Cartography. MOOC

Exercise

Authoring a 3D Map

Section 5 Exercise 2

05/2018

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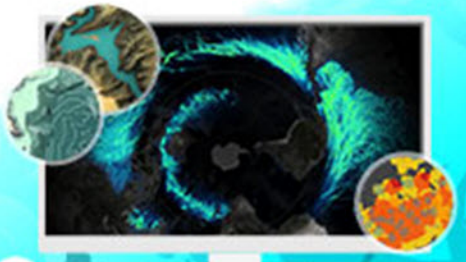


Authoring a 3D Map

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screenshots you see in the course materials.

Time to complete

Approximately 55-60 minutes.

Software requirements

ArcGIS Pro 2.1

Introduction

Some GIS content is best viewed in three dimensions. Not only is this a more natural way for people to visualize spatial data within an understandable context, but it also supports the display of vertical information, such as building heights, tree volumes, and sloping ground. Many 3D maps—also referred to as scenes—are reconstructions of the physical world, such as cities, geological strata, and regional terrains. While that kind of use case will be the focus of this exercise, it is worth noting that 3D views can also be very powerful with thematic content, such as extruded symbol heights representing property values or surfaces that represent crime levels.

There are three main components to consider when authoring any 3D scene:

1. The ground elevation surface
2. The textures that draw on that surface
3. The three-dimensional features that live within the scene

What will you learn?

In this exercise, you will learn how to perform the following tasks:

- Improve the ground surface of your scene by using multiple data sources.
- Change what is drawn on the ground surface.
- Use extrusion for simple 3D symbology.
- Use procedural symbols for more advanced 3D symbology.
- Add a preset trees layer with per-feature height.
- Add street furniture content with per-feature rotation.
- Add bookmarks to help users find their way around your scene.

Exercise scenario

A small city has some simple GIS data including the outlines of their buildings and the locations of the city-managed trees, street furniture, and points of interest. City officials would like to create a thematic 3D view to share on the web. They also have lidar data for their city. Lidar (light detection and ranging) is an optical remote-sensing technique that uses laser light to densely sample the earth's surface, producing highly accurate x,y,z measurements. City officials have used the lidar data to populate 3D information, such as building heights, into their features.

You will create a thematically styled 3D city scene using this data, and then, you will share it as an interactive web scene for others to view.

Step 1: Download the exercise files

In this step, you will download the exercise files.

a. Open a new web browser tab or window.

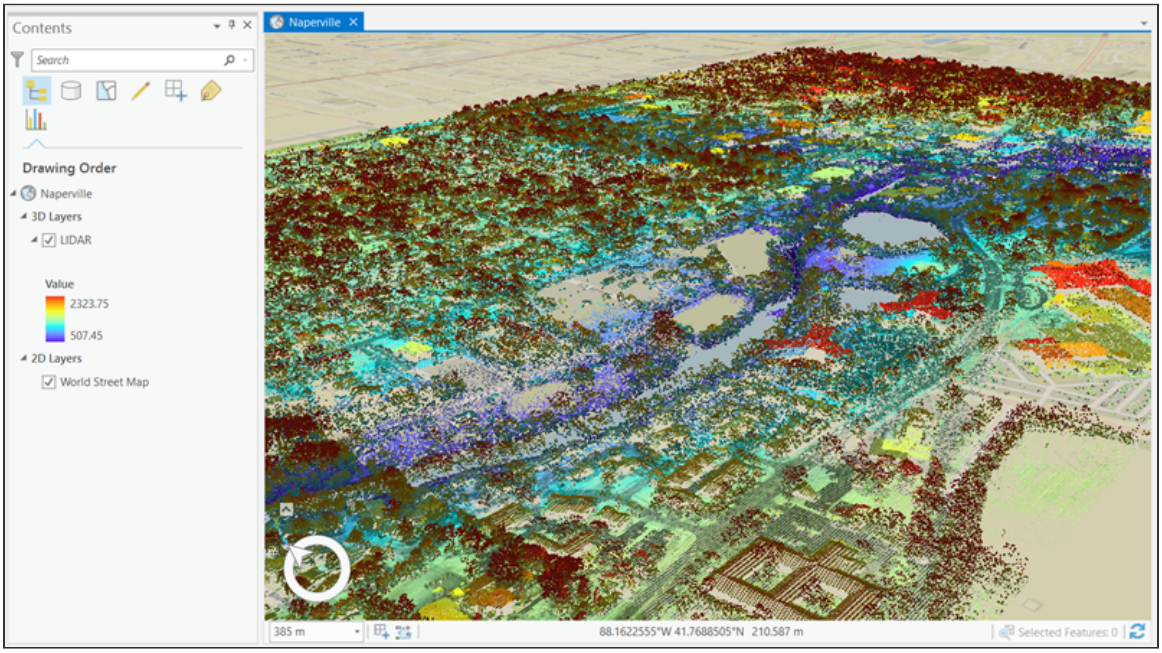
b. Go to https://bit.ly/2IF4Ptl, and download the exercise ZIP file.

c. Extract the files to a folder on your local computer, saving them in a location that you will remember.

Step 2: Open an ArcGIS Pro project file

a. From the main ArcGIS Pro start page, click Open Another Project, and browse to the Sec5Ex2_Authoring3DMaps.aprx project file that you saved on your computer.

The Naperville scene opens, with just the lidar (https://bit.ly/2Jy0VDQ) data in the scene.

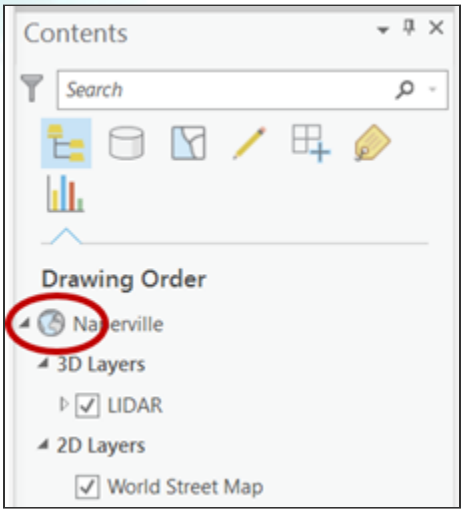


To maintain the original exercise project file, you will save your project with a different name.

b. From the Project tab, click Save As and type a name for your project, such as **Sec5Ex2_Author3DMaps_<yourfirstandlastname>.aprx**.

c. Save the file to the folder on your computer where you are saving your work.

As you learned previously, a 3D map is called a scene in ArcGIS Pro. The globe icon to the left of the Naperville item in the Contents pane identifies it as a scene. The Contents pane lists the layers contained in the Naperville scene.

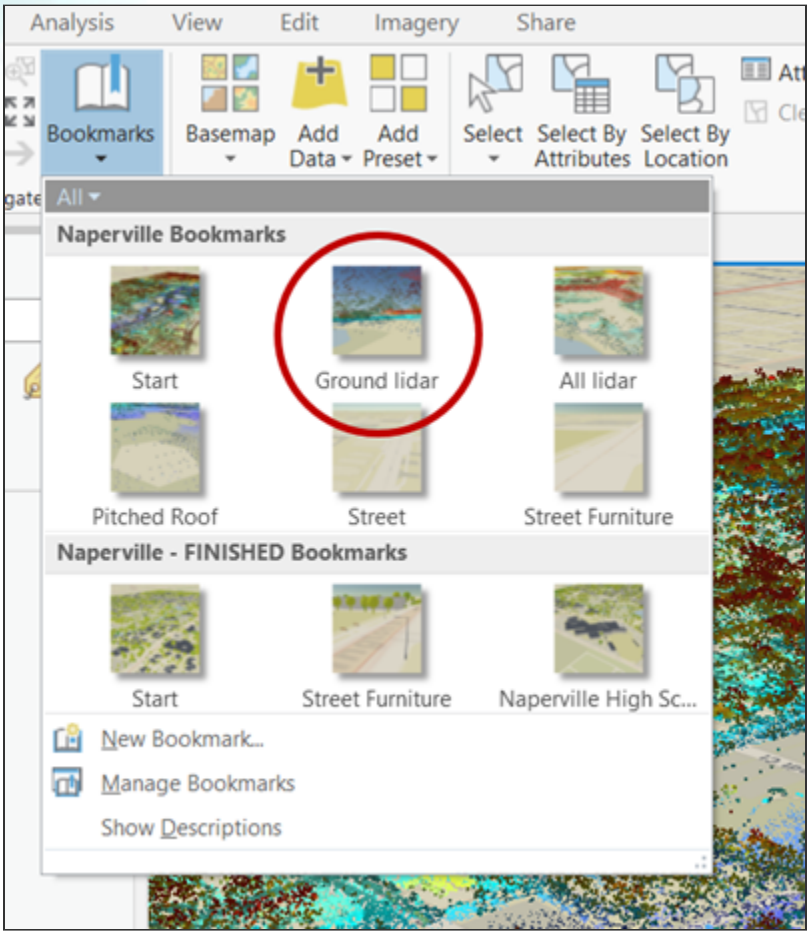


Step 3: Improve the surface

The lidar points show which objects and surfaces exist in the real world. You will improve the scene to more closely match this representation.

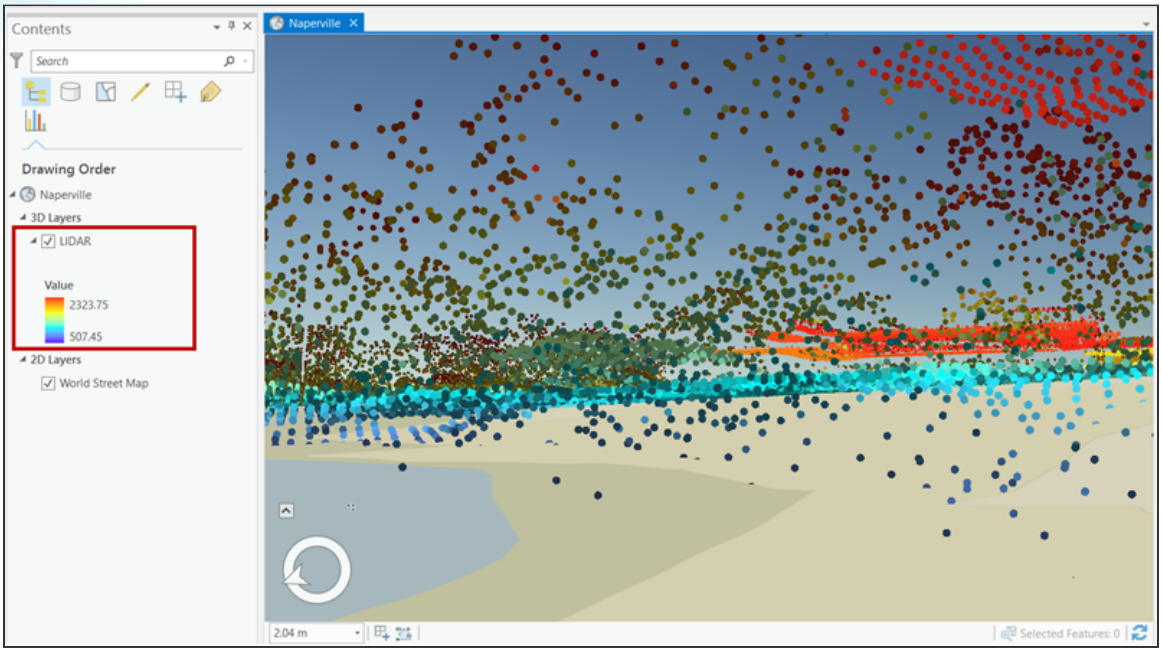
a Zoom to the Ground Lidar (Naperville) bookmark.

Hint: From the Map tab, in the Navigate group, click Bookmarks. From the Naperville Bookmarks section, select Ground Lidar.



The points are symbolized (color-coded) using their elevation values.

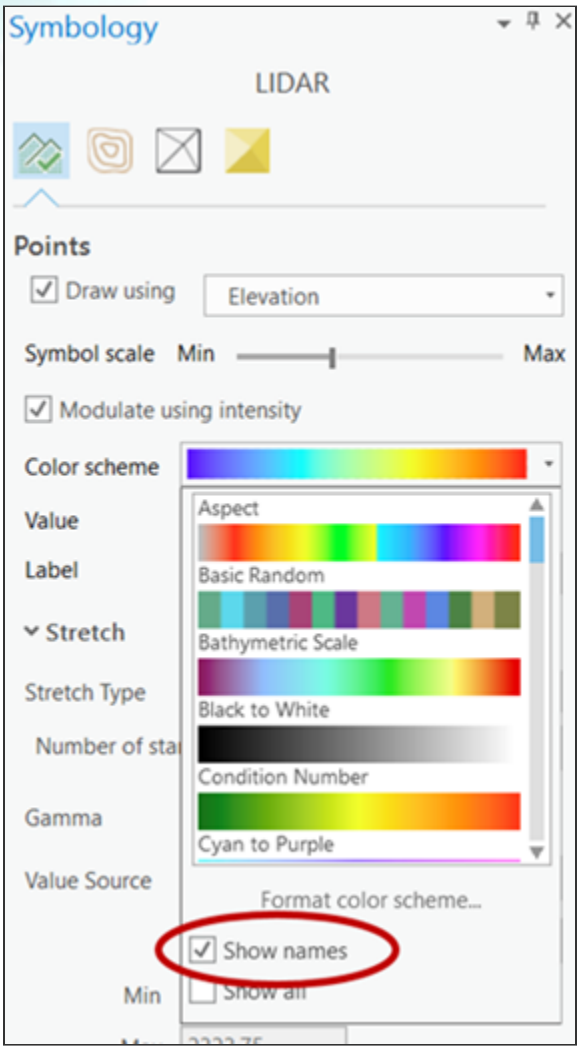
b. In the Contents pane, expand the LIDAR layer, if necessary, so that you can see the elevation values.



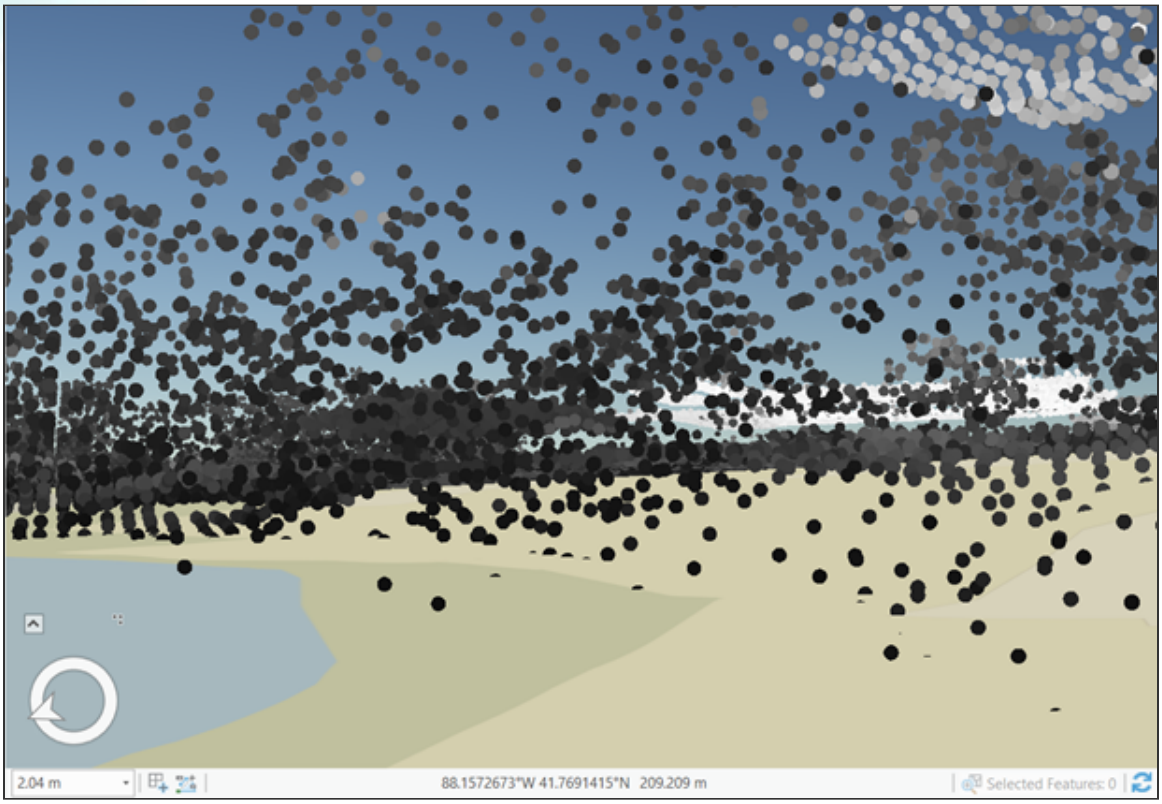
A simpler color ramp (https://bit.ly/2GQclji), such as black-to-white, could be used to more effectively visualize the elevation points.

c. In the Contents pane, for the LIDAR layer, click the existing color ramp symbol.

d. In the Symbology pane that opens, for Color Scheme, check the Show Names box.



e With the names displayed, scroll down and select the Black To White color scheme.



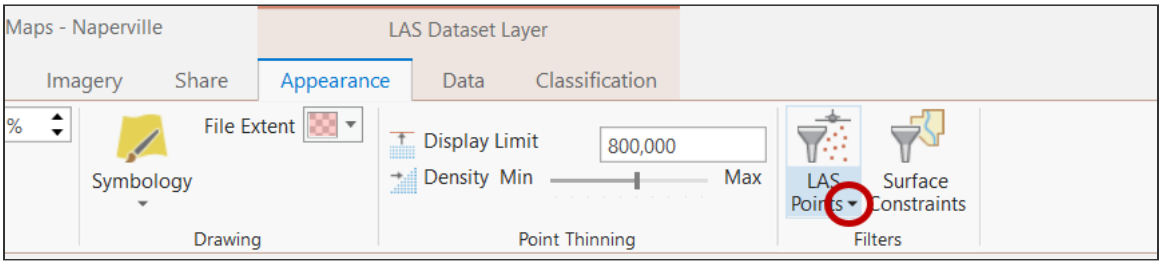
f Close the Symbology pane.

With the simpler color ramp, the elevation of the points can be better understood.

