

SOUTH DAKOTA NRCS CIVIL 3D 2010 DRAFTING NOTE

DAM – PIPE NETWORK

USING A PIPE NETWORK TO CREATE A PRINCIPAL SPILLWAY

In this example, a pipe network is created for the principal spillway pipe. A 12-inch diameter PVC pipe barrel and a 4-foot tall 48-inch diameter concrete riser will be used. The crest of the riser is at elevation 1740.0, the barrel inlet crest is at 1736.0, and the outlet pipe crest is at 1724.5.

Using a Pipe Network is an advanced Civil 3D tool and is an optional way to draw and display a principal spillway pipe.

Set the Parts Network Catalog

The National and South Dakota templates have not customized the Pipe Networks, so the settings are the standard configuration from AutoCAD Civil 3D. The pipe network catalog is the file location for the default parts that come with Civil 3D. There are separate catalogs for pipes and structures.

The default catalog folder for the pipe network catalog should be **C:\Documents and Settings\All Users\Application Data\Autodesk\C3D 2010\enu\Pipes Catalog**

The US Imperial Pipe Catalog and US Imperial Structure Catalog should be selected.

Figure 1: Set Network Catalog

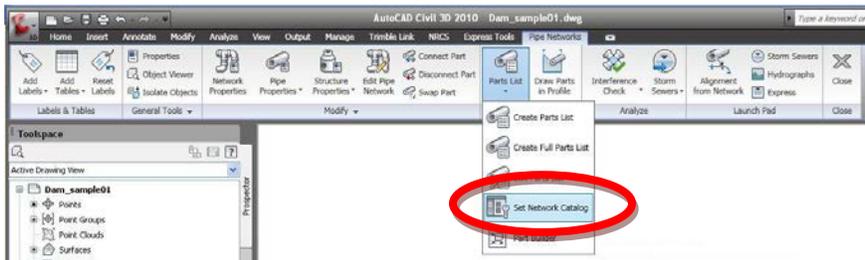
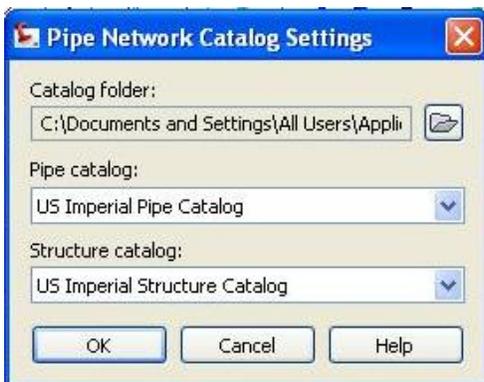


Figure 2: Pipe Network Catalog Settings Window



Set the Parts Lists

Civil 3D comes with parts already created. The parts are the building blocks for the pipe network. There are already various diameters of pipe with several materials such as PVC, HDPE, CMP, ductile iron, and concrete. Structures are needed to join the pipe segments together. Many of the structures are for storm sewer or sanitary sewer systems. However, some basic structures would work for both a circular or square drop inlet structure. These structures are called Junction Structures without Frames. It is possible create additional pipes and structures in a tool in Civil 3D called Part Builder, but it is beyond the goal of this drafting note to describe the procedure.

It is best to create a parts list for this project in order to avoid having pipes and structures that do not pertain to a principal spillway for a dam. In this example, 12" PVC pipe and a 48" Cylindrical Junction Structure NF is needed.

To create a parts list, go to the Modify Ribbon; click Pipe Network on the Design Panel. This will display the Pipe Networks Ribbon. Under Parts List, select Create Parts List. Use a unique name to describe the parts list and in this example, the name is Principal Spillway Parts.

Figure 3: Create Parts List.

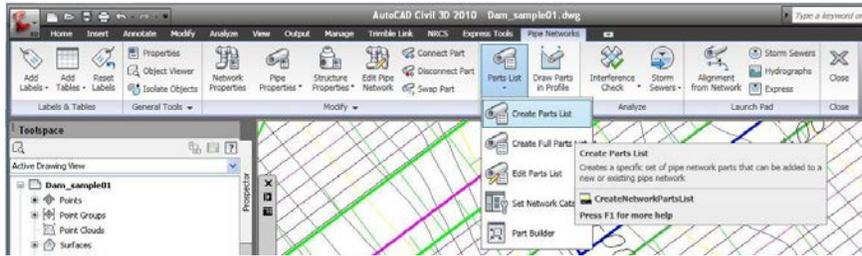


Figure 4: Network Parts List window – Information Tab.

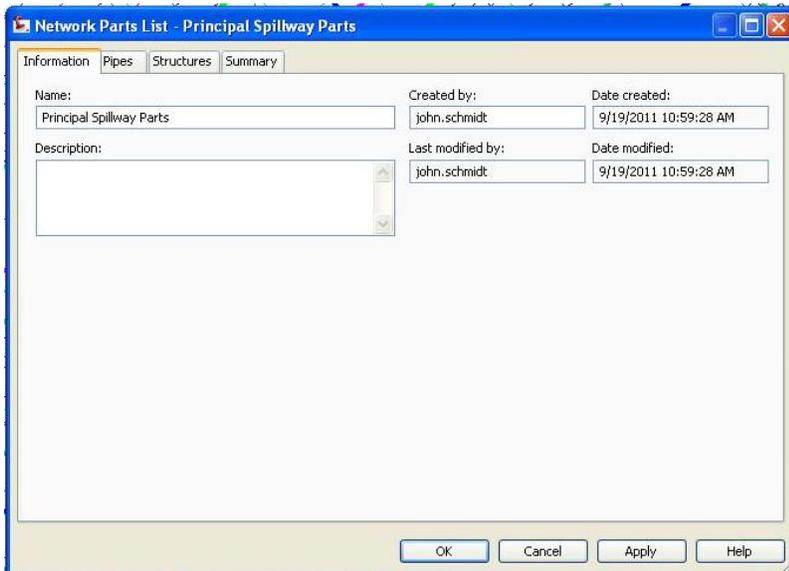
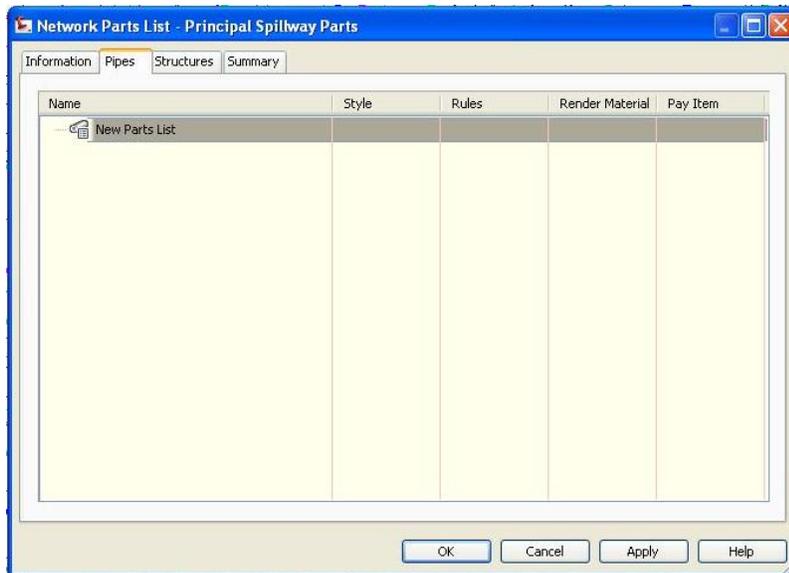
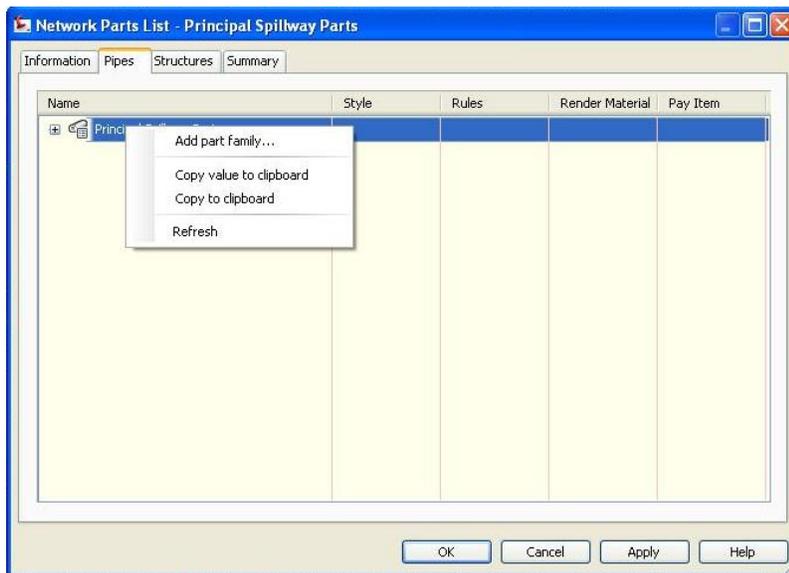


