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## ArcMap Basics: WPES, How Do I...? Quick Guide

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WPES, How Do I...?



*Quick Guide to*

ARCMAP BASICS

# WPES, How Do I...?

*Quick Guide to*

## **ArcMap Basics**

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for

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The “WPES, How Do I...?” series of instruction manuals were originally developed for internal use by the Watershed Process and Estuary Sustainability Research Group (WPES) at the University of Maine. They have been updated and published through DigitalCommons@UMaine to provide open access for academic use.

This document is formatted for print in booklet form on letter size paper.

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# Introduction

This document is a quick guide to performing common geospatial tasks in ArcMap 10.x (ArcGIS Desktop) for new users. In many cases, there are multiple ways to accomplish different tasks; presented here are the methods the author finds easiest or most straightforward. Mouse click sequences and menu/tool layout may differ if using previous versions of ArcMap. In-depth official documentation and help topics from Esri are available online at [desktop.arcgis.com/en/arcmap/latest/map](http://desktop.arcgis.com/en/arcmap/latest/map).

The University of Maine licenses ArcGIS from Esri for academic use by students and faculty. ArcGIS may be downloaded for student-owned computers at [umaine.edu/it/software/](http://umaine.edu/it/software/).


The “Maine Town and Townships Boundary Polygons Feature” (METWP24P) layer is used for illustration throughout this document. It can be obtained from the Maine GeoLibrary at [maine.gov/geolib/catalog.html](http://maine.gov/geolib/catalog.html).

# Basic Layout of ArcMap Window

## Map Window

This is where your spatial data will appear. The coordinates of your cursor in the Map Window's current projection / coordinate system are shown at the bottom right. Other windows such as the Table of Contents can be docked along the boundaries of the Map Window by clicking and holding their title bars and dragging them toward the desired location. Map Window properties, most importantly the coordinate system, can be changed by right-clicking in the Map Window and opening the "Data Frame Properties" dialog.

## Table of Contents

From this window you can open and close data layers and change the appearance of the map by changing the order of opened layers, turning visibility of layers on and off, and changing layer symbology. If this window is not showing, it can be opened from the Windows menu in the File Menu bar or by clicking its icon in the "Standard" toolbar. In Figure 1, the Table of Contents is in its default "List By Drawing Order"  view.

## Catalog

From this window you can connect to data folders on your hard drive and navigate currently connected folders. Data layers can be dragged and dropped from the Catalog into the Map Window or Table of Contents. If you delete a data file directly from the Catalog, it does not go to your computer's Recycle Bin and **cannot** be recovered. This window can be opened from the Windows menu in the File Menu bar or by clicking its icon in the "Standard" toolbar. In Figure 1, it has been docked on the right side of the Map Window and set to auto-hide by clicking the pin icon in its title bar.

## ArcToolbox

In this window you can access different toolboxes, collections of interactive tools for performing specific geospatial analyses and tasks. This window can be opened from the Geoprocessing menu in the File Menu bar or by clicking its icon in the "Standard" toolbar.

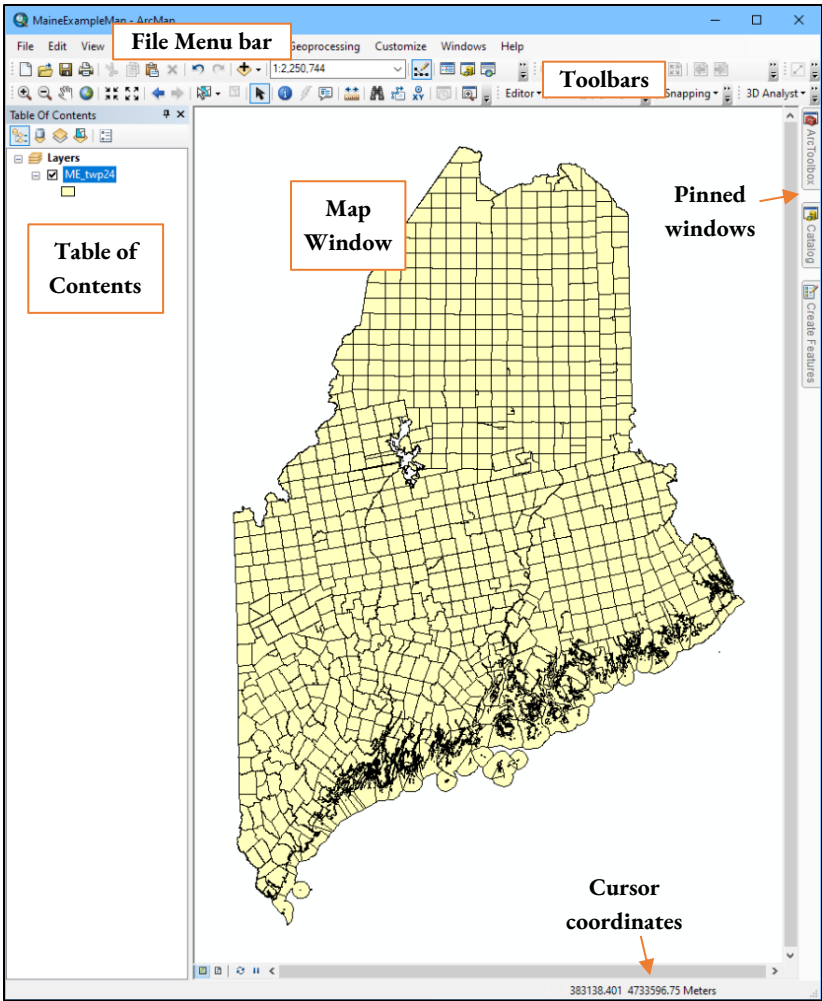



Figure 1. Labeled ArcMap window in Data View with one open data layer.

