MARICOPA COUNTY
FLOOD CONTROL DISTRICT

DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

VERSION 6.8.0

TUTORIAL # 3
DEVELOPING A NEW PROJECT USING RATIONAL METHOD

KVL Consultants, Inc.

DEVELOPING A NEW PROJECT USING RATIONAL METHOD

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DEVELOPING A NEW PROJECT USING RATIONAL METHOD

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TUTORIAL TIME: 45 MINUTES

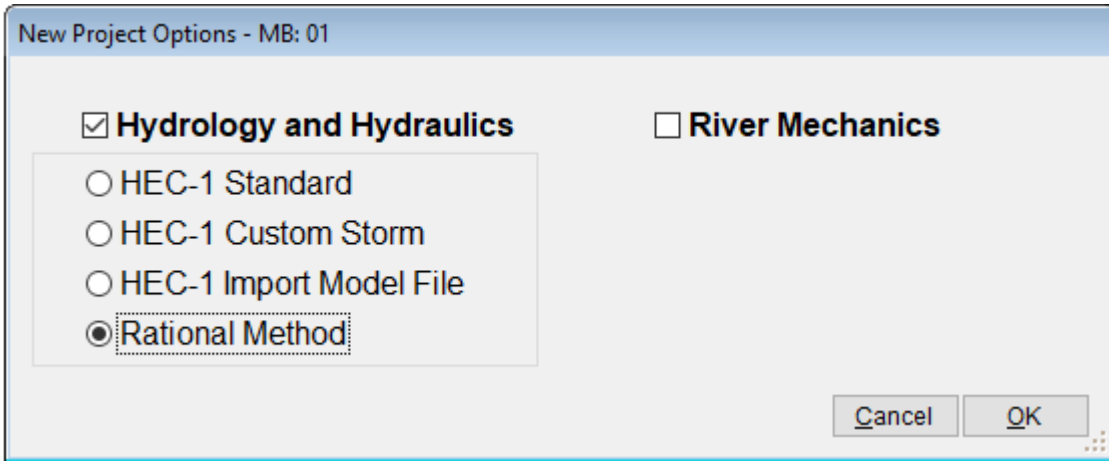
1.0 INTRODUCTION

This tutorial document is developed to guide users in developing a hydrology model using Rational Method. By following the procedure outlined in this document, one should become familiar with the approach with the ultimate objective of implementing the procedure to building a much larger hydrology model using the DDMSW program.

DDMSW has many capabilities not covered in this tutorial and it is recommended that you spend the time to read through the User's Manual and other supporting documents. Users are encouraged to explore the many features of the program through the use of pre-packaged example projects.

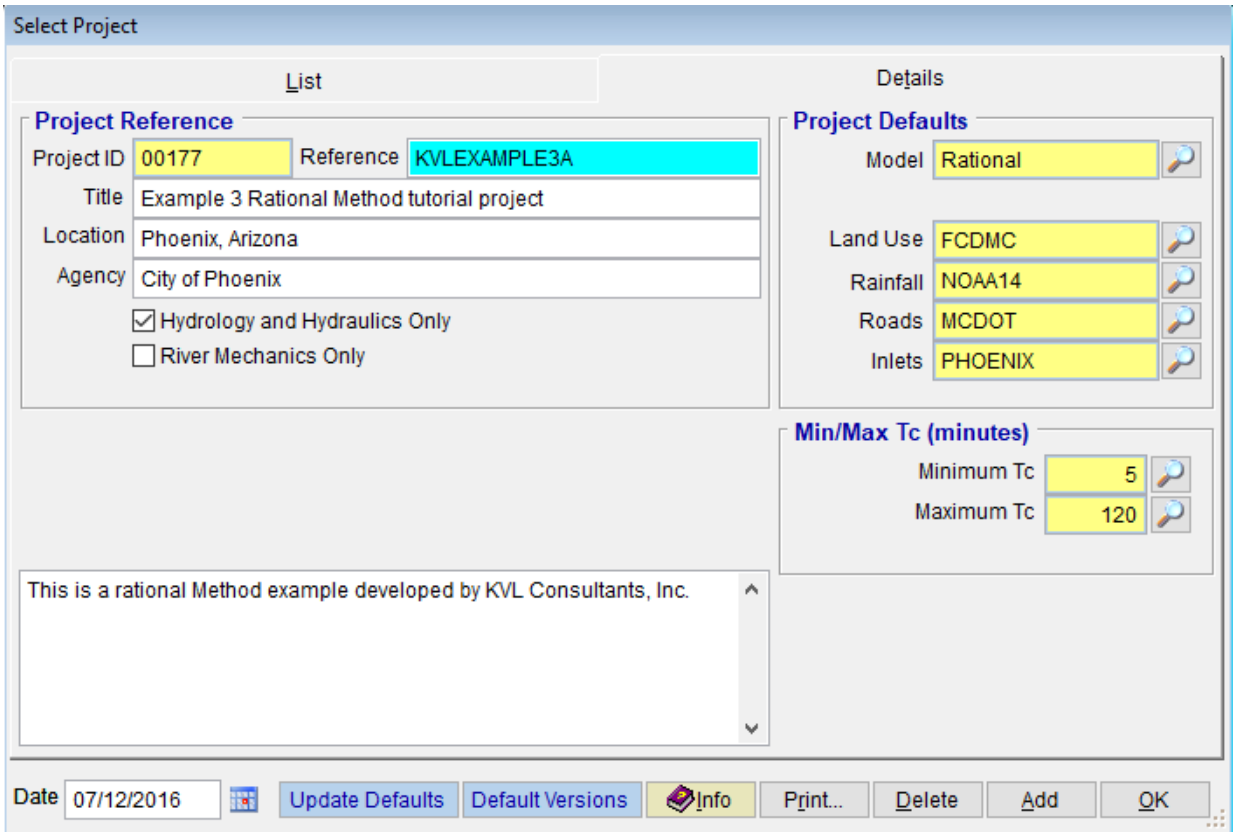
2.0 ESTABLISH A NEW PROJECT AND SET DATA DEFAULTS

After launching the program, select ***"File ➔ New Project"***. On the **NEW PROJECT OPTIONS** form, select the **Hydrology and Hydraulics** checkbox, and the **Rational Method** radio button as shown. Click the **OK** button to close the dialog box.



On the **SELECT PROJECT** form, type "*KVLEXAMPLE3A"* into the **Reference** textbox. This is the name of this newly created project. The users can choose the name as long as it does not exist in the DDMSW database. Each project must have a unique **Reference** (without spaces), a formal **Title**, **Location** and an **Agency** name (this can be your firm's name if you are a consultant). Then select the appropriate **Model** (*'Rational'* for this example), **Land Use**, **Rainfall**, **Roads** and **Inlet** project defaults.

Also add any appropriate comments in the Comment Box.

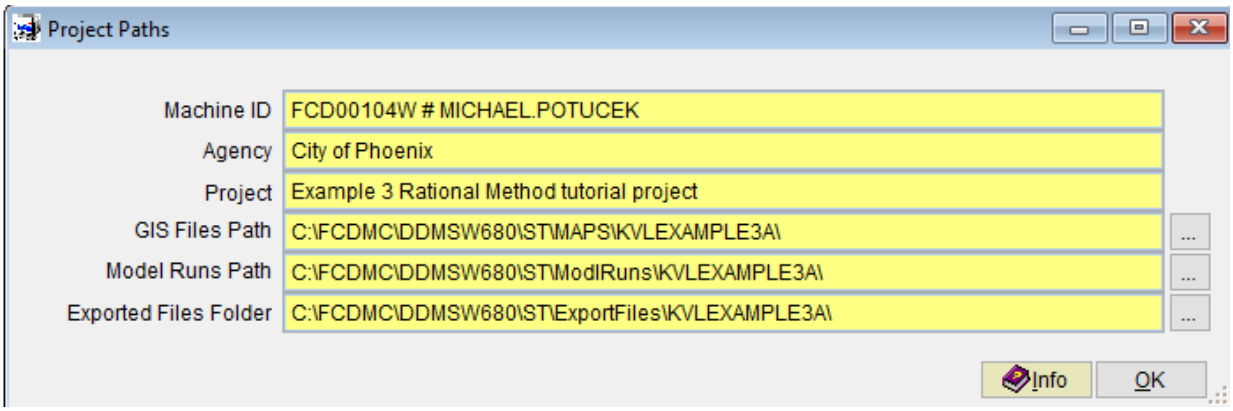


After entering the data, press **'*Save*'**. Then, press ***'OK'*** to close the **'SELECT PROJECT'** form. Hit 'OK" to continue.

3.0 SETTING THE MODEL RUNS PATH

When running models, the input and result files have similar file names for each project. To prevent one project from overwriting the results of another project, it is necessary to establish a unique directory for each project's model runs.

Go to ***"File ➔ Project Paths"*** to establish the model runs path. Press the ellipse button **('…')** to the right of the **Model Runs Path** textbox and navigate to an appropriate directory. Choose the folder as the model runs path or create one if the desired folder does not exist by pressing the ***'Make New Folder'*** button. Press ***'OK'*** to close the **'BROWSE FOR FOLDER'** form. Press ***'Save'*** to save the Project Path information. Click ***'OK'*** to exit the **'PROJECT PATHS'** form.

