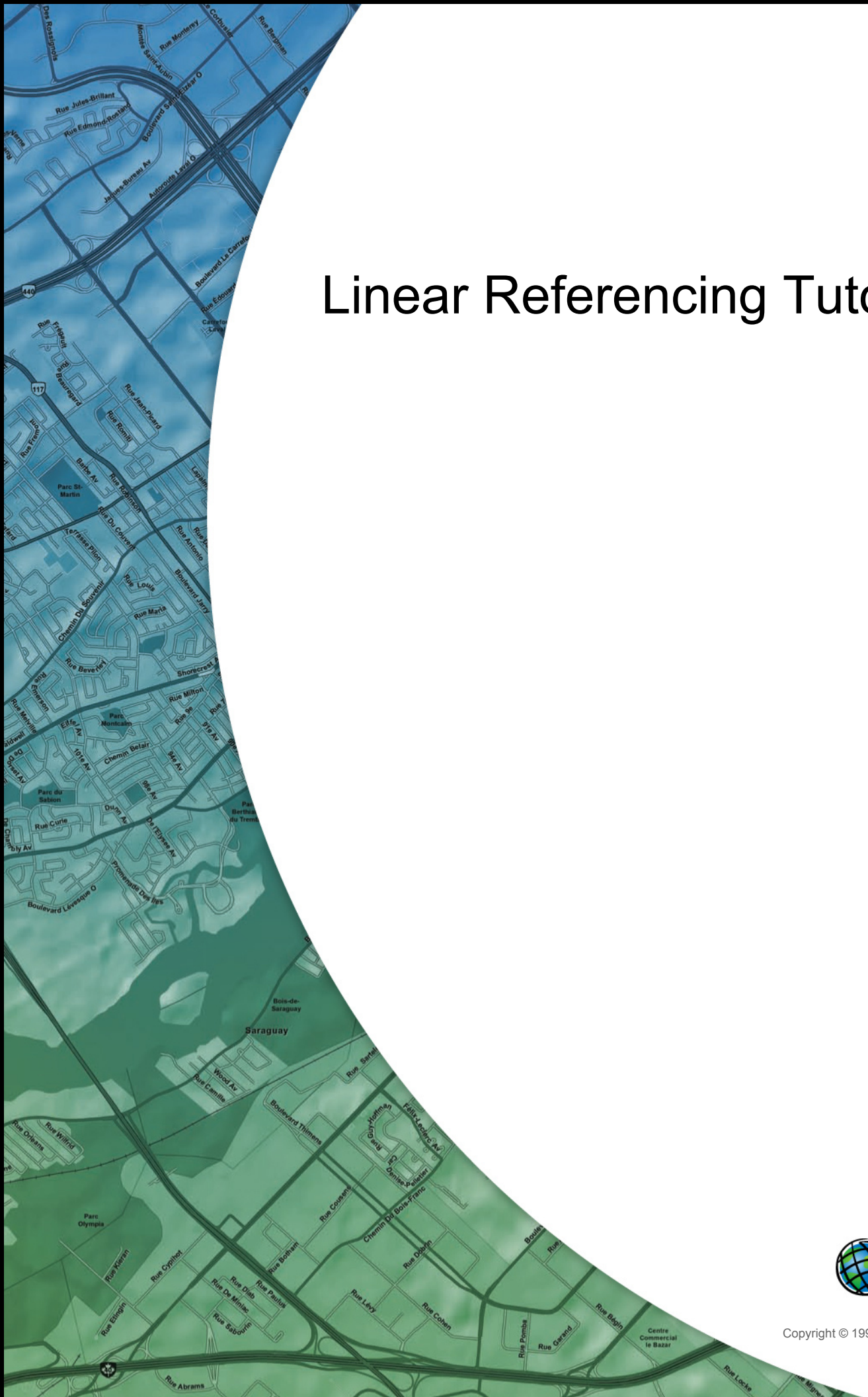


Linear Referencing Tutorial

esri

Table of Contents

An overview of the linear referencing tutorial

ArcGIS has the tools you need for linear referencing applications. The easiest way to start learning about linear referencing is to complete the exercises in this tutorial. Before you start, however, it is assumed you know the fundamentals of ArcGIS software. For more information, see A quick tour of geoprocessing, A quick tour of ArcCatalog, and A quick tour of editing.

For this tutorial, imagine that you work in the GIS department of a highway authority, responsible for the maintenance and safety of your region's highways. In the exercises to follow, you will perform some of the linear referencing tasks typical to such a person. Specifically, you will use the linear referencing geoprocessing tools to create and recalibrate route data. Next, you will learn how to display and query your newly created route data, then your route event data, in ArcMap. Lastly, you will learn how to edit your route data in ArcMap.

This tutorial includes five exercises, each of which takes 5 to 30 minutes to complete. The exercises build on one another, so it is assumed that you will complete them in order.

The study area for this tutorial is Pitt County, North Carolina. The data was compiled from various sources and has been modified to suit the needs of the exercises. The reliability and suitability of the information, therefore, cannot be guaranteed.

Exercise 1: Organizing your linear referencing data in ArcCatalog

The exercises in this chapter use the tutorial data distributed with ArcGIS and work with an ArcView license. Some of these exercises require you to make changes to the data; therefore, you will need to have write access to the data. To be sure you have write access, you will begin this exercise by making a working copy of the LinearReferencing tutorial folder.

Complexity:
Beginner

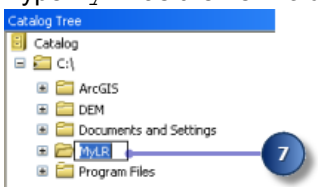
Data Requirement:
ArcGIS Tutorial Data Setup

Goal:
Organize the linear referencing tutorial data in ArcCatalog.

Copying the data

Steps:

1. Start ArcCatalog by clicking **Start** > **All Programs** > **ArcGIS** > **ArcCatalog 10.**
2. Navigate to the LinearReferencing folder on the local drive where the tutorial data is installed—for example, C:\arcgis\ArcTutor\LinearReferencing.
   If the data was installed by your system administrator in a shared folder on the network, the path to the tutorial folder includes the names of the computer and the connection through which the folder is accessed—for example, \\dataserver\public\ArcGIS\ArcTutor\LinearReferencing.
3. Right-click the LinearReferencing folder and click **Copy**.
4. Navigate to the location where you would like to make a copy of this data, such as the C drive.
5. Right-click this location and click **Paste**.
   A new folder called LinearReferencing is created at this location.
6. Right-click this new folder and click **Rename**.
7. Type `MyLR` as the new folder name.

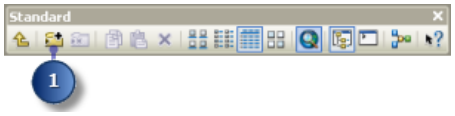


Connect directly to your tutorial data

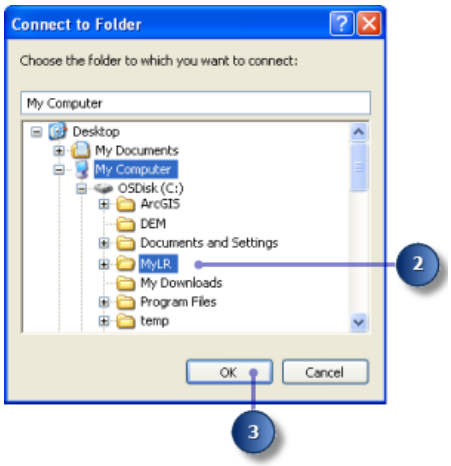
In ArcCatalog, folder connections let you access specific directories on local disks or shared folders on the network. Further, database connections allow you to access the contents of a database.

Steps:

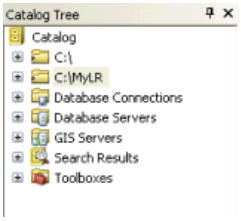
1. Click the **Connect To Folder** button on the Standard toolbar.



2. Navigate to and choose the location of your MyLR folder.
3. Click **OK**.



The new folder connection is now listed in the Catalog tree.



You will now be able to access all the data needed for the remaining exercises in this tutorial via the new connection.

Exercise 2: Creating and calibrating route data

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Goal:
Creating and calibrating route data using the linear referencing geoprocessing tools.

The first thing you will need for any linear referencing project is accurate route data. In this exercise, you use tools in the Linear Referencing toolbox to create and calibrate route data. The first activity is to create a temporary layer representing only the line features that have route and measure information stored as attribute values. Next, you will create a route feature class by merging the input line features of the temporary layer that share a common route identifier. Finally, you will recalibrate the newly created routes using a point feature class storing route and measure information as attributes.

Creating a layer

Not every feature in the base_roads feature class has route and measure information. Therefore, before any routes are created, you will want to isolate only those routes that contain this information. Creating routes using features that do not have this information would be pointless.

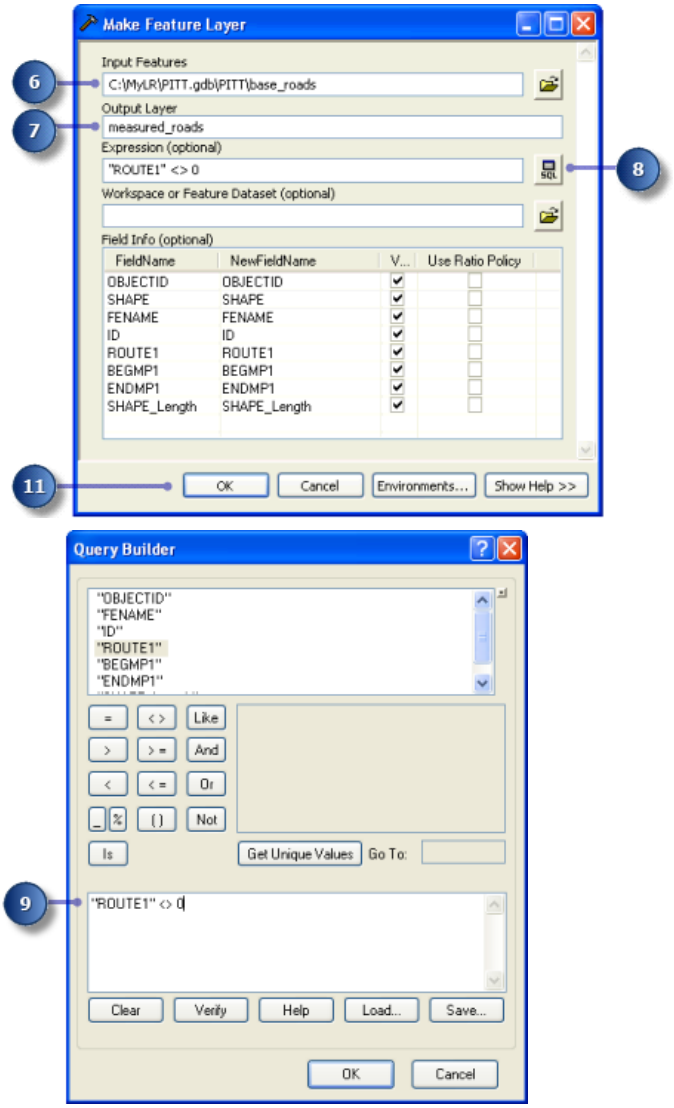
Creating a temporary layer allows you to do things, such as make selections, without affecting the original data source. This layer will not appear in the ArcCatalog table of contents, because it is created inmemory and simply references the data stored on disk. These layers can be used as inputs to other geoprocessing tools within your working session. Once you exit the application, the in-memory layers will be removed.

Steps:

1. In ArcCatalog, expand the **Toolboxes** folder in the **Catalog tree**.
2. Expand **System Toolboxes** to show its contents.
3. Expand the **Data Management Tools** toolbox to show its contents.
4. Expand the **Layers and Table Views** toolset to show its contents.
5. Right-click the **Make Feature Layer** tool and click **Open**. Alternatively, you can double-click the **Make Feature Layer** tool to open it.

