Geographic Information System (GIS)

What is GIS?

Think About Geography

What is Geography?

- Association of American Geographers' definition:
  - Geography is the science of place and space

- Merriam-Webster's definition:
  - A science that deals with the description, distribution, and interaction of the diverse physical, biological, and cultural features of the earth's surface

Think About Geography

Questions Geographers Ask

- Where is it located?
- Why is it located there?
- How and why are places different?
- How do people interact with their environment?

The answer to these questions is spatial data

History of Cartography

- The First Maps
  - Rock walls
  - Clay tablets
- Uses of Maps
  - Topographic
  - Celestial
  - Cosmographic

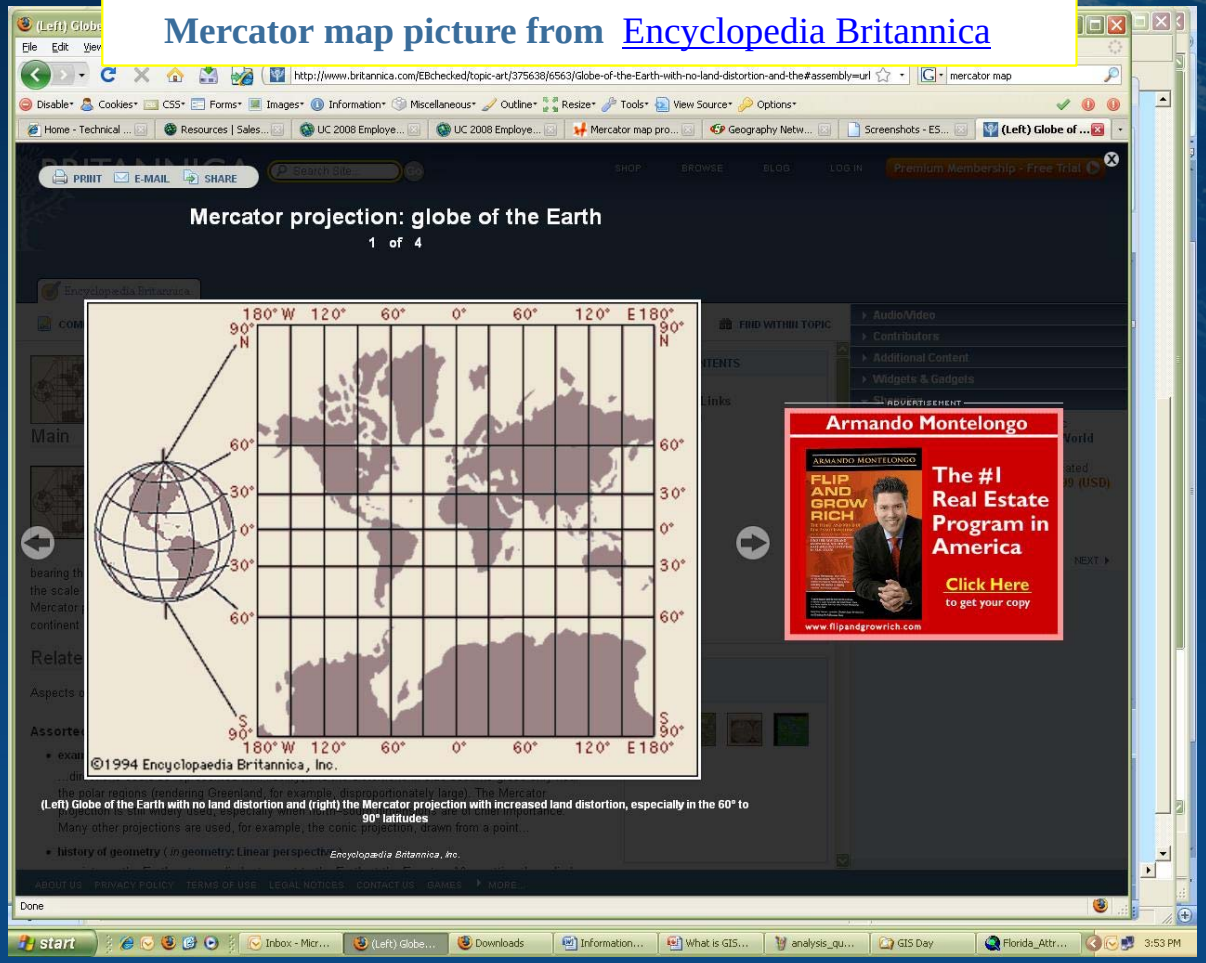
Picture of a cuneiform tablet from
http://www.crystalinks.com/cuneiformtablets.html

Early Maps of the World

Picture of a T-O map from University of Texas, Foundations of Western European Cartography

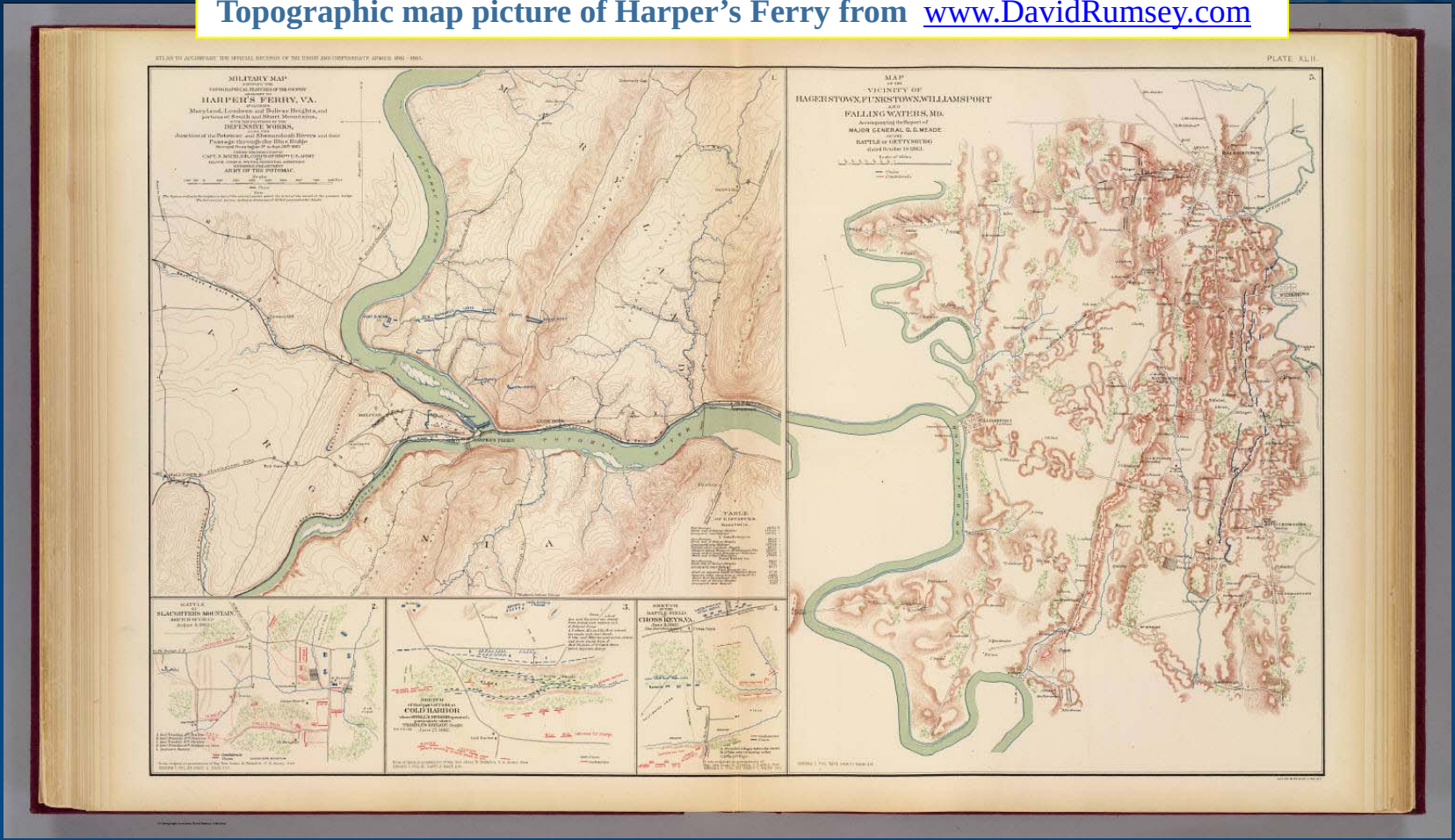
Exploring the World

Mercator map picture from [Encyclopedia Britannica]

