United States Coast Guard
U.S. Department of Homeland Security

AN INTRODUCTION TO GIS AND GEOSPATIAL DATA FOR PROTECTION AND MANAGEMENT OF WETLANDS AND WATERCOURSES

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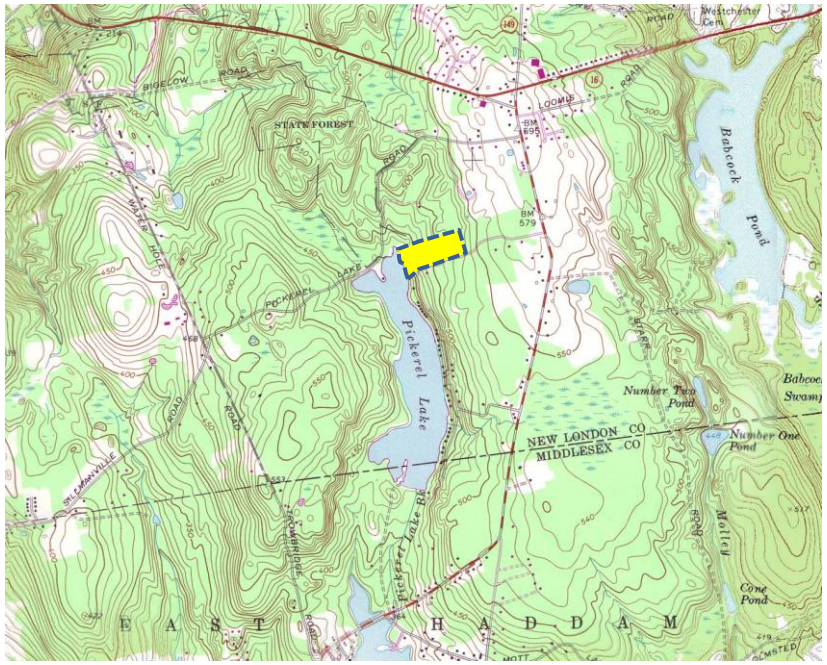
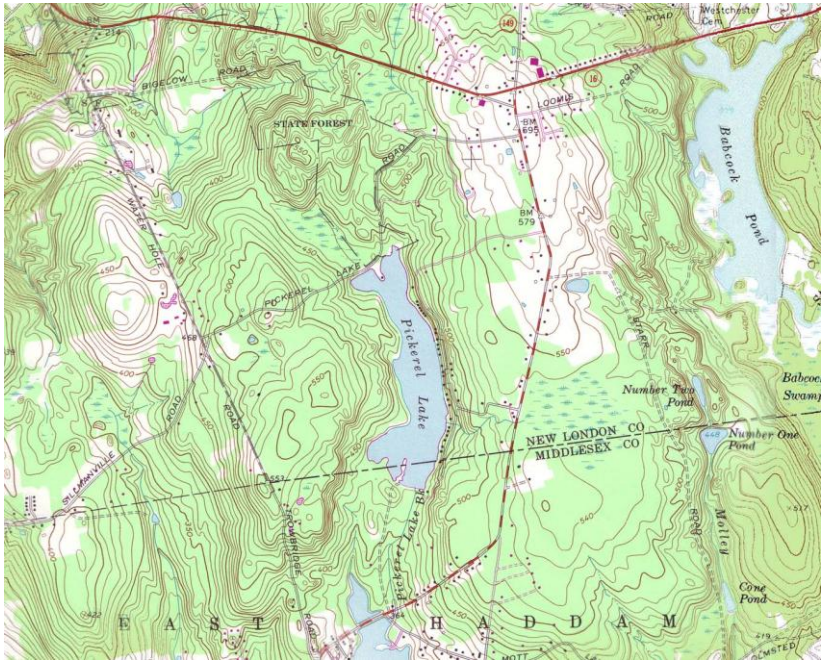
Goal of commissioners and agents

- Permit and enforcement activities in municipal wetlands and watercourses per IWWA
- What do you need?
  - Information or data to make a determination for a permit or a violation
- Traditionally methods use maps and site plans
- Often at regional or site scale



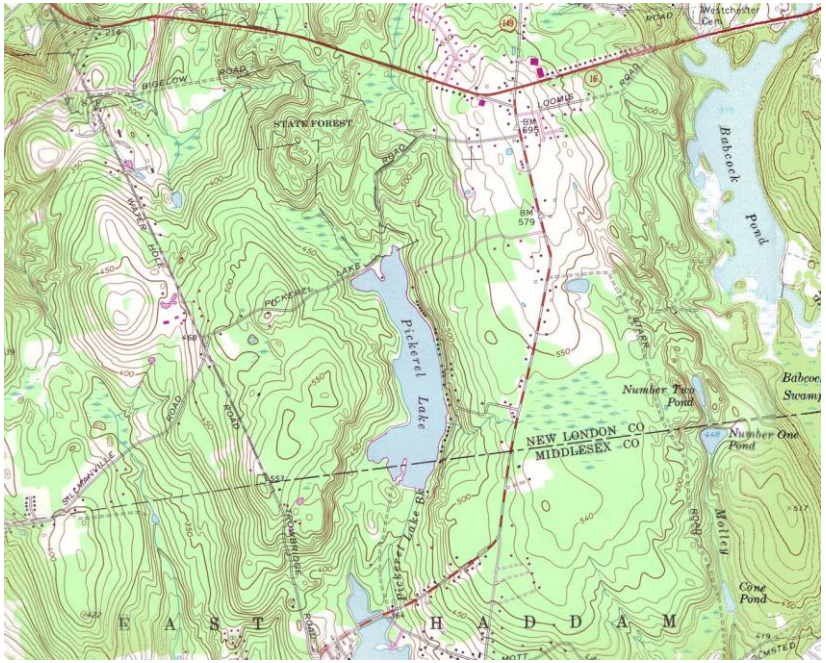
What is the information used?

- MAPS
  - They are representations of the earth's surface, or some portion of it, that has a specific scale and theme.
  - Characteristics:
    - Condense and symbolize information
    - Always abstractions of reality.
  - Excellent for environmental data
  - Printed on paper or fixed areas



Problems with maps

- Fixed scale, time, scope & graphics
- Difficult to combine with other kinds of data
- Theme and symbols controlled by the producer/cartographer
- Can't model land-use/impacts

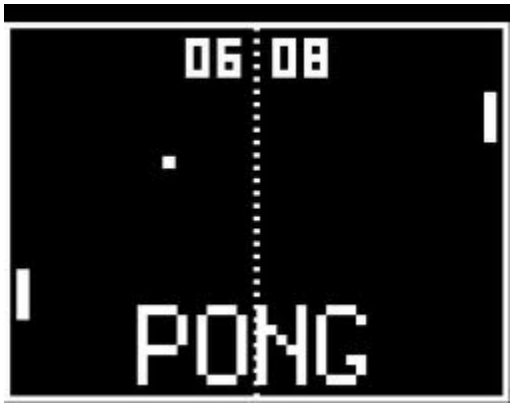


Consumer trends & feedback loop

- Video games
- PC's
- Internet (jokes, music, gossip, software, find friend from high school)
- CCD, scanners, and digital cameras
- Cheap graphic processors
- Common platform and microprocessors
- Big data "pipes"
- Inexpensive capture of images

Ex: Video games

Older



Found at eyeris.blogspot.com

Found at www.somethingwonderful.com

Newer

Found at wrcm.ca

Found at www.gamersbox.com

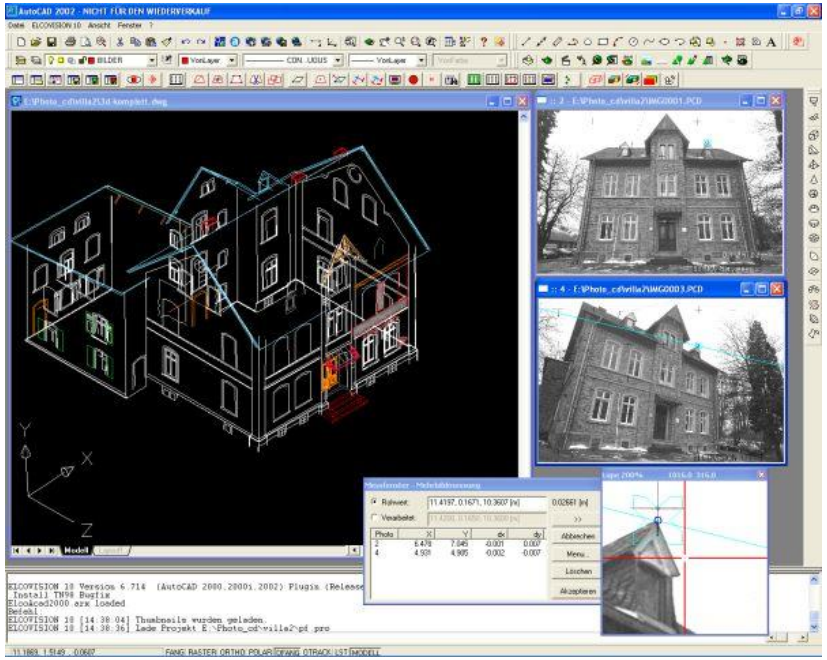
Data trends

- Satellite data

Found at landsat.gsfc.nasa.gov

Data trends

- CAD/CAM



Found at architecture411.com

Data trends

- Databases (DB) and land-use records

Found at historyofredding.com

Trends set the stage commercialization of GIS

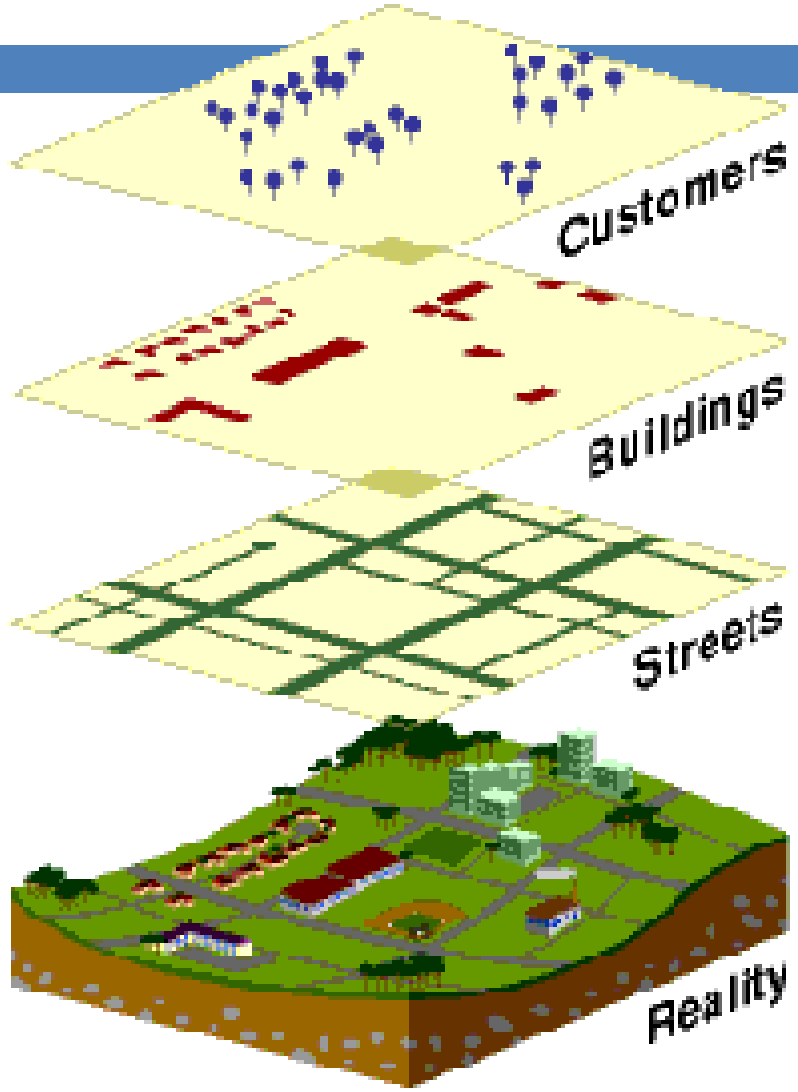
Where GIS Started

- **Ian McHarg- Design with Nature**
  - Used a series of trace paper overlays to prioritize development. Came out of landscape architecture and urban planning traditions (integration)
  - Regional planning scale
  - Structure very similar to GIS
  - Answers question: How do you plan development while limiting damage to the environment?
  - How do we live and build within our environment?