   There are several ways to set the input feature class. You can drag a feature class from the ArcCatalog tree and drop it onto the text box, click the browse button and navigate to the feature class in the dialog box, or simply type the full path to the feature class in the text box.

   The tutorial instructions ask you to type names and paths into the appropriate text boxes. Feel free, however, to use any of the available techniques.
6. Type `C:\MyLR\PITT.gdb\PITT\base_roads` for the value of the **Input Features** parameter.
7. Type `measured_roads` for the value of the **Output Layer** parameter.
8. Click **Expression**.
   The ***Query Builder*** dialog box opens.
9. Type `"ROUTE1" <> 0` in the text box.
10. Click **OK** on the ***Query Builder*** dialog box.
11. Click **OK** on the ***Make Feature Layer*** dialog box.



A status bar appears in the lower right of your screen as the tool runs. When the tool completes, a status message appears.

Creating route data

The Create Routes tool is used to specify the input line features, the route identifier field, the method used to set the route measures, and the output feature class. Note that the input features can be any supported format. This includes coverage, shapefile, personal, file, and enterprise geodatabases and computer-aided design (CAD) data.

Steps:

1. Expand the **Linear Referencing Tools** toolbox to show its contents.
2. Right-click the **Create Routes** tool and click **Open**.
3. Click the **Input Line Features**drop-down arrow and click the **measured_roads** layer.
4. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.

The values in the route identifier field uniquely identify each route.

Next, you need to specify the name for the output feature class. This feature class can be contained within the same geodatabase as the input, or you can save it to another geodatabase or shapefile. If it is saved to a geodatabase, it can be contained within a feature dataset or on its own as a feature class. For this exercise, you will be writing the new data to the same feature dataset as the input.

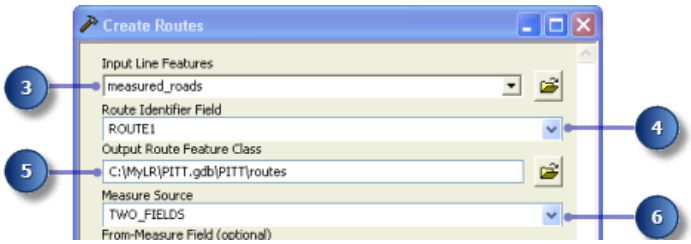
5. Type `C:\MyLR\PITT.gdb\PITT\routes` for the value of the **Output Route Feature Class** parameter.

   Next, specify how the route measures will be obtained. There are three choices:

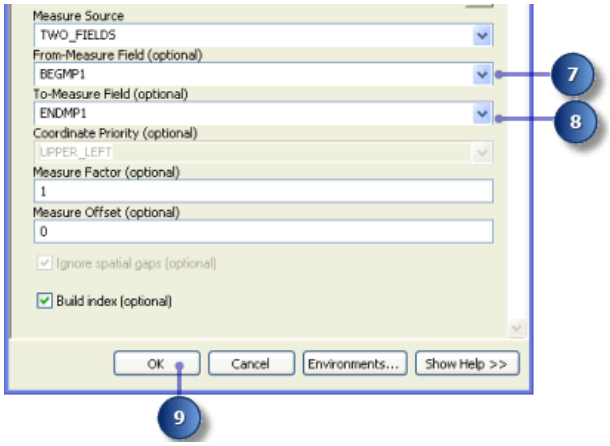
   - **LENGTH—**Geometric lengths of the input features are used to accumulate the measures.
   - **ONE_FIELD—**Values stored in a measure field are used to accumulate the measures.
   - **TWO_FIELDS—**Values stored in from- and to-measure fields are used to set the measures.

   You will use the last method.

6. Click the **Measure Source** drop-down arrow and click **TWO_FIELDS**.
   This enables both the **From-** and **To-Measure Field** input fields.



7. Click the **From-Measure Field** drop-down arrow and click **BEGMP1**.
8. Click the **To-Measure Field** drop-down arrow and click **ENDMP1**.
9. Click **OK** to execute the tool.



A status bar appears in the lower right of your screen as the tool runs. When the tool completes, a status message appears.

Calibrating route data

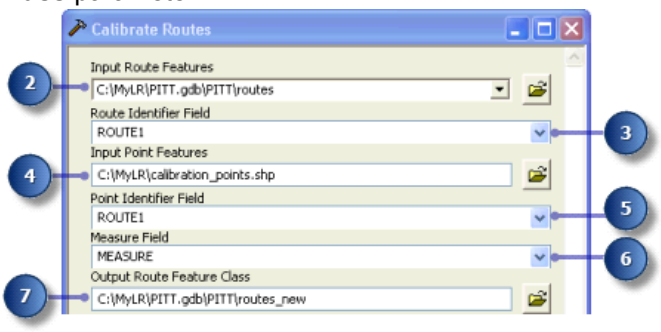
Imagine that at some point in the future, the highway authority's road maintenance crew acquires a distance measuring instrument (DMI) to accurately record mileage information along the highways. For a sample set of highways, the crew goes out and captures mileage information approximately every 1/10 of a mile. The results of this effort are stored as points in a shapefile, where the route and mileage information are stored as attributes.

In the next section of this tutorial, you will use the Calibrate Routes tool to adjust the measures of the routes you just created to match those of the points in the shapefile. The result will be written to a new feature class.

The Calibrate Routes tool is used to specify the input route feature class, the route identifier field, the input point feature class, the measure field, the methods used to set the route measures, and the output feature class.

Steps:

1. Right-click the **Calibrate Routes** tool in the Linear Referencing toolbox and click **Open**.
2. Type `C:\MyLR\PITT.gdb\PITT\routes` for the value of the **Input Route Features** parameter.
3. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.
   The values in the **Route Identifier Field** uniquely identify each route.
4. Type `C:\MyLR\calibration_points.shp` for the value of the **Input Point Features** parameter.
5. Click the **Point Identifier Field** drop-down arrow and click **ROUTE1**.
   This is the common field, shared with the route feature class.
6. Click the **Measure Field** drop-down arrow and click **MEASURE**.
7. Type `C:\MyLR\PITT.gdb\PITT\routes_new` for the value of the **Output Route Feature Class** parameter.

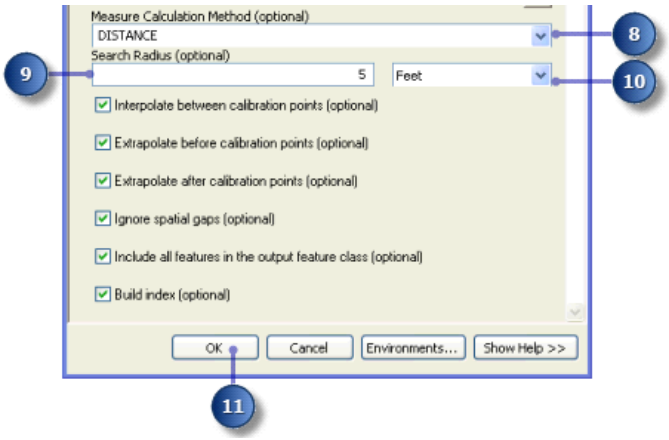


   A tolerance can be specified to limit how far a calibration point can be from its route. Points outside the tolerance will not be used by the calibration process.

8. Click the **Measure Calculation Method** drop-down arrow and click **DISTANCE**.
9. Type `5` for the value of the **Search Radius** parameter.
   This is more than enough for the data that is being used here.
10. Click the **Search Radius** drop-down arrow and click **Feet**.

This sets to feet the units to be used for the search radius.

11. Click **OK** to execute the tool.



A status bar appears in the lower right of your screen as the tool runs. When the tool completes, a status message appears.

In this exercise, you learned how to create a route feature class by merging input line features that shared a common identifier and how to adjust the route measures using measure information stored in a point shapefile.

Exercise 3: Displaying and querying routes

Complexity:
Beginner
Data Requirement:
ArcGIS Tutorial Data Setup
Goal:
Displaying and querying routes

In this exercise, you will add the route data you created in Exercise 2 Creating and calibrating route data to an existing map document and symbolize it. You will then do the following:

- Set the route identifier field.
- Add the Identify Route Locations tool to a toolbar.
- Identify route locations.
- Find route locations.
- Display route measure anomalies.

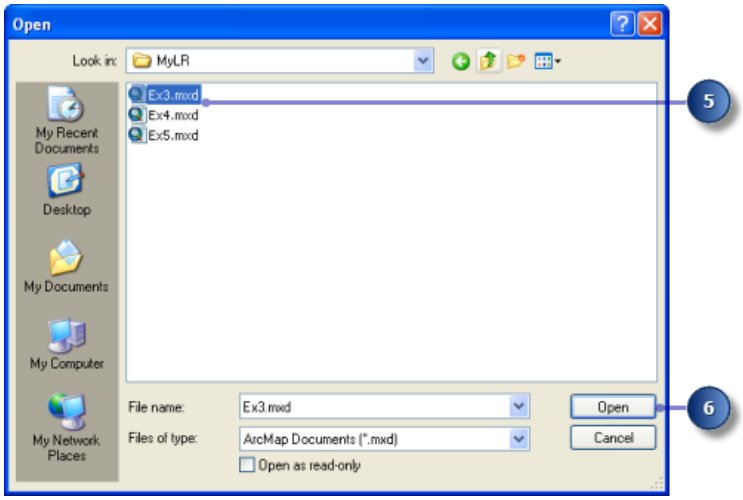
If you have not completed Exercise 2 Creating and calibrating route data, open ArcCatalog. Within the table of contents, delete PITT.gdb in your \MyLR folder and rename PITT_Results.gdb to PITT.gdb.

Open an existing map document

To begin this exercise, you will start ArcMap and open an existing document.

Steps:

1. Start ArcMap by clicking **Start** > **All Programs** > **ArcGIS** > **ArcMap 10.**
2. In the ***Getting Started*** dialog box, choose **Existing Maps**.
3. Double-click **Browse for more**.
4. Click the **Look in** drop-down arrow in the ***Open*** dialog box and navigate to the folder where you copied the data for this tutorial (in other words, C:\MyLR).
5. Click **Ex3.mxd**.
6. Click **Open**.



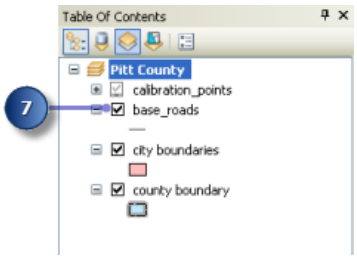
This map contains the following layers in a data frame called Pitt County:

calibration_points	The points used in exercise 2 to recalibrate the route measures
base_roads	All the roads in Pitt County

city boundaries	The boundaries of the cities in Pitt County
county boundary	Pitt County boundary

The map currently displays the city boundaries and county boundary layers. Their check boxes are checked in the table of contents. The calibration_points layer is checked, but scale suppression has been set. It will only be visible when you zoom in to a scale beyond 1:25,000.

7. Check the box next to the **base_roads** layer in the contents.

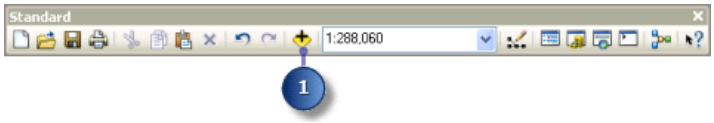


You will now see all the roads in Pitt County. This includes roads not maintained by the highway authority. The roads maintained by the highway authority were written to the routes feature class.

