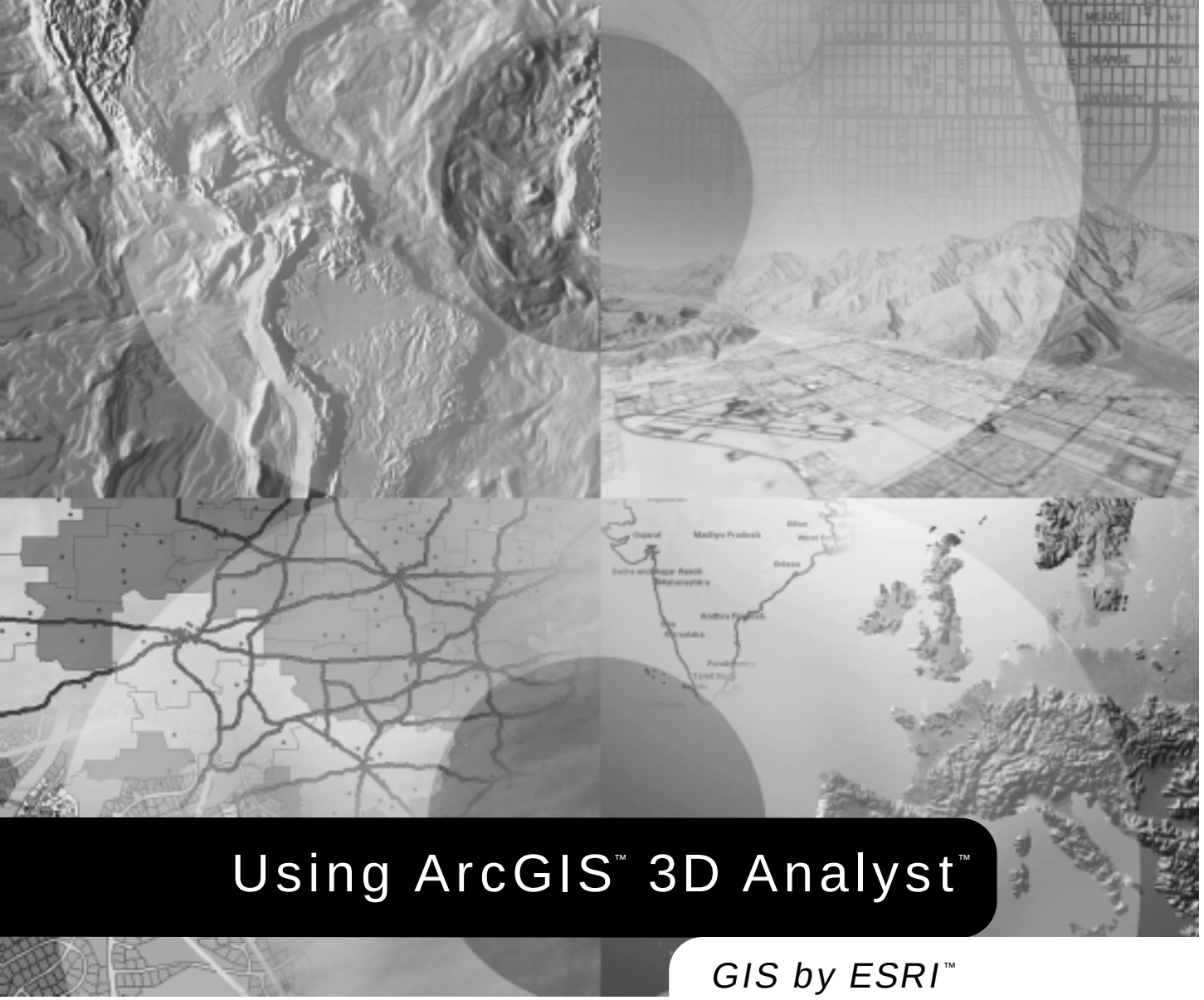

Using ArcGIS™ 3D Analyst™

GIS by ESRI™

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DATA CREDITS

Exercise 1: Death Valley image data courtesy of National Aeronautics and Space Administration (NASA)/Jet Propulsion Laboratory (JPL)/Caltech.

Exercise 2: San Gabriel Basin data courtesy of the San Gabriel Basin Water Quality Authority.

Exercise 3: Belarus CS137 soil contamination and thyroid cancer data courtesy of the International Sakharov Environmental University.

Exercise 4: Hidden River Cave data courtesy of the American Cave Conservation Association.

Exercise 5: Elevation and image data courtesy of MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs.

CONTRIBUTING WRITERS

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Quick-start tutorial

2

IN THIS CHAPTER

- Copying the tutorial data
- Exercise 1: Draping an image over a terrain surface
- Exercise 2: Visualizing contamination in an aquifer
- Exercise 3: Visualizing soil contamination and thyroid cancer rates
- Exercise 4: Building a TIN to represent terrain
- Exercise 5: Working with animations in ArcScene

The best way to learn 3D Analyst is to use it. In the exercises in this tutorial, you will:

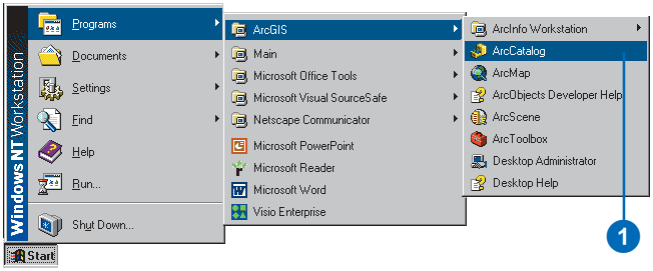
- Use ArcCatalog to find and preview 3D data.
- Add data to ArcScene.
- Set 3D properties for viewing data.
- Create new 3D feature data from 2D features and surfaces.
- Create new raster surface data from point data.
- Build a TIN surface from existing feature data.

In order to use this tutorial, you need to have the 3D Analyst extension and ArcGIS installed and have the tutorial data installed on a local or shared network drive on your system. Ask your system administrator for the correct path to the tutorial data if you do not find it at the default installation path specified in the tutorial.

Copying the tutorial data

First you will copy the tutorial data to a local drive. You will use ArcCatalog to browse to and copy the data.

1. Click Start, point to Programs, point to ArcGIS, and click ArcCatalog.

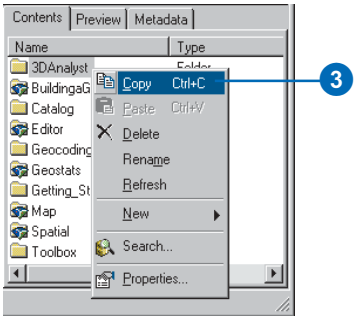


   ArcCatalog lets you find and manage your data. The left side of the ArcCatalog window is called the *Catalog tree*; it gives you a bird's-eye view of how your data is organized and provides a hierarchical view of the geographic data in your folders. The right side of the Catalog window shows the contents of the selected branch of the Catalog tree.

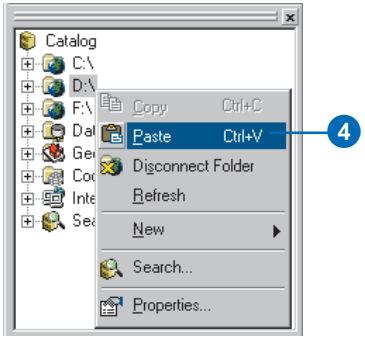
2. Click in the Location combo box and type the path to the \arcgis\ArcTutor folder on the drive where the tutorial data is installed. Press Enter.

   The ArcTutor folder is now the selected branch of the Catalog tree. You can see its contents in the Contents tab.

3. Right-click the 3DAnalyst folder and click Copy.

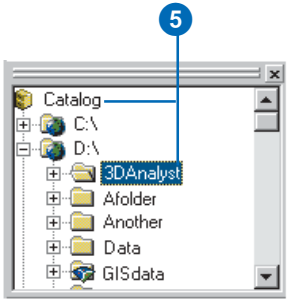


4. Right-click the local drive where you want to place the tutorial data and click Paste.



   The folder is copied to your local drive. Now you will make a folder connection to the 3DAnalyst folder in the Catalog tree.

5. Click the 3DAnalyst folder on your local drive and drag it onto the top-level node, Catalog, of the Catalog tree.



There is now a folder connection in the Catalog for your local copy of the tutorial data.

In the graphics illustrating this tutorial, the ArcCatalog option to use a special folder icon for folders containing GIS data is turned on. That is why the folder GISdata, in the graphic above, looks different from the other folders. You can turn this option on in ArcCatalog, in the Options dialog box, on the General tab. ArcCatalog works faster when this option is turned off, so it is off by default.

Exercise 1: Draping an image over a terrain surface

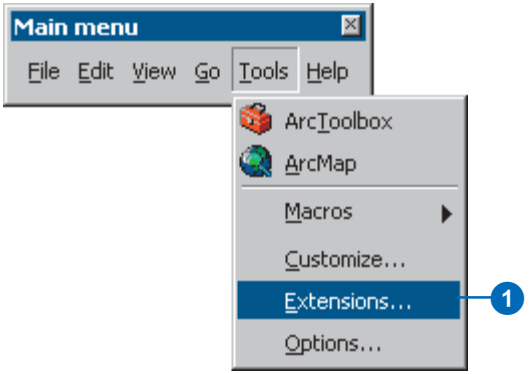
Viewing a remotely sensed image draped over a terrain surface can often lead to greater understanding of the patterns in the image and how they relate to the shape of the earth's surface.

Imagine that you're a geologist studying Death Valley, California. You have collected a TIN that shows the terrain and a satellite radar image that shows the roughness of the land surface. The image is highly informative, but you can add a dimension to your understanding by draping the image over the terrain surface. Death Valley image data was supplied courtesy of NASA/JPL/Caltech.

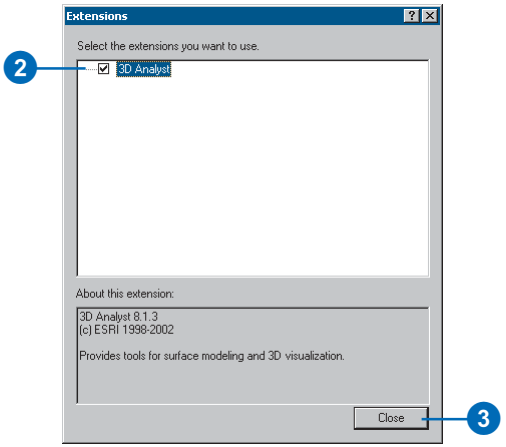
Turning on the 3D Analyst extension

You will need to enable the 3D Analyst extension.

1. Click Tools and click Extensions.



2. Check 3D Analyst.
3. Click Close.

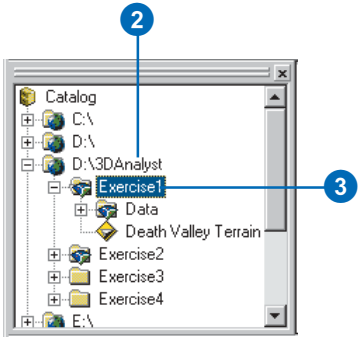


Previewing 3D data in ArcCatalog

Before you drape the image, you will browse to the terrain data and preview it in ArcCatalog.

1. Navigate to the 3DAnalyst folder connection in the Catalog tree.

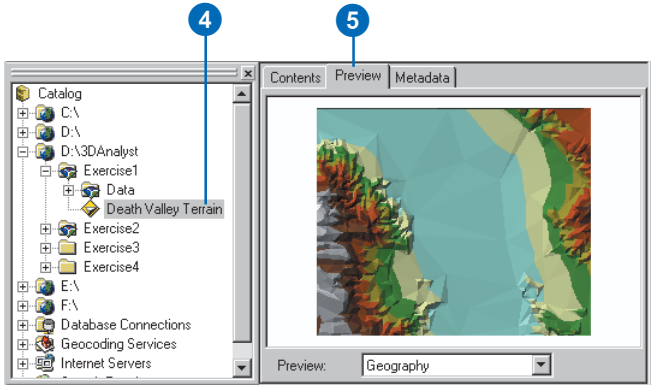
2. Double-click 3DAnalyst.
3. Double-click Exercise1.



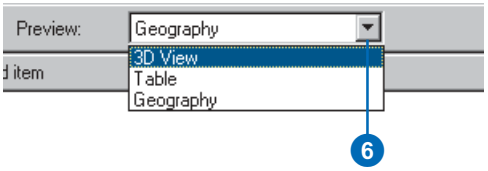
You see a folder called Data and a TIN layer called Death Valley Terrain.

A layer is a shortcut to geographic data. It also stores information about how the geographic data should be drawn on a map or in a 3D scene.

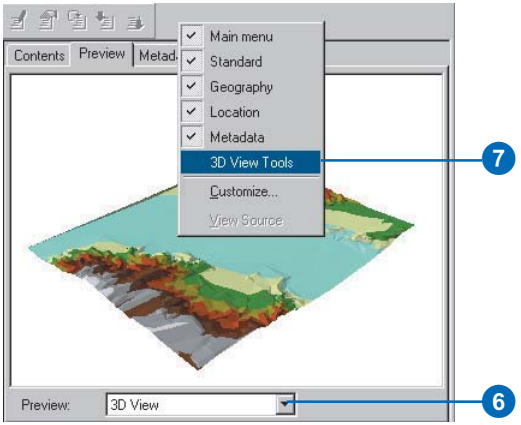
4. Click Death Valley Terrain.



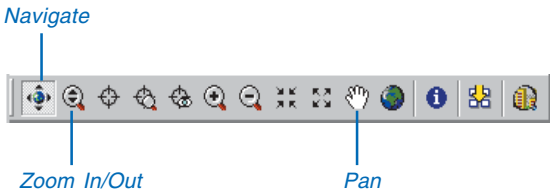
5. Click the Preview tab. You can preview your GIS data in ArcCatalog. With 3D Analyst installed, you can also preview some data in three dimensions.
6. Click the Preview dropdown arrow and click 3D View.



7. Right-click above the preview window and click 3D View Tools.



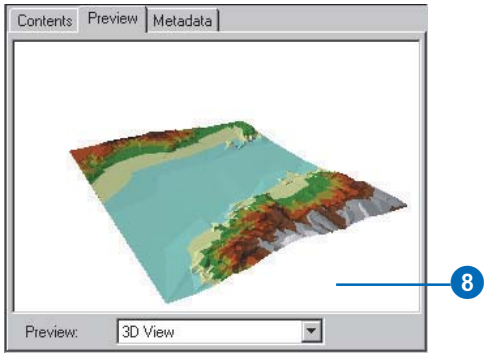
The preview becomes a 3D preview, and a new set of tools appears on the 3D View Tools toolbar.



The Navigate tool is active when you first preview data in 3D. You can see the names of tools by hovering the pointer over the tool.

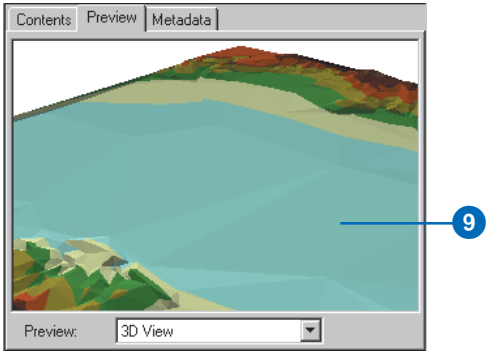
The Navigate tool allows you to rotate 3D data and change the apparent viewer height by clicking and dragging left and right and up and down, respectively, in the 3D preview.

8. Click on the 3D preview and drag to the right.



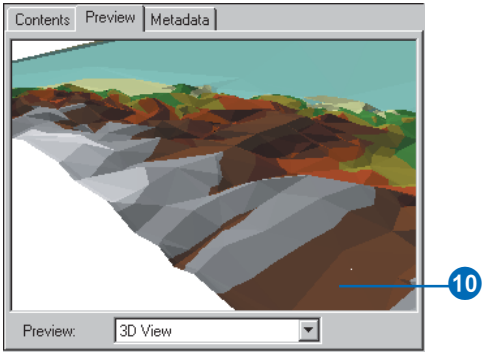
The data rotates around its center. The Navigate tool also allows you to zoom in and out and pan across the data, depending on the mouse button that you click while dragging in the 3D preview.

9. Right-click on the 3D preview and drag down.



The pointer changes to the Zoom In/Out pointer, and the view zooms in to the data.

10. Click the middle button—or both the right and left buttons if you have a two-button mouse—and drag to the right.

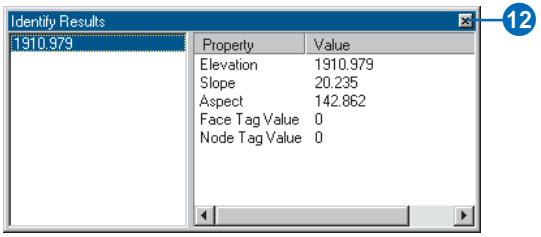


The pointer changes to the Pan pointer, and the view pans across the data.

11. Click the Identify button and click on the TIN.

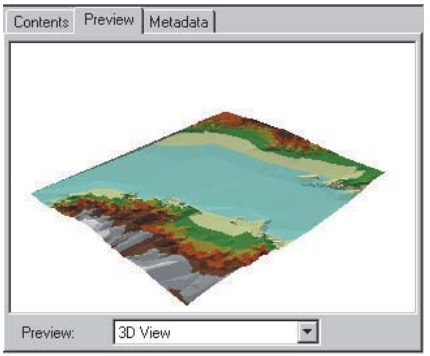
The Identify Results window shows you the elevation, slope, and aspect of the surface at the point you clicked.

12. Close the Identify Results window.



13. Click the Full Extent button.

The view returns to the full extent of the data.



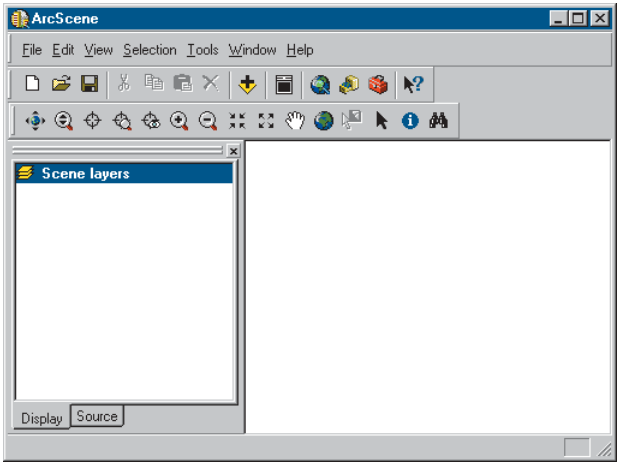
Now you've examined the surface data and begun to learn how to navigate in 3D. The next step is to start ArcScene and add your radar image to a new scene.

Starting ArcScene and adding data

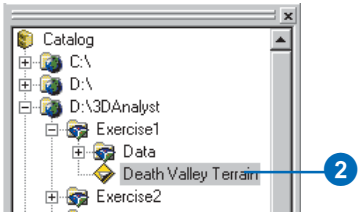
ArcScene is the 3D viewer for 3D Analyst. Although you can preview 3D data in ArcCatalog, ArcScene allows you to build up complex scenes with multiple sources of data.

