



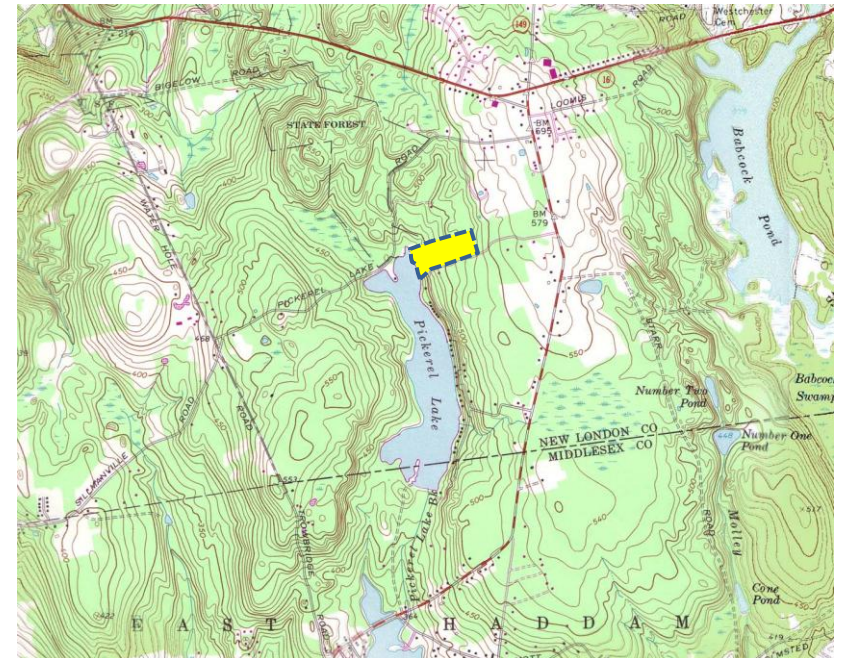
AN INTRODUCTION TO GIS AND GEOSPATIAL DATA FOR PROTECTION AND MANAGEMENT OF WETLANDS AND WATERCOURSES

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Carl L. Zimmerman
Science Dept., United States Coast Guard Academy

Goal of commissioners and agents

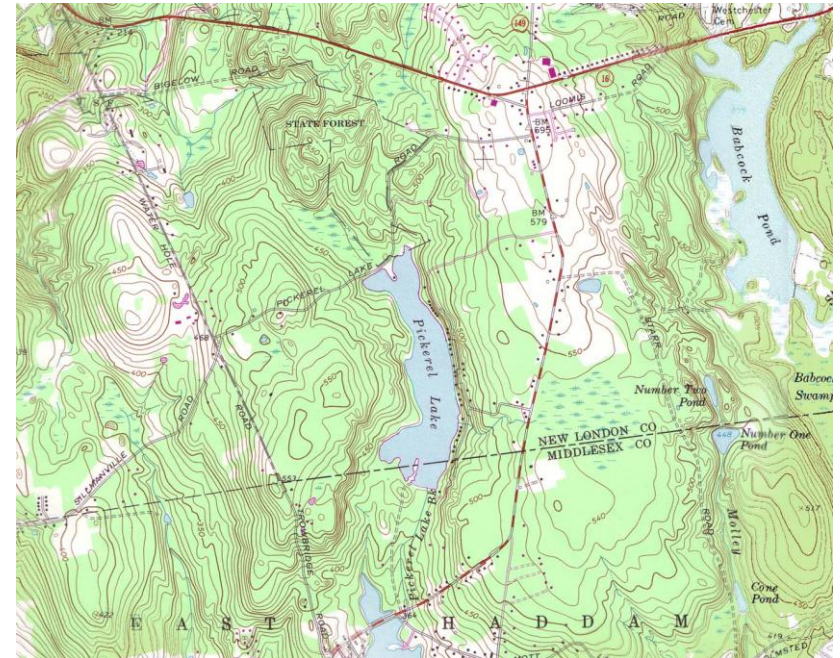
- Permit and enforcement activities in municipal wetlands and watercourses per IWWA
- What do you need?
 - ▣ Information or data to make a determination for a permit or a violation
- Traditionally methods use maps and site plans
- Often at regional or site scale



What is the information used?

