

CES473712

Rediscover Pressure Pipes in Civil 3D 2021 with new path-based workflows

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Learning Objectives

- Discover the new Pressure Pipe Runs that were added to Civil 3D 2021
- Create and edit Pipe Runs based on horizontal and vertical paths
- Design pipe runs vertically to avoid crossing pipes and follow directional drilling
- Configure your pressure content to take advantage of the new workflows

Description

Layout and editing of Pressure Pipe Networks was improved in Civil 3D 2021 with new workflows focused on horizontal and vertical paths of pipe runs. Pressure pipe, fitting and appurtenance locations are modified by controlling the path of the pipe runs instead of having to move each individual part in the network.

This class is intended for designers both new to Pressure Pipes in Civil 3D as well as users of the earlier versions that want to learn the new workflows. This class will explore easier methods to define a lowering at a crossing pipe and follow the path of horizontal directional drilling.

Speaker

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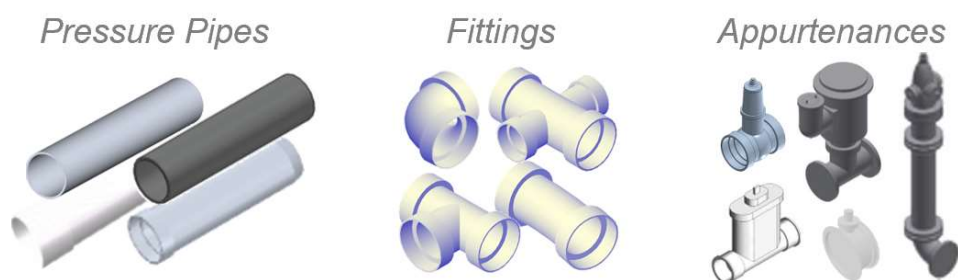


Discover Pressure Pipe Runs

Layout and editing of Pressure Pipe Networks is now path-based in Civil 3D 2021 compared to the part-based workflows in earlier versions. These new workflows are enabled using horizontal alignments and vertical profiles to control the path of pipe runs in the pressure network.

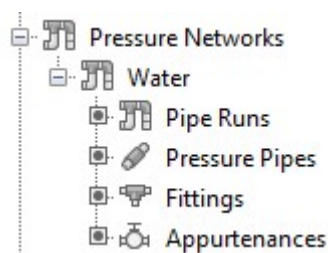
Pressure Pipe Networks

A Pressure Pipe Network in Civil 3D is a collection of Pressure Pipes, Fittings and other Appurtenances forming a 3D model for a utility network or a part of a network. The pressure pipe fittings are the parts that connect pipes together but allow a change in direction or size, and/or branch off to another direction, or cap off the run. Examples of fittings include elbows/bends, tees, crosses, reducers, etc. Appurtenances are other parts that get added along a run of pipes or at the end of a run of pipes. Examples of appurtenances include different types of valves, hydrants, pumps, etc. The image below shows examples of different types of pressure parts.



Pressure Pipe Runs

A pressure pipe run is a new concept in Civil 3D 2021 that represents a path of pressure parts formed in a continuous series. A pressure pipe network can consist of many different pressure pipe runs. This new concept uses an integrated Alignment to control the horizontal path and a Profile to control the vertical path of the parts in the run.

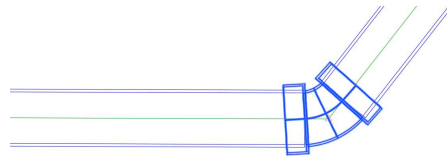


Pressure Pipe Runs in plan view

When first selecting a pressure pipe part in plan view the entire pipe run is selected. The pipe run alignment is highlighted and it's grips are enabled so the user can easily alter the path of the run. When the path is altered the bends will update to the closest bend angle.



After a pressure pipe run is first selected, selecting a second time on any part in the run will highlight that part and allow the user to alter it. The user could edit the parts properties, or style, or the user could swap it to a different part.



Pressure Pipe Runs in profile views

The behaviors in profile views are similar to the behaviors in plan view with the path following a linked profile. When first selecting a pressure pipe part in profile view the entire run is highlighted. The pipe run profile is highlighted and it's grips enabled so the user can easily alter the vertical path of the run.

The vertical path of a pipe run is meant to be edited on a profile view associated with the pipe run alignment. In this case the vertical separation to profile surfaces and piping networks is relative to the location of the pipe run instead of an offset location. Although pressure parts can be shown on other profile views, the pipe run profile and grips will only be enabled on profile views associated with the same pipe run alignment.

Configure Pressure Network Content

Before we get to far with layout and editing we should understand the content.

Pressure Network Content Structure

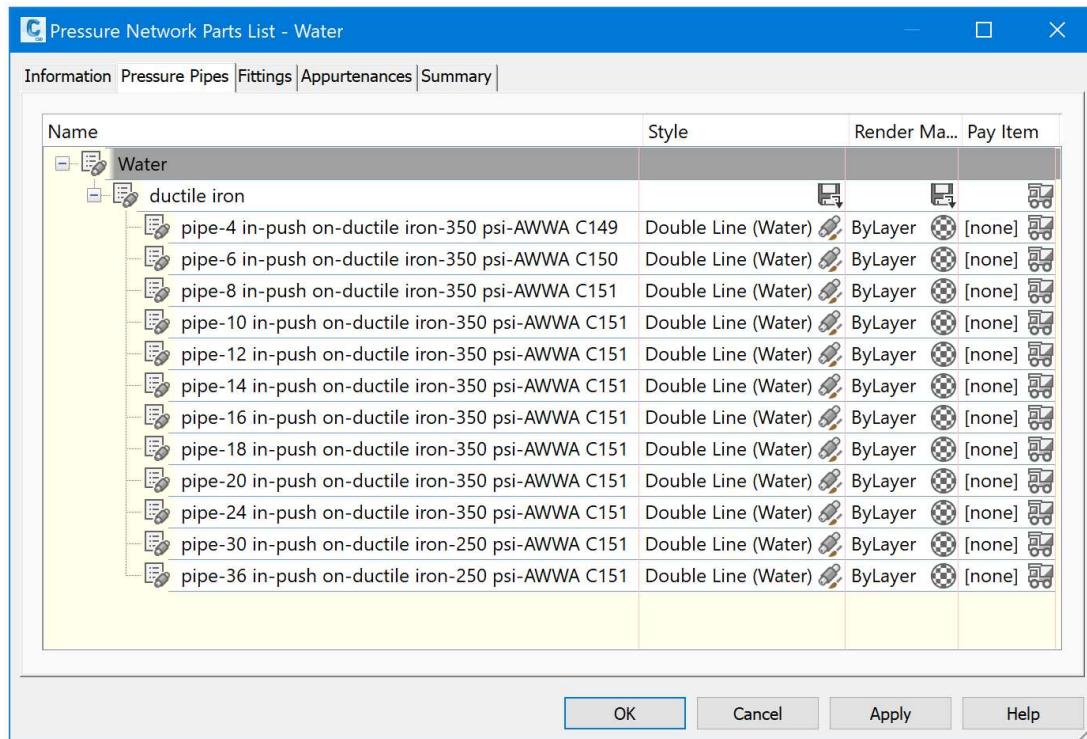
A Parts List organizes pipes, fittings and appurtenances that can be used in a pressure network. The parts in a Parts List are added from a Part Catalog. There are a number of part catalogs installed with Civil 3D, but users can also create their own.