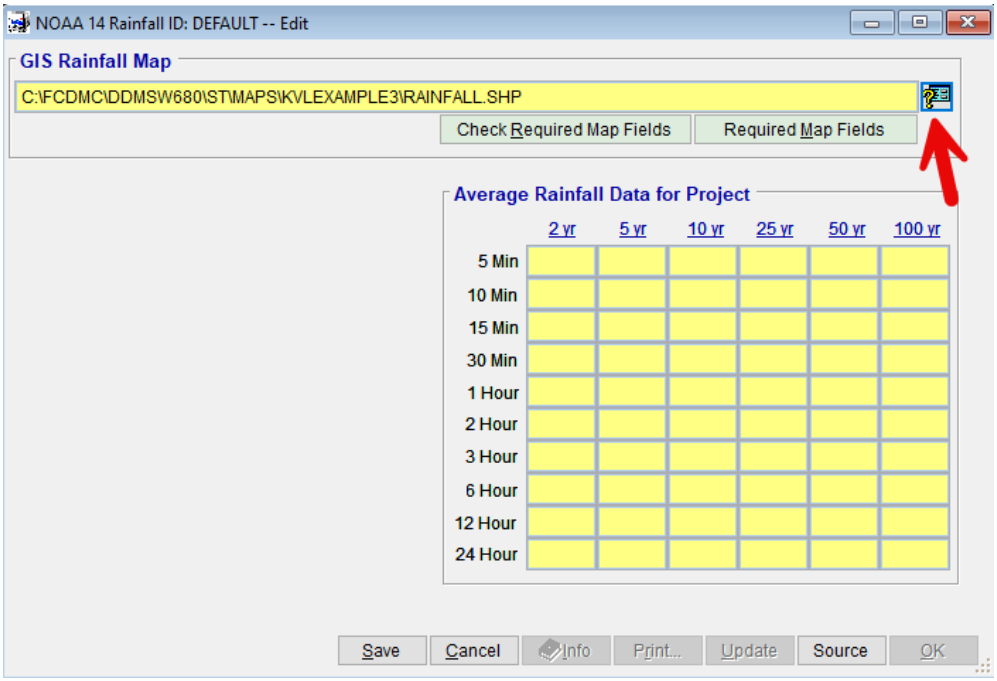


4.0 ESTABLISHING RAINFALL DATA FOR THE PROJECT

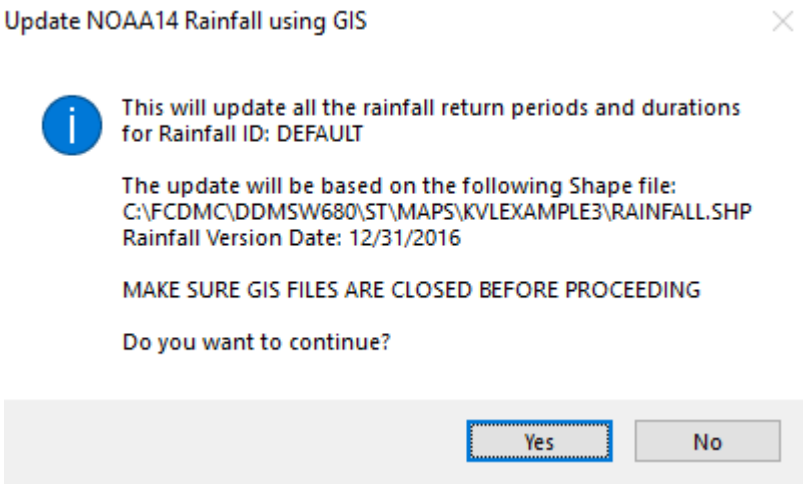
Select ***'Hydrology ➔ Rainfall'*** and click on the button ***SOURCE*** to select either *'Manual', 'Lat/Long','State Plane',* or *'GIS'*. After the rainfall data has been evaluated, the Rainfall Intensity graph can be viewed in ***'Hydrology ➔ Rational Method ➔ Rainfall Intensity'*** and clicking the ***'Graph'*** button.

4.1 GIS

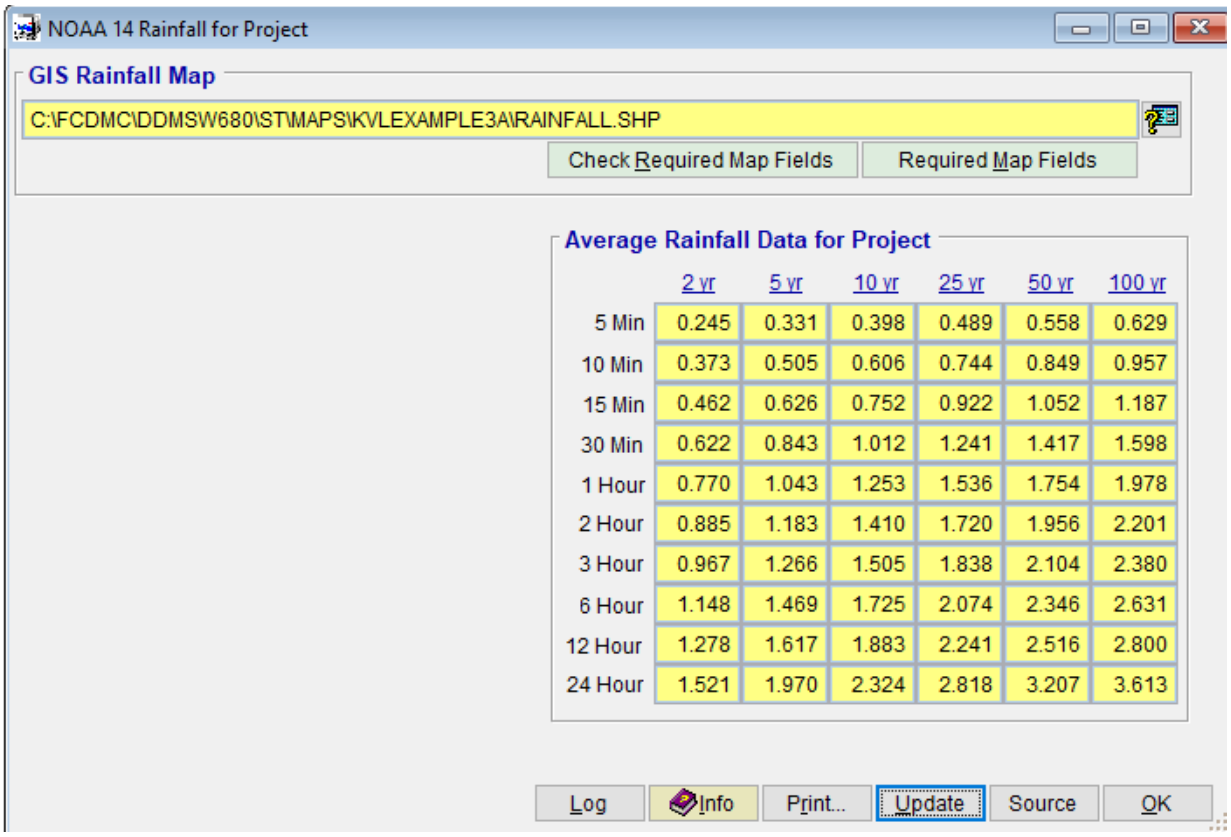
If *'GIS'* is selected as the **Source**, it is necessary to select the Rainfall Shape file. This file should cover the entire project area. The rainfall map can be found by navigating clicking the "Select a file (Right-click to reset/clear)" button shown with the red arrow below. Navigate to the /st/maps/KVLEXAMPLE3 folder where your DDMSW program is installed and selecting Rainfall.shp.



Click **"Save"** then click the ***'Update'*** button to process the ***AVERAGE RAINFALL DATA FOR THE PROJECT***. Click ***'Yes'*** to continue.



After the update, click the ***'OK'*** button to close the **NOAA14 RAINFALL** form.

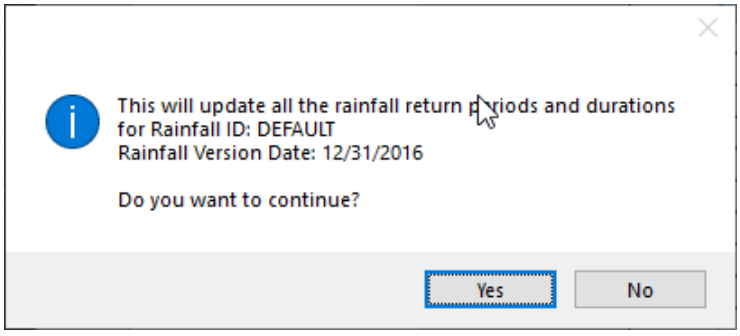


4.2 Manual

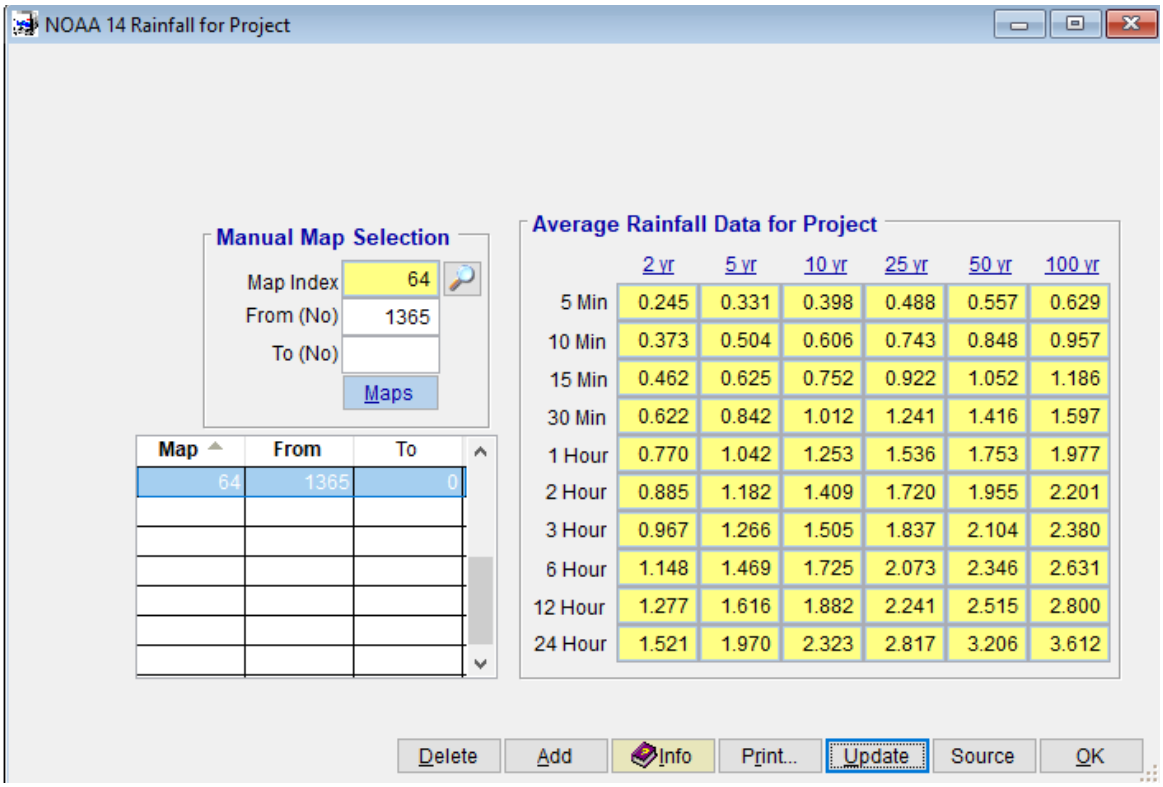
If *'Manual'* is selected as the **Source**, it is necessary to select the appropriate cells to develop the Rainfall data. Click the ***'Maps'*** button (in ***DATA SOURCE*** data group) and determine the project location. For this tutorial project, Map No '64' will be used.

Each map has a Township and Range (T02NR04E for this example) information to assist in locating the project. Street atlas maps (not included here) often show the Township and Range information. Each cell size on the map is at most 160 acres, and this is the recommended upper limit where the Rational Method is most effective. Selecting a single cell that is reasonably close to the project area will produce reasonable results because rainfall does not change significantly between adjacent cells.

Click the selection button on the right side of the **Map Index** textbox and select *'64'* from the drop down list. Enter *'1365'* in the **From (No)** textbox field. Click ***'Save'*** to save the data entered, then click the ***'Update'*** button to evaluate the rainfall data for the project.



