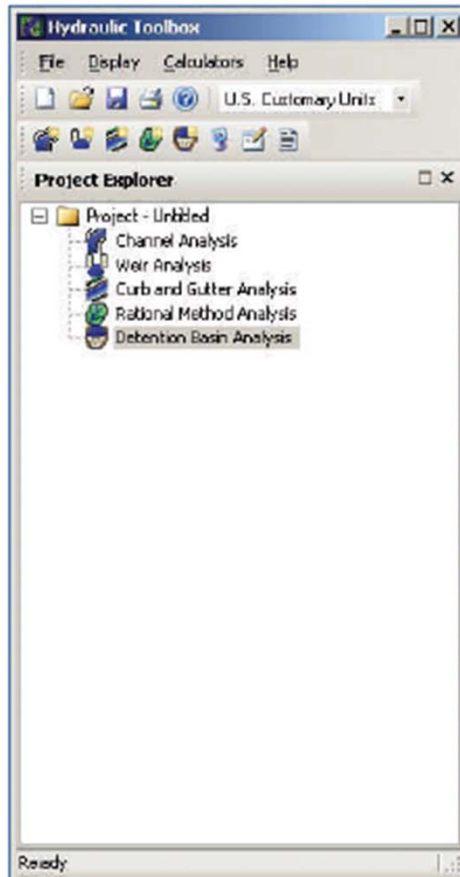




# Freely available software US Federal Highways Agency Toolkit

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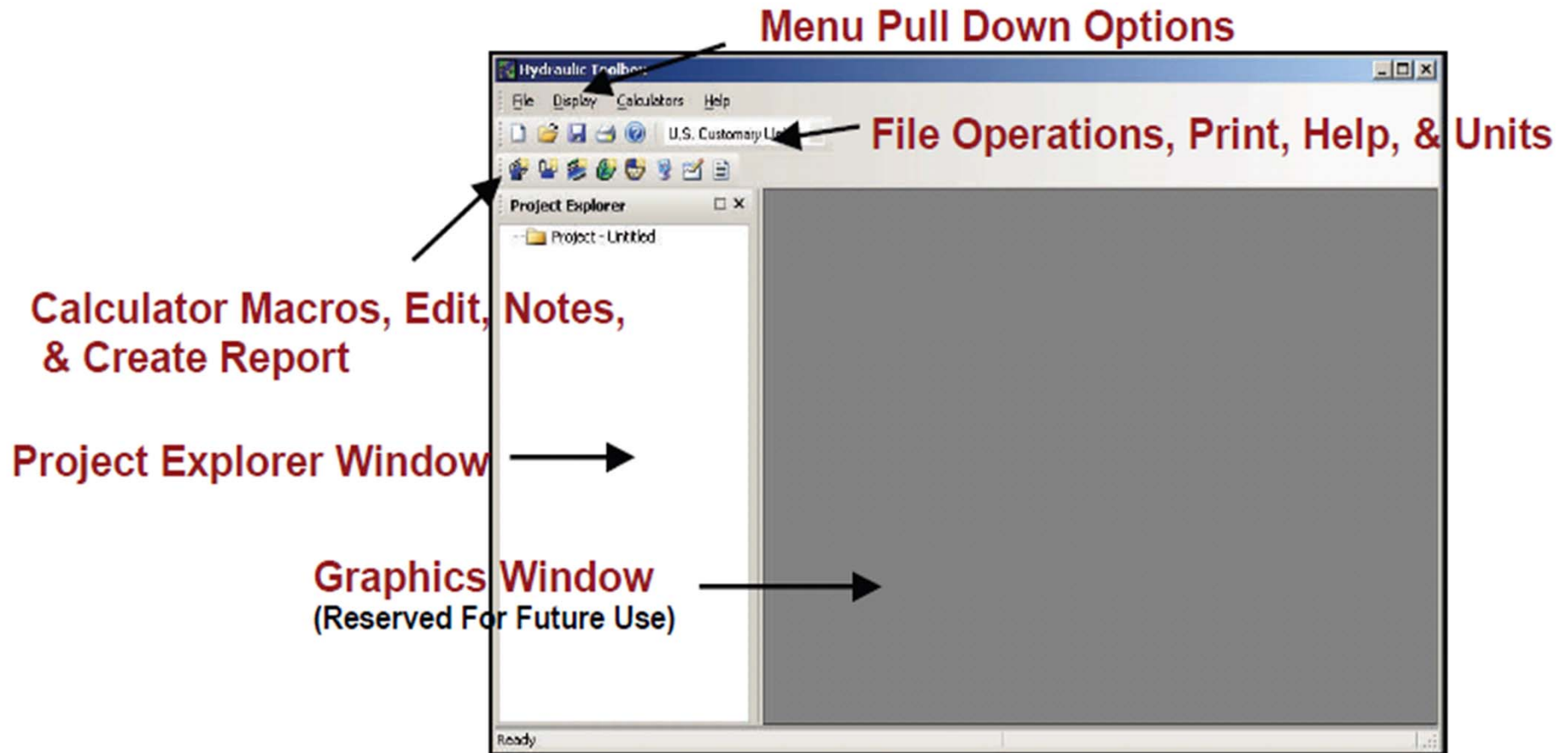
## FHWA Hydraulic Toolbox Version 1.0 Desktop Reference Guide



