



DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 6.0.5

TUTORIAL # 2 DEVELOPING A NEW HEC-1 MODEL USING GIS SHAPEFILES



KVL Consultants, Inc.

DEVELOPING A NEW HEC-1 MODEL USING GIS SHAPEFILES

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DEVELOPING A NEW HEC-1 MODEL FROM GIS

DATE UPDATED: APRIL 20, 2022

TUTORIAL TIME: 30 MINUTES

1.0 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 HEC1 for this example), *Soils*, *Land Use* and *Roads 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.

Select Project

List Details

Default Table Versions

Project Reference

Project ID: 00095 Reference: KVLEXAMPLE2

Title: Example 2 using Shape files and NOAA 14

Location: Maricopa County

Agency: KVL Consultants, Inc.

☐ Hydrology and Hydraulics Only ☐ Custom Storm Event

☐ River Mechanics Only ☐ Imported HEC-1 File

Project Defaults

Model: HEC1

Soils: FCDMC

Land Use: FCDMC

Rainfall: NOAA14

Roads: MCDOT

Return Periods to Model

1. 2. 3. 4. 5. 6.

2 5 10 25 50 100

This project is the tutorial example for establishing sub basin, land use and soils data from ESRI Shape files and also using the new NOAA 14 Rainfall.

HEC-1 Defaults

Unit Hydrograph: Clark

Loss Method: Green-Ampt

Storms: Single

Duration: 24 Hour

Tab Interval (NMIN): 3

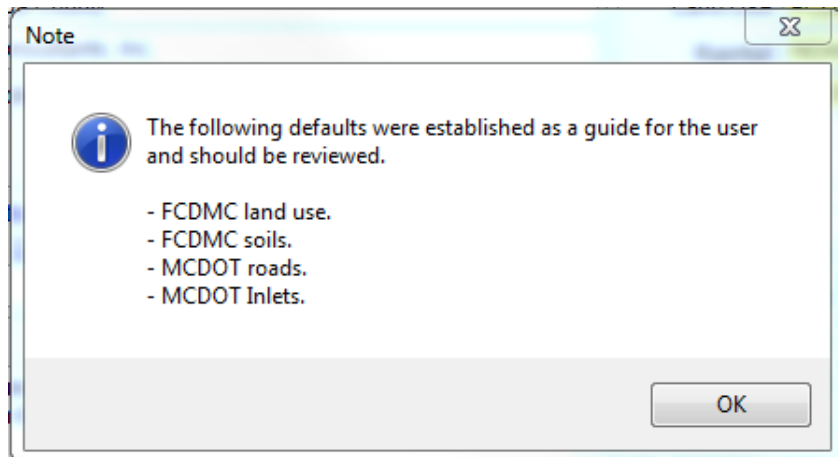
No. Ordinates (NQ): 2000

Output (IO): 5

Modification Date: 01/01/2011

Update Project Defaults Info Print... Delete Add OK

After entering the data, press 'Save'. Then, press 'OK.' to exit the Select Project form.

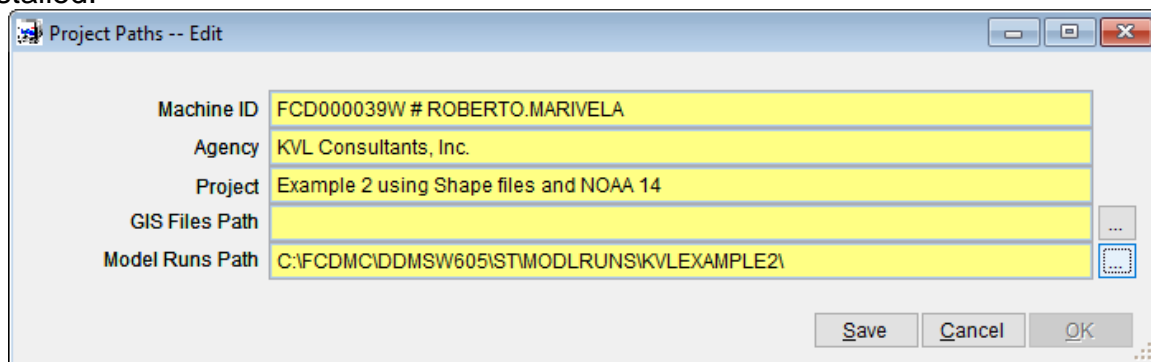


Then click 'OK' to accept the land use, soils, roads, and Inlets defaults.

2.0 SETTING THE MODEL RUNS PATH

When running models, the input and result files have similar file names for each project. Therefore, to prevent one project 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' field and navigate to an appropriate directory. Identify and select this folder as the model runs path or press the 'Make New Folder' button if the desired folder does not exist. Press 'OK' after identifying and selecting the model runs path location. Press 'OK' to close the Project Paths form. Note that the file path defined in the 'Model Runs Path' in the following figure is not necessarily the same as the Model Runs Path for all users. The path depends on the location of the program installed.



3.0 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, no modification on the form is needed at this time. After the sub basins are established, the user needs to return here to update *Major Basin* 01. Click on the 'OK' button to close the form.

