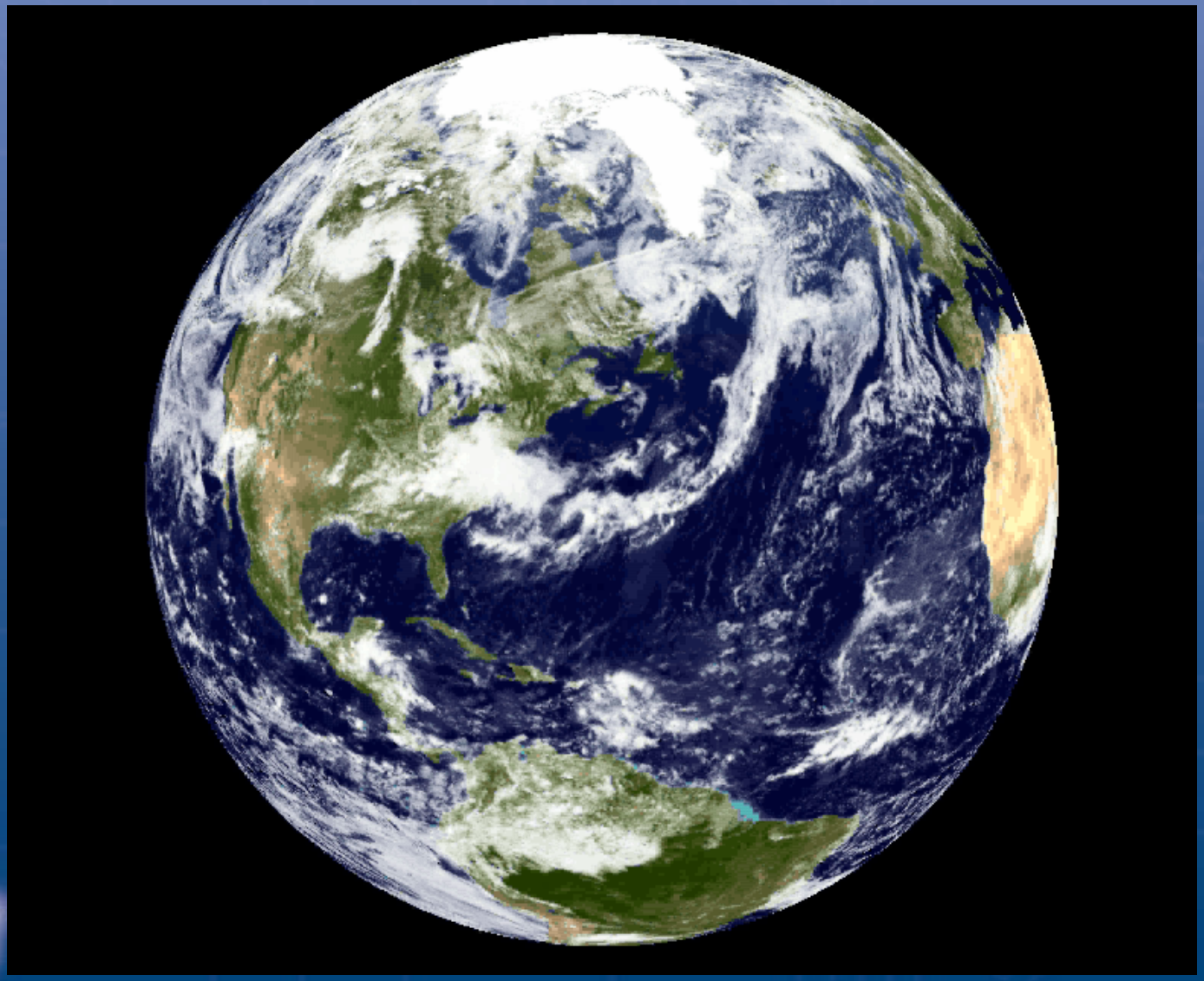
Geographic Information Systems: Opportunities for Innovative Partnerships In Conservation



Agenda

- GIS Primer – What is GIS
  - Demonstration
- Who Uses GIS
- Why is GIS Important
- Examples of Partnerships using GIS
  - Demonstration
- Opportunities
- Q & A

What is GIS ?
A Generic Definition

- A spreadsheet with a map added
- A different way of looking at existing data
- A digital representation of the real world

GIS - A Conceptual Definition

Real World

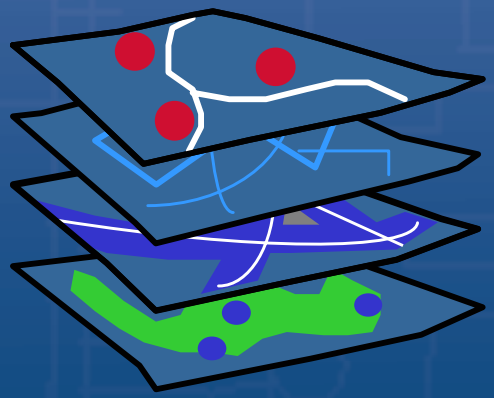
Abstraction

Representation

Printed Maps

Analysis

Action



Digital Model

Conversion

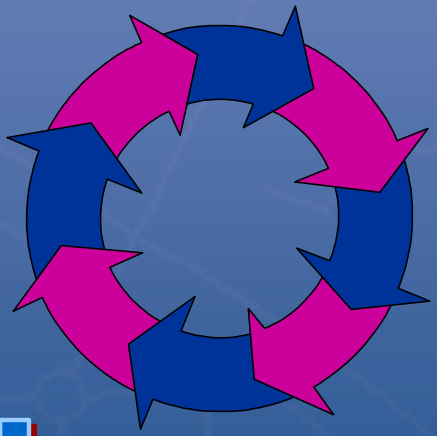
Presentation

ArcGIS ESRI

GIS Defined

Hardware

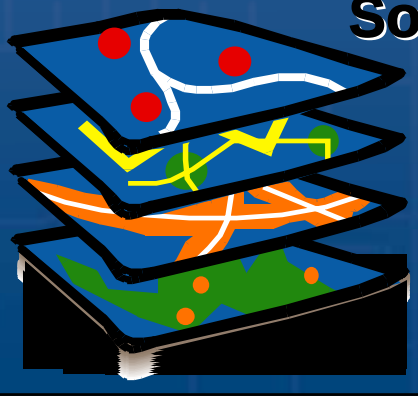
People



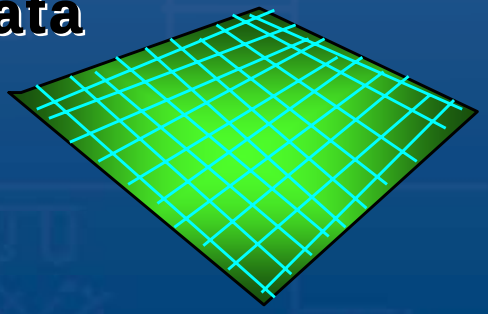
Procedures

Integration!

Software

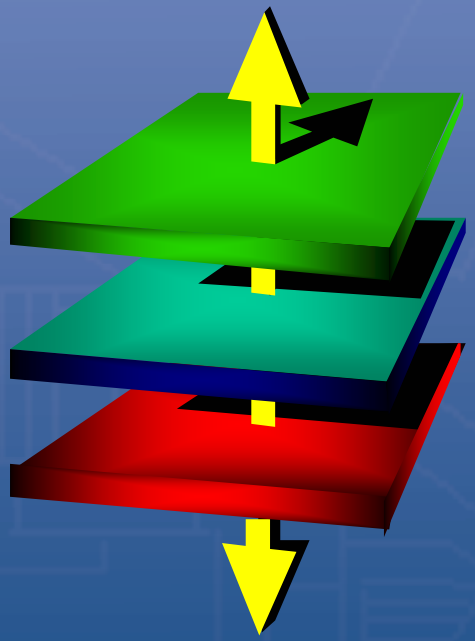


Data



Benefits of GIS

- Time & money savings
- Consistency
- Better science
- Cross-cutting thinking
- Better problem solving
- Better decisions



No different than any other information system

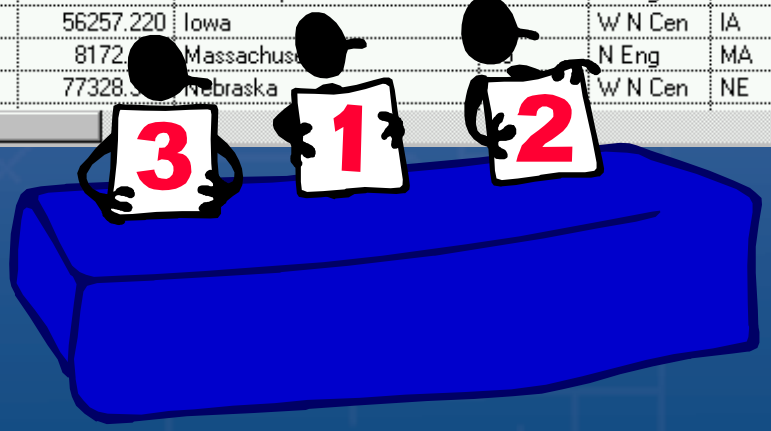
Geographic

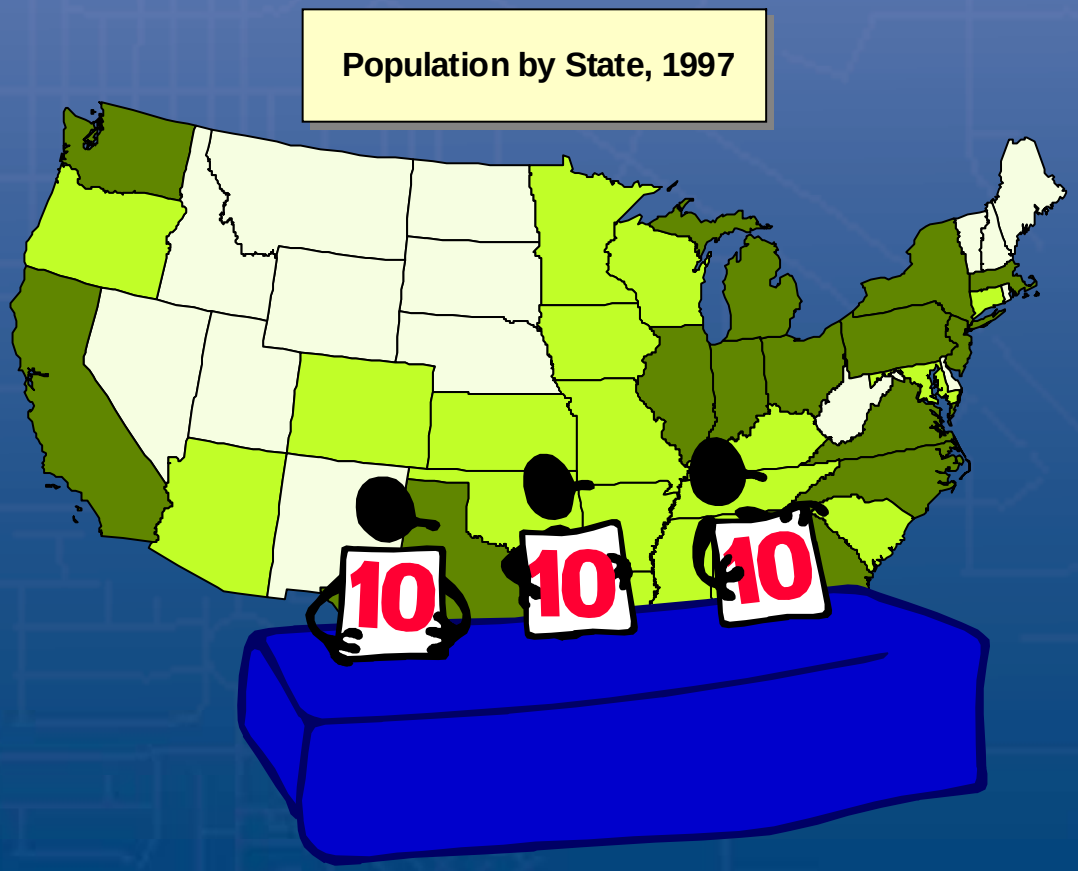
- Geography is a science that enables us to find answers to questions about the world around us—about where things are and how and why they got there
- The common theme is **location**

Geography Gives Us A Different Perspective

Attributes of Population

Shape	Area	State_name	State_fips	Sub_region	State_abbr	F
Polygon	67286.878	Washington	53	Pacific	WA	
Polygon	147236.028	Montana	30	Mtn	MT	
Polygon	32161.664	Maine	23	N Eng	ME	
Polygon	70810.153	North Dakota	38	W N Cen	ND	
Polygon	77193.624	South Dakota	46	W N Cen	SD	
Polygon	97799.492	Wyoming	56	Mtn	WY	
Polygon	56088.066	Wisconsin	55	E N Cen	WI	
Polygon	83340.595	Idaho	16	Mtn	ID	
Polygon	9603.218	Vermont	50	N Eng	VT	
Polygon	84517.465	Minnesota	27	W N Cen	MN	
Polygon	97070.748	Oregon	41	Pacific	OR	
Polygon	9259.514	New Hampshire	33	N Eng	NH	
Polygon	56257.220	Iowa		W N Cen	IA	
Polygon	8172	Massachus		N Eng	MA	
Polygon	77328	Nebraska		W N Cen	NE	





ESRI ArcGIS

Traditional Tools Of The Geographer

- **Databases**

Shape	Area	State_name	State_fips	Sub_region	State_abb
Polygon	67286.878	Washington	53	Pacific	WA
Polygon	147236.028	Montana	30	Mtn	MT
Polygon	32161.664	Maine	23	N Eng	ME
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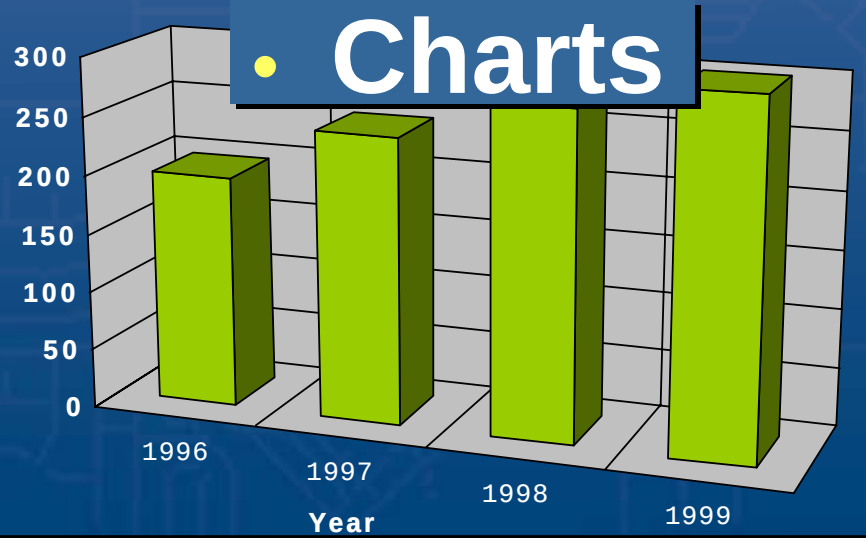
Polygon	9259.514	New Hampshire	33	N Eng	NH
Polygon	56257.220	Iowa	19	W N Cen	IA
Polygon	8172.482	Massachusetts	25	N Eng	MA
Polygon	77328.337	Nebraska	31	W N Cen	NE

- **Maps**

- **Charts**

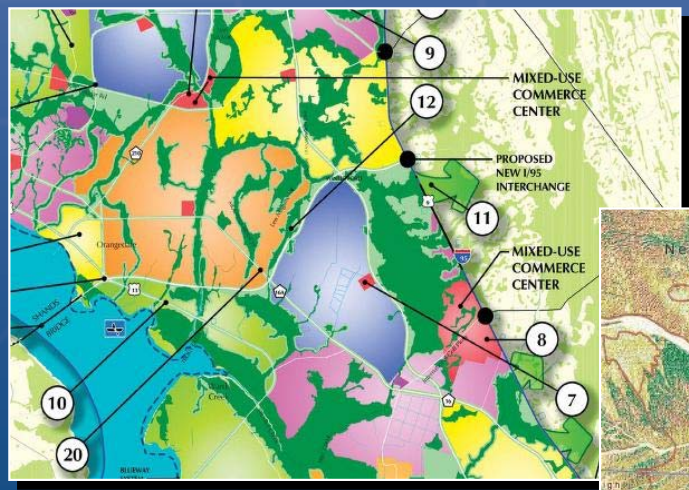


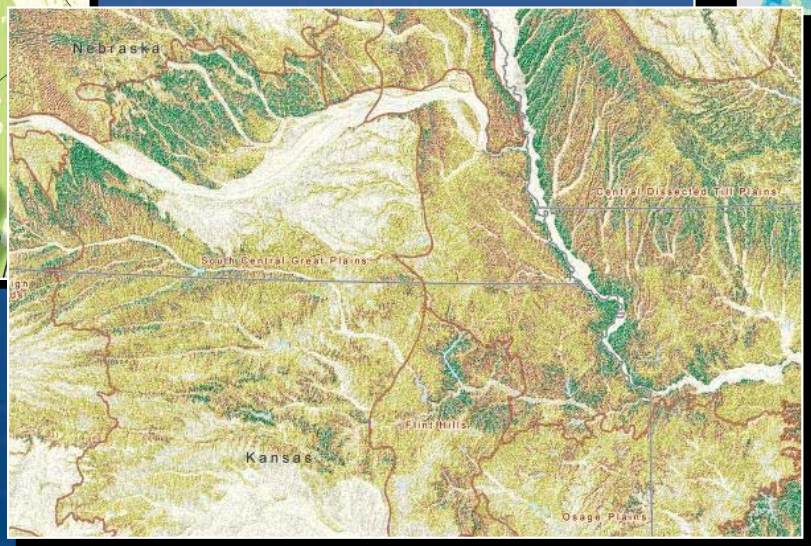
- **Statistics**

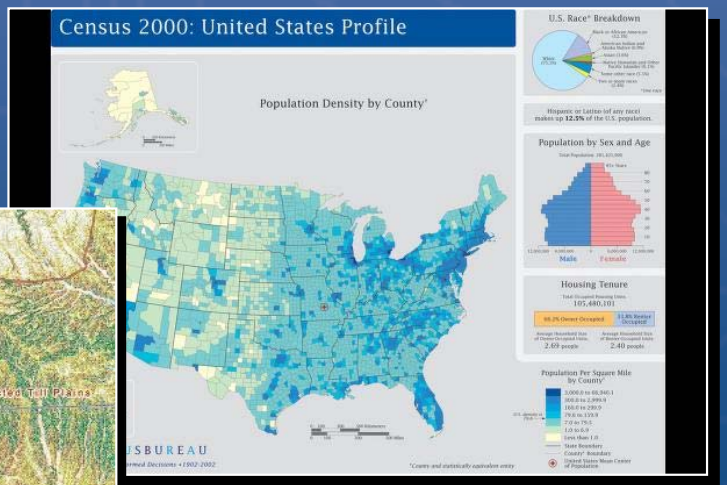
$$SD = \sqrt{\frac{\Sigma(x - \bar{x})^2}{N}}$$

Geographic Information Systems (GIS)

Tools For Geographers and Other People Interested In Location







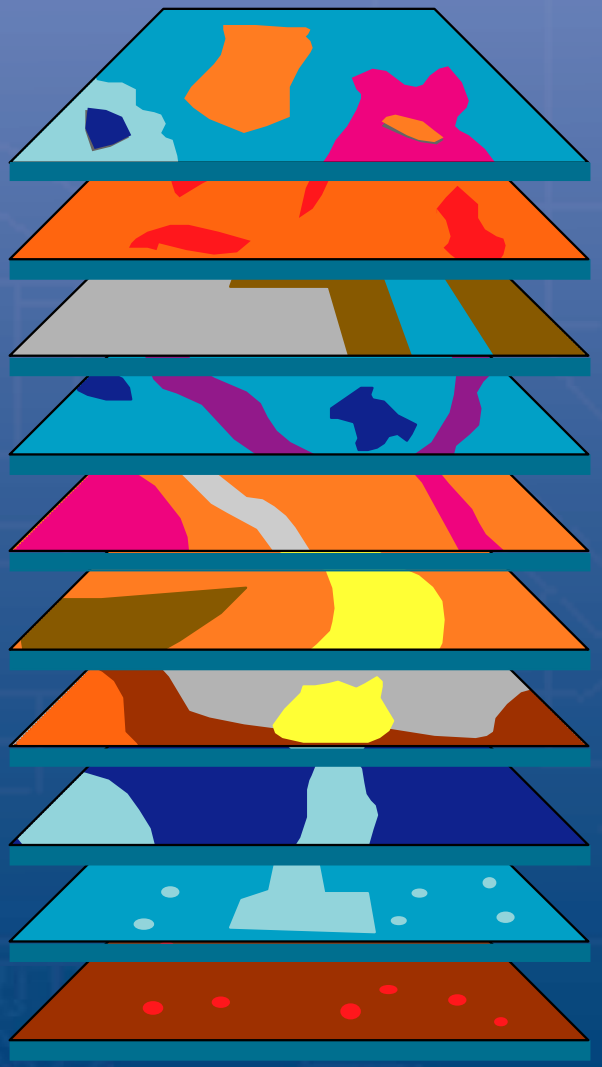
Information

Websters Defines Information:

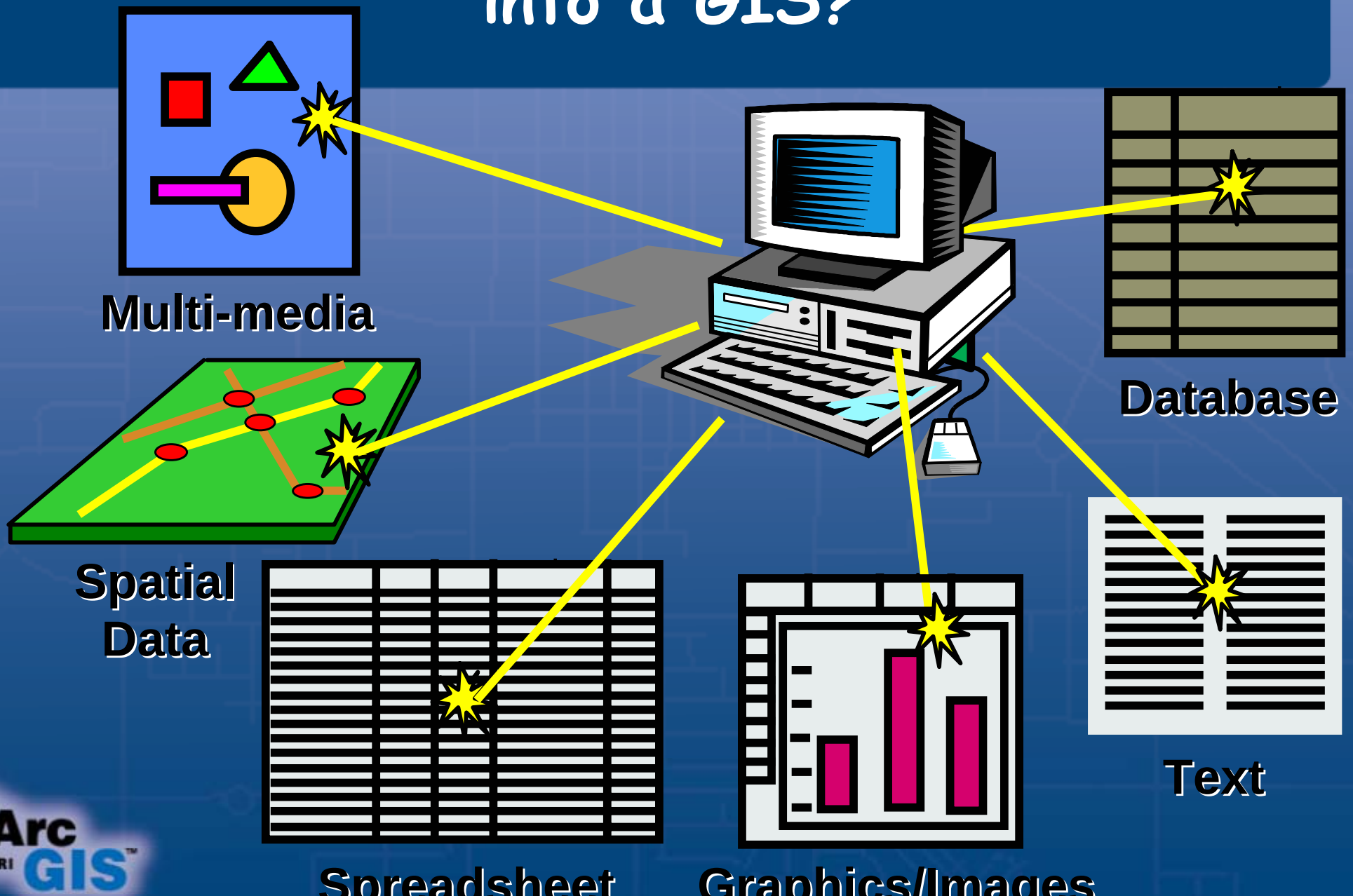
1. Knowledge derived from study, experience, or instruction.
2. Knowledge of specific events or situations that has been gathered or received by communication; intelligence or news. See Synonyms at knowledge.
3. A collection of facts or data: *statistical information.*
4. The act of informing or the condition of being informed; communication of knowledge: *Safety instructions are provided for the information of our passengers.*
5. *Computer Science.* Processed, stored, or transmitted data.
6. A numerical measure of the uncertainty of an experimental outcome.

Examples of Spatial Data within a GIS database

- Census Tracts
- Roads
- Cadastral Data
- Public Utilities
- Private Utilities
- Zip Codes
- Natural Features
- School Attendance Districts
- Planimetric Data
- Zoning

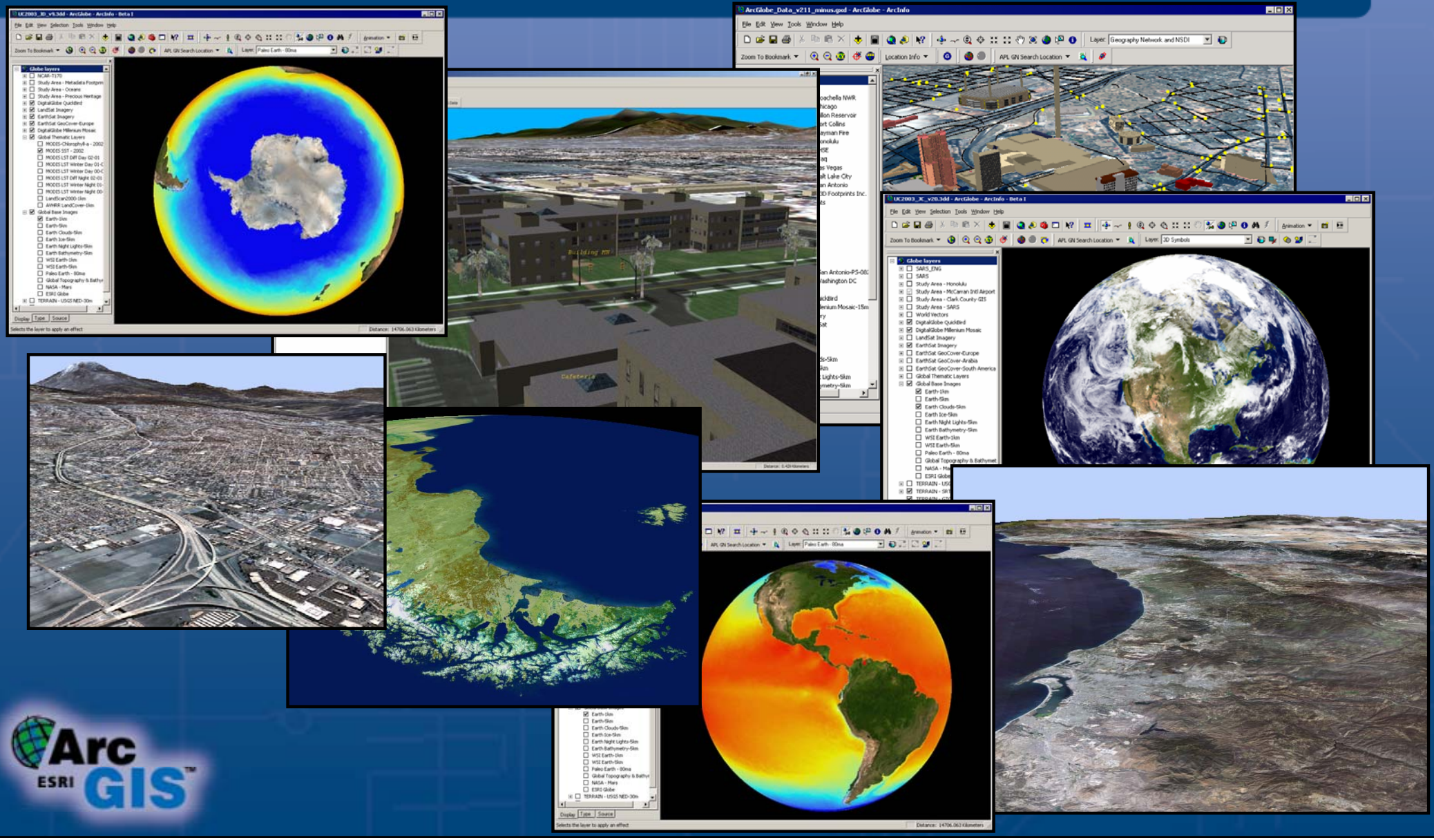


What Information is integrated into a GIS?



