Supporting the Planning Process With ArcGIS ModelBuilder and Visualization Tools

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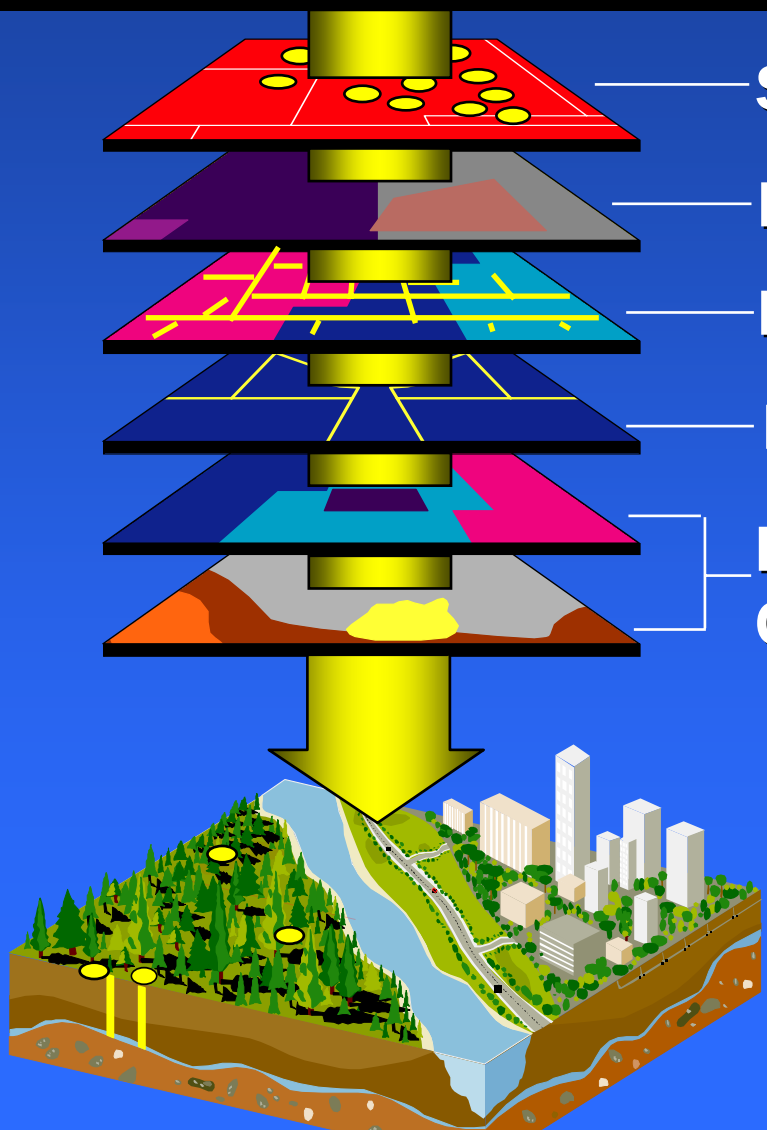
CORP 2005
February, 2004

CORP GEO·MULTIMEDIA 2005

ESRI

GIS Planning Support Systems / Models & Visualization: Integrating Information



Socioeconomic Factors

Bio-Diversity

Engineering

Land Use

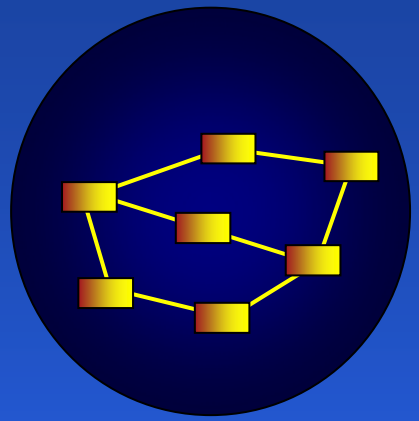
Environmental Considerations

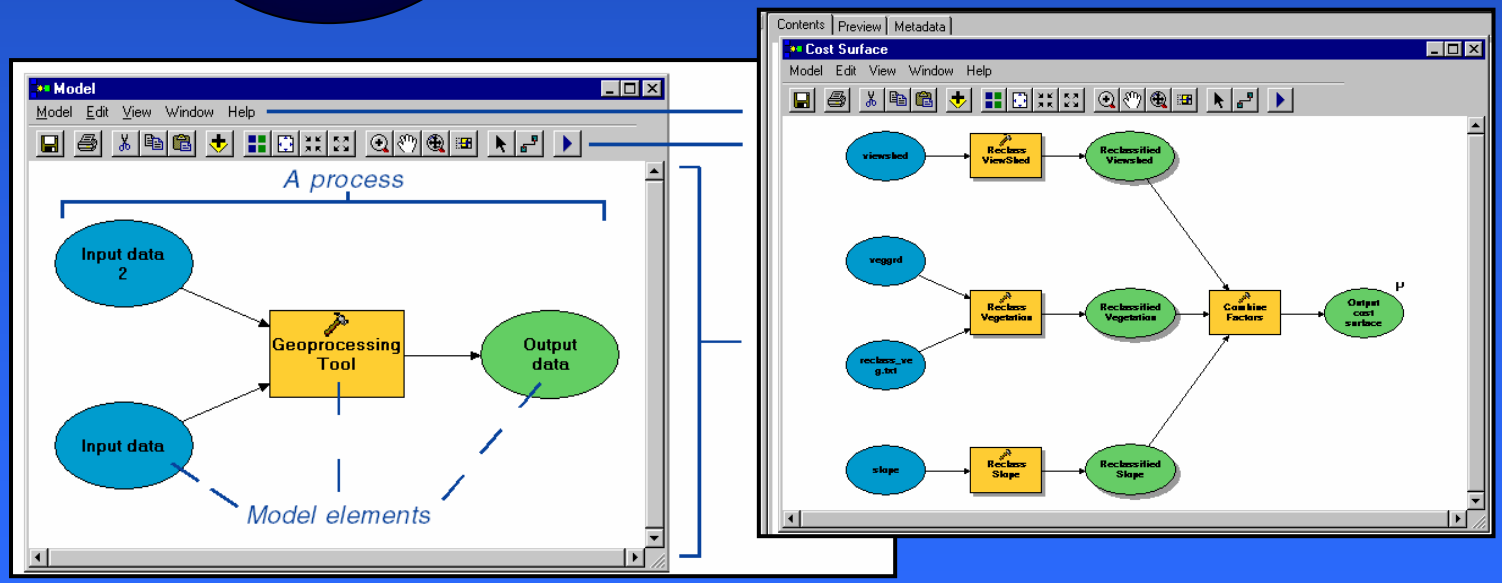
Building models

Modeling concepts and tools

- Why build models?
- Binary suitability models
- Weighted suitability models
  - Methodology
- Reclassify and Weighted Overlay tools
- Demo

Models – Best Practices and Applications





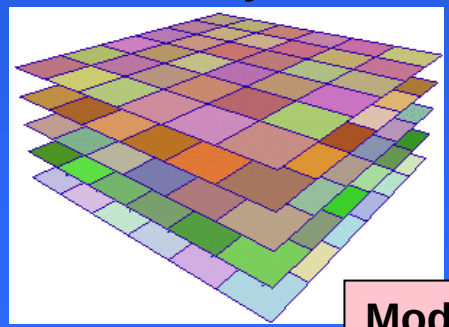
. . . Sharing Geographic Knowledge

Modeling spatial problems

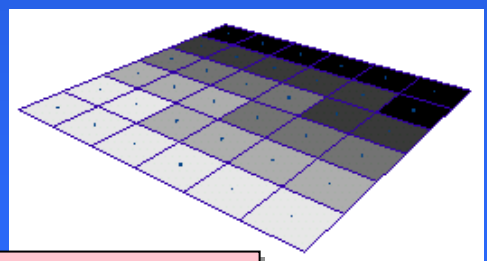
- Models help us understand and solve complex town and regional problems
  - Simplify reality
  - Combine geographic layers to answer questions
    - e.g., “Where should you build your next community center?”

Reality

GIS layers



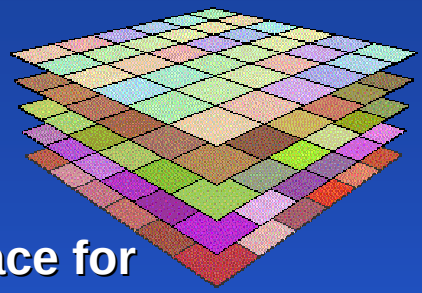
Suitability for community center



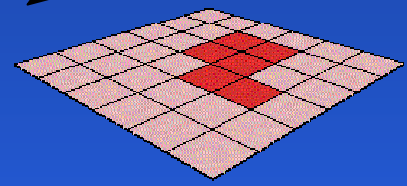
Model criteria:
- Zoned commercial
- Near target population
- Near transit

Types of models

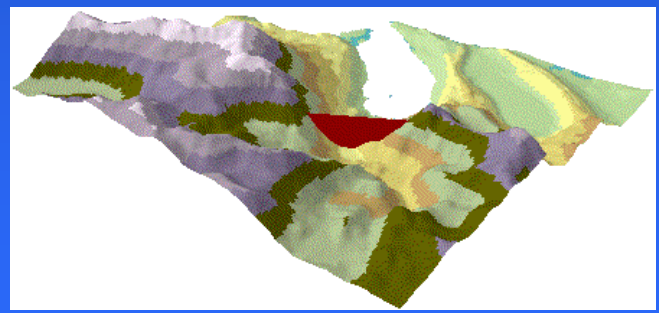
- Representation models
  - Describe the landscape (your GIS data layers)
- Suitability models
  - Use GIS layers to find best place for something (businesses, vineyards, evacuation centers)
  - Relatively easy; standard methodology
- Process models
  - Show the landscape as conditions change (fire spreads, rivers flood, oil slicks move)
  - Often difficult; no standard methodology
- Automated work flows
  - Data processing



GIS data layers



Best store location

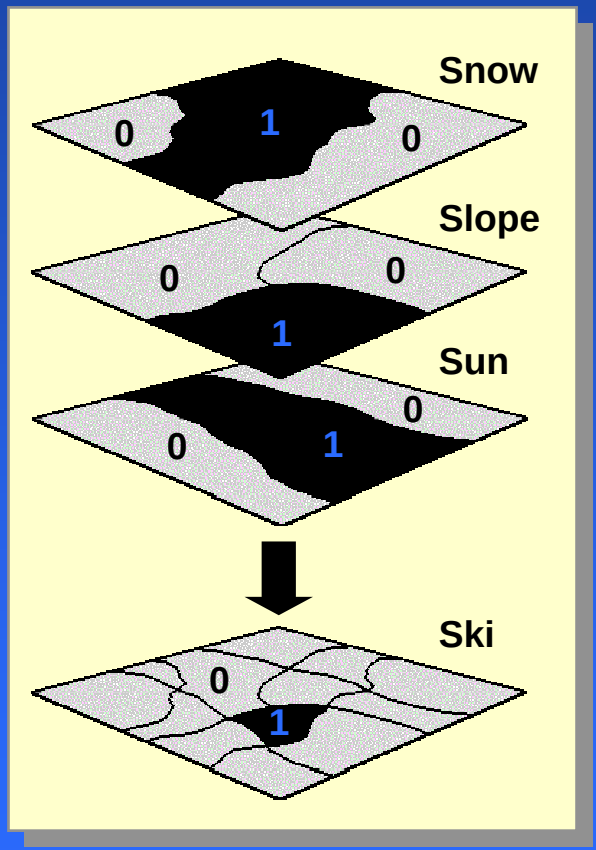


Filling a reservoir

Binary suitability models

- Use for simple problems
  - Like a query
- Classify layers into good (1) and bad (0)
  - Combine with AND, addition, or multiplication:

    `Ski = Snow And Slope And Sun`
- Advantages:
  - Easy
- Disadvantages:
  - No ‘next-best’ sites
  - All layers have same importance
  - All good values have same importance

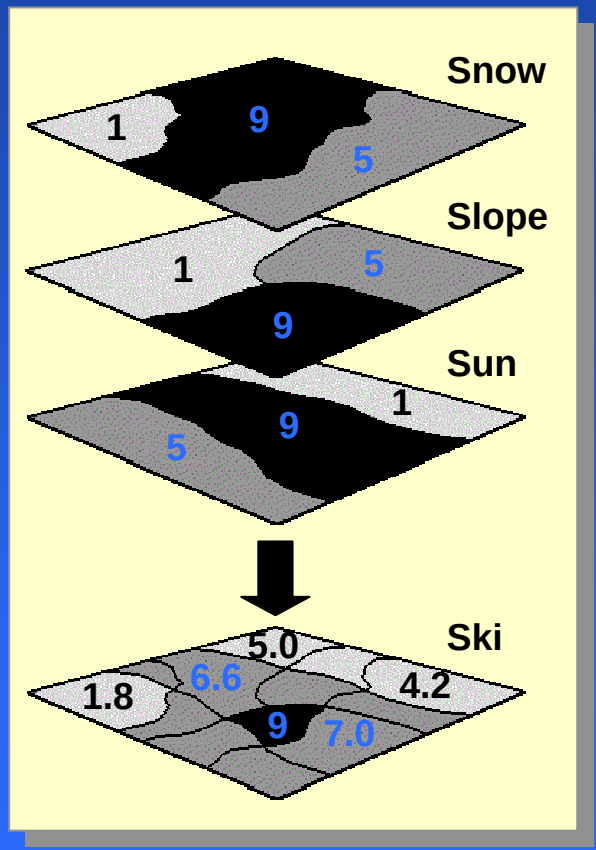


Weighted suitability models

- Use for complex problems
- Classify layers into suitability 1–9 (9 = best)
  - Weight and add together:

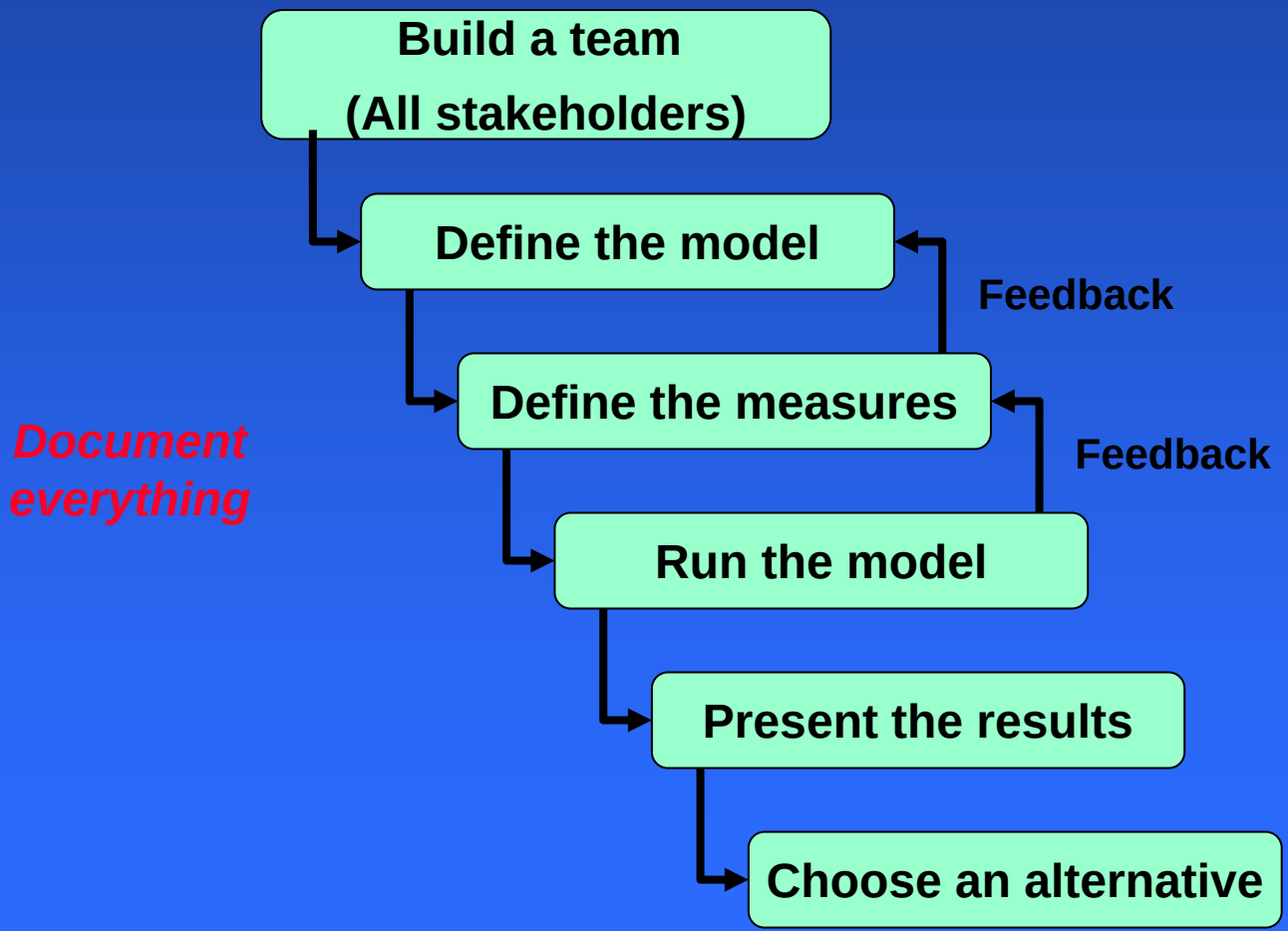
```
Ski = (Snow  * 0.5)
    + (Slope * 0.3)
    + (Sun   * 0.2)
```

- Advantages:
  - All values have relative importance
  - All layers have relative importance
  - Returns suitability on a scale 1–9
- Disadvantages:
  - Preference assessment is harder



Weighted suitability methodology

- There is a fairly standard methodology to follow:

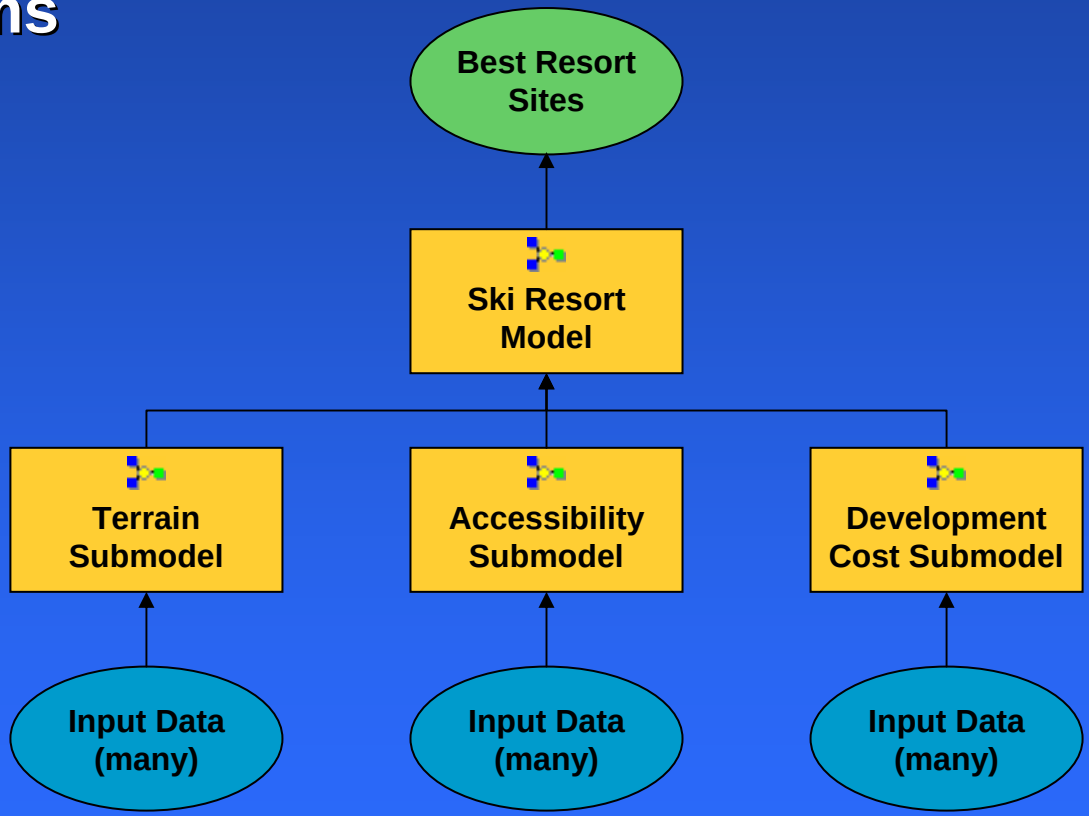


Define the model

- This is a team activity
  - Stakeholders, decision makers
- Define the problem (i.e. Economic development)
  - "Locate a ski resort"
- Identify issues
  - "Accessible to skiers"
- Determine how to measure
  - "Drive time to the city"
- Obtain GIS data

Break big models into submodels

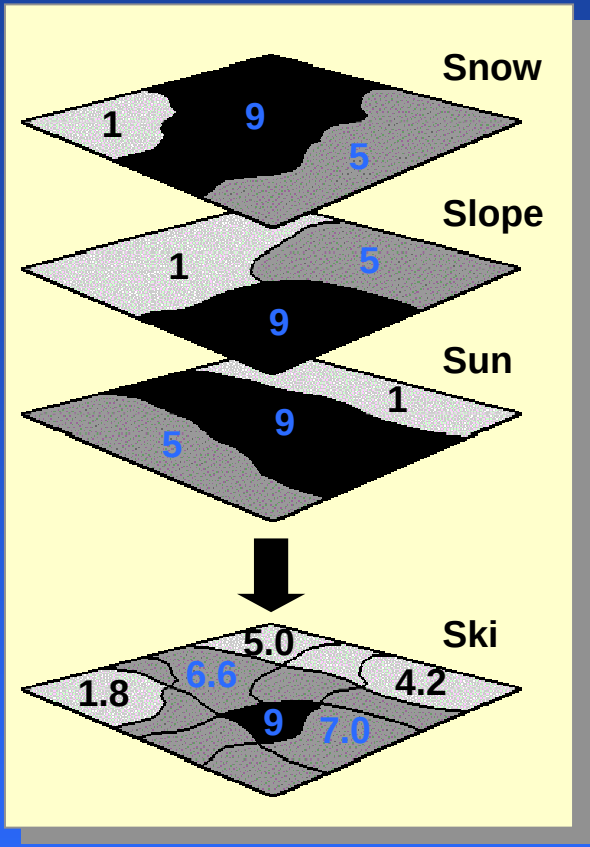
- Helps clarify relationships and simplifies problems



Weight and combine the layers

- For each submodel
  - Multiply suitability layers by weights
    - Weights must add up to one
  - Add the weighted layers together
- Repeat to combine submodels

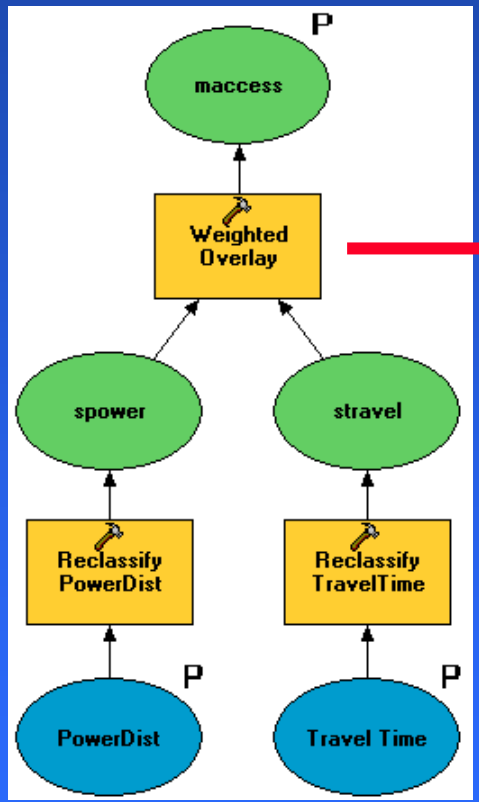
- Use the Weighted Overlay tool
- Or use a Map Algebra expression

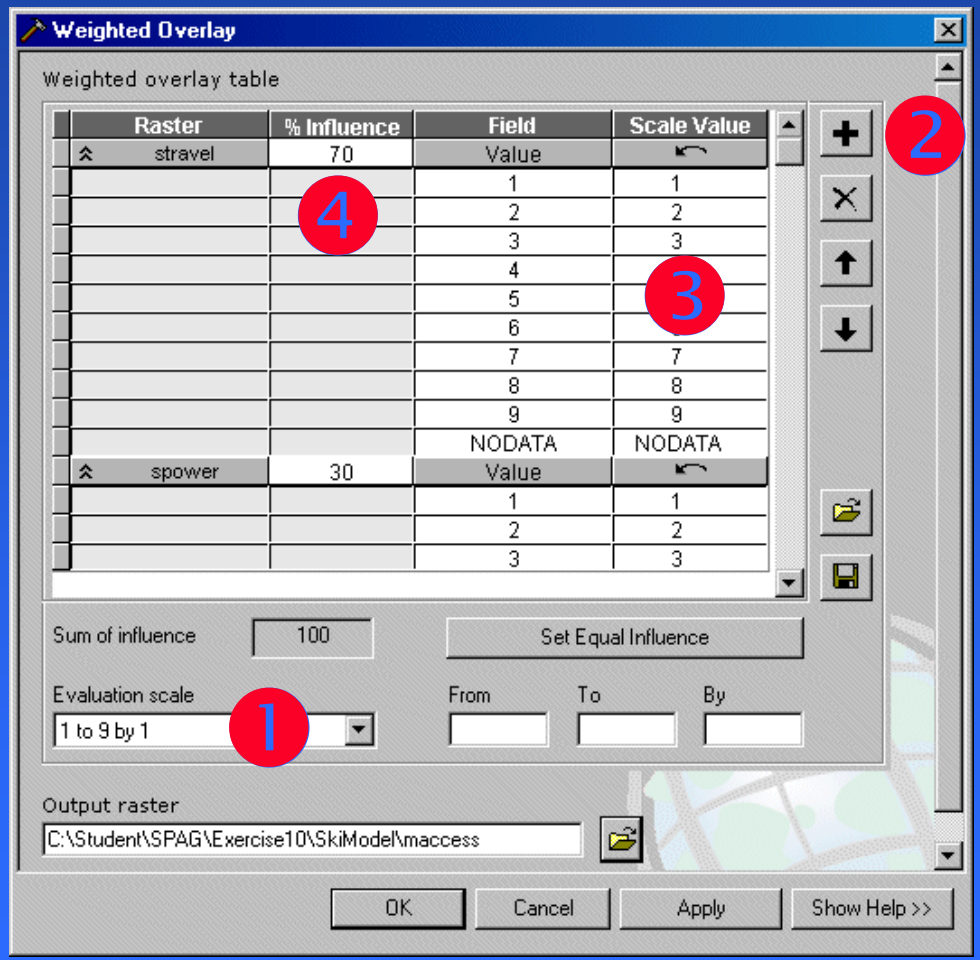



```
Ski = (Snow * 0.5) + (Slope * 0.3) + (Sun * 0.2)
```