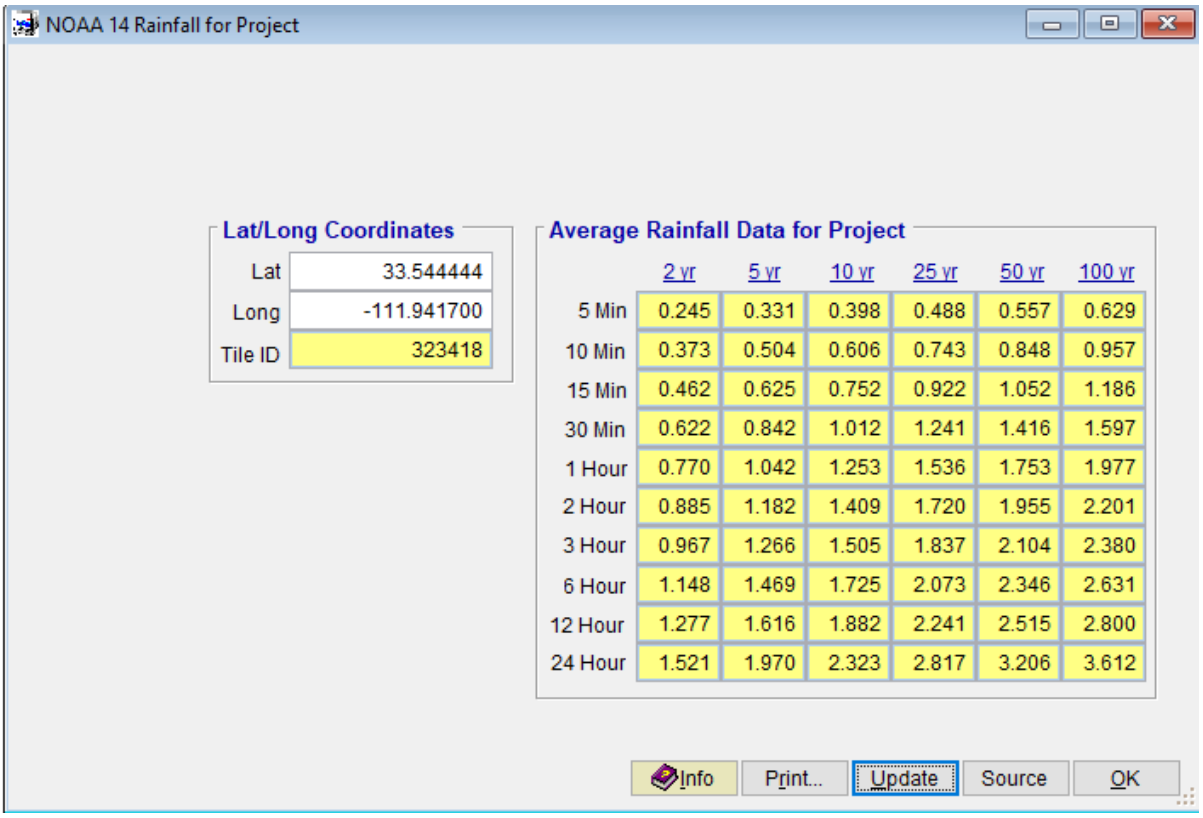
After the update, click the ***'OK'*** button, to close the **NOAA RAINFALL** form.



Note that the selection of the single cell using the *'Manual'* method gave the same rainfall results as the *'GIS'* method.

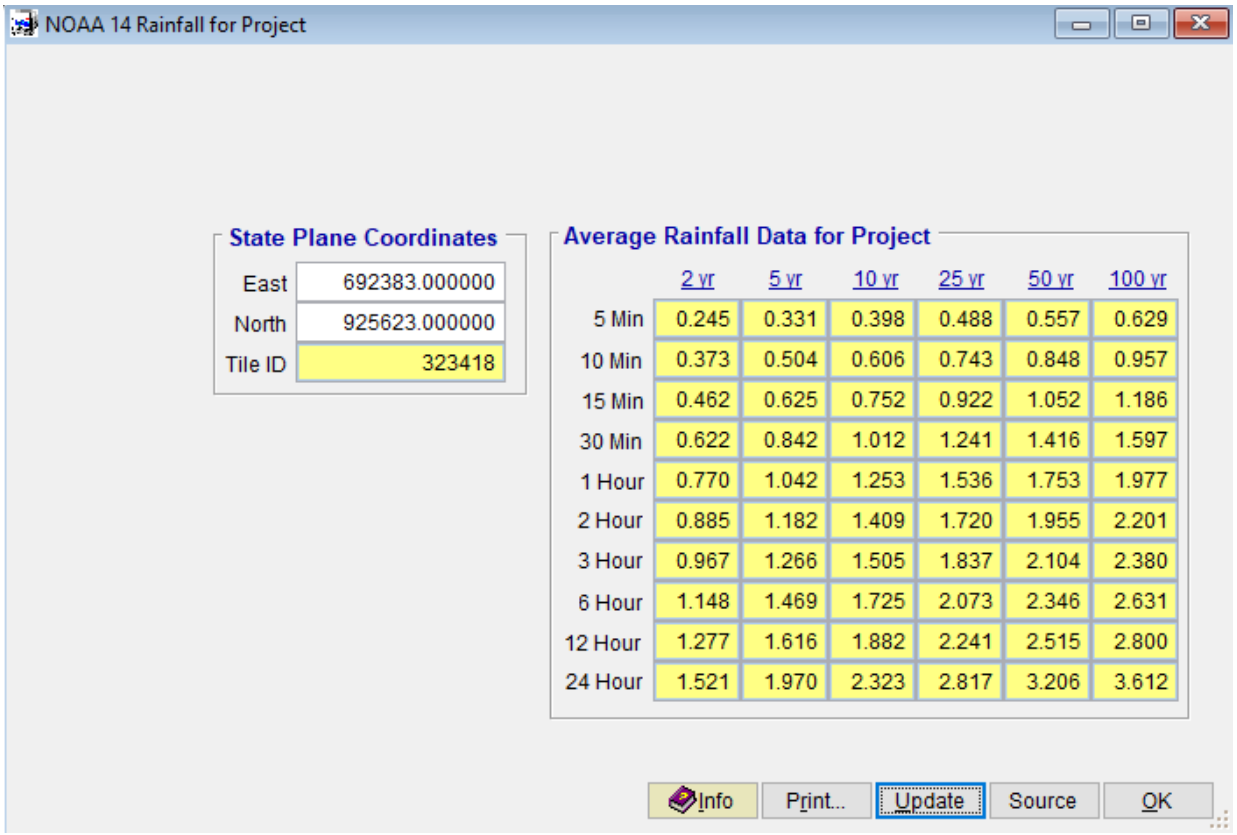
4.3 Lat/Long

If 'Lat/Long' is selected as the Source, simply type in the Lat and Long coordinates in decimal degrees. Type the coordinates in the screenshot below. Click "Save" and then click "Update."



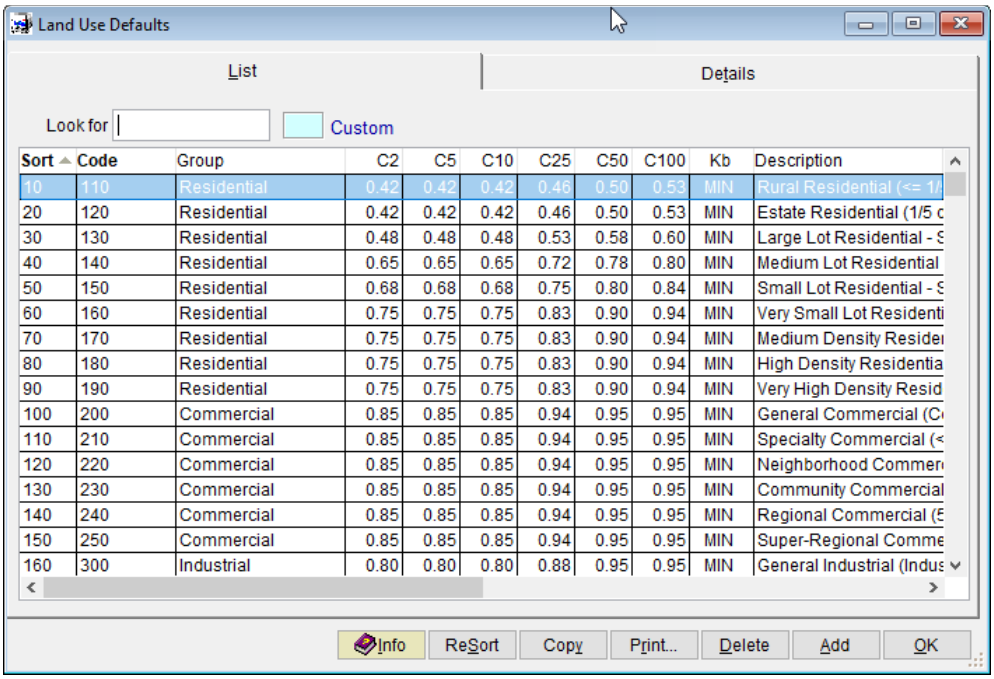
State Plane

If 'State Plane' is selected as the **Source**, simply type in the Arizona State Plane Central East and North coordinates. Type the coordinates in the screenshot below. Click "Save" and then click "Update."



5.0 REVIEW THE LAND USE DEFAULTS

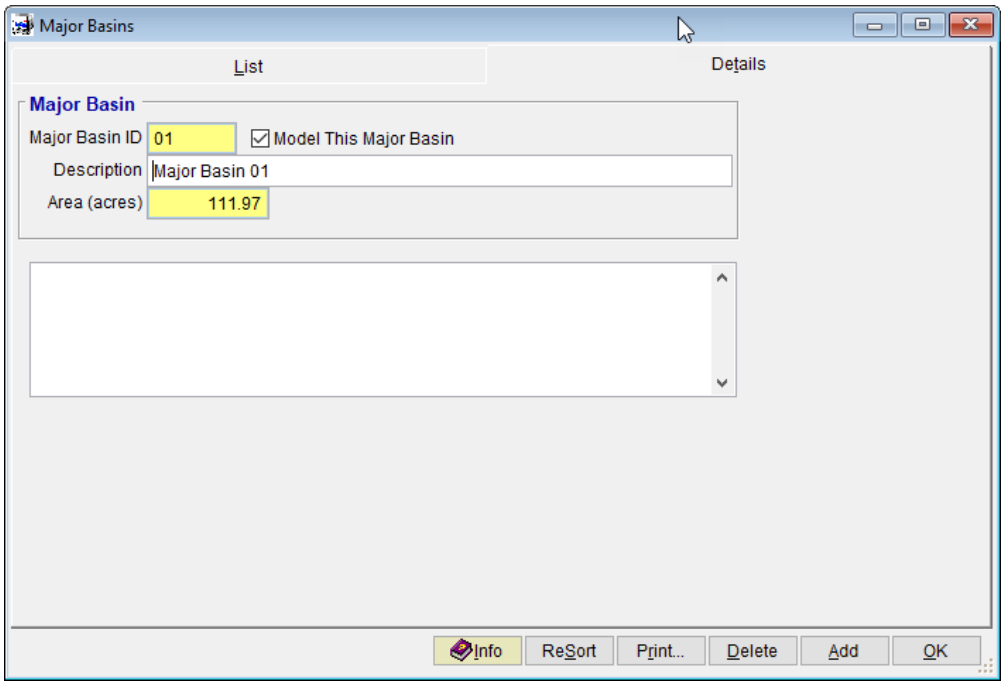
Select ***'Hydrology ➔ Land Use Defaults'*** to access the land use defaults data. Since we are using *FCDMC* default data, none of the records can be modified. To see all the default values, use the horizontal and vertical scroll bars of the form to scroll to the right and bottom, respectively. These Agency default data cannot be modified; however, *'Custom'* land use data can be added.



Click on the ***'OK'*** button to close the **LAND USE DEFAULTS** form.

