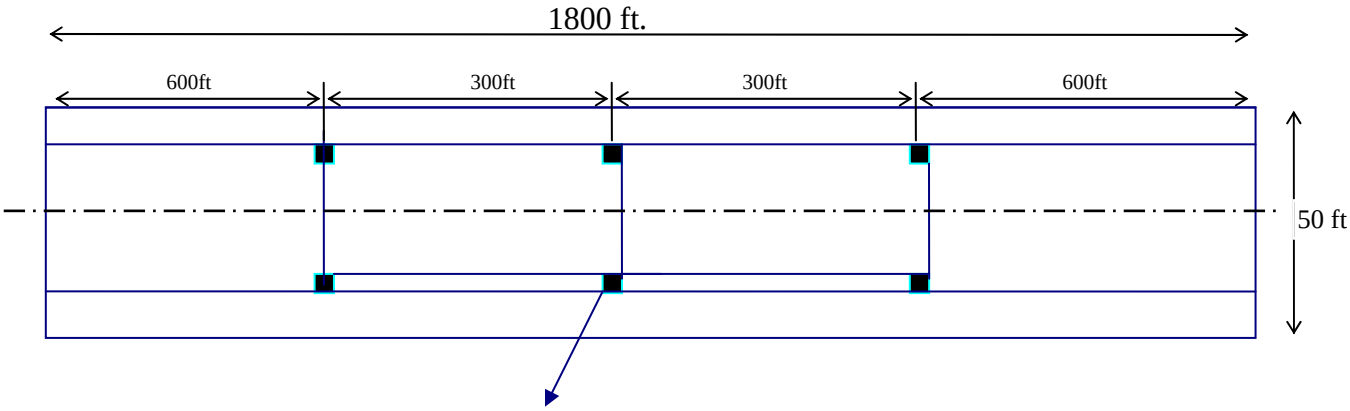
Example Basin

This portion of Storm Shed training will demonstrate how to: create a new file, drainage area options (precipitation values), calculate the short duration storm MRI and create basins.

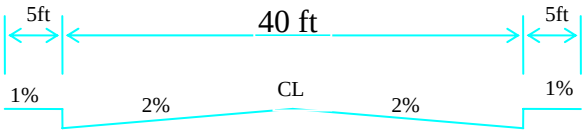
Example Problem

The basin we will be using today has the following description: A new two-lane roadway section is to be constructed near Spokane. Spokane is located in **Climatic Region 3** with a MAP of **18 inches**. The existing site conditions are approximately **1800 feet** in length and **50 feet** wide all forest. The SCS soil type for the entire project is **Type C** and the ground cover is primarily forest in fair conditions. The average slope of the ground before the construction is **1%**. The calculated time of concentration should be assumed that for the forested condition will be **50 feet** of sheet flow with the remainder **1750 feet** being shallow concentrated flow. The proposed conditions for the new impervious roadway will be slightly elevated and will utilize curb and gutter to control the flow. The developed site will have a sag in the profile. Using the plan, cross section, and profile view below for the proposed layout. Develop the before and after basin conditions.

