Flood Control District of Maricopa County

Drainage Design Management system Software for Windows *(DDMSW)* Introductory Seminar

June 21st or June 22nd, 2005

Flood Control District of Maricopa County

Drainage Design Management system Software for Windows (DDMSW) Seminar Agenda

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Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

8:30 am – 10:15 am

System Overview
Program Installation
General Features
File
Tools
Admin
Help

10:15 am – 10:30 am

Break

10:30 am – 11:30 am

Hydrology
Agency Defaults
Project Defaults
Rainfall
Soils
Land Use
HEC-1 Diversions, Routing and Storage
HEC-1 Network
HEC-1 Model
HEC-1 Graphs

11:30 am – 12:30 pm

HEC-1 Example

Flood Control District of Maricopa County

Announces a FREE Seminar On

Drainage Design Management system Software for Windows (DDMSW)

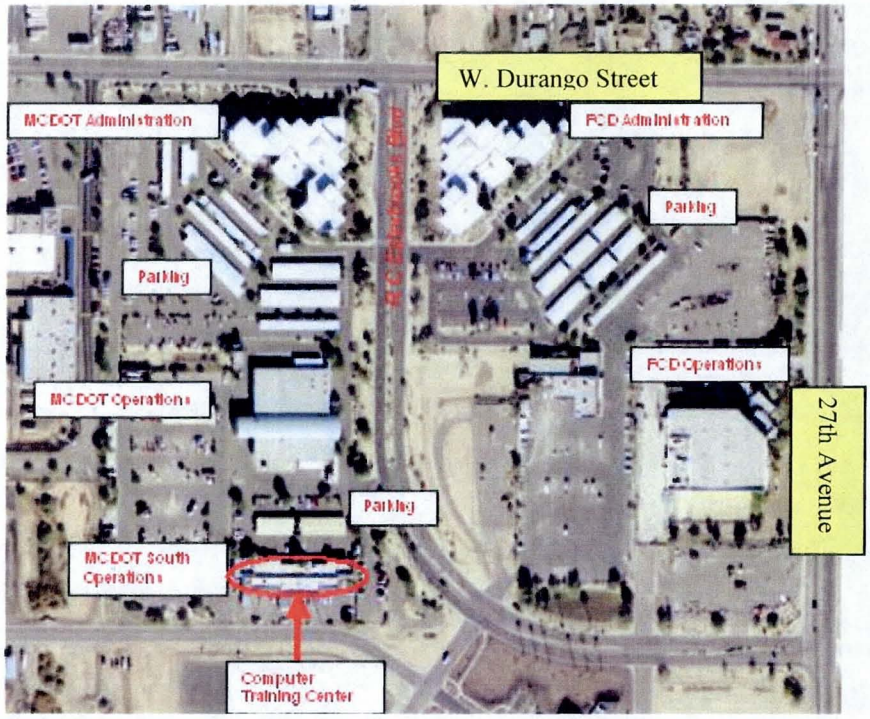
Seminar

A free, four-hour seminar on the completely revised DDMSW software including: revised user interface, new features, software overview, hydrology elements, and a working example will be held twice at the Maricopa County Public Works Computer Learning Center (see map below). The first session will be 8:30 am – 12:30 pm on Tuesday June 21, 2005 and the second session will be 8:30 am – 12:30 pm on Wednesday June 22, 2005.

Each seminar will be presented by Kenneth Lewis of KVL Consultants Inc. Mr. Lewis is President of KVL Consultants, Inc., a firm specializing in Stormwater and Flood Control Master Planning and developing computer applications for GIS/System modeling integration. Before establishing his own firm in 1994, Mr. Lewis served as: Director of GIS for Boyle Engineering Corporation in the US; Manager of Planning for Europe, the Middle East and Africa for Ingersoll Rand Company in London, UK; Manager, Malaysia for Sinclair Knight Consulting Engineers, in Kuala Lumpur, Malaysia and Project Engineer for Sinclair Knight Consulting Engineers in Sydney, Australia. He is the author and programmer for DDMSW.

To Register

Please contact Harry Hollander, Organizational Development and Training Manager, Maricopa County Public Works, at hah@mail.maricopa.gov .



Agenda

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- Help

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- HEC-1 Network
- HEC-1 Model
- HEC-1 Graphs

11:30 am – 12:30 pm

- HEC-1 Example

For Technical Questions

Please contact Bing Zhao, Engr. Application Development Branch Manager, Engineering Division, FCDMC at biz@mail.maricopa.gov, or
Joel Finkel, Engr. Application Developer/Programmer, Engineering Division, FCDMC, at jlf@mail.maricopa.gov .

FLOOD CONTROL DISTRICT
of
MARICOPA COUNTY

Drainage Design Management System for Windows

Version 3.2.6

4/5/2005

Users' Manual

KVL Consultants, Inc.

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KVL Consultants, Inc.

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Chapter 1 Introduction

System Overview

The Drainage Design Management System for Windows (DDMSW) has been written to facilitate data management and computational procedures required for drainage analysis in Maricopa County. This manual serves as a guide in the use of the program and is intended to be used in conjunction with the County's Drainage Design Manuals.

The program is written in Microsoft Visual FoxPro and currently includes modules for File, Edit, Hydrology, Tools, Admin, Agency and Help. Agency is only available with a password.

DDMSW is a relational database that can manage multiple projects from one single location. The System is a multi-tasking window based application that enables the user to open several 'windows' simultaneously. New features include pull-down menus, user-friendly screens which the user can arrange on the desktop, and windows editing tools to facilitate data entry. DDMSW utilizes a relational database that includes tables for data entry and editing. Each table appears as a separate '.DBF' file on disk. The tables are related to each other based on the key field 'ProjectID' which is established when starting a new project. Model runs are automated from a menu and the data for running the models is extracted from the various tables in the database.

Basic Database Terminology

The application stores data (values) in a relational Database. This data is organized into *tables, fields*, and *records* to make it more meaningful. For example, 01 by itself is meaningless. However, in a table called 'Basins', in a field called 'BasinId', in a record corresponding to 'EXAMPLE1', we now understand that 01 is a major basin in project EXAMPLE1.

A table is a grouping of data. The data is dynamic because it can be modified, deleted, added to and used in other relations. The following is an example of a table:

Table: Basins

ProjectID	BasinID	Description	Sort
00002	01	Major Basin 01	10
00002	02	Major Basin 02	20

A table is composed of one or more fields. In the example, the fields are ProjectID, BasinID, Description, and Sort. Fields are similar to columns in a spreadsheet. All fields in a table have the same format (e.g. text of maximum 70 characters, numeric 12 places with 2 decimals) and they share the same characteristics.

A table also consists of one or more records. Records are similar to rows in a spreadsheet. In the example, "00002, 01, Major Basin 01, 10' compose one record in the table 'Basins'. The example shows a total of two records and four fields.

In DDMSW, the database is composed of tables that organize and store information. A common field in each table, ProjectID, ties all the table data together for each individual project.

Program Installation

DDMSW

The software used in DDMSW requires:

DDMSW	Compiled application
HEC-1	Most recent HEC-1 with modifications
Prefre	Rainfall model
MCUHP1	FCDMC's DOS program to calculate time of concentration and storage coefficient for Clark unit hydrograph
PFE	Text editor (Programmer's File Editor)
Acrobat Reader	PDF file reader

All required software for DDMSW is included except Acrobat Reader, which can be downloaded from the Web.

Insert the DDMSW CD in the CD drive (here denoted as X). Run X:\DDMSW\Setup from the RUN command (substitute your CD drive letter for X). Follow the instructions on the screen.

The user can choose the program's location, but assuming C:\DDMSW, the following directory structure will be created:

C:\DDMSW	Program files
C:\DDMSW\Backup	Directory for archiving data
C:\DDMSW\Data	Data Files
C:\DDMSW\Help	Help files
C:\DDMSW\Models	Model programs
C:\DDMSW\ModlRuns	Default directory for model runs
C:\DDMSW \Reports	Reports
C:\DDMSW\Temp	Directory for temp files

The procedure will notify the user when the installation is complete.

Adobe Acrobat Reader

Adobe Acrobat Reader is required to print the user manual and view other files. If Adobe Acrobat Reader is not currently installed on your computer, then it will be necessary to install the program. The latest version can be downloaded from Adobe's website at www.Adobe.Com. Follow their instructions to download and install 'Acrobat Reader'.

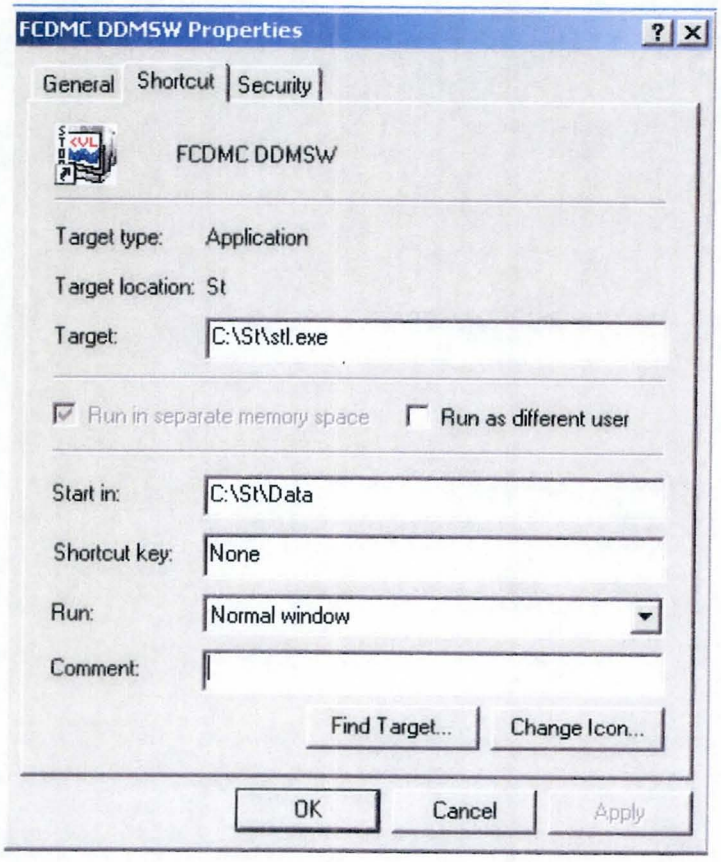
Starting the Software

DDMSW is started by running 'STL.EXE'. The program can be accessed from the Windows Startup menu or other selected folder or by double-clicking on the icon. The Startup directory should be 'C:\ST\Data' or wherever the data files are located.

When the software is first installed, it is necessary to access:

1. 'File/Select Project' to establish project defaults.
2. 'File/Project' Paths to establish project paths.
3. 'Tools/Options' to establish system settings and paths.

The following is a sample of the desktop icon to run the application and the properties of the program are shown on the following page. These may vary depending on the installation directory selected.


FCDMC DDMSW Properties
General
Shortcut
Security
FCDMC DDMSW
Target type: Application
Target location: St
Target: C:\St\stl.exe
Run in separate memory space
Run as different user
Start in: C:\St\Data
Shortcut key: None
Run: Normal window
Comment:
Find Target...
Change Icon...
OK
Cancel
Apply

Network Installation

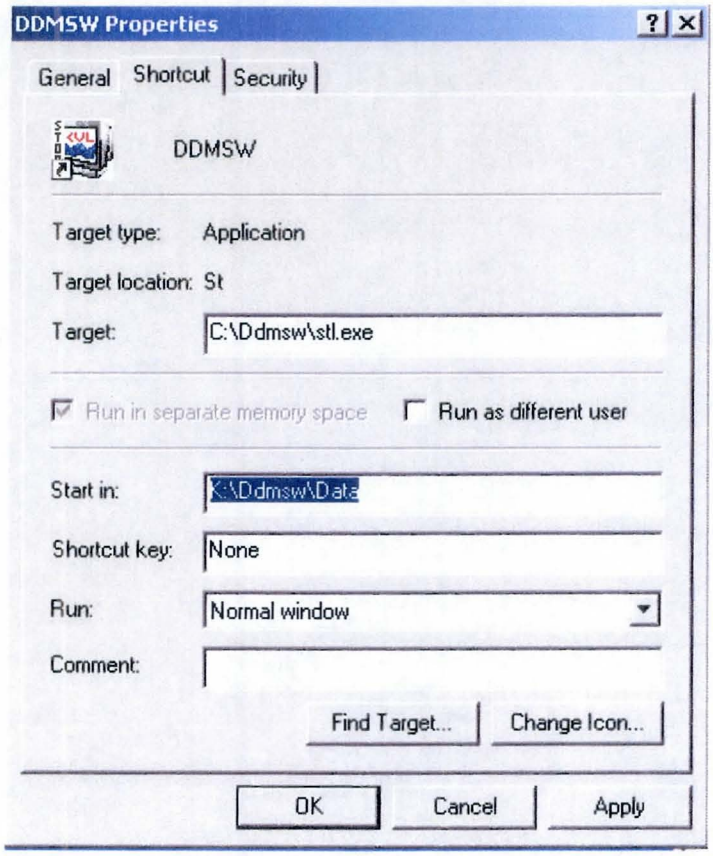
For Users wishing to manage their projects on a network, the following procedure should be followed:

1. Install the application on all computers that will be running the application.

2. Install the application on the network drive (Shown as K: on the figure below).

3. Right click on the icon used to start the software and select properties.

4. Modify the Start in property to point to the "Data" subdirectory on the Network Drive. For example, assume that the network installation for DDMSW is located at "K:\DDMSW" where "K" is a mapped directory to the local network, and then modify the "Start in:" field of the DDMSW properties to "K:\DDMSW\Data".



When software patches become available, it is ONLY NECESSARY TO UPDATE THE NETWORK INSTALLATION. **When individual users access the network data, a check of the Network's application version, reports, models and help files is carried out and any necessary updates to the local machine are carried out automatically**.

Chapter 2 General Features

Main Menu

File Edit Hydrology Tools Admin Agency Window Help

The Main Menu is the center of the application. This is the screen that is displayed when the user starts the application. It is also the screen the user is always returned to after closing a submenu or screen.

Specific actions can be accessed through the pull-down menus shown on the Main Menu bar. This manual will explain the functions available on each menu and will describe the individual elements shown on data entry screens. Depending on the type of application installed, some of these menu options may not be available.

Standard Buttons

There is a toolbar of standard buttons, which is identical on each data entry screen. The buttons become available/unavailable depending on the current action.

Goes to the first record in the table.

Moves to the previous record.

Moves to the next record.

Goes to the last record in the table.

Save the changes to the current record.

Undoes the last command or action.

Prints a report of the current table to the screen.

Searches for the first record based on the typed selection criterion.

Deletes the current record. Use this with caution! Deleted records cannot be retrieved.

Use this to add a new record. When this button is clicked, a blank record appears for the user to enter values. Select *Save* to keep the data, or *Cancel* to discard the addition.

Closes the current screen and returns the user to the Main Menu or previous screen. Pressing [Esc] will also close the screen and return the user to the previous screen. However, changes to the current record may not take effect.

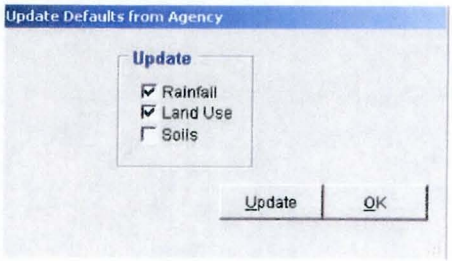
Common Buttons

The following buttons appear on several forms and basically perform the same function:

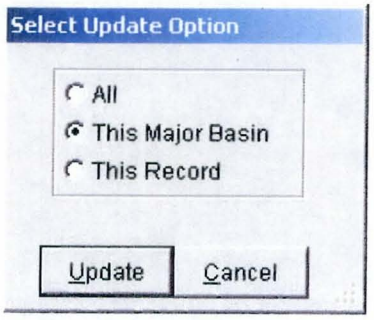
Copy — Copies the existing record to a new record so that only changes need to be edited.

Major Basin — Shows a screen of all available major basins in the current project. Data on open forms will be filtered to the selected major basin.

Update — There are two types of update:
On a default form, it updates default data from agency data. Check the options to be updated.



On a non-default form, it updates the data by performing calculations. The user selects the record, major basin or entire project to be updated.



Renumber — This renumbers the current 'sort' data in tens.

Print... — Prints the corresponding report for this data.

Save — Saves the record with the current edits. This is only visible in "Edit" mode.

Cancel — Discards all current edits. This is only visible in "Edit" mode.

Edit Menu

The Edit menu is available to the user during data entry or editing. The menu comprises the following functions. Some or all may be available depending on the action currently being executed.

Undo	Undoes the last command or action.
Redo	Repeats the last command or action.
Cut	Removes the selection and places it onto the Clipboard.
Copy	Copies the selection onto the Clipboard.
Paste	Pastes the contents of the Clipboard.
Clear	Removes the selection and does not place it onto the Clipboard.
Select All	Selects all text or items in the current window.
Find	Not available
Replace	Not available

Window

This menu item is available when a screen is opened.

Arrange All	Arranges the open screens tiled on the desktop.
Cascade	Arranges the open screens in a cascading from left to right on the desktop.
Close All	Closes all open screens.
1 Rainfall Data ✔ 2 Soils - MB: 01	Lists all open screens with a checkmark next to the current one.

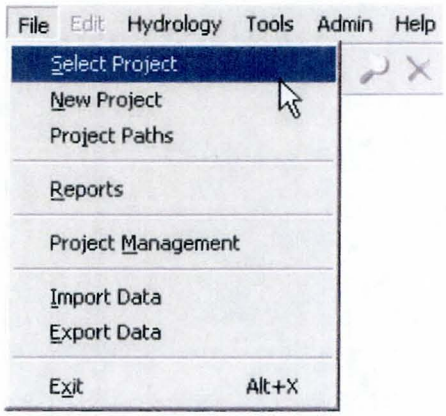
Data Screens

Screens display multiple records on a grid and details of the current record. Only data for the current record can be edited. Use the vertical scroll bar to move through records on the grid and highlight a record to edit.

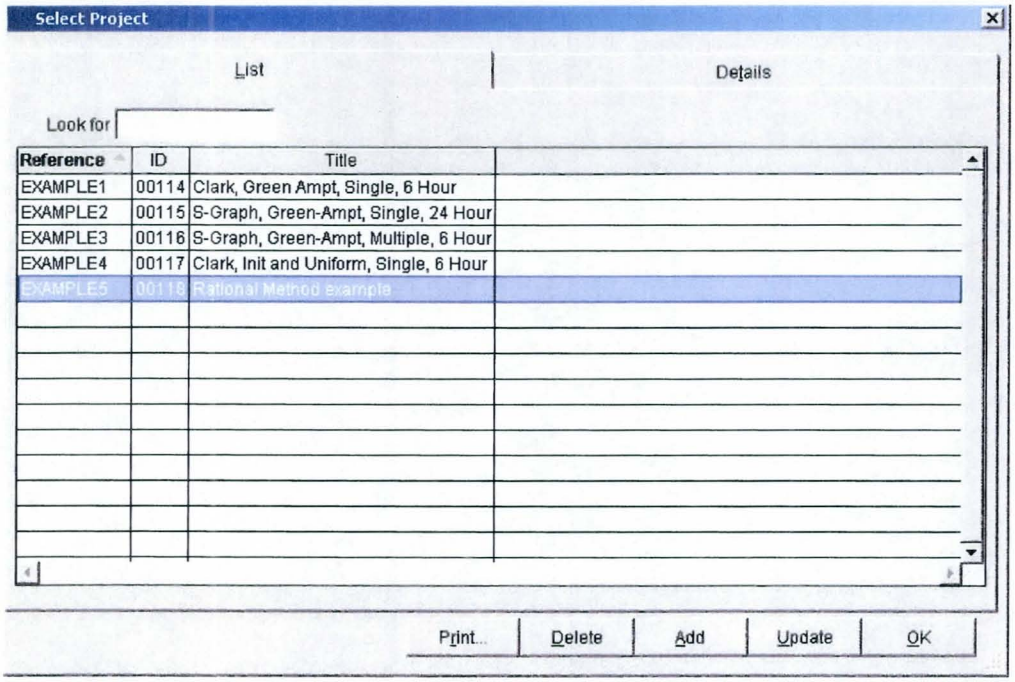
The user can move and resize screens according to preference. Changes made to window position are retained in the application.

On tabbed forms, right clicking on the tab of the grid or details screen will display information about the form. On regular forms, the user can right click on the body of the form to display information.

Chapter 3 File



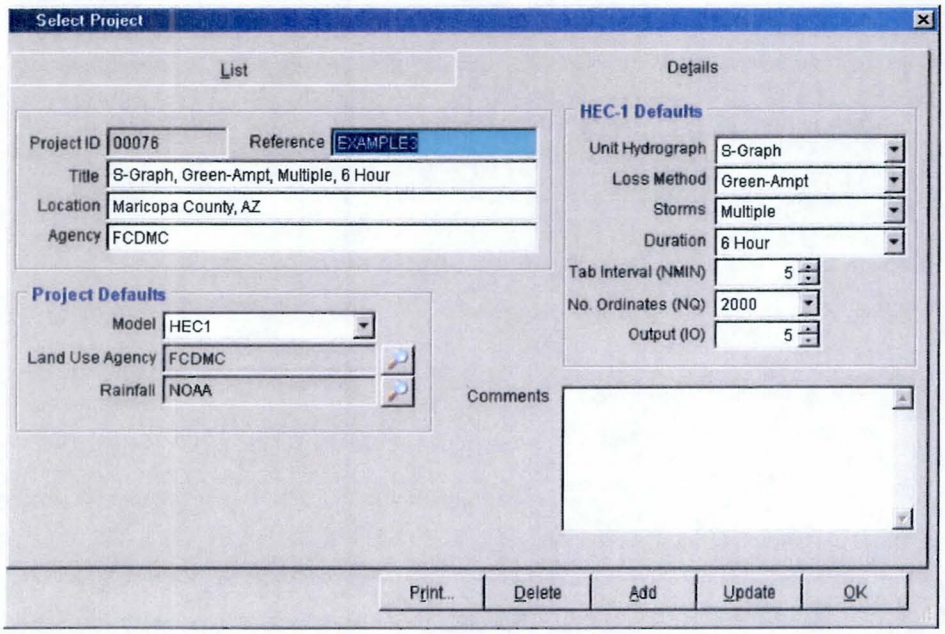
Select Project



The selection of Select Project from the File Menu is used to select, edit or create a new project. To add a new Project, click on the Add button. To delete a Project, click on the Delete button.

New Project

The selection of New Project from the File Menu is the same as Select Project except that a new record is automatically added to the Projects table.



When adding a new Project, it is necessary to fill in the data for the Reference. The Reference field can be letters or numbers and should not contain spaces. The reference is used in the header for reports and in naming the backup "zip" file. The Project ID will be used throughout the application for all files that refer to this project. It is automatically created when adding a project. To select a project, use the mouse to highlight a project from the list and click *OK*.

The defaults entered are used to establish available forms throughout the application. Click on the 'Details' tab to enter or edit defaults for the project.

- The selection of HEC-1 or Rational for the Model will determine available options for this project.
- 'Land Use Agency' establishes the agency land use default data to be used.
- 'Rainfall' establishes the Rainfall data (if custom) or method to develop the data.

If the HEC-1 model is selected, then additional hydrology defaults need to be set. These include: Unit Hydrograph, Loss Method, Storms, Duration, Tabulation Interval, Number of Ordinates and Output.

Updating this form opens a screen to 'Update Defaults'. By checking any or all of the options, the default data will be imported into the project. The 'Update Defaults' screen is available on all default data forms.

To add a new project, click the *Add* button to display a blank record. After entering all project data, click Save .

When deleting a record from this form, all records in all tables for this project will be deleted.

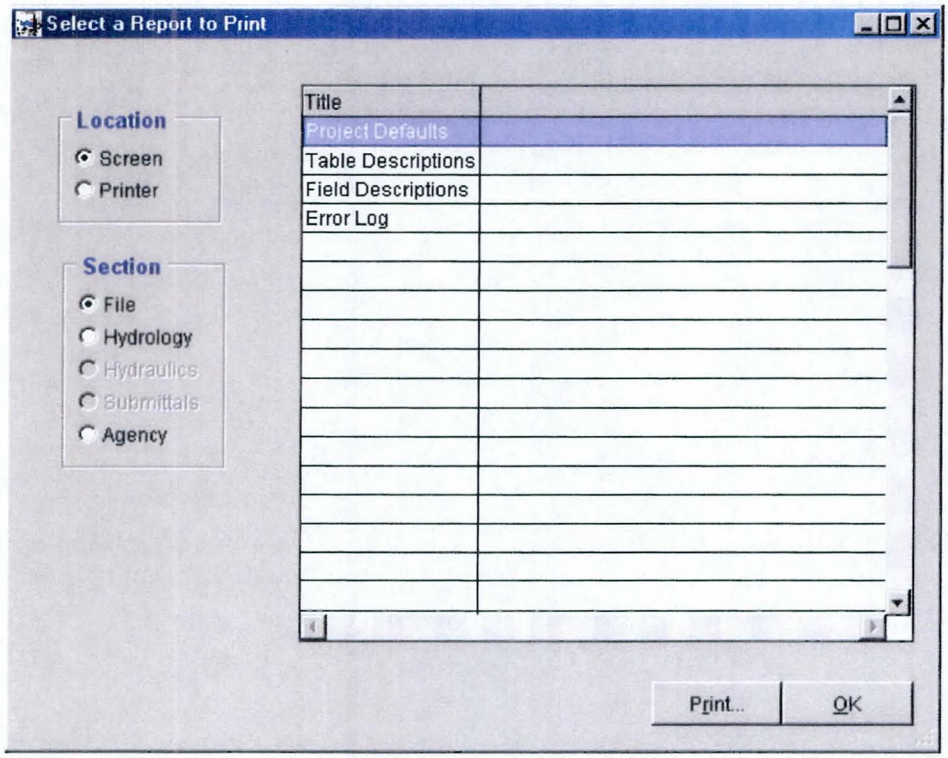
Project Paths

Use the Project Paths screen to input the location of model runs. This is machine dependent and may be different for each computer. Use the ... button to locate the folder or file and then save the change.

The Model Runs Path should be a separate subdirectory for each project to prevent one project's model runs overwriting the model runs from another project.

Reports

The Reports screen lists all reports or a sub-group of reports.



Select the report to be printed, and choose the output location (Screen or Printer), and click Print... .

FCDMC
Drainage Design Management System
SOILS
Project Reference: EXAMPLE1

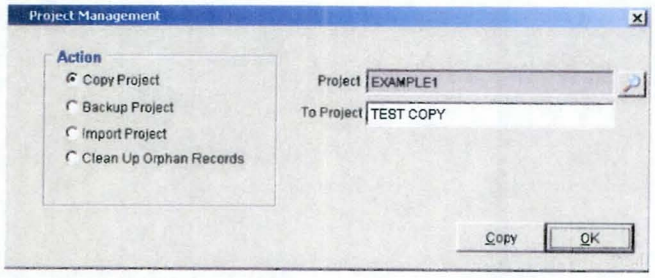
Page 1

Area ID	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
1A	64612	1.720	25.70	0.01	-	100
	64619	0.450	6.70	0.19	-	100
	64612	0.270	4.00	0.01	-	100
	64672	0.890	13.30	0.09	30.00	100
	64622	0.670	10.00	0.04	-	100
	64677	0.220	3.30	0.05	-	100
	64622	1.120	16.80	0.04	-	100
	64624	1.340	20.10	0.02	-	100
1B	64612	1.380	24.20	0.01	-	100
	64619	1.230	21.50	0.19	-	100

Keep in mind that when a report outputs to the screen, the user is able to select to print or export it by using the Reports toolbar at the top of the report. By clicking , the user can choose to print all or selected pages of the report. Click the Export Icon to select a format and destination for the export file. This enables the user to exchange project data with other applications. Always close the current report view when you are finished, otherwise the report generator will remain open.