6.0 ESTABLISH MAJOR BASIN ID'S

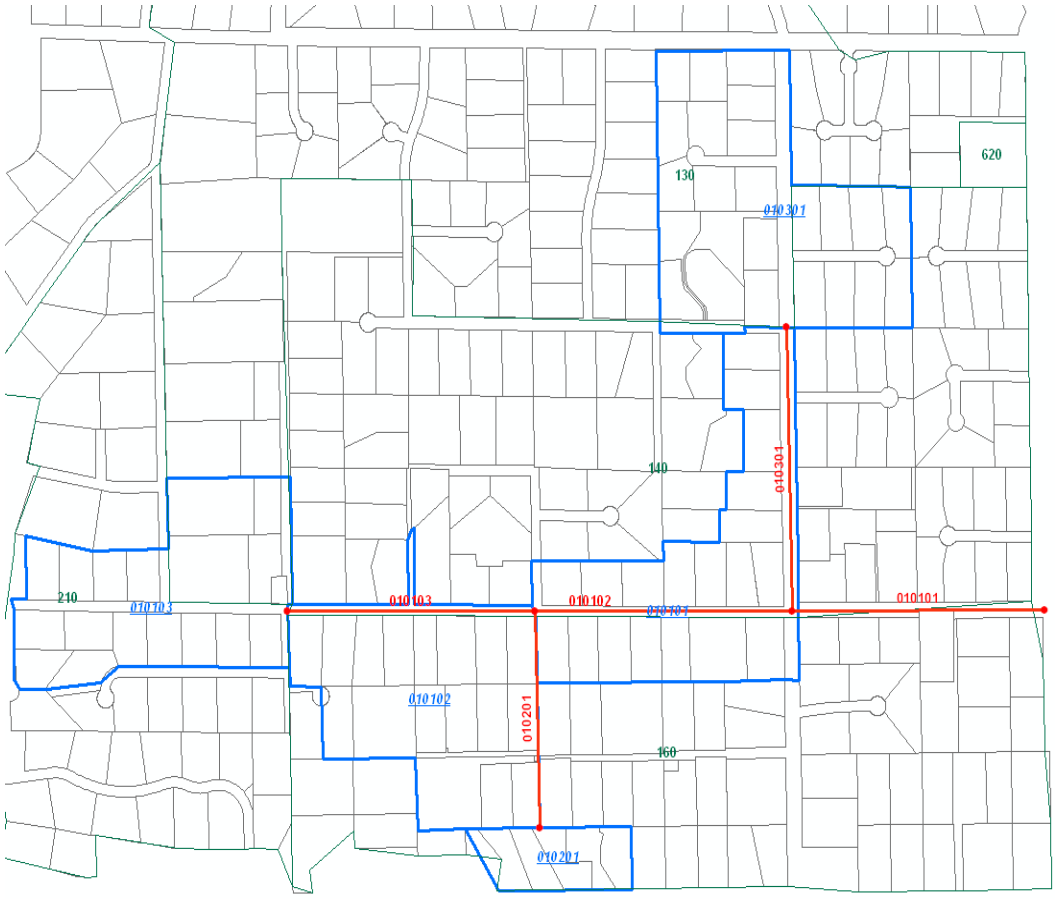
Select ***'Hydrology ➔ Major Basins'*** to access the Major Basins data. **DDMSW** automatically establishes at least one Major Basin (*01*) when creating a new project. Since we will only have one major basin in this project, there is no need for further modification at this time. The area will be updated when updating the Sub Basins. Click the ***'OK'*** button to close the **MAJOR BASINS** form.



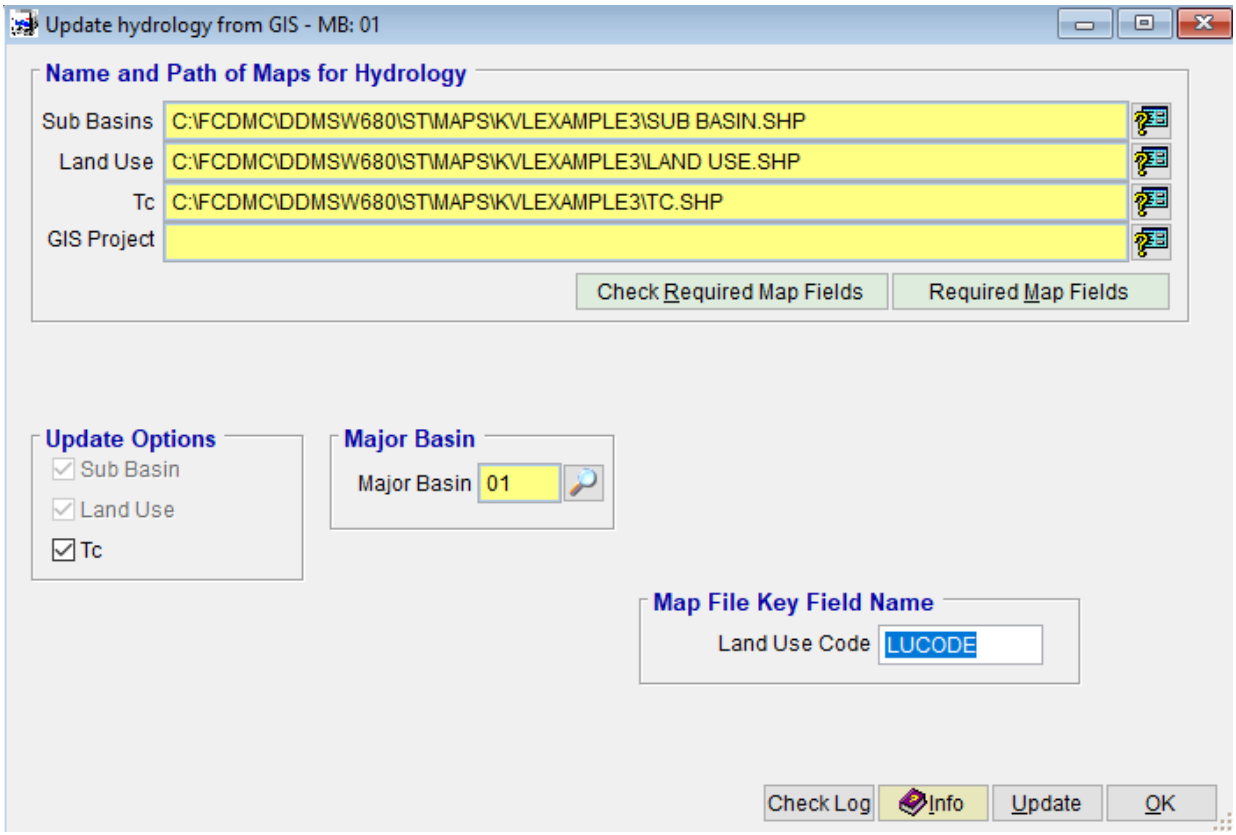
7.0 ESTABLISH THE SUB BASIN AND LAND USE DATA USING GIS

Sub Basin data can be developed automatically through GIS. If the GIS data is open, make sure nothing is in the Edit mode.

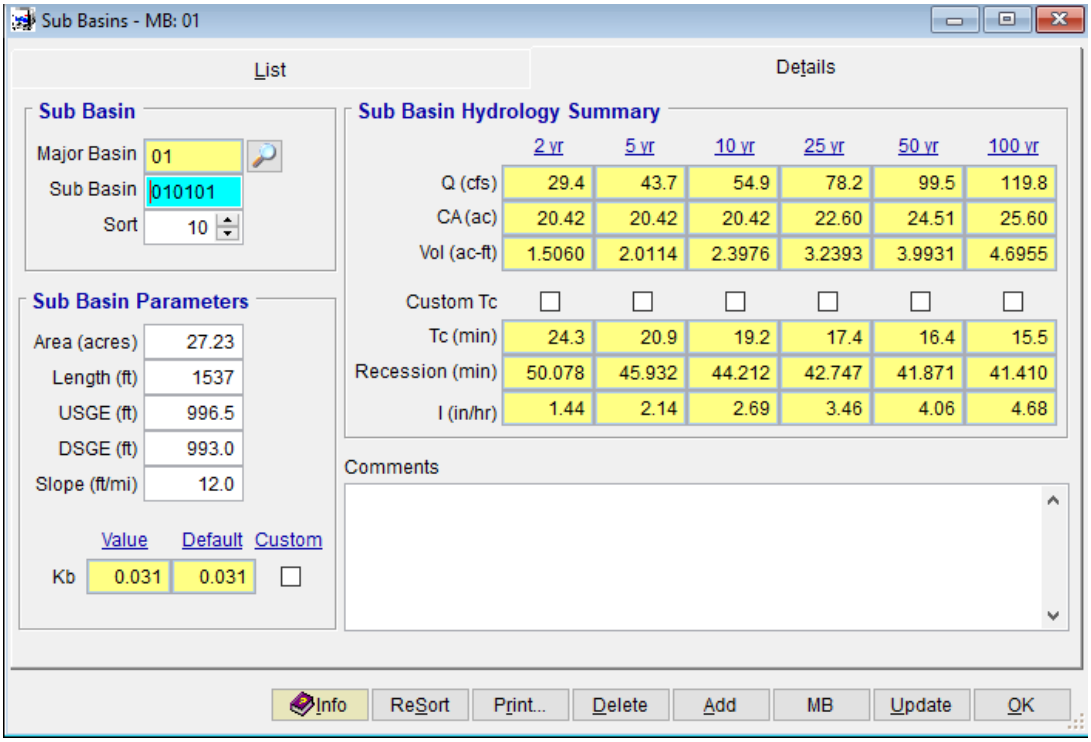
1. Digitize the Sub Basin polygons (*SUBBASINS.SHP*). Create two attribute fields for the Sub Basins, namely: **AreaID** and **BasinID**. For each Sub Basin, enter the data values for these attribute fields. .
2. Digitize the Time of Concentration polylines (*TC.SHP*) representing the flow paths for the Sub Basins. It is important that the Tc polylines are digitized within the Sub Basin areas, Create two attribute fields for the Tc, namely: **USGE** (which is the upstream ground elevation), and **DSGE** (which is the downstream ground elevation). It is not necessary to enter any other data for the Tc polylines.
3. Digitize the Land Use polygons (*LANDUSE.SHP*) or obtain it from appropriate authorities). Create one attribute field called, **LUCODE**, and enter the land use code for each land use polygon. The land use codes used for the project should match the land use codes in the land use defaults.

