

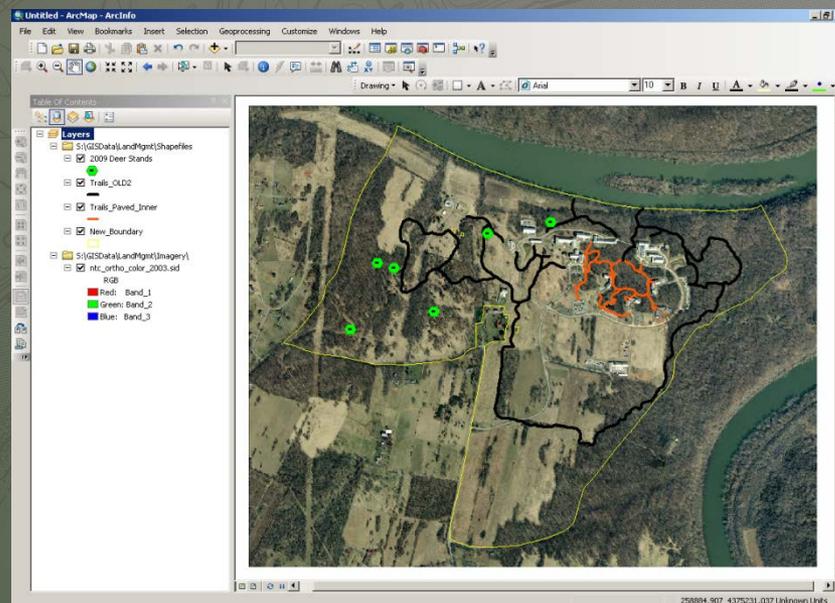
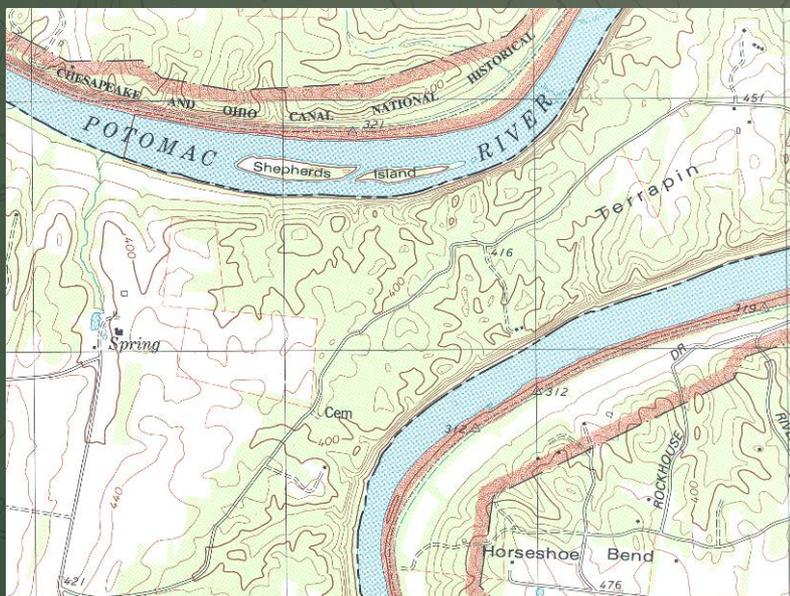


What is a Geographic Information System?

Power point developed by Mark Richardson (Rev March 2015)



Wikipedia: geographic information system (GIS) is a computer system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.





A GIS can be VERY challenging

So have patience... We're here to help!!!

Please ask lots of questions!



There are two general categories of spatial data which can be manipulated and or displayed in a computer based GIS...