1. Click the ArcScene button on the 3D View Tools toolbar.

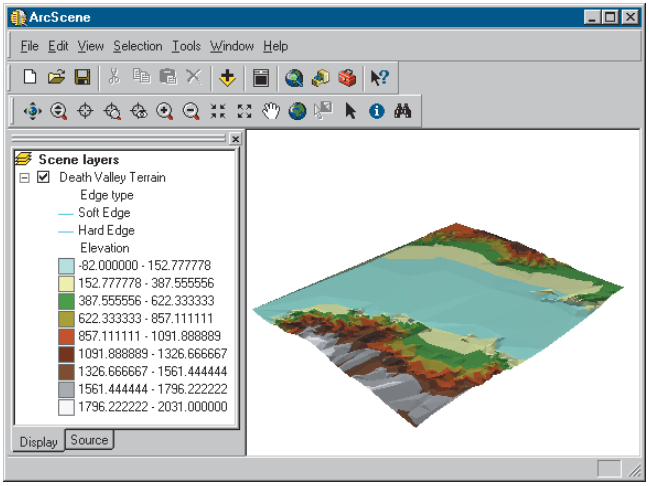
ArcScene starts. Note that many of the tools on the ArcScene Standard toolbar are the same as the 3D navigation tools that you see in ArcCatalog.



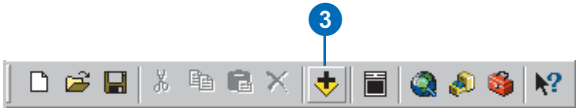
2. Click the Death Valley Terrain layer in the Catalog tree and drag it onto the right-hand side of the ArcScene window, then release the mouse button.



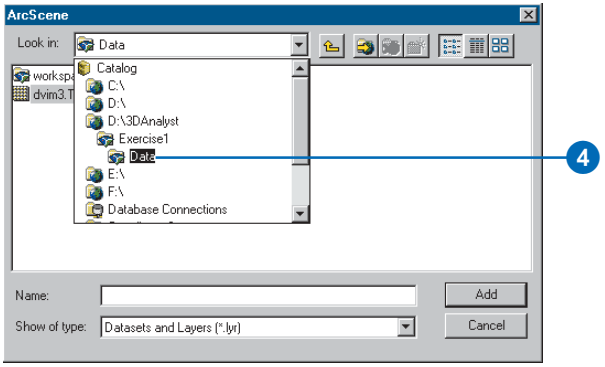
The TIN is drawn in the new scene.



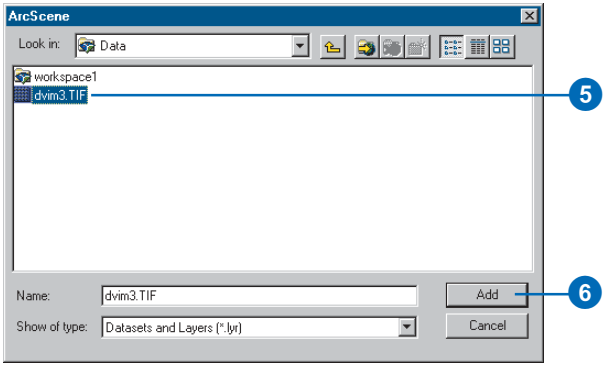
3. Click the Add Data button on the ArcScene Standard toolbar.



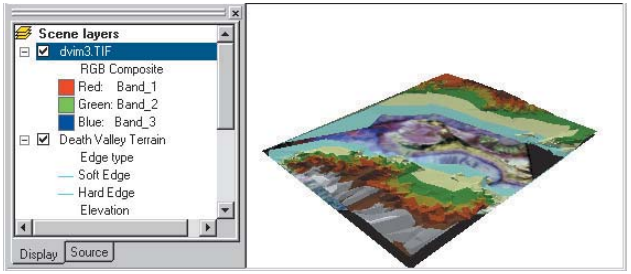
4. Navigate to the Data folder for Exercise1.



5. Click dvim3.TIF.
6. Click Add.

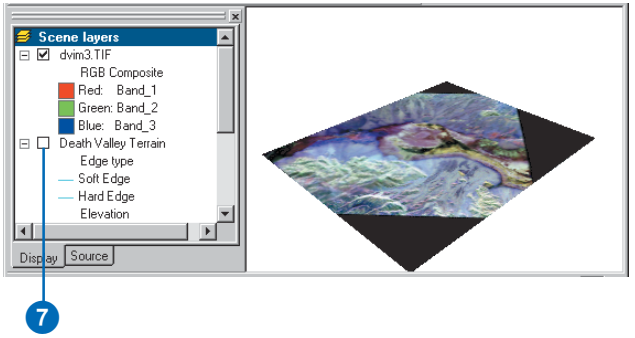


The image is added to the scene.



The image is drawn on a plane, with a base elevation value of zero. You can see it above the Death Valley terrain surface where the terrain is below 0 meters elevation (sea level); it is hidden by the terrain surface everywhere else.

7. Uncheck the Death Valley Terrain layer.



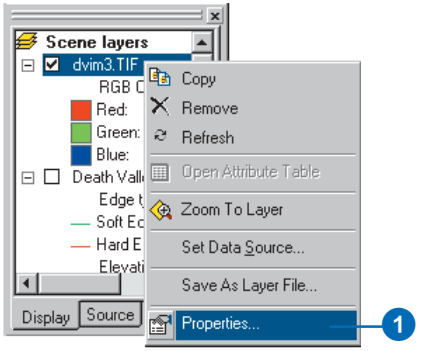
Now you can see the whole image. The black areas are parts of the image that contain no data and are a result of previous processing to fit the image to the terrain.

You have added the image to the scene. Now you will change the properties of the image layer so that the image will be draped over the terrain surface.

Draping the image

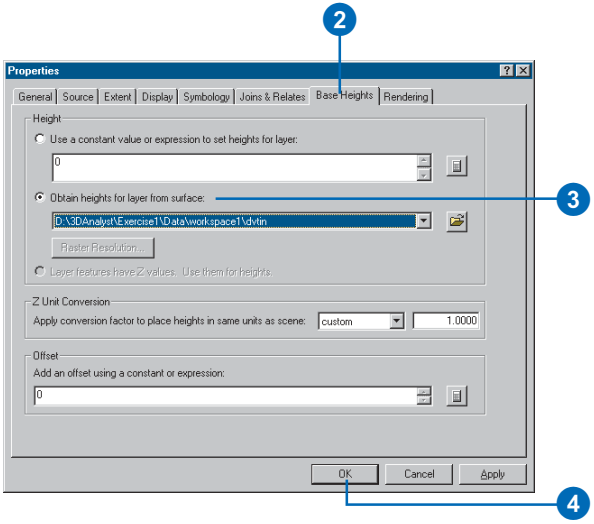
While the surface texture information shown in the image is a great source of information about the terrain, some relationships between the surface texture and the shape of the terrain will be apparent when you drape the image over the terrain surface. In ArcScene, you can drape a layer—containing a grid, image, or 2D features—over a surface (a grid or TIN) by assigning the base heights of the layer from the surface.

1. Right-click dvim3.TIF in the ArcScene table of contents and click Properties.



The layer Properties dialog box appears. You can change how a layer is drawn on a map or in a scene by setting its properties.

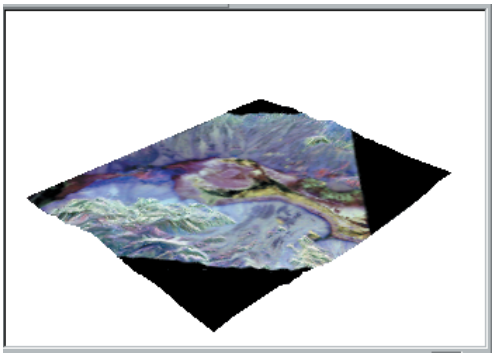
2. Click the Base Heights tab.



3. Click the option to Obtain heights for layer from surface.

   Because the TIN is the only surface model in the scene, it appears in the surface dropdown list.

4. Click OK.



The image is draped over the terrain surface.

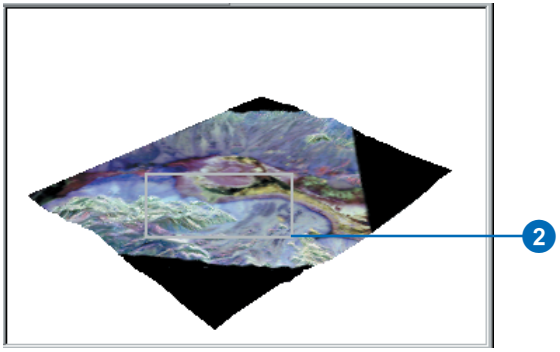
Now you will be able to navigate around the image and see the relationship between surface texture, as shown by the image colors, and the shape of the terrain.

Exploring the image

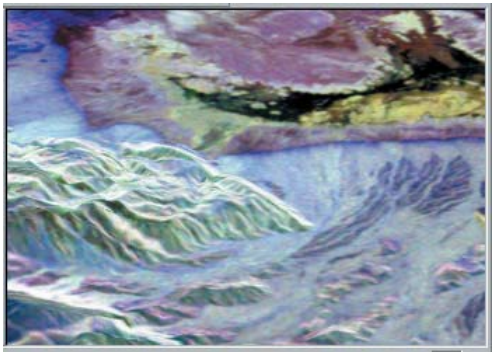
You will use the navigation tools on the ArcScene Tools toolbar to explore the draped image.

1. Click the Zoom in button.

2. Click and drag a rectangle around the middle of the image.

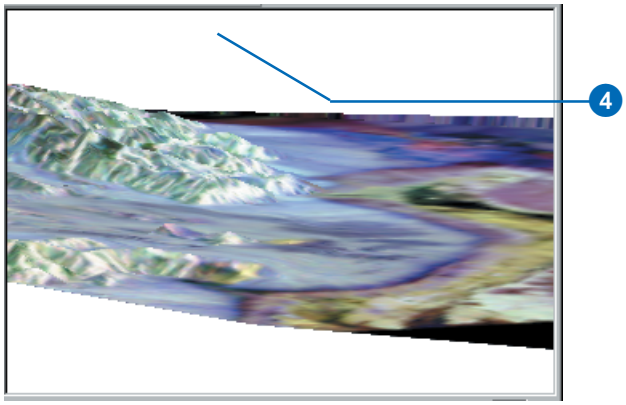


The scene zooms to the middle part of the image.

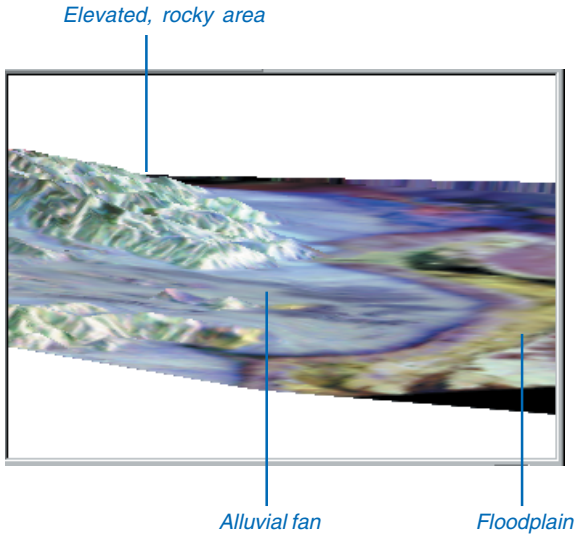


3. Click the Navigate button.

4. Click on the scene and slowly drag up and to the left.



The scene rotates, and the view angle lowers, so it looks as though you are looking down the valley, past the higher land on the left side of the scene.



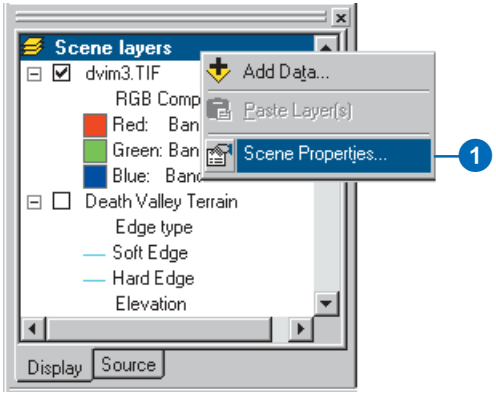
The elevated land is visibly rougher terrain than the flat valley bottom. The surface texture—and therefore the color, in the radar image—of this rocky area is different than the fine sediment of the floodplain—the yellow and black region in the valley bottom. The rocky area is also a different texture from the gently sloping alluvial fan that runs past it, down onto the valley floor.

Draping the radar image over the terrain surface allows you to see the relationship between the general shape of the land surface and the texture of the rocks and sediment that make up the surface.

Exaggerating the terrain

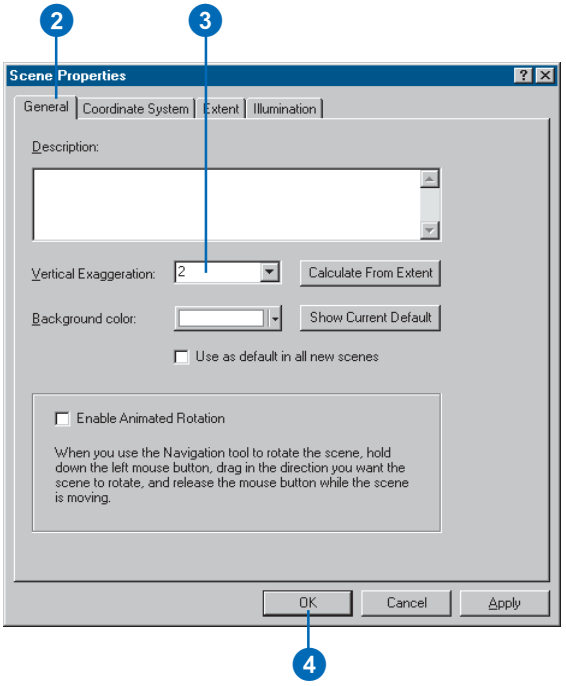
The valley is a broad area, relative to the height of the terrain, even though the mountains at the edge of the scene are more than 2,000 meters above the valley floor. In order to enhance the sense of depth in the scene, and to bring out subtle features in the terrain, you will exaggerate the height of the terrain.

1. Right-click Scene layers in the table of contents and click Scene Properties.



The Scene Properties dialog box lets you set properties that are shared by all of the layers in the scene. These include the vertical exaggeration, the background (sky) color, the coordinate system and extent of the data, and the way that the scene is illuminated (the position of the light source relative to the surface).

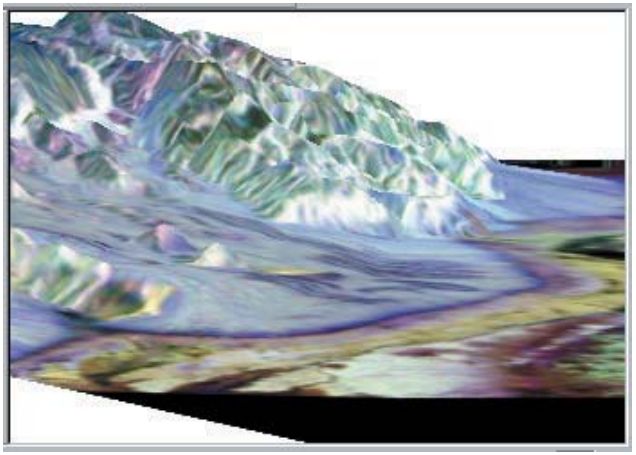
2. Click the General tab.



3. Type “2” in the Vertical Exaggeration combo box.
4. Click OK.

   The apparent height of the terrain is now doubled.

You can now clearly see how the alluvial fan spreads out onto the valley floor, between the larger rocky area at the center of the scene and the smaller rocky area in the foreground at the left side of the scene.

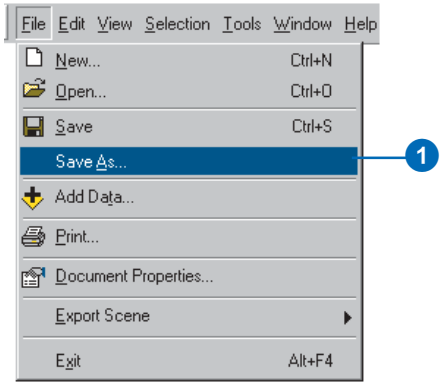


You have added depth to the radar image, explored the general relationship between the data in the image and the terrain data, and enhanced the scene so that you can perceive more subtle variations in the terrain.

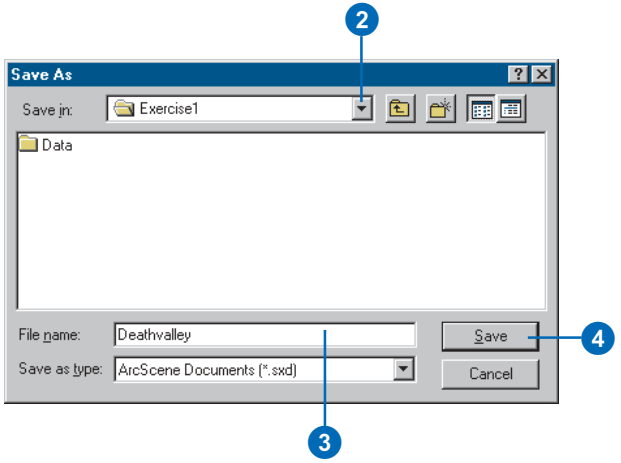
Now that you've built the scene, you will save it so that you can explore it later if you choose.

Saving the scene

Scenes, also called Scene Documents, are like maps. They contain information about how the layers that are in the scene should be rendered and where the data is located.



1. Click File and click Save As.



2. Navigate to the Exercise1 folder.
3. Type "Deathvalley".
4. Click Save.

The scene will now be available for you to open later.

Exercise 2: Visualizing contamination in an aquifer

Imagine that you work for a water district. The district is aware of some areas where volatile organic compounds (VOCs) have leaked over the years. Scientists from your department have mapped some plumes of VOCs in the aquifer, and you want to create a 3D scene to help officials and the public visualize the extent of the problem.

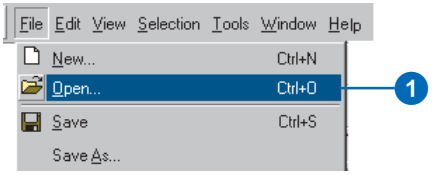
Some of the data for the scene has already been assembled in the Groundwater scene. You will modify the scene to better communicate the problem.

VOC data was supplied courtesy of the San Gabriel Basin Water Quality Authority.

Opening the Groundwater scene document

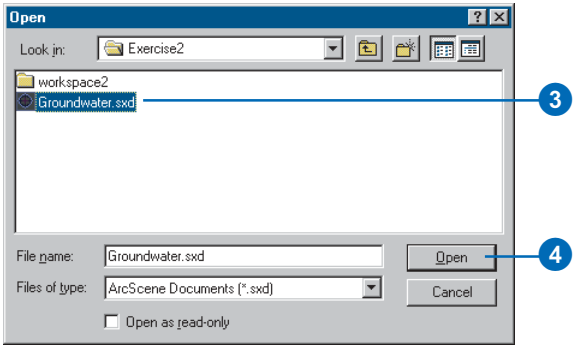
This scene document contains a TIN that shows the shape of the contaminant plume, a raster that shows the concentration of the contaminant, and two shapefiles that show the locations of parcels and wells. You will drape the concentration raster over the plume TIN, extrude the building features and change their color, and extrude the well features so that the wells that are most endangered by the contamination may be more easily recognized.

