# WEBINAR HANDOUT
"INTRODUCTION TO ARCGIS FOR DDACTS"
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DDACTS is an operational paradigm that encourages the analysis of data to help police reduce social harms--primarily crime and traffic collisions. These are some of its characteristics:

- DDACTS is **hot spot-focused.** It analyzes streets, intersections, neighborhoods, and other discrete locations where crime, disorder, and collisions gather in numbers greater than in the rest of the community.

- Identifying DDACTS hot spots is not necessarily as simple as mapping crime and collisions and looking for areas of overlap. The key to DDACTS is to **synthesize responses to crime and collisions**. Obviously, this is easy when hot spots for both directly overlap, but there are ways to create this synthesis even when the hot spots occur some distance apart.

- DDACTS works best with **crimes and disorder incidents that can be affected by patrol-based strategies**, such as thefts from vehicles, burglary, street robbery, vandalism, youth disorder, street prostitution, and open-air drug markets.

- A cornerstone of DDACTS is **highly-visible enforcement**, meant to suppress crime and collisions, deter offenses, identify suspects, gather intelligence, and educate the community.

- Beyond highly-visible enforcement, DDACTS supports a **wide variety of tactics and strategies**. The term "approaches" is meant literally. DDACTS encourages problem-oriented approaches, community-based problem-solving, re-engineering, community education, offender-focused tactics, and situational crime prevention strategies if they help abate the hot spots.

- As such, DDACTS is **compatible with most progressive policing models**, including problem-oriented policing, intelligence-led policing, community policing, Crime Prevention through Environmental Design (CPTED), and "broken windows" approaches.

- DDACTS also works well with **CompStat**. CompStat serves as a natural mechanism to review analysis, determine responses, and monitor results.
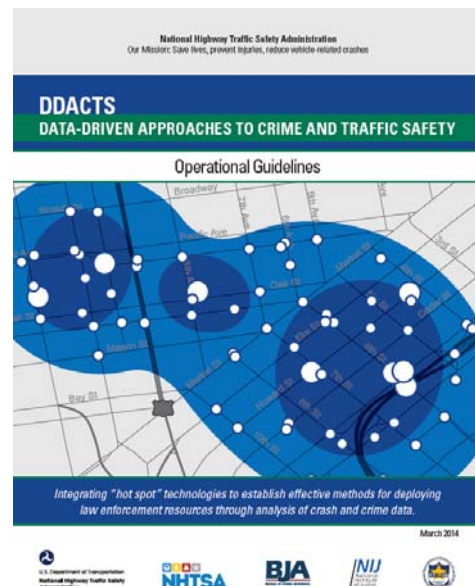
DDACTS Guiding Principles

The DDACTS model is built upon seven guiding principles, with associated key elements.[1]

1. *A focus on **outcomes***: Agencies should set specific crime and collision reduction goals, administrative goals, and community goals, and evaluate observed results against them.

2. ***Partner and stakeholder participation****.* Agencies should identify key partners and stakeholders, both internal and external, to both assist in the development of DDACTS strategies and share information.

- Identify and make contact with potential partners and stakeholders.
- Develop a plan for partner and stakeholder participation.

3. ***Data collection***. DDACTS depends on quality, timely data on calls for service, crimes, collisions, and enforcement. The agency should have the ability to flexibly query these data sets.

- Review current data collection and analysis systems
- Identify data sources and create a data collection plan
- Select mapping and analysis software

4. ***Data analysis***. DDACTS responses are built on quality, thorough analysis of who, what, when, where, and how factors. Mapping is a key component of DDACTS data analysis, but it does not end with the identification of hot spots; hot spots are dissected for temporal, offender, victim, property, and causation factors to help direct the best enforcement.

- Develop a clear process for data analysis
- Develop reporting procedures

5. ***Strategic operations****.* The agency uses the analysis to develop the right responses for the hot spot. In addition to highly-visible enforcement, this might include traffic engineering and environmental engineering strategies, warning signs and other community information, automated enforcement, surveillance (direct or camera-based), apprehension tactics, intelligence collection, and community-based problem solving.

- Identify strategies and tactics
- Develop short-term and long-term operational plans
- Implement plans

6. ***Information sharing and outreach***. The agency shares information on crime, collisions, and enforcement with its partners and stakeholders, and receives feedback on its approaches.