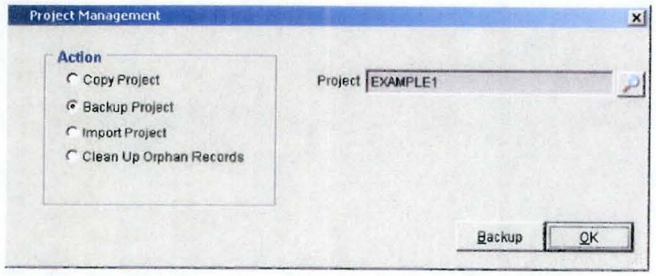
Project Management

The following options are available to the user for managing project files:



Copy Project

Creates a new project and copies all records in the in the selected From Project to the new "To Project". Model files are not copied. Select the current project from the drop-down list and enter the name of the new project in the 'To' field. Click the *Copy* button.

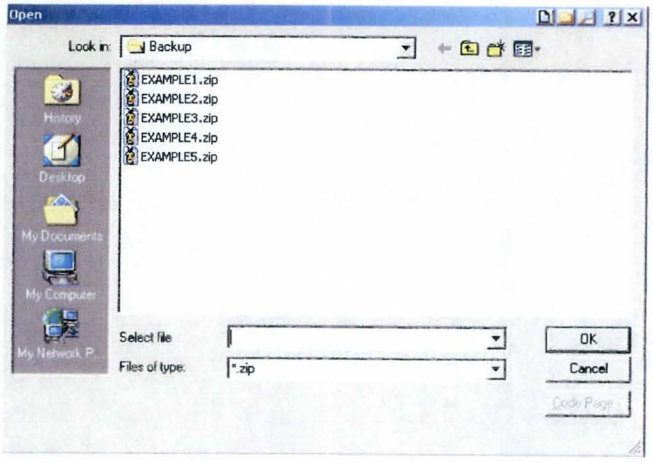


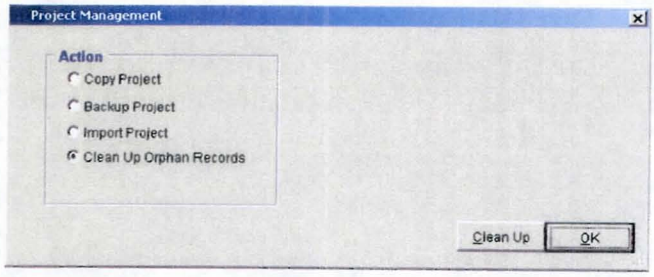
Backup

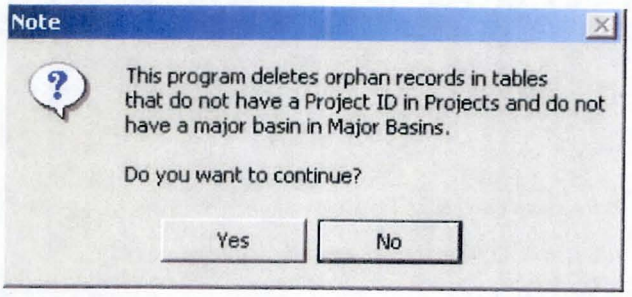
As a security measure, backups should be performed on a regular basis. The selected files are backed up into a compressed file in the 'Backup' subdirectory of the main program. For additional insurance, these .zip files can be copied onto a CD and taken offsite.

Import

When the 'Import' button is clicked, a dialogue box appears for the user to select a project backup file (.zip extension). If the project already exists in the database, a message appears to warn the user that all data in the current project will be deleted and replaced with the imported data. The user has the choice to continue or cancel.







Clean Up Orphan Records

Occasionally there are records left in tables that are not associated with a project. This option deletes the 'orphan records' in tables that do not have a Project ID in the Projects table.

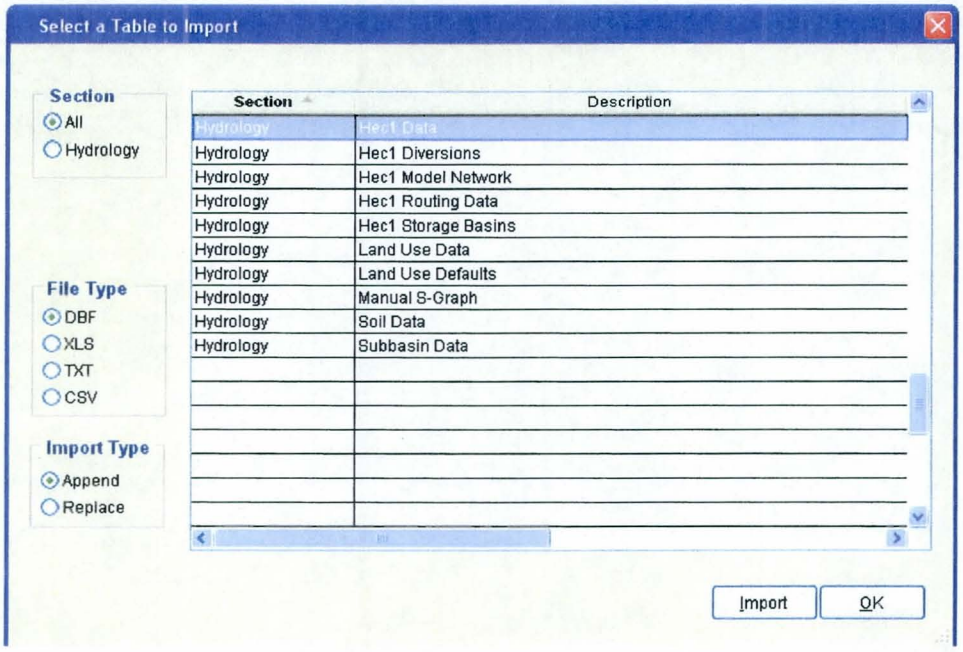
Import Data

The selection of 'Import Data' from the 'File' menu is used to import data originating from another source, such as a spreadsheet, text file or database, into a selected table. The file formats supported include DBF, XLS, TXT and CSV, as described in 'Export Data'. There are two options:

Append Data This option adds the data to the existing data. The results will include the current and the newly imported data.

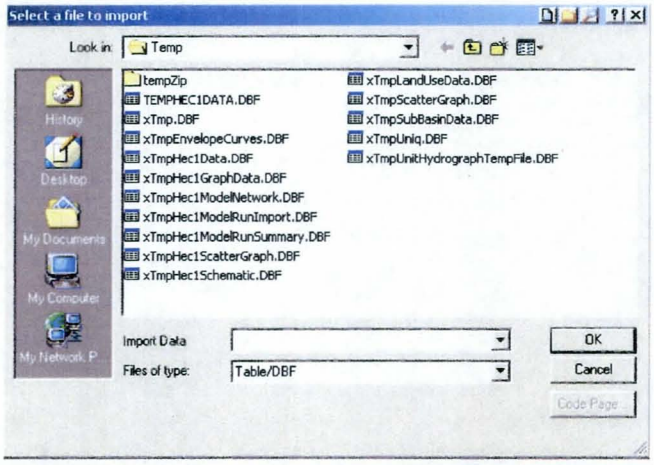
Replace Data This option deletes the current data in the table, and then replaces it with the new data.

It is important that the data to be imported has the same structure as the importing table, otherwise fields will be truncated and records rejected. For this reason, a good practice is to first export a table and then use the exported file as a template for the acceptable format.



! It is crucial that data is imported using the Import Data tool only and not through any other means, otherwise primary keys are lost and the database loses its referential integrity.

The user can view the list of tables pertaining to a specific section by clicking on the appropriate Section button. Highlight the table to append or replace, select the file type and click *Import*. The following dialogue box appears for the user to select the file to import. Highlight the filename and click *OK*.



Export Data

The selection of Export Data from the Utilities menu is used to export a Table from the Database to a file in a different format. All the record data in the Table are exported. Note that the Table contents are not removed, but are copied to a different file format. The file formats supported include:

DBF Exports data into a format that can be read by a Database program such as Dbase or FoxPro. Please note that this DBF format is not the same file structure as the DBF files in this application.

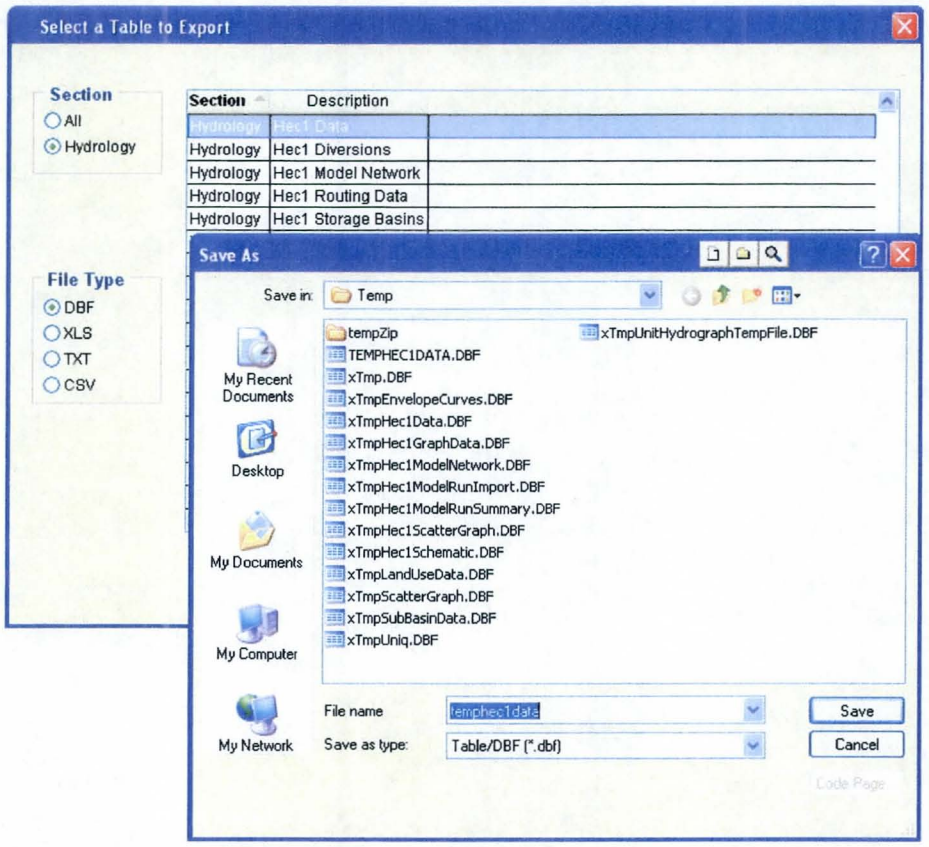
XLS Select this type to create a spreadsheet that can be opened in Microsoft Excel.

TXT Data is exported one record per line in ASCII text that can be read by any text editor. The data is in fixed format (columns). For example:

```
BETA010 H   Dry   25.0    0 0.25 0.050  Max     Mountain  0.00 10
BETA010 H   Dry   30.0    0 0.15 0.040  Hi      Hillslope  0.00 20
```

CSV Data is exported into a file one record per line, with each field separated by a comma. Character fields are enclosed in quotes. For example:

```
"BETA010","M","Dry",25.0,0,0.25,0.050,"Max","","MOUNTAIN",0.00,"",10
"BETA010","H","Dry",30.0,0,0.15,0.040,"Hi","HILLSLOPE",0.00,"",20
```

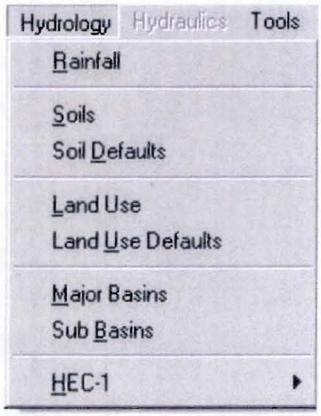


Use the mouse to highlight a Table, select an export type from the 'File Type' selection box and click *Export*. The contents (all records) of the selected Table are saved on disk in the chosen format. The user is prompted to enter a filename and location for the export file.

Exit

Closes all open database files and exits the application. Programs such as Acrobat, Crystal Reports, and the Text editor must be closed separately.

Chapter 4 Hydrology



Overview

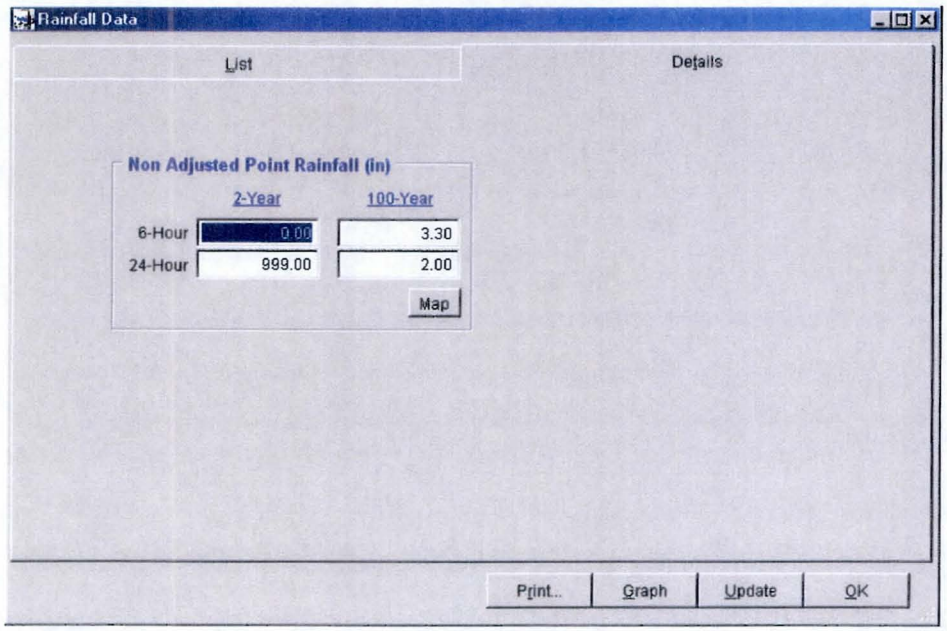
The options available for Hydrology depend on whether the HEC-1 Model or Rational Method was selected as the project default model in 'Select Project'. Rainfall, Land Use, Land Use Defaults, Major Basins and Sub Basins are common for both models. Soils, Soil Defaults and HEC-1 are only available for the HEC-1 model selection.

ID Naming Convention

Although not required, it is recommended that a systematic naming convention be used to designate the unique ID's of sub basins. A typical naming convention is as follows:

010005	The first two characters (01) designate the major basin and the last four characters designate the sub basin.

Rainfall



When first going into the module, if rainfall data is not available, the user is informed to update the data from the agency default values (by pressing *Update*). These should be changed depending on the project location.

The choices for the rainfall default (in 'Select Project') are NOAA or Custom. If NOAA is selected as the default rainfall then precipitation data is required for the 2-Year, 6-Hour; 2-Year, 24-Hour; 100-year, 6-Hour, and 100-Year, 24-Hour storm events. Once the data has been entered, click Update to run the Prefre model. Prefre populates the data for all of the remaining return periods and durations.

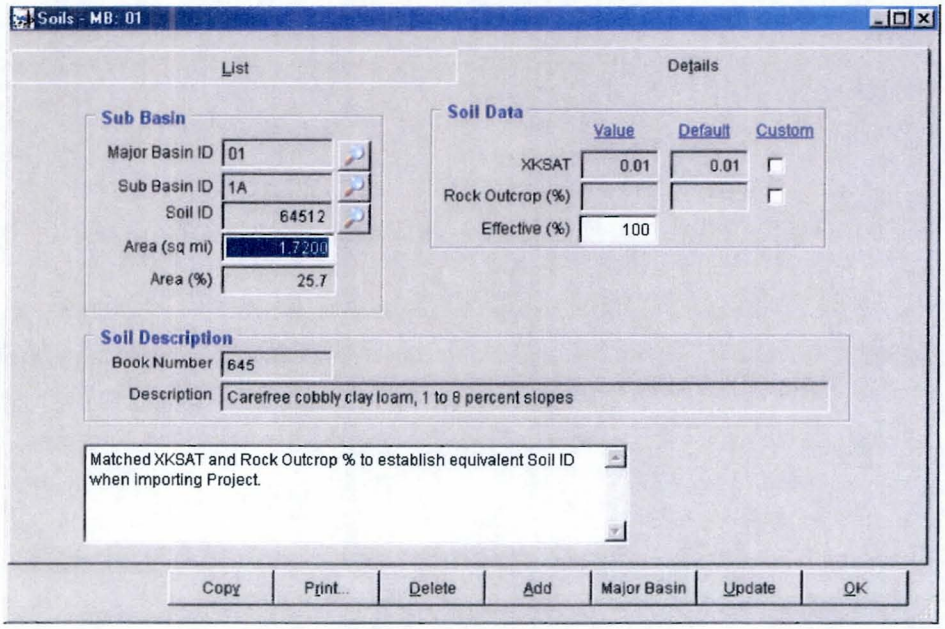
The precipitation data for an area can be determined by clicking on Map and going to the appropriate location.

If 'Custom' is selected as the default rainfall, no updating takes place and the rainfall data must be entered manually.

Intensity-Duration-Frequency (IDF) curves are developed for each minute by a log interpolation of the point rainfall data. The curves can be viewed in graphic format by clicking Graph.

Soils

This screen is only available for the HEC-1 model option.

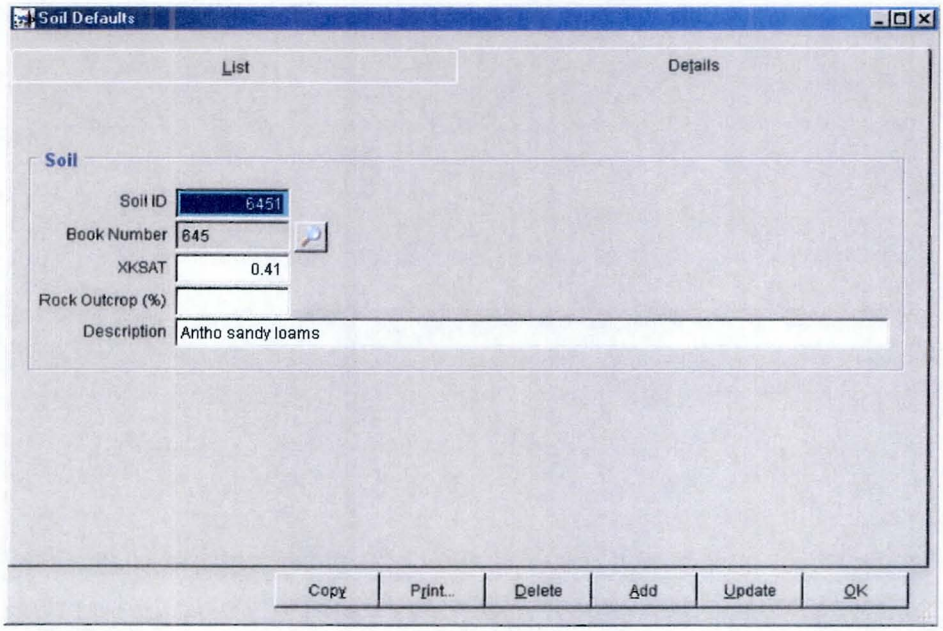


The Soils screen is used to enter soils data for the sub basin areas. Soil data is comprised of 'Value', 'Default' and 'Custom' fields. The 'Value' fields are used for the analysis. These fields are populated with the Default values available in Soil Defaults. To enter a new value, check 'Custom' and input the value. When Update is clicked, the area percents are calculated. Note that 'Custom' must be checked for non-default values to be used, otherwise the default value will automatically override it. When a non-default value is used, describe the reason in the 'Comments' field.

Generally, the data for this table can be populated by intersecting soils and sub basin area polygons in a Geographic Information System (GIS) and saving the results to a table with the same format. (Export this table to see the format). The data can then be imported using the 'Import' function.

Soil Defaults

This screen is only available for the HEC-1 model option.

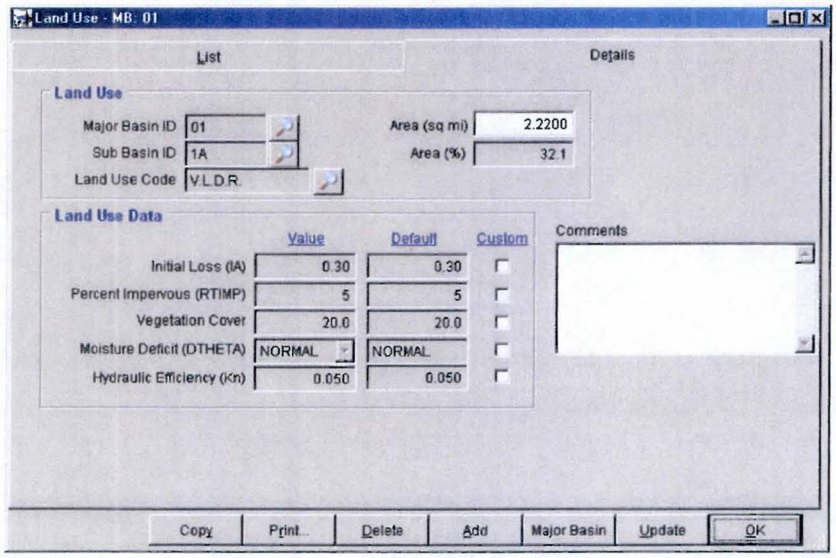


Each project has specific soil defaults saved with the project. When [Update] is clicked, the agency soil defaults are imported and saved with the project. This form is used to modify default soil values, although this is not advisable. Rather, it is recommended that the user create custom values in 'Soils' data.

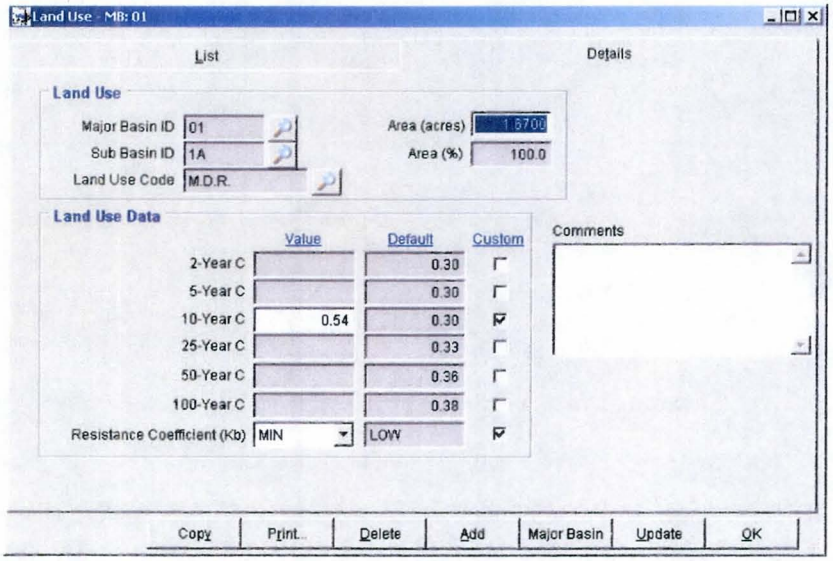
It is important to enter appropriate values for all fields, as soil calculations for the entire project will be based on these values. When first entering this form for the project, if soil default data does not exist, the Agency's default data is loaded into the system.

Land Use

HEC-1



Rational Method



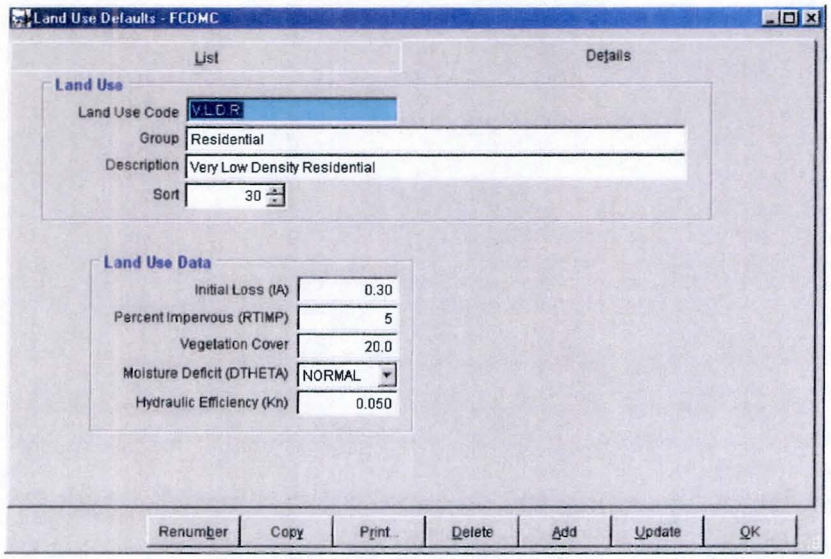
The 'Land Use' screen is used to enter land use data for the sub basin areas. Enter the major basin, sub basin and land use code using the selection buttons. Land Use is comprised of 'Value', 'Default' and 'Custom' fields. The 'Value' fields are used for the analysis. These fields are populated with the Default values available in Land Use Defaults. To enter a new value, check 'Custom' and input the value.

When Update is clicked, the area percents are calculated. Note that 'Custom' must be checked for non-default values to be used, otherwise the default value will automatically override it. When a non-default value is used, describe the reason in the 'Comments' field.

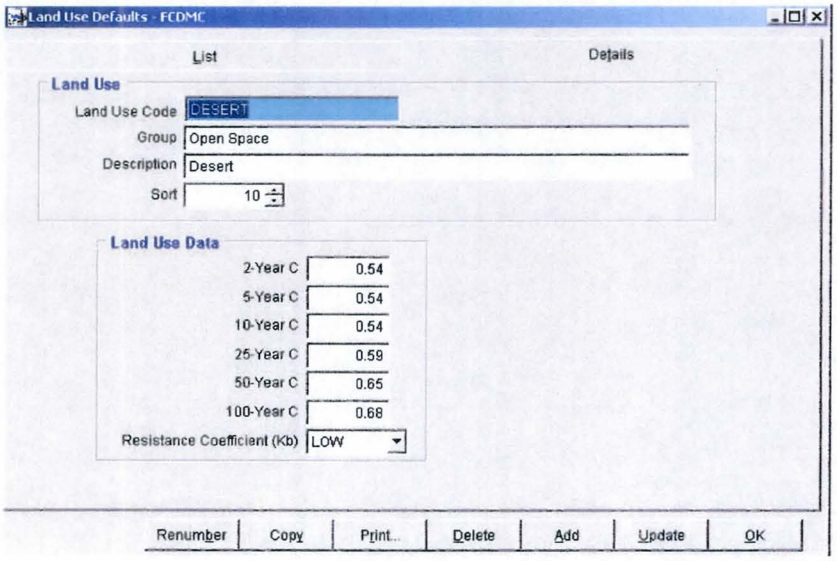
Generally, the data for this table can be populated by intersecting land use and sub basin area polygons in a Geographic Information System (GIS) and saving the results to a table with the same format. (Export this table to see the format). The data can then be imported using the 'Import' function.