Figure 5: Network Parts List window – Pipes Tab.**Figure 6:** Adding a part family under pipes. Right click on the parts list to add the part family.

Under Circular Pipes, check PVC Pipe or the pipe material to be used for the principal spillway barrel. Remember to use material that is appropriate for use in an embankment dam.

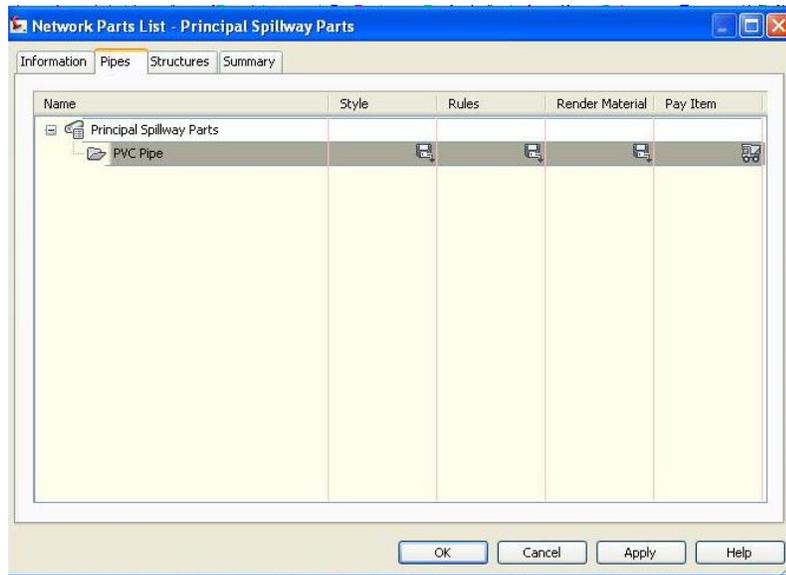
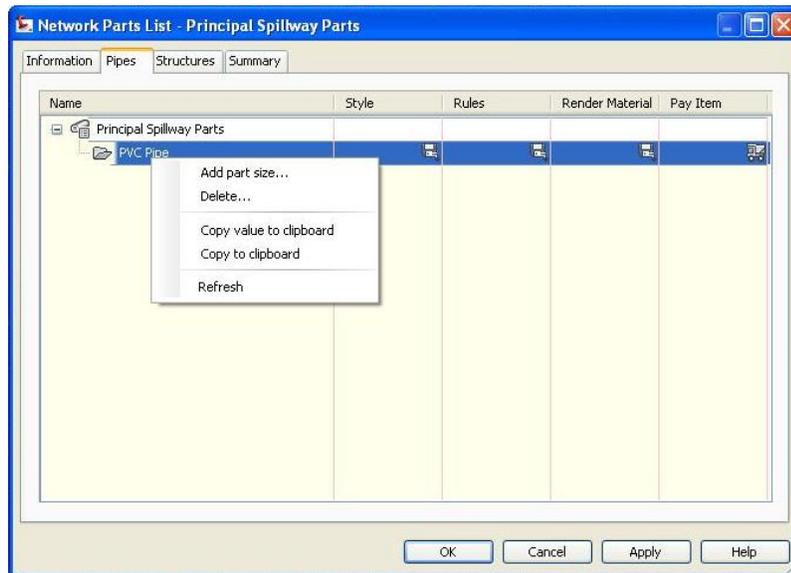
Figure 7: The PVC pipe family is added.**Figure 8:** Add a part size to the PVC pipe family. Many pipe sizes can be added if this step is repeated. Right click on the Part family (PVC Pipe) to add the part size.

Figure 9: The Pipe part size creator. Select the Inner Pipe Diameter to select the size.

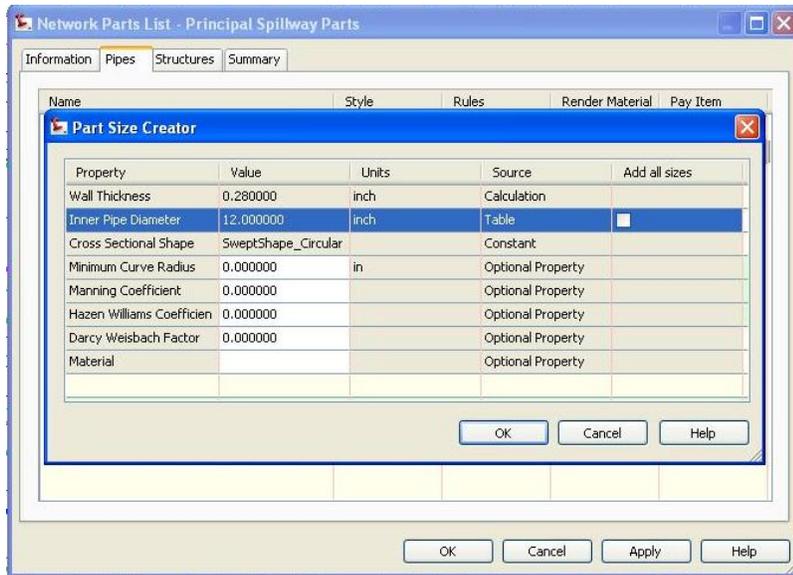


Figure 10: The Principal Spillway Parts List with 12-inch PVC pipe.