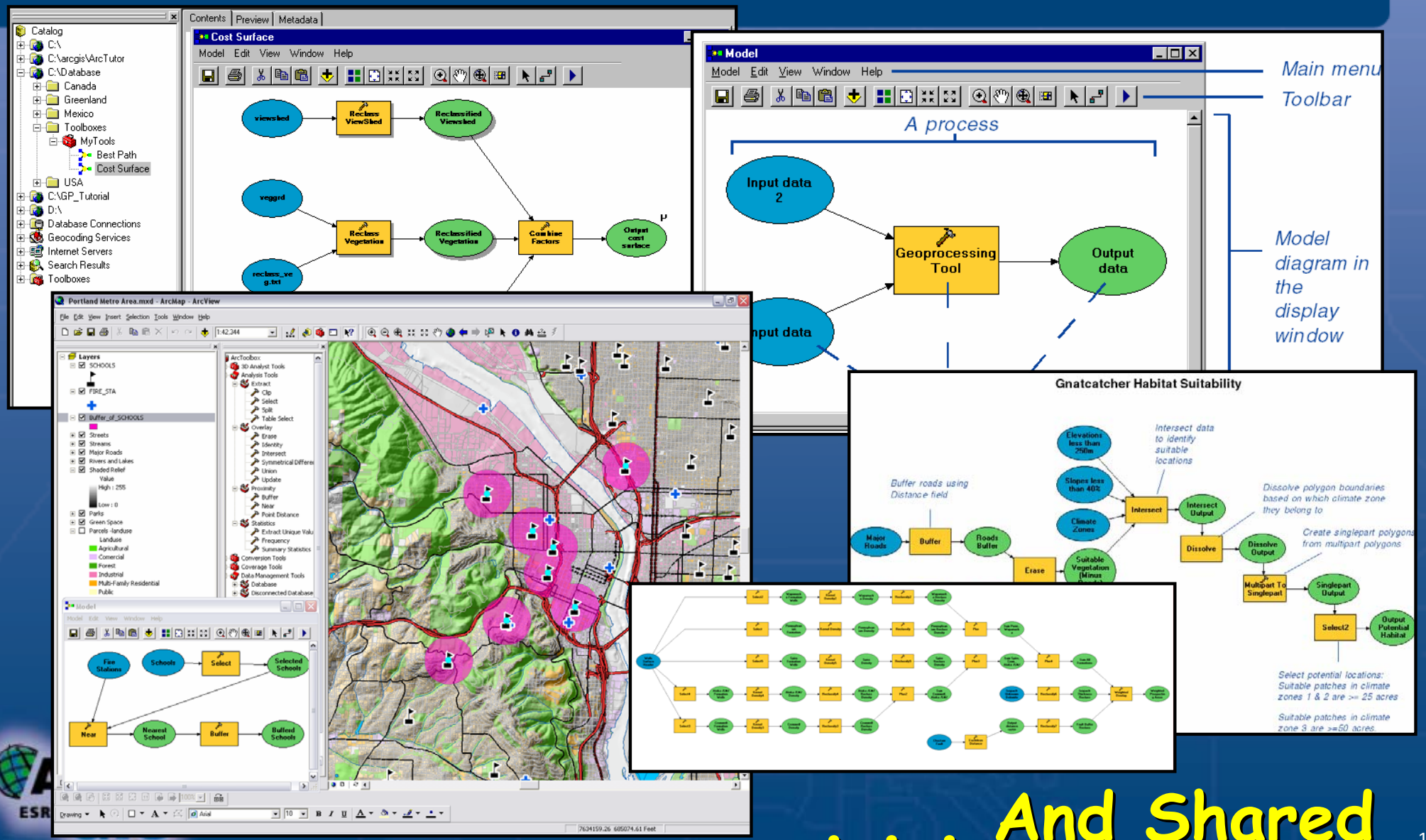
Whole Earth Visualization

New Context for Geographic Information



ArcGIS ESRI GIS

"Best Practices" Applications are Modeled and Scripted



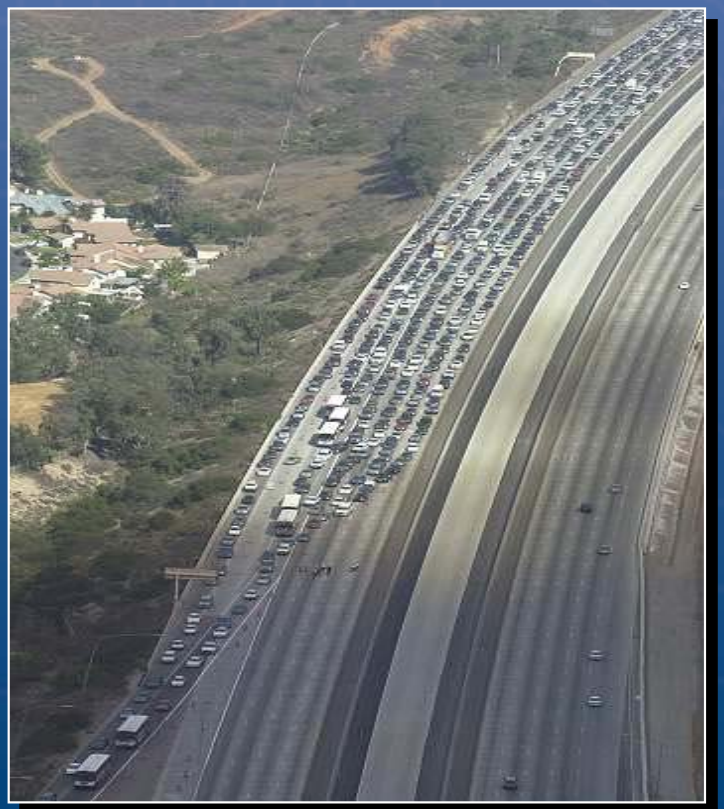
. . . And Shared

Sample Geographic Questions

- Where should Wildfire control / prevention measures take place?

Wildfire Factors

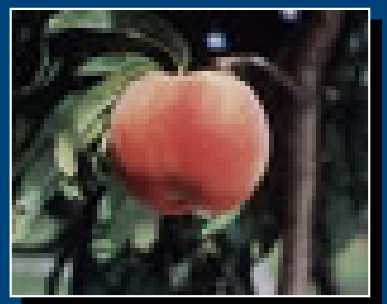
- Fuels
- Wildland Urban Interface
  - Home locations
  - Water sources
  - Defensable area
  - Evacuation
- Ignition sources
- Terrain



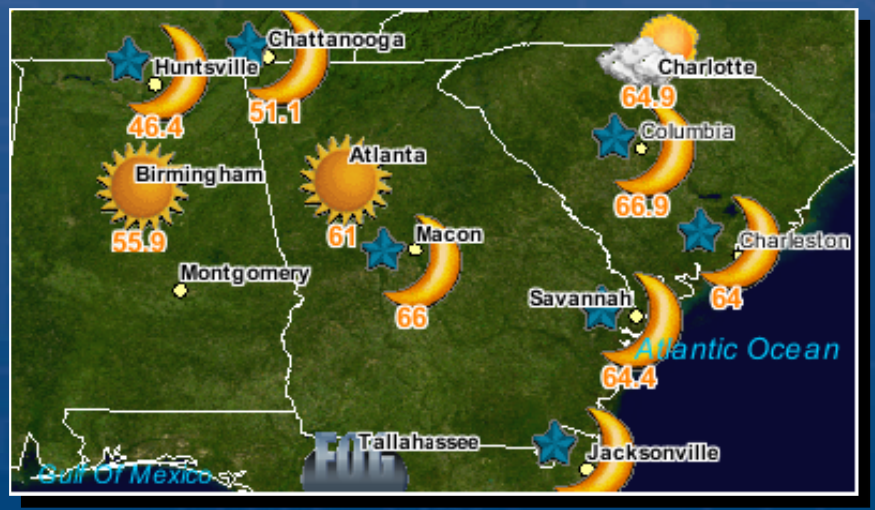
Sample Geographic Questions

- Where should Wildfire control / prevention measures take place?
- Why do peaches grow well in Georgia but not in Idaho?

Peach Preferences



- Soil type
- Topography
  - Elevation
  - Aspect
- Climate
  - Length of growing season
  - Precipitation
  - Hours of sun
  - Temperature

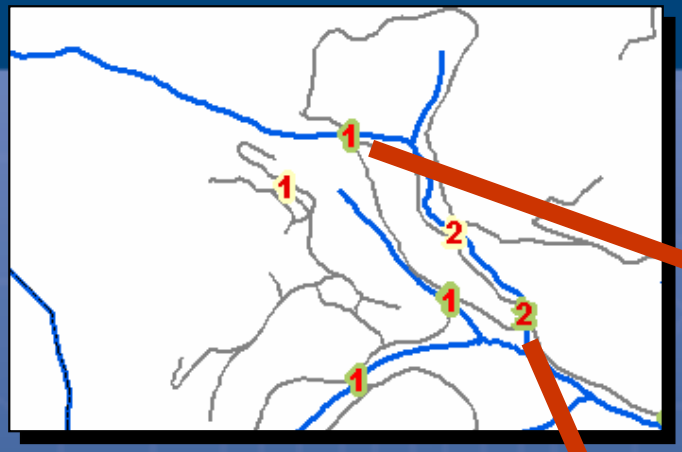


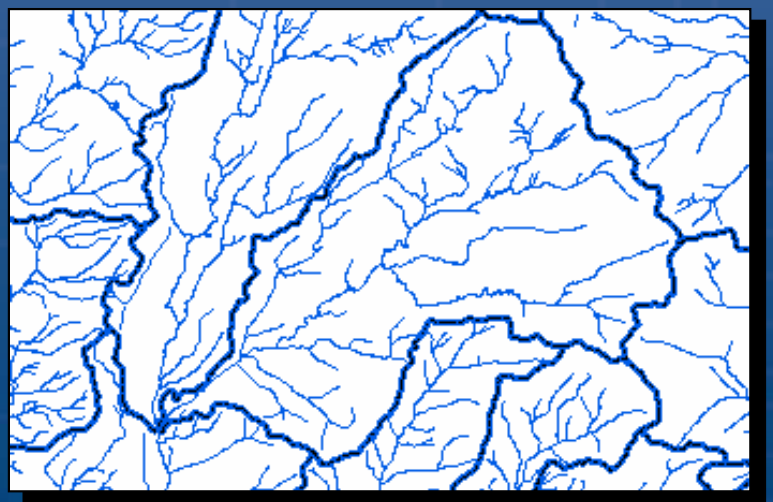
Sample Geographic Questions

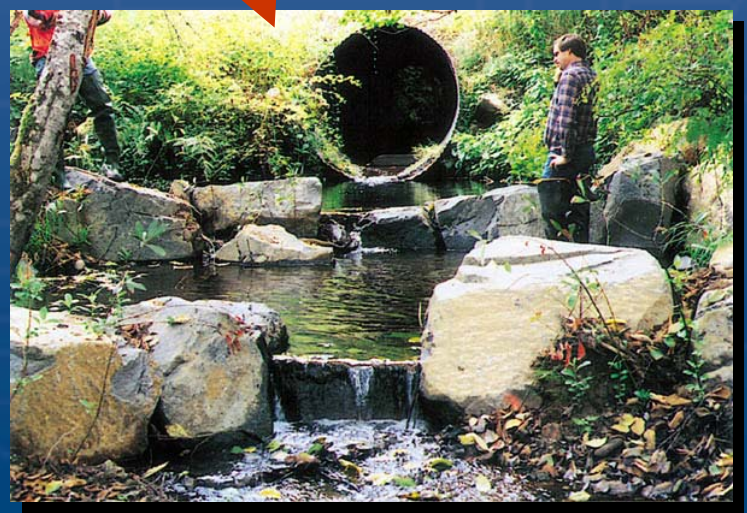
- Where should Wildfire control / prevention measures take place?
- Why do peaches grow well in Georgia but not in Idaho?
- What affects the migration of Salmon in the Pacific Northwest?

Salmon movement

- Streams
- Roads
  - Culverts
  - Bridges
- Land ownership





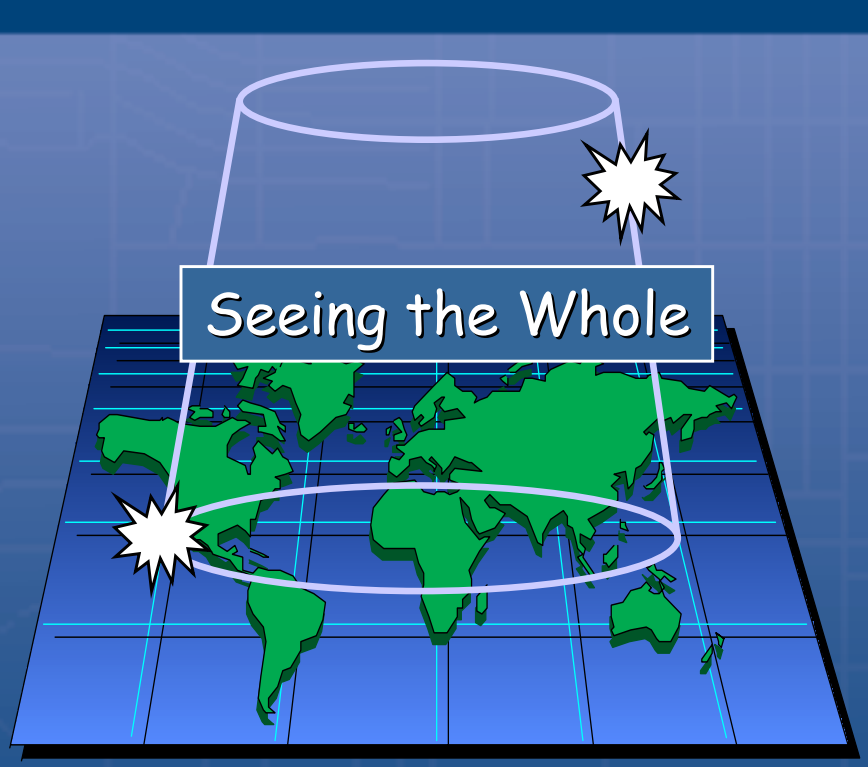


Organizing The World To Make Understanding It Easier

More Thoughts On GIS

- An instrument for implementing geographic thinking
- Provides the framework for studying complex systems
- Provides access to information to diverse groups of people
- Provides the context for discussion across multiple disciplines

Context and Content

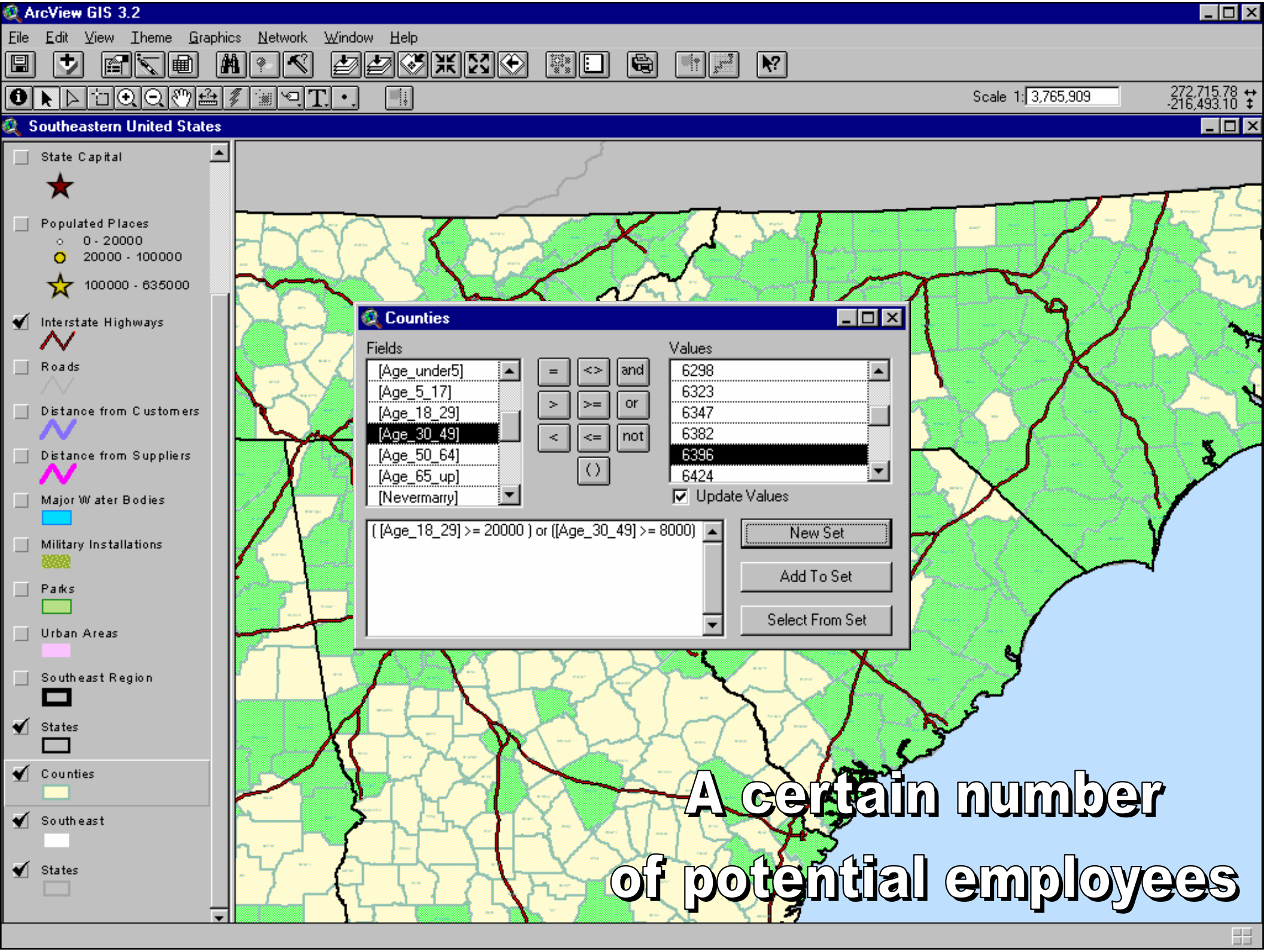


- Patterns
- Linkages
- Trends

- Watersheds
- Communities
- Neighborhoods
- Ecosystems

Finding Solutions

- Use an example to explain this
- Let's look at finding a suitable location for an industrial location
- This problem works to see how solutions are found using GIS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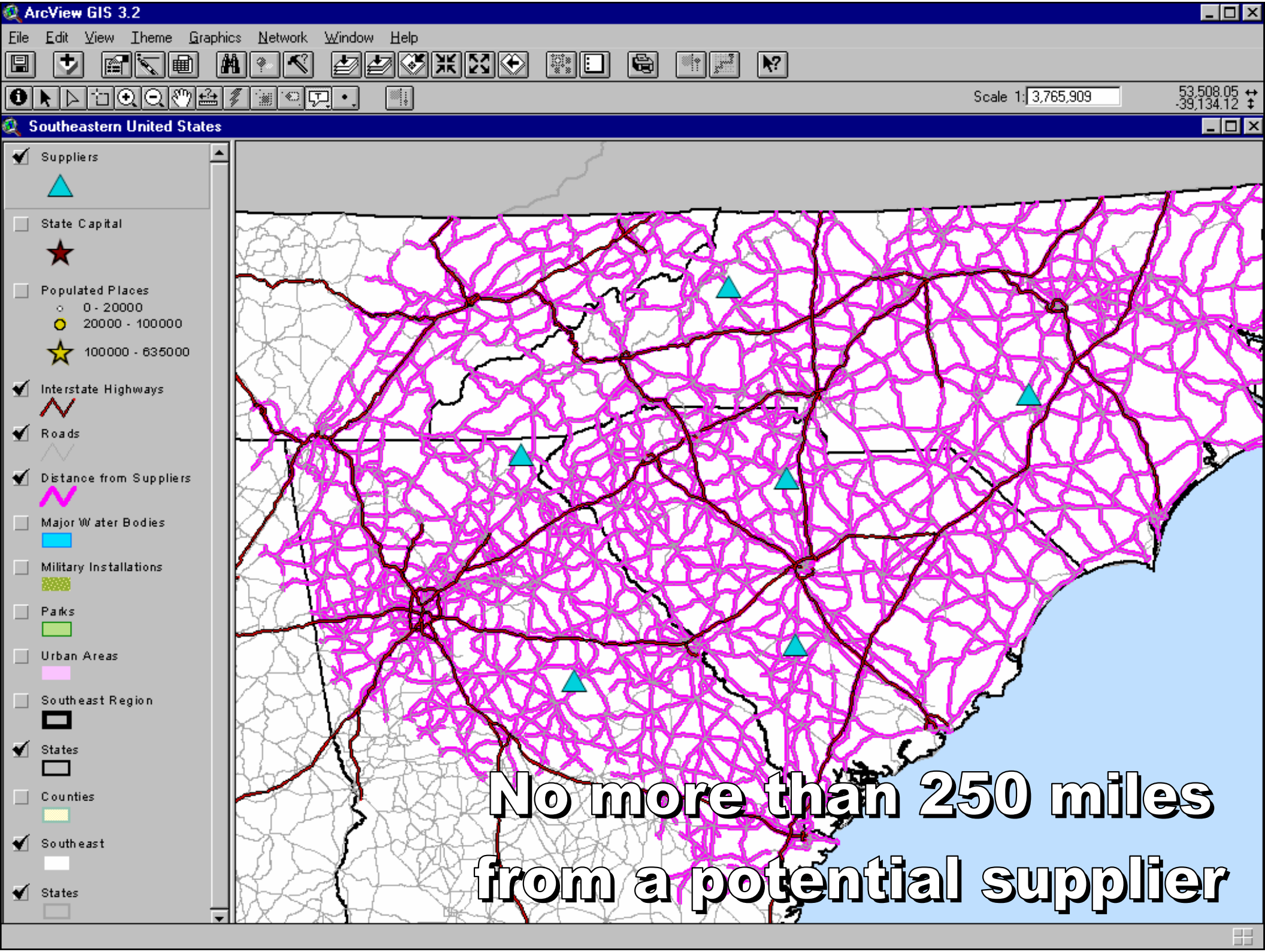
-216,493.10
Southeastern United States
State Capital
Populated Places
0 - 20000
20000 - 100000
100000 - 635000
Interstate Highways
Roads
Distance from Customers
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Southeast Region
States
Counties
Southeast
States
Counties
Fields
[Age_under5]
[Age_5_17]
[Age_18_29]
[Age_30_49]
[Age_50_64]
[Age_65_up]
[Nevermarry]
= <> and
> >= or
< <= not
( )
Values
6298
6323
6347
6382
6396
6424
Update Values
([Age_18_29] >= 20000) or ([Age_30_49] >= 8000)
New Set
Add To Set
Select From Set
A certain number
of potential employees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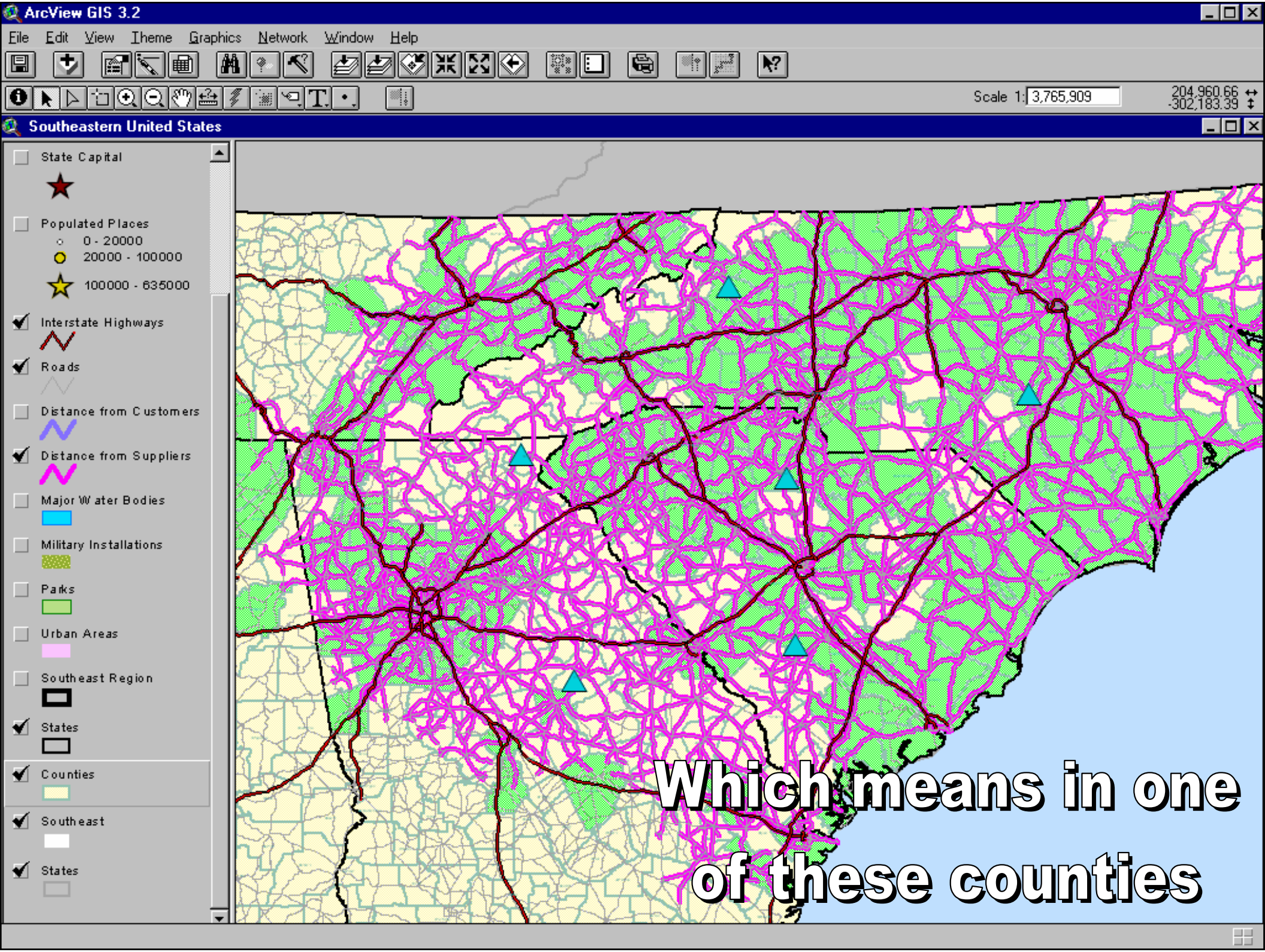
Suppliers
State Capital
Populated Places
0 - 20000
20000 - 100000
100000 - 635000
Interstate Highways
Roads
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Southeast Region
States
Counties
Southeast
States
No more than 250 miles
from a potential supplier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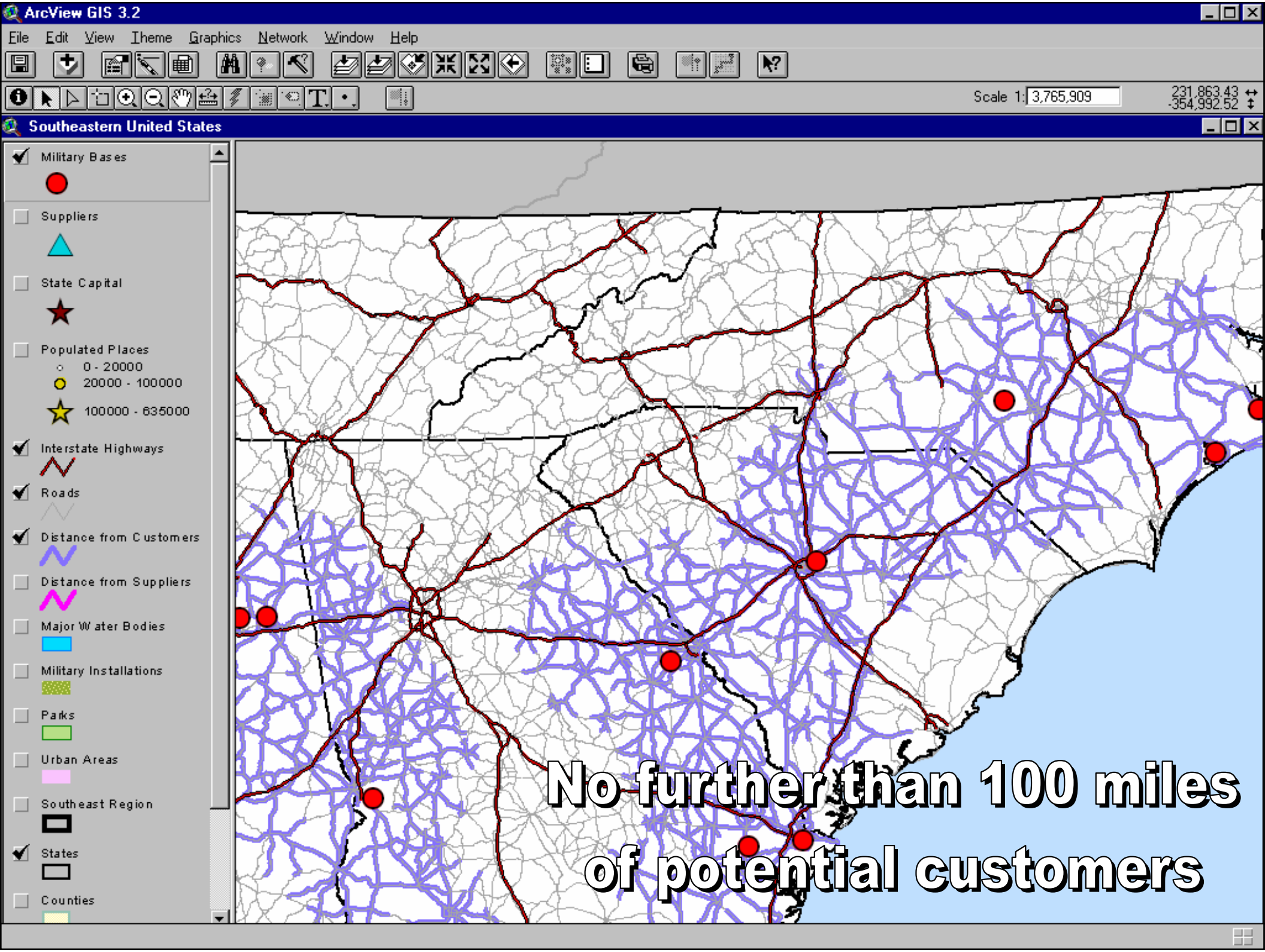
Populated Places
0 - 20000
20000 - 100000
100000 - 635000
Interstate Highways
Roads
Distance from Customers
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Southeast Region
States
Counties
Southeast
States
Which means in one
of these counties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Military Bases
Suppliers
State Capital
Populated Places
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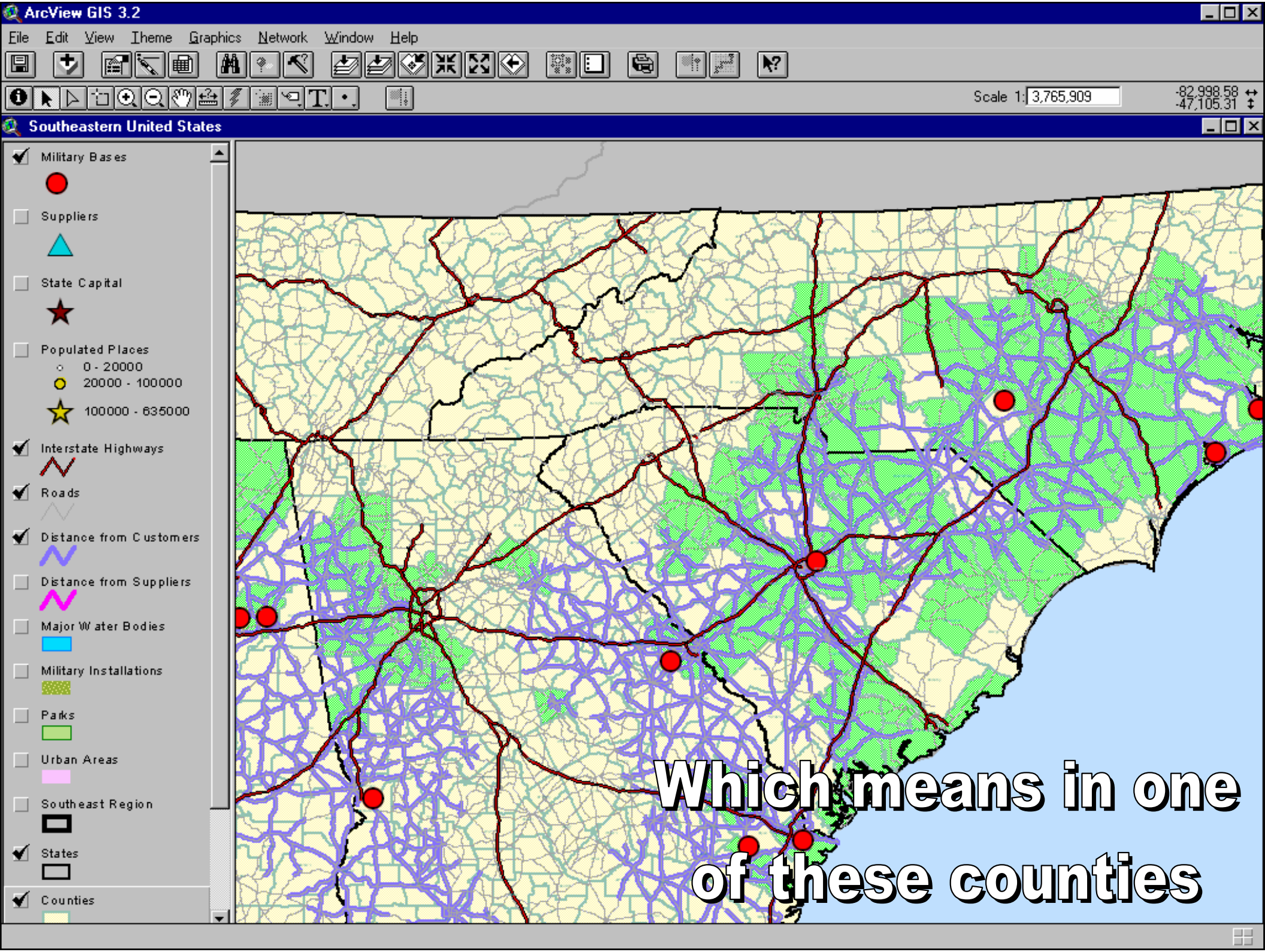
100000 - 635000
Interstate Highways
Roads
Distance from Customers
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Southeast Region
States
Counties
No further than 100 miles
of potential customers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Military Bases
Suppliers
State Capital
Populated Places
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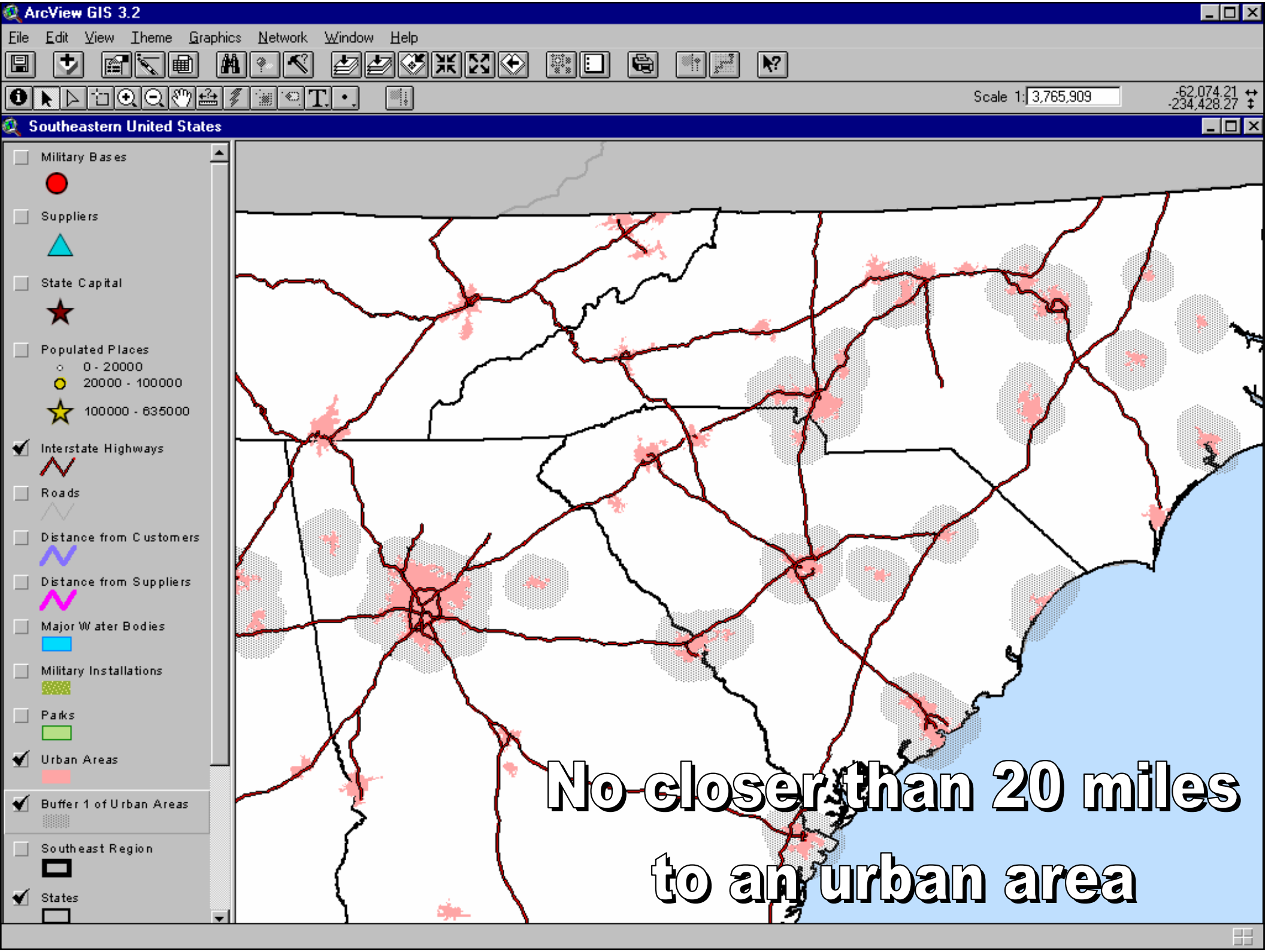
20000 - 100000
100000 - 635000
Interstate Highways
Roads
Distance from Customers
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Southeast Region
States
Counties
Which means in one
of these counties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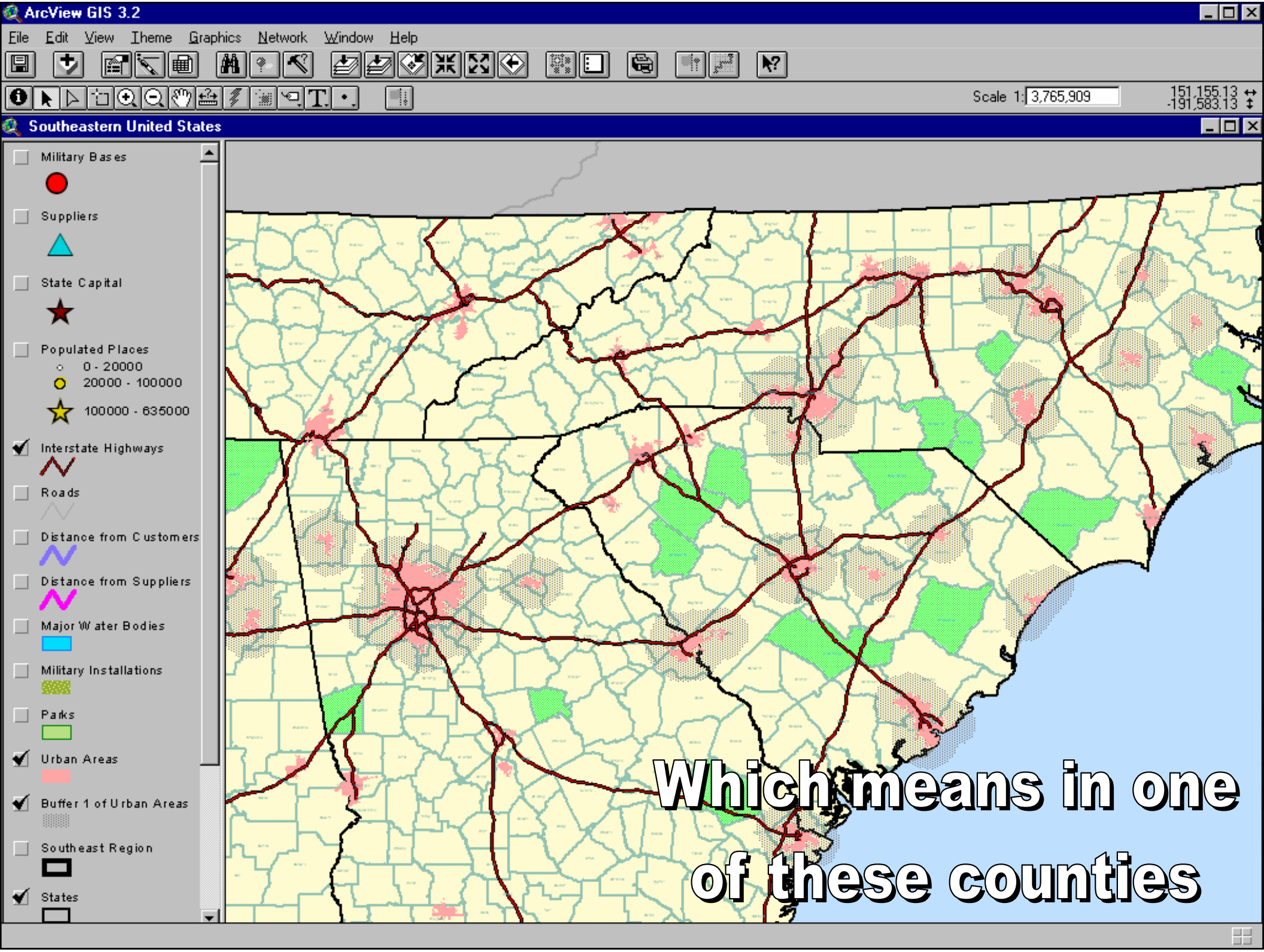
Military Bases
Suppliers
State Capital
Populated Places
0 - 20000
20000 - 100000
100000 - 635000
Interstate Highways
Roads
Distance from Customers
Distance from Suppliers
Major Water Bodies
Military Installations
Parks
Urban Areas
Buffer 1 of Urban Areas
Southeast Region
States
No closer than 20 miles
to an urban area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Interstate Highways
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Major Water Bodies
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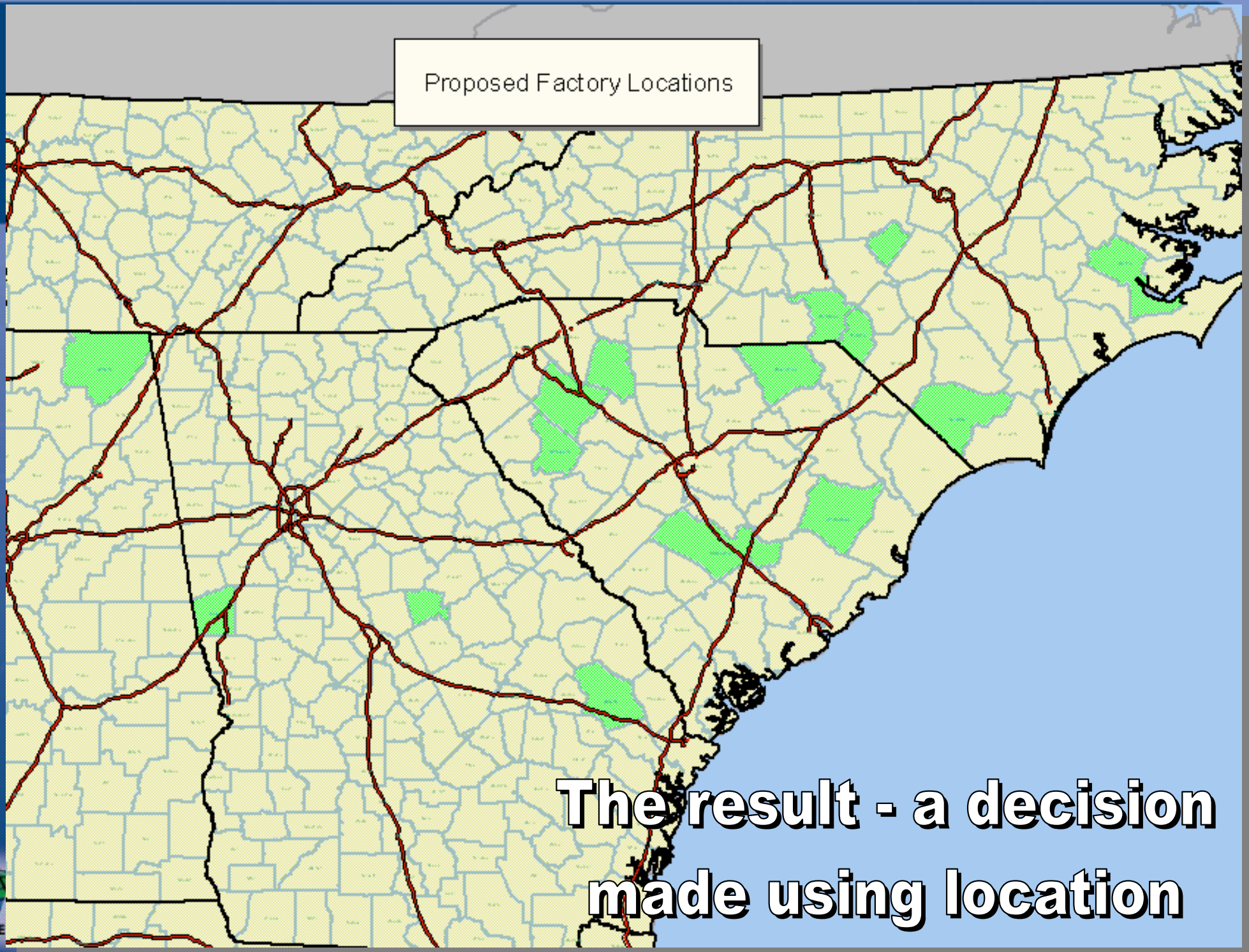
Urban Areas
Buffer 1 of Urban Areas
Southeast Region
States
Which means in one
of these counties