Land Use Defaults

HEC-1



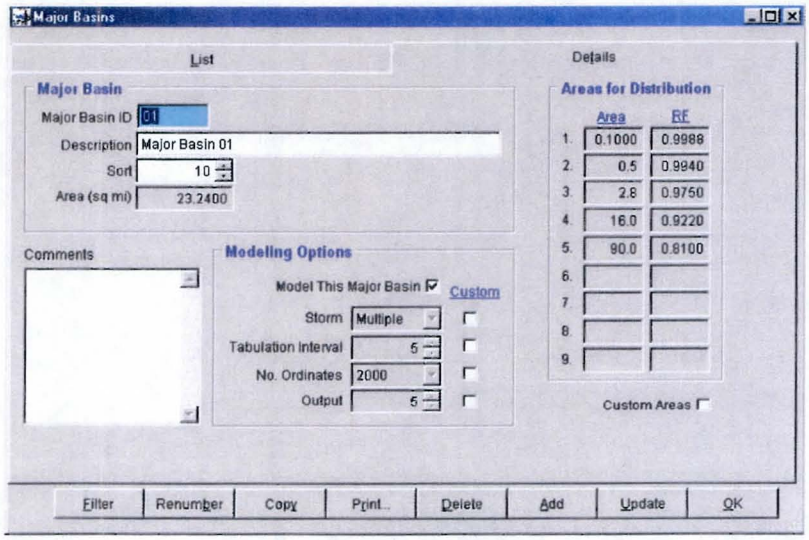
Rational Method



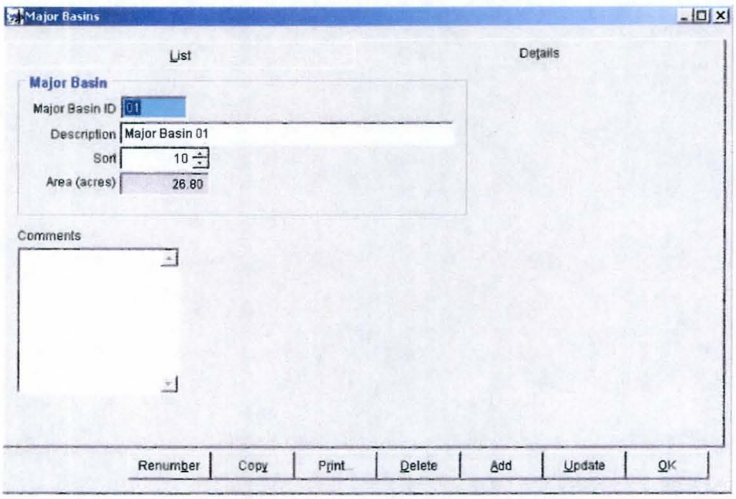
Each project has specific land use defaults saved with the project. When *Update* is clicked, the agency land use defaults are imported and saved with the project. This form is used to modify default land use values, although this is not advisable. Rather, it is recommended that the user create custom values in 'Land Use' data.

Major Basins

HEC-1



Rational Method



The Major Basins screen is used to enter Major Basin data and defaults for modeling. Major Basins within a project are drainage basins that generally have a major outfall. Major Basins for HEC-1 models will have separate HEC-1 input files and a two-character field designates their ID. Single digit numbers must therefore be preceded by a zero. Within a project, the first Major Basin ID is designated as "01", the second as "02" etc. until Basin "99" is reached. If the number of basins exceeds ninety-nine, letters can be used. It is necessary to have at least one Major Basin (01) in a project.

For HEC-1, check 'Model This Major Basin' to include it when modeling 'All Basins'. To override the default HEC-1 modeling parameters for Storm, Tabulation Interval, No. of Ordinates and Output, check the associated 'Custom' and enter a new value. Note that 'Custom' must be checked for non-default values to be used, otherwise the default value in Project Setup (File=>Select Project=>Details) will automatically override it. When a non-default value is used, describe the reason in the 'Comments' field.

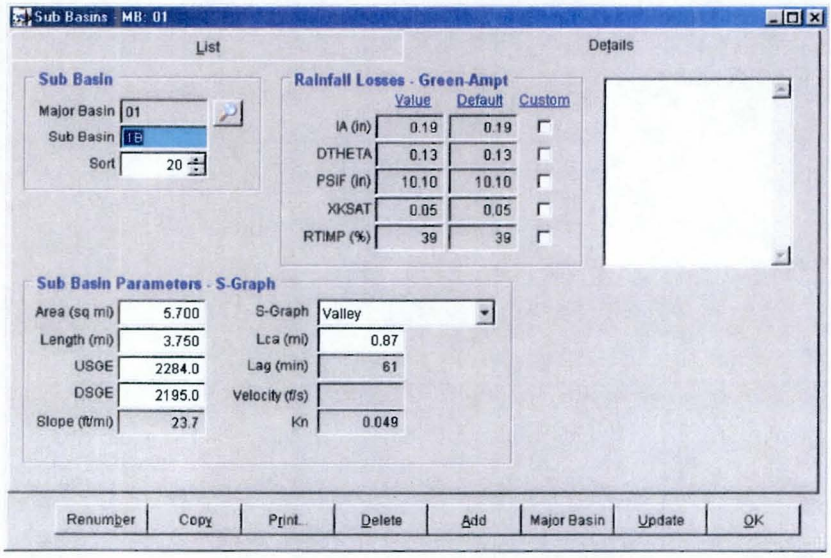
When the Update button is clicked, all sub basin areas are summed to obtain the major basin area. For HEC-1 the appropriate distribution and reduction factor for a single storm or distributions and reduction factors for multiple storms are established. .

Sub Basins

This screen is used to enter sub basin data required for hydrological analysis of the sub basin. It is necessary to enter the sub basin ID and area. Other parameters are required depending on the model used.

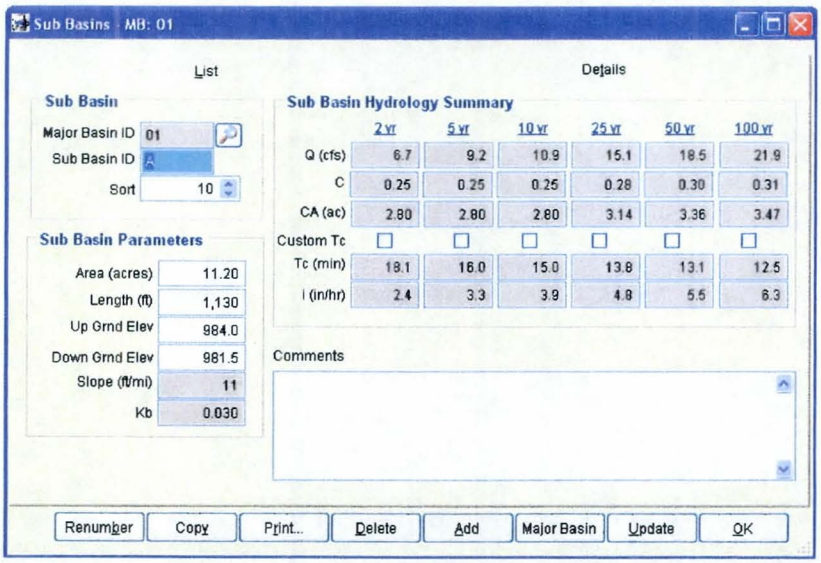
HEC-1

Composite values for land use and soils will be developed from data in the land use and soil tables when 'Update' is clicked. When updating the screen, information on the soils and land use tables are consolidated for each sub basin and either the time of concentration or lag is calculated. The calculated values become the defaults for the sub basin. To override these and enter a new value, check 'Custom' and input the value. Note that 'Custom' must be checked for non-default values to be used, otherwise the default value will automatically override it. When a non-default value is used, describe the reason in the 'Comments' field.

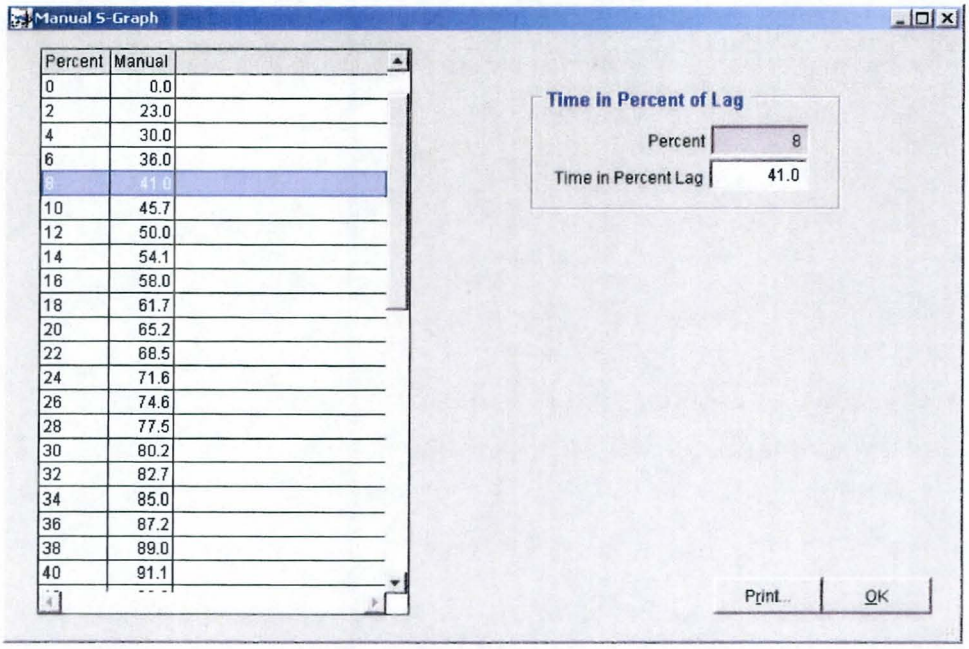


Rational Method

When 'Update' is clicked, composite C values, time of concentration and rainfall intensity are established. From this data, the sub basin Q is calculated. To override the time of concentration methodology for the County, check 'Custom Tc' and enter an appropriate value. When a non-default value is used, describe the reason in the 'Comments' field.



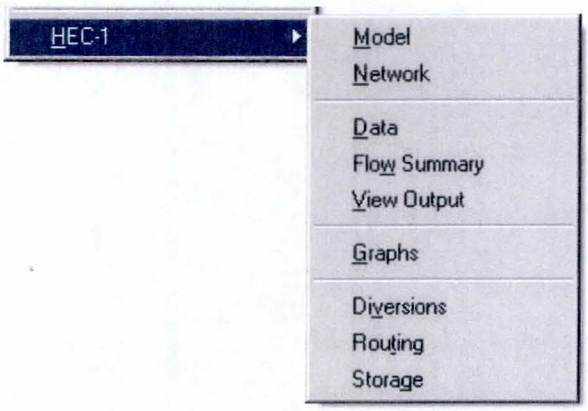
Manual S-Graph



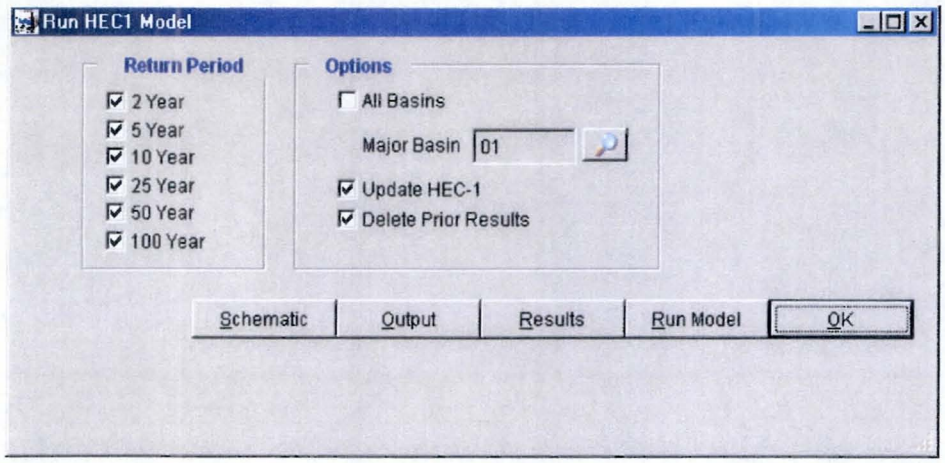
The Manual S-Graph option in the HEC-1 menu only shows up if the user selects S-Graph as the default Unit Hydrograph. It is only necessary to populate the data in this form if "MANUAL" is selected as the S-Graph in the Sub-Basins form.

HEC-1

The HEC-1 option appears on the Hydrology Menu if it selected as the default model for the project. The HEC-1 submenu includes the following functions:



Model



The model screen is used to run the HEC-1 model for the selected return period(s) and major basin. All major basins selected to model in "Major Basins" can be modeled if the 'All Basins' box is checked. Options for running the model include:

Update HEC-1

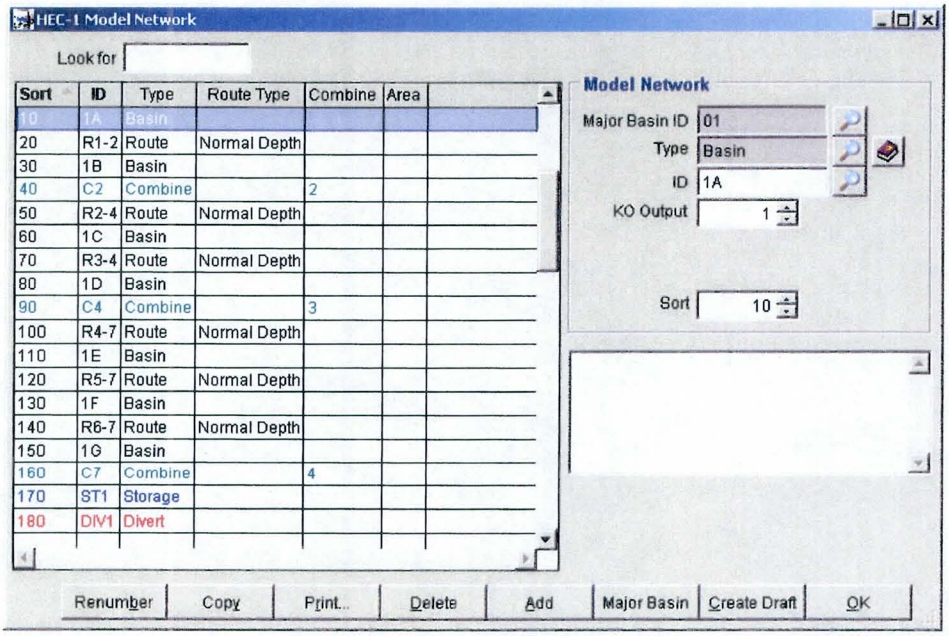
This updates HEC-1 data from sub basins, routing, storage and diversion data. It requires the appropriate data to be available in the management system.

Delete Prior Results

This deletes all model results for the selected major basin(s) in the Flow Summary table before running the model.

After making selections, click Run Model to run the HEC-1 model. To view results, click the Results button. Note, that clicking this button prior to running the model will display the previous model run results. If there are any errors when modeling multiple runs, it will be necessary to model one basin and a single return period to help determine the problem. To view the HEC-1 schematic for the 100-Year model, click Schematic .

Network



This form is used to establish draft data for the HEC-1 model.

Select the major basin, type and ID. Depending on the type selected, appropriate IDs for basins, divert, retrieve, route and storage are available for selection. The data needs to be available in their respective tables to be available. If 'Combine' is entered as the type, it is necessary to enter an ID and the number of Combines. If 'Route' is entered as the type, it is necessary to enter the 'Routing Type'.

At any location a KO output number between 1 and 5 can be selected. See the HEC-1 manual for a description of the outputs for each number.

Create Draft will place draft data for running the HEC-1 model in 'HEC-1 Data' and also a model input file in the Model Runs Path directory. The model (with assumed data) can then be run without updating data to check for network errors. If there are no errors, then update the data with correct information from project tables (refer to the next section, Data, in this Manual).

Click to display descriptions for the HEC-1 cards in PDF format.

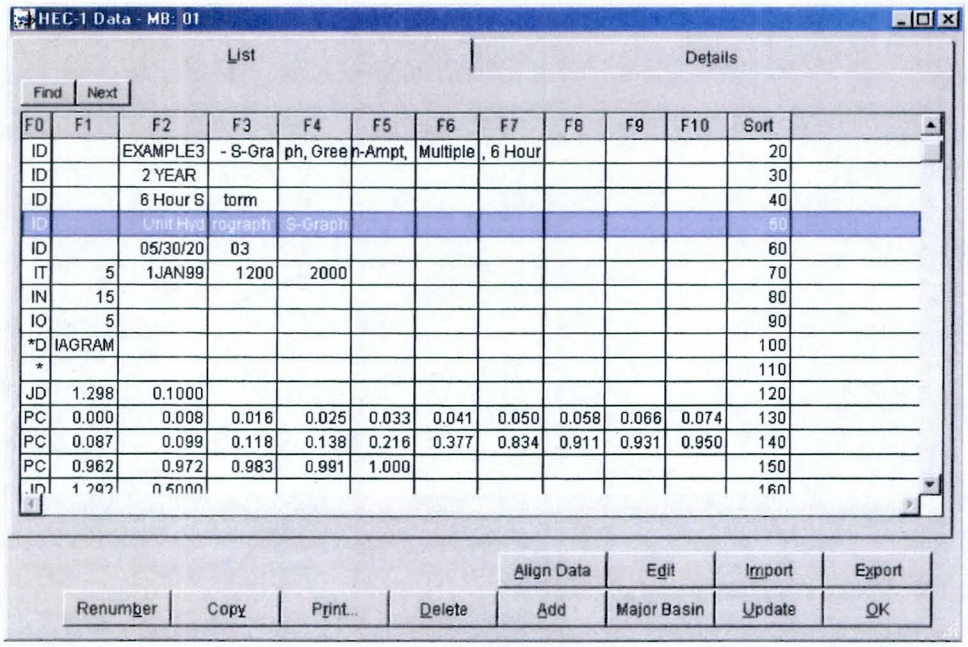
Data

This screen is used to manage data to run the HEC-1 model. It allows the user to import a HEC-1 file or to edit an existing Major Basin HEC-1 file within a project.

If a file is imported without associated sub basin, land use, soils or routing data, the 'Update' option should not be used.

Updating the data will search all the appropriate tables for the latest data and replace the existing data in this file. The same option is available when running the model. When updating from this section, the Return Period is requested. This way the appropriate rainfall data can be inserted. Use this function together with "Export" to give another user the HEC-1 file.

An example of importing a "Stand Alone" HEC-1 model is provided in the Help menu for DDMSW.



F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Sort
ID		EXAMPLE3	- S-Gra	ph, Gree	n-Ampt,	Multiple	, 6 Hour				20
ID		2 YEAR									30
ID		6 Hour S	torm								40
ID		Unit Hyd	rograph	S-Graph							50
ID		05/30/20	03								60
IT	5	1JAN99	1200	2000							70
IN	15										80
IO	5										90
*D	IAGRAM										100
*											110
JD	1.298	0.1000									120
PC	0.000	0.008	0.016	0.025	0.033	0.041	0.050	0.058	0.066	0.074	130
PC	0.087	0.099	0.118	0.138	0.216	0.377	0.834	0.911	0.931	0.950	140
PC	0.962	0.972	0.983	0.991	1.000						150
JD	1.292	0.5000									160

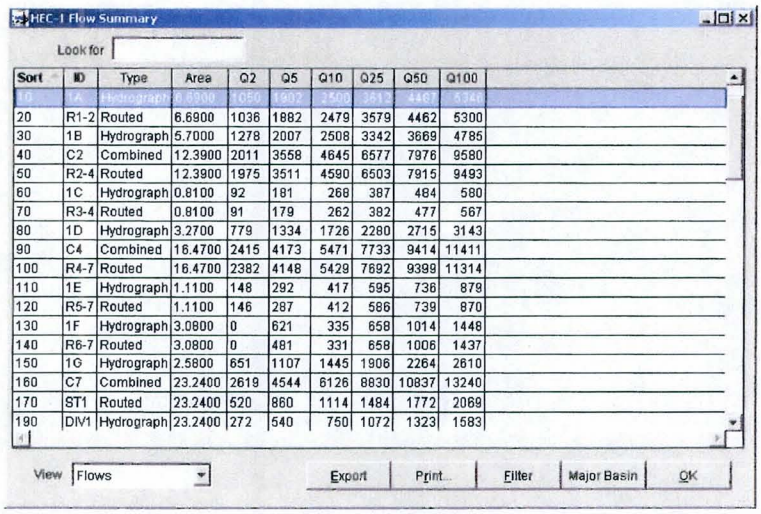
Data can normally be established by creating a draft model or by importing an existing HEC-1 model file. When importing a "Stand Alone" HEC-1 file, the labels for the F2 field of the KK card are automatically added.

The data in this file can be exported to an ASCII file to facilitate editing by clicking on the 'Export' button and following the instructions on the screen. When finished editing, the file can be imported by clicking on the 'Import' button. Importing replaces the existing data for the selected Major Basin. To view a different Major Basin's data, click on the 'Major Basin' button and select a new major basin.

Update replaces HEC-1 model data with data from appropriate sub basin, diversion, routing or storage tables in the project.

Flow Summary

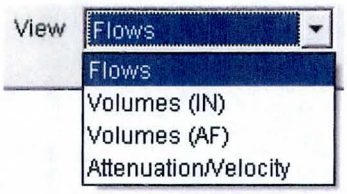
Flow Summary displays summary results of HEC-1 model runs. The data cannot be edited. This is the same screen that is displayed when the Results button is clicked on the 'Run HEC-1 Model' screen.



Sort	ID	Type	Area	Q2	Q5	Q10	Q25	Q50	Q100
10	1A	Hydrograph	6.6900	1050	1902	2509	3615	4467	5340
20	R1-2	Routed	6.6900	1036	1882	2479	3579	4462	5300
30	1B	Hydrograph	5.7000	1278	2007	2508	3342	3669	4785
40	C2	Combined	12.3900	2011	3558	4645	6577	7976	9580
50	R2-4	Routed	12.3900	1975	3511	4590	6503	7915	9493
60	1C	Hydrograph	0.8100	92	181	268	387	484	580
70	R3-4	Routed	0.8100	91	179	262	382	477	567
80	1D	Hydrograph	3.2700	779	1334	1726	2280	2715	3143
90	C4	Combined	16.4700	2415	4173	5471	7733	9414	11411
100	R4-7	Routed	16.4700	2382	4148	5429	7692	9399	11314
110	1E	Hydrograph	1.1100	148	292	417	595	736	879
120	R5-7	Routed	1.1100	146	287	412	586	739	870
130	1F	Hydrograph	3.0800	0	621	335	658	1014	1448
140	R6-7	Routed	3.0800	0	481	331	658	1006	1437
150	1G	Hydrograph	2.5800	651	1107	1445	1906	2264	2610
160	C7	Combined	23.2400	2619	4544	6126	8830	10837	13240
170	ST1	Routed	23.2400	520	860	1114	1484	1772	2069
190	DIV1	Hydrograph	23.2400	272	540	750	1072	1323	1583

The natural order of the model run can be viewed by double clicking on 'Sort' in the grid header. The data can also be sorted by 'ID'.

Use the drop down list to select an appropriate view.



View Output

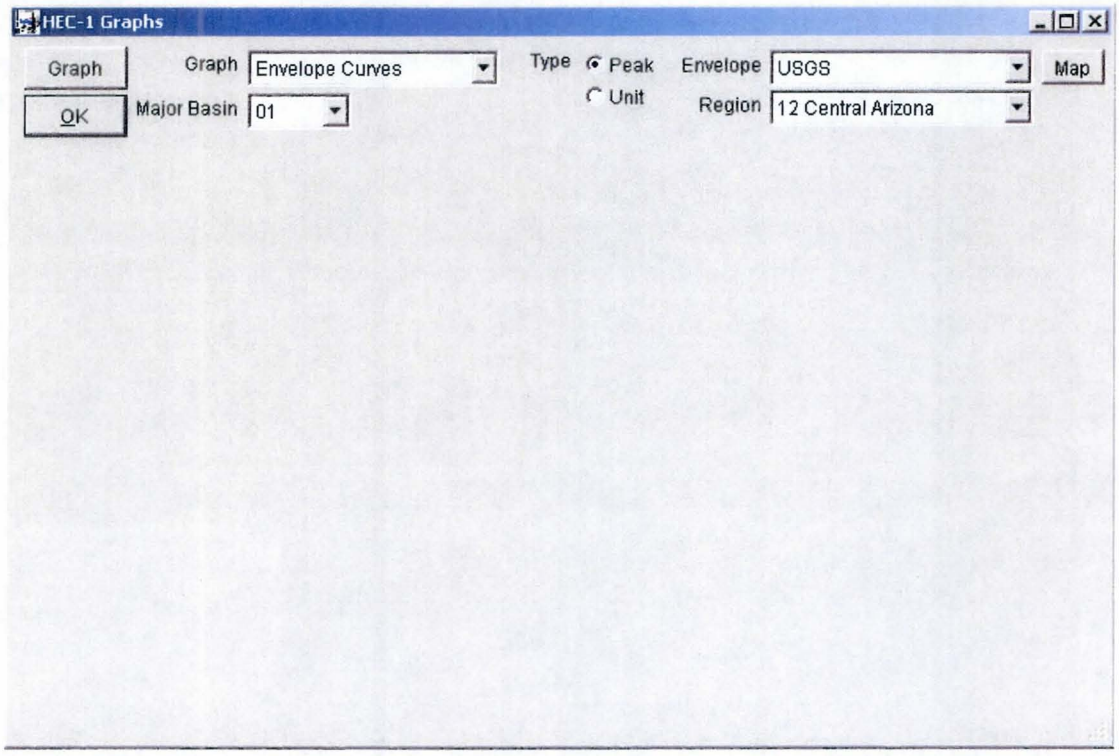
This option enables the user to view the HEC-1 ASCII output file. Select the output file by highlighting the file name and pressing *OK* or by double clicking on the specific file name. The text editor (as specified in 'Tools/Options') displays the file on the screen. When finished viewing, close the window by clicking ☒, otherwise the text editor program will remain loaded in memory.

```
                                        X     X  XXXXXXX   XXXXX          X
                                        X     X  X        X     X        XX
                                        X     X  X        X              X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X              X
                                        X     X  X        X     X        X
                                        X     X  XXXXXXX   XXXXX         XXX


 THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

 THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

                                                HEC-1 INPUT                                                    PAGE  1

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1          ID   Project ID: ANYTOWN - Major Basin: 02 - Return Period: 10 Years
   2          ID   10 YEAR 6 HOUR
   3          IT       1  5FEB99    1200     2000
   4          IO       5

   5          KK  020505   BASIN
   6          BA   0.025
   7          PB   2.019
   8          IN      15
   9          PC   0.000    0.014    0.027    0.039    0.058    0.074    0.089    0.106    0.122    0.137
  10          PC   0.154    0.174    0.200    0.248    0.331    0.484    0.665    0.786    0.856    0.901
  11          PC   0.938    0.953    0.969    0.985    1.000
  12          LG    0.20     0.15     9.70     0.05       44
  13          UC   0.450    0.200
  14          UA       0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
  15          UA     100
```

Graphs

The 'Graphs' option has been developed to facilitate the review of hydrological results and data input. Graphs that facilitate the review of hydrological results include envelope curves for USGS, Malvick and Boughton. These curves are compared to peak or unit discharge model results. Graphs that facilitate the review of input data include channel cross-sections, diversions, stage-discharge and stage-volume relationships.

Click Map to view the map of the USGS region.



Graphs Toolbar

The following tools are available on the graph screen:

Copies the graph to the clipboard as a bitmap, metafile, text or OLE object.

Data Editor. This displays the data values at the bottom of the screen. These values can be edited, and the graph dynamically reflects these changes.

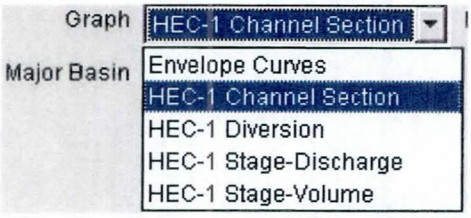
	1	2	3	4	5	6	7	8
— 1	510	1510	1585	1596	1600	1612	1662	2262
	99.70	94.10	93.60	92.20	92.20	93.60	94.90	99.70

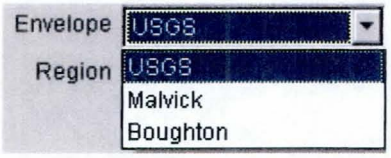
Zoom tool. Click this icon and draw an area of the graph to be magnified.

Prints the graph.