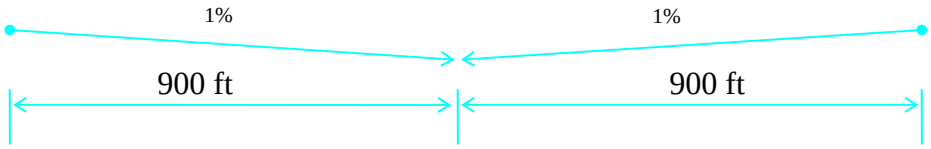
PLAN VIEW
Figure 1



CROSS SECTION
Figure 2

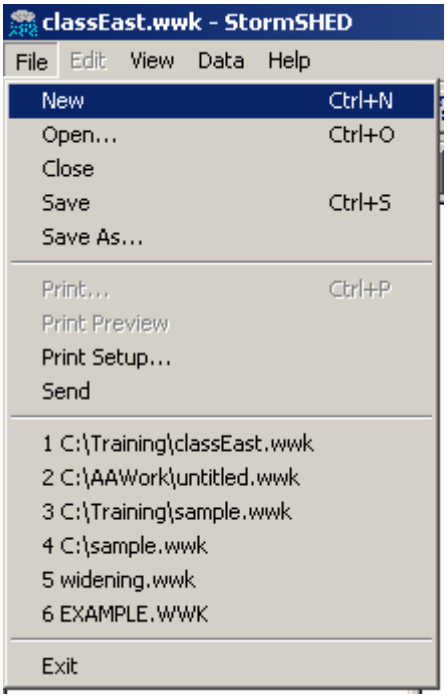


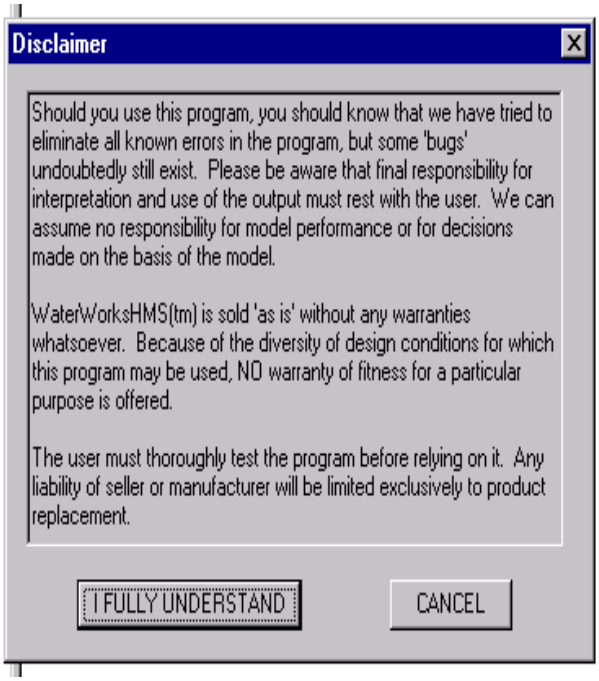
PROFILE
Figure 3

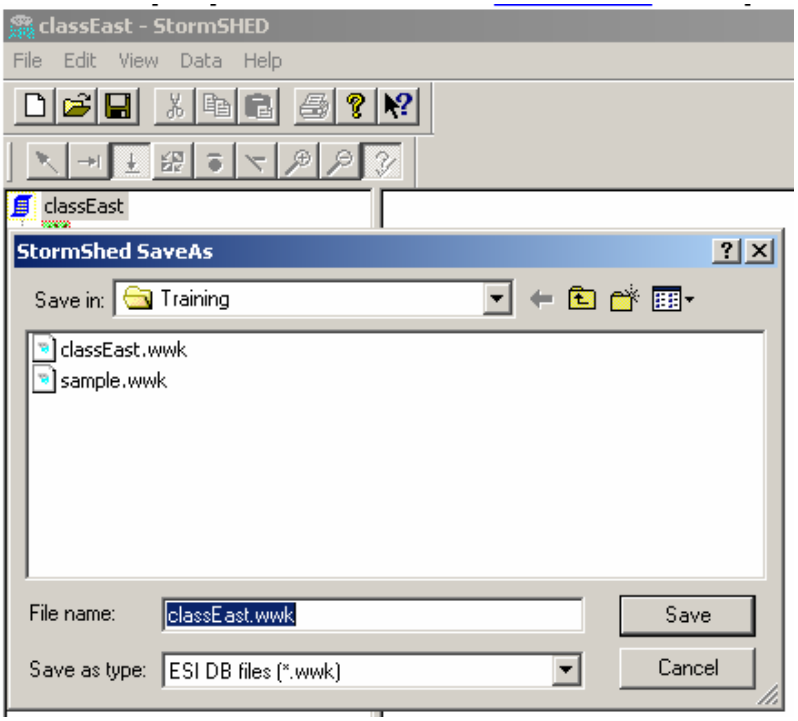


Creating a New File

The first thing that needs to be done when starting StormSHED is to create a new project. Click on the new project icon (blank piece of paper) then use the Save As command in the File menu to give it a unique name.

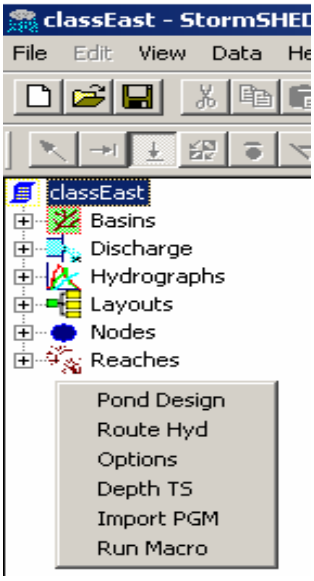




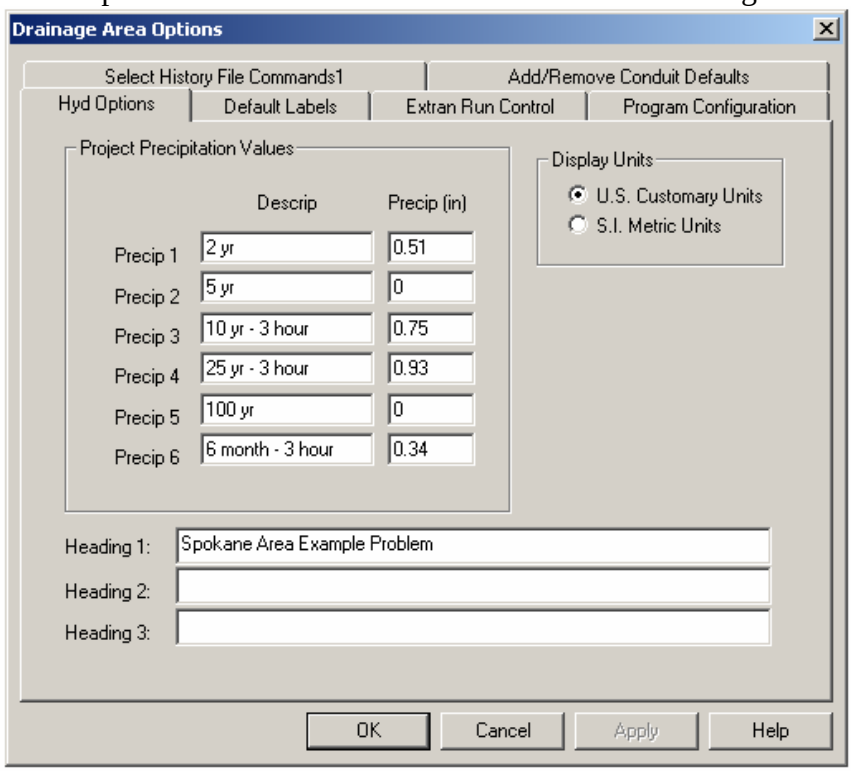


Set Project Defaults

Next set the project defaults. Click with the right mouse button in a blank part of the Tree Menu.



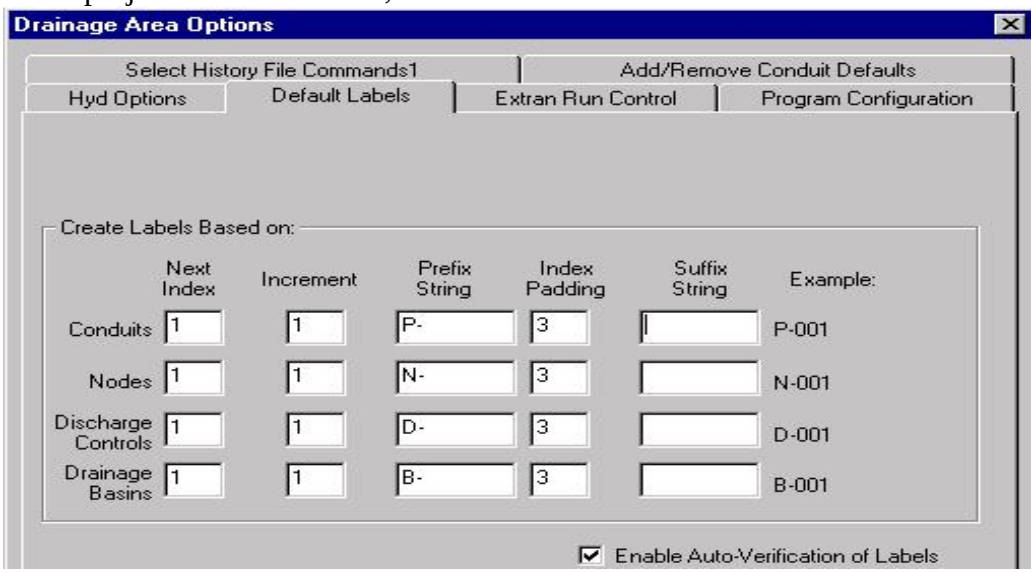
Click Options with the left mouse button and the following menu will pop up.