Every lidar point can have a classification assigned to it that defines the type of object that has reflected the laser pulse. Lidar points can be classified into several categories, including bare earth or ground, top of canopy, and water.

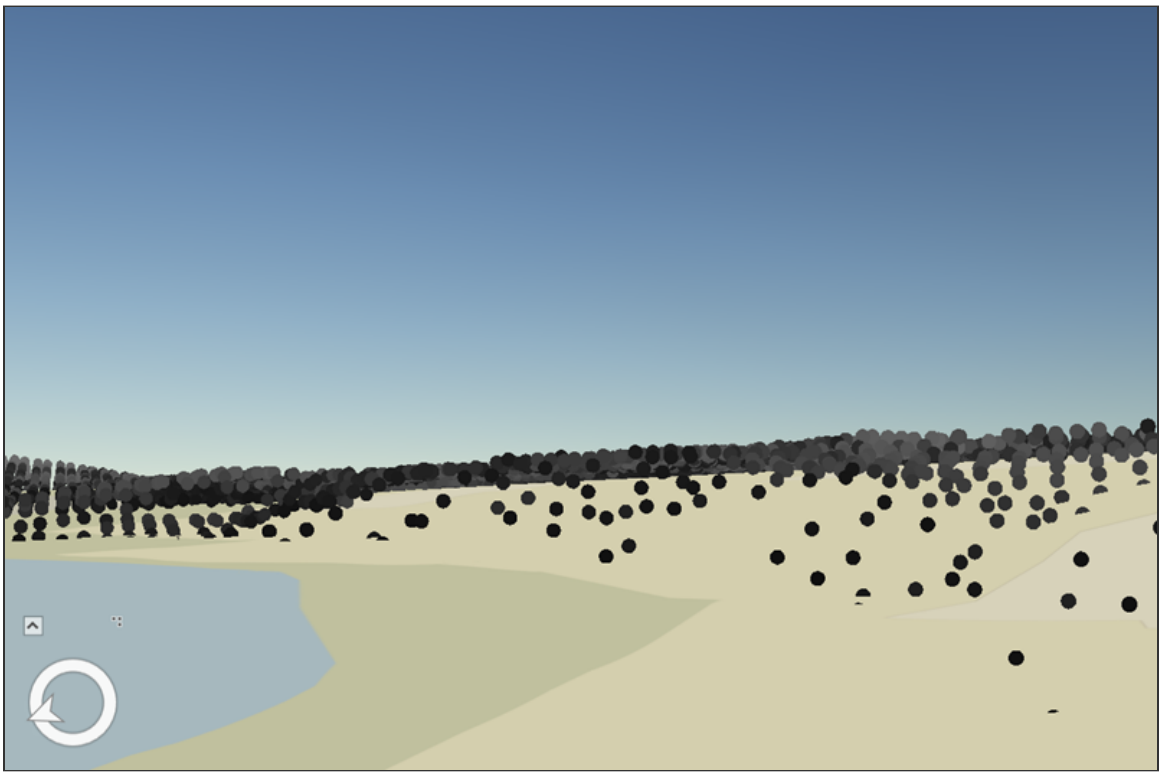
Next, you can filter out the non-ground lidar points so that you are only seeing points that are close to the current ground surface.

g With the LIDAR layer selected in the Contents pane, from the ArcGIS Pro ribbon, click the Appearance contextual tab for the LAS Dataset layer.



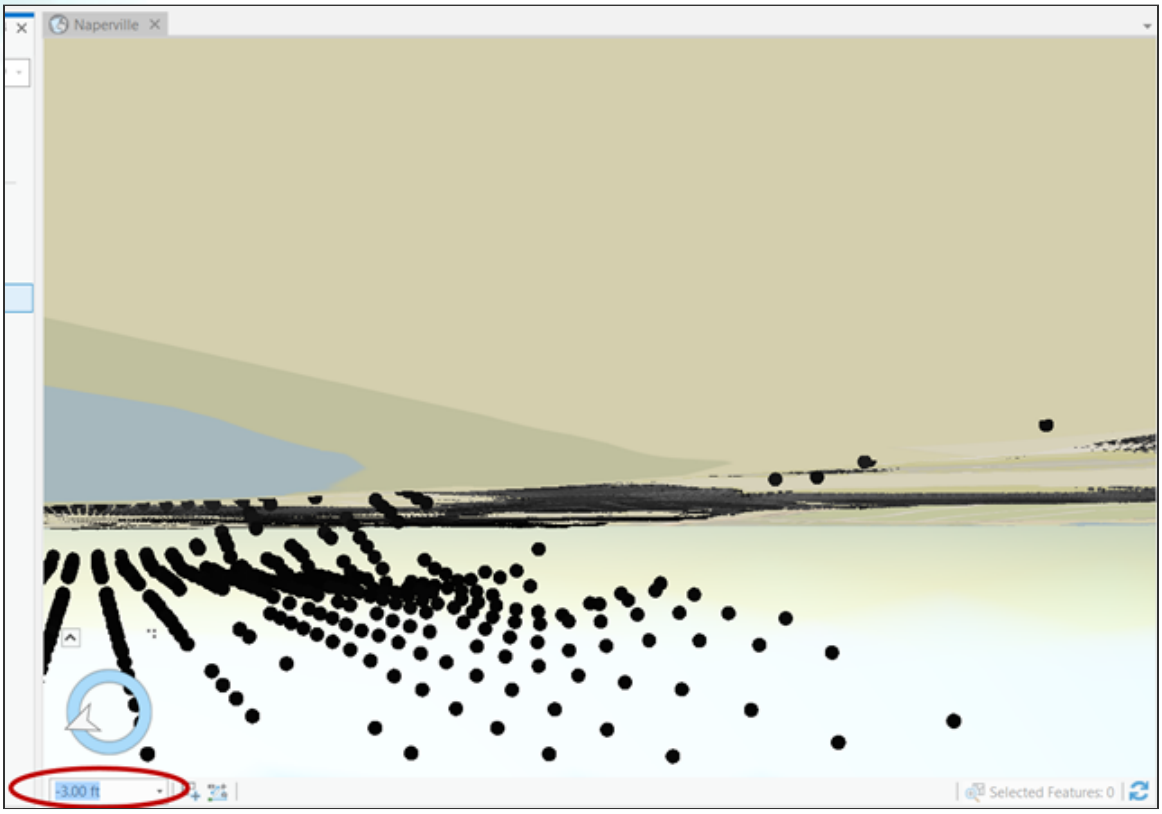
h. In the Filters group, click the LAS Points down arrow.

i. Choose Ground to show only points that are classified as ground (non-ground points will not be shown).



While this image is better, the current elevation surface does not line up with the lidar points because it is a world-extent elevation service that has a coarse cell size. You can investigate the mismatch further by navigating underground.

j. In the bottom-left corner of the map, in the elevation control field, type **-3.00 ft** and press Enter to select the -3.00 ft scale.



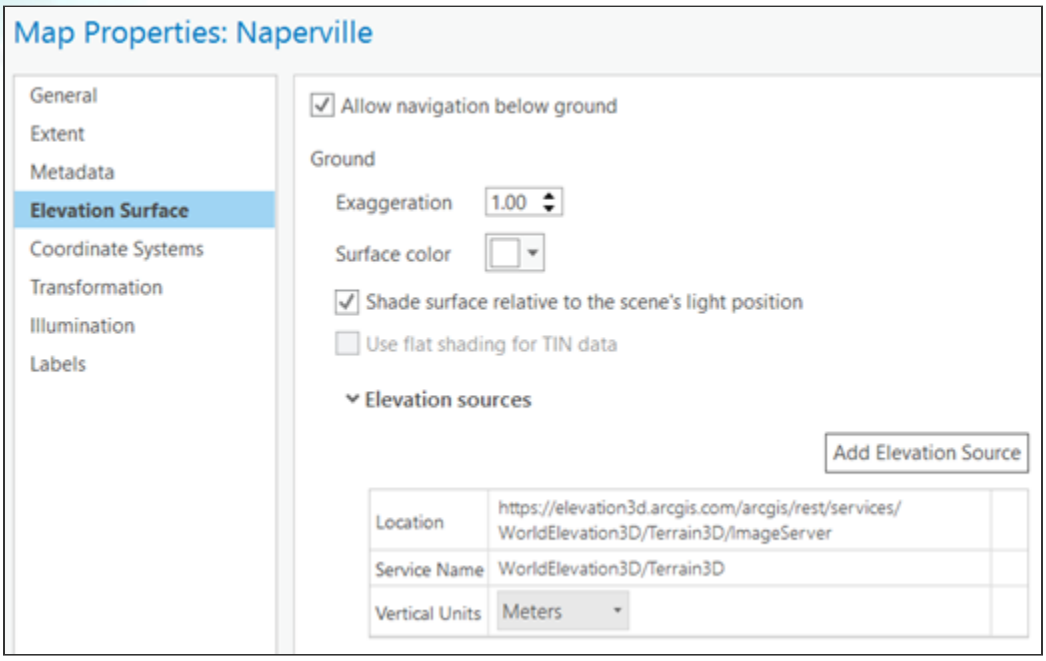
The lidar points show that the surface of the lake is actually lower than the current surface being displayed in the scene. You need to improve the quality of the ground surface to better match reality so that you can make informed decisions against it. For example, knowing the true boundary of the lake tells you where emergency response vehicles could be placed.

Now you will add a higher-resolution elevation DEM (digital elevation model) into the scene.

k. In the Contents pane, right-click the Naperville scene and choose Properties.

l. In the Map Properties dialog box, click the Elevation Surface tab and check the box next to Shade Surface Relative To The Scene's Light Position, if necessary.

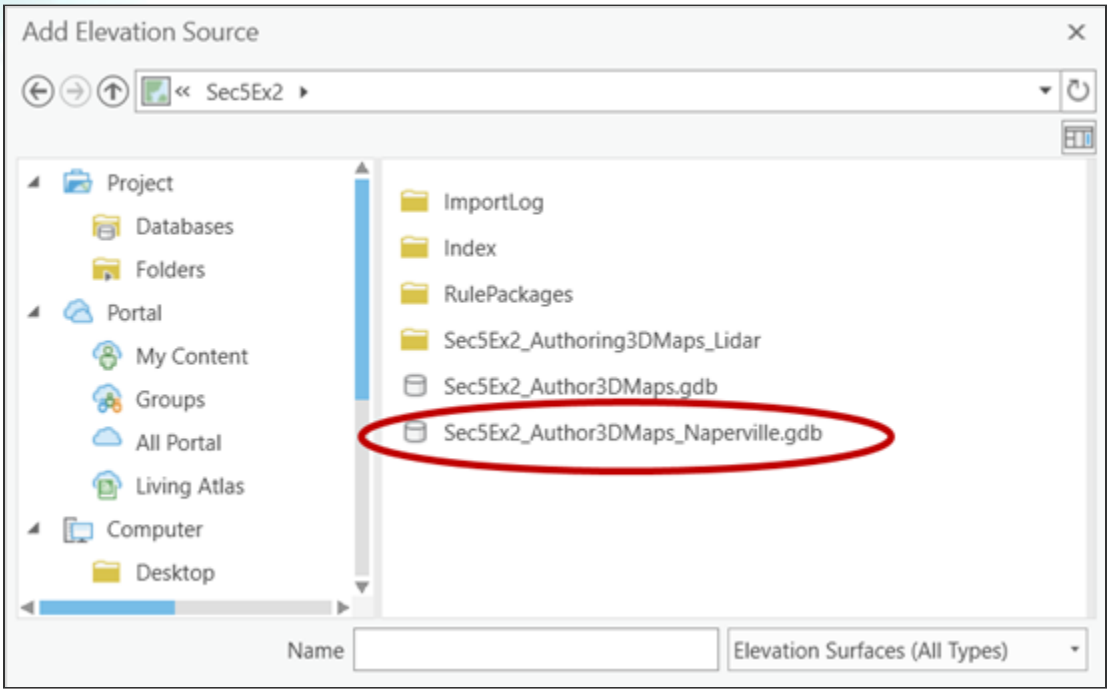
m. Expand Elevation Sources.



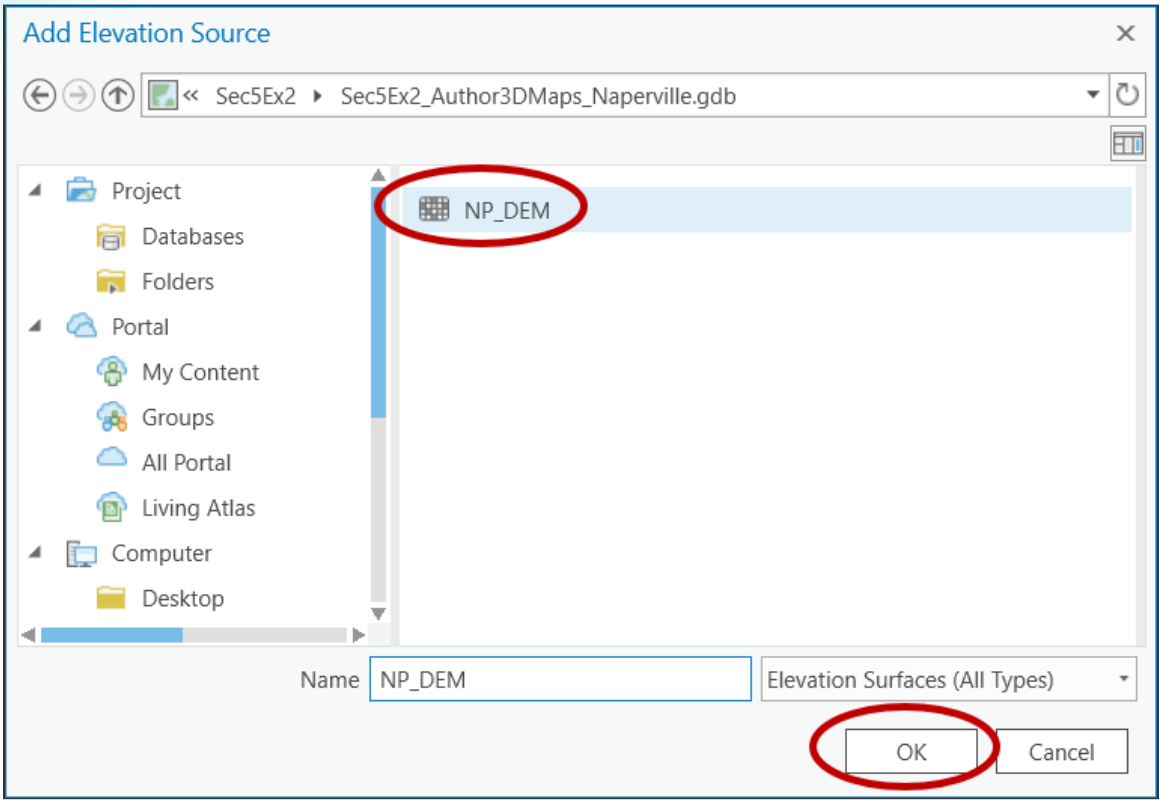
The scene only has one elevation source, listed in the Service Name field: a world-extent online service from ArcGIS Online called WorldElevation3D/Terrain3D. This service is not accurate enough for your needs, so you will add a local DEM image as a second elevation source.

n. Click Add Elevation Source.

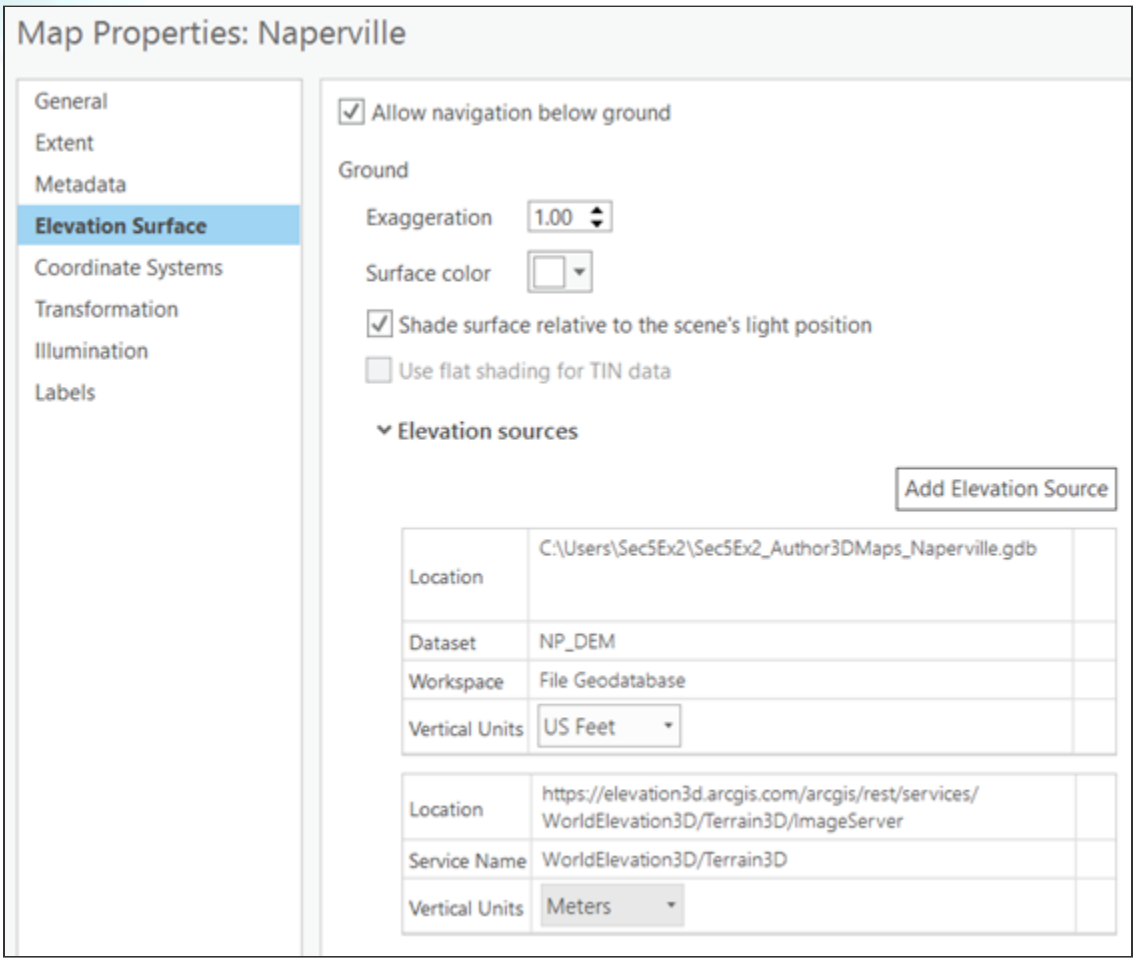
o. In the Add Elevation Source dialog box, browse to the folder where you saved your exercise files and locate the Sec5Ex2_Author3DMaps_Naperville.gdb file.



p Double-click the Sec5Ex2_Author3DMaps_Naperville.gdb geodatabase file to expand its contents, select NP_DEM, and click OK to add the new elevation source.