1. In ArcScene, click File, then click Open.



2. Navigate to the Exercise2 folder.

3. Click Groundwater.sxd.



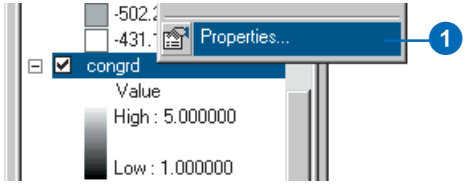
4. Click Open.

   The Groundwater scene opens. You can see the four layers in the table of contents.

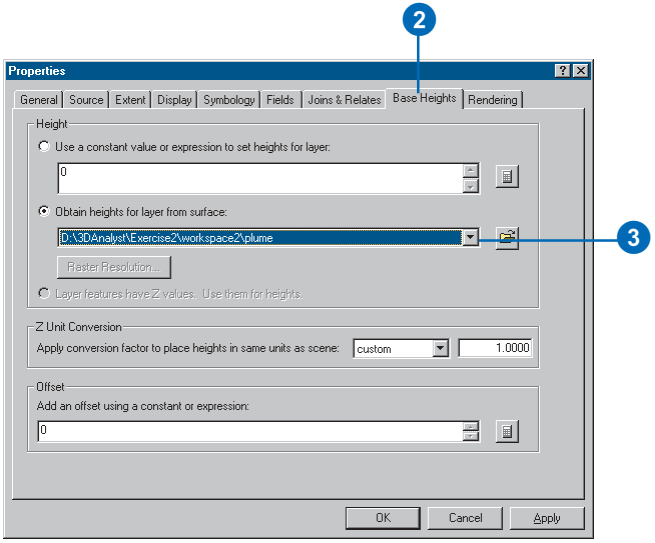
Showing the volume and intensity of contamination

You'll drape the raster of VOC concentration over the TIN of the contaminant plume surface to show the volume and intensity of contamination in the aquifer.

1. Right-click congrd and click Properties.



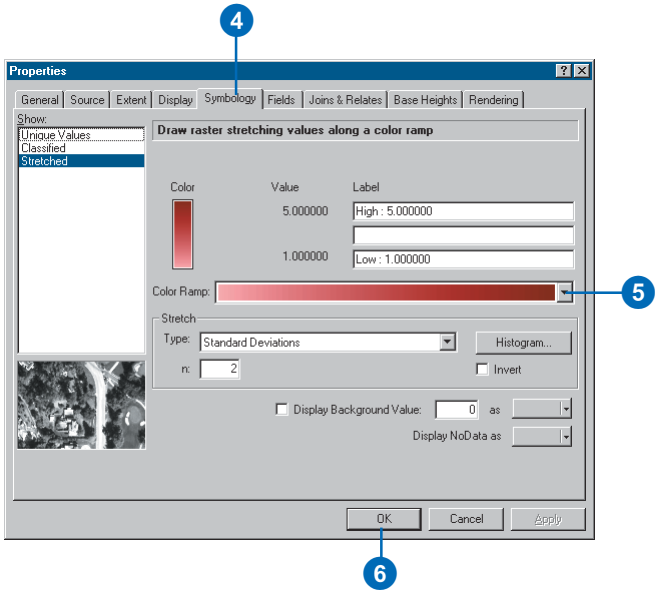
2. Click the Base Heights tab.



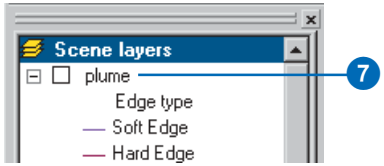
3. Click the dropdown arrow and click plume to get the heights from the plume TIN.

   Now you will change the symbology of the raster to show the intensity of the contamination.

4. Click the Symbology tab.



5. Click the Color Ramp dropdown arrow and click a red color ramp for the raster.
6. Click OK.
7. In the table of contents, uncheck plume.



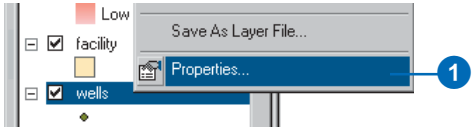
Now it is possible to see the shape of the plume and its intensity in 3D.

Showing the relationship of the plume to wells

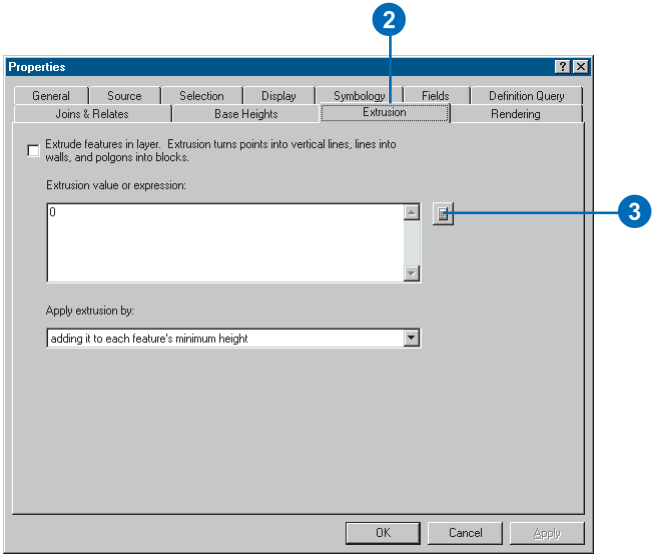
You can see that some of the wells are within the area of the plume. However, it is difficult to see which wells are most seriously affected because the contamination is more widespread but less concentrated at greater depths.

You will extrude the well features based on their depth attribute in order to see which wells intersect the plume.

1. Right-click wells and click Properties.



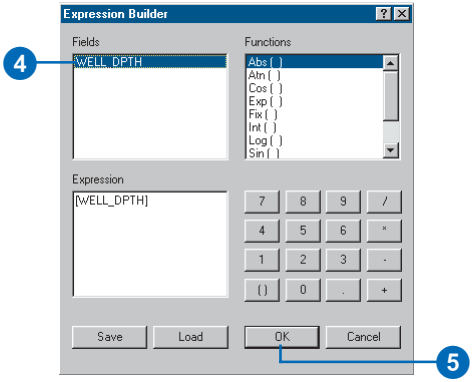
2. Click the Extrusion tab.



3. Click the Calculate Extrusion Expression button.

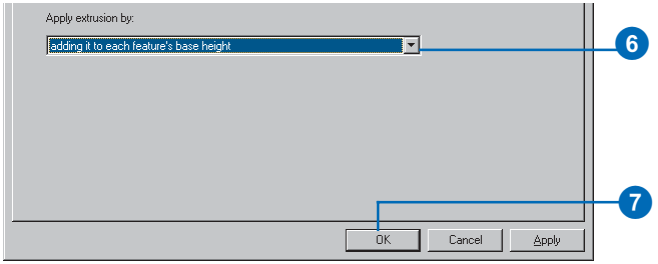
You will display the well points as vertical lines equal to the depth of the well. This information is stored in the WELL_DPTH field.

4. Click WELL_DPTH.



5. Click OK.

6. Click the dropdown arrow to apply the extrusion expression by adding it to each feature's base height. The well depths are expressed as negative values, so they'll be extruded downward.



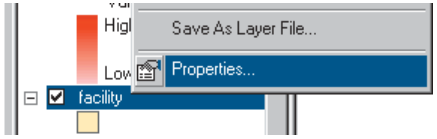
7. Click OK.

You can see the places where the wells intersect, or are close to, the plume. Now you will modify the scene to show the priority of various facilities that have been targeted for cleanup.

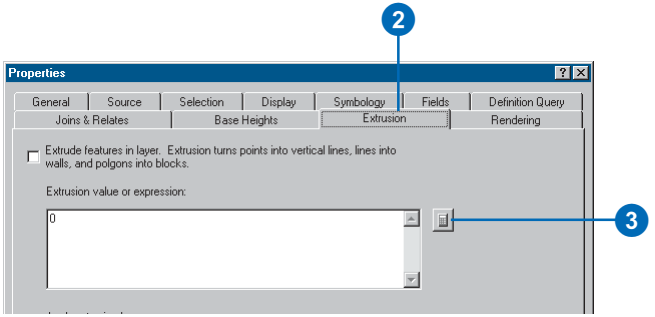
Showing the facilities with a high cleanup priority

Analysts in your department have ranked the facilities according to the urgency of a cleanup at each location. You'll extrude the facilities into 3D columns and color code them to emphasize those with a higher priority for cleanup.

1. Right-click facility and click Properties.
2. Click the Extrusion tab.

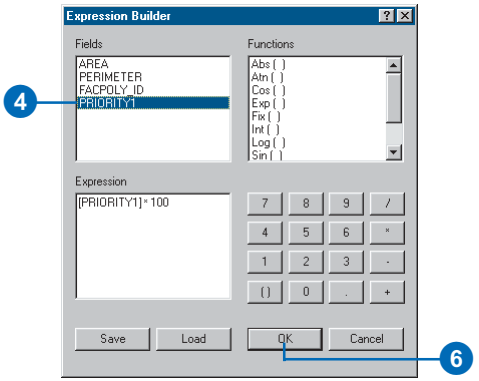


3. Click the Calculate Extrusion Expression button.



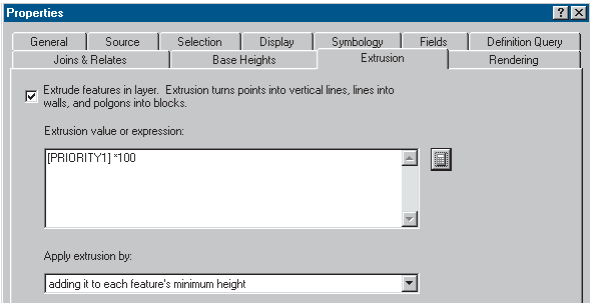
4. Click PRIORITY1.

5. Type "* 100".

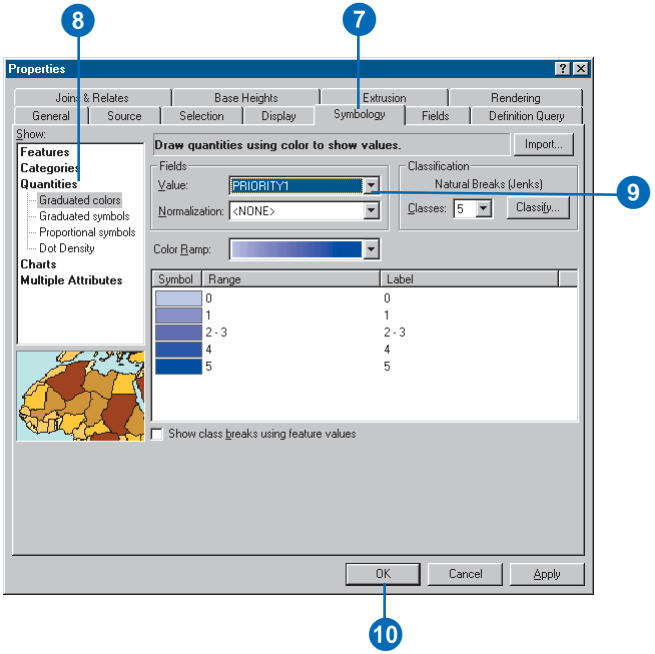


6. Click OK.

   The expression you created appears in the Extrusion value or expression box.



7. Click the Symbology tab.
8. Click Quantities.
9. Click the Value dropdown list and click PRIORITY1.



10. Click OK.

    The facilities are now extruded in proportion to their priority score. The scene now shows the shape and intensity of the contamination, the wells in relationship to the plume, and the facilities that need to be cleaned up in order to prevent further pollution of the groundwater.

    Now you'll save your changes to the scene.

11. Click the Save button.

Exercise 3: Visualizing soil contamination and thyroid cancer rates

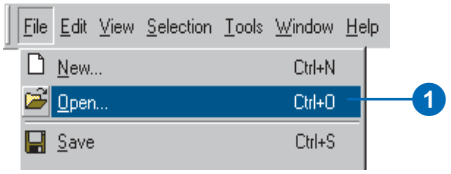
In 1986, after the catastrophic accident at the Chernobyl nuclear power plant in Ukraine, a large amount of radioactive dust fell on Belarus. Since then, scientists have studied the aftermath of the accident. One tool for exploring the data is 3D visualization. In this exercise, you will create two surfaces from point data collected in Belarus. One set of points contains measurements of soil CS137 concentrations. CS137 is one of several radioactive isotopes released by the accident. The other set of points shows the rates of thyroid cancer, aggregated by district, with the sample point placed near the district centers.

The CS137 contamination and thyroid cancer data was supplied courtesy of the International Sakharov Environmental University.

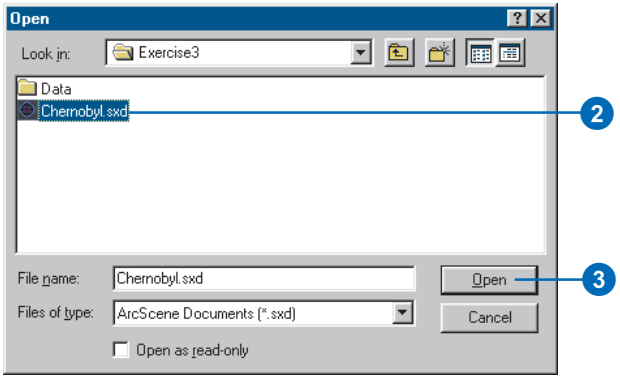
Viewing the point data

First, you will open the Chernobyl scene and view the point data.

1. Click File and click Open.



2. Navigate to Exercise3 and click Chernobyl.
3. Click Open.



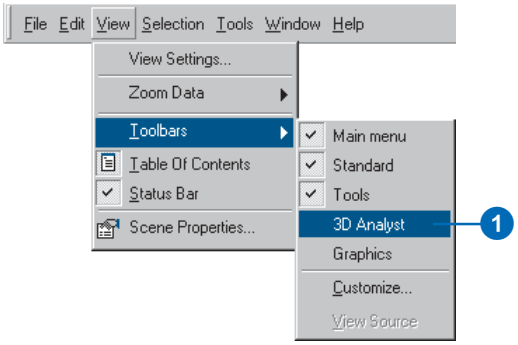
The CS137 soil measurements are shown with small point symbols, using a graduated color ramp to show the intensity of the contamination. The districts' thyroid cancer rates are shown with larger symbols, using a different color ramp.

Creating 3D point features

The soil CS137 samples are 2D points with some attributes. One way to view 2D points in 3D is by setting an extrusion expression, or a base height. You can also incorporate a z-value into a feature's geometry to allow it to be directly viewed in 3D without the need to set a base height from a surface or an attribute.

First, you'll add the 3D Analyst toolbar to ArcScene.

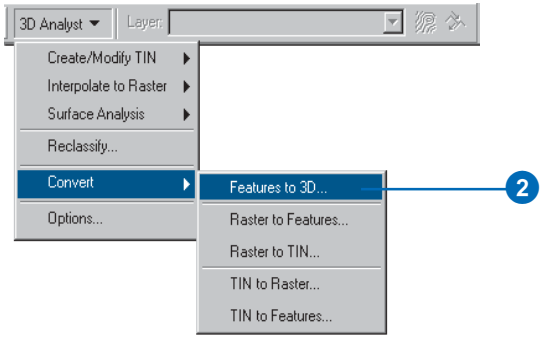
1. Click View, point to Toolbars, and click 3D Analyst.



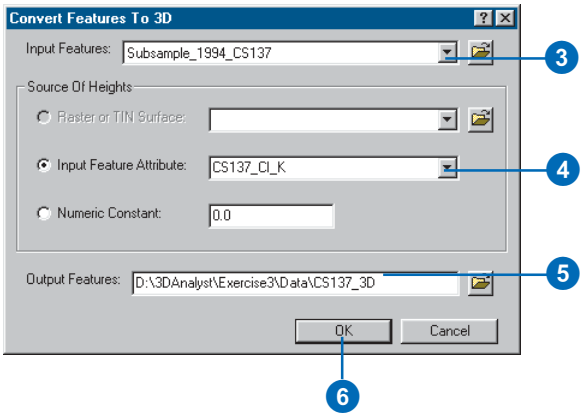
The 3D Analyst toolbar in ArcScene contains several 3D analysis and data conversion tools. The ArcMap 3D Analyst toolbar contains the same tools, plus several additional tools that you can use in ArcMap.

Now you will create 3D point features from the soil CS137 points.

2. Click 3D Analyst, point to Convert, and click Features to 3D.



3. Click the Input Features dropdown list and click Subsample_1994_CS137.



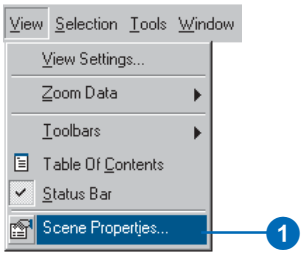
4. Click the Input Feature Attribute button, then click the Input Feature Attribute dropdown list and click CS137_CI_K.
5. Change the output feature name to CS137_3D.
6. Click OK.

The features are converted to 3D point features. However, they still seem to be resting on a flat plane because the CS137 concentration values range from 0 to 208.68, which is small relative to the horizontal extent of the data.

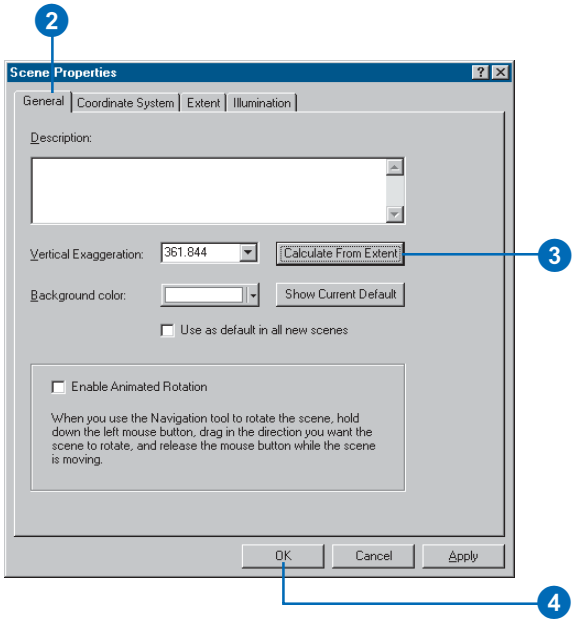
Increasing the vertical exaggeration

You will exaggerate the scene to show the new points with their height embedded in the feature geometry.

1. Click View and click Scene Properties.



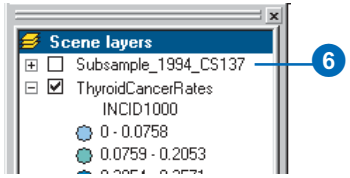
2. Click the General tab.



3. Click Calculate From Extent.
4. Click OK.
5. Click the Full Extent button.

Now that you can see the new 3D points in the scene, you can turn off the original CS137 sample point layer.

6. Uncheck the box in the table of contents beside Subsample_1994_CS137 and click the minus sign beside the box to hide the classification.

