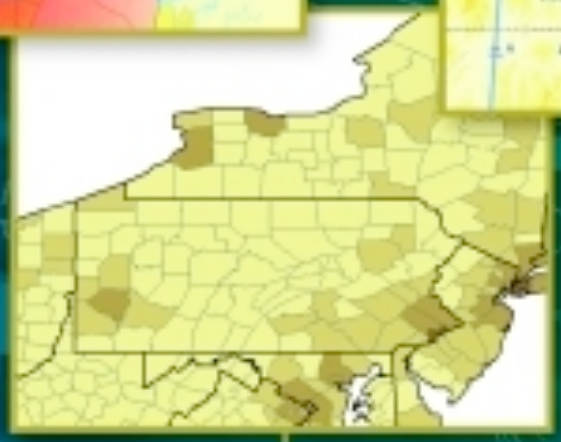
GIS Tutorial

Quick Reference Guide



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for ENGL 379c

Table of Contents

1. Introduction

This quick reference guide is a companion volume to GIS Tutorial: Workbook for ArcView 9, and is organized similarly to the workbook, with the added features of indexing and searchability.

The Workbook and Quick Reference Guide are designed to aid the user in familiarizing themselves with the basic functionality of ESRI ArcMap and illustrate the fundamentals of GIS.

Maps in ArcMap consist of layers and underlying feature attribute data tables (for example: for states, cities, counties, streets, streams, and rivers). Layers are made up of geographic features consisting of points, lines, and polygons, and each geographic feature has a corresponding data record.

Conventions used in this Reference Guide:

- Corresponding page numbers in the Workbook are indicated in [ ] after the section heading.
- Menu-driven actions are represented in 14-point Lucida Console in red, with arrows showing the flow of menu action. For example: `File-> Save As`.
- Other actions, such as clicking on a tool or a context menu for a map part, are distinguished by dark-grey 14-point Lucida Console text with a very light grey highlighting. For Example: `Properties`
- Titles of specific tools or windows are capitalized. For example: Table of Contents, or Attribute Table.
- Text that refers to a specific action in the Workbook is *italicized*.
- Particularly important information may be **bolded**.

Launch ArcMap [2]

If you have a standard installation of ArcMap: From the Windows taskbar, click `Start-> All Programs-> ArcGIS-> ArcMap`.

Open an existing map [3]

After launching ArcMap: In the resulting ArcMap dialog window, click the radio button next to `An existing map` radio button and click `OK`.

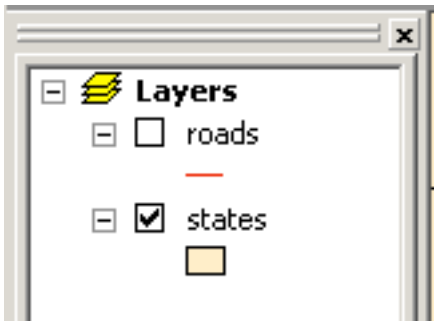
Browse to the drive and directory where the .mxd file is located, highlight the file name, and click `Open`. *For this example in the workbook, open Tutorial1-1.mxd*

Open a new map

After launching ArcMap: In the resulting ArcMap dialog window, click the radio button next to `A new empty map` and then click `OK`.

Map layers [4]

Map layers are references to data sources such as point, line, and polygon shapefiles; geodatabase feature classes; raster images; and so forth, representing spatial features that can be displayed on a map. The layers are referenced in the Table of Contents, which is situated to the left of the map display, and looks like this:



Turn a layer on [4]

Click the small empty check box to the left of the layer name in the Table of Contents to turn that layer on.

Map layers continued [5]

Turn a layer off [4]

Click the checked box to the left of the layer name in the Table of Contents to turn that layer off.

Add a layer [5]

Click the Add Data button.  In the Add Data browser dialog, browse to the location of the data file you wish to add, highlight the file, and click `Add`.

Change a layer's display order [6]

ArcMap draws layers from the bottom up. The topmost layer will obscure the layers underneath if they overlap.

In the map's Table of Contents, click and hold down the left mouse button on the name of the layer you wish to move. Drag the layer over or under another layer.

Change a layer's color [7]

Click the legend symbol for the layer. The legend symbol is the rectangle below the layer name in the Table of Contents. In the resulting Symbol Selector window, click the `Fill Color` button in the Options section of the Symbol Selector dialog box. Select a new color, and click `OK`.