## Toolbars

Toolbars are collections of tools for performing general tasks in ArcMap. Toolbars can be turned on and off through the Customize menu in the File Menu bar or by right-clicking in the Toolbars area above the Map Window. The “Standard,” “Tools,” and “Editor” toolbars are generally the most important to have open for everyday tasks, and the “Layout” toolbar should be open when preparing map documents to print.





### Standard



Contains general tools related to opening and saving maps, undoing and redoing edits, adding data , and setting map cartographic scale, as well as icons to open other important toolbars and windows.


### Tools



Contains tools that work specifically with controlling the view of the map window, including zoom, pan, view full data extent, and previous/next view, as well fundamental tools for working with and exploring spatial data, particularly Select Features  (with dropdown arrow to change the mechanism of selection) and its opposite Clear Selected Features , Identify , which displays information about features or raster values, and the Measure  tool.

### Editor




Contains tools for directly editing vector features, most importantly the multipurpose Edit Tool .



# Importing and Opening Data

## Connecting to Folders

Unlike most programs, ArcMap has to be explicitly told to access a folder before data within it can be opened. When a folder has been connected, all of its subfolders will also be accessible; you may choose to connect directly to commonly used subfolders in order to reduce the amount of clicking through layers of subdirectories you must do when connecting to data.

1. Open “Connect To Folder”  dialog.


*Note: This can be accessed by clicking its icon in the Catalog window -or- through the Add Data dialog.*

2. Navigate to the data folder you wish to connect to.

*Note: The C: and D: (if applicable) drives will be under “This PC.”*

3. Click “OK.”

## Opening Spatial Data

Shapefiles<sup>A</sup> are the basic ArcGIS format for nontopological georeferenced vector data (points, lines, and polygons) and their associated attribute data. Raster<sup>B</sup> files are gridded representations of data such as aerial photos or the LiDAR-derived digital elevation models (DEMs) we commonly work with. Geodatabases<sup>C</sup>  are ArcGIS containers that can hold topological vector feature, raster, and tabular data.

1. Open “Add Data”  dialog.

*Note: This can be accessed by clicking its icon in the Standard toolbar -or- through the File menu under “Add Data” -or- by right-clicking the name of the active data frame (by default, this is “Layers”) in the Table of Contents.*

2. Use dropdown to navigate to folder/geodatabase containing your data.

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<sup>A</sup> [desktop.arcgis.com/en/arcmap/latest/manage-data/shapefiles/what-is-a-shapefile.htm](https://desktop.arcgis.com/en/arcmap/latest/manage-data/shapefiles/what-is-a-shapefile.htm)

<sup>B</sup> [desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/what-is-raster-data.htm](https://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/what-is-raster-data.htm)

<sup>C</sup> [desktop.arcgis.com/en/arcmap/latest/manage-data/geodatabases/what-is-a-geodatabase.htm](https://desktop.arcgis.com/en/arcmap/latest/manage-data/geodatabases/what-is-a-geodatabase.htm)

3. Click to select desired data file.

*Note: To select multiple individual files, hold CTRL while clicking each. To select range of files, click top file, hold SHIFT, and click bottom file.*

4. Click “Add.”

5. Data layer(s) will appear in Table of Contents and Map Window. To view attribute data for a layer, right-click layer name in Table of Contents and select “Open Attribute Table.”

*Note: Some raster datasets do not contain attribute tables. To access underlying gridded data for a raster, see [Exporting Raster Data](#) section.*

## Opening Tabular Data


Tabular<sup>D</sup> data files can be opened in ArcGIS even though they are not directly associated with spatial features. In cases where there are coordinate columns in the data (e.g., latitude and longitude or northing and easting), georeferenced spatial features can be created from the data.

### Opening Table from Text File

This method directly opens text files (including .csv) for viewing in ArcGIS.


1. Use “Add Data”  dialog to navigate to and select and add desired data file.

*Note: See [Opening Spatial Data](#) section.*

2. The table and its containing folder will appear in the “List By Source”  view in the Table of Contents. To view table data, right-click table name in Table of Contents and select “Open.”



### Opening Table from Excel File

Microsoft Excel spreadsheets can generally be opened using the same methods as text files (above), but may not always import correctly. Below is the more proper method for opening them.

1. Open “Excel to Table” tool in ArcToolbox .  
(ArcToolbox > Conversion Tools > Excel > Excel To Table)

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<sup>D</sup> [desktop.arcgis.com/en/arcmap/latest/manage-data/tables/what-are-tables-and-attribute-information.htm](http://desktop.arcgis.com/en/arcmap/latest/manage-data/tables/what-are-tables-and-attribute-information.htm)

2. For “Input Excel File,” browse  to location of file and click “Open.”
3. For “Output Table,” browse to or type in desired location for new table to be saved.
4. For “Sheet,” use dropdown to select desired sheet from workbook.
5. Click “OK.”
6. The table and its containing folder will appear in the “List By Source”  view in the Table of Contents. To view table data, right-click table name in Table of Contents and select “Open.”