Intro to GIS

- "Simply put, a GIS combines layers of information about a place to give you a better understanding of that place. What layers of information you combine depends on your purpose—finding the best location for a new store, analyzing environmental damage, viewing similar crimes in a city to detect a pattern, and so on."

From ESRI's Web Page (www.esri.com)



What is a GIS?

- It stands for Geographic Information System
- Geospatial technology is the broader term which includes GPS and remote sensing

Definition: What is a GIS?

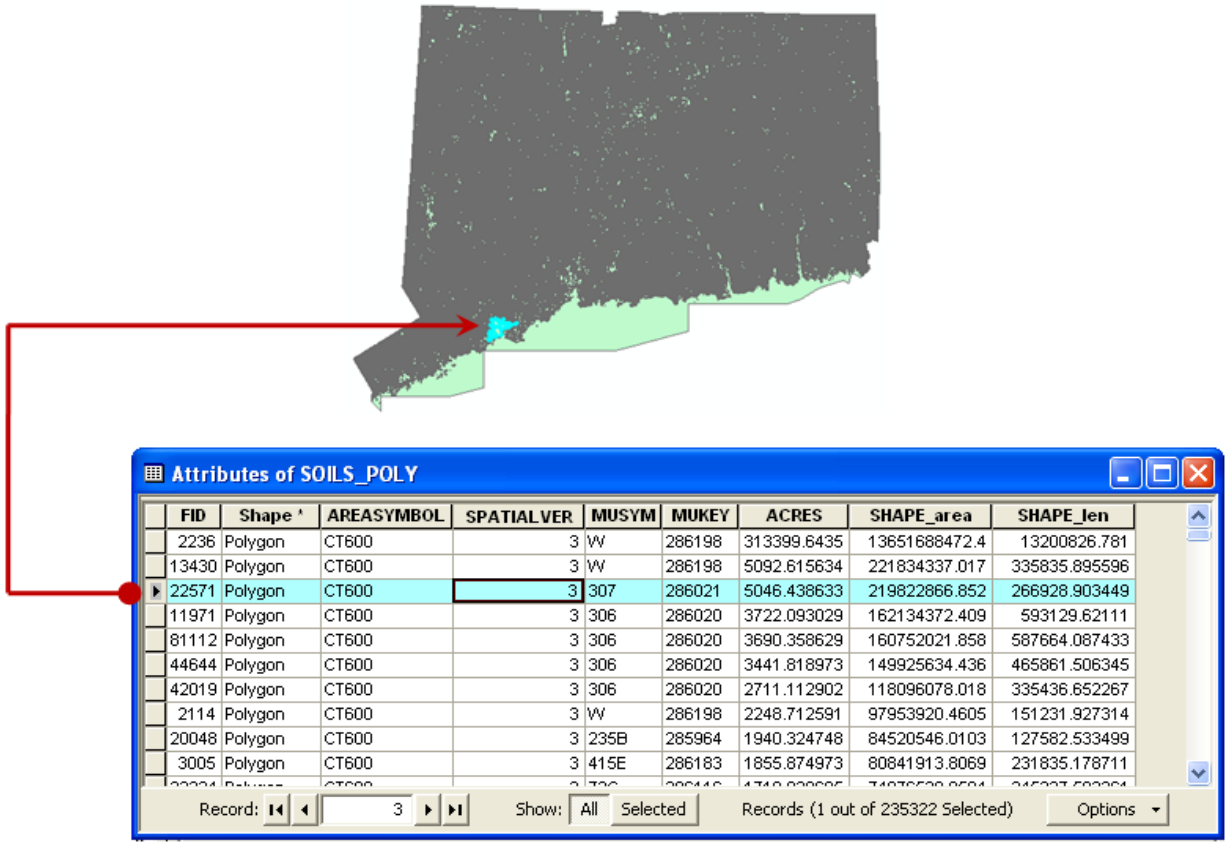
- **Geographic**
  Information System
- Definition of
  Geographic:
  - A. Spatial arrangements of surface elements…
  - B. human and natural landscapes…
  - C. Ordered arrangement of elements…

What is a GIS?

- Geographic **Information System**
- Business Def: DB Management system with spatial capabilities
- A DB or table with special properties

Concept of GIS

- Tabular data is linked to locations



Attributes of SOILS_POLY

FID	Shape *	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	ACRES	SHAPE_area	SHAPE_len
2236	Polygon	CT600	3	W	286198	313399.6435	13651688472.4	13200826.781
13430	Polygon	CT600	3	W	286198	5092.615634	221834337.017	335835.895596
22571	Polygon	CT600	3	307	286021	5046.438633	219822866.852	266928.903449
11971	Polygon	CT600	3	306	286020	3722.093029	162134372.409	593129.62111
81112	Polygon	CT600	3	306	286020	3690.358629	160752021.858	587664.087433
44644	Polygon	CT600	3	306	286020	3441.818973	149925634.436	465861.506345
42019	Polygon	CT600	3	306	286020	2711.112902	118096078.018	335436.652267
2114	Polygon	CT600	3	W	286198	2248.712591	97953920.4605	151231.927314
20048	Polygon	CT600	3	235B	285964	1940.324748	84520546.0103	127582.533499
3005	Polygon	CT600	3	415E	286183	1855.874973	80841913.8069	231835.178711

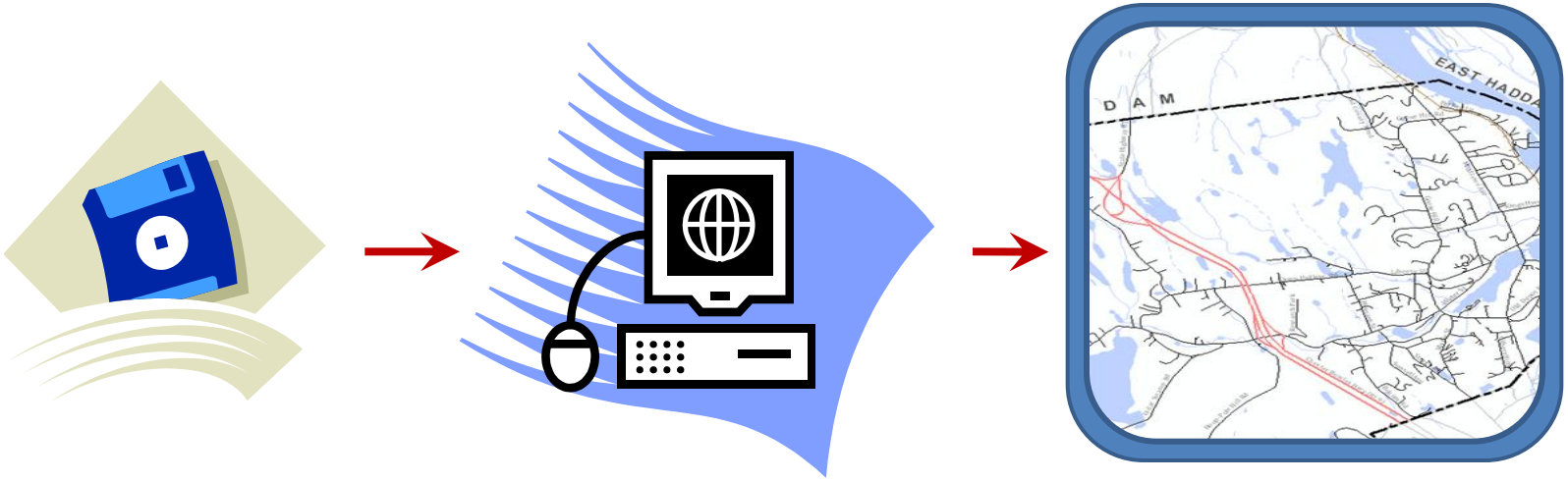
Record: 3 Show: All Selected Records (1 out of 235322 Selected) Options