The screenshot shows the 'Major Basins' dialog box with the 'Details' tab selected. The 'Major Basin' section contains fields for Major Basin ID (01), Description (Major Basin 01), Area (sq mi), and Rain ID (DEFAULT). The 'Modeling Options' section includes a checkbox for 'Model This Major Basin' (checked), a 'Custom' button, and dropdown menus for Storms (Single), Duration (24 Hour), Tab Interval (5), No. Ordinates (2000), and Output (5). The 'Return Period for Steps' section has a 'Step RP' field set to 100. The 'Reduction Factors' section features a table with 9 rows and 2 columns (Area and RF), all highlighted in yellow, and a 'Custom' checkbox. The bottom of the dialog has buttons for Info, ReSort, Print..., Delete, Add, Update, and OK.

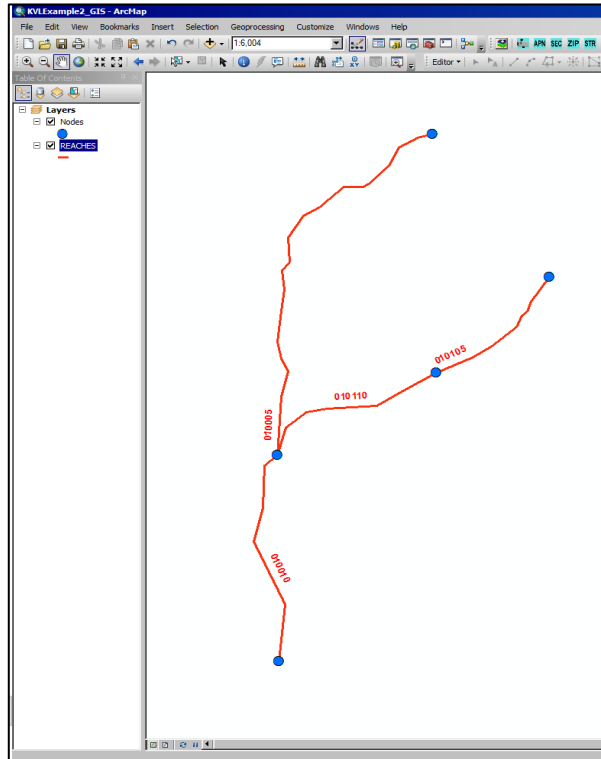
	Area	RF
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		

4.0 DIGITIZE THE DATASETS IN GIS

All GIS files must be in ESRI Shape file format.

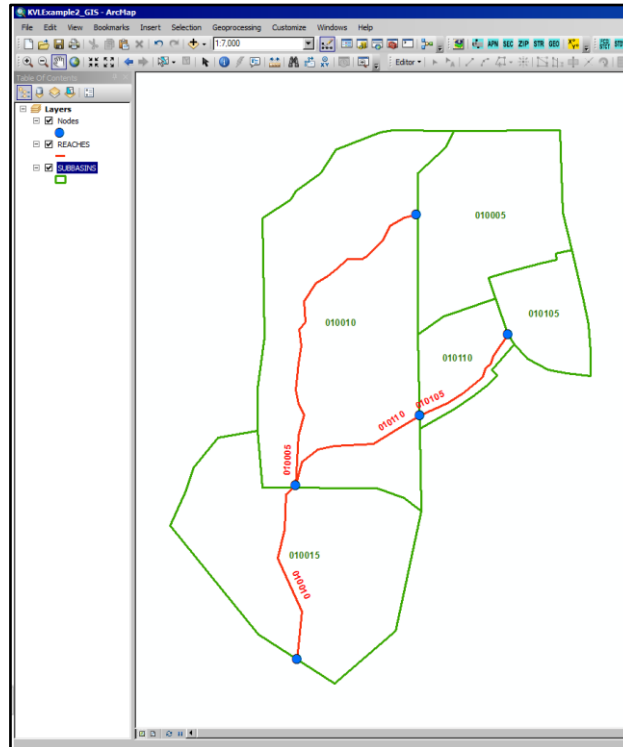
5.0 NODES AND ROUTING DATA

Digitize the Nodes and Routing data and provide Routing IDs for the routing reaches. The Nodes data shown are for cosmetic purposes only to show the location of the starting and ending points of routing reaches.



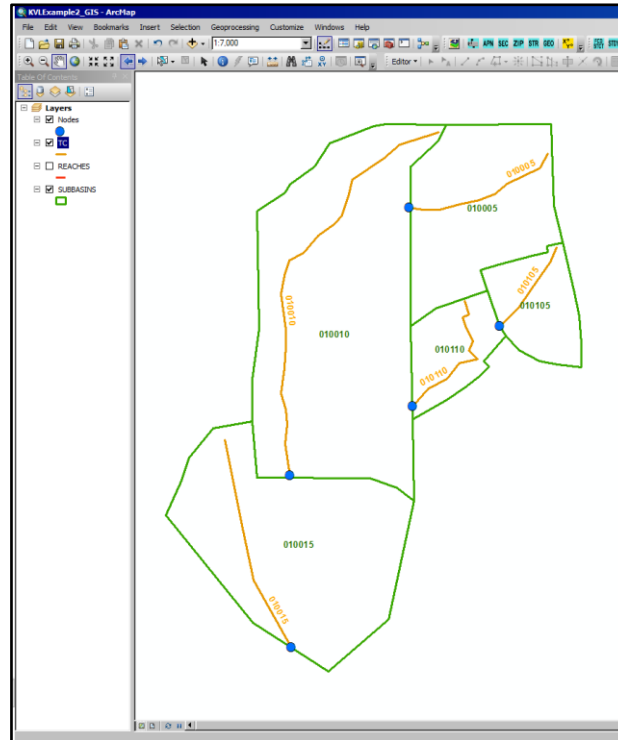
6.0 SUB BASINS

Digitize the Sub Basin areas and provide AREA IDs.