Reference Guide Version 1.0.0

All calculators can use SI and English units

## Hydraulic Toolbox Interface



Hydraulic Toolbox Interface



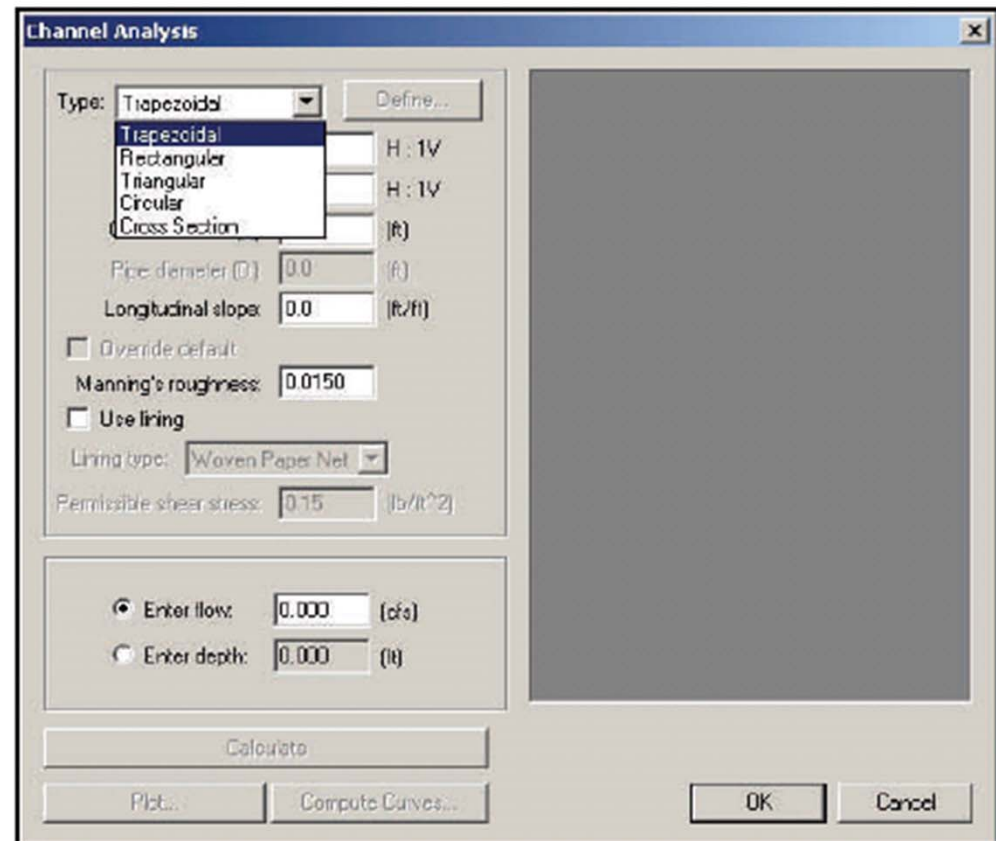
## Channel Analysis Calculator

The **Channel Analysis Calculator** can compute the full range of hydraulic parameters for trapezoidal, rectangular, triangular, circular, or user defined (irregular) channel shapes for a given depth or discharge. For a selected cross section, the user is prompted for necessary input including channel side slopes, bottom width, diameter, channel slope, and Manning's n value. Hydraulic parameters are computed using the Manning Equation shown below.