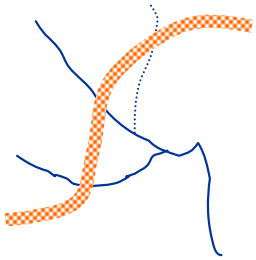


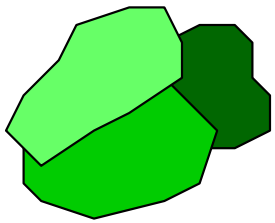
The result - a decision made using location

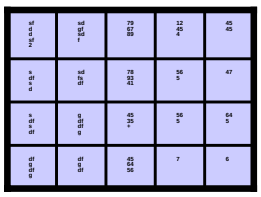
Evolution of a GIS

In the beginning…

There was Points, Lines, and Polygons…..







Points represent discrete locations on the ground or area features too small to portray as polygons.

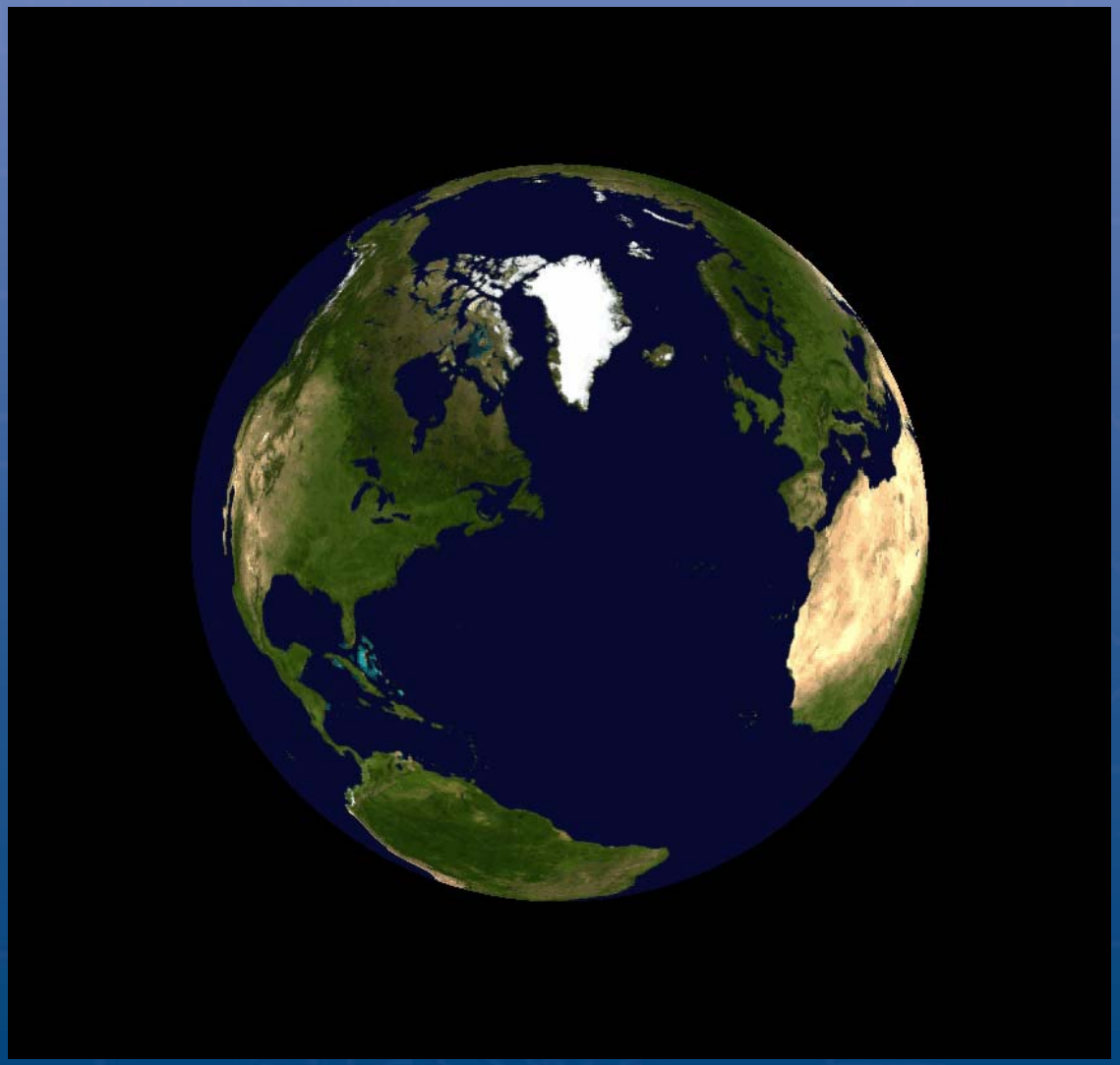
Lines represent linear features such as streams and roads as well as the boundary between areas.

Polygons represent areas that have some common values such as political designation, natural resource, ownership, and others.

Attributes add intelligence to these features by describing the features.

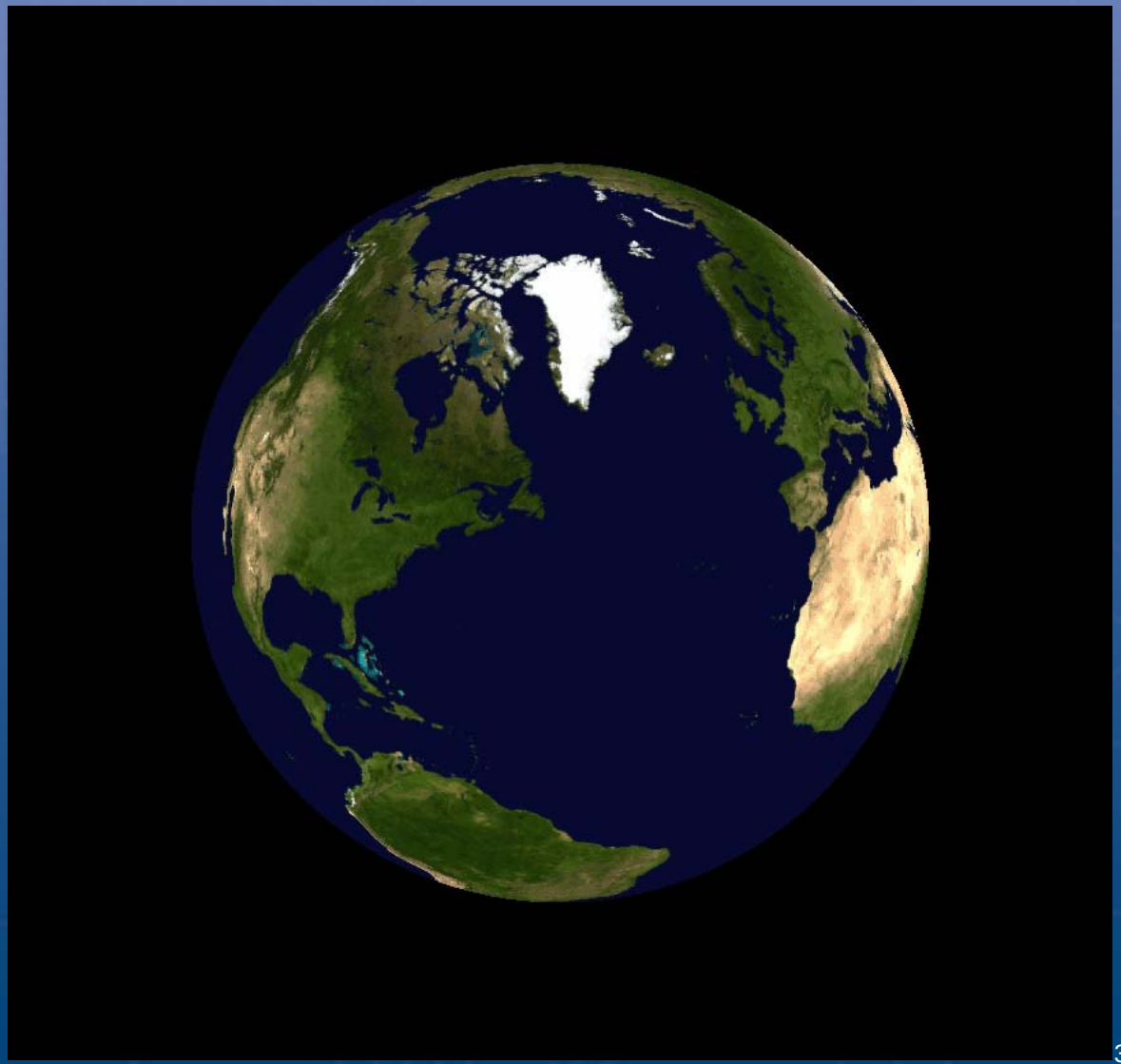
Case Study: SCA Fire Wise Inventory Van Buren, Missouri

- Field Crews perform details property assessments
- Properties categorized by defensible distance categories:
  - < 30 feet
  - 30 to 70 feet
  - 70 to 100 feet
  - > 100 feet
- Priority areas selected based on property buffer and proximity to open road



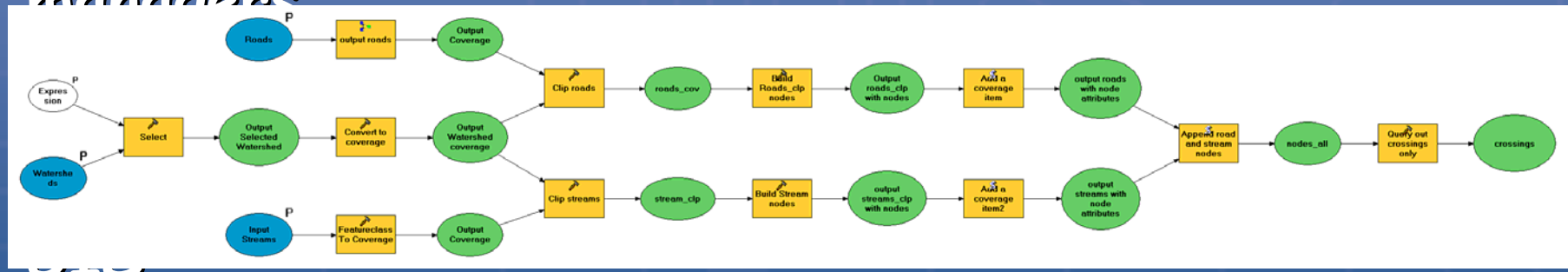
Case Study: SCA Property Asset inventory in Shelter Cove, CA

- Detailed Asset inventory of Shelter Cove subdivision
- Information provided to fire fighters in advance of several fires within a few miles of the subdivision
- Evacuation plans and suppression tactics supplemented with information



Case Study: Culvert inventory for fish migration, Boise and Sawtooth National Forests

Challenge: Provide detailed information on the status of fish migration corridors to area managers



GIS.

action

GIS can be used to direct crews to priority locations for survey.

GIS can then be used to analyze the data to focus on remediation to improve upstream migration paths.

Who Uses GIS – Federal Civilian

- Federal Civilian
  - National Park Service
  - Bureau of Land Management
  - US Geological Survey
  - Minerals Management Service
  - Bureau of Reclamation
  - Office of Surface Mining
  - Bureau of Indian Affairs
  - Fish and Wildlife Service
  - US Forest Service
  - Natural Resources Conservation Service
  - Farm Services Agency
  - APHIS
  - Environmental Protection Agency
  - NASA
- Health and Human Services
- Department of Homeland Security
- National Oceanic and Atmospheric Administration
- National Weather Service
- Department of Energy
- Centers for Disease Control
- Smithsonian
- Federal Emergency Management Agency
- Department of State
- US Department of Transportation
- Department of Labor
- Department of Justice
- Department of Labor
- Plus many more….

Who Uses GIS - Defense

- Joint Forces Command
- Naval Surface Warfare Center
- US Coast Guard
- US Navy
- Office of Naval Intelligence
- US Air Force
- US Army
- Strategic Command
- Defense Intelligence Agency
- National Imagery and Mapping Agency
- Central Intelligence Agency
- Office of Naval Intelligence
- Defense Intelligence Agency
- National Security Agency
- National Reconnaissance Office
- National Geospatial Intelligence School
- US Army Topographic Engineering Center
- US Army National Guard
- US Marine Corp
- Naval Security Group
- US Army Environmental Center
- US Army Facilities and Ranges

Who Uses GIS – State / Local

- States - All of them
  - Departments of Natural Resources/Conservation
  - Departments of Revenue
  - Departments of Transportation
  - Departments of Agriculture
  - Departments of Environmental Quality
- Counties (<2/3's)
- Cities
  - Most over 20-30K population
  - Metro Districts
- Conservation Districts (2700+)
- Fire Districts
- Others

Who Uses GIS – Universities / NGO's

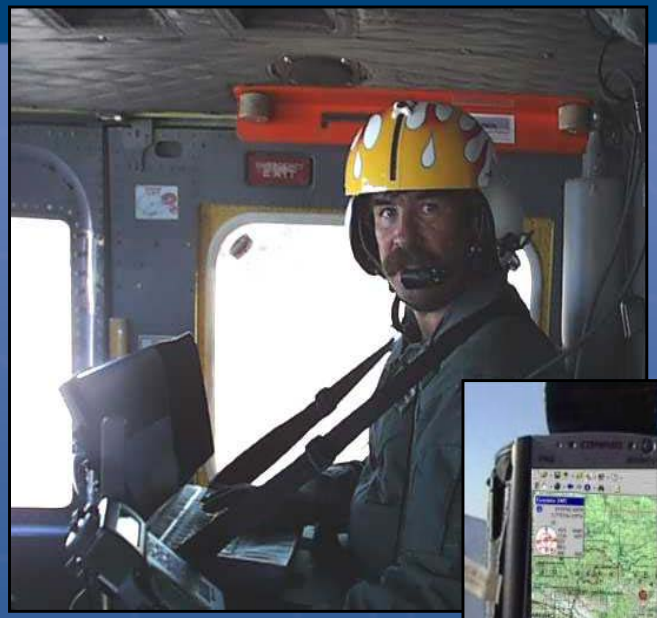
- Auburn University
- University of Alaska
- Johns Hopkins
- Towson University
- Louisiana State University
- University of Kentucky
- Kansas State
- University of Iowa
- University of Maine
- Michigan State University
- University of Nebraska
- Harvard University
- Hundreds more…
- Also Community Colleges, K-12, Museums

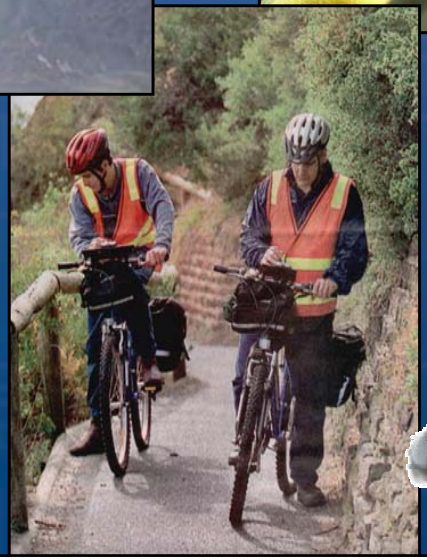
- Student Conservation Association
- Conservation Fund
- NatureServe
- The Wilderness Society
- Ducks Unlimited
- World Wildlife Fund
- World Resources Institute
- Global Forest Watch
- Ecotrust
- Environmental Defense Fund
- George Wright Society
- Thousands more both in the US and worldwide

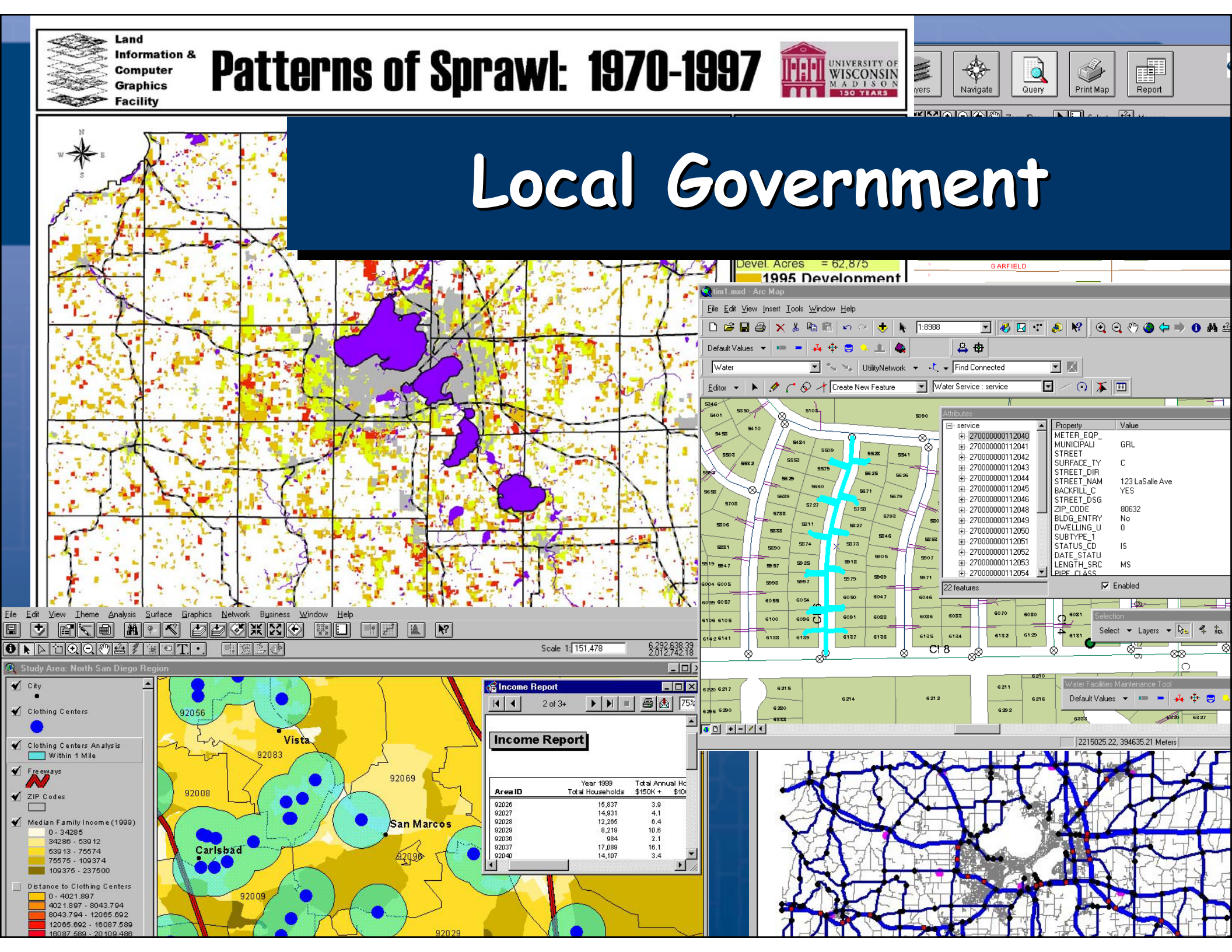
What Do They All Do With GIS

- Development
- Forestry
- Natural Resources
- Land use
- Urban Development
- Health
- Defense
- Utilities
- Education
- Science
- Roads/Transportation
- Survey/Cadastral
- Planning
- Environmental Conservation
- Agriculture
- Statistics
- Energy
- Telecommunications
- Public Safety
- Business