### **Creating Points from Table**

1. Right-click table name in Table of Contents and select “Display XY Data...”
2. For “X Field,” select Easting or Longitude column (as appropriate) from dropdown menu.
3. For “Y Field,” select Northing or Latitude column.
4. For “Z Field,” select Elevation column if present, otherwise leave as “<None>.”
5. Select appropriate coordinate system for your data.  
*Note: See [Creating New Datasets](#) section.*
  - 5.1. Click “Edit...”
  - 5.2. Navigate through folder structure to coordinate system.
  - 5.3. Click “OK.”
6. Click “OK.”
7. A new point layer named “[YourTableName] Events” will appear in Table of Contents.
8. Save points in Events layer as new shapefile.

*Note: See [Exporting Data](#) section.*


# Querying Data

When working with data layers with many features/records, it can be helpful to be able to find and select records based on their attribute values or on the spatial location of the features rather than having to select each record manually.

## Querying by Attributes

1. Open Selection menu in the File Menu bar and click “Select By Attributes...”

*-or-*

With target layer’s attribute table open in “Table” window, click “Table Options”  and choose “Select by Attributes...”

2. In “Layer” dropdown, choose which layer to select records from.

*Note: If you opened Select By Attributes window from Table Options in Table window, this dropdown is unnecessary and does not appear.*

3. In “Method” dropdown, choose what type of selection should be made.

4. Enter query conditions in box under “SELECT \* FROM [LayerName] WHERE:”

*Note: The “Help” button below the text box provides a helpful rundown from Esri of how to format queries in more detail than is provided here.*

- 4.1. To enter a specific attribute column from the table into the query conditions box, double-click its name in the list below the “Method” dropdown.
- 4.2. To select an operator for the query, click its icon or type the appropriate symbol/word into the query conditions box.
- 4.3. To see a list of all attribute values that appear in a particular column within the table, single-click the column name to highlight it in the list below the “Method” dropdown and click “Get Unique Values” button.
- 4.4. To enter a specific unique value into the query conditions box, double-click its name in the list of unique values.

- 4.5. The simplest type of query selects all records that match a specific attribute value in a specific column, e.g.,

“COUNTY” = ‘Penobscot’

More complex queries may involve multiple values or conditions, such as

“COUNTY” IN (‘Penobscot’, ‘Aroostook’, ‘Piscataquis’)

or

“COUNTY” = ‘Penobscot’ AND “ShapeArea” < 100000

5. (Optional) Click “Verify” button to check whether query is valid.

*Note: Verification error messages are unfortunately not particularly verbose or helpful. “A column was specified that does not exist” may mean that double quotes were put around something other than a proper column name, but also may mean that a text string value was not enclosed in single quotes. “An invalid SQL statement was used” may indicate that a numeric value was enclosed in quotes, or may signify a mismatch between the data type of the specified column and the operator used, e.g., “COUNTY” > 100 will cause an error if County is a text attribute column rather than a numeric attribute column.*

6. Click “Apply” to run query.
7. When satisfied with query, click “OK” to close Select By Attributes dialog.
8. To create a new layer from a selection, right-click the source layer in the Table of Contents and choose “Selection” > “Create Layer from Selected Features.”

## Querying by Location

1. Open Selection menu in the File Menu bar and click “Select By Location...”
2. In “Selection method” dropdown, choose what type of selection should be made.
3. Under “Target layer(s),” check the boxes of all layers you wish to select features from.
4. In “Source layer” dropdown, choose the layer you wish to use as the basis or comparison against which to select from the target layer.


*Note: If the plain-language version of an intended query is “Select all towns within 25 km of Bangor,” the Target layer is the layer containing all towns, while the Source layer is a layer or selection containing only the city of Bangor.*

5. In “Spatial selection method for target layer feature(s)” dropdown, choose which measure of proximity the Target layer features should have to the Source features.
  - 5.1. For some selection measures such as “are within a distance of the source feature,” you must specify the search distance. For some other selection measures, applying a search distance is optional.
6. Click “Apply” to run query.
7. When satisfied with query, click “OK” to close Select By Location dialog.
8. To create a new layer from a selection, right-click the source layer in the Table of Contents and choose “Selection” > “Create Layer from Selected Features.”

## Editing Data

### Creating New Datasets

Users may use the Catalog to create new empty datasets in which they can add new data. Most commonly, these will be vector datasets to hold points, polylines, or polygons. If creating a raster or tabular dataset, some details may differ from the steps outlined below.

1. Open Catalog  window and navigate to folder in which you wish to create new dataset.
2. Right-click folder and select “New” > “Shapefile” to open “Create New Shapefile” dialog.

*Note: If working in a geodatabase, the equivalent is vector file type is “Feature Class.” Feature classes have a slightly more involved creation dialog but share with shapefiles the same three mandatory fields described below.*

3. Enter name for new layer.
4. Use dropdown to select feature type for new layer.
5. Click “Edit...” to open “Spatial Reference Properties” dialog.

- 5.1. Navigate through folder structure to select appropriate coordinate system<sup>E</sup>.

Latitude/Longitude:

- (Commonly) World Geodetic System (WGS) 1984 – *Geographic Coordinate Systems > World > WGS 1984*
- (Occasionally) North American Datum (NAD) 1983 – *Geographic Coordinate Systems > North America > USA and territories > NAD 1983*

Northing/Easting:

- (Commonly) Universal Transverse Mercator (UTM) projection (Zone 19 for Maine) – *Projected Coordinate Systems > UTM > NAD 1983 > NAD 1983 UTM Zone 19N*
- (Rarely) State Plane survey projection – *Projected Coordinate Systems > State Plane > NAD 1983 (Meters) > NAD 1983 Maine 2000 [East\Central\West] Zone (Meters)*  
*Note: If your state plane Northing/Easting coordinates are in feet, substitute “NAD 1983 (US Feet)” folder.*

- 5.2. Click “OK.”