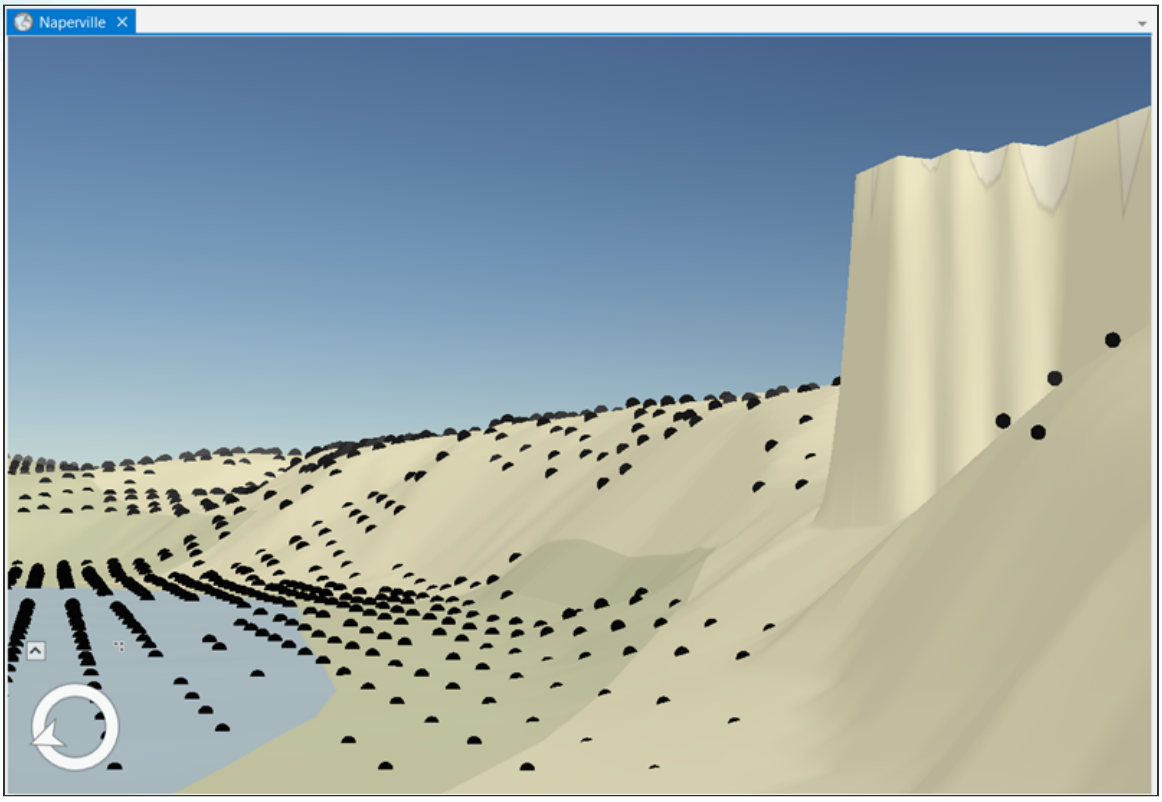


The ground surface is now constructed from two data sources: the online global service and the local dataset with a high resolution for the area of Naperville.



q Click OK to apply the change and close the Map Properties dialog box.

Note: The scene will take a few seconds to redraw as the updated surface is calculated.



The surface now lines up with the lidar points, which shows that it is a better representation of reality. If you look closely, you might notice that the lake area (a body of water) is also much flatter than before.

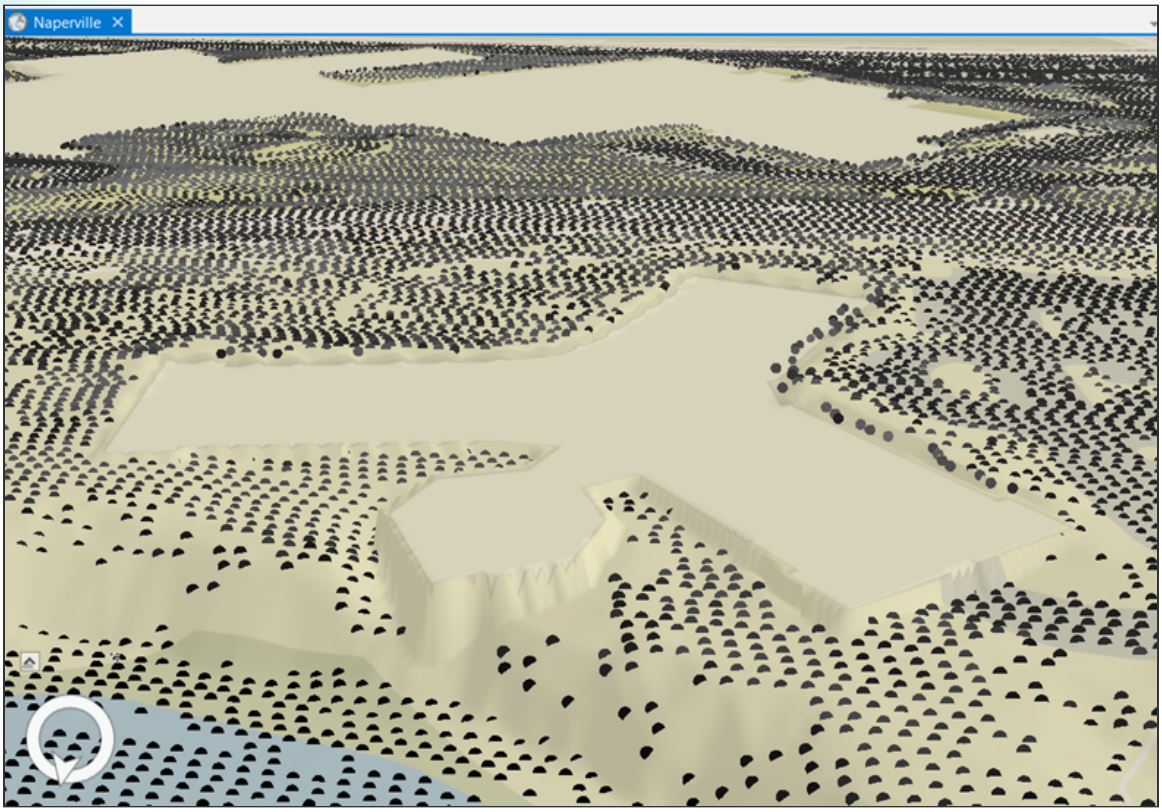
This surface can be used as a canvas for other content.

Step 4: Drape content on the surface

The ground surface can have other GIS content draped on it, such as a cartographic map, aerial imagery, or feature data. The design choices that you make should be consistent with the purpose of your scene. In this case, you would like to maintain a more thematic representation of the city, rather than a photorealistic one.

a. Zoom to the All Lidar (Naperville) bookmark.

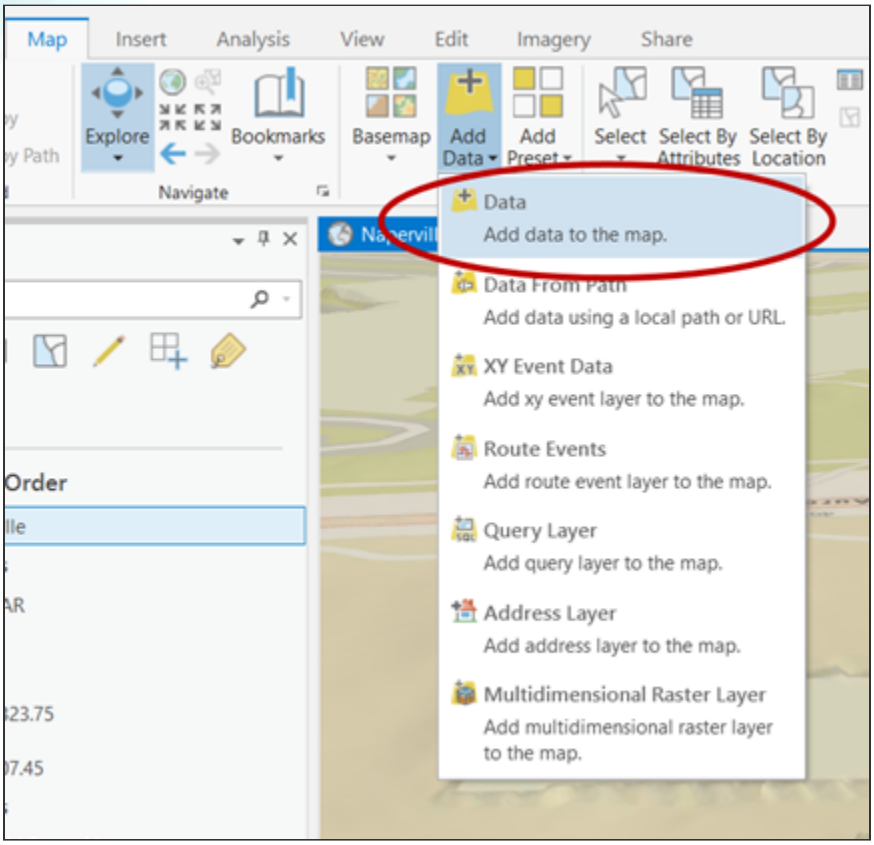
Hint: From the Map tab, in the Navigate group, click Bookmarks and choose All Lidar from the Naperville section.



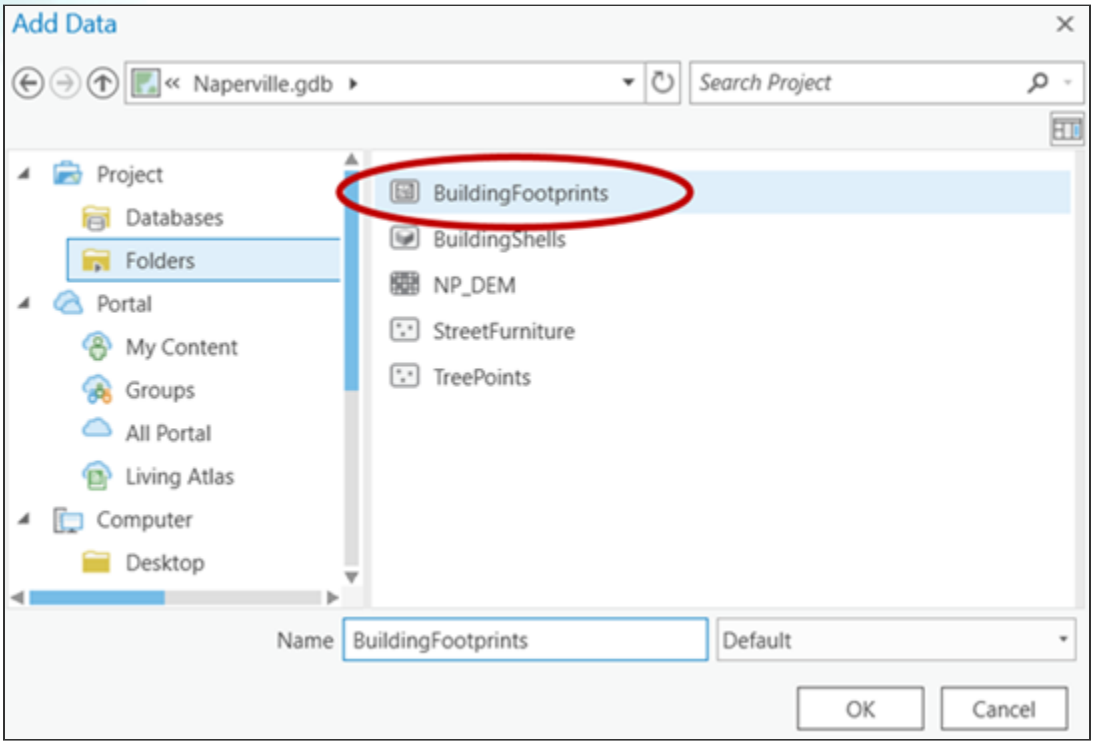
b. In the Contents pane, turn off the LIDAR layer.

Next, you will add in building footprint polygons.

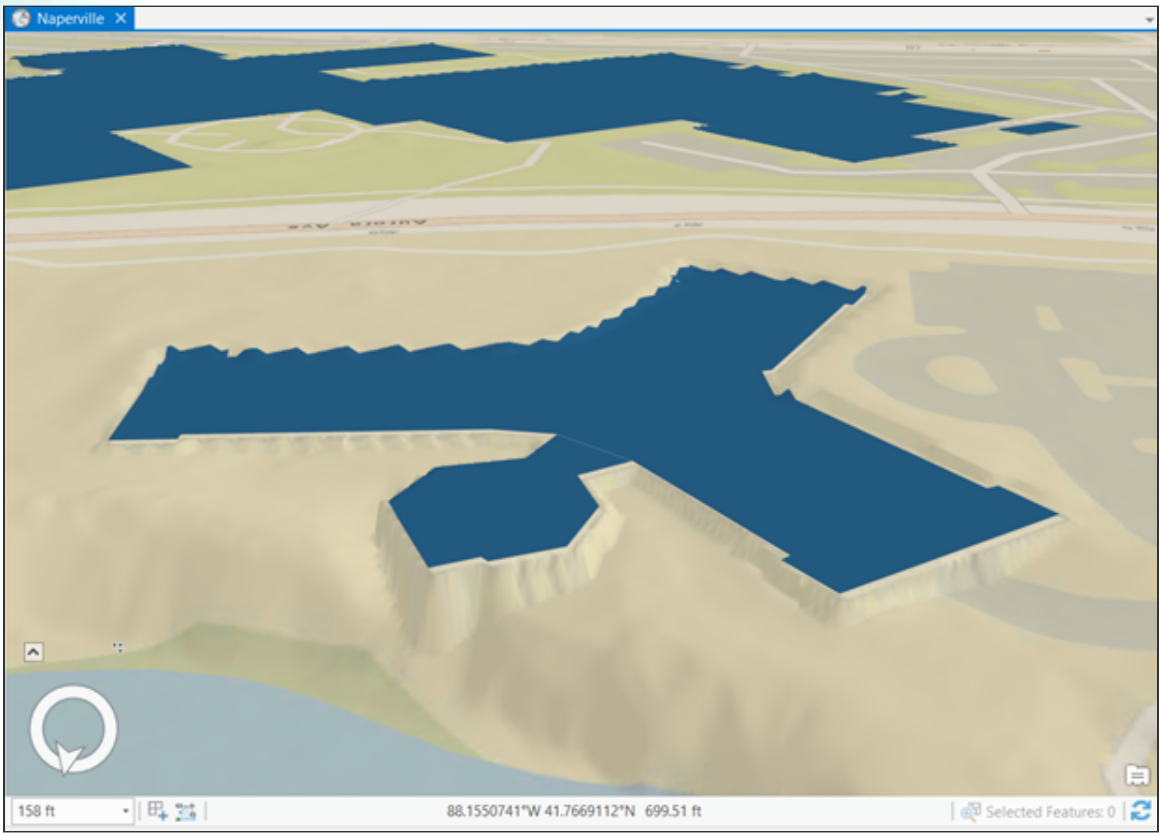
c. From the Map tab, in the Layer group, click the Add Data down arrow and choose Data.



d Browse to the location of the Sec5Ex2_Author3DMaps_Naperville.gdb geodatabase file and select BuildingFootprints.



e Click OK to close the Add Data dialog box.

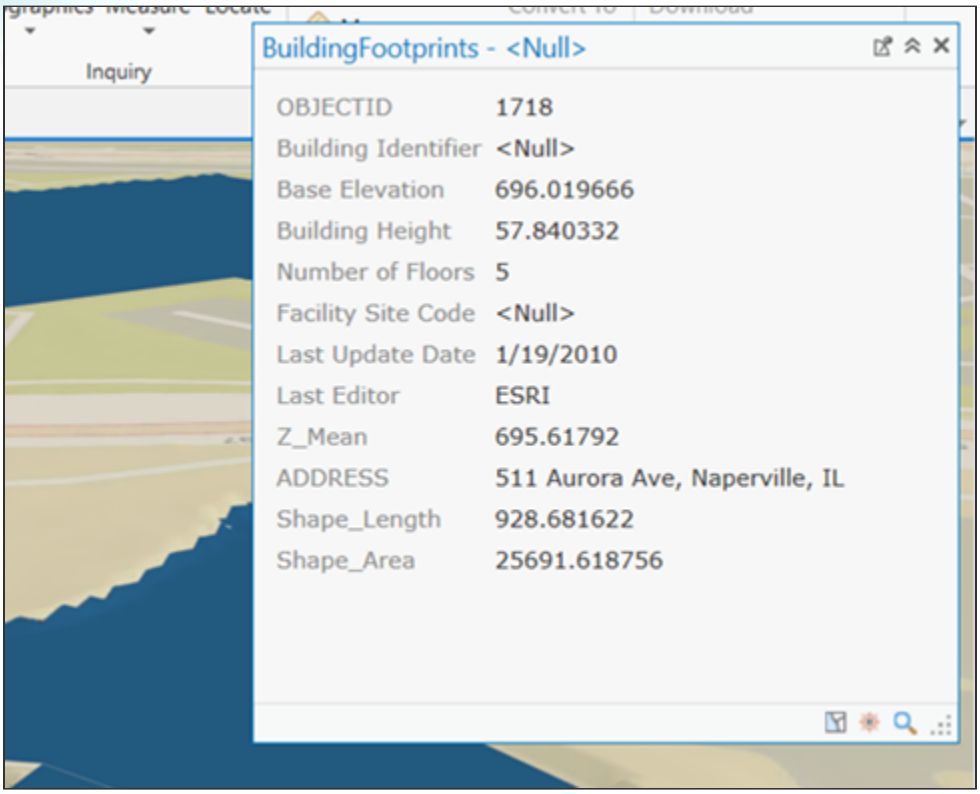


Footprint polygon data appears draped on top of the ground. The colors in your scene may be different as ArcGIS Pro randomly assigns colors to this data.

