Application of Remote Sensing and GIS on Environmental Studies (GeES 524)

Debre Tabor University

Faculty of Social Sciences and Humanities

Department of Geography and Environmental Studies

Post Graduate programme/2020

Part Two

Geographic Information System

Lesson Objectives

- Understand what a GIS is
- Understand how a GIS functions
- Understand how spatial data is represented in a GIS
- Look at some GIS applications

Data vs. Information

- Data, by itself, generally differs from information.
- Data is of little use unless it is transformed into information.
- Information is an answer to a question based on raw data.
- We transform data into information through the use of an Information System.

INFORMATION SYSTEM OVERVIEW

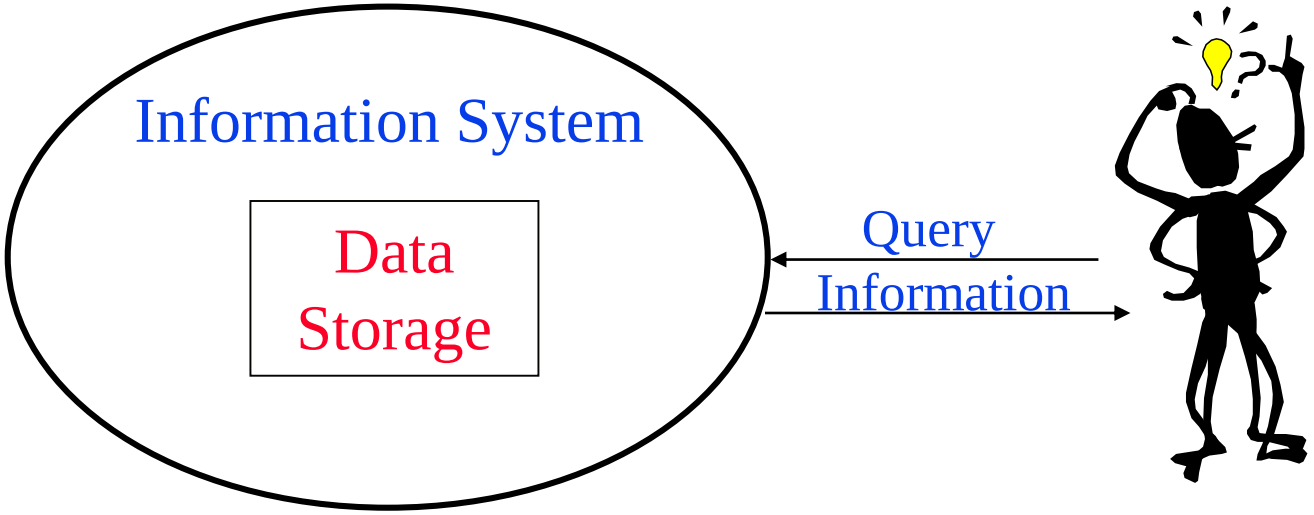
What is an Information System?

SYSTEM USED FOR:

capturing
storing
updating
manipulating
analyzing

DATA

What is an Information System?

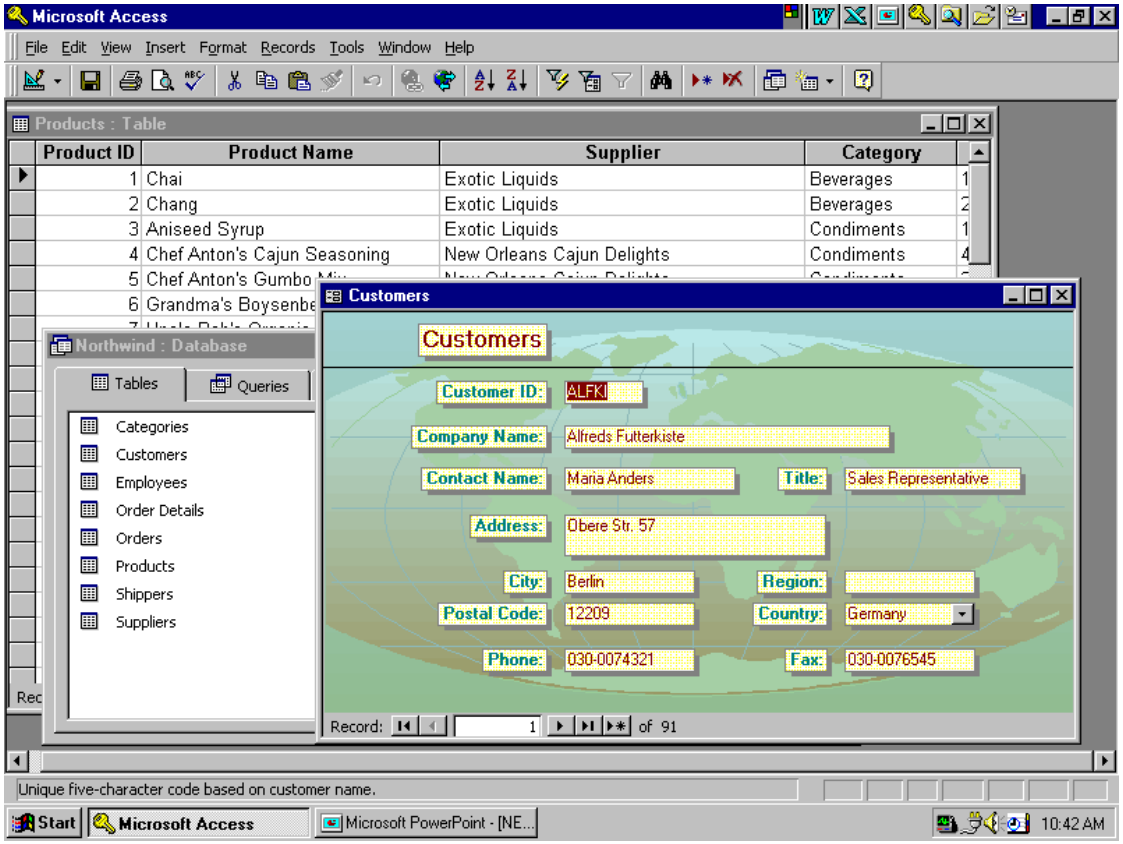


Information systems can be very simple, such as a telephone directory.

What is an Information System?

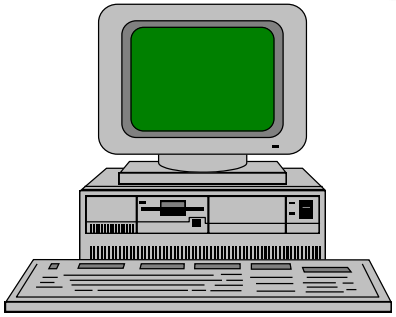
In the digital environment we use software to create complex information systems.

Database Management



What is a GIS?

