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All hands-on exercises are located in the first half of this manual.

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Module 1: Introduction to GIS

GIS Basics & The ArcGIS Platform

Geospatial Technologies at Work: An Introduction to GIS
Brought to you by the Geospatial Training Program
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Welcome!

- **Instructor Introductions**
- **Course Logistics**
- **Student Introductions**
 - **Name**
 - **Organization**
 - **Role in organization**
 - **GIS experience**
 - **Goals and expectations for this class**

 
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Overall Learning Objectives

- 1) Understand basic GIS concepts**
- 2) Learn how to visualize geographic data**
- 3) Master the basics of attribute tables and map features**
- 4) Learn how to create maps for publishing**
- 5) Learn how to use GIS to answer questions**



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What to Expect

- Powerpoint presentations**
- Instructor led “follow the leader” exercises**
- On your own “cookbook” exercises**
- Demos and discussion**
- 10 minute “lightning round” talks**
- Lightning round reference exercises**



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The Road Ahead

Module	Presentation Topic	Exercise Type
Module 1: Introduction to GIS	1-1 - Introduction to GIS Introduction to ArcGIS	Follow the Instructor Exercise 1a - Hands on
Module 2: All about Data	2-1 - Where to Find Data (Lightning Talk) 2-2 - Data Types 2-3 - Understanding Spatial Reference	Exercise 2a – Hands on Exercise 2b – Hands on
Module 3: Working with Tables	3-1 - Introduction to Tables 3-2 – Working with Tables 3-3 – Selections & Queries	Ex 3a - Hands on Ex 3b - Hands on Ex 3c - Hands on
Module 4: Map Production	4-1 – Layer Symbology 4-2 - Adding Text & Graphics 4-3 - Creating a Cartographic Output 4-4 - Data Driven Pages (Lightning Talk)	Ex 4a - Hands On Ex 4b - Hands on Ex 4c - Hands on Reference Exercise 6c
Module 5: Data Manipulation	5-1 - Georeferencing (Lightning Talk) 5-2 - Editing & Creating Data Layers 5-3 - Working with ArcToolbox	Reference Exercise 6f Ex 5a - Hands on Ex 5b - Hands on
Module 6: GIS Hodgepodge Lightning Talks	6-1 - Adding XY Coordinates to ArcMap 6-2 - Mind Over Metadata 6-3 - Google Earth (KML) 6-4 - ArcGIS Online	Reference Exercise 6a Reference Exercise 6b Reference Exercise 6e Reference Exercise 6d

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What is GIS?

Geographic Information System

A computer system that hold and uses data describing places on the earth’s surface.

The diagram shows a globe on the left with a blue line representing a river. To its right is a 3D terrain model with a blue line. Further right is a 2D map with a blue line. A large curly bracket on the right side of these three elements points to a computer system consisting of a monitor, a tower unit, a keyboard, and a mouse.

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Examples of Geographic Information

Physical features of phenomena:
rivers, roads, forests, earthquakes, canyons,
vegetation, precipitation

Human features or phenomena:
population, disease, poverty, ethnicity,
education, unemployment

US Shaded Relief Map

US Population and Growth Trends
Change in county population, 1970-2030

Decreasing population Increasing population

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What is GIS used for?

- Wetland regulation
- Community planning
- Crime mapping
- Site suitability analysis
- Land use analysis
- Forest management
- Water quality protection
- School bus routing
- Emergency response
- Hazard assessment
- Public health
- Service delivery
- Crop management
- Property assessment
- Land use permitting
- Open space planning
- Environmental research
- Infrastructure management

<http://www.esri.com/what-is-gis/showcase>

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Geographic Data in a GIS

Hardware

Software

Digital Data

Parcels

Contours

Soils

Zoning

Land use

Common Coordinate System

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GIS Functions

Capture
Features & attributes

Store
Vector & raster data

Query
Find specific features

Analyze
Answer questions

Display
Visualize data

Output
Maps, reports & graphs

customers

streets

parcels

elevation

land usage

real world

Image: NOAA


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Vector Data Model


Points (single X,Y coordinate)
Examples: fire hydrants, buildings, utility poles

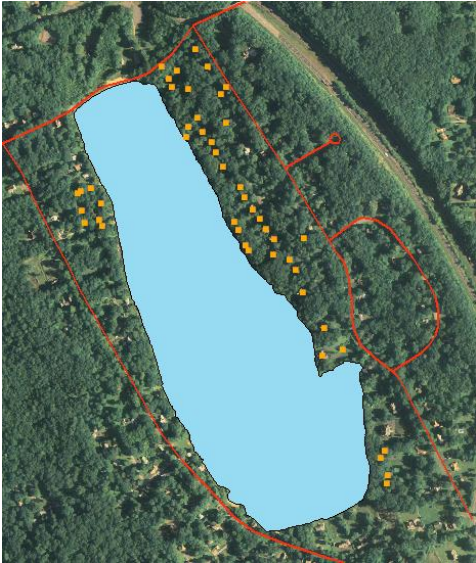


Lines (ordered set of X,Y coordinates)
Examples: power lines, road centerlines, streams



Polygons (sets of X,Y coordinates that start and end at the same location)
Examples: parcels, wetlands, lakes





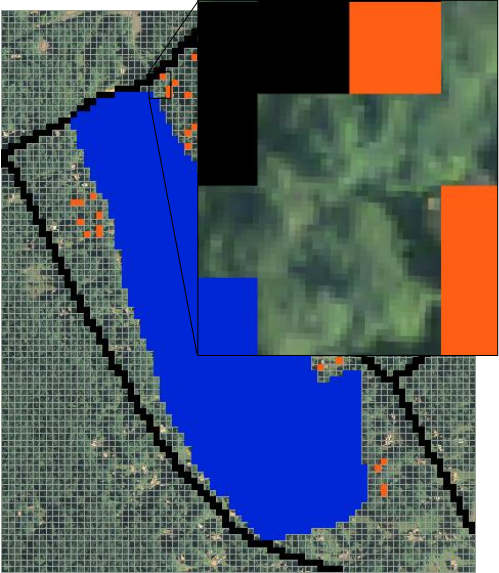
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Raster Data Model

Geographic space is divided into an array of square areas called cells, grids, pixels or rasters.

To map “features” the entire area of a cell is classified as that feature type.

Detail is a function of cell size – smaller cells allow for greater detail.



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Essential Elements of GIS

Andover Trail Access

Geographic Information

Location

Shape

Description

Location & Shape

Longitude	Latitude	Parking	Open Year-round?	Water	Restroom
-72.3822	41.7411	Parking Lot	Yes	Yes	Yes
-72.3896	41.7452	Roadside	Yes	No	No
-72.3486	41.7492	No parking	No	No	No

Descriptive Information

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Vector Data Samples

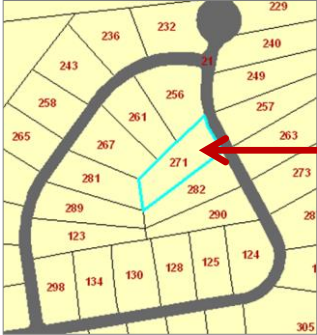
Presentation 1-1 – Introduction to GIS/ArcGIS

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GIS as a geo-relational database

Parcels with IDs displayed





Parcel attributes stored in a feature attribute table

OBJECTID	PARCEL_ID	Deed ID	Street address	Size (deed)	Units	Size (GIS)
269	1/3A/101	60 866	66 SO BUCKBOARD LN	1.74 AC		1.78
269	1/1/21	133 92	345 JONES HOLLOW RD	1.57 AC		1.597
270	1/3A/3	104 85	342 JONES HOLLOW RD	1.25 AC		1.288
271	1/3A/68	56 1076	69 SO STONY BROOK DR	1.4 AC		1.428
272	1/1/22	45 544	JONES HOLLOW RD	1.47 AC		1.346
273	1/3A/60	84 665	64 SO STONY BROOK DR	1.69 AC		1.681
274	1/3A/10	126 753	64 SO BUCKBOARD LN	1.54 AC		1.485
275	1/3A/15	126 548	22 STANDISH DR	1.32 AC		1.282
276	1/3A/86	74 894	15 MAYFLOWER RD	1.76 AC		1.74
277	1/3A/9	60 38	19 STANDISH DR	1.26 AC		1.275

Additional attributes stored in a related table (Excel, Access)

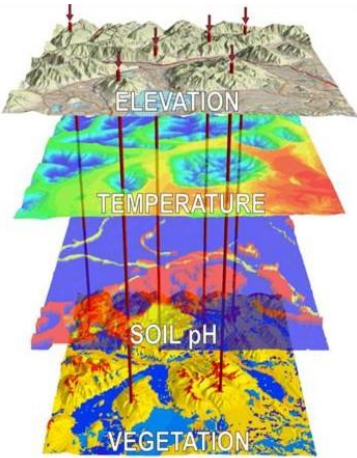
PIN	Owner name	Land value	Building value	Shape_Leng
1/3A/101	Smith, James and Emily	225000	355000	1193.59473140000
1/1/21	Smithfield, Hamn and Pamela	190000	375000	1580.60675952000
1/3A/3	Frederickson, Mathew Jr.	175000	299000	989.333351342000
1/3A/68	Buddington, Kenneth and Pamelee, Faith	195000	342500	1176.76126995000
1/1/22	Johnson, Christopher and	255500	299000	1479.68037626000
1/3A/60A	Miller, Stephen	150000	355000	1197.47711392000
1/3A/100	Kent, Clark and Lane, Lois	155000	190500	1063.46285420000
1/3A/15	Rodriguez, Alex	195000	500500	948.697085353000
1/3A/86	Nelson, Willie and Ann-Marie	205000	446500	1153.47923956000
1/3A/9	Perez, Amanda	220500	223500	962.69642740100



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Using GIS to Analyze Spatial Relationships



Spatial analysis provides insight and additional information from existing data creating value-added products

Analyzing spatial relationships allows us to:

- Answer questions
- Predict future conditions
- Assess location suitability



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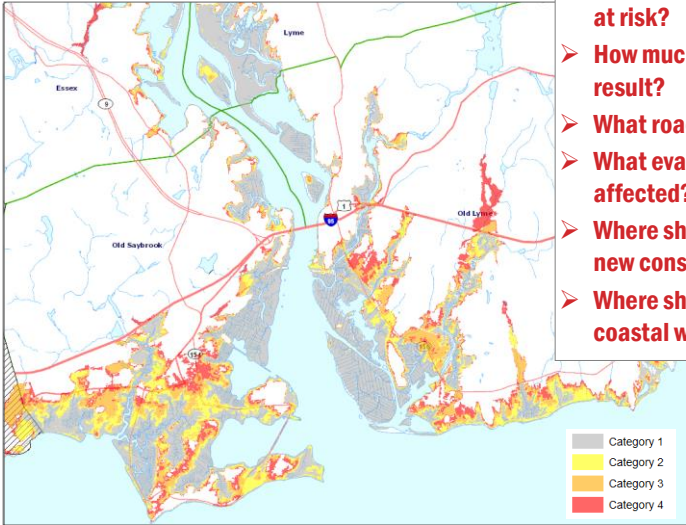
Presentation 1-1 – Introduction to GIS/ArcGIS

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Hurricane Storm Inundation Predictions

Example: Lower Connecticut River

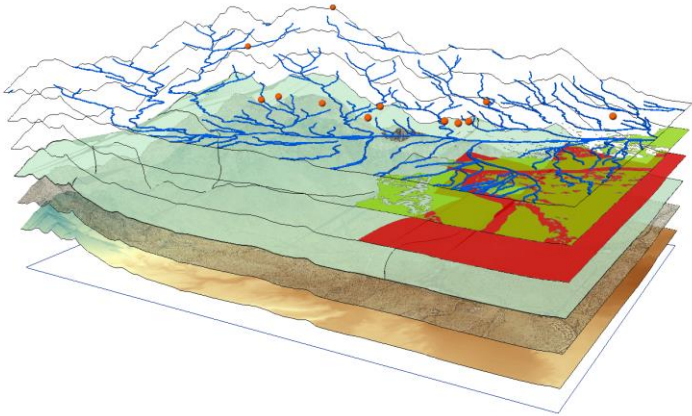


- Which property owners are most at risk?
- How much property damage will result?
- What roads are under water?
- What evacuation routes are affected?
- Where should we avoid building new construction?
- Where should we preserve coastal wetlands?


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Break for Questions



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Jumping Right in to ArcGIS

Desktop GIS

ArcGIS® Desktop
ArcGIS Engine
ArcGIS Explorer

Server GIS

ArcGIS Server
ArcGIS Image Server

Mobile GIS

ArcGIS Mobile
ArcPad®

ESRI Data

Community™ Data
StreetMap™
ESRI Data & Maps

Online GIS

ArcGIS™ Online

Spatial Analysis

Visualization & Cartography

Spatial Data Management

Focus on Desktop GIS

Specific Functions:

- Visualization & Cartography

- Spatial Analysis

- Spatial Data Management

And also... Online GIS

- visualization

- sharing

- mobile

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Jumping Right in to ArcGIS

Desktop GIS

ArcGIS® Desktop
ArcGIS Engine
ArcGIS Explorer

Server GIS

ArcGIS Server
ArcGIS Image Server

Mobile GIS

ArcGIS Mobile
ArcPad®

ESRI Data

Community™ Data
StreetMap™
ESRI Data & Maps

Online GIS

ArcGIS™ Online

Spatial Analysis

Visualization & Cartography

Spatial Data Management

Focus on Desktop GIS

Three license levels:

- Basic

- Standard

- Advanced

Basic

Standard

Advance

Compile, author, map, analyse and publish Geographic information and knowledge

• Entry Level
• Mapping
• Basic Modeling
• GeoProcessing

• Compilation
• Data Management
• Multisuser Editing

• Analysis
• Advanced
• Geoprocessing
• High End
• Cartography

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What is ArcGIS Desktop?

ArcGIS Desktop = Mapping, Analysis & Management

ArcGIS Desktop

Mapping & Visualization


ArcMap
ArcGlobe
ArcScene


Tool & Analysis

ArcToolbox

Organization & Management

ArcCatalog


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Focus on ArcMap & ArcCatalog

ArcMap 

Go-to application. Create beautiful maps.

➤ Visualize data layers


➤ Edit features

➤ Cartography

➤ Geoprocessing

➤ Data Analysis

➤ Map Layouts, Publishing

ArcCatalog 

Organize and catalog data.


➤ Create geodatabases

➤ Read and write metadata

➤ Cut, copy, paste, delete, move data

➤ Manage GIS servers


➤ Search for and add content to ArcMap

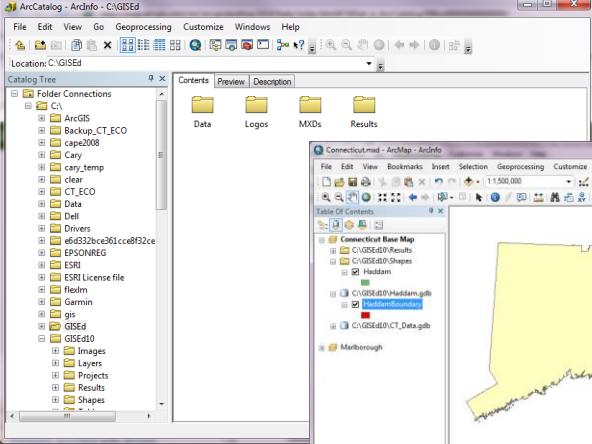


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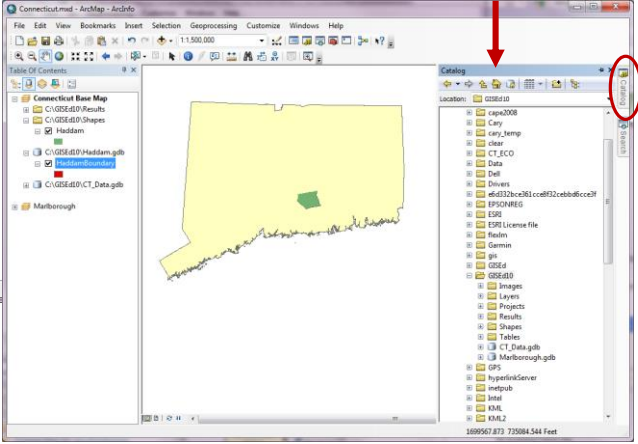
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ArcCatalog Two Ways





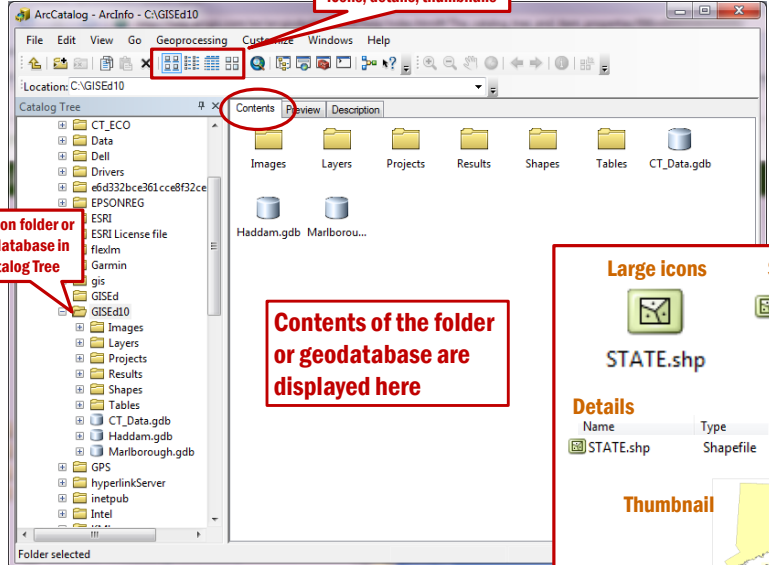
Stand-alone program



Catalog Tab in ArcMap

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Stand Alone




Click on folder or geodatabase in Catalog Tree


Change the appearance of items: large icons, small icons, details, thumbnails

Contents of the folder or geodatabase are displayed here

Large icons




Small icons



Details

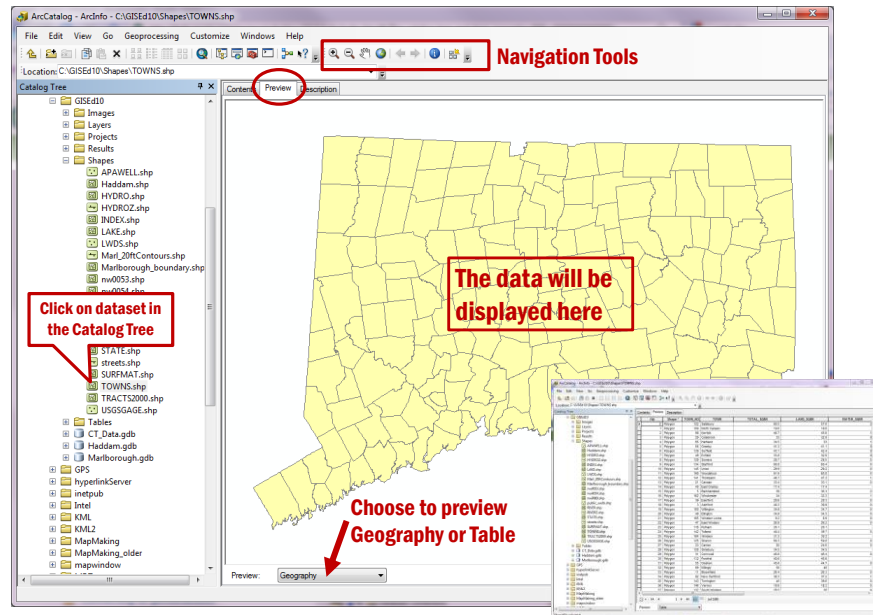
Name	Type	Read/Write	# of Features
STATE.shp	Shapefile	W	603

Thumbnail

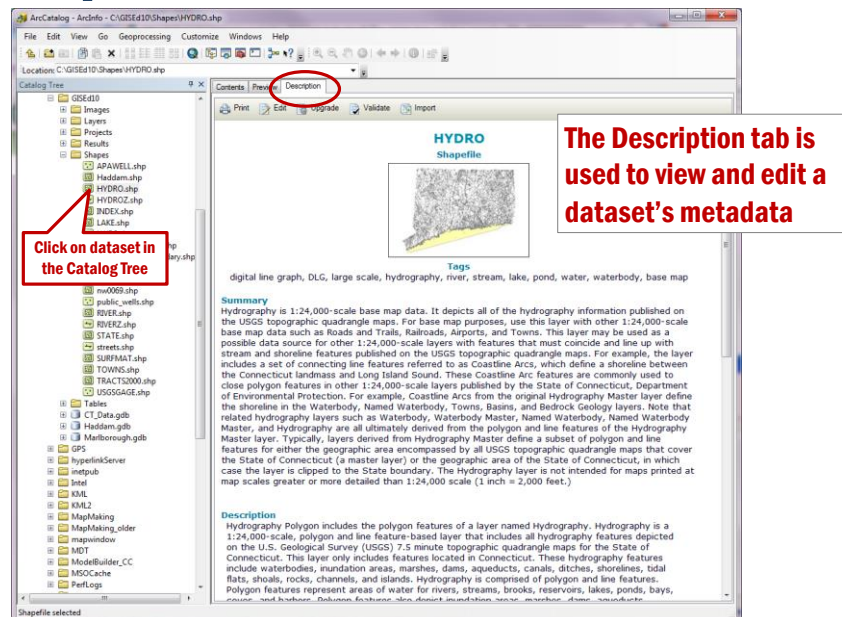


STATE.shp

Preview Tab - Geography

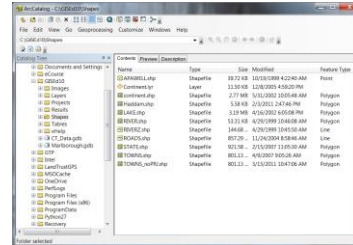


Description Tab



Follow the Leader - ArcCatalog

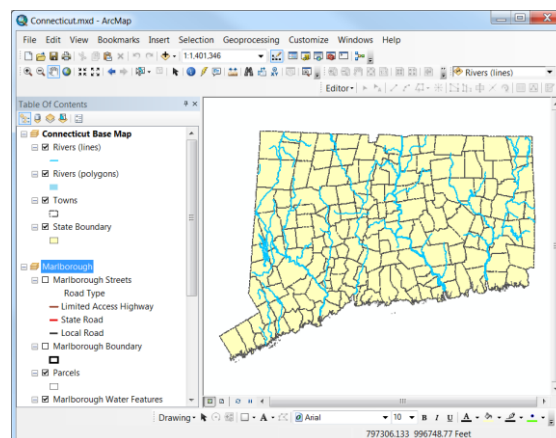
1. Click the ArcCatalog icon on your desktop
2. Locate the C://GIS/Ed10 Folder
3. Sort Contents
4. Preview a dataset
5. View Metadata
6. Create Catalog connection



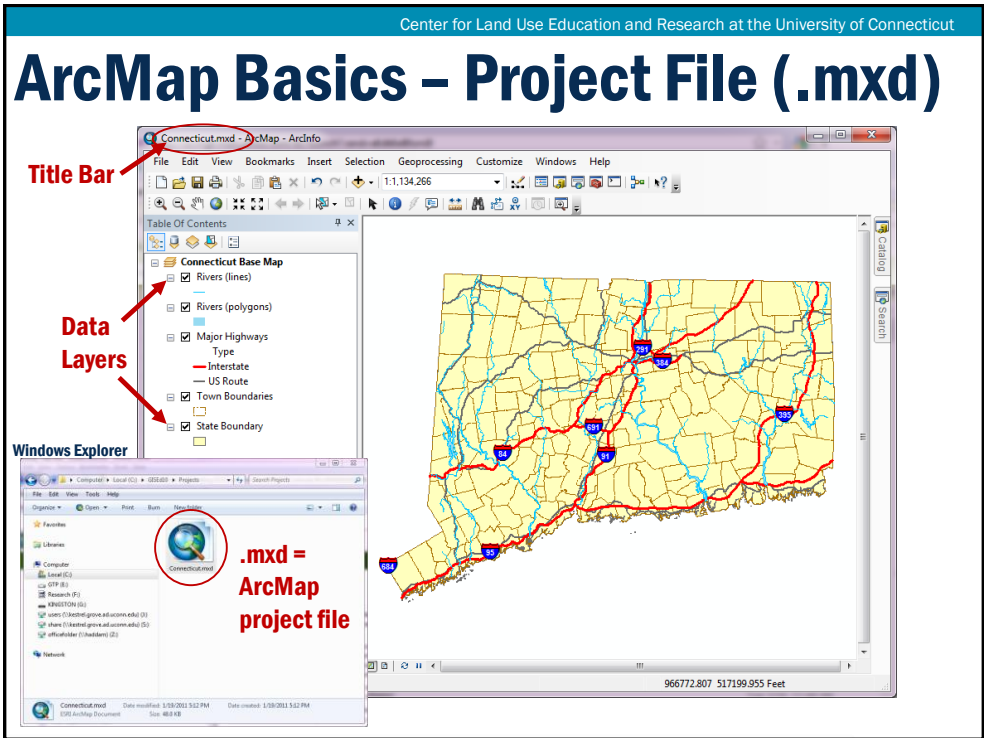
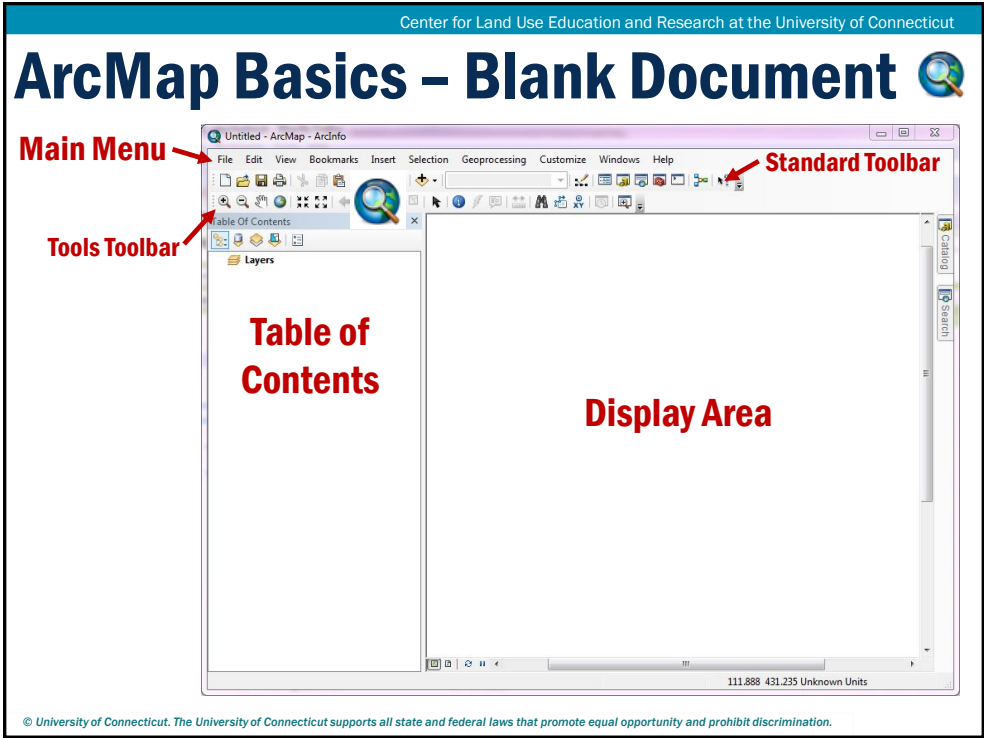
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On to ArcMap



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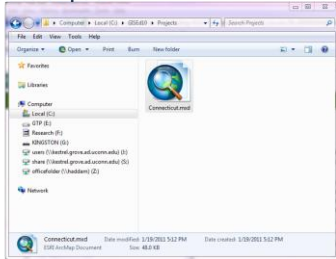


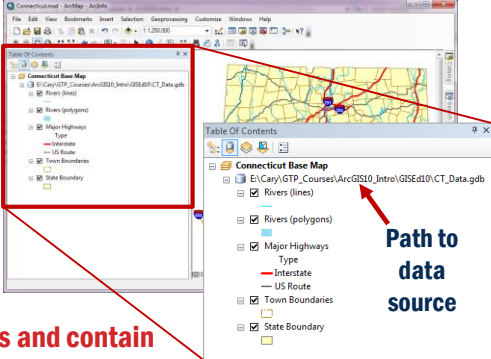
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ArcMap Documents

ArcMap project file = “filename”.mxd


Windows Explorer






Path to data source

Map documents reference data layers and contain instructions on how those data layers are to be displayed in ArcMap. They **DO NOT** store actual data!

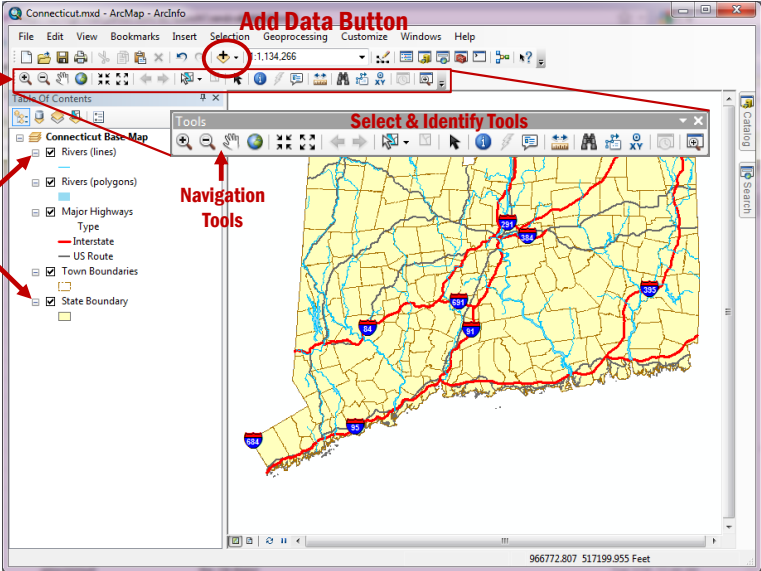
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ArcMap Basics – Project File (.mxd)



Tools Toolbar

Add Data Button

Data Layers

Navigation Tools

Presentation 1-1 – Introduction to GIS/ArcGIS

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ArcMap Details

The screenshot shows the ArcMap interface with several components labeled:

- Current Map Scale:** Points to the scale bar at the top of the map window.
- Table of Contents:** Points to the left-hand pane showing the map's structure.
- Data Frame:** Points to the 'Connecticut Base Map' layer in the Table of Contents.
- Layer List Methods:** Points to the 'Rivers (lines)' layer in the Table of Contents.
- Data Layers:** Points to the 'Rivers (polygons)' layer in the Table of Contents.
- Display Area:** Points to the main map window showing the map of Connecticut.
- Toggle between Data View and Layout View:** Points to the 'Data View' button at the bottom of the map window.
- XY Location:** Points to the coordinate display at the bottom right of the map window.
- Catalog window:** Points to the right-hand pane showing the project's file structure.
- Search Tool:** Points to the 'Search' button in the Catalog window.

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Adding/Removing Toolbars

The screenshot shows the ArcMap interface with the 'Customize' menu open, highlighting the 'Toolbars' option. A tip box indicates that right-clicking on the header bar will also display toolbars.

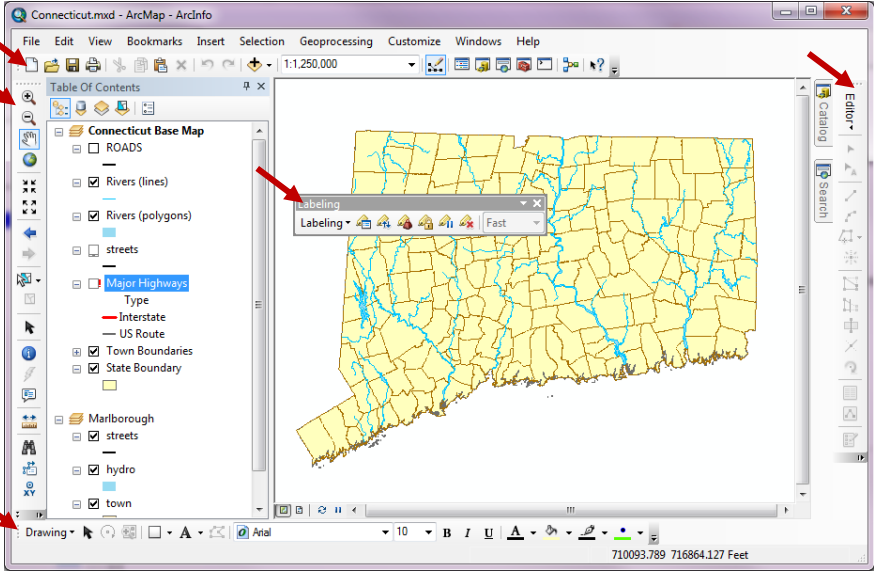
To add or remove a toolbar, click on Customize>Toolbars

A toolbar is "on" when checked

Tip: right click on header bar will also display toolbars

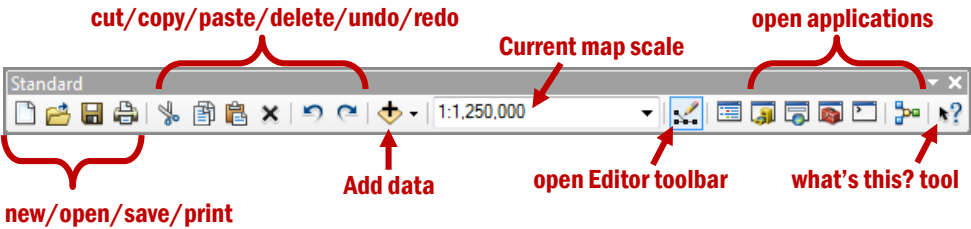
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Moving & Docking Toolbars



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The Standard Toolbar



map scale

1:1,000,000
1:1,000
1:10,000
1:24,000
1:100,000
1:250,000
1:500,000
1:750,000
1:1,000,000
1:3,000,000
1:10,000,000
<Customize This List...>

Methods of scale entry:

- Type number, no separator
- 1: and a number
- Relative scale (e.g. 1 in = 1 mile)
- Numbers and words (e.g. one inch = 5 mi)
- Commas or no commas (e.g. 1,000 or 1000)

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The Tools Toolbar

The screenshot shows the ArcGIS Tools toolbar with the following tools and labels:

- zoom/pan/full extent/fixed zoom**: A bracket groups the first four tools (Zoom In, Zoom Out, Pan, Full Extent).
- go forward/back extent**: Points to the Forward and Back arrows.
- select elements**: Points to the Select tool.
- select/unselect features**: Points to the Select tool.
- identify features**: Points to the Identify tool.
- hyperlink**: Points to the Hyperlink tool.
- HTML popup**: Points to the HTML Popup tool.
- measure**: Points to the Measure tool.
- find**: Points to the Find tool.
- route**: Points to the Route tool.
- go to XY**: Points to the Go to XY tool.
- time slider**: Points to the Time Slider tool.
- viewer**: Points to the Viewer tool.

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Basic Tools

The screenshot shows the ArcGIS interface with the following tools and labels:

- identify**: Points to the Identify tool, which is open and showing a list of features.
- select**: Points to the Select tool, which is open and showing a map of the area.
- measure**: Points to the Measure tool, which is open and showing a measurement of a line segment.

