Arc Hydro Groundwater (AHGW) is a geodatabase design for representing groundwater datasets within ArcGIS. The data model helps to archive, display, and analyze multidimensional groundwater data, and includes several components to represent different types of datasets, including representations of aquifers and wells/boreholes, 3D hydrogeologic models, temporal information, and data from simulation models. The Arc Hydro Groundwater Tools help to import, edit, and manage groundwater data stored in an AHGW geodatabase. Subsurface Analyst is a subset of the AHGW Tools that is used to manage 2D and 3D hydrogeologic data, and create subsurface models including generation of borehole representations, cross sections, surfaces, and volumes.

In this tutorial we will learn how to transform points and lines to existing cross sections.

1.1 Background

In this tutorial we will demonstrate how to add points to existing cross sections. In a separate tutorial named Creating 2D Cross Sections we have described the process of creating 2D cross sections in ArcMap. The result from that tutorial is a map document with two cross section data frames A-A' and B-B'. In this tutorial we will add additional information from point and line features representing transportation features (roads and railroad) and gas stations (Figure 1). Data used in this tutorial was modified from its original source and some of the data are mock datasets created for the purpose of this tutorial.
The objective of this tutorial is to introduce the basic workflow and tools for transforming lines and point features onto cross sections in ArcMap. The tutorial includes the following steps:

1. Create an XS2D Point feature class for storing new XS2D point features.
2. Transform lines to XS2D Points.
3. Transform points to XS2D Points.
4. Visualize the transformed features in the cross sections.

### 1.3 Required Modules/Interfaces

You will need the following components enabled in order to complete this tutorial:

- ArcGIS for Desktop license (Basic\Standard\Advanced).
- Arc Hydro Groundwater Tools.
• AHGW Tutorial Files.

The AHGW Tools require that you have a compatible ArcGIS service pack installed. You may wish to check the AHGW Tools documentation to find the appropriate service pack for your version of the tools. The tutorial files should be downloaded to your computer and saved on a local drive.

2 Getting Started

Before opening the tutorial map, let’s ensure that the AHGW Tools are correctly configured.

1. If necessary, launch ArcMap.

2. If necessary, open the ArcToolbox window by clicking on the ArcToolbox icon.

3. Make sure the Arc Hydro Groundwater Toolbox is loaded. If it is not, add the toolbox by right-clicking anywhere in the ArcToolbox window and selecting the Add Toolbox... command. Browse to the top level of the Catalog and then browse down to the Toolboxes\System Toolboxes directory. Select the toolbox and select the Open button.

4. Expand the Arc Hydro Groundwater Tools item and then expand the Subsurface Analyst toolset to expose the tools we will be using in this tutorial.

We will also be using the Arc Hydro Groundwater Toolbar. The toolbar contains additional user interface components not available in the toolbox. If the toolbar is not visible, do the following:

5. Right-click on any visible toolbar and select the Arc Hydro Groundwater Toolbar item.

When using geoprocessing tools you can set the tools to overwrite outputs by default, and automatically add results to the map/scene. To set these options:

6. Select the Geoprocessing | Options... command.

7. Activate the option: “Overwrite the outputs of geoprocessing operations” as shown in Figure 2.

8. Enable the option to “Add results of geoprocessing operations to the display” as shown in Figure 1Figure 2.

9. Select OK to exit the setup.
Figure 2  Setting Geoprocessing tools to overwrite outputs by default, and to add results of geoprocessing tools to the display.

3  Opening the Map

We will begin by opening a map containing some background data for the project.

1. Select the File| Open command and browse to the location on your local drive where you have saved the AHGW tutorials. Browse to the XS2D Points folder and open the file entitled woburn_xs2d_points.mxd.

Once the file has loaded you will see a map of the model domain and the pre-created cross sections.
4 Creating an XS2D point feature classes

In this tutorial we will be transforming transportation features (lines) and gas stations (points) to XS2D points. Before we can transform features to the cross sections we need to create feature classes to hold the transformed lines/points.

1. Make sure you are working in Layout View (if you see the cross sections and the overview map you are in layout view). You can change the map to Layout View by selecting the Layout View command in the View menu.

2. Make sure the Layers data frame is activated. You can activate the data frame by selecting the data frame, right clicking and selecting the Activate command, or by selecting the layer and selecting the F11 keyboard key.

3. Open the Create XS2D Point Feature Class tool located in the Arc Hydro Groundwater | Subsurface Analyst | XS2D Editor toolset.

4. Select the SectionLine layer for the Input Section Line Features.

5. Select the XS2D_Catalog table as the Input XS2D Catalog Table.

6. Specify XS2DPoints for the XS2DType value of the XS2D Point features.

7. Specify XS2DPoints for the Feature Class Name Prefix.

At this point your inputs should be similar to the ones shown in Figure 3.

![Create XS2D Point Feature Class window](image)

Figure 3 Inputs for the Create XS2D Point Feature Class tool.

