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Introduction to Visual HELP for Windows 95/98/NT

The HELP Model

HELP (**H**ydrologic **E**valuation of **L**andfill **P**erformance), is a versatile model used to test the effectiveness of landfill designs and also to predict landfill hydrologic processes and groundwater recharge rates. Now, HELP has become a requirement for obtaining landfill operation permits in the U.S.A. and is becoming the standard for landfill optimization around the world.

HELP is a quasi-two-dimensional hydrologic model and uses the following input data to create the landfill profile:

- Weather (precipitation, solar radiation, temperature, evapotranspiration parameters)
- Soil (porosity, field capacity, wilting point, and hydraulic conductivity)
- Engineering design data (liners, leachate and runoff collection systems, surface slope)

The landfill profile structure can be multi-layered, consisting of a combination of natural (soil) and artificial materials (waste, geomembranes) with an option to install horizontal drainage. HELP also accounts for the change in slope for different parts of the landfill profile.

HELP uses numerical solution techniques that account for the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembranes, or composite liners.

Built-in Database tools include:

- Weather Generator, a tool for synthetic generation for up to 100 years of daily values of precipitation, air temperature and solar radiation.
- Soil, waste and geomembrane database which contains parameters for 42 materials.

History

WHI has developed a Windows 95/98/NT interface for version 3.07 of the HELP model which was released in May 1998 under the name Visual HELP version 1.101. Visual HELP can be used as a pre- and post-processor for the HELP model, allowing you to perform all of the functions of the DOS version 3.08 of HELP. Visual HELP was presented at the trade show at SWANA's WASTECON 1998 and ISWA World Congress 1998 in Charlotte, North Carolina. Currently, more than 300 copies of this product are being used by consulting companies, government regulators and Universities in U.S.A., Canada, U.K., Germany, Australia, Sweden, and Hungary.

After running through this demonstration tutorial, we trust you will agree that Visual HELP is now the most complete and easy-to-use modeling tool for designing & optimizing landfills.

Visual HELP is also now available as part of the **WHI UnSat Suite Plus**. This ultimate suite of 1-D unsaturated flow models is comprised of Visual HELP, VS2DT, VLEACH, and PESTAN. Now you can design landfills, predict leachate & contaminat migration, and show degradation of pesticides in one package! For details about the **WHI UnSat Suite Plus,** please call (519) 746-1798 or visit our web page at www.flowpath.com.

New Features of Visual HELP version 2.1

Profile Viewing and Editing:

- A layer can now be split into two separate layers
- Layers are systematically numbered, and labelled in the Project Tree, which simplifies interpreation of the results

Weather Generating:

- New databases and GIS searching tools have been developed for the major regions of the world (more than 3000 weather stations)
- Data in NOAA format can now be imported automatically
- Diagnostics are provided to detect missing records in NOAA files

Output Presentation:

- Output units can be changed now without restarting the project
- Water Balance Tables have been added
- New tree-like interface structure allows the user to easily select results
- Report Generator (a new feature of Visual HELP) allows you to display, print and export to Microsoft Word project input settings and output graphs and tables.

System Requirements

To run Visual HELP, you will need the following minimum system configuration:

•Windows 95/98, or Windows NT 3.5.1 or later;

•IBM PC or compatible,

•Pentium 100 processor;

•CD-ROM drive for software installation;

•32 Mb of RAM;

•60 Mb of free hard disk space; and

• Minimum display resolution of 1024 x 768

The following fonts should be installed on your computer: MS Sans Serif, Arial, and Courier New.

Installing Visual HELP

The Visual HELP 2.1 demo must be installed on your computers hard disk. Please ensure that your system meets the minimum requirements before proceeding with the installation. To install, simply navigate to the Visual HELP page found on the Demo CD ROM and select the appropriate button.

Visual HELP Demonstration Exercise

We have included example data with the installation to help you familiarize yourself with the Visual HELP 2.1 interface. The examples are found as the default projects in Visual HELP. Since this is a demonstration installation, you are restricted to only running the default projects, however are free to browse the entire Visual HELP interface.

How to Contact Waterloo Hydrogeologic Inc.

If after reviewing the Visual HELP demo, you would like to contact Waterloo Hydrogeologic Inc.(WHI), please use the address below:

Waterloo Hydrogeologic, Inc.
180 Columbia Street West, Unit 1104
Waterloo, Ontario, CANADA
N2L 3L3
Phone: (519) 746-1798
Fax: (519) 885-5262

To purchase the product: contact the WHI Sales Department at sales@flowpath.com or visit our web page order form at: http://www.flowpath.com/order_form.html.

Please forward addtional comments or suggestions to the Visual HELP development team at:

Mikhail Gogolev, Product Manager mgogolev@flowpath.com

Dmitri Eidenzon, Chief Programmer deidenzon@flowpath.com

Demonstration Exercise

Learning Objectives

In this demonstration exercise, you will:

- Use Visual HELP as a tool for landfill design and hydrologic simulation;
- Use the Weather Generator to predict meteorological data for a twenty year period and use the predicted data as input to Visual HELP;
- Run the Visual HELP simulation, view the water balance of the landfill, assess the performance of the drainage and leachate collection system, and
- Prepare a report.

The instructions for this demo exercise are provided in a step-by-step format that will allow you to choose the features that you are interested in, and examine them without having to complete the entire exercise.

The default landfill profile used in this exercise was designed in accordance with the EPA's recommendations. This design is also used in the official HELP 3.0 User's Manual. The layer properties for the default landfill profile were taken from the HELP database. The simulated landfill is located near Toronto, Ontario, Canada. The area of the landfill is 1 acre.

Terms and Notation

The following terms and notations will be used throughout this tutorial exercise:

type- Type in the given word or value

select- Click the left mouse button where indicated

a - Press the **<Tab>** key

↵ - Press the **<Enter>** key

☞ - Click the left mouse button where indicated

☞☞- Double-click the left mouse button where indicated

The **bold faced type** indicates menu or window items to click, or values to be entered.

[...] denotes a button to click.

...\...\... denotes a menu selection.

NOTE: All theoretical parts of the demo tutorial are italicized

Starting Visual HELP

To start Visual HELP, you must have it installed on your hard disk. Once installed, click Windows **Start** button, choose **Programs**, navigate to the folder that contains Visual HELP, and click **Visual HELP**.

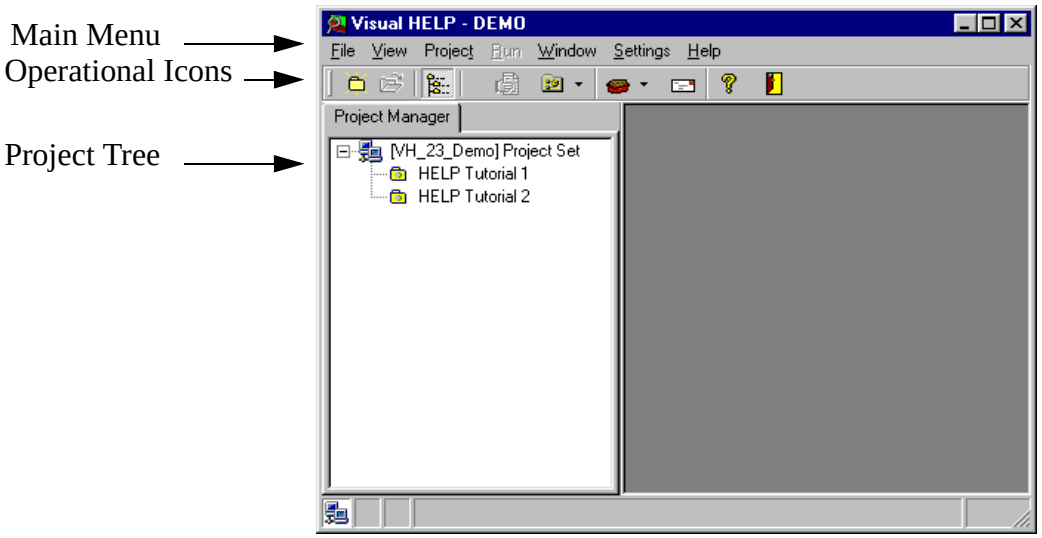


The installation program will also place an icon on your desktop, which you can also click to start the Visual HELP demo exercise.

An introductory screen will be displayed when you open Visual HELP



After the program is loaded, the main Visual HELP window will appear on your display:



The Visual HELP interface structure has been designed to help you navigate through the program with ease. The main menu is located at the top, similar to our other programs. The operational icons are located directly below the main menu items to allow quick access to additional options. The Project Tree View is located in the left part of the screen and shows the various ongoing projects, and their specific structure.

The default projects **HELP Tutorial 1**, and **HELP Tutorial 2** are snapshots of a HELP Tutorial project taken at different stages of model development. Since the demo version does not allow you to save or edit new projects, these default projects have already been prepared for you to use. In the full working version of Visual HELP, all results of the editing process are saved within the same project.

Module I: Creating a New Project

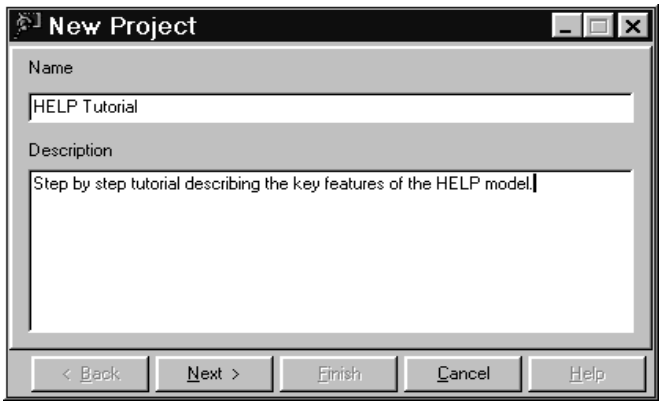
To create a new project, go the the **File Menu**,

☞ **New Project**, the **New Project** dialog box will open.

The **New Project** wizard will guide you through the steps required to setup a new Visual HELP project.

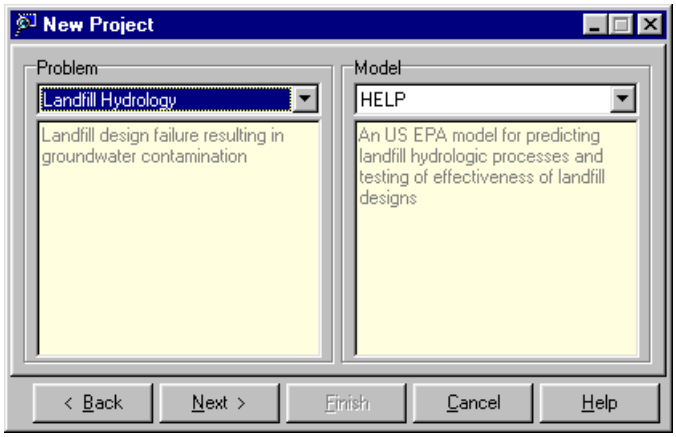
In the **Name** box type: **HELP Tutorial**.