Vector Data & Raster Data



Vector Data vs Raster Data

Points

Lines

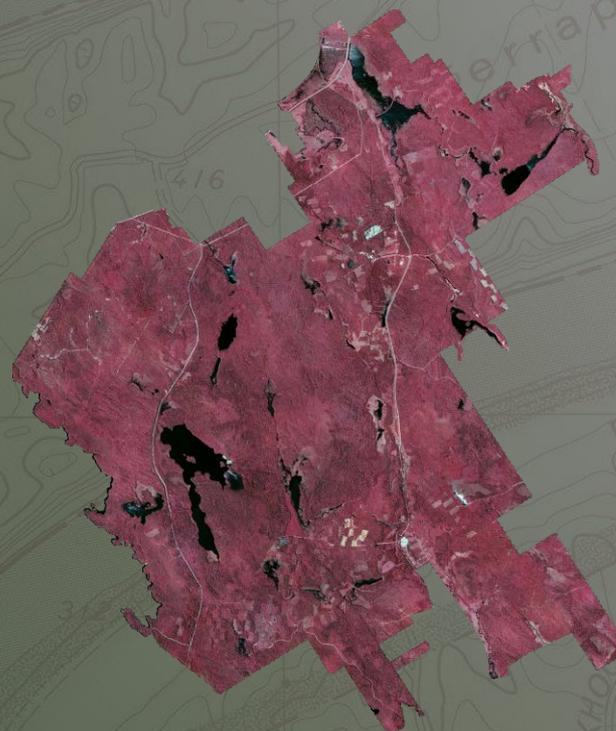
Polygons



Cells

or

Pixels



Moosehorn National Wildlife Refuge



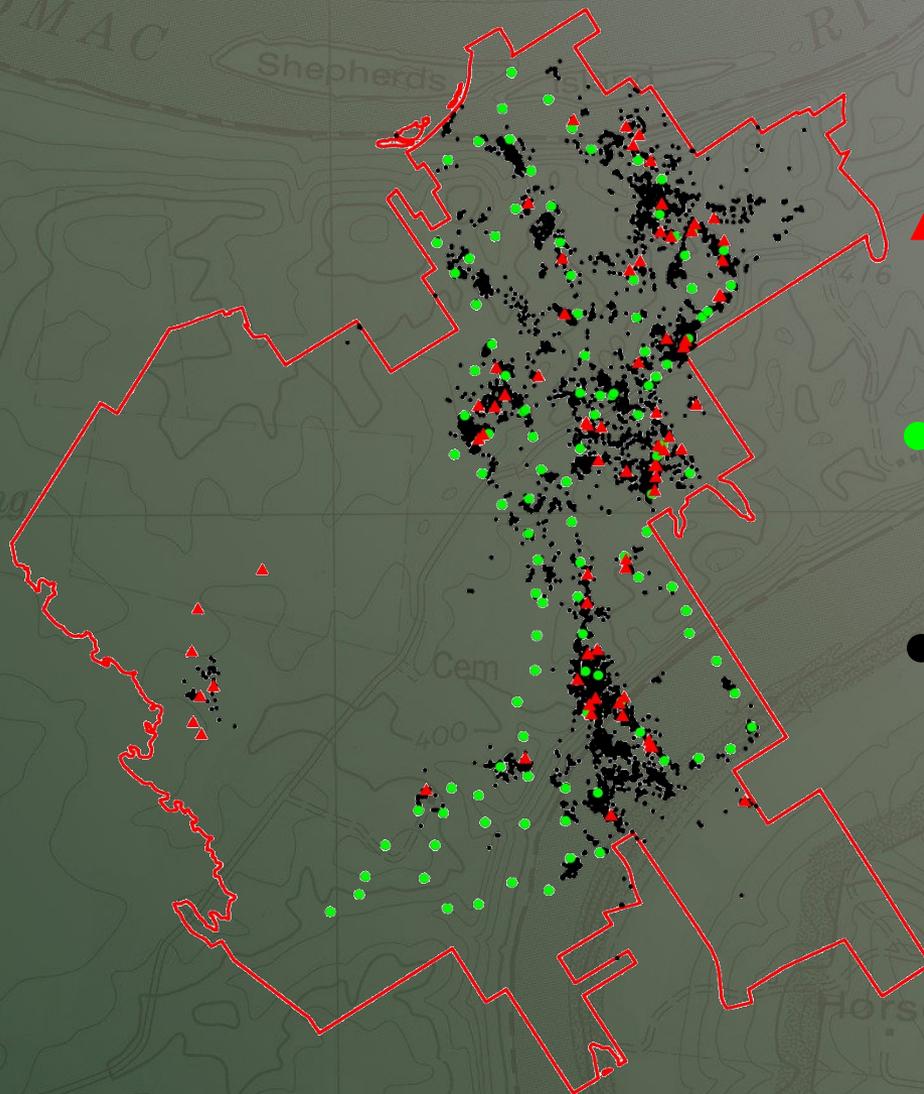
Vector Data - Points

Examples

▲ Woodcock Nests

● Survey Site Locations

● Singing Male Woodcock





Vector Data - Lines

Examples

Roads

Trails

Streams





Vector Data - Polygons



Examples

Soils

Land Cover

Management Units



Land Cover - South Florida

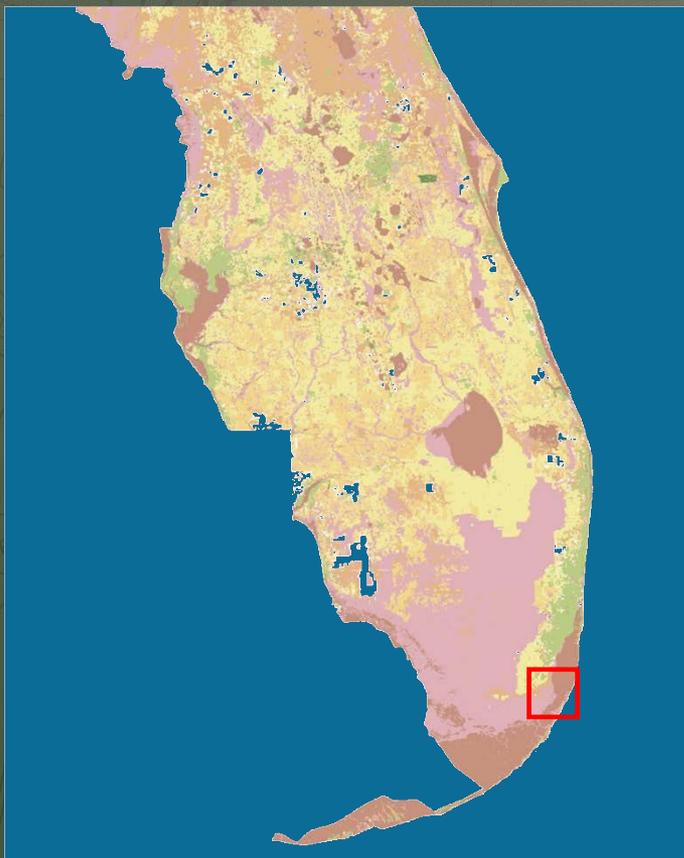


Image from www.fgdl.org

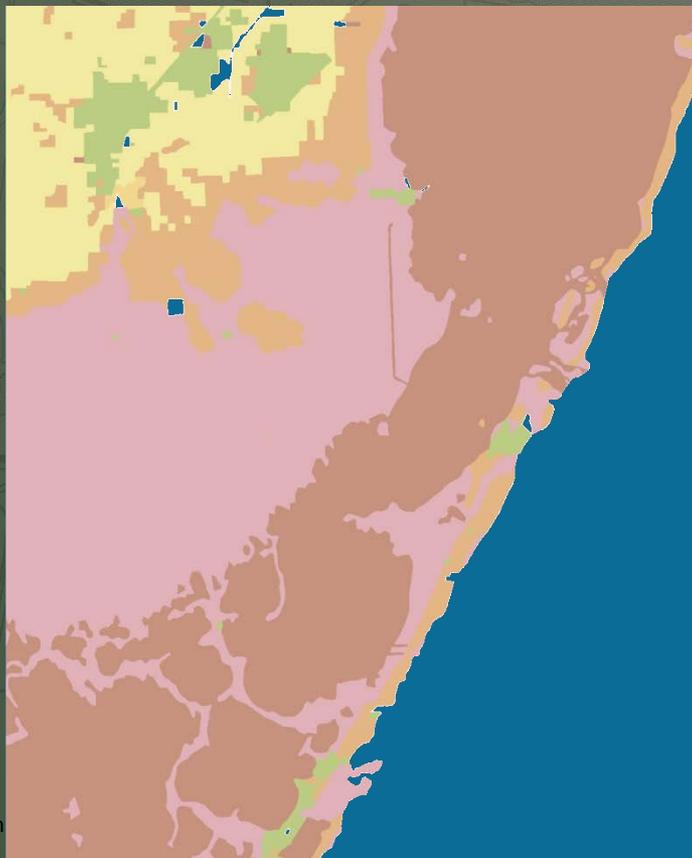
Vector



Raster



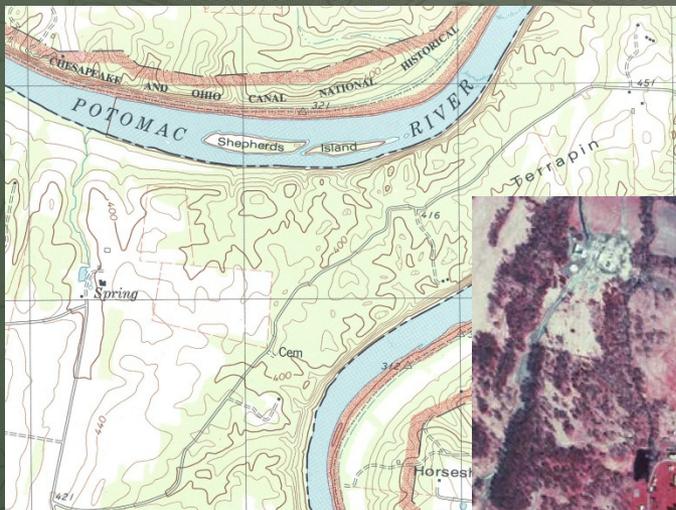
Land Cover - South Florida



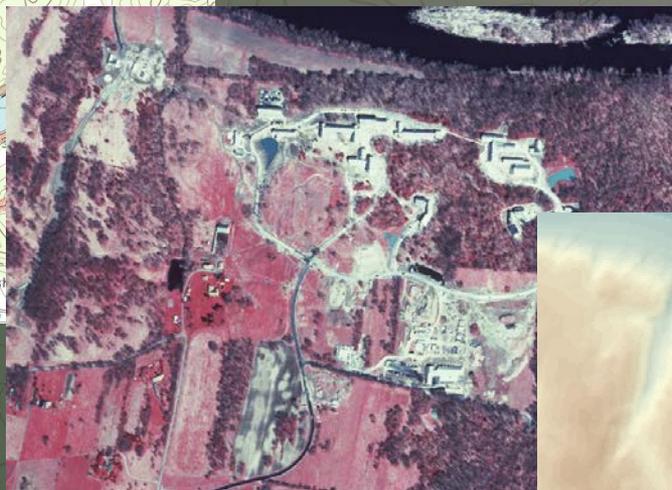
Zoomed-In



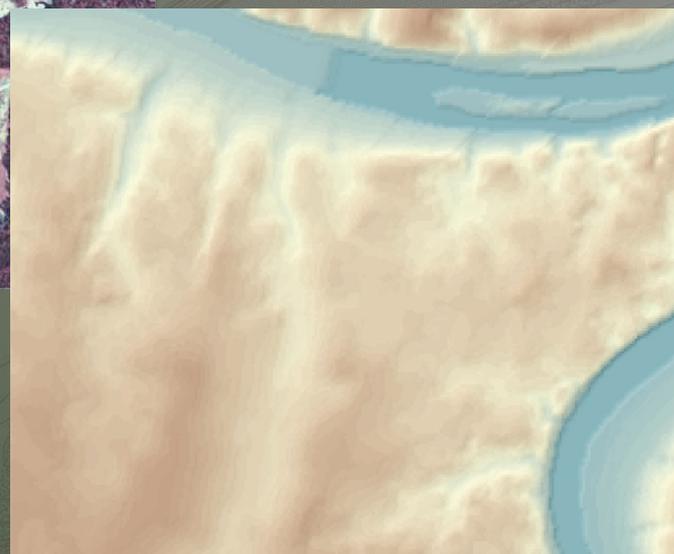
Other Raster Data – NCTC Examples



DRG



DOQQ



DEM



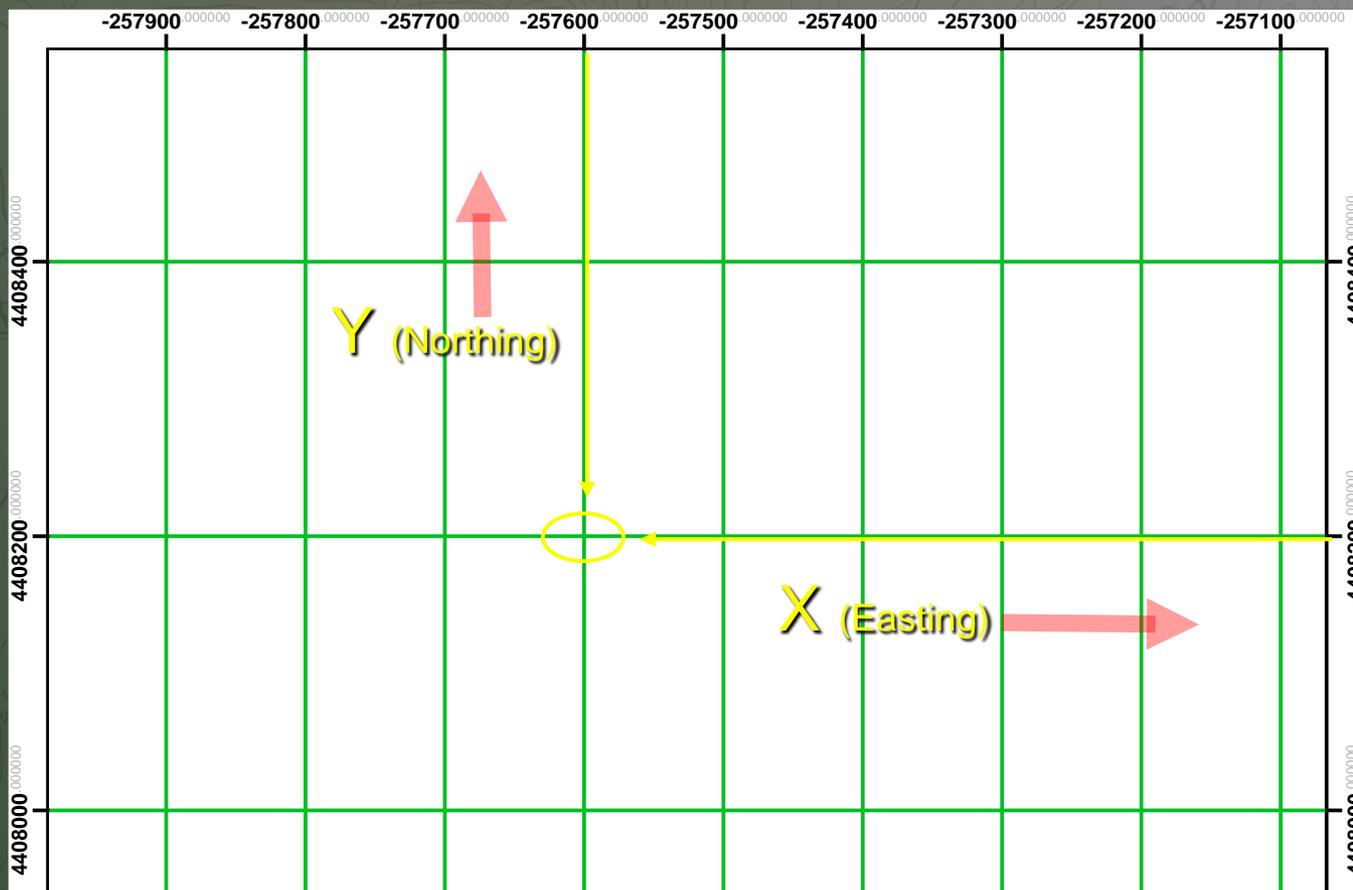
To use spatial data in a GIS you need to know:

- Where each feature is located (Coordinates)
- What each feature represents (Attributes)
- Relationships among features (Topology)



Coordinates

- The x, y (and z) values that define a position in a spatial reference.





Attributes

- Non-spatial information linked to a unique spatial feature
- Stored in a relational database
- Used to query, label and identify



FID	Shape *	AREA	PERIMETER	UIIT	COVTYPE	SPECIES	ACRES	HECTARES
117	Polygon	93182.34375	1964.421726	BARING	FOREST	RED SPRUCE	23.026	9.318
118	Polygon	4115.828125	531.002135	BARING	WETLAND	WV	1.017	0.412
119	Polygon	5476.34375	411.82207	BARING	FOREST	ASPEN	1.353	0.548



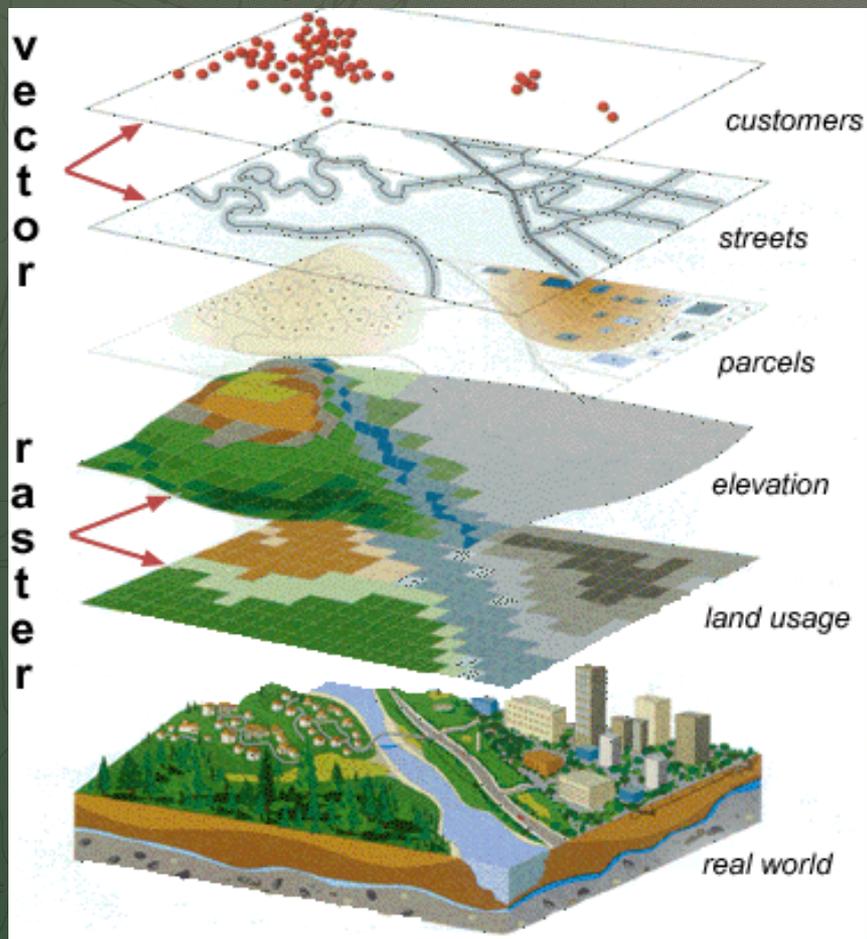
Topology

- Data management and integrity
- Points, lines and polygons share the same geometry





A GIS Consists of Data Layers

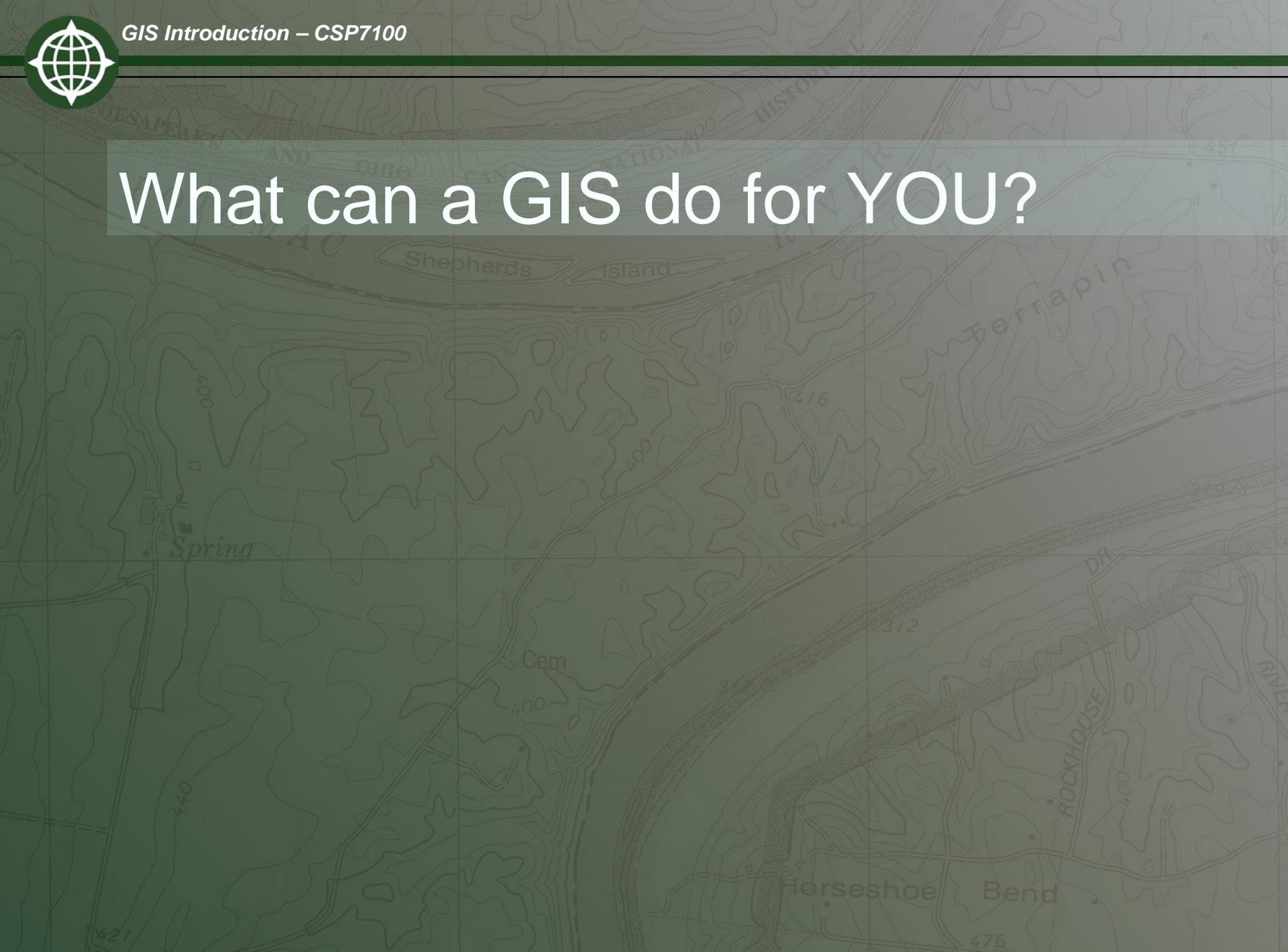


Spatial Data and its attributes must be arranged in a logical order to create a GIS

This arrangement is a series of layers, which share a common theme.



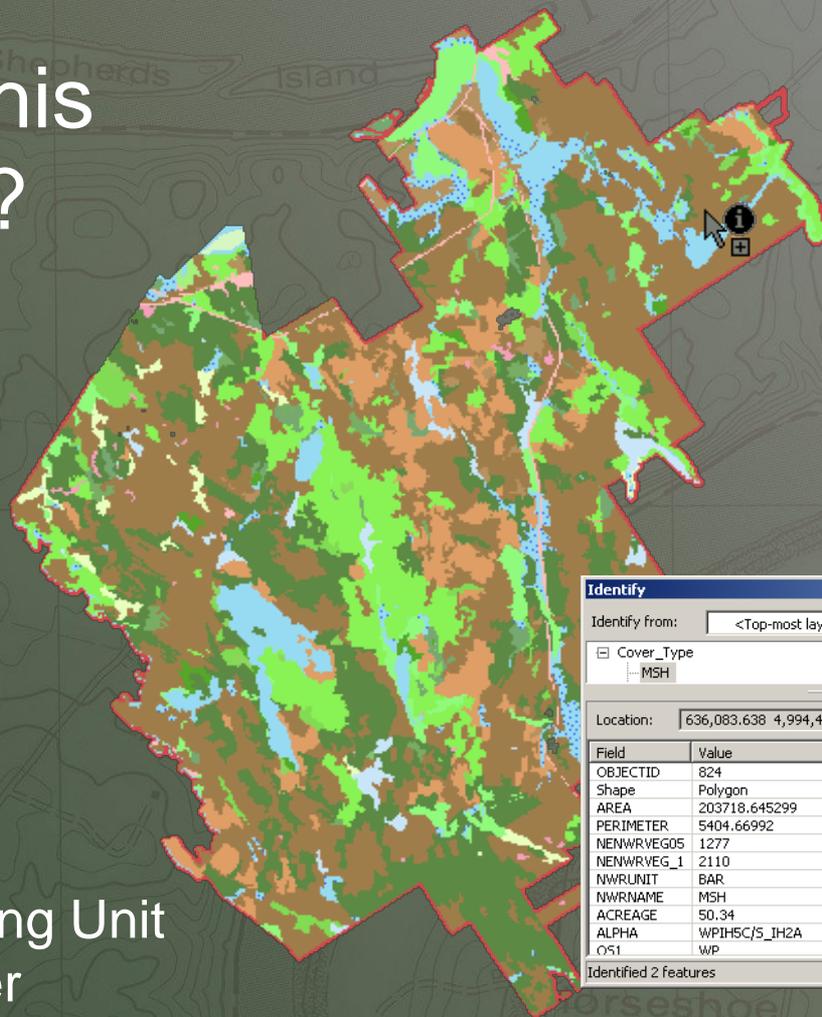
What can a GIS do for YOU?





Typical questions include:

What is at this location...?