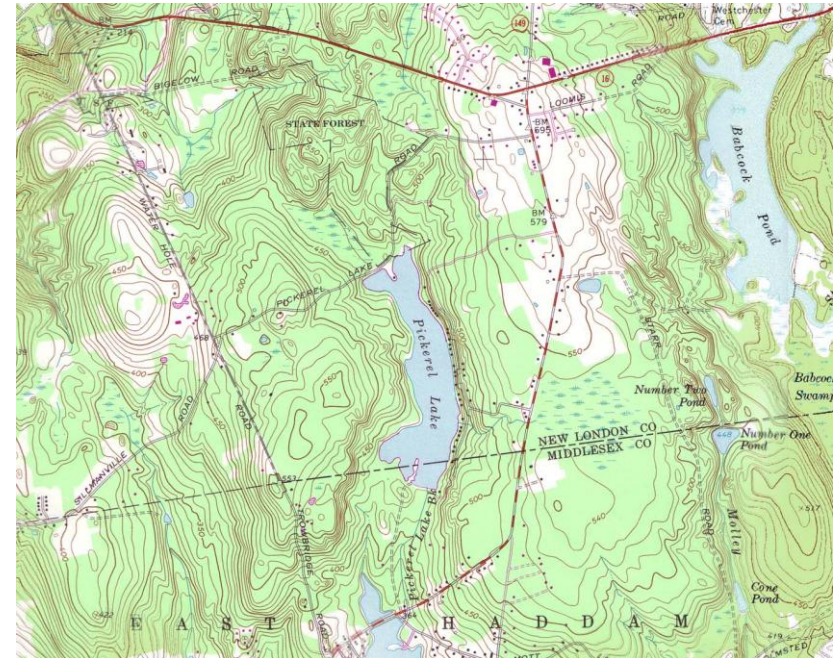
□ MAPS

- ▣ 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

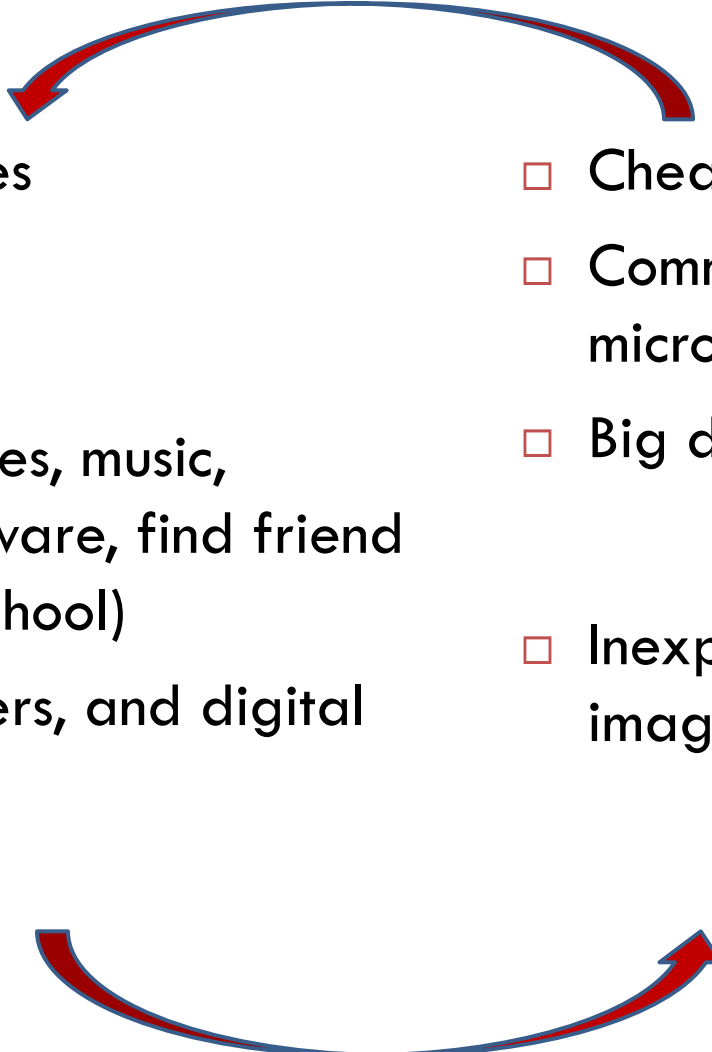


Problems with maps

- ❑ 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

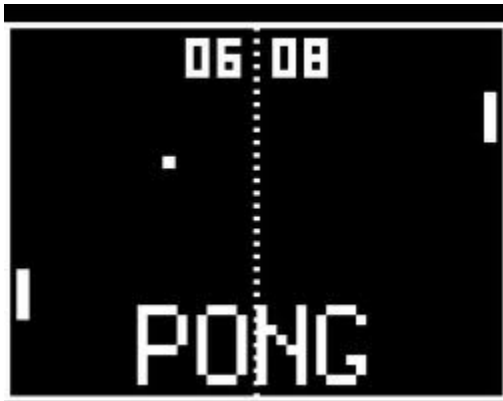


Consumer trends & feedback loop

- 
- 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

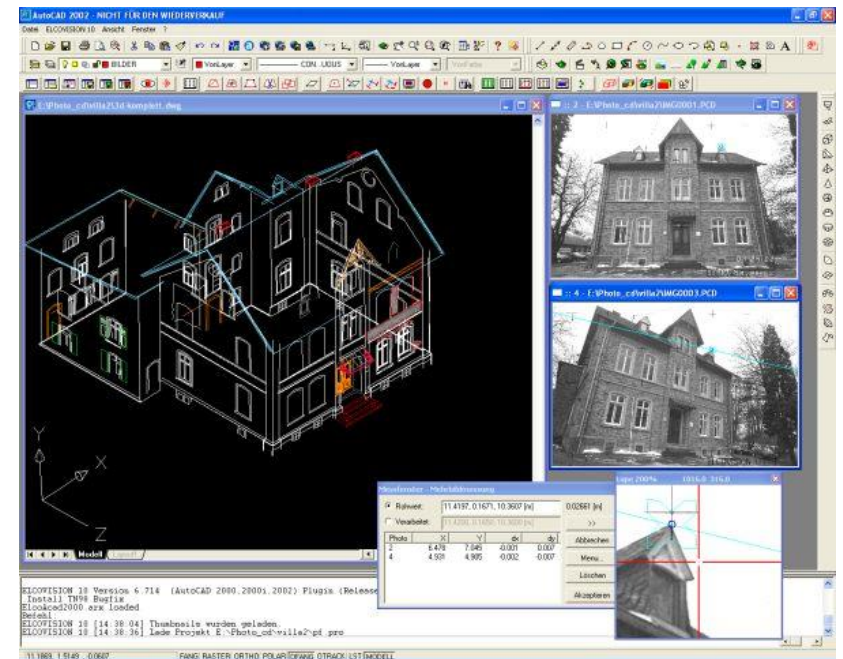
- Satellite data



Found at landsat.gsfc.nasa.gov

Data trends

□ CAD/CAM



Found at architecture411.com

Data trends

- Databases (DB) and land-use records



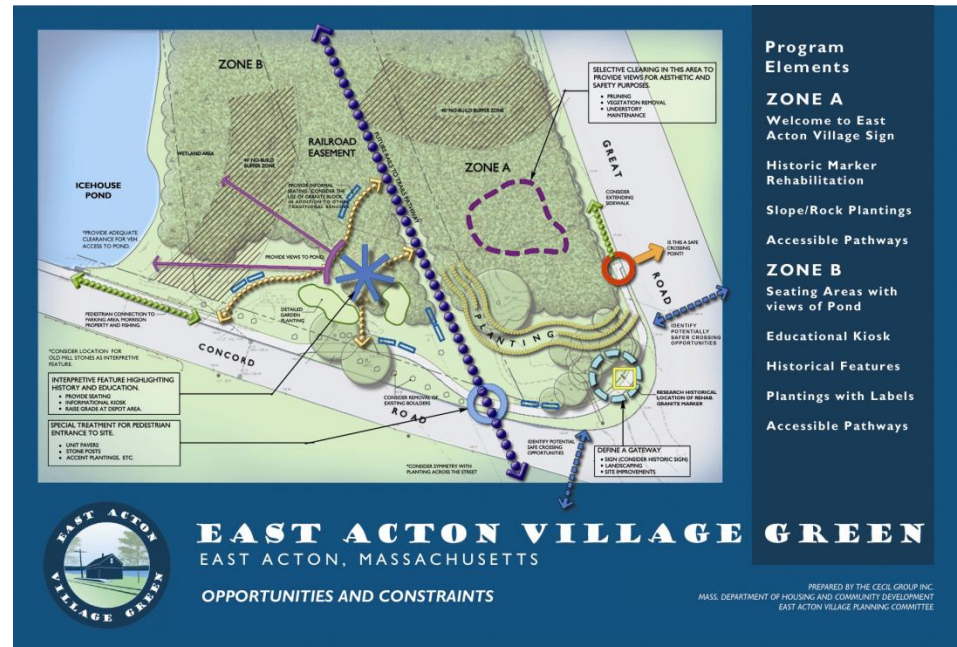
Found at historyoffreeding.com

Trends set the stage commercialization of GIS

Where GIS Started

□ Ian McHarg- Design with Nature

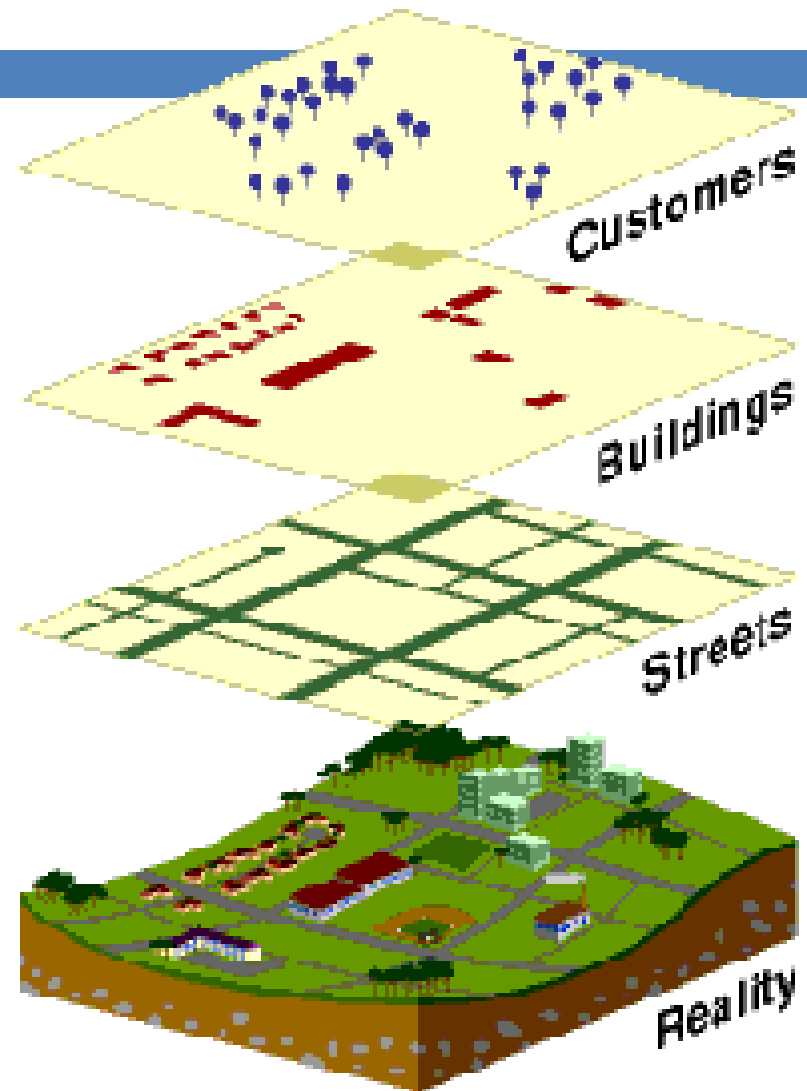
- Used a series of trace paper **overlays** to prioritize development. Came out of landscape architecture and urban planning traditions (integration)
- Regional planning scale
- Structure very similar to GIS
- Answers question: How do you plan development while limiting damage to the environment?
- How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