6. Click “OK.”

7. Newly created layer will be added to Table of Contents and may be edited using steps in following section.

## Editing Vector Datasets

Spatial components of vector datasets (shapefiles and geodatabase feature datasets containing points, lines, or polygons) may be edited directly (e.g., by moving individual vertices) with the Editor toolbar. Additionally, more complex automated tasks can be performed using tools from the ArcToolbox, most of which output a separate new vector dataset at the end of the operation. Instructions for these tools are not included here, but several common operations can be explored within the “Analysis Tools” toolbox.

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<sup>E</sup> [desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm](https://desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm)






## Editor Toolbar

1. Ensure Editor toolbar is turned on/visible.
2. Open Snapping toolbar (“Editor” dropdown > “Snapping”) and set desired snapping behaviors.

*Note: Snapping allows nodes to be placed precisely coincident with existing vertices, intersections, and shape or line edges*

3. Right-click vector layer to be edited in Table of Contents and select “Edit Features” > “Start Editing.”

*Note: This makes all vector data layers in the same geodatabase or file folder editable. To avoid inadvertent edits to other layers, it can be helpful to turn them off in the Table of Contents.*


4. To manipulate vertices in existing features:
  - 4.1. Double-click feature using Edit Tool  to enter “Edit Vertices” mode.
  - 4.2. Use Edit Tool to select individual vertices by clicking or drag a bounding box to select multiple vertices.
  - 4.3. Click and hold on selected vertex and drag to reposition.
  - 4.4. Add  or Delete  vertices using tools in Edit Vertices toolbar.
  - 4.5. Click outside the feature to exit “Edit Vertices” mode.
5. To add new features:
  - 5.1. Open “Create Features”  editing window (“Editor” dropdown > “Editing Windows”).
  - 5.2. Click name of editable layer in “Templates” panel (top part of Create Features window).
  - 5.3. Click desired feature type in “Construction Tools” panel (bottom part of Create Features window).
  - 5.4. In Map Window, click each location where you wish to place a new feature vertex. To end a new line or polygon, double-click final vertex location.
6. To copy an existing feature into an editable layer:
  - 6.1. Select feature(s) with Edit Tool .



*Note: Feature to be copied may be in either an editable or non-editable layer.*


- 6.2. Right-click in Map Window and select “Copy” or use keyboard shortcut CTRL+C to copy feature.
- 6.3. Right-click in Map Window and select “Paste” or use keyboard shortcut CTRL+V to paste feature into editable layer.
  - 6.3.1. If there are multiple editable layers with the compatible feature type, select the correct layer from the “Target” list in the pop-up Paste dialog.
7. To combine multiple features in the same editable layer:

*Note: This option is only available with line and polygon features, not points.*

  - 7.1. Select features with Edit Tool .

*Note: Hold Shift key while clicking each.*

  - 7.2. Open “Editor” dropdown and select “Merge.”
  - 7.3. In “Merge” dialog, select feature into which the other feature(s) will be merged and click “OK.”


*Note: Attribute data for the target feature will be retained in the attribute table, while attribute data for the other input feature(s) will be lost.*
8. To undo an edit, click “Undo”  icon in Standard toolbar or use keyboard shortcut CTRL+Z.
9. To save edits at any point, open the “Editor” dropdown and select “Save Edits.”
10. When finished editing, open the “Editor” dropdown and select “Stop Editing.”

## Editing Raster Datasets


Raster datasets cannot be directly edited in ArcMap and must instead be manipulated using tools from the ArcToolbox, most of which output a separate new raster at the end of the operation. Following are instructions for two of the most common editing operations.

## Merging Rasters

Used for combining multiple adjacent rasters such as Digital Elevation Model (DEM) tiles, or for overwriting values in one raster with values from an overlapping raster.

1. Open “Mosaic to New Raster” tool – *Data Management Tools > Raster > Raster Dataset*
2. Use dropdown or browse  to select input rasters to be merged.
3. Browse to select output location and click “Add.”
4. Enter desired output dataset name and extension.

*Note: We most commonly use the TIFF format, extension “.tif”. If no extension is specified, output will be saved as a “File System Raster” if saved to a normal file system folder. Any output saved to a geodatabase will be saved as a “Geodatabase Raster Dataset;” specifying an extension may result in that extension alone being used as the file name.*

5. Browse  to desired spatial reference (coordinate system) for output.

*Note: Spatial references for data layers can be found in their Layer Properties under the “Source” tab. See also pg. 6, [Creating Points from Table](#).*

6. Use dropdown to select Pixel Type.

*Note: This value refers to the amount and type of data that can be stored as a cell value and should generally correspond to the largest pixel depth of the input rasters. Pixel depths for data layers can be found in their Layer Properties under the “Source” tab.*

7. Enter number of bands of data in raster output.

*Note: This is effectively the number of separate values each raster cell may hold, and may be no more than the minimum number of bands among the input rasters. For satellite imagery and other photo rasters, the number of bands is generally three or more (for Red, Green, Blue, and occasionally Gamma or other data), while elevation rasters generally have only one band.*

8. Use dropdown to set mosaic operator.


*Note: ArcMap defaults to “Last,” in which the value for any cell is taken from that of the last overlapping raster listed among the input rasters (step 2). For merging adjacent tiled rasters this is relatively unimportant, but*

when updating one raster with values from another the correct order is crucial.