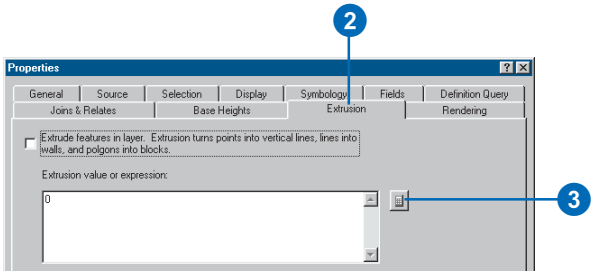


Extruding columns

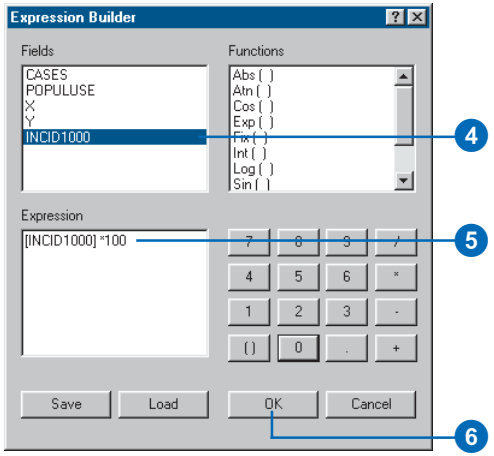
Viewing points in 3D space is one way to investigate data. Another way is to extrude points into columns. You will extrude the thyroid cancer points into columns to compare them to the contamination data.

1. Right-click ThyroidCancerRates and click Properties.

2. Click the Extrusion tab.



3. Click the Calculate Extrusion Expression button.
4. Click INCID1000 (the rate of cases per 1,000 persons).



Because the z-values of the phenomena that you are comparing have different ranges, you will multiply the cancer rate by 100 to bring the values into a range similar to that of the CS137 measurements.

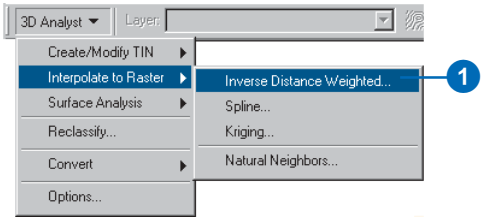
5. Type "* 100".
6. Click OK on the Expression Builder dialog box.
7. Click OK on the Layer Properties dialog box.

Now the district centroid points are shown with columns proportionate to the thyroid cancer rates. If you navigate the scene you will see that the areas with the highest contamination levels also tend to have high thyroid cancer rates, although there are areas with lower CS137 contamination levels that also have high cancer rates.

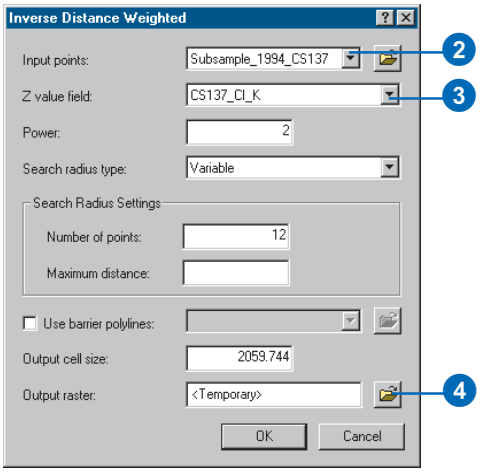
Creating a surface from point sample data

You know what the soil concentrations of CS137 are at the sample point locations, but you do not know what they are at the locations between sample points. One way to derive the information for locations between sample points is to interpolate a raster surface from the point data. There are many ways to interpolate such surfaces, which result in different models of varying accuracy. In this exercise you will interpolate a surface from the samples using the Inverse Distance Weighted (IDW) interpolation technique. IDW interpolation calculates a value for each cell in the output raster from the values of the data points, with closer points given more influence and distant points less influence.

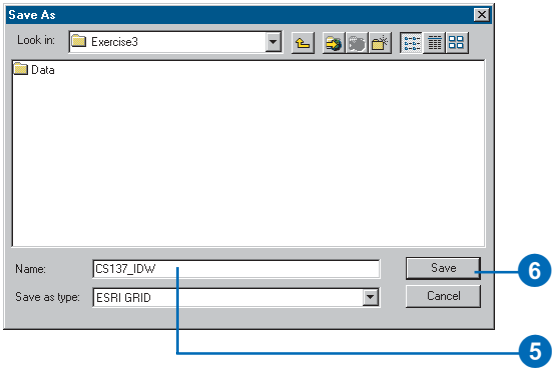
1. Click 3D Analyst, point to Interpolate to Raster, and click Inverse Distance Weighted.



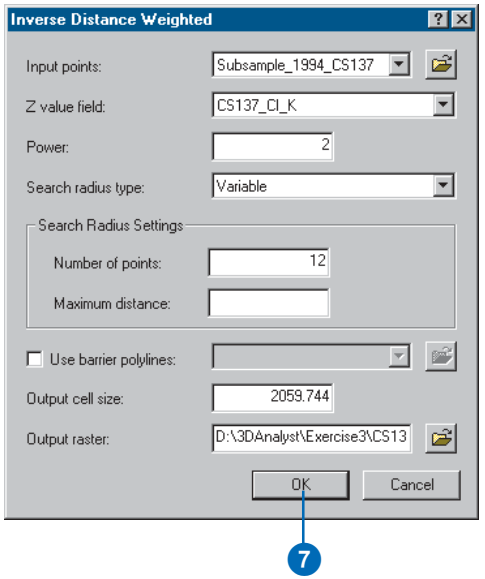
2. Click the Input points dropdown list and click Subsample_1994_CS137.



3. Click the Z value field dropdown list and click CS137_CI_K.
4. Click the Browse button.
5. Navigate to the Exercise3 folder and type "CS137_IDW" in the Name field.



6. Click Save.
7. Click OK.

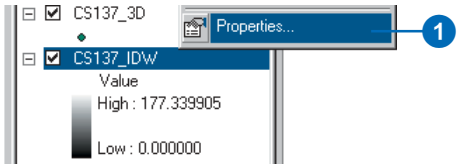


ArcScene interpolates the surface and adds it to the scene.

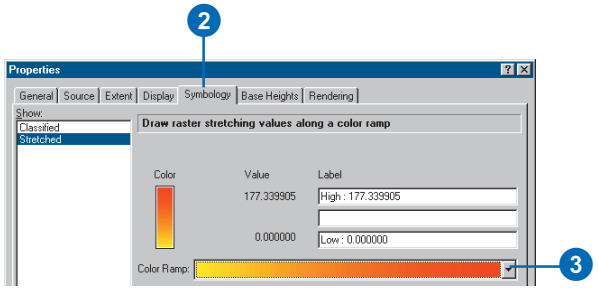
Viewing the interpolated surface

Now that the surface has been added to the scene, you can see that there are two areas with very high concentrations of CS137. You will view the surface in perspective, with a new color ramp, to better see its shape.

1. Right-click CS137_IDW and click Properties.

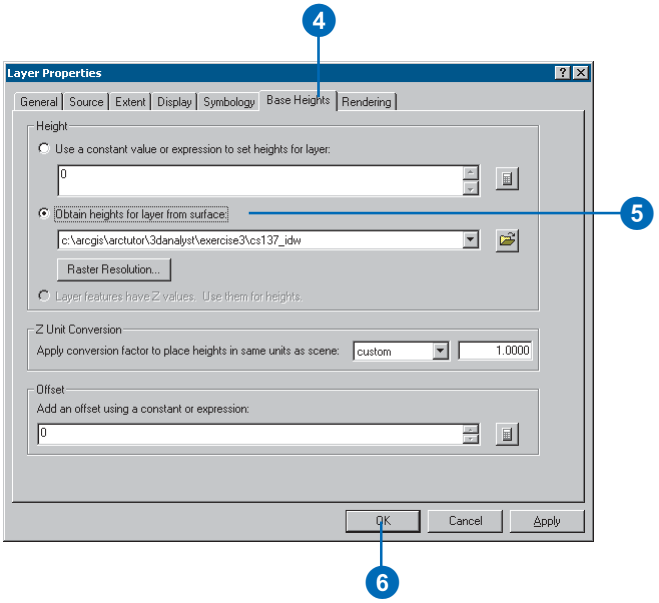


2. Click the Symbology tab.



3. Click the Color Ramp dropdown arrow and click a new color ramp.

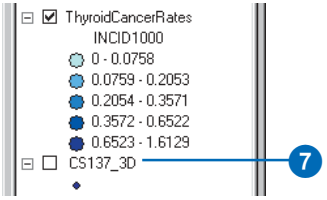
4. Click the Base Heights tab.



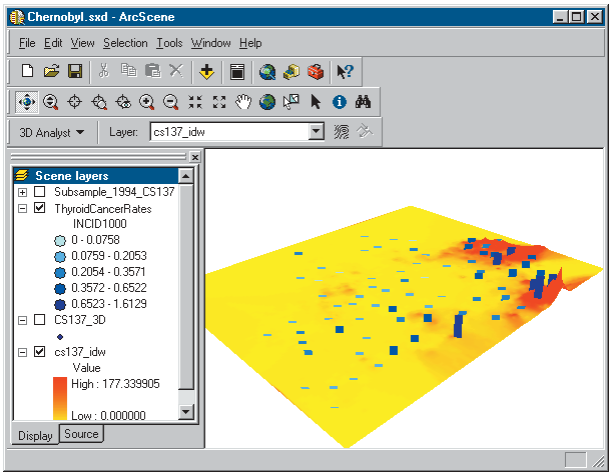
5. Click Obtain heights for layer from surface.

6. Click OK.

7. Uncheck CS137_3D in the table of contents.



Now you can see the interpolated surface of CS137 contamination, along with the thyroid cancer rate data.

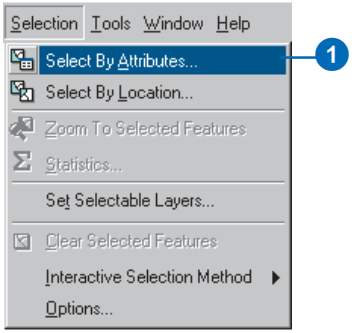


Next, you will select the province centers with the highest rates of thyroid cancer.

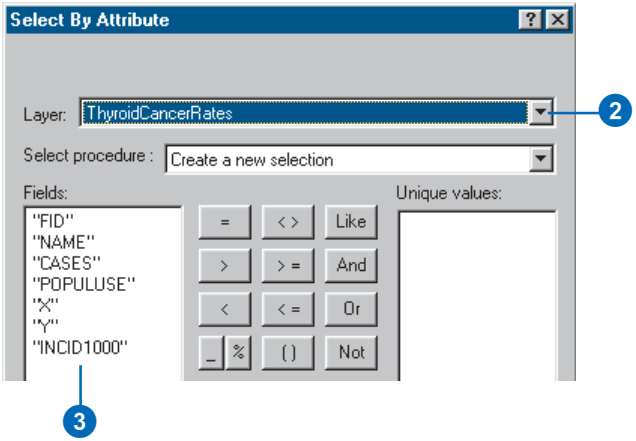
Selecting features by an attribute

Sometimes it is important to focus on a specific set of data or specific features. You can select features in a scene by their location, by their attributes, or by clicking them with the Select Features tool. You will select the province centers by attribute to find the locations with the highest rates.

1. Click Selection and click Select By Attributes.

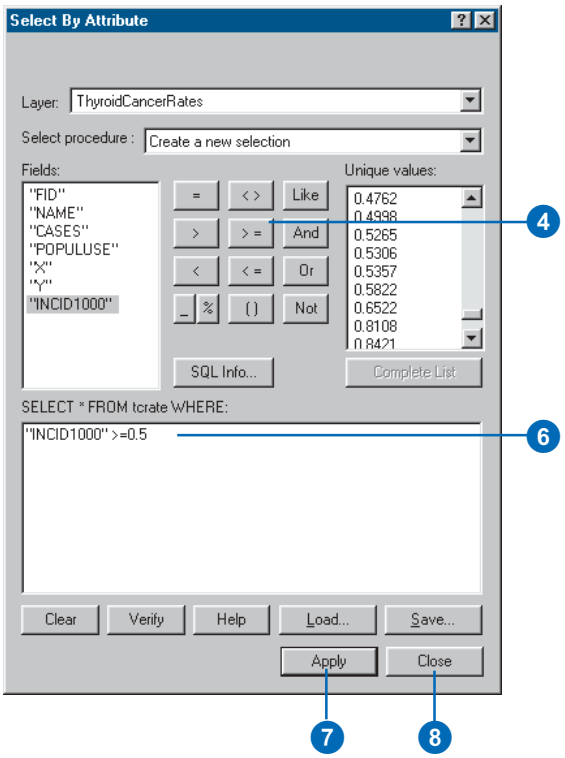


2. Click the Layer dropdown arrow and click ThyroidCancerRates.



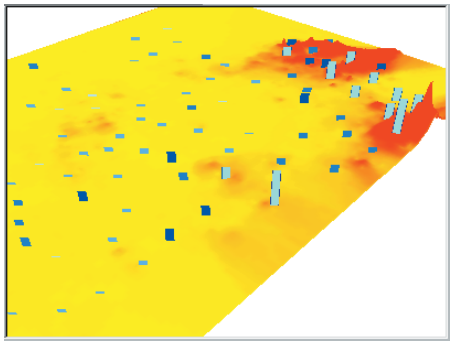
3. Double-click INCID1000 in the Fields list.

4. Click the >= button.



5. Type "0.5".
6. Check the selection expression you've built.
7. Click Apply.
8. Click Close.

   The province centers with thyroid cancer rates greater than 0.5 cases per 1,000 are now selected in the scene.

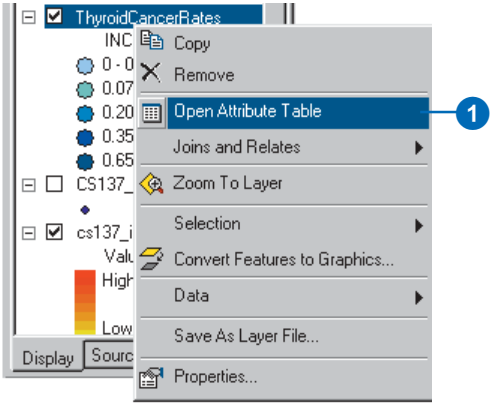


They are drawn in light blue to indicate that they are selected.

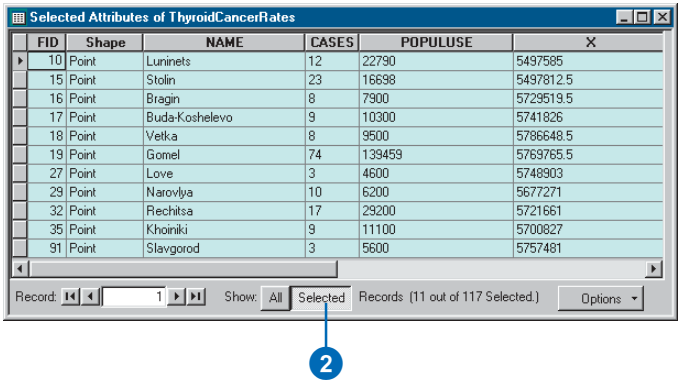
Viewing the attributes of features

You will investigate attributes of the selected locations and find out how many cases of thyroid cancer occurred in these districts.

1. Right-click ThyroidCancerRates and click Open Attribute Table.

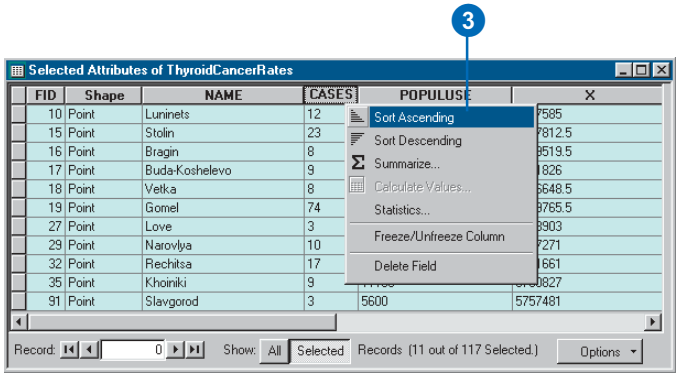


2. Click the Selected button.



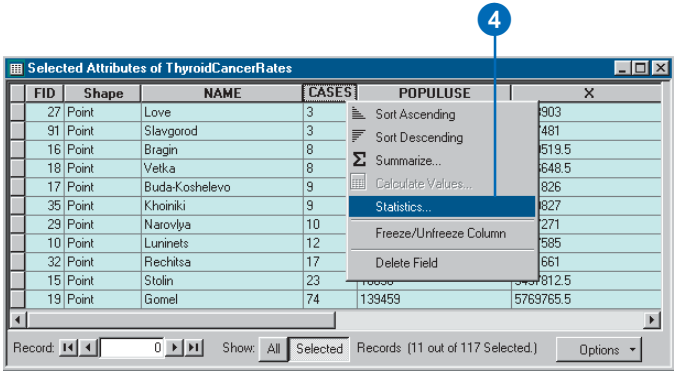
The table now shows only those features that you selected.

3. Right-click CASES and click Sort Ascending.



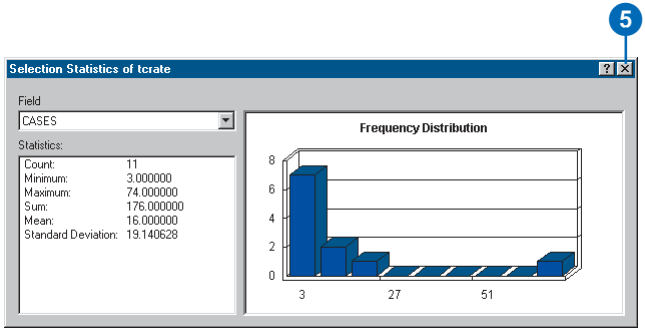
The selected province centers are sorted according to the number of cases.

4. Right-click CASES and click Statistics.

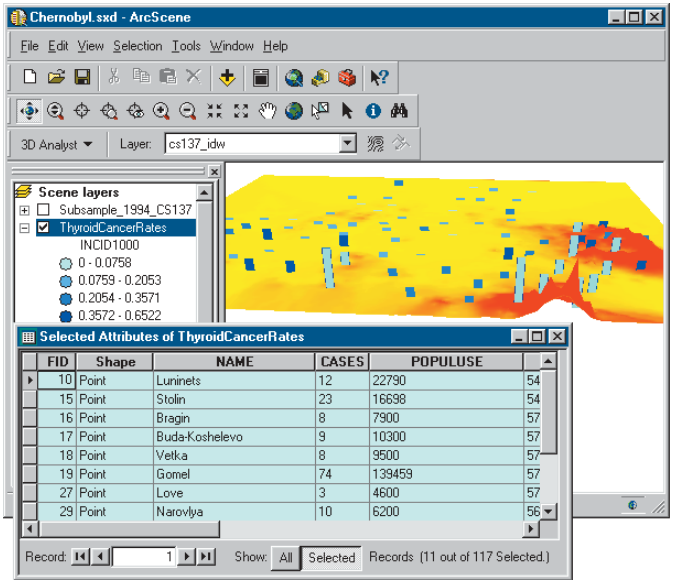


The total number of cases in the selected set of 11 province centers is 176.

5. Close the Selection Statistics dialog box.



6. Click the Navigate button and click on the scene.



You can work in ArcScene while the attribute table is open.

7. Click the Save button.

In this exercise you have created 3D features, extruded point features, and interpolated a raster surface from a set of data points. You've compared the extruded vector data to the surface data and explored the attributes of the vector data.