### Manning Equation

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

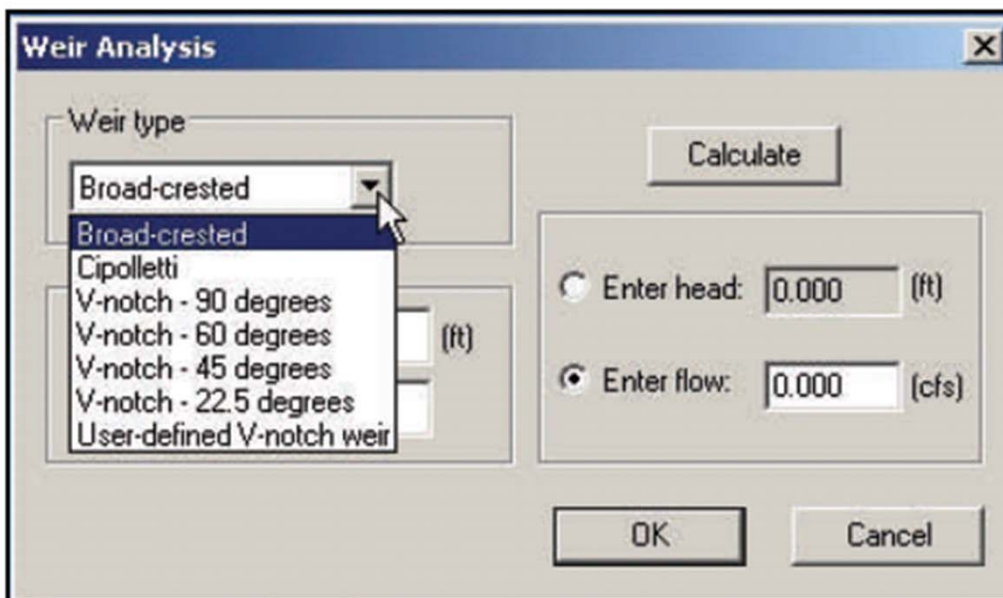
Q = Discharge  
n = Manning Roughness Coefficient  
A = Area  
R = Hydraulic Radius, A/P  
P = Wetted Perimeter



The screenshot shows the 'Channel Analysts' dialog box. The 'Type:' dropdown is set to 'Trapezoidal'. The 'Define...' button is visible next to it. Below the dropdown, there are input fields for 'Pipe diameter (D)' (0.0), 'Longitudinal slope' (0.0), 'Manning's roughness' (0.0150), 'Lining type' (Woven Paper Net), and 'Permissible shear stress' (0.15). There are also checkboxes for 'Override default' and 'Use lining'. At the bottom, there are radio buttons for 'Enter flow' (0.000 cfs) and 'Enter depth' (0.000 ft). The 'Calculate' button is highlighted, and there are also 'Plot...', 'Compute Curves...', 'OK', and 'Cancel' buttons.

### Channel Types

## Weir Analysis Calculator



Weir Equation

$$Q = CLH^{3/2}$$

Where:

Q = Discharge  
C = Weir Discharge Coefficient  
L = Weir Length  
H = Head

### Weir Analysis Calculator Menu

The **Weir Analysis Calculator** offers 7 types of weir for analysis: broad crested, cipolletti (trapezoidal), v-notch (90 degrees) v-notch (60 degrees), v-notch (45 degrees), v-notch (22.5 degrees), and v-notch (user defined coefficient). The weir analysis window requires the user to enter the type of weir, weir length, the weir coefficient (if the default value is not acceptable) and either the head or the amount of flow. The tool-box will then calculate the missing variable.