Information System



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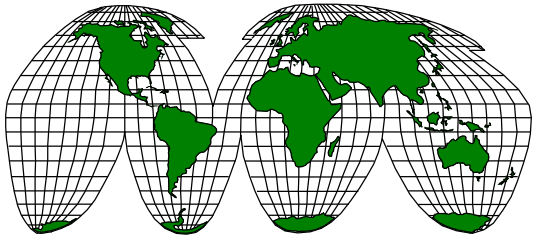
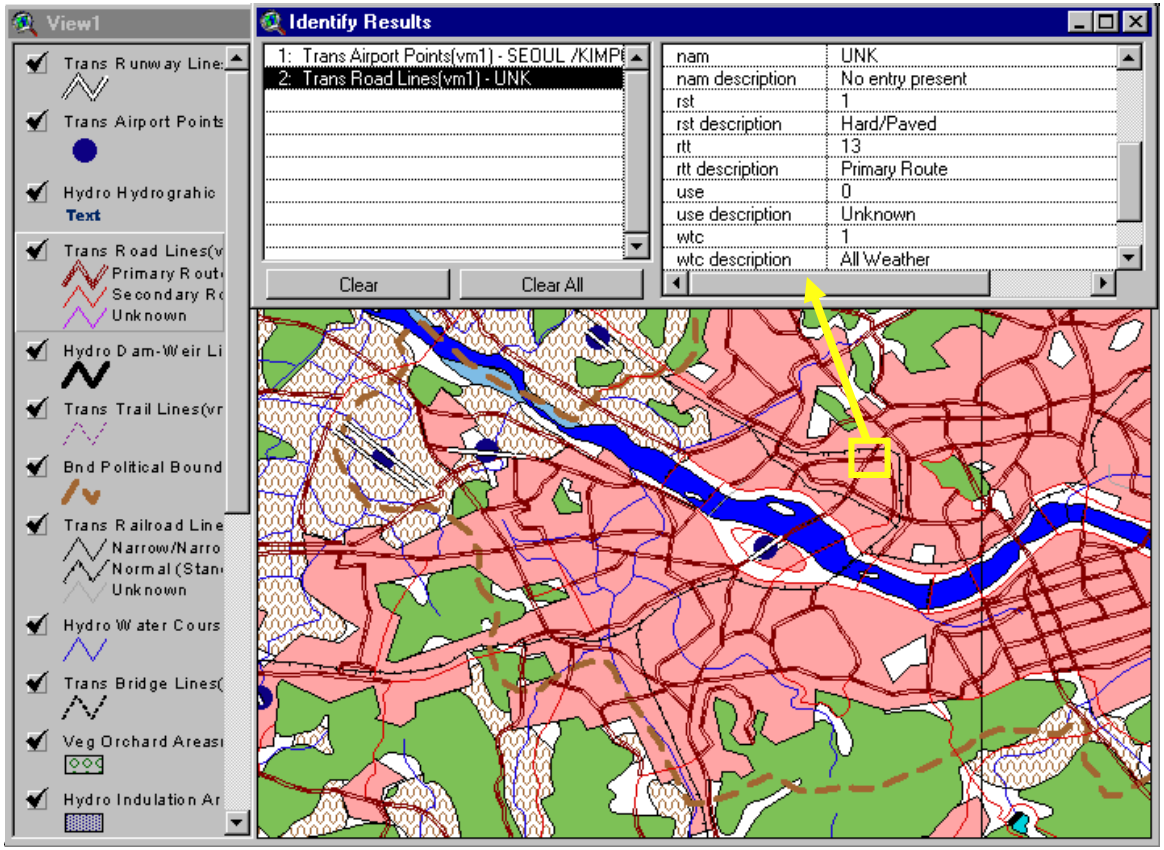
Geographic Position



A means of storing, retrieving, sorting, and comparing *spatial data* to support some analytic process.

What is a GIS?

GEOGRAPHIC Information System



GIS links graphical features (**entities**) to tabular data (**attributes**)

GIS Definition

- A GIS is a system (hardware + database engine) that is designed to efficiently, assemble, store, update, analyze, manipulate, and display **geographically referenced information** (data identified by their locations).

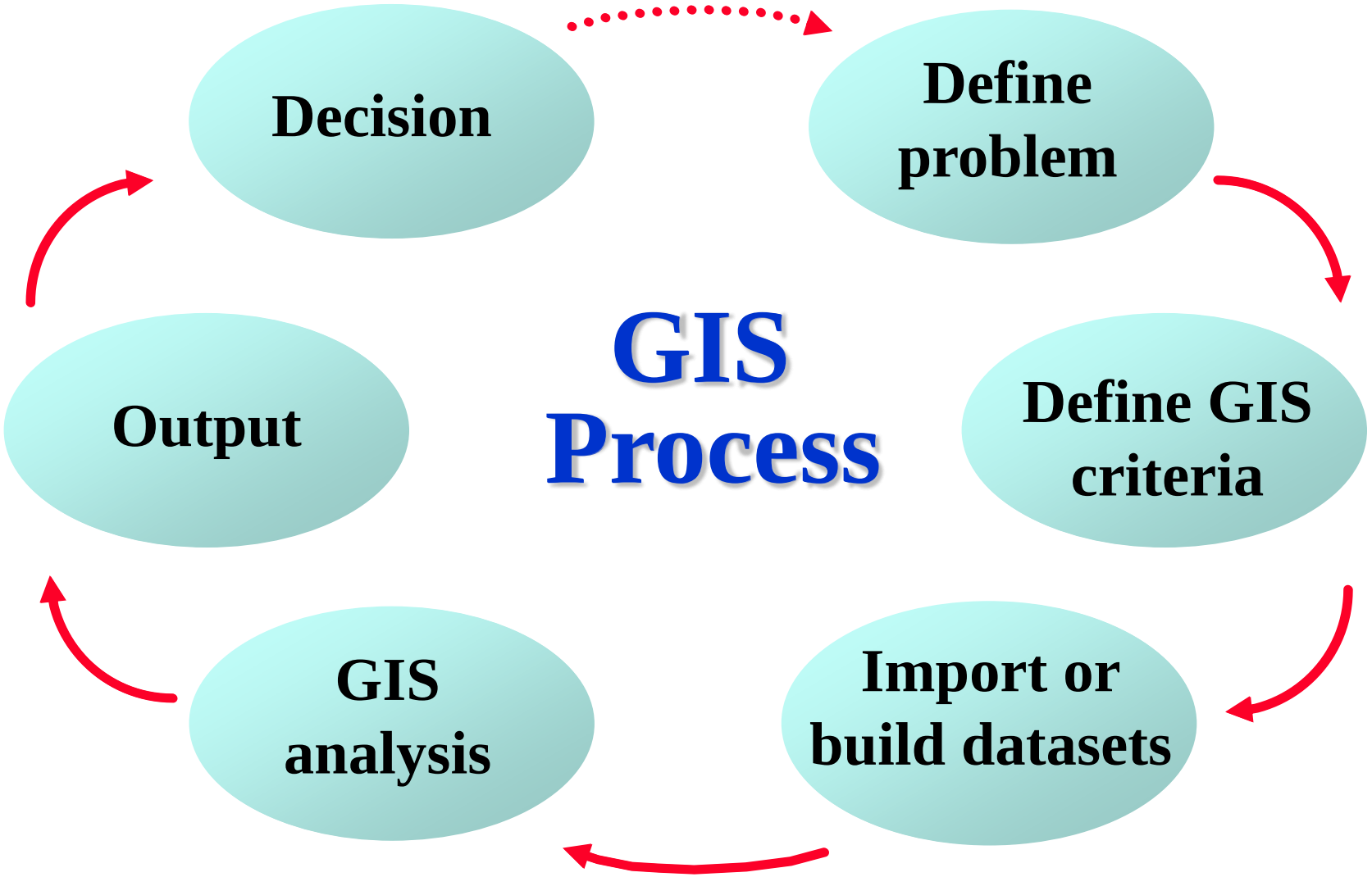
- A GIS also includes the **people** operating the system and the **data** that go into the system.