Weighted Overlay tool

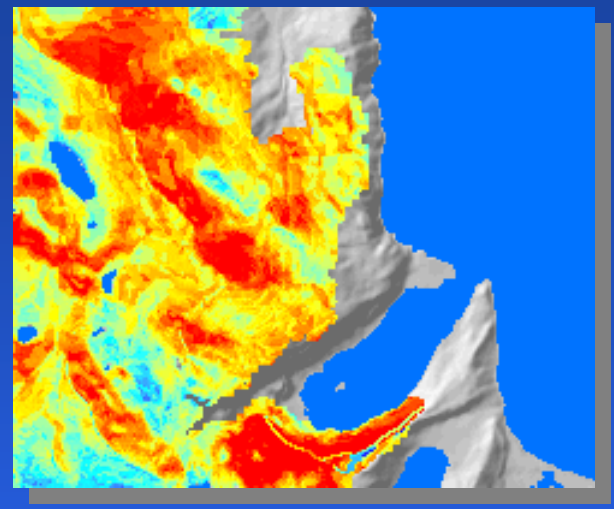
- Weights and combines multiple inputs

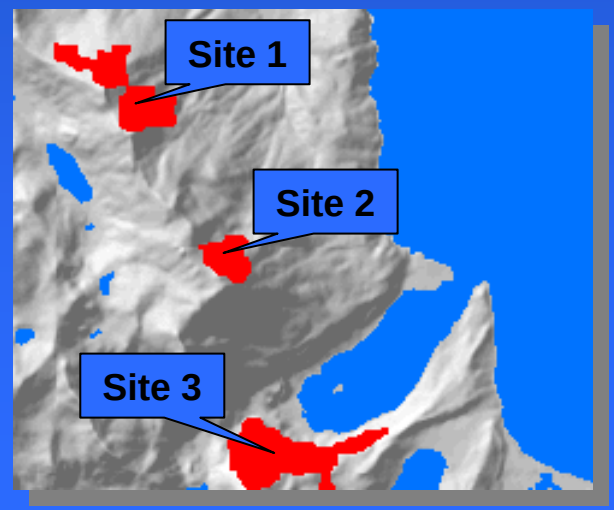




Find the best locations

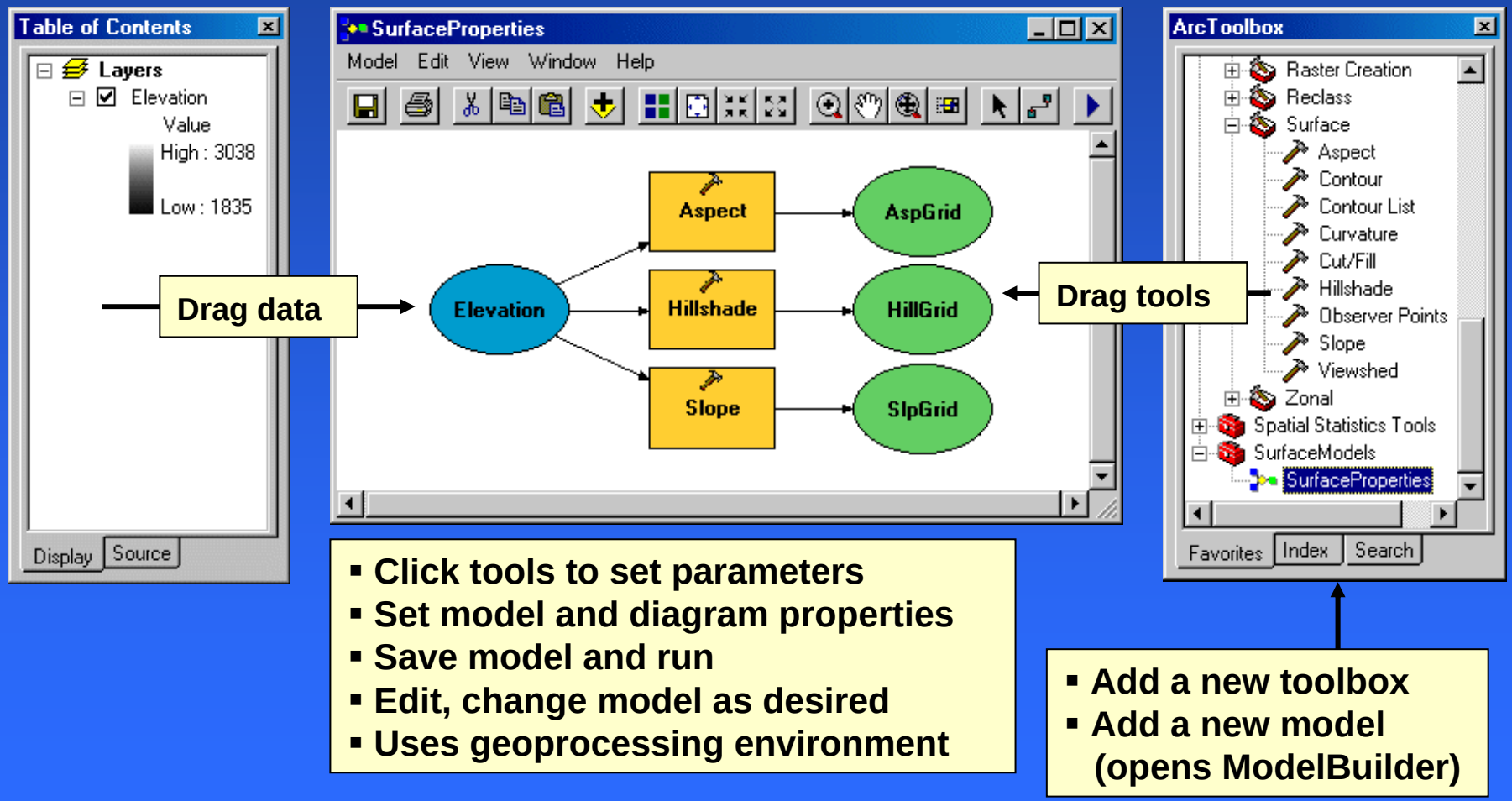
- Model returns a suitability ‘surface’
  - Often does not return a perfect 9
- Create candidate sites
  - Select cells with highest scores
  - Define regions with unique IDs
  - Eliminate regions that are too small
- Choose between the candidates
  - Another modeling problem?





Building models with ModelBuilder

- A graphical modeling environment for ArcGIS

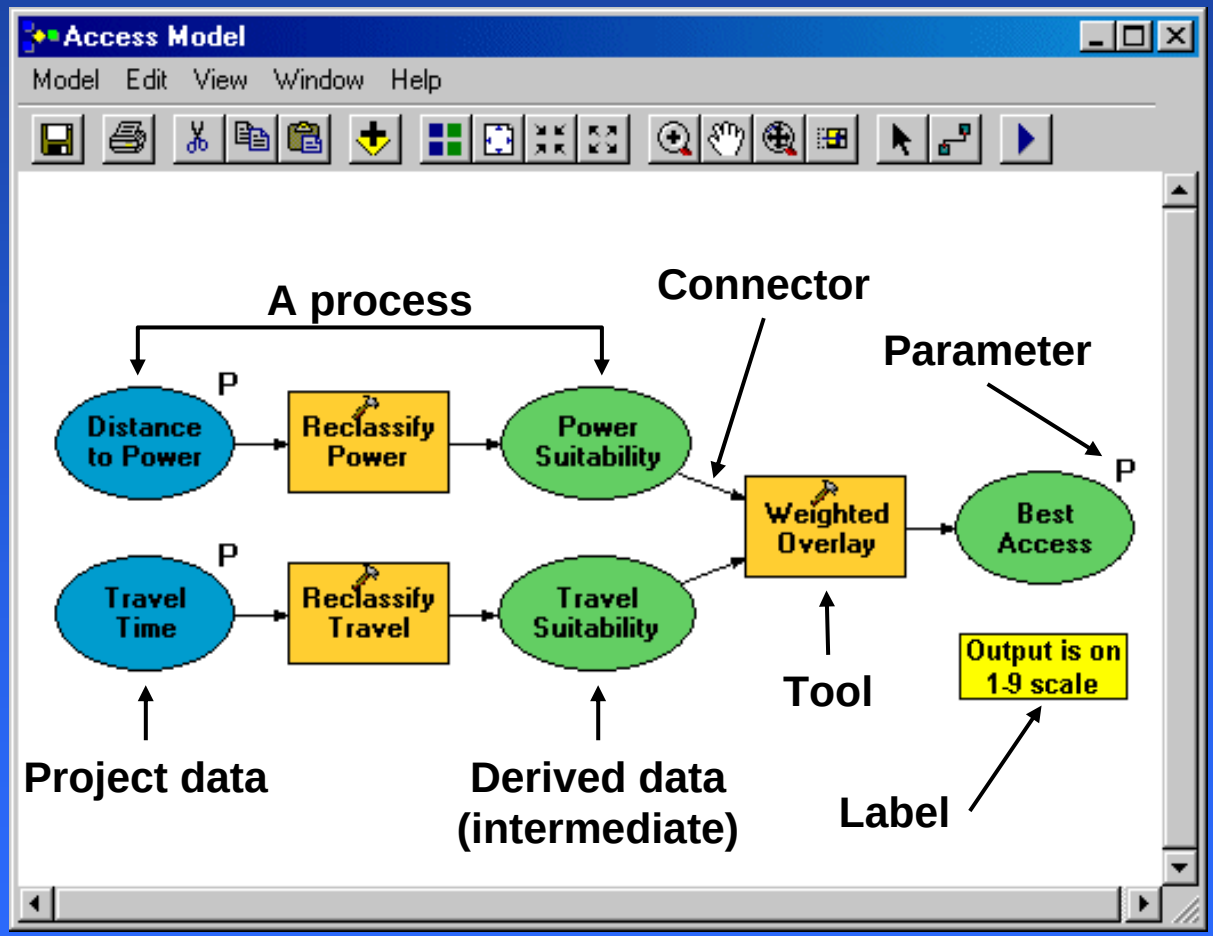


- Click tools to set parameters
- Set model and diagram properties
- Save model and run
- Edit, change model as desired
- Uses geoprocessing environment

- Add a new toolbox
- Add a new model (opens ModelBuilder)

A

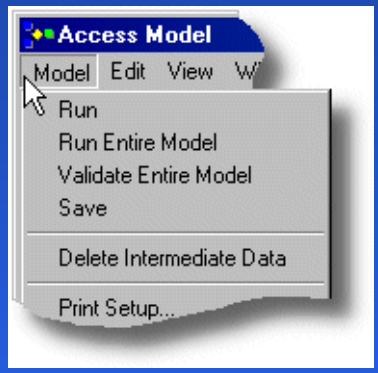
Model elements

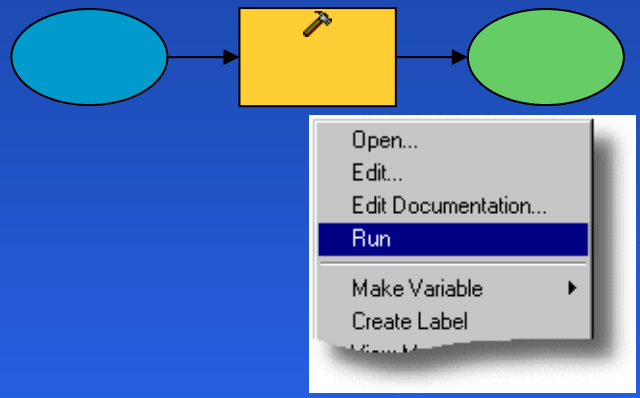


All elements have context menus

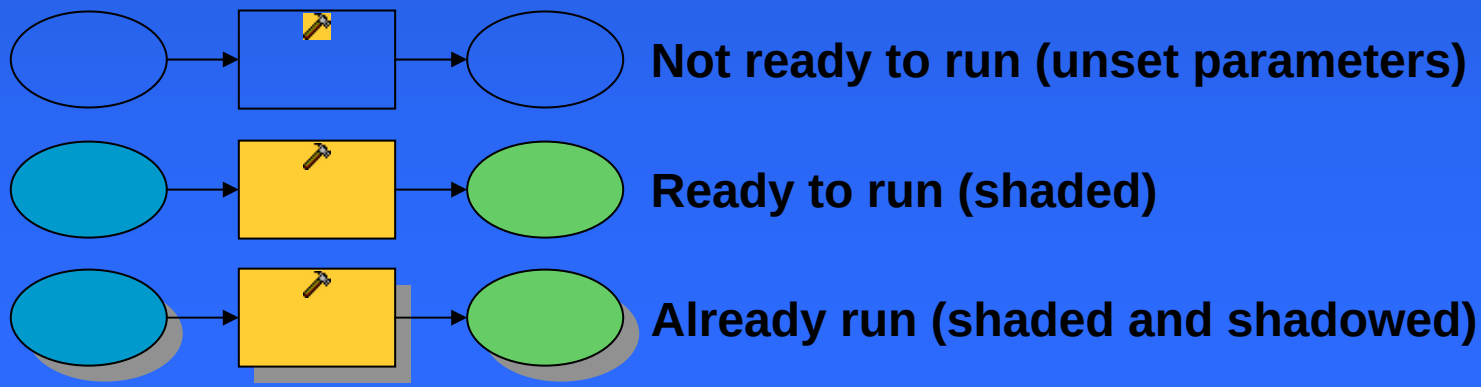
Running a model

- Run from ArcToolbox like other tools
- Run in the ModelBuilder window—all or one process





  - Three states of a process:



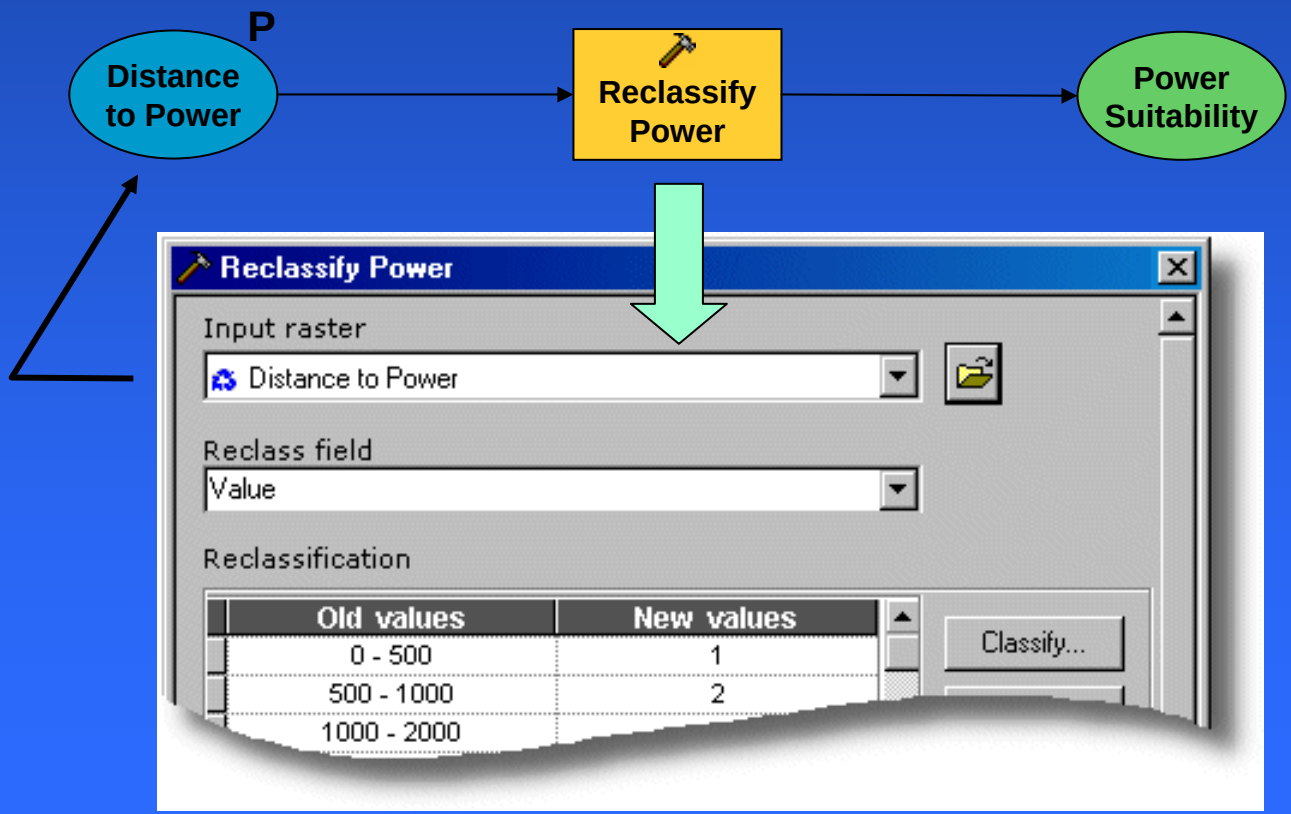
Not ready to run (unset parameters)

Ready to run (shaded)

Already run (shaded and shadowed)

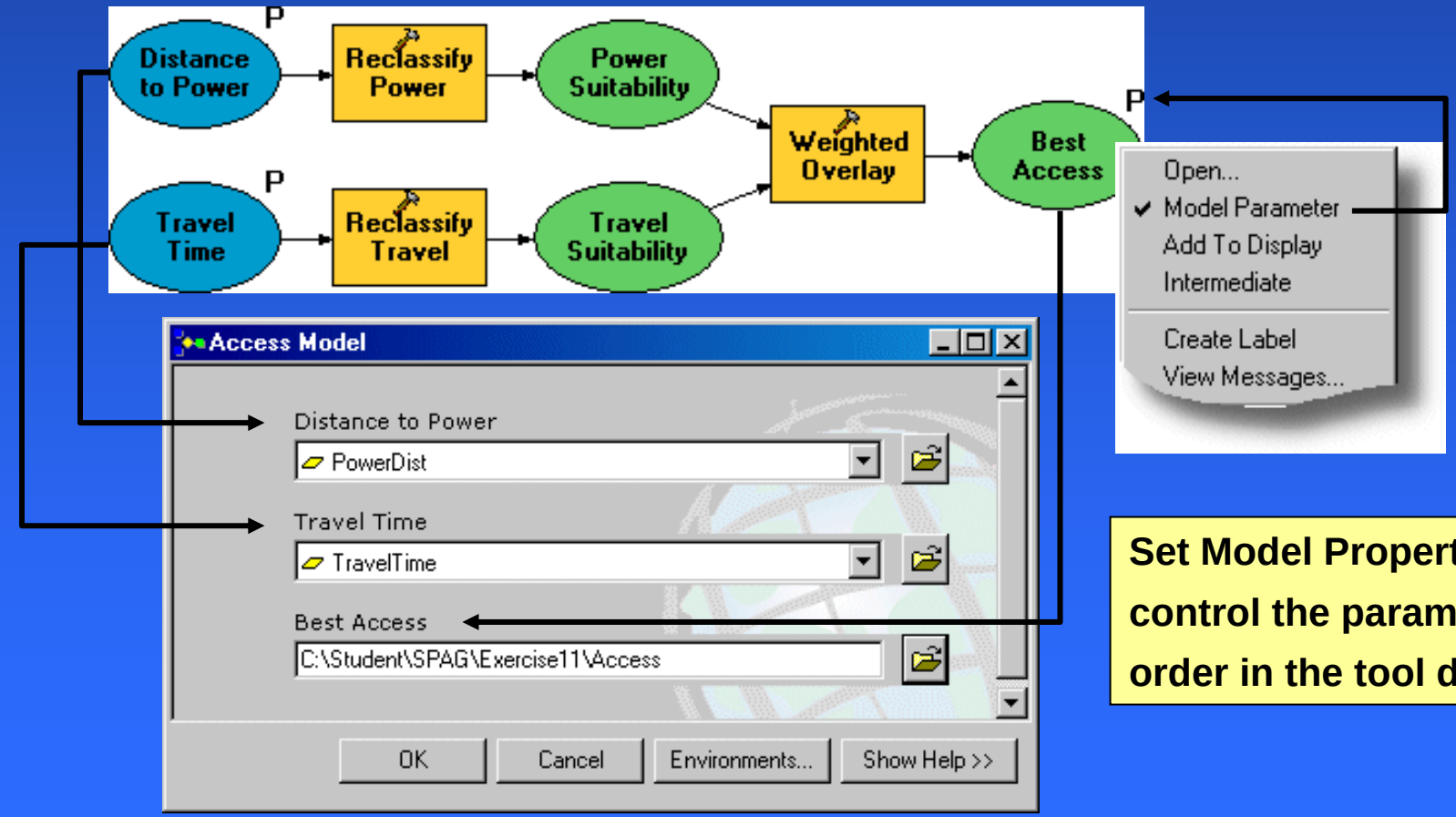
Setting tool parameters

- Open the standard tool dialog
  - Double-click the tool or choose Open from the context menu



Setting model parameters

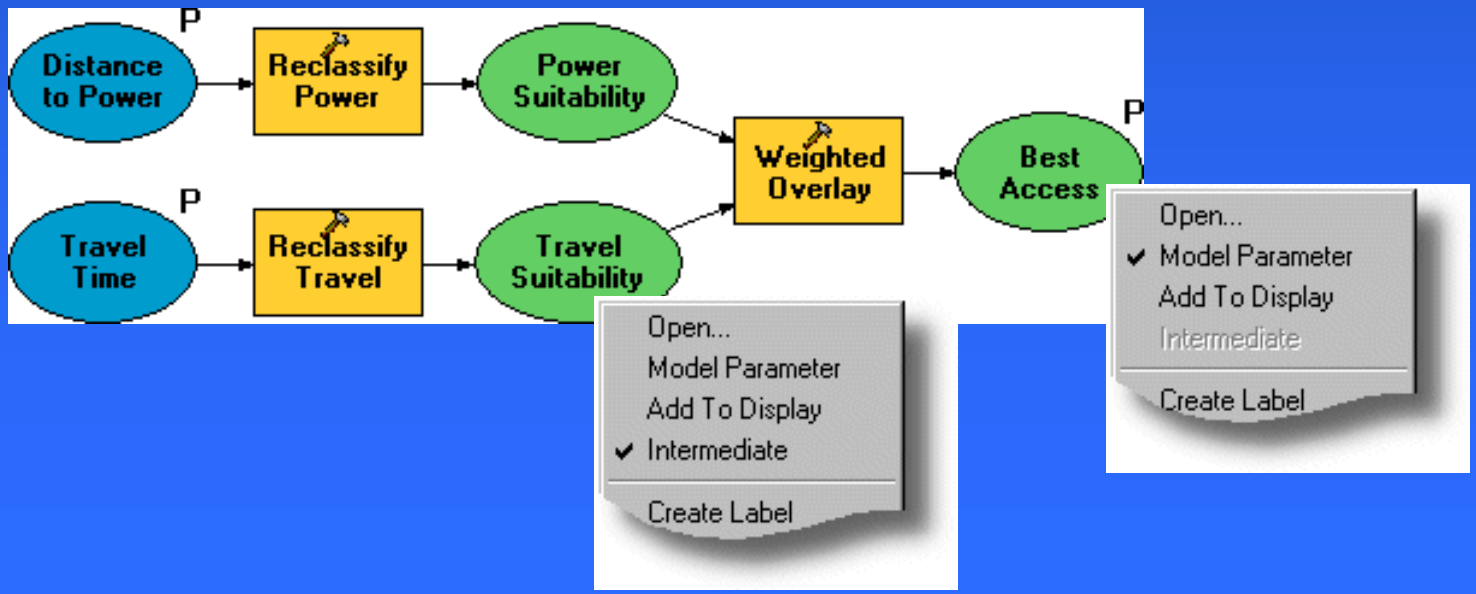
- Mark data as a parameter; appears in the model dialog



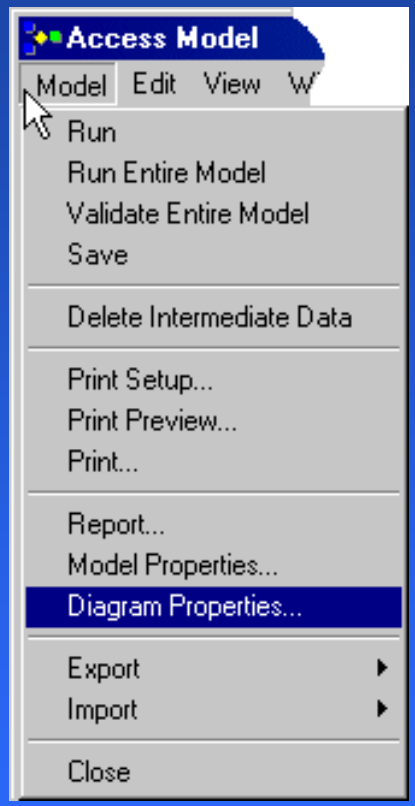
Set Model Properties to control the parameter order in the tool dialog

Setting derived data properties

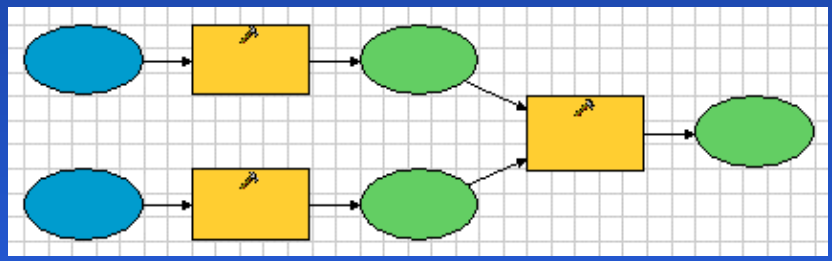
- Control how derived data is handled
  - Intermediate: Temporary (auto-delete … or not)
  - Add to Display: Add to ArcMap Table of Contents
  - Model Parameter: Add to ArcMap and permanent



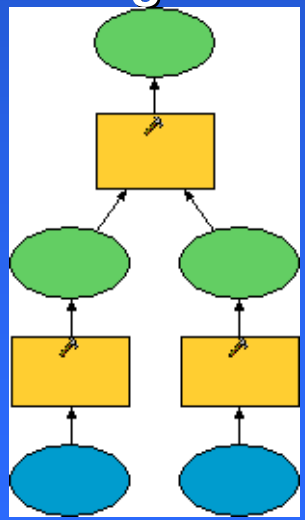
Setting diagram properties



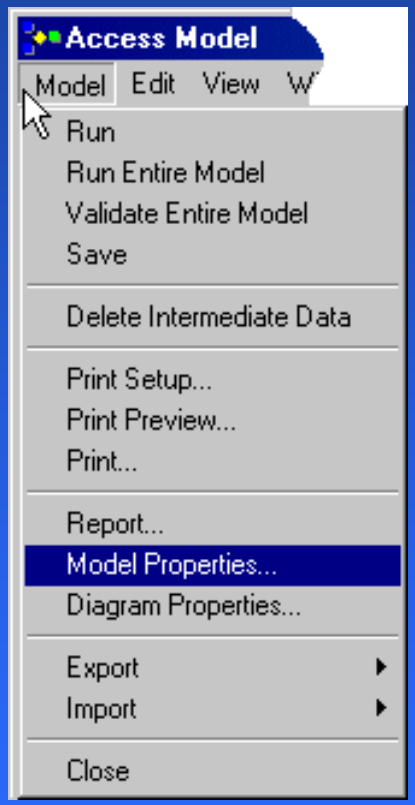
- Set Manual or Automatic layout mode
- Turn snapping grid on or off