Pressure Network Parts Lists

Pressure Parts Lists are stored in a drawing or template. Multiple parts lists can be created to represent the parts you would use on different types of networks. For example you might have a different parts list for a water distribution network than you have for a sanitary sewer force main or a local gas main.

Follow these steps to create a pressure Parts List

1. Use the command **SetPressureNetworkCatalog** (Home > Create Design > Set Pressure Network Catalog) to select the catalog to use for the Parts List
2. Expand Pressure Network on the Settings tab of Toolspace and right-click on Parts Lists to choose **New...**
3. On the Information tab enter a Name and Description
4. On the Pressure Pipes tab right-click on the name of the Parts List and select **Add Material...** and check the boxes for the materials to add.



5. Expand the list and right-click on the material and select **Add Size...** to choose a size or choose **Add all sizes**. Repeat this for each size you want to add, and for each material.
6. For Fittings and Appurtenances repeat steps 4 & 5 selecting **Add Type...** instead of materials.

One item to check in the parts list is that the pipes have a cut length specified. In the Parts List right-click on a pipe size and choose **Edit...** The cut length is important for this workflow because the pipes in profile view can be laid out vertically to follow a profile by bending at the cut lengths. The cut length value can be modified in the dialog box. However, if the cut length is not filled in the catalog then the property will not be available in the Parts List dialog box. We'll look at fixing that next...

pipe-8 in-push on-ductile iron-350 psi-AWWA C151

Property	Value	Unit
Nominal Diameter	8.000000	in
Inner Diameter	8.000000	in
Outer Diameter	9.050000	in
Wall Thickness	0.525000	in
Cut Length	18.000000	ft
Allowable Deflection	5.000000	deg
Minimum Flex Radius	0.000000	ft

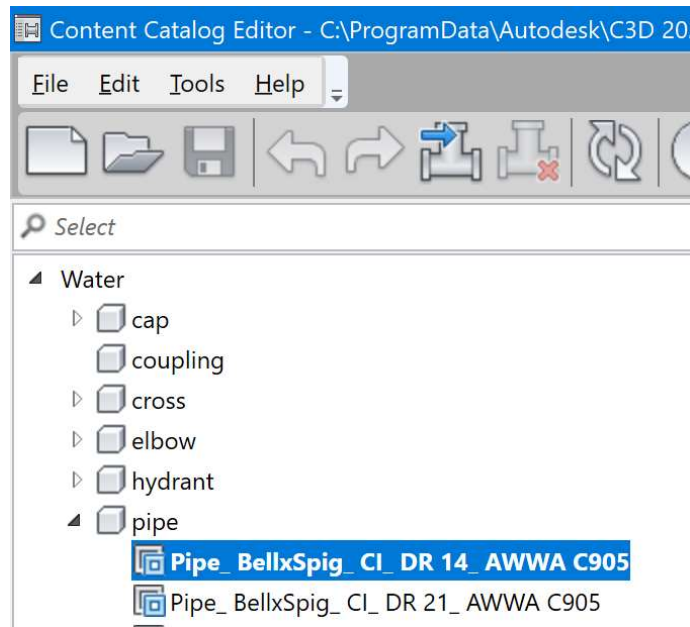
OK Cancel Help

Pressure Network Catalogs

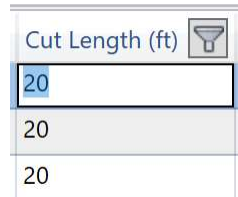
A Pressure Network Catalog is an external set of content that is used to build a Parts List. The catalog can be used as installed or customized or can be created from scratch. We won't cover creation or detailed customization of catalogs in this class, but do want to point out how to add missing properties like the Cut Length value.

Some of the catalogs that are installed with Civil 3D do not have Cut Length values entered – and parts lists created from these catalogs will not have Cut Length available. These catalogs can be edited using the **Content Catalog Editor** that installs with Civil 3D using the following steps:

1. From windows launch the **Content Catalog Editor** and open a catalog (for example, the Imperial_AWWA_PVC catalog that installs with Civil 3D)
2. Expand the collection of pipe and select one of the pipe part families, for example "Pipe_BellxSpig_CI_DR 14_AWWA C905"



3. Enter a value for the Cut Length and any other properties.



4. Save the catalog.

Note: if you are editing a catalog from the Civil 3D installed location or if the catalog is in use by Civil 3D the catalog will be read only. It's best to close Civil 3D and make a copy using the SaveAs command in the Content Catalog Editor before making your edits. SaveAs will also copy the files in the corresponding DWG and IMG folders.

The above steps can also be used to enter values for other properties that you might want to use in labels. For example, values like pressure class, strength class, SDR, Schedule, etc.

Creating and customizing pressure network catalogs is not covered in this class. However, there are a number of classes from past Autodesk Universities available online. Here are a couple:

- [Pressure Pipe Networks in AutoCAD® Civil 3D® 2013](#), presented by speakers James Paquette and Matthew Anderson is great overview to the catalog creation tools.
- [The Pressure of Content Catalog Editor-How to Create Parts in CCE for AutoCAD Civil 3D](#), presented by speaker Heidi Boutwell is a detailed look at creating custom parts.

Create and Edit Pressure Pipe Runs

Before you can create a Pressure Pipe Run you need to create a Pressure Network. There are two commands in the Ribbon to create a Pressure Network:

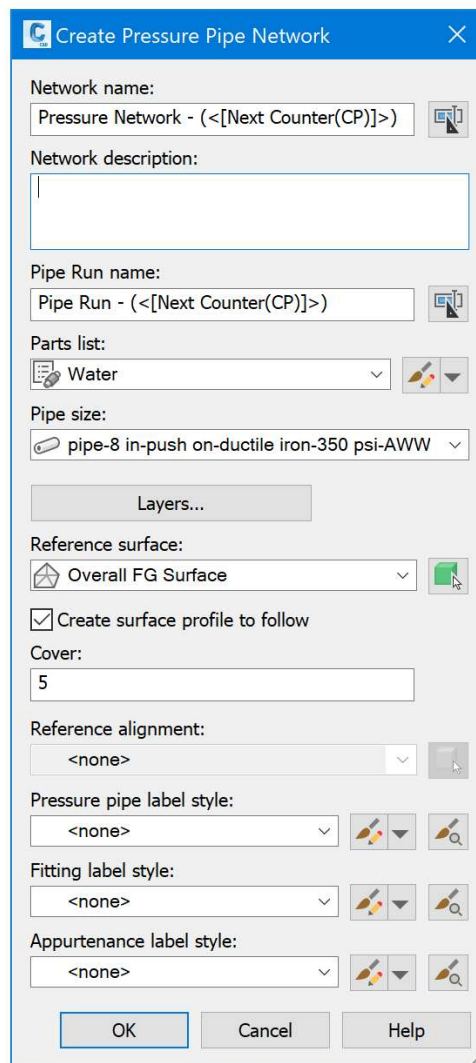
1. Pressure Network Creation Tools
2. Create Pressure Network from Object

Each of these commands will create the network and at least one pipe run. You can add additional pipe runs to the network after creating the first pipe run.

