

## **GEOREFERENCING, PROJECTIONS Part I**

## **PRESENTING DATA Part II**

# topics of the week

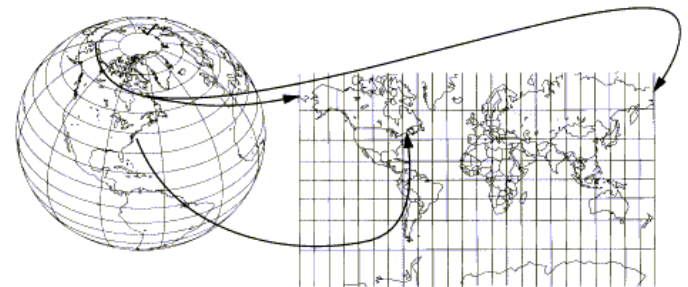
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- ❑ **Georeferencing**
- ❑ **Coordinate systems**
- ❑ **Map Projections**
- ❑ **ArcMap and Projections**

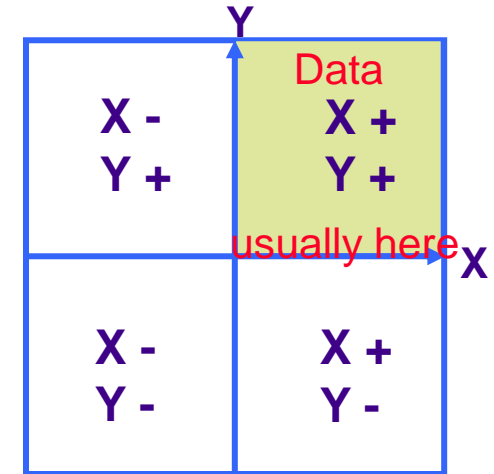
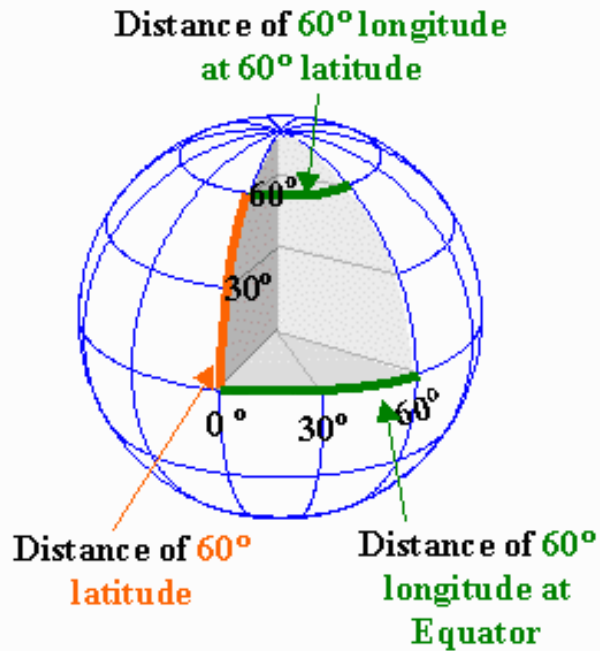
# Geo-referencing

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- **Geo-referencing is the process of establishing a relationship between the data displayed in your GIS software and its real-world location**
- **In simple terms, it is a process that adds geographic intelligence to the data**
- **Geo-referencing is accomplished by using:**
  - **Coordinate systems – four components**
    - *Ellipsoid*
    - *Datum*
    - *Projection*
    - *Units*



# Coordinate systems



- Geographic coordinate system
- Parallels and Meridians form a graticular network
- Latitude and longitude are angles measured from Earth's center to a point on the Earth's surface

- Cartesian coordinate system
- Measures of length and angle are uniform

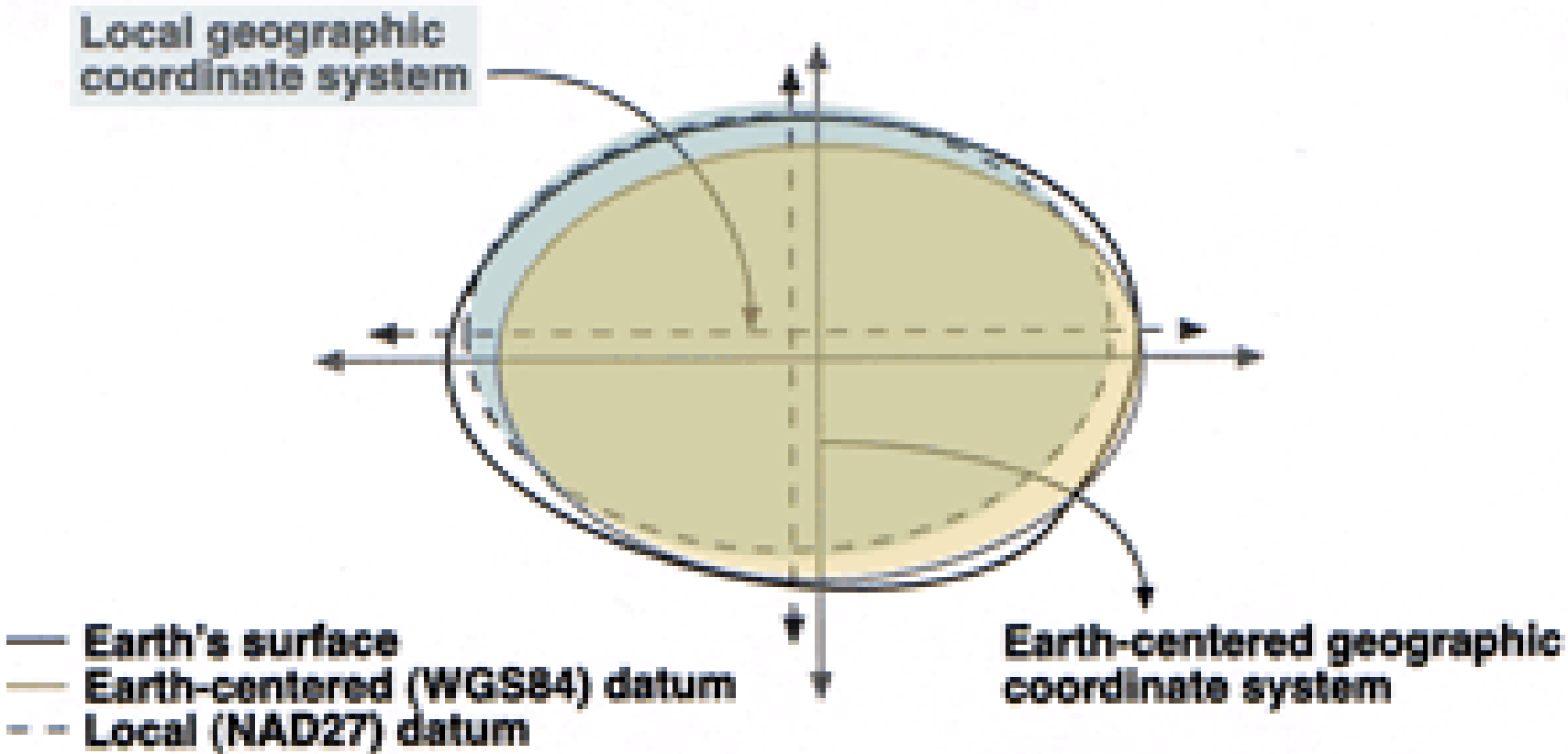
# Datums

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- A *datum* is a mathematical representation of the shape of the Earth's surface.
- A *datum* is defined by a spheroid, which approximates the shape of the Earth and the spheroid's position relative to the center of the Earth.
- There are many spheroids that represent the shape of the Earth and many more *datums* based on them.
- A *horizontal datum* provides a frame of reference for measuring locations on the surface of the Earth.
- A *local datum* aligns its spheroid to closely fit the Earth's surface in a particular area, its origin point is located on the surface of the Earth.

