地理信息系统与遥感应用

第三讲 矢量数据处理

南方科技大学 · 环境科学与工程学院

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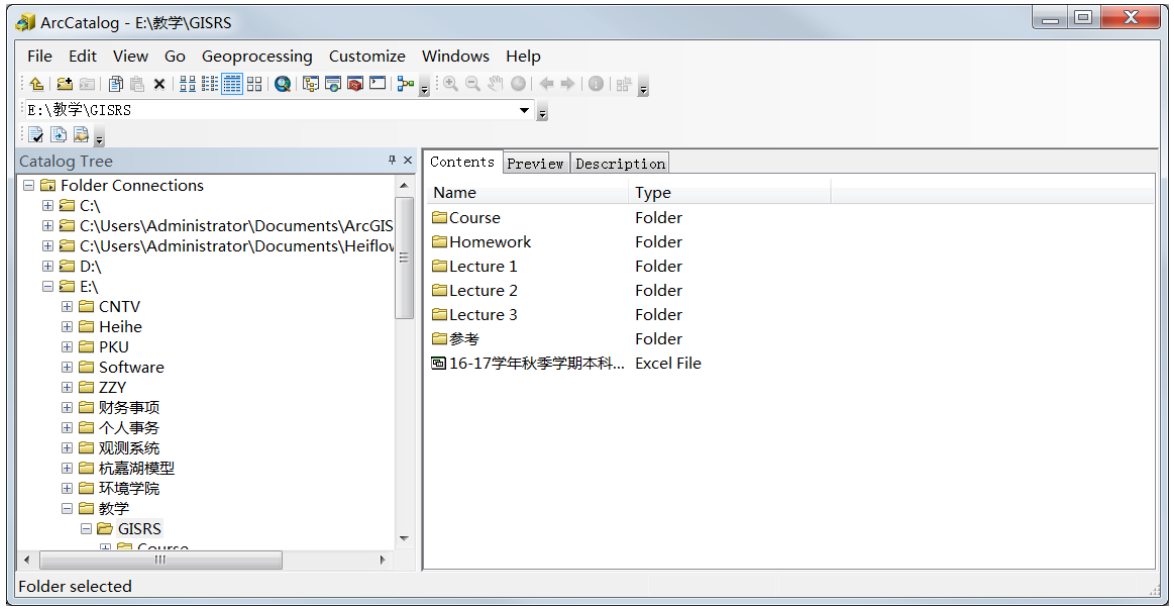
— Getting Started with ArcMap & ArcCatalog

ArcCatalog

- Copying and deleting GIS data sets in ArcCatalog
- Previewing geography and attribute tables
- Reading data documentation (metadata)



ArcCatalog is a useful way to manage your GIS data, and it offers access to metadata if the source agency has put the documentation into a format that ArcGIS can read. In many instances, you'll find metadata online or it may be in a text file that comes with your data set.

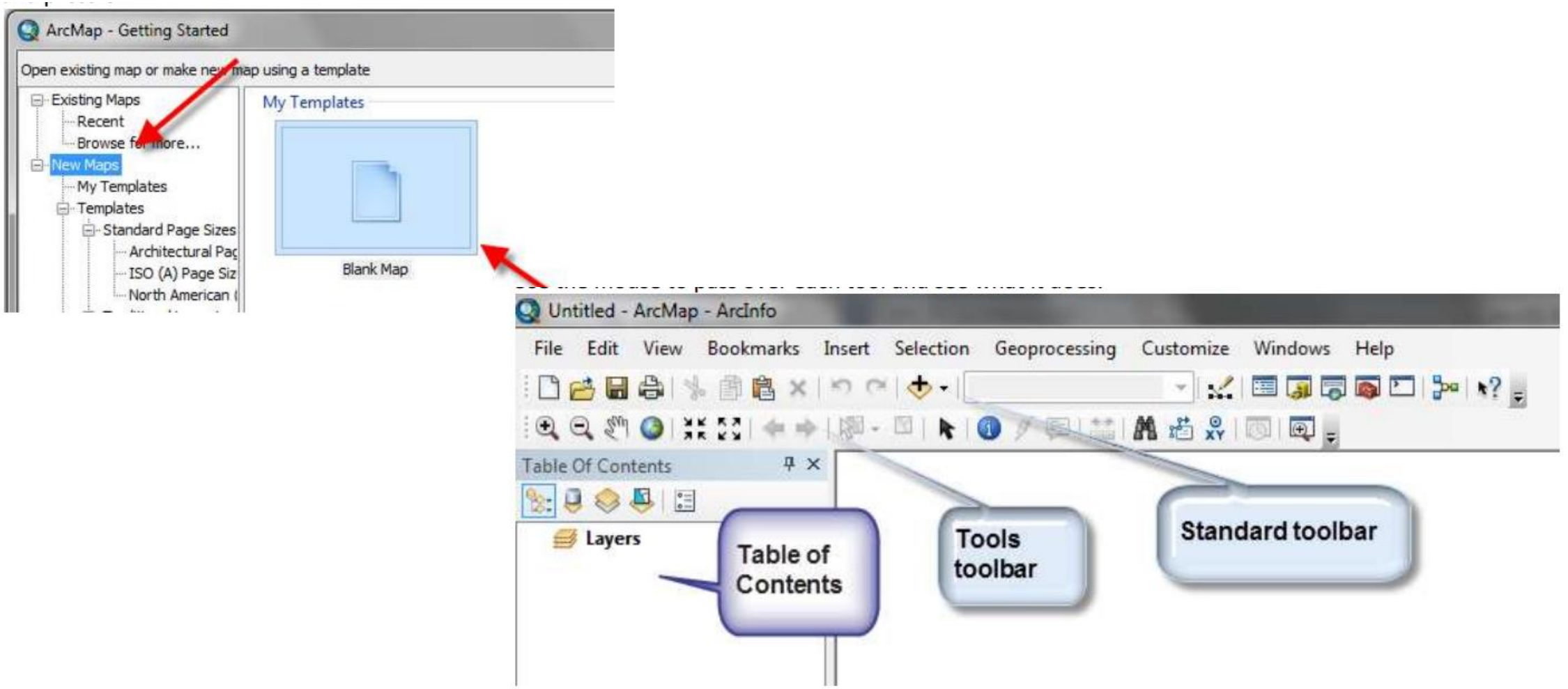
Common GIS File Types

- Geodatabase – The personal geodatabase, or geographic database, file is called the “modern container for GIS data” and is specific to ArcGIS. Geodatabases define, manage, process and store all the types of data that can be used in ArcGIS (i.e., feature, rasters, relationships, measurements, attributes, etc) inside either a Microsoft Access database (.mdb) or a full relational database (SQL Server, Oracle, Informix or DB2).
- Shapefiles – ArcGIS shapefile format is a widely adopted standard and comprises three or more associated files. Be careful copying this data to a disk. You must get all of the files associated with a single layer. They will have a variety of file extensions: .shp, .shx, .dbf and sometimes others. If you are copying shapefiles, we recommended that you use the ‘File’ > ‘Data’ > ‘Export Data’ function in ArcMap or through ArcCatalog. This will automatically copy all files associated with a layer. Also, be aware that some of these files may be very large in size.

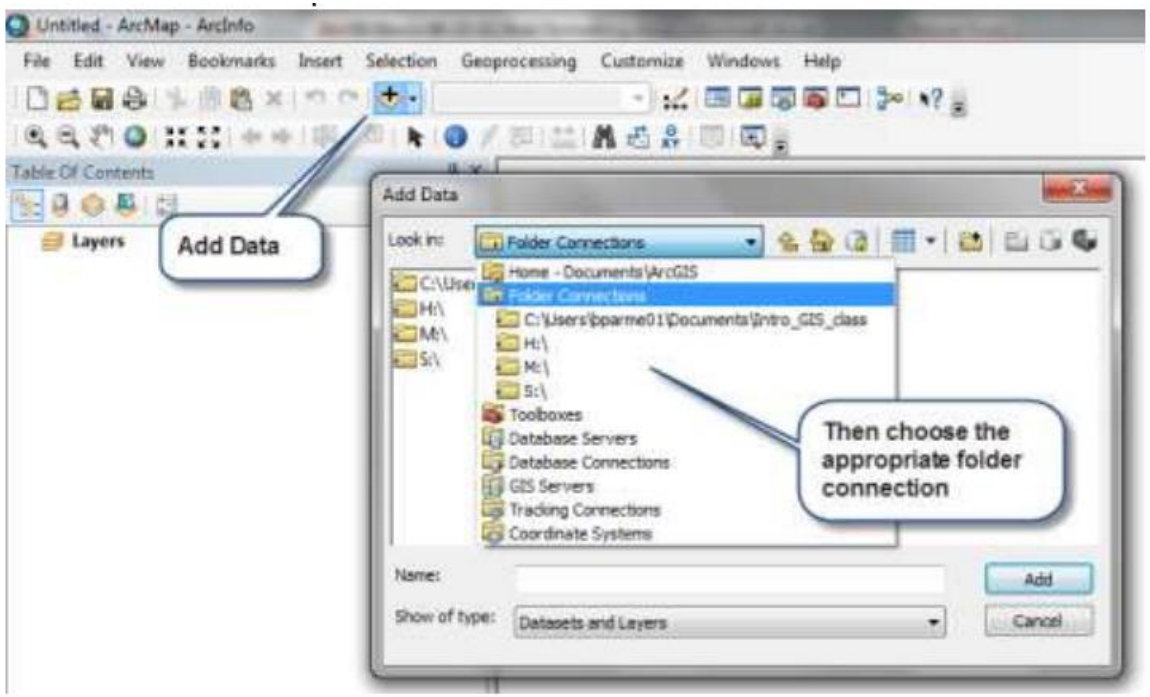
- Layer – According to ESRI, the layer file (.lyr) stores symbology, symbology classifications, labeling properties, scale dependency, and definition. If you save something in this format it means that, unlike shapefiles, colors and other characteristics are saved and will appear the same every time you open it.
- Coverages – “A coverage stores a set of thematically associated data considered to be a unit. It usually represents a single layer, such as soils, streams, roads, or land use. In a coverage, features are stored as both primary features (points, arcs, polygons) and secondary features (tics, links, annotation).” Source: ESRI Data Dictionary.
- CAD (computer-aided design) – “A computer-based system for the design, drafting, and display of graphical information.” Although most commonly used to support engineering, planning, and illustrating activities, these files can be used in a GIS. Source: ESRI Data Dictionary.
- Image formats – ArcGIS accepts and uses a variety of image files (.tiff, .jpg, .jp2, .png, etc). Text files (with x,y coordinates)
- Many others…