Pressure Network Creation Tools

To launch the Pressure Network Creation Tools, from the **Create Design** panel on the Home tab expand **Pipe Network** and select **Pressure Network Creation Tools**. This command will first create a new Pressure Network and then open the Pressure Network Creation Tools menu.

Note: If you already have a Pressure Network and you simply want to add additional pressure Pipe Runs we'll bet to those options below.



Create Pressure Pipe Network

Network name:
Pressure Network - (<[Next Counter(CP)]>)

Network description:
[Empty text box]

Pipe Run name:
Pipe Run - (<[Next Counter(CP)]>)

Parts list:
Water

Pipe size:
pipe-8 in-push on-ductile iron-350 psi-AWW

Layers...

Reference surface:
Overall FG Surface

☒ Create surface profile to follow

Cover:
5

Reference alignment:
<none>

Pressure pipe label style:
<none>

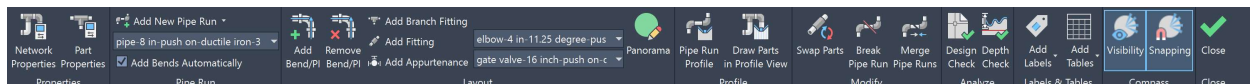
Fitting label style:
<none>

Appurtenance label style:
<none>

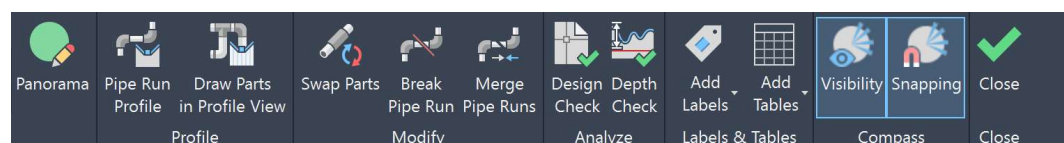
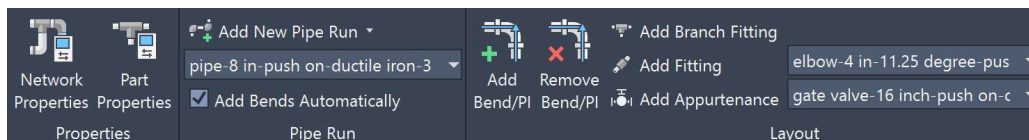
OK Cancel Help

The dialog box in the image above opens in order to create the Pressure Pipe Network.

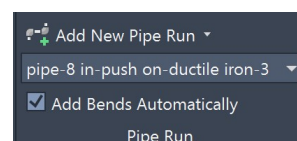
1. Enter a name for both the new Pressure Network and the first Pipe Run.
2. Select the Parts list you want to use for this pressure network
3. Select the pipe size for the pipe you want to start laying out.
4. You can select a Reference Surface and Cover so that the parts are placed at the correct depth below the surface.
5. If you select the **Create surface profile to follow** box it will automatically create a Surface Profile from the Reference Surface at the specified cover and link the pipe run elevations to that profile.
6. A reference alignment can be selected if you want station labeling relative to an alignment in your drawing.
7. Selecting label styles will choose the default labels to be used for the network.
8. Selecting **OK** will create a new pressure network, open the Pressure Network Layout Tools and prompt you to start drawing the path of your first pipe run.



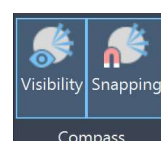
Most of these tools will be used for editing the network. The ones that are most important while first laying out the path are on the Pipe Run and Compass panels. Here are closer views:



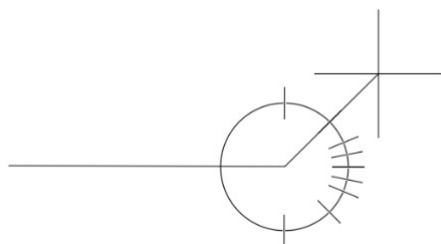
The Pipe Run panel will let you change the pipe size and choose to add bends automatically. Civil 3D will add the bend with the closest bend angle to the deflection angle between the pipes.



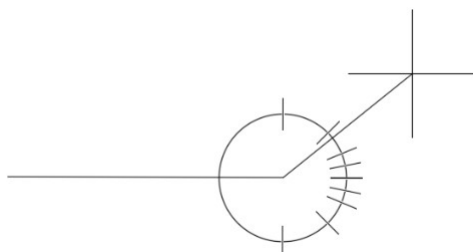
The compass controls the allowed angles at points of intersection during layout. There are two toggles available: Visibility and Snapping.



By default the compass is visible and is snapping to allowed bend angles. The allowed bend angles are based on the bends in the Parts List that match the current pipe material and size. This will force your layout to conform to allowed bend angles.

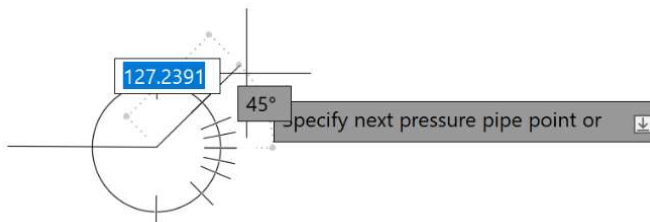


Since the connection between fittings and pipes often provides a little flexibility with an allowed deflection, you could turn Snapping off. If you turn off Snapping, but leave Visibility turned on then this will allow you to draw close to an allowed bend angle but not force the exact angle.

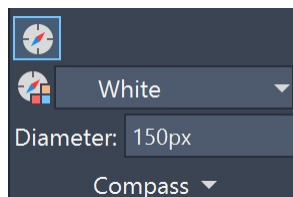


You could also turn them both off if you want to ignore the compass completely.

Tip: Turn dynamic input on to see the bend angle values, and enable entering a pipe length directly:



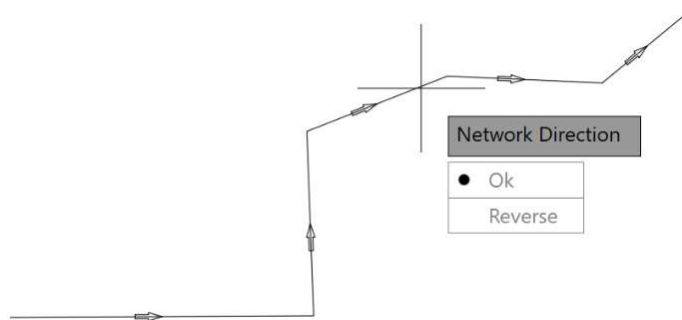
Tip: The color and size options are not currently available on this menu toolbar. However, you can change the color and size by running the old part-based layout tools. To do this, right-click on the Pressure Network collection in Prospector and choose Create Pressure Network by Layout. Then on the Compass panel you have options to change the color and size:



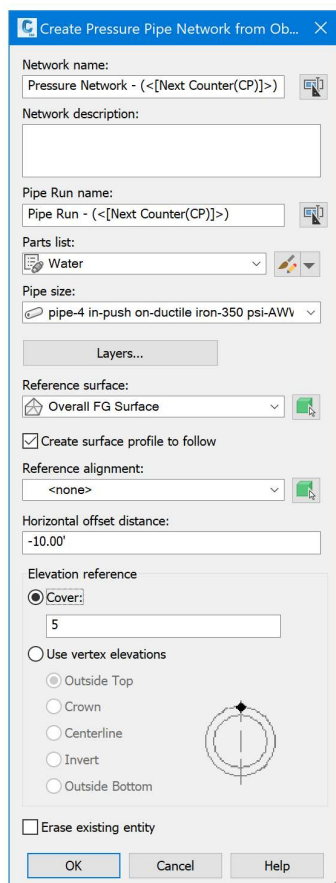
Create Pressure Network from Object

The other way to create a Pressure Network is to create it from Objects. This command is also found on the Create Design panel of the Home tab by expanding the Pipe Network menu. This allows you to create a pressure network and pipe run from a linear object such as a line, arc, alignment, polyline, feature line or survey figure.