Change a layer's outline color [8]

Click the legend symbol for the layer. In the resulting Symbol Selector window, click `Outline Color` in the Options section. Select a new color, and click `OK`.

Tools menu [3]

If you do not see the Tools menu, click `View-> Toolbars-> Tools` to make it visible.

Your tools menu may be free-floating on your screen or may be docked someplace on the interface. To anchor the Tools menu, click in its top area, dragging it to a side of the map display window and releasing when you see a thin rectangle outline materialize.

Zoom and pan [9]

Zooming and panning enlarges or reduces the display and shifts the display to reveal different areas of the map. The zoom and pan buttons are found on the Tools menu.

Zoom In [9]

The Zoom In button is found on the left of the Tools menu bar. Click the Zoom In button. 

There are two ways to zoom in:

- Click and hold down the mouse button above and to the left of the area you wish to zoom to; then drag the mouse below and to the right of the area you wish to zoom to, and release the mouse button.
- Click once on the screen to zoom in to an area centered on the point you clicked.

Fixed Zoom In [9]

The Fixed Zoom In button  has four arrows pointing from each of the corners of the button to the center of the button.

Clicking the Fixed Zoom In button zooms in a fixed distance on the center of the current display.

Zoom Out [10]

The Zoom Out button  is next to the Zoom In button.

Click the Zoom Out button, then click once on the map to zoom out from the point you clicked.

Fixed Zoom Out [10]

The Fixed Zoom Out button  has arrows pointing from the center of the button to each of the four corners.

Clicking the Fixed Zoom Out button zooms out a fixed distance from the center of the current display.

Zoom and Pan continued [10]

Pan [10]

Panning shifts the current display in any direction without changing the current scale. The pan button  has an icon of a hand on it. To pan:

- Click the Pan button
- Move the cursor anywhere on the map display.
- Hold down the left mouse button and drag the mouse in any direction.
- Release the mouse button.

Zoom to Full Extent [10]

Clicking Zoom to Full Extent  zooms to a full display of all layers, regardless of whether they are turned on or turned off. The Zoom to Full Extent button has an icon of the earth on it.

Zoom to the Previous Extent [11]

The Zoom to the Previous Extent button  consists of an arrow pointing to the left. This button returns the display to its previous extent. Continue to click this button to step back through the views. If the arrow is greyed out, it is not possible to step back any farther.

Zoom to the Next Extent [11]

The Zoom to Next Extent button  , an arrow pointing to the right, moves forward through the sequence of zoomed extents you have just viewed. You can continue to click this button until you reach the most recently viewed extent. If the arrow is greyed out, you are at the most recent extent.

Magnifier window [12]

The magnifier window adjusts the map display to see more detail or get an overview of an area. This window works like a magnifying glass: as you pass the window over the map display, you see a magnified view of the location under the window. Moving the window does not affect the current map display.

Opening the magnifier [12]

Click `Window-> Magnifier`. A magnifier window will open over the map. Drag the magnifier over an area of the map to see crosshairs for area selection and then release to see zoomed details.

Magnifier properties [13]

Right-click the title bar of the magnifier window, and click `Properties…`

You can now change the Connection properties between Live Update and Snapshot, and the Zoom percentage or scale. After making changes, click `OK`.

Overview window [14]

The overview window shows the full extent of the layers in a map. A red box shows the area currently zoomed to. You can move the red box to pan the map display. You can also make the red box lager or smaller to zoom the map display in or out.

Opening the Overview window [14]

Click `Window-> Overview`.

Spatial bookmarks [16]

Spatial bookmarks save the extent of a map display or a geographic location so you can return to it without having to use the Pan or Zoom tools. To save a bookmark for your current location/extent: click `View-> Bookmarks-> Create`. Type an appropriate name in the text box, and click `OK`.

To return to a spatial bookmark named "Foo": click `View-> Bookmarks-> Foo`.

Measuring distances [17]

The Measure Tool  is located in the Tools menu bar. When you measure distances with the Measure Tool, the resulting segment and total distances are displayed in the status bar on the on bottom left corner of the ArcMap window.

Measure distance [17]

Click the Measure Tool. Click once where you wish to begin measuring, and drag the mouse to the endpoint of what you wish to measure. Click once to create a segment endpoint and continue measuring, or double-click to create a final endpoint.

Change distance units [18]

Click `View-> Data Frame Properties`. Select the `General` tab. In the Units section, change the Display units to your preferred units, and click `OK`.