Structures are components of a pipe network that represent manholes, catch basin, and inlets. Junction structures with frames are used for manholes, catch basins with grates. Structures such as risers for a principal spillway can be represented with junction structures without frames.

Adding structures is similar to adding pipe sizes in the previous section.

Figure 11: Adding a part family under Structure.

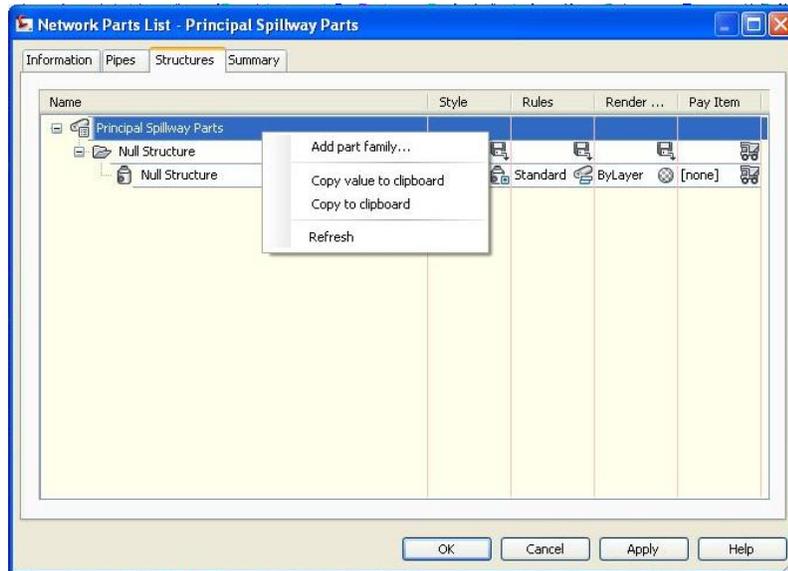


Figure 12: A Cylindrical Junction Structure NF.

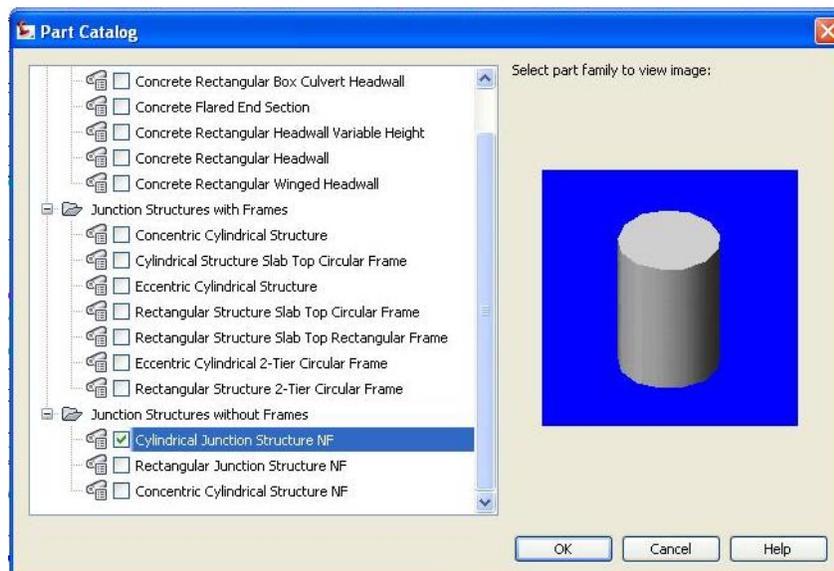


Figure 13: A Rectangular Junction Structure NF.

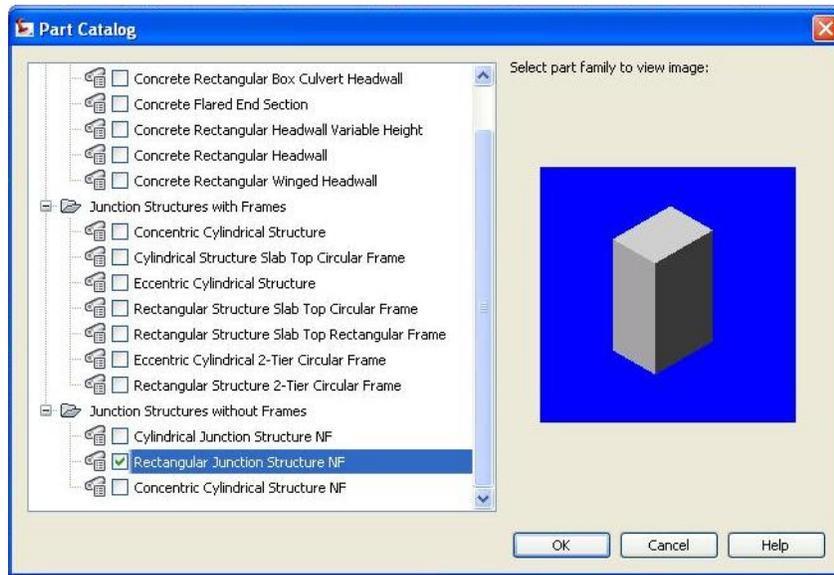


Figure 14: Add a part size to the Cylindrical Junction Structure NF family.