The footprint polygon data appears as "draped" on top of the ground, just like the World Street Map basemap. In the Contents pane, both layers are listed in the 2D Layers category.

This is usually the correct symbology choice for polygon and line data that lay over the ground surface, such as municipal boundaries, parks, and walking routes. If, however, you wanted the layer to have 3D vector symbology, such as building shapes, volumetric trees, or 3D pipes, then the layer would need to be moved into the 3D Layers category in the Contents pane.

f In the scene, click one of the building footprints to see a pop-up window listing the feature's attributes.



The polygons contain 3D information, including the base elevation, height, and floor count.

These values were calculated from the lidar based on the points that fell within and around each polygon. The true accuracy of the results will vary from building to building, especially with factors such as rooftop structures and overhanging trees. However, the numbers do allow for use of these features to generate 3D block buildings.

g. Close the information pop-up window, and save your map.

Step 5: Create 3D buildings

You want to use your draped and flattened polygons as 3D building objects, so the first thing that you will do is reclassify the layer as 3D.

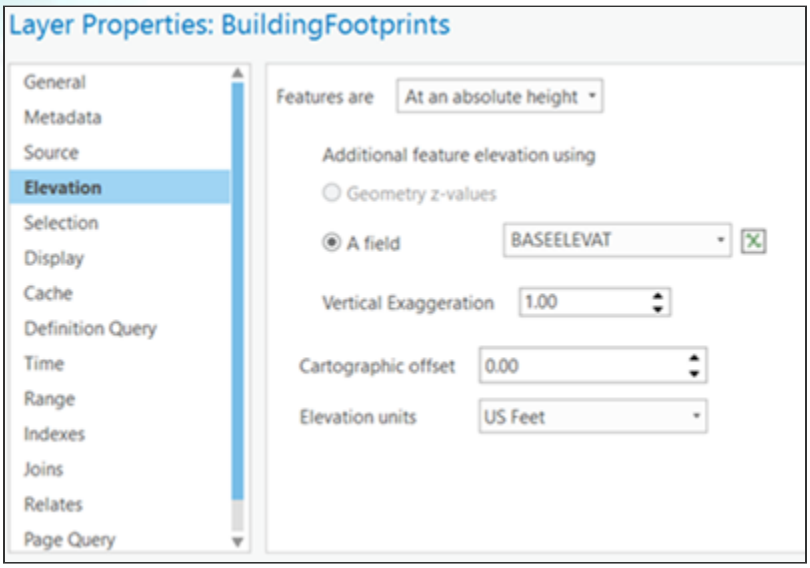
a. In the Contents pane, click and drag the BuildingFootprints layer into the 3D Layers category, placing it above the LIDAR layer.

The layer will look like it is fragmented because the vertices of each polygon are being placed on the uneven surface and slicing in and out of the ground. You will set their display height to a single flat value using their Base Elevation attribute.

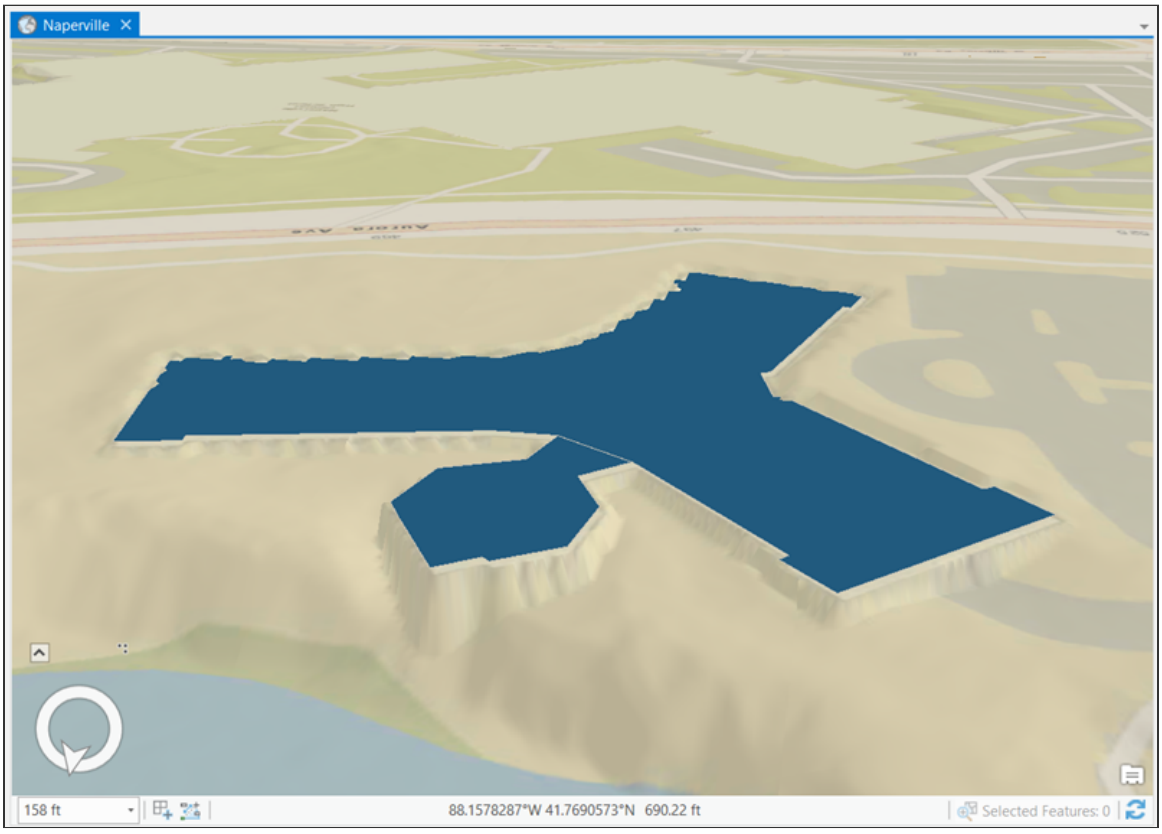
b. In the Contents pane, right-click the BuildingFootprints layer and choose Properties.

c. In the Layer Properties dialog box, from the Elevation tab, set the layer features to be At An Absolute Height.

d. Select the A Field option and choose BASEELEVAT from the drop-down list to set the height value to the BASEELEVAT (base elevation) field.



e Click OK to close the Layer Properties dialog box.



The polygons will display again (in line with the surface) because their height values and the ground surface came from the same source—the lidar. The footprints are at their correct base

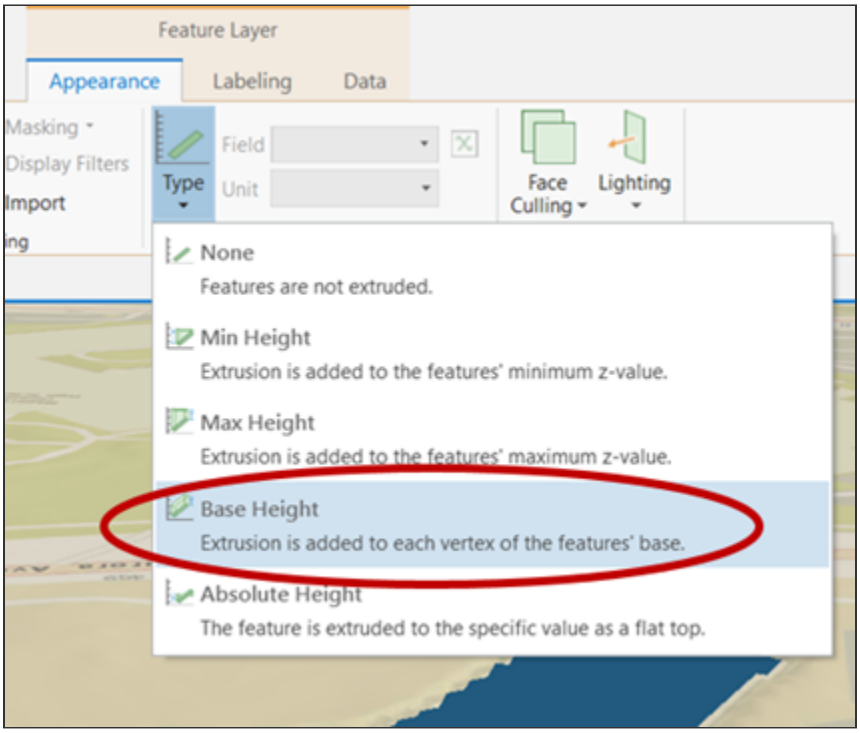
height, so you now need to extrude each of them up to their building height. Extrusion (https://bit.ly/2Hd51CR) is the process of stretching a flat 2D shape vertically to create a 3D object. This provides a simple method to create three-dimensional symbology from two-dimensional features.

Next, you will apply extrusion to the polygon shapes.

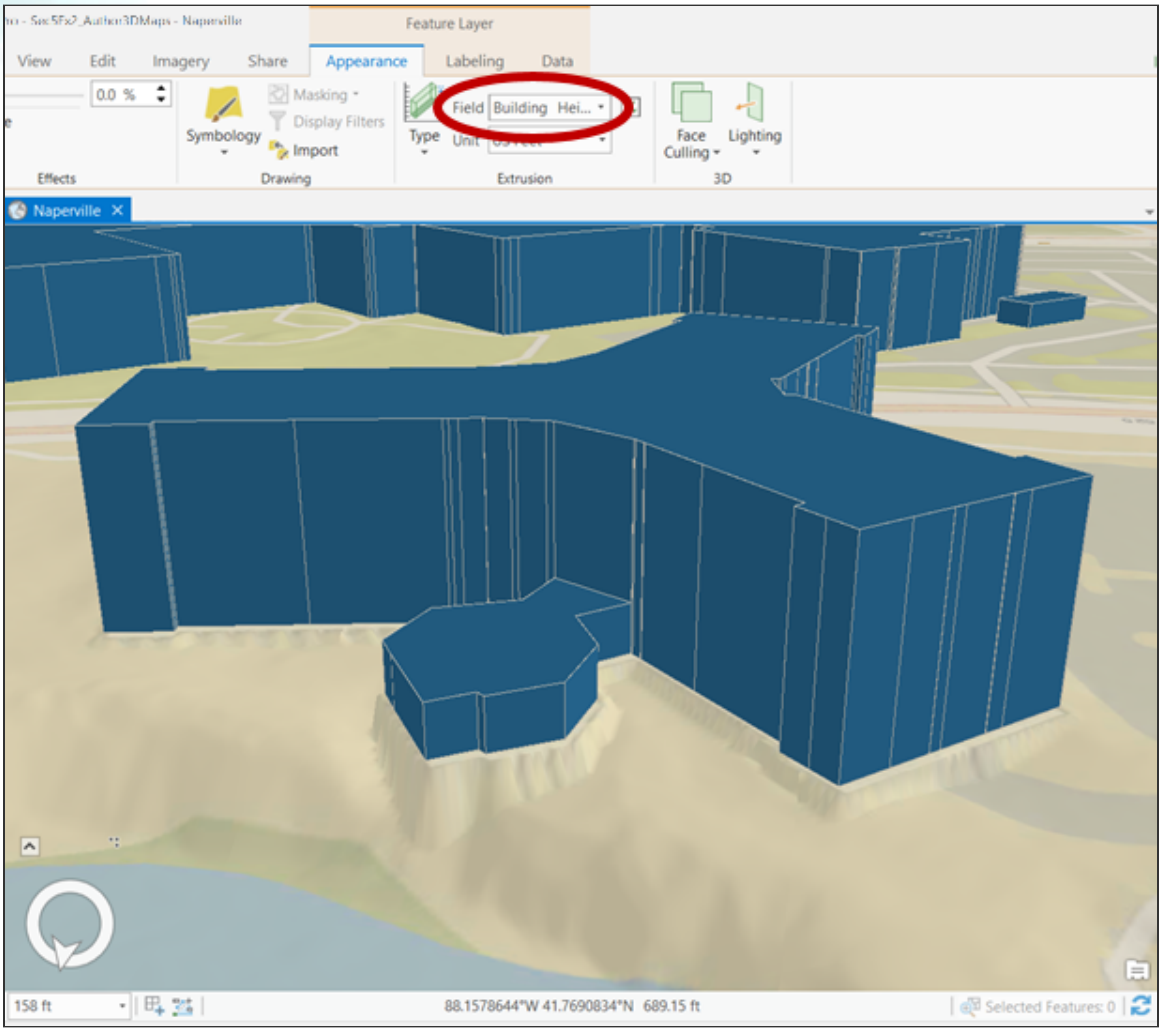
f. In the Contents pane, click the BuildingFootprints layer once to select it.

g. From the contextual Feature Layer tab, click the Appearance tab.

h. In the Extrusion group, click the Type down arrow and choose Base Height.



i. For Field, choose Building Height from the drop-down list.



This is a very simple way to show volumetric shapes from 2D features with a few important attributes, and it works well for regular shapes like buildings.

The current representation doesn't show the number of floors per building, though, which could be important information to communicate quickly to users like first responders and city planners. You can use a different kind of symbol—a procedural symbol—to incorporate that information in, as well.

Step 6: Add procedural symbols to incorporate more detail

Procedural symbols (https://bit.ly/2qoS5zp) are like a script that can construct additional geometry, colors, and textures from a source feature's geometry and then apply that as a symbol within the scene. You can build your own procedural symbols using Esri CityEngine (https://bit.ly/1eK1JiK), or simply use one that comes with an Esri product or solution.

a Disable extrusion for the Building Footprints layer.

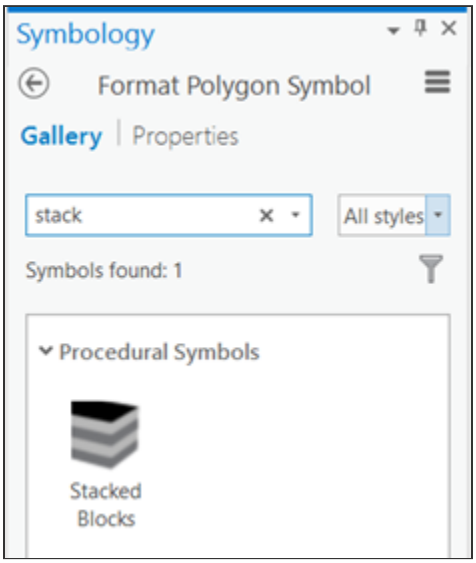
Hint: From the Appearance tab, in the Extrusion group, click the Type down arrow and choose None.

b In the Symbology pane for the BuildingFootprints layer, click the symbol for the layer to modify it.

Hint: If the Symbology pane is not open, right-click the BuildingFootprints layer name in the Contents pane and choose Symbology.

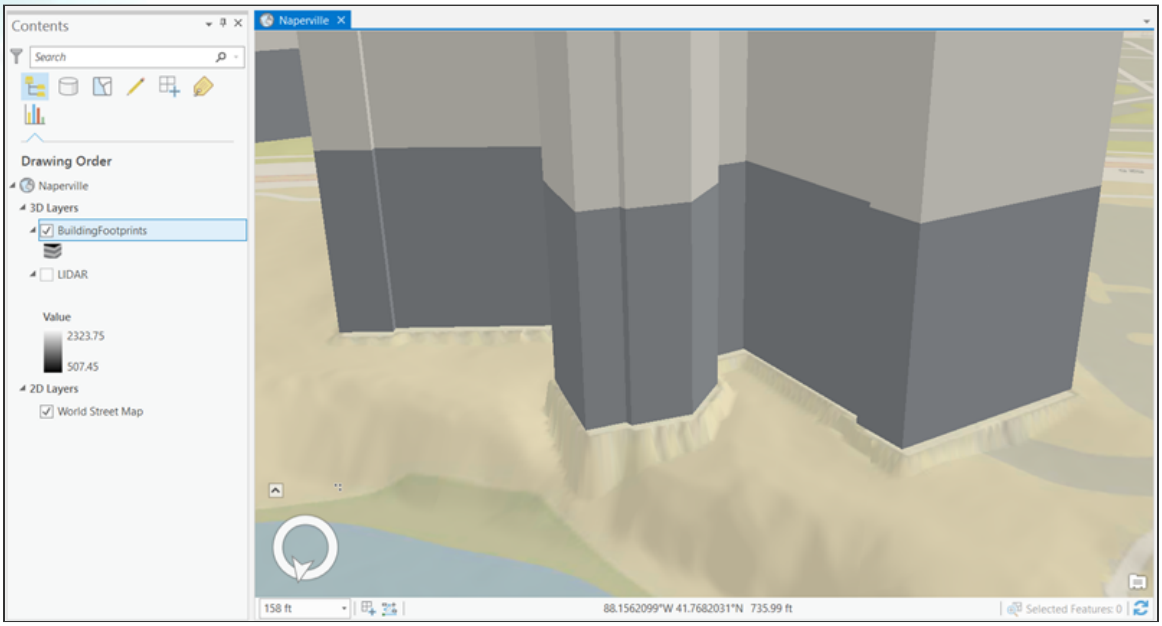
c At the top of the Format Polygon Symbol gallery, in the search field, type **stack**.

d From the drop-down list next to the search field, choose All Styles.



e Click once on the Stacked Blocks symbol to assign it to the layer.

In the Contents pane, you will see the new Stacked Blocks procedural symbol appear under the BuildingFootprints layer. In the map window, you will see the building polygons symbolized as stacked blocks.



Next, you will configure the procedural symbol to more accurately reflect the building types.

f. At the top of the Format Polygon Symbol pane, click the Properties tab.

g. Click the Layers button to configure the symbol.

h. Change Representation to Thin Divider.