# Datums - continues

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# Datums and referencing

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- **Two horizontal datums used almost exclusively in North America**
  - North American Datum of 1927
  - North American Datum of 1983
- **Locations on the earth are referenced to the datum**
- **Different datums have different coordinate values for the same location**



**13<sup>th</sup> Street in Gainesville**

- ← State Plane Florida North NAD83
- ← State Plane Florida North NAD27

# Projections

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- Projection is the process that transforms three-dimensional space onto a two-dimensional map.
- Projection formulas are mathematical expressions which convert data from a geographical location on a sphere to a representative location on a flat surface.
- This process distorts at least one of these properties making geographers [sadd]:
  - Shape [S]
  - Area [A]
  - Distance [D]
  - Direction [D]



# Types of projections

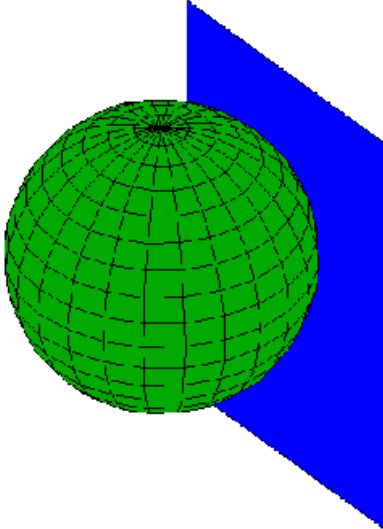
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- *Classified by the spatial attribute they preserve best*
- **Conformal maintains shape**
  - Example: Lambert Conformal Conic
- **Equal-area maintains area**
  - Example: Albers Equal Area Conic
- **Equidistant maintains distance**
  - Example: Equidistant Conic
- **Direction or Azimuthal maintains some directions**
  - Example: Lambert Equal Area Azimuthal

# Projection surfaces

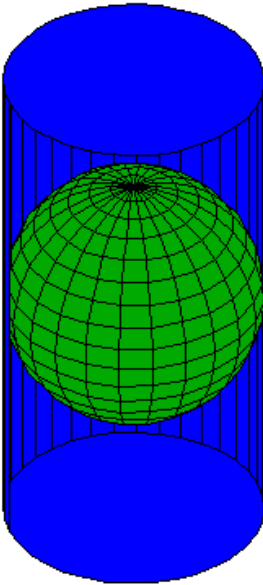
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Peter H. Dana 9/20/94



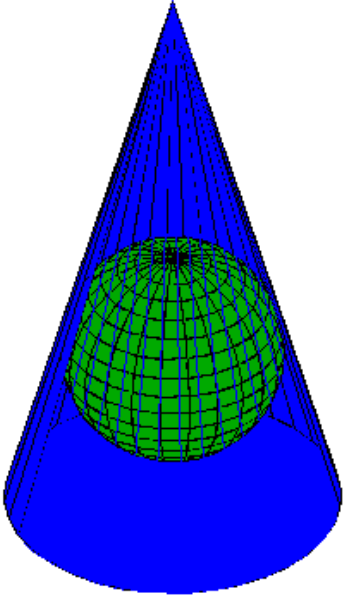
**Planar Projection Surface**

Peter H. Dar



**Cylindrical Projection Surface**

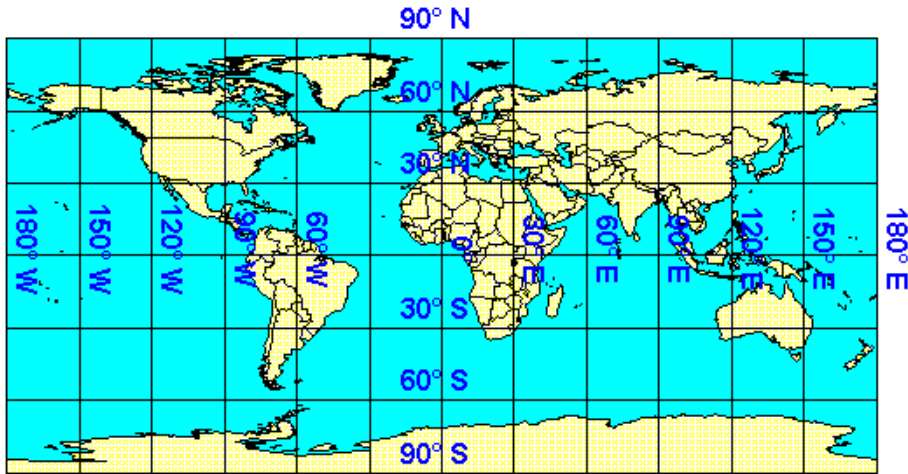
Peter H. Dana 9/20/94



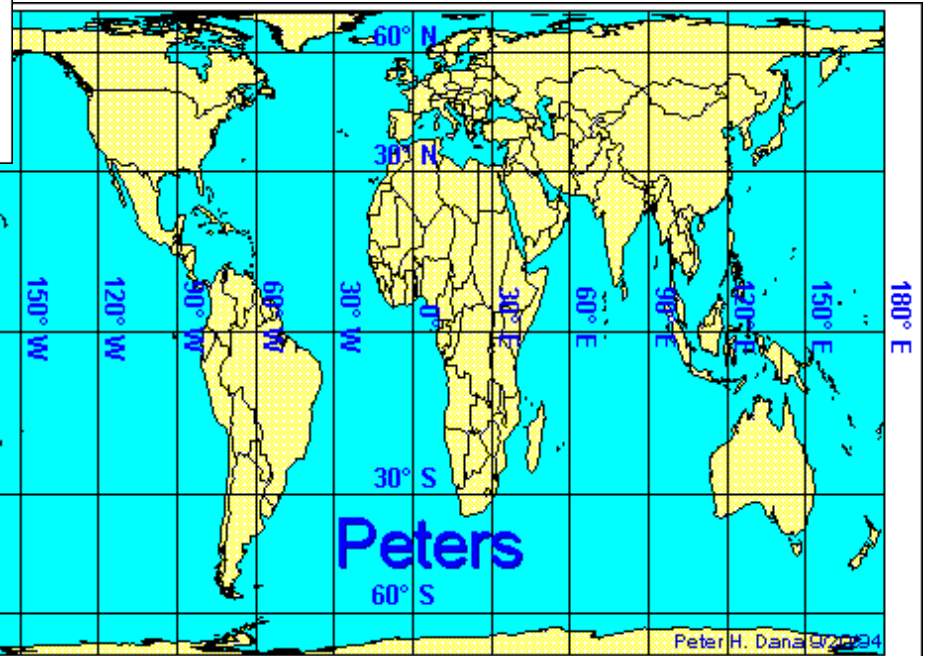
**Conical Projection Surface**

# Projection distortion examples

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**Unprojected Latitude and Longitude**

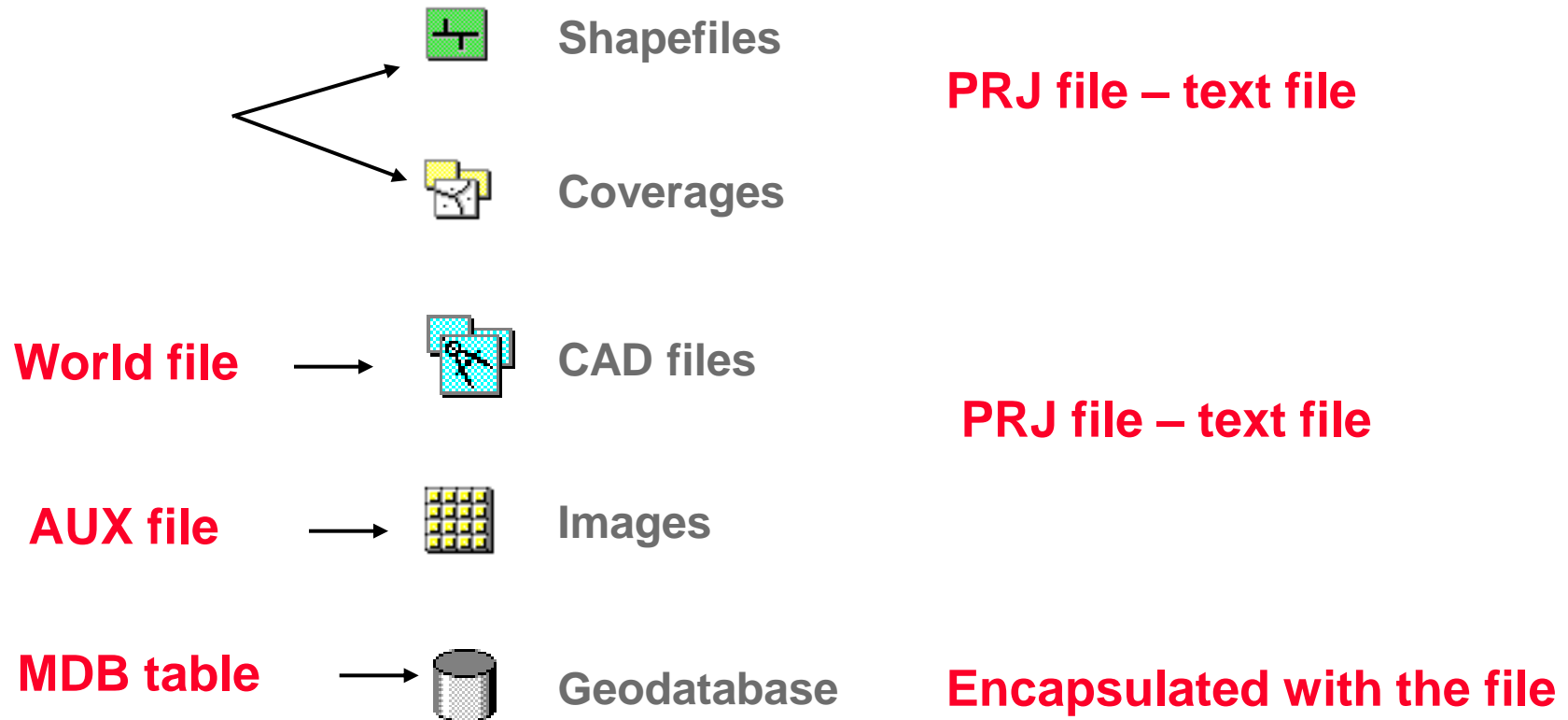


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# Storing projection information