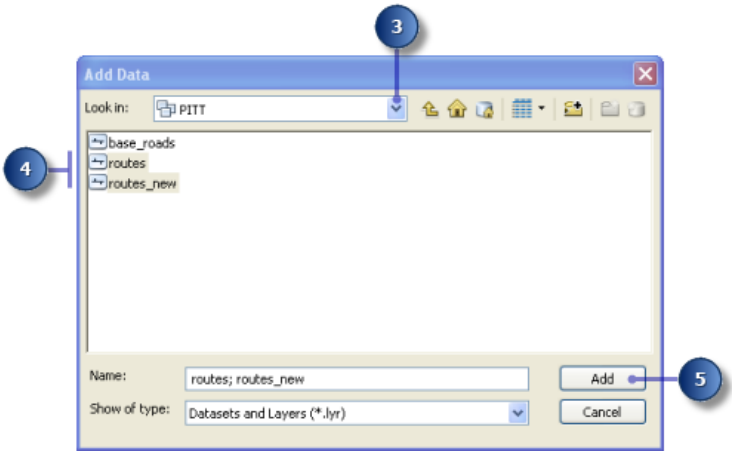
Adding route data to your map

Steps:

1. Click the **Add Data** button.



2. Click the **Look in** drop-down arrow and navigate to your \MyLR folder.
3. Double-click **PITT.gdb** and double-click the **PITT** feature dataset.
4. Press the CTRL key and select both the **routes** and **routes_new** feature classes.



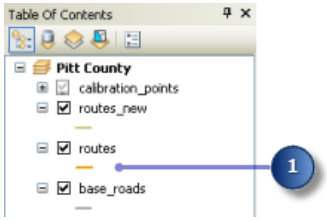
5. Click **Add**.

Changing the display symbol

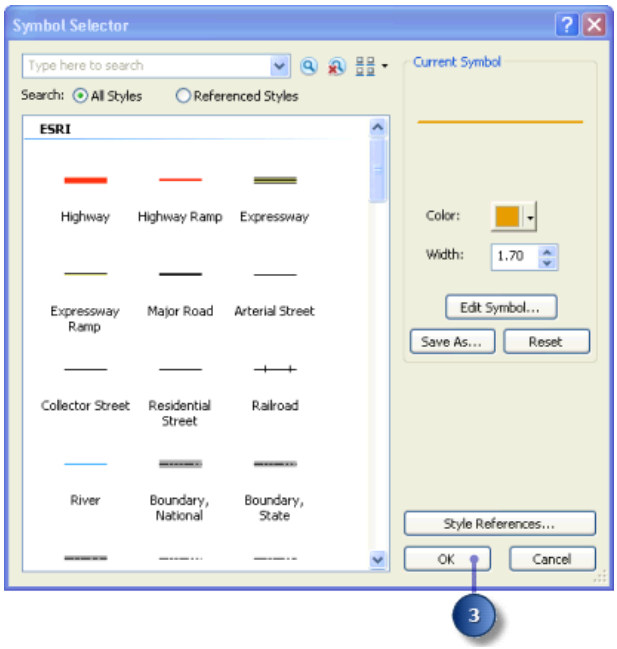
The default colors and symbols with which ArcMap displays the routes layer might make it difficult to see where the route features are located. It is easy to change the colors and symbols used to display features in ArcMap.

Steps:

1. Click the line symbol in the contents for the **routes layer** to display the ***Symbol Selector*** dialog box.



2. Scroll down until you find a symbol you like and click it.
3. Click **OK**.
   Your routes layer is displayed with the symbol you chose.



4. Repeat steps 1 through 3 for the routes_new layer.

Tip: You can also open the ***Symbol Selector*** dialog box by right-clicking the layer in the table of contents, clicking **Properties**, then clicking the **Symbology** tab. To simply change the color of a symbol, right-click the symbol in the table of contents to display the color palette and click any color or **More Colors**.

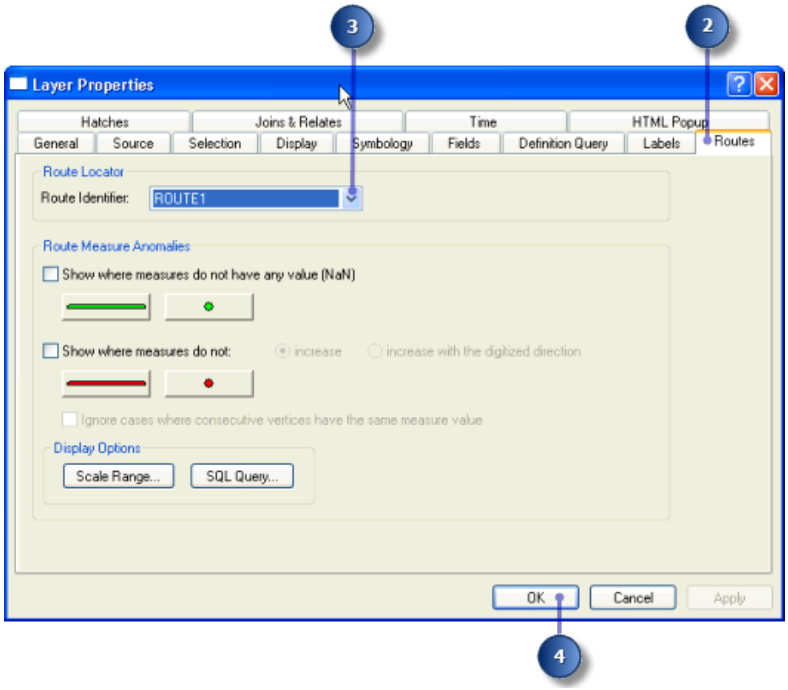
Setting the route identifier field

Whenever route data is added to a map, ArcMap exposes some additional layer properties. One of these properties is the Route Identifier field. The contents of this field uniquely identify each route.

Setting the Route Identifier field is not required. Doing so, however, reduces the number of steps required to use many of the ArcMap linear referencing dialog boxes, tools, and wizards.

Steps:

1. Right-click the **routes**layer in the table of contents and click **Properties**.
   The ***Layer Properties*** dialog box opens.
2. Click the **Routes** tab.
3. Click the **Route Identifier** drop-down arrow and click **Route1**.
4. Click **OK**.



5. Repeat steps 1 through 4 for the **routes_new** layer.

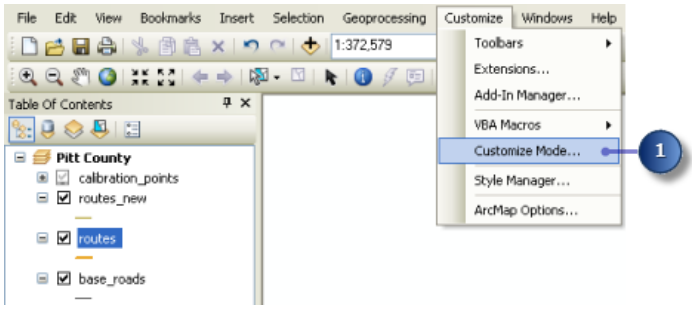
Adding the Identify Route Locations tool

ArcMap gives you the ability to point to a route in a map and find the route identifier along with the measure value at that location. In this part of the exercise, you will use the Identify Route Locations tool to inspect the measures on the routes you created in exercise 2.

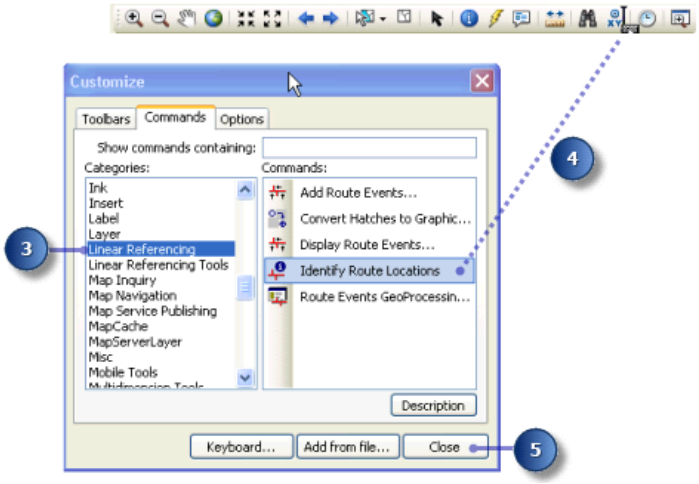
The Identify Route Locations tool does not appear on any toolbar by default. You will have to add it to one.

Steps:

1. Click **Customize** > **Customize Mode**.
   The ***Customize*** dialog box opens.



2. Click the **Commands** tab.
3. Click **Linear Referencing** in the **Categories** list.
4. Drag and drop the **Identify Route Locations** tool to the toolbar of your choice, such as the **Tools** toolbar.



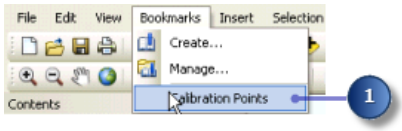
5. Click **Close**.

Identifying route locations

In ArcMap, a bookmark is a saved map location. A bookmark has been created for you containing some of the calibration points used to recalibrate the routes in Exercise 2 Creating and calibrating route data.

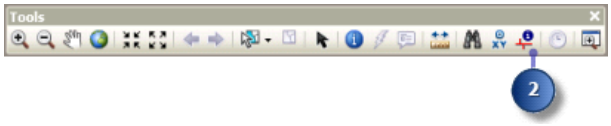
Steps:

1. Click **Bookmarks** and click **Calibration Points**.

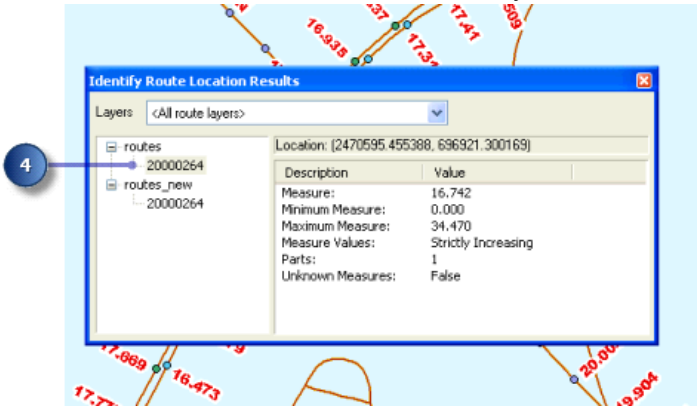


When ArcMap moves to the saved location, the calibration points appear with labels that represent the measure values for each point. The reason they appear when the bookmark has been used is because scale suppression was set on the layer.

2. Click the **Identify Route Locations** button.

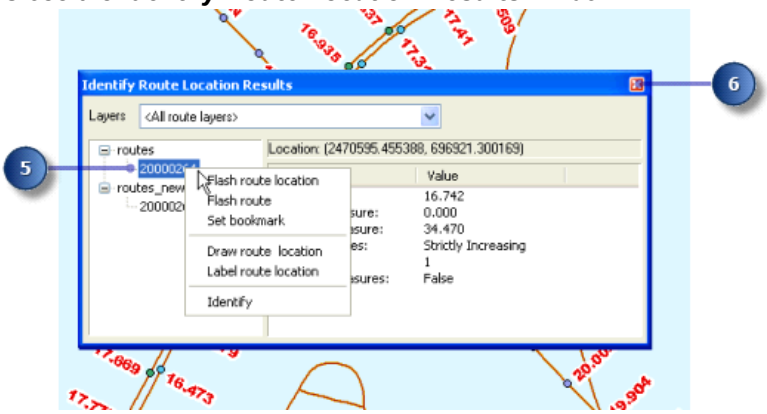


3. Move the pointer over one of the calibration points and click.
   Route locations from both the routes and routes_new layers are identified.
4. Click the route node for each of the route layers.

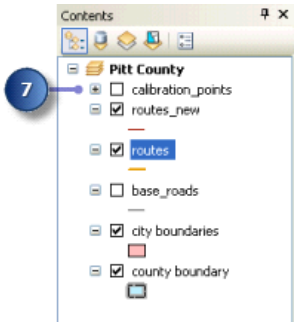


The numeric value listed for each of these nodes corresponds to the value stored in the Route Identifier field, which you set in a previous section of this exercise. Note that the measure values for the two routes differ. Note further that the measure value for the routes_new layer corresponds closely to the measure value of the calibration point you clicked—the closer you are to a calibration point, the closer the measure will be.