9. Click “OK.”

## Clipping Raster

Used for cropping rasters to a specified extent using a bounding box or other spatial data layer.

1. Open “Clip” tool – *Data Management Tools > Raster > Raster Processing.*
2. Use dropdown or browse  to select input raster to be clipped.
3. Output extent may be specified in one of two ways:

- 3.1. Enter bounding coordinates directly in X and Y Minimum and Maximum boxes


*-or-*

- 3.2. Use dropdown or browse to select existing polygon layer to clip to.

*Note: If layer chosen from the dropdown has an active selection, the tool will clip to only the selected features, not the entire layer.*

- 3.2.1. Optionally, check “Use Input Features for Clipping Geometry” box.


*Note: If this box is not checked, the tool will populate the bounding coordinate boxes with the minimum bounding rectangle surrounding the polygon layer features and not clip to the edges of the polygon features.*

4. Browse  to desired output location.
  - 4.1. Enter desired output dataset name with extension.

*Note: We most commonly use the TIFF format, extension “.tif”. If no extension is specified, output will be saved as a “File System Raster” if saved to a normal file system folder. Any output saved to a geodatabase will be saved as a “Geodatabase Raster Dataset;” specifying an extension may result in that extension alone being used as the file name.*
  - 4.2. Click “Save.”
5. Click “OK.”

## Editing Tabular Data


ArcMap is inconsistent in the way it allows editing of tabular data, including attribute tables of vector and raster layers. Common operations are outlined below.

All operations begin with right-clicking layer or table name in Table of Contents and selecting “ Open [Attribute Table]” to open Table window.

*Note: Not all table types may be edited. Existing text (including .csv) and Excel files that have been opened for viewing in ArcMap through the Add Data dialog may not be edited; editable versions can be created by exporting the data (see [Exporting Tabular Datasets](#)).*

*Not all raster layers will have attribute tables.*

### Adding New Column

1. For this operation, table or layer must **not** be in an active edit session.
2. With table open in Table window, click “Table Options”  icon and click “Add Field...” to open Add Field dialog.
3. Enter name for new field.  
*Note: Column names are limited to ten characters in length.*
4. Use dropdown to select type of data the new column will hold.
5. Click “OK.”

### Deleting Column

1. For this operation, table or layer must **not** be in an active edit session.
2. With table open in Table window, right-click column to be deleted and click “Delete Field.”
3. If and only if you wish for the field and all its data to be **permanently and irretrievably** deleted, confirm deletion by clicking “Yes.”

## Adding New Row


*Note: New rows added to a feature layer through this method will be created without an associated spatial feature (point/line/polygon). The spatial feature can be added later (Editor Toolbar > Edit Vertices > Continue Feature Tool), but this is an uncommon workflow.*

1. Right-click table or layer to be edited in Table of Contents and select “Edit Features” > “Start Editing.”
2. With table open in Table window, scroll to blank row at bottom of table.
3. In blank row, click empty cell under non-keyword column (i.e., not “OBJECTID” or “FID”) and enter desired column attribute value for new record.
  - 3.1. Any other numeric fields in the row will auto-populate with “<Null>” (for tables saved in geodatabase) or “0”.
4. Continue entering attribute values for other columns in row.
5. To save edits at any point, open the “Editor” dropdown in Editor toolbar and select “Save Edits.”
6. When finished adding and populating new rows, open the “Editor” dropdown and select “Stop Editing.”

## Deleting Row


*Note: Deleting row in a feature layer will also delete associated spatial feature (point/line/polygon).*

1. Right-click table or layer to be edited in Table of Contents and select “Edit Features” > “Start Editing.”
2. With table open in Table window, select desired row by clicking box to left of first column.

*Note: To select multiple rows, hold CTRL key while clicking each, or to select a contiguous block of rows click the topmost selection, hold SHIFT, and click the bottommost.*
3. Click “Delete Selected”  icon.
4. To save edits at any point, open the “Editor” dropdown in Editor toolbar and select “Save Edits.”

5. When finished editing, open the “Editor” dropdown and select “Stop Editing.”

### Updating Single Cell Value

1. Right-click table or layer to be edited in Table of Contents and select “Edit Features” > “Start Editing.”
2. With table open in Table window, click cell you wish to edit.
3. Enter desired new value.
4. To undo an edit, click “Undo”  icon in Standard toolbar or use keyboard shortcut CTRL+Z.
5. To save edits at any point, open the “Editor” dropdown in Editor toolbar and select “Save Edits.”
6. When finished editing, open the “Editor” dropdown and select “Stop Editing.”

### Updating Column with Formula

Values for an entire column may be updated at once using a formula. This operation may be used to populate all rows in the column with a single value or with new unique values based on attributes in other columns (e.g. [Column\_A]+[Column\_B]-[Column\_C]). If there is an active selection in the table, updates will be applied **only** to selected records, not to all records in table.

1. For this operation, table or layer may or may not be in an active edit session.

*Note: If the table is currently editable, unwanted or erroneous column updates may be undone until editing session is ended. If operation is performed while table is not in an editing session any changes may not be reverted – any previous values are permanently lost.*

2. With table open in Table window, right-click name of column you wish to update and select “Field Calculator.”
3. In Field Calculator window, enter formula in “[ColumnName] =” text box.
  - 3.1. To incorporate values from another column, double-click column name in “Fields:” list.