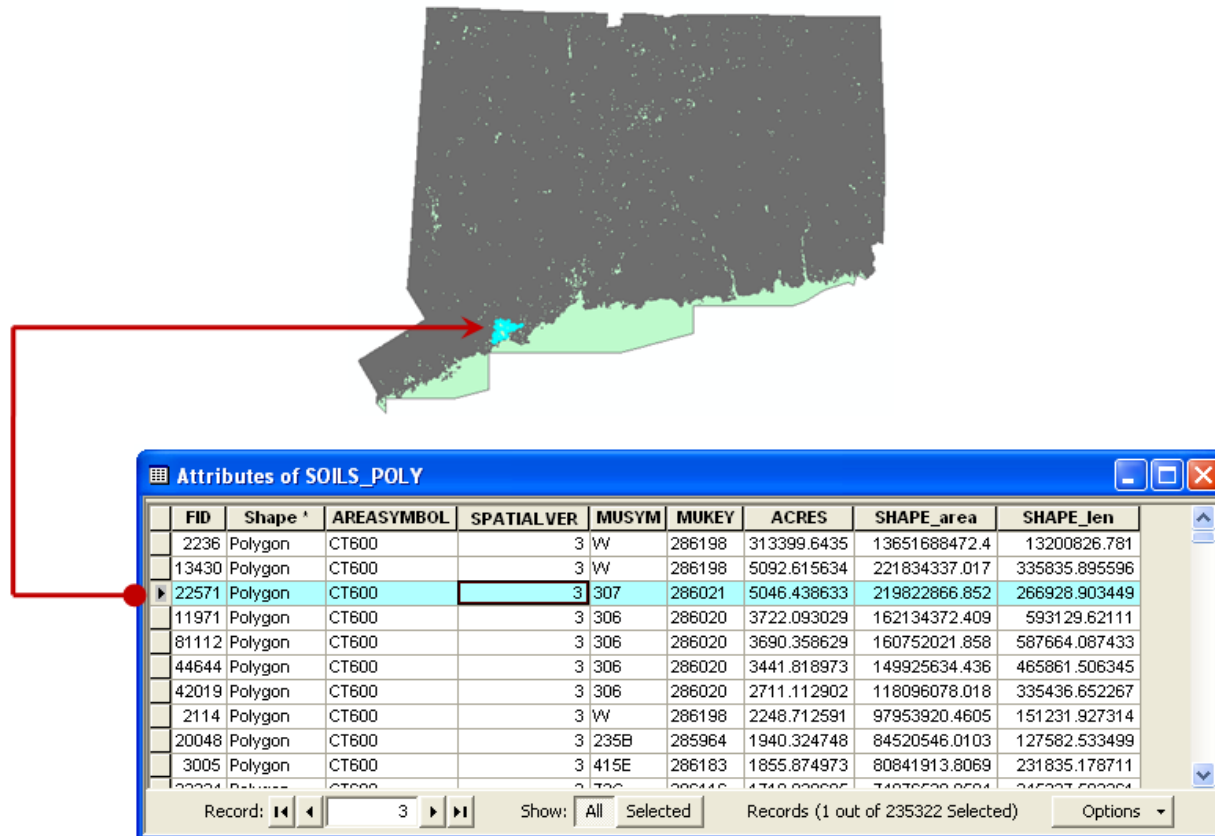
What is a GIS?