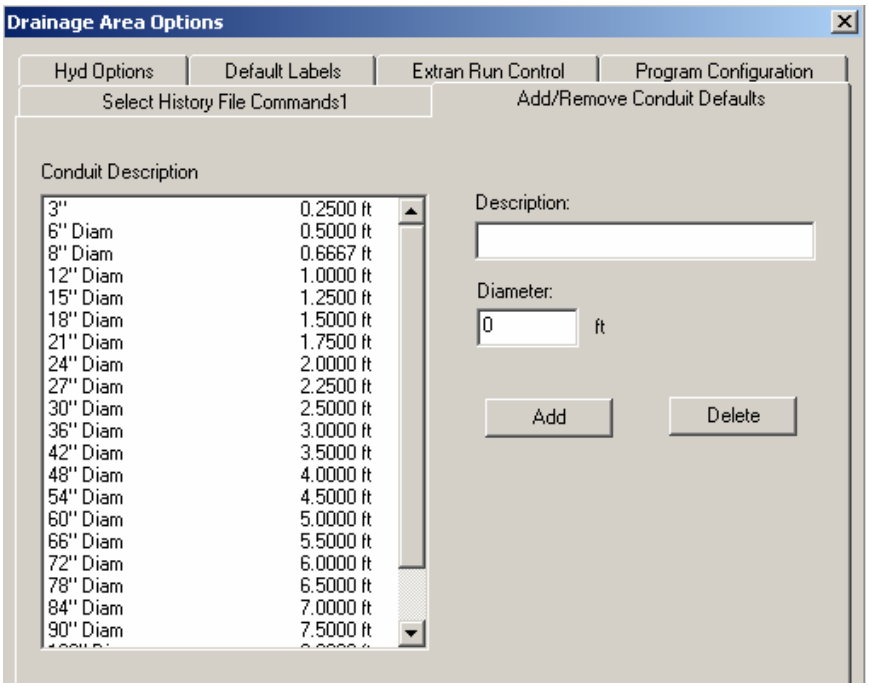
The first "options" screen we see is "Hyd Options" where the precipitation for a specific location and design storm is set. This screen also lets us chose metric or English units. Before inputting the values above, the Short Duration Storm section will further discuss how the values above were computed.

Example Basin

Next we will set the Default Labels. Click on the Default Labels tab to open the screen shown below. This screen allows the designer to customize labels for new pipes, ditches, ponds, catch basins, etc. While it is often convenient to use the auto labels, be sure to check the "Enable Auto-Verification of Labels" box. This will allow the designer to override the StormSHED' auto labels and instead create a label that is more meaningful to the project. When finished, click on OK to return to the main screen.



Lastly, we will review how to edit the default pipe sizes. Select 'Add/Remove Conduit Defaults' and the screen below will appear. If a unique pipe size will be used on a project, it can be added here. Input the description, inside pipe diameter and then click on add.



The 'Program Configuration' will be reviewed in the 'Example Network' example.

Short Duration Storm

The precipitation values for conveyance design (structures, ditches and bioswales) are based on the Short Duration Storm in Eastern Washington. The precipitation values are determined from the following steps.

1. Determine the 2-year 2-hour precipitation from the Eastern Isopluvial Maps using Appendix 4A in the 2004 HRM.
2. Using the climatic region descriptions in section 4D-2 the Highway Runoff Manual, determine the climatic region for a given area. Climatic regions are also shown on the MAP maps, the location is further discussed in step 3.
3. Find the MAP using the web link in Appendix 4A of the Highway Runoff Manual. The links will go to the HQ Hydraulics Web Page. Select Eastern Washington Isopluvials and Mean Annual Precipitation Maps, the MAP's are located toward the back.
4. Given the MAP and the climatic region, locate the C_{sds} from the table below, which can also be found in the last section of Appendix 4D.
5. Next, using the 2 year 2 hour precipitation from step 1 and the C_{sds} from step 4, determine the applicable 3 hour storm using the equation below.

$$P_{sds} = C_{sds} (P_{2yr2hr})$$

Where:

P_{sds} - the 3-hour precipitation (inches) for a selected return period for the short-duration storm.

C_{sds} - a coefficient from Table 4D-12 for computing the 3-hour precipitation for a selected return period based on the 2-year 2-hour precipitation.

P_{2yr2hr} - is the 2-year, 2-hour precipitation in Appendix 4A.

Table 4D-12. Precipitation for selected return periods (C_{sds}).

Region #	Mean Annual Precipitation (in.)	6-Month	1-Year	2-Year	10-Year	25-Year	50-Year	100-Year
	6-8	0.65	0.84	1.06	1.73	2.30	2.84	3.49
	8-10	0.66	0.85	1.06	1.70	2.22	2.70	3.28
2	10-12	0.68	0.86	1.06	1.65	2.14	2.59	3.10
2, 3	12-16	0.70	0.87	1.06	1.60	2.01	2.40	2.82
3	16-22	0.71	0.88	1.06	1.56	1.93	2.26	2.63
	22-28	0.73	0.89	1.06	1.52	1.84	2.13	2.45
	28-40	0.74	0.90	1.06	1.48	1.78	2.04	2.32
	40-60	0.76	0.91	1.06	1.44	1.71	1.93	2.17
1, 4	60-120	0.78	0.92	1.06	1.41	1.64	1.84	2.05

