DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

VERSION 5.6.0

TUTORIAL # 17

STREET DRAINAGE SYSTEM HYDRAULIC ANALYSIS

KVL Consultants, Inc.

STREET DRAINAGE SYSTEM HYDRAULIC ANALYSIS

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STREET DRAINAGE HYDRAULICS MODULE

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1.0 INTRODUCTION

This tutorial was developed to showcase the capability of the Street Drainage Hydraulics module within DDMSW. Important feature elements of the tutorial include:

- Hydrologic model development for Rational Method from GIS shapefiles
- Model network development for the Rational Method
- Hydraulics analysis of Catch Basin inlets using the Street Drainage Network Model.
- Hydraulic Grade Line (HGL) evaluation of the Conveyance Facilities using the StormPro Backwater Model.

The Street Drainage Hydraulics module is comprised of three hydraulic analysis tools, namely: Street Drainage Calculator, Street Drainage Network Model, and StormPro Backwater Model.

The Street Drainage Calculator is designed for stand-alone hydraulic analysis of individual catch basin inlets and the street section on which the inlet structures are located. The tool evaluates the inlet capacity and the corresponding spread of surface flow on the street. This tool is useful for identifying and selecting inlet types and sizes to use during the pre-design stage for preliminary project cost evaluation and public safety assessment.

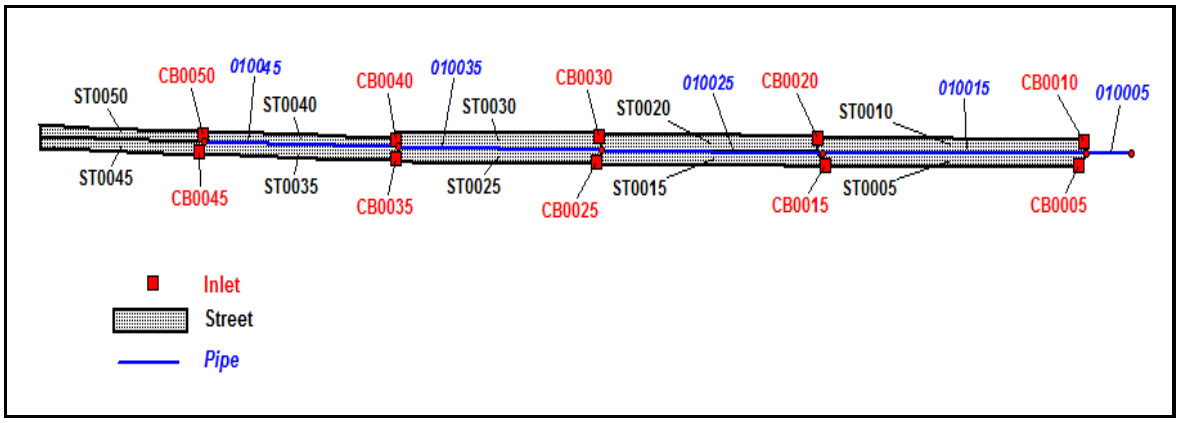
The Street Drainage Network Model is designed for hydraulic analysis of a network of inlets where types and capacities of upstream inlet facilities impact the selection of types and sizes of the downstream facilities. This tool evaluates the hydraulic performance of the entire drainage network as well as immediate street spread of surface flows.

The StormPro Backwater Model is designed to evaluate the hydraulic grade line (HGL) of the sub-surface flows in the pipe network that is serving to convey the collected flows from the ground surface to be discharged to system outfall(s).

In summary for Urban Drainage applications, the Street Drainage Calculator and the Street Drainage Network Model are designed to evaluate the hydraulics of the surface flows through the catch basin inlets and the respective adjoining streets, while the StormPro Backwater Model analyzes the hydraulics of the subsurface flows in the underground conduit network aimed at evaluating the hydraulic grade line (HGL) of the sub-surface drainage system.

2.0 EXAMPLE PROBLEM

This tutorial provides a Street Drainage working example already developed in **DDMSW** (Project Name: **KVLEXAMPLE12).** The layout of the drainage system that shows both the surface and sub-surface components to be analyzed is illustrated below.



The drainage system is comprised of ten (10) sub-basin areas represented by half-streets from which the design flows would be generated. The flows from these contributing areas enter ten (10) inlets - one inlet for each sub-basin area. From the inlets, the flows are conveyed to the sub-surface piping system located in the middle of the street. The flows are conveyed from the upstream end (left) to the downstream end (right) to be discharged at the system outfall.

The physical association of the sub-basins, inlets and the underground pipes could be explained from the Table below. For example, the flows from SUB BASIN ST0050 (north half-street) enter INLET CB0050 and received by PIPE 010045 for conveyance downstream. Similarly, the flows from SUB BASIN ST0045 (south half-street) enter INLET CB0045 and received by PIPE 010045.

NO.	SUB BASINS IDS	INLET IDS	RECEIVING UNDERGROUND PIPE IDS	SUB BASIN AREA NOTES
1	ST0050	CB0050	010045 (U/S)	North half-street
2	ST0045	CB0045		South half-street
3	ST0040	CB0040	010035	North half-street
4	ST0035	CB0035		South half-street
5	ST0030	CB0030	010025	North half-street
6	ST0025	CB0025		South half-street

NO.	SUB BASINS IDS	INLET IDS	RECEIVING UNDERGROUND PIPE IDS	SUB BASIN AREA NOTES
7	ST0020	CB0020	010015	North half-street
8	ST0015	CB0015		South half-street
9	ST0010	CB0010	010005 (D/S)	North half-street
10	ST0005	CB0005		South half-street

From the flows being conveyed through the main trunk comprising of the five (5) pipe segments (i.e., PIPE IDs 0100045, 010035, 010025, 010015, and 010005), the program generates the water surface pressure gradient (WSPG) which represents the water surface profile of the event flows that pass through the drainage system.

3.0 STEP-BY-STEP PROCEDURE

This tutorial presents the procedure in the use of the Street Drainage Program tools that are available in DDMSW. These tools are employed from model development to running the model. The analysis procedure is divided into four stages – each stage of analysis has a defined objective. Each stage is foundational to achieving the objective of the next stage that would follow. The four stages are identified as follows:

- Stage 1 - Model Development for Rational Method
- Stage 2 - Model Network Development
- Stage 3 - Surface Flow Hydraulics Analysis [Inlet and Street Facilities]
- Stage 4 - Sub-Surface Flow Hydraulics Analysis [Underground Pipe Network]

3.1 MODEL DEVELOPMENT FOR RATIONAL METHOD

Rational Method is used in this tutorial to evaluate the flows for the sub-basin areas. GIS shape files for the sub-basins, rainfall, times of concentration, and land uses were already developed. The following steps are provided to build the hydrologic model from which the contributing flows are generated.

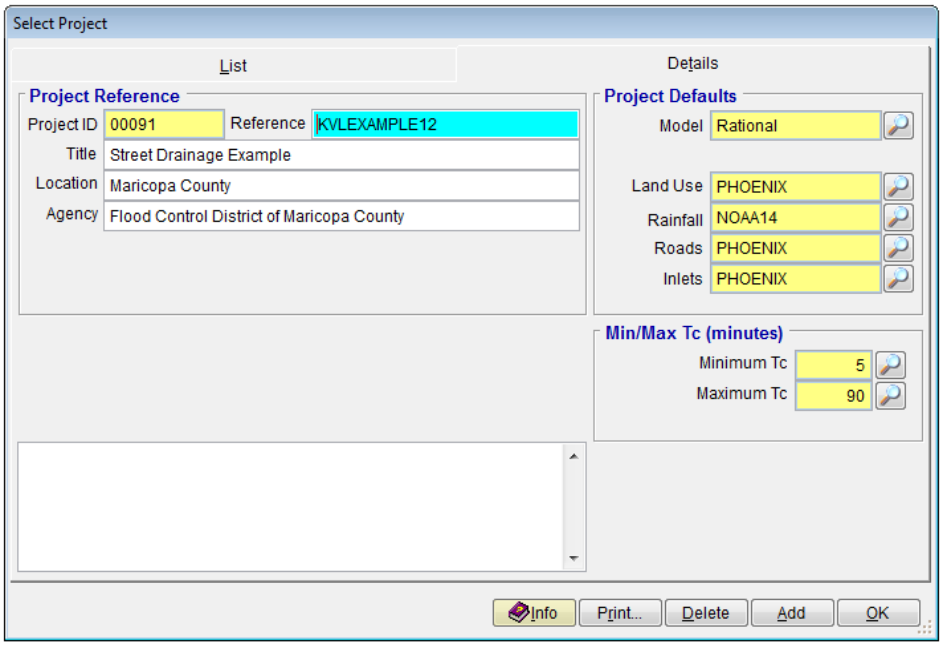
3.1.1 SET PROJECT DEFAULTS

(1) Start DDMSW

(2) Open the Select Project form (***File*** ➔ ***Select Project*** ➔ ***List*** *tab*)

(3) Select **KVLEXAMPLE12** from the project list

(4) Click the ***Details*** tab. Set the project defaults as shown on the screen capture below. Click *OK* to close window.



3.1.2 EVALUATE THE AVERAGE RAINFALL OF THE PROJECT

For this tutorial, NOAA14 Rainfall shall be used to generate the rainfall data for the project area using GIS shape file. The GIS shape file of the Rainfall polygon is included in the KVLExample12 subfolder in the **MAPS** folder (C:\FCDMC\DDMSW482\Maps\KVLExample12). Your path to this file may be different from that shown in this example.

(1) Open the NOAA 14 Rainfall form (***Hydrology ➔ Rainfall***)

(2) Click the 'Browse' button at the right end of the Rainfall Map textbox to navigate to the folder location of the Rainfall.shp.