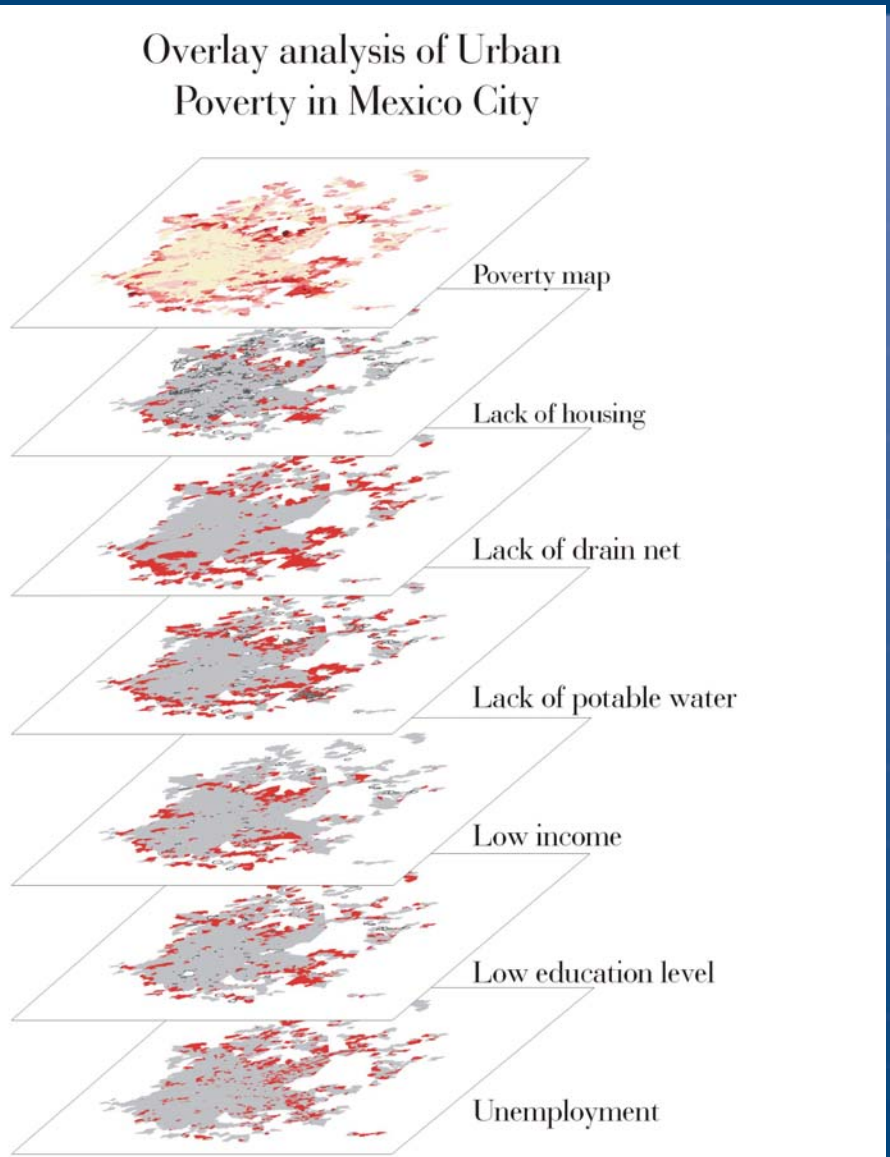
Mobile GIS

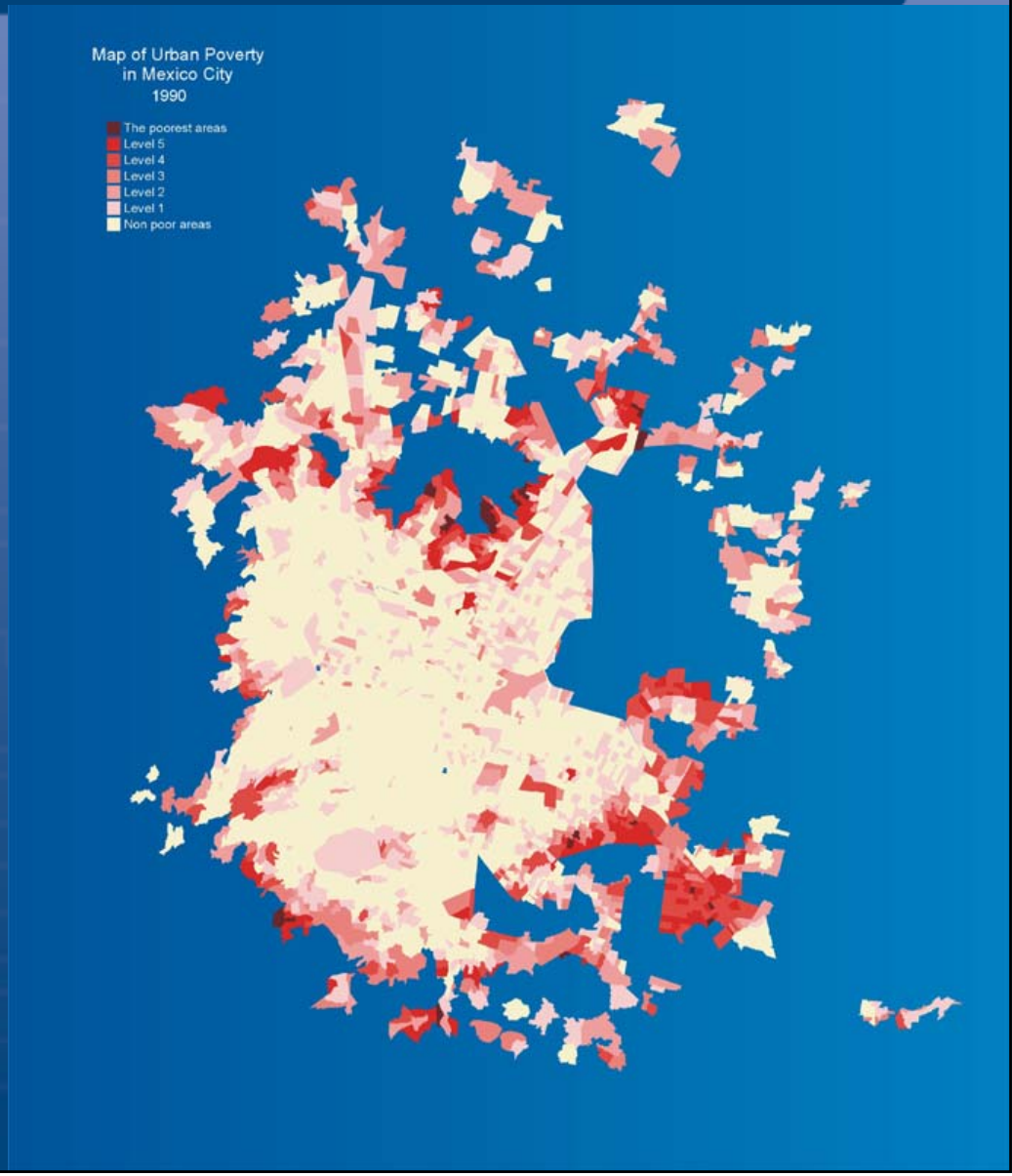




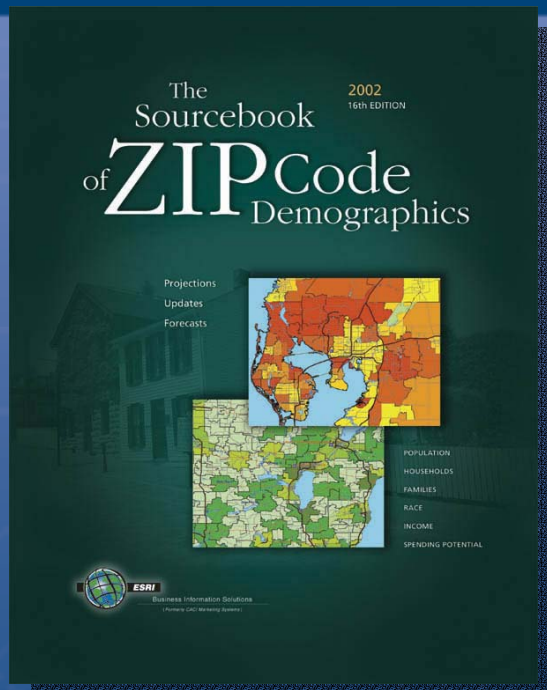

Land Information & Computer Graphics Facility
Patterns of Sprawl: 1970-1997
University of Wisconsin Madison 150 Years
Local Government
Navigate
Query
Print Map
Report
Devel. Acres = 62,875
1995 Development
GARFIELD
tim1.mxd - Arc Map
File Edit View Insert Tools Window Help
Default Values
Water
UtilityNetwork
Find Connected
Editor
Create New Feature
Water Service : service
Attributes
service
Property
Value
METER_EQP_
MUNICIPALI
GRL
STREET
SURFACE_TY
C
STREET_DIR
STREET_NAM
123 LaSalle Ave
BACKFILL_C
YES
STREET_DSG
ZIP_CODE
80632
BLDG_ENTRY
No
DWELLING_U
0
SUBTYPE_1
STATUS_CD
IS
DATE_STATU
LENGTH_SRC
MS
22 features
Enabled
Selection
Select
Layers
Water Facilities Maintenance Tool
Default Values
2215025.22, 394635.21 Meters
File Edit View Theme Analysis Surface Graphics Network Business Window Help
Scale 1: 151,478
6,292,638.39
2,012,742.18
Study Area: North San Diego Region
City
Clothing Centers
Clothing Centers Analysis
Within 1 Mile
Freeways
ZIP Codes
Median Family Income (1999)
0 - 34285
34286 - 53912
53913 - 75574
75575 - 109374
109375 - 237500
Distance to Clothing Centers
0 - 4021.897
4021.897 - 8043.794
8043.794 - 12065.692
12065.692 - 16087.589
16087.589 - 20109.486
92056
Vista
92083
92069
92008
San Marcos
Carlsbad
92009
92029
Income Report
2 of 3+
75%
Income Report
Area ID
Year 1999 Total Households
Total Annual Hc $150K +
92026 15,837 3.9
92027 14,931 4.1
92028 12,265 6.4
92029 8,219 10.6
92036 984 2.1
92037 17,089 16.1
92040 14,107 3.4

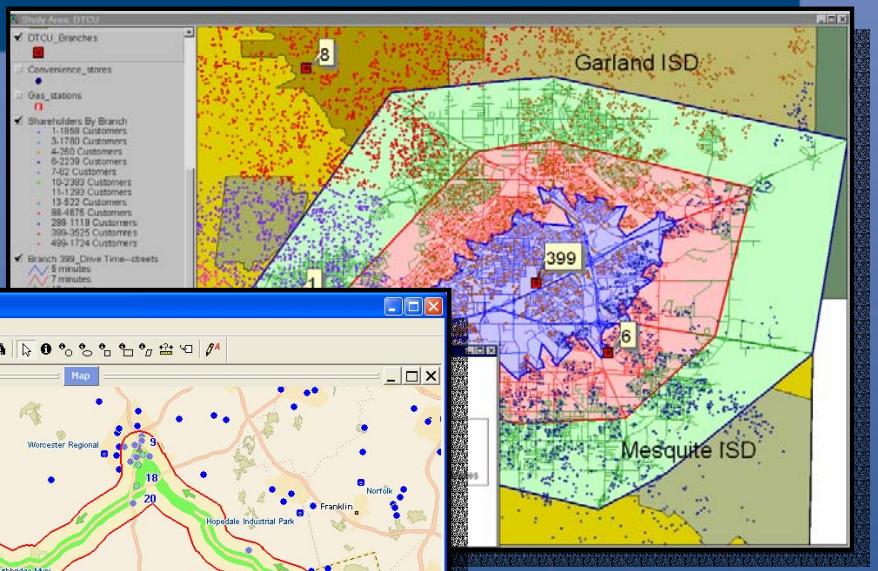
Socioeconomic Analysis

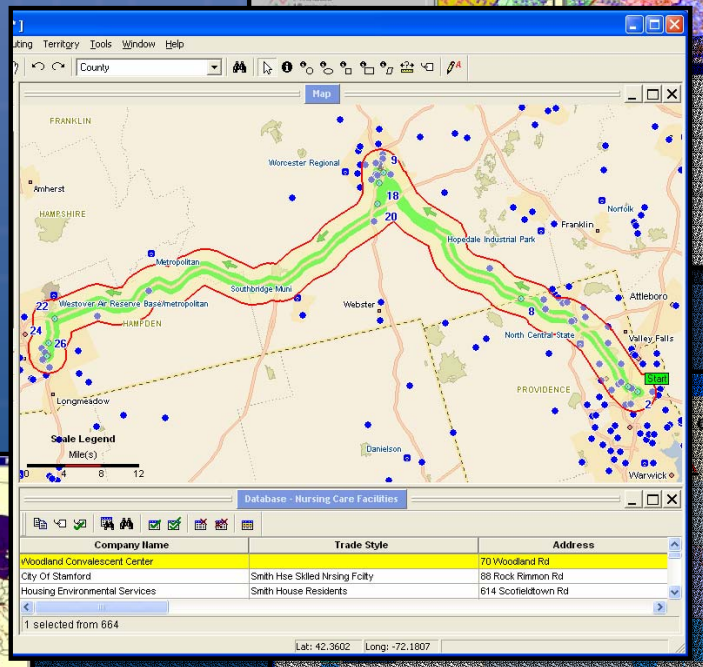


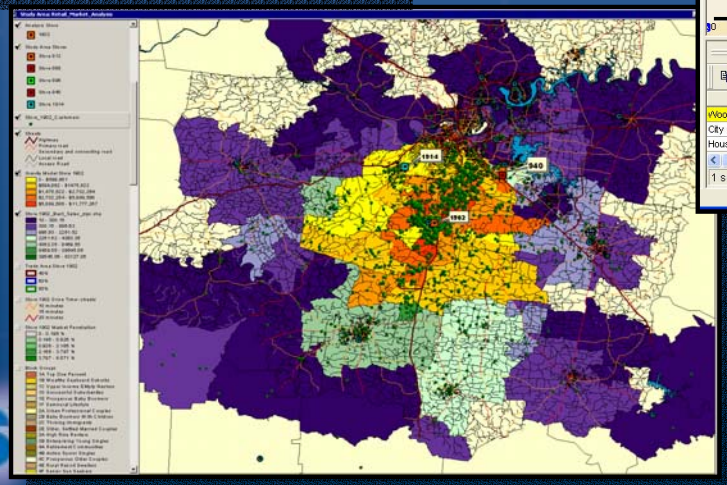


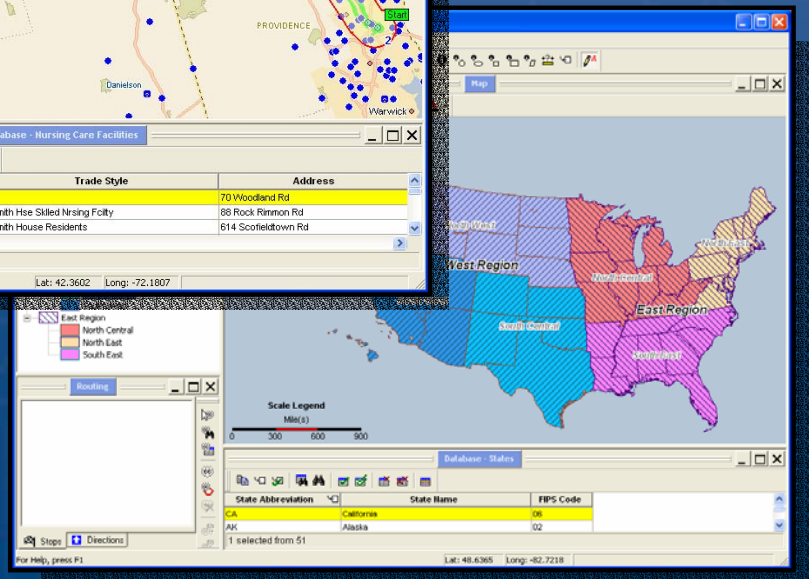
Demographic Analysis





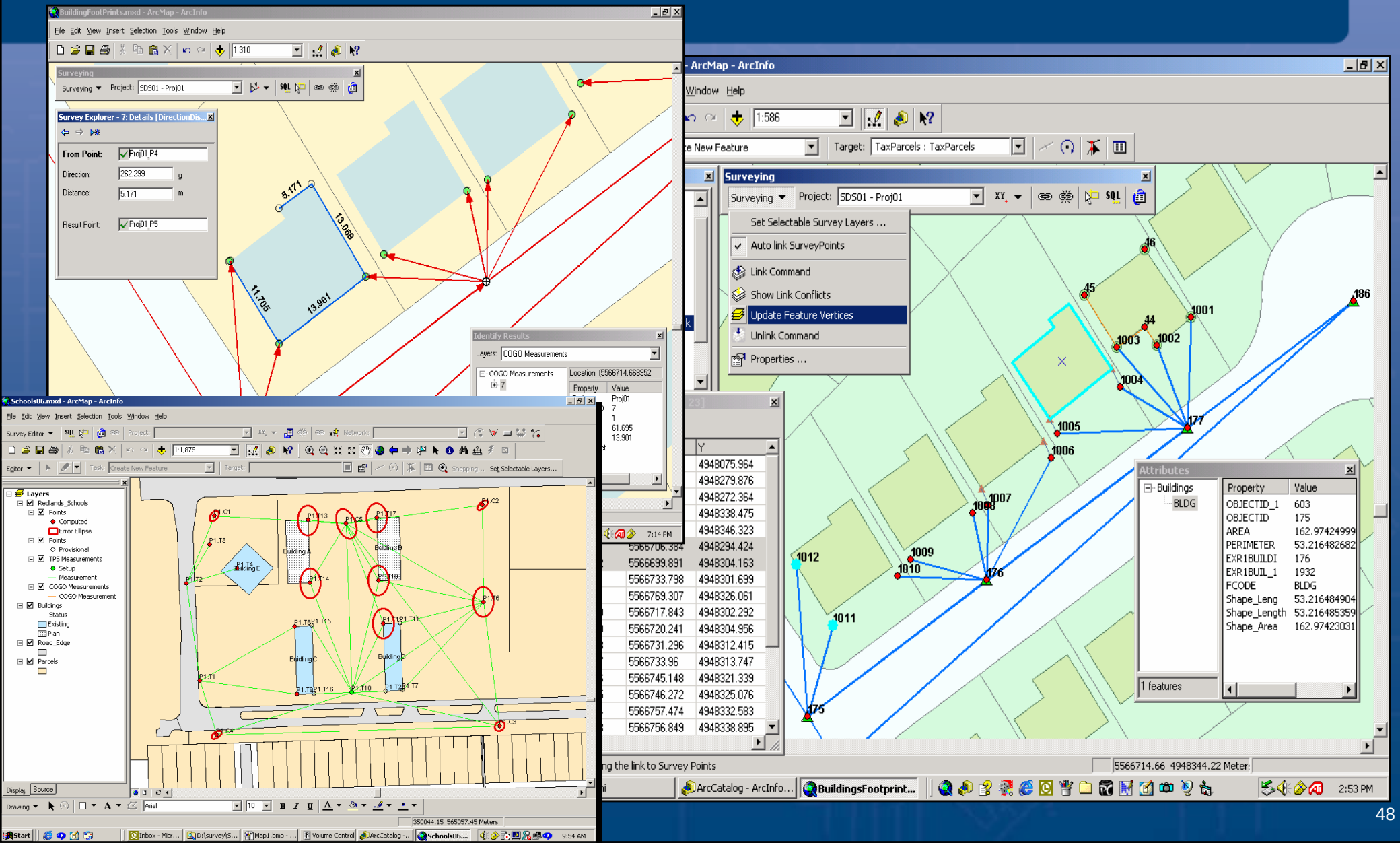




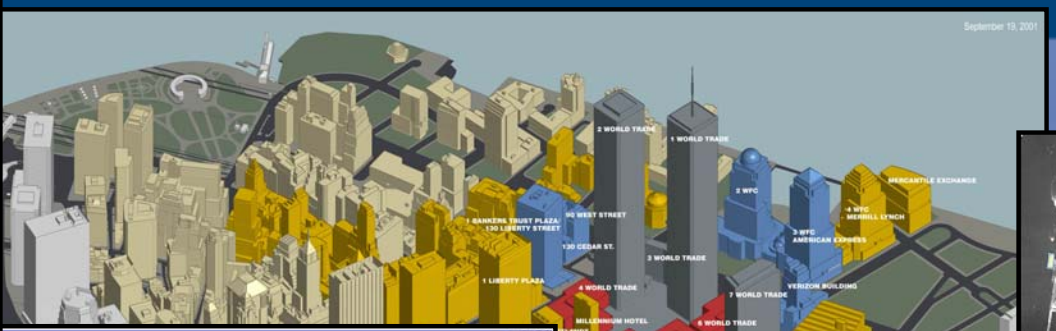


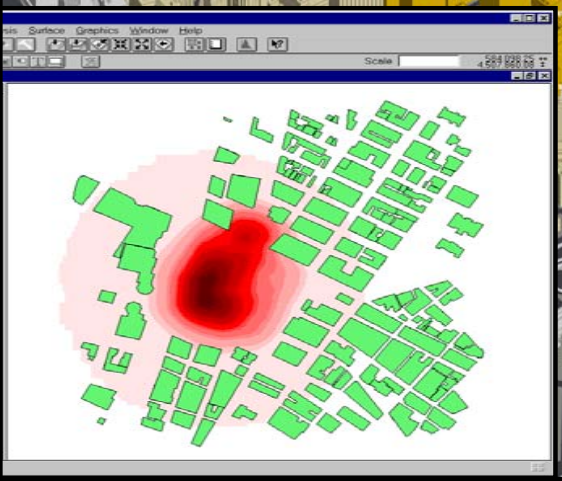
ArcGIS ESRI

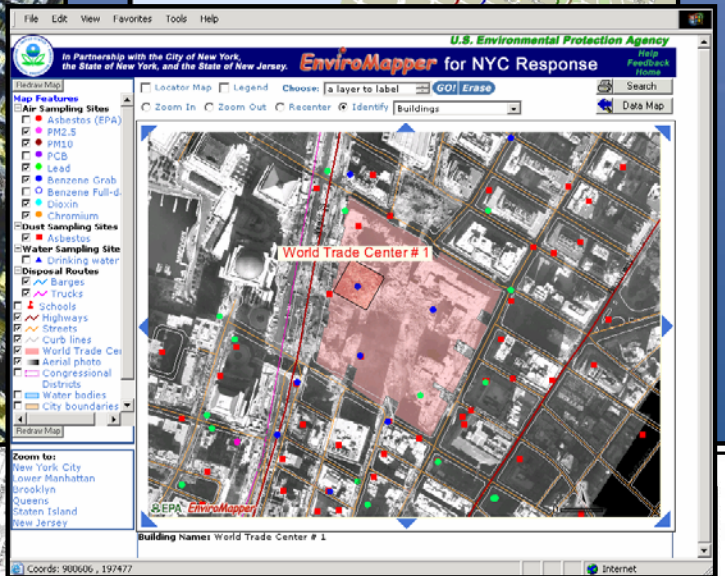
Surveying

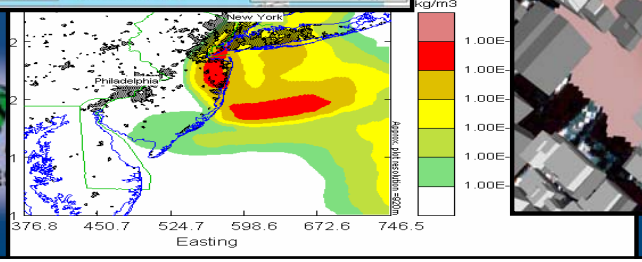

BuildingFootPrints.mxd - ArcMap - ArcInfo
Surveying
Survey Explorer - 7: Details [DirectionDis...
From Point: Proj01_P4
Direction: 262.299 g
Distance: 5.171 m
Result Point: Proj01_P5
5.171
13.059
11.705
13.901
Identify Results
Layers: COGO Measurements
Location: (5566714.668952
Property Value
Proj01
7
1
61.695
13.901
Schools06.mxd - ArcMap - ArcInfo
ArcMap - ArcInfo
Surveying
Project: SDS01 - Proj01
Set Selectable Survey Layers ...
Auto link SurveyPoints
Link Command
Show Link Conflicts
Update Feature Vertices
Unlink Command
Properties ...
Target: TaxParcels : TaxParcels
Attributes
Buildings
BLDG
Property Value
OBJECTID_1 603
OBJECTID 175
AREA 162.97424999
PERIMETER 53.216482682
EXR1BUILDI 176
EXR1BUIL_1 1932
FCODE BLDG
Shape_Leng 53.216484904
Shape_Length 53.216485359
Shape_Area 162.97423031
1 features
5566714.66 4948344.22 Meter:
ArcCatalog - ArcInfo...
BuildingsFootprint...
2:53 PM

