Introducing Storm&Sanitary

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Goals:

- Provide a streamlined but thorough conceptual introduction to the primary Storm&Sanitary workflow.
- Segregate the user's steps from the narrative, so that the "button-pushing" can be performed during a 90-minute workshop.
 1. User steps begin with a number and are border with horizontal lines.

Note: this lab is quick and dirty, aimed at getting the user to "push buttons" in the most basic workflow. For a full, integrated, Good Technique/Good Results Training Manual, see http://civilxlr8.com/Mastering_SnS.htm

Section 1 Storm&Sanitary: Getting Started

Launching S&S

1. Select Start>Programs>Bentley Civil Engineering>InRoads Storm&Sanitary
2. In your CAD program select the following file:
   MicroStation: C:\training\SnS_2002\data\SnS_2002.dgn
   AutoCAD: C:\training\SnS_2002\data\SnS_2002.dwg

Your CAD file should look something like the screenshot below:
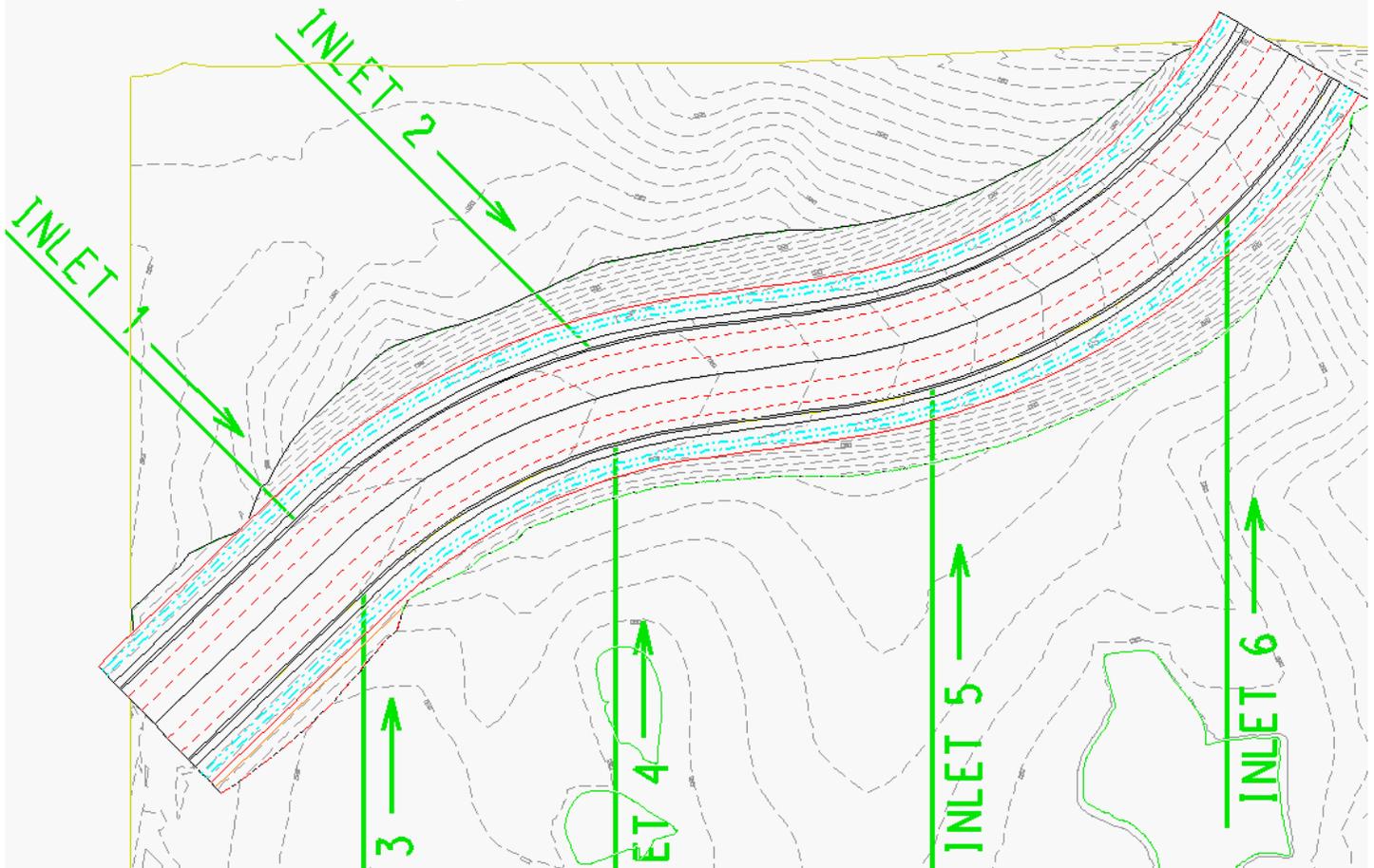
The file should be empty, with all the information in reference files.

Setting Project Defaults

This step helps manage the files. "Project Defaults" is a good QA/QC tool.

3. Select InRoads>Project Defaults…	

This form is used to automatically load the primary settings file and to set project default directories.

If "SnS_2002" is not listed under "Configuration Name, then:

- Click the New… button.
- Key in "SnS_2002", Hit OK.
- Place your cursor in the Preferences (*.ini) field, then click the Browse button.
- Select the following file:
  C:\training\SnS_2002\data\sns02_dgn_xl.ini

- Place your cursor in the "Project Default Directory" field, then hit the Browse button.
  Select the project directory:
  C:\training\SnS_2002\data
- Repeat for all the Directory paths.
- Hit Apply.
- Close the form.

4. Click on the Configuration Name listbox.
5. If "SnS_2002" is listed, Select it.
6. Hit Apply.
7. Close the form.

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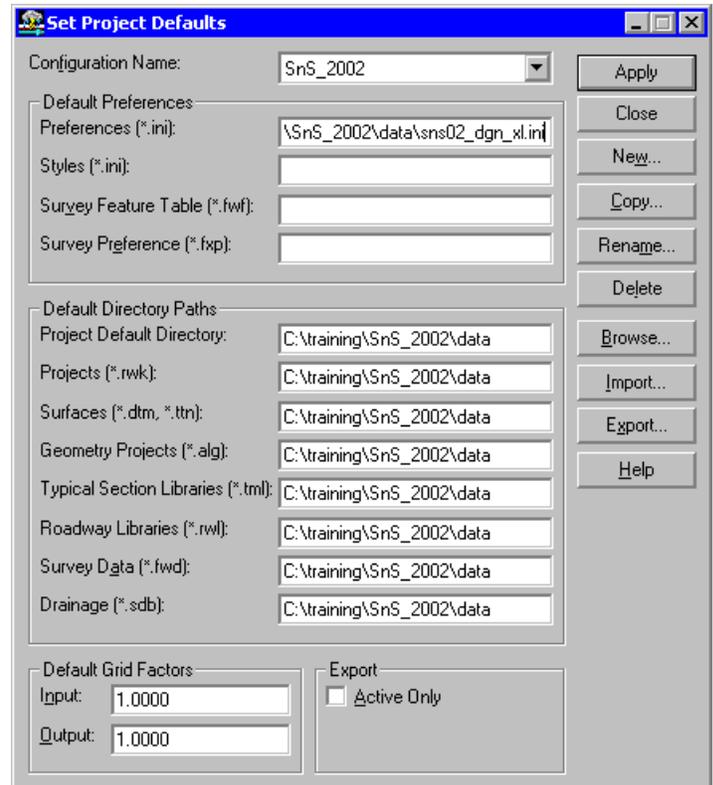
Loading the Data files

8.	Select InRoads>File>Open
9.	In the Open form, make sure the "Files of type" box lists "Projects (*.rwk).
10.	Select the Project file "sns_biuc02.rwk"
11.	Hit Open.

If "sns_biuc02.rwk" is not visible, verify that you are in the correct directory and that the "Files of type:" listbox displays "Projects (*.rwk)"

12.	Close the form.
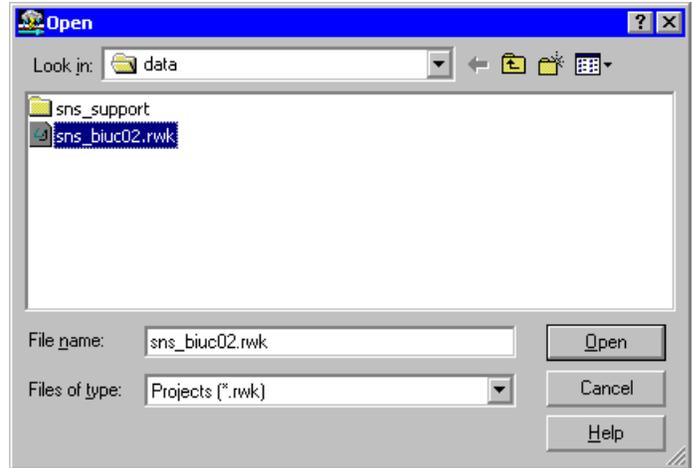
The .rwk file is a text file listing other files for S&S to load. In this case, "sns_biuc02.rwk" loads a Surface (*.dtm), a Geometry Project (*.alg) and a Drainage database (*.sdb)

Section 2 Laying Out Structures

Laying Out Curb Opening Inlets

13.	Select InRoads>Drainage>Lay Out

The Drainage Lay Out form is invoked.

From this form, all Drainage structures, [Drainage] Areas, and [Sanitary] Zones are Created.
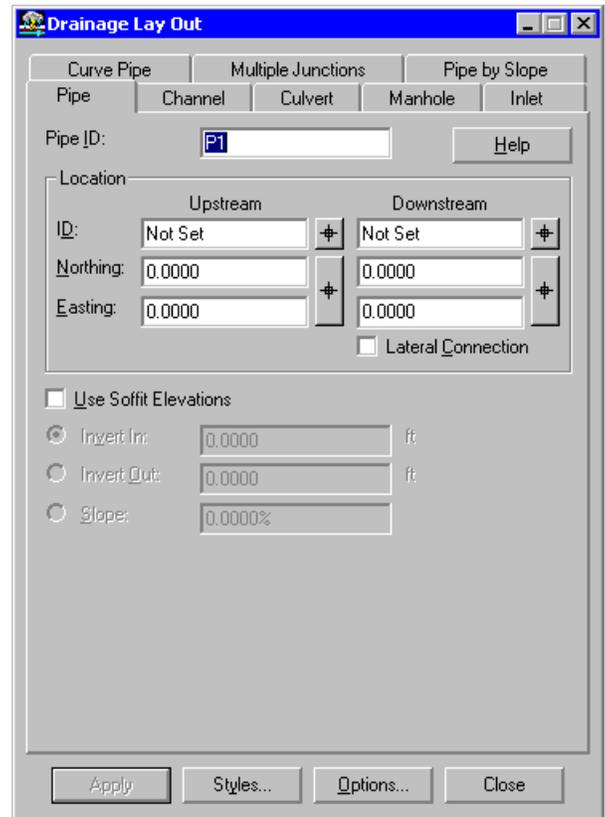
14.   Click on the "Inlet" tab.

The Lay Out form contains controls for those structure properties that change for every structure, . More "permanent" properties can be checked and set from the "Options" button at the bottom of the form.

It is good QA\QC to check the Options before placing new structures (while making changes is easy, it is saves time to verify before placing).