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Adding a Data Layer to ArcMap

Add Data

Browse to a local or network drive or web server to find and add a data layer

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The Table of Contents

Functions:

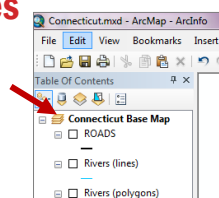
- Lists all layers and tables in the map document
- Allows you to control the visibility of a layer
- Shows layer symbology
- Provides access to a layer's attribute table
- Provides access to a layer's properties window
- Allows you to organize data into one or more "data frames"

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The Data Frame

- A Data Frame is a “container” for layers
- ArcMap supports multiple Data Frames in a single project
- Only one Data Frame can be active at a time
- Only one Data Frame can be visible at a time in Data View however all Data Frames are visible in Layout View
- Layers can be dragged between Data Frames
- Data Frames have Properties



The Data Frame – Data View

A data frame is a container for layers

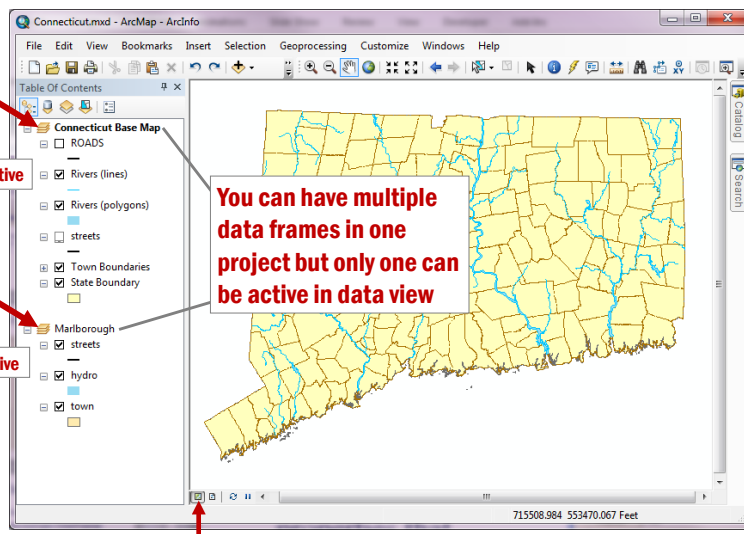
Data frame

active

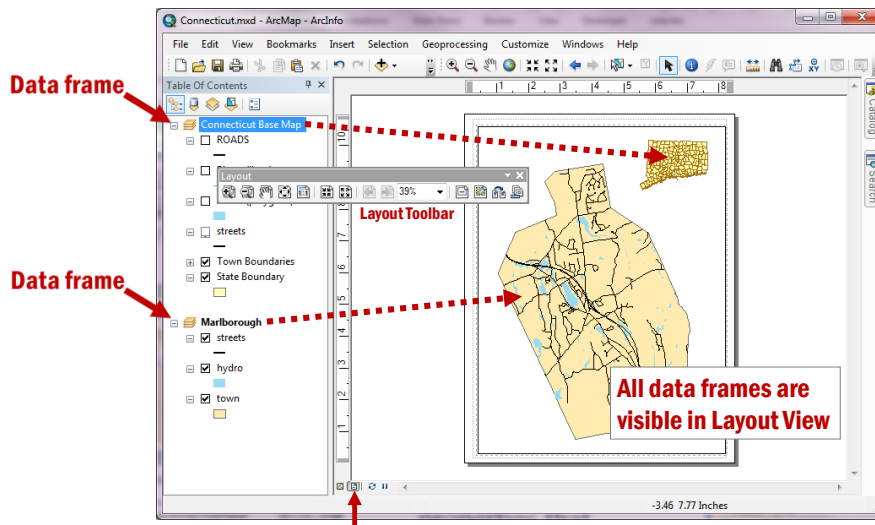
Data frame

inactive

You can have multiple data frames in one project but only one can be active in data view



The Data Frame – Layout View



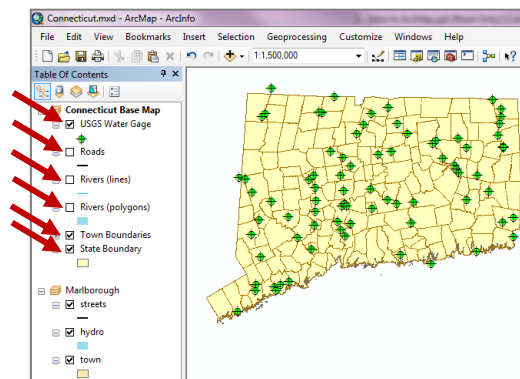
Layers

A layer references a dataset – a shapefile, a geodatabase feature class, CAD file, image, coverage, etc. Layers typically represent a single category of data such as parcels, wells, roads, soils or buildings.

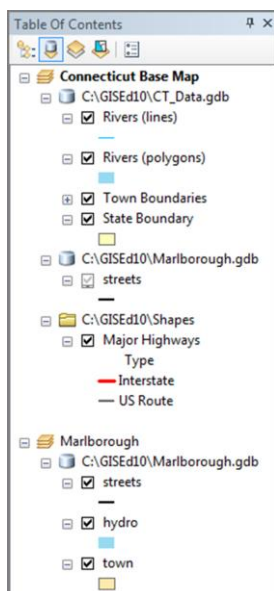
Layers have:

- **A data source**
- **Properties**
- **Attributes**

Layers DO NOT store geographic data, they simply point to the data source.



Layers and Data References



- A data set is a feature class, shapefile or raster stored in a geodatabase or file on disk.
- A data set is represented by a layer in the TOC.
- Project files (.mxd) contain layers and layer properties but DO NOT contain actual data sets.
- A layer references the data set (points to it) and controls how the data set is displayed on your map. These display properties can be established through the Layer Properties window.

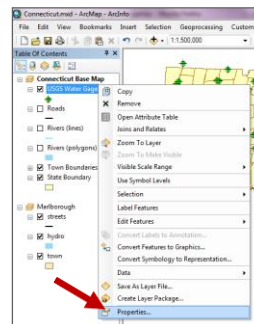
Absolute Path: C:\GIS\Ed10\Boundary.shp

Relative Path: \GIS\Ed10\Boundary.shp

Layers Have Properties

All aspects of a layer can be controlled through the layer's Properties. These include:

- How to draw features (symbology)
- What features to draw (definition query)
- What data source the layer is based on
- Feature labels
- Scale dependency
- Attribute field properties



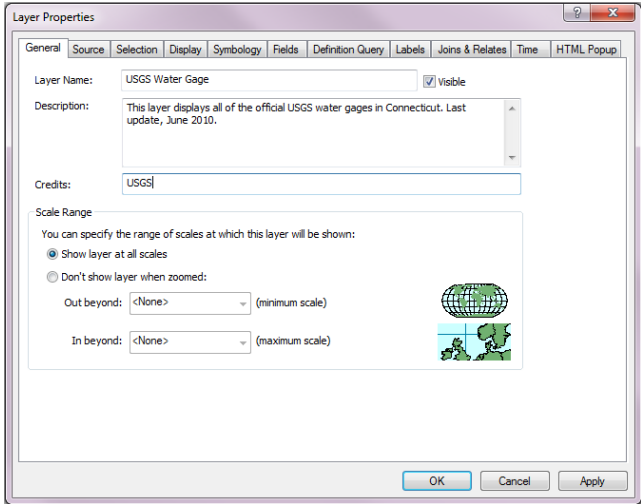
The Layer Properties dialog window will look different depending on what type of geographic data you are working with (shapefiles will look different from rasters and CAD datasets).

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Layers Have Properties

Feature Layer Properties:

- **General**
- **Source**
- **Selection**
- **Display**
- **Symbology**
- **Fields**
- **Definition Query**
- **Labels**
- **Joins & Relates**
- **Time**
- **HTML Popup**



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Layer Property Tabs


- **General**: layer description, credits, scale dependent drawing
- **Source**: view and change data source, view extent of data
- **Selection**: specify how selected features draw
- **Display**: layer transparency, MapTips, hyperlinks
- **Symbology**: control how features are rendered on your map
- **Fields**: Define field properties (aliases, number formats, visibility)
- **Definition Query**: specify a subset of features to be used & displayed
- **Labels**: label features, manage label classes & placement
- **Joins & Relates**: join or relate attribute table to other tables
- **Time**: used to specify the time properties of time aware layers
- **HTML Popup**: used to specify how pop-ups are generated when you click a feature to display information about it.

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Saving Layer Properties


Layer Properties are saved in:

The project file (.mxd)



A layer file (.lyr)





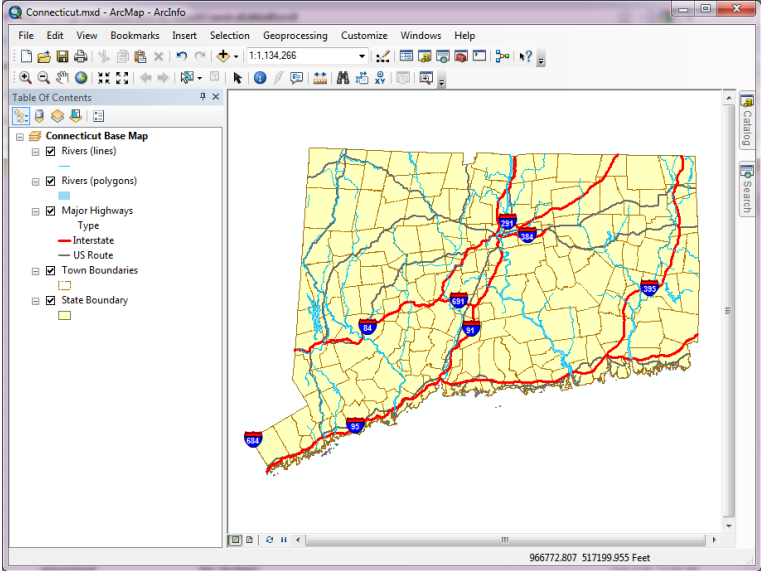
Marl_Zoning.shp

Both .mxd and .lyr files reference the actual dataset

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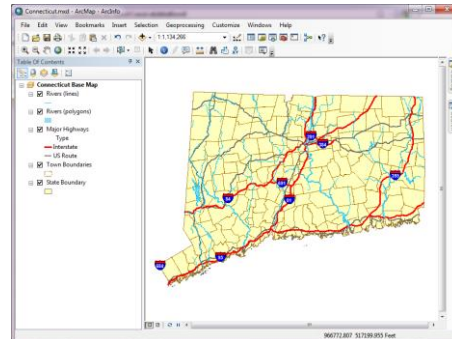
ArcMap Basics – Live Demo



ArcMap Basics – Hands on Exercise

Exercise 1 a

- **Getting to know the ArcMap Interface**
- **Working with Project Files (.mxd)**
- **Toolbars**
- **Adding Data**
- **Layer Properties**
- **Data Frames**
- **Finding Help**



Module 2: All About Data

LT: Where to Find GIS Data

Geospatial Technologies at Work: An Introduction to GIS

Brought to you by the Geospatial Training Program

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Talking Points

- 1) Federal, State, Local resources for viewing and downloading GIS Data**
- 2) Connect to data vs. download data?**

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Where's the Data?

ArcGIS is the software.

But data (plus people, methods & procedures) drive the System.

Show me the data!

Software

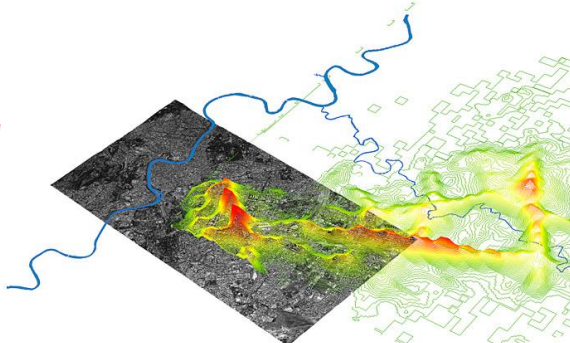
People

Methods & procedures

Hardware

Data

Five Parts of GIS



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Federal Data Source – Data.gov

DATA.GOV

DATA TOPICS IMPACT APPLICATIONS DEVELOPERS CONTACT

location

Filter by location

Connecticut

9,524 datasets found

Aerial Photography and Imagery, Ortho-Corrected, Black and white 0.82 feet pixel resolution leaf-off ortho imagery that covers the state of Connecticut, Published in 2004, University of Connecticut.

NSGIC GIS Inventory (Julia Ramona) – This Aerial Photography and Imagery, Ortho-Corrected dataset, was produced all or in part from Orthoimagery information as of 2004. It is described as "Black and..."

Aerial Photography and Imagery, Ortho-Corrected, Leaf-on September 2004 0.5m resolution CIR or tholimagery that covers Connecticut's coastal communities. Data were collected by Earth Data, under contract to NOAA, using a Leica ADS40 sensor., Published in 2004, University of Connecticut.

topic

Filter by topic

Climate (251)

251 datasets found

Coastal Flood Hazard Composite Layer for the Coastal Flood Exposure Mapper

National Oceanic and Atmospheric Administration, Department of Commerce – This is a map service for the Coastal Flood Hazard Composite dataset. This dataset was created by combining hazard zones from the following datasets: FEMA V zones...

Regional Snowfall Index (RSI) 27 recent views

National Oceanic and Atmospheric Administration, Department of Commerce – NOAA's National Climatic Data Center is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern half of the U.S.

Fixed-Guideway Transit Stations (National) - National Geospatial Data Asset (NGDA) Transit (Stations)

Department of Transportation – Version 2004 of the Fixed-Guideway Transit Network is a network database of the nation's fixed-guideway transit systems (NTAD 2015). The data set covers systems in...

Presentation 2-1 – Where to Find Data

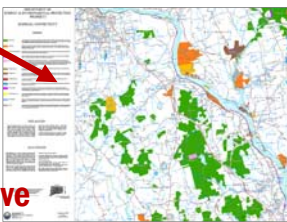
28

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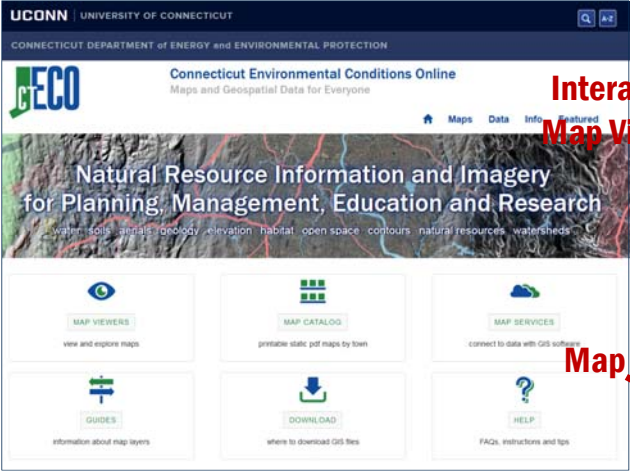
State Data Source - CTECO

<http://cteco.uconn.edu>

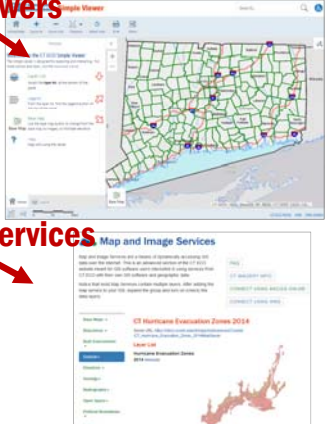
PDFs



Interactive Map Viewers




Map Services




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Data Download – CT DEEP, MAGIC

<http://magic.lib.uconn.edu>





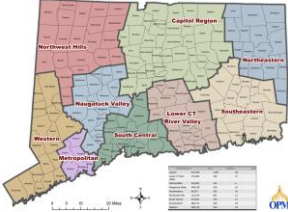
http://magic.lib.uconn.edu





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Local Data Resources – COGs, Towns

Regional GIS



Municipal GIS




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Connect or Download?


Connect to Data – Map services

- Hosted online, connect to via URL
- Mainly for display purposes only
- Limited user control
- No hard drive (local) storage



Download Data – Data files, formats, storage

- Physical download of geodata file(s)
- Requires desktop GIS software to use
- Local storage (can be significant)
- More functional within a desktop GIS



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Questions?



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Module 2: All About Data

Working with Data Types

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Learning Objectives

- 1) Geographic data types**
- 2) Shapefiles**
- 3) The ESRI Geodatabase**
- 4) ArcCatalog**
- 5) Data Management**
- 6) Connecting to Online Data**

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Geographic Data Types

Esri Supported Data Formats (there are more)		
ArcGIS Server geocode services	OLE DB tables	DFAD
ArcGIS Server globe services	PC ArcInfo coverages	DIME
ArcGIS Server image services	Rasters (.img, grid, .sid, .tif, .ntf, ArcSDE raster and more)	DLG
ArcGIS Server map services	SDC	ETAK
ArcInfo coverages	SDE layers	GIRAS
ArcIMS map services	Shapefiles (.shp)	IGDS
DNG	Text files (.txt)	IGES
DWG	Excel files (.xls)	MIF
DXF	TIN	MOSS
ESRI Geodatabases	VPF	SDTS
OGC WCS services	ADS	SLF Tiger
OGC WMS services	AGF	Sun Raster

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Geodata Models



Vector Data Model

- points, lines, polygons

Raster Data Model

- row, column, cell size, resolution

Real World Vector Raster



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Shapefiles

A shapefile is a simple data format for storing the geometric location and attribute information of geographic features.

Shapefiles are made up of three or more files with specific file extensions.

Required

Anatomy of a Shapefile

.shp – the main file that stores feature geometry	.shx and .sbx – store spatial indexes
.shx – the index file that stores the index of the feature geometry	.prj – stores coordinate system information
.dbf – the dBASE table that stores the attribute features	.xml – stores metadata information

A shapefile must have the same prefix and each associate file must be located in the same workspace (folder)

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Shapefiles are Vector Data

Points (single X,Y coordinate)
Examples: fire hydrants, buildings, utility poles

Lines (ordered set of X,Y coordinates)
Examples: power lines, road centerlines, streams

Polygons (sets of X,Y coordinates that start and end at the same location)
Examples: parcels, wetlands, lakes

A single shapefile can only contain one geometry type

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Esri Geodatabase Feature Class

The diagram shows two evolutionary paths. The top path starts with an ape and progresses through three stages of human evolution, ending with a modern human carrying a briefcase. Below this path is a red arrow pointing right with the text: **Shapefile – stable, cross- platform, no longer evolving**. The bottom path also starts with an ape and progresses through three stages of human evolution, but the final stage is a modern human holding a smartphone. Below this path is a red arrow pointing right with the text: **Geodatabase Feature Class – Utilizes the full potential of ArcGIS**.

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The Geodatabase

The geodatabase is a native data structure for ArcGIS and is the primary data format for editing and data management.

The diagram illustrates the structure of GIS Data in the Geodatabase (GDB). It shows a central circle labeled 'GIS Data in the Geodatabase (GDB)' containing a list of data types: Attribute Table, Feature Class, Cartographic Representation, Annotation, Dimension, Relationship Class, Raster Dataset, Raster Catalog, Topology, Geometric Network, Network Dataset, Terrain, Locator, Survey Dataset, and Toolbox. To the left, a 'Single-User GDB' is shown as a cylinder containing 'File GDB' and 'Personal GDB'. An orange arrow points from the 'File GDB' to the 'Single-User GDB'. To the right, a 'Multiuser GDB' is shown as a cylinder containing 'RDBMS'. Below the 'Multiuser GDB', three boxes are stacked: 'Enterprise GDB', 'Workgroup GDB', and 'Desktop GDB'. The text 'Image: ESRI' is at the bottom right of the diagram.

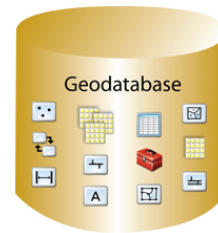
At its most basic level, an ArcGIS geodatabase is a container for spatial and attribute data. It is a collection of geographic datasets of various types held in a common file system folder, Access database or a multiuser relational DBMS (Oracle, Microsoft SQL Server, PostgreSQL, Informix, or IBM DB2).

An illustration of a trash can with a map and data layers being thrown into it, symbolizing the disposal of old data formats.

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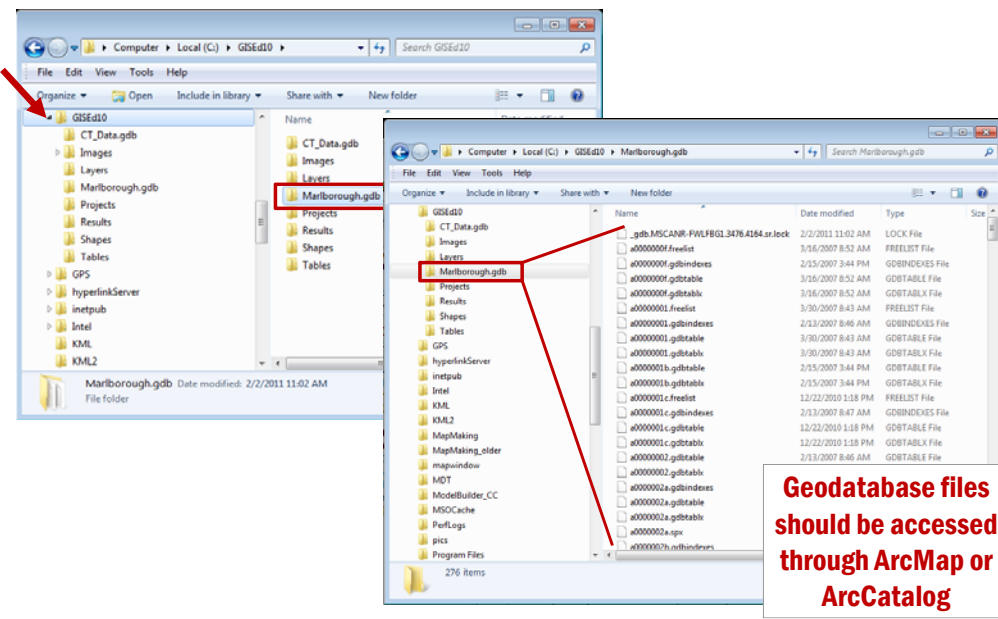
Advantages of Geodatabases

- **Centralized data storage location**
- **Improved data integrity**
- **No size limitation**
- **Improved data entry and editing environment**
- **Increased performance - faster**
- **Multi-user database**
- **ESRI's #1 supported format**
- **Evolving**



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File Geodatabase in Explorer



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Geodatabase in ArcCatalog

The screenshot shows the ArcCatalog interface. The main map area displays a map of Marlborough, CT, with various data layers. The Catalog pane on the right lists the contents of the 'Marlborough.gdb' geodatabase, including feature classes like 'streets', 'hydro', 'town', and 'public_wells'. A red arrow points to the Catalog pane, and another red arrow points to a specific feature class in the list.

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Anatomy of a Geodatabase

The diagram illustrates the anatomy of a geodatabase. It shows a central 'Geodatabase' cylinder connected to three main categories: 'Feature classes', 'Raster datasets', and 'Tables'. These categories are further detailed in a table below. The diagram also shows a 'File Geodatabase.gdb' structure with various feature classes and datasets, including 'boundary', 'parcels', 'streets', 'Haddam_DRGs', 'election', 'public_wells', 'State_Roads', and 'watersheds'. Red arrows indicate the relationships between these components.

GIS Data	Geodatabase Dataset
Coverage	Feature dataset containing feature classes
Shapefile	Feature class
Raster data (e.g., satellite images, air photos, scanned maps, and digital pictures)	Raster dataset and/or raster catalog
CAD data	Feature dataset containing feature classes
Surface modeling or 3D data	Terrain
Utility network data (e.g., water systems, gas pipelines, and telecommunication networks)	Geometric network
Transportation network data (e.g., street networks)	Network dataset
GPS coordinates	Table of x,y coordinates that can be generated into a feature class
Survey measurements	Cadastral fabric

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Geodatabase Feature Classes

Feature classes are homogeneous collections of features. The most common types of geodatabase feature classes are: points, lines, polygons and annotation (map text).

➤ **Points** – features too small to be represented as lines or polygons. These are represented as a single XY location.

➤ **Lines** – represented by an ordered set of XY coordinates. Features that have length but no area.

➤ **Polygons** – represented by an ordered set of XY coordinates that begin and end at the same coordinate. An enclosed shape.

➤ **Annotation** – map text including properties for how the text is rendered. Can be linked to features.

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Image: ESRI

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Geodatabase Feature Classes

FID	Shape *	OBJECTID	TOWN_NO	TOWN	TOTAL_SQMI	LAND_SQMI	WATER_SQMI	COUNTY	PLAN_ORG	DEP_DIST
0	Polygon	111	61	Haddam	46.7	44.5	2.2	Middlesex	Midstate	DEP Eastern District

Shape *	OBJECTID	TOWN_NO	TOWN	TOTAL_SQMI	LAND_SQMI	WATER_SQMI	COUNTY	PLAN_ORG	DEP_DIST	Shape_Length	Shape_Area
Polygon	111	61	Haddam	46.7	44.5	2.2	Middlesex	Midstate	DEP Eastern District	151854.411178	1290435984.17261

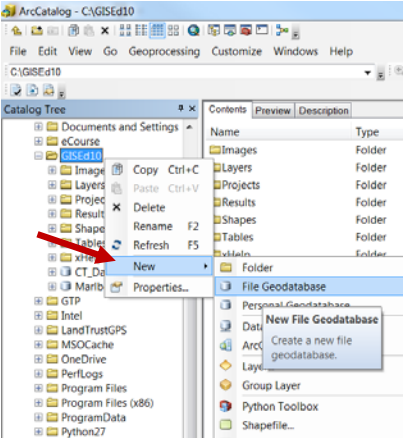
Presentation 2-2 – Data Types

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File Geodatabase Admin

ArcCatalog!

- Create and manage a file geodatabase
- Create/import/export feature classes, rasters, tables, other data types
- Set up feature class subtypes, domains, relationship classes (not for this class)



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Geodatabase Benefits

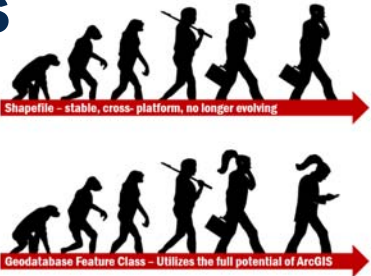
Data organization

Standardization

Data Distribution


Industry-specific data models (support.esri.com/datemodels)

Common download format



Shapefile – stable, cross-platform, no longer evolving

Geodatabase Feature Class – Utilizes the full potential of ArcGIS



Presentation 2-2 – Data Types

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Connecting to Data through the Web

New(er) paradigm of accessing GIS data over the Internet:

1. GIS user creates data in desktop
2. Creates a “service” of data hosted in the cloud. Accessible through a URL.
3. Service can be accessed using URL from various mapping platforms – desktop, web maps, web apps, mobile apps, etc.

The diagram illustrates the cloud-based GIS paradigm. At the bottom, an 'Author' (represented by a desktop computer) creates data. This data is then 'Served' (represented by a server icon) to a 'Cloud' (represented by a blue cloud icon). From the cloud, the data is 'Used' (represented by various mobile and desktop devices) by different users. A double-headed arrow connects the cloud to the 'Use' section, indicating bidirectional communication.

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Add ArcGIS Online Data (in ArcMap)


This screenshot shows the ArcMap interface. The 'Add Data From ArcGIS Online...' option is highlighted in the 'Add Data...' menu. A red arrow points to this menu item. Another red arrow points to the 'Add Data From ArcGIS Online...' button in the 'Layers' panel on the right.

This screenshot shows the ArcGIS Online web interface. The search results for 'CT Spring 4 band 2016 3inch' are displayed. A red arrow points to the search bar at the top. Another red arrow points to the 'Add' button next to the 'CT Shaded Relief No Adjustment (Statewide h)' result.

Presentation 2-2 – Data Types

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LOTS of Web Enabled Data Out There!



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The ArcGIS REST Services Directory

Services Directory allows you to browse the contents of an ArcGIS Server, link to metadata, and find information to help develop applications.

Often, organizations serving their GIS Data will direct users to the REST services directory for their server. It's important to know how to use these services!



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Examples

USGS The National Map Viewer

The National Map - Service Endpoints

Natural Hazards

USGS US Hazards	REST	WMS	ArcGIS.com	ArcMap	Legend	Thumbnail	Published Date: Refresh Cycle:
USGS Stream Flow, Weather & Tide Stations	REST	WMS	ArcGIS.com	ArcMap	Legend	Thumbnail	Published Date: Refresh Cycle:
NGA US National Grid	REST		ArcGIS.com	ArcMap		Thumbnail	Published Date: Refresh Cycle:

National Oceanic and Atmospheric Administration's National Weather Service

National Weather Service Data as OGC Web Services

This page is for data that is available as OGC Web Services. The [WMS Service Page](#) links to the pages containing the WMS and other NOAA Line Office web service. This page contains web services that conform to the International Consortium (IOC) standards for web services. These standards are supported: Web Mapping Services (WMS), Web Feature Services (WFS) and Web Coverage Services (WCS). A limited set of data are available at this time and the Web are below.

The following links will lead you to a REST page for services or a download page for images:

Current Weather

Forecasts

Past Weather/Climate

Watches, Warnings and Radar

Hurricanes/Tropical Storms

From the Climate Prediction Center (CPC)

+ 6 to 10 Day Precipitation and Temperature Outlooks

+ 8 to 14 Day Precipitation and Temperature

Hartford Data

public safety

SEARCH WITHIN MAP

Location details of 528,215 features

Police Crime Data

Details Table Charts

DESCRIPTION

ABOUT

Full Dataset

GeoJSON

http://gisdata.hartford.gov/datasets/h226933a414046

GeoService

http://gis1.hartford.gov/arcgis/rest/services/OpenData

Filtered Dataset

GeoJSON

http://gisdata.hartford.gov/datasets/h226933a414046

GeoService

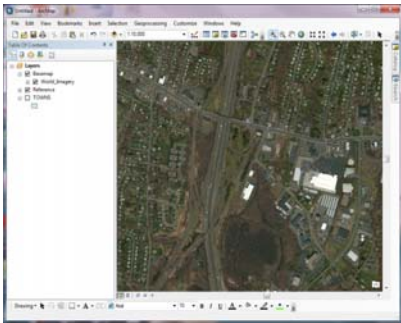
http://gis1.hartford.gov/arcgis/rest/services/OpenData

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Hands on Exercise: All About Data

- **Get to know ArcCatalog**
- **Exploring Data Types**
- **Working with File Geodatabases**
- **Connecting to Web Enabled Data**
- **Adding Content from ArcGIS Online**
- **Adding Data from a REST Endpoint**




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Presentation 2-2 – Data Types

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Questions?



Up next...Tables.

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Module 2 – All About Data Projections & Coordinate Systems

Geospatial Technologies at Work: An Introduction to GIS

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Learning Objectives

- 1) What are Projections, Coordinate Systems?**
- 2) The Spatial Reference**
- 3) Data Frame and Feature Settings**
- 4) ArcMap Tools – Defining and Converting**

This presentation will **not** make you an expert (not even close).

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Latitude and Longitude

Haddam, CT
41.4771° N (latitude)
72.5123° W (longitude)

Line of latitude

Line of longitude

Equator

Prime meridian

One degree of longitude:
Near pole: ~ 35 miles
At equator: ~ 69 miles

In order to fix this, we need to convert our 3D sphere to a 2D map with the help of datums, coordinate systems and projections.

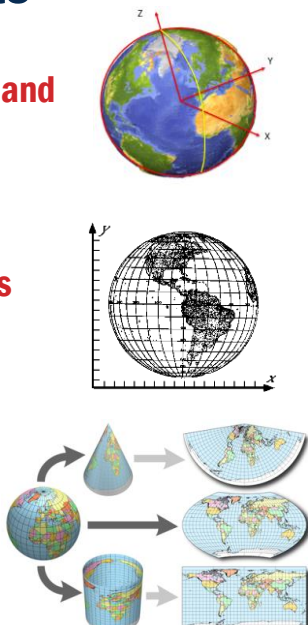
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Transformation Components

The Datum – provides the reference for 2D and 3D models of the physical Earth.

The Coordinate System – a pair of axes superimposed on a map projection that is used to locate features on the map.

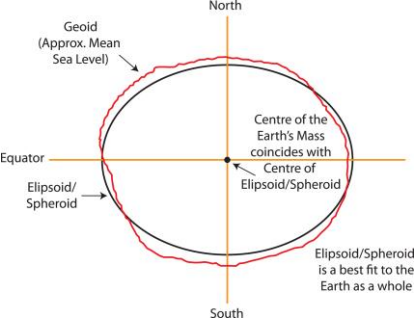
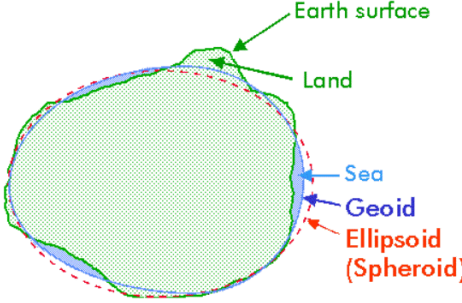
Map Projection – a mathematical function for converting the Earth’s curved surface to a flat plane.



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Datums

A datum characterizes the shape of the Earth’s surface and is defined by specifying the origin of the coordinate system, the orientation of the coordinate system, and the dimensions of the ellipsoid.



The most common horizontal datum in use in the U.S. is the **North American Datum of 1983 (NAD83)**. It’s origin is located at the center of the earth’s mass.

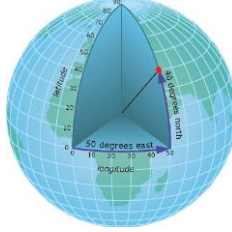
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Coordinate Systems

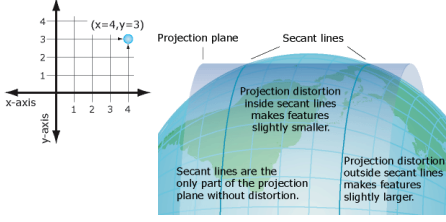
Datum defines a standard point of reference (origin) for a coordinate system. The coordinate system acts as the frame of reference for location and plotting any feature on a map.

Two main types of Coordinate Systems:

Geographic Coordinate Systems (Global latitude-longitude)



Planar or Cartesian Coordinate Systems (State Plane, UTM)



Coordinate Systems provide the numbers to define your position on a globe or a map.

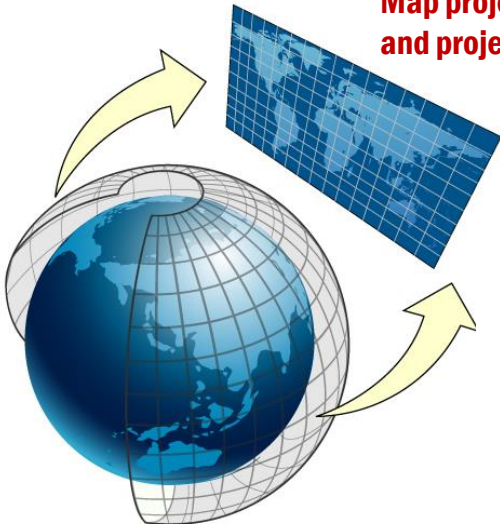
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Map Projections

Map projections allow us to take a sphere and project it on a two-dimensional plane

Because 3D surfaces cannot be displayed perfectly in a 2D space, some distortion can occur

Examples: distance, direction, scale, area, conformality



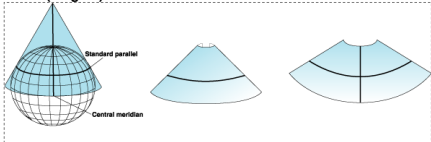
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Projections in Detail

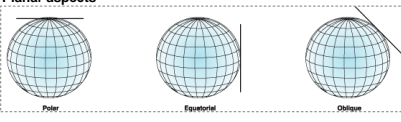
Projections attempt to project a sphere onto a flat map.

Common map projections are classified by the projection surface used to define them (conic, cylindrical, or planar). Samples from the ArcGIS help file:

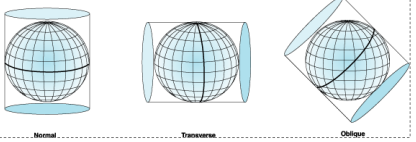
Conic (tangent)



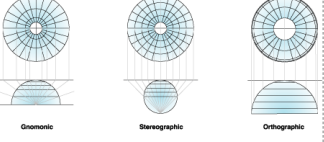
Planar aspects



Cylindrical aspects



Polar aspect (different perspectives)



Want more? Search "List of supported map projections"

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Projections - Types

DIRECTION
• Suited for Navigation

Mercator

Mercator

SHAPE
• Suited for Cartography

Lambert Conformal Conic

AREA
• Suited for Land Management

Albers Equal-Area Conic

Albers Equal Area

DISTANCE
• Suited for Road Atlas

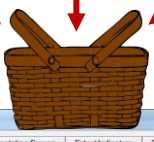
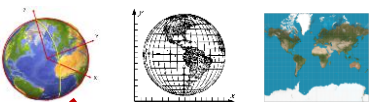
Azimuthal Equidistant

Want more? Search "List of supported map projections"

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Defining it ALL.

Spatial Reference: A more inclusive term describing everything required to enable each layer to reference locations on the earth's surface in a common way. A spatial reference contains the projection, projection parameters, ellipsoid, datum, units of measure, and other spatial related properties.



Data Frame Properties

Feature Cache

Annotation Groups

Data Frame

Extent Indicators

Frame

Size and Position

Type here to search

NAD 1983 StatePlane Colorado South FIPS 5003 (US Feet)

[NAD 1983 StatePlane Colorado South FIPS 5003 \(US Feet\)](#)

NAD 1983 StatePlane Delaware FIPS 0700 (US Feet)

NAD 1983 StatePlane Florida East FIPS 0901 (US Feet)

NAD 1983 StatePlane Florida North FIPS 0903 (US Feet)

NAD 1983 StatePlane Florida West FIPS 0902 (US Feet)

NAD 1983 StatePlane Georgia East FIPS 1001 (US Feet)

NAD 1983 StatePlane Georgia West FIPS 1002 (US Feet)

NAD 1983 StatePlane Guam FIPS 5400 (US Feet)

Current coordinate system:

Central_Meridian: -72.75

Standard_Parallel_1: 41.2

Standard_Parallel_2: 41.86666666666667

Latitude_Of_Origin: 46.83333333333334

Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983

Angular Unit: Degree (0.0174532925199433)

Prime Meridian: Greenwich (0.0)

Datum: D_North_American_1983

Spheroid: GRS_1980

Transformations...