Exercise 4: Building a TIN to represent terrain

The town of Horse Cave, Kentucky, is situated above a cave that once served as the source of drinking water and hydroelectric power for the town. Unfortunately, the groundwater that flows in the cave was polluted by household and industrial waste dumped on the surface and washed into sinkholes. Dye tracing studies and a three-dimensional survey of the cave revealed the relationship between the cave passages and the town and demonstrated the connection between open surface dump sites and contamination of the groundwater in the cave below.

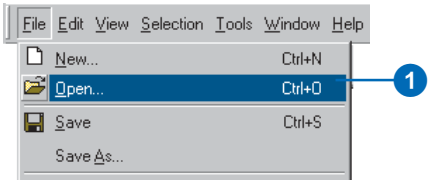
Thanks to the development in 1989 of a new regional sewage facility and the joint efforts of the Cave Research Foundation and the American Cave Conservation Association (ACCA), the groundwater is cleaner, and the cave has been restored. It is now operated as a tour cave and educational site by the ACCA.

Cave data was provided courtesy of the ACCA.

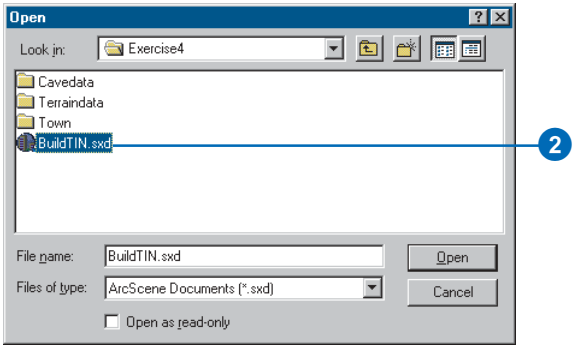
Viewing the cave and the landscape

First you will open the BuildTIN scene and view the cave survey and some terrain data layers. You'll use this terrain data to create a TIN and drape some other layers on it to visualize the relationship of the cave to the town.

1. Click File and click Open.

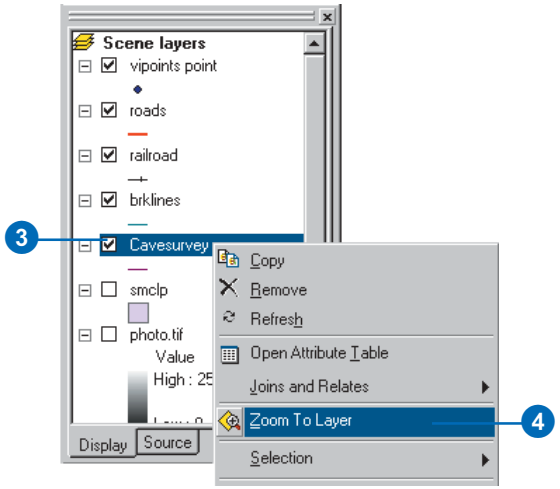


2. Navigate to the Exercise4 folder and double-click BuildTIN.sxd.



The scene opens, and you can see the location of roads and railroads, some sample elevation points, and a few significant contour lines. In the table of contents, you can see that some layers have been turned off.

3. Check the box to show the Cavesurvey layer.



4. Right-click Cavesurvey and click Zoom To Layer.

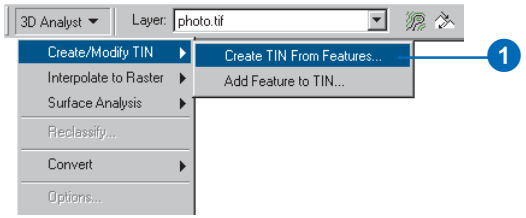
   The cave survey data consists of PolylineZ features, which are automatically drawn in 3D because they have z-values embedded in their geometry. They appear above the rest of the data because all of the other layers are drawn with the default elevation of 0.

   In the next steps you will build a TIN to provide the base heights for the streets and a photo of the town.

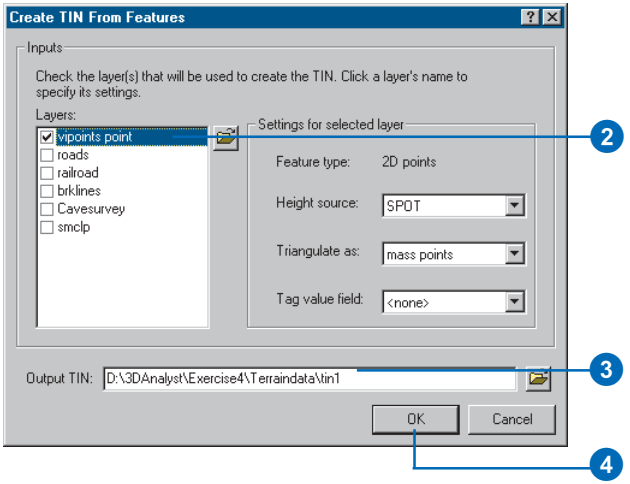
Creating a TIN from point data

You have a point layer called vipoints point. This coverage consists of points with an attribute called SPOT that contains elevation values taken at these points. You'll create the TIN surface model from these points.

1. Click 3D Analyst, point to Create/Modify TIN, and click Create TIN From Features.



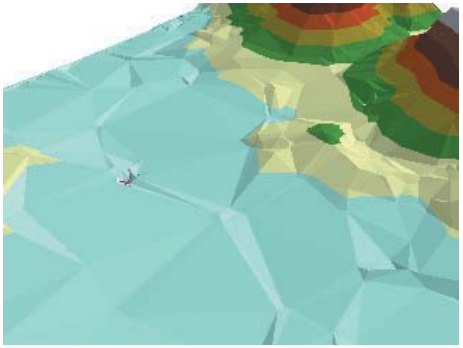
2. Check vipoints point.



   The SPOT field name appears in the Height source dropdown list, and the layer will be triangulated as mass points.

3. Change the default path so that the new TIN will be created in the Exercise 4\Terraindata\ folder.
4. Click OK.

The TIN is created and added to the scene. Note that it is drawn above the Cavesurvey layer; the elevation values in the TIN define its base height.

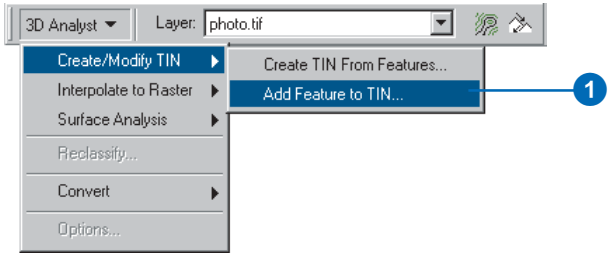


While this TIN is a fairly good model of the surface, you can make it more accurate by adding some more features.

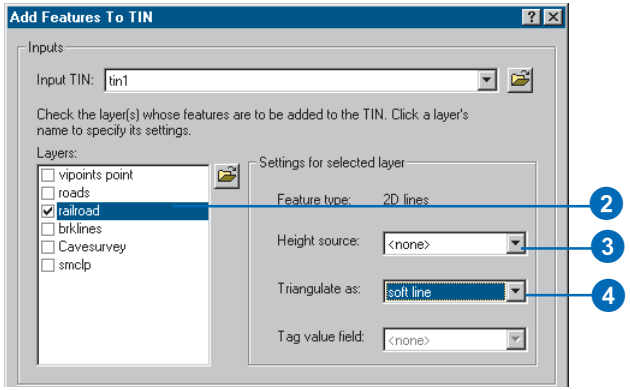
Adding features to a TIN

Now you will add hard and soft breaklines and a clip polygon to the TIN. You'll add the railroad features as soft breaklines, so they'll be represented on the surface but won't influence the shape of the surface. You'll add the brklines features as hard breaklines with elevation values to refine the shape of the surface in areas that you're most interested in. Finally, you will add the smclp polygon as a soft clip polygon to more smoothly define the edge of the TIN.

1. Click 3D Analyst, point to Create/Modify TIN, and click Add Feature to TIN.

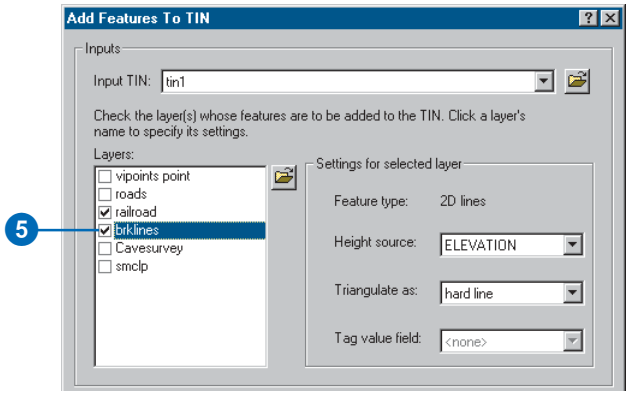


2. Check railroad.



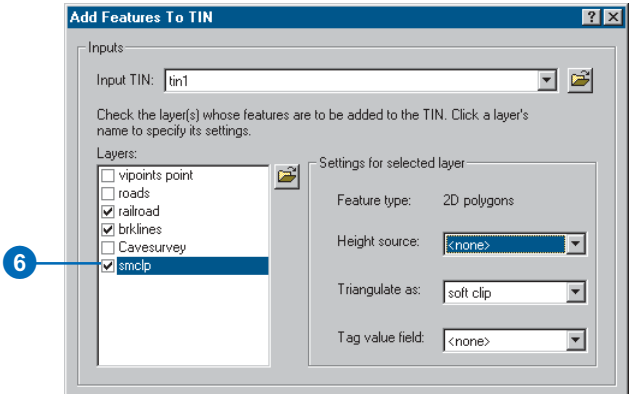
3. Click the Height source dropdown arrow and click <none>.
4. Click the Triangulate as dropdown arrow and click soft line.

5. Check brklines.



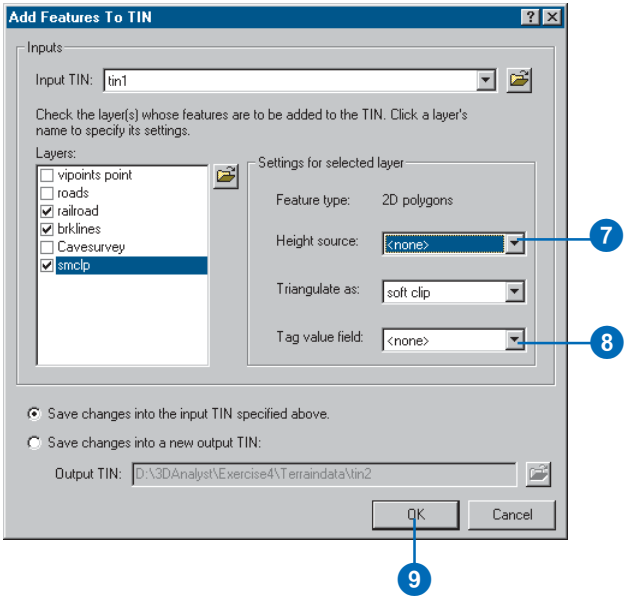
The Add Features To TIN tool detects that there is an ELEVATION field and uses it for the height source. You will accept the default and triangulate them as hard breaklines.

6. Check smclp.

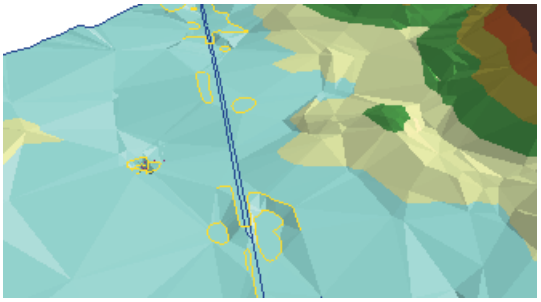


7. Click the Height source dropdown arrow and click <none>.
8. Click the Tag value field dropdown arrow and click <none>.

   You have defined the feature layers that you want to add to your TIN and specified how they should be integrated into the triangulation.



9. Click OK.



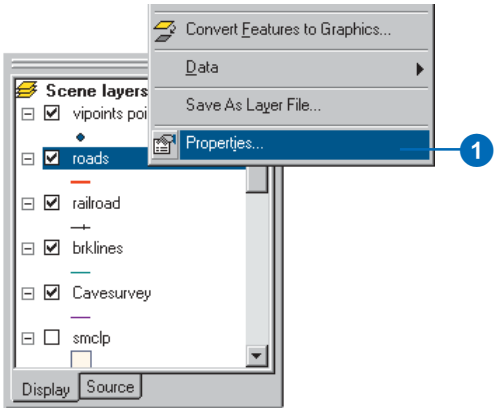
The new features are added to the TIN.

You can see that the railroad follows a bed that has been leveled somewhat relative to the surface.

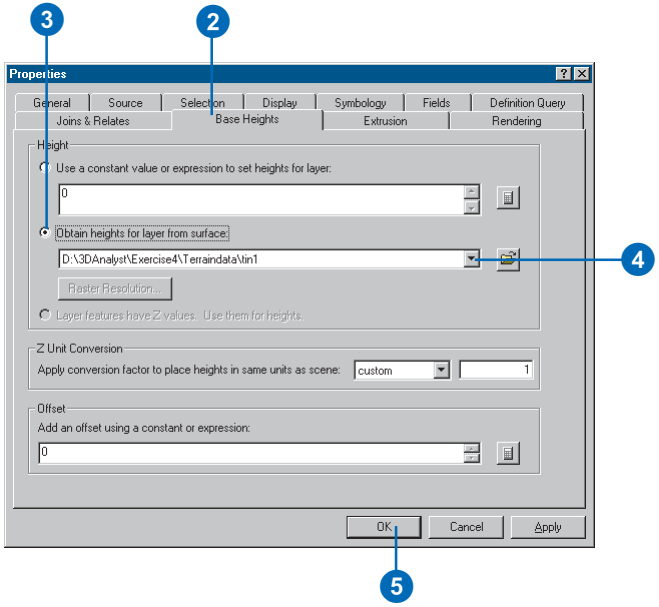
Setting features' base heights from the TIN

Now you will set the base heights for the road and railroad features from the new TIN.

1. Right-click roads and click Properties.



2. Click the Base Heights tab.

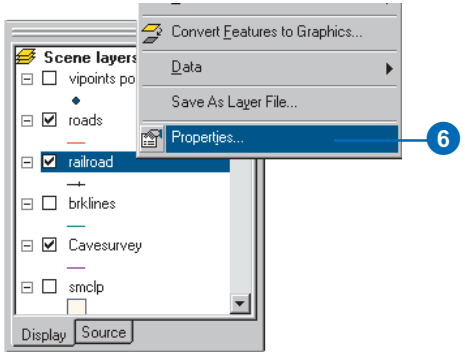


3. Click Obtain heights for layer from surface.
4. Click the dropdown arrow and click tin1.
5. Click OK.

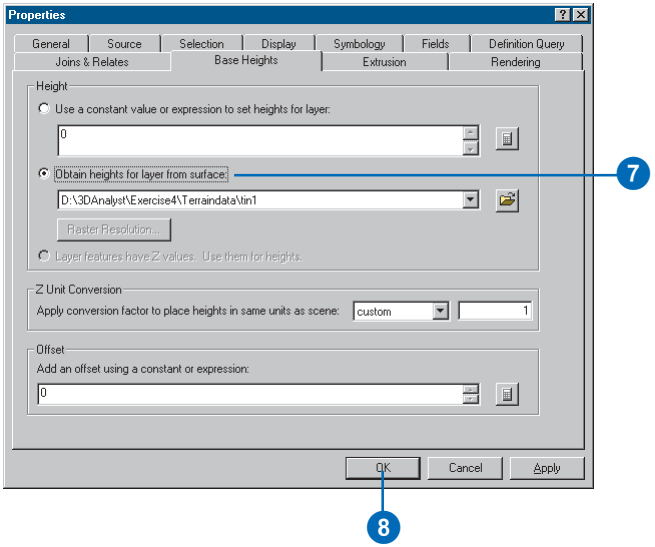
   The road features are now draped over the TIN surface that you created. Now you will drape the railroad features over the surface.

6. Right-click railroad and click Properties.

7. Click Obtain heights for layer from surface.



8. Click OK.

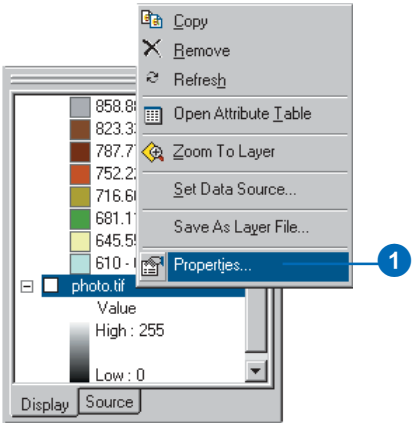


The railroad features are now draped over the TIN surface that you created. Next you'll drape the aerial photo over the TIN.

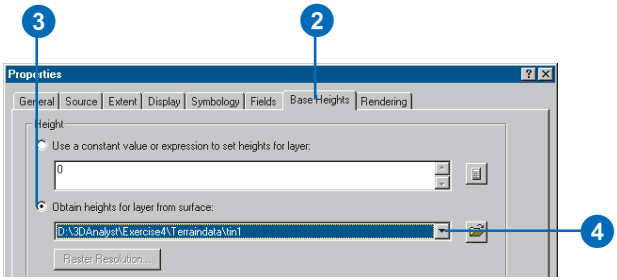
Setting raster base heights from the TIN

Including the aerial photo of the town in the scene makes the relationship between the cave and the town much more evident. You'll drape the raster over the TIN and make it partly transparent so that you'll be able to see the cave beneath the surface.

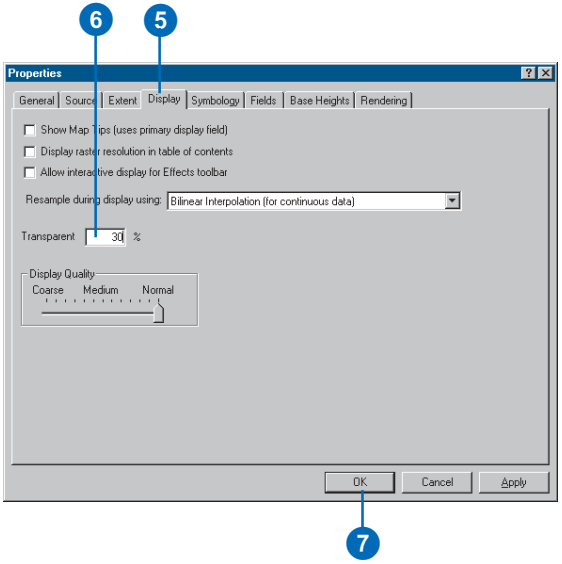
1. Right-click photo.tif and click Properties.



2. Click the Base Heights tab.



3. Click Obtain heights for layer from surface.
4. Click the dropdown arrow and click tin1.
5. Click the Display tab.



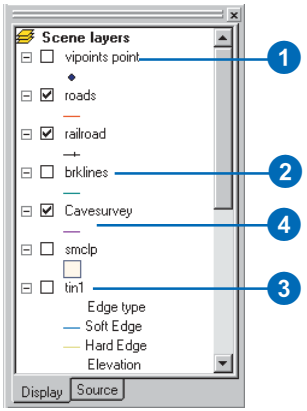
6. Type “30” in the Transparent text box.
7. Click OK.
8. Check photo.tif.