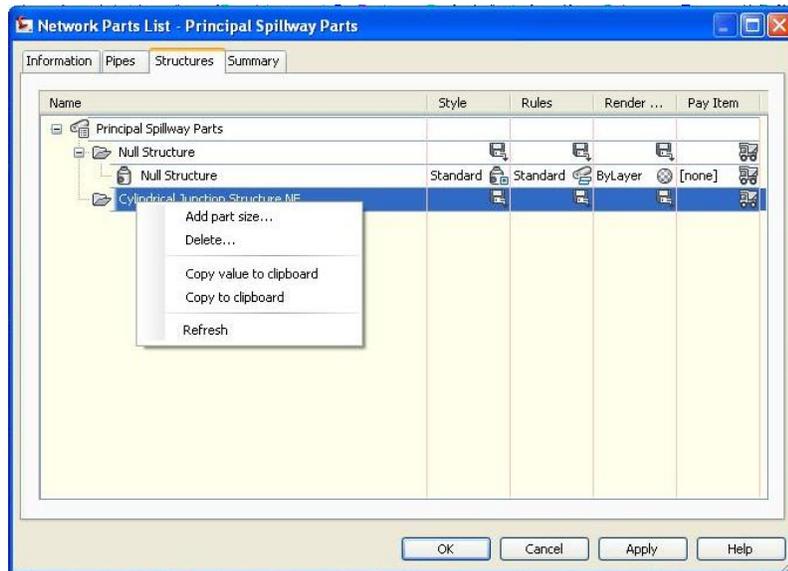
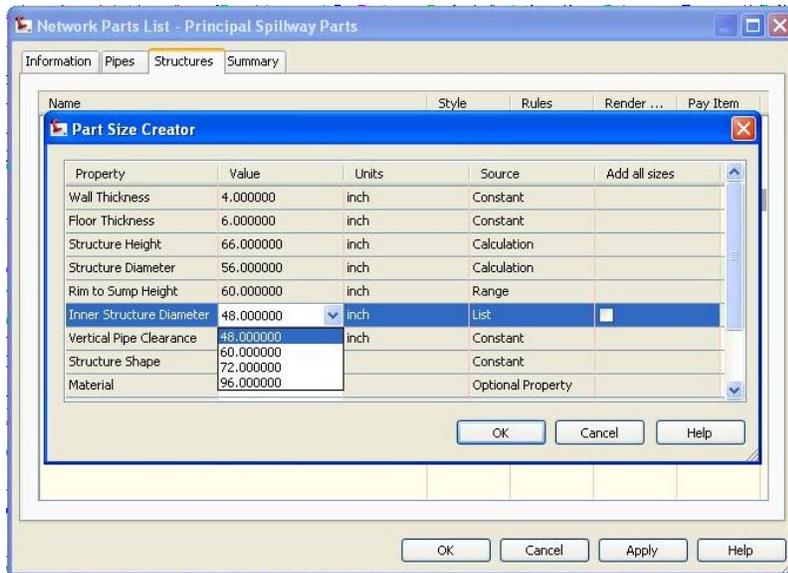
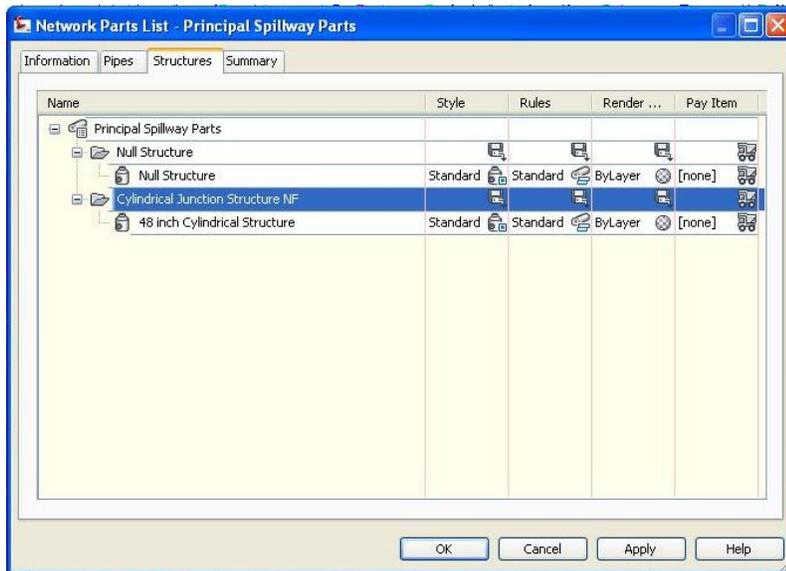


Figure 15: The structure part size creator. Select the Inner Structure Diameter to select the size.**Figure 16:** The Principal Spillway Parts list with a 48-inch Cylindrical Structure.

Create Pipe Network

Under the Create Design panel on the Home ribbon, click on Pipe Network and select Pipe Network Creation Tools. This opens up the Create Pipe Network window as shown in Figure 17.

Network Name: Choose a name for the pipe network that is meaningful. In this example, Principal Spillway is used.

Network Parts List: Choose the parts list that contains the parts, rules, and styles needed. The Principal Spillway Parts list was created in this example.

Layers: Select the layers for the plan, profile, and section view layers. See Figure 18.

Surface Name: Choose the surface that will provide a basis for applying cover rules, as well as the insertion elevations for the structures.

Alignment Name: Choose an alignment that will provide station and offset information for your structures in Prospector, as well as any labels that call for alignment stations and/or offset information.

Figure 17: The Create Pipe Network window

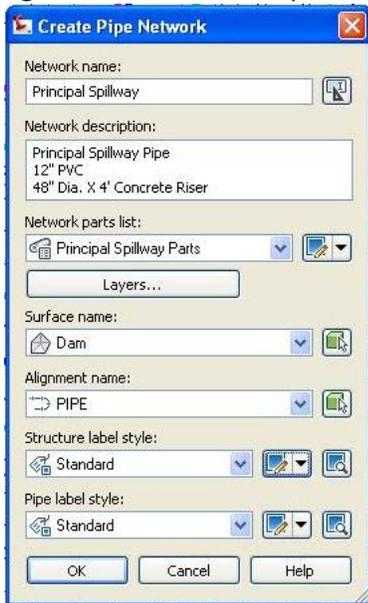


Figure 18: Pipe Network Layers Window.