15.   Click on the Options button.
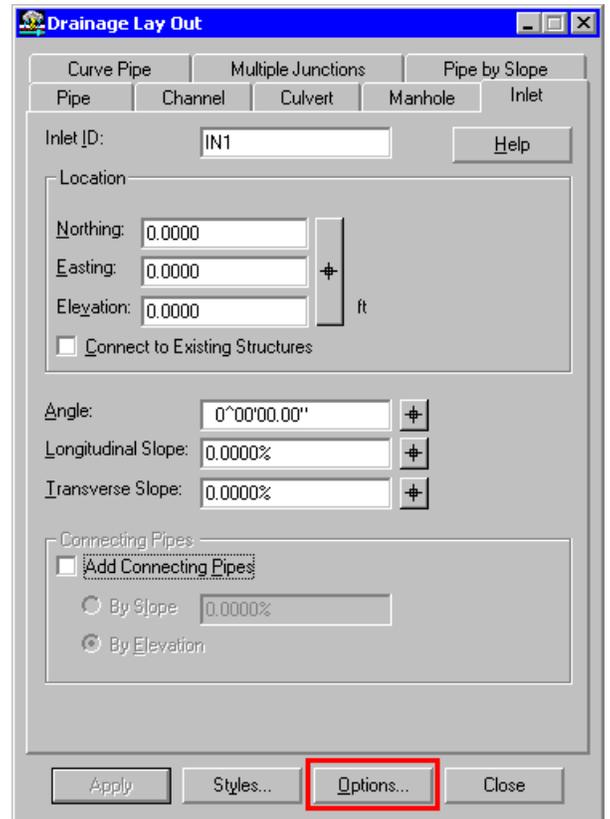
These are some of the less "volatile" of the settings available for Inlets. These settings tend not to change for every structure placed. Examples can be Inlet Types or Pipe Size.

(Information that rarely changes tends to be stored in external support files. Material tables, zoning densities and Intensity-Duration-Frequency tables are an example).

Note: Storm&Sanitary recognizes five different Inlet Types.

16.   Close the Drainage Options form.
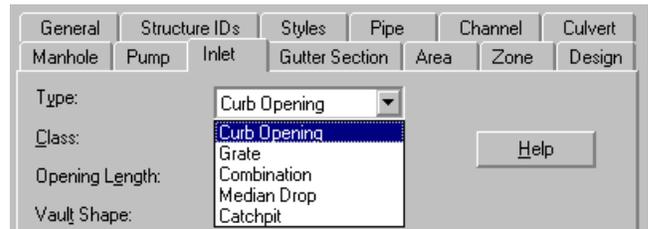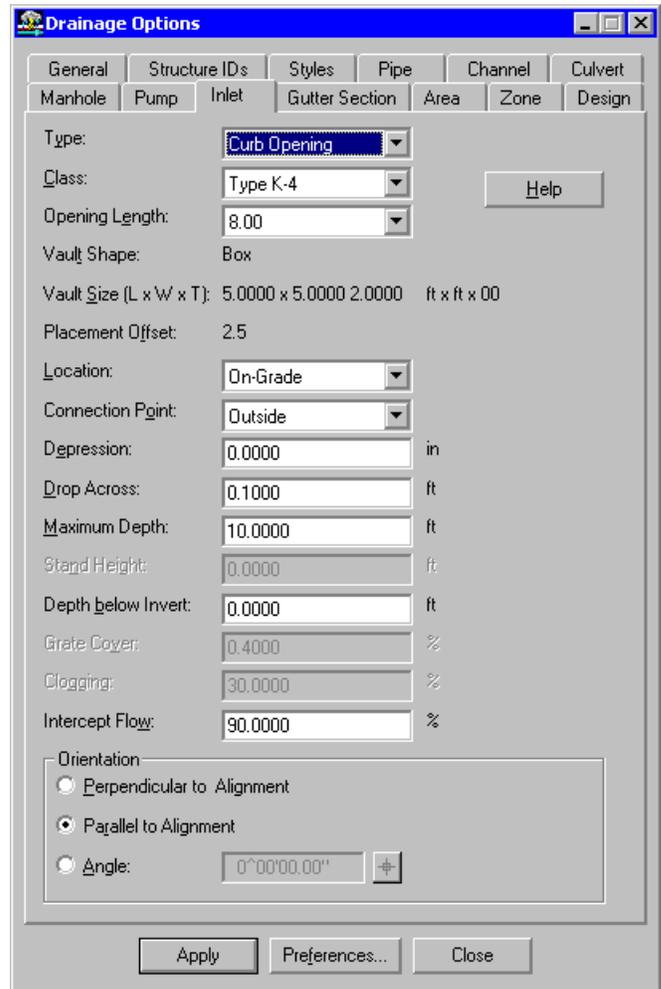
The Lay Out form (as well as many of the forms in InRoads and Storm&Sanitary) has controls called Target buttons which are used to get information from the CAD package.

One of the properties that changes for every structure is the Location. The Northing, Easting and Elevation can be keyed in or the adjacent Target buttons can be used to get the coordinates from the CAD package. CAD Snaps/Osnaps can be used for precise input.

Upon pressing a Target button, the form is minimized so as to minimize the form's interference with the CAD view. Upon selecting a location or object within the CAD file (using the CAD package procedure, including snaps and "verification") the form returns with the information from the CAD package.

Some Target buttons are adjacent to fields which require additional steps within the CAD package. For example, the Angle Target button requires two points be placed within the CAD package, the angle being calculated from those two points.
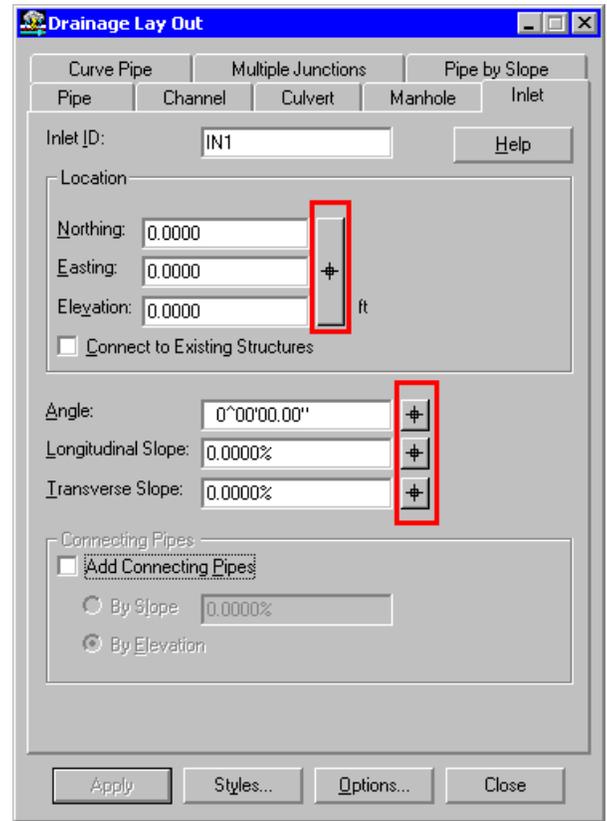
We will now place a Curb Opening Inlet along the curb of the road.

| 17.	Hit the Target button next to the Northing, Easting and Elevation fields.

The form is minimized.

18.	Snap to the end of the line labeled "INLET 1".
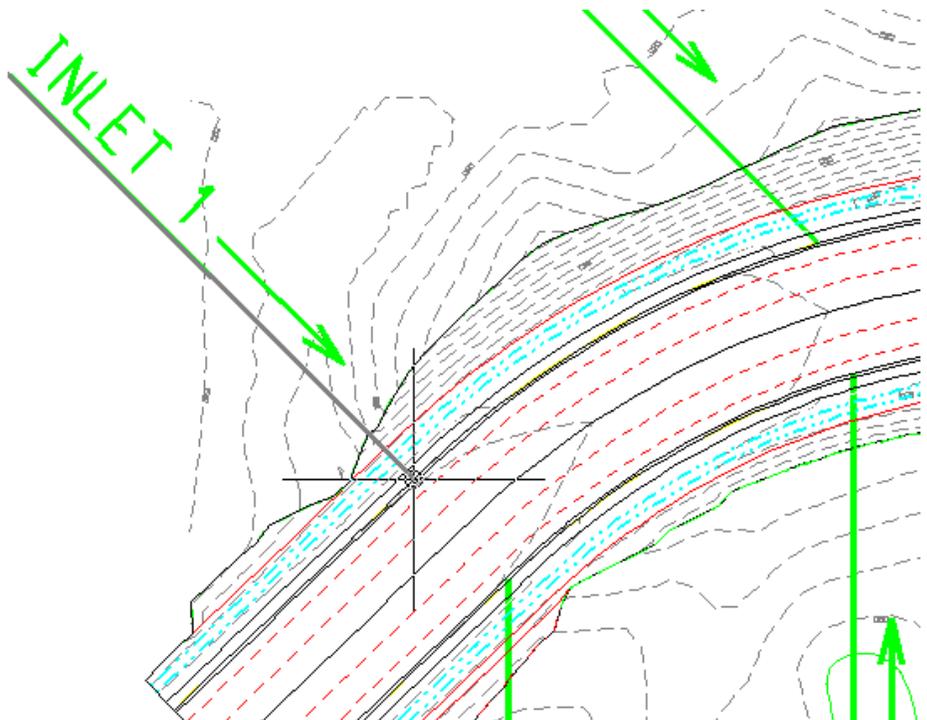
The form is restored, with Northing, Easting, and Elevation information from the CAD package. Elevation is derived from the active surface at the Northing, Easting coordinate.

Additional information is also available for review or editing.

19.	Hit Apply to Create the Inlet.
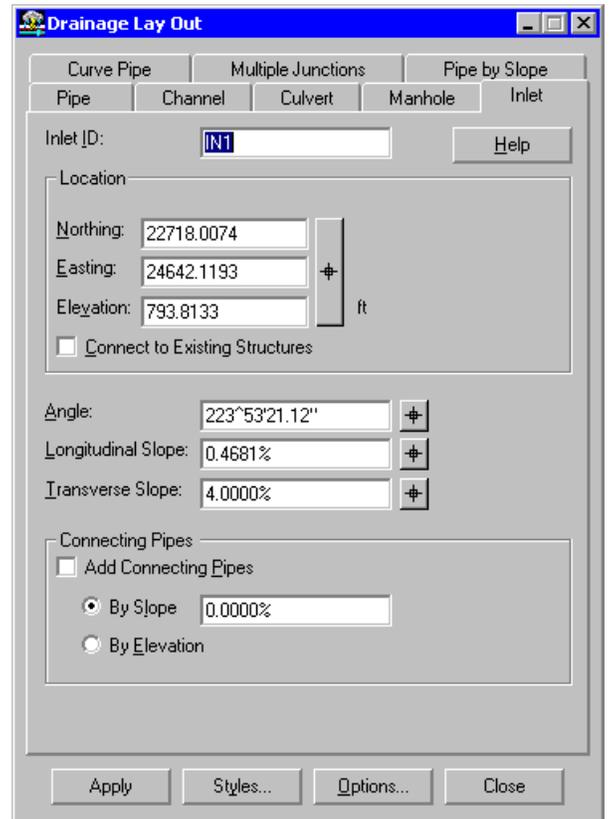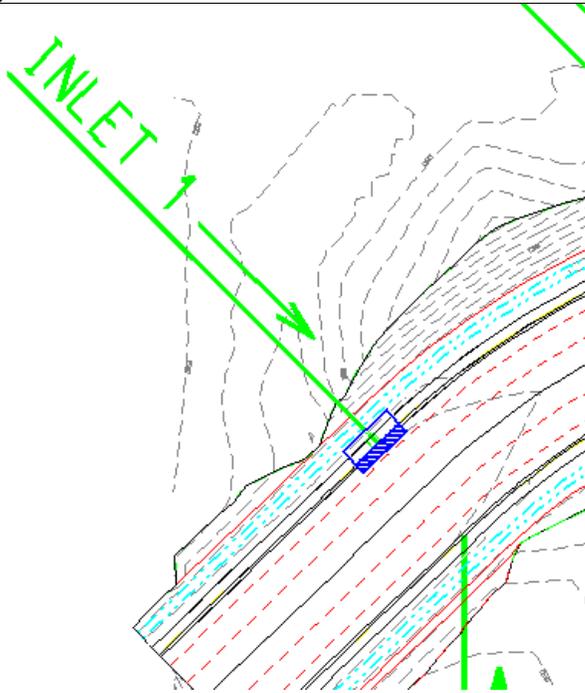
The inlet is placed and the form is ready for the next structure.

