

Build a 3D Scene for the Oso Mudslide in Washington

learn.arcgis.com/

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Time: 30 minutes

Overview

In March 2014, after a month of heavy rainfall, a massive landslide wiped out a rural community near Oso, Washington. The tragic event destroyed homes and highways, dramatically altered the landscape, and caused the deaths of 43 people. It was one of the deadliest slides ever in the United States.

In this lesson, you'll build a 3D scene using before and after elevation surface layers to investigate the mudslide and its effects on the community.

In this lesson, you will learn to do the following:

- Identify different kinds of surfaces and data sources in the workflow
- Author multiple surfaces for a 3D map
- Assign a surface to your 2D content so it renders in 3D

Create a project

First, you will download the data. Then you will create a project in ArcGIS Pro.

1. Download the Oso_Elevation.zip compressed folder.
2. Locate the downloaded file on your computer and extract it to a location you can easily find, such as your Documents folder.
3. Open the Oso_Elevation folder.

   In the folder, you will find the following:

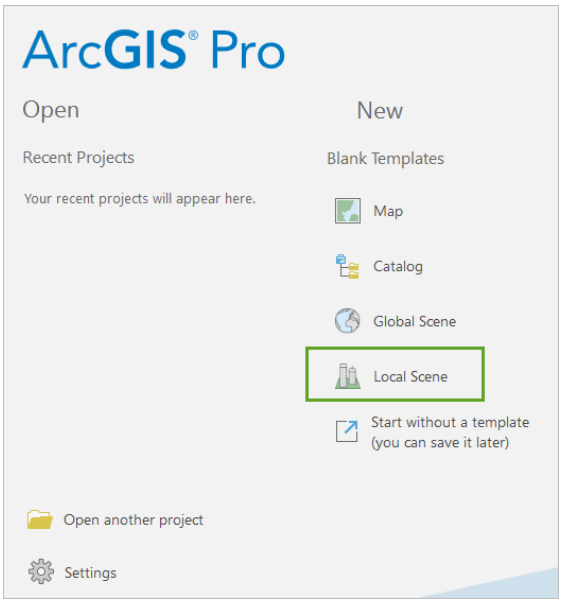
   - Oso_Imagery folder—contains imagery before and after the mudslide.
   - Oso_Mapping_Terrain_Data folder—contains a geodatabase (Oso_Landslide_Data) that holds the elevation layers before and after the event.

   The imagery has been provided by the Washington Department of Transportation, rehosted by the Esri Disaster Response Program. The digital elevation model was extracted from lidar data, from the Puget Sound Lidar Consortium.

4. Start ArcGIS Pro. If prompted, sign in using your licensed ArcGIS account.

   Note: If you don't have ArcGIS Pro or an ArcGIS account, you can sign up for an ArcGIS free trial.

5. Create an ArcGIS project, based on the Local_Scene project template.



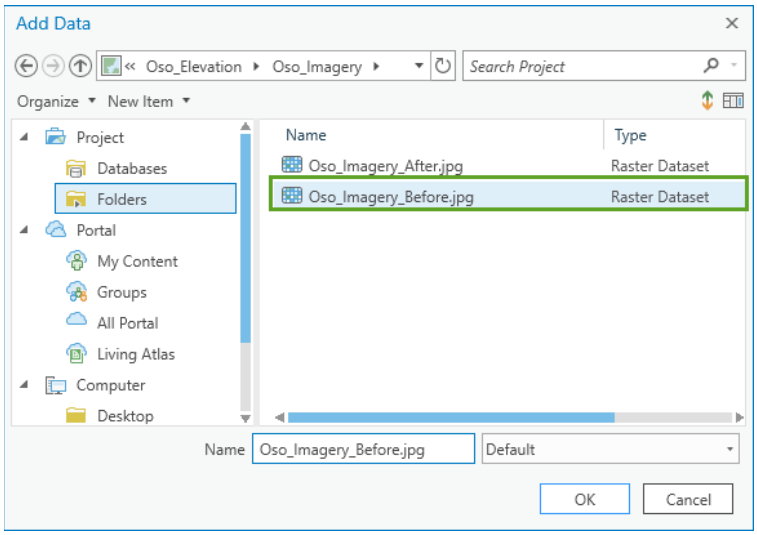
6. On the Quick Access toolbar, click Save  or press Ctrl+S to save your project.

7. Save the project as **Oso_Elevation** in the default projects folder.

Add imagery to the scene

ArcGIS Pro includes the ability to "tilt up" your 2D map and view spatial relationships in a 3D scene. This makes the data more understandable and helps reveal new insights in the process. To gain an understanding of the area around Oso, Washington, that was affected by the mudslide, you'll add some imagery of the area from before the mudslide.