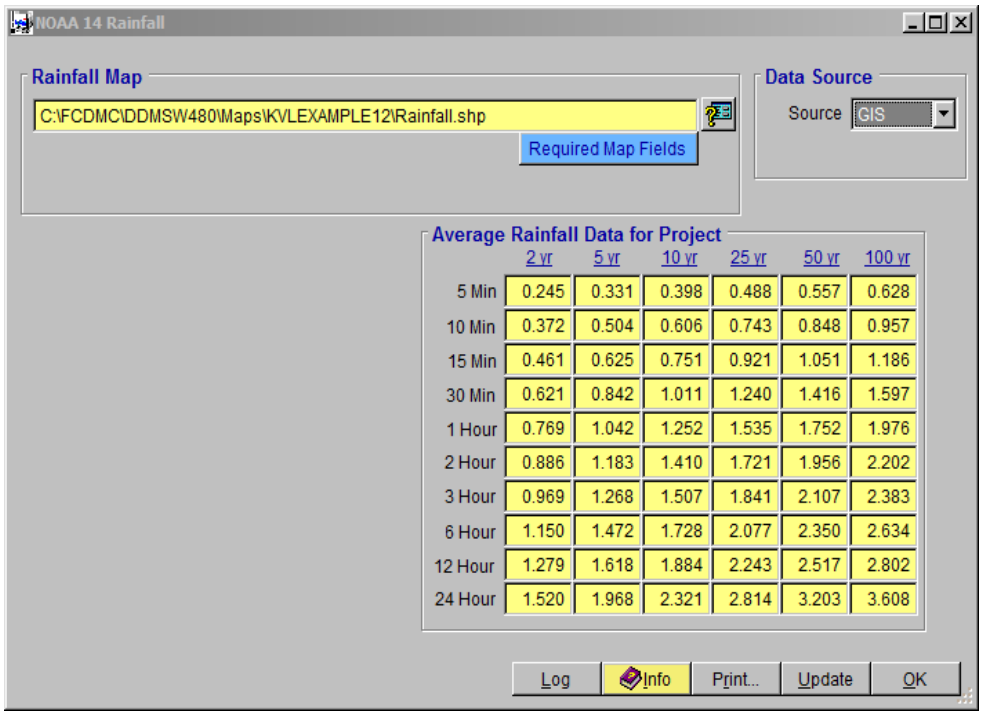
(3) Select the *Rainfall.shp* and press *OK*

(4) On the NOAA 14 Rainfall form, click *Save.*

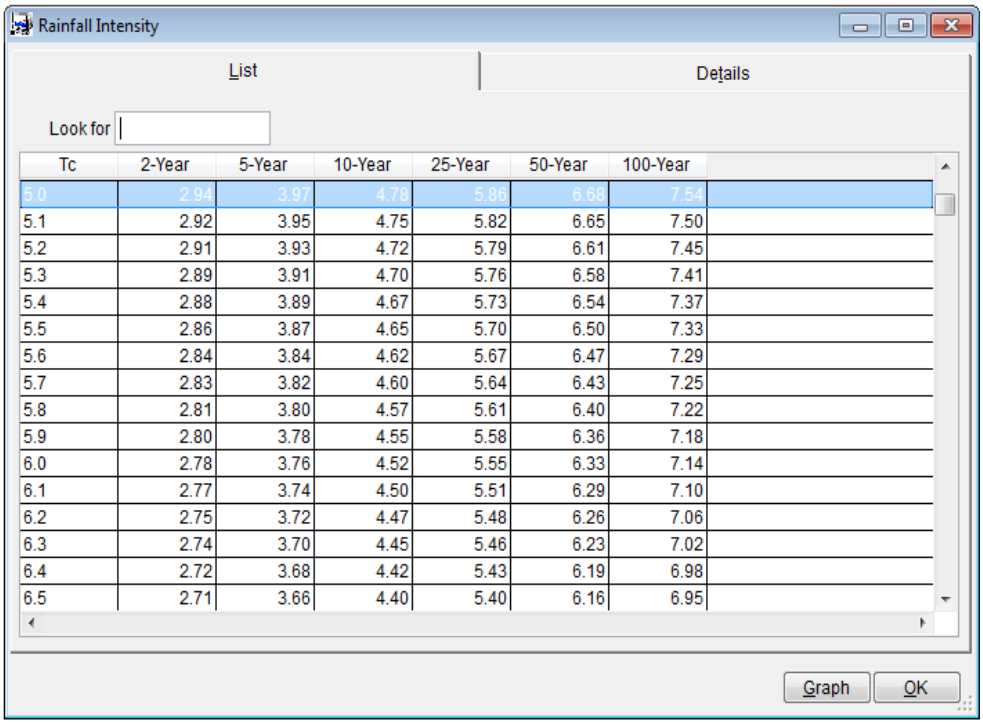
(5) Click *Update* to develop the average rainfall data for the project.

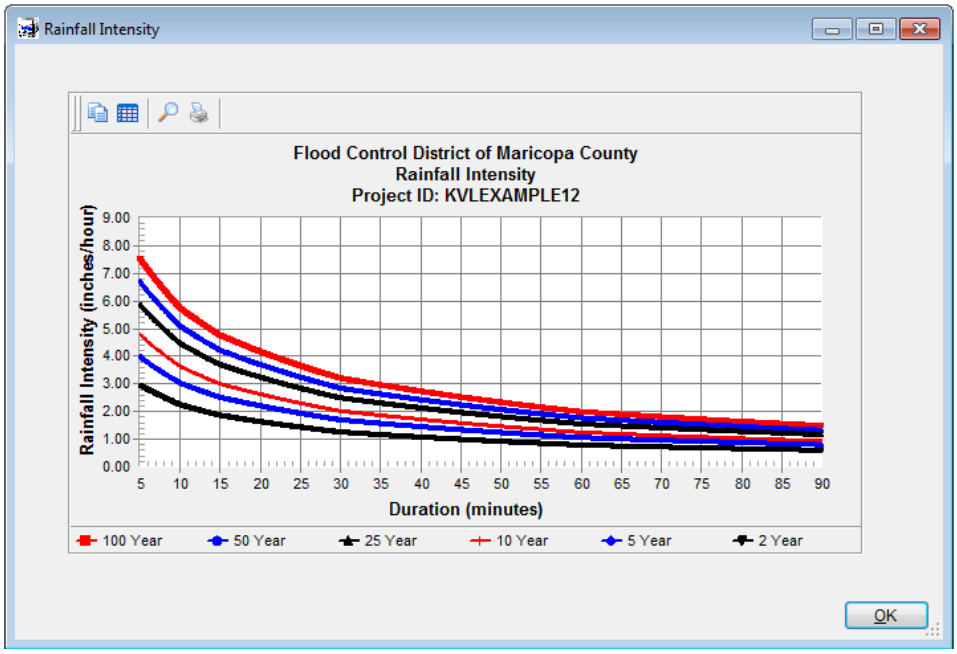
(6) Click *Yes* to continue and to exit the **UPDATE NOAA14 RAINFALL USING GIS** window

(7) Click OK to exit **NOAA14 RAINFALL** window.



(8) To see the graph of the IDF curves, open the Rainfall Intensity form (***Hydrology ➔Rational Method ➔Rainfall Intensity***) and click the *Graph* button at the bottom right of the form.





(9) Click ***OK*** to close the form that shows the IDF plots of the Rainfall Intensities for different return periods.

(10) Click ***OK*** to exit the **Rainfall Intensity** window

3.1.3 EVALUATE THE MODEL PARAMETERS FOR THE SUB BASINS USING GIS

The sub-basins, times of concentration (Tc), and land use data for the project have already been developed. The shape files of the sub-basins, land use and Tc are all located in the **KVLExample12** folder (C:\FCDMC\DDMSW530\Maps\KVLExample12\). Again, your path to these relevant project files may be different.

(1) Open the Update Hydrology from GIS form (M***aps*** ➔ ***Update Hydrology***)

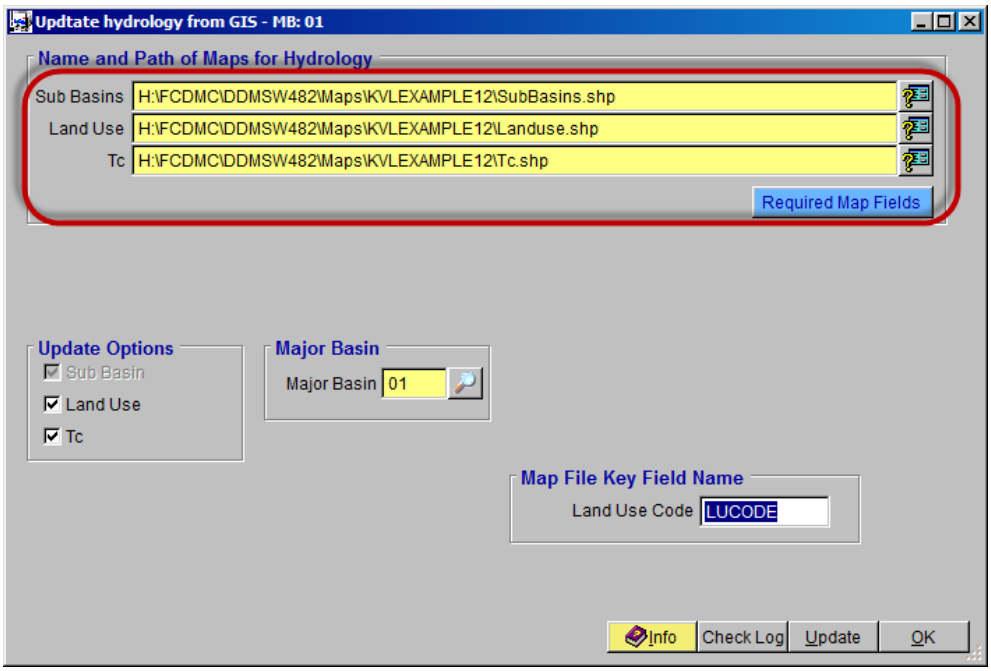
(2) Using the *Browse* button at the right side of the Sub Basins textbox, navigate to the folder location of the SubBasins.shp and select the file.

(3) Click *OK* to close the Open form.

(4) Click *Save* to continue.

(5) Repeat steps (2), (3) and (4) for the Land Use and Tc data files.

The completed form is shown below:



(6) To update the model parameters using the information provided by the three shape files, click the *Update* button.

(7) If no warning or program error messages are generated, click *OK* to exit the 'Update hydrology from GIS' form.

The model parameters are now evaluated. It is a good practice for the user to check and validate the evaluated model parameters to make sure that the values on the form are correct.

(8) To view the model parameters, open the Sub Basins form (***Hydrology ➔ Sub Basins***).