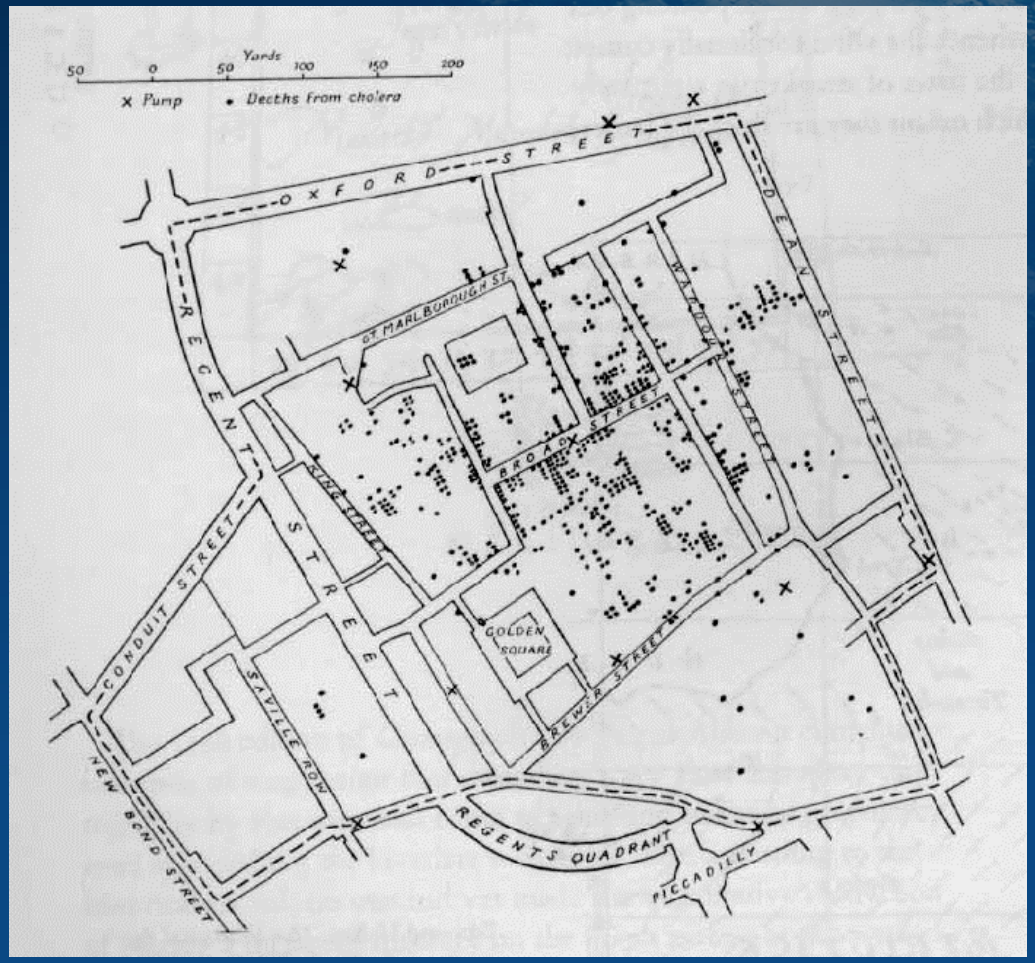


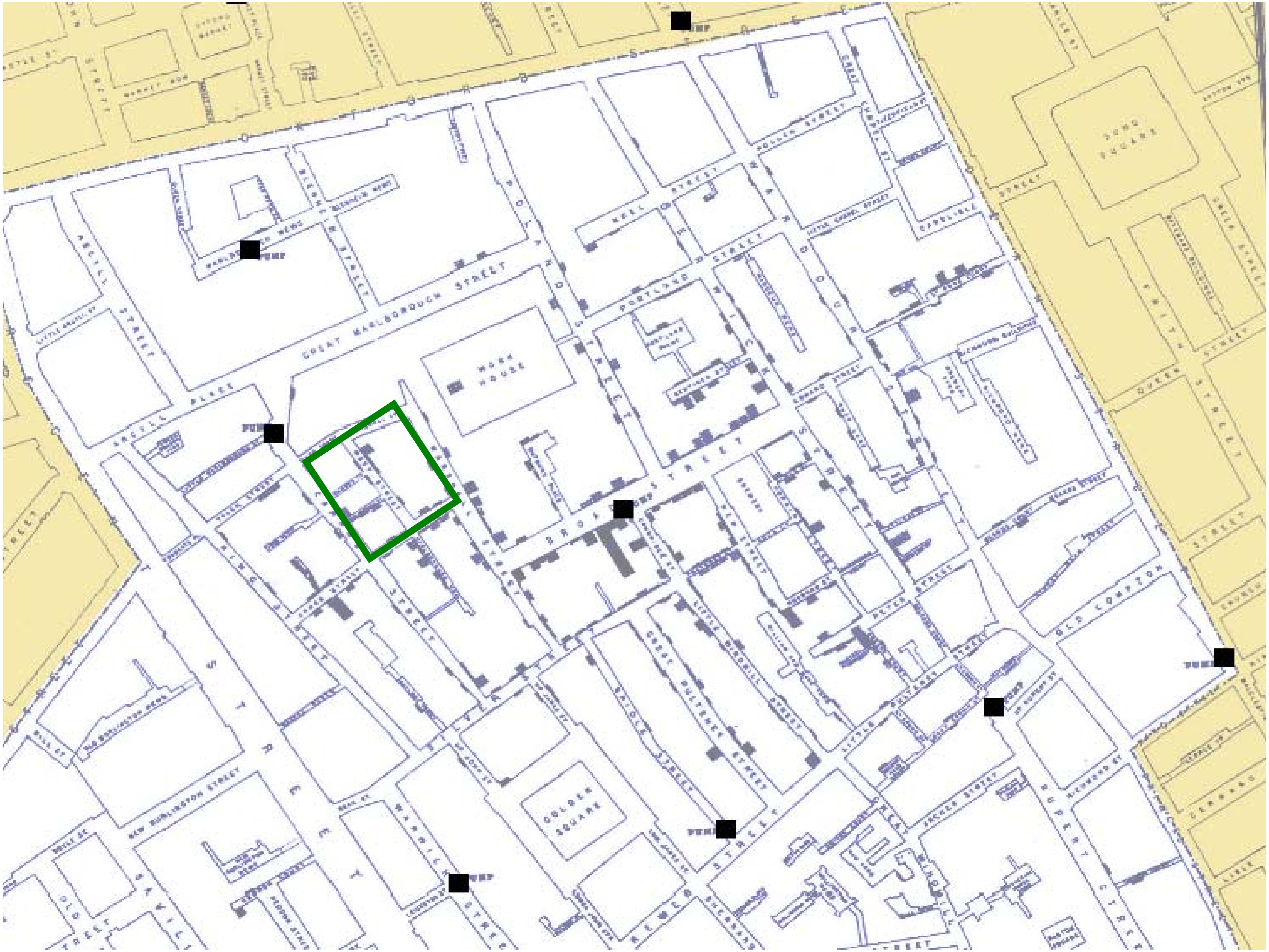
Maps at War

Topographic map picture of Harper's Ferry from www.DavidRumsey.com



Linked information reveals patterns…

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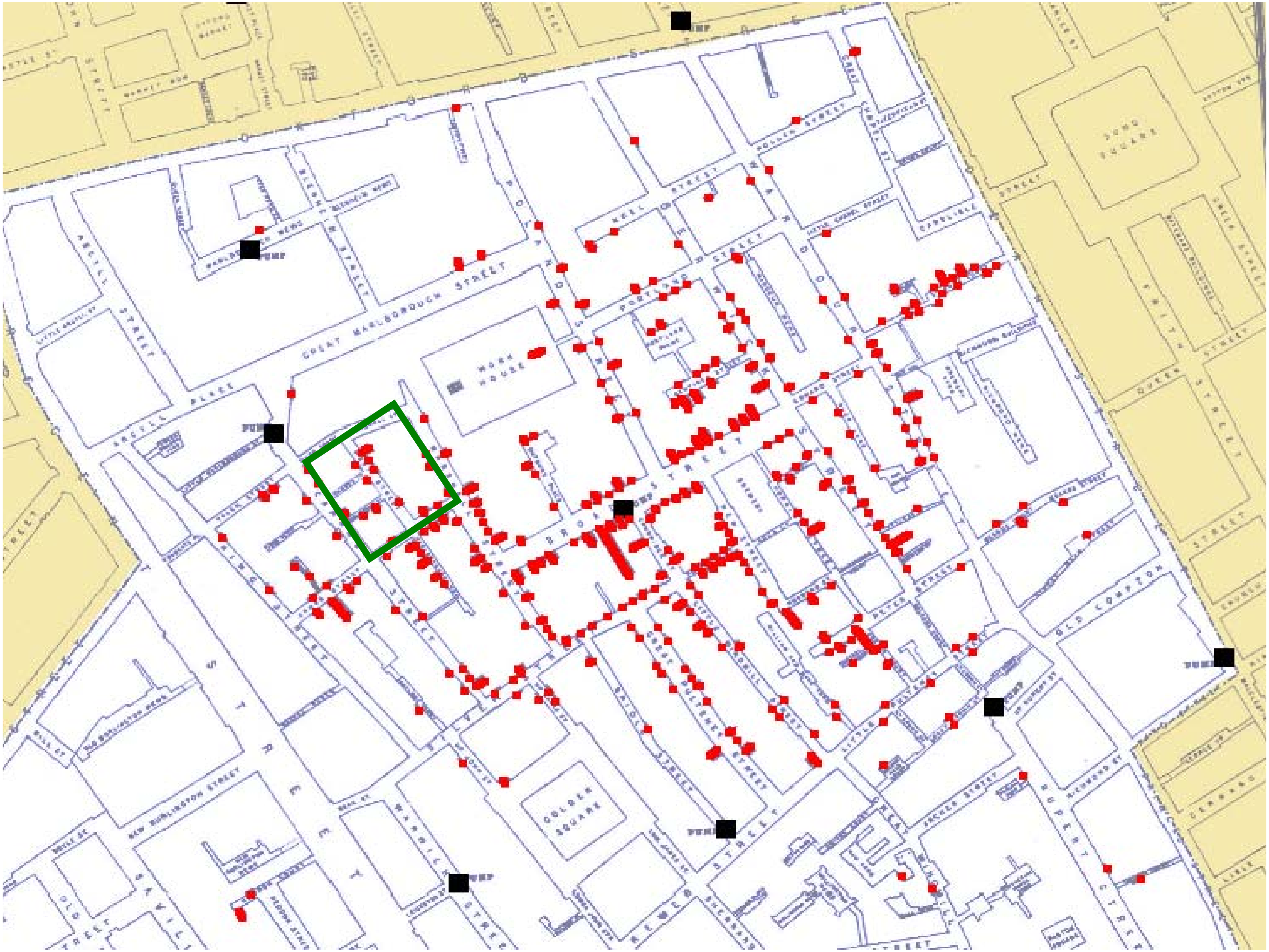
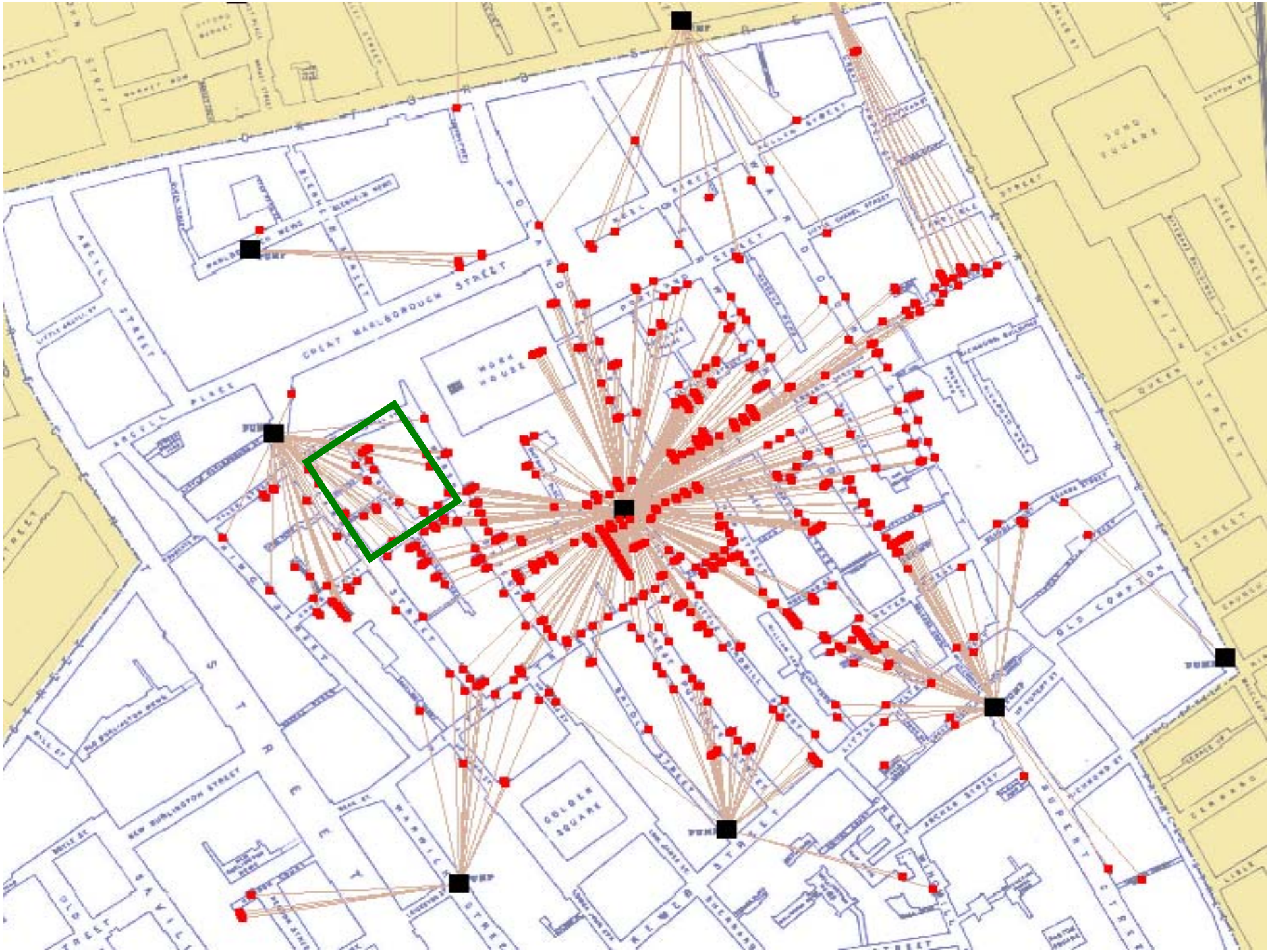
WORK HOUSE
SOHO SQUARE
GOLDEN SQUARE
OLD COMPTON
NEW BURLINGTON STREET


GREAT MARLBOROUGH STREET
WORK HOUSE
GOLDEN SQUARE
SOHO SQUARE
OLD COMPTON
PUMP


GREAT MARLBOROUGH STREET
ARGYLL PLACE
ARGYLL STREET
MOSS HOUSE
GOLDEN SQUARE
OLD COMPTON
NEW BURLINGTON STREET

What is Spatial Data?

Location Data
- How Many? – What Kind? – Where?

Scale of Data
- Local to Global to Beyond

Data Presentation
- Words, Charts, Graphs, Tables, or Maps

Estimates are that 80% of all data has a *spatial* component
- Data from most sciences can be analyzed spatially

Geographic Information Systems
A Definition of GIS

A Geographic Information System (GIS) links locational and attribute information and enables a person to visualize patterns, relationships, and trends. This process gives an entirely new perspective to data analysis that cannot be easily seen in a table or list format or on a paper map.