You will first be prompted to select the object and either confirm or reverse the direction indicated:



Like the previous creation method you first create the pressure network, and the top of the dialog box is very similar:



1. Enter the names and other choices in the top of the dialog box down to the Reference Alignment just as described for the Create Pressure Pipe Network dialog box.
2. The **Horizontal offset distance** allows you to create the pressure pipe run at a specified offset from the selected object. Just like a station offset, a negative value will offset to the left along the object and a positive value will offset to the right – relative to the direction chosen when selecting the object.
3. The **Elevation reference** allows you to choose between setting a cover value relative to a surface, or using the vertex elevations of the selected object.
4. Lastly choose to erase the original object or not.

Tip: You can use this method to create parallel pipe runs by selecting an existing pipe run's alignment. **Note:** the horizontal offset is not maintained dynamically, so changing the original pipe run will not cause the offset pipe run to change.

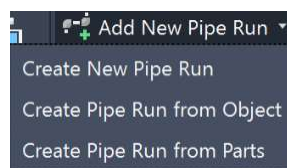
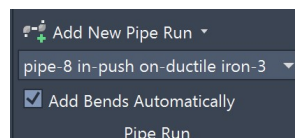
Adding new Pressure Pipe Runs

Once you've created a pressure network you can add additional pipe runs. There are multiple ways to do this:

1. Add New Pipe Run from Pressure Pipe Network Creation Tools
2. Add Pipe Run...
3. Add Pipe Run from Object...
4. Add Pipe Run from Parts...

Add New Pipe Run

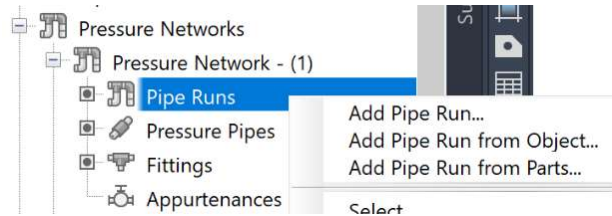
After you've created your first pipe run with the Pipe Network Creation Tools, the tools remain open to allow you to continue creating pipe runs or other editing. If you've created the pipe network from an object, or if you already have pipe runs in a network you can reopen the Pipe Network Creation Tools by selecting a pipe run. The tools will open for the pressure network of the selected pipe run – so if you have multiple networks just be aware of which one you are editing.



From the Pipe Run panel of the Pipe Network Creation Tools you can expand **Add New Pipe Run** to select an option for creating the pipe run:

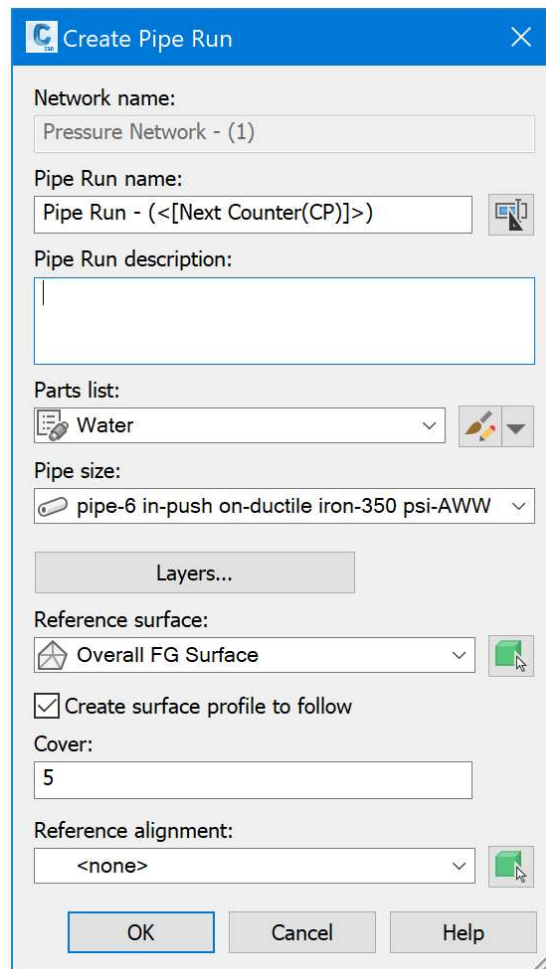
1. Create New Pipe Run
2. Create Pipe Run from Object
3. Create Pipe Run from Parts

Another way to get to these Pipe Run creation methods is from the Pipe Run collection in Prospector:



Create Pipe Run

The following dialog box opens when you select **Create New Pipe Run** or **Add Pipe Run...** allowing you to give a new name and options to the new pipe run:



Create Pipe Run

Network name:
Pressure Network - (1)

Pipe Run name:
Pipe Run - (<[Next Counter(CP)]>)

Pipe Run description:

Parts list:
Water

Pipe size:
pipe-6 in-push on-ductile iron-350 psi-AWW

Layers...

Reference surface:
Overall FG Surface

☒ Create surface profile to follow

Cover:
5

Reference alignment:
<none>

OK Cancel Help

Selecting **OK** to the above dialog box puts you back into the layout mode to pick the path for the pipe run.

Create Pipe Run from Object

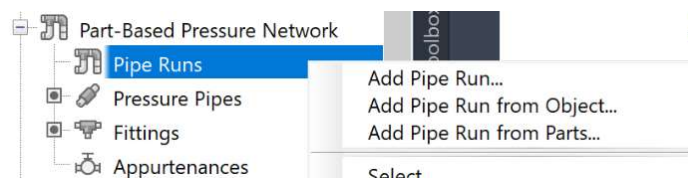
Creating a new pipe run from an object restarts the same workflow described above to create a Pressure Network from Object. The only difference is that the Pressure Network

is already entered and cannot be changed because you are creating the new pipe run in an existing Pressure Network.