5. Right-click the route node for one of the layers and explore the context choices available to you.
6. Close the ***Identify Route Location Results*** window.



7. Uncheck the check box for the **calibration_points** layer in the table of contents to make it not visible. It will not be used any further in this exercise.

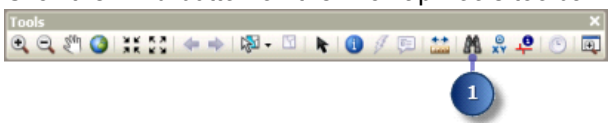


Finding route locations

In many linear referencing applications, you will discover that you will often need to find a location along a route. For example, you may need to find where an accident occurred along a highway. On a paper map, it is hard to find a route location. This is because route measures are typically not shown. In ArcMap, finding a route location is made easy.

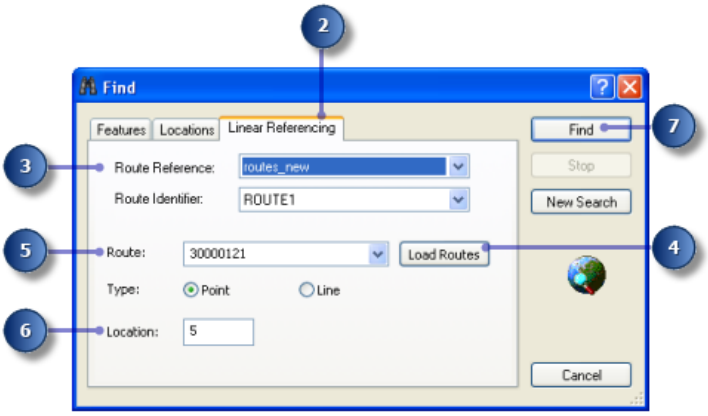
Steps:

1. Click the **Find** button on the ArcMap Tools toolbar.

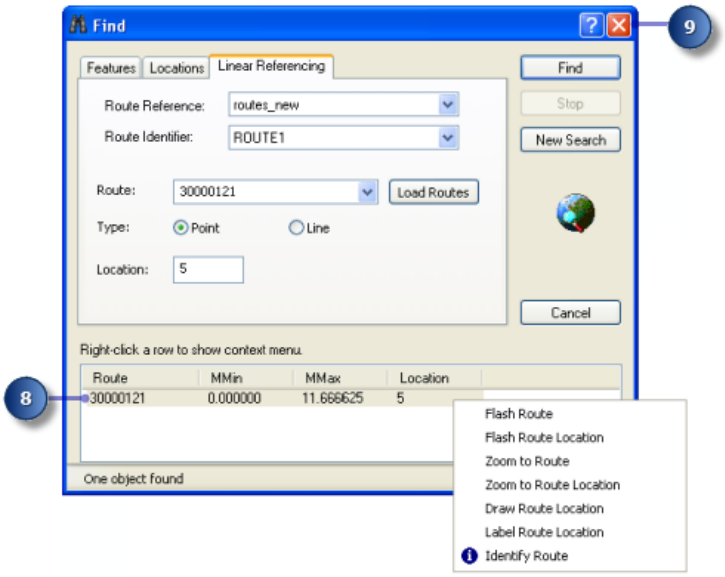


2. Click the **Linear Referencing** tab.
3. Click the **Route Reference** drop-down arrow and click **routes_new**.

   Notice that the field listed in the **Route Identifier** drop-down list corresponds to the Route Identifier field you set previously in this exercise.
4. Click **Load Routes**.
5. Click the **Route** drop-down arrow and choose**30000121**.
   This number is often a combination of many numeric fields and is meant to have no political, social, or economic meaning, so that it will not change over time.
6. Type `5` in the **Location** text box.
7. Click **Find**.



8. Right-click the route location that was found and explore the context choices available to you.



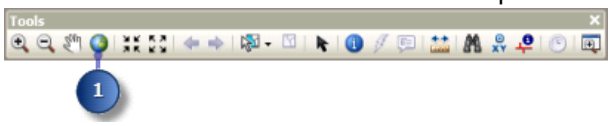
9. Close the ***Find*** dialog box.

Displaying route measure anomalies

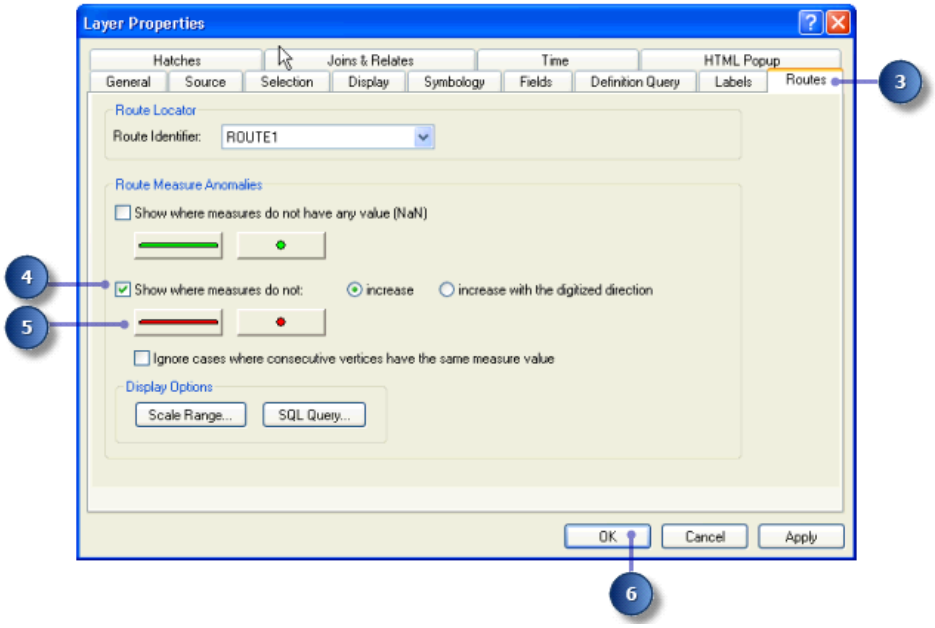
In most linear referencing applications, route measure values are expected to follow a set of rules. For example, you might expect that route measures always increase over the course of a route. ArcMap has the ability to show you where route measures do not adhere to the behavior you expect. These are known as route measure anomalies.

Steps:

1. Click the **Full Extent** button on the ArcMap ***Tools*** toolbar.



2. Right-click the routes layer in the contents and click **Properties**.
3. Click the **Routes** tab.
4. Check **Show where measures do not increase**.
5. Click the **Line Symbol** button and choose a line symbol you like. Do the same for the marker symbol.
6. Click **OK**.



Remember that the routes feature class was created from the base_roads feature class in Exercise 2 Creating and calibrating route data. There are a few digitizing and attribute errors that caused the measure anomalies to exist in the routes feature class. Route measure anomalies can be fixed with ArcMap route editing tools.

Exercise 4: Displaying and querying route events

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Goal:
Display and query route events

In this exercise, you will create a new event table that represents where injury accidents occurred along sections of poor-quality pavement.

To do this, you will first use the Make Route Event Layer tool to display the accident location and pavement quality event data on your map. You will then use the Select By Attributes dialog box to select the injury accidents and poor-quality pavement locations. You will use the Overlay Route Events tool to create a new event table whose records represent where injury accidents occurred along poor-quality pavement. Finally, you will add these events to the ArcMap display.

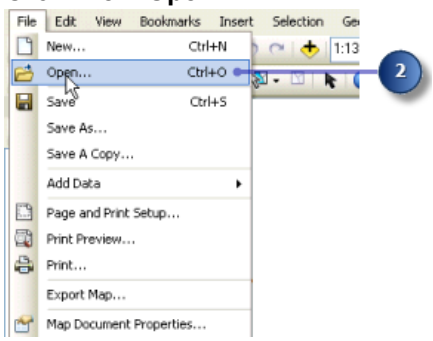
If you have not completed Exercise 2 Creating and calibrating route data, open ArcCatalog. Within the table of contents, delete PITT.gdb in your \MyLR folder and rename PITT_Results.gdb to PITT.gdb.

Opening an existing map document

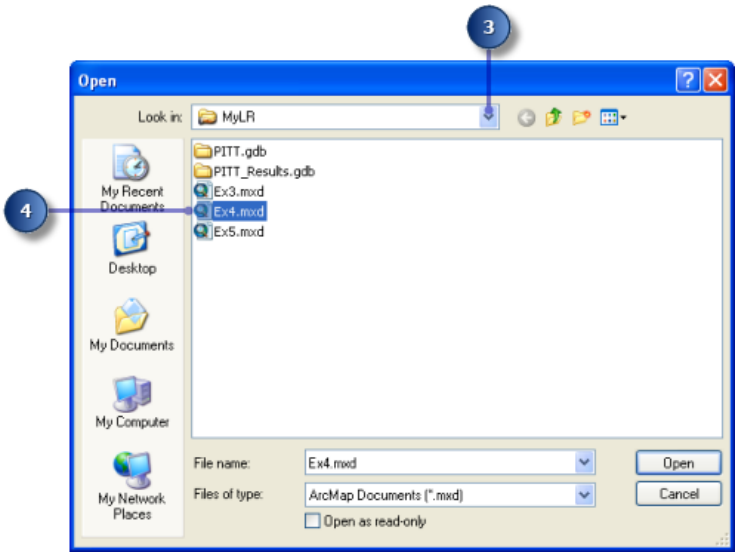
To begin this exercise, you will start ArcMap and open an existing document.

Steps:

1. Start ArcMap by clicking **Start** > **All Programs** > **ArcGIS** > **ArcMap 10.**
2. Click **File** > **Open**.



3. Click the **Look in** drop-down arrow on the ***Open*** dialog box and navigate to the location where you created the \MyLR folder.
4. Double-click **Ex4.mxd**.



The map opens.

5. Click the **List by Source** view in the table of contents.

This map contains the following layers in a data frame called Pitt County:

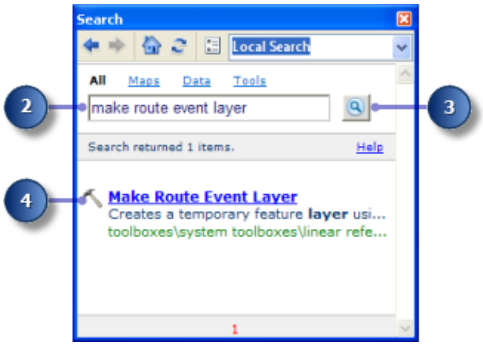
routes_hwy	Shapefile copy of routes_new feature class you created in Exercise 2 Creating and calibrating route data
county boundary	Pitt County boundary
accident	Point event table storing accident information
pavement	Line event table storing pavement information
base_roads	All the roads in Pitt County

Displaying point events on your map

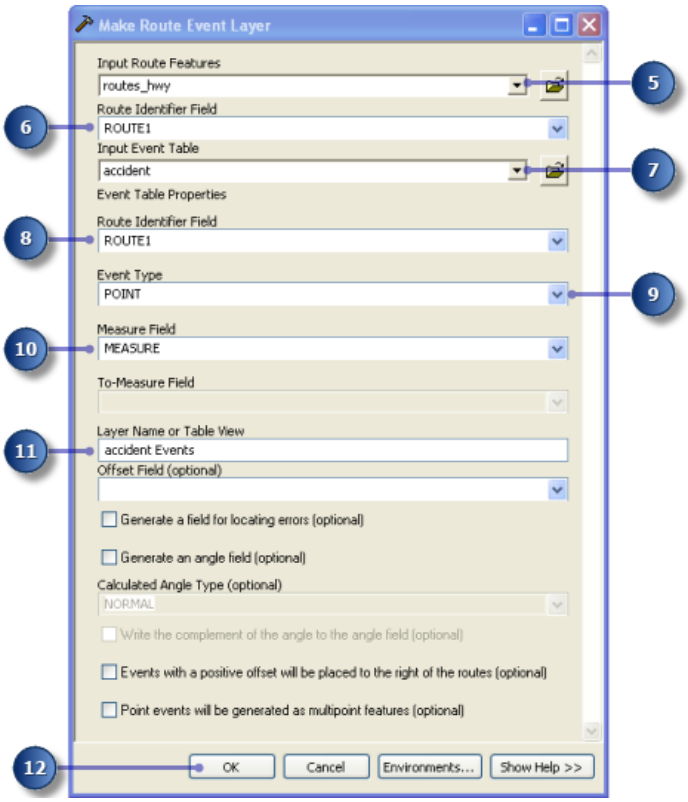
The accident table is a point event table. Point events occur at a precise point location along a route. In this section of the exercise, you will display the accident event data as a layer.