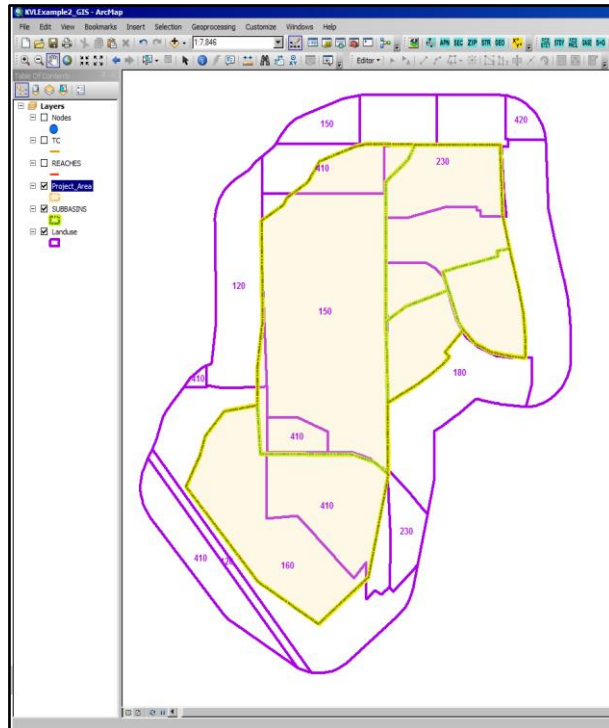
7.0 TIME OF CONCENTRATION, T_c

Digitize the Reach segments for the Sub basin areas from which the Time of Concentration information are derived. Enter the Upstream Ground Elevation (USGE) and Downstream Ground Elevation (DSGE) data.



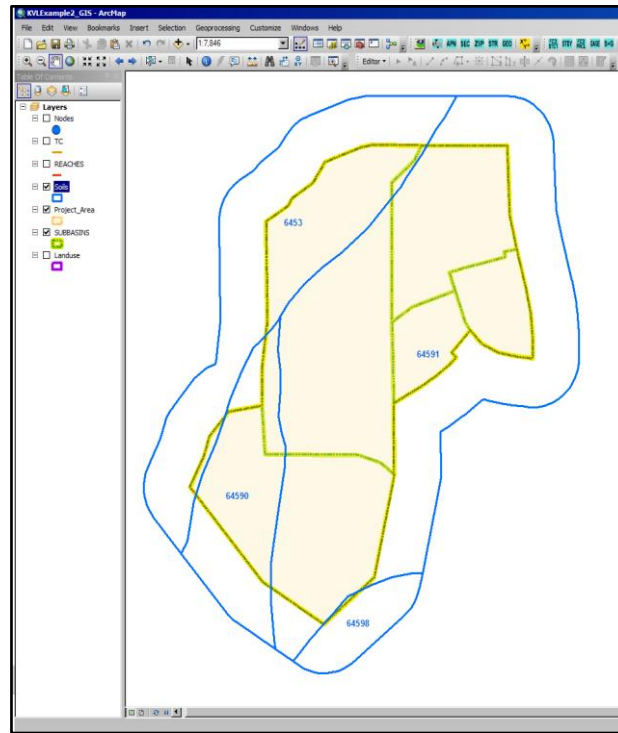
8.0 LAND USE

Obtain the Land Use Map, if it is available, or digitize the land use areas that should envelope the entire project area. Make sure that the Land Use codes used in the digitized land use maps are included in the Land Use Defaults defined in DDMSW.



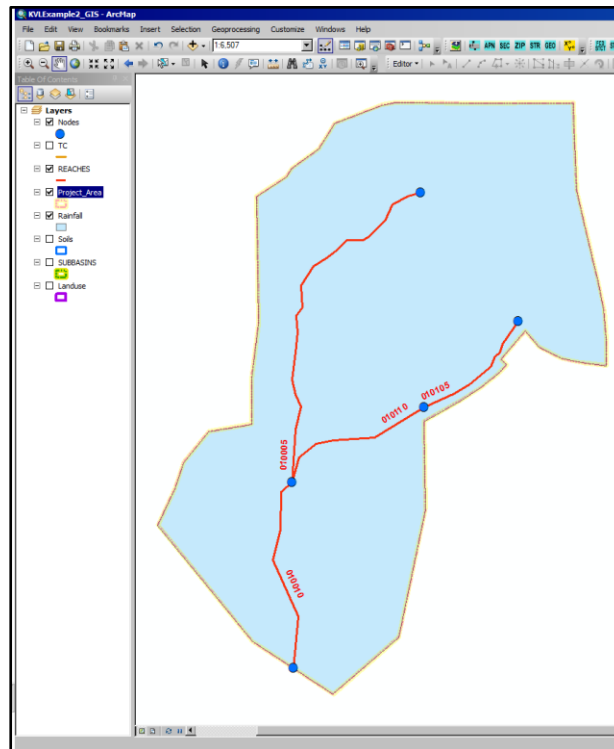
9.0 SOILS MAP

Obtain Soils dataset or if not available, to digitize using GIS from hardcopies of soils map. Make sure that Soil IDs are defined in the Soils dataset and that they should match the Soil IDs that are in the Soil Defaults in DDMSW. Also, make sure that the soils map created for the project extends beyond the entire project area (i.e., areas covered by all the sub basins).