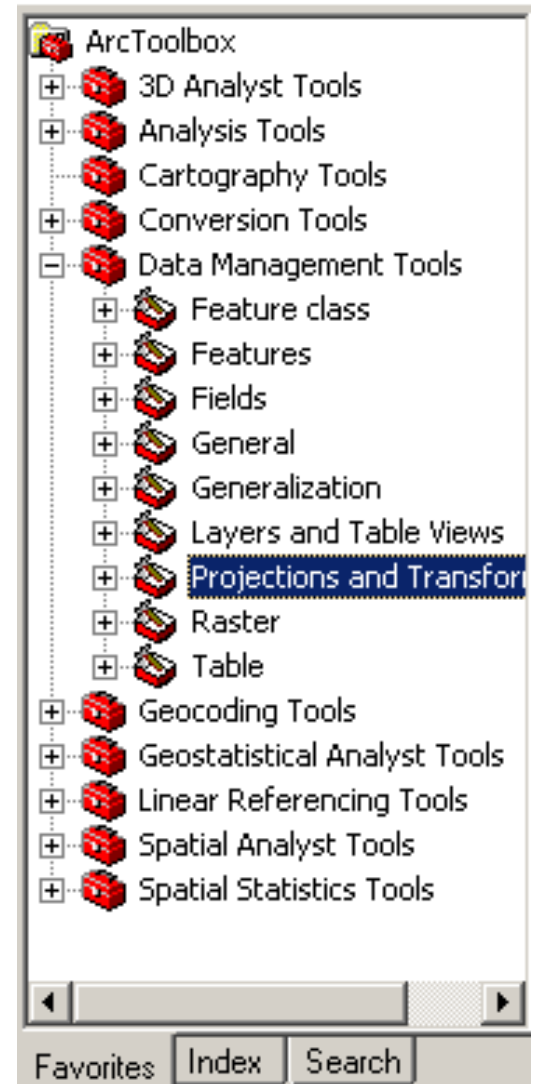
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Different spatial data formats store the projection information differently



# Projections in ArcGIS

- There are 65 map projections supported by ArcGIS 10
- There are hundreds of pre-defined projection files for specific zones and regions
- On-the-fly projection eliminates the need to change the projection of the data
- A data frame's projection can be pre-set by the user or ArcMap will default to the projection of the first layer added
- On-the-fly projection is possible only if projection information is with the data
- If re-projection or projection of the data is needed, ArcToolbox provides the tools



# Viewing projection information in ArcGIS

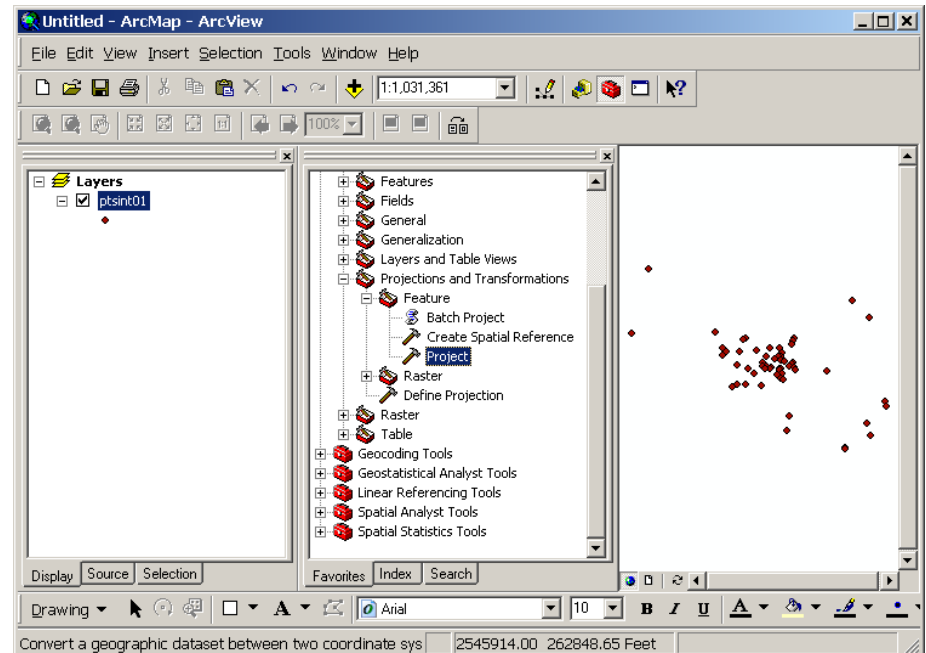
- ❑ In ArcCatalog, from the Description tab
- ❑ In ArcMap from the Source tab in Layer Properties
- ❑ In ArcToolbox can define projection if it does not exist or can edit it

The image displays three overlapping windows from the ArcGIS suite:

- Layer Properties (Left):** Shows the 'Source' tab with the following information:
  - Extent: Top: 314822.887743 ft, Left: 2555273.725211 ft, Right: 2742468.264958 ft, Bottom: 181656.892071 ft
  - Data Source: Shapefile Feature Class, Shapefile: M:\Data\FGDL\alachua\_core\ptsint01.shp, Geometry Type: Point
  - Projected Coordinate System: NAD\_1983\_StatePlane\_Florida\_North\_FIPS\_0
  - Projection: Lambert\_Conformal\_Conic
  - False\_Easting: 1969500.000000000
  - False\_Northing: 0.000000000
  - Central\_Meridian: -84.500000000
  - Standard\_Parallel\_1: 29.583333333
  - Standard\_Parallel\_2: 30.750000000
- ArcCatalog (Top Right):** Shows the 'Description' tab for a folder connection. The 'ESRI Spatial Information' section displays:
  - EXTENT IN THE ITEM'S COORDINATE REFERENCE BOUNDING RECTANGLE
    - \* WEST LONGITUDE 2554361.768974
    - \* EAST LONGITUDE 2744891.934355
    - \* NORTH LATITUDE 348520.352254
    - \* SOUTH LATITUDE 172351.401660
    - \* EXTENT CONTAINS THE RESOURCE Yes
  - COORDINATE REFERENCE TYPE Projected
  - PROJECTION NAD\_1983\_StatePlane\_Florida\_North\_FIPS\_0
  - GEOGRAPHIC COORDINATE REFERENCE
- ArcToolbox (Bottom Center):** Shows the 'Projections and Transformations' folder expanded, with the 'Define Projection' tool highlighted.

# Re - projecting the data source

- If you want to change the coordinates - projection of the datasource
- Use the Project wizard in ArcToolbox as follows:
  - Input projection must have been defined (.prj file must exist)
  - Can use pre-defined coordinate systems
  - Can Import the coordinate system from an existing dataset
  - Can create your own projection