20.	Hit the Target button next to the Northing, Easting and Elevation fields.
21.	Snap to the end of the "INLET 2" line.
22.	Hit Apply.
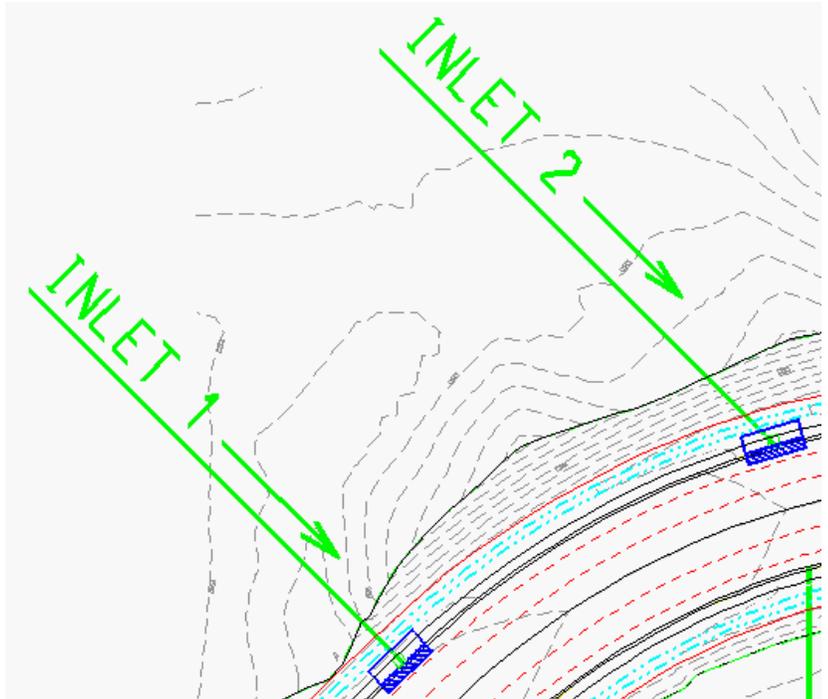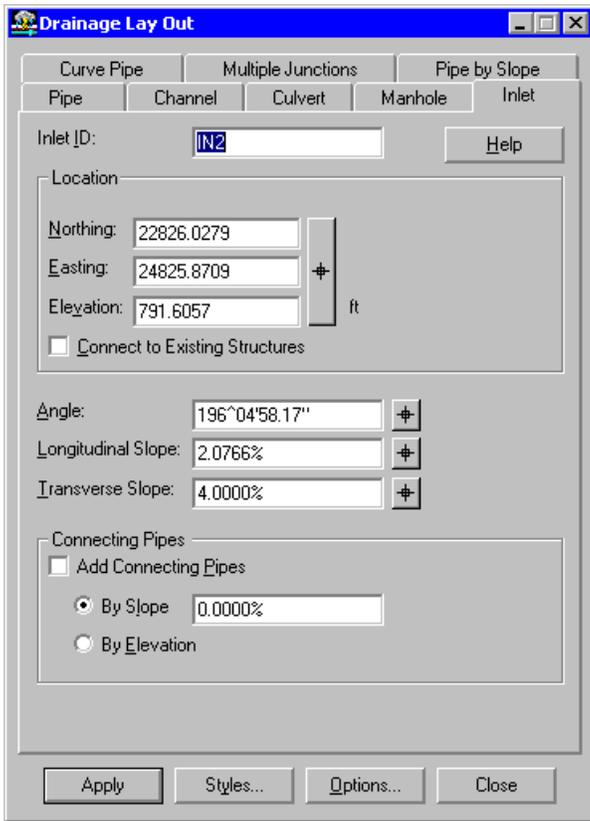
Laying Out a Pipe

Let's now Lay Out a Pipe between the Inlets

23.	Select the Pipe tab on the Drainage Lay Out form.

The Pipe Lay Out tab is similar to the Inlet tab, in that only the most essential input is required to place the pipe.

Like Inlets, the Location of the pipe, both Upstream and Downstream ends, is required for each pipe.

Note that there are Target buttons corresponding to Structure ID's and Northing's and Easting's.

Selecting a Target button next to an ID field tells S&S to look for an S&S Structure.

When selecting a Target button next to the Northing and Easting fields, S&S will ignore any structure and get only the coordinates of the data point. These are known as Free-Entrance or Free-Exit pipes (examples can be laterals or outfall pipes).

If, for example, you were to select the Target button next to the Upstream ID and then place a data point over an S&S structure, S&S would look for a Structure near the CAD data point. Finding one, it would reflect the Structure ID in the Upstream ID field. The Northing and Easting of the structure will also be echoed in the Northing and Easting fields.

If you were to select the Target button next to the Northing and Easting fields and place a CAD data point in the same location, even directly upon an S&S Structure, S&S would return ONLY the Northing and Easting. Because S&S is NOT looking for a structure, it will not find one. "FREE_ENT" or "FREE_EXT" will show in the ID fields.

For our lab, the flow direction is from Inlet1 to Inlet2; that is, Inlet1 is the UPSTREAM Inlet and Inlet2 is the DOWNSTREAM Inlet. Storm&Sanitary Lay Out is robust, but Upstream and Downstream are NOT interchangeable: it defines the flow direction and impacts how the system is networked.
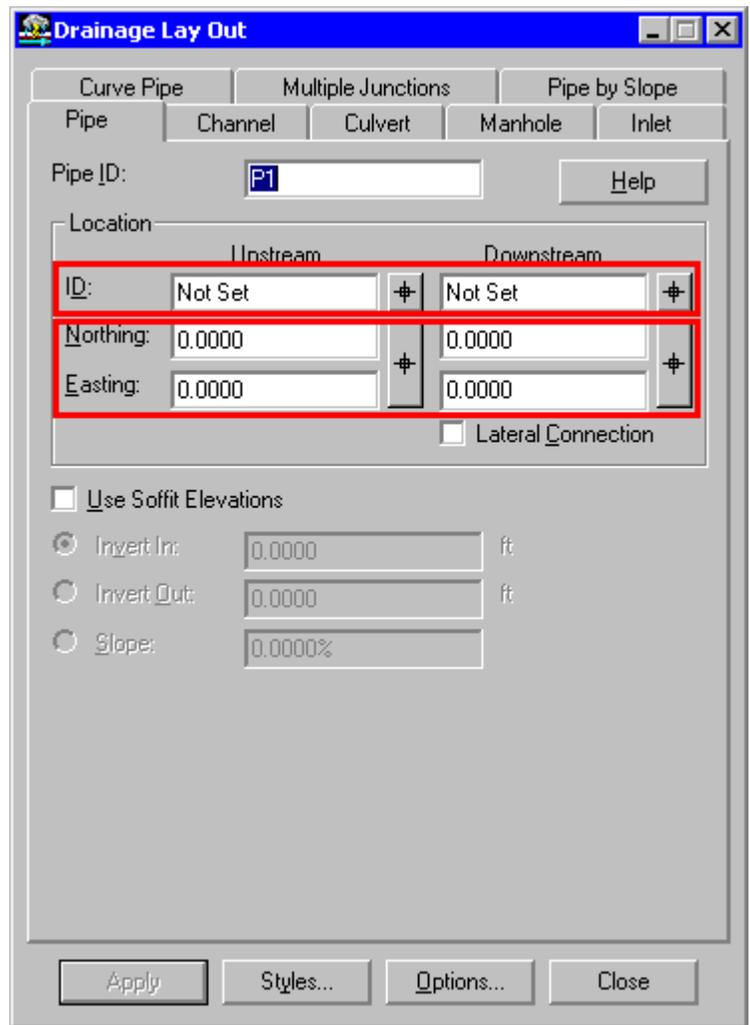
Before actually Laying Out the Pipe, it is a good idea to see what kind of pipe you are Laying Out.

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24.   Hit the Options button.

These are the active pipe settings. Unless we change any of the fields, we will be placing a 12" round Reinforced Concrete Pipe.

Notice that minimum and maximum design preferences can be set here. These numbers are used in calculating default invert elevations and other settings.

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25.   Close the Drainage Options form.

Drainage Options

Manhole | Pump | Inlet | Gutter Section | Area | Zone | Design
General | Structure IDs | Styles | Pipe | Channel | Culvert

Shape: Circular

Material: RC C76-A

Size (W x T): 12.00 x 1.7500

Minimum Slope: 0.1000%

Maximum Slope: 20.0000%

Minimum Cover: 6.0000 ft

Maximum Cover: 30.0000 ft

Help

Apply   Preferences...   Close

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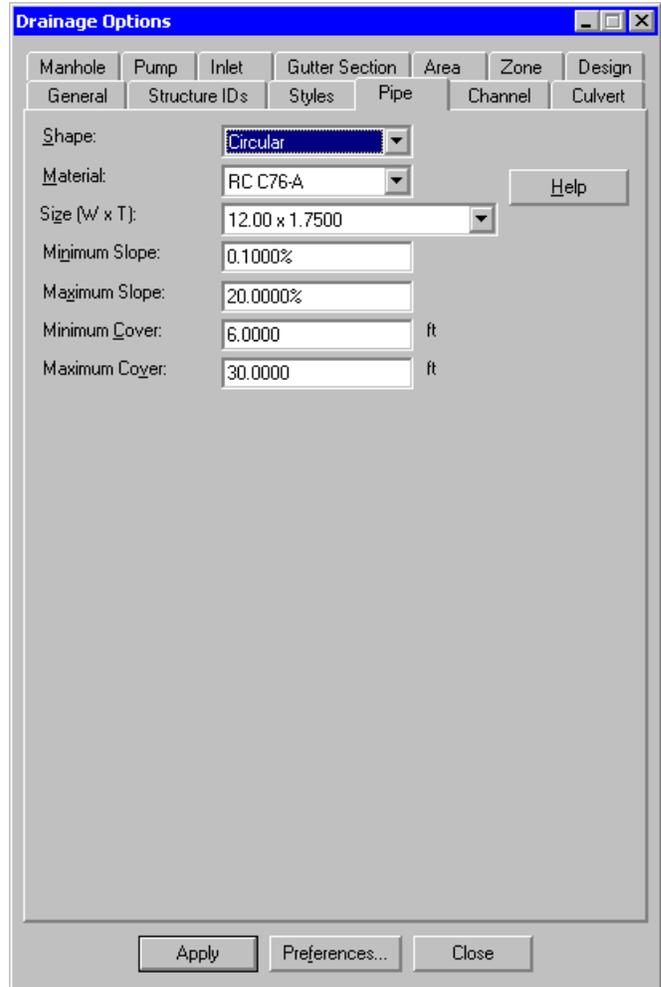
26. Select the Target button next to the Upstream ID field.
27. Place a data point on INLET1.
28. Select the Target button next to the Downstream ID field.
29. Place a data point on INLET2

As the Upstream and Downstream locations are selected, elevation and slope information is calculated from the Inlet elevations and the pipe Drainage Option settings.

Default Inverts and Slopes can be overwritten through the interface.