Key Functions of a GIS

Data can be:

1. Positioned by its known spatial coordinates.
2. Input and organized (generally in **layers**).
3. Stored and retrieved.
4. Analyzed (usually via a Relational DBMS).
5. Modified and displayed

Geographic Information Systems

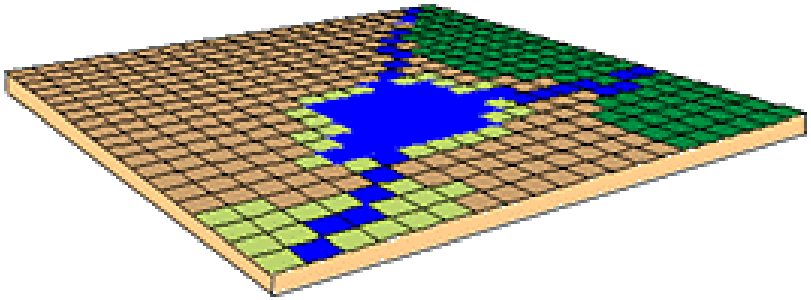


MODELLING AND STRUCTURING DATA

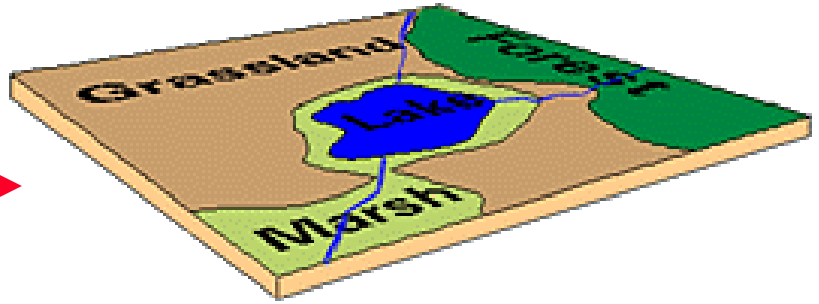
(How we represent features or spatial elements)

Representing Spatial Elements

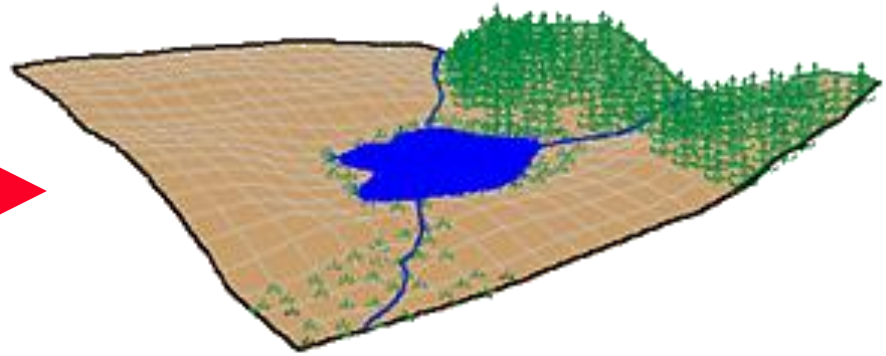
- RASTER



- VECTOR



- Real World



Representing Spatial Elements

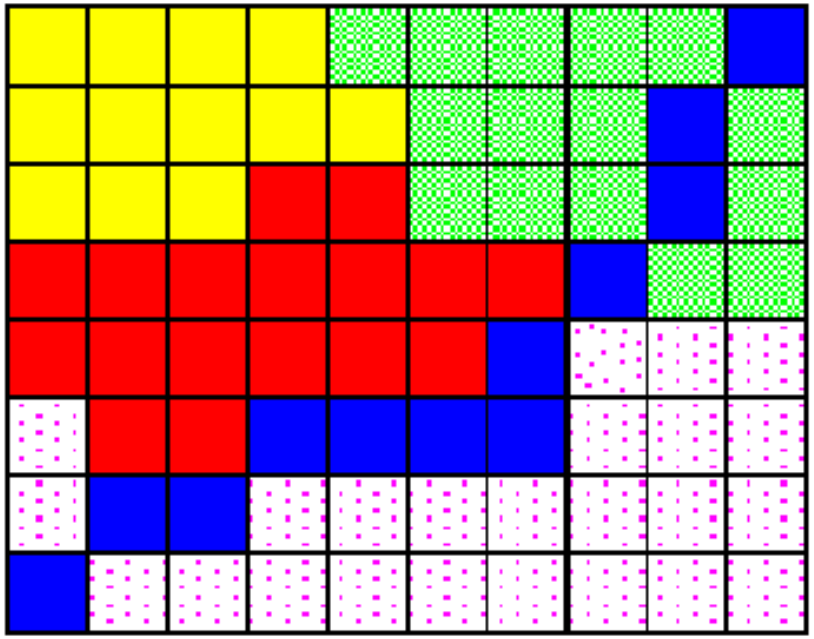
Raster

Stores images as rows and columns of numbers with a Digital Value/Number (DN) for each cell.

Units are usually represented as square grid cells that are uniform in size.

Data is classified as "*continuous*" (such as in an image), or *"thematic"* (where each cell denotes a feature type.

Numerous data formats (TIFF, GIF, ERDAS.img etc)

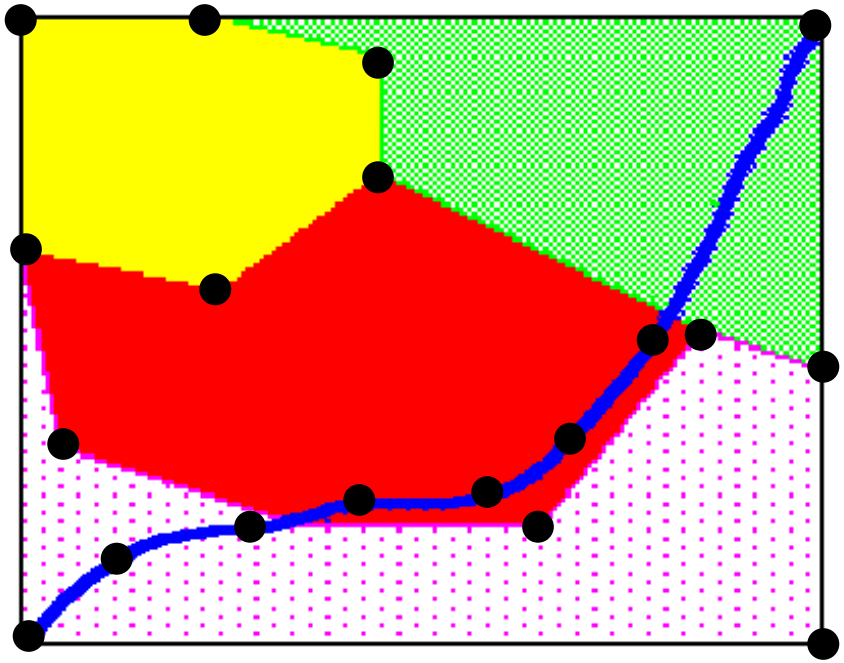


Representing Spatial Elements

Vector

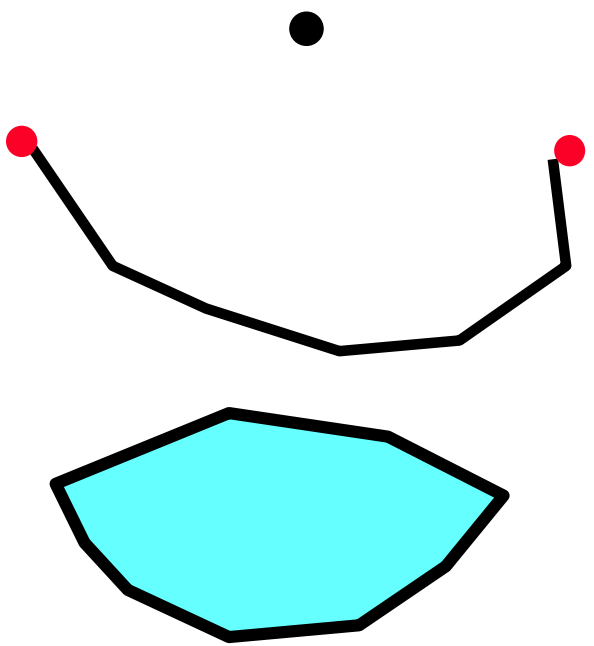
Allows user to specify specific spatial locations and assumes that geographic space is continuous, not broken up into discrete grid squares

We store features as sets of X,Y coordinate pairs.