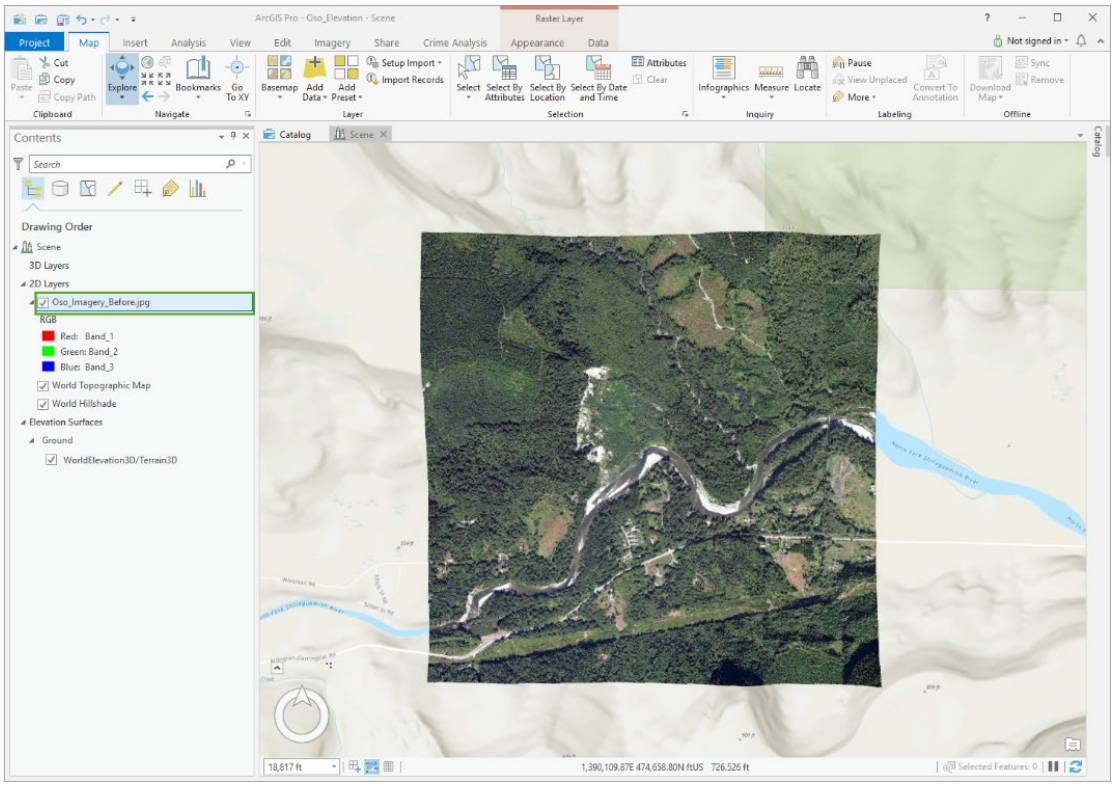
1. From the **Map** tab, in the **Layer** group, click the **Add Data** down arrow and choose **Data**.
2. In the **Add Data** dialog box, browse to the location of your Oso_Elevation folder.
3. Open the Oso_Imagery folder and select the **Oso_Imagery_Before.jpg** file.



This file depicts how the area of interest looked before the mudslide.

4. Click **OK** to close the **Add Data** dialog box.

   Note: If you get a Transformation Warning window, click OK to accept the suggestion.

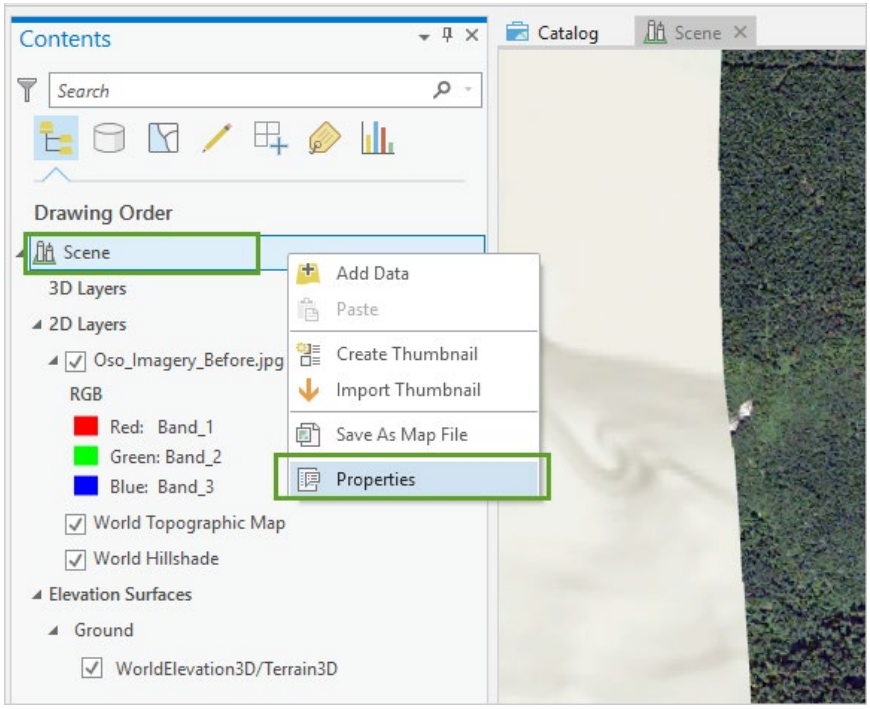


The scene is rendered with basemap content off into the distance, so the small swatch of imagery looks a little out of place. You can clip the visible area of the local scene to a limited extent (area of interest). The extent can be manually typed in, calculated from the current view point, or imported from a layer in the scene.

