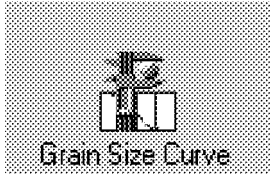
- Create the chemical portion of the Ground Water Information System (GWIS) with unlimited number (except for practical reasons!) of constituents and parameters. You may include any contaminant, trace metal, rare elements, and the like.
- Display on the screen the following diagrams: STIFF, PIPER, WILCOX, and SCHOELLER. Customize the displays, colors, fonts and other attributes. Translate to languages other than English if you need so.
- Add a location map to your reports.
- Input data in ppm or epm units.
- Import chemical data as ASCII files from other data base programs or spreadsheets. Prepare data for contouring, create internal files with random points to be used in the Mapping application for gridding and contouring.
- Report chemical data in tables and graphs.
- Create chemical constituent time series and print as stand-alone graphics.
- Create chemical constituent concentration - depth diagrams and present them either as stand-alone graphics or as histograms superimposed on lithologic cross sections.

**GRAIN SIZE
DISTRIBUTION
CURVES**

This is one application which might become handy if you have collected plenty of granulometric samples and have them analyzed in a lab. Coupled with another application, MISCELLANEOUS, in which you may calculate hydraulic conductivities based on empirical formulas by Hazen, Kozeny, Terzaghi, Slichter, Zamarin, and the U.S. Bureau of Reclamation, you can produce hydraulic conductivities and transmissivities for layers in boreholes.

You may produce grain size curves as a documentation report, or you may keep them in the data base.

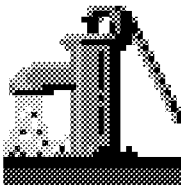
**PUMPING TEST
DATA
APPLICATION**



This is a data base and field-data processing package. The following methods and options are featured:

- Confined aquifer tests and corrections for unconfined aquifer conditions.
- Corrections for partial penetration of test well and/or observation well in a confined or unconfined non-leaky aquifer.
- Classical Theis and Hantush methods for non-leaky and leaky aquifers.
- Recovery method.
- Possibility to remove any test data from the fitting procedure.
- Possibility to use test wells which were pumped at various rates during the test.

Some of these solutions appear for the first time in the theory of pumping tests. The computer processing of the variable pumping rates is the new methodology which, to the best of the authors knowledge, has not been implemented before.



For the display of test data or the quality of fit, or for printing results, you may use one of the three methods:

- linear (time) - linear (drawdown) scale
- logarithmic (time) - linear (drawdown) scale
- logarithmic (time) - logarithmic (drawdown) scale

You may report the test results in a graph form or as a table.

**WATER LEVEL
MEASUREMENTS
APPLICATION**

You may use this application to keep in the data base all water level measurements for all observation or monitoring wells. The options included in the module are:

- Display of water levels in a selected time period.
- Selection of water levels in absolute elevations or depths to water from a measuring point.
- Display of all points connected by lines, or selection of a "connection criterion" within which the measurements would remain as scattered and not connected points.
- Interpolation of water levels or depths to water at a selected interval. This permits the creation of water level contour maps for a certain date although there may not be measurements on that day.

**STEP DRAWDOWN
PUMPING TEST
APPLICATION**

The step drawdown test is conducted to show the efficiency of a well to be used as a production or water supply well. The total drawdown is broken down into two components: aquifer loss (inevitable) and well loss (to be prevented). Two methods of fitting are built in the GWW:

- $S_w = aQ + bQ^2$ (classical Jacob theory)
- $S_w = aQ + bQ^n$ (Rorabaugh theory)

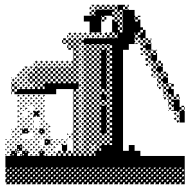
The calculation is demonstrated with a display and a table containing aquifer loss, well loss, and efficiency for each pumping step. The average efficiency for all pumping steps is written into the data base for an eventual comparison and areal analysis.

**MISCELLANEOUS
CALCULATIONS**

In this application you have the following options:

- Well functions for leaky and non-leaky aquifers. You may calculate drawdowns as a function of distance from a pumped well, time of pumping, hydrogeological characteristics of the aquifer, namely transmissivity and storage coefficients, characteristics of the semiconfining layer if the aquifer is a leaky one, and the pumping rate.
- Empirical formulas by various authors for calculating the hydraulic conductivity on the basis of effective grain sizes (Hazen, U.S.B.R., Kozeny, Terzaghy, Slichter) or the total curve (Zamarin).
- Design of a well considering its diameter, screen characteristics, length of screen, entrance velocity to screen, and the pumping rate. With all but one of these parameters known, the program calculates the remaining unknown parameter. The program also suggests a casing diameter for a corresponding pumping rate if a vertical turbine pump is to be used.

ABSTRACTION APPLICATION



You may store data on pumping (abstraction) using a "water meter" concept. One well may be defined with more than one water use ("water meter"). The program sums up cumulative abstractions for a water use, a group of wells, an aquifer, or any user-defined unit, over a user-specified time interval.

Reporting is for one individual well or for a group of wells, either as cumulative abstraction or average monthly pumping rates.

USER APPLICATIONS

You may decide to keep in the data base some information which has not been foreseen by GWW. A good example is inventory of production wells in an irrigation area, or data on rainfall and evaporation. Theoretically you may store just about anything. You assign a name to your "additional" application, prepare entry and reporting forms as for any other application and use most of options available for other applications.

**GENERAL
CAPABILITIES**

The GWW software is independent of printers, plotters, mice devices, digitizing tablets, video display standards, fonts, etc. All this is taken care of by WINDOWS.

The GWW is also language independent. Well, almost! The program and its messages will remain in English, but you may create every reporting form without a single English word.

You may create displays and printouts with 16 million colors, if you need to and have a printer capable of printing them.

You may use any WINDOWS-supported font that you may get hold of, such as TrueType, Adobe fonts, CorelDraw fonts, etc.

You may reduce a large data base to a smaller working set. This is accomplished with a very versatile Selection Condition which permits you to use any piece of information in your data base as a filtering criterion.

You may create even smaller Working Groups to display wells belonging to them on chemical diagrams and lithologic cross sections.

Maps, cross sections, pumping tests, step-drawdown tests, and grain size distribution curves remain in the data base as an integral part of the information system. You do not need to recalculate or reconstruct them if you do not wish to.

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