Entity Representations

We typically represent objects in space as three distinct spatial elements:



Points - simplest element

Lines (arcs) - set of connected points

Polygons - set of connected lines

We use these three spatial elements to represent real world features and attach locational information to them.

Attributes

- In the raster data model, the cell value (Digital Number) is the attribute. Examples: brightness, landcover code, SST, etc.
- For vector data, attribute records are linked to point, line & polygon features. Can store *multiple* attributes per feature. Vector features are linked to attributes by a *unique feature number*.

Raster vs. Vector

Raster Advantages

The most common data format

Easy to perform mathematical and overlay operations

Satellite information is easily incorporated

Better represents “continuous”- type data

Vector Advantages

Accurate positional information that is best for storing discrete thematic features (e.g., roads, shorelines, sea-bed features.

Compact data storage requirements

Can associate unlimited numbers of attributes with specific features

GIS FUNCTIONALITY

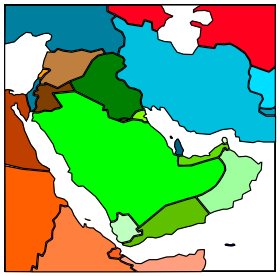
(What do they do?)

GIS Functions

- Data Assembly
- Data Storage
- Spatial Data Analysis and Manipulation
- Spatial Data Output

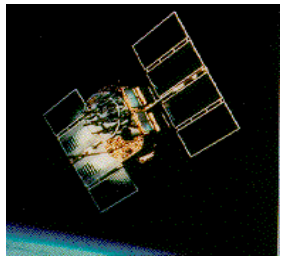
GIS Functions

Data Assembly



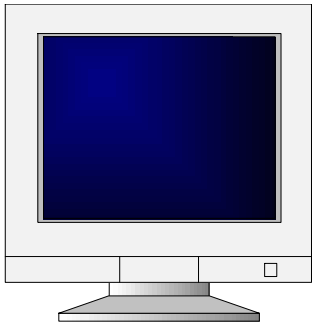
Maps

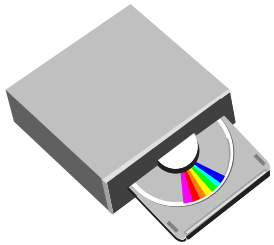
Manual Digitizing
Scanning



RSI

Manual Digitizing
Scanning





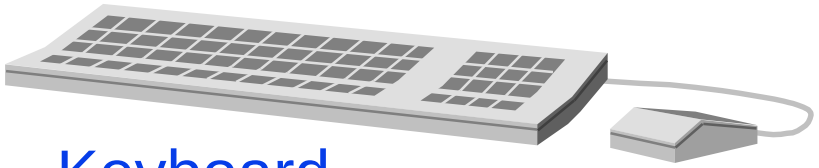
Intel Database

Data Transfer

Data Transfer

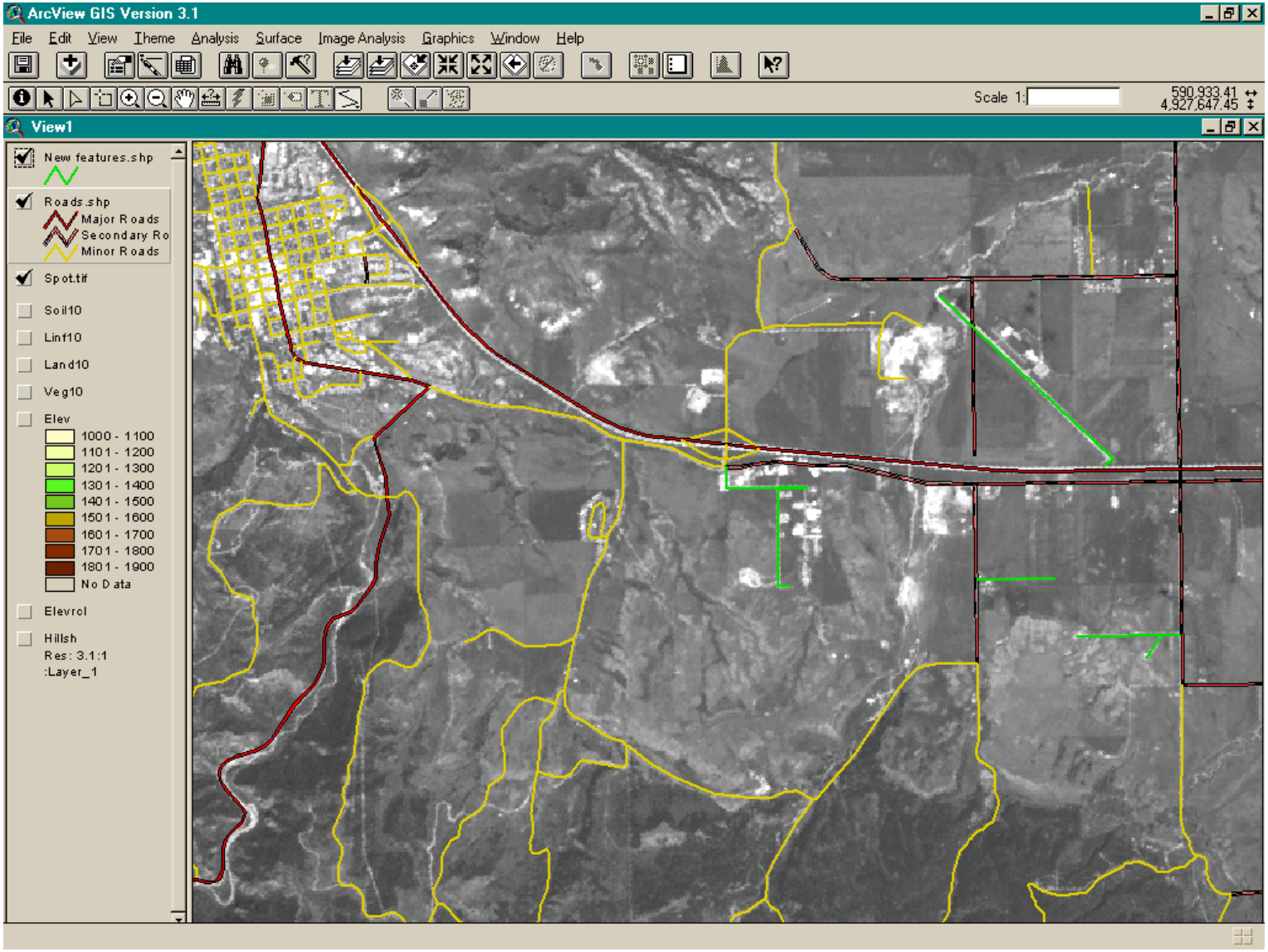
GPS

Direct Entry



Keyboard

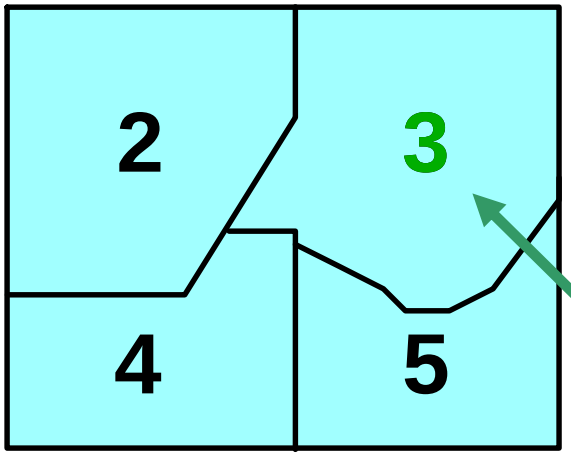
Data Input/Creation



GIS Functions

GIS Storage

1 (Universe polygon)