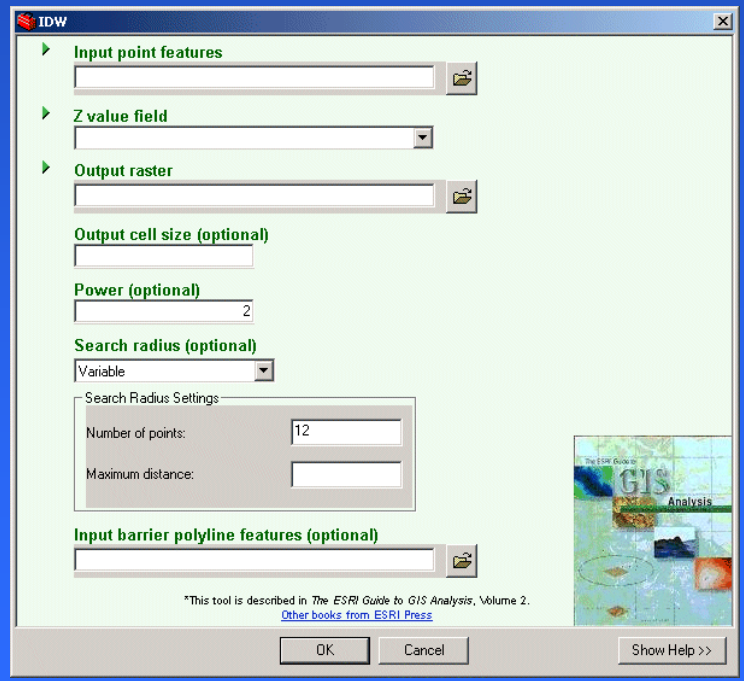
- Control Auto Layout tool settings
  - Orientation
  - Element spacing
  - Layout quality
  - Connector routing
  - More …



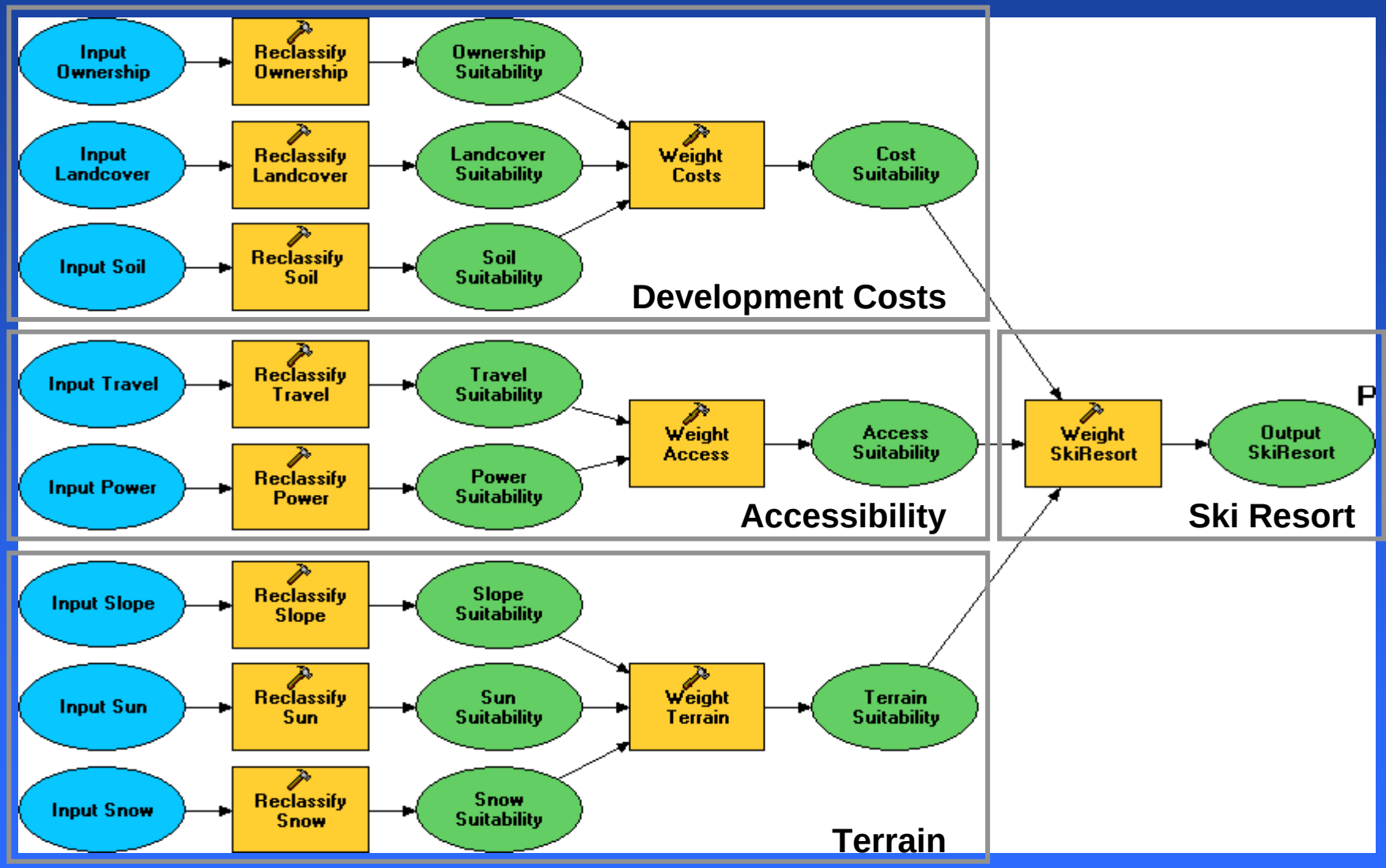
Setting model properties



- Set Name, Label, Description
- Set Parameters order
- Set Environments (local to model)
- Set Help file (HTML)
- Set Stylesheet (XSL)

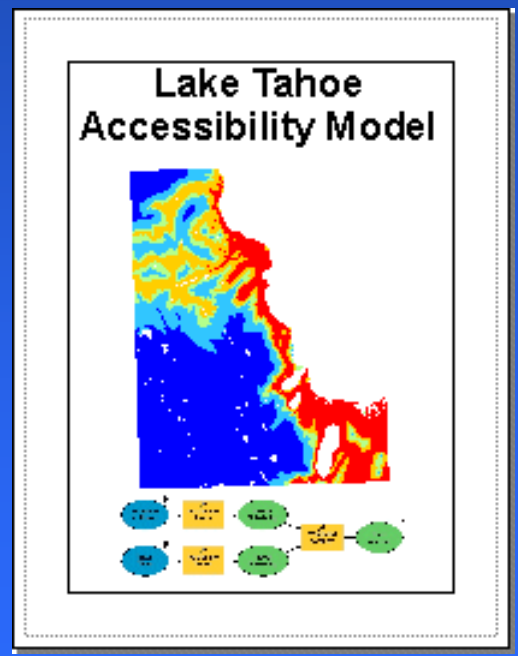


Ski Resort model



Saving, exporting, and printing a model

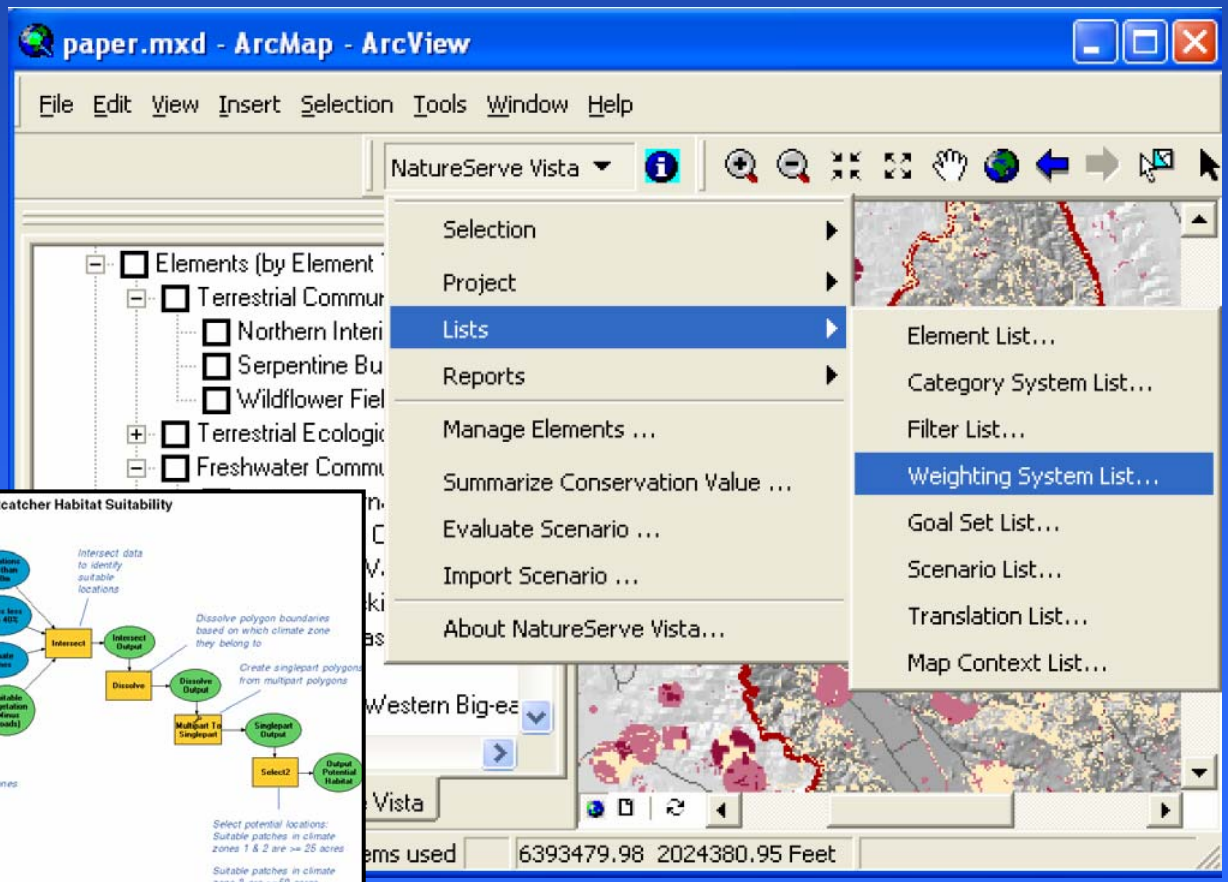
- Model is saved to a TBX file or a geodatabase
  - Share TBX or geodatabase with others
- Export models
  - To a graphic: BMP, JPG, EMF (may add to ArcMap layouts)
  - To a script: Python, JScript, VBScript (quick way to learn scripting)
- Print models
  - With borders, captions, page numbers
- Generate reports
  - List data, all tool parameters, and so on

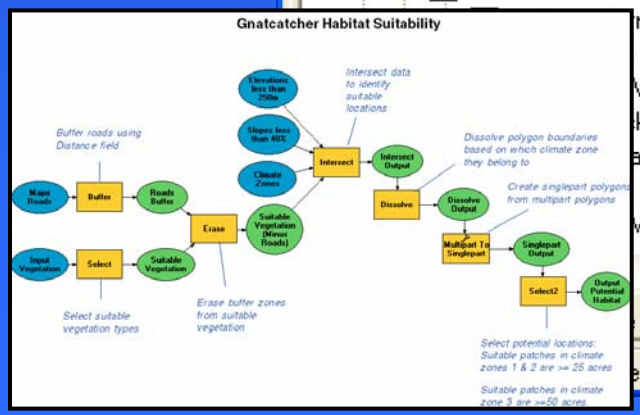


Examples

Integrating biodiversity information into planning processes

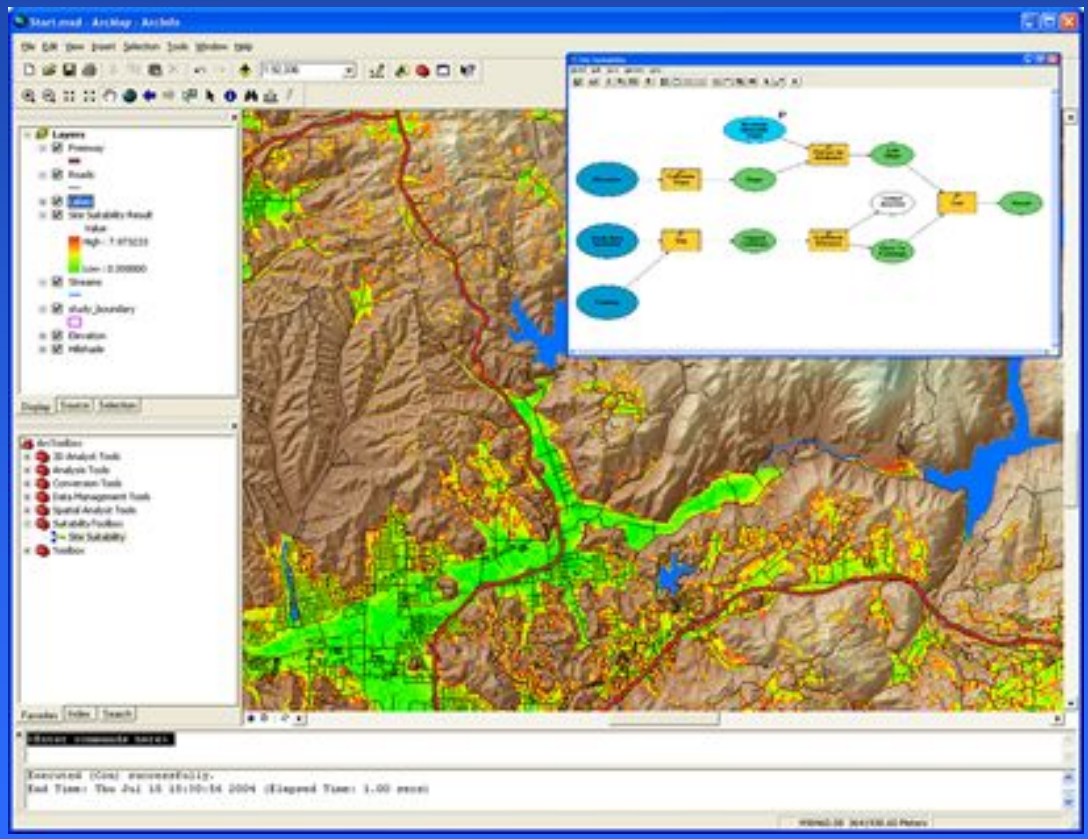
NatureServe Vista





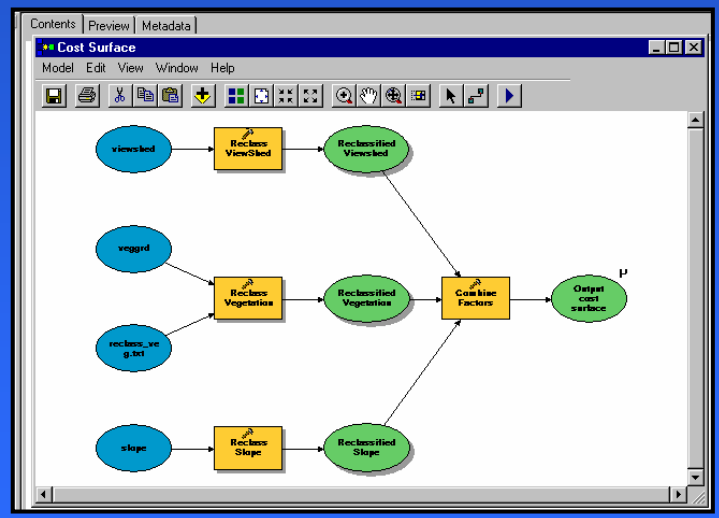
By NatureServe. (www.natureserve.org)

Hierarchical models for open space protection/programs



By Trust For Public Lands . (www.tpl.org)

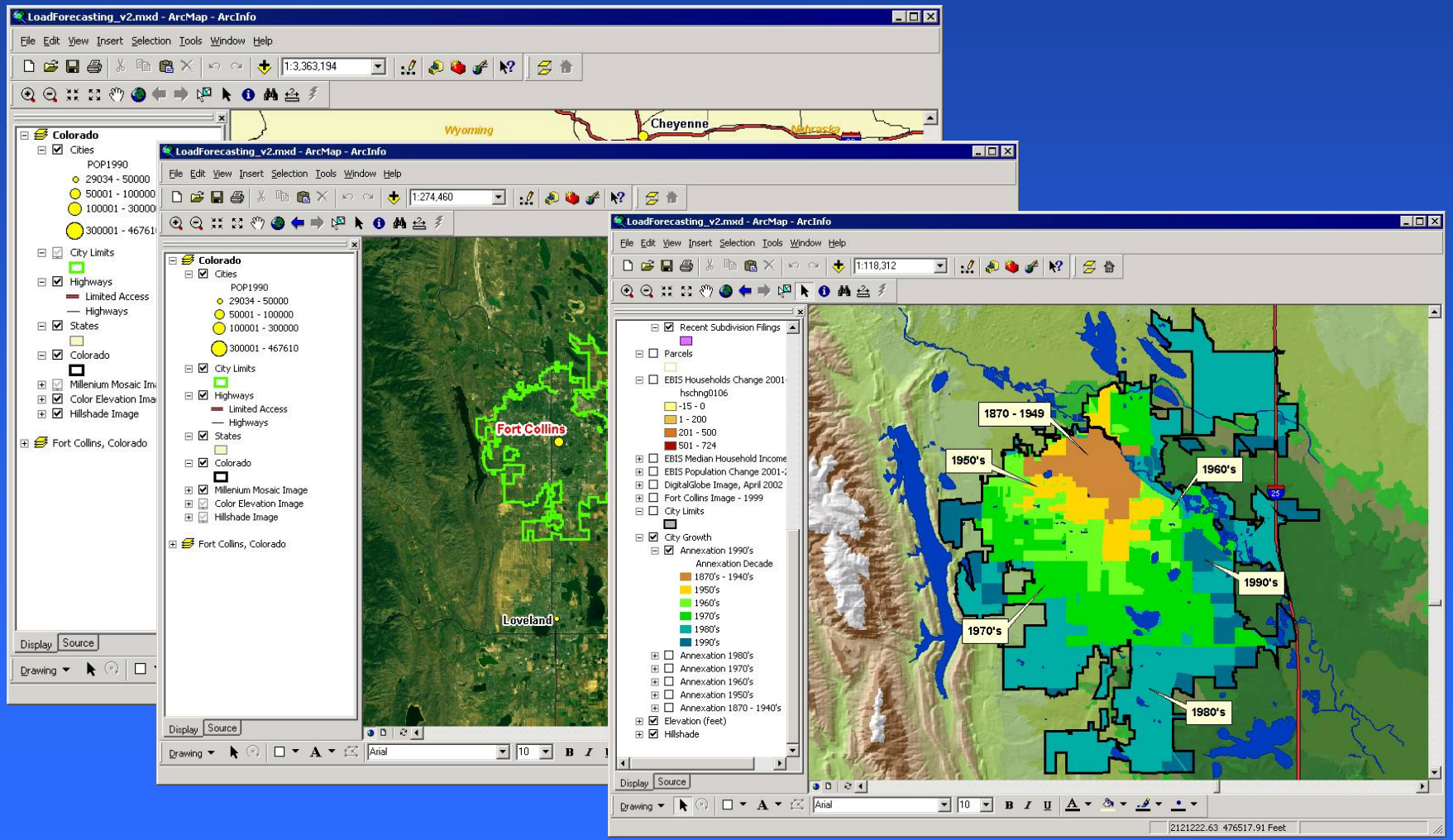
Water Demand Prediction Models



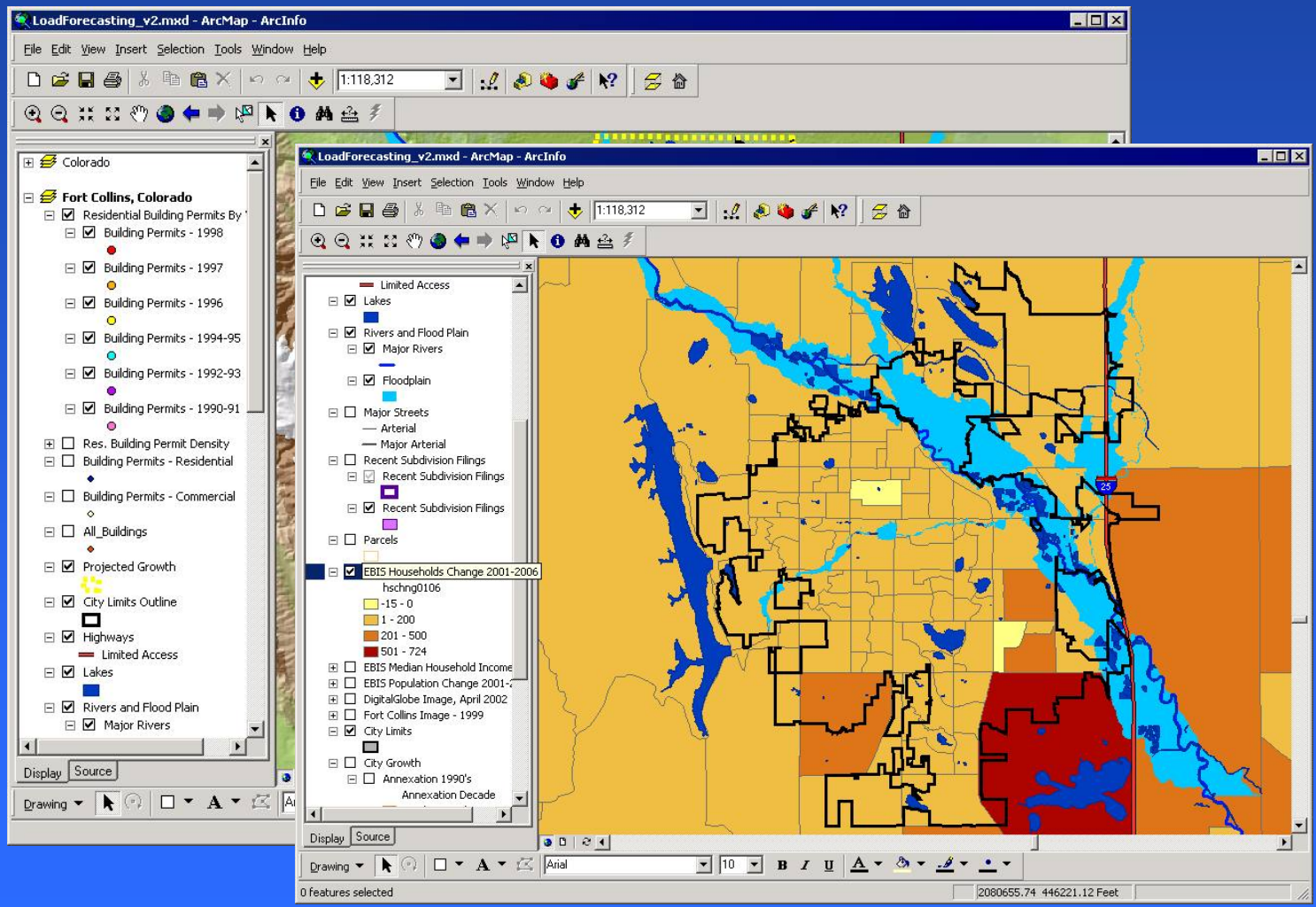
Being developed by (http://www.envisionutah.org/)

ModelBuilder Demo

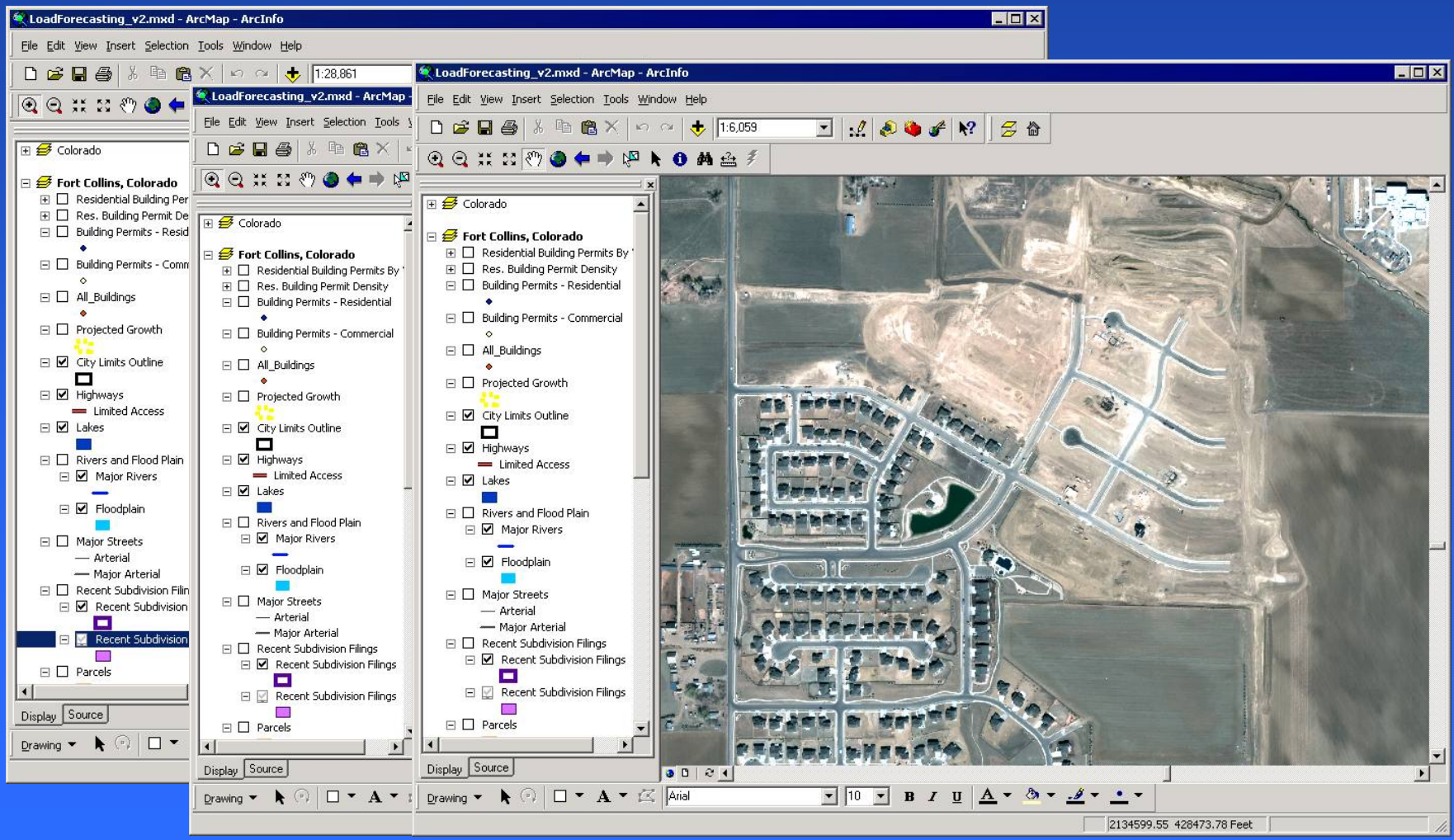
Utility Load Forecasting / Urban Growth Modeling



