Week 7

GEOREFERENCING, PROJECTIONS
Part I

PRESENTING DATA
Part II

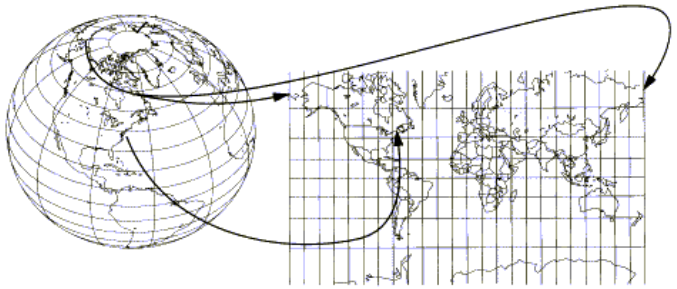
topics of the week

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

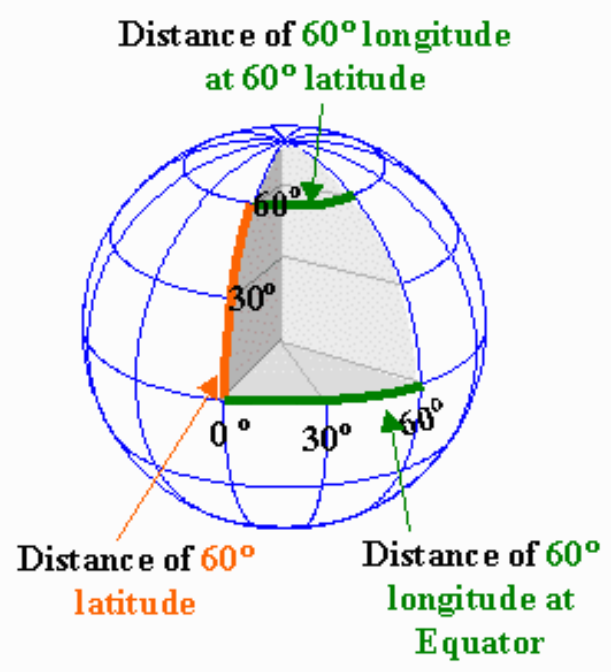
Geo-referencing

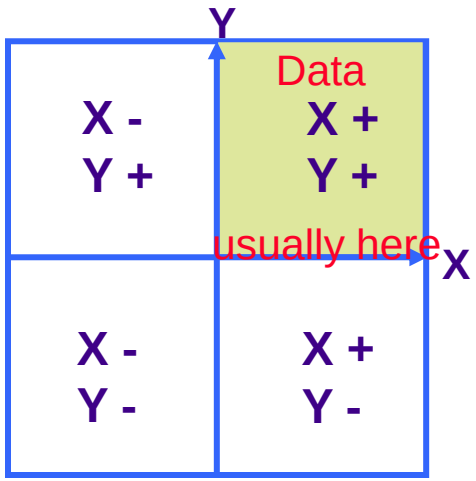
- **Geo-referencing is the process of establishing a relationship between the data displayed in your GIS software and its real-world location**
- **In simple terms, it is a process that adds geographic intelligence to the data**

- **Geo-referencing is accomplished by using:**
  - **Coordinate systems – four components**
    - *Ellipsoid*
    - *Datum*
    - *Projection*
    - *Units*



Coordinate systems





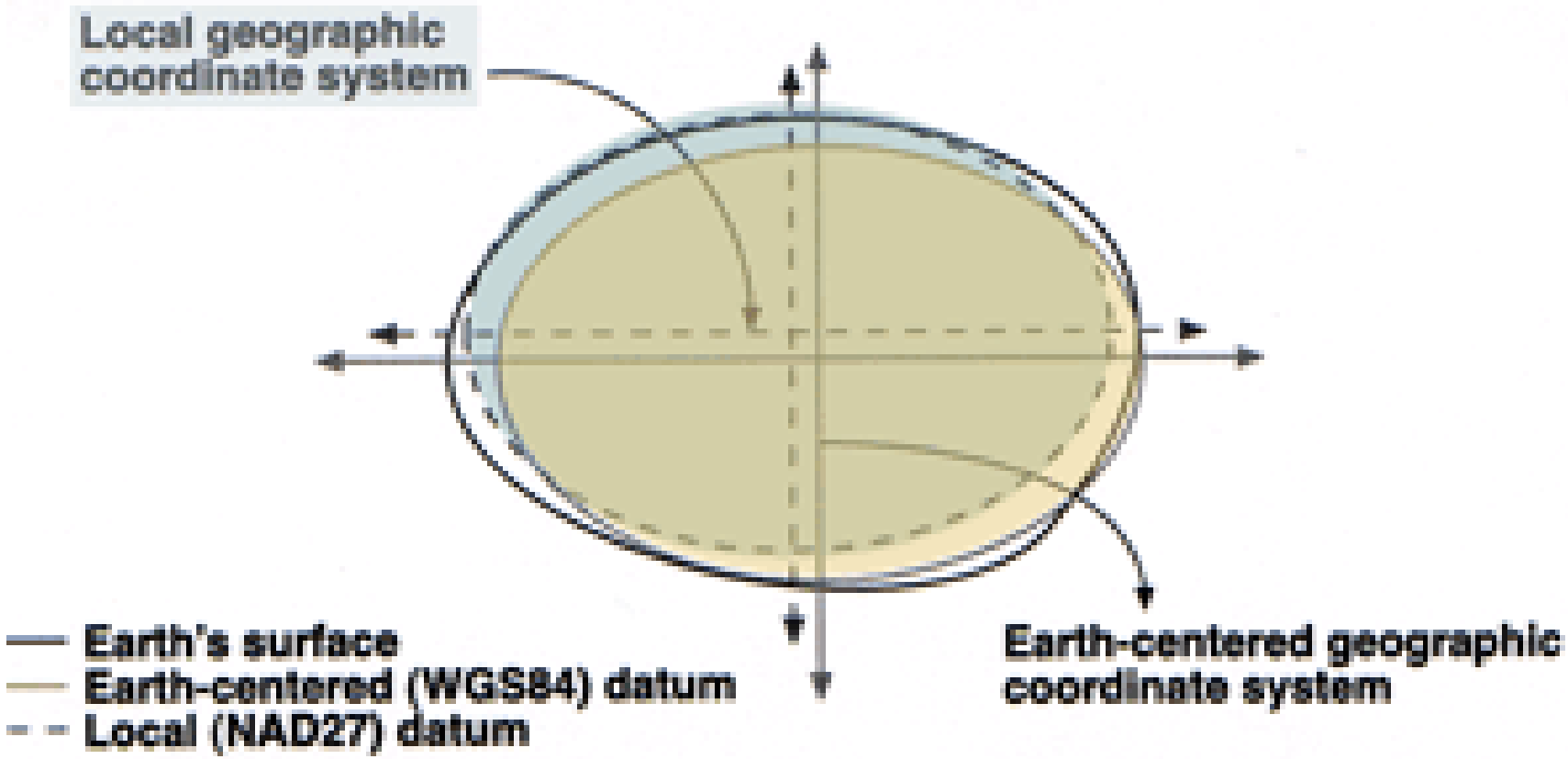
- Geographic coordinate system
- Parallels and Meridians form a graticular network
- Latitude and longitude are angles measured from Earth's center to a point on the Earth's surface

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

Datums

- 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



Datums and referencing

- **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**

13th Street in Gainesville

State Plane Florida North NAD83

State Plane Florida North NAD27

Projections

- 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]:

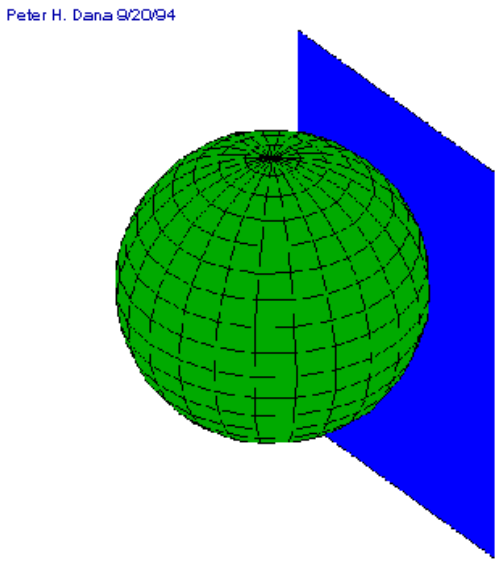
  - Shape [S]
  - Area [A]
  - Distance [D]
  - Direction [D]