Identify

Identify from: <Top-most layer>

Cover_Type
MSH

Location: 636,083.638 4,994,438.333 Meters

Field	Value
OBJECTID	824
Shape	Polygon
AREA	203718.645299
PERIMETER	5404.66992
NENWRVEG05	1277
NENWRVEG_1	2110
NWRUNIT	BAR
NWRNAME	MSH
ACREAGE	50.34
ALPHA	WPIH5C/5_IH2A
OS1	WP

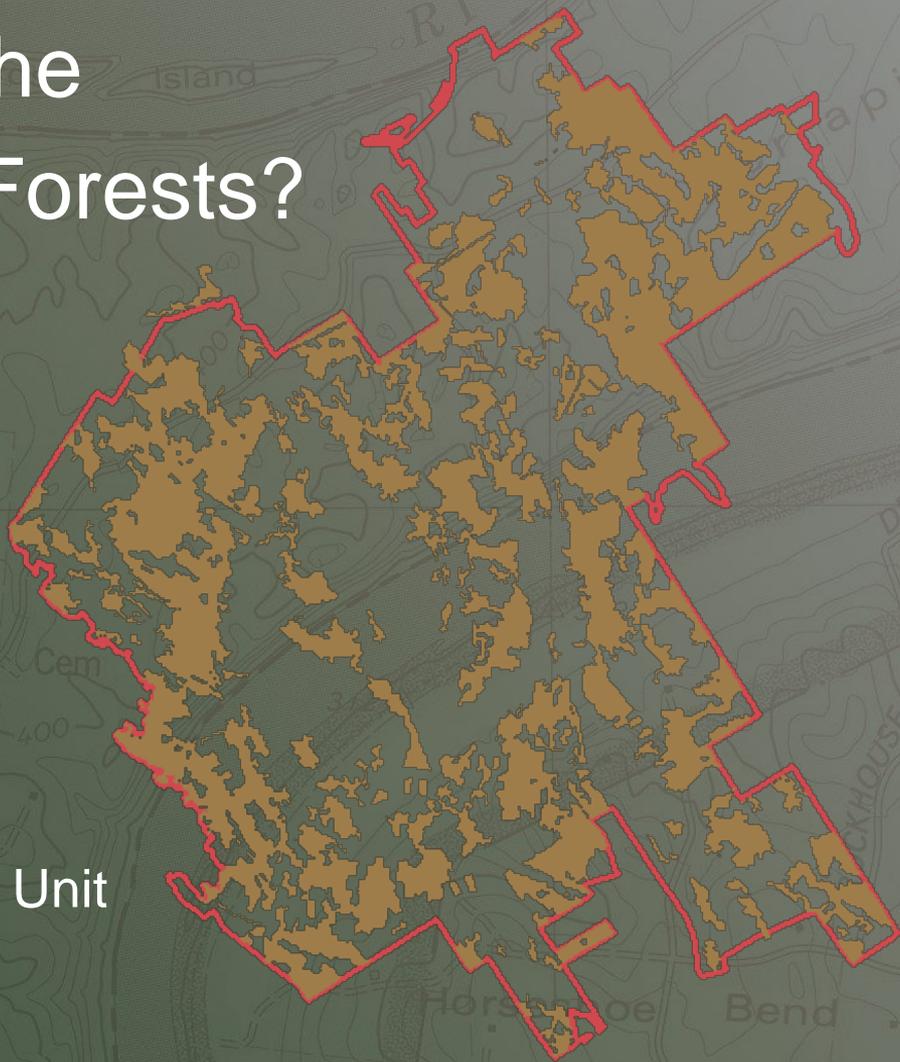
Identified 2 features

Moosehorn NWR - Baring Unit
Cover Type Layer



Typical questions include:

**Where are all the
Aspen – Birch Forests?**

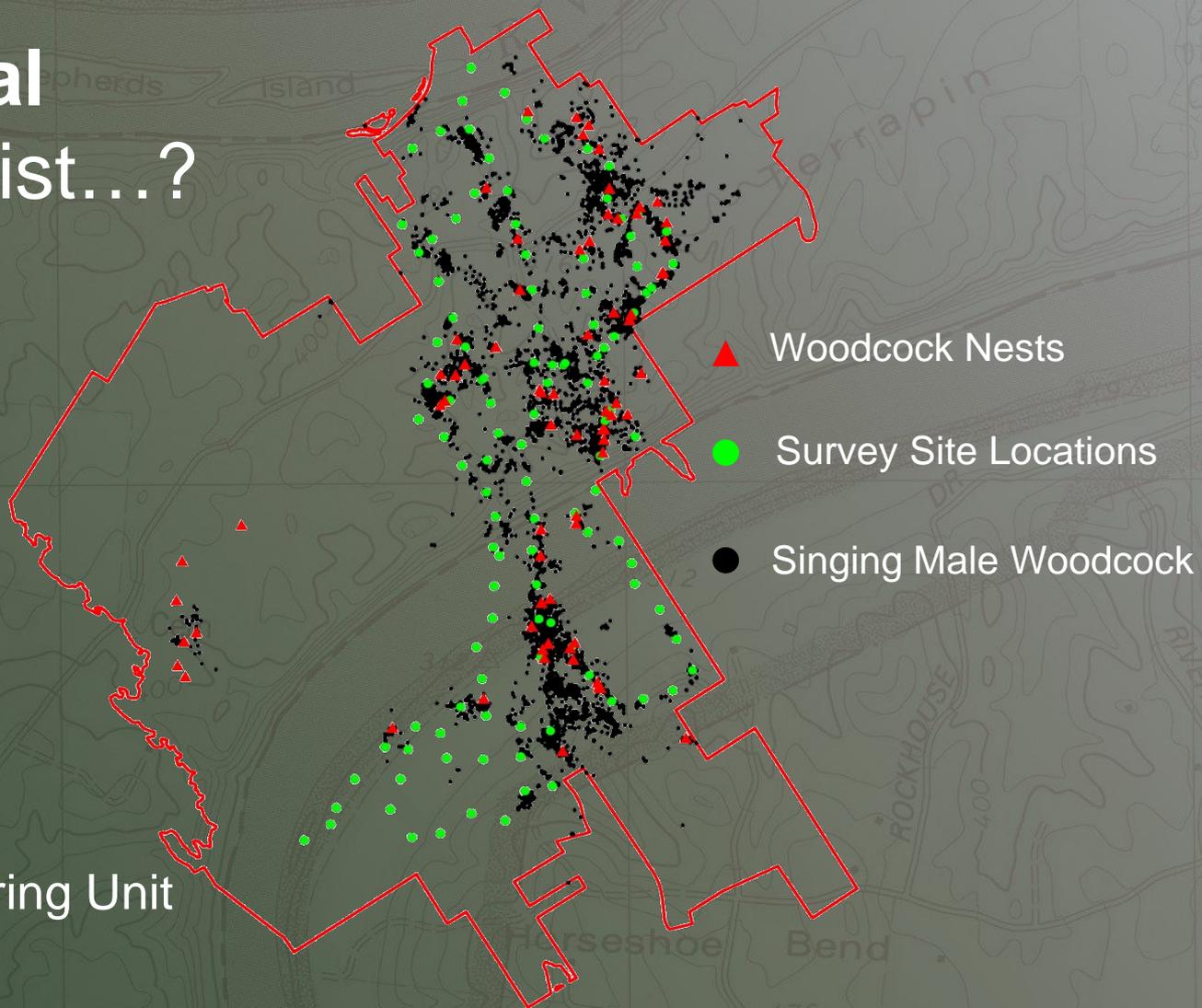


Moosehorn NWR - Baring Unit
Cover Type Layer



Typical questions include:

What spatial patterns exist...?



Moosehorn NWR - Baring Unit



Typical questions include:

What has **changed** at
NCTC since ...?



Image from terraserver_usa.com

1988

Hendrix Farm

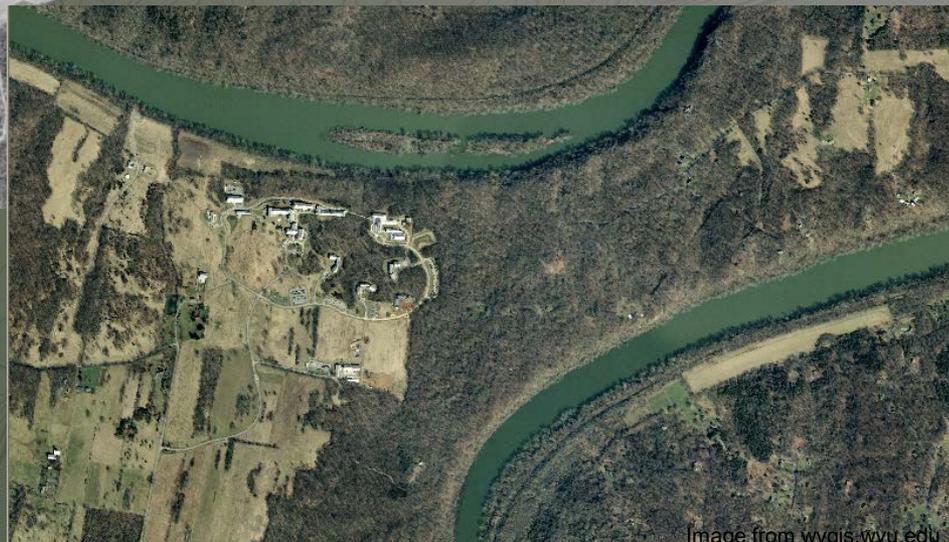


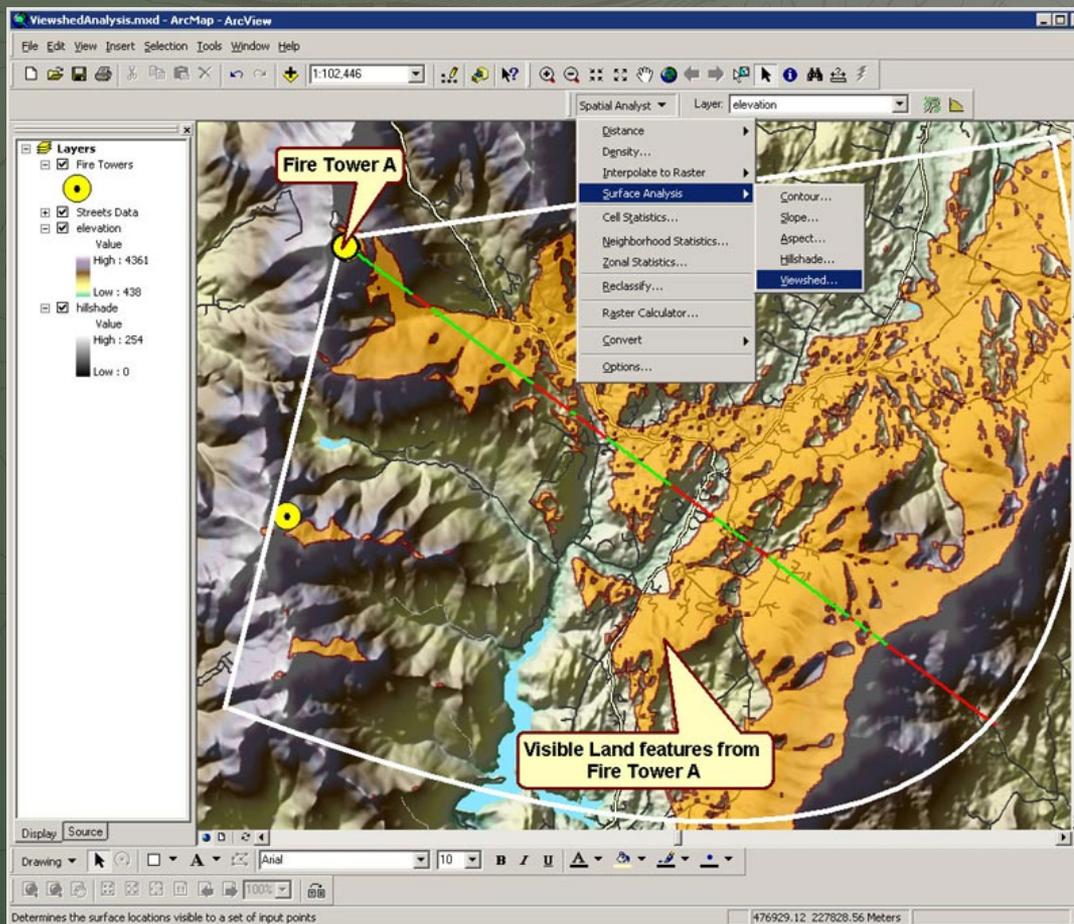
Image from wvgis.wvu.edu

2006

NCTC Campus



Typical questions include: What if...a Fire Tower was built?





The ultimate purpose of a **GIS** is to answer spatial questions...and help achieve land management/conservation goals and objectives

A GIS is another **tool** in your tool bag



What is ArcGIS?

- An integrated collection of GIS software products for building a complete GIS

Desktop, Mobile, Server, On-line, Developer Tools and Viewers

- FWS primarily uses the **Desktop** family



Why ArcGIS?

- The defacto GIS software standard within the FWS

Who else uses ArcGIS?

- Most Federal & State Land Management Agencies
USGS, Forest Service, NPS, BLM, FWS



Who is ESRI ?

- Environmental Systems Research Institute,
Redlands, CA

<http://www.esri.com/index.html>



Are there other GIS software packages?