GIS software structure

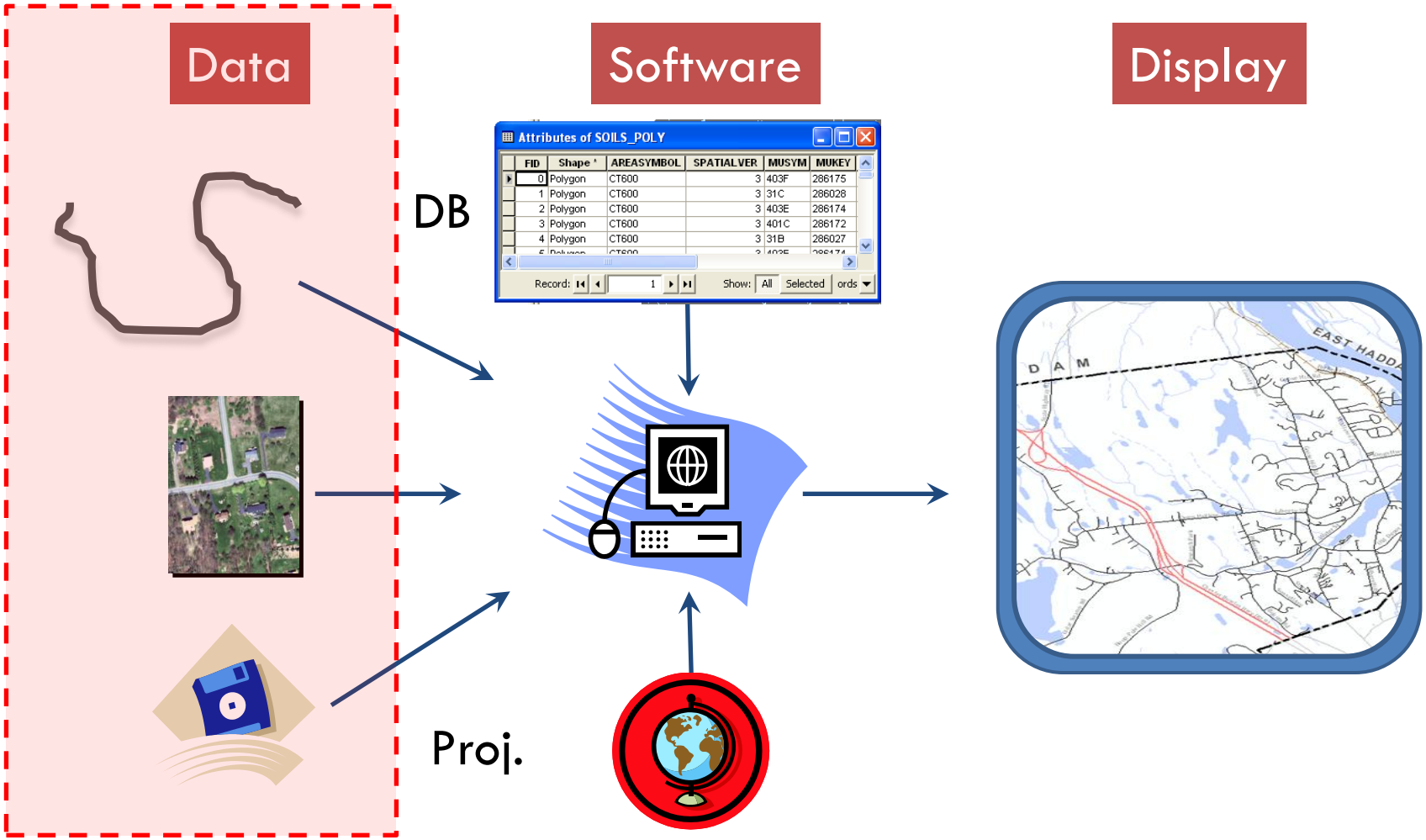
Data

Software

Display



Components of GIS: Data



Data Types

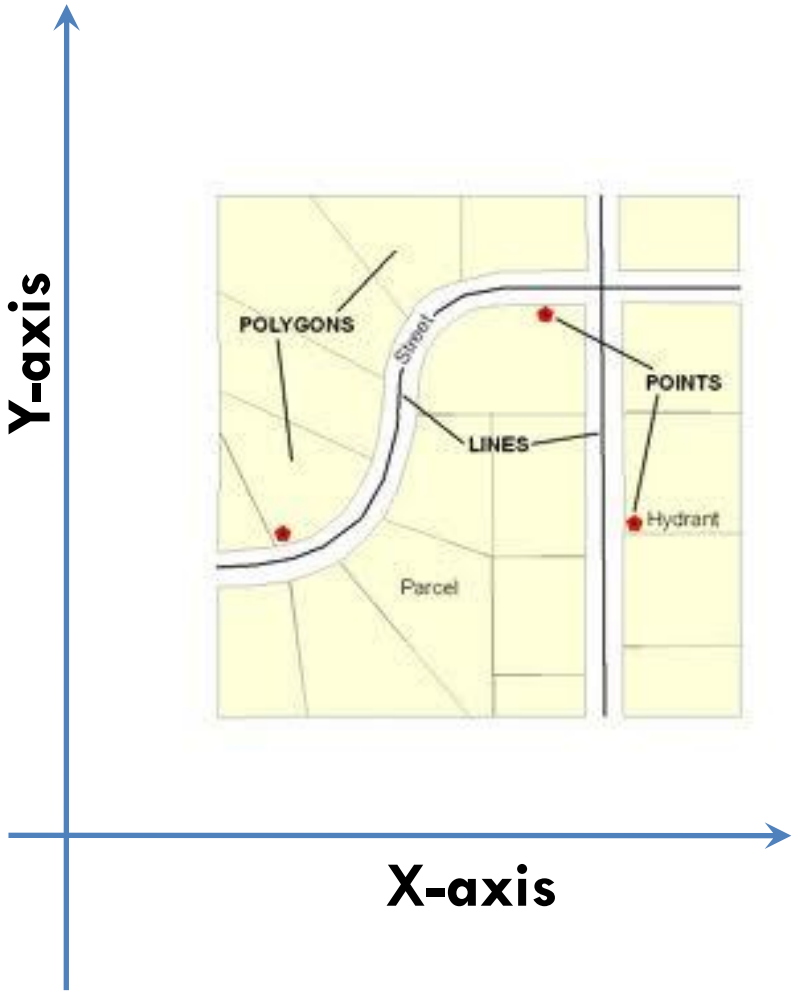
Vector

Raster

Aspatial data

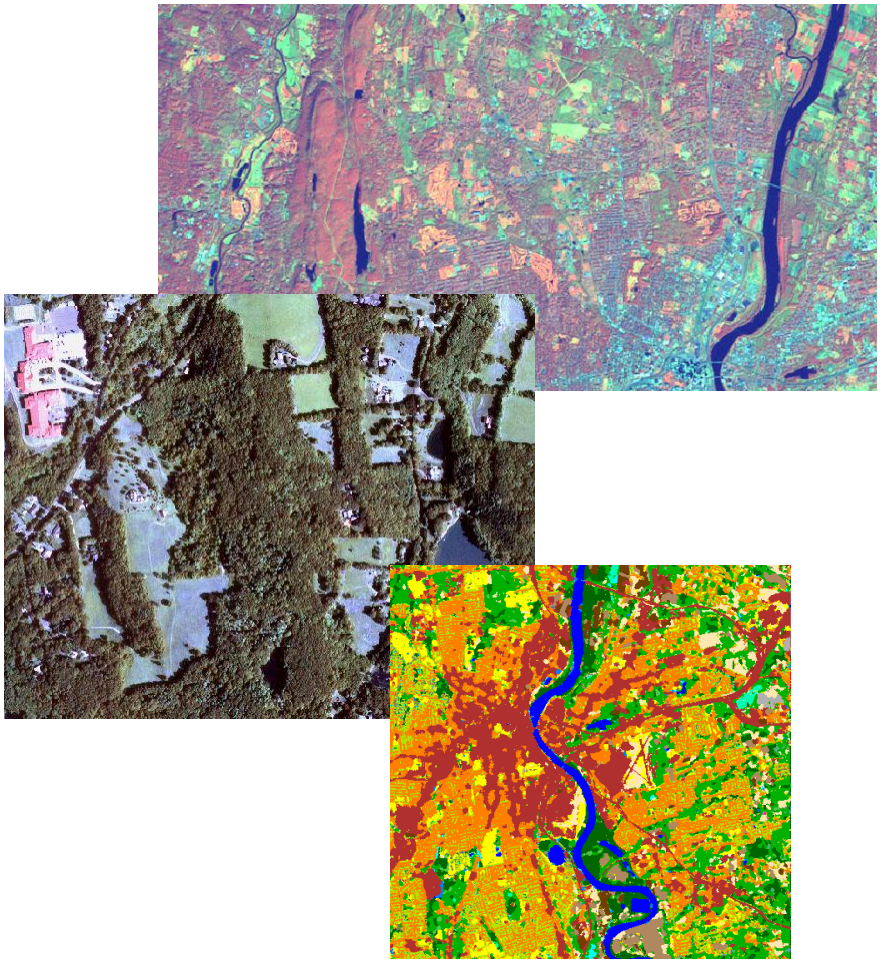
Vector data

- Point
  - facility
- Line
  - road
- Polygon
  - county
- Each spatial component can have data and it is queried in a database
- Needs “topology”



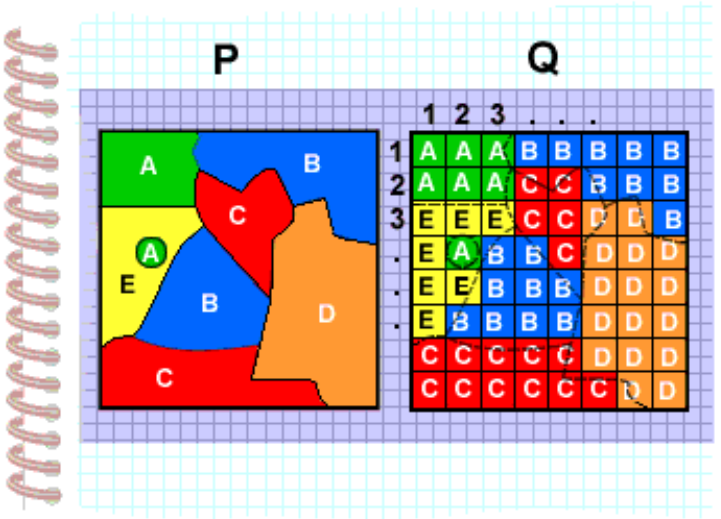
Raster

- Like your digital photograph
- A tesselation of space. It is matrix of cells or pixels that completely covers an area of interest and is referenced to a coordinate system.
- Used in land cover maps and imagery
  - High-res imagery particularly useful



Comparison between vector and raster models

- A vector model:
  - Spatially explicit
  - Scales up and down well
  - Utilized for survey, cadastral and construction data
  - Represents different environmental phenomena
- A raster model:
  - Covers the entire AOI
  - Good for environmental models
  - Primary info source (if imagery)



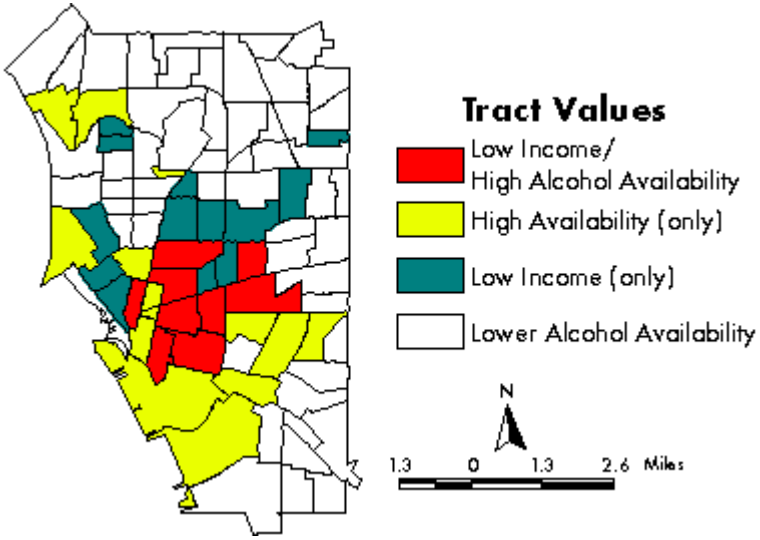
Data types and Modeling the "Real World"

Data type	Real world examples
Points	Soil pits
Lines	Stream thalweg
Polygon	Soil type
Raster	Topography/imagery