Spatial data
(ARC functions)

Attribute data
(INFO or TABLES functions)

COV#	ZONE	ZIP
1		0
2	C-19	22060
3	A-4	22061
4	C-22	22060
5	A-5	22057

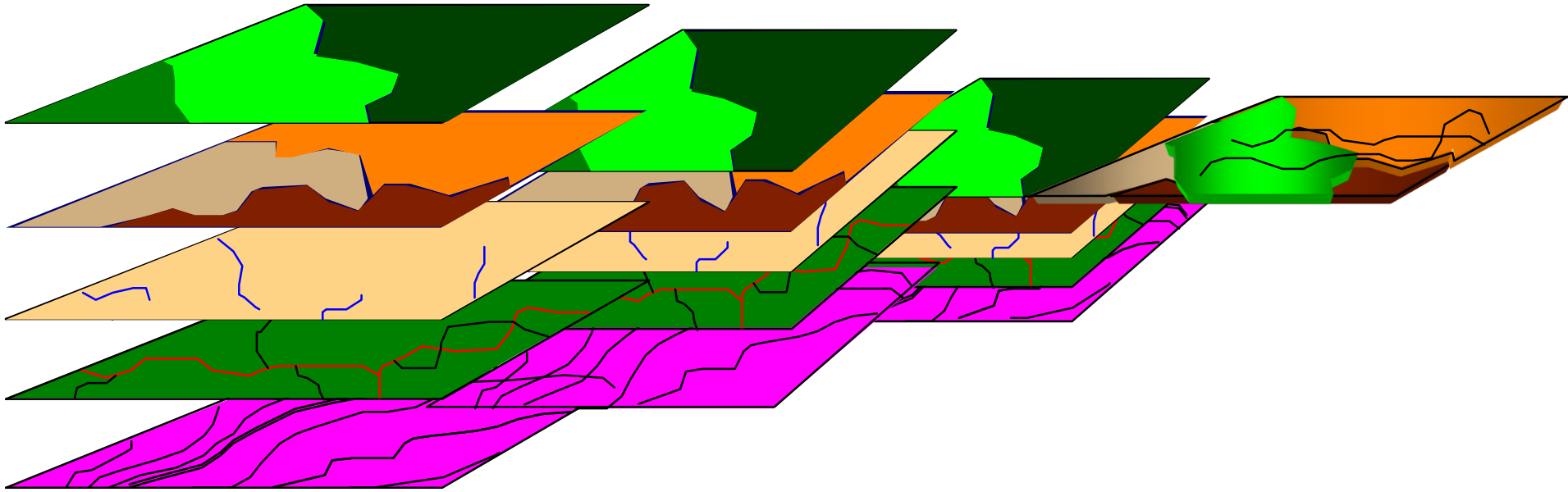
GIS Functions

Spatial Data Manipulation and Analysis

- Common Manipulation
  - Reclassification
  - Map Projection changes
- Common Analysis
  - Buffering
  - Overlay
  - Network

Spatial Analysis

- Overlay function creates new "layers" to solve spatial problems



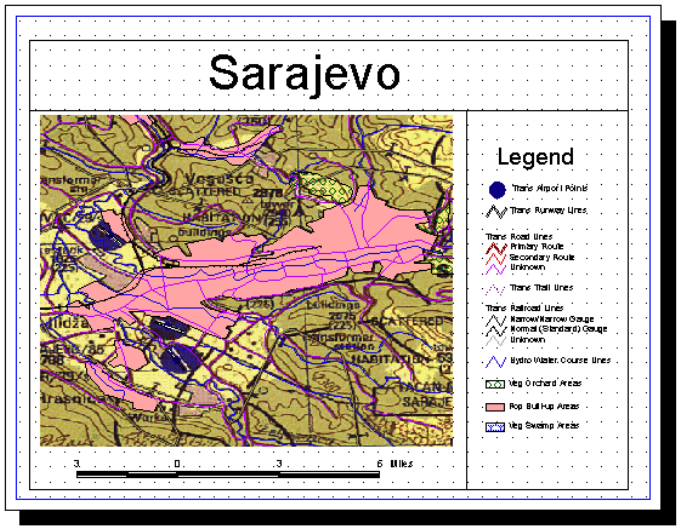
GIS Functions

Spatial Data Output

- Tables
- Maps
- Interactive Displays
- 3-D Perspective View

Attributes of Pop Built-up Areas(vm1)

Shape	id	f_code	f_code description	exs	exs description	nam
Polygon	1	AL020	Built-Up Area	999	Other	Vinkovci
Polygon	2	AL020	Built-Up Area	999	Other	Nustar
Polygon	3	AL020	Built-Up Area	999	Other	Bobota
Polygon	4	AL020	Built-Up Area	999	Other	Otok
Polygon	5	AL020	Built-Up Area	999	Other	Bijelo Brdo
Polygon	6	AL020	Built-Up Area	999	Other	Trpinja
Polygon	7	AL020	Built-Up Area	999	Other	Komletinci
Polygon	8	AL020	Built-Up Area	999	Other	UNK
Polygon	9	AL020	Built-Up Area	999	Other	Backi Monostor
Polygon	10	AL020	Built-Up Area	999	Other	Hercegszanto



SOME EXAMPLES

AND APPLICATIONS

Areas of GIS Application

Business
- Banking and Financial Services
- Facilities Management
- Insurance
- Media and Press
- Real Estate
- Retail

Defense and Intelligence
- Defense and Force Health Protection
- Enterprise GIS
- Geospatial Intelligence
- Installations and Environment
- Military Operations (C4ISR)

Education
- Libraries and Museums
- Schools (K–12)
- Universities and Community Colleges

Government
- Federal, State, Local, Gov 2.0
- Architecture, Engineering and Construction (AEC)
- Economic Development
- Elections and Redistricting
- Land Administration
- Public Works

Health and Human Services
- Public Health
- Human Services
- Hospital and Health Systems
- Managed Care
- Academic Programs and Research

Mapping and Charting
- Aeronautical
- Cartographic
- Nautical
- Topographic

Natural Resources
- Agriculture
- Climate Change
- Conservation
- Environmental Management
- Forestry
- Marine and Coast
- Mining
- Oceans
- Petroleum
- Water Resources

Public Safety
- Computer-Aided Dispatch
- Emergency/Disaster Management
- Fire, Rescue, and EMS
- Homeland Security
- Law Enforcement
- Wildland Fire Management

Transportation
- Aviation
- Highways
- Logistics
- Railways
- Ports and Maritime
- Public Transit