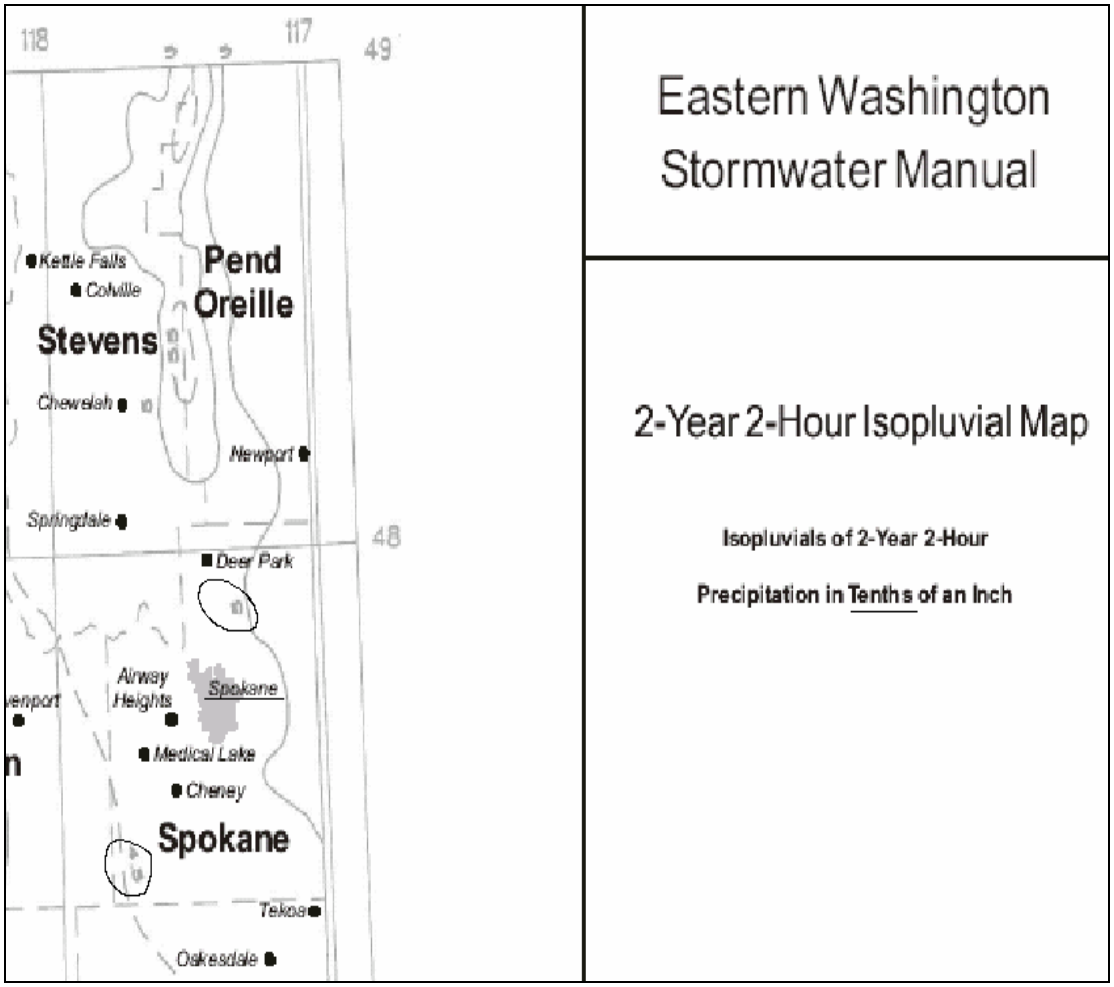
**Note – Table 4D-12 above has been modified from the table in the 2004 Highway Runoff Manual. The fall version of the HRM will reflect the changes above. For the process described in this course, use the table above.

Example Basin

For example:

This example is set in Spokane.

1. From the Isopluvial Map, the 2 year 2 hour storm was found to be 0.48” for, see below.



2. Spokane is located in climatic region 3 as shown on the map below and described in the Highway Runoff Manual Appendix 4D-2. (Both the NC and SC are located in are located in climatic regions 1 and 2.)
3. The MAP for Spokane is 18”, which is also shown on the map below.
4. Given the MAP of 18 and climatic region 3, the $C_{sds} = 0.71$ for the 6 month duration.
5. Lastly, convert the 6month 2 hour to the 3 hour duration for the 6 month MRI, as shown below. Repeat set 5 for the 1, 2, 5, 10, 25, 50 and 100 year duration, for this course we will only need the 6 month, 2, 10 and 25 year MRI.