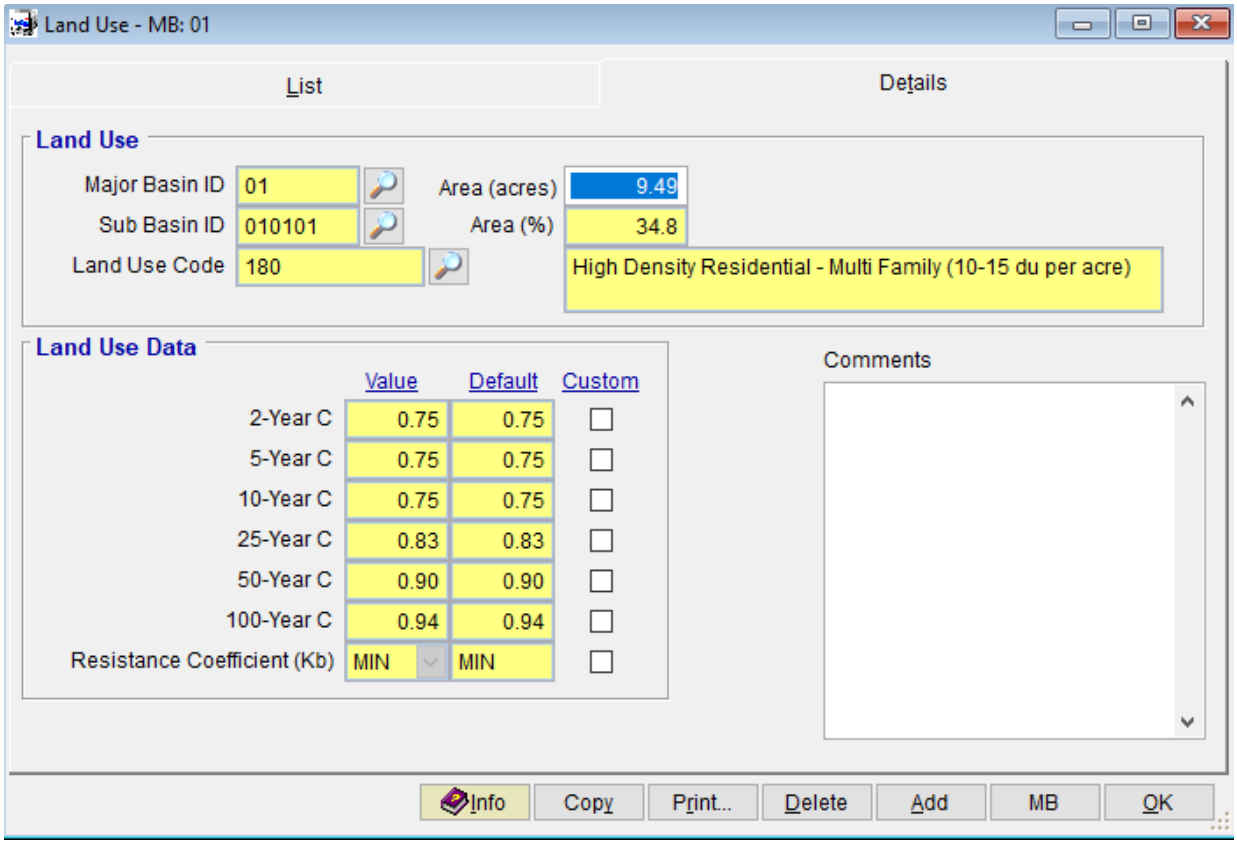


When all the data has been digitized, go to ***'Maps ➔Update Hydrology'***. Check the **Land Use** and **Tc** checkboxes in the **UPDATE OPTIONS** group data. Make sure the **Major Basin** *'01'* is selected. Select the Sub Basins, Land Use and Tc maps (i.e., *SUBBASINS.SHP, LANDUSE.SHP*, and *TC.SHP*) using the adjacent buttons. On the **Land Use Code** textbox, enter *'LUCODE'*. Click the ***'Save'*** *button and then the* ***'Update'*** button to load (or update) the Sub Basin, Land Use, and Tc data to be used for building the hydrologic model of project.



The **SUB BASINS** (***'Hydrology ➔ Sub Basins'***) and **LAND USE** (***'Hydrology ➔ Land Use'***) forms are provided below:





8.0 ESTABLISHING THE SUB BASIN DATA MANUALLY

If GIS files are not available, the required Sub Basins data can be manually entered. Select ***'Hydrology ➔ Sub Basins'*** to open the **SUB BASINS** form.

Click ***'Add'*** to enter the first Sub Basins record. Enter the following data on the named textboxes:

Sub Basin	*010101*
Area (acres)	*27.23*
Length (ft)	*1537.00*
USGE (ft)	*996.50*
DSGE (ft)	*993.00*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin	*010102*
Area (acres)	*25.12*
Length (ft)	*1520.00*
USGE (ft)	*1001.50*
DSGE (ft)	*997.00*

Click *'**Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin	*010103*
Area (acres)	*24.00*
Length (ft)	*1694.00*
USGE (ft)	*1002.50*
DSGE (ft)	*1001.00*

Click 'Save' to save the data and then 'Add' for the next record.

Sub Basin	*010201*
Area (acres)	*5.25*
Length (ft)	*627.00*
USGE (ft)	*1000.00*
DSGE (ft)	*999.00*

Click ***'Save'*** to save the data and then ***'Add'*** for the last record.

Sub Basin	*010301*
Area (acres)	*30.37*
Length (ft)	*1818.00*
USGE (ft)	*999.00*
DSGE (ft)	*996.00*

Click ***'OK'*** to close the **SUB BASINS** form.

9.0 ESTABLISHING THE LAND USE DATA MANUALLY

Select ***'Hydrology ➔ Land Use'*** to access the **LAND USE** form

Click on ***'Add'*** for the first Land Use record.

Sub Basin ID	*010101* (Use adjacent button to select)
Land Use Code	*190* (Use adjacent button to select)
Area (Acres)	*17.75*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010101* (Use adjacent button to select)
Land Use Code	*180* (Use adjacent button to select)
Area (Acres)	*9.49*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010102* (Use adjacent button to select)
Land Use Code	*220* (Use adjacent button to select)
Area (Acres)	*.02*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010102* (Use adjacent button to select)
Land Use Code	*190* (Use adjacent button to select)
Area (Acres)	*1.72*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010102* (Use adjacent button to select)
Land Use Code	*180* (Use adjacent button to select)
Area (Acres)	*23.38*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010103* (Use adjacent button to select)
Land Use Code	*220* (Use adjacent button to select)
Area (Acres)	*15.34*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010103* (Use adjacent button to select)
Land Use Code	*190* (Use adjacent button to select)
Area (Acres)	*0.06*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010103* (Use adjacent button to select)
Land Use Code	*140* (Use adjacent button to select)
Area (Acres)	*8.60*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010201* (Use adjacent button to select)
Land Use Code	*180* (Use adjacent button to select)
Area (Acres)	*5.02*

Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010301* (Use adjacent button to select)
Land Use Code	*190* (Use adjacent button to select)
Area (Acres)	*9.85*

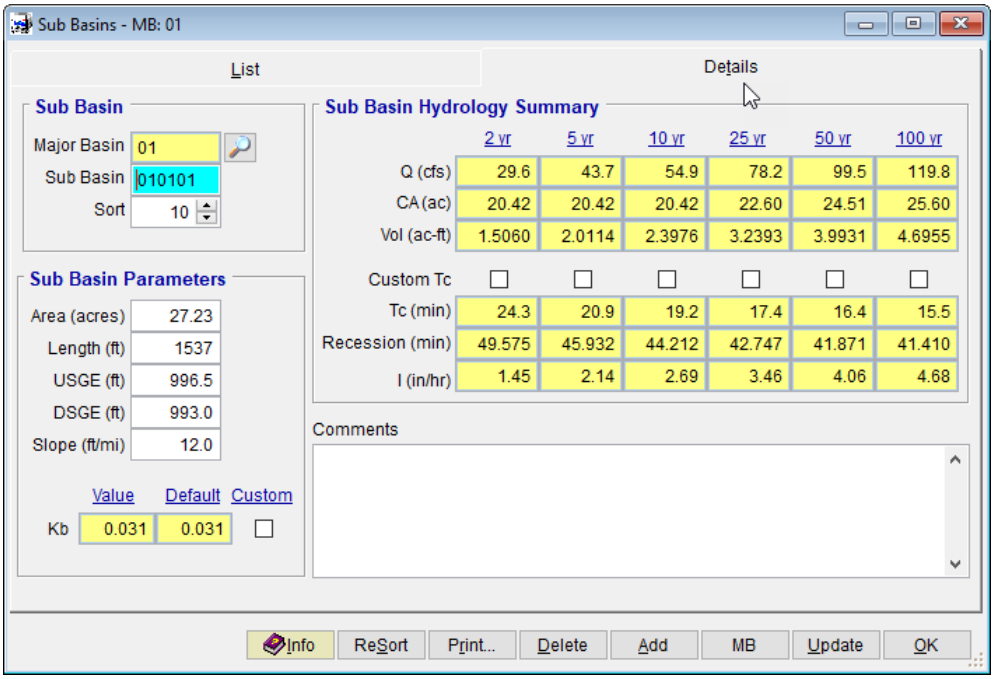
Click ***'Save'*** to save the data and then ***'Add'*** for the next record.

Sub Basin ID	*010301* (Use adjacent button to select)
Land Use Code	*140* (Use adjacent button to select)
Area (Acres)	*20.52*

Click ***'Save'*** to save the data and then click ***'OK'*** to close the **LAND USE** form.

10.0 UPDATE SUB BASIN DATA - MANUAL

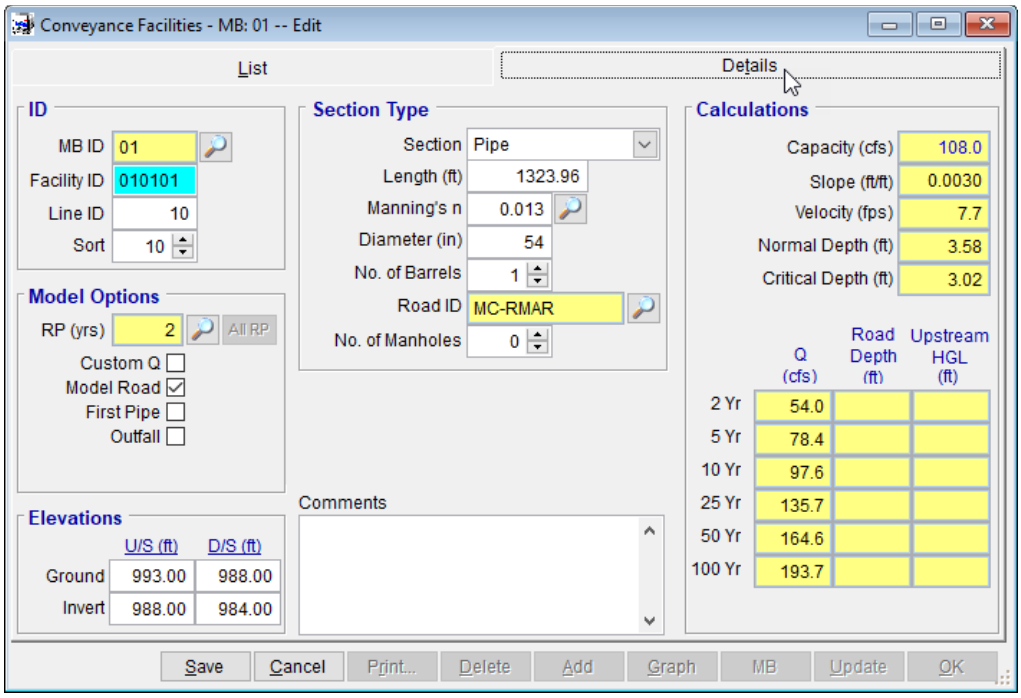
Once all the Sub Basin and Land Use data has been entered, select ***'Hydrology ➔ Sub Basins'*** to open the **SUB BASINS** form. Click the ***'Details'*** tab to view all the data for a particular record. Click ***'Update'*** to update the data introduced manually.



Click ***'OK'*** to close the **SUB BASINS** form and continue.

11.0 ESTABLISH CONVEYANCE FACILITY DATA

Select ***'Hydraulics ➔ Conveyance Facilities'*** to access the **CONVEYANCE FACILITIES** form. Select the **Details** tab and click on ***'Add'*** to add the first record.