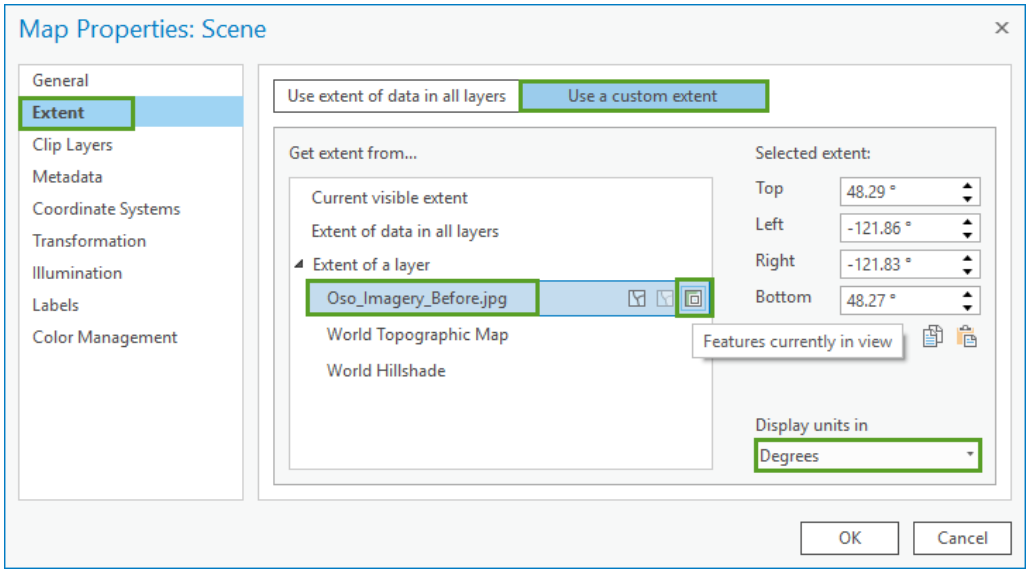
Clip the scene to an area of interest

You will clip the scene by importing from a layer to limit the view to the data extent.

1. In the **Contents** pane, right-click **Scene**, and choose **Properties**.



2. Click the **Extent** tab, and then choose the **Use a custom extent** option.
3. For **Get extent from**, hover over **Oso_Imagery_Before.jpg** and click **Features currently in view**.
4. Set **Display units in** to **Degrees**.



5. Click **OK** to apply the changes.

   The basemap is hidden, and only the imagery layer is now visible in the scene.

