ARCNEWS

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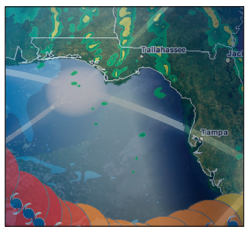
Getting to Know the Mapping Sciences Committee

By Keith Clarke, Chair, Mapping Sciences Committee, the National Research Council



Important to the GIScience research community and agenda, especially as far as the federal government is concerned, is the Mapping Sciences Committee (MSC), a standing committee of the Board on Earth Science Resources of the National Research Council. What is this committee; where did it come from; what are its activities and responsibilities; and how do they impact the world of geographic information science, especially with regard to research and development? In this essay, the current MSC chair attempts to answer these questions and reveal MSC as

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Opening the World to Everyone

By Jack Dangermond

The work of GIS professionals is changing our world. You are working on virtually all the big challenges facing society today, from global climate change and managing natural resources to health care, environmental conservation, and making our cities more livable. Among all these efforts, there is a common thread: visualization through mapping has become our universal language. This language is the most effective way to communicate geographic knowledge and is especially useful in helping make our

Jack Dangermond.

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Imagery and Rasters in ArcGIS 10

Imagery Is Core to GIS

At version 10, imagery management and exploitation has become a core part of ArcGIS technology. Whether it is used as a context-providing basemap, the source for creating new datasets, or support for geospatial analysis, most users consume imagery. Imagery is everywhere—from the desktop to the

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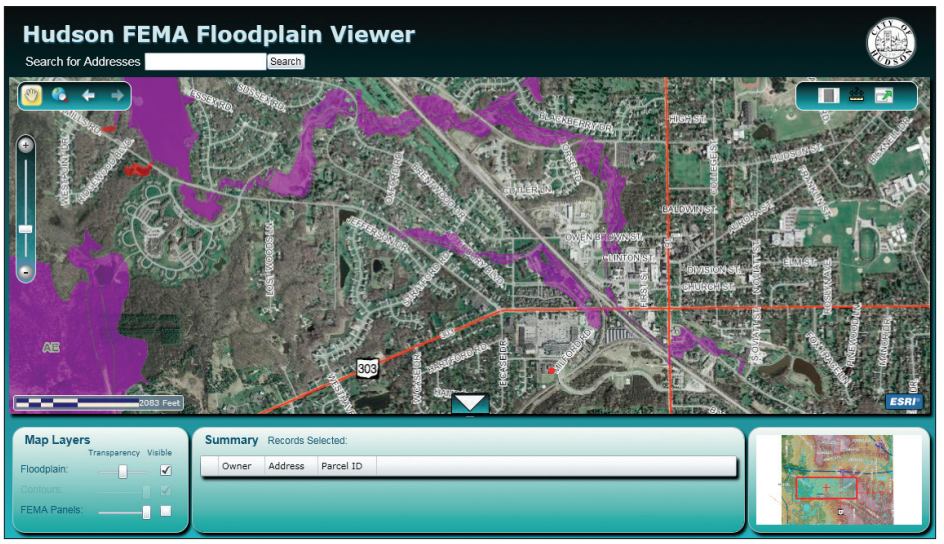

The City of Hudson, Ohio, integrated imagery and a U.S. Federal Emergency Management Agency floodplain map to assist with resident appeals submissions for the new floodplain designations.

European Union's Environmental Map Services Move to Cloud

The European Union's (EU) European Environment Agency (EEA) is working closely with Esri to improve the agency's cloud environment map services. EEA and Esri have signed a memorandum of understanding that allows EEA to expand deployment of ArcGIS 10 and better fulfill its project goals. European countries will be able to share environmental data more easily, and agencies, scientists, and policy makers will have quick access to data for viewing and analysis in GIS.

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Nonprofit Program Grants to Help NGOs

The newly launched Esri Nonprofit Program provides software and technology grants to nonprofit organizations, such as nongovernmental organizations (NGO) whose focus is on environmental and humanitarian initiatives. This program enables a

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Widespread Adoption of GIS in Public Safety

Not so long ago, monitoring remote incidents in real time with dozens of camera feeds and sensors linked seamlessly together was something you'd expect from the National Aeronautics and Space Administration (NASA) or science fiction. You

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Through EEA, the quality of bathing water can be assessed across Europe for quick understanding of information and trends in each country and across time.

Esri Releases the Open GeoServices REST Specification

At the FOSS4G Conference in Barcelona, Spain, Esri announced the release of the GeoServices REST Specification. This open specification provides a standard way for Web clients to communicate with GIS servers through Representational State Transfer (REST) technology. The specification has been opened such that developers can expose the GeoServices API request structure from ArcGIS Server and other non-Esri, back-end GIS servers or processes.

By adopting the GeoServices REST Specification for a server implementation, users are choosing a proven specification that has been widely deployed and exercised in the field and exposes server-side resources to a broad range of

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Online-Only Articles

More *ArcNews*

The Fall 2010 issue of ArcNews Online (**www.esri.com/arcnews**) presents the following special online-only articles:

Why Use Imagery or Raster Data?

World's Tallest Eucalyptus Tree Found with Lidar and GIS

High-Tech Web Mapping Helps City of New York's Fire Department Before Emergencies

INSPIRE Geoportals Bridge Producers and Consumers

Also, look for the expanded Esri T-shirt section online, as well as new supplemental podcasts.

Featured in This Issue

Regular Features and Departments

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National Geographic Society and Esri

Far-Sighted Agreement Broadens the Geographic Story

The National Geographic Society has signed an agreement with Esri that allows expansion of the GIS user base within the society and improves public access to geographic data. The nonprofit site license (NSL) gives the National Geographic Society unlimited deployments of ArcGIS software, thereby providing greater support of the society's goal of increasing and diffusing geographic knowledge.

"Our relationship with Esri and use of its products over the years has helped us more effectively utilize GIS technology in our cartographic workflow and analysis," says Charles Regan, vice president and general manager, National Geographic Maps. "This new agreement will provide our staff with even greater access to GIS applications and data, allowing us to better incorporate geographic information into our storytelling."

Esri has worked with the National Geographic Society for more than 25 years and has provided solutions for robust analysis of geographic data. The National Geographic Society will use the NSL to

- Improve efficiency in data sharing.
- Reduce GIS maintenance and support costs.
- Deploy ArcGIS on more desktops and give employees greater access to GIS applications and data.
- Enable more people to use spatial data and analysis to effectively tell stories.

The National Geographic Society will deploy Esri's ArcGIS Server technology both on the premises and in the cloud. These Web-enabled applications are being designed to help the public have a more in-depth and interactive experience with geographic information.

"Historically, the National Geographic Society has been preeminent in using geography to tell compelling, dramatic, and engaging stories," notes Jack Dangermond, president of Esri. " The society has gone far beyond the service of delivering maps and data. It uses GIS as an education tool to describe the cultures, landscapes, and environments of our world. This NSL affirms Esri's support of the National Geographic Society's work and continues our long-standing relationship, respect for, and appreciation of the many education projects it provides the world."

National Geographic uses ArcGIS for a wide range of data production, cartography, publishing, and analysis tasks. Staff often queries and combines datasets to create statistics and graphs for National Geographic maps, Web sites, and magazine articles. For example, National Geographic's FieldScope application uses ArcGIS to enable students and citizen scientists to compute watersheds and flow paths on the fly. This helps them understand how water flows to and from their locations. In addition, ArcGIS Server enables LandScope America, an online resource for land protection that is a collaborative project of NatureServe and the National Geographic Society, to publish hundreds of conservation map layers at multiple scales and extents. LandScope America also uses ArcGIS Server to make available thousands of geotagged articles, photos, and videos.

More Information
For more information, contact Charlie Fitzpatrick, Esri (e-mail: cfitzpatrick@esri.com).

Esri and NGA Form Strategic Alliance

The National Geospatial-Intelligence Agency (NGA) and Esri are forming a strategic alliance to strengthen national geospatial intelligence (GEOINT) capabilities that will provide a framework to advance the strategic goals and objectives of the National System for Geospatial Intelligence (NSG) in geospatial sciences and systems and computer science. The alliance is meant to support the strategies and goals that U.S. Navy Vice Admiral Robert B. Murrett, NGA director, set last year to ensure the interoperability and reliability and improve the quality of NSG products and services.

The agreement underscores the critical role geospatial technology plays in GEOINT within the national security community, which provides GIS products, services, and analysis to intelligence officers and decision makers. GIS technology continues to evolve in national security. Originally restricted to technical analysts, the technology is now available throughout the community in Web-enabled enterprise applications.

"We have successfully collaborated with NGA for more than two decades," says Jack Dangermond, Esri president. "This new initiative will permit us to continue working together on projects that will use and improve geospatial technology, thereby strengthening our country's national security. We are honored to partner with NGA in this important endeavor."

The agreement was signed in June by Murrett and Dangermond.

The mission of NGA—which combines aspects such as technology, data, people, and policies needed to produce GEOINT—is to provide timely, relevant, and accurate geospatial intelligence to support national security. NSG is a unified community of GEOINT experts, producers, and users organized around the goal of integrating technology, policies, capabilities, and doctrine to produce GEOINT in a multi-intelligence environment. NGA, as the functional manager for NSG, provides strategic thinking, guidance, and direction to the intelligence community concerning all aspects of GEOINT, from acquisition to utilization. NGA collaborates with its mission partners to ensure that accurate and timely GEOINT is part of decision making and operations where and when it is needed.

Agencies, allies, and coalition partners rely on GIS to share geospatial data and products with one another within this worldwide network. This is increasingly important in intelligence, counterterrorism, counterinsurgency, and humanitarian operations. The GEOINT system—cloud computing, mobile environments, the Web, and embedded geospatial capabilities—requires robust enterprise software that supports the global information grid. Esri's research and development in these areas provide the technical leadership needed to deliver critical geospatial support to meet the requirements of the intelligence community's fast-paced mission.

More Information
For more information, visit **www.esri.com/industries/defense**.

Environmental Advocate Creates Path to More Informed and Effective Conservation Efforts

Every once in a while, you meet individuals who impress you with their ability to build a rewarding life and innovative career based on uncompromised ideals. Steve Beckwitt is one of them and is a GIS hero. His passion for conservation led him to become a pioneer in the use of GIS to assess and protect our natural resources.

He carries out his work from his home on an organic farm in the Sierra Nevada foothills, which—as you'll soon find out—is where his family's remarkable conservation story began in the 1980s. What started as a heartfelt effort initiated by his two sons to protect old-growth forests turned into a career supporting scientists, organizations, and governments around the globe in using GIS to better manage our land and water.

Inset: Steve Beckwitt, above center, in old Lhasa, Tibet, near the Jokhang Temple. Beckwitt was in the country to work on a GIS project to establish citizen-managed protected areas. Also pictured is a Tibetan prince from Chamdo in eastern Tibet (left) and a Tibetan Buddhist monk (right). Above: This image, depicting grizzly bear killings in British Columbia, was produced for the media as part of a series of GIS analyses on endangered species, which Beckwitt performed for the Suzuki Foundation of Canada.

Building an Environmental Consciousness

Beckwitt developed an awareness of the importance of conservation at a young age. Particularly compelling was the time he spent exploring the natural environment in the Desert Hot Springs area of California with an older cousin, Dorothy Green, who went on to become a water conservation advocate and founded Heal the Bay in Santa Monica, California.

"We kind of coevolved a conservation ethic and understanding together just by discussing and reading about environmental issues," says Beckwitt.

Beckwitt's time as a student at the University of California, Berkeley, in the 1960s was another important catalyst in shaping his conservation career. Among other "green" endeavors, he contributed to the creation of an environmentalist take on the *Declaration of Independence* called the "Unanimous Declaration of Interdependence," which influenced Greenpeace's famous 1976 "Declaration of Interdependence."

Just short of completing a Ph.D. in biophysics, he left Berkeley for the wilderness of the Sierra Nevada. In the 1980s, his two young sons expressed an interest in botany, inspiring the launch of a family nursery business. They propagated several hundred species of unusual and difficult-to-grow native plants, as well as over a thousand other Mediterranean plant species, which they sold to many of California's botanical gardens.

Conservation Activism: A Family Affair

In the process of gathering seeds and cuttings for their nursery, the Beckwitts noticed alterations in the landscape. At the time, significant areas of the Sierra Nevada Mountains were being clear-cut, resulting in the degradation of the ecosystem.

Beckwitt and his sons, who were teenagers at the time, founded the nonprofit Sierra Biodiversity Institute to submit scientifically based appeals to protect old-growth forests in the Sierra Nevada Mountains under the provisions of the National Environmental Policy Act (NEPA).

"We did our own fieldwork," says Beckwitt. "We evaluated the landscape and tried to discover what potential ecological impacts were not addressed in the original NEPA documents and called them out with photographs."

This work was done before the U.S. Forest Service or the Beckwitts were using GIS technology, but the appeals did include Forest Service maps overlaid with data on environmental aspects that had not yet been considered in policy making.

"My sons really were the lead," he adds. "I helped them when they needed help, but most of the work they did themselves."

They won 23 of the 24 appeals they submitted, and most of them were reviewed by the Forest Service at the national level. The Beckwitts' technical appeals, along with the work of many other concerned citizens, prompted the Forest Service to reverse forestry policy decisions and readdress environmental issues raised in the appeals.

What GIS Means for Conservation

In 1989, Beckwitt was asked to write an article on ecological restoration for the *Whole Earth Review,* an alternative culture magazine of that time. He had read about GIS technology and was interested in its potential uses in restoration planning. He researched and wrote about this emerging technology and quickly began to use GIS in his conservation work.

The Sierra Biodiversity Institute incorporated the data it gathered in the field with quad maps from the U.S. Geological Survey, which the Forest Service had just captured as cartographic feature files (CFFs). Using ARC Macro Language, the group translated CFF data for the entire Sierra Nevada into ArcInfo format.

"We used GIS to prepare a full-fledged dataset for the Sierra Nevada, then captured a lot of timber cutting history and made what were among the first presentations using GIS to Senate and congressional staff," says Beckwitt. "It was all about educating the public and our legislators about the landscape impacts of the forest practices of the time."

In the 1990s, Beckwitt began focusing on professional GIS consulting work, primarily in support of academic scientific research projects. He contributed his expertise to an assessment of the Pacific Northwest's Inland Empire, published by the Wildlife Society, which eventually led to a major Forest Service study. He trained graduate students at the University of California, Davis, to use GIS for the Sierra Nevada Ecosystem Project, a regional landscape assessment requested by Congress in 1992. Later, among many other consulting projects, he provided fire impact modeling for Grand Canyon National Park's Environmental Impact Statement.

"Once GIS became available, it was impossible to do a thorough assessment without it because of the power of the tools and the ability to explore relationships between different themes," says Beckwitt. "GIS is fundamental for inventorying the various facets of our environment and for developing indicators to monitor and assess environmental change over time. It helps guide public policy—and personal policy, too."

By this point, Beckwitt was also consulting internationally. Under a U.S. Agency for International Development (USAID) grant, he and one of his sons traveled through Russia to evaluate how GIS could be applied toward conservation efforts in protected areas that were struggling after the collapse of the Soviet Union.

Shortly thereafter, he met a representative from the Wildlife Institute of India who was preparing a presentation on the Narmada Dam for the World Bank. Beckwitt assisted with the GIS analysis portion of the presentation, which communicated the potential impact of the dam and had a powerful effect on policy. The Wildlife Institute of India then asked him to become a United Nations consultant. In that capacity, he trained scientists to integrate GIS into their wildlife research and helped establish a database of protected areas, including tiger and elephant habitats.

In 2006 and 2007, Beckwitt worked with a team of scientists to establish citizen-managed protected areas in the Four Great Rivers region of eastern Tibet. In 2008, Tibetan political turmoil limited access to the area and halted the project. "We'd love to go back and continue," he says.

Sharing Technology to Help Preserve Natural Resources

For the past 20 years, Beckwitt has helped others pursue their conservation efforts by advising Esri on its grants of GIS technology to deserving organizations. He helps ascertain each organization's goals, accomplishments, resilience, and technical capacity and determines which products best meet their needs. He continues to support grantees by evaluating maintenance grant requests to keep their GIS technology up-to-date. In addition, since 1996, he has consulted for the U.S. Forest Service and other government agencies on their conservation-related contracts with Esri. He also currently serves as the senior GIS consultant to the State of California's Sierra Nevada Conservancy.

Beckwitt cites several exceptional examples of large organizations leveraging GIS technology to advance conservation efforts, such as the Nature Conservancy and the Wilderness Society. Those that stand out the most to him, however, are small, grassroots organizations, such as the Pacific Biodiversity Institute, that use GIS to create maps and models to analyze vegetation and habitat suitability.

"I'm most proud of having been involved in helping thousands of organizations get GIS projects up and running and providing technical support when needed," notes Beckwitt. "If I were to look back at my life in terms of having an impact on the world, that's probably it. It was a small impact, but it was wide ranging, and I'm glad I did it."

More Information

For more information, contact Steve Beckwitt (e-mail ecp@esri.com and put ***@steve*** anywhere in the subject line).

Getting to Know the Mapping Sciences Committee

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a unique and important vehicle for advancing the science relating to geographic information in the United States.

Introduction

To understand the Mapping Sciences Committee, it is first important to understand the role that the National Academy of Sciences (NAS) has played in United States history. The NAS origins lie in the Civil War, when President Abraham Lincoln was attempting to get access to the highest level of expertise and knowledge available to the small and stretched federal government. The Civil War Act of Incorporation, signed by Lincoln on March 3, 1863, established service to the nation as the dominant purpose of the National Academy of Sciences. The initial mission was to "investigate, examine, experiment, and report upon any subject of science or art" whenever called upon to do so by any department of the government. With only a small number of initial members, the early NAS took on studies commissioned by the government on everything from weights and measures to currency to the permanence of military gravestones. Slowly, the workload increased, such that in 1916 the academy established the National Research Council (NRC) at the request of President Woodrow Wilson to recruit specialists from the larger scientific and technological communities to participate in advising the nation during World War I. With the armistice in 1918 and the formal end of the war in 1919, Wilson issued an executive order asking the academy to perpetuate the National Research Council for the peacetime to follow. This arrangement has persisted: subsequent executive orders by President Dwight Eisenhower in 1956 and President George H. W. Bush in 1993 have reaffirmed the importance of NRC and further broadened its charter. The academy has enjoyed presidential support, most recently when President Barack Obama addressed NAS on April 27, 2009, stressing the value of expert scientific advice to the nation.

Today, the National Academies perform an unparalleled public service by bringing together committees of experts in all areas of scientific and technological endeavor. Experts serve pro bono to address critical national issues and give advice to the government and the public. Four organizations now comprise the National Academies: Institute of Medicine, National Academy of Engineering, National Academy of Sciences, and National Research Council. Members of the National Academy of Sciences are elected to the prestigious office and include GIScientists such as Michael Goodchild, Waldo Tobler, and Luc Anselin.

While NRC has conducted many mapping-related studies, MSC has somewhat more recent origins. In 1989, NRC established MSC to provide "independent advice to society and to government at all levels on scientific, technical, and policy matters related to spatial information." MSC's initial years coincided with the developing vision of a U.S. National Spatial Data Infrastructure.

Public Domain Geospatial Data

Two early reports in particular set forth many of the arguments that later found their form in the many projects to make public domain geospatial data available over the Internet and the World Wide Web. In 1990, the Office of Management and Budget (OMB) established the Federal Geographic Data Committee (FGDC), an interagency group that has remained important in the development of standards, policy, and Web portals ever since. In 1994, under President Bill Clinton, Presidential Executive Order 12906 was issued, calling for a national "Spatial Data Infrastructure," formalizing standards across the government and smoothing the way for accessible and useful geospatial data from many agencies, such as the Census Bureau, National Oceanic and Atmospheric Administration (NOAA), and the United States Geological Survey (USGS). By the end of the 1990s, the vision of ubiquitous and highly accessible data for the general public saw several practical implementations, including MapQuest (1996) and TerraServer (1998). MSC input had led federal agencies to think seriously about public data, open access, and value-added information.

Since 2000, we have seen the rise of the concept of a Digital Earth; the 2002 Revision of Circular A-16, *Coordination of Geographic Information and Related Spatial Data Activities;* the 2002 *National Map* (which was reviewed in concept by MSC); the e-initiatives and Geospatial One-Stop (2003); and, by 2005, the popularization of new Web mapping and visualization technologies.

The Promise Becoming Real

Much of the promise of concepts examined in the early MSC studies had, in effect, come into existence. Given this, MSC's scope not only started to broaden for reasons of national needs but also because GIScience was already being considered a mature, rather than an emergent, field of study.

The scope of MSC includes the following:

- Fundamental research and science for advancing geographic information technologies
- Policies affecting the development and use of spatial data throughout society
- Technological and institutional developments needed for improving the capabilities of spatial data infrastructures
- Coordination opportunities and efforts from local to global scales for the collection and dissemination of spatial data
- Human resources and education in support of the advancement of geographic information science
- Hardware and software systems in support of the advancement of geographic information science and spatial data infrastructure developments

MSC Range of Activities

The Mapping Sciences Committee still performs important functions and often drives major issues surrounding geographic information science. The committee's membership is appointed, and appointments are carefully screened to balance the user communities that the committee serves, including the government, industry, and academia. All NRC committees are held to rigorous standards of independence and peer review. Goals are to provide an impartial forum for discussing geospatial issues, develop emerging study ideas, respond to agency and congressional requests, conduct outreach, and host the National Geospatial-Intelligence Agency (NGA) Academic Research Program Symposium. Most meetings have both open and closed sessions; open sessions are public meetings, and a great deal of the information assembled and used (including the reports as PDF files) is distributed either via Web sites or the National Academies Press (**www.nap.edu**).

The Mapping Sciences Committee organizes and oversees studies that provide independent advice to society and government at all levels on scientific, technical, and policy matters relating to spatial data. It also addresses aspects of geographic information science that deal with the acquisition, integration, storage, and distribution of spatial data. Furthermore, through its studies, the committee promotes the informed and responsible development and use of spatial data for the benefit of society. The committee primarily does this by commissioning studies, assembling teams of well-qualified individuals willing to serve on those committees, and seeing the studies through to their results by holding a workshop or producing a major report.

The committee members' responsibilities include surveying and assessing the field and its development and soliciting ideas on problems and opportunities from the broader community (agencies, academia, the private sector). This is sometimes done by having theme meetings, where briefings and discussions during one day of the twice-yearly meetings are devoted to an area with the potential for a new study. The committee also nominates ad hoc committee membership and oversees the follow-up to the various reports created. In most cases, MSC deals with selecting a report topic, writing and clarifying the statement of task for the study, collaborating with the report's sponsors, and nominating members of the ad hoc committee. At that point, the ad hoc committee takes over the task of conducting the study, often spread over multiple meetings, workshops, briefings, etc. The ad hoc committee writes the report, which is edited and subjected to rigorous external peer review.

The last few years have been very active for MSC, with a strong sequence of reports published,

many of which have drawn a great deal of attention and interest nationally.

In 2009, MSC released the report *Mapping the Zone: Improving Flood Map Accuracy.* This study examined the factors that affect the quality and accuracy of flood maps; assessed the costs and benefits of map improvement efforts; and recommended ways to improve flood mapping, communication, and management of flood-related data.

This research has proved valuable in follow-up activities related to flooding and hurricane impacts. The study concludes that even the most expensive aspect of making more accurate maps—collecting high-accuracy, high-resolution topographic data—yields more benefits than costs and that continued investments should be made in updating and improving flood maps.

This study was sponsored by the Federal Emergency Management Agency (FEMA) and NOAA.

Mapping the Zone followed another flood-related report from 2007, *Elevation Data for Floodplain Mapping.* That report examined the adequacy of the basemap information available to support FEMA's floodplain map modernization program.

The report concluded that existing land surface elevation data is not adequate to determine whether a building should have flood insurance and recommended that high-accuracy lidar data be collected nationwide and incorporated into the National Elevation Dataset that USGS maintains for flood mapping and other applications. This report was a direct response to a congressional request.

Many NRC reports have been related to the basics of collecting geospatial data for the nation. The report *National Land Parcel Data: A Vision for the Future,* also from 2007, assessed the status of land parcel data (also known as cadastral data) in the United States and concluded that nationally integrated land parcel data is necessary, feasible, and affordable. The report recommended ways to establish a practical framework for sustained intergovernmental coordination and funding that are required to develop a nationally integrated land parcel data system.

This highly circulated study was sponsored by the Bureau of Land Management, the Census Bureau, the Department of Homeland Security, the Federal Geographic Data Committee, and Esri.

The year 2007 was a bumper year for MSC. Also published that year was *A Research Agenda for Geographic Information Science at the United States Geological Survey,* which assessed current GIScience capabilities at USGS, recommended strategies for strengthening these capabilities and for collaborating with others to maximize research productivity, and identified research areas.

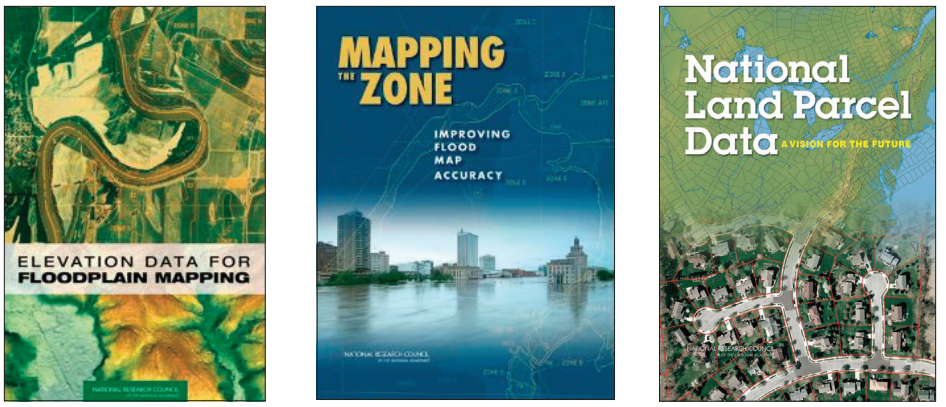
The report called for an initial focus on improving the capabilities of the *National Map,* which required research on information access and dissemination, data integration, and data models.

USGS, which sponsored the study, has placed into action many of the report's recommendations, including a new release of the National Map Viewer. The year 2007 also saw completion of an important report reflecting lessons learned from Hurricane Katrina in 2005. *Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management* was a report designed to assess the use of geospatial data, tools, and infrastructure in disaster management. It recommended that significant investments be made in training of personnel, coordination among agencies, sharing of data and tools, planning and preparedness, and development of tools.

Sponsors were the National Aeronautics and Space Administration, NGA, NOAA, and USGS.

These reports cover most of the scope of MSC's research tasks, examining technologies and science challenges surrounding issues of national importance. By holding regular meetings and briefings and by focusing on meeting themes, MSC continues to strive toward providing guidance and leadership on national geospatial issues. Other groups—professional societies, trade organizations, the National Geospatial Advisory Committee, and state and local organizations—and many other entities follow the GIScience industry and its needs. What distinguishes MSC are its forward-looking focus, a foundation in science, support from rigorous peer review, and the ability to make recommendations likely to influence policy.

The list of ongoing issues and studies is continuously evolving. Current studies and meeting information, including membership, are available from the committee Web site at **dels.nas.edu/global/besr/MSC**. MSC hopes to remain at the heart of the nation's activities surrounding geospatial data and information and to continue to serve the nation as we "investigate, examine, experiment, and report upon" the mapping sciences, a field where the United States often leads the world.



The Mapping Sciences Committee releases many reports that have drawn national attention and interest.

About the Author

Dr. Keith C. Clarke is a research cartographer and professor. He holds an M.A. and a Ph.D. from the University of Michigan, specializing in analytic cartography. He joined the faculty at the University of California, Santa Barbara, in 1996. Clarke's most recent research has been on environmental simulation modeling, modeling urban growth using cellular automata, terrain mapping and analysis, and the history of the CORONA remote-sensing program. He is the author of the textbooks *Analytical and Computer Cartography* (Prentice Hall, 1995) and *Getting Started with Geographic Information Systems*, 5th Edition (Prentice Hall, 2010). He is now the chair of the Mapping Sciences Committee of the National Research Council.

More Information

For more information, contact Professor Keith Clarke, University of California, Santa Barbara (e-mail: kclarke@geog.ucsb.edu).

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Widespread Adoption of GIS in Public Safety

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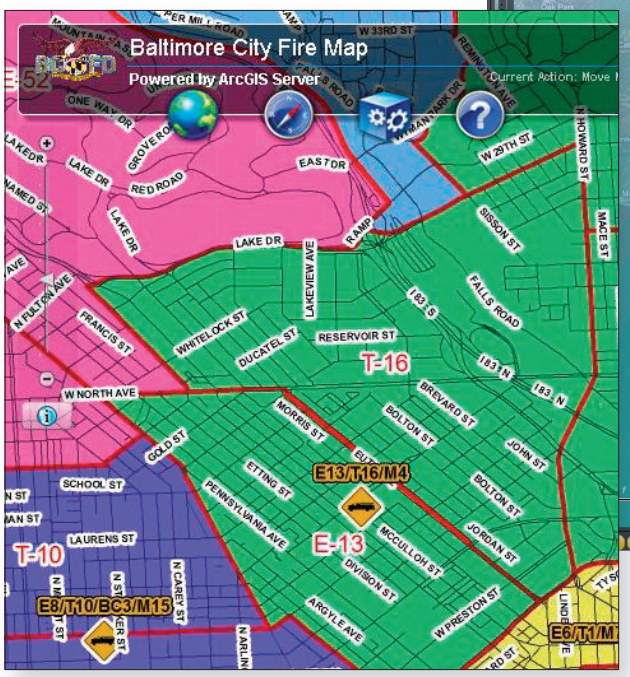
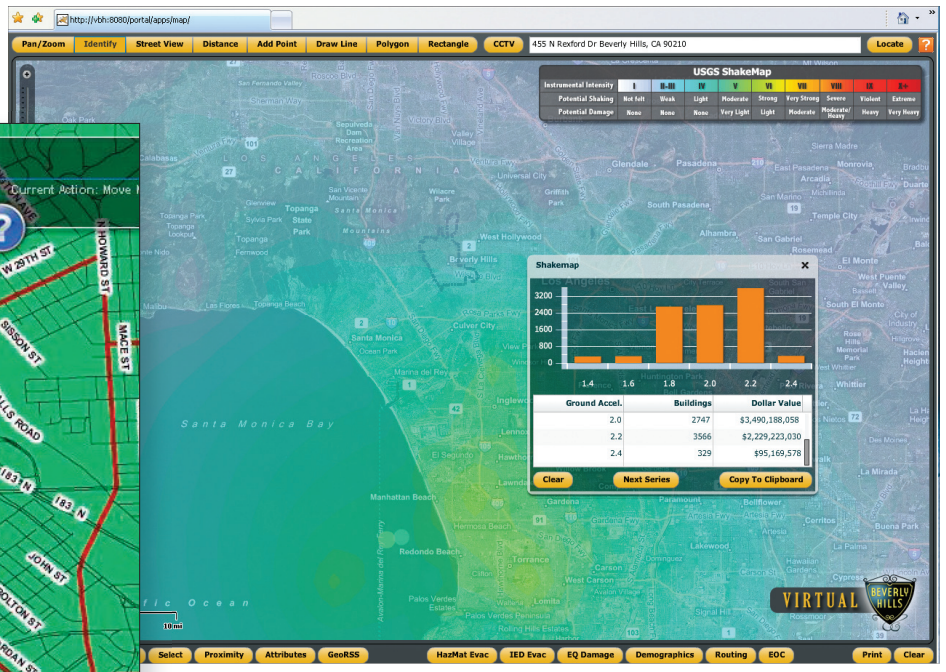
Highlights

- Miami-Dade County's ArcGIS software-based FLIPPER supplies real-time information from the State of Florida Web site.
- Baltimore Fire uses ArcGIS API for Flex to push out building information quickly and easily to responders.
- The City of Beverly Hills develops GIS tools essential for emergency management and public safety.





Left: The red lines distinguish the Baltimore, Maryland, inspection area (designated area for hydrant, home visit, and building inspections) for each company. Above: Virtual Beverly Hills is used to visualize real-time earthquake ground acceleration value recorded by the U.S. Geological Survey/California Institute of Technology.

wouldn't think of it as something used daily in firehouses or local city government buildings. Public safety agencies have used state-of-the-art computers and information systems to capture data for emergencies, but this type of high-tech emergency management involved multiple pieces that weren't connected, and data certainly wasn't available in real time using a single seamless interface.

GIS has long provided an integration platform for meeting the mission of public safety. This includes providing data management, planning and analysis, field enablement, and situational awareness. From 9/11 to Hurricane Katrina to the 2007 fires in California and the more recent Haiti earthquake and Gulf of Mexico oil spill, GIS has been a foundational technology linking data and workflows.

A more recent development has transformed how many agencies prepare and respond to disasters using real-time information.

Esri developed an API—ArcGIS API for Flex—that enables people in public safety to build dynamic, rich Internet applications on top of ArcGIS Server. These agencies can create interactive Web applications that take advantage of ArcGIS Server resources—such as maps, locators, feature services, and geoprocessing models—and Flex components, such as grids, trees, and charts.

This is creating a profound shift in the use of public safety GIS. More agencies can now build an intuitive solution for creating situational awareness. All types of data and information are tied together and viewed in real time using the map as the interface.

Organizations everywhere are building their own systems using ArcGIS API for Flex to more effectively carry out their missions. Following are just a few examples.

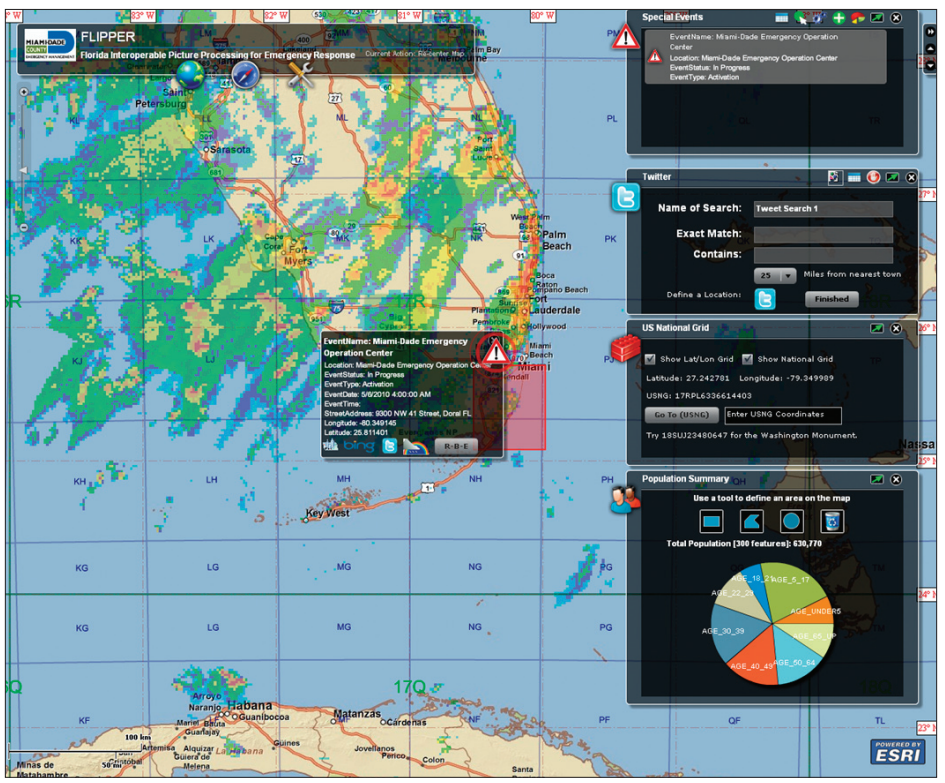
Miami-Dade County

The Miami-Dade County, Florida, Department of Emergency Management has unique challenges, even for an agency that expects the unexpected. Since the City of Miami is a tourist mecca and hosts major sporting events, like the National Football League's 2010 Super Bowl and Pro Bowl, providing safety and preparedness can be an arduous undertaking. This is only made more complex by the area's risk of natural disasters.

The agency has developed a solution to meet these challenges. The Florida Interoperable Picture Processing for Emergency Response (FLIPPER) was built to make more information available using the Web and a highly intuitive map interface.

FLIPPER is built using ArcGIS Server and the Flex Viewer. It is integrated with WebEOC, a Web-enabled crisis information management system from Esri partner Esi of Augusta, Georgia, that provides secure, real-time information. FLIPPER gets the data from WebEOC and links it to additional live data feeds.

As the Gulf of Mexico oil spill stretched from weeks to months—and the impact potentially lasting for years—FLIPPER supplied real-time information from the State of Florida Web site when and where it was needed as the office tracked the oil response.



For Miami-Dade County, Florida, live information, such as Twitter and National Weather Service data, is shown in combination with population and the U.S. National Grid on the same map.

FLIPPER also helped the county with international responses. "For the Haiti earthquake, we reached out to help with the response, and FLIPPER was a tool we used," says Soheila Ajabshir, systems manager, Department of Emergency Management, Miami-Dade County.

FLIPPER has many tools available. It supplies Request By Exception (RBE) functionality, which allows a person to view more than 6,000 critical facilities, such as schools, fire, police, hazmat sites, and hospitals, based on a set vicinity. Tools and applications, such as Twitter, Bing Maps, hazardous plume modeling, live traffic, U.S. National Grids, and population estimates, are tied to FLIPPER and viewable via the unified map interface. FLIPPER is designed to use WebEOC prepopulated boards/data, such as mass migration and nuclear plants.

Baltimore Fire

Led by fire chief James Clack, the Baltimore, Maryland, City Fire Department serves a geographic area of 81 square miles and a population of more than 640,000 residents. The department has more than 1,800 members, who are divided into two management branches—Emergency Operations and Planning and Administration. The department responds to more than 235,000 emergency 911 calls per year.

For every single call, emergency responders need to know as much information as they can about the incident and its location before responding. Building information is often captured and maintained using large databases, but getting that information quickly and easily to fire personnel responding to a call can be a challenge. Paper notebooks with building preplans help responders know what they're walking into, but they can be cumbersome.

Baltimore Fire is piloting the use of ArcGIS API for Flex to push out building information quickly and easily to responders. The agency, which is an Esri 2010 Special Achievement in GIS Award winner, has in just two years built a robust ArcGIS platform. It has developed successful applications, such as its GIS-based digital pegboard, that are changing the way the agency serves its citizens. The ArcGIS API for Flex application is a new method being tested to better supply building information using an intuitive map display.

"This application will aid first responders to view and become familiar with the location of vacant buildings in their districts," says Peter Hanna, firefighter/paramedic and GIS manager, Baltimore Fire. "The first objective of fighting a fire is that everyone goes home, and this joint effort between the city's Housing Authority, which collects the data, and the fire department, which is building the application, will help greatly in firefighter safety efforts."

Fire staff can view the data and pan and zoom to any of the 4,000-plus buildings deemed "dangerous" by the city's Housing Authority. They can then click a particular building icon to see available information specific to that structure.

Virtual Beverly Hills

Known for its affluence and celebrity residents, the City of Beverly Hills, California, also has many emergency management concerns. It hosts major events like the Golden Globe Awards and the Los Angeles Marathon, has dignitaries visiting from around the world, and is situated in an area prone to natural disasters. All this has spurred the city's need for actionable, cross-jurisdictional geospatial information. To this effect, Beverly Hills designed and deployed a unique, city-level version of Virtual USA—an initiative aimed at improving decision making for local, state, tribal, and federal homeland security practitioners. Called Virtual Beverly Hills (VBH), the comprehensive system—based on ArcGIS—helps prepare for and respond to special events, earthquakes, wildfires, and hazmat and explosive material incidents, as well as daily operations like analyzing crime patterns.

"The power of GIS to manage and analyze spatial data, together with its performance and presentation advantages, offered us a good combination," says Lema Kebede, GIS manager of the City of Beverly Hills. "We were able to develop advanced spatial analysis and intuitive reporting tools. This is essential for emergency management and public safety, where speed, usability, interoperability, and availability are critical."

VBH integrates various datasets to provide instantaneous access to situational information from multiple sources. Its enterprise geodatabase hosts more than 120 detailed layers representing all departments. More data is automatically generated from the city's property records, police record management systems, and human resources databases. Live spatial feeds include thematic earthquake shake maps, fire perimeters, weather, closed-circuit television, automated vehicle location, and reported emergency incidents. In addition, users have the ability to view any GeoRSS feed. VBH's security profile controls what data and tools are available for each user. Additionally, integrated analytic tools generate real-time reports.

More Information

For more information, contact Russ Johnson, Esri (e-mail: russ_johnson@esri.com).

Opening the World to Everyone

continued from cover

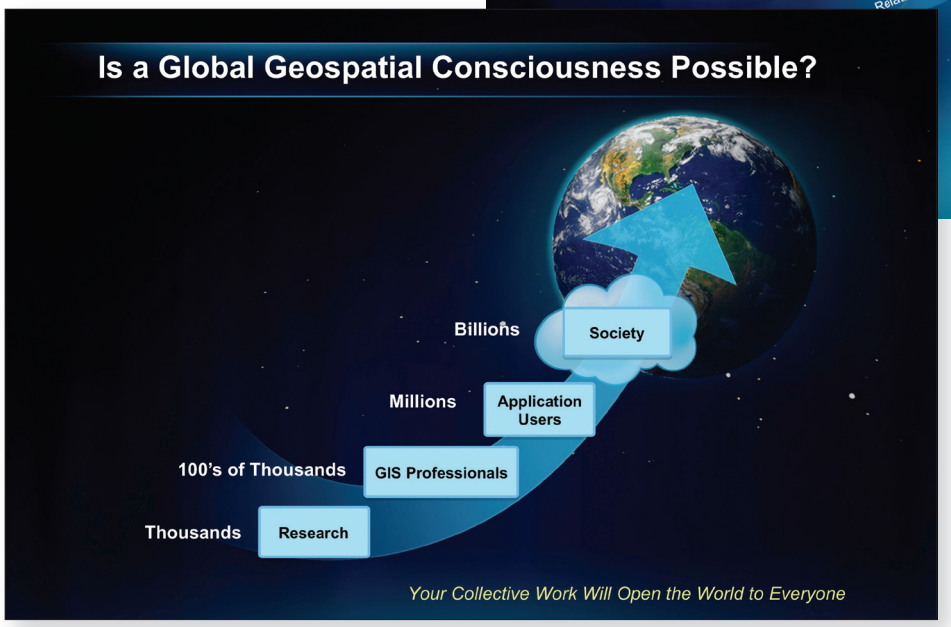
governments transparent, accountable, and engaged with citizens. Geographic knowledge itself is becoming a new kind of infrastructure, driving all the agencies in regions and countries of the world to work together in new ways.

The New Explorers

Geography—the scientific foundation of GIS—was for many years concerned with exploring and describing our world. Early explorers led grand expeditions to the poles, to the tops of mountains, to the bottoms of the oceans, the farthest reaches on the globe. Through their explorations, they discovered a new understanding of how the world works, and they came back to share their new understanding with everyone else.

About 50 years ago, a new kind of geography was born—I like to call it *computational geography*—which opened up our world to new forms of exploration: not just treks to the tops of mountains but research and analysis of the relationships, patterns, and processes of geography. This is leading to a much deeper understanding of how our world works. This new exploration leverages computers, mapping, and geographic science. The early explorers were driven by curiosity, as we saw with Waldo Tobler, David Simonett, and John Borchert. Some, like Roger Tomlinson, Carl Steinitz, and Duane Marble, were more interested in the applications of geographic information. Their work led to the development of a new technology: GIS. GIS has advanced the science of geography itself, implementing systematic measurements, digital data models, quantitative analysis, and modeling—the underpinnings of everything that supports the work of geospatial professionals today.

Esri recently concluded its 30th Annual International User Conference. More than 13,000 people were in attendance, coming from 134 different countries and 6,000 different organizations, representing a wide variety of disciplines, with a multitude of interests. The collaboration, camaraderie, and sharing we experience every year at the User Conference are quite inspirational. For those who were able to attend this unique event, we appreciate your participation and thank you for your valuable contribution to the community. Esri president Jack Dangermond has provided this summary of his thoughts behind this year's conference theme "GIS: Opening the World to Everyone."



For GIS evolution to occur, we must find ways to share geographic knowledge with everybody and to integrate this knowledge into everything we do.

Much of our world remains unexplored, and there are many geographic problems left to solve—population growth, environmental degradation, loss of biodiversity, climate change, globalization, lack of sustainability, urbanization, health care, poverty, hunger, and more. We still have a long way to go to develop a comprehensive understanding of our world. And we need the participation of everyone—not just government administrators, scientists, and GIS professionals, but *everyone* deserves a voice in these important issues.

Today, thanks to new Web mapping technologies and visualization, everyone can be an explorer. Everyone now has tools to examine the earth in different ways. Everyone has the potential to discover something new. This democratization of exploration and spatial analysis will lead to a better, more complete, more equitable understanding of our world and open new dimensions in our relationships with each other and our planet.

Our New Infrastructure

GIS is already the tool of choice for organizing our geographic knowledge. Professionals have widespread access to this important body of knowledge and leverage it every day to support complex decision making. For the next step in GIS evolution to occur, we must find ways to share this knowledge with everybody else—to integrate this geographic knowledge into everything we do. Building communities—working across disciplines, across geographies, across organizations, and across cultures—is a key aspect of this sharing. Is it really possible to develop a global vision of GIS, leveraging our collective geospatial investments and knowledge, and make GIS available to everyone?

Many forces are currently converging to facilitate the opening of geographic knowledge to everyone. Computing technology continues to evolve, following Moore's Law: *The number of transistors on a chip doubles every two years.* Machines, networks, and the Internet have become faster, and there has been the recent explosion in the use of mobile devices. Measurement is also increasing with more sensor networks, real-time delivery, and the recent addition of geographically referenced crowdsourced data. GIS software is also evolving in its ability to handle temporal data and provide full 3D support and, therefore, many more new features, all while becoming much easier to use. At the same time, GIS is coevolving with geographic science, increasing our understanding of relationships, patterns, and processes that are now extending into a greater understanding of networks. And perhaps the biggest force of all is the opening of government: open data policies are providing the underpinnings for this information to come together, creating a collective geographic understanding, truly opening our world to everyone.

GIS professionals are playing key roles in making this geographic knowledge available: sharing data and publishing apps and services. They are also developing more collaborative approaches—from connecting to other parts of their organizations to serving citizens with information, using maps as a common language to communicate with and engage everyone in a geographic context.

All these efforts are creating a Web-based, geospatial platform for creating, storing, sharing, and using geographic knowledge, and people will become increasingly dependent on it. When technology is so universally adopted that society becomes highly dependent on it, it can be considered infrastructure. And that's really what we are all building here: a geospatial infrastructure that is the basis for opening geographic knowledge to everyone. GIS has been a very useful tool for more than 40 years, but we are about to discover its true power: the power to transform the way we all live.

More Information

To watch videos of the 2010 International User Conference plenary, visit www.esri.com/uc. For more information on ArcGIS 10, visit www.esri.com/arcgis10. We hope to see you in San Diego next year, July 11–15, 2011.

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GIS for Everyone—A Dream Coming True

New Era of Geographic Information Sharing Highlights at the 2010 Esri UC

Geospatial professionals from 134 countries representing 6,000 organizations gathered in San Diego for the 2010 Esri UC.

The 30th Esri International User Conference (Esri UC) was the largest gathering of the GIS community ever. People from 134 countries representing 6,000 organizations learned how GIS is changing collaboration for doing work and managing the enterprise. Experts described how technological advancements in GIS have changed the global geospatial landscape. During the weeklong event held in San Diego, California, in July, more than 13,000 attendees participated in talks, watched software demonstrations, and attended paper sessions describing the ways that geospatial information and analysis are becoming available to everyone.

Esri president Jack Dangermond's plenary address described the role of GIS in a new era of information sharing. "Converging forces of advancements in computers, the Web, mobile devices, real-time measurement, and GIS software are making a high level of collaboration possible," Dangermond said. "A Web-based geospatial platform with a distributed network of data and services is changing the way we work together."

Esri technology experts demonstrated how ArcGIS 10 is a system that can be used to collaborate in an enterprise environment that is connected to everyone else. They demonstrated Community Maps, ArcGIS Online, ArcGIS.com, ArcGIS for iOS, productivity in ArcGIS 10, the integration of Python scripting, imagery, ArcGIS Network Analyst, and analysis using 3D and new space and time enhancements.

Cloud technology is driving a different class of Web apps. The recently formed business City Sourced showed mobile apps that allow people with location devices to see and report geodatabase information. This means they can become involved in their communities and that cities can better interact with their citizens. The team at City Sourced represents a new league of developers who start from the base of geoinformation and move directly to creating Web-based geoapplications. "We don't see ourselves as GIS programmers; we are consumers of the services," said City Sourced CEO Kyle Brinkman.

Bigfork High School students Tia Bakker and Ernie Cottle from Montana took the stage wearing caver helmets. They explained their GIS analysis of cave natural resources inside Glacier National Park. Their teacher and GIS mentor Hans Bodenhamer encouraged the many GIS professionals in the audience to volunteer as GIS mentors to the youth in their communities.

Author of more than 80 books and founder of the renowned Technology, Entertainment, and Design (TED) conferences, Richard Saul Wurman gave the keynote presentation. He and Jon Kamen, CEO of @radical.media, described the project 19.20.21 that studies the 19 cities in the world with populations of more than 20 million people in the 21st century. Wurman discussed the necessity of standards for sharing and comparing urban information *(see below)*.

The success of GIS is community based. Esri acknowledged 200 organizations for outstanding work in their organizations and industries by giving them the Special Achievement in GIS (SAG) Award.

The Abu Dhabi Systems and Information Centre, United Arab Emirates, received the Making a Difference Award for its use of GIS to manage cities, utilities, health, response, and science. Abu Dhabi has also provided technology and expertise to the global community. His Excellency Mohammed Ahmed Al Bowardi, secretary-general executive council, Abu Dhabi, accepted the award. More than 60 delegates from the emirate attended the Esri UC. During the week, they showed several enterprise GIS applications that provide insight for decision making.

Dangermond acknowledged the work of the United Nations and especially its cartographic and statistical unit that has diligently worked to bring standards and templates to build a foundation for GIS users throughout the world.

The City of Frisco, Texas, received the President's Award *(see page 9)*. Frisco has embedded GIS throughout the community from the school district to health care to incident response. Paul Siebert, the city's assistant fire chief, came onstage to the sound of flashing lights and alarms. Dressed in firefighter gear, he showed all the ways GIS is used in responding to an early morning smoke alarm from the high school: routing, water system, real-time camera feed, and facilities plan. City of Frisco information services and GIS manager Susan Olson accepted the award.

The Lifetime Achievement Award was presented to Carlos Salmán Gonzalez, the president and CEO of Sistemas de Informacíon Geográfica, S.A. (SIGSA), Esri's distributor in Mexico. He brought modern mapping tools to Mexico. He also purchased a nursery and led a movement that has planted millions of trees in that country. After working for the Mexican government, Gonzalez opened his own mapping company, which today is the largest mapping company in South America.

National Geographic Society's board chairman Gil Grosvenor awarded the society's highest honor, the Alexander Graham Bell Award, to Jack Dangermond for his innovations that are transforming the world of geography, bringing the use of geographic information to every part of the globe. Grosvenor also presented the Alexander Graham Bell Award to Roger Tomlinson, the "father of GIS." "The award honors Tomlinson's qualities of great innovation," said Grosvenor. "His efforts have made geographers out of people who didn't even know they were geographers."

Throughout the week, conference attendees had the opportunity to talk with experts in their fields, geospatial technology vendors, and consultants; mingle with groups during Special Interest Group sessions; share their GIS maps in the poster and digital map galleries; attend ArcGIS software technical sessions; participate in lightning talks for fast application synopses; see demonstrations of software applications, tools, and solutions; and sit in on session and panel discussions provided by fellow users.

Next year's Esri UC will be held July 11–15 at the San Diego Convention Center, San Diego, California. Highlights and presentations from the Esri UC are available on the conference Web site at **www.esri.com/uc.**

Thought Leaders Describe Their Vision of 19.20.21 at Esri UC

Measuring Super Cities

Most people in the world live in cities. Populations in urban areas are growing at a higher rate than the population as a whole. Cities need to plan for their futures, have a vision for the use of urban space that reduces poverty and promotes sustainability, protect the environment and manage ecosystems, and improve the nature and form of future urban expansion. To do this, people need good information that helps them ask the right questions for understanding urban situations and design solutions that support a sustainable future.

Cities flow over their political boundaries, land-use descriptors vary, and definitions of population density differ. Effectively measuring cities at a global level requires a common yardstick, a universal language, and standard methodologies that allow us to understand the city itself and to compare cities with each other. The initiative 19.20.21 is designed to help people better understand our world's urban environments.

Richard Saul Wurman, a prolific author and the founder of the Technology, Entertainment, and Design (TED) conferences, conceived the project 19.20.21 from the realization that there will be 19 cities in the world with populations of 20 million people in the 21st century. "Large urban hubs will radically redefine the world's future macroeconomic and cultural landscapes," said Wurman. "It is critical to gain a truer understanding of what is happening. The rise of super cities is the defining megatrend of the 21st century. Furthermore, the growth of cities has global challenges, such as shipping, food supply, and meteorological patterns."

One objective of 19.20.21 is to create methodologies for studying super cities. To do this, 19.20.21 partners want to drive the standardization of urban data and methodologies; design urban observation resources that help people learn about their city and how it compares to other cities; and disseminate information via communication media, such as printed publications, television, live presentations, and the World Wide Web. Wurman envisions a free Web site that would provide access to detailed, extensive, and standardized data, including graphics, maps, videos, and links. "People will be able to go to these resources to ask questions, do comparative analysis, and communicate with people around the globe," he said.

Wurman teamed up with project partner chairman and CEO of @radical.media Jon Kamen and president of Esri Jack Dangermond. These three thought leaders explained the vision of the 19.20.21 project to the audience at the 2010 Esri International User Conference. They presented a mocked-up version of an urban observatory, a place where people could immerse themselves with this information, interact with it, and see it in a new and different way. The presentation included five different ways of measuring and comparing cities:

Jon Kamen and Richard Saul Wurman.

- Population density and demographics—Education levels, immigrant communities, and age
- Modes of transportation—Cars, taxis, subways, and bicycles and percentage of usage by mode
- Health—Hospitals, trauma centers, epidemiology, accessibility, and proximity
- Crime—Police precincts, violent and nonviolent crime classifications, and social services
- Land use—Dwellings, parks, and industrial areas

"By comparing this data, people can see relationship patterns emerge," noted Kamen. "For example, in the Bronx neighborhood of New York City, you can see crime activity on the map. You can also see data about the area's dwelling types, population density demographics, and land use. This might cause a person to ask the question, Are these factors related to crime rates? The following question might be, If so, do other cities have a similar pattern?

Seeing these similarities helps analysts understand an urban problem and think about ways to solve it. They can compare their findings to other cities, look at the ways those cities have approached the problem, and consider how these solutions would fit into their own city's landscape.

The challenge to understanding mass urbanization is that no two cities currently measure themselves in the same way. Land-use patterns are different between cities because cities have different land-use classification systems. Even cartographers disagree on mapping methodologies. For instance, in an atlas of urban land use, the reader will note wide variations in legends and category definitions. Without standardization, it is difficult if not impossible to do legitimate comparisons.

To ensure the success of a worldwide mechanism for people to share urban information, people must use common measurements and methods for collecting and sharing information. Wurman believes that it will be easy to get people to adopt the standards if they have the means to do it.

Dangermond agreed. "If all cities harmonize environmental performance indicators, sustainability indicators, and other indicators, we will have a common metric for comparing progress," he said. Esri already makes it possible for people to create and share community maps and content using ArcGIS Online. Esri also works with users and partners to develop templates that help people harmonize data and classifications.

With harmonized databases, people can use GIS to study urban environments, do comparative analysis, and create designs that will improve life in the 21st century.

"I believe that public information should be made public," concluded Wurman. "Although this seems a benign statement, it is not benign. Rather, it is a very political statement. Making urban information available, accessible, and understandable pushes action. The urban observatory will offer people everywhere real-time information about where they live on this planet."

More Information

For more information, visit **www.192021.org**.

High Tech Leads to Higher School Safety

City of Frisco, Texas, Wins Esri President's Award

Highlights

- SAFER helps visualize the scene of an incident so that response planning can begin immediately.
- Emergency responders can easily drill down into the information they require at a moment's notice.
- The application lowers risk and better prepares responders on the way to an emergency.

A hazardous chemical spill in a classroom science lab; a cafeteria kitchen fire; or worst of all, a school shooting—these are the events that school authorities, parents, and public safety officials alike dread. Maintaining school safety and effectively responding to any type of emergency are continuous processes. Thankfully, technology is helping in these endeavors. Better communication equipment, live cameras, and databases with building footprints and other information help schools plan for incidents, and responders get the information they need when an emergency strikes.

One local government's school safety journey just took a quantum leap. The City of Frisco, Texas, now deploys an application called Situational Awareness For Emergency Response (SAFER), which provides fire, police, and emergency responders with access to maps and live data feeds while en route to school incidents. SAFER takes advantage of Esri partner GeoComm's GeoLynx solution, which is built using ArcGIS technology. The system became fully operational at the City of Frisco in 2009.

Using GIS as an integration platform, the City of Frisco is able to integrate volumes of data using an intuitive map interface. Responders view school maps and other information while racing to an emergency. They have a better understanding of what they're facing when they arrive. Officials at command centers and other remote locations can see a macro-level view of events and drill down to a specific area or room in a school to understand how the response is unfolding. More information is made available in a faster time frame. It's the key to a better response and, ultimately, safer schools.

"The project makes the schools, students, and first responders safer," says Susan Olson, GIS manager, City of Frisco. "It enables public safety departments to better serve the school district. Implementing this system has allowed the departments to reduce operations costs by having all relevant information easily accessible in one place. It lowers risk and better prepares responders on the way to an emergency."

SAFER makes it easier to visualize the scene of the incident and begin planning response immediately. It also improves the communication between the City of Frisco's emergency responders by presenting a common operating picture. Critical decisions can be made quickly by everyone using shared information.

"SAFER has provided us with the kind of information we have always wanted to have while responding to an emergency," says Mack Borchardt, City of Frisco fire chief. "Site plans, floor plans, contact information, and hazard information all feed directly to those first responding units to give them the awareness they need. When you put the cameras on top of that, you're looking at a level of situational awareness that is unheard of in this industry."

The application and its deployment have proved so innovative and successful that the City of Frisco was honored with the prestigious Esri President's Award. The award was presented at the 2010 Esri International User Conference, held in San Diego, California.

"The City of Frisco's SAFER program demonstrates the role that GIS can play in enhancing communications for multiple agencies and ultimately improving emergency response to their citizens," says Jody Sayre, vice president of Client Services at GeoComm. "The City of Frisco's SAFER project team was highly engaged in this project from day one, and it is very deserving of this award."

The SAFER program includes GIS links to more than 1,500 Frisco school video cameras showing live pictures so that authorities can make better decisions.

A mobile application in each fire and police vehicle provides up-to-the-minute information about incidents, vehicle locations, floor plans, and site contact information.

Bringing Schools and Public Safety Closer Together

The impetus behind the SAFER application stems from the desire of Frisco Independent School District (FISD) administration to work more closely with the City of Frisco Fire and Police departments to ensure that everything possible was being done to provide for the safety of students. The administration wanted to fully prepare in the event of a catastrophic school event, such as a major fire or school shooting.

FISD also wanted to supply its information to public safety agencies to help them when responding to an emergency. Both of these goals stemmed from the recognition that, at the time, response to a school emergency was mainly paper based. This made it difficult to quickly access information when needed.

Only select emergency vehicles in each fire station had sufficient room to maintain rolling files of information. In addition, there were few common systems or processes in place to communicate changes to the information between the agencies involved.

The City of Frisco's Information Technology (IT) Department works closely with the city's Police and Fire departments. Olson, with more than 18 years of GIS experience—most of it in local government—was in communication with both departments for several years about building a system.

Says Olson,"Our fire chief was certain we could develop a system internally that would take advantage of the good working relationships already in place and the technology the city already used."

After looking at the possibility of outsourcing another company to build a system, a proposal was developed that led to an agreement between FISD and the City of Frisco. Together, they would develop, implement, and maintain a new application in-house: the SAFER project. Once built, the SAFER system was within budget, saving taxpayers a large amount of money versus outsourcing for a similar system. But as Olson puts it, there was a larger benefit: "SAFER is far superior to what had been previously proposed," she explains.

SAFER

The SAFER applications were built to allow emergency responders to easily drill down into the information they require at a moment's notice. Using touch screen mobile data computers (MDCs) with air cards for network access in all emergency vehicles, first responders can view and interact with the city's GIS databases and mapping functionality. This includes access to all spatial layers of information. In addition, first responders can access online emergency preplan documents for a specific school; up-to-date contact information for school administration; and detailed, georeferenced floor plans for all schools.

Floor plans include visual data, such as room numbers/names and locations of nurses' offices, administration, special needs students, and hazardous chemicals, as well as roof access. In addition, more than 1,500 video cameras at all facilities are represented on floor plans; each floor plan is hyperlinked to bring up a live video feed with a single click. All this information is available to first responders via their MDCs, to 911 dispatchers, to emergency management personnel in the city's Emergency Operations Center, to the mobile command vehicle, and to FISD and city administration personnel via secure Web access.

ArcGIS is used to populate the map framework for all public safety mobile data computers, dispatch workstations, and display in the Emergency Operations Center. When police officers or firefighters are on the way to a school emergency, they can pull up the GIS map to view the surrounding area, pictometry, detailed floor plans, automated vehicle locations (AVL), and live video streaming from the school cameras.

GIS layers were developed for SAFER specifically to hold school floor plan information, preplan hazard notes and symbols, links to video camera live streams, pictures, and an internally developed Web site with preplanning information and site contacts.

GIS hyperlinks attach the system to a Web page called the Site Detail Interface. This interface compiles information harvested from the Fire Department records system (Firehouse) and an external FISD Microsoft SharePoint site. This SharePoint site allows FISD staff to maintain school contact information. The advantage of the SharePoint solution is that the school district has control over the information it sends into the system and is responsible for maintaining it.

The next phase for the City of Frisco is to expand its GIS use to include commercial buildings.

"GIS is not simply a map but a database and analysis tool that serves as a framework for a complex and integral process used by public safety to better serve our community," says Olson. "Our requirements were developed without a specific system in mind, but with GeoComm and Esri, along with an exceptional support staff, we were able to develop something great that exceeded the expectations of all involved."

More Information

For more information, contact Susan Olson, Information Services and GIS manager, City of Frisco (e-mail: SOlson@friscotexas.gov), or Amanda Romaine, Inside Sales & Marketing manager, GeoComm, Inc. (e-mail: aromaine@geo-comm.com).

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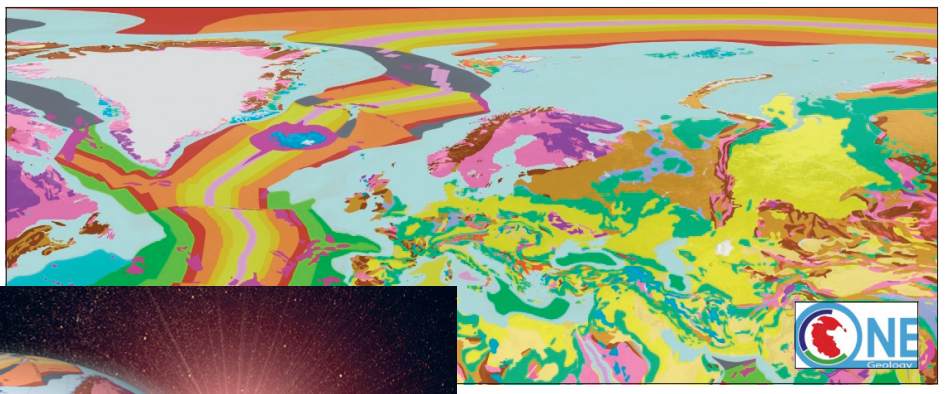
World's Geologic Survey Data Shared

OneGeology Geospatial Portal



The OneGeology portal joins geographic survey data for a complete view of the earth's geology.

Highlights

- OneGeology project provides a genuinely dynamic Web portal to make available the world's geologic data.
- Many geologic surveys capture and attribute data and prepare it for the Internet.
- Web mapping services are developed with ArcGIS Server.

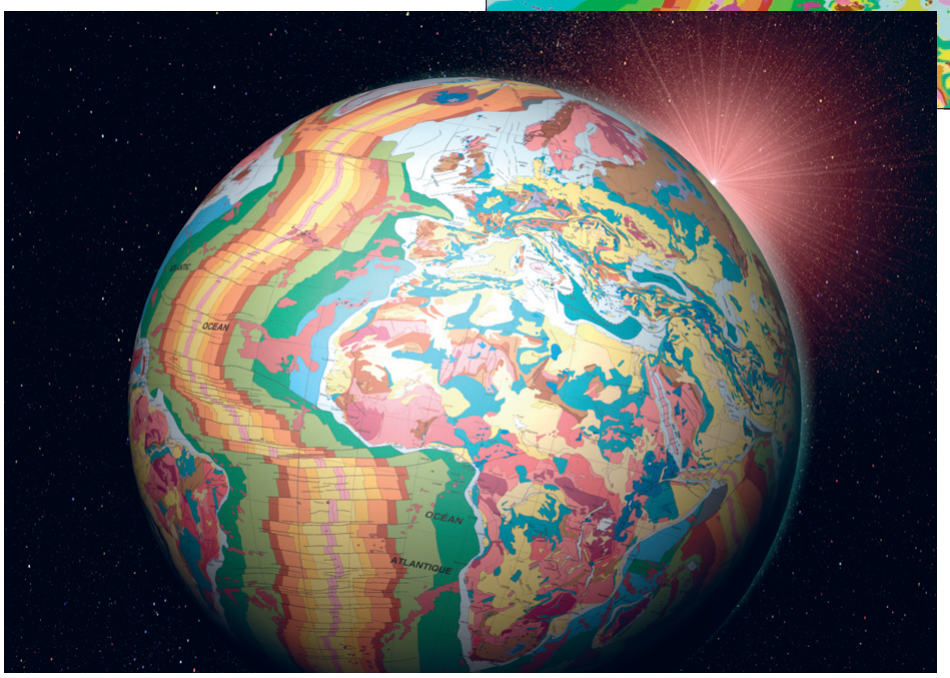
Nearly every country in the world has a geologic survey, some of which are the oldest scientific organizations in existence. Geologic surveys, both federal and state, are responsible for maintaining the geologic data and knowledge of their territory. Access to this data benefits the economy of the nation and the health of its people and furthers geoscience. The problem is in accessing geologic data from so many contributors, because it has been collected, stored, and coded with huge variation. Fortunately, today's GIS technology helps collectively show what lies beneath the earth's surface.

OneGeology (www.onegeology.org) is the first-ever open-access portal to the geologic survey data of the world. Its Web mapping service (WMS) makes the world's geologic data available at a general scale of 1:1 million, and for some countries at scales of 1:50,000. All the data is available to view for free, and an increasing amount is available to download for free. OneGeology ushers in a new era of geography services with the launch of distributed Web service systems, much of them using Esri technology. Many geologic surveys are using ArcGIS Desktop to capture and attribute data and prepare it for the Internet and ArcGIS Server to serve the WMS. GIS users can use geologic survey data to generate specific maps, show correlations, and create basemaps that can be brought as map layers directly into their project environments.

The GIS-enabled portal provides access to a truly distributed system—geology data available and stored on the servers of each country's survey organization. OneGeology also offers access to many regional and global datasets provided by the Commission for the Geological Map of the World. You can see all the geology of Europe, North America, South America, and Asia at a variety of scales from 1:1 million to 1:25 million. Furthermore, the portal allows users to look at metadata, statements of use, and catalogs and visualize geographic data at small to large scales. The original data's format may be diverse, but as long as it is spatially referenced and the contributor has put it into OneGeology's interoperable format, it can be viewed and accessed. Some countries actually provide high-resolution data on their servers that is accessible through the portal.

Geologic mapping varies in approach and detail from country to country, between the developed and the developing world, between Europe and the United States, and even between the countries of one region or the states of one nation. Over the years, geologic survey organizations have faced, and still do face, the challenges of scanning, vectorizing, attributing, and Web-enabling their data. An essential part of the development of OneGeology has been the exchange of know-how and provision of guidance and support so that any geologic survey can take part in serving its data. Participating geologic surveys contribute the best geologic data they can that covers their territories.

OneGeology participants help each other. If a country has geologic data but does not have the technology to serve that data, it can enter an agreement with another country to host the data as a service. For example, Ghana's geologic data is served from the German Geological Survey in Hannover, Germany. The UK serves Afghanistan's data, the Netherlands serves Surinam's data, and France serves Cameroon's data. The French are also helping Cameroon build its technology. The aspiration is that supported countries will eventually be able to serve their own data, but in the meantime, their data is on the Web and accessible. The data, however, remains within the originating country's ownership.



Geology on a 3D globe.

"OneGeology's arms are wide," says Ian Jackson, British Geological Survey (BGS) Operations director and OneGeology coordinator. "OneGeology accepts any geologic survey organization that wants to join and does not turn anyone away; therefore, it has inherently assumed the challenge of getting this data ready to serve. Fortunately, all participants have happily taken up the challenge, and those who have never before been interested in interoperability are now willing to shape and adopt these standards and markup language to make their work more easily accessible through the portal."

Today, 116 countries participate in OneGeology, more than 40 of which are serving data using a Web map portal, protocols, registries, and GIS server technology to harvest and serve data from around the world. OneGeology is a working example of a spatial data infrastructure (SDI). More than 200 map datasets at local, national, continental, or global levels are registered and documented with standardized metadata.

Two regional initiatives are strongly linked to OneGeology. The first is OneGeology-Europe, a two-year project funded by the European Commission that involves 21 European countries. The second is the U.S. project Geoscience Information Network (GIN), which is funded by the National Science Foundation. Within the United States, many states' geologic survey organizations, as well as the United States Geological Survey (USGS), are OneGeology participants.

OneGeology is coordinated through a two-part hub—a secretariat based at BGS and the portal technology and servers provided by the French geologic survey, BRGM. To support the portal and the registry access, BRGM has put in place an infrastructure of 15 virtual servers. The hub is guided and supported by two international groups—the Operational Management Group (OMG) and the Technical Working Group (TWG). The Steering Group, which provides strategic guidance for OneGeology, is composed of geologic survey directors who represent six continents.

The objective of the OneGeology project is to provide a genuinely dynamic Web portal that makes available up-to-date information that can be accessed and consumed by a host of sectors in the international community. To do this, the team needed the model to accept data from its diverse community. It has adopted and helped accelerate the development of GeoSciML—a geography markup language derivative. Developed by the International Union for the Geological Sciences Commission, this application is used to transfer geologic information, and it supports interoperability of information served from geologic surveys. Using this tool allows surveys to more easily share data, communicate, and collaborate through a common language.

Using the Web service address available in the register, each dataset can be displayed in various GIS packages or portals. Built on technology that makes extensive use of Esri products, including ArcGIS Server and ArcGIS Desktop software, the OneGeology system has been designed and optimized to serve, search, and display multiple layers coming from distributed providers. The portal provides the usual visualization tools (e.g., zoom, pan, transparency control), as well as the functionality to save a combination of datasets into a Web map context that can be shared with other users. Maps produced on distributed servers are sent directly to Web clients on the user side. Every participant delivers its geologic data via a standard Web service (WMS, WFS, or WCS). The list of metadata for the map service is collected into a catalog of services, which is centrally managed. The portal can display and aggregate all map data.

To help the participants register their datasets, a Technical Working Group has developed standards, including those for naming the datasets. It also provides "cookbooks" for preparing Web services to deliver maps or features according to GeoSciML standards. These cookbooks are available for download on the OneGeology Web site.

The project progressed much faster than anyone anticipated. At the initiation of the project in 2006, the OneGeology team thought it would eventually show some results in 2012. The idea was so popular that the team was actually able to have data available via the portal by 2008. In 2009, ArcGIS Server technology contributed to giving this global system a boost in performance and extendability. A new version of the portal was released in June 2009 that provides better performance, an improved user interface, and new functions for searching the registry dataset. The services that deliver features (WFS) will be more visible for the users looking for data access and download. A technical evolution from the current "register" to an Open Geospatial Consortium, Inc. (OGC), catalog was achieved before the end of 2009. This makes possible the connection between the OneGeology catalog and external catalogs supporting OGC/ISO standards.

According to Jackson, the missions of OneGeology and Esri—to make spatial data more accessible and add value to that data for societal benefit—are entirely aligned, as is their common goal of improving the quality and consistency of that data through global standards. As many of the geologic surveys that provide data to OneGeology already use Esri technology, this agreement will level the playing field. It means that many other surveys will have an opportunity to deploy up-to-date technology.

The benefits for the scientific and educational communities are enormous. Participating countries are gaining economic advantages as well. Natural resource ventures that normally spend a large portion of their exploration and development budgets on geologic data gathering and harmonization are finding that OneGeology is an entry-level resource to begin their own more in-depth projects. The portal also provides them with the contact information for surveys within the country or region they are interested in exploring. This capability helps countries attract some of these investors.

The progress that OneGeology has made is impressive; however, some serious challenges remain.

Getting in touch with organizations in countries that are not participating in OneGeology and reaching the right people in these organizations have not been easy. Some organizations say they are unable to serve data because their national laws or organization business models require them to charge a fee for geologic map data. A major challenge is that many participating nations will need GIS and Web technology and training to allow them to contribute as they would want. This underlines the fact that OneGeology's goal of knowledge transfer is of prime importance.

Esri is now fully aiding the collaborative endeavor by providing OneGeology with GIS technology and support that will surely improve the Web mapping service capabilities of the participating geologic survey organizations. Participants and users will find a richer GIS experience for publishing and using this geologic data.

More Information

For more information, contact Ian Jackson, Operations director, British Geological Survey (e-mail: ij@bgs.ac.uk). Experience the OneGeology Web site at www.onegeology.org.

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European Union's Environmental Map Services Move to Cloud

continued from cover

EEA executive director Jacqueline McGlade.

EEA helps EU and its member countries make informed decisions about improving the environment, integrating environmental consideration into economic policies, and moving toward sustainability. It also coordinates the European Environment Information and Observation Network (Eionet). Esri's complete integrated software system ArcGIS 10 plays a prominent role in helping EEA achieve its goal of delivering geographic visualization and analysis capabilities to environmental data consumers.

"We were very pleased to sign a new agreement with Esri for use of its ArcGIS 10 software," says EEA executive director Jacqueline McGlade. "This relationship will enable the 450 institutions participating in Eionet to access the software and will allow us to develop technologies, such as mobile GIS, within our community."

EEA collaborates with its member countries in the European Commission's Shared Environmental Information System (SEIS) initiative. The initiative aims to improve data availability and quality, streamline data handling, modernize reporting, and foster the development of information services and Web-based applications. Many countries have started to apply the principles of SEIS, which are based on distributed information management. Several European initiatives are providing the building blocks for SEIS, including

- *Infrastructure for Spatial Information in Europe (INSPIRE)*—A European Union directive to create a spatial data infrastructure that enables sharing geospatial data among European public-sector organizations and with the public
- *Global Monitoring for Environment and Security (GMES)*—A collaboration between the European Commission and the European Space Agency for the establishment of a European capacity for earth observation from space and in situ that supports sustainable development and global governance
- *Water Information System for Europe (WISE)*—EEA and European Commission's Internet tool that informs citizens about water quality and EU water policy
- *Ozone Web*—EEA portal for near real-time ozone information
- *Eye on Earth*—EEA's two-way communication platform, which brings together scientific information with feedback and observations of millions of ordinary people via social networking sites
- *Biodiversity Information System for Europe (BISE)*—A Web portal for data and information on biodiversity in the European Union

EEA gives access to the CORINE land cover, a European land cover map produced by photointerpretation of Landsat ETM+ images as well as LUCAS (land use/cover area frame survey) to estimate areas that do not coincide with the administrative regions.

These services are transitioning to cloud computing, wherein technological capabilities are commonly maintained off premises and delivered on demand as services via the Internet. An advocate of cloud computing, McGlade notes, "Our community has a great appetite for all kinds of applications, and we can move these in and out of the cloud as needed. Every time we add a new service that has a transaction element, we see the access numbers go up and up. We have to accommodate the fact that the more information we put out there, the more people want to look at it. We anticipate that people want to do their own start-ups and their own applications out of the reference data that we are creating."

Cloud GIS offers data storage, end-user Web applications, and focused computing services. It costs less, is always available, has faster application delivery, is flexible, and has improved business continuity. Most importantly, it enables collaboration and community computing for easier and faster information sharing.

"Costs of this type of service are falling and tumbling," continues McGlade. "As far as cost, EEA is looking at a significant reduction of costs by moving to the cloud technology." Together with the development of Web mapping services offered by EEA, a much larger user community is served with high-quality, up-to-date environmental data.

The memorandum of understanding supports the design and development of a means for sharing and accessing essential geographic environmental data provided by the agency's 32 member countries and 6 cooperating countries in approximately 450 organizations. During the next year, EEA and Esri will work together to develop

- Cloud architecture that serves EEA initiatives and European Union directives
- Data sharing that is in line with the principles of INSPIRE and SEIS
- Standardized templates and layer definitions that are based on the Esri Community Basemaps initiative
- A collaborative plan that supports the Eye on Earth initiative

"We want our users to be able to access multiple layers, do their own mashups, and create their own applications," explains McGlade. "GIS technology is moving rapidly ahead. In our latest discussions with Esri, we talked about crowdsourcing and mashing possibilities and getting data into the working environment so that people in the field can use GIS for analysis. Esri's providing the way to make this happen."

More Information

For more information, contact Guenther Pichler, Esri (e-mail: gpichler@esri.com).

Migration to ArcGIS Server Improves EEA Map Services

The European Environment Agency (EEA) is one of the first European Union agencies to offer Web mapping services. EEA sees this service as an information product and a way to promote its message of sustainable environments. Its Shared Environmental Information System (SEIS) supports an initiative that helps environment data providers share methodologies, ideas, standards, and technologies. SEIS is a means for exchanging data from local to global levels. ArcGIS is used as an important component to build SEIS.

EEA's GIS team has been devising a social networking system to improve base data and reduce the complexity that surrounds data sharing, but this effort is not without challenges. Data gathering and sharing differ among nations. Community members have varying platforms and a variety of data centers. EEA's solution is to create templates that make it easier to collect data from thematic areas, such as air, water, biodiversity, lands, and climate change. EEA is using ArcGIS Server to accommodate different data types.

Another challenge for the Web map service provider has been to match capacity to demand. Initially, EEA's map service platform was built using ArcIMS to deploy 100 percent of the Internet mapping software's functionality. EEA's GIS team is migrating map services to ArcGIS Server. This move has improved the system's stability.

"ArcGIS Server is very stable," notes EEA's project officer of geospatial developments, Jan Bliki. "It allows us to isolate our services in a well-defined way. A poorly behaving map service won't bring down the rest of the infrastructure."

The GIS shop consists of three in-house people and some GIS consultants. EEA has 100 map applications running more than 65 map services. In the past, this was very difficult to manage, and the team often worried that the servers would go down when demand was high. After the migration to ArcGIS Server, the service had no single crashes or major problems. Bliki explains, "One day, we had a huge peak of demand. In just four hours, 35,000 visitors hit one map service. That is about two million map requests. The system worked through it without any problem. We could have easily withstood 50,000 visitors and been fine."

ArcGIS for INSPIRE: A Collaborative Geospatial Information-Sharing Solution for the European Union

The Infrastructure for Spatial Information in Europe (INSPIRE) is chartered by a European Union (EU) directive and is intended to give EU member states the ability to share geographic information through an Internet-accessible infrastructure. INSPIRE will act as a foundation for producing, sharing, and consuming geospatial information, improving decision making and operations with respect to issues affecting Europe as a whole.

For European countries and organizations that need to implement this infrastructure, Esri has created ArcGIS for INSPIRE, a solution that supports the evolution from existing geospatial solutions to a fully operational, INSPIRE-compliant spatial data infrastructure (SDI). ArcGIS for INSPIRE provides a comprehensive, integrated technology base that ensures successful participation in the EU geospatial information-sharing community and takes out the complexity of implementing an SDI.

With ArcGIS for INSPIRE, Esri is providing a complete solution for an SDI in Europe. The solution is extensible and supports the needs of both INSPIRE data and service providers, as well as consumers, allowing them to

- Manage, publish, and discover INSPIRE-compliant data and metadata, as well as transform existing data to conform to INSPIRE initiatives.
- Provide INSPIRE-compliant view and download services.
- Consume geospatial data and services that comply with INSPIRE directives.

ArcGIS for INSPIRE is an extension to the ArcGIS system. The solution includes the ArcGIS Server Geoportal extension, which allows organizations to manage and publish metadata for their geospatial resources. The Geoportal extension not only supports standards-based clearinghouse and metadata/service directory applications but is now also open source. This continues the software's evolution to support users who need integration with various content management systems, map viewers, and other software.

Users can license ArcGIS for INSPIRE to supplement their existing ArcGIS implementation or begin creation of their own SDIs by implementing an ArcGIS system, being assured that their software is both INSPIRE compliant and compatible with open source solutions they may already use. ArcGIS for INSPIRE has been developed based on experience gained during the implementation of the SDI in a number of European countries, including Portugal, Lithuania, and Croatia.

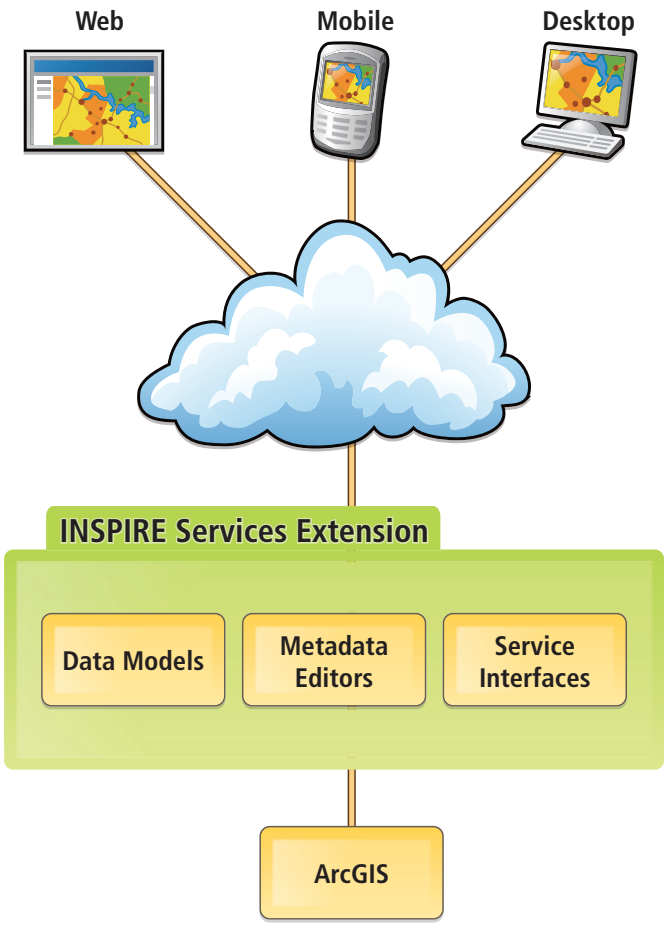
Portugal—Early Adopter of SDI and INSPIRE

Portugal is an example of a country that adopted an SDI early on and is now offering INSPIRE-compliant data and services throughout the country. Established 18 years ago through Decree-Law, Sistema Nacional de Informação Geográfica (SNIG), Portugal's national geographic information system, was the first national SDI in Europe and is maintained by the Instituto Geográfico Português (IGP). SNIG has helped shift GIS implementation in the country to more collaborative production and dissemination of geographic information using the Internet, user groups, and mobile technologies.

SNIG is the tool used to discover, understand, and explore the geographic wealth in Portugal. This is accomplished through a geocommunity that serves as a meeting point for users to exchange knowledge through a forum, entrances created for specific thematic data networks, and provision of education about SNIG. Through this geocommunity, users collaborate and exchange ideas and knowledge about geographic information. The Official Administrative Boundaries Map, a fire risk assessment map, and a set of maps produced for the *Atlas of Portugal* are a few examples of the Web services used by the geocommunity.

SNIG is one of the first SDIs to have a fully operational portal and is built on ArcGIS Server and the ArcGIS Server Geoportal extension.

SDI in Portugal today means that GIS is more than simple land representation through cartography; it is important to collect, organize, store, retrieve, and explore spatial data to create action. "We understand that more important than having data repositories, we must have dynamic information flowing through the channels," says Professor Doctor Rui Pedro Juliao, the deputy director-general for IGP.



The need to collaborate and share data across national boundaries has driven the European Union to implement the Infrastructure for Spatial Information in Europe (INSPIRE) initiative. ArcGIS for INSPIRE is designed to simplify that collaboration.

Lithuania Connects Data Providers into a United National SDI

The Lithuanian Geographic Information Infrastructure (LGII) was created to connect major national spatial information providers to a spatial information infrastructure. LGII is an open, shared National Spatial Data Infrastructure (NSDI) for accessing and distributing geographic information products and services online. The solution connects major public-sector information sources through a single Internet portal (www.geoportal.lt) that was launched in 2009.

HNIT-BALTIC, UAB, Esri's Lithuanian distributor, worked with German firm con terra GmbH to create a system to effectively manage, integrate, and manipulate the multitude of diverse data layers and create a user-friendly, front-end Web portal to view and distribute the data. The system—based on ArcGIS Server, including the ArcGIS Server Geoportal extension; IBM's WebSphere; and FME, a spatial extraction, transformation, and loading (ETL) solution from Safe Software Inc.—provides the ability to translate, transform, integrate, and distribute spatial data so users can continue to work in their native GIS formats.

Data providers include 10 Lithuanian government institutions and enterprises that are connected by a centralized national metadata system and the federal geographic data system, which are based on a uniform reference data model and standards. Both systems conform to INSPIRE initiatives.

Users can access the LGII portal anytime to discover data offerings and acquire whatever specific dataset they may need for their business tasks. Once in the system, the user simply selects the desired area from a map view, chooses the data layers required, and specifies the particular GIS output parameters by selecting from 18 different data formats and 10 coordinate systems.

"People in Lithuania have newfound knowledge now, and that knowledge is power," says Mindaugas Pazemys, deputy director, GIS-Centras. "Rather than being consumed by trying to find data, public and private users can now focus on how to capitalize on that data and develop revenue-generating applications or services. That's working smarter and ultimately leads to economic growth."

In Croatia, Simplifying Access Leads to Growth

The Republic of Croatia has simplified access to countrywide geographic data through an online geoportal, a type of Web site that makes it easier for citizens, government, and private-sector users to find and access vast quantities of geographic information and related services. The geoportal has already proved its value as an essential component of the country's Organized Land Project, which streamlines and regulates the real property registration of land in the republic. By making data more accessible, the average time for processing changes to land titles has dropped from a 400-day average to 37 days.

The geoportal is hosted by the State Geodetic Authority (SGA) of Croatia and can be found at www.geo-portal.hr/Portal. Dr. Zeljko Bacic, head of SGA, states, "Simple access to geospatial data is the key prerequisite for an efficient and economically prosperous society. The geoportal in active operation means that other governmental organizations can [not only] use SGA data but also make their data accessible. This is the first step to establishing a Croatian national geoportal as part of a national SDI."

Modeled after the INSPIRE directive, SGA is able to support the discovery and purchase of national data through the geoportal while also providing strict access control and data quality policies. Data available through the geoportal includes digital orthophotos, basemaps, administrative units, and land survey information.

The geoportal was developed by Esri distributor GISDATA d.o.o. and con terra GmbH using Esri's ArcGIS Server Geoportal extension. The Geoportal extension provides the platform for organizations to quickly access geospatial resources regardless of location or type.

"The implementation of this portal is enabling a change in behavior from a restrictive data policy to a more open, transparent, and efficient use of spatial information," says Andrej Loncaric, director of GISDATA in Croatia and the southeastern region of Europe.

More Information

For more information on ArcGIS for INSPIRE, visit www.esri.com/sdi-in-europe.html.

ArcGIS Online is an important piece of EEA's infrastructure. Esri is working with EEA to discuss and define environmental layers to enter into the community basemap. EEA receives huge amounts of data on a weekly basis. Esri technology will make it possible for European citizens to access that data. Community members can feed their data into a data template and post it on ArcGIS Online.

"We find that ArcGIS Online is a new way to promote map services and give developers mashup capabilities they never had before," Bliki says. "It is a place where our members and anybody else can share data and compare environmental messages with each other. Map services as a product for the public rather than for developers is a new way of thinking but will totally change the reusability of our information."

Because ArcGIS Server is based on open geospatial and IT standards, EEA can serve data to anybody. "Most of the other GIS products don't provide that," notes Bliki. "We serve a full packet for open source, Google, Bing Maps, and Esri ArcGIS products. Once we set up the service, it is very easy to serve it to everybody." EEA SEIS users can consume data on Web browsers, mobile devices, and desktop systems.

"We have already moved most of our services from ArcIMS to ArcGIS Server," continues Bliki. "The applications were a bit harder to move over because we had to establish the best approach. Now that we have it set up, we can make map services available on the Internet in a few days rather than what used to be weeks."

The GIS team considers the whole design process to be faster and much more dynamic when they use ArcGIS Server," says Bliki. "Previously I had to ask a developer to help with high-level tasks. Now I can divide these tasks easier between cartographers, database managers, and developers and create very stable and reliable service products."

Many people use EEA's integrated spatial information system to access relevant themes and products. They can easily search and view data and download functions that help them with analysis and policy making. "EEA's Web site (discomap.eea.europa.eu) makes it possible for people to reuse our map services together with their own data," concludes Bliki. "We believe that the new approach of ArcGIS Online and map services seen as a product to everyone is going to change the international approach of serving environmental data."

More Information

For more information, contact Guenther Pichler, Esri (e-mail: gpichler@esri.com).

Business Analyst 10: Dramatic Performance Improvements, Enhanced User Experience

Esri Business Analyst Desktop and Esri Business Analyst Server users can now research their markets, analyze customers, and evaluate sites in even less time. This performance improvement is just one of the many new features that increase users' efficiency. The user interface can be customized to allow users to access the tools and information they need more quickly and easily. Additionally, the latest release incorporates more online resources, including Esri's latest demographic data, thus eliminating the lag time to receive the new data in the software and ensuring availability of the latest information when needed.

The performance improvement from 9.3.1 to 10 for Business Analyst is significant. Processes in Business Analyst 10 are 60 times faster than they were in 9.3.1. This includes delivering faster results in how demographic calculations are made and reports created. The speed of data aggregation for trade areas makes it possible to process data nationwide without having to break up work into smaller groups. With the new business search tool, users can filter, add, and remove criteria quickly and easily and display only the information they want.

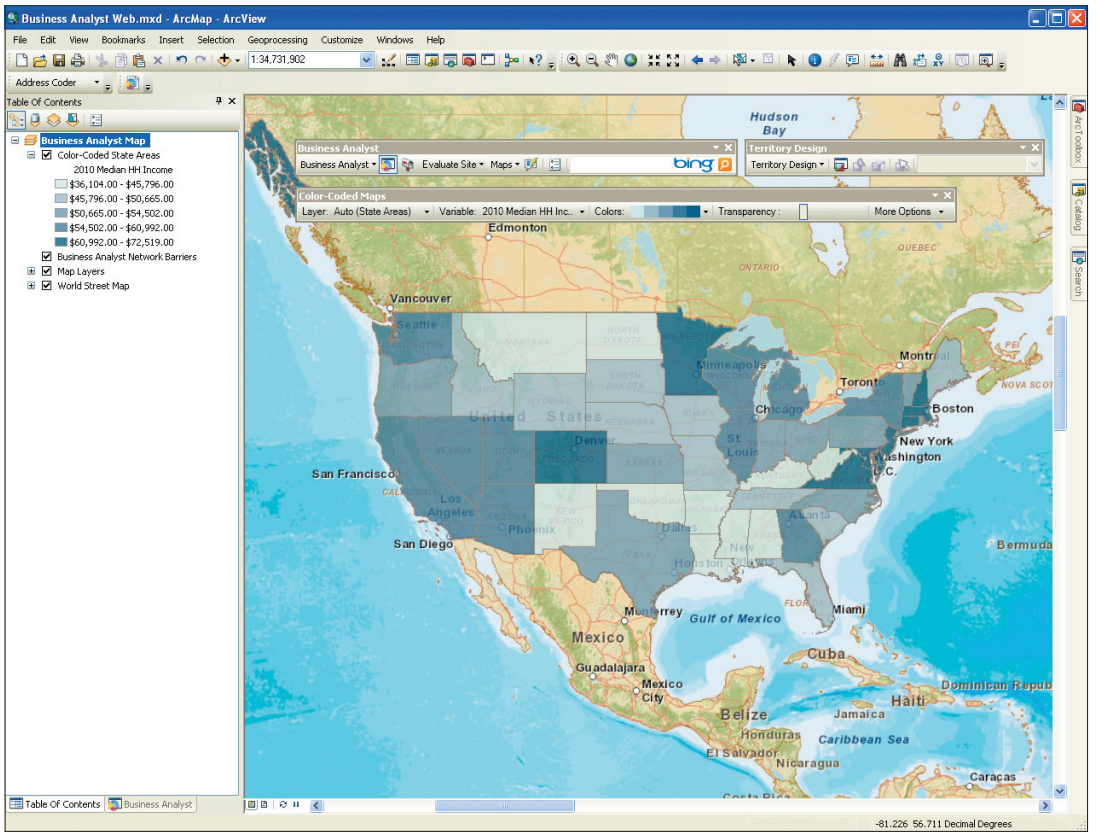
Additionally, the new release of Business Analyst focuses on faster performance through a more customized user experience. The Business Analyst toolbar and menu have been redesigned and reorganized, allowing users to work more efficiently. Users can pick what tasks they want and don't want to see on the new, dockable Business Analyst window. This includes adding favorite commands, accessing project files, and running batch tasks. The Custom Data Setup wizard (renamed from Analysis Layer Setup) is now on the Business Analyst menu, and the workflow has been simplified to allow a more streamlined way to bring your own data into Business Analyst.

Finally, the format of all reports generated in Business Analyst has been updated, making the reports easier to read and comprehend both on-screen and in print.

With more resources and data available online, Business Analyst users get more timely and direct access to the information they need. The 2010/2015 data is now accessible in Business Analyst 10. However, with the recently released Business Analyst Online (BAO) Reports Add-in, Business Analyst Desktop users can access the data updates as soon as they have been released. The updates are generally available in BAO months before being included in Business Analyst. With the add-in, desktop users can seamlessly incorporate the latest data into their workflows as soon as it is available. With the new Message Center that launches with Business Analyst, users have quick access to recently used projects and maps. They can also connect to the Business Analyst blog and forum, get the latest news, view demos, access help files, check for software updates, and submit product feedback.

Business Analyst is available for use on the desktop and as a server-based, collaborative solution. New with the 10 release is Business Analyst Desktop Premium. This premium version contains everything in the standard version plus more demographic, business, consumer spending, and market potential data, along with all the segmentation tools from the Segmentation Module, as well as the full version of Address Coder software for geocoding and data appending.

For developers who want to create applications that include the demographic data reporting capabilities of Business Analyst, there are now Flex and Silverlight versions of the BAO API. Complete code samples are available on the Business Analyst Resource Center at resources.arcgis.com/ba-online-apis.



With Esri Business Analyst 10, users can customize the interface for quick access to the tools they use most. The new color-coded maps toolbar streamlines the process for creating thematic maps.

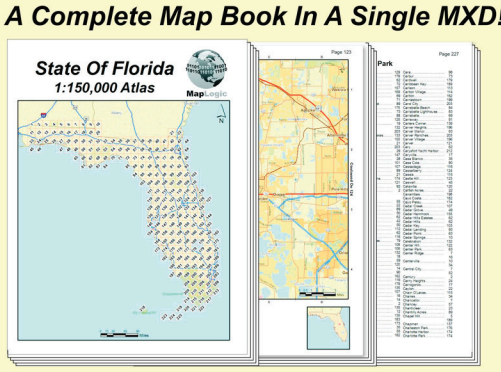
More Information

For more information on Business Analyst solutions and help to determine which product is right for you, visit www.esri.com/ba.

Looking For A Map Book Solution For ArcGIS®?

MapLogic Layout Manager™

A Complete Map Book In A Single MXD!



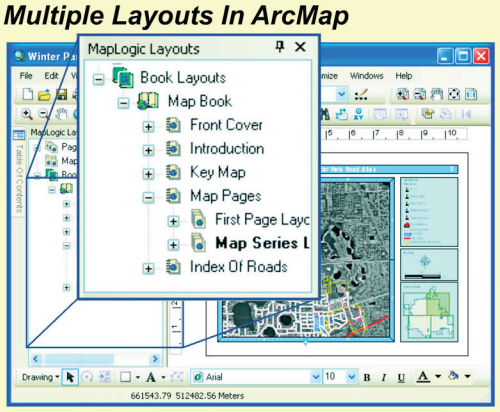
MapLogic Layout Manager provides all the tools needed to create one seamless map book within a single ArcMap™ document.

- **Automated map book creation**
- **Map Series** (maps that span multiple pages)
- **Thematic Series** (maps that remember layer settings)
- **Locator Maps** (map showing location of current page)
- **Key Maps** (overview of map series with page #s)
- **Series Text** (text that changes from page to page)
- **Location indexes** (i.e. Main Street...Page 9 B3)
- **Multiple Layouts in a single ArcMap MXD**
- **Seamless integration with ArcMap**
- ***Basic*, *Advanced* and *Pro* licenses**

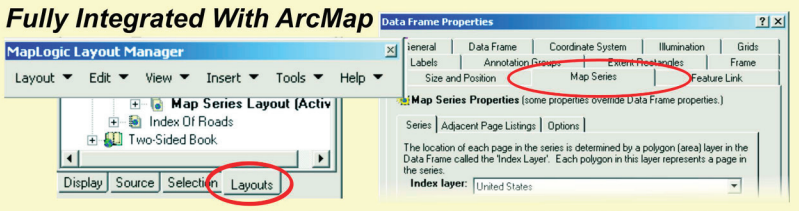
NEW FEATURES:

- **Book Wizard** - Build a complete map book including an overview map and street index with a few simple selections
- **Grid Wizard** - Complete flexibility in determining how to break your map into multiple sheets
- **Indexing Wizard** - Create indexes from multiple data sources in multiple maps
- **VBA Customization** - Run your custom code while moving from page to page
- **ArcGIS 10 Compatible**

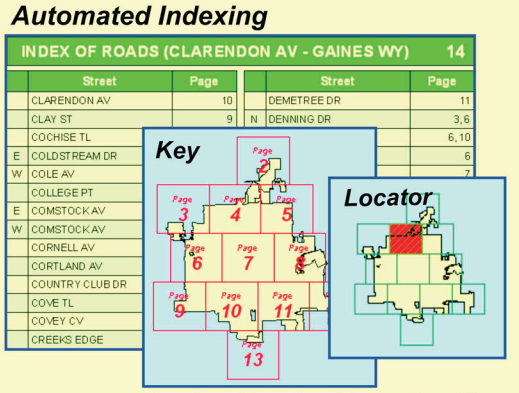
Multiple Layouts In ArcMap



Fully Integrated With ArcMap



Automated Indexing



Series Key And Locator Maps

Try it out for 30 days at WWW.MAPLOGIC.COM

e-mail: marketing@maplogic.com TEL: (407) 657-1250

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Business Analysis on the Go with New iPhone App

Esri's Business Analyst solutions have been extended to the iPhone with the release of Business Analyst Online (BAO) for iOS. This free app, available for download from the Apple App Store, provides access to 2010 U.S. demographic and business data and analysis from BAO on the go.

BAO delivers powerful market analyses through a Web browser. Users generate on-demand reports and maps to get a detailed, comprehensive view of the demographic makeup of various populations and their lifestyles and buying behaviors. This revealing information allows users to find their best locations, customers, and products/services. With the BAO for iOS app, they can now get this valuable information through an iPhone, iPad, or iPod touch.

The BAO for iOS app provides the demographic and market information needed to instantly evaluate an area on-site. It helps answer three key questions about a location:

- **What types of people live here?—**Get a demographic and market snapshot of a location (e.g., population, age, income, education, homeownership, and consumer spending).
- **How do they differ from the people in another location?—**Compare the demographic and market data for two locations or one location versus the entire United States.
- **Is this a good location based on specified needs?—**Set the desired criteria and find out how the location measures up.

In addition, subscribers to the BAO Web application are able to access the full set of BAO reports and maps through BAO for iOS. A subscription to BAO allows users access to even more data, such as market potential, retail marketplace, and consumer spending, along with more analysis functionality, such as the ability to customize drive times and rings and create color-coded maps.

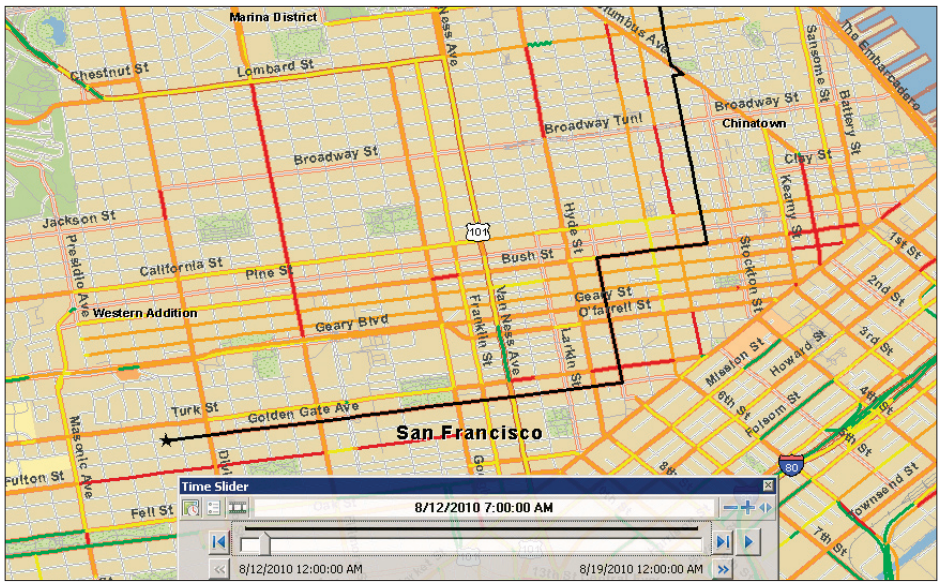
More Information
For more information and to download the app, visit www.esri.com/baoforios.

The demographic and market information of BAO is now available on the iPhone.

New Advanced Version Includes Address-Point Geocoding, Historical Traffic Data, and Transport Restrictions

Esri StreetMap Premium Advanced Takes Geocoding, Routing to the Next Level

ArcGIS users who need street data for their projects that require the most accurate geocoding and routing can now leverage the new Esri StreetMap Premium Advanced. The latest release of StreetMap Premium with NAVTEQ map data includes an advanced version with even more detailed data and functionality. This advanced version provides a greater level of precision geocoding and additional routing capabilities. Also new with the latest release of StreetMap Premium with NAVTEQ data is the expansion of coverage to Mexico.



StreetMap Premium Advanced incorporates historical traffic data to generate the most efficient route based on day of the week and time of day.

StreetMap Premium is an enhanced, ready-to-use street dataset that works with ArcGIS software to provide geocoding, routing, and high-quality map display. The dataset is based on commercial street data that has been optimized, structured, and compressed to ensure ease of use and quick deployment.

With StreetMap Premium Advanced, users can now

- *Geocode to the building level*—With points adjusted to the road, the dataset provides even more precise address location, enabling to-the-building accuracy. Users can now position a geocoded point on a main building or on the centroid of a parcel.
- *Leverage historical traffic data*—Information about average speed of travel for specific sections of roadways is included for more accurate arrival time projections and avoidance of congestion based on day of the week and time of day.
- *Manage transport restrictions*—Detailed road attributes, such as physical and legal restrictions, hazmat warnings, and points of interest specific to the transport industry, allow users to more effectively leverage turn-by-turn navigation and route optimization for trucks and other large vehicles.

To get this geocoding precision and sophisticated routing functionality, StreetMap Premium Advanced includes additional NAVTEQ products, such as Point Addressing, Transport, and Traffic Patterns.

In addition to the United States, Canada, and most European countries, StreetMap Premium with NAVTEQ data is now available for Mexico. StreetMap Premium Advanced is available for the United States, Canada, and Mexico. It will also be available for Europe later this year.

The flexible licensing model for StreetMap Premium allows users to get data customized to their desired geography and mapping needs, specifying regions and type of usage. Geography licensing options include continent (North America or Europe), country, or state/province. Usage licensing options include geocoding, routing, and/or cartographic display for both StreetMap Premium and StreetMap Premium Advanced.

StreetMap Premium is delivered on DVD and provides a secure way for organizations to access street data comparable to ArcGIS Online World Street Map behind their firewall.

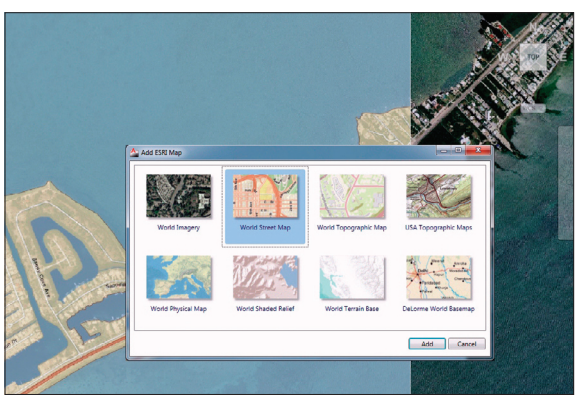
More Information
For more information and to request a quote, visit www.esri.com/streetmap.

AutoCAD 2010 and 2011 Support Included

ArcGIS for AutoCAD Improved

ArcGIS for AutoCAD, a free downloadable plug-in from Esri, is part of the ArcGIS system and plays an important role in facilitating the sharing of data between ArcGIS and AutoCAD. ArcGIS for AutoCAD can be used to access both free and premium maps from ArcGIS Online as well as enterprise GIS data and imagery published by ArcGIS Server, all from within the AutoCAD environment. In addition, ArcGIS for AutoCAD can be used to provide attributed GIS layer information in a CAD drawing when this information needs to be shared with ArcGIS.

The latest release of ArcGIS for AutoCAD contains significant improvements, including faster performance and enhanced map image quality when accessing map services in AutoCAD. In addition, with ArcGIS for AutoCAD Build 250, AutoCAD 2010 and AutoCAD 2011 are now supported.

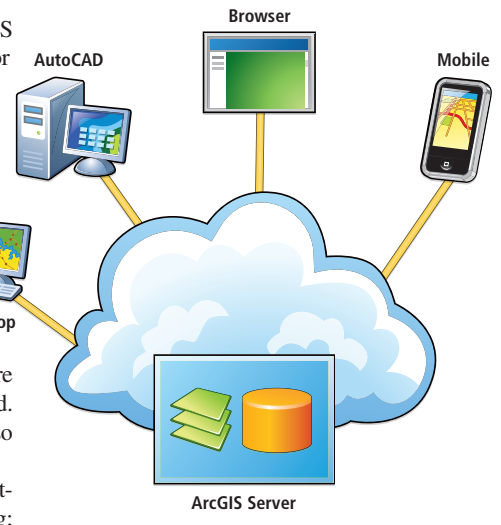


ArcGIS for AutoCAD can be used to add a World Street Map service from ArcGIS Online into AutoCAD.

Maps add a powerful visual context to a CAD design, making it easier to interpret the conditions and characteristics of a project site. GIS maps are authoritative resources for attaining this information and can best depict existing infrastructure and physical properties, roads, the natural environment, and more. Furthermore, this information can be accessed simply and with little effort by using ArcGIS for AutoCAD. The new version of ArcGIS for AutoCAD can access GIS maps from ArcGIS Online directly via the new ribbon interface in AutoCAD. A single click to the Esri Maps and Data Gallery on the ribbon interface will add GIS maps to an open AutoCAD session. Services can be accessed more quickly, and maps display with better image quality.

The updated plug-in also includes a new query by attribute feature. Objects filtered by the current feature class and GIS attribute values can be selected. Better support for secure and proxy servers is also offered with the new version.

Private engineering firms; public works departments; electric, water, and gas utilities; mining; pipeline; oil exploration; and other professions that work within AutoCAD and want simple and easy access to authoritative GIS content can benefit from using ArcGIS for AutoCAD, particularly when there is a need to be interoperable with the ArcGIS system. With ArcGIS for AutoCAD, AutoCAD users can save time by accessing GIS basemaps directly within AutoCAD and have confidence that they are working with the most current products of GIS analysis.



AutoCAD is fully integrated with the ArcGIS system.

More Information
ArcGIS for AutoCAD Build 250 requires AutoCAD 2010 or higher versions. It is compatible with map services from ArcGIS Server 9.3 and higher for the Microsoft .NET Framework. To download the free plug-in and learn more, visit www.esri.com/autocadapp.

Trends from Esri's 2010/2015 Updated Demographics Data

Lingering effects of the recession—high unemployment, stagnant household incomes, and lower housing prices—continue to drag economic recovery in 2010. Even though some economists and Wall Street mavens say that technically the Great Recession may be over, the crash is still severely impacting Main Street. The end of the recession is good news for business, but this growth has yet to help the average consumer. Housing prices continue to drop, jobs are scarce, and consumers are shopping only when necessary. How do these issues translate across the country? Esri's 2010/2015 Updated Demographics data provides clear information about the 2010 demographic landscape in the United States.

Esri's 2010/2015 Updated Demographics data offers more than 2,000 data variables, including current-year estimates and 2015 forecasts for 11 different U.S. geographies from national to block group levels. Demographic data categories include Population, Households, Income, and Housing. This data helps identify areas of high unemployment, adjustments in the housing market, rising vacancy rates, changes in income and consumer spending, and increased population diversity. Agencies, businesses, and organizations use the data to analyze trends, identify growth, and reveal new market opportunities. Current data can track critical changes and preclude the cost of being wrong.

Economic Trends

Many states and cities are suffering from severe budget shortfalls due to declining tax receipts. Consumers aren't shopping as often and homes are being foreclosed, so governments are losing revenue from lower sales and property tax collection. Commercial real estate is also suffering as storefronts remain empty and dark. Banks are still cautious about lending.

Income

U.S. households are still feeling the pinch of the recession. The median household income for 2010 is $54,442, down slightly from $54,719 in 2009. In 98 percent of U.S. counties, the median household income has declined. Average household income dropped even more, falling from $71,437 to $70,135.

Housing

The first quarter of 2010 saw foreclosures jump by 16 percent over the comparable period in 2009. Short sales are still impacting the market in some areas. Housing unit vacancies rose by 7.4 percent, pushing the overall U.S. vacancy rate to nearly 12 percent.

Population

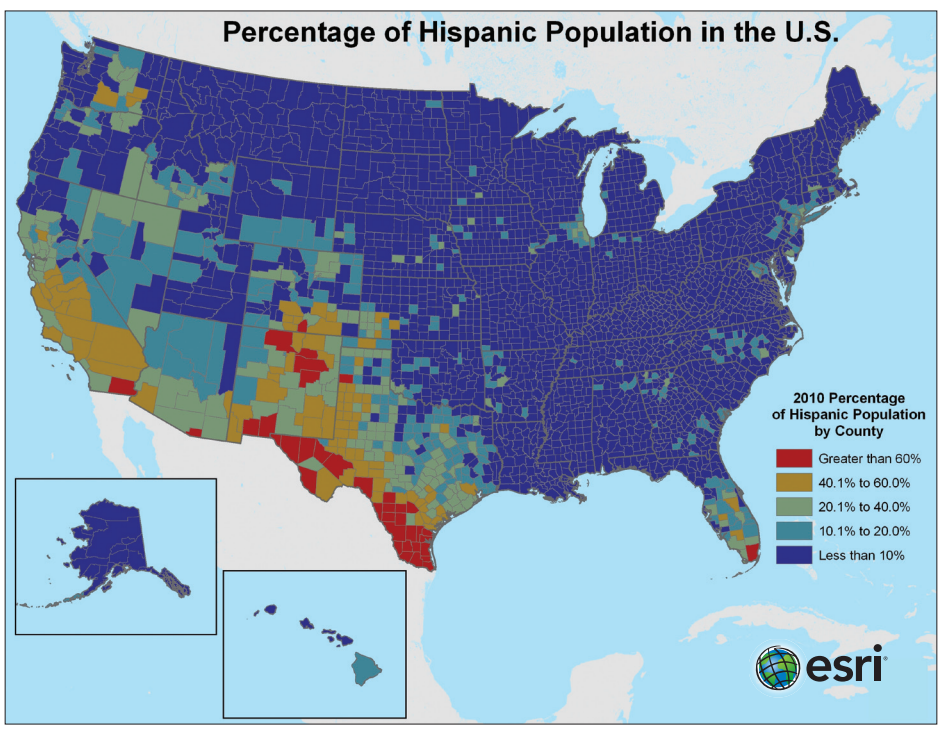
The U.S. population continues to change and diversify. In 2010, the median age in the United States is 37 years. Population growth and change slowed in most markets due to fewer births and the inability to move due to low home values and unemployment. Ten states, including Florida and Michigan, lost population from 2009 to 2010; more than half of all U.S. counties also lost population.

Diversity

The Diversity Index for the United States in 2010 is 61. The Diversity Index from Esri represents the likelihood that two persons, chosen at random from the same area, belong to different race or ethnic groups. Ethnic diversity as well as racial diversity is included in our definition of the Diversity Index. In 2010, the most diverse states are California, Hawaii, New Mexico, Texas, and Nevada. At 50.5 million, Hispanics now comprise 16.2 percent of the total U.S. population. From 2000 to 2010, this segment grew at an annual rate of 3.5 percent. The Asian population rose and now stands at 14.1 million, comprising 4.5 percent of the U.S. population. This segment grew at an annual rate of 3.2 percent from 2000 to 2010. Now numbering 9.3 million people and 3 percent of the U.S. total, the 2010 multiracial population also expanded and grew at an annual rate of 3.1 percent from 2000 to 2010.

More Information

For more information about Esri's 2010/2015 Updated Demographics data, visit **www.esri.com/datawhatsnew** or call 1-800-447-9778.



The Hispanic population in the United States—50.5 million in 2010—comprises 16.2 percent of the population and is growing at a rate of more than 3.5 percent annually.

GIS Mapping Made Easy

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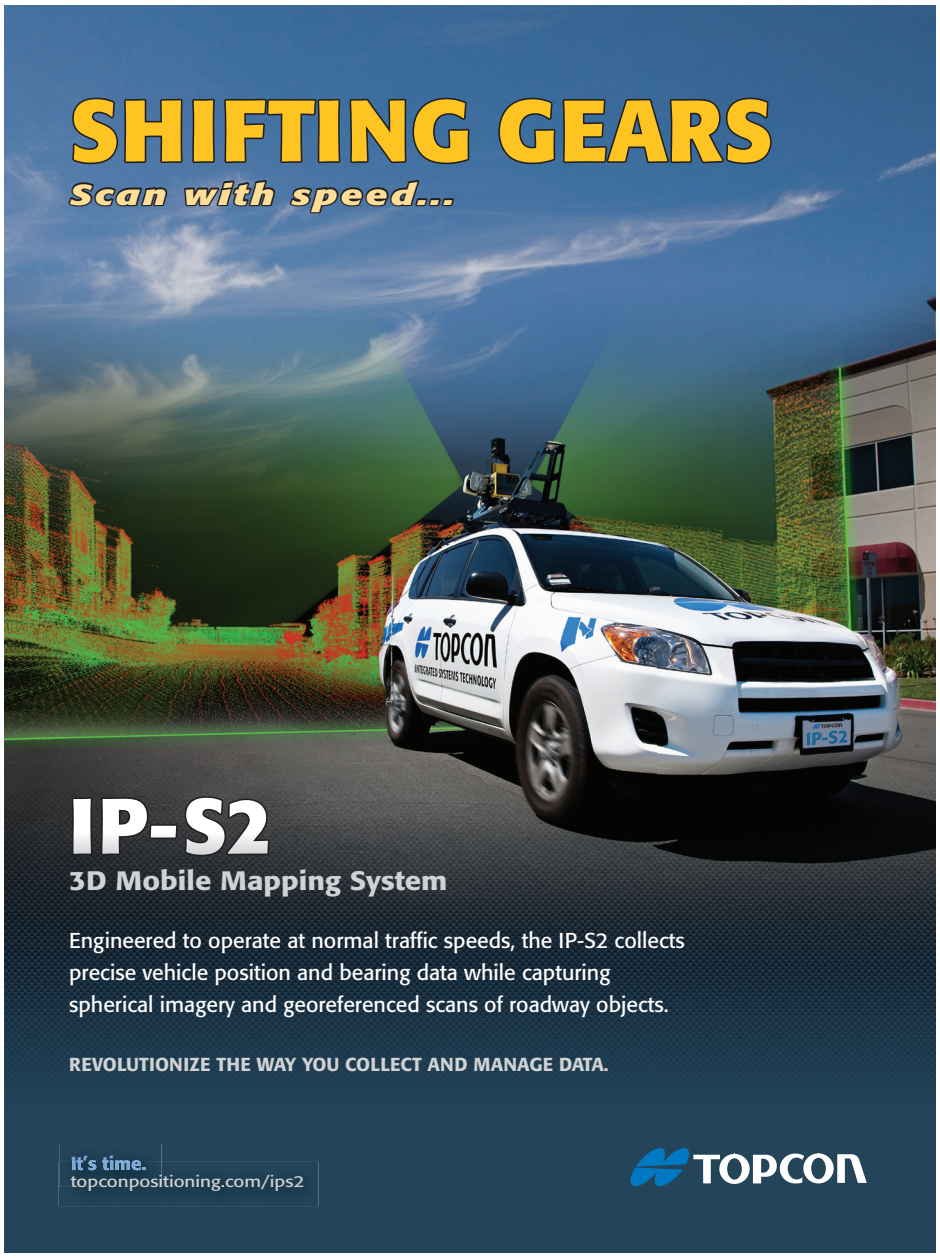
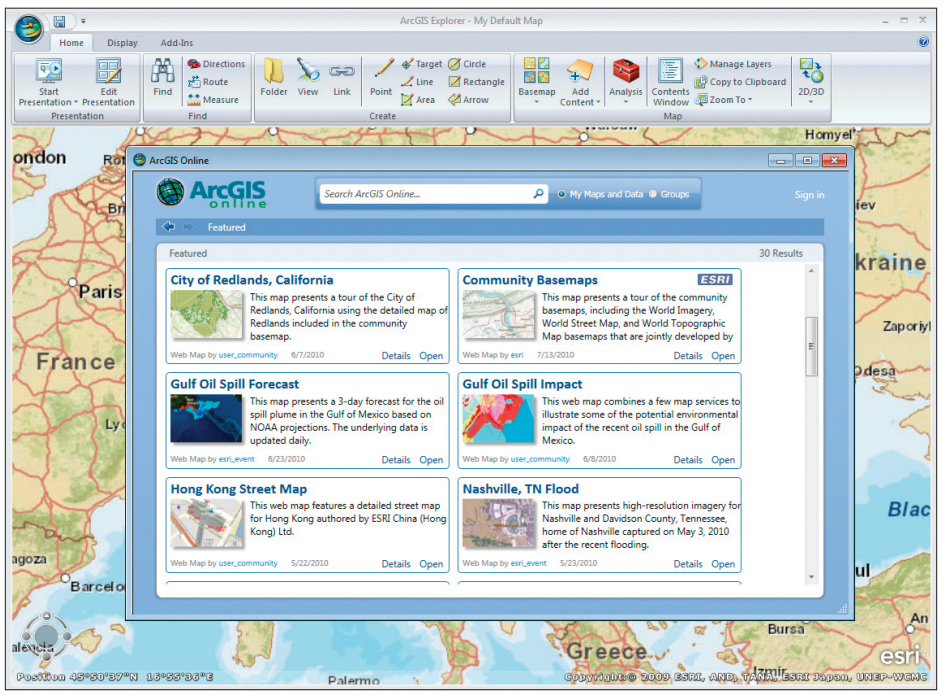


New Version of ArcGIS Explorer Makes Sharing Easier

The new version of ArcGIS Explorer offers many compelling features and enhancements, including tools to increase productivity and more ways to share geographic information. It has many updates that help integrate it with ArcGIS 10, including direct support for image services, improved support for ArcGIS 10 layer packages and geodatabases, and more ways to leverage ArcGIS Online.



With ArcGIS Explorer, users can search for and add content directly from ArcGIS Online, as well as share map items immediately, to their online account. All ArcGIS Online maps, data, and groups can be accessed from ArcGIS Explorer.

ArcGIS Online, which is deeply integrated into the ArcGIS Explorer experience, provides an easy way to find and share geographic information and form online communities. With the new ArcGIS Explorer release, users can search for and add content directly from ArcGIS Online, as well as share map items immediately, to their online account. All maps, data, and groups can be accessed from ArcGIS Explorer.

This release of ArcGIS Explorer offers a number of features that support enhanced interoperability, both with the ArcGIS system and via KML. ArcGIS Explorer now allows users to share (export) to layer packages to provide better ArcGIS Desktop interoperability. Users can also export to and create notes from KML. Shared layer packages, notes, and KML can be saved locally, added to ArcGIS Online, or e-mailed directly from the application. KML handling has been improved in both 2D and 3D modes, and region-based KML is now supported in 2D mode.

Additionally, the ability to add data directly from Excel spreadsheets is available. ArcGIS Explorer users directly use and optimize image services.

Many other enhancements have been made to ArcGIS Explorer. For example, OpenStreetMap is now included in the basemap gallery. Notes can now be labeled, and the note, presentation, pop-up, and Analysis Gallery features have all been improved with new tools to help users be more productive and more easily share information. A new query capability enables users to create expressions to filter data displayed on their maps. Enhancements to symbology improve symbol appearance in 2D and 3D modes.

In addition to the free download of ArcGIS Explorer, Esri offers a free ArcGIS Explorer Software Developer Kit (SDK). This SDK has been updated to support Visual Studio 2010, including templates for the new add-in types and an updated add-in wizard. The reference and conceptual help have also been updated, and new samples are included.

ArcGIS Explorer is supported in English, German, French, Spanish, Japanese, and Chinese.

More Information

To learn more about ArcGIS Explorer, visit **www.esri.com/explorer**.

For Additional Information About Esri Products

Inside the United States, please call Esri at 1-800-447-9778.

Contact your local office:
www.esri.com/locations

Contact your local Esri reseller:
www.esri.com/partners

ArcGIS Viewer for Flex 2.0 Available

Esri's newest Web client viewer, ArcGIS Viewer for Flex 2.0, can now be downloaded at no cost from the ArcGIS Viewer for Flex Resource Center.

ArcGIS Viewer for Flex is a ready-to-use, configurable Web mapping application. It enables organizations to quickly and easily deploy a Web mapping application with minimal effort.

The application is designed to support existing business workflows that need mapping visualization, editing, and analysis on the Web. The look and feel, functionality, and data content of the viewer can be customized by editing an XML configuration file. Organizations can add their own corporate logo and branding to the viewer, extend functionality by adding widgets, and set up the viewer to work with their own GIS services. ArcGIS Viewer for Flex includes more than a dozen core widgets that extend its functionality. No programming skills are required to configure the viewer.

"ArcGIS Viewer for Flex allows nondevelopers to set up and deploy a fast, modern-looking Web mapping application very quickly," says Derek Law, product manager for the viewer. "Mapping content from ArcGIS Online is already preloaded in the application, including worldwide street, imagery, and topographic maps, as well as a set of sample ArcGIS Server map services and several widgets."

GIS professionals with access to ArcGIS Server will find that ArcGIS Viewer for Flex is a great prototyping tool for demonstrating proposed Web mapping solutions. They can also use it to quickly stand up internal and public-facing Web mapping applications for their organization. This makes the viewer an ideal out-of-the-box product solution for quickly creating Web client applications for ArcGIS Server. Example application use cases include an organization's operational mapping viewer, management dashboards, and emergency response mapping scenarios.

Adding and removing widgets allow users to customize the functionality of the viewer in a modular fashion. Widgets that are included with the viewer provide a range of functionality, including

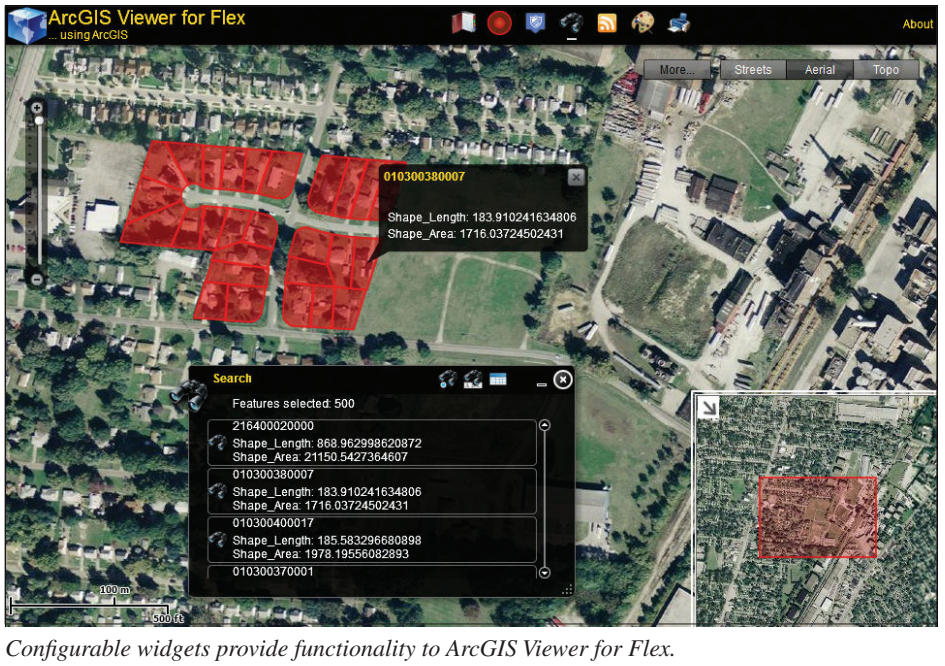
- Displaying basemaps through ArcGIS Online and ArcGIS Server services
- Finding addresses and place-names through ArcGIS Online and ArcGIS Server services
- Creating new map features and editing existing map features using ArcGIS Server feature services
- Clipping and extracting map features and saving them locally in different formats
- Drawing simple graphics on the map display
- Performing GIS analysis
- Performing simple printing

Application developers interested in exploiting the ArcGIS Viewer for Flex framework can download the application source code and use Flash Builder 4 or the integrated development environment of their choice to develop more customized Web mapping applications by creating their own widgets and/or extending the core viewer framework.

The ArcGIS Viewer for Flex Resource Center (**www.esri.com/viewerforflexRC**) hosts online sample viewer applications showing different configuration possibilities along with interactive previews of each of the widgets. The resource center also offers online help documentation, samples, and a forum where users can discuss the viewer.

More Information

For more information, visit **www.esri.com/viewerforflexRC**.



Configurable widgets provide functionality to ArcGIS Viewer for Flex.

2010 ArcLogistics Government Grant Program

Esri wants to help governments that, in today's tough economy, are finding ways to do more for their constituents with less. Esri's 2010 ArcLogistics Government Grant Program will award up to US$450,000 in ArcLogistics subscriptions to state and local governments in the United States.

ArcLogistics is Esri's cloud-based vehicle routing and scheduling solution designed specifically to help non-GIS professionals create optimized vehicle and mobile workforce routes and schedules. When routes and schedules are built using ArcLogistics, organizations realize substantial reductions in vehicle wear-and-tear, fuel use, and emissions and significant cost savings.

State or local government managers responsible for setting up routes and schedules are encouraged to apply for the grant. Government tasks where ArcLogistics could be used to save time, costs, and fuel include

- Health, housing, and building inspections
- Property appraisals
- Graffiti removal and street sign service
- Solid waste disposal
- Special needs transportation
- Routing polling place workers

More Information

Visit **www.esri.com/govgrants** and tell us how you will make ArcLogistics work in your government department. We've made US$450,000 available in ArcLogistics grants; if you've got a good idea for how you will use ArcLogistics, chances are Esri has a grant for you.

Imagery Is Core to GIS

continued from cover

Highlights

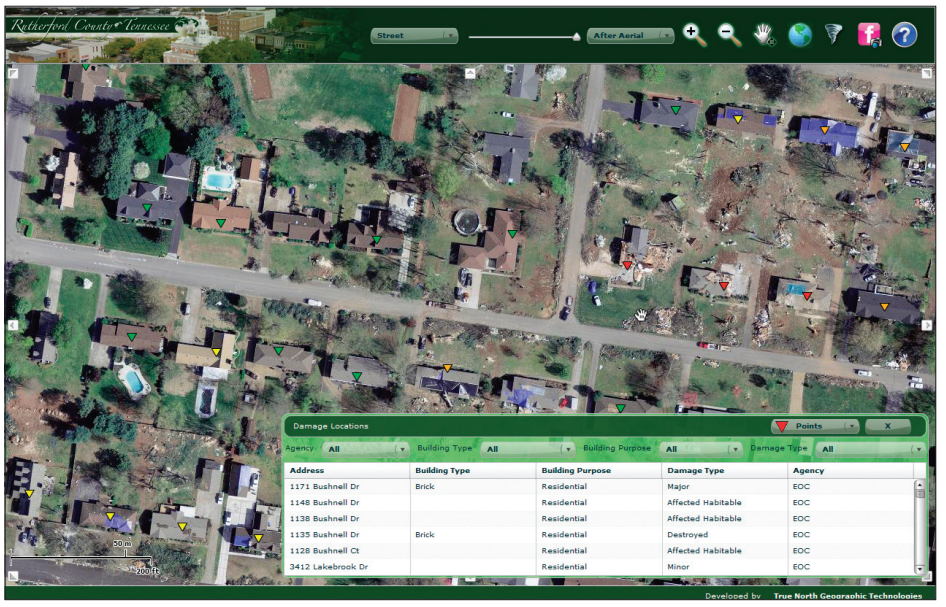
- Esri's imagery technology is now integrated into all aspects of the ArcGIS system.
- A mosaic dataset is a new geodatabase data model used for managing and disseminating imagery.
- ArcGIS enables quick access and visualization of imagery with other geospatial data.

server and from the field to the cloud—and it is now integrated into all aspects of the standards-based ArcGIS system. This full integration is new and provides the foundation for building advanced workflows that work with all types of geospatial data, including imagery.

Esri's imagery technology is now integrated into all aspects of the ArcGIS system. Here are some examples:

- *ArcGIS Desktop*—The complete desktop environment for imagery management, analysis, and use.
- *ArcGIS Server*—Versatile solution for disseminating individual images, static caches, and powerful dynamic image services.
- *Mobile*—Everything from Tablet PCs to smartphones, including iOS 4, Windows Mobile, and the forthcoming Android API, can use imagery to enhance field operations.
- *Web APIs*—Integrates image services from ArcGIS Online and image services powered by ArcGIS Server into these flexible and customizable browser-based applications.
- *Geodatabase*—The repository for organizing, managing, and integrating imagery with other geospatial data.
- *Geoprocessing*—Advanced capabilities to enable workflows that can incorporate image processing and analysis.

ArcGIS is a standards-based information system that is easily integrated with other enterprise systems or extended and customized by Esri's partners, which provide domain expertise for focused and specialized solutions.



Rutherford County, Tennessee, used imagery to show the before and after effects of an F4 tornado that hit the county in April 2009.

Who Uses Imagery?

Imagery is everywhere. Here are a few examples:

After Cyclone Nargis devastated Myanmar (formerly called Burma) in May 2008, the **Foreign Agriculture Service of the United States Department of Agriculture** used imagery to monitor the condition of the country's agricultural lands, which was critical to plan and track relief efforts.

The **Woods Hole Research Center** in Falmouth, Massachusetts, uses imagery in its environmental and conservation efforts. It is tracking carbon footprints by measuring biomass, deforestation, and land use.

Ste. Michelle Wine Estates uses multispectral imagery over 3,500 acres of grapes in Washington and Oregon to analyze canopy density and plant and environmental health, track temporal changes, and generate optimized harvesting schedules.

The **Indian Space Research Organisation** uses the imagery it collects from its satellites to support many valuable societal applications and government agencies.

Imagery at ArcGIS 10

The integration of imagery into all aspects of the ArcGIS 10 system makes it easy for all industries to integrate imagery. The improvements to managing, disseminating, visualizing, and analyzing imagery mean that it is easy to organize and maintain, is right at the fingertips of those who need it when they need it, looks great and displays quickly, and provides more actionable information.

Countless Images, One Dataset

ArcGIS meets all the demands of imagery management, from independent users with small collections of image files to organizations with large collections of processed imagery to organizations collecting new imagery. The new mosaic dataset is the simple solution to managing entire imagery collections within the geodatabase.

The mosaic dataset enables collections of images and rasters to be stored as a catalog and viewed as a single image. The collection or each image can have its own metadata and image processes. A mosaic dataset is accessible to applications both as an image, with all required processing applied on the fly, or as a catalog of footprints and metadata. Image processing rules may be defined automatically based on type of image but can also be user defined and refined. The mosaic dataset is supported in both file and enterprise geodatabases and accessible in all editions of ArcGIS Desktop, although an ArcInfo or ArcEditor license level is required to create or edit mosaic datasets.

The mosaic dataset quickly catalogs different image sources that range from individual files to imagery collections, as well as directly from sensors. It supports most existing raster and imagery formats to simplify migration and implementation workflows. Imagery does not have to be reprocessed as the existing datasets are referenced and additional processing is applied upon access.

Since the mosaic dataset does not move or duplicate imagery, storage requirements are minimized, and redundant imagery is eliminated.

The mosaic dataset directly supports imagery captured from satellites, aerial photography, and other sensors. This is extremely useful for organizations that collect, process, and distribute their own imagery. The processing to be applied can be automatically assigned based on imagery type, or processing templates and tools can be used to refine the imagery processing.

Right at the Fingertips

The value of even the most well-managed imagery collections is limited if the imagery is not in the hands of those who need it when they need it. ArcGIS Server provides the power and flexibility to unshackle imagery and deliver it in less time and with less effort. ArcGIS Server can disseminate a single image file or a vast collection with equal ease. It serves imagery as part of a map service or directly as an image service using GIS services, which can be accessed directly or integrated with other services and applications.

The map service is the classic ArcGIS Server method for publishing maps authored in ArcGIS Desktop to the Web. When these services are served as static map caches, they are the most scalable way to deliver imagery over the Web. This makes them ideal basemaps.

ArcGIS Server uses image services to provide dynamic access to imagery and raster data for visualization and analysis. Image services are a core capability of ArcGIS Server to efficiently serve imagery stored in a raster dataset.

The ArcGIS Server Image extension enables image services to serve mosaic datasets. These Image extension-powered services can take advantage of all the advanced functionality found in the mosaic dataset, such as dynamic mosaicking and on-the-fly processing. Dynamic mosaicking is the ability to handle overlapping imagery and enables both the author of the mosaic dataset and the user accessing it to redefine the order of the imagery so that the most appropriate image is displayed on top.

This functionality is critical for organizations that have different groups exploiting different information from the same imagery collection. Instead of creating a new image service for each need, the different groups can all access the same image service.

Imagery at the Speed of Light

The imagery technology built into the core of ArcGIS enables quick access and visualization of imagery with other geospatial data, simplifying workflows and reducing costs. Supporting nearly all image sources, ArcGIS makes it easy to visualize imagery through a variety of platforms, including desktop, server, cloud, Web, and mobile.

The accelerated image display added in version 10 vastly improves the ability of ArcGIS to quickly display imagery and other geospatial data. It uses a combination of hardware and software rendering, as well as localized caching, to optimize draw time and provide smoother pan and zoom capabilities. Even imagery accessed

Please see "Imagery Is Core" poster on pages 24–25.

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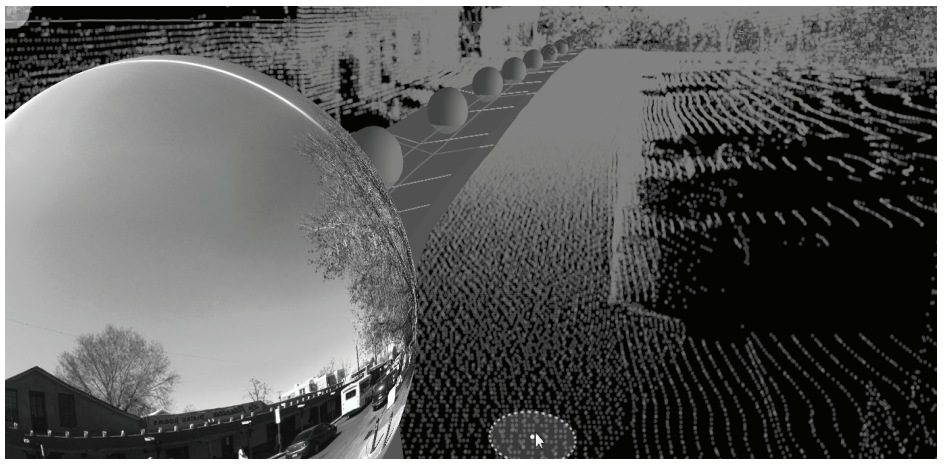

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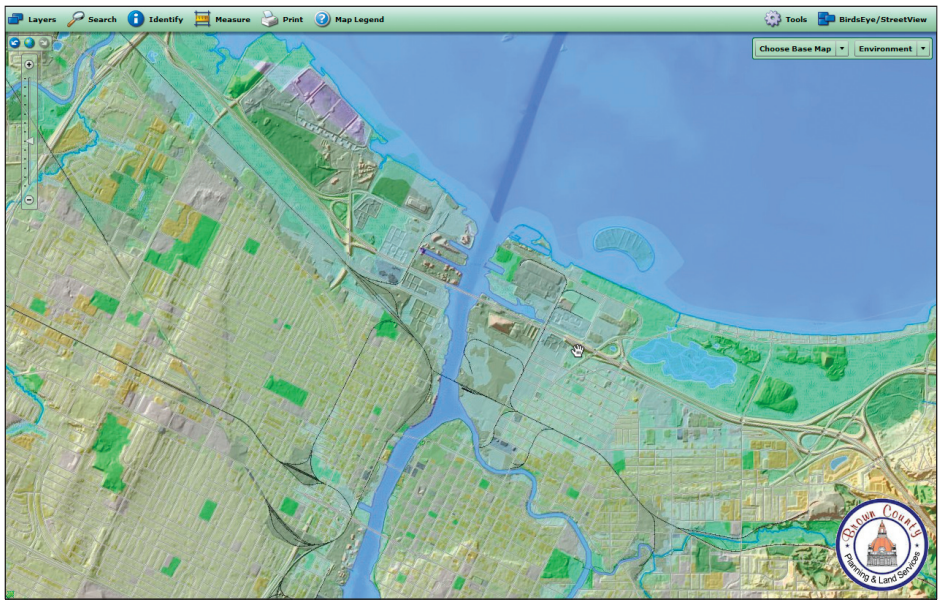


This application allows citizens of Brown County, Wisconsin, to combine historical aerial imagery with various county maps to learn more about the neighborhood they live in and how it's changed over the past 70 years.

through Internet image services will show dramatic improvements. This allows continuous panning and zooming of both imagery and the new basemap layer. ArcGIS 10 means less time waiting for imagery to load and display and more time to analyze data and make decisions.

More than Just a Pretty Picture

Imagery is more than just a pretty picture or a background for "real" GIS layers. It provides real knowledge for real analysis so users can make real decisions. Imagery is valued because it is not preinterpreted and so retains all the original information, making it a perfect choice for advanced analysis capabilities, including feature extraction, elevation and terrain models, classification, suitability, and measurement.

ArcGIS Desktop includes the new Image Analysis window, which brings together over 25 imagery tools to enhance and interpret imagery. This context-sensitive window provides one-click access to many display and on-the-fly processing functions, which include

- Sliders for contrast, brightness, transparency, and gamma
- One-click dynamic range adjustment
- Resample and stretch
- Composite bands to integrate and customize band combinations for multispectral imagery
- Pan sharpening and orthorectification
- Normalized Difference Vegetation Index calculations
- Shaded relief of a raster elevation dataset

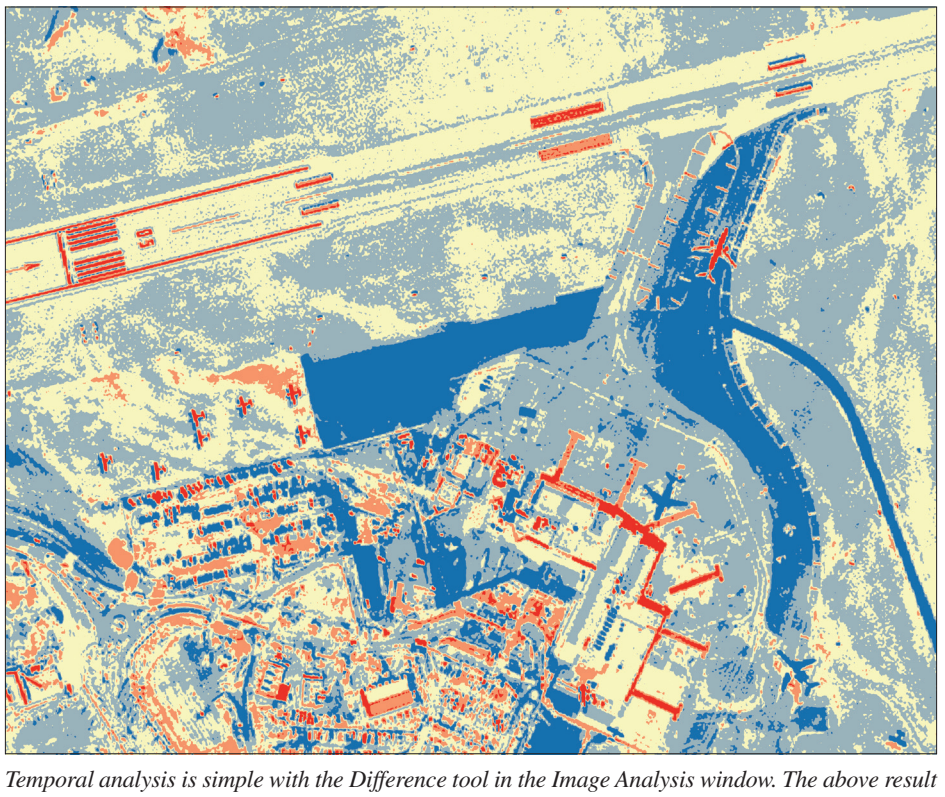
The tools in the Image Analysis window are readily accessible and simple to use. Functions are applied on the fly; no new datasets are created, and the results are available instantly. This is very different from traditional linear workflows that waste time and storage, creating intermediate outputs. Naturally, the on-the-fly results can be easily exported and saved.

Pixel Perfect

Simply put, imagery is a core component of a complete GIS. ArcGIS 10 provides a comprehensive system that integrates imagery into every GIS workflow. It is now faster, easier, and simpler to manage, disseminate, visualize, and analyze all geospatial information, including imagery, to make the best decisions possible. Furthermore, Esri partners provide the domain expertise that our customers require, as well as advanced imagery analysis tools, image collection, processing and distributing tools, and industry-customized solutions for specific industries.

More Information

For more information, visit **www.esri.com/imagery**.



Temporal analysis is simple with the Difference tool in the Image Analysis window. The above result highlights the differences between 2005 and 2008 imagery of the Queenstown Airport. Notice the new Jetways in red and parking apron expansion in blue.

Penn State Public Broadcasting Series Shows Why Geography Matters

Geospatial Revolution Showcases Global Embrace of Digital Mapping

Penn State Public Broadcasting launched the first of four episodes of "Geospatial Revolution," an online documentary series that showcases the explosion of digital mapping and GIS, which impacts millions of people daily. The video series is part of the Geospatial Revolution Project, an integrated public media and outreach initiative. Visit **geospatialrevolution.psu.edu** and check out Facebook and Twitter for more details.

"This is a skillfully-crafted production that translates the importance of GIS technology," says Jack Dangermond, president of Esri. "The series gives the audience a glimpse of how geographic knowledge is making the world a better place."

On September 15, the first of the project's four Web-based high-definition video episodes was released, accompanied by a Web site and free outreach resources, including videos, essays, and discussion questions.

The first episode, 13 minutes in length, is divided into four chapters. It begins with an overview and moves into how geospatial and location-based devices work. Following a brief history of the evolution of mapping, the episode concludes with examples of wide-reaching applications like crisis mapping and crowdsourcing. These are featured as part of a case study on digital mapping and the Haiti earthquake.

The mission of the Geospatial Revolution Project is to expand public knowledge about the history, applications, related privacy and legal issues, and the potential future of location-based technologies. It provides the general public audience with a view into how geospatial information influences nearly everything. Some of the uses highlighted include fighting climate change, improving neighborhoods and communities, tracking disease, assisting first responders, providing better public services, and navigating through daily life.

Penn State Public Broadcasting worked with numerous GIS, mapping, and technology experts in private business, government, the military, health, public safety, education, and nonprofits. Esri provided significant support for the production effort.

"We are hoping our viewers will realize how broadly, deeply, and irrevocably these technologies are part of our lives, mostly for good but with their social side effects as well," says Penn State Public Broadcasting writer-director Stephen Stept. "We want folks to share these stories with family, friends, and colleagues, and perhaps even to join the revolution in some way."

More Information

For more information, contact Elaine Brzycki, Penn State Public Broadcasting (e-mail: ejb23@psu.edu).

Nonprofit Program Grants to Help NGOs

continued from cover

worldwide community of conservationists and social activists to use GIS technology to fulfill their objectives by providing Esri software and related resources to qualified organizations and to the developers that assist them.

Ever since its founding as a nonprofit organization about four decades ago, Esri has had a deep commitment to the goals and mission of the nonprofit world. Esri later found that a commercial model was better suited for developing professional GIS tools, but its belief in and support of the nonprofit model has remained a core value. The nonprofit ethos is characterized by a passion to help society and the environment, and a commitment to serve others. Esri passionately believes that GIS concepts, theories, and technology are uniquely appropriate to this mission of service. GIS is integrative, able to include information from many different kinds of groups, cultures, and disciplines and unite it into a collaborative vision of how our world works and what we need to do to help it work better. Esri's first commercial tool to do this was ARC/INFO, which has been used by thousands of businesses and governments to better understand markets, resources, logistics, and costs and to help them become more efficient, more capable, and more thoughtful.

Through the years, Esri has offered various grant programs and donated many millions of dollars in software, training, consulting, and project support to nonprofit organizations and the people and businesses who help them. Esri knows that nonprofit groups need the same tools and capabilities that large commercial groups and governments need. In response to this need, the newly launched Esri Nonprofit Program offers ArcGIS to nonprofit groups throughout the world.

"We have always provided our software to NGOs around the world," says Jack Dangermond, president of Esri. "We want geospatial technology to be available to NGOs of all types so they can build their own data, use government data, and be more active participants in maintaining the health of our planet."

The Esri Nonprofit Program provides qualified participants with single seat licenses of ArcGIS Desktop, ArcGIS Desktop extensions, ArcGIS Server, ArcGIS Server extensions, and community and self-help support via the Esri Resource Centers and Esri Support services. Annual administrative fees apply. Some applicants will qualify for various tiers of the Esri Enterprise License Agreement (ELA) to support the entire organization.

In the context of geospatial technology Web 2.0, the second generation of the World Wide Web, the grant means NGOs will have very fast and high-quality mapping/globe services, geoprocessing, and support for all the standards that enable this environment. Esri's ArcGIS Server enables these users to create more services and use mashups to develop interactive applications. Furthermore, ArcGIS geoprocessing and spatial analysis capability will give NGOs insight for helping our planet.

More Information

Learn more about qualifying for the Esri Nonprofit Program by visiting the Web site at **www.esri.com/nonprofit**. People and organizations outside the United States can contact their local Esri distributor for more details.

Cloud-Based Routing Software Is What the Doctor Ordered

Home Medical Equipment Company Saves Time and Fuel, Improves Scheduling and Customer Windows

Highlights

- ArcLogistics helps provide two-hour delivery time windows for customers.
- The software has helped decrease fuel consumption by 15 percent.
- Drivers return one to two hours earlier each day.

Based in Sunnyvale, Texas, Shalem Medical Supply services a multitude of health care patients, including those who are on hospice and home health, as well as several medical facilities. The company provides durable medical equipment and supplies, with delivery trucks running 24 hours a day, 7 days a week. Shalem employs around 25 people and has three locations: Sunnyvale, Fort Worth, and Houston.

As the company grew and took on new patients, the complexity of getting equipment and supplies delivered in a timely manner had grown next to impossible.

"We were lackluster in efficiency, and it was difficult to maintain accountability," says Zach Paton, operations manager with Shalem. "We had no time frames whatsoever. It presented some very serious challenges."

Shalem realized that it needed to find a vehicle routing and scheduling solution that would help manage daily deliveries.

"We were looking for a software system that you could manipulate in real time and update during the day, and a lot of the systems just didn't offer that," Paton adds.

After a review of several vendors, Shalem chose ArcLogistics, thanks to the solution's cloud-based deployment model, cost, and ability to interface with the inventory management software.

A Competitive Industry

Depending on the day, each Shalem office could have up to 10 vehicles in the field, making anywhere from 15 to 25 deliveries. In a business that is growing due to aging baby boomers and the social acceptance of health care taking place in the home, Shalem realized that its outdated procedures would cost it in the long run if the booming industry continues to see consolidation of smaller home medical equipment providers.

Shalem dispatchers were immediately able to start building routes using GIS.

"In this industry, everybody is looking to get it quick, because we're dealing with a multitude of illnesses and disabilities," says Dennis Morgan, operations manager.

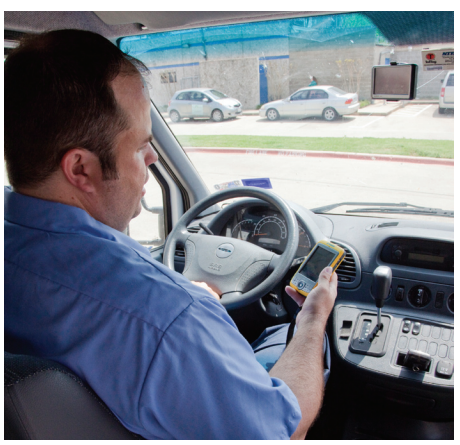
Morgan works with the Shalem dispatchers, monitoring where the drivers are; where they're headed; and the amount of stops and deliveries they have to make that day, including any last-minute additions.

"We may start our day with each driver having 12 stops," he says, "but by the end of the day, there may be 10 to 12 more tickets added to our routes."

Prior to acquiring ArcLogistics, Morgan says the company was constantly rearranging routes and providing very large time windows to customers, which was hurting Shalem competitively. Shalem employees would joke about their time windows being in the realm of, "We'll be there sometime between noon and 7:00 p.m." Since the implementation of ArcLogistics, the routing software has helped reduce time windows to two hours.

Did the Drivers Revolt?

A concern many have when considering routing and scheduling software is whether or not dispatchers and drivers will accept the software. In many cases, these are professionals who have spent years learning their local street networks and customer needs and establishing processes to help get the job done.



At each stop, ArcLogistics Navigator helps drivers reach their destinations according to the streets selected and sequence established in the route plan.

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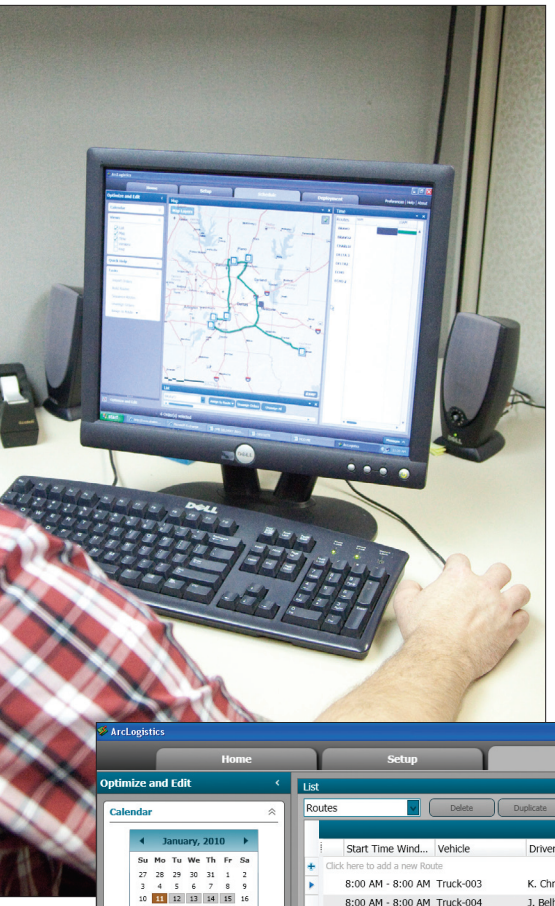
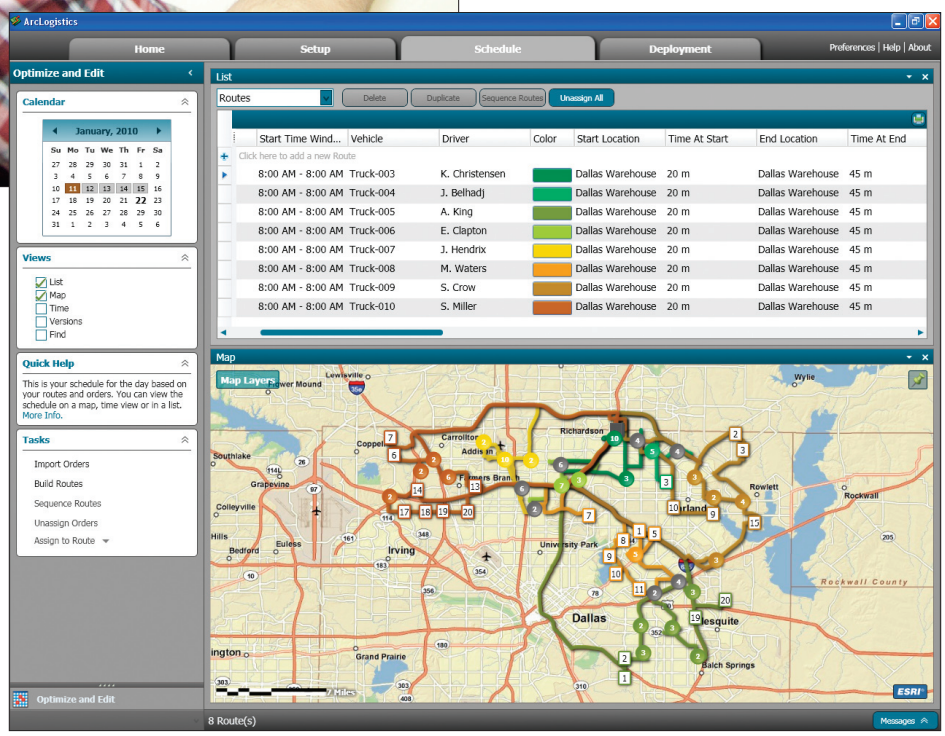


Morgan said initially his drivers were against following the plan established by the software. At first, early routes were suggested, then drivers were able to run their routes according to their old ways and compare the two when they got back.

"They were out there three hours longer [with the older routes]. And you can track them and see," Morgan says. He explains that eventually, the drivers came around when they realized the route plans created with ArcLogistics would get them back to base sooner. There were a few drivers who had issues, especially when it came to the touchy subject of overtime. However, Morgan and Shalem came up with a bonus system. The drivers realized they were driving around 50 fewer miles per day, which began to add up dramatically, resulting in significant cost savings for the company. Morgan would reiterate to the drivers that if they saved on fuel and maintenance, that meant the potential for more money in the employees' pockets, not to mention job security in an unstable economy.

"We've got some mature drivers who have been in the business for a while," says Morgan. "And



Route solvers, street data, and imagery are now all accessed via the cloud, making the solution affordable for midsize operations like Shalem.

Patients waiting for vital medical aids from Shalem are now provided with tighter time windows.

once you sit down and explain to them, yeah, maybe you're not getting 10 hours overtime, but with the time we're saving, it's going to allow the company to put more money in your pocket and give you a bigger hourly raise or be able to give bonuses."

Immediate ROI

"Our overtime costs dropped by at least 20 or 25 percent. It's decreased our fuel consumption and maintenance costs on the vehicles at least 10 or 15 percent, if not more than that," says Paton, who runs a daily report for the stops made, which includes the mileage that's driven and the fuel costs. Since using ArcLogistics, the first thing he noticed was the big drop in total mileage driven. He estimates a mileage decrease of around 10 percent just in the first week the solution was put in use.

"You will see your money is being recouped right away in maintenance, gas, [employee] hours, and the whole ball of wax. It's something that I would advise anyone that's going into a business where you're going to have multiple vehicles to look into it," Morgan says.

More Information

For more information, contact Zach Paton, Shalem Medical Supply (e-mail: zach@shalemmedicals.com, Web: www.shalemmedical.com). To download a free 30-day trial of ArcLogistics, visit **www.esri.com/arclogistics**.

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Largest U.S. Health Care System Links Staff and Resources

Highlights

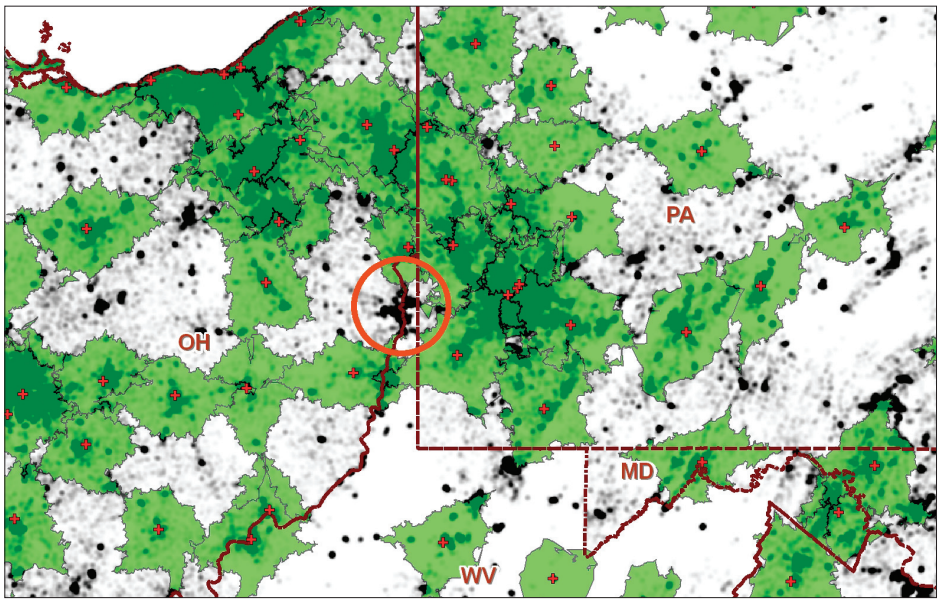
- The mapping portal leverages new technologies.
- GIS analysts can activate a cached layer that identifies drive-time service areas.
- Portal provides direct access to information, freeing GIS analysts to meet other demands.

The Veterans Health Administration (VHA) operates the United States' largest integrated health care system, public or private, with 1,100 facilities serving 8.5 million enrolled veteran beneficiaries. The system is divided into 21 service regions, which in turn are divided into 80 market areas, 103 submarkets, and 508 sectors. Access by distance to VHA health care facilities is monitored at all these levels.

Planning for such a large system requires accurate and timely geographic analysis of facility and enrollee locations. To that end, VHA geocodes its inventory of facilities quarterly and its list of beneficiaries—all 8.5 million of them—annually. This work is done by the Planning Systems Support Group (PSSG) in Gainesville, Florida.

Historically, PSSG provided planners with a host of static cartographic products and statistical reports on access to facilities at all levels of VHA geography. In basic ways, these products identified spatial gaps in access to health care where new facilities might best be located. They also compared local access statistics to various benchmarks.

However, as demand for planning support grew, Duane Flemming, a director in the office of the Assistant Deputy Undersecretary for Policy and Planning in Washington, D.C., realized that PSSG needed to grow as well. The first major goal was to enable hundreds of planners and administrators nationwide with little or no GIS background to perform predefined but sophisticated GIS-based planning activities on their own. This would greatly improve systemwide planning in terms of quality, relevance, and timeliness. It would also free GIS staff to do other planning and ad hoc analyses. The other goal was to enhance and modernize the infrastructure for the GIS staff in Florida and make those resources available to GIS professionals throughout VHA.



Beneficiary density overlaid by VHA primary care delivery sites (red crosses) and 30-minute drive-time service areas (green transparent polygons). Dark areas not covered by green suggest locations for new clinics to improve overall access to care.

Flemming knew that a GIS mapping portal could link both staff and resources. To achieve these goals, he contracted Penobscot Bay Media, LLC (PenBay), an Esri partner in Rockland, Maine, to develop a Web-based mapping and planning portal and upgrade GIS hardware, software, and data infrastructure. He also recruited Dr. Mark Guagliardo, an authority on geospatial accessibility of health care, to help design and manage the project.

The Web Portal

PenBay and Guagliardo based the portal on ArcGIS Server—and a Web-based GIS mapping portal for planners and administrators went online in October 2009. With ArcGIS Server, the portal leverages a number of new technologies to deliver powerful tools with an easy-to-use interface. Planners are able to see how their current facility locations relate spatially to the residential locations of beneficiaries. They can also instantly activate a cached layer that identifies drive-time service areas to quickly find unserved areas that are densely populated with beneficiaries.

With the candidate site evaluation tool, users can choose potential health care facility locations by clicking on the map or entering an address, presumably in a densely populated, unserved area. The tool renders drive-time service areas around the new location. Best of all, the user can request a statistical report on the impact of the new facility on an area of interest (e.g., a VHA health care market area) that gives the number of newly served beneficiaries and the change in percentage of beneficiaries who are within VHA drive-time guidelines. A similar tool assesses the impact of decommissioning an existing health care facility.

A number of additional map layers help planners identify potential non-VHA partners for care delivery in underserved areas. These include point locations for military treatment and Indian Health Service facilities, as well as health care facilities supported by the Health Resources and Services Administration. The portal also supports planning in rural areas, a topic of particular interest to Congress. Users can activate a layer showing urban, rural, and highly rural areas according to VHA definitions for rurality. This and all layers have pop-up metadata in Federal Geographic Data Committee format, a handy resource that has reduced the number of inquiries that must be fielded by PSSG staff. The portal enabled GIS analysts to explore how higher levels of geospatial analysis might benefit VHA planning.

More Information

For more information, contact Dr. Mark Guagliardo, program analyst, Veterans Health Administration (e-mail: mark.guagliardo@va.gov).

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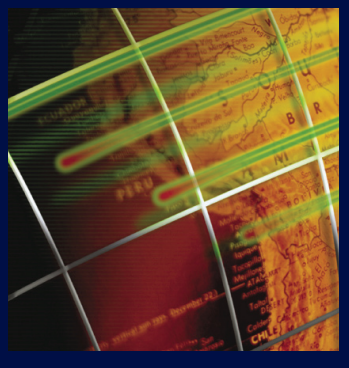

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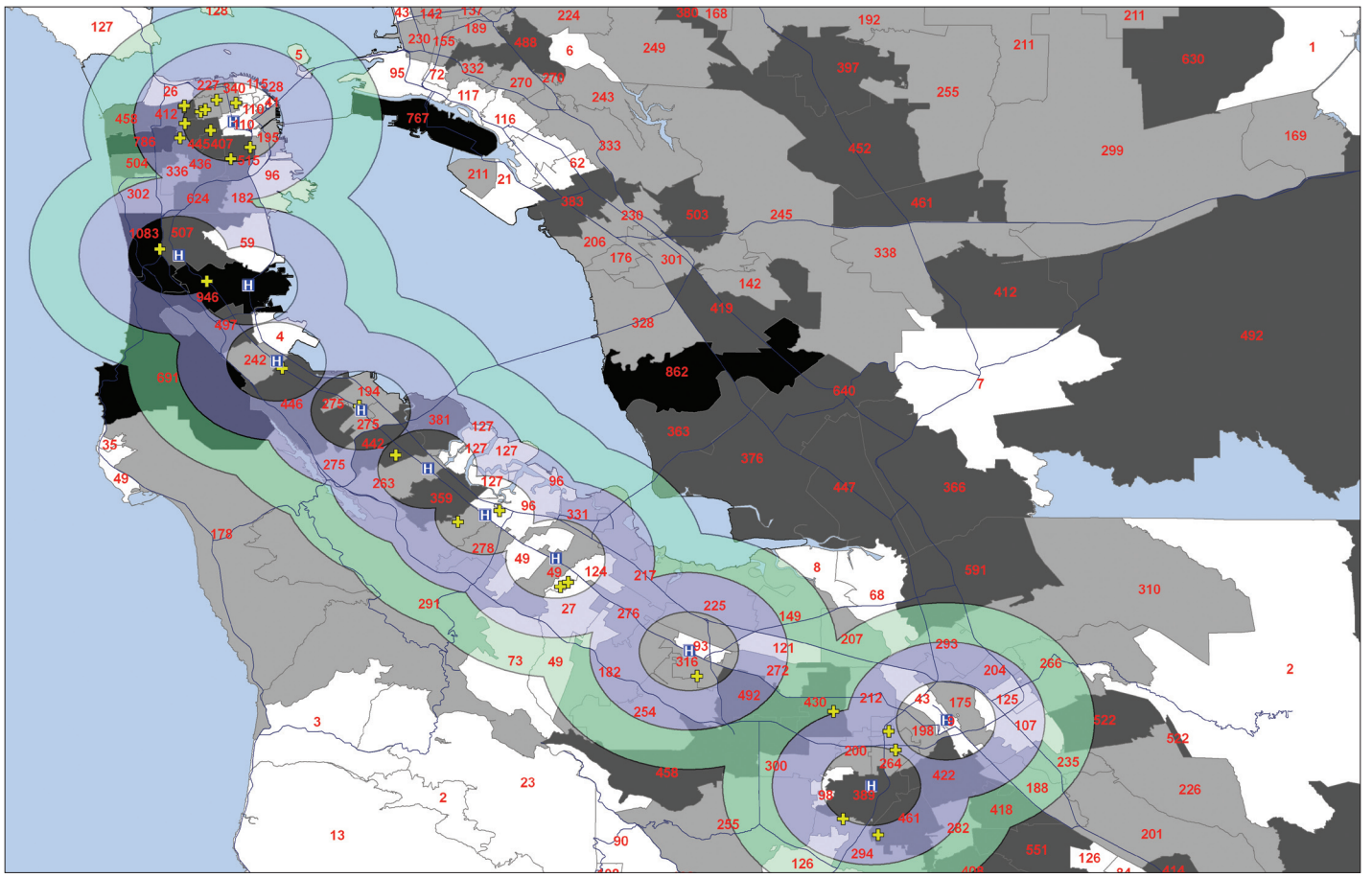
The Healthy Model for Nursing Workforce Management and Planning

Stanford University Medical Center Estimates a $22.5 Million Potential Cost Savings Over Two Years

Highlights

- GIS is ideal for workforce planning because of its geographic approach and visual, map-based results.
- GIS will help free up $22.5 million in replacement/retraining costs.
- GIS helps anticipate and mitigate potential interruptions to continuity of care.



The entire San Francisco Bay Area external registered nurse population with hospital points buffered at two, four, and six miles up and down the San Francisco Peninsula, showing the ease with which nurses can establish their careers by leapfrogging from one hospital to another.

For many years, health care administrators and hospital human resources (HR) departments in particular have had difficulty finding solid business intelligence for workforce planning. Hospitals acknowledge a heavy reliance on their nursing workforces, as well as on a direct relationship between the strength of those workforces and patient care outcomes. Hence, the development of workforce planning methods and tools is crucial to helping hospitals not only solve the puzzle of successfully recruiting and retaining top-caliber teams of nurses but also be prepared to successfully provide staff and operate during regional emergencies (e.g., earthquakes, fires, pandemics). An additional factor has been recent media coverage of potential nurse shortages, which has increased pressure to detect and plan for any such lack of availability.

Stanford University Medical Center, located in Palo Alto, California, on the Stanford University campus, comprises three main components: the Stanford School of Medicine, Stanford Hospital and Clinics, and Lucile Packard Children's Hospital. With 885 licensed beds, the Stanford University Medical Center also serves as the primary teaching environment for the Stanford School of Medicine and provides a clinical backdrop for world-class research. The nursing staff occupies the largest clinical workforce category, with approximately 2,700 registered nurses. Long-range workforce planning for maintaining an adequate nursing staff is therefore an essential administrative challenge.

"By drawing the analogy to epidemiology and emergency planning," says David Schutt, principal planning analyst, HR Programs, Stanford University Medical Center, "I was able to convince hospital leadership that GIS would be ideal for workforce planning because it introduces a geographic approach and provides visual, map-based results. In actual practice, we discovered that, while a GIS has the ability to access, manipulate, and analyze internal and external data on any type of workforce, it has an almost uncanny hand-and-glove fit with health care, especially relative to hospitals."

Schutt explains that this is because just about every external clinical professional at any hospital, especially nurses, must be state licensed and registered, making their geographic location easy to map. ArcGIS Desktop, which was selected at Schutt's recommendation, enabled HR to analyze and map this external data combined with internal HR workforce data, providing an overview of the hospitals' nursing supply and demand, as well as information about employee commute patterns and distances traveled to work.

With internal and external data for nurse populations mapped, ArcGIS, with its buffering functionality, and the ArcGIS Spatial Analyst extension help answer just about any question as it relates to workforce planning. Queries have included

- If the nursing population living within a six-mile radius of our hospitals is projected to retire in 10 years, but the average home price in the area has become far too expensive for just about any clinical professional, how will we be able to attract new entrants to our workforce to this location?
- What if we experience an earthquake in the middle of the night, and the majority of our nurses live on the other side of a major bridge affected by the quake?
- Many hospitals around the rest of the country are or will be experiencing a nurse shortage. Do we or will we have a shortage in our metro area?

"We have been able to ask and answer all these questions and many more," says Tony Redmond, director, Nursing and Allied Health Talent Acquisition Programs, Stanford University Medical Center. "Our HR and hospital leadership is no longer experiencing a business intelligence deficiency as it relates to the development of actionable workforce plans." Answers to these kinds of questions also help workforce planning for the medical school staff and allied health professional workforces, such as pharmacists, clinical lab professionals, and physical therapists.

Schutt says, "While recruiters have had hunches for decades about what may or may not be attractive recruitment features for nurses—such as pay, shift, and location—GIS analysis has, once and for all, laid the location controversy to rest. The nurse comfort zone for Stanford University Medical Center is about a 12-mile radius. Looked at another way, this is also a retention factor. When close proximity to the hospitals is coupled with nurses surpassing the milestone of three to five years of service, they are more likely to stay on board until they retire."

Real Savings and Better Coordination

While long-term planning must always be a work in progress, large returns on investment are already being realized. The recruitment advertising budget has been reduced by at least 50 percent, a monumental amount considering the San Francisco Bay Area is one of the most expensive advertising regions in the United States.

"GIS enables the hospitals to identify places where there are too few nurses or too much competition and to stop wasteful advertising in those areas," says Schutt.

GIS also allows the hospitals to precisely target candidates and use direct mail to reach them. In addition, mapping and analysis of workforce retention data provide insight into why nurses leave the medical center to work elsewhere. For example, when Schutt compared the medical center location to latitude-longitude points of all other hospitals on the San Francisco Peninsula, applying a buffer at two, four, and six miles and comparing it to other internal retention data, it became visually obvious that nurses just starting their careers could actually leapfrog from one hospital to another, up and down the peninsula, until they were able to locate the right pay and the right shift, as most of these other locations are potentially within their comfort zone.

This knowledge helps hospitals anticipate and mitigate potential interruptions to continuity of care and avoid the astronomical costs associated with hiring and retraining replacements. Schutt estimates that this knowledge could free up approximately $22.5 million over the next two years that would otherwise be spent on replacement/retraining costs.

In the Works

The Stanford University Medical Center HR department has established ongoing dialogs with other medical center departments; the Stanford School of Medicine; and Stanford University GIS labs, libraries, and administrative offices, all of which are also using ArcGIS and ArcGIS Server. Plans are in the works to develop and support coordinated efforts relative to both people and places throughout the campus community, including potential disaster preparedness planning.

More Information

For more information, contact David Schutt, principal planning analyst, HR Programs, Stanford University Medical Center (e-mail: dschutt@stanfordmed.org).

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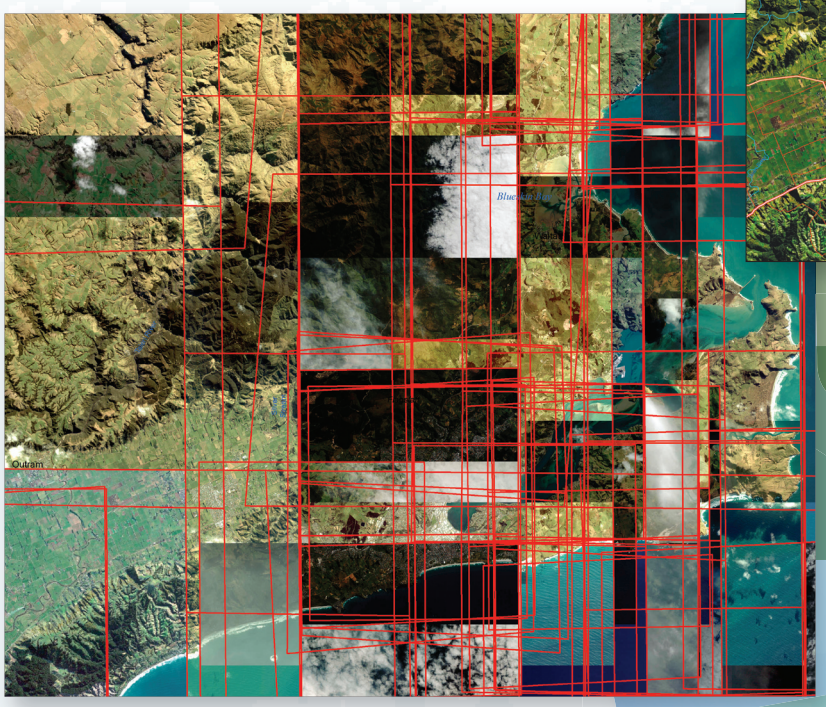

The mosaic dataset simplifies imagery management with dynamic mosaicking and on-the-fly processing.

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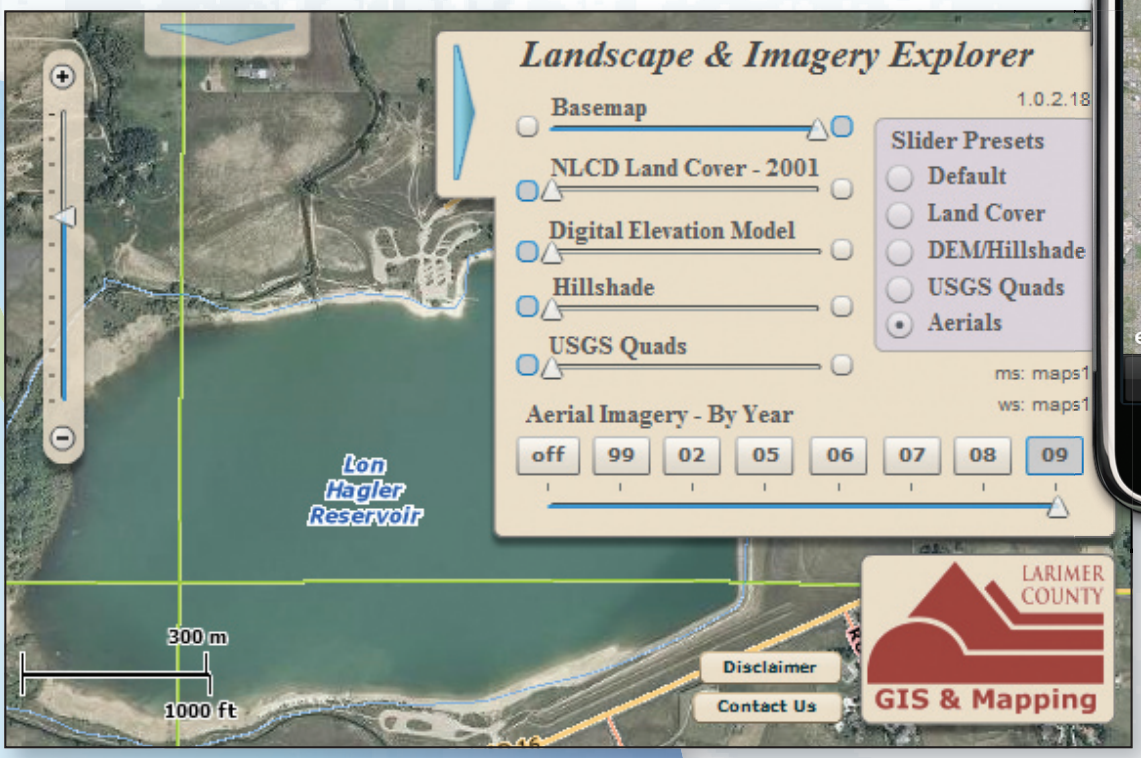

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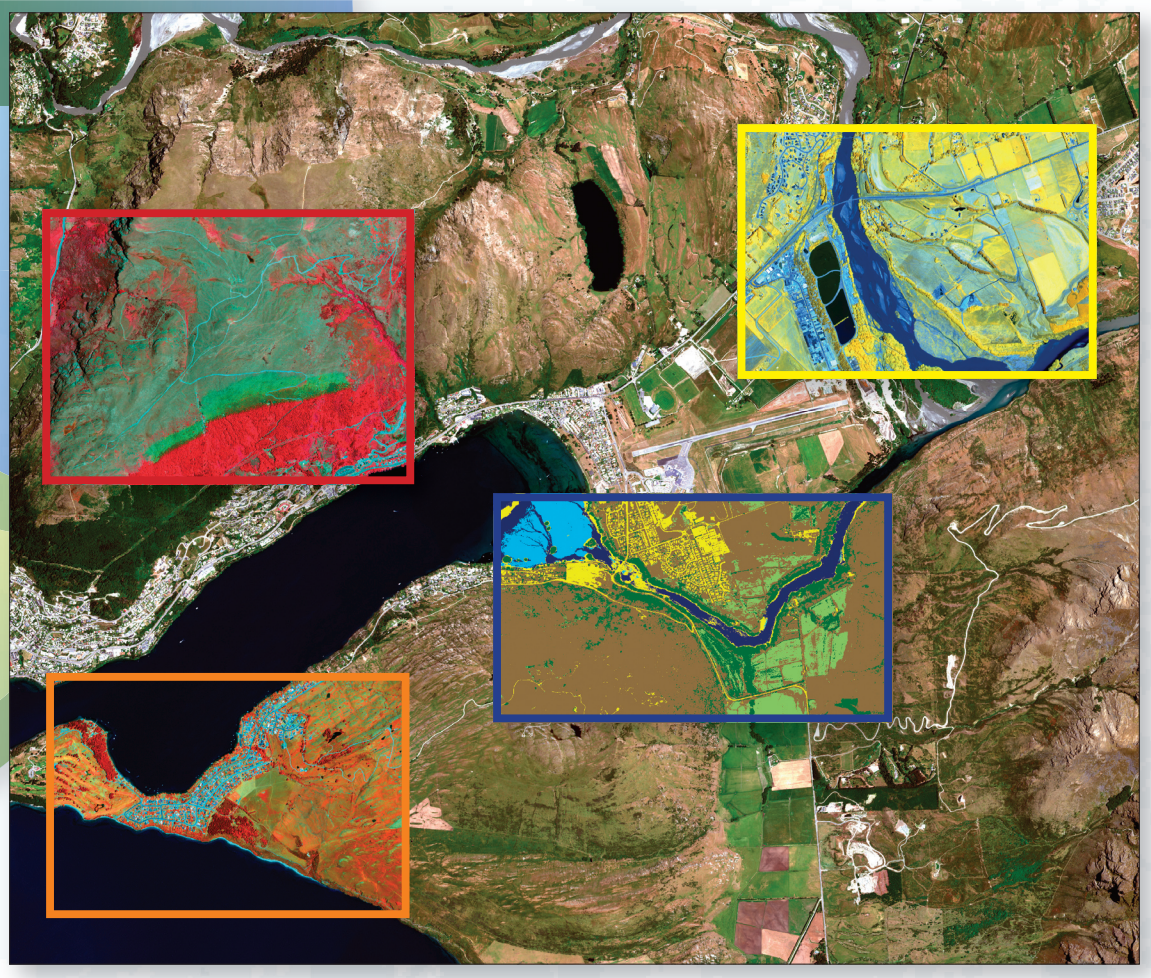

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Designing Wildlife Corridors Helps Species Survive

Highlights

- Wildlife corridors reduce fragmented populations, increase biodiversity, and decrease wildlife-vehicle collisions on highways.
- CorridorDesigner is a suite of tools for ArcGIS for creating habitat and corridor models.
- Tools based on ArcGIS streamline the wildlife corridor design and management process.

Habitat loss is the number one threat to biodiversity. With increasing human population growth and urbanization, wildlife habitat continues to decline and become fragmented. Fragmentation and isolation can have dramatic negative effects on plant and wildlife populations, ranging from decreased genetic diversity to extinction. Restoring and protecting existing habitat and providing linkages between fragmented areas are becoming critically important to the continued existence of many species. Wildlife habitat corridors allow populations to interact; interbreed; and, as climate changes, shift their geographic range. Planning, designing, and implementing wildlife corridors can be difficult, but GIS technology is helping streamline the process.

It didn't take long for Northern Arizona University's School of Forestry professor Paul Beier to realize the importance of wildlife corridors. While studying mountain lion populations in the Santa Ana Mountain Range in California during 1988–1992, Beier noted that habitat fragmentation was the biggest problem the big cats were facing. Without habitat corridor links between mountain ranges, the Southern California mountain lion population would be doomed. "I documented that based on their demography, they must have connectivity, and that based on animal movement, they'd use linkages that were available if we gave them half a chance," says Beier. "They were using some highly degraded existing corridors, and so I got really excited at the prospect of designing corridors on purpose. Wouldn't that be terrific?"

Years later at Northern Arizona University, Dan Majka began working with Beier. Majka created corridor models using ArcGIS based on methodology designed by Beier and South Coast Wildlands, a nonprofit organization dedicated to ensuring functional habitat connectivity. To improve workflow and analysis speed, Majka refined, enhanced, and implemented the organization's tools into a toolset called CorridorDesigner through Northern Arizona University's Esri university site license.

CorridorDesigner is a suite of tools for ArcGIS for creating habitat and corridor models. It provides a user-friendly, three-step process that applies least cost modeling for multiple focal species. The core input is habitat suitability modeling, which allows users to assess the quality of habitat for a species within the study area or a modeled corridor and mask out any unsuitable habitat.

GIS habitat suitability models relate suitability to raster-based layers, such as land use/land cover, elevation, topographic position, human disturbance (e.g., distance from roads, road density, housing density), or other relevant data. Using this data and a habitat suitability threshold that ranks habitat quality for breeding, the user can model a single species corridor, then repeat the procedure for other species. Next, the user can join the single species corridor models to create a preliminary linkage design. This union of corridor data is the most obvious way to ensure that all target species are included.

The CorridorDesigner tools connect the best available habitat for individual wildlife species between two larger habitat blocks. All would be well if this exact region could be conserved. Unfortunately, for a variety of reasons, the best choice areas are usually not available for corridor development, so the model is best used as a baseline to compare alternatives.

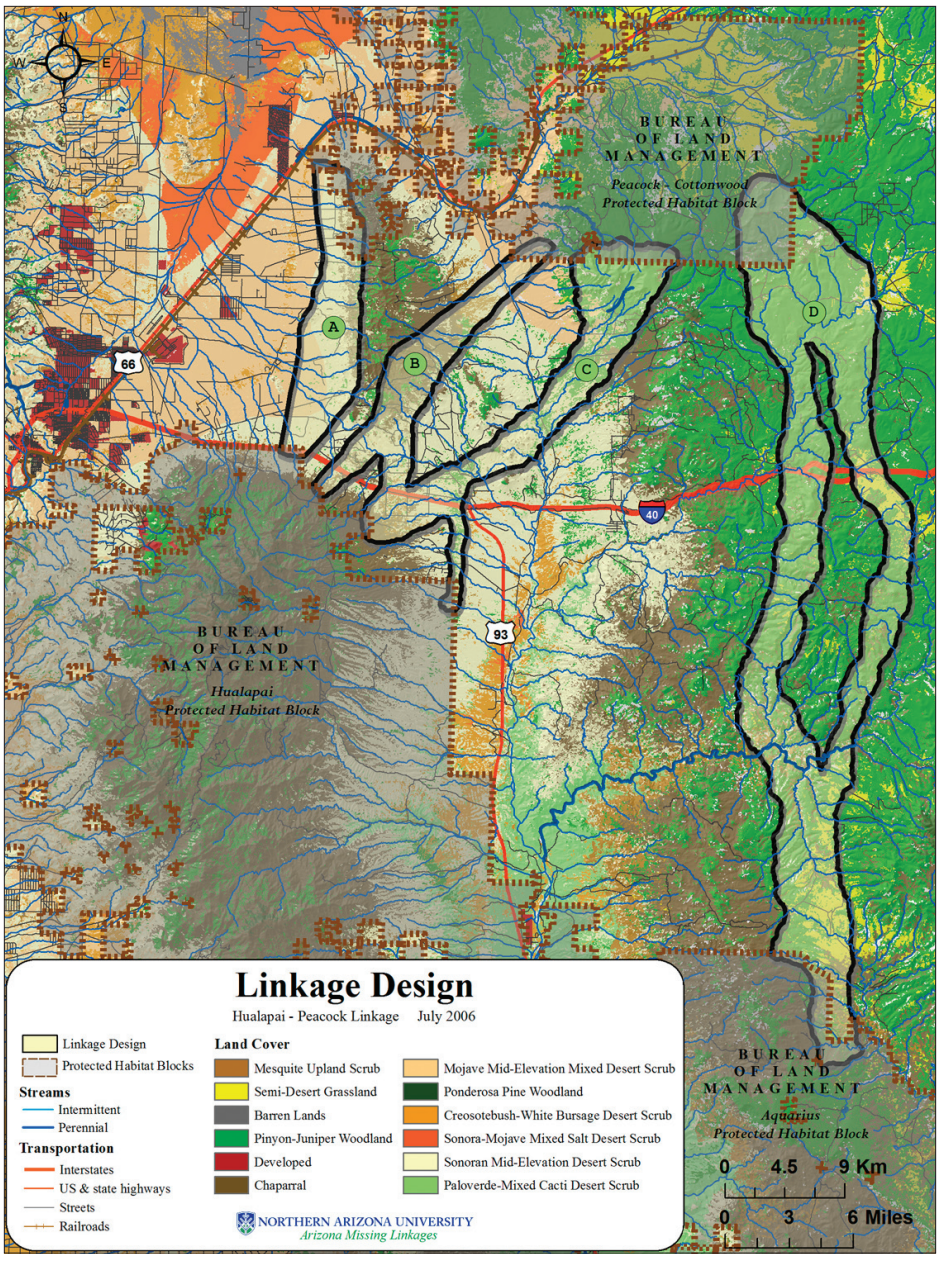
GIS consultant Jeff Jenness, GISP, joined the project and lent his expertise by creating an ArcGIS extension for CorridorDesigner that provides a set of tools to evaluate the best corridors and compare them with more realistic alternatives. These tools include calculation of patch-to-patch distances, bottleneck analysis, size-weighted general statistics, size-weighted histogram statistics, size-weighted cross-tabulation statistics, and cumulative surface tools. These statistics help land managers and conservation investors make educated decisions about what to conserve. By factoring in the reality conservationists face every day, this extension ensures that the optimal corridor is designed using what land is available.

Climate and Transportation Concerns

New concerns about a changing climate have forced wildlife managers to rethink how corridors should be designed for the success of species in the future. In response, spatial analyst Brian Brost and Jenness have added another set of tools to the CorridorDesigner toolbox, including the ArcGIS extension Land Facet CorridorDesigner and a set of complementary land facet functions that run in the computer program R. Land facets are based only on topographic and soil features on the landscape, which don't change over time and will not change as climate changes. "Until now, corridors were primarily designed to encourage movement of focal species through present land-cover maps," says Jenness. "Because of the strong possibility that land-cover maps will change in this century, any corridor linkage based on those maps might fail due to climate change." It is thought that future vegetation (and, indirectly, animal assemblages) will be determined primarily by the interaction among land facets and future climate regimes. This land facet approach is a valuable geographic approach to designing wildlife corridors that considers the future effects of climate change.

Wildlife corridors don't just conserve connectivity; they also provide ways to make highways safer for both people and wildlife. The CorridorDesigner tools can be useful in helping determine the ideal location of wildlife crossings for various species along major thoroughfares and highways. Building these crossings reduces wildlife-vehicle collisions, leading to a decrease in mortality on highways for countless animals while keeping drivers safe. "For large mammals like mountain lions that tend to occur in low densities and take several years to raise their young, the loss of an individual can have a snowball effect on a local population," says Emily Garding, a wildlife biologist/GIS analyst for the Arizona Missing Linkages Project, who has worked extensively with the CorridorDesigner tools. "I'm excited that our work promotes developing a more wildlife-friendly transportation infrastructure that will contribute to maintaining sustainable wildlife populations."

The significance of wildlife corridors is clear. "Corridors are important because they provide a way of connecting species and habitats in a changing world," says Majka. "They provide a possible way to deal with increased pressures, whether it's urbanization or fragmentation; increased transportation; and climate change." GIS-based tools have significantly streamlined the design and implementation of corridors. With GIS, CorridorDesigner, and the continued support and enthusiasm of people like those who work on and with these tools, wildlife can look forward to a sustainable, connected future.



Multispecies linkage of the area between Hualapai and Peacock Mountains, Arizona.

Mountain lion mother and cub in Caspers Wilderness Park, Orange County, California, are photographed by motion-activated camera (photo by Donna Krucki).

More Information

For more information, contact Dan Majka (e-mail: dan@corridordesign.org), Jeff Jenness (e-mail: jeffj@jennessent.com), or Brian Brost (e-mail: bmbrost@gmail.com). To download the free CorridorDesigner tools, visit corridordesign.org.

Conservation Group Seeks to Save Rare Ethiopian Wolves

Rabies Threatens Endangered Species in Africa

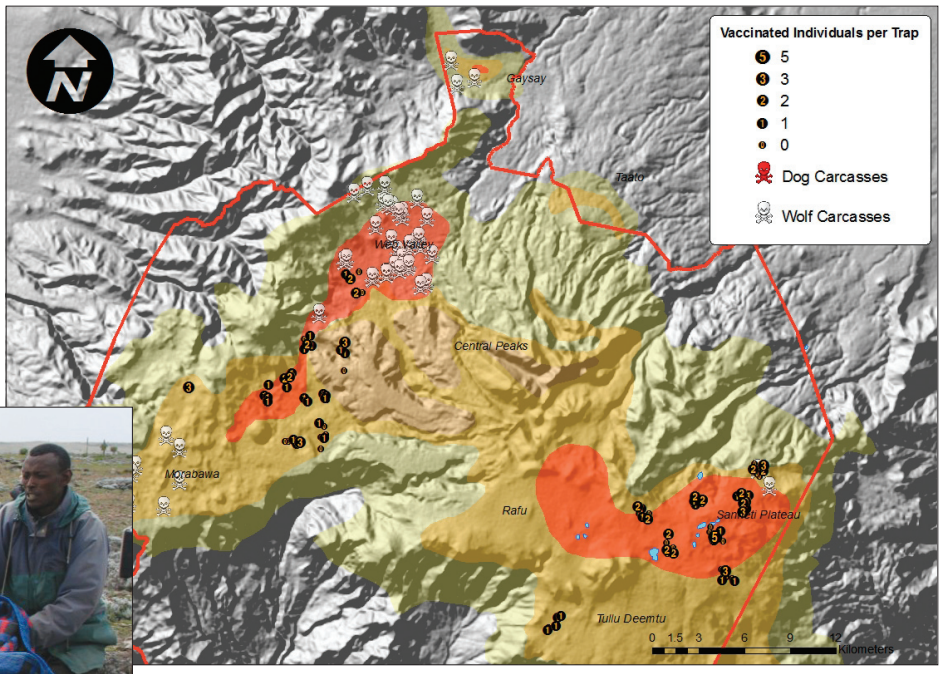
By Christopher H. Gordon, Graham Hemson, and Anne-Marie E. Stewart, Ethiopian Wolf Conservation Programme

Highlights

- GIS mapped where vaccinations were concentrated from year to year and where to target vaccinations in the future.
- ArcGIS maps convinced Ethiopian authorities to allow vaccinations.
- The locations of carcasses were mapped along with previous data on pack locations and viable habitats.

Ethiopian wolves, the rarest canids in the world, face many threats to their survival. One of the most serious comes from rabies, transmitted to the animals from domestic dogs.

To protect the wolves, the Ethiopian Wolf Conservation Programme (EWCP) (**www.ethiopianwolf.org**), with help from other organizations, operates a rabies vaccination program that uses GIS technology to target the best locations to vaccinate the dogs and wolves that will prevent the spread of the virus.



Left: A wolf released after a vaccination (photo copyright © Anne-Marie E. Stewart). Above: Overview of BMNP showing all dog and wolf carcasses found.

The Danger the Wolves Face

Fewer than 450 Ethiopian wolves still roam the mountainous regions of Ethiopia, Africa. They live at altitudes of more than 9,800 feet and are only found in seven isolated populations. The largest comprises 250 wolves that make their home in the protected area of the Bale Mountains National Park (BMNP) in south central Ethiopia.

EWCP was founded in 1995 to promote sustainable solutions for protecting the Ethiopian wolf. The organization mainly focuses its efforts in and around BMNP.

EWCP takes a three-pronged approach to saving the wolves: Educating people about the importance of protecting the wolves, monitoring the wolf populations, and vaccinating the wolves and local dogs against diseases.

The Ethiopian highlands, where the wolves reside, have become some of the most densely populated agricultural areas within Africa. With human development surrounding and encroaching on the animals' habitat, the wolves are confined to small areas and isolated from other wolf populations.

The majority of people living here are pastoralists, and their livestock overgraze and trample the natural Afro-alpine habitat. With the climate warming, the cultivation of crops at high altitudes is becoming more viable and results in the loss of indigenous plant species. This leads to the destruction of habitat for rodents, which are the wolves' main prey.

While the Ethiopian wolf is threatened by habitat loss, and thus prey reduction, persecution, and hybridization, diseases transmitted from the local domestic dog population remain the primary threat to the species. There were rabies outbreaks in Ethiopian wolves in BMNP in 1991–92 and again in 2003–04. This disease is fatal, and in past known cases, it has killed at least 70 percent of wolves in the core infection area. This is obviously a significant threat to an already critically endangered species.

Vaccination Program Gets Under Way

In 1996, EWCP launched a domestic dog vaccination program, aiming to vaccinate 70 percent of the 20,000 dogs living in and around the national park. Theoretically, such vaccinations would curtail the disease and stop it from spreading to the wolves. However, dogs have a tough life and a short lifespan in Ethiopia, with many vaccinated dogs dying young and puppies constantly being born that need to be inoculated. Furthermore, during the dry season, herders and their livestock and dogs travel into wolf range from many miles away to take advantage of the grazing still available within the park. This increased contact with the Ethiopian wolves raises the risk of rabies spreading to the wolves.

Currently, EWCP can only afford to vaccinate 7,000 dogs per year (at a cost of $6 per dog). All these factors combine to make it extremely difficult to vaccinate 70 percent of the local domestic dog population and ensure the wolves will be protected.

Dr. Jorgelina Marino, EWCP's ecologist, first began implementing ArcGIS software in 2005 with support from the Society for Conservation GIS (SCGIS). ArcGIS was used to collate data collected by the organization's wolf monitoring team on wolf distribution, individual pack territories, and habitat availability. Using GIS, EWCP mapped where vaccinations were concentrated from year to year and more efficiently planned where to target vaccinations in the future.

Understanding a Rabies Outbreak

During a recent rabies outbreak among Ethiopian wolves, ArcGIS software helped EWCP stop the disease from spreading.

Most wolves in BMNP are split into three linked subpopulations: Sanetti Plateau, Morebawa, and the Web Valley. In late August 2008, EWCP researchers in the Web Valley found a dead Ethiopian wolf. The monitoring team regularly discovered more carcasses from early October 2008 onward, with laboratory testing confirming seven rabies cases. As each case was discovered, it was added to a rapidly growing GIS layer of the area, helping EWCP better understand the likely origin of the outbreak and which direction it was spreading through the population. The rabies had been carried into the wolf range by a rabid dog, which must have bitten a wolf. Wolves are social pack animals (once one has rabies, the disease spreads quite rapidly).

Thirty-nine carcasses were recovered from the Web Valley between August 28, 2008, and January 15, 2009. Because EWCP researchers are so familiar with the wolf population there, they knew 13 more wolves were missing from the area.

Due in part to the information gained from mapping the outbreak, EWCP received permission from Ethiopian conservation authorities to vaccinate 50 wolves against rabies. Permission for vaccinating wolves is only granted by the authorities once a rabies outbreak has occurred.

The intervention began on October 20, 2008. The objectives were to contain the rabies virus within the Web Valley and reduce the probability of BMNP wolves becoming extinct by protecting wolf packs in other key adjacent subpopulations.

Effective planning for such an endeavor is critical, and ArcGIS Desktop ArcView excelled in this task. The locations of discovered carcasses were mapped, along with previous data on pack locations and viable habitats.

Based on the maps and EWCP's understanding of the two previous rabies epidemics, the disease's potential spread was estimated. Decisions about where to set the live traps for the wolves were also made before mobilizing the vaccination team. Since restrictions exist on the number of wolves that can be vaccinated, it was crucial to ensure that every vaccination was utilized to maximum effect.

As Morebawa was the most immediately threatened subpopulation, trapping the wolves for vaccination was focused on the Web Valley, East Morebawa, and the Web Isthmus (a small corridor) between these two populations.

During more than 1,200 hours of trapping, 50 wolves were vaccinated from 11 packs. Vaccination efforts were based on population viability modeling outcomes showing that, if 40 percent of the wolves in each pack were vaccinated, the probability of that pack's survival would increase from 54 percent to 90 percent.

But despite wolf vaccinations conducted in October, rabies was spreading swiftly through the domestic dog population around the national park. The EWCP team began to find wolf carcasses from West Morebawa in early May 2009. In total, 11 carcasses were found, while the monitors only identified 32 live wolves in a population that should have numbered closer to 90. Samples were collected from one wolf, and it tested positive for rabies.

Authorities again granted EWCP permission to vaccinate 50 wolves. By the time the outbreak was discovered, however, it was considered too far advanced to protect the remaining wolves from the West Morebawa area. Fortunately, 8 of the 32 remaining wolves had been vaccinated against rabies during the 2003 epidemic. EWCP focused the second intervention effort on the third major subpopulation, the wolves on the Sanetti Plateau, and vaccinated 48 wolves from nine packs in fewer than 700 hours of trapping. During the second trapping effort, two more carcasses were discovered on the Sanetti Plateau. Both were juveniles, found dead at a time when mortality would be naturally high in individuals of that age due to their recent independence and inexperience in finding food. They tested negative for rabies.

Benefits of Long-Term Monitoring

The swift response to outbreaks such as these could not be possible without EWCP's long-term population monitoring program. Strategic decisions were made based on in-depth demographic knowledge about the carcasses discovered and wolves that were missing. This knowledge was also integral for implementing the rabies vaccination program and postintervention monitoring. Combined with new technologies such as GIS, EWCP launched rapid and effective intervention procedures. Reactive intervention campaigns are costly, both financially and in terms of potential loss of population size and viability. Careful planning helps reduce the costs somewhat while increasing the effectiveness of any action taken.

The constant threat of rabies and the past history of two previous known outbreaks combined with this current epidemic suggest that this problem is not solved yet. Despite the early detection, a significant number of wolves in BMNP still died.

An estimated 67 percent of wolves from six unvaccinated packs in Web Valley and 73 percent of wolves in West Morebawa were lost. In all, the 50 carcasses and 66 missing wolves represent approximately 36 percent of BMNP's wolf population and possibly more than 25 percent of the global population, (a worrisome and real threat to a wonderful species).

About the Authors

Christopher H. Gordon, Graham Hemson, and Anne-Marie E. Stewart are with the Ethiopian Wolf Conservation Programme, Robe, Bale, Ethiopia, of the Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, Oxford, United Kingdom.

More Information

For more information, contact Dr. Jorgelina Marino, EWCP ecologist (e-mail: jorgelina.marino@zoo.ox.ac.uk), or the Ethiopian Wolf Conservation Programme, Robe, Bale, Ethiopia, at **info@ethiopianwolf.org**. Acknowledgments are online at **www.esri.com/arcnews**.

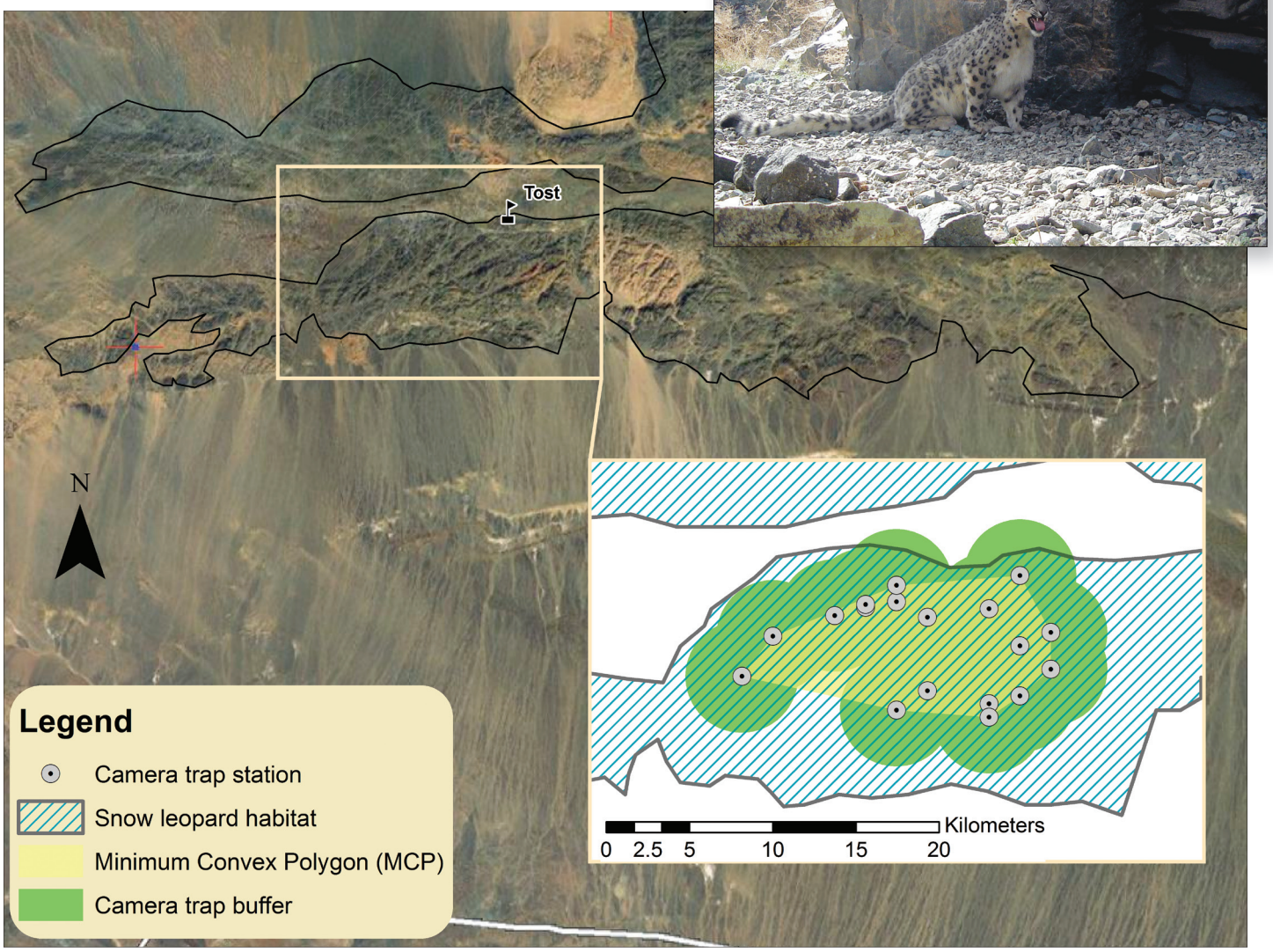
Saving the Ghost Cat of Central Asia

GIS Helps Revolutionize Snow Leopard Research and Conservation

By Rodney M. Jackson, Charleen Gavette, and Joyce Robinson

Highlights

- Conservancy integrates camera imagery and data to count and track snow leopards.
- Using GIS helps improve population estimates by capturing data from many locations.
- The SLC uses ArcGIS to map snow leopard distribution.



The Mongolian survey area's camera trap layout, buffer area, and regular activity centers. Inset: A snow leopard.

Snow leopards, *Panthera uncia,* inhabit some of the highest, most rugged, snow-swept, least productive territories on the earth. They prefer the gorges, cliffs, and rocky outcrops above the tree line. Their numbers may be as low as 3,500, though they are found in a dozen countries in South and Central Asia, from Nepal to Russia—an area of more than half a million square miles. The Snow Leopard Conservancy (SLC) works to advance community-based stewardship of the snow leopard through education, research, and grassroots conservation action.

Local communities live by agropastoralism. In seven range countries, more than half the people depend on animal husbandry, with over 40 percent living below poverty on average per capita incomes of US$250–$400 per year. While herders seldom see snow leopards, the cats occasionally kill their valuable livestock, so herders respond if they can by poisoning or trapping the cats.

Conserving this charismatic species presents many challenges, but SLC knows that by protecting the species, the conservancy also protects many plants and other animals of Asia's high mountain ecosystems. The introduction of remotely triggered cameras and sophisticated tools for extracting genetic material from scats has revolutionized SLC's ability to learn about snow leopards. SLC is now using GIS to enumerate snow leopards and map their distribution with far greater confidence. It uses GIS to improve population estimates by incorporating spatially explicit information on camera trap sites, habitat conditions, and photo-capture history of snow leopards.

Conserving snow leopards requires determining which places contain the best populations and which mountain ranges serve as critical corridors linking fragmented populations. The cats follow predictable routes along ridges or valley edges, where they scent mark overhanging rocks and leave scats or scrapes in prominent places. These signs are important communication methods for a species living an essentially solitary life; they also help biologists decide where best to place the remote, noninvasive camera traps.

The SLC survey was undertaken in May–July 2007 in the isolated desert massif of Tost Uul in the South Gobi province (100°35'E/43°10'N). The conservancy deployed 20 TrailMaster TM1550 active-infrared sensors for detecting the passage of any warm-blooded animal. These were connected to two cameras positioned to photograph either side of a passing snow leopard, with all traps set along characteristic travel paths next to clusters of scrapes or active scent rocks. SLC captured 120 snow leopard photographs during the 66-day survey, and it identified the individuals by their distinctive spotting pattern. From the number of captures and recaptures of each cat, it was able to estimate the total number present within the survey area.

With ArcGIS Desktop software and the ArcGIS Spatial Analyst extension (supplemented by third-party vendor tools), SLC mapped camera trap locations and snow leopard habitat (mountain areas) or nonhabitat (surrounding desert plains). To establish the extent of area trapped, SLC generated a buffer of fixed width around the trap array based on the mean maximum distance that snow leopards moved between successive captures. Then, using the computer program Capture (**www.capture.com**), SLC estimated the capture probability and population size of the leopards, which amounted to a density of 0.75 or 1.52 cats per 100 square kilometers (just over 38 square miles), depending on the buffer width applied. Although SLC photographed a female and her three cubs, it excluded the cubs from analysis because they avoid remote cameras and are not yet part of the breeding population.

Then, to make use of all available GIS information, SLC supplemented its analysis with the recently released, spatially explicit software package SPACECAP (**cran.r-project.org/web/packages/SPACECAP/index.html**), which operates under R (Project for Statistical Computing, version 2.9.2). This software utilizes GIS information fully to implicitly exclude areas of nonhabitat and to better model variation among individuals in capture probability attributed to behavior or different use patterns. Drawing on Bayesian theory, it provides nonasymptotic inferences that are more appropriate for small samples, typical of most carnivore photo-capture studies.

SLC turned to ArcGIS Desktop (ArcMap) to generate a set of regularly spaced points across the entire sample area for representing potential snow leopard activity centers needed by the algorithm implemented in SPACECAP. By examining graphic output, the conservancy was better able to determine how to improve trap coverage for future surveys in Tost Uul, along with designing more efficient photo-capture surveys for other areas. GIS can also be used to build other environmental covariates, such as landform ruggedness, vegetation, or slope steepness. Models that best explain the observed variation could then be integrated into future population surveys.

GIS provides a highly useful tool for immeasurably improving the robustness and precision of population estimates for long-term monitoring, especially when involving a rare species occupying remote, rugged, or diverse terrain. Combining sound field techniques with GIS spatial modeling enables researchers to generate the necessary data for informing program managers whether conservation interventions are working or not, as indicated by any increase or decrease in the number of snow leopards roaming the project area.

Equally important, the Snow Leopard Conservancy approaches such work collaboratively with local communities that coexist with snow leopards. Herders may collect scats for DNA analysis and monitor wildlife in their area. GIS-generated maps can be a meeting of Western and indigenous views of ecology, showing where livestock grazing areas are at the most risk of snow leopard depredation or where important habitat for ibex or blue sheep—the snow leopard's natural prey—might best be placed off limits for livestock. It's a win-win for everyone.

About the Authors

Rodney M. Jackson, Ph.D., is founder-director of the Snow Leopard Conservancy and an internationally recognized expert who has worked on snow leopards for over 30 years. He and his associates were the first to radio-collar snow leopards in Nepal in the early 1980s. Charleen Gavette is a GIS technician with the National Marine Fisheries Service, National Oceanic and Atmospheric Administration. She volunteers her time with the Snow Leopard Conservancy, helping incorporate snow leopard field data into state-of-the-art habitat modeling and three-dimensional landscape maps. Joyce Robinson, Snow Leopard Conservancy's office administrator, plays a key role in maintaining the organization's GIS database along with preparing maps for publication and dissemination.

More Information

For more information, contact Dr. Rodney Jackson, director, Snow Leopard Conservancy (tel.: 707-935-3851; e-mail: info@snowleopardconservancy.org; Web: **www.SnowLeopardConservancy.org**).

Conserving Earth's Gentle Giants

Save the Redwoods League Maps the Future of Important Ecosystem

Highlights

- GIS allowed the League to visually determine which areas are most important for protection.
- GIS helps create detailed regional conservation strategies for redwood forests, parks, and connecting landscapes.
- Save the Redwoods League is partnering with Redwood National and State Parks.

The logger's saw. Real estate development. Vineyard plantation. Climate change.

All pose threats to California's giant redwood trees, according to the Save the Redwoods League. In 1850, there were two million acres of ancient coast redwood forests in California. Today, fewer than 120,000 acres of these old-growth forests remain, having fallen victim for years to unsustainable logging practices, urbanization, poorly planned development, and road building. Climate change is another concern, and the Save the Redwoods League hopes to answer how it might affect the health of redwood forests and giant sequoias through its $2.5 million research project called the Redwoods and Climate Change Initiative.

To help protect these majestic trees, the oldest of which dates back 2,200 years, the Save the Redwoods League buys land in northern and central California, where the coast redwoods grow. Since forming in 1918, the California-based nonprofit organization has purchased more than 189,000 acres for preservation. Some of the land also includes giant sequoias, as well as upstream acreage of coast redwood forests, which is important to preserve from a watershed standpoint.

In the past, the League bought land based in part on recommendations from concerned citizens who wanted a particular piece of land protected, but it was hard to know the entire picture based solely on word of mouth.

Today, the Save the Redwoods League uses maps, scientific knowledge, more than 90 years of experience, and the latest technology—including GIS—to create detailed regional conservation strategies for redwood forests, parks, and connecting landscapes. Much of the land purchased and protected now lies in Humboldt Redwoods State Park and Redwood National and State Parks, along the coast of Northern California. Many of the League's conservation efforts would not have been possible without GIS, which is used to analyze data about the redwoods, development, nearby watersheds, and rare plants and endangered animals in those areas.

To strategically guide, prioritize, and focus its land protection efforts, the Save the Redwoods League launched the Master Plan for the Redwoods in the late 1990s. As part of this plan, the League used GIS models to identify areas that are important to protect. The models incorporated data on the locations of

- Trails
- Ancient redwoods
- Existing parks
- Habitat for imperiled and sensitive species, such as the coho salmon, northern spotted owl, and marbled murrelet
- Threats to the forest, including residential development, land conversion to vineyards, road building, and incompatible forestry practices, plus many other dangers

The League wants people to experience the redwoods, so if an area contains features that encourage people to visit the majestic trees—such as good hiking trails or beautiful scenery—the area is given a higher rank and has a better chance of receiving public support to protect it. Based on these conservation models, the data is then analyzed using ArcGIS Desktop software, and maps are created and used throughout the organization for deciding what parcels of land to try and acquire, fund-raising appeals, outreach, and resource management.

Access to accurate data is crucial for the League's GIS analysis and mapping. Data comes from public agencies, such as the California Department of Fish and Game, California State Parks, the National Park Service, and the U.S. Forest Service.

Laura Kindsvater, senior conservation planner at the Save the Redwoods League, says the GIS data used in analyses includes

- Rare and sensitive species, such as the northern spotted owl, Pacific giant salamander, Sonoma tree vole, and Humboldt milk vetch
- Fish streams that provide habitat to the threatened or endangered coho and Chinook
- The U.S. Forest Service's existing vegetation data depicting where mature, second-growth forests occur
- Habitat model data for wide-ranging species, such as the mountain lion, Pacific fisher, and other forest carnivores
- Projected development, roads, and timber harvest plan boundaries

"Combining and analyzing this data using GIS allows us to visually determine which areas are most important for protection," Kindsvater says, "and we can then act on this newfound knowledge."

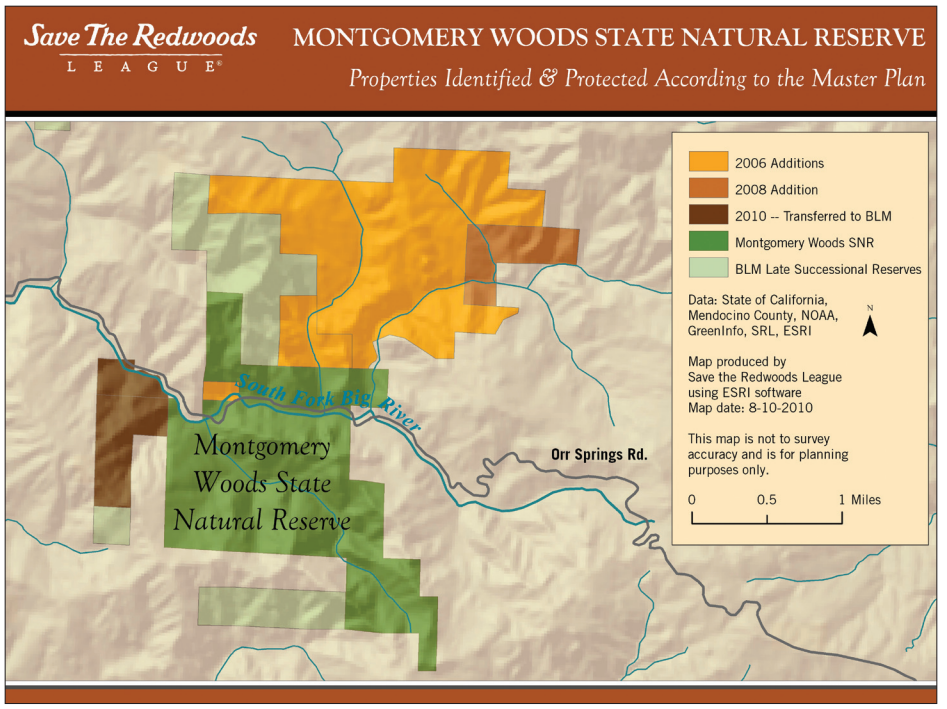
By using GIS to assist in creating the master plan, the Save the Redwoods League has identified land across the entire range of coast redwood forests in California, down to the property level, that rank highly for protection. Based on GIS analyses, the League has created detailed regional strategies that outline land acquisition goals. Now that the League has completed the detailed regional strategies, the organization will implement the master plan and contact owners of higher-ranked land in areas such as the Santa Cruz Mountains, Humboldt and Del Norte counties, coastal Mendocino and Sonoma counties, and the San Francisco Bay area to find out if they are willing to sell their land or work together on a conservation agreement. (An example of a conservation agreement is when a landowner donates or sells the right to develop land to the Save the Redwoods League while continuing to own the property.)

ArcGIS is also helping the League discover more about important ecological characteristics specific to the site of the lands it is working to protect so that it can build a case for the property.

For example, when the League was raising funds to purchase land to add to Montgomery Woods State Natural Reserve in Mendocino County, it used GIS in combination with fieldwork to find out what types of vegetation grew on each piece of property and which of these were rare and targeted for conservation at the statewide level. Several of the properties have native grasslands and Oregon white oak forests on them, which are both a high priority for acquisition by state natural resource agencies. GIS was also used to better understand how each parcel contributes to increased protection of the surrounding Big River watershed, as well as the good health of specific fish populations within the watershed and downstream of the parcels. Since the 1960s, when several large floods in Humboldt County caused massive erosion from logged areas upstream that then inflicted heavy damage to old-growth forests downstream, the League has had a commitment to protecting redwood ecosystems at a watershed scale.

"In addition," says Kindsvater, "we have been able to identify, using GIS, 35 project areas across the state of California that are a priority for protection. Focusing on these project areas allows us to be much more effective as an organization in protecting the last remaining groves of old-growth redwoods, building the viability of parks and reserves, and maintaining and restoring connecting landscapes."

Sixteen of the 35 project areas have been identified as high priority to purchase and protect, allowing the League to further focus its energy. For example, the Coastal Sonoma project area in Sonoma County, located to the west and northwest of Santa Rosa, has been identified as high priority. Sonoma County has a wealth of incredibly beautiful redwood forests, a low percentage of currently protected lands, significant groves of old growth that remain unprotected, and a high potential to provide inspiration and recreation for millions of people who live less than two hours away. Yet these old-growth stands are also threatened by a rapid growth rate in population throughout Sonoma County. Through the master plan, the Save the Redwoods League has learned that there are important lands in the coastal Sonoma region to protect and that the organization must act now to conserve them. It has therefore been investing a great amount of time, energy, and resources in increasing land protection in this region over the last several years, culminating in several large land purchases, such as the Jenner Headlands and Stewarts Point acquisitions.



In 2006, the Save the Redwoods League doubled the size of the Montgomery Woods State Natural Reserve by purchasing and adding parcels with old-growth Douglas-fir forests and rare oak woodland habitats on them, as shown on this map (courtesy of Save the Redwoods League).

Old-growth coast redwood forest (photo by Howard King).

More Information

For more information, contact Laura Kindsvater, senior conservation planner, Save the Redwoods League (e-mail: lkindsvater@savetheredwoods.org), or to receive monthly e-mail updates, visit **SaveTheRedwoods.org**.

National Park Service Follows the Modern Lewis and Clark Trail

FEDERAL GIS

Historic Trail Auto Route Road Signs Inventoried with GIS and GPS

By William J. Gribb, Geography Department, University of Wyoming

Highlights

- Using ArcGIS Desktop analytic capabilities, NPS examined the clustering of route signs at road intersections.
- To provide one consistent road base file, the StreetMap dataset was incorporated into the project.
- The digital imagery of the signs provided a mechanism to assess road sign repairs without going into the field.

The courage, determination, and adventure of the Lewis and Clark Corps of Discovery have inspired many to follow its pathway, just not in the same arduous way. Congress recognized the importance of preserving the historic and nation-building significance of the Lewis and Clark Corps of Discovery journey. In a series of legislative actions, Congress created the Lewis and Clark National Historic Trail, an auto route that follows as closely as possible the water route that the Corps of Discovery traveled in 1804–1806. The 11 states, which Lewis and Clark traversed, designated roads that parallel the actual route taken as the auto route roads. The National Park Service (NPS) worked with the individual states and made available the official signage designating the auto route. Lewis and Clark followed one route on their westward journey and slightly different routes on their eastward return journey, thus creating routes that can be followed with several different roads representing the westbound and eastbound pathways.

In an effort to update, integrate, and computerize the auto route and signage, as well as link the auto route to significant historic, cultural, and landscape features, the National Park Service's Lewis and Clark National Historic Trail group formed a partnership with the Wyoming Geographic Information Science Center (WyGISC) at the University of Wyoming to create a GIS database. The objectives of the project were to construct an accurate location of the auto route; locate and inventory existing Lewis and Clark auto route signs; locate and categorize the significant historic, cultural, and landscape features in close proximity to the auto route; and assess the way-finding capabilities of existing signage. To meet these objectives and create a database that integrates with the current NPS GIS configuration, a combination of ArcGIS Desktop, Wind Image software, and Trimble's Pathfinder Office was used.

Working with the Lewis and Clark NPS group, the WyGISC team identified initial U.S. Geological Survey 1:100,000-scale digital line graph databases that could be incorporated to provide the initial road and hydrology datasets.

The Lewis and Clark National Historic Trail auto route extends from the plains to the Pacific.

Census Bureau TIGER files were included for state and county boundaries and the location of the 1,431 places, towns, and cities the auto route crosses. Four states had already produced accurate ArcGIS Desktop compatible shapefiles; the remaining seven states provided only hard-copy maps of the auto route. In the effort to provide one consistent road base file, the Esri StreetMap dataset was incorporated into the project and the auto route layer adjusted to it. The project objective, however, was to locate and inventory the road signs designating the route and signs directing travelers along the route. To accomplish this objective, the team completed a combination of location and data coding using Trimble Pathfinder Pro XRS receivers with data logger and a Ricoh Caplio 500SE GPS camera. The location of each sign was recorded with the XRS unit along with 13 characteristics of the sign, including number and condition of panels, and road characteristics. In addition, the team captured high-resolution digital images of the sign and the surrounding landscape with the Ricoh camera. To assist NPS with integrating the auto route with significant cultural, historic, and landscape features complementary to the Lewis and Clark journey, a total of 607 sites were also recorded using the GPS and digital images.

After 42 days of field data collection, the team needed several months to edit the data and create a system to integrate the auto route with the corrected sign locations and the digital images. With Visual Basic for Applications, a script was developed that created an identification system that linked the sign to the digital image using a combination of route designation, date, and time. This ID system allows NPS researchers to select a sign along the auto route and access the attribute database about the sign, its location, and condition and the digital images of the sign. The same potential is available for all the cultural/historic/landscape sites along the route. Overall, researchers will have access to 1,817 signs, 607 sites, and 10,295 images along the 6,885 miles (11,080 km) of the Lewis and Clark National Historic Trail auto route.

As part of the field collection data, the team captured the types of signs and their conditions and effectiveness characteristics. This allows NPS to not only create descriptive information about all the signs but also provide the ability to query and produce maps of the location of signs based on any of the attributes. For instance, NPS can now determine which signs need repair or maintenance because of vandalism or excessive wear or which signs are obstructed by vegetation overgrowth or some other barrier. This information provides a very cost-efficient means to determine the number of signs needing repair and their location so the appropriate repair teams can schedule the needed action. The digital imagery of the signs provides a mechanism to assess the repairs without going into the field.

As part of the project, NPS wanted the capability to examine and assess the distribution of the auto route signs. Using ArcGIS Desktop analytic capabilities, the clustering of route signs at road intersections and route turns can be examined to determine if the correct combination of signs, densities, and distances is available to direct the traveler along the auto route. In addition, the ability to view the digital images allows NPS staff to assess the signage along the route at potentially hazardous locations.

About the Author

William Gribb, Ph.D., is an associate professor and director of the Graduate Program in Planning at the University of Wyoming and an affiliate researcher at the university's Geographic Information Science Center.

More Information

For more information, contact Neal Bedlan, outdoor recreation planner, Lewis and Clark National Historic Trail (e-mail: neal_bedlan@nps.gov), or visit the Lewis and Clark National Historic Trail Headquarters site at **www.nps.gov/lecl/index.htm**. Key personnel for this project at the University of Wyoming's Wyoming Geographic Information Science Center were William J. Gribb (e-mail: planning@uwyo.edu), Scott Lieske (e-mail: lieske@uwyo.edu), and Phil Polzer (e-mail: ppolzer@uwyo.edu).

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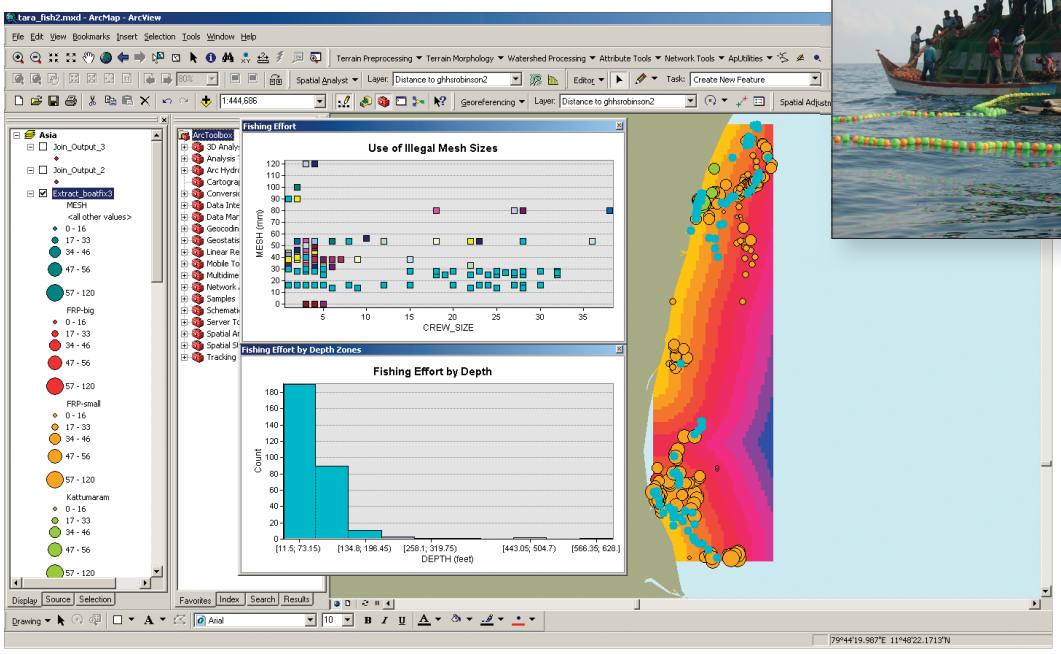
Fishing Catch Data Mapped Off the East Coast of India

By Tara N. Lawrence, Neil W. Pelkey, and R. S. Bhalla

Non-Governmental ngo Organization

Highlights

- Data can be visualized and analyzed in a short time using GIS.
- On-screen dynamic displays are quickly turned into publication-quality graphs.
- Visually exploring theories and perceptions is quick and efficient with GIS.



Left: Fishing data is linked to maps and show the use of illegal mesh sizes at the respective depths and distances. This shows a clear lack of implementation of specified rules and regulations. Inset: A large mechanized boat comprising up to 80 fishermen. The ring seine net often extends for kilometers, therefore resulting in considerably large catches of sardines or mackerel.

Coastal fishing in small boats with ragged nets, refurbished motors, and overworked crews is a dangerous occupation. These days, catches seldom contain big fish complete with bragging rights. If a catch fetches enough cash for tomorrow's diesel fuel, it's a good day. If not, fish harder, deeper, and longer tomorrow.

For decades, it was clear that some form of regional management was necessary on the east coast of India. In 2004, the Banda Aceh tsunami provided both the motivation and the funding to get this under way. Boats, nets, motors, GPS units, and fish finders were distributed in nearly every community.

However, the management tools used at the government level at that time were hampered because the data used in the analysis was limited to information collected at the jetties where hundreds of men and women sold fish.

But, of course, fishing itself happens at a place, depth, and time with real boats, real people, real gear, and real fish of certain weights and species. The proper information to govern fisheries needs to have "what," "when," "where," "who," "how deep," and "with what" data. This information is also critical for fisheries governance in India since traditional and mechanized craft have different legally defined fishing zones.

A nonprofit research organization called the Foundation for Ecological Research, Advocacy and Learning (FERAL) purchased a commercial license in 2003, and researchers at FERAL have been using ArcGIS since then for various mapping applications within research projects. This fisheries dataset required the ability to explore the complex relationships between fishing and gear, catch, and location—a task that ArcGIS is ideally suited for. The researchers linked the dynamic mapping and graphics capabilities in ArcGIS to explore and demystify this data. They then transferred the on-screen dynamic displays to publication-quality graphs using the ggplot2 graphic plotting system designed by Hadley Wickam of Rice University, Houston, Texas.

The "what" is quite detailed, as there are roughly 243 species of fish recorded that are caught, sold, and consumed. The "where" and "how deep" questions were covered by a straightforward GIS application using existing coastline maps, GPS, and a Humminbird echo sounding device. The "when," "who," and "with what" data was supplied by observation as researchers traveled standard fishing routes in three regions of the Coromandel Coast in the Bay of Bengal. Catch data would no longer be 300 kilos of shad, but rather, for example, 300 kilos of shad caught at 79.38765 E, 12.345 N at a 20-meter depth in sandy soils by five men using 25 millimeter nets who fished from 7:00 a.m. to 8:30 a.m. on January 3, 2008.

The researchers "pinged" the fishing coordinates, depth, and substrate where they found men fishing. They also collected data on type of gear, mesh size, and target species. All data was integrated and fed into ArcGIS.

ArcGIS software's dynamic data visualization and exploratory analysis helped immediately identify data entry errors, but more importantly, it illuminated the "where" of artisanal fisheries. Researchers were also able to move the data quickly into the R programming language and ggplot2 to create publication-quality statistical graphics.

The combination of graphs linked to the map display showed many Marine Fisheries Regulation Act (MFRA 1983) violations in terms of location and gear type. It was also clear that the fish cluster, and hence so do the fishermen. The often-told story that plenty of illegal fishing occurred in these waters turned out to match the data. Banned nets and mesh sizes were used, and large trawl boats regularly fished well within the 3-nautical-mile limit.

The distance tool, combined with the extraction tool in the ArcGIS Spatial Analyst extension, provided accurate measurements of distance to shore. Knowing the distance from shore is critical, because mechanized craft are not allowed to fish less than 3 nautical miles from shore, and motorized craft cannot go beyond 12 nautical miles without additional licenses. This creates tension, since the big trawl catches of shrimp are often within 3 nautical miles of the shore and the big long-line catches of the motorized boats are often beyond the 12-nautical-mile limit.

A huge plus of the GIS was the ease and rapidity of visualizing and analyzing the data. It took less than an hour to pull data from multiple sources; create and add the different layers; and define categories, such as boat size by depth or crew size by boat. After that, it was a simple matter of cleaning up errors, adding the distance grid, and redefining categories. The dynamic analysis and publication-quality maps were only a few clicks away.

Visualizing the data in ArcGIS and R was a quick and efficient way of visually exploring theories and perceptions on the fisheries sector. It took only nine days of sampling to map more than 250 boats fishing in the same zone in only a part of the Coromandel Coast. The ease with which this assessment could be done in so little time presents a useful tool for fisheries management. It was cost-effective in terms of time spent collecting the data and analyzing it and therefore could be used frequently to map fishing efforts on both coasts of India.

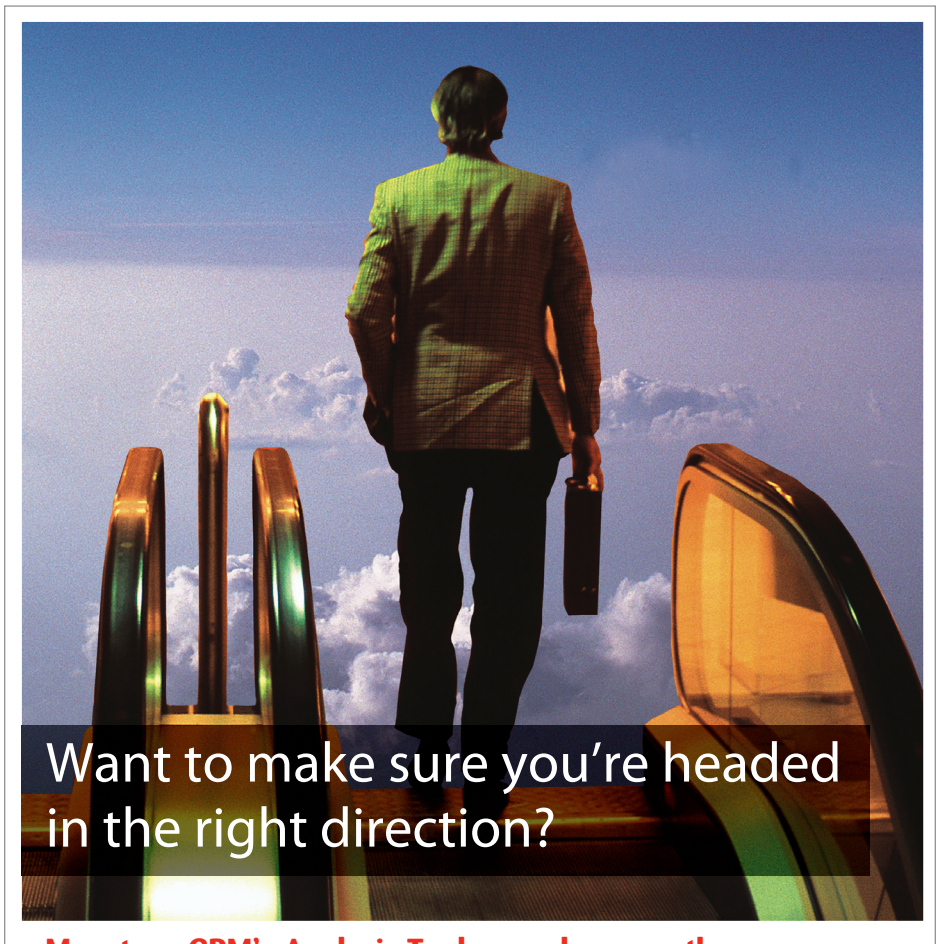
The real impact of the kind of fishing effort expended on a daily basis will only hit home then. Catches can no longer satiate this massive demand. Overfishing is a real issue that needs to be addressed on several levels in this complex yet dynamic sector, and a spatial context can solidify/silence any arguments raised on the ground.

About the Authors

Tara N. Lawrence is a marine biologist with the Foundation for Ecological Research, Advocacy and Learning, Pondicherry, India. Her current position as a junior research fellow involves building a qualitative and quantitative profile for the traditional and motorized sector in fisheries along the Coromandel Coast of India. Dr. Neil Pelkey is an associate professor at Juniata College, Huntingdon, Pennsylvania, whose area of expertise involves ecological modeling and environmental economics. R. S. Bhalla is a senior research fellow and trustee of FERAL. He is a landscape ecologist whose area of expertise also involves GIS and remote sensing.

More Information

For more information, contact Tara N. Lawrence (e-mail: tara@feralindia.org), Dr. Neil Pelkey (e-mail: pelkey@juniata.edu), and R. S. Bhalla (e-mail: bhalla@feralindia.org).



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Changing the Channel

Lidar and GIS Fast-Track Australia's Wimmera Mallee Pipeline Project

Highlights

- Enterprise GIS manages data-rich lidar and orthophotography, saving time, resources, and money.
- Massive surface datasets were stored in an ArcGIS database.
- Terrain data is quickly processed and analyzed using the ArcGIS Server 3D extension.

The Wimmera Mallee Pipeline Project is one of the largest engineering initiatives currently under way in Australia. It spans an area of 11,700 square kilometers and aims to increase the efficiency of water distribution in the Wimmera and Mallee regions through pipelines and pump stations. From the outset, the project had a design and construction timeline of 10 years, with an estimated cost of $US688 million. But when data-rich lidar and orthophotography were introduced into the project, which is managed in an enterprise GIS, project engineers were able to fast-track the 8,800-kilometer (5,468-mile)-long pipeline project, saving time, resources, and money.

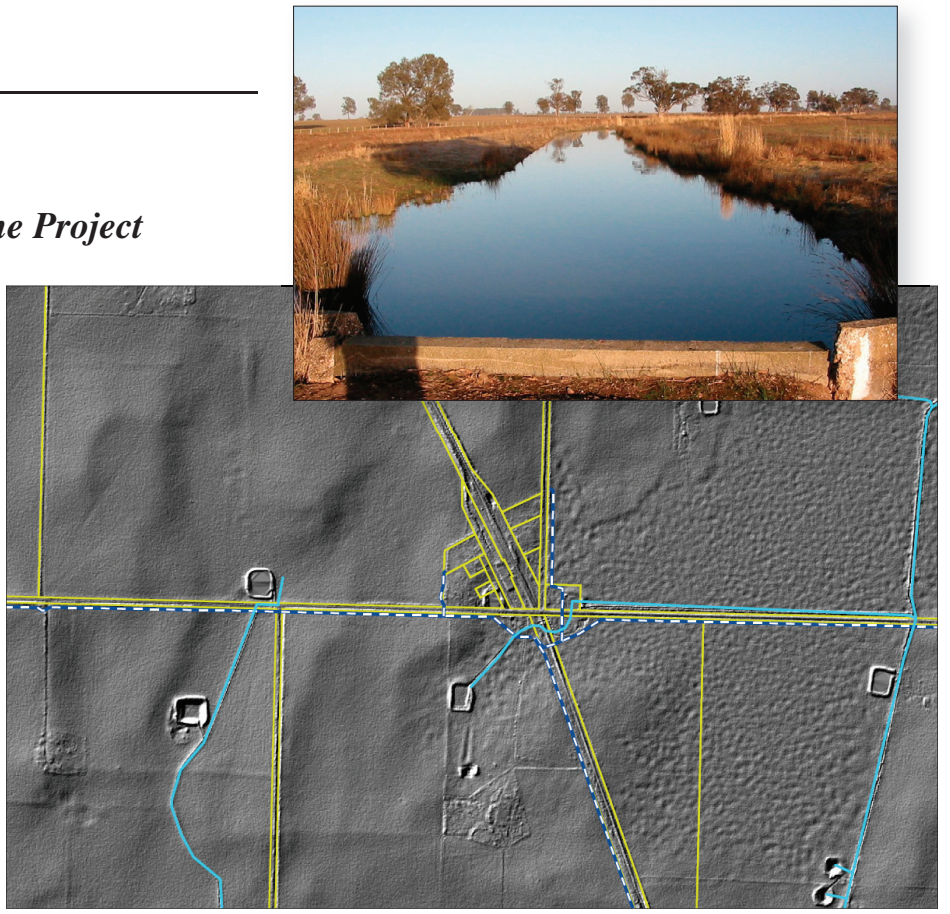
Pipe Dreams

As early as the 1890s, there had been talk of replacing the inefficient Wimmera Mallee open-channel system with a more effective pipeline network that would provide a sustainable water supply to the farms and residents of northwestern Victoria, Australia. But it was just talk—a pipe dream for the dryland farming and rural region reaching from the Grampian Mountains in the south to the Murray River, some 300 kilometers north.

Throughout the twentieth century, despite its inefficiencies in supporting the area's agriculture, the channel system was extended, branching out for a total of 17,500 kilometers (10,800 miles). Meanwhile, the earthen channel system continued to divert water away from already taxed sources such as the Wimmera and Murray rivers; reservoirs in the Grampians; and Victoria's largest freshwater lake, Lake Hindmarsh. Add six years of below-average rainfall at the turn of the century, regional reservoirs at less than 10 percent capacity, and a channel system that was highly dysfunctional, and the result was a dryland region that could no longer sustain agriculture.

Studies done around the same time showed that of the 120,000 megaliters of water released into the channel system in an average year, only 17,000 were actually used by customers. The rest, up to 80 percent, was lost from the open channels due to evaporation and leakage. A water loss analysis concluded that 85,000 megaliters of water per year were being lost from the channels, plus another 18,000 megaliters from farm dams through evaporation and seepage.

By the year 2000, it became evident that the 100-year-old pipe dream needed to become a reality, and it had to happen quickly. Without a new pipeline system, the Wimmera Mallee region's production of livestock, wheat, barley, canola, faba beans, field peas, and chickpeas would cease to exist, not to mention the towns and businesses in the area that required water to survive.



Inset Above: Although it served northwestern Victoria for more than a century, the branching 17,500-kilometer-long Wimmera Mallee open-channel system was losing drastic amounts of water due to evaporation and leakage. Above: An example of the 2-meter hillshade elevation grid created using ArcGIS data processing tools. Visible features include redundant on-farm storage dams as well as the open-channel network.

Members of the community and a steering committee lobbied for a pipeline, yet it was not until 2005 that the Commonwealth of Australia and the Victoria state government reached an agreement on the funding of the Wimmera Mallee Pipeline Project (WMPP). In the same year, it was announced that Grampians Wimmera Mallee Water (GWMWater) would be responsible for the delivery of the estimated 10-year project, but those with livelihoods at stake had to wonder if a completed pipeline in 10 years would be too little, too late.

Let There Be Lidar

Before GWMWater could start designing more than 8,800 kilometers of pipeline and building 40 pump stations, it had to undertake a time-intensive environmental analysis and survey of more than 11,700 square kilometers (4,530 square miles) of land. GWMWater knew that capturing and analyzing the required amount of data over such a large and diverse area of terrain and vegetation would not be feasible by relying on photogrammetry and surveyors alone. Plus the massive amount of data resulting from such a survey also needed to come in a file format friendly to the GIS-based software platform that GWMWater had launched to manage the project.

The search for the right solution led GWMWater to AAMHatch, an Australia-based firm specializing in geospatial services and products. GWMWater knew it could fast-track the project from a 10-year to a 5-year schedule by utilizing light detection and ranging (lidar)-based imagery packaged in GIS spatial datasets of the entire project area, and AAMHatch possessed the lidar expertise to make it happen.

Covering New Ground

Utilizing Esri's terrain data type, which allows massive surface datasets to be stored in an ArcGIS geodatabase, AAMHatch created terrain datasets of the project area comprising 1.3 billion points. ArcGIS terrains provide optimized performance at multiple resolutions through the use of terrain pyramids that quickly retrieve only the data needed for the required level of detail in a given area of interest. Having all this data in a GIS would prove crucial in project workflows and data sharing, since the range of people accessing the WMPP GIS data varied from design engineers, planners, contractors, and government agencies to auditors, project managers, field inspectors, environmental and cultural heritage advisors, and land officers.

Armed with multiple lidar units with large-format digital cameras, air crews worked day and night to capture the data and check successful coverage while surveyors processed the GPS data and airborne laser scanner data and analysts worked on data processing. Within a week, AAMHatch provided digital terrain model datasets of approximately 15-meter vertical accuracy at one sigma on open areas, with an average laser strike spacing of 1.3 meters.

The data was delivered in phases, so GWMWater and its contractors would receive components of the data as they became available. The terrain data was complemented by orthoimagery with 60-centimeter image resolution. Stored in the WMPP GIS, the lidar and orthoimagery data provided a current view of the land use, land cover, and terrain—all data that was essential for engineers working on the project. At the time, the spatial foundation dataset was the largest single-file terrain dataset ever produced in Australia.

The terrain data was easily and quickly processed and analyzed using the ArcGIS Server 3D extension. By generating terrain products and terrain files that were 1/15 the size of the standard file size, a savings of more than 20 days was achieved.

WMPP supplies stock and domestic water to 7,000 rural customers and 36 towns across the Mallee region, saving approximately 100 billion liters of water a year.

More Information

For more information, contact Shane Schwarz, network coordinator, GWMWater (e-mail: shane.schwarz@gwmwater.org.au).

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Unemployment Trends Spotted by the *Philadelphia Inquirer*

Stories That Were Not Apparent Suddenly Pop Out with GIS

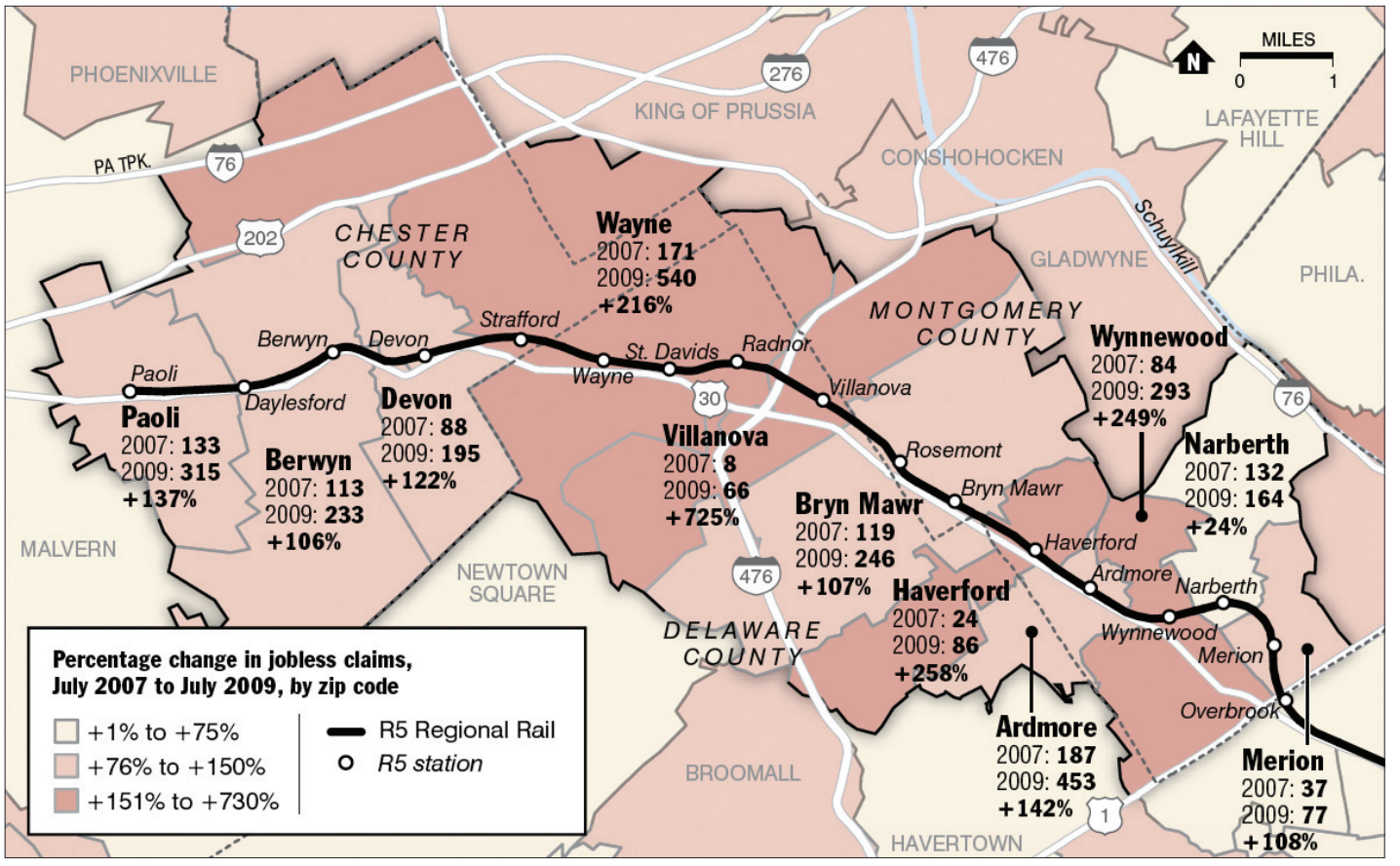
Highlights

- The jobless rate from the local government was geocoded and displayed by location on a map.
- The map showed editors and reporters exactly where the "story" was.
- GIS saved the newspaper time and resources.

The *Philadelphia Inquirer*'s John Duchneskie says that finding a meaningful story can sometimes be more difficult than you would think. As the graphics editor for the daily newspaper serving the metropolitan area of Philadelphia, Pennsylvania, he works with the writing staff to investigate stories. Every day, the paper is tasked with finding news that will hook readers and keep them coming back for more.

Each afternoon, Duchneskie sits in a news meeting discussing the planned investigations and which stories will be considered. During one meeting, Jane Von Bergen, an *Inquirer* business writer, had an idea to take a look at unemployment, an area of focus for her. Von Bergen was interested in using Route 202, a main highway linking Pennsylvania and New Jersey, as a "clothesline" for individual vignettes about people who have been affected by the recent recession. Unemployment in four counties in the area exceeds that of the national average. Seven counties recorded increases larger than the national increase of 1.2 percentage points over the past year.

"In fact, all 11 counties have posted higher unemployment rates than the previous year," says Von Bergen.



Though Philadelphia's wealthiest suburbs are faring better than other regions in the area, unemployment has risen dramatically along the Main Line.

When the recession began in March 2008, jobless rates ranged from 3.6 percent in Chester County to 6.6 percent in Philadelphia. Fast-forward to March 2010 and the unemployment rates for the three metropolitan divisions in the Philadelphia-Camden-Wilmington metropolitan statistical area were 10.4 percent (Bureau of Labor Statistics).

Duchneskie, who is a graphics designer, brought his laptop into the meeting loaded with ArcGIS, the software he uses to create illustrative maps, and data—including roads, county boundaries, unemployment, and demographic information—that would be relevant to the story. He hooked the system up to an overhead projector so Von Bergen and her editor could see the information. They started discovering trends, selecting areas, and querying data to see what was happening where. "Looking at the mapped unemployment data, we didn't see any real patterns that jumped out at us along Route 202," Duchneskie says. "What did jump out at us was the Main Line. The entire area had a high increase in the percentage of unemployment claims. Right away we could tell this was where the real story was."

The Main Line is an unofficial region of suburban Philadelphia made up of affluent towns first built along the old main line of the Pennsylvania Railroad. The Pennsylvania Railroad was the largest railroad by traffic and revenue in the United States throughout most of the 20th century and, at one time, was the largest publicly traded corporation in the world.

Towns that shoulder the Main Line include Bryn Mawr, Merion, and Overbrook, locations not normally associated with a discussion about unemployment claims. Gladwyne has the 14th highest per capita income in the country among places with a population of 1,000 or more. The eastern section of Villanova was ranked 39th in the Elite 100 Highest Income Neighborhoods in America with a median household income of about $367,000 (the Higley 1000).

Data displayed to investigate this trend included the rail line, Route 202, boundaries of the counties and towns, ZIP Codes within counties, and the information about the percentage change in the jobless rate from July 2007 to July 2009. Duchneskie used data included with ArcGIS and brought in jobless rate information from the local government. He geocoded the jobless rate information to the ZIP Codes and counties so it could be displayed by location on the map. Viewing the data, the reporters and editors saw there was an interesting pocket of change in employment in this area.

Finding that this pocket ran along the Main Line was intriguing. Duchneskie outlined towns along the main railroad line, and places typically containing homes with higher-than-average incomes lit up: Merion, Radnor, Wayne, Bryn Mawr, Devon. Continuing claims for unemployment benefits rose 50 percent from July 2007 to July 2009 in Philadelphia, according to state statistics. In the Main Line region, however, unemployment claims rose as much as 730 percent. As a whole, the region's claims rose 143 percent.

Finding this trend shifted the story's focus away from the highway to the railway. Once Von Bergen had a geographic focus, she went looking for real people to tell the story. She found them in a church support group for the unemployed: former bankers, executives, marketing managers, top sales representatives, and international investment directors—people with Main Line addresses and occupations that historically would not be thought to be affected by a recession.

"This is another marker that, unlike previous economic downturns that affected blue collar and young workers, this recession is affecting bankers and managers," notes Von Bergen. "Subsequently, we may be seeing a recovery taking a longer time than previously thought."

Using GIS to analyze the data to catch patterns and trends saved the newspaper time and resources. The team members were able to collaborate on their investigation while still in the office. Once they had a clearer picture of the story, they were able to pinpoint exactly where their photographer and reporter should focus their investigation.

"Without seeing the data in that manner, through the geography of it, we wouldn't have picked up on this trend," says Duchneskie. "We would have missed an important story."

More Information

For more information, contact John Duchneskie, graphics editor, the *Philadelphia Inquirer* (e-mail: jduchneskie@phillynews.com).

Irish Agricultural Catchments Programme Protects Water Quality While Supporting Productive Agriculture

By Sarah Mechan, Edward Burgess, and Réamonn Fealy

Highlights

- Use of multiple GIS-based applications ensures compliance with European legislation.
- An innovative GIS-MCDA approach results in optimized catchment selection.
- GIS aids in supplying farmers with spatially targeted farming advice.

Situated on the western fringe of Europe and subject to the moderating influence of the Atlantic Ocean, Ireland is fortunate to have a temperate maritime climate that is particularly suited to grassland agriculture. With conditions facilitating a grass growing season that extends almost throughout the entire year, grass-based dairy and beef production constitute the primary agricultural sectors. From a land area of 6.9 million hectares, 4.2 million hectares are used for agriculture. With 80 percent of agricultural area devoted to pasture and hay and grass silage, 10 percent to rough grazing, and the other 10 percent to tillage, it is little wonder that Ireland is known as the "Emerald Isle."

However, as in other countries, issues around maintaining a high-capacity, productive agricultural sector while ensuring a sustainability-based farming approach remain a focus for all stakeholders. In partnership with farmers and other stakeholders, the Irish Agricultural Catchments Programme (ACP) is mandated to support productive agriculture while protecting water quality. It is funded by the Irish Department of Agriculture, Fisheries and Food and run by Teagasc, Ireland's Agriculture and Food Development Authority. ACP advisers provide an intensive advisory and planning service to farmers in small river catchment areas (500 to 2,900 hectares) with support from their colleagues both locally and nationally. They help the farmers improve their profitability and implement the necessary agri-environmental measures contained in the National Action Programme recently introduced under the European Union (EU) Nitrates Directive. This directive aims to protect water quality across Europe by preventing nitrates and phosphorus from agricultural sources from polluting surface and groundwater. ArcGIS software-based applications have played a primary role in facilitating both the establishment and operation of the program.

Catchment Selection Application

The selection of catchments was influenced by EU guidelines that indicate monitoring efforts should be concentrated in "areas of intensive crop and livestock production . . . with elevated nitrate concentrations . . . adjacent to existing or projected eutrophication areas . . . with similar land use, soil type, or agricultural practice." Thus, it was necessary to devise a method for selecting small catchments (from 400 to 1,200 hectares) that were farmed intensively, either predominantly grassland or arable, and at risk of high phosphorus or nitrogen losses from land into the rivers that drain them.

Given the spatial and environmental context of the task of candidate catchment selection, the role for a GIS-based methodology was immediately obvious. Given a long association with Esri products and a significant investment by the Spatial Analysis Unit in Teagasc in both ArcGIS Desktop and ArcGIS Server software, Teagasc chose ArcInfo to build a geodatabase to hold and manage the range of datasets required for the task, which were supplied from a diverse group of government departments and agencies. Oracle was chosen as the main database solution for the operational stage of the project.

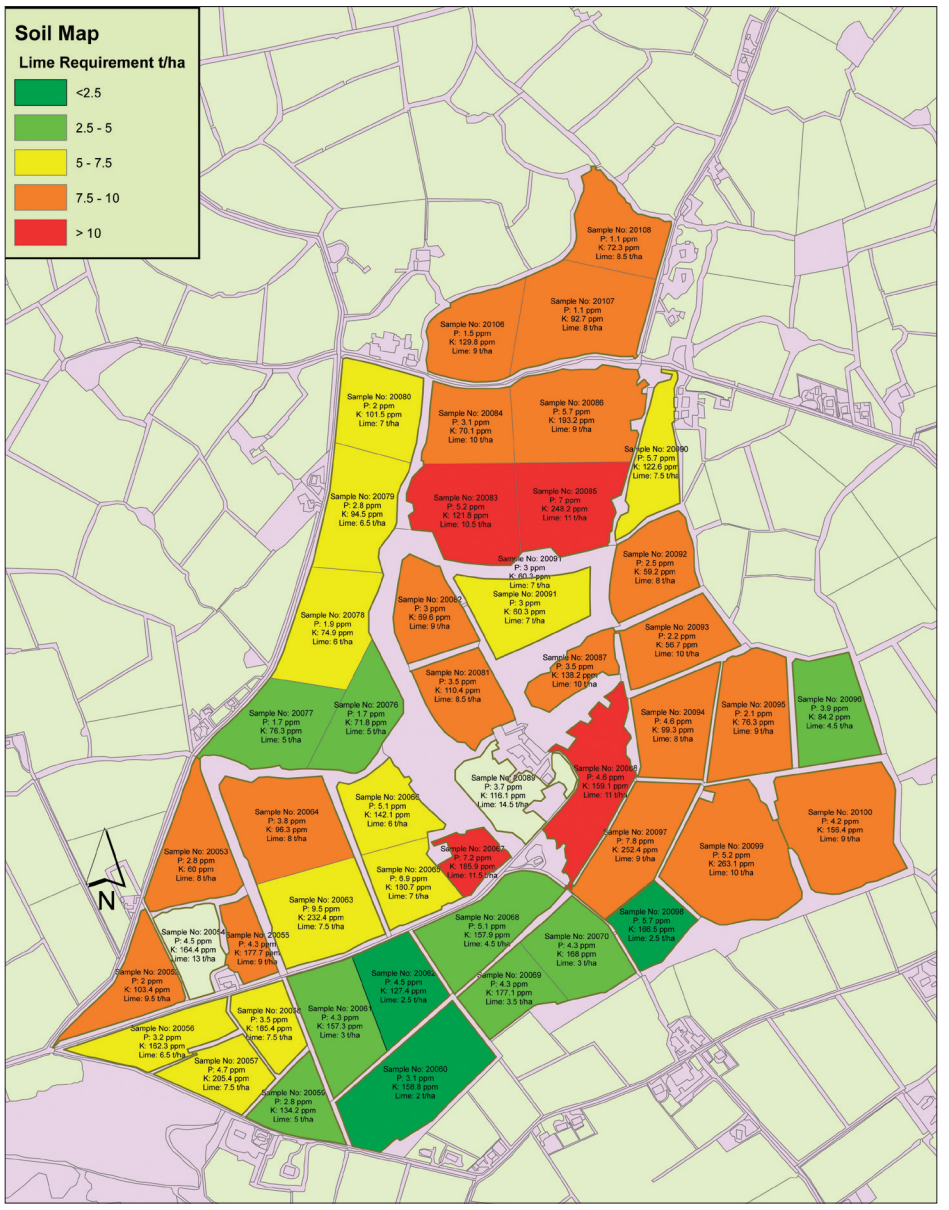
In beginning the selection process, Spatial Analysis Unit staff first examined a national catchment boundary dataset of approximately 6,000 catchments to generate a list of 1,300 possible small river catchments based on size and stream order. These were further divided into two broad categories—grassland and arable cropping. The data analyzed included land use, forestry, area of peat, livestock density, nonagricultural land use, arable cropland, forage areas, housing density, geology, and soil types. A Multiple Criteria Decision Analysis (MCDA) approach was employed in the analysis using the onboard attribute table tools already available in the ArcInfo processing environment.

After detailed consultation with a broad range of experts from scientific, policy, and farm sector backgrounds, various selection criteria were chosen and given weights, reflecting the suitability of the catchments for monitoring by ACP. The internal attribute tables of each of these input parameters were reclassified into appropriate ranges, and these, too, were ranked according to selection suitability. A weighted summation provided an ordered list of catchments ranked by their suitability. The ArcGIS Spatial Analyst extension was used to model the risk at the catchment level of nitrogen or phosphorus moving from land to water. This model implemented a risk assessment procedure devised at the national level for formal reporting to the European Commission on the Water Framework Directive. ACP had at its disposal the most detailed national-scale datasets, and the risk model developed for the program is the most highly resolved available nationally.

The model is primarily based on soil drainage and subsoil hydrologic characteristics. Generally, more poorly drained soils have a greater risk of phosphorus loss through overland flow or runoff, while the more freely drained soils have a greater risk of nitrogen loss through leaching down through the soil. Of the 1,300 eligible catchments initially identified, a short list of 50 top-ranking arable and grassland catchments was drawn up. ACP staff visited these catchments to assess their physical suitability as study sites. Six catchments were selected for detailed study—four that were predominantly grassland and two with a high proportion of arable farming. The GIS-MCDA approach was shown to be particularly suitable to the selection task, and its implementation in ArcInfo proved highly efficient in handling the large number of input datasets and processing requirements.

Presentation of Soil Analysis Results

Upon selection of the catchments for monitoring purposes, ACP needed to establish baseline soil nutrient levels for each catchment area. To achieve this, ACP undertook a field-based sampling campaign to establish soil nutrient status. To accurately represent the variation in soil nutrients across the catchments, high-resolution soil sampling was employed (the average area per sample was approximately two hectares). This high-resolution soil nutrient data facilitated the preparation of accurate nutrient management plans for catchment farmers. However, there was a risk that farmers would find these plans difficult to interpret given the high level of detail they contained and the large number of land management units (whole fields or subfield areas). To make the interpretation of the plans easier, ACP decided to develop clearly labeled, color-coded maps. Each field and sample area was digitized and allocated a unique code as part of the catchment digitizing process. The sample area codes were then entered into a Laboratory Information Management System, along with the corresponding soil sample code. This enabled the results to be linked back to produce intelligent maps. For each farm within the catchment areas, color-coded maps labeled with unique soil sample numbers can now be produced.



A soil index map indicating the lime requirement and concentrations of phosphorus and potassium in sampled fields.

Maps illustrated by different colors, displayed in each sample area, can easily be produced in ArcGIS, which shows the phosphorus, potassium, and lime requirements of the crops to be grown. A set of maps can now be printed for each farm in less time than it would take to print the original soil analysis report. This analysis helps each farm increase its crop yield through targeted application of nutrients to match crop requirements and minimizes the leaching of nutrients (and effective loss of a farm resource) into local watersheds. The most satisfying aspect is the feedback from the farmers. They find the maps very informative and easy to use, leaving the advisers more confident that nutrient management on these farms will be carried out in an accurate and informed manner. This technology can be used to overlay many years of soil analysis results to track temporal changes in soil fertility and nutrient management.

About the Authors

Sarah Mechan is data manager for ACP. Her core role within the project is to develop and maintain an information management system to ensure the most efficient data capture and integration from multiple sources. Edward Burgess is an adviser to the farmers in the Castledockerell and Ballycanew catchments. He provides an advisory service to assist farmers' compliance with National Action Programme measures. Réamonn Fealy was part of the initial working group that proposed ACP, and he designed the catchment selection procedure described here. The authors would like to acknowledge the contribution to this article by David Wall, ACP soil scientist, and Ger Shortle, program manager.

More Information

For more information, visit the Agriculture and Food Development Authority Web site at **www.teagasc.ie/agcatchments**.

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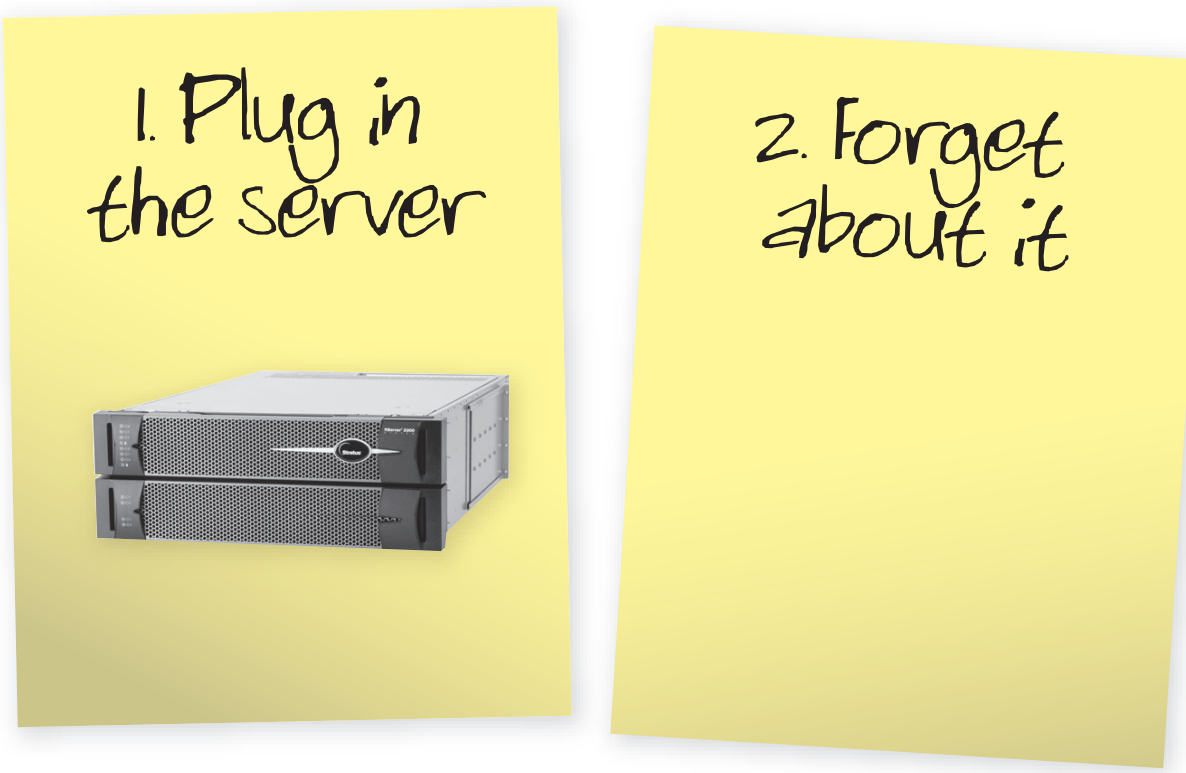

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Chesapeake Bay Restoration Made Transparent to Public

Program Builds Web-Based Accountability Tool

Highlights

- GIS makes the ChesapeakeStat database user-friendly so that the public can visualize data geographically.
- The database includes management activities for conservation and restoration.
- GIS shows people what agencies are doing and how they are spending money.

More than 10,000 years ago, melting glacier ice caused the Atlantic Ocean's sea level to rise and form the largest estuary in North America. The Algonquin Indians who lived in the once pristine regions of the watershed called the bay Chesepiooc, meaning "Great Shellfish Bay." Today, we know it as Chesapeake Bay. An estimated 2,700 species of plants and animals, including 200 species of fish, live in the estuary.

In recent times, bay communities have been concerned with pollution in the watershed. The results of a five-year, federally funded study that builds upon earlier studies begun in the late 1970s, identified excess nutrient pollution as the main source of the bay's degradation. These nutrients, mostly from animal waste and nitrogen used in farming and livestock management and phosphorus used in detergents, find their way into tributaries to the bay and create conditions harmful to aquatic life, such as clams, blue crab, and underwater grasses.

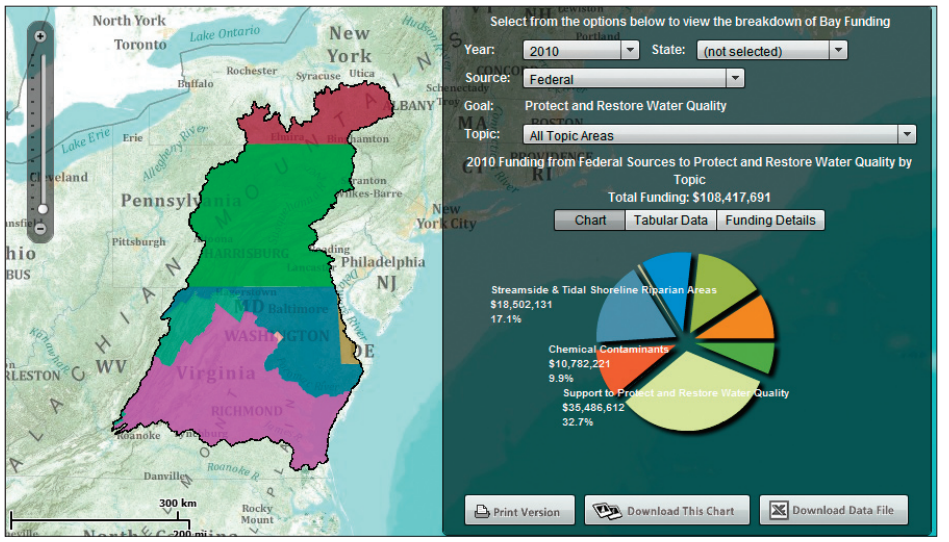
In the 1980s, Congress recognized the bay's pollution crisis. Thus, Chesapeake Bay became the nation's first estuary targeted by Congress for restoration and protection. Restoration of the Chesapeake Bay watershed is a collaborative effort among stakeholders, including nongovernmental organizations (NGOs), federal agencies, six states, and the District of Columbia.

The watershed is 64,000 square miles and affects approximately 17 million people. In 2009, President Barack Obama signed Executive Order 13508 that recognizes Chesapeake Bay as a national treasure and calls for an unprecedented federal effort to ensure the bay's restoration and protection. In response, the Federal Leadership Committee for the Chesapeake Bay released strategies and goals for reducing nitrogen, phosphorus, and sediment pollution; restoring 180,000 acres of wetlands; conserving another two million acres of undeveloped land; and reducing farm runoff on four million acres. The goal is to complete these tasks within 15 years.

The Chesapeake Bay Program (CBP) is a regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. One of the goals of the CBP is to provide transparency and accountability to the restoration process to ensure the public remains involved and informed about the progress of restoration. Influenced by the success of the Maryland BayStat Web-based reporting and accountability tools, the CBP formed a ChesapeakeStat team to create a similar tool.

At the May 2009 Chesapeake Executive Council Meeting, Environmental Protection Agency (EPA) administrator Lisa Jackson announced, "Governor O'Malley's leadership in developing BayStat has inspired work on a similar effort at the Chesapeake Bay Program to improve decision making and convey important information to the public. We're looking forward to creating a similar program, something like Chesapeake Bay Stat to guide the Partnership's work in the watershed."

The Executive Council formed a team that worked with Esri Professional Services and others to build ChesapeakeStat (**stat.chesapeakebay.net**), an online Web mapping application that allows the public, Congress, restoration stakeholders, and project managers to follow the restoration program's progress, status, and funding allocations. Esri was instrumental in developing the successful StateStat



The ChesapeakeStat Web site promotes transparency by sharing performance information on funding, among other factors. Funding is presented for each of the five goal areas. Information can be sorted by year, location, source of funding, goal, and topics within goals. This image shows funding for the goal "Protect and Restore Water Quality."

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About the Meeting

The AAG Annual Meeting will be held April 12-16, 2011, in Seattle, WA, at the Washington State Convention Center and the Seattle Sheraton Hotel. Sessions and workshops will feature presentations from many leading scholars and experts on the latest in research, policy, and scientific applications.

The meeting also will feature a large Jobs in Geography Career Center, an International Networking Reception, and exhibits showcasing the latest scholarly publications and advanced geographic technologies. Many educational field trips will explore the rich cultural and physical geography of Seattle and the surrounding Pacific Northwest region.

Call for Papers

The AAG welcomes presentations from scholars, professionals, and students on these and other related topics. If you are interested in presenting in these sessions, please submit a 250 word abstract at www.aag.org.

For more information on the symposium, see www.aag.org/GIScienceResearch.

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and BayStat models that were implemented under the leadership of Maryland governor Martin O'Malley. It was a natural step to work with Esri Professional Services staff in the design of the project.

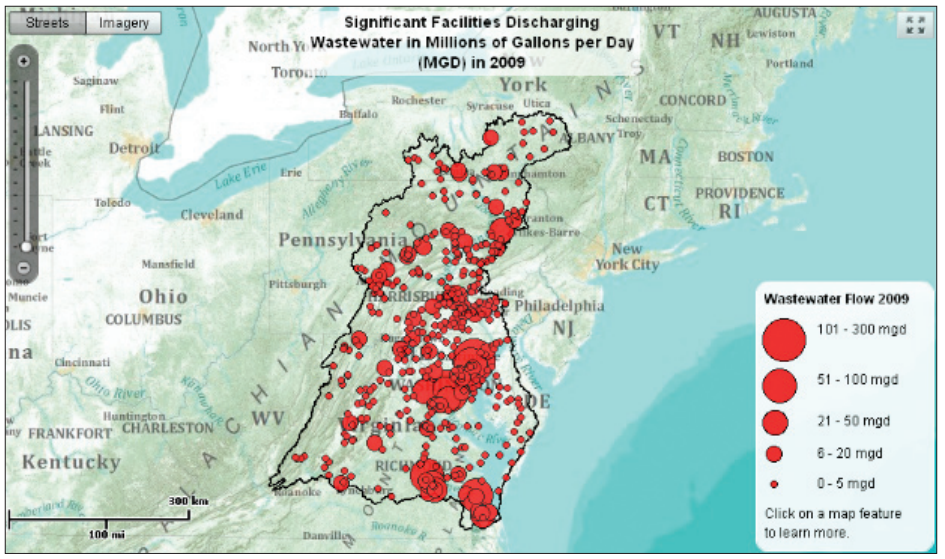
"ChesapeakeStat is a geoaccounting tool," explains John Wolf, U.S. Geological Survey and GIS team leader of CBP. "GIS is a useful tool for showing people what agencies are doing and how they are spending money. But our project takes it a step further. People can see in a geographic context how an agency's goals, strategies, and outcomes are being accomplished."

ChesapeakeStat is built, in part, on ArcGIS Server and ArcGIS API for Flex. This makes it easy for site visitors to zoom to an area and locate restoration activities, then drill down into smaller watershed units to see what is happening in a specific area. The Web site is the first one-stop GIS project to improve accountability for all partners in this restoration effort. Eventually the public will be privy to all bay and watershed restoration activities, funding levels, and progress toward goals.

ChesapeakeStat's design is closely related to the CBP Strategic Framework and describes how federal, state, and other partner funding will be used during each fiscal year. GIS has made this database user-friendly so that the public can visualize this information geographically. ChesapeakeStat organizes information around the CBP goal areas of sustainable fisheries, healthy habitats, water quality, healthy watersheds, and Chesapeake stewardship. Each category contains a suite of environmental and performance indicators.

Another unique characteristic of the ChesapeakeStat tool is that it supports an adaptive management approach, which is the CBP's management strategy that progresses through setting goals, defining strategies, setting priorities, taking actions, monitoring results, and making management adjustments. This means that beginning from the overall goal level, users will ultimately be able to drill into detailed scientific data and analysis that support decision making.

The CBP's goals and strategies are included in the design of the Web site dashboards that interactively present performance and environmental information organized by strategic topics. The database includes management activities for conservation and restoration throughout the watershed and in the estuary.



GIS applications give ChesapeakeStat users insight into pollutant and remediation activities. A wastewater application built with ArcGIS API for Flex accesses and displays wastewater discharge data.

The ChesapeakeStat application accesses a geodatabase that contains the spatial and tabular information visualized on the Web site. Content is organized by operational stages of measuring progress, taking action, and developing priority areas for targeting activities.

Topic-based navigation includes five major program areas that relate directly to the business goals of the CBP:

- Sustainable Fisheries (crabs, oysters, striped bass, etc.)
- Healthy Habitats (fish passages, bay grasses, wetlands)
- Water Quality (wastewater treatment, agriculture, storm water)
- Healthy Watersheds (land conservation and protection)
- Chesapeake Stewardship (public access, environmental education, citizen and community action)

Starting at these program areas, users can drill into the level of detail they need to see. These CBP business goals are categorized in the application. For example, a resource manager can select the Water Quality goal category, select the topic Wastewater, then quickly understand the collective issues and initiatives dealing with this topic in the partnership. Furthermore, the ArcGIS Server capabilities of ChesapeakeStat support scale dependency. For example, as one drills into a selection, the accompanying map interface can change as it is related to the user-selected topic.

More Information

For more information, contact John Wolf, GIS team leader of CBP, U.S. Geological Survey (e-mail: jwolf@chesapeakebay.net), or Liza Casey, Esri (e-mail: lcasey@esri.com). Access the ChesapeakeStat tool from the Chesapeake Bay Program Web site at **stat.chesapeakebay.net**. Read more about Esri's solutions for environmental management at **www.esri.com/environment**.

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Rome and Manila Will Host Upcoming Events

International User Conferences Connect Geospatial Professionals Around the Globe

These two Esri International User Conferences are coming up fast.

In the coming months, users from all over the world will have the opportunity to connect, collaborate, and share their latest work with peers at Esri International User Conferences encompassing Europe, the Middle East, Africa, and the Asia Pacific regions.

"Collaboration is at the core of GIS; these conferences will allow our international users to collaborate in ways even they might not believe possible," says Esri president Jack Dangermond. "Tackling an issue that just a few years ago didn't seem probable to solve is what GIS is all about. And these events inspire our international users to achieve what was once impossible."

Europe, Middle East, and Africa User Conference

This year, the European User Conference (EUC) will join the Middle East and North Africa User Conference to create a super-UC—the 2010 Europe, Middle East, and Africa User Conference (EMEA UC)—to be held October 26–28 in Rome, Italy. This combination of conferences creates a can't-miss event for all geospatial professionals in these regions.

Hosted by ESRI Italia, the EMEA UC will offer users from three continents an opportunity to network with other geospatial professionals and apply the successes and lessons learned from challenges faced across many industries. Attendees will also learn about the advantages of ArcGIS 10 directly from Esri president Jack Dangermond, keynote speaker at this year's event.

"This will be the largest GIS event in Italy this year, and we expect that it will have a positive effect for GIS in this region," says Bruno Ratti, president of ESRI Italia. "We are excited to host the participants and let them taste not only the best of GIS but also the best of our Italian traditions and food. Rome is the perfect setting for this conference."

Attendees at the EMEA UC will hear about best practices and new solutions from presenters in several different industries, from defense and intelligence to local government. Technical sessions will pave the way for developers to get the most out of ArcGIS 10.

The EMEA UC will be held at the Ergife Palace Hotel in Rome. On-site registration is available. For more information and to preview the agenda, visit www.esri.com/emea.

Asia Pacific User Conference

The 2011 Asia Pacific User Conference will be held January 26–27 in Manila, Philippines, at the EDSA Shangri-la Hotel. All Esri technology professionals from throughout the Asia Pacific region are encouraged to attend and discuss the latest trends, share successes, and network with peers at the conference.

The Asia Pacific region comprises more than 35 billion square kilometers of land and is home to 3.5 billion people. It has grown significantly in global economic, political, defense, and social and environmental arenas.

With a population of more than 15 million people, the Manila metro area is one of the most populous in the world. This makes it one of the case study cities for the 19.20.21 project (192021.org)—an attempt to understand comparative data on 19 cities that will have 20 million or more inhabitants in the 21st century—in which GIS plays a key role *(see related article on page 8)*.

"We are delighted to host users from across the Asia Pacific region in Manila," says Francisca N. Dayrit, executive vice president for Esri distributor Geodata Systems Technologies, Inc. "From the many sessions at the conference, users will take away concepts that may be adapted to create solutions across their region or in their own city."

All Esri users in the Asia Pacific region are also invited to submit maps or posters for the conference Map Gallery that show examples of GIS work. Share your knowledge and experience implementing GIS at your organization with other attendees by displaying your maps. The deadline for submission is the first week in January 2011.

Visit www.geodata.com.ph for more information on how you can become involved in this event.

Latin America User Conference

Look for a complete wrap-up of the Latin America User Conference in the next issue of *ArcNews*.

More Information

For a complete listing of Esri events worldwide, visit www.esri.com/events.

November 17, 2010

Organizations Around the World Use GIS Day to Promote Geographic Awareness

The twelfth annual GIS Day celebration is right around the corner—November 17, 2010. If you haven't planned your event just yet, there is still time, and resources are available online (www.gisday.com), along with success stories from previous years, to help your organization create a successful event. Users that have hosted past events often mention how rewarding it is for them to demonstrate to local schoolchildren, people in their community, or those within their organization how GIS technology impacts our daily lives. Events are typically held every year on the third Wednesday of November during Geography Awareness Week, a geographic literacy initiative sponsored by the National Geographic Society (www.mywonderfulworld.org/gaw).

South Florida Water Management District celebrates GIS Day (photo courtesy of SFWMD).

South Florida Water Management District, Florida

In 2009, the South Florida Water Management District (SFWMD) celebrated GIS Day at Pine Jog Elementary School in West Palm Beach, Florida. Pine Jog Elementary is a public county school with an environmental science focus. The school provides a unique environment where kids learn appreciation for Florida's natural ecology and learn about environmental sustainability. During GIS Day, SFWMD volunteers helped educate fifth-grade students about the importance of geography and how SFWMD uses GIS/GPS technologies to study, manage, and conserve South Florida's precious water resources and the habitats they support.

This year, SFWMD is planning another wonderful event. GIS Day will be held like a conference, offering various ways to participate for juniors and seniors from Jupiter High School and Jupiter Environmental Research and Field Studies Academy, as well as all interested district employees. The day will start with a brief welcome and overview of activities. During the event, attendees will be able to choose from three concurrent 60-minute sessions, each held during three different periods (for a total of nine sessions). Each session will include a talk from a district employee, a student presentation, and a tour of the following:

- The "control room," which is full of big TV screens and computer monitors and where engineers and meteorologists monitor water levels across the region (South Florida is very flat and depends on more than 2,000 miles of canals and levees and lots of control structures and large pumps to manage its freshwater.)
- The Emergency Operations Center that is activated when hurricanes/big storms hit the region
- Demo exhibits that include what water control structures look like, a robotic boat that monitors water in hard-to-reach areas, and "tipping buckets" that measure rainfall
- A map gallery and poster exhibit hall where students can vote during breaks on maps submitted by district GIS users. (This year's map gallery theme is "So You Think You Can Map?")

Resources Available

There are many more event examples and success stories available at www.gisday.com/success, including hands-on GIS workshops, training seminars, special presentations and talks, map galleries, treasure hunts, and field trips. Once an idea is in the works, users are encouraged to access the free resources and support that Esri provides online, including sample agendas, proposal letters, white papers, information on how to do a GIS Day proclamation in your area, and even ways to create your own GIS Day cake.

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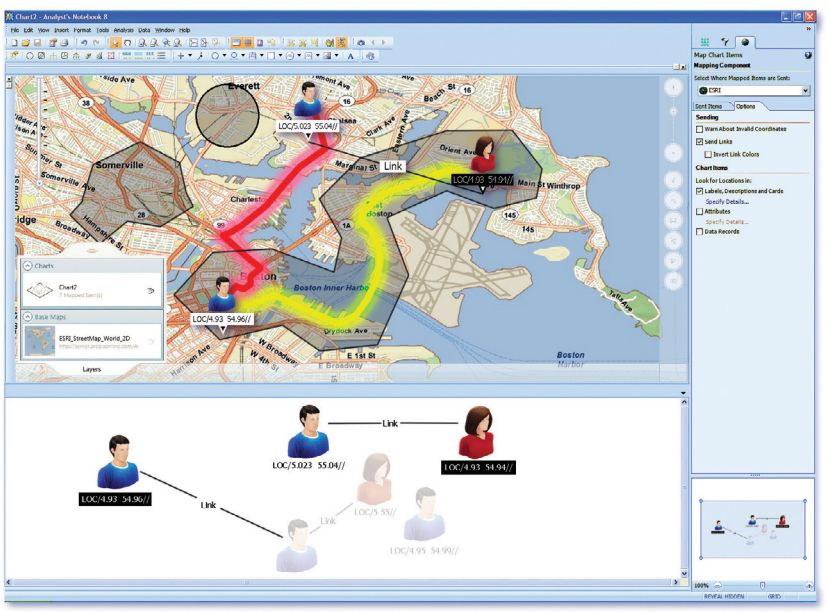

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NATIONAL GEOGRAPHIC™

"Geo Learning"

A column by Daniel C. Edelson,
Vice President for Education, National Geographic Society

Back to School with Geo-Literacy

It is back-to-school season as I write this, and I'm thinking about goals for the next year. In education, as in many other domains, goals are everything. If you don't have clear goals that you can communicate effectively, then you're never going to make any progress.

When I started working at the National Geographic Society, I was immediately confronted with the challenge of clarifying and articulating the goals of our K–12 educational efforts. This process has taken some time. I've been here more than two years, and we're still working on it, but it's probably the most important work we'll do.

National Geographic has been committed to improving K–12 geography education in the United States and Canada for decades. However, *improving geography education* is, at the same time, too broad and too narrow. Geography is boundless, so our first goal-setting challenge was to find a focus that is narrower than geography as a whole.

Using the broader National Geographic mission to inspire people to care about the planet as a guide, we are focusing our efforts on those aspects of geography that will prepare students to *care for the planet*. Specifically, we have chosen to focus on the geographic knowledge and skills that young people will need to make the decisions they will face throughout their lives that have consequences for the well-being of the planet and its inhabitants. We call these *far-reaching* decisions because—even though the decision makers may not realize it—the consequences of the decisions extend far beyond the individual and his or her location. Far-reaching decisions may be personal, professional, or civic. They may be routine or come once in a lifetime. They range from decisions about how to commute to work to whether to outsource your company's manufacturing overseas to how to vote on a public referendum on immigration.

As we have investigated what people need to know to make far-reaching decisions, we have found that the knowledge and skills that they need go beyond geography. So we've found ourselves adjusting our scope to be more focused within geography and to extend beyond geography. In our current conception, our goals include three primary components: systems thinking, geographic reasoning, and evidence-based decision making.

- *Systems thinking:* Scientists today view the world as a set of interconnected natural and human systems. These systems create, transform, and move resources. Natural systems include atmospheric, hydrologic, and ecological systems. Human systems include economic, political, and cultural systems. To be geo-literate, a person must be able to reason about how he or she depends on these different systems and how his or her actions can affect them.
- *Geographic reasoning:* Most of geography is based on two key principles: (1) the characteristics of a particular location influence what can and does happen in that location and (2) every place on earth is connected to every other. To be geo-literate, a person must be able to reason about the characteristics of and about the connections between places to understand the implications of decisions.
- *Evidence-based decision making:* Well-reasoned decisions involve a multistep reasoning process that includes both objective analysis of consequences and subjective weighing of trade-offs based on values. A person must be able to systematically analyze consequences of decisions and evaluate their pros and cons based on his or her values.

When combined, these three components provide an individual with the knowledge and skills to recognize decisions as being far reaching and make them systematically. Of course, this does not mean that everyone will make the same decisions. There will always be differences of opinion about the likelihood of various consequences and how to value different outcomes.

Because these goals no longer fit neatly within the traditional conception of geography, we have coined a new term for them, which I've used in this column before. We call this combination of systems thinking, geographic reasoning, and evidence-based decision making *geo-literacy*.

Clearly, having a geo-literate populace is valuable for more than just caring for the planet. It is valuable for economic competitiveness, national security, and personal well-being, to name a few, and we have allies in our educational reform initiatives who are motivated by these concerns more than concern for the well-being of the planet. However, geo-literacy is a priority for National Geographic's education programs because of our particular concern for environmental and cultural conservation.

So as I enter this back-to-school season, I am pleased to have a set of clear, coherent, and focused goals to guide our efforts. On the other hand, I am acutely aware that the components of geo-literacy cross traditional curricular boundaries and call for knowledge and skills that have not been part of any curriculum before. That gives the idea of *back-to-school* a new meaning. As I enter the school year with more clearly defined and articulated goals, I am also aware that over the next few years, we will have to go back to school in the design of the K–12 curriculum.

More Information

For more information, contact Daniel C. Edelson (e-mail: dedelson@ngs.org). To find out how you can support National Geographic's geo-literacy initiatives, visit **www.nationalgeographic.com/foundation/geographic_literacy.html**.

Esri Releases the Open GeoServices REST Specification

continued from cover

clients and applications. The JavaScript Object Notation (JSON)-based, REST-ful specification makes the server instantly usable by thousands of developers working in popular client-side development environments with the ArcGIS Web mapping APIs for JavaScript, Flex, Silverlight, iOS, and Android, all of which are powered by the GeoServices REST Specification.

"In many ways, by releasing the GeoServices REST Specification as open technology, Esri is repeating what it did in the early '90s, releasing shapefiles as an open data format," explains Dr. Satish Sankaran, Esri product manager for interoperability and standards. "This specification encapsulates a strong platform that allows developers to create services that support rich GIS Web applications and allows geospatial services to be embedded into anything on the Web, including commercial off-the-shelf products, open source, and even mashups. The GeoServices REST Specification helps make all GIS data more open and interoperable on the Web."

More Information

To download the GeoServices REST Specification, visit **www.esri.com/technology-topics/standards**.

52°North Supports the GeoServices REST Specification

The open source software initiative 52°North is an international network of partners from research, industry, and public administration. It promotes, within a common innovation process, the development of technologies in the field of geoinformatics. A particular focus is on Web-based geoprocessing and cloud computing.

52°North now extends its Open Geospatial Consortium, Inc. (OGC), standards-compliant Web processing service (WPS) implementation using the open GeoServices REST Specification. The new interface enables 52°North WPS users to offer complex geoprocessing capabilities in a lightweight manner that can easily integrate with ArcGIS technology.

"The major benefit of the GeoServices REST Specification is its lightweight approach to integrating the power and reliability of ArcGIS Server technology with other technological domains," says Dr. Andreas Wytzisk, general manager of 52°North. "In particular, our implementation demonstrates how ArcGIS and 52°North's open source technology can be seamlessly combined to generate added value on both sides."

More Information

For more information, visit **svn.52north.org**.

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www.slstomahawk.com
Systems Development
Steigerwaldt Land Services, Inc., a forestry and real estate consulting firm, develops GIS systems suited to its clients' specific project needs, including resource management, property feature characteristics for appraisal needs, or right-of-way acquisition and document management. Many of the applications Steigerwaldt develops are mobile GIS applications that use ArcPad for timber inventory, mapping, and property reconnaissance needs.

Utilities

Topographic Mapping Company
www.topographic.com
LandScape
LandScape is a Web-based GIS application that provides secure and accessible surveying and mapping deliverables, as well as project and document management capabilities, for utility users. LandScape uses ArcGIS Server to create, map, and share geospatial data, which is then linked to other files like deeds, plats, photos, notes, and drawings. This allows the user to visualize, interact with, and communicate all aspects of a project from a single platform, available from any computer with an Internet connection.

CAD/GIS

Universal Information Technologies Ltd.
www.uni-yaz.com
UniGIS
UniGIS is a complete software package that integrates CAD and GIS and is used by city planners and GIS professionals for their daily needs. UniGIS is built on the ArcGIS Engine Runtime infrastructure and includes custom tools and workflows that help planners with zoning and urban design. UniGIS can also be used to edit and update related Web map services of U.KBS, a city information system from Universal, and is fully integrated with it.

"Crossing Borders"

A column by Doug Richardson,
Executive Director,
Association of American Geographers

Space-Time Integration in GIS and GIScience

Every year, the Association of American Geographers (AAG) identifies a particularly timely or relevant set of themes to feature during its Annual Meetings. Last year, an overriding theme was climate change, for example, and previous years have included featured sessions on topics such as human rights, landscape and literature, sustainable development in Africa, geography of water, and many other topics.

A special symposium—focused on the research status, recent advances, and research needs of space-time integration, modeling, and analysis in geography and GIScience—will be organized within the AAG Annual Meeting in Seattle, Washington, April 12–16, 2011. This special set of invited papers will feature many leading GIScience researchers from Asia and Europe, as well as from other regions of the world, and will form a high-profile international symposium within the AAG Annual Meeting.

Space-time analysis is a rapidly growing research frontier in geography, GIS, and GIScience. Advances in integrated GPS/GIS technologies; the availability of large datasets (over time and space); and increased capacity to manage, integrate, model, and visualize complex data in (near) real time offer the GIS and geography communities extraordinary opportunities to begin to integrate sophisticated space-time analysis and models in the study of complex environmental and social systems, from climate change to infectious disease transmission.

This special symposium will build on momentum generated from a space-time analysis workshop cosponsored by the AAG, the University of Redlands, the University of Southern California, and Esri in early 2010, as well as from several other initiatives during the past few years. GIScientists, geographers, modelers, computer programmers, GPS/GIS systems scientists, climate change scientists, epidemiologists, ecologists, planners, transportation experts, and others with active research expertise in integrating space-time in GIS and geography are encouraged to participate in this special symposium, which will open with plenary sessions led by prominent theorists and pioneers in space-time GIScience and technology research.

Doug Richardson
drichardson@aag.org

The symposium organizers are

Michael Goodchild—University of California, Santa Barbara
Doug Richardson—Association of American Geographers
Mei-Po Kwan—Ohio State University
Luc Anselin—Arizona State University
Kathleen Stewart—University of Iowa
Tomoki Nakaya—Ritsumeikan University, Japan
Dan Griffith—University of Texas, Dallas
Martin Dijst—Utrecht University, the Netherlands
Jeremy Mennis—Temple University, Philadelphia, Pennsylvania
Elizabeth Wentz—Arizona State University
Michael Gould—Esri
Donggen Wang—Hong Kong Baptist University, China
Jean McKendry—Association of American Geographers
May Yuan—University of Oklahoma
Seraphim Alvanides—Northumbria University, UK

The symposium organizers welcome paper or poster abstracts in the following areas:

Research advances and needs in space-time analysis and representation, such as

- Collaborations among GIScientists and modelers (systems, agent based, network, etc.)
- Real-time GPS/GIS interactive systems
- Technological challenges and R&D needs
- Visualization of space-time in GIS
- Sharing discoveries and results with decision makers
- Integrating analysis and results into Web 2.0
- Ontological frameworks
- Qualitative space-time analysis
- Temporal scale and event representation
- Historical time and HGIS
- Computational algorithms
- Analytic tools for time-constrained decision support systems
- Sensor integration
- 3D or 4D representations of time and space interactive data
- Real-time geographic management systems
- Uncertainty analysis
- Community or participatory GPS/GIS and related systems (including "vgi")

State-of-the-art applications of space-time modeling and analysis in areas such as

- Climate change response and adaptation
- Species migrations and habitat connectivity
- Marine environments (oil spill impacts, other persistent pollution, fisheries, ocean transport)
- Hydrology (flows and observations)
- Land use/Land cover change
- Location-based services (LBS)/Mobile GIS/Navigation
- Homelessness and poverty research
- Health (epidemics, disease transmission)
- Disaster response, crisis mapping
- Crime analysis and mapping
- Dynamics of urban renewal/decay
- Dynamics of the global financial system
- Wars, revolutions, and military activities
- Flows of labor and trade in a global economy
- Transportation (information, materials, people)
- Refugee populations

Education and the GIS workforce using space-time analysis, such as

- Needs of business, nonprofit, governmental, and academic organizations for expertise
- Opportunities and pathways to educate geographers and GIScientists (students to mature GIS professionals) in new research techniques, tools, and concepts

If you are interested in presenting a paper or poster in this Space-Time GIScience Research Symposium, please go to **www.aag.org** to register for the conference and submit your abstract by November 10, 2010. Indicate Temporal as one of your keywords. Also, e-mail a copy of your abstract submission page to Megan Overbey (e-mail: moverbey@aag.org).

Other Special Themes

In addition to this featured Space-Time GIScience Research Symposium, other special themes of the AAG Seattle meeting will include session tracks focused on Asian geographies and research collaborations, geography and public health, diversifying our discipline, and the changing role of universities in today's globalizing societies. These and hundreds of other cutting-edge research and education sessions and workshops will be held at the Seattle meeting. The AAG Annual Meeting, with more than 8,000 attendees from over 60 countries, represents one of the most dynamic, substantive, and innovative GIScience research and scholarship events in the world. I hope you will join us in 2011 in Seattle, one of my favorite cities.

More Information

For more information on the symposium, see **www.aag.org/giscienceresearch**.

"Managing GIS"
A column from Members of the
Urban and Regional Information Systems Association

A Local Government Perspective of Spatial Data Management

By Ron Stanfield, GIS Coordinator, Montgomery County, Alabama

One goal of local government could be stated as, "To provide quality service to its citizens in the most cost-efficient manner possible." There are many things government can do to accomplish a noble goal such as this, and one is in the area of geospatial data and technologies. While using the technology to satisfy the needs of agencies and departments that employ us, we can also think about how what we do relates to other areas of local government and, together, how they relate to state and federal government. If we do it right at the local level, we can not only serve our citizens better but also help state and federal government and the private sector serve them better too. In "GIS 101," we learn that GIS is hardware/software, data, processes, and people. We also learn the benefits of collaboration and sharing data. The hardware/software tools we need are improving, and technical issues are becoming fewer. It's the people and processes of government that are the most difficult to change or improve. Local government GIS managers and practitioners are playing an important role in the evolution of spatial data management and availability.

About Montgomery County

Montgomery County is located in central Alabama; is 780 square miles; and has a population of approximately 225,000, with 102,000 parcels. The incorporated areas are the City of Montgomery and the Town of Pike Road.

In 1993, Montgomery County converted from a manual system of property ownership mapping to an automated system using CAD software. The Data Processing Department, as it was known then, wasn't using GIS, so we had to educate ourselves on basic IT concepts. As our technical knowledge grew, so did our desire to do more with it. Supported by an Esri partner, we converted to Esri software and coverage format around 1997 and immediately began improving our processes and products for mass property appraisal and ad valorem taxation. Since then, the system has been slowly evolving and growing in the types and number of users within county government, and it is now supported by the county's Information Systems Department.

Acting Locally

Some of the ways GIS has served as a change agent and improved local government in Montgomery are common among many jurisdictions across the country. Data sharing with other departments and the municipalities within the county enhances the return on investment for the taxpayers by increasing service capacity and keeping overall costs of data maintenance as low as possible.

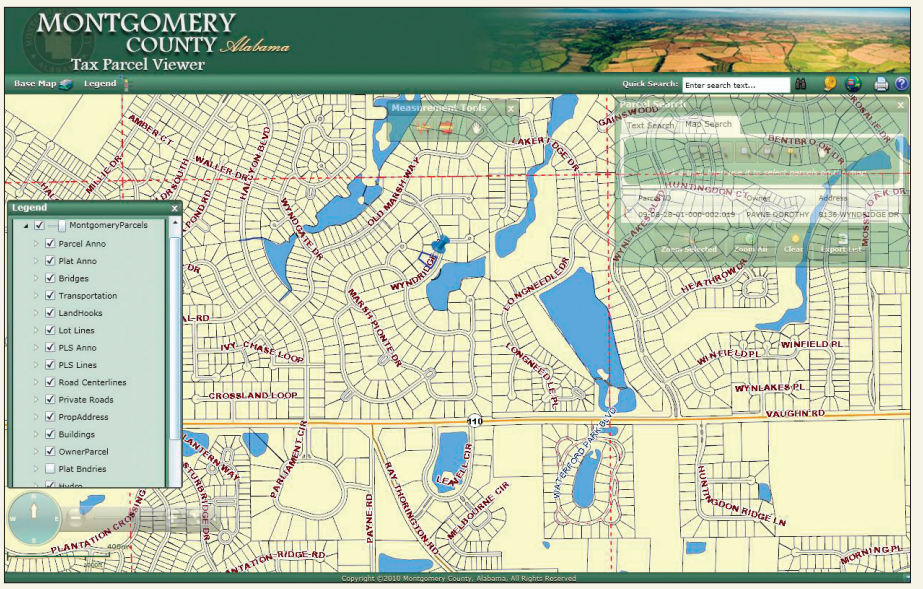
Around 1997, Montgomery County completed an addressing project, converting Rural Route and P.O. Box addresses to street-style addresses. The final product was address points located on the structures and an updated Master Street Address Guide to be used in the Public Service Answering Point's (PSAP) Computer-Aided Dispatch system. Data maintenance required GPS and CAD software, and through a maintenance contract, new data had to be sent to the contractor to be converted into Esri shapefile format. However, there was a serious lag time between address creation/capture and the dispatcher's ability to find it in the mapping system.

This was an opportunity for our GIS to be a change agent by improving a process and saving the county money. In 1998, the suggestion was made to maintain the addresses within the county's GIS and establish the procedures to update the Public Service Answering Point's data. The benefits would be less time between address creation and query ability and elimination of the cost of data conversion. This was successfully implemented, and the addresses are now available to everyone through the GIS.

The evolution in providing quality service locally with spatial information was also demonstrated after the city/county Emergency Management Agency (EMA) implemented a reverse 911 system. The system was proposed to use address data from a national data provider. We offered to provide the address point and road centerline data on a consistent basis, and EMA has been able to spatially identify and warn residents of emergencies and dangers using accurate and more up-to-date address data.

Using the same data, the County Board of Education, which also governs the city and town, was able to geocode and locate 98 percent of the students, which made school assignment and bus routing more efficient.

After Census 2000 results were used to redistrict, maps were hung on the walls of the Board of Registrars and the Elections Board. They were not maps from the county's GIS but from a contractor that had used the Census Topologically Integrated Geographic Encoding and Referencing (TIGER) data. The suggestion



The Montgomery County, Alabama, Tax Parcel Viewer is one result of the county's evolving GIS.

was made to bring the resultant new political districts into the county's GIS and give users in those departments desktop access to it. Again, GIS became a change agent by giving the departments the ability to streamline the voter registration maintenance process by simply having a visualization tool that also allowed the query of an address and returned an overlay that identifies all the political districts and the voting precinct the address is within.

Helping Nationally

Although the authoritative geospatial data at the local level exists to serve the local governments, as GIS managers, we should be conscious of a bigger picture. We maintain a piece of a puzzle defined by the Federal Geographic Data Committee (FGDC) as the National Spatial Data Infrastructure (NSDI). The NSDI initiative is promoted at the national level, but support from local government has to exist for it to be as effective as possible.

The initiatives proposed by FGDC are not new, and the concepts in this article are echoes of many knowledgeable GIS practitioners. But as the landscape of regularly maintained geospatial data has been evolving, so have the options available to share it. Some programs, such as Virtual Alabama, have established partnerships with city and county governments and provide the capability to upload data on a regular basis for specific government use. But the ability to develop Web applications and publicly expose map services is quickening the evolutionary pace of current data availability. It is up to the managers of authoritative data to embrace the practice of data sharing and take it to the level envisioned years ago.

Continuous Improvement

One of the ways Montgomery County must improve its cooperation and contribution is in the area of metadata. Unfortunately for the NSDI initiative, we are not alone. But we realize that our inaction over this important aspect of the NSDI cannot continue if we are to do our part. We feel that another way to participate in the bigger picture is to embrace the FGDC standard on addressing. We will have to reconfigure some desktop applications for PSAPs and EMA, among others, but the value of the data will increase as it is being optimized and shared with state and federal government. We plan to participate in online data publishing as we strive to increase the value of all we do.

As our GIS matures, we will continue improving the data and processes "to provide quality service to our citizens in the most cost-efficient manner possible," and we will keep an eye on how we can help others do the same.

About the Author

Ron Stanfield, GISP, is a member of the Alabama Association of Assessing Officials, the International Association of Assessing Officers (IAAO), and the Urban and Regional Information Systems Association (URISA) and is on the board of directors for the Alabama chapter of URISA. He holds the Alabama Certified Mapper designation through the Alabama Department of Revenue, the Certified Mapping Specialist designation through IAAO, and the GISP certification from the GIS Certification Institute.

More Information

For more information, contact Ron Stanfield (e-mail: ronstanfield@mc-ala.org).

New Book from Esri Press

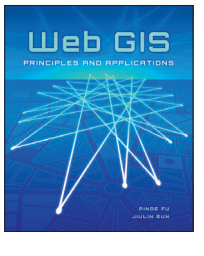
Web GIS: Principles and Applications

The Web has become a significant component of GIS, whether the use is for commercial business or a nonprofit or government agency. The latest publication from Esri Press, *Web GIS: Principles and Applications,* offers principles, concepts, and techniques to guide readers toward an understanding of how the Web can expand and modernize the way GIS technology is used.

Pinde Fu and Jiulin Sun, authors of *Web GIS,* believe that the Web has a variety of uses for GIS applications and that harnessing the power of it will greatly benefit, or even determine, the future of many organizations.

Professionals, organizations, and the public are able to better share and collaborate using the Web; GIS is then more accessible to a wide range of users—and at a much lower cost. "Nowadays, you can discover lots of resources from the Web or the cloud—data, maps, models," states Fu, a senior developer and project lead for Esri Professional Services.

This book explores the evolution, applications, and future trends of Web GIS. Several topics are discussed, including geospatial Web services, REST Web services, cloud computing, geoportals, mashups, mobile GIS, Gov 2.0, business intelligence, virtual reality, volunteered geographic information, geotagging, and geotargeting.



Web GIS addresses an area not easily or collectively covered elsewhere. It focuses on methodology and principles of the growing technology being careful to avoid extensive details on software versions.

More Information

For more information about *Web GIS: Principles and Applications* and other books from Esri Press, visit **www.esri.com/esripress**.

Esri Call for Presentations

2011 International User Conference

You're a leader in your field who realizes the value of geographic information system (GIS). Seize this opportunity to share and discuss your experiences with a worldwide community of like-minded enthusiasts at the 2011 Esri International User Conference in San Diego, California, July 11–15.

Submit your abstract by November 5, 2010 at www.esri.com/ucpapers, or papers@esri.com.

The most valuable thing was meeting people who do the same work in different countries and organizations. It's important to share the experience of GIS.

—Alejandra Episcopo, Aeroterra S.A.

The paper sessions were by far the most valuable—mainly being able to listen and learn about the interesting things that others were doing with the technology.

—Nisha Krishnan, Resources for the Future

For a complete list of available tracks and to submit your abstract, visit **www.esri.com/ucpapers**.

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Dangermond Awarded Patron's Medal from Royal Geographical Society

Esri president Jack Dangermond has been honored with the Patron's Medal by the United Kingdom's Royal Geographical Society (RGS). In the official announcement, RGS declared that Dangermond "received the award for his extensive work promoting geographical science through the development of geographic information systems. He is one of the greatest advocates for geography and its key role in understanding and responding to many of the challenges of the 21st century."

Founded in 1830, RGS was granted a royal charter by Queen Victoria in 1859 and continues to enjoy royal patronage under Queen Elizabeth II. British commentator Michael Palin is the current president of the Royal Geographical Society.

The Patron's Medal was established in 1839 for "the encouragement and promotion of geographical science and discovery." Each award is officially recognized and approved by the ruling monarch.

Upon receiving the award, Dangermond said, "I am honored to be a recipient of the Royal Geographical Society's Patron's Medal and join its group of explorers and geographic scientists. I have worked in the scientific field of computational geography for more than 40 years. During that time, the use of GIS-based analytic methodology has increased exponentially and is now implemented in numerous applications ranging from monitoring climate change to optimizing soil amendments for improved crop yield. The technology is also commonly used by first responders for natural and man-made disasters.

"I believe that as we expand the use of this technology on the Web, people throughout the world will better understand how our actions generate interrelated patterns and processes that affect us all. This insight will spur the age of applied geography and be used as a foundation for a greater understanding of ourselves and our planet, providing the incentive for positive change. I accept this award on behalf of my colleagues and, more importantly, our users, who are leveraging geographic knowledge to expand our perception of the dynamics that shape our world."

Past honorees of the Patron's Medal include David Livingstone, Roald Amundsen, Edmund Hillary, and Richard Leakey. The society is a key supporter of many famous expeditions, including those of Charles Darwin, the evolutionary biologist, and Robert Scott's Antarctic explorations. In addition, it sponsors geographic research, education, conferences, and workshops.

Jack Dangermond receives the Royal Geographical Society's Patron's Medal from Society president Michael Palin (photo copyright © Howard Sawyer/RGS-IBG).

Added Dangermond, "Mapmakers have systematically recorded our increased understanding of the world for more than 2,300 years. With the development of GIS technology, we now have the tools to perform detailed analysis of both physical and human geographies that can help us provide a better stewardship of the planet."

Dangermond is recognized not only as a pioneer in spatial analysis methods but also as one of the most influential people in GIS. He takes a leadership role in national and global initiatives to facilitate standards for data access and sharing across agencies and organizations. He is personally committed to applying GIS methods to advance sustainable communities and has led initiatives to donate software to environmental, educational, and nongovernmental organizations around the world.

Dangermond received a master of science degree in landscape architecture from the Graduate School of Design, Harvard University, and has been awarded several honorary doctorates.

Among the many honors he has received in recent years are the Carl Mannerfelt Medal from the International Cartographic Association, the Distinguished Public Service Award for Outstanding Contributions to National and International Affairs from the U.S. Department of State, and the Lifetime Achievement Award from the Geospatial Information & Technology Association. At the recent Esri International User Conference, both Dangermond and Roger Tomlinson received Alexander Graham Bell medals from Gilbert M. Grosvenor, chairman of the National Geographic Society, for extraordinary achievement in geographic research.

ArcGIS Server Disseminates Geospatial Services

Esri's ArcGIS Server adds geographic data and analysis to Web applications that serve organizations and communities in a variety of ways. To submit your ArcGIS Server site address and view other Web sites powered by ArcGIS Server, visit **www.esri.com/serversites**.

American Heart/Stroke Association
maps.heart.org/quality
In conjunction with Stroke Awareness Month, this ArcGIS API for Flex/ColdFusion-based application helps people find the nearest hospitals that specialize in stroke care.

Texas Beach Watch
www.texasbeachwatch.com
The Texas Beach Watch Program is a nonregulatory program that monitors water for *Enterococcus* bacteria along the Texas coast. *Enterococcus* bacteria thrive in waters where sewage or storm runoff is present. Scientists often use the bacteria to indicate the presence of harder-to-detect, disease-causing microorganisms. When *Enterococcus* levels exceed those recommended by the Environmental Protection Agency, water quality advisories are issued.

City of St. George, Utah
maps.sgcity.org/sgcitymaps
The SGCityMaps application allows users to quickly access property locations, recreational features, public services, zoning, and other information of interest to learn more about the city of St. George and what it has to offer.

Find out more about ArcGIS Server at www.esri.com/arcgisserver.

New Training Offerings from Esri

Ready, Set, Go with ArcGIS 10

Esri offers a variety of learning opportunities to help you integrate new tools and capabilities of ArcGIS 10 into your daily workflows.

Learn Through Hands-on Exercises

Esri instructors will introduce you to many of the new tools and workflows for mapping, editing, analyzing, and managing your GIS data. Hands-on course exercises help you quickly acquire and apply new skills using ArcGIS 10 productivity enhancements.

What's New in ArcGIS 10 introduces you to new interfaces, tools, and workflows that make visualizing, managing, and analyzing your GIS data faster and easier. You'll practice using time-aware and 3D enhancements, as well as learn shortcuts using Python scripts to automate geoprocessing tasks. This two-day (16-hour) course is offered in the interactive, online Virtual Classroom. **www.esri.com/10newcourses**

What's New in Editing in ArcGIS 10 immerses you in using streamlined editing workflows. You'll gain experience with the more intuitive, sketch-based editing environment in ArcGIS 10, including the Parcel Editor toolbar, which replaces Cadastral Editor. This one-day (8-hour) course is offered in traditional classrooms and the online Virtual Classroom. **www.esri.com/10newcourses**

Instructor-Led Training

Demonstrations, exercises, and lectures for most Esri courses have already been updated to ArcGIS 10. More than 200 instructor-led classes are scheduled to support your transition to ArcGIS 10. Some courses will continue to be taught using ArcGIS 9.3. Go to **www.esri.com/training10** for more information.

Live Training Seminars

Esri technical experts are streamed live to your desktop in these free, one-hour seminars with interactive Q&A at the end. Visit **www.esri.com/lts** for an up-to-the-minute schedule.

Recorded Training Seminars

Get up to speed on ArcGIS 10 with free, one-hour seminars when it's convenient for you. Find the complete seminar list at **www.esri.com/ts**

Free Nationwide Seminar

Join us for an all-day seminar that shows how ArcGIS 10 makes it easier to be more productive in your job, whether you're working in a desktop, mobile, server, or cloud environment. **www.esri.com/10seminar**

Request a New Course Catalog

The new *Esri Course Catalog,* detailing instructor-led course offerings, is now available. Download a copy at **www.esri.com/training** or subscribe to have a copy sent to you.

Is the Virtual Classroom for You?

Tight travel budgets keep many GIS professionals from attending training they really need. Esri provides a no-travel-required option for participating in classes led by Esri instructors. The interactive, online Virtual Classroom replicates the traditional classroom experience without your having to travel.

Students can ask questions, interact with classmates, and even request that the instructor shadow work on their computer while they complete hands-on exercises.

Most Esri instructor-led courses are available in the Virtual Classroom. A new two-minute video provides an introduction and gives you a sampling of what the Virtual Classroom is like. Watch it at **www.esri.com/virtualclassroom**.

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Developers from Coast to Coast Will Meet Up at Regional Events

Developers at all levels of expertise who are interested in geospatial technology are invited to attend regional Dev Meet Ups scheduled to take place between now and May 2011. The free events will give you the opportunity to demonstrate your application or framework, present an interesting concept or idea, share your experiences, and connect with other developers. For more information or to register for the Dev Meet Up closest to you, go to **www.esri.com/events/dev-meetup**.

Australia and Vietnam— Esri T-Shirts Go Everywhere!

Ian Harper, land surveyor and director of Geodata Australia, is pictured at Cape Raoul and Tasman Island on the southern coast of Tasmania, returning home after the Sydney to Hobart Yacht Race. And his Esri T-shirt doesn't even look wet.

Eric Lomeli, senior GIS analyst for Bexar County, Texas, and his wife Amber are wearing their Esri T-shirts during their honeymoon in Halong Bay, Vietnam.

Wear an Esri T-shirt in a unique location and send a photograph to *ArcNews*. Photos will be considered for use in *ArcNews,* the expanded T-shirt section at *ArcNews* Online, or both. While digital photos sent via e-mail (tmiller@esri.com) are preferred, prints or slides can be sent to Thomas K. Miller, *ArcNews* Editor, *ArcNews* T-Shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews* Online at **www.esri.com/arcnews**.

Eric and Amber Lomeli in Vietnam.

Ian Harper on the southern coast of Tasmania.

For URISA, Education Is Key

URISA has been connecting great ideas and great people to inspire leadership and achievement since 1963. The association strives to provide exceptional educational experiences to all parts of the spatial data community. The coming months will be no exception.

URISA's Fifth Caribbean GIS Conference will take place in Trinidad December 6–10, 2010. The theme for the conference is "Geospatial Technologies: Connecting Our Industries in Meeting the Region's Challenges."

The 2011 calendar is filled with programs that will appeal to a variety of disciplines:

• The 15th Annual GIS/CAMA Technologies Conference (in partnership with the International Association of Assessing Officers) will be held in Memphis, Tennessee, February 28–March 3, 2011.

• The URISA Leadership Academy, where GIS professionals will learn about developing crucial GIS leadership skills, will take place in St. Louis, Missouri, May 16–20, 2011.

• The Third URISA GIS in Public Health Conference will be presented in Atlanta, Georgia, June 27–30, 2011.

• The URISA/NENA Addressing Conference will be held in Anaheim, California, August 15–18, 2011.

• The GIS in Public Transportation Conference (presented in partnership with the National Center for Transit Research) will take place in St. Petersburg, Florida, September 12–15, 2011.

• GIS-Pro 2011, URISA's 49th Annual Conference for GIS Professionals, will be held in Indianapolis, Indiana, November 1–4, 2011.

More Information

There is a URISA educational program for you. Check out the details for each event at **www.urisa.org**.

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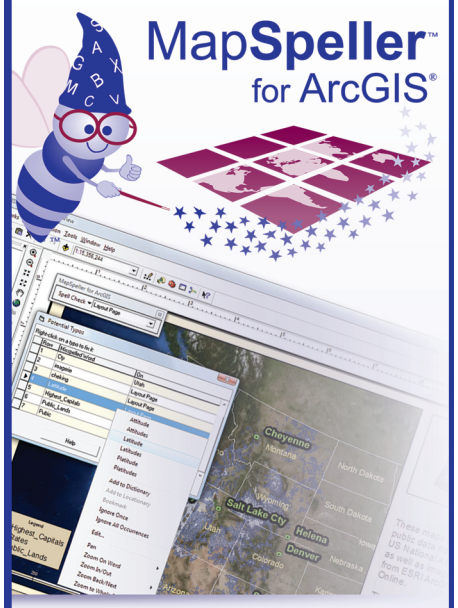

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ENVIRONMENTAL VISUALIZATION SYSTEM

MINING VISUALIZATION SYSTEM

Trichloroethylene contaminant plume at an industrial facility on the coast. Sand and rock layers shown plunging below the ocean.

Ocean, sand and bedrock layers cut away along shoreline and dock to reveal the plume. Aerial photo of the site was used to texture map a 3D CAD model of the facility buildings and the ground surface and ocean layer.

Ocean

Sand

Bedrock

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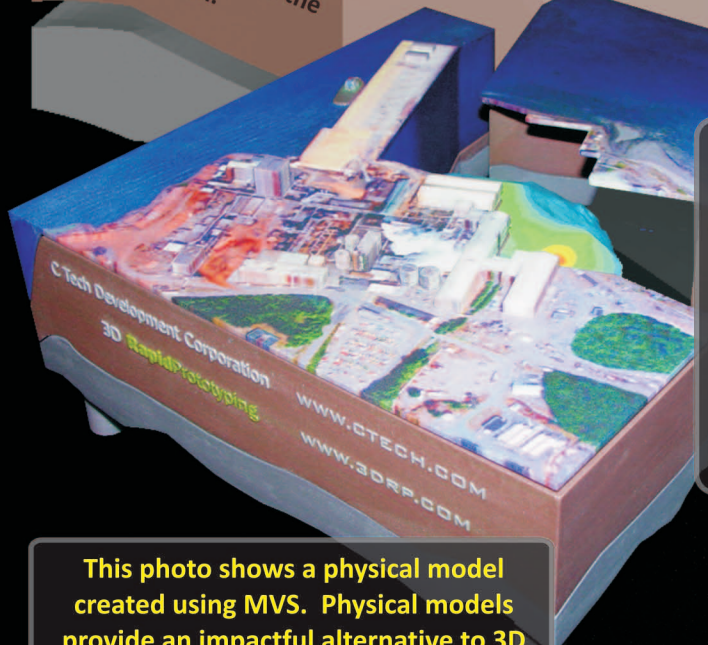
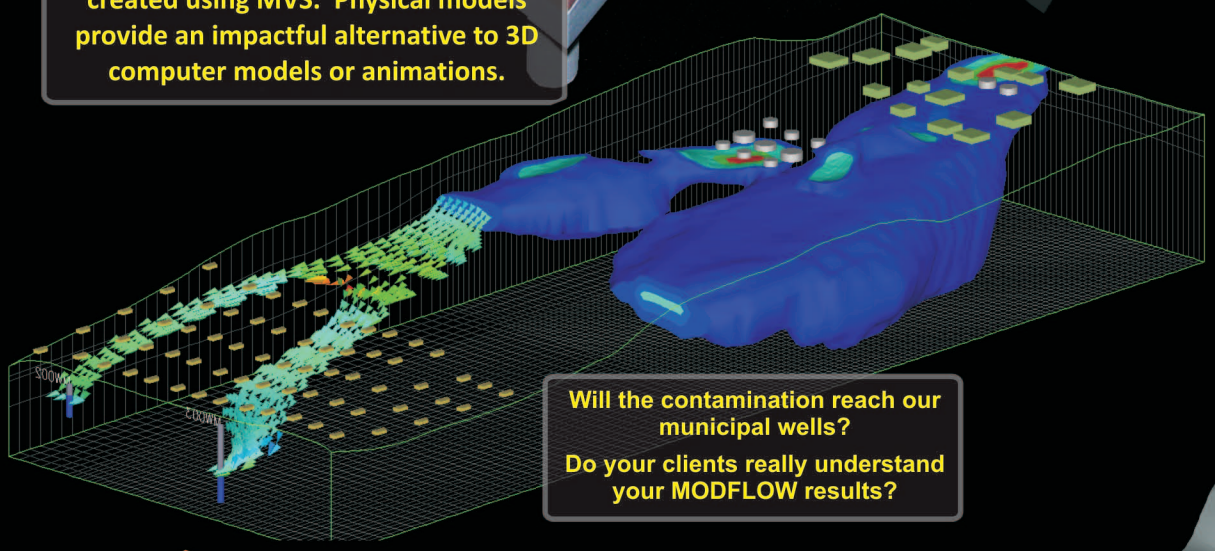
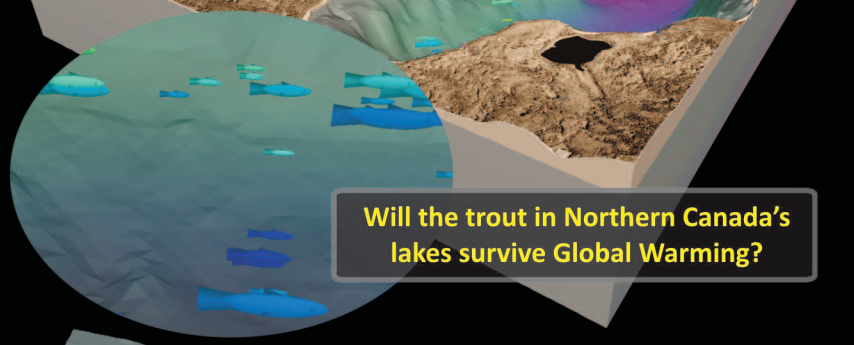


This photo shows a physical model created using MVS. Physical models provide an impactful alternative to 3D computer models or animations.

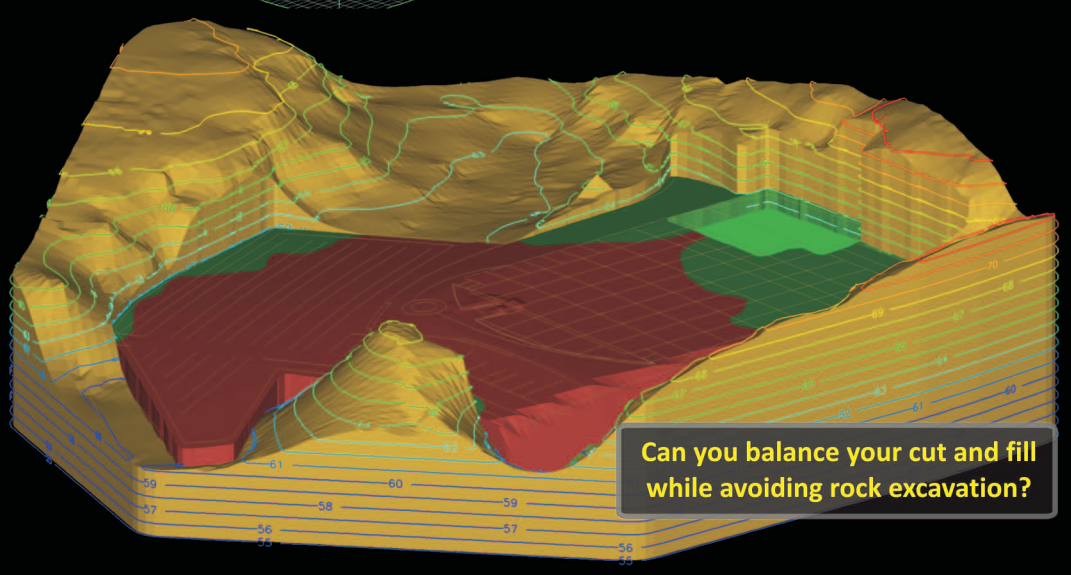


Will the contamination reach our municipal wells?

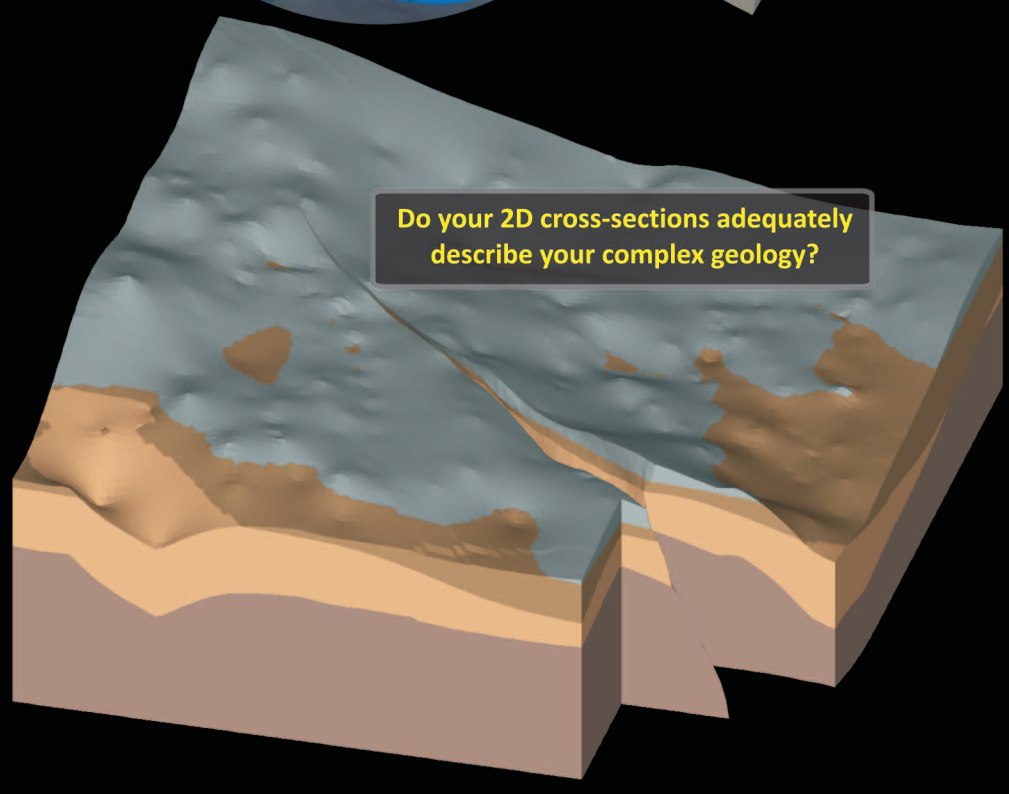
Do your clients really understand your MODFLOW results?



Will the trout in Northern Canada's lakes survive Global Warming?



Can you balance your cut and fill while avoiding rock excavation?



Do your 2D cross-sections adequately describe your complex geology?

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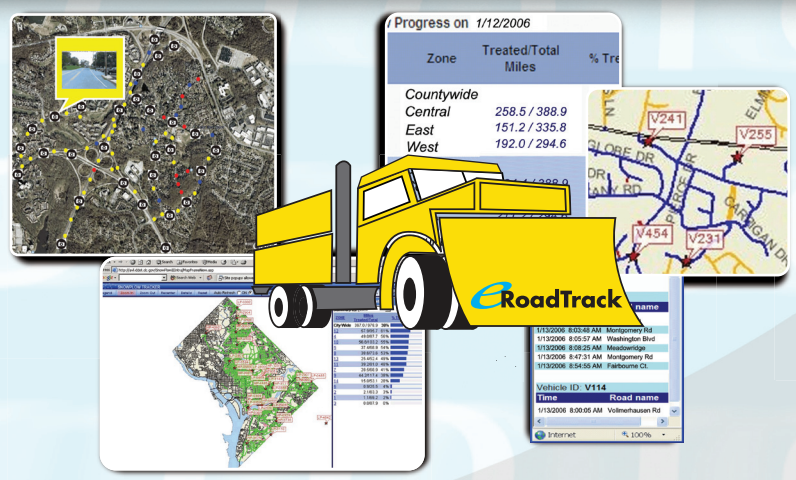

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