Exploring data using GIS turns data into information and knowledge

Five Components of GIS

Hardware

The computer, peripherals, and sometimes servers on which the GIS operates

Software

Provides the functions and tools required to store, analyze, and display data

Data

Data is stored as vector, raster, or attribute data

Methods

The guidelines, specifications, standards, and procedures for collecting and analyzing data and applying GIS

People

GIS needs people to ask the questions; choose, collect, and analyze the data; and interpret the results

A Complete GIS

Visualization

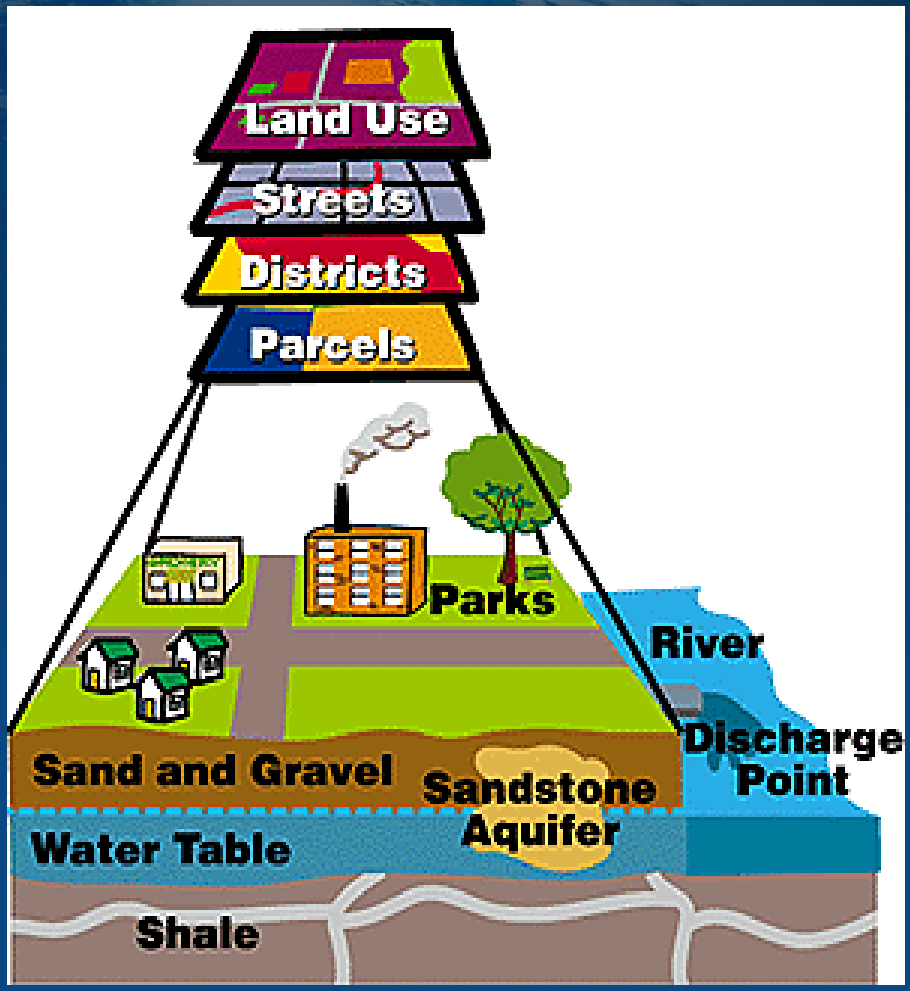
- *GIS as a tool to display spatial data as a map*

Database Management

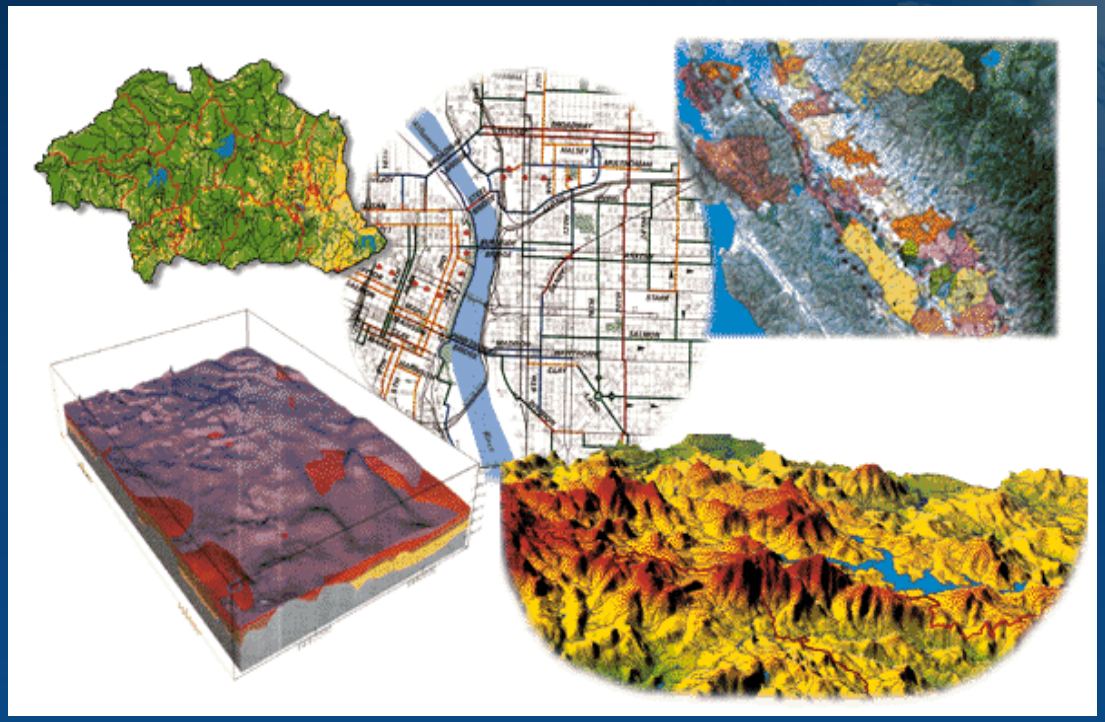
- *GIS as a tool to store and organize spatial data*