OK

Cancel

Apply

Presentation 2-3 – Understanding Spatial Reference

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Spatial Reference & ArcMap

The coordinate system (spatial reference) within ArcMap

Several spatial reference files supported by ArcMap

What the *.prj file contains

Name	Size	Type	Date Modified
APAWELL.apr	2 KB	AVL File	7/1/2002 10:59 AM
APAWELL.dbf	24 KB	DBF File	10/19/1999 3:22 AM
APAWELL.prj	1 KB	PRJ File	11/9/2004 12:19 PM
APAWELL.shp	11 KB	SHX File	5/5/1999 7:04 AM
APAWELL.shx	1 KB	SHX File	5/5/1999 7:04 AM
APAWELL.sbn	1 KB	SBN File	5/5/1999 7:04 AM

APAWELL.prj - WordPad

```
PROJCS["NAD_1983_StatePlane_Connecticut_FIPS_6000_Feet",GEOGCS["GCS_North_American_1983",DATUM["D_North_American_1983",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION["Lambert_Conformal_Conic"],PARAMETER["False_Easting",999999.999999],PARAMETER["False_Northing",499999.999999],PARAMETER["Central_Meridian",-72.75],PARAMETER["Standard_Parallel_1",41.2],PARAMETER["Standard_Parallel_2",41.86666666666667],PARAMETER["Latitude_Of_Origin",40.83333333333334],UNIT["Foot_US",0.3048006096012192]]
```

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Why a Spatial Reference?

To line up correctly, layers must:

1. have the same coordinate system - or -
2. have their spatial references defined

Early versions of ArcView did not have the ability to read spatial reference files, all datasets had to be projected to the same coordinates system or their alignments would be off.

Layers with NAD27 and NAD83 coordinate values, but no spatial reference, might display like this.

Presentation 2-3 – Understanding Spatial Reference

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Spatial Reference & ArcMap

Setting Coordinate Systems:

Three options:

1. Dataset has no “defined” spatial reference? = Define Projection Tool

2. Dataset has a different spatial reference than you want to “see” = Change Data Frame Properties!

3. Dataset is in the wrong projection = Project Tool!

Table Of Contents

Layers

Data Frame Properties

ArcToolbox

Projections and Transformations

Define Projection

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Spatial Reference & ArcMap

Define Projection Use if layer has unknown or incorrect coordinate system

1

2

3

4

5

Define Projection

Spatial Reference Properties

Spatial Reference Properties

Define Projection

Presentation 2-3 – Understanding Spatial Reference

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Coordinate Systems & ArcMap

Project

Use to convert a layer from an existing coordinate system to another

ArcToolbox

3D Analyst Tools

Analysis Tools

Cartography Tools

Conversion Tools

Data Interoperability Tools

Data Management Tools

Data Comparison

Database

Distributed Geodatabase

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Projections and Transformations

Feature

Batch Project

Project

Convert Coordinate Notation

Create Custom Geographic Transformation

Create Spatial Reference

Define Projection

Raster

Relationship Classes

Subtypes

Table

Transform

Project

Input Dataset or Feature Class

TOWNS

Input Coordinate System (optional)

Unknown (Source Coordinate System: EPSG:6000 Feet)

Output Dataset or Feature Class

C:\GIS\edit\result\shapes\TOWNS_UTM18.shp

Output Coordinate System

NAD_1983_UTM_Zone_18N

Geographic Transformation (optional)

OK

Cancel

Environments...

Show Help >>

Spatial Reference Properties

XY Coordinate System

Z Coordinate System

Type here to search

Favorites

NAD 1983

NAD 1983 StatePlane Connecticut FIPS 6000 (US Feet)

NAD 1983 UTM Zone 18N

New York StatePlane

WGS 1994

Geographic Coordinate Systems

Projected Coordinate Systems

Layers

Current coordinate system:

NAD_1983_UTM_Zone_18N

WGS: 32618 Authority: EPSG

Projection: Transverse_Mercator

False_Easting: 500000.0

False_Northing: 0.0

Central_Meridian: -75.0

Scale_Factor: 0.9996

Latitude_Of_Origin: 0.0

Linear Unit: Meter (1.0)

OK

Cancel

Different from “Define” – with Project you actually create a new dataset.

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Coordinates: Additional Info

You may see warning messages if you combine layers with different coordinate systems, or if a layer's spatial reference is unknown.

The warnings can usually be ignored, but combining projection types during an edit session can cause problems.

What if you don't know the coordinate system for layers without a spatial reference?

First check any metadata for the file. If nothing is available, try defining common projections. Sometimes you can guess by displaying both and unknown and a known together (over time you begin to recognize the x/y values for your area).

Geographic Coordinate Systems Warning

The following data sources use a geographic coordinate system that is different from the one used by the data frame you are adding the data into:

Data Source

Geographic Coordinate System

TOWNS

GCS_North_American_1983

Alignment and accuracy problems may arise unless there is a correct transformation between geographic coordinate systems.

You can use this button to specify or modify the transformation(s) used by this data frame:

Transformations...

The Transformations dialog can also be accessed via the Coordinate Systems tab after you have:

☐ Don't warn me again in this session

☐ Don't warn me again ever

Unknown Spatial Reference

The following data sources you added are missing spatial reference information. This data can be drawn in ArcMap, but cannot be projected

TOWNS_noPRJ

OK

Presentation 2-3 – Understanding Spatial Reference


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Spatial Reference: Take Home Message

If your data have a spatial reference, ArcMap will know where to place features relative to the data frame's coordinate system

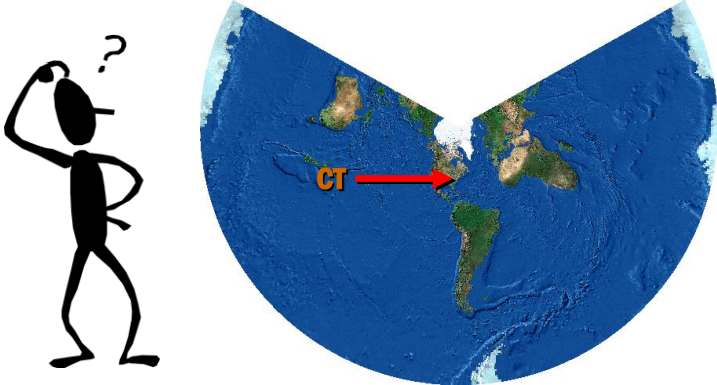
If your data lack a spatial reference, ArcMap will draw the X/Y coordinates but will be ignorant of where they are relative to the data frame's coordinate system



A cartoon by Courtney Gibbons (2006) depicting two people in winter gear standing in a snowy landscape. One person is holding a book and says, "I don't think this is what the professor meant by 'polar coordinates'". The other person points to a small igloo and says, "igloos make a lot more sense in spherical coordinates, though." The cartoon is signed "© COURTNEY GIBBONS" and "2006".

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Questions?



A stick figure stands on the left, scratching its head with a question mark above its head. To the right is a globe showing the Americas. A red arrow points from the label "CT" (Connecticut) on the globe to the right. The globe is a semi-circle showing the Western Hemisphere.

Exercise 4a: Coordinates

Get ready to:

- **Change the spatial reference of a Data Frame**
- **Define a layer's spatial reference**
- **Use the Project tool to change a layer's coordinate system**
- **Add common spatial references to “Favorites” list**

Open C:\GISEd10\Projects\Projections_GTP.mxd

Module 3: Tables

Introduction to Tables

Geospatial Technologies at Work: An Introduction to GIS

Brought to you by the Geospatial Training Program

UConn CLEAR

Module 3: Tables

➤ A. Introduction to Tables

➤ Exercise

➤ B. Working with Tables

➤ Exercise

➤ C. Selections

➤ Exercise

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Introduction to Tables

- Opening a Table
- Anatomy of a Table
- Viewing Multiple Tables
- Field Properties
- Field Functions (sort, summarize, statistics)
- Selections and Queries
 - Selection in a Table
 - Selection using a Query
- Multi-part vs. Single Part

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Tables contain the description of the geography

- Each layer has an attribute table
- Generally, attribute tables contain one record of descriptive data for each feature in the layer.

Identify

Identify from: **Top-most layer**

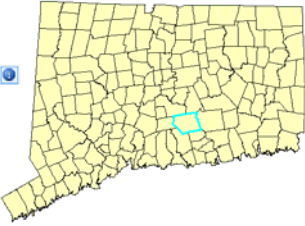
TOWNS

Haddam

Location: 1,062,653.560 733,057.156 Feet

Field	Value
OBJECTID	111
Shape	Polygon
Land Area (sq. miles)	44.5
TOWN_ID	61
TOWN	Haddam
TOTAL_SQMI	46.7
WATER_SQMI	2.2
COUNTY	Middlesex
PLAN_ORG	Midstate
POP_DIST	DEP Eastern District
COAST_AREA	
Shape_Length	151854.411178
Shape_Area	1290435984.17361

Identified 1 feature



Table

TOWN_ID	TOWN	TOTAL_SQMI	WATER_SQMI	COUNTY	PLAN_ORG	
41	East Haddam	57.6	2	Middlesex	Midstate	DE
91	New Fairfield	25.9	5	Fairfield	Housatonic Valley	DE
115	Prospect	14.3	0.1	New Haven	Central Naug Valley	DE
102	North Stonington	56.3	0.8	New London	Southeastern Conn	DE
88	Stonington	43.9	1.8	New London	Southeastern Conn	DE
61	Haddam	46.7	2.2	Middlesex	Midstate	DE
88	Naugatuck	18.2	0	New Haven	Central Naug Valley	DE
18	Bristolfield	19.8	0.2	Fairfield	Housatonic Valley	DE
143	Wallingford	39.8	0.4	New Haven	South Central Conn	DE
130	Southbury	40.9	0.2	New Haven	Central Naug Valley	DE
36	Durham	23.3	0.1	Middlesex	Midstate	DE
100	Oxford	33	0.4	New Haven	Central Naug Valley	DE
72	Ledyard	40.5	1.2	New London	Southeastern Conn	DE
97	Newtown	59.3	0.8	Fairfield	Housatonic Valley	DE
8	Bethany	21	0.3	New Haven	South Central Conn	DE

111 (1 out of 169 Selected)

TOWNS

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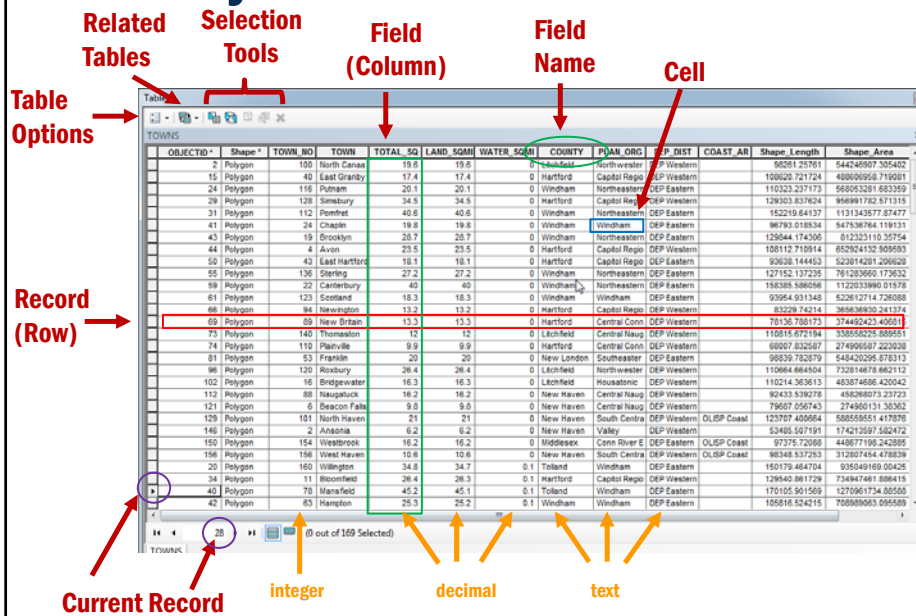
Opening the Attribute Table

Right-click on a Layer name and then click **Open Attribute Table**

The screenshot shows the ArcMap interface. A map of Connecticut is displayed. A context menu is open over the 'TOWNSHIP' layer in the Table of Contents. The menu options include: Copy, Remove, **Open Attribute Table** (highlighted with a red arrow), Joins and Relates, Zoom To Layer, Zoom To Make Visible, Visible Scale Range, Use Symbol Levels, Selection, Label Features, Edit Features, Convert Labels to Annotation..., Convert Features to Graphics..., Convert Symbolology to Representation..., Data, Save As Layer File..., Create Layer Package..., and Properties... The 'Table' window is also open, showing a list of towns with columns: OBJECTID, Shape, TOWN_ID, TOWN, TOTAL_AQ, LAND_USE, WATER_NAME, COUNTY, PLAX_OGR, DEP_ABT, COAST_ABT, Shape_Length, and Shape_Area.

OBJECTID	Shape	TOWN_ID	TOWN	TOTAL_AQ	LAND_USE	WATER_NAME	COUNTY	PLAX_OGR	DEP_ABT	COAST_ABT	Shape_Length	Shape_Area
1	Polygon	100	North Haven	17.4	17.4		1	North	North Haven	DEP	10000	10000
2	Polygon	40	East Hartford	17.4	17.4		2	East	East Hartford	DEP	10000	10000
3	Polygon	110	Plainville	20.1	20.1		2	Plain	Plainville	DEP	10000	10000
4	Polygon	120	Meriden	20.1	20.1		2	Meriden	Meriden	DEP	10000	10000
5	Polygon	130	Rocky Hill	20.1	20.1		2	Rocky	Rocky Hill	DEP	10000	10000
6	Polygon	140	East Windsor	20.1	20.1		2	East	East Windsor	DEP	10000	10000
7	Polygon	150	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
8	Polygon	160	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
9	Polygon	170	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
10	Polygon	180	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
11	Polygon	190	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
12	Polygon	200	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
13	Polygon	210	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
14	Polygon	220	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
15	Polygon	230	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
16	Polygon	240	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
17	Polygon	250	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
18	Polygon	260	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
19	Polygon	270	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
20	Polygon	280	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
21	Polygon	290	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
22	Polygon	300	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
23	Polygon	310	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
24	Polygon	320	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
25	Polygon	330	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
26	Polygon	340	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
27	Polygon	350	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
28	Polygon	360	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
29	Polygon	370	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
30	Polygon	380	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
31	Polygon	390	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
32	Polygon	400	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
33	Polygon	410	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
34	Polygon	420	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
35	Polygon	430	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
36	Polygon	440	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
37	Polygon	450	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
38	Polygon	460	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
39	Polygon	470	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
40	Polygon	480	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
41	Polygon	490	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
42	Polygon	500	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
43	Polygon	510	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
44	Polygon	520	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
45	Polygon	530	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
46	Polygon	540	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
47	Polygon	550	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
48	Polygon	560	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
49	Polygon	570	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
50	Polygon	580	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
51	Polygon	590	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
52	Polygon	600	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
53	Polygon	610	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
54	Polygon	620	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
55	Polygon	630	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
56	Polygon	640	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
57	Polygon	650	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
58	Polygon	660	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
59	Polygon	670	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
60	Polygon	680	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
61	Polygon	690	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
62	Polygon	700	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
63	Polygon	710	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
64	Polygon	720	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
65	Polygon	730	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
66	Polygon	740	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
67	Polygon	750	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
68	Polygon	760	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
69	Polygon	770	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
70	Polygon	780	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
71	Polygon	790	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
72	Polygon	800	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
73	Polygon	810	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
74	Polygon	820	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
75	Polygon	830	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
76	Polygon	840	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
77	Polygon	850	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
78	Polygon	860	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
79	Polygon	870	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
80	Polygon	880	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
81	Polygon	890	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
82	Polygon	900	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
83	Polygon	910	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
84	Polygon	920	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
85	Polygon	930	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
86	Polygon	940	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
87	Polygon	950	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
88	Polygon	960	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
89	Polygon	970	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
90	Polygon	980	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
91	Polygon	990	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
92	Polygon	1000	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
93	Polygon	1010	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
94	Polygon	1020	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
95	Polygon	1030	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
96	Polygon	1040	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
97	Polygon	1050	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
98	Polygon	1060	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
99	Polygon	1070	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
100	Polygon	1080	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
101	Polygon	1090	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
102	Polygon	1100	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
103	Polygon	1110	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
104	Polygon	1120	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
105	Polygon	1130	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
106	Polygon	1140	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
107	Polygon	1150	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
108	Polygon	1160	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
109	Polygon	1170	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
110	Polygon	1180	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
111	Polygon	1190	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
112	Polygon	1200	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
113	Polygon	1210	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
114	Polygon	1220	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
115	Polygon	1230	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
116	Polygon	1240	East Granby	20.1	20.1		2	East	East Granby	DEP	10000	10000
117	Polygon	1250	East Granby	20.1	20.1		2	East	East Granby	DEP		

Anatomy of a Table



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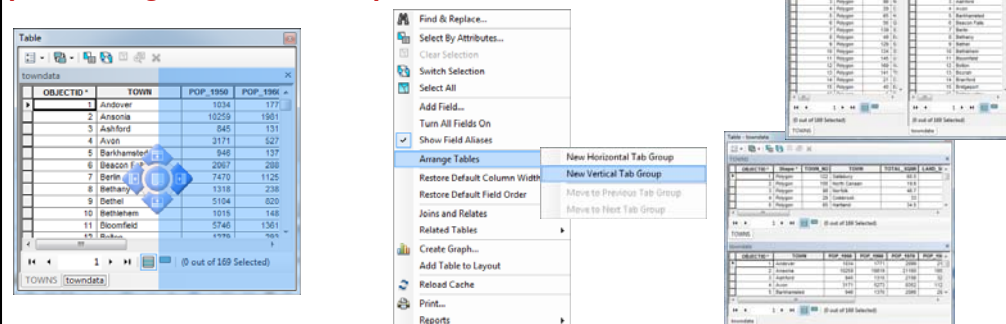
Viewing Multiple Tables

ArcMap opens tables in the Table Window.
The Table Window is a container for all tables.

If a second table is opened, a tab is added

Arrange tables by:

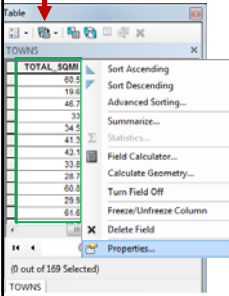
- Dragging into a docked position using the blue arrows **OR** **- Choose Arrange Tables on the Table Options menu**



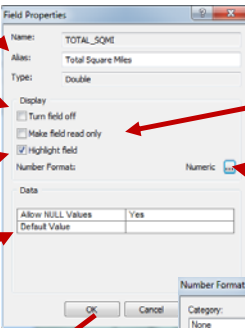
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Field Properties

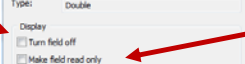
Right-click over the field



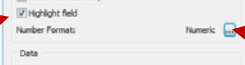
Change Field Alias name




Hide field in table (does not delete field)




Make read-only so field cannot be edited



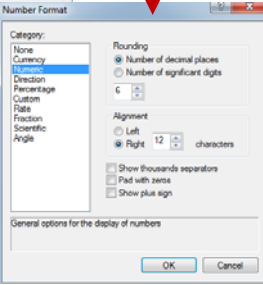
Highlight the field in the table display



Assign a default value



Change number format display



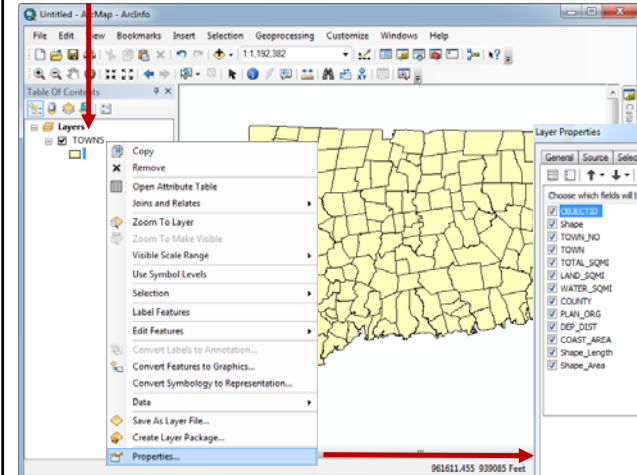
TOWN_ID	TOWN	Total Square Miles	LAND_SQMI
122	Salisbury	60.5	57.6
100	North Canaan	19.6	19.6
88	Norfolk	46.7	45.6
29	Coastbrook	33	32.8
65	Hartland	34.5	33
56	Granby	41.3	41.1
139	Stafford	43.1	42.4
49	Enfield	33.6	32.9
129	Somers	28.7	28.5
154	Stafford	60.8	60.4
145	Union	29.9	29.2
169	Woodstock	61.6	60.8
141	Thompson	48.7	47.3
21	Canaan	33.4	33.1

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Field Properties in Layer Properties

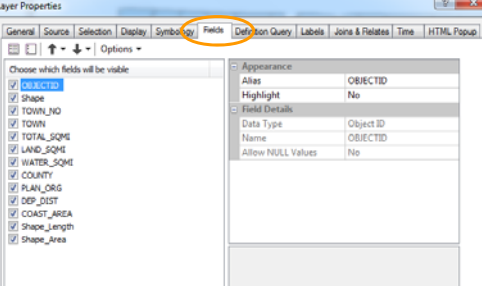
Many of the field properties available through the table are also available from Layer Properties

Right-click over the layer



Choose Properties

Choose the Fields tab



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Field Properties in Layer Properties

Choose which fields will be visible

☐ OBJECTID

☐ Shape

☐ Land Area (sq. miles)

☐ TOWN_NO

☐ TOWN

☐ TOTAL_SQMI

☐ WATER_SQMI

☐ COUNTY

☐ PLAN_ORIG

☐ DEP_DIST

☐ COAST_AREA

☐ Shape_Length

☐ Shape_Area

Turn all fields off (uncheck)

Turn all fields on (check)

Uncheck to hide field in table (does not delete field)

Layer Properties

General

Source

Selection

Display

Symbology

Fields

Definition Query

Labels

Join & Related

Tools

HTML Popup

Sort Ascending

Sort Descending

Reset Field Order

Show Field Names

Show Field Aliases

Appearance

Alias

Highlight

Number Format

Read-Only

Field Details

Data Type

Name

Precision

Scale

Allow NULL Values

Change the order of the fields in the table

Change Field Alias name

Highlight the field in the table display

Change number format display

Make read-only so field cannot be edited

Layer Properties

General

Source

Selection

Display

Symbology

Fields

Definition Query

Labels

Join & Related

Tools

HTML Popup

Choose which fields will be visible

☒ OBJECTID

☒ Shape

☒ Land Area (sq. miles)

☒ TOWN_NO

☒ TOWN

☒ TOTAL_SQMI

☒ WATER_SQMI

☒ COUNTY

☒ PLAN_ORIG

☒ DEP_DIST

☒ COAST_AREA

☒ Shape_Length

☒ Shape_Area

Sort Ascending

Sort Descending

Reset Field Order

Show Field Names

Show Field Aliases

Appearance

Alias

Highlight

Number Format

Read-Only

Field Details

Data Type

Name

Precision

Scale

Allow NULL Values

Table

TOWNS

OBJECTID

Shape

Land Area (sq. miles)

TOWN_NO

1

Polygon

57.6

102

2

Polygon

19.6

100

3

Polygon

45.6

98

4

Polygon

32.8

29

5

Polygon

30

65

6

Polygon

41.1

56

7

Polygon

42.4

139

8

Polygon

52.9

49

9

Polygon

28.5

129

10

Polygon

60.4

134

11

Polygon

29.2

145

12

Polygon

60.6

189

13

Polygon

47.5

141

14

Polygon

33.1

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Field Functions

Operate on a single Field (Column)

➤ Sorting

➤ Summarize

➤ Statistics

➤ Field Calculator

➤ Calculate Geometry

➤ Freeze/Unfreeze

Table

TOWNS

OBJECTID

Shape

TOWN_NO

TOWN

TOTAL_SQ

LAND_SQMI

WATER_SQMI

COUNTY

PLAN_ORIG

DEP_DIST

Sort Ascending

Sort Descending

Advanced Sorting...

Summarize...

Statistics...

Field Calculator...

Calculate Geometry...

Turn Field Off

Freeze/Unfreeze Column

Delete Field

Properties...

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Field Functions: Sort

Right-click over the field name and click Sort Ascending or Sort Descending.

OBJECTID*	Shape*	TOWN_NO	TOWN	TOTAL_SQ	LAND_SQM	WATER_SQM	COUNTY	PLAN_ORG	DEP
2	Polygon	100	North Canaan				0	Litchfield	Northwestern DEP
13	Polygon	40	East Granby				0	Hartford	Capitol Regio DEP
24	Polygon	116	Puham				0	Windham	Northeastern DEP
29	Polygon	128	Simsbury				0	Hartford	Capitol Regio DEP
31	Polygon	112	Pomfret				0	Windham	Northeastern DEP
41	Polygon	24	Chapin				0	Windham	Northeastern DEP
43	Polygon	19	Brooklyn				0	Windham	Northeastern DEP
44	Polygon	4	Aven				0	Hartford	Capitol Regio DEP
50	Polygon	43	East Hartford				0	Hartford	Capitol Regio DEP
55	Polygon	136	Staring				0	Windham	Northeastern DEP
59	Polygon	22	Canterbury				0	Hartford	Capitol Regio DEP
61	Polygon	123	Scotland				0	Hartford	Capitol Regio DEP
66	Polygon	84	Newington				0	Hartford	Capitol Regio DEP
69	Polygon	89	New Britain				0	Hartford	Capitol Regio DEP
73	Polygon	140	Thomaston				0	Hartford	Capitol Regio DEP
74	Polygon	110	Plainville				0	Hartford	Capitol Regio DEP
81	Polygon	53	Franklin				0	Hartford	Capitol Regio DEP
86	Polygon	120	Andover				0	Hartford	Capitol Regio DEP
102	Polygon	16	Bridgewater				0	Windham	Northeastern DEP
112	Polygon	88	Naugatuck				0	Windham	Northeastern DEP
121	Polygon	6	Beacon Falls				0	Hartford	Capitol Regio DEP
129	Polygon	101	North Haven				0	Hartford	Capitol Regio DEP
146	Polygon	2	Ansonia				0	Hartford	Capitol Regio DEP
150	Polygon	154	Westbrook				0	Hartford	Capitol Regio DEP
156	Polygon	156	West Haven				0	Hartford	Capitol Regio DEP
160	Polygon	24	Hamden				0	Hartford	Capitol Regio DEP
34	Polygon	11	Bloomfield				0	Hartford	Capitol Regio DEP
40	Polygon	70	Manchester				0	Hartford	Capitol Regio DEP
42	Polygon	63	Hampton				0	Hartford	Capitol Regio DEP

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Field Functions: Sort

Right-click over the field

OBJECTID*	Shape*	TOWN_NO	TOWN	TOTAL_SQ	LAND_SQM	WATER_SQM	COUNTY	PLAN_ORG	DEP	DIST	COAST	AR	Shape_Length	Shape_Area
43	Polygon	19	Brooklyn				0	Windham	Northeastern	DEP Eastern			129044	174305
59	Polygon	22	Canterbury				0	Windham	Northeastern	DEP Eastern			812323	11035754
19	Polygon	39	Eastford				0	Windham	Northeastern	DEP Eastern				
33	Polygon	89	Kelley				0	Windham	Northeastern	DEP Eastern				
57	Polygon	109	Plainfield				0	Windham	Northeastern	DEP Eastern				
31	Polygon	112	Pomfret				0	Windham	Northeastern	DEP Eastern				
24	Polygon	116	Puham				0	Windham	Northeastern	DEP Eastern				
69	Polygon	136	Staring				0	Windham	Northeastern	DEP Eastern				
13	Polygon	141	Thompson				1	Windham	Northeastern	DEP Eastern				
12	Polygon	169	Woodstock				0	Windham	Northeastern	DEP Eastern				
19	Polygon	3	Ashford				0	Windham	Northeastern	DEP Eastern				
41	Polygon	24	Chapin				0	Windham	Northeastern	DEP Eastern				
42	Polygon	83	Hampton				0	Windham	Northeastern	DEP Eastern				
61	Polygon	123	Scotland				0	Windham	Northeastern	DEP Eastern				
66	Polygon	163	Windham				0	Windham	Northeastern	DEP Eastern				
69	Polygon	12	Andover				0	Tolland	Capitol Regio	DEP Eastern			93904	276546
48	Polygon	12	Bolton				0	Tolland	Capitol Regio	DEP Eastern			505334	692598284
21	Polygon	48	Ellington				0	Tolland	Capitol Regio	DEP Eastern			167639	999436
64	Polygon	67	Hebron				0	Tolland	Capitol Regio	DEP Eastern			183643	41262932
9	Polygon	129	Somers				0	Tolland	Capitol Regio	DEP Eastern			115361	155796
25	Polygon	142	Tolland				0	Tolland	Capitol Regio	DEP Eastern			851806	76162402
37	Polygon	146	Vernon				0	Tolland	Capitol Regio	DEP Eastern			129077	189080
10	Polygon	134	Stafford				0	Tolland	Capitol Regio	DEP Eastern			811526	9021343
11	Polygon	145	Union				0	Tolland	Capitol Regio	DEP Eastern			176274	949481
83	Polygon	30	Columbia				0	Tolland	Capitol Regio	DEP Eastern			1066702	26926427
39	Polygon	32	Coventry				0	Tolland	Capitol Regio	DEP Eastern			170105	901569
40	Polygon	70	Manchester				0	Tolland	Capitol Regio	DEP Eastern			1270961	17348858
29	Polygon	160	Willington				0	Tolland	Capitol Regio	DEP Eastern			180176	484104
126	Polygon	75	Lyme				1	New London	Conn River E	DEP Eastern	OLSP Coast		143094	402020

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Field Functions: Summarize

Right-click over the field

Summarize creates a new table containing one record for each unique value of the selected field, along with statistics summarizing any of the other fields.

1. Select a field to summarize:
COUNTY

2. Choose one or more summary statistics to be included in the output table:
☒ OBJECTID
☒ TOWN_NO
☒ TOTAL_SQMI
☐ Minimum
☐ Maximum
☒ Sum
☐ Average
☐ Standard Deviation
☐ Variance

3. Specify output table:
C:\GIS\10-Results\results.gdb\summarize.dbf

☒ Summarize on the selected records only

OK Cancel

Summarize creates a new table based on your criteria. Here, we asked it to add all the sq. mile attributes and summarize them by the county.

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Field Functions: Statistics

Right-click over the field

Statistics of TOWNS

Field:
TOTAL_SQMI

Statistics:
☒ Count
☒ Minimum
☒ Maximum
☒ Sum
☒ Mean
☒ Standard Deviation

Frequency Distribution

Count: 169
Minimum: 5.3
Maximum: 64.4
Sum: 5088.2
Mean: 29.53432
Standard Deviation: 12.963773

You can change the statistics field from within the Statistics box.

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Field Functions: Freeze/Unfreeze

Right-click over the field

Note: You can select multiple columns by holding down the Keyboard Ctrl Key and clicking with the left mouse button. You can then freeze/unfreeze the selected columns.

Right-click on the field name and select Freeze/Unfreeze. The column will be moved to the left and won't scroll when the table is scrolled left/right. You can freeze more than one column.

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Table Options: Create Graph

Many choices for setting up a graph
Graphs interact with the input data (colors from map are passed to the graph, etc.)

Right-click over final graph

Selected features on the map and table are also selected on the graph

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Table Options: Reports

Report wizard:

- Select input fields
- Choose all records or selected records
- Determine how data is grouped
- Determine how data is sorted and summarized
- Choose layout and style
- Determine if all records or only selected records should only be showed,
- Modify design and much more

- Saved
- Exported as htm, pdf, text, excel
- Added to ArcMap layout

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Introduction to Tables

- Opening a Table
- Anatomy of a Table
- Viewing Multiple Tables
- Field Properties
- Field Functions (sort, summarize, statistics)
- Selections and Queries
 - Selection in a Table
 - Selection using a Query
- Multi-part vs. Single Part

What is a ...

➤ **Selection**

A subset of the features in a layer or records in a table

➤ **Many ways to select**

- **Inside the table**
- **Inside the map**
- **Queries**

Why Create a Selection/Query?

- **To retrieve and examine attribute data**
- **To answer simple questions**
- **To create summary statistics**
- **To create a new feature class or shapefile**
- **To focus an analysis on appropriate features**
- **To select features based on spatial relationships with other layers**

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Select is all over the place!

Tables

Identify Tool

Layer Properties

Feature Selection Tools

ArcToolbox Tools

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Anatomy of a Table: Selection

Switch Selection

Select By Attributes

Zoom to Selected

Clear Selection

A selection is subset of features in a layer, or records in a table.

Selected Records

Show All Records

Show Selected Records

OBJECTID	Shape	TOWN_NO	TOWN	TOTAL SQ	LAND SQ[M]	WATER SQ[M]	COUNTY	PLAN_ORG	DEP_DIST	COAST_AR	Shape_Length	Shape_Area
2	Polygon	100	North Canaan	19.6	19.6	0	Litchfield	Northwestern	DEP Western		80261.25761	544240807.305402
15	Polygon	40	East Granby	17.4	17.4	0	Hartford	Capitol Regio	DEP Western		100620.721724	408020958.719081
24	Polygon	116	Putnam	20.1	20.1	0	Windham	Northeastern	DEP Eastern		110323.237172	565053261.663359
29	Polygon	128	Simsbury	34.6	34.6	0	Hartford	Capitol Regio	DEP Western		126053.637624	666861762.671315
31	Polygon	112	Pomfret	40.6	40.6	0	Windham	Northeastern	DEP Eastern		152219.64137	1131343577.67477
41	Polygon	24	Chaplin	19.6	19.6	0	Windham	Windham	DEP Eastern		96793.018534	547536764.119151
43	Polygon	19	Brooklyn	20.7	20.7	0	Windham	Northeastern	DEP Eastern		126644.174206	812223116.35754
44	Polygon	4	Avon	23.6	23.6	0	Hartford	Capitol Regio	DEP Western		108112.719814	612924132.906993
50	Polygon	43	East Hartford	18.1	18.1	0	Hartford	Capitol Regio	DEP Eastern		93638.144463	523814381.206628
55	Polygon	136	Sterling	27.2	27.2	0	Windham	Northeastern	DEP Eastern		127152.137235	761203660.173632
69	Polygon	22	Canterbury	40	40	0	Windham	Northeastern	DEP Eastern		184386.586294	1122033960.016176
61	Polygon	123	Scotland	16.3	16.3	0	Windham	Windham	DEP Eastern		93354.931345	523612714.792005
68	Polygon	94	Newington	13.2	13.2	0	Hartford	Capitol Regio	DEP Western		83229.74214	366658936.241374
69	Polygon	89	New Britain	13.3	13.3	0	Hartford	Central Conn	DEP Western		78136.788173	374492423.406815
73	Polygon	140	Thomaston	12	12	0	Litchfield	Central Naug	DEP Western		110815.672194	338556225.869551
74	Polygon	110	Heavily	9.9	9.9	0	Hartford	Central Conn	DEP Western		68007.632687	274688467.223038
81	Polygon	53	Franklin	20	20	0	New London	Southeastern	DEP Eastern		96839.782879	548420295.670313
96	Polygon	120	Roxbury	26.4	26.4	0	Litchfield	Northwestern	DEP Western		110664.664554	732814878.662112
102	Polygon	16	Bridgeville	16.3	16.3	0	Litchfield	Housatonic	DEP Western		110214.363613	46387468.420042
112	Polygon	60	Haughtown	16.2	16.2	0	New Haven	Central Naug	DEP Western		92433.538278	455266073.23223
121	Polygon	6	Beacon Falls	9.8	9.8	0	New Haven	Central Naug	DEP Western		79607.056743	274900131.38362
129	Polygon	101	North Haven	21	21	0	New Haven	South Central	DEP Western	OLISP Coast	123707.400664	588569651.417876
146	Polygon	2	Ansonia	6.2	6.2	0	New Haven	Valley	DEP Western		83485.507181	174213987.582472
150	Polygon	154	Westbrook	16.2	16.2	0	Madison	Conn River E	DEP Eastern	OLISP Coast	97375.72566	446877166.242665
158	Polygon	156	West Haven	10.6	10.6	0	New Haven	South Central	DEP Western	OLISP Coast	96348.537253	312807454.470859
20	Polygon	160	Willington	34.8	34.7	0.1	Tolland	Windham	DEP Eastern		150178.464704	935049169.00425
34	Polygon	11	Bloomfield	26.4	26.3	0.1	Hartford	Capitol Regio	DEP Western		126540.861729	734947461.886415
40	Polygon	73	Mansfield	49.2	49.1	0.1	Tolland	Windham	DEP Eastern		170108.901949	5220187174.60668
42	Polygon	63	Hampton	25.3	25.2	0.1	Windham	Windham	DEP Eastern		105016.524215	705860603.095559

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Select in the Table: Click Rows

Left-click on the row →

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

Selected Records

Click and drag OR hold down SHIFT to select multiple, consecutive records →

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

Hold the Control key to select multiple, non-consecutive records →

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

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Select in the Table

Switch Selection

Switch Selection

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

Select All

Select All

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

Clear Selection

Clear Selection

OBJECTID	Shape	TOWN_NO	TOWN
1	Polygon	122	Salisbury
2	Polygon	100	North Canaan
3	Polygon	98	Norfolk
4	Polygon	29	Colebrook
5	Polygon	65	Hardland
6	Polygon	56	Granby
7	Polygon	139	Suffield
8	Polygon	49	Enfield
9	Polygon	129	Somers

Presentation 3-1 – Introduction to Tables

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Select by Attributes

You control the Selection Method

➤ Create new selection

➤ Add to current selection

➤ Remove from current selection

➤ Select from current selection

Selection query entered in the form of field operator value

“County” = “Middlesex”

Select By Attributes

Enter a WHERE clause to select records in the table window

Method: **Create a new selection**

“TOWN_NO” Remove from current selection

“TOTAL_SQ” Select from current selection

“LAND_SQMI”

“WATER_SQMI”

“COUNTY”

Like Fairfield
Hartford
Litchfield
Middlesex
New Haven
New London

Get Unique Values

Go To:

SELECT * FROM TOWNS WHERE
“COUNTY” = “Middlesex”

Clear Verify Help Load Save

Table

Find & Replace...