Types of projections

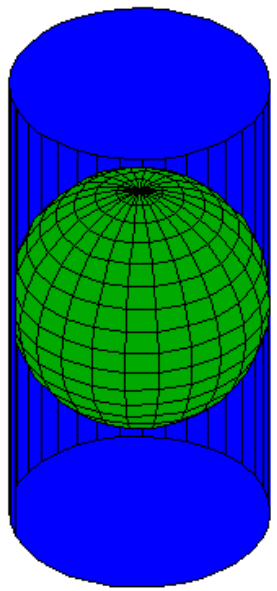
- ***Classified by the spatial attribute they preserve best***

- **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**

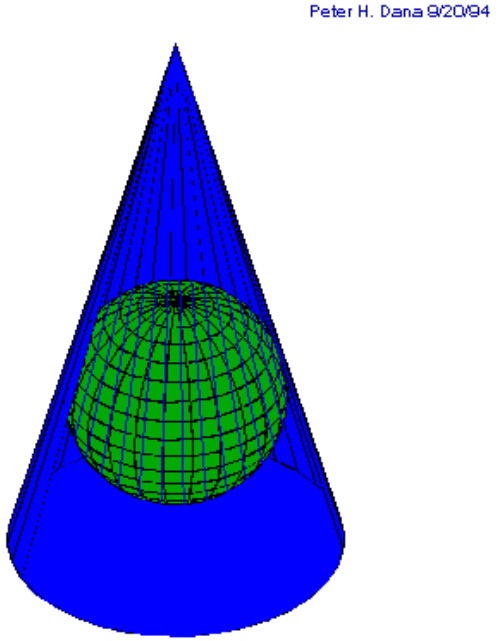
Projection surfaces



Planar Projection Surface

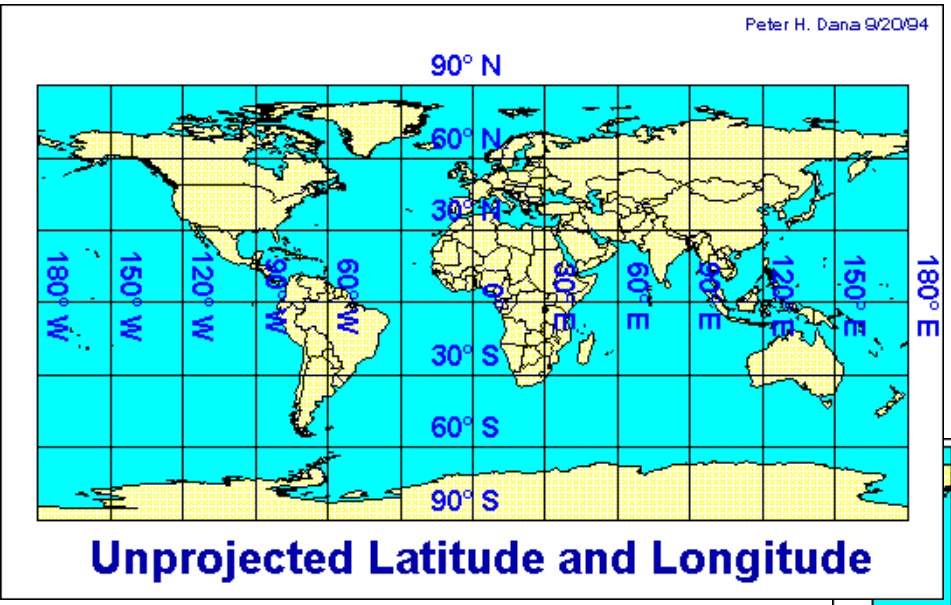


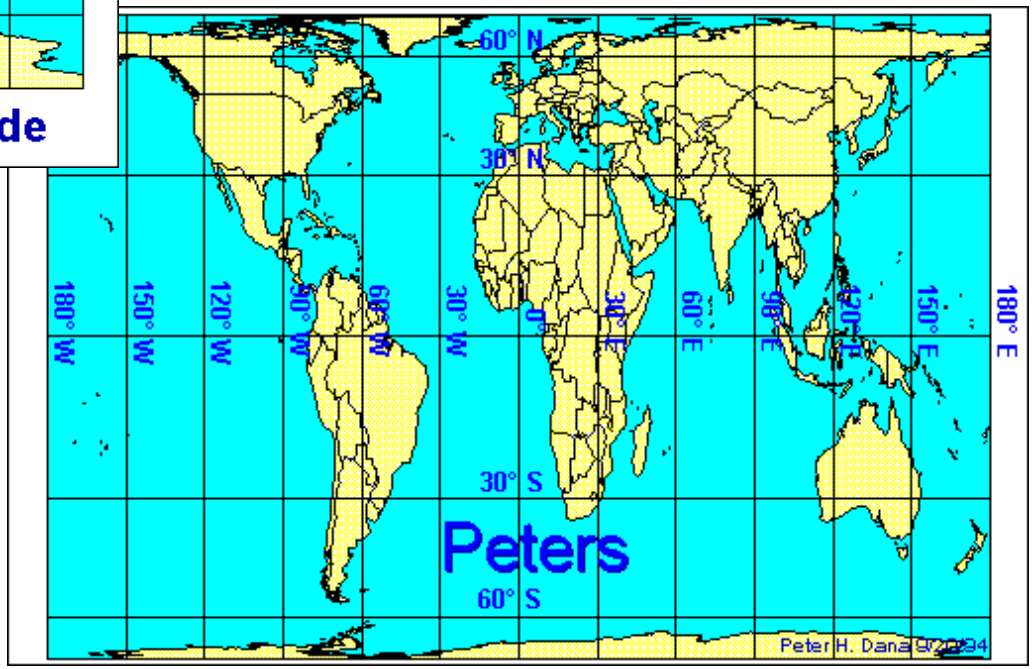
Cylindrical Projection Surface



Conical Projection Surface

Projection distortion examples





Storing projection information

Different spatial data formats store the projection information differently

Shapefiles

Coverages

PRJ file – text file

World file →

CAD files

PRJ file – text file

AUX file →