- 3.2. Text strings must be enclosed in quotation marks.
4. Click “OK.”

## Updating Column with Geometry

*Note: This operation is available only for vector layers with spatial features.*

Values for an entire column may be updated at once based on feature geometry (e.g., point coordinates, line length, or shape area).

If there is an active selection in the table, updates will be applied **only** to selected records, not to all records in table.

1. For this operation, layer may or may not be in an active edit session.

*Note: If the layer is currently editable, unwanted or erroneous column updates may be undone until editing session is ended. If operation is performed while table is not in an editing session any changes may not be reverted – any previous values are permanently lost.*



2. With attribute table open in Table window, right-click name of column you wish to update and select “Calculate Geometry.”
3. In Calculate Geometry window, use “Property:” dropdown to select geometry attribute you wish to populate column with.
4. Use radio buttons to select which coordinate system to use for calculation.
5. Use “Units:” dropdown to select units for value calculation.
6. Click “OK.”

## Exporting Data

Exporting data is analogous to the “Save As...” function of many programs and is most often done to convert an existing data layer to a different format or to create a new file containing a subset of an existing dataset (e.g., a selection or query).

### Exporting Vector Datasets

1. Right-click vector layer to be exported in Table of Contents and select “Data” > “Export Data” to open Export Data dialog.


2. Use drop-down to choose whether to export all features in the layer, only selected features (if any selection is active), or only features currently within the visible area of the map window.  
*Note: Before entering the Export Data dialog, a subset of features may be selected manually using the Select Features  tool in the map window or through the Select by Location or Select by Attribute dialogs under the Selection menu in the File Menu bar.*
3. Use radio buttons to choose whether exported data will use coordinate system of the original dataset or that of the data frame.
4. Browse  to desired output location.
  - 4.1. Use dropdown to select output file type (most commonly Shapefile or File and Personal Geodatabase feature).  
*Note: Geodatabase feature classes may only be saved into geodatabases, while shapefiles may only be saved into normal file folders. Geodatabases will not appear in file tree if "Save as type" is set to Shapefile.*
  - 4.2. Enter desired file name.
  - 4.3. Click "Save."  
*Note: If an "Error Saving Object" pop-up message appears, ensure you are not trying to save a geodatabase feature class into a file folder.*
5. Click "OK."

## Exporting Raster Datasets

### As Spatially Referenced Raster



1. Right-click raster layer to be exported in Table of Contents and select "Data" > "Export Data" to open Export Data dialog.
2. Under "Extent," use radio buttons to select whether to export the entire raster dataset, only the portion currently showing in the data frame (map window), or only the portion within a selected graphic.  
*Note: The selected graphics (clipping) option requires the user to have drawn a polygon using the Draw toolbar. To clip rasters to features from an existing data layer, see [Editing Raster Datasets](#) section.*
3. Under "Spatial Reference," use radio buttons to choose whether exported data will use coordinate system of the original raster or that of the data frame.




4. (Uncommon) Under “Output Raster,” make desired changes to output cell size (in map units) and “NoData” (null cell) value.
5. Browse  to desired output location and click “Add.”
6. Use “Format” dropdown to select output file type.  
*Note: We most commonly use the TIFF format. If selected output file location is a geodatabase, output file format will be automatically set to File Geodatabase.*
7. Enter desired file name.
8. Click “Save.”

### Underlying Data Only


While many statistical analyses on raster datasets can be run directly in ArcMap using tools included in the ArcToolbox, it may be occasionally desirable to export only the underlying gridded data values from a raster for analysis outside of ArcGIS (e.g., in Python or R). Output file is a space-delimited ASCII text file with six header rows describing the data followed by a number of data rows equal to the number of rows in the raster image.

1. From ArcToolbox , open “Conversion Tools” > ”From Raster” > ”Raster to ASCII.”
2. Use dropdown or browse  to select input raster to be exported.
3. Browse to desired output location.
  - 3.1. Enter desired file name.
  - 3.2. Click “Save.”

### Exporting Tabular Datasets

1. Right-click table to be exported in “List By Source”  view of Table of Contents and select “Data” > “Export Data” to open Export Data dialog.

-or-

With table open in “Table” window, click “Table Options”  and select “Export.”

*Note: The latter allows you to export attribute tables, if present, from vector or raster layers without the accompanying spatial data.*

2. Under “Export,” use dropdown to choose whether to export all records in the table or only selected records (if a selection is active).

3. Browse  to desired output location.

- 3.1. Use dropdown to select output file.

*Note: Geodatabase tables may only be saved into geodatabases.*

*Geodatabases will not appear in file tree if “Save as type” is not set to geodatabase table type.*

- 3.2. Enter desired file name.


- 3.3. Click “Save.”

*Note: If an “Error Saving Object” pop-up message appears, ensure you are not trying to save a geodatabase table into a file folder.*

4. Click “OK.”

## Changing Map Appearance

### Changing Layer Order

Spatial data layers in the Map Window are drawn in order of appearance in the “List By Drawing Order”  view of the Table of Contents, with layers at the top of the list drawn above (overlying) those lower on the list.

Layers can be dragged and dropped in the desired order.

### Changing Layer Symbology

1. Right-click layer name in Table of Contents and select “Properties” to open Layer Properties dialog.
2. Click “Symbology” tab.
3. In “Show:” list at left, select type of symbology, then make desired adjustments.

