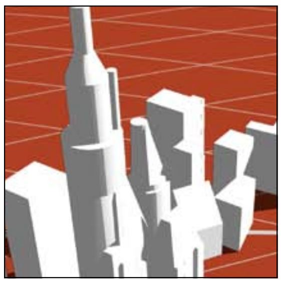
ArcNews

Esri | Spring 2013 | Vol. 35, No. 1

Agents, Models, and Geodesign

By Michael Batty, Bartlett Professor, University College London



There are now many new methods for modeling cities that differ from the traditional approaches to simulating urban structure, land use, and transportation flows. As data has become richer and bigger and computers have become all-pervasive, with ever-increasing memories and ever-faster processing times, it has become possible to model the behaviors of individual objects that make up data aggregates, such as populations, that were the focus of simulation models a decade or more ago. Individuals that compose these populations can now be represented as distinct objects within

continued on page 25

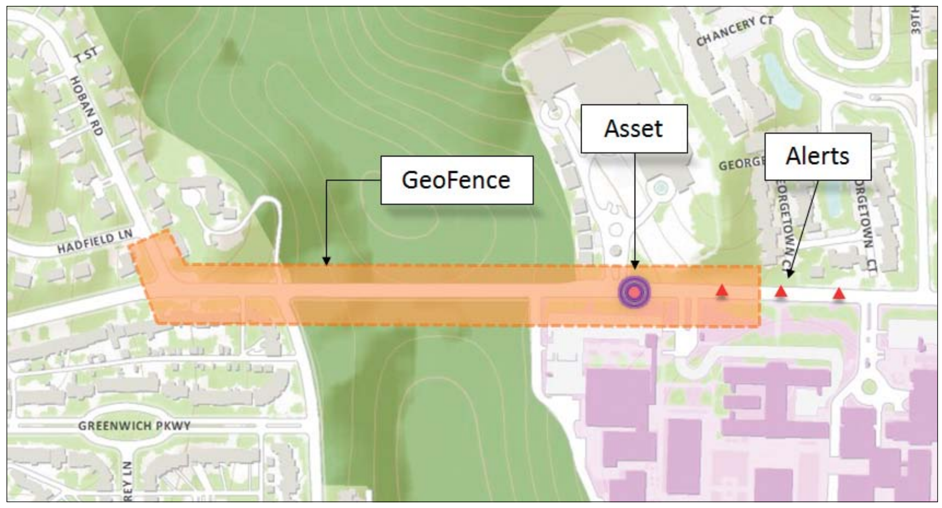
FEMA Provides Mapping Assistance for Superstorm Sandy

In the immediate aftermath of Superstorm Sandy, tens of thousands of people were suffering from its impacts. Houses were destroyed, and whole communities lay devastated. As soon as Sandy finished, Federal Emergency Management Agency (FEMA) staff arrived to provide aid and assistance, including mapping. FEMA regional GIS coordinator Cory MacVie and FEMA geospatial coordinator Josh Keller created an application that allowed people to see what happened to their homes. ***Read the full story on page 4.***

ArcGIS Enables Real-Time GIS

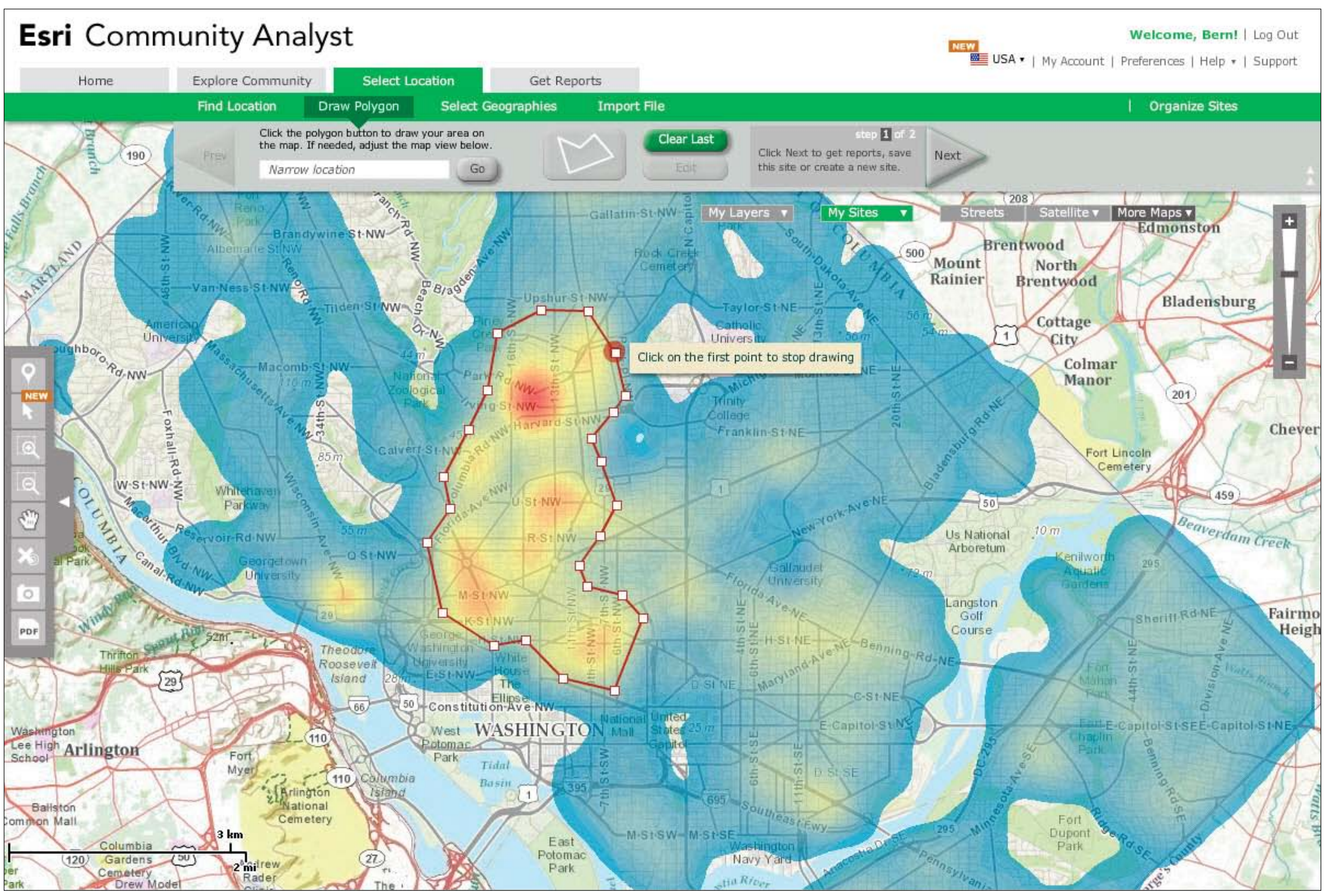
ArcGIS includes the capability to use real-time data in everyday decision making. Users will be able to answer questions, such as, Where are all the vehicles in my fleet at this moment? and Are my field personnel working within the designated project area? They'll be able to tell a customer that the delivery truck is 10 minutes away, get notified when a certain type of vehicle enters a dangerous area, alert the five nearest responders when an incident occurs, be warned when equipment begins operating abnormally, and even be able to monitor lightning strikes.

continued on page 3



GeoEvent Processor for Server makes it possible to use GIS features as geofences and create geofences on the fly.

Geodesign Tackles Big Problems and Brings GIS into the Design Fields



The Community Analyst geodesign tool can be used to glean information about a variety of community/people focused demographic data and reports (esri.com/software/arcgis/community-analyst).

Four years ago, designer and technologist Bran Ferren issued a challenge during the first Geodesign Summit: become better storytellers using geodesign.

Ferren, the chief creative officer of Applied Minds LLC, returned to Esri in January to keynote the fourth Geodesign Summit, reiterate his first call to action, and deliver another: develop a 250-year plan for the planet enabled by geodesign to create a vision of the future.

"Geodesign combines geography and data with modeling, simulation, and visualization to tell stories and [show] the consequences of your actions," Ferren told the more than 260 architects, urban and transportation planners, GIS and design professionals, educators, and others, in attendance. He sees great potential for geodesign to ultimately help find solutions to complex problems. "It is still in the shiny object stage, but it will be *very* important," he said.

Geodesign technology will mature naturally, much like other technologies, such as GPS, did. But meanwhile, said Ferren, in this era of short attention spans, people need to start thinking far, far into the future to create a problem-solving template that can be built on over time. "If we are going to address these big global issues facing us—whether that's disease, education, freshwater, war, or global warming—you actually have to take a long view," Ferren said. "For this planet, we need—pick a number—a 250-year plan."

continued on page 2

Geodesign Tackles Big Problems and Brings GIS into the Design Fields

continued from cover

Ferren said questions need to be posed, such as the following:

- What is your current state of affairs or the topic you are worried about?
- What is your desired end state?
- How are you going to get there?

"I argue that just having the discipline to sit down for a day and think about that will change your whole thought process," Ferren said. "It doesn't mean you are going to know exactly what the future is, but having a sense that in 250 years you would like to address these things at least gives you an intellectual template and road map to test your ideas against."

This process will be collaborative, too, according to Ferren. "That's the power of geodesign," he said. "It's this network extension of shared intelligence where the insights of individuals can be shared among others and that can be used as the foundation to build upon."

Ferren also said that geodesigners in the future will be entrusted with the same power over life and death that doctors have today, because the decisions they make will be critical to humans and other species. "The mistakes you make in planning and designing our cities may take 100 years until someone understands the consequences of those actions. The Hippocratic Oath for geodesign: First, do no harm," he said. "Understand what you are doing and the effect; if you know this is going to do long-term damage, it is not okay to do it. We aren't on this earth very long. It's a mere blip. Try to leave it a little better than how we found it."

The fourth Geodesign Summit in the Esri auditorium.

"Geodesign is about integrating geographic knowledge with the spatial design process."

—Jack Dangermond, Esri President

Technology Matters

Summit attendees also heard from Esri president Jack Dangermond, who spoke about his enduring belief in technology as an agent of positive change to tackle the planet's big problems. "In my life, I always believed technology could matter," he said.

He also spoke about a shift, with GIS becoming a platform technology that's more participatory than ever before because it is now widely available via a cloud gateway that supports applications on the web and on mobile devices.

"This potentially has the power of making the concepts of geography, the models, the analytics—not simply the visualization—available to everyone," Dangermond said.

For organizations, this means that geographic knowledge—including geodesign tools—will become available to a much wider audience than in the past.

This idea of GIS as a platform was brought home to the audience with demonstrations that showed the increasing simplicity of making online maps using ArcGIS Online and Esri Story Maps templates. Esri staff also gave short demonstrations of Community Analyst, which is used for mapping demographic, health, and other data, and Esri landscape analysis services, a new set of data services (still being tested in beta) geared specifically toward geodesign work.

For his demonstration, Esri technology evangelist Bern Szukalski used Esri landscape analysis services to study the siting of the Ivanpah Solar Electric Generating System, currently being built in the Mojave Desert. He used Esri landscape analysis tools to study the solar power-generating potential at the site, the slope of the terrain, and critical habitat areas for desert tortoises in proximity to the solar project. Esri landscape analysis services are well suited for regional planning projects to study various scenarios.

Modeling the Future

Another geodesign-related technology demonstration showed how Esri technology was used to model the impacts of transit-oriented development in 3D for the city of Honolulu, Hawaii *(see related article on page 10)*.

With the city's population expected to increase by 164,000 people by 2050 and traffic congestion a problem now, Honolulu faces major development decisions.

Esri solutions engineer Eric Wittner showed how Esri software was used to model alternative futures for Honolulu. First, GIS information, prepared using Esri ArcGIS for Desktop, and 3D GIS data from Pictometry and PLW Modelworks, which represented realistic building models for portions of the city, were combined in Esri CityEngine. CityEngine is 3D modeling software for urban environments.

Using a set of rules, a 3D representation of the city as it looks now was generated in CityEngine. Then the software was used to model different scenarios of how the city might grow.

One scenario showed significant urban sprawl if thousands of new single-family homes were built outside the urban core. Another 3D model showed much less of a footprint in undeveloped areas if the city built up with people living in tall buildings near a multibillion dollar light rail system currently under construction.

These technology demonstrations were inspiring to many Geodesign Summit attendees, such as Juan C. Perez, director of transportation and land management for the Transportation and Land Management Agency, County of Riverside, California.

"The session that focused on the visual modeling and analytic tools when presenting land-use decisions to policy makers was excellent," Perez said, adding that he would like Riverside County to use some of the tools.

Perez also said Ferren's proposal of a 250-year plan was thought provoking. "While perhaps extreme at first blush, it really puts into perspective that the land-use decisions that we make have very long-term consequences."

The Instant City

Elliot Hartley, a director of Garsdale Design Limited in Cumbria, United Kingdom, gave a talk called "The Instant City—Geodesign and Urban Planning." His firm, along with its Iraqi Planners Group, is creating a master plan for the city of Nasiriyah, Iraq, which includes plans for future housing, utilities, and infrastructure. Garsdale used the capabilities in Esri CityEngine, 3D modeling software for urban environments, to change the plans when new data was added or late changes were made. Work that took four days using other software took only a half day using CityEngine, he said *(see related article on pages 14–15)*.

For more information, visit geodesignsummit.com.

Featured in This Issue

Regular Columns and Departments

Editor in Chief
Thomas K. Miller

Graphic Designer
Steve G. Pablo

Illustrator
Daniel Gill

Founding Editor
Karen Hurlbut

***ArcNews* Subscription Additions or Deletions and Changes of Address**
To subscribe to Esri publications, visit esri.com/subscribe. To unsubscribe from Esri publications, visit esri.com/unsubscribe. Requests for back issues, missed issues, and other circulation services may also be sent via requests@esri.com; 909-793-2853, extension 1-2778; or faxed to 909-798-0560. To update your mailing address, visit esri.com/coa or use any of these e-mail, phone, or fax options. Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit esri.com/distributors.

How to Reach *ArcNews*
Tel.: 909-793-2853, ext. 1-1660

Article submission guidelines/advertising information:
esri.com/arcnews

ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100, USA
tmiller@esri.com

See *ArcNews Online* at
esri.com/arcnews

ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100, USA. *ArcNews* is written for the Esri user community as well as others interested in mapping and geographic information system (GIS) technology. It contains material of interest to planners, foresters, scientists, cartographers, geographers, engineers, business professionals, and others who use spatial information.

ArcGIS Enables Real-Time GIS

continued from cover

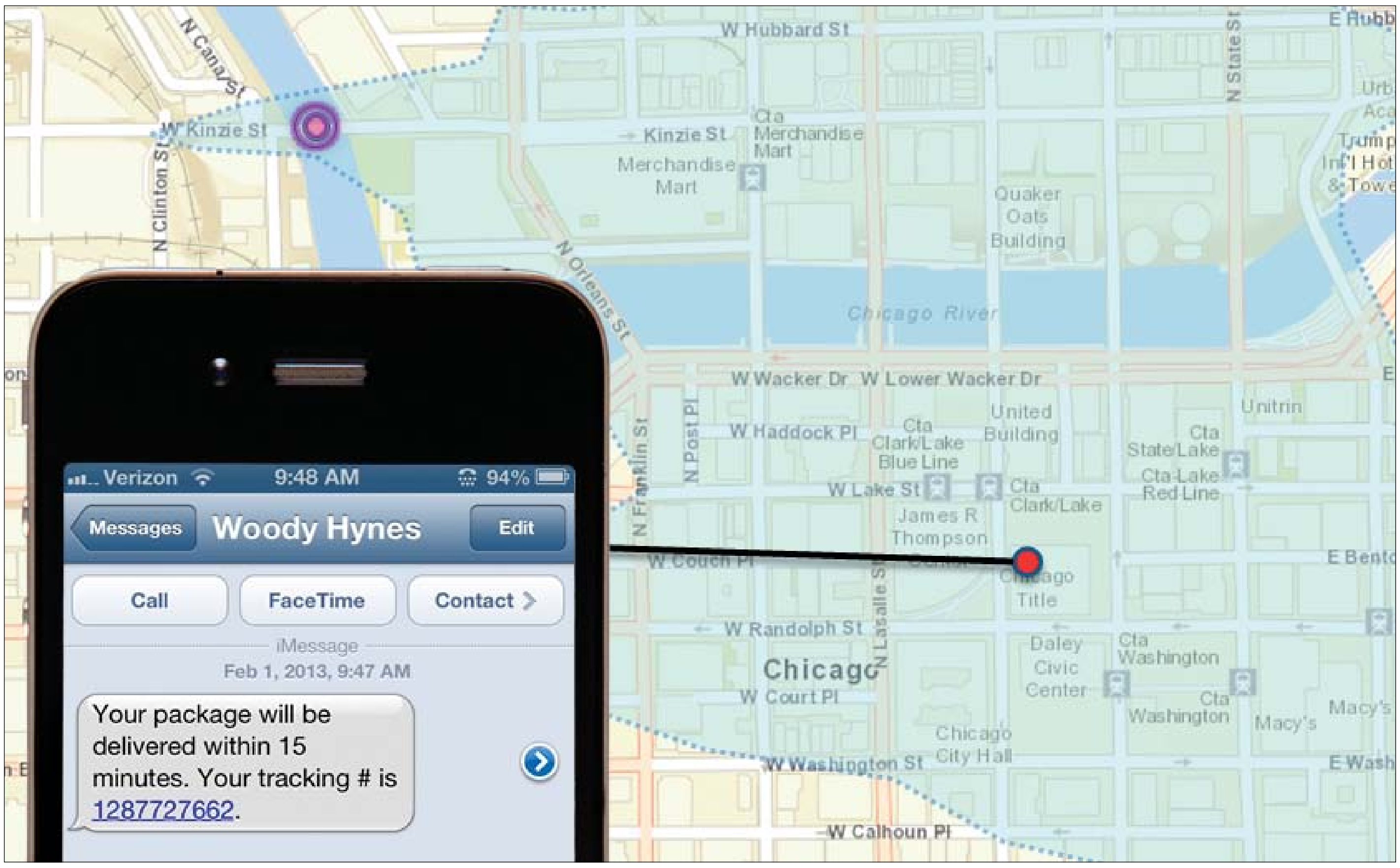
Highlights

- Incorporate real-time data into your decision-making process.
- Visually track locations of field personnel and trigger alarms based on geographic and attribute rules.
- Analyze incoming streams of data to discover relevant patterns in real time.

ArcGIS GeoEvent Processor is a new ArcGIS for Server extension. It gives users the ability to connect to real-time data streams from a wide variety of sensors, perform continuous processing and analysis of those data streams, and send relevant information to users or other systems.

Connecting to Real-Time Data Streams

ArcGIS GeoEvent Processor for Server delivers the flexibility to incorporate virtually any source of real-time data into a GIS. It contains ready-to-use input connectors for the most common data stream sources, including built-in GPS connectors for Sierra Wireless and Trimble, and specific data streams for air traffic control, vessel positions, and others. GeoEvent Processor also provides an extensibility framework for creating custom connectors. Connectors can be configured to work over common transport protocols, including UDP, TCP, and XMPP, and tap into vehicle telematics used by CompassCom, networkfleet, and many others.



GeoEvent Processor can generate travel-time geofences that notify customers when a delivery is minutes away.

Processing Data Streams

GeoEvent Processor is designed to process and filter events in real time. This means that it can be set up to receive large amounts of data and extract from it just the information that is relevant to users. For example, GeoEvent Processor can be configured to receive real-time weather and pollution measurements from a network of sensors and trigger alarms when specific pollution or wind thresholds are met. Or it can be used to detect and highlight vehicles that are speeding, stopped for a long period of time, or moving away from a predefined route. GeoEvent Processor provides a simple visual environment for configuring and processing data streams. It allows users to easily remove noise and filter the data into the most important and actionable information.

Making Real-Time Information Available to Decision Makers and Customers

GeoEvent Processor provides the capability to share real-time information with users and other systems. Examples include sending an e-mail or instant message to a person when a particular alarm is triggered and writing incidents to a log file or sending messages to an enterprise messaging system.

ArcGIS applications, including the new Operations Dashboard for ArcGIS, can receive and display the output of GeoEvent Processor on a map. ArcGIS applications running on web browsers, smartphones, and tablets can also take advantage of GeoEvent Processor output. For example, a construction company can track expensive equipment and alert operators and supervisors when a piece of equipment moves outside the project area. The location of the equipment can be tracked in real time on a map at the headquarters and from a smartphone in the field. Alerts can be configured so an instant message or e-mail is issued to the appropriate persons when needed.

In another example, a city police department can maintain a common operating picture of units in the field, analyze their movement patterns, and then optimize their patrol routes.

Or a company can improve customer service by alerting customers that their package will be delivered within the next 15 minutes.

A New Paradigm for Geofencing

A geofence is a virtual perimeter for a real-world geographic area. In the case of GeoEvent Processor, the GIS server is detecting and using geofences to alert the user or an authority when the device approaches, enters, and leaves the geofenced area. GeoEvent Processor provides the ability to use any map feature as a geofence. This means that geofences can be defined using jurisdictional areas, such as a city boundary, or an area defined through analysis, such as a high-crime area, an area determined by specified drive time, or a hand-drawn polygon. For example, an operations center may want to monitor vehicle assets as they approach, pass through, and leave hazardous areas defined by spatial conditions, such as flooding or suspicious behavior. These GIS-based geofences will help end users deliver more accurate, real-time assessments of live events.

Conclusion

ArcGIS provides users with exciting new capabilities to incorporate real-time information into decision making. ArcGIS users can manage the flow of real-time data by collecting data streams from sensors; processing and analyzing this data in real time to determine the course of action; and finally presenting relevant information to users as a map via an e-mail, instant message, etc. These capabilities are delivered through the new ArcGIS for Server extension, ArcGIS GeoEvent Processor for Server.

GeoEvent Processor is sure to be a game changer in many industries, including fleet and asset management, telematics, defense and intelligence operations, public works, public health, forestry, mining, water and petroleum management, public safety and emergency management, transportation, and utilities.

To learn more about GeoEvent Processor for Server, request a demonstration; to evaluate the extension, contact your local Esri office or Esri distributor. ArcGIS GeoEvent Processor for Server is expected to be released with the next update to ArcGIS for Server.

Providing Information as a Resource—Responding to Superstorm Sandy

FEMA Coordinators Cory MacVie and Josh Keller Go Above and Beyond

GIS Heroes

Cory MacVie

Josh Keller

In late October 2012, Superstorm Sandy pummeled the Northeast with violent winds, surging tides, and heavy rain and snow. In the immediate aftermath, tens of thousands of people were impacted. Houses were destroyed. Millions were left without electricity. Roads were impassable. Whole communities lay devastated from the storm's path.

For those impacted by the storm—and for people with loved ones in the area—information, like where to find clean water and food, was a precious commodity.

One of the first questions people would ask: what happened to my home?

The Federal Emergency Management Agency (FEMA) was preparing in advance of the storm. As soon as Sandy finished its destructive path, staff arrived to provide aid and assistance, including mapping. FEMA regional GIS coordinator Cory MacVie, along with fellow FEMA geospatial coordinator Josh Keller, worked late into the night to create an application that allowed people to look at imagery that could help them see what happened to their home. It was made available—along with many other vital Sandy response mapping applications—to the public using FEMA's recently developed GeoPortal platform. Built using ArcGIS Online and taking advantage of cloud capabilities hosted by Esri, the GeoPortal proved the perfect mechanism to get information out quickly. The application, called Check Your Home, provided easy access to imagery FEMA collected in coordination with Civil Air Patrol (CAP) and National Oceanic and Atmospheric Administration (NOAA) immediately after the storm.

"Like all FEMA employees, we can be deployed when needed," says MacVie. "We both work with our local GIS personnel to support regional geospatial needs. For Sandy, we began assisting immediately."

In the Check Your Home application, the transparency bar on the left allows comparison of pre- and post-Sandy imagery.

FEMA's Superstorm Sandy GIS Efforts

FEMA activated thousands of employees for Superstorm Sandy, and its full arsenal of staff provided all manner of assistance. MacVie arrived October 31 in New Jersey, two days after Sandy made landfall. He is the regional GIS coordinator over Region VII in Kansas City, Missouri, and is responsible for Kansas, Nebraska, Iowa, and Missouri.

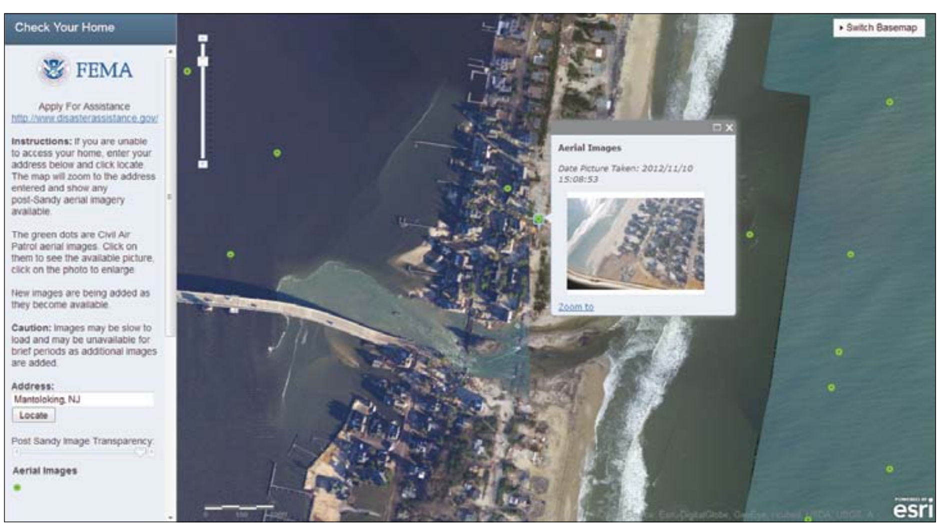
Keller worked remotely from his region to support those in the field. He is the GIS coordinator for FEMA Region X, located in Bothell, Washington, and is responsible for Alaska, Idaho, Oregon, and Washington.

MacVie first deployed as the remote-sensing specialist in New Jersey and was the first FEMA GIS support on scene in Trenton, New Jersey, at the state Emergency Operations Center. Two weeks later, he was sent to Tinton Falls, New Jersey, at the joint field office as it was being set up to coordinate the recovery effort. At each location, he produced a variety of geospatial products, such as the magnitude of damage, the extent of storm surge, and the damage to infrastructure. These products then aided federal and state decision makers with numerous logistic and operational decisions related to personnel and resource allocation.

Prior to Superstorm Sandy, Keller had been working on FEMA's GeoPortal, which is a platform for FEMA to publish applications for use by both response agencies and the public. Built using ArcGIS Online, FEMA's GeoPortal allowed FEMA staff to build useful information and analysis tools and immediately make them available. The agency didn't have to spend time and resources on maintenance and hardware. It could focus on end-user wants and needs in designing applications.

"When Sandy looked like it was going to impact the East Coast, I was activated to support the National Response Coordination Center remotely, especially in the use of the GeoPortal," says Keller. "Since the portal was new, we had little data and few people trained in publishing to the portal. I assisted with training, technical questions, etc."

FEMA had many GIS personnel around the country, including Keller, publishing GIS data that was being collected and made available on the GeoPortal. This data included aerial imagery, surge models, damage assessments, open and closed gas stations, power outages, school closures, and more. This type of information was of great assistance to federal, state, and local officials as they determined the prioritization of resources.



Using National Oceanic and Atmospheric Administration (NOAA) nadir imagery and Civil Air Patrol (CAP) imagery of Breezy Point, New York, to show homes destroyed by gas fire.

Check Your Home

In a meeting on November 4, which included FEMA deputy administrator Richard Serino, MacVie presented a map showing the aerial imagery collected up to that point. It consisted of 65,000 images of damaged structures. Within two more weeks, more than 140,000 images were collected.

The oblique imagery was captured by CAP, whose volunteer pilots flew several flights a day over the designated states. The collections also included a layer of NOAA's orthoimagery, which provided almost complete coverage of the impacted areas.

"One of the things that we threw together very quickly prior to the Check Your Home application was the ingesting of Civil Air Patrol geotagged photos," says Keller. "In the past, they would upload the photos to the USGS [US Geological Survey] Hazards Data Distribution System website, where they would later be downloaded and viewed. But this often did not take advantage of the geotagging."

Keller wrote a Python script to process the geotagged JPEG images from CAP and generate a shapefile that was automatically published to the GeoPortal. That script reduced the time it would take to acquire, process, and publish CAP photos from days to hours or minutes. This became the basis for the Check Your Home application.

Late on the night of November 5, MacVie contacted Keller to brainstorm how they could make a simple tool for the public to use. They both worked through the night over the phone to create an application that would allow users to type in an address and view before and after imagery of that location.

At the time, there were still more than 50,000 known displaced individuals in the New Jersey Barrier Islands. The majority of the Barrier Islands had not been reopened yet. MacVie worked on the design and layout of the site while Keller handled the coding, and later he moved the application from the development environment to the production environment.

As Keller fine-tuned the code, MacVie coordinated technical and policy logistics with FEMA headquarters, FEMA External Affairs, and Esri to prepare a production environment to host the site.

The initial application was a customized Esri portal template. It was up by November 6 at 3:00 a.m. In five hours, the concept became a reality.

Both Keller and MacVie wanted to make sure that once the site was up, it didn't crash if mainstream media outlets picked it up. The site was in alpha stage within 24 hours, and they announced a soft launch for testing purposes with a large geospatial group. After additional improvements, the site was launched as version 1.0 and officially went public November 7 within only 48 hours of its original conception.

Within 24 hours, the application received thousands of views. Feedback was positive.

"The site was well received by senior leadership at FEMA, and it will be used in future disasters where aerial resources are available," adds MacVie. "In the near future, we will make it even easier to use and possibly accompany the site with a small video explanation and tutorial on its purpose."

For more information, contact Cory MacVie, regional GIS coordinator, Federal Emergency Management Agency (e-mail: cory.macvie@dhs.gov).


EPSON

ArcGIS Online

What's New?

This regular column contains information about the latest updates to ArcGIS Online, including new features and capabilities, as well as updates to basemaps and content contributed by the global user community through the Community Maps Program.

In this issue, we are focusing on the new Community Maps design and basemap updates.

New World Topographic Map Design

One of Esri's most popular basemaps, the World Topographic Map, or Community Basemap, is a GIS crowdsourced basemap that compiles data from the best available sources, including commercial data providers and GIS users around the world who contribute their content through the Esri Community Maps Program. We recently redesigned the basemap to offer a more global appeal. The World Topographic Map now provides both a better background to overlay your operational data and consistent data across all map scales.

Updated monthly, the World Topographic Map includes boundaries, cities, water features, physiographic features, parks, landmarks, transportation, and buildings. The initial rollout of the new design features global coverage from 1:591,000,000 down to 1:72,000 scale. In the United States, Mexico, and Europe, the new design persists down to large scales. At scales larger than 1:72,000, where there are program contributions or where NAVTEQ data is used (outside the United States, Mexico, and Europe), you will continue to see the old design.

Also new is a dynamic attribution feature that ensures map content contributors are credited for their contribution. Based on bounding boxes, contributors will now see the name of their jurisdiction appear at the bottom of web maps in ArcGIS Online when panning over the map at scales where the contributed content is displayed. While this is currently available only in the ArcGIS Online map viewer, mobile implementations will follow later in 2013.

ArcGIS Online Basemap Updates

As in the past, the World Topographic Map continues to receive the most contributions of authoritative content. Updates since the last column was written include the first contribution from a high school GIS class, which contributed content for Banning High School and Nicolet Middle School in Banning, California, at 1:2,000 scale. New and updated content from 1:9,000 to 1:1,000 scale is available for several areas in Canada, including Cornwall, Ontario; Val-d'Or, Quebec; Inuvik, Colville Lake, Déline, Fort Smith, Hamlet of Aklavik, Hamlet of Fort Liard, Hamlet of Paulatuk, Hamlet of Sachs Harbour, Nahanni Butte, Trout Lake, Tsiigehtchic, and Ulukhaktok, Northwest Territories; and Oak Bay, Regional District of Central Okanagan, Regional District of Sunshine Coast, District of Saanich, and Kamloops, British Columbia.

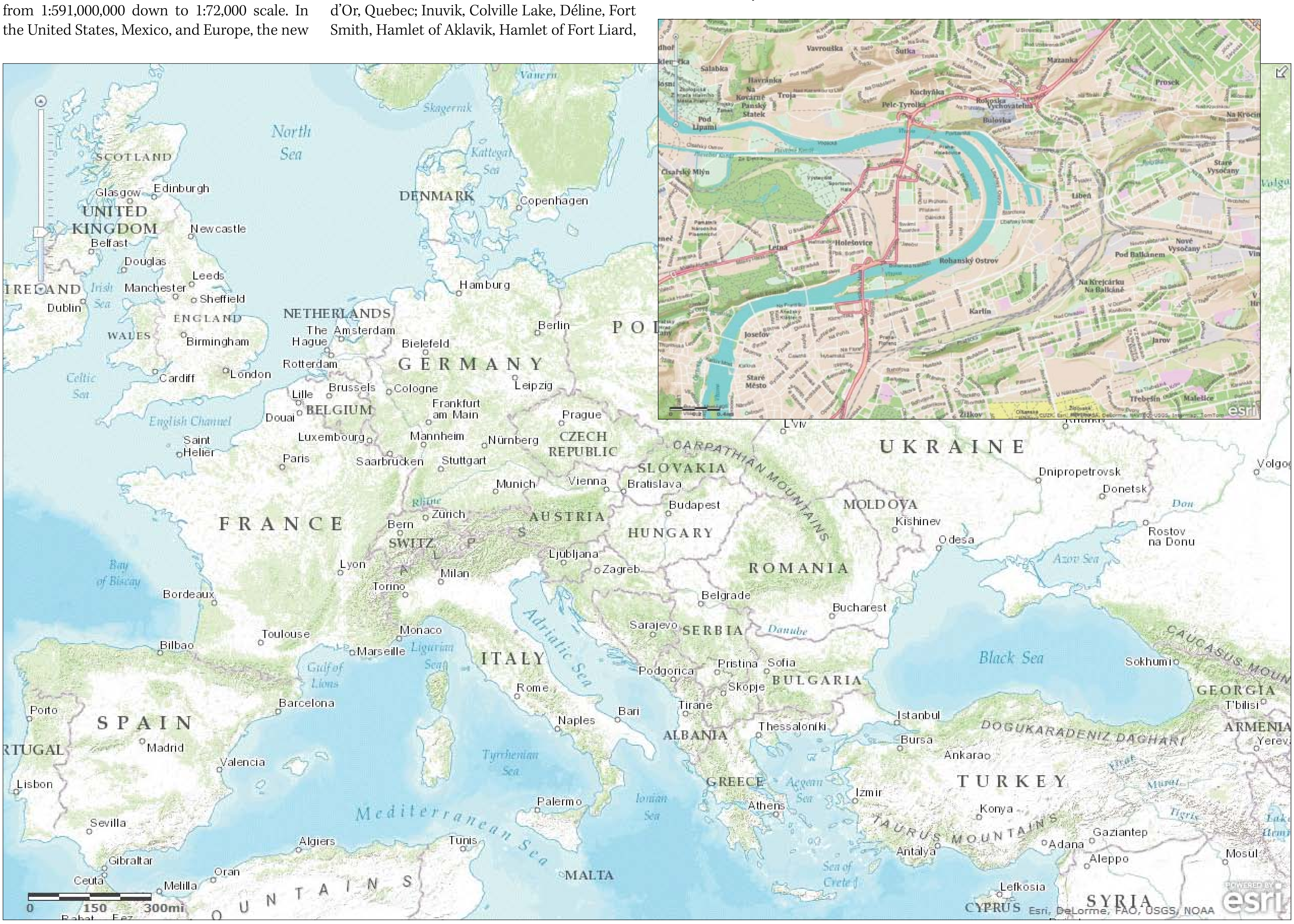
New and updated content has also been added for international areas, including Europe and Russia at 1:288,000 to 1:1,000 scale; Canada at 1:360,000,000 to 1:2,000,000 and 1:577,000 to 1:18,000 scale; North America at 1:288,000 to 1:172,000 scale; Bosnia and Herzegovina at 1:577,000 to 1:1,000 scale; EuroPark Mielec SSE, Poland, at 1:19,000 to 1:1,100 scale; the islands of Aruba, Bonaire, Curaçao, Sint Maarten, Saba, and Sint Eustatius at 1:72,000 to 1:4,000 scale; Niedersachsen-Bremen, Berlin-Brandenburg, Thüringia, and Saarland, Germany, at 1:144,000 to 1:12,000 scale; the Netherlands at 1:72,000 to 1:1,100 scale; the University of Agriculture, Krakow, Poland, at 1:9,000 to 1:1,000 scale; Vienna, Austria, at 1:9,000 to 1:1,000 scale; and University Jaume I, Spain, at 1:9,000 to 1:1,000 scale.

Several areas in the United States also include new and updated content at 1:9,000 to 1:1,000 scale, including Arvada, Boulder, Clear Creek County, and Greenwood Village, Colorado; Ashland and Dane Counties, Wisconsin; Boston, Massachusetts; Bucks County, Pennsylvania; Campbell County, Wyoming; DuPage County, Illinois; Florence County, South Carolina; Iredell County, North Carolina; Muscatine County, Iowa; Salem, Oregon; Sioux Falls, South Dakota; Bismarck, North Dakota; Taney County, Missouri; University of Washington, Tacoma, Washington; Duval County, Florida; Frisco, Houston, McKinney, and Grand Prairie, Texas; Hartford, Connecticut; and Bakersfield, Rancho Cucamonga, San Diego County, the Port of Los Angeles, Redlands, and Irvine, California.

The Ocean Basemap was recently updated to include bathymetric data from the National Institute of Water and Atmospheric Research in New Zealand at scales of 1:4,600,000 to 1:72,000 for the country's exclusive economic zone. The new update also includes several feature corrections, improved rendering of the bathymetric data, and minor design changes.

The goal of the Community Maps Program is to work with the global user community to provide effective, accurate, and freely available basemaps that anyone can use. Learn how you can contribute your authoritative content by visiting **esri.com/communitymaps**.