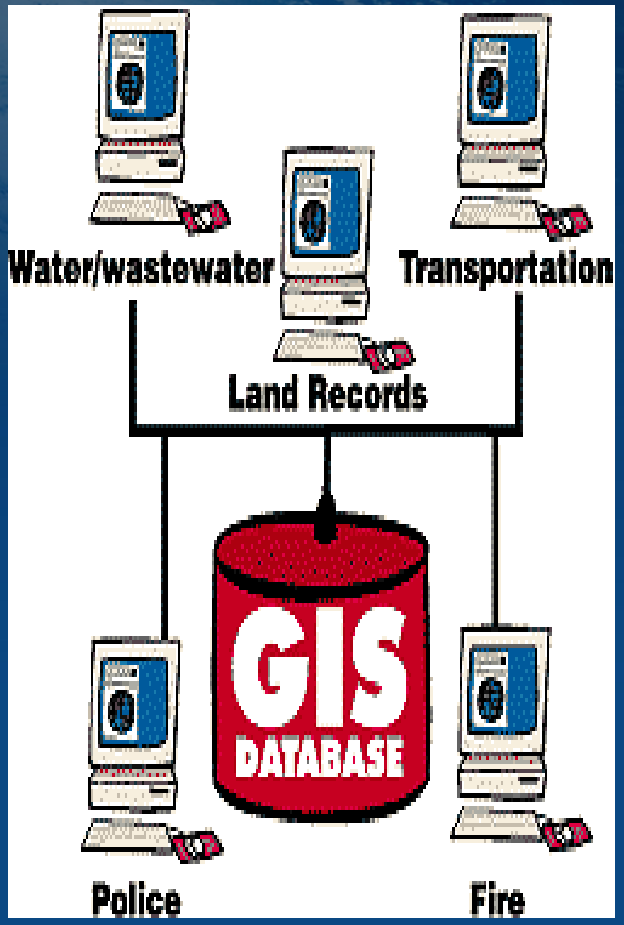
Spatial Analysis

- *GIS as a tool to analyze and interpret spatial data*

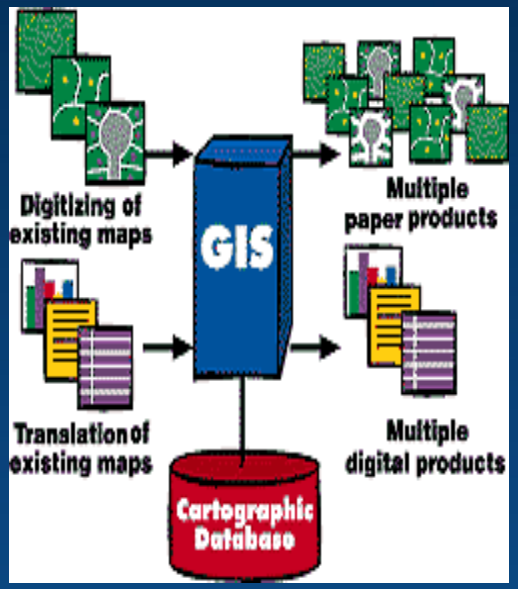


GIS Combines Spatial Data From Many Sources





Sources of Spatial Data



Digitized and Scanned Maps

- Purchased, donated, free (Internet)
- Created by user

Databases

- Tables of data

GPS

- Global Positioning System
- Accurate locations

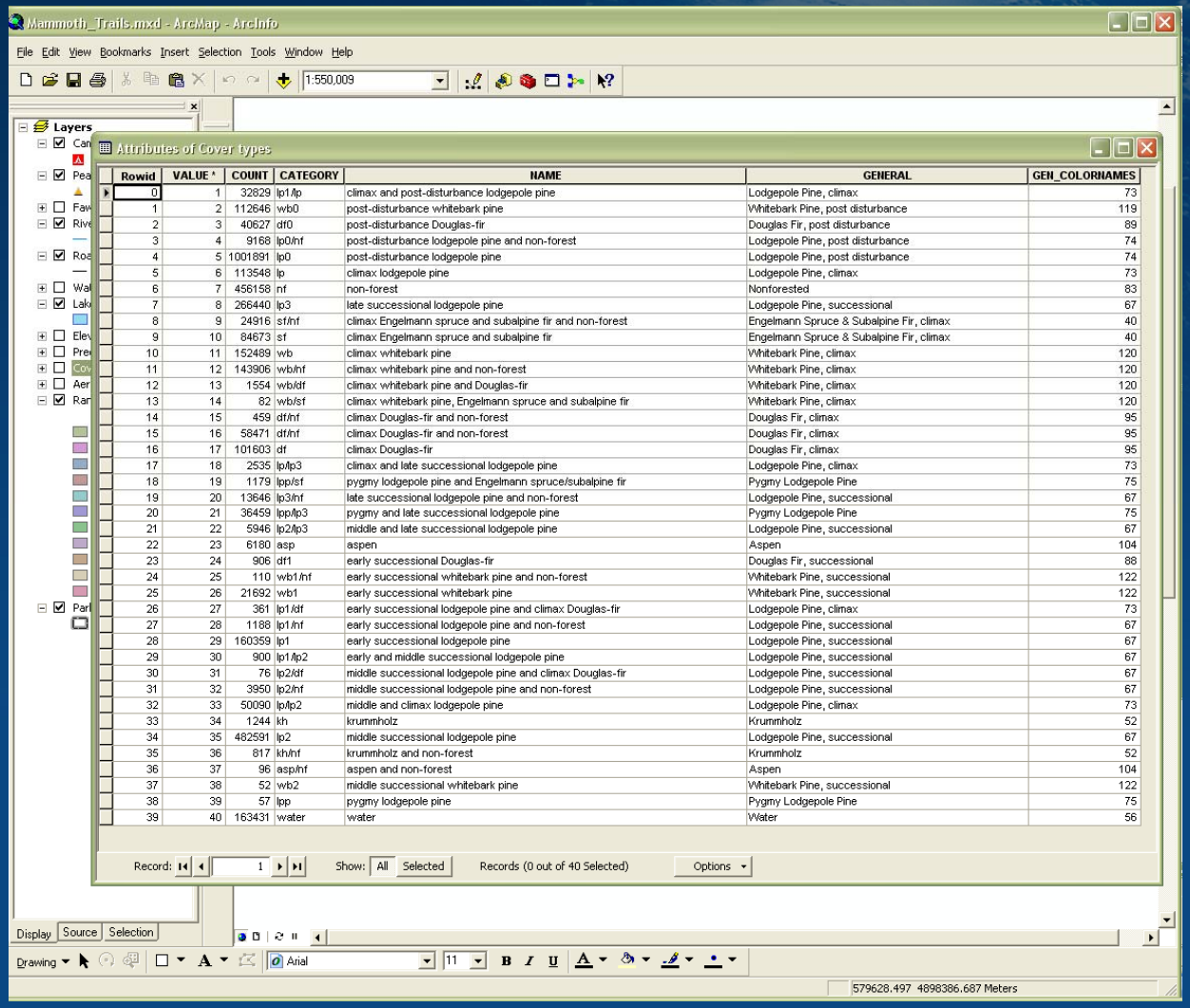
Field Sampling of Attributes

Remote Sensing and Aerial Photography

GIS stores and organizes spatial data in databases

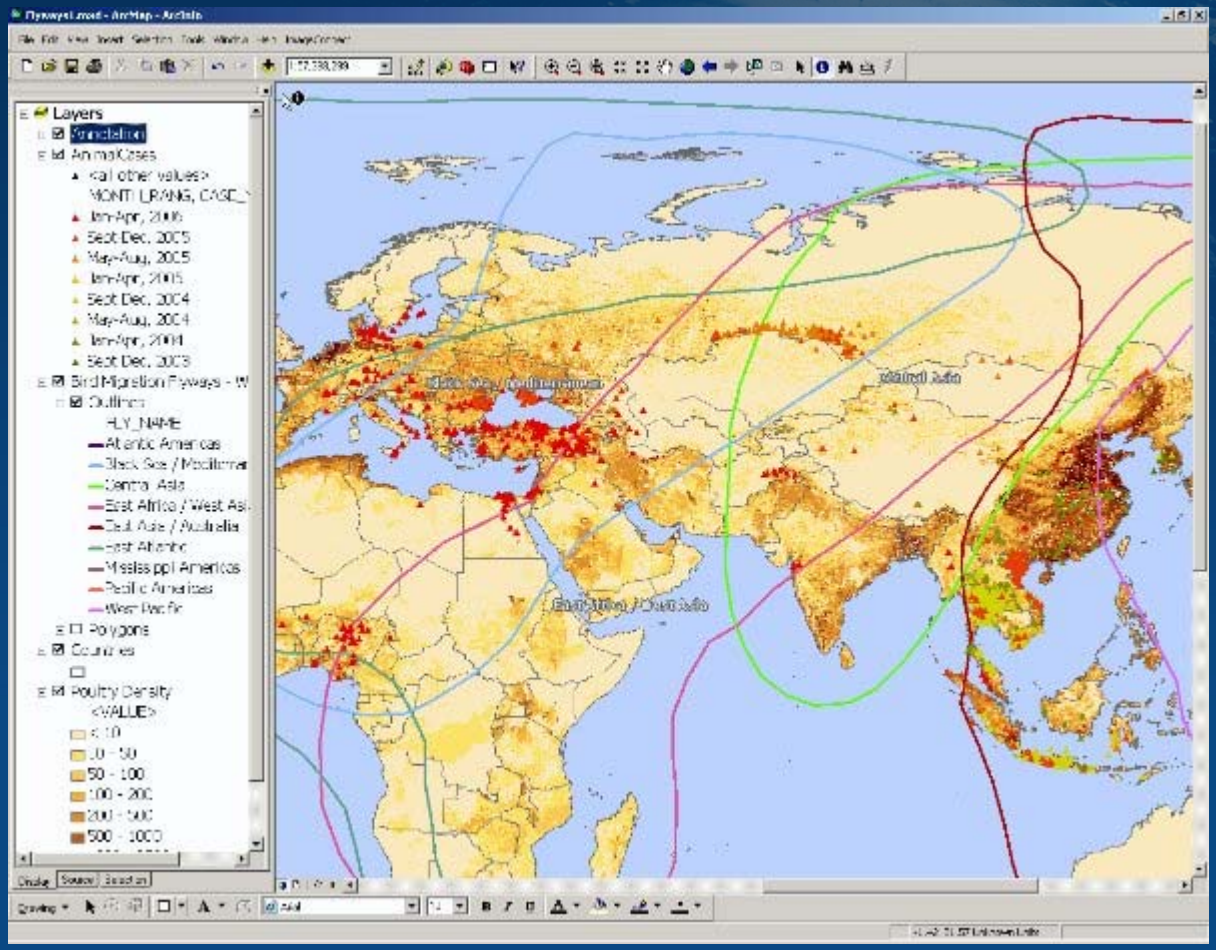
Database

Not easy to interpret

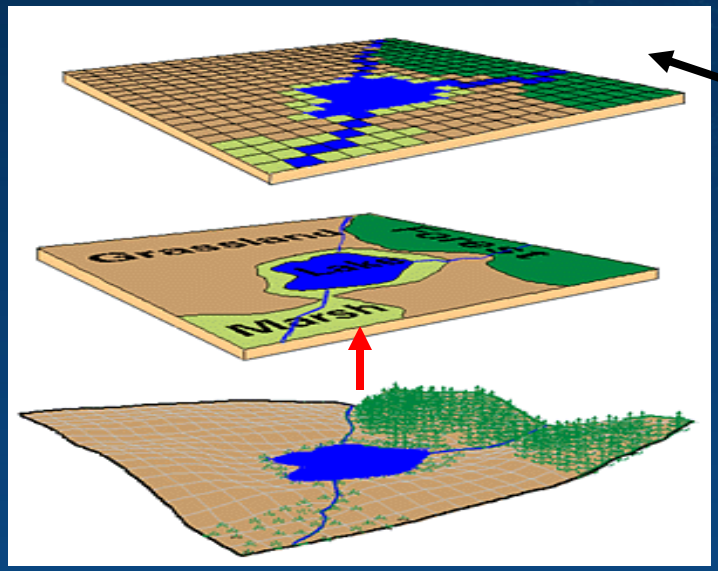


Rowid	VALUE	COUNT	CATEGORY	NAME	GENERAL	GEN_COLORNAMES
0	1	32829	lp1/lp	climax and post-disturbance lodgepole pine	Lodgepole Pine, climax	73
1	2	112646	wb0	post-disturbance whitebark pine	Whitebark Pine, post disturbance	119
2	3	40627	df0	post-disturbance Douglas-fir	Douglas Fir, post disturbance	89
3	4	9168	lp0/nf	post-disturbance lodgepole pine and non-forest	Lodgepole Pine, post disturbance	74
4	5	1001891	lp0	post-disturbance lodgepole pine	Lodgepole Pine, post disturbance	74
5	6	113548	lp	climax lodgepole pine	Lodgepole Pine, climax	73
6	7	456158	nf	non-forest	Nonforested	83
7	8	266440	lp3	late successional lodgepole pine	Lodgepole Pine, successional	67
8	9	24916	sf/nf	climax Engelmann spruce and subalpine fir and non-forest	Engelmann Spruce & Subalpine Fir, climax	40
9	10	84673	sf	climax Engelmann spruce and subalpine fir	Engelmann Spruce & Subalpine Fir, climax	40
10	11	152489	wb	climax whitebark pine	Whitebark Pine, climax	120
11	12	143906	wb/nf	climax whitebark pine and non-forest	Whitebark Pine, climax	120
12	13	1554	wb/df	climax whitebark pine and Douglas-fir	Whitebark Pine, climax	120
13	14	82	wb/sf	climax whitebark pine, Engelmann spruce and subalpine fir	Whitebark Pine, climax	120
14	15	459	df/nf	climax Douglas-fir and non-forest	Douglas Fir, climax	95
15	16	58471	df/nf	climax Douglas-fir and non-forest	Douglas Fir, climax	95
16	17	101603	df	climax Douglas-fir	Douglas Fir, climax	95
17	18	2535	lp/lp3	climax and late successional lodgepole pine	Lodgepole Pine, climax	73
18	19	1179	lpp/sf	pygmy lodgepole pine and Engelmann spruce/subalpine fir	Pygmy Lodgepole Pine	75
19	20	13646	lp3/nf	late successional lodgepole pine and non-forest	Lodgepole Pine, successional	67
20	21	36459	lpp/lp3	pygmy and late successional lodgepole pine	Pygmy Lodgepole Pine	75
21	22	5946	lp2/lp3	middle and late successional lodgepole pine	Lodgepole Pine, successional	67
22	23	6180	asp	aspen	Aspen	104
23	24	906	df1	early successional Douglas-fir	Douglas Fir, successional	88
24	25	110	wb1/nf	early successional whitebark pine and non-forest	Whitebark Pine, successional	122
25	26	21692	wb1	early successional whitebark pine	Whitebark Pine, successional	122
26	27	361	lp1/df	early successional lodgepole pine and climax Douglas-fir	Lodgepole Pine, climax	73
27	28	1188	lp1/nf	early successional lodgepole pine and non-forest	Lodgepole Pine, successional	67
28	29	160359	lp1	early successional lodgepole pine	Lodgepole Pine, successional	67
29	30	900	lp1/lp2	early and middle successional lodgepole pine	Lodgepole Pine, successional	67
30	31	76	lp2/df	middle successional lodgepole pine and climax Douglas-fir	Lodgepole Pine, successional	67
31	32	3950	lp2/nf	middle successional lodgepole pine and non-forest	Lodgepole Pine, successional	67
32	33	50090	lp/lp2	middle and climax lodgepole pine	Lodgepole Pine, climax	73
33	34	1244	kh	krummholz	Krummholz	52
34	35	482591	lp2	middle successional lodgepole pine	Lodgepole Pine, successional	67
35	36	817	kh/nf	krummholz and non-forest	Krummholz	52
36	37	96	asp/nf	aspen and non-forest	Aspen	104
37	38	52	wb2	middle successional whitebark pine	Whitebark Pine, successional	122
38	39	57	lpp	pygmy lodgepole pine	Pygmy Lodgepole Pine	75
39	40	163431	water	water	Water	56

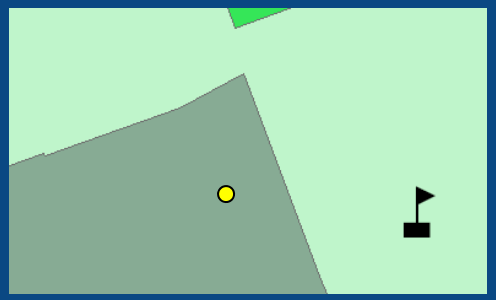
Visualization
Worth a Thousand Words



Two Ways to Visualize Data
"The World" in GIS



Real world



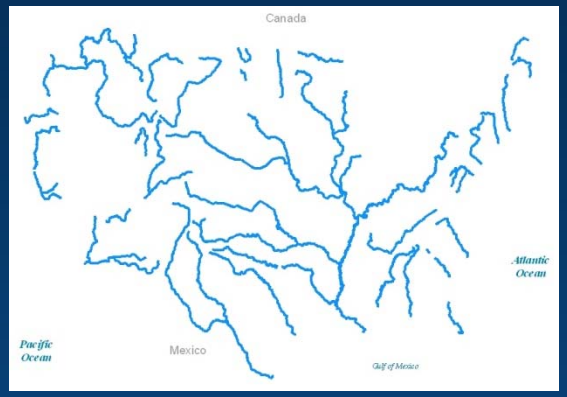
Raster -- Grid

- "Pixels"
- A location and value
- Satellite images and aerial photos are already in this format

Vector -- Linear

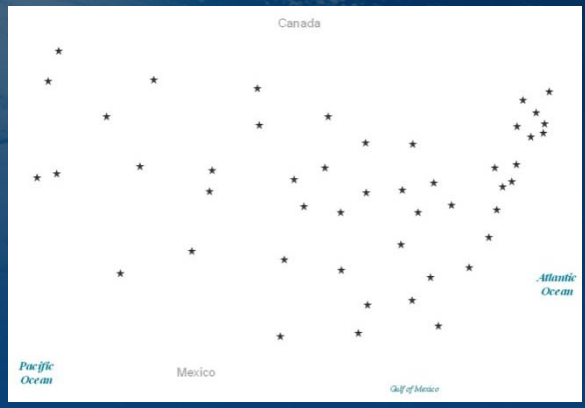
- Points, lines, and polygons
- "Features" (house, lake, etc.)
- Attributes
  - size, type, length, etc.