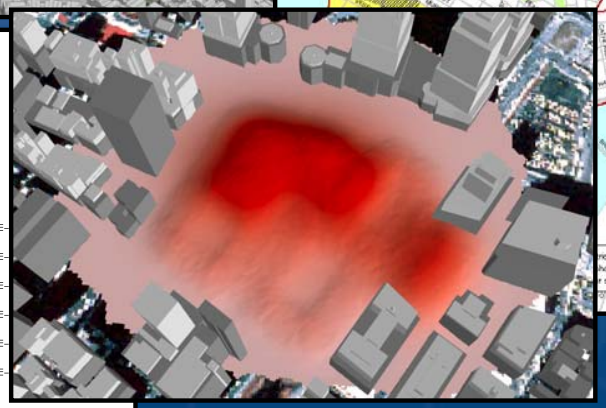
Disaster Management

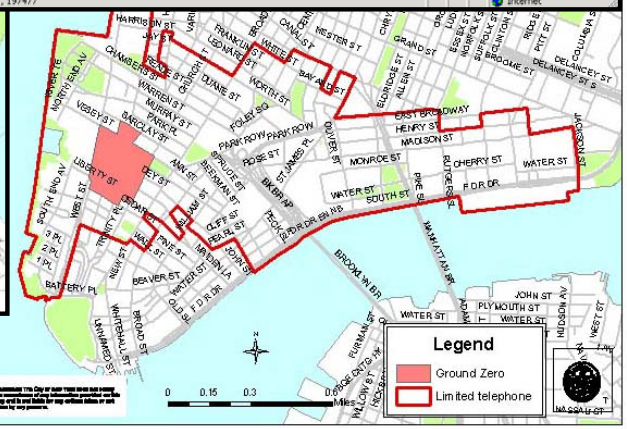


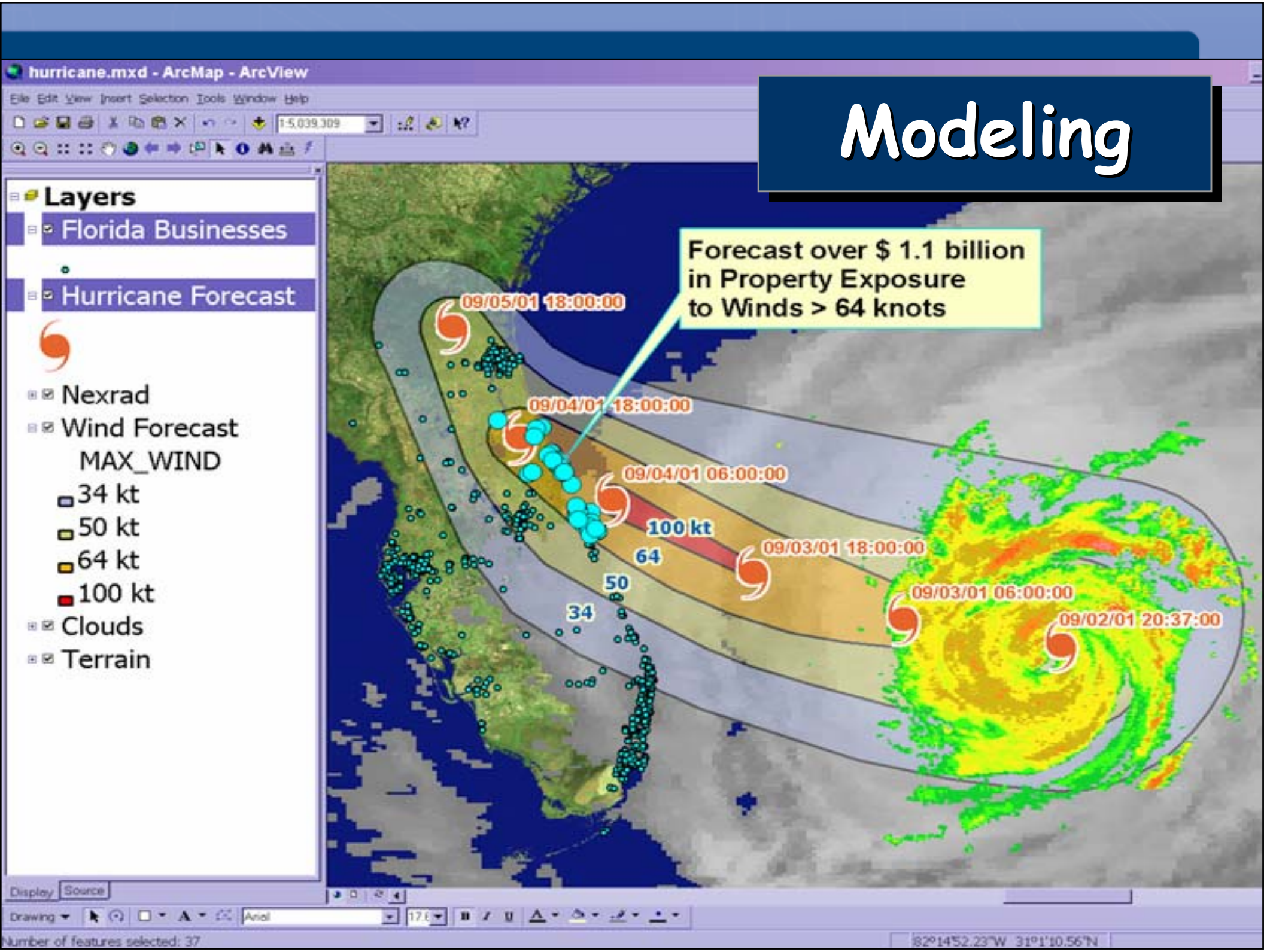






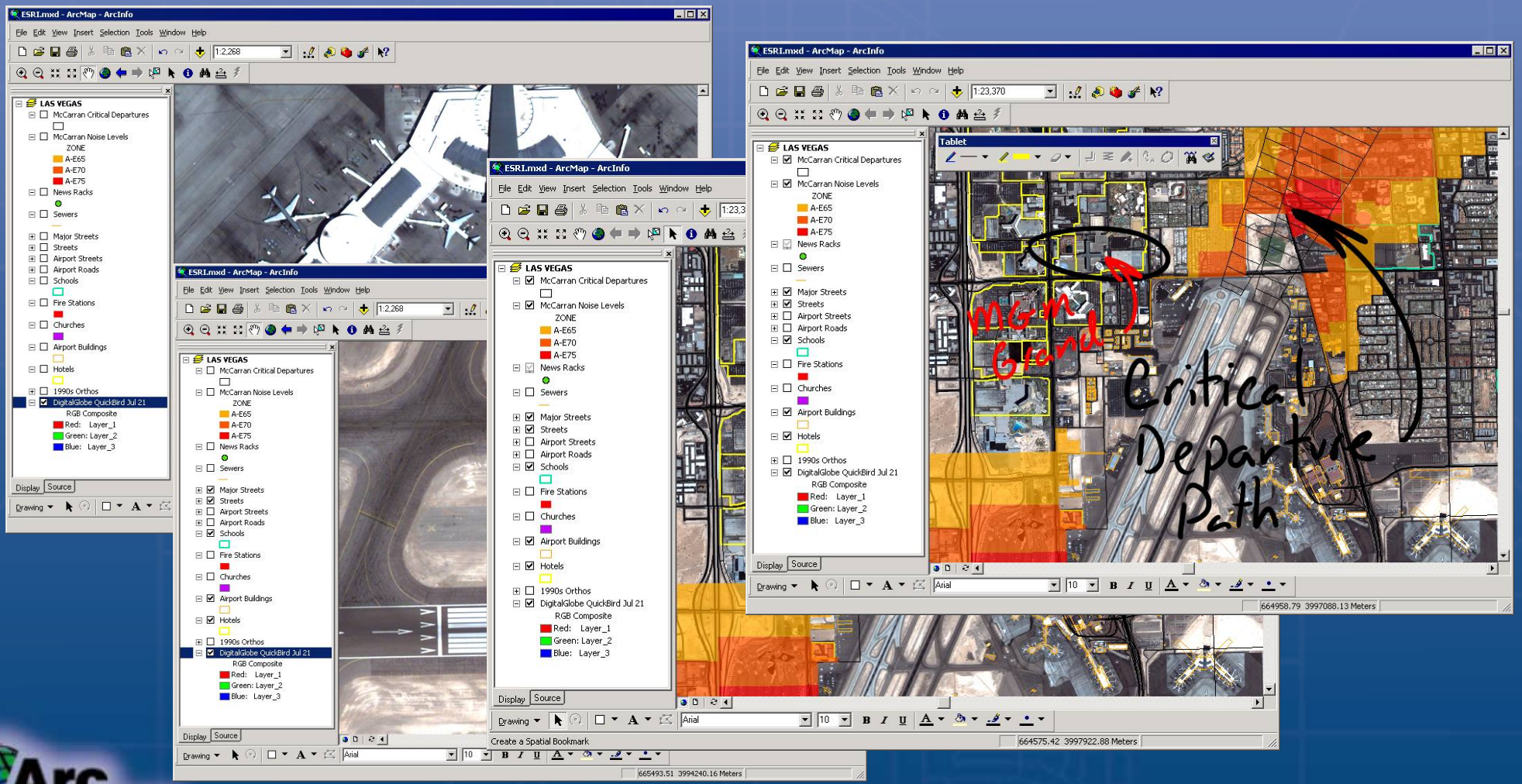




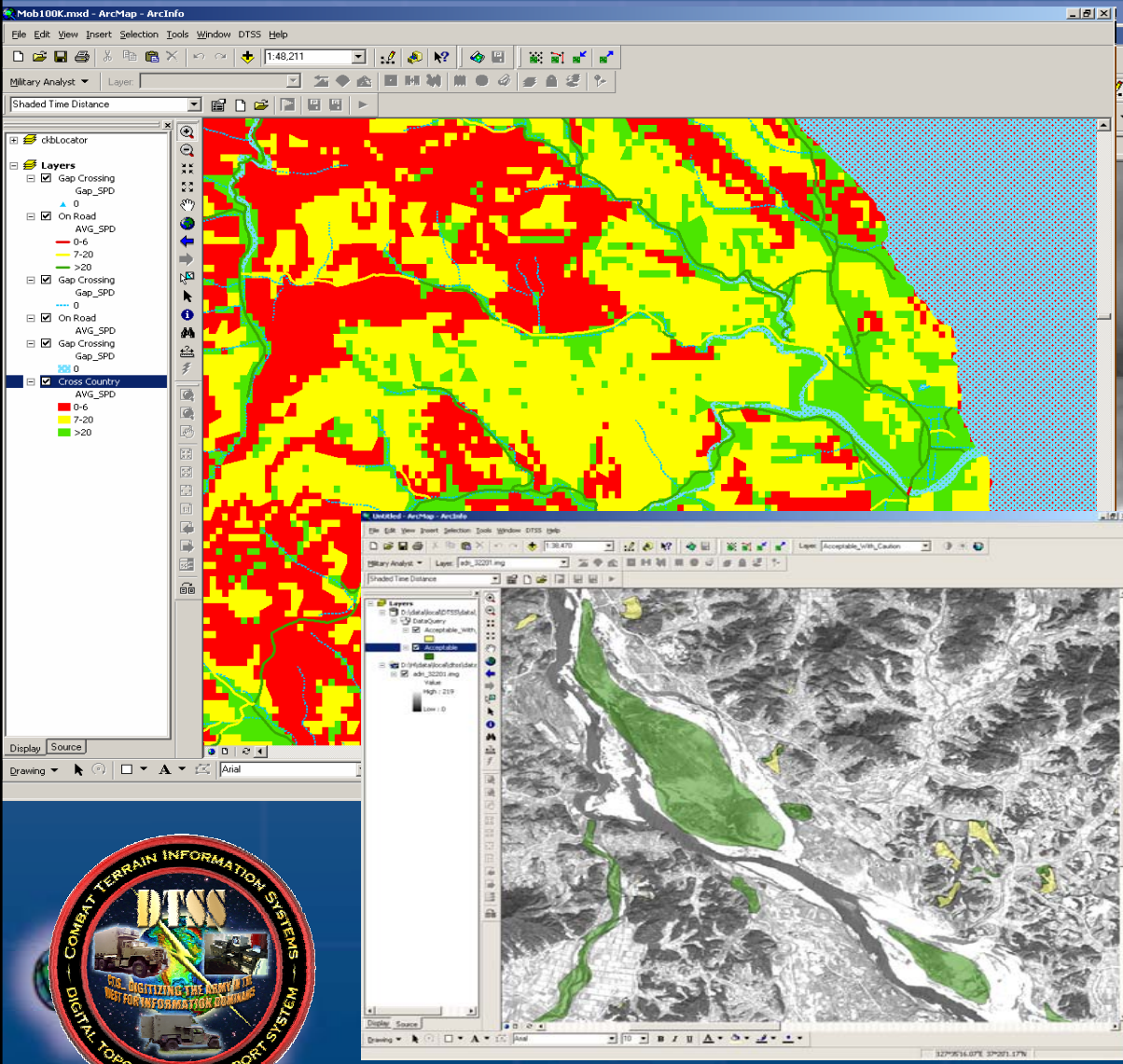

hurricane.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
Modeling
Layers
Florida Businesses
Hurricane Forecast
Nexrad
Wind Forecast
MAX_WIND
34 kt
50 kt
64 kt
100 kt
Clouds
Terrain
Forecast over $ 1.1 billion
in Property Exposure
to Winds > 64 knots
09/05/01 18:00:00
09/04/01 18:00:00
09/04/01 06:00:00
09/03/01 18:00:00
09/03/01 06:00:00
09/02/01 20:37:00
100 kt
64
50
34
Display
Source
Drawing
Number of features selected: 37

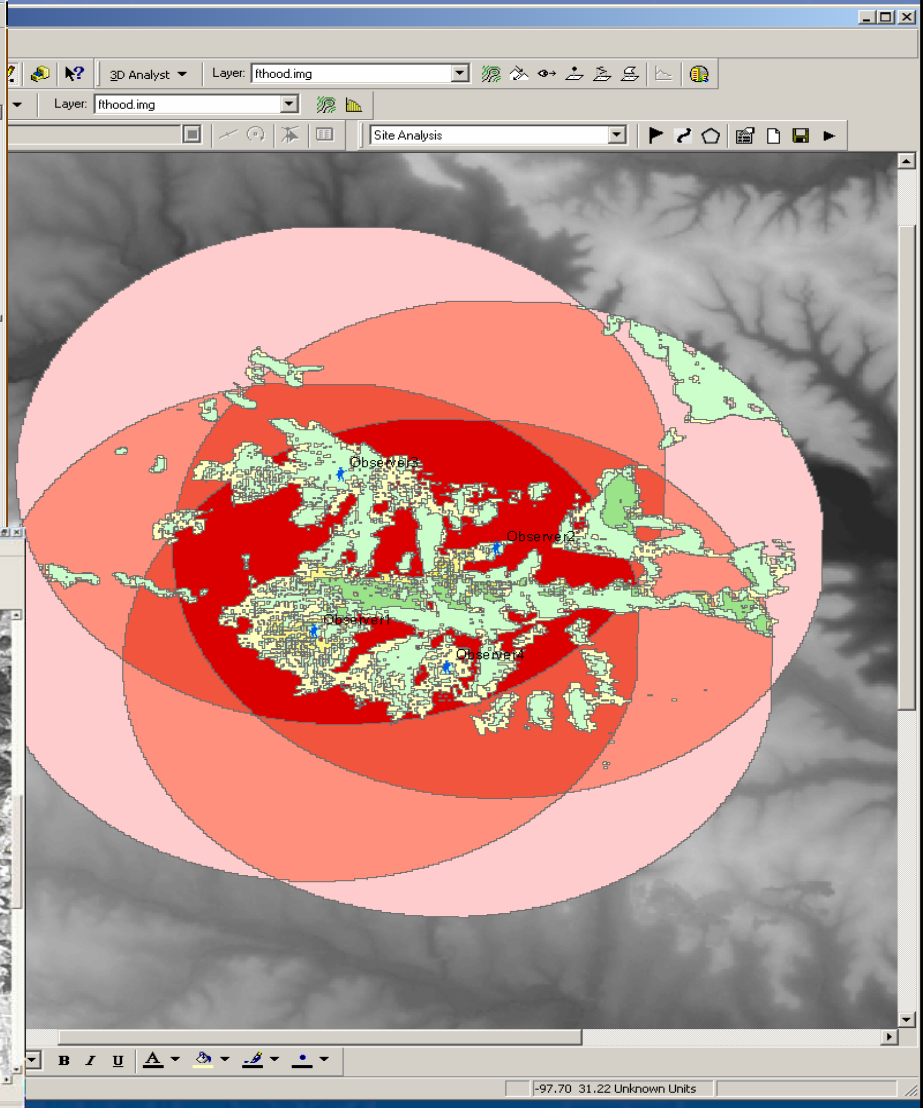
Emergency Response: US Department of Health and Human Services Command Center

Las Vegas – Homeland Security at McCarran Airport

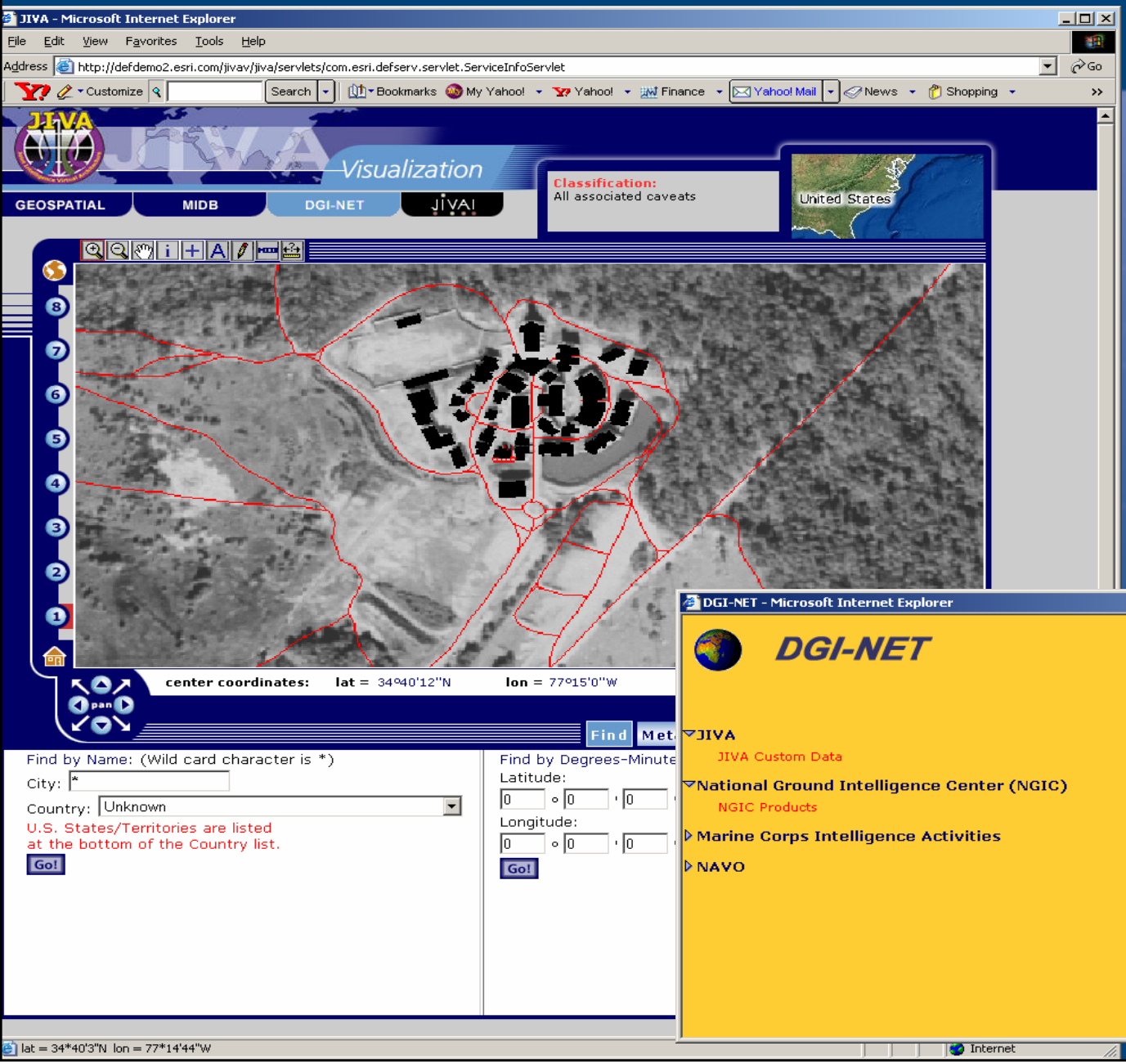


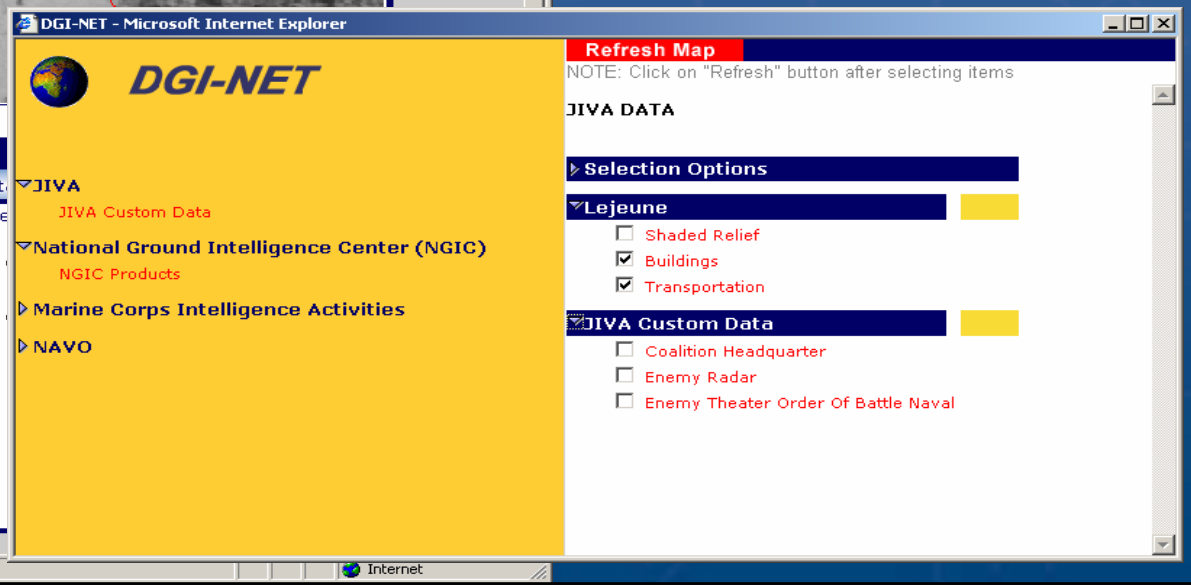
Defense


Mob100K.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window DTSS Help
Military Analyst
Shaded Time Distance
Layers
Gap Crossing
Gap_SPD
On Road
AVG_SPD
0-6
7-20
>20
Cross Country
Display
Source


3D Analyst
Layer: fthood.img
Site Analysis
Observer1
Observer2
Observer3
Observer4
-97.70 31.22 Unknown Units