- 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



GIS software structure

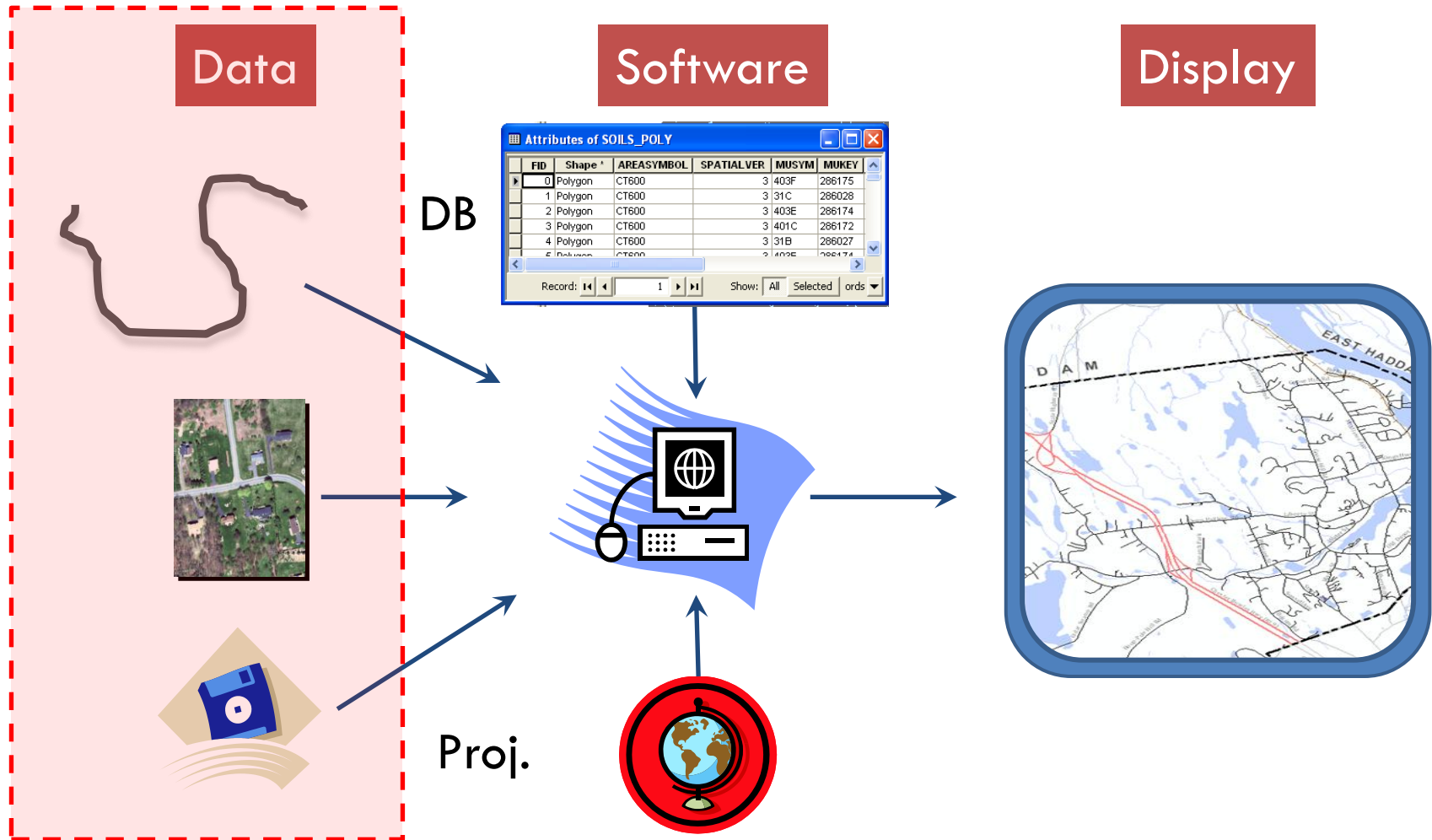
Data

Software

Display



Components of GIS: Data



Data Types

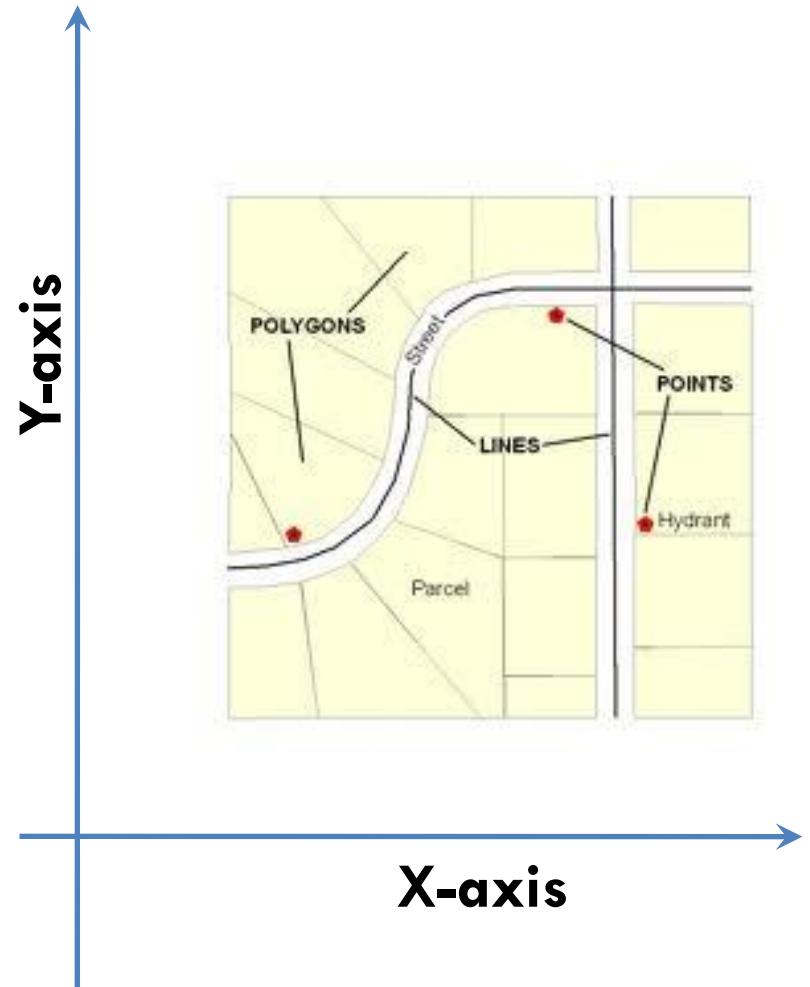
Vector

Raster

Aspatial data

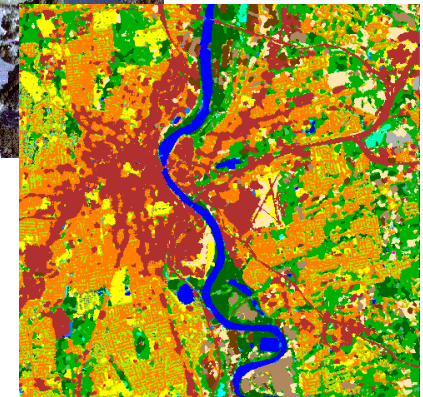
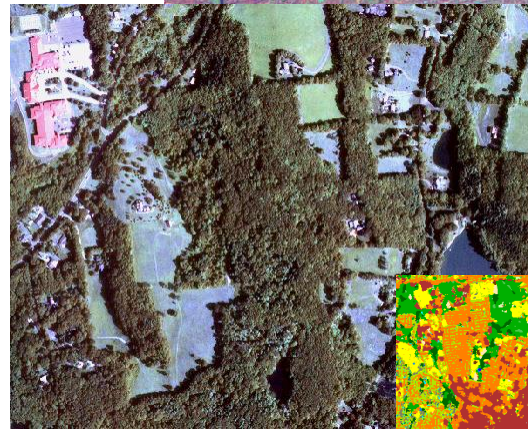
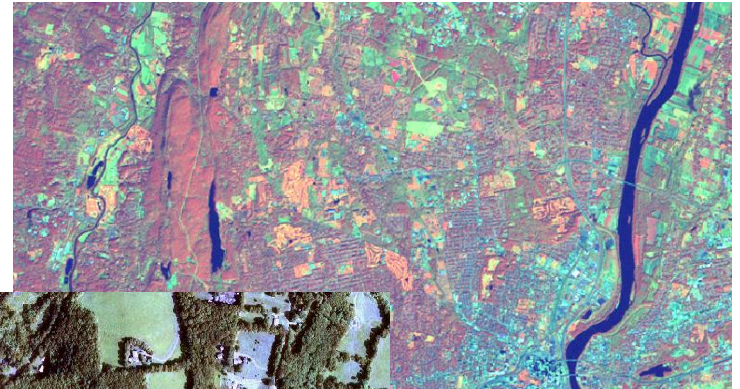
Vector data

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



Raster

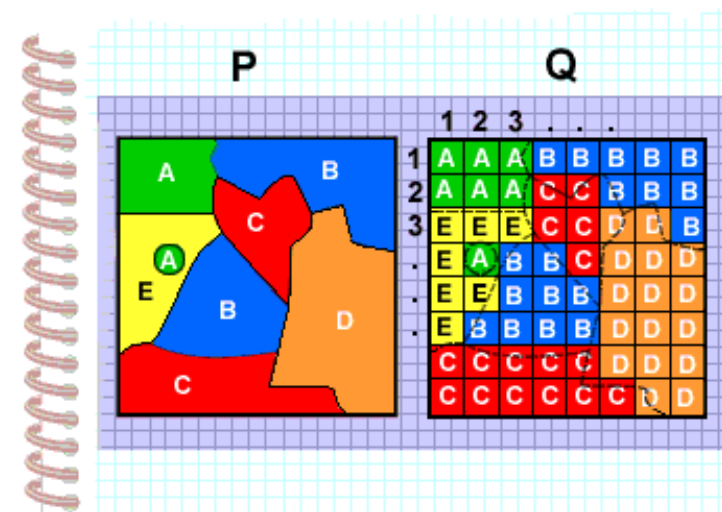
- Like your digital photograph
- A tessellation of space. It is matrix of cells or pixels that completely covers an area of interest and is referenced to a coordinate system.
- Used in land cover maps and imagery
 - ▣ High-res imagery particularly useful