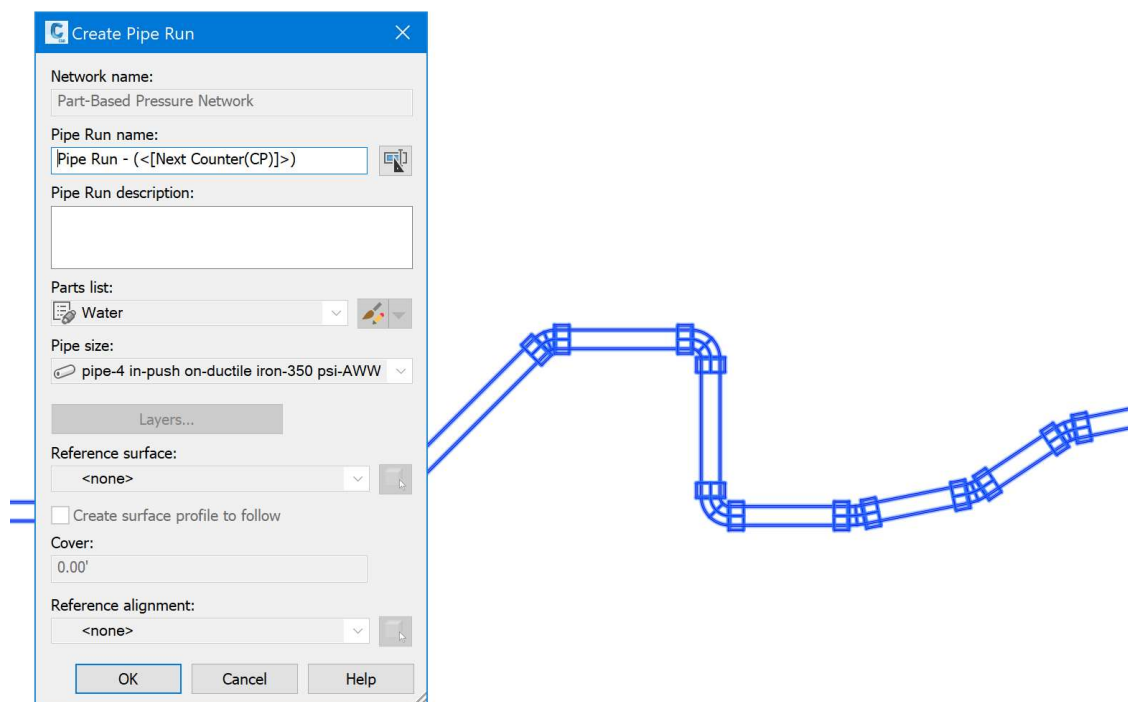
Tip: If you return to Create Pressure Network from Object then Civil 3D will create a separate pressure network for each object selected. Instead, reuse this command when you have multiple linear objects that you want to add to the same Pressure Network.

Create Pipe Run from Parts

Creating Pipe Runs from Parts converts part-based pipe network parts into a path-based Pipe Run. You may have part-based pipe network parts if you opened a drawing from an earlier version of Civil 3D. Use this command to turn those into Pipe Runs.



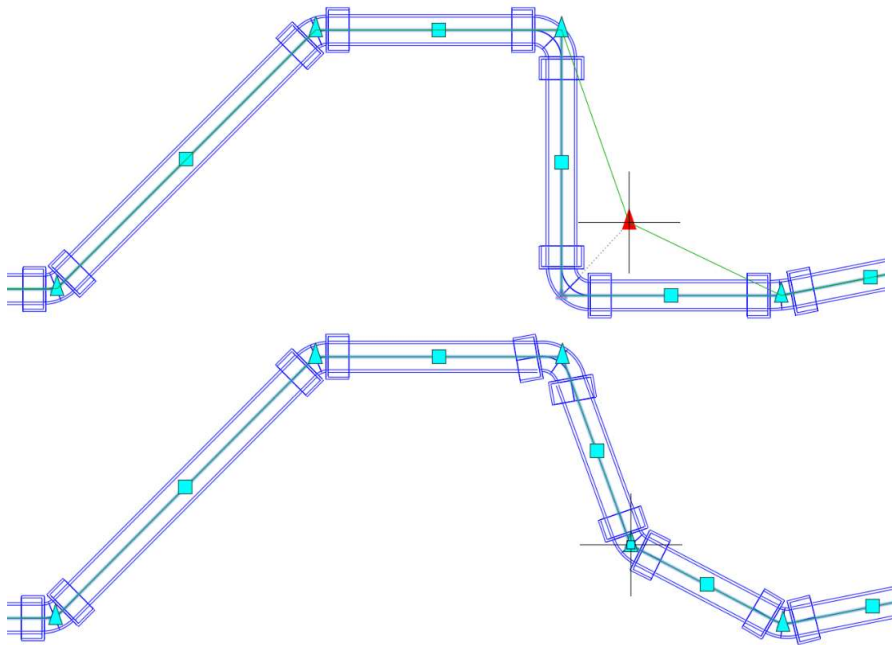
When adding pipe runs from parts, the only option enabled is to give the new run a name.



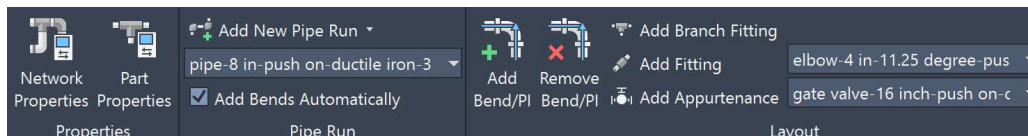
Note: The new pipe run will remain in the pressure network of the original parts – even if you selected the Pipe Runs collection from a different network.

Editing Pressure Pipe Runs

Once a pipe run is created you can edit it directly by moving the point of intersection (PI) grips of the pipe run alignment. This will realign the pipe run path. The pipe run elbows will update to fittings that most closely matches the new angle in the alignment.



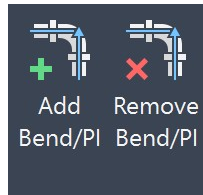
Pipe runs can also be edited with some of the other tools in the Pressure Network Creation Tools:



Add and Remove Bends

It may be necessary to add or remove bends in the pipe run. Since elbow/bends are placed at PI points along the pipe run alignment, adding bends and adding PI points is the same thing, as is removing bends and PI points.

The **Add Bend/PI** command will add a PI point to the pipe run alignment. First select the pipe run, and then pick a point in the drawing for the PI location. An elbow/bend fitting that best matches the created angle will be placed at this PI point. Adjacent bends may update if those angles change.

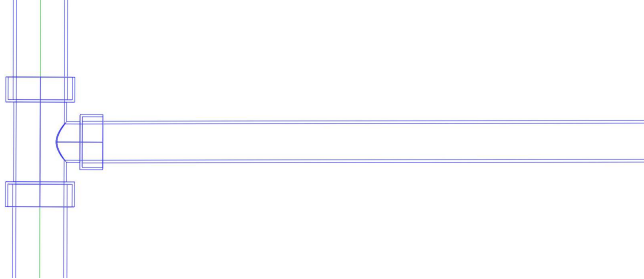


To remove bends and PI points first select the pipe run, and then select a point near the bend/PI point to be removed. Both the PI point in the pipe run alignment and the bend fitting with both be removed.

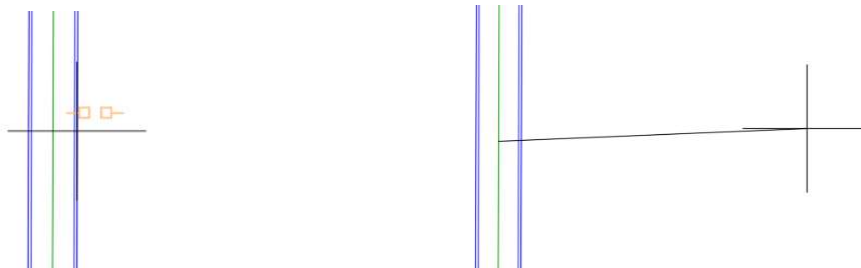
Pressure Pipe Branch Fittings

As you add multiple pipe runs to a network, eventually you will likely connect some pipe runs to each other – creating branches. Branch fittings include fittings such as tees, crosses, and wye's. Currently, the branch fitting commands support tees and crosses by using the Add Branch Fitting command. Tees can also be added automatically when two pipe runs connect.