## PRESENTING DATA Part II



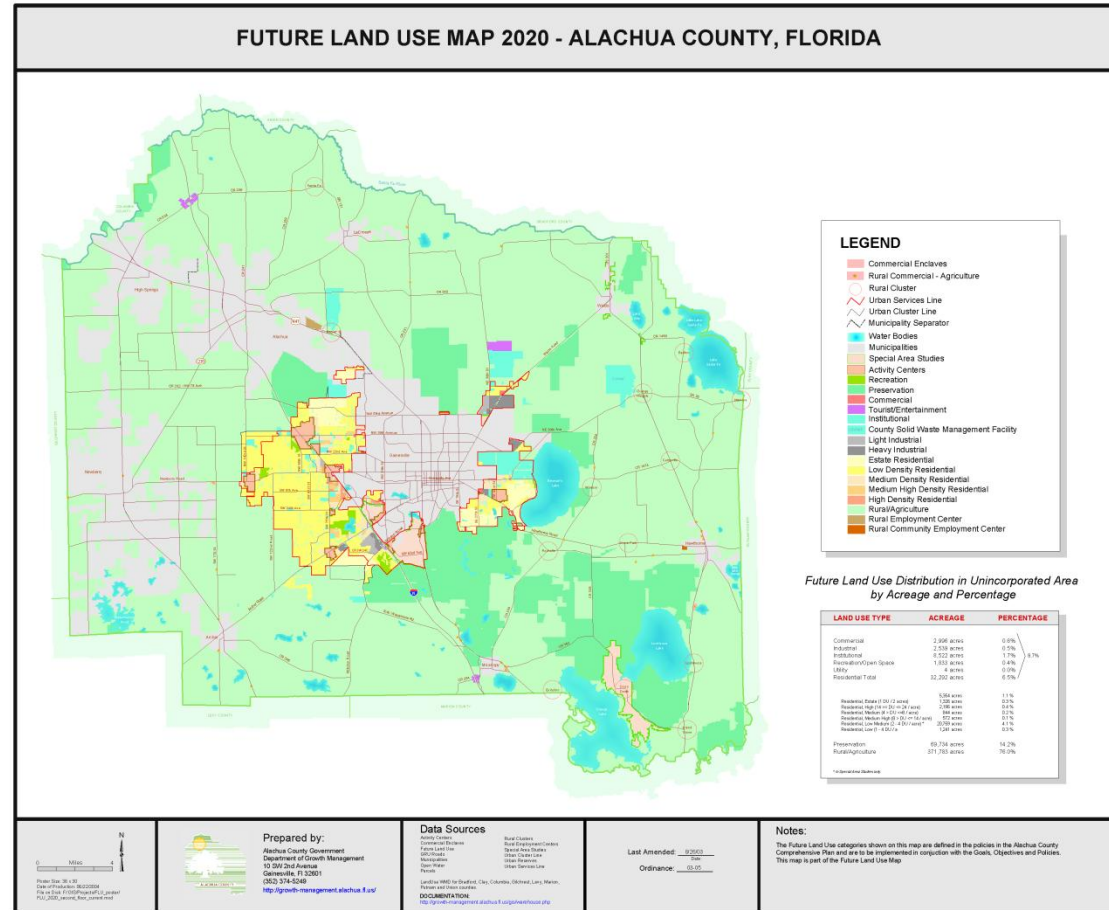
# topics of the week – presenting data

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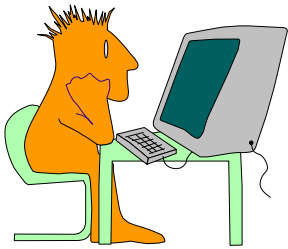
- ❑ **Cartographic principles**
- ❑ **Cartographic design**
- ❑ **Maps in ArcMap**
- ❑ **Map elements**

# Why Maps?

- Objectives - Strategy
  - Present information
  - Highlight relationships
  - Share analysis results
  - *Tell the story*
- Design - Tactics
  - Clear
  - Effective
  - Efficient

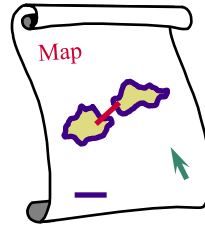


# How do maps tell the story?

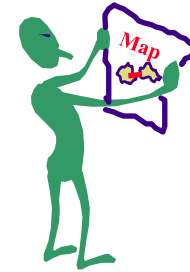


Map maker

Select  
Classify  
Generalize  
Symbolize



Map



Map reader

Read  
Analyze  
Interpret

Understands reality



Understands reality



Same?

# Cartographic design

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## Some factors to consider in cartographic design:

- ❑ **What is your major objective?**
- ❑ **Who is your audience?**
- ❑ **Do you have a good understanding of the reality the map is depicting?**
- ❑ **What would an appropriate scale to use?**
- ❑ **Is there a need to generalize and simplify information?**
- ❑ **How will the map be used?**
- ❑ **What would be its size?**
- ❑ **Are there any technical limitations, both in hardware and software?**

# More on cartographic design

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- ❑ **Colors, shade patterns, and text**
  - ❑ **Perception of colors and symbols**
  - ❑ **Up to 12 colors & 7-8 shades per color**
  - ❑ **Legibility of features and text**
  - ❑ **Visual contrast and hierarchy**
  - ❑ **Color conventions ex. In Urban Planning**
    - ❑ **Green – conservation**
    - ❑ **Blue - water**
    - ❑ **Orange - urban areas**
    - ❑ **Red - Commercial**
    - ❑ **etc**
  - ❑ **Visual balance**

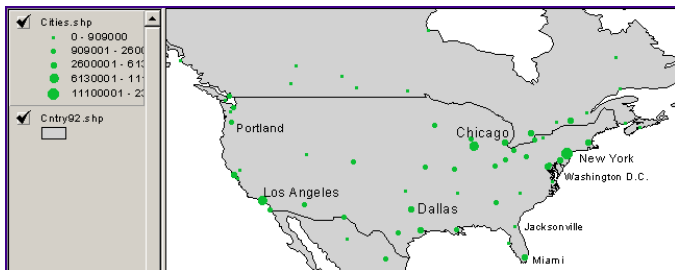
# Classification of maps

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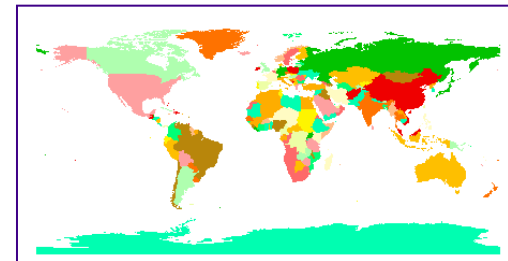
There are many more ways to classify maps, but here is one:

- **General maps**
  - **Locational / Positional**
  - **That depict a variety of features and uses**
- **Thematic maps, show distribution of a single attribute**
  - **Qualitative (*soils*)**
  - **Quantitative (*rainfall*)**
- **Different design objectives for each category**