In the Description box type: **Visual HELP step-by-step tutorial.**



☞ **[Next],** to continue with your project setup. A **Problem/Model** dialog window will appear. This allows you to select which type of problem you are working on.

☞ **[Problem]** dropdown menu, select **Landfill Hydrology** from the drop down list. The problem list displays all the problem classes available with the WHI UnSat Suite Plus. Also notice that Visual HELP automatically recognizes the appropriate Problem class that should be used with the select Problem type.

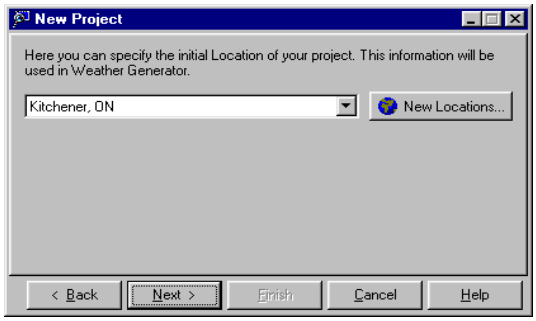


☞ **[Next]**

Once completed, the site location must be defined.

Selecting the Location

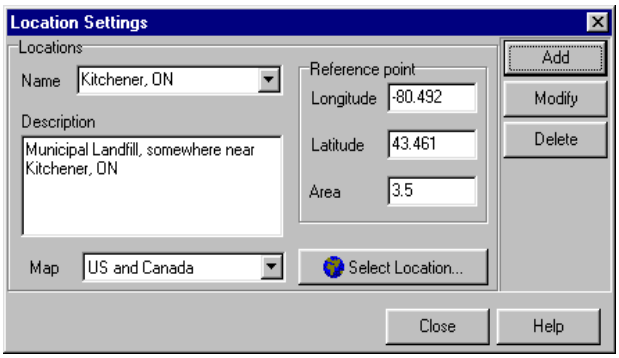
We will now select the location of our project using the GIS - WHI Locator. The following dialog box should already appear on your screen.



At this stage, the location list will only contain Kitchener, ON and Buffalo, NY by default. To add a new location,

☞ **[New Locations...]**

The following **Location Settings** dialog box will appear.



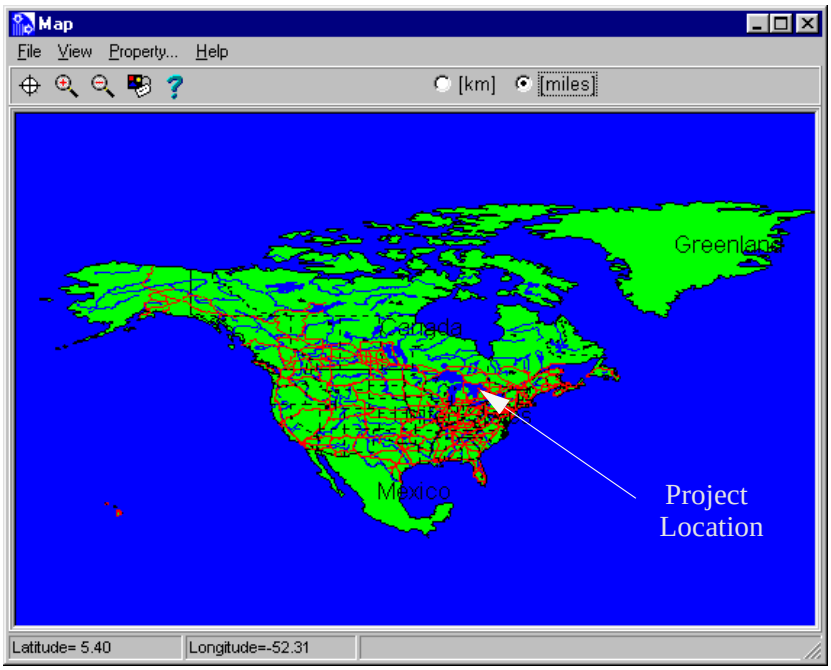
From the **Map** drop-down list,

☞ **North America,** to enable the WHI Locator, developed by WHI. The additoinal maps found in the list refer to various global regions that will help you with build projects from around the world!



☞ **[Select Location...],** to define our specific project location using the WHI Locator map.

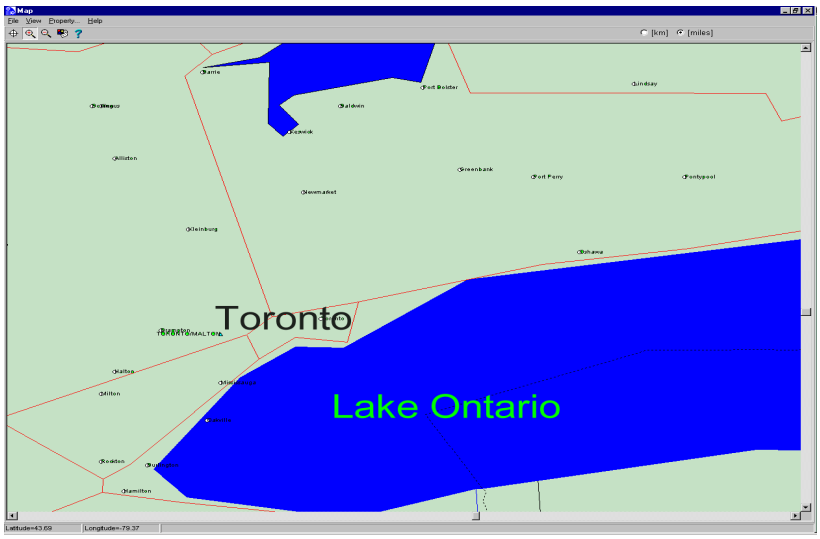
As shown below, a map of USA, Canada, and Mexico appears on your display:.



Now lets select Toronto, Ontario, Canada as our site location.

☞  , to zoom into our location.

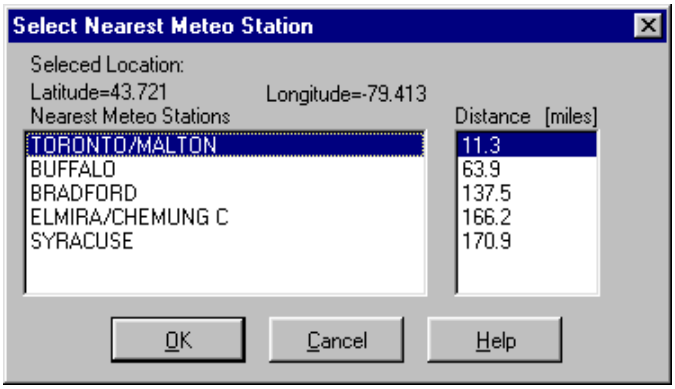
Move the mouse to the right of the region where the landfill project is located (in center of the Great Lakes region). The coordinates, seen in the bottom left of the screen, should read approximatelly Latitude:46.8, Longitude:-84.7. Press the left mouse button and stretch a zoom rectangle to the right of the Lake Ontario, release the button (approximate Latitude:43.3, Longitude:-76.2). After one or two zooms, figure below should resemble your screen.



Now select Toronto to set the longitude and latitude of the project location.

☞  , to activate the crosshairs.

Move the crosshair to the spot on the map where Toronto is located and click on it with the left mouse button. The dialog box showing the five nearest weather stations, including distance will appear.



Note: If you wish to calculate the distance in kilometers, simply click the appropriate option button at the top of the map.

In the "Select Nearest Meteo Station" dialog box,

☞ **[TORONTO/MALTON],** as the nearest weather station.

☞ **[OK]**

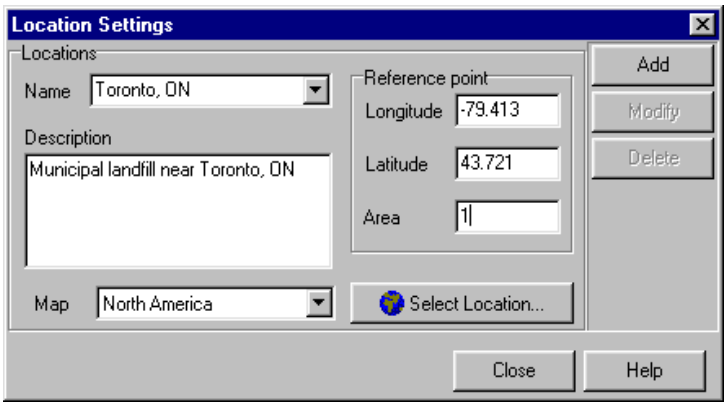
The **Location Settings** dialog box will show the selected weather stations and coordinates of the location you have selected.

Type: Toronto, ON., in the **Name** box.

Type: Municipal landfill near Toronto, ON., in the **Description** text box.

Type: 1 , in the landfill area text box: **1**.

Finally, the **Location Settings** dialog box should appear as follows.



☞ **[Add],** to add the new location to the database for future use.

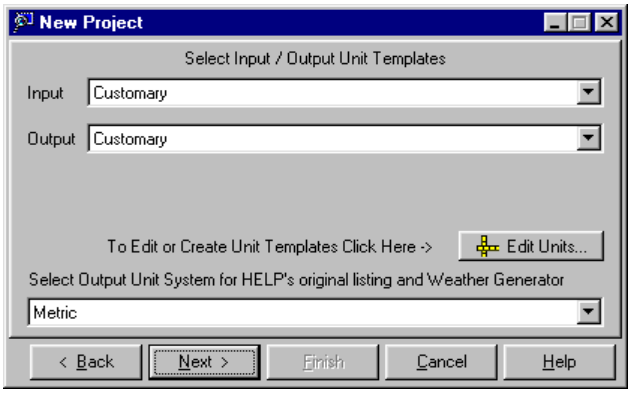
☞ **[Close]**

In the **New Project** dropdown list, select **Toronto, ON**.

☞ **[Next]**

Selecting Units

The next step is to define the units. This is completed in the "Select Input/Output Unit Templates" dialog box which allows you to define the units for both input and output. In addition, you may select the units used for the Weather Generator data and original DOS HELP output.



The Visual HELP Unit Converter was developed to maximize the flexibility for data input and output unit conversion. To show you the range of possibilities, just view the list of available units for hydraulic conductivity, by opening the **[Edit Units]** option.



For this demo excercise we will specify that all input units will be in **Metric**, and output will be in **Customary** units.

From the **Input** drop-down list,

☞ **Metric**

From the **Output** drop-down list

☞ **Customary (in)**.

From the **Select Output Unit System for original listing and Weather Generator** list box,

☞ **Metric**

☞ **[Next]**

Assigning Authors and Clients

Visual HELP allows you to create and maintain your own database of project Authors and Clients for use in future projects. For this exercise we will use the default settings.

☞ **[Next]**

All the project information will be presented, as seen in the figure below.



☞ **[Finish]** to save the information as a project in the database and add it to the project tree.

After the project settings were specified, the **New Profile Wizard** will open.