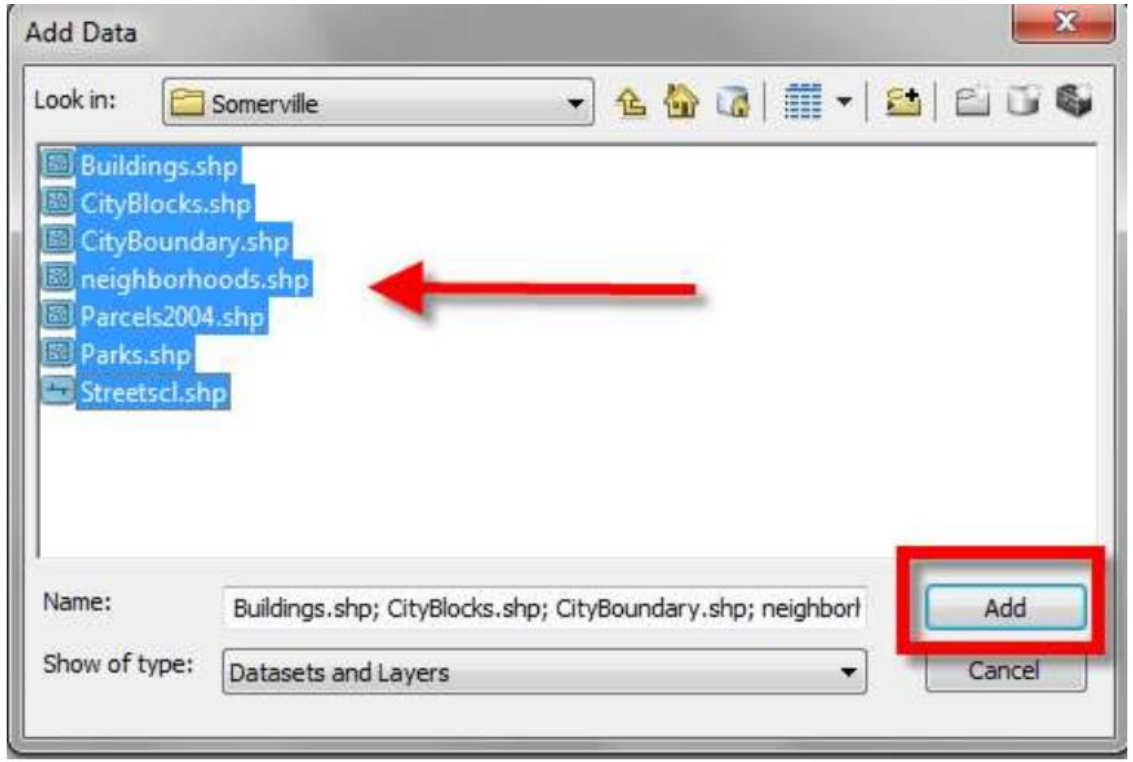
ArcMap

- **Create Map**

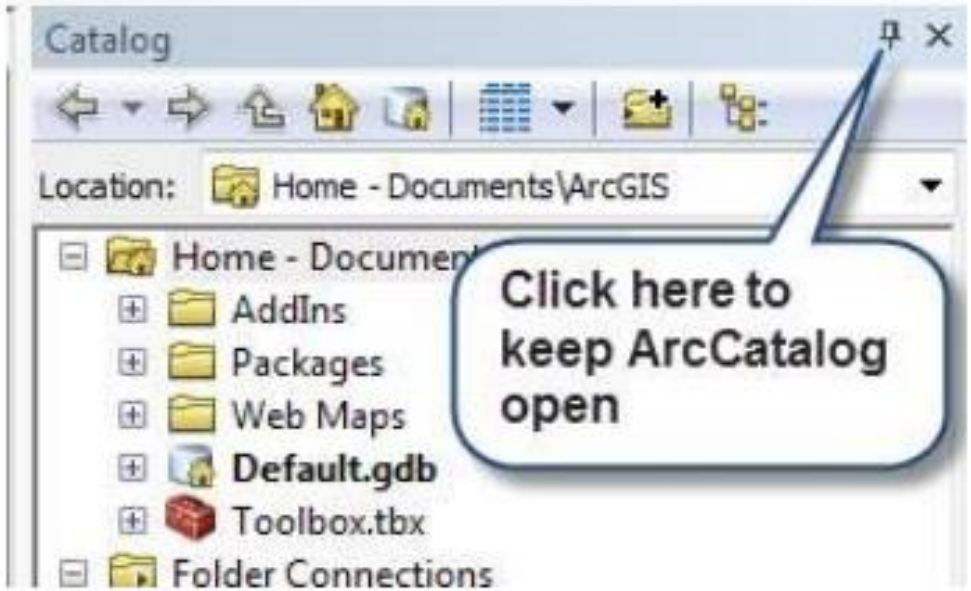


- **Add Data**

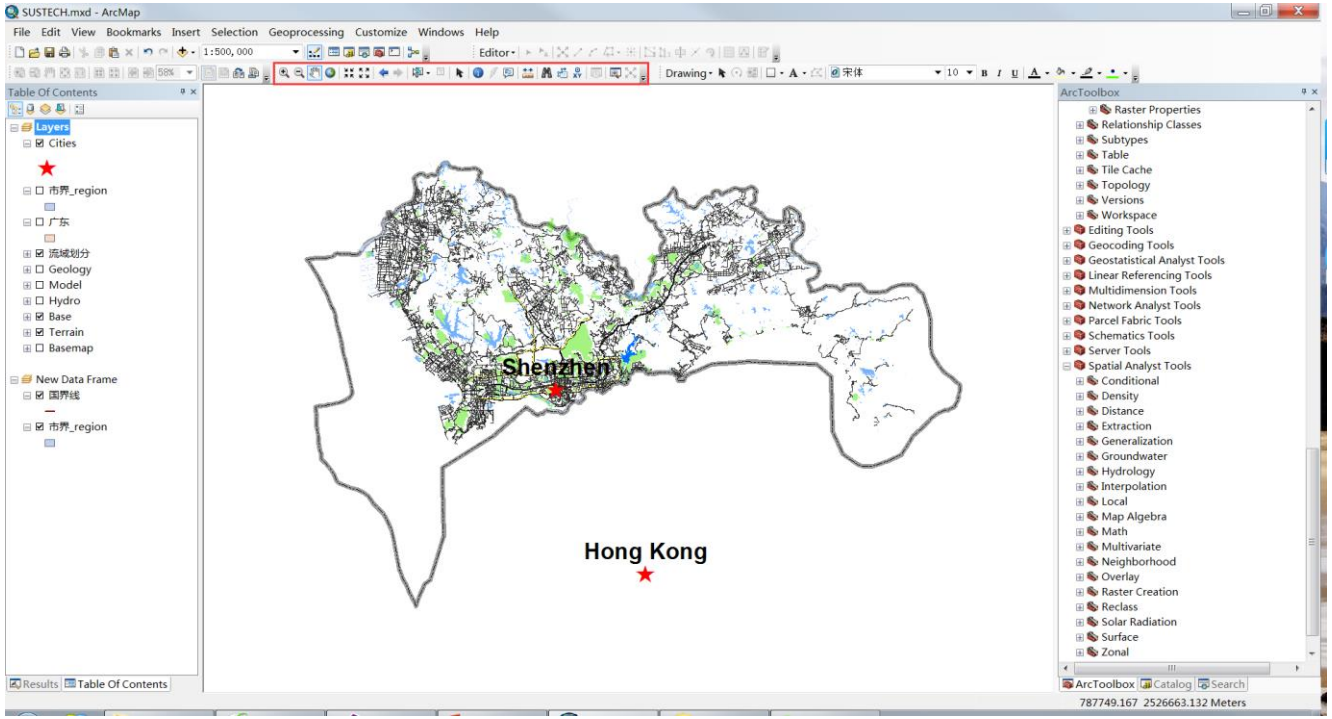

Untitled - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
Add Data
Add Data
Look in:
Folder Connections
Home - Documents\ArcGIS
Folder Connections
C:\Users\bparme01\Documents\Intro_GIS_class
H:\
M:\
S:\
Toolboxes
Database Servers
Database Connections
GIS Servers
Tracking Connections
Coordinate Systems
Then choose the appropriate folder connection
Name:
Add
Show of type:
Datasets and Layers
Cancel

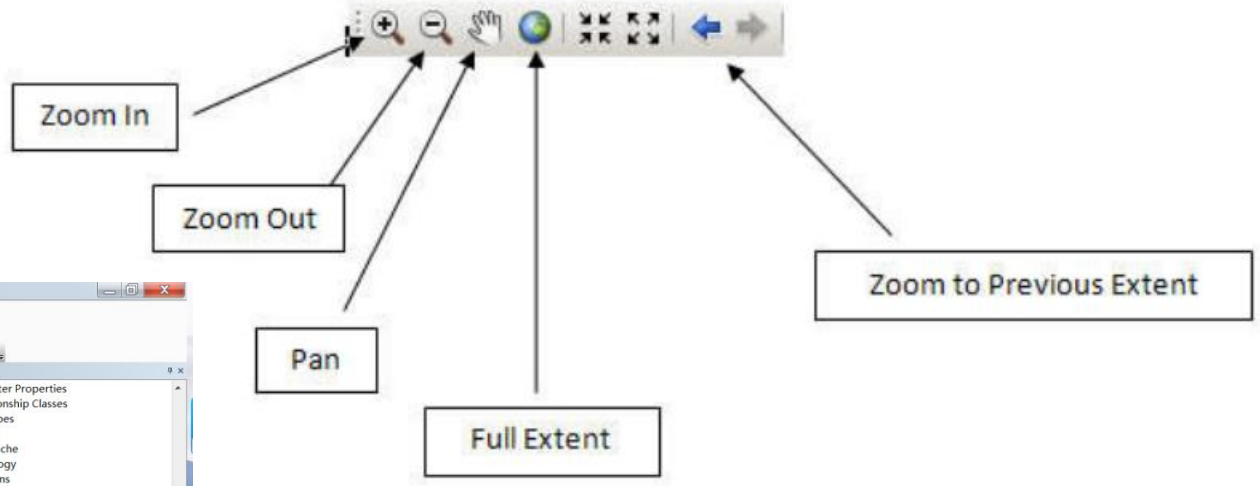

Add Data
Look in:
Somerville
Buildings.shp
CityBlocks.shp
CityBoundary.shp
neighborhoods.shp
Parcels2004.shp
Parks.shp
Streetscl.shp
Name:
Buildings.shp; CityBlocks.shp; CityBoundary.shp; neighborl
Add
Show of type:
Datasets and Layers
Cancel