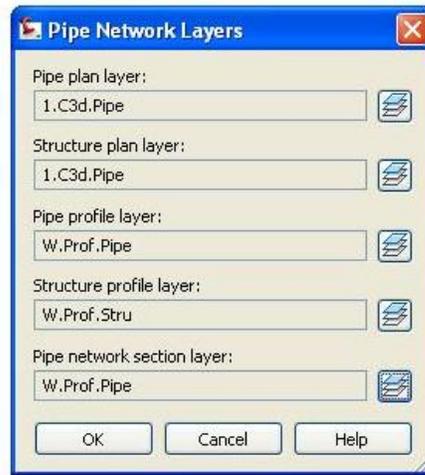
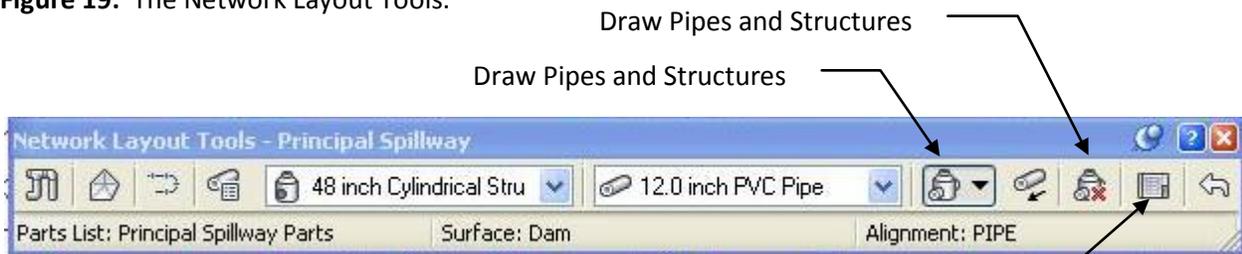
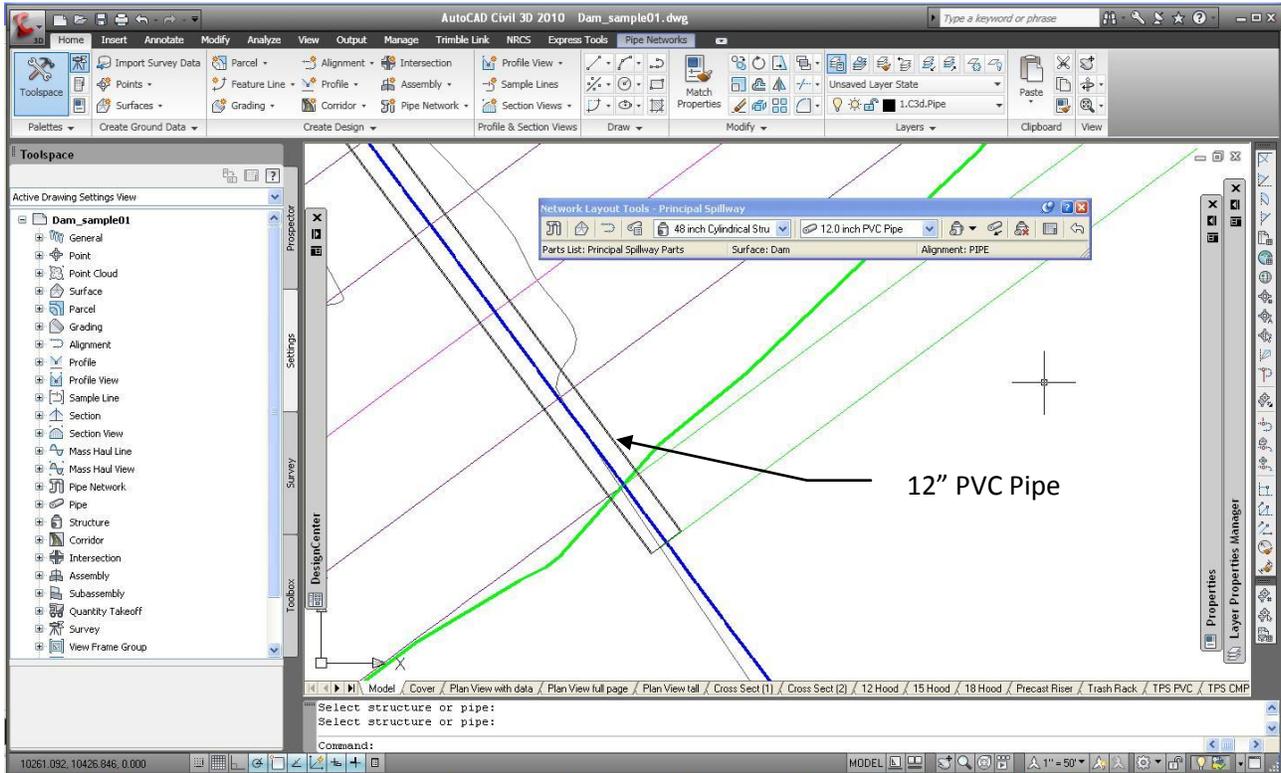


Figure 19: The Network Layout Tools.



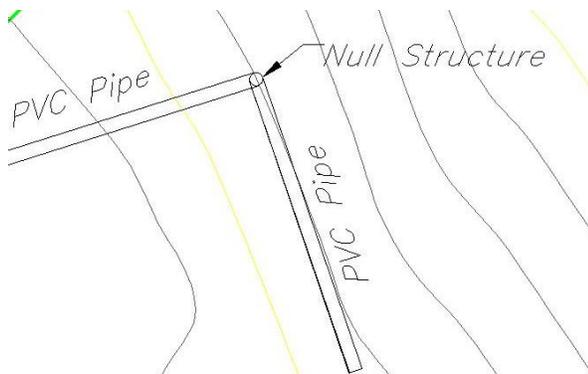
Select Draw Pipes and Structures from the Network Layout tools. Start by selecting the location of the inlet riser and then select the pipe outlet location. It may be helpful to have a line or object to use the object snaps at these locations. This will draw in a riser at both ends, which is not what is wanted. Use the Delete Pipe network Object to delete the 48-inch structure at the outlet of the pipe. Figure 20 shows the pipe at the outlet after the extra structure is deleted.

Figure 20: The pipe after the extra structure is deleted.



Null structures are created automatically when two pipes are joined together without a structure and act as a placeholder for a pipe endpoint. If the pipe had an elbow in it so the outlet slope of the pipe is less than five percent, a null structure would be located at the elbow. No null structures are used for the dam principal spillway pipe.

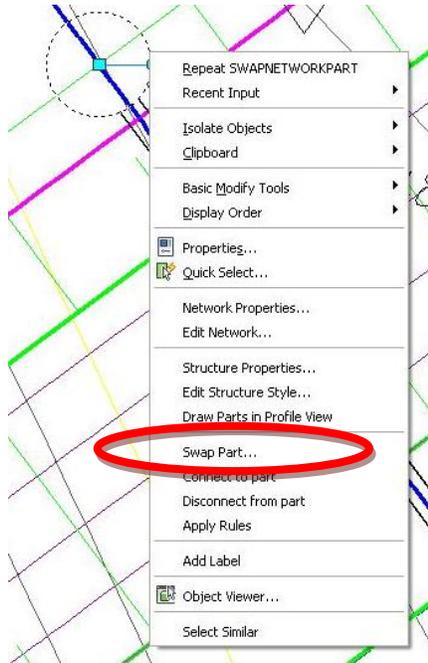
Figure 21: A sample null structure.



Swap Parts

To change a part, either a structure or a pipe, right click on the part and select swap part. An example would be to change pipe size or material. Another use would be to change a structure to a null structure.

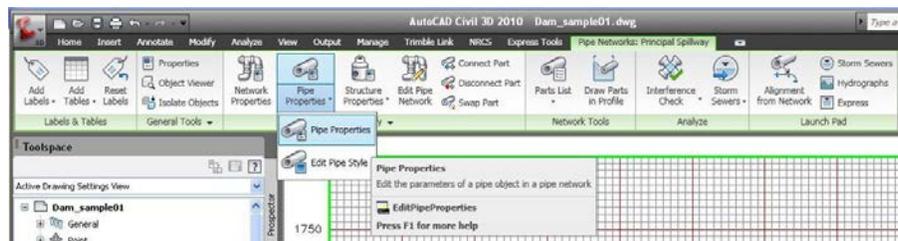
Figure 22: Swap Part.