<http://www.intergraph.com/>



<http://www.pbinsight.com/welcome/mapinfo/>



<http://grass.osgeo.org/>



<http://www.qgis.org/en/site/>



ArcGIS Desktop, Versions 10.1 - 10.2.2

Basic - \$



Standard - \$\$



Advanced - \$\$\$





ArcGIS Desktop, Versions 8.3 - 10.0

ArcView - \$



ArcEditor - \$\$

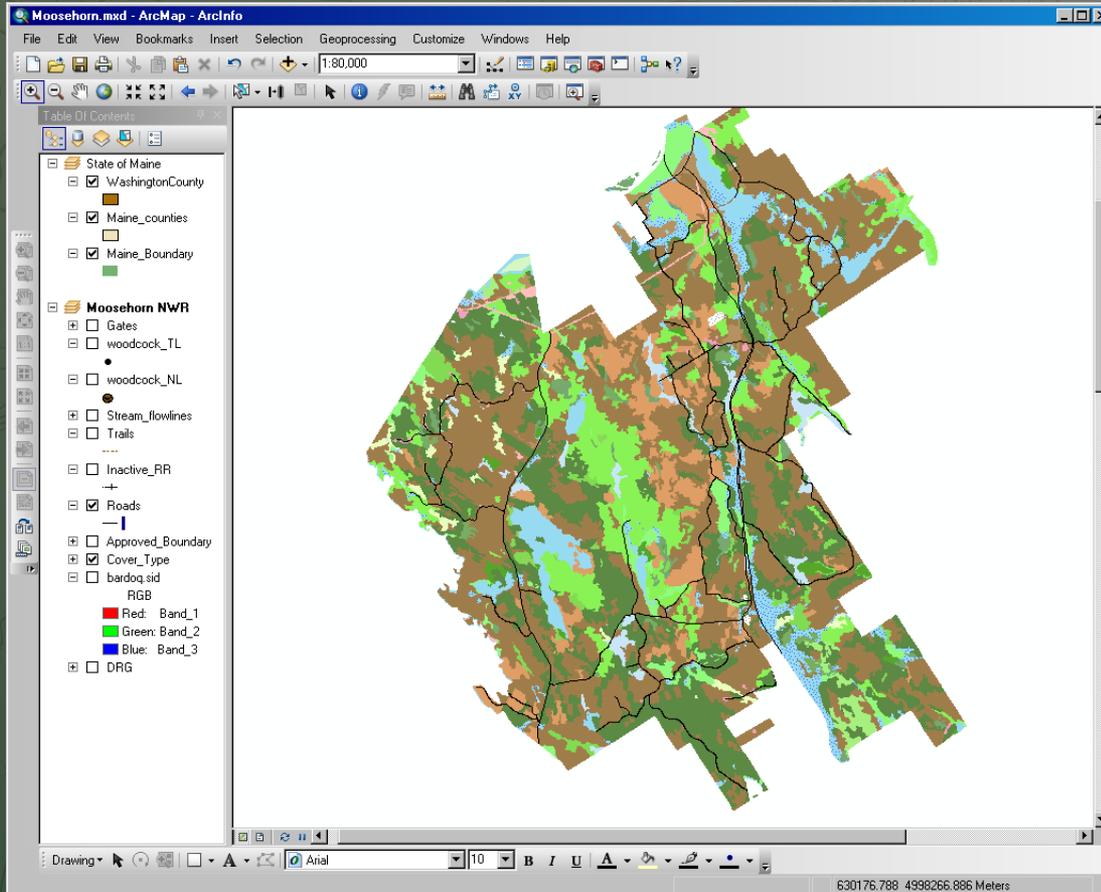


ArcInfo - \$\$\$





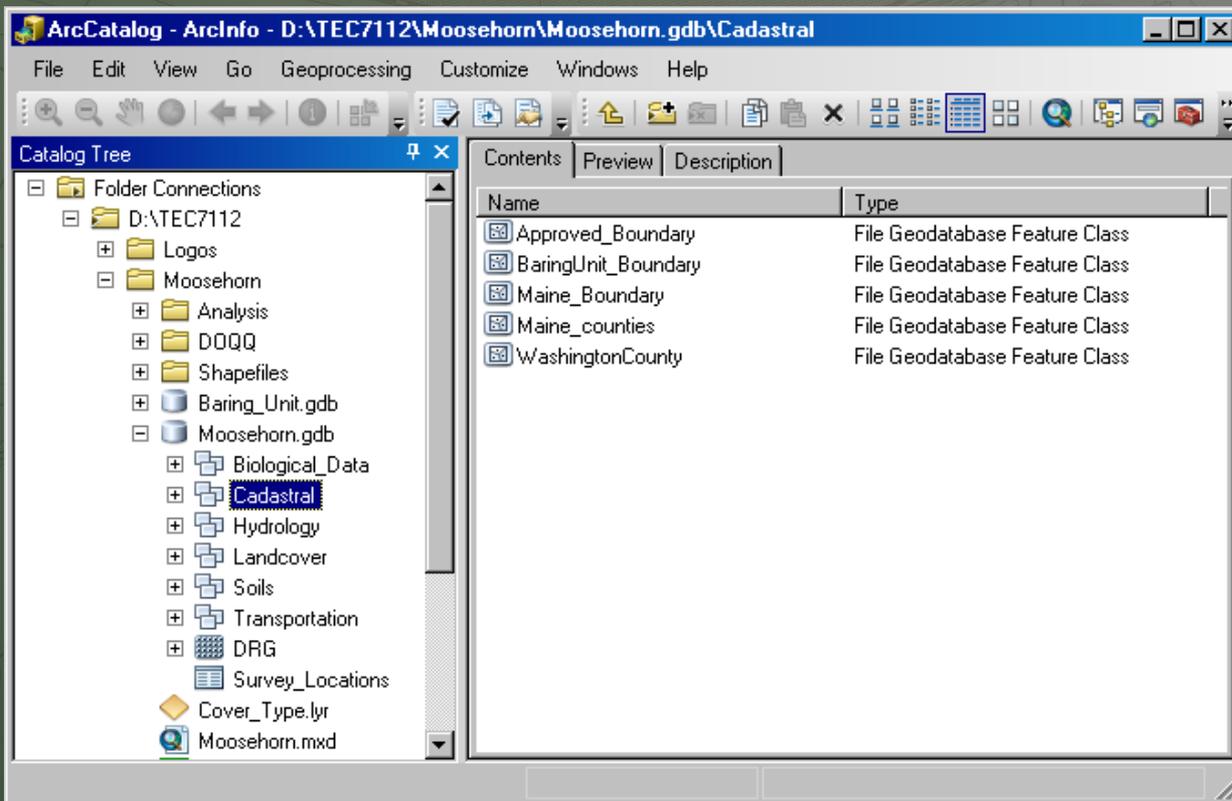
ArcMap



View GIS data
(graphically or in tables)
& create maps



ArcCatalog



Manage & organize
GIS files



ArcToolbox



Manipulate GIS data
(reproject & transform)

Moosehorn.mxd - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:66,532

ArcToolbox

- 3D Analyst Tools
- Analysis Tools
 - Extract
 - Overlay
 - Proximity
 - Buffer**
 - Create Thiessen Po
 - Generate Near Tab
 - Multiple Ring Buffer
 - Near
 - Point Distance
- Statistics
- Cartography Tools
- Conversion Tools
- Data Interoperability Tools
- Data Management Tools
- Geocoding Tools
- Geostatistical Analyst Tools
- Linear Referencing Tools
- Network Analyst Tools
- Spatial Analyst Tools
- Spatial Statistics Tools

Buffer

- Input Features
- Output Feature Class
- Distance [value or field]
 - Linear unit
 - Field
- Side Type (optional)
- End Type (optional)
- Dissolve Type (optional)
- Dissolve Field(s) (optional)

OK Cancel Environments... Show Help >>

Drawing Arial 10 B I U A

642626.893 4992979.656 Meters



ArcInfo Workstation (1981-1999) Versions 1.0 - 8.0

- High end developers tool – High geek factor
- Hosted on a Unix, IBM mainframe or Prime Mini computer
- Command line - **Arc:**
- Proprietary Programming Language - AML
- Not user-friendly or for the casual user!



The old ArcView (1991-Present) Versions 1.0 – 3.3

- Originally developed for non-GIS specialists - Biologist, Managers, Recreation Planners
- GUI Graphical User Interface
- User-friendly, sort of
- Proprietary Programming Language - Avenue
- Reads Shape files and Coverages



DOI ESRI Enterprise License Agreement (ELA):

- The ELA is a set yearly cost for software, extensions, virtual campus, ESRI International User Conference passes, ArcGIS online credits and more...
- The cost is paid nationally through IT Shared Costs that are incurred by Regions/Programs - individual field offices/programs are not billed
- How to obtain a desktop license, installation guides/scripts are found on the Geospatial Services SharePoint site



The ELA also includes :

- Category A Software (other software can be purchased through ESRI with GSA prices)
- ArcPad
- Unlimited ESRI Virtual Campus Seats for standard & premium classes
- Limited complementary ESRI Annual User Conference Passes
- Authorized tech support callers (25). Please contact your Regional Representative to have ESRI tech support call you back



FWS GeoSpatial Services SharePoint

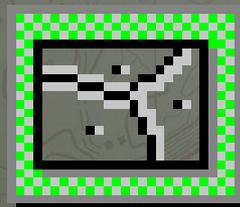
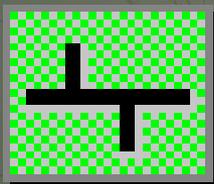
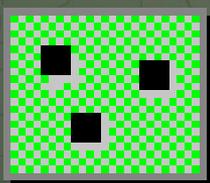
<https://fishnet.fws.doi.net/projects/GIS>

- Regional Points of Contact
- FWS GIS Listserve
- ESRI Authorized Callers
- ESRI On-line Training
- NCTC Training/Courses/Workshop

Must be on the **FWS Active Directory** to gain access



Vector File Format Overview





ESRI Vector File Formats

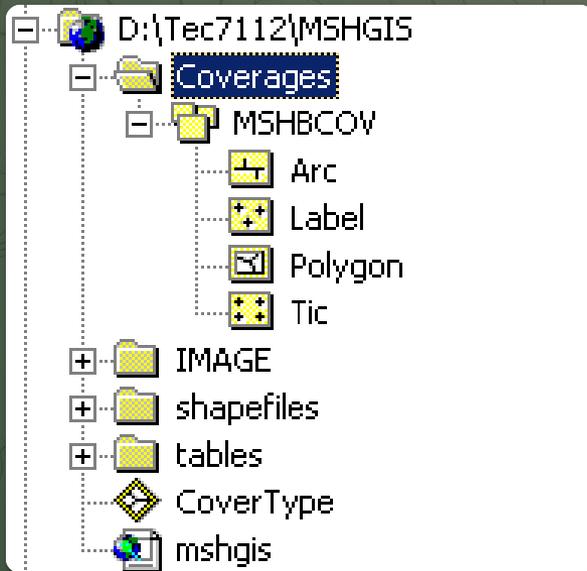
- Coverage
 - old file format
 - .e00
- Shapefiles (.shp)
 - most common and widely available format
 - 3-7 supporting files
 - static
- Geodatabase (.mdb or .gdb)
 - 3 types
 - dynamic

Category	Layer Name	Checked	Symbology
State of Maine	WashingtonCounty	<input checked="" type="checkbox"/>	Orange square
	Maine_counties	<input checked="" type="checkbox"/>	Green square
	Maine_Boundary	<input checked="" type="checkbox"/>	Orange square
Moosehorn NWR	Gates	<input checked="" type="checkbox"/>	Red square
	woodcock_TL	<input type="checkbox"/>	Black circle
	woodcock_NL	<input checked="" type="checkbox"/>	Black circle
	streams_flowlines	<input type="checkbox"/>	Yellow circle with black border
	Trails	<input checked="" type="checkbox"/>	Black line
	Inactive_RR	<input checked="" type="checkbox"/>	Black line
	Roads	<input checked="" type="checkbox"/>	Black line
	Cover_Type	<input checked="" type="checkbox"/>	Black line
	Approved_Boundary	<input checked="" type="checkbox"/>	Red square



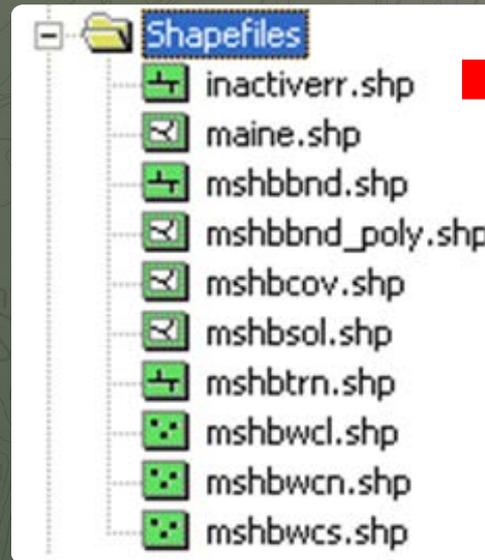
Vector File Formats

Coverage

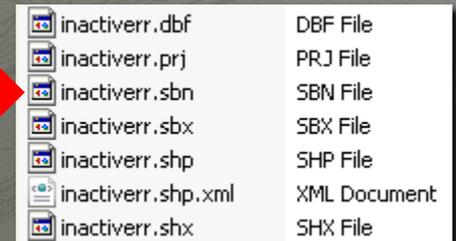


ArcCatalog

Shapefile (.shp)



ArcCatalog

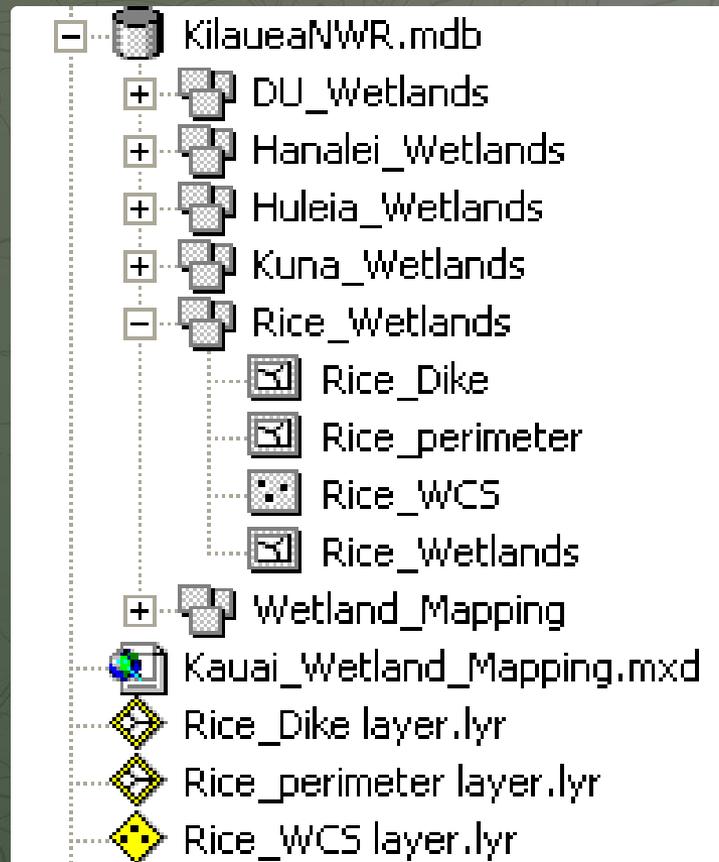


Windows Explorer



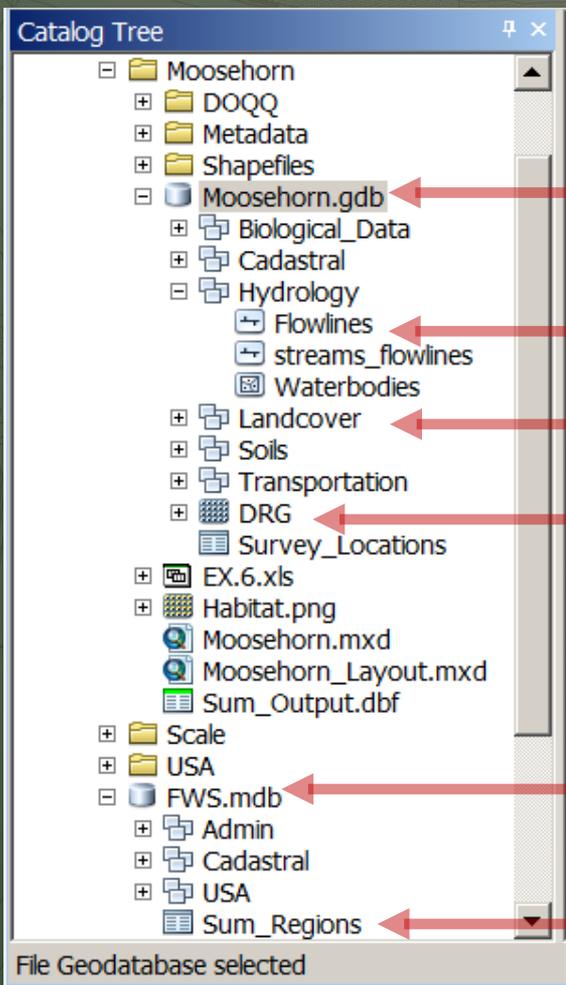
Vector File Formats

Geodatabase (.mdb or .gdb)