Select By Attributes...

Clear Selection

Switch Selection

Select All

Add Field...

Turn All Fields On

Show Field Aliases

Arrange Tables

Restore Default Column Widths

Restore Default Field Order

Joins and Relates

Related Tables

Create Graph...

Add Table to Layout

Reload Cache

Print...

Reports

Export...

Appearance...

TOWNS

TOWN	OBJECTID	Shape	TOWN_NO	TOTAL_SQ	LAND_SQMI	WATER_SQMI	COUNTY	PLAN_ORIG	IMP_INF	COAST_ASI	Shape_Length	Shape_Area
Andover	111	Polygon	63	46.9	44.5	2.2	Middlesex	Shelton	DEP Eastern	OLSP Coast	151854.411178	1256435886
Andover	121	Polygon	62	32	32.7	0.1	New Haven	South Central	DEP Western	OLSP Coast	114400.030178	82827617
Andover	42	Polygon	61	25.3	25.3	0.1	Windham	Shelton	DEP Western	OLSP Coast	108116.524715	70889063
Hartford	41	Polygon	64	18.4	17.2	1.2	Hartford	Capitol Region	DEP Western	OLSP Coast	108981.151765	513241429
Hartford	5	Polygon	65	16.9	16.9	1.5	Hartford	Litchfield Hill	DEP Western	OLSP Coast	112523.29662	867584817
Hartford	51	Polygon	66	17.4	17.4	0.1	Litchfield	Litchfield Hill	DEP Western	OLSP Coast	118217.721515	867584817
Hartford	48	Polygon	67	17.4	17.4	0.1	Tolland	Capitol Region	DEP Western	OLSP Coast	114516.484791	104713332
Hartford	13	Polygon	68	48.9	48	0.1	Litchfield	Northwestern	DEP Western	OLSP Coast	108586.507758	118213887
Hartford	137	Polygon	69	50	48	0.1	Hartford	Northwestern	DEP Western	OLSP Coast	117767.976121	126241842
Hartford	128	Polygon	70	38	35.8	0.2	Middlesex	Capitol Region	DEP Western	OLSP Coast	104286.173224	1062913315
Hartford	70	Polygon	71	54.1	54.1	0.1	New London	Shelton	DEP Western	OLSP Coast	102711.118891	831748448
Hartford	118	Polygon	72	40.5	38.3	1.2	New London	Southwestern	DEP Western	OLSP Coast	104505.101114	1112610841
Hartford	85	Polygon	73	18.5	18.2	0.3	New London	Southwestern	DEP Western	OLSP Coast	101102.240818	681544585
Hartford	42	Polygon	74	27.3	26.1	0.4	Litchfield	Litchfield Hill	DEP Western	OLSP Coast	107145.435521	740758758
Hartford	128	Polygon	75	35	31.2	1.8	New London	Capitol Region	DEP Western	OLSP Coast	104384.402328	860115636
Hartford	127	Polygon	76	28.9	26	0.3	New Haven	South Central	DEP Western	OLSP Coast	105623.108849	1022232461
Hartford	48	Polygon	77	27.2	26.9	0.3	Hartford	Capitol Region	DEP Western	OLSP Coast	114236.00545	771181760
Hartford	40	Polygon	78	44.2	42.1	0.1	Tolland	Shelton	DEP Western	OLSP Coast	110108.801881	872096725
Hartford	79	Polygon	79	23.5	23.4	0.1	Hartford	Capitol Region	DEP Western	OLSP Coast	106323.91818	68479873
Hartford	79	Polygon	80	24	23.7	0.3	New Haven	South Central	DEP Western	OLSP Coast	107764.1784	887158451
Hartford	101	Polygon	81	10	10.1	0.1	New Haven	Capitol Region	DEP Western	OLSP Coast	100272.201768	817003281
Hartford	184	Polygon	82	13.3	12.3	0.8	Middlesex	Shelton	DEP Western	OLSP Coast	106171.11888	368821181
Hartford	97	Polygon	83	48.9	49.1	1.2	Middlesex	Shelton	DEP Western	OLSP Coast	101481.088114	115849315
Hartford	118	Polygon	84	23.5	22.3	1.2	New Haven	South Central	DEP Western	OLSP Coast	108854.014055	646444124

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Select Based on Attributes (QUERY)

1) choose the layer from your map

2) double-click the field you want to use

3) click an operator

4) click “get unique values” then double-click the value

Select By Attributes

Layer: **TOWNS**

Method: **Create a new selection**

OBJECTID

TOWN_NO

TOWN

TOTAL_SQMI

LAND_SQMI

Like 33.4

33.8

34

34.5

34.8

35

Get Unique Values

Go To:

SELECT * FROM TOWNS WHERE
“TOTAL_SQMI” > 35

Clear Verify Help Load Save

Create a new selection

Add to current selection

Remove from current selection

Select from current selection

This query will select all the towns greater than 35 sq. miles.

“TOTAL_SQMI” > 35

Presentation 3-1 – Introduction to Tables

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Select Based on Attributes (QUERY)

1) choose the layer from your map

2) double-click the field you want to query

3) click an operator

4) click "get unique values" to see the values in the field

Create a new selection

Add to current selection

Remove from current selection

Select from current selection

This query will select all the towns greater than 35 sq. miles.

"TOTAL_SQMI" > 35

ROADS

parcels

wetlands

zoning

buildings

RIVER

TOWNS

Select By Attributes

Layer: TOWNS

Only show selectable layers in this list

TOTAL_SQMI > 35

Clear

Verify

Help

Load...

Save...

OK

Apply

Close

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Advancing Queries

Multiple attributes

"TOTAL_SQMI" > 35 AND "COUNTY" = "Hartford"

"TOTAL_SQMI" > 35 AND NOT "COUNTY" = "Hartford"

"COUNTY" = "Middlesex" OR "COUNTY" = "Hartford"

"TOTAL_SQMI" > 35 AND "COUNTY" = "Hartford"

"COUNTY" = "Middlesex" OR "COUNTY" = "Hartford"

"TOTAL_SQMI" > 35 AND NOT "COUNTY" = "Hartford"

Other operators and wildcards

Calculations

"TOWN" LIKE 'East%'

"TOWN" LIKE '%Haven'

"LAND_SQMI" / "TOTAL_SQMI" > 0.99

"LAND_SQMI" * "WATER_SQMI" = "TOTAL_SQMI"

Presentation 3-1 – Introduction to Tables

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Multipart features - a place or thing that has more than one part but is defined as one feature because it references one set of attributes.

Multipart

Many features share a table record

[illegible]

Table

ct_towns_multisort

TOWN_ID	TOWN	CNTY_CD	COUNTY	#
12	Bolton	13	Tolland	9
13	Bozrah	11	New London	12
14	Bradford	9	New Haven	10
15	Bridgesport	1	Fairfield	10
16	Bridgewater	5	Litchfield	11
17	Bratton	3	Hartford	17
18	Brockton	1	Fairfield	15
19	Bromley	16	Windham	18
20	Burlington	3	Hartford	19
21	Canaan	5	Litchfield	11
22	Canterbury	16	Windham	25
23	Canton	3	Hartford	16
24	Chaplin	16	Windham	12
25	Cheeshire	9	New Haven	10
26	Chester	7	Middlesex	10

(1 out of 170 Selected)

ct_towns_multisort

To Review

- **Opening a Table**
- **Anatomy of a Table**
 - Rows, columns and selections
- **Field Properties**
 - Alias names
 - Hiding or showing fields
 - Number format
- **Field Functions**
 - Sorting
 - Summarize
 - Statistics
 - Freeze/Unfreeze
- **Selections**
 - Why create a selection?
 - Select using tables
 - Select using attributes (aka Queries)
 - Advanced Queries and Syntax
- **Shapefile vs. Geodatabases**
- **Multi-part vs. Single Part**

Table Basics – Q & A



Up next...Working with Tables

Module 3: Tables

Working with Tables

Geospatial Technologies at Work: An Introduction to GIS

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Module 3: Tables

➤ A. Introduction to Tables

➤ Exercise

➤ B. Working with Tables

➤ Exercise

➤ C. Selections

➤ Exercise

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Working with Tables

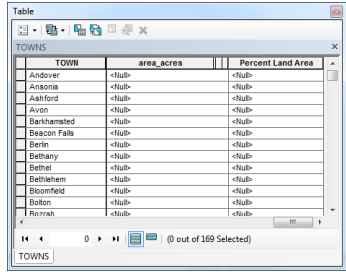
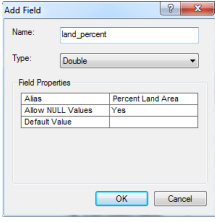
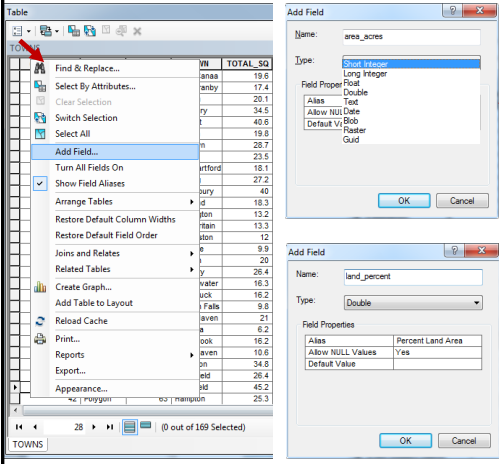
- Add a Field
- Delete a Field
- Calculate Geometry
- Field Calculator
- Add an External Table
- Join Table
- Related Table

Distinction: these topics **CHANGE** the data in the table by adding or deleting data, or calculating new data.

The previous presentation only **VIEWED** or **ARRANGED** the data in the table.

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Add a Field



If you are going to be doing calculations, it is a good idea to add a field and use it rather than changing values in an original field. That way, if you make a mistake, you won't lose the original data.

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Delete a Field

Right-click over the field

Careful – You can't undo a delete field operation. Once it's gone it's gone!

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Calculate Geometry

Right-click over the field

Select the geometry that will be calculated.

Select the unit.

The Calculate Geometry tool allows you to access the geometry of the features in a layer. The tool can calculate coordinate values, lengths, and areas, depending on the geometry of the input layer.

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Field Calculator

Right-click over the field

Equation or Value is entered here

Tip: Syntax matters!

- Double-click on the Fields to add them to the equation box.
- Pay careful attention to quotes “” and parens ().
- If you use the same equation frequently, save it.
- Help can be very helpful!

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Add an External Table

- Data tables that are not associated with a layer can be added to ArcMap
- Use the Add Data button to add tables
- ArcMap will switch to the List By Source view
- Tables can be dbase files, delimited text files, excel files or Info tables.

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Open the table

➤ Attribute tables are opened by right-clicking on the table name

➤ Tables are listed in the **List By Source** view

➤ **Table Properties**
Right-click and select Properties
Fields tab same as discussed in earlier presentation

Note: When you switch to **List By Drawing Order** the tables will not be visible.



Open

Joins and Relates

Remove

Data

Edit Features

Geocode Addresses...

Display Route Events...

Display XY Data ...

Properties...

Table Properties

General | Source | Display | Fields | Definition Query | Joins & Relates | Time

Choose which fields will be visible

POP_1950

POP_1960

POP_1970

POP_1980

POP_1990

POP_2000

PERCAPITA

CRIMRAT98

Appearance

Highlight

Field Details

Data Type

Name

Allow NULL Values

OBJECTID

No

Object ID

OBJECTID

No

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Join Tables

Joining two tables appends the attributes from one table to the other table based on a common field.

Table - towndata

TOWNS

TOWN_ID	TOWN	TOTAL_SQMI	LAND_SQMI
1	Andover	15.6	15.3
2	Ansonia	6.2	6.2
3	Ashford	40.3	39.9
4	Avon	23.5	23.5
5	Barkhamsted	39	36.3
6	Beacon Falls	9.8	9.8
7	Berlin	27	26.8
8	Bethany	21	20.7
9	Bethel	17	16.9
10	Bethlehem	19.7	19.6
11	Bloomfield	26.4	26.3

TOWNS

towndata

TOWN	POP_1950	POP_1960	POP_1970
Andover	1034	1771	2099
Ansonia	10259	15619	21160
Ashford	645	1315	2156
Avon	3171	5273	8352
Barkhamsted	945	1370	2095
Beacon Falls	2957	2086	3546
Berlin	7470	11250	14149
Bethany	1318	2384	3857
Bethel	5104	6200	10945
Bethlehem	1015	1486	1923
Bloomfield	5746	13613	18301

towndata

Join is useful for one-to-one relationships or one-to-many relationships.

Tip: The name of the Join field doesn't have to be the same but the two fields must be the same data type (numbers to numbers, text to text, etc.)

Presentation 3-2 – Working with Tables

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Join Tables

In the Table of Contents, right-click over the layer and select Joins and Relates

Copy

Remove

Open Attribute Table

Joins and Relates

Zoom To Layer

Zoom To Make Visible

Visible Scale Range

Use Symbol Levels

Selection

Label Features

Edit Features

Convert Labels to Annotation...

Convert Features to Graphics...

Convert Symbolology to Representation...

Data

Save As Layer File...

Create Layer Package...

Properties...

Join...

Remove Join(s)

Relate...

Remove Relate(s)

Join Data

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?

Join attributes from a table

1. Choose the field in this layer that the join will be based on:

TOWN

2. Choose the table to join to this layer, or load the table from disk:

towndata

Show the attribute tables of layers in this list

3. Choose the field in the table to base the join on:

TOWN

Join Options

Keep all records

All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.

Keep only matching records

If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.

Validate Join

About Joining Data

OK

Cancel

Choose which fields will be visible

OBJECTID

TOWN

POP_1990

POP_1990

POP_1970

POP_1980

POP_1990

POP_2000

PERCAPINC

CRIMERAT98

+

Choose which fields will be visible

OBJECTID

Shape

TOWN_NO

TOWN

TOTAL_SQMI

LAND_SQMI

WATER_SQMI

COUNTY

PLAN_ORG

DEP_DIST

COAST_AREA

Shape_Length

Shape_Area

area_acres

Percent Land Area

OBJECTID

TOWN

POP_1990

POP_1970

POP_1980

POP_1990

PERCAPINC

CRIMERAT98

Percent Land Area

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Joined Data

Data from Layer Table

Data from Joined table

Identify

Identify from: <Top-most layer>

Location: 1,052,435.413 727,380.408 Feet

Field	Value
OBJECTID	111
Shape	Polygon
TOWN_NO	61
TOWN	Haddam
TOTAL_SQMI	46.7
LAND_SQMI	41.5
WATER_SQMI	2.2
COUNTY	Midsex
PLAN_ORG	Midstate
DEP_DIST	DEP Eastern District
COAST_AREA	151854.411178
Shape_Length	1280435984.17261
Shape_Area	29624.320308
area_acres	85.289079
Percent Land Area	61
OBJECTID	61
TOWN	Haddam
POP_1990	2636
POP_1960	3466
POP_1970	4934
POP_1980	6383
POP_1990	6769
POP_2000	7157
PERCAPINC	30080
CRIMERAT98	16.093

Identified 1 feature

You have:

1) Parcel layer with map/block/lot attributes

2) Excel spreadsheet with map/block/lot column

Parcel boundaries

Owner information change infrequently

Owner information changes frequently

Why Use a Join?

The excel file can be maintained outside of ArcMap

Each time the ArcMap document is opened, the join is reestablished

The new information will be reflected on the map

Presentation 3-2 – Working with Tables

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Relates

Relating tables defines a relationship between two tables, based on a common field, but doesn't append the attributes to one another. Instead, the related data can be accessed when working with the layer's attributes.

Relate is useful for one-to-many or many-to-many relationships.

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Relates

Create the Relate:

In the Table of Contents, right-click over the layer and select Joins and Relates

Access the Relate:

After setting up the relate (left)

- Open the Layer's Table
- Select record(s) of interest
- Click the Related Tables button
- Select the Relate (here, Relate1)

OBJECTID	Shape	TOWN	TOTAL_SQMI	LAND_SQMI	WATER_SQMI	COL
32	Polygon	Goshen	45.6	44.7	0.9	Litchfield
6	Polygon	Granby	41.3	41.1	0.2	Hartford
168	Polygon	Greenwich	50.6	47.3	3.3	Fairfield
88	Polygon	Grainwold	37.6	35.1	2.5	Newtown
136	Polygon	Grainwold	38.3	33	5.3	Newtown
131	Table					
111	Polygon					
123	Polygon					
42	Polygon					
47	Polygon					
4	Polygon					

TOWN	POP_1950	POP_1960	POP_1970	POP_1980	POP_1990
Grainwold	2728	2472	2763	2867	10384
Groton	21998	29937	30244	41062	45144
Guilford	5082	7913	12033	17375	19648
Haddam	2636	3466	4934	6383	6769

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Saving Joins and Relates

When you save a map containing joins and relates


- **ArcMap saves the definition of how the two attribute tables are linked rather than saving the linked data itself**
- **The next time you open your map, ArcMap reestablishes the join or relate by reading the tables**
- **Any changes to the source tables are automatically included and reflected on the map**

To permanently append joined data to a layer, export the file and save with a new name. Right-click over the layer, select Data, then Export Data. The new file will include all the attributes.

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Advantages of geodatabase tables

Over shapefile tables



- **Area and perimeter fields are updated**

In a shapefile table, area needs to be recalculated after geoprocessing or other changes.
- **Attribute Domains**

Specify a list or range of valid values for attribute columns. Helps ensure the integrity of attribute values.
- **Relationship Classes**

Build relationships between two tables using a common key.

- **Subtypes**

Manage a set of attribute subclasses in a single table. This is often used on feature class tables to manage different behaviors on subsets of the same feature types.
- **Versioning**

Manage long update transactions, historical archives, and multiuser editing required in GIS workflows.

To Review

- **Adding table fields**
- **Deleting table fields**
- **Calculate Geometry**
- **Field Calculator**
- **Adding and opening external tables**
- **Table Joins**
- **Table Relates**


Hands On Exercise

Table Basics:

- **Explore Attribute Tables**
- **Field Properties**
- **Add/Remove Fields**
- **Calculate Areas**
- **Join Tables**

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Working With Tables – Q & A



Up next...Selections and Queries

Module 3: Working with Tables Selections

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Module 3: Tables

➤ **A. Introduction to Tables**

➤ **Exercise**

➤ **B. Working with Tables**

➤ **Exercise**

➤ **C. Selections**

➤ **Exercise**

Selection - A subset of the features
(in a layer AND records in a table)

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Selection Using the Map

- **Selectable Layers and Settings**
- **Interactive Feature Selection Tools**
- **Select Based on Location**
- **Select Using Graphics**
- **Post-selection: Now What?**
 - Bookmark
 - “Use Selected Features”
 - Create Graph or Report
 - Export

GeoSpatial Technologies at Work

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Selectable Layers

- **Selected** – lists layers that currently have selected features.
- **Selectable** – lists layers that are selectable.
- **Not Selectable** – lists the layers that cannot be selected from using the interactive selection tools.

Number of Features selected

Click the icon to the left of the feature to deselect it (when there are only a few selected features).

Click the icon to turn on or off visibility for the layer

Tip: By default, all layers are selectable.

List By Selection

Click to make the layer selectable or not selectable

Click to clear selected features

Presentation 3-3 – Selections and Queries

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Other Selection Settings

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

Select By Attributes...
Select By Location...
Select By Graphics
Zoom To Selected Features
Pan To Selected Features
Statistics...
Clear Selected Features
Interactive Selection Method
Selection Options...

Create New Selection
Add to Current Selection
Remove From Current Selection
Select From Current Selection

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

Select By Attributes...
Select By Location...
Select By Graphics
Zoom To Selected Features
Pan To Selected Features
Statistics...
Clear Selected Features
Interactive Selection Method
Selection Options...

Selection Options

Interactive selection

When you select features with the selection tools, the Select By Graphics command, or the Edit tool, how do you want features to be selected?
☒ Select features partially or completely within the box or graphic(s)
☐ Select features completely within the box or graphic(s)
☐ Select features that the box or graphic(s) are completely within
☒ Clear the selection for invisible layers when a new selection is made

Selection Tools Settings
Selection tolerance: 3 pixels
Choose the color you want selected features to be shown with by default:
☐ Scale selection symbols when a reference scale is set

Warning Threshold
☒ Display a warning when performing a 'Select All' or 'Switch Selection' if the number of records is greater than this threshold.
Record Count > 2000
☒ Save layers with their current selections

OK Cancel

These settings apply to all methods of selecting

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Interactive Feature Selection Tools

Select by Rectangle
Select by Polygon
Select by Lasso
Select by Circle
Select by Line

➤ Works only on selectable layers
➤ Disabled if no layers are selectable
➤ Click on individual features or click and drag around multiple features to select .

Tip: To select multiple features in multiple clicks as you use these tools, hold down SHIFT.

Presentation 3-3 – Selections and Queries

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Select Based on Location

Select features from towns that intersect Selected features of roads (Rt 91 is selected)

Two maps of a region in Connecticut. The top map shows a network of roads and towns. The bottom map shows the same region with the roads layer selected, highlighting the features that intersect the towns layer.

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Select Using Graphics

Selects features according to whether they fall inside the selected graphic(s)

1) Draw graphics using the tools in the Drawing toolbar
2) Selection menu > Select By Graphics

Three maps of a region in Connecticut. The top map shows a network of roads and towns. The middle map shows the same region with a red line drawn over it. The bottom map shows the same region with the roads layer selected, highlighting the features that intersect the red line.

Selection is often

An intermediate step

Post-selection: “Use Selected Features”

Many tools and processes throughout

ArcMap and ArcToolbox have a checkbox

☒ **Use Selected Features**

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Post Selection: Export Table

Creates a new file that contains just the table (no feature class or shapefile)

Multiple format choices

- Geodatabase table
- dBase table (for shapefiles and excel)

Tables can be used in future analyses

Export Data

Export: Selected records

Use the selected records

Output table: C:\GIS\10\Results\results.gdb\middlesex

Save as type: dBase table

OBJECTID	Shape	TOWN_NO	Town	TOTAL SQM
87	Polygon	42	East Hampton	58.8
90	Polygon	113	Portland	23.7
91	Polygon	33	Cromwell	13.5
97	Polygon	83	Middletown	42.9
104	Polygon	82	Middlefield	13.3
106	Polygon	41	East Haddam	57.6
111	Polygon	61	Haddam	46.7
116	Polygon	38	Durham	23.3
125	Polygon	70	Killingworth	36
130	Polygon	26	Chester	15.9
137	Polygon	36	Deep River	14.2
141	Polygon	50	Essex	12.2
150	Polygon	154	Westbrook	16.2
151	Polygon	106	Old Saybrook	18.3
152	Polygon	27	Clinton	17.2

(15 out of 169 Selected)

OBJECTID	TOWN_NO	TOWN	TOTAL SQM
1	42	East Hampton	58.8
2	113	Portland	23.7
3	33	Cromwell	13.5
4	83	Middletown	42.9
5	82	Middlefield	13.3
6	41	East Haddam	57.6
7	61	Haddam	46.7
8	38	Durham	23.3
9	70	Killingworth	36
10	26	Chester	15.9
11	36	Deep River	14.2
12	50	Essex	12.2
13	154	Westbrook	16.2
14	106	Old Saybrook	18.3
15	27	Clinton	17.2

(0 out of 15 Selected)

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Post-selection: Export Shapefile or Feature Class

Right-click over layer in the Table of Contents

Use Export to create a new file that is smaller than the original. For example

- All towns within a county
- All parcels in a subdivision
- All tributaries of a stream

Choose shapefile or feature class output

Export Data

Export: Selected features

Use the selected features

Output feature class: C:\GIS\10\Results\towns.shp

Layers
ROADS
parcels
Zoning
wetlands
buildings
REVER
towns

Right-click context menu:

- Copy
- Remove
- Open Attribute Table
- Joins and Relates
- Zoom To Layer
- Zoom To Make Visible
- Visible Scale Range
- Use Symbol Levels
- Selection
- Label Features
- Edit Features
- Convert Labels to Annotation...
- Convert Features to Graphics...
- Convert Symbology to Representation...
- Data
 - Repair Data Source...
 - Export Data...**
 - Export to CAD...
 - Make Permanent
 - View Item Description...
 - Review/Reattach Addresses...
- Save As Layer File...
- Create Layer Package...
- Properties...

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To Review

Q & A

- Selectable Layers**
- Selection Settings**
- Select using Interactive Feature Selection Tools**
- Select using Graphics**
- Select based on Location**

Post-selection

- **Statistics and Viewing**
- **“Use Selected Features”**
- **Export**



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Hands On Exercise

Selections and Queries:



- **Work with Excel file in ArcMap**
- **Multiple methods for Selecting features**
- **Selection Options**
- **Definition Queries**
- **Create new data from selected features**

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Module 4: Map Production

Symbology and Thematic Maps

Geospatial Technologies at Work: An Introduction to GIS
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Module 4: Map Production

- **Symbology and Thematic Maps**
 - Hands On Exercise
- **Labels, Text and Graphics**
 - Hands On Exercise
- **Layouts**
 - Hands On Exercise

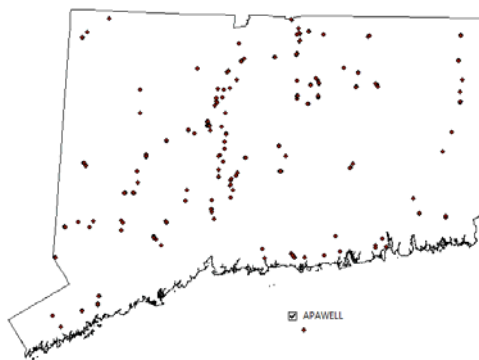
 

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Symbology and Thematic Maps

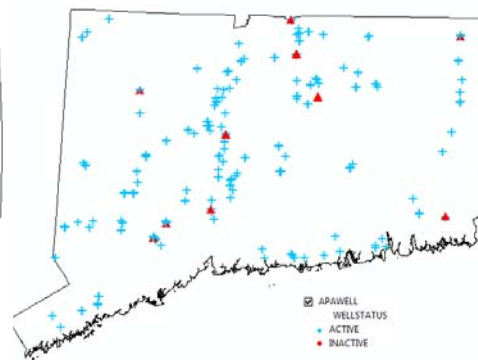
- Examples of Symbology
- How to edit symbolization
- Making thematic maps
- Classifying data
- Saving layer files
- Layer packages

Legend Examples: Points



Single Symbol

When data are first added to ArcMap, features are all symbolized the same.

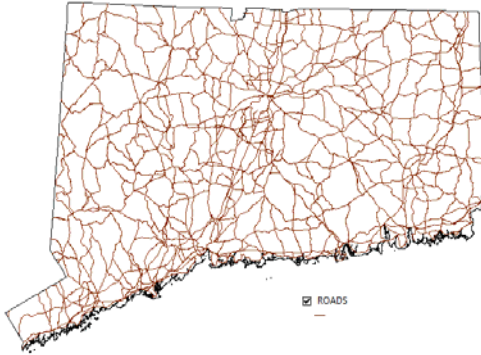


Symbolized

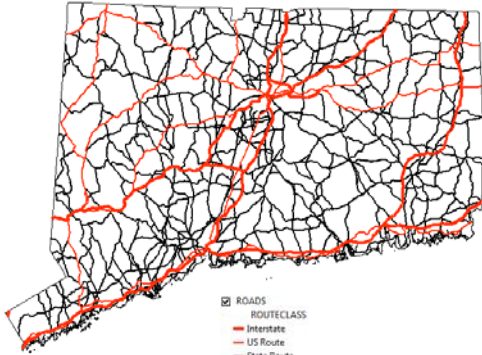
You can use attribute values to assign different symbols to classes of data. In this example wells are symbolized based on the field "Wellstatus."

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Legend Examples: Lines



Legend: ☒ ROADS



Legend: ☒ ROADS
☒ ROUTECLASS
— Interstate
— US Route
— State Route

Single Symbol

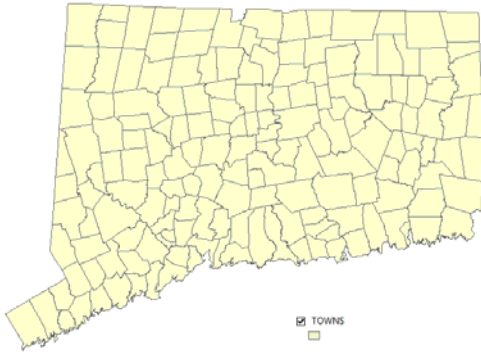
Symbolized

ROADS symbolized based on the field **ROUTECLASS**.

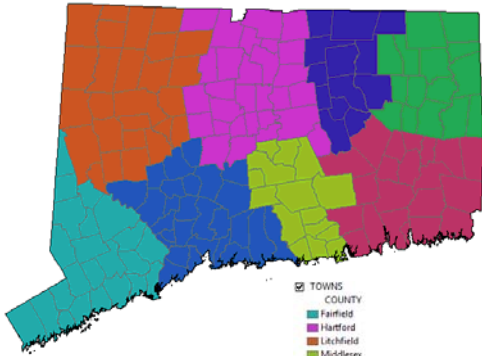
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Legend Examples: Polygons



Legend: ☒ TOWNS



Legend: ☒ TOWNS
☒ COUNTY
Fairfield
Hartford
Litchfield
Middlesex
New Haven
New London
Tolland
Windham

Single Symbol

Symbolized

TOWNS symbolized based on the field **COUNTY**.

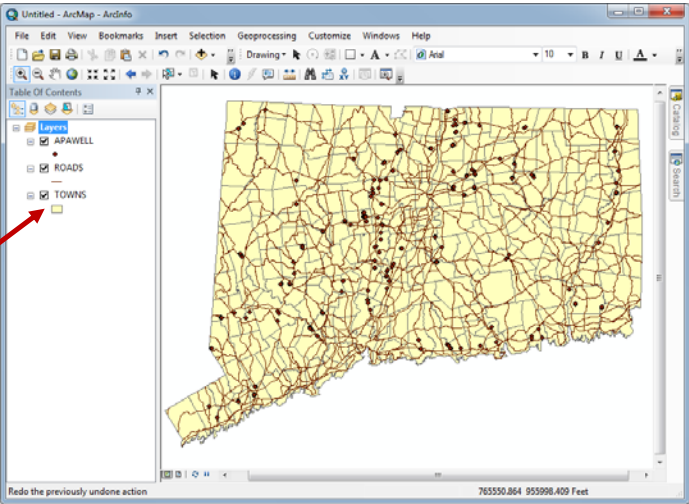
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Default Symbols

When you add data to ArcMap, a default symbol (single symbol) is used to draw all features in the layer.

Click on a symbol in the ArcMap Table of Contents to open the appropriate Symbol Selector.



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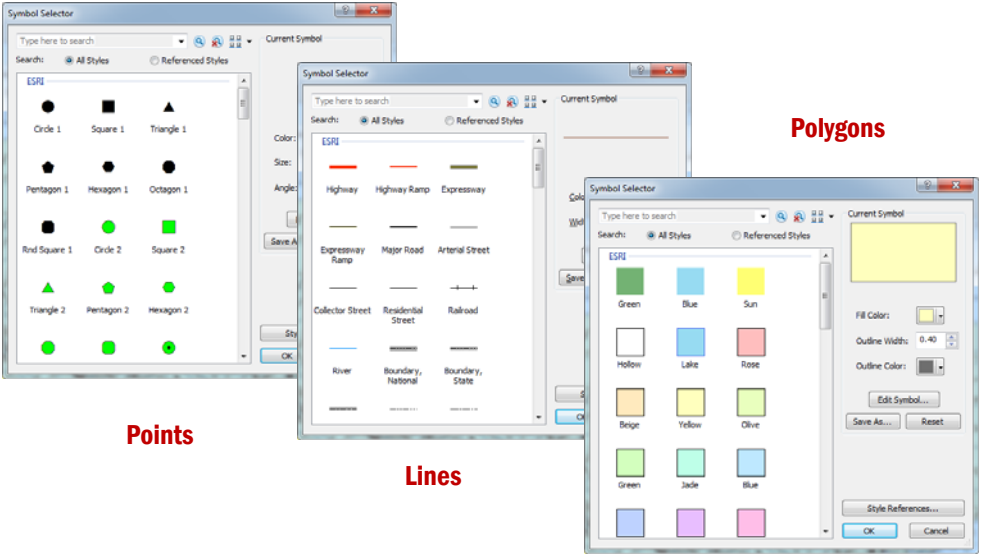
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Symbol Selectors

Points

Lines

Polygons



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Polygon Symbol Selector

There are many options for changing the symbol:

1. Choose a pre-made symbol.

2. Make variations of the premade or default symbol.

Polygon symbols include a fill color, an outline color and an outline width. Change these by clicking on the buttons under Options.

3. Make big changes to a symbol with **Edit Symbol**.

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Symbol Selector: Edit Symbol

TIP: Symbol selector allows you to build most any symbol you can dream up.

Change

- Fill and type (solid, gradient, line, picture, etc.)
- Foreground color
- Background color
- Outline color and line type
- Size
- Much more

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Symbol Selector: Edit Symbol

Current Symbol

Symbol Property Editor

Cartographic Line

Color: [Pink] Width: 2.5000

Line Caps: [Butt] [Round] [Square] [Miter] [Bevel]

Line Joins: [Miter] [Round] [Bevel]

Layers: [List of layers]

Template

The template specifies a repeating mark/gap line pattern. Click and drag the gray square to set the length of the pattern. Click on the white 'squares' to indicate the dot or dash marks. Use the Interval to set the length of the template 'square'.

Interval: 2

Line Properties

Create your own hashed symbol.

The symbol is built using Layers. Each layer is changed separately.

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Symbology is a Layer Property

Default symbology is Single Symbol

Current Symbol

Only appears in the layout

Controls how overlapping symbols are handled

Transparency

Text in TOC

Layer Properties

General Source Selection Display Symbology Fields Definition Query Labels Join & Relates Time HTML Popup

Show: [Single symbol] [Category] [Quantities] [Charts] [Multiple Attributes]

Draw all features using the same symbol.

Symbol: [Yellow square] [Advanced]

Legend

Label appearing next to the symbol in table of contents: []

Description: []

Additional description appearing next to the symbol in your map's legend

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Thematic Map: Categories: Unique Values

1. Choose Unique Values

2. The Value Field is the attribute that you are using for display

3. Add All Values

4. Choose Color Ramp

5. Edit Labels

6. OK

Unique Values should be used when symbolizing fields that have a small number values. Usually 10 or 12 is a good cut-off, such as counties or planning regions. Unique Values is not appropriate for numeric fields (such as area) or discrete fields with lots of values (such as towns with 169 records).

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Thematic Map: Categories: Unique Values

Click on the column headings to access more symbolization and labeling options.

Select many values by holding down the Ctrl key while clicking on them with the mouse.

Right-click on a symbol, value or label to open more choices.