Profiles and Multiple Profiles in Visual HELP. *For the purpose of hydrological simulation, a profile represents a part of a landfill that is assumed to have the same cross-section throughout. The profile contains all of the layers of the landfill that it represents. It may also contain details of engineering components, such as subsurface drainage, leachate recirculation systems, geomembranes, geonets, and composite liners. The surface of the profile can be sloped, which is typical for the peripheral parts of the landfill, or flat, which is typical for the central part of the landfill. The slope of the landfill usually mimics the shape of the waste body. At the time of landfill closure, the waste layer at the periphery of the landfill is usually sloped and the entire landfill site is capped by several layers, which form the landfill cap. Although drainage pipes are not usually installed in the landfill cap, permeable sand layers in the cap can transport water to the bottom drain or sump that surrounds the landfill. This process can be simulated with Visual HELP 2.1.*

A typical landfill can be represented as a set of profiles. This is done by creating several profiles in one project. This is useful because it allows you to use one profile to simulate the middle of the landfill, and several other profiles to simulate the edges, where the cross-section is tapering.

Selecting an Existing Profile

The **New Profile Wizard**, which appears after you finish creating a project, is shown below:

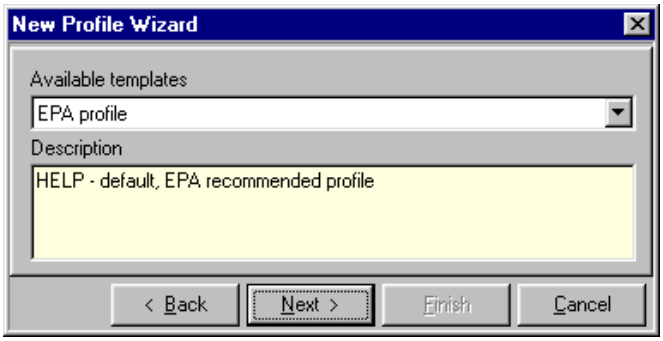


In this dialog box you may select an already existing profile template or you can build a profile 'from scratch'. In this demonstration exercise we will use the default profile template.

☞ **[use existing profile template]**

☞ **[Next]**

The **Available templates** list will appear:



☞ **EPA Profile**

☞ **[Next]**

All the profile information will be presented:.



☞ **[Finish]** to load the profile.

The new project details will be added to the project tree. This concludes creating a new project using Visual HELP. We will now continue with designing the landfill profile.

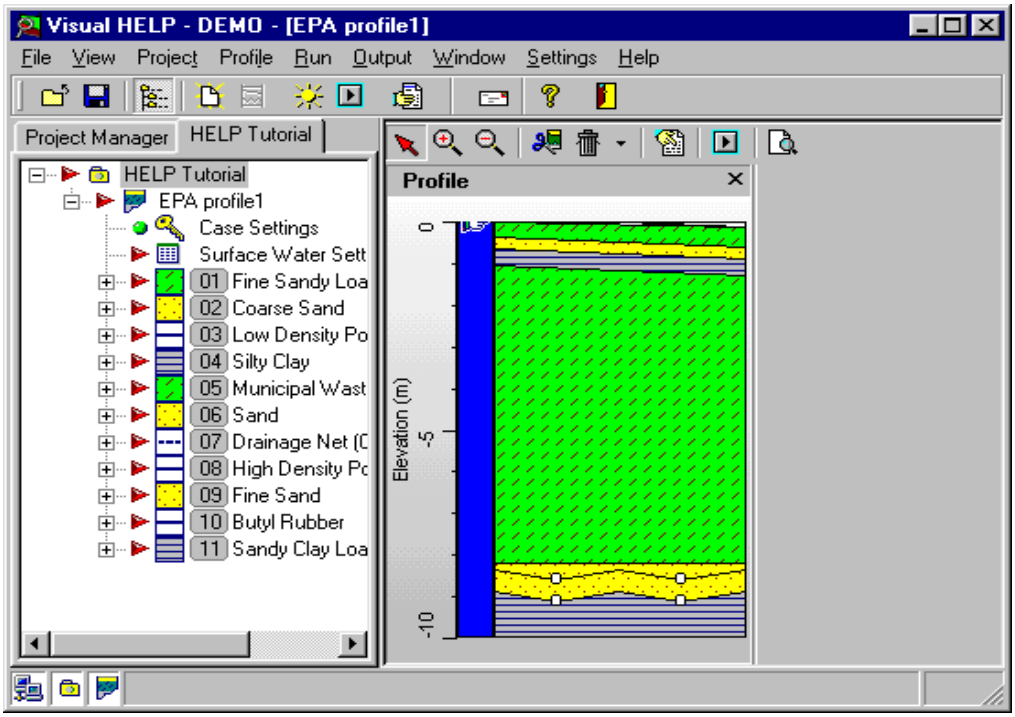
Module II: Designing a Landfill Profile

If you have skipped the steps in Module I and wish to start the Visual HELP demo exercise from this point,

☞☞ **HELP Tutorial 1,** from the Project Tree.

If you have run through Module I, you may continue with the project **HELP Tutorial.**

In both cases, the following picture will appear on your display.



Viewing the Default Profile

In the Profile View, located in the center part of the Visual HELP window, you will see the loaded default landfill profile with a depth scale.

A description of each landfill layer will appear when the mouse cursor is pointed at the layer.

As you can see, this profile consists of:

- a sloped landfill cap in the depth interval 0.0 - 1.2 m, consisting of fine sandy loam, coarse sand and silty clay
- a 7 m thick waste layer in the depth interval 1.2 - 8.2 m; and
- a double liner leachate collection and removal system in the depth interval 8.2-9.6 m.

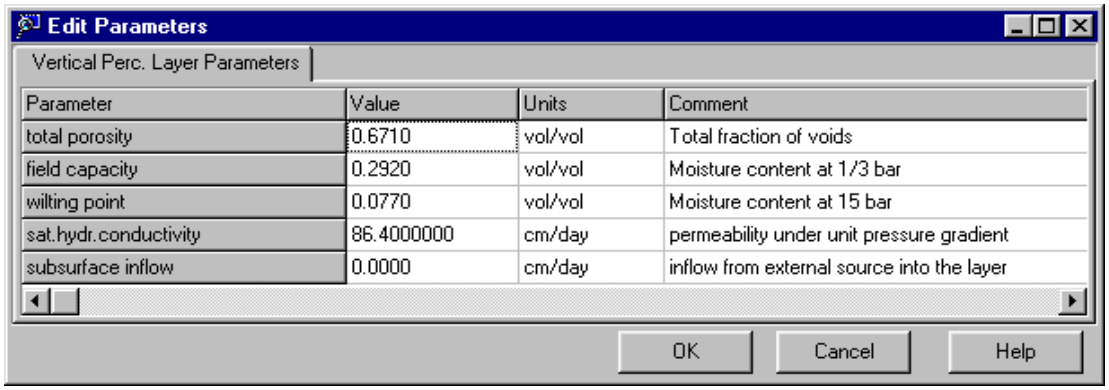
The profile construction can also be seen in the Project Tree View in the left part of the screen.

The Project Tree View is also used to view and modify the parameters of specific layers.

☞ **'+'** sign in the box to the left of the **Municipal Waste (312 kg/cub.m)** icon.

☞☞ **Vertical Percolation Layer Parameters**. The **Edit Parameters** dialog box will appear.

The **Edit Parameters** menu allows you to modify the values of specific parameters.



☞ **[Cancel],** in the **Edit Parameter** dialog box to exit.

☞ **'-'** sign in the box to the left of the **Municipal Waste (312 kg/cub.m)** icon.

As you can see, the Project Tree View can be used to easily access specific Profiles, Profile Layers, and Layer Parameters.

Now that you have become familiar with some viewing functions of Visual HELP, you will now learn how to edit the profile. In this part of the exercise we will:

- learn how to edit the layer structure of the landfill profile
- learn how to edit parameters of individual layers
- learn how to set initial moisture conditions and runoff parameters of the profile

Editing the Layer Structure of the Landfill Profile

To assist you in designing a landfill, Visual HELP offers many convenient tools for resizing, splitting, inserting and deleting layers. Visual HELP is a graphical user interface for the US EPA HELP model and, as such, obeys all conventions of the original HELP model.

The layers in the landfill are classified by the hydraulic function that they perform. Four categories of layers are available in original HELP:

•vertical percolation layers,

•lateral drainage layers,

•barrier soil liners, and

•geomembrane liners.

The topsoil and waste layers are generally vertical percolation layers. Sand layers above liners are typically lateral drainage layers; compacted clay layers are typically barrier soil liners. Geomembranes are typed as geomembrane liners. Composite liners are modeled as two layers. In the original HELP, geotextiles are not considered as layers unless they perform a unique hydraulic function.

In Visual HELP, taking into account that this class of landfill materials is growing extensively, geotextiles and geonets were defined as a separate category.

Although HELP allows a wide range of layer combinations, there are some basic rules and restrictions for the arrangement of layers in a profile that should be followed. These rules are obeyed by Visual HELP and you will get a warning if you try to delete or insert a layer incorrectly.

Resizing Layers

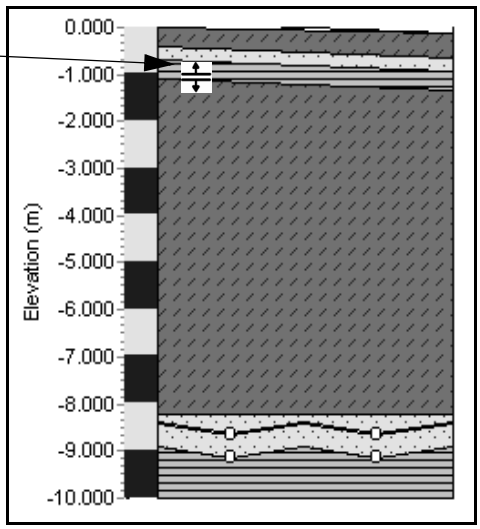
In Visual HELP, the layers are either resizable or non-resizable.

Resizable Layers *Layers built from soil and waste, grouped in the Vertical Percolation, Lateral Drainage, Barrier Soil design categories, are resizable.*

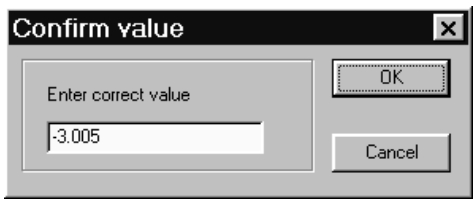
Non-Resizable Layers *Layers built from industrially produced materials with fixed thickness, grouped in the Geomembrane Liner and Geotextile and Geonet categories, are non-resizable.*

To test the resizing feature, move the mouse arrow on the **Municipal Waste (312 kg/cub.m)** layer in the profile view and move the arrow upwards to the top of the layer. As soon as the cursor encounters the layer's boundary, the cursor symbol changes:

New Cursor Symbol



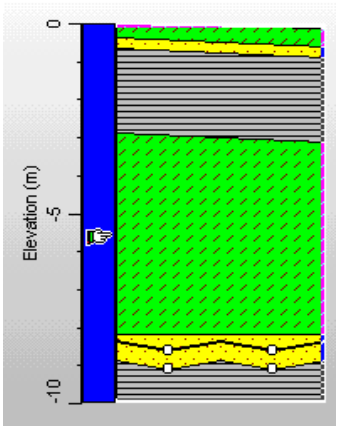
Press the left mouse button and, holding the mouse button, move the cursor downwards to approximately **-3.000** and release the mouse button. A **Confirm Value** dialog box will appear.