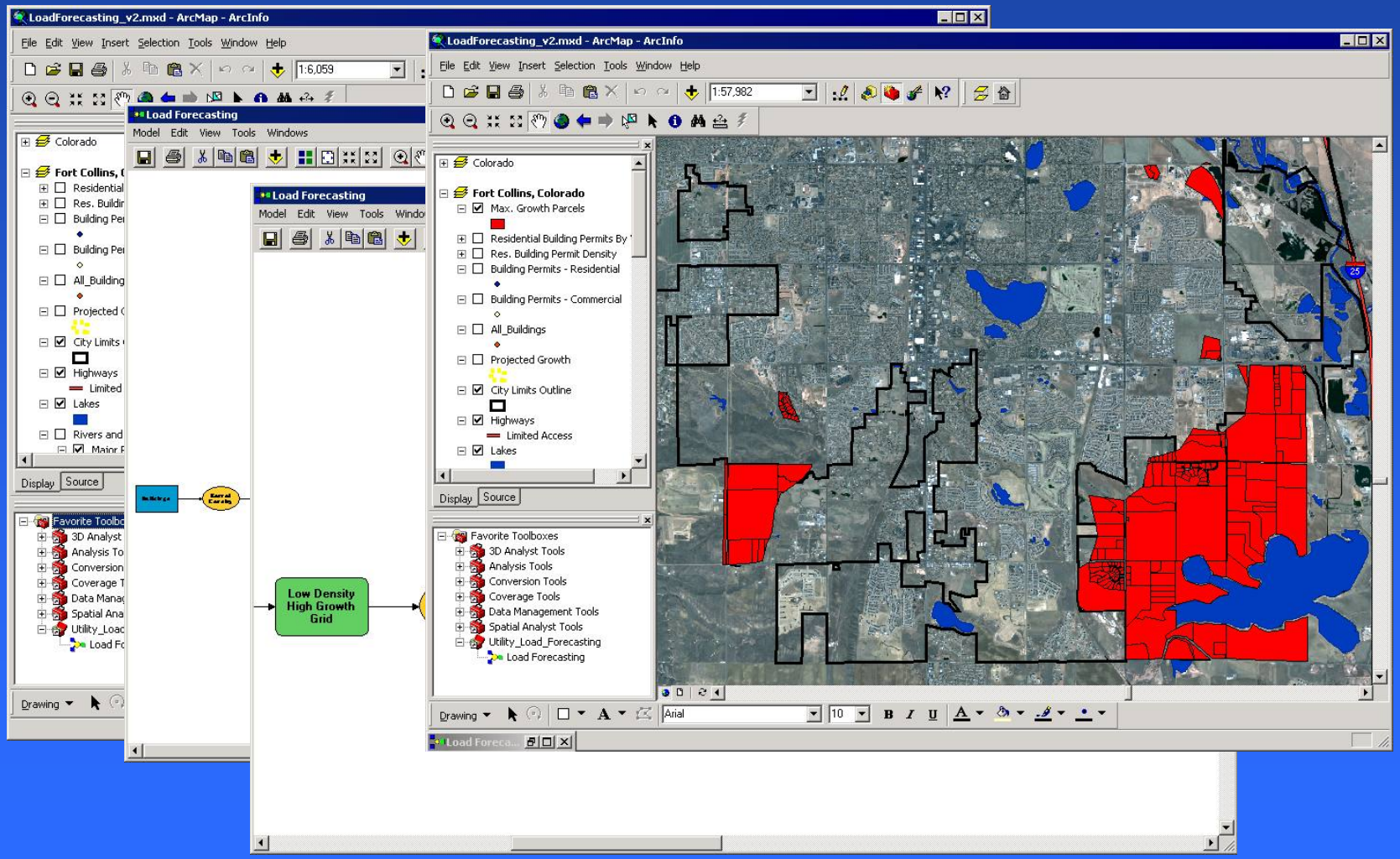
Utility Load Forecasting / Growth Modeling



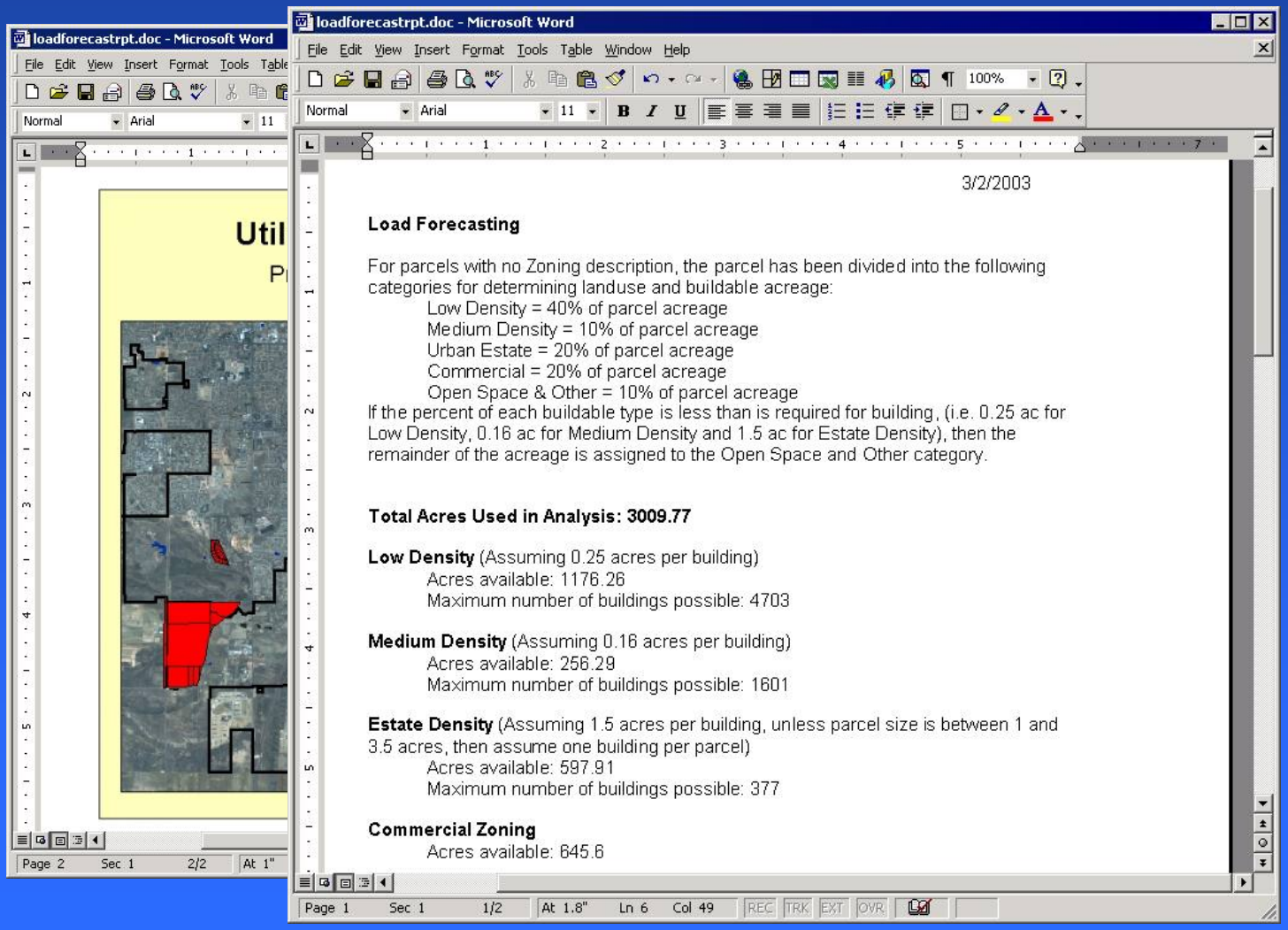
Utility Load Forecasting / Growth Modeling



Utility Load Forecasting / Growth Modeling



Utility Load Forecasting / Growth Modeling

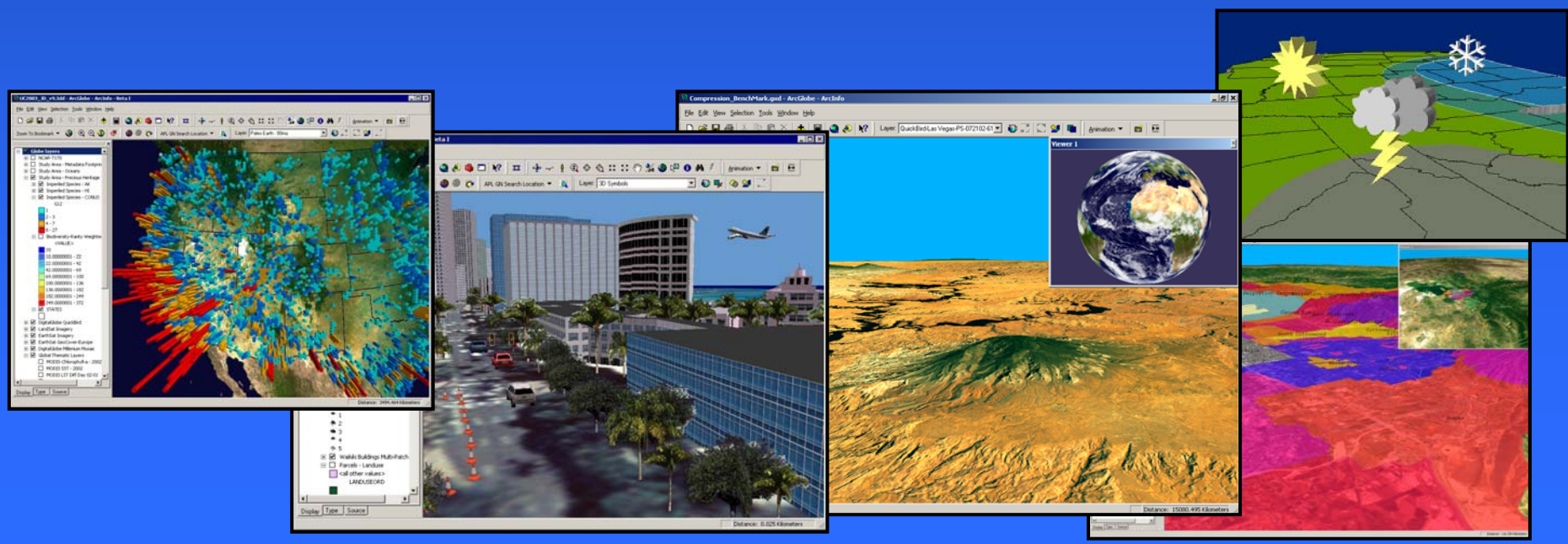


Global and 3D Visualization

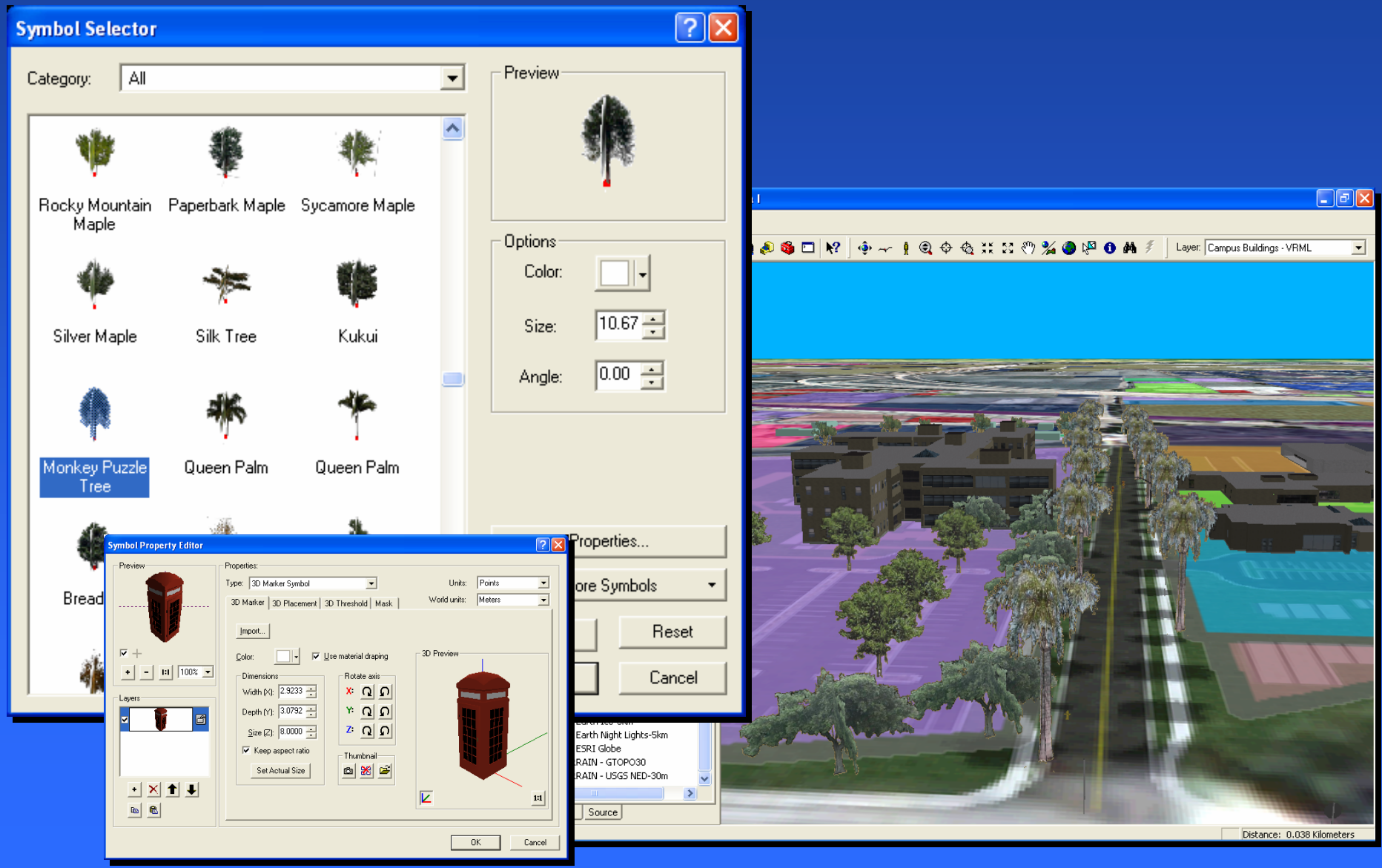
ESRI ArcGIS™

ArcGIS 3D Analyst

- Perspective visualization of data for analysis and communication
- Supports all GIS data types
- Includes symbol library, import tools, and 150 m global imagery

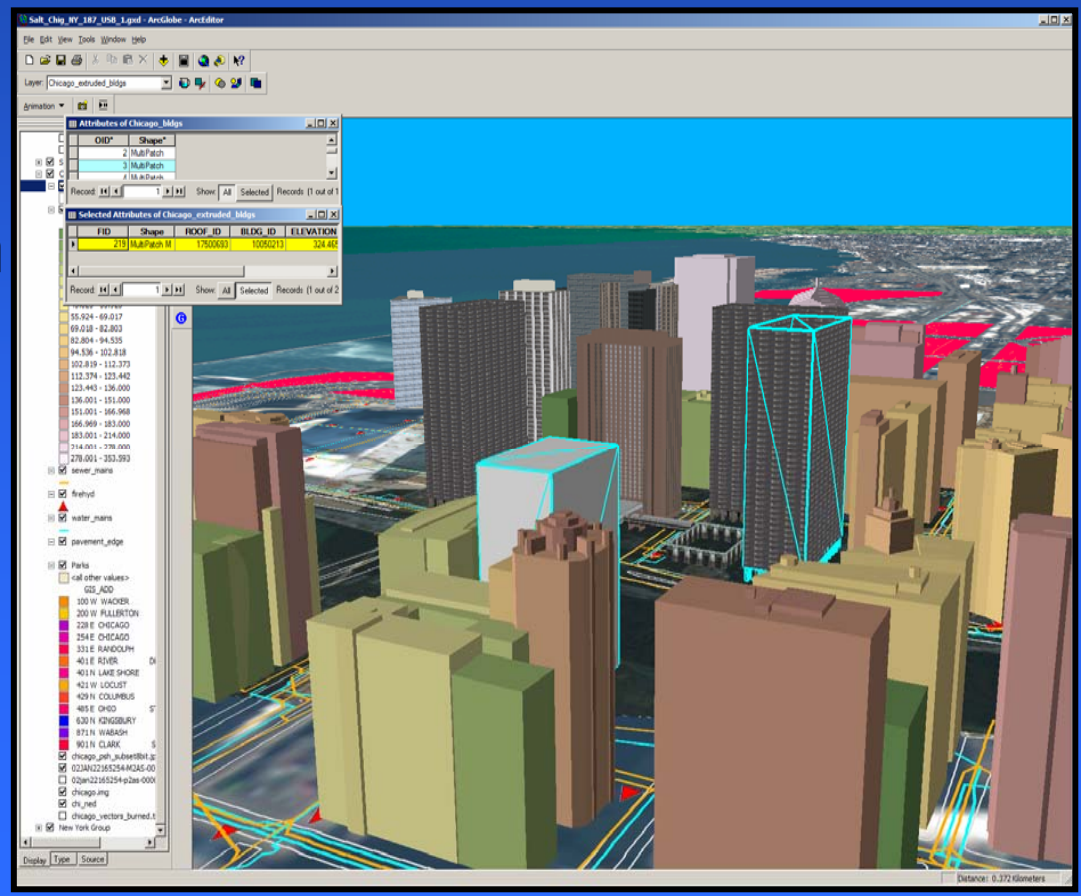


3D Symbols


Symbol Selector
Category:
All
Preview
Options
Color:
Size:
10.67
Angle:
0.00
Rocky Mountain Maple
Paperbark Maple
Sycamore Maple
Silver Maple
Silk Tree
Kukui
Monkey Puzzle Tree
Queen Palm
Queen Palm
Properties...
Reset
Cancel
Symbol Property Editor
Preview
Properties:
Type:
3D Marker Symbol
Units:
Points
World units:
Meters
3D Marker
3D Placement
3D Threshold
Mask
Import...
Color:
Use material draping
3D Preview
Dimensions
Width (X):
2.9233
Depth (Y):
3.0792
Size (Z):
8.0000
Keep aspect ratio
Set Actual Size
Rotate axis
Thumbnail
Layers
100%
OK
Cancel
Layer:
Campus Buildings - VRML
Earth Night Lights-5km
ESRI Globe
RAIN - GTOPO30
RAIN - USGS NED-30m
Source
Distance: 0.038 Kilometers

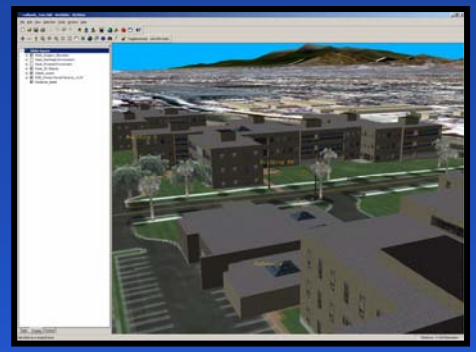
3D Features

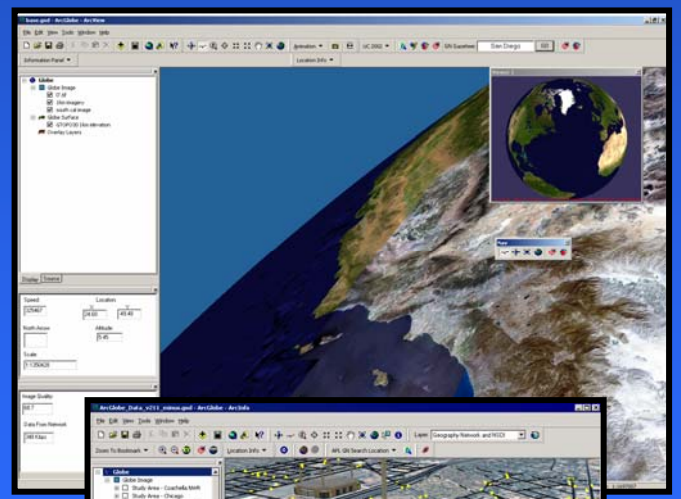
- 3D Features Coordinates (x, y, z or x, y, z, m)
- Multipatch geometry (solids) with textures in the shape column



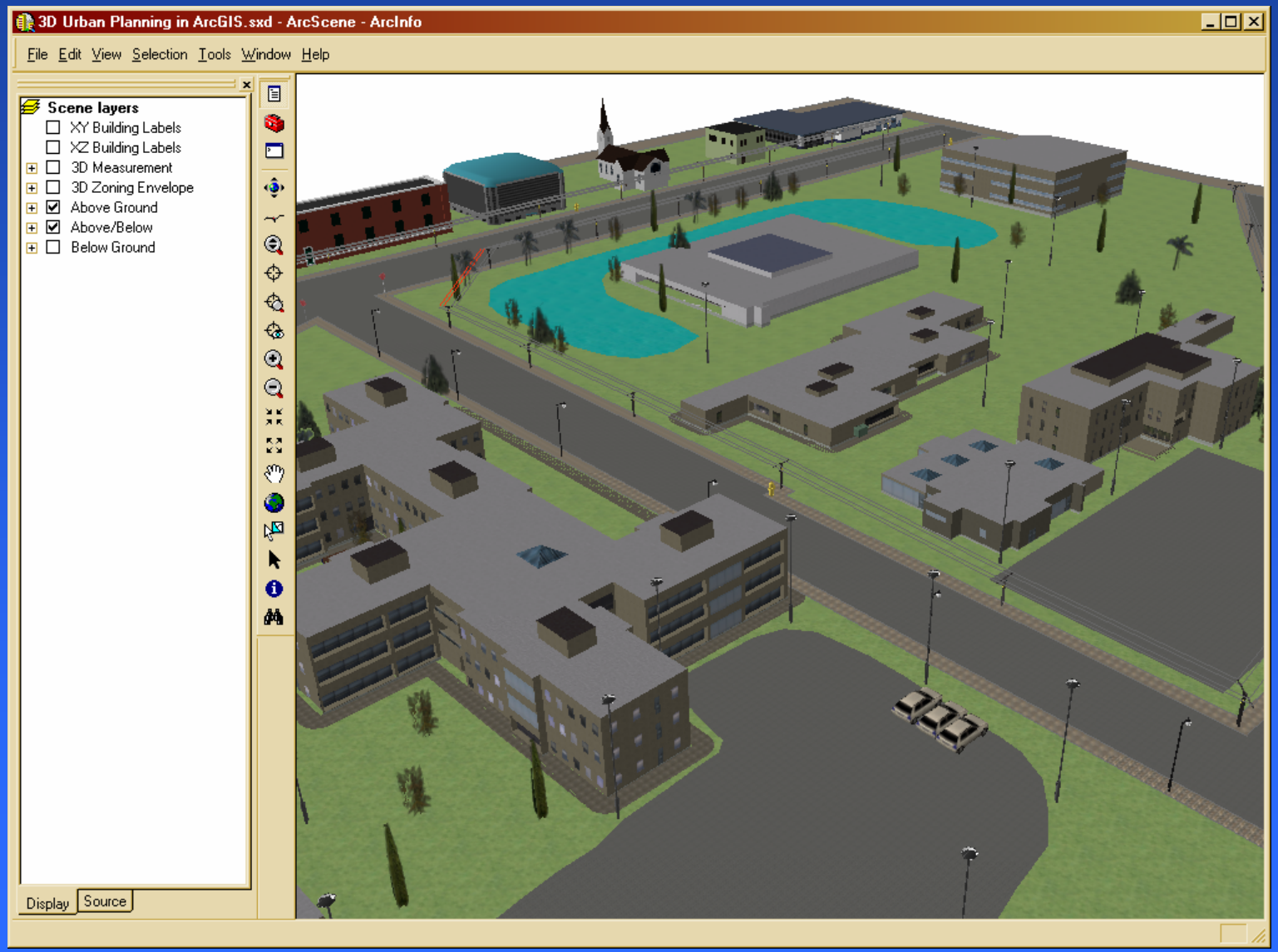
ArcGIS 3D Analyst Featuring ArcGlobe

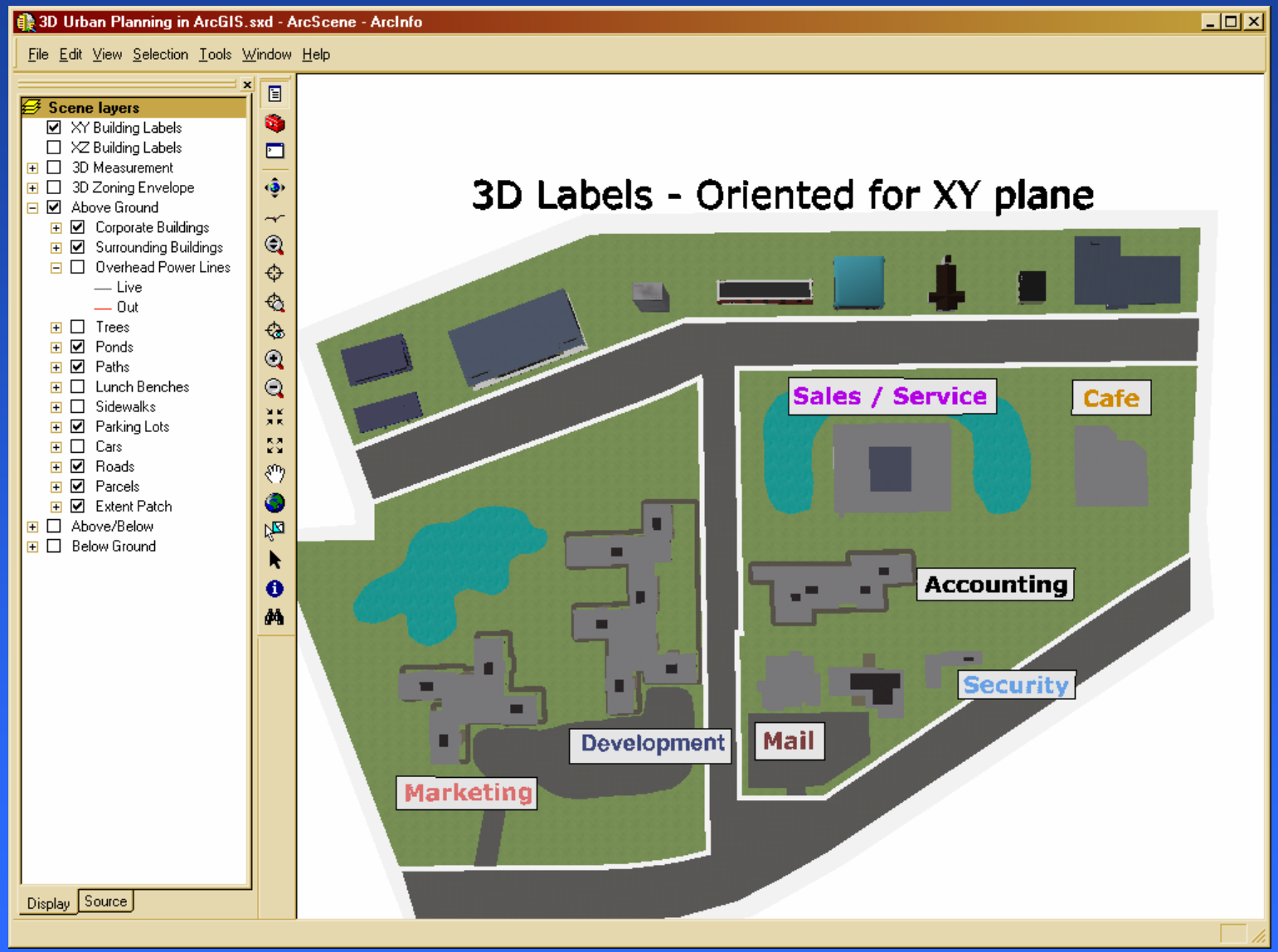
- High performance, continuous pan and zoom
- Real-time, multiresolution data access for easy data exploration
- Supports all GIS data types including terrain, raster, and vector
- Includes global base data