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[1] National Highway Traffic Safety Administration. (2009). *Data-Driven Approaches to Crime and Traffic Safety (DDACTS): Operational Guidelines*. Washington, DC: Author. Retrieved from http://www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811185.pdf

- Review partner and stakeholder plan to identify strategies for information sharing and outreach
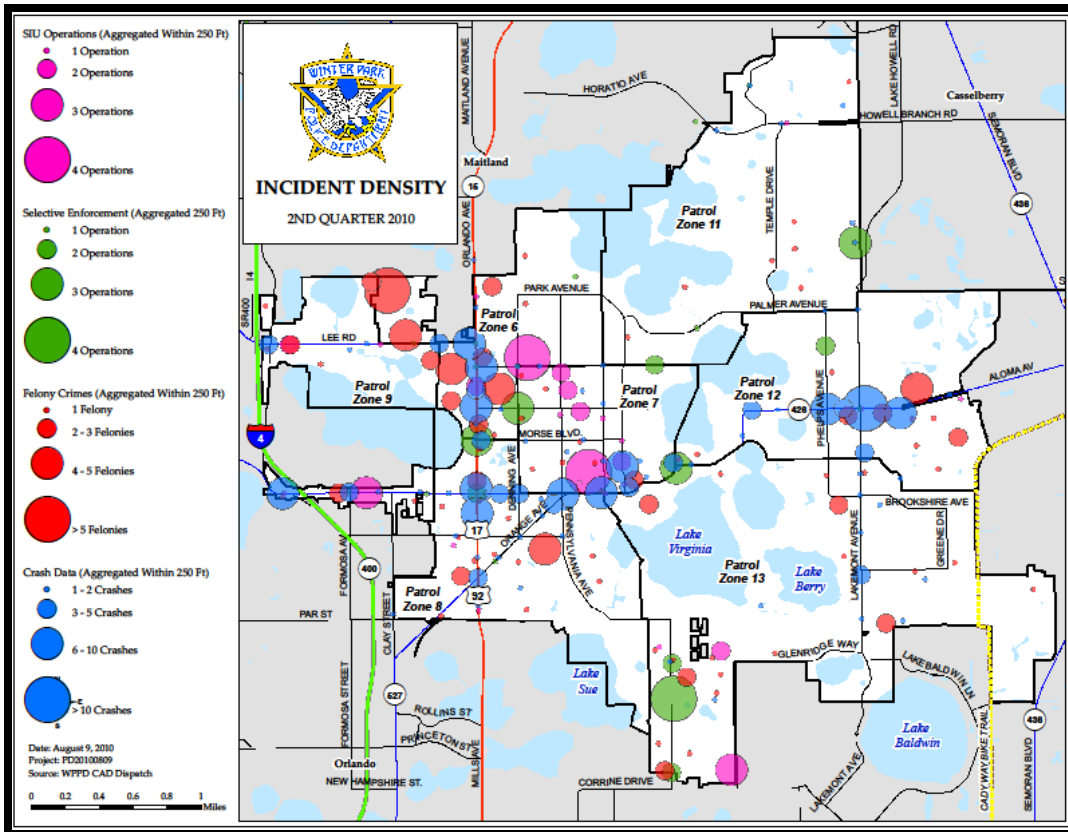- Develop a plan for communicating through media outlets

Figure 1: The ability to map crime, collisions, and other social harms, as well as enforcement data, is a key element of DDACTS.

7. ***Monitoring, evaluation, and adjustments***. The agency continually monitors the effectiveness of its strategies, applies an evaluation model to determine the level of success towards its goals, and adjusts its responses as indicated by the evaluation.

- Develop a robust evaluation model
- Use analysis to make adjustments to field operations
- Document and report changes

DDACTS and GIS

DDACTS is a location-based paradigm, so spatial analysis of police data with geographic information systems, popularly called "crime mapping," is a major part of any DDACTS approach. While some small agencies may get by with simple pin maps in cheap desktop mapping tools, online tools, or even paper, any serious approach to DDACTS requires the use of a proper GIS with querying and hot spot identification techniques.

DDACTS has uses for GIS in almost all of the guiding principles:

Partner and stakeholder participation	Use GIS to determine potential business, residential, and governmental partners based on proximity to hot spots
Data collection	GIS data is a unique type of data to be included in the collection process
Data analysis	Hot spot mapping is a key part of the DDACTS analysis process
Strategic operations	Use GIS to designate target areas, identify enforcement points, and simulate impacts of enforcement efforts
Information sharing and outreach	GIS can help prepare visuals for both internal and external information sharing
Monitor, evaluate, adjust	Use GIS to evaluate effects of DDACTS in designated target areas and to compare enforcement locations with problem locations
Outcomes	Mapping can help highlight the specific crash and crime problems that you hope to solve