## Curb and Gutter Calculator

The inlet capacity calculator contains five inlet types:

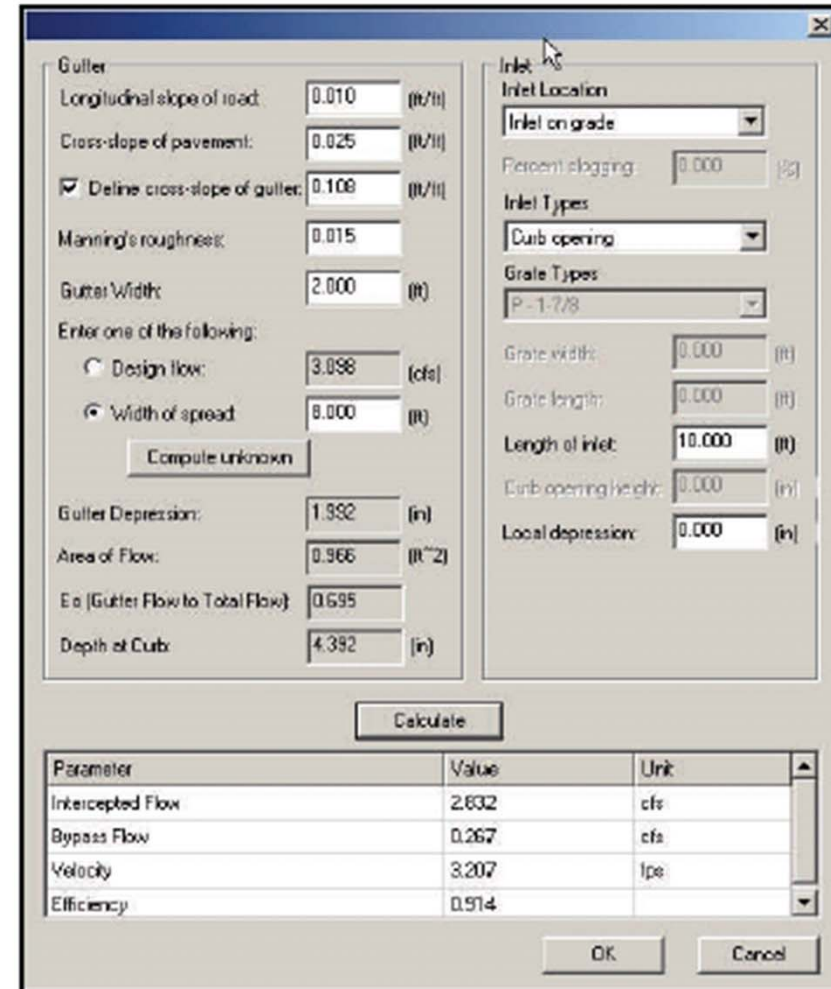
- Grate Only (P-1-7/8, P-1-7/8-4, P-1-1/8, Curved Vane, 45 Degree Tilt Bar 2-1/4", 45 Degree Tilt Bar 3-1/4", 30 Degree Tilt bar, Reticuline)
- Curb Opening
- Slotted Drain
- Sweeper Combination
- Equal Length Combination

Typical computed results for on-grade inlets include:

- Area of Flow
- Intercepted Flow
- Bypass Flow
- Velocity
- Splash-over Velocity
- Efficiency

Typical computed results for inlets in sags include:

- Flow Type
- Effective Perimeter (accounting for clogging)
- Effective Area (accounting for clogging)
- Depth at Curb Face
- Width of Spread



Parameter	Value	Unit
Intercepted Flow	2.832	cfs
Bypass Flow	0.267	cfs
Velocity	3.207	fps
Efficiency	0.914	