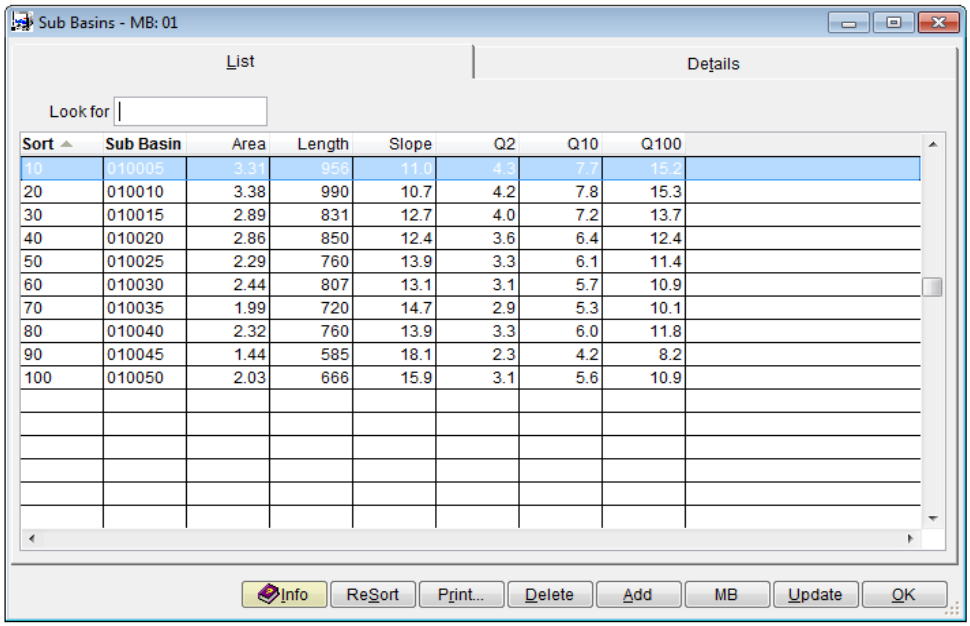
(9) On the *List* tab, select the first record (i.e., Sub Basin ID 010005).

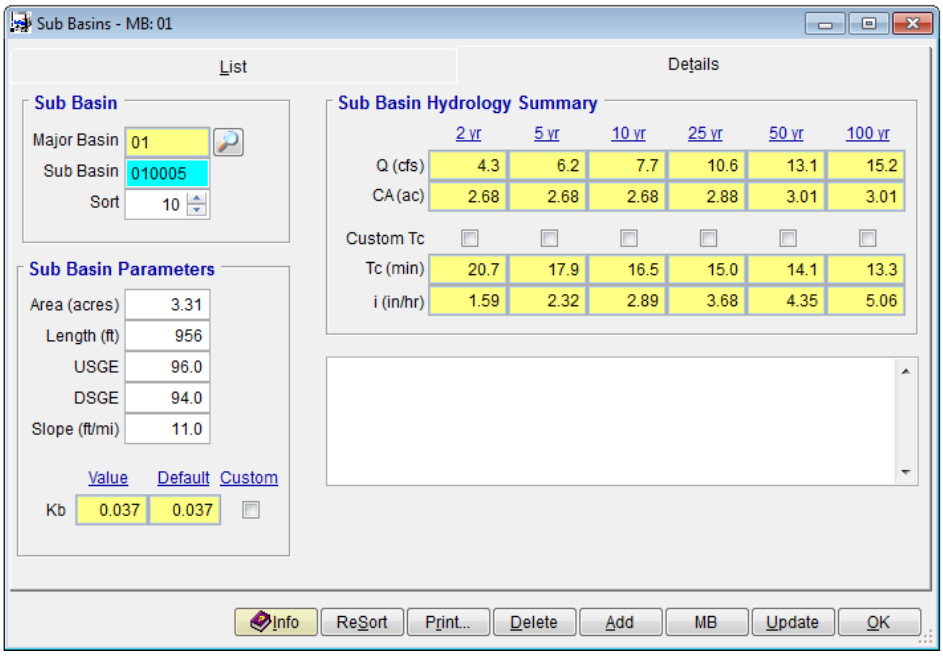
(10) Select the *Details* tab to view the evaluated Sub Basin Parameters and the Sub Basin Hydrology Summary table.

(11) Check the other Sub Basins if the evaluated Sub Basins parameters and the tabulated Sub Basin Hydrology Summary make sense.

(12) Click *OK* to exit the Sub Basins form.

(13) by Navigate the the , he program is now ready to eva Open the Sub Basins form (***Hydrology ➔ Sub Basins > List tab***) and select the first record (i.e., Sub Basin 010005) and select the 'Details' tab.





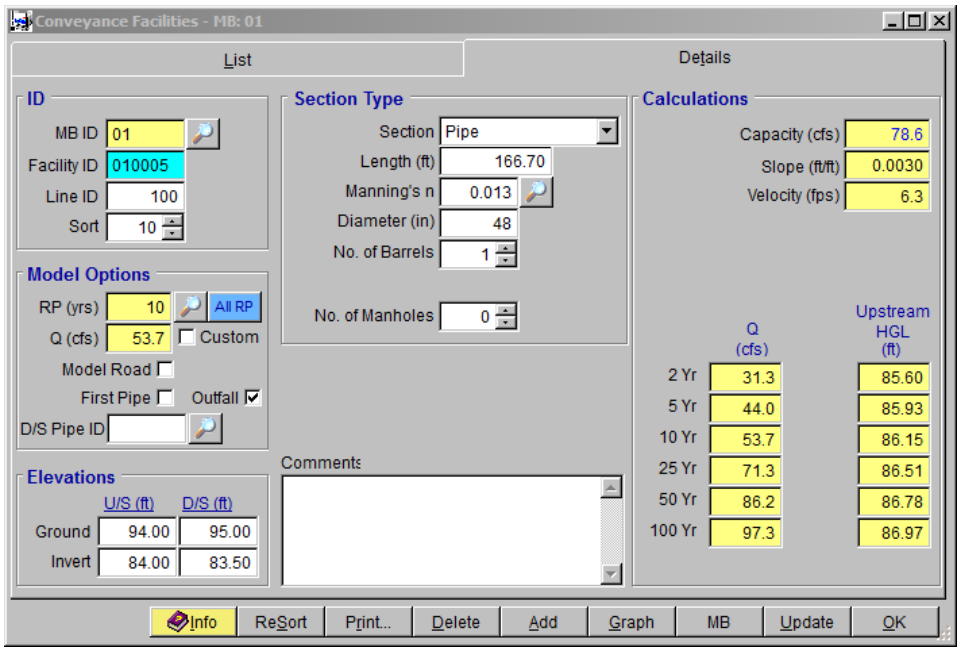
Navigate from one Sub Basin record to another to check the 'Sub Basin Hydrology Summary' results. All textboxes should all have values.

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

3.1.4 UPDATE CONVEYANCE FACILITIES DATA (HYDRAULICS➔ CONVEYANCE FACILITIES)

For this example, the **STORMPRO** backwater model will be used to develop the hydraulic grade line (HGL). Therefore it is necessary to Sort the Conveyance facilities in the correct order and establish the **Line ID** for each Conveyance Facility. With respect to the Figure (i.e., configuration of the drainage system) shown on the first page, all Conveyance Facilities comprising of the main trunk line will be **Line** "*100*".

Open the Conveyance Facilities form (***Hydraulics ➔ Conveyance Facilities > List tab***), and select Facility ID 010005. Select the '***Details***' tab.



The following table presents the input data for all Conveyance Facilities. Common to all are the following: All "*Pipe*" **Section**; **Manning's n** is "*0.013*"; **No of Barrels** is "*1*".

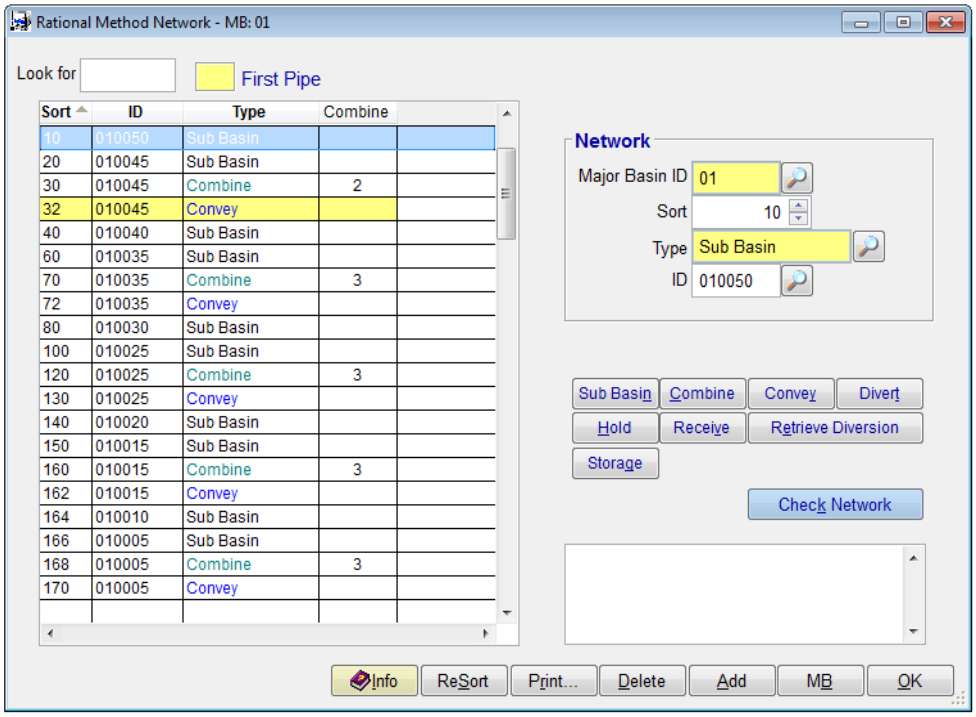
ID			Model Options					Elevations				Section		
Facility ID	Line ID	Sort	RP	Model Road	First Pipe	Outfall	DS Pipe ID	USGE	DSGE	USIE	DSIE	Length	Dia	Manholes
010005	100	10	10			X		94.00	95.00	84.00	83.50	166.70	48	
010015	100	20	10					95.00	94.00	85.00	84.00	100.00	48	1
010025	100	30	10					96.00	95.00	86.50	85.50	829.30	42	1
010035	100	40	10					97.00	96.00	88.00	87.00	761.10	36	1
010045	100	50	10		X			98.00	97.00	89.50	88.50	727.10	30	1

After validating the entered data for the conveyance facilities, click 'OK to close the Conveyance Facilities form.