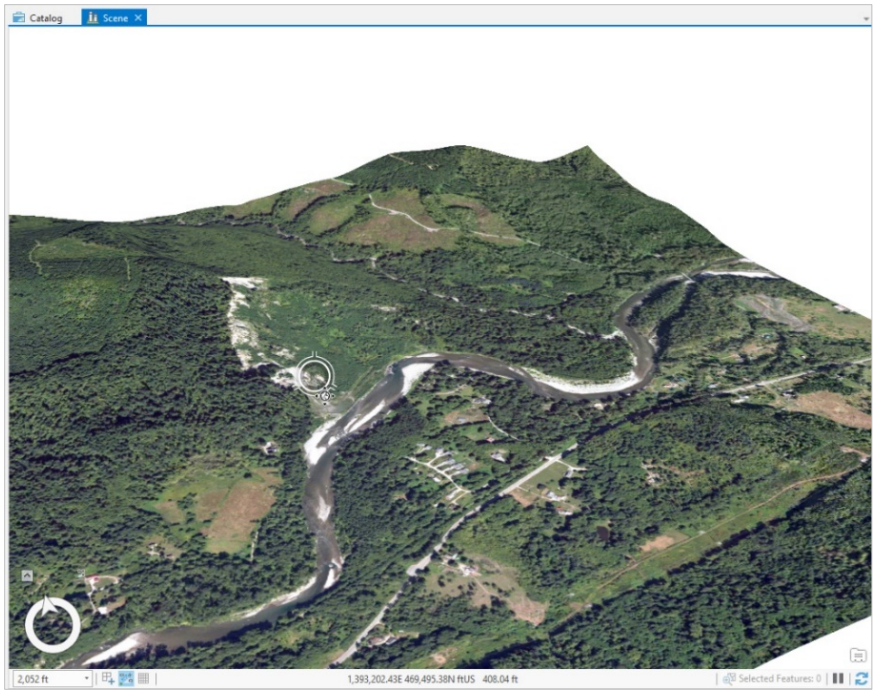


6. In the **Contents** pane, 2D layers group, check off the **World Topographic** basemap layer.

Navigate the view

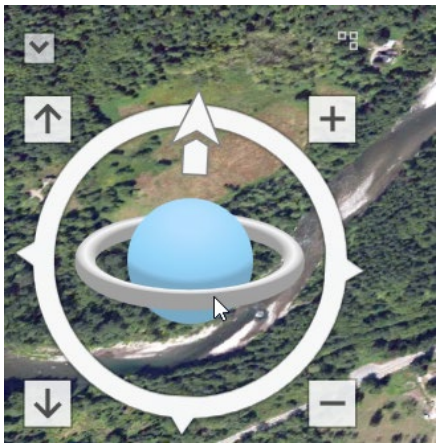
You can explore the area of interest by navigating around the view using the Explore tool, which is active by default.

1. Right-click in the view, hold the button down, and drag down to zoom in.
2. Click the middle mouse button (the screen wheel on a two-button mouse), hold it down, and move the mouse around to rotate the view.



3. Click in the view, hold the button down, and move around to pan.

   Note: Learn more about navigation in ArcGIS Pro here. You can also use the on-screen Navigator control.



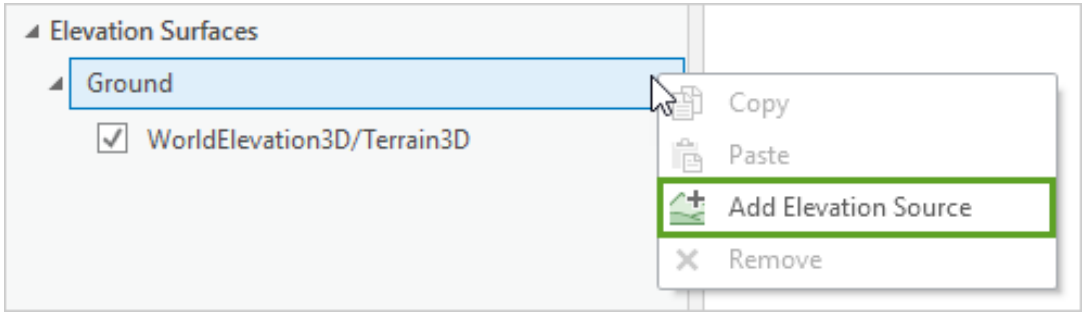
   Note that the ground and the imagery don't fully complement each other; the ground is too smoothed out and simple to properly match the higher-resolution imagery. This is because the only elevation surface in the scene is the default global service, which has a resolution between 10 meters by 10 meters and 30 meters by 30 meters per cell. This means that, best case, there is a single elevation value for almost 1,000 square feet of area.

Add a digital elevation model

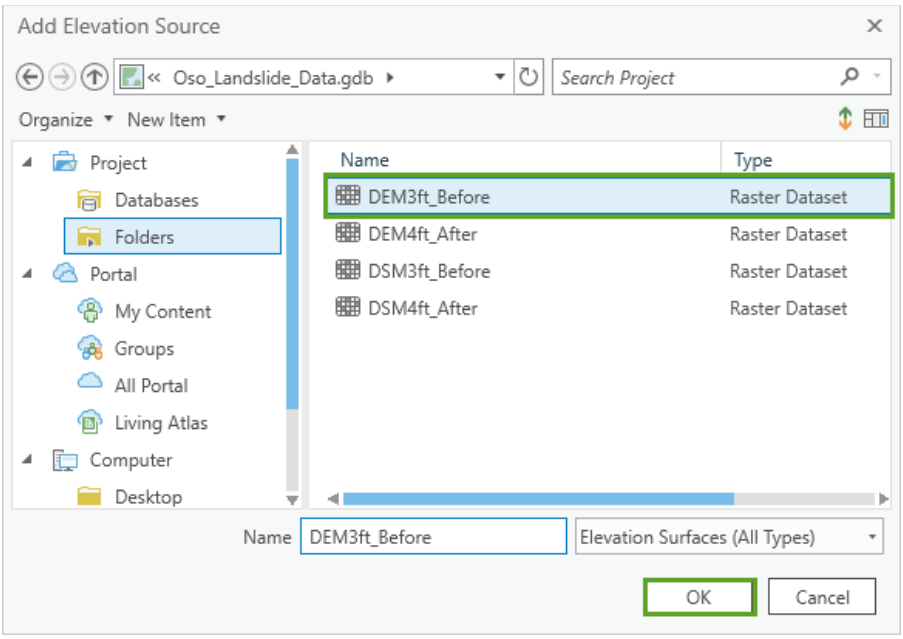
Elevation surface layers are an integral component of a 3D scene. They represent height values at every point across their extent, and they are often used to provide height values for other content in the map. You define elevation surfaces as part of the map, and then layers in the map can use them as needed.