Images

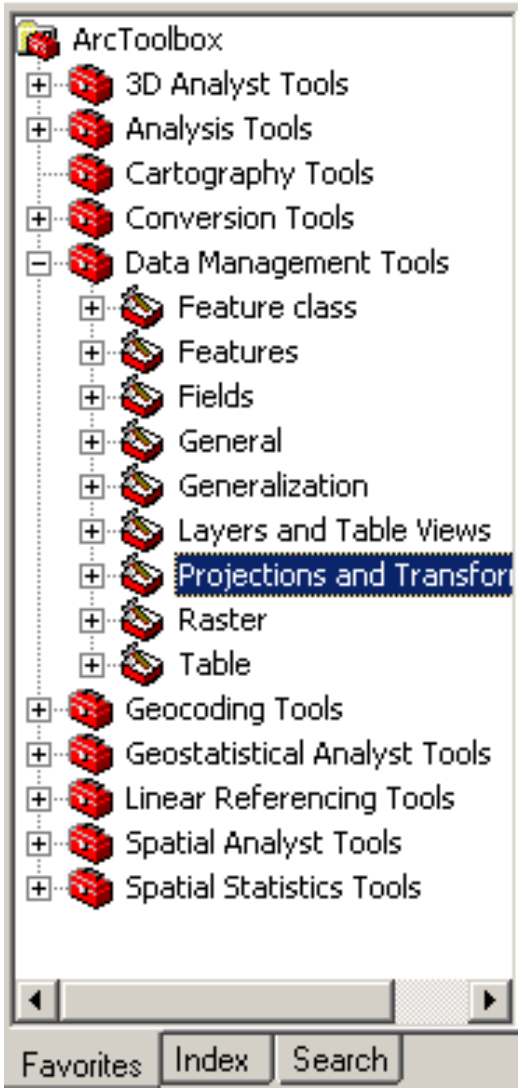
MDB table →

Geodatabase

Encapsulated with the file

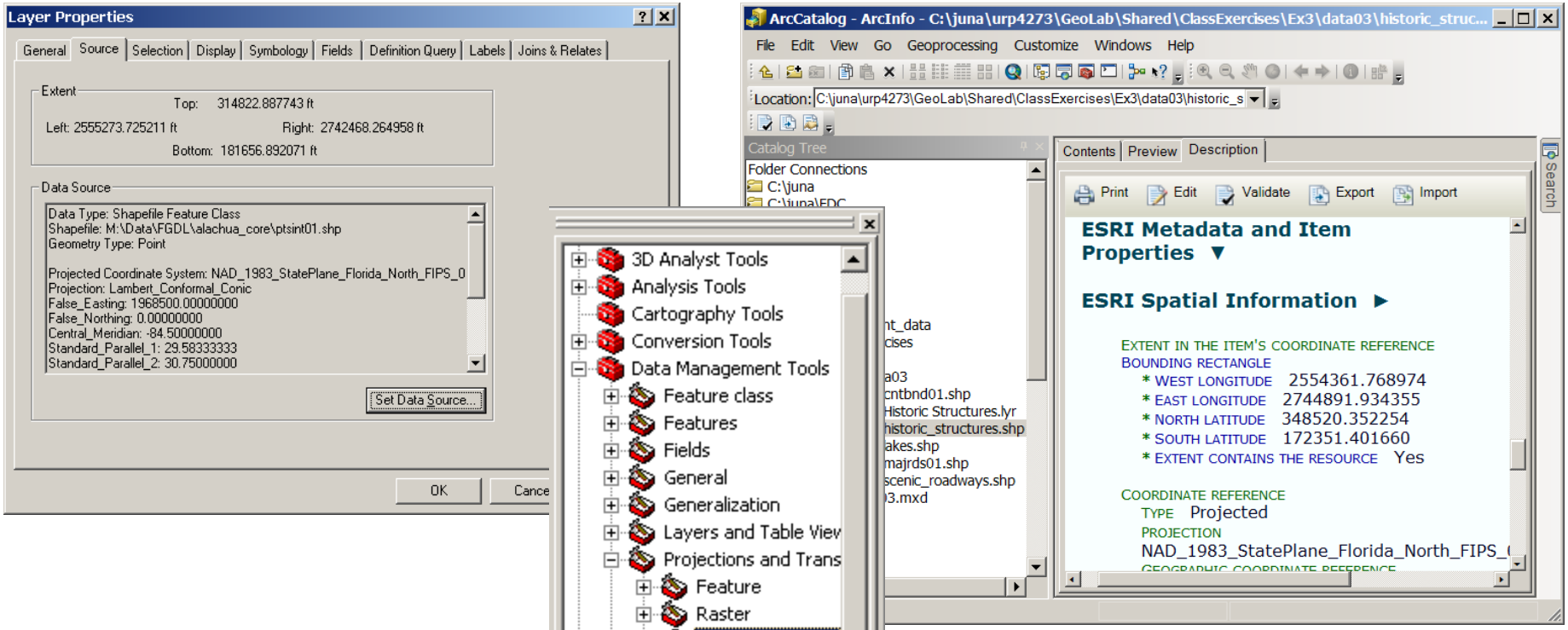
Projections in ArcGIS

- **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**



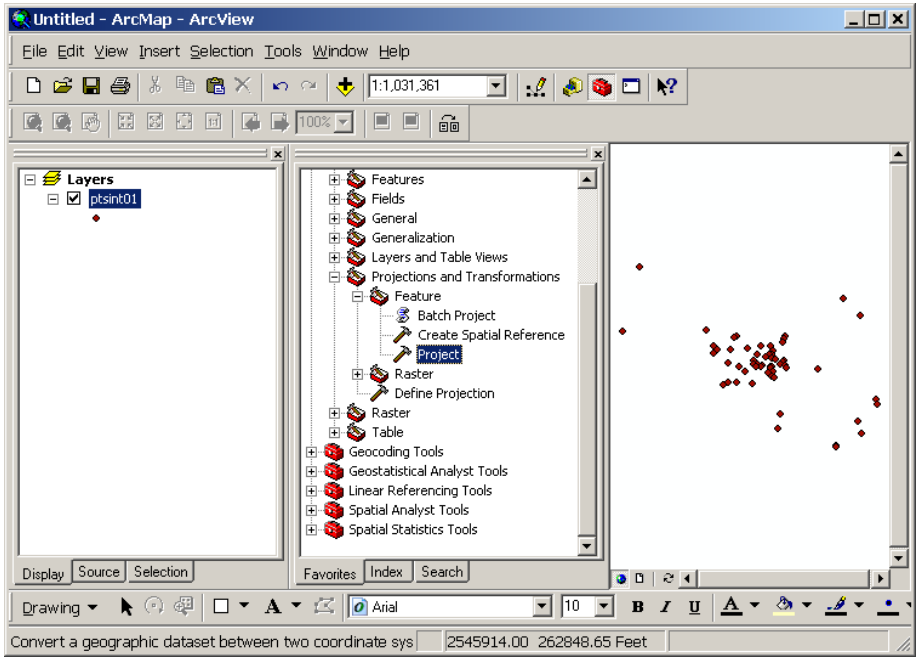
Viewing projection information in ArcGIS

- 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



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



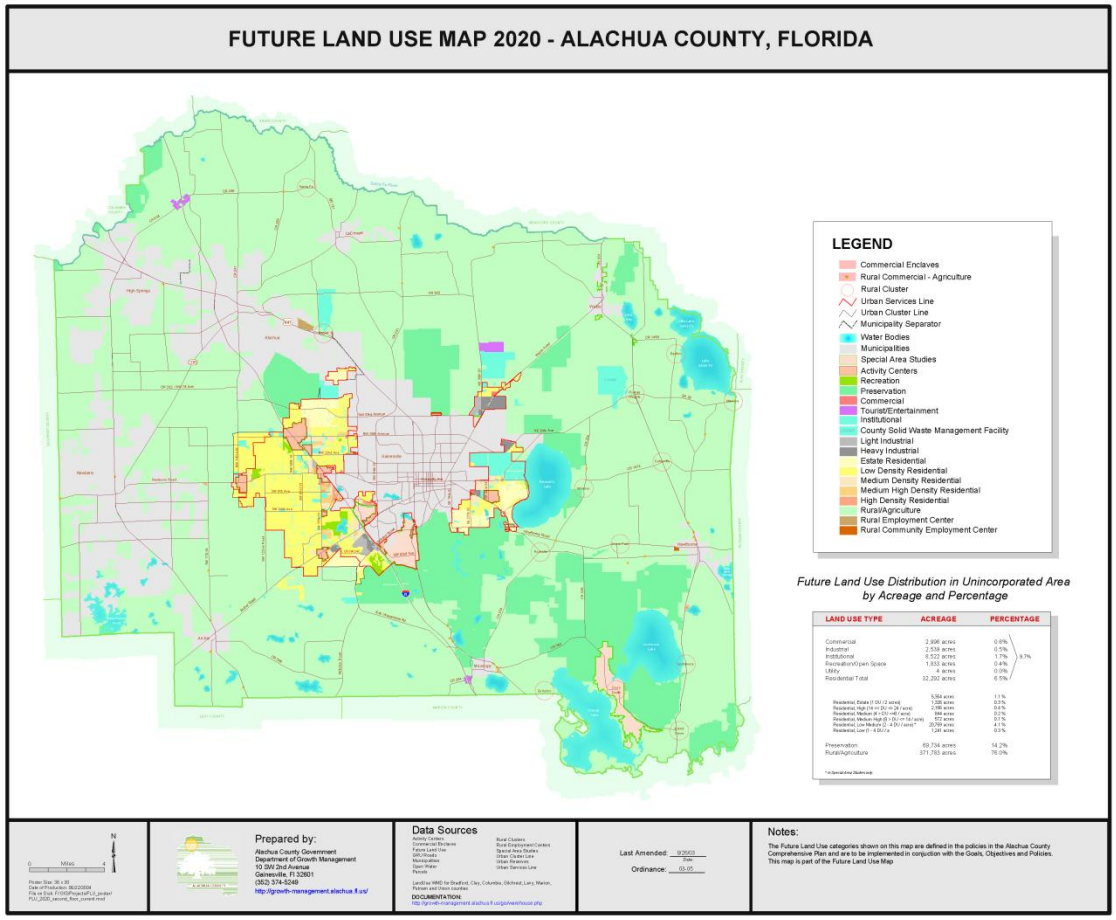
PRESENTING DATA
Part II

topics of the week – presenting data

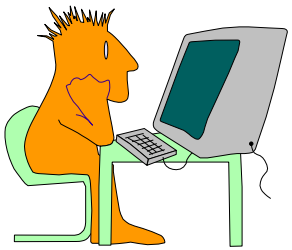
- Cartographic principles
- Cartographic design
- Maps in ArcMap
- Map elements

Why Maps?