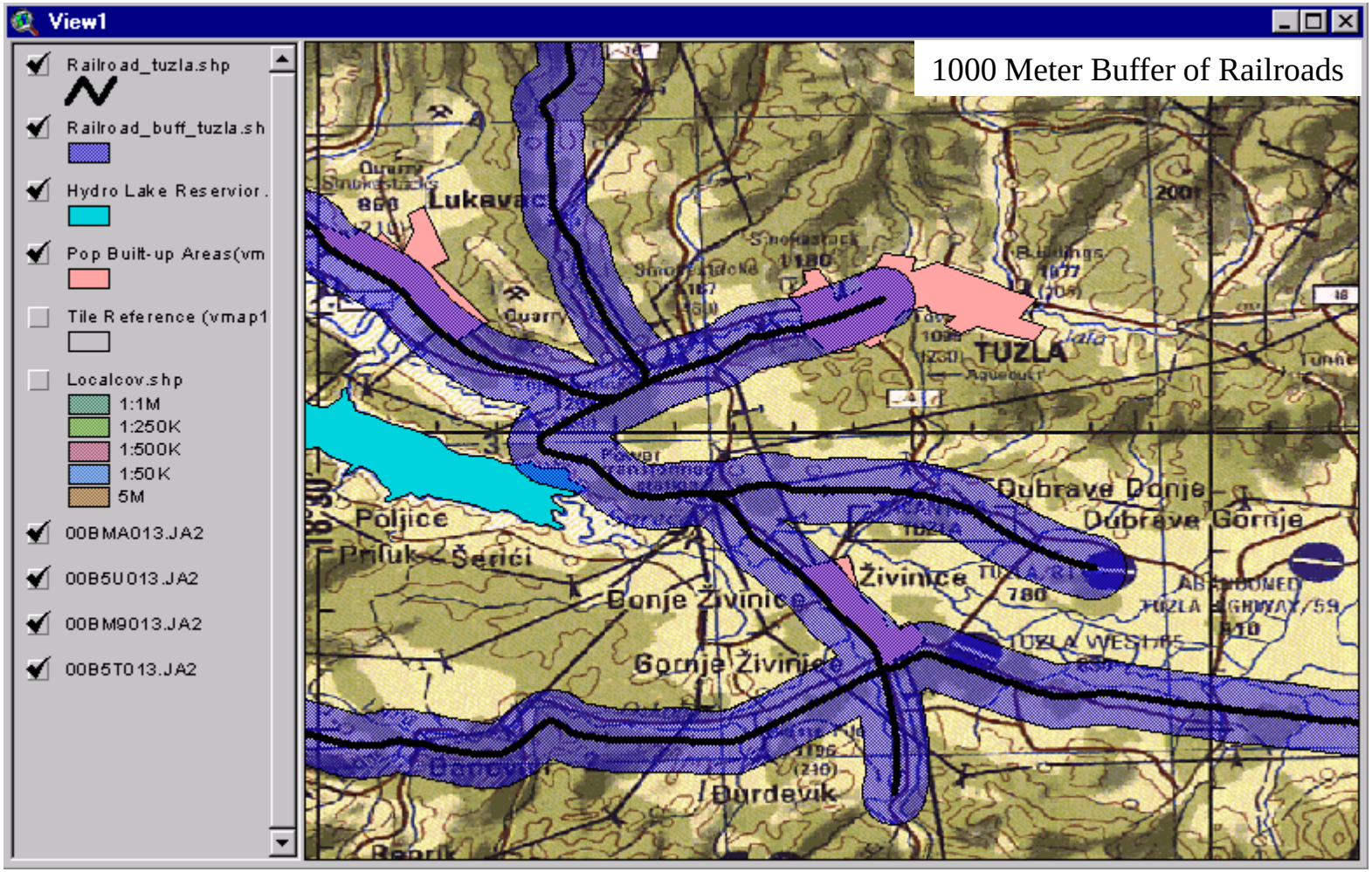
Utilities and Communications
- Electric
- Gas
- Location-Based Services
- Pipeline
- Telecommunications
- Water/Wastewater

GIS Applications ……

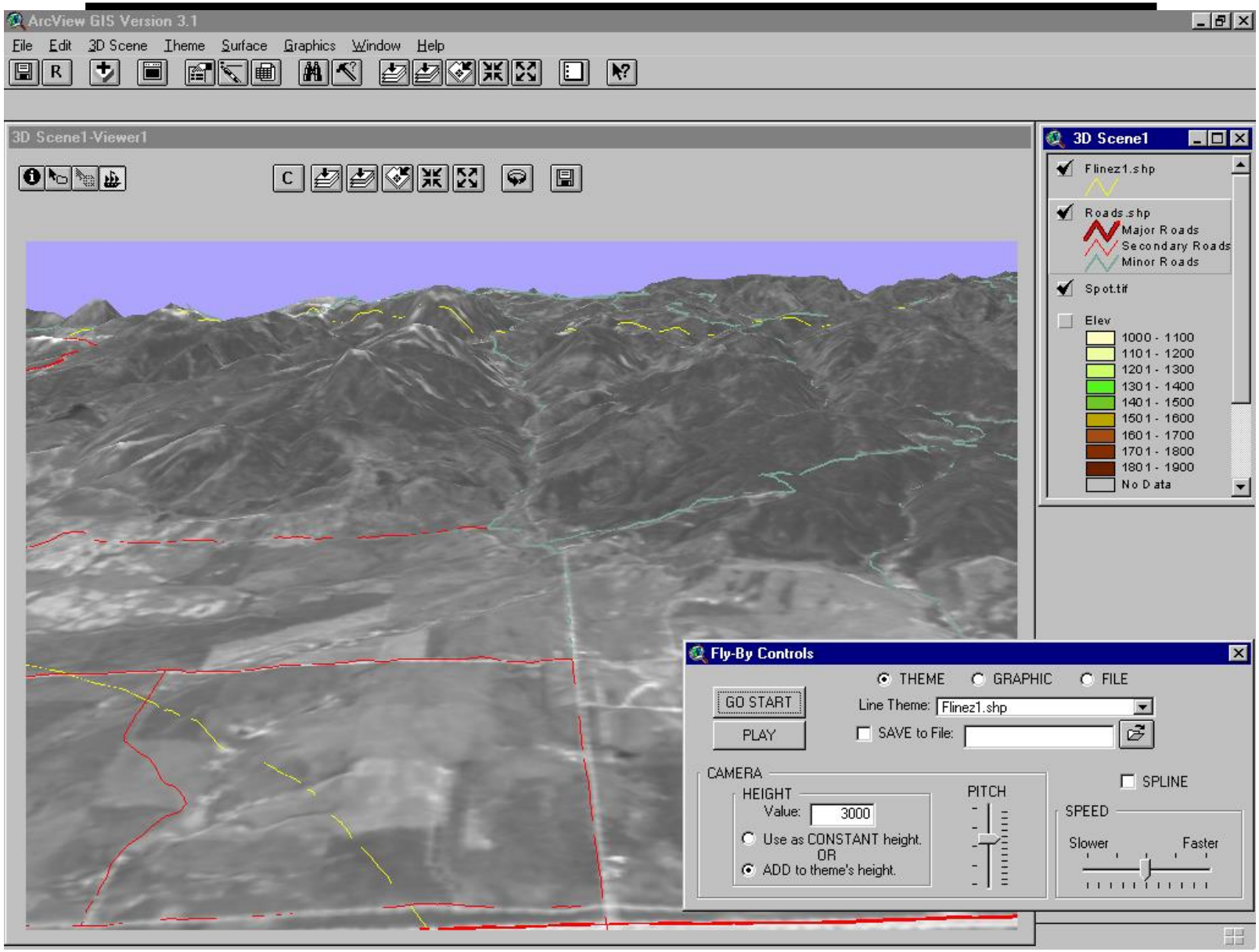
- Site selection
  - Buffer Zones
  - Flight Planning
  - Battlefield Visualization