ArcGIS 3D Analyst for Urban and Site Design




3D Urban Planning in ArcGIS.sxd - ArcScene - ArcInfo
File Edit View Selection Tools Window Help
Scene layers
XY Building Labels
XZ Building Labels
3D Measurement
3D Zoning Envelope
Above Ground
Corporate Buildings
Surrounding Buildings
Overhead Power Lines
Live
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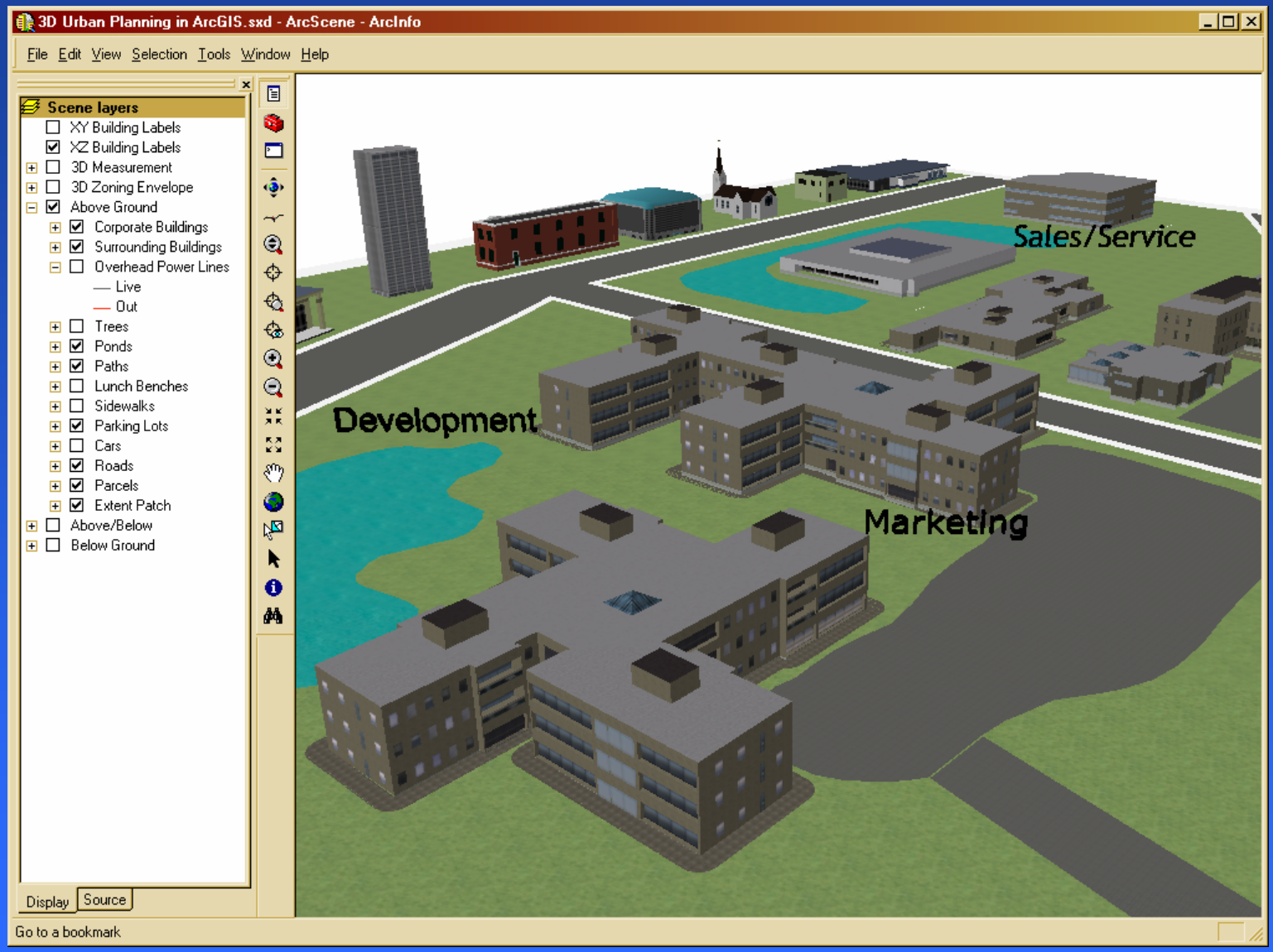
Trees
Ponds
Paths
Lunch Benches
Sidewalks
Parking Lots
Cars
Roads
Parcels
Extent Patch
Above/Below
Below Ground
Display
Source
3D Labels - Oriented for XY plane
Sales / Service
Cafe
Accounting
Security
Mail
Development
Marketing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Below Ground
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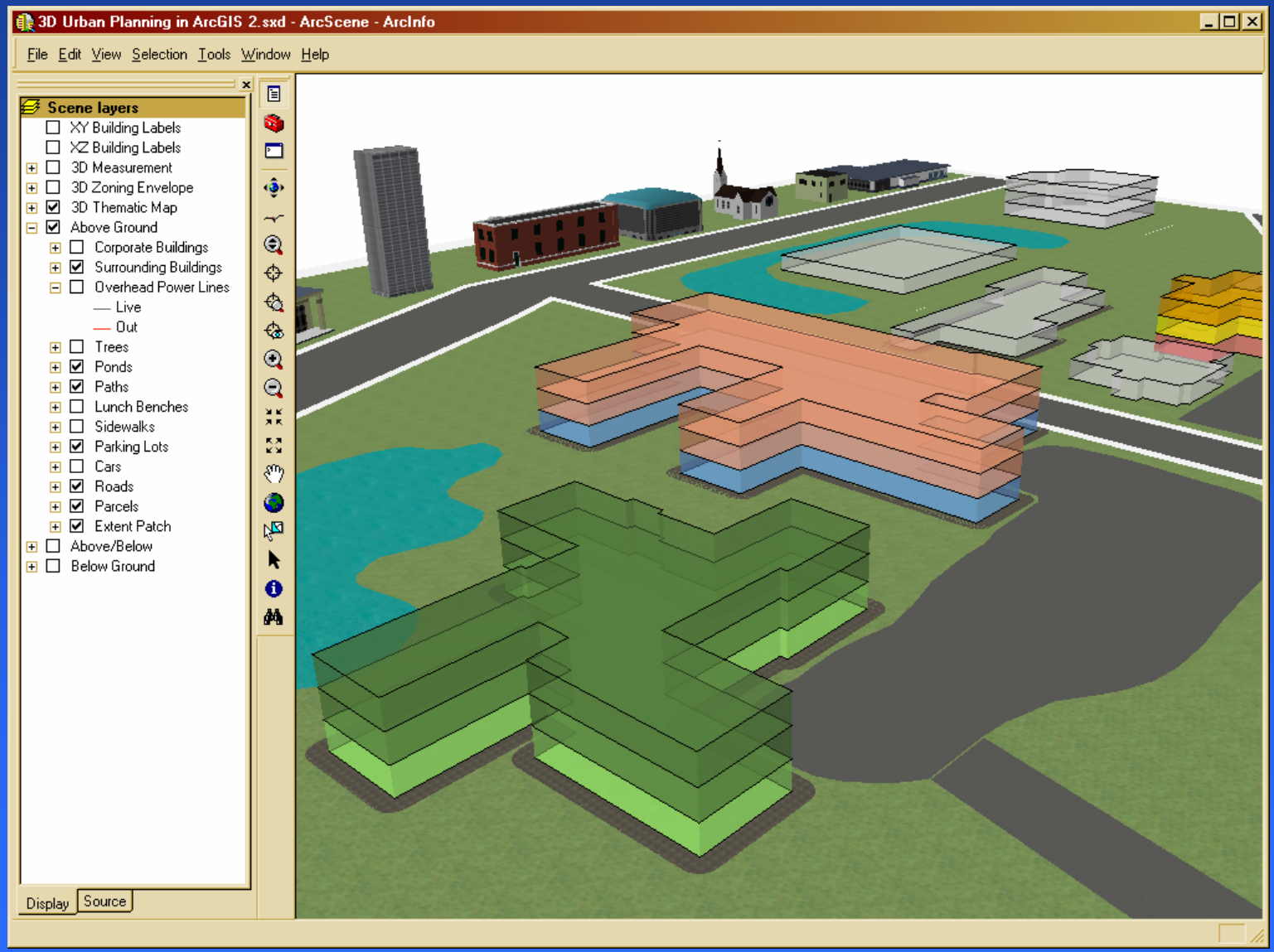
Sales/Service
Development
Marketing
Go to a bookmark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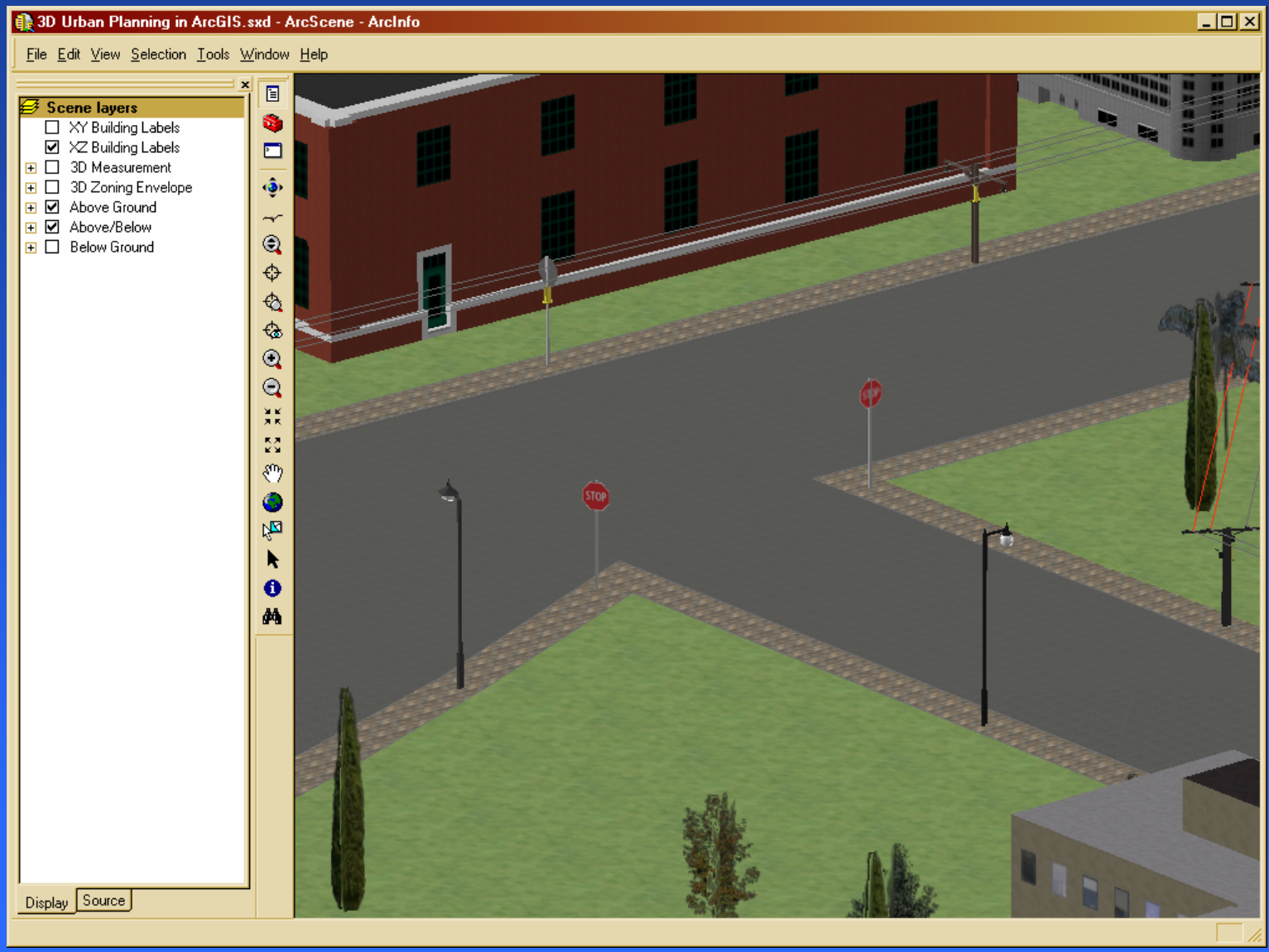
3D Urban Planning in ArcGIS.sxd - ArcScene - ArcInfo
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3D Zoning Envelope
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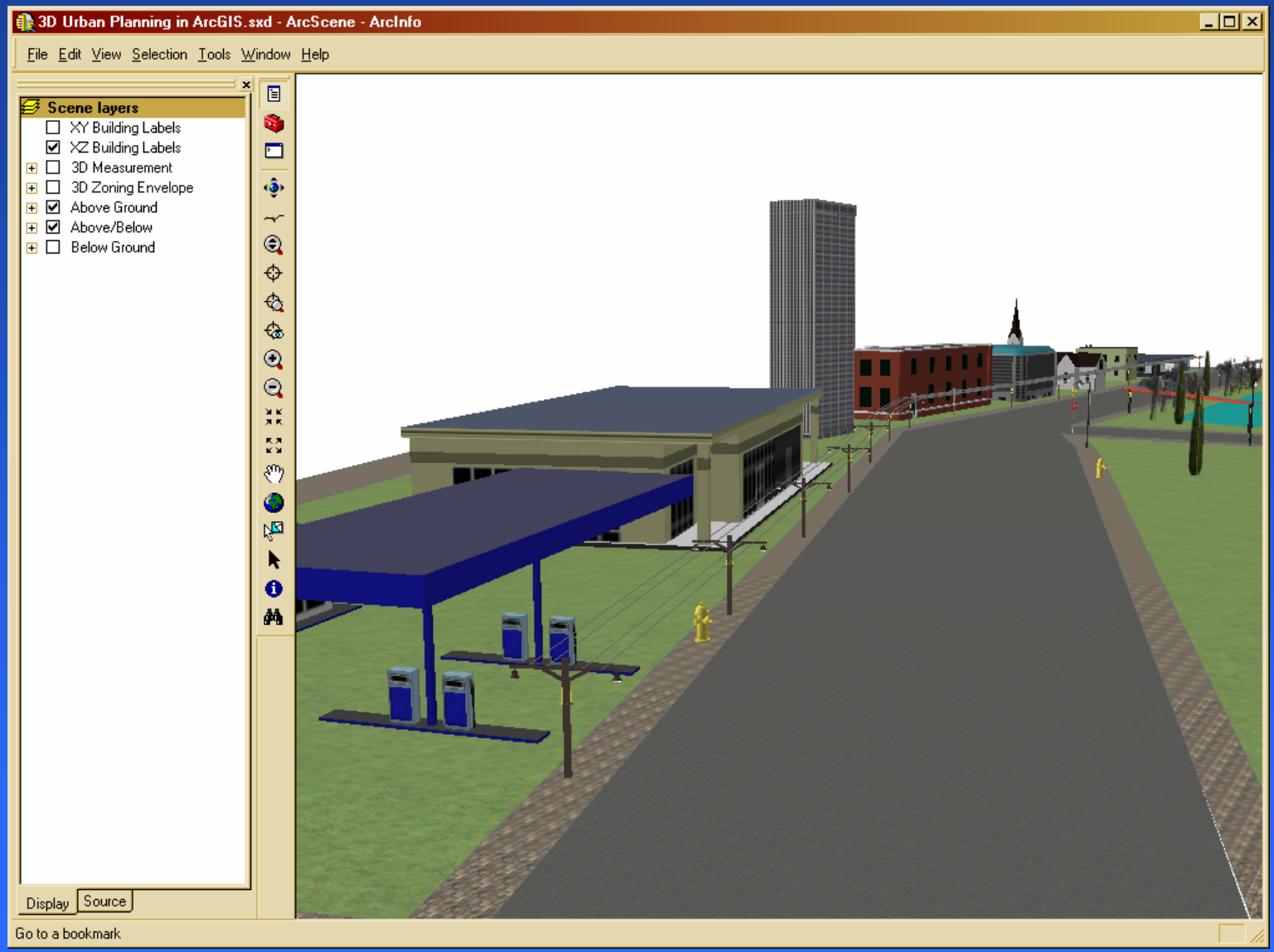
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3D Zoning Envelope
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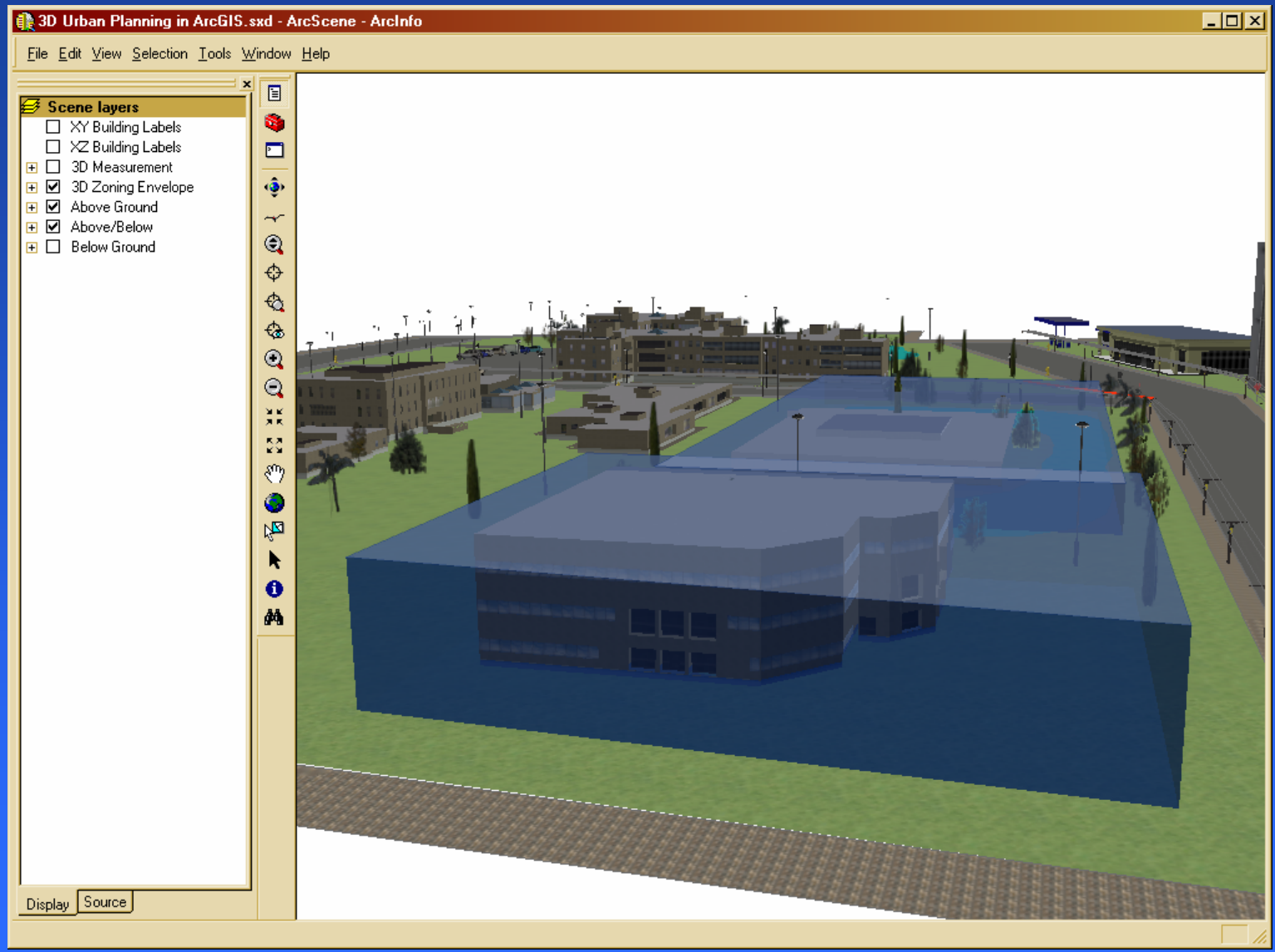
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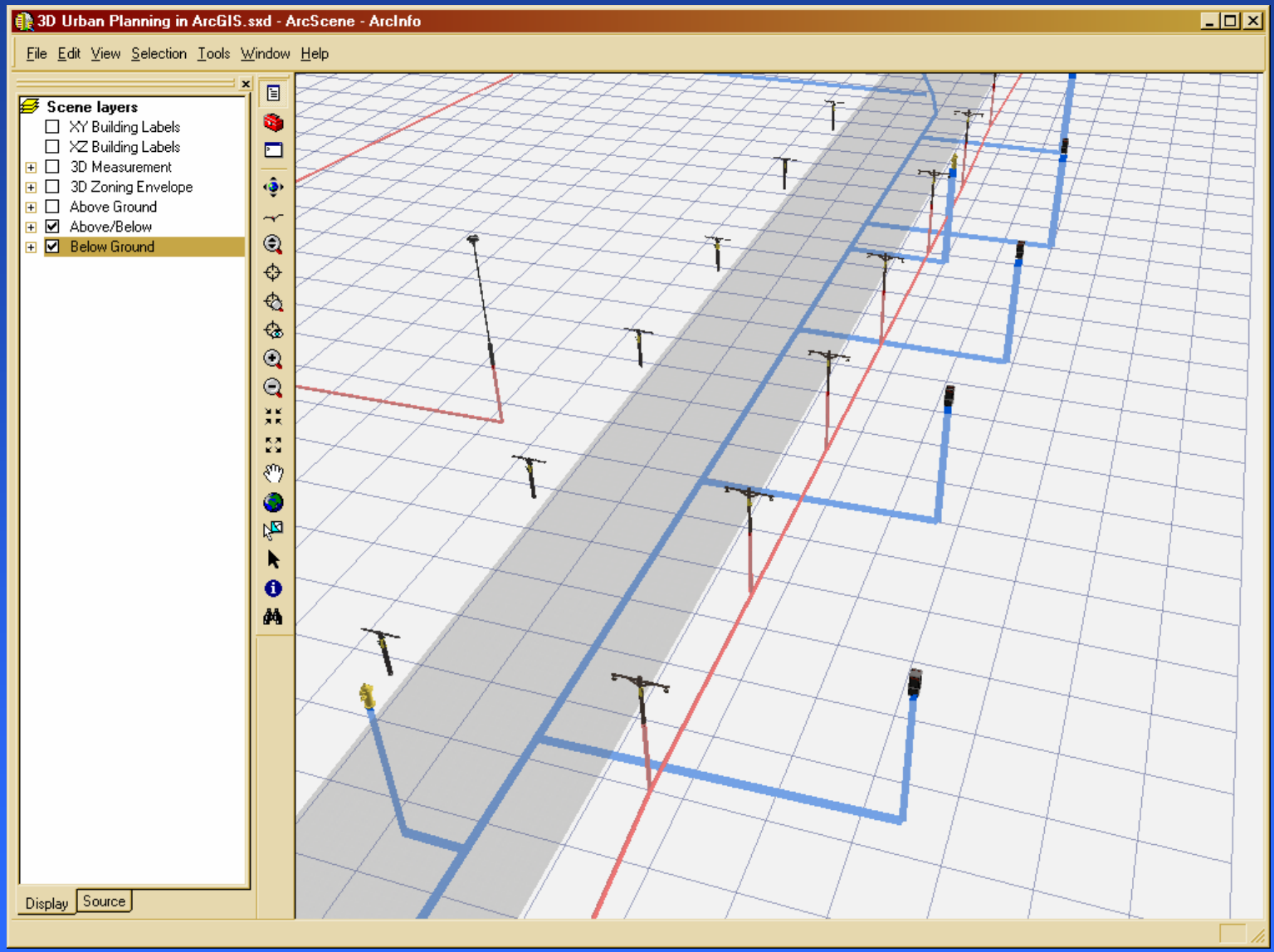
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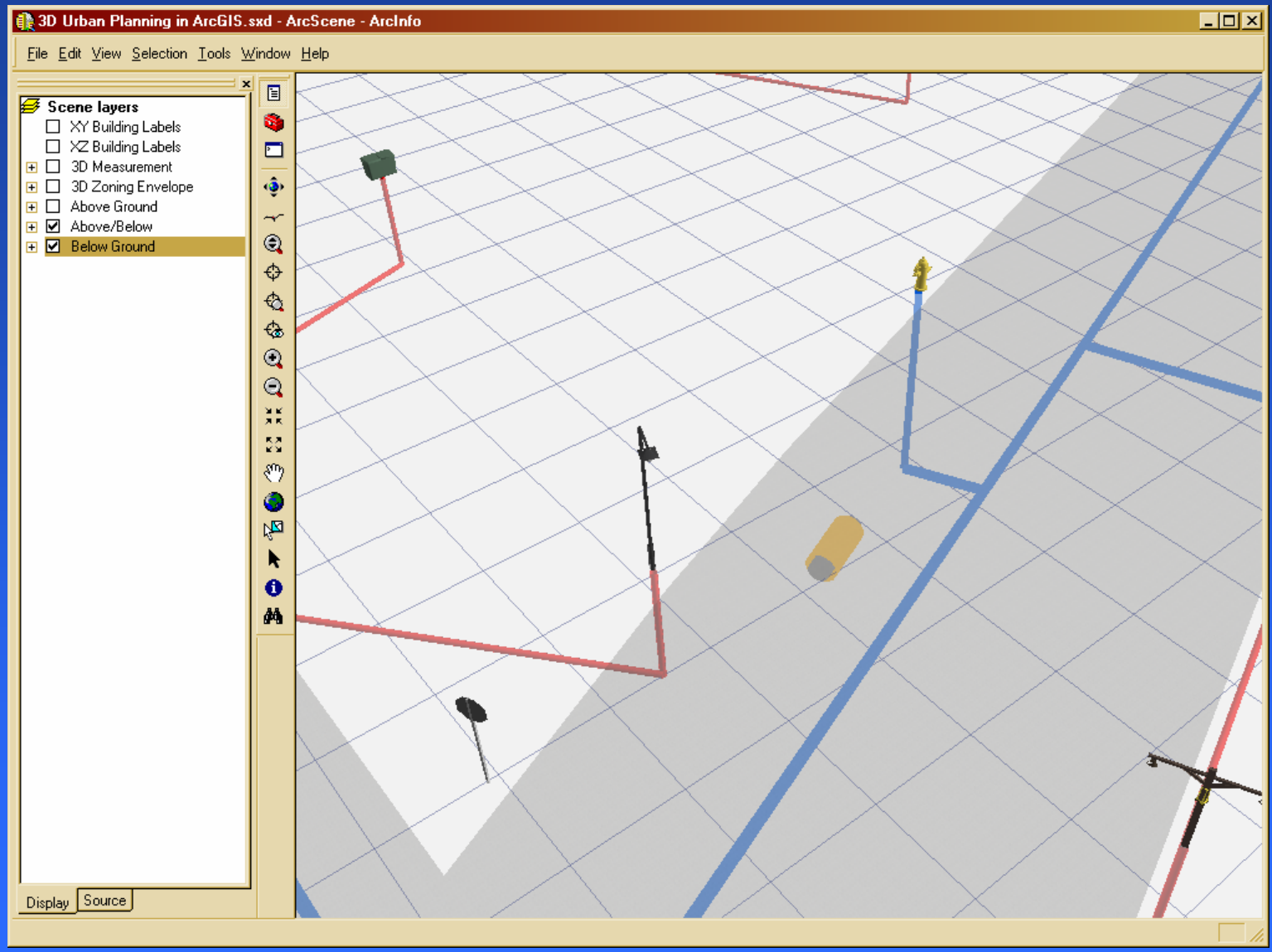
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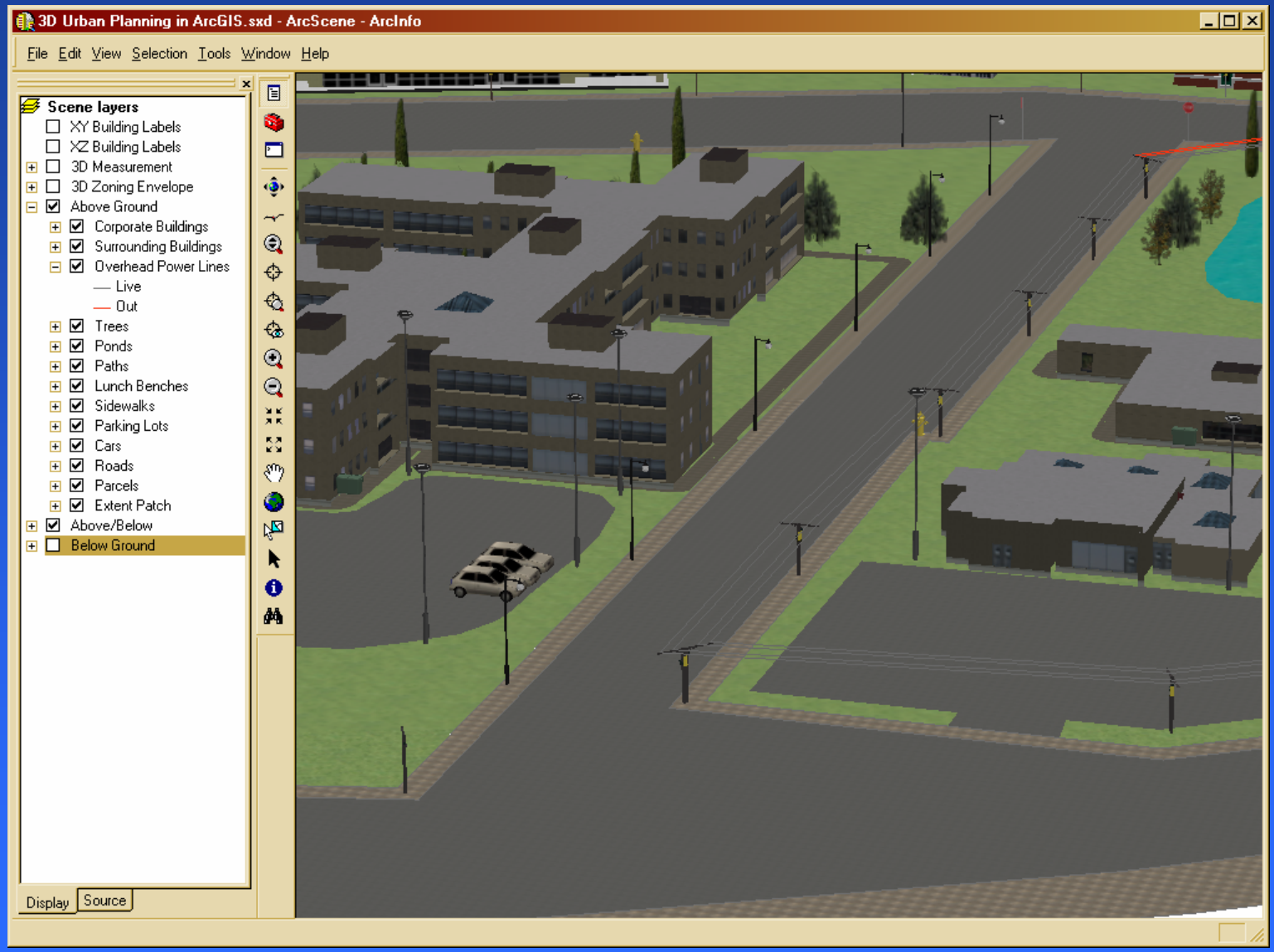
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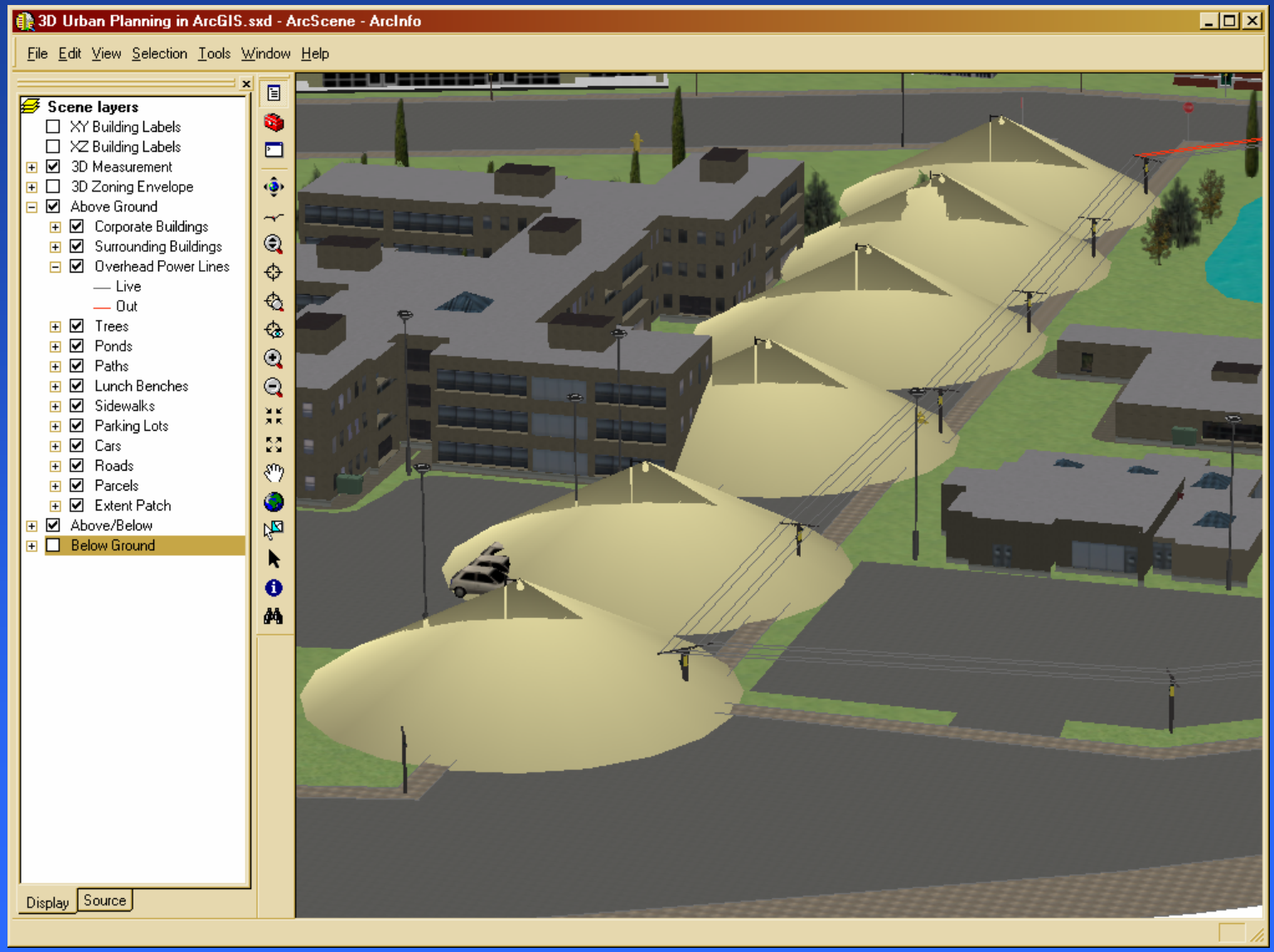
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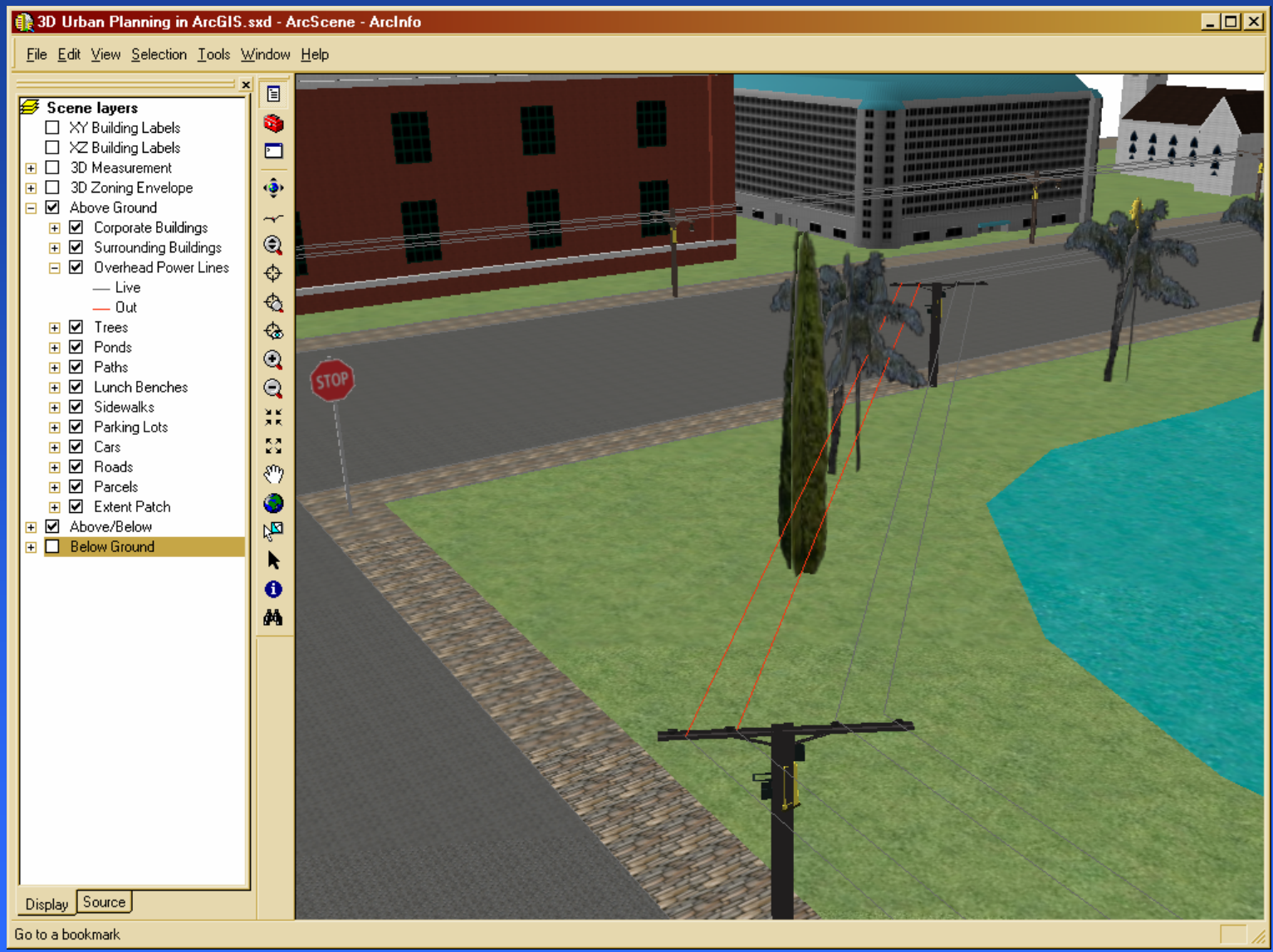
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Below Ground
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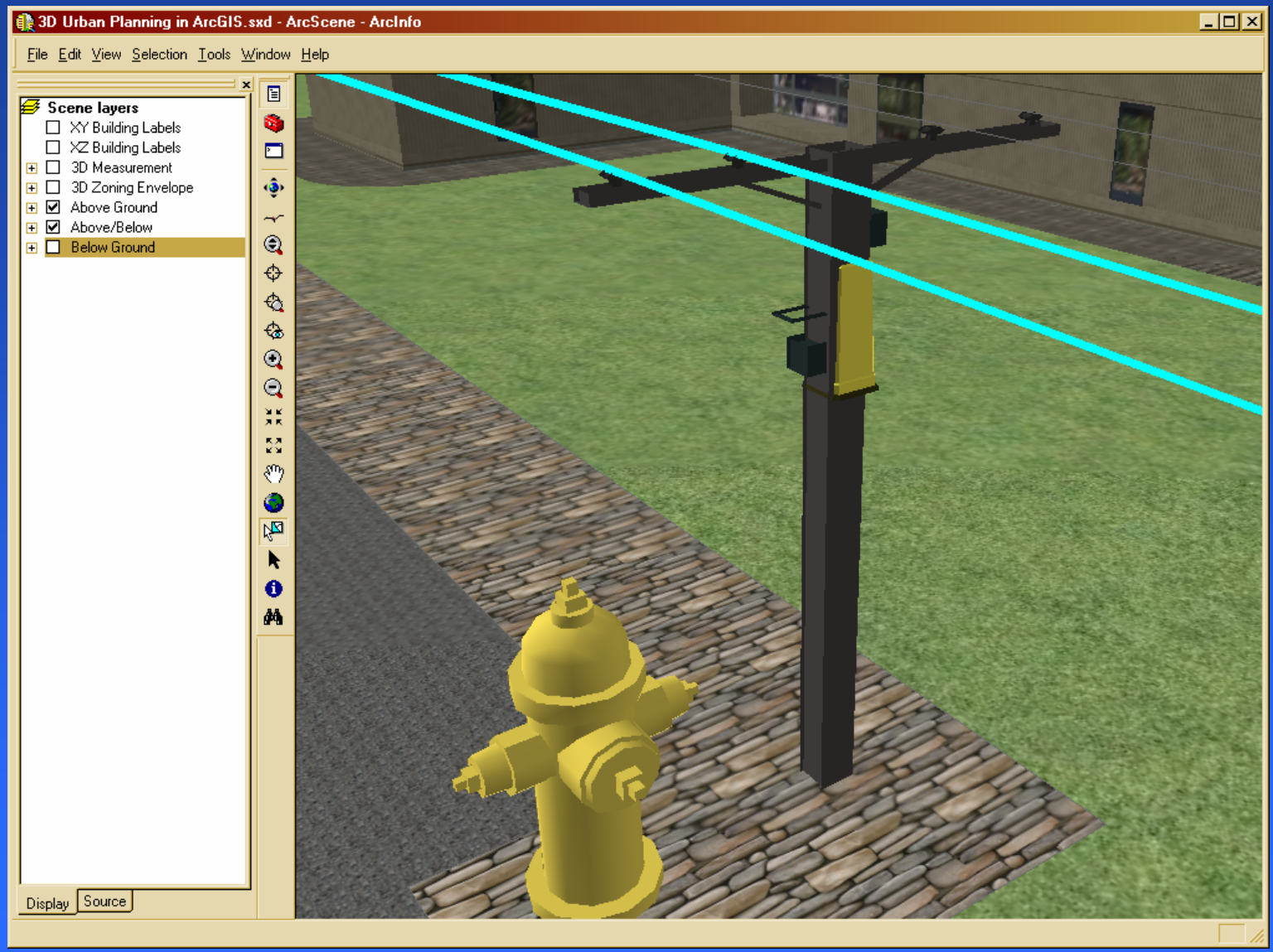
STOP
Go to a bookmark