Components of the Geodatabase



File Geodatabase (.gdb)

Feature Classes

Feature Datasets

Raster Catalog

Personal Geodatabase (.mdb)

Objects Class (tables)



Geodatabase Types

- Personal (.mdb)
 - 2 GB size limit
- File (.gdb)
 - 1 Terabyte (1024 GB) limit per table
 - “FWS Standard”
- Enterprise - ArcSDE
 - Multi-edit and multi-read
 - No size limit
 - National or Regional Office Level



Geodatabase Benefits

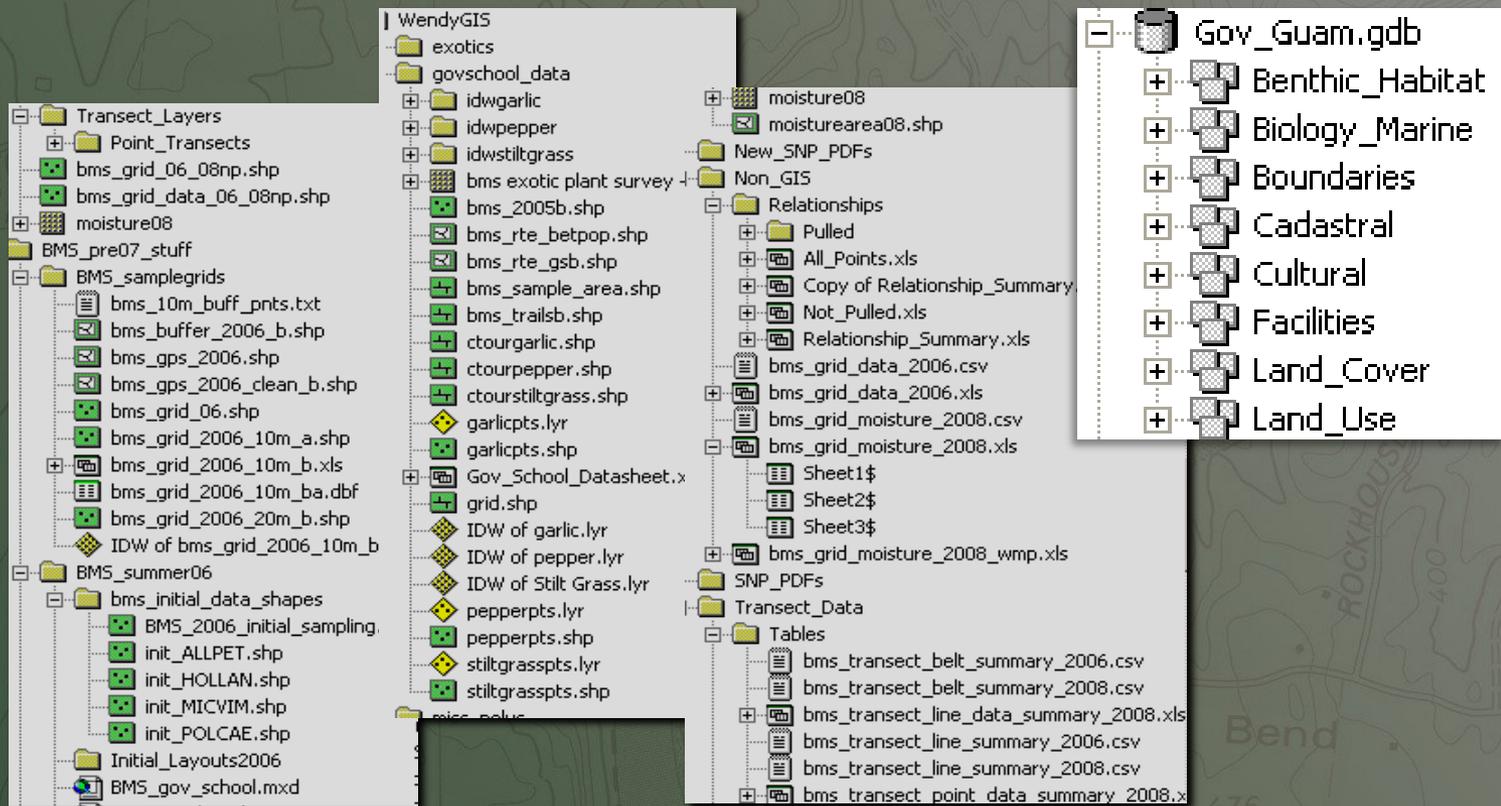
- All geographic data can be stored and managed in one location
 - Portability
 - Organization
- Maintains database integrity
 - Required spatial reference
 - Topology and relationships
 - Attribute domains and sub-types





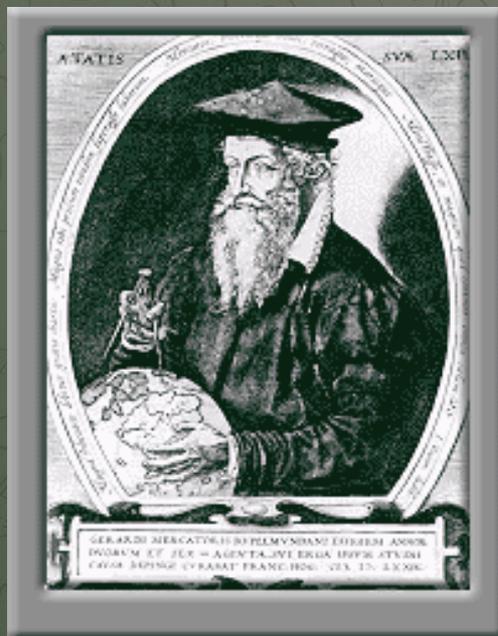
Geodatabase Benefits

- Requires you to be organized and logically think about your data structure before you collect and assemble data





Datums, Map Projections & Coordinates





Why is this important?

- Creating spatial data
- Overlay themes for analysis (registration)
- Acquiring spatial data
- Display your map products/presentations



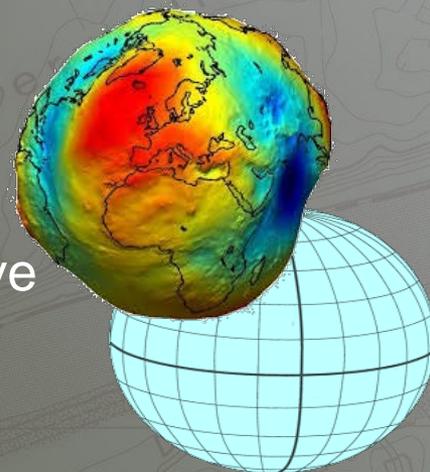
Datum:

1. A model of the earth used for Geodetic calculations.
2. Any point, line, or surface used as a reference for a measurement of another quantity.

Geodetic Datums are established through the relative positioning of the Ellipsoid to the Geoid

Common Horizontal Datums:

- NAD27 (North American Datum 1927)
- NAD83 (North American Datum 1983)
- WGS84 (World Geodetic System 1984)

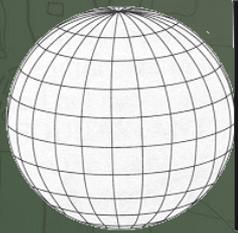




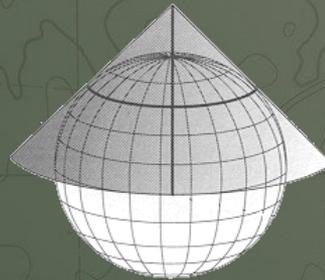
Map Projection:

A method of representing the earth's curved three-dimensional surface as a flat two-dimensional surface.

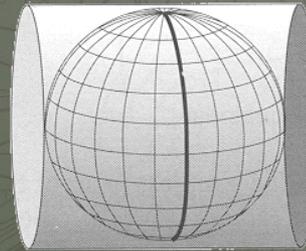
Planar



Conic



Cylindrical



- Transverse Mercator (UTM)
- Albers Conic Equal-Area
- Lambert



Map Projection:

This process of flattening the earth will cause distortions in one or more of the following spatial properties:

- Shape
 - Conformal map projections preserve shape
- Area
 - Equal area map projections preserve area
- Distance/Scale
 - Equidistant map projections preserve distance
- Direction/Angle
 - Azimuthal map projections preserve true direction

Tip: Use ArcMap **Help** to view the individual map projection characteristics

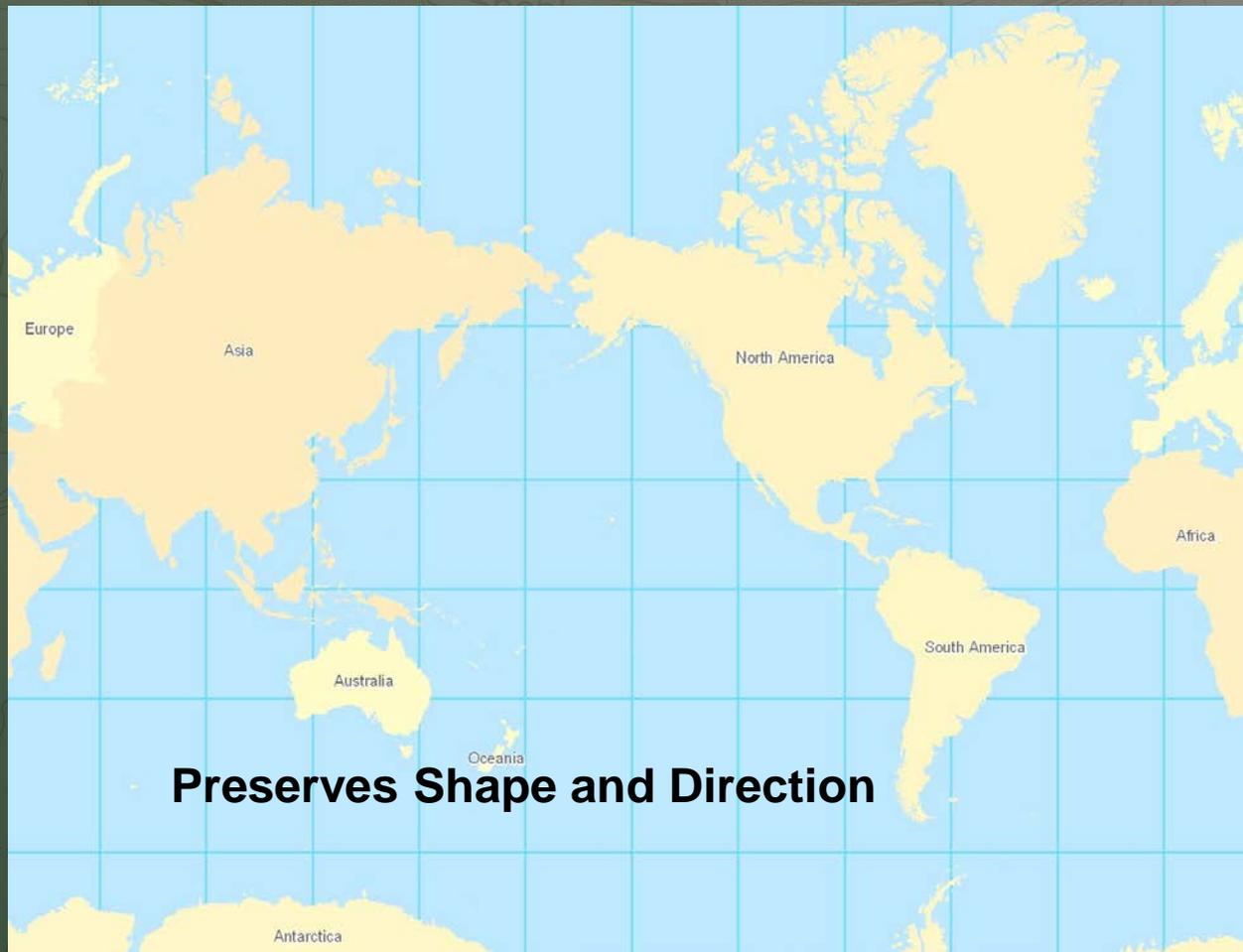


Sinusoidal Projection





Mercator Projection





Coordinate Systems:

- Longitude, Latitude (Degrees, Minutes, Seconds)

$-77^{\circ}45'00''$ Longitude
 $39^{\circ}30'00''$ Latitude

- UTM Grid (Meters)

258,839 m
4,374,446 m

- SPCS (Feet or Meters)

755,460 ft. E
111,029 ft. N; West Virginia, N

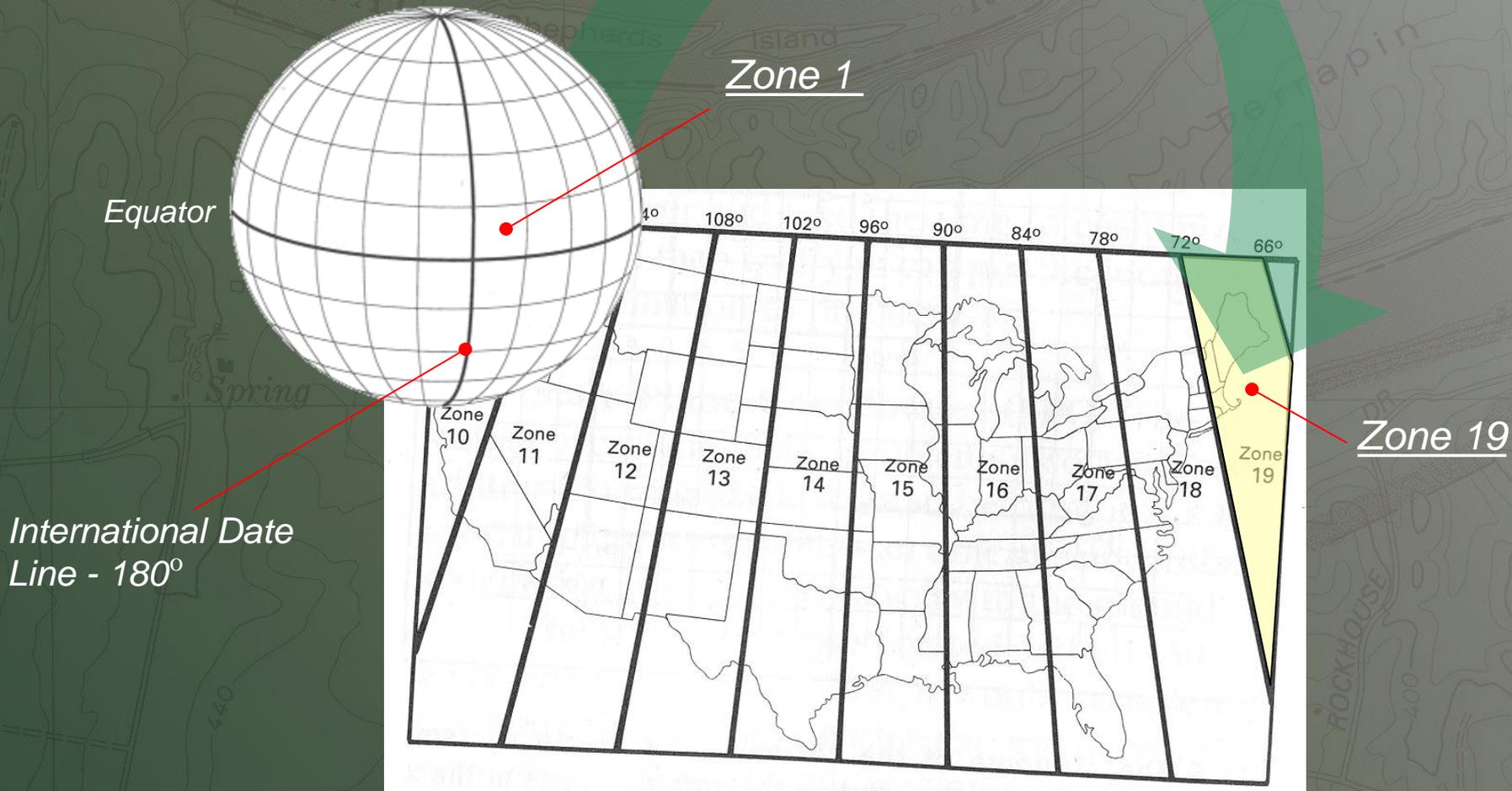


Universal Transverse Mercator (UTM)