## Quantitative

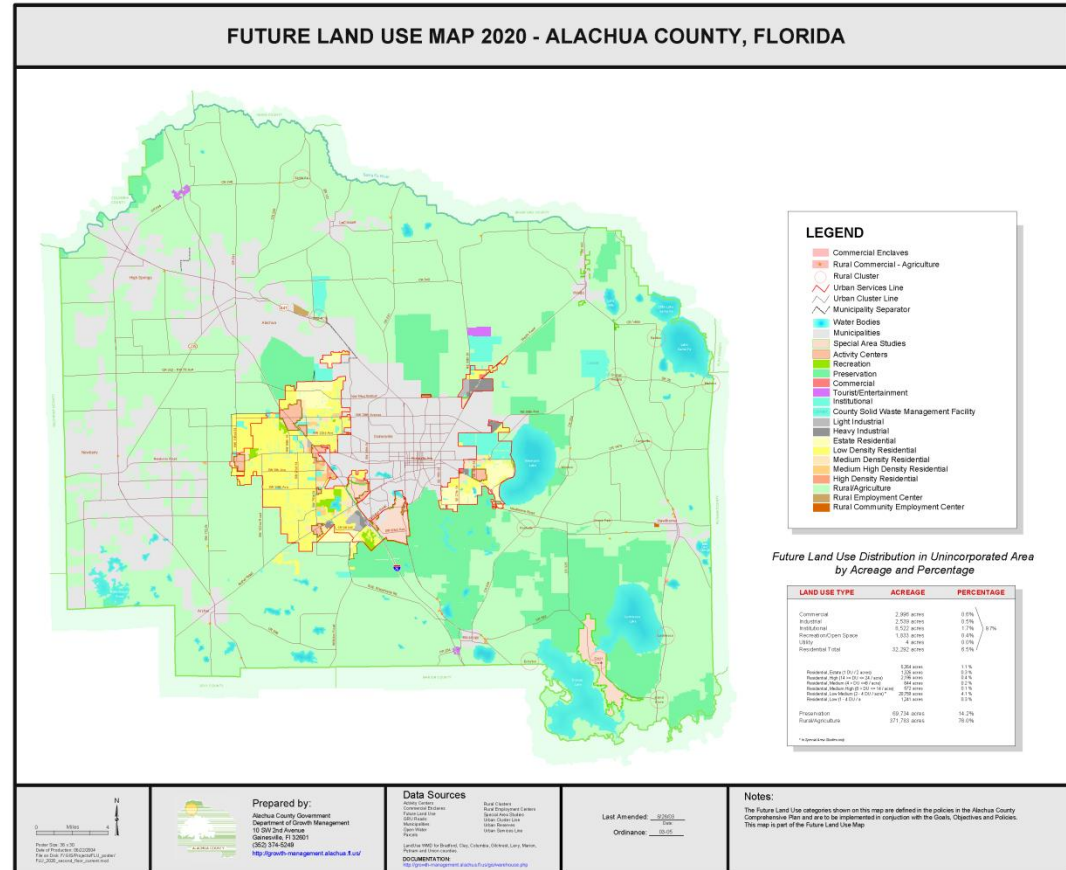


## Qualitative



# Maps in ArcMap

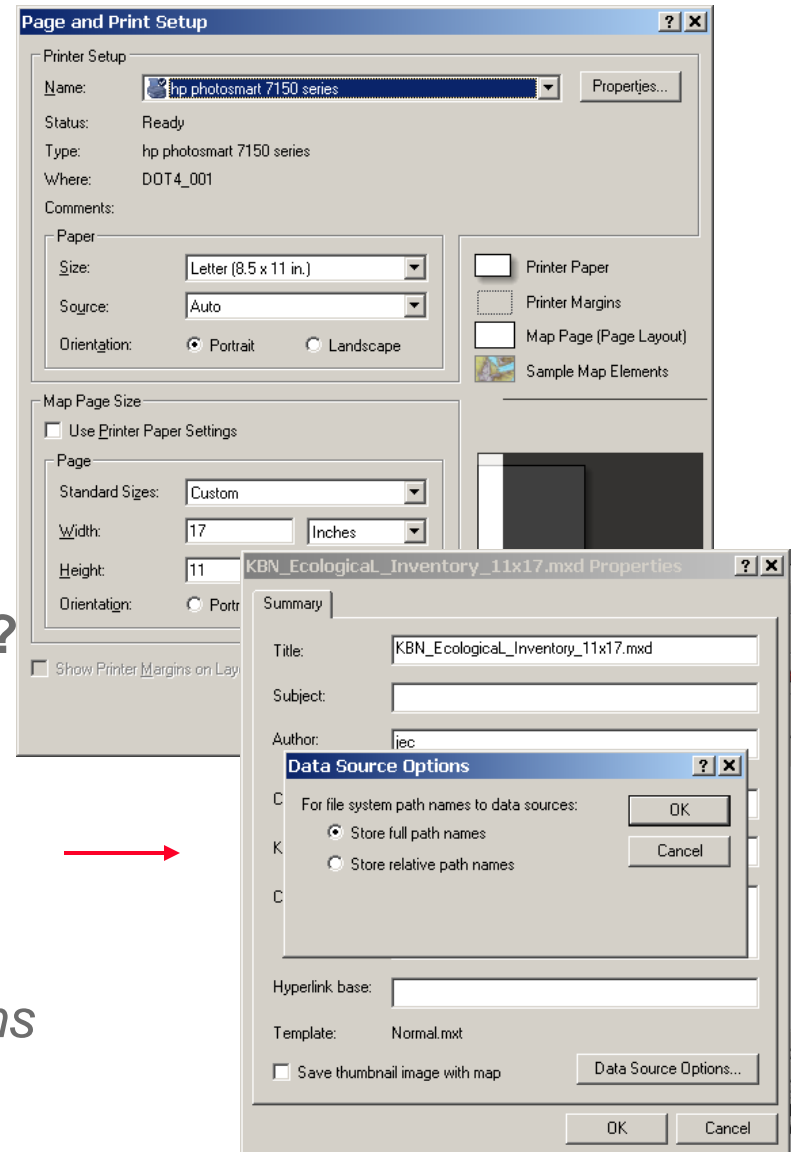
- *Data View vs. Layout View*
- **Data frames**
- **Map elements**
- **File format .mxd files**
  - **Data location/path**
  - **Layer properties**



# Map size

- What is the goal?
  - Wall map?
  - Report map?
  - Digital map?
- What is the best page size?
- Landscape or portrait?
- What printer / plotter will I be using?
- Are there technical limitations?
- Will the map need to be shared?
- If yes, go under:

*File/Map Properties/Data Source Options*

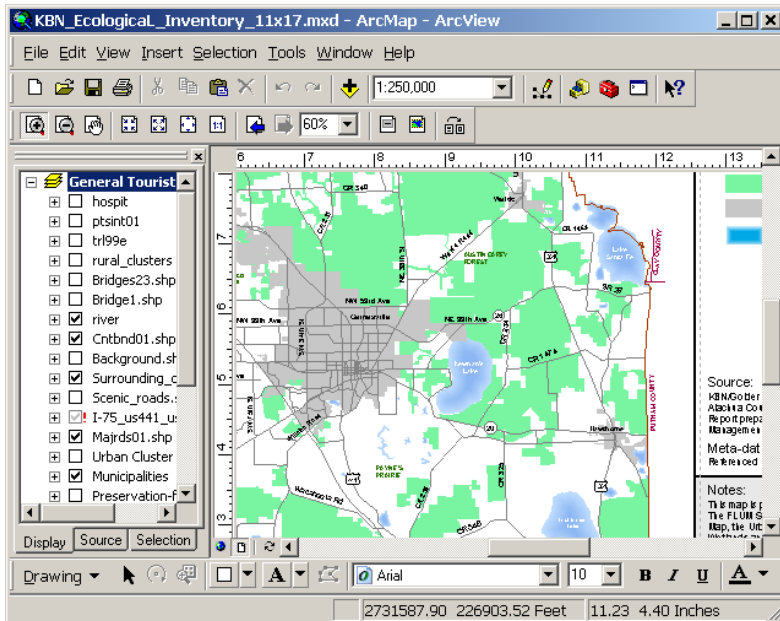




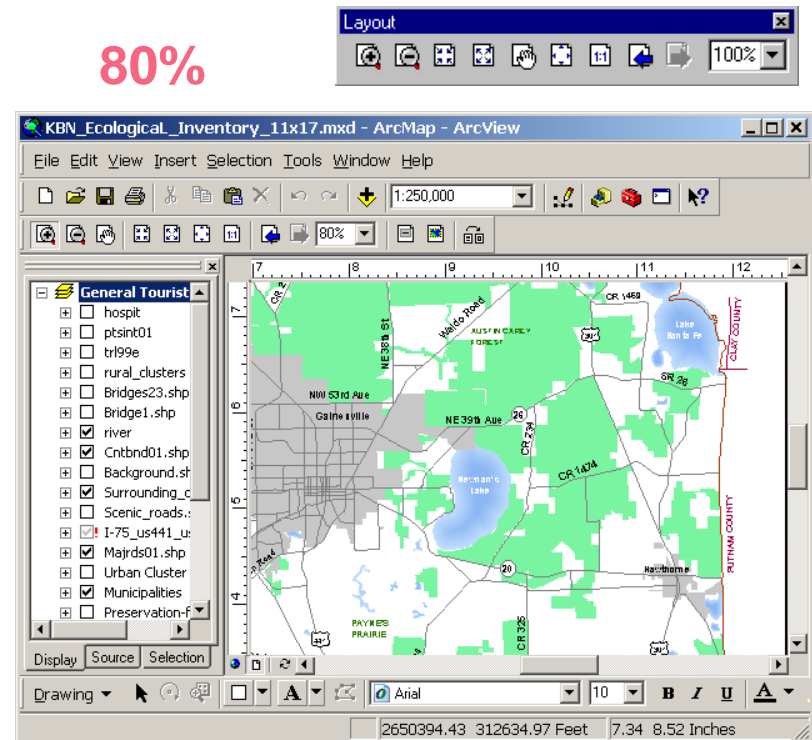
# Layout View toolbar

- ❑ *Data View toolbar differs from Layout View toolbar*
- ❑ **Zoom-in and zoom-out tools do not change the scale of the map display**
- ❑ **Zoom-in and zoom-out tools only allow one to zoom in up to 100% into the map element**

60%



80%



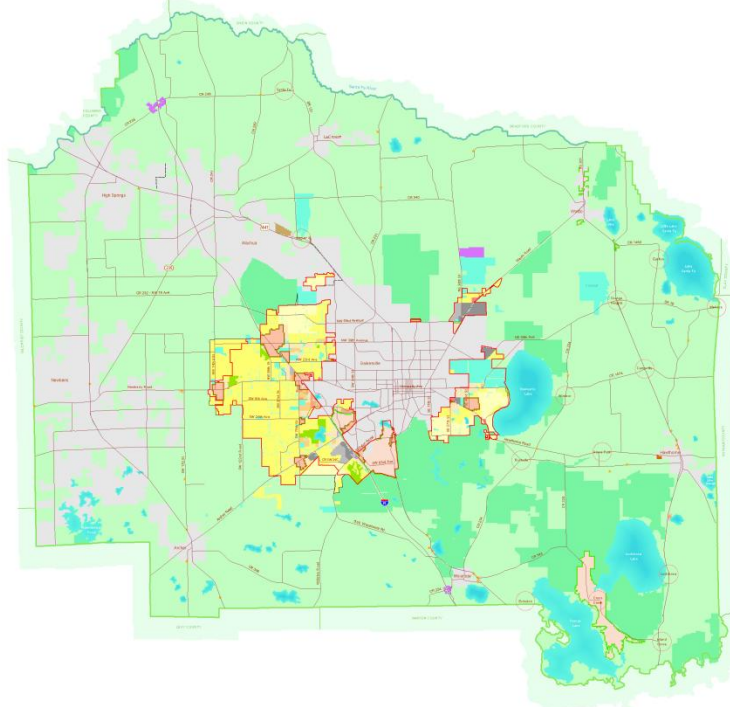
# Map elements

Title



FUTURE LAND USE MAP 2020 - ALACHUA COUNTY, FLORIDA

Map body



**LEGEND**

- Commercial Enclaves
- Rural Commercial - Agriculture
- Rural Cluster
- Urban Services Line
- Urban Cluster Line
- Municipality Separator
- Water Bodies
- Municipalities
- Special Area Studies
- Activity Centers
- Recreation
- Preservation
- Commercial
- Tourist/Entertainment
- Institutional
- County Solid Waste Management Facility
- Light Industrial
- Heavy Industrial
- Estate Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Rural/Agriculture
- Rural Employment Center
- Rural Community Employment Center