Using ArcCatalog within ArcMap to Add Data

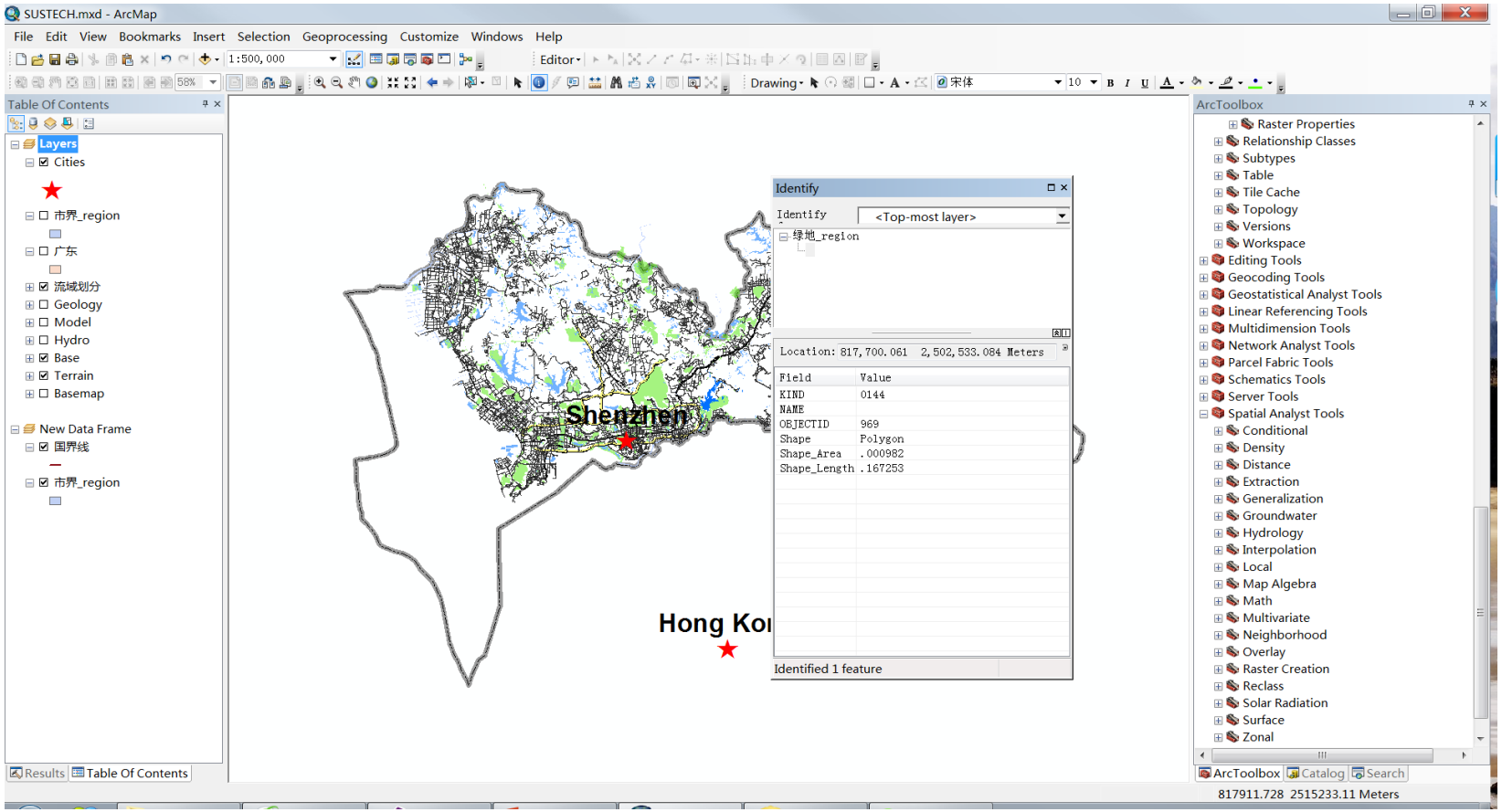


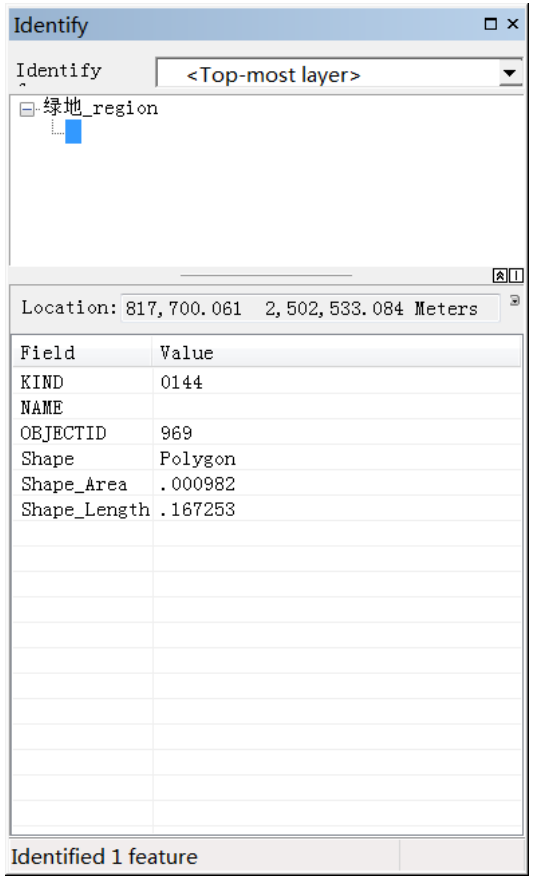
- **Getting around a map**



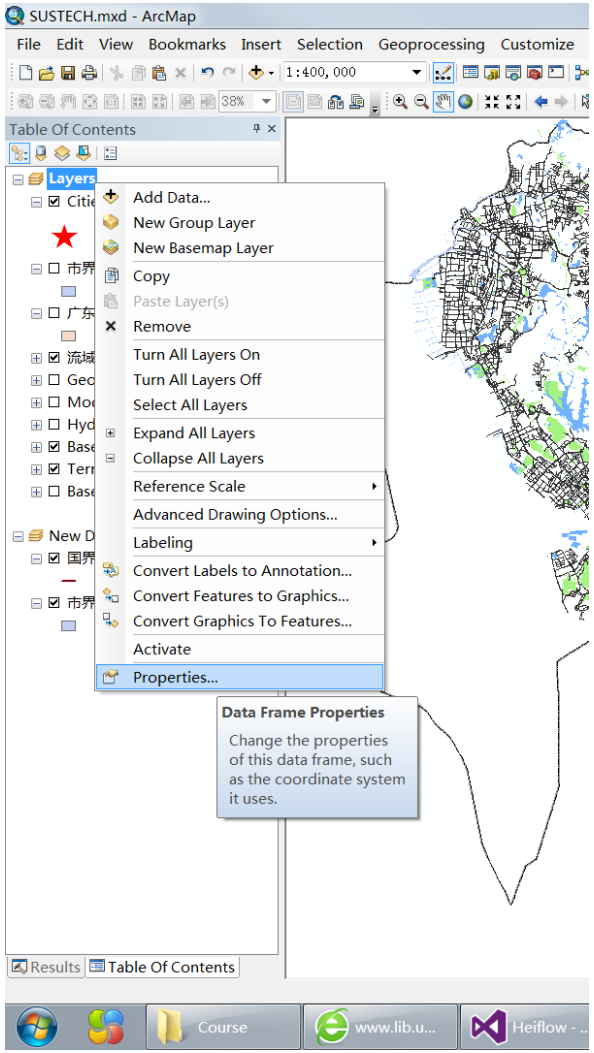


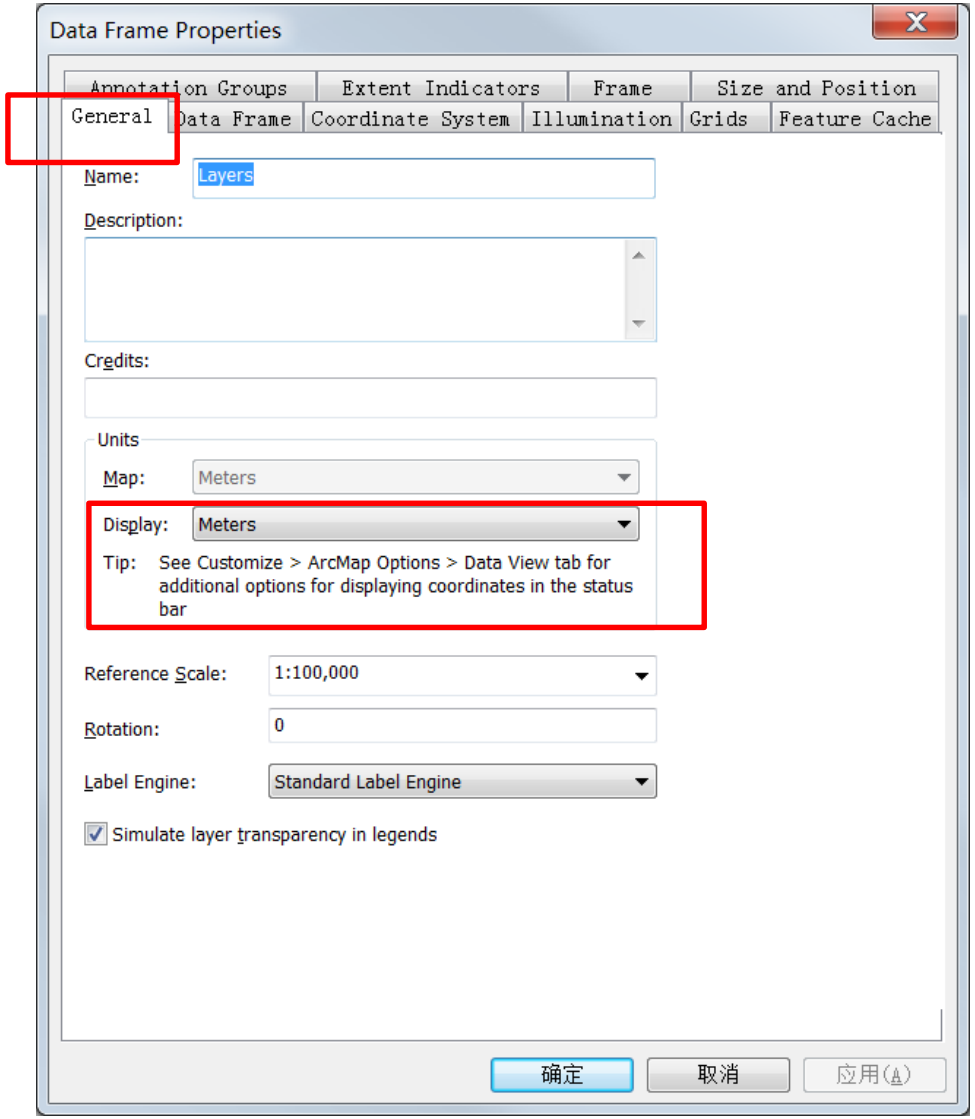
• Identifying Objects



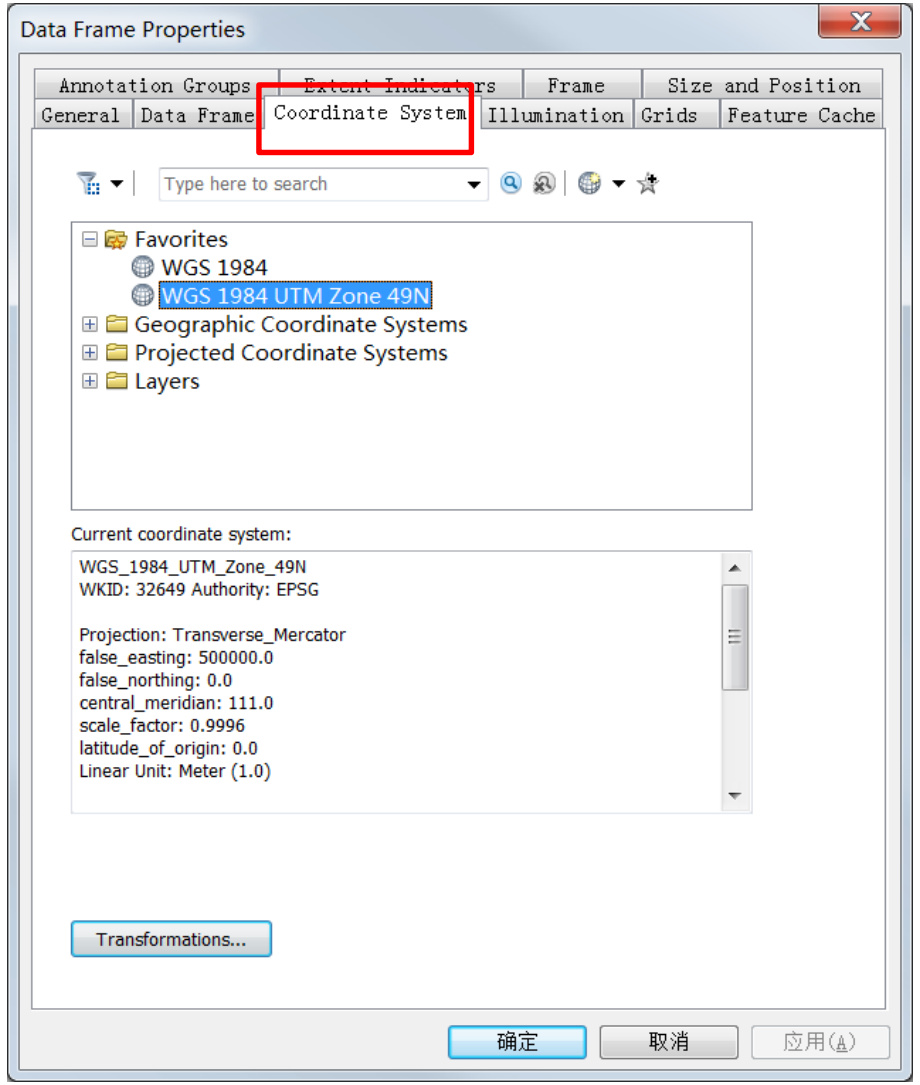


- **Setting Map Units, Display Units**

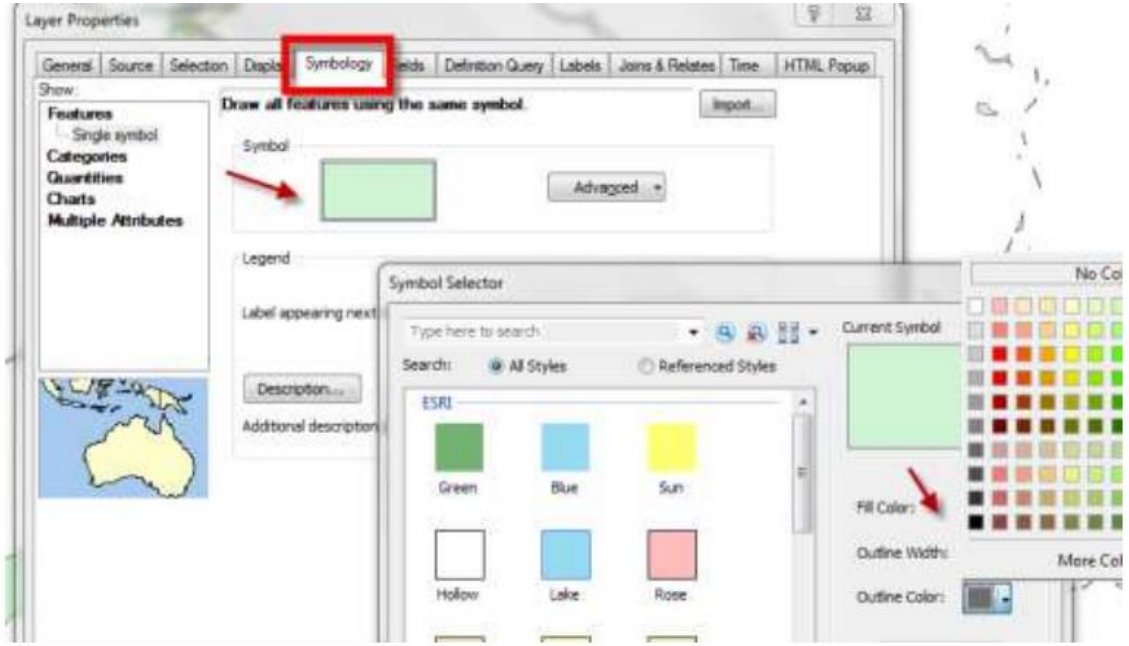


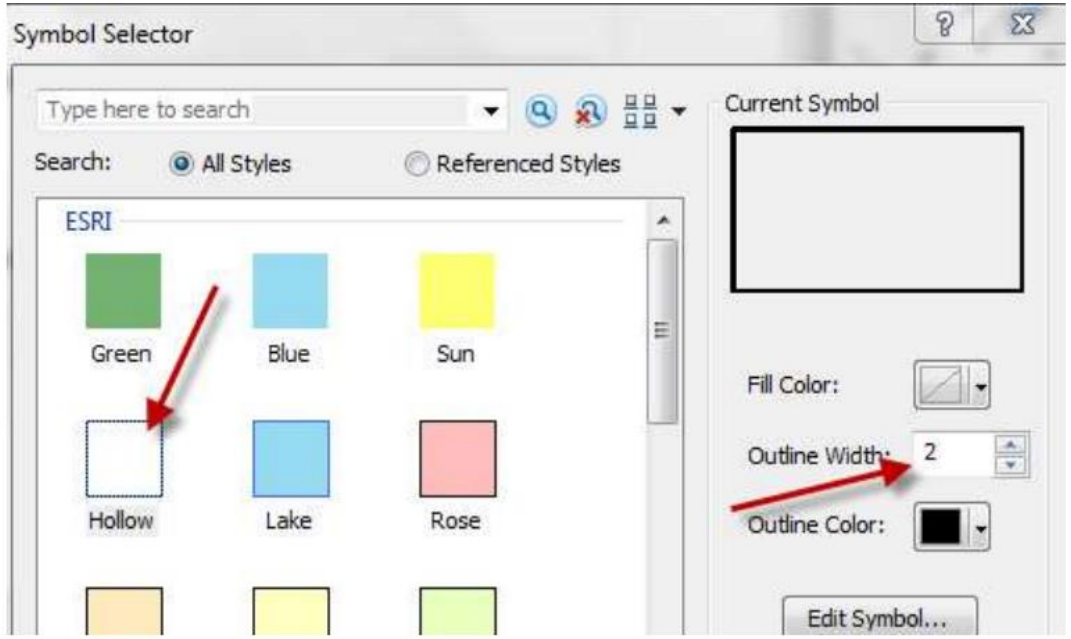


- **Setting Map Projection**

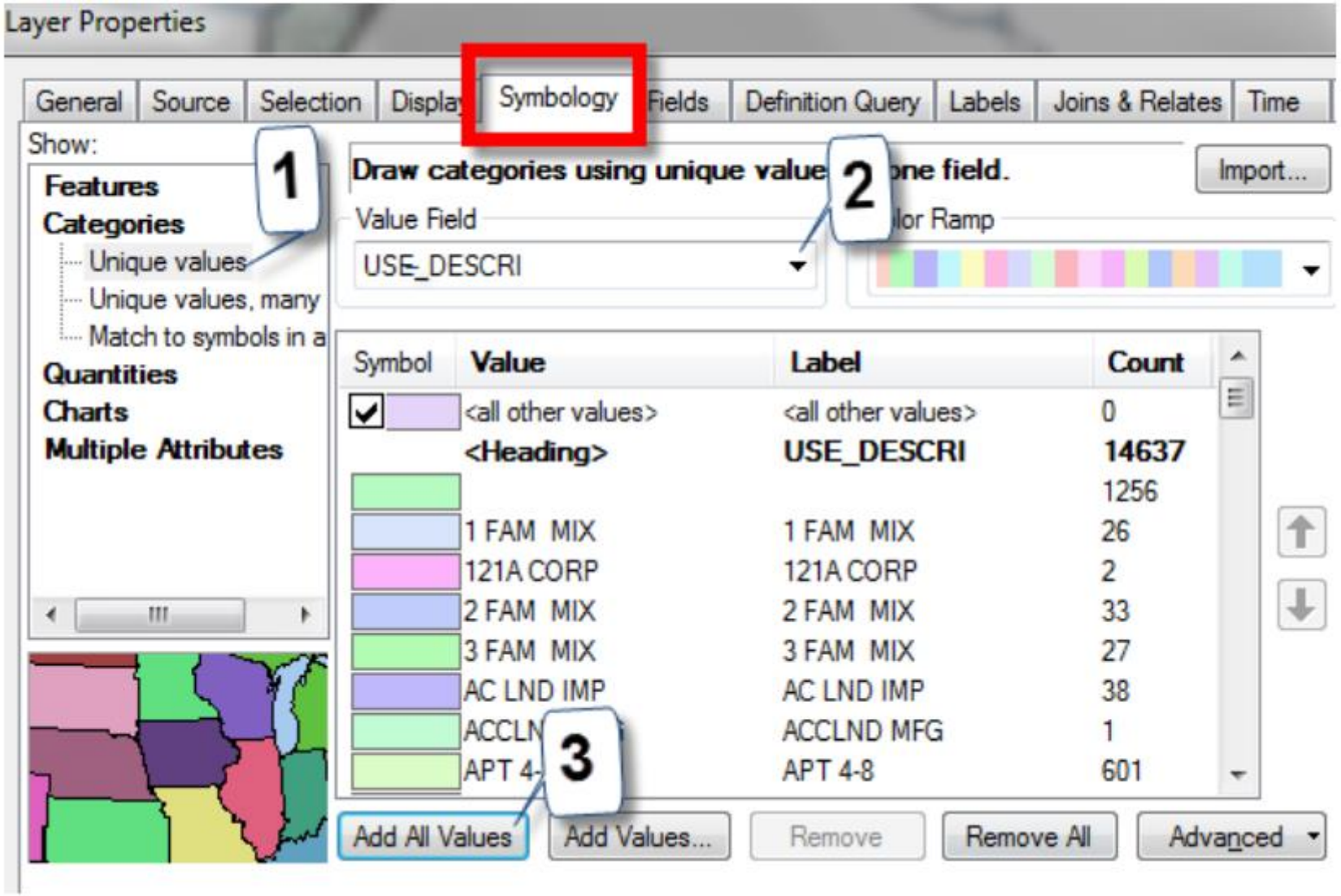


- **Defining the General and Symbology Properties for a Layer**
  - Assigning proper layer names
  - Assigning proper colors