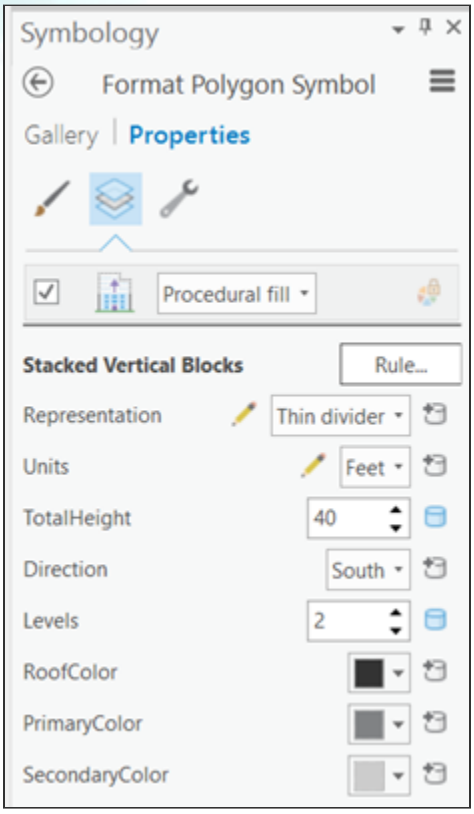
i. Change Units to Feet.

j. Next to the TotalHeight field, click the database icon to set attribute mapping properties.

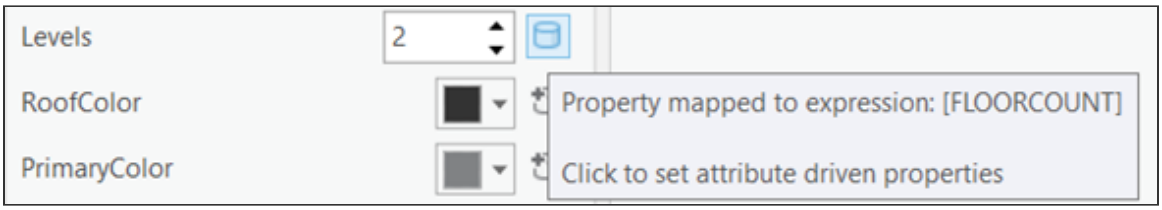
You can connect most symbol properties to the value in a feature attribute field.

k. In the Set Attribute Mapping drop-down list, choose BLDGHEIGHT to connect the TotalHeight symbol property to the BLDGHEIGHT field, and then click OK.

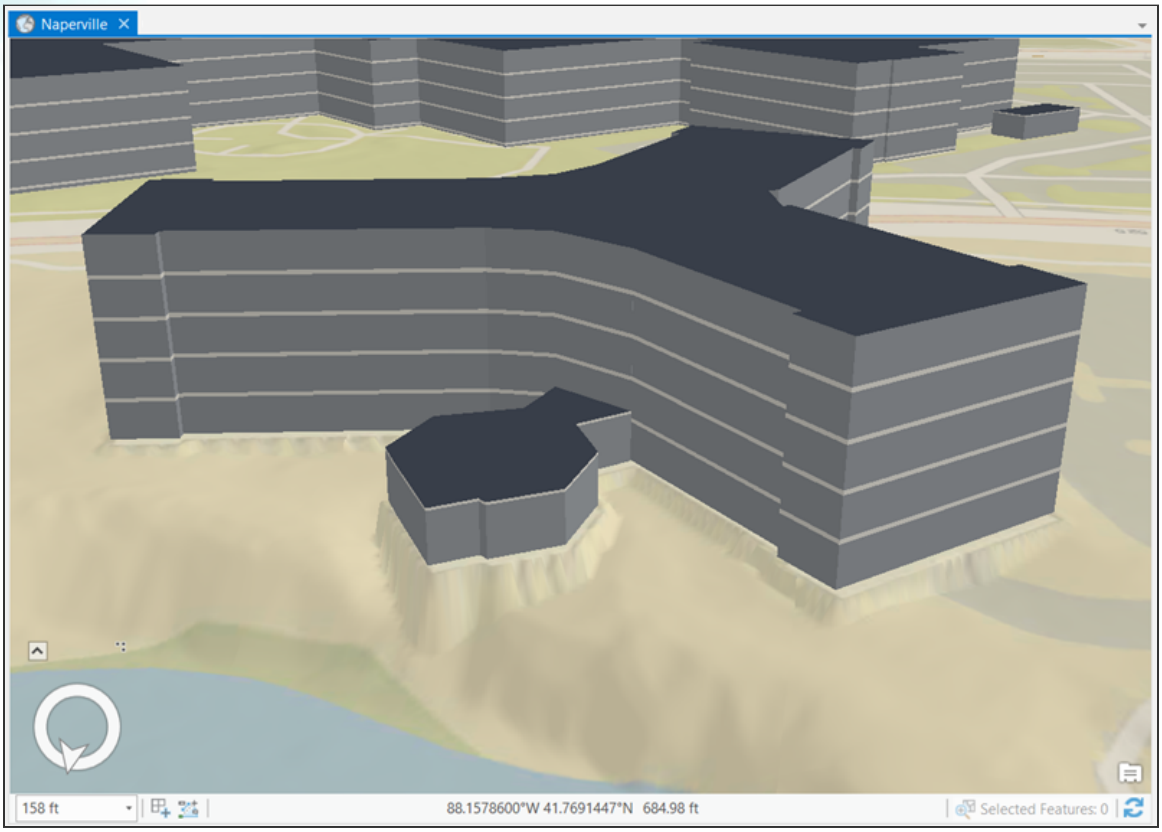
l. Next to the Levels field, click the database icon and set the attribute mapping to FLOORCOUNT.



Note: For any fields with attribute mapping set, the database icon will appear blue. You can pause your mouse pointer over the blue database icon to see which value a field is mapped to.



m At the bottom of the Symbology pane, click Apply, and then close the pane.



Now you will confirm how well these block-style buildings line up with the lidar.

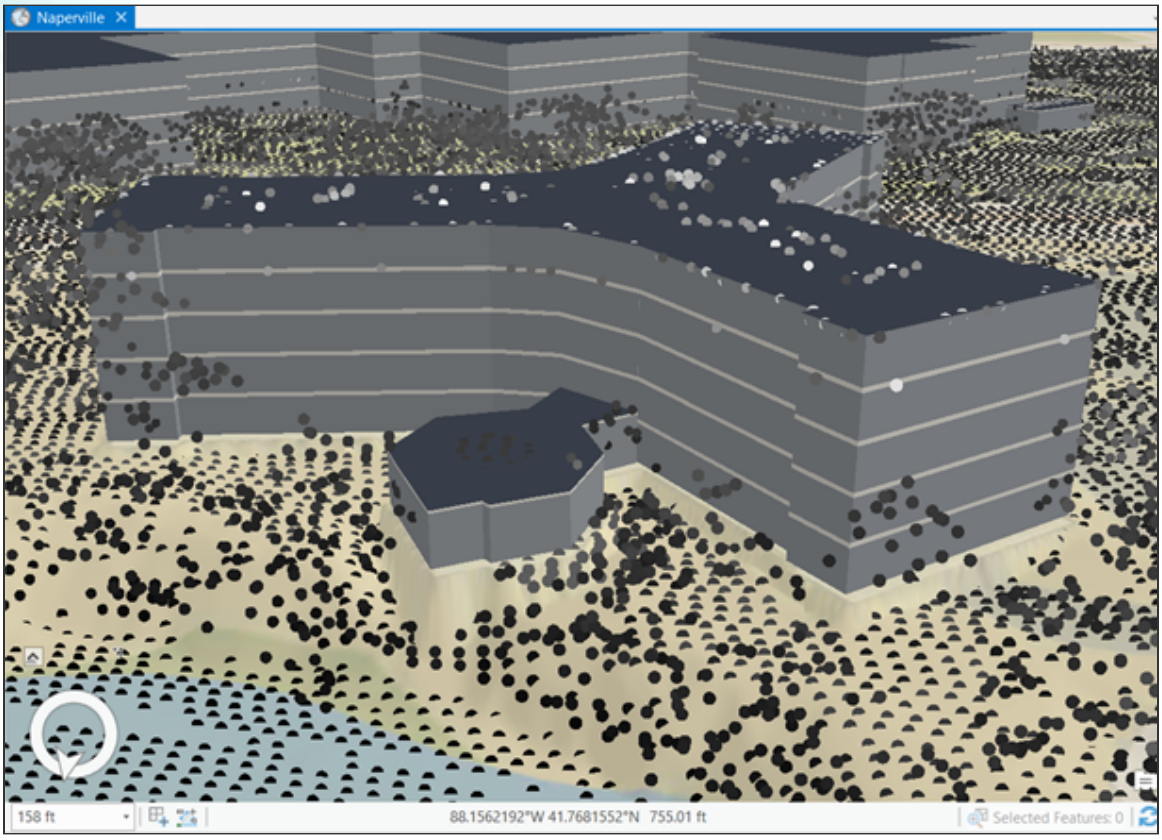
n. In the Contents pane, turn on the LIDAR layer.

Remember, only ground points are currently being shown.

o. To display all the points in the lidar data, in the Contents pane, click the LIDAR layer once to select it.

p. From the LAS Dataset Layer contextual feature layer tab, click the Appearance tab.

q. In the Filters group, click the LAS Points down arrow and choose All Points.



For flat-roofed buildings, this technique produces useful content for many 3D mapping needs. However, not all buildings have flat rooftops. To capture pitched roof forms, you need to move away from simple extruded shapes and into a more comprehensive way of modeling buildings.

r Save your work.

Step 7: Model buildings with pitched roofs

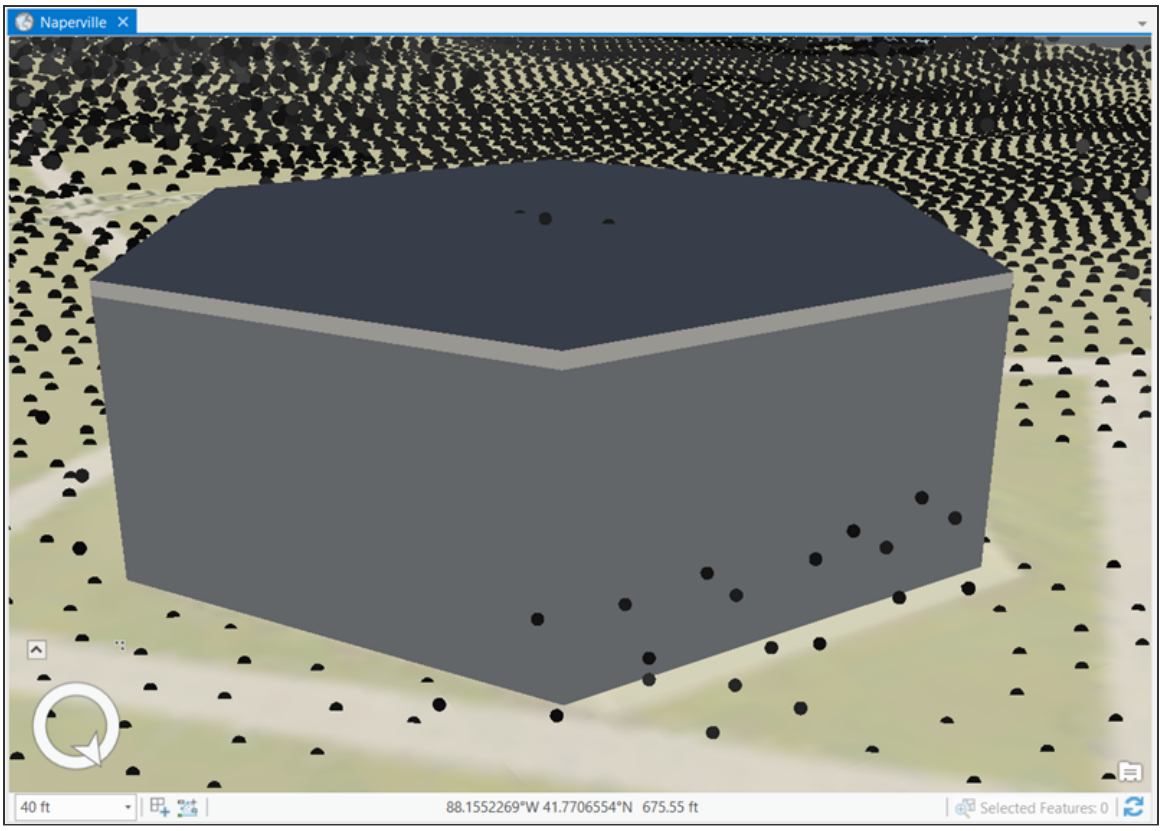
You will inspect a building that has a pitched roof to see how simple extrusion isn't always effective. Then, you will work with a more accurate 3D shape for the building that was created beforehand.

a Zoom to the Pitched Roof (Naperville) bookmark.

Hint: From the Map tab, in the Navigate group, click Bookmarks and choose Pitched Roof from the Naperville section.

You will see that the roof does not match the lidar. If city officials are willing to either do additional work on their data using solution tools (such as those described in this series of

Learn ArcGIS lessons: https://bit.ly/2IFKkNi) or pay an outside data or service provider, they can get to 3D shapes that include a more accurate roof form. In this case, a set of processing tools was run against the lidar, and roof-form information was captured and processed to create additional data.

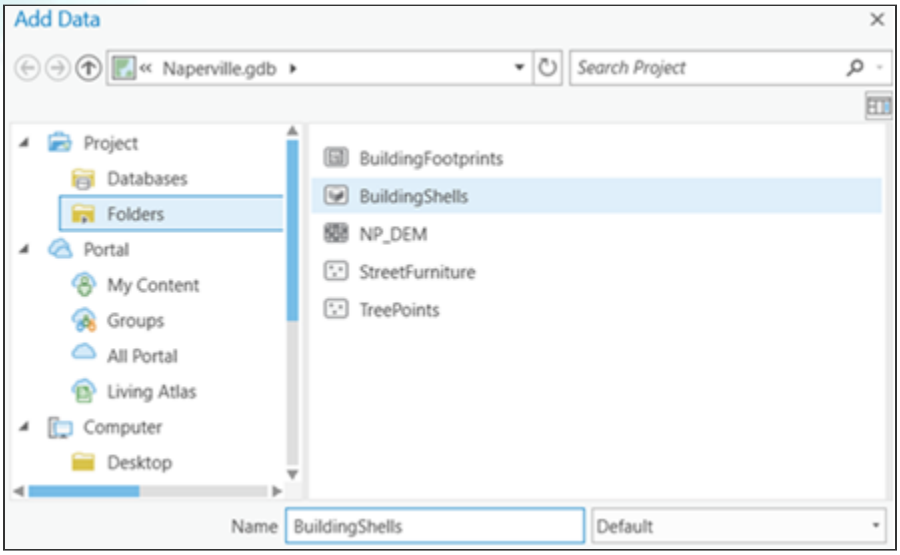


b. In the Contents pane, turn off the BuildingFootprints layer.

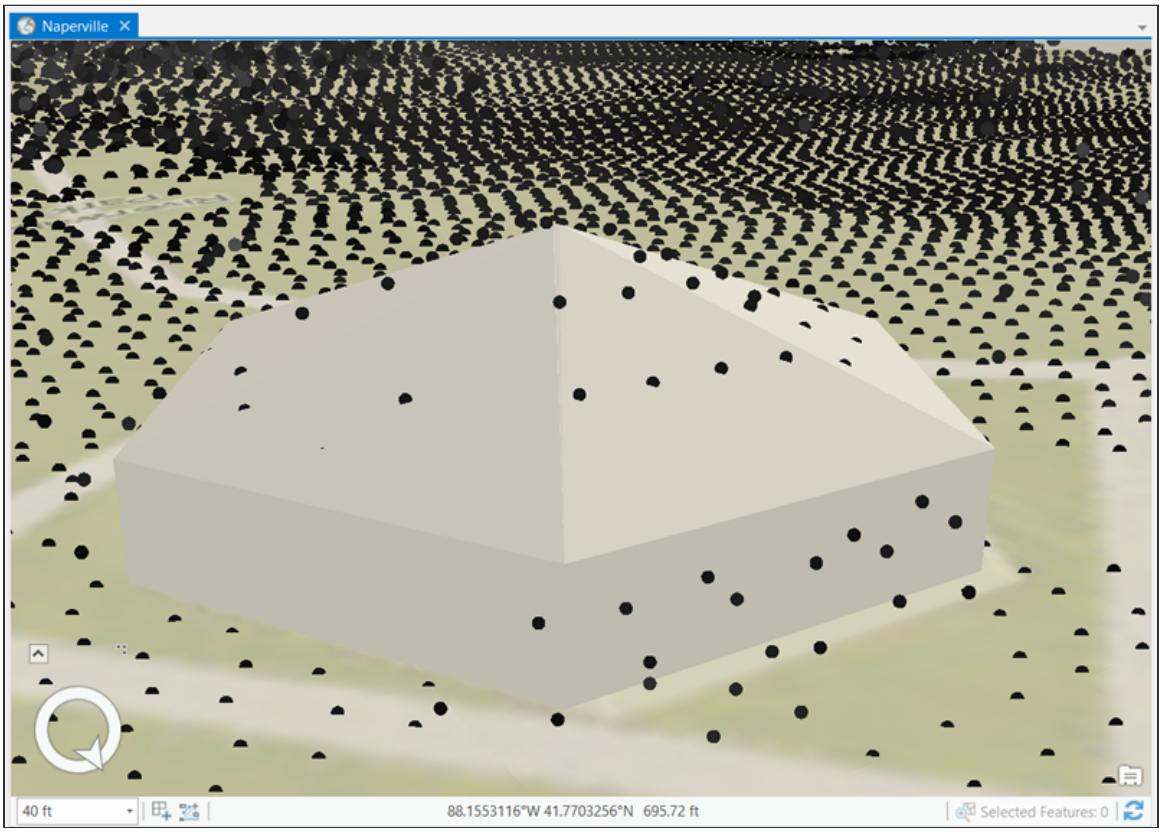
Next, you will add the Building Shells data into the scene.

c. From the Map tab, in the Layer group, click the Add Data down arrow and choose Data.

d. Browse to the Sec5Ex2_Author3DMaps_Naperville.gdb file and select BuildingShells.



e Click OK to add the layer to the map.