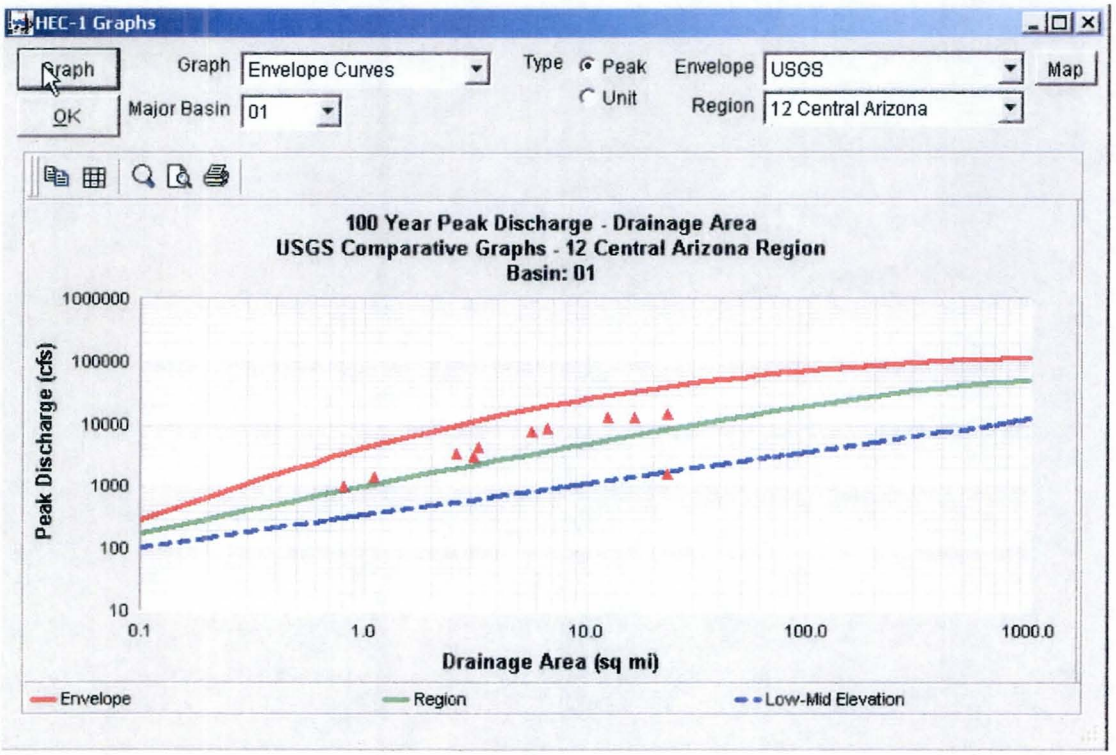
Please note that the data for the graphs has been rounded to facilitate the graphing function. Therefore the data is not as precise as the data in the application.

Select the type of graph, a Major Basin ID, Type, Envelope and Region from the pull-down lists.

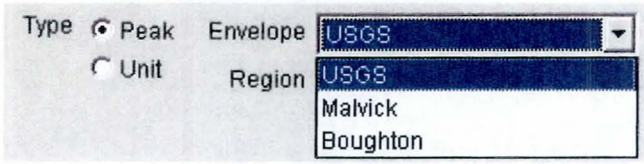




Click the Graph button to display the graph on the screen.



Envelope Curves (USGS, Malvick and Boughton)

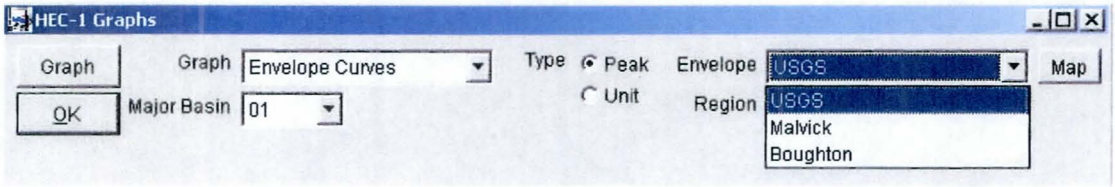


Select USGS, Malvick or Boughton data. The USGS data was derived manually from the data contained in "Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States", United States Geological Survey Water-Supply Paper 2433. Northeastern Arizona – Figure 39, Central Arizona – Figure 41, Southern Arizona – Figure 42 and Upper Gila Bend – Figure 44. The legend on each of the graphs is as follows:

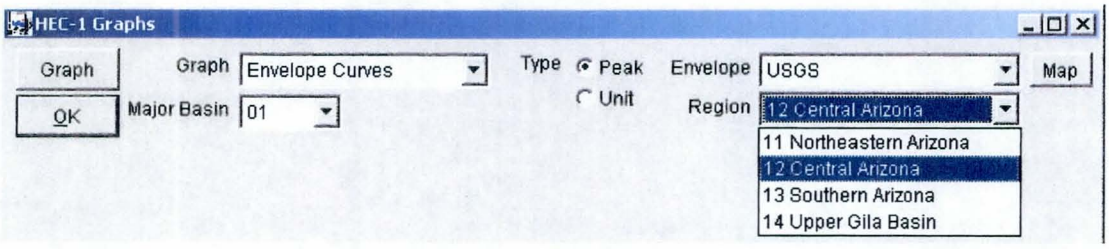
Envelope	Envelope Curve for Study Area
Region	100-Year Peak Discharge Relation for Region
Low-Mid Elevation	100-Year peak Discharge Relation for Low to Middle-Elevation Study Area

The Malvick data was derived from "A Magnitude-Frequency-Area relation for Floods in Arizona", Allan J. Malvick, January 1980, Figure 6 – 100-year curve. The Boughton data was derived from "Highway Drainage Design Manual Hydrology", Report Number FHWA-AZ93-281, March 1993, Figure 10-1 Curve H.

The selection of Envelope Curves from the Graphs pull-down provides the following choices.



If USGS is selected from the Envelope pull-down, then the user can select the appropriate Region as shown.

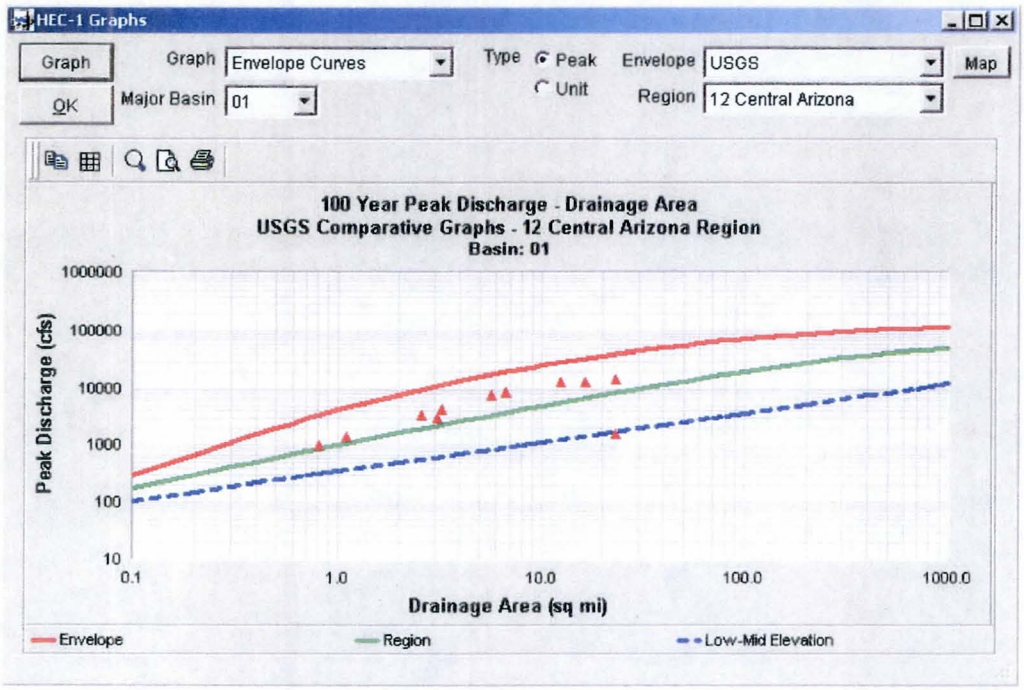


All of the envelope curves can be graphed in either Peak (Peak Discharge in cfs) or Unit (Unit Discharge in cfs/sq mi).

Peak Discharges Scatter Graph

The Peak Discharges Graph is a graph of drainage area verses peak discharge (or unit discharges) for sub-basins and combined flows. The data is generated when running HEC-1 and is saved in Table HEC1SUMM.DBF. For this analysis, only the 100-year flows are graphed. From within a specific Project, the user selects a major basin. If the major basin has been modeled, the 100-year area and discharges for *"Hydrographs"* (sub-basins) and *"Routed"* (routed flows) are copied to a temporary file for graphing.

Selection of Major Basin 01, USGS Envelope with Central Region and Peak will produce the following graph:



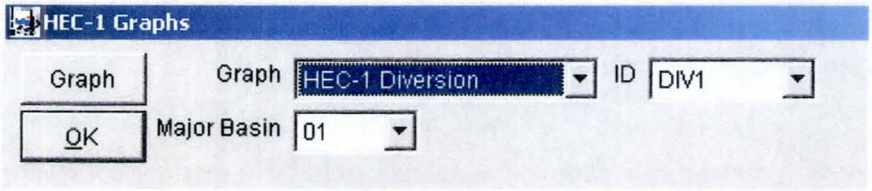
Note that the toolbar can moved anywhere on the graph screen.

Rating Curves Plot

Rating curves are for Stage-Discharge, Stage-Volume and Diversions. The data is developed from the HEC-1 input file as follows:

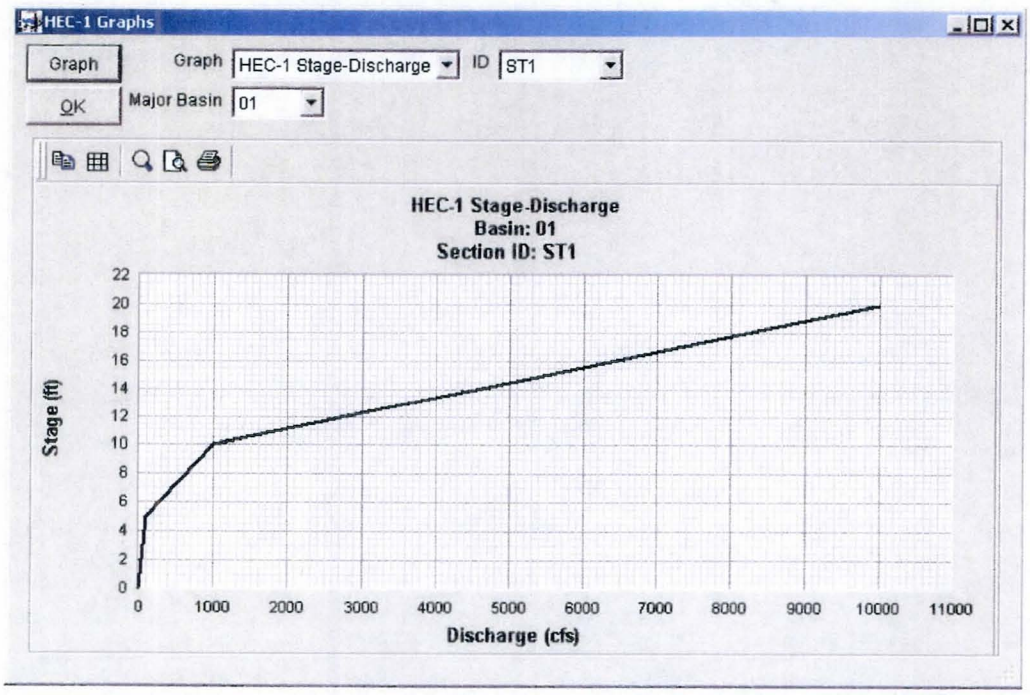
Stage-Discharge	SE and SQ cards
Stage-Volume	SE and SV cards
Diversions	DI and DQ cards

When the user selects a new Major Basin, the HEC-1 input file for the Major Basin is scanned for SE and DI cards. The KK value for all found SE and DI cards establishes the available ID's to graph. The ID's are saved to a temporary file and the data for the graphs (SE-SQ, SE-SV and DI-DQ) are saved to a separate temporary file. The user must also select an ID.

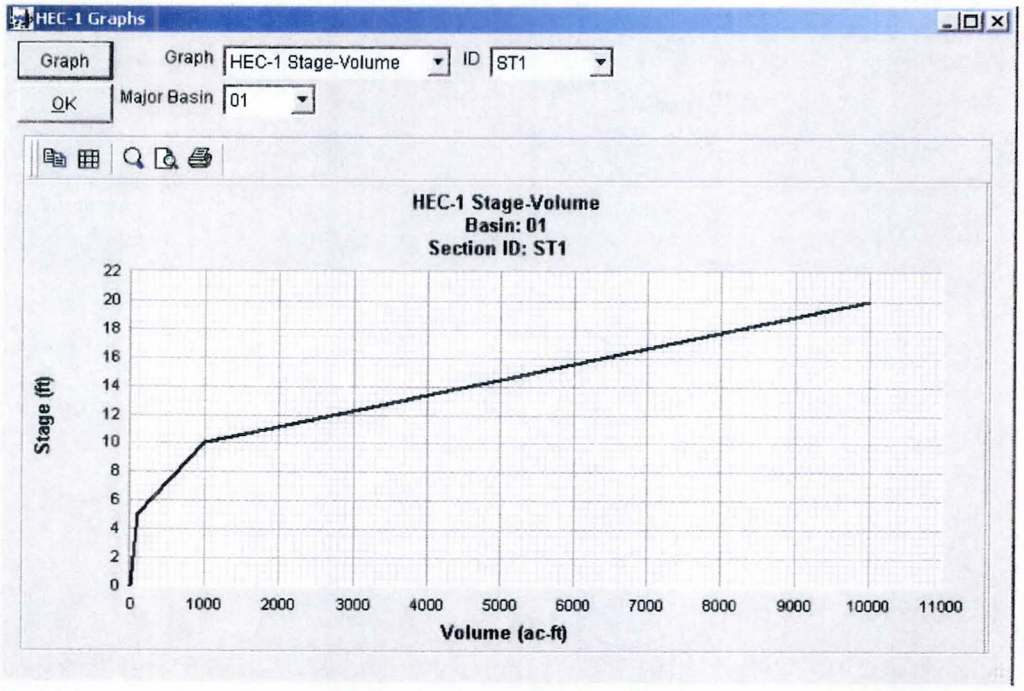


The following three Rating Curve graphs are available:

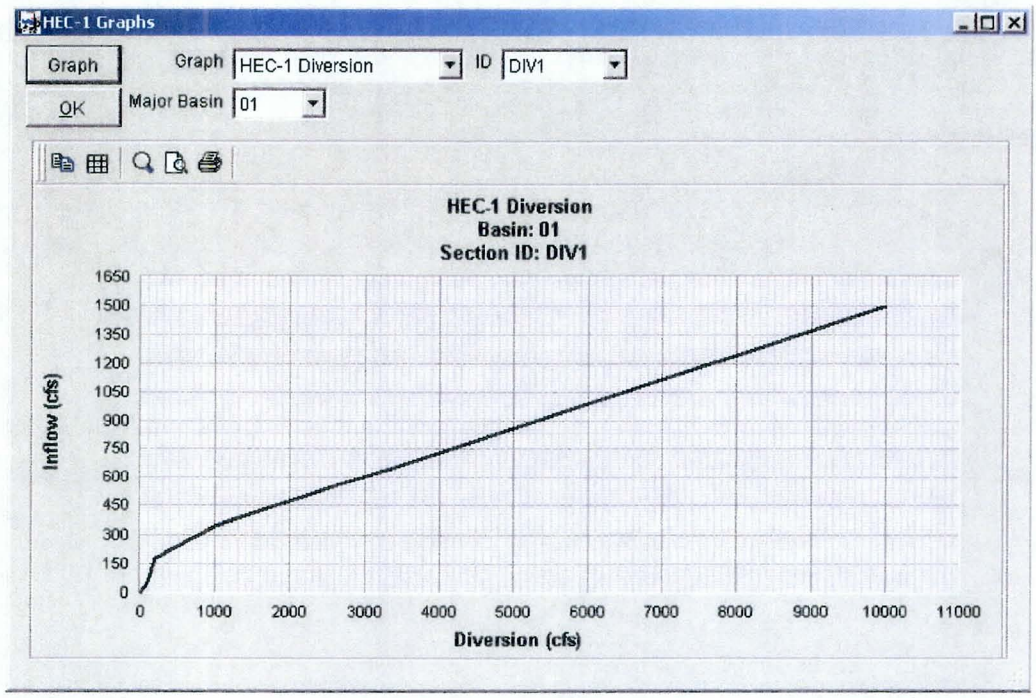
Stage-Discharge Plot



Stage-Volume Plot

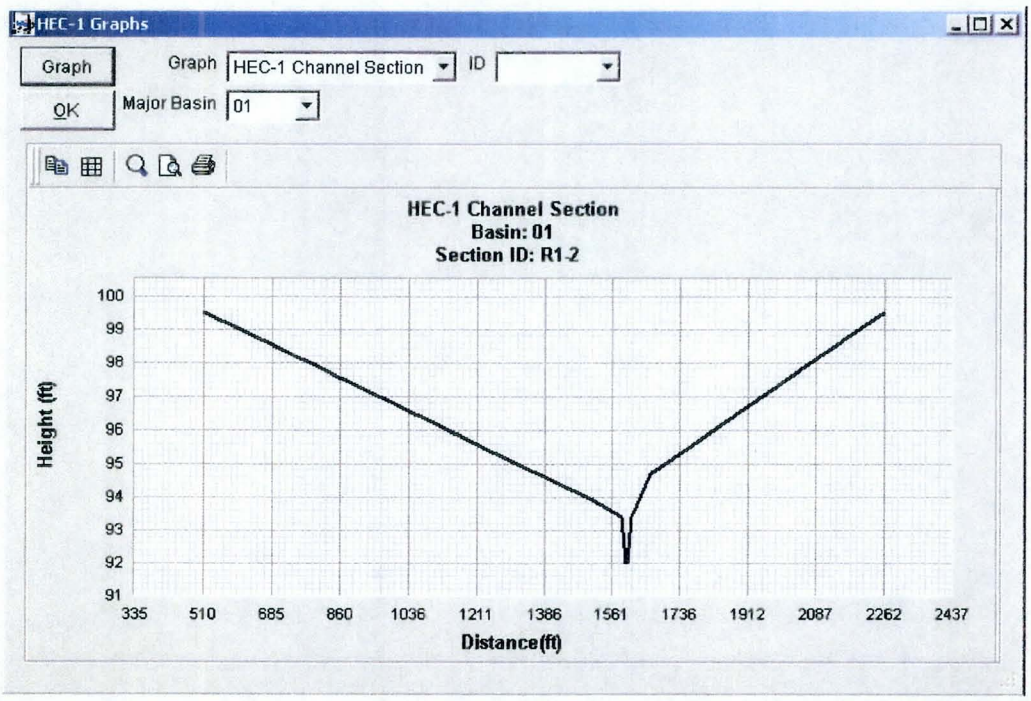


Diversion Plot

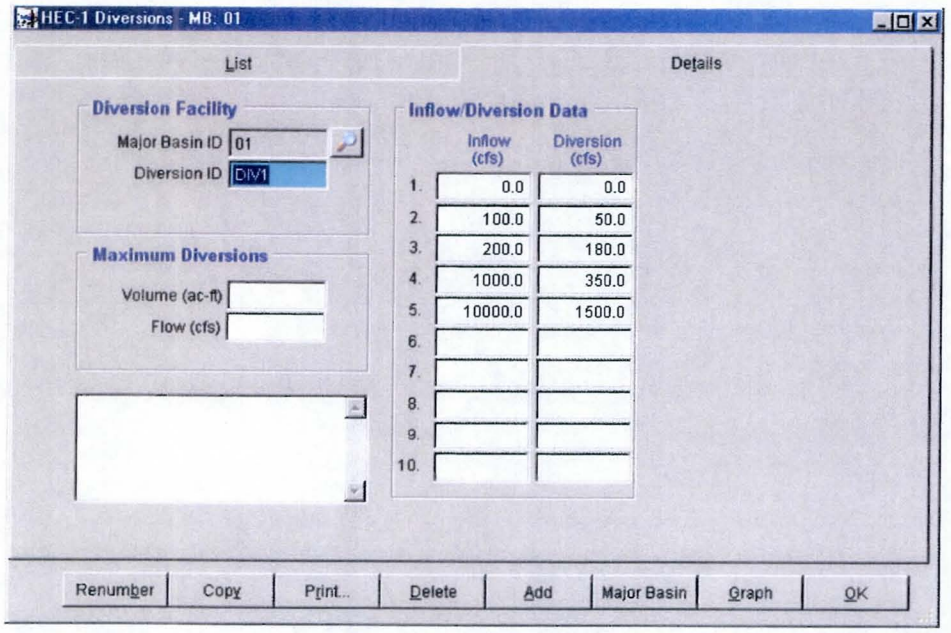


Channel Section Plot

Channel section plots are for RX-RY cards developed from the HEC-1 input file. When the user selects a new Major Basin, the HEC-1 input file for the Major Basin is scanned for RX cards. The KK value for all found RX cards establishes the available ID's to graph. The ID's are saved to a temporary file and the data for the graphs (RX-RY) are saved to a separate temporary file. The user selects an ID for the following typical graph.



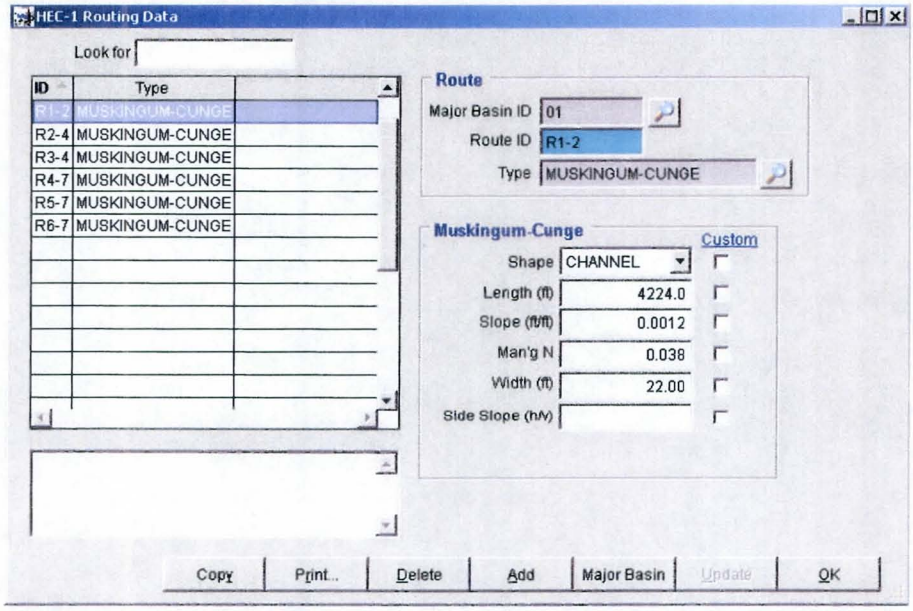
Diversions



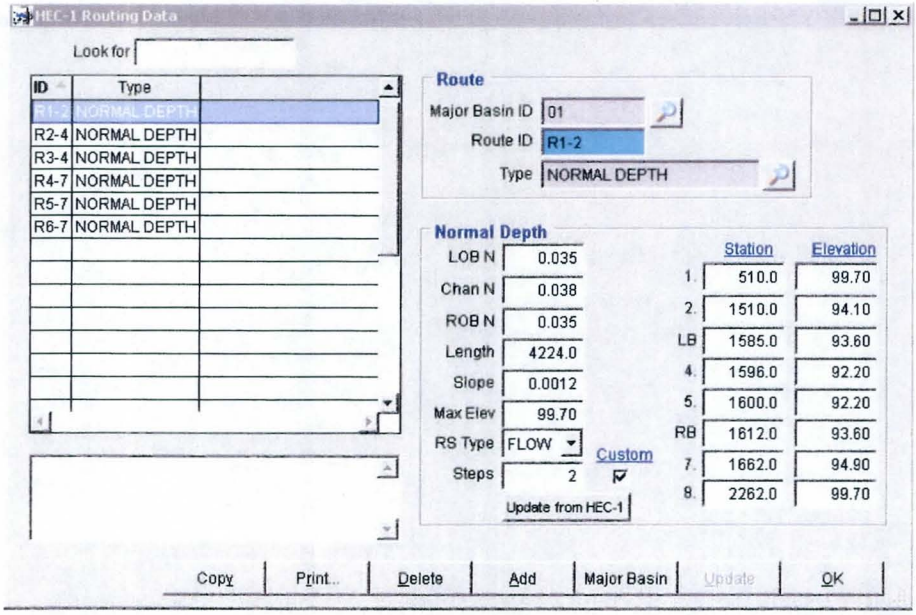
This is used to enter diversion data for the HEC-1 model. Enter an appropriate Diversion ID and diversion data. For the Update to run correctly in the HEC-1 model, the Diversion ID must be the same as F1 for the KK record in the HEC-1 file.

Routing

Kinematic Wave and Muskingum-Cunge



Normal Depth

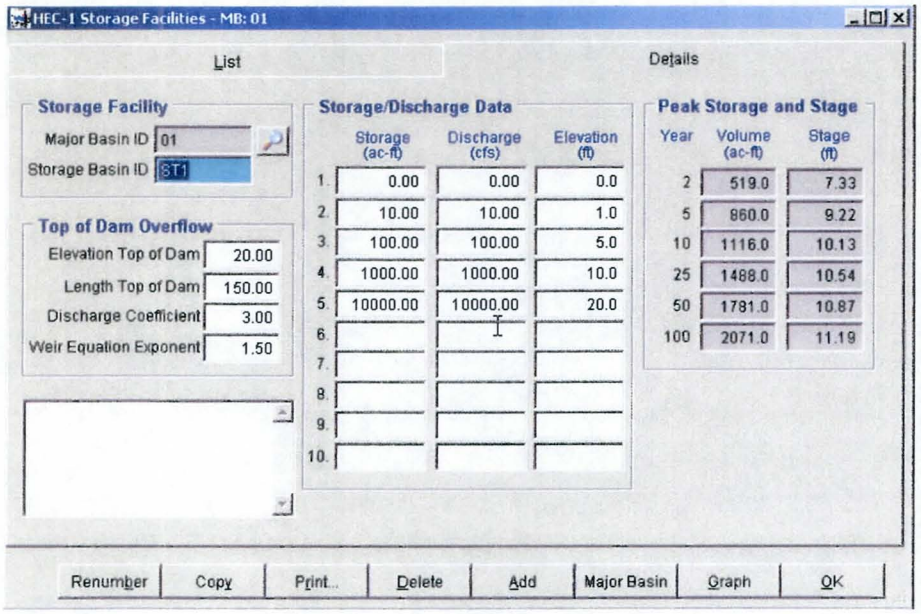


The Routing screen is used to enter data required for the routing of flows in the HEC-1 model. Select the routing type for each section using the drop down list.

Depending on the routing type selected, different data will be required. It is important that the routing type and data match the data in the HEC-1 model for the associated ID.

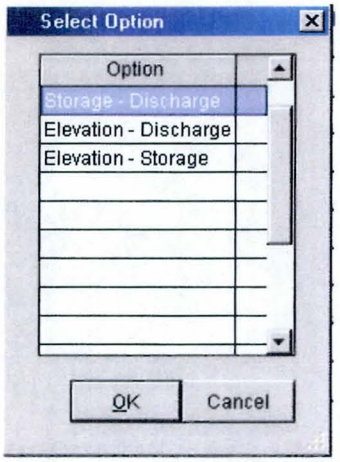
For Normal Depth Routing, the steps can be established by clicking *Update from HEC-1*. An example of this procedure can be found in the Help Menu for this application.

Storage

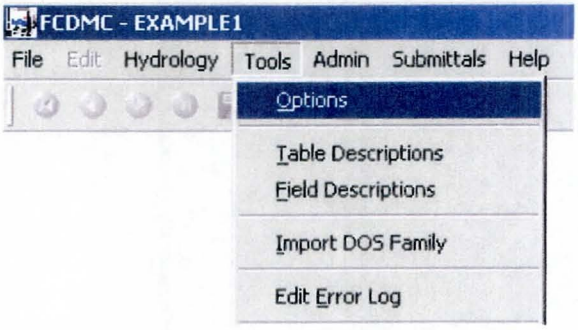


This is used to enter storage data for the HEC-1 model. Enter an appropriate Storage Basin ID and storage data. For the Update to run correctly in the HEC-1 model, the Storage Basin ID must be the same as F1 for the KK record in the HEC-1 file. Peak Storage and Stage data is automatically populated when running the HEC-1 model.