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

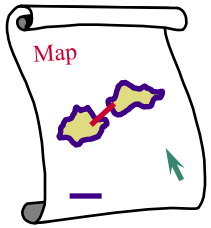


How do maps tell the story?

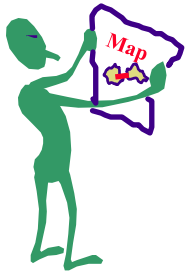


Map maker

Select
Classify
Generalize
Symbolize



Map



Read
Analyze
Interpret

Map reader

Understands reality

Understands reality

?

Same?

Cartographic design

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

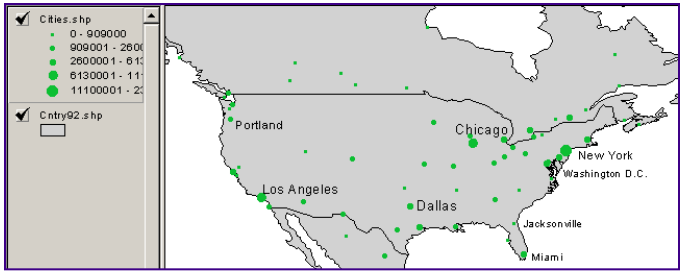
- Colors, shade patterns, and text
  - Perception of colors and symbols
  - Up to 12 colors & 7-8 shades per color
  - Legibility of features and text
  - Visual contrast and hierarchy
  - Color conventions ex. In Urban Planning
    - Green – conservation
    - Blue - water
    - Orange - urban areas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

Classification of maps

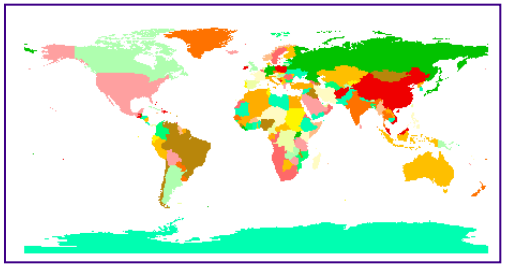
There are many more ways to classify maps, but here is one:

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

Quantitative

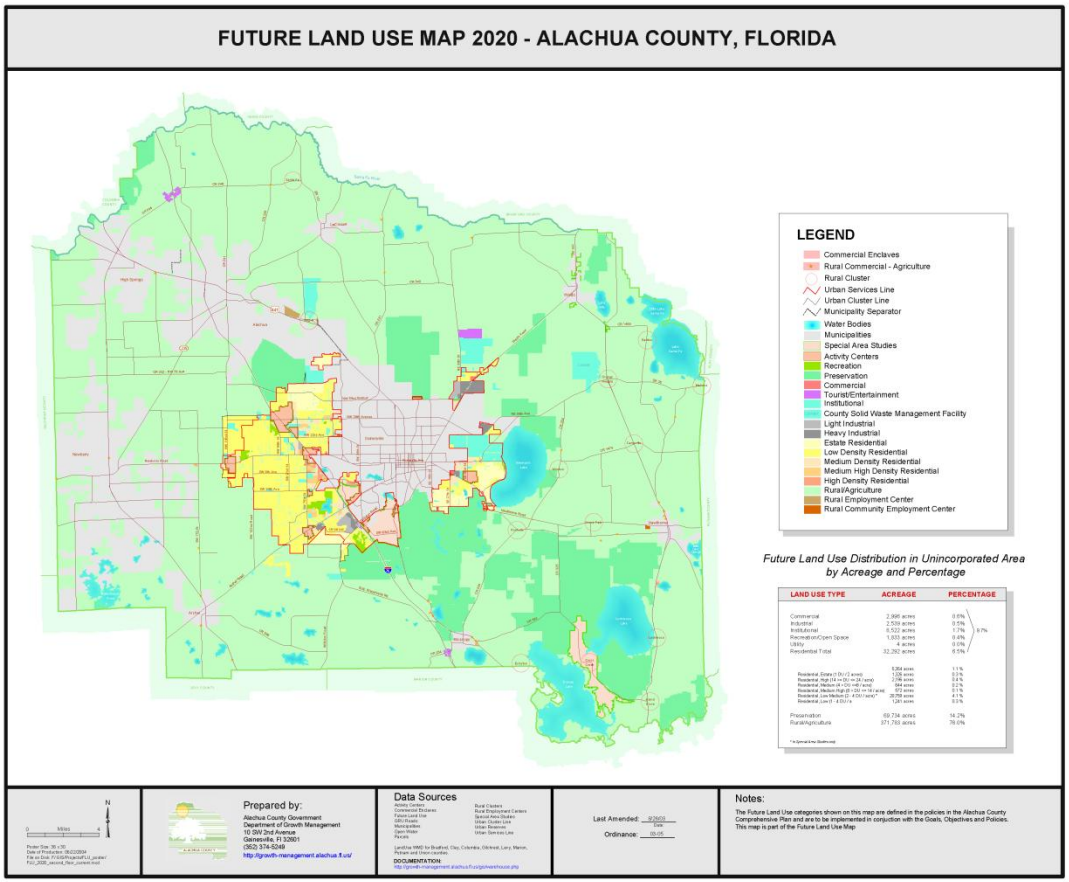


Qualitative



Maps in ArcMap

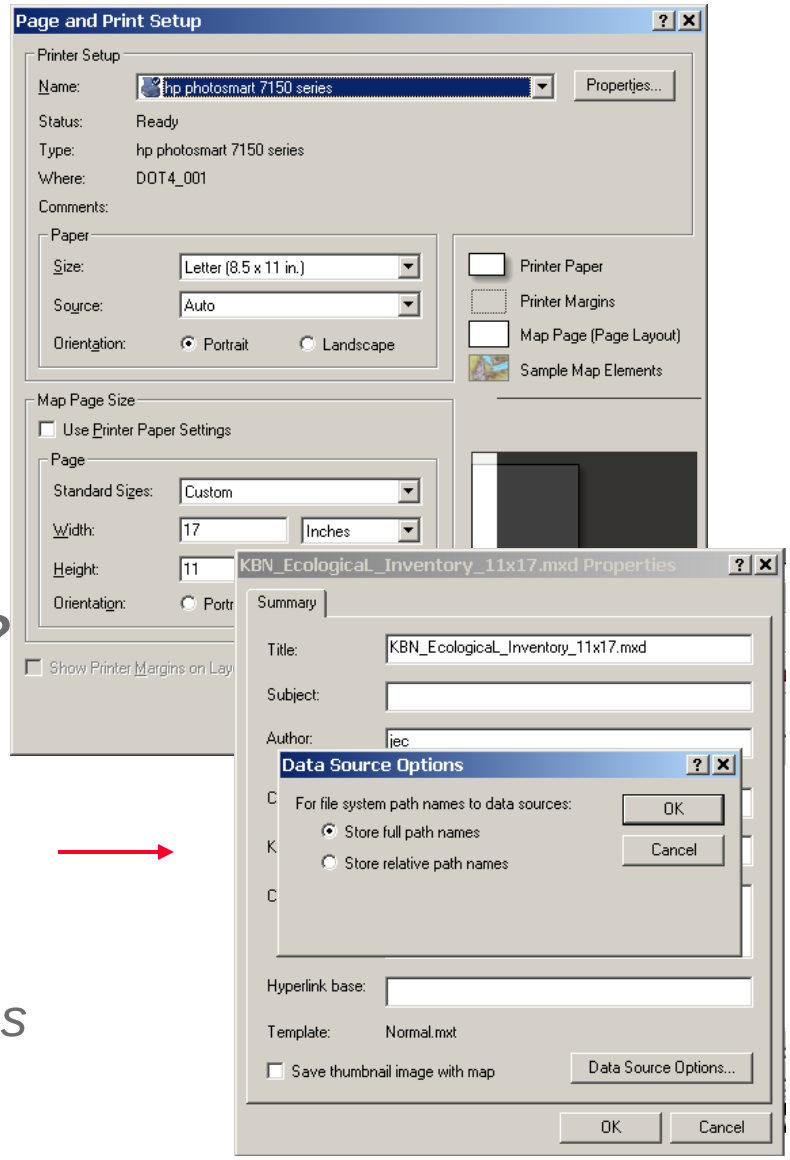
- *Data View* **vs.** *Layout View*
- **Data frames**
- **Map elements**
- **File format** *.mxd* **files**
  - **Data location/path**
  - **Layer properties**