**Gutter and Inlet**



## Rational Method Calculator

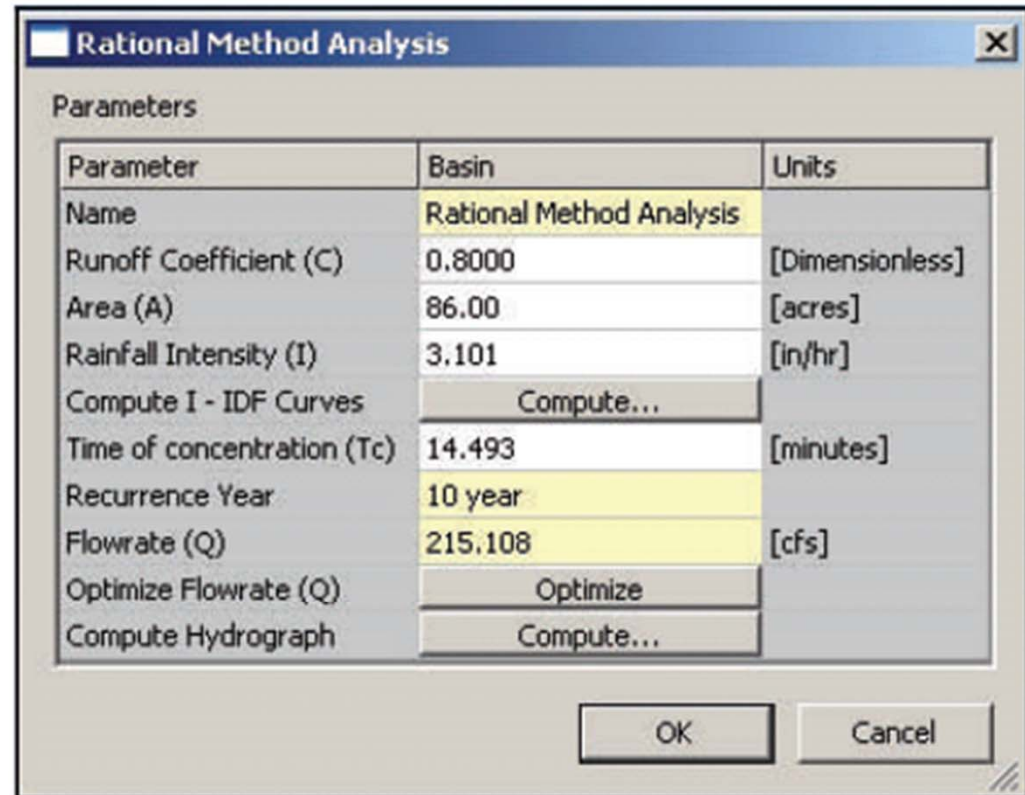
The **Rational Method Calculator** can be used to enter the variables required to compute discharge rate by the Rational Method. The calculator can also compute the total time of concentration,  $t_c$ , and plot the intensity-duration-frequency (IDF) curves. Once discharge has been determined, a hydrograph can be computed by various methods and displayed.

### Rational Method

$$Q = CIA$$

Where:

- Q = Discharge
- C = Rational Method Runoff Coefficient
- I = Rainfall Intensity
- A = Area



The screenshot shows a software dialog box titled "Rational Method Analysis". It contains a table of parameters and their values, along with several buttons for calculations.

Parameter	Basin	Units
Name	Rational Method Analysis	
Runoff Coefficient (C)	0.8000	[Dimensionless]
Area (A)	86.00	[acres]
Rainfall Intensity (I)	3.101	[in/hr]
Compute I - IDF Curves	Compute...	
Time of concentration (Tc)	14.493	[minutes]
Recurrence Year	10 year	
Flowrate (Q)	215.108	[cfs]
Optimize Flowrate (Q)	Optimize	
Compute Hydrograph	Compute...	

At the bottom of the dialog box are "OK" and "Cancel" buttons.