Type: -3.000 in the **Enter correct value** box.

☞ **[OK]**

The profile will change according to the new setting specified.



Note: ***Moving the layer's boundary resizes both layers which are separated by this boundary, however it does not change the total thickness of the profile. You can also change the thickness of an individual layer. This feature will be described later in this tutorial.***

Now resize the municipal waste layer back to its original size.

Place the mouse arrow on the **municipal waste** layer in the profile view, and move the arrow up until the cursor symbol changes.

Click and drag the boundary to approximately -1.200.

Type: -1.2, in the **Enter correct value** text box.

☞ **[OK]**

Deleting a Layer

We will now examine how to delete a layer.

☞ **Silty Clay**, in the Project Tree View.



.

Click the right mouse button. A shortcut menu will appear

☞ **Delete**

The layer **Silty Clay** will disappear from the Profile View. Notice an 'X' beside the silt clay layer to represent a deleted layer.

Restoring a Layer

Now let us restore the **Silty Clay layer**.

<Right click> the layer's name in the Project Tree View.

Click **Restore,** the original layer returns.

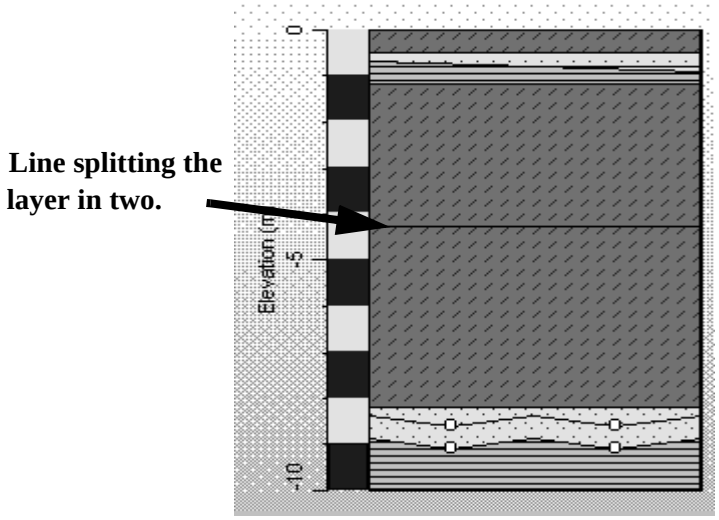
Splitting a Layer

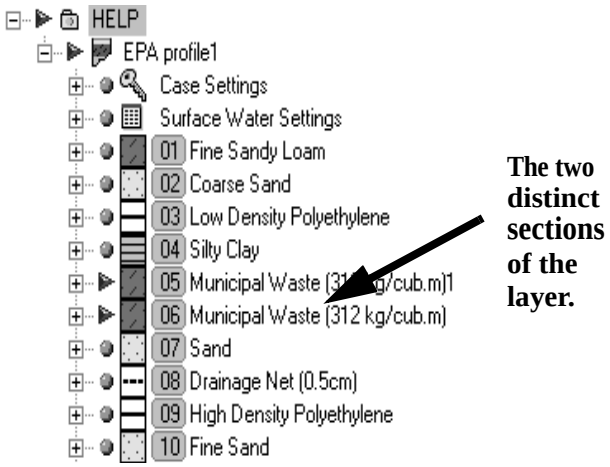
You can split a layer up into multiple sections and substitute materials for each section or assign different values of parameters for each section.

<right click> on the **Municipal Waste (312 kg/cub.m)** layer in the profile view.

☞ **Layer/Split**

A line will appear through the layer at cursor position and a new layer will appear in the project tree. Now the layer can be edited as two separate layers with unique properties in the Profile View and the Project Tree View.



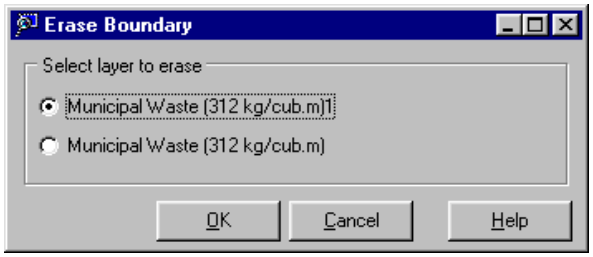


You may also substitute a material in the new layer or insert another layer between two separate parts of the layer. To return to the original profile construction, simply merge the two layers.

Place a cursor at the boundary between two parts of a layer and **<right click>**,

☞ **Merge Layers**.

In the **Erase Boundary** dialog box select the layer to erase: **Municipal Waste (312 kg/cub.m)1**



☞ **[OK]**.

Inserting a Layer

<right click> on **Sand**, in the Project Tree View

The following shortcut menu will appear



:

☞ **[Insert Layer]**

An empty **Profile Material Properties** dialogue box will appear. You can now specify the new material to insert.

Note: The new layer will always be inserted above the current layer.

Note: To insert the new layer inside the existing layer, split the layer first with the split function.

Material Category Click a category from the **Material Category** list. The list will be limited to those categories that are specified by the HELP Model only.

☞ **[HELP] Barrier Soil Liner.**

Material Click the appropriate material from the **Material** list. Each layer category is associated with several textures that can be used in the design of the layer. The texture number in Visual HELP corresponds directly to the texture number in the original DOS HELP.

☞ **[Clay Loam**]

Once the material is selected, the top and bottom settings are activated.

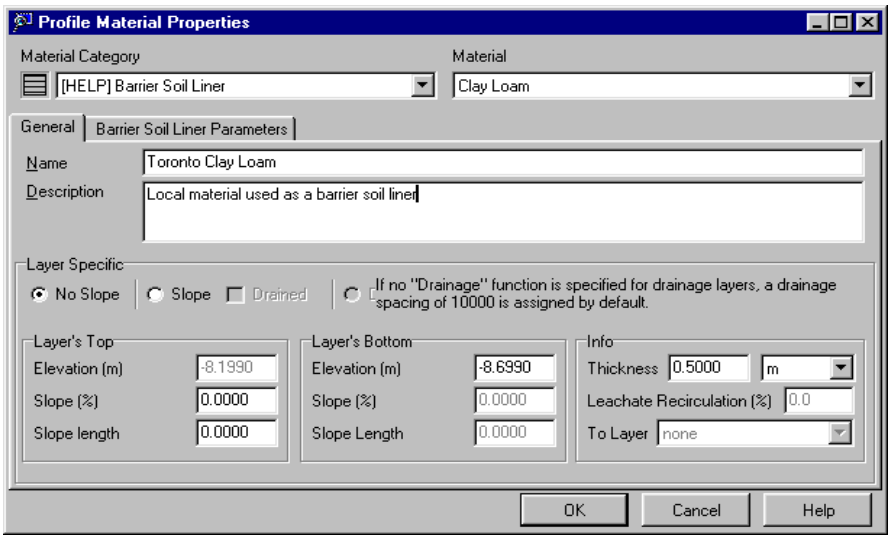
Name **Type: Toronto Clay Loam,** as the unique name for the material.

Description **Type: Local material used as a barrier soil liner**, in the comments field.

No Slope ☞ **No Slope**

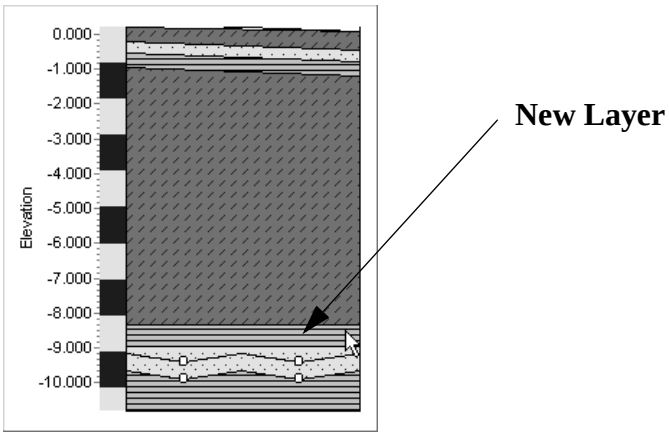
Type: 0.5 in the **Thickness** box.

Once completed, your **Profile Material Properties** dialogue box will appear as the figure below:



☞ **[OK]**

The new layer is now defined::



☞  icon, to save changes.

☞ **[OK],** to confirm the changes

The **Toronto Clay Loam** has now become part of the profile and you can modify it like the rest of profile layers.

To return to the original profile construction, which will be used for the rest of this tutorial, delete the recently inserted layer.

<right click> on **Toronto Clay Loam,** in the Project Tree View.

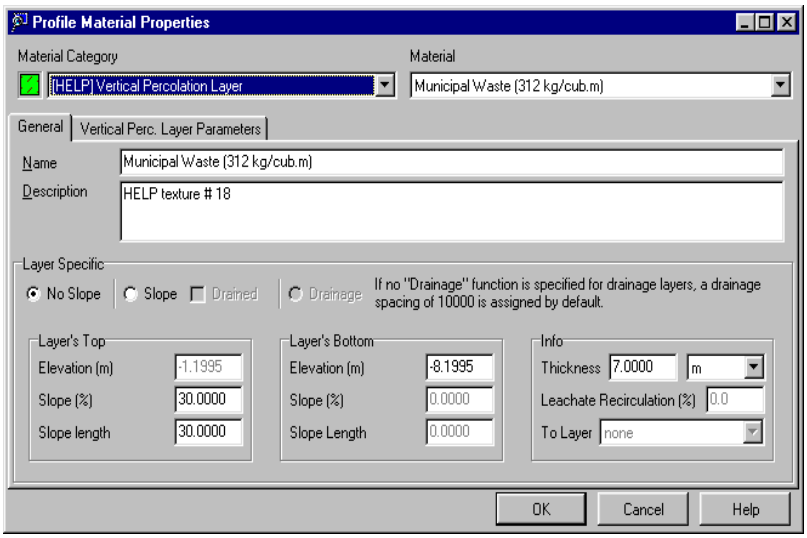
☞ **[Delete]**.

Editing Layer Parameters

The Visual HELP parameters of a landfill material depend on the material category.

☞ ☞ **Municipal Waste (312 kg/cub.m),** in the Project Tree.

The **Profile Material Properties** dialogue box will appear.



In this dialogue box, you can view and edit information about the layer including;

category, material texture, slope, top or bottom elevation, and thickness.

☞ **Vertical Perc. layer Parameters** tab to edit the material properties of particular layer.