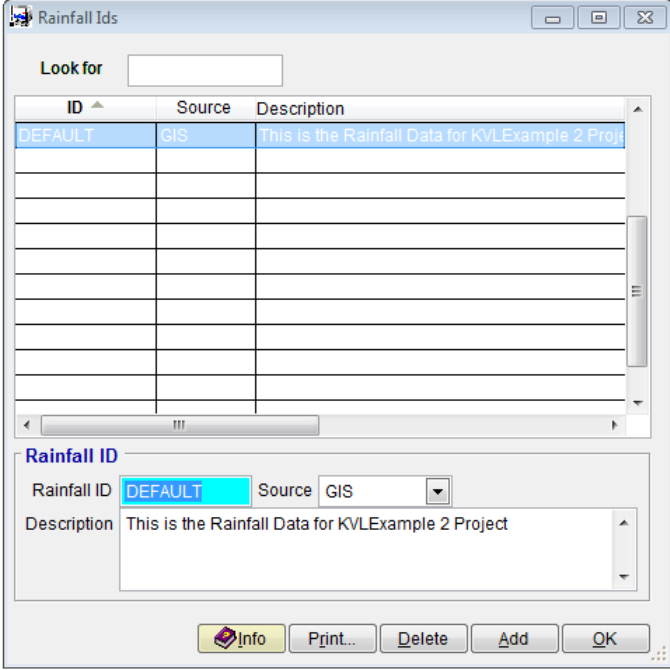
10.0 PROJECT AREA

Consolidate all the Sub Basin areas to define the extent of the Project Area. This consolidated polygon will be used to evaluate the Rainfall data for the project.



11.0 ESTABLISH RAINFALL DATA FOR PROJECT

Select *Hydrology* ➔ *Rainfall Ids* and on the *Rainfall Ids* form to select *GIS* from the drop down menu. Type “*DEFAULT*” on the Rainfall ID textbox and add a text description on the Comment Box (Optional). Click the “Save” button to save the entered data and click “OK” to close the “Rainfall Ids” form.



The screenshot shows the 'Rainfall Ids' window. At the top is a 'Look for' search box. Below it is a table with three columns: 'ID', 'Source', and 'Description'. The first row contains 'DEFAULT', 'GIS', and 'This is the Rainfall Data for KVLEExample 2 Project'. Below the table is a section titled 'Rainfall ID' with a 'Rainfall ID' text box containing 'DEFAULT', a 'Source' dropdown menu set to 'GIS', and a 'Description' text box containing 'This is the Rainfall Data for KVLEExample 2 Project'. At the bottom are buttons for 'Info', 'Print...', 'Delete', 'Add', and 'OK'.

ID	Source	Description
DEFAULT	GIS	This is the Rainfall Data for KVLEExample 2 Project

Rainfall ID

Rainfall ID: DEFAULT Source: GIS

Description: This is the Rainfall Data for KVLEExample 2 Project

Info Print... Delete Add OK

Select *Hydrology* ➔ *Rainfall* and on the NOAA14 Rainfall form, locate and select the Rainfall map (Rainfall.shp) using the button on the right side of the Rainfall Map textbox. Click “Save” to save data and click “Update” to populate the Average Rainfall Data table for the six (6) Return Intervals (2 yr, 5-yr, 10-yr, 25-yr, 50 yr, and 100 yr) and 10 time durations (5 Min, 10 Min, 15 Min, 30 Min, 1 Hour, 2 Hour, 3 Hour, 6 Hour, 12 Hour, and 24 Hour). Note that the file path name defined in the ‘*Rainfall Map*’ as shown in the following figure might not be necessarily the same as the file path for individual modelers or users. The file path depends on the location of the shape files.

NOAA 14 Rainfall ID: DEFAULT

GIS Rainfall Map

C:\FCDMC\DDMSW605\STMaps\KVLEXAMPLE2\Rainfall.shp

Check Required Map Fields Required Map Fields

Average Rainfall Data for ID: DEFAULT

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
5 Min	0.266	0.358	0.429	0.524	0.595	0.669
10 Min	0.404	0.545	0.653	0.796	0.906	1.018
15 Min	0.501	0.676	0.810	0.987	1.123	1.262
30 Min	0.675	0.911	1.090	1.330	1.513	1.700
1 Hour	0.835	1.127	1.349	1.646	1.872	2.104
2 Hour	0.968	1.286	1.530	1.862	2.110	2.368
3 Hour	1.048	1.369	1.623	1.977	2.258	2.549
6 Hour	1.241	1.581	1.854	2.224	2.512	2.812
12 Hour	1.420	1.792	2.084	2.478	2.781	3.094
24 Hour	1.689	2.187	2.585	3.141	3.582	4.044

Log Info Print... Update Rainfall ID OK

12.0 REVIEW SOIL DEFAULTS

Select *Hydrology* → *Soil Defaults* to view or to modify the Agency Soil Defaults or to add 'Custom' data. For this example custom values are not required. Click on the 'OK' button to close the form.