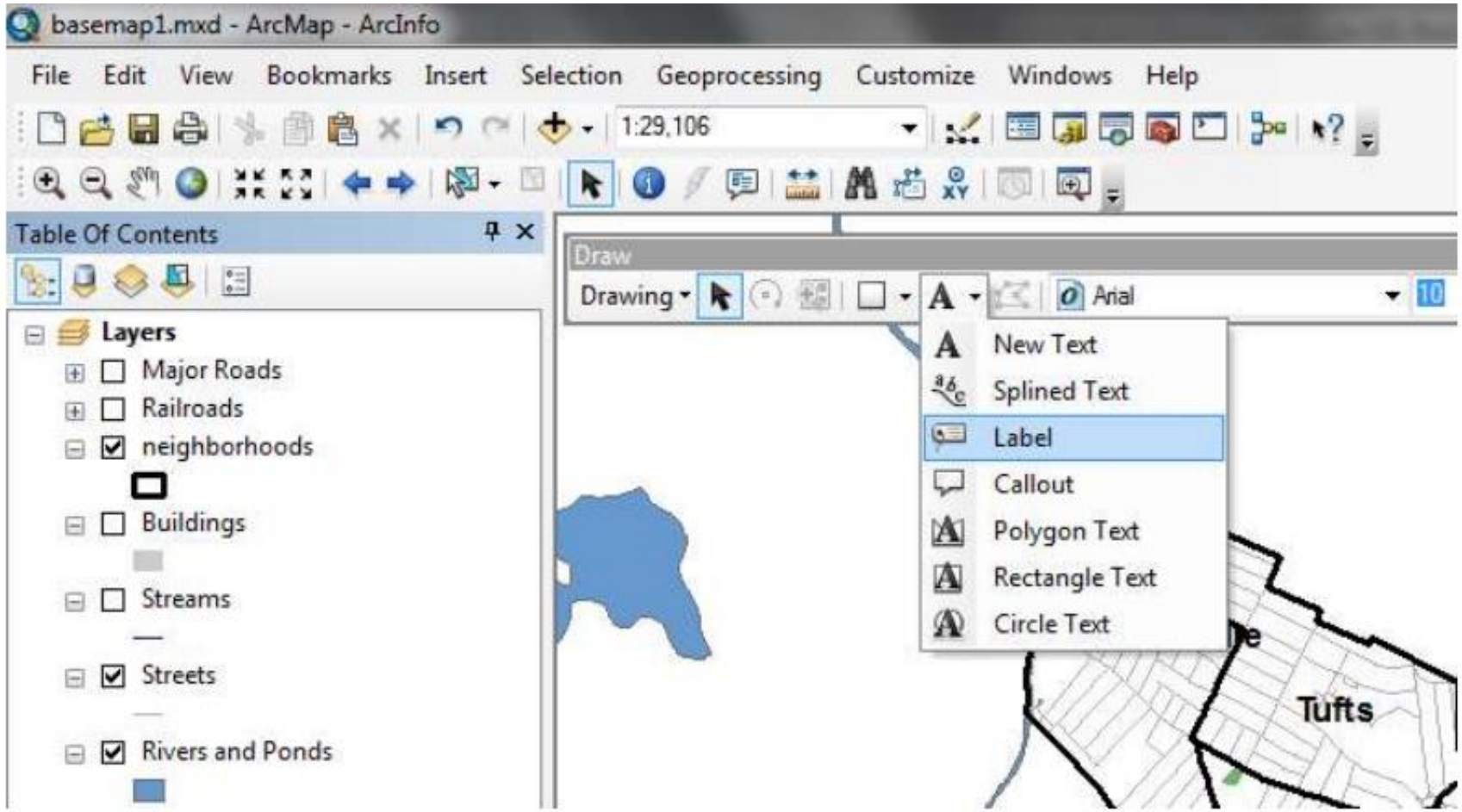




- **Drawing a layer based on an attribute value**

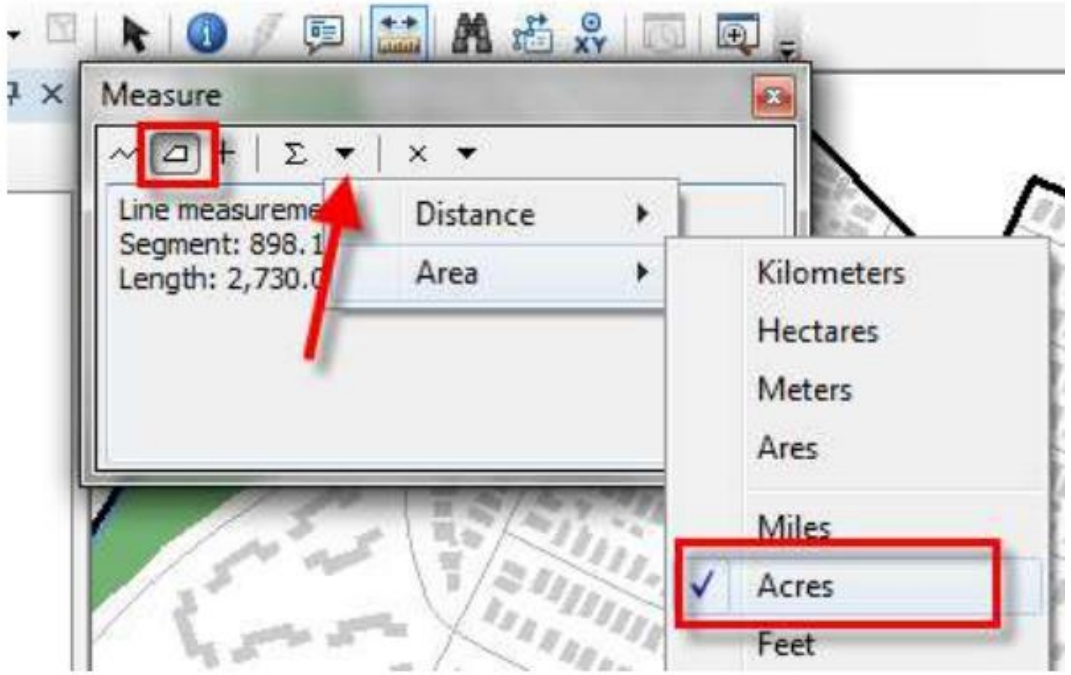


- **Labeling a layer based on an attribute field**



- **Measuring features**

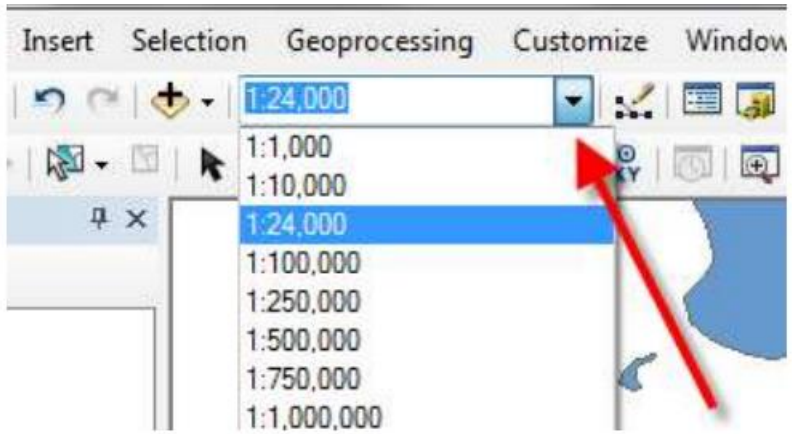
Measuring distances and areas

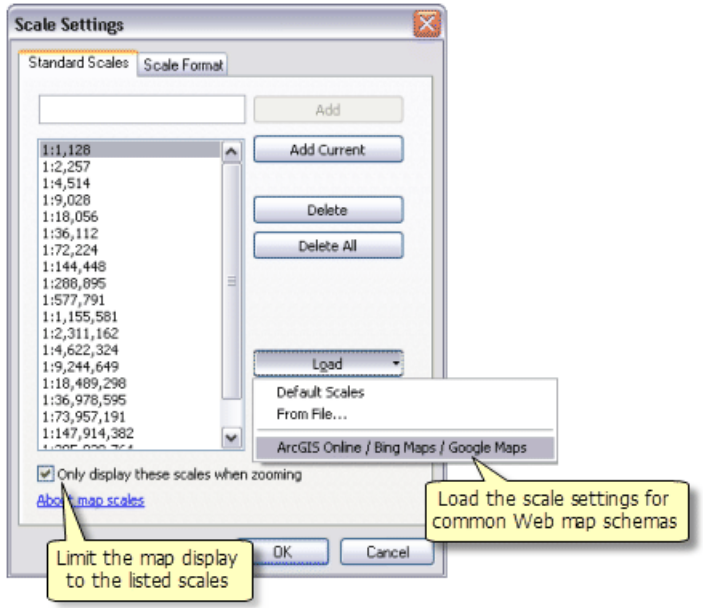


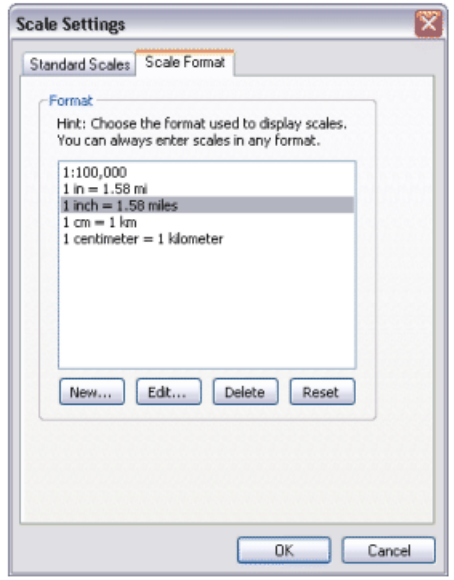
- # Understanding map scale

Scale	Ground distance of 1cm on map	Number of maps held by GA	Example uses
Largest	1:10000	100m	In-car navigation, education, facilities, street directories
	1:25000 (Local scale)	250m	Bushwalking, in-car navigation, environmental impact assessment, agriculture, emergency response, adventure touring
	1:50000 (Local scale)	500m	Bushwalking, fauna surveys, 4 wheel driving, emergency response, adventure touring
	1:100000 (Regional scale)	1km	Emergency response, planning, GPS navigation, reports/books, 4 wheel driving, adventure touring
	1:250000 (Regional scale)	2.5km	4 wheel driving, route planning, GPS navigation, mineral exploration, environmental planning, reports/books, emergency management, tourism
	1:1 million	10km	General reference, tourist maps, wall map
	1:2.5 million	25km	General reference, tourist maps, wall map
	1:5 million	50km	General reference, tourist maps, wall map
Smallest	1:10 million	100km	General reference, tourist maps, wall map