30. Hit Apply to Lay Out the Pipe.

Pipe1 is Laid Out and information in the form incremented to facilitate placing the next pipe.
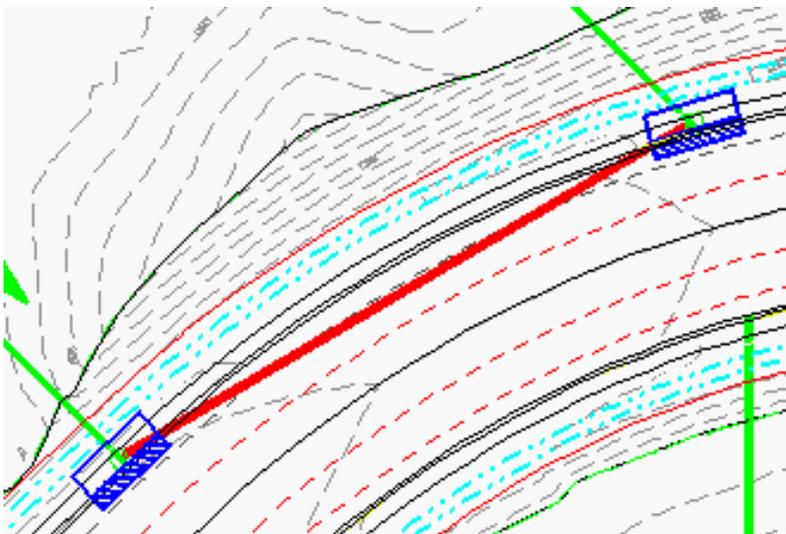
31. Close the Lay Out form.

Section 3 Editing/Reviewing, Displaying, and Deleting S&S Structures.

Editing/Reviewing S&S Structures

The first place to look for feedback is in the InRoads Explorer. For example, some of the Inlet information is displayed in the right "feedback" panel.
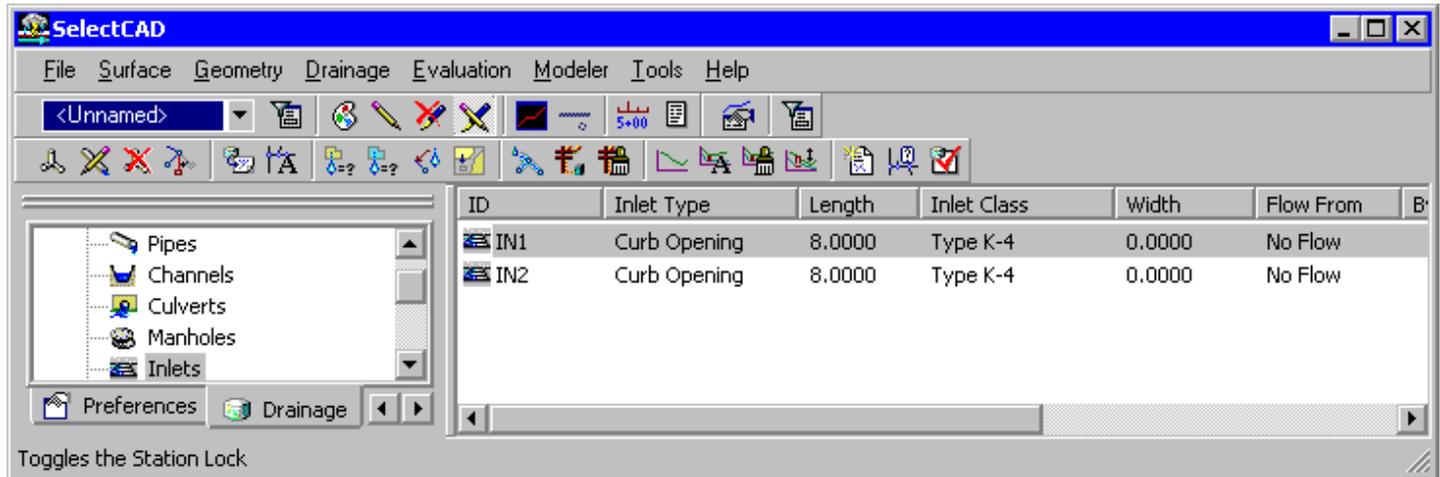
To review or edit detailed information of a structure,

32.   Select InRoads>Drainage>Edit/Review…

33.   At the "Key in ID or identify structure" prompt, Place a CADD data point on Inlet1

Once the structure is found, the Edit/Review Inlet form is displayed.

Information can be edited in this form.

Structure information is broken down by type. The first tab tends to be physical information about the structure. Information under other Tabs, such as Flow, will be blank until an appropriate time in the workflow, such as a Network Design.

Information for Pipe1 can be be found by selecting the Pipe in the CAD view or by hitting the "Edit Down…" button, which shows the information for the next structure downstream.

Hit Apply after making any changes.

1
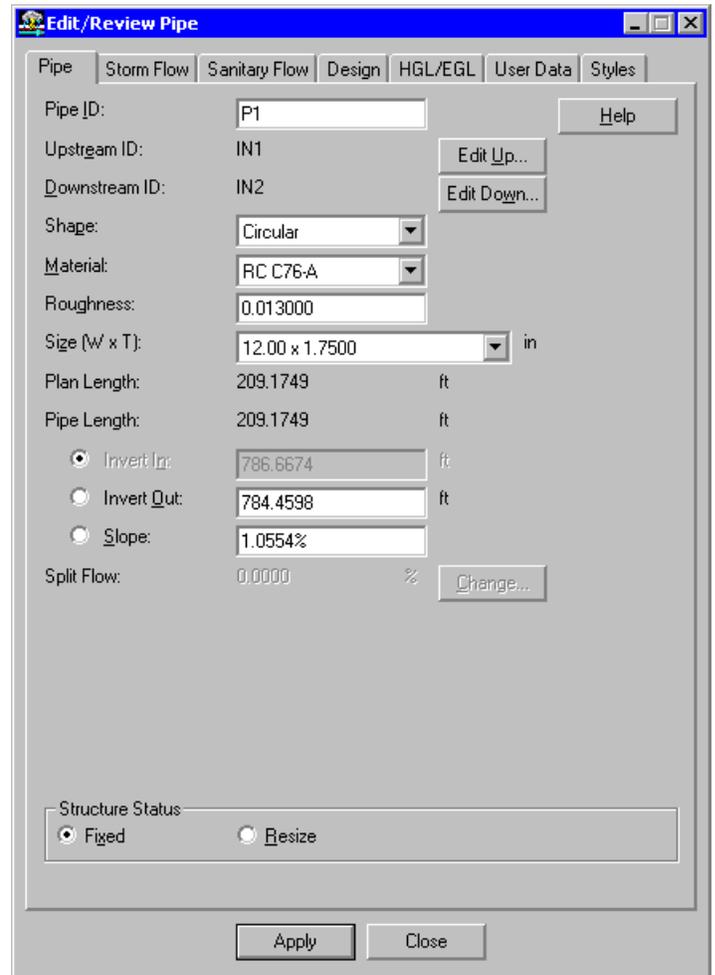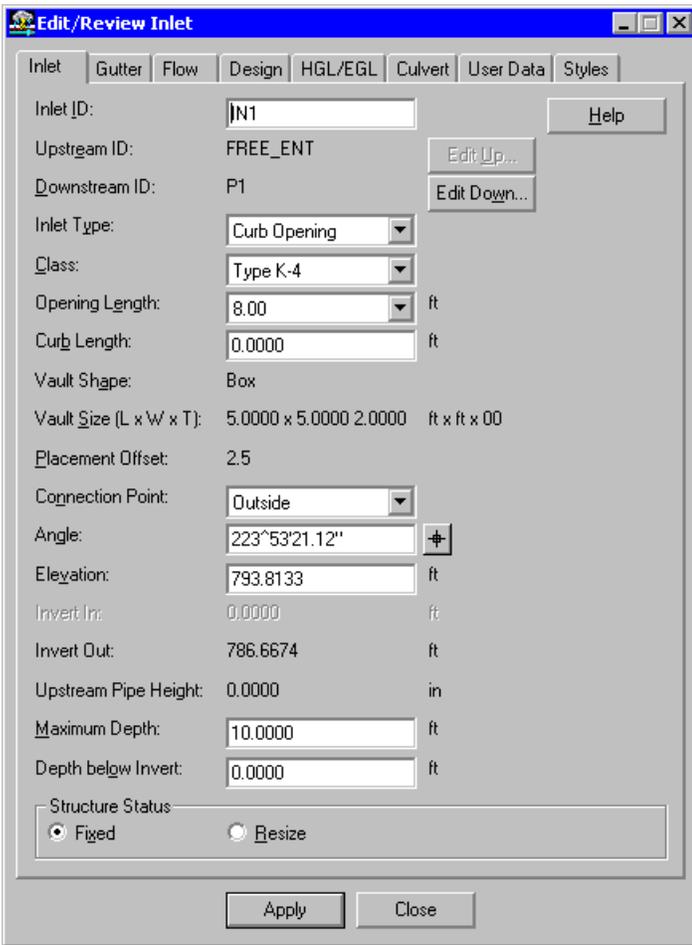
34.   Close the form when finished.

Displaying S&S Structures

Like most newer database systems, the S&S "database" record for a structure contains spatial information from which graphics can be displayed.

35.   Select InRoads>Drainage>View Drainage
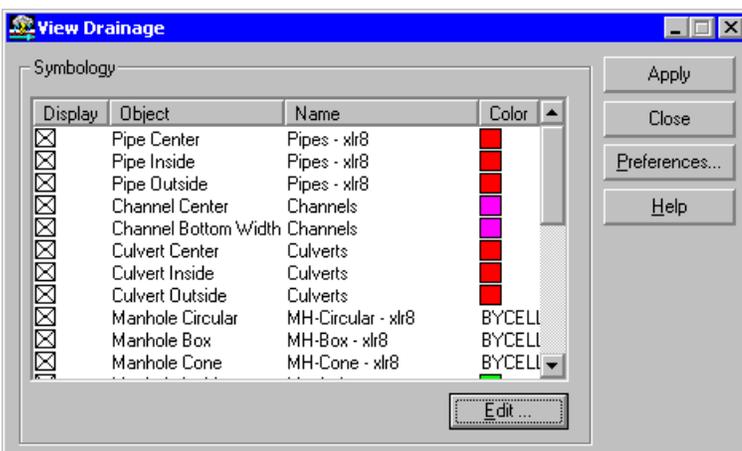
| 36. | Hit Apply to have the contents of the S&S database be displayed according to the settings defined in this form. |

While the WHERE comes from the data record, this form enables the user to set WHAT displays and HOW it is displayed. .For example, Pipes can be displayed any combination of center line, pipe wall interior, and pipe exterior. The Symbology settings for Circular Manholes is shown below. Junctions can be displayed as Cells/Blocks as well as a variety of other shapes.
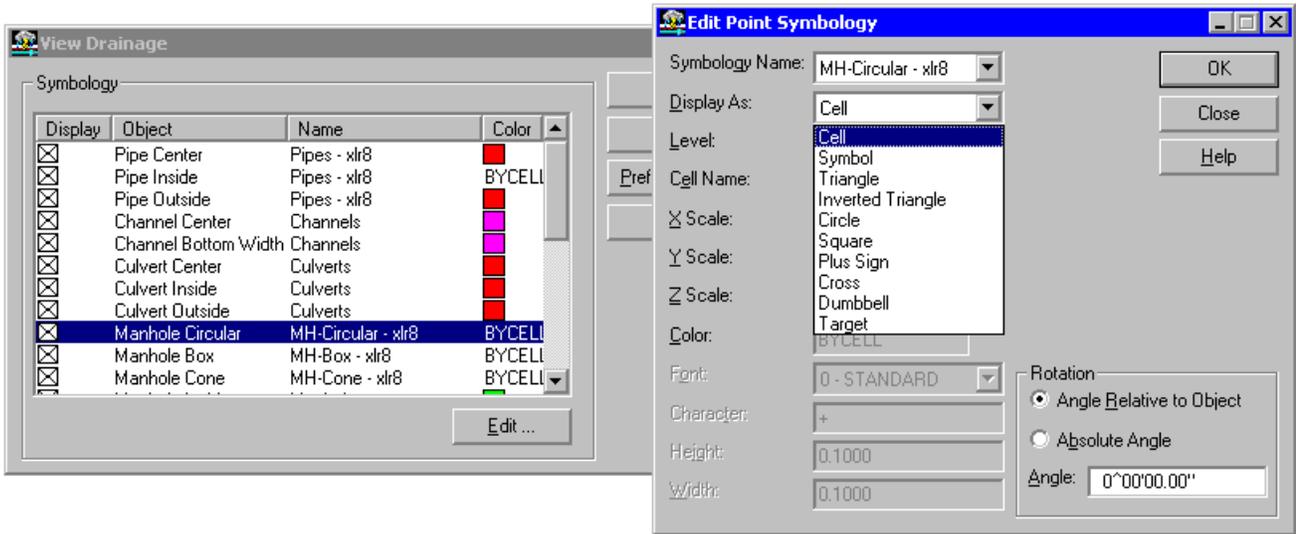
(Note: If the InRoads Style Lock is ON, the form is not invoked and the structures are displayed according to InRoads feature styles assigned to each structure, which may be different).