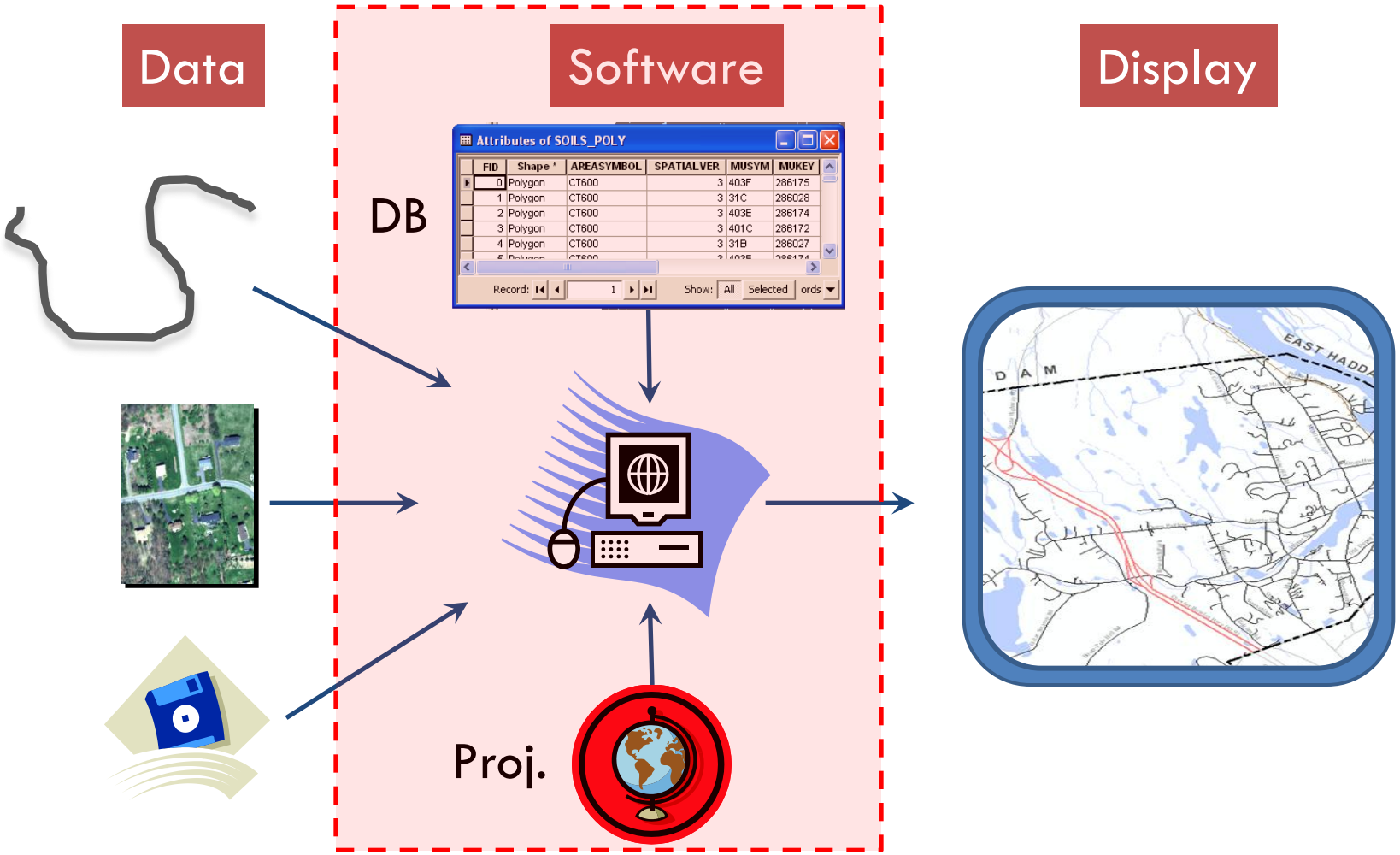
Remember: Ultimate goal is to represent the environment sufficiently well so that information is useful for enforcement and management of wetlands and watercourses

Non-spatial

- Non-spatial data can be linked to spatial data like political boundaries
- Examples
  - Address
    - Gender
    - Income
    - Health
    - Mortality



Components of GIS: Software

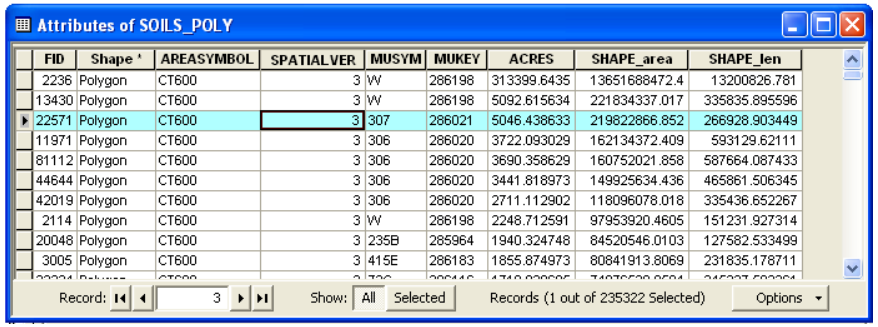


Software

- Database
- Georeferencing and Projections
- Geoprocessing

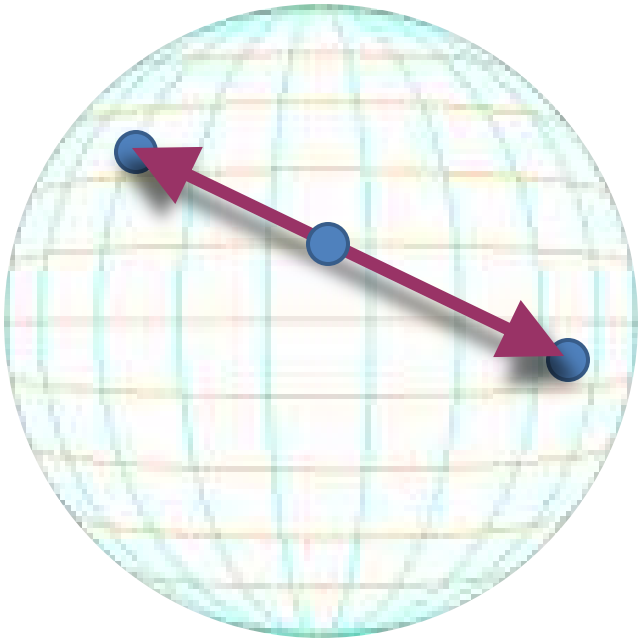
Database

- A DB is a special kind of table at the heart of the software structure
- DB designed for rigor and scalability
- Holds both aspatial and spatial data
- The DB facilitates searches, mathematical operations and “joins”



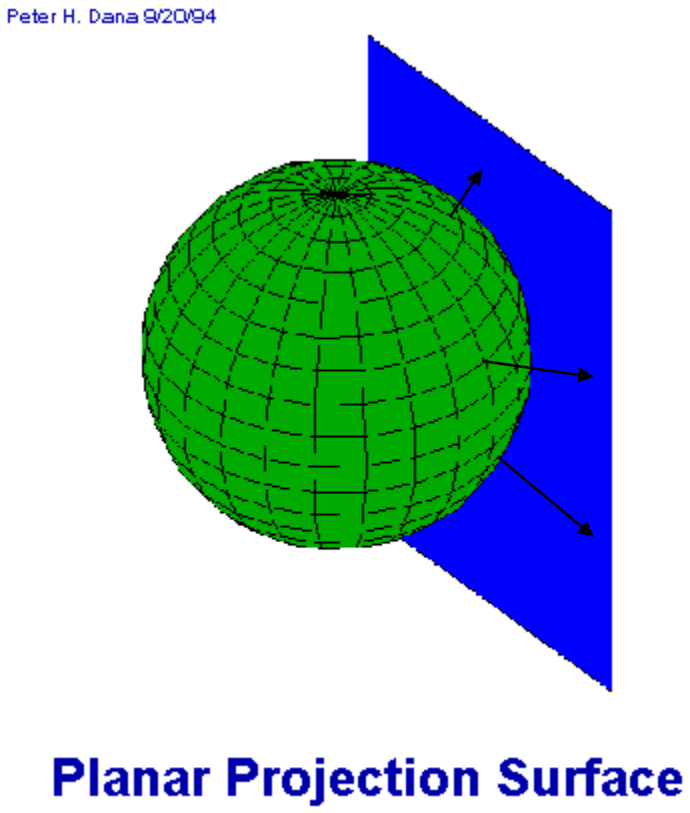
Unique capability of a GIS

- Location and spatial data linkage is unique component of GIS
- Why is the spatial linkage a problem?
  - Earth is **NOT** round
  - X-Y-Z coordinates don't work well on a spheroid because lines aren't straight
  - Mathematics are tough



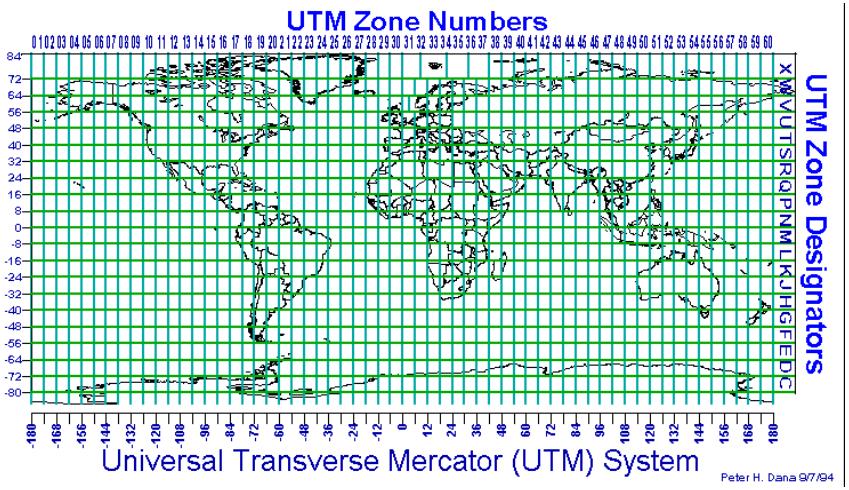
Projections

- We need a method to translate a 3-d surface onto a 2-d plain so that lines are straight.
- Solution: Projections are essentially translations of a 3d surface onto a flat plane
  - like casting a shadow of a ball onto wall