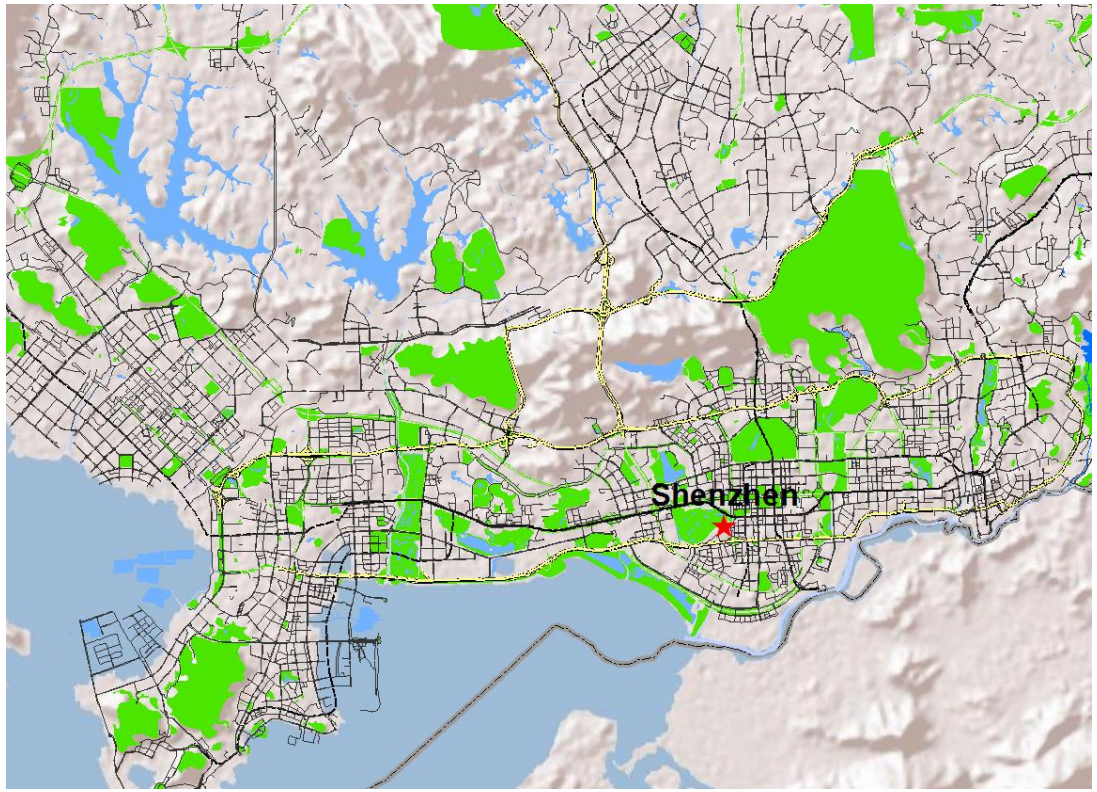
- **Drawing a map to scale**

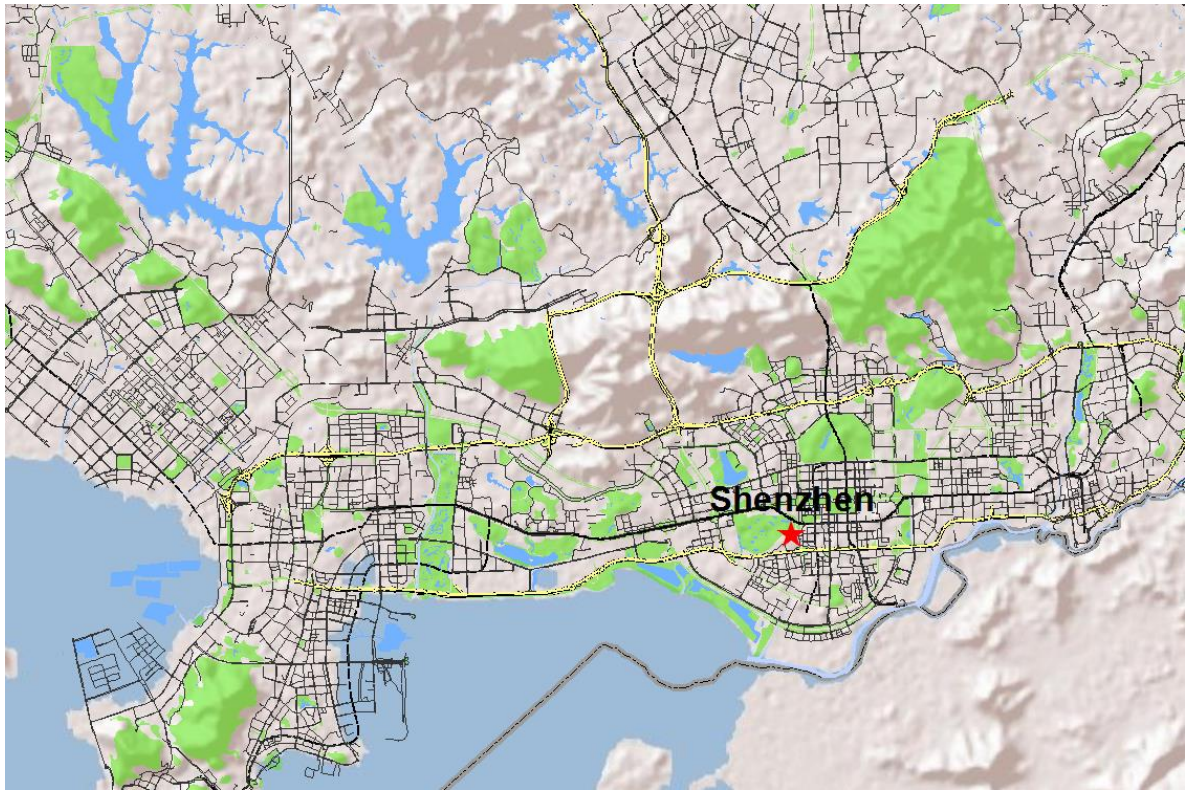






- **Making data layers transparent**



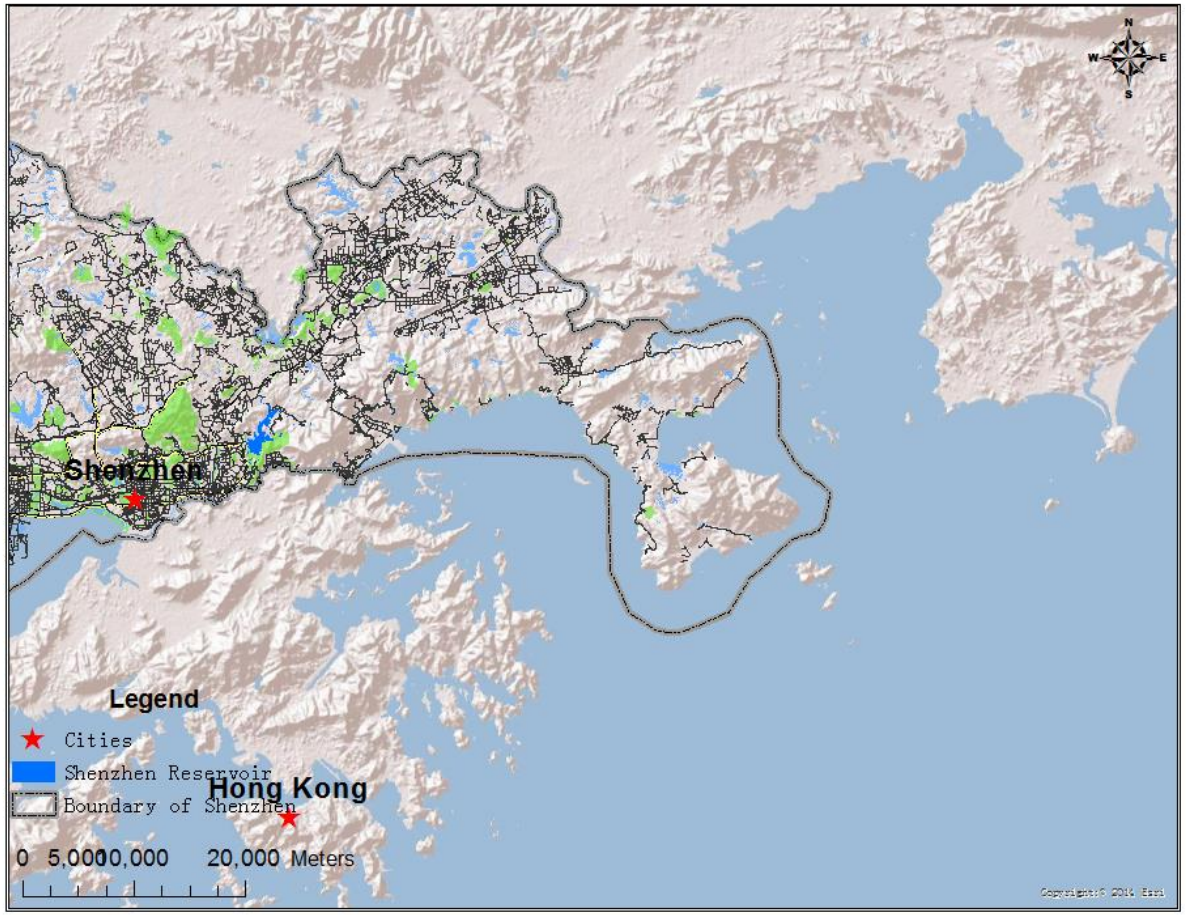


- **Setting up a map layout**

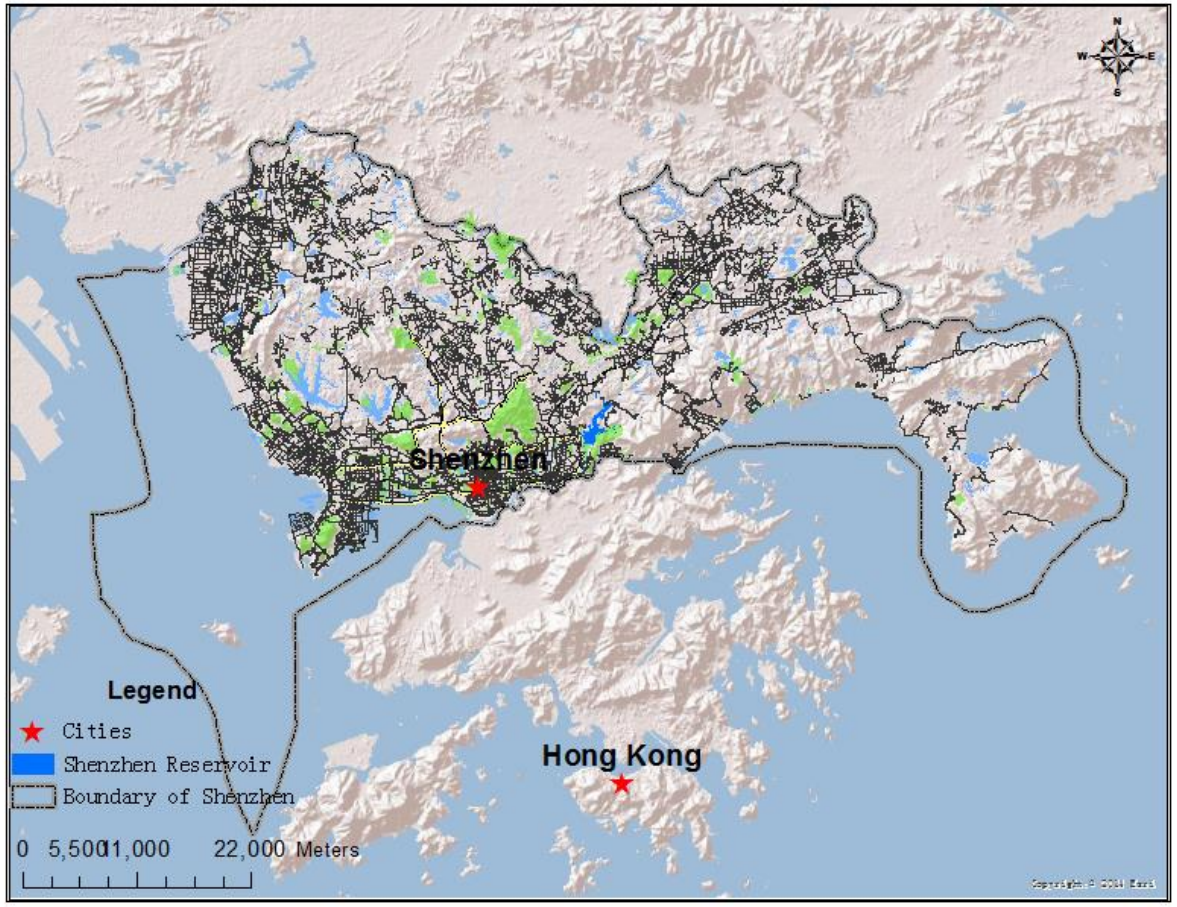
The Tools Toolbar	The Layout Toolbar
	
Use these to navigate within the *data frame* on your map (e.g., you want the data frame to be slightly more zoomed into Davis Square, or you need to pan the data frame to the north).	The 1:1 tool  is particularly useful to see what the map features and text looks like at actual print size. The Zoom to Whole Page tool  will take you back to the entire page view.

- **Resizing and moving the data frame**

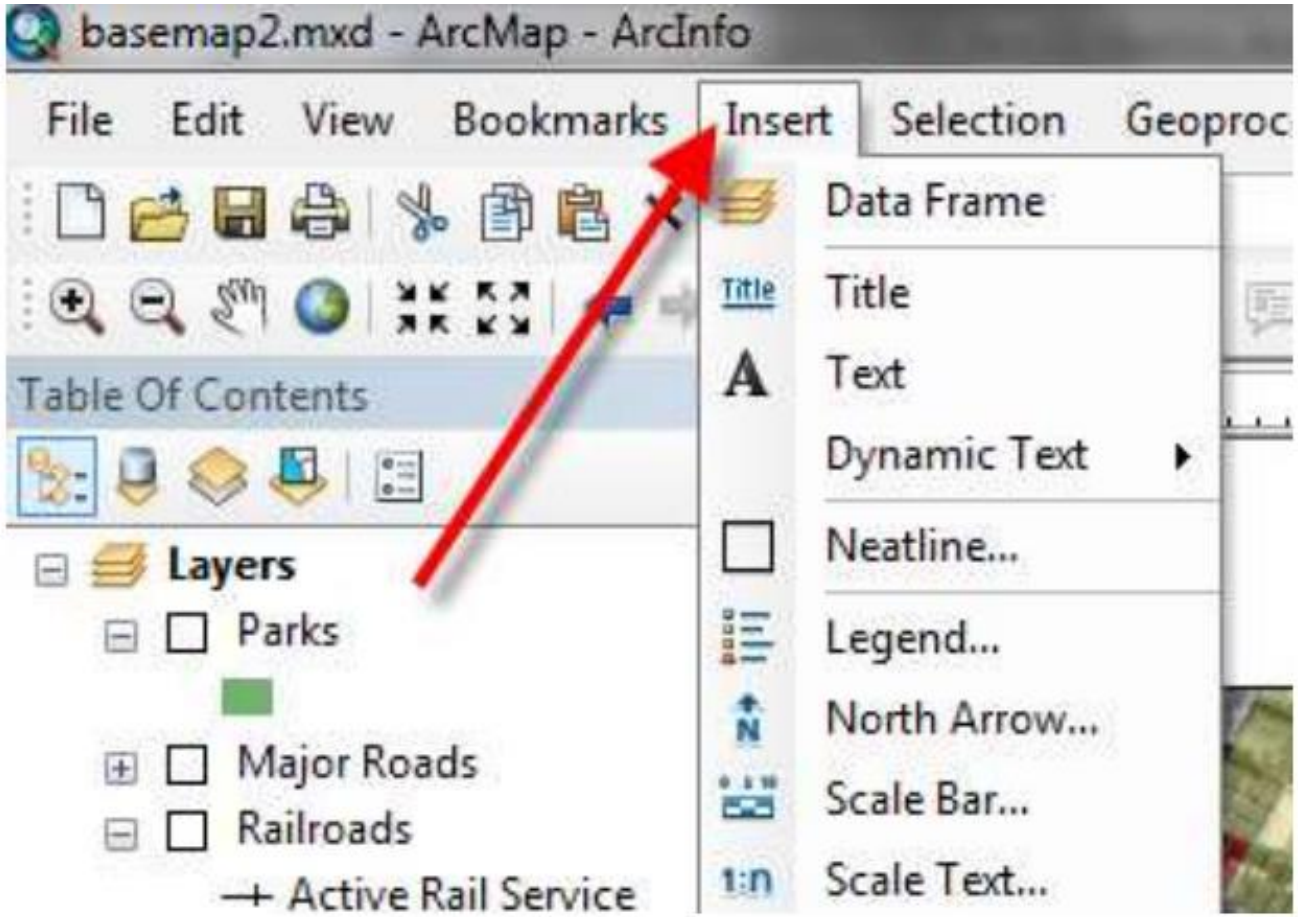
Data frame and layout page not adjusted



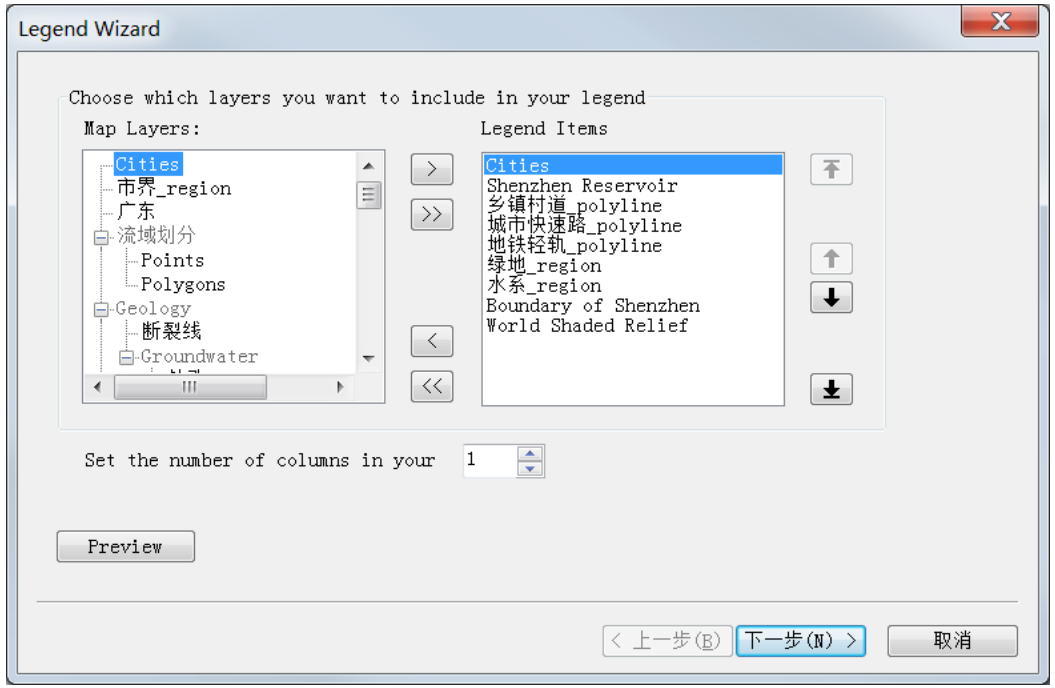
Data frame after resizing and moving to fit the layout page