Software

While spatial analysis for DDACTS can be performed with any GIS application, there is currently no serious competitor, with law enforcement agencies, to ArcGIS.
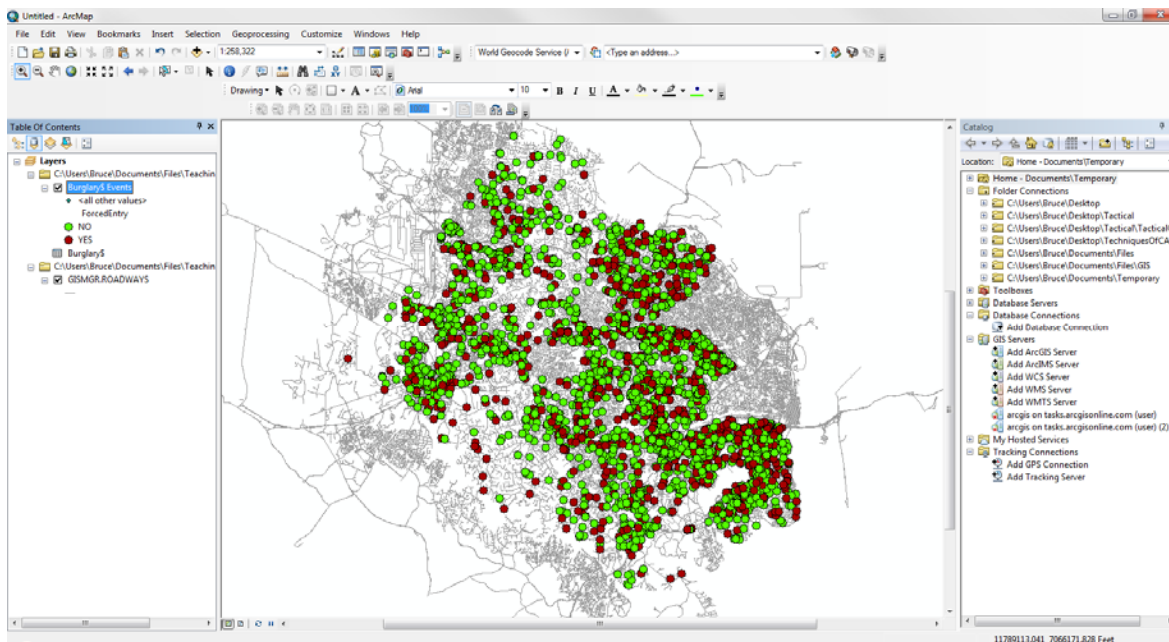

Figure 2: The ArcMap application is where most GIS users do their primary work.

ArcGIS is an umbrella term to describe a suite of software and services from **Esri** (this capitalization is the company's current preference). The software includes:

- **ArcGIS for Desktop Basic**: the software we are using in this class, formerly known as ArcView. ArcGIS for Desktop Basic is the most widely-used GIS software in American law enforcement.
- **ArcGIS for Desktop Standard**, formerly known as ArcEditor. This software provides additional editing capabilities.
- **ArcGIS for Desktop Advanced**, formerly known as ArcInfo, which provides even more editing and analysis capabilities.

These three applications are essentially the same, with more features unlocked as the user produces higher license levels.

- **ArcReader**, **ArcGIS Explorer**, and **ArcExplorer**, all free applications that, with various capabilities and restrictions, allow users to view maps created with the Desktop applications.
- **ArcGIS for Mobile**, a suite of smart phone and tablet solutions.
- **ArcGIS for Server**, an enterprise application that allows organizations to deliver GIS as a service to desktops and mobile applications.
- **ArcGIS Online**, a suite of services with applications hosted, and data stored, on the Internet.

Within the ArcGIS for Desktop installations, there are a number of individual applications:

- **ArcMap**, the main mapping application in which users will spend most time.
- **ArcCatalog**, where users organize and manage their GIS layers and data connections.
- **ArcGlobe**, a 3D visualization application that requires the 3D Analyst extension.
- **ArcScene**, a 3D visualization application that uses the Spatial Analyst extension.

In 2015, ESRI introduced a new flagship application meant to eventually replace ArcGIS Desktop, called **ArcGIS Pro**. Within a few years, literature and training for analysts will have to switch to this new software.

GIS Data

Broadly speaking, there are two types of data in a GIS: **vector data**, stored as geographic coordinates, and **raster data**, stored as pixels. Of the two, vector data is the most common and most useful. Raster data is used for special purposes, such as displaying an aerial photograph of the jurisdiction.