Deleting Structures

MicroStation and AutoCAD know little about Storm&Sanitary. Storm&Sanitary knows all about MicroStation and AutoCAD. Upon Laying Out a Structure S&S creates a database record and tells the CAD package to place a graphic. A CAD Delete/Erase command deletes ONLY the graphic, doing nothing to the information in the S&S database. Only an S&S Delete command will delete BOTH the graphic and the data record.

If a fence or region is active during this command S&S will prompt the user to confirm that all structures in the fence/region will be deleted.

| 37. | Use your CAD Delete/Erase command to delete one or more structures. |
| 38. | View the Drainage Structures using InRoads>Drainage>View>Drainage Command. |

Notice that the "deleted" structures reappear.

| 39. | Use InRoads>Drainage>Structure>Delete to delete one or more structures. |
| 40. | View the Drainage Structures using InRoads>Drainage>View>Drainage Command. |

Notice that the Deleted structures are gone.

Section 4 Laying Out More, Faster.

For this section we will do more of what we did in the earlier section, but more of it, faster.

We will use the "Add Connecting Pipes" function, which, during Inlet Lay Out, also Lays Out the pipes by a Keyed In Slope or by the active Pipe Drainage Options (minimum cover, etc.).

41.	Select InRoads>Drainage>Lay Out.
42.	Toggle the "Add Connecting Pipes" checkbox ON.
43.	Click the "By Elevation" radio button.
44.	Hit the "Location" Target button
45.	Snap to the top end of the line labeled "Inlet 3".
46.	Hit the Apply button.

 Inlet3 should be placed.

47.	Hit the "Location" Target button
48.	Snap to the top end of the line labeled "Inlet 4".
49.	Hit the Apply button. Inlet4 and Pipe 2 should be placed.

50.	Continue Placing Inlets 5 and 6.
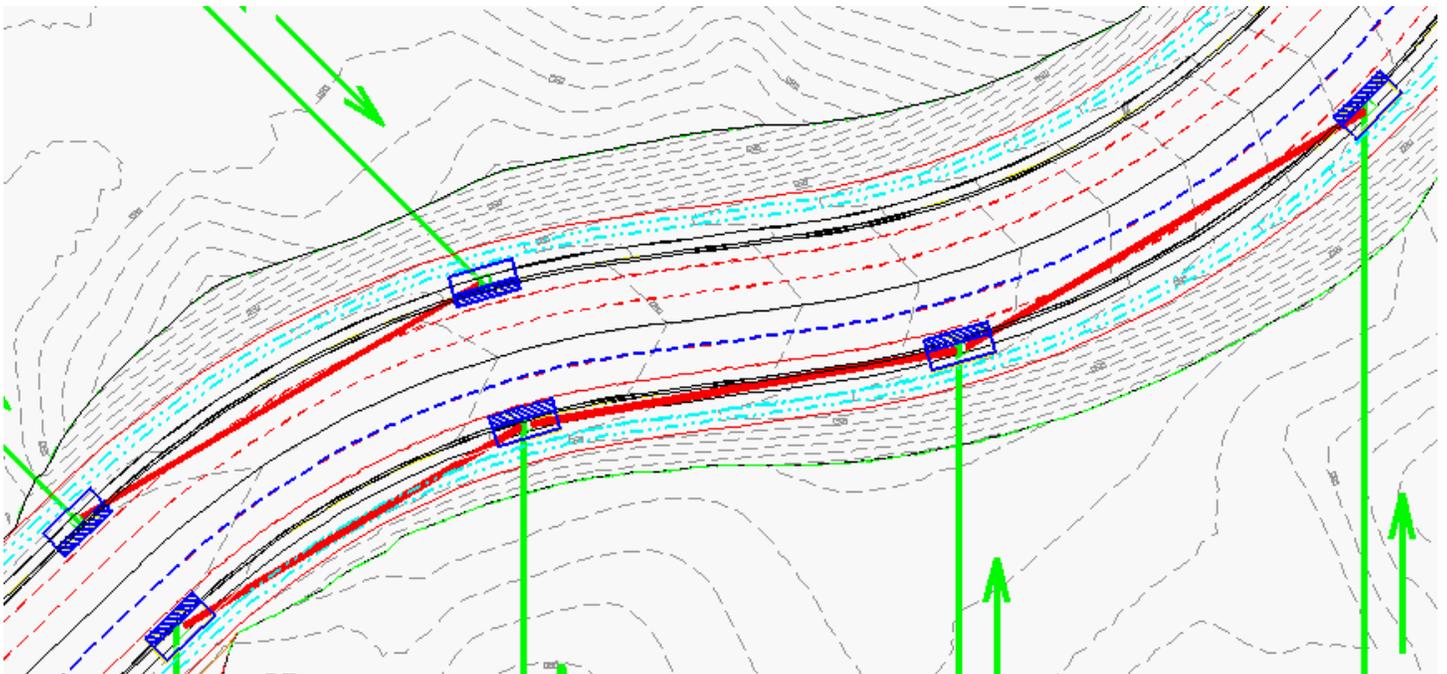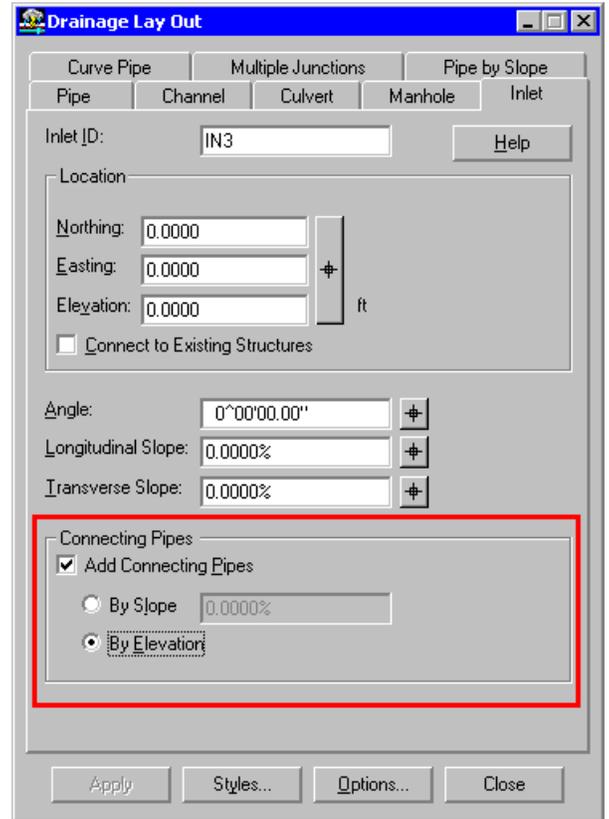
Section 5 Profiles

Let's take a look at the vertical information using the Profile command.
The S&S Profile functionality is a superset of the InRoads Profile functionality.

The S&S Profile form is identical to the InRoads Profile form with the addition of "Network" in the Source frame and the addition of the Network tab.

Profiles is EXTREMELY customizable. Hours can be spending exploring all the options. Typically, if there is something about the profile results that needs to be changed to meet your standards, there is a setting to change it.

On the Main tab, the Important settings are:
The Source, which should be set to "Network" in order to cut a profile along the network; and

The Symbology frames and the "Display" checkboxes which enable the Display of any of the surfaces.

The Network tab contains the Network Structures frame, where the beginning and ending of the profile is chosen and the Symbology frame, where the display of various structures, HGL, EGL and Branch Lines can be toggled ON or OFF.

Profiles can be run between any connected structures. It does not matter if the flow is uphill, downhill, or even changes directions.
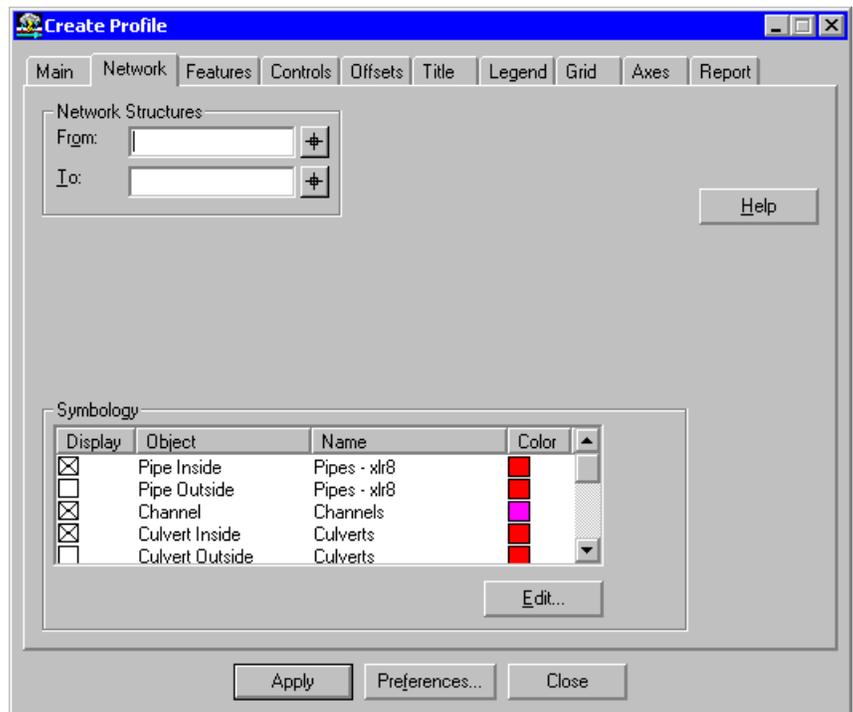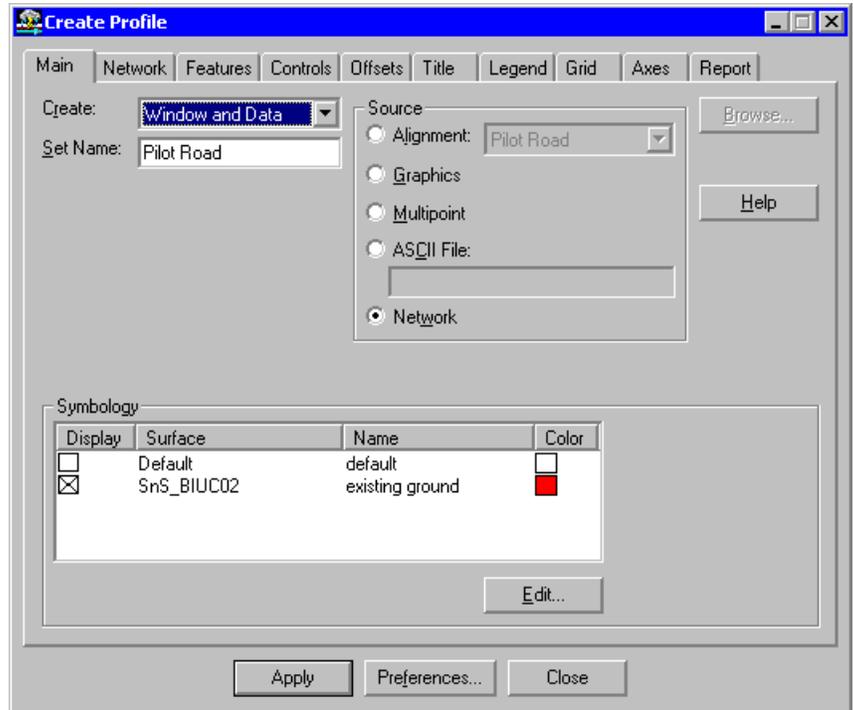
The Control tab contains two controls specific to S&S.