Snapping a new pipe run to an existing pipe run in the same network will automatically create a tee at the branch location – and match the pipe sizes:

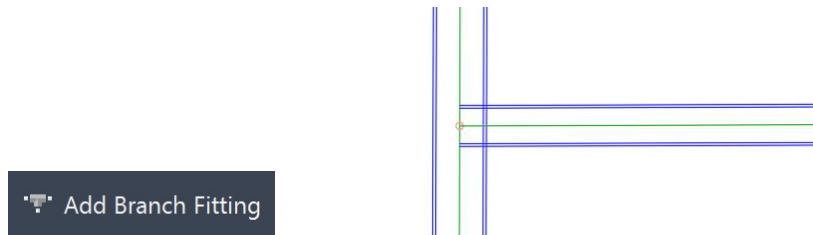


In order to snap to an existing pipe run, hover over the pipe and verify that the connection glyph is shown, and then start drawing the path:



Note: you can also draw this in the opposite direction by ending on the existing pipe run.

Maintaining these branch fittings has not yet been supported, so editing the pipe runs may cause the tee to be removed. If the tee is removed you can add it back using the Add Branch Fitting command on the Layout panel.



1. Select the **Add Branch Fitting** command, shown above
2. Select the first pipe run at the branch intersection (For crossing pipe runs at different elevations, first select the pipe run with the elevations you want to maintain.)
3. Select the second pipe run at the branch intersection
4. If the pipes are at different elevations you will be notified at the command line.

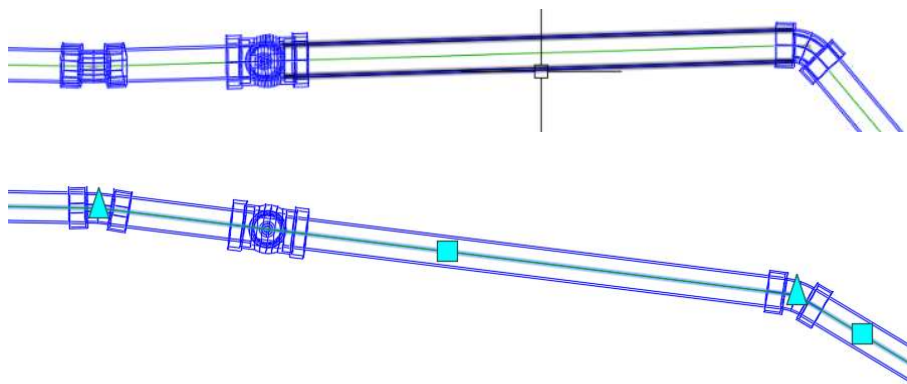
Note: The prompt in this case states that the first pipe run will remain unchanged, and the second pipe run may change elevation – however, that is only correct for crosses – not tees. For a tee, the elevation of the pass-through pipe will remain unchanged, and the connecting branch pipe elevation will be adjusted to meet it.

Other Pressure Pipe Run Tools

You can add an appurtenance, such as a gate valve or air-release valve, along a pipe run using the Add Appurtenance command.

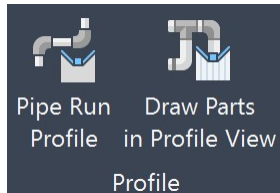
1. First pick the appurtenance from the drop-down list
2. Select the **Add Appurtenance** command
3. Select a point along the pipe run where you would like the appurtenance added.

The appurtenance will automatically break the pipe it's being added to and place the appurtenance. However, it will not add a PI point at the appurtenance – so if the path of the pipe run is changed, the appurtenance will move with the pipe run instead of adding a deflection point.



Design Pressure Pipe Runs Vertically



Pressure Pipe Runs can be designed vertically using the commands on the Profile panel of the Pressure Network Creation Tools, and the Pressure Network Profile Layout tools.






Pressure Pipe Run Profiles

The vertical path of pipe runs are controlled at the crown of pipe to follow its Pipe Run Profile. The Pipe Run Profile is associated with the vertical layout of the pipe run similar to the alignment that controls the horizontal path of the pipe run. It can be built dynamically to reference a surface profile or a layout profile along the same pipe run alignment.

Reference Profile:

Create from Surface  

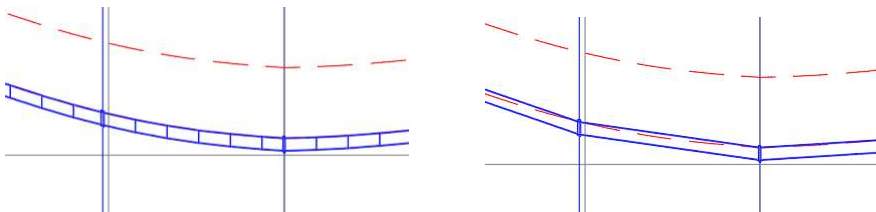
Pick a Surface:

 Overall FG Surface  

Offset Distance:

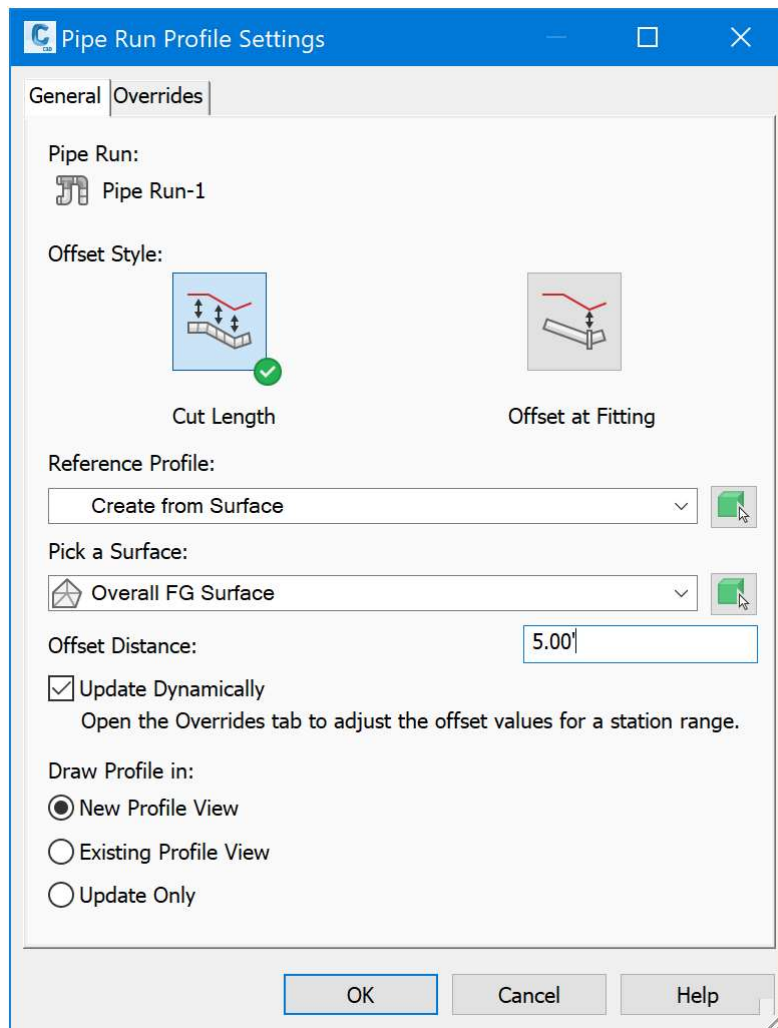
☒ Update Dynamically

The pipes can be vertically offset in profile at increments equal to the cut length of the pipe or simply in straight sections of pipe only offset at the fittings. This is set by the Offset Style.