Legend

**Future Land Use Distribution in Unincorporated Area by Acreage and Percentage**

LAND USE TYPE	ACREAGE	PERCENTAGE
Commercial	2,660 acres	0.0%
Industrial	2,553 acres	0.0%
Multi-Family	8,522 acres	1.7%
Recreation/Open Space	1,383 acres	0.0%
Utility	4 acres	0.0%
<b>Residential Total</b>	<b>32,262 acres</b>	<b>0.0%</b>
Residential Single-Family	638 acres	1.1%
Residential Medium Density (10-20 units)	228 acres	0.4%
Residential Medium Density (20-30 units)	158 acres	0.3%
Residential Medium Density (30-40 units)	372 acres	0.7%
Residential Low Density (40+ units)	2138 acres	4.1%
<b>Preservation</b>	<b>60,734 acres</b>	<b>14.3%</b>
<b>Rural/Agriculture</b>	<b>271,783 acres</b>	<b>70.0%</b>

Report

Scale bar



North arrow

Map footer containing: Logo, contact info, Data Sources, Last Amended: 07/2003, Ordinance: 03-02, and Notes.

Info on data, etc.  
Logo, contact info

Other notes

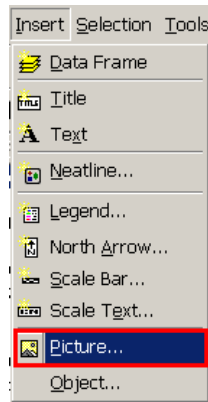
Map date

# Placing map elements

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- Add map elements from the *Insert* menu
- Four basic steps to map element insertion

**1** Choose and insert



**2** Element appears



**3** Resize and position frame of element

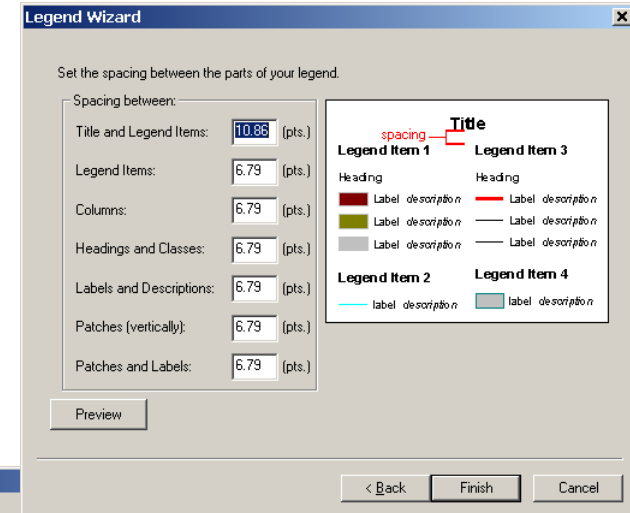
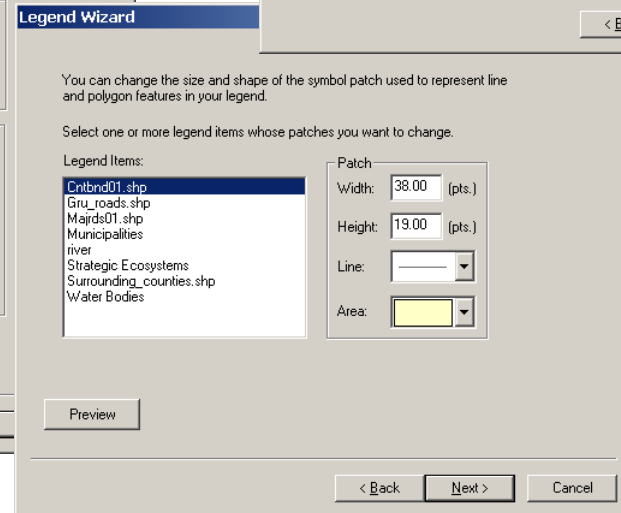
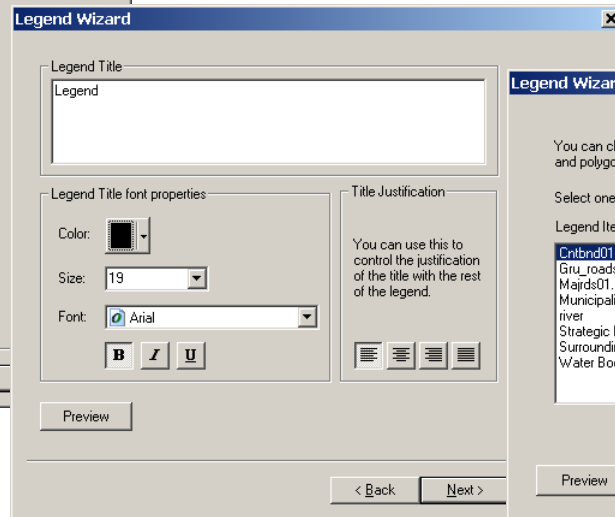
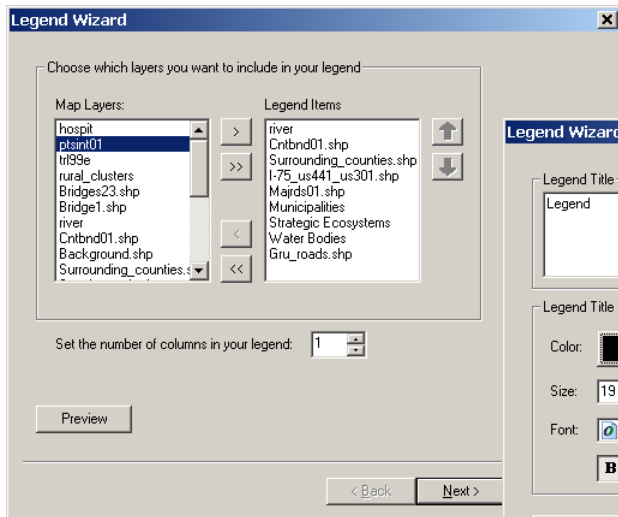


**4** Modify content if needed

- Change labels
- Change symbols
- etc.

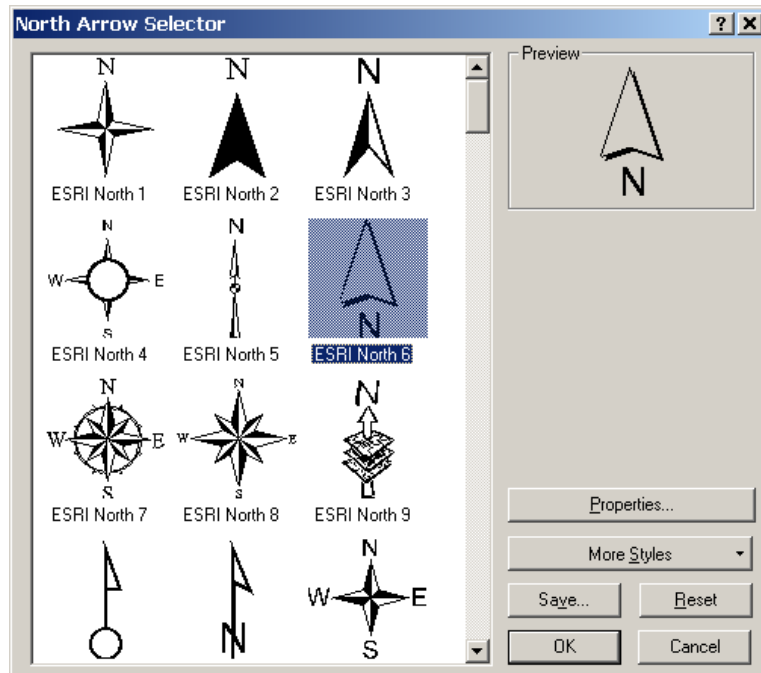
# The Legend Wizard

- ❑ Choose layers to include in legend
- ❑ Set text and text properties
- ❑ Set legend frame
- ❑ Set legend symbology
- ❑ Preview, refine, and finish