3.1.5 DEVELOP RATIONAL METHOD NETWORK (HYDROLOGY➔RATIONAL METHOD ➔NETWORK)

Open the Rational Method Network form (***Hydrology ➔ Rational Method ➔ Network***) to build the model network.

Enter the data as shown below:



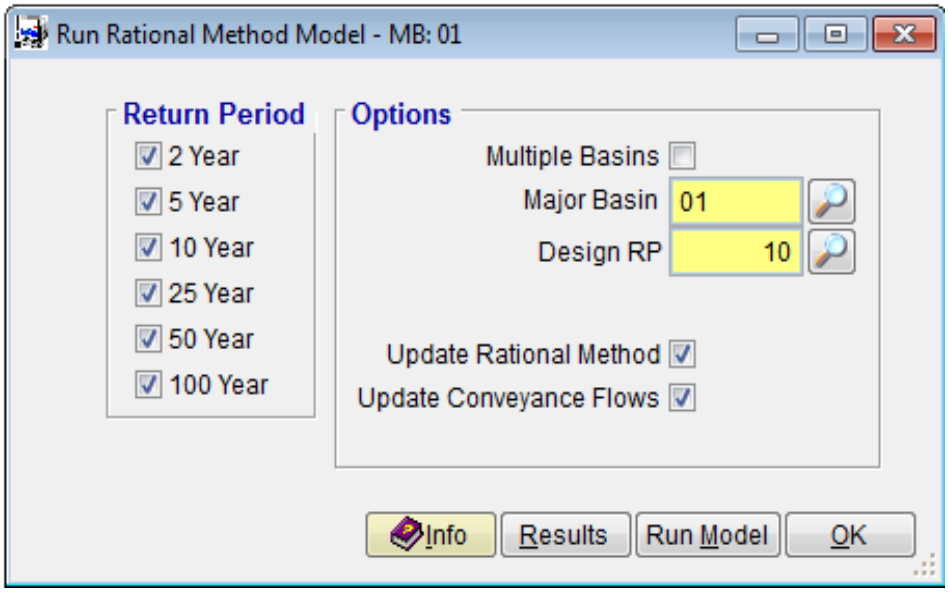
After completing the data entry, click the 'Check Network' button to make sure that all the 'Sub Basins' elements are in the network.

After the program verifies that the Network has no issues, click 'OK' to close the Rational Method Network form.

3.1.6 RUN THE MODEL (HYDROLOGY ➔ RATIONAL METHOD ➔ MODEL)

The model is now ready to be run.

Open the 'Run Rational Method Model' form (Hydrology ➔ Rational Method ➔ Model) and enter the data as shown below.

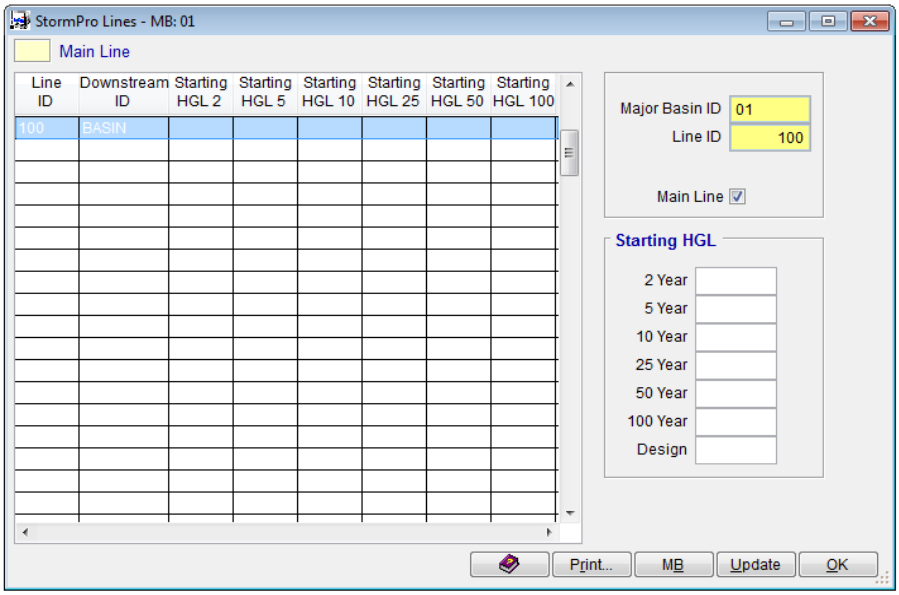


Click the '**Run Model'** button to execute the program. Click 'Yes' to continue.

Click 'OK' to close the form.

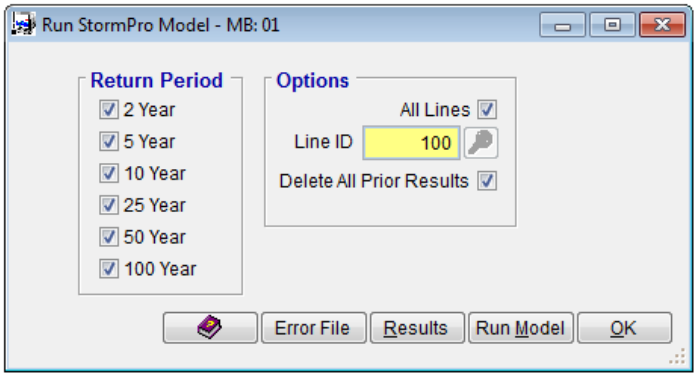
3.1.7 UPDATE StormPro LINES (HYDRAULICS ➔ StormPro BACKWATER ➔ LINES)

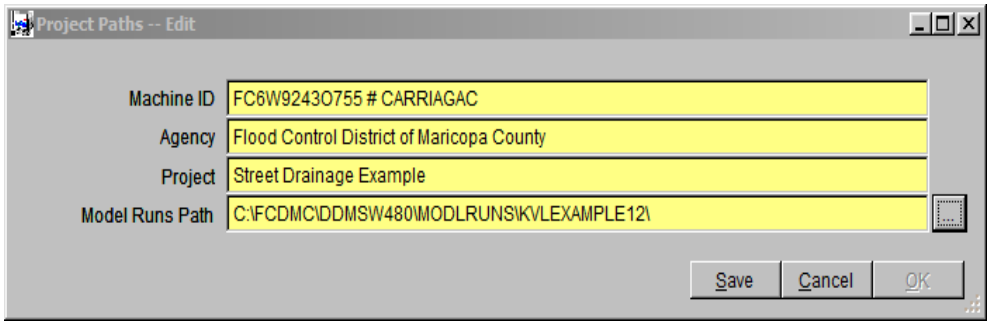
It is necessary to establish the starting water surface elevation for **Line ID** *100*. If left blank, the value will default to (D+Dc)/2, where D is the depth of the facility, and Dc is the critical flow depth. For **Line ID** *100*, check that it is a **Main Line**.

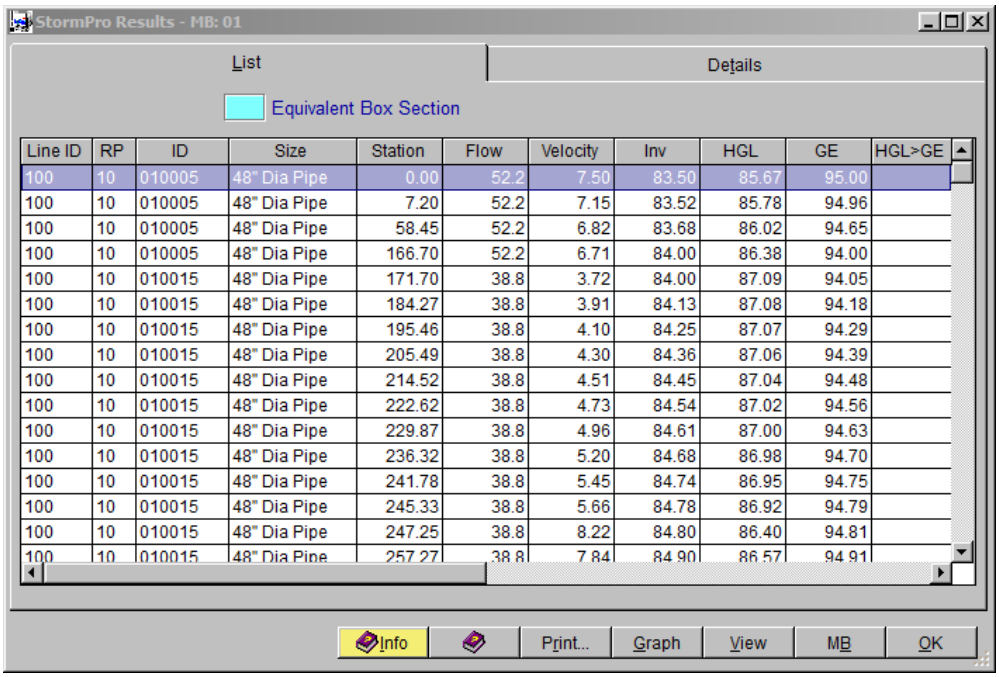


3.1.8 STEP 8 - RUN STORMPRO MODEL (HYDRAULICS ➔ STORMPRO BACKWATER ➔ MODEL)

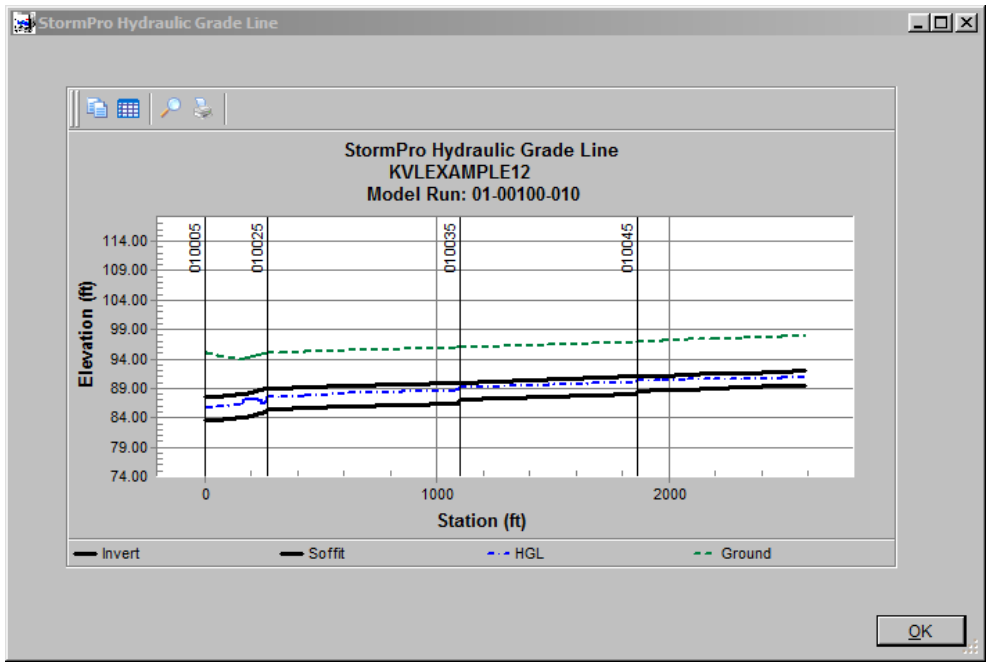
Select all **Return Periods**, check **All Lines** checkbox and check **Delete All Prior Results**. Please note that it is necessary to establish a folder for the model results. The results can be viewed by clicking **Results** and can be graphed by clicking **Graph** on the **STORMPRO RESULTS** window. If a model runs path is not stated, a warning message may show. If a warning is shown, click **Ok**, then the Project Paths – Edit window will pop up. Click the Model Runs Path button (the box that shows "…") and create a folder for the model runs path.