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Thematic Map: Quantities: Graduated Colors

1. Choose Graduated Colors

2. Value is the field from the table

3. Choose field for normalization, if desired. For example, normalizing population by area maps population density.

4. Choose color ramp

5. Classification method chooses how many and where the breaks are made in the quantitative data.

6. Format labels

Layer Properties

General

Source

Selection

Display

Symbology

Fields

Definition Query

Labels

Join & Related

Time

HTML Popup

Show:

Features

Categories

Quantities

Graduated colors

Graduated symbols

Proportional symbols

Charts

Multiple Attributes

Draw quantities using color to show values.

Fields

Value: POP_2000

Normalization: TOTAL_SQMI

Classification: Natural Breaks (Jenks)

Classes: 5

Classify...

Color Ramp

Symbol Range

Label

Reverse Sorting

Format Labels...

Edit Description...

Number Format

Category

Rounding

Alignment

General options for the display of numbers

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Thematic Maps: Quantities: Classify

1. Select method which determines where the class breaks are made

2. Select the number of classes

3. Drag breaks or type in values to change where class breaks are

Classification

Method: Natural Breaks (Jenks)

Classes: 5

Data Exclusion: Exclusion...

Sampling...

Columns: 100

Show Std. Dev.

Show Mean

Classification Statistics

Counts

Minimum

Maximum

Sum

Mean

Median

Break Values

OK

Cancel

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Presentation 4-1 – Layer Symbology

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Thematic Maps: Quantities: Classify

Classification

Classification Statistics

Method: Natural Breaks (Jenks)

Class: 5

Data Exclusion: Exclusion...

Sampling: Sampling...

Columns: 100

Show Std. Dev.

25

20

15

10

5

0

23

953

1913

3998

☐ Snap breaks to data values

Choose a classification method for your data:

Manual: Lets you set the class breaks manually. Use this choice if, for example, you want to emphasize particular patterns by placing breaks at important threshold values, or if you need to comply with a particular standard that demands certain class breaks. The Classes dropdown list is disabled when you choose this method. You specify the classes by working with the histogram in this dialog!

- To insert a class break, right-click in the histogram and choose Insert Break.
- To remove a class break, select it by clicking on it in the histogram or in the break values list to the right of the histogram (it will turn red when selected) and then right-click it in the histogram and choose Delete Break.
- To move a class break, either click on it in the histogram and drag, or edit its value in the break values list to the right of the histogram.

Equal Interval: This method divides the attribute range into equally sized classes, and is best applied to familiar data ranges such as percentages and temperature. Use this method to emphasize the relative amount of attribute values compared to other values.

Defined Interval: This method is similar to the Equal Interval method, except here you define the size of the interval. The Classes dropdown list is disabled when you choose this method because it adjusts automatically to reflect the number of classes needed for the interval size you defined once you've pressed OK on the Classification dialog.



Quantile: Each class will contain an equal number of features. This method is well suited to linearly distributed data.

Natural Breaks (Jenks): Classes are based on natural groupings of data values. In this method, data values are arranged in order. The class breaks are determined statistically by finding adjacent feature pairs, between which there is a relatively large difference in data value. This is the default classification method.

Geometrical Interval: This method creates class ranges based on intervals that has a geometric sequence based on a multiplier (and its inverse). It creates these intervals by minimizing the square sum of elements per class; this ensures that each interval has an appropriate number of values within it and the intervals are fairly similar. This algorithm was specifically designed to accommodate continuous data. It produces a result that is visually appealing and cartographically comprehensive. The geometrical interval method minimizes variance between classes and even works on data that is not normally distributed. This classification method is called Smart Quantiles in the Geostatistical Analyst extension.

Standard Deviation: Use this method to emphasize how much feature values vary from the mean. Best used on normally distributed data.

Tip: For more information about classification, search for the topic called 'Ways to map quantitative data' in the ArcGIS Desktop Help by typing its name into the Search tab in the Desktop Help.



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Symbology Choices

Show:

➤ Features

★ Single Symbol

➤ Categories

★ Unique Values

Unique Values, many fields

Match to symbols in a style

➤ Quantities

★ Graduated Colors

Graduated Symbols

Proportional Symbols

Dot Density

➤ Charts








Pie

Bar/Column

Stacked

➤ Multiple Attributes

Quantity by Category



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Presentation 4-1 – Layer Symbology

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Import Symbolology

Use the import button to use symbology from

A layer already in the map

A legacy ArcView 3.x AVL file (ArcView Legend File)

Layer Properties

General | Source | Selection | Display | Symbology | Fields | Definition Query | Labels | Joins & Relates | Time | HTML Popup

Draw quantities using color to show values.

Fields: POP_2000

Value: 23.1772575 - 388.395052

Normalization: TOTAL_SQMI

Classification: Natural Breaks (Jenks)

Classes: 5

Color Ramp: [Color Ramp]

Symbol Range Label

Symbol	Range	Label
[Green]	23.1772575 - 388.395052	23 - 388
[Yellow]	388.395053 - 953.407407	389 - 953

Import Symbolology

Import symbology definition from another layer in the map or from a layer file:

Import symbology definition from an ArcView 3 legend file (*.avl):

Layer: 2000 Election Results

What do you want to import?

Complete symbology definition

Just the symbols

Just the classification

OK Cancel

A Layer File .lyr (coming up next)

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Layer Files

- Layer Files store symbolization, labels, and other layer properties.
- They can be created and then used to quickly restore and/or share a dataset's symbology.
- Layer Files **DO NOT** store geographic data; they only store a **pathname** to the data.
- A Layer File without Source Data is useless.

ArcCatalog - Info - C:\GIS6410\Layers

File | Edit | View | Go | Geoprocessing | Customize | Windows | Help

Location: C:\GIS6410\Layers

Catalog Tree

- Folder Connections
- C:\GIS6410
- Images
- Layers
- Projects
- Results
- Shapes
- Tables
- CT_D4 Layer Properties

Contents

Name	Type
APAWELL.lyr	Layer
Hydro.lyr	Layer
Hydro.lyr	Layer
LWDS.lyr	Layer
Map Impervious Features.lyr	Layer

Layer File

Source Data of Layer File

Extent

Top: 934116.875000 ft

Left: 779820.750000 ft

Right: 1236786.750000 ft

Bottom: 591188.062500 ft

Data Source

Data Type: Shapefile Feature Class

Shapefile: C:\GIS6410\Shapes\APAWELL.shp

Geometry Type: Point

Projected Coordinate System: NAD_1983_StatePlane_Connecticut_FIPS_3600_Feet

Projection: Lambert_Conformal_Conic

False_Easting: 500000.000000

False_Northing: 0.000000

Central_Meridian: -72.75000000

Standard_Parallel_1: 41.20000000

Set Data Source...

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Layer Files

Layer Properties

GeneralSourceSelectionDisplaySymbologyFieldsDefinition QueryLabelsJoins & RelatesTimeHTML Popup

All parameters entered on each tab in Layer Properties is saved with the Layer File

General: Name, description, display scales

★ **Source:** Pathname to the data source

Selection: Set how to display selected features

Display: Map tips, scale symbols, transparency, hyperlinks

→ **Symbology:** Methods to classify and symbolize features

Fields: Primary display field, set aliases, field visibility, formats

→ **Definition Query:** Create a query to subset data

Label: How to label features, label placement, formats, scales


→ **Joins & Relates:** Establish links to other tables

HTML Popup: Turns on HTML popup window & characteristics

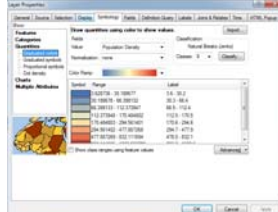
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Layer Files: How

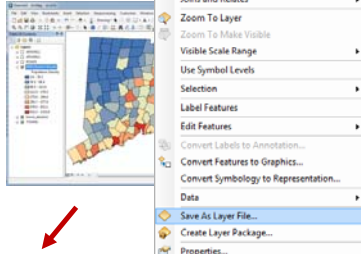
1. Add data to ArcMap. Defaults to single symbol symbology.




2. Open Layer Properties and change desired settings on all tabs.



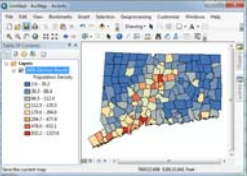
3. Right-click over Layer in the TOC and choose Save As Layer File.



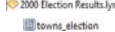
4. .lyr file is created



5. Add .lyr file to ArcMap OR



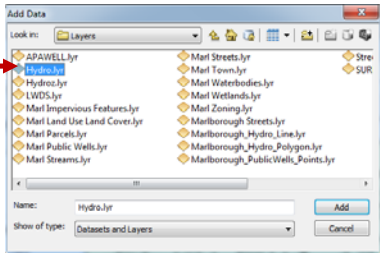
5. Share Layer File AND Source Data



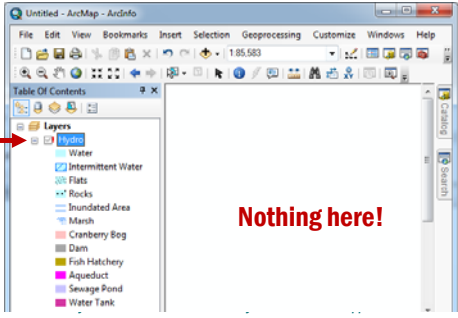
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Layer File: Missing Data Source

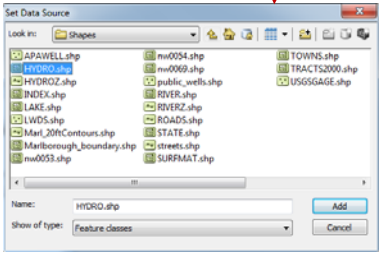
1. Add a Layer File



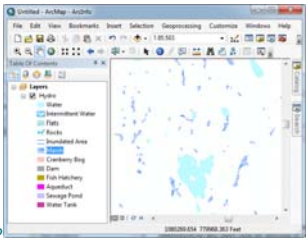
2. Layer shows in the TOC but doesn't draw and has an !



3. Click on ! to open the Set Data Source box.



4. Layer File has Source Data and draws.



Nothing here!

federal laws that promote equal oppo

Layer Packages

- **Saves a Layer with its Source Data**
- **Larger file size than just a Layer because it contains the Source Data**
- **.lpk file extension**
- **To use the Layer Package**
 - **In ArcCatalog, right-click over the Layer Package and Unpack**
 - **Starting with ArcCatalog, drag the Layer Package to ArcMap**

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Layer Packages: How

1. Right-click over Layer in the TOC and choose Create Layer Package.

2. Select a file name and location for saving the Layer Package

3. Validate

4. Any errors will show. To fix, right-click over the error and choose Change General Layer Properties. Fix the problem.

5. After Validation is successful, the Share button is enabled Click Share.

6. The Layer Package, .lpx is created.

7. Share the Layer Package.

TIP: Multiple layers can be included in the Layer Package. Hold the CTRL key while selecting layers in the TOC before choosing Create Layer Package.

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Map Document Properties

• The default geodatabase you work with most in this document.

• After setting it, use the shortcut to default database.

• Default is unchecked so full paths to data are stored. C:\GIS\Ed10\Shapes\TOWNS.shp

• If box is checked, pathnames stored are relative to the current location of the mxd. LocationOfMXD\shapes\TOWNS.shp.

• Relative paths is useful when sharing documents. ArcGIS will resolve the paths to the data sources relative to the document's current location, rather than by full paths that include a drive letter or machine name.

Creates a thumbnail for ArcCatalog. Thumbnail is static.

Presentation 4-1 – Layer Symbology

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To Review

- **Default single symbol symbology**
- **Symbol Selectors: Points, Lines and Polygons**
- **Symbology as a Layer Property**
- **Symbology: Unique Values**
- **Symbology: Quantities**
- **Data Classification**
- **Other Symbology Choices**
- **Import Symbology**
- **Layer Files**
- **Layer Packages**

Symbology and Thematic Maps – Q & A



Hands On Exercise

- **Set Map Document Properties**
- **Single Symbol Symbology**
- **Thematic Maps**
- **Classifying Data**
- **Creating Layer (.lyr) files**

Module 4: Map Production

Labels, Graphics & Annotation

Geospatial Technologies at Work: An Introduction to GIS

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Learning Objectives

1) Dynamic feature based labels

- Layer Properties Labels tab
- Label Classes
- Label Expressions

2) Reference Scales

3) Graphic text objects

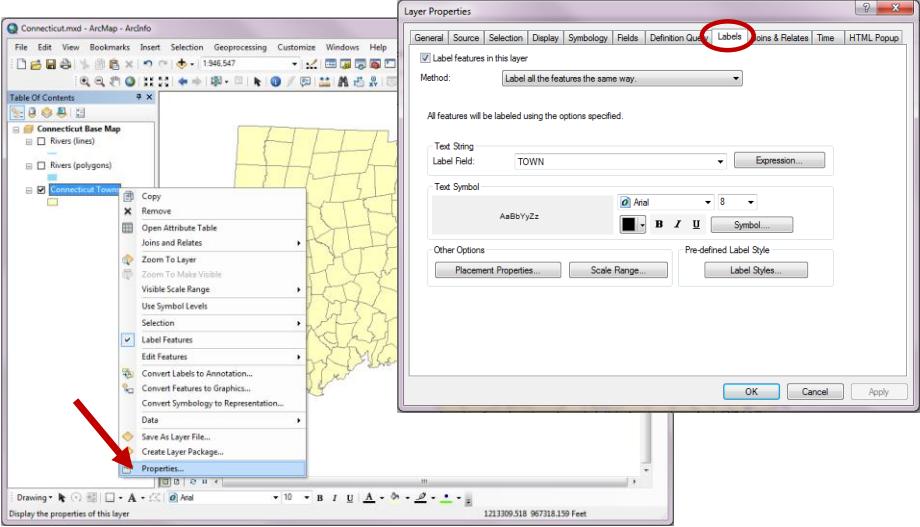
4) Graphic feature objects

5) Geodatabase map annotation

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Dynamic Feature Based Labels

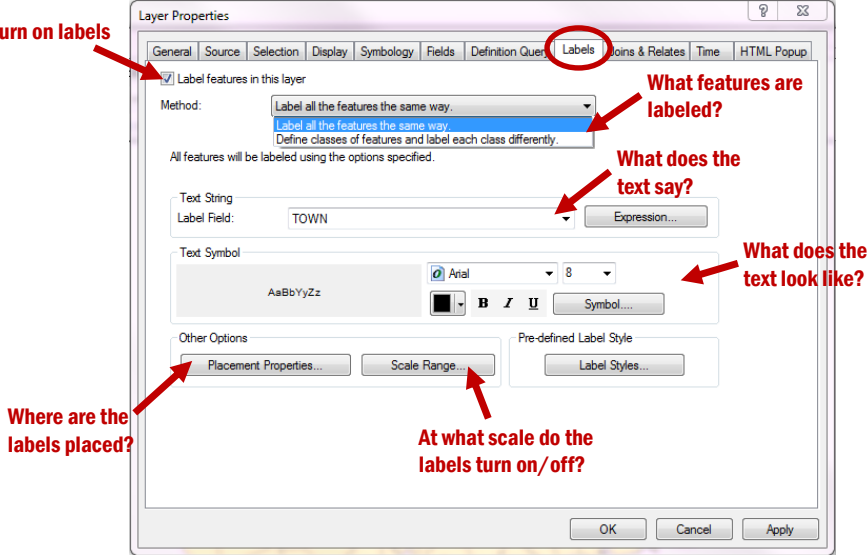
Labels are a Property of a Layer



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Setting Up Layer Properties



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Basic Labels

Looks a little crowded, right?
We'll get to that in just a bit...

Features on map are being labeled using the value in the TOWN field

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Label Placement Properties

How to deal with duplicates

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Label Scale Range

Display Scale

The screenshot shows the ArcMap interface with a map of Connecticut. The 'Scale Range' dialog box is open, showing the 'Don't show labels when zoomed' option. The 'Out beyond' scale is set to 1:250,000 (minimum scale) and the 'In beyond' scale is set to 1:1,000 (maximum scale). The map display scale is shown as 1:300,000. The 'Table of Contents' shows the 'Connecticut Towns' layer selected.

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Setting a Reference Scale

A Reference Scale allows labels or graphics to be scaled proportionally with the map scale of a Data Frame.

This means the labels and graphics will scale up/down when you zoom in/out on your map.

The top map shows a small-scale view of Connecticut with labels for towns and counties. The bottom map shows a larger-scale view of the same area, where the labels are scaled up to match the map scale. A red arrow points to the labels in the bottom map with the text 'Labels scale with map'.

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Setting a Reference Scale

Steps to setting a Reference Scale:

- 1. Set properties of Label through Layer Properties**
- 2. Zoom in on map until labels appear at appropriate size**
- 3. Right click on Data Frame name and select Reference Scale>Set Reference Scale**

You can also zoom to a reference scale and clear a reference scale from this menu

Reference Scales are a property of the Data Frame

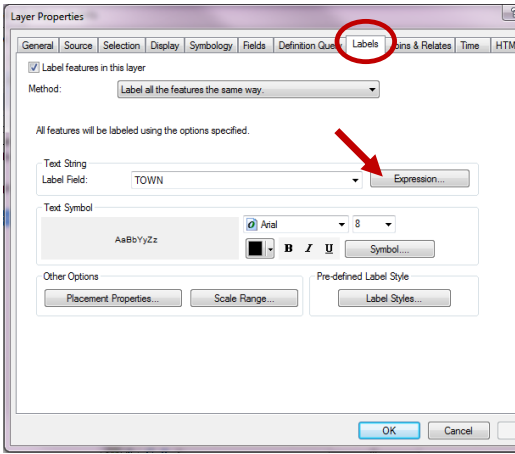


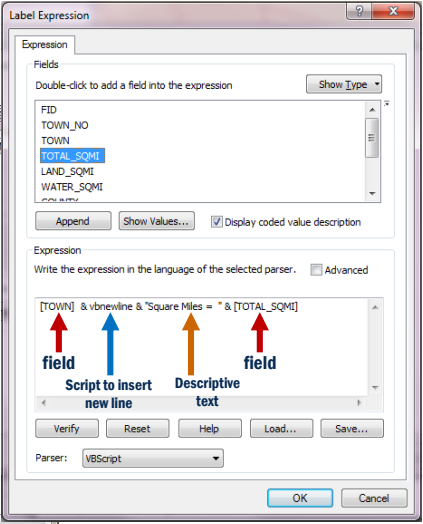
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Using a Label Expression

A Label Expression allows you to add text from more than one attribute field







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Presentation 4-2 – Adding Text, Graphics & Annotation

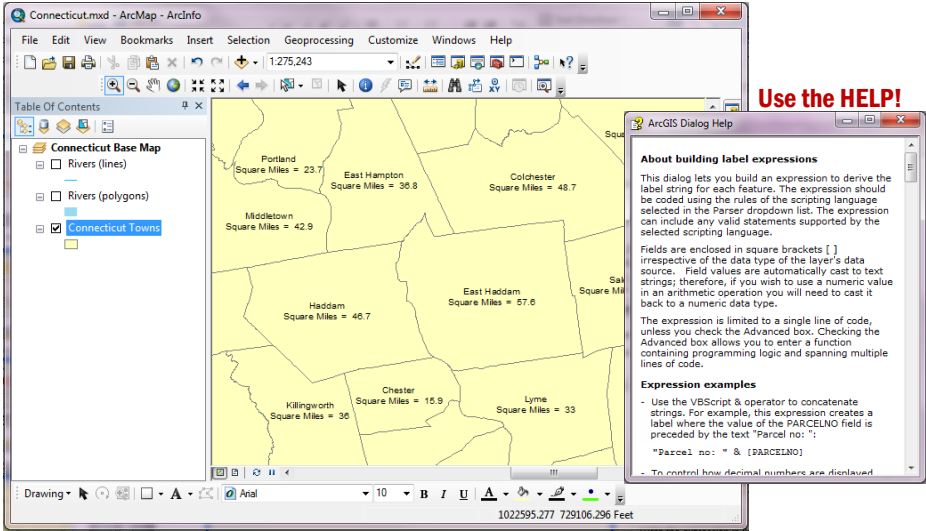
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Using a Label Expression

[TOWN] & vbnewline & "Square Miles = " & [TOTAL_SQMI]

Use the HELP!



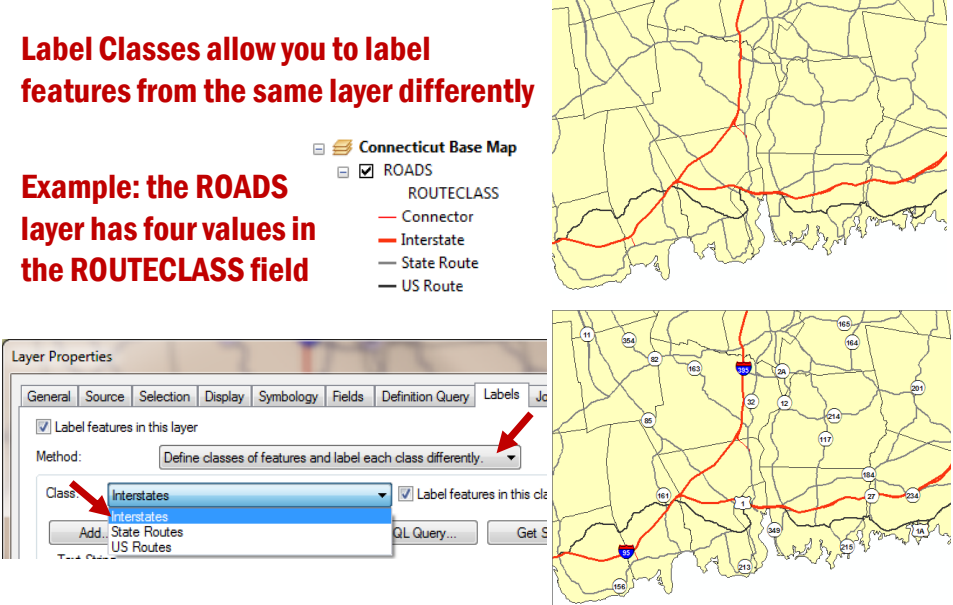
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Label Classes

Label Classes allow you to label features from the same layer differently

Example: the ROADS layer has four values in the ROUTECLASS field



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Creating a Label Class

1. Define Method

2. Create Class

3. Define Class using SQL Query

4. Select Field for Text String

5. Define Text Symbol

6. Set Placement Properties & Scale Range

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The Good & Bad of Labels

The GOOD:

- Labels are a quick and easy way to add descriptive text to your map
- ArcMap dynamically generates and places text labels for you

The BAD:

- Label positions are generated automatically
- Labels are not selectable
- You cannot edit the display properties of individual values

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Presentation 4-2 – Adding Text, Graphics & Annotation

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Graphic Text & Shape Elements

Graphic elements can be added to your map from the Draw toolbar

Graphic tools

- Rectangle
- Polygon
- Circle
- Ellipse
- Line
- Curve
- FreeHand
- Marker

Text tools

- New Text
- Splined Text
- Label
- Callout
- Polygon Text
- Rectangle Text
- Circle Text

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Text and Graphic Elements

Connecticut Towns

Selected text element

Selected graphic element

Properties

Symbol Area Size and Position

Fill Color: [Light Blue]

Outline Color: [Red]

Outline Width: 3

Preview: [Light Blue rectangle with red outline]

Change Symbol...

OK Cancel Apply

Element Properties

- Symbol
- Location
- Size & Position

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Advanced Formatting

This is a line of text.

This is a **formatted line of text**.

Properties

Text

Size and Position

Text:

This is a <BOL><CLR red="155" green="10" blue="235"> formatted line</CLR></BOL> of <UND> text </UND>.

Font: Arial 10.00

Angle: 0.00

Character Spacing: 0.00

Leading: 0.00

About Formatting Text

Change Symbol...

OK

Cancel

Apply

ArcGIS Dialog Help

About formatting text

The text in this dialog is drawn on the map or page layout using its symbol settings. To change these settings, click the Change Symbol button. You can also change these settings by selecting the text on the map and using the controls on the Draw toolbar to change its font, size, color, etc.

ArcMap text formatting tags

You can modify or override the symbol settings for particular portions of the text by inserting ArcMap text formatting tags into the text. This lets you create mixed-format text where, for example, one word in a sentence is underlined. Here are the tags you can use:

Font: <FNT name="Arial" size="18">My text</FNT>
<FNT name="Arial" scale="200">My text</FNT>

Color: <CLR red="255" green="255" blue="255"> text</CLR>
<CLR cyan="100" magenta="100" yellow="100" black="100">My text</CLR>

Bold: <BOL>My text</BOL>

Italic: <ITA>My text</ITA>

Underline: <UND>My text</UND>


All caps: <ACP>My text</ACP>


Small caps: <SCP>My text</SCP>

Superscript: ^{My text}

Subscript: _{My text}

Character spacing (0%): <CHR spacing="25">My text</CHR>

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Graphic Label Tool

Label Tool on the Draw Toolbar

The Label tool allows you to click on a map feature and automatically label it using the value for the layer's label field

The label will be symbolized based on the layer's Label settings

Labels function as graphics and can be edited individually

Label Tool Options

Placement

☒ Automatically find best placement.

☐ Place label at position clicked.

Label Style

☒ Use properties set for the feature layer.

☐ Choose a style

Label Styles

Layer Properties

General

Source

Selection

Display

Symbology

Fields

Definition Query

Labels

Joins & Relates

Time

HTML Popups

Label features in this layer

Method: Label all the features the same way.

All features will be labeled using the options specified.

Text String

Label Field: TOWN

Expression...

Text Symbol

Arial 14

AaBbYyZz

Symbol

Other Options

Placement Properties...

Scale Range...

Pre-defined Label Style

Label Styles...

OK

Cancel

Apply

Presentation 4-2 – Adding Text, Graphics & Annotation

Presentation 4-2 – Adding Text, Graphics & Annotation



Presentation 4-2 – Adding Text, Graphics & Annotation

Presentation 4-2 – Adding Text, Graphics & Annotation

Presentation 4-2 – Adding Text, Graphics & Annotation

Presentation 4-2 – Adding Text, Graphics & Annotation

Presentation 4-2 – Adding Text, Graphics & Annotation



Two Types of Annotation

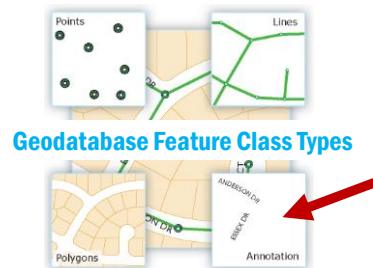
Geodatabase

- **Annotation is stored as a special type of feature class inside a geodatabase**
- **All features in an annotation feature class will have their own text string, XY location and properties**
- **Standard or Feature-linked annotation:**
Standard annotation are pieces of geographically placed text that are not associated with other features in the geodatabase. Feature linked annotation* is directly linked to the features that are being annotated by a geodatabase relationship class.

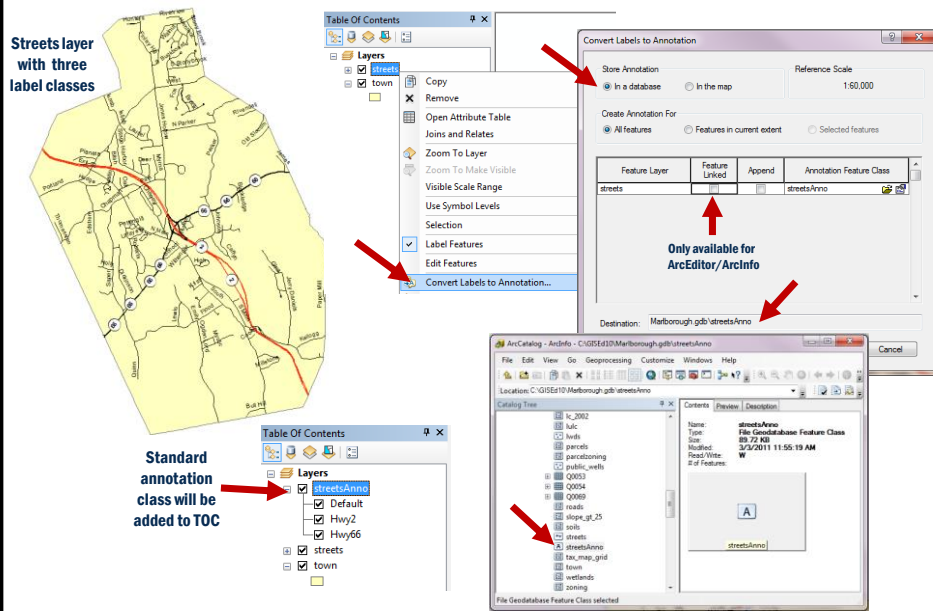
****An ArcEditor or ArcInfo license is required to create and edit feature linked annotation.***

Map Document

- **Annotation stored within the Map Document (.mxd)**
- **Organized using annotation groups which can be created using the Draw Toolbar**
- **Useful if you have a relatively small amount of editable text and text that will be used in a single map.**



Standard Geodatabase Annotation



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Standard Geodatabase Annotation

Table Of Contents

Layers

- streetsAnno
 - Default
 - Hwy2
 - Hwy66
- streets
- town

Editor

Annotation features are edited using the Editor toolbar

Attributes

Annotation / Attributes

Acc2

66

100%

Table

streetsAnno

OBJECTID*	SHAPE*	FeatureID	ZOrder	AnnotationClassID*	SymbolID	Status*	TextString	FontName	FontSize	Bold	I
1	Polygon	46	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
2	Polygon	58	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
3	Polygon	59	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
4	Polygon	140	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
5	Polygon	146	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
6	Polygon	149	<Null>	Default	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>
7	Polygon	89	<Null>	Acc2	<Null>	Placed	<Null>	<Null>	<Null>	<Null>	<Null>

1 (0 out of 254 Selected)

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Live Demo – Labels, Graphics and Annotation

Town of Marlborough, CT

Labels

Graphic

Annotation

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Hands On Exercise

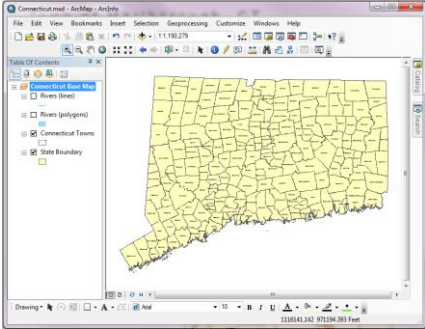
Labels, Text, Graphics and Annotation:


➤ Dynamic Labels


➤ Label Properties

➤ Graphic Shapes and Text

➤ Geodatabase Annotation




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Questions?



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Presentation 4-2 – Adding Text, Graphics & Annotation

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Module 4: Map Production Layouts & Cartographic Design

Geospatial Technologies at Work: An Introduction to GIS

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Learning Objectives

- 1) ArcMap Layouts**
- 2) Map Templates**
- 3) Cartographic Elements**
- 4) Map Export and Dynamic PDFs**
- 5) Map Packages**

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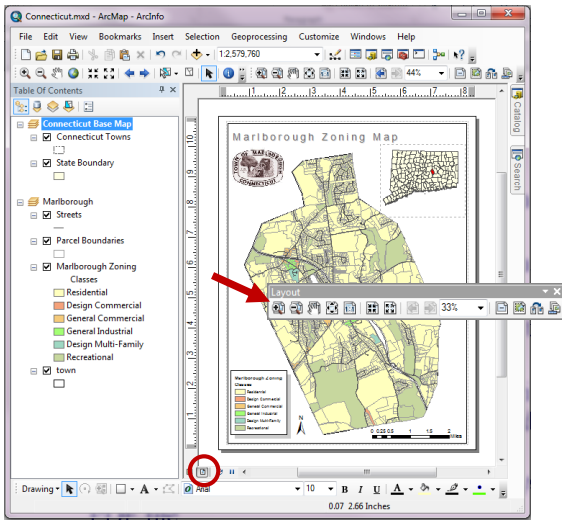
Layout View in ArcMap

Layout View is where you create and design a map for printing or export

Layout mode provides a “virtual” page for you to add content including Data Frames, titles and text boxes, legends, scale bar, images, graphs, etc.

The “virtual” page can be set up for standard page sizes to plotter size outputs

Layouts can be exported to various image formats as well as interactive Adobe PDFs

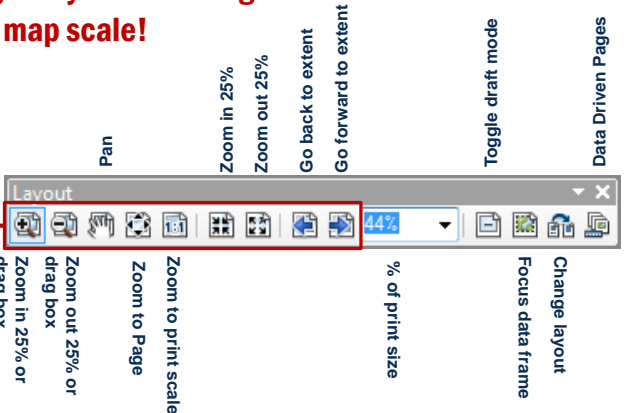


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Layout Toolbar

Tools work on the Layout page they do not change the map scale!



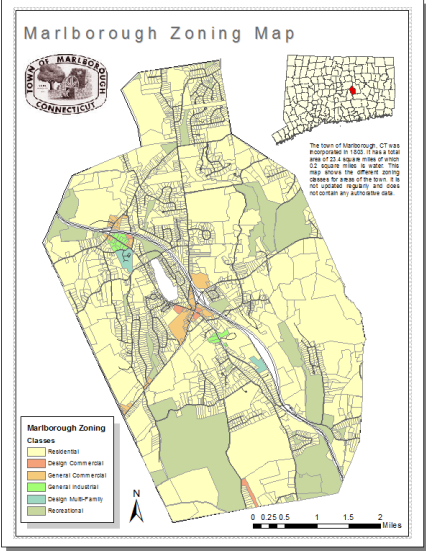
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Cartographic Components

What Makes a Good Map?

- Geographic data
- Title
- Legend
- Scale Bar
- North Arrow
- Context
- Images and Graphics
- Composition



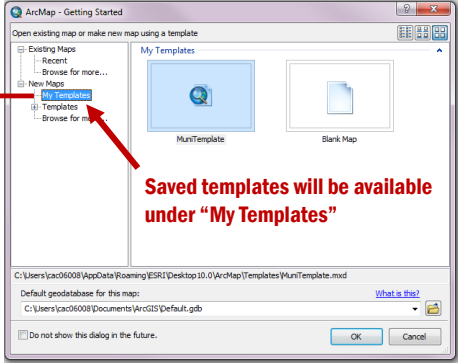
The Marlborough Zoning Map displays various land use zones in different colors: Residential (yellow), Design Commercial (orange), General Commercial (light green), General Industrial (dark green), Design Multi-Family (light blue), and Recreational (dark blue). The map includes a title, a legend, a scale bar, a north arrow, and a context map of Connecticut. A disclaimer note states: 'The town of Marlborough, CT was incorporated in 1820. It has a total area of 2.4 square miles. All 12 square miles of water. This map shows the current zoning design for areas of the town. It is not a legal document and does not contain any authoritative data.'

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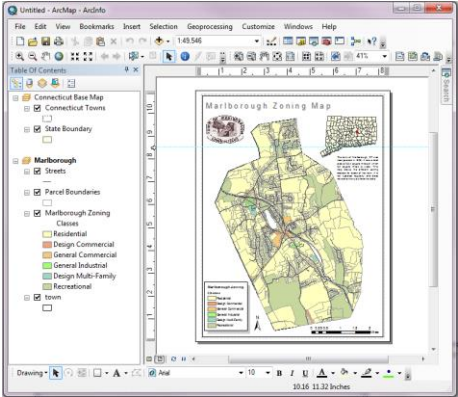
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Map Templates

A Map Template is a map document from which new documents can be created. They make it easy to reuse or standardize a layout on a series of maps.



The 'ArcMap - Getting Started' dialog shows 'My Templates' with a 'MuniTemplate' icon. A red arrow points from the 'My Templates' section to the file path below.



The ArcMap interface shows the 'Marlborough Zoning Map' loaded in the map canvas. The 'Table of Contents' pane on the left lists the map layers, including 'Marlborough Zoning' and 'Classes'.