The Drainage Network Reference allows the user to specify whether to

- cut the Profile Along the Network or
- cut the Profile Along the Active Alignment (e.g., a Roadway Centerline) and project the Drainage Structures to it.

Manholes are displayed as prisms unless the "Display Manholes as Cones" checkbox is ON.
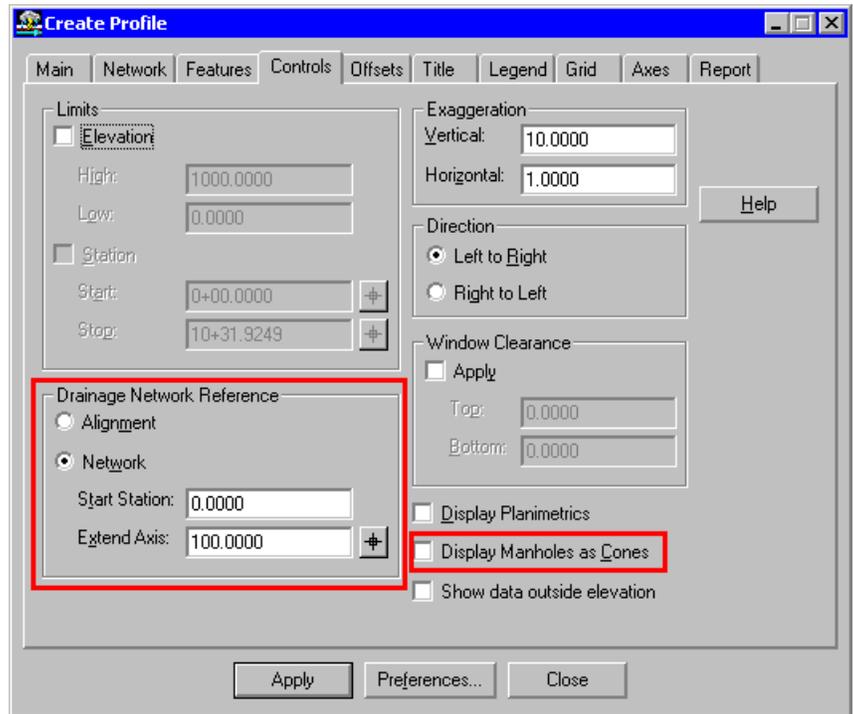
51.   Select InRoads>Evaluation>Profile>Create Profile…

52.   Select the Network tab.
53.   Select the Target button to the Right of the "From:" field.
54.   Select the Lower Left Inlet (IN3).
55.   Select the Target button to the Right of the "To:" field.
56.   Select the rightmost Inlet (IN6).
57.   Hit Apply.

The form is minimized.

58.   At the "Identify Location" prompt, select a location for the origin of the profile.

The profile is placed and the form returns.

59.   Close the form.
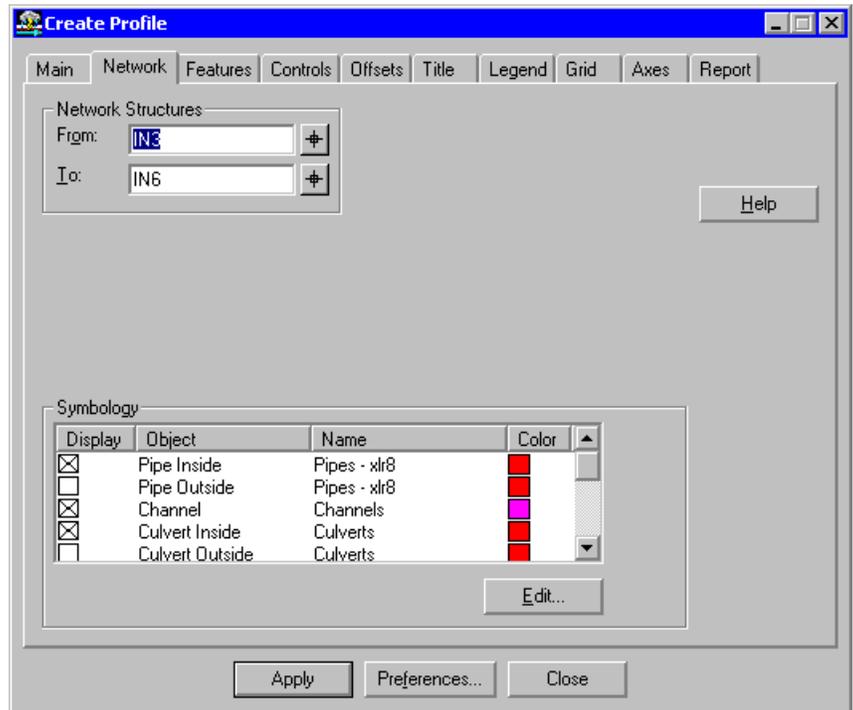
Remember: if you see something in the displayed profile that you would like to change or turn off, there is probably a setting for it. Hit the Help button for help.
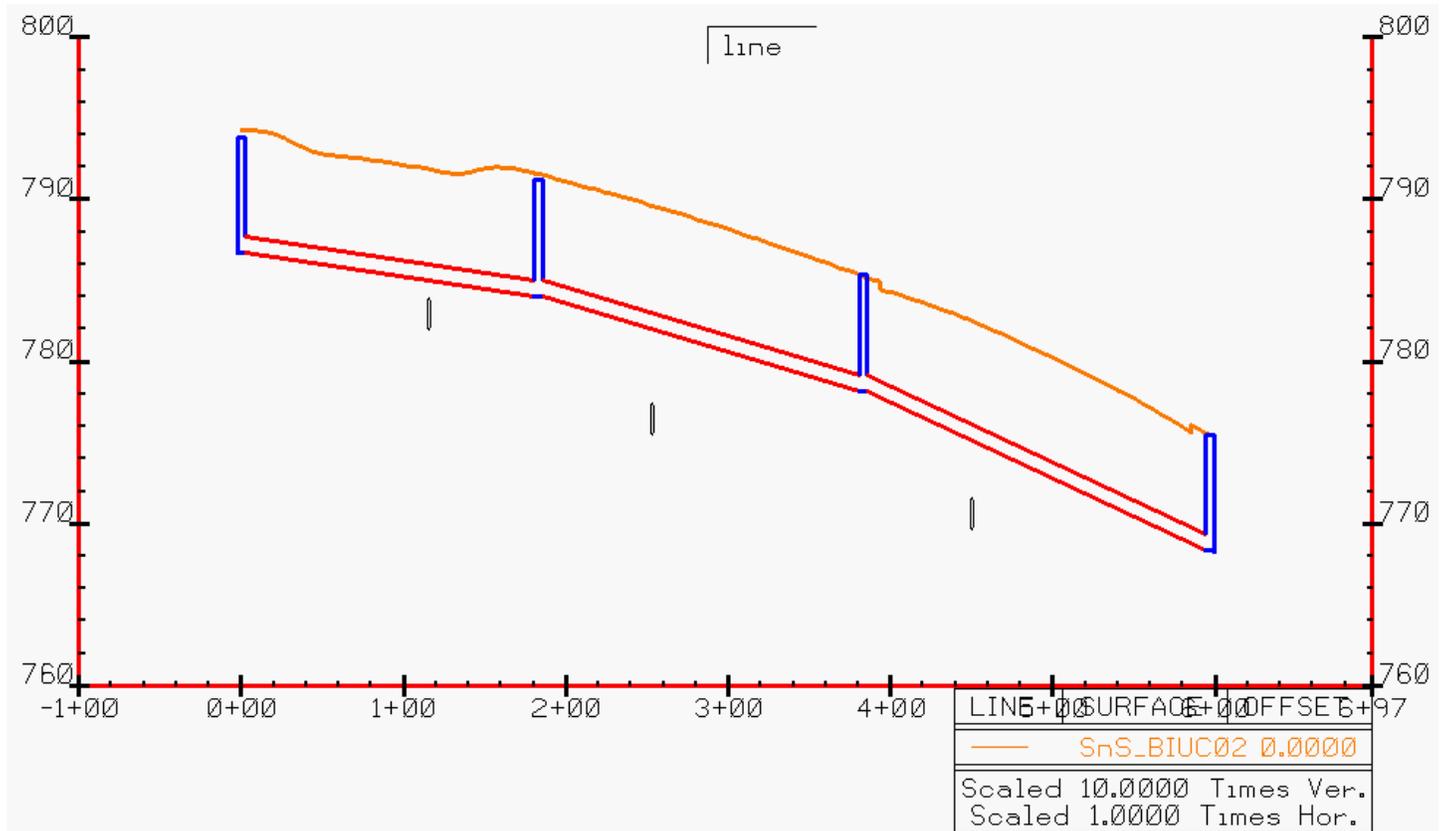
Section 6 Getting Flows into the System

A network is not much good without flows. Two things must be known about flows:

    HOW MUCH flow? And
    WHERE does the flow enter the system?

"How much?" is modeled in S&S in two ways: "known quantity" flows, modeled as "Injected Flows," and "area based flows". Injected flows are fixed quantities that never change throughout the number-crunching; Drainage "Area" and Sanitary "Zone" based flows can be adjusted (automatically by S&S) during computations. For example, drainage flow can be adjusted due to travel time in the system and sanitary flow can be attenuated due to decreasing population-based peaking factors.

Drainage "Areas" and Sanitary "Zones" can be calculated from MicroStation shapes or closed AutoCAD Polylines.

Given a Runoff Coefficient, intensity, and an area, a Flow can be computed and attached to a structure.

S&S has functions to calculate a composite runoff coefficient from weighting a number of areas (hit the Compute button to the right of the "Runoff Coefficient" field).

It also has functions to determine overland travel time (hit the Compute button to the right of the "Time of Concentration" field). Given a time of concentration, S&S reads an IDF table to compute the Intensity.

How Much? {

Where? ———➤

Compute Flow

Modified Rational | SCS Unit Hydrograph

Area ID: Astorm1   Help

Drainage Area : 0.0000   ⊕ ac

Runoff Coefficient: 0.60   Compute...