Now the aerial photo is 30 percent transparent. You can see large patches of the TIN over the photo because the TIN and the photo have the same drawing priority. If you wanted the TIN to be visible below the photo, you could change its drawing priority to 10 (lowest) on the Rendering tab of the TIN’s Layer Properties dialog box. You could also offset the base height of the TIN or the photo by a small amount.

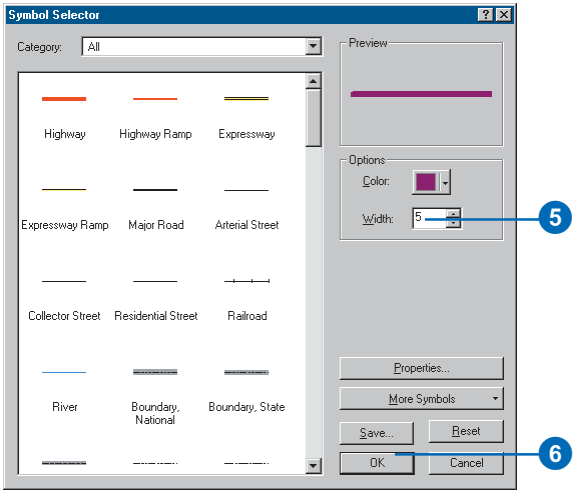
Cleaning up the scene

To clean up the scene you’ll turn off some layers that are no longer needed and make the cave line symbol larger.

1. Uncheck vipoints point.
2. Uncheck brklines.
3. Uncheck tin1.
4. Double-click the line symbol for the Cavesurvey layer.



5. Type “5” in the Width box.



6. Click OK.

   Now you can see the three-dimensional passages of the cave, symbolized by thick lines. The surface features and the aerial photo provide context, so you can easily see the relationship of the cave to the town.

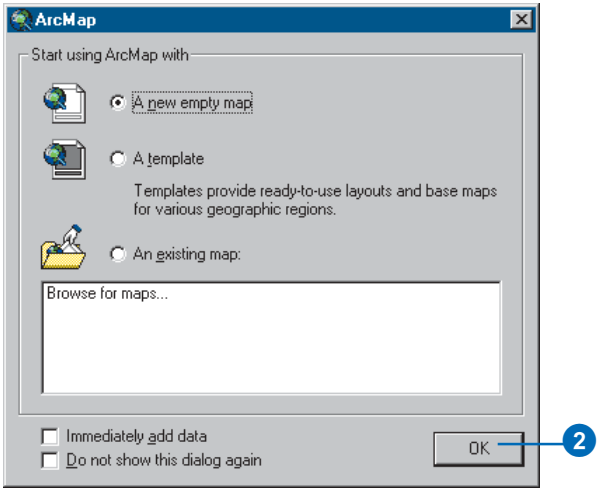
Creating a profile of the terrain

The cave follows the valley floor orientation. To get an understanding of the shape of the valley, you will create a profile across the TIN. In order to create a profile, you must first have a 3D line (feature or graphic). You will start ArcMap, copy the TIN to the map, and digitize a line to make your profile.

1. Click the Launch ArcMap button.

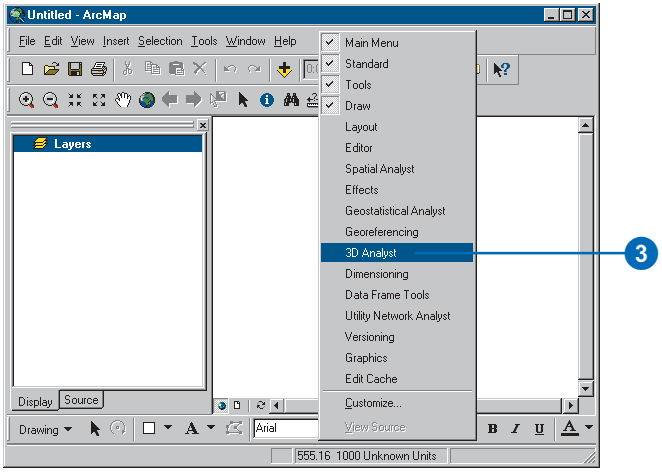
   ArcMap starts.

2. Click OK.



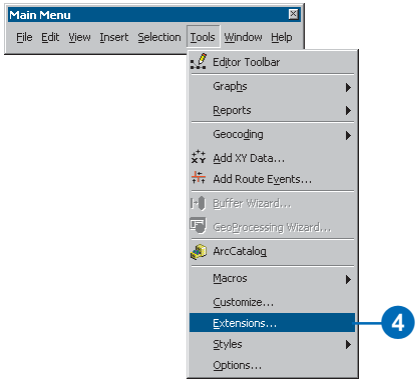
Now you will add the 3D Analyst toolbar to ArcMap. The ArcMap 3D Analyst toolbar contains a few tools that do not appear on the ArcScene 3D Analyst toolbar. Two of these are the Interpolate Line tool and the Create Profile Graph tool, which you will use to create your profile of the surface.

3. Right-click on one of the ArcMap toolbars and click 3D Analyst.



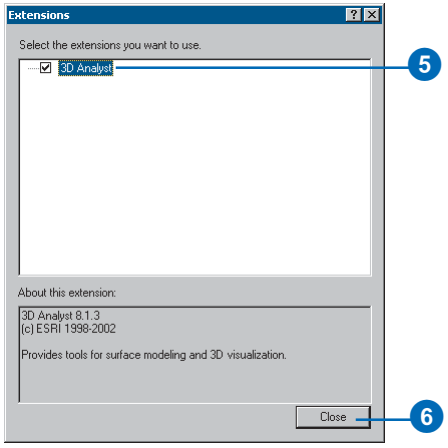
The 3D Analyst toolbar appears.

4. Click Tools and click Extensions.



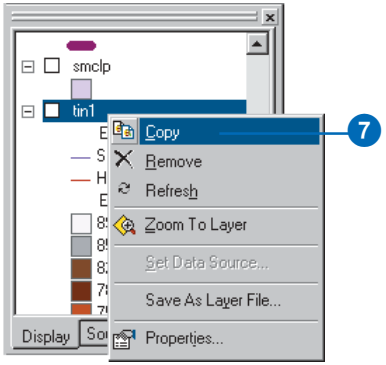
5. Check 3D Analyst.

6. Click Close.

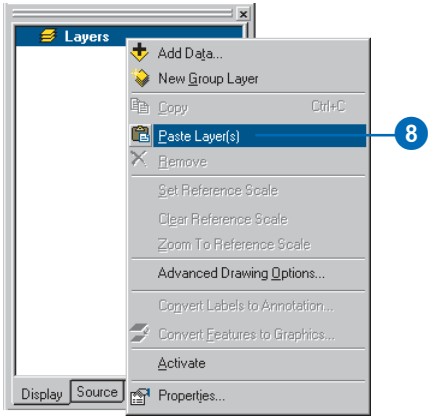


The 3D Analyst extension is enabled.

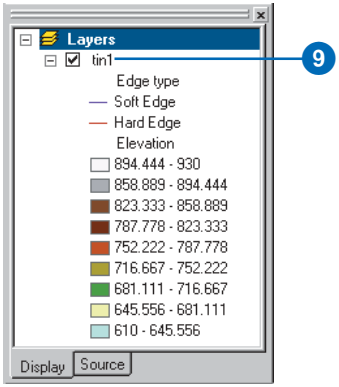
7. In the ArcScene table of contents, right-click tin1 and click Copy.



8. In the ArcMap table of contents, right-click Layers and click Paste Layer(s).

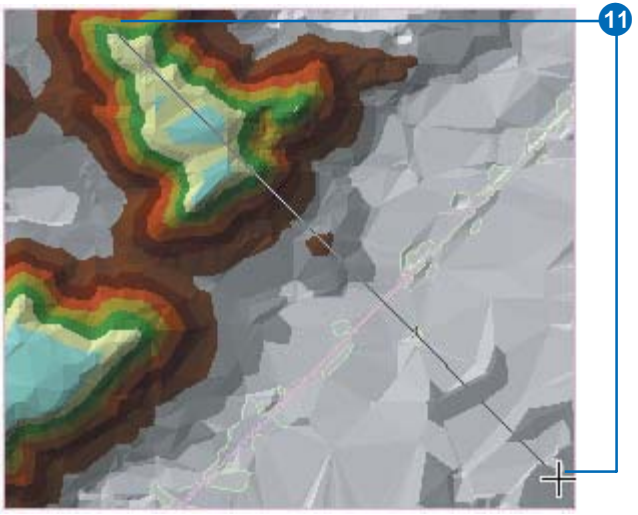


9. In the ArcMap table of contents, check tin1.



10. Click the Interpolate Line button.

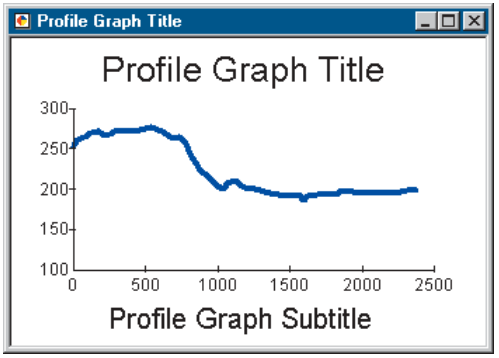
11. Click on the upper-left corner of the TIN, drag the line to the lower-right corner, and double-click to stop digitizing.



You can create a profile along a line with more than one segment, but in this case you'll just make one straight line.

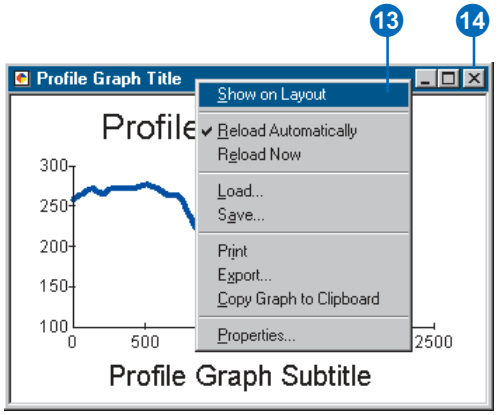
12. Click the Create Profile Graph button.

The profile graph is created.



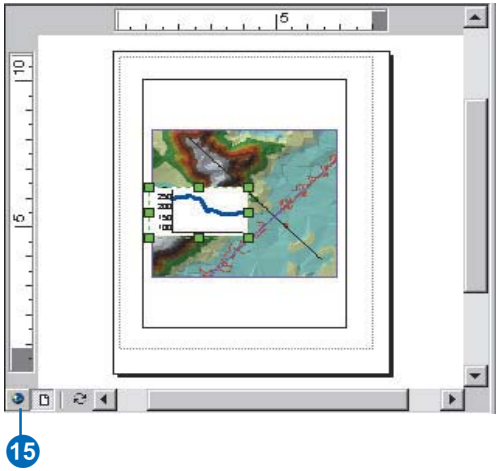
You can edit the title, subtitle, and other properties of the graph; you can save, print, or export the graph; you can copy it to the clipboard; and you can show the graph on the layout. You can also simply close the graph.

13. Right-click on the Profile Graph Title bar and click Show on Layout.
14. Close the profile graph window.



You can see the graph on the layout of the map.

15. Click the Data View button to return to data view.

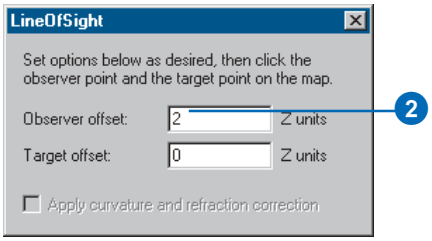


Creating a line of sight on the terrain

Another way of understanding the terrain is to create a line of sight. Lines of sight show what parts of a surface are visible and what parts are hidden along a line from an observer point to a target point.

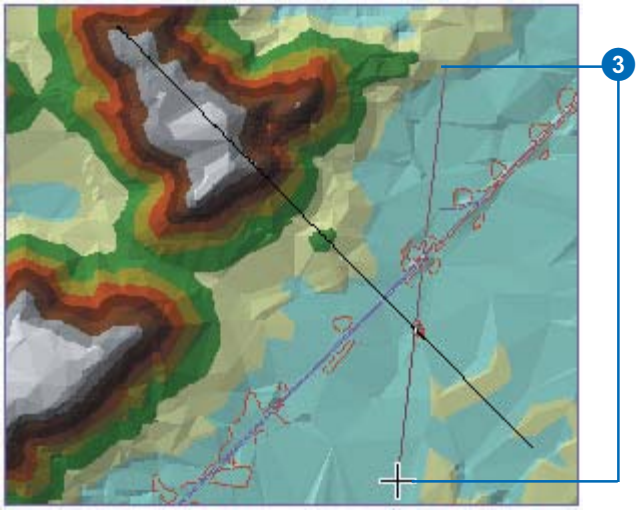
1. Click the Create Line of Sight button.

2. Type “2” in the Observer offset text box.

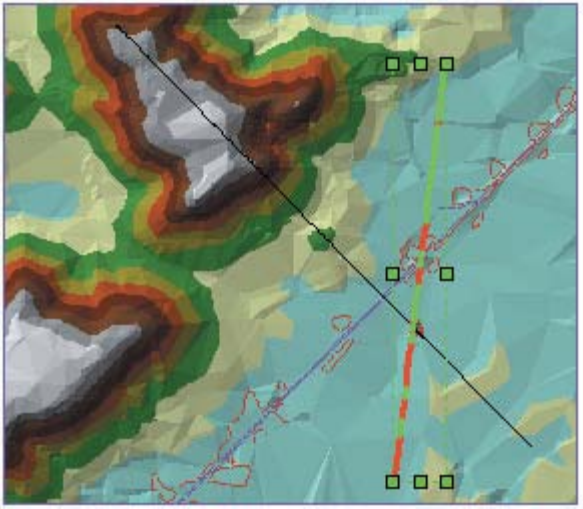


The line of sight will be calculated to show what is visible from the perspective of an observer two meters tall, as the z units for this scene are meters.

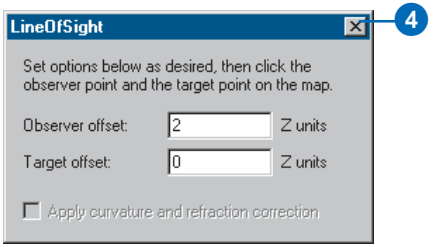
3. Click on the south slope of the higher land in the upper-right part of the TIN (the observer point), drag the line to the lower-right part, and release the mouse button (the target point).



The line of sight is calculated. The green segments show areas that are visible from the observer point; the red segments are hidden from the observer.

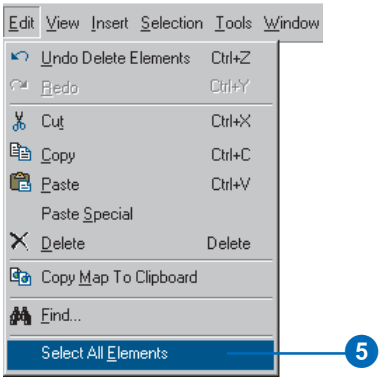


4. Close the LineOfSight dialog box.



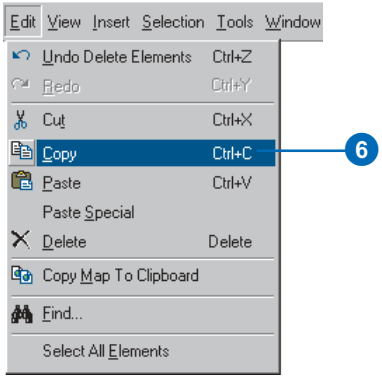
Lines of sight, like other graphic lines, can be copied from ArcMap to ArcScene. Now you will copy both the lines you've created into the scene.

5. Click Edit and click Select All Elements.

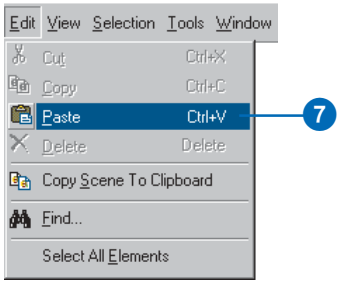


Both of the lines you created are selected.

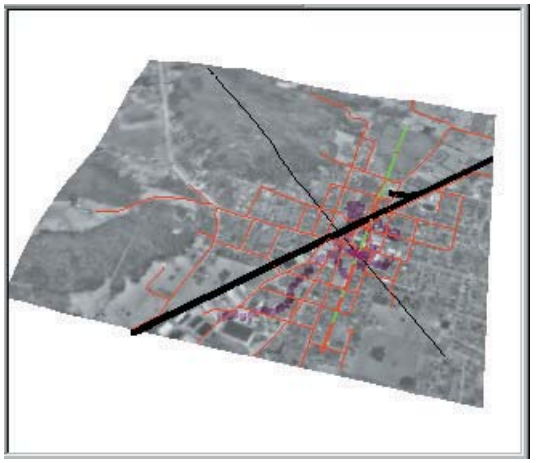
6. Click Edit and click Copy.



7. In ArcScene, click Edit and click Paste.

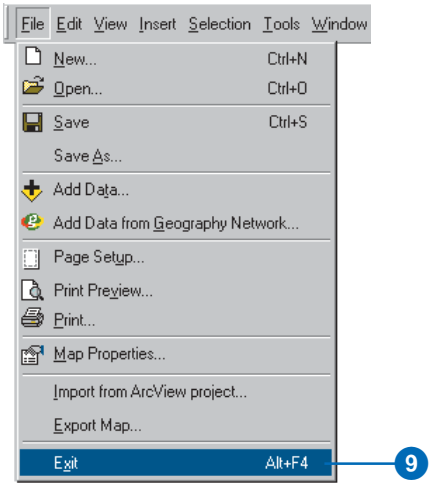


The lines are pasted into the scene.

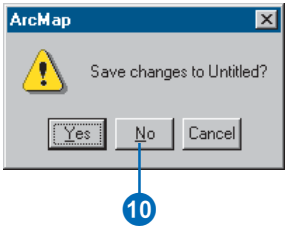


8. In ArcScene, click the Save button.

9. In ArcMap, click File and click Exit.



10. Click No.



This tutorial introduced you to a sample of the tasks you can do with 3D Analyst and showed how ArcCatalog, ArcMap, and ArcScene can be used together. The remaining chapters in this book discuss in detail the variety of tasks you can accomplish with 3D Analyst.

Exercise 5: Working with animations in ArcScene

Imagine that you wish to create an animated sequence showing the flight of an object over a landscape. You've created a TIN and have draped images over it to show the area. You also have some data pertaining to a strange phenomenon that has been occurring in the region. You are interested in displaying all the data in a dynamic way, making an animation to tour points of interest, and showing how you made the surface. You would also like to model the phenomenon by moving a layer in the scene.

The tutorial data has already been assembled in the scene document named Animation.sxd. You will use ArcScene animation tools to effectively convey the points you want to show.

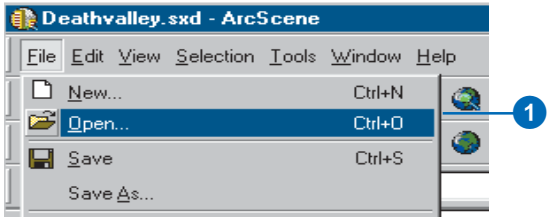
Data was supplied courtesy of MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs.