C:\Users\<user>\AppData\Roaming\ESRI\Desktop10.0\ArcMap\Templates

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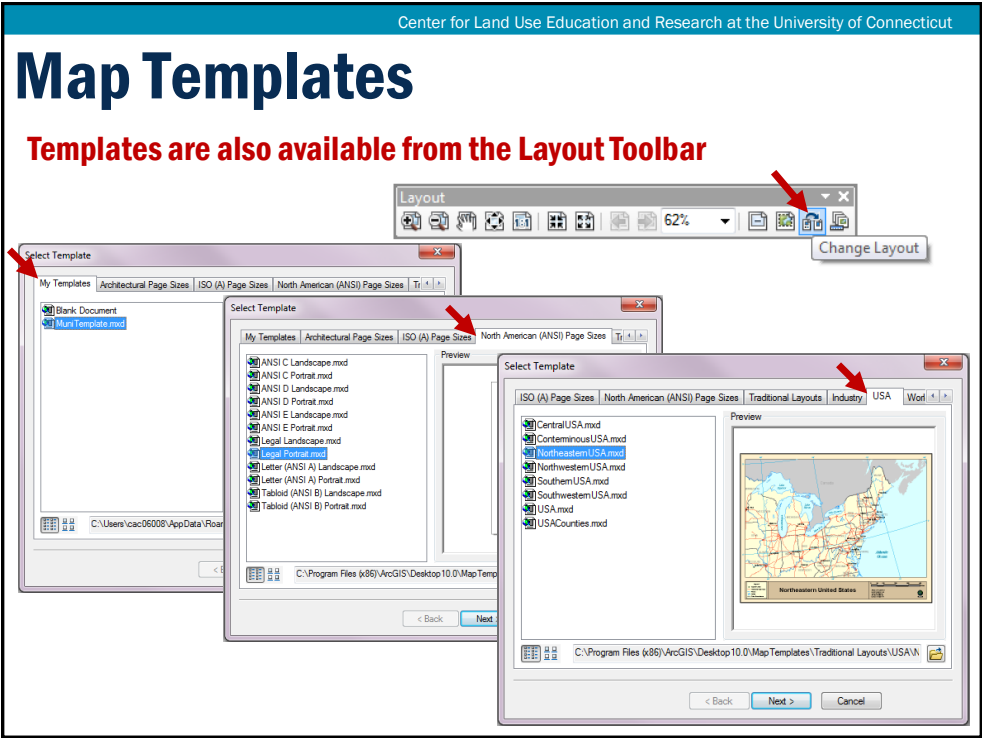
Presentation 4-3 – Creating a Cartographic Output

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Map Templates

Templates are also available from the Layout Toolbar

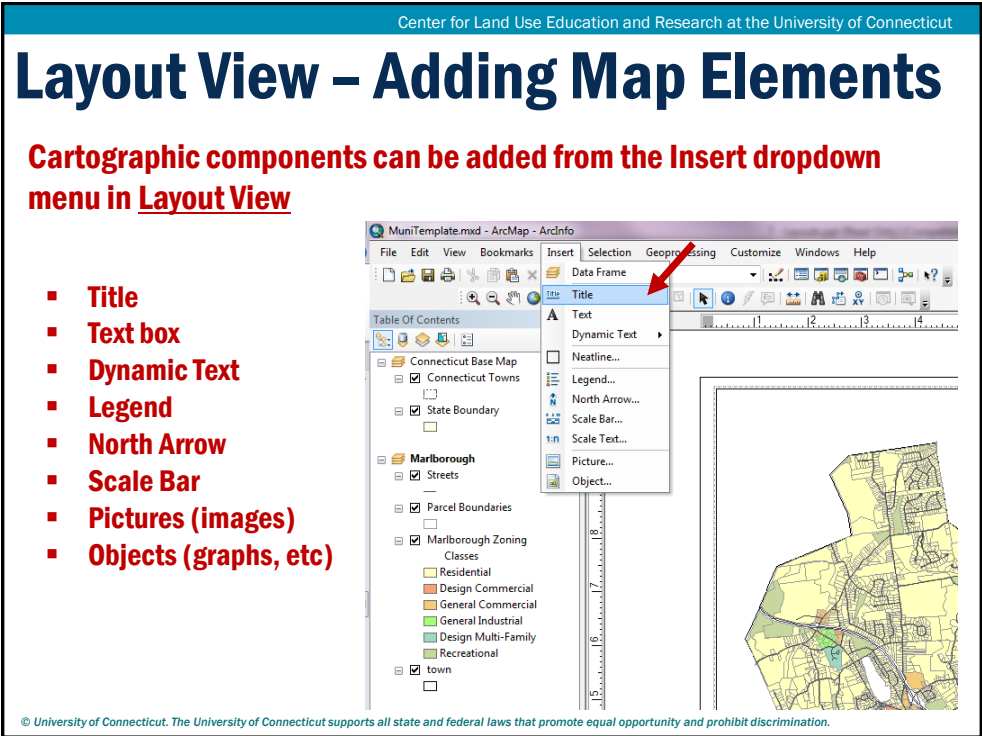


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Layout View – Adding Map Elements

Cartographic components can be added from the Insert dropdown menu in Layout View

- Title
- Text box
- Dynamic Text
- Legend
- North Arrow
- Scale Bar
- Pictures (images)
- Objects (graphs, etc)



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Key Components – Title & Text

Text tools:

- Add Title (Insert menu)
- Add Text (Insert menu)
- Text tools (Draw toolbar)

The screenshot shows a map of the Town of Marlborough with a text box containing a paragraph of text. A red arrow points from the 'Polygon Text' tool in the 'Draw' toolbar to the text box. Two dialog boxes are open: 'Properties' for the text box, showing font settings (Arial, size 21.00), and 'Symbol Selector' for the text box, showing various symbol styles.

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Key Components - Legend

The screenshot shows a series of overlapping 'Legend Wizard' dialog boxes. The first dialog box shows the 'Map Layers' list with 'Streets', 'Parcel B', and 'Marlborough town'. The second dialog box shows the 'Legend Title' and 'Legend Title font properties'. The third dialog box shows the 'Legend Frame' and 'Legend Frame font properties'. The fourth dialog box shows the 'Legend Items' list with 'Marlborough Zoning'. The fifth dialog box shows the 'Set the spacing between the parts of your legend' options, with a red circle around the 'Preview' button.

Marlborough Zoning Classes

- Residential
- Design Commercial
- General Commercial
- General Industrial
- Design Multi-Family
- Recreational

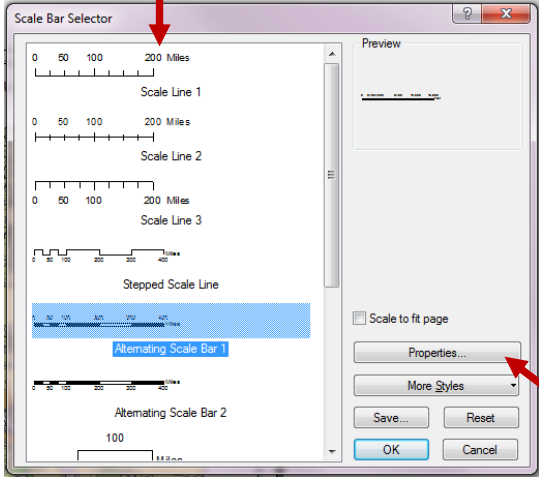
Presentation 4-3 – Creating a Cartographic Output

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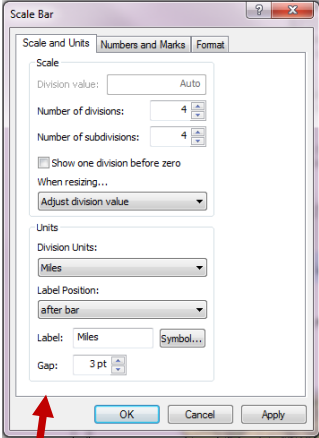
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Key Component – Scale Bar

Choose a style



Format Properties

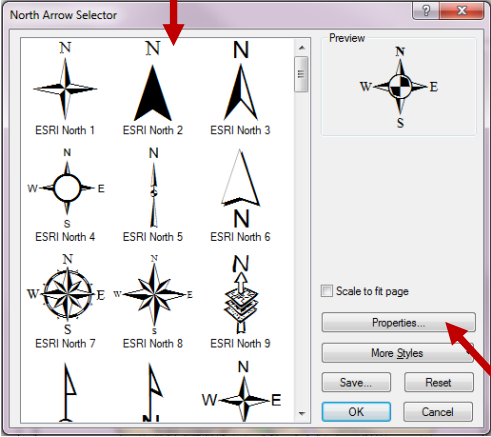


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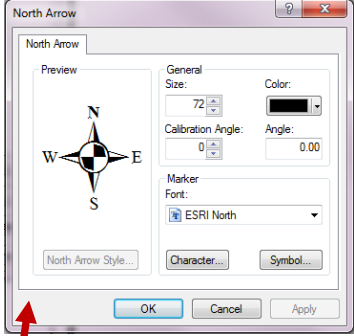
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Key Component – North Arrow

Choose a style



Format Properties



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Presentation 4-3 – Creating a Cartographic Output

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Other Cartographic Components

Picture

Data Frame

Graphic & Text elements

Neat Line

Dynamic Text

Town of Marlborough

There is a lot of text in this textbox and I want it to wrap in the box and fit in a very defined location on my page. Therefore I will use the polygon text tool to define the boundaries of my textbox.

Date: 3/6/2011

Marlborough Zoning Classes

- Residential
- Design Commercial
- General Commercial
- General Industrial
- Design Multi-Family
- Recreational

0 0.25 0.5 1 1.5 2 Miles

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Modifying Elements

- **Elements are selectable**
- **Easy to move, reshape and modify**
- **Double-click to open Properties**

Town of Marlborough

There is a lot of text in this textbox and I want it to wrap in the box and fit in a very defined location on my page. Therefore I will use the polygon text tool to define the boundaries of my textbox.

Date: 3/6/2011

Marlborough Zoning Classes

- Residential
- Design Commercial
- General Commercial
- General Industrial
- Design Multi-Family
- Recreational

0 0.25 0.5 1 1.5 2 Miles

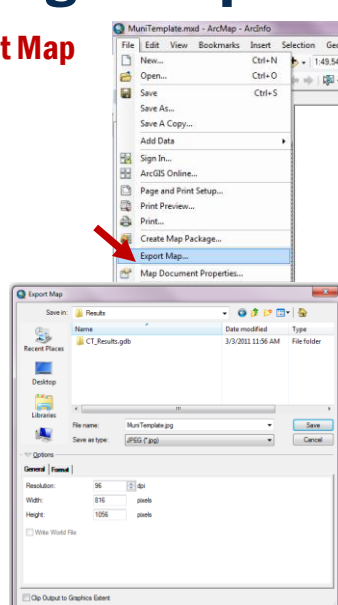
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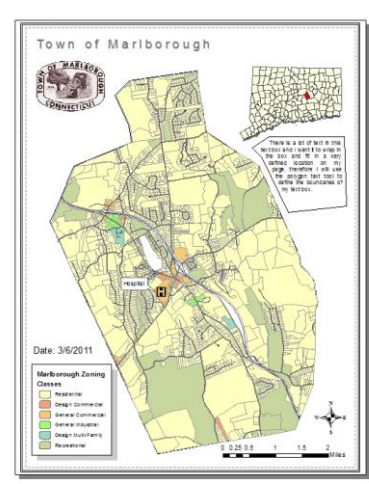
Exporting a Map

File> Export Map

.bmp
.jpg
.pdf
.png
.tiff
.gif
.svg
.emf
.eps
.ai



The screenshot shows the ArcMap interface. The 'File' menu is open, and 'Export Map' is highlighted. Below it, the 'Export Map' dialog box is open, showing the 'Save in' folder as 'Results' and the 'File name' as 'MunTemplate.jpg'. The 'Save as type' is set to 'JPEG (*.jpg)'. The 'Options' section shows 'Resolution' as 96, 'Width' as 816, and 'Height' as 1056. The 'Clp Output to Graphics Extent' checkbox is checked.



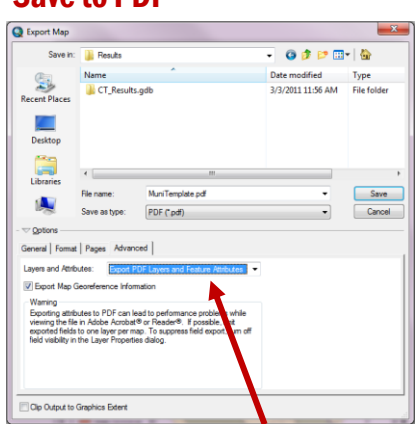
The screenshot shows a map titled 'Town of Marlborough' with a legend for 'Marlborough Zoning Classes'. The legend includes: Residential (yellow), Design Commercial (orange), General Commercial (green), General Industrial (blue), Design Multi-Family (light green), and Recreational (dark green). The map shows a street grid with various colored areas representing different zoning types. A scale bar at the bottom right indicates distances from 0 to 2 miles. A date stamp 'Date: 3/6/2011' is visible on the map.

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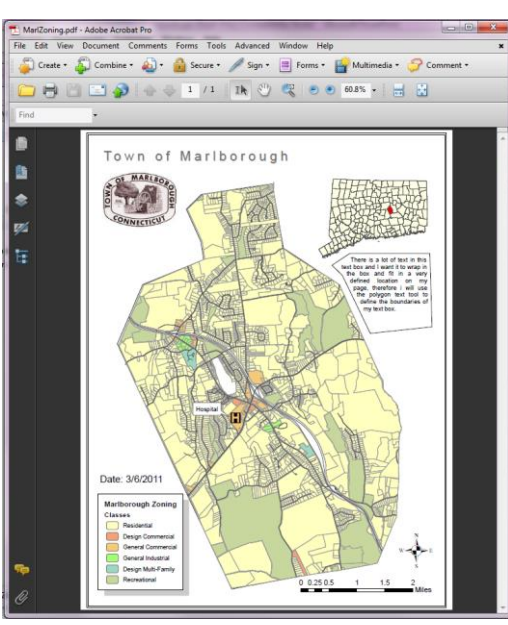
Export to PDF

Save to PDF



The screenshot shows the 'Export Map' dialog box with the 'Advanced' tab selected. The 'Layers and Attributes' section shows 'Export PDF Layers and Feature Attributes' selected. A red arrow points to the 'Warning' section, which states: 'Warning: Exporting attributes to PDF can lead to performance problems while viewing the file in Adobe Acrobat® or Reader®. If possible, export fields to one layer per map. To suppress field export, turn off field visibility in the Layer Properties dialog.'

Specify Advanced Options



The screenshot shows the resulting PDF map titled 'Marlborough Zoning'. The map is displayed in Adobe Acrobat Pro, showing the same zoning data as the previous map. The legend and scale bar are visible. A date stamp 'Date: 3/6/2011' is also present.

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Presentation 4-3 – Creating a Cartographic Output

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Export to PDF – Analysis Tools

PDF Layers

Click on eye to turn on/off

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Export to PDF – Analysis Tools

Geospatial Location Tool

Tools

Advanced

Window

Help

Comment & Markup

Select & Zoom

Advanced Editing

Typewriter

Analysis

Multimedia

Customize Toolbars...

Forms

Multimedia

62.8%

Find

Object Data Tool

Measuring Tool

Geospatial Location Tool

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Export to PDF – Analysis Tools

Measuring Tool

Tools

Advanced

Window

Help

Comment & Markup

Select & Zoom

Advanced Editing

Typewriter

Analysis

Multimedia

Customize Toolbars...

Forms

Multimedia

62.8%

Find

Object Data Tool

Measuring Tool

Geospatial Location Tool

MarlZoning.pdf - Adobe Acrobat Pro

File

Edit

View

Document

Comments

Forms

Tools

Advanced

Window

Help

Create

Combine

Collaborate

Secure

Sign

Forms

Multimedia

Comment

1 / 1

62.8%

Find

Layers

Other 3

Marlborough

Streets

Parcel Boundaries

Marlborough Zoning

town

Connecticut Base Map

Other

Town of Marlborough

There is a lot of text in this test box and I want it to wrap in the box and fit in a very defined location on my page, therefore I will use the polygon tool to define the boundaries of my test box.

Date: 3/6/2011

Marlborough Zoning Classes

Residential

Design Commercial

General Commercial

General Industrial

Design Multi-Family

Recreational

Geospatial Distance Tool

Distance: 4.05 mi

Acrometry: -94.60

Latitude: 41.6509

Longitude: -72.5031

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Export to PDF – Analysis Tools

Object Data Tool

Tools

Advanced

Window

Help

Comment & Markup

Select & Zoom

Advanced Editing

Typewriter

Analysis

Multimedia

Customize Toolbars...

Forms

Multimedia

62.8%

Find

Object Data Tool

Measuring Tool

Geospatial Location Tool

MarlZoning.pdf - Adobe Acrobat Pro

File

Edit

View

Document

Comments

Forms

Tools

Advanced

Window

Help

Create

Combine

Collaborate

Secure

Sign

Forms

Multimedia

Comment

1 / 1

62.8%

Find

Model Tree

Other 3

Marlborough

Streets

Parcel Boundaries

Marlborough Zoning

DC

DMR

DRE

GC

GI

SI

town

Connecticut Base Map

Other

Town of Marlborough

There is a lot of text in this test box and I want it to wrap in the box and fit in a very defined location on my page, therefore I will use the polygon tool to define the boundaries of my test box.

Date: 3/6/2011

Marlborough Zoning Classes

Residential

Design Commercial

General Commercial

General Industrial

Design Multi-Family

Recreational

Property Value

OBJECTID

2

ZONE

DMR

COUNT

2

SUM_AREA

2857548.0625

Shape_Length

11022.918852

Shape_Area

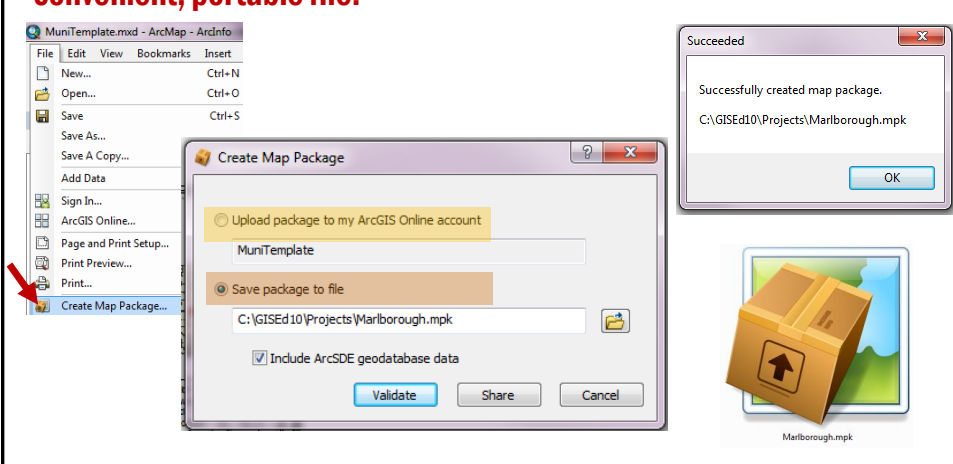
2857548.093212

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Map Packages

A Map Package file (.mpk) contains a Map Document (.mxd) and the data referenced by the layers it contains, packaged into one convenient, portable file.



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Cartography Resources

ESRI Mapping Center <http://mappingcenter.esri.com/>

- **Map examples**
- **Downloadable styles, models & scripts**
- **“Ask a Cartographer” FAQs**
- **Blog**

ColorBrewer2 <http://colorbrewer2.org/>

- **Web tool for selecting color schemes for thematic maps**
- **Provides 35 schemes with CMYK, RGB, Hex, Lab and HSV specs**

Forums and Blogs:

Making Maps <http://makingmaps.net/>

Cartogrammer <http://www.cartogrammar.com/>

Cartography 2.0 <http://cartography2.org/>

Hands On Exercise

Cartographic Design – Layouts:

- **Working in Layout View**
- **Working with multiple Data Frames**
- **Cartographic Components**
- **Adding Map Elements**
- **Exporting to PDF**
- **Map Packages**

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Questions?



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Module 4: Map Production

⚡ LT - Data Driven Pages

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Data Driven Pages

Data Driven Pages allow you to quickly create a series of layouts of pages from a single map document.

An Index Layer divides the map into sections based on each index feature and generates one page per index features



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Data Driven Pages

Marlborough Tax Maps

0 200 400 800 Feet

26 27 28 37 38 39 48 49 50

East Hartford, Connecticut

0 0.35 0.7 1.4 2.1 2.8 Miles

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Data Driven Pages Setup

Data Driven Pages

show Name

Data Driven Page Setup...

Setup Window

Required Elements for DDP:

▪ Data Frame

▪ Index Layer

▪ Name Field

▪ Sort Field

Data Driven Pages Toolbar

Setup Data Driven Pages

Definition

What are data driven pages?

An index layer is used to produce multiple output pages using a single layout. Each page shows the data at a different extent. The extents are defined by the features in the index layer.

Enable Data Driven Pages

Index Layer

Data Frame:

Layers

Layer:

Connecticut Towns

Name Field:

TOWN

Sort Field:

TOWN

Sort Ascending

Optional Fields

Rotation:

none

Spatial Reference:

none

Page Number:

none

Starting Page Number:

1

OK

Cancel

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Presentation 4-4 – Data Driven Pages

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Navigating Data Driven Pages

Dynamic Text

Properties

Text

Size and Position

Text:

`<dyn type="page" property="NAME" />`

Base Map

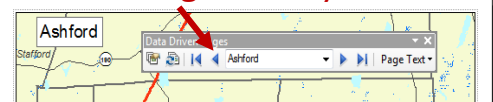
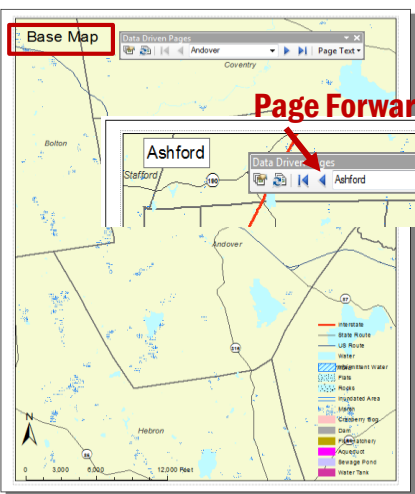
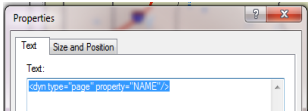
Page Forward/Back


Ashford

Data Driven Pages

Ashford

Page Text



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Exporting Data Driven Pages

Export to PDF Options

Export Map

Save in:

DDP

Name

CT.pdf

Date mod

3/8/2011

File name:

Untitled.pdf

Save as type:

PDF (*.pdf)

Save

Cancel

Options

General

Format

Pages

Advanced

☐ All (169 pages)

☒ Current (page 42)

☐ Selected (0 pages)

☐ Show Selection Symbology

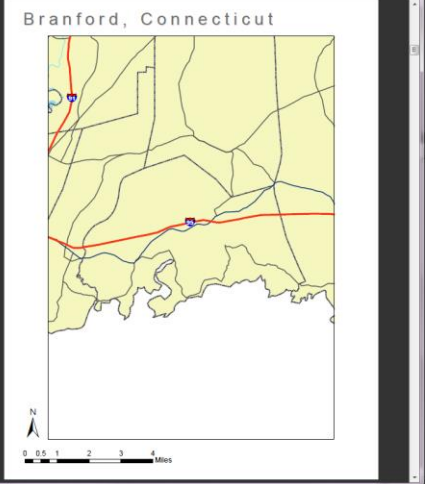

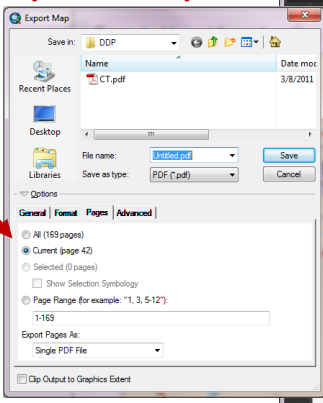
☐ Page Range for example: "1, 3, 5-12":


1-169

Export Pages As:

Single PDF File

☐ Clip Output to Graphics Extent



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Presentation 4-4 – Data Driven Pages

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Questions?



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Module 5 – Data Manipulation

LT -Georeferencing

Geospatial Technologies at Work: An Introduction to GIS

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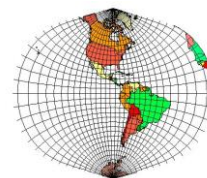
UConn CLEAR

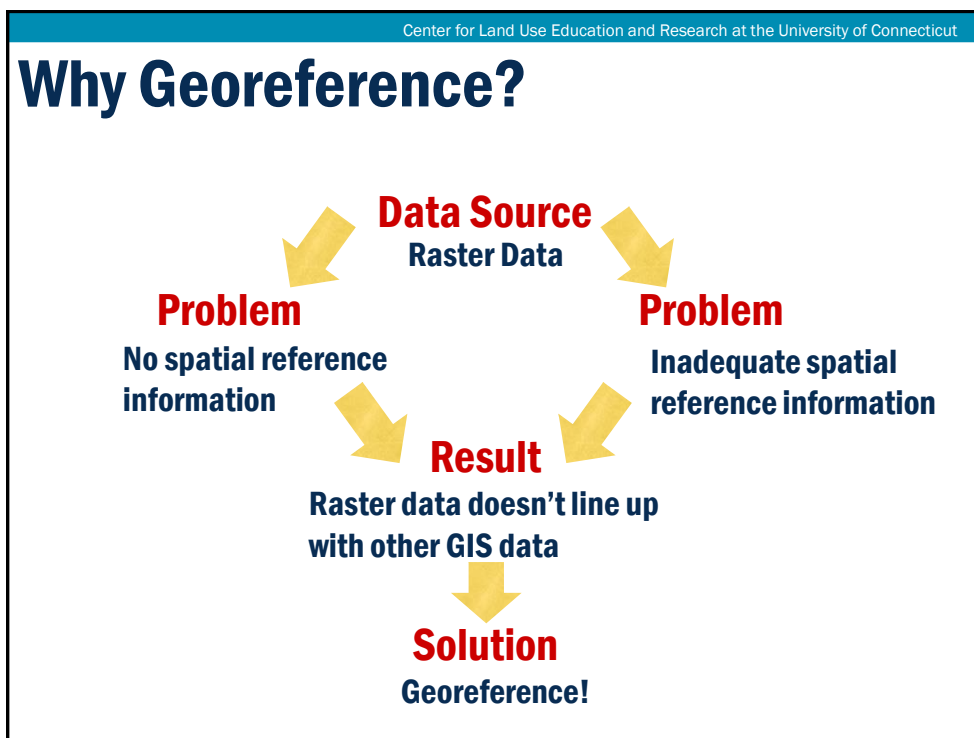


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Georeferencing


- **Assigning coordinates from a known reference system, such as latitude/longitude, UTM, or State Plane, to a raster (image) or a planar map.**
- **Georeferencing raster data allows it to be viewed, queried, and analyzed with other geographic data.**



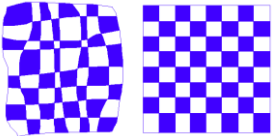


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Reference Data



- **Required to georeference.**
- **Source can be GPS points or good GIS data where features can be seen in both the raster and the reference.**
- **The reference should cover the entire area of the image to be georeferenced.**
- **Georeferenced data is only as accurate as the data to which it is aligned (if the reference stinks, so will the georeferenced image!).**



Terminology

Georeferencing: The process of assigning map coordinates to image data (grid of the image does not change)

Registration: The process of making an image conform to another image (a map coordinate system is not necessarily involved)

Rectification: The process of transforming the data from one grid system into another grid system using geometric transformation

- Involves georeferencing because map projections are associated with map coordinates.
- Because the pixels of the new grid may not align with the pixels of the original grid, the pixels must be resampled.

Orthorectification: A form of rectification that corrects for terrain displacement and can be used if there is a DEM of the study area

Process

- On the reference, identify a series of **ground control points (GCPs)** with known coordinates
- **Link** the locations of these points to the un-rectified raster
- Control points are used to build a **polynomial transformation** that will convert the raster dataset from its existing location to the spatially correct location

First Order Transformations

Translation is a simple displacement (shift) of the entire map by a certain offset distance along one or both axes.

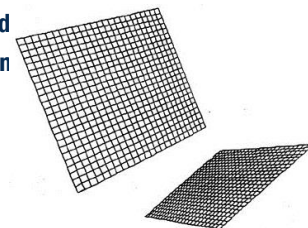
Scaling is a simple multiplication of the X and Y units by some constant.

- For example, maps having the same projection but different units (meters vs. feet).

Rotation

- Rarely required when dealing with data in known coord
- Almost always necessary when georeferencing a scan

The plane is moved as a unit but the plane itself does not change



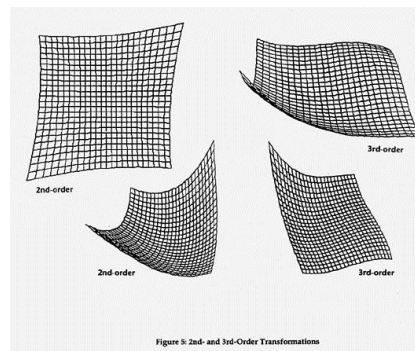
Higher Order Transformations

Polynomial Transformation (2nd order, 3rd order).

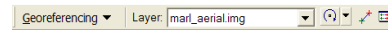
Transforms straight lines into curved ones.

The higher order of the polynomial, the more curvy the result.

Requires resampling.



Step 1: Add Data

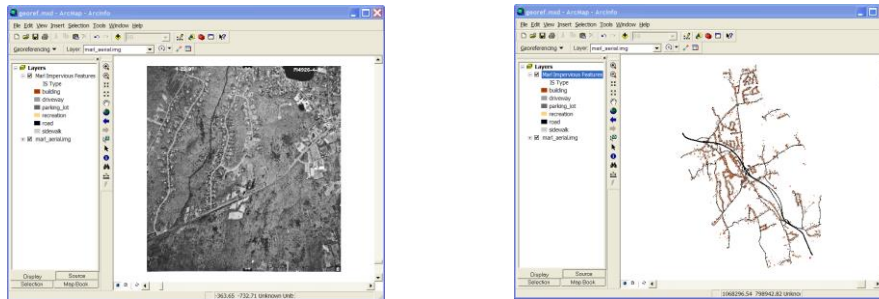


Turn on Georeferencing Toolbar

Add the image to be georeferenced

- Study the area covered

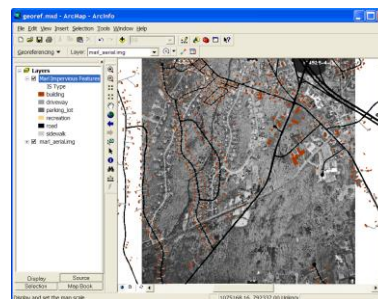
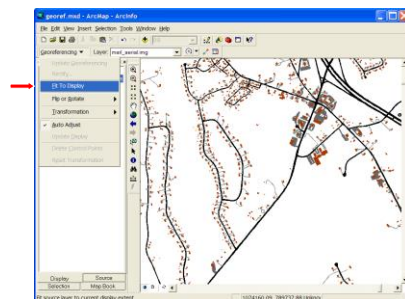
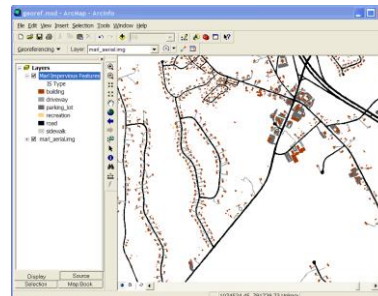
Add reference data and zoom to layer



Step 1: Add Data

Zoom to general area

Fit image to display



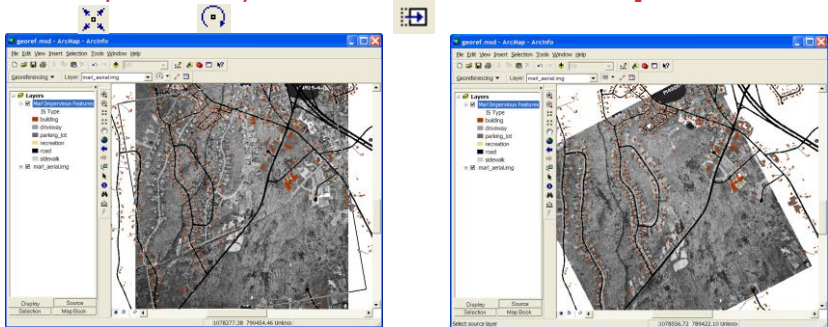
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Step 2: Roughly Line Up Datasets

Zoom and Fit to Display

- If SMALLER, zoom Out and Fit to Display
- If LARGER, zoom In and Fit to Display

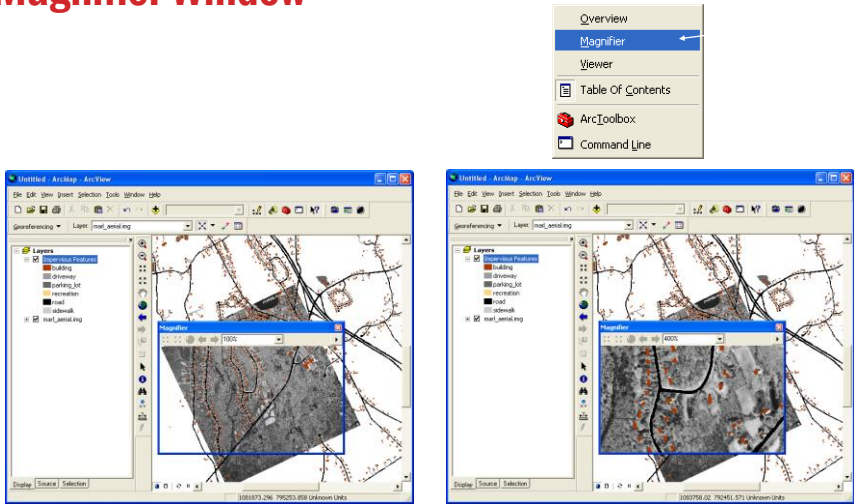
Scale, Rotate, and Shift until lined up



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Side Note: Helpful Viewing Tools

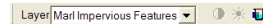
Magnifier Window



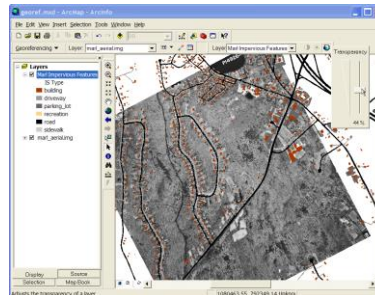
Side Note: Helpful Viewing Tools

Layer Transparency

Turn on Effects Toolbar



Choose layer and use slider to change transparency




Ground Control Points (GCPs)

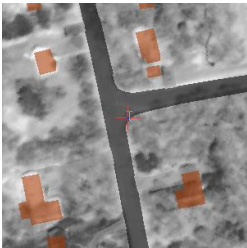
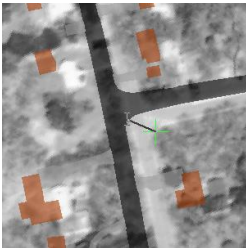
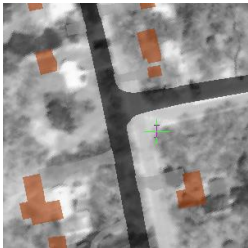
- **GCPs define the transformation equation.**
- **More is not always better.**
- **Should be spread across the image and as close to each corner as possible.**
- **Choose points that don't change such as road intersections.**
- **Avoid water and vegetative features that change over time.**
- **Need at least 3 points for 1st order and 6 points for 2nd order transformations.**

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Step 3: Add Control Points

Zoom so you can see the desired point on the raster and reference

Click Add Control Points button 



It is possible to have the reference layer off, click the raster, turn the reference on (click checkbox) and then click the point on the reference.

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Step 4: Evaluation

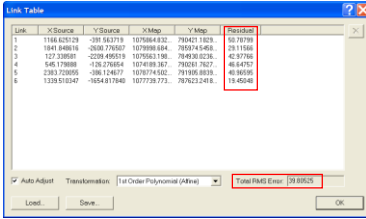
Look at GCPs in Links Table

Residual Error

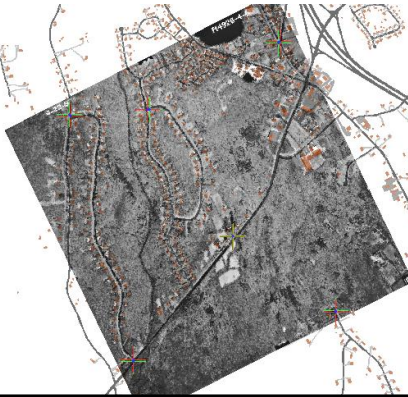
- Compares the actual location of the map coordinate to the transformed position in the raster. Residual error is this distance.

Total RMS Error

- Computed by taking the root mean square (RMS) sum of all the residuals.
- Describes how consistent the transformation is between the different control points.