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:

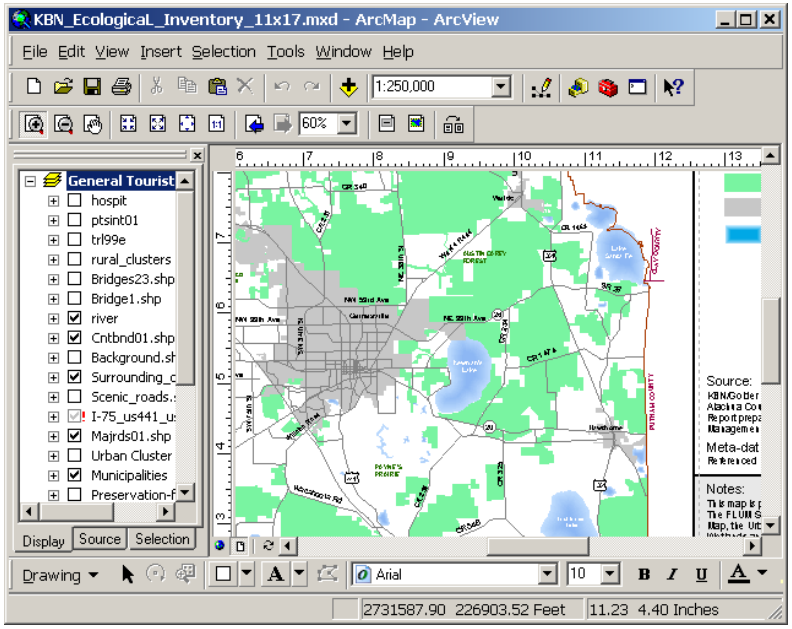
  File/Map Properties/Data Source Options



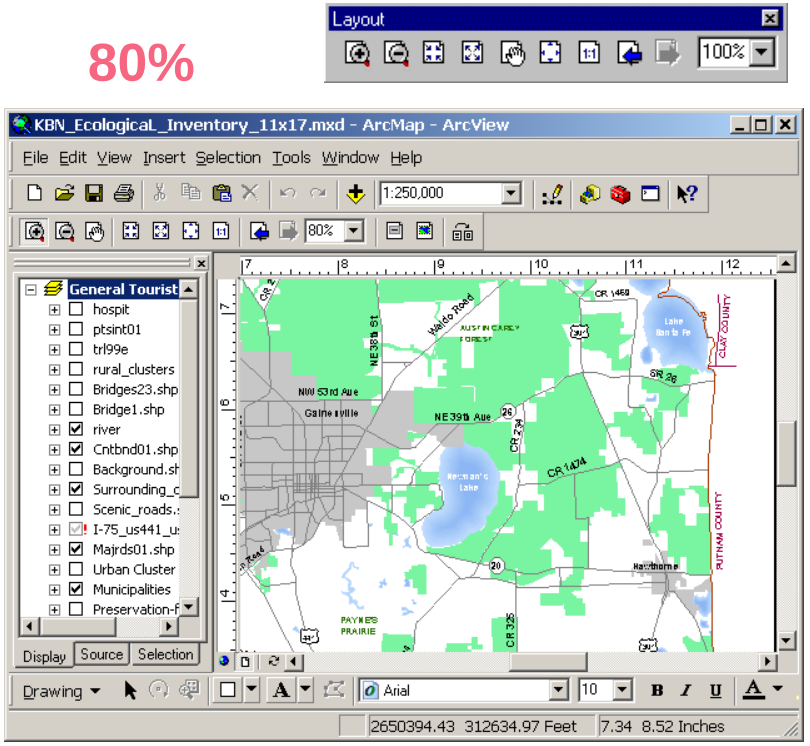
Layout View toolbar

- *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%



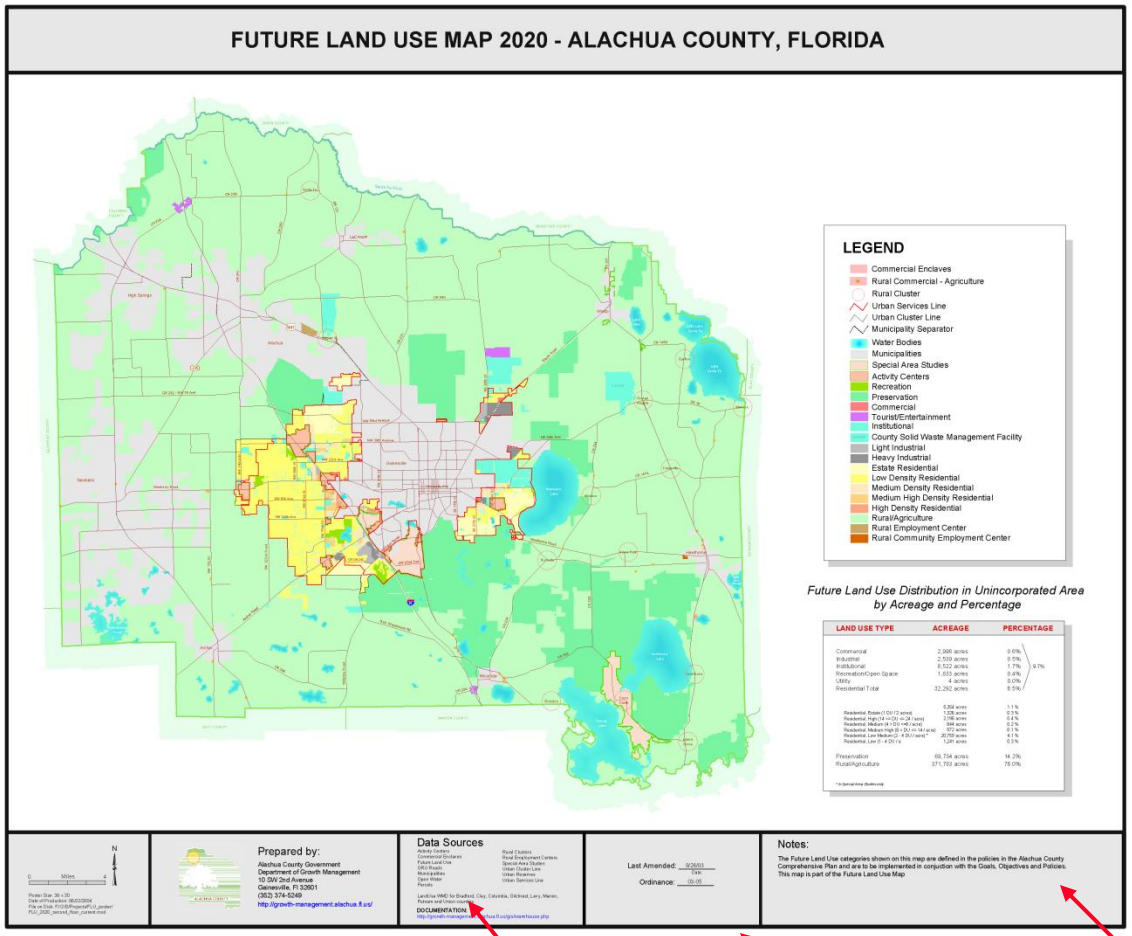
Map elements

Title

Map body

Scale bar

North arrow



Legend

Report

Info on data, etc.