Identify features [19]

To display the data attributes of a map feature, activate the Identify Tool  by clicking once on the Identify Tool icon in the Tools menu bar. Then click on any feature in the map. By default, ArcMap will identify the features in the layer at the top of the Table of Contents first. Hold down Shift to select multiple features.

Identify actions [19]

By right-clicking the name of the feature in the left-hand frame of the Identify Results window, you can perform the following actions:

- `Set Bookmark`
- `Add Hyperlink`
- `Manage Hyperlinks`

Restricting Identify Results [21]

Click the `Layers` drop-down list in the Identify Results window, and select a layer or series of layers. ArcMap will then only identify features in those specified layers.

Selecting features [22]

Selecting features identifies the features on which you want to perform certain operations. For example, before you move, delete, or copy a feature, you must select it. Selected features also appear highlighted in the layer's Attribute Table and in the map.

Select button [22]

Click the Select Features button  on the Tools bar, and then click inside any feature on the map. The feature will be highlighted with a thick, bright blue line.

Selecting multiple features [22]

Hold down the Shift key and click inside multiple features. All of the selected features will be highlighted with a thick, bright blue line.

Clearing selected features [23]

Click `Selection-> Clear Selected Features`, or click **once** anywhere outside the features on the map.

Selection Color [23]

To change the color you want to use to outline selected features, click `Selection-> Options`, then click on the color box on the Selection Color section and pick a new color. Click OK.

Changing selection symbol [24]

Right-click the target layer in the Table of Contents. Click `Properties`. The resulting Layer Properties window is one you will use quite often. (Another way to open the Layer Properties window is to double-click the layer name.)

Click the `Selection` tab, and then pick a new symbol and/or color for the point features. Click `OK`.

Selectable layers [25]

Making a layer selectable allows features to be selected via the Select Features tool, Select by Graphics, Find tool, and so forth.

Click `Selection-> Set Selectable Layers`

Find features [26]

The find tool is used to locate features in a layer or layers based on their attribute values. You can also use this tool to select, flash, zoom to, bookmark, identify, or unselect the feature in question.

From the Tools menu bar, click the Find button  (an icon of binoculars). In the resulting dialog window, type in the name of the attribute you'd like to find, and specify the layers if needed. Click `Find`. The matching object will appear in the results frame of the Find dialog box. Right-click a row to show the context menu for that row.

Feature Attribute Tables [28]

Tabular attribute data associated with map features can be viewed via the layer's Attribute Table. To explore the attributes of a layer on a map, open its Attribute Table to select features and find features with particular attributes.

Open a table [28]

Right-click the selected layer in the Table of Contents. Click `Open Attribute Table`.

The table opens, containing one record for each feature.

Connection of layers and tables [29]

If a feature is selected on the map, it will also be selected in the Attribute Table. If a feature is selected in the Attribute Table it is also selected on the map.

Click on the grey box at the far left of the row you desire to select. The entire row will be highlighted if it is selected.

Show only selected records [29]

In the Attribute Table, click the `Selected` button to Show: Selected Records. This will change the table view to show only the records for the features selected in the map.

Feature Attribute Tables continued [30]

Clear selections [30]

To the right of the `Show Records` button, there is an `Options` drop down button. If you cannot see the options button, widen the Attribute Table window. Click on the `Options` drop-down and scroll down to `Clear Selection.` Click and release.

Select more than one record [30]

To select more than one record from the Attribute Table or from the map, hold the Ctrl key as you click once on the desired feature.

To select all records between two records: Click the first record. Scroll to the end of the desired list, and hold Shift down as you click the terminal record. The indicated records and all of the records between them are now selected.

Deselect a single record [30]

To deselect a single record or feature, hold down the Ctrl key as you click the record or feature.

Zoom to selected feature [31]

Click `View-> Zoom Data-> Zoom to Selected Features`.

Switch selections [31]

To deselect all of the currently selected records, while simultaneously selecting the currently unselected records (also known as *inverting the selection*), click the `Options` drop-down at the bottom of the Attributes Table, and click `Switch Selection`.

Sort a field [32]

In the Attributes Table, right-click any column name field. Among other options, you may choose `Sort Ascending` or `Sort Descending`.

Move a field [33]

To move a column in the Attribute Table, click the grey title of the column, and then drag the column to the left or right of another field and release.

Sort by multiple fields [33]

To sort by multiple fields: rearrange the table's fields so that two fields you wish use for the sort are next to each other. Make sure to place the field to be sorted first appears directly to the left of the second field. While holding down the Ctrl key, click the heading of the two fields you want to use to sort the records. Right-click the name of those fields and choose a sort order. When you sort, the selected fields will be in the sort order you chose.