Five Data Layers
"Alike Features"



Rivers Layer

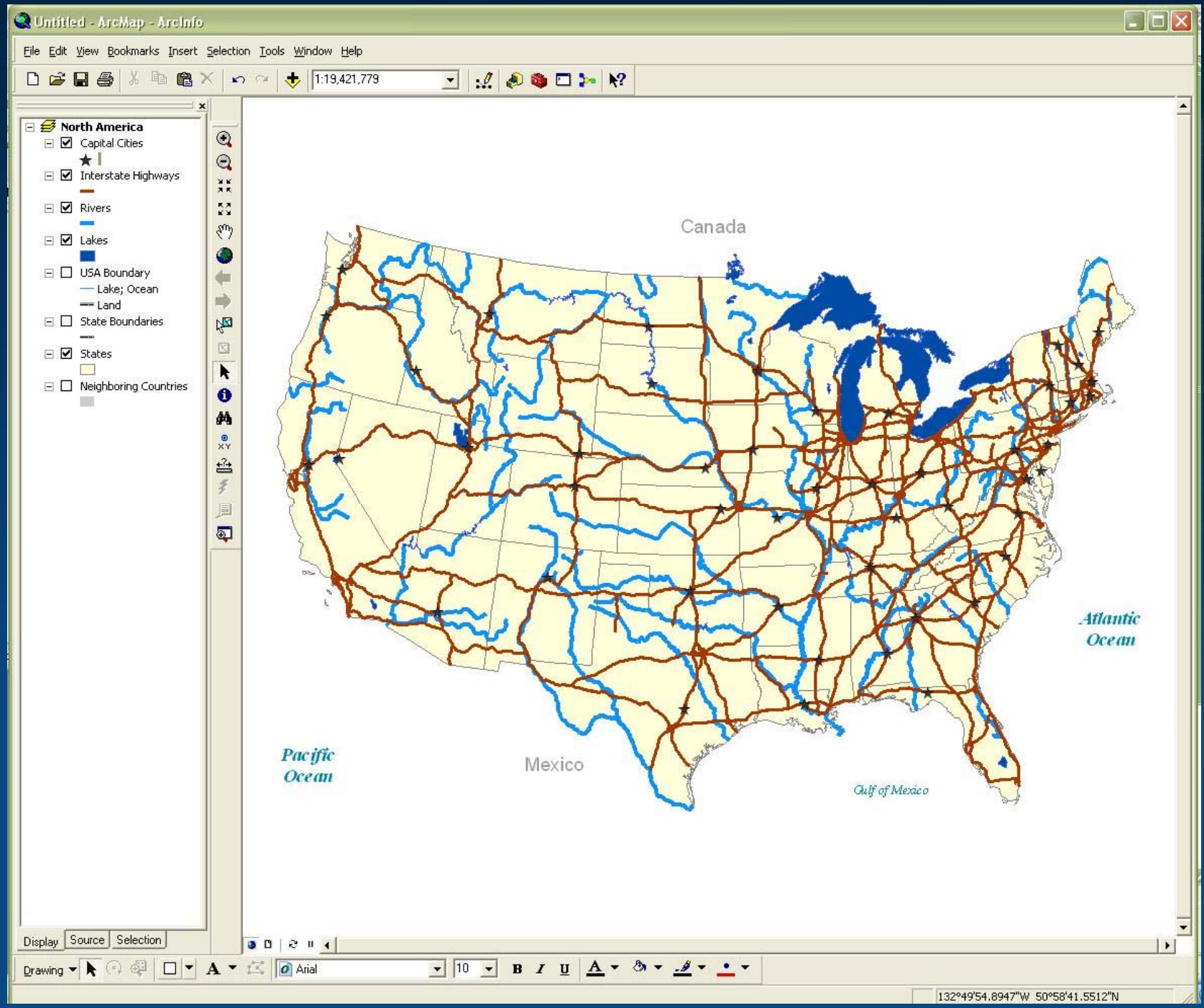
Lakes Layer



Capitals Layer

Roads Layer

States Layer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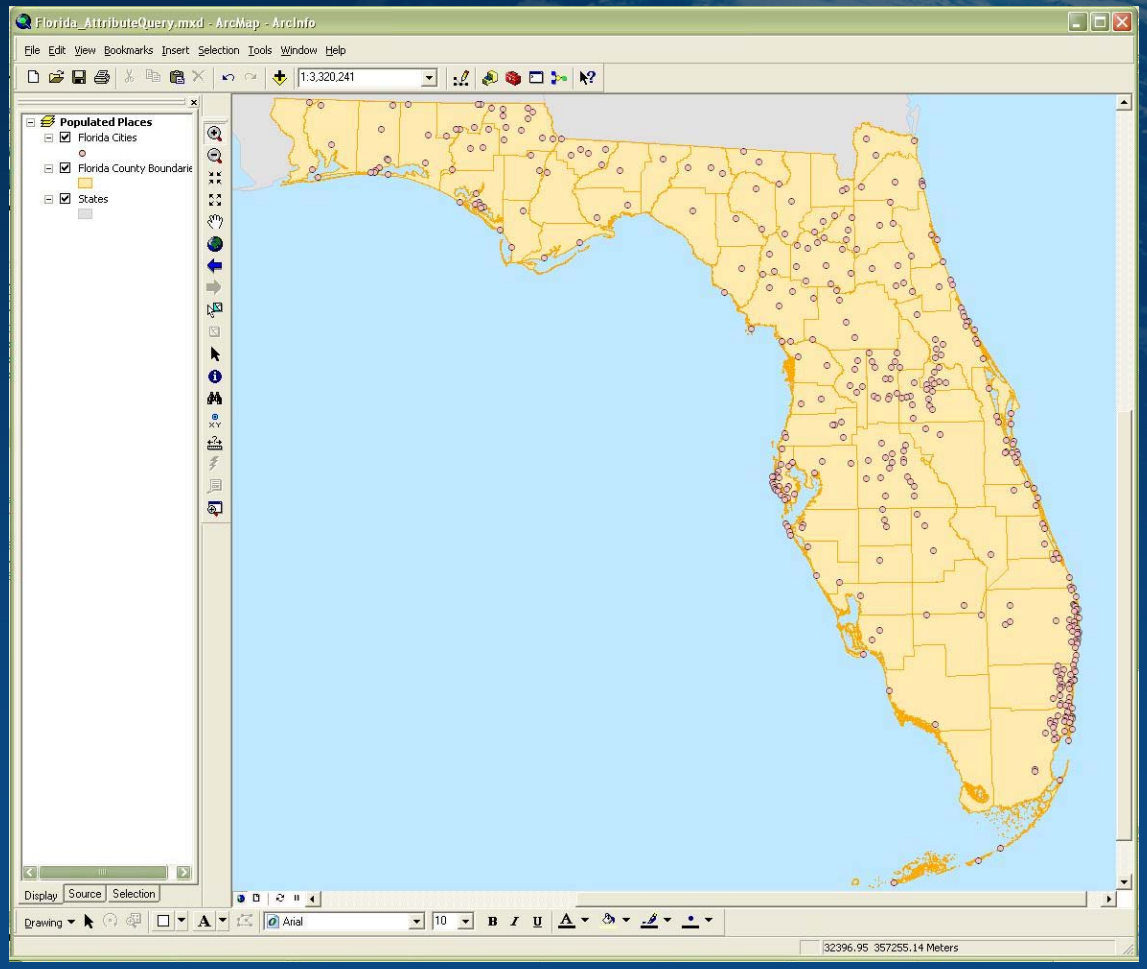
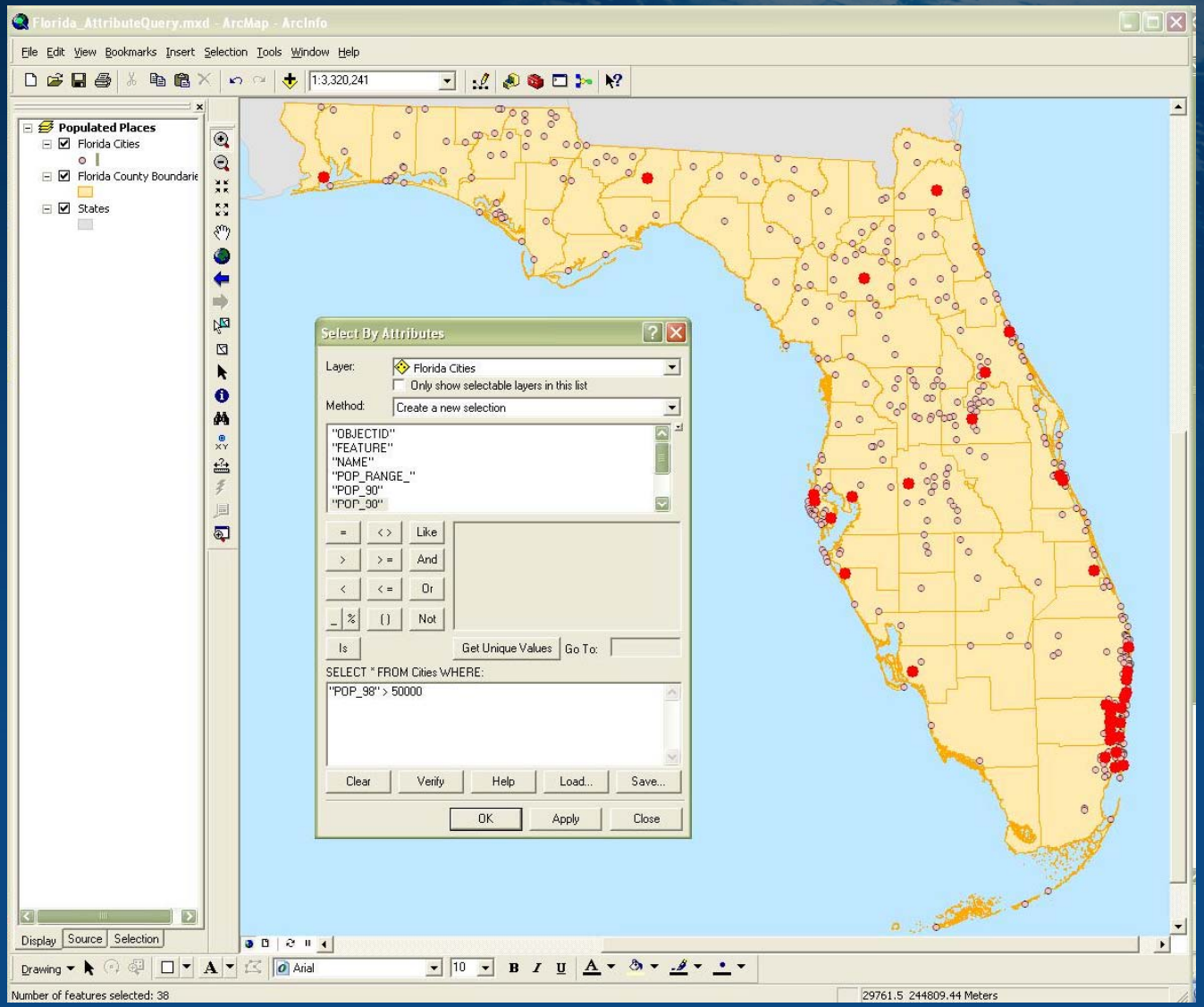
North America
Capital Cities
Interstate Highways
Rivers
Lakes
USA Boundary
Lake; Ocean
Land
State Boundaries
States
Neighboring Countries
Display Source Selection
Drawing
Arial
10
Canada
Atlantic Ocean
Pacific Ocean
Mexico
Gulf of Mexico
132°49'54.8947"W 50°58'41.5512"N

Turning Data Into Information

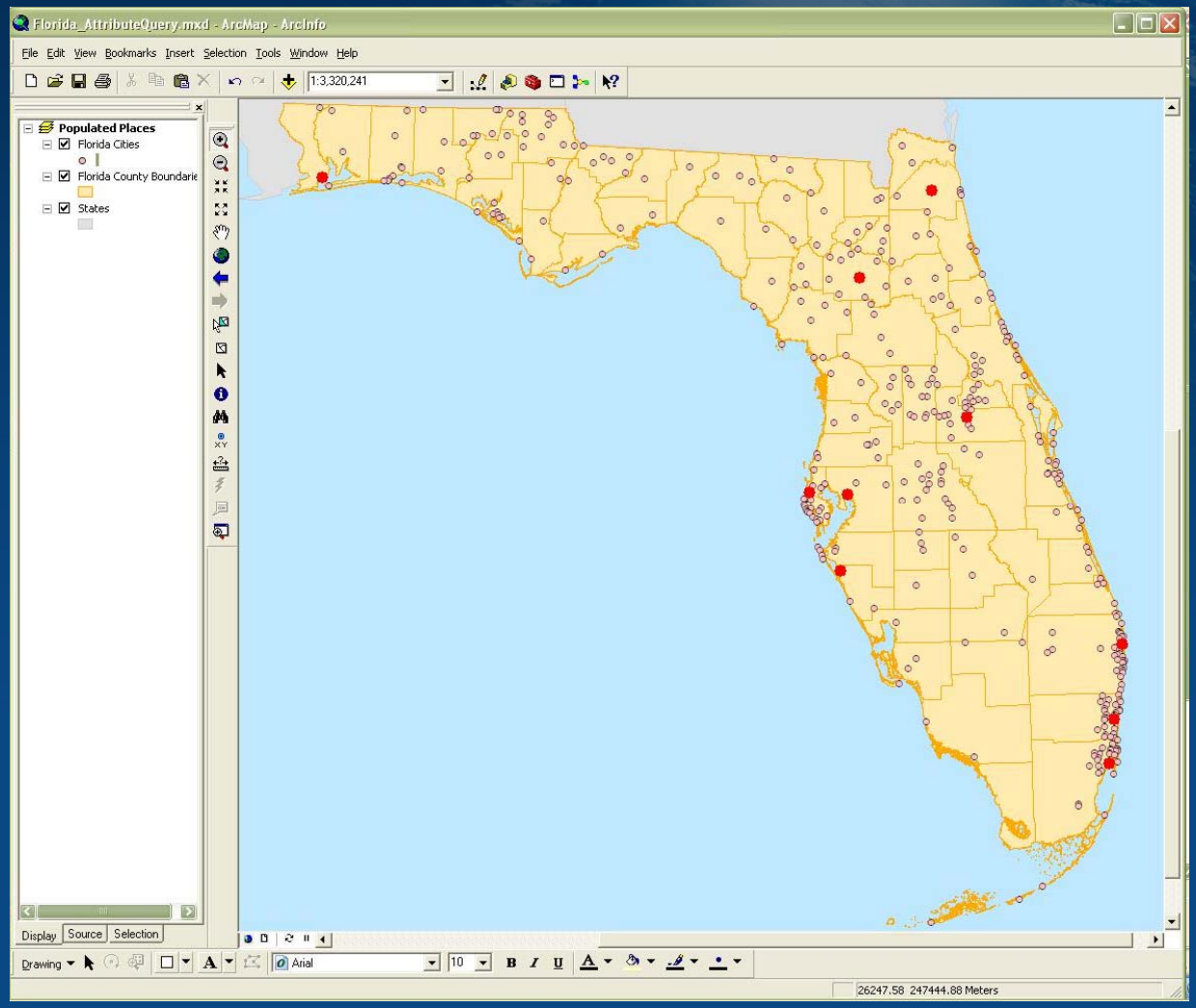


“Spatial Analysis” -- Not Just a Map

Asking a Question -- Interaction



Maps and Databases are Interactive



The Goal of GIS

The goal of GIS is to help people and companies do their work better, faster, and cheaper through