Steps:

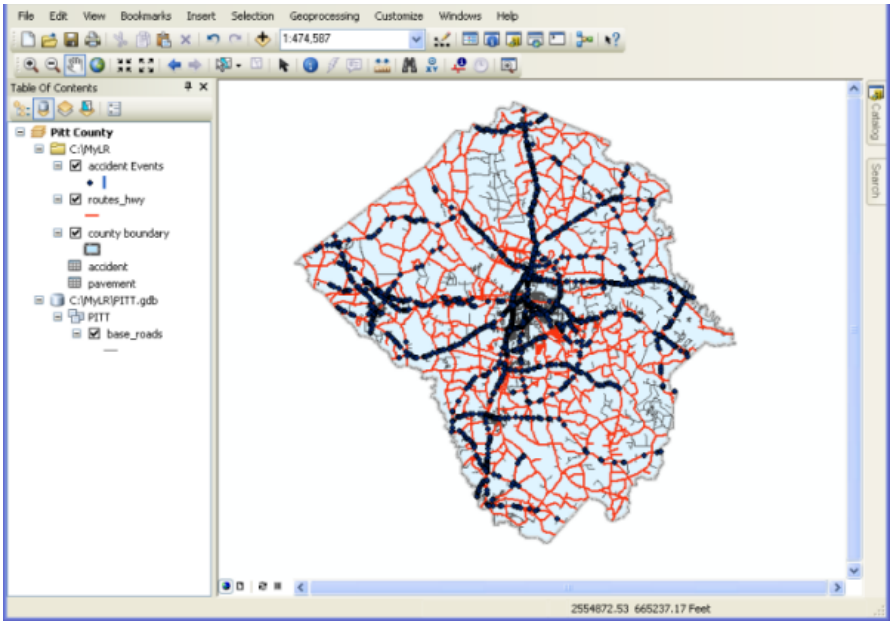
1. Click **Geoprocessing** > **Search For Tools.**
   The ***Search*** window opens.
2. Type `Make Route Event Layer` in the search box.



3. Click **Search Tools**.
   The ***Search*** window lists tools that are related to the search string you entered.
4. Click the **Make Route Event Layer** tool in the search results.
5. Click the **Input Route Features** drop-down arrow and click **routes_hwy**.
6. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.
7. Click the **Input Event Table** drop-down arrow and click **accident**.
8. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.
9. Click the **Event Type** drop-down arrow and click **POINT**.
10. Click the **Measure Field** drop-down arrow and click **MEASURE**.
11. Type `accident Events`in the **Layer Name** text box.
12. Click **OK**.



A new layer—accident Events—has been added to your map.

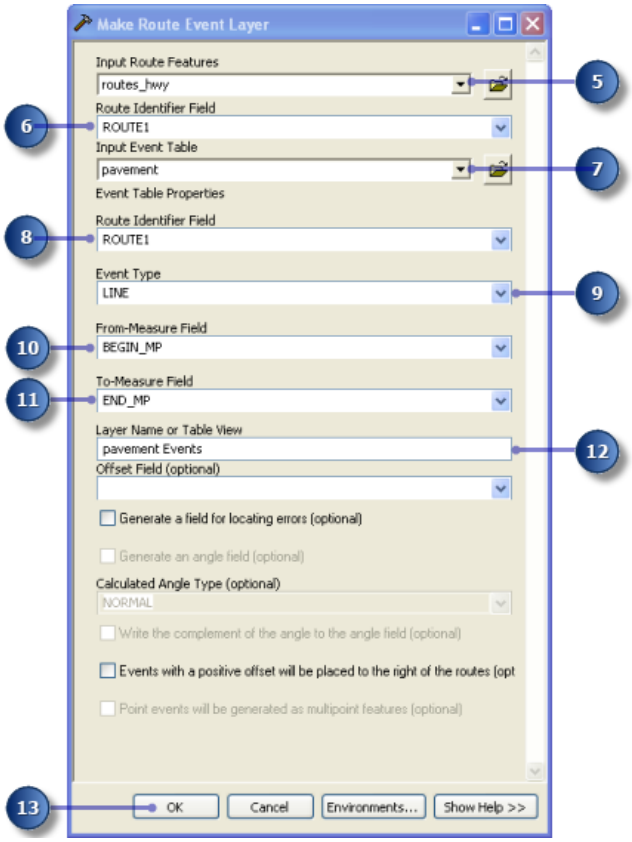


Displaying line events on your map

The pavement table is a line event table. Line events differ from point events in that they have two measure fields that define a portion of a route. The procedure for adding line events to your map is almost the same as adding point events.

Steps:

1. Click **Geoprocessing** > **Search For Tools.**
   The ***Search*** window opens.
2. Type `Make Route Event Layer` in the search box.
3. Click **Search Tools**.
   The ***Search*** window lists tools that are related to the search string you entered.
4. Click the **Make Route Event Layer** tool in the search results.
5. Click the **Input Route Features** drop-down arrow and click **routes_hwy**.
6. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.
7. Click the **Input Event Table** drop-down arrow and click **pavement**.
8. Click the **Route Identifier** drop-down arrow and click **ROUTE1**.
9. Click the**Event Type** drop-down arrow and click **LINE**.
10. Click the **From-Measure Field** drop-down arrow and click **BEGIN_MP**.
11. Click the **To-Measure Field** drop-down arrow and click **END_MP**.
12. Type `pavement Events`in the **Layer Name** text box.
13. Click **OK**.



A new layer—pavement Events—has been added to your map.

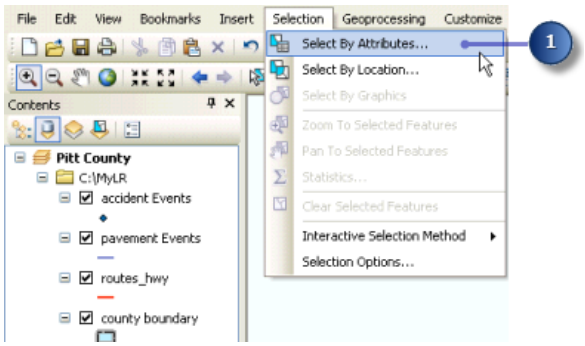
You might have to use the Zoom tool to zoom in on the map to see the pavement events, or you could click and move the pavement Events layer to the top of the layer list in the table of contents.

Querying events

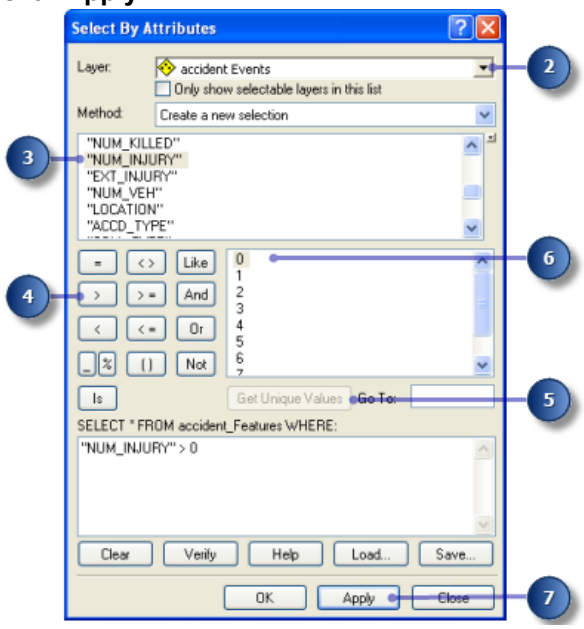
Layers based on an event table can be queried in many ways. They can be identified by clicking them, selected by dragging a box or clicking them on the map, selected by clicking them in an attribute table, and selected using a Structured Query Language (SQL) expression. You will use the Select By Attributes dialog box to input expressions to select the event records needed for this exercise. Specifically, you will select injury accidents and poor-quality pavement.

Steps:

1. Click **Selection** > **Select By Attributes**.

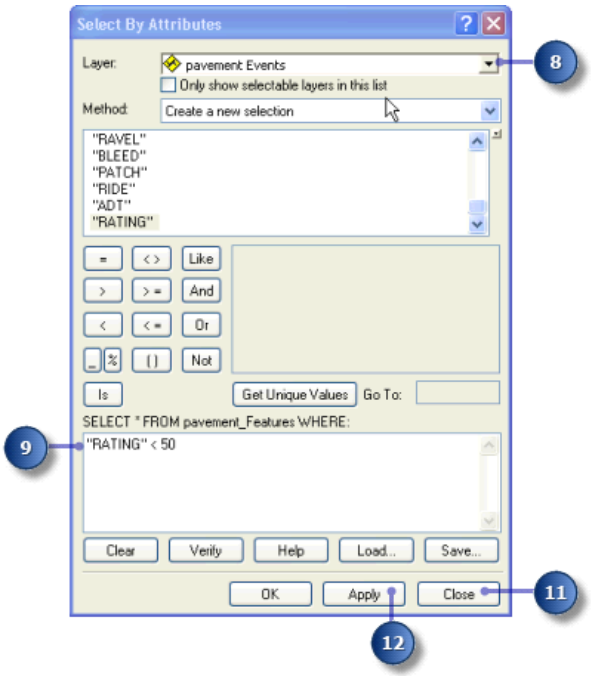


2. Click the **Layer** drop-down arrow and click **accident Events**.
3. Scroll down and double-click **NUM_INJURY** in the **Fields** list.
4. Click the greater than operator (>).
5. Click **Get Unique Values**.
6. Double-click **0** in the **Unique Values** list.
   "NUM_INJURY" > 0 is the expression that appears in the text box.
7. Click **Apply**.



You will see a number of the features in the accident Events layer selected in the ArcMap display window.

8. Click the **Layer** drop-down arrow and click **pavement Events**on the ***Select By Attributes*** dialog box.
9. Type `"RATING" < 50` in the text box.



10. Click **Apply**.
11. Click **Close**.

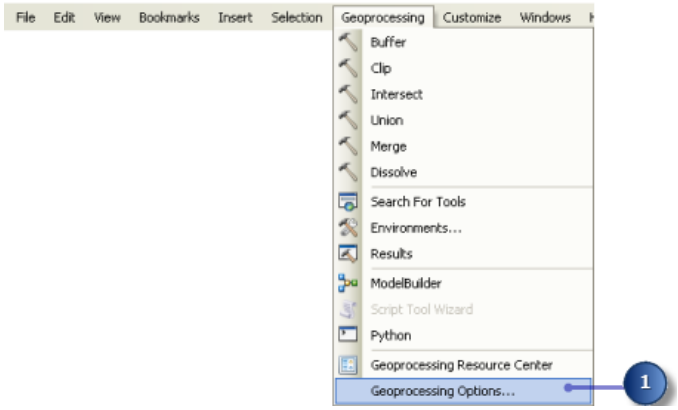
Now both the accident and pavement events are selected on your map. To see this more clearly, you may want to uncheck and check the accident Events and pavement Events layers in the table of contents.