3D Urban Planning in ArcGIS.sxd - ArcScene - ArcInfo
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XZ Building Labels
3D Measurement
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Below Ground
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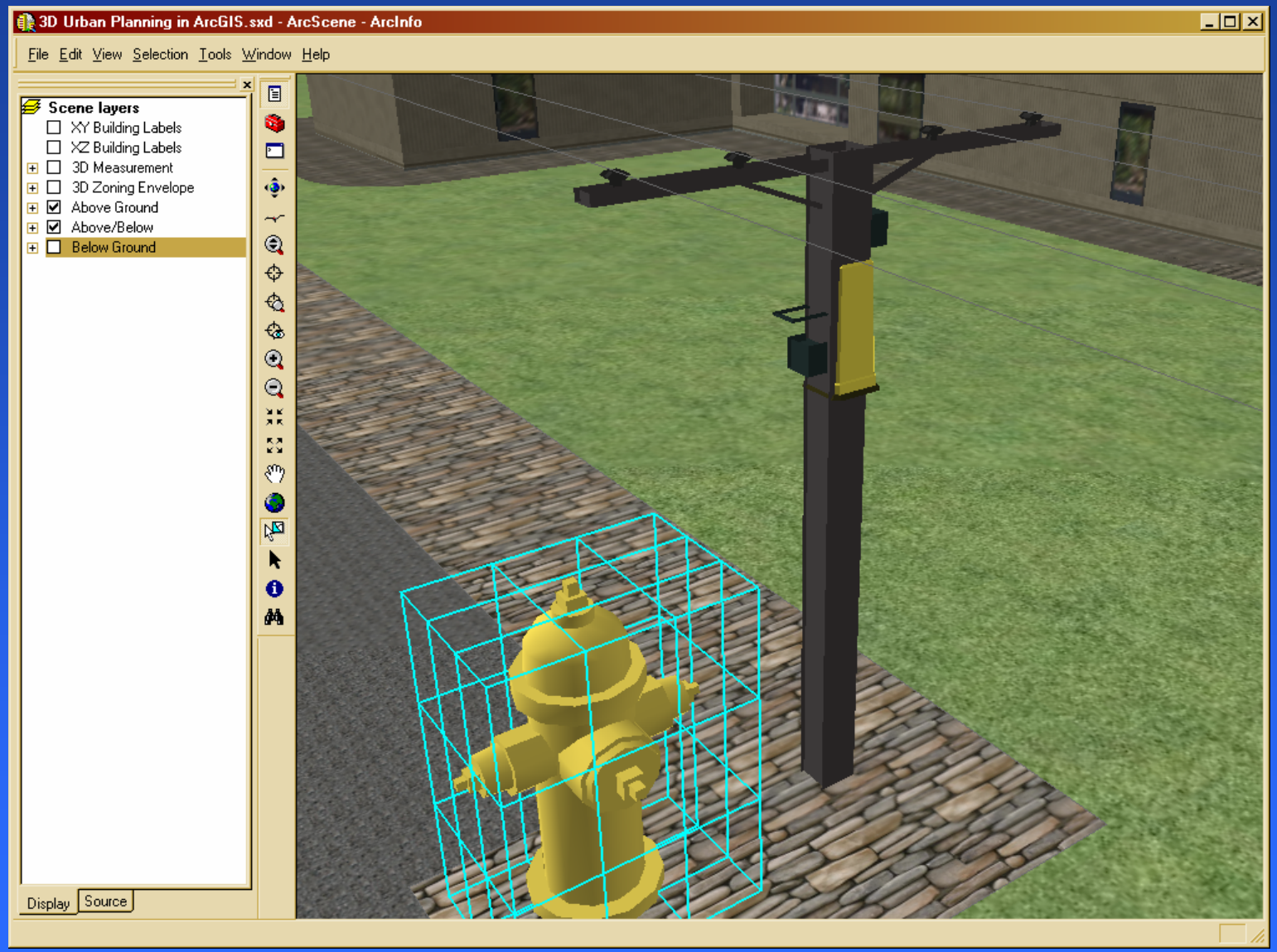
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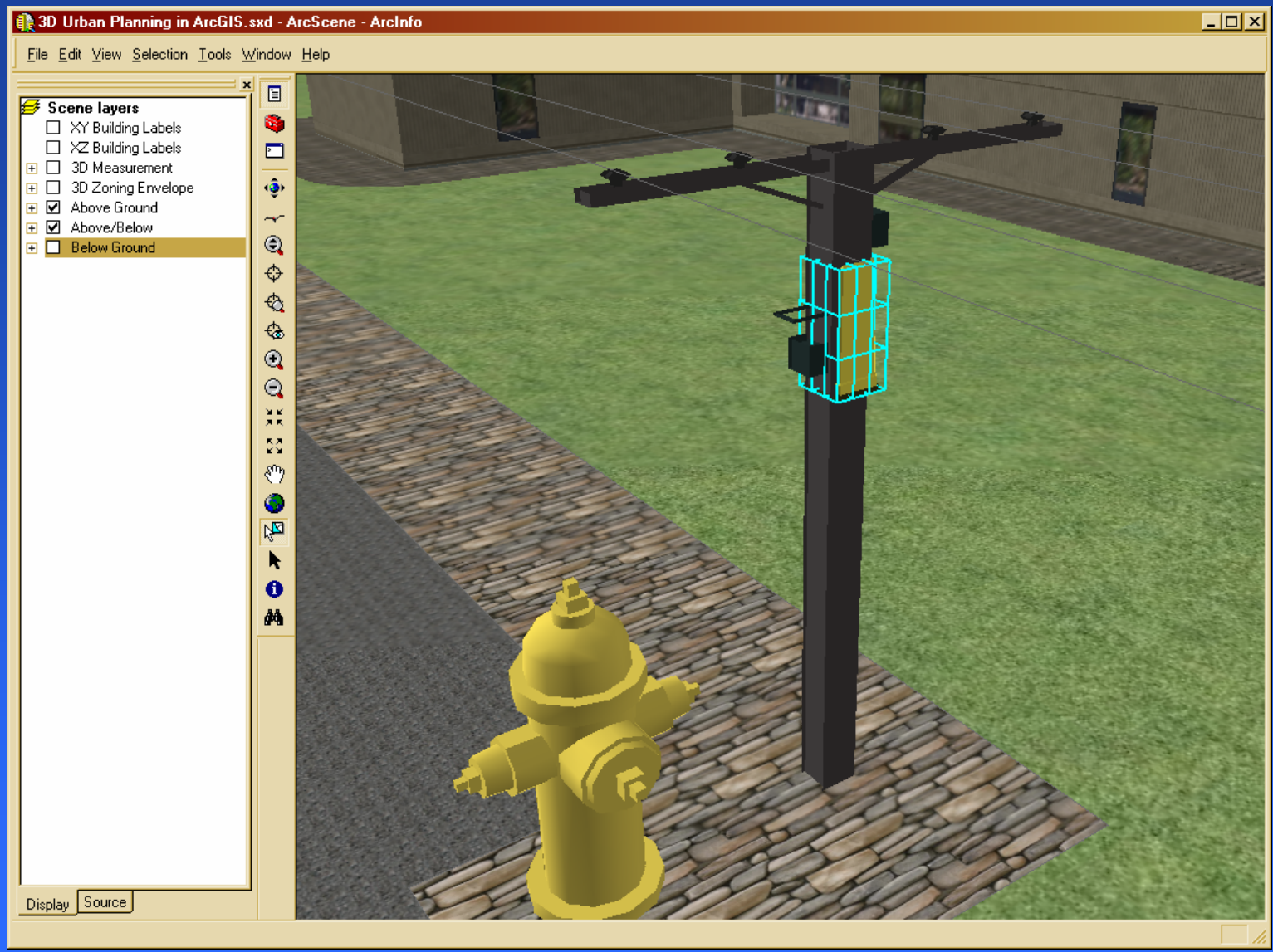
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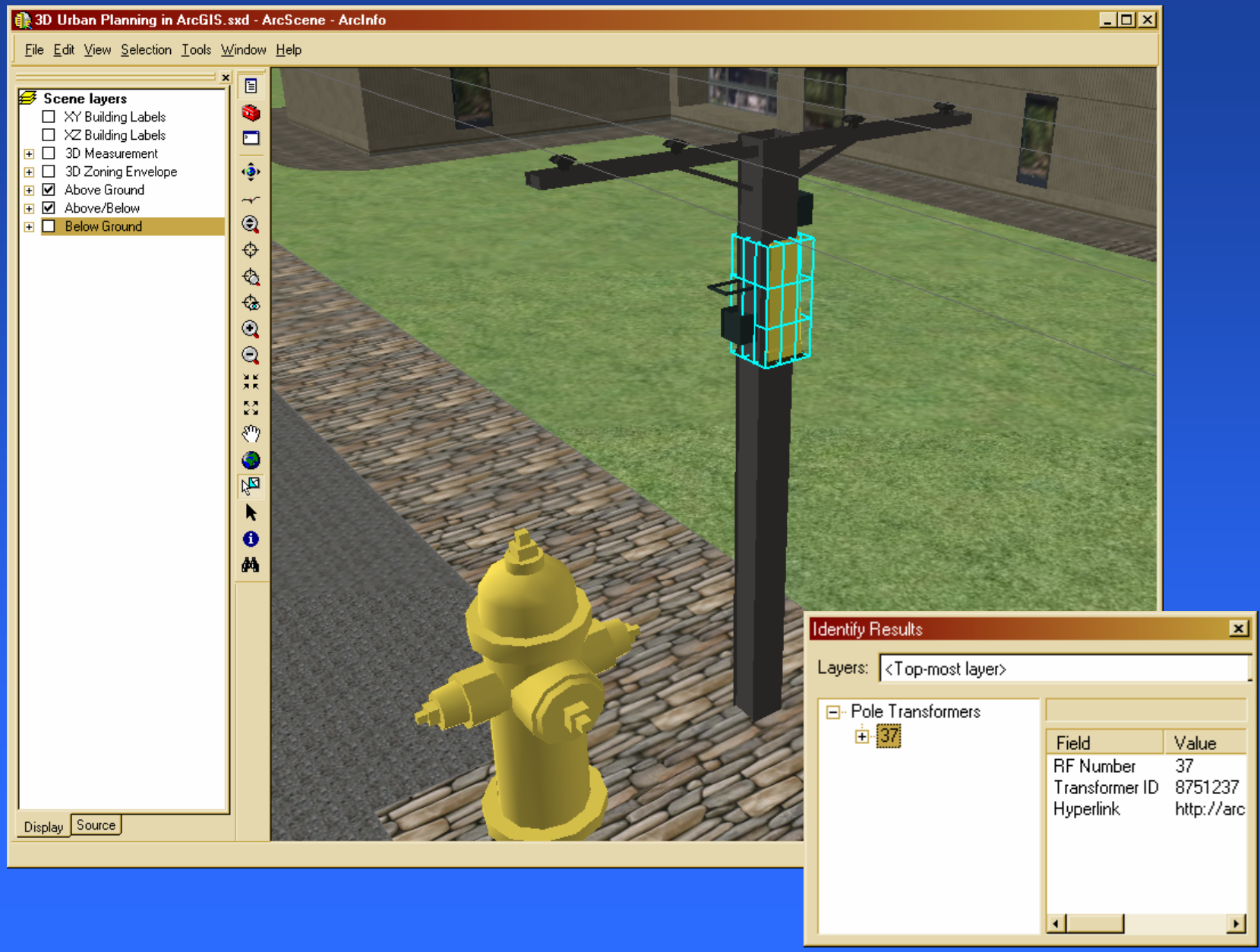
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XZ Building Labels
3D Measurement
3D Zoning Envelope
Above Ground
Above/Below
Below Ground
Display
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Field
Value
RF Number
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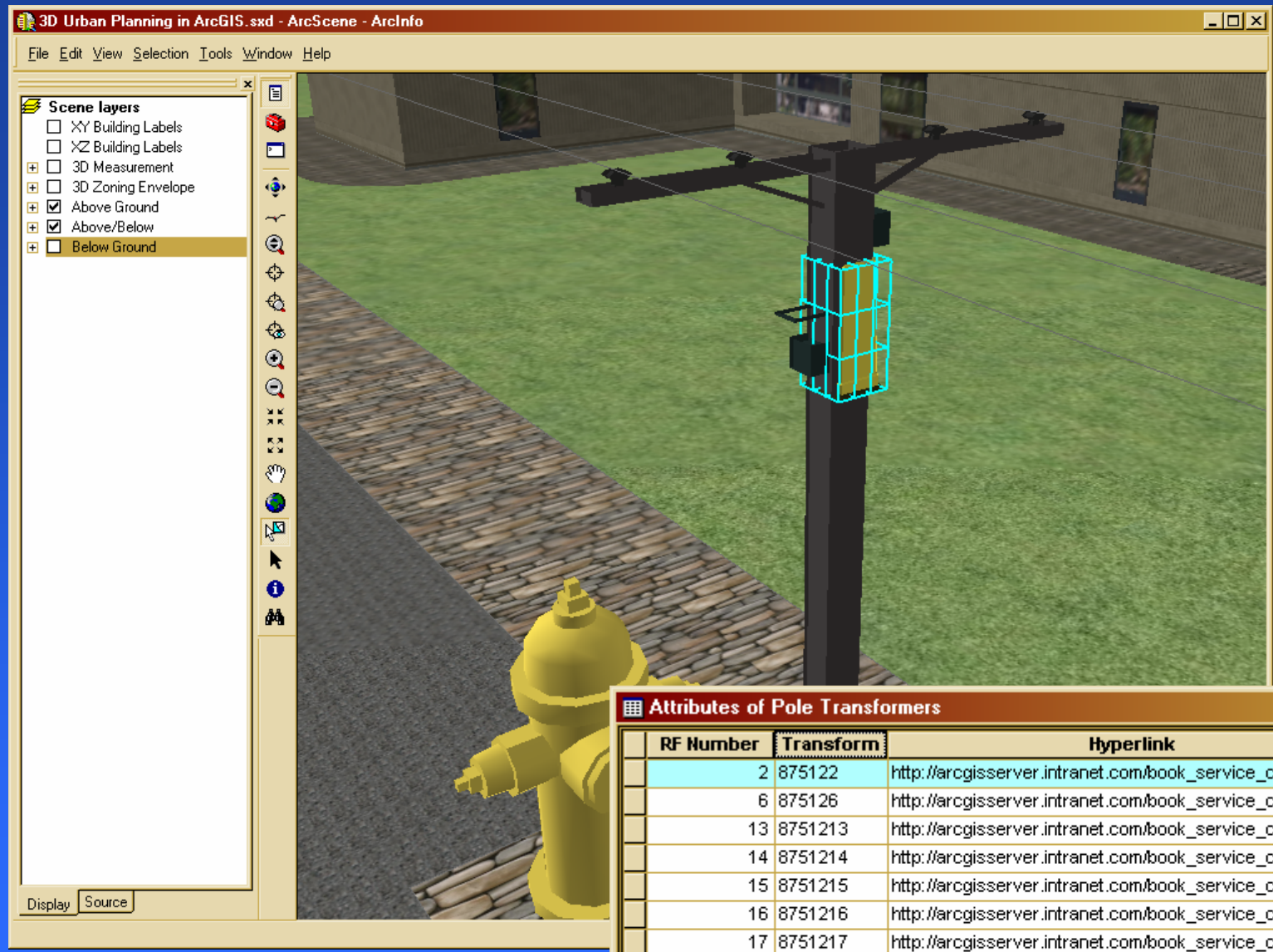
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XY Building Labels
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3D Measurement
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Above Ground
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Display
Source
Attributes of Pole Transformers
RF Number
Transform
Hyperlink
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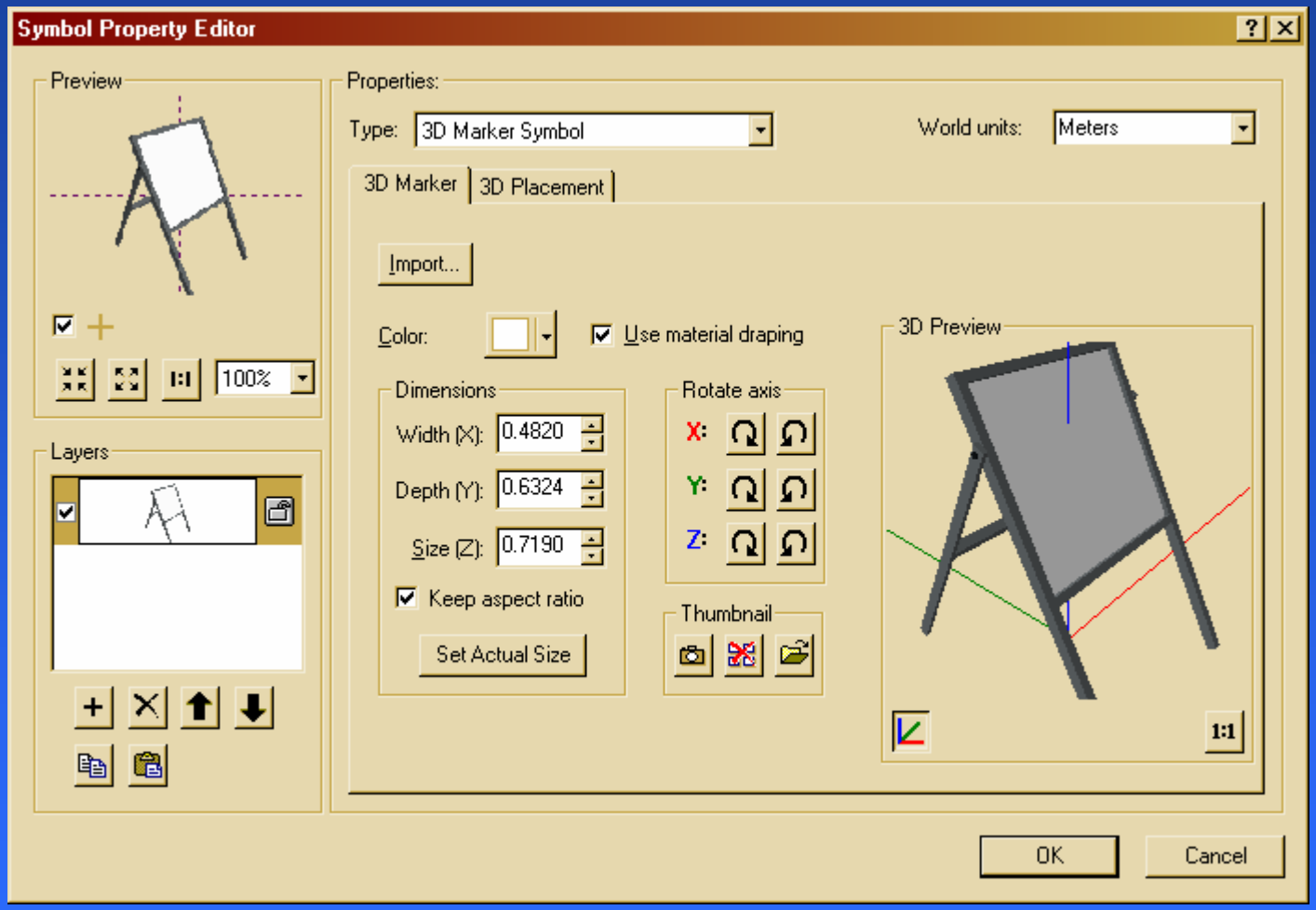
Records (1 out of 34 Selected.)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Meters
3D Marker
3D Placement
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Color:
Use material draping
Dimensions
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Depth (Y):
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Size (Z):
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Thumbnail
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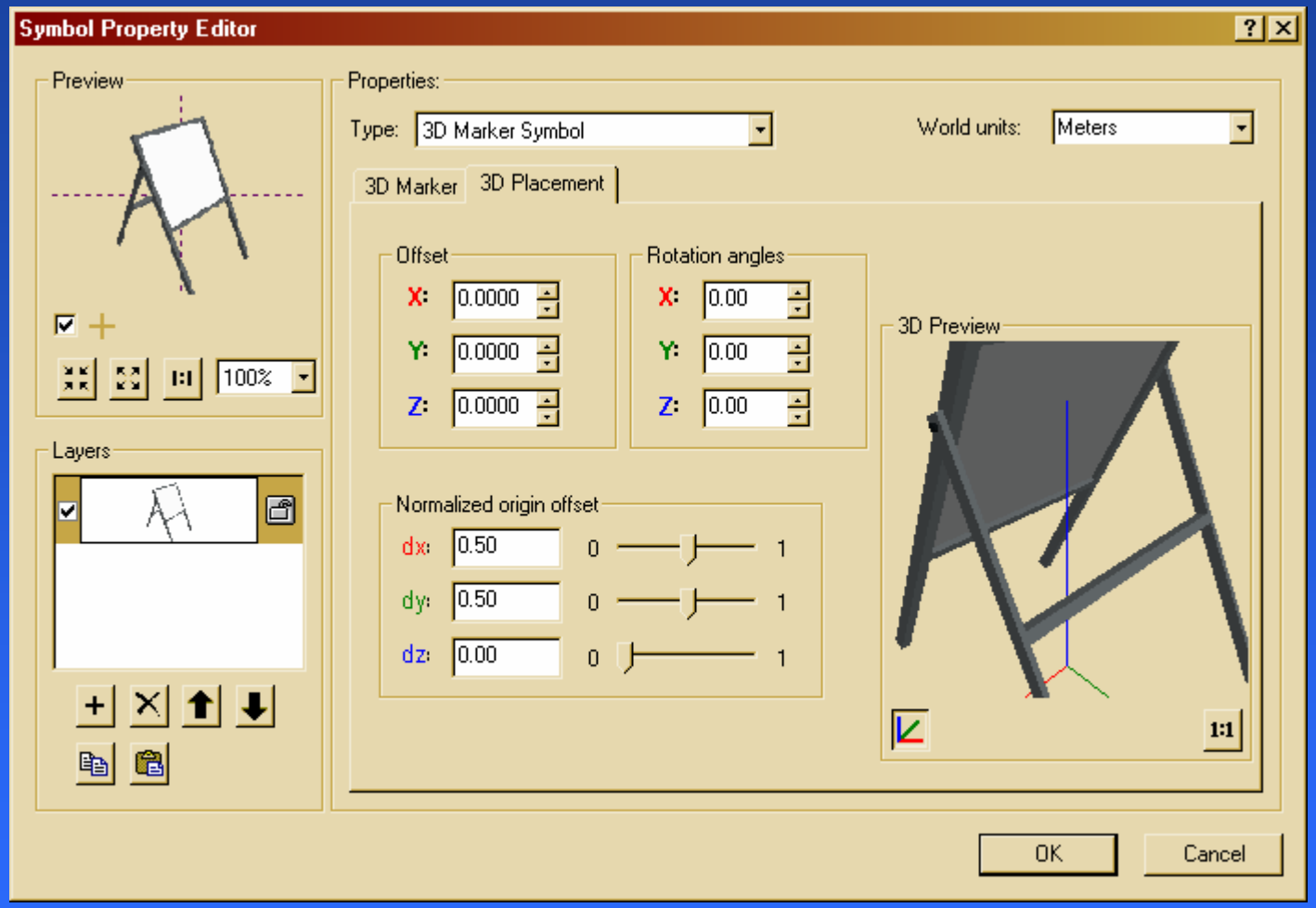
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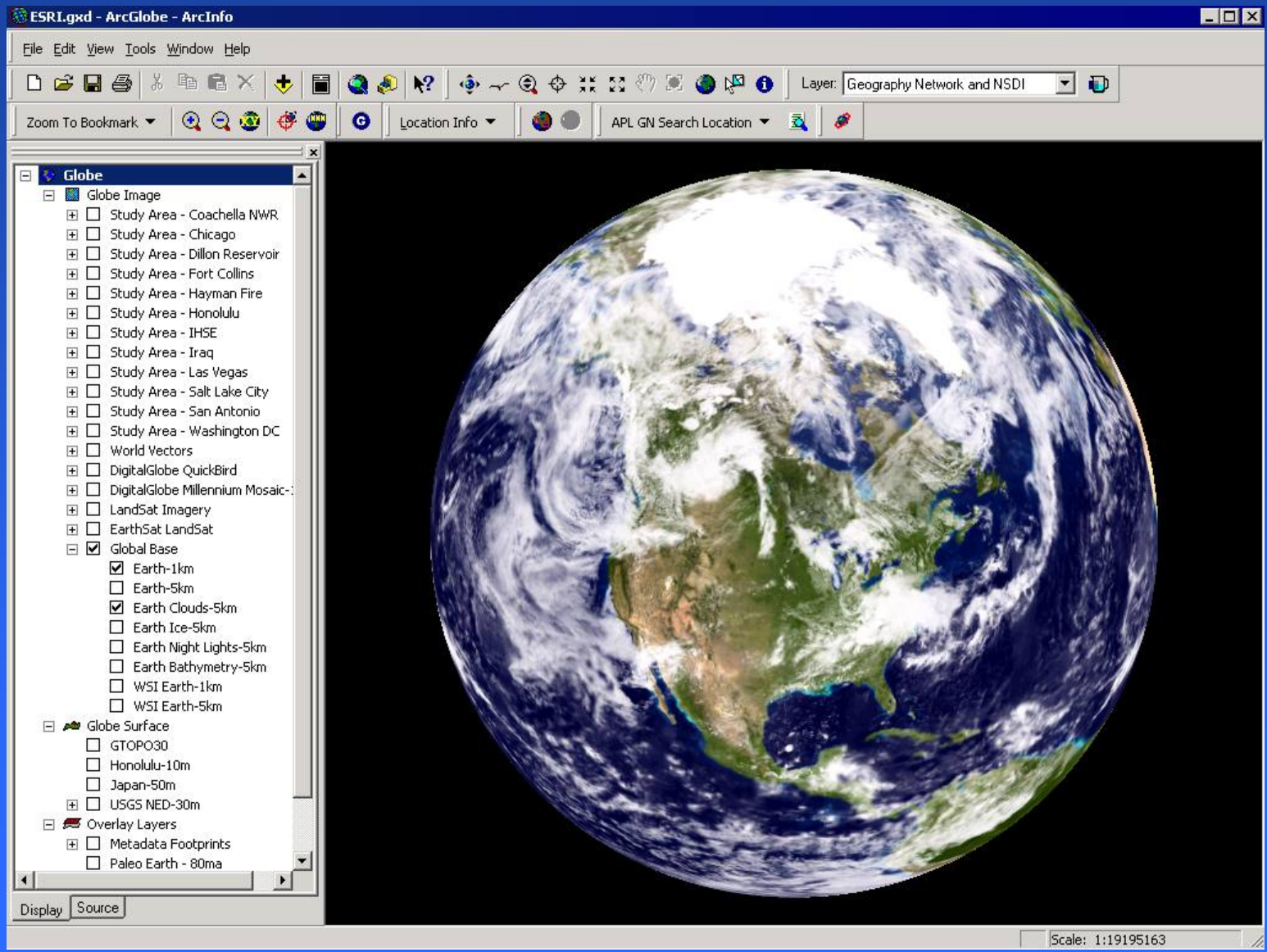
1
3D Preview
1:1
OK
Cancel