☞ **Value** beside **total porosity**

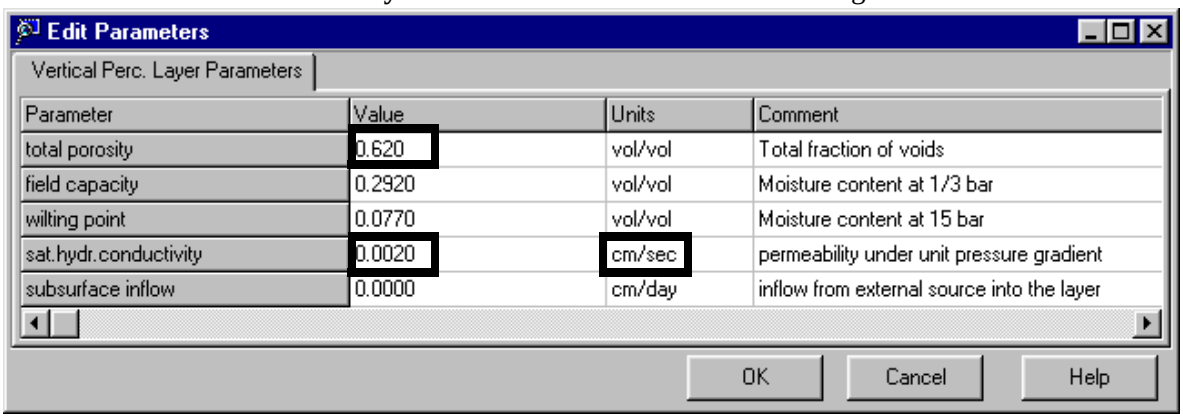
Type: 0.62

☞ **Units** beside the **sat. hydr. conductivity**, a drop-down list with available units will appear.

☞ **cm/sec**

Type: 0.002, in the **Value** field.

The new **Vertical Perc. layer Parameters** tab will look like the figure below:



☞ **[OK]**

☞ **[-] ,**beside **Municipal Waste (312 kg/cub.m)** in the Project Tree.

Now lets edit the properties of the Lateral Drainage Layer. Layers from this category have the same hydraulic parameters as Vertical Percolation Layers. In addition, the drainage and leachate recirculation parameters may be specified.

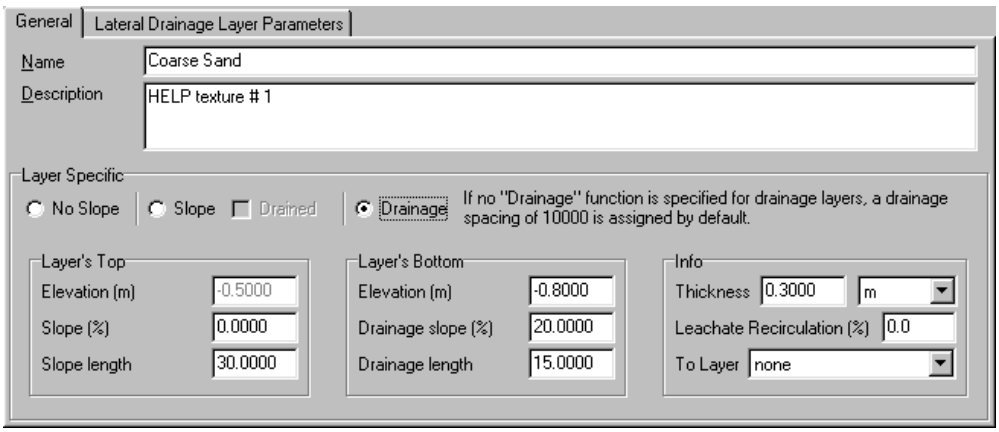
☞☞ **Coarse Sand** in the Project Tree. By default, the **Slope** function is selected for this layer.

Select **Drainage** by clicking the appropriate radial button. The name of parameter **Slope** in the **Layer's Bottom** box will change to **Drainage Slope** and the name of parameter **Slope Length** will change to **Drainage Slope**.

Type: 20 (%) for **Drainage Slope**

Type: 15 (m) for **Drainage Length**.

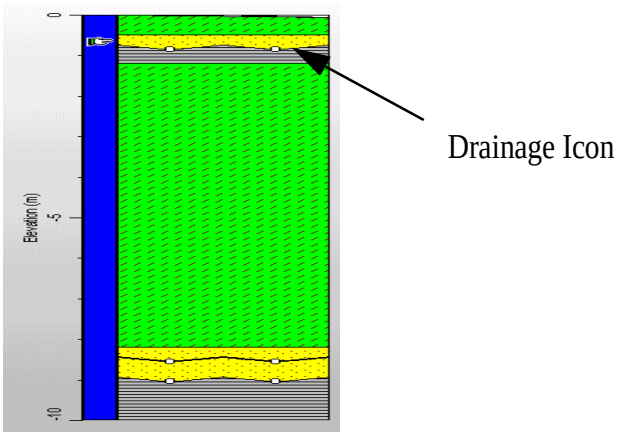
The **General** tab for **Coarse Sand** should be similar to the figure below.



☞ **[OK]**

☞ **[-],** beside **Coarse Sand** in the Project Tree.

The Profile View will change.



Finally, we will edit parameters of a Geomembrane Liner.

☞ **[+],** beside the **Low Density Polyethylene**

☞☞ **[Geomembrane Liner Parameters]**

☞ **Units,** beside the **sat. hydr. conductivity**

☞ **[cm/sec],** from the drop-down list.

Type: 7.00E-13, in the **Value** field.

☞ **[Units]**, beside the **pinhole density.**

☞ **[# / acre],** from the drop-down list.

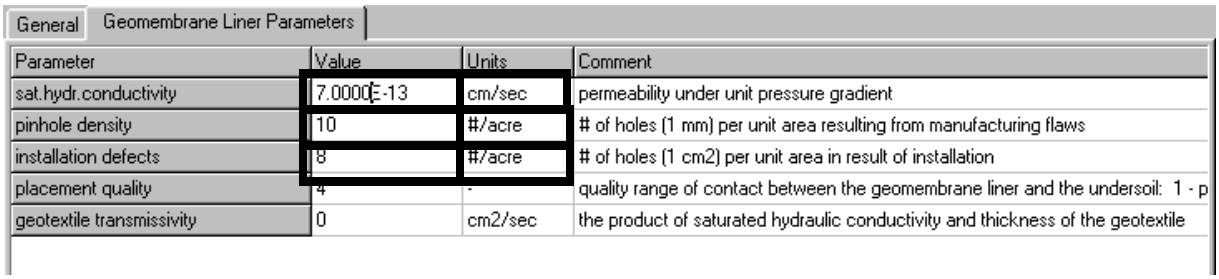
Type: 10, in the **Value** field.

☞ **Units,** beside the **installation defects.**

☞ **[# / acre],** from the drop-down list.

Type: 8, in the **Value** field.

The **Vertical Perc. layer Parameters** tab for LDPE liner will look like the figure below.



☞ **[OK]**

☞ **[-],** beside **Low Density Polyethylene** in the Project Tree.

With this action completed, we have finished editing the parameters of individual layers of our profile. However, there are more ways to do this, including the possibility of reassigning geometrical properties (slope, slope length) or drainage properties for a set of layers that perform a specific hydraulic function within a landfill (e.g. landfill cap).

Setting Initial Moisture Conditions & Runoff Parameters

Finally, we will now define our landfills moisture conditions and runoff parameters. This can be completed through the **Case Settings** parameter group located in the project tree..

As with the original HELP model, Visual HELP gives you two options for setting the initial moisture storage and surface water on top of the soil. You may use:

- *the model simulate values, or*
- *the user specify values.*

Depending on the selection made, runoff can be:

- *calculated by the model which will account for the type of material, slope, slope length and type of land cover,*
- *specified by the user,*
- *specified by the user and further adjusted to the slope and slope length.*

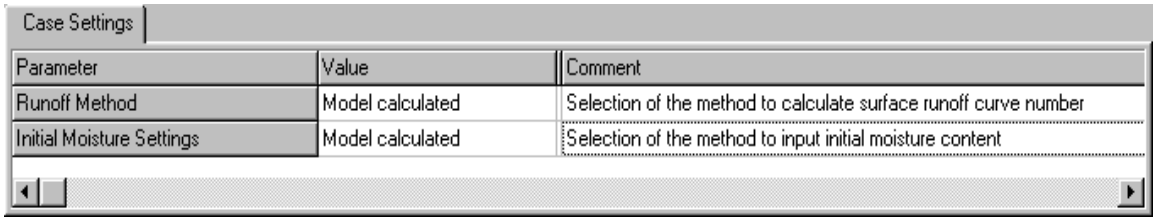
In the first case, which is the default, the model will assign realistic values for the initial moisture storage and simulate one year of landfill life. The values of moisture storage obtained from this simulation will be used as initial values.

For this specific exercise, the runoff curve number and initial moisture content will be calculated by Visual HELP. To set the automatic calculation,

☞☞ **Case Settings**, found in the Project Tree**.**

In the **Value** field beside **Runoff Method,** select **Model Calculated.** The program will automatically pick up the slope and slope length values for the top layer and use them in the runoff calculation.

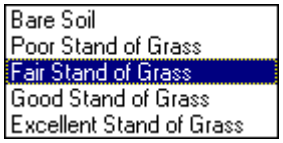
We will also leave the **Initial Moisture Settings** as **Model Calculated**



☞ **[OK]**

To specify additional parameters for surface runoff,

☞☞ **Surface Water Settings** from the Project Tree View.



To set the various vegetation classes, click in the **Value field**, found beside the **Vegetation Class.** The drop down list of available types of the land cover will appear.

☞ **Fair Stand of Grass**

☞ **[OK]**

Note: Surface Slope and Slope Length which regulate the runoff also, may be editied at the General Tab of the top profile layer.

You have now have completed creating your specific landfill profile. With a fully functional version of Visual HELP, you could save your work at this point however, as a demo, you will need to load a pre-run profile included with this demo. To continue,

☞ **File** from the main menu

☞ **Close Project**

☞ **[NO]** to close the project without saving your changes.

The next step is to generate your site specific weather using the USDA Weather Generating program that synthetically generates daily values for precipitation, temperature and solar radiation.

NOTE: Visual HELP has also an effective tool for generating aquifer recharge values that can be used in other models such as Visual MODFLOW. To calculate accurate recharge rates for your project, simply set your model profile to represent you site specific hydrogeological conditions and run!

Module III: Generating Weather Data, Running the Model, Viewing Output, and Reporting

We will now create site specific weather data that will be considered when modeling our landfill profile. As an added feature, Visual HELP also allows you to easily input historical daily data in NOAA and Canadian Climate Centre formats.

☞☞ **HELP Tutorial 2** in the Project Tree. Note that two profiles (DEMO A & B) appear. **DEMO profile A** is a continuation fo the previous changes made in Module II.

IMPORTANT: The HELP model requires three different types of meteorological data that must be provided as daily values:

- *Precipitation (rain or snow),*
- *Solar radiation, and*
- *Mean air temperature.*

In addition, HELP requires a set of parameters to simulate evapotranspiration that are constants for the duration of the simulation.