For the data to more accurately reflect the real world, you will add a higher-resolution digital elevation model (DEM) of the area of interest before the mudslide. This type of elevation content captures the underlying bare-earth terrain of the surface and excludes elements above the ground, such as structures and trees.

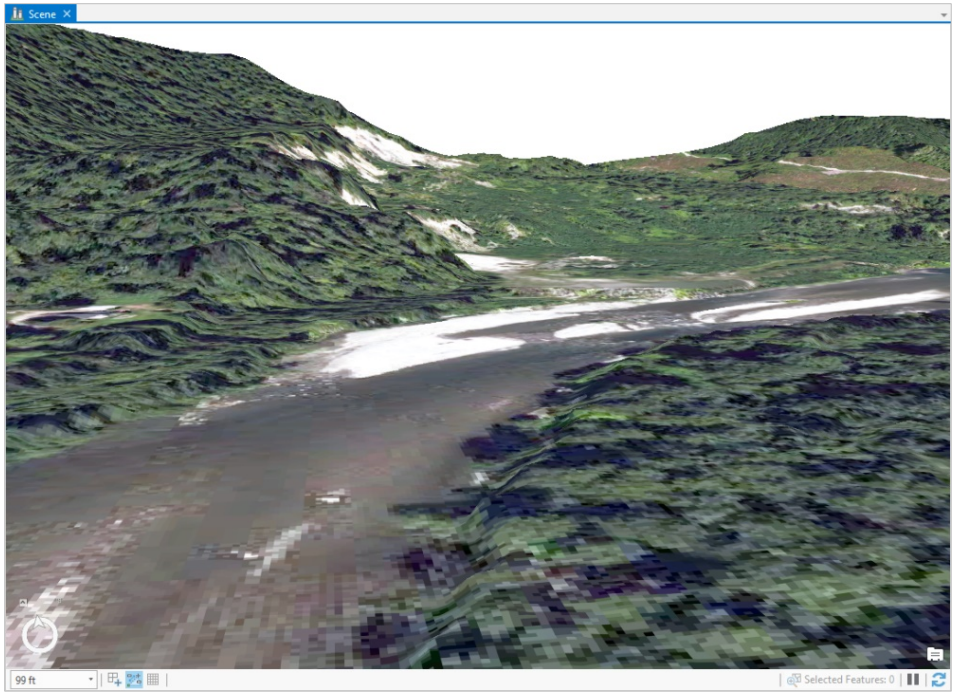
1. In the **Contents** pane, right-click **Ground**, located below the **Elevation Surfaces** group layer.
2. Click **Add Elevation Source**.



3. Browse to the location of your Oso_Elevation folder, open the Oso_Mapping_Terrain_Data folder and open the **Oso_Landslide_Data.gdb** file.
4. Select **DEM3ft_Before**. (Verify that you're clicking the **DEM3ft_Before** and not the **DSM3ft_Before**.)



5. Click **OK**.
6. Navigate around the view and note how the elevation and imagery align much better, especially along the river's edge and in locations without trees.



Hint: Use the Explore tool for scene navigation. Hold down the wheel button on your mouse and drag to tilt your view or rotate around the point you clicked.

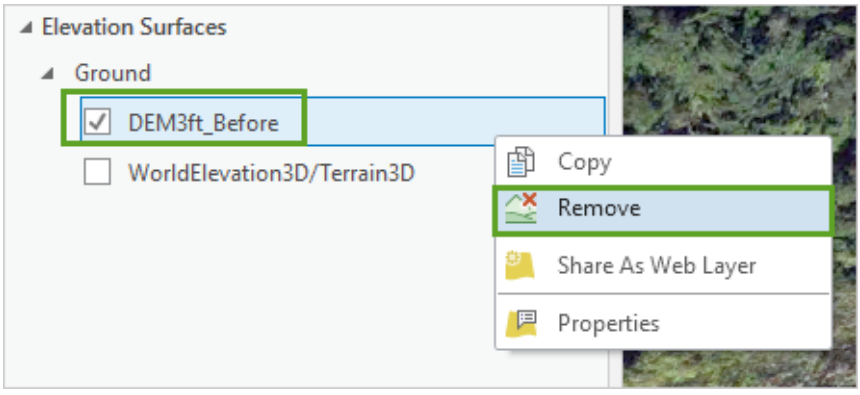
When making a 3D map, you usually require additional 3D vector content (such as buildings, trees, and power poles) that stick up from your bare-earth surface to make it more complete. If you don't have that kind of additional data, you might be able to use a digital surface model (DSM) as an elevation layer instead.