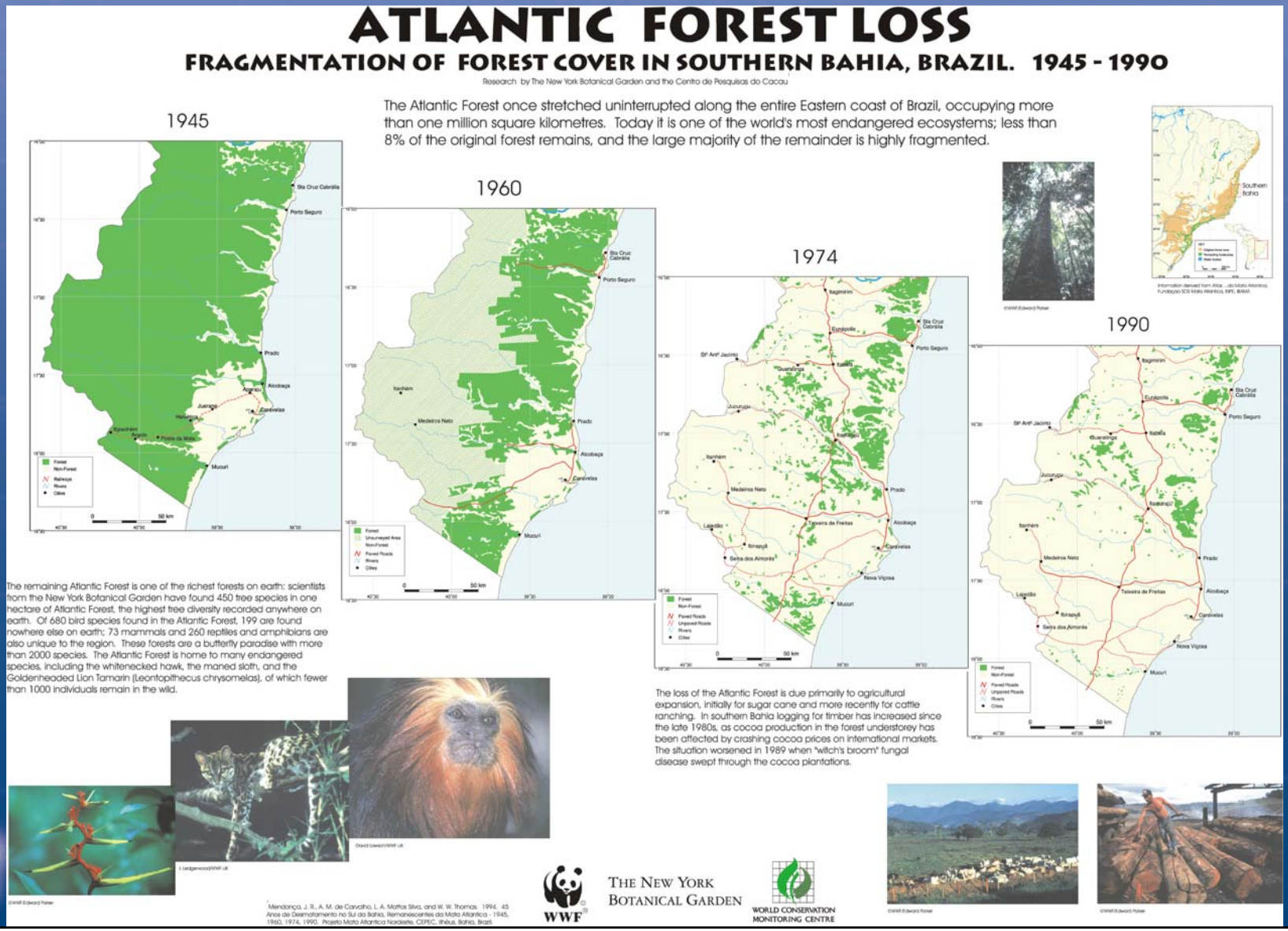
Intel



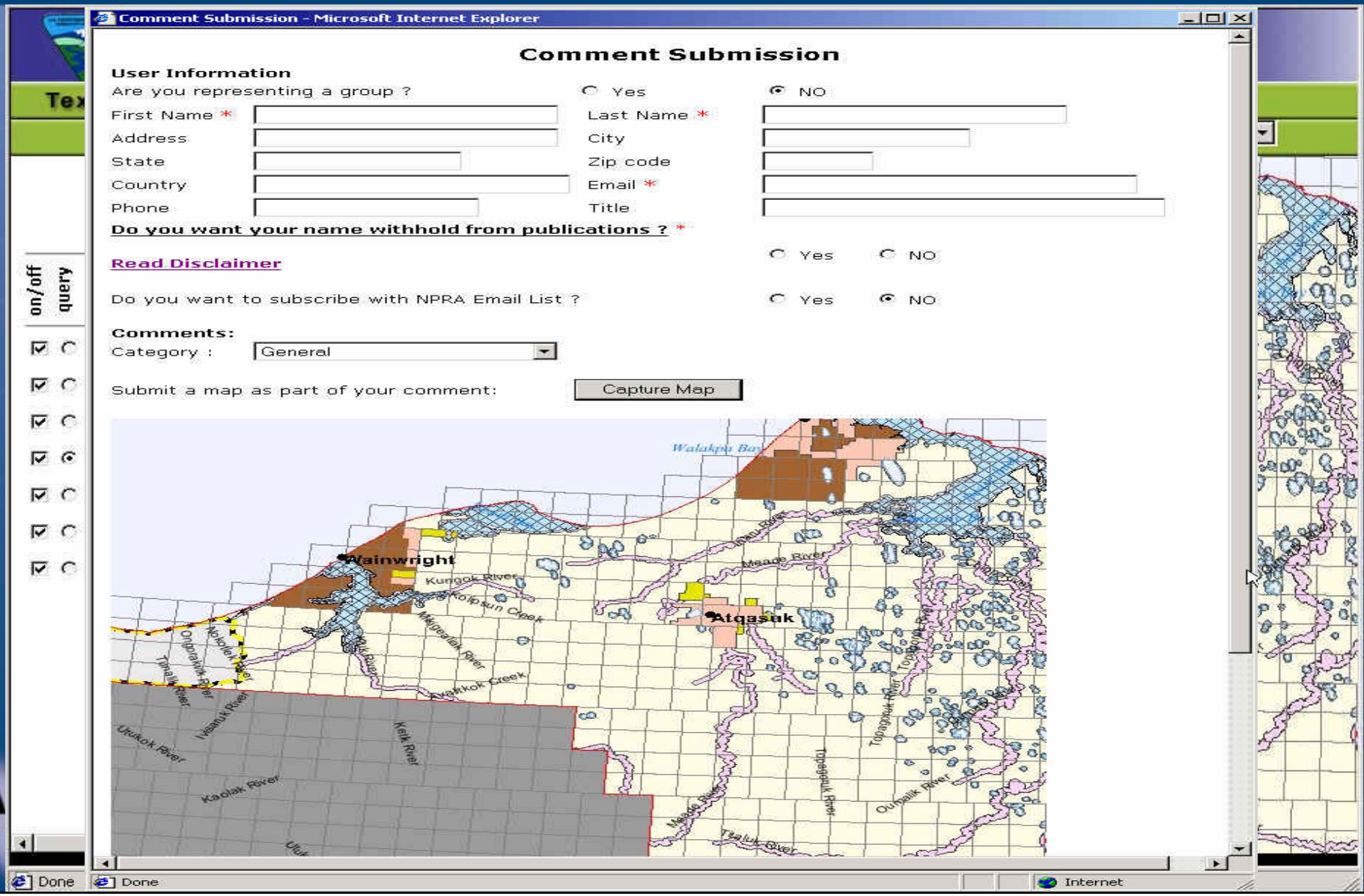


Joint Intelligence Virtual Architecture Visualization

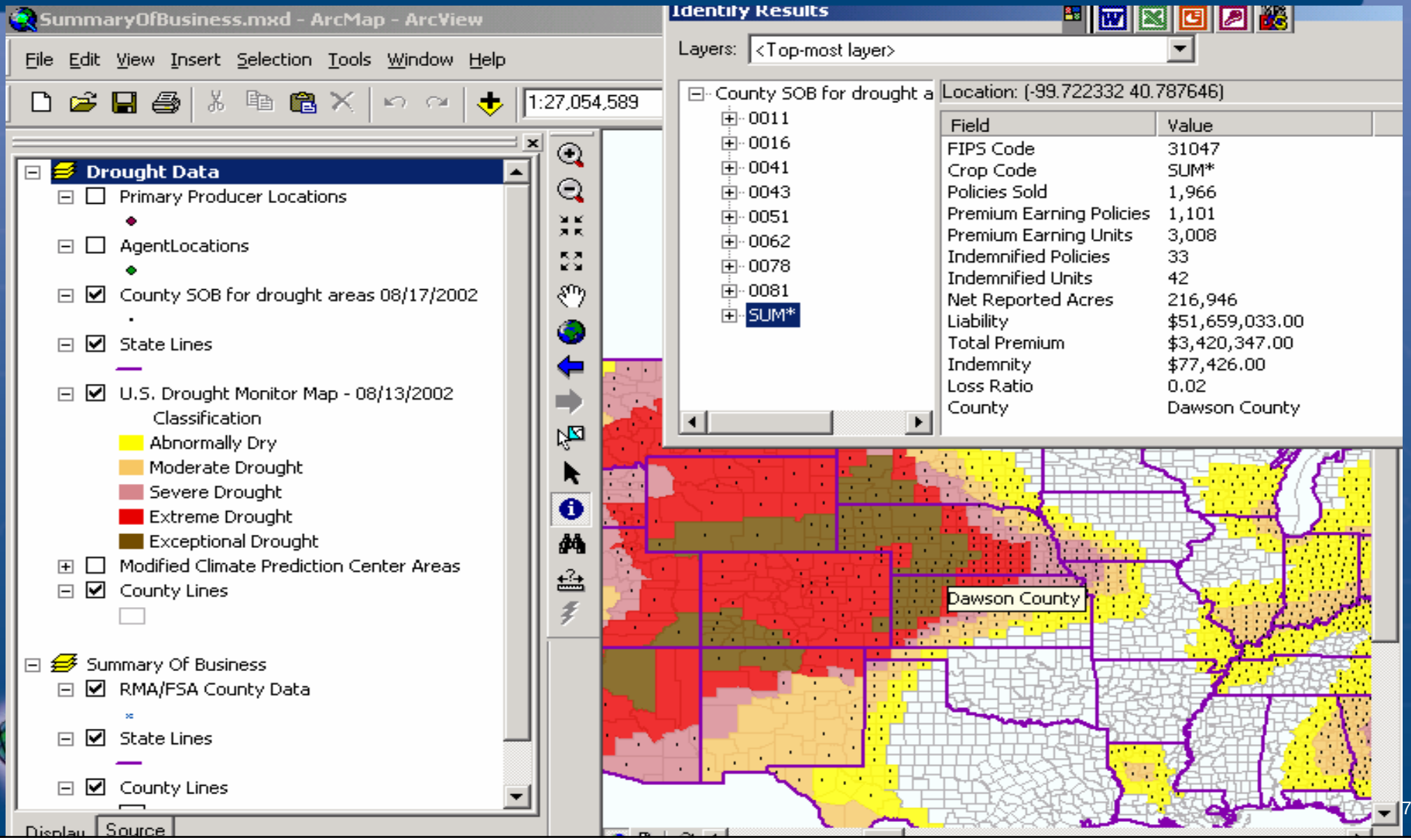
Resource Assessment



Land Management Planning

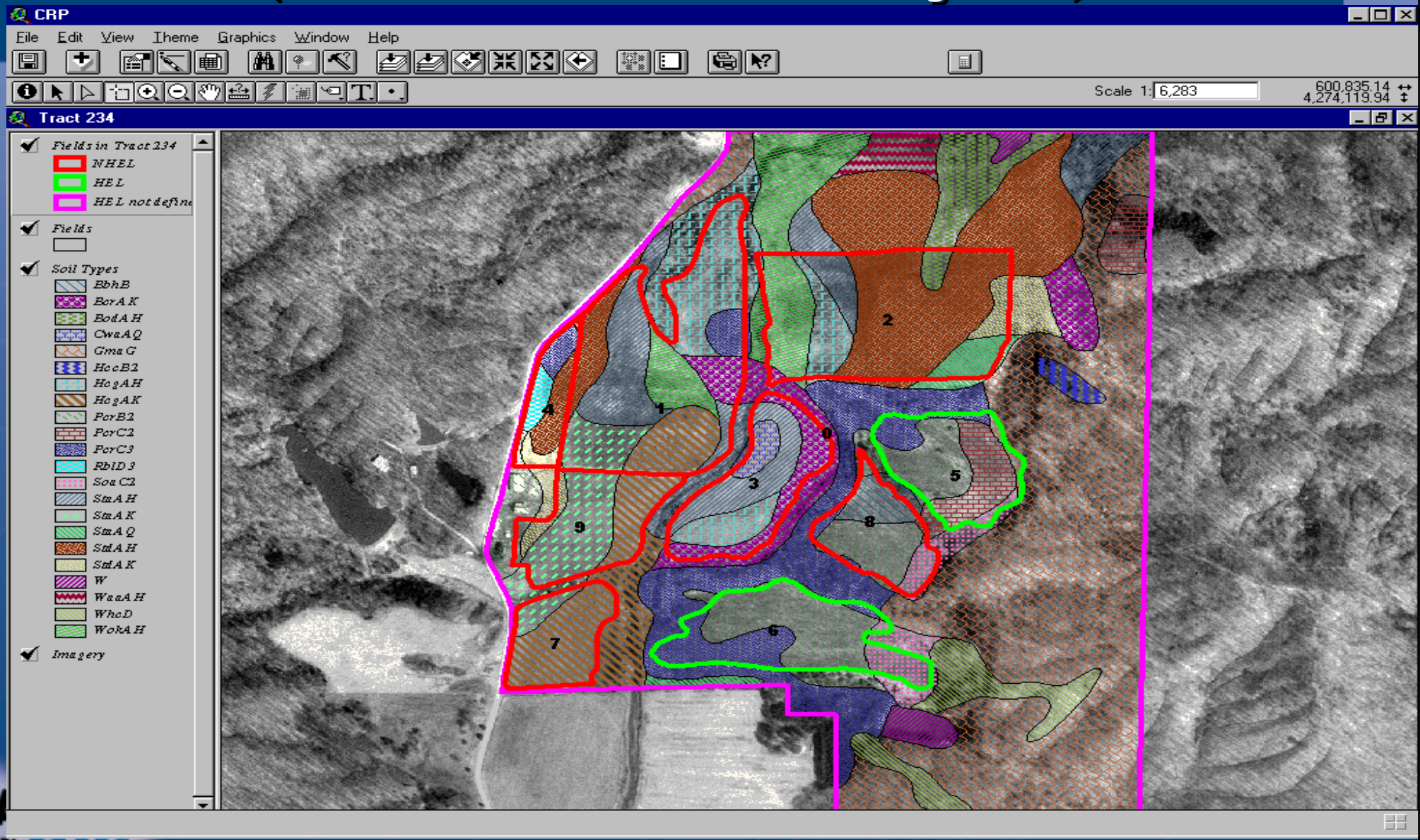


RMA – Crop Loss Prediction



Farm Service Agency - SCIMS

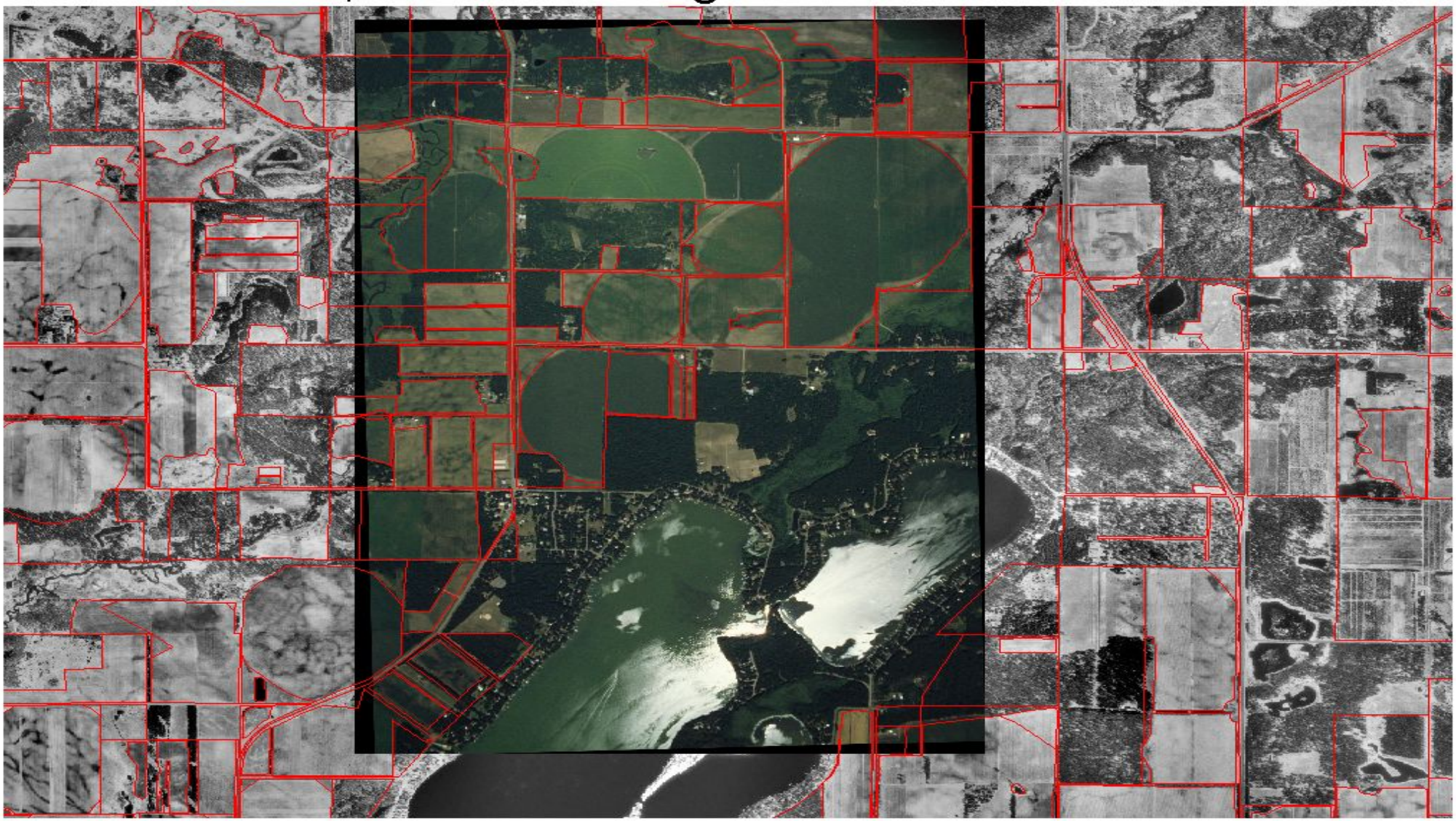
(Customer and Land Records Management)



ESRI GIS

Farm Service Agency Digital Compliance

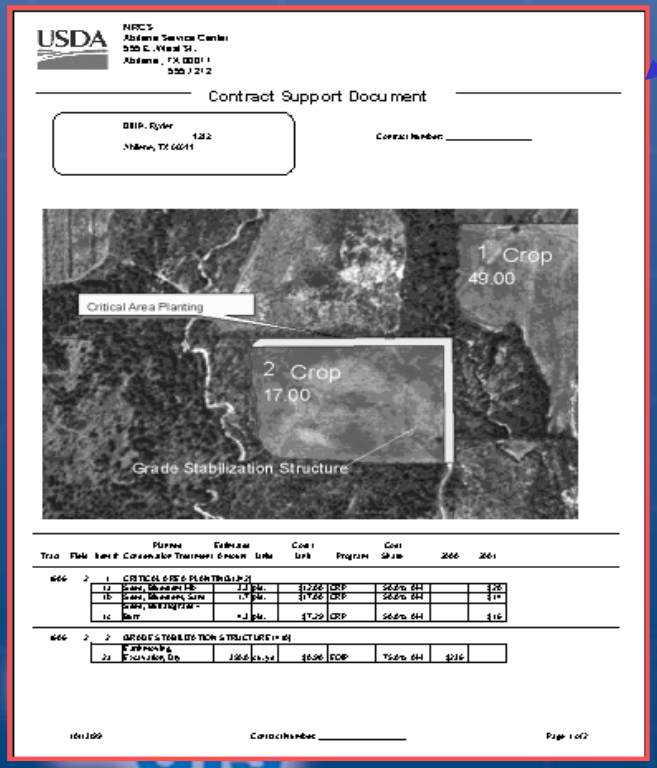
DOQ, CLU with Single Rectified 35mm Slide



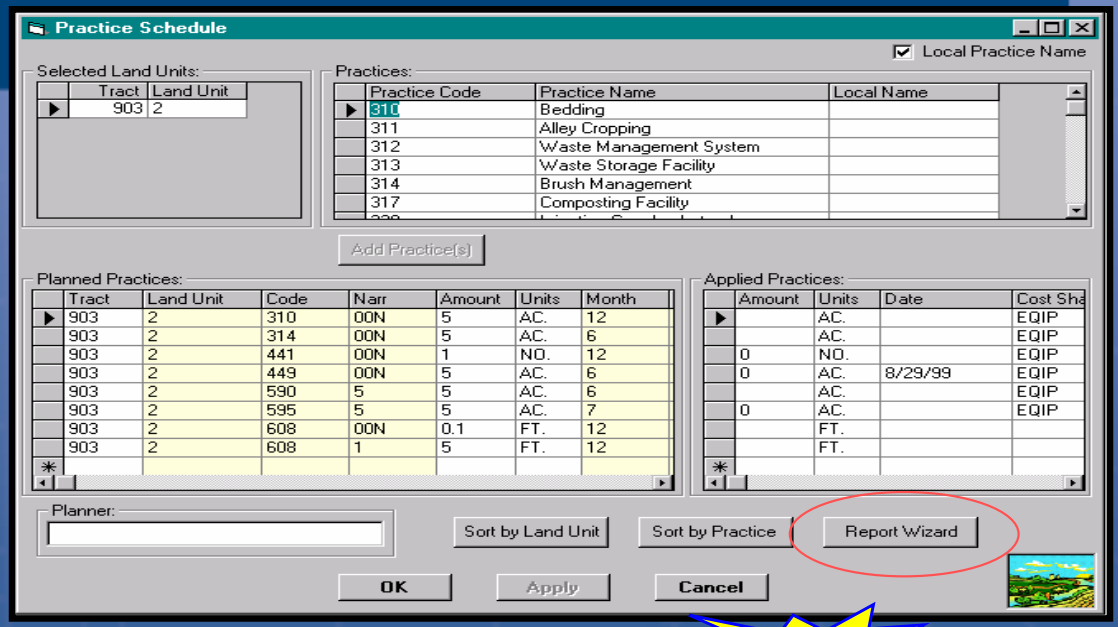
NRCS - Conservation

Conservation Reports

- Create new plans and contracts quickly with the Report Wizard
- Print conservation plans and contracts from Excel
- Revise plans and contracts in Excel



MS Excel



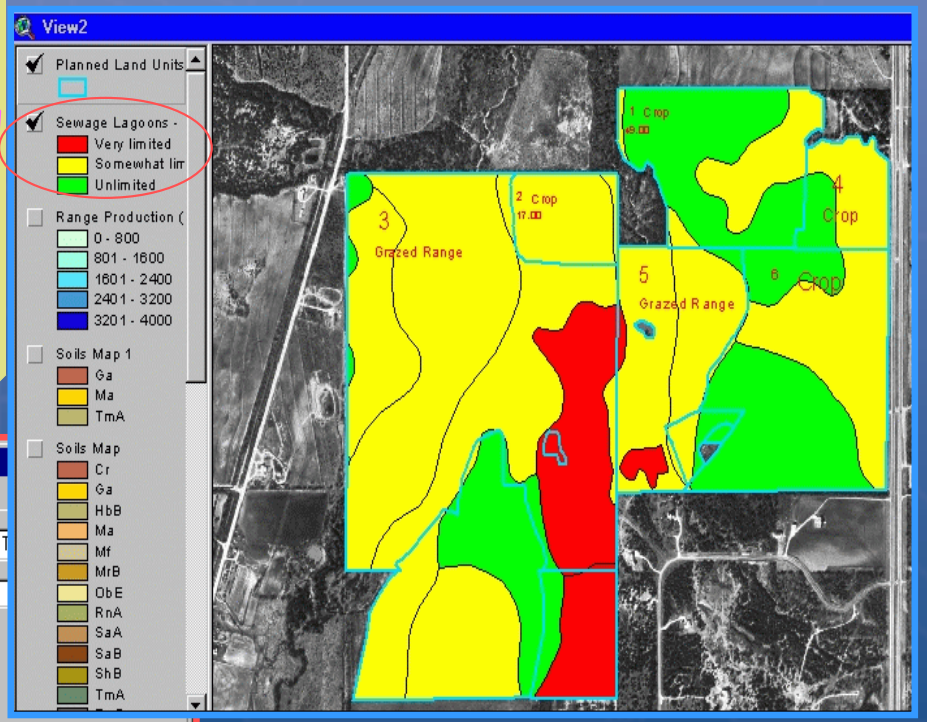
Toolkit Function

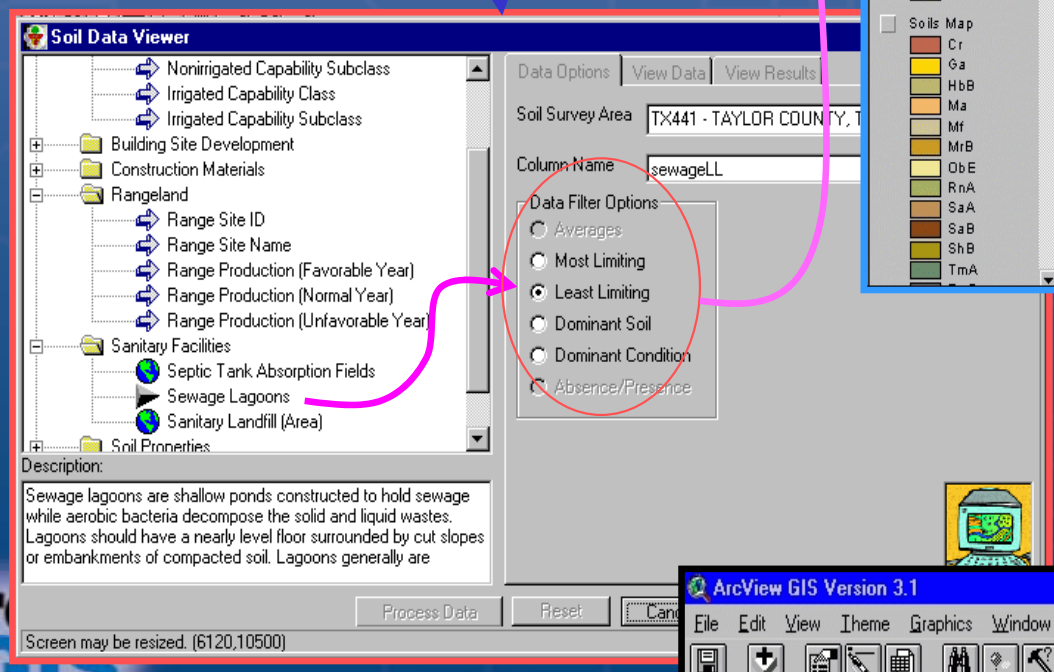
NRCS – Soils Interpretations

Soil Data Viewer

Access and display soils data in ArcView

- Create maps of a variety of soils interpretations
- Create maps based on soil properties
- Show best/worst locations for conservation practices based on soil properties





Toolkit Functions in ArcView

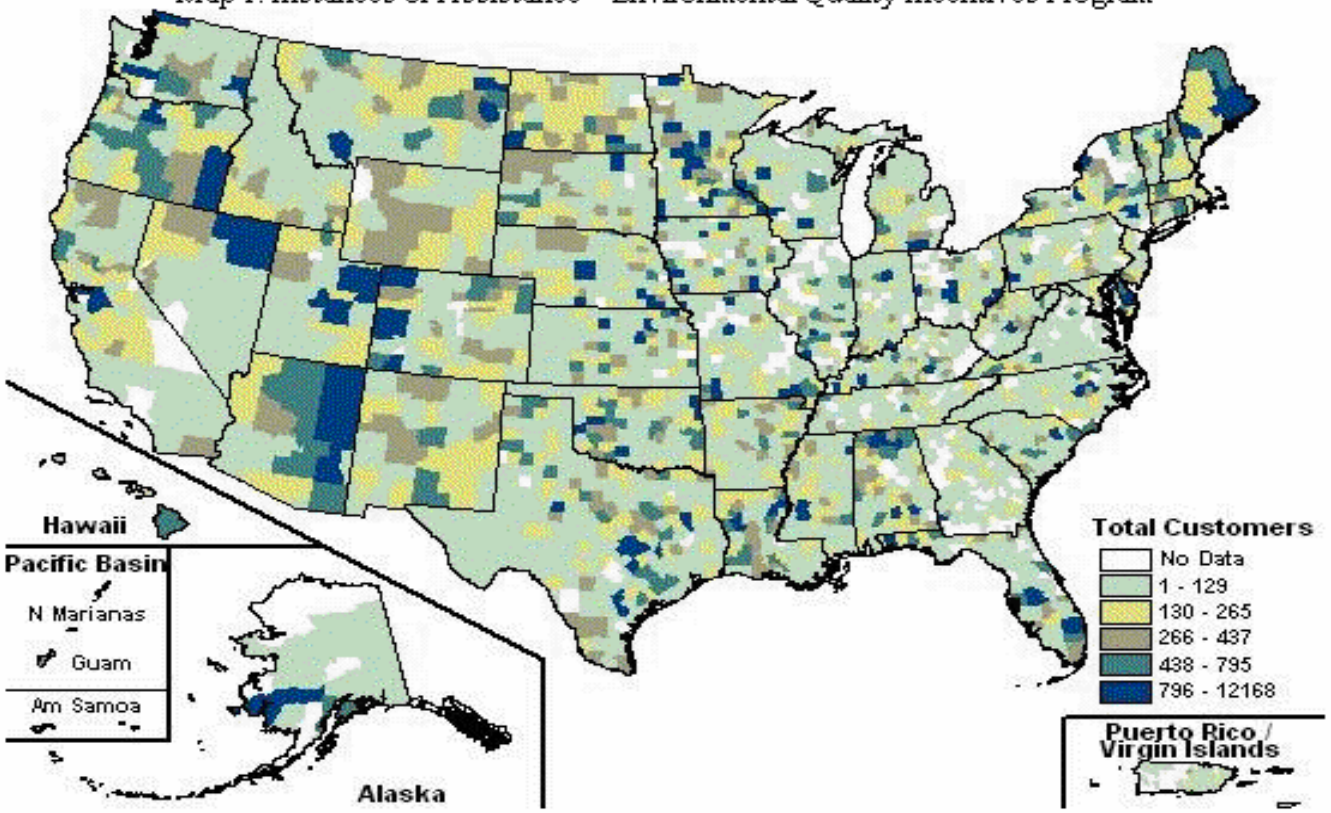
NRCS – Performance Reporting

USDA PRMS

Natural Resources Conservation Service
Performance and Results Measurement System

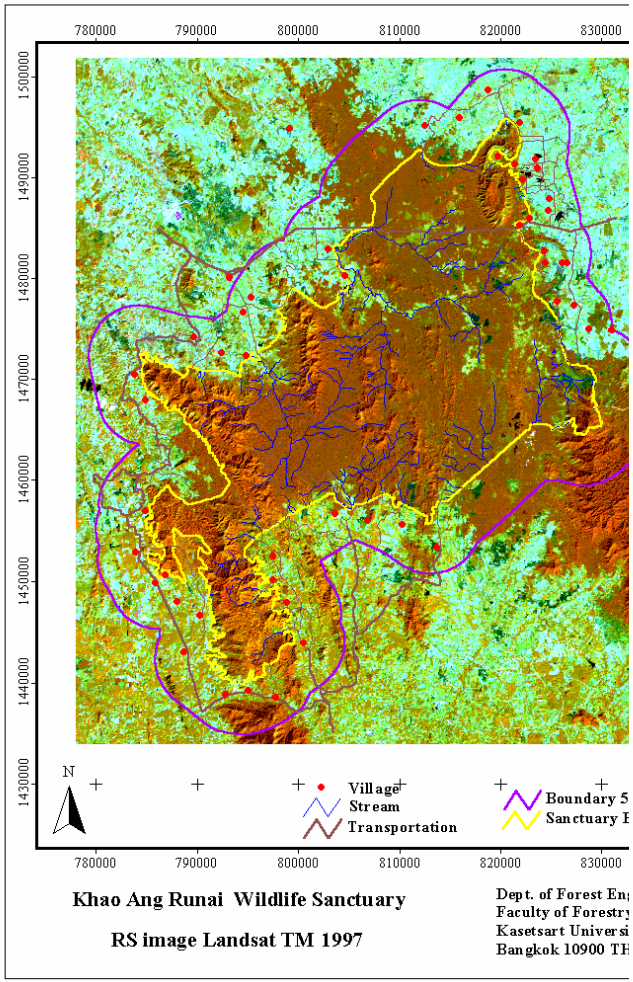
Instances of Assistance
Environmental Quality Incentives Program
National Summary (October 1 through September 18, FY 2000)*

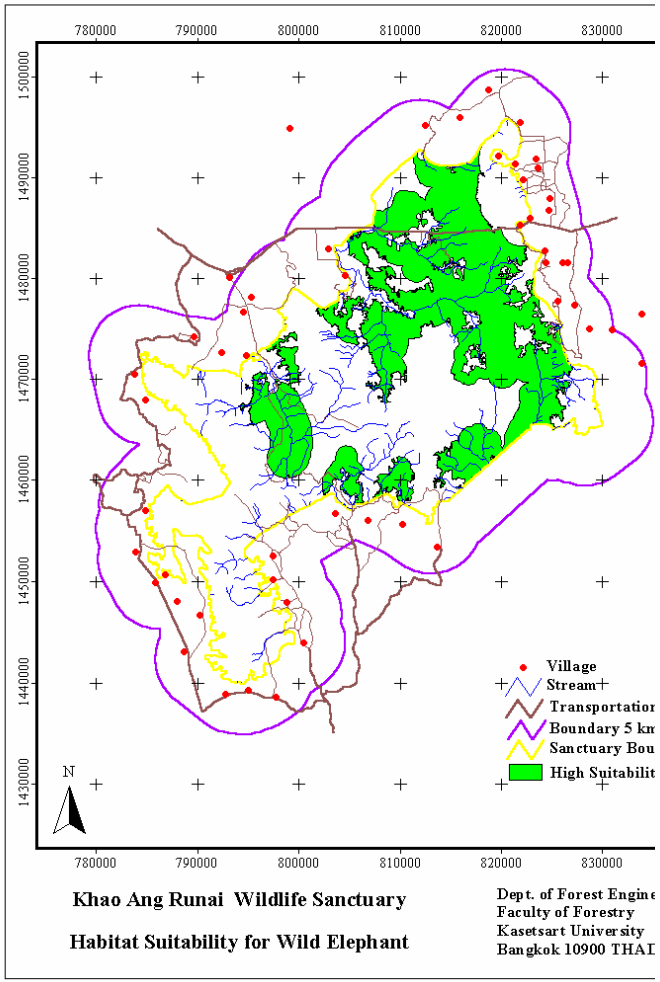
Map 1: Instances of Assistance—Environmental Quality Incentives Program

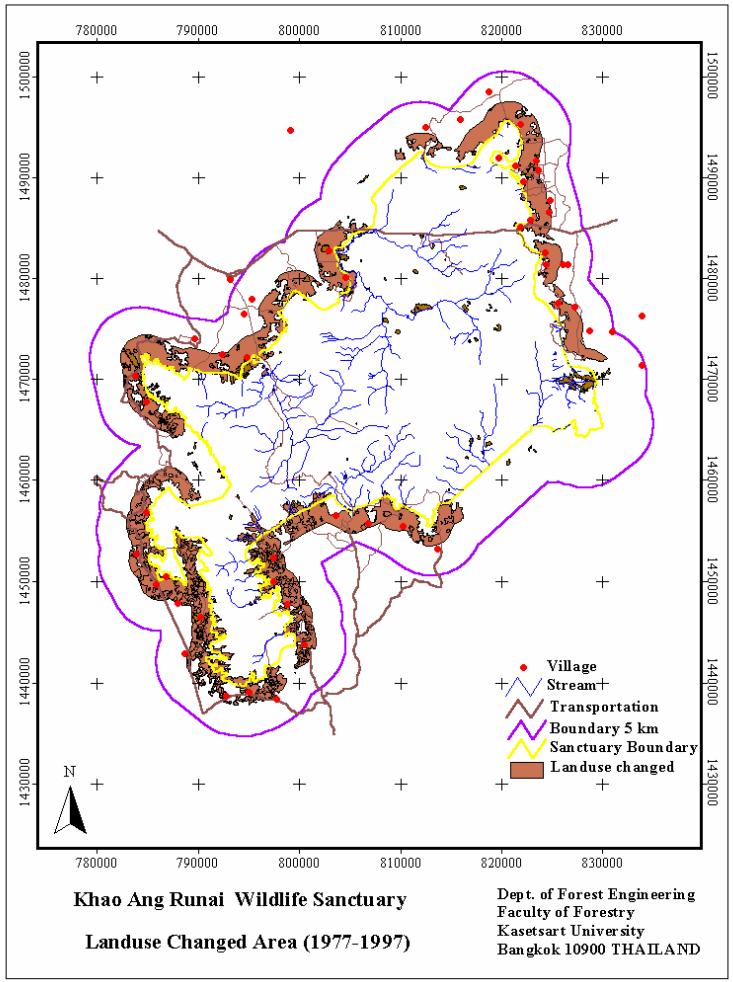


*Caution: This report may have incomplete data. All NRCS offices may not report regularly.