HELP will then use this data to:

- *Calculate the volume of water flowing into the landfill, and simulate surface runoff, evaporation, vegetation growth and transpiration, and infiltration during warm periods; and*
- *simulate surface storage, snowmelt, runoff and infiltration during cold periods.*

For synthetic generation of daily values of precipitation, mean temperature, and solar radiation DOS HELP and Visual HELP version 1 included a Weather Generator developed by the Agricultural Research Service of the USDA (U.S. Department of Agriculture), as well as parameters for generating synthetic data for 139 U.S. cities. After Visual HELP 1.01 was released, WHI received requests from our clients worldwide to expand the area of Weather Generator application to other regions of the world.

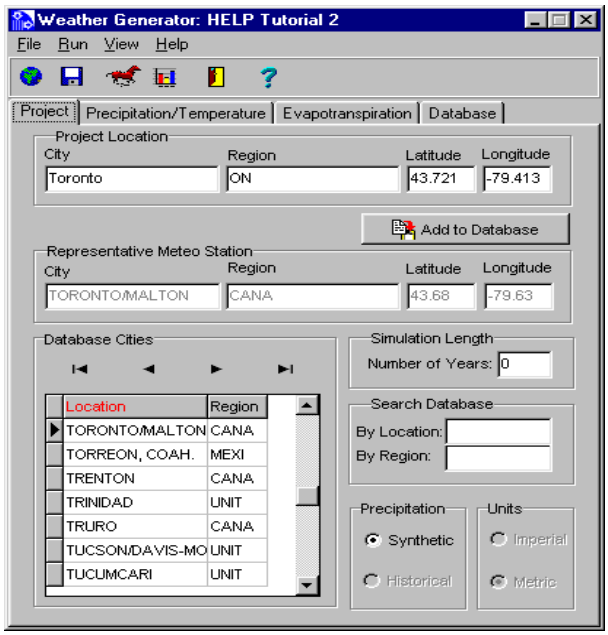
Trying to meet these requests, WHI developed a global database that includes more than 3000 stations and a GIS feature for searching the nearest stations globally for the Visual HELP version 2.1. If your landfill site is not located in our database, we recommend that you choose the closest city to your site and use the generated data for that location for your simulations. Visual HELP will search for the closest location of a given set of co-ordinates. This co-ordinate set can be entered as actual values or interactively with a map.

To import weather data not found in the database, you must modify the format of your data so that it meets the standards of Visual HELP. If you are in Canada, you can automatically import data in the format of the Canadian Climate Centre. Customers in the U.S.A. may automatically import data in the NOAA format. Visual HELP checks NOAA files for missing daily and monthly records and informs the user about the times, for which data are missing to make the correction process easy.

☞ **Run** from the main menu

☞ **Weather Generator**

After an introductory splash screen, the Weather Generator dialogue box will appear.



For this tutorial, you will be using data for the TORONTO/MALTON weather station. The TORONTO/MALTON station was selected among five stations located nearest to our landfill site.

Parameters for TORONTO/MALTON appear automatically in the text boxes throughout the **Weather Generator** dialogue boxes after it starts (if you have time, click **Precipitation/ Temperature, Evapotranspiration and Database** tabs to see the options to customize the weather parameters).

Let's generate weather data for our site for the next 20 years.

☞ **Number of Years** text box,

Type: 20, to represent the number of years you wish to build weather data for.

To run the Weather Generator,

☞  ,on the **Weather Generator** toolbar. The Weather Generator will begin computations.

☞  ,to save the generated files

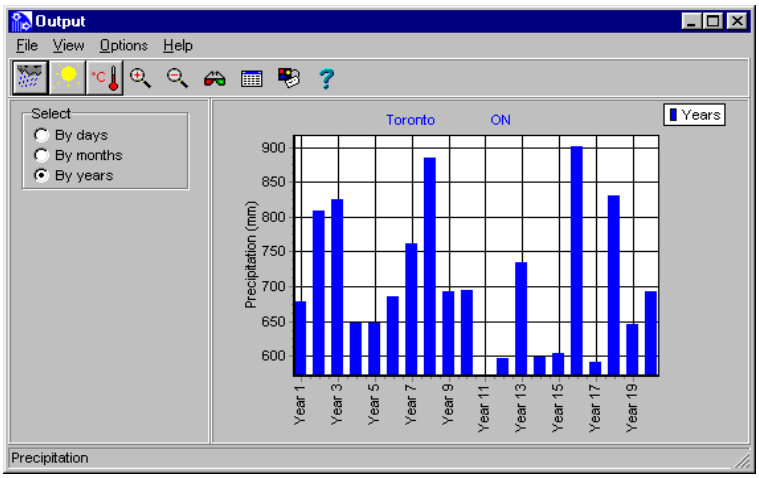
Viewing Weather Data

To view the results for the weather data you just generated,

☞  ,on the toolbar to view the **Output** dialogue box.

☞  ,on the toolbar to view generated precipitation values

By default annual totals will be presented, as shown below.

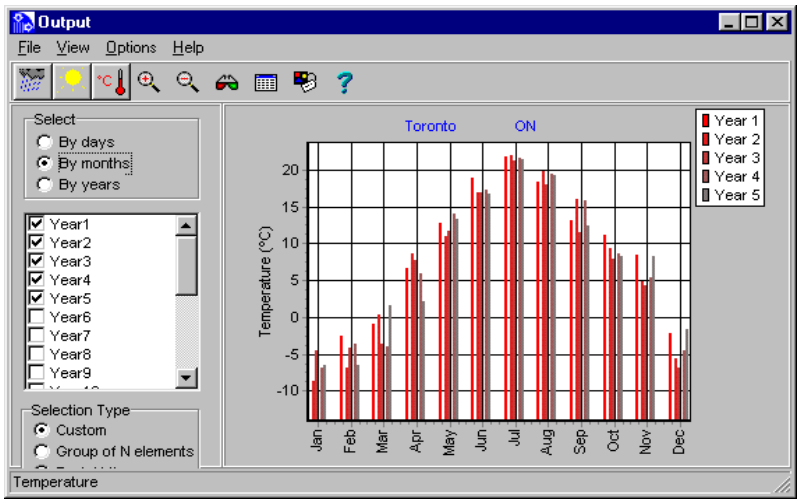


☞  ,to view the generated solar radiation data.

☞  ,to view the generated air temperature data.

☞ **By months** to view monthly outputs.

By default, monthly results for the first five years will be displayed:



☞  ,to view the generated raw data in table format.

☞  ,to close the table.

☞  ,to close the graphics.

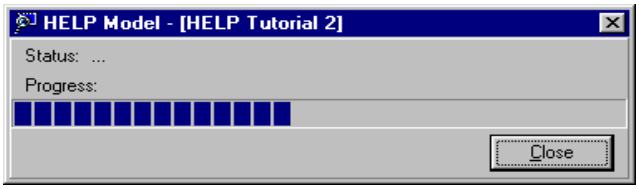
☞  ,to exit the Weather Generator.

You are now ready to run Visual HELP for 20 years using the landfill profile you created.

Running Visual HELP

☞  in the main toolbar to run the HELP simulation.

The program will collect input files and run the HELP model. A progression bar will appear showing you the status of your model run.

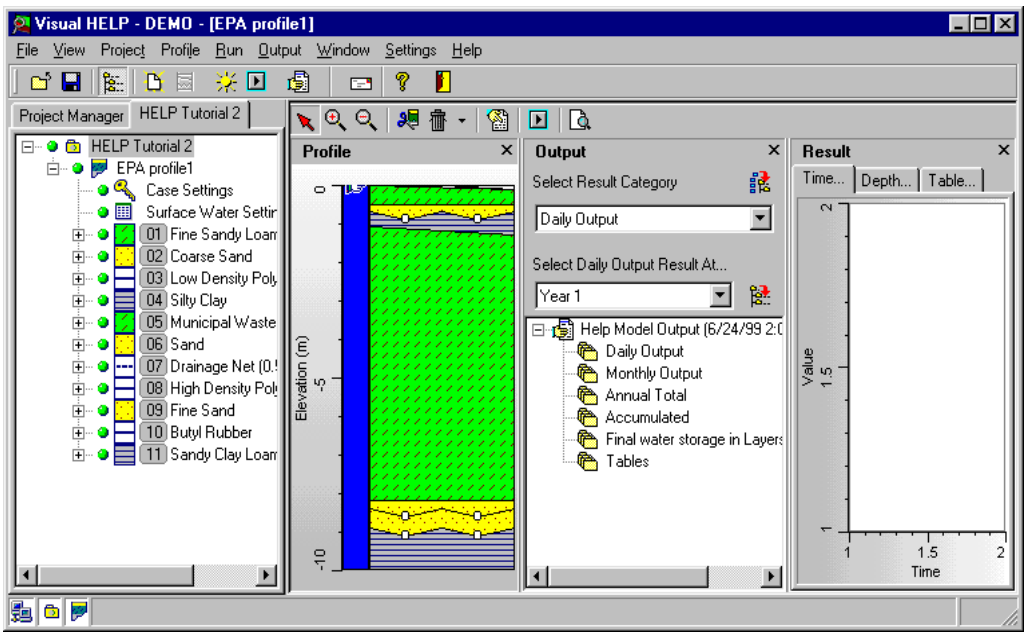


Viewing Results

Although you can easily view and print the original DOS HELP reports, we will only discuss graphical output using the Visual HELP interface.

Viewing the Output Graphs

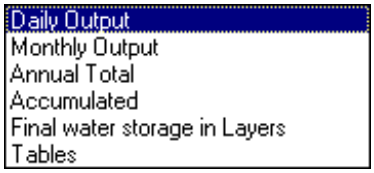
After the model has successfully run, Visual HELP will display the Output View and Result View windows.



☞  ,to enlarge the graphs viewing area

☞ **X** ,in the Profile View to close the window.

To select the output category, click the arrow in the **Select Result Category** drop-down listbox. The following list will appear:



You may select the category you wish to view however for this exercise, we recommend viewing your results with an **Accumulated** category. The option to graph **Accumulated Volumes** is a new feature, offered only in Visual HELP 2.1. This plot will show you the total volumes of water that were drained during the simulation period. This allows you to examine the total volume of leachate percolated through the landfill bottom during the simulated time and assess the total volumes of other water balance constituents.

☞ **Accumulated**

The results for the the **Accumulated** category will appear in the listbox below. To view all available results, click the arrow in the drop-down listbox.

☞ **Select Accumulated Result at...** , to view the available balance types. ie) rate, volume

Rate means the annual rate of the balance constituent, and **volume** means the volume for the area represented by the profile.