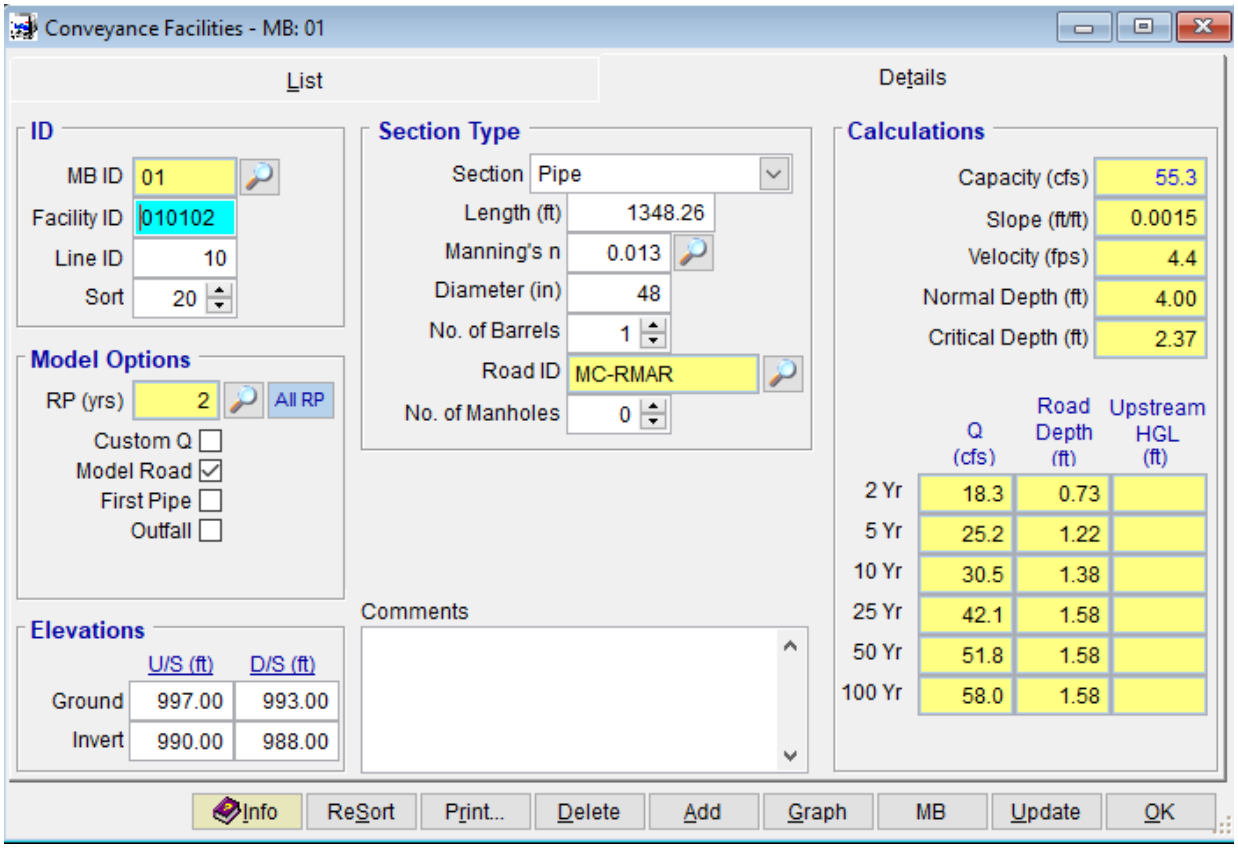


Enter the following data for the first record.

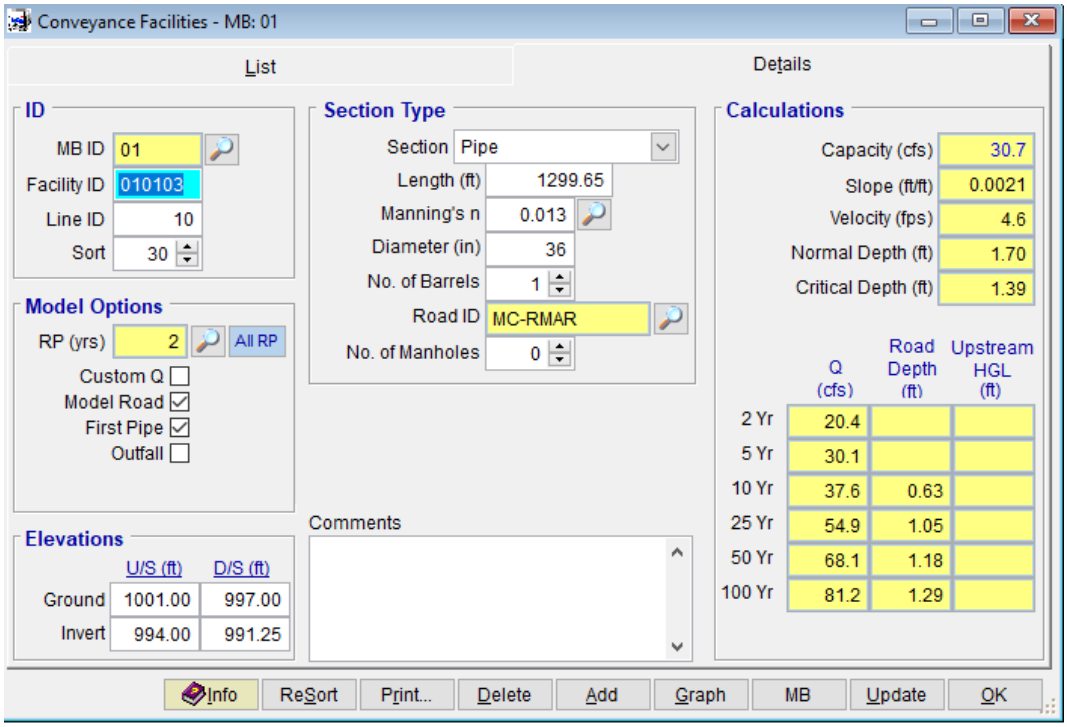
PARAMETERS	VALUES
Facility ID	*010101*
Line ID	*10*
Sort	*10 (Sort from downstream to upstream)*
RP (yrs)	*2 (Use adjacent button to select)*
Model Road	*Check*
Outfall	*Check*
D/S Pipe ID	***Leave Blank***
Section	*Pipe*
Length (ft)	*1323.96*
Manning's n	*0.013 (Use adjacent button to select)*
Diameter (in)	*54*
No. of Barrels	*1*
No. of Manholes	*0*
Road ID	*MC-RMAR (Use adjacent button to select)*
Ground U/S (ft)	*993.00*
Ground D/S (ft)	*988.00*
Invert U/S (ft)	*988.00*
Invert D/S (ft)	*984.00*

Click ***'Save'*** to save the data just entered and then click ***'Add'*** to enter the second

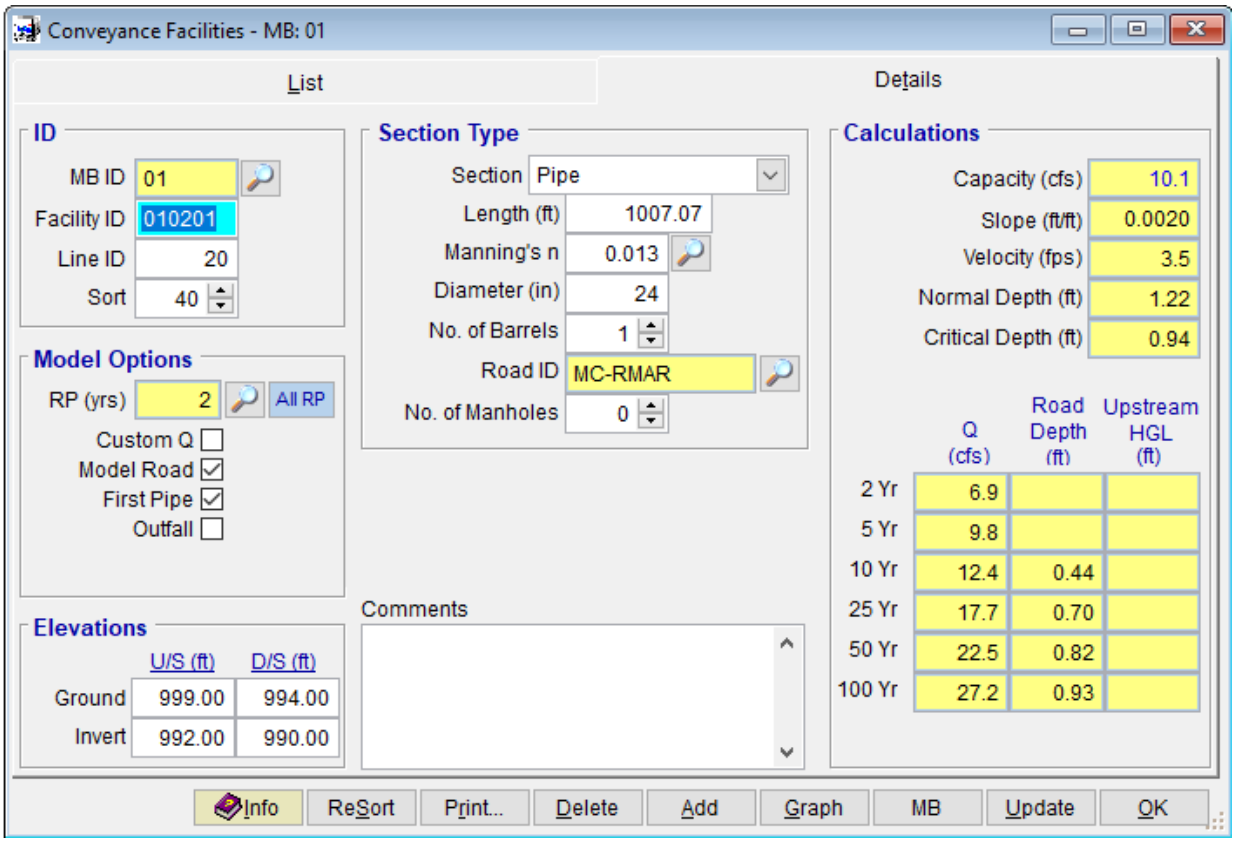
record.