Label features on the map [34]

Labels are text items that are dynamically placed and whose text value is derived from one or more feature attributes.

Set label properties [34]

Right-click the layer in the Table of Contents. Click `Properties`. Click the `Labels` tab. Click the `Label Field` drop-down arrow and select which field you wish to use to label features. Click `OK`.

(Alternatively: to open the Layer Properties window, double-click the layer name.)

Label features [34]

To turn on feature labels for that layer, Right-click the layer in the Table of Contents, and click Label Features. A checkmark will appear next to Label Features, and all of the features in that layer will be labeled.

Remove labels [35]

To turn off feature labeling for that layer, Right-click the layer in the Table of Contents, and click Label Features. The checkmark will be removed, and labeling will be turned off for that layer.

Convert labels to annotation [35]

Sometimes the labels are not placed quite as the cartographer would wish. When you convert labels to annotation, the labels are turned into text boxes that can be manipulated and moved and changed like other text boxes.

This can be done for:

- all features
- features in the current extant of the map
- currently selected features.

Right-click the layer in the Table of Contents, then click `Convert Labels to Annotation`. In the Store Annotation section of the Convert Labels to Annotation dialog window, select `In the map`. In the Convert Annotation For section, choose which labels you are converting, then click `Convert`.

Relative paths and saving maps [37]

When a layer is added to a map, the path name to the data is stored in the map, but the layer is not copied form its original location. When a map is opened, ArcMap locates the layer data it needs using these stored path names. If Arc Map cannot find the data for a layer, the layer will appear in the ArcMap Table of Contents but it won't be drawn. Instead, a red exclamation mark (**!**) will appear next to the layer name to indicate that it needs to be repaired.

Absolute path names [37]

An example of an absolute path is C:\Gistutorial\Tutorial1.mxd. To share maps saved with absolute paths, everyone who uses the map must either do so on the same computer or have the data on their computer in exactly the same folder structure (e.g. C:\Gistutorial). This is not conducive to a computer lab environment, as instructors, teaching assistants, and students all work on different machines. Instead the relative map option is favored.

Unless you change your preferences, **ArcMap defaults to absolute path names.**

Relative paths and saving maps continued [37]

Relative path names [37]

An example of a relative path is \Gistutorial\Tutorial1.mxd. Relative paths in a map specify the location of the layers relative to the current location on disk of the map document (.mxd file). Because relative paths do not contain drive letter names, they enable the map and its associated data to point to the same directory structure regardless of the drive the map resides on. If a project is moved to a new drive, ArcMap will still be able to find the maps and their data by traversing the relative paths.

For ease of copying, it is best if you place your data files in the directory your map is in before adding the layers to the map.

Saving layers as relative paths [37]

Click `File -> Map Properties-> Data Source Options.` In the Data Source Options dialog box, click the radio button next to `Store relative path names` and click `OK`. In the next dialog box, check the box next to `Make relative path names the default for all new maps`, and click `OK` again.

Save the project [38]

Saving your work session in ArcMap is referred to as saving your map. When you save your map, you save it to a map document file, which has a .mxd file extension. When working with ArcMAp you usually spend time setting properties that affect the look, feel, and functionality of your map and its layers.

Click `File-> Save As`.

Exit ArcMap [38]

Click `File-> Exit`.

Exercises [39]

Finding Statistics [39]

The Attributes Table has several calculations of statistics available. To perform this option, right-click the column title field and then click on `Statistics`. A dialog box appears with the statistics for that selected field. The statistics box displays the number of records in the table and the minimum, maximum, sum, mean, and standard deviation values. The frequency distribution chart represents the distribution of values graphically.

Exporting Fields

Fields can be exported from the Attribute Table. In the table, choose `Options` and then `Export`. Save the selected records to a .dbf file, which can then be opened in Microsoft Excel.

GIS Tutorial 2 Map Design [43]

This section addresses composing common maps from available map layers. One type of map is a chloropleth map that color-codes polygons to convey information about areas. Another is a "pin map" that uses point markers to display spatial patterns in point data. Both of these types of maps are common ways to display information of interest to demographers and policy makers.

Create choropleth maps [45]

A choropleth map is a map in which polygon areas are colored or shaded to represent attribute values.