☞ **rate**

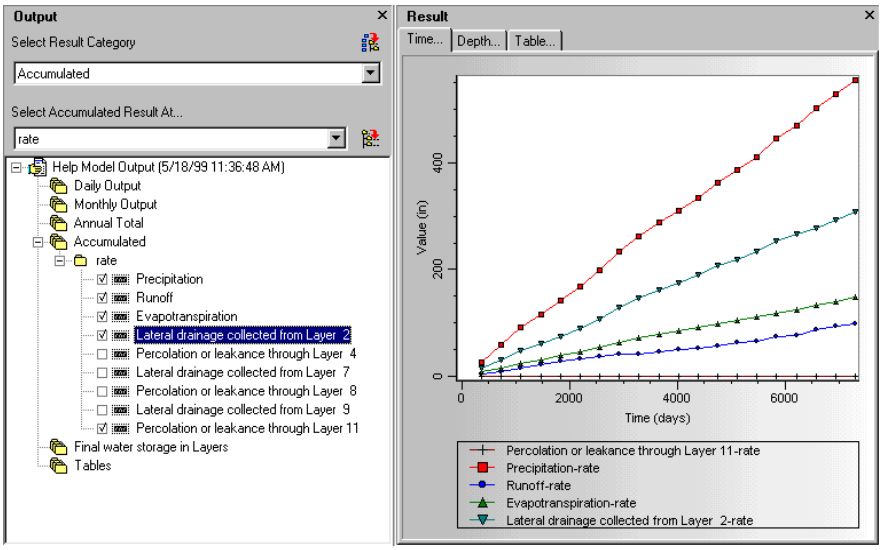


To view all the available results for this specific type of balance, click the icon to the right of the **Select Accumulated Result at...** box.

The list of available balance constituents will open in the Result Tree.

Click the check boxes beside the following variables: **Precipitation, Runoff, Evapotranspiration, Lateral Drainage collected from Layer 2** (the first drainage layer), **Percolation or leakance through Layer 11** (percolation through the bottom).

The graph of the variables will appear in the Result View window.



To erase a variable from the Result View window, deselect the corresponding check box in the Result Tree.

From the graph, one may conclude that Runoff, Evapotranspiration, and Lateral Drainage collected from Layer 2 play an important role in the landfill balance while Percolation through Layer 11 (the landfill bottom) is equal or close to 0. For specific values, the landfill balance constituents may be viewed in table format.

Viewing Tables

To view HELP tables,

☞ **Tables,** from the **Select Result Category** drop-down listbox.

☞ **Accumulated rate**, from the **Select Table Result at..** lower listbox.

☞  **Add to Output Tree** icon to the right of the lower output listbox

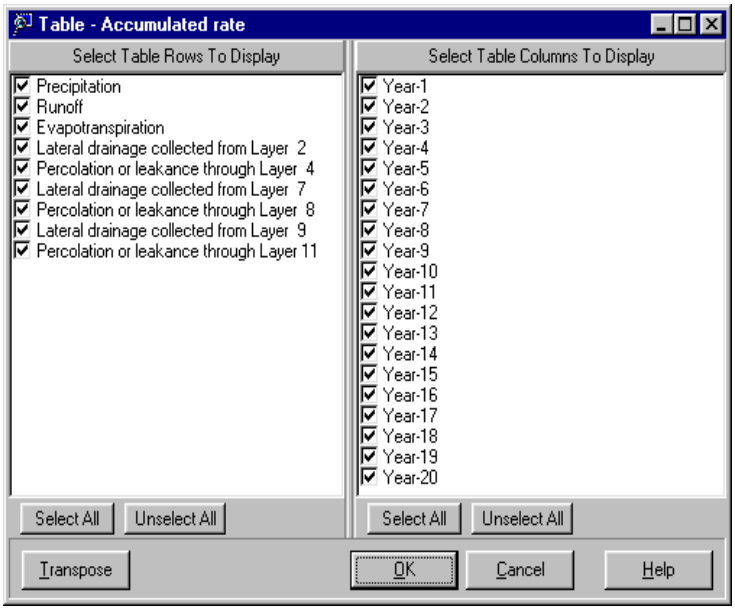
The table name **Accumulated rate** will appear in the Output Tree. For future use, let's place the table results into a new Result Window.

To do this, **<right click>** the name, **Accumulated rate** in the Output Tree. The following menu will appear:



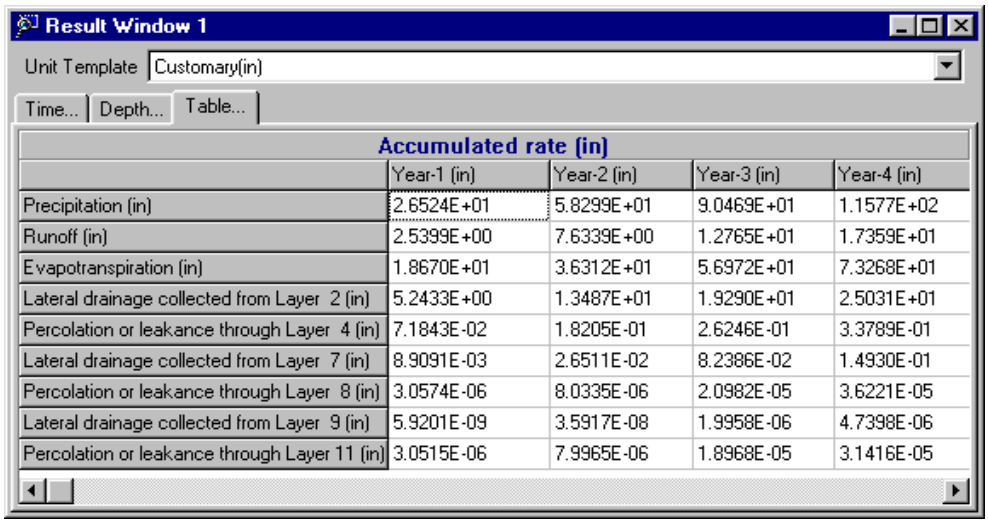
Choose **New Result Window**.

The New **Result Window 1** will open at the background and the table editing dialog box will appear.



☞ **[OK]**

The table will appear in **Result Window 1**:



Accumulated rate (in)

	Year-1 (in)	Year-2 (in)	Year-3 (in)	Year-4 (in)
Precipitation (in)	2.6524E+01	5.8299E+01	9.0469E+01	1.1577E+02
Runoff (in)	2.5399E+00	7.6339E+00	1.2765E+01	1.7359E+01
Evapotranspiration (in)	1.8670E+01	3.6312E+01	5.6972E+01	7.3268E+01
Lateral drainage collected from Layer 2 (in)	5.2433E+00	1.3487E+01	1.9290E+01	2.5031E+01
Percolation or leakance through Layer 4 (in)	7.1843E-02	1.8205E-01	2.6246E-01	3.3789E-01
Lateral drainage collected from Layer 7 (in)	8.9091E-03	2.6511E-02	8.2386E-02	1.4930E-01
Percolation or leakance through Layer 8 (in)	3.0574E-06	8.0335E-06	2.0982E-05	3.6221E-05
Lateral drainage collected from Layer 9 (in)	5.9201E-09	3.5917E-08	1.9958E-06	4.7398E-06
Percolation or leakance through Layer 11 (in)	3.0515E-06	7.9965E-06	1.8968E-05	3.1416E-05

Scroll to the end of the table to see the final values for accumulated volumes.

Precipitation **553.98 in**

Runoff **74.84 in**

Evapotranspiration **359.14 in**

Lateral Drainage collected from Layer 2 **119.43 in**

Percolation or leakance through Layer 11 **0.00 in**

These values show that the default EPA landfill design which was slightly modified by you during the exercise, provides good ground water protection for our project location. Having made such an optimistic conclusion, lets prepare the Visual HELP report.

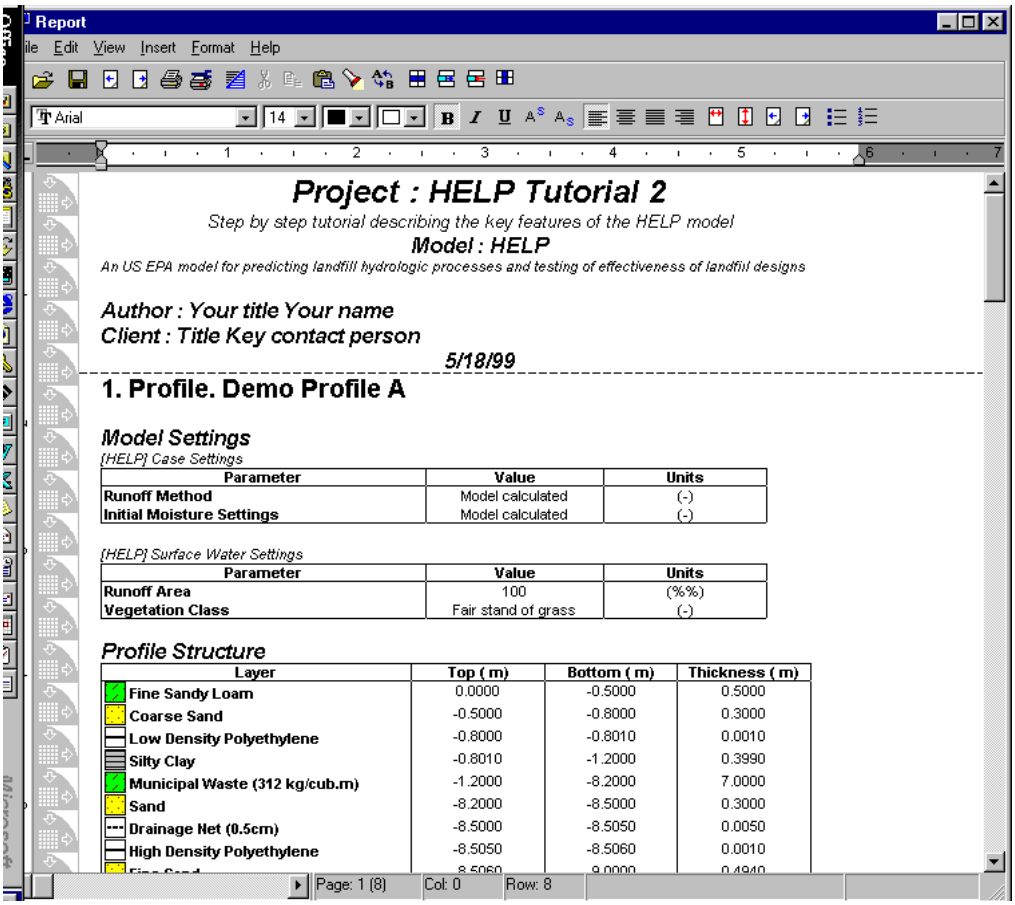
☞ , to close Result Window 1.

Creating a Report

As an added feature of Visual HELP, we have developed a time saving, report generator that will help you prepare profession reports of the model simulation.

To create a report and add the project input data, click the icon from the Operational Icons toolbar.

The Visual HELP Report Generator will display your report in a separate window.



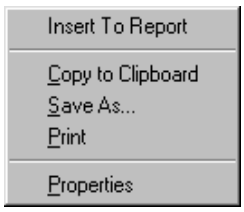
By default, the Report Generator lists all input data for your project. In the **Report** window you may edit the report, input your own text and add any type of graphics or table outputs produced by Visual HELP.

Note: The graphs and tables will be placed at the insertion point.

To add a graph form the Result View to the report:

In the **Report** window scroll the cursor to the end of the report

<right click> the graph in the Visual HELP Result View window. The following menu will appear:



☞ **Insert To Report**. The graph will be inserted into the report.