Spatial Analysis

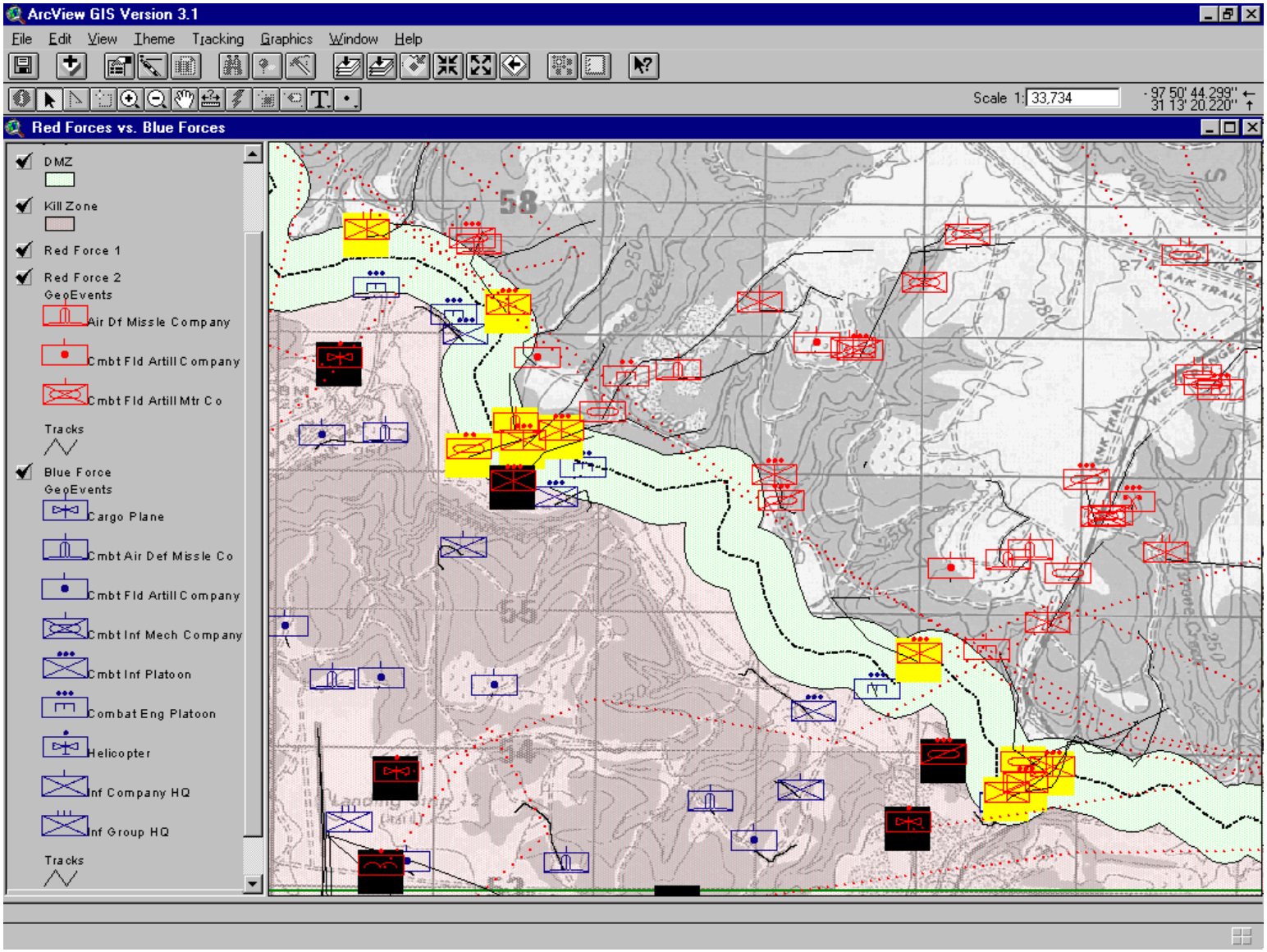
Proximity Analysis (Buffers)



Flight Planning/Flythroughs



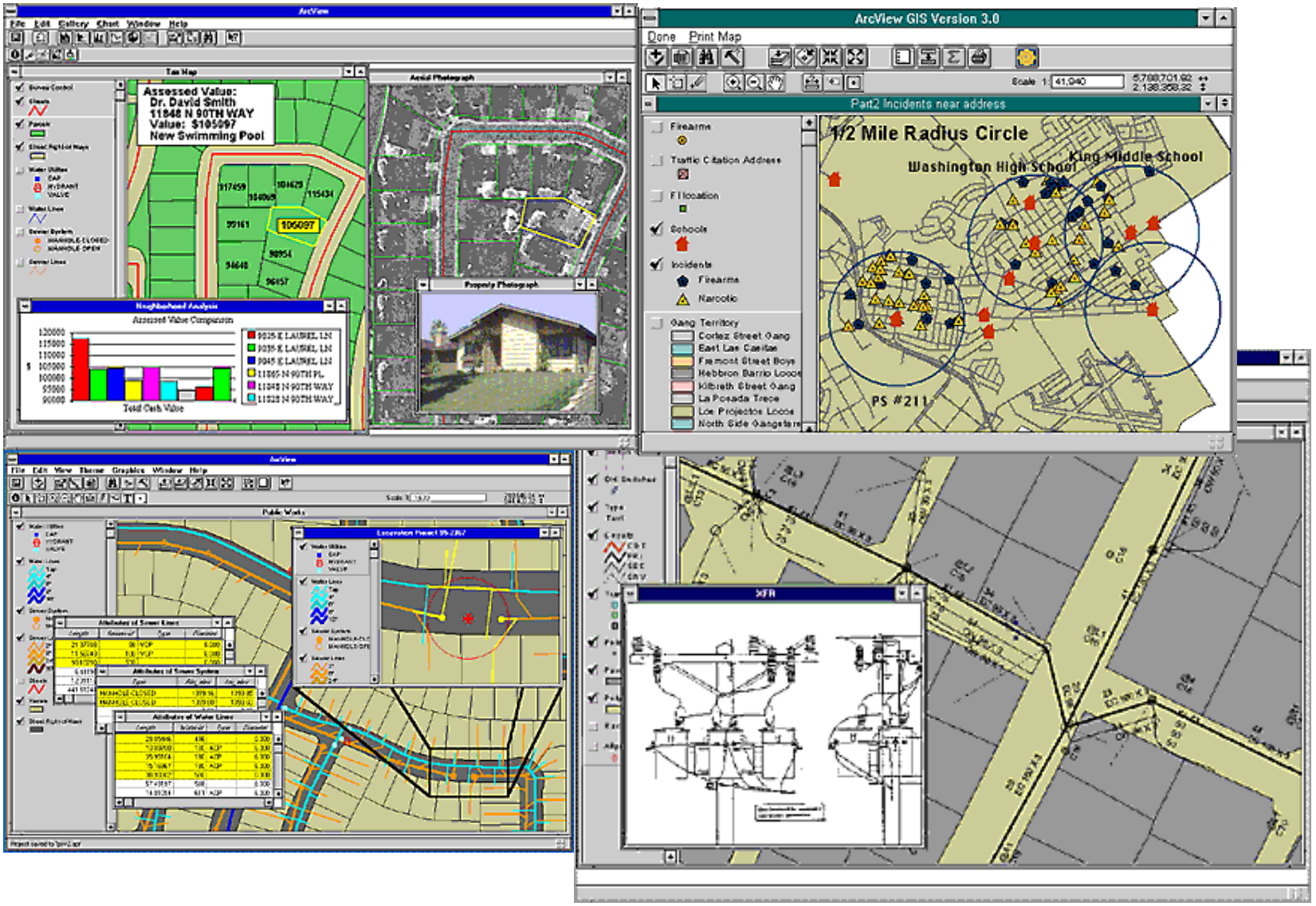
Battlefield Visualization and/or Situation Awareness