Add a digital surface model

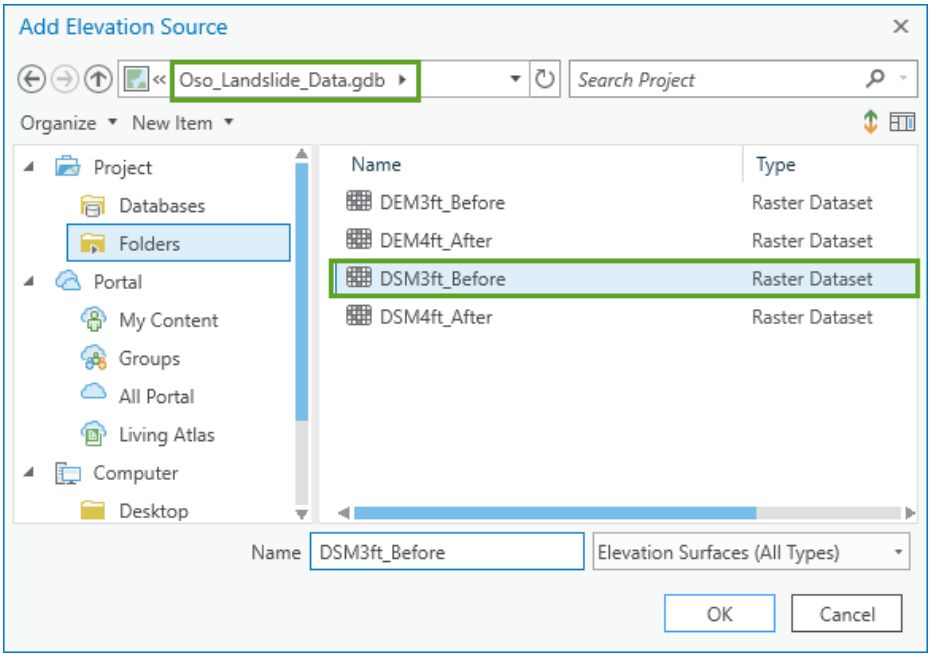
A DSM captures everything into the surface, including elements above the ground, and thereby includes real-world obstructions. These obstructions would have an impact on the visibility, shadows, and proximity analysis. From a certain viewing distance, a DSM represents a more true-to-life surface. This approach is generally less effective when viewed closer to the surface, though, as limitations with data resolution and vertical walls with a lack of overhangs become apparent.

For this scene, you intend to keep a reasonable viewing distance, so a DSM is a reasonable and time-efficient option to use. For the ground surface, you will replace the DEM data source with the DSM data source.

1. In the **Contents** pane, right-click **DEM3ft_Before**.
2. Click **Remove**.



3. Right-click **Ground**.
4. Click **Add Elevation Source**.
5. Browse to the location of your Oso_Elevation folder, open the Oso_Mapping_Terrain_Data folder and open the **Oso_Landslide_Data.gdb**.
6. Select **DSM3ft_Before**.



7. Click **OK**.



8. Navigate around the view and note how the surface has become more extreme now that above-ground features have been incorporated into the surface.
9. Zoom in close to the surface to see its limitations.
10. Zoom back out to see it in a more visually pleasing way.



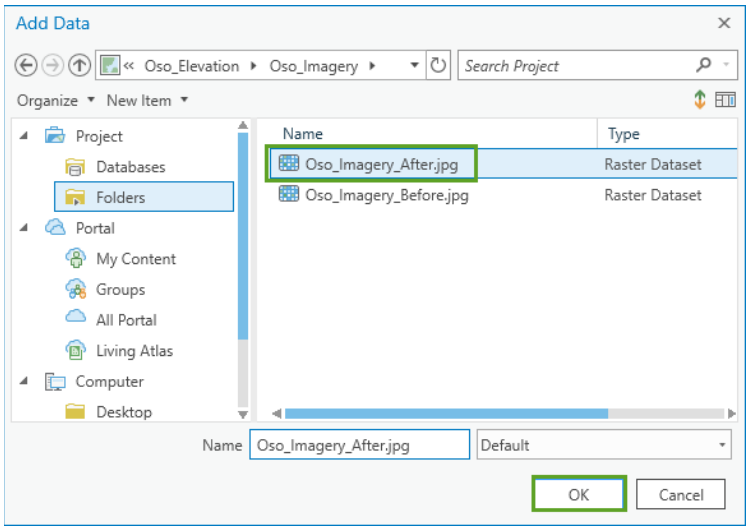
The content now looks more realistic. This is the before state of the 3D map, where the houses on the small peninsula and their surrounding trees look idyllic.

All of that changed on March 22, 2014, at 10:37 a.m. local time. A major landslide occurred, collapsing an unstable hill, spreading mud and debris, and engulfing a rural neighborhood. There were some casualties and several homes and other structures were destroyed. You will examine the area after the mudslide.