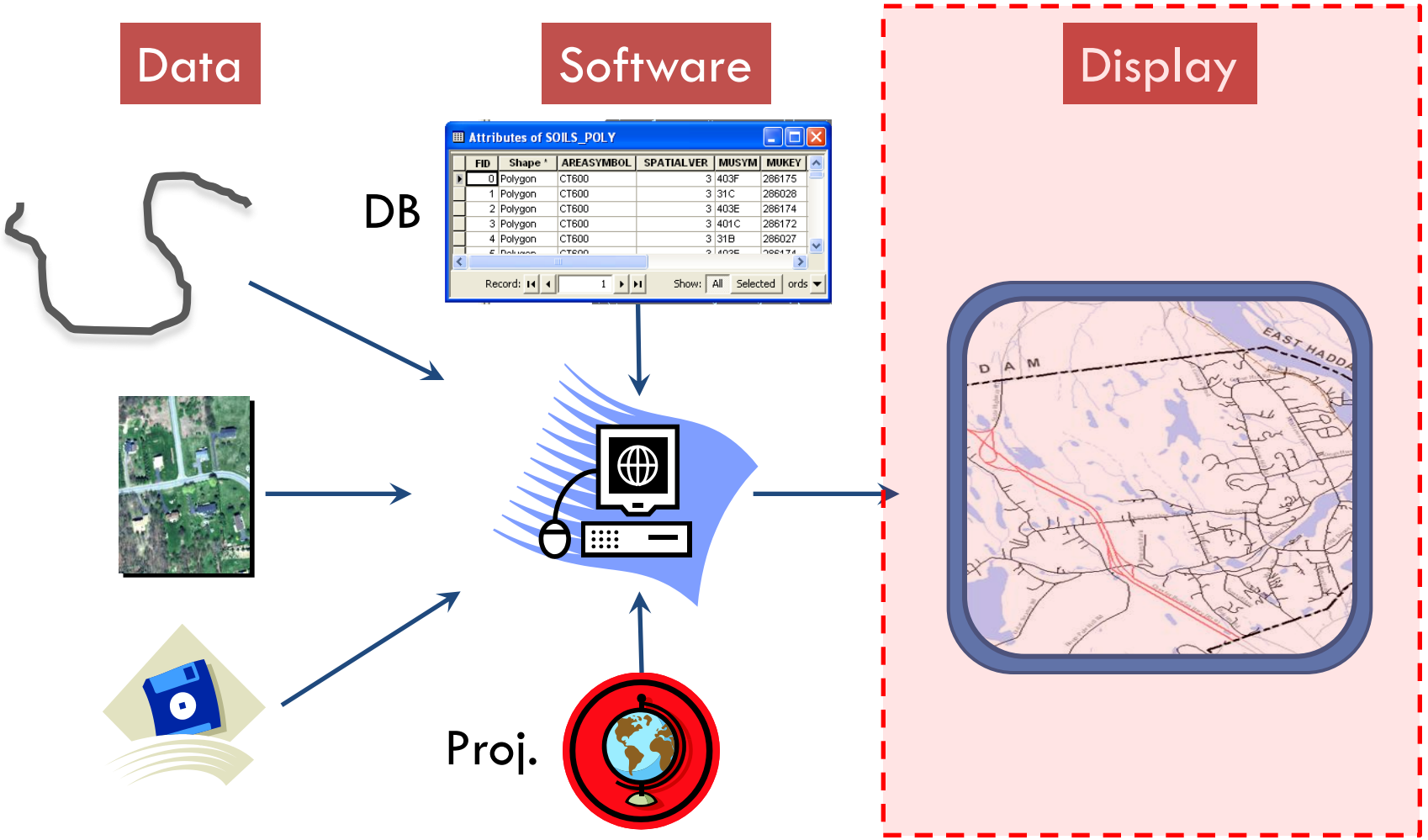


Coordinate systems

- Projections allow us to have 2-d grids systems that are far simpler to use in mapmaking
- Two common systems
  - State Plane
  - UTM
- **Behind every GIS application is a projection and coordinate system**



Components of GIS: Display



Display

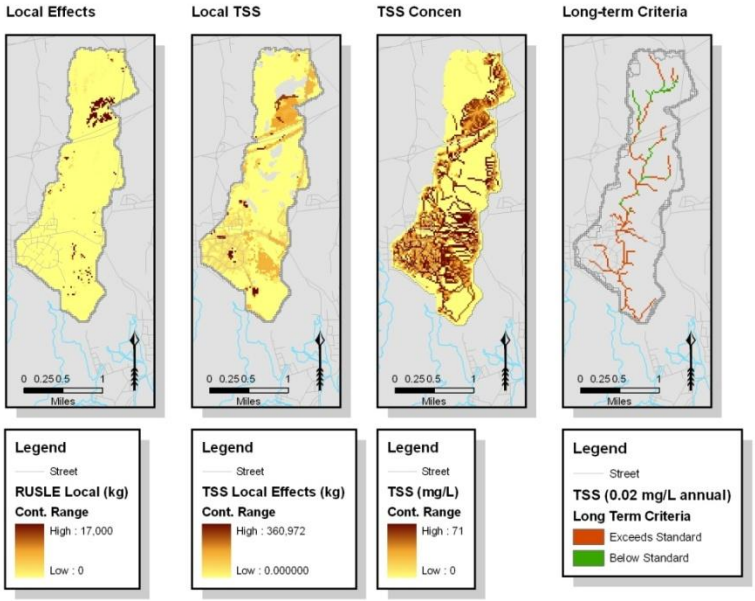
PC

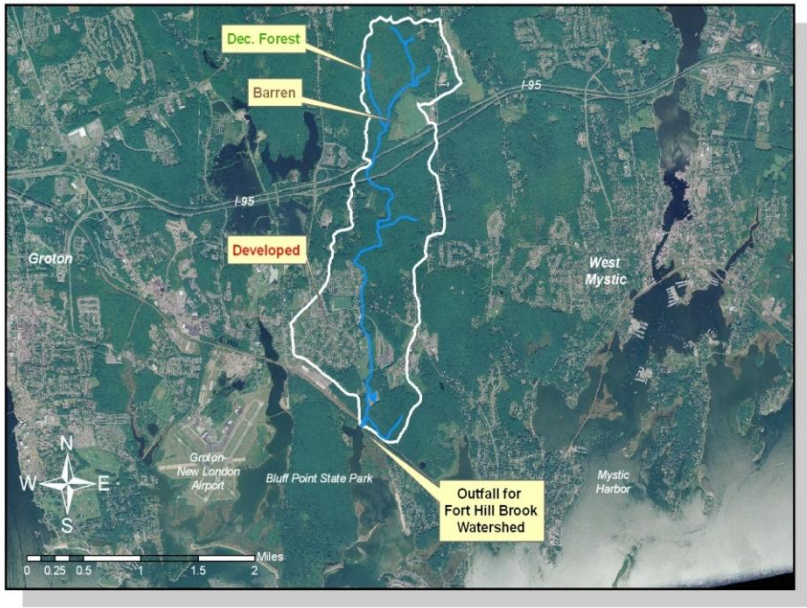
Web-served

PC or Desktop

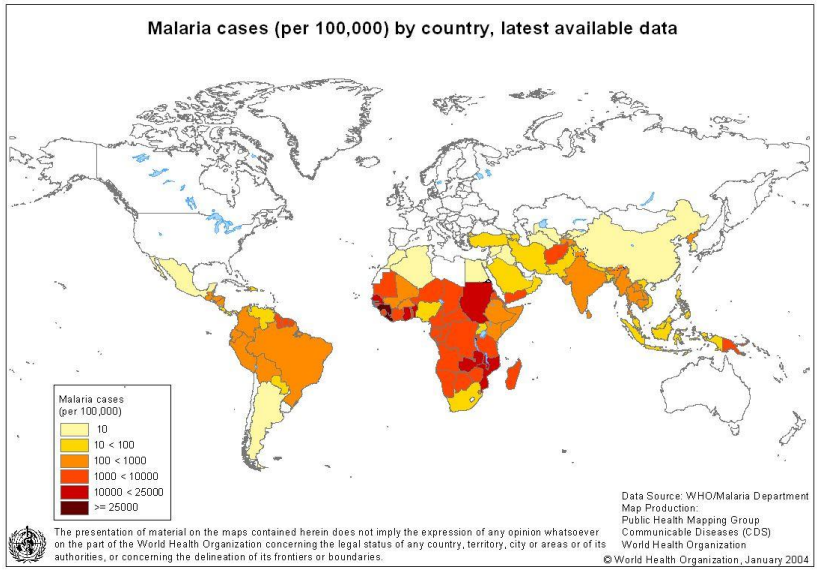
- Scalable
- Cartographic flexibility and producer oriented
- Production oriented
- Highly flexible

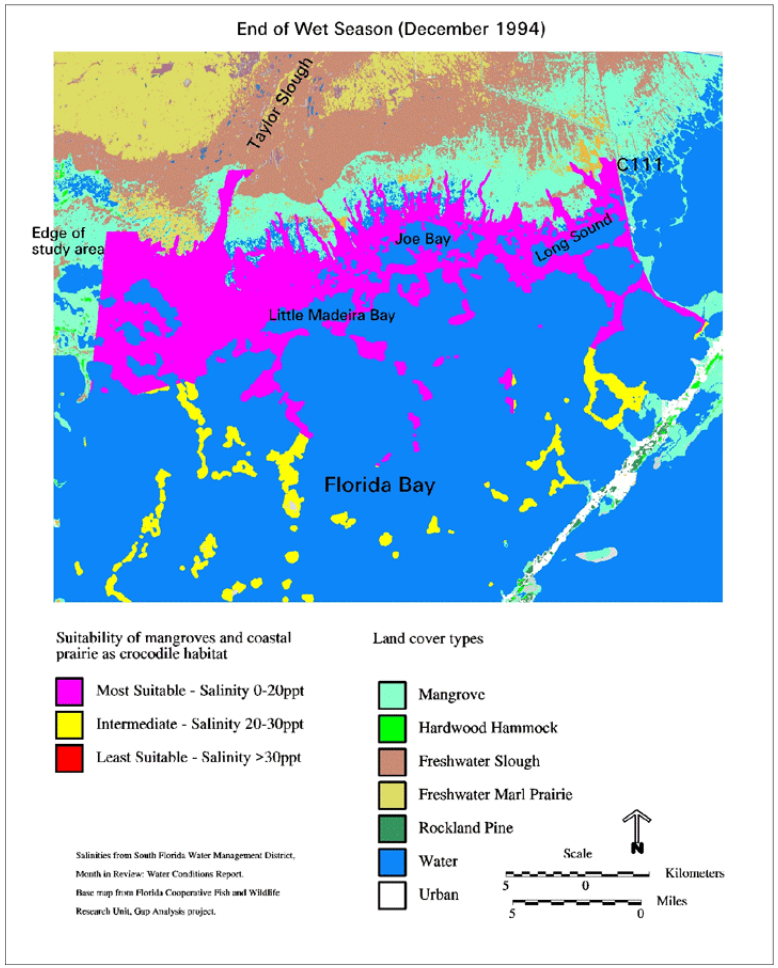
Cartographic flexibility





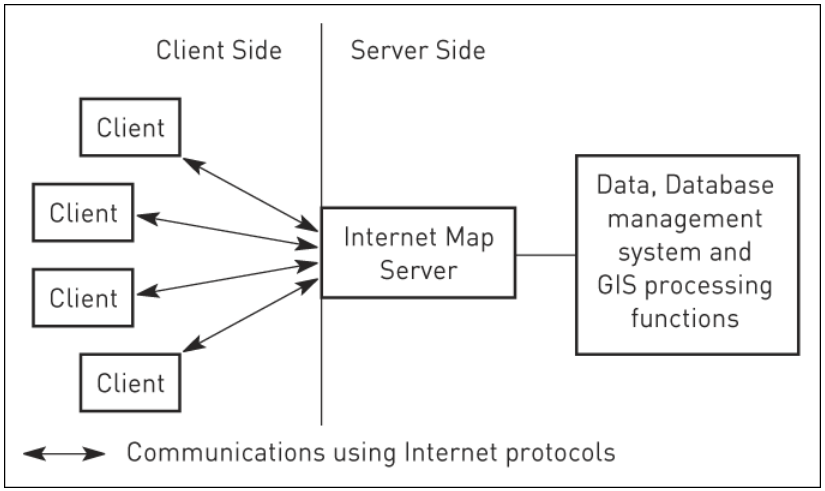
Cartographic flexibility





Web-served

- Simple
- Platform independent
- Processing away from machine
- Consumer oriented
- Gives geospatial information to phone or mobile device



Characteristic comparisons

Original Maps

- Environmental information
- Cartographic display
- Fixed scale and scope
- Difficult to compare data across scales and maps
- Producer controlled
- One point in time