Soil Defaults

List Details

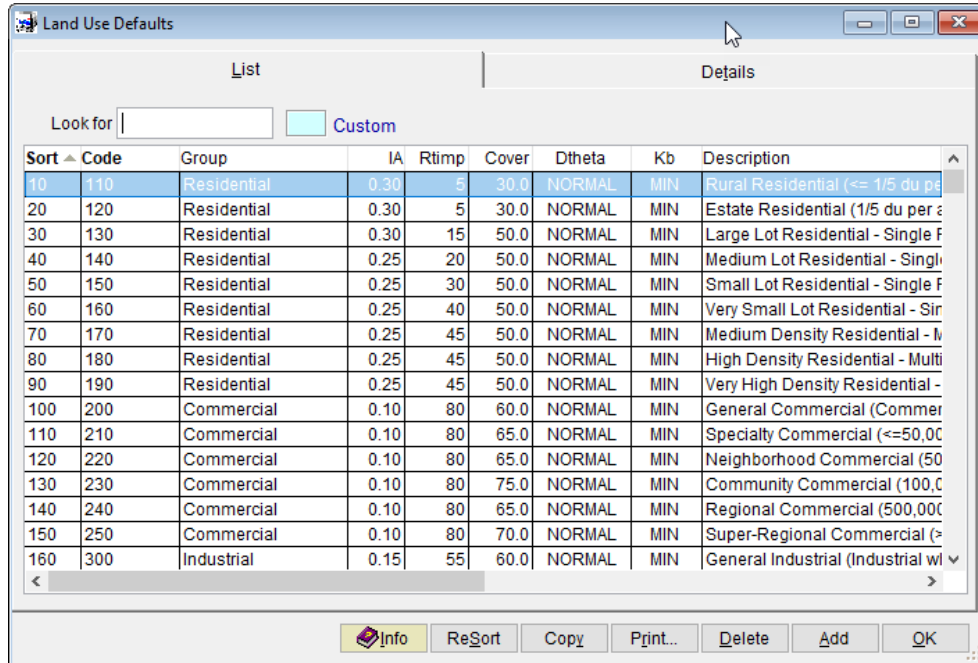
Look for Custom

Soil ID ▲	Book	Map Unit	XKSAT	Rock Pct	Description
6451	645	1	0.410	0.00	Antho sandy loams
6452	645	2	0.410	0.00	Antho gravelly sandy loams
6453	645	3	0.580	0.00	Antho-Carrizo-Maripo complex
6454	645	4	0.580	0.00	Antho-Carrizo-Maripo complex low precipitation
6455	645	5	0.430	0.00	Anthony sandy loam
6456	645	6	0.620	0.00	Anthony-Arizo complex
6457	645	7	0.620	0.00	Anthony-Arizo complex low precipitation
6458	645	8	0.960	0.00	Arizo cobbly sandy loam
6459	645	9	0.270	0.00	Beeline-Cipriano complex 3 to 45 percent slopes
6531	653	1	0.230	0.00	Agualt and Ripley soils
6532	653	2	0.210	0.00	Agualt and Ripley soils saline-sodic
6533	653	3	0.530	0.00	Ajo-Gunsight-Pompeii complex 3 to 25 percent slopes
6534	653	4	0.400	40.00	Akela-Rock outcrop complex 15 to 65 percent slopes
6535	653	5	0.790	0.00	Carrizo-Dateland complex 0 to 3 percent slopes
6536	653	6	1.170	0.00	Carrizo-Momoli complex 0 to 3 percent slopes

Info Copy Print... Delete Add OK

13.0 REVIEW LAND USE DEFAULTS

Select *Hydrology* → *Land Use Defaults* to view or to modify Agency land use defaults or to add 'Custom' data. For this example custom values are not required. Click on the 'OK' button to close the form.



Sort	Code	Group	IA	Rtimp	Cover	Dtheta	Kb	Description
10	110	Residential	0.30	5	30.0	NORMAL	MIN	Rural Residential (<= 1/5 du per
20	120	Residential	0.30	5	30.0	NORMAL	MIN	Estate Residential (1/5 du per
30	130	Residential	0.30	15	50.0	NORMAL	MIN	Large Lot Residential - Single F
40	140	Residential	0.25	20	50.0	NORMAL	MIN	Medium Lot Residential - Single
50	150	Residential	0.25	30	50.0	NORMAL	MIN	Small Lot Residential - Single F
60	160	Residential	0.25	40	50.0	NORMAL	MIN	Very Small Lot Residential - Sir
70	170	Residential	0.25	45	50.0	NORMAL	MIN	Medium Density Residential - M
80	180	Residential	0.25	45	50.0	NORMAL	MIN	High Density Residential - Multi
90	190	Residential	0.25	45	50.0	NORMAL	MIN	Very High Density Residential -
100	200	Commercial	0.10	80	60.0	NORMAL	MIN	General Commercial (Commer
110	210	Commercial	0.10	80	65.0	NORMAL	MIN	Specialty Commercial (<=50,00
120	220	Commercial	0.10	80	65.0	NORMAL	MIN	Neighborhood Commercial (50
130	230	Commercial	0.10	80	75.0	NORMAL	MIN	Community Commercial (100,0
140	240	Commercial	0.10	80	65.0	NORMAL	MIN	Regional Commercial (500,000
150	250	Commercial	0.10	80	70.0	NORMAL	MIN	Super-Regional Commercial (>
160	300	Industrial	0.15	55	60.0	NORMAL	MIN	General Industrial (Industrial w