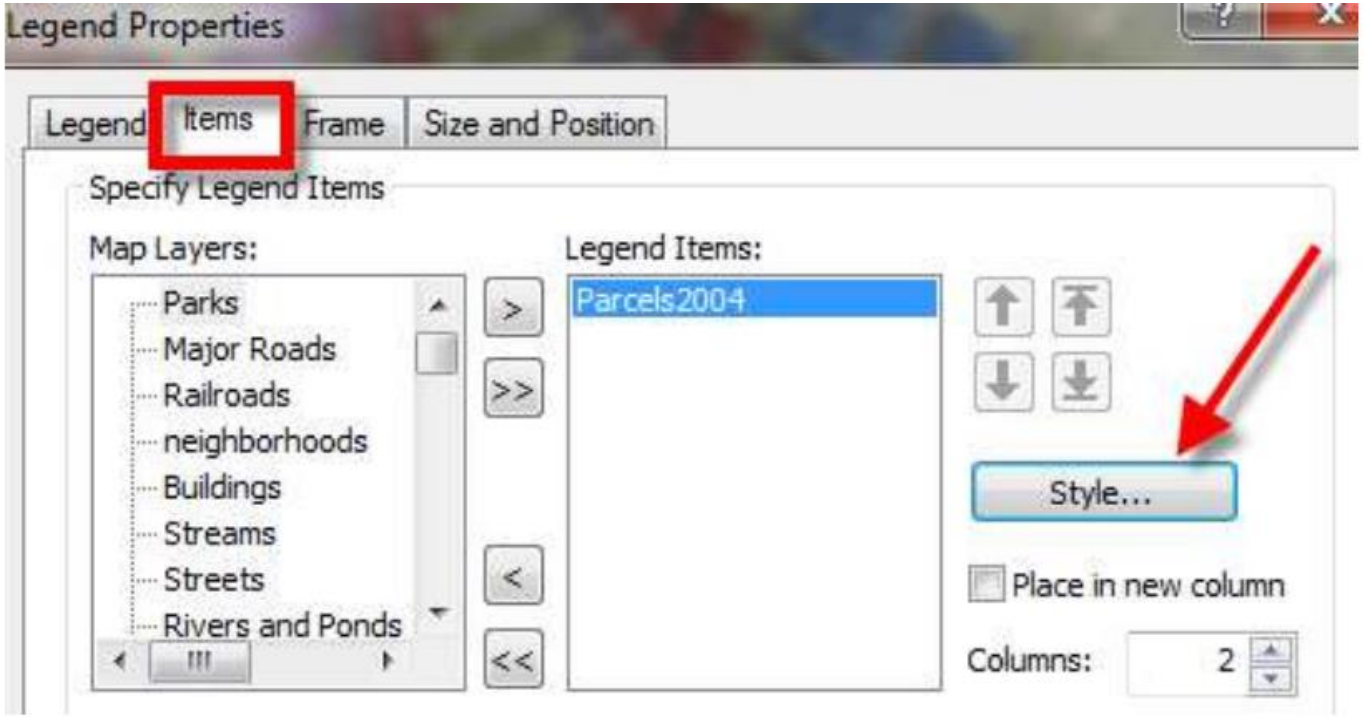


- **Inserting a title, north arrow, and legend**



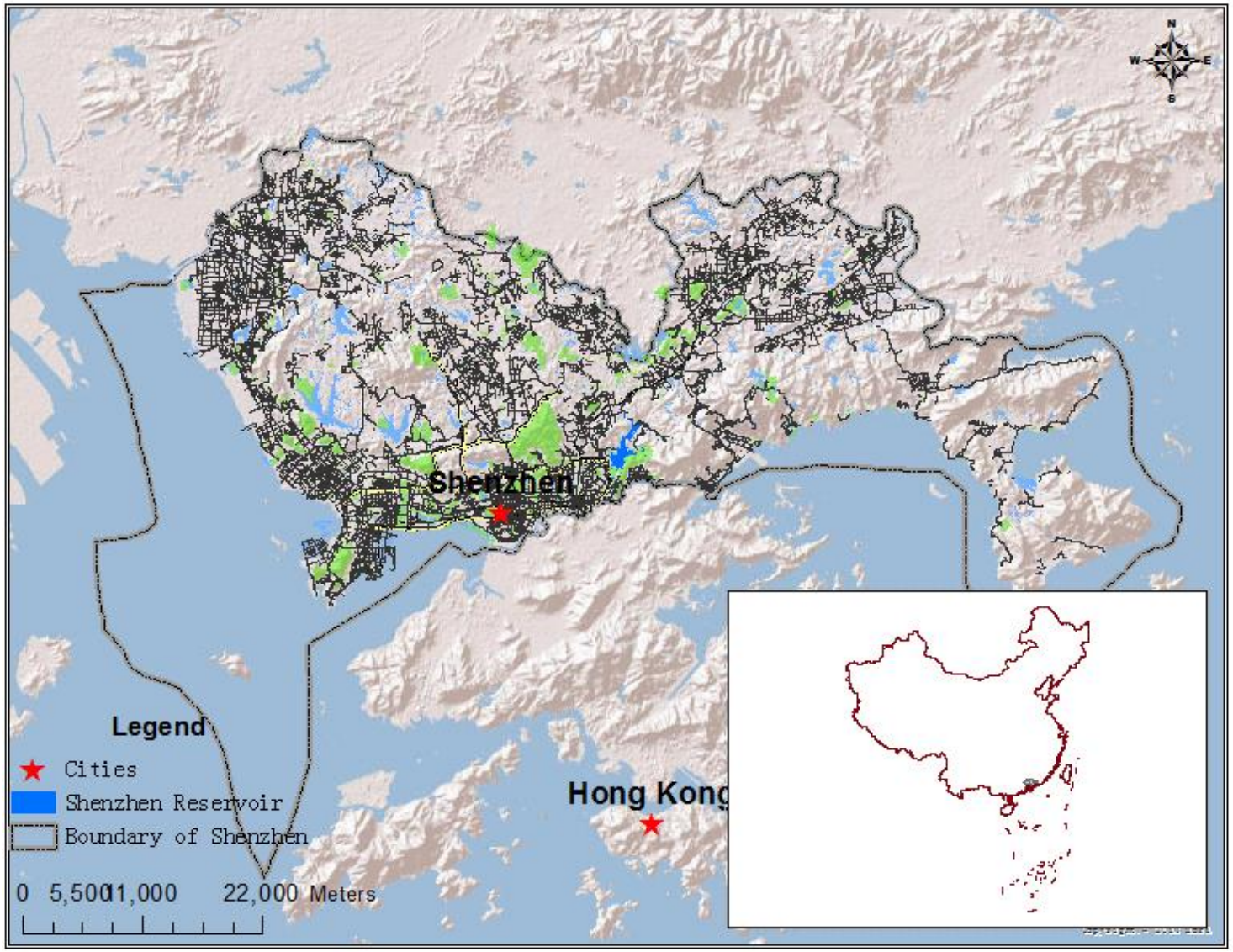
- **Insert Legend**



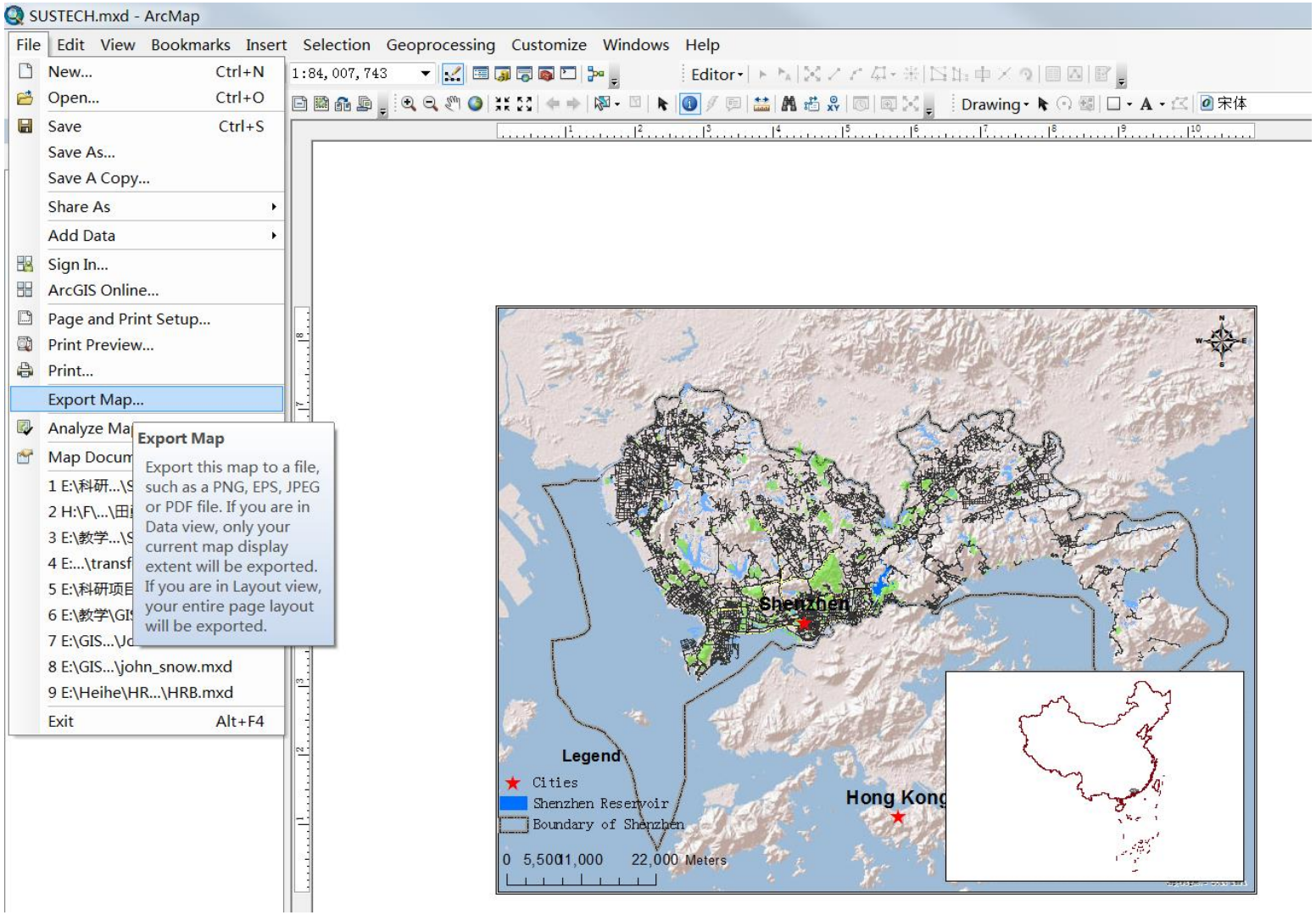


- **Try out different styles and preview how they will look:**

- **Adding a second data frame to show an inset map**

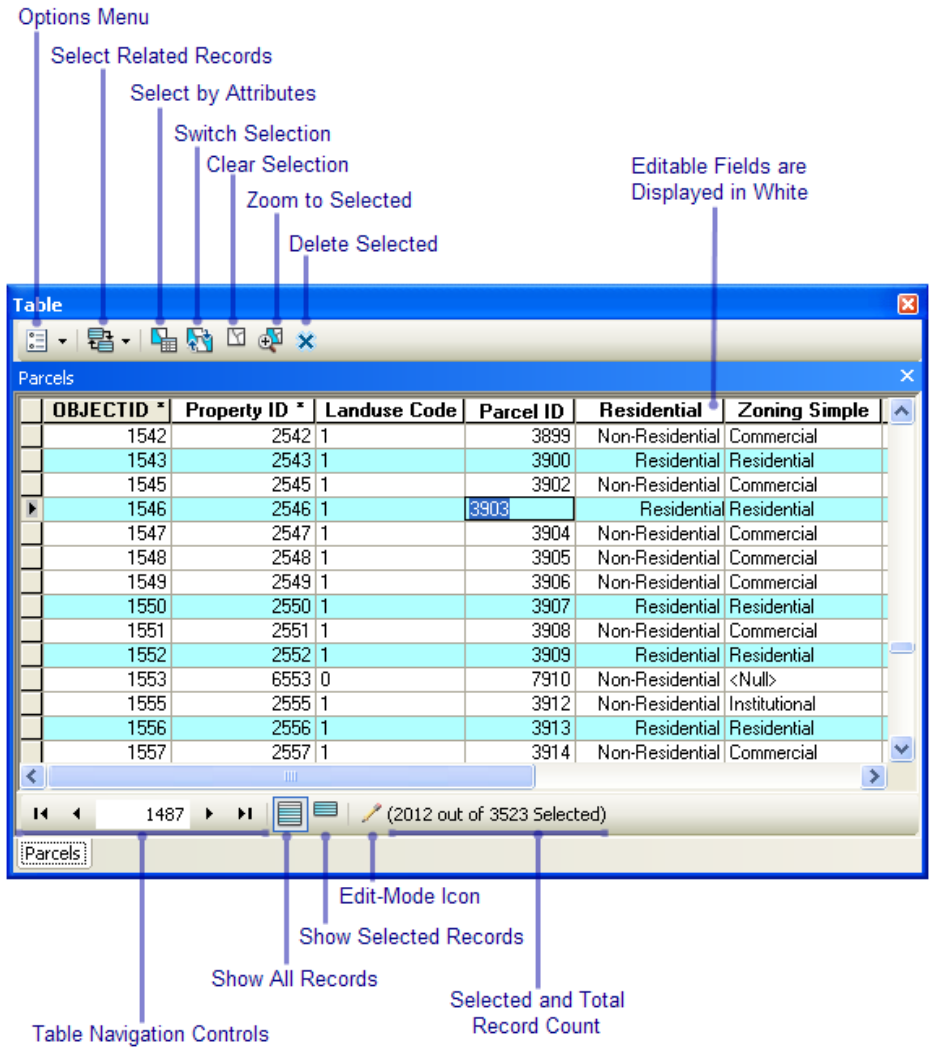


- **Printing or exporting your map**

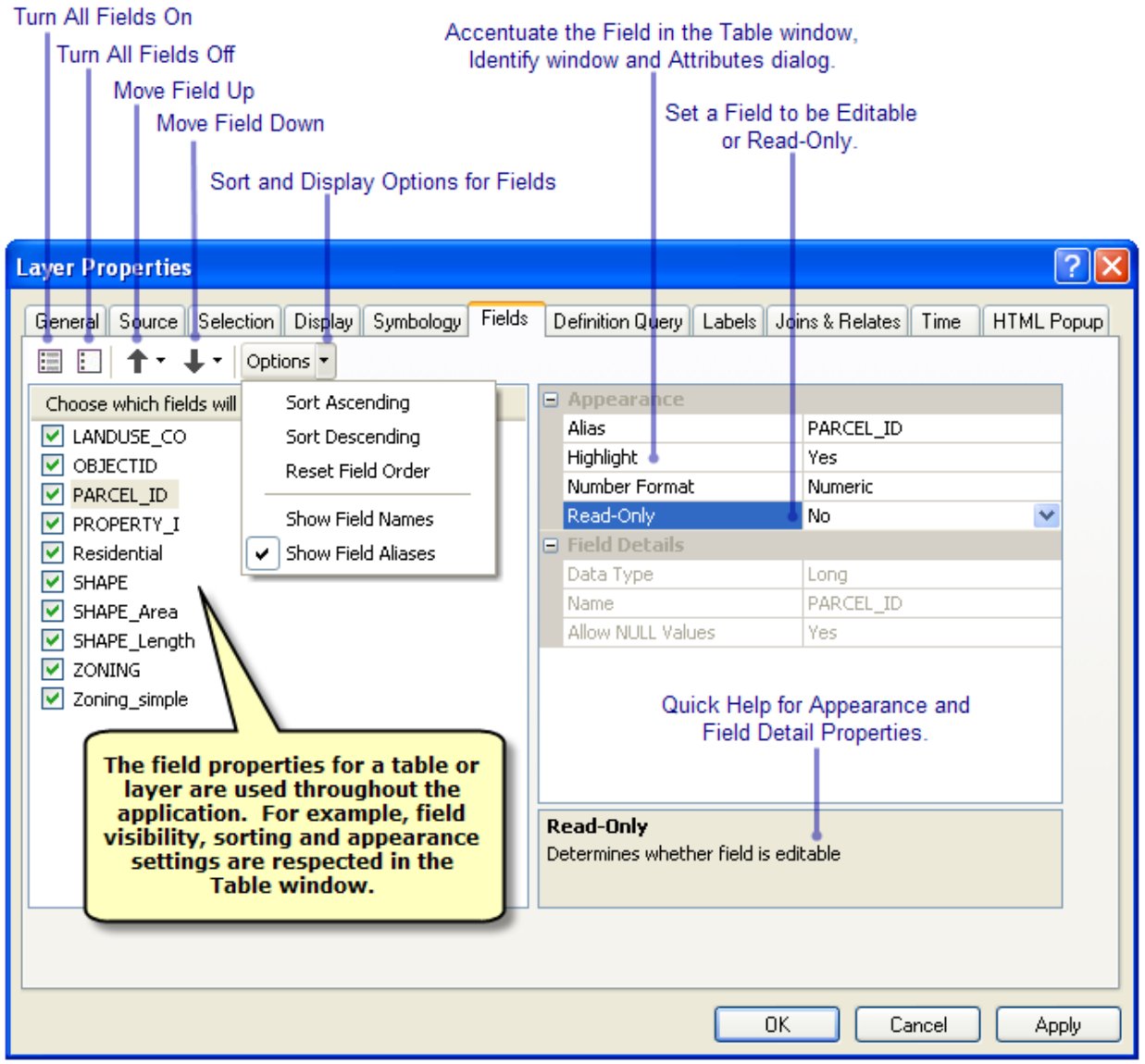


二 Working with Tables

- # Tables and attribute information



- **Field and Layer properties**



- **Essential table and attribute information vocabulary**

Term	Definition
Table	A set of data elements arranged in rows and columns. Each row represents a single record. Each column represents a field of the record. Rows and columns intersect to form cells, which contain a specific value for one field in a record.
Attribute	Nonspatial information about a geographic feature in a GIS, usually stored in a table and linked to the feature by a unique identifier. For example, attributes of a river might include its name, length, and sediment load at a gauging station.
Field	A column in a table that stores the values for a single attribute.
Field alias	An alternative name specified for fields, tables, files, or datasets, which is more descriptive and user-friendly than the actual name.
Record	A row in a table.
Joining	Appending the fields of one table to those of another through an attribute or field common to both tables. A join is usually used to attach more attributes to the attribute table of a geographic layer.
Relate	An operation that establishes a temporary connection between records in two tables, using a key common to both.

Relationship class	An item in the geodatabase that stores information about a relationship. A relationship class establishes a permanent connection between records in two tables, using a key common to both.
Domain	In a geodatabase, a mechanism for enforcing data integrity. Attribute domains define what values are allowed in a field in a feature class or nonspatial attribute table. If the features or nonspatial objects have been grouped into subtypes, different attribute domains can be assigned to each of the subtypes.
Subtype	In geodatabases, a subset of features in a feature class or objects in a table that share the same attributes. For example, the streets in a streets feature class could be categorized into three subtypes: local, collector, and arterial. Creating subtypes can be more efficient than creating many feature classes or tables in a geodatabase.
Query table	A table containing results from a query. You can create a query table by using the Make Query Table geoprocessing tool.
Definition query	In ArcMap, a request that examines feature or tabular attributes based on user-selected criteria and displays only those features or records that satisfy the criteria.
ObjectID	In ArcGIS, a system-managed value that uniquely identifies a record or feature.

- **Common table tasks**

Common task or workflow	Where to go for more information	Available geoprocessing tools
Creating a new table	Creating tables To learn about other types of data sources you can use in tables, see About tabular data sources.	Create Table
Importing, copying, and converting tabular data sources	Importing tables An overview of adding datasets to the geodatabase To learn about the importing process and the geodatabase, see How data converts when importing.	Table To Geodatabase Table To Table Table To dBASE Copy Rows
Adding fields	Adding and deleting fields To learn about fields and their data types, seeGeodatabase field data types.	Add Field Delete Field

Common task or workflow	Where to go for more information	Available geoprocessing tools
Displaying tables	Adding and viewing tables in ArcMap Previewing a table in ArcCatalog Setting field properties, aliases, and table display options	Make Table View