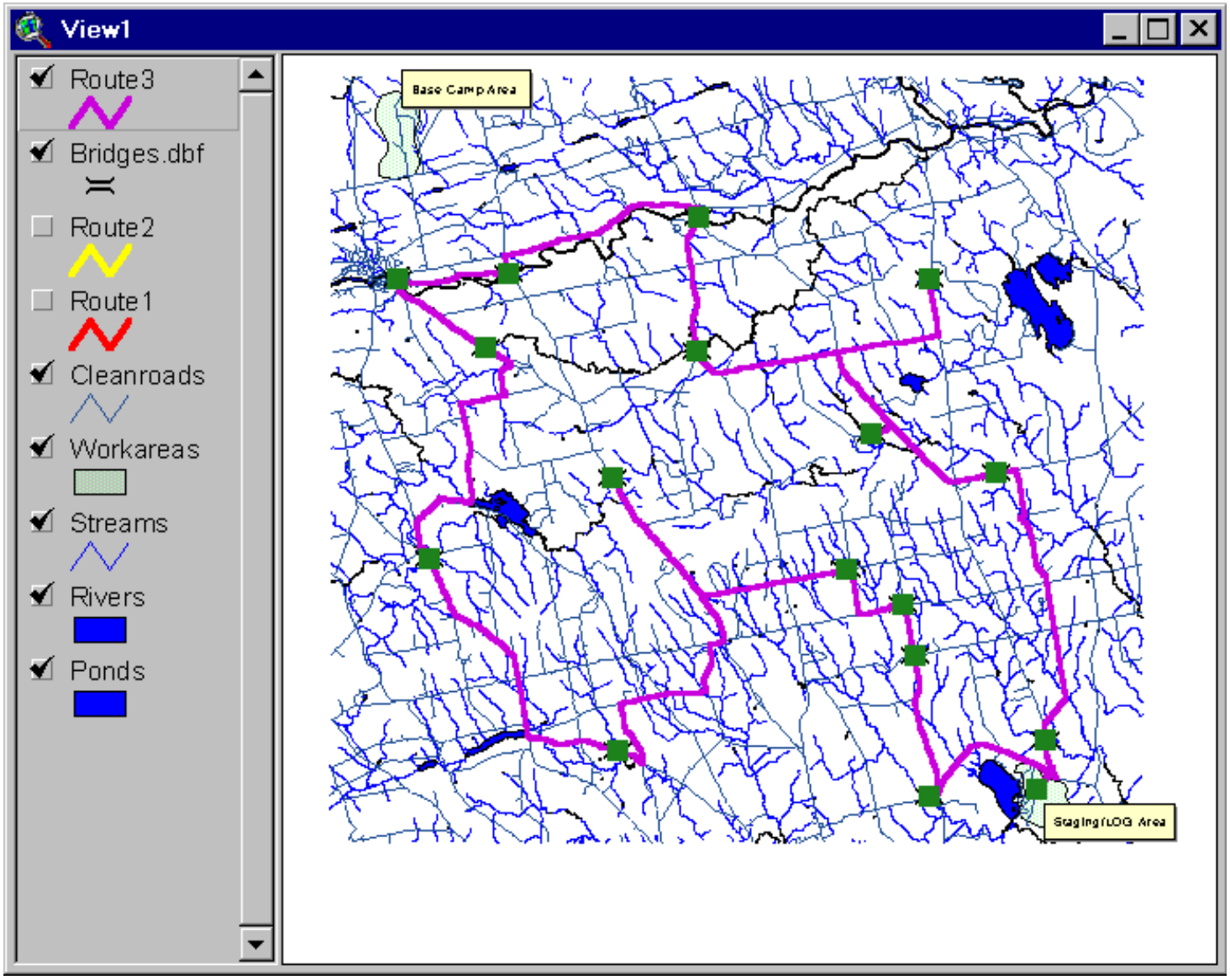
Other GIS Applications

- Cross country movement
  - Route planning
  - Intervisibility study
- Facilities management
- Road network analysis (convoys)
- Perspective views

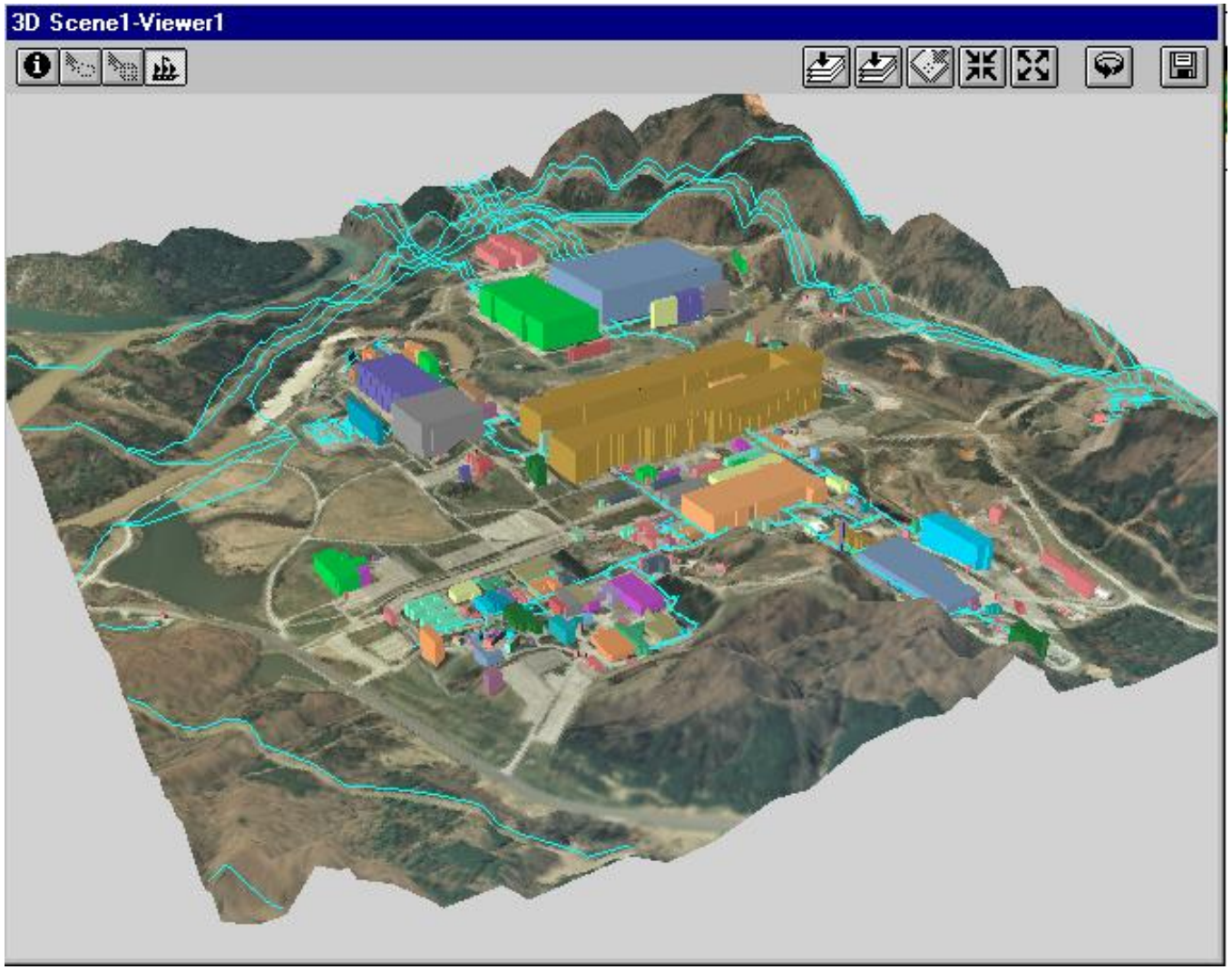
Facilities Management



Network Analysis



Perspective Views



THANK YOU!