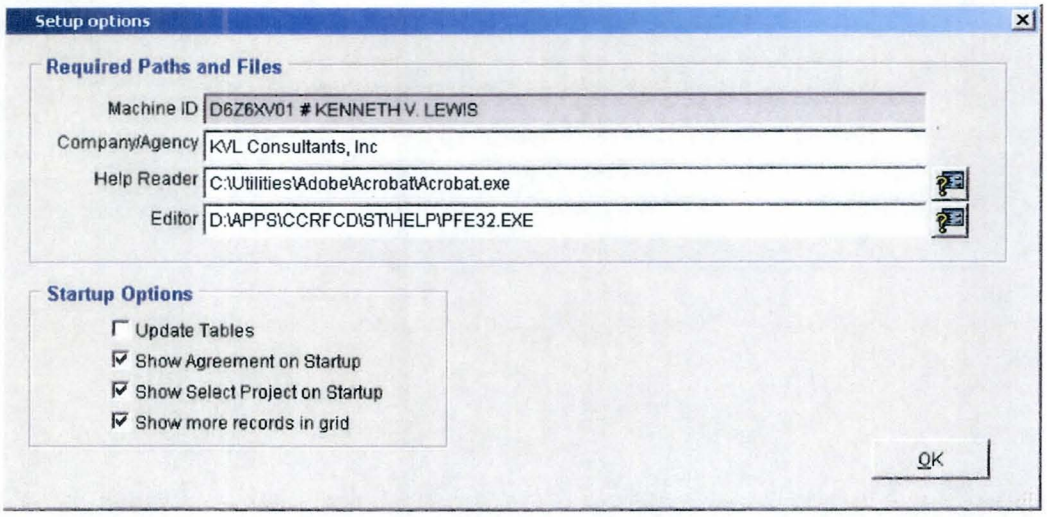
A graph of Storage-Discharge, Elevation-Discharge or Elevation-Storage can be viewed by clicking [Graph] and selecting the appropriate option.



Chapter 5 Tools



Options

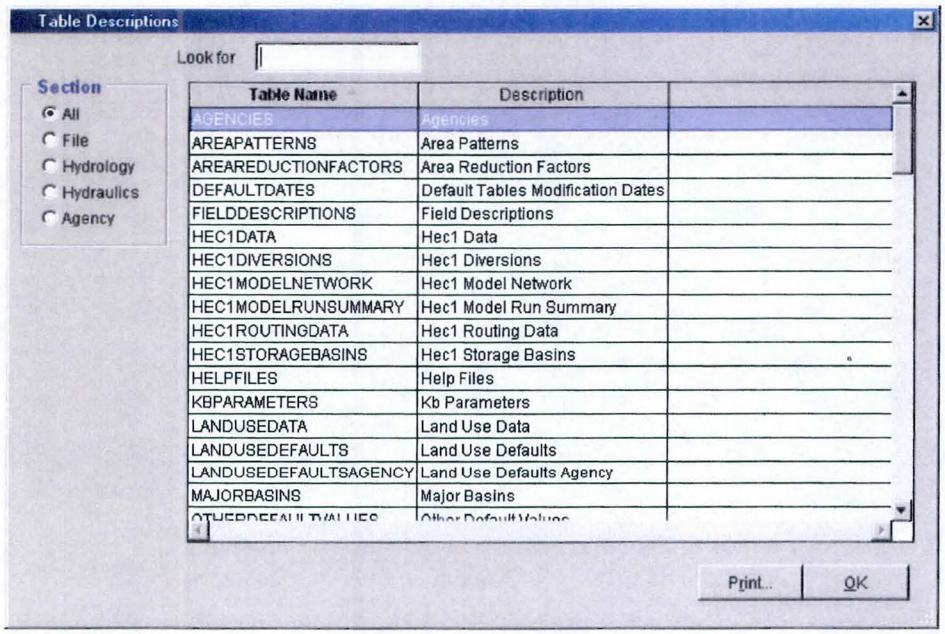


The selection of Options from the Tools Menu is used to edit System settings. Enter the Company or Agency name and the paths to Acrobat Reader and the text editor (i.e. Notepad). The default text editor is 'pfe32.exe' but the user can change to another preferred text editor.

Check which Startup Options should apply.

Update Tables	Forces an update to the tables the next time the user enters the system.
Show Agreement	Displays the Flood Control District of Maricopa County Drainage Design Management System agreement window.
Show Select Project	Automatically loads the "Select Project Form on startup. If not selected, the system will default to the last project edited when exiting the system.
Show More records in Grid	If selected, the grid font size will not change when making the form larger enabling more records to be shown.

Table Descriptions



The selection of Table Descriptions from the Tools menu is used to view the name and description of tables used in the application. This data is for viewing only and cannot be edited. Use the 'Section' radio buttons to view tables pertaining to a specific function. The user can print a table description using the *Print* button.

Field Descriptions

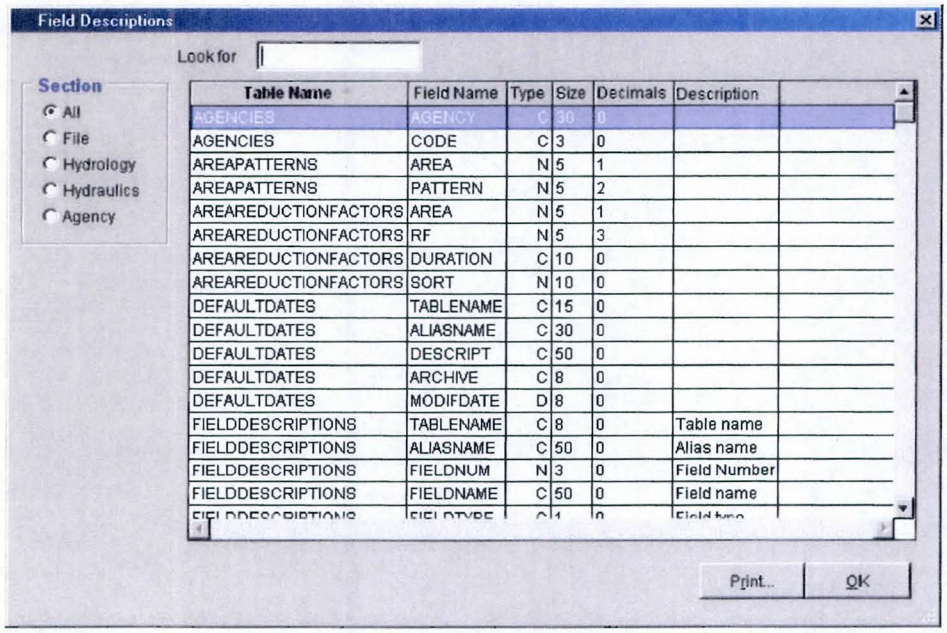
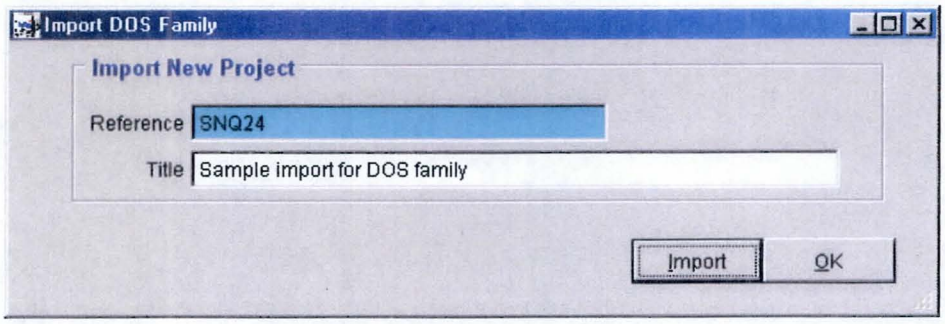


Table Name	Field Name	Type	Size	Decimals	Description
AGENCIES	AGENCY	C	30	0	
AGENCIES	CODE	C	3	0	
AREAPATTERNS	AREA	N	5	1	
AREAPATTERNS	PATTERN	N	5	2	
AREAREDUCTIONFACTORS	AREA	N	5	1	
AREAREDUCTIONFACTORS	RF	N	5	3	
AREAREDUCTIONFACTORS	DURATION	C	10	0	
AREAREDUCTIONFACTORS	SORT	N	10	0	
DEFAULTDATES	TABLENAME	C	15	0	
DEFAULTDATES	ALIASNAME	C	30	0	
DEFAULTDATES	DESCRIPT	C	50	0	
DEFAULTDATES	ARCHIVE	C	8	0	
DEFAULTDATES	MODIFDATE	D	8	0	
FIELDDESCRIPTIONS	TABLENAME	C	8	0	Table name
FIELDDESCRIPTIONS	ALIASNAME	C	50	0	Alias name
FIELDDESCRIPTIONS	FIELDNUM	N	3	0	Field Number
FIELDDESCRIPTIONS	FIELDNAME	C	50	0	Field name
FIELDDESCRIPTIONS	FIELDTYPE	C	1	0	Field type

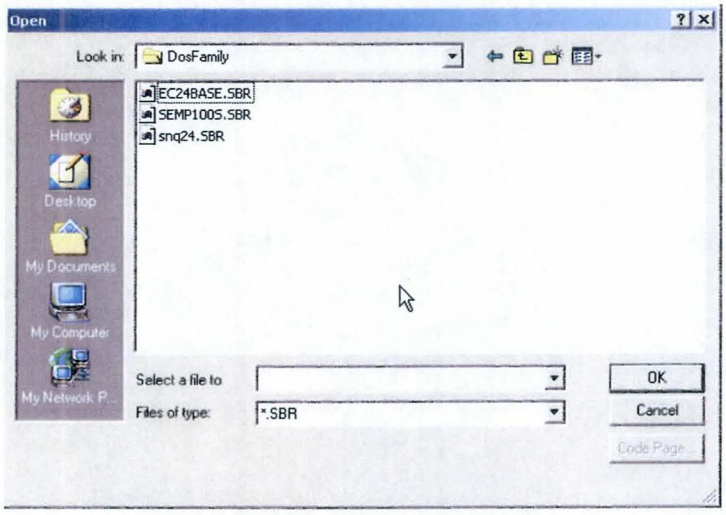
The selection of Field Descriptions from the Utilities menu is used to view the structure of each table used in the application. This data is for viewing only and cannot be edited. Use the 'Section' radio buttons to view fields pertaining to a specific function. The user can print the field description using the *Print* button.

Import DOS Family

The selection of Import DOS Family from the Tools menu is used to import data developed in the DOS version of DDMS.



Enter a Reference and title to the project being imported similar to when starting a new project in Select Project. Click Import and navigate to the appropriate file with an .SBR extension.



The program will import data as follows:

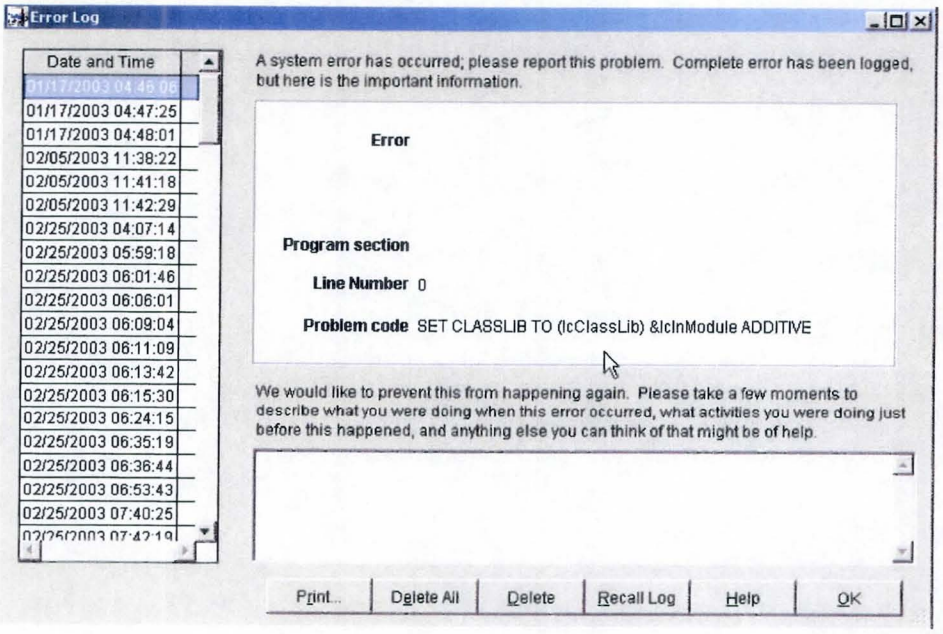
Sub Basin Area data	From a file with an .SBR extension
Default Land Use data	From a file with an .LDF extension
Sub Basin Land Use data	From a file with an .SUB extension
Sub Basin Soil data	From a file with an .SUB extension
Hydrograph Type	From a file with an .SUB extension
Precipitation data	From a file with an .PFI extension
Storms, duration, Timearea, NMIN	From either *M1I or *M2I

If the above files are not available for the *"family"*, then not all of the required data will be imported and the remaining required data will have to be entered manually.

When importing a DOS family with HEC-1 data, the appropriate labels for the F2 field of the KK card are automatically added.

Edit Error Log

Whenever an error occurs in the Application, an Error Log is automatically placed in the Error Log Table. This is used to explain what happened and to send the report to the Agency for problem resolution.

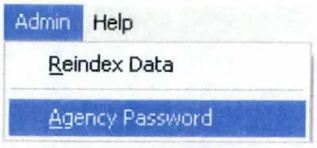


The User should enter the appropriate information in the bottom box and print a report of the incident. In Crystal Reports, Click the to export the report to a PDF file. This should be emailed to the Agency with any other explanations to help resolve the issue.

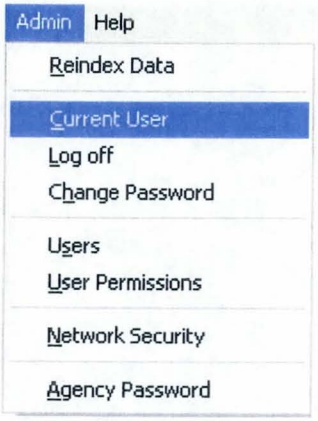
Chapter 6 Admin

The Pull down menu for Admin is different depending on the type of installation.

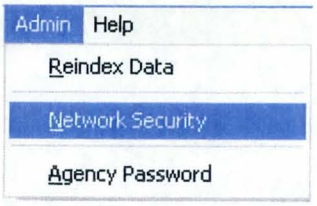
- Application installed on a single computer.



- Application data accessed over a network with security options



- Application data accessed over a network without security options.



Reindex Data and Agency Password are available for all options. Change Agency Password is only available after entering a valid Agency Password.

Reindex Data

Caution: Reindexing and packing tables take a few minutes to complete. Interrupting the process once it has begun will result in data corruption.

This function can only be used when there are no other users accessing the application. The option is used for two purposes. In the event of a corrupt index, the administrator needs to reindex tables and rebuild the table indexes.

The option also packs all tables in the database. When a record is deleted, it is not physically erased from disk until the database is packed. Packing permanently removes deleted records and restores disk space occupied by those deleted records. The database should be packed occasionally to restore disk space.

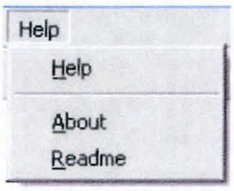
Agency Password

Access to the Agency menu is restricted. Enter the password to access the Agency menu. Passwords are not case sensitive.

Change Agency Password

This is only visible if an appropriate Agency password has been entered. This enables the user to change the password. A window appears confirming the new password. If this is correct, click *OK* to confirm the change.

Chapter 7 Help and Window

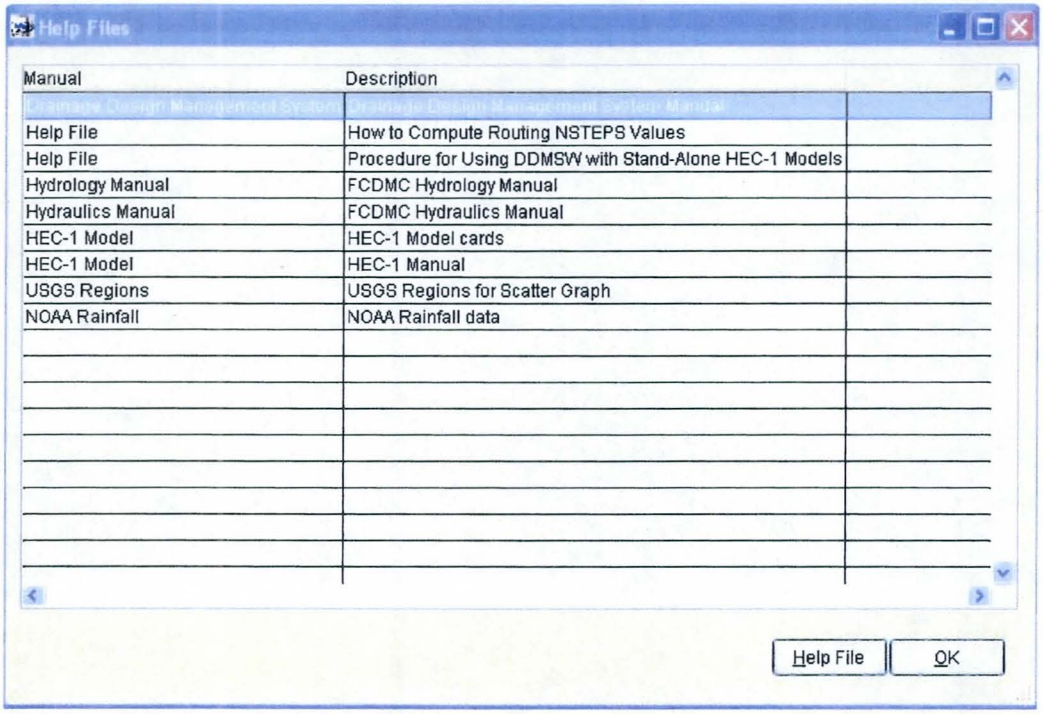


Help

The Help menu offers 3 options:

Help

This option on the Help menu displays a list of manuals that the user can view. Highlight a manual and click Help File. Acrobat reader opens the manual on the screen. When finished viewing, close the Acrobat screen otherwise it will remain open on the desktop. The correct path to Acrobat Reader must be entered on the 'Setup Options' screen available on the Tools menu.



Manual	Description
Drainage Design Management System	Drainage Design Management System Manual
Help File	How to Compute Routing NSTEPS Values
Help File	Procedure for Using DDMSW with Stand-Alone HEC-1 Models
Hydrology Manual	FCDMC Hydrology Manual
Hydraulics Manual	FCDMC Hydraulics Manual
HEC-1 Model	HEC-1 Model cards
HEC-1 Model	HEC-1 Manual
USGS Regions	USGS Regions for Scatter Graph
NOAA Rainfall	NOAA Rainfall data

About

This displays the informational screen for the application.

Readme

Displays the Readme.txt file to view a cumulative record of updates. When finished viewing, close the editor screen otherwise it will remain open on the desktop. The correct path to the text editor must be entered on the 'Setup Options' screen available on the Tools menu.

How to Compute Routing NSTEPS Values

This procedure is for models with data in the application and is not for stand alone models.

1. Open an existing project (File => Select Project). Press "OK" to close the menu.

2. Go to the Routing Menu (Hydrology => HEC-1 => Routing). Check the custom checkbox to the right of the 'Steps' field. This allows you to enter an initial step value into the current routing card. Type an initial steps value into the 'Steps' field. Now, uncheck the custom checkbox and press "Save". Repeat for every routing card. When finished, press "OK" to close the Routing Menu.

3. Go to the Data Menu (Hydrology => HEC-1 => Data). Press the "Update" button. Select a return period. Press the "OK" button. This will update the HEC-1 data with the latest parameters from the data entry menus, including the initial routing NSTEP values. Press "OK" to close the Data Menu.

4. Go to the Routing Menu (Hydrology => HEC-1 => Routing). Press the "Update from HEC-1" button. A pop-up message will appear stating that HEC-1 will run 3 times and update Steps, but only if the custom checkbox is unchecked. Press "Yes". After the third HEC-1 run finishes, the 'Steps' values for the routing cards will be updated. Press "OK" to close the Routing Menu.*

5. After all steps are final, you can run the model to obtain results (Hydrology => HEC-1 => Model). Afterwards, you can view the output file, see summary results (peak flows, etc), and create graphs. Please refer to the appropriate sections in the manual for more information.

***NOTES:**

A. When you press the "Custom" checkbox next to the "Steps" field, it will lock the value so it cannot be changed with the "Update from HEC-1" button.

B. If you receive 'output file not found' messages after pressing the "Update from HEC-1" button in the Routing Menu, check the model runs path. It may not be set for the project.

Procedure for Using DDMSW with Stand-Alone HEC-1 Models

This procedure outlines the method for importing an existing HEC-1 model to use the reporting and graphing features of DDMSW without the supporting land use, soils, sub-basin and network data.

1. Create a new project (File => New Project). Put a short name for the project in the Reference field. The Reference field can be letters and numbers (no space) and can hold 20 characters. Press the "Save" button to save the new project information. Press the "OK" button to close the menu.
2. Set the model run path (File => Project Paths). Press "OK" when prompted about checking the default paths and files before proceeding. Fill in the 'Model Runs Path' field by pressing the "..." button to the right of it and selecting the path where the HEC-1 output file will be stored. After finding the folder, press "Select" to choose it. Then, press "Save" and "OK".
3. Go to the HEC-1 Data Menu (Hydrology => HEC-1 => Data). Press the "Import" Button. Find the HEC-1 input file, highlight it, and press "OK". DDMSW will warn you that you will replace any existing data for the current project. Select "Yes" to continue.
4. Review the model data and make modifications if necessary. Press "OK" to close the Data Menu.*
5. Now it is time to run the model. Go to the Model Menu (Hydrology => HEC-1 => Model). Uncheck the "Update HEC-1" option. Check the 100-year return period and uncheck the other return periods. Press "Save". Then, execute the model by pressing "Run Model". If the model run is successful, DDMSW will display the message "Model Run Complete!".
6. You can now view the output file, see summary results (peak flows, etc), and create graphs. Please refer to the appropriate sections in the manual for more information.

***NOTE:**

To perform a modification to the standalone HEC-1 model at Step 4) above go to the Data Menu (Hydrology => HEC-1 => Data). Highlight the line to change by left clicking on it. Use the "find" and "next" buttons to search for a specific line. Press the "find" button. A 'Find Value' pop-up window will appear. The find function looks only in the F1 column, so type in a value such as a basin name (1A), a routing channel name (R1-2), or a specific number like the IA value for a Green-Ampt Parameter (0.28). Press "Save" and then "OK" to perform the search. The "next" button looks for the next line that contains the same F1 content. When you find and highlight the specific line to change, click the 'Details' Tab (or double-click on the line). Edit the HEC-1 field(s) by typing into the appropriate column(s) labeled by 'F1'-'F10'. Press "Save" to save your changes. You can get back to the line-by-line view of the data by left clicking to the "List" Tab. When you are finished making changes, press "OK" to exit the data menu.

FOR STANDALONE HEC-1 MODELS, DO NOT PRESS THE "Update" BUTTON! THE MODEL DATA MAY BE DAMAGED OR LOST!

FLOOD CONTROL DISTRICT
of
MARICOPA COUNTY

Drainage Design Management System
for Windows

kvlExample1
Instructions for Developing a New Project Using HEC1

KVL Consultants, Inc.

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kvlExample1

Introduction

This document is a guide to lead you through the creation of an example HEC-1 Model. After its completion, you should be familiar with the following concepts:

1 Create a Project Models Folder
2 Using the Help Feature of DDMSW
3 Establish a New Project and Set Defaults
4 Setting the Model Runs Path
5 Establish Rainfall Data for Project
6 Review Soil Defaults
7 Review Land Use Defaults
8 Establish Major Basin Id's
9 Establish Preliminary Sub Basin Data
10 Update Major Basin Data
11 Establish Soil Data
12 Establish Land Use Data
13 Update Sub Basin Data
14 Establish Preliminary Routing Data
15 Establish Draft HEC1 Input File
16 Run Draft HEC1 Model
17 Initialize Routing Steps Values (Normal Depth only)
18 Run HEC-1 Model and Update Data
19 Compute the Routing Steps for the Final Model (Normal Depth only)
20 Verify the Final HEC-1 Model Data
21 Run Final HEC-1 Model for All Return Periods
22 Graph HEC-1 Results
23 Backup Project

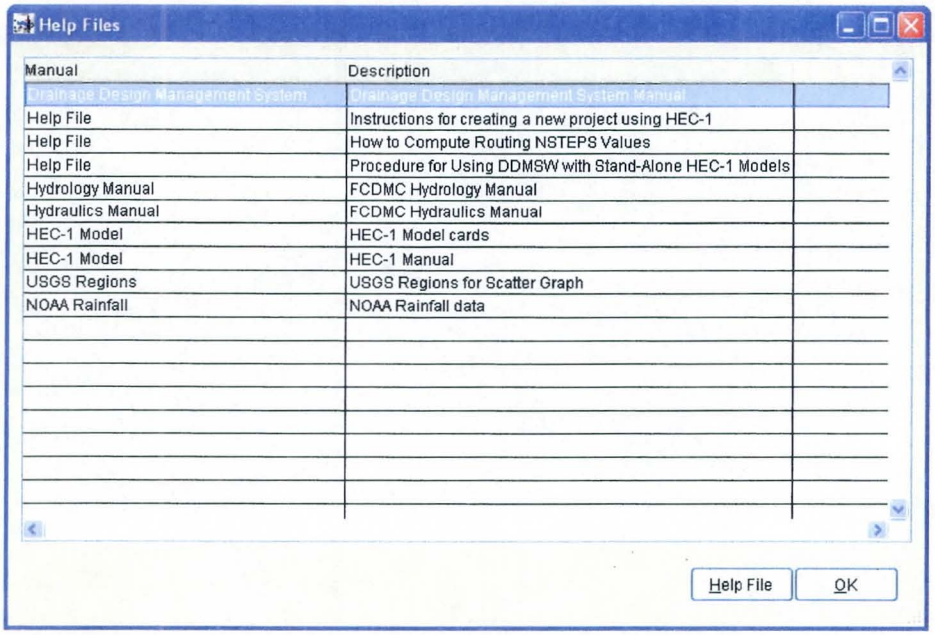
DDMSW has many capabilities not covered in this tutorial and it is recommended that you spend the time to read through the user manual and other supporting documents as well as explore the environment through the use of the pre-packaged example projects.

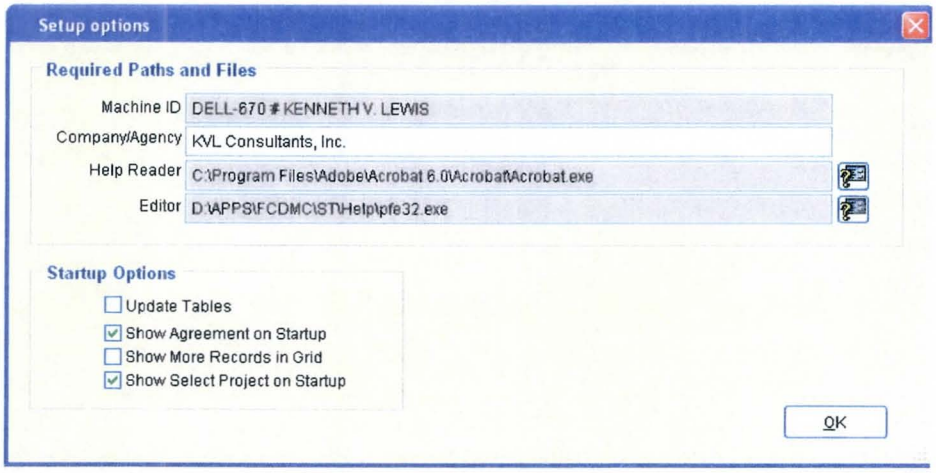
1. Create a Project Models Folder

Before starting the DDMSW Program, create a unique folder for the example HEC-1 model files. All projects use the same naming convention for the input and output HEC-1 files. As a consequence, two or more projects in the same folder can have data overwritten. For this example, use Windows Explorer to make a new folder 'C:\Fcdmc\St\Modlruns\kvlExample1\'.