◉ Time of Concentration: 0.00   Compute... min

○ Intensity: 0.000   in/h

Peak Flow: 0.000   cfs

Attach To: [   ] ⊕

Options...   Apply   Close
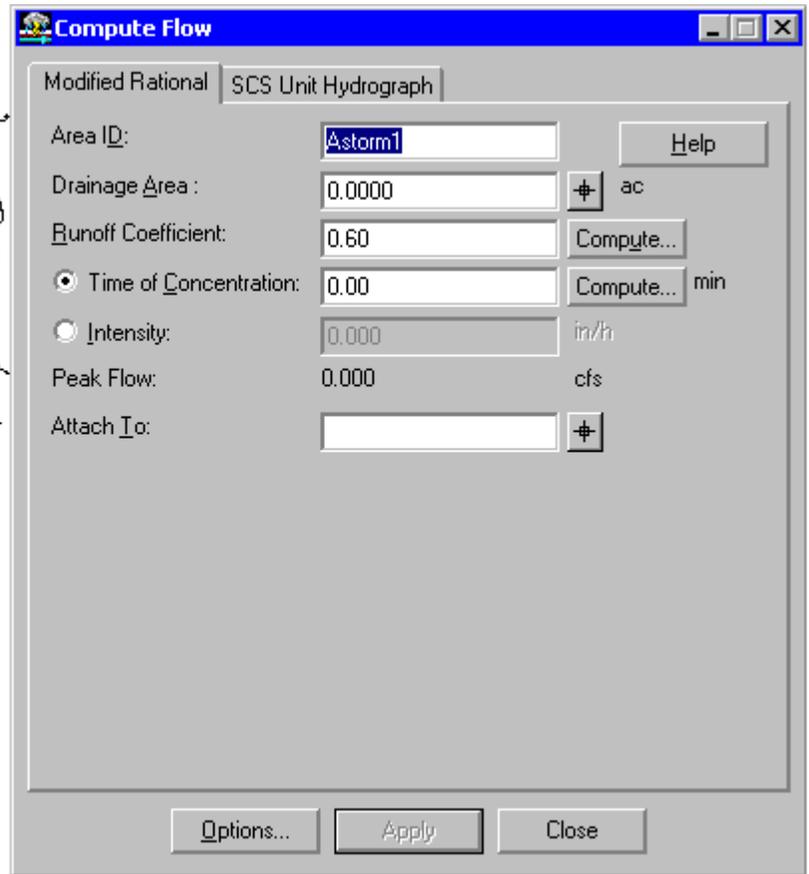
Area Flow

Let's Add some flow to our Network.
The road in the dataset is normally crowned and flows to the right. Let's assume that the drainage areas for the curb inlet are bounded by the centerline, curb line, and the positions of the inlets.

60.	Place a MicroStation shape or AutoCAD P-line to represent the drainage area as shown to the right (Key in "place shape" in the MicroStation key-in field).
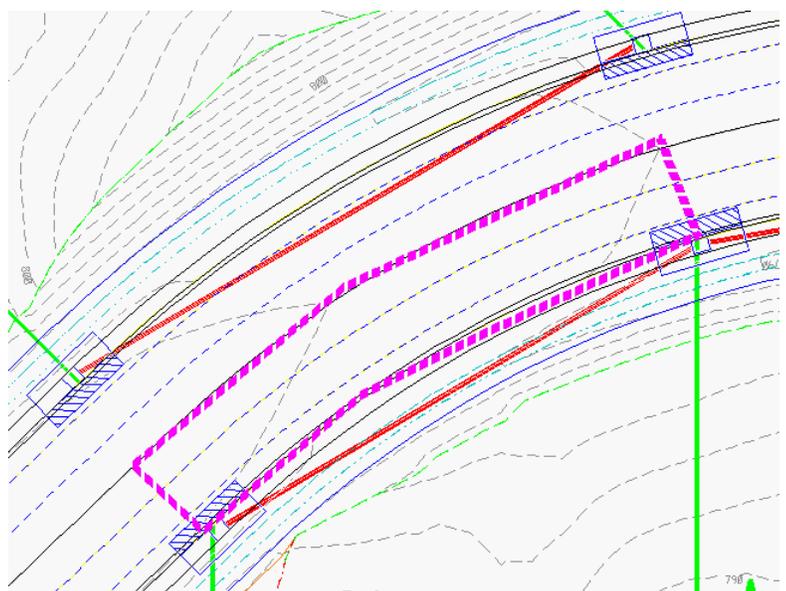
61.   Select "InRoads>Drainage>Flow>Compute Flow.

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62. Select the Target button to the right of the Drainage Area field.
63. Select the graphic shape placed in the previous step.

The area for the shape is calculated and appears in the Area field (like all S&S default values, this can be overwritten).

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64. Since the entire area is pavement, key in a Runoff Coefficient of "0.90"
65. Key in a Time of Concentration of "10" minutes. An intensity is calculated from an Intensity-Duration-Frequency

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Once a "c", an "i" and an "A" are defined, then a "Q" is calculated.

Now we define WHERE the flow enters the system.

Compute Flow

Modified Rational | SCS Unit Hydrograph

|		
Area ID:	Astorm1	Help
Drainage Area :	0.1458	✛ ac
Runoff Coefficient:	0.90	Compute...
⦿ Time of Concentration:	10.00	Compute... min
○ Intensity:	6.771	in/h
Peak Flow:	0.889	cfs
Attach To:		✛

Options... | Apply | Close

---

66. Select the Target button to the right of the "Attach To:" field.
67. Select the inlet the area drains to (the second inlet on the south side of the street).
68. Hit Apply.

Compute Flow

Modified Rational | SCS Unit Hydrograph

Area ID:	Astorm1	Help
Drainage Area :	0.1458	✛ ac
Runoff Coefficient:	0.90	Compute...
⦿ Time of Concentration:	10.00	Compute... min
○ Intensity:	6.771	in/h
Peak Flow:	0.889	cfs
Attach To:	IN4	✛

Options... | Apply | Close

A database record is created for Astorm1 and the form prepares for the next area, by incrementing the "Area ID" and blanking out the "Drainage Area" and "Attach To:" fields.
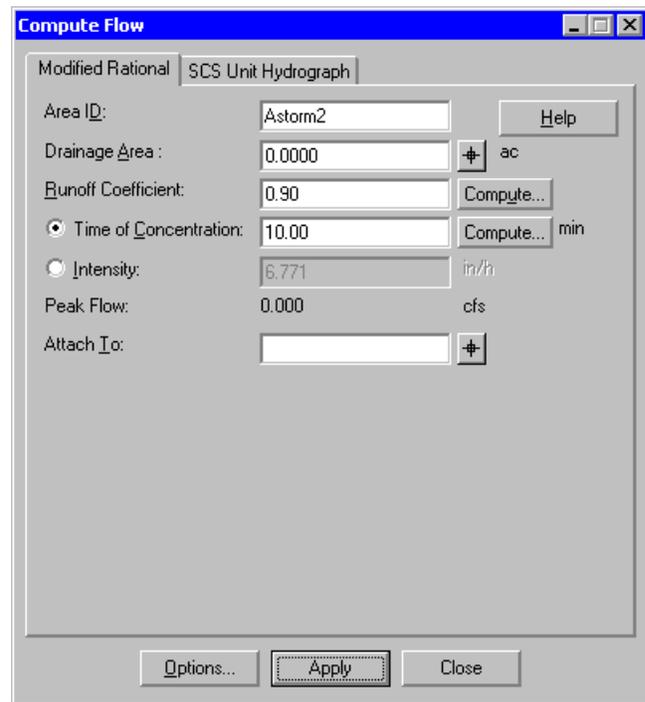
The shape's symbology is changed to that defined for S&S Drainage Areas.
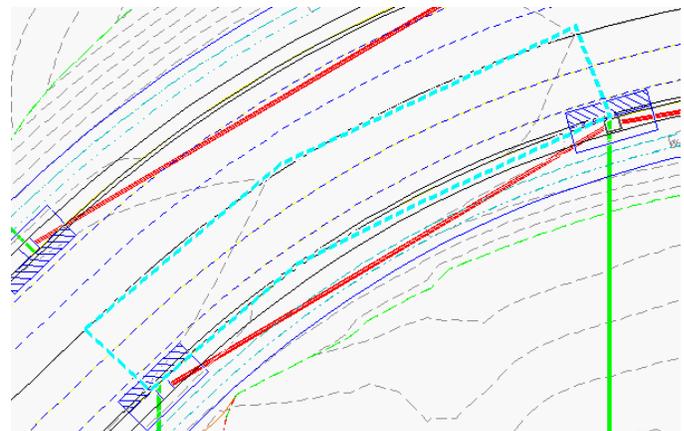

Injected Flow

69.   Select InRoads>Drainage>Flow>Inject Flow.
70.   Select the Target button to the right of the "Attach To:" field.
71.   Select the "Upstream-most" (westernmost) inlet on the south side of the street (IN4).
72.   Key in "0.5" in the "Storm Flow" field.
73.   Hit Apply.
74.   At the "Identify Point" prompt, identify a point for the Flow label.
75.   Close the form.
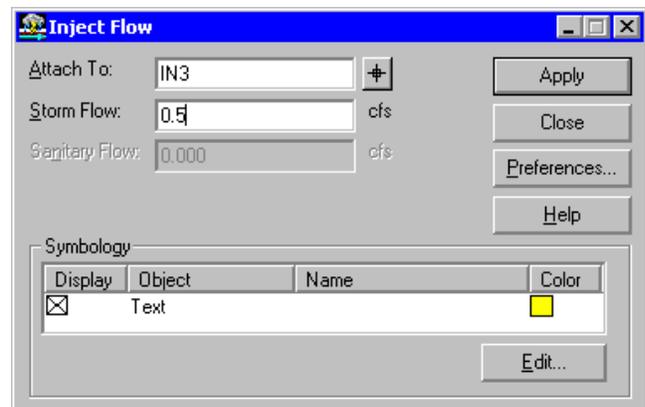
Section 7 Doing the Number Crunching.

76.	Select InRoads>Drainage>Network>Design
77.	Select the "Tree Network Containing" radio button.
78.	Select the Target button next to the "Tree Network Containing" field.
79.	Select any of the structures in the southern network.
80.	Make sure that the "Generate HGL and EGL" checkbox is ON.
81.	Hit Apply.
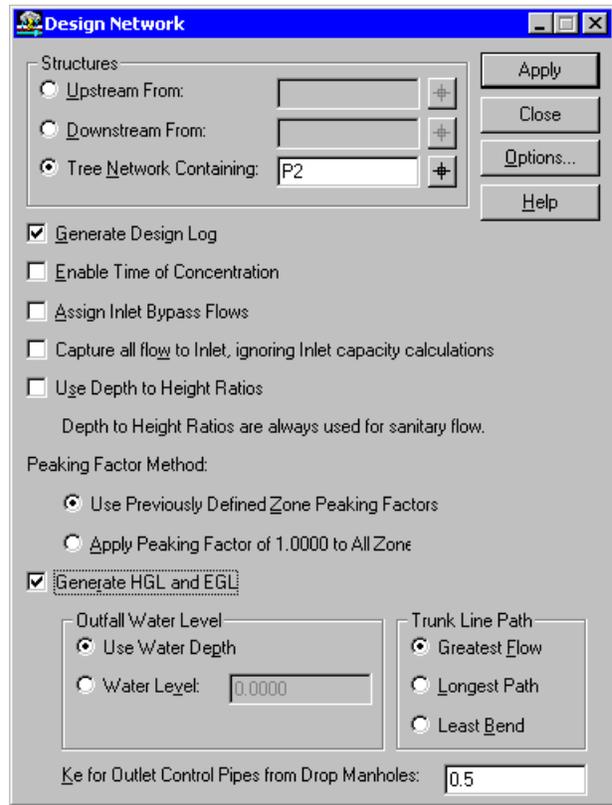
The network is designed, sequentially, structure-by-structure. Some of the calculations performed include:

- Establish connectivity based on Upstream and Downstream ID's
- Sum upstream injected flows
- Sum upstream area flows
- (Storm) Calculate flow travel time in pipes for time of concentration recalculations
- (Storm) Recalculate rainfall intensity based times of concentration plus travel time.
- Gutter flow depth and spread calculations
- Inlet capture percentage from gutter flow characteristics
- Adjust downstream gutter flow to include inlet bypass
- Infiltration
- Headloss at junctions
- Hydraulic and Energy Grade line analysis
- Pipe Sizing based on calculated flow and capacity.
- Inlet Sizing based on sump/gutter capture capacity.
- Junction resizing based on maximum pipe size.