Visualization

- *GIS provides users with quicker, more accurate representations of spatial data*

Database Management

- *GIS makes it easier to keep the spatial data accurate and up to date*

Spatial Analysis

- *GIS helps users make more informed decisions*

Wherever Spatial Data Analysis Is Needed

Some Ways GIS is Used

Emergency Services
- Fire and Police

Environmental
- Monitoring and Modeling

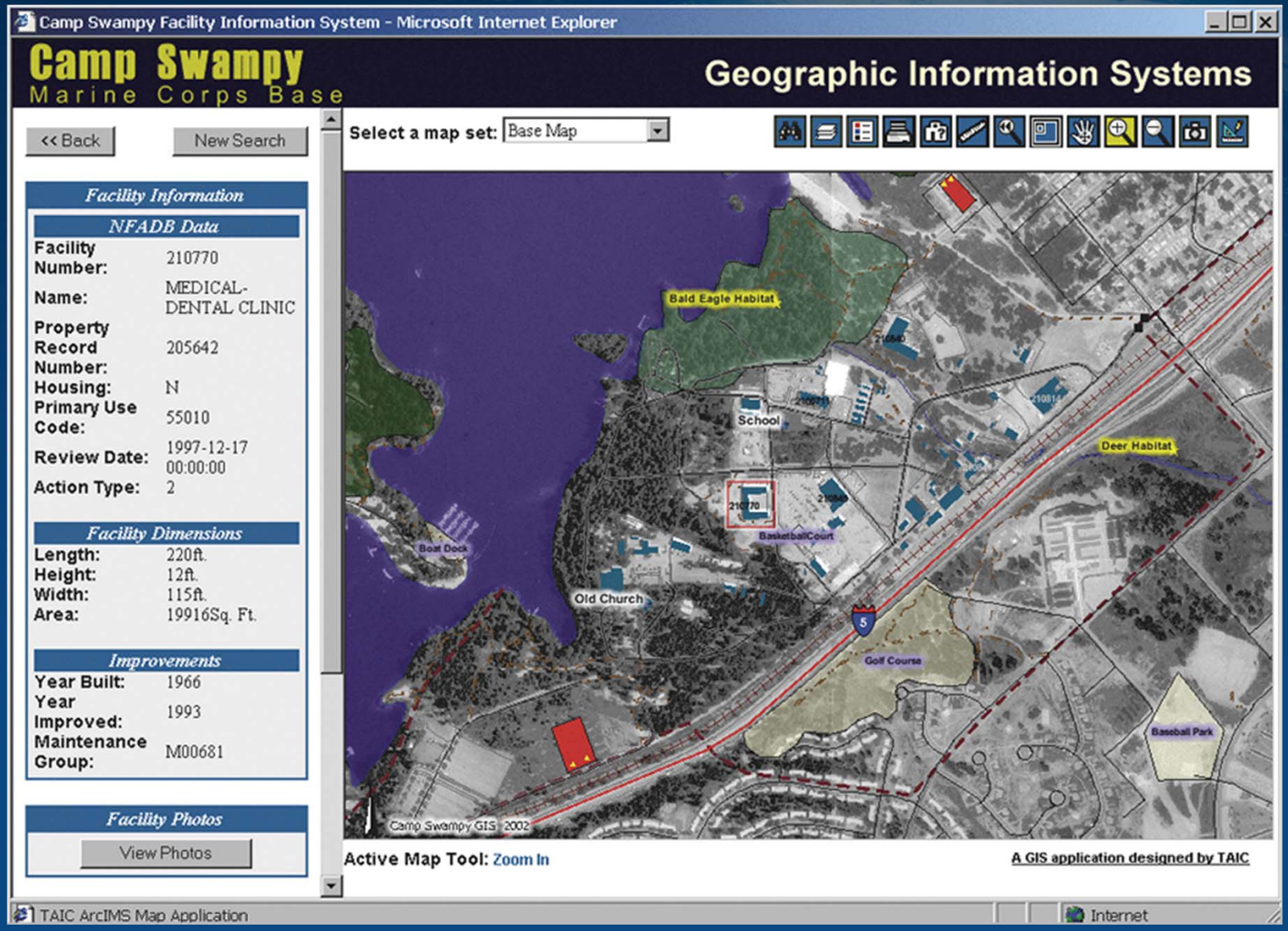
Business
- Site Location, Delivery Systems

Industry
- Transportation, Communication, Mining, Pipelines, Healthcare

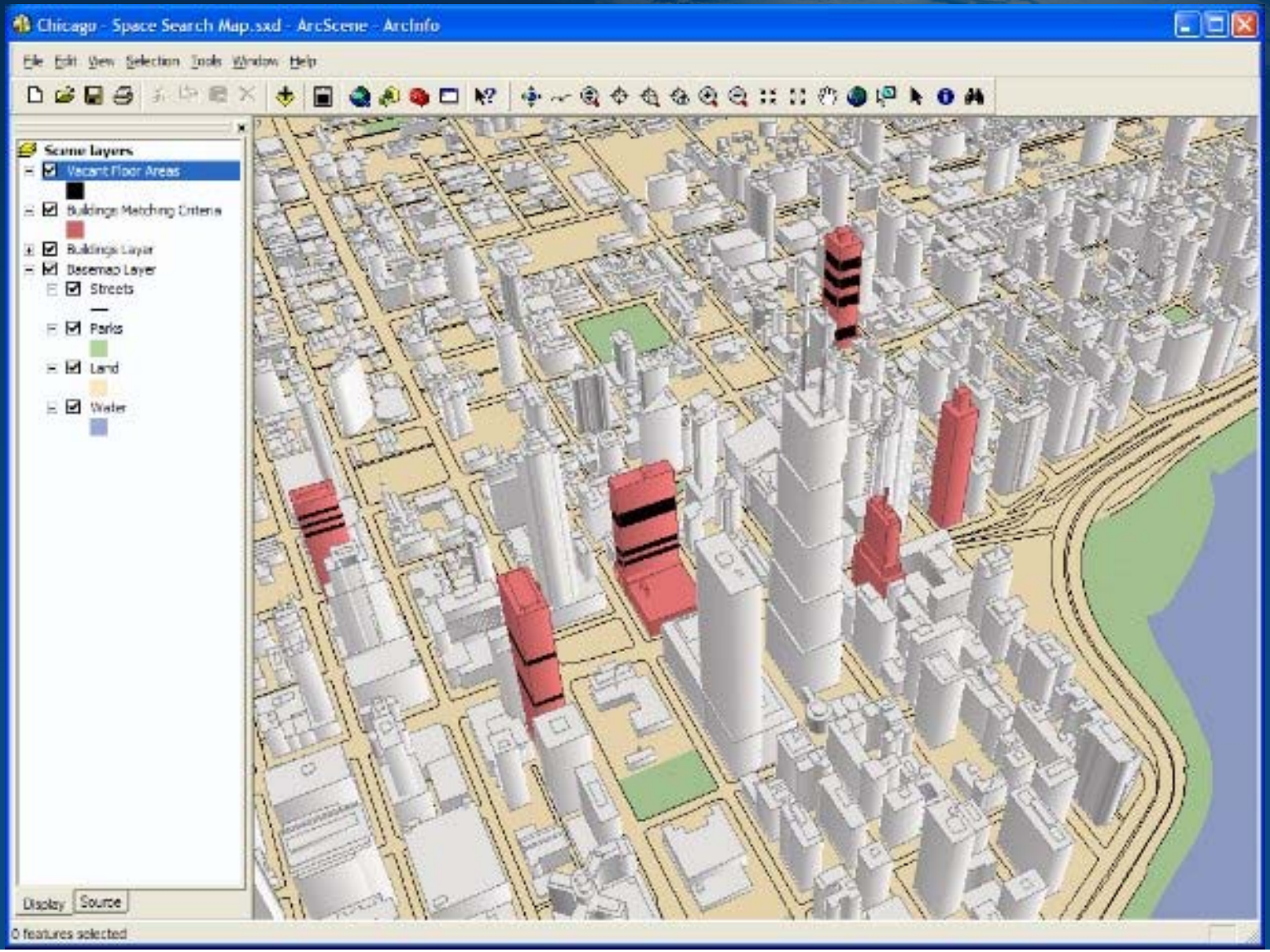
Government
- Local, State, Federal, Military