2. Using the Help Feature of DDMSW

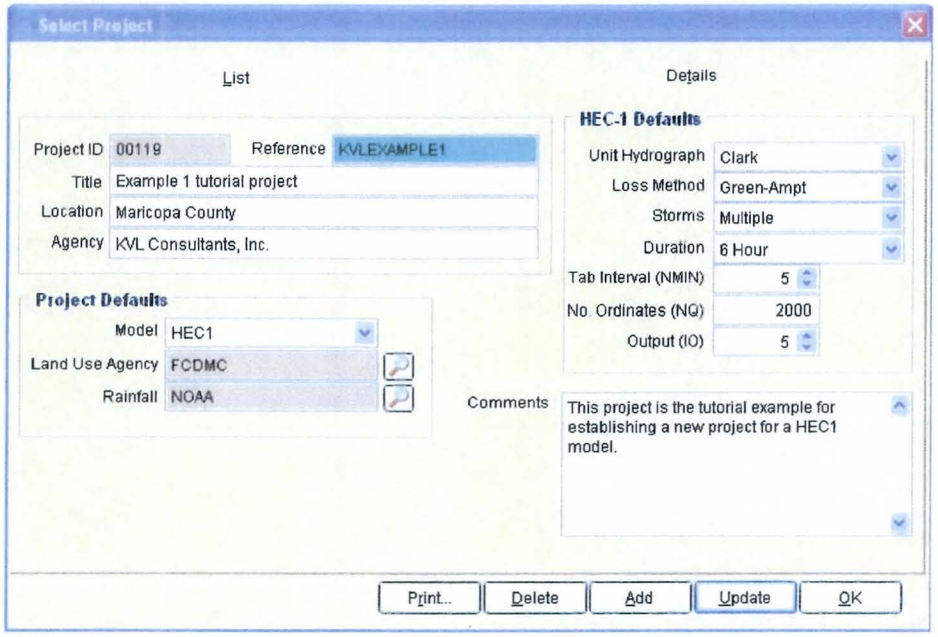
Now, open DDMSW. Go to the Help Menu and go to the Help Submenu. For the remainder of this tutorial, this will be abbreviated through the use of the following convention (Help => Help). You can read the DDMSW user manual by selecting the manual titled 'Drainage Design Management System' and pressing the 'Help File' button. This will launch Adobe Acrobat Reader and open the DDMSW user manual. If your computer does not have Adobe Acrobat or Adobe Acrobat Reader installed, please contact your IT Department. After they install it, they must point the DDMSW Program to the Acrobat executable file, under Tools => Options => Help Reader. Additionally, there is a text editing program (e.g. Notepad, PFE Editor, Textpad) listed under Tools => Options => Editor. It will be used to read text files used by DDMSW.



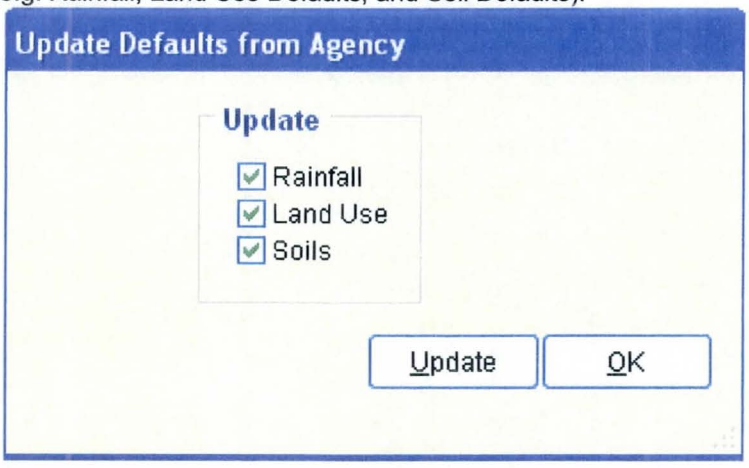


3. Establish a New Project and Set Defaults

Select File => *New Project*. Fill in the fields using the data shown in the screen capture below. Each project must have a unique Reference (without spaces), a formal Title, a project Location and an Agency name (this can be your firm's name if a consultant). Then select the appropriate Model (HEC1 or Rational, but select HEC-1 for this example), Land Use Agency and Rainfall Method. Finally select the appropriate HEC-1 parameters: Unit Hydrograph, Loss Method, Storms, Duration, Tab Interval, No of Ordinates and default Output. Also add any appropriate comments.



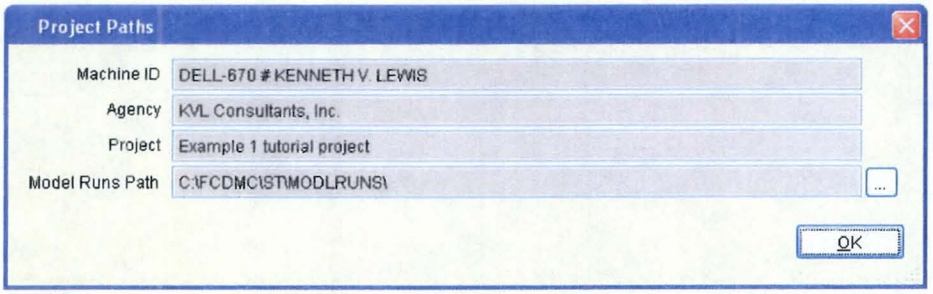
After entering the data, press 'Save'. Then, press *'Update'* to open the Update Defaults from Agency Window. Make sure that the 'Rainfall', 'Land Use', and 'Soils' options are checked and press the 'Update' button. This will establish **Project Defaults** for Rainfall, Land Use and Soils. Default values can be edited at a later stage in the various menus (e.g. Rainfall, Land Use Defaults, and Soil Defaults).



When the update is complete, click *'OK'* to exit the Select Project form.

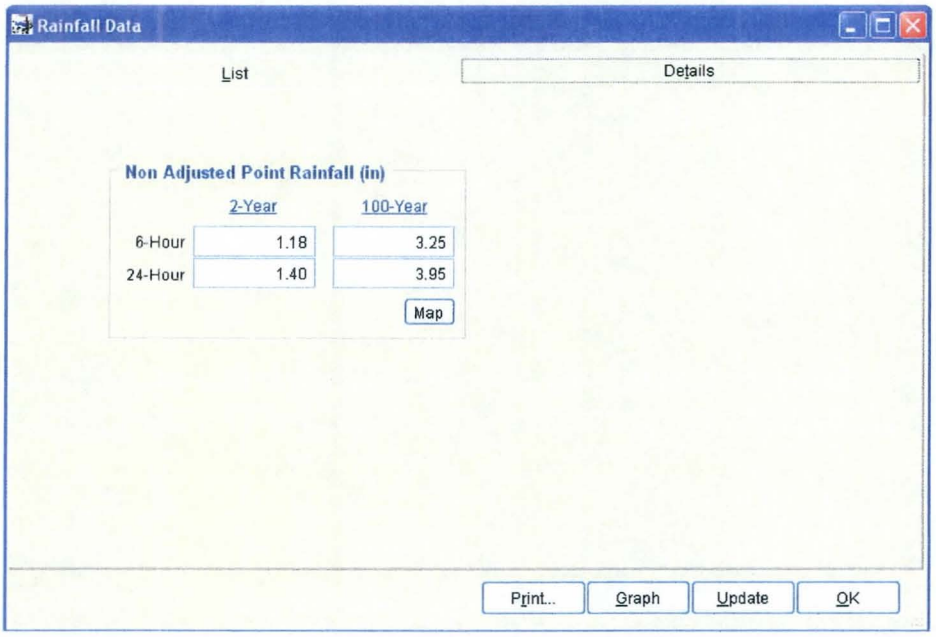
4. Setting the Model Runs Path

Next, go to File => Project Paths to establish the model runs path. Press the elipse button ('...') to the right of the 'Model Runs Path' field and navigate to the 'C:\Fcdmc\St\Modlruns\kvlExample1\' folder. Press 'Select' to choose this folder as the model runs path. Press 'Save' to save the change to the model runs path location and press 'OK' to close the Project Paths form.

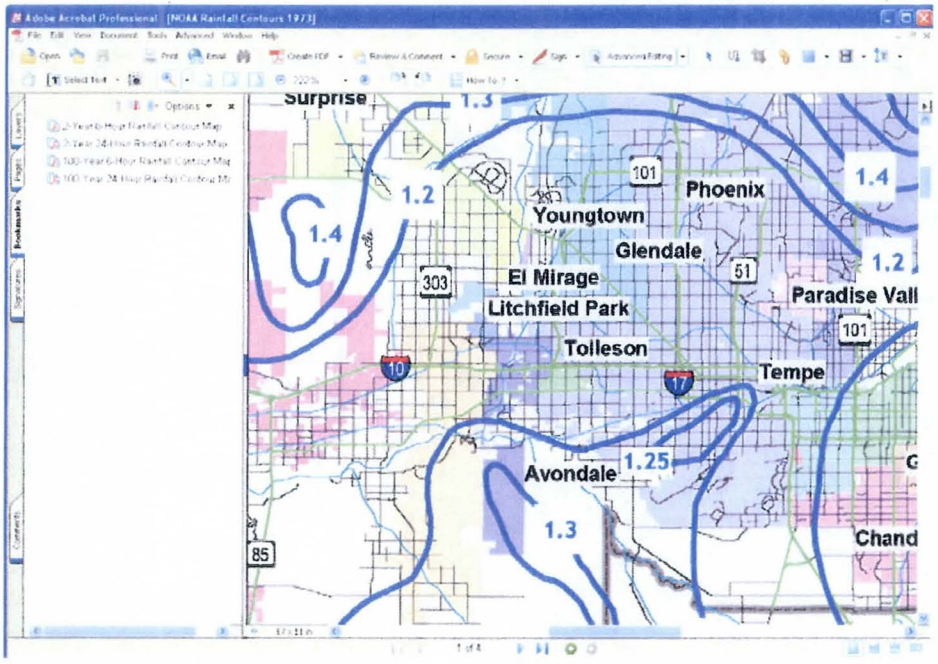


5. Establish Rainfall Data for Project

Select Hydrology => *Rainfall* and click on the *'Details'* tab to edit the Non Adjusted Point Rainfall data as necessary. It is important that the data reflect the location of the project.

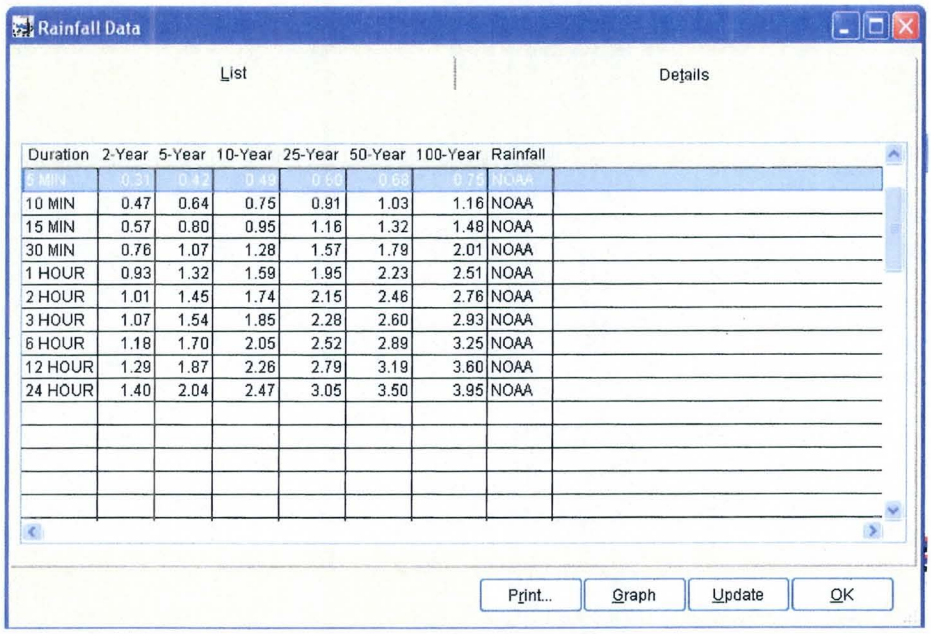


Appropriate values for the Maricopa County 2-Year and 100-Year 6 and 24-Hour can be determined by clicking on *'Map'* and locating to the project site.



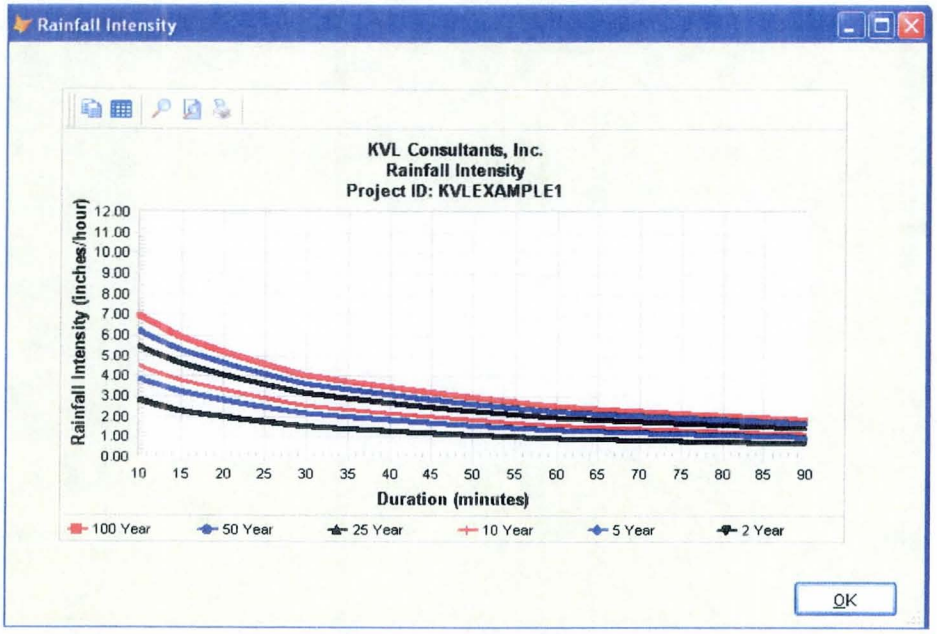
Once the correct values have been entered, press *'Save'*. Then press *'Update'* to update the rainfall data for all other durations and return periods.

Make sure that the rainfall checkbox has been selected and press the 'update' button to initiate the new table computation. The final data can be viewed by clicking the *'List'* tab on this form.



Duration	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Rainfall
5 MIN	0.31	0.42	0.49	0.60	0.68	0.75	NOAA
10 MIN	0.47	0.64	0.75	0.91	1.03	1.16	NOAA
15 MIN	0.57	0.80	0.95	1.16	1.32	1.48	NOAA
30 MIN	0.76	1.07	1.28	1.57	1.79	2.01	NOAA
1 HOUR	0.93	1.32	1.59	1.95	2.23	2.51	NOAA
2 HOUR	1.01	1.45	1.74	2.15	2.46	2.76	NOAA
3 HOUR	1.07	1.54	1.85	2.28	2.60	2.93	NOAA
6 HOUR	1.18	1.70	2.05	2.52	2.89	3.25	NOAA
12 HOUR	1.29	1.87	2.26	2.79	3.19	3.60	NOAA
24 HOUR	1.40	2.04	2.47	3.05	3.50	3.95	NOAA

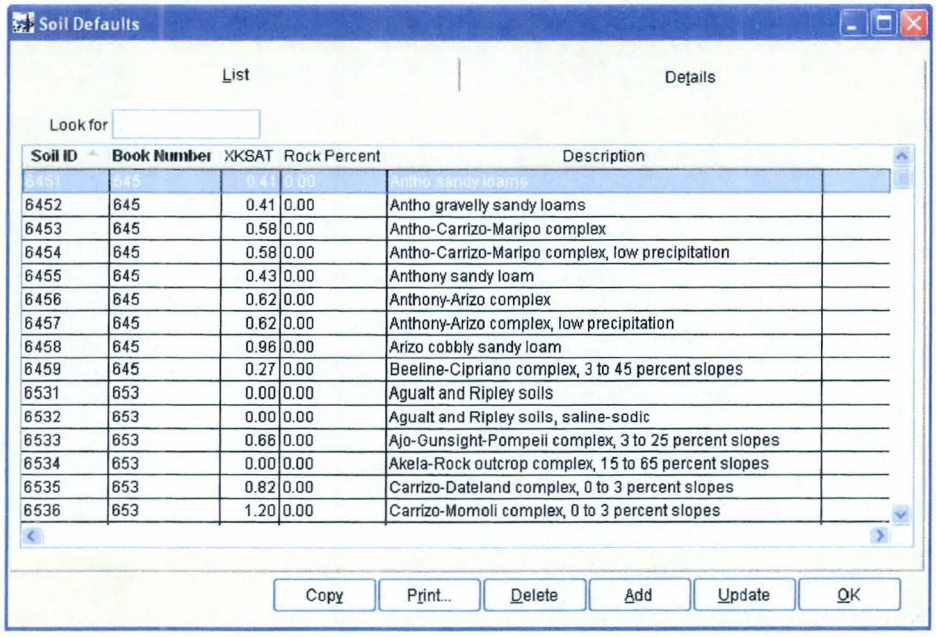
The data can be graphed (generally for use in the Rational method) by clicking on the *'Graph'* button.



When the Rainfall data has been updated, click on the *'OK'* button to close the Rainfall Intensity Graph and 'OK' to close the Rainfall Data form.

6. Review Soil Defaults

Select Hydrology => *Soil Defaults* to access the soil defaults data. Since we are using FCDMC default data, none of the records will be modified. If you ever decided to change or add a soil default record, it is done here.

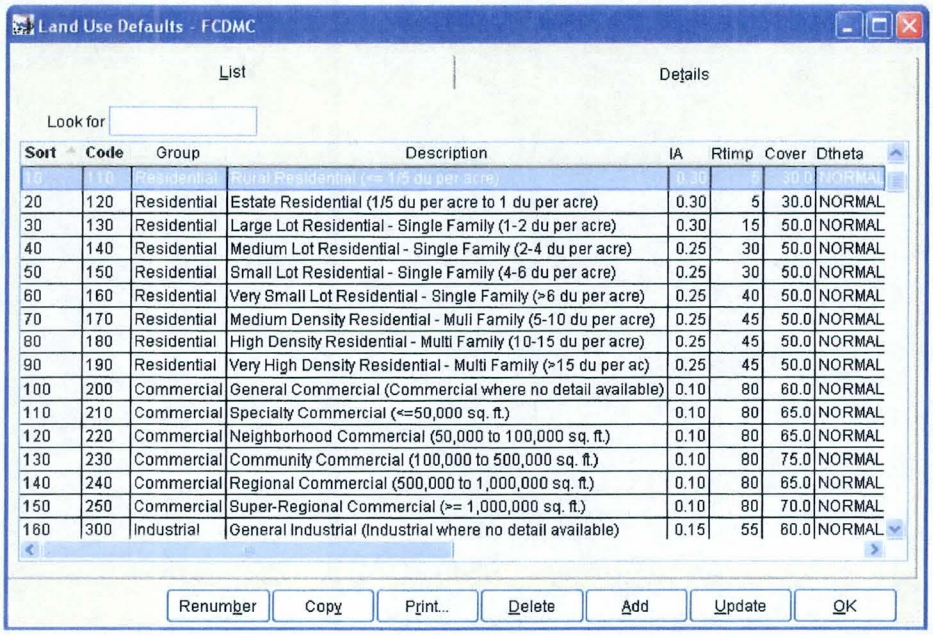


Soil ID	Book Number	XKSAT	Rock Percent	Description
6451	645	0.41	0.00	Antho sandy loams
6452	645	0.41	0.00	Antho gravelly sandy loams
6453	645	0.58	0.00	Antho-Carrizo-Maripo complex
6454	645	0.58	0.00	Antho-Carrizo-Maripo complex, low precipitation
6455	645	0.43	0.00	Anthony sandy loam
6456	645	0.62	0.00	Anthony-Arizo complex
6457	645	0.62	0.00	Anthony-Arizo complex, low precipitation
6458	645	0.96	0.00	Arizo cobbly sandy loam
6459	645	0.27	0.00	Beeline-Cipriano complex, 3 to 45 percent slopes
6531	653	0.00	0.00	Agualt and Ripley soils
6532	653	0.00	0.00	Agualt and Ripley soils, saline-sodic
6533	653	0.66	0.00	Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes
6534	653	0.00	0.00	Akela-Rock outcrop complex, 15 to 65 percent slopes
6535	653	0.82	0.00	Carrizo-Dateland complex, 0 to 3 percent slopes
6536	653	1.20	0.00	Carrizo-Momoli complex, 0 to 3 percent slopes

Click on the *'OK'* button to close the form.

7. Review Land Use Defaults

Select Hydrology => *Land Use Defaults* to access the land use defaults data. Since we are using FCDMC default data, none of the records will be modified. To see all the default values use the horizontal scroll bar to scroll to the right on the form or maximize the form. If you ever decided to change or add a land use default record, it is done here.

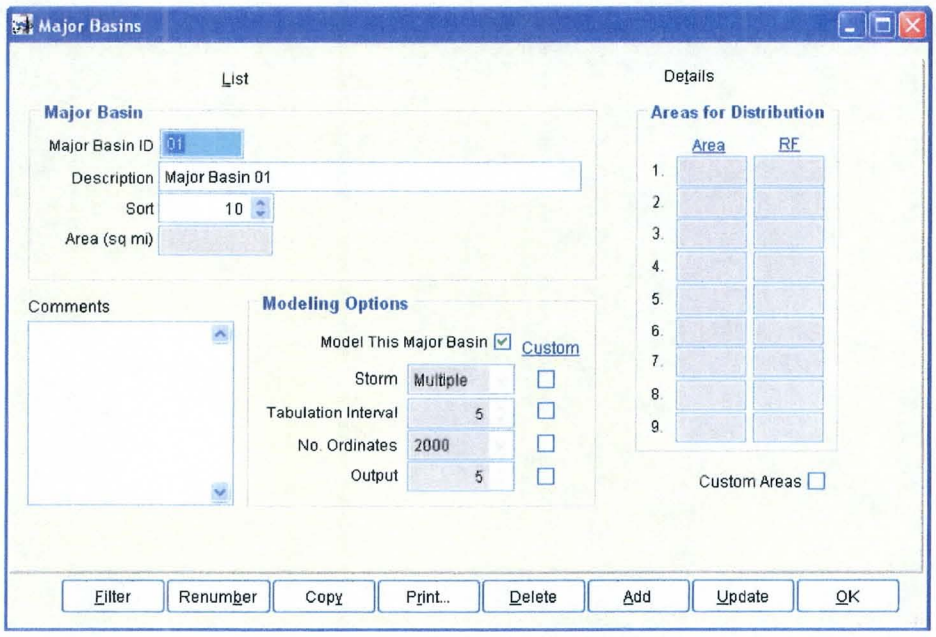


Sort	Code	Group	Description	IA	Rtimp	Cover	Dtheta
10	110	Residential	Rural Residential (<= 1/5 du per acre)	0.30	5	30.0	NORMAL
20	120	Residential	Estate Residential (1/5 du per acre to 1 du per acre)	0.30	5	30.0	NORMAL
30	130	Residential	Large Lot Residential - Single Family (1-2 du per acre)	0.30	15	50.0	NORMAL
40	140	Residential	Medium Lot Residential - Single Family (2-4 du per acre)	0.25	30	50.0	NORMAL
50	150	Residential	Small Lot Residential - Single Family (4-6 du per acre)	0.25	30	50.0	NORMAL
60	160	Residential	Very Small Lot Residential - Single Family (>6 du per acre)	0.25	40	50.0	NORMAL
70	170	Residential	Medium Density Residential - Muli Family (5-10 du per acre)	0.25	45	50.0	NORMAL
80	180	Residential	High Density Residential - Multi Family (10-15 du per acre)	0.25	45	50.0	NORMAL
90	190	Residential	Very High Density Residential - Multi Family (>15 du per ac)	0.25	45	50.0	NORMAL
100	200	Commercial	General Commercial (Commercial where no detail available)	0.10	80	60.0	NORMAL
110	210	Commercial	Specialty Commercial (<=50,000 sq. ft.)	0.10	80	65.0	NORMAL
120	220	Commercial	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	0.10	80	65.0	NORMAL
130	230	Commercial	Community Commercial (100,000 to 500,000 sq. ft.)	0.10	80	75.0	NORMAL
140	240	Commercial	Regional Commercial (500,000 to 1,000,000 sq. ft.)	0.10	80	65.0	NORMAL
150	250	Commercial	Super-Regional Commercial (>= 1,000,000 sq. ft.)	0.10	80	70.0	NORMAL
160	300	Industrial	General Industrial (Industrial where no detail available)	0.15	55	60.0	NORMAL

Click on the *'OK'* button to close the form.

8. Establish Major Basin Id's

Select Hydrology => *Major Basins* to access the Major Basins data. The software automatically establishes at least one Major Basin (01) when creating a new project. Since we will only have one major basin in this project, there is no need for further modification at this time. After the sub basins have been established, we will return here to update Major Basin 01.

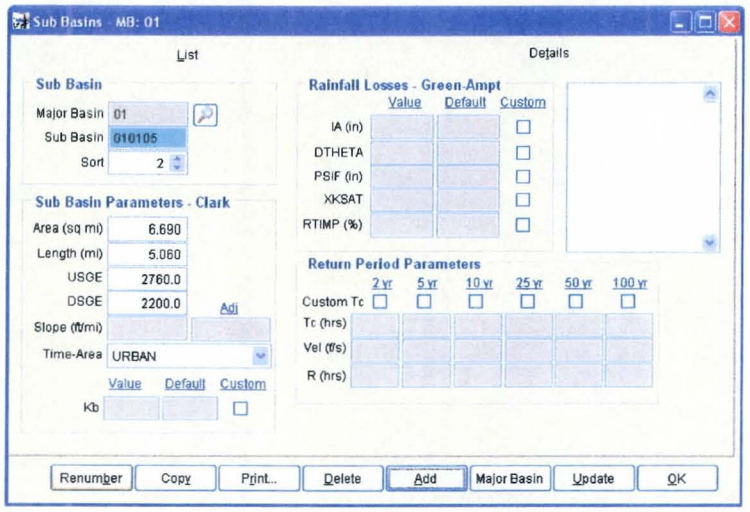


Click on the *'OK'* button to close the form.