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

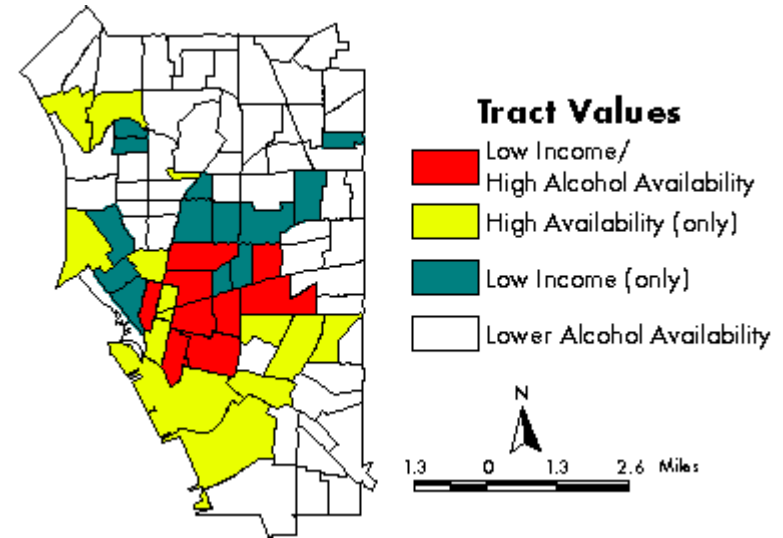
Non-spatial

□ Non-spatial data can be linked to spatial data like political boundaries

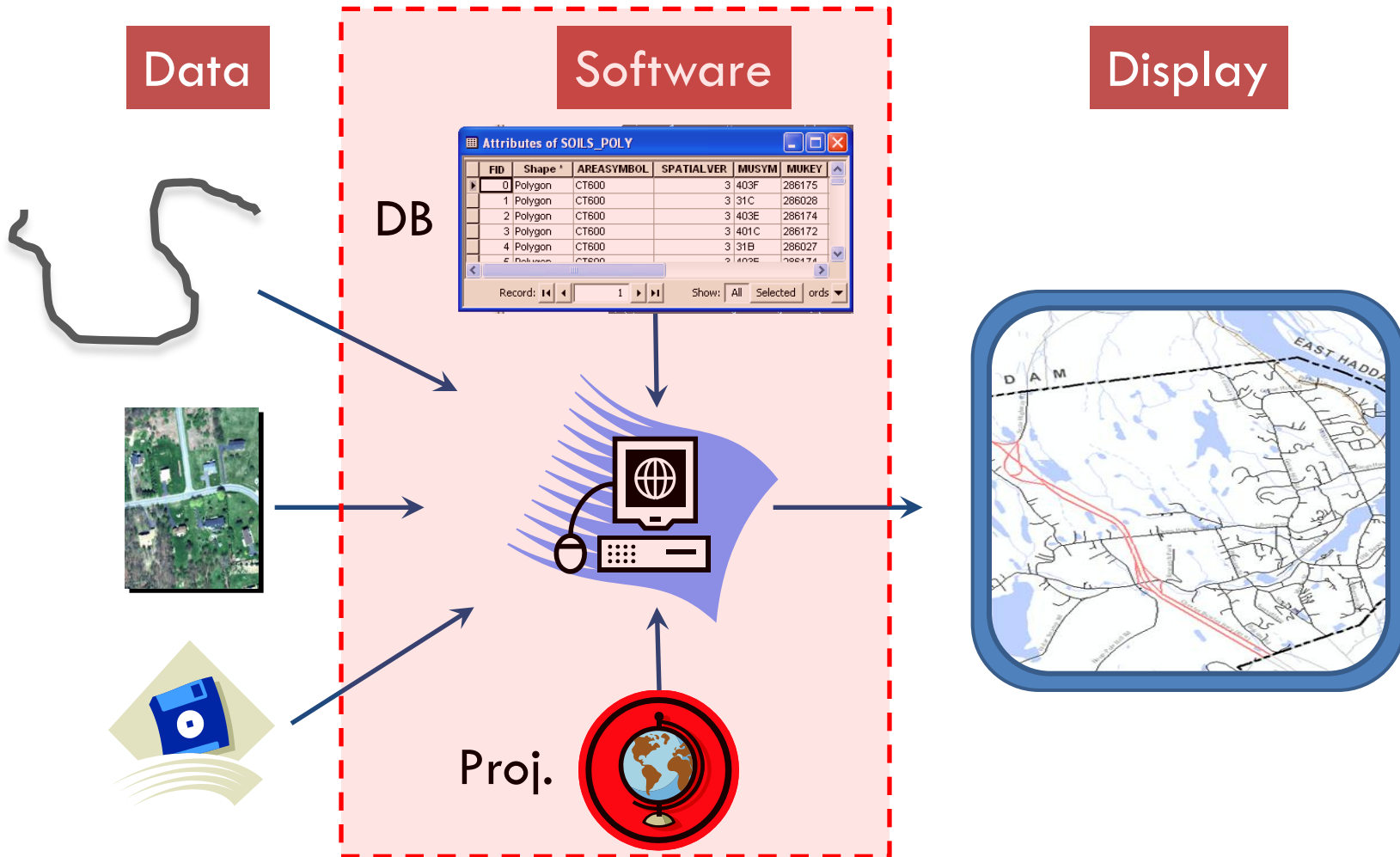
□ Examples

▣ Address

- Gender
- Income
- Health
- Mortality



Components of GIS: Software



Software

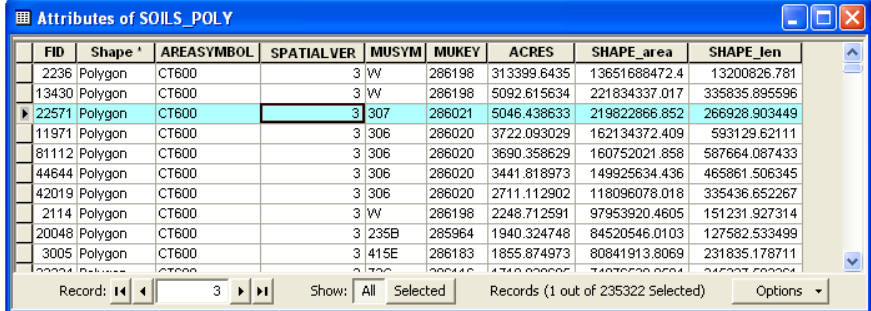
Database

Georeferencing and Projections

Geoprocessing

Database

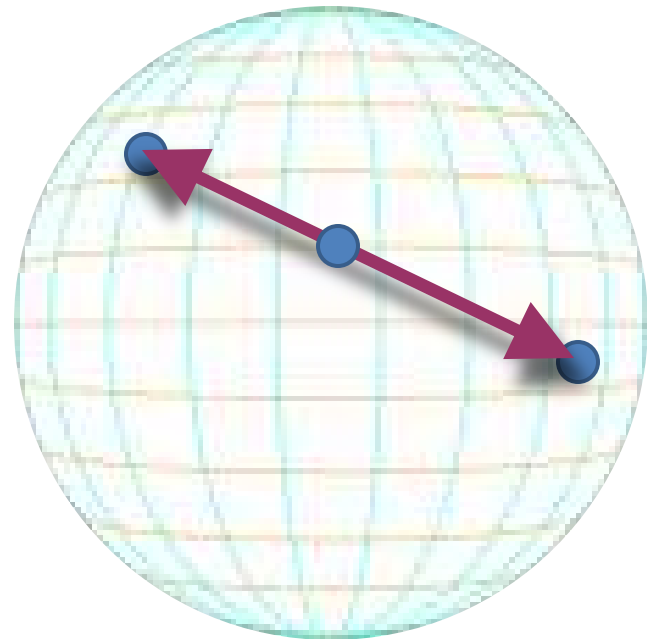
- A DB is a special kind of table at the heart of the software structure
- DB designed for rigor and scalability
- Holds both aspatial and spatial data
- The DB facilitates searches, mathematical operations and “joins”



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
20004	Polygon	CT600	3	W	286198	2710.000000	14000000.0000	140000.000000

Unique capability of a GIS

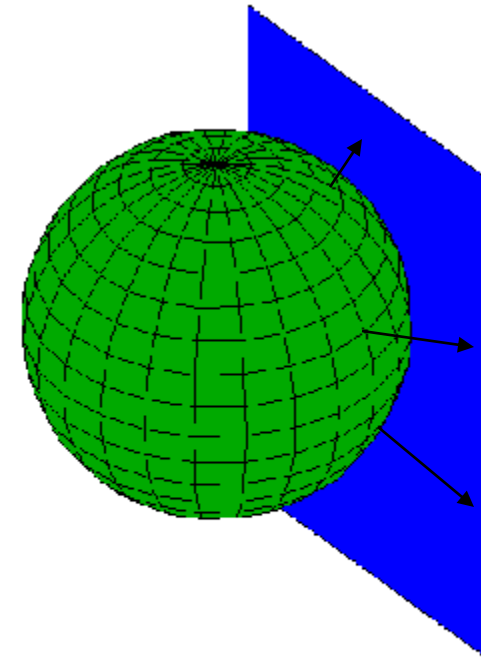
- Location and spatial data linkage is unique component of GIS
- Why is the spatial linkage a problem?
 - ▣ Earth is **NOT** round
 - ▣ X-Y-Z coordinates don't work well on a spheroid because lines aren't straight
 - ▣ Mathematics are tough