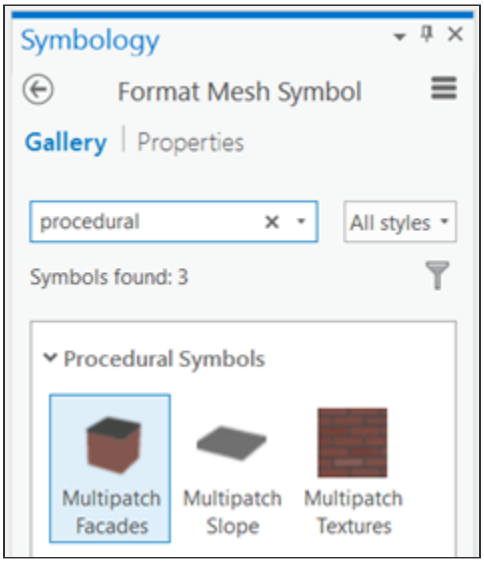
These shapes are more precise and would support further 3D analysis, such as viewshed, line of sight, and shadows. Like you did earlier with the stacked blocks, you can also use a procedural symbol to show the floors and roof area for each feature.

Now you will apply and configure a procedural symbol for the building shapes.

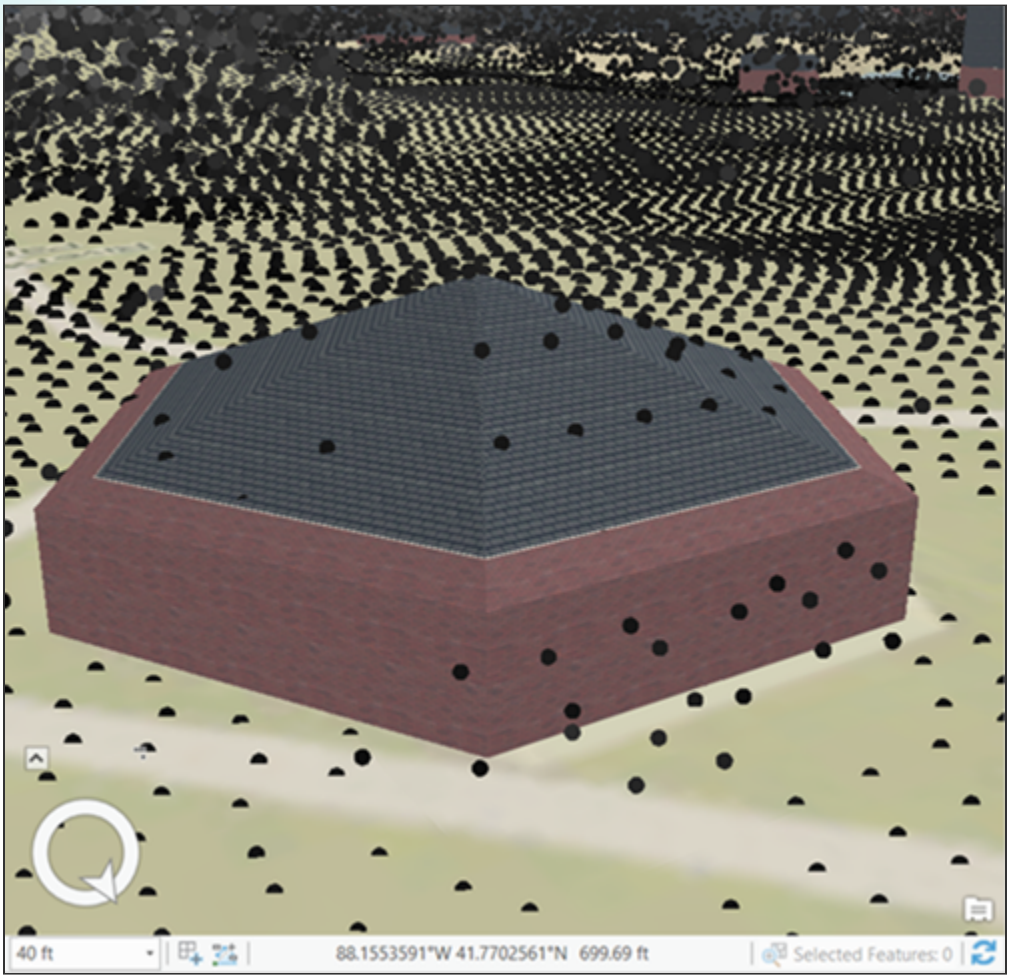
f. In the Contents pane, click the symbol for the BuildingShells layer.

g. At the top of the Format Mesh Symbol pane, click the Gallery tab.

h. In the search field, type **procedural**, ensure that All Styles is selected, and then press Enter.



i. In the results, click Multipatch Facades.



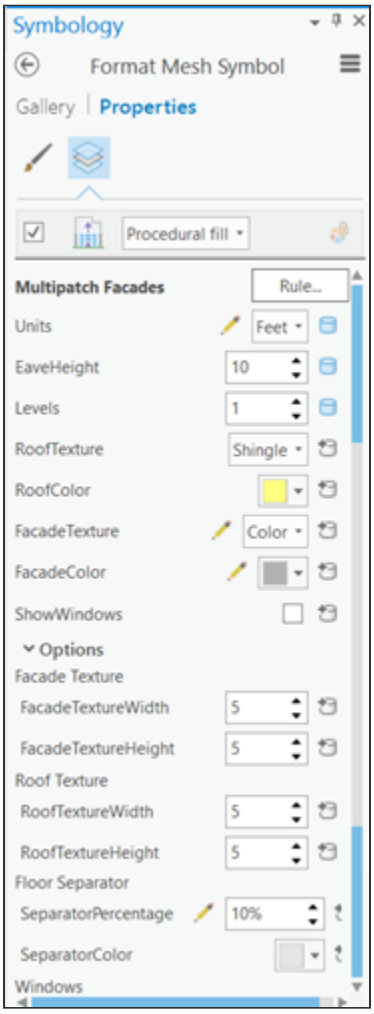
Multipatch (https://bit.ly/2I8B47L) is a geometry type, just like point, line, and polygon. Multipatch features (https://bit.ly/2HUcmUY) are 3D objects defined with 3D rings and triangular patches. They are used to model the outer surface or shell of natural and as-built 3D features. Examples include trees, buildings, bridges, and interior spaces.

You can see that the procedural symbol is applied to the BuildingShells layer and now shows in the Contents pane.

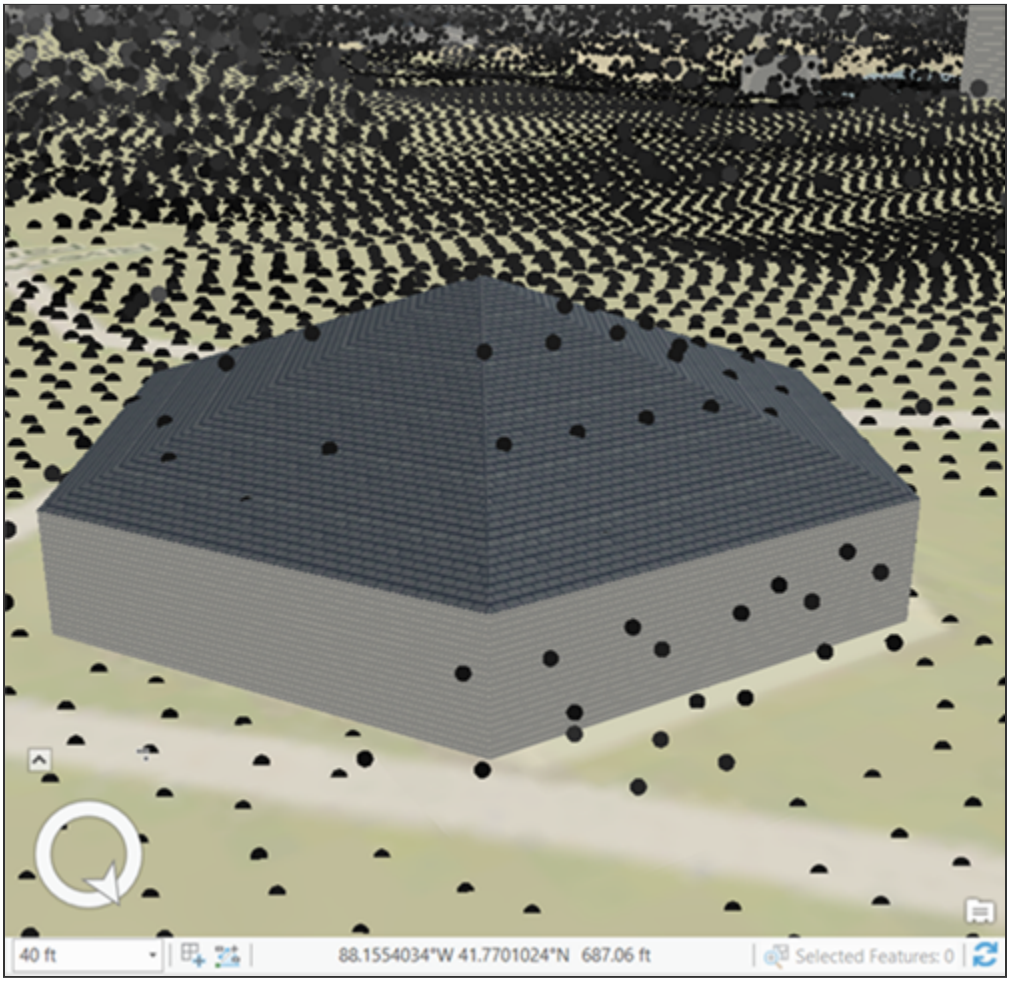
j In the Symbology pane, click the Properties tab, and then (if necessary) click the Layers button.

k Configure the Multipatch Facades symbol as follows:

- For Units, pause your mouse pointer over the database icon and verify that it is mapped to the Units field, and then, if necessary, choose Feet from the drop-down list. (Remember that the database icon will turn blue when a field has been mapped.)
- For EaveHeight, map to EAVEHEIGHT and leave the value as 10.
- For Levels, map to FloorCount and leave the value as 1.
- For FacadeTexture, choose Color.
- For FacadeColor, choose a mid-gray, such as Gray 30%, from the color palette.
- Expand Options, and under FloorSeparator, for SeparatorPercentage, set the value to **10**%.



l At the bottom of the pane, click Apply.



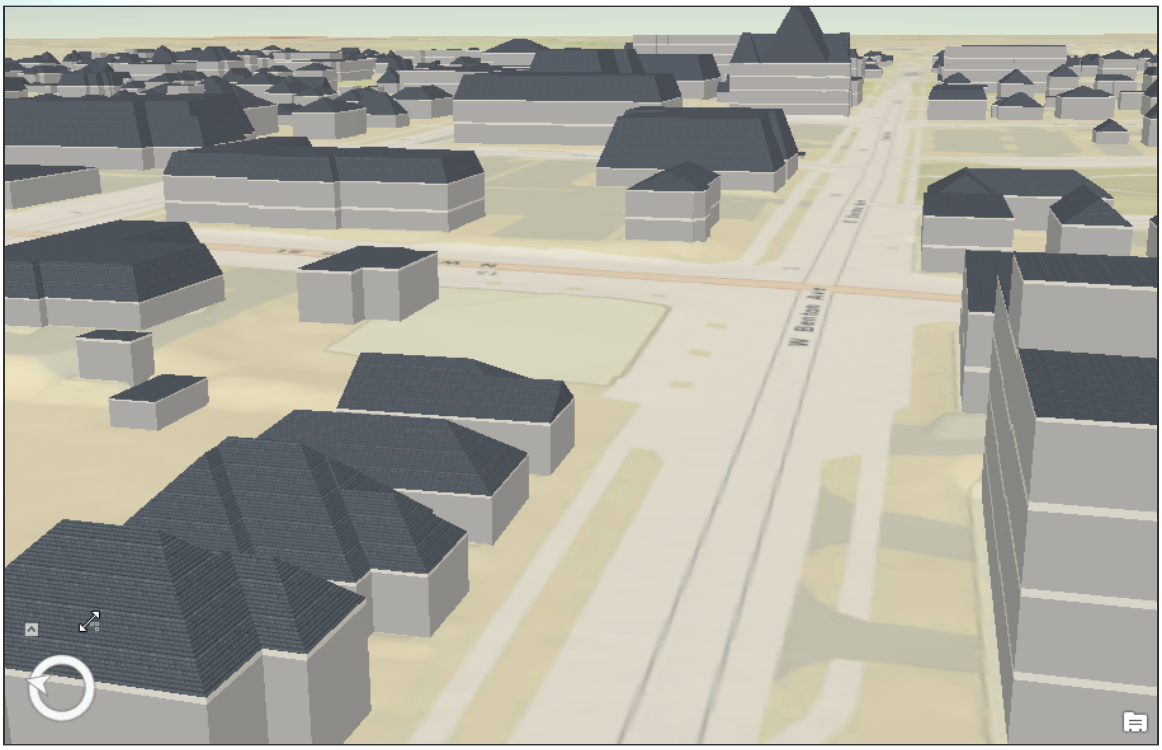
Note: As you can see, this symbol has a lot of options. Feel free to experiment with different settings.

You now have ground, a surface image, and buildings. To enhance the appearance of your 3D city map, you can add a thematic layer of tree features.

Step 8: Use preset layers to add tree features

a Turn the LIDAR layer off.

b Zoom to the Street (Naperville) bookmark.



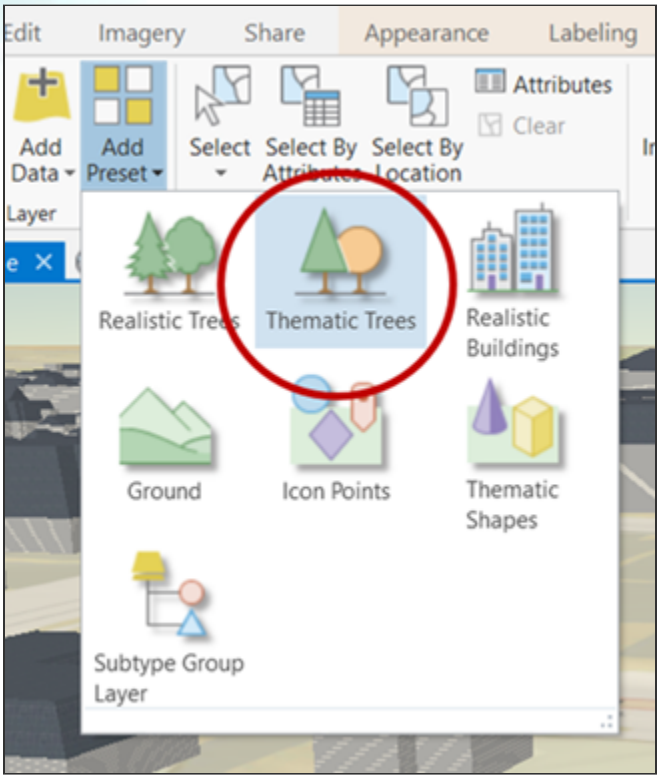
Hint: From the Map tab, in the Navigate group, click Bookmarks and choose Street from the Naperville Bookmarks section.

To assist you with authoring 3D maps, ArcGIS Pro has a simplified process called Preset Layers that you can use for adding certain types of layers into the scene; tree features are one of them.

Note: Refer to ArcGIS Pro help to read more about Preset Layers (https://bit.ly/2qG9G6f) and options for trees, including using genus names to set their styling.

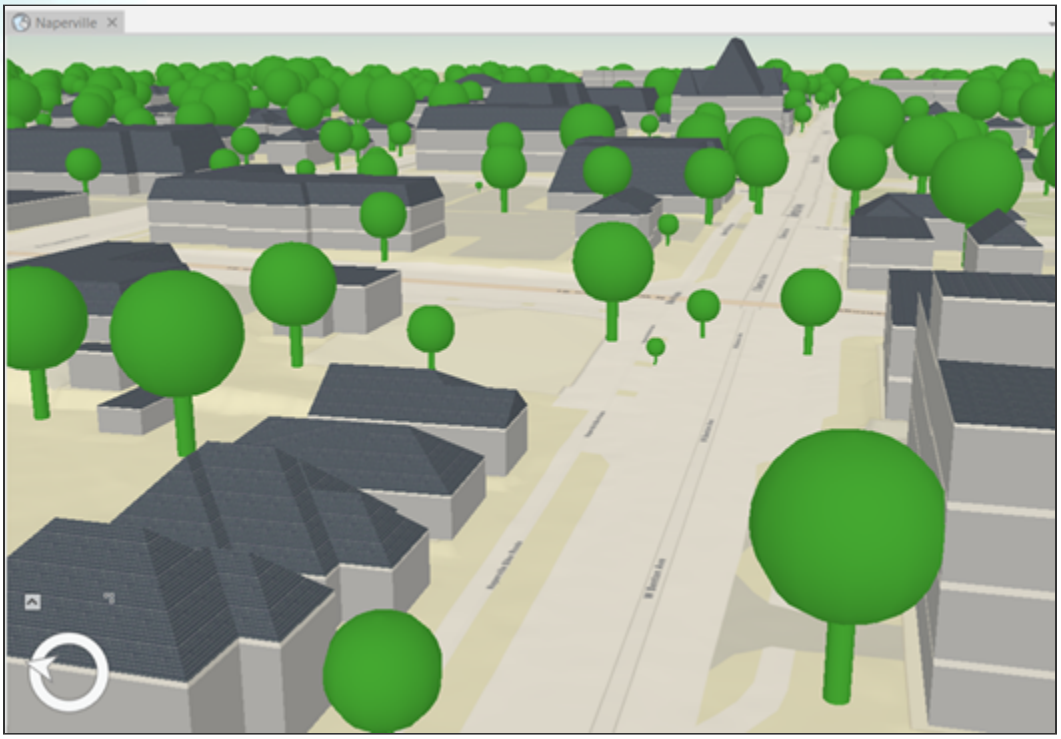
Thematic trees use geometric forms, such as spheres and cones, to represent the tree shape. This styling should be used for the scene (rather than the Realistic Trees option) because it fits in with the styling of the basemap and building features. Each tree has a property for carbon accumulation, which you will use to apply a range of colors across the scene.

c. To add a preset tree layer into the scene, from the Map tab, in the Layer group, click the Add Preset down arrow and choose Thematic Trees.