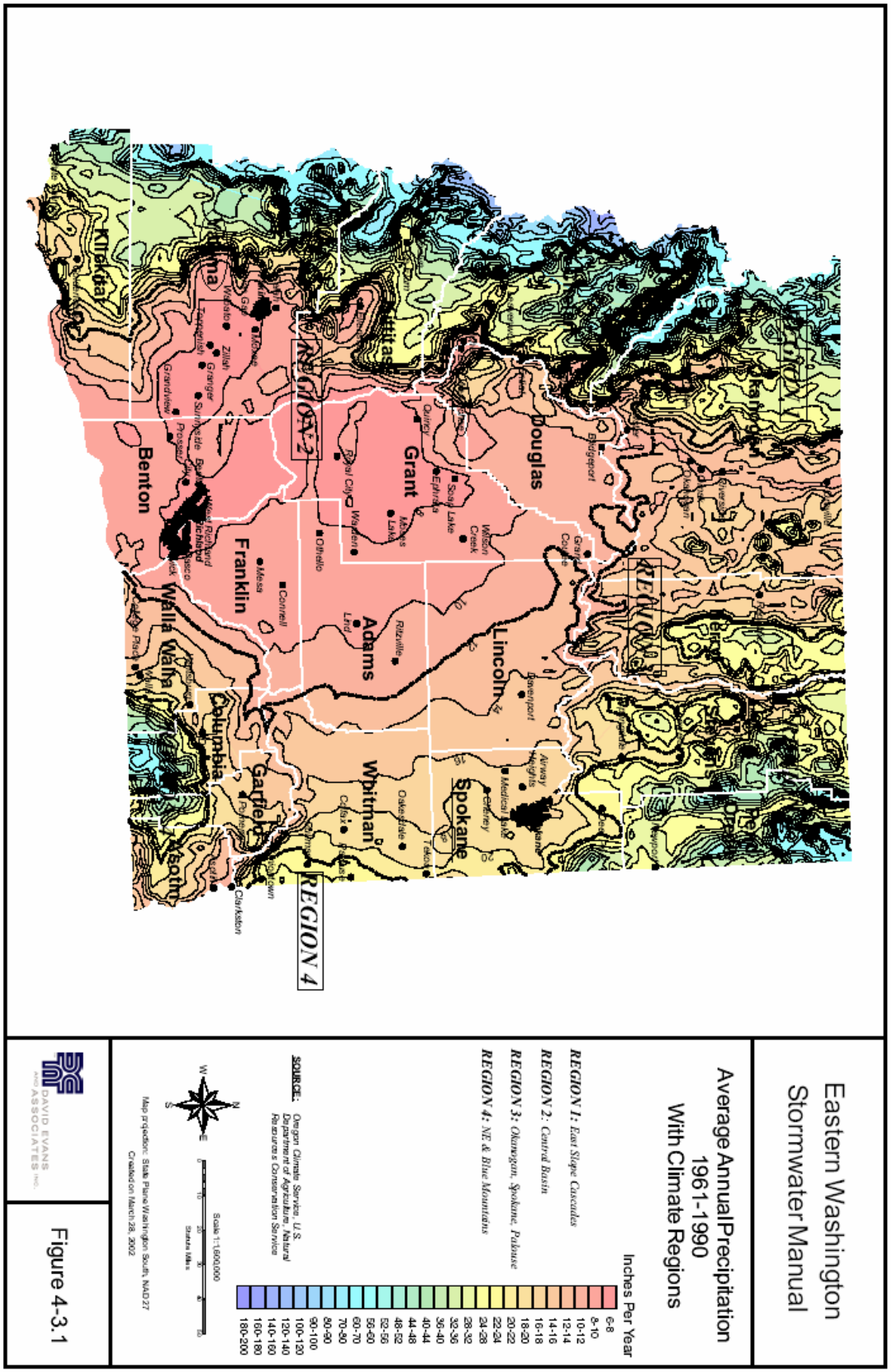
$$P_{6mon3hr} = 0.71x0.48'' = 0.34''$$

$$P_{2yr3hr} = 1.06x.48'' = 0.51''$$

$$P_{10yr3hr} = 1.56x.48'' = 0.75''$$

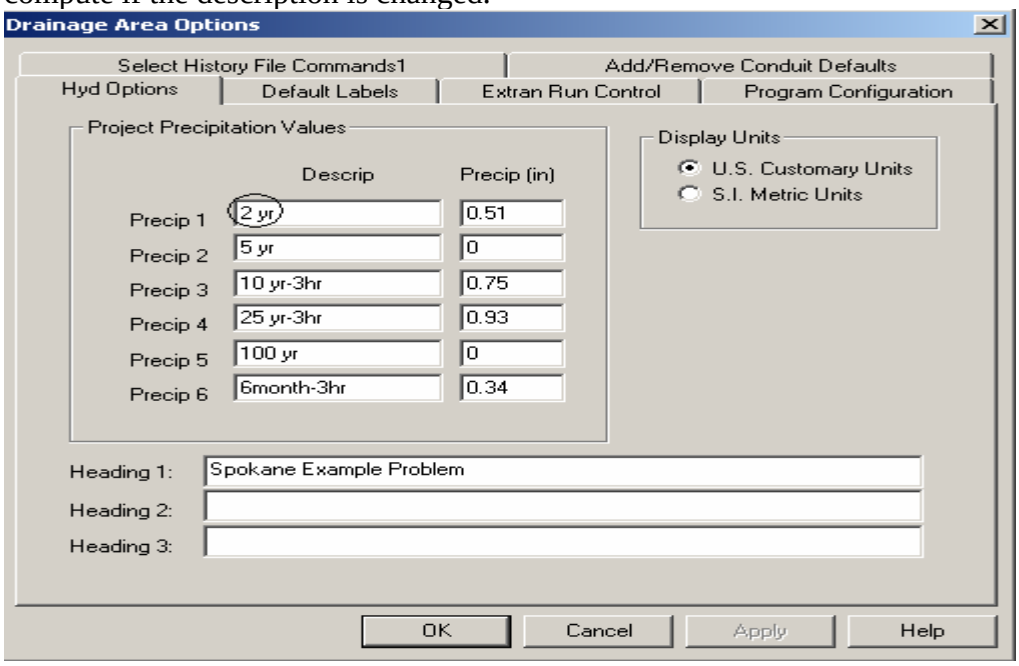
$$P_{25yr3hr} = 1.93x.48'' = 0.93''$$

Example Basin



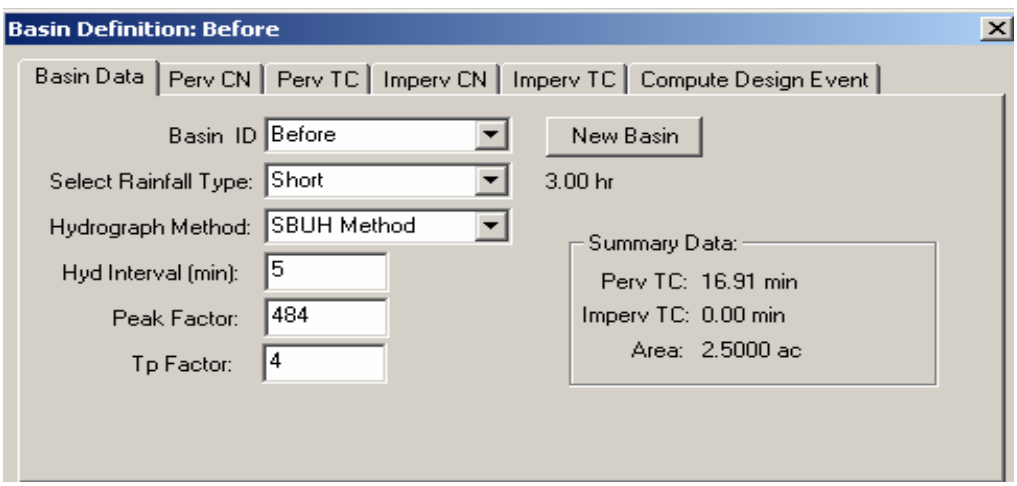
Example Basin

The precipitation values for this project are shown below. **It's important not to over ride Precip 1 (2 yr)**, the first value under the description that is circled below. It will not compute if the description is changed.