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

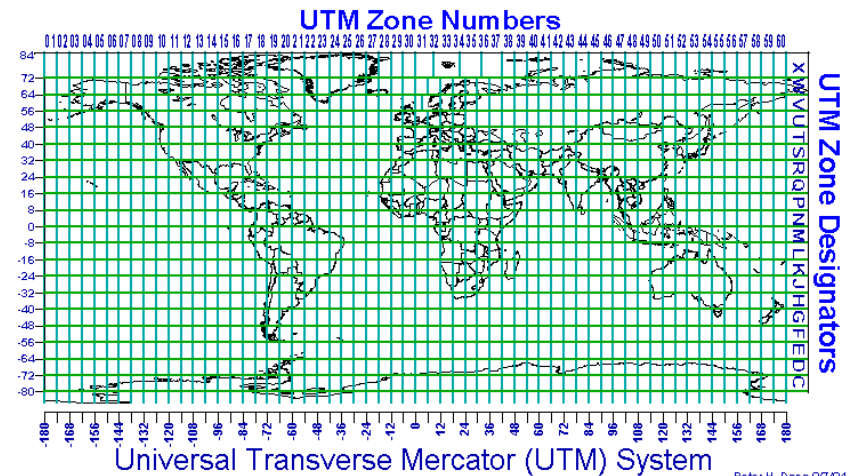
Peter H. Dana 9/20/94



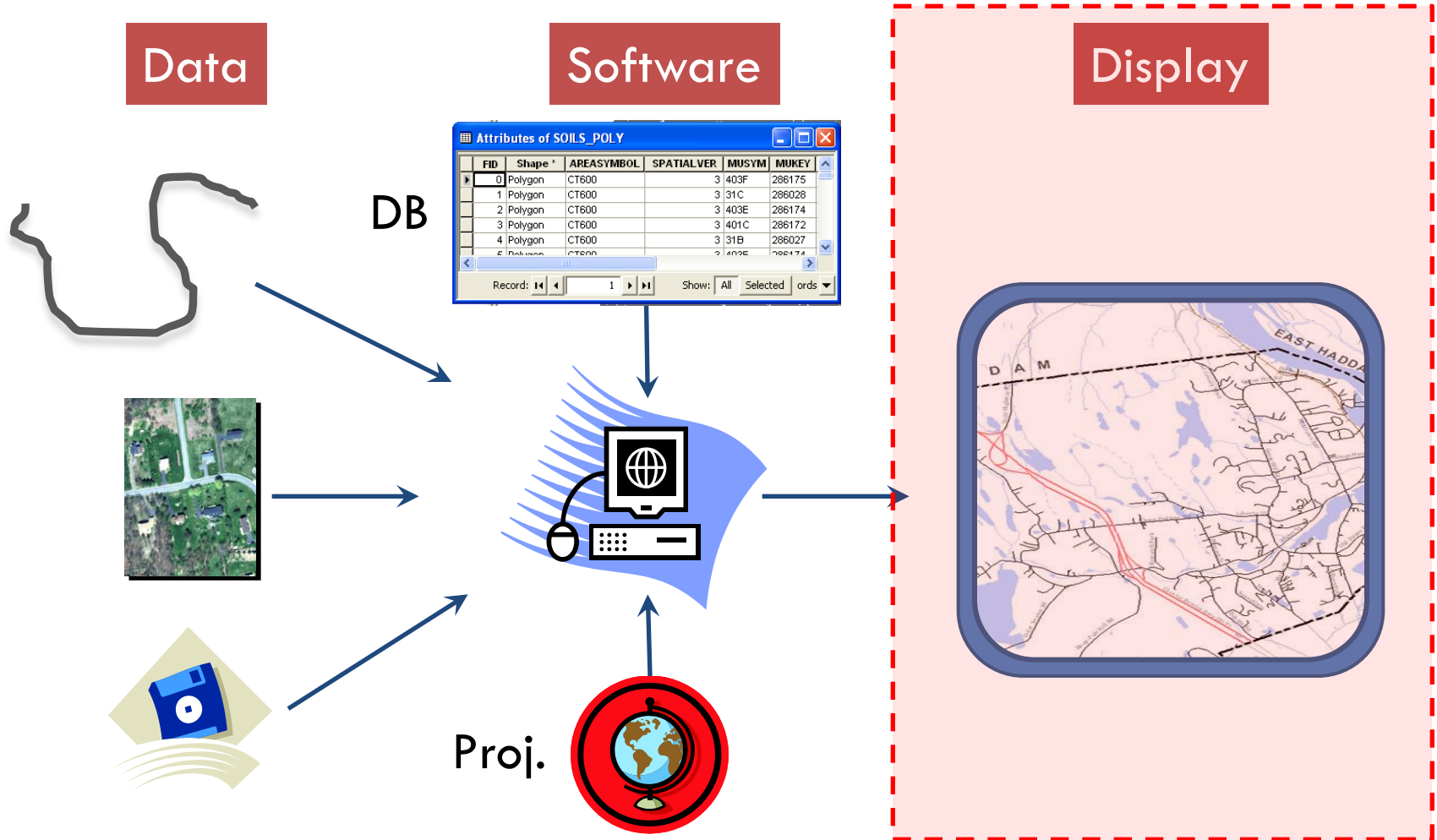
Planar Projection Surface

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

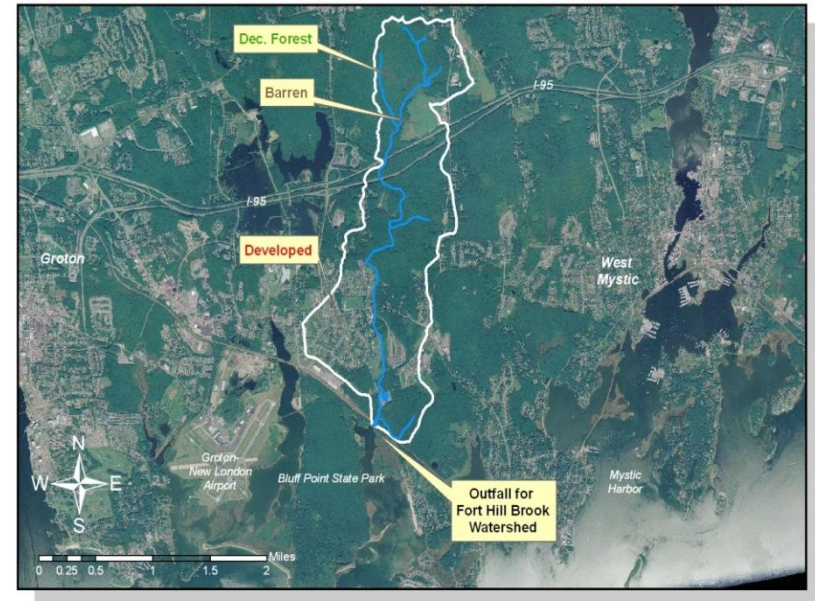
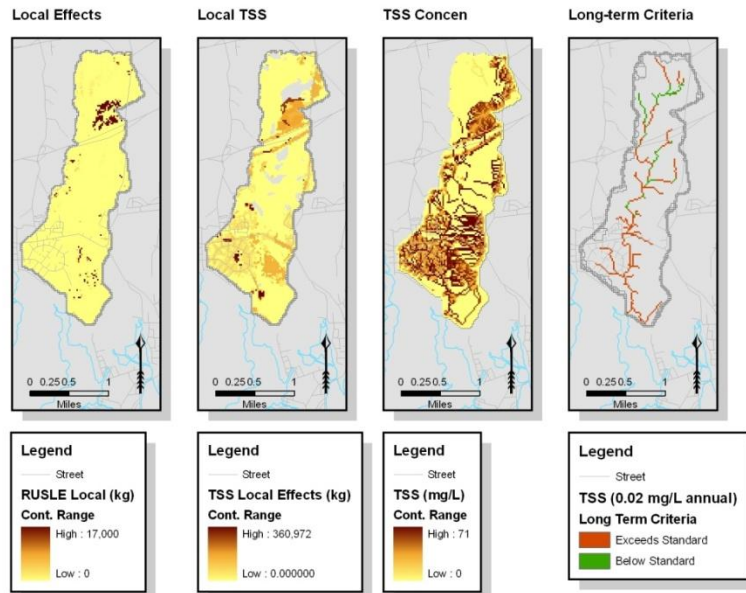
Web-served

PC or Desktop

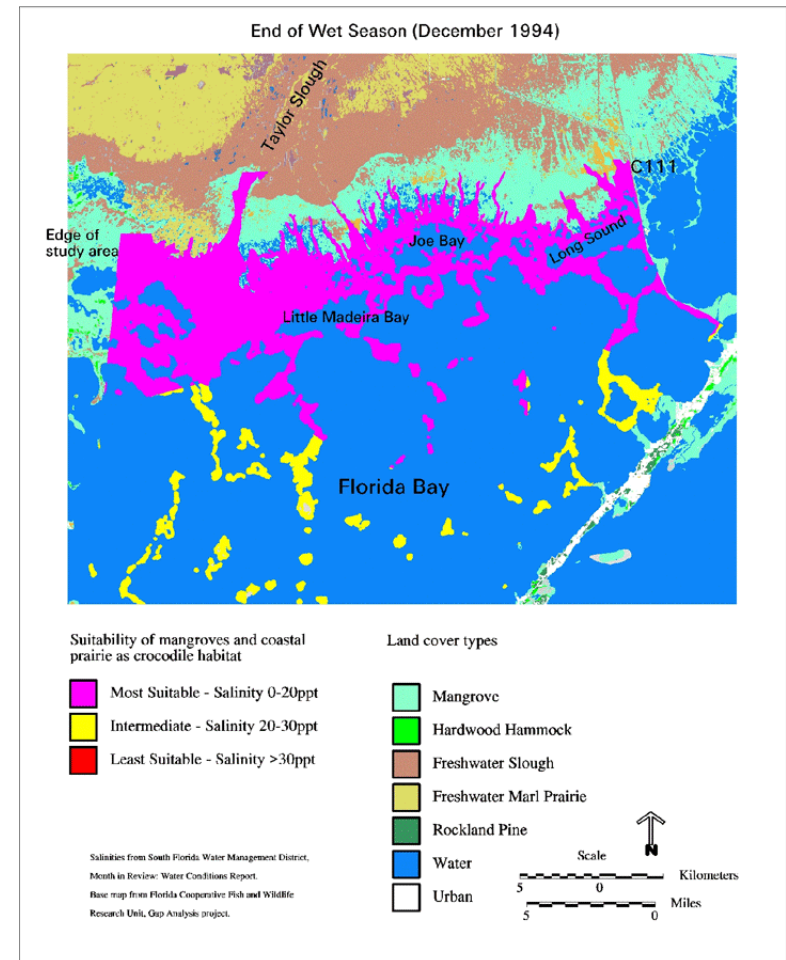
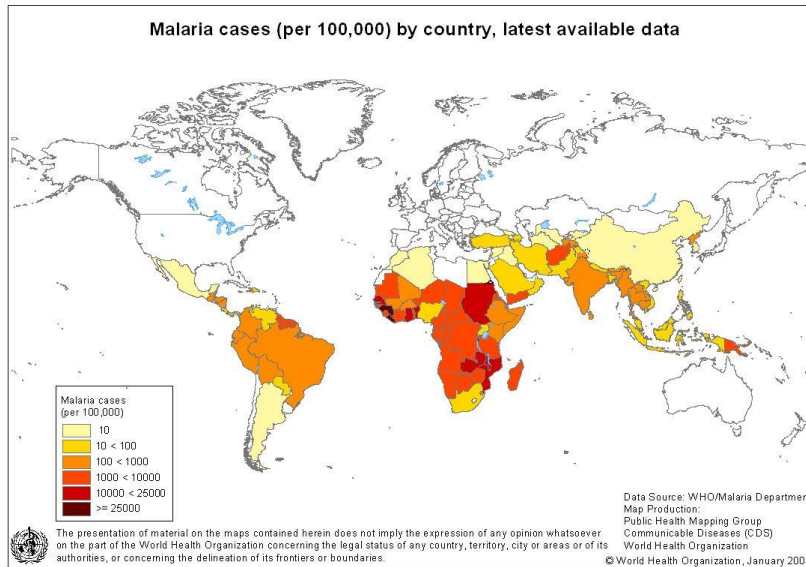
- ❑ Scalable
- ❑ Cartographic flexibility and producer oriented
- ❑ Production oriented
- ❑ Highly flexible



Cartographic flexibility

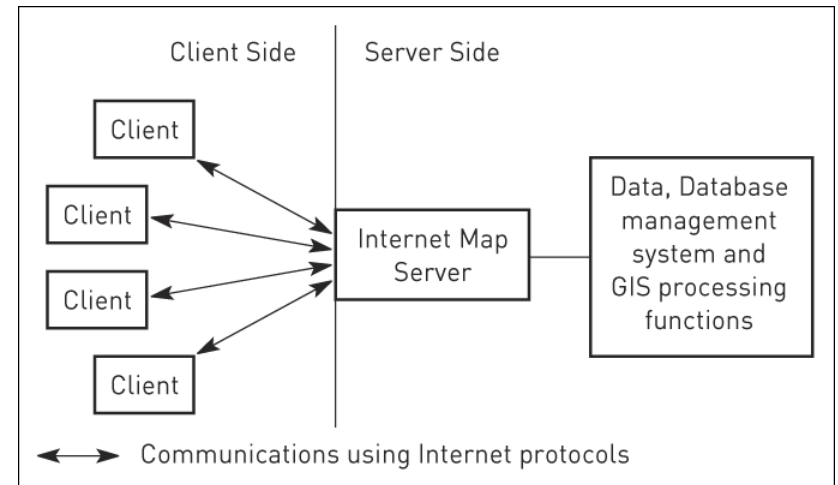


Cartographic flexibility



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 orthophotos
- 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



- ▶ Maps
- ▶ Guides
- ▶ Data
- ▶ Training



CT ECO provides a variety of tools for sharing natural resource and environmental information. Types of information include water resources, soils, open space, geology and aerial imagery.