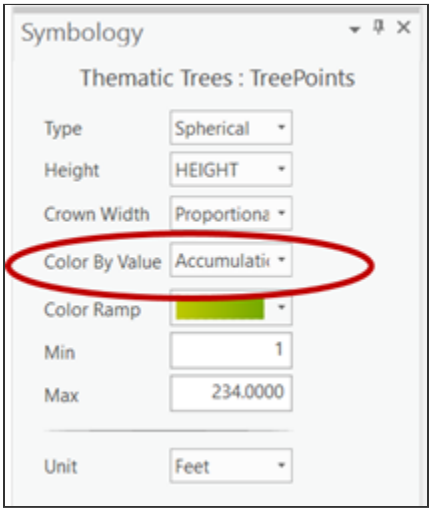
d. Browse to the location of the Sec5Ex2_Author3DMaps_Naperville.gdb file, select TreePoints, and then click OK to add the preset layer to your scene.

Note: It may take a minute for the thematic trees to draw.



All of the trees share the same solid green color. Next, you will color the trees using a value.

e In the Symbology pane for the TreePoints layer, for Color By Value, choose Accumulation.



The changes are automatically applied.

f Save your work.

Another common type of content that city officials might want to see is street furniture (https://bit.ly/2Hf0VKK), such as benches, light poles, and bus stops.

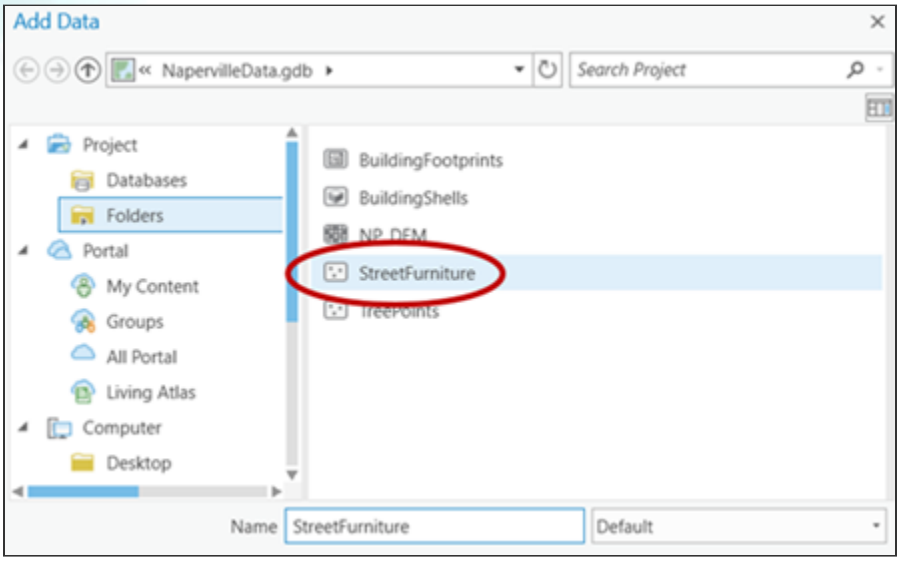
Step 9: Add street furniture to the scene

For this exercise, you only have a small set of features to experiment with, but the technique is the same regardless of the data size.

a Zoom to the Street Furniture (Naperville) bookmark.

Next, you will add the street furniture data.

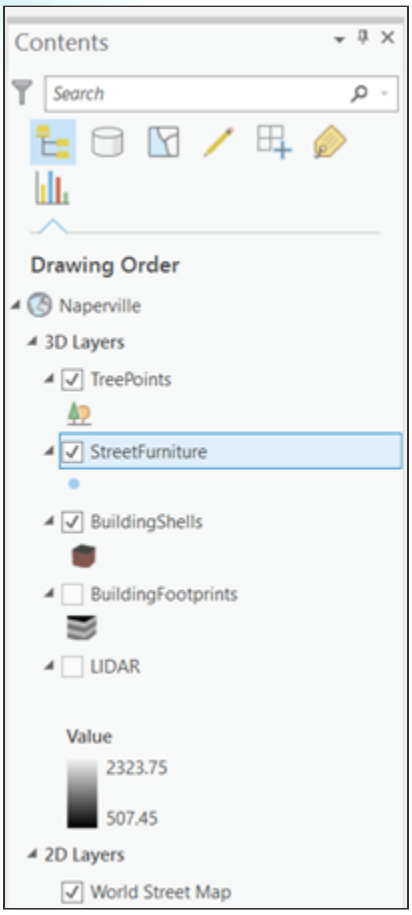
b From the Map tab, in the Layer group, click the Add Data down arrow and choose Data.



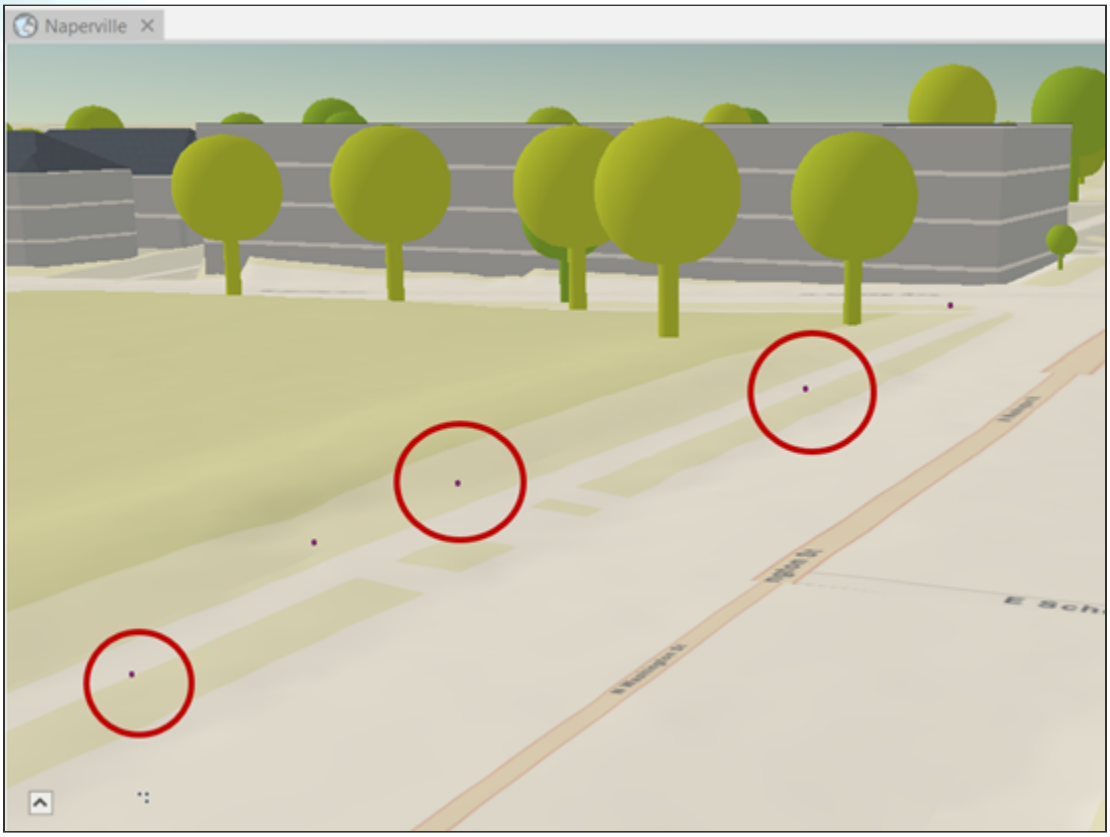
c. Browse to the location of the Sec5Ex2_Author3DMaps_Naperville.gdb file, select StreetFurniture, and then click OK to add the data to your scene.

The point features are 2D, so by default, they have been placed in the 2D Layers category in the Contents pane. To display them using 3D symbols, you need to change the layer's category.

d. In the Contents pane, click and drag the StreetFurniture layer from the 2D Layers group into the 3D Layers group, placing it just below the TreePoints layer.



You will see small points representing street furniture features on the map.



e. Zoom in on one of the point features (using a "click and drag" motion with the right mouse button).

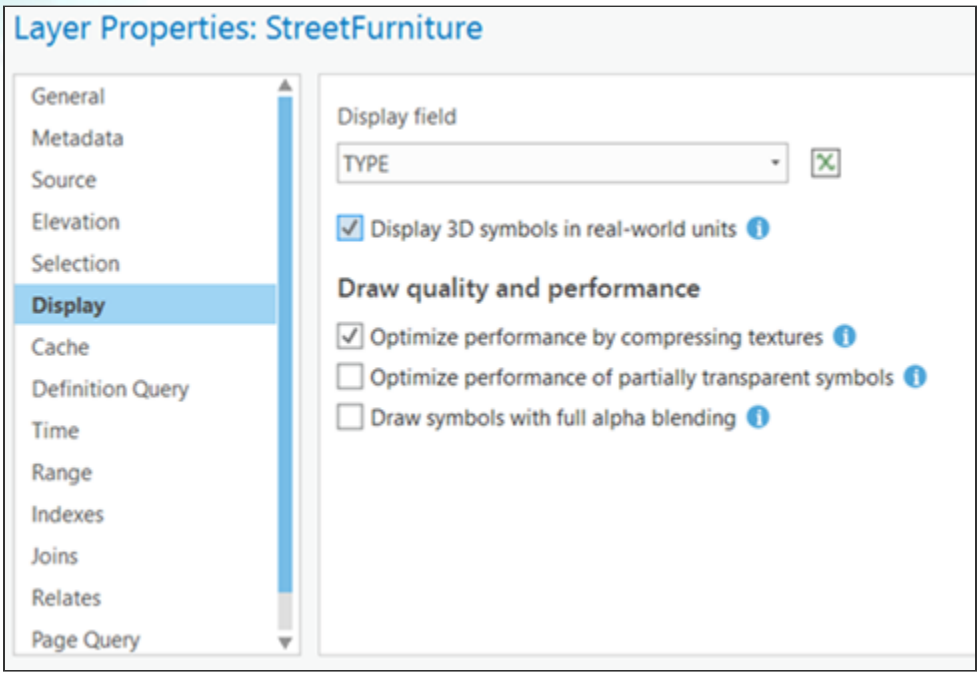
It might feel like the symbol is shrinking as the camera moves in closer. This is because it's drawing to remain the same size on the screen, rather than the same size in the scene.

This type of symbology is great for points of interest because, regardless of how far away you zoom, the symbol will take up the same amount of space on the screen.

However, for streetlights and park benches, you want the symbols to be in real-world sizes. So, you will need to change the display setting to be in real-world units.

f. In the Contents pane, right-click the StreetFurniture layer and choose Properties.

g. In the Layer Properties dialog box, from the Display tab, check the Display 3D Symbols In Real-World Units box.



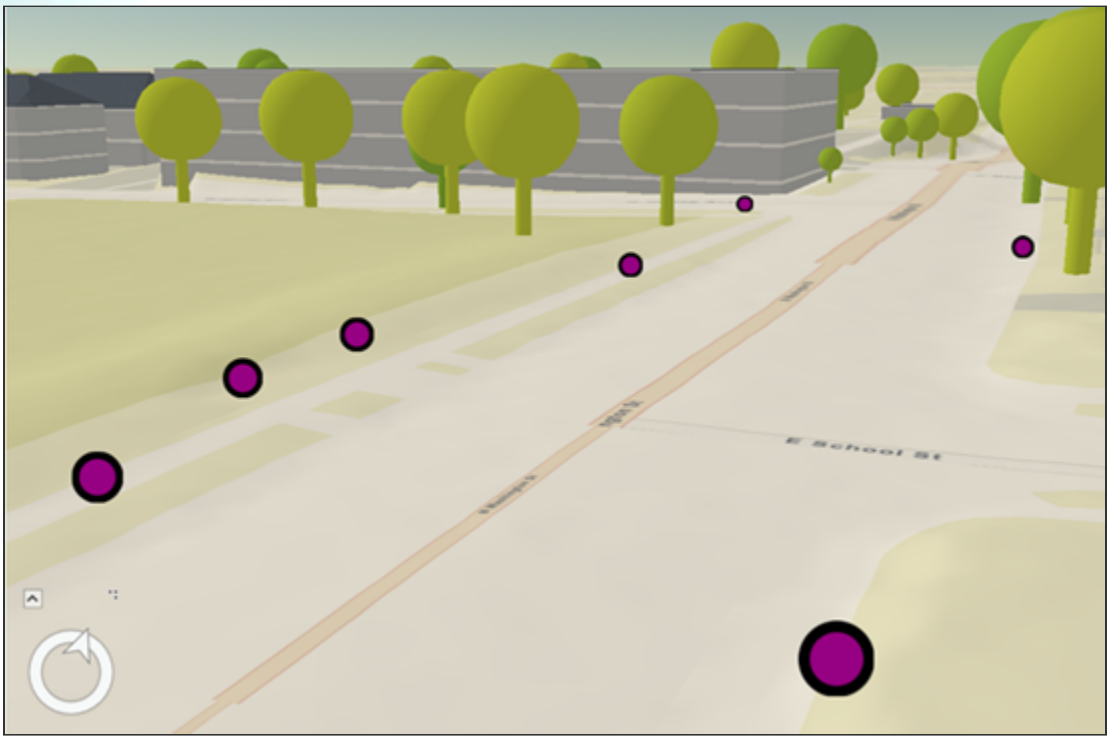
h. Click OK to close the Layer Properties dialog box.

i. Zoom out to see the difference in the symbol size.

Now you need more appropriate symbols. You will use 3D model symbols to render the street furniture points.

Step 10: Modify street furniture symbology

a. Zoom back to the Street Furniture bookmark.

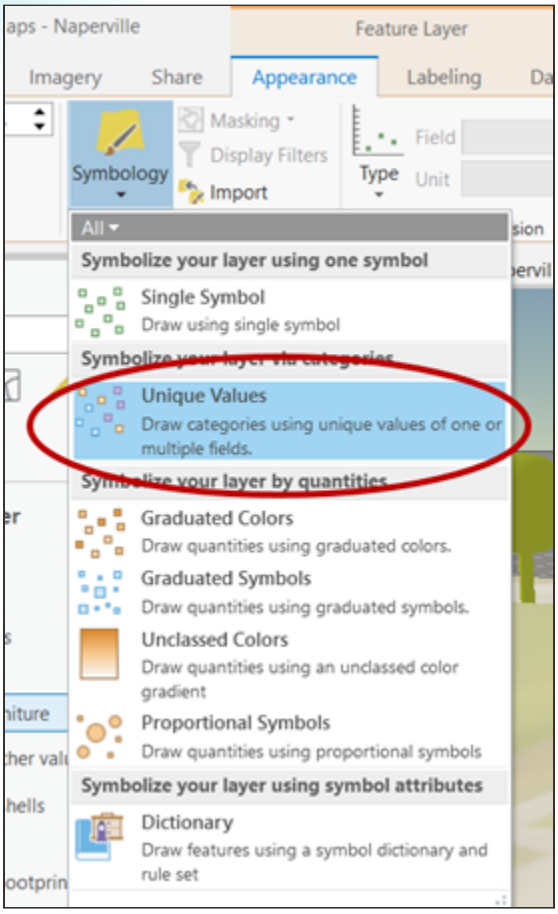


The StreetFurniture data that you are using for this exercise includes unique values to identify light poles and park benches. You will use these unique values in the data to create two classes. You can then apply a different 3D model symbol to each class.

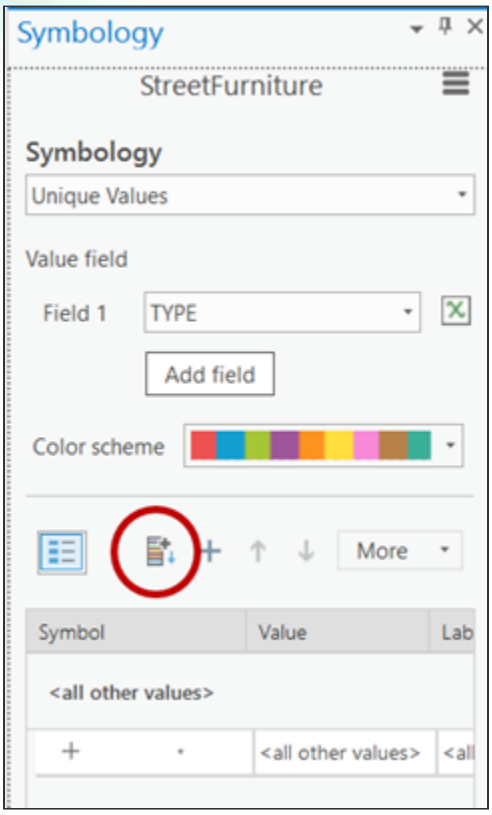
b. In the Contents pane, select the StreetFurniture layer.

c. From the Feature Layer contextual tab, click the Appearance tab.

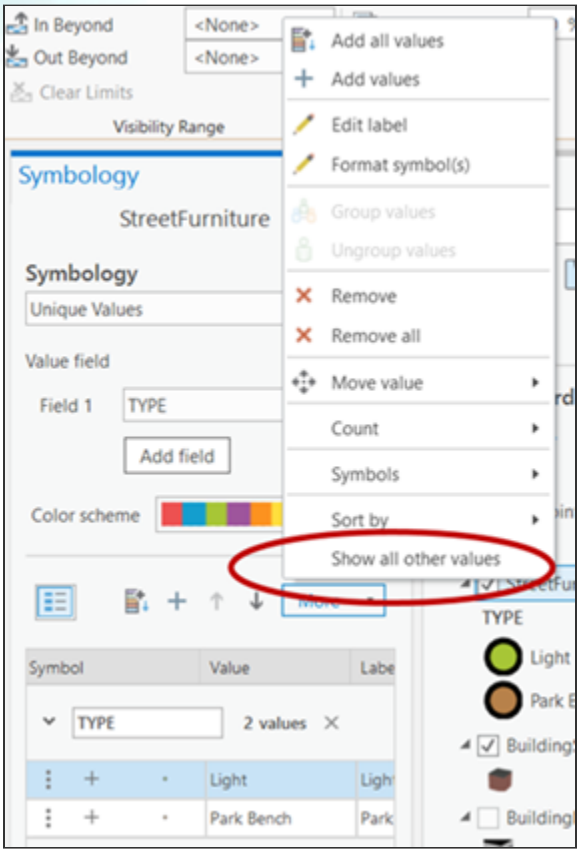
d. In the Drawing group, click the Symbology down arrow and choose Unique Values.



e In the Symbology pane, under Value Field, confirm that Field 1 is set to TYPE, and then click the Add All Values button.