9. Establish Preliminary Sub Basin Data

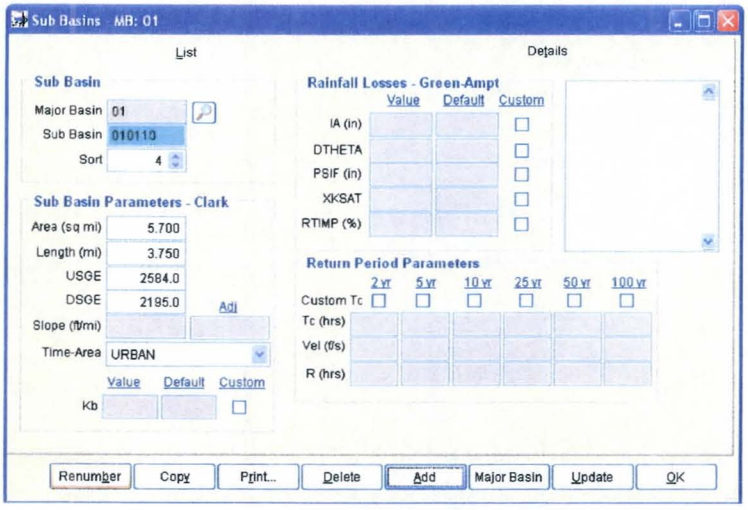
Select Hydrology => *Sub Basins* to access the sub basin data. Click on *'Add'* to add the first record. Enter the following:

Sub Basin	010105
Area	6.690
Length	5.060
USGE	2760
DSGE	2200
Time-Area	URBAN



Click *'Save'* to save the data and then click *'Add'* to add a second record.
Enter the following:

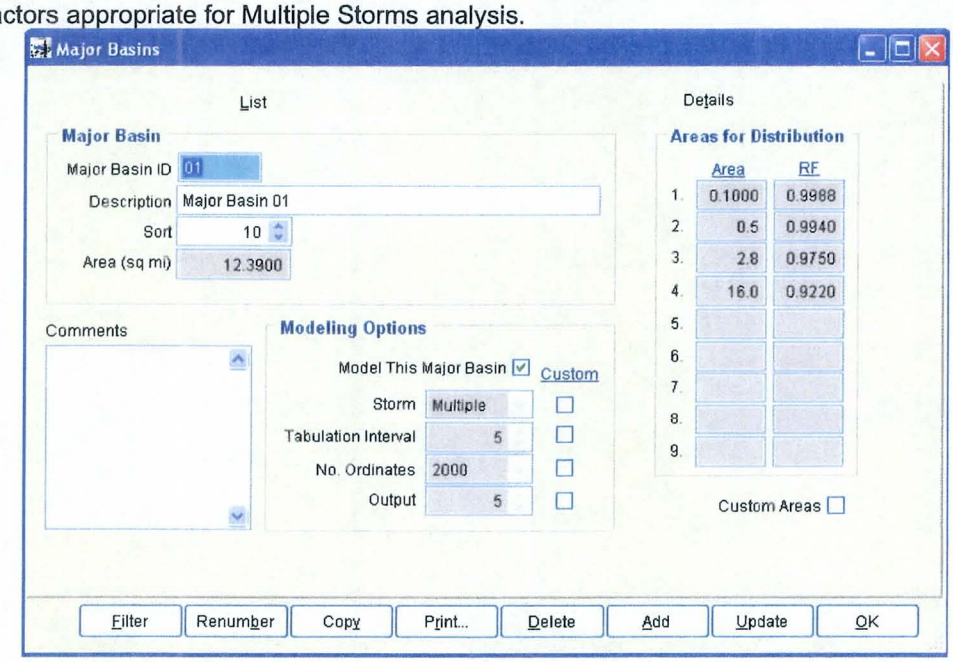
Sub Basin	010110
Area	5.700
Length	3.75
USGE	2584
DSGE	2195
Time-Area	URBAN



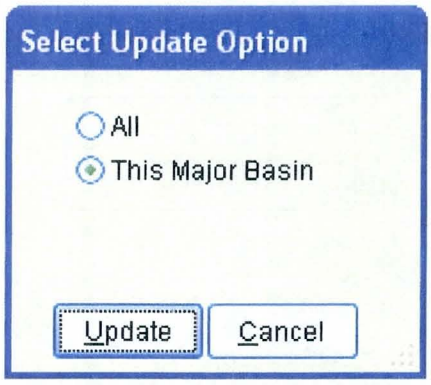
Click *'Save'* to save the data and then click *'OK' to exit this form.*

10. Update Major Basin Data

Select Hydrology => Major Basins to access the Major Basin data. Click on the *'Details'* tab and then click on *'Update'* to update the data. Updating the data will sum the sub basin areas and establish the Areas and Reduction factors appropriate for Multiple Storms analysis.



The 'Update' button in the Major Basins form will open a 'Select Update Option' form. The first choice, 'All', can be used when there are multiple major basins within a project. The second choice, 'This Major Basin', only updates the current major basin. For this example project, it does not matter which option you select. Choose an option and press 'Update'. When this is complete the Major Basin data will look like the following:

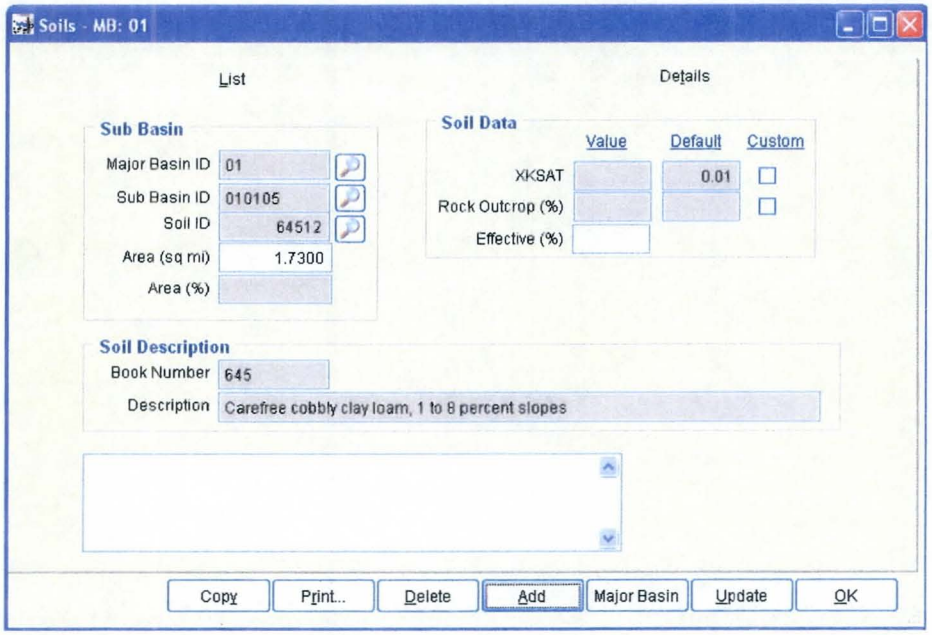


After the Update is complete, click on the *'OK'* button to close the form.

11. Establish Soil Data

Select Hydrology => *Soils* to access the Soils data. Click on *'Add'* to add the first record. Enter the following:

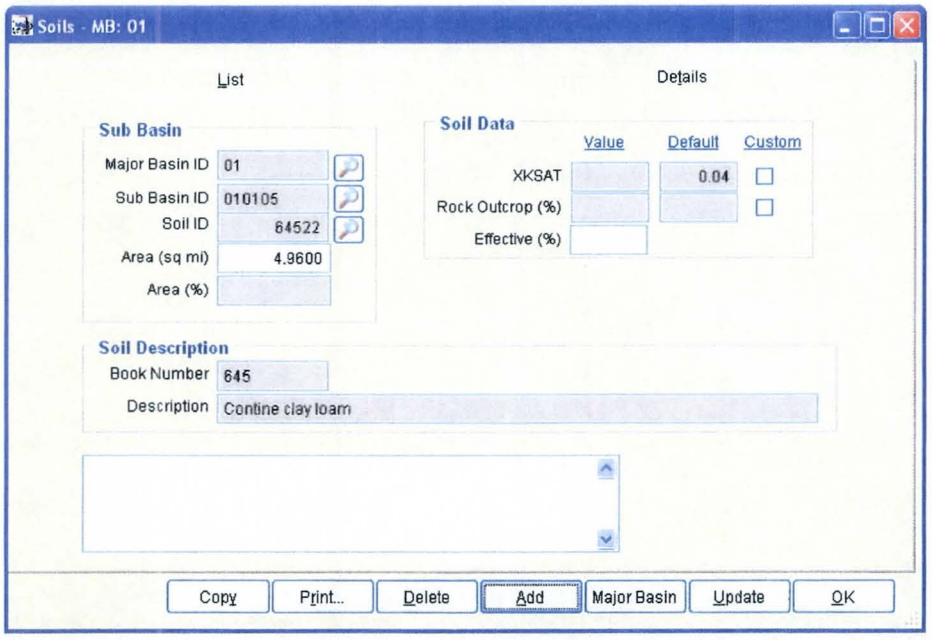
Sub Basin	010105	(Click on adjacent icon to select)
Soil ID	64512	(Click on adjacent icon to select)
Area	1.73	



When you press *'Save'*, the **Soil Description** and **Soil Data** values will **auto populate**.

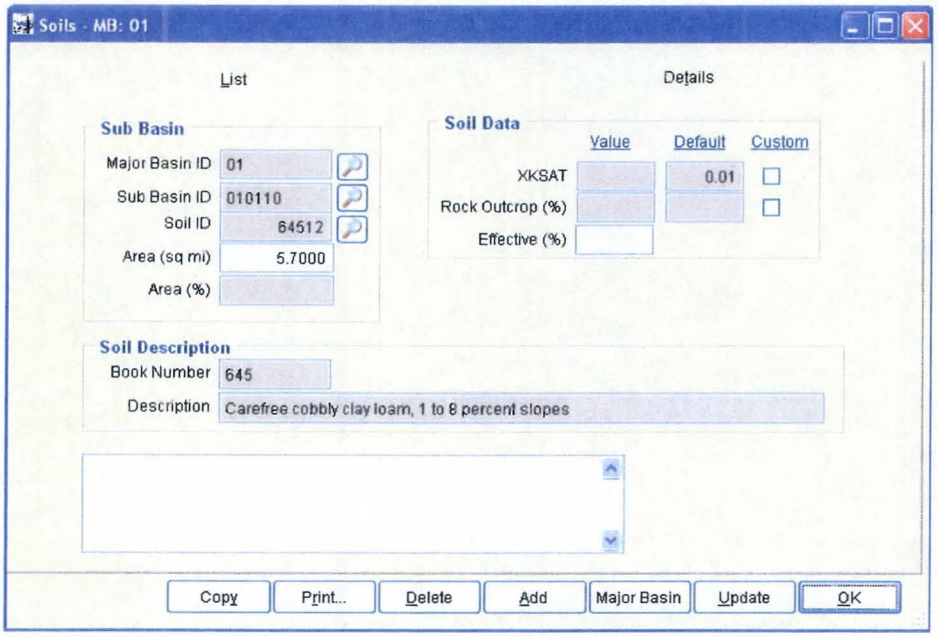
Click *'Add'* to add a second record. Enter the following:

Sub Basin	010105	(Click on adjacent icon to select)
Soil ID	64522	(Click on adjacent icon to select)
Area	4.96	

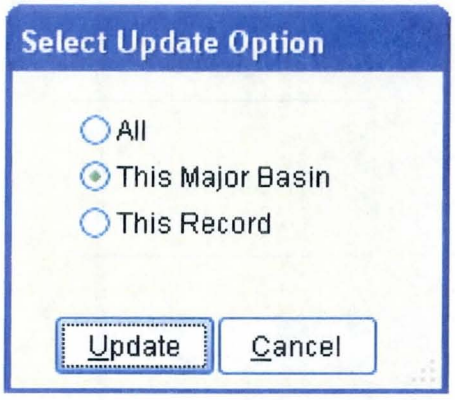


Click *'Save'* to save the data and then click *'Add'* to add a third record. Enter the following:

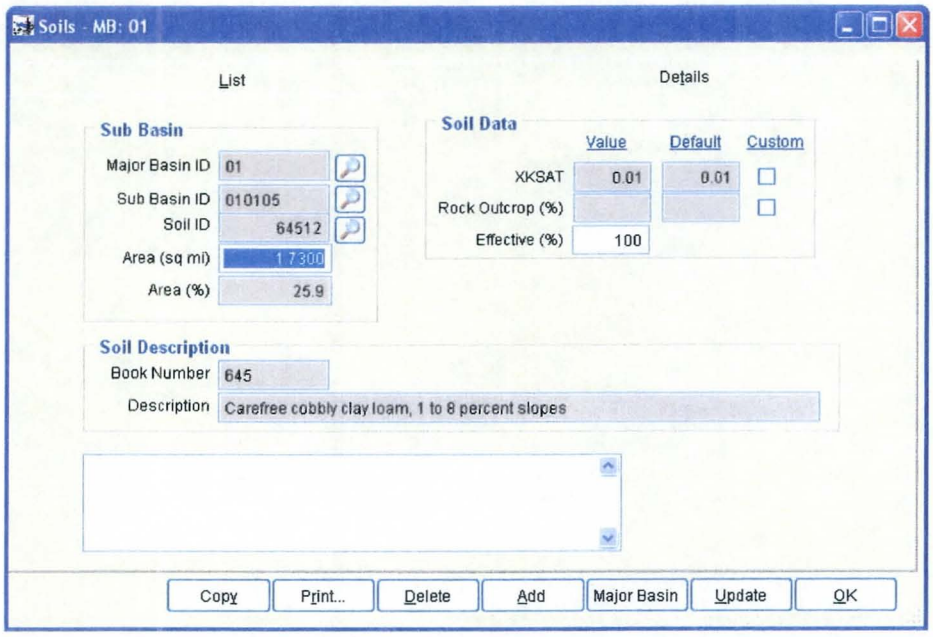
Sub Basin	010110	(Click on adjacent icon to select)
Soil ID	64512	(Click on adjacent icon to select)
Area	5.70	



Click *'Save'*. Click on *'Update'* to update the Soils Data. Select 'This Major Basin' or 'All' and press 'Update'.



A typical updated record will look like the following:

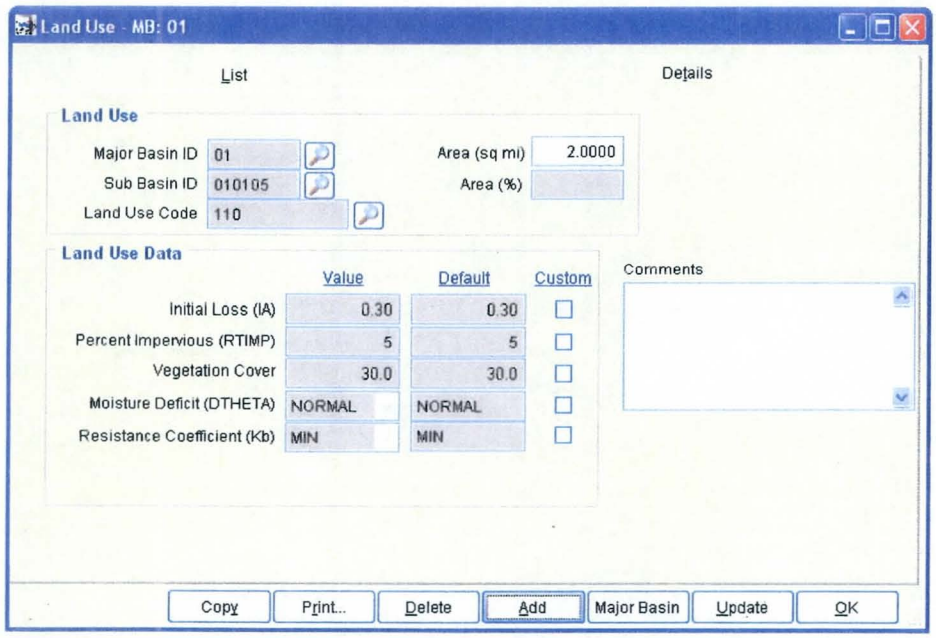


After all Soils data has been entered and updated, click on the *'OK'* button to close the form.

12. Establish Land Use Data

Select Hydrology => *Land Use* to access the Land Use data. Click on *'Add'* to add the first record. Enter the following:

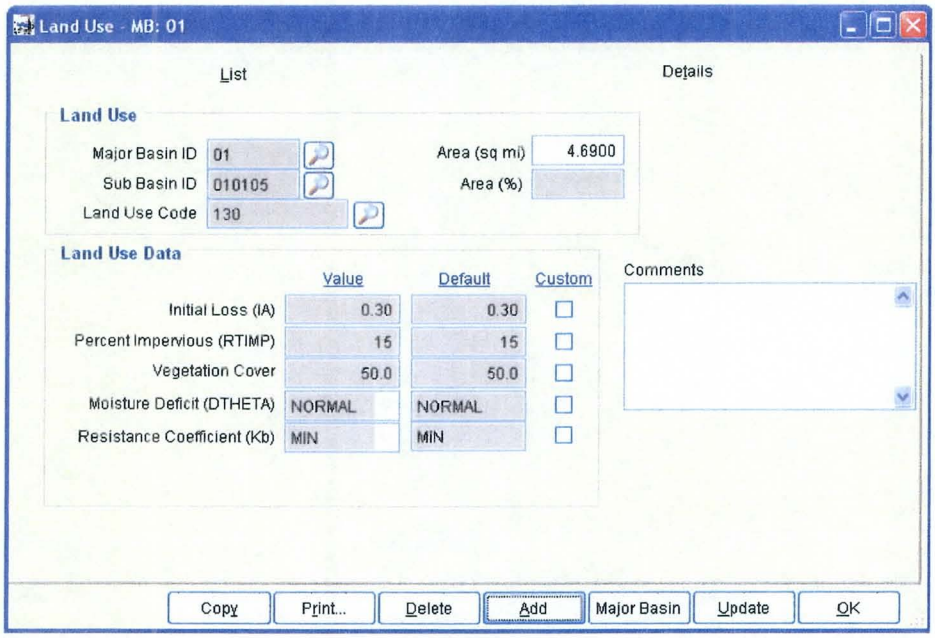
Sub Basin	010105	(Click on adjacent icon to select)
Land Use Code	110	(Click on adjacent icon to select)
Area	2.00	



Click *'Save'* to save the data.

Click *'Add'* to add a second record. Enter the following:

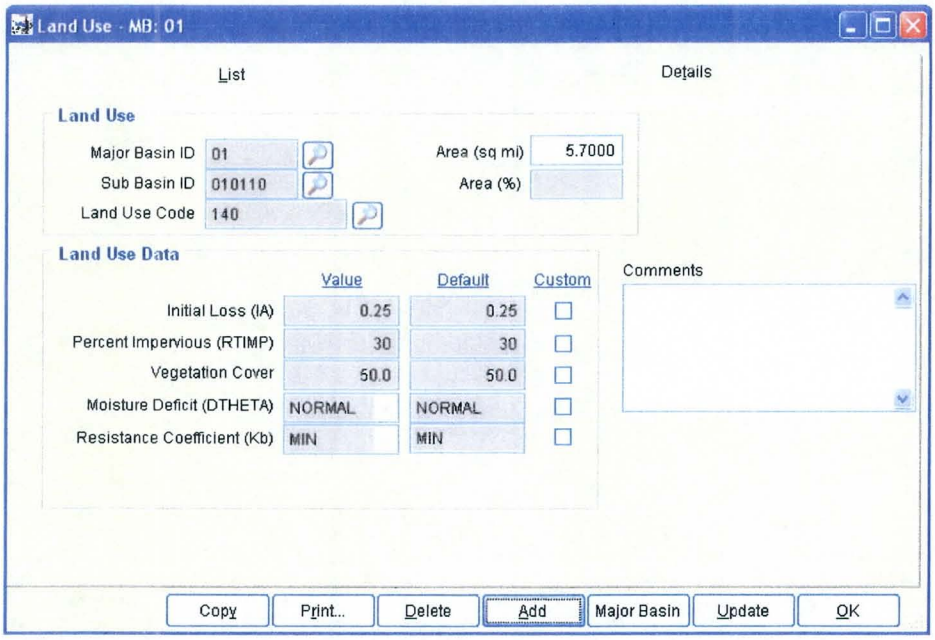
Sub Basin	010105	(Click on adjacent icon to select)
Land Use Code	130	(Click on adjacent icon to select)
Area	4.69	



Click *'Save'* to save the data.

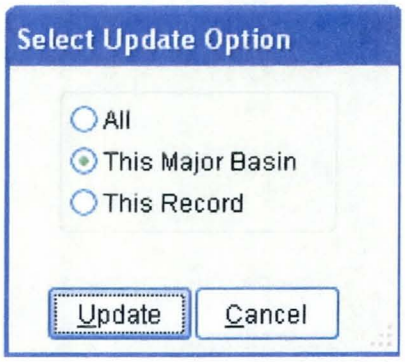
Click *'Add'* to add a third record. Enter the following:

Sub Basin	010110	(Click on adjacent icon to select)
Land Use Code	140	(Click on adjacent icon to select)
Area	5.700	

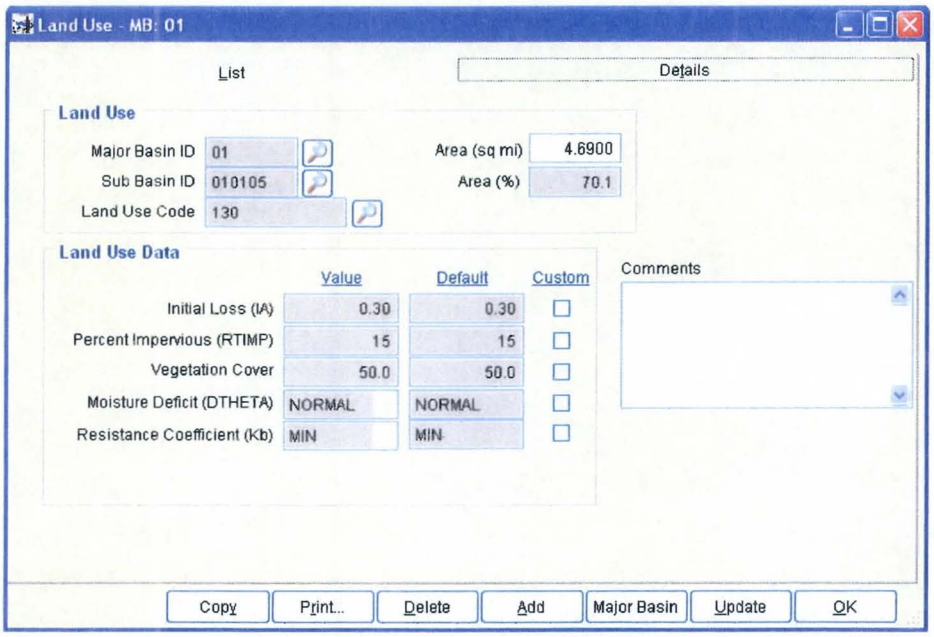


Click *'Save'* to save the data.

Now that all of the Land Use data has been entered click on *'Update'* to update the Soils Data. Select 'This Major Basin' or 'All' and press *'Update'*.



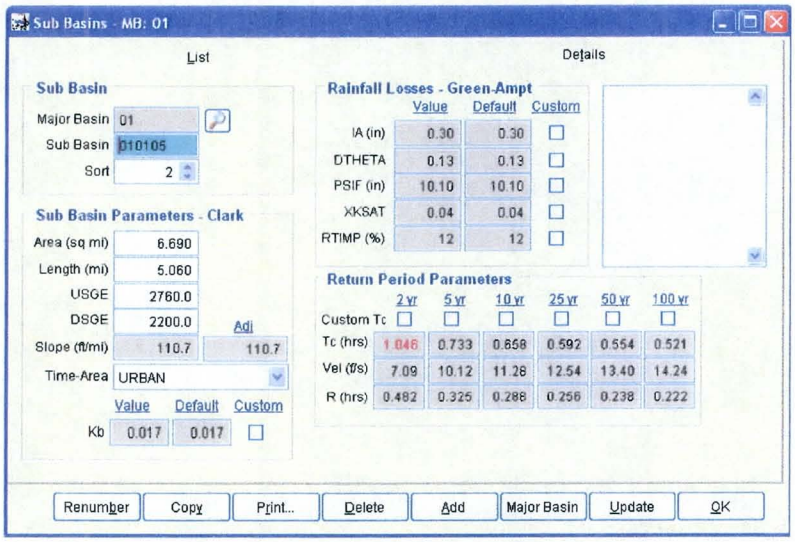
A typical updated record will look like the following:

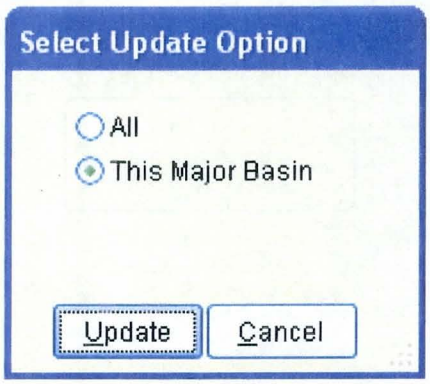


After all Land Use data has been entered and updated, click on the *'OK'* button to close the form.

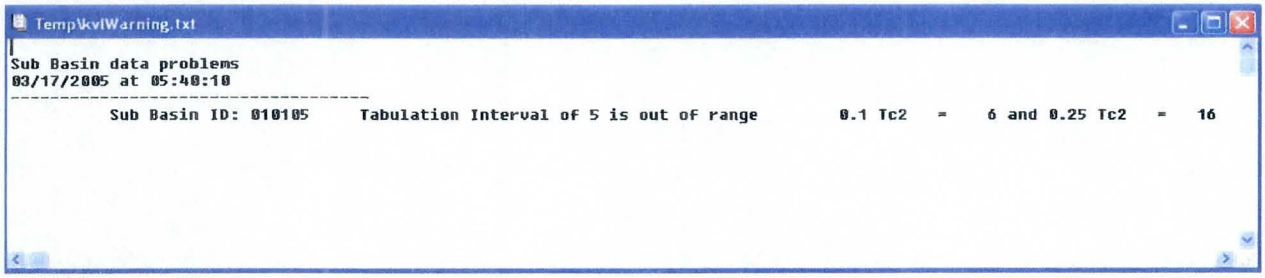
13. Update Sub Basin Data

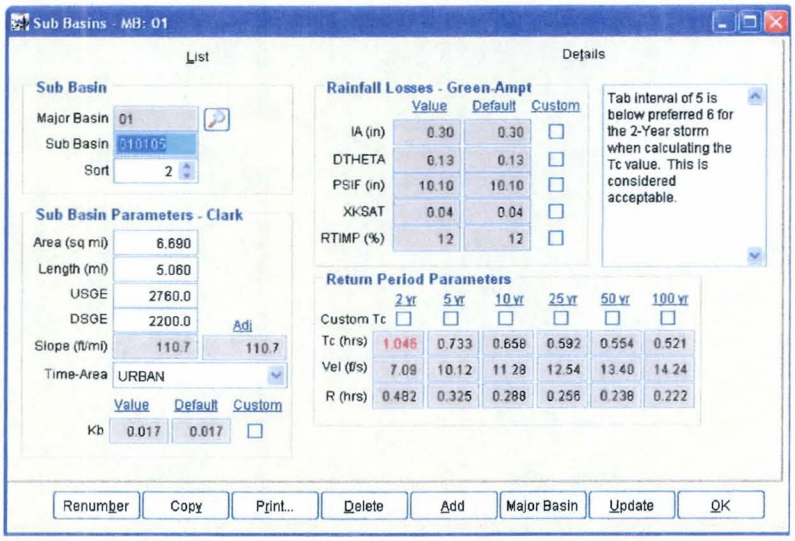
Select Hydrology => *Sub Basins*. Click on the *'Details'* tab to view all the data for a record. Click *'Update'* to Update the data, select either update option and press 'Update'.





Following the Update, the following warning message is developed from the data and calculations. In this example, the tabulation interval of 5 is outside of the preferred range. Since it is close, and is for the 2-Year storm, the data is considered acceptable. Note that the Tc value for the 2-Year storm is shown in red, indicating an issue. Enter a comment in the comment field to explain the issue and press 'Save' when finished.