Creating associations among tables, such as joining, relating, and using relationship classes	About joining and relating tables Joining tables Relating tables Relationships and ArcGIS Deciding between relationship classes, joins, and relates	Add Join Remove Join Create Relationship Class
Editing attribute values	Editing values in a table Editing attributes	

Common task or workflow	Where to go for more information	Available geoprocessing tools
Calculating the values in fields	Making field calculations Working with date fields	Calculate Field
Printing tables	Printing a table	
Creating a layer from a table with x,y coordinate data	Add x,y data to ArcMap to display it	Make XY Event Layer

Editing and Deleting Fields

- **Adding fields**

1. Right-click the table or layer in the table of contents and choose Open Attribute Table.
2. Click the Table Options button  in the table window.
3. You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.
4. Click Add Field.
5. Type the name of the field.
6. Click the Type arrow and click the field type.
7. Set any other field properties as necessary.
8. Click OK.

- **Deleting fields**

1.Right-click the table or layer in the **table of contents** and choose **Open Attribute Table**.

2.Right-click the field header in the table window of the field you want to delete and click **Delete Field**.

3.Click **Yes** to confirm the deletion.

4.Deleting a field cannot be undone.

- **Fundamentals of ObjectID fields**

The ObjectID field is maintained by ArcGIS and guarantees a unique ID for each row in a table. When you look at a table or a layer's attribute table, you will usually see the ObjectID field listed under the aliases of OID or ObjectID. Key functions, such as scrolling and displaying selection sets, depend on the presence of this field.

Tip: ObjectID fields are sequential and start with the number 1 for geodatabase data. For shapefiles and dBASE tables, the OID or FID column begins at 0.

- ## Adding an ASCII or text file table

In ArcGIS, you can directly access data in delimited text files and work with them as tables. ArcCatalog and the Add Data dialog box in ArcMap list files with .txt, .asc, .csv, or .tab extensions and assign them a file type of text file.

Files with a .txt, .asc, or .csv extension are interpreted as comma delimited, while files with a .tab extension are interpreted as tab delimited by default. Any file with one of these extensions will be interpreted as a text file table even if it doesn't contain tabular data. If you attempt to display a text file that doesn't contain tabular data, the software will either produce an error or attempt to display the data as a table. To avoid this problem, give your delimited text files a .csv or a .tab extension. This will help differentiate text files with delimited data from unformatted text files.

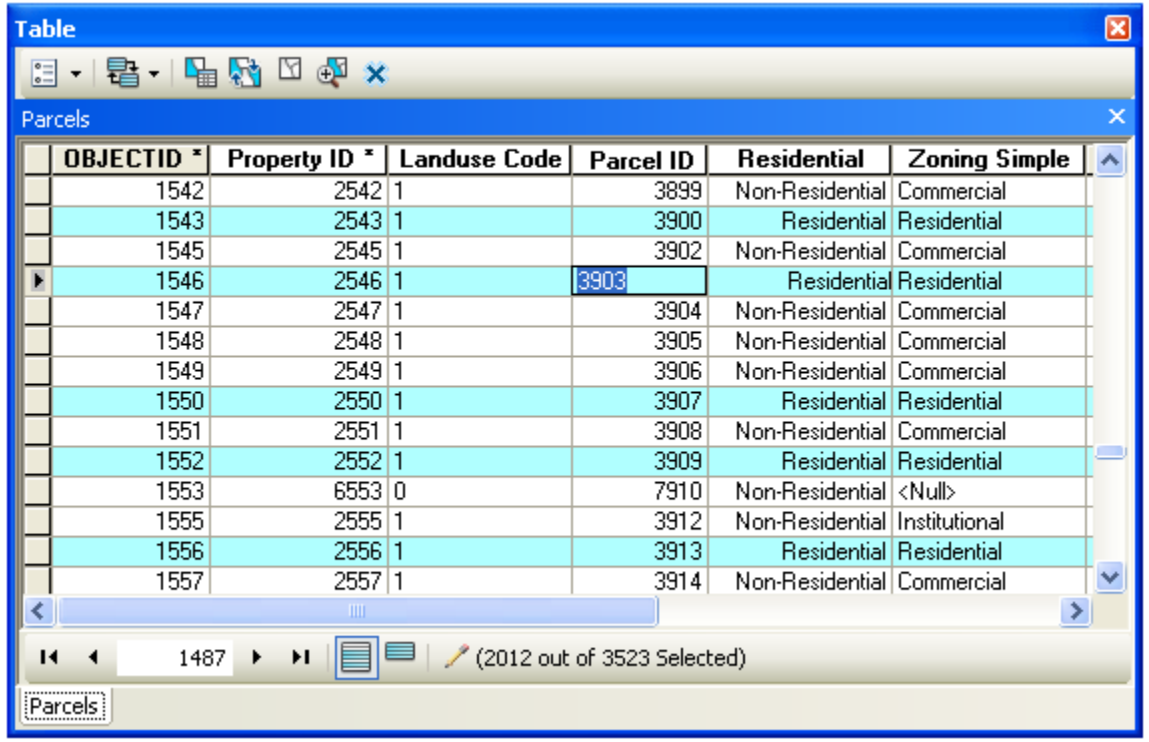
The first row of your text file can contain the column headings. The following rows can contain coordinates and attributes. Remember to use commas or tabs to distinguish the columns. The following is an example of a comma-delimited text file:

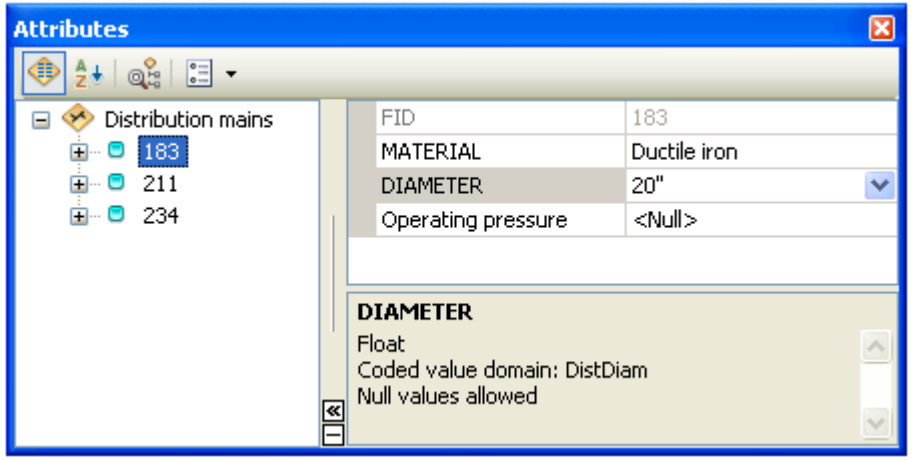
```
x,y,ID,color
8.6,5.6,001,blue
99.3,77.0,002,blue and red
8.01,44.3,003,orange
```

Edit Values in a Table

- **Understanding how to edit values in a table**

  - Editing values in the table window
  - Editing values in the Attributes window

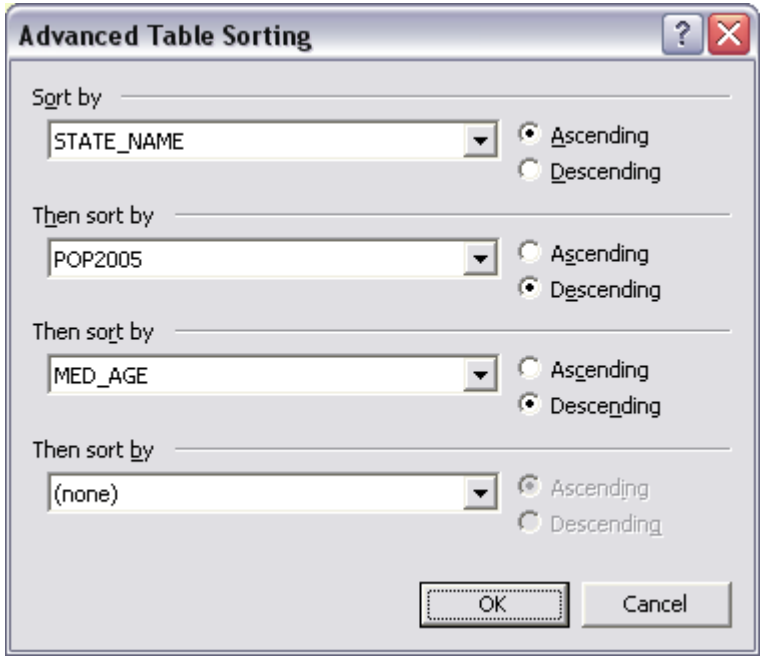




- ## About sorting records in tables

Sorting the rows in a table lets you more easily derive information about its contents, such as which county had the highest rent last year. After sorting a column's values in ascending order, the values are ordered from A to Z or from 1 to 10. With descending order, a column's values are arranged from Z to A or from 10 to 1. When a table's rows are sorted, only the table's display is modified.