GIS

- Environmental information
- Cartographic display
- Flexible scale and scope
- Easy to compare data
- Massively scalable
- Consumer controlled?
- Iterative or multiple time periods

Data for Commissioners and Agents

Geospatial Data: Imagery

- Aerial photography (AP) and satellite imagery
- If AP is referenced then called othophotos
- Primary data source
- Raster format so can be viewed in any GIS
- Especially useful for enforcement and examining land-use change over 2 or more time periods
- Scale depends on sensor used

CT ECO

http://www.cteco.uconn.edu/

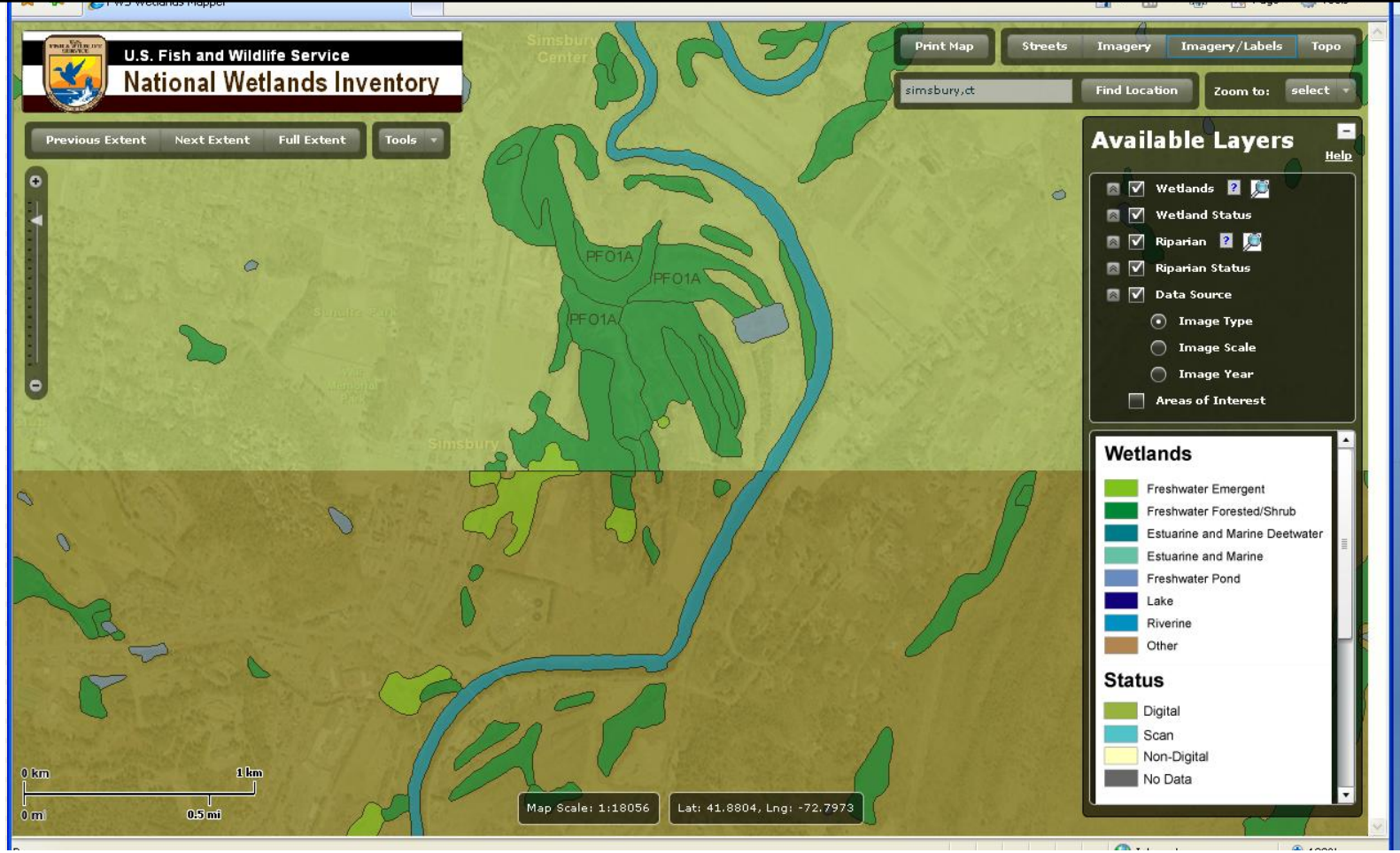
Web Soil Survey

NRCS official data!

Produces reports for any location

Huge data repository and comprehensive resource.

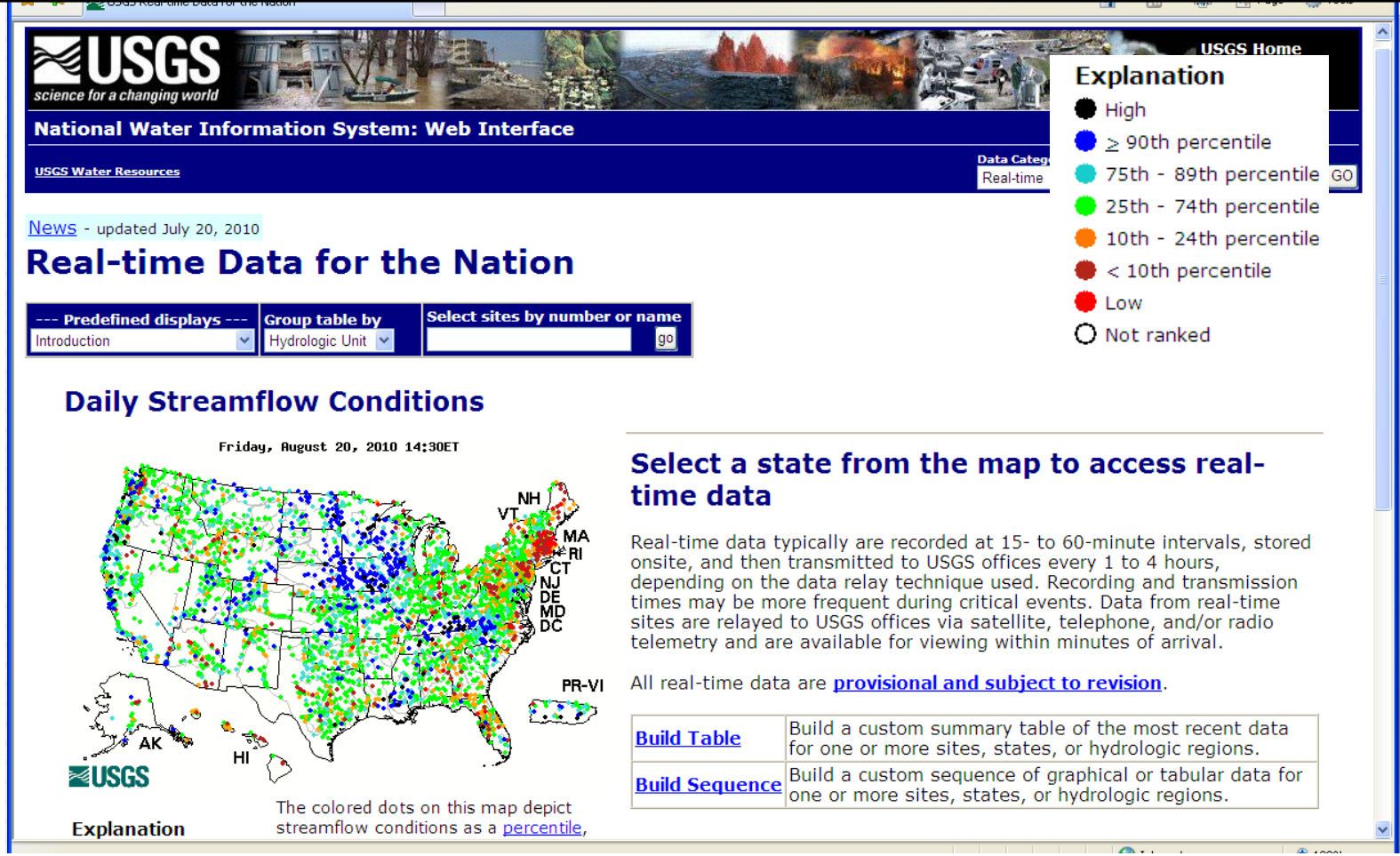
http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx



Wetlands Mapper

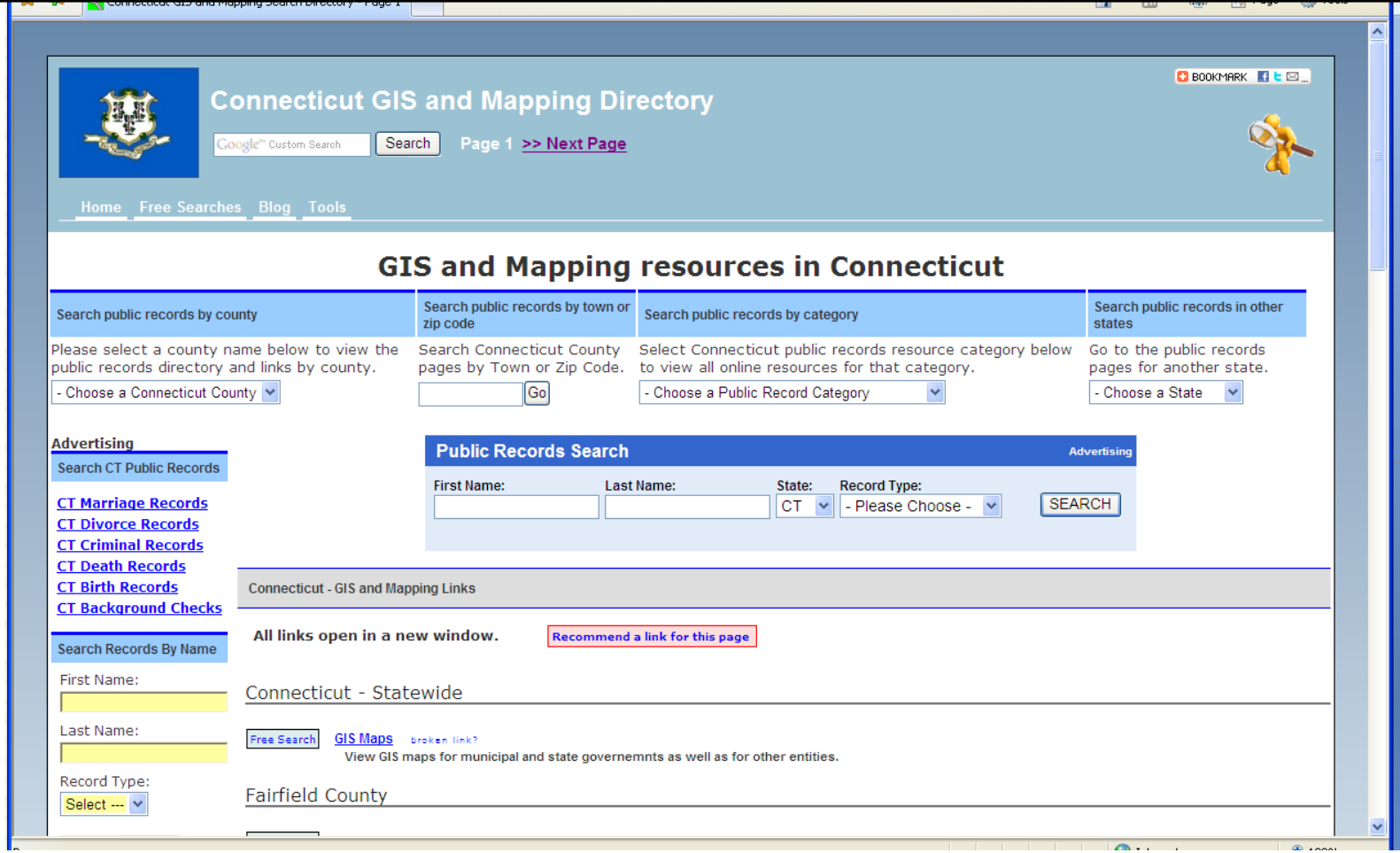
Ecological maps using federal definition of wetlands