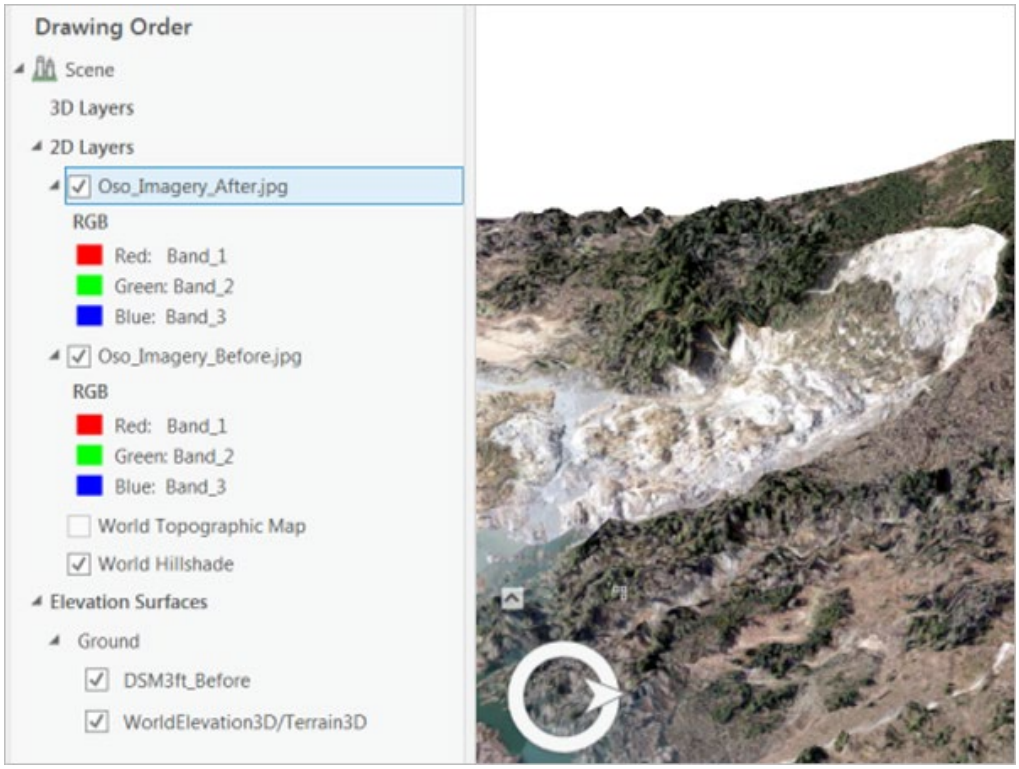
Create a second surface to represent the ground after the mudslide

You will add aerial imagery for this area, collected immediately after the mudslide, to enhance the 3D scene. You need two surfaces: one for the before state of the terrain and one for the after state.

1. From the **Map** tab, in the **Layer** group, click **Add Data**.
2. Browse to the location of your Oso_Elevation folder and open the Oso_Imagery folder.
3. Select the **Oso_Imagery_After.jpg** file and click **OK** to close the dialog box.



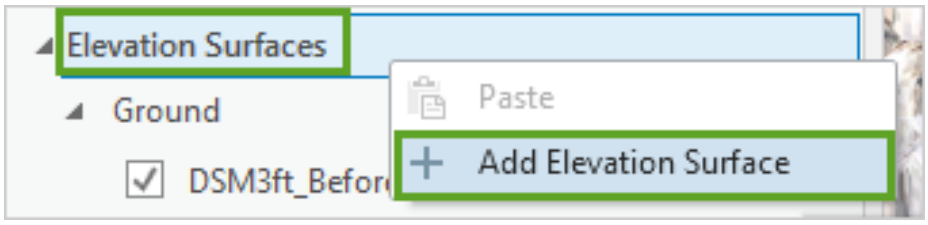
At the top of the 2D Layers in the **Contents** pane, you can now see the after imagery. By default, the new imagery layer will be drawn on the ground surface (that is, on top of the before elevation surface). As you can tell from the imagery, that is no longer an accurate representation of the ground. You need a separate and distinct surface for the post-mudslide elevation. To correct this, you will create a surface for the after state.



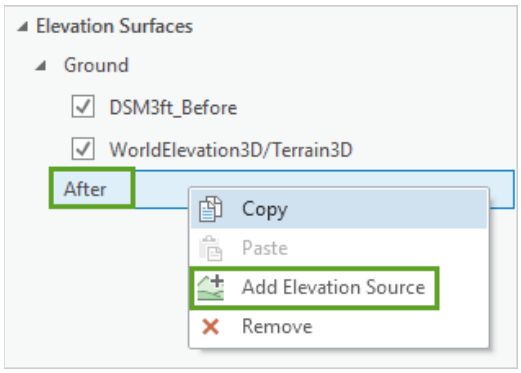
Note: you may need to zoom out to see the full imagery layer.