In this exercise, you will play an existing animation in the scene document, Final Animation_A.sxd, and perform the tasks typically used to create the animation.

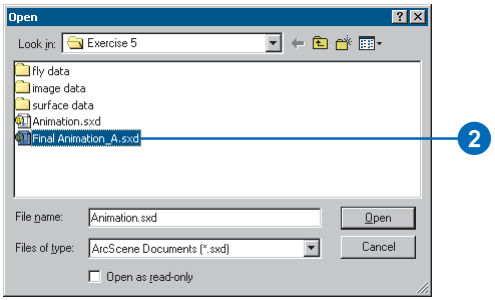
Opening the Final Animation_A scene document

In this section, you will play an animation that demonstrates some of the effects that you can create when you animate a scene.

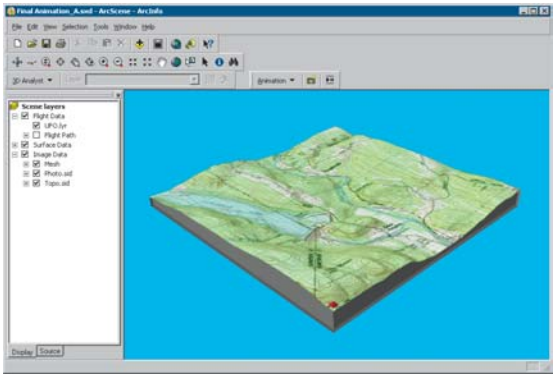
1. In ArcScene, click File and click Open.



2. Navigate to the Exercise5 folder and double-click Final Animation_A.sxd.



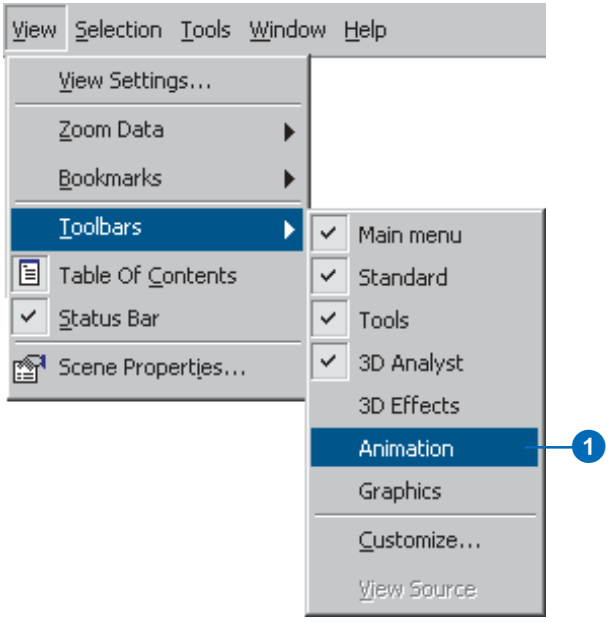
This scene contains geographic information and recorded special effects that have been combined to make an animation.



Playing the scene's animation

In order to view a scene's animation, you need to turn on the Animation toolbar.

1. Click View, point to Toolbars, and click Animation.



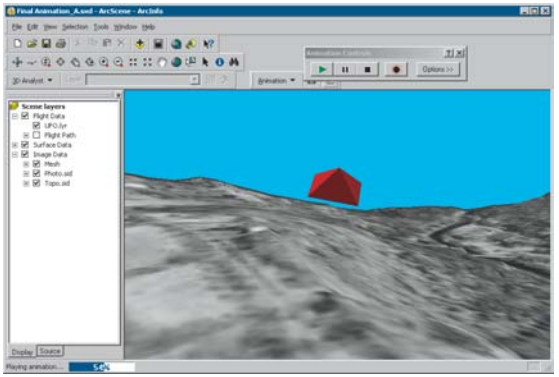
The Animation toolbar appears. Now you'll play the animation.

2. Click the Open Animation Controls button.

This animation shows the flight of a hypothetical unidentified flying object (UFO) over the terrain.

3. Click the Play button.

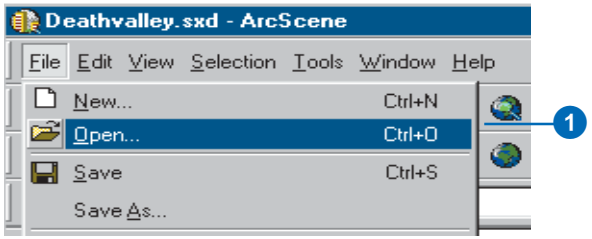
The animation plays, illustrating some of the effects you can use in an animated scene.



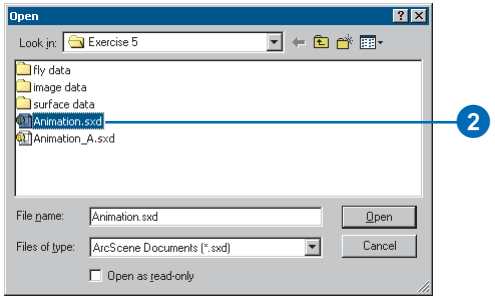
In the next section you will work through the steps used to make animations like this one.

Opening the Animation scene document

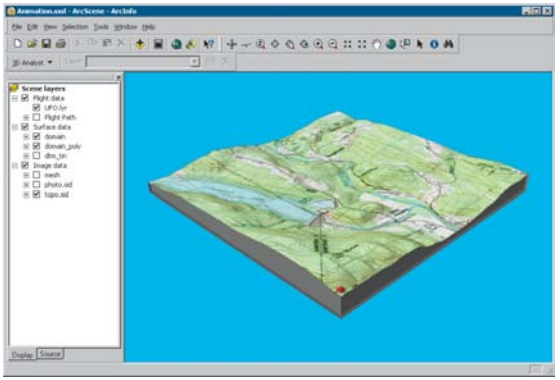
1. In ArcScene, click File and click Open.



2. Navigate to the Exercise 5 folder and double-click Animation.sxd.



The scene contains an ortho photo, a scanned topographic map, and other data you need to make your animation.



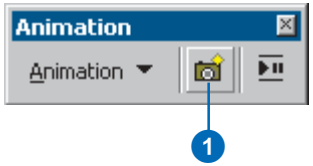
In this section, you'll use the animation tools to capture keyframes, import tracks, play back your animations, and save them to a scene document.

There are three types of keyframes that you can use to build animations. The first is a camera keyframe. A camera keyframe is a snapshot of the view you see in a scene. The second, a layer keyframe, is a snapshot of a layer's properties.The third type is a scene keyframe, which stores properties of a scene. In this section, you will create a simple animation from a set of camera keyframes.

Capturing Perspective views as keyframes to make an animation

The simplest way to make animations is by capturing views to be stored as keyframes. The captured views are snapshots of camera perspectives in a scene at a particular time. The most fundamental element of an animation is a keyframe. Keyframes are used as snapshots to interpolate between in a track. You'll create a set of keyframes to make a camera track that will show an animation between points of interest in your study area.

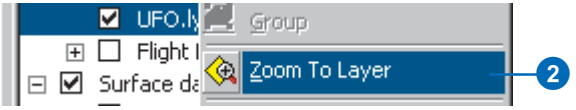
1. Click the Capture View button to create a camera keyframe showing the full extent of the scene.



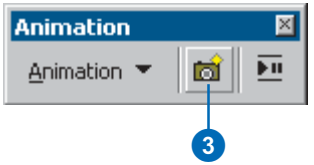
For a camera keyframe, the object is the virtual camera through which you view the scene. Navigating the scene changes camera properties that determine its position.

ArcScene interpolates a camera path between keyframes, so you'll need to capture more views to make a track that shows animation.

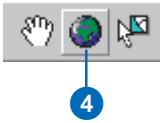
2. Right-click on UFO.lyr and click Zoom To Layer.



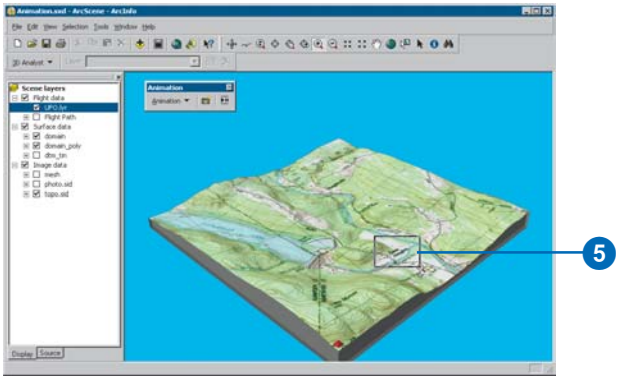
3. Click the Capture View button to create a camera keyframe showing the UFO layer.



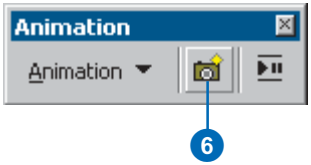
4. Click the Full Extent button to view all the data.



5. Click Zoom In on the Navigation toolbar and zoom to Goss Heights, located near the center of your view.

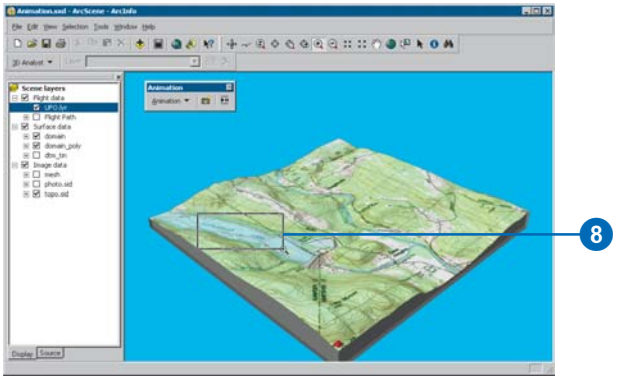


6. Click the Capture View button to create a camera keyframe of Goss Heights.

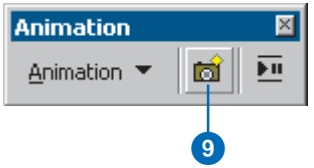


7. Click the Full Extent button.

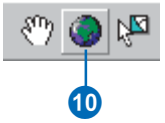
8. Zoom to Littleville Lake.



9. Click the Capture View button to capture a view of Littleville Lake.



10. Click the Full Extent button.



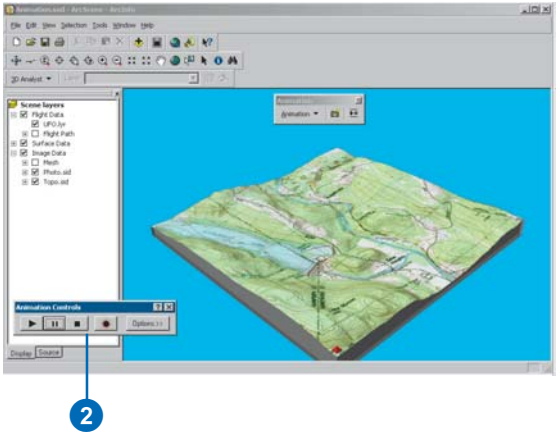
The captured views you just made are stored as a set of camera keyframes in a camera track. When the track is played, it shows a smooth animation between the keyframes. Next, you'll play your animation track.

Playing back your animation

You will play back animations using simple tools that resemble the controls of a video cassette recorder (VCR).

1. Click the Open Animation Controls button.

2. Click the Animation toolbar and drag it to the lower-left corner of the scene so it won't block your view of the tools or data.



3. Click the Play button.

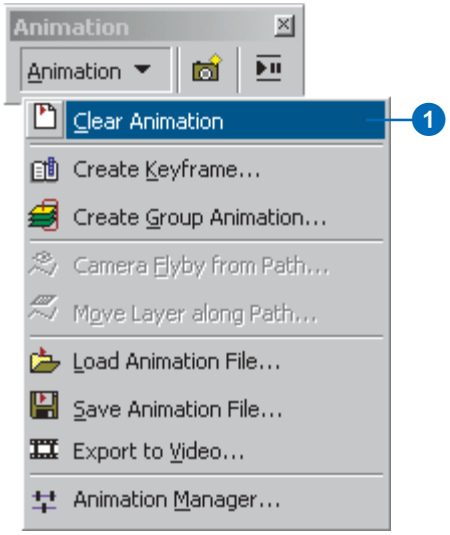
An animation is played back by interpolating the camera position between the keyframes in the track. In this case, the animation shows a virtual tour through the views you captured.

Clearing an animation

If you want to start over, you can erase all the tracks you created. In this section, you'll remove the tracks you just created so you can improve your animation.

1. Click Animation and click Clear Animation.

   All animation tracks are removed from the scene.

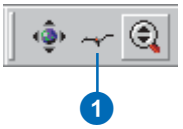


Recording navigation

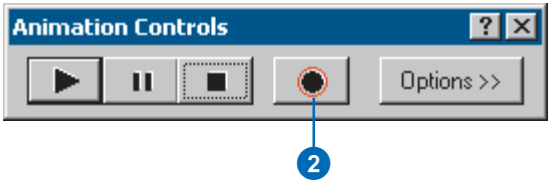
Another way to create a camera track for an animation is to record in real time while you navigate in a scene. In this section, you will record your view of the scene while you navigate using the Fly tool.

1. Click the Fly tool on the navigation toolbar.

   The Fly tool allows you to fly through your scenes.

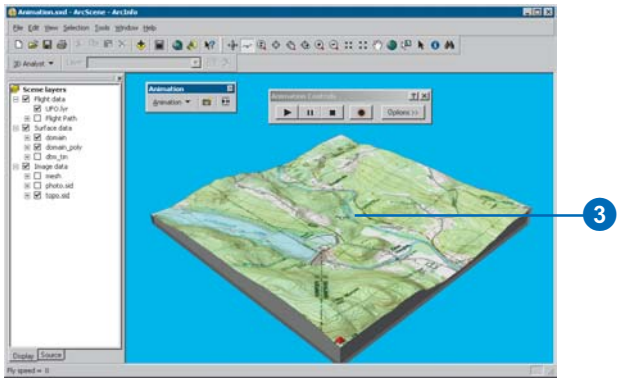


2. Click the Record button to start recording your navigation.



   ArcScene begins recording as soon as you click the Record button. If you don't navigate right away, your track will reflect this.

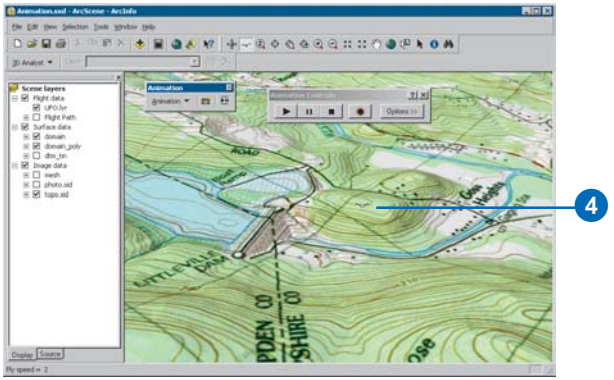
3. Click once in the center of the scene to activate the Fly tool. You start flying by entering into hovering mode.



In this mode your viewpoint follows the cursor. Point in the direction you wish to look.

4. Click once more to begin flying through the scene.

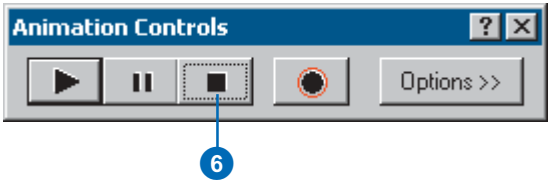
   Point in the direction you want to move. Click again to increase your speed and right-click to decrease your speed. Your speed is indicated in the status bar in the lower-left corner of the ArcScene window.



5. Press Esc to stop flying.

   You can also stop flying by clicking until your speed is zero.

6. Click the Stop button to finish recording.



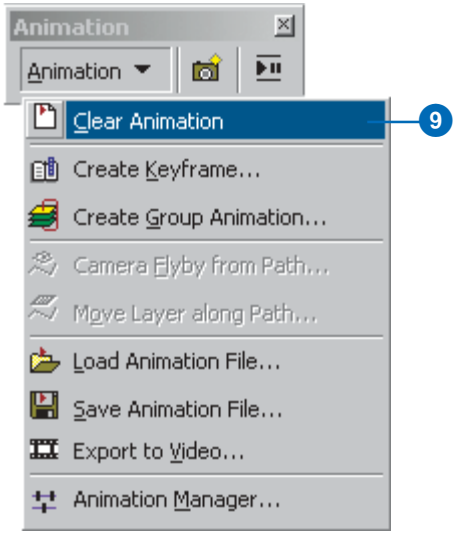
You have recorded your flight path through the scene as a new camera track that began when you clicked the Record button and ended when you clicked the Stop button.

7. Click the Full Extent button.

8. Click the Play button to see the animation you recorded.

When you are done viewing the animation you recorded, clear the track so you can make a better one in the next section.

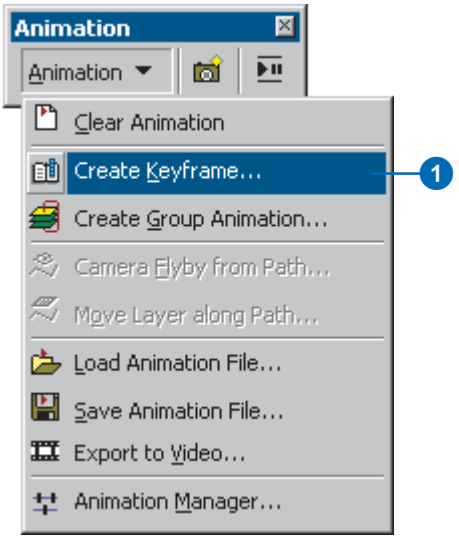
9. Click Animation and click Clear Animation.



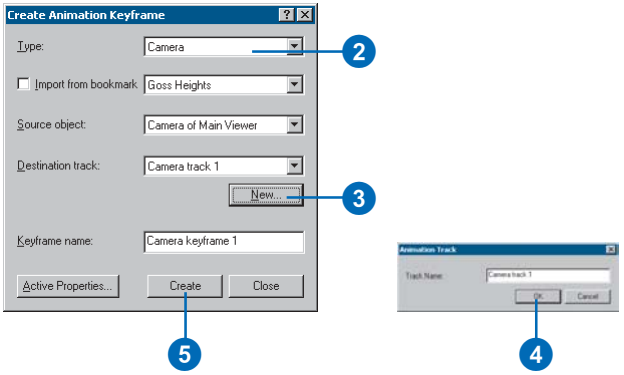
Making a camera track from 3D bookmarks

In the previous sections, you navigated in a scene and created keyframes to build a camera track. Another way to create the keyframes for a camera track is to import bookmarked perspective views of a scene. In this section, you'll create keyframes from 3D bookmarks.

1. Click Animation and click Create Keyframe.

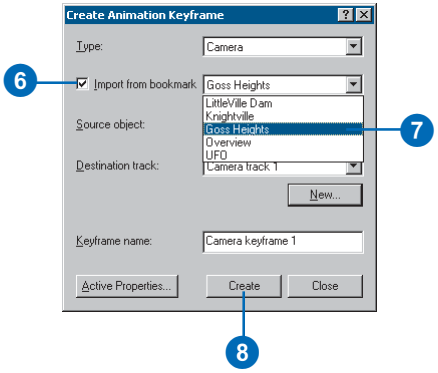


2. Click the Type dropdown arrow and choose Camera.
3. Click New to create a new track.
4. Click OK.
5. Click Create.



You've now created a camera track with one camera keyframe showing the full extent of your scene. You'll need to add more keyframes to your track so that it will show animation. Now, you'll import bookmarks to create the keyframes for the rest of the animation.