Found at http://www.fws.gov/wetlands/Data/Mapper.html



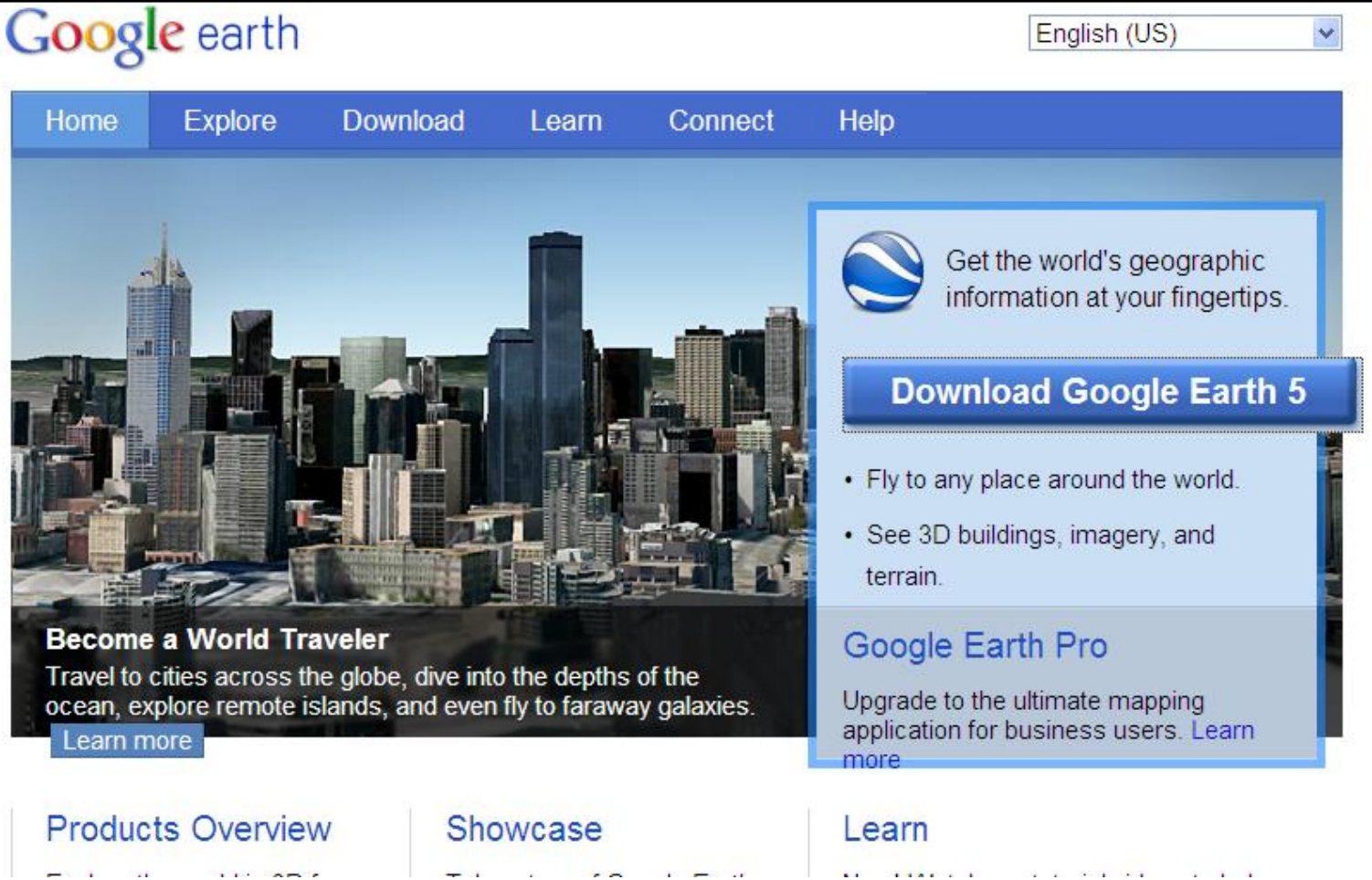
USGS National Water Information System

Found at: http://waterdata.usgs.gov/nwis



Aggregate Site of GIS and Mapping Info

http://publicrecords.onlinesearches.com/Connecticut-GIS-and-Mapping.htm

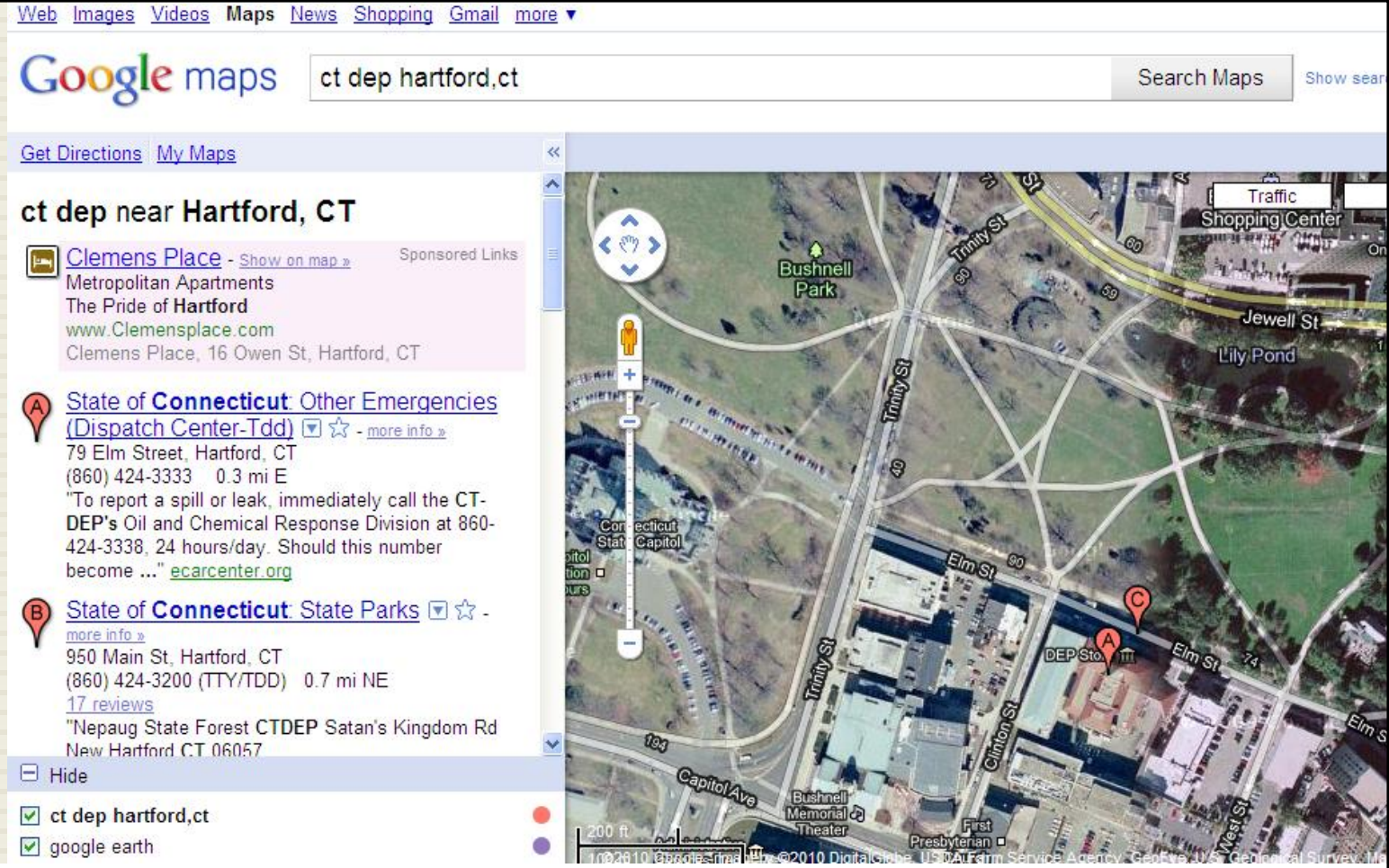


Google Earth

Need to download application at http://www.google.com/earth/index.html

Free GIS that can be used to look at polygons, lines, pts, and attribute info (.kml format only, ESRI products typ. use .shp format)

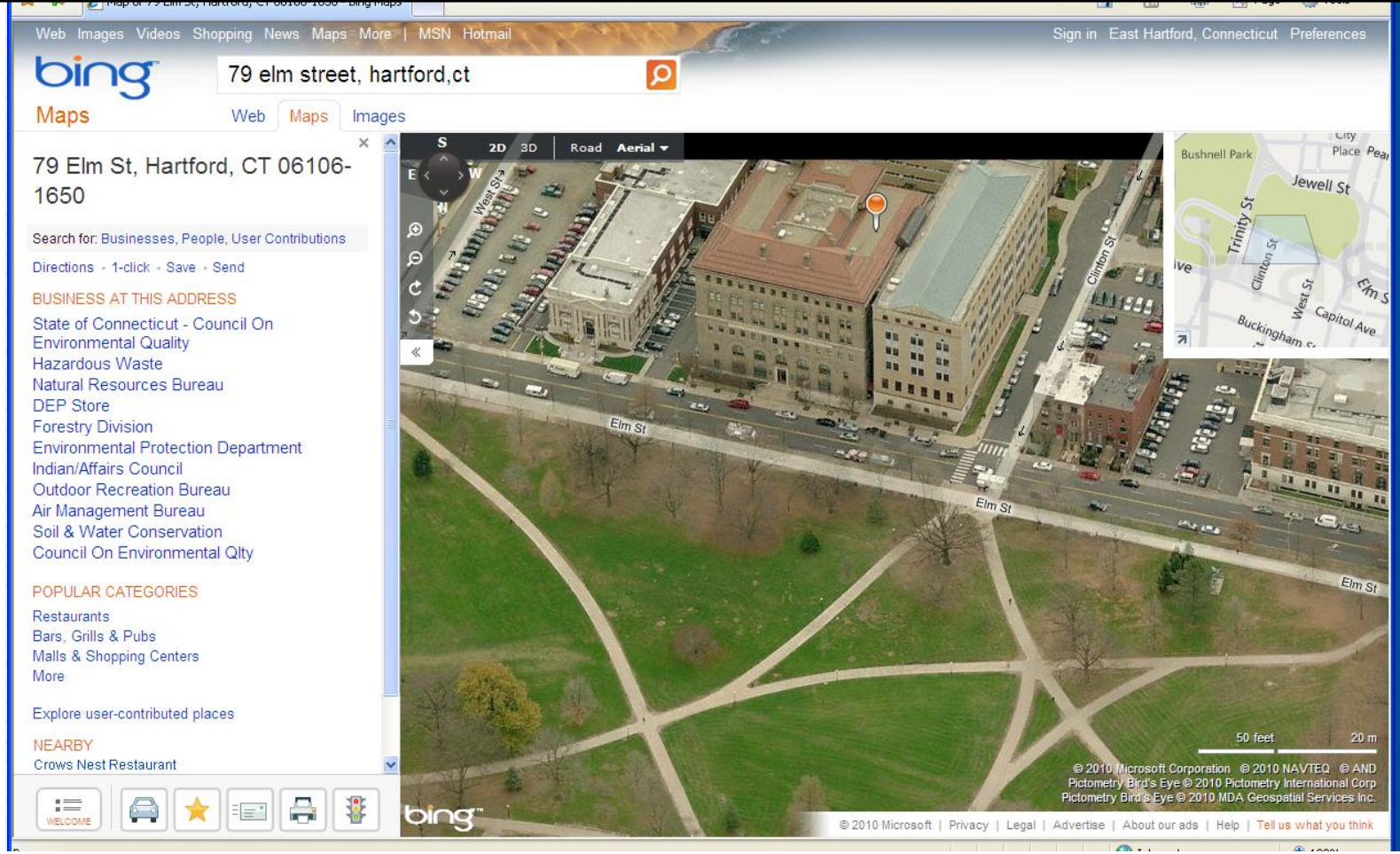
Easy navigation but orthophotos only.