CTMAPS

- ▶ **Map Catalog**

A variety of maps in PDF format.

- ▶ **Simple Map Viewer**

INFOGUIDES

- ▶ **Data Guides**

Basic description of CT ECO geospatial data and maps.

GISDATA

- ▶ **Data Download**

Link to sources of geospatial data for Connecticut.



Web Soil Survey

You are here: Web Soil Survey Home

Search

Enter Keywords
All NRCS Sites

Browse by Subject

- ▶ Soils Home
- ▶ National Cooperative Soil Survey (NCSS)
- ▶ Archived Soil Surveys
- ▶ Status Maps
- ▶ Official Soil Series Descriptions (OSD)
- ▶ Soil Series Extent Mapping Tool
- ▶ Soil Data Mart
- ▶ Geospatial Data Gateway

The simple yet powerful way to access and use soil data.



Welcome to Web Soil Survey (WSS)



Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

I Want To...

- Start Web Soil Survey (WSS)
- Know the requirements for running Web Soil Survey
- Know whether Web Soil Survey works in my web browser
- Know the Web Soil Survey hours of operation
- Find what areas of the U.S. have soil data

Announcements/Events

- Web Soil Survey Release History

I Want Help With...

- How to use Web Soil Survey

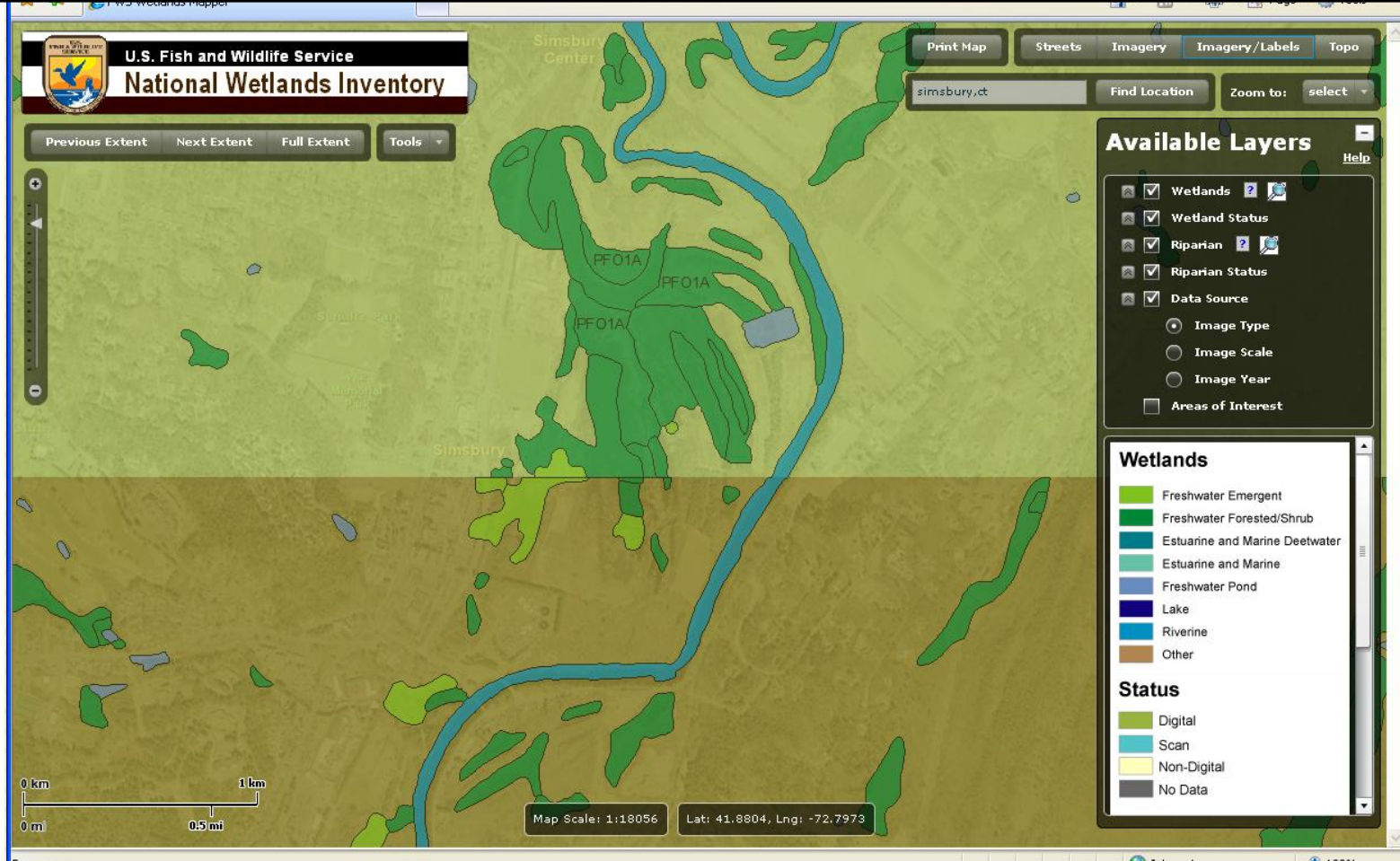
Web Soil Survey

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>

Explanation

- High
- ≥ 90th percentile
- 75th - 89th percentile
- 25th - 74th percentile
- 10th - 24th percentile
- < 10th percentile
- Low
- Not ranked

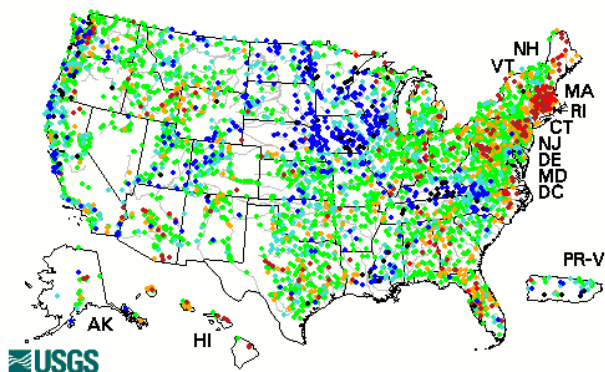
[News](#) - updated July 20, 2010

Real-time Data for the Nation

--- Predefined displays --- Group table by Select sites by number or name
 Introduction Hydrologic Unit

Daily Streamflow Conditions

Friday, August 20, 2010 14:30ET



Explanation

The colored dots on this map depict streamflow conditions as a [percentile](#).

Select a state from the map to access real-time data

Real-time data typically are recorded at 15- to 60-minute intervals, stored onsite, and then transmitted to USGS offices every 1 to 4 hours, depending on the data relay technique used. Recording and transmission times may be more frequent during critical events. Data from real-time sites are relayed to USGS offices via satellite, telephone, and/or radio telemetry and are available for viewing within minutes of arrival.

All real-time data are [provisional and subject to revision](#).

Build Table	Build a custom summary table of the most recent data for one or more sites, states, or hydrologic regions.
Build Sequence	Build a custom sequence of graphical or tabular data for one or more sites, states, or hydrologic regions.

USGS National Water Information System

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



GIS and Mapping resources in Connecticut

<p>Search public records by county</p> <p>Please select a county name below to view the public records directory and links by county.</p> <p>- Choose a Connecticut County <input type="button" value="v"/></p>	<p>Search public records by town or zip code</p> <p>Search Connecticut County pages by Town or Zip Code.</p> <p><input type="text"/> <input type="button" value="Go"/></p>	<p>Search public records by category</p> <p>Select Connecticut public records resource category below to view all online resources for that category.</p> <p>- Choose a Public Record Category <input type="button" value="v"/></p>	<p>Search public records in other states</p> <p>Go to the public records pages for another state.</p> <p>- Choose a State <input type="button" value="v"/></p>
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Advertising

Search CT Public Records

- [CT Marriage Records](#)
- [CT Divorce Records](#)
- [CT Criminal Records](#)
- [CT Death Records](#)
- [CT Birth Records](#)
- [CT Background Checks](#)

Public Records Search

Advertising

First Name: Last Name: State: Record Type:

Connecticut - GIS and Mapping Links

All links open in a new window.

[Recommend a link for this page](#)

Connecticut - Statewide

[Free Search](#)

[GIS Maps](#) broken link?

View GIS maps for municipal and state governments as well as for other entities.

Fairfield County

Search Records By Name

First Name:

Last Name:

Record Type:

Aggregate Site of GIS and Mapping Info

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

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Travel to cities across the globe, dive into the depths of the ocean, explore remote islands, and even fly to faraway galaxies.

[Learn more](#)

Get the world's geographic information at your fingertips.

Download Google Earth 5

- Fly to any place around the world.
- See 3D buildings, imagery, and terrain.

Google Earth Pro

Upgrade to the ultimate mapping application for business users. [Learn more](#)

[Products Overview](#)[Showcase](#)[Learn](#)

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.