Vector data can exist in three categories: **points, lines, and polygons**, and in ArcGIS, only one type can exist per layer.

Points are stored as only two coordinates: X and Y. Although you can change the size of the symbol, they have no actual dimensions. They are used for collisions, crimes, offender residences, trees, fire hydrants, and other fixed objects and locations.

Lines are stored as two or more pairs of coordinates representing the beginning, ending, and each **node** where the line turns. They are commonly used to depict street (centerlines), rivers, railroads, and other linear features.
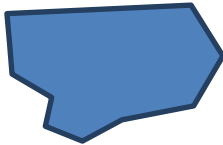
Polygons are stored as three or more pairs of coordinates and represent areas, such as parks, lakes, buildings, police beats, city and county boundaries, and DDACTS target areas.

In reality, all features and events on the surface of the Earth are three-dimensional and would be best represented by polygons. However, we use points and lines as acceptable *abstractions* of data

A primary advantage of vector data is that it does not simply exist as a map object. Rather, there is an underlying **database** underneath it, in which each object is a record. It is this database that makes the application a geographic information system, and not simply a map that happens to exist on the computer. The database makes it possible for us to query and represent data in various ways.
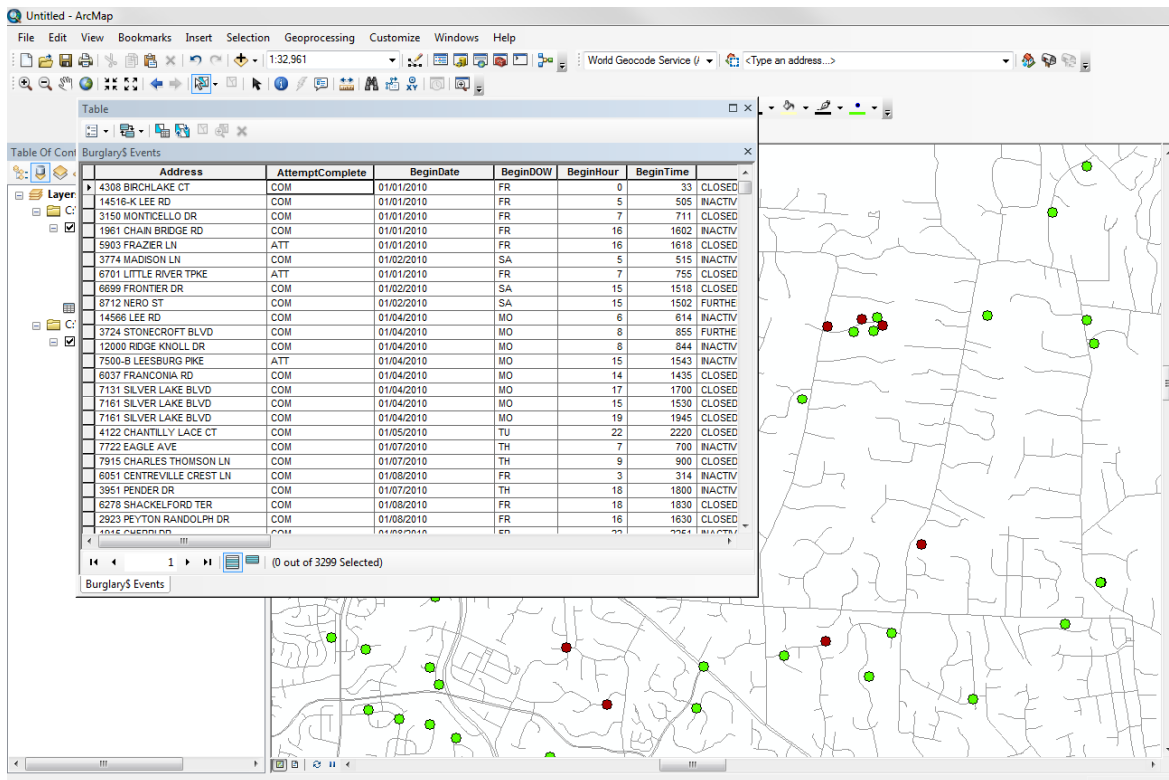

Figure 3: Each object on the map has an entry in the database attached to the map layer.