4. In the **Contents** pane, right-click **Elevation Surfaces**.

5. Click **Add Elevation Surface**.



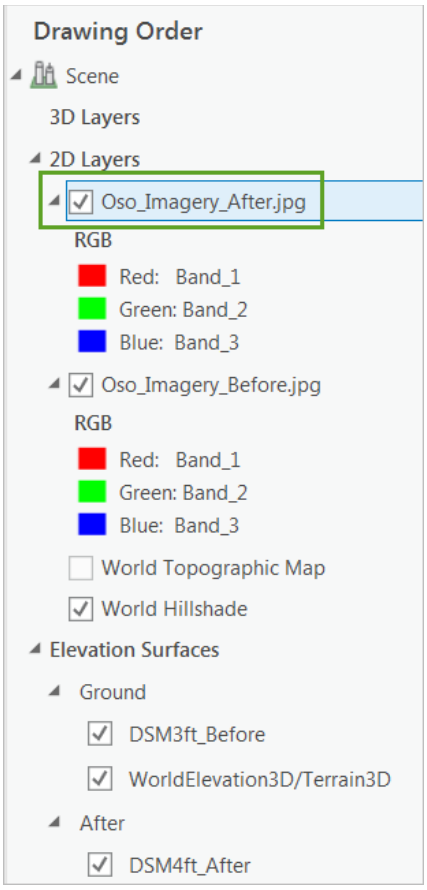
6. Rename **Surface 1** to **After**.
7. Right-click **After**, then click **Add Elevation Source**.



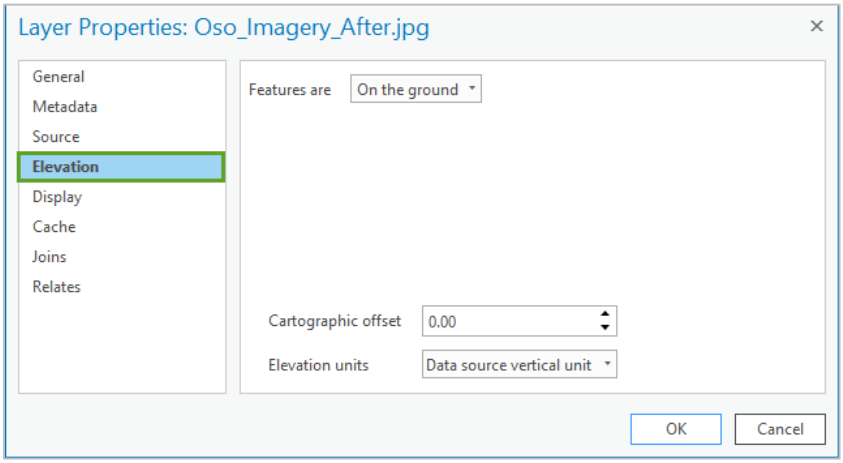
8. Browse to the location of your Oso_Elevation folder, and in the Oso_MappingTerrain_Data folder, open the **Oso_Landslide_Data.gdb** file, and then add **DSM4ft_After**.

   You will use the After surface for the after aerial image layer.

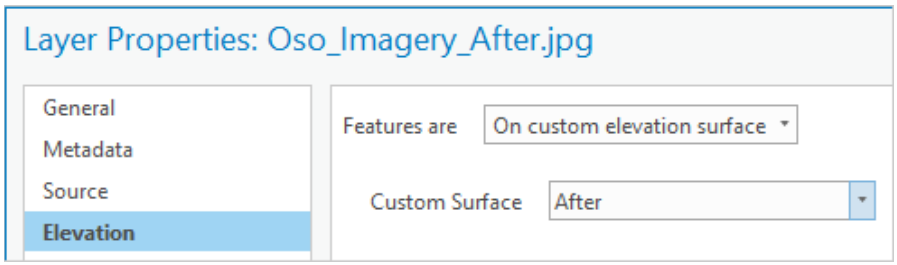
9. In the **Contents** pane, right-click the **Oso_Imagery_After.jpg** layer and choose **Properties**.



10. In the **Layer Properties** dialog box, click the **Elevation** tab.



11. For **Features are**, choose **On custom elevation surface** from the drop-down list.
12. In the **Custom Surface** drop-down list, confirm that the **After** surface is selected, and then click **OK** to close the **Layer Properties** dialog box.



13. In the **Contents** pane, turn off the **Oso_Imagery_Before.jpg** layer.



The change is dramatic. The huge volume of the hillside that slipped away and the homes on the peninsula that were swallowed up by the mudslide are clearly shown with the updated imagery and elevation layers.

14. Navigate around the view, and switch between the two layers to see the change.
15. Save your project when you are done.
16. Close ArcGIS Pro.

    Note: The final scene state is available in the FINAL_Oso_Elevation.mpkx map package in the Oso_Elevation folder, if you would like to compare it to yours.

Summary

In this lesson, you used different data sources to represent the ground surface of the Oso mudslide scene. There were two types of surfaces, a bare-earth elevation surface and an above-ground elevation surface, that were captured at two distinct moments in time. By combining an elevation surface with a matching

imagery layer, you could observe and understand how a natural disaster could catastrophically change the area's terrain.