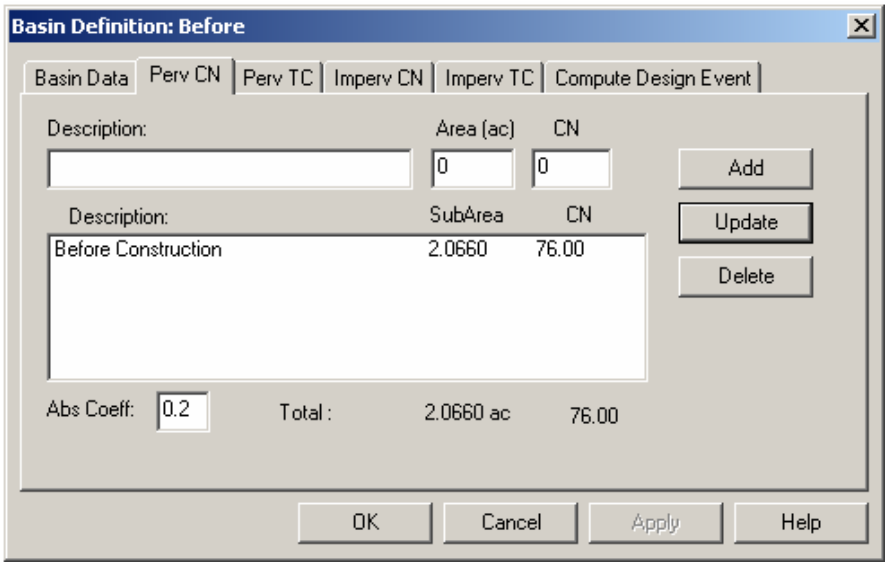
Create Basins

First, you want to define the Before drainage basin site conditions.



The basin rainfall type for conveyance design is the **Short** Duration 3hr storm for Eastern Washington. The hydrograph method can be either the SBUH or SCS Method, however; the hydrograph interval time needs to be changed to **5 minutes** instead of the 10 minute default. This is due to the duration of the high intensity portion of the storm, which may last from 5 to 30 minutes with a total duration typically ranging less than an hour to several hours.

Example Basin

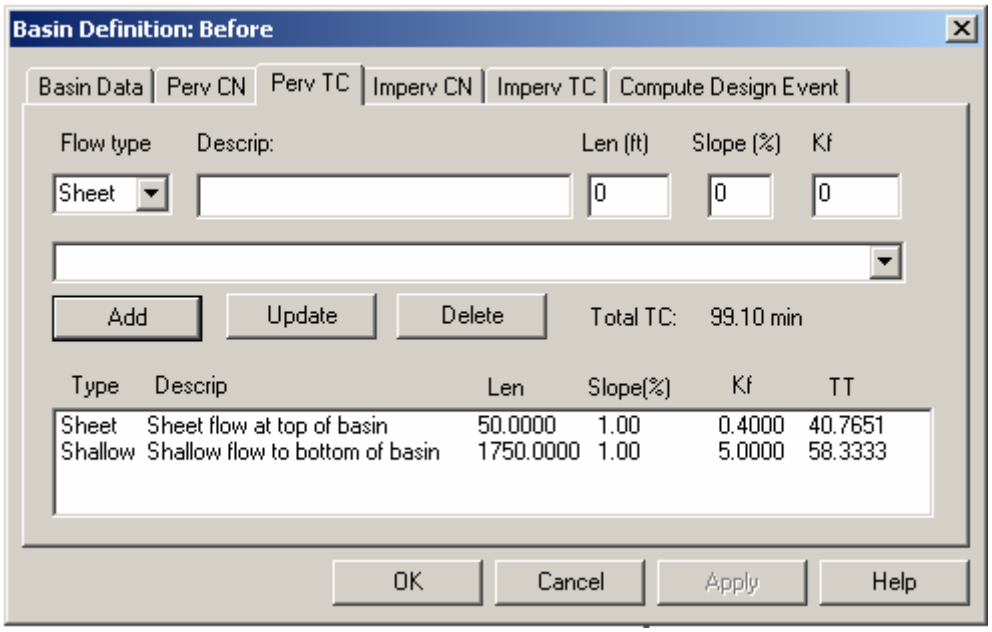


The Perv CN tab is where the pervious drainage basin area (DBA) is defined for both total area in acres and the Curve Number (CN). The CN value is derived from the TR55 Curve Number table in Appendix 4B of the 2004 HRM, as shown on the next page. Note there are CN tables for both eastern and western Washington, be sure to applicable table for your project.

Table 4B-3. Runoff curve numbers for selected agricultural, suburban and rural areas (eastern Washington).

Cover type and hydrologic condition	CNs for hydrologic soil group A	B	C	D
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.): [1]				
Poor condition (grass cover <50% of the area)	68	79	86	89
Fair condition (grass cover on 50% to 75% of the area)	49	69	79	84
Good condition (grass cover on >75% of the area)	39	61	74	80
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Porous Pavers and Permeable Interlocking Concrete (assumed as 85% impervious and 15% lawn):				
Fair lawn condition (weighted average CNs)	95	96	97	97
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, Grassland, or Range-Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Cultivated Agricultural Lands:				
Row Crops (good) e.g. corn, sugar beets, soy beans	64	75	82	85
Small Grain (good) e.g. wheat, barley, flax	60	72	80	84
Meadow (continuous grass, protected from grazing and generally mowed for hay):	30	58	71	78
Brush (brush-weed-grass mixture with brush the major element):				
Poor (<50% ground cover)	48	67	77	83
Fair (50% to 75% ground cover)	35	56	70	77
Good (>75% ground cover)	30[2]	48	65	73
Woods - grass combination (orchard or tree farm): [3]				
Poor	57	73	82	86
Fair	43	65	76	82
Good	32	58	72	79

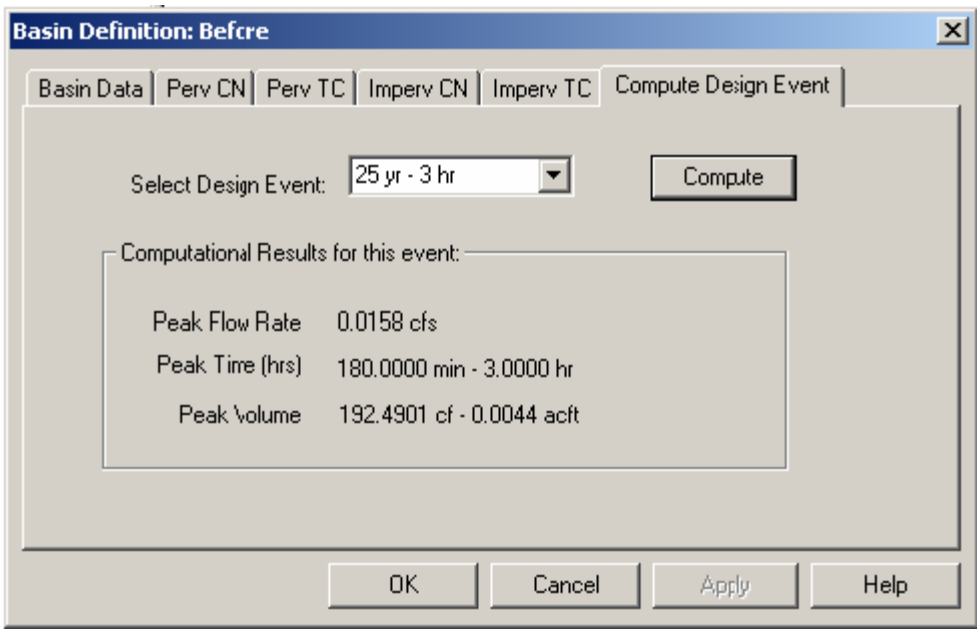
Defining the Time of Concentration (TC) is the next step for the pervious surface.