- Developed by military
- Grid system (UTM Grid)
- Earth divided into 60 zones
- Great for small areas
 - minimal map distortion
 - distortion greater at edge of zones
- Most common map projection used by NWRs

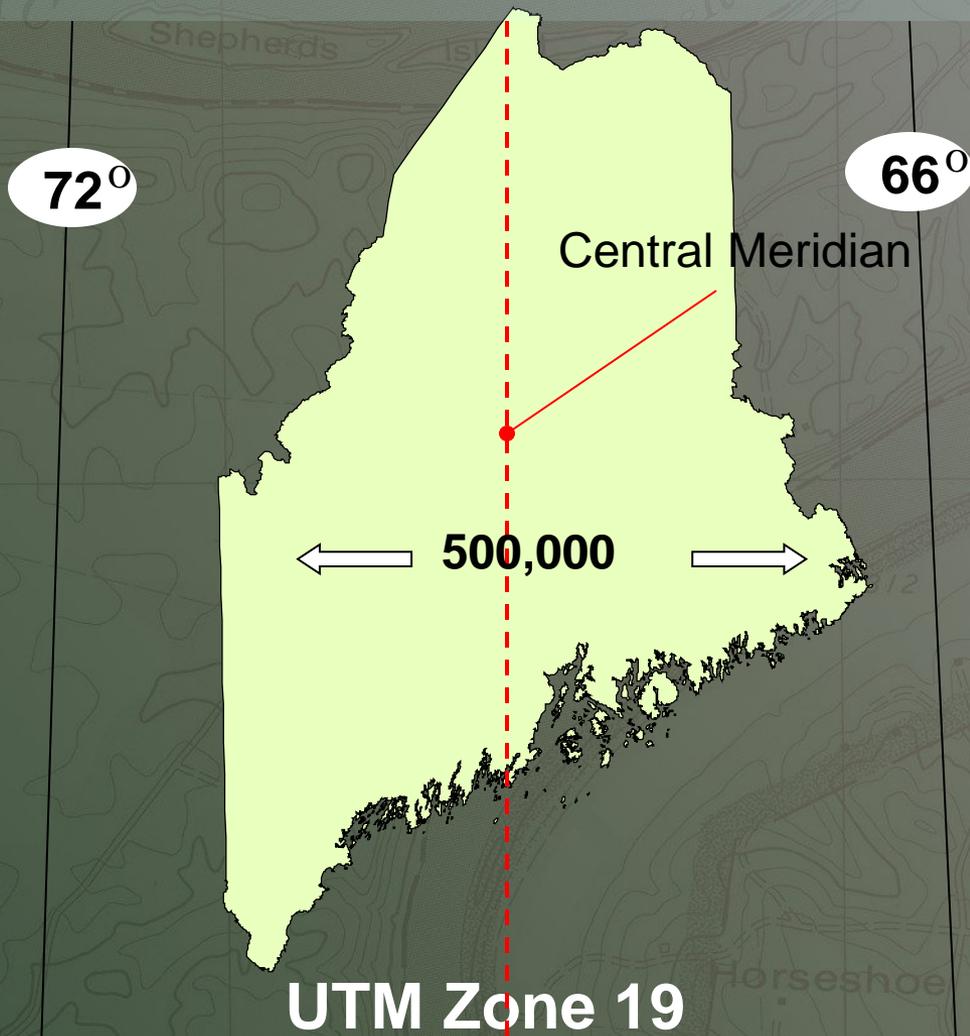


Universal Transverse Mercator- Grid



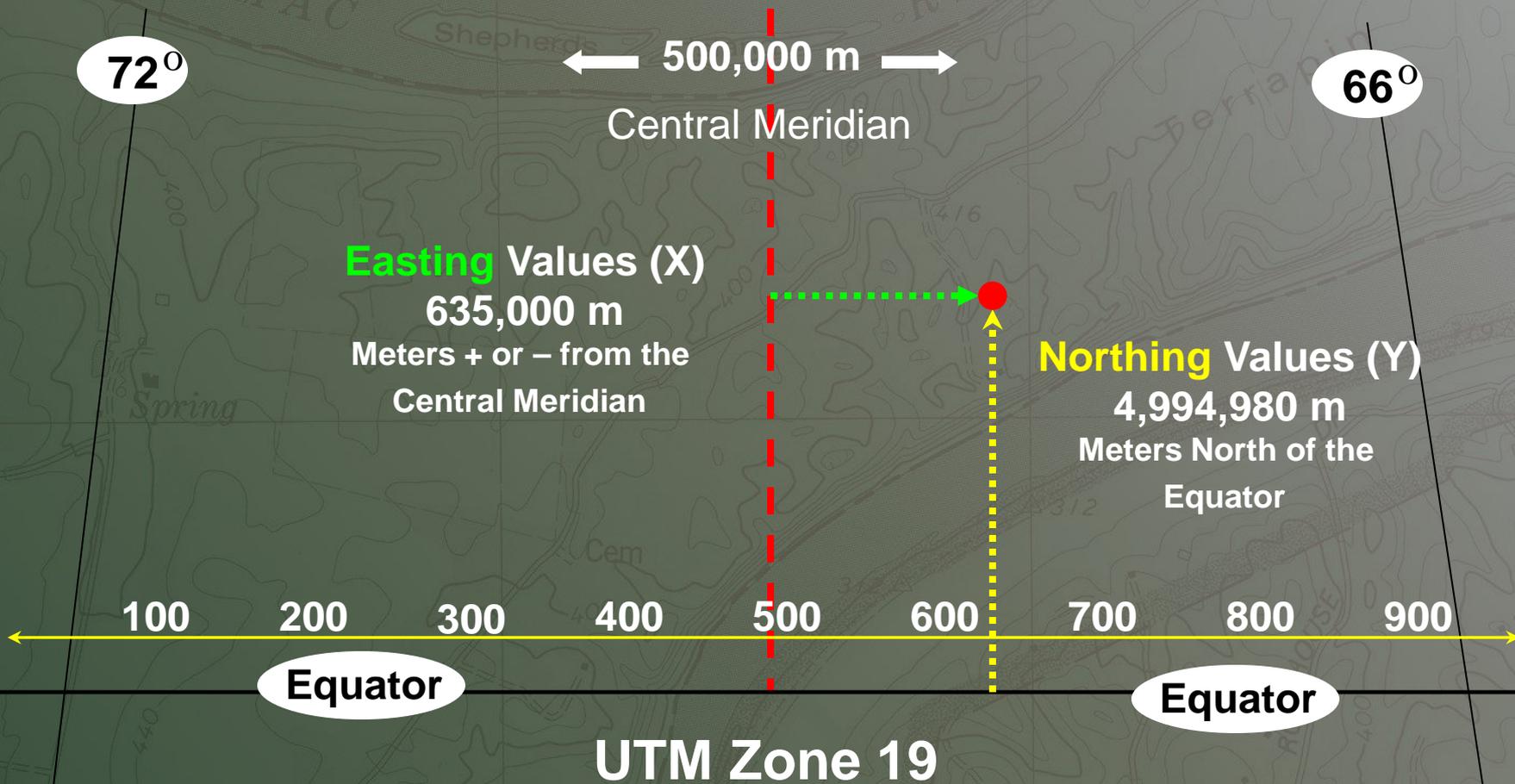


Universal Transverse Mercator- Grid





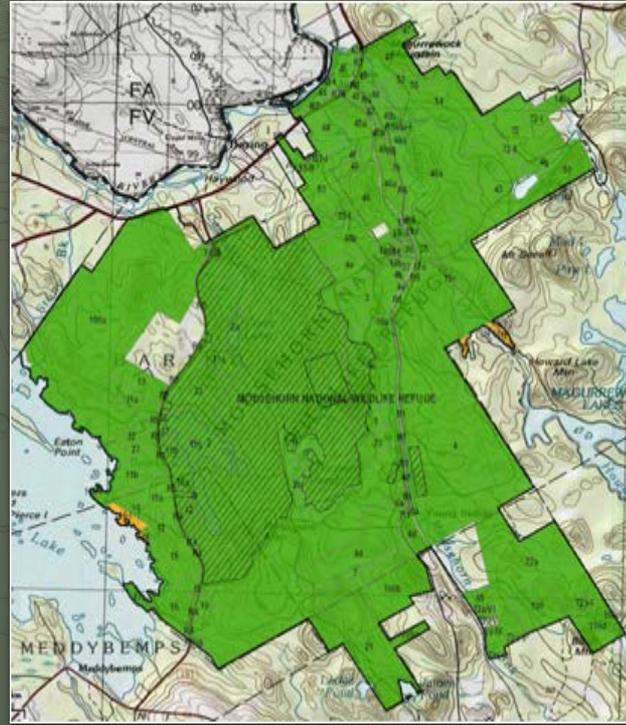
Universal Transverse Mercator



Tip: Use Google Earth to visually see how this coordinate system works



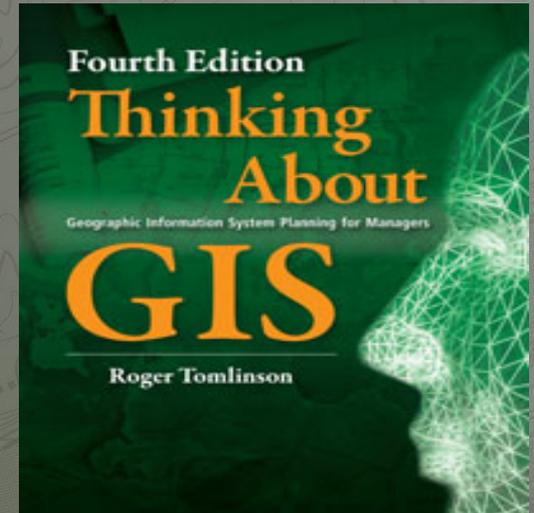
Acquiring Geospatial Data





Where do I start ?

- What is the purpose/goal of the project?
- What data do I need?
- Where can I get the data?
- Will the data meet my needs?
- What do I need to do with the data?





Where can I get data?

- FWS Regional GIS Coordinators/Contacts (See Web site)

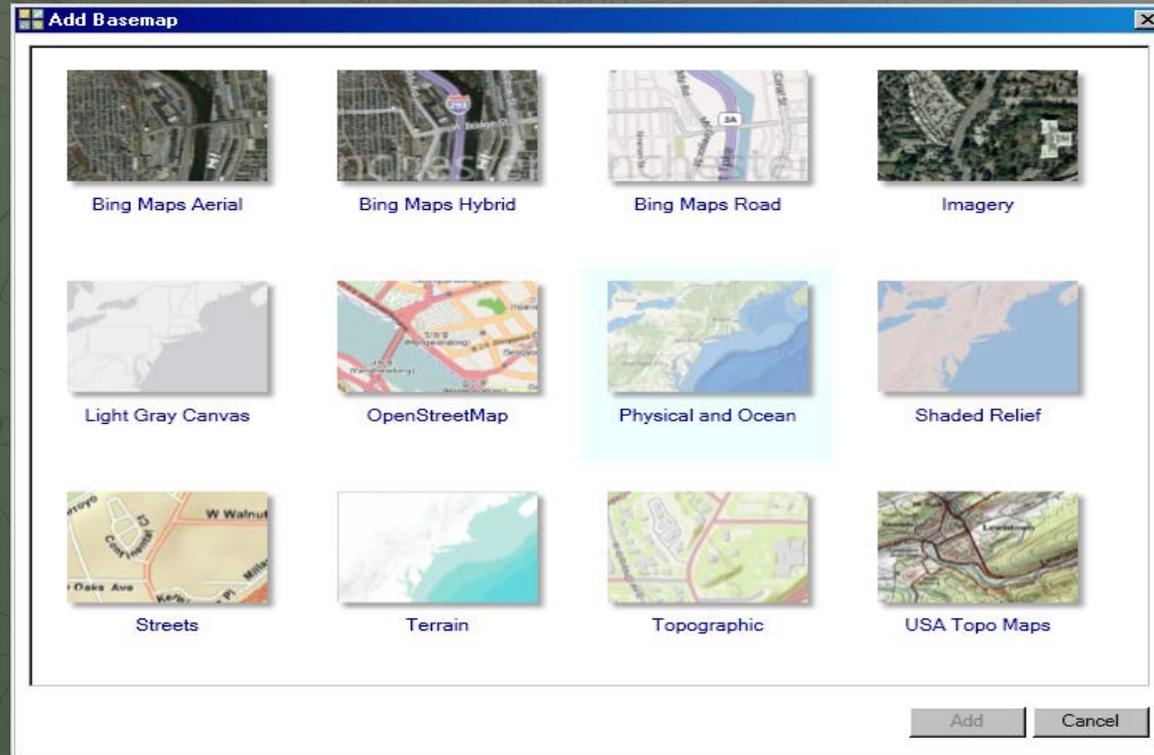


- **Google it!** (See list of recommended Web sites)



Where can I get data?

- ArcGIS/ArcInfo 10.2 - ESRI Online Services



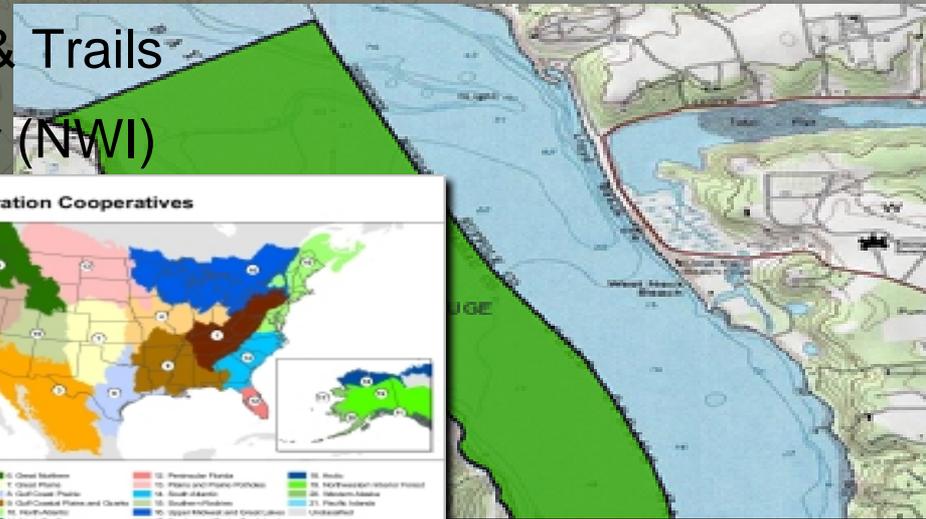


Where can I get data?