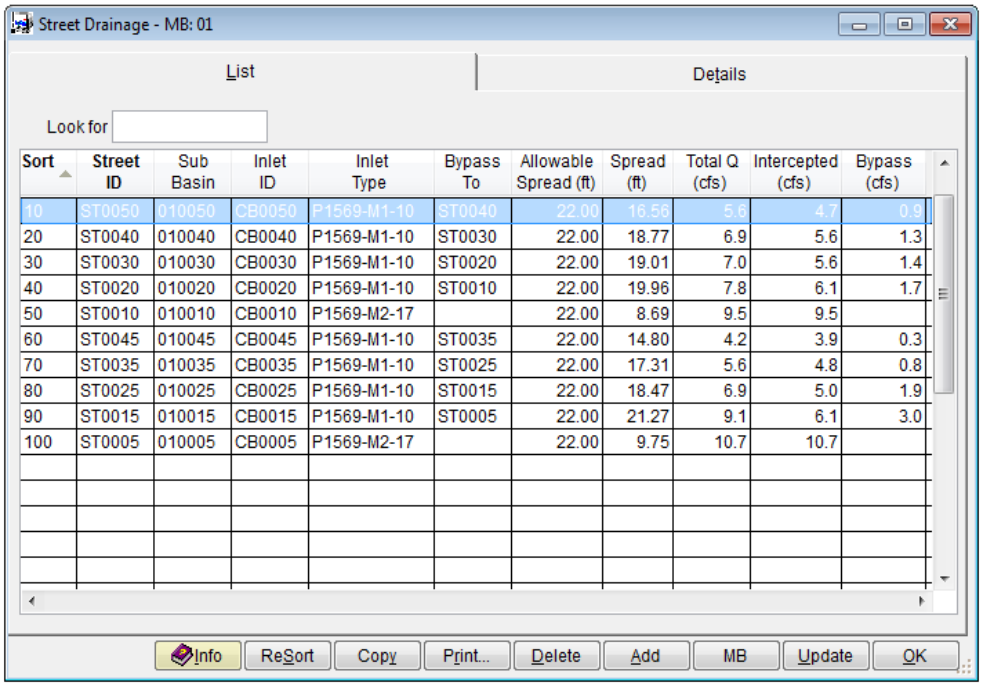


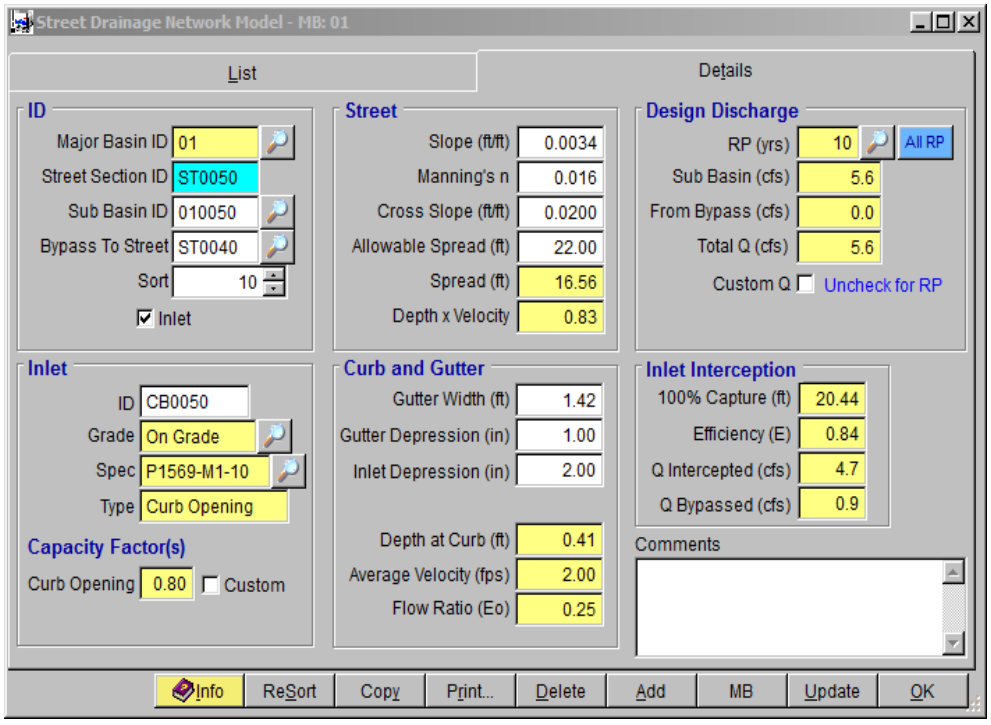
Line ID	RP	ID	Size	Station	Flow	Velocity	Inv	HGL	GE	HGL>GE
100	10	010005	48" Dia Pipe	0.00	52.2	7.50	83.50	85.67	95.00	
100	10	010005	48" Dia Pipe	7.20	52.2	7.15	83.52	85.78	94.96	
100	10	010005	48" Dia Pipe	58.45	52.2	6.82	83.68	86.02	94.65	
100	10	010005	48" Dia Pipe	166.70	52.2	6.71	84.00	86.38	94.00	
100	10	010015	48" Dia Pipe	171.70	38.8	3.72	84.00	87.09	94.05	
100	10	010015	48" Dia Pipe	184.27	38.8	3.91	84.13	87.08	94.18	
100	10	010015	48" Dia Pipe	195.46	38.8	4.10	84.25	87.07	94.29	
100	10	010015	48" Dia Pipe	205.49	38.8	4.30	84.36	87.06	94.39	
100	10	010015	48" Dia Pipe	214.52	38.8	4.51	84.45	87.04	94.48	
100	10	010015	48" Dia Pipe	222.62	38.8	4.73	84.54	87.02	94.56	
100	10	010015	48" Dia Pipe	229.87	38.8	4.96	84.61	87.00	94.63	
100	10	010015	48" Dia Pipe	236.32	38.8	5.20	84.68	86.98	94.70	
100	10	010015	48" Dia Pipe	241.78	38.8	5.45	84.74	86.95	94.75	
100	10	010015	48" Dia Pipe	245.33	38.8	5.66	84.78	86.92	94.79	
100	10	010015	48" Dia Pipe	247.25	38.8	8.22	84.80	86.40	94.81	
100	10	010015	48" Dia Pipe	257.27	38.8	7.84	84.90	86.57	94.91	