Education
- Research, Teaching Tool, Administration

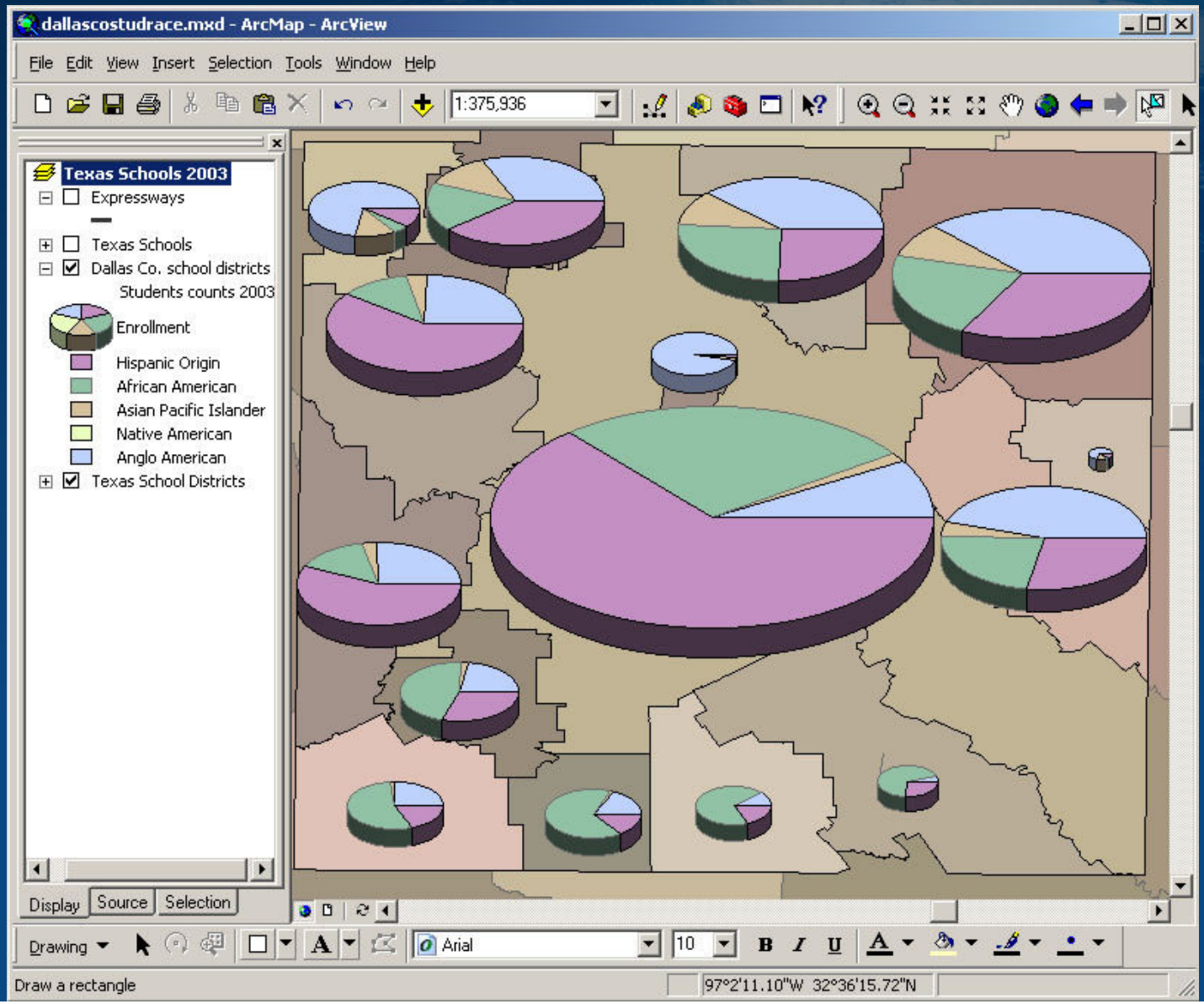
Defense Management



Real Estate Management



Education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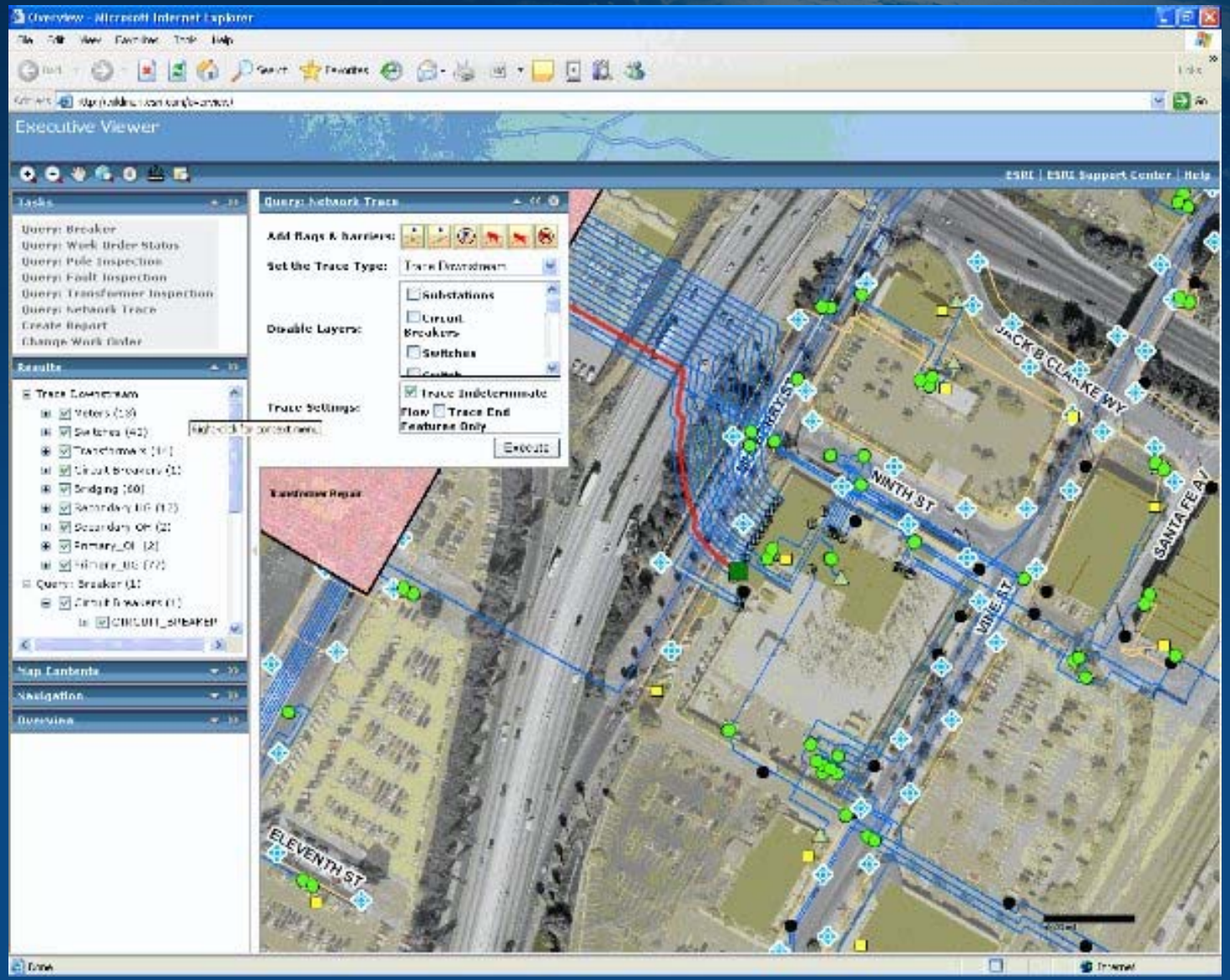
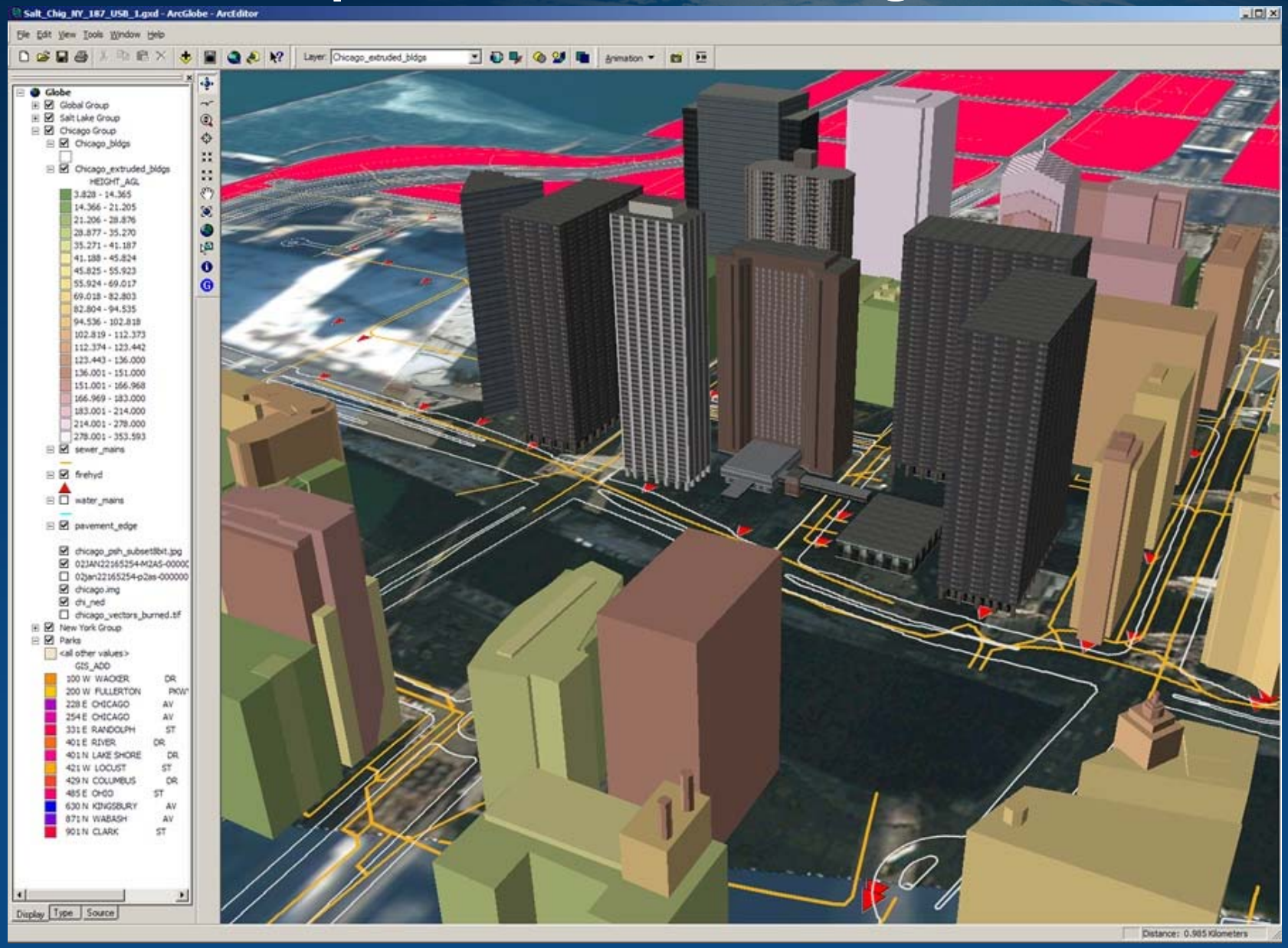
File Edit View Insert Selection Tools Window Help
1:375,936
Texas Schools 2003
Expressways
Texas Schools
Dallas Co. school districts
Students counts 2003
Enrollment
Hispanic Origin
African American
Asian Pacific Islander
Native American
Anglo American
Texas School Districts
Display Source Selection
Drawing
Arial
10
Draw a rectangle
97°2'11.10"W 32°36'15.72"N