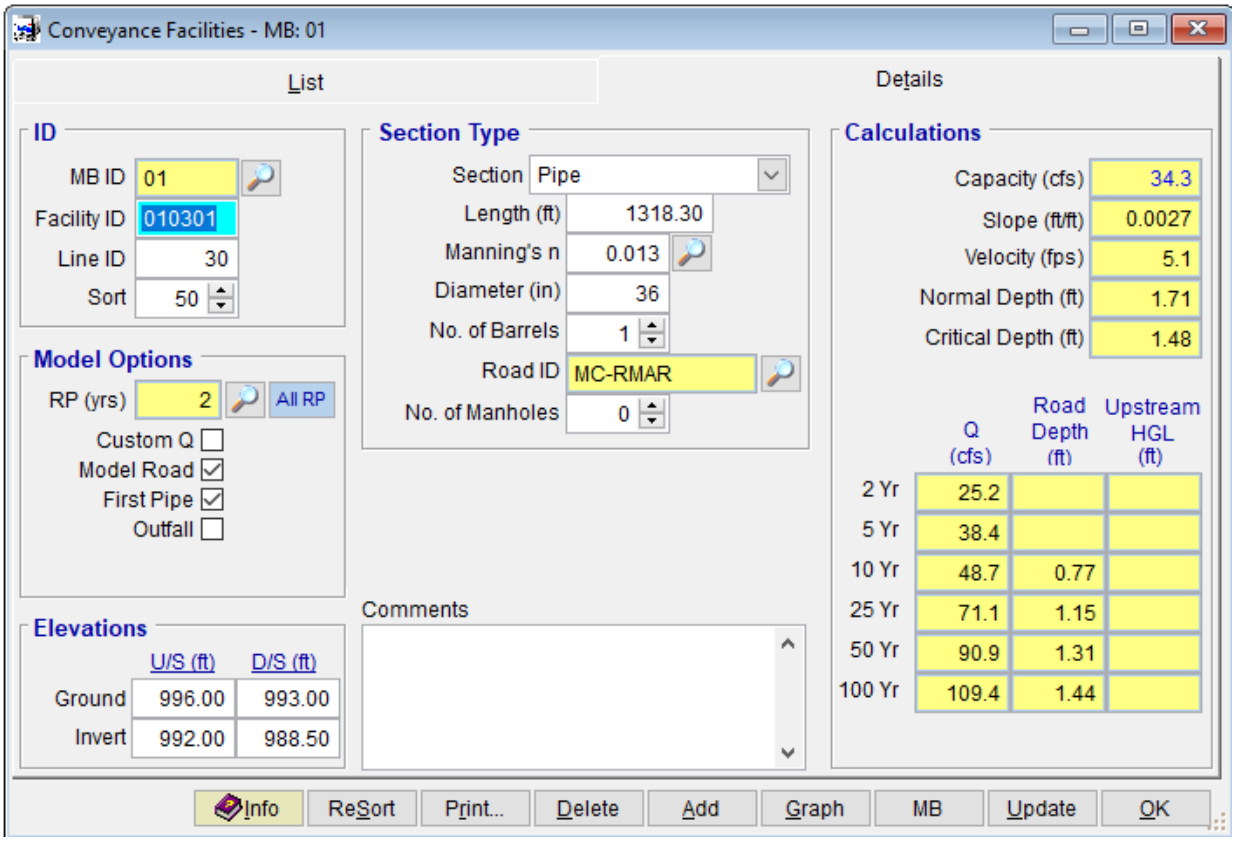
Click *'**Save**'* **t**o save the data just entered and then click *'**Add**'* to enter the third record.



Click *'**Save'** t*o save the data just entered and then click ***'Add'*** to enter the fourth record.



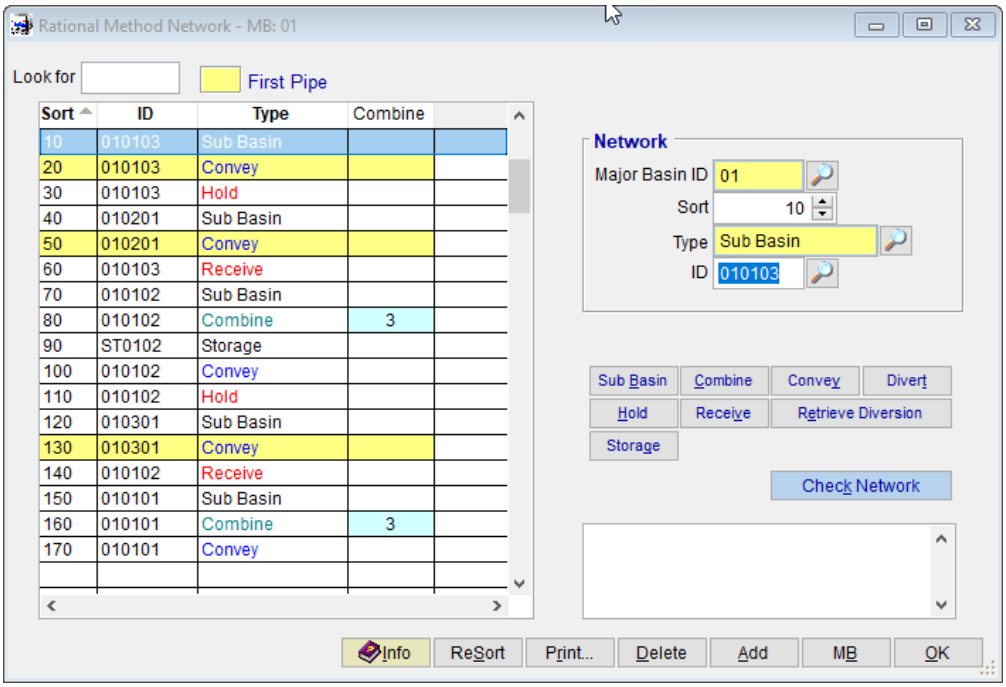
Click *'**Save'** t*o save the data just entered and then click ***'Add'*** to enter the fifth and last record.



Click ***'OK'*** to close the **CONVEYANCE FACILITIES** form and continue.

12.0 ESTABLISH THE MODEL NETWORK

Select ***'Hydrology ➔ Rational Method ➔ Network'*** to access the model Network data.



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

PARAMETERS	VALUES
Type	*Sub Basin*
ID	*010103 (Use adjacent button to select)*
Sort	*10*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the second record.

PARAMETERS	VALUES
Type	*Convey*
ID	*010103 (Use adjacent button to select)*
Sort	*20*
First Pipe	*Check*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the third record.

PARAMETERS	VALUES
Type	*Hold*
ID	*010103 (Use adjacent button to select)*
Sort	*30*
First Pipe	*Check*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the fourth record.

PARAMETERS	VALUES
Type	*Sub Basin*
ID	*010201(Use adjacent button to select)*

Sort	*40*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the fifth record.

PARAMETERS	VALUES
Type	*Convey*
ID	*010201(Use adjacent button to select)*
Sort	*50*
First Pipe	*Check*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the sixth record.

PARAMETERS	VALUES
Type	*Receive*
ID	*010103 (Use adjacent button to select)*
Sort	*60*
First Pipe	*Check*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the seventh record.

PARAMETERS	VALUES
Type	*Sub Basin*
ID	*010102 (Use adjacent button to select)*
Sort	*70*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the eight record.

PARAMETERS	VALUES
Type	*Combine*
ID	*010102 (Use adjacent button to select)*
Sort	*80*
Combine	*3 (Combines prior three records)*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the ninth record.

PARAMETERS	VALUES
Type	*Storage*
ID	*ST0102 (Use adjacent button to select)*
Sort	*90*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the tenth record.

PARAMETERS	VALUES
Type	*Convey*
ID	*010102 (Use adjacent button to select)*
Sort	*100*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the eleventh record.

PARAMETERS	VALUES
Type	*Hold*
ID	*010102 (Use adjacent button to select)*
Sort	*110*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 12th record.

PARAMETERS	VALUES
Type	*Sub Basin*
ID	*010301(Use adjacent button to select)*
Sort	*120*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 13th record.

PARAMETERS	VALUES
Type	*Convey*
ID	*010301(Use adjacent button to select)*
Sort	*130*
First Pipe	*Check*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 14th record.

PARAMETERS	VALUES
Type	*Receive*
ID	*010102 (Use adjacent button to select)*
Sort	*140*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 15th record.

PARAMETERS	VALUES
Type	*Sub Basin*
ID	*010101 (Use adjacent button to select)*
Sort	*150*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 16th record.

PARAMETERS	VALUES
Type	*Combine*
ID	*010101 (Use adjacent button to select)*
Sort	*160*
Combine	*3 (Combines prior three records)*

Click ***'Save'*** to save the record. Click ***'Add'*** to enter the 17th record.

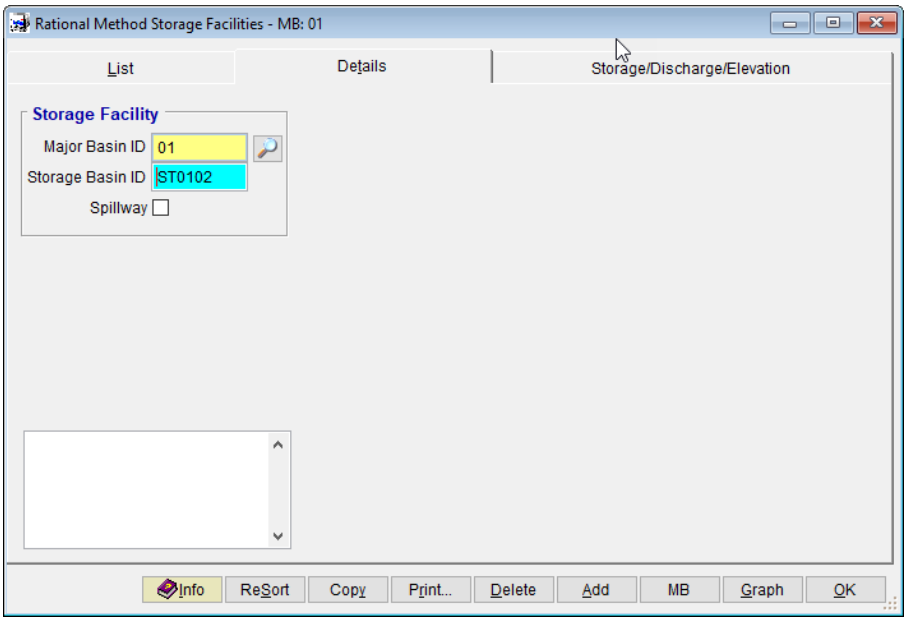
PARAMETERS	VALUES
Type	*Convey*
ID	*010101 (Use adjacent button to select)*