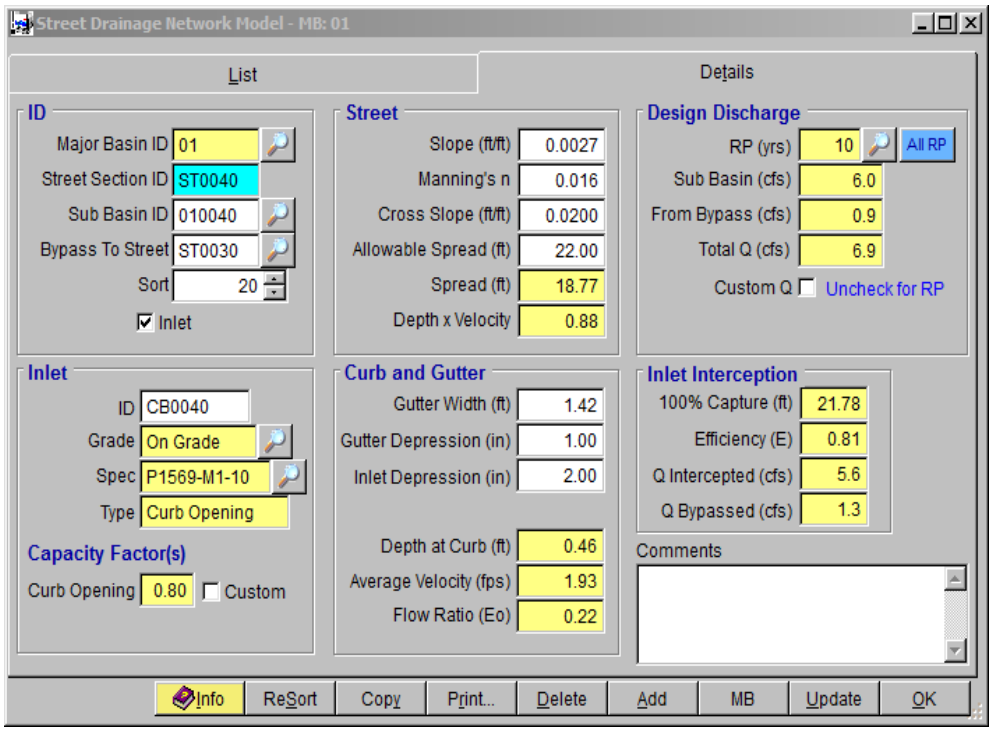


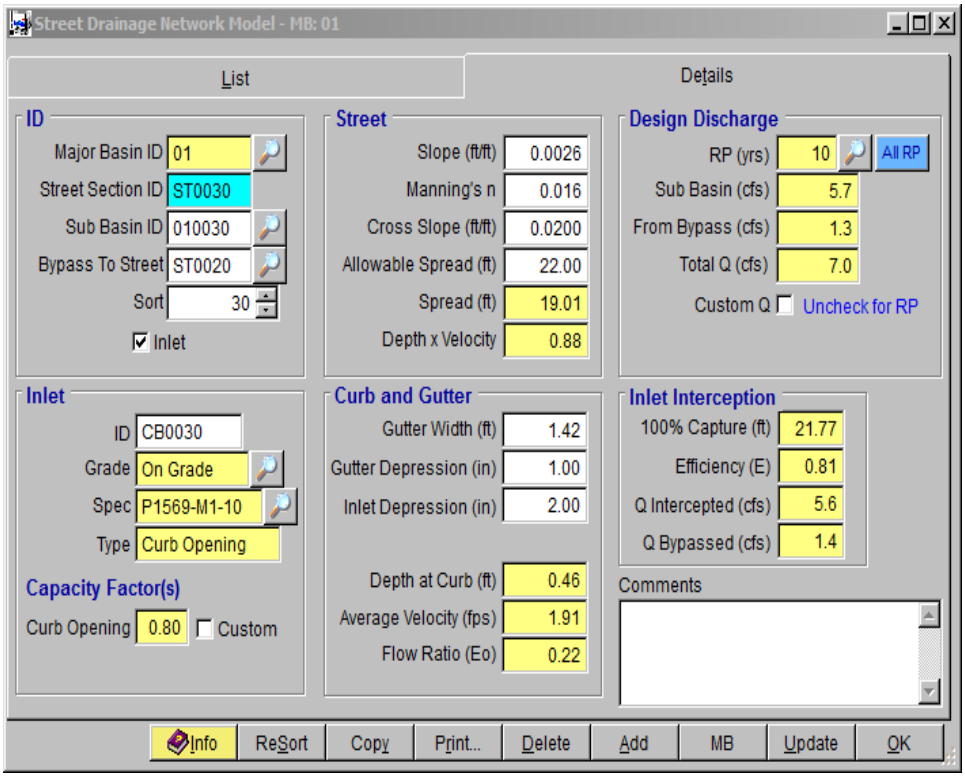
3.1.9 ANALYZE STREET DRAINAGE HYDRAULICS (HYDRAULICS ➔ STREET DRAINAGE ➔ NETWORK MODEL)

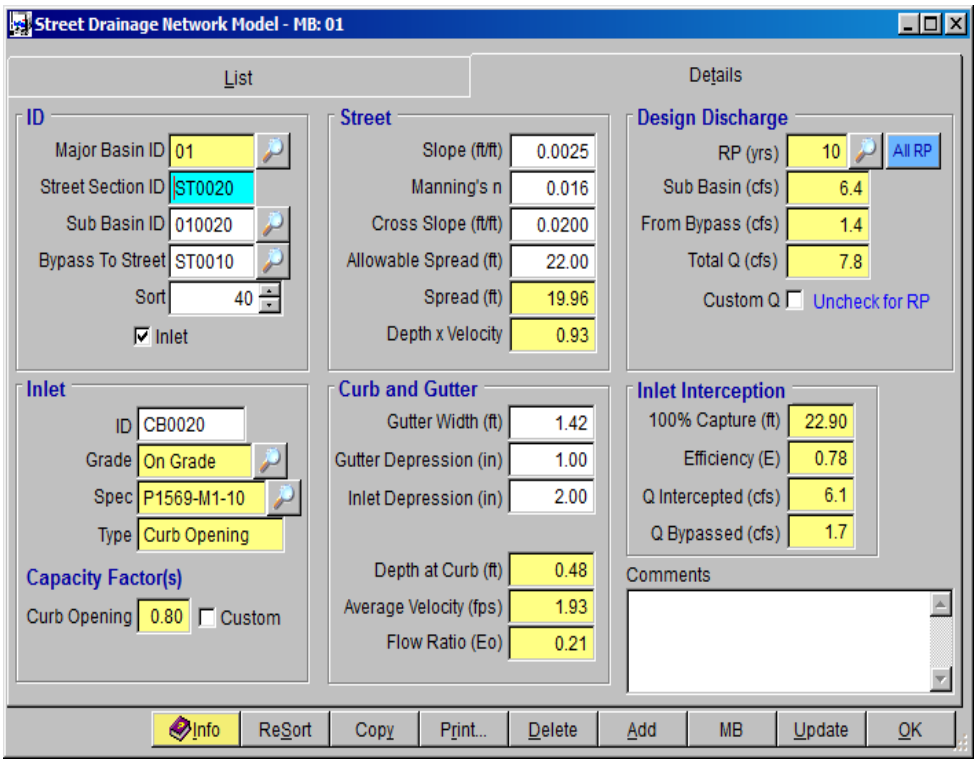
There are 10 street sections that need to be modeled as shown on the Figure in the first page of this tutorial. A summary of the data is shown below and details for each section are shown on the figures that follow. **It is important that the records are sorted in the order they need to be modeled.** After entering all the data, click **Update** to run the Model.

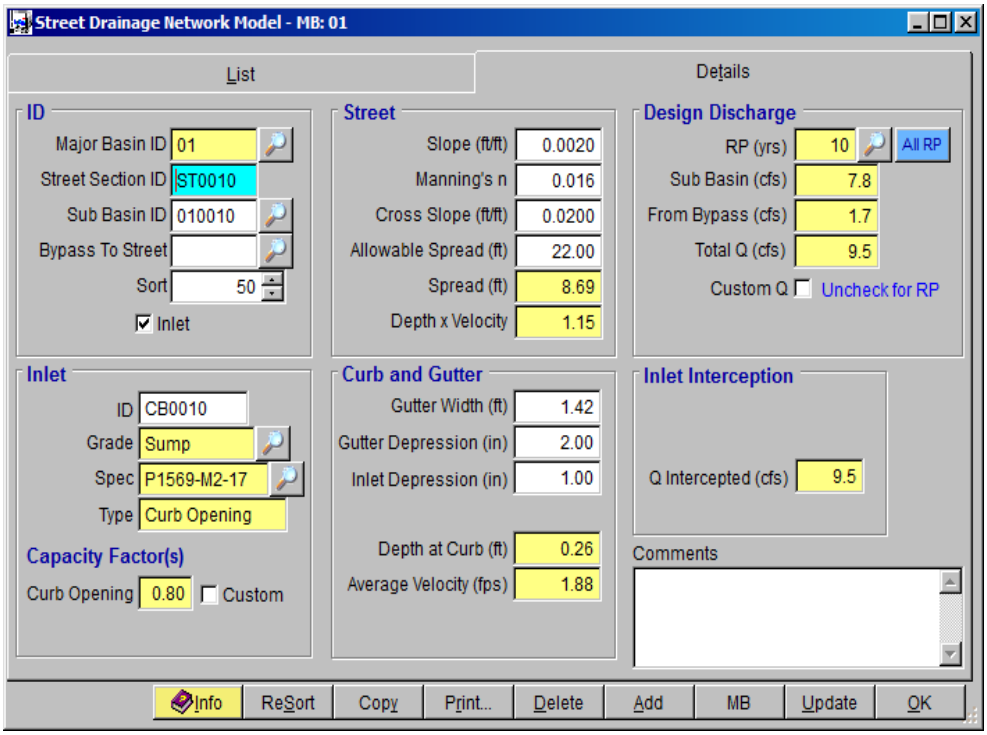

Street Drainage - MB: 01
List
Details
Look for
Sort
Street ID
Sub Basin
Inlet ID
Inlet Type
Bypass To
Allowable Spread (ft)
Spread (ft)
Total Q (cfs)
Intercepted (cfs)
Bypass (cfs)
10 ST0050 010050 CB0050 P1569-M1-10 ST0040 22.00 16.56 5.6 4.7 0.9
20 ST0040 010040 CB0040 P1569-M1-10 ST0030 22.00 18.77 6.9 5.6 1.3
30 ST0030 010030 CB0030 P1569-M1-10 ST0020 22.00 19.01 7.0 5.6 1.4
40 ST0020 010020 CB0020 P1569-M1-10 ST0010 22.00 19.96 7.8 6.1 1.7
50 ST0010 010010 CB0010 P1569-M2-17 22.00 8.69 9.5 9.5
60 ST0045 010045 CB0045 P1569-M1-10 ST0035 22.00 14.80 4.2 3.9 0.3
70 ST0035 010035 CB0035 P1569-M1-10 ST0025 22.00 17.31 5.6 4.8 0.8
80 ST0025 010025 CB0025 P1569-M1-10 ST0015 22.00 18.47 6.9 5.0 1.9
90 ST0015 010015 CB0015 P1569-M1-10 ST0005 22.00 21.27 9.1 6.1 3.0
100 ST0005 010005 CB0005 P1569-M2-17 22.00 9.75 10.7 10.7
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

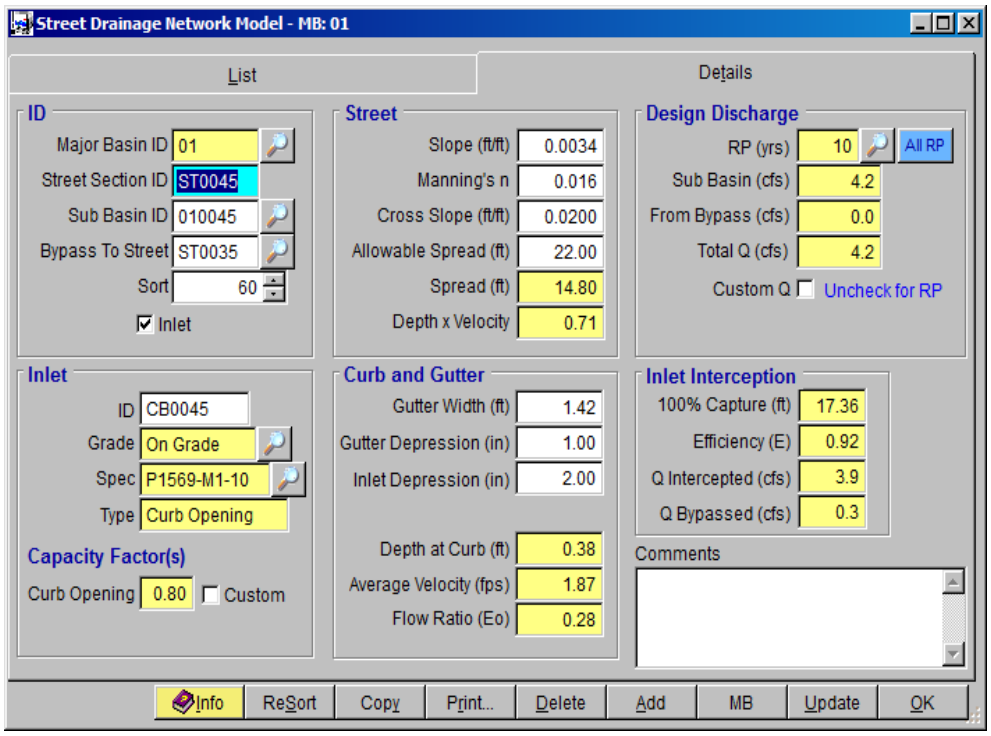

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0050
Sub Basin ID 010050
Bypass To Street ST0040
Sort 10
Inlet
Street
Slope (ft/ft) 0.0034
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 16.56
Depth x Velocity 0.83
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 5.6
From Bypass (cfs) 0.0
Total Q (cfs) 5.6
Custom Q
Uncheck for RP
Inlet
ID CB0050
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.41
Average Velocity (fps) 2.00
Flow Ratio (Eo) 0.25
Inlet Interception
100% Capture (ft) 20.44
Efficiency (E) 0.84
Q Intercepted (cfs) 4.7
Q Bypassed (cfs) 0.9
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

