

ESRI White Paper  
June 1998

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# Geography Matters

## An ESRI White Paper

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# Geography Matters

## Why Geography Matters

To most of us, geography is a tangle of dusty facts, like *The capital of New Zealand is Wellington* or *Death Valley is the lowest place in the Western Hemisphere*. Unless you're a game show contestant, it's hard to see the relevance of these tidbits of information.

But suppose an acquaintance wants to sell you a roadside diner in the Mojave Desert. Are you interested? If you know that the diner is located on Interstate 15—the main thoroughfare between Southern California and Las Vegas, Nevada—you just might be. If, on the other hand, it lies on a forsaken stretch of highway in the Sheep Hole Mountains, you'd tell the seller to take a hike.

It's in this sense—the sense in which knowing where things are is essential to rational decision making—that geography matters.

Fine, but isn't this just plain common sense? After all, it doesn't take a genius to put a hamburger stand next to a high school or a bait shop next to a lake. But things aren't always that simple.

Consider a couple of examples. After studying the movement of drug activity across City neighborhoods, the Pittsburgh, Pennsylvania, Police Department conducts City-wide drug sweeps to disrupt the narcotic marketplace and help bring stability to affected neighborhoods. In Texas, a department store, analyzing credit card receipts by ZIP Code, infers that a large number of its customers drive along a particular section of freeway to reach a mall—so the store makes some smart choices about where to place billboard ads.

In cases like these, the decisions on where to deploy resources are not at all obvious: what is clear, though, is that geographical considerations shaped the outcome.

Linking location to information (or bringing the where to bear on the what) is a process that applies to many aspects of business and community decision making. Choosing a site, targeting a market, planning a distribution network, zoning a neighborhood, allocating resources, responding to emergencies—all these problems involve questions of geography. Where are my actual and potential customers? In which neighborhoods or ZIP Code areas do consumers with the right profile live? Where are my competitors? At which intersections do most traffic accidents occur? What parts of a city are most vulnerable to seasonal flooding or other natural disasters? Where is a city growing most and in most need of increased water, power, and telecommunication services?

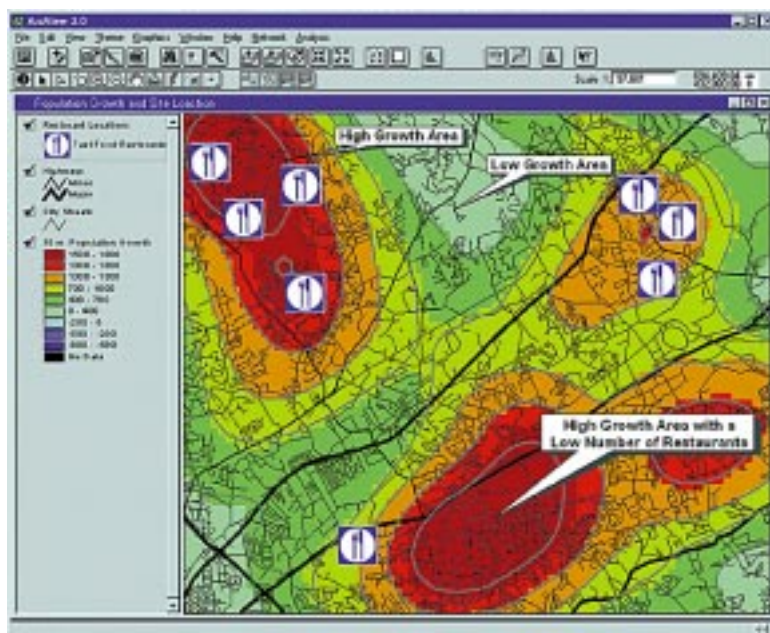
Sometimes the questions are large in scope, and sometimes they're quite specific: How close is the nearest freeway exit? How far away is the airport or the waterfront? Which buildings are properly zoned, have affordable leases, and lie within a five-minute walk of the subway station?

## How GIS Can Help

Geographic information system (GIS) software gives you the power to answer these and many other questions quickly, accurately, and demonstrably by letting you see, explore, and analyze data by location. And that, in short, is what makes it such a valuable tool.

*Portions of this white paper are excerpted from ArcView GIS Means Business, written by Christian Harder of ESRI and modified slightly.*

## Geography Matters for Business



Businesses manage a world of information about sales, customers, inventory, demographic profiles, mailing lists, and so much more. At the very core of this information is a geographic location, an address, a service boundary, a sales territory, and a delivery route that can be illustrated and interactively managed on a map.