### Rational Method Analysis

# Estimated rainfall intensities (mm/hour) from Mauritian Met Service

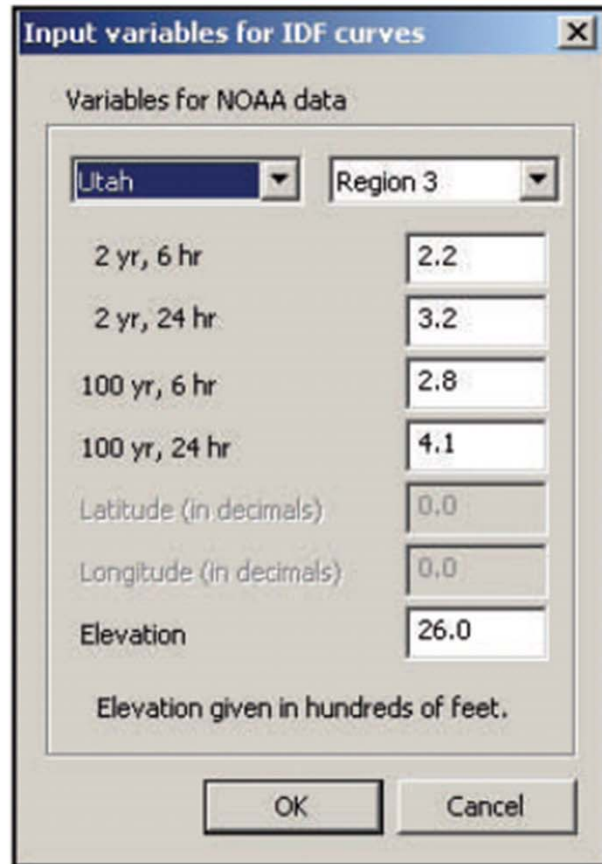
Duration  
minutes

		Duration minutes						
mm/hr		1	5	10	15	30	60	120
Return period	T2	125	<b>103</b>	<b>85</b>	<b>69</b>	<b>56</b>	<b>38</b>	22
	T5	175	<b>136</b>	<b>110</b>	<b>87</b>	<b>74</b>	<b>56</b>	37
	T10	208	<b>157</b>	<b>127</b>	<b>99</b>	<b>85</b>	<b>67</b>	46
	T25	250	<b>185</b>	<b>149</b>	<b>114</b>	<b>100</b>	<b>81</b>	59
	T50	281	<b>205</b>	<b>165</b>	<b>125</b>	<b>111</b>	<b>92</b>	68
	T100	312	<b>225</b>	<b>180</b>	<b>136</b>	<b>122</b>	<b>102</b>	77



# Mauritius Met Service data can be imported into the Rational Method Calculator

## Rational Method Calculator—IDF Curve Generator



**Input variables for IDF curves**

Variables for NOAA data

Utah Region 3

2 yr, 6 hr: 2.2

2 yr, 24 hr: 3.2

100 yr, 6 hr: 2.8

100 yr, 24 hr: 4.1

Latitude (in decimals): 0.0

Longitude (in decimals): 0.0

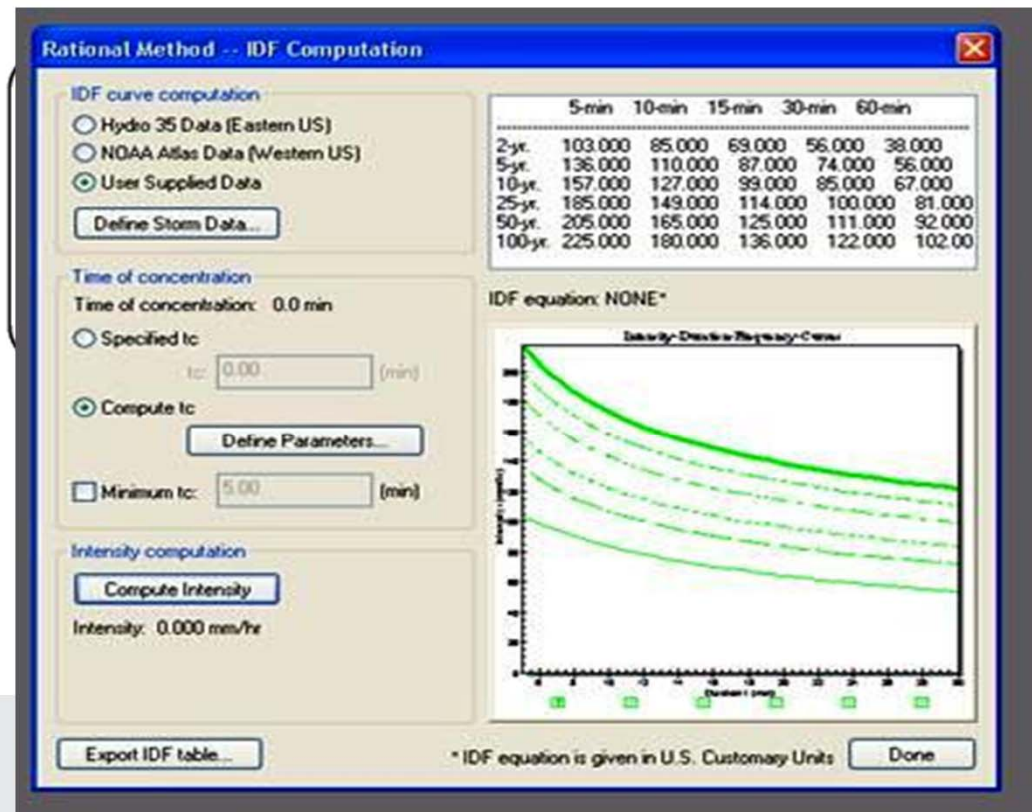
Elevation: 26.0

Elevation given in hundreds of feet.