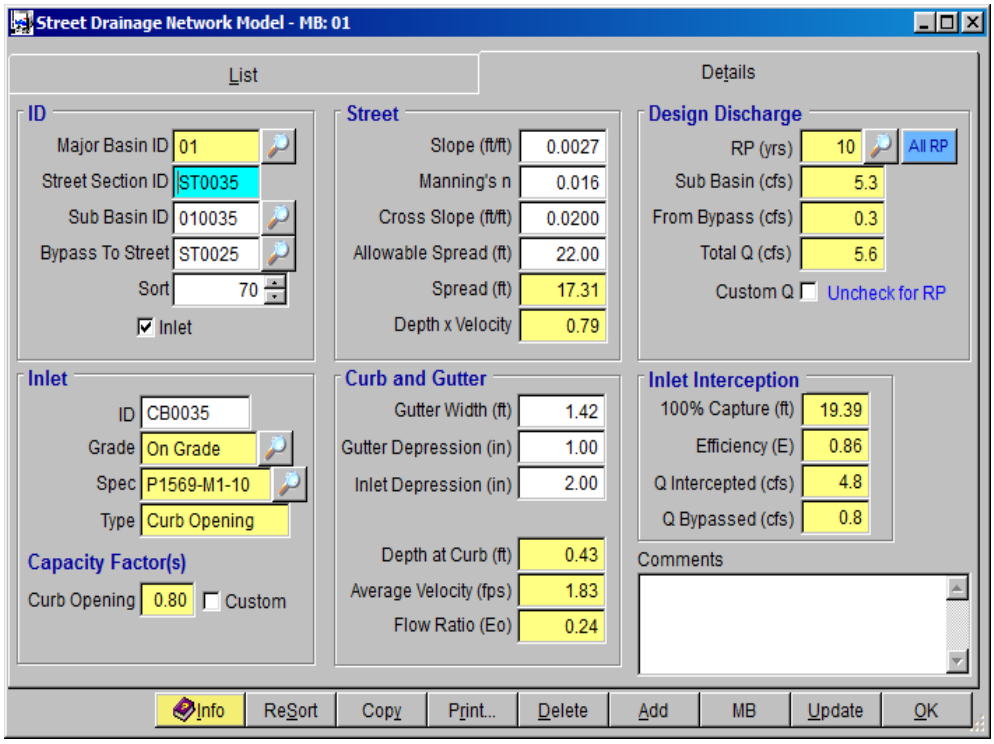

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0040
Sub Basin ID 010040
Bypass To Street ST0030
Sort 20
Inlet
Street
Slope (ft/ft) 0.0027
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 18.77
Depth x Velocity 0.88
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 6.0
From Bypass (cfs) 0.9
Total Q (cfs) 6.9
Custom Q Uncheck for RP
Inlet
ID CB0040
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80 Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.46
Average Velocity (fps) 1.93
Flow Ratio (Eo) 0.22
Inlet Interception
100% Capture (ft) 21.78
Efficiency (E) 0.81
Q Intercepted (cfs) 5.6
Q Bypassed (cfs) 1.3
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

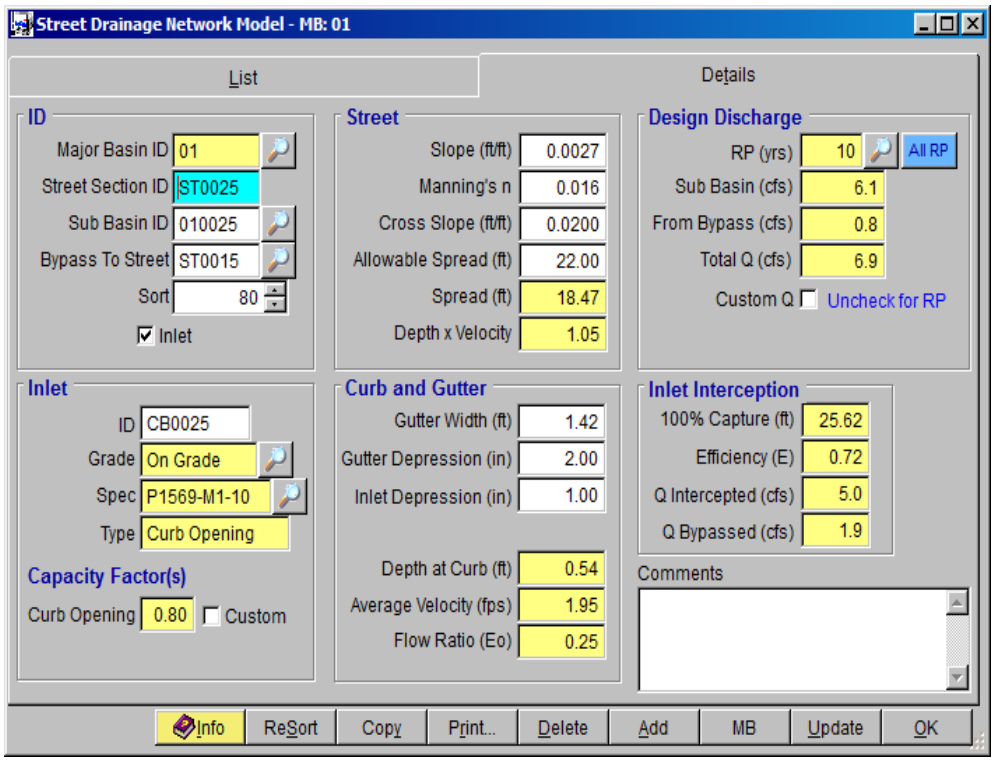

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0030
Sub Basin ID 010030
Bypass To Street ST0020
Sort 30
Inlet
Street
Slope (ft/ft) 0.0026
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 19.01
Depth x Velocity 0.88
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 5.7
From Bypass (cfs) 1.3
Total Q (cfs) 7.0
Custom Q Uncheck for RP
Inlet
ID CB0030
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80 Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.46
Average Velocity (fps) 1.91
Flow Ratio (Eo) 0.22
Inlet Interception
100% Capture (ft) 21.77
Efficiency (E) 0.81
Q Intercepted (cfs) 5.6
Q Bypassed (cfs) 1.4
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

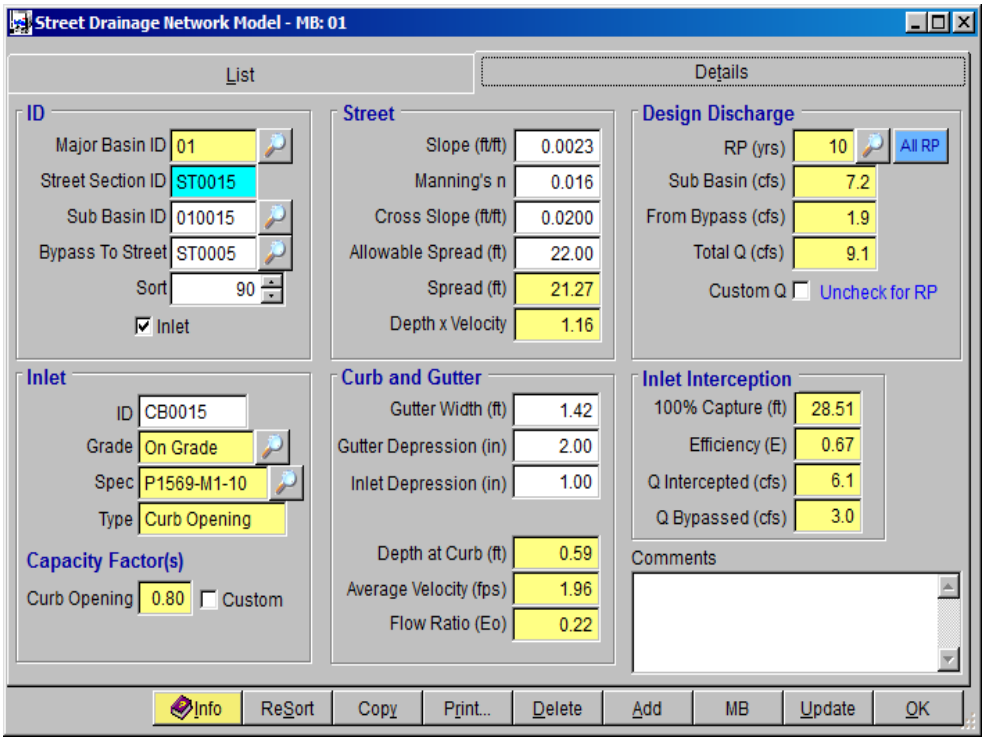

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0020
Sub Basin ID 010020
Bypass To Street ST0010
Sort 40
Inlet
Street
Slope (ft/ft) 0.0025
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 19.96
Depth x Velocity 0.93
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 6.4
From Bypass (cfs) 1.4
Total Q (cfs) 7.8
Custom Q
Uncheck for RP
Inlet
ID CB0020
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.48
Average Velocity (fps) 1.93
Flow Ratio (Eo) 0.21
Inlet Interception
100% Capture (ft) 22.90
Efficiency (E) 0.78
Q Intercepted (cfs) 6.1
Q Bypassed (cfs) 1.7
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