8. Select OK to run the tool.
Upon completion, two layers (XS2DPoints_1 and XS2DPoints_2) should be added to your map, one for SectionLine with HydroID = 1 and one for SectionLine with HydroID = 2.

If the layers do not appear in the Layers data frame you can add them from the woburn_xs2d_points.mdb/Data feature dataset.

5 Transforming line and point features to XS2D points

Next, we will populate the new XS2D point feature classes by transforming lines representing transportation features (railroad and roads). The features are intersected with the section lines and elevations can be read from a raster surface (e.g. digital elevation model). This forms a 3D point which is projected onto the selected cross section.

1. Open the Transform Lines to XS2D Points tool located in the Arc Hydro Groundwater | Subsurface Analyst | XS2D Editor toolset.

2. Select the Transportation layer for the Input Polyline Features.

3. Select the SectionLine layer for the Input Section Line Features.

4. Specify the XS2D_Catalog table for the Input XS2D_Catalog Table.

5. Select XS2DPoints as the XS2DType value (notice that this value is read from the XS2D_Catalog table and is based on the input you provided when creating the XS2D point feature class).

6. Input Transportation in the FType value of the features to create. This value will be written to the FType field in the new XS2D point features.

7. Select the dem100ft raster as the Ground Surface DEM or Raster Elevation Source.

8. Leave the Overwrite Existing XS2D Point Features option enabled.

At this point your inputs should be similar to the ones shown in Figure 4.

9. Select OK to run the tool.
Figure 4 Inputs for the Transform Lines to XS2D Points tool.

When finished, new features should be added to the XS2DPoints_1 and XS2DPoints_2 feature classes (you can also run the tools for each section line separately by selecting a SectionLine before running the tool).

To view the new points on the cross section:

1. Add the XS2D_Point layers to the cross section data frames. Layer XS2DPoints_1 should be added to the A-A' data frame and layer XS2DPoints_2 to the B-B' data frame.

   You can add the layers by activating the A-A' or B-B' data frame, using the *Add Data* command, and browsing to the datasets in the *woburn_xs2d_points.mdb* geodatabase, or by changing the Table Of Content to *List By Drawing Order* and dragging the layers from the Layers data frame to the A-A' and B-B' data frames.

2. You should see the new XS2D point features appear in the cross sections.

Next, we will transform point features representing gas stations and append them to the XS2D point feature class:

3. Make sure the **Layers data frame** is activated.

4. **Select SectionLine A-A'** using the Select Features tool.
5. **Select Gas Stations 1, 3 and 4.**

At this point your selections should be similar to Figure 5. When we run the transform tool only the selected points will be projected to the selected cross sections.

![Figure 5](image)

**Figure 5** Selection of features before running the Transform Points to XS2D Points tool.

6. Open the **Transform Points to XS2D Points** tool located in the Arc Hydro Groundwater | Subsurface Analyst | XS2D Editor toolset.

7. Select the **GasStations** layer for the **Input Point Features**.

8. Select the **SectionLine** layer for the **Input Section Line Features**.

9. Specify the **XS2D_Catalog** table for the **Input XS2D_Catalog Table**.

10. Select **XS2DPoints** as the **XS2DType value**.

11. Input **Gas station** in the **FType value of the features to create**. This value will be written to the FType field in the new XS2D point features.

12. Select the **dem100ft** raster as the **Ground Surface DEM or Raster Elevation Source**.

13. **Disable** the **Overwrite Existing XS2D Point Features** option.

At this point your inputs should be similar to the ones shown in Figure 3Figure 6.

14. Select **OK** to run the tool.
15. **Refresh** the map by selecting the *Refresh* button or by selecting F5.

Upon completion, you will see a set of points added to the XS2DPoints_1 feature class. We can now symbolize the features based on their type.

To symbolize the XS2D points:

16. Activate **data frame A-A’**.

17. Open the **Symbology** tab in the properties of the XS2DPoints_1 layer.

18. **FType** as the *Value Field*.

19. Select **Categories | Unique** values in the *show: window*.

20. Select the **Add All Values** option.

21. Modify the colors and size of the symbols.

At this point your inputs should be similar to the ones shown Figure 7.
Figure 7  Defining the symbology for XS2D point features.

At the end of this process you should have XS2D points showing the intersection of line features (representing railroads and roads) with section line A-A', and the location of point features (e.g. gas stations) along the section line (Figure 8).

Figure 8  XS2D Points added to cross section A-A'.
22. Repeat steps 3-19 to add and symbolize points in cross section B-B’. In Steps 4 and 5 change the selection to B-B’ section line and to gas stations 2, 1, and 5 along section line B-B’.

Upon completion, cross section B-B’ should be similar to the one shown in Figure 9.

![Cross Section B-B’](image)

*Figure 9  XS2D Points added to cross section B-B’.*

### 6 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- XS2D points can be added to a cross section to represent a wide array of features.

- The *Transform Lines To XS2D Points* tool creates XS2D Points representing the intersection of line features with section lines.

- The *Transform Points To XS2D Points* creates XS2D Points representing point features along the section lines.