In the GIS map, multiple **layers** appear at once, in the order that the user specifies, much like transparent sheets laid on top of each other. The order matters; polygon features on top of point features will block the user from seeing the points. It generally makes sense to put points above lines, lines above small polygons, and small polygons above large polygons.
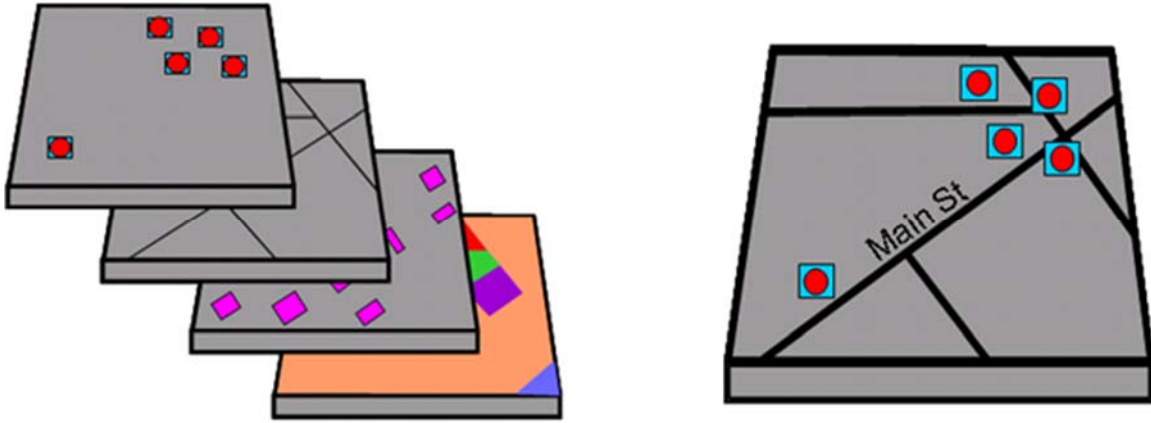

Figure 4: Multiple vector layers, overlaid, make the final map.

Projection and Coordinates

Any space on the surface of the Earth can be identified by its **coordinates**, usually given as the horizontal coordinate, or **x coordinate**, followed by the vertical coordinate, or **y coordinate**. Some advanced GIS applications, particularly in institutions like universities and hospitals, will also include a vertical coordinate, or **z coordinate**, to indicate the specific floor on which an incident occurred.
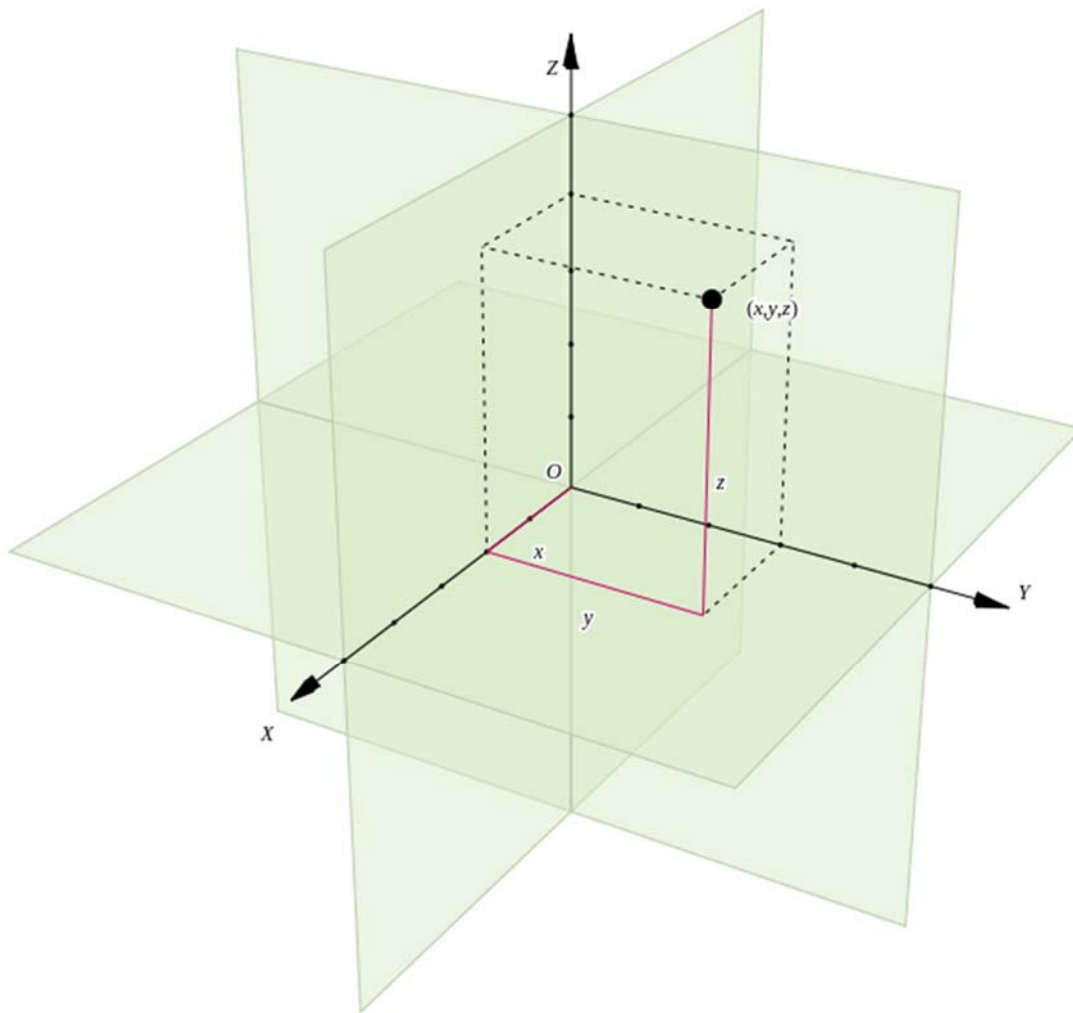
Figure 5: A location on the Earth's surface can be represented by two coordinates: X and Y. If we want to also take elevation into account, we need a Z coordinate as well.