- FWS Geospatial Services Web Site - National Data Sets

<http://www.fws.gov/gis/data/national/index.html>

- NWRS Boundaries, Roads & Trails
- National Wetlands Inventory (NWI)
- Office Locations
- Critical Habitat
- LCC's





Who creates GIS data?

- Federal Agencies
 - USGS, NRCS, EPA, Census Bureau, FWS (NWI),
 - Forest Service, BLM, FEMA, NOAA
- State & Local Governments
- Commercial/Private Companies
 - Remote Sensing Firms
 - Third Party Vendors



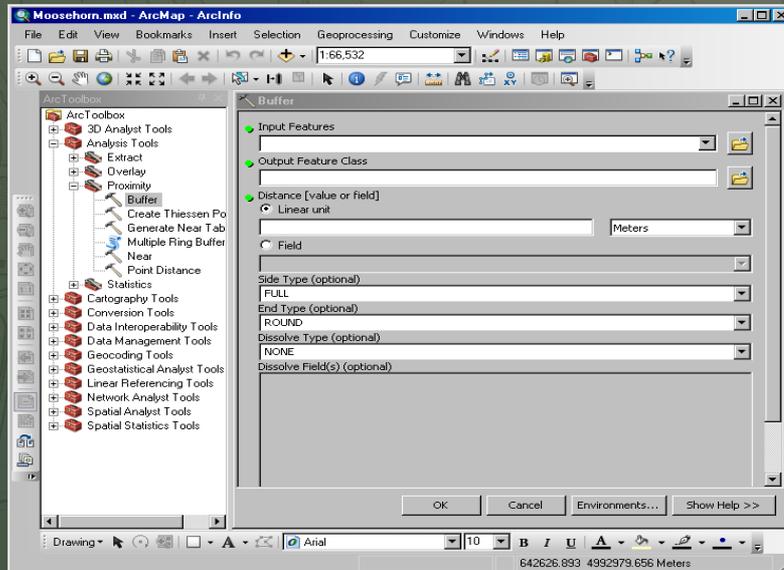
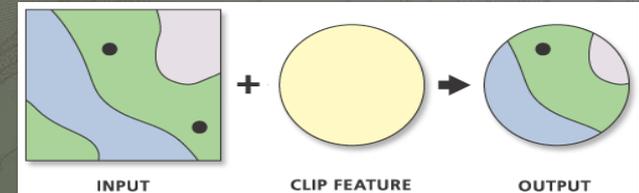
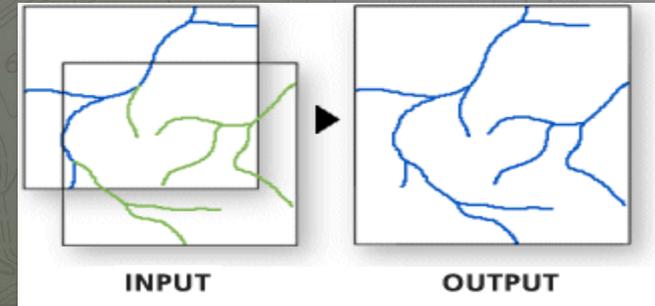
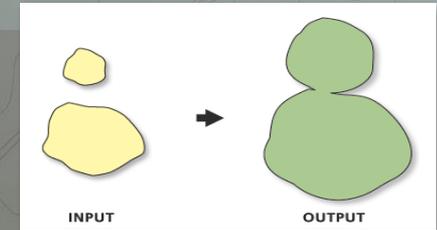
Data Development

- Contracting
- Create it yourself - “in-house”
 - GeoProcessing Techniques & Tools
 - GPS
 - On Screen Digitizing
- Data Development requires time, planning & effort
 - GIS Project Design I - Data Development & Management (CSP7200)



Creating your own GIS data

- Queries & GeoProcessing
 - Select by Attribute, Definition and Location
 - ArcTool Box





Creating your own GIS data

- Global Positioning System (GPS) and mobile GIS devices
- 3 Grades
 - Survey
 - Mapping
 - Recreation
- Requires specialized training and software
 - ArcPad 10, CartoPac, TerraSync, Garmin DNR



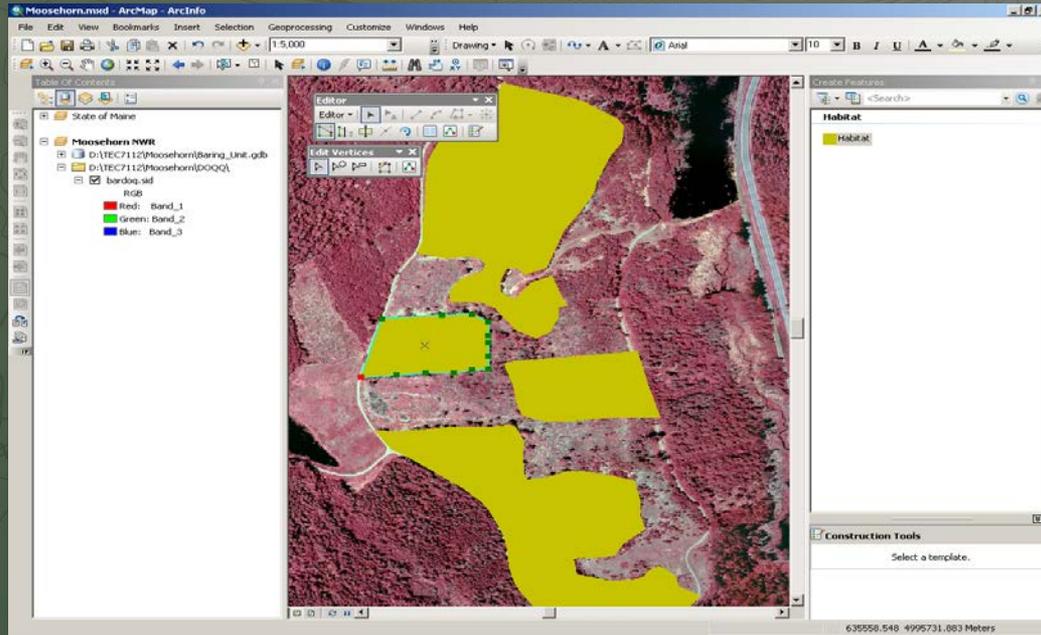
GPS I - Field Mapping and Inventory (CSP7101)

GPS II - Advanced Field Mapping and Inventory (CSP7301)



Creating your own GIS data

- On-screen digitizing in ArcMap 10





Metadata



PowerPoint created by Todd Sutherland and Mark Richardson (Rev March 2015)



What is Metadata?

- Simply put, Metadata is “data about data.”
- Metadata will answer any question you may have about a particular dataset.
- Who, what, when, why, where, how...
- Essentially, a full blown description of your data



The Metadata Standard

- Executive Order 12906 – signed April 1994
 - “Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure” - NSDI
 - Federal agencies who create geospatial data must document their data in standard format
 - In addition, Federal agencies are required to make this data documentation accessible
- Federal Geographic Data Committee - (FGDC)
 - Interagency Committee
 - Developed the Metadata standard
 - Promotes the coordinated use, sharing, and dissemination of geospatial data on a national basis.



Metadata Content

shepherdstown_ne.sid

Metadata:

- [Identification Information](#)
- [Data Quality Information](#)
- [Spatial Data Organization Information](#)
- [Spatial Reference Information](#)
- [Entity and Attribute Information](#)
- [Distribution Information](#)
- [Metadata Reference Information](#)

}
}
}

Seven Main
Sections

Identification_Information:

Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: Unknown

Title:

shepherdstown ne.sid



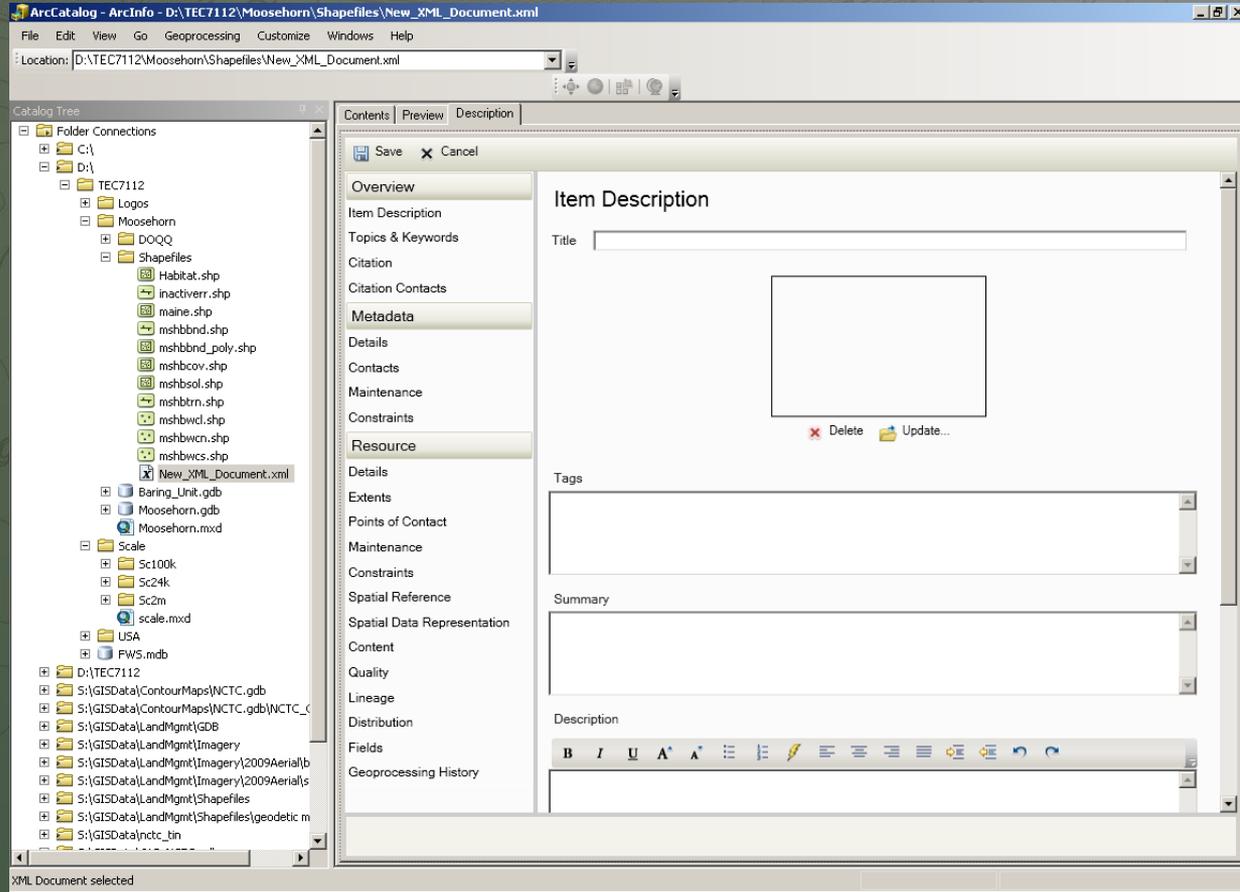
Metadata Tools

- Metadata creation software
 - ArcCatalog 10.2.2
 - EPA Metadata Editor 3.2 (Recommended)
- FGDC Metadata Tools and Utilities

<http://fgdc.gov/metadata/geospatial-metadata-tools>



ArcCatalog





EME

idinfo_ptcontac / Panel26 / X: 11 - Y: 25

File Edit Tools Help

Basic Data Set Information | Quality, Coordinate System, and Attribute Information | Distribution & Metadata Information

Citation

* **Origin:** U.S. Fish and Wildlife Service

* **Title:** Habitat

Publisher

* **Published by:** U.S. Fish and Wildlife Service

* **Published at:** NCTC * **Date:** 20141125 today

Online Linkage

** **Primary Linkage:**

** **Secondary Linkage:**

Description

* **Abstract:** Polygon layer (Habitat) located at Moosehorn National Wildlife Refuge

* **Purpose:** Polygon file created during the GIS Introduction course. This layer was generated to demonstrate how to manually digitize polygons using the Edit tools available within ArcMap 10.2.2.

Supplemental Info:

Time Period

* **Date of Data Set**

Single Date **OR** Multi Dates: Date1, Date2. * **Progress of data:** In work

OR Range of dates: Date1 - Date2 * **Data currency:** Ground condition

20141125 today * **Update frequency:** As needed

Bounding Box

N: E: S: W: (from metadata record)

* **N:** 45.104684 * **E:** -67.278616

* **S:** 45.096135 * **W:** -67.284901

Keywords

ISO | **EPA** | **USFWS GIS Thesaurus** | **Place**

Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Mexico
Michigan
Minnesota
Mississippi
Missouri

Data Set Constraints

* **Access:** None.

* **Use:** Although these data and information have

* **Security Classification:** No Confidentiality

Contact

Primary Person Primary Organization

Your work station address

YELLOW * mandatory GREEN ** mandatory if applicable BLUE optional

Click on text to link to element description

Save Save & Close Cancel

See the EMEGuide (.pdf) for detail installation instructions and use



Why is Metadata Important?

Several reasons, but here are some key ones:

- Protect your organization's investment
- Allow you to evaluate someone else's data
- Support DATA.gov



More than Pretty Maps



Key Principles for Creating Maps that Communicate Effectively



Key Principles

1. know your audience, venue, purpose and media
2. take time to understand basic geodesy
3. think simple when designing
4. understand and apply contrast/figure ground
5. balance your map composition



“The purpose of design is to focus the attention of the user.”