GIS software is reshaping the business world. From multinational corporations to entrepreneurial start-ups, from hardware stores to hospitals, companies of every kind are introducing geographic analysis to solve business problems. In the process, they're making better decisions, delivering better service, and finding new market opportunities. Businesses are using GIS technology to find solutions for marketing, site selection, asset management, risk analysis, regulatory compliance, delivery routing, customer service, demographic analysis, and much more.

GIS enables businesses to better understand and evaluate their data by creating graphic displays using information stored in their databases. But a GIS does more than just display data; it enables users to interactively and dynamically analyze and manage the information linked to those locations. And by simply updating the information linked to a map, the map automatically reflects those changes. It is this analytical capability that

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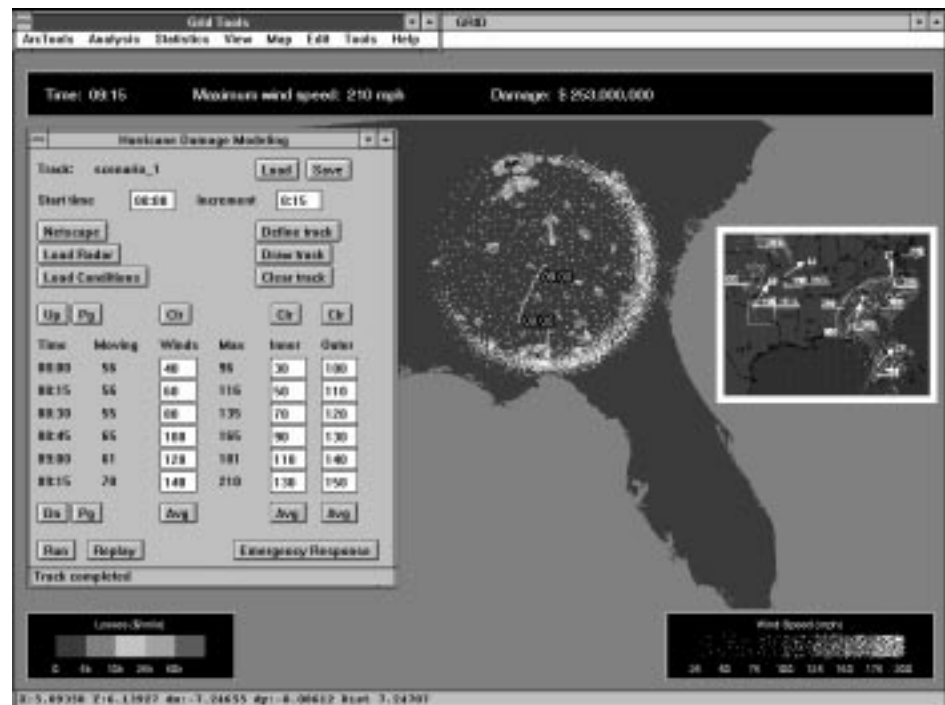
allows a medical practice, for example, to decide where it should open an outlying clinic based on census and demographic data.

GIS allows the creation of map displays simply by pointing and clicking. GIS lets users visualize and analyze information in new ways, revealing previously hidden relationships, patterns, and trends. Business people in marketing, advertising, insurance, and retail are already using GIS to analyze markets, optimize media campaigns, pinpoint the best store locations, and model demographic spending patterns.

GIS technology can be used by just about any business and industry including banking/finance, consumer goods, direct marketing, health care, insurance, real estate, facility management, restaurant/fast food, retail, automotive, business associations, business services, database services, food/beverage, manufacturing, small business, and travel/tourism.

Companies like Sears, Metropolitan Life, Chase Manhattan Bank, Gold's Gym Enterprises, and countless others are using GIS to improve operational excellence and profitability.

## Geography Matters in Disaster Response



Geography plays an important role in planning for disasters and coordinating emergency response. Emergency response relies on the coordination of tremendous amounts of data from multiple sources. The capability to access and process information quickly and deploy resources where needed is mission critical. GIS software from ESRI supports this mission by using geography and computer generated maps for integrating and accessing

massive amounts of location-based information. Many government and private agencies rely on GIS to access real-time information, make better decisions, and respond more effectively. Here are some areas where geographic data can make a difference.

### Emergency Response

The Federal Emergency Management Agency and the National Institute of Building Sciences are working together to use geographic information in assessing nationwide catastrophic risk, as well as in providing local, state, and regional officials with the necessary tools for planning and simulating efforts to mitigate losses from natural hazards and to prepare for emergency response and recovery from disasters.

### Disaster Modeling

All types of disasters can be modeled in GIS such as those caused by earthquakes, hurricanes, tsunamis, wildfires, oil spills, chemical cloud releases, and others. When the appropriate geographic data are coupled with modeling applications, a disaster can be modeled before or during the event on computer generated maps. This gives disaster managers and response personnel the opportunity to train and prepare for disasters before they occur. Response personnel and disaster managers can also predict disaster movement as it occurs. A specific example of how modeling assists agencies is wildfire modeling.

### Equipment Routing

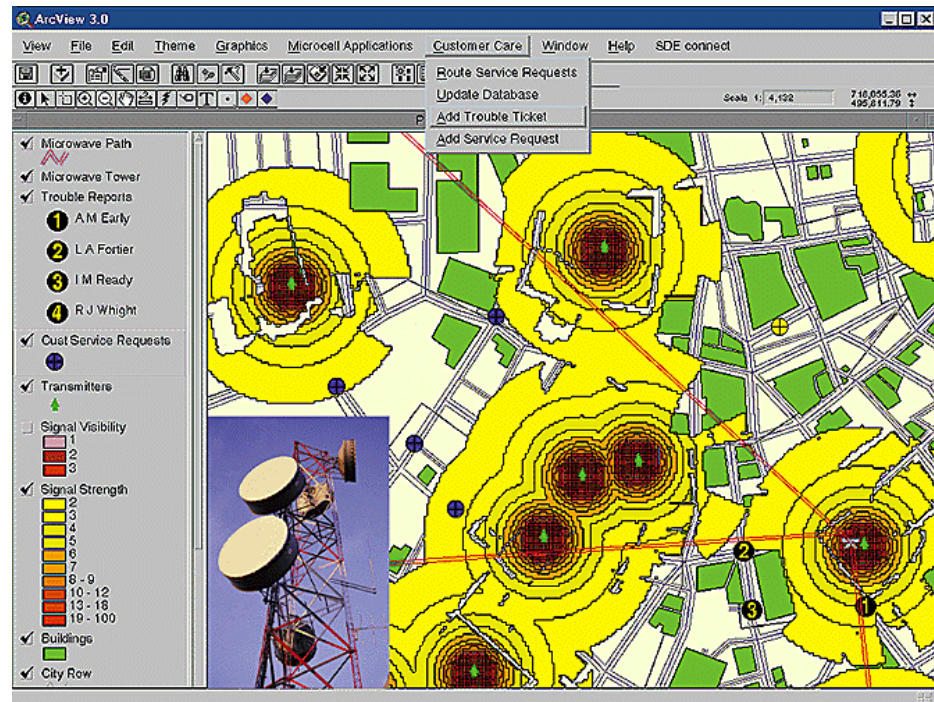
Fire departments use geographic data to generate efficient routes between fire stations and reported incident locations, as well as to predict and potentially decrease the risk of damage caused by lightning.

Advanced vehicle location (AVL) and tracking is one of the newest technologies to hit the emergency response profession. Dispatch managers can track the location of various apparatuses through global positioning system (GPS) transponders attached to the vehicles along a GIS generated basemap at the dispatch terminal.

As you can see geography, computer generated map data, and integrated information access can significantly improve planning, mitigation, and response capabilities.



## Geography Matters for Electric and Gas Utilities



The utility industry is about to migrate from the safe haven of a regulated market to a highly competitive deregulated market, dramatically changing the way utilities operate and serve customers. The utilities, though varying in size and scope, all have similar and fundamental needs: multiuser, enterprise technology configurations that can ease organizational reengineering and improve customer service.

GIS is helping electric utilities worldwide to reduce costs and increase productivity. GIS technology gives electric utilities the tools they need to become more customer focused, more competitive, and better prepared to compete in an evolving marketplace. Electric utilities use GIS solutions in a wide variety of areas including engineering, operations, marketing, and finance.

### Engineering

Through the use of GIS, the utility user is able to plan, design, estimate, and choose cost-effective solutions in order to properly serve the rate paying customer. GIS also allows the utility user to analyze the performance of the electrical network by performing a variety of calculations that use a model of the electrical distribution system in order to evaluate its performance. The GIS will allow the user to identify features that meet certain criteria, examine relationships between features, analyze data, and retrieve/display results more quickly in both geographic and tabular form.

### Operations

Two processes are involved in operations: maintenance and service restoration. GIS helps make the maintenance process more efficient and provides a geographic representation of the maintenance process. The most common type of maintenance is preventative or periodic. The service restoration group is responsible for providing

reliable and accurate communication with customers during a power outage. With the trouble call and outage management process, the GIS allows the utility to restore services quickly and safely.

**Marketing** Demographics and service area analysis are two areas of concern for marketing. Through the use of GIS, the utility is able to locate eligible customers that are not currently being served and identify high use/high value customers. GIS can help the utility provide its customers with reliable service. For example, if a large company or plant is moving into the service area, then the utility can provide them with information on what is the best available and the most reliable service location.

**Finance** GIS provides the utility with a geographic perspective of the service area and location to help determine the fixed cost of utility to the customer. Geographic representation also allows the utility to obtain an accurate inventory of the number of poles that are owned by the utility company but are used by other companies as well, so that the utility can then determine how much to bill each company. In addition, GIS allows the utility user to automate the design environment that streamlines this process.

## **Geography Matters in Emergency Medical Services**

Geography plays an important role in responding to emergencies and saving lives. Response capabilities often rely on a variety of data from multiple agencies. The capability to access and process this information quickly and deploy resources where needed can be critical.

GIS software from ESRI uses geography and computer generated maps as an interface for integrating and accessing massive amounts of location-based information. Many agencies rely on GIS to access real-time data.

**Response** Emergency response teams use geographic data to generate efficient routes between hospitals or fire stations and report incident locations. Using AVL and tracking, dispatch managers can track the location of various apparatuses through GPS transponders attached to the vehicles along a GIS generated basemap at the dispatch terminal.

**Analysis** With call information stored in a database, emergency medical response calls can be analyzed and displayed by type, time of call, location, and other criteria. Trends, volume of business, and areas of high impact can be visually displayed and quickly reviewed. Epidemics can be displayed and tracked to determine where and how fast a disease is spreading. Future response activity can be anticipated and planned. Computer generated map data and integrated information access can significantly improve emergency and response capabilities.

## Geography Matters for Environmental Professionals



Environmental professionals use GIS software in the areas of environmental compliance, permit tracking, environmental impact assessment, groundwater modeling, natural resource management, policy development, and public review. GIS is used every day to help protect the environment, produce maps, inventory species, trace pollutants, protect habitats, and study vegetation—the environmental applications for GIS are almost endless. Here are just a few.

### Study and Manage Ecosystems

The National Biological Services uses GIS to study and manage the Gap Analysis Program. Using the GIS, they can visualize the ecosystem as a complete unit and display graphics of sensitive areas. The Bureau of Land Management uses GIS to manage the ecosystem for the Columbia River basin. Using GIS they can assess environmental impact, develop planning strategies, and create maps that show the entire system.

### Identify Site Characterization

GIS can organize and refine data to help with site assessments, site inspections, and feasibility studies. Data, such as survey, hydrological, and aerial photos, can be organized and evaluated using the GIS.

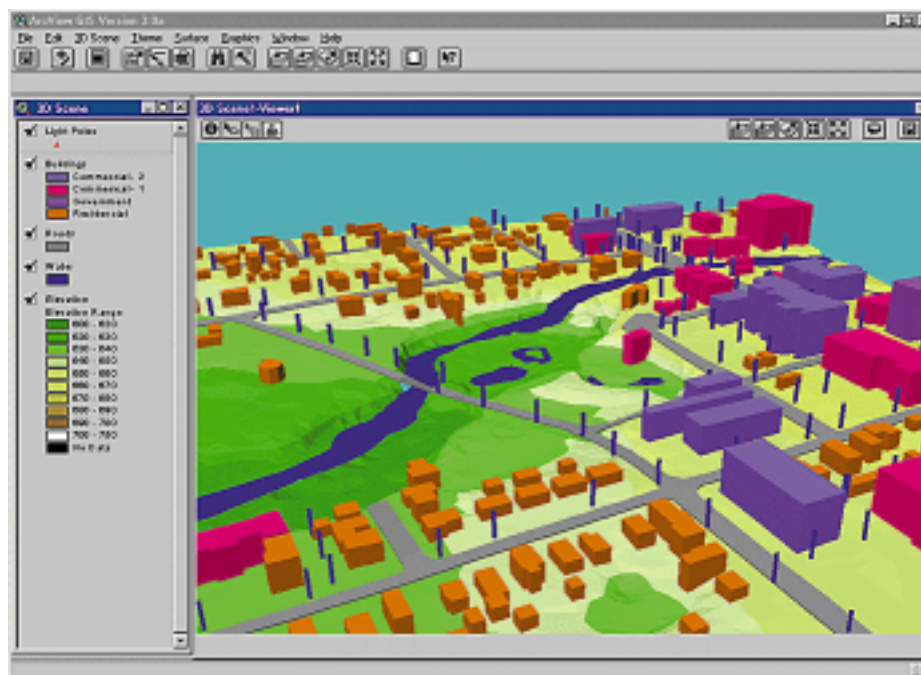
### Track the Effects of Pollutants

The damaging effects of pollution, such as oil spills, can be assessed using a GIS. With this information, the GIS can model potential contamination for different locations and help develop risk assessment strategies. GIS technology helped the Exxon Valdez Oil Spill Council to prioritize areas that need protection and to restore damaged species. In addition, the effects of oil spills on tourism were assessed by using the same data to analyze the scenic appeal of different areas.

Only GIS software can truly keep up with the complex spatial data management requirements for environmental monitoring and reporting. A GIS streamlines data management and makes it easier to share crucial data throughout an organization. GIS

reduces the cost of doing environmental business while giving the organization that uses it a competitive advantage in an evolving marketplace.

## Geography Matters for Local Government



Local governments are increasingly required to operate with the speed and efficiency of private businesses while adhering to complex political or regulatory requirements. Local governments must digest an immense amount of information to perform their duties in a fair and sound manner. Only a GIS has the data management tools to help accomplish this task. GIS technology provides a flexible set of tools to perform the diverse functions of government. More importantly, it makes data sharing among departments easy so that the government can work as a single enterprise.

GIS is most often used by local governments to assist with administrative services, public utilities, human services, public counter, land records, public safety, and school districts. It is used for keeping track of equipment and facilities, as well as government-owned property and fleets. GIS can help determine patterns of complaints in certain neighborhoods and track their resolution by the appropriate department. Here are just a few of the many ways GIS is used by local governments.

## Engineering

Engineering departments perform engineering and survey, transportation and traffic engineering, and maintenance of streets, storm drains, street lighting, rights-of-way, and trees. GIS, computer-aided design and drafting, global positioning systems, document management, and related technologies are commonly used to support the project planning, design, construction, and ongoing operation of developments from street realignments to new subdivisions, industrial parks, and even entire planned communities.



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## Community Development

Community development departments include planning and zoning, economic development, building permits and inspection, redevelopment agency, and resource management. GIS tools are very useful in supporting the functions of these departments and are commonly used for modeling land use and environmental conditions and constraints.

## Public Utilities

In public utilities, GIS can be used to model and analyze network flow, analyze specific facilities or features of the network, predict runoff rates, and determine pressure zones when planning new water distribution facilities. GIS is also used to support the planning, operation, and maintenance functions of the solid waste department. Network routing tools support design and evaluation of solid waste collection routes. The often controversial task of finding a suitable location for a new landfill can be eased greatly by using GIS.

## Election Districts

GIS technology is playing an increasing role in the election process. Departments such as the registrar of voters, the clerk of the court, and city and county clerks all benefit from using GIS in conjunction with their counterparts in land records and special district departments.

## Geography Matters for Marketing



Businesses can use geography in a variety of ways from publishing interactive maps of store locations on the Web to address matching just the right customer profile for a targeted marketing campaign.

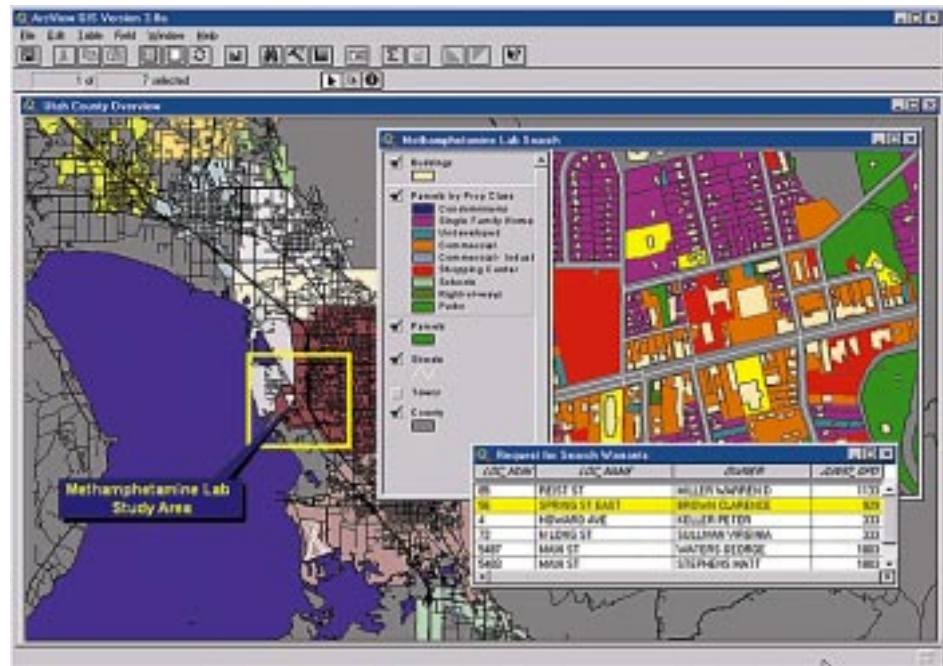
GIS software significantly improves the analysis process so that businesses can better coordinate distribution and delivery routes, enhance customer service by pinpointing delivery time estimates, and offer the right merchandise to match the customer mix in a service area. The geographic location of facilities and customers is a launching point for a wide range of business geomapping applications such as

- Site selection/analysis
- Pricing comparisons
- Performance analysis
- Service contract management
- Data access and reporting
- Geographic locator
- Geocoding customer and facility locations
- Customer profiles
- Trade area development
- Interactive maps of store locations on the Internet

GIS uses the inherent geographic component of business data (an address, a territory, a distribution path) to visualize information and display patterns and trends. GIS can also be used to create a multidimensional snapshot of trends to plan trade areas, predict sales, design sale territories, plan media, and much more.

ESRI offers a complete range of software from sales and territory mapping for individuals to complete desktop GIS tools. ESRI® software is customizable so that users can create unique interfaces and applications. Business units within companies can share and access business and customer data with powerful, enterprisewide solutions for spatial data servers and engines. And ESRI offers complete Internet and intranet mapping components for publishing interactive maps on the Web.

## Geography Matters in Public Safety



Geography plays an important role in public safety. Response capabilities often rely on a variety of data from multiple agencies. The capability to access and process information quickly and deploy resources where needed can be mission critical. GIS software from ESRI supports this mission by using geography and computer generated maps as an interface for integrating and accessing massive amounts of location-based information. Many law enforcement agencies rely on GIS to access real-time information, make better decisions, and respond more effectively. Here are some areas where geographic data can make a difference.

### Crime Analysis

The vast majority of information used in law enforcement is map based. Agencies need to display the location of incidents and be able to view incidents by categories, time, or date. GIS offers flexibility for viewing data and facilitates a wide range of map-based analyses. For example, incidents can be displayed by beat, reporting district, or zone. Advanced GIS capabilities can generate incident density and contour maps that can be used to predict the probability of crimes occurring. Law enforcement agencies use GIS in records management.

### Communications

In communications, GIS is used to display incident locations, vehicle locations, and positions based on global positioning systems. Further, GIS can be used as the engine to generate the route. Law enforcement agencies are building mapping capabilities into both dispatch centers and individual patrol vehicles.

### Operations

The operations division of most law enforcement agencies consists of patrol, crime analysis, investigations, special units, and planning. These are the units that conduct the

majority of analyses and need to have tools that facilitate research into specific types of incidents. GIS in this arena is developed as a series of end user applications that meet the specific needs of each unit.

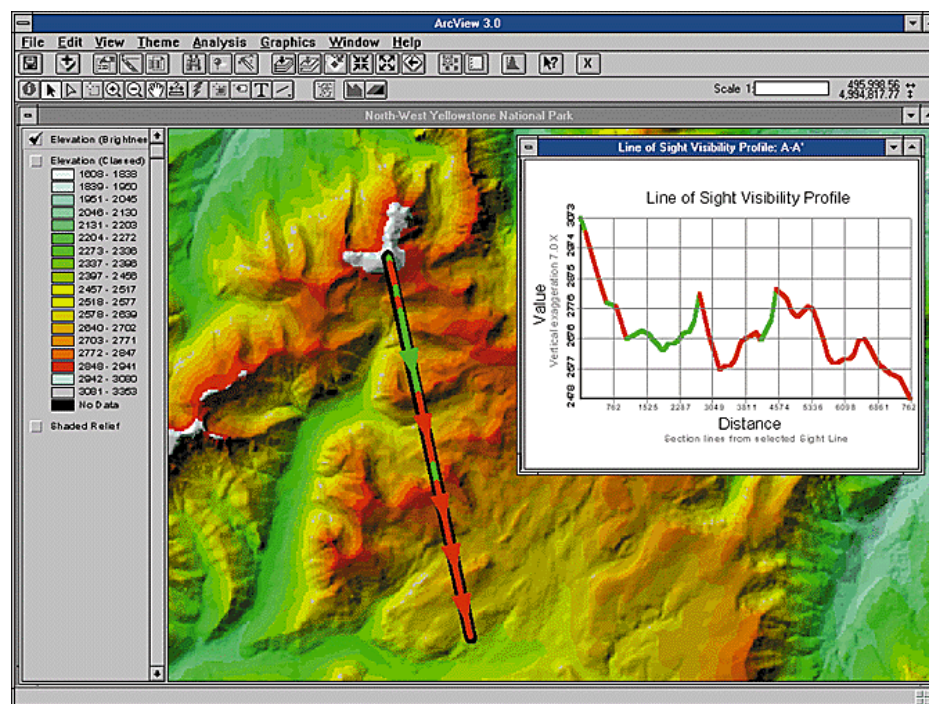
## Records Management

Records management maintains the incident data used in GIS. Incidents, arrest reports, calls for services, and citations make up a small portion of a law enforcement agency's record management system. Often the GIS map data need to be coordinated with records management data for optimum efficiency.

## E-911

GIS is used as a decision support module for locating and routing apparatuses when street map data are included in the dispatcher's window of a computer-aided design system or in the vehicle of a first-out engine company. GIS may also be used to create routes and direction to or from an incident location. Furthermore, dispatch managers can track the location of various apparatuses through GPS transponders attached to the vehicles along a GIS base plan at the dispatch terminal.

## Geography Matters for Schools and Libraries



Geography is part of our everyday lives. It's part of the places we call our home—our neighborhood, our nation, our planet. It's part of the things we come in contact with every day—weather, traffic, the quality of our water and land, the economy. Geography is literally everywhere in the world. Often overlooked because we simply don't see it, geography and its questions of where and why find broad exposure in schools, libraries, and similar educational institutions.



In a school, geography finds a place in more than just a geography classroom. In a library, geography spans more than the map reading room. Because geography ties together all aspects of the earth and its many societies, geography is part of many disciplines such as geology, biology, environmental science, mathematics, sociology, economics, and literature.

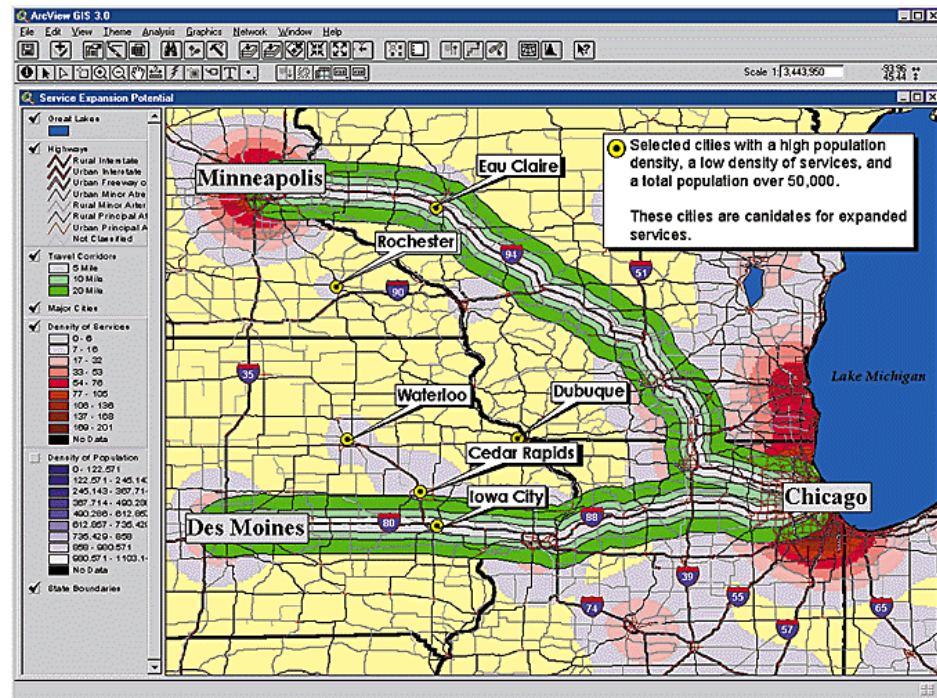
To study things geographic traditionally has meant using maps, atlases, and globes. These are no longer the limits. New technologies make it easier to create maps and conduct geographic studies. This class of geographic tool being used by planners, researchers, and technicians is also being used by teachers, students, and library patrons.

A GIS (composed of mapping software, geographic data, and a questioning explorer) allows students and persons of all ages to ask and answer geographic questions by designing and analyzing maps. In the process, the people doing the mapping expand their knowledge of the world, see connections between and among things, and gain new informational and technological skills. Likewise, because a GIS is not a sit-back-and-watch gadget, persons creating GIS maps are building their thinking skills.

A GIS in a local school or library also can offer a new connection between these institutions and the community. Students and local residents accessing information about their hometowns will find they are better informed on community successes and problems. In the process, they may find themselves more actively involved in their communities.

This same geographic tool also can open a doorway to a range of vocations. Just as geography is tied to everyday life, GIS is tied to a diverse and growing array of occupations. Archaeologist, farmer, real estate agent, park ranger, geologist, police dispatcher, and historian are but a few.

## Geography Matters in Transportation



In transportation, geography is key, and the GIS is a vital data management and analysis tool. GIS serves three distinct transportation markets: transportation infrastructure management, fleet and logistics management, and transit management.

### Transportation Infrastructure Management

GIS is used to manage and analyze information with a geographic component. GIS is used to support many aspects of infrastructure management including planning, design, construction, operations, and maintenance. More than 80 percent of the information used to manage road, rail, and port facilities have a spatial component. GIS can be used to determine the location of an event or asset and its relationship or proximity to another event or asset, which may be the critical factor leading to a decision about design, construction, or maintenance.

### Fleet and Logistics Management

Efficient operations require accurate, timely decision making. GIS solutions for fleet and logistics management exist in the areas of customer service, crew management, street and rail network management, and vehicle/depot management. Knowing where a vehicle, pickup, or delivery is at any given time leverages assets for optimum deployment and cost savings. Customer satisfaction, competitive position, timely response, effective deployment, and profitability all stand to gain. GIS is being used in thousands of organizations for the creation, display, analysis, and presentation of location-based information. GIS can be used to support everything from inventory tracking to ideal delivery routes.

### Transit Management

Improving the mobility of today's citizens is a great challenge for public transit operators. Expanding urban areas and geographically dispersed employment centers have replaced

the dominant central business location. Automobiles have reduced the demand for public transportation. And it is difficult to offer choices and preferred services when revenues and subsidies are at risk. Route planners, dispatch technicians, service analysts, marketing and community relations managers, and transit patrons can all benefit from a better understanding of transit vehicle, route, and facility locations. Routes can be maintained directly in street network databases and tied to neighborhood and employment center demographics, as well as schedule databases. GIS is used by transit operators to great advantage, supporting several disciplines and functional areas. Moreover, because all departments can access a single geographic database along with their specific departmental data, organizational coordination and decision making are improved. GIS is successfully used for bus management and rail management.

Bus management has used GIS for route planning and analysis, bus dispatch and emergency response, automatic vehicle location and tracking, paratransit scheduling and routing, and bus stop and facility inventory. Rail management has used GIS for rail system facility management; track, power, communications, and signal maintenance; accident reporting and analysis; demographic analysis and route restructuring; ridership analysis and reporting; and transportation planning and modeling.



For more than 25 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users.

ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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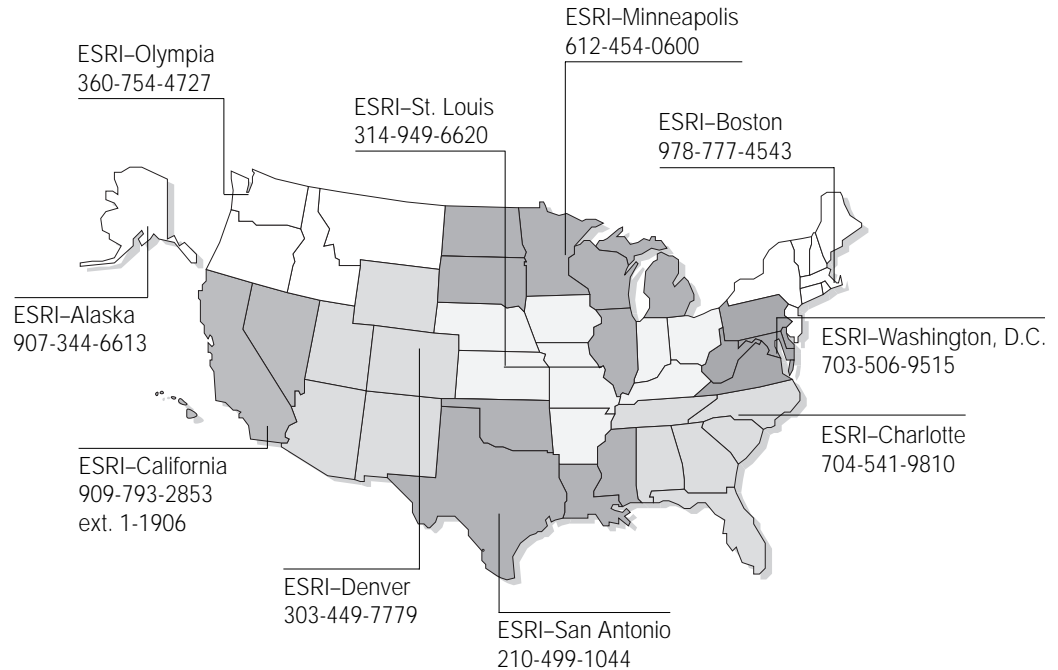
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