There are various systems for representing coordinates depending on a) the origin point; and b) the method used to translate the curved surface of the earth to a flat map. There are two types of coordinate systems commonly encountered in crime analysis:

1. **Geographic coordinate systems**, which do not project the result. These are based on the spherical surface of the Earth. Of these, the most common is simple **longitude** (X) and **latitude** (Y), which use Prime Meridian (running north/south through Greenwich, England) and the equator as their respective origin points. Locations in the western hemisphere, including the United States, have negative X coordinates. Locations in the southern hemisphere have negative X coordinates.

2. **Projected coordinate systems**, which use a *projection* to render the curved surface of the Earth on a flat map. All projections distort some element of shape or distance, but these effects are minimal at the county or city level. In any event, projected coordinate systems use an origin point at an arbitrary location to the south and west of the area of study. In the U.S., the most common

projections are transverse Mercator and Lambert conformal conic, both used in the *U.S. State Plane Coordinate System*.

Crime mappers rarely have to worry about choosing the appropriate coordinate system or projection. Moreover, ArcGIS does a fine job synthesizing data from multiple coordinate systems on the same map. However, crime mappers often have to troubleshoot problems with data showing up at the wrong location, and this is often the result of an incorrectly-applied projection.

The key point to understand about ArcGIS and coordinates is this: **If ArcGIS does not know the coordinate system of the data source, it will assume that it uses the same coordinate system as the active data frame**. The coordinate system of the active data frame, in turn, is determined by the first file opened unless the user deliberately changes it.
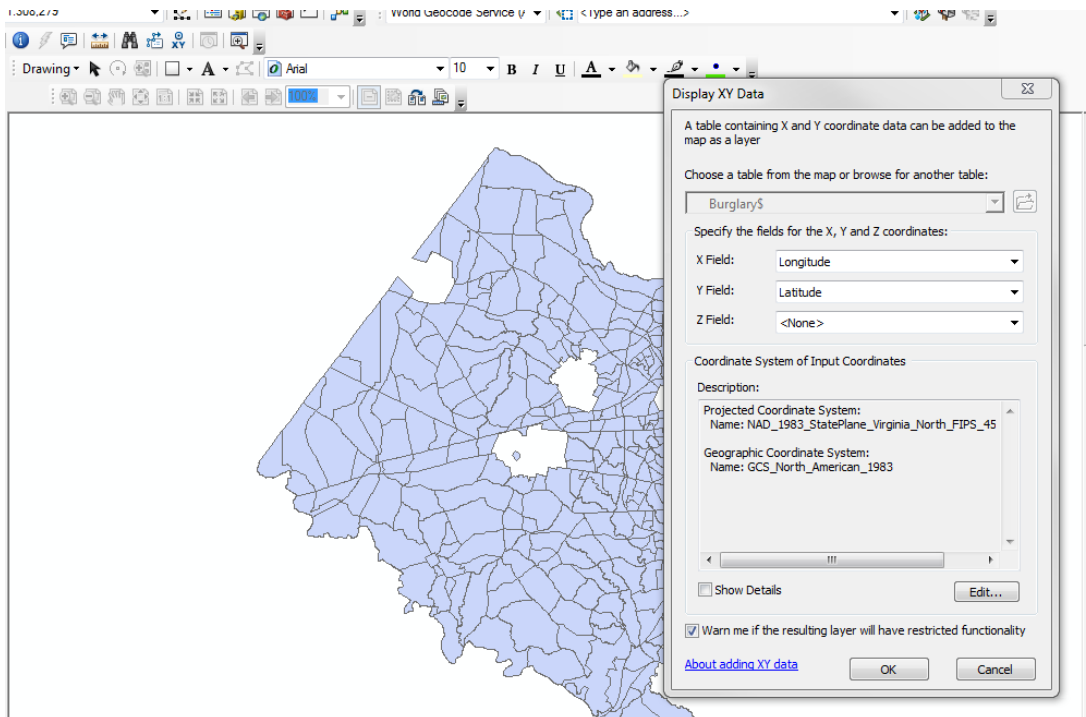
Figure 6: Displaying X/Y data from a dataset, ArcGIS prepares to assume that the dataset uses the same coordinates as the data frame (U.S. State Plane). If it is wrong, the data will not display in the right location.
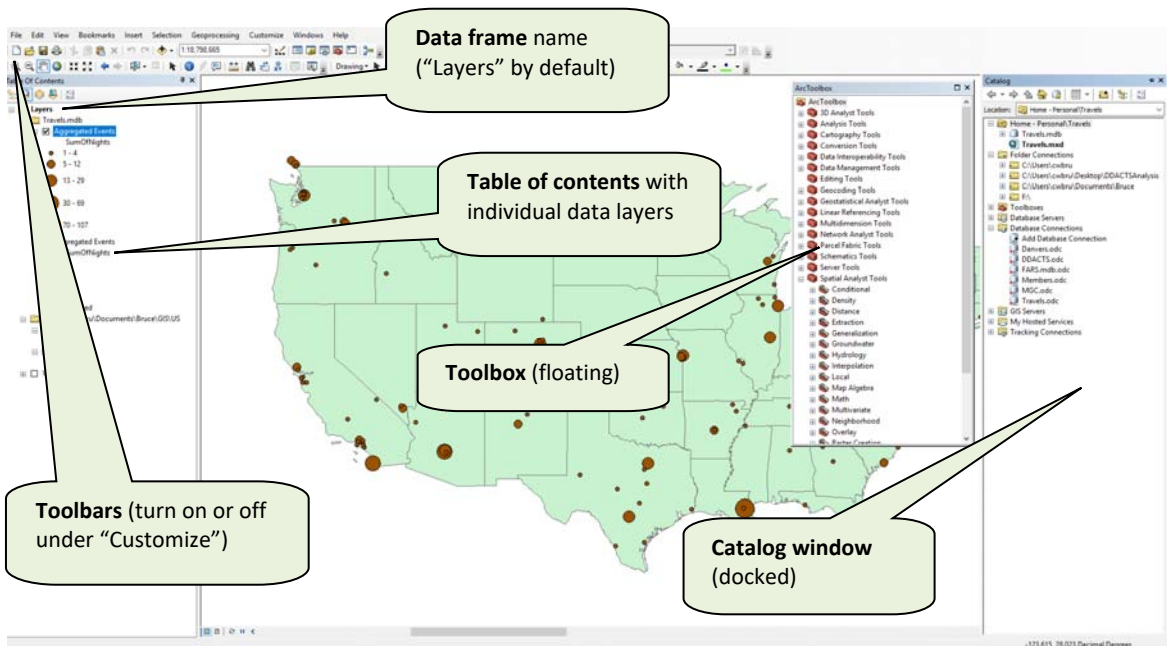
Navigating the Map

Figure 7: The ArcMap display with key elements

ArcMap has several tools for simply moving around the map. Power analysts learn how to use these tools unconsciously.

![zoom in]	**Zoom in**. Click to zoom in at fixed intervals or click and drag to zoom in to a box.
![zoom out]	**Zoom out**. Click to zoom out at fixed intervals or click and drag a box to make the current visible map fit into that area.
Mouse Wheel	The mouse wheel will also let you rapidly zoom in and out.
![pan]	**Pan**. Move around the map without changing the scale.
![full extent]	**Full extent**. Zoom out to the full extent of all layers.
![return]	**Return to previous.** Return to the previous position and zoom level.
Right Click on Layer	**Zoom to layer**. Right-clicking on a layer name and choosing "Zoom to Layer" will zoom to a level where that entire layer is visible but nothing beyond.
![identify]	**Identify**. Lets you see the underlying data for one object at a time.