ArcGIS 3D Analyst

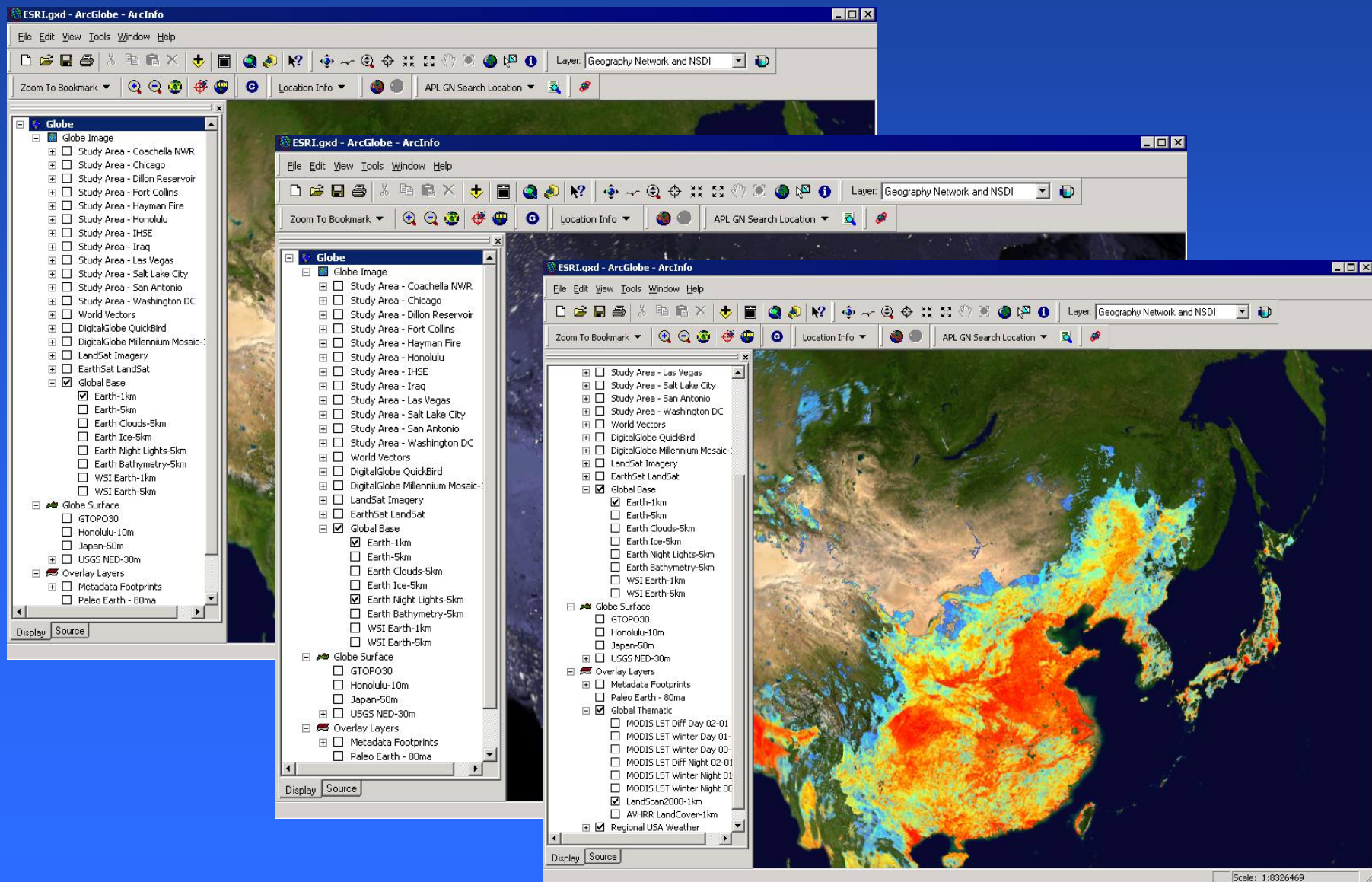
- Map features stored in a database.
- Coordinates, measures, symbology, attributes, hyperlinks, links to other applications, management processes, websites, email…
- Advanced ArcGIS users build and maintain a 3D GIS using out of the box 2d editing tools, 3D visualization tools and VBA customization techniques.
- Hook into live data feeds, use geoprocessing and analysis tools.