Google Maps

Address driven system. Orthophotos only.

Found at http://maps.google.com/

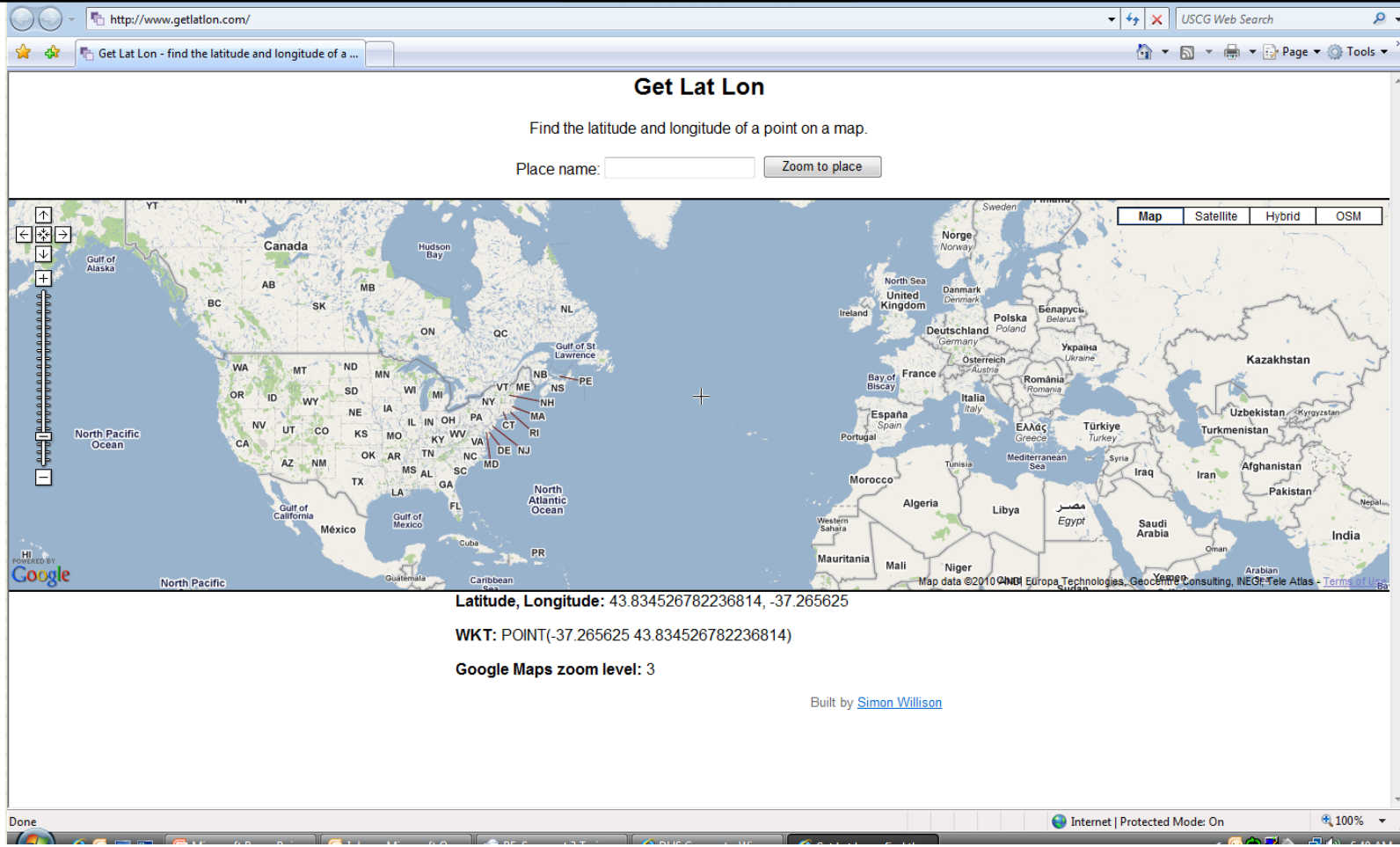


Bing Maps-Aerial and Oblique Imagery

http://www.bing.com/maps

Superb oblique imagery from four cardinal points and orthophotos

Uses address for location methods



GPS Coordinate finder

Finds high precisions GPS lat/long coordinates using a map

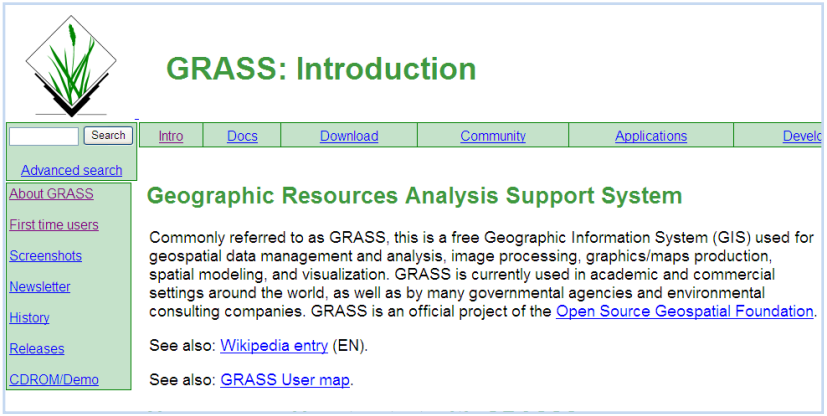
www. Getlatlon.com

CT Historical Imagery

Year	*Site*	*Location*	*Imagery Type*	*How*
1934	Connecticut State Library-Town Map Locator/CLEAR	http://cslib.cdmhost.com/custom/State_Index.php	B&W Hi-resolution	Web-served by single scanned photo
1951-1953	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
1965	Connecticut State Library-Town Map Locator	http://cslib.cdmhost.com/custom/State_Index1965.php		Web-served by single, scanned photo
1970	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
1975	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
1980	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
1985-1986	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
1990-1991	UCONN Map and Geographic Information Center (MAGIC)	http://econmap.com/magic/Map.aspx	B&W Hi-resolution orthophoto	Web-served by scanned photo mosaic
1995	Connecticut State Library	Secured collection	B&W Hi-resolution	Special collection
2004	CT DEP GIS/CT ECO	http://www.ct.gov/dep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707	B&W Hi-resolution	
2006	CT ECO National Agricultural Imagery Program (NAIP) from US Dept. of Interior	http://ctecoapp1.uconn.edu/advancedviewer/	Color, hi-resolution, orthophoto	Web-served by scanned photo mosaic
2008	CT ECO National Agricultural Imagery Program (NAIP) from US Dept. of Interior	http://ctecoapp1.uconn.edu/advancedviewer/	4-band (includes near IR), hi-resolution	Web-served by scanned photo mosaic
2008	CT ECO National Agricultural Imagery Program (NAIP) from US Dept. of Interior	http://ctecoapp1.uconn.edu/advancedviewer/	Color hi-resolution	Web-served by scanned photo mosaic
2008	CT ECO Homeland Security Imagery of Urban Areas	http://ctecoapp1.uconn.edu/advancedviewer/	Color, hi-resolution	Web-served by scanned photo mosaic

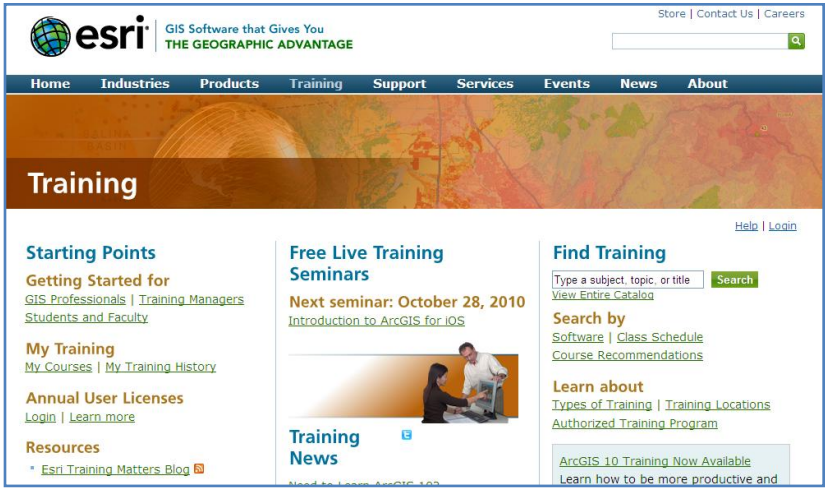
Free GIS

- ArcGISExplorer-viewer
  - http://www.esri.com/software/arcgis/explorer/arcexplorer.html
  - Viewer program with limited functionality
- Grass GIS
  - http://grass.osgeo.org
  - Full-blown gis
- ERDAS Viewfinder
  - Imagery viewer
    - http://www.erdas.com/



Learning more about GIS & RS

- ESRI
  - GIS oriented
  - Commercial site with many free training programs
- GIS lounge
  - http://gislounge.com/free-gis-stuff/
- NASA Remote Sensing Site
  - http://rst.gsfc.nasa.gov/Front/overview.html



Data and Imagery Sources

- www.geocomm.com
  - Very good and inexpensive commercial site
- Earth Explorer
  - USGS site with many type of free data
  - http://edcsns17.cr.usgs.gov/EarthExplorer/
- Geoeye
  - Commercial site for high-resolution imagery
- CT ECO

STATE OF CONNECTICUT
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
79 Elm Street
Hartford, CT 06106

Amey Marrella, Commissioner

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Questions?

Email: carl.zimmerman@uscg.mil