14.0 UPDATE HYDROLOGY DATA

Select *Maps* → *Update Hydrology* to access the "Update Hydrology from GIS" form. Check the *Land Use*, *Soils* and *Tc* check boxes to be able to access the individual Name and Path of Maps for individual datasets that are used for updating the hydrology of the project. Locate the *Sub Basin*, *Land Use*, *Soils* and *Tc* shape files by clicking the locator button on the right side of each data text box. Once, all the Name and Path of Maps of datasets are defined, click on the '*Update*' button to establish the land use, soils, and sub basin data as well as to update the hydrologic model parameters. Note that the file path names defined in the '*Sub Basins*', '*Land Use*', '*Soils*', and '*Tc*' fields as shown in the following figure might not be necessarily the same as those file path names from individual modelers and users. The file paths depend on the location of the shape files.

16.0 ESTABLISH THE HEC-1 MODEL NETWORK

Select *Hydrology* → *HEC-1* → *Network* to access the “HEC-1 Model Network” form.

The screenshot shows the "HEC-1 Model Network - MB: 01" window. It features a table with columns: Sort, ID, Type, Retrieve ID, Combine, and Area. The table contains 12 rows of data. To the right of the table is a "Model Network" panel with fields for MB (01), Sort (10), Type (Basin), ID (010005), and KO Output (0). Below these fields are buttons for Basin, Divert, ID, Combining, Retrieve, *, Route, Storage, KM Comment, Hydrograph, and Special Code. At the bottom of the window are buttons for Info, ReSort, Copy, Print..., Delete, Add, MB, Create Draft, and OK.

Sort	ID	Type	Retrieve ID	Combine	Area
10	010005	Basin			
20	010005	Route			
30	010105	Basin			
40	010105	Route			
50	010110	Basin			
60	010110	Combine		2	
70	010110	Route			
80	010010	Basin			
90	010010	Combine		3	
100	010010	Route			
110	010015	Basin			
112	010015	Combine		2	

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010005” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the first record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010005” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save

the second record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010105” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the third record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010105” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the fourth record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010110” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the fifth record.

Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010110”. On the Combine textbox, enter 2, which requesting the program to combine two hydrographs. Click “Save” to save the sixth record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010110” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the seventh record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010010” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 8th record.

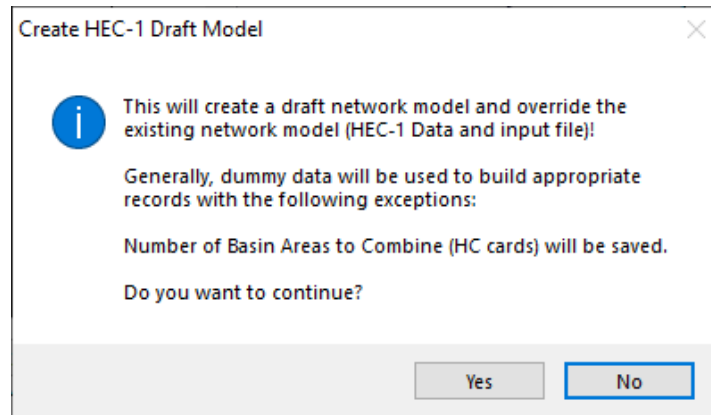
Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010010”. On the Combine textbox, enter 3, which is requesting the program to combine three hydrographs. Click “Save” to save the 9th record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010010” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 10th record.

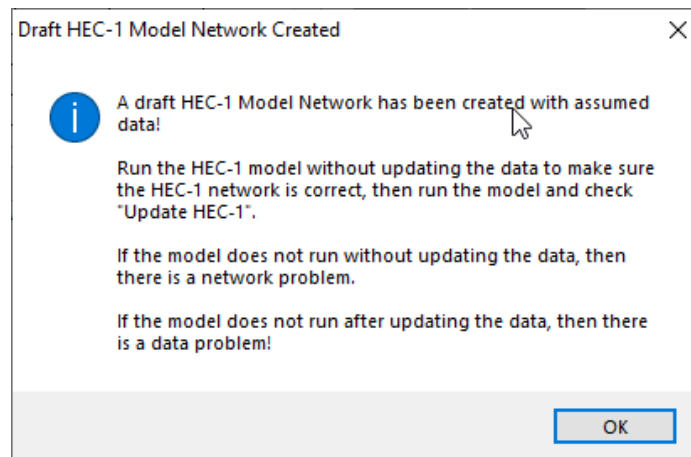
Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010015” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 8th record.

Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010015”. On the Combine textbox, enter 2, which is requesting the program to combine two (2) hydrographs. Click “Save” to save the 11th record.

After all data has been entered click the ‘*Create Draft*’ button.



On the “Create HEC-1 Draft Model” form, click Yes for the program to create a HEC-1 Draft Model of the project. Click OK, to close the “Draft HEC-1 Model Network Created” form.



After exiting from the previous form, the program shows automatically the Draft “HEC-1 Model” file. Close the Text Editor after viewing file. Click “OK” to close the “HEC-1 Model Network” form.

```

\FCDMC\ST5.5.7\MODLRUNS\KVLEXAMPLE2\01.Dat
ID      KUL Consultants, Inc.
ID      KVLEXAMPLE2 - Example 2 Using Shape Files and NOAA 14
ID      100 Year
ID      24 Hour Storm
ID      Unit Hydrograph: Clark
ID      Storm: Single
ID      04/13/2018
*DIAGRAM
IT      3              0      2000
IO      5
IN      15
*
*
KK010005  BASIN
BA      1.0
PB      4.0
PC 0.000  0.002  0.005  0.008  0.011  0.014  0.017  0.020  0.023  0.026
PC 0.029  0.032  0.035  0.038  0.041  0.044  0.048  0.052  0.056  0.060
PC 0.064  0.068  0.072  0.076  0.080  0.085  0.090  0.095  0.100  0.105
PC 0.110  0.115  0.120  0.126  0.133  0.140  0.147  0.155  0.163  0.172
PC 0.181  0.191  0.203  0.218  0.236  0.257  0.283  0.387  0.663  0.707
PC 0.735  0.758  0.776  0.791  0.804  0.815  0.825  0.834  0.842  0.849
PC 0.856  0.863  0.869  0.875  0.881  0.887  0.893  0.898  0.903  0.908
PC 0.913  0.918  0.922  0.926  0.930  0.934  0.938  0.942  0.946  0.950
PC 0.953  0.956  0.959  0.962  0.965  0.968  0.971  0.974  0.977  0.980
PC 0.983  0.986  0.989  0.992  0.995  0.998  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
*
KK010005  ROUTE
RK 1000  0.005  0.025  TRAP  100  8
*
KK010105  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
*
KK010105  ROUTE
RK 1000  0.005  0.025  TRAP  100  8
*
KK010110  BASIN
BA 1.0
LG 0.15  0.25  4.50  0.50  50

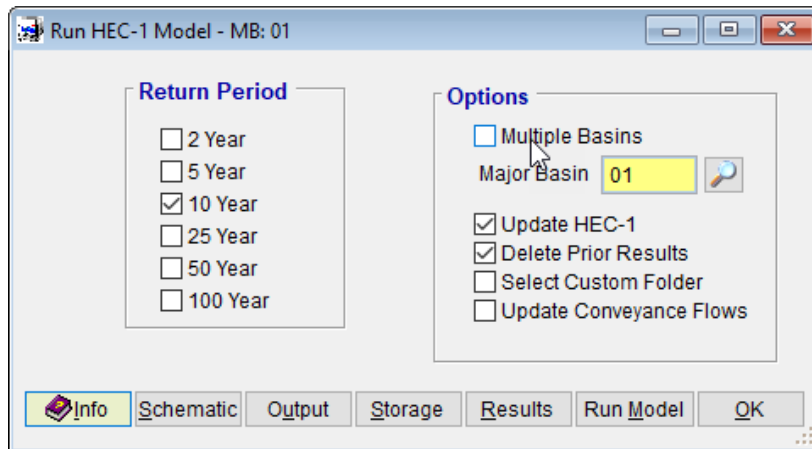
```

```
C:\FCDMC\ST5.5.7\MODLRUNS\KVLEXAMPLE2\01.Dat
KK010110 ROUTE
RK 1000 0.005 0.025 TRAP 100 8
*
KK010010 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
*
KK010010 COMBINE
HC 3
*
KK010010 ROUTE
RK 1000 0.005 0.025 TRAP 100 8
*
KK010015 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
*
KK010015 COMBINE
HC 2
*
ZZ
```

17.0 RUN THE DRAFT HEC-1 MODEL

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

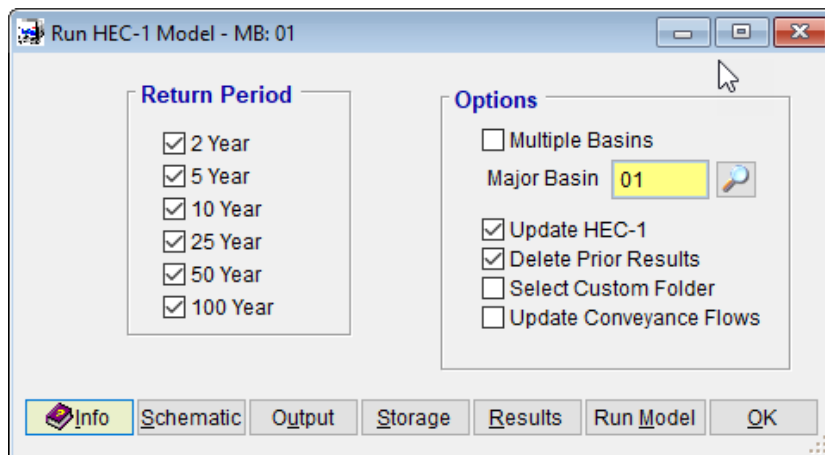
Check the '10 Year' Return Period and the 'Delete Prior Results' option. Uncheck all other return periods and options. Click 'Save' to save the entered preferences.