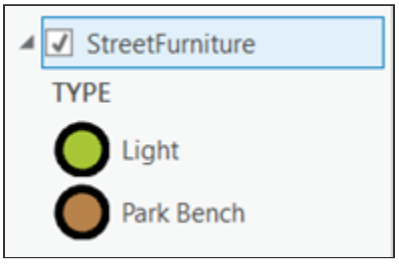


f Click the More drop-down list and uncheck Show All Other Values.



In the Contents pane, there are now two different types of StreetFurniture listed.

Note: ArcGIS Pro randomly assigns colors, so yours may be different.



Based on color, you can distinguish between lights and park benches. Next, you will choose slightly more realistic symbols to represent the types of street furniture.

g. In the Contents pane, click the symbol for the Light type to modify it.

h. In the Symbology pane, if necessary, click the Gallery tab.

i. In the search field, type **light**, confirm that you are searching All Styles, and then press Enter.

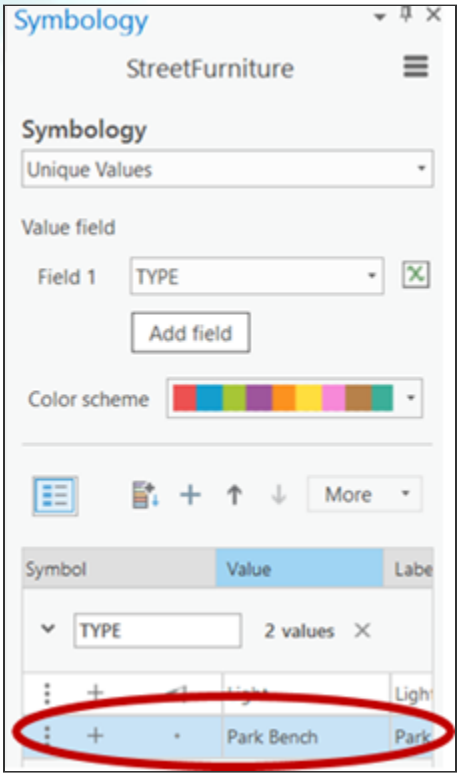
j. In the 3D Street Scene section of the results, select the Overhanging Street - Light Off symbol (the first symbol in the section).

Hint: To help you find the correct symbol, pause your mouse pointer over the symbols to see a pop-up with more detail.

Now you will select a different symbol for the park benches.

k. At the top of the Format Point Symbol pane, click the Back button to return to the full Symbology pane.

l. At the bottom of the pane, click the Park Bench row.

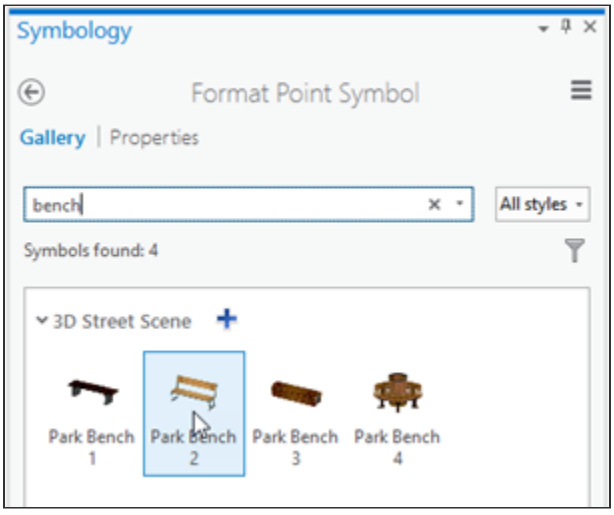


m. In the Contents pane, click the symbol for the park bench.

n. In the Format Point Symbol pane, from the Gallery tab, in the search field, type **bench**.

o. Confirm that you are searching All Styles, and then press Enter.

p. In the 3D Street Scene section, select the Park Bench 2 symbol.



q At the top of the pane, click the Back button to return to the Symbology pane for the StreetFurniture layer.

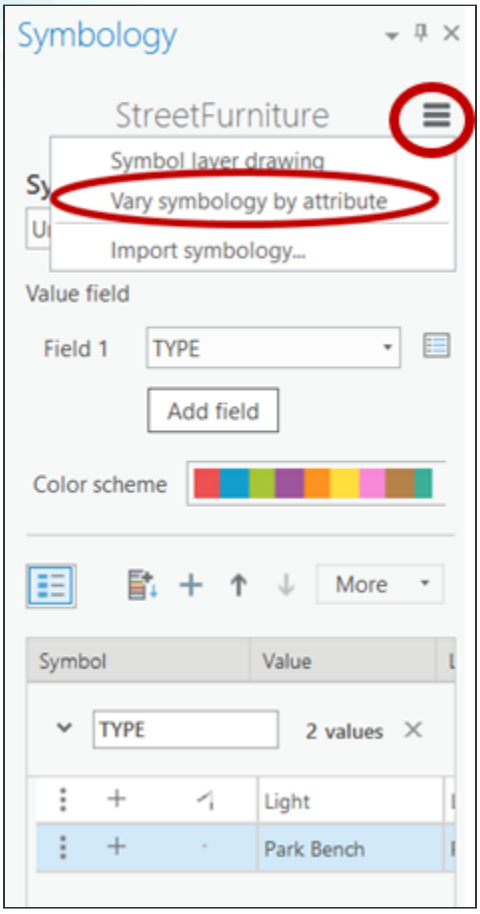
The symbols are the correct size, but they are facing the wrong way. You can adjust the rotation angle so that each feature turns to face the correct direction.

Step 11: Vary symbology by attribute

In this step, you will rotate the street light features so that they face in to light the road and rotate the park benches so that they face each other.

a In the Contents pane, ensure that the StreetFurniture layer is selected.

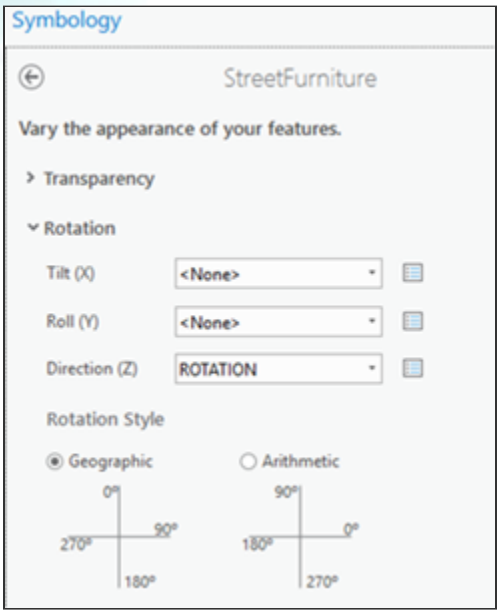
b In the Symbology pane, click the menu button and choose Vary Symbology By Attribute.



Several options are presented that allow you to vary the appearance of your features.

c. Expand the Rotation section, and for Direction (Z), choose ROTATION.

d. For Rotation Style, choose the Geographic option.



The street furniture should now look like the following graphic.

e Close the Symbology pane.

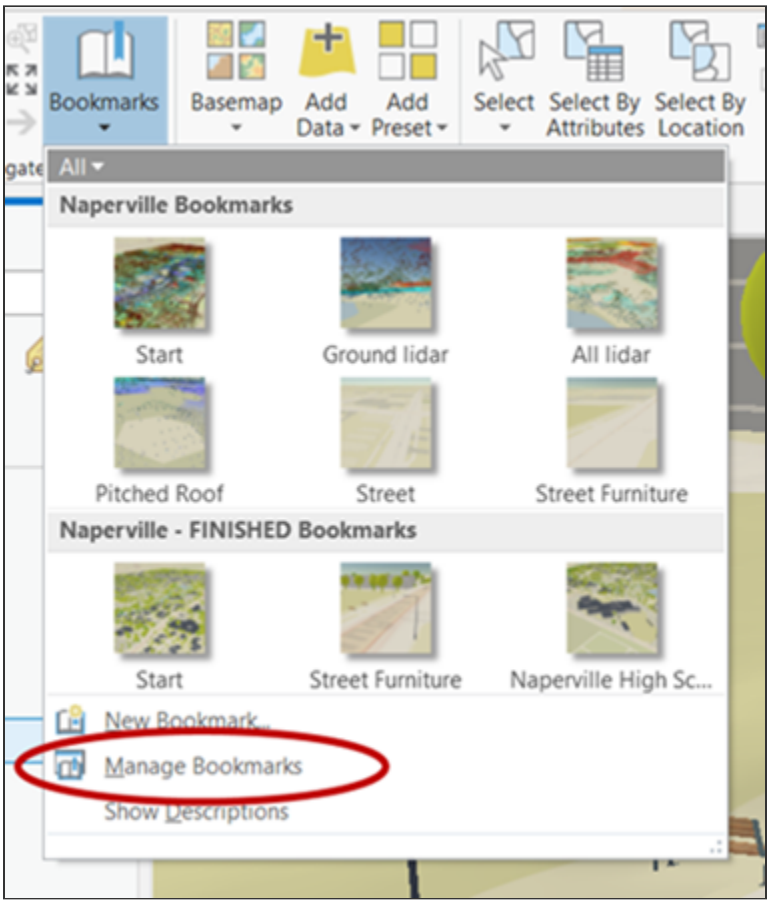
Your 3D city map looks pretty good!

Step 12: Use bookmarks to navigate a 3D view

Navigating around a 3D view, especially for an area that you're not familiar with, can be difficult. Creating a set of stored locations, or bookmarks, for the user to return to is helpful. This technique has been used throughout this exercise, but with a focus on authoring the scene.

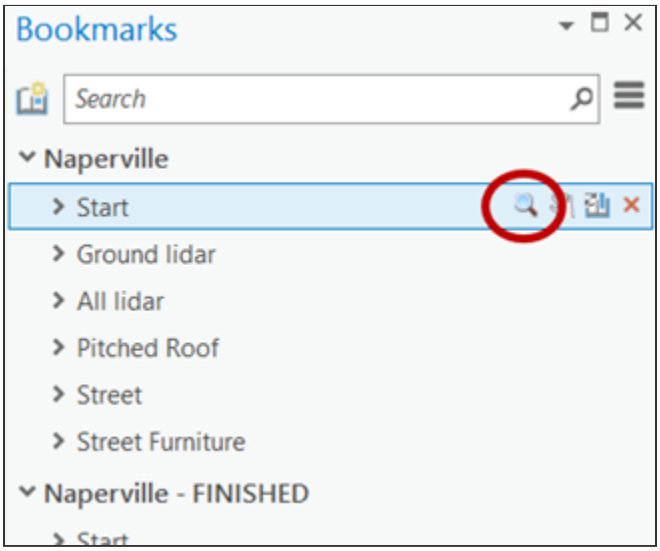
For a better end-user experience and because you may want to share this view with others, you will update the bookmarks so that they are better suited for navigating to important locations within the scene.

a From the Map tab, click the Bookmarks down arrow and click Manage Bookmarks to open the Bookmarks pane.



b In the Naperville section, zoom to the Start bookmark.

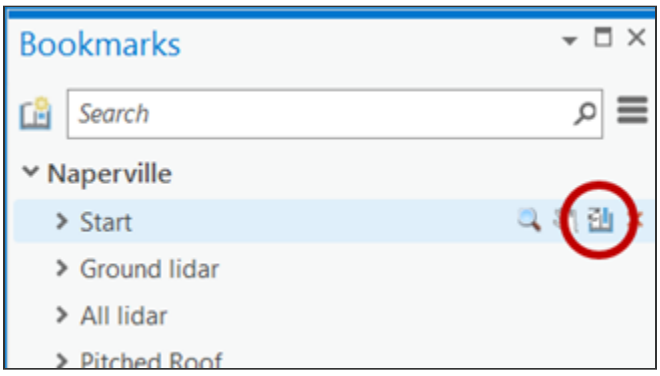
Hint: Point to the Start bookmark in the Naperville section and click the Zoom To (magnifying glass) button.



Note: There are two view modes in the Bookmarks pane. Gallery view shows bookmark thumbnails, while Outline view shows text bookmarks. You can use the menu button at the top of the pane to switch between views.

Having an initial place to come back to is critical.

c. Either accept the current position, or pan and zoom to a new location, and then point to the bookmark again and click the Update button.



For this exercise, bookmarks were used for the locations of the surface, pitched roof, and tree layer authoring steps. These are not important for the public, so you will delete the four unnecessary bookmarks.

d. In the Bookmarks pane, in the Naperville section, point to the following bookmarks and click the Remove (red X) button:

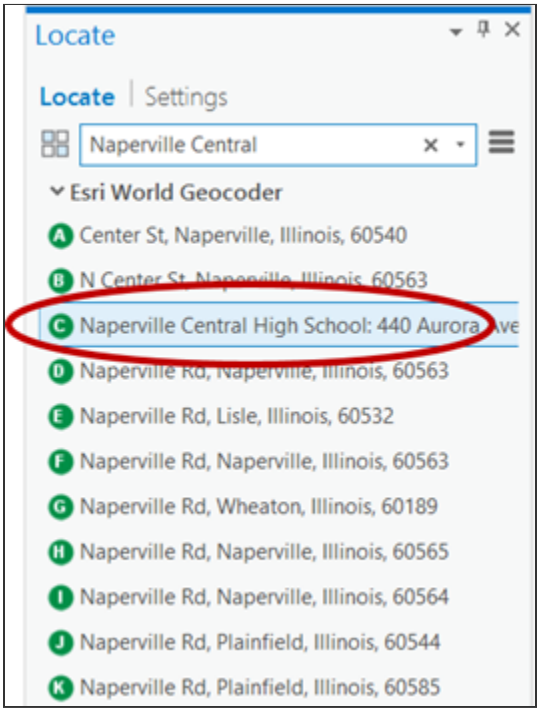
- Ground Lidar
- All Lidar
- Pitched Roof
- Street

The Start and Street Furniture bookmarks will remain. Now you will add a bookmark to identify something of interest to the map's audience.

Some cities have well-known landmarks. You might want to create a bookmark for a landmark, such as the local high school.

e. From the Map tab, in the Inquiry group, click Locate.

f. In the Locate pane, in the Search field, type **Naperville Central** and press Enter.



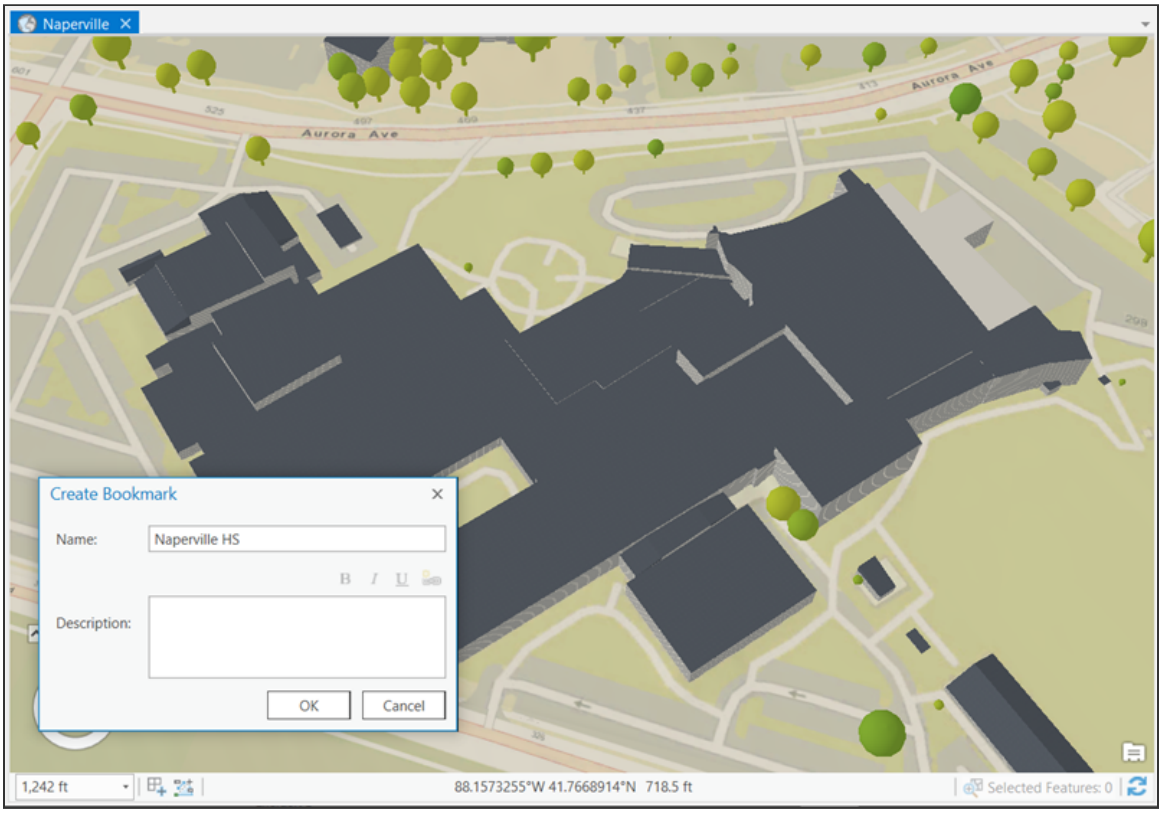
g. Select the result, right-click it, and choose Zoom To to see the high school in the middle of your map.

Note: The search will auto-complete for the high school, and you can select it without typing more.

h. Right-click and drag in the center of the screen (on the high school) to zoom in more closely.

i. From the Map tab, in the Navigate group, click Bookmarks, and then choose New Bookmark.

j. For Name, type **Naperville HS**, and then click OK.



The small area with the street furniture would be hard to find without specific knowledge, so you will keep that bookmark in place. You can rename it if you want.

This gives your users three bookmarks to access when navigating the view. You can add as many bookmarks as you want.

k. Save your map, and then exit ArcGIS Pro.

Conclusion

In this exercise, you learned some techniques for authoring 3D maps. You improved the ground surface of the scene by using multiple data sources, you used extrusion to create 3D building shapes, you configured procedural symbols for façade rendering, you configured a

prebuilt tree layer, you built a realistic layer for street furniture, and throughout it all you relied heavily on feature attributes to provide critical symbology properties, such as size, number of floors, and rotation.

The types of 3D maps you build using ArcGIS Pro will vary greatly upon the type of data you have available, but this exercise has shown you can get a long way even with a relatively simple set of well-attributed 2D data.

Use the Lesson Forum to post your questions, observations, and map examples.