*Note: See [Vector Layers](#) and [Raster Layers](#) below for explanation of most commonly used symbology types.*

4. To preview updated symbology, click “Apply.”
5. To finalize symbology change, click “OK.”

## Vector Layers

- “Features” displays all features in the layer with the same symbol. To change appearance of that symbol, click the symbol (to right) to open Symbol Selector and make desired style adjustments.
- “Categories” displays features with different symbology using categorical (qualitative) groupings based on unique values from one or more attribute columns specified under “Value Field.” Symbol color can be adjusted for each included value individually by clicking symbol or for all values using one of many preset Color Ramps.
- “Quantities” displays features in multiple ordered classes based on numeric values from an integer or float datatype attribute column specified under “Value” field. Data may be classified into equal intervals ( $\text{max} - \text{min} / \text{\#classes}$ ), defined intervals (e.g., by 5s), or other standard class type, or users can manually set break values between ranges.

## Raster Layers

- “Unique Values” displays cells with different colors based on unique cell values. This is appropriate for categorical (qualitative) data like land cover type. Cell color can be adjusted for each included value individually by clicking symbol or for all values using one of many preset Color Schemes.
- “Classified” displays cells in multiple ordered classes based on numeric cell values. Data may be classified into equal intervals ( $\text{max} - \text{min} / \text{\#classes}$ ), defined intervals (e.g., by 5s), or other standard class type, or users can manually set break values between ranges.
- “Stretched” displays cells with colors stretched along a color ramp (vs. in discrete classified ranges) based on numeric cell values. This is appropriate for continuously varying data fields such as digital elevation models. Distribution of values along the color ramp can be adjusted by changing “Stretch Type.”

## Changing Layer Transparency

Layers may be made semitransparent in order to allow underlying data to show through without entirely turning off the overlying layer.


1. Right-click layer name in Table of Contents and select “Properties” to open Layer Properties dialog.
2. Click “Display” tab.
3. Enter desired value in Transparency field.  
*Note: For vector layers, the field is labeled “Transparent.”*
4. Click “OK.”

## Preparing Print Maps

Users may need to prepare finished maps for print or for online display, such as for sharing visualized data with colleagues or stakeholders. An in-depth discussion of the philosophy and practice of effective cartographic design is beyond the scope of this manual,<sup>F</sup> but following is a basic overview of how to construct map layouts in ArcMap and the elements that should be included in most maps.

### Layout View

To this point, we have been working in ArcMap’s default “Data View.” Print maps are instead prepared in the Layout View, which is opened from the “View” menu in the File Menu bar.

The Layout View shows a stylized sheet of paper on which the map and other elements can be arranged. Elements can be selected, dragged and dropped, and resized using the Select Elements  tool in the Tools toolbar. A thin dashed line running just inside page border marks the edge of the printable area. To change paper orientation (landscape vs portrait) or size,

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<sup>F</sup> For a short primer on map design principles, see e.g. [esri.com/news/arcuser/0112/make-maps-people-want-to-look-at.html](http://esri.com/news/arcuser/0112/make-maps-people-want-to-look-at.html)

right-click in the white space just outside the page boundaries and select “Page and Print Setup.”

## **Adding Map Elements**

In addition to the spatial data visualization (i.e., the “map” itself), map layouts should carry certain other information to clarify and contextualize the map data. The elements below are added using the “Insert” menu in the File Menu bar. Other basic shapes and text can also be added to the layout using the Draw toolbar. In the included example map (Figure 2), map elements are arranged in white space within the borders of the map frame; when spatial data extends to the edges of the map frame it is often preferred to place elements in a separate bar above or below the map frame.

### **Title**

*Insert > Title or Insert > Text*

Maps should be given a concise title that conveys their main focus or purpose. A subtitle can be added as a second text element. Text can be changed and font updated by double-clicking text element or right-clicking element and selecting “Properties.”

### **North Arrow**

*Insert > North Arrow*

A north arrow allows the user to properly orient the map. This is particularly important on maps where north is not at the top of the page, in which case the north arrow should be rotated by the appropriate angle under “Properties” in the North Arrow Selector. If arrow is oriented to magnetic rather than true north, a separate text element to that effect should also be included adjacent to the arrow (this may be as simple as placing an “M” before the “N” of the arrow).