In the next section of this exercise, you will use the Overlay Route Events tool to intersect the two event layers. The result will be a table that contains the injury accidents that happened on poor-quality pavement. All attributes from both inputs are maintained. First, however, you need to be sure that your geoprocessing results are automatically added to your display.

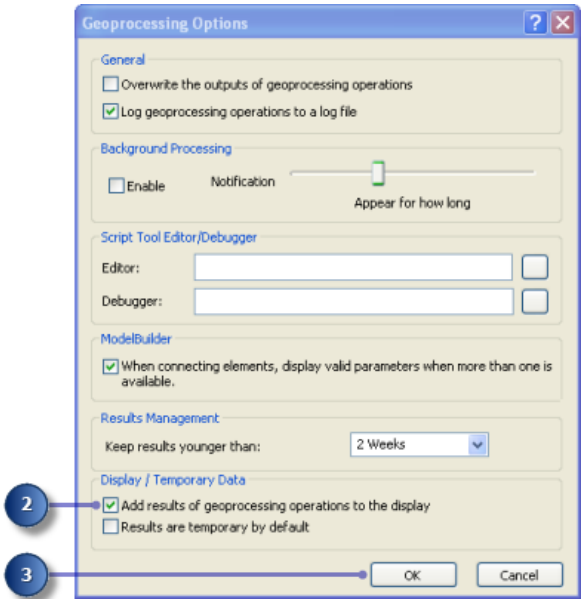
Setting geoprocessing results to display automatically

Steps:

1. Click **Geoprocessing** > **Geoprocessing Options**.



2. Check **Add results of geoprocessing operations to the display**.



3. Click **OK**.

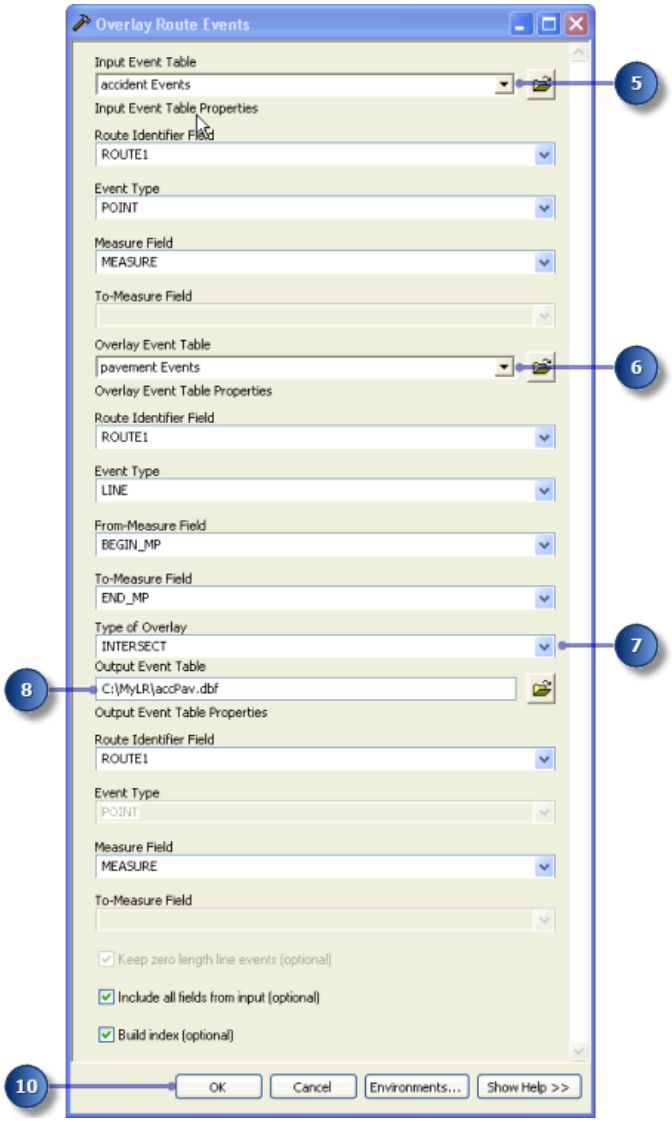
Intersecting event layers

Steps:

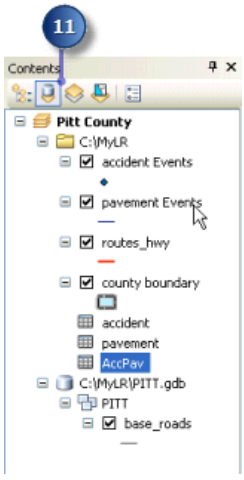
1. Click **Geoprocessing** > **Search For Tools.**
   The ***Search*** window opens.
2. Type `Overlay Route Events` in the search box.
3. Click **Search Tools**.
   The ***Search*** window lists tools that are related to the search string you entered.
4. Click the **Overlay Route Events** tool in the search results.
5. Click the **Input Event Table** drop-down arrow and click the **accident Events** layer.

   Note: Because you chose an event layer, the Route Identifier Field, Event Type, and Measure Field values were set automatically. If you had chosen an event table, you would be responsible for setting these parameters.

6. Click the **Overlay Event Table** drop-down arrow and click the **pavement Events** layer.
7. Click the **Type of Overlay** drop-down arrow and click **INTERSECT**.
   This allows you to find the intersecting event layers.
8. Type `C:\MyLR\AccPav.dbf` for the value of the **Output Event Table** parameter.
9. Keep the remaining defaults.



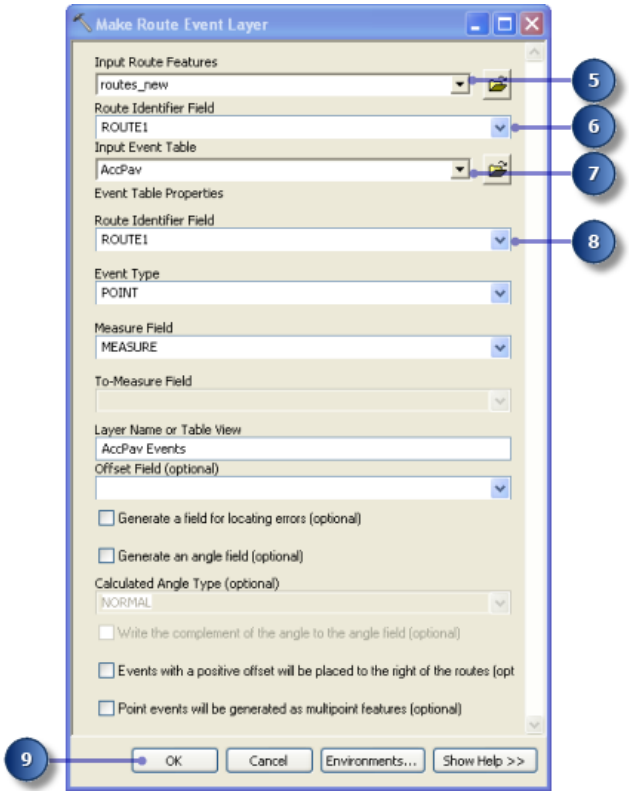
10. Click **OK** to execute the tool.
11. The AccPav.dbf table is added to the ArcMap session. If you cannot see it in the table of contents, click the **List by Source** button in the ***Table of Contents*** window.



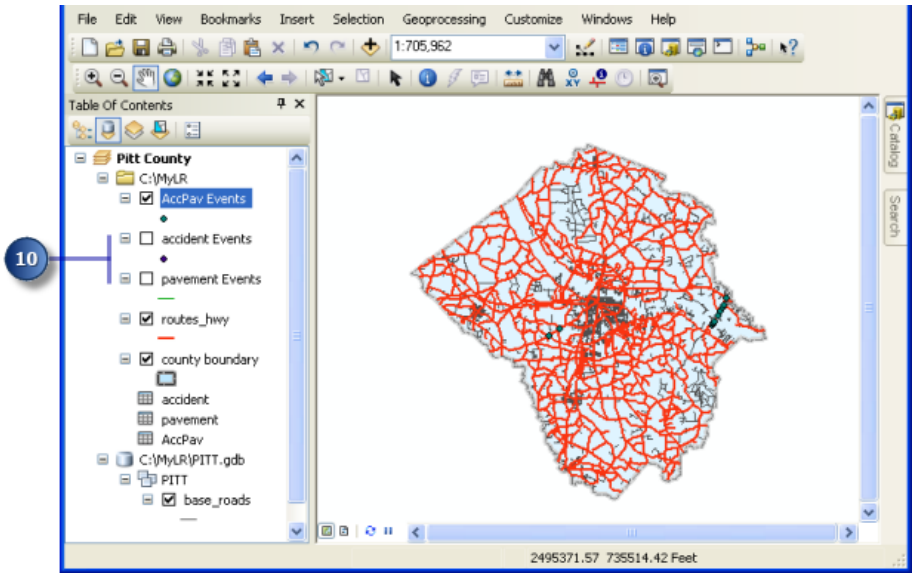
Displaying the intersected event results

Steps:

1. Click **Geoprocessing** > **Search For Tools.**
   The ***Search*** window opens.
2. Type `Make Route Event Layer` in the search box.
3. Click **Search Tools**.
   The ***Search*** window lists tools that are related to the search string you entered.
4. Click the **Make Route Event Layer** tool in the search results.
5. Click the **Input Route Features** drop-down arrow and click the **routes_hwy** layer.
6. Click the **Route Identifier Field** drop-down arrow and click **ROUTE1**.
7. Click the **Input Event Table** drop-down arrow and click **AccPav**.
8. Click the **Route Identifier Field** drop-down arrow for the event table and click **ROUTE1**.
9. Click **OK**.



The AccPav events layer is added to the contents.



10. Uncheck the **accident Events** and **pavement Events** layers in the contents.
    You see only the injury events that occurred along poor-quality pavement. Each of these new events has all the attributes from both the accident and pavement tables.

Exercise 5: Editing routes

Complexity:
Beginner
Data Requirement:
ArcGIS Tutorial Data Setup
Goal:
Edit routes

There are a number of tools in ArcMap that make the interactive creation and editing of route measures easy. In this exercise, you will create a new route from a selected set of linear features and set its identifier. You will then convert the measures of this newly created route from feet to miles. Last, you will recalibrate the route using known measure values at specific locations on your map.

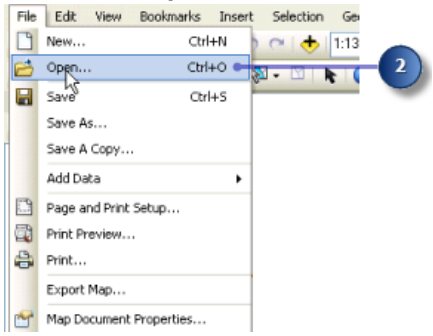
If you have not completed Exercise 2, open ArcCatalog. Within the table of contents, delete PITT.gdb in your \MyLR folder and rename PITT_Results.gdb to PITT.gdb.

Opening an existing map document

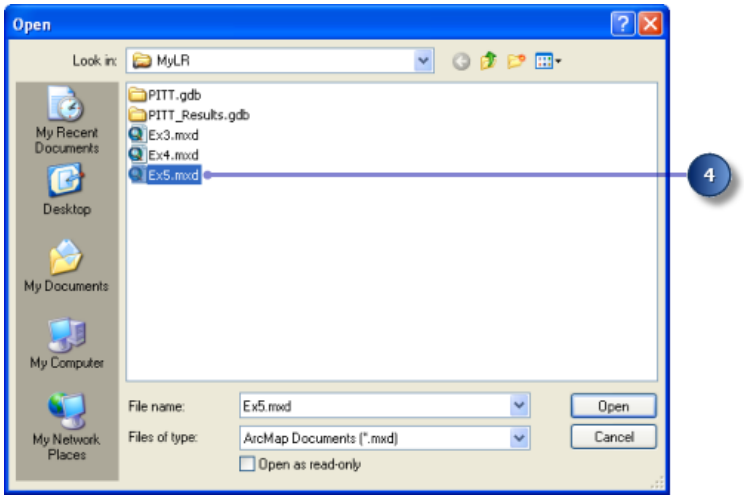
To do this exercise, you must start ArcMap.