Go to the "Project" in the main menu and select **[view report]** to continue editing. To re-size the graph you just inserted, click the graph in the **Report** window and stretch it until it reaches the proper size.

To add a table from the **Result Window 1** to the report:

In the **Report** window place the cursor below the imported graph.

<right click> the table in the **Result Window 1**

3) ☞ **Insert To Report**. The table will appear in the report. Again, go to the "Project" in the main menu and select **[view report]** to continue editing or to view your report at any time.

The table may be larger than the Report window allows. In this case, the table will be automatically wrapped to improve the general appearance of the report. The report is fully customizeable and allows you to , insert a headers /footers, change fonts/ letters size, etc..

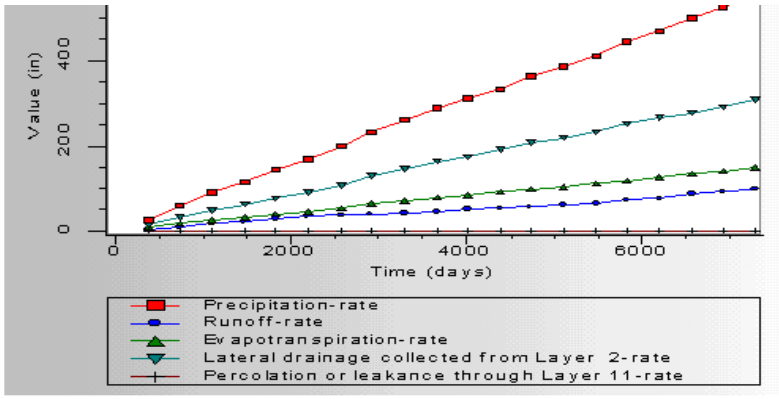


Fig.1 Accumulated balance constituents.

Table 1. Accumulated rate (in)

	Year-1 (in)	Year-2 (in)	Year-3 (in)	Year-4 (in)
Precipitation	2.6669E+01	5.8476E+01	9.0929E+01	1.1642E+02
Runoff	3.9219E+00	9.5287E+00	1.6193E+01	2.2387E+01
Evapotranspiration	8.2591E+00	1.5974E+01	2.4371E+01	3.1858E+01
Lateral drainage collected from Layer 2	1.4484E+01	3.1264E+01	4.8366E+01	6.2130E+01
Percolation or leakance through Layer 4	3.7569E-03	6.5516E-03	9.2846E-03	1.2289E-02
Lateral drainage collected from Layer 7	3.7532E-03	6.5417E-03	9.2717E-03	1.2271E-02
Percolation or leakance through Layer 8	3.7459E-06	8.9520E-06	1.2983E-05	1.7380E-05
Lateral drainage collected from Layer 9	3.5588E-06	8.4902E-06	1.2188E-05	1.6448E-05
Percolation or leakance through Layer 11	1.8707E-07	4.6209E-07	7.9524E-07	9.3185E-07

Once you are satisfied with your report, you may print the report and/or save it for future use. Let's take a look at additional output features available with Visual HELP.

Peak Daily Values

To assess the landfill hydrologic performance in extreme conditions, it is important to know when the peak hydrologic events occured. The **Peak Daily Values** table picks up the dates of such events.

☞ **[Tables]** from the **Select Result Category** drop-down listbox.

☞ **[Peak daily values]** from the **Select Table Result at..**

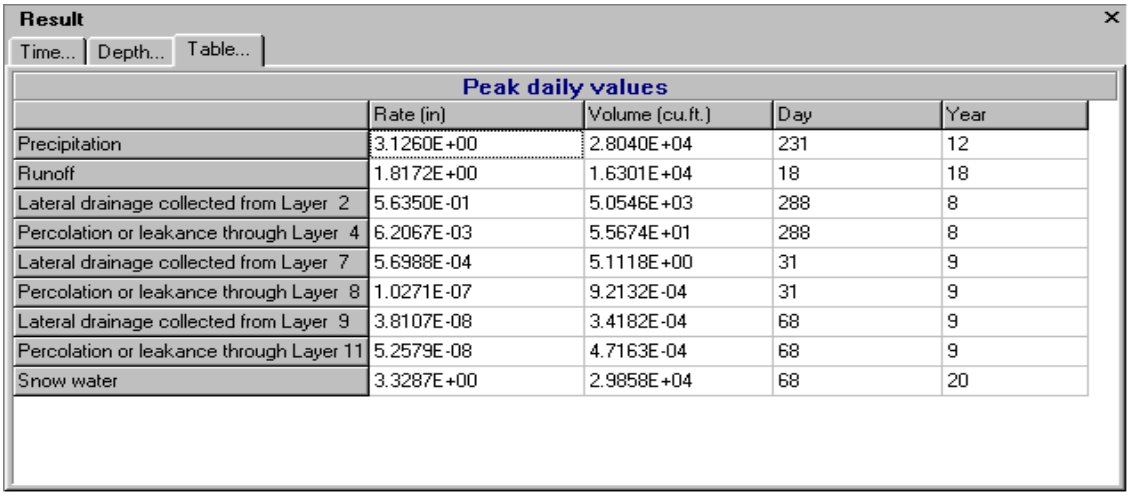


☞ **Add to Output Tree** icon to the right of the lower output listbox.

The table name "**Peak daily values**" will appear in the Output Tree. Click the check box beside it.

☞ **[OK]** in the table editing dialog box.

The following table will appear:



Peak daily values

	Rate (in)	Volume (cu.ft.)	Day	Year
Precipitation	3.1260E+00	2.8040E+04	231	12
Runoff	1.8172E+00	1.6301E+04	18	18
Lateral drainage collected from Layer 2	5.6350E-01	5.0546E+03	288	8
Percolation or leakance through Layer 4	6.2067E-03	5.5674E+01	288	8
Lateral drainage collected from Layer 7	5.6988E-04	5.1118E+00	31	9
Percolation or leakance through Layer 8	1.0271E-07	9.2132E-04	31	9
Lateral drainage collected from Layer 9	3.8107E-08	3.4182E-04	68	9
Percolation or leakance through Layer 11	5.2579E-08	4.7163E-04	68	9
Snow water	3.3287E+00	2.9858E+04	68	20

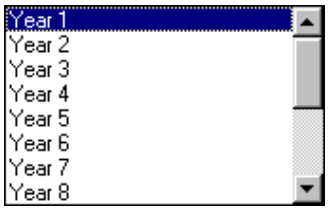
You may conclude that no leakage occurred through the bottom of the landfill (Peak daily percolation/leakage through layer 11). You may also find that the peak precipitation (3.12 in) happened on day 231 of year 12 and that peak runoff (1.81 in) happened on day 18 year 18.

To learn more about the circumstances of these events, Daily Output graphs may be studied.

Daily Output

☞ **[Daily Output]** from the **Select Result Category** drop-down listbox.

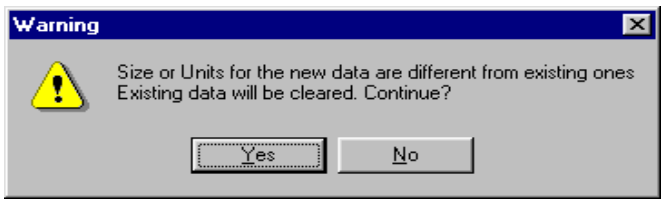
Next select the year for which you would like to have the results to be displayed from in the listbox.





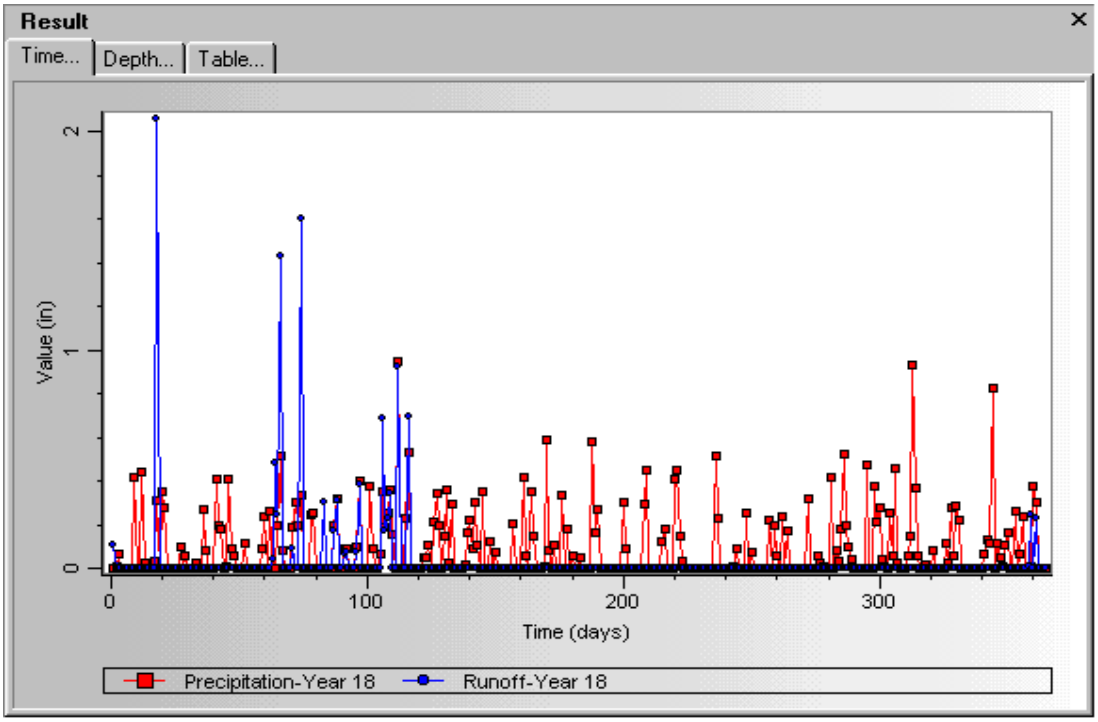
Scroll the list of years, and select the desired year: **18**. To view the available results for this specific type of balance, click the **Add to Output Tree** icon to the right of the lower output listbox.

The tree of available variables for year 18 will appear. Select **Precipitation** and **Runoff** by clicking the appropriate check boxes. This means that you are going to place these graphs to the Main Result Window. A warning will appear:



☞ **[Yes]**

The graph for the daily values of these variables will appear:



This graph shows that the maximum runoff event was not preceded by very intensive precipitation. However, after reviewing the weather data, it appears that day 18 was the first warm day with an average temperature of 5 degrees C (41 Fahrenheit) after a long span of frosty days. The peak runoff was caused by the intensive thaw of snow accumulated during the previous cold period.

Click to close the graph.

This concludes the Visual HELP demonstration exercise. Close Visual HELP by clicking in the top right corner.

We hope these instructions have provided you with a good understanding of the capabilities and tools Visual HELP offers. If you have time, we would encourage that you to go back and re-examine some of the other powerful features and analysis capabilities which were not covered by this demo exercise. If you have any questions about the functionality, capabilities, or features of this software, please do not hesitate to contact us.