6. Check Import from bookmark.
7. Click the Import from bookmark dropdown arrow and click Goss Heights.



8. Click Create to make the second keyframe in your track.
9. Click the Import from bookmark dropdown arrow and choose LittleVille Dam.
10. Click Create to import this bookmark as a keyframe.
11. Click the Import from bookmark dropdown arrow and click Knightville.
12. Click Create to make the Knightville keyframe.
13. Click the Import from bookmark dropdown arrow once more and click Overview.
14. Click Create to create a keyframe showing all the data.

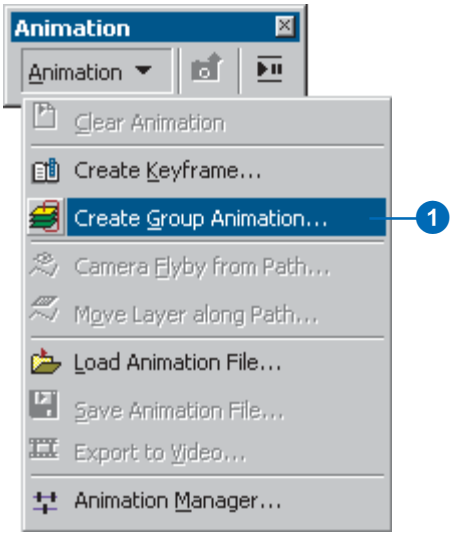
15. Click Close.
16. Click the Play button.

The camera track plays, moving the camera through the set of keyframes you imported from existing 3D bookmarks.

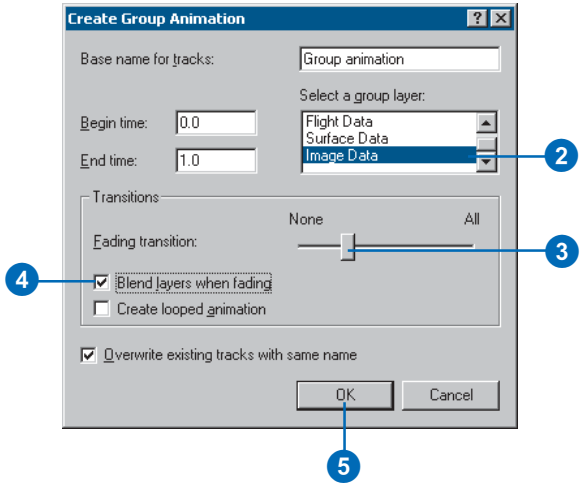
Switching the visibility between layers using a group animation

Now that you have explored some of the ways to create an animated camera track from keyframes, you'll learn how to change the way layers in a scene are displayed during animation. In this section, you will switch the layer that is draped over the terrain model to show different ways of representing the terrain.

1. Click Animation and click Create Group Animation.



2. Select the group layer named Image Data.
3. Slide the Fading transition bar about a quarter of the way to the right.
4. Check Blend layers when fading.
5. Click OK.



The layer track you just created toggles the visibility of successive layers to animate a progression between them. The transition settings you modified will show a smooth blending between the layers in the progression.

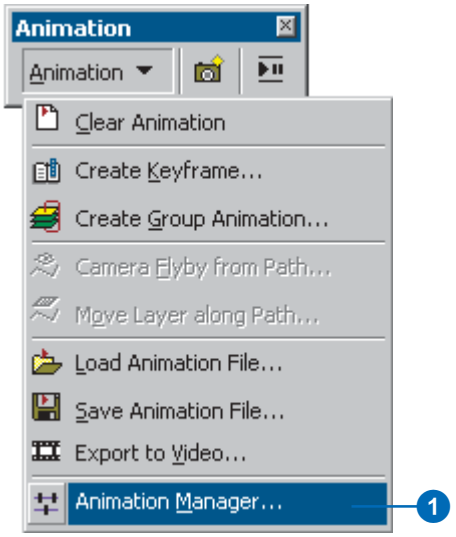
6. Click the Play button to watch your animation.

Since you didn't clear the animation track you made from the keyframes, it plays in addition to the layer tracks you just created. However, you can stop the camera track from playing. You'll do this next.

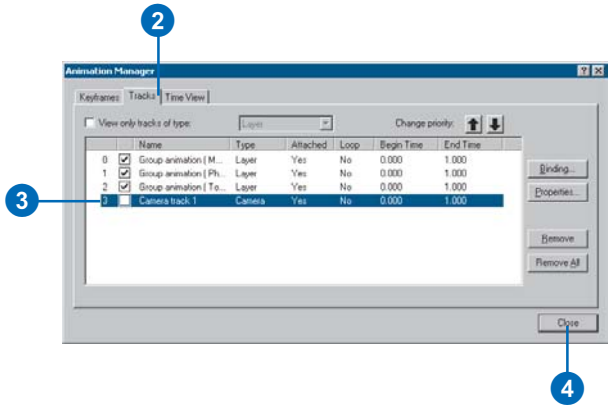
Using the Animation Manager to disable a track from playing

The Animation Manager allows you to control many properties of an animation. In this section, you'll use the Animation Manager to stop a camera track from playing.

1. Click Animation and click Animation Manager.



2. Click the Tracks tab.
3. Uncheck Camera track 1.
4. Click Close.



You have disabled the camera track. Now it will not play as part of the animation.

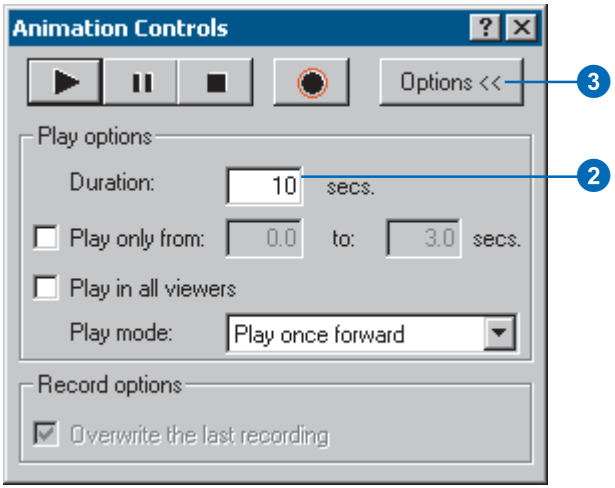
5. Click the Play button.

The animation plays again, only showing the layer tracks this time. It may now seem that the duration of the animation is too long. You can control the amount of time in which an animation is played.

Using Animation Controls to adjust the playback duration

1. Click Options.

2. Type "10" in the Duration text box.
3. Click Options to close this portion of the dialog box.



4. Click the Play button.

The animation now plays more quickly.

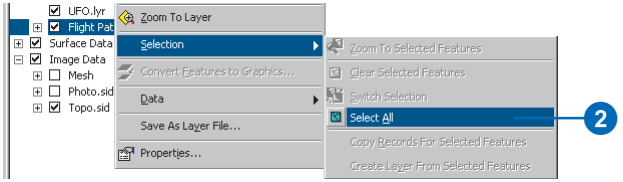
Moving an object along a predefined path

One of the things an animation allows you to do is move an object through a scene. You can add a layer containing a model vehicle and move it through the scene along a specified track.

You can choose to move a layer along a selected line feature or graphic. The scene contains a graphic layer with a model UFO that was created using Visual Basic code. In the next set of steps, you'll fly the model UFO along a shapefile that shows its flight path.

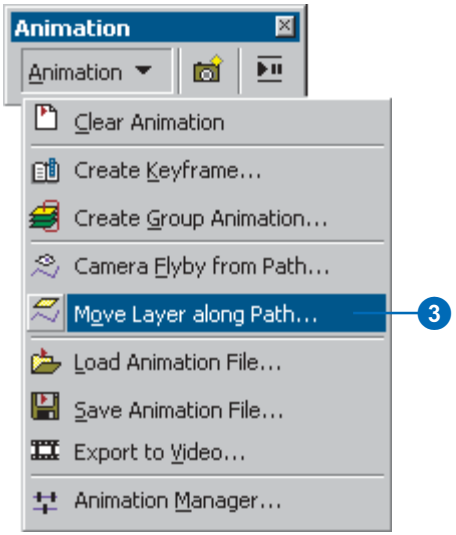
1. Check Flight Path.

2. Right-click Flight Path, point to Selection, then click Select All.

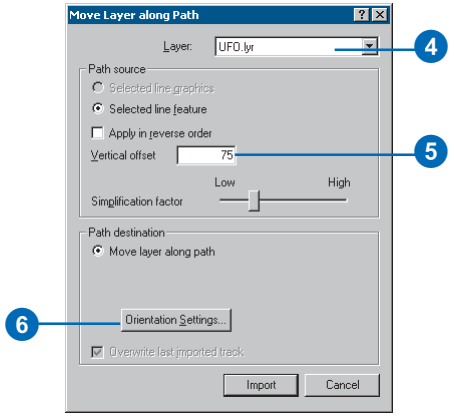


You can also use the Select Features or Select Graphics tools to select the path you want to use. A path is constructed from a single selected line feature or graphic.

3. Click Animation and click Move Layer along Path.



4. Click the Layer dropdown arrow and click UFO.lyr.



5. Type a Vertical offset of "75". This will make the object appear to fly above the surface.

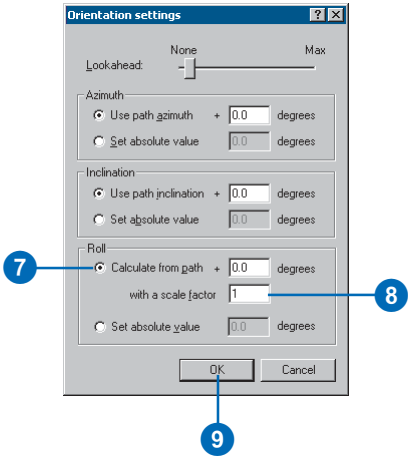
   ArcScene can improve the simulation of flight of an object, such as an airplane, along a path by making the object point in the direction it is moving and by rolling it from side to side as if it were banking. In the next steps, you'll define a roll for the UFO layer.

6. Click Orientation Settings to modify the layer's position while it's animated.

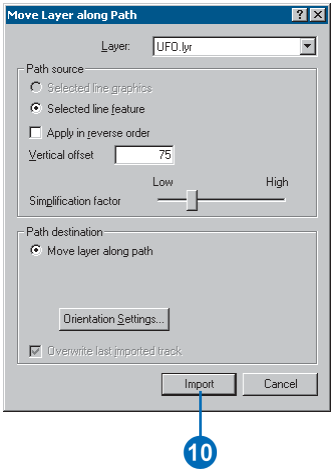
7. Click Calculate from path to calculate the layer's roll based on the path's shape.

8. Type "1" as a scale factor.

9. Click OK.

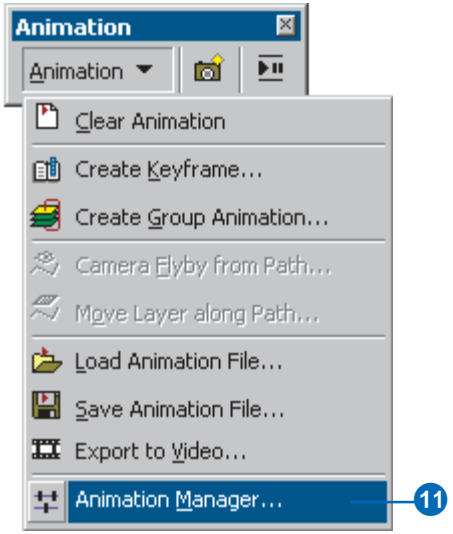


10. Click Import to import the selected line as a flight path.

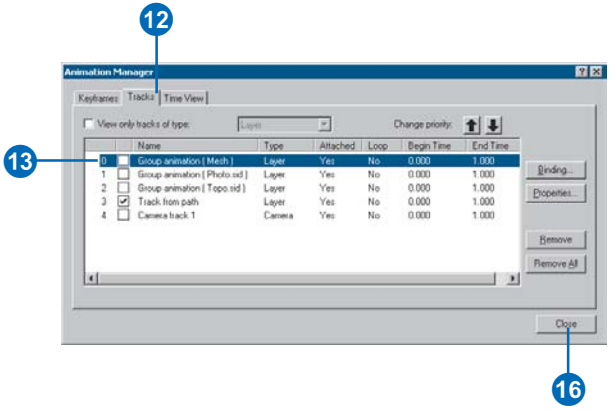


The UFO layer moves along the selected path. The movement is stored as a set of layer keyframes in a layer animation track. Now you'll disable the tracks you created previously so that just the UFO track is played.

11. Click Animation and click Animation Manager.



12. Click the Tracks tab.
13. Uncheck Group animation (Mesh).
14. Uncheck Group animation (Photo.sid).
15. Uncheck Group animation (Topo.sid).



16. Click Close.
17. Uncheck Flight Path to turn off the visibility of this layer.

18. Click the Play button.

The UFO flies along the path you indicated. Next, you'll move the camera along a predefined path.

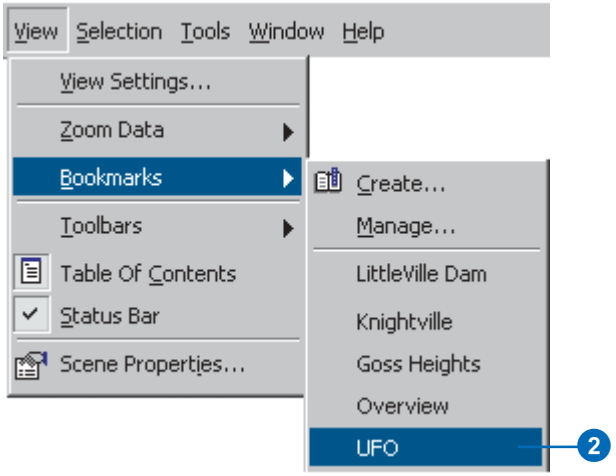
Creating a camera flyby from a path

You can move a camera along a flight path in the same way you just moved a layer along a path. Next, you'll combine the track you made in the last step with one that will point the camera at the UFO as it flies.

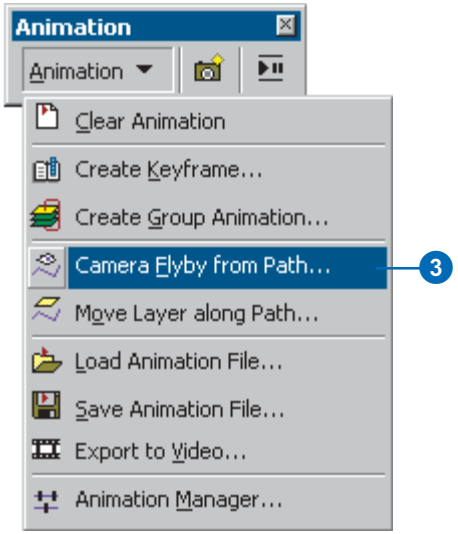
1. Check Flight Path, make sure the line you chose for your path is still selected, then uncheck Flight Path.

You'll move the camera location to a predefined location in the center of the scene that will give you a better vantage point from which to view the UFO layer as it is moved.

2. Click View, point to Bookmarks, then click UFO.

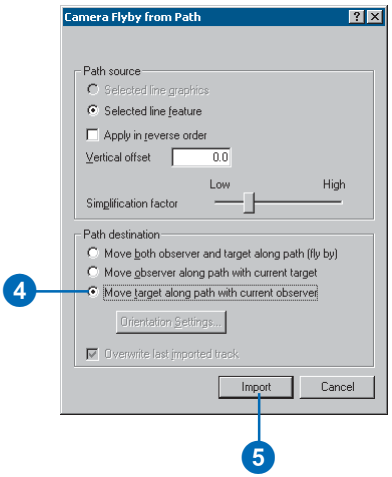


3. Click Animation and click Camera Flyby from Path.



4. Click the third path destination option.

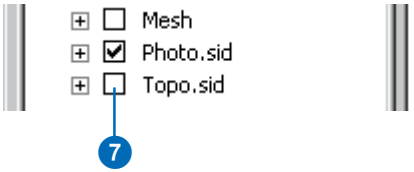
   This option lets you observe the UFO as it moves along the path.



5. Click Import.
6. Click the Play button.

   Both tracks play. The UFO layer moves, and the camera follows its movements.

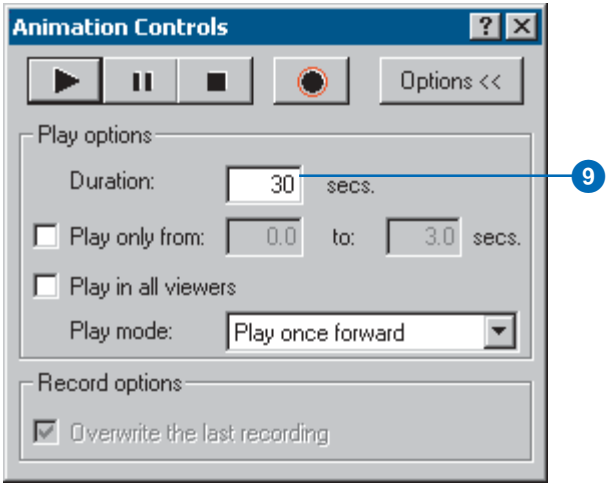
7. Uncheck the Topo.sid check box to make the ortho photo visible.



   The animation is playing too quickly. Next, you'll learn how to adjust the duration that the animation is playing to enhance the visual effect.

8. Click Options.

9. Type “30” in the Duration text box.



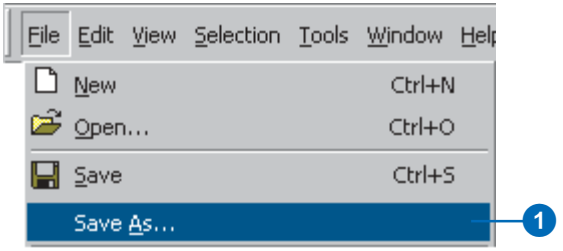
10. Click Options to minimize the dialog box.
11. Click the Play button.

Now the animation plays more slowly as the UFO flies over the terrain.

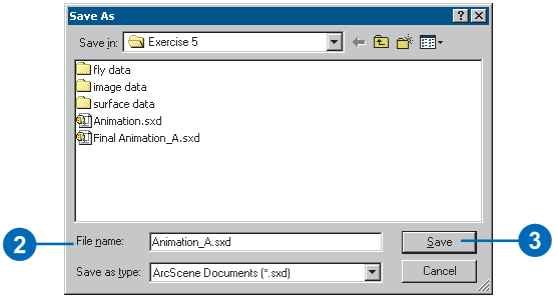
Saving an animation in a scene document

You can save animation tracks in a scene document. In the next step, you’ll save the animations you made in a scene document.

1. Click File and click Save As.



2. In the File name text box, type “Animation_A.sxd”.
3. Click Save.



The new scene document is created, storing the animation tracks.

In this exercise you learned how to create and save simple animations that help you better visualize 3D data. There are other more advanced ways of creating, saving, and sharing animations. For more information, see Chapter 8, 'Animation'.