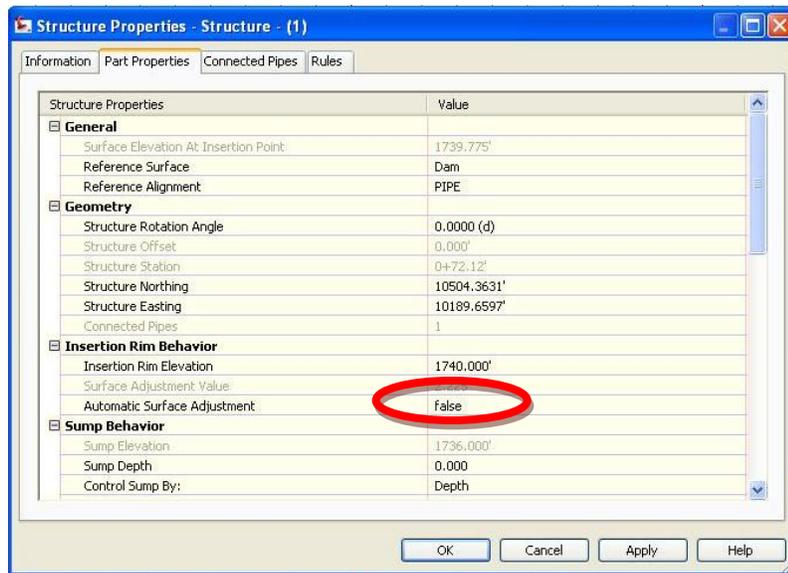
Pipe and Structure Properties

To change modify the pipe or structure properties, such as elevations, slopes, and sump behavior, click on the pipe or structure in either the profile or plan layout. This will display the Pipe Networks ribbon. Click on Pipe Properties or Structure Properties on the Modify panel.

Figure 23: Pipe Properties on the Pipe Networks ribbon tab.

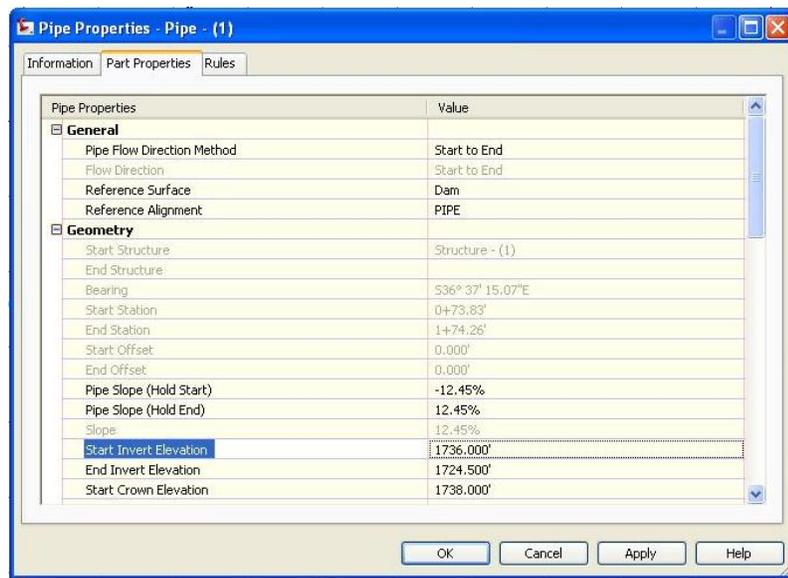


Change the automatic surface adjustment to false and the insertion rim elevation to 1740.0 in Figure 24. By setting the automatic surface adjustment to false, whatever happens to the reference surface, the rim elevation will stay locked in place. The insertion rim elevation is the same elevation as the top of the riser. Also, change the sump depth to 0.00. When the sump depth is equal to zero, the sump elevation is equal to the invert of the deepest connected pipe.

Figure 24: Structure Properties window

To change the structure diameter, scroll to the bottom of the Part Properties tab. Click on the Inner Structure Diameter value and a drop down list will list appear.

Open the pipe properties window to change the elevations of the pipe. Change the start invert elevation to 1736.0 and the ending invert elevation to 1724.5.

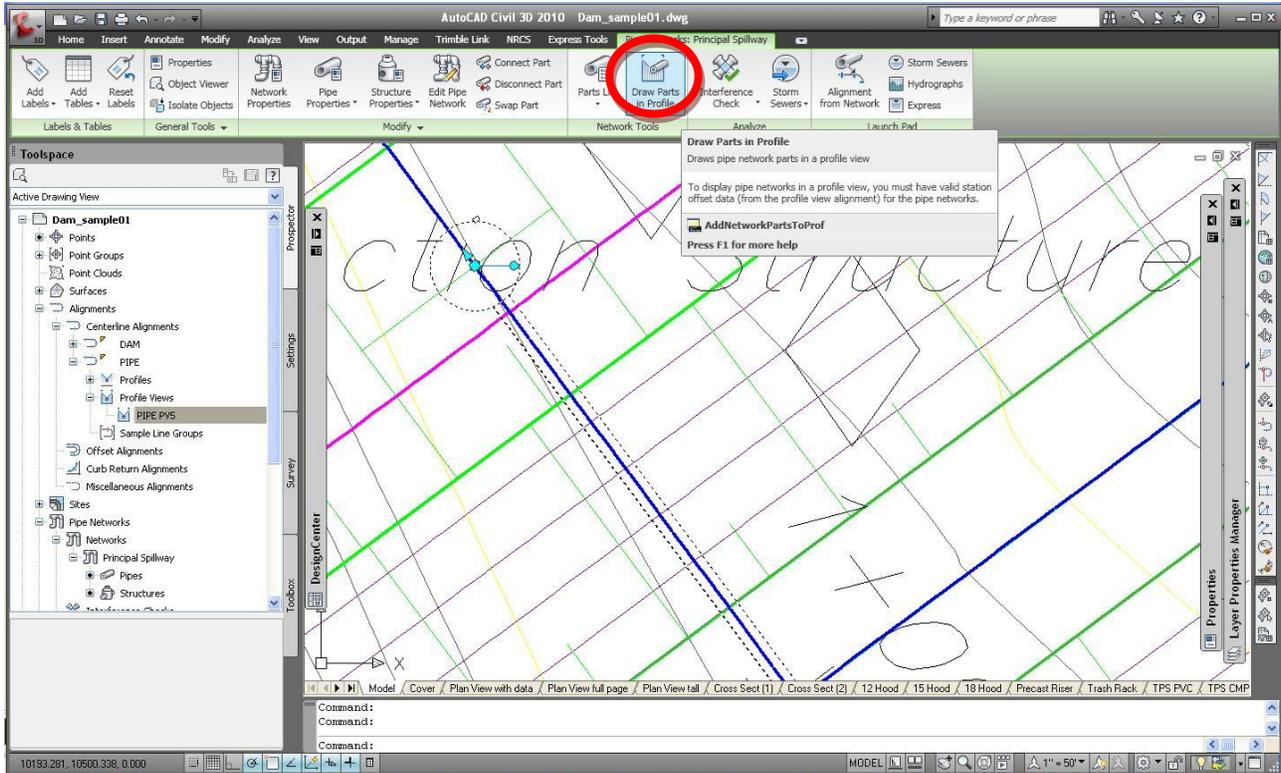
Figure 25: Pipe Properties window

Draw Pipe Network in Profile

The alignment and a profile view should already be created. See SD NRCS Civil 3D 2010 Drafting Note, *Dam – Profile*.