Steps:

1. Start ArcMap by clicking **Start** > **All Programs** > **ArcGIS** > **ArcMap 10.**
2. Click **File** > **Open**.



3. Click the **Look in** drop-down arrow on the ***Open*** dialog box and navigate to the folder where you installed the data for this tutorial.
4. Double-click**Ex5.mxd**.
   The map opens.

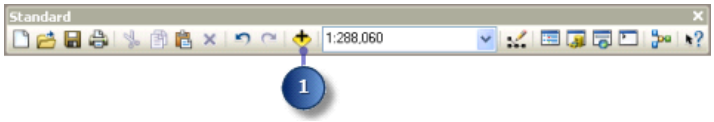


Adding route data to your map

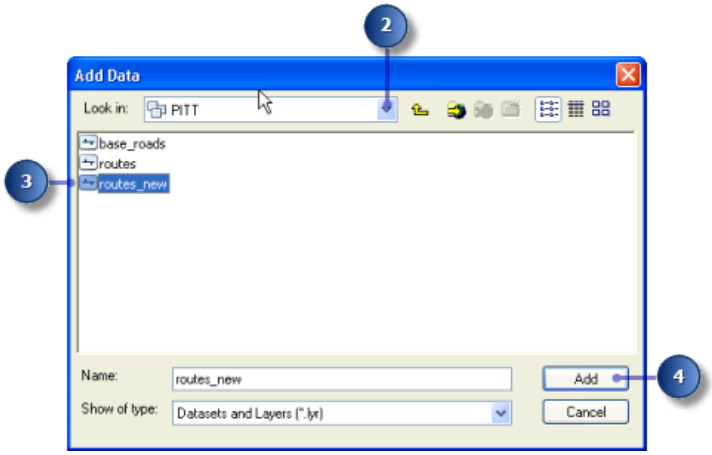
You will use one of the route feature classes you created in Exercise 2: Creating and calibrating route data to complete this exercise.

Steps:

1. Click the **Add data** button.



2. Click the **Look in** drop-down arrow and navigate to your \MyLR folder. Double-click PITT.gdb and double-click the PITT feature dataset.
3. Click the routes_new feature class.



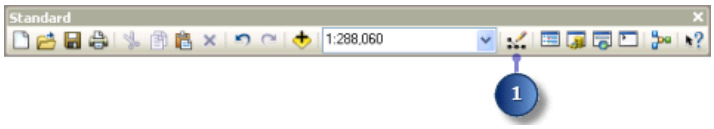
4. Click **Add**.

Adding the toolbars and editing

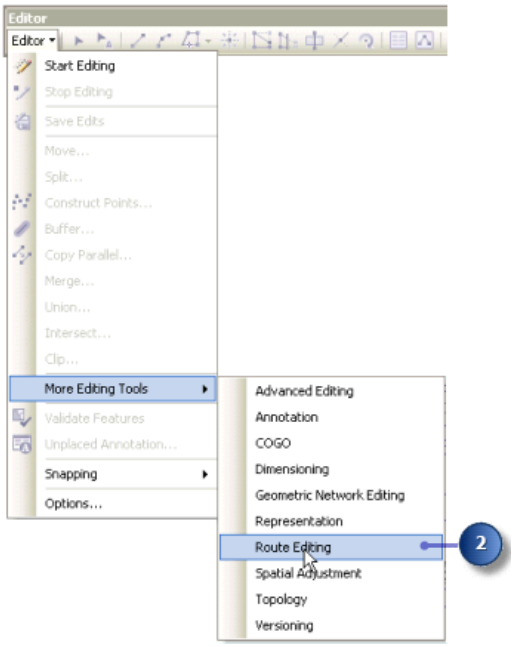
The toolbars necessary to complete this exercise might not be visible.

Steps:

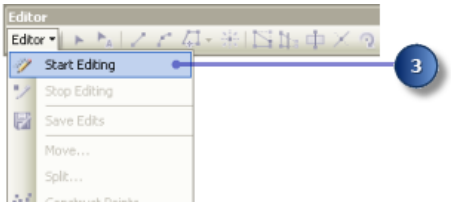
1. Click the **Editor Toolbar** button to add the Editor toolbar to ArcMap.



2. Click the **Editor** menu, point to **More Editing Tools**, then click **Route Editing**.



3. Click the **Editor** menu and click **Start Editing**.



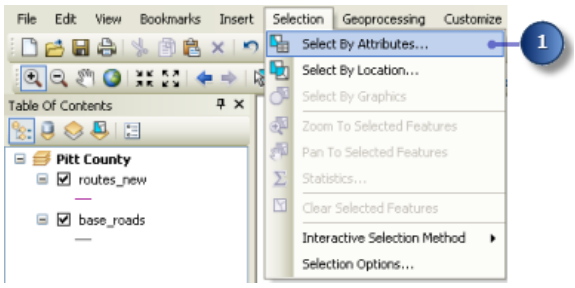
Making a route from selected features

The highway authority has been informed that it will now be responsible for maintaining a road that it previously had not been maintaining. It is necessary, therefore, to select the appropriate features from the base_roads feature class and make a route in the routes_new feature class out of them.

The Make Route command creates a new route in the target feature layer by merging a selected set of line features and setting the measure values. The selected line features do not need to be from the target feature layer.

Steps:

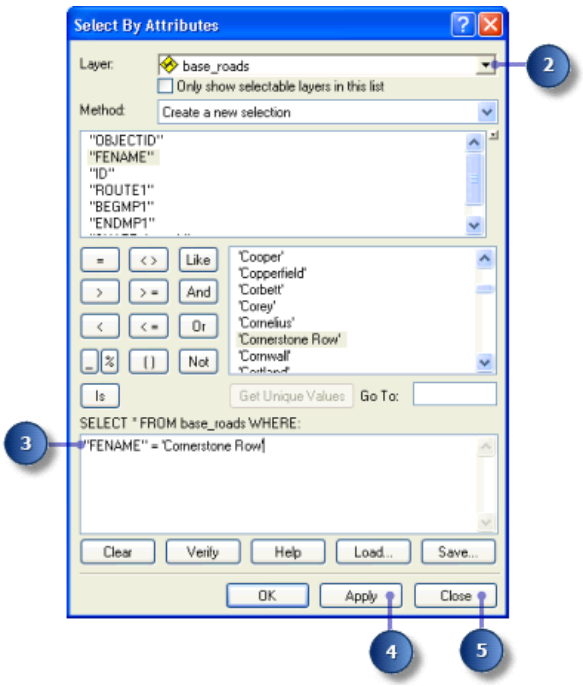
1. Click **Selection** on the Main menu and click **Select By Attributes**.



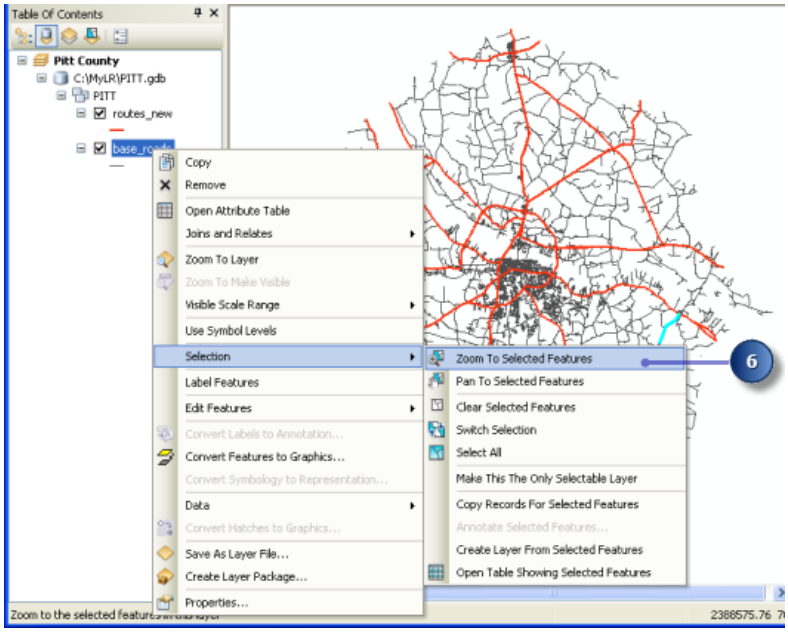
2. Click the **Layer** drop-down arrow and click **base_roads**.
3. Type the following in the text box: `"FENAME" = 'Cornerstone Row'`.

Tip: If you are clicking in the field boxes to build the expression, you may need to click **Complete List**, under **Unique sample values**.

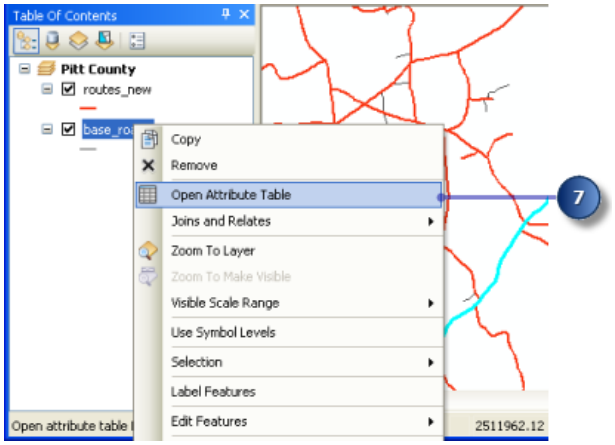
4. Click **Apply**.



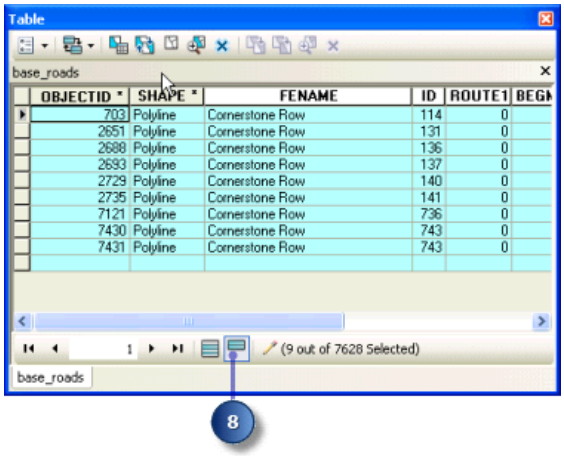
5. Click **Close**.
   Nine features from the base_roads feature layer are now selected.
6. Right-click the base_roads layer in the table of contents, point to **Selection**, then click **Zoom To Selected Features**.



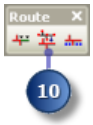
7. Right-click the base_roads feature layer and click **Open Attribute Table**.



8. Click the **Show Selected Records** button to show only the selected records.
   You can also see the total number of selected records shown along the bottom of this window.