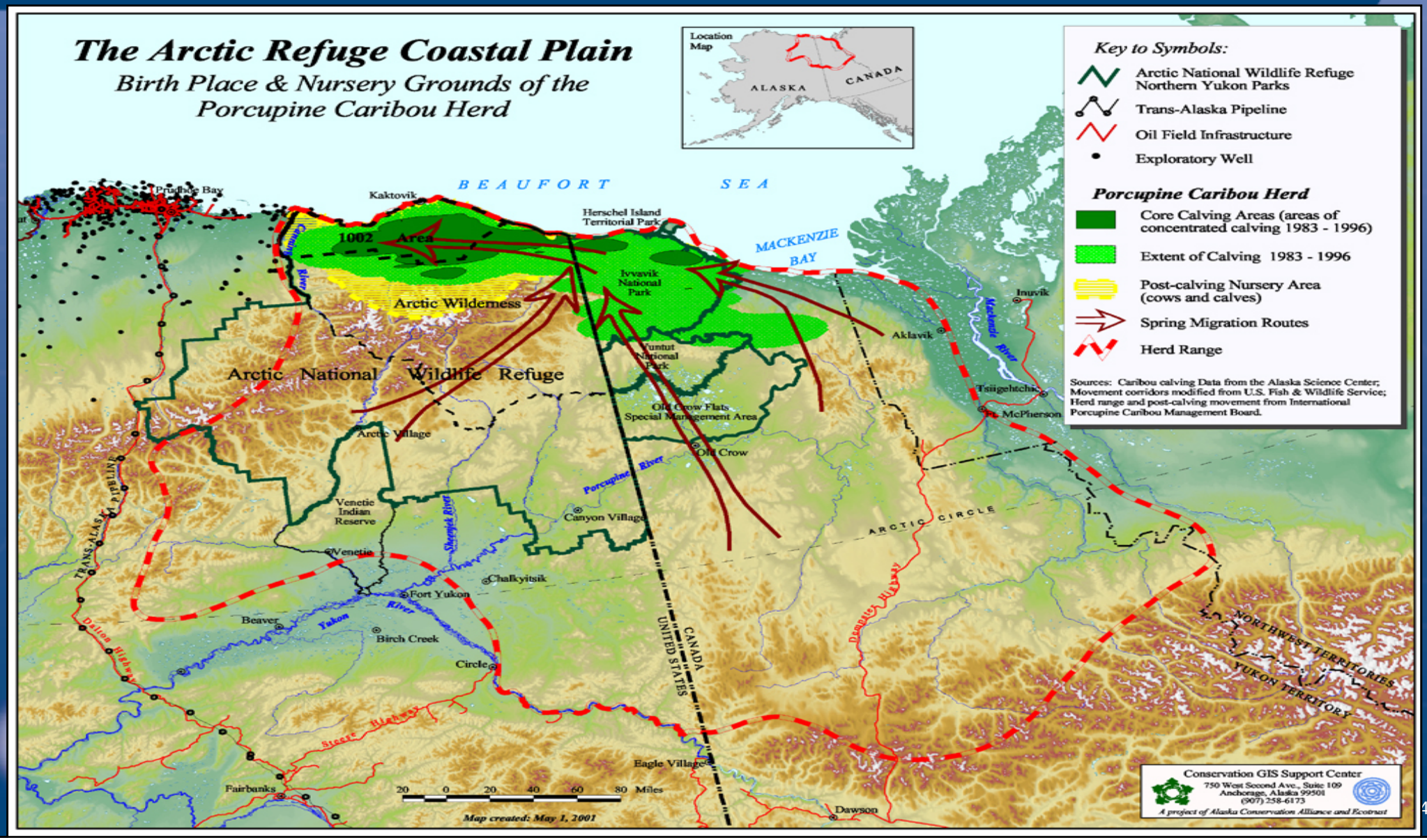
Thailand - Wildlife Conservation







Natural Resources: Habitat Protection

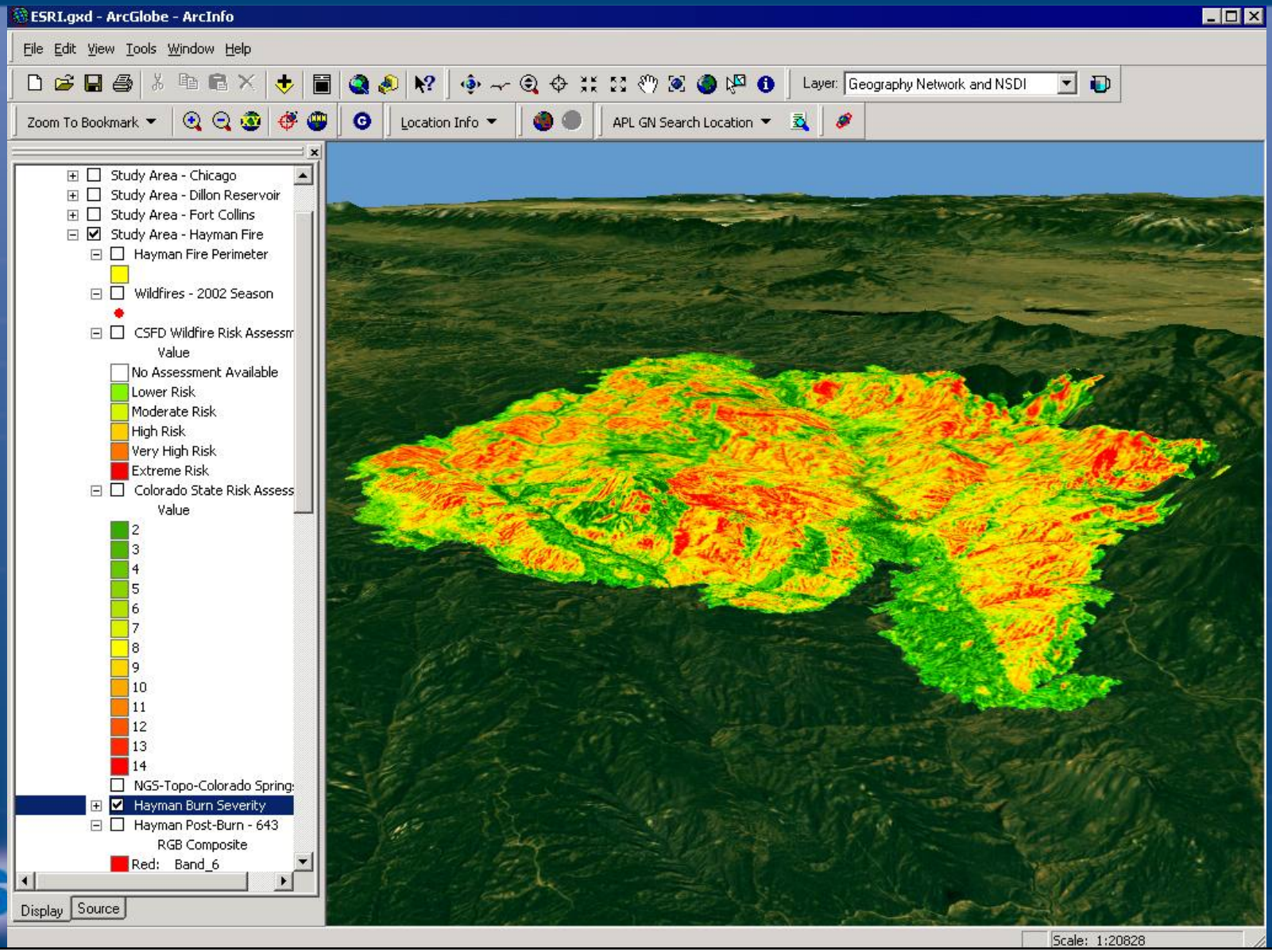


Wildland Fire - Incident Command

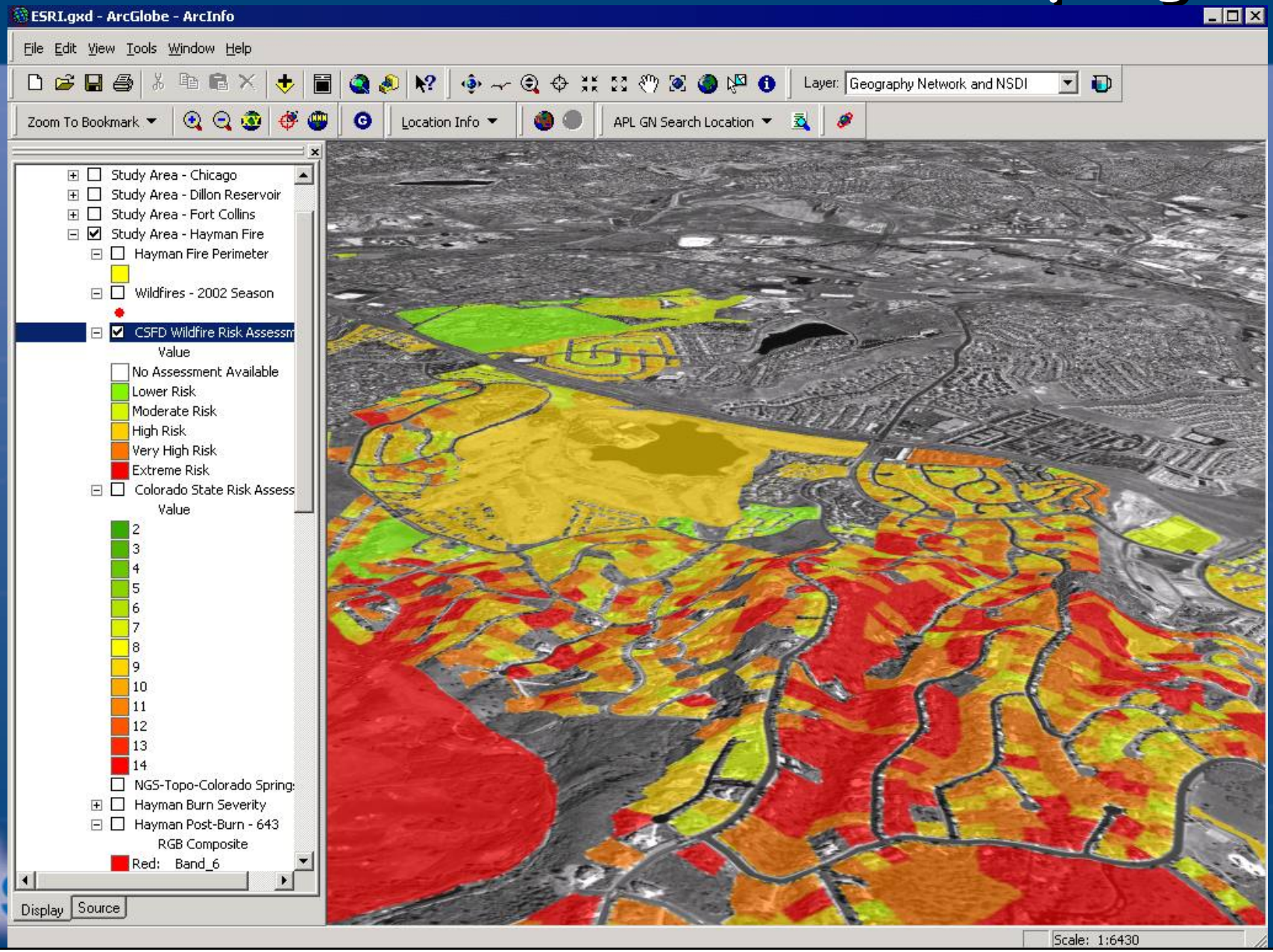
OLALLIE COMPLEX 08/28/2001 OR-MTH-143

WARM SPRINGS RESEVATION / MOUNT HOOD NATIONAL FOREST

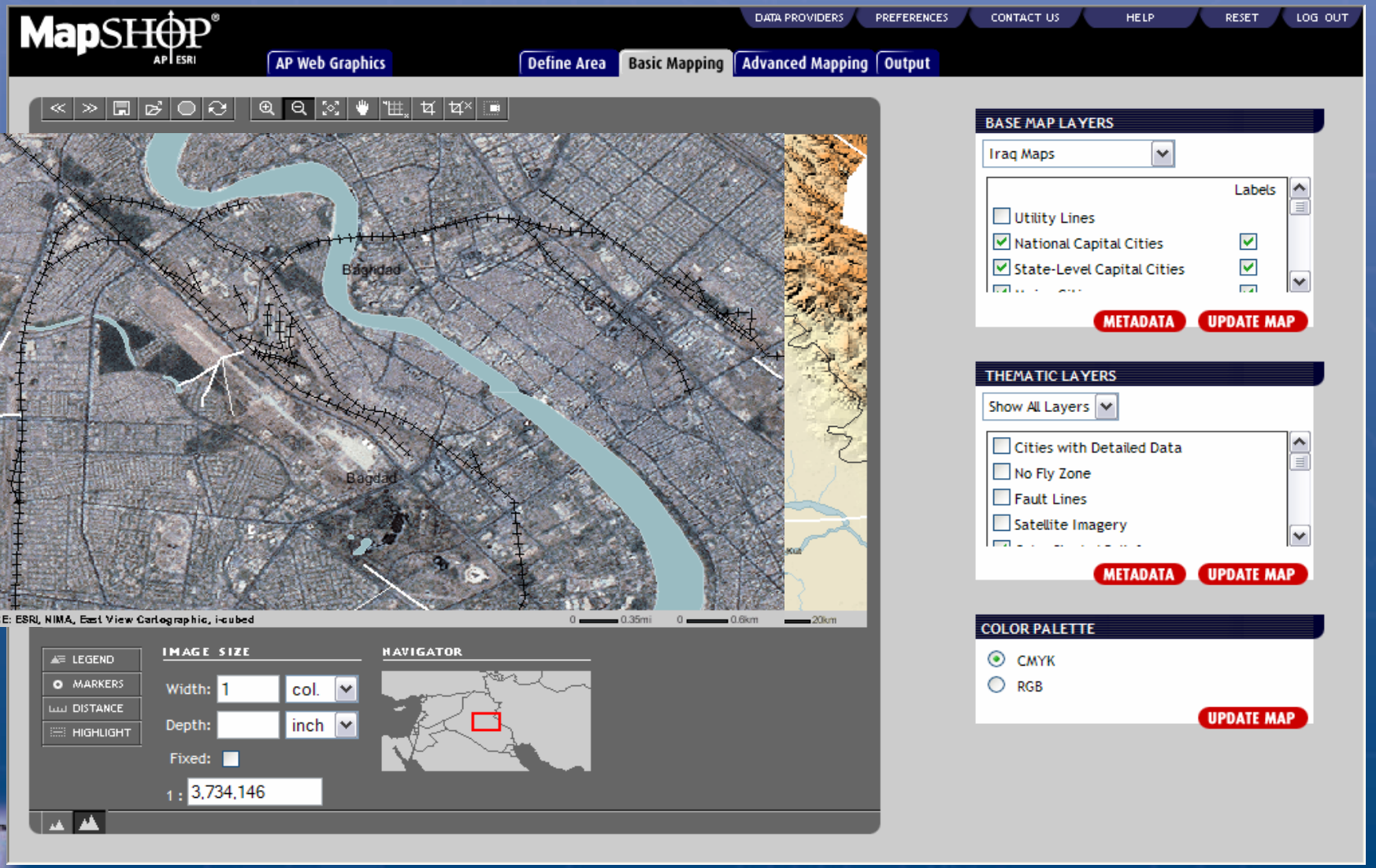
Wildland Fire - BAER
Hayman Fire - 30m Landsat



ArcGlobe – QuickBird
Wildfire Risk Assessment – Colorado Springs



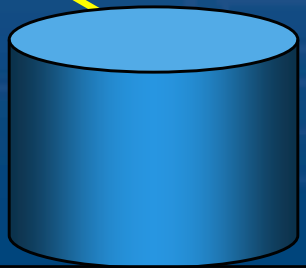
MapShop
Map Graphics for Non-GIS Users



OnStar Virtual Advisor - Traffic

Voice Request

Profile Setup



Real-Time Traffic Data

ESRI Conservation Program

- Support (Over 4100 Organizations)
- Grants (Hardware, Software Training Scholarships)
- Society for Conservation GIS
  - Conference
  - Scholars
  - Publications

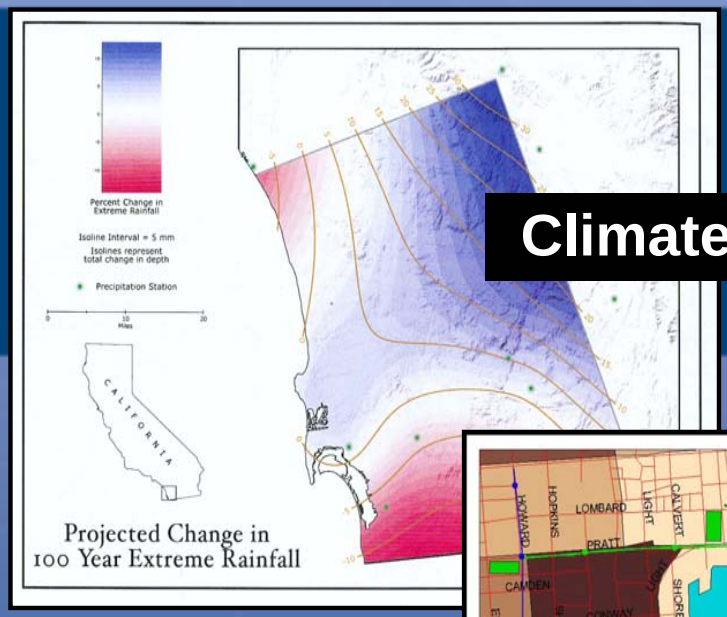
www.conservationgis.org

- Partners
  - Hewlett Packard (HP)
  - World Bank
  - Wilderness Society
  - TNC & Nature Serve
  - National Geographic Society

Education - MYCOE

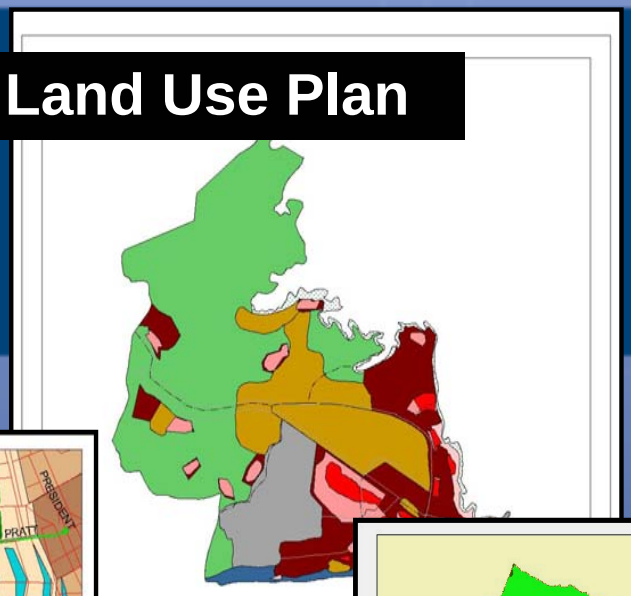
A Program for GIS and Sustainability

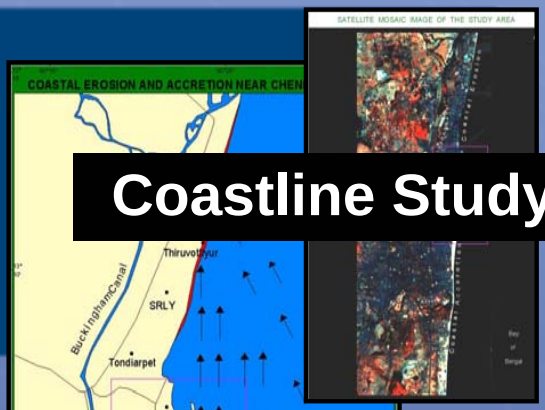
2000+ Schools, Hundreds of Projects and Mentors . . . Ongoing



Climate

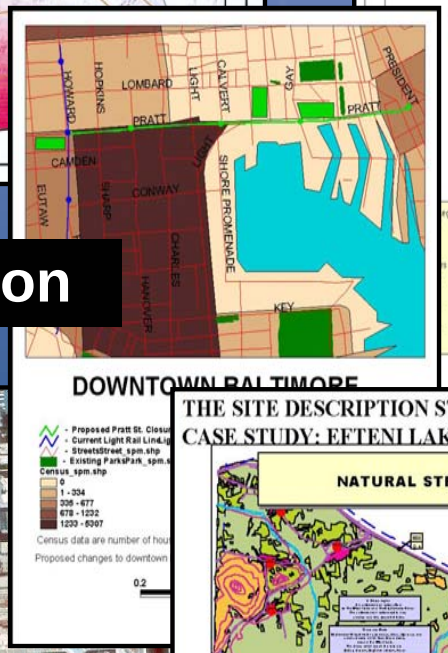
Land Use Plan

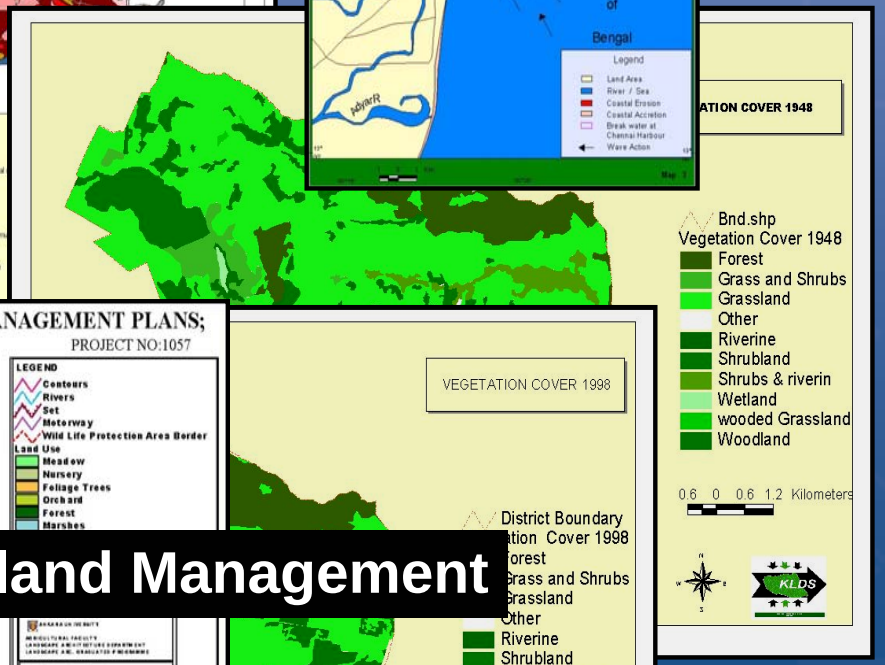


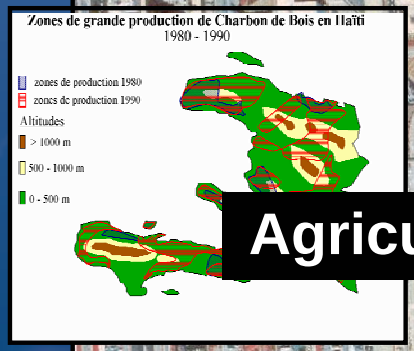


Coastline Study

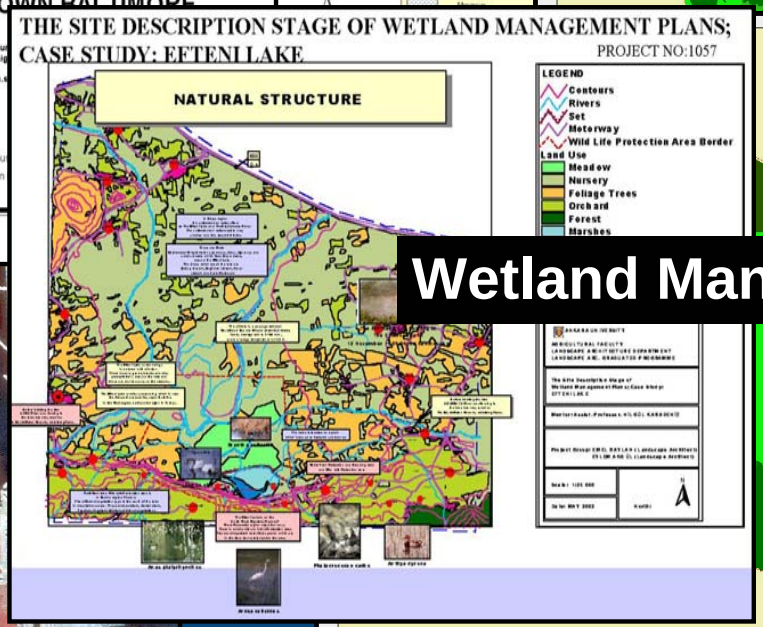
Transportation







Agriculture



Wetland Management

Vegetation Change

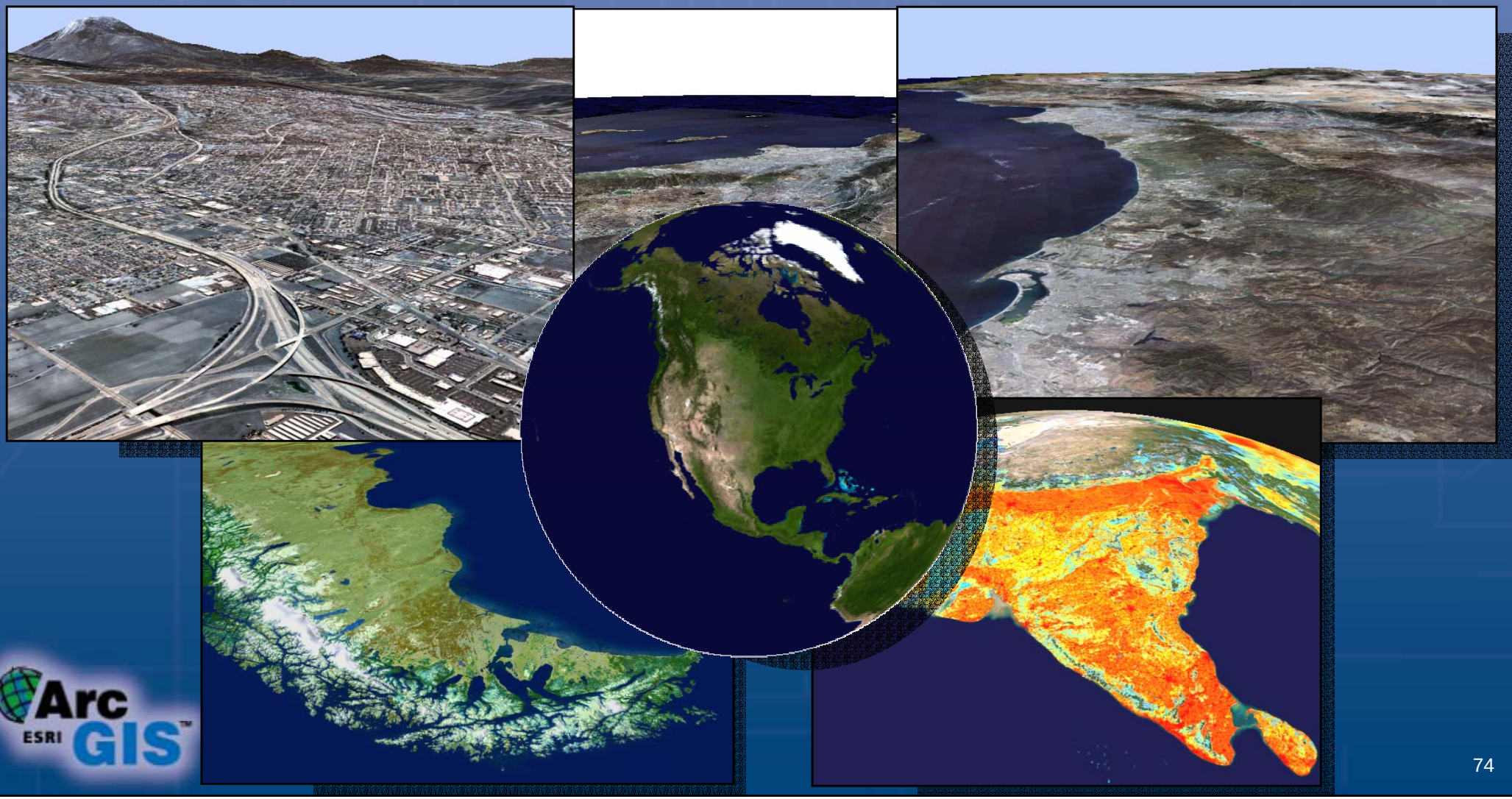
GIS Day

November 19, 2003

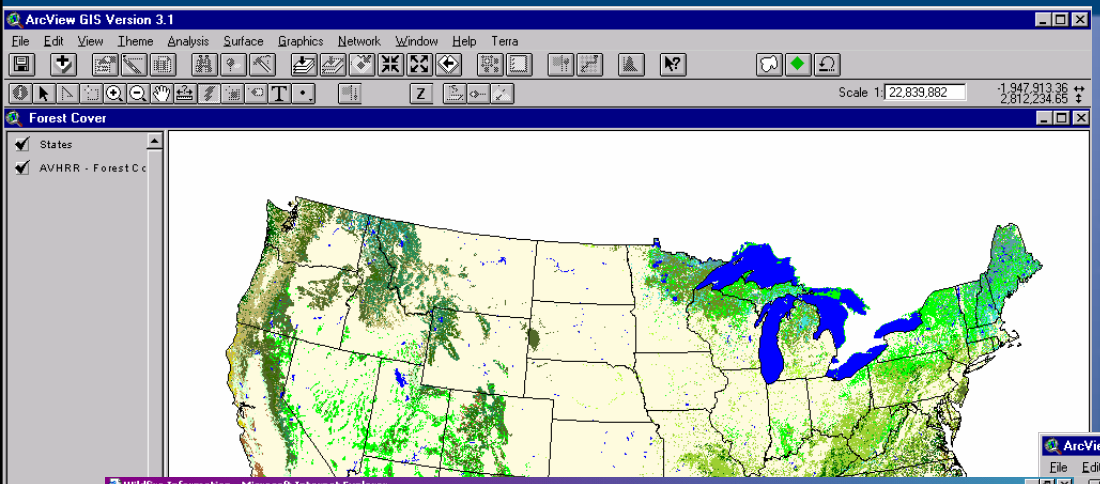
- Single Day Event
- Teach A Class
- Open House/Demos
- Poster Exhibits
- Press Event