Logo, contact info

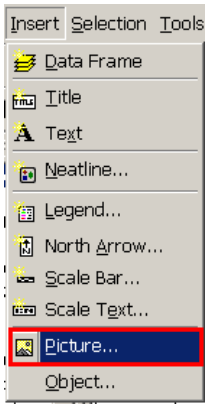
Other notes

Map date

Placing map elements

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

1 Choose and insert



2 Element **appears**

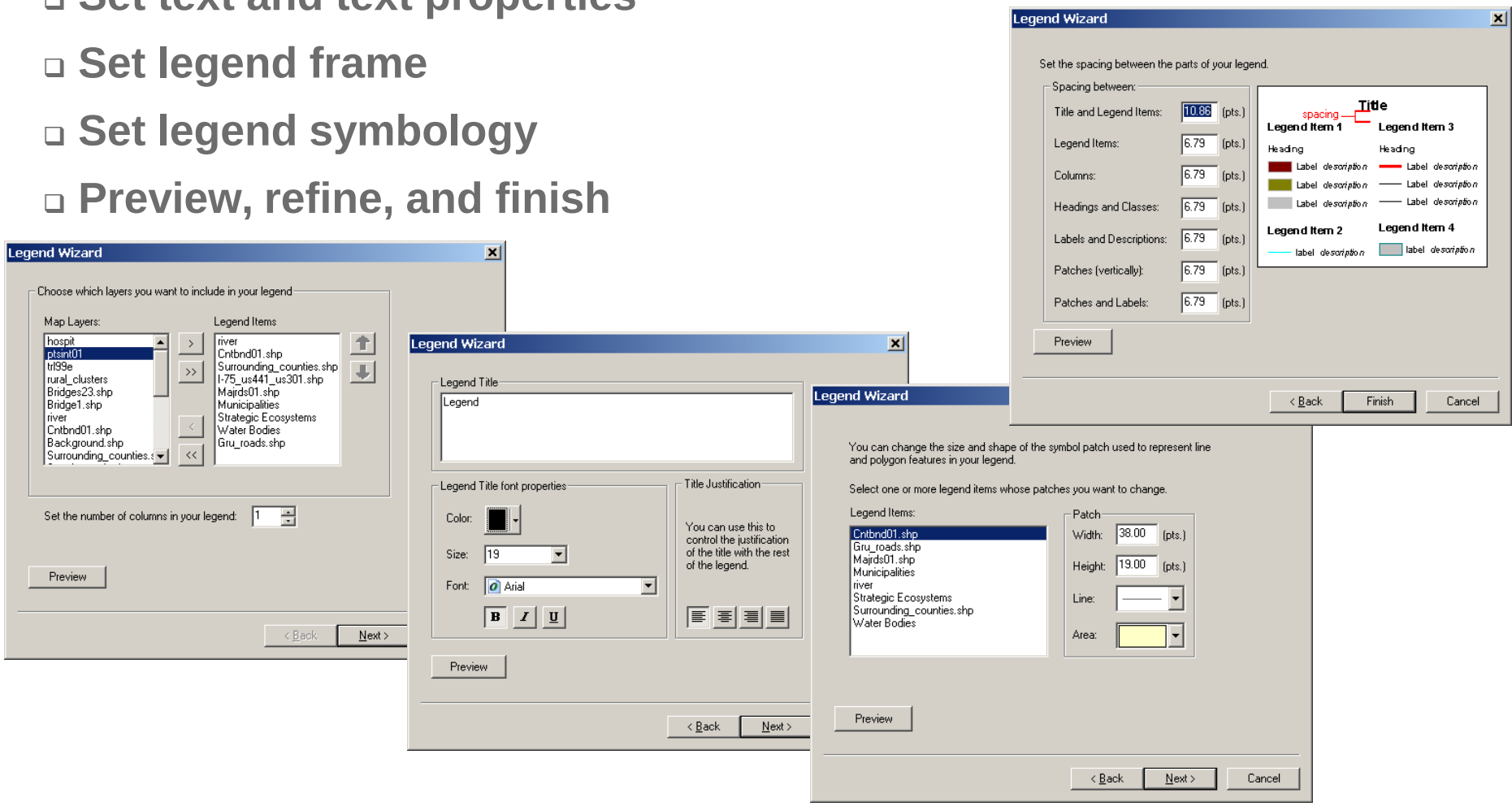
3 Resize and position frame of element

4 Modify content if needed

- Change labels
- Change symbols
- etc.