Link	X-Source	Y-Source	X-Map	Y-Map	Residual
1	1146.625178	-385.583719	1075684.432	790421.1829	50.79789
2	1547.448516	-3030.730237	1075958.054	789214.4482	29.11584
3	127.238587	-3238.495518	1075683.156	784530.8236	42.97165
4	546.178889	-1735.256554	1074618.187	789351.7837	46.44752
5	2383.728895	-386.124877	1078774.652	791895.8819	40.98595
6	1228.512047	-1854.817940	1077728.773	787823.2418	15.45649



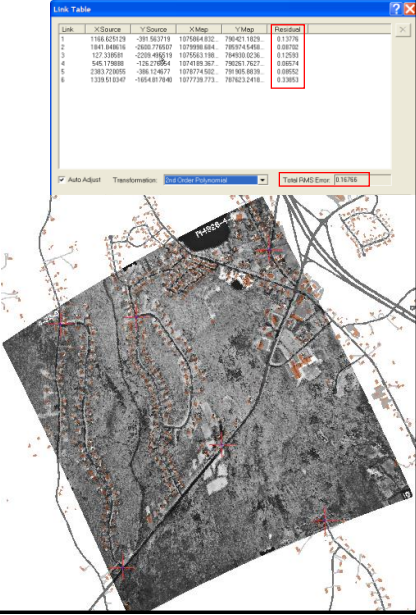
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Step 4: Evaluation

Compare transformations

1st order if the raster dataset needs to be stretched, scaled and rotated

2nd order if the raster dataset needs to be bent or curved



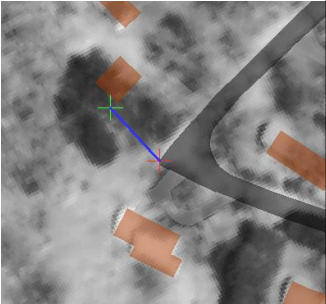
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Step 5: Iterations

If points have too high a residual or the line on the image is too long (indicates image and reference parts are far apart), remove

Add more points

Continue to evaluate and edit



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Step 6: Acceptance

Georeference

- Saves the transformation information with the raster dataset.
- Creates a new file with the same name as the raster dataset, but with an .aux file extension. It also creates a world file for .tif and .img files.

Rectify

- Permanently transforms the raster dataset after georeferencing.
- Creates a new raster dataset that is georeferenced to map coordinates. Can save this in GRID, TIFF, or IMAGINE format.

Why Rectify?

- ArcMap doesn't require rectification to display raster with other spatial data.
- Rectify if you want to use the image with another software package that doesn't recognize the external georeferencing information created by ArcMap.

Georeferencing ▾ | Layer: ma

Update Georeferencing

Rectify...

Fit To Display

Flip or Rotate ▸

Transformation ▸

✓ Auto Adjust

Update Display

Delete Control Points

Reset Transformation

Georeferencing ▾ | Layer: ma

Update Georeferencing

Rectify...

Fit To Display

Flip or Rotate ▸

Transformation ▸

✓ Auto Adjust

Update Display

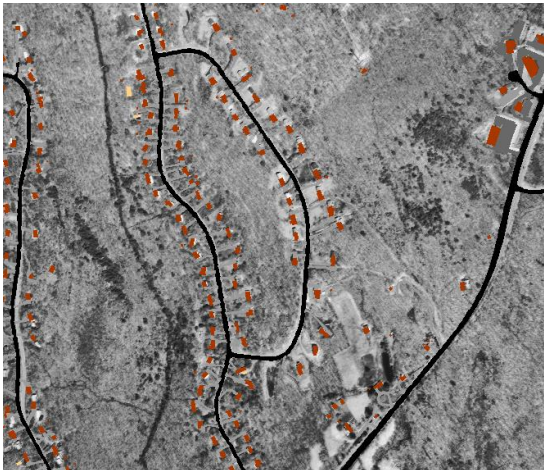
Delete Control Points

Reset Transformation

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The Result

Data that lines up!



Presentation 5-1 – Georeferencing

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Module 5: Data Manipulation

Introduction to Digitizing and Editing

Geospatial Technologies at Work: An Introduction to GIS

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Learning Objectives

- 1) What is Digitizing and Editing?**
- 2) Basics of creating points, lines, polygons**
- 3) The ArcGIS editor interface**
- 4) The edit session work flow**
- 5) Tools and Tips**
- 6) A few advanced concepts (tip of iceberg)**

Disclaimer: This module will not make you an expert

What is Digitizing?

Digitizing - the process of converting information into a digital format

Digitizing in GIS - the process of converting geographic data either from a hardcopy or a scanned image into digital data (vector or raster)



What is Digitizing?

Hard-copy digitizing

- uses a special table surface with a system for converting positions on its surface into digital x,y coordinates in the computer



Heads up digitizing

- draw identifiable features using the mouse or other input device (i.e. pen tablet) directly over orthophotographs, satellite imagery, or scanned maps



Automated Tools

- analyze pixels from imagery and attempt to create vector
- has improved considerably over the years
- often require a lot of post editing (clean up)

Digitizing Features - Points

Points

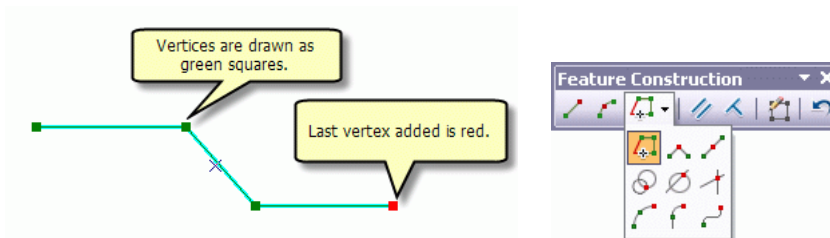
- Simplest form of editing
- Left click on a location to add a point
- Points can also be added by typing the coordinates



Digitizing Features - Lines

Lines

- Have a start and end point
- Vertices in between
- Feature construction tools are activated when creating lines



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Digitizing Features - Polygons

Polygons

- Include the same tools for line features, plus
 - closure, overlap, cutting, shapes, and advanced auto-complete operations
- Multiple tools are available while editing

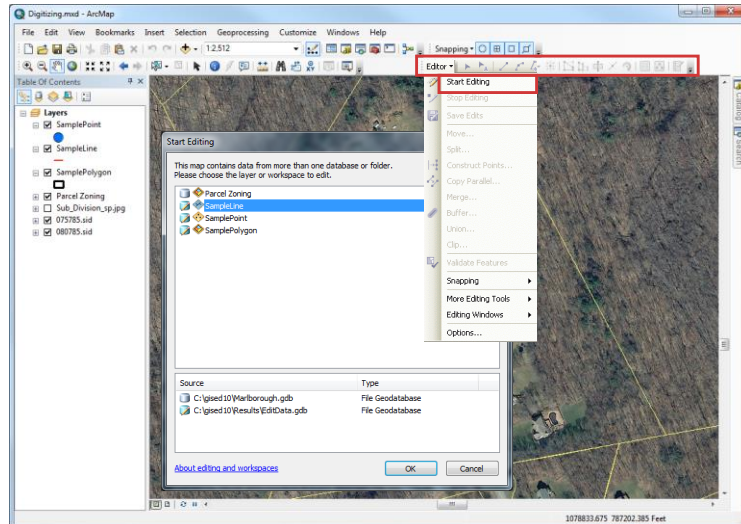
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Editing in ArcGIS– Workflow

```
graph LR; A[Add data to ArcMap and set up mxd] --> B[1. Turn on Editor toolbar]; B --> C[2. Start an edit session]; C --> D[3. Choose a workspace to edit]; D --> E[4. Choose a feature template and construction tool from the Create Features window]; E --> F[5. Set up additional editing properties or options, such as snapping]; F --> G((Sketch)); G --> H[6. Create a new feature]; H --> I[7. Add or edit attributes for the feature]; I --> J[8...Repeat]; J --> K[Save Edits]; K --> L[Stop Editing];
```

Editing

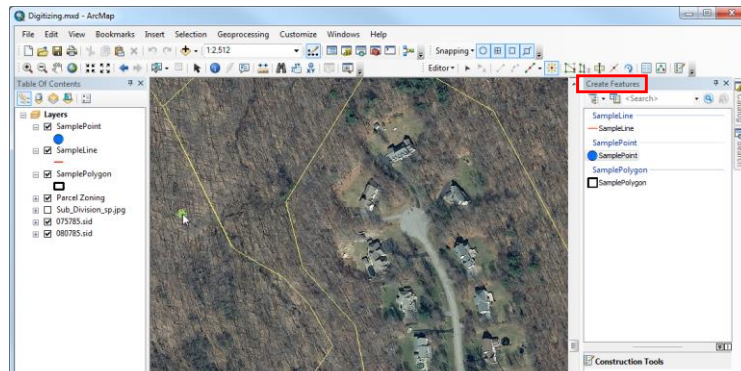
1. Turn on the Editor toolbar
2. Start Editing
3. Choose a workspace to edit



A “pencil” indicates they are part of the same editable folder.

Editing

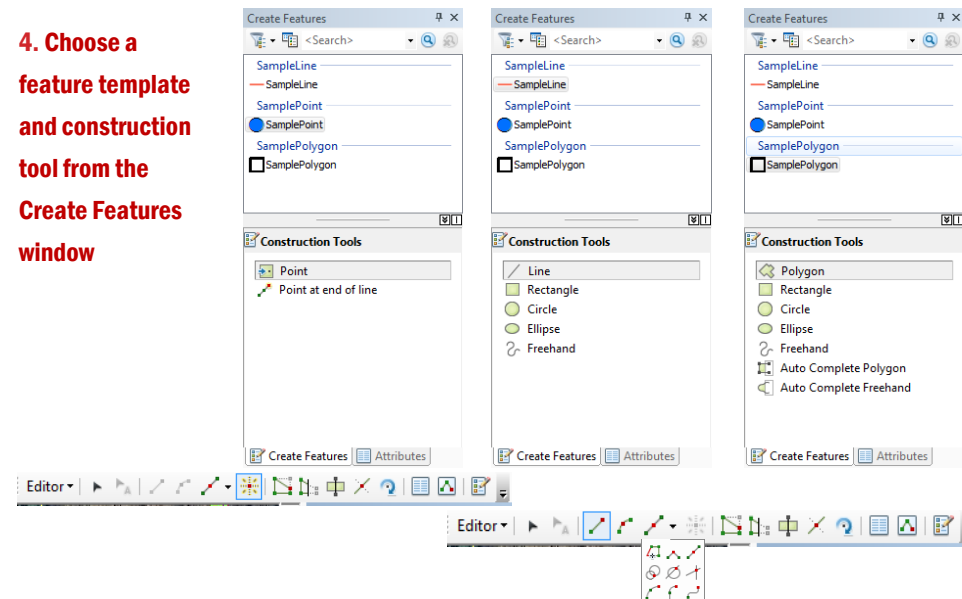
- 4. Choose a feature template and construction tool from the Create Features window**



- A **Feature Template** defines all the information required to create a feature:
 - the layer where a feature will be stored
 - the attributes a feature is created with
 - and the default tool used to create that feature
- If a template is not present when editing starts, one is created for each layer in the current editing workspace
- Templates are saved in the map document (.mxd) and the layer file (.lyr)

Editing

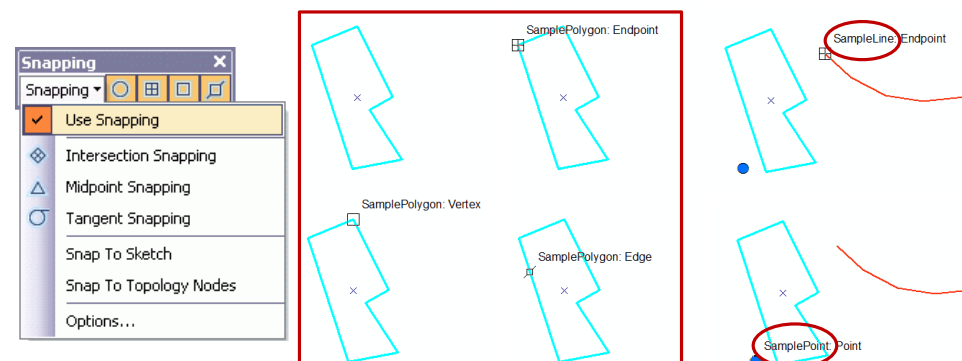
4. Choose a feature template and construction tool from the Create Features window



Editing – Snapping Toolbar

5. Set up additional editing properties or options, such as snapping

- **A depressed button means that option is enabled**
- **When within the snapping distance, the mouse changes to show the type of snap and the layer**



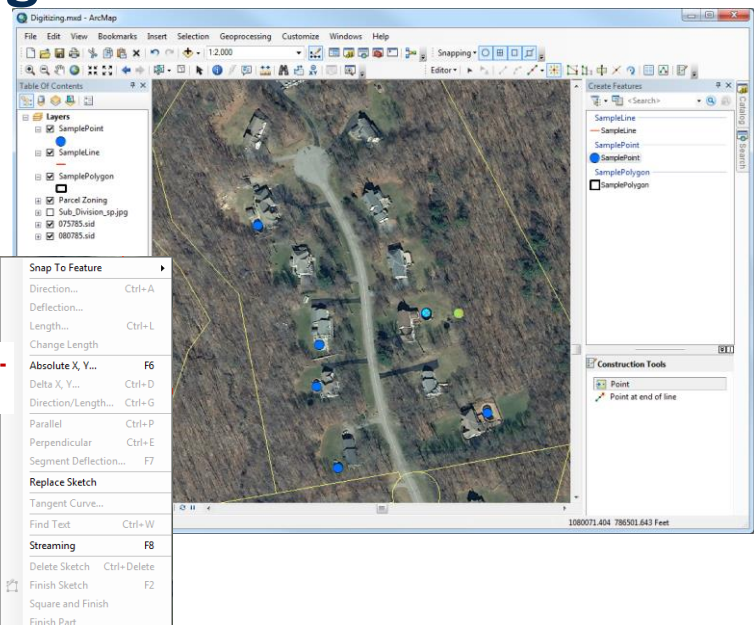
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Digitizing - Points

6. Create a new feature

- Left-click on the location
- Right-click for options

Right-click



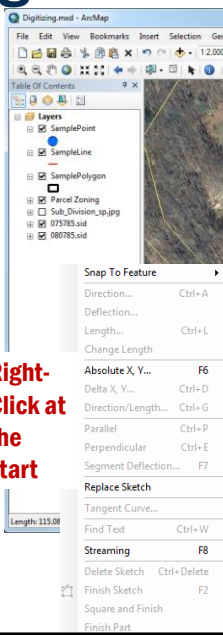
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Digitizing – Lines

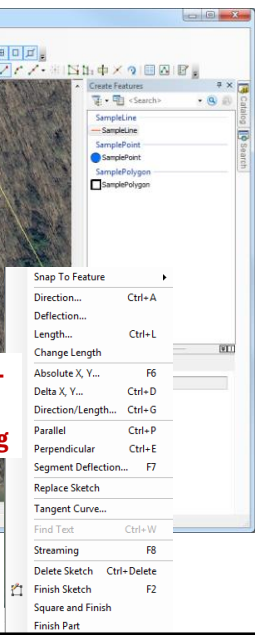
6. Create a new feature

- Left-Click to add a point to start
- Left-click to add each vertex
- Double-Click to end a line segment

Right-Click at the start



Right-Click during



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Digitizing – Polygons

6. Create a new feature

- **Left-Click** to add a point to start
- **Left-click** to add each vertex
- **Double-Click** to close a polygon

Left-Click

- Snap To Feature
 - Direction... Ctrl+A
 - Deflection... Ctrl+L
 - Length... Ctrl+L
 - Change Length
- Absolute X, Y... F6
- Delta X, Y... Ctrl+D
- Direction/Length... Ctrl+G
- Parallel Ctrl+P
- Perpendicular Ctrl+E
- Segment Deflection... F7
- Replace Sketch
- Tangent Curve...
- Find Text Ctrl+W
- Streaming F8
- Delete Sketch Ctrl+Delete
- Finish Sketch F2
- Square and Finish
- Finish Part

Right-Click during

- Snap To Feature
 - Direction... Ctrl+A
 - Deflection... Ctrl+L
 - Length... Ctrl+L
 - Change Length
- Absolute X, Y... F6
- Delta X, Y... Ctrl+D
- Direction/Length... Ctrl+G
- Parallel Ctrl+P
- Perpendicular Ctrl+E
- Segment Deflection... F7
- Replace Sketch
- Tangent Curve...
- Find Text Ctrl+W
- Streaming F8
- Delete Sketch Ctrl+Delete
- Finish Sketch F2
- Square and Finish
- Finish Part

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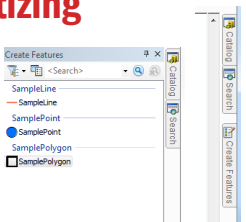
Digitizing – Feature Construction

- The **Feature Construction** mini toolbar may follow you around
- Provides advanced options (parallel, perpendicular, etc.)
- Press **TAB** to make it visible, **TAB** again to turn it off

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Tips During Digitizing

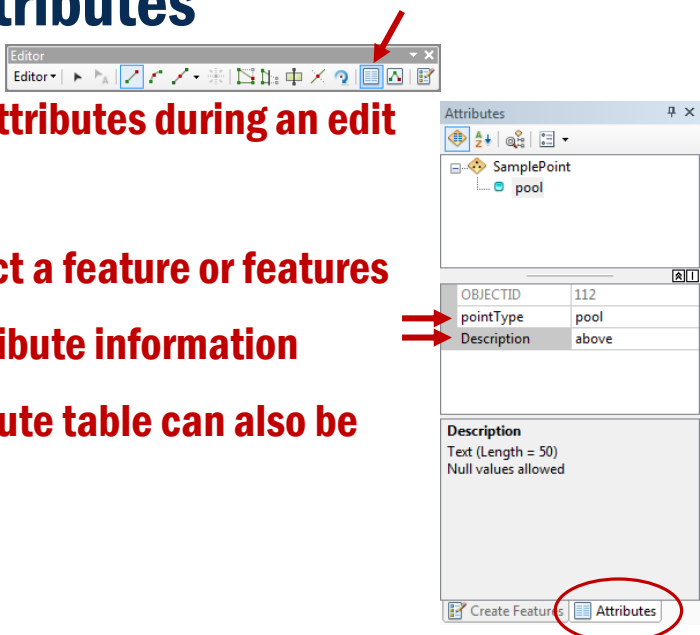
- **Use the Scroll wheel WHILE digitizing**
 - Scroll down = zoom in
 - Scroll up = zoom out
 - Hold scroll wheel = pan
- **Pin or Un-pin windows**
- **You are only working on a SKETCH until you save edits**
- **Press the space bar to temporarily disable snapping**
- **Set the polygon symbology so that the fill is see-through (transparent, hatched)**



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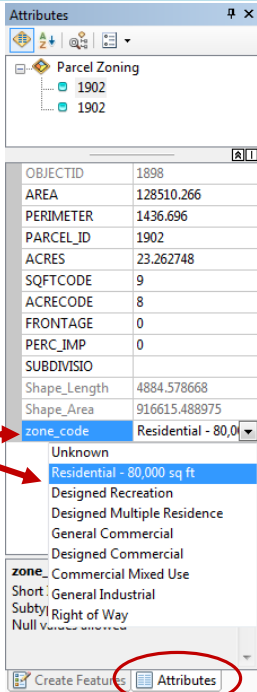


Editing Attributes

- **Edit the attributes during an edit session**
- **First select a feature or features**
- **Enter attribute information**
- **The attribute table can also be edited**



Editing Attributes

- If geodatabase subtypes have been set up, there will be a pick list
- Advantages – faster editing, less error



OBJECTID	1898
AREA	128510.266
PERIMETER	1436.696
PARCEL_ID	1902
ACRES	23.262748
SQFTCODE	9
ACRECODE	8
FRONTAGE	0
PERC_IMP	0
SUBDIVISIO	
Shape_Length	4884.578668
Shape_Area	916615.488975
zone_code	Residential - 80,000 sq ft

zone_code dropdown menu options:

- Unknown
- Residential - 80,000 sq ft
- Designed Recreation
- Designed Multiple Residence
- General Commercial
- Designed Commercial
- Commercial Mixed Use
- Short General Industrial
- Subtype Right of Way
- Null Value

Editing – Saving

- **Save Edits as you go**
- **Edits cannot be undone (make backup copies)**
- **When finished, Stop Editing**


A screenshot of a software application's 'Editor' menu. The menu is open, displaying a list of editing tools and options. The 'Save Edits' option is highlighted with a blue background. Other visible options include 'Start Editing', 'Stop Editing', 'Move...', 'Split...', 'Construct Points...', 'Copy Parallel...', 'Merge...', 'Buffer...', 'Union...', 'Clip...', 'Validate Features', 'Snapping', 'More Editing Tools', 'Editing Windows', and 'Options...'. The menu has a light gray background and a thin border.

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Editing – Advanced Concepts

- Shortcuts (Function Keys, etc.)
- Copy/Paste from other layers
- Magnifier, Viewer Windows
- Edit Sketch Properties
- Feature Templates
- Construction Methods (cutting, reshape, trace...)

- Construction Tools (auto-complete polygon, circles ..)
- Advanced Editing Toolbar
- Topology
- Coordinate Geometry
- Parcel Editor
- Editing Annotation, and more...



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Editing in ArcGIS– Workflow

Add data to ArcMap and set up mxd

1. Turn on Editor toolbar

2. Start an edit session

3. Choose a workspace to edit

4. Choose a feature template and construction tool from the Create Features window

5. Set up additional editing properties or options, such as snapping

6. Create a new feature

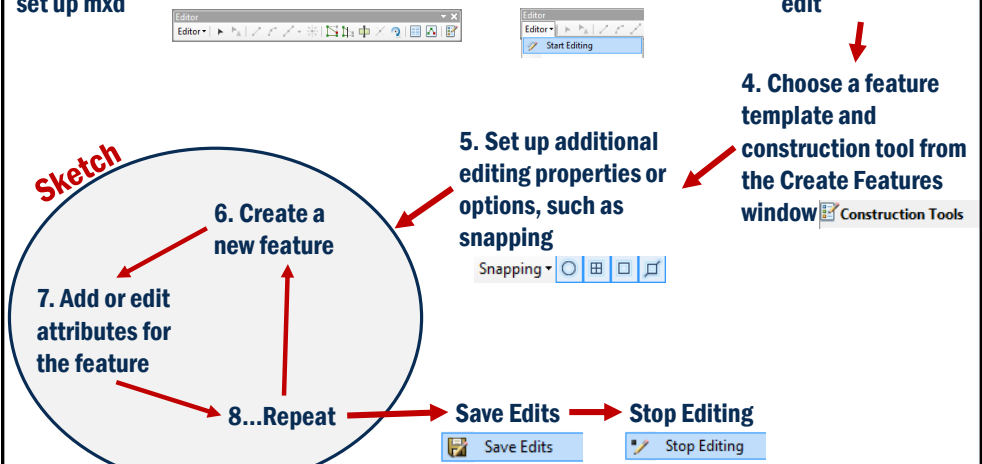
7. Add or edit attributes for the feature

8...Repeat

Save Edits

Stop Editing

Sketch



Questions?



Hands on Exercise: Digitizing

- **Prepare for editing**
- **Start an edit session**
- **Set up snapping**
- **Digitize points (pools), lines (roads and driveways), polygons (roofs)**
- **Edit vertices**
- **Add attribute data**
- **Cut a polygon (add new parcels to town layer)**

Module 5: Data Manipulation ArcToolbox

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Module 5: Data Manipulation

- **Digitizing**
 - Digitizing Exercise
- **ArcToolbox**
 - ArcToolbox Geoprocessing Exercise

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Outline

- **ArcToolbox**
- **Analysis Tools**
 - **Extract Toolbox**
 - **Proximity Toolbox**
 - **Overlay Toolbox**
 - **Clip Tool**
 - **Buffer Tool**
 - **Union Tool**
 - **Spatial Join Tool**
 - **Intersect Tool**
- **Data Management Tools**
 - **Generalization Toolbox**
 - **Dissolve Tool**

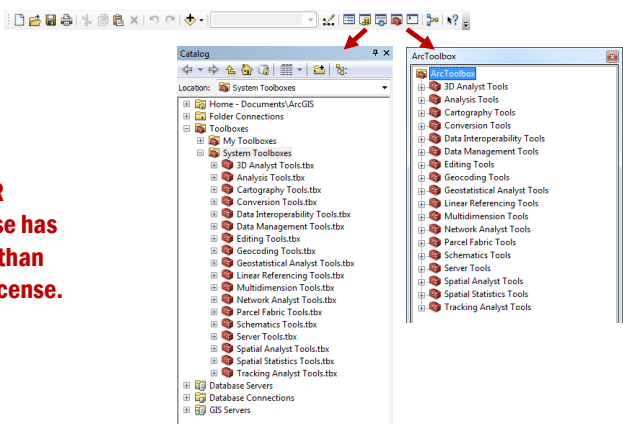
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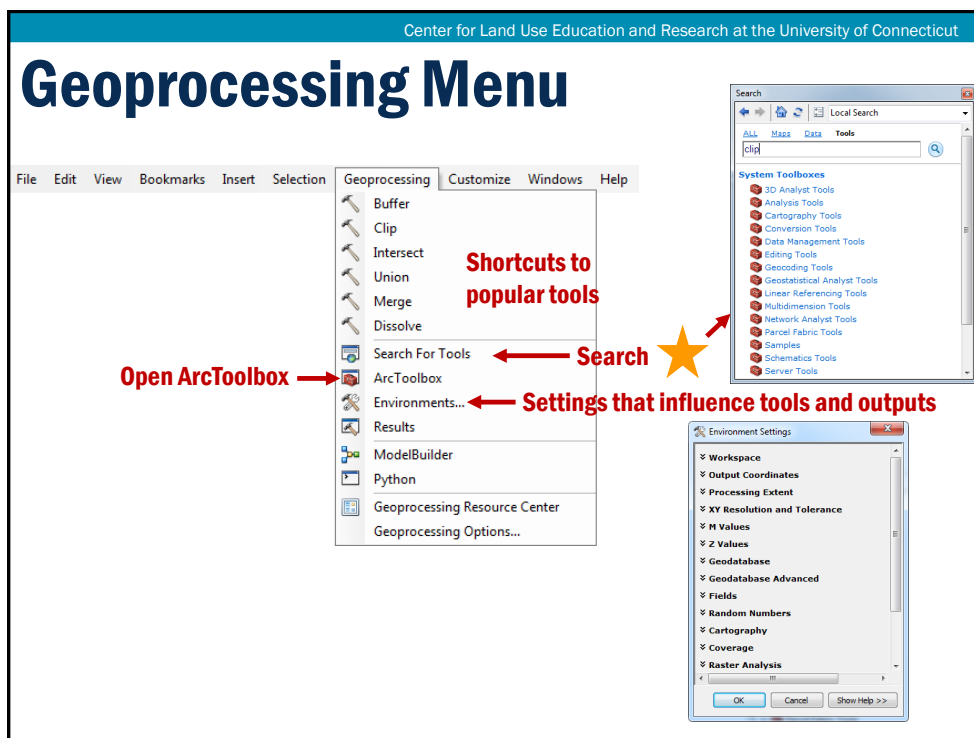
ArcToolbox

Tools to perform various types of spatial analyses are accessed through Toolbox.

ArcToolbox can be opened from both ArcCatalog and ArcMap .

REMEMBER
Basic license has fewer tools than advanced license.





Tools

- **Each tool does a specific process.**
- **Usually several tools are necessary to complete an analysis.**
- **It is helpful to first know what you want in the end and then to think about which combination of tools will get you there.**
- **Most tools create a NEW output file**

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Clip

Extracts input features that overlay the clip features.

Use clip to cut out a piece of one feature class using one or more of the features in another feature class as a “cookie cutter.” This is particularly useful for creating a new feature class that contains a geographic subset of the features in another, larger feature class.

Data that will be clipped

The “cookie cutter”

New dataset

Clip

Input Features

[HYDROZ]

Clip Features

[town]

Output Feature Class

C:\GIS6410\Results\results.gdb\mri_hydroz

XY Tolerance (optional)

Feet

OK Cancel Environments... Show Help >>

ArcToolbox

Clip

Select

Split

Table Select

INPUT

+

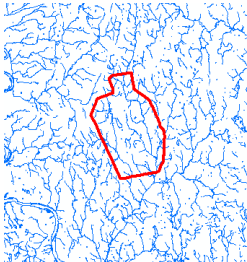

CLIP FEATURE



↓

OUTPUT

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Clip

ArcToolbox

Clip

Select

Split

Table Select

INPUT

+

CLIP FEATURE

↓

OUTPUT

Presentation 5-3 – Working with ArcToolbox

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Clip – Recalculate Area

Identify window reveals table attribute values

After running Clip, most area measurements will have to be recalculated.

Use Calculate Geometry (inside the table).

Measure tool reveals area

The Identify window shows the following table of attribute values for the selected feature:

Field	Value
CTWET_IMS	Non-wetland soils
HYDRIC	No
FARMLAND	Not prime farmland
FARMLAND_IMS	Not Prime or not CT Important Farmland
ACRES	109.401651
Shape_Length	1241.054928
Shape_Area	4765514.563466

The Measure tool window shows the following values for the selected feature:

Measure	Value
Polygon Feature	
Perimeter	1241.054928 Feet
Area	109.401651 Acres

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Recalculating Area and Length Values

Polygon feature classes in a geodatabase have two fields that are maintained by ArcMap – *Shape_Length* and *Shape_Area*. These fields store the area and perimeter in map units of all polygon features and automatically are updated whenever feature geometry changes.

Line feature classes in a geodatabase have just a *Shape_Length* field that stores the length in map units of each line feature and automatically is updated.

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Buffer Tool

➤ **Buffer:** a zone of specified distance around a feature or set of features. Buffers are used for proximity analysis.

➤ **Examples**

➤ Which streams are located within 500' of a road?

➤ How many homes are within 20 miles of a nuclear power plant?

➤ What is the zoning within 300 meters of a limited access highway?

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Buffer with Dissolve Option

Input Features

public_wells

Output Feature Class

C:\GIS510\Results\results.gdb\buffer_dissolve

Distance (value or field)

1000 Feet

Field

Side Type (optional)

End Type (optional)

Dissolve Type (optional)

Dissolve Field(s) (optional)

ALL

OBJECTID

ID

OWNER

YIELD_GPD

Setback

Select All

Unselect All

Add Field

OK

Cancel

Environments...

Show Help >>

Input Data

Output Data

Distance and Units

Dissolve?

Overlap areas are joined together

Selected Points

Presentation 5-3 – Working with ArcToolbox

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Buffer without Dissolve Option

Buffer

Input Features

public_wells

Output Feature Class

C:\GIS5610\Results\results.gdb\buffer

Distance (value or field)

1000 Feet

Dissolve Type (optional)

NONE

Dissolve Field(s) (optional)

Select All

Unselect All

Add Field

OK

Cancel

Environments...

Show Help >>

Identify

Identify from: <Top-most layer>

buffer

Aqua Diablo

Aqua Diablo

Locations: 1,084,375.302 793,627.450 Feet

Field	Value
OBJECTID	3
Shape	Polygon
ID	4
OWNER	Aqua Diablo
YIELD_GPD	1000000
Setback	500
BUFF_DIST	1000
Shape_Length	6283.185109
Shape_Area	3141592.45563

Identified 2 features

Output includes overlapping polygons

Same inputs as previous slide.

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Buffer Using Field Option

Buffer

Input Features

public_wells

Output Feature Class

C:\GIS5610\Results\results.gdb\buffer_setback

Distance (value or field)

Setback

Dissolve Type (optional)

NONE

Dissolve Field(s) (optional)

Select All

Unselect All

Add Field

OK

Cancel

Environments...

Show Help >>

Table

public_wells

ID	OWNER	YIELD_GPD	Setback
1	Clean Waters Inc.	100000	200
2	Aqua Diablo	750000	350
3	Aqua Diablo	250000	200
4	Aqua Diablo	1000000	500
5	Aqua Diablo	500000	350
6	Thirst Quenchers, Inc.	1250000	500
7	Thirst Quenchers, Inc.	800000	350
8	Gulping Gallons	675000	350
9	Thirst Quenchers, Inc.	280000	350
10	Thirst Quenchers, Inc.	450000	350
11	Gulping Gallons	750000	350
12	Gulping Gallons	1100000	500
13	Thirst Quenchers, Inc.	395000	350
14	Clean Waters Inc.	250000	200
15	Clean Waters Inc.	250000	200

Buffer width based on Setback Attribute.

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Union

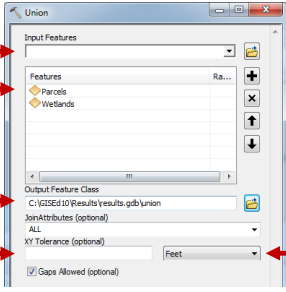
Overlays two or more polygon datasets and combines all features into a new dataset. Attributes from all inputs are preserved in the output.

Select Input Feature

Must have two or more input layers

Output Feature

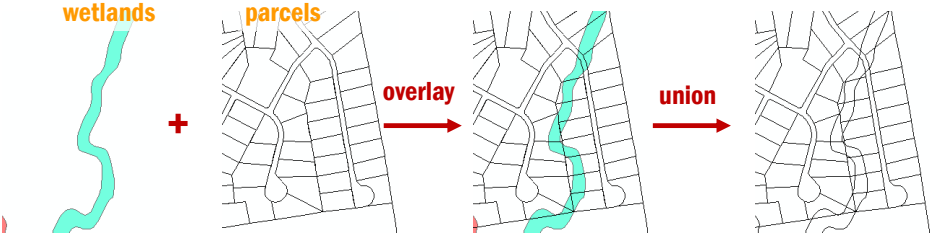
Minimum distance between vertices



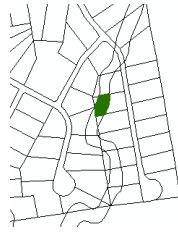
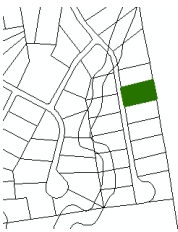
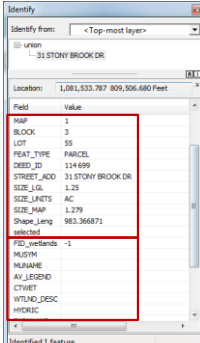
Tolerance units for min distance between vertices

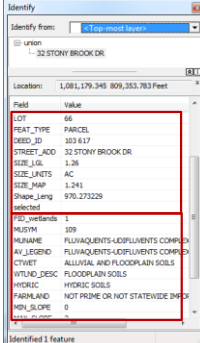
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Union



Union output contains attributes from all inputs





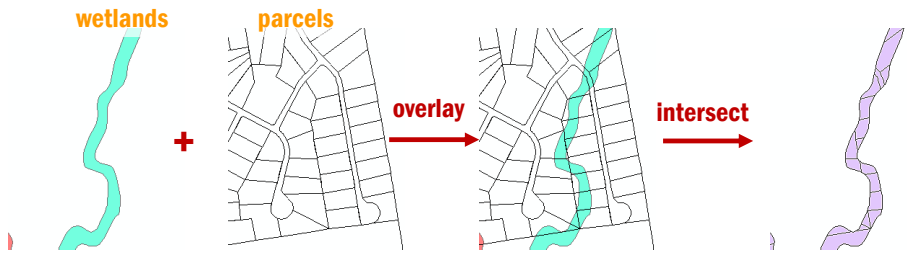
Presentation 5-3 – Working with ArcToolbox

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Intersect

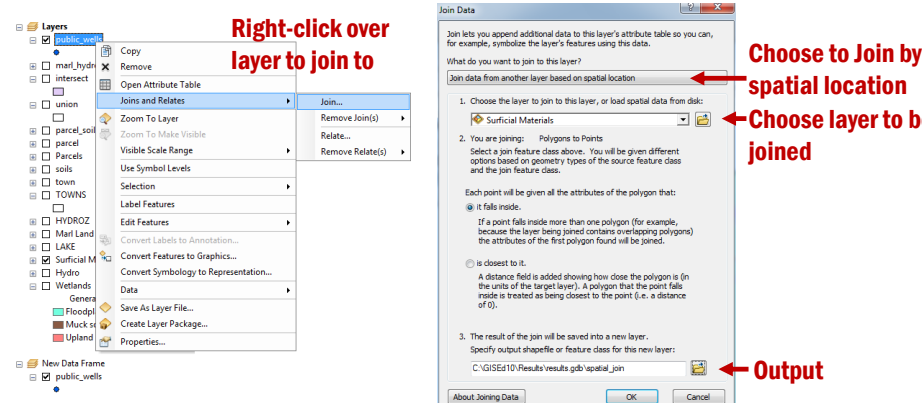
Overlays two datasets and combines the areas/features common to both into a new dataset. Attributes from both input datasets are preserved in the output dataset. Input form same as for Union.



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Spatial Join

A Spatial Join appends the attributes of a layer to a target layer based on spatial relationships that you specify and creates a new layer.



Right-click over layer to join to

Choose to Join by spatial location

Choose layer to be joined

Output

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Spatial Join

Join now contains attributes from the point dataset and the underlying polygon of the surficial materials layer.