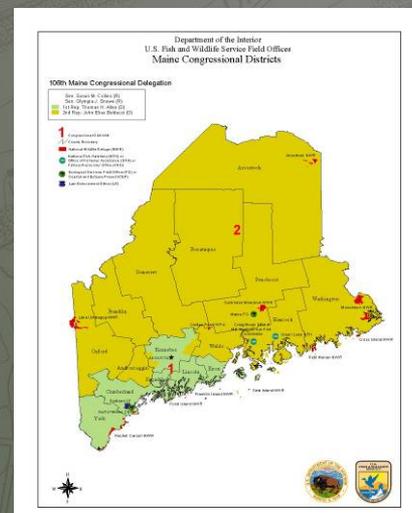
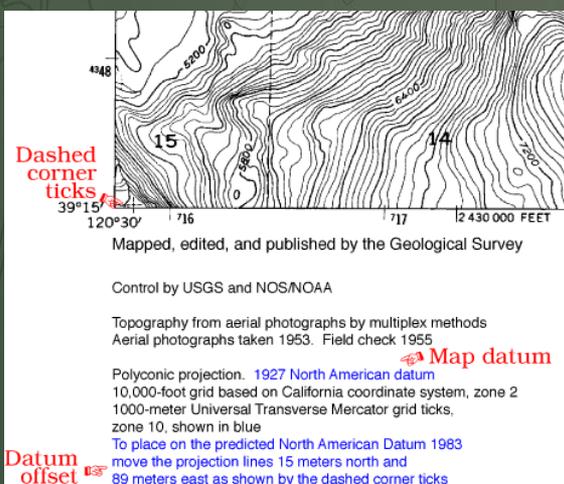
1. know your audience, venue, purpose and media

- age, profession, limitations, expertise...
- web-site, report, town meeting, newspaper...
- general purpose, topic-specific, one of a series...
- large printed map, 8.5x11 hand outs, projected on a screen, on the web, figure in a report



2. take time to understand basic geodesy

- datums - NAD27, NAD83, WGS84...
- projections - Mercator, Lambert conformal conic...
- coordinate systems - latitude/longitude, UTM, SPCS



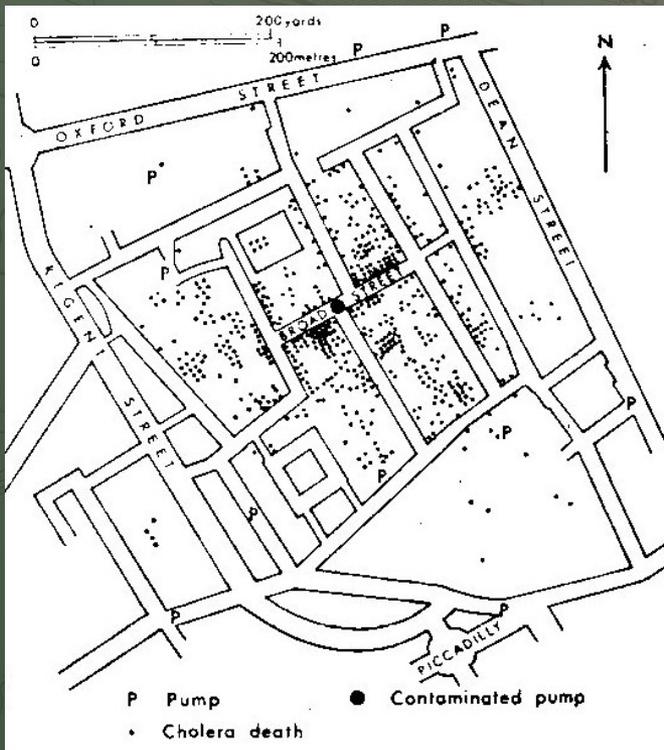


3. think simple

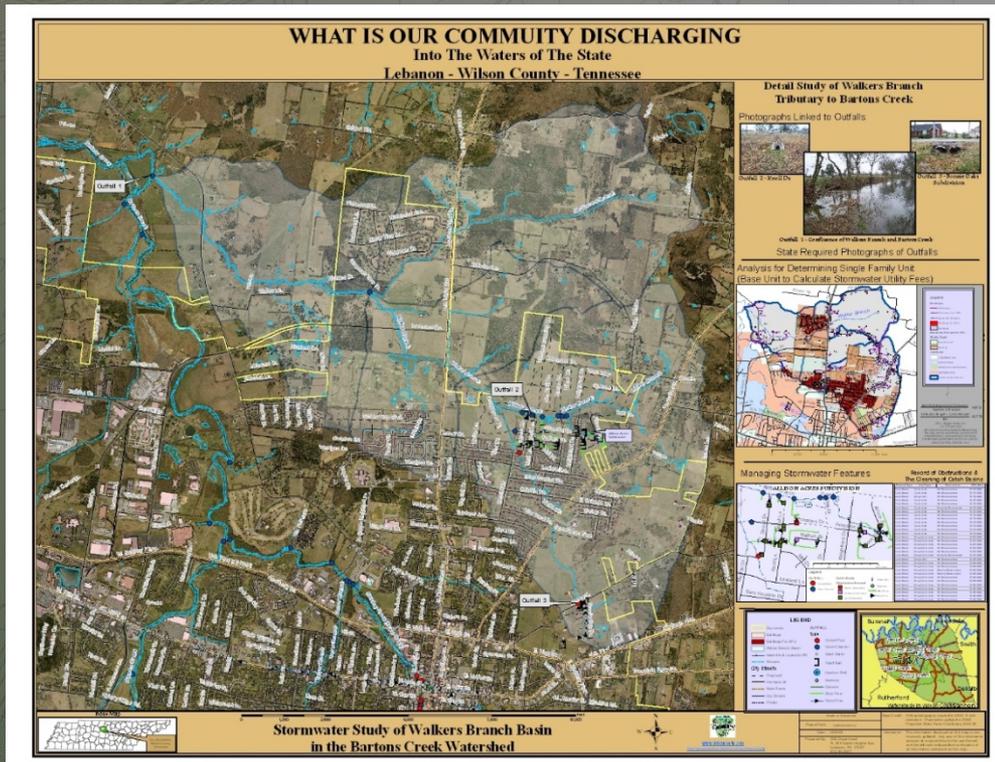
- Good design leans toward simplicity
- There must be a defensible reason for every element in a map composition
- The composition is complete when nothing else can be removed
- Honor the empty spaces



3. think simple



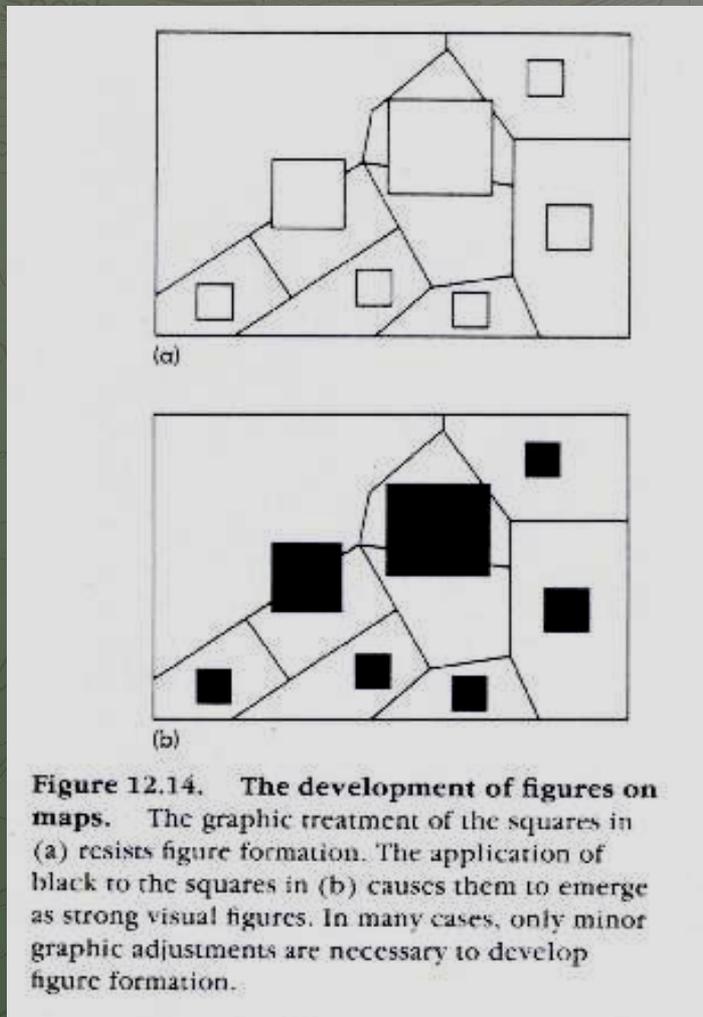
Less can be more



Just because you can doesn't mean you should



4. understand and apply contrast/figure ground



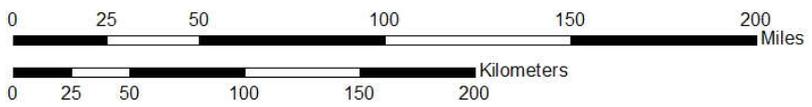


4. understand and apply contrast/figure ground

National Wildlife Refuges in Tennessee



Coordinate System: State Plane Tennessee FIPPS 4100
Datum: NAD 83
Units: Feet

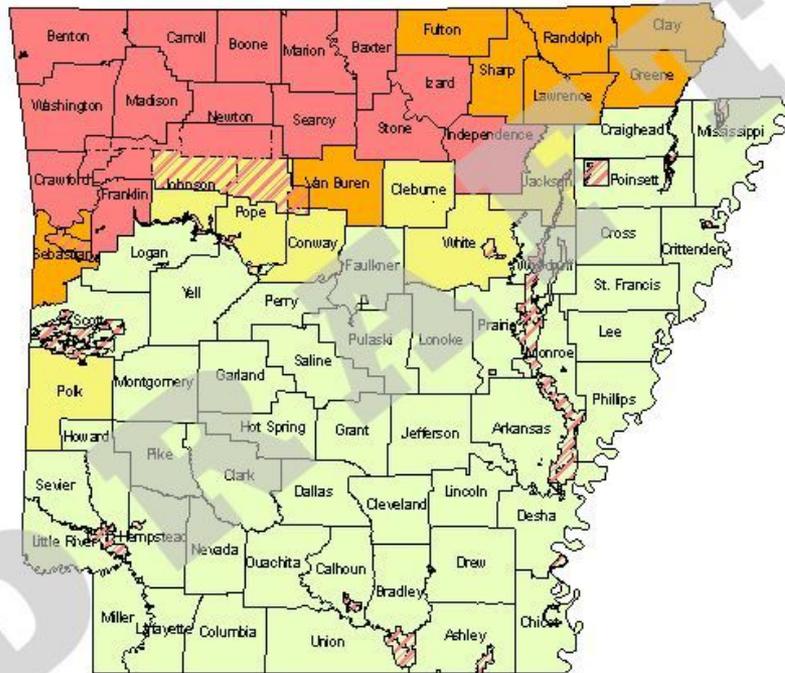


Map Production: Southeast Region GIS Center in Cookeville, TN
Map Production Date: September 11, 2012
File Location: G:\projects\TN_NWR_map\tn_nwr_map.pdf



5. balance your map composition

- Visual balance results from two major factors: weight and direction
- Visual weight depends on location
- Elements at the center of a composition pull less weight than those lying on the tracks of the structural net.
- So, the farther away you get from the middle of the page, the heavier an object is perceived. ...



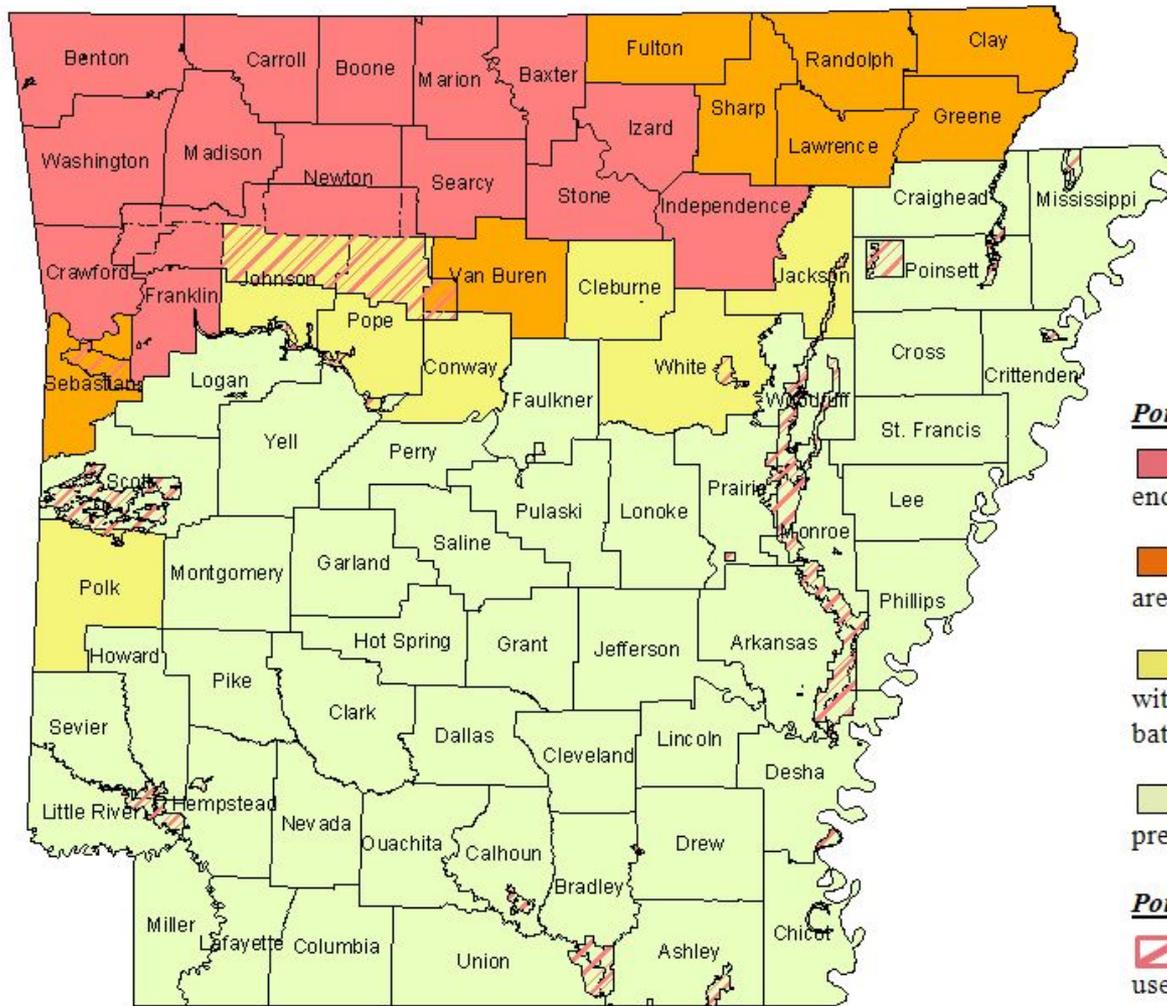
Potential Risk: BATS

-  **High** Important caves used by endangered bats are present in this county
-  **Moderate-High** Endangered bats are or have been present in this county
-  **Moderate** These counties are within the potential range of endangered bats, but none have been documented
-  **Low** No known or predicted presence of endangered bats

Potential Risk: BIRDS

-  **High** Important known habitat used by local and migratory birds

NOTE: The map above depicts potential risk (due to construction of wind farms) for endangered bats (by county) as well as local and migratory birds (known habitat areas). Proposed construction in a high risk county or known bird use area does not mean automatic termination of a project. Each project will be assessed individually.



Potential Risk to Endangered Bats and Migratory Birds from Wind Farms

Potential Risk: BATS

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NOTE: The map above depicts *potential* risk (due to construction of wind farms) for endangered bats (by county) as well as local and migratory birds (known habitat areas). Proposed construction in a high risk county or known bird use area does not mean automatic rejection of a project. Each project must be assessed individually.



Six Simple Suggestions

1. just because you *can* do it, doesn't mean you *have* to
2. steal the best ideas and make them your own
3. don't (necessarily) accept the defaults
4. you're done when you can't take anything else out
5. the customer is NOT always right
6. have someone else check/review your map