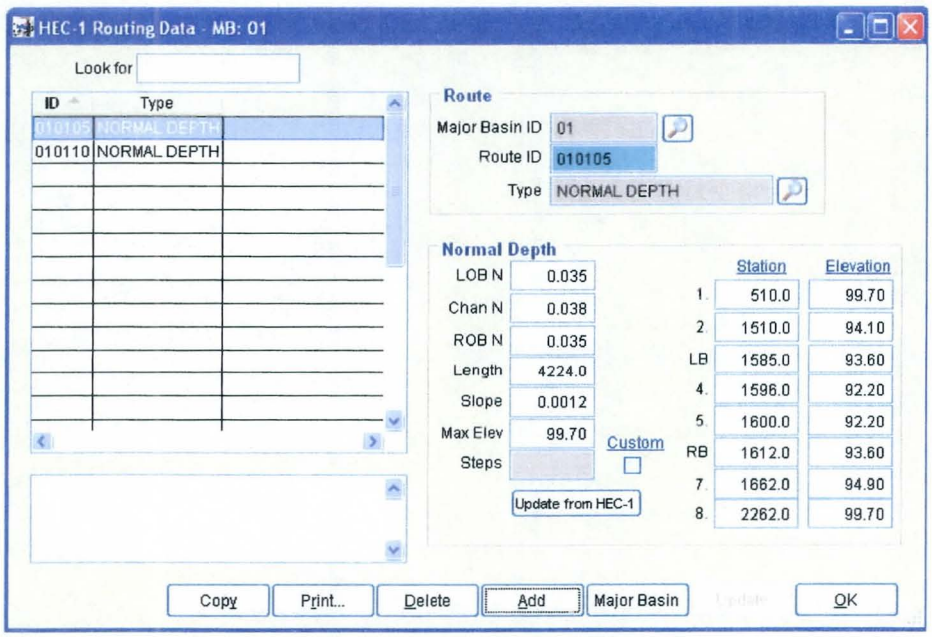




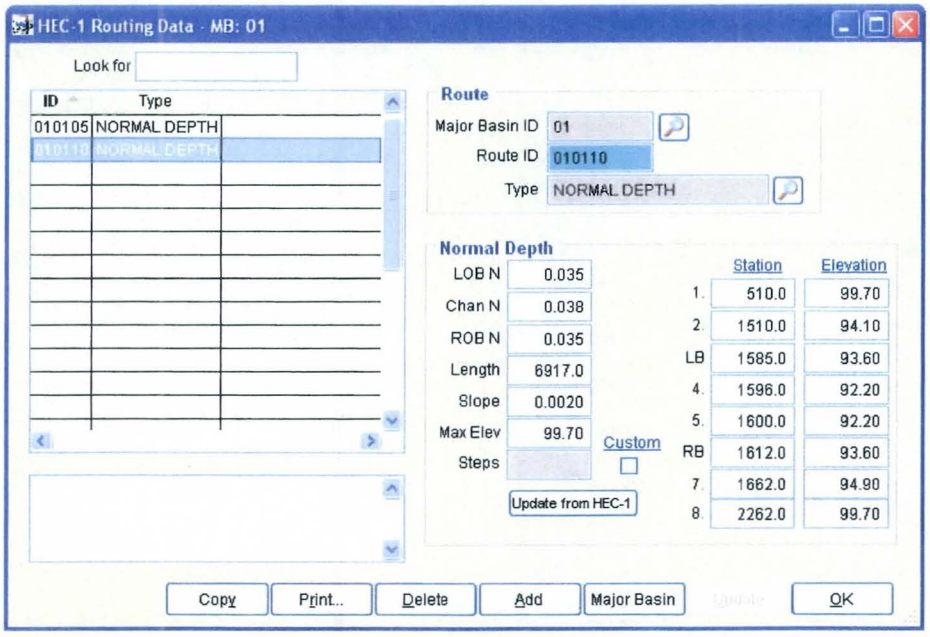
Click 'OK' to close the Sub Basins form and continue.

14. Establish Preliminary Routing Data

Select Hydrology => HEC-1 => *Routing* to access the Routing data. Click on *'Add'* to add the first record. Enter the data as shown on the following for Route ID 010105.



After data has been entered click *'Save'* and the *'Add'* to add another record. Enter the following data in the new record for Route ID 010110.

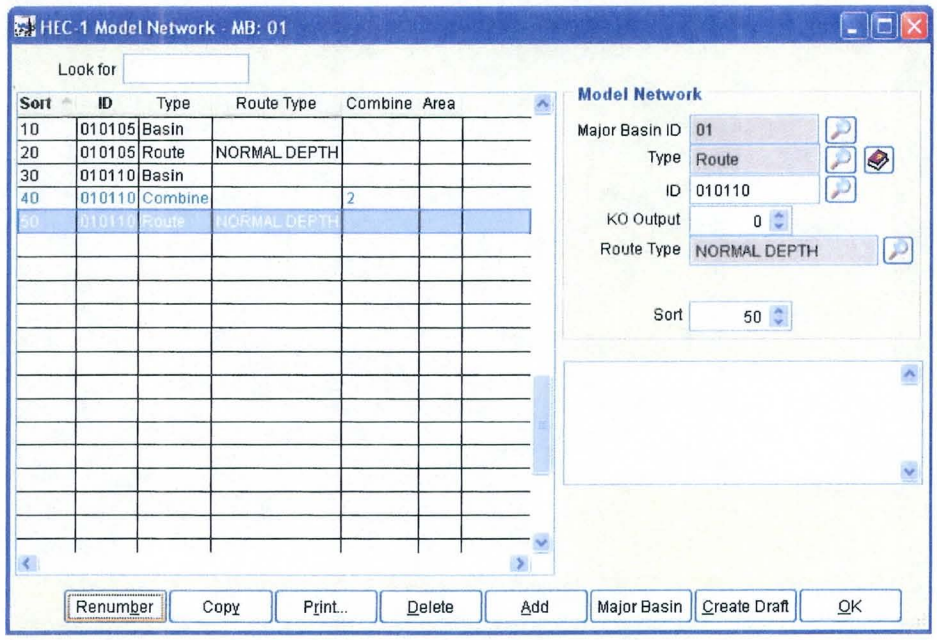


DO NOT UPDATE FROM HEC-1 FOR THE STEPS AT THIS TIME BECAUSE THE HEC-1 MODEL HAS NOT YET BEEN ESTABLISHED!

Press 'Save' when finished entering the data for 010110. Press 'OK' to close the HEC-1 Routing Data form.

15. Establish Draft HEC-1 Model

Select Hydrology => HEC-1 => *Network* to access the model Network data.



Click on *'Add'* to add the first record. Enter the following data:

Type	Basin	(Click on adjacent icon to select)
ID	010105	(Click on adjacent icon to select)

Click *'Save'* and the *'Add'* to add another record and enter the following data:

Type	Route	(Click on adjacent icon to select)
ID	010105	(Click on adjacent icon to select)
Route Type	NORMAL DEPTH	(Click on adjacent icon to select)

Click *'Save'* and the 'Add' to add another record and enter the following data:

Type	Basin	(Click on adjacent icon to select)
ID	010110	(Click on adjacent icon to select)

Click *'Save'* and the 'Add' to add another record and enter the following data:

Type	Combine	(Click on adjacent icon to select)
ID	010110	
Combine No	2	

Click *'Save'* and the *'Add'* to add another record and enter the following data:

Type	Route	(Click on adjacent icon to select)
ID	010110	(Click on adjacent icon to select)
Route Type	NORMAL DEPTH	(Click on adjacent icon to select)

Click *'Save'*

After all data has been entered click *'Create Draft'* to establish a draft HEC-1 input file. A note pops up and says that the procedure will override the existing model network. Select 'Yes'. Now, the following file will come to the screen:

C:\FCDMC\ST\MODLRUNS\KVLEXAMPLE1\01.Dat

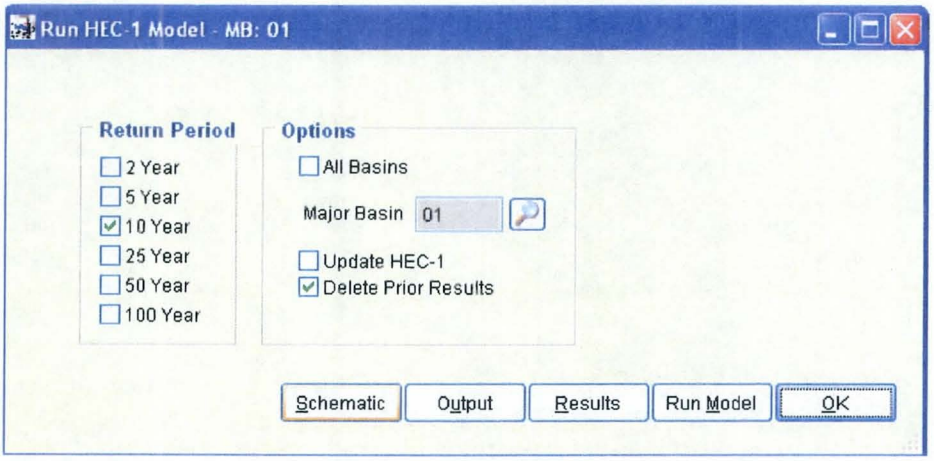
```
ID      KVL Consultants, Inc.
ID      KVLEXAMPLE1 - Example 1 tutorial project
ID      100 Year
ID      6 Hour Storm
ID      Unit Hydrograph: Clark
ID      03/17/2005
IT     5       0       0    2000
IN    15
IO     5
*DIAGRAM
*
*
KK010105   BASIN
BA   1.0
PB   4.0
PC 0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
PC 0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
PC 0.962   0.972   0.983   0.991   1.000
LG  0.15    0.25    4.50    0.50      50
UC   1.0     1.0
UA     0       5      16      30      65      77      84      90      94      97
UA   100
*
KK010105   ROUTE
RS     5    FLOW      -1
RC 0.016   0.016   0.016    1000   0.015
RX    10      25      50      52      82      84     100     110
RY  15.0    15.0    15.0     0.0     0.0    15.0    15.0    15.0
*
KK010110   BASIN
BA   1.0
LG  0.15    0.25    4.50    0.50      50
UC   1.0     1.0
UA     0       5      16      30      65      77      84      90      94      97
UA   100
*
KK010110 COMBINE
HC     2
*
KK010110   ROUTE
RS     5    FLOW      -1
RC 0.016   0.016   0.016    1000   0.015
RX    10      25      50      52      82      84     100     110
RY  15.0    15.0    15.0     0.0     0.0    15.0    15.0    15.0
ZZ
```

Click back onto the DDMSW screen. A message pops up saying that the draft file was created with assumed data. It also says to run the draft to make sure that the HEC-1 network is ok. If it is, then you can update it with the real HEC-1 model data from the tables and run it again to obtain real model results. Press 'OK' to close the note and press 'OK' again to close the HEC-1 Model Network form.

16. Run Draft HEC-1 Model

Select Hydrology => HEC-1 => *Model* to access the HEC-1model.

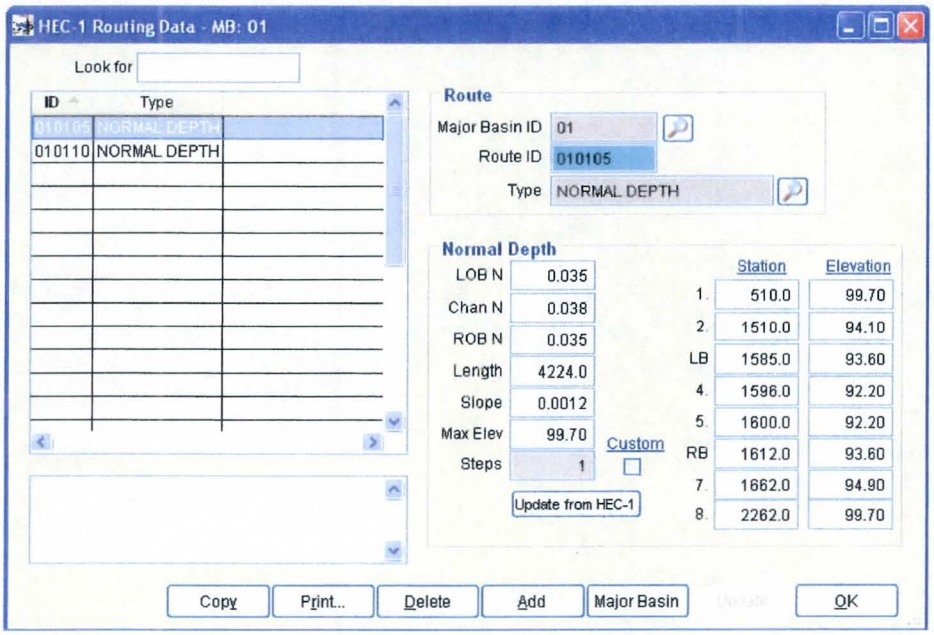
Check the '10 Year' Return Period and the 'Delete Prior Results' option. Uncheck all other return periods and options.



Click 'Save'. Click *'Run Model'* to run the Draft HEC-1 Model. If the model runs correctly, it means the HEC-1 Network is fine. Press 'OK' to close the Run HEC-1 Model form.

17. Initialize Routing Step Values

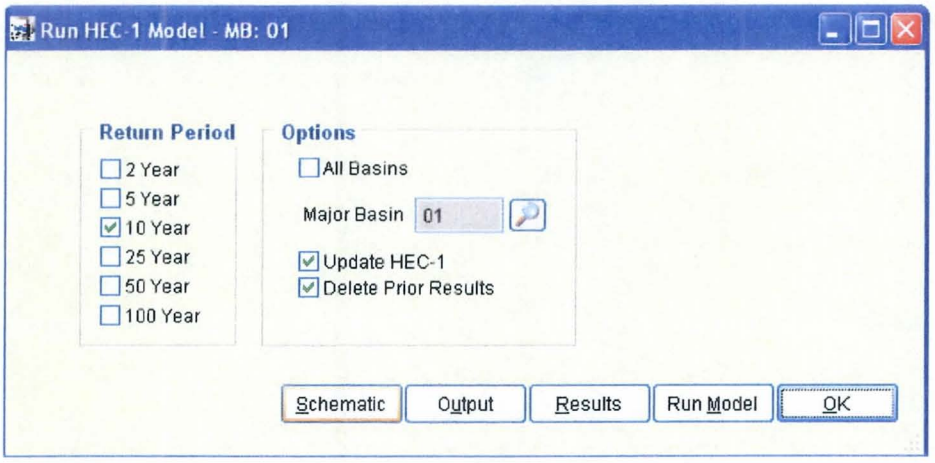
Select Hydrology => HEC-1 => *Routing* to access the Routing data. Click on the *'Update from HEC-1'* button to update the Steps. A note will pop up saying that the HEC-1 model will run three times and the 'Steps' field for all routing channels will be updated if the custom checkbox is not filled in. Select 'Yes'. The following will be the results for Route ID 010105. Press 'OK' to close the HEC-1 Routing Data form.



18. Run HEC-1 Model and Update Data

Select Hydrology => HEC-1 => *Model* to access the HEC-1 model.

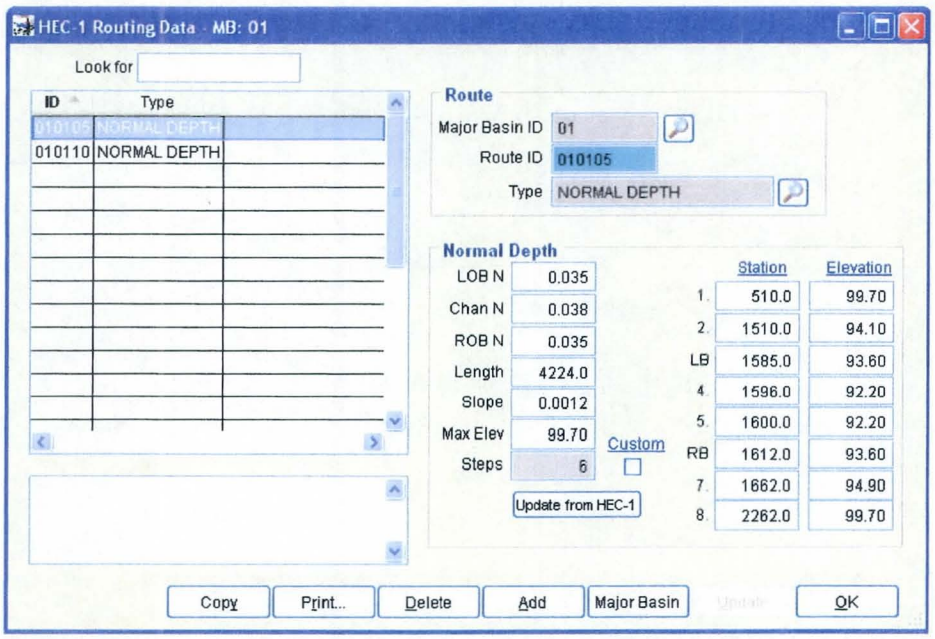
Check the '10 Year' Return Period, the 'Update HEC-1' option and the 'Delete Prior Results' option. Uncheck all other return periods and options.



Click *'Save'*. Click *'Run Model'* to run the Updated HEC-1 Model. If the model runs correctly, it means the HEC-1 Network and data are fine. Press 'OK' to close the Run HEC-1 Model form.

19. Compute the Routing Steps for the Final Model

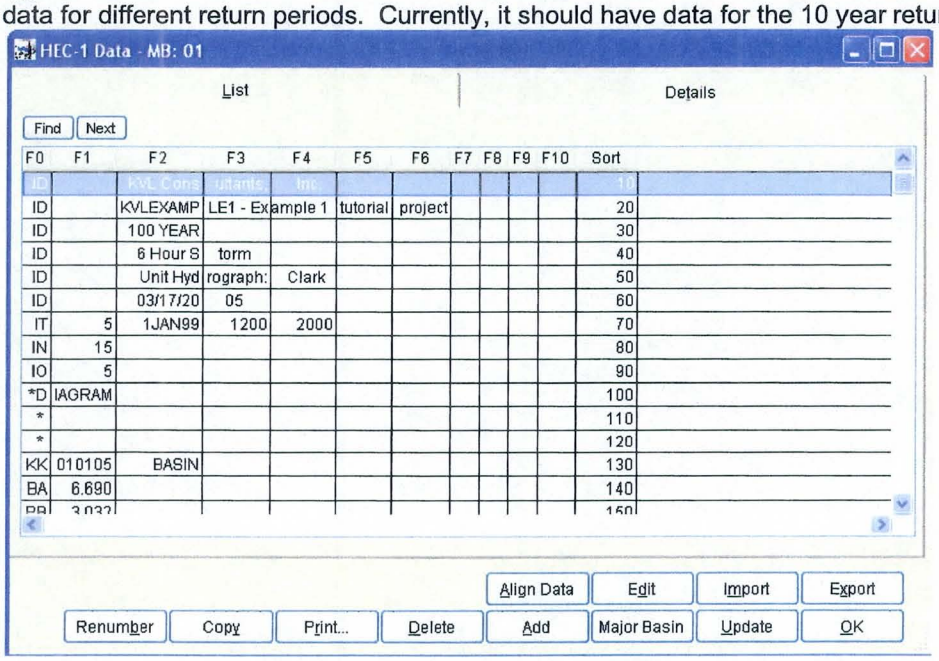
Select Hydrology => HEC-1 => *Routing* to access the Routing data. Click on *'Update from HEC-1'* to update the Steps with the updated HEC-1 data and select 'Yes'. The following will be the results for Route ID 010105.



Click the *'OK'* button to close the Routing form.

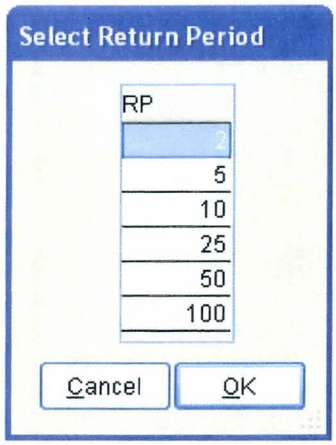
20. Verify the Final HEC-1 Model Data

Select Hydrology => HEC-1 => Data to access the HEC-1 Data form. You can use this form to review the HEC-1 model data for different return periods. Currently, it should have data for the 10 year return period.



F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Sort
ID		KVL Cons	ultants,	Inc							10
ID		KVLEXAMP	LE1 - Ex	ample 1	tutorial	project					20
ID		100 YEAR									30
ID		6 Hour S	torm								40
ID		Unit Hyd	rograph:	Clark							50
ID		03/17/20	05								60
IT	5	1JAN99	1200	2000							70
IN	15										80
IO	5										90
*D	IAGRAM										100
*											110
*											120
KK	010105	BASIN									130
BA	6.690										140
PB	3.032										150

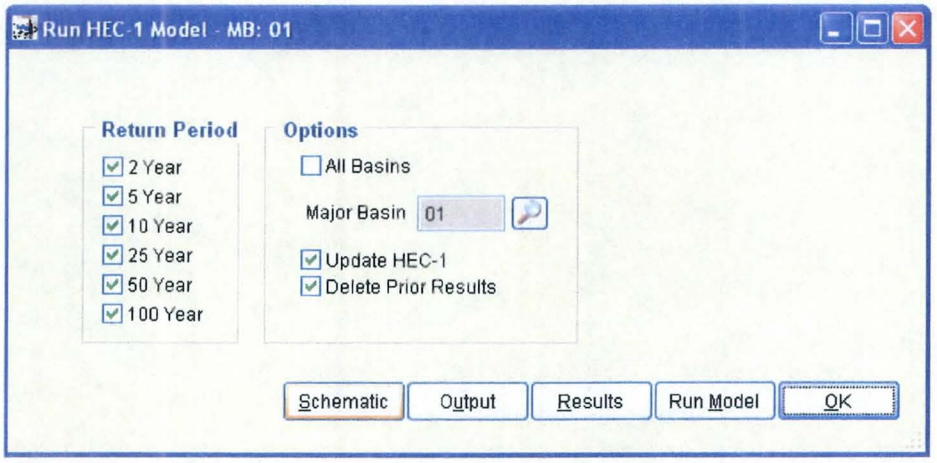
To change the return period, press 'Update', highlight a desired return period and Select 'OK'. Press 'OK' to close the HEC-1 Data form when finished.



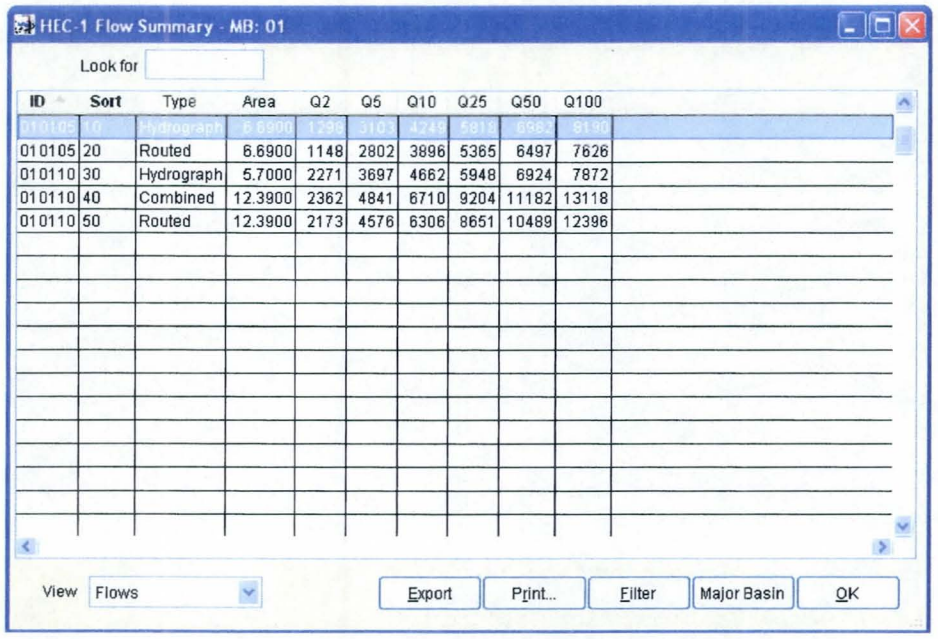
21. Run Final HEC-1 Model for All Return Periods

Select Hydrology => HEC-1 => *Model* to access the HEC-1model.

Check All Return Periods, Update HEC-1 and Delete Prior Results.
Uncheck All Basins. Press 'Save'.



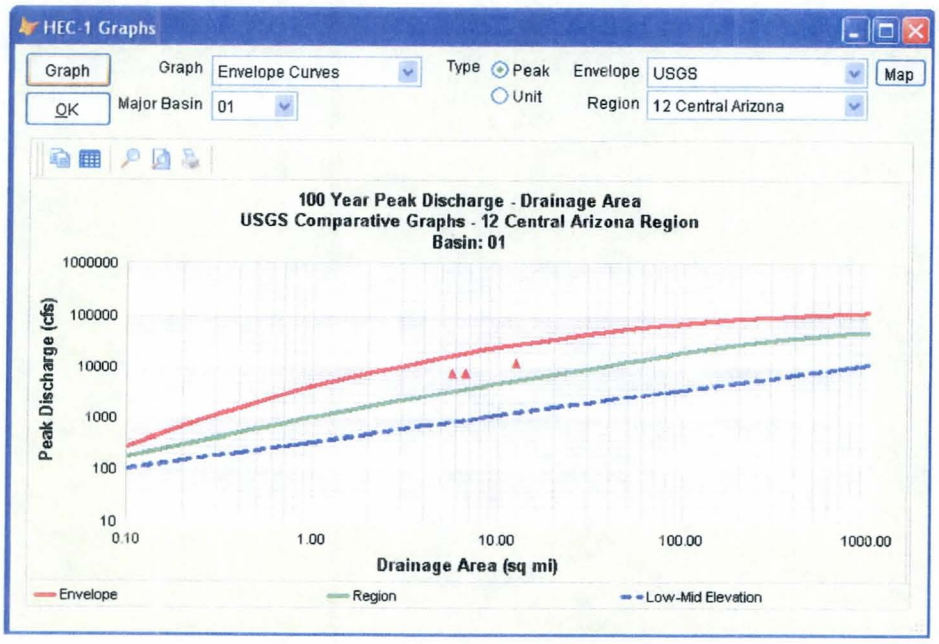
Click *'Run Model'* to run the Updated HEC-1 Model for all return periods. If the model runs correctly, it means the HEC-1 Network and data are fine. The results can be viewed by clicking *'Results'*. A full output file can be viewed with the 'Output' button, selecting the specific output file to view and pressing 'OK'. The 100-Year Schematic can be viewed by pressing the 'Schematic' button.



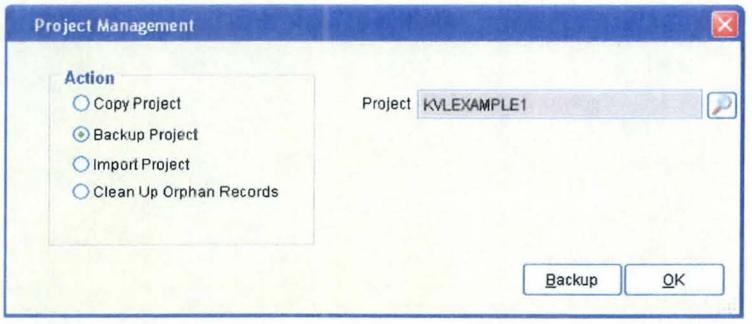
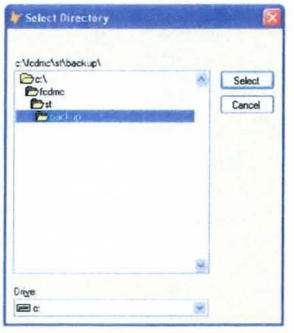
ID	Sort	Type	Area	Q2	Q5	Q10	Q25	Q50	Q100
010105	10	Hydrograph	6.6900	1296	3103	4245	5818	6982	8190
010105	20	Routed	6.6900	1148	2802	3896	5365	6497	7626
010110	30	Hydrograph	5.7000	2271	3697	4662	5948	6924	7872
010110	40	Combined	12.3900	2362	4841	6710	9204	11182	13118
010110	50	Routed	12.3900	2173	4576	6306	8651	10489	12396

21. Graph HEC-1 Results

Select Hydrology => HEC-1 => *Graph* to access the Graphing module. Enter the appropriate data for your location and click the *'Graph'* button as follows:



22. Backup Project

This final step is one of the two most critical steps. The other is the creation of unique folders for each project (Step 1). Backup your projects on a regular basis. You will save yourself from wasted time and unnecessary stress!

Select File => *Project Management* to access the Project Management module. Select *'Backup Project'* as the Action and KVLEXAMPLE1 as the project (use the adjacent icon to select). Click *'Backup'* to backup the project and select the directory where your backup file should go and finally click *'Select'* when a directory is chosen.