Map Symbology and Properties

Each layer has a set of **properties**, including the symbology used to depict it on the map. You can change the symbology by double-clicking on it in the symbol beneath the layer name in the table of contents. But to change *all* the properties for the layer, you must double-click on the layer name or right-click on it an choose "properties."
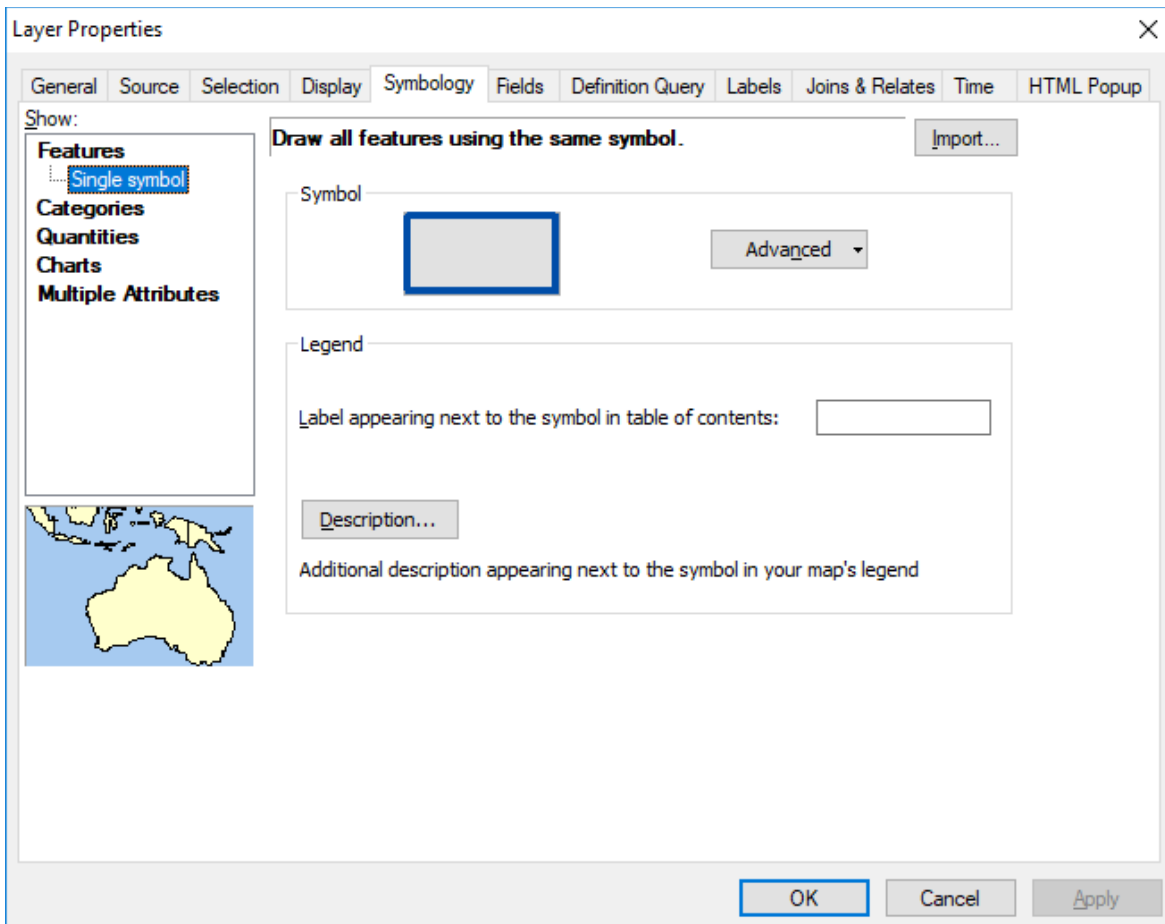
Figure 8: The properties window for a data layer

Some useful properties to set include:

- "General" tab: The name of the layer. You do not need to leave it set to the name of the file.
- "General" tab: A description of the layer for other people who might use this file
- "General" tab: The scale range. You can have the layer automatically turn on or off depending on the zoom level.
- "Symbology" tab: Full symbology options for points, lines, and polygons.
- "Definition Query": Determine which features to show on the map and which to exclude based on underlying attribute data.
- "Labels": Set a label style for your features, including a zoom level.

Basemaps

A **basemap** is a collection of commonly-used layers, establishing the basic geography of the jurisdiction, with the features an analyst or user would most often want to see, with appropriate colors and symbology. Most analysts have a basemap that they use as a starting point for other maps.