Get Directions My Maps

ct dep near Hartford, CT

 [Clemens Place](#) - [Show on map](#) » Sponsored Links
Metropolitan Apartments
The Pride of Hartford
www.Clemensplace.com
Clemens Place, 16 Owen St, Hartford, CT

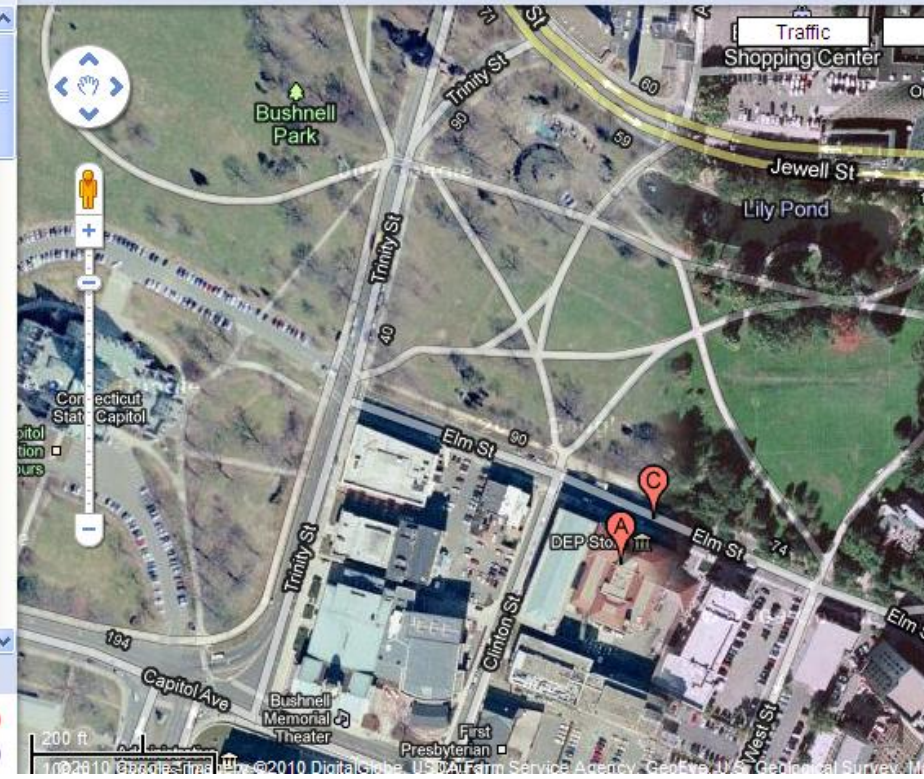
 [State of Connecticut: Other Emergencies \(Dispatch Center-Tdd\)](#) ▾ ☆ - [more info](#) »
79 Elm Street, Hartford, CT
(860) 424-3333 0.3 mi E
"To report a spill or leak, immediately call the CT-DEP's Oil and Chemical Response Division at 860-424-3338, 24 hours/day. Should this number become ..." ecarcenrcenter.org

 [State of Connecticut: State Parks](#) ▾ ☆ - [more info](#) »
950 Main St, Hartford, CT
(860) 424-3200 (TTY/TDD) 0.7 mi NE
[17 reviews](#)
"Nepaug State Forest CTDEP Satan's Kingdom Rd New Hartford CT 06057"

Hide

ct dep hartford,ct

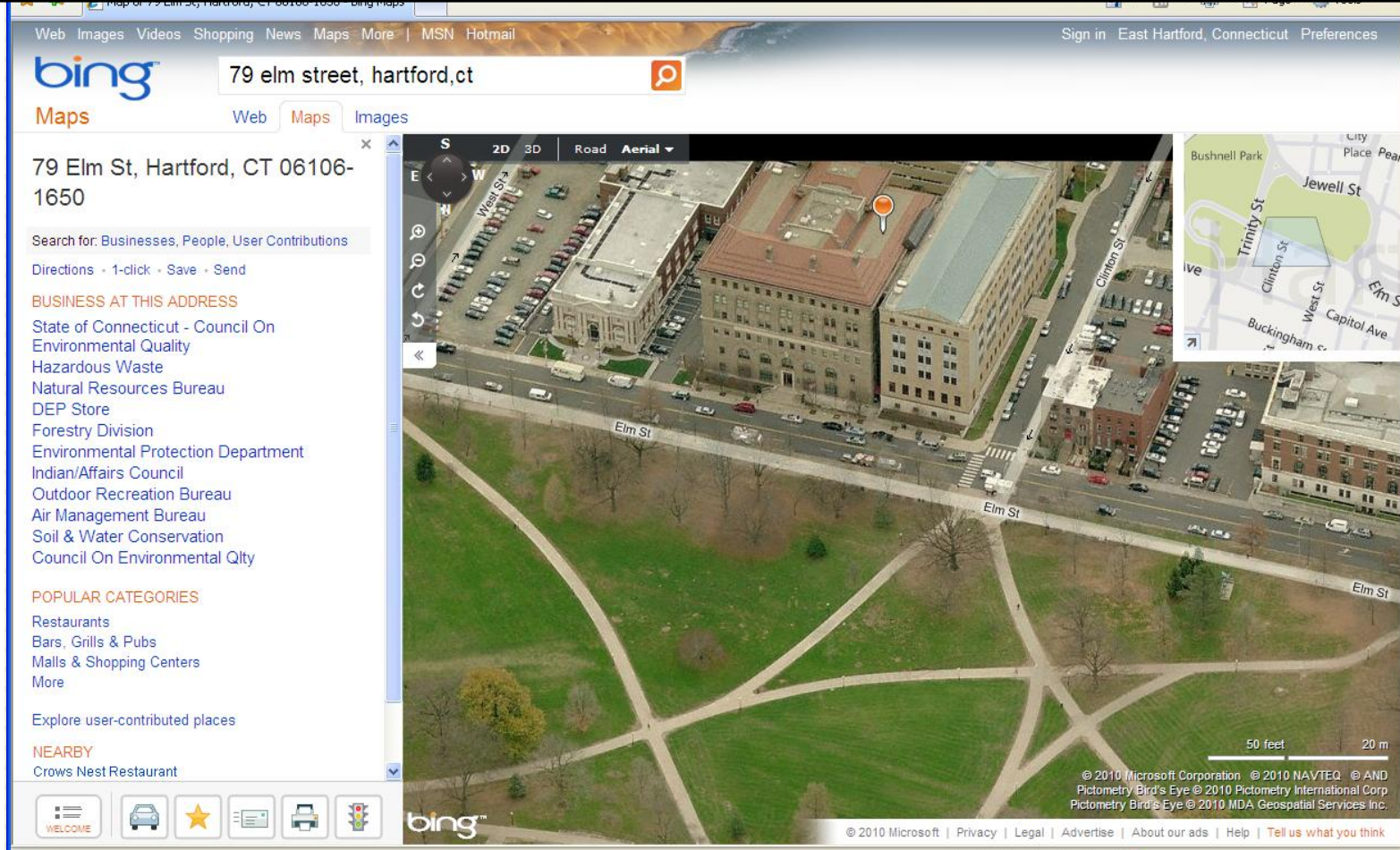
google earth



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

http://www.getlatlon.com/ USCG Web Search

Get Lat Lon - find the latitude and longitude of a ...

Get Lat Lon

Find the latitude and longitude of a point on a map.

Place name:

Map Satellite Hybrid OSM

Latitude, Longitude: 43.834526782236814, -37.265625

WKT: POINT(-37.265625 43.834526782236814)

Google Maps zoom level: 3

Built by [Simon Willison](#)

Done Internet | Protected Mode: On 100%

GPS Coordinate finder

Finds high precisions GPS lat/long coordinates using a map
[www. Getlatlon.com](http://www.Getlatlon.com)

CT Historical Imagery

<i>Year</i>	<i>Site</i>	<i>Location</i>	<i>Imagery Type</i>	<i>How</i>
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

□ ArcGIS Explorer-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>



The screenshot shows the ESRI website's training section. At the top, the ESRI logo is followed by the tagline "GIS Software that Gives You THE GEOGRAPHIC ADVANTAGE". A navigation menu includes Home, Industries, Products, Training, Support, Services, Events, News, and About. The main heading is "Training". Below this, there are three main columns: "Starting Points" with links for "Getting Started for GIS Professionals", "Training Managers", and "Students and Faculty"; "My Training" with links for "My Courses" and "My Training History"; and "Annual User Licenses" with links for "Login" and "Learn more". A "Resources" section includes a link to the "Esri Training Matters Blog". The "Free Live Training Seminars" section features a "Next seminar: October 28, 2010" titled "Introduction to ArcGIS for iOS" and a small image of two people at a computer. The "Find Training" section has a search bar and a "Search" button. Below the search bar, there are links for "Search by Software", "Class Schedule", and "Course Recommendations". A "Learn about" section includes links for "Types of Training", "Training Locations", and "Authorized Training Program". At the bottom right, there is a link for "ArcGIS 10 Training Now Available" with the subtext "Learn how to be more productive and".



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



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AN INTRODUCTION TO GIS AND
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Questions?

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