Click 'Run Model' to run the Draft HEC-1 Model. If the model runs without issues, it means that the HEC-1 Model Network that was built for the project is fine.

18.0 RUN THE FINAL HEC-1 MODEL

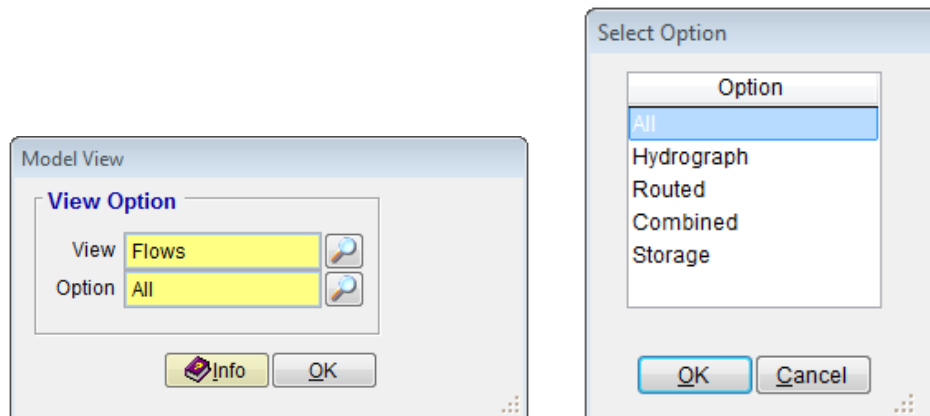
To run the model for all the return periods, click all the textboxes for the six return periods, and then check the "Update HEC-1" and "Delete Prior Results" options. Click "Save" to save the execution settings and run the model by clicking the "Run Model" button.



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. Press 'OK' to close the Run HEC-1 Model form.

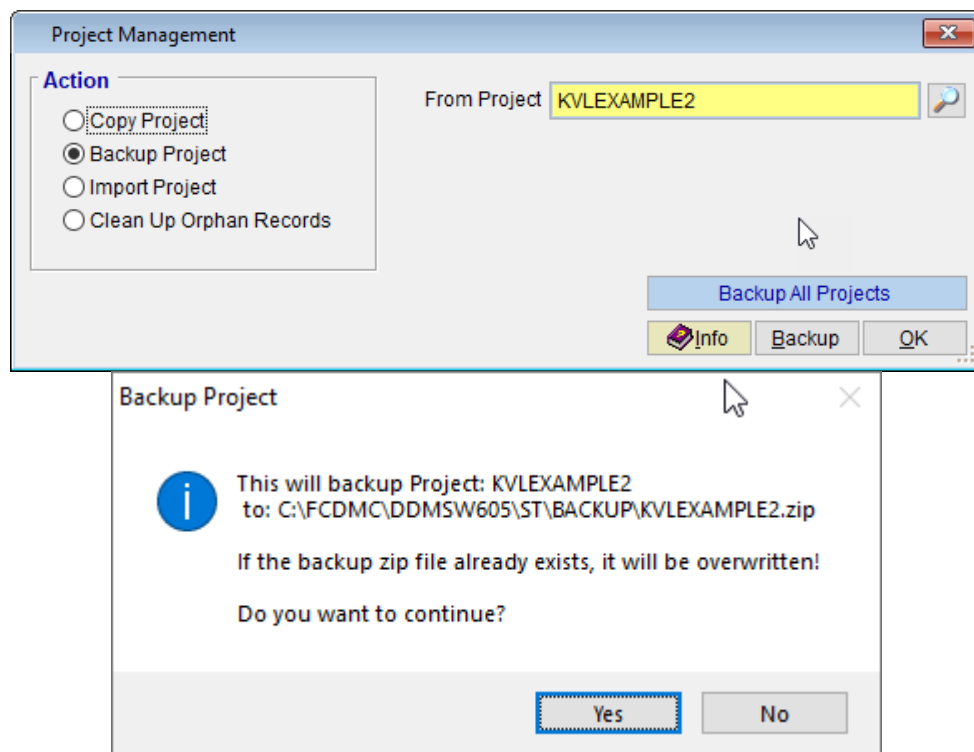
19.0 VIEW FLOW SUMMARY

Select *Hydrology* → *HEC-1* → *Flow Summary* to access the HEC-1 model results. Click 'View' to view other summary items.



20.0 BACKUP PROJECT

Select *File* → *Project Management* to access the Project Management form. Select '*Backup Project*' as the *Action* and *KVLEXAMPLE2* as the project (use the adjacent button to select). Click the '*Backup*' button to create a backup copy of the project. Select the directory where the backup file should go and finally click '*OK*' when a directory is chosen. Click "Yes" to confirm.



This ends this tutorial.