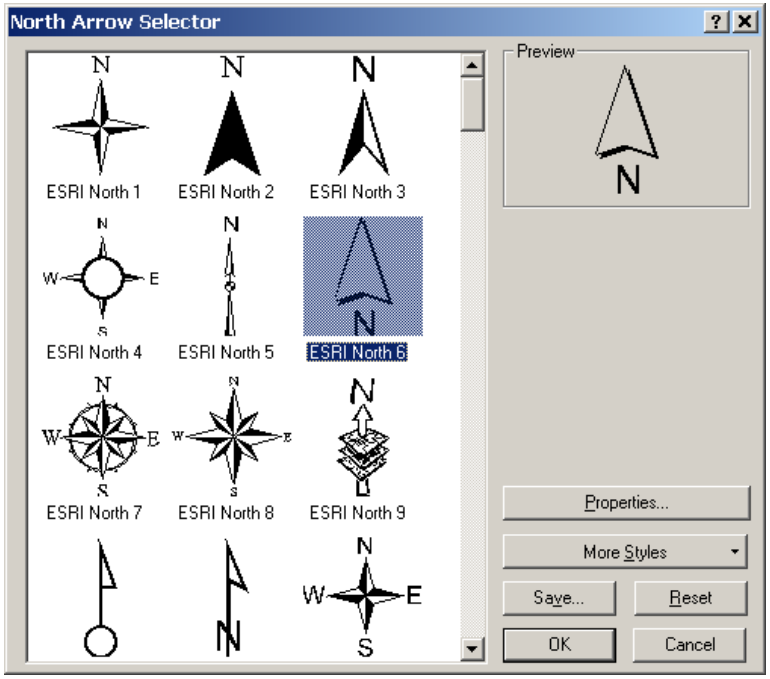
The Legend Wizard

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

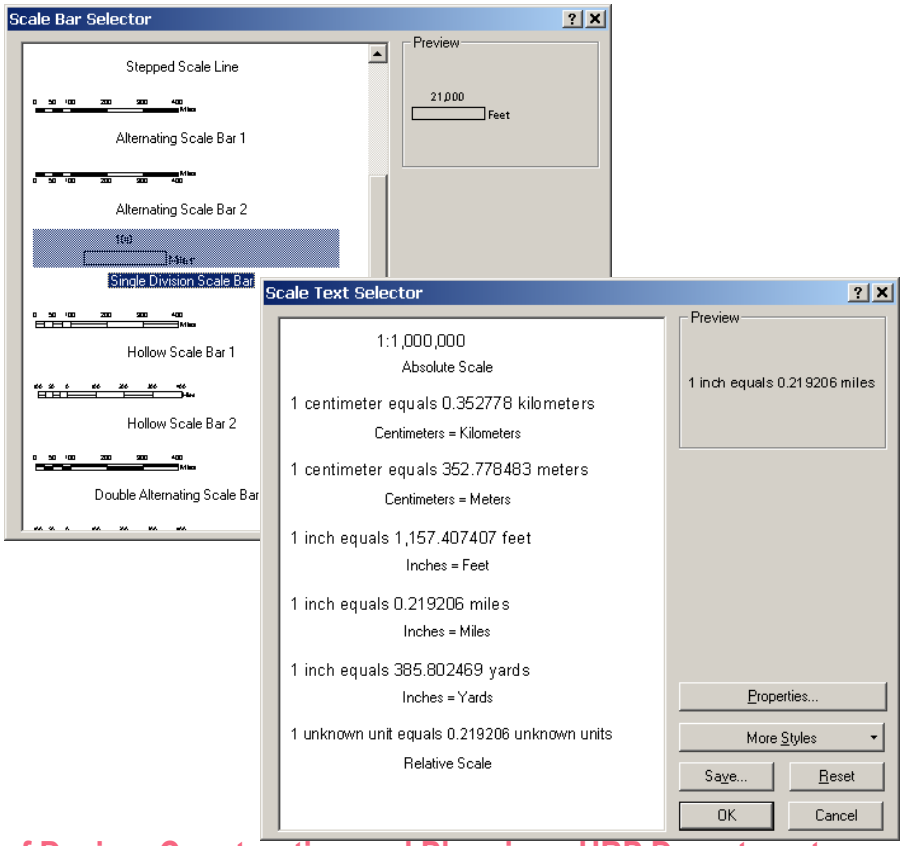


North arrow and scale

- Select and preview type
- Change properties

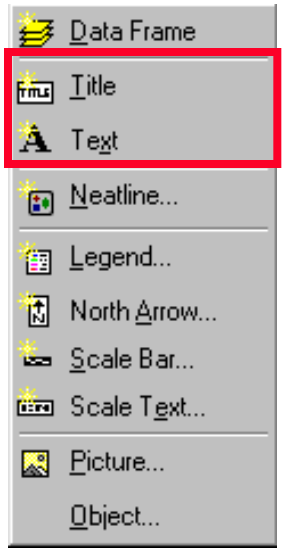


- Add scale bar or scale text
- Select and preview type
- Change unit increments, color, font and other properties

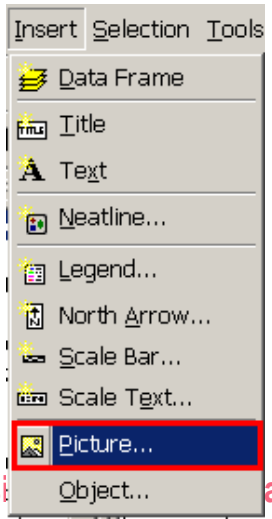


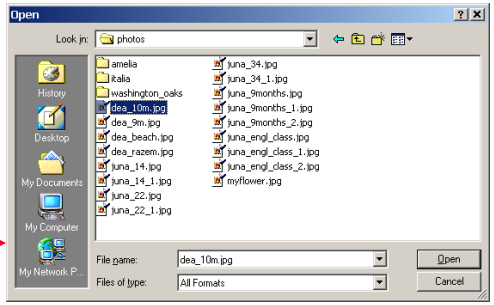
Text and pictures

- To add text interactively use either one:
  - Drawing Toolbar
  - Insert Menu

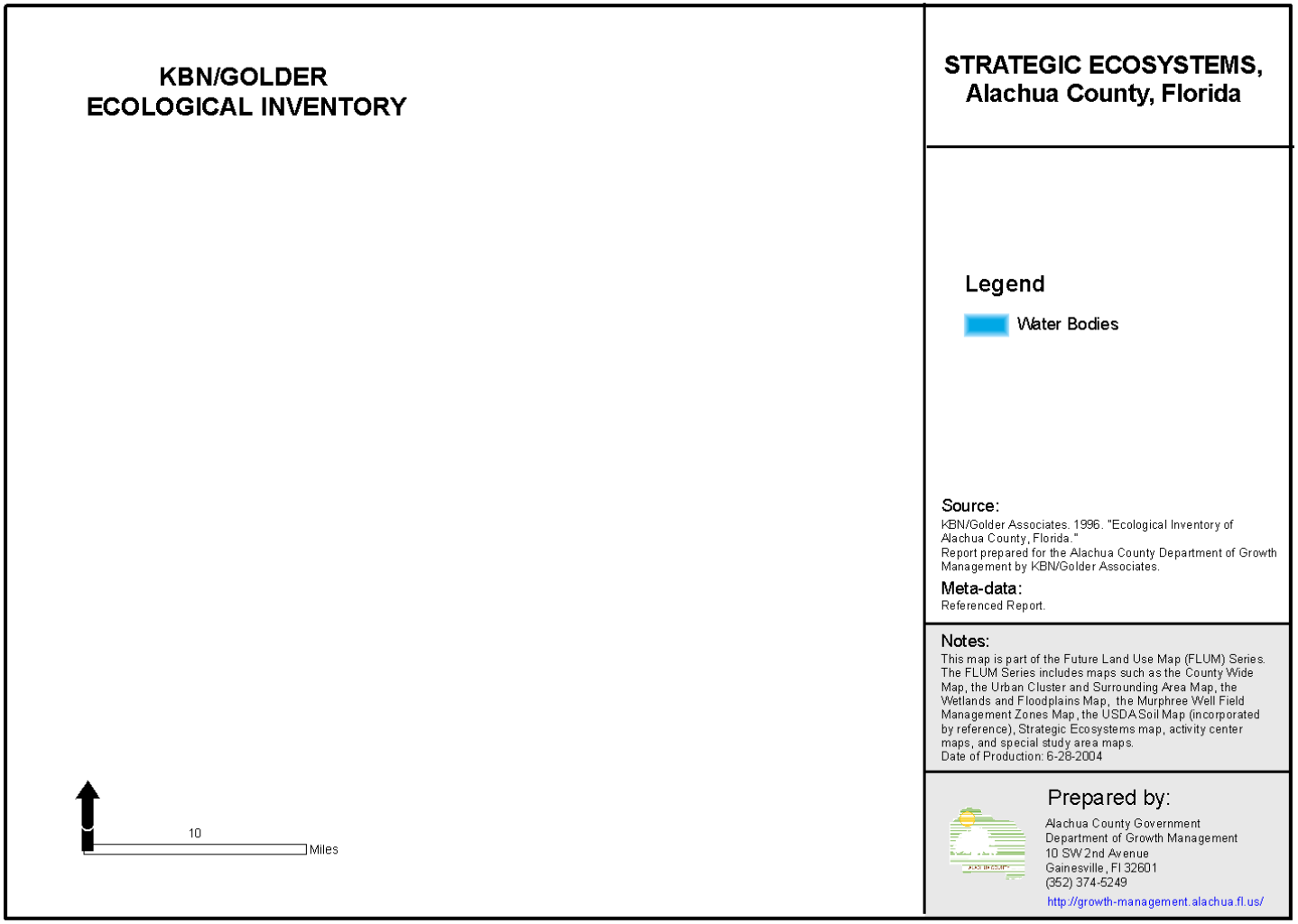


- To add pictures, logos to your map use:





ArcMap templates



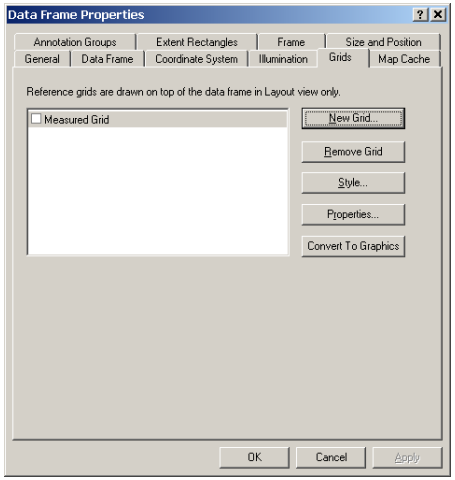
ArcMap templates

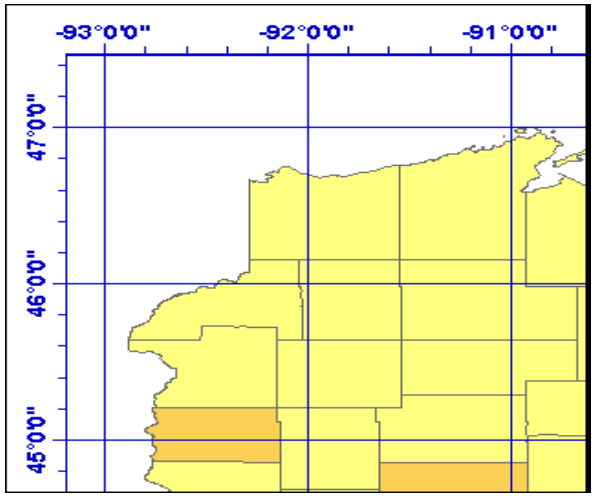
- Templates are useful for the following reasons:
  - Secure consistency to maps in a series or in an organization
  - Increase efficiency of work
- ArcGIS comes with a set of templates
- You can always create your own
- Can save templates anywhere or in the ArcMap Templates folder:

  (\Program Files\ArcGIS\Desktop10.0\MapTemplates)
- Templates can store path to the data or just map elements and graphics

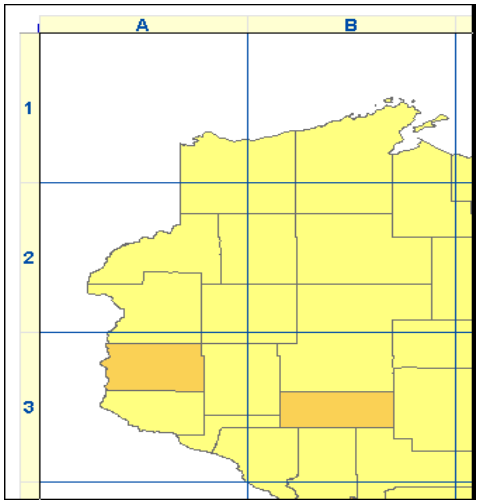
The reference system

- 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





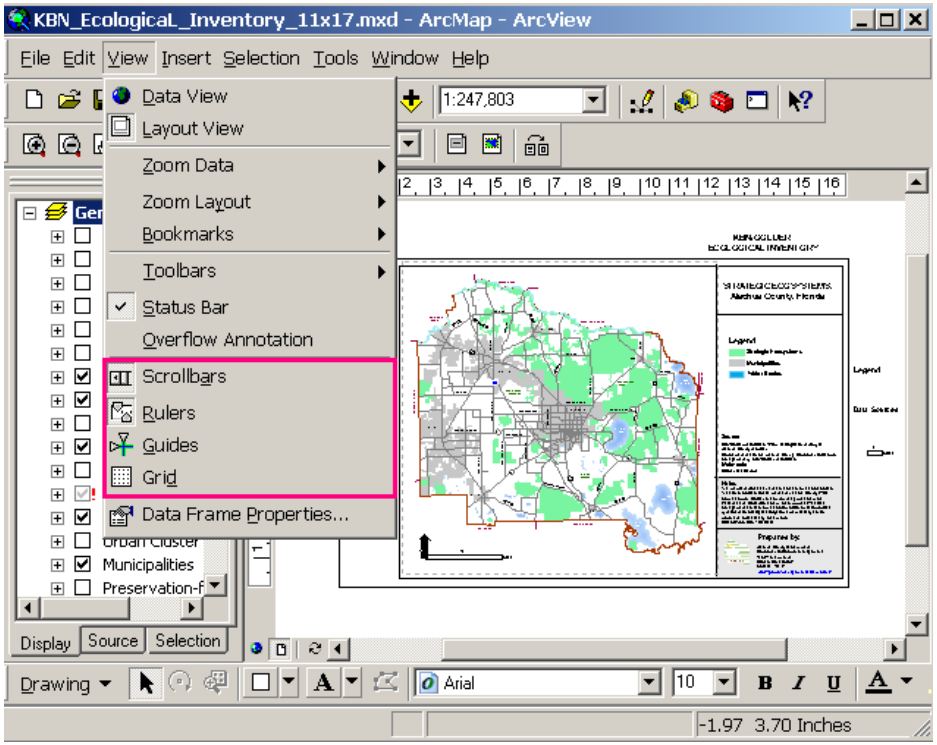
Graticule: *Lat/Long, feet, meters, etc.*



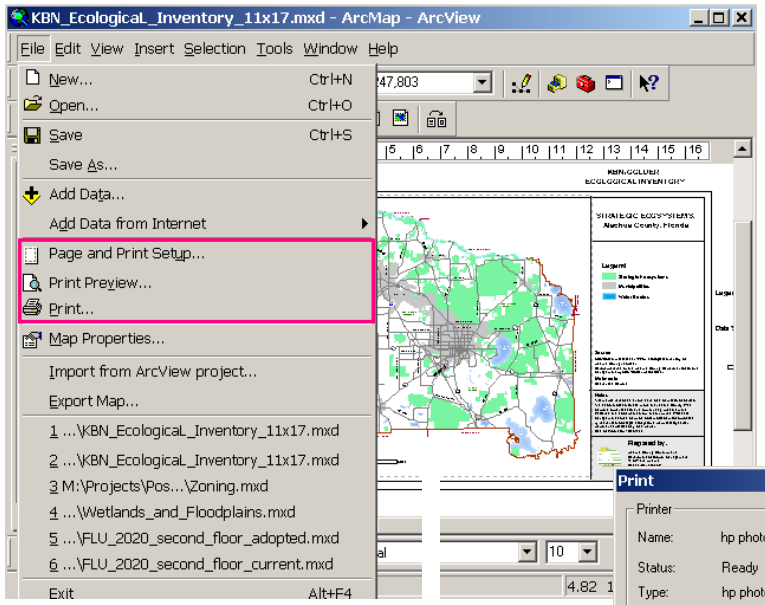
GRID: *ABC/123, etc.*

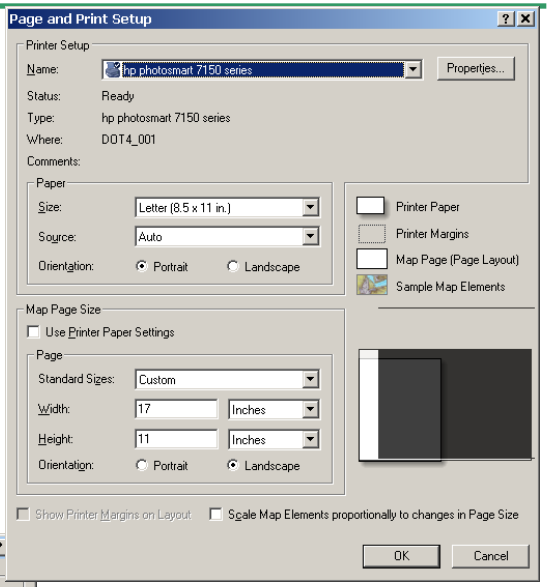
Rulers and Grids

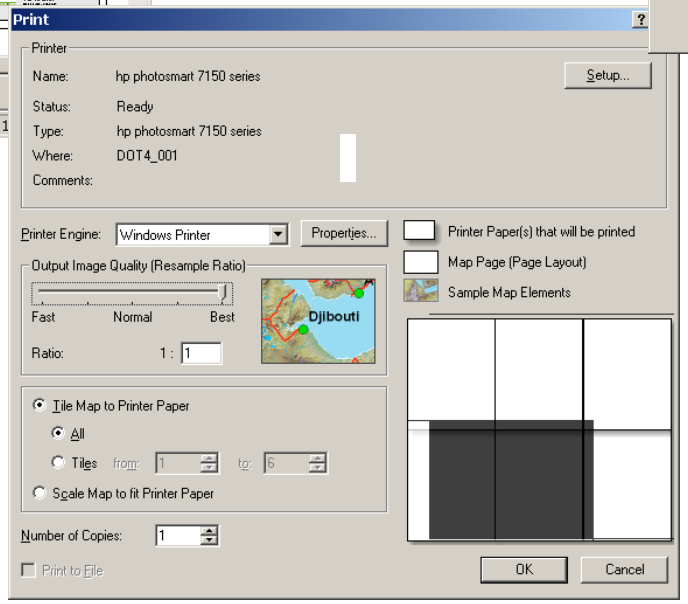
- Balance size of map elements
- Align properly map elements
- Position map elements at specific points
- Set snapping tolerance and snap for precision and efficiency



Printing maps







Page Setup

Print