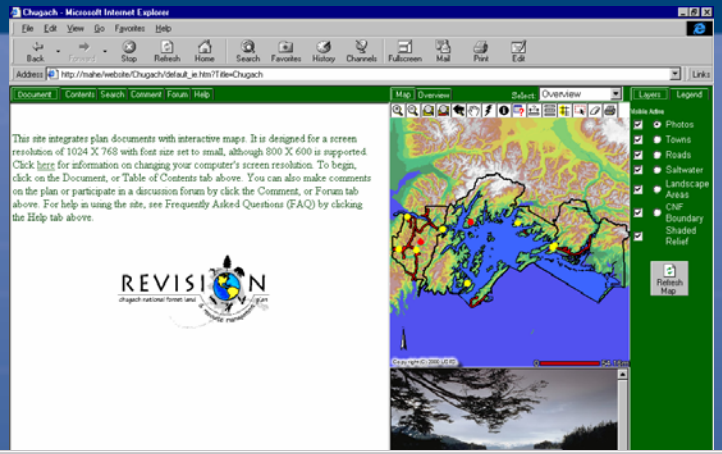
Sharing Your Knowledge

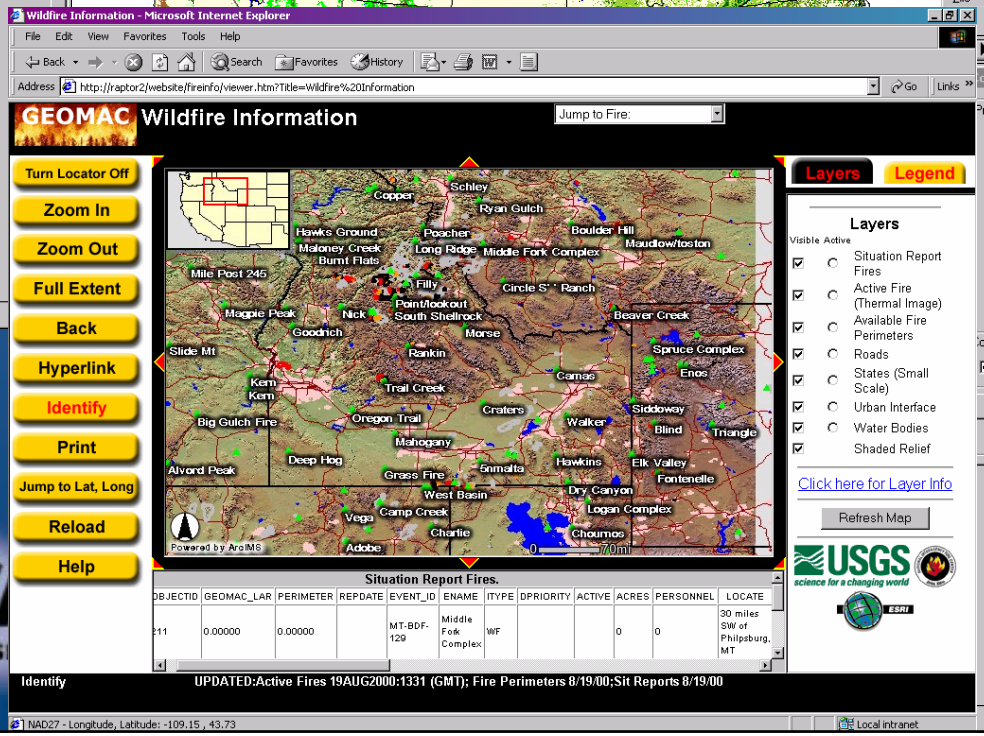
Visualization

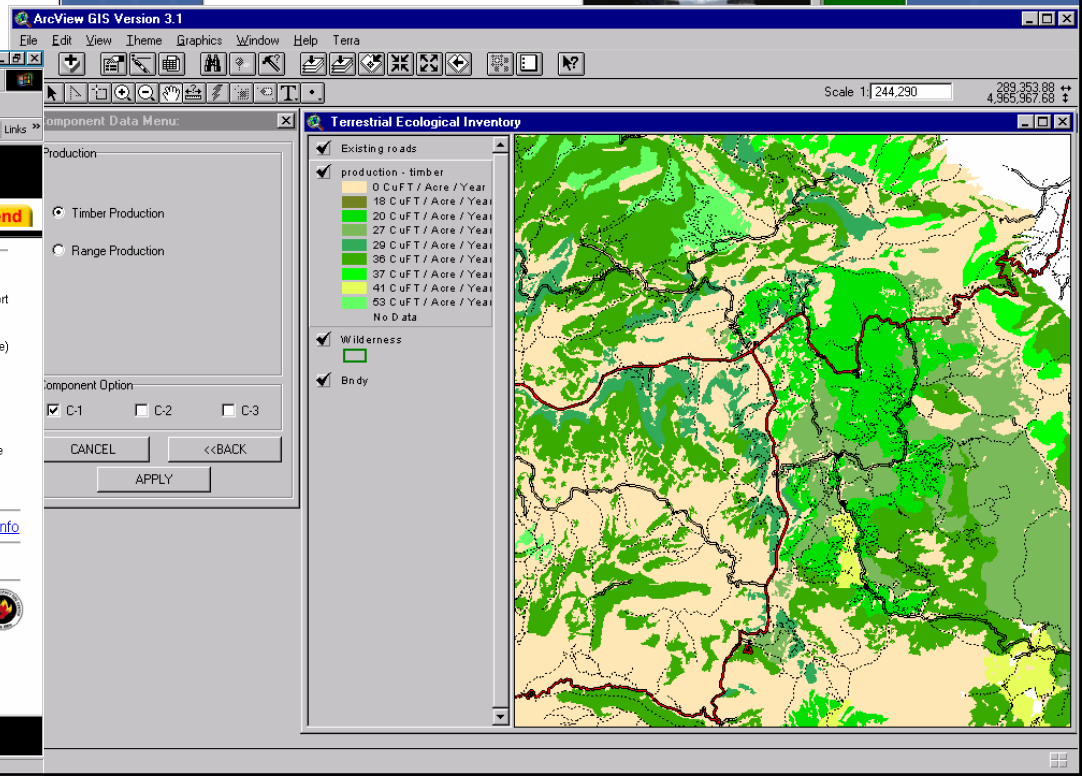


Federal - US Forest Service

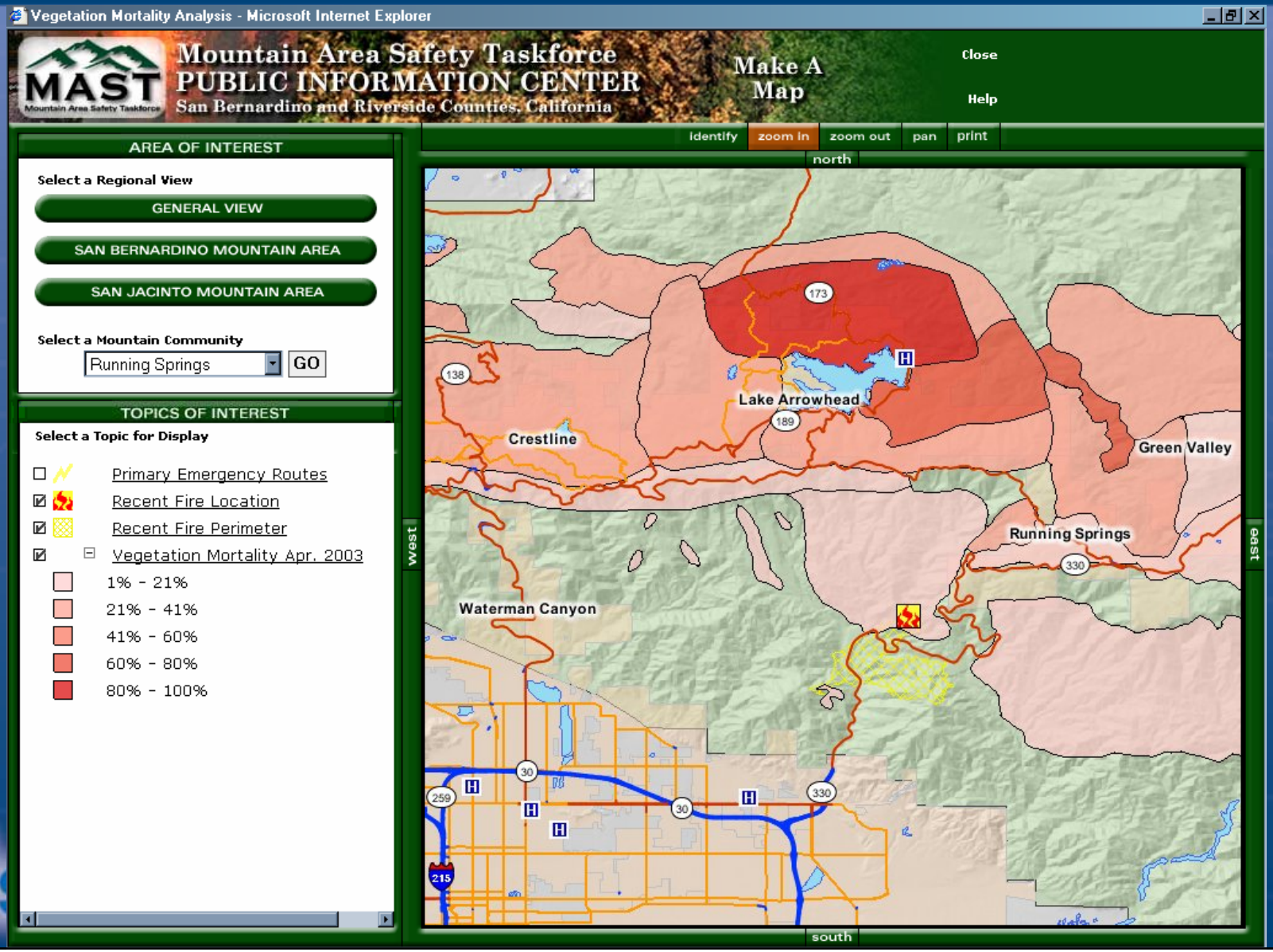








MAST
www.calmast.org



Information Center

Public Information

Web-Based Maps

Community Status Maps

Database

Database

Imagery

Analysis & Mapping

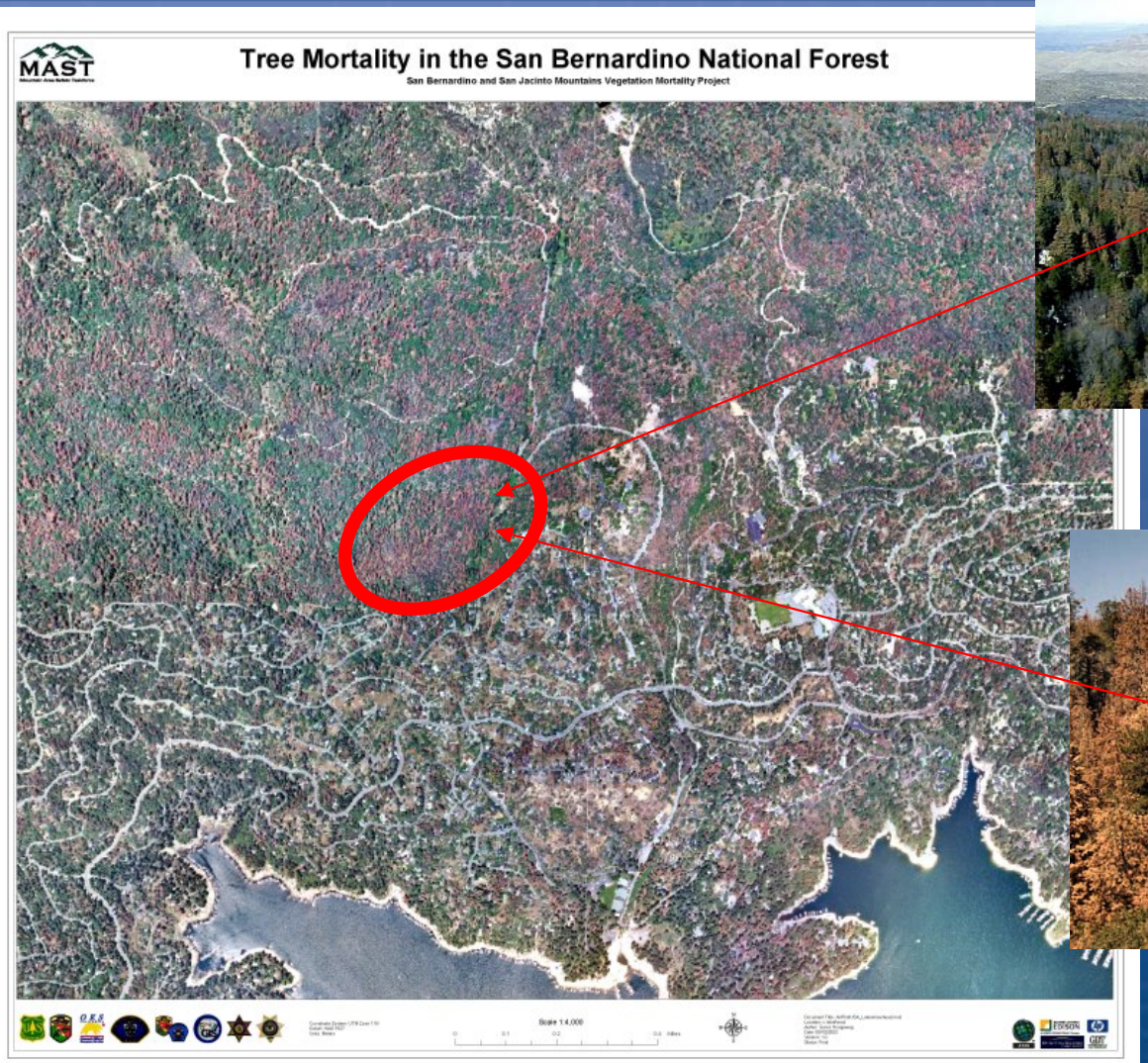
Fire Modeling

Mortality Modeling

Evacuation Routing

Status Mapping

Forest Health
One Example of Affected Forest

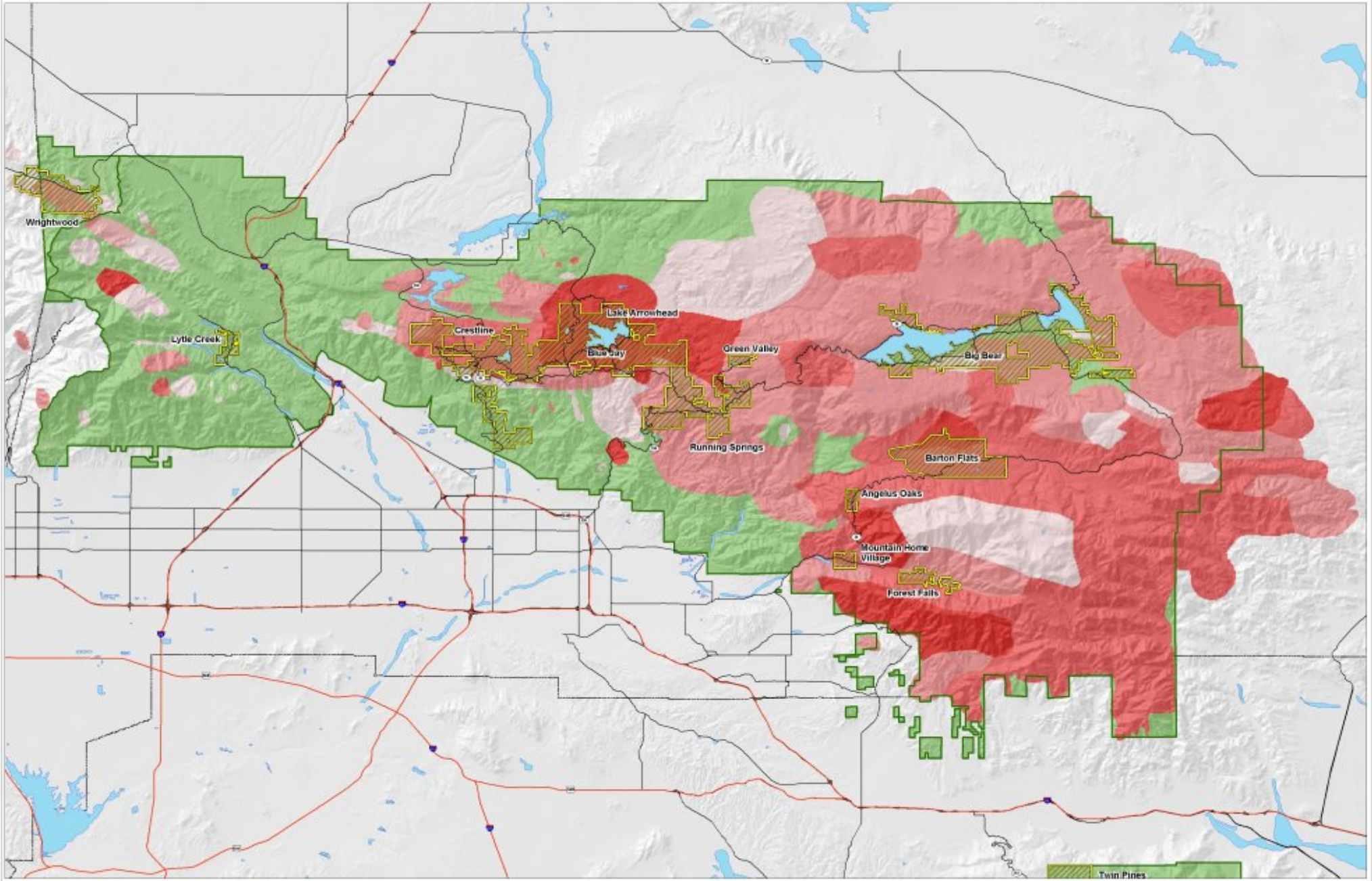


April 2003

August 2003

San Bernardino Mountain Area - Vegetation Mortality

San Bernardino and San Jacinto Mountains Vegetation Mortality Project



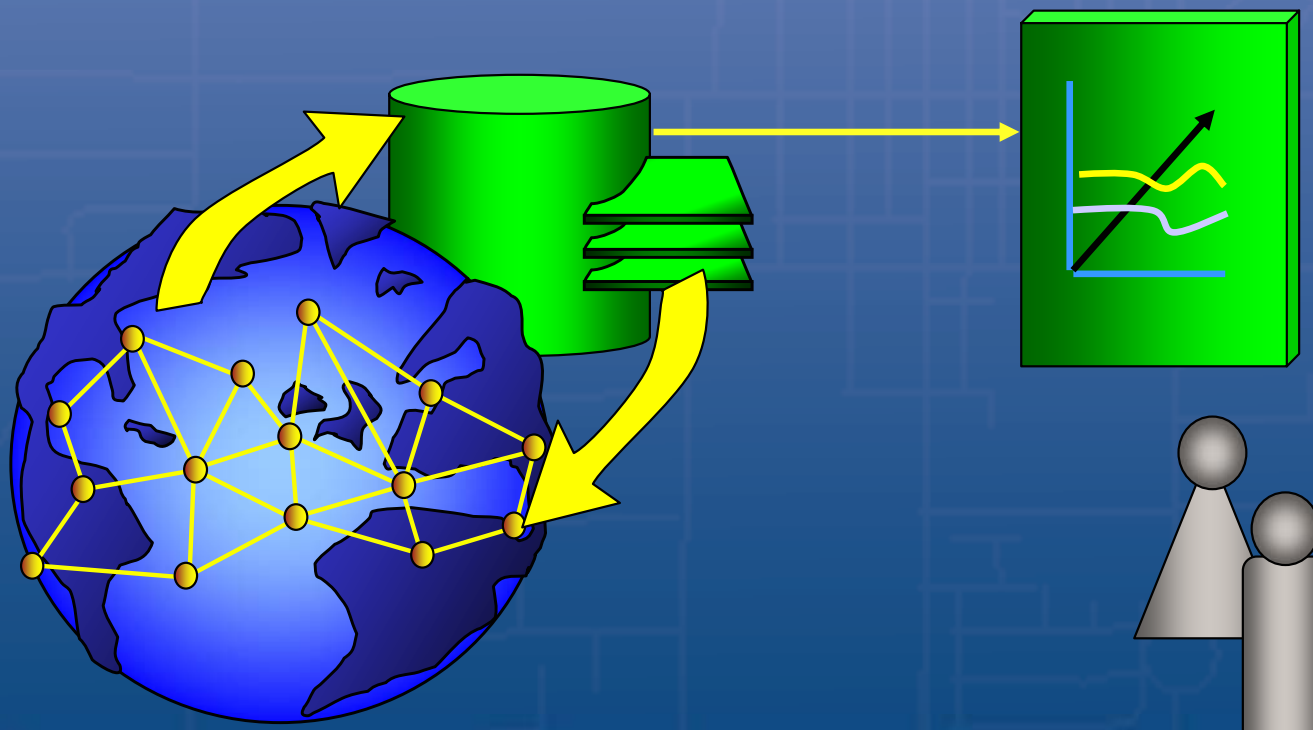
Scale 1:95,000

0 3.5 7 14 Miles

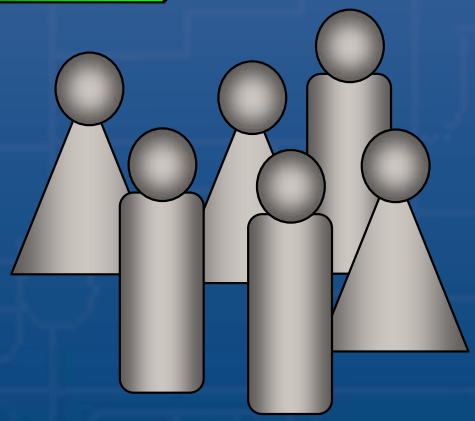
Why Is GIS Important

- GIS is an Information System
- GIS is an Integrative Technology
- Underlying Concepts
- Provides a Framework
  - To improve our Knowledge
  - To integrate our activities
- It's pervasive in conservation and resource management
  - Skilled practitioners are in high demand
  - Practical experience sometimes difficult to obtain

Geography and GIS Provide a Ideal Framework for Understanding What's Going On

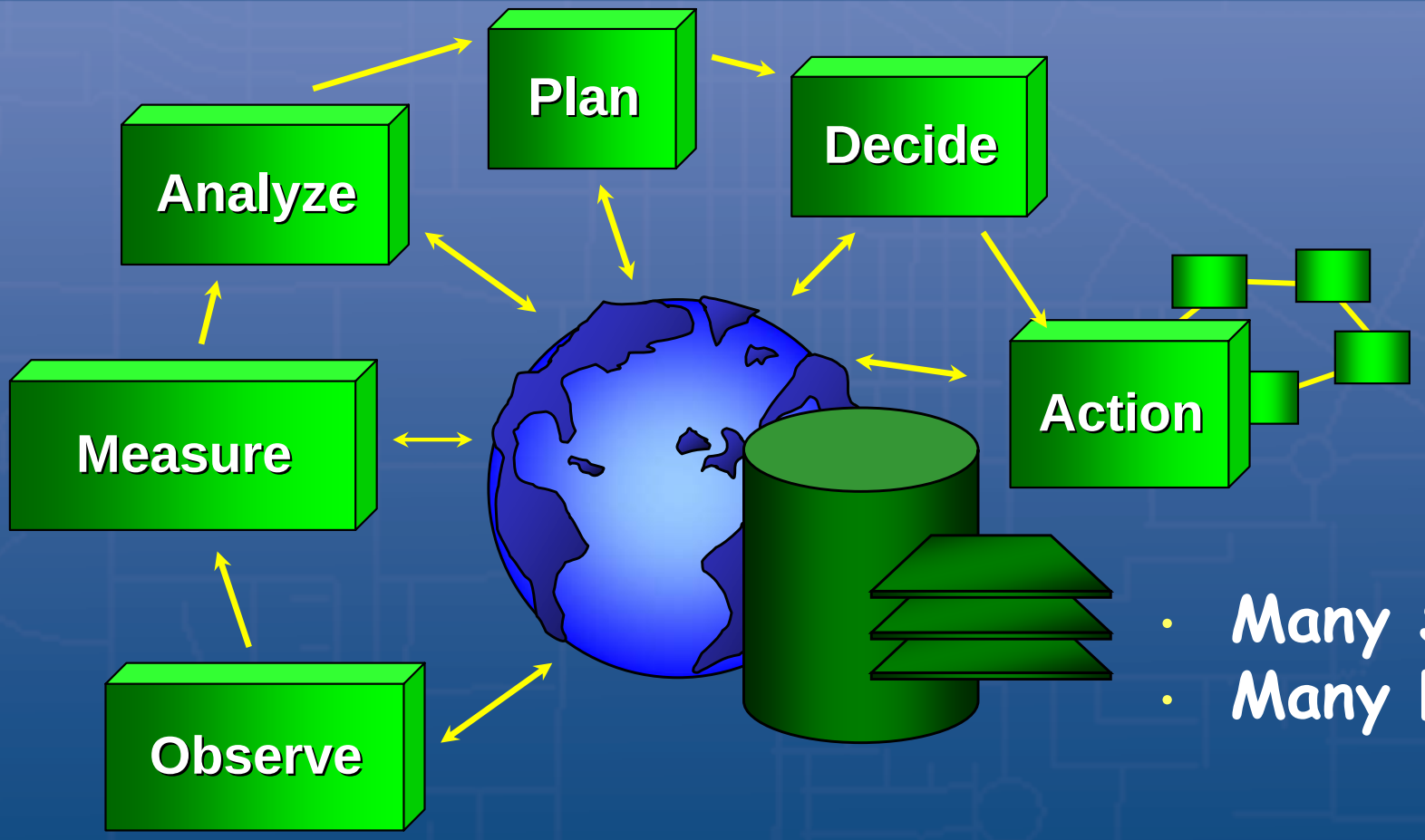


- Resources
- Processes
- Relationships
- Threats/Risks
- Dependencies



. . . Improving Our Scientific Knowledge

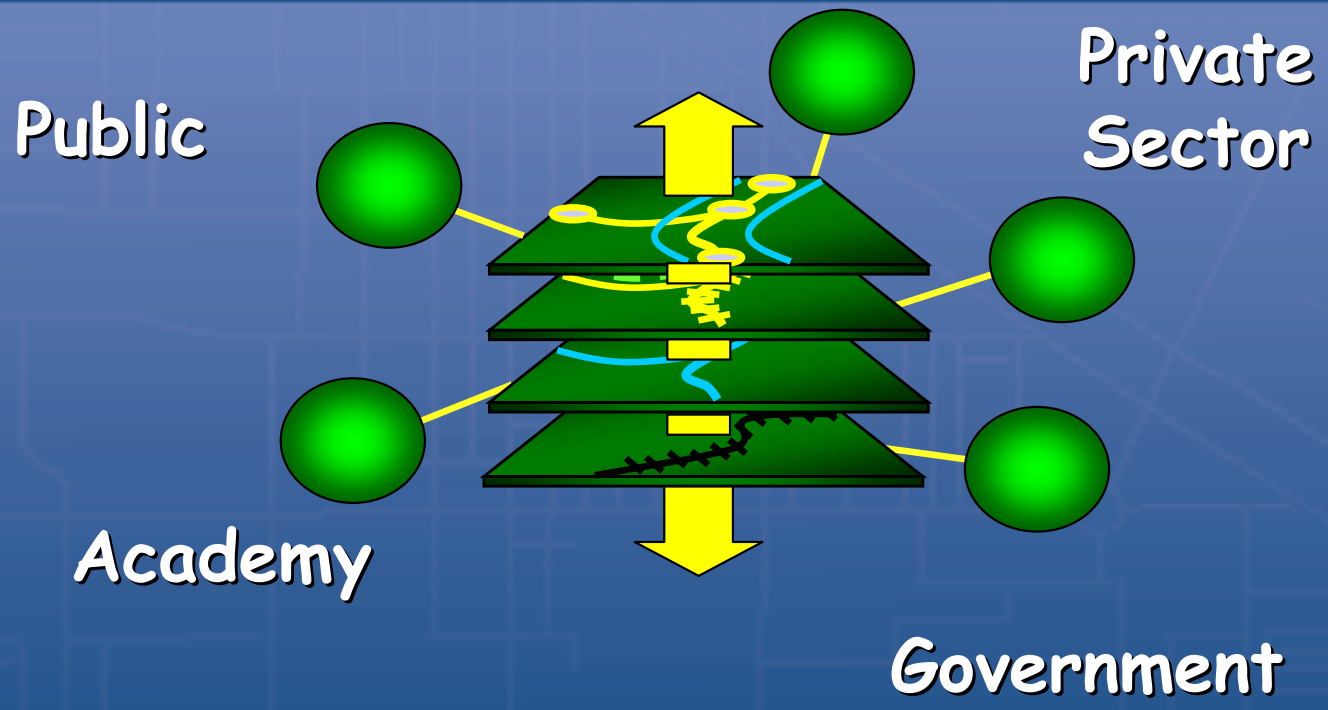
. . . And a Process for Guiding and Integrating Human Activities



- Many Scales
- Many Fields

. . . a Framework For Action

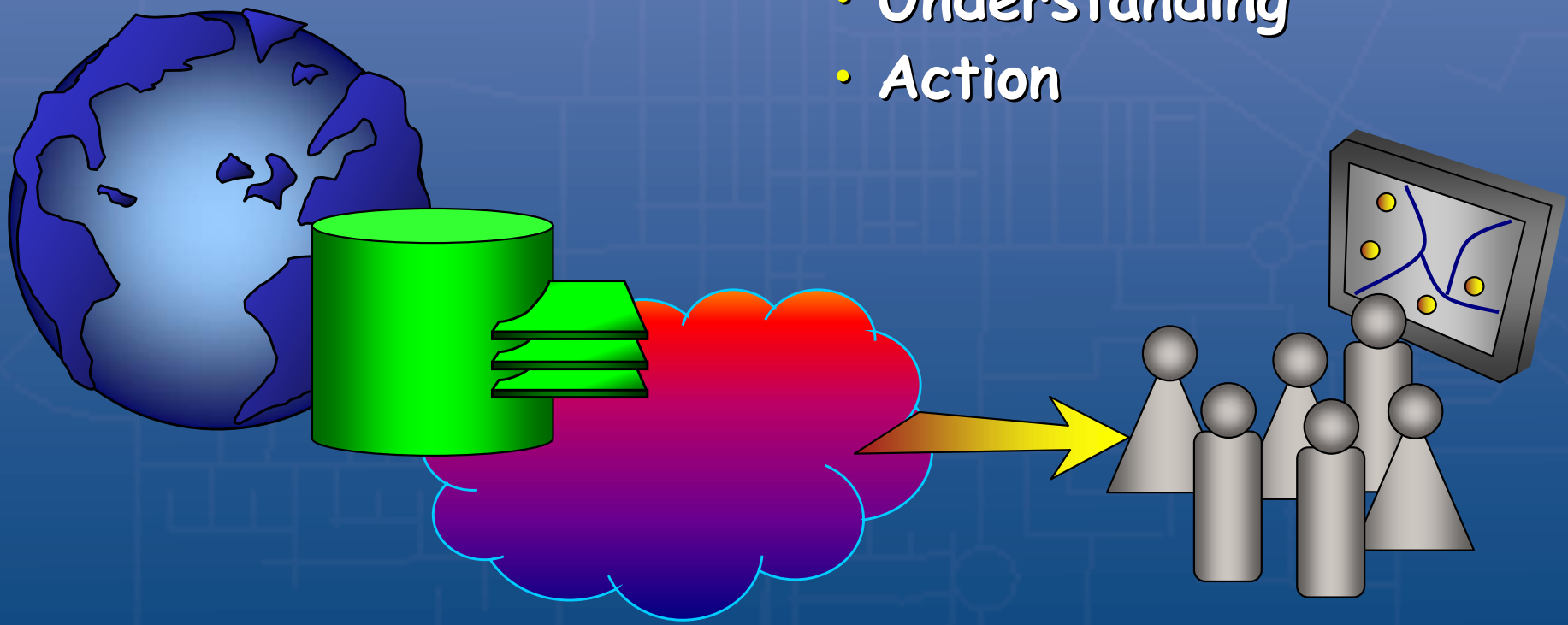
GIS Helps Us Integrate Many Points of View



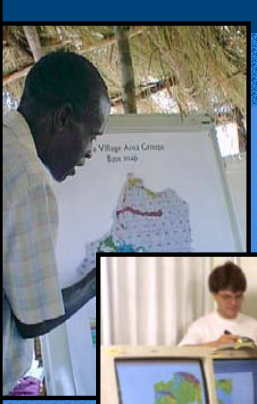
Incorporating Many Values into Our Decision Making Process

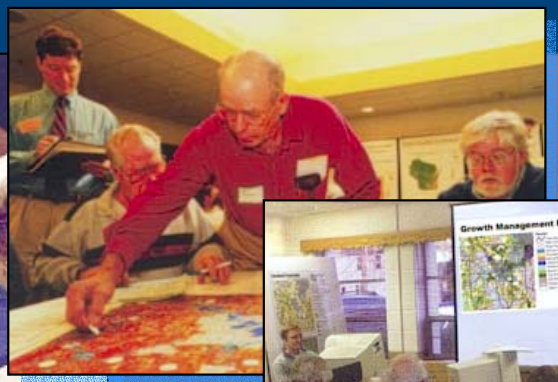
...And Helps Us Communicate About Sustainability

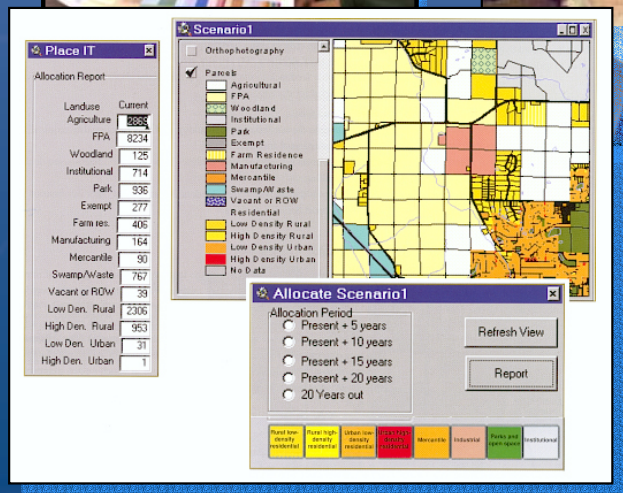
- Awareness
- Understanding
- Action



GIS Provides an Infrastructure



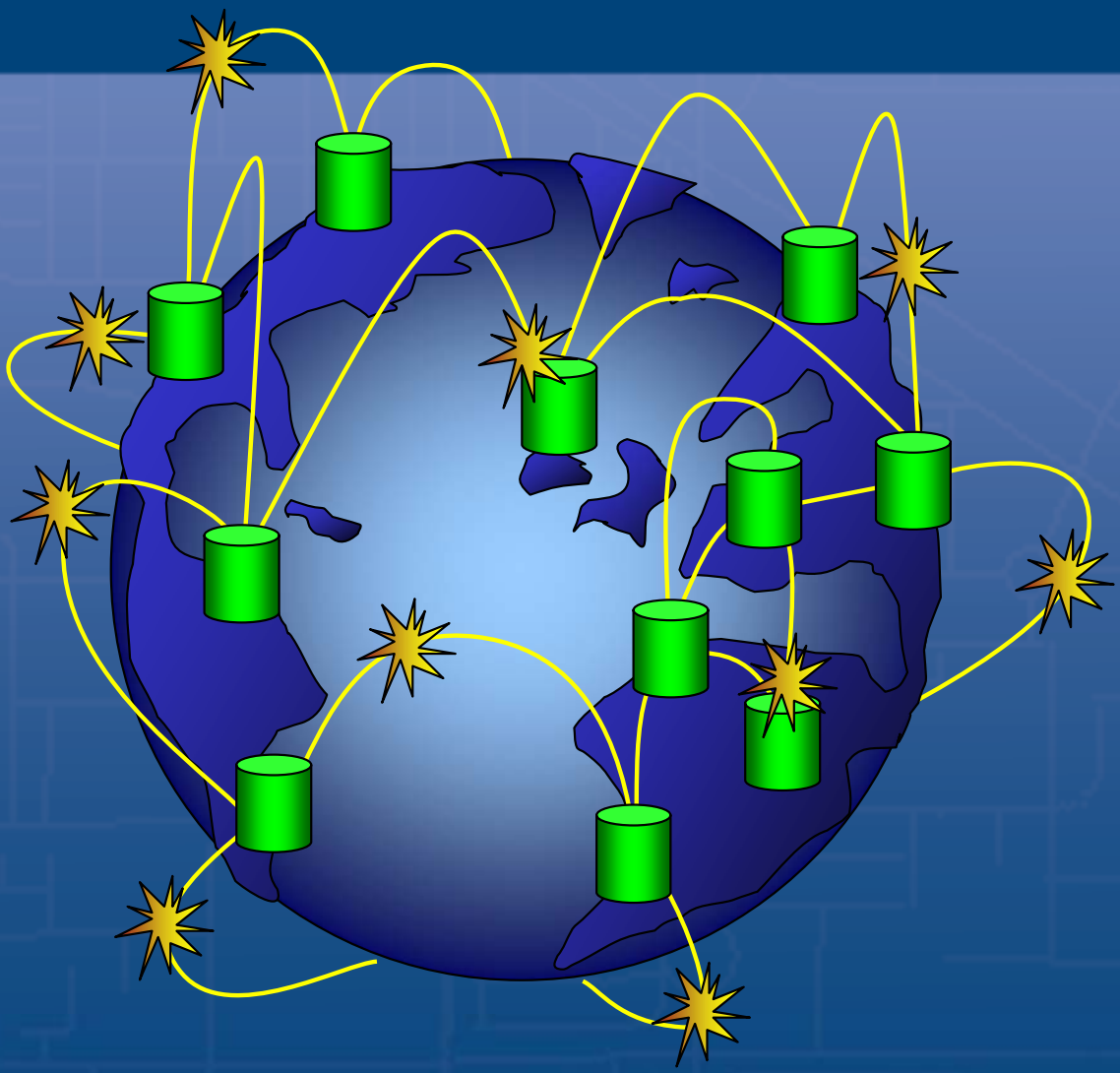




- Data
- Systems
- Applications
- Products
- Organization

ArcGIS ESRI . . . Systems That Make a Difference

Creating a Digital Earth



. . . A Nervous System for Spaceship Earth

Opportunities

- No agency has all of the GIS resources they could use
  - Data collection / validation / QA/QC
  - Collaborative analysis
  - Monitoring
  - Outsourcing of services
- A technology for NGO use
  - Marketing
  - Advocacy
  - Meeting unmet needs
  - Democratizes the process / levels the playing field

…But

- Implementation is not a trivial consideration
- Any information system needs care and feeding
  - People
  - Data
  - Technology
  - Policy
  - Process

Questions?

John Steffenson / Tim Clark
ESRI
One International Court
Broomfield, Colorado 80021
303-449-7779
jsteffenson@esri.com
tclark@esri.com
www.esri.com

Thank You