ArcGlobe

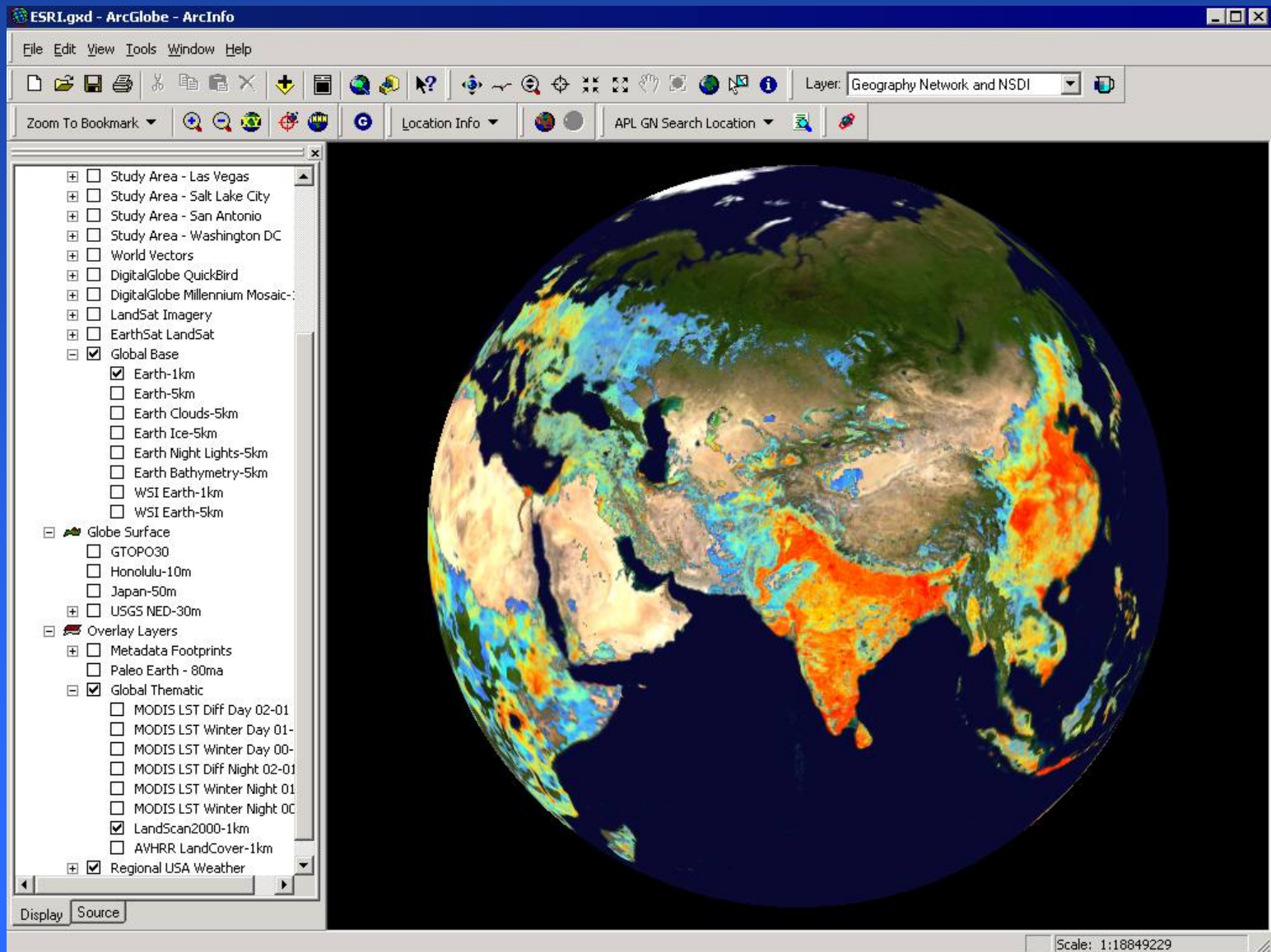
ArcGlobe – Earth With Clouds



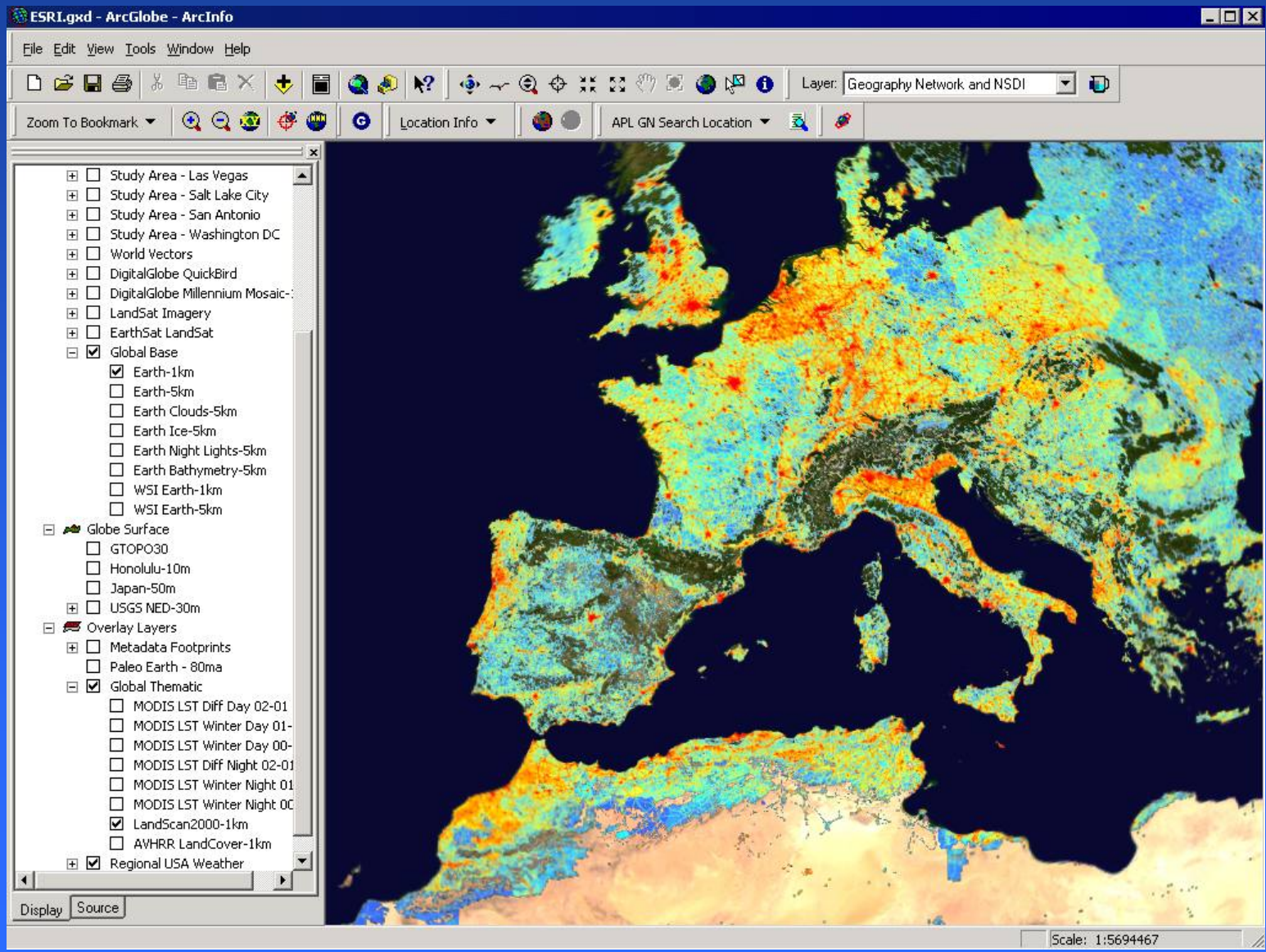
ArcGlobe – Korea Population Density



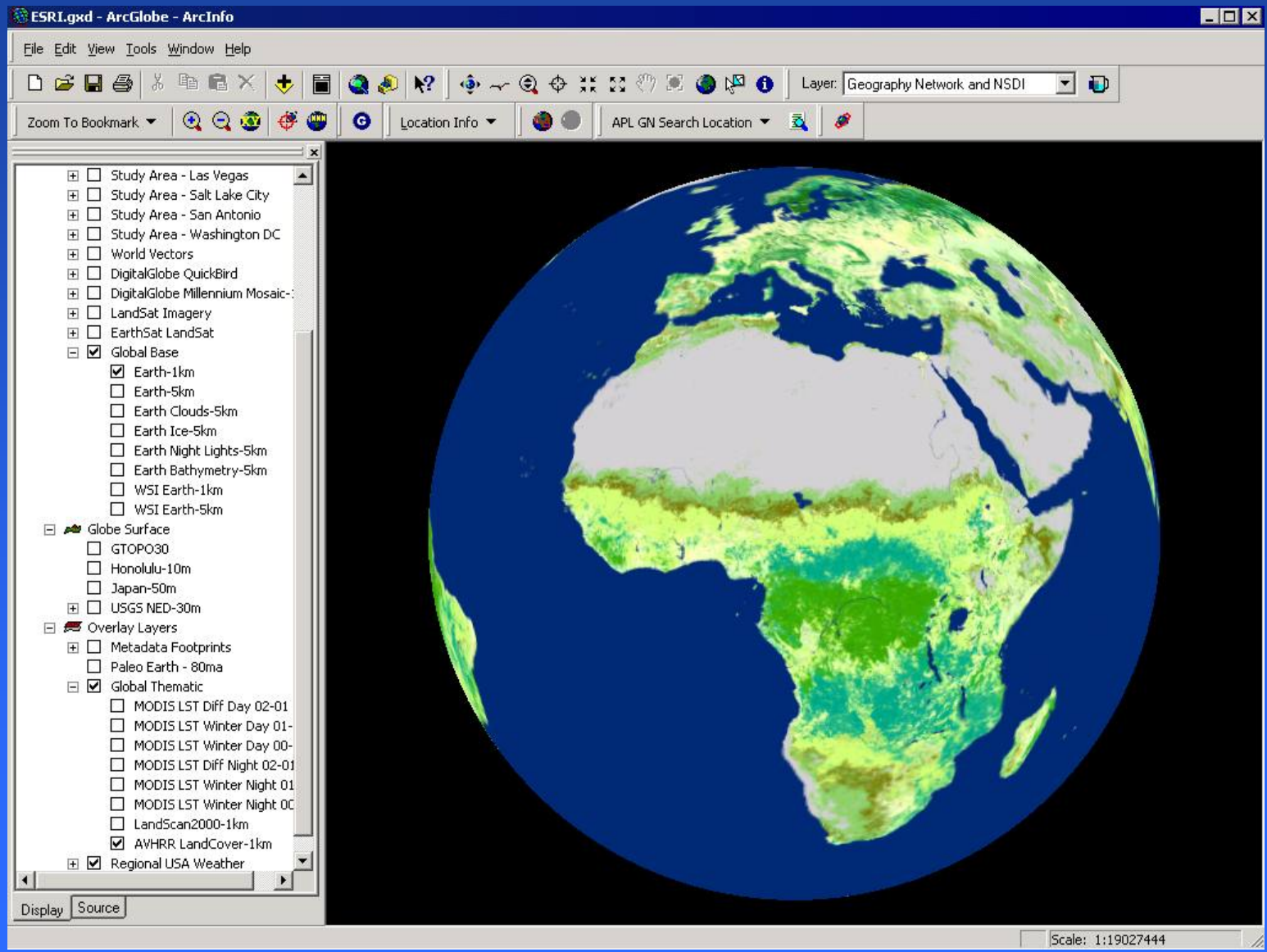
ArcGlobe – Population Density



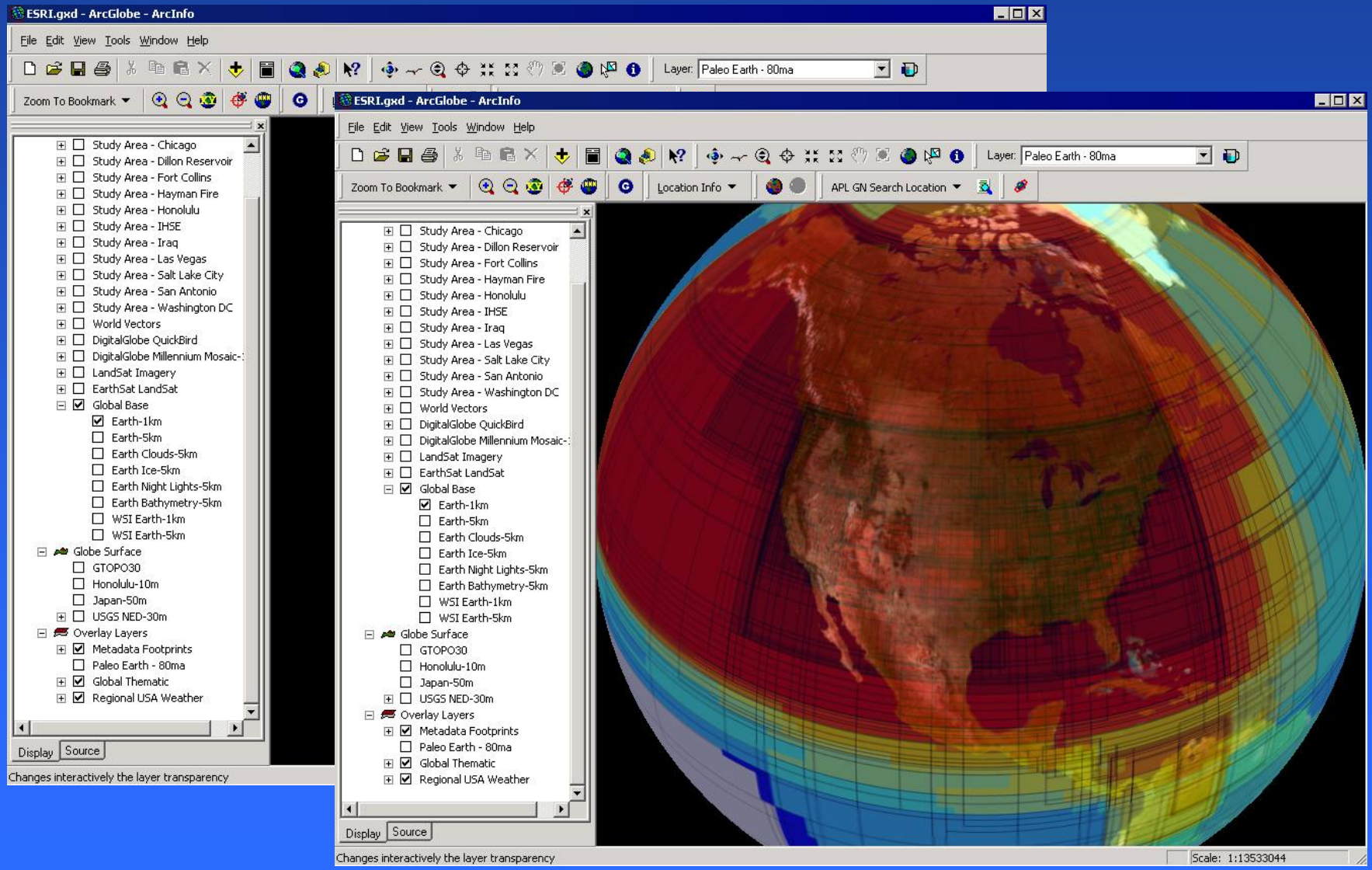
ArcGlobe – Population Density



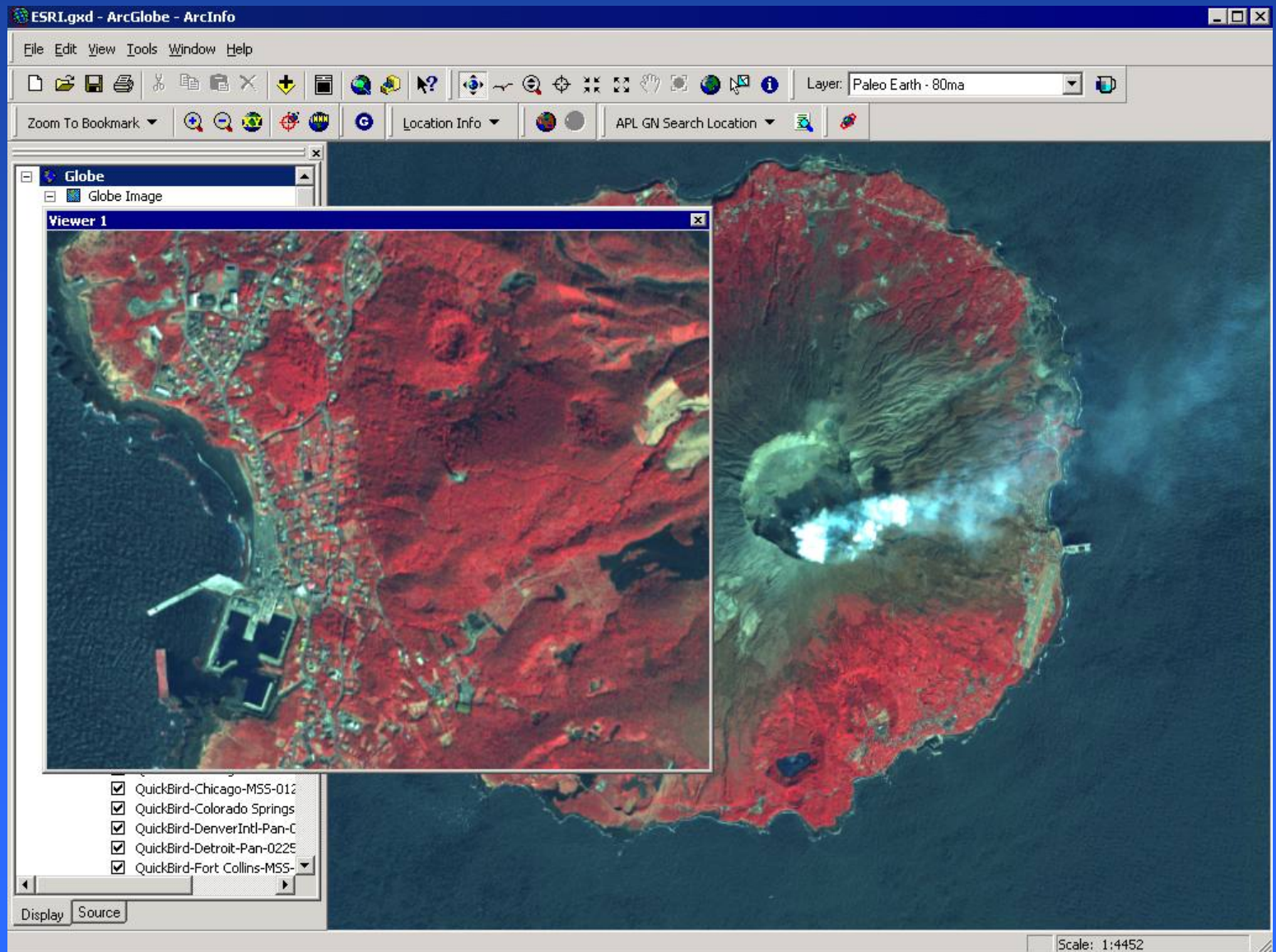
ArcGlobe – Land Cover



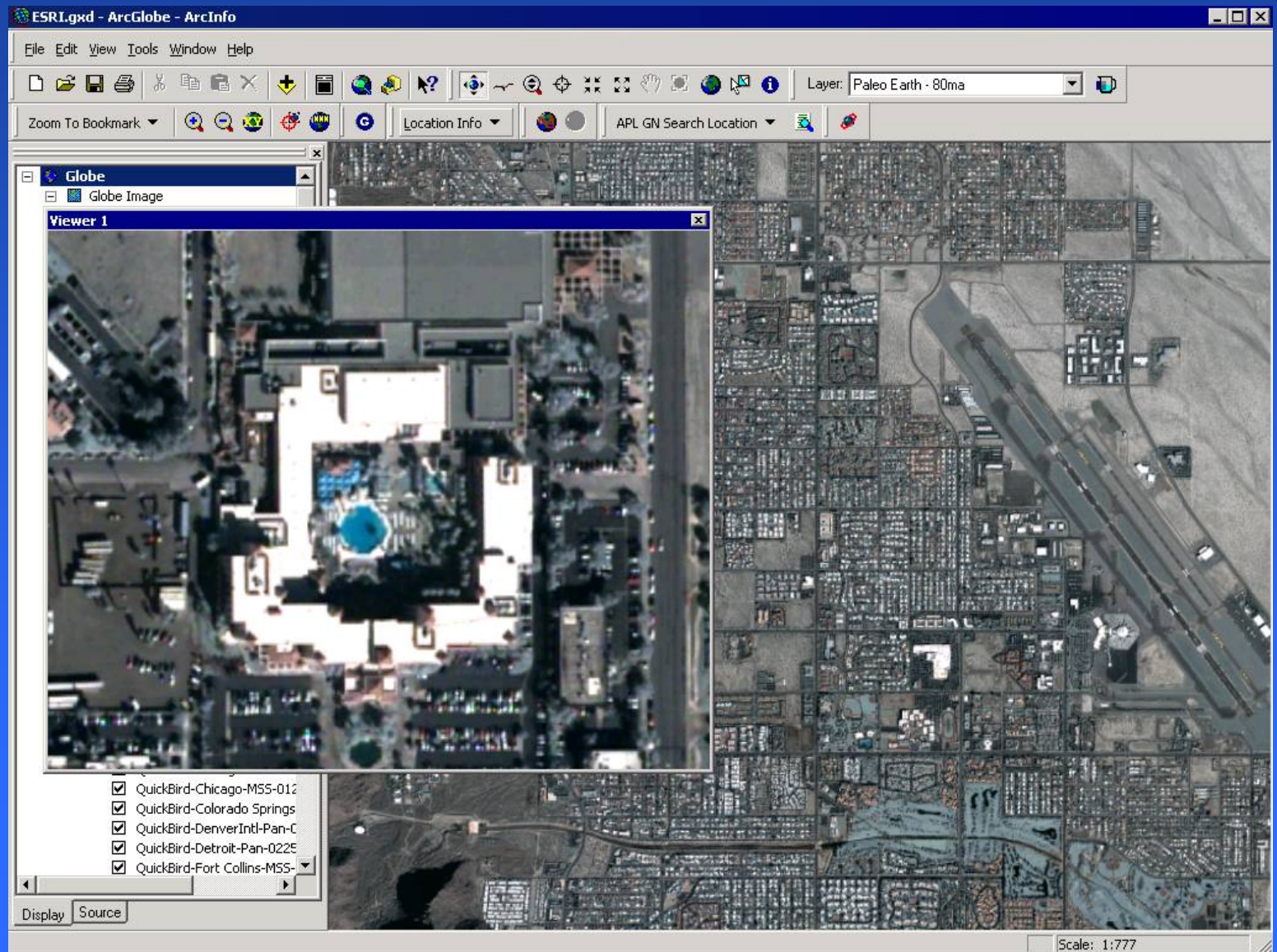
ArcGlobe – Geography Network & NSDI



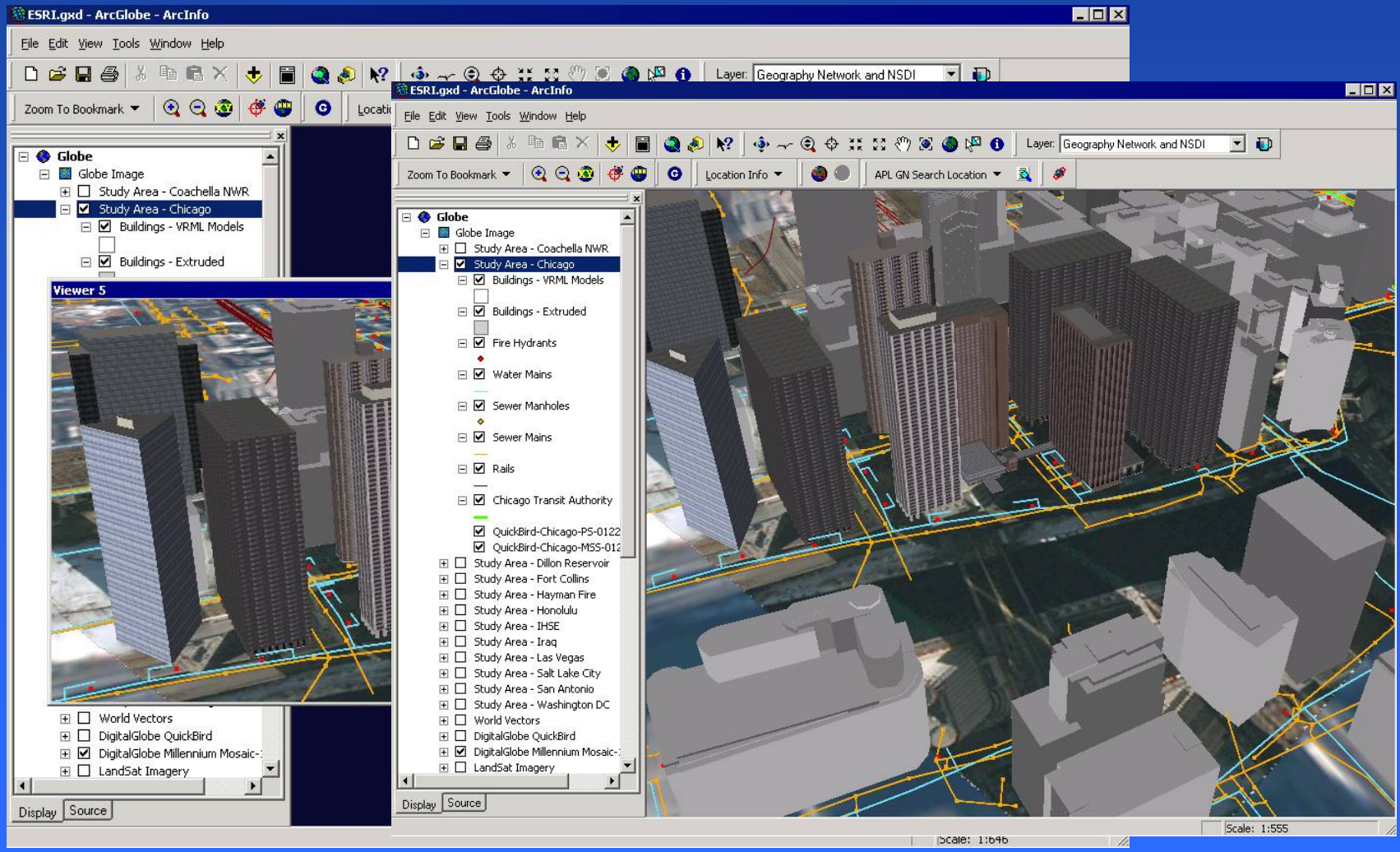
ArcGlobe – QuickBird
Miyake Jima – Volcano Eruption



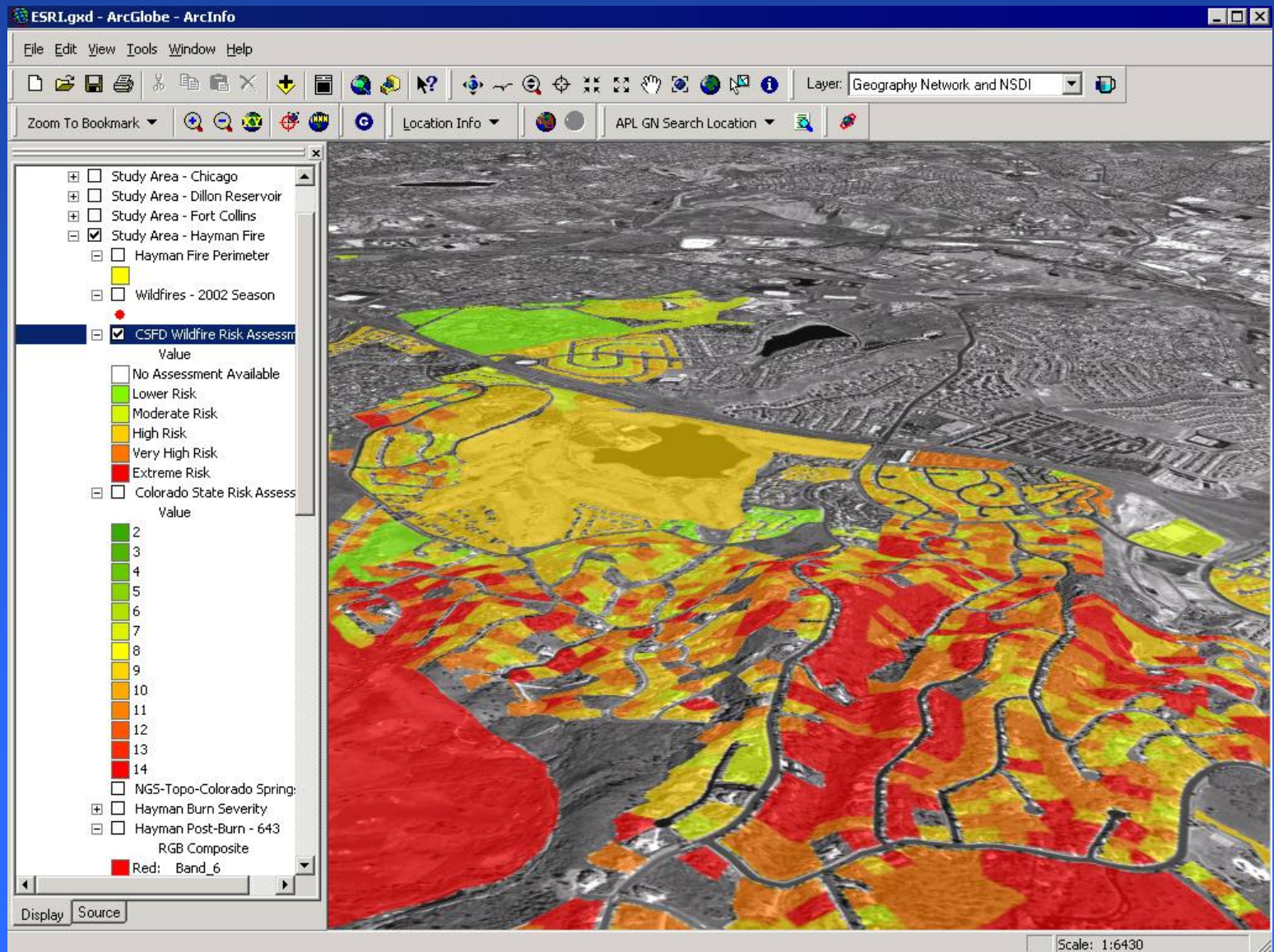
ArcGlobe – QuickBird
Urban Sprawl Impact Palm Springs



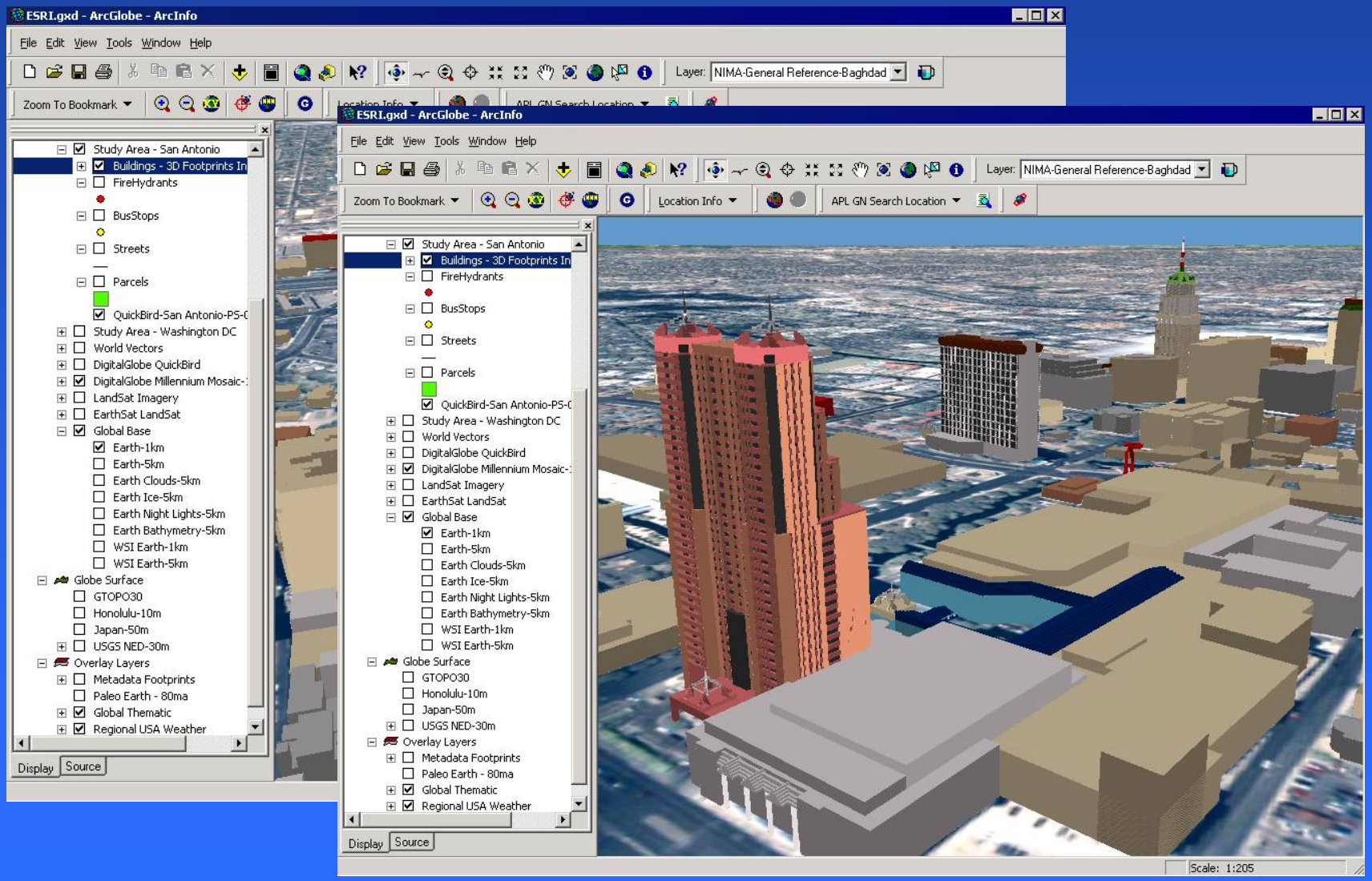
ArcGlobe – QuickBird
Urban Design Chicago



ArcGlobe – QuickBird
Wildfire Risk Assessment – Colorado Springs



ArcGlobe – QuickBird San Antonio



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