Sometimes it's helpful to sort a table by more than one column. For example, when working with demographic data, it might be helpful to sort counties first by state, then by population and age—the effect is similar to producing a report. The easiest way to sort by more than one column is to right-click a field name and click Advanced Sorting. This opens a dialog box that allows you to choose up to four fields to sort by and set each field's sorting order.



Summarizing & Calculating Data in a Table

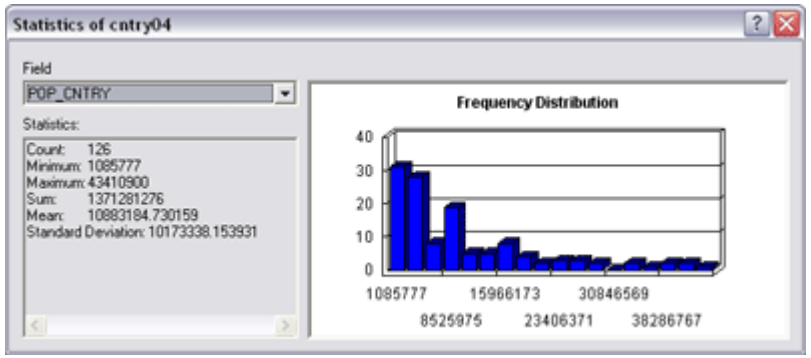
• Summarizing data in a table

Sometimes the attribute information you have about map features is not organized the way you want—for instance, you have population data by county when you want it by state. By summarizing the data in a table, you can derive various summary statistics—including the count, average, minimum, and maximum values—and get exactly the information you want. ArcMap creates a new table containing the summary statistics. You can then join this table to the attribute table of a layer so you can symbolize, label, or query the layer's features based on their values for the summary statistics.

1. Right-click the field heading of the field you want to summarize and click Summarize.
2. Check the box next to the summary statistics you want to include in the output table.
3. Type the name and location of the output table you want to create or click the browse button Browse and navigate to a workspace.
4. Click OK.
5. A new layer is added to the map.
6. Click Yes when prompted to add the new table to your map.

- **Viewing statistics for a table**

When exploring a table, you can get statistics describing the values in numeric columns. You'll see how many values the column has, as well as the sum, minimum, mean, maximum, and standard deviation of those values. A histogram is also provided showing how the column's values are distributed. Statistics are calculated for all numeric columns in the table. To see a description of another column's values, click its name in the Field list.



1. Right-click the heading of a field that contains numeric data and click Statistics.
2. On the Statistics dialog box, you'll see information about the values in the field whose heading you clicked.
3. If you want to see statistics for another numeric field, click the Field arrow and click the field's name.
4. Click the Close button when you are finished exploring statistics.

- **Fundamentals of field calculations**

Entering values with the keyboard is not the only way you can edit values in a table. In some cases, you might want to perform a mathematical calculation to set a field value for a single record or even all records. Field Calculator in ArcMap lets you perform simple as well as advanced calculations on all or selected records.

In addition, you can calculate area, length, perimeter, and other geometric properties on fields in attribute tables

Performing calculations on feature geometry

If you're working with an attribute table of a feature layer, you can easily calculate the area; perimeter; 3D perimeter; length; 3D length; coordinates of the centroid; coordinates of a point; minimum and maximum z-values; or coordinates of a start, end, or midpoint using the Calculate Geometry dialog box.

You can use the coordinate system of the data source or of the data frame when performing calculations. In addition, if one or more records are currently selected, only the selected records are calculated.

- ## Making simple field calculations

1. Start an edit session. You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.
2. Right-click the layer or table you want to edit and open its table.
3. Right-click the field heading for which you want to make a calculation and click **Field Calculator**.

> Note: If you are working with the attribute table of a geodatabase feature class that participates in a geodatabase topology, geometric network, or a relationship class, the **Field Calculator** command is unavailable when you are not in an edit session.

> Tip: You can press CTRL+SHIFT+F as a shortcut to opening the **Field Calculator**.

4 Use the Fields list and Functions to build a calculation expression. You can also edit the expression in the text area or type a value for the field.

> Tip: Use double quotes when calculating strings.

> Note: Fields that have been turned off for the layer or table you are working with are not listed in the **Field Calculator**. Field visibility is set on the **Fields** tab of the **Layer Properties** or **Table Properties** dialog box or from the **Table window**.

5 Click **OK**.

> Tip: When you use the **Field Calculator** on a text field, a warning message appears if truncation occurs because the field length is too small to hold the calculated values. Truncated values are flagged with an asterisk so you can easily find and fix them if necessary.

> Note: To avoid seeing the warning message when you attempt to calculate values outside an edit session, you can check the **Don't warn me again** box on the message. You can turn on the warning message again from the Tables tab of the **Customize** > **ArcMap Options** dialog box.

> Caution: You can't undo a field calculation when performed outside an edit session.

- # Calculating area, length, and other geometric properties

1. Start an edit session.

   You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.

2. Right-click the layer and click **Open Attribute Table**.

   You can only perform geometric calculations on attribute tables.

3. Right-click the field heading for which you want to make a calculation and click **Calculate Geometry**.

   Optionally, you can press CTRL+SHIFT+G to open the **Calculate Geometry** dialog box.

4. Click the geometric property you want to calculate.
   Different properties are available depending on the type of layer you're using.

5. Click to use either the coordinate system of the data source or the coordinate system of the data frame.

6 Click the units of the output calculations.

> **Tip:** If you are calculating into a text field, you can choose to add a units abbreviation to the calculation. For instance, 47.5673 sq m is an example of the output of area calculated into a text field with the units abbreviation.

7 Optionally, if you have selected records in the table, choose whether to apply the calculations to all records or just the selected ones.

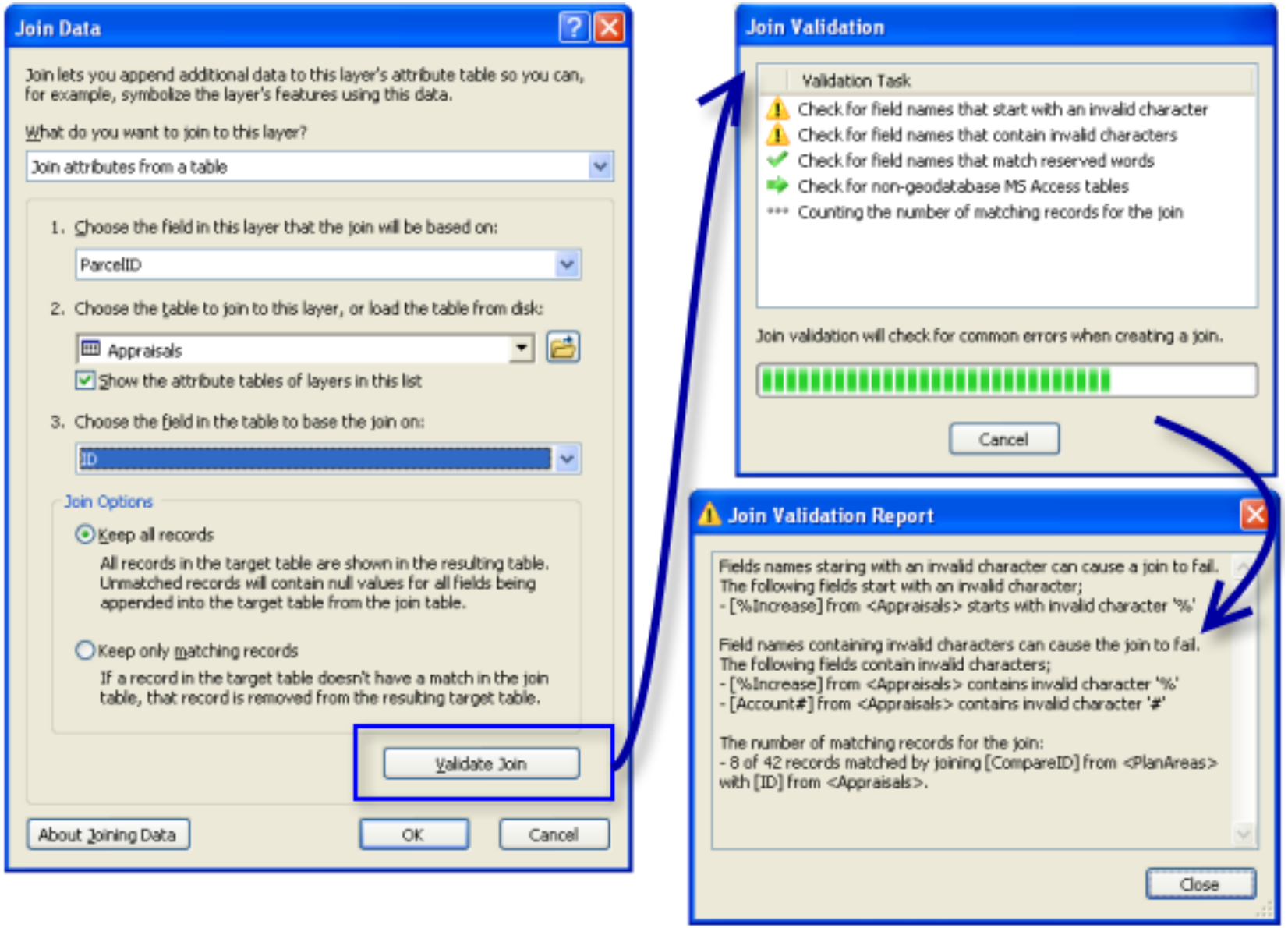
8 Click **OK**.

> **Caution:** You can't undo a field calculation when performed outside an edit session.

> **Tip:** To avoid seeing a warning message when you attempt to calculate values outside an edit session, you can check the **Don't warn me again** box on the message. You can turn on the warning message again from the **Tables** tab on the **ArcMap Options** dialog box.

> **Note:** The **Calculate Geometry** dialog box respects the number of decimal places (three, by default) specified on the **General** tab of the **Editing Options** dialog box. To change this setting, click the **Editor** menu on the Editor toolbar and click **Options**. This setting is saved in the map document.

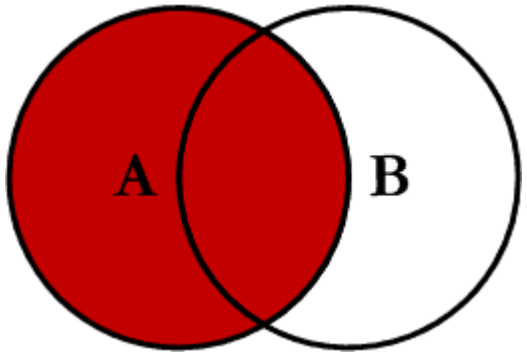
- **Calculating area, length, and other geometric properties**



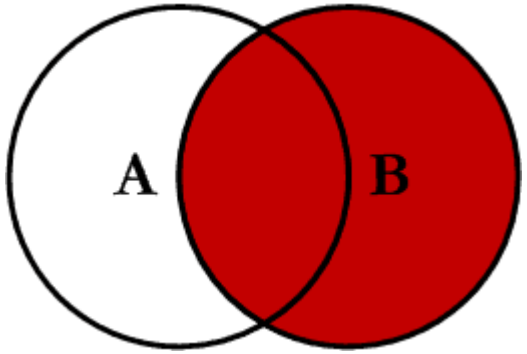
Joining and Relating Tables by Attributes

- **Understanding joining**

Left JOIN



Right JOIN



Outer JOIN

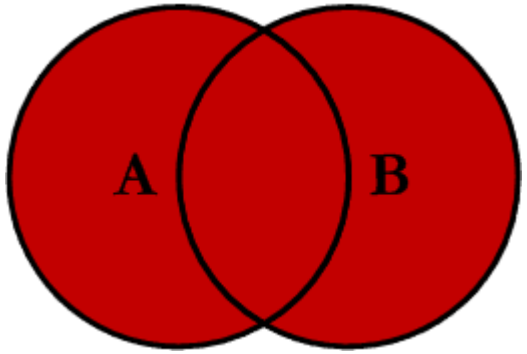


Table A

ID	AValue
1	11
2	22

Table B

ID	BValue
1	0.1
2	0.2
4	0.4

A join B on A.ID=B.ID

Table C (Cartesian product)

A.ID	B.ID	AValue	BValue
1	1	11	0.1
1	2	11	0.2
1	4	11	0.4
2	1	22	0.1
2	2	22	0.2
2	4	22	0.4

Final Result

ID	AValue	BValue
1	11	0.1
2	22	0.2

Table B

ID	BValue
1	0.1
2	0.2
4	0.4

B left join A on B.ID=A.ID

Table A

ID	AValue
1	11
2	22

Table C (Cartesian product)

A.ID	B.ID	AValue	BValue
1	1	11	0.1
1	2	11	0.2
1	4	11	0.4
2	1	22	0.1
2	2	22	0.2
2	4	22	0.4

Final Result

ID	AValue	BValue
1	11	0.1
2	22	0.2
4	NULL	0.4

Finally add this row back, and assign null for Avalue field

Editing

☰ Practice