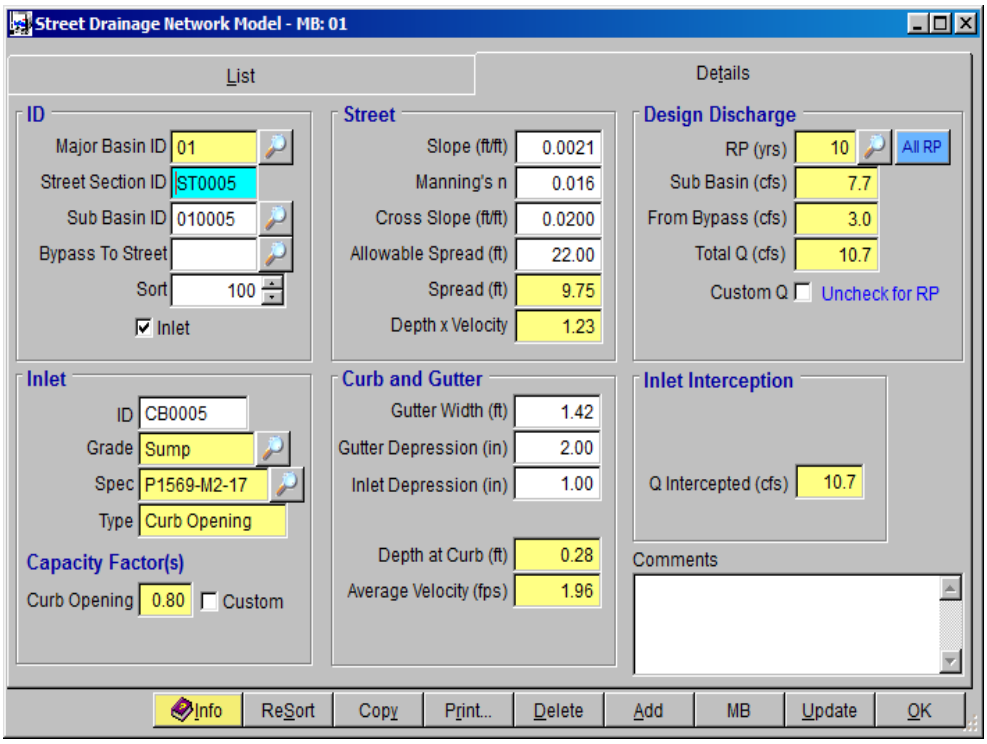

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0010
Sub Basin ID 010010
Bypass To Street
Sort 50
Inlet
Street
Slope (ft/ft) 0.0020
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 8.69
Depth x Velocity 1.15
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 7.8
From Bypass (cfs) 1.7
Total Q (cfs) 9.5
Custom Q
Uncheck for RP
Inlet
ID CB0010
Grade Sump
Spec P1569-M2-17
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 2.00
Inlet Depression (in) 1.00
Depth at Curb (ft) 0.26
Average Velocity (fps) 1.88
Inlet Interception
Q Intercepted (cfs) 9.5
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK


Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0045
Sub Basin ID 010045
Bypass To Street ST0035
Sort 60
Inlet
Street
Slope (ft/ft) 0.0034
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 14.80
Depth x Velocity 0.71
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 4.2
From Bypass (cfs) 0.0
Total Q (cfs) 4.2
Custom Q
Uncheck for RP
Inlet
ID CB0045
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.38
Average Velocity (fps) 1.87
Flow Ratio (Eo) 0.28
Inlet Interception
100% Capture (ft) 17.36
Efficiency (E) 0.92
Q Intercepted (cfs) 3.9
Q Bypassed (cfs) 0.3
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK


Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0035
Sub Basin ID 010035
Bypass To Street ST0025
Sort 70
Inlet
Street
Slope (ft/ft) 0.0027
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 17.31
Depth x Velocity 0.79
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 5.3
From Bypass (cfs) 0.3
Total Q (cfs) 5.6
Custom Q
Uncheck for RP
Inlet
ID CB0035
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 1.00
Inlet Depression (in) 2.00
Depth at Curb (ft) 0.43
Average Velocity (fps) 1.83
Flow Ratio (Eo) 0.24
Inlet Interception
100% Capture (ft) 19.39
Efficiency (E) 0.86
Q Intercepted (cfs) 4.8
Q Bypassed (cfs) 0.8
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK

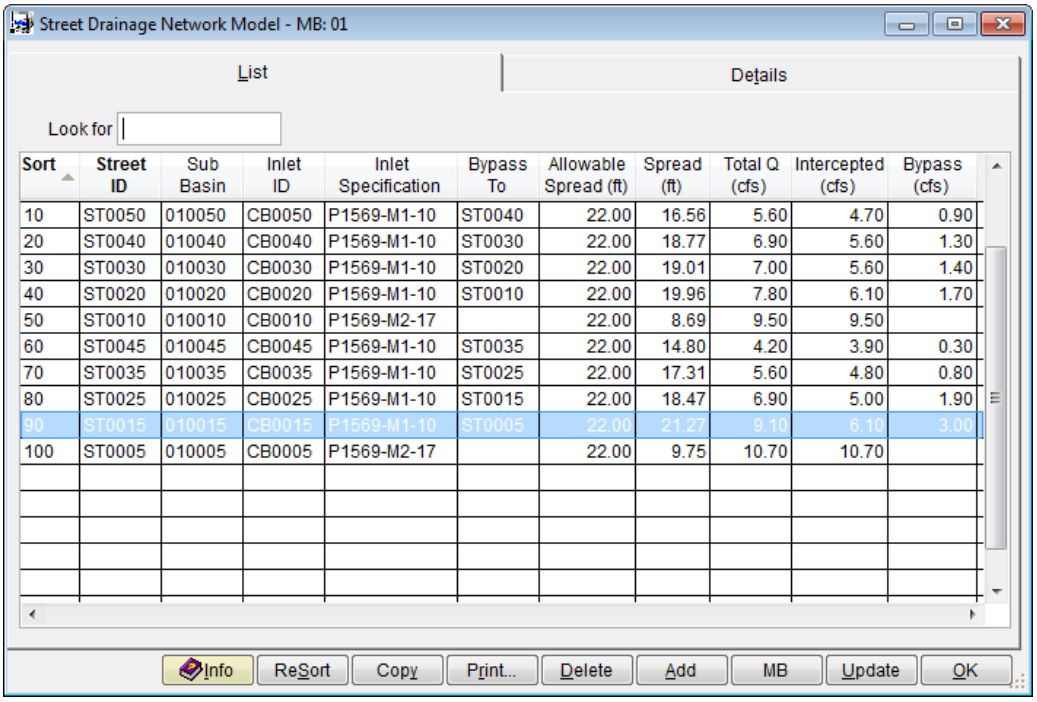

Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0025
Sub Basin ID 010025
Bypass To Street ST0015
Sort 80
Inlet
Street
Slope (ft/ft) 0.0027
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 18.47
Depth x Velocity 1.05
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 6.1
From Bypass (cfs) 0.8
Total Q (cfs) 6.9
Custom Q
Uncheck for RP
Inlet
ID CB0025
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 2.00
Inlet Depression (in) 1.00
Depth at Curb (ft) 0.54
Average Velocity (fps) 1.95
Flow Ratio (Eo) 0.25
Inlet Interception
100% Capture (ft) 25.62
Efficiency (E) 0.72
Q Intercepted (cfs) 5.0
Q Bypassed (cfs) 1.9
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK


Street Drainage Network Model - MB: 01
List
Details
ID
Major Basin ID 01
Street Section ID ST0015
Sub Basin ID 010015
Bypass To Street ST0005
Sort 90
Inlet
Street
Slope (ft/ft) 0.0023
Manning's n 0.016
Cross Slope (ft/ft) 0.0200
Allowable Spread (ft) 22.00
Spread (ft) 21.27
Depth x Velocity 1.16
Design Discharge
RP (yrs) 10
All RP
Sub Basin (cfs) 7.2
From Bypass (cfs) 1.9
Total Q (cfs) 9.1
Custom Q
Uncheck for RP
Inlet
ID CB0015
Grade On Grade
Spec P1569-M1-10
Type Curb Opening
Capacity Factor(s)
Curb Opening 0.80
Custom
Curb and Gutter
Gutter Width (ft) 1.42
Gutter Depression (in) 2.00
Inlet Depression (in) 1.00
Depth at Curb (ft) 0.59
Average Velocity (fps) 1.96
Flow Ratio (Eo) 0.22
Inlet Interception
100% Capture (ft) 28.51
Efficiency (E) 0.67
Q Intercepted (cfs) 6.1
Q Bypassed (cfs) 3.0
Comments
Info
ReSort
Copy
Print...
Delete
Add
MB
Update
OK



4.0 SUMMARY

The summary of the street drainage analysis is provided below:



Sort	Street ID	Sub Basin	Inlet ID	Inlet Specification	Bypass To	Allowable Spread (ft)	Spread (ft)	Total Q (cfs)	Intercepted (cfs)	Bypass (cfs)
10	ST0050	010050	CB0050	P1569-M1-10	ST0040	22.00	16.56	5.60	4.70	0.90
20	ST0040	010040	CB0040	P1569-M1-10	ST0030	22.00	18.77	6.90	5.60	1.30
30	ST0030	010030	CB0030	P1569-M1-10	ST0020	22.00	19.01	7.00	5.60	1.40
40	ST0020	010020	CB0020	P1569-M1-10	ST0010	22.00	19.96	7.80	6.10	1.70
50	ST0010	010010	CB0010	P1569-M2-17		22.00	8.69	9.50	9.50	
60	ST0045	010045	CB0045	P1569-M1-10	ST0035	22.00	14.80	4.20	3.90	0.30
70	ST0035	010035	CB0035	P1569-M1-10	ST0025	22.00	17.31	5.60	4.80	0.80
80	ST0025	010025	CB0025	P1569-M1-10	ST0015	22.00	18.47	6.90	5.00	1.90
90	ST0015	010015	CB0015	P1569-M1-10	ST0005	22.00	21.27	9.10	6.10	3.00
100	ST0005	010005	CB0005	P1569-M2-17		22.00	9.75	10.70	10.70	

This concludes this tutorial.