OK Cancel

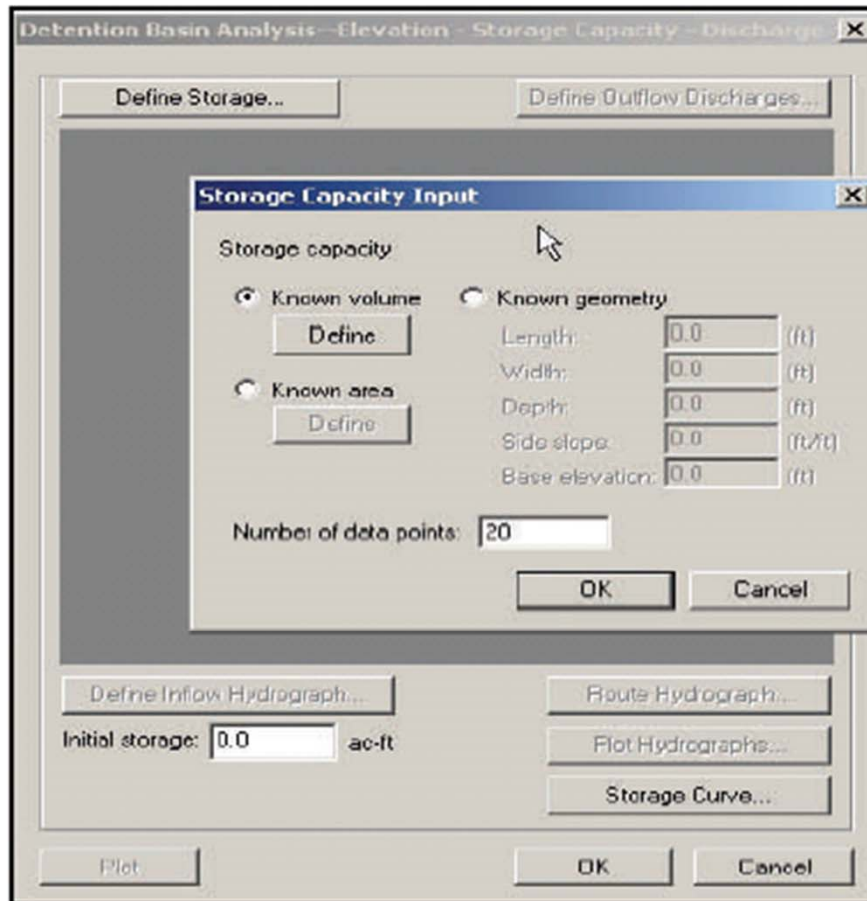
IDF Curve Input Variables

The **Rational Method Calculator** allows the input of precipitation information from a variety of sources. Hydro-35 for the Eastern United States, NOAA Atlas 2 for the Western United States, and user defined precipitation values from other sources such as NOAA Atlas 14 (various regions of the United States).



# Detention basin calculator

## Detention Basin Calculator



### Detention Basin Storage Capacity

One of the fundamental objectives of storm water management is to maintain the peak runoff rate in a developed area at or below the predevelopment rate. The **Detention Basin Calculator** uses the basin storage, the inflow hydrograph and the outflow discharge to achieve this goal.

The volume of storage must be estimated to reduce the basin peak discharge. The calculator subtracts the volume of water that can be stored in the basin from the volume of water entering the basin based on the inflow hydrograph. When the entering volume of water exceeds the storage volume of the basin, the excess water is discharged through the user defined structure.

The detention basin analysis begins by selecting the “Define Storage” button and entering the volume, geometry, or area of the basin. By selecting the “Define” button for the known volume, a new window opens and the user enters the acre-ft of storage below its corresponding elevation. If the “Known area” option is selected, the user enters the elevation and area of the surface in acres. Up to 200 data pairs are allowed. If the geometry is known, the user enters the dimensions of the basin.





Any questions?

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