9. Close the Attributes table.
10. Click the **Make Route** button on the ***Route Editing toolbar***.

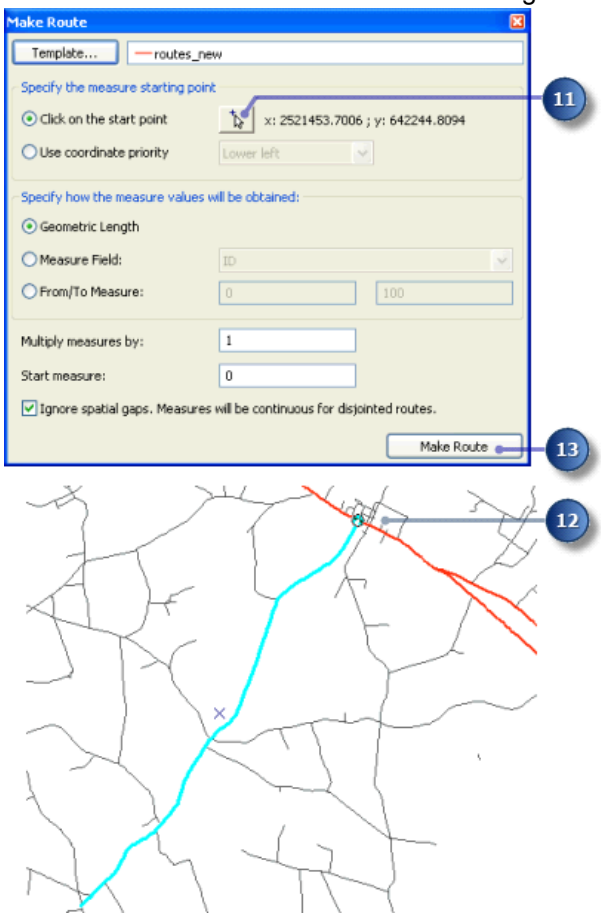


    Notice routes_new is automatically specified as the feature template, because it is the only route feature class in the map. Had there been multiple route feature classes in the map, you could specify the appropriate template. Feature templates define all the information required to create a new feature: the layer where a feature will be stored and the attributes new features will be created with.

11. Click the **Start Point** button.
    The ***Make Route*** dialog box changes and lets you know you need to pick a route starting point.
12. Click the map near the upperright corner of the selected set of features. This is where the output route's measures will begin.

The program tries to assist you by circling the endpoint it will select. As you move your pointer along the route, this point can change. This is useful because you do not need to select the exact spot on the route; just click on the display when the correct location is circled.

13. Click **Make Route** on the ***Make Route*** dialog box.



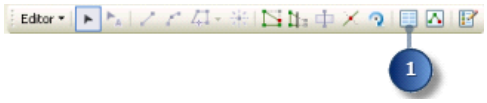
The new route flashes when it is being created. During the route creation process, the selected lines are deselected and the new route is selected. This is so you can set the new route's attributes.

Setting the route identifier

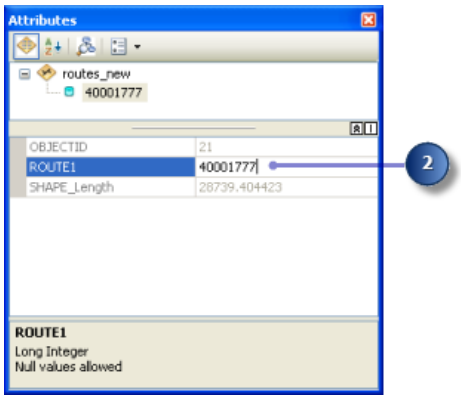
Because the newly created route is selected, you can now set the route identifier. The route identifier uniquely identifies each route.

Steps:

1. Click the **Attributes** button on the ***Editor*** toolbar.



2. Click the **ROUTE1** value and type `40001777`.



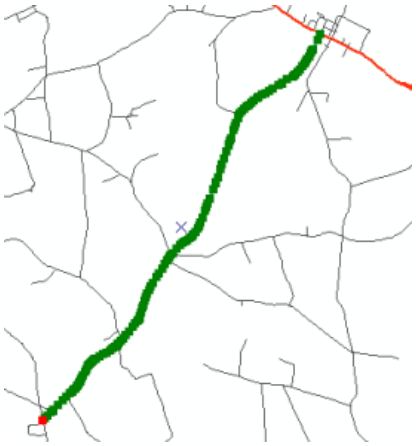
3. Press ENTER on your keyboard.
4. Close the ***Attributes*** window.

Converting route measure units

When you created the new route, you accepted the default method for setting the route measures. This method accumulates the geometric length of the input line features and uses the length as the measure. Because the coordinate system of the feature class is state plane feet, the measures on the new route are in feet. However, the measures on all other routes in the feature class are in miles.

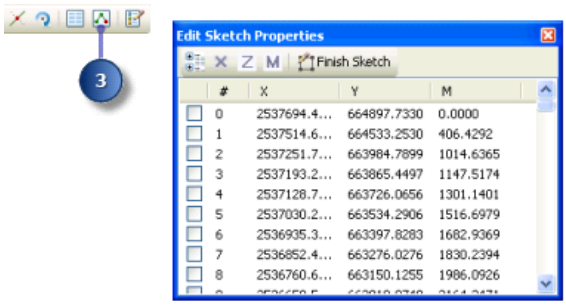
Steps:

1. The newly created route should still be selected. If it is not, select it.
2. Double-click the selected route feature.
   The selected feature will now be loaded into the edit sketch.

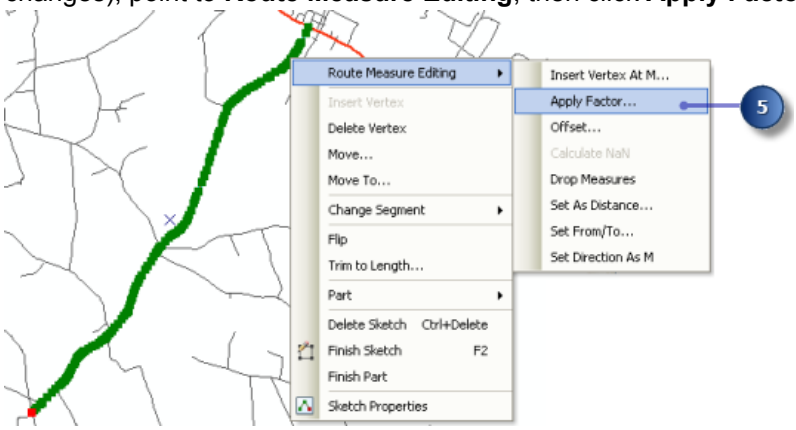


3. Click the **Sketch Properties** button.
   The ***Edit Sketch Properties*** opens.

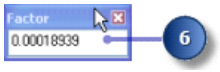
Note the size of the measure values (in column M).



4. Close the ***Edit Sketch Properties*** window.
5. Right-click anywhere over the edit sketch (you know you are over the line when the pointer changes), point to **Route Measure Editing**, then click **Apply Factor**.



6. Type `0.00018939` in the **Factor** text box and press ENTER on the keyboard.
   This converts feet to miles.



   At this point, you have only made changes to the edit sketch, not the route feature.

7. Press F2 to finish the edit sketch. Alternatively, right-click anywhere over the edit sketch and click **Finish Sketch**.

Your route measures are now in miles. You can verify this by double-clicking the selected route to bring it into the edit sketch, right-clicking anywhere over the sketch, then clicking **Sketch Properties**. Note that this is an alternate way to perform steps 2 and 3.

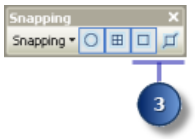
Recalibrating a route

So far in this exercise, you have created a route and transformed its measures from feet to miles. Imagine that at some point the maintenance crew went out into the field and recorded the actual mileage for this new route. The mileage was captured every time the new route intersected with another route from the same feature class. In this section of the exercise, you will recalibrate the newly created route based on this mileage information.

Steps:

1. The newly created route should still be selected. If it is not, select it.

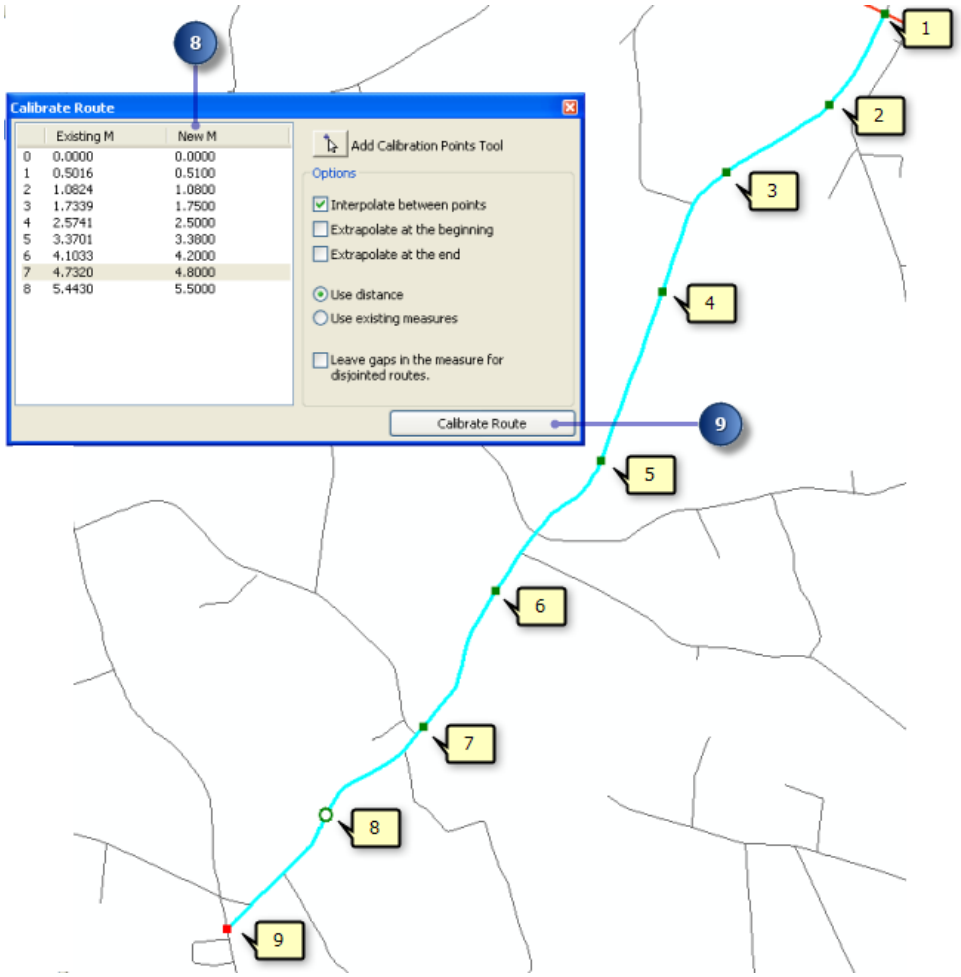
2. Click the **Editor** drop-down arrow and click **Snapping** > **Snapping Toolbar**.
   This Snapping toolbar is now visible.
3. Ensure that vertex snapping is enabled and edge snapping is disabled.



4. Close the ***Snapping*** toolbar. It will not be used again in this exercise.

   With the snapping environment set, you will be able to create calibration points that are snapped to the end vertex of the features in the routes_new layer, thereby ensuring accuracy of the route measures at the calibration points. Setting the snapping environment, however, is not necessary for the Calibrate Route tool to work.

5. Click the **Calibrate Route** button on the ***Route Editing*** toolbar.
   The ***Calibrate Route*** dialog box is now on the screen, but it is empty. Your next task is to digitize the calibration points.
6. With the ***Calibrate Route*** dialog box open, click the **Add Calibration Points**tool.
7. Click along the route at nine different places to create the calibration points. The locations of the calibration points are indicated in the graphic below.
8. Enter the new m-values (see values in graphic below) for each calibration point by clicking each value in the column and typing the new value.
9. Click **Calibrate Route**.

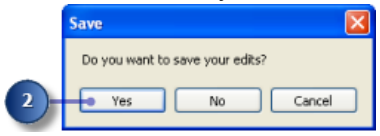


Saving your edits

Once you have completed the steps in this exercise, you can choose to save or discard your edits by stopping the edit session.

Steps:

1. Click the **Editor** menu and click **Stop Editing**.
2. Click **Yes** to save your edits.



In this exercise, you first learned how to create a route from a selected set of line features. Next, you converted the route measures from feet to miles. Last, you learned how to recalibrate a route using calibration points you digitized on the map.