Example Basin

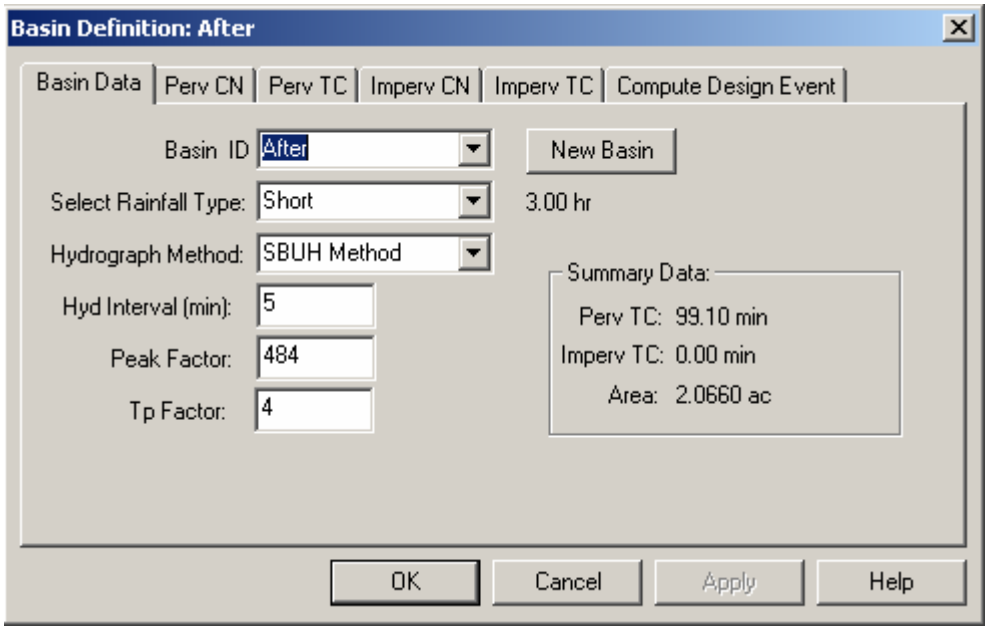
Each flow path must be defined in the basin. For this example we were told we had **50ft** for **sheet flow** on a **1%** and the land cover type is a **fair forest** condition. Thus when defining the Kf value for the sheet flow, select **wood or forest with light under brush, with the pull down arrow.** The second type of pervious flow is **shallow** for a length of **1750ft at** a **1%** slope. Select **brushy ground with some trees** for the ns value.

Since the before conditions of this basin do not have impervious surface, there next two Imperv tabs should be blank. The last tab, Compute Design Event, will quickly compute a flow rate and volume based on the pervious basin characteristics.

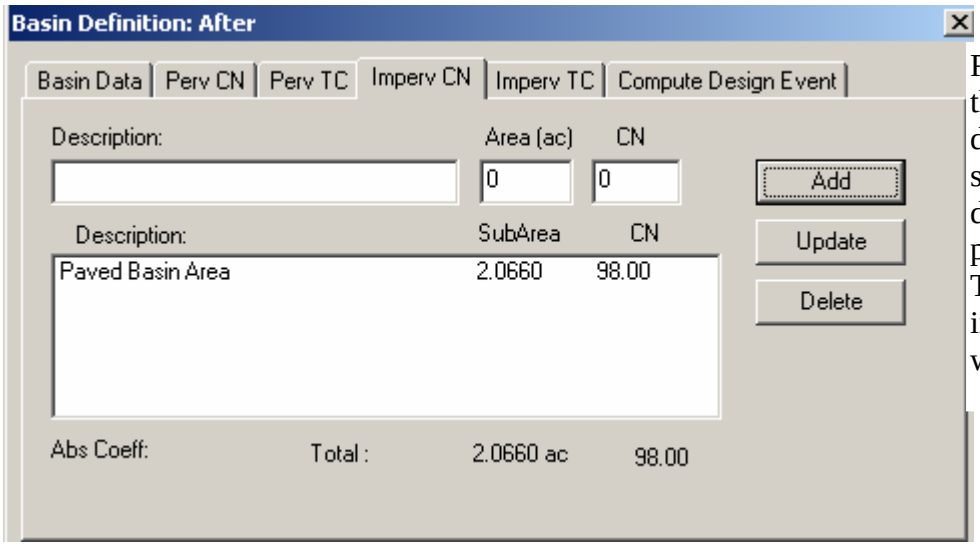


Now, input the After drainage basin site conditions that were defined back on page 11 (impervious roadway with curb and gutters). Again, first click on the New Basin Radio button, to create a new basin and then name it After.