Change a layer's name [46]

Layer names by default are the name of the file. File names tend to be short and compressed, and do not always provide useful information. As layer names are ultimately displayed in the Legend, it is important to change the layer name to be as clear and as informative as possible. Be sure to use appropriate capitalization and spacing.

Double-click the desired layer in the Table of Contents, and then click the `General` tab. Replace the current layer name. Click `OK`.

Alternatively, click once on the layer name itself, and wait for the text box to appear. Type in the new name.

Select an attribute to display [47]

Double-click the desired layer in the Table of Contents, and then click the `Symbology` tab. In the Show box to the left, click `Quantities` and then click `Graduated colors`. In the Fields section, click the `Value` drop-down list and choose the attribute to quantify and display. Click `OK`.

The default result is a single-color scheme that applies the Natural Breaks classification scheme. ArcMap picks an arbitrary color fill for the polygons. The colors and classifications can be changed.

Create group layers [48]

Group layers are layers that contain other layers, allowing for better organization of the layers in your map. Group layers have behavior similar to other layers in the Table of Contents. Turning off the visibility of a group layers turns off the visibility of all its component layers.

Add a group layer to the map [48]

Right-click Layers in the Table of Contents. Click `New Group Layer`. Right-click the resulting New Group Layer and click `Properties`. Click the `General` tab, and rename the group layer to something appropriate.

Add a layer to the group [49]

Click the `Group` tab in the `Group Layer Properties` window. Click the `Add` button. Navigate to the location of the shape files or layers that you wish to add. Select the items you wish to add. Click `OK`.

Change the symbology [50]

Click once on the legend symbol beneath the layers name. In the Symbol Selector's Options panel, you can change the Fill Color, change the Outline width, and change the Outline Color. Click `OK` when done.

Saving group layer files [53]

Right-click the group layer name, and click `Save As Layer File`. Navigate to the folder you wish to save the group layer in, and name it appropriately. Click `Save`.

The group layer file, once saved, can be added to any map you create.

Threshold scales for dynamic display [54]

If a layer is turned on in the Table of Contents, ArcMap will draw it, regardless of the map scale. To help you automatically display layers at an appropriate scale, you can set a layer's visible scale range and define the range of scales at which ArcMap draws the layer.

Threshold scales continued [55]

Set a minimum visible scale based on the current scale [54]

Zoom into a set of features. Right-click a layer in the Table of Contents, then click `Visible Scale Range, Set Minimum Scale`. . ArcMap will display this layer when zoomed in this close or closer. Zooming out any further will turn off the polygons for this layer.

Set a maximum scale based on the current scale [55]

Zoom into a set of features. Right-click a layer in the Table of Contents, then click `Visible Scale Range, Set Maximum Scale`. ArcMap will not will display this layer when zoomed in beyond this maximum scale just set. Zooming out will turn on the layer again.

Clear a layer's visible scale [56]

Right-click the layer name in the Table of Contents. Click `Visible Scale Range, Clear Scale Range`. The layer's contents are displayed again at all zoom layers.

Set a minimum or maximum visible scale [57]

Double-click the desired layer in the Table of Contents, then click the `General` tab of the Layer Properties window. In the Scale Range section, you can select the `Don't show layer when zoomed`: radio button to set the minimum and maximum scales in this section.

Create choropleth maps with custom attribute scales [59]

Earlier in the tutorial, you symbolized a layer with graduated colors using all of the ArcMap defaults. ArcMap automatically applies a classification method called Natural Breaks with 5 classes and applies a single-color scale, but you can choose other methods of classification.

Create custom classes in a legend [59]

Double-click the desired layer in the Table of Contents. In the Layer Properties window, click the `Symbology` tab. In the Classification section, click the `Classes` drop-down list and select the number of classes you wish to display in your map. Then click `Classify`.

The Classification dialog box shows the current classification, statistics and break values. Click the drop-down list for `Classification Method`. The following classification methods are available:

- Natural Breaks: This classification creates classes according to clusters and gaps in the data.
- Equal Interval: This classification creates classes of equal value ranges.
- Defined Interval: This classification is like equal interval, but the interval chosen determines the number of classes produced instead of the number of classes producing the interval.
- Quantile: This classification creates classes containing an equal number of features.
- Standard Deviation: This classification creates classes according to a specified number of standard deviation from the mean value.
- Manual Method: This classification allows the user to set their own preferred class breaks.