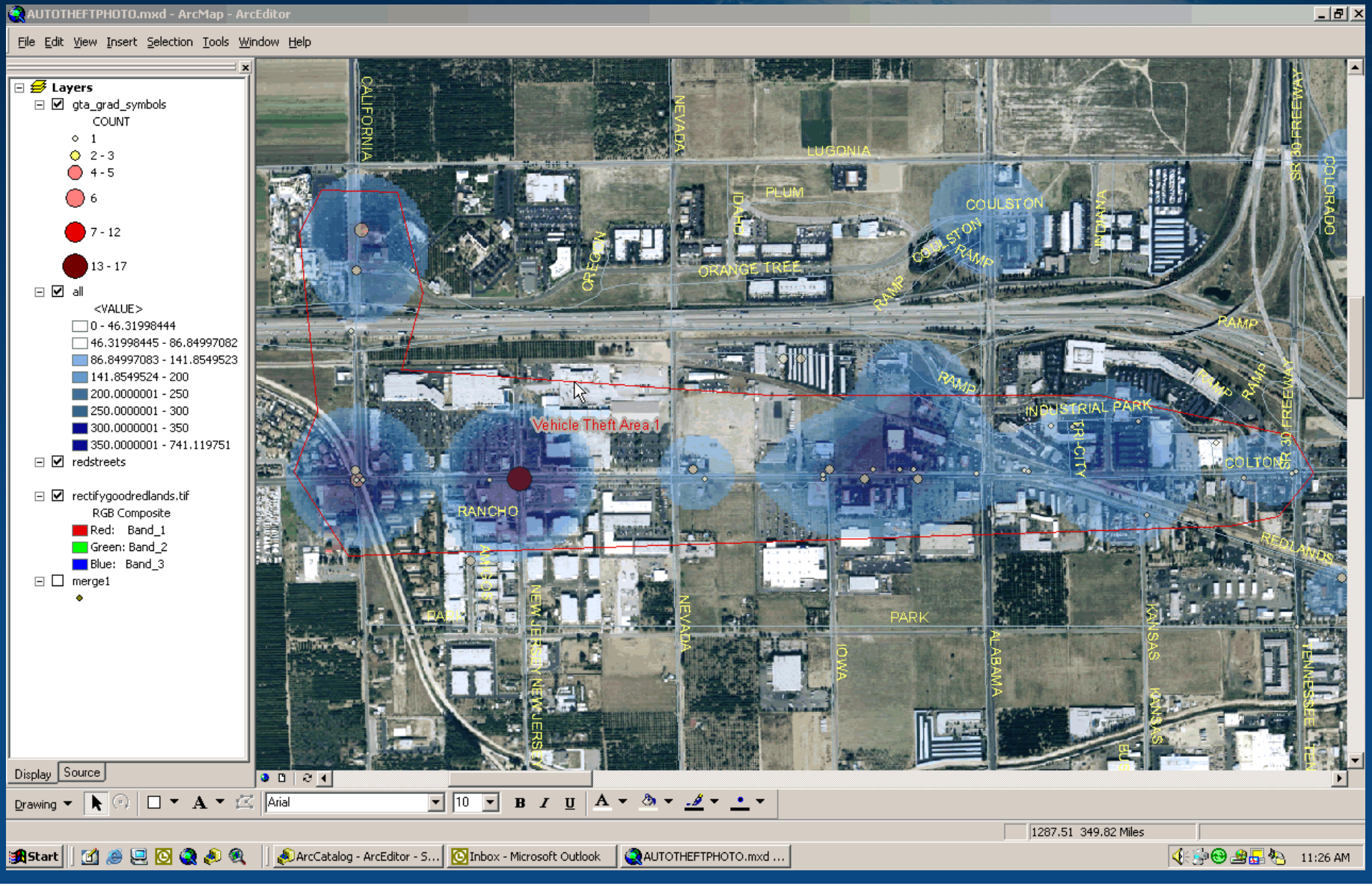
Utility Management



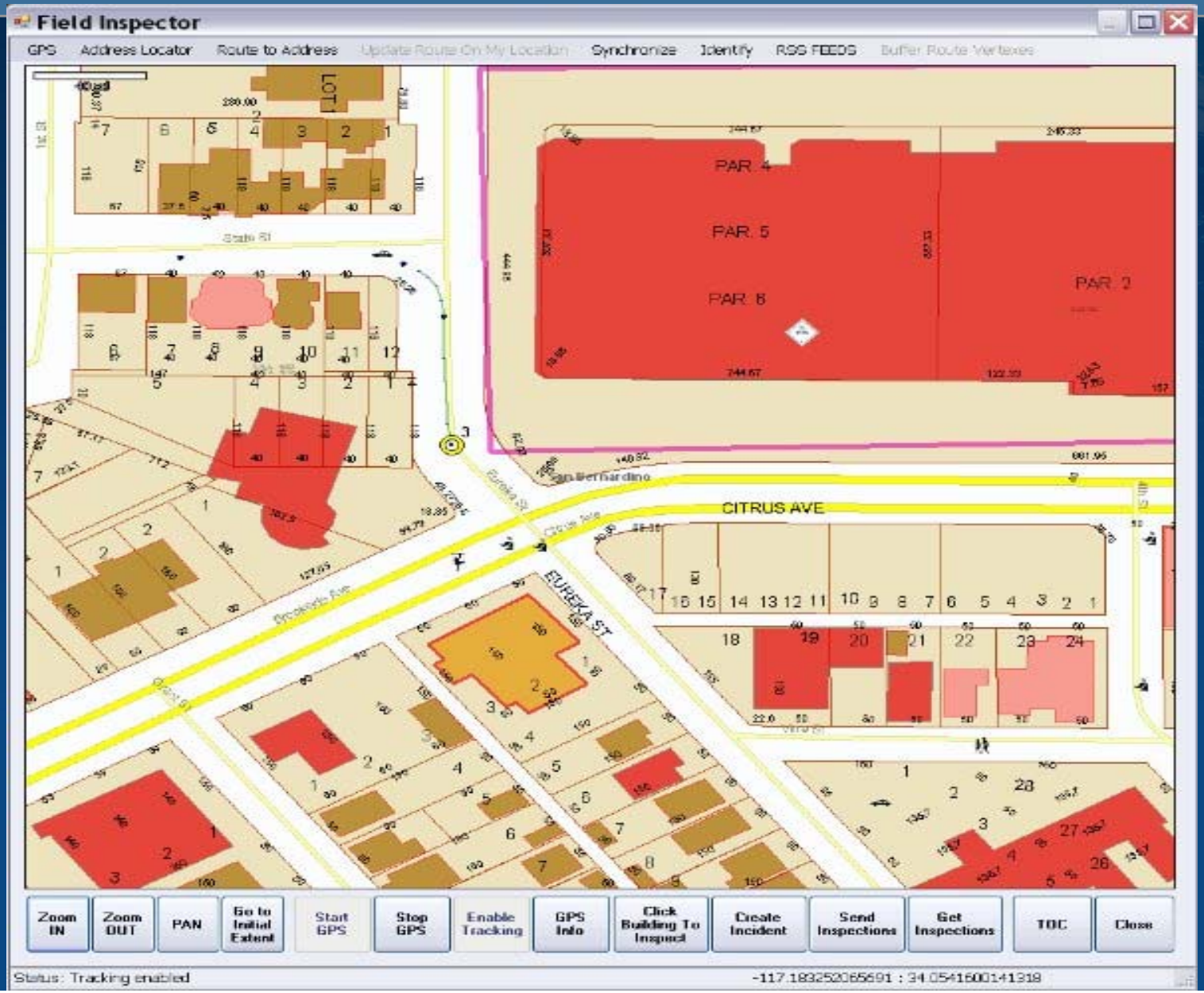
Transportation Management



Public Safety



Government


Field Inspector
GPS
Address Locator
Route to Address
Update Route On My Location
Synchronize
Identify
RSS FEEDS
Buffer Route Vertexes
PAR. 4
PAR. 5
PAR. 6
PAR. 3
CITRUS AVE
EUREKA ST
Zoom IN
Zoom OUT
PAN
Go to Initial Extent
Start GPS
Stop GPS
Enable Tracking
GPS Info
Click Building To Inspect
Create Incident
Send Inspections
Get Inspections
TOC
Close
Status: Tracking enabled
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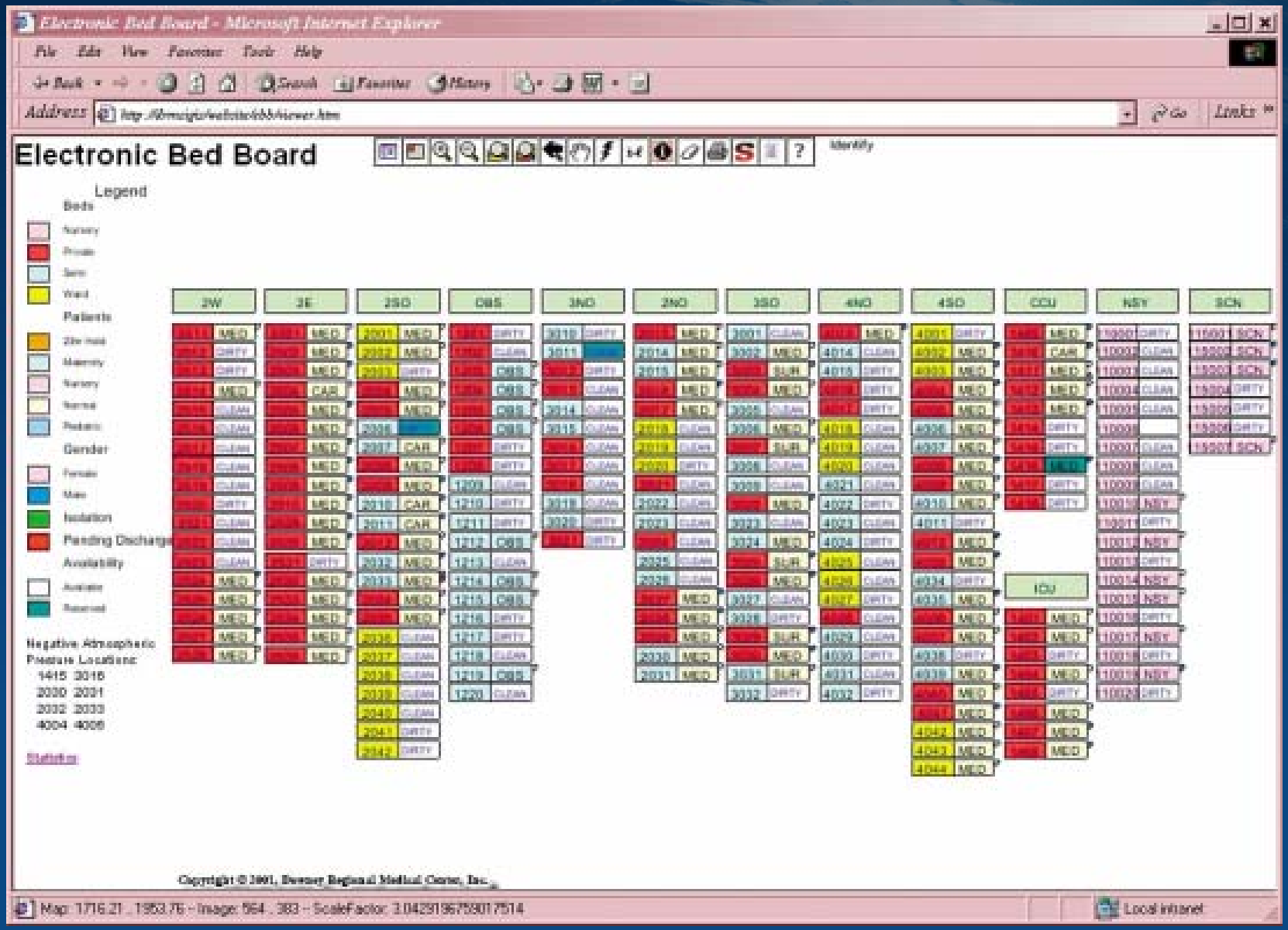
Hospital Facilities



ArcGIS

ArcGIS provides users with a *complete* GIS

- *Visualization*
- *Database Management*
- *Spatial Analysis*

ArcGIS offers more than just GIS software ….

offers GIS solutions.

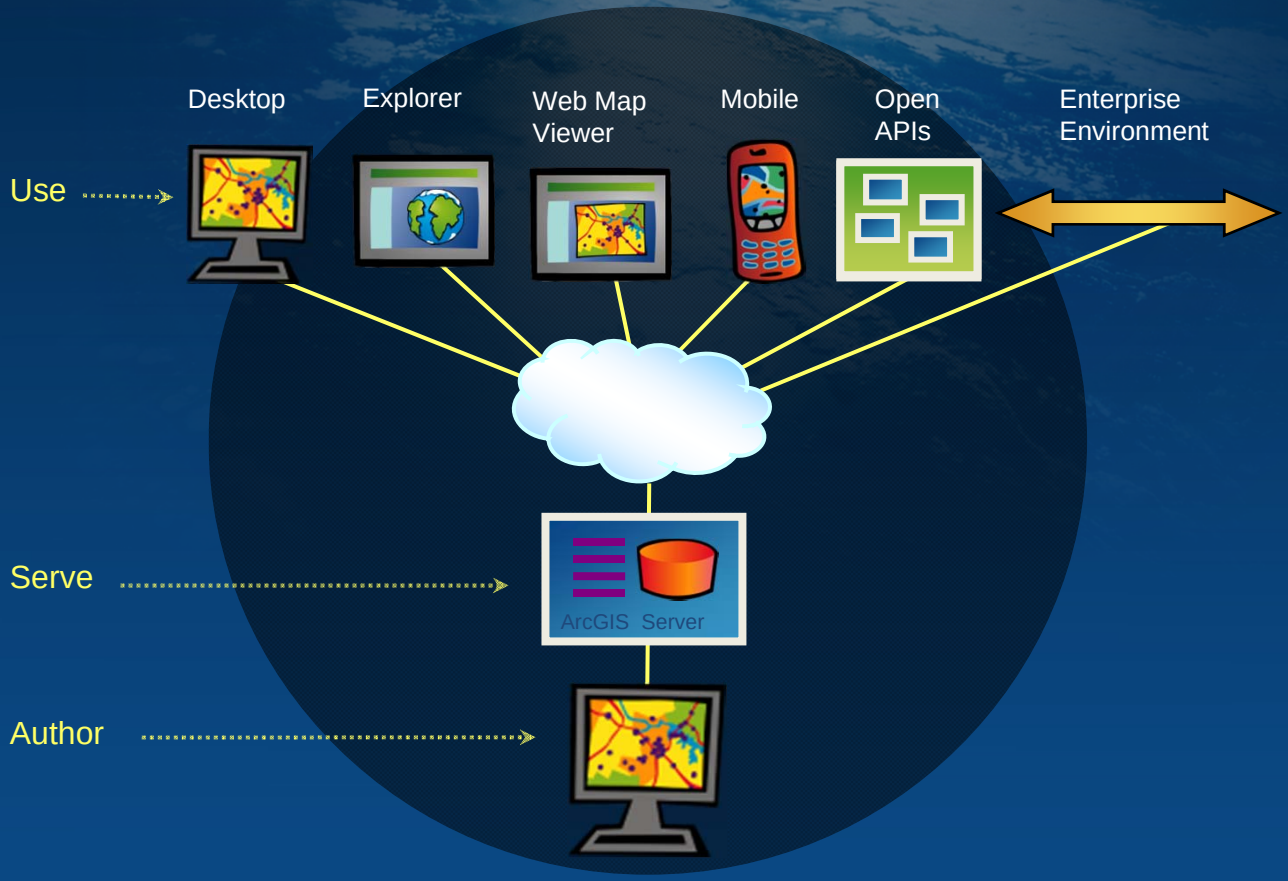
The goal is to make users more successful

ArcGIS Family of Products

ArcGIS Server Platform

Author/Serve/Use

- Maps
- Data
- Models
- Globes
- Metadata



Making GIS Knowledge Available To Anyone . . .

. . . Integrates With Other Systems Via Standards

NCDOT IT GIS UNIT

NCDOT GIS Standards and Practices

As part of the North Carolina Department of Transportation's efforts to maximize the value of our investment in Geographic Information Systems (GIS), data management, and access to data, we have developed geospatial standards and practices. The purpose of these standards and practices is to provide users with necessary information about the data, to support improved linking of different data sets, and to better manage the Department's GIS investments.

NCDOT IT GIS UNIT

Visit our website at

http://www.ncdot.org/it/gis/

Email us at

www.gishelp@ncdot.gov