Example Basin



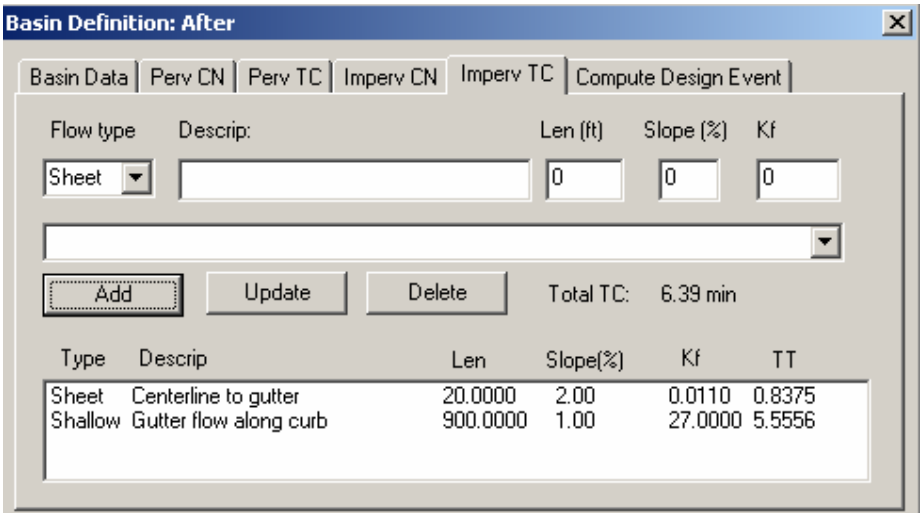
The basin rainfall type for conveyance design is the **Short** Duration 3hr storm for Eastern Washington. The hydrograph method can be either the **SBUH** or SCS Method, however; the hydrograph interval time needs to be changed to **5minutes** instead of 10 minute default. The change is due to the duration of the high intensity portion of the storm may last from 5minutes to 30 minutes with a total duration typically ranging less than an hour to several hours.



Remember to go through each tab and delete the Perv Calc., since the After basin does not have any pervious surface. The CN value for impervious surface will always be 98.

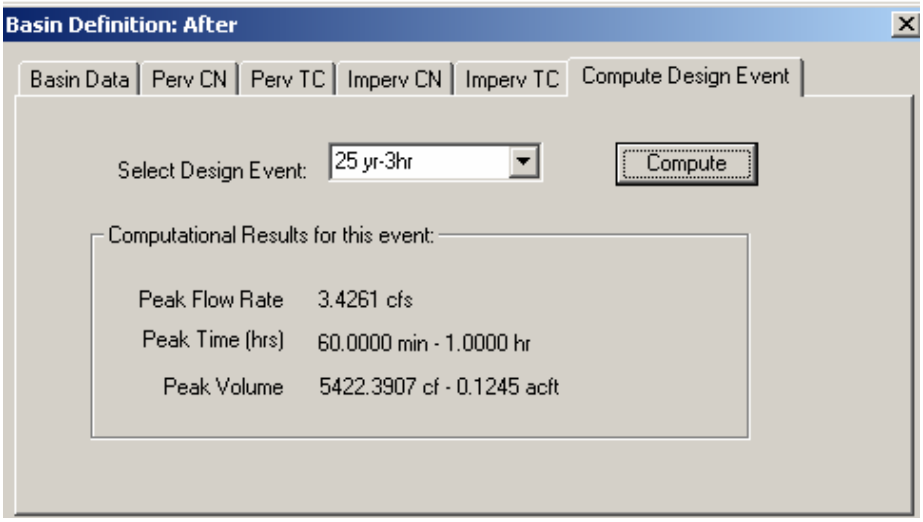
Defining the Time of Concentration (TC) is the following step for the impervious surface.

Example Basin



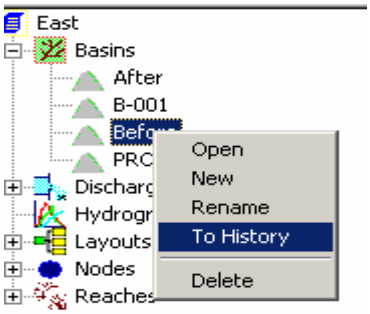
Each flow path must be defined in the impervious basin. For this example we were told we had **20ft** for **sheet flow** on a **2%** and the land cover type is a **paved** condition. Thus when defining the Kf value for the sheet flow, we will select is a **smooth surfaces, with the pull down arrow.** The second type of flow we have on the pervious site is **shallow** for a length of **900ft** on a **1%** slope and we will select**, paved and gravel areas** as the ns value.

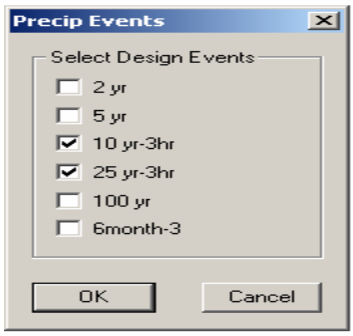
The last tab, Compute Design Event, will quickly compute a flow rate and volume based on the impervious basin.



Once information for each basin is entered, the designer will need to provide this information in the hydraulic report. The designer can send this information to the History View and then copy it into the hydraulic report word document. This can be done by clicking on the RMB on each basin and clicking on the To History option with your left mouse button. A dialog box asking which design event you want will appear.

Example Basin





Check the design event you would like a report on and the record will be copied into the History View. These steps need to be repeated for each additional design event desired. The following information should appear in the project History View.

Before Event Summary:

BasinID	Peak Q	Peak T	Peak Vol	Area	Method	Raintype	Event
-------	(cfs)	(hrs)	(ac-ft)	ac	/Loss		
Before	0.00	3.00	0.0007	2.07	SBUH/SCS	Short	10 yr - 3 hr
Before	0.02	3.00	0.0044	2.07	SBUH/SCS	Short	25 yr - 3 hr

Drainage Area: Before

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	3.00 hrs		Intv:	5.00 min
	Area	CN	TC	
Pervious	2.0660 ac	76.00	1.65 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	2.0660 ac			

Supporting Data:

Pervious CN Data:

Before Construction	76.00	2.0660 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Sheet flow at top of basin	50.00 ft	1.00%	0.4000	40.77 min
Shallow	Shallow flow to bottom of basin	1750.00 ft	1.00%	5.0000	58.33 min

After Event Summary:

BasinID	Peak Q	Peak T	Peak Vol	Area	Method	Raintype	Event
-------	(cfs)	(hrs)	(ac-ft)	ac	/Loss		
After	2.63	1.00	0.0948	2.07	SBUH/SCS	Short	10 yr - 3 hr
After	3.43	1.00	0.1245	2.07	SBUH/SCS	Short	25 yr - 3 hr

Drainage Area: After

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	3.00 hrs		Intv:	5.00 min
	Area	CN	TC	
Pervious	0.0000 ac	76.00	0.00 hrs	
Impervious	2.0660 ac	98.00	0.11 hrs	
Total	2.0660 ac			

Supporting Data:

Impervious CN Data:

Paved Basin Area	98.00	2.0660 ac

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Centerline to gutter	20.00 ft	2.00%	0.0110	0.84 min
Shallow	Gutter flow along curb	900.00 ft	1.00%	27.0000	5.56 min