Click on the pipe and riser. On the Pipe Network tab, click on Draw Parts in Profile. Now select the profile (Pipe Profile) to draw the pipe and structure.

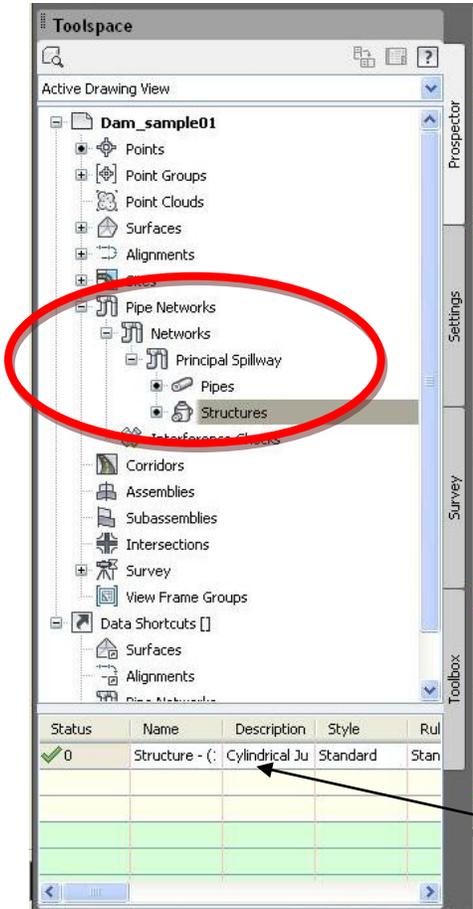
Figure 26: Draw part in profile.



Modify Labels

The pipe and structures are labeled using the description from the Parts List. For the structure, this is Cylindrical Junction Structure NF, which is not very descriptive when labeling the design drawings. A way to change the description is to expand the Pipe Networks on the Prospector tab of Toolspace. Highlight Structures and all the structures included in this network will be listed below in a table. Change the description column to what is more descriptive of the structure.

Figure 27: Toolspace with the Pipe Networks expanded on the Prospector tab.



The Description is used to label the plan and profile views

Edit Network in Plan View

When selected a pipe end has two types of grips. The square-shaped endpoint is a location grip. The location of the pipe end can be moved without constraint. The triangle grips are a pipe length grip to shorten or lengthen the pipe.

There are also two midpoint grips for the pipe. The square-shaped grip is a location grip to move the pipe using its midpoint as a base point. The triangle grip will give a tooltip showing allowable diameters for the pipe, based on the parts list.

A structure has two types of grips. The square-shaped grip stretches /moves the structure to a new location using the insertion point as a base point. Stretching a structure will result in the movement of the structure, as well as any connected pipes. The circle grip is a rotational grip used to spin the structure and is most useful for aligning eccentric structures and rectangular structures.

Figure 28: Plan view pipe grips.

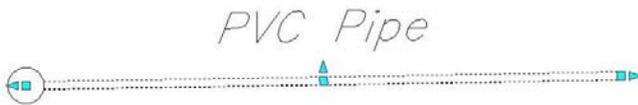
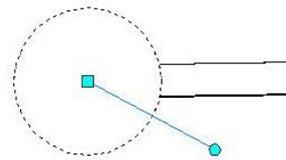


Figure 29: Plan view structure grips



Edit Network in Profile View

In the profile view, when a pipe is picked, it has three grips. The grip edits are the invert crown and centerline elevations. Picking any of the three grips will raise or low the pipe, changing the pipe's slope. Picking the one grip at its midpoint will raise or lower the entire pipe keeping the slope constant.

In the profile view, the structure has two triangular grips. The top triangle raises or lowers the rim insertion point. No matter what happens to our reference surface, the rim will stay locked in place. The bottom triangle is located at the sump depth. In this example, the sump depth is zero (from the structure properties). Moving this arrow increases or decreases the sump depth because the structure is set to control sump by depth. In the structure properties, the structure can be set to control sump by elevation instead of depth.

Figure 30: Profile view pipe grips

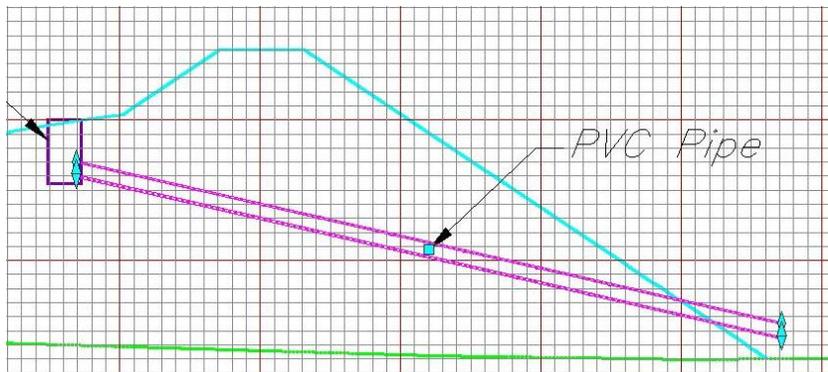
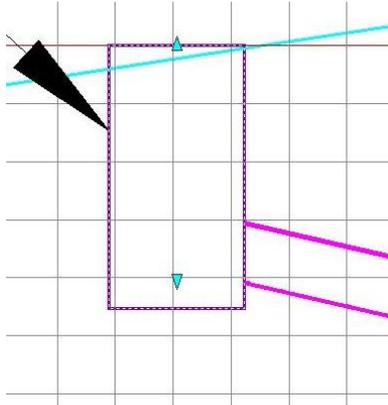


Figure 31: Profile view structure grips

Create Pipe Style Settings

Pipe style settings can be created to reflect the type of pipe being used, how walls are drawn in different views, and how the pipe is displayed.

Plan Tab: Controls what represents the pipe when working in the plan view. Specify how to draw in the wall size (from pipe catalog, scaled, or constant dimension), pipe hatch options, and pipe end lines

Profile Tab: Almost identical to the Plan tab, but controls how the pipe is represented in the profile view.

Display Tab: Controls the visibility and display properties off all the possible pipe style elements. Figure 33 is open to this tab. Note the pipe centerline is not visible in the profile view.

Figure 32: Under the Settings tab in Toolspace, copy the Standard Pipe style. Then rename and modify the copy to create a new pipe style.

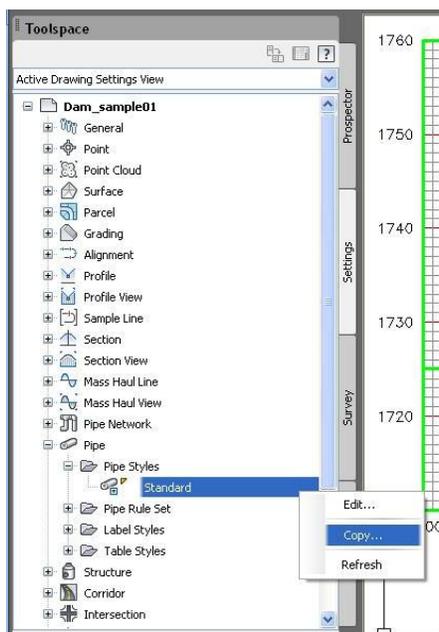
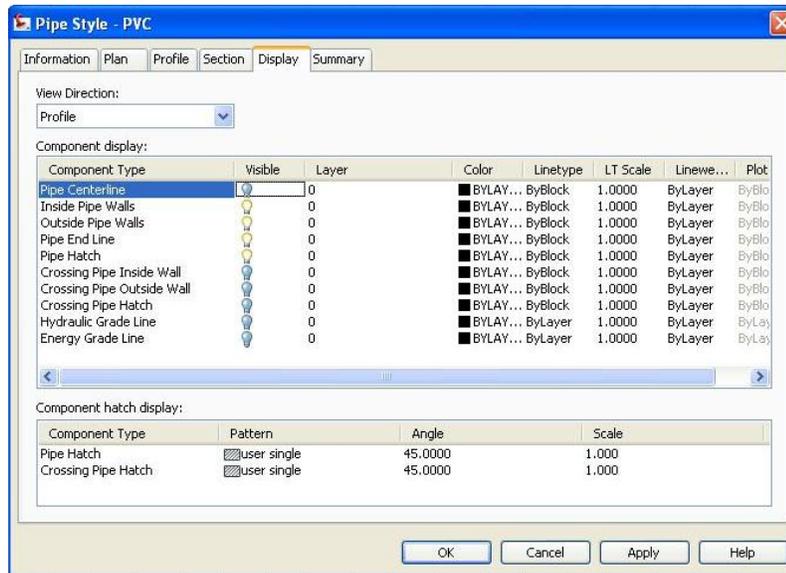


Figure 33: The pipe style window open to the display tab.

To change the pipe style from Standard to PVC, click on the pipe in either the profile or plan layout. This will display the Pipe Networks ribbon. Click on Pipe Properties (Figure 23) and then under Object Styles, change the style PVC.

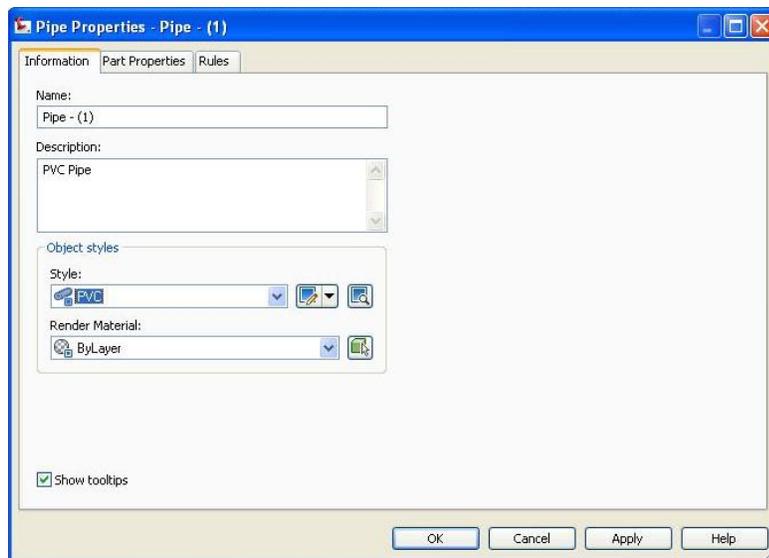
Figure 34: Change the Object style to PVC on the pipe Properties window.

Figure 35: The cross-section of the dam with the pipe profile.

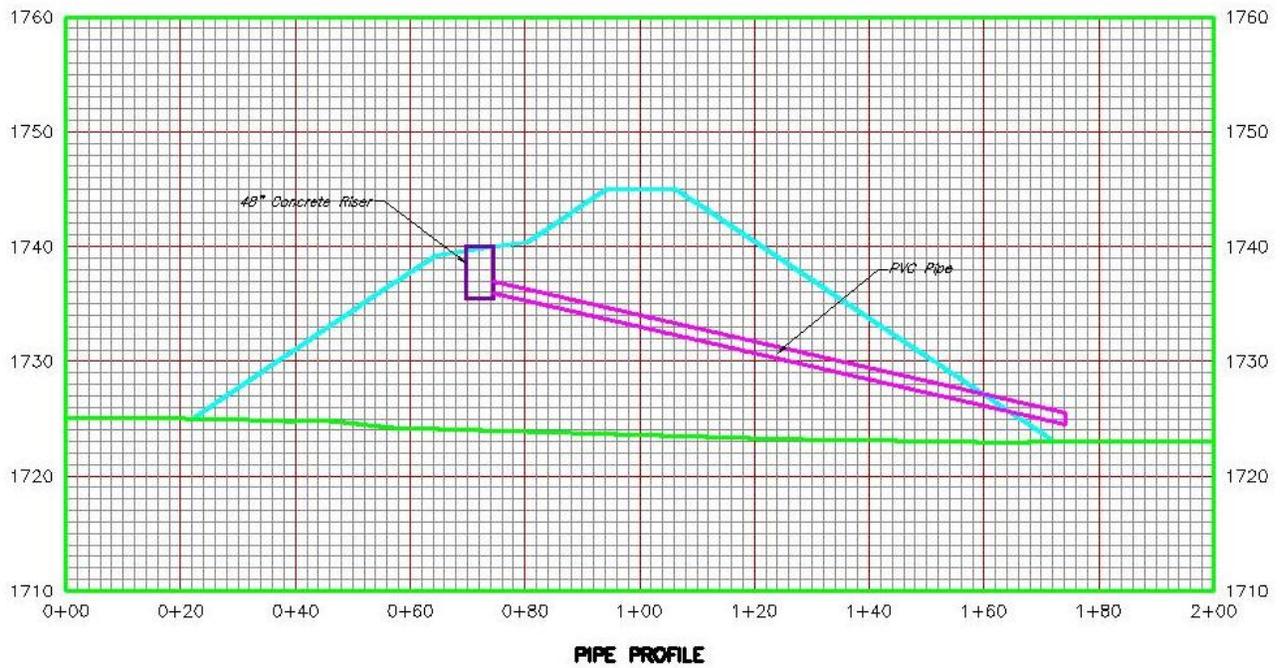


Figure 36: The principal spillway plan view.