A Design log is generated, which echoes a good portion of the calculations and lists Warnings of exceeded design criteria and Errors. This is the first and best source of information relating to how the network behaved during design. This log can be saved to files or sent to printers.
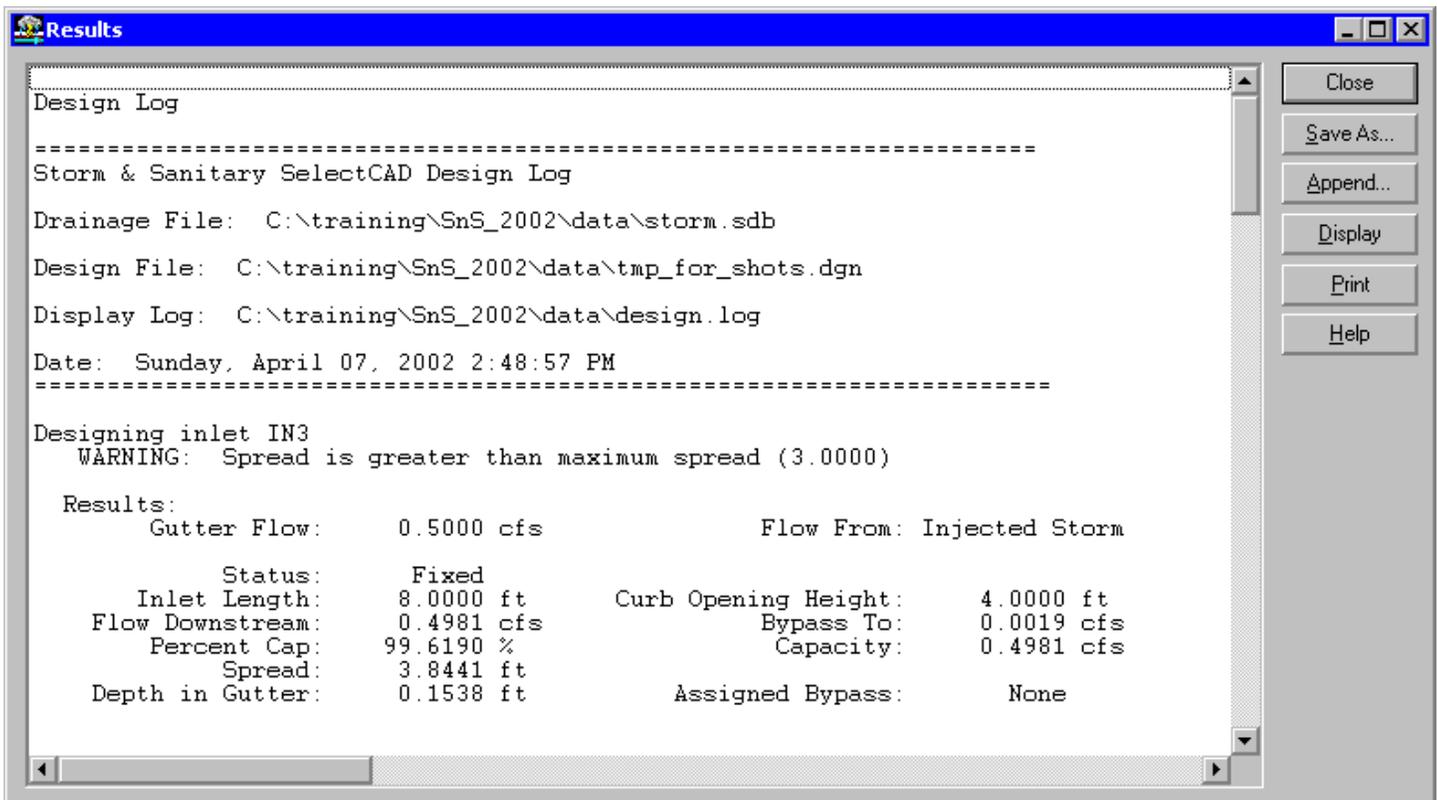
82.   Close the Results form and the Network Design form.

83.   Select InRoads>Evaluation>Profile>Create Profile.
84.   Hit the Apply button (the settings have not changed since the last profile was created).
85.   At the "Identify Location" prompt, Identify a Location to place the lower left corner of the profile.

Notice that the HGL is included, now that HGL information has been calculated during the Network Design.

Section 8 Saving the Drainage File.

The Drainage file is saved in a way similar to any windows file, via the "Save" and "Save As…" The drainage with the label "s&sdata" was loaded at the beginning of the lab, as part of the "sns_biuc02.rwk" project file.

| 86. | To save the open file without changing the name, hit InRoads>File>Save>Drainage Data. |

To change the name,
- hit InRoads>File>Save As...

- Select "Drainage (*.sdb)" from the "Save as type:" list.

- Key in a suitable filename.

- Hit the Save button.
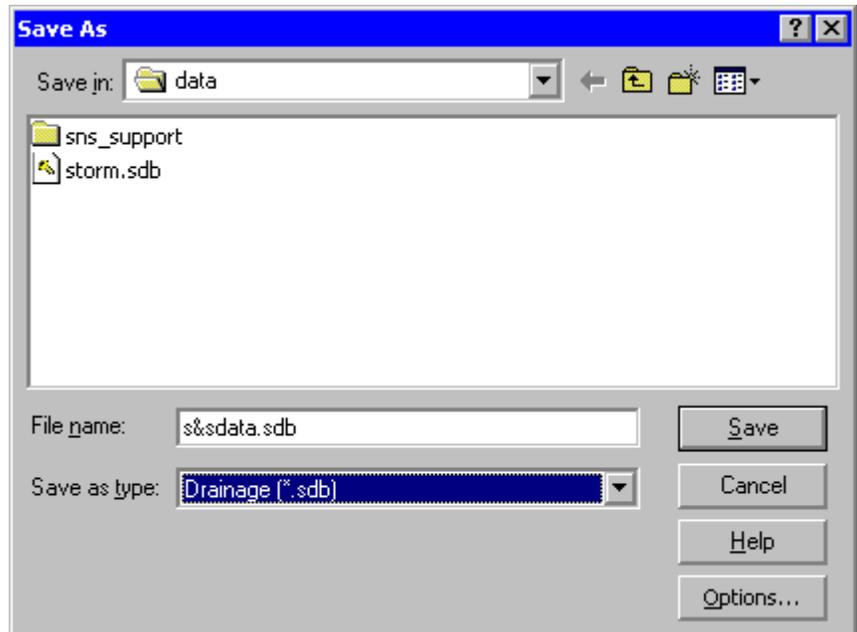
Section 9 Exploring On Your Own…

This concludes the formal part of the workshop. The essentials "buttons" of Laying Out a Network, Attaching Flows, and Designing the Network has been touched upon. Storm&Sanitary contains a great deal more functionality, most of which is found under the Drainage menu header.

Additional Structures (Manholes, Channels, Culverts can be Laid Out) from the Lay Out form, using the same techniques as used for Inlets and Pipes.

The "Access™ database" data architecture of the Drainage file allows wide-open access to all the copious information used by Storm&Sanitary. Easy and versatile Annotation, Reporting, and Querying interfaces exist within S&S; more sophisticated Reports and Queries can be performed in Access.

Important highlights include Structure Annotation, found at InRoads>Drainage>View>Annotate Structures, and Drainage Reports, found at InRoads>Tools>Drainage>Reports. S&S also contains a suite of functions to quickly and intelligently modify network attributes, either individually or in bulk.

Quickie: Annotate Structures

| 87. | Select InRoads>Drainage>View>Annotate Structures. |
| 88. | Hit Apply |
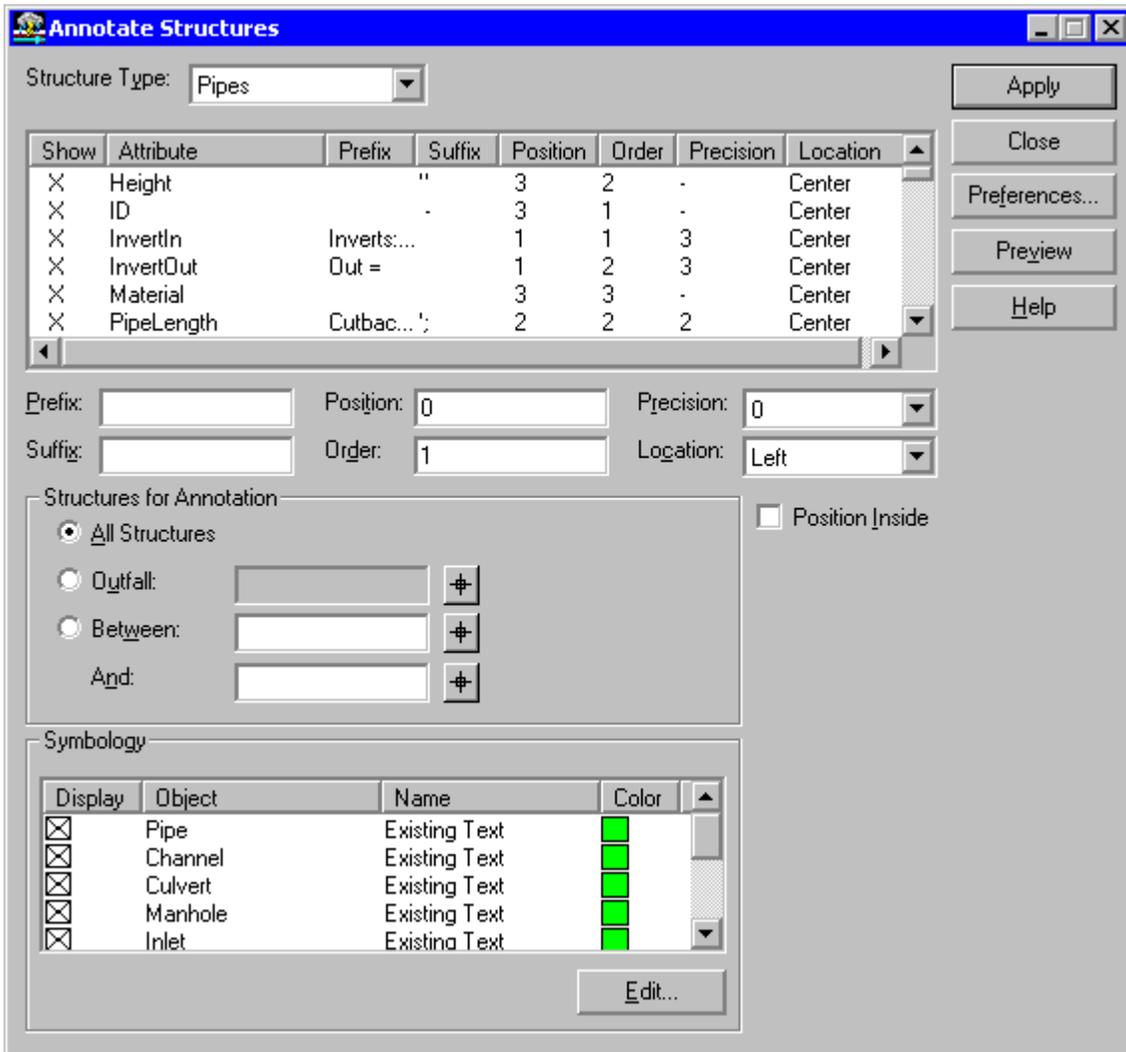
The size of the resulting CAD text is based on the settings in the Symbology frame Multiplied by the Text Scale Factor which can be set in InRoads>Tools>Options>>Factors.

This form provides the ability to annotate any of the structure or area attributes stored in the Drainage database. Position, Order, Precision, and Prefixes and Suffixes can be set via this form.