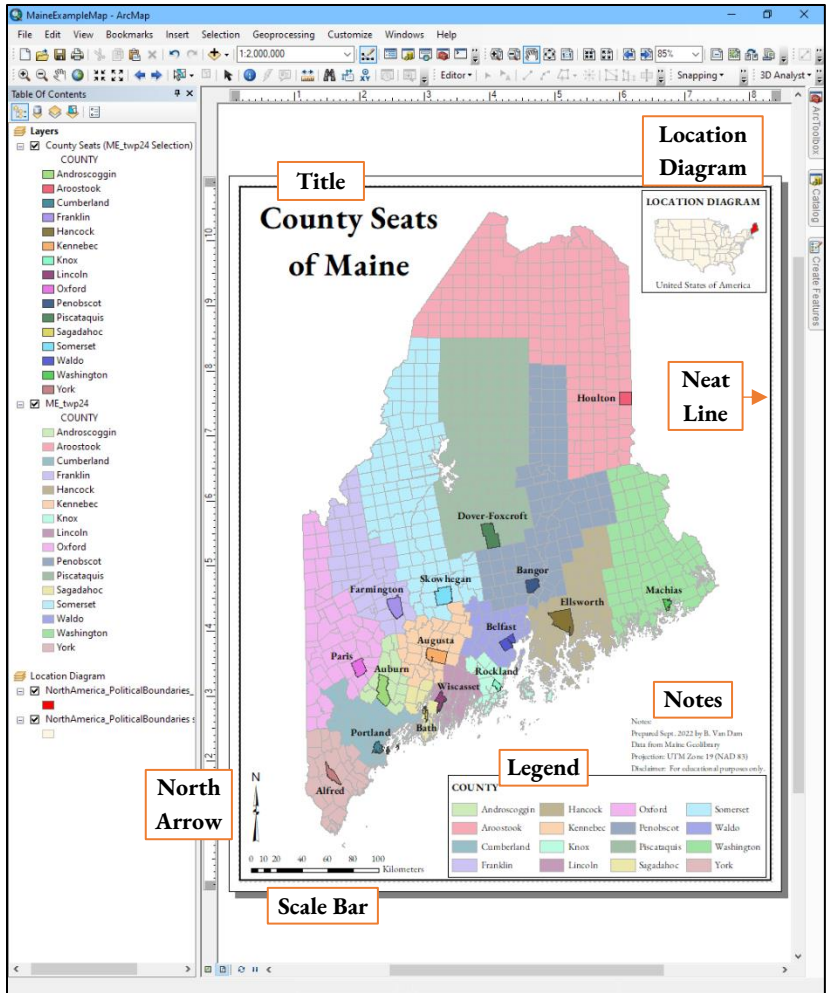


Figure 2. ArcMap window in Layout View showing a simple thematic (categorical symbology) map layout with important map elements labeled. When designing maps, consider their accessibility for different viewers – this example labels the county seats but relies on color to identify associated county names, making it less accessible to readers with certain types of colorblindness and those who are seeing a copy printed in grayscale (as some of you may be experiencing right now).

## Scale Bar

### *Insert > Scale Bar*

A scale bar provides a visual representation comparing units of distance in the real world to their corresponding representation on the page. Unlike scale text (“1:24,000,” “1 cm = 5 km,” etc.), a scale bar is accurate even when an image of the map layout is reproduced at a different size than the original (e.g., enlarged to fit on a poster or shrunk to fit in a booklet). Properties such as number of divisions, division length, bar height, and fonts can be customized from the Scale Bar Selector dialog.

If working with multiple map frames, the scale bar will correspond to whichever frame is active when the scale bar is inserted (see [Multiple Map Frames](#)). Be sure to activate the correct map frame before inserting a scale bar, and place the bar in a location that makes it clear which map it is associated with (often in a lower corner of the appropriate map frame).

## Legend

### *Insert > Legend*

Legends explain the symbology used in the map, making them perhaps the most important element to include in your layout. From within the Legend Wizard, you may choose which map layers to show in the legend, adjust their arrangement, and change fonts and other formatting. For an in-depth explanation of the extensive legend customization options, see Esri’s documentation<sup>G</sup>.

To change the way layer names and symbology labels appear in the legend, right-click layer name in the Table of Contents and select “Properties.” Layer Name may be updated in the “General” tab and symbol description may be updated in the “Symbology” tab under the “Label” field.

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<sup>G</sup> [desktop.arcgis.com/en/arcmap/latest/map/page-layouts/working-with-legends.htm](http://desktop.arcgis.com/en/arcmap/latest/map/page-layouts/working-with-legends.htm)

## Notes

*Insert > Text*

Maps should include some basic information about how they were produced, including cartographer name, production date, and sources if using data you did not produce yourself. For maps involving any type of spatial measurement, include the projection/datum the data are visualized in. For liability purposes it is also recommended to include a short disclaimer outlining intended uses and limitations of the map.

## Neat Line

*Insert > Neatline*



A neat line is a border enclosing the various map elements inside the layout margins. Neat lines are occasionally omitted for stylistic reasons, but generally give a more professional look to the layout.

## Location Diagram


*See Multiple Map Frames*

It is often useful to contextualize your spatial data by including an additional map frame that shows the location of your mapped area in relation to a more easily recognized boundary, such as a town, county, state, or country. If your map depicts an area or feature that your intended audience will recognize by sight (such as the State of Maine in Figure 2), the location diagram may not add useful context and is not strictly necessary.

## Multiple Map Frames

It is sometimes necessary or desirable to show multiple maps in the same layout, such as to include a location diagram or an inset map showing additional detail for a small area. A second map frame can be added via *File Menu bar > Insert >  Data Frame*. This will add a blank data frame (labeled “New Data Frame”) to the map layout and to the Table of Contents. Like the default data frame (labeled “Layers” in the Table of Contents), layers can be added using the Add Data  dialog and manipulated as described throughout this manual. Layers can also be dragged from one frame in to another, which maintains their symbology.



When working with multiple data frames, only one can be active for manipulation at a time. From the Layout View, simply click the desired data frame with the Select Elements  tool to activate it. If working in the Data View, right-click the data frame name in the Table of Contents and select “Activate.”

## **Exporting Finished Map**

Electronic versions of the map layout may be saved by opening the File menu in the File Menu bar and selecting “Export Map.” Outputs may be as a variety of image file format (e.g., PNG, BMP, etc.) or as a PDF.

Paper copies of the map layout may be printed by opening the File menu and selecting “Print.” The “Setup” option in the Print dialog allows the user to select a printer and choose print options as well as to print to PDF.