Choropleth maps continued [60]

Manually change class values [60]

To manually modify the break values, select `Manual Method` in the drop-down list. Then, click the individual values in the Break Values section of the Classification dialog box, and adjust them as you see fit. When you are done, click OK.

Change Symbology labels. [60]

In the Label field of the `Symbology` tab, click the individual values in the list. For example, you may wish to change the labels to whole numbers and useful ranges, like "0 to 100" and "200 or greater". These labels are what ArcMap applies to the Legend when one is inserted into the map, so it is important that the labels be as clear as possible.

When you are finished modifying the labels, click `OK`.

Then, save your layer as a layer file: Right-click the layer name in the Table of Contents and click `Save As Layer File`. Browse to the location you wish to save your layer files in, and click `Save`.

Manually change class colors and hues [62]

Color for classes can be changed manually. Generally, it is best to have more classes with light colors and a few with dark (the human eye can differentiate light colors more easily.

Double-click the layer name. In the Layer Properties window, click the `Symbology` tab. Right-click the color ramp and click `Properties`. Click the color box beside Color 1 and select a light color. Click the color box beside Color 2 and select a dark color, then click OK. Right-click the new color ramp again, and click Save to style, and name your new color ramp. Click OK, and then OK again. The map will change to reflect the new colors.

You can also double-click the color symbol next to each class to change the colors manually.

Pin (point) maps [63]

Pin maps, otherwise known as point maps, show exact locations of data or events using individual point markers for each record.

Create a graduated symbols pin map [63]

Graduated symbols are a good illustration of quantity at a specific point. Double-click the layer you wish to classify to open the Layer Properties window. Click the `Symbology` tab, and change the layer's symbology from `Single Symbol` to `Quantities, Graduated Symbols`.In the Fields section, change the `Value` to the attribute you wish to classify. Change the template symbol to a color that contrasts with the base of your map, and change the `Classification` to one that makes sense for your data set. When you are finished, click `OK`.

Create a pin map based on feature query [65]

Pin maps can be created by selecting a subset of features from an existing layer. For example, suppose you have a layer containing all the cities in Pennsylvania, but only want to display the cities with populations between 10,000 and 49,999. To display the correct cities, you can create a definition query to filter out all the cities with populations outside the desired range.

Display a queried subset [67]

Double-click the layer name in the Table of Contents, and then click the `Definition Query` tab. Click the `Query Builder` button. In the Query Builder window, double-click `"FEATURE"`, then click the `Get Unique Values` button. Next, click `"="` as the logical operator.

In the example case, the cities layer has population values expressed as ranges. In the Unique Values List, double-click '10,000 to 49,999'.

If a query has an error, just edit it in the lower panel of the Query Builder, or delete the query by clicking `Clear` and start over.

You can check that you have a valid query by clicking `Verify`. When your query is complete, click `Apply`, and then `OK`.

Add other queried data [69]

You may wish to display additional information from the layer. You will need to add another copy of the original layer to the map. (Click the Add Data button, and navigate to the location of the layer data.)

You can now build another query, and symbolize the new results differently.

In the tutorial, you are asked to search for the State Capital, and symbolize that with a star.

This illustrates an important feature of ArcMap: by default, ArcMap makes no changes to the source data files; the .mxd file specifies how ArcMap displays the information in each layer. So you can add the same data file repeatedly, displaying different information in each layer, without altering the source.

Create hyperlinks [71]

The Hyperlink tool allows access to documents or Web Pages by clicking features. There are three types of hyperlinks: documents, URLs, and macros.

Create a dynamic hyperlink [71]

Click the Identify button.  Click a feature. In the Identify Results window, right-click the feature name in the left panels and select `Add Hyperlink` from the context menu. Click the Link to a URL radio button and type in the full URL of the destination. Click `OK`, and then close the Identify Results window.

For the tutorial, you would type: http://www.harrisburg.com/

Launch the hyperlink [72]

Click the Hyperlink button in the Tools bar.  Make sure that the layer containing the feature you want to access is checked (visible) in the Table of Contents. Move the cursor over to the feature, and click the feature to go to the website.

Create MapTips [73]

When you hover your pointer over a feature on the map, it is possible to have an attribute of that feature automatically displayed as a MapTip. Double-click a layer in the Table of Contents, and click the `Fields` tab. Select the field you wish to be displayed. Click the `Display` tab, and check the box next to `Show MapTips`. Click `OK`.

View MapTips [73]

Click the `Select Features` button  in the Tools menu bar. Hover over any feature in the layer you selected to see the MapTip.

INDEX

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