ID	OWNER	YIELD_GPD	Setback	SV_LEGEND	SMPOLY_C	DESC	ACREAGE
14	Clean Waters Inc.	250000	250	TLL	T	TLL	320065.125
16	Clean Waters Inc.	400000	350	TLL	T	TLL	320065.125
17	Clean Waters Inc.	500000	350	TLL	T	TLL	320065.125
18	Clean Waters Inc.	600000	350	TLL	T	TLL	320065.125
15	Clean Waters Inc.	250000	250	ALLUVISAN	A/S	ALLUVIUM O	86.159
13	Thirst Quenchers, Inc.	395000	350	ALLUVISAN	A/S	ALLUVIUM O	141.458
2	Aqua Doble	750000	350	SAND	S	SAND	8.17
7	Thirst Quenchers, Inc.	800000	350	THICK TLL	TT	THICK TLL	117.961

A point-to-point spatial join will join the data from the closest point.
EXAMPLE: Join the wastewater discharge sites to wells.

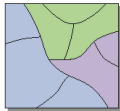
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Dissolve

The Dissolve Tool removes boundaries between adjacent polygons when the attribute value is the same on both sides.

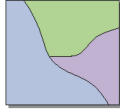
Dissolve can be used to generalize data - to create larger features from a collection of smaller features.

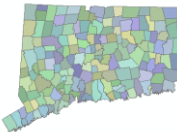
INPUT



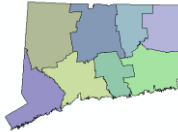
↓

OUTPUT





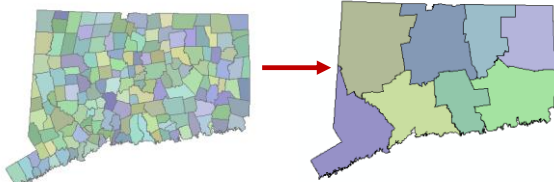
Dissolve by County attribute



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Dissolve

Selecting Dissolve Field(s) lets you determine what field(s) are dissolved on and saved to the output file.



Choose 1 or more dissolve fields

Specify Summary fields and statistic type

Input Features

C:\GIS\Ed10\Results\CT_Results.gdb\TOWNS

Output Feature Class

C:\GIS\Ed10\Results\CT_Results.gdb\county

Dissolve Field(s) (optional)

☐ OBJECTID

☐ TOWN_ID

☐ TOWN

☐ TOTAL_SQMI

☐ LAND_SQMI

☐ WATER_SQMI

☒ COUNTY

☐ PLAIN_ORG

☐ DEP_DIST

Select All

Unselect All

Add Field

Field

Statistic Type

acres

SUM

TOWN

COUNT

☒ Create multipart features (optional)

☐ Unsplit lines (optional)

OK

Cancel

Environments...

Show Help >>

Table

county

OBJECTID	Shape	COUNTY	SUM_acres	COUNT_TOWN	Shape_Length	Shape_Area
1	Polygon	Fairfield	412634.183945	23	1086466.860708	17974345488.3536
2	Polygon	Hartford	404048.280114	26	629050.715041	20929191410.5081
3	Polygon	Litchfield	604766.280795	26	759721.40508	26343163959.704
4	Polygon	Middlesex	245817.562118	15	619596.703484	10707829994.2424
5	Polygon	New Haven	385427.819103	27	962445.260809	17224838800.1328
6	Polygon	New London	441369.619011	21	855643.185809	19226334460.1595
7	Polygon	Tolland	267061.875868	13	592488.075454	11633215312.8068
8	Polygon	Windham	333704.823864	15	554810.935411	14536182127.5322

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Exercise Overview: Answer Questions

For a Marlborough Subdivision:

How much of the subdivision as a whole is covered by wetlands?

How many parcels in the subdivision have wetlands?

What percentage of each parcel in the subdivision is covered by wetlands?

How many parcels have more than 50% wetlands?

How many buildings are partially or fully inside the 100 foot buffer zone?


Presentation 5-3 – Working with ArcToolbox

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Exercise Overview


- **Clip** the Marlborough soils data by the subdivision boundary.
- **Dissolve** the soils so that the wetland soils all belong to one class. In Connecticut, wetlands are determined solely by soil type.
- **Export** the wetland polygons to a new layer. This is one way to get rid of the non-wetland areas.



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Exercise Overview

- **Buffer** the wetlands to create and determine the 100 foot buffer zone.
- Use the **Union** tool with wetlands and parcels in order to determine how much of each parcel is covered by wetlands. This requires several table functions also.
- Use the **Intersect** tool to determine how many buildings are partially or fully inside the 100 foot buffer zone.



To Review

- **Accessing ArcToolbox**
- **Geoprocessing menu**
- **Customizing ArcToolbox**
- **Clip Tool and recalculate area**
- **Buffer Tool**
 - With dissolve
 - Without dissolve
 - Field option for multiple widths
 - Multiple ring
- **Union Tool**
- **Intersect Tool**
- **Spatial Join**
- **Dissolve**
- **Exercise Overview**

Tools– Q & A



Module 6 – Lightning Talks

LT – Working with XY Data

Geospatial Technologies at Work: An Introduction to GIS

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Talking Points

- 1) What is “XY” Data**
- 2) Data sources and formats**
- 3) Using the Add XY Tool in ArcMap**
- 4) XY Event Layers**

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What is XY Data?

XY Data is location data stored in a table or text file which can be imported to ArcMap and displayed geographically using the XY coordinates stored in the file

Comma Separated Values (CSV) text file

archdata_WGS84.txt - Notepad

"Lat", "Long", "Descrip", "Discovered"

41.6391255837931,-72.4352011058078,Encampment,1952

41.6085680159477,-72.418013148384,Established village site,1986

41.6122864502755,-72.424667924133,Encampment,1944

41.6352333839159,-72.4862953991423,Burial site,1999

41.6427592775566,-72.4692303676126,Encampment,2001

41.6349672394598,-72.4723077007101,Artifacts,1974

41.6438576123238,-72.4728732909092,Large number of animal skeletons,1974

41.648178220055,-72.4825765140393,Encampment,1959

41.6374546791204,-72.4274170382098,Burial site,1982

41.6153562802206,-72.420406680837,Burial site,1982

41.6075690788669,-72.467375235611,Encampment,1962

41.6631343628625,-72.4574748112463,Encampment,1971

Lat	Long	Descrip	Discovered
41.6391255837931	-72.4352011058078	Encampment	1952
41.6085680159477	-72.418013148384	Established village site	1986
41.6122864502755	-72.424667924133	Encampment	1944
41.6352333839159	-72.4862953991423	Burial site	1999
41.6427592775566	-72.4692303676126	Encampment	2001
41.6349672394598	-72.4723077007101	Artifacts	1974
41.6438576123238	-72.4728732909092	Large number of animal skeletons	1974
41.648178220055	-72.4825765140393	Encampment	1959
41.6374546791204	-72.4274170382098	Burial site	1982
41.6153562802206	-72.420406680837	Burial site	1982
41.6075690788669	-72.467375235611	Encampment	1962
41.6631343628625	-72.4574748112463	Encampment	1971

Excel Table

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Source Data

- **Comma or tab delimited text files, Excel files or .dbf tables**
- **Other delimiters can be set up through ArcMap properties**
- **First line must contain field names**
- **Field names should not contain dashes, spaces or brackets**
- **Following rows should contain feature coordinate and attribute values**

archdata_WGS84.txt - Notepad

"Lat", "Long", "Descrip", "Discovered"

41.6391255837931,-72.4352011058078,Encampment,1952

41.6085680159477,-72.418013148384,Established village site,1986

41.6122864502755,-72.424667924133,Encampment,1944

41.6352333839159,-72.4862953991423,Burial site,1999

41.6427592775566,-72.4692303676126,Encampment,2001

41.6349672394598,-72.4723077007101,Artifacts,1974

41.6438576123238,-72.4728732909092,Large number of animal skeletons,1974

41.648178220055,-72.4825765140393,Encampment,1959

41.6374546791204,-72.4274170382098,Burial site,1982

41.6153562802206,-72.420406680837,Burial site,1982

41.6075690788669,-72.467375235611,Encampment,1962

41.6631343628625,-72.4574748112463,Encampment,1971

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Add XY Data in ArcMap

File

Edit

View

Bookmarks

Insert

Selection

Geoprocessing

Customize

Win

New...

Ctrl+N

Open...

Ctrl+O

Save

Ctrl+S

Save As...

Save A Copy...

Add Data

Add Data...

Add Basemap...

Add Data From ArcGIS Online...

Add XY Data...

Geocoding

Add Route Events...

Add Query Layer...

Sign In...

ArcGIS Online...

Page and Print Setup...

Print Preview...

Print...

Create Map Package...

Export Map...

Map Document Properties...

File> Add Data> Add XY Data

Add XY Data

A table containing X and Y coordinate data can be added to the map as a layer

Choose a table from the map or browse for another table:

archdata_WGS84.txt

Specify the fields for the X, Y and Z coordinates:

X Field: Long

Y Field: Lat

Z Field: <None>

Coordinate System of Input Coordinates

Description:

Geographic Coordinate System:

Name: GCS_WGS_1984

Coordinate System

Source data

Coordinate Fields

Coordinate System

Show Details

Warn me if the resulting layer will have restricted functionality

OK

Cancel

Table Does Not Have Object-ID Field

The table you specified does not have an Object-ID field so you will not be able to select, query, or edit the features in the resulting layer, or define relates for them.

After you create this layer, you can export it to a shapefile or feature class if you need these functions. To export a layer, right-click it in the Table Of Contents and choose Data>Export Data. Add the exported data to the map as a new layer.

OK

Cancel

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XY Event Layer

An XY Event layer references the original data source

Table Of Contents

Marlborough

archdata_WGS84.txt Events

Streets

Tax Grid

Parcel Boundaries

Marlborough Zoning

Classes

Residential

Design Commercial

General Commercial

General Industrial

Design Multi-Family

Recreational

Town

Table

archdata_WGS84.txt Events

Lat	Long	Descript	Discovered	Shape *
41.839126	-72.435501	Encampment	1952	Point
41.608568	-72.418013	Established village site	1966	Point
41.612286	-72.424668	Encampment	1944	Point
41.635233	-72.468295	Burial site	1999	Point
41.842759	-72.468203	Encampment	2001	Point
41.834967	-72.472308	Artifacts	1974	Point
41.643858	-72.472873	Large number of animal skeletons	1974	Point
41.648178	-72.482577	Encampment	1959	Point
41.637455	-72.427417	Burial site	1962	Point

Table has no Object ID Field

OIDs are necessary perform certain functions like querying, selecting and editing features

To create an OID field, you must export Event Layer to a new shapefile or feature class

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Questions?



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Module 6 – Lightning Talks

⚡ LT – Metadata

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Talking Points

- 1) What is Metadata and why is it important?**
- 2) Viewing Metadata**
- 3) Writing Metadata**



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Metadata Overview

Metadata is the component of data that describes its contents.

Three components of GIS Data

How do we know the details?

Date	Latitude	Longitude	Chlor
3/22/2011	32.677	-117.896	210
3/23/2011	33.011	-117.193	150
3/25/2011	33.523	-116.328	

Chlor (chlorophyll a concentration) measured in ug/L

Latitudes and longitudes were collected using a Trimble....

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Why Bother with Metadata?

- **Provides a standardized way to document data and avoid loss of information when key people leave an organization**
- **Provides information to help determine the data's suitability for a particular use**
- **Provides detailed information about the overall dataset and about the attributes for features**
- **Provides a basis for searching for geospatial data either based on geography or content**

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Presentation 6-2 – Metadata

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Presentation 6-2 – Metadata



Presentation 6-2 – Metadata

- ## Presentation 6-2 – Metadata



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Metadata in ArcGIS

ArcCatalog - ArcInfo - C:\GIS\10\CT_Data.gdb\HYDRO

Catalog Tree

CT_Data.gdb

HYDRO


Contents

Preview

Description

HYDRO

File Geodatabase Feature Class



digital line graph, DLG, large scale, hydrography, river water, waterbody, base map

Summary
Hydrography is 1:24,000-scale base map data. It depicts hydrography information published on the USGS topographic maps. For base map purposes, use this layer with other base map data such as Roads and Trails, Railroads, Air This layer may be used as a possible data source for layers with features that must coincide and line up with shoreline features published on the USGS topographic example, the layer includes a set of connecting line features, Coastline Arcs, which define a shoreline between the Connecticut and Long Island Sound. These Coastline Arc features are close polygon features in other 1:24,000-scale layers State of Connecticut, Department of Environmental Protection, Coastline Arcs from the original Hydrography Master Layer.

ArcMap

MuniTemplate.mxd - ArcMap - ArcInfo

Table of Contents

Marlborough

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View Item Description...

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Editing Metadata in ArcCatalog

ArcCatalog - ArcInfo - C:\GIS\10\CT_Data.gdb\APAWELL

Catalog Tree

APAWELL


Contents

Preview

Description

APAWELL

File Geodatabase Feature Class



digital line graph, DLG, large scale, hydrography, river water, waterbody, base map

Description
This is a 1:24,000-scale datalayer of public water supply wells for which Aquifer Protection Areas have been delineated. These aquifer protection areas were adopted for Connecticut by the Department of Environmental Protection (DEP). The Aquifer Protection Wells datalayer is a point Shapefile of public water supply wells that provide water service to more than 1,000 people and are set in stratified drift aquifers. The geographic location of these wells is based on well locations in the Community Wells datalayer, which is maintained by the Department of Environmental Protection, Water Supply Services, Water Supply Section.

Credits
There are no credits for this layer.

Access and use limitations
There are no access and use limitations for this layer.

Metadata toolbar

Metadata Editor

Overview

Item Description

Topics & Keywords

Citation

Citation Contacts

Metadata

Details

Contacts

Maintenance

Constraints

Resource

Details

Extents

Points of Contact

Maintenance

Constraints

Spatial Reference

Spatial Data Representation

Content

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Presentation 6-2 – Metadata

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Questions?



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Module 6 – Lightning Talks

LT – Google KML Files

Geospatial Technologies at Work: An Introduction to GIS

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Learning Objectives

- 1) Better understanding of KML files and their use**
- 2) Converting to and from KML (KMZ) format**
- 3) Tips for conversion**


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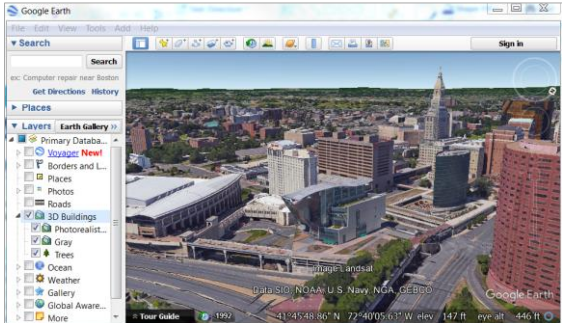
KML Files – Used For??

KML: KML stands for Keyhole Markup Language.

Before Google Earth - there was Keyhole.

The KML has become a primary open source format for displaying geographic data in mapping programs and “3d” mapping environments.

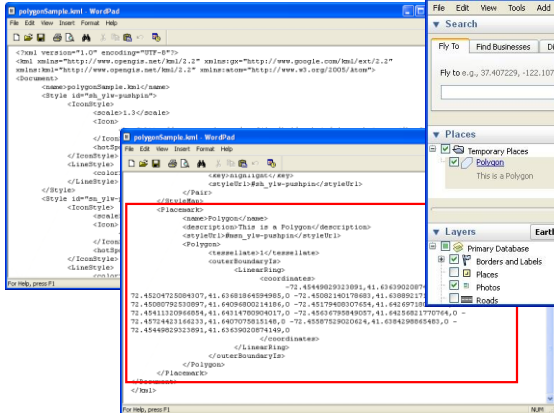


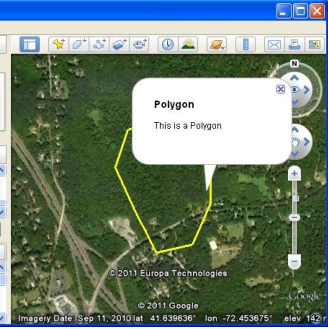


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What is a KML?

KMLs are text based files that follow XML (eXtensible Mark-up Language) format rules. If they follow the rules, various computer programs can then process the data.





Google Earth, Google Maps, ArcGIS Explorer, ArcGlobe, etc. will read KML files

Presentation 6-3 – Google KML

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How to make a KML

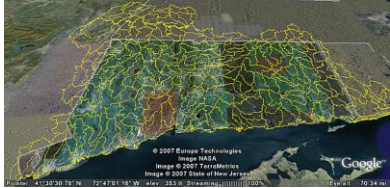
You can create KMLs:

- from scratch using a text editor
- with software to convert your existing data
- export from Google Earth or Google Maps
- GPS apps often use/save to KML

ArcMap has several built in tools for converting your data to and from the KML (or KMZ) format.



What is KMZ? KMZ files are Zipped KML files, basically to help reduce the size for transport over the internet. You don't need to do this, but if you were to change the *.KMZ extension to *.ZIP you could then unpack the file directly with software like WinZip. The result would be one (or more) KML files.

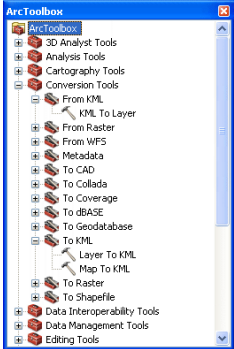


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ArcMap KML Tools

Help Tip: Search "Using KML"

ArcMap has several built in tools for converting your data to and from the KML (or KMZ) format. Earlier versions of Arc relied on scripts you could download.



ArcGlobe can read KML/KMZ files directly. ArcMap requires Conversion tools. The KML Tools are:

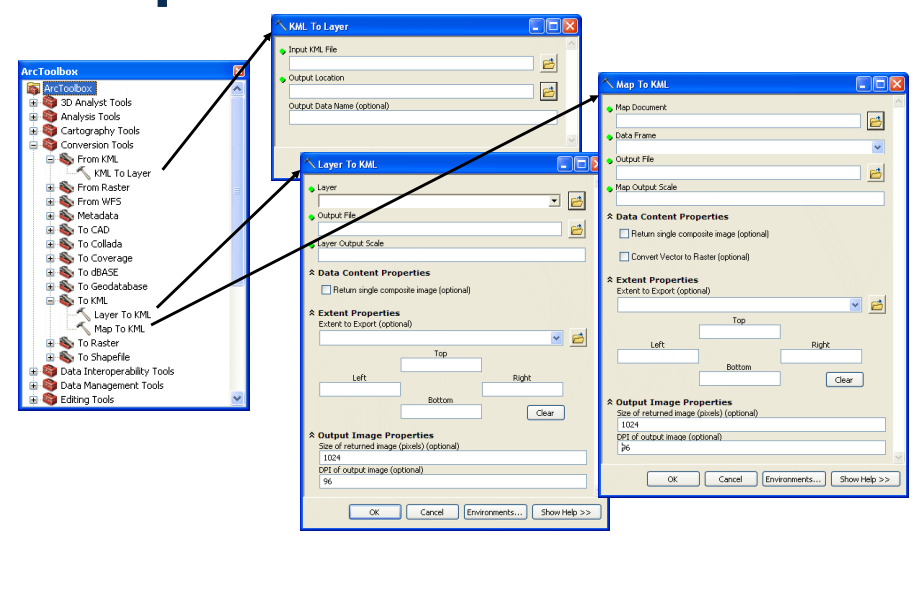
- * From KML – KML to Layer
- * To KML – Layer to KML and Map to KML

Presentation 6-3 – Google KML

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ArcMap KML Tools

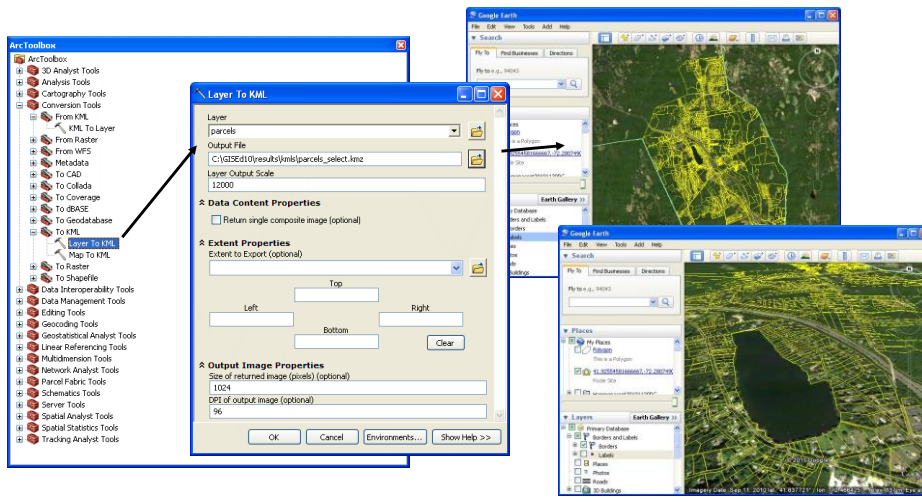


This screenshot displays the ArcMap interface with the ArcToolbox open. The 'KML To Layer' and 'Map To KML' tool windows are shown. The 'KML To Layer' window has fields for 'Input KML File', 'Output Location', and 'Output Data Name (optional)'. The 'Map To KML' window has fields for 'Map Document', 'Data Frame', 'Output File', and 'Map Output Scale'. Both windows have sections for 'Data Content Properties', 'Extent Properties', and 'Output Image Properties'. Arrows point from the ArcToolbox to the 'KML To Layer' and 'Map To KML' tool windows.

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ArcMap KML Tools

Help Tip: Search "Layer to KML"



This screenshot shows the ArcMap interface with the ArcToolbox open. The 'Layer To KML' tool window is highlighted. The 'Layer' dropdown is set to 'parcels'. The 'Output File' field is set to 'C:\GIS\010\results\kml\parcels_select.kml'. The 'Layer Output Scale' is set to 12000. The 'Map To KML' tool window is also visible. Arrows point from the ArcToolbox to the 'Layer To KML' and 'Map To KML' tool windows. In the background, a Google Earth window shows a map of a city with yellow lines representing the 'parcels' layer.

Conversion Tips: KML

- **Avoid converting large vector files**
- **Make a selection and export to a temporary feature**
- **Set the feature layer colors for intended goal**
- **Reduce the fields to only those you want to show**
- **Experiment with various layer types (pt, line, poly)**

Questions?





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Module 6 – Lightning Talks

LT – ArcGIS Online

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Talking Points

- 1) What is ArcGIS Online**
- 2) ArcGIS Accounts - Free and Paid**
- 3) ArcGIS Online**
 - 1) Search for data**
 - 2) Upload your data**
 - 3) Make a web map**
 - 4) Share a web map**

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What is ArcGIS Online

ArcGIS Online is Esri's cloud based solution for GIS. Includes tools for uploading data, creating new data, making custom web maps, sharing maps and data and creating web applications.

Esri launches ArcGIS.com in 2010

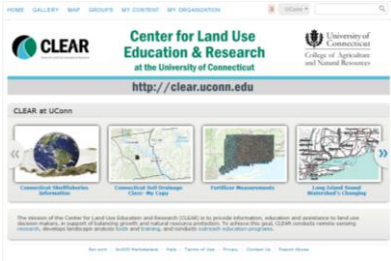
- Many revisions. Quarterly updates.
- Free Public Accounts (limited, non-commercial use only)
- ArcGIS Online for Organizations launched June 2012

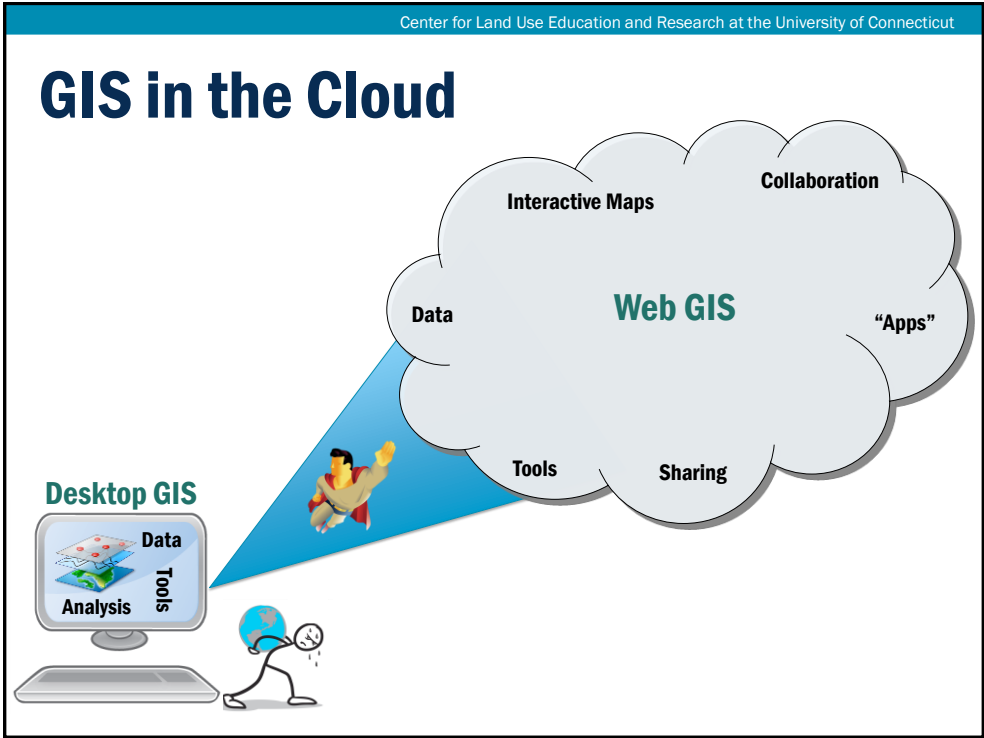


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AGOL Accounts

- **Free “Public” Accounts for not for profit work**
- **Subscription based “Organization” accounts**
 - “free” if you are up to date on desktop license & maintenance agreement
 - \$2500/yr for 5 user accounts
 - More tools, additional functions, personalized website
 - Advanced functions cost “credits”





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AGOL Maps and Applications


The block contains three screenshots of AGOL maps and applications:

- Find a Park**: A map interface showing various park locations with a legend on the left. The legend includes categories like **State Park**, **State Park Swales Area**, **State Park Trail Overview**, and **State Forest**.
- Thames, Pawcatuck and Southeast Coast Major Basin Stream Flow Classifications**: A map showing stream flow classifications with a legend on the left. The legend includes categories like **Thames, Pawcatuck and Southeast Coast Major Basin Stream Flow Classifications** and **Thames, Pawcatuck and Southeast Coast Stream Flow Classifications**.
- UConn Green Infrastructure Virtual Tour**: A virtual tour interface showing a 3D model of a building and a map of the campus. The interface includes a **UConn Green Infrastructure Virtual Tour** title and a **UConn Green Infrastructure Virtual Tour** description.

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AGOL Story Maps

Connecticut's Changing Landscape



Tracking Land Cover Change in Connecticut

Credited by Emily Wilson, Chester Arnold and John Kuhn
College of Agriculture, Health and Natural Resources
University of Connecticut

How is Connecticut's landscape changing? Where? How fast? Come explore the information and maps that answer those questions.

14 million

59%

190-

UConn

CLEAR


http://clear.uconn.edu/storymaps

https://storymaps.arcgis.com


UCONN UNIVERSITY OF CONNECTICUT

CLEAR Story Map Gallery


At CLEAR we become top fans of the "Story Map," a format created by Esri that enables the seamless combination of interactive maps with other types of information such as photos, videos, graphics and graphics. Below are links to six Story Maps created by CLEAR or CLEAR affiliated students. From landscapes to bears, there's something in this gallery for you to explore.




The Bears are Back: Getting to Know Connecticut's Bears
Explore bear population and distribution in Connecticut.
By Cory Chabrowski and Mike Jones




Connecticut's Coast: Then and Now
Explore changes to Connecticut's shoreline using 1934 imagery.
By Emily Wilson and Paul Becker




The State of Low Impact Development in Connecticut
Explore LID regulations and analysis of 85 towns across the state.
By Steve Dickson and Megan LaFrance



Connecticut's Changing Landscape
Explore a study of land cover change in Connecticut, 1980-2010.
By Emily Wilson and Chester Arnold



UConn Campus Green Infrastructure Tour
A tour of green infrastructure practices in place at UConn.
By Steve Dickson and Mike Jones



Modeling Site Suitability of Living Shorelines
Information and maps from a living shoreline research project.
By Aaron Zylberman

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The AGOL Map Viewer

HOME

My Map

NEW MAP

UConn

Details

Add

Basemap

Share

Directions

Find address or place

Make your own map

Zoom tools

Driving directions / find address or place

Details: view layers & legend

Measure features

Bookmark

3. Add more to your map.

4. Save and share your map.

CONNECTICUT

Map of Connecticut showing major cities and towns.

Presentation 6-4 – ArcGIS Online

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Basemap Options & Add Data

Select a basemap

Imagery Imagery with Labels Streets Topographic Terrain with Labels Light Gray Canvas National Geographic Oceans OpenStreetMap

HOME My Map

Details Add Basemap

Search for Layers Search ArcGIS Online

Browse Esri Map Layers Add Esri Selected Layers

Add Layer from Web Add a Map Service from URL

Add Layer from File Add a spatial dataset from your local computer

Add Map Notes Create a graphic layer on your map

Search for Layers

Find: wildlife

In: My Organization

Within map area

1 Result Found

Connecticut Habitat Map Service by deepgis

Browse Esri Map Layers

All Categories World USA Top Maps World Boundaries All Styles

Add to Map Add to Map Add to Map Add to Map Add to Map Add to Map

World Traffic USA Federal Landmarks Pale Color/Heat/Range (2000)

Add to Map Add to Map Add to Map Add to Map Add to Map Add to Map

Add Layer from Web

What type of data are you referencing?

An ArcGIS Server Web Service

URL: <http://www.ctecapp2.uconn.edu/arcgis/rest/>

Use as Basemap

Add Layer from File

Locate the file you want to import. You can import a zipped shapefile (ZIP), a comma, semi-colon, or tab delimited text file (CSV or TXT), or a GPS data file (GPX) with up to 1,000 features in it.

File: [Browse...](#) ncco_impervious.zip

Generalize features for web display

Keep original features

Get help adding shapefiles

IMPORT LAYER CANCEL

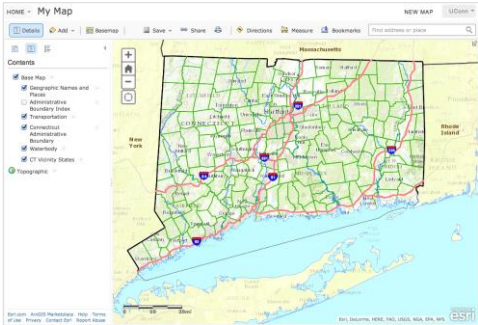
Adding CT ECO Map Services

ctecoapp2.uconn.edu

- Vector map services

ctecoapp3.uconn.edu

- Image services



The screenshot shows the CT ECO Map Services interface. On the left, there is a sidebar with a 'Contents' panel listing various map layers such as 'Base Map', 'Administrative Boundary', 'Transportation', 'Cemeterial', 'Administrative Boundary', 'Waterbody', 'CT County States', and 'Topographic'. The main area displays a map of Connecticut with various features like roads, water bodies, and administrative boundaries. The map is titled 'My Map' and includes a 'NEW MAP' button. The map is centered on the state of Connecticut, showing major cities like Hartford and Springfield, and the surrounding water bodies like Long Island Sound and the Connecticut River.

CT ECO Map Services

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Details Add Basemap

Search for Layers

Find: GO

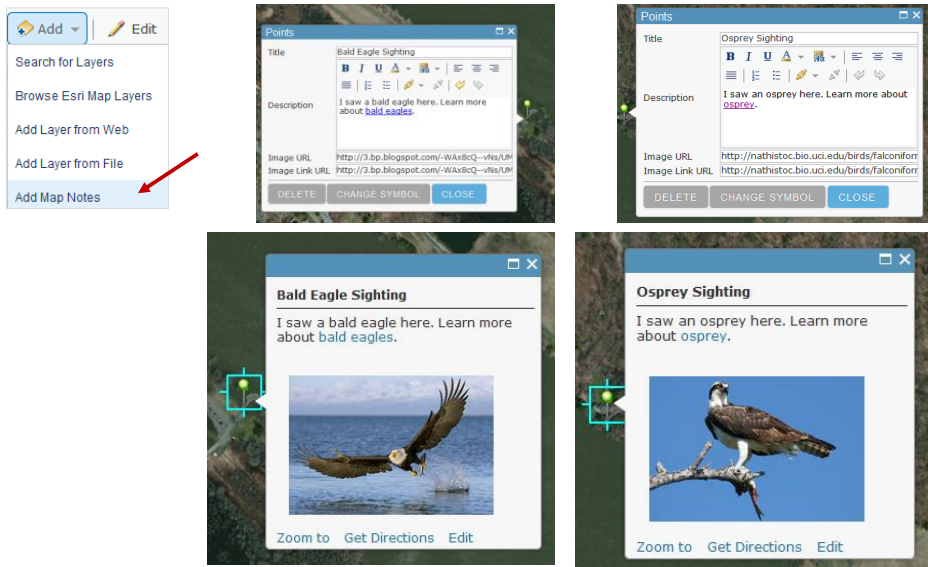
In: A GIS server

URL: ctecoapp2.uconn.edu

16 Results Found

Ortho_2008_Color_USGS_Urban_Area_Tiled	Add
Folder: tiled	
Ortho_2009_Color_CRCOG_Tiled	Add
Folder: tiled	
Ortho_2010_Color_NAIP_Tiled	Add
Folder: tiled	
Base_Map	Add
Folder: maps	
Base_Map_Political_Northeast_US	Add
Folder: maps	
Bedrock_Geology	Add
Folder: maps	
Elevation_Bathymetry	Add
Folder: maps	
Erosion_Susceptibility	Add
Folder: maps	
Habitat	Add
Folder: maps	

Adding Map Notes & Pop Ups



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DEMO

HOMENEW MAPUConn

Cary's Sunrise Suitability Map

DetailsAddBasemapShareDirectionsFind address or place

Legend

WaterAccess

Trails

parking

SunriseRoads

SunriseWetlands

Habitat

Critical Habitats

Critical Habitat Labels

Critical Habitat Communities

Beachshore, B (Estuarine)

Esri.comArcGIS MarketplaceHelpTerms of UsePrivacyContact EsriReport Abuse

Powered by esri

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Wrap Up & Review



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Revisiting Our Learning Objectives

- 1) Understand basic GIS concepts**
- 2) Learn how to visualize geographic data**
- 3) Master the basics of attribute tables and map features**
- 4) Learn how to create maps for publishing**
- 5) Learn how to use GIS to answer questions**

 
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We Covered a LOT of Ground!

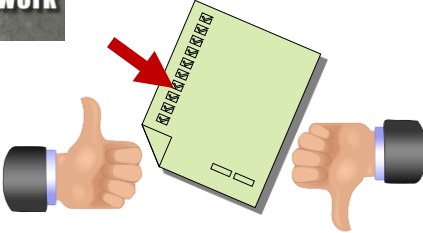


Module	Presentation Topic	Exercise Type
Module 1: Introduction to GIS	1-1 - Introduction to GIS 1-2 - Introduction to ArcGIS	Follow the Instructor Exercise 1a - Hands on
Module 2: All about Data	2-1 - Where to Find Data (Lightning Talk) 2-2 - Data Types 2-3 - Understanding Spatial Reference	Exercise 2a – Hands on Exercise 2b – Hands on
Module 3: Working with Tables	3-1 - Introduction to Tables 3-2 – Working with Tables 3-3 – Selections & Queries	Ex 3a - Hands on Ex 3b - Hands on Ex 3c - Hands on
Module 4: Map Production	4-1 – Layer Symbology 4-2 - Adding Text & Graphics 4-3 - Creating a Cartographic Output 4-4 - Data Driven Pages (Lightning Talk)	Ex 4a - Hands On Ex 4b - Hands on Ex 4c - Hands on Reference Exercise 6c
Module 5: Data Manipulation	5-1 - Georeferencing (Lightning Talk) 5-2 - Editing & Creating Data Layers 5-3 - Working with ArcToolbox	Reference Exercise 6f Ex 5a - Hands on Ex 5b - Hands on
Module 6: GIS Hodgepodge	6-1 - Mind Over Metadata 6-2 - Adding XY Coordinates to ArcMap 6-3 - Google Earth (KML) 6-4 - ArcGIS Online	Reference Exercise 6a Reference Exercise 6b Reference Exercise 6e Reference Exercise 6d

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Follow Up Email

- GISEd10 data folder download
- Link to free 60 day ArcGIS software
- Info about the CT GIS User Network and Listserv
- Course survey





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Thank You, Happy Mapping!

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860-345-5226

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Workshop Review – Contact Information

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