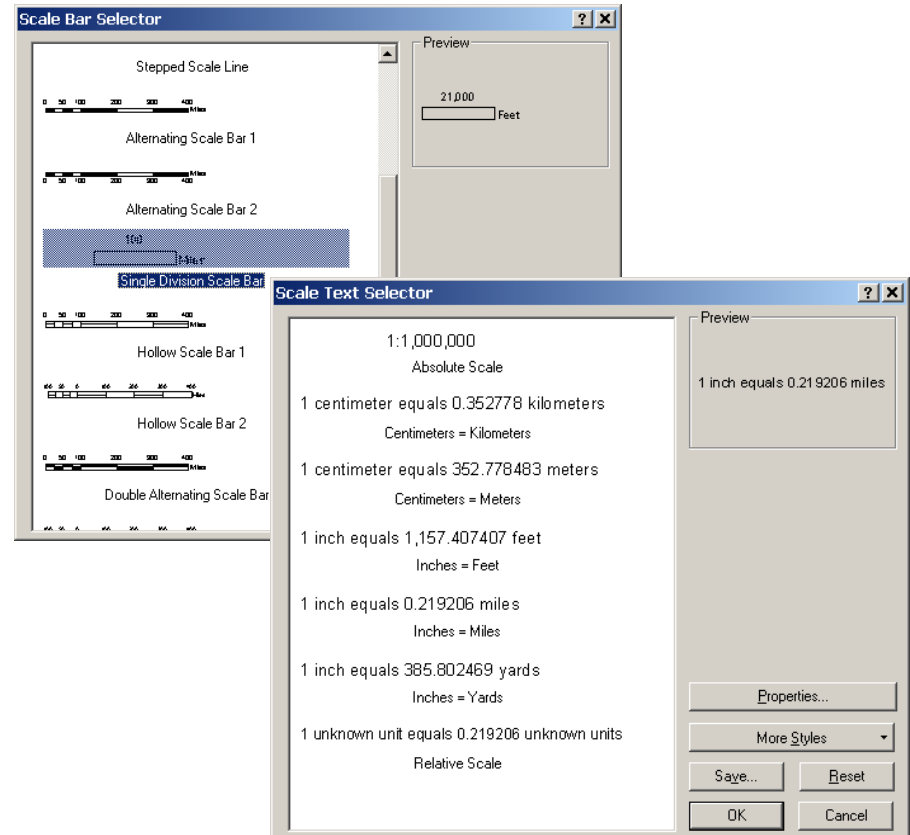


# North arrow and scale

- ❑ Select and preview type
- ❑ Change properties



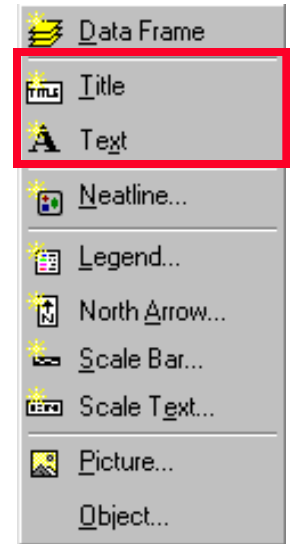
- ❑ Add scale bar or scale text
- ❑ Select and preview type
- ❑ Change unit increments, color, font and other properties



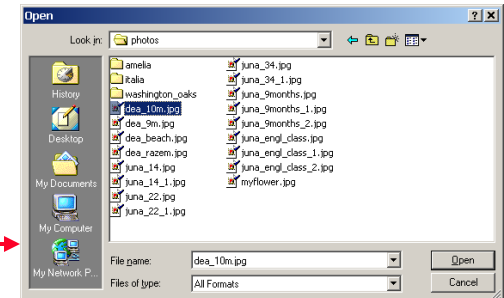
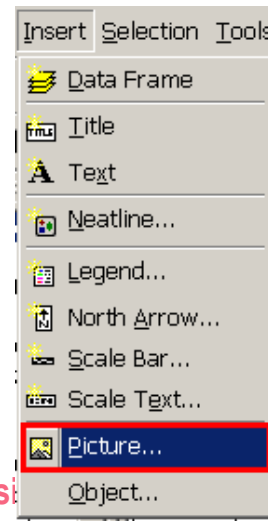
# Text and pictures

□ To add text interactively use either one:

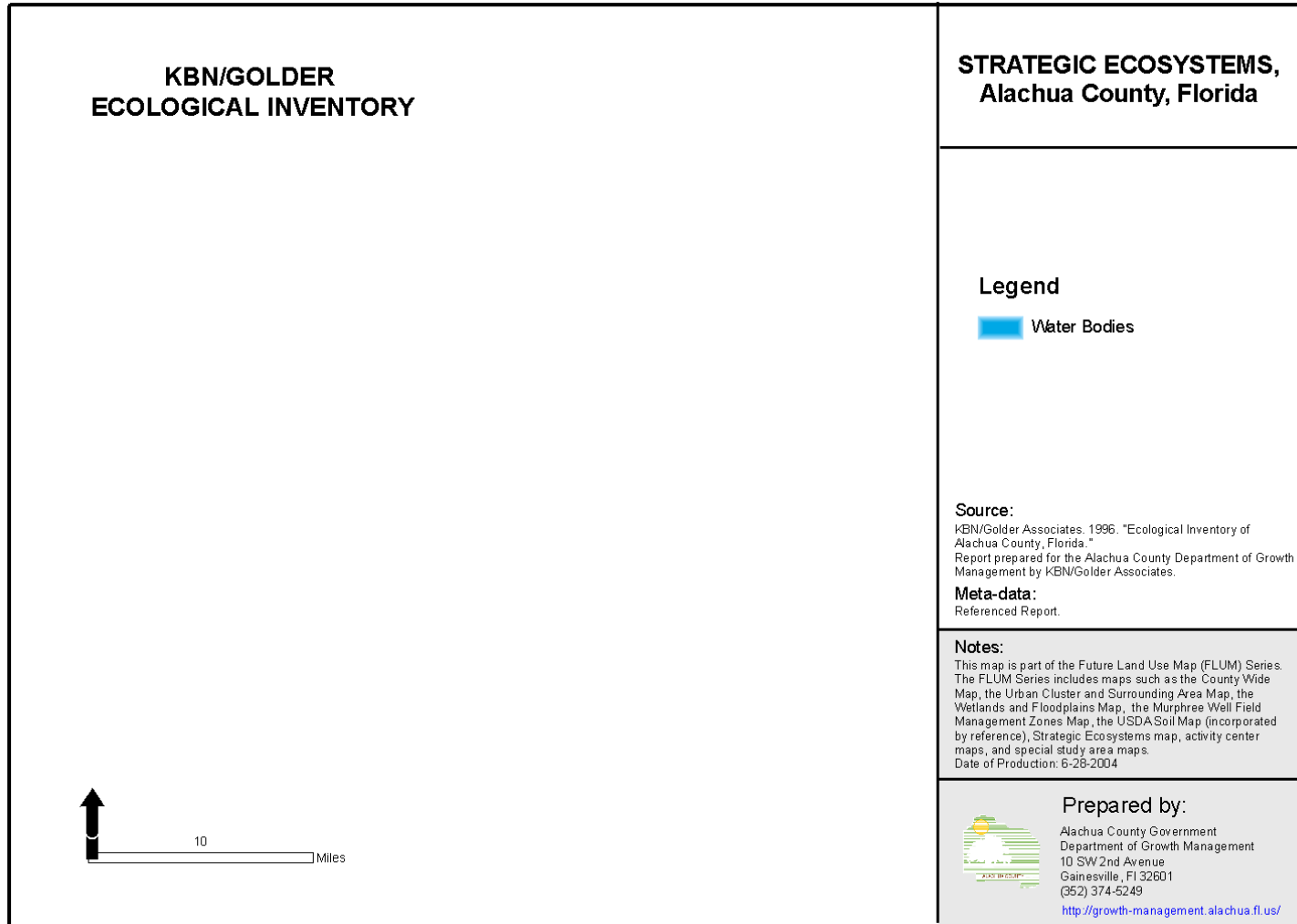
- Drawing Toolbar
- Insert Menu



□ To add pictures, logos to your map use:



# ArcMap templates



# ArcMap templates

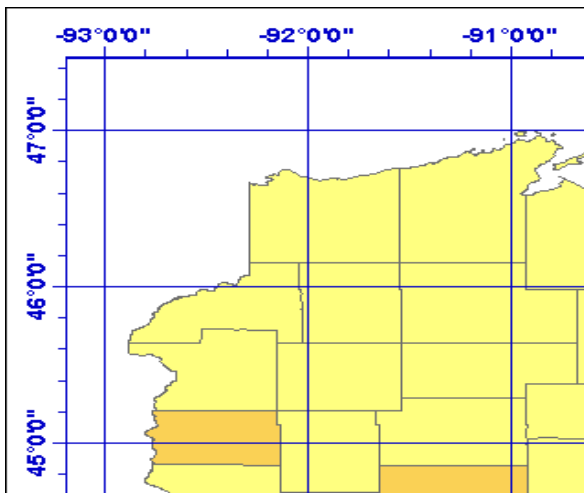
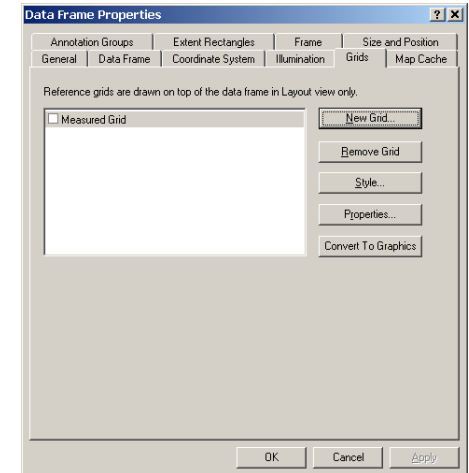
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- ❑ **Templates are useful for the following reasons:**
  - ❑ **Secure consistency to maps in a series or in an organization**
  - ❑ **Increase efficiency of work**
- ❑ **ArcGIS comes with a set of templates**
- ❑ **You can always create your own**
- ❑ **Can save templates anywhere or in the ArcMap Templates folder:  
(*\Program Files\ArcGIS\Desktop10.0\MapTemplates*)**
- ❑ **Templates can store path to the data or just map elements and graphics**

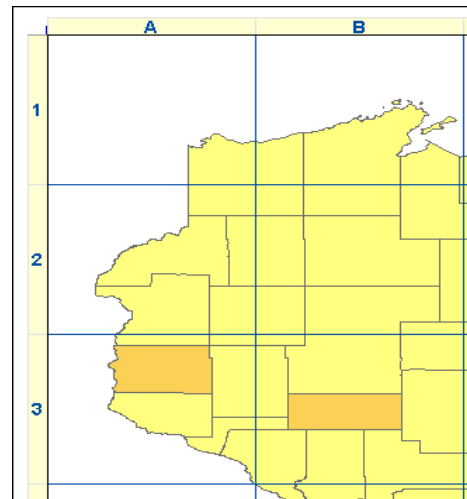


# The reference system

- A reference structure/system can be displayed on maps
- There are two available reference systems
  - Graticules
  - Grids
- Different graticule or grid types on the same map
- Data Frame Properties/Grid tab/ New Grid button



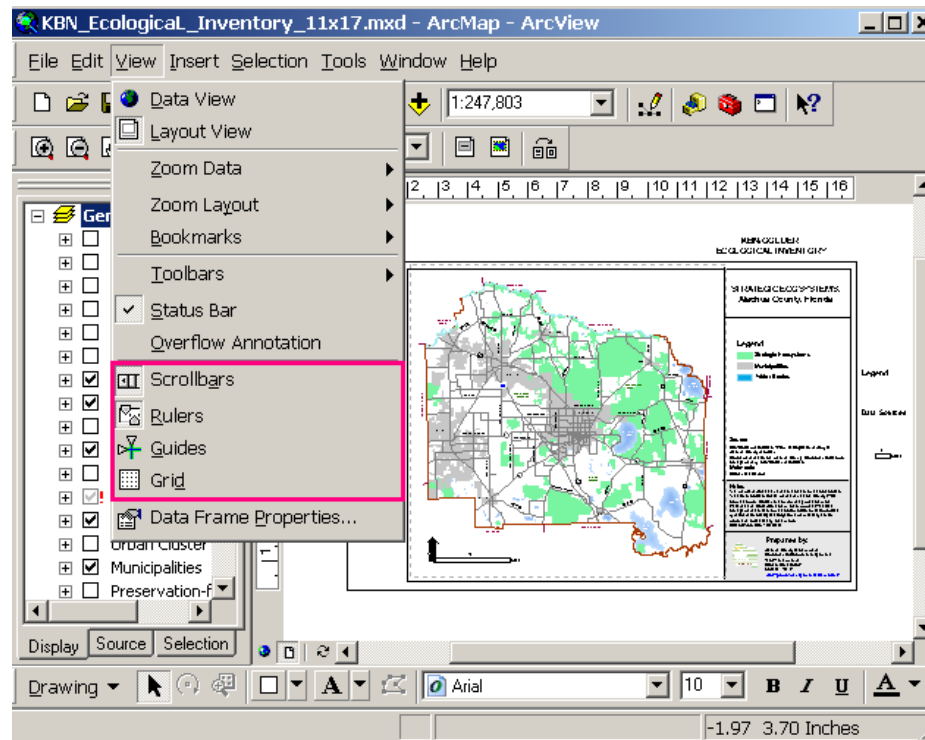
Graticule: *Lat/Long, feet, meters, etc.*



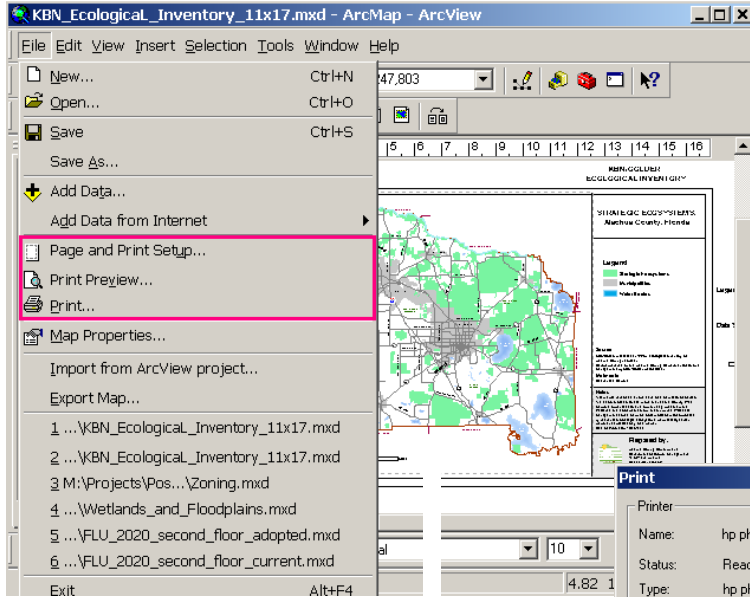
GRID: *ABC/123, etc.*

# Rulers and Grids

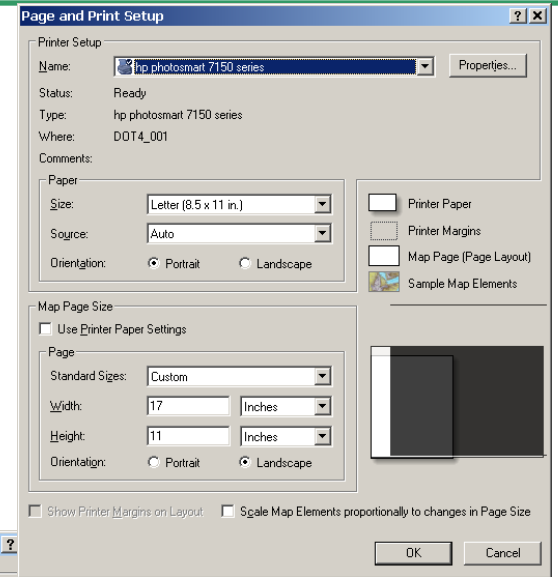
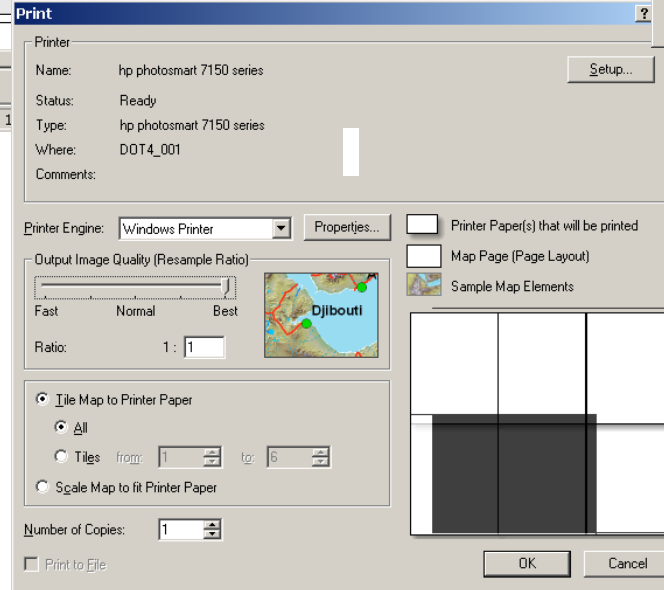
- Balance size of map elements
- Align properly map elements
- Position map elements at specific points
- Set snapping tolerance and snap for precision and efficiency



# Printing maps



Print



Page Setup