Sort	*170*

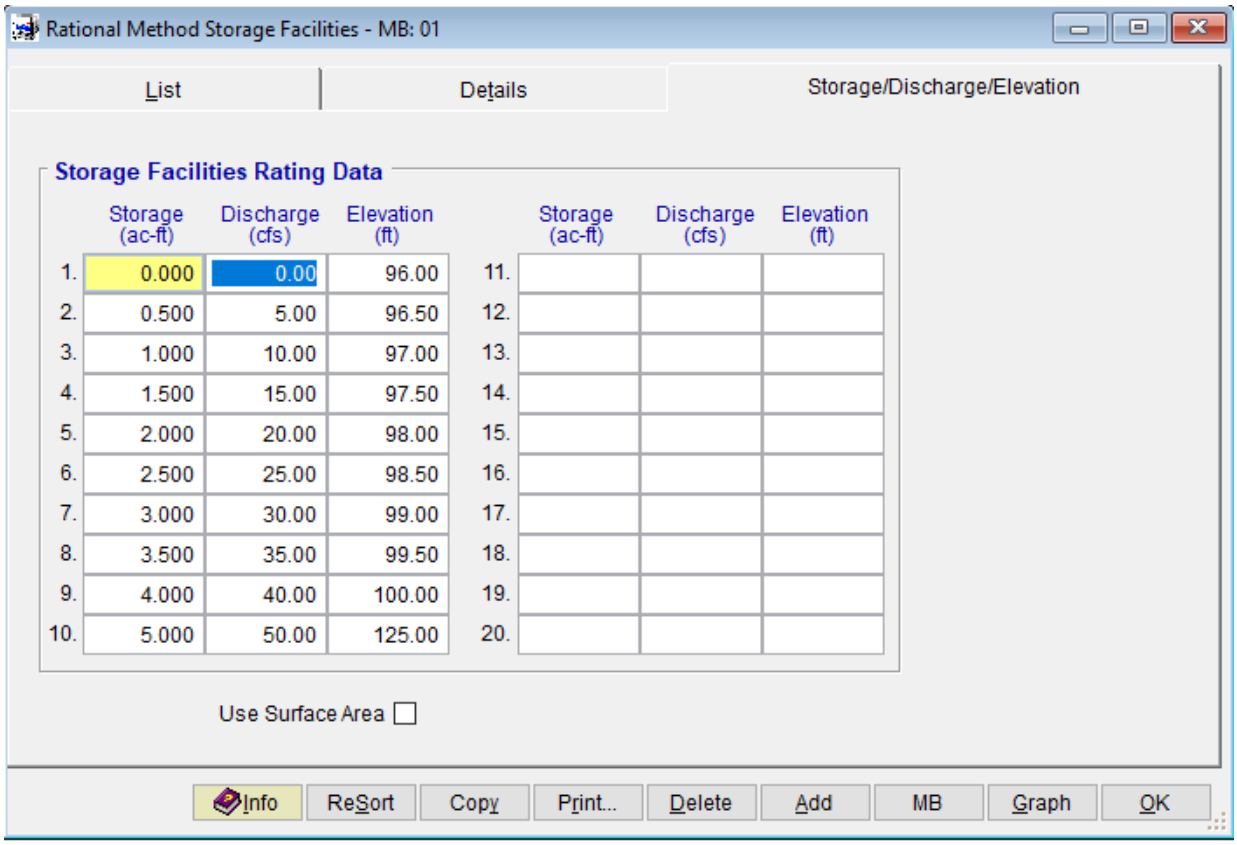
Click ***'Save'*** to save the record. Click the ***'Check Network'*** button to determine if the model network that was built has issues.

13.0 ESTABLISH THE STORAGE

Select ***'Hydrology ➔ Rational Method ➔ Storage'*** to create the storage. Click "Add" to create the storage facility and enter ST0102 in the Storage Basin ID field. Click *"Save"* and *"OK"*



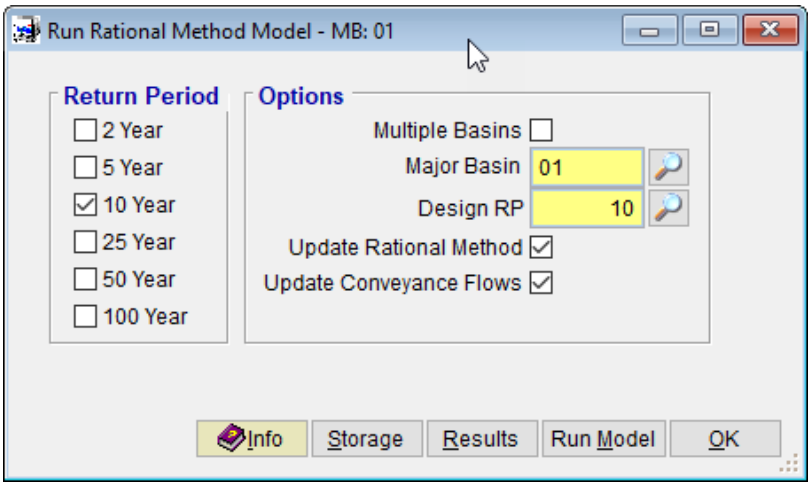
Enter the following Storage/Discharge/Elevation data in its corresponding tab as shown below.



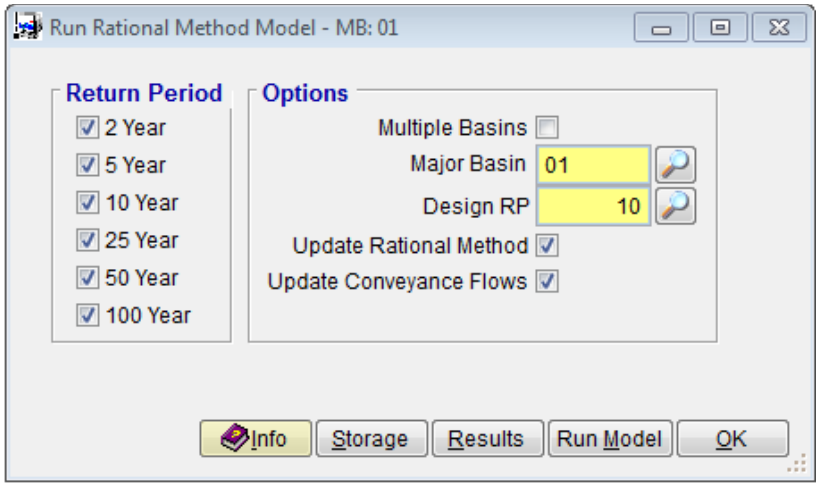
14.0 RUN RATIONAL METHOD MODEL

Select ***'Hydrology ➔ Rational Method ➔ Model'*** to access the **RUN RATIONAL METHOD MODEL** form.

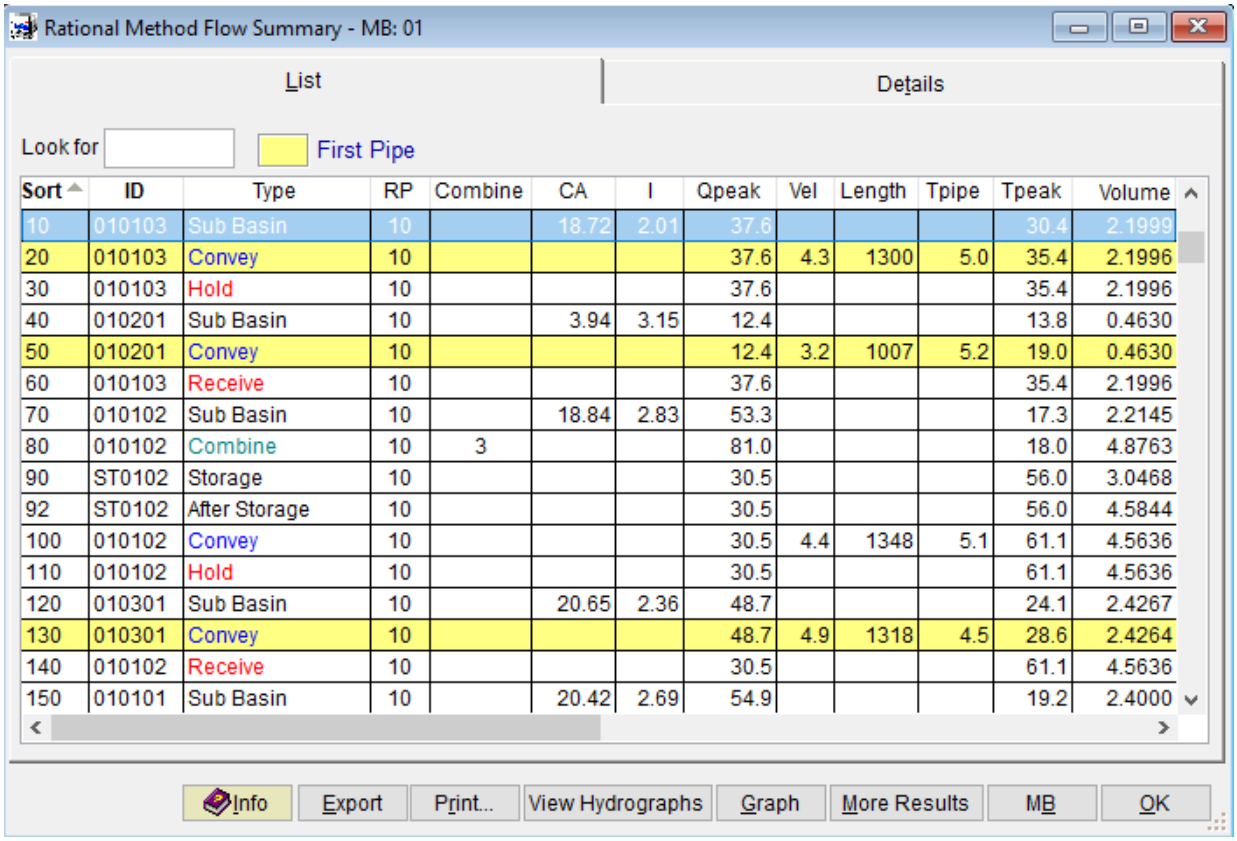
Enter the data as shown on the following screen. Click ***'Save'*** to save the Model Run settings. Click ***'Run Model'*** to execute the model for the one return period selected.



If the model runs correctly, check all the Return Periods and re-run the model.



To view the model run results, click the ***'Results'*** button on the **RUN RATIONAL METHOD MODEL** form.



Sort	ID	Type	RP	Combine	CA	I	Qpeak	Vel	Length	Tpipe	Tpeak	Volume
10	010103	Sub Basin	10		18.72	2.01	37.6				30.4	2.1999
20	010103	Convey	10				37.6	4.3	1300	5.0	35.4	2.1996
30	010103	Hold	10				37.6				35.4	2.1996
40	010201	Sub Basin	10		3.94	3.15	12.4				13.8	0.4630
50	010201	Convey	10				12.4	3.2	1007	5.2	19.0	0.4630
60	010103	Receive	10				37.6				35.4	2.1996
70	010102	Sub Basin	10		18.84	2.83	53.3				17.3	2.2145
80	010102	Combine	10	3			81.0				18.0	4.8763
90	ST0102	Storage	10				30.5				56.0	3.0468
92	ST0102	After Storage	10				30.5				56.0	4.5844
100	010102	Convey	10				30.5	4.4	1348	5.1	61.1	4.5636
110	010102	Hold	10				30.5				61.1	4.5636
120	010301	Sub Basin	10		20.65	2.36	48.7				24.1	2.4267
130	010301	Convey	10				48.7	4.9	1318	4.5	28.6	2.4264
140	010102	Receive	10				30.5				61.1	4.5636
150	010101	Sub Basin	10		20.42	2.69	54.9				19.2	2.4000

Click ***'OK'*** to exit the **RATIONAL METHOD FLOW SUMMARY** form. Click ***'OK'*** to exit the **RUN RATIONAL METHOD MODEL** form.

15.0 UPDATE CONVEYANCE FACILITIES

Select ***'Hydraulics ➔ Conveyance Facilities'*** to access the **CONVEYANCE FACILITIES** form. Click on ***'Update'*** to update the hydraulics data with the design flows. If pipe sizes need to change, then keep updating until satisfied with the capacities. When finished, re-run the Rational Method Model and re-run the Conveyance Facilities Update.

16.0 BACKUP PROJECT

This final step is important. Backup your projects on a regular basis. You will save yourself from wasted time and unnecessary stress, if you keep a backup copy of your project. The backup process is done as follows:

Select ***'File ➔ Project Management'*** to access the **PROJECT MANAGEMENT** form. Select ***'Backup Project'*** as the Action and select the project you want to backup (Use the adjacent button select the project). Click the ***'Backup'*** button to backup the project and select the directory where your backup project file should go. Finally, click ***'OK'*** to continue. Once the backup is completed, click ***'OK'*** to close the **PROJECT MANAGEMENT** form.