To define the pipe run profile

1. Launch the Pipe Run Profile dialog box

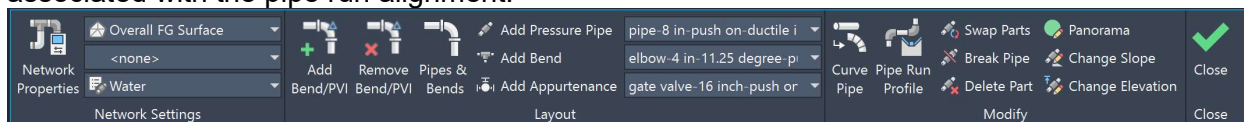


To define the pipe run profile:

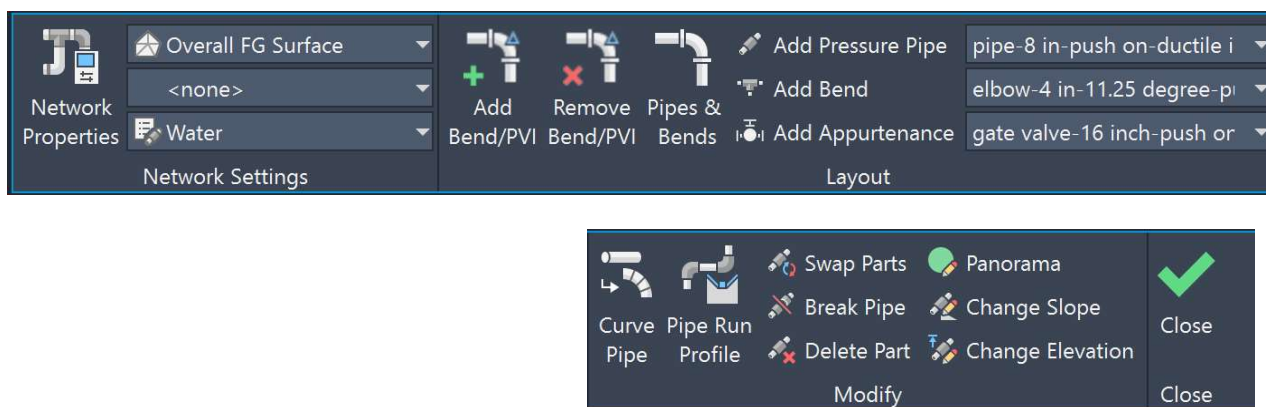
1. Select the **offset style**
2. Select the reference profile, the options are:
 - a. A Surface profile or Layout profile that's already been created along the pipe run alignment. **Note:** there may already be a reference profile if it was created previously – this should be selected by default.
 - b. Create a new surface profile from a surface by selecting the surface to reference.
3. Select the vertical **offset distance**
4. Choose if you want the pipe run to stay dynamic with the reference profile
5. Choose where to draw the pipe run profile, the options are:
 - a. New Profile View – use this if you do not have a profile view where you want to display the pipe run.
 - b. Existing Profile View – use this if you already have a profile view in the drawing where you want to display the pipe run.
 - c. Update only – use this if the parts are already displayed in a profile view(s) and you only want to update the parts in that (and all) profile views.

Editing Pressure Pipe Profiles

The vertical layout and path of pressure pipe runs can be edited once they are in a Profile View associated with the pipe run alignment.



Here's a closer look at those tools:



Note: Editing the vertical path of the pressure pipe run must be done in a profile view associated with the pipe run alignment. Pressure pipe runs and/or individual parts can be added to any profile view, but editing the pipe run profile will not be enabled if the profile view is not associated with the pipe run alignment.

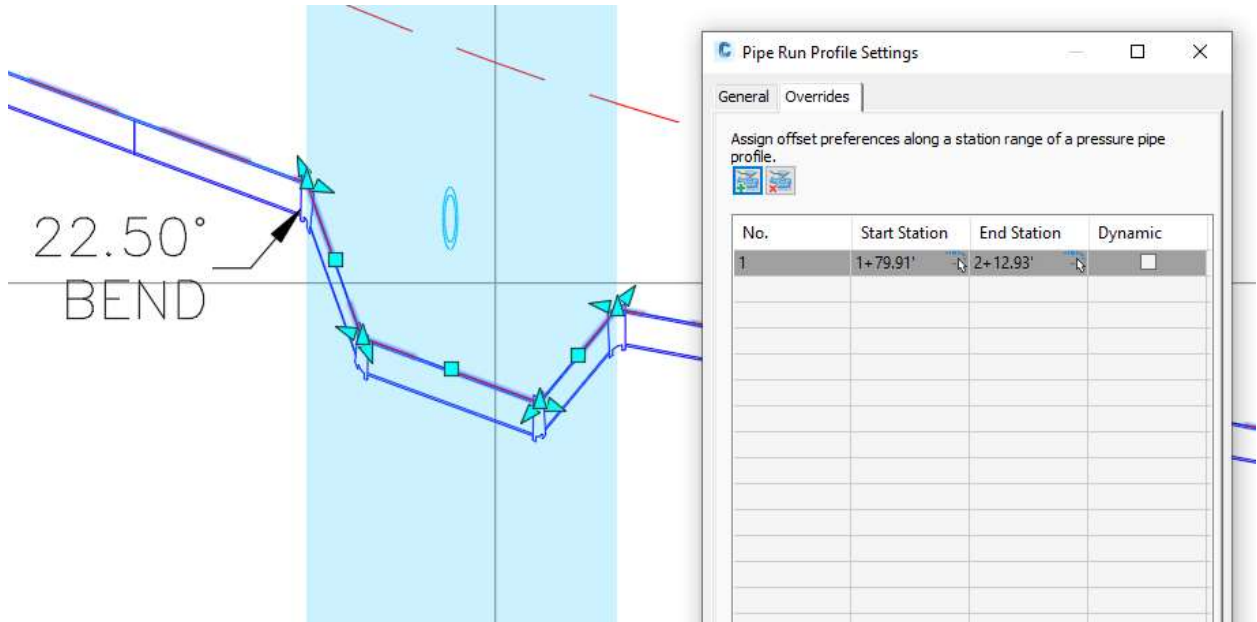
Pipe Run Profile Overrides

For most pipe runs you may wish to have the vertical path dynamically linked to the surface profile while maintaining the required cover depth. In areas where a change needs to be made – often to avoid obstacles like other pipes – you may want that change to override the dynamic behavior of the pipe run profile. For this we can define override station ranges. The majority of the pipe run may stay linked to the pipe run profile, except where overrides are defined.

1. Select the Pipe Run in Profile View
2. Select the **Pipe Run Profile** button from the ribbon
3. On the **Overrides** tab use the Add button to add a station override
4. In the table set the start station and end station
5. Uncheck the **Dynamic** checkbox (if checked) so that this range can be manually edited without reverting to the pipe run offset.

Note: You may also see override stations added automatically. This occurs when you directly edit the pipe run profile PVI's.

To remove station overrides, use the Remove button on the Overrides tab.



Adding and Removing Bends / PVIs

One way to define a lowering or other manual edit is to add Bends on the pipe run profile. The **Add Bend/PVI** button will add a point of vertical intersection (PVI) to the profile and add a bend fitting at that location.

Tip: If you want to add a bend fitting at an existing PVI without adding another PVI next to it, then use the End Osnap to be sure the exact PVI point is picked.

Use the **Remove Bend/PVI** button to simultaneously remove the bend fitting and the PVI at a desired point.

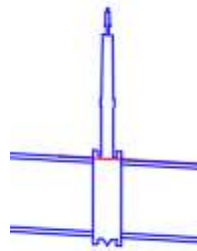
Note: There are times when a change to the profile may cause a bend fitting to no longer be located at a PVI point in the pipe run profile. Since there is no PVI at this location you cannot use the Remove Bend/PVI button. Instead, use the **Delete part** to remove bends no longer at PVI.

Add an Appurtenance

It may be convenient to add appurtenances from the profile view. For example, when adding air release valves it helps to see where the high points in the pipe run are.

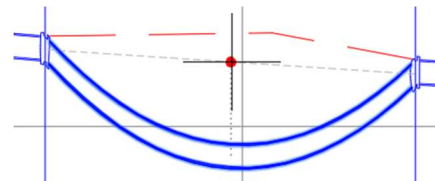
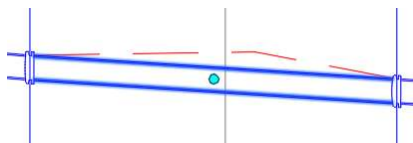
1. Select the appurtenance that you want to add
2. Select the **Add Appurtenance** button and then pipe a point along the pipe run to add the part.





Pressure Pipe Vertical Curves

A straight pipe in a profile view can be curved vertically using the vertical curve grip. The vertical curve can be removed by using the vertical curve grip again and moving it back to the original point.



Note: You cannot curve a pipe that uses the Cut Length offset style.

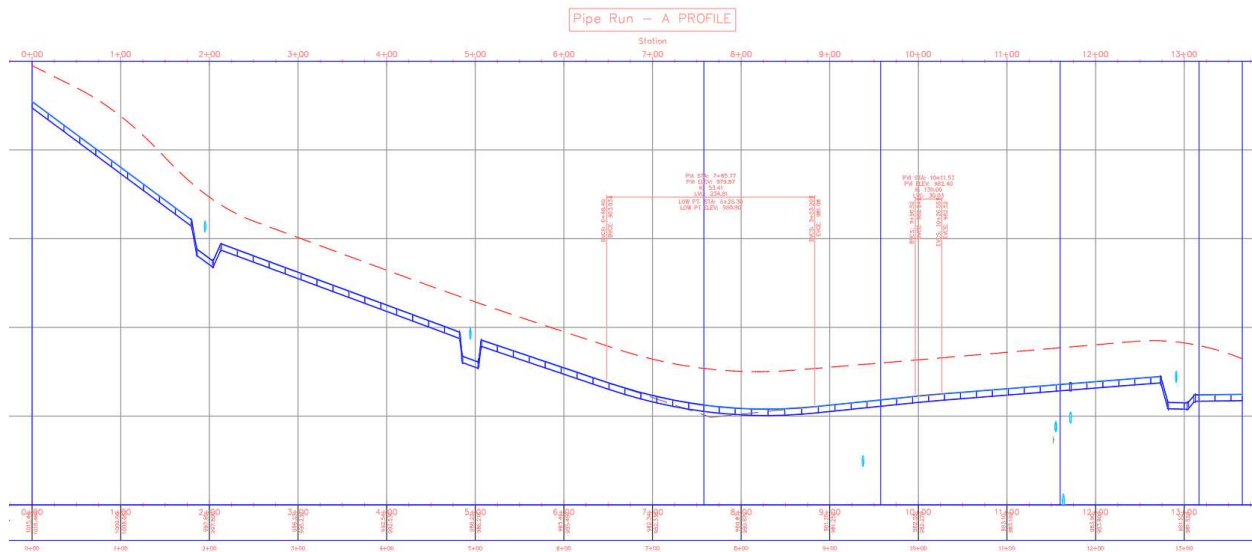
Tip: If you notice during any edits that the Pipe Run did not update as expected, or the pipes don't seem to be following the same path as the referenced profile – then open the Pipe Run Profile dialog box and then select **OK** to close it. This will trigger the Pipe Run Profile to update.

Designing Pipe Crossings

Pipe crossings can be designed using the Pressure Network Profile Layout tools, or by creating a Layout Profile and choosing that as the profile to follow vertically.

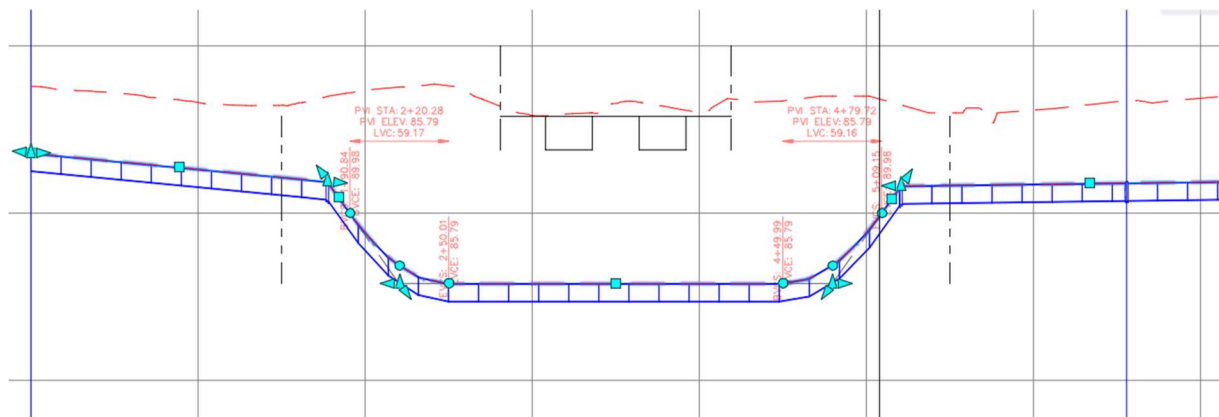
Use the Pipe Run Profile dynamically linked to the surface profile as a guide to define the proposed layout profile.

In the Pipe Run Profile Settings dialog box select this new layout profile for the Reference Profile.



Horizontal Directional Drilling

To model a pipe run along a horizontal directional drill the workflow is exactly the same as following a Layout Profile. First create a layout profile along the pipe run alignment that represents the vertical path of the directional drilling. Then have the pipe run profile follow this directional drill profile as the reference profile.



Hopefully this helps you to rediscover the pressure network tools inside Civil 3D – or to discover them for the first time!

Where To Go Next

For more details on Pressure Networks and Pipe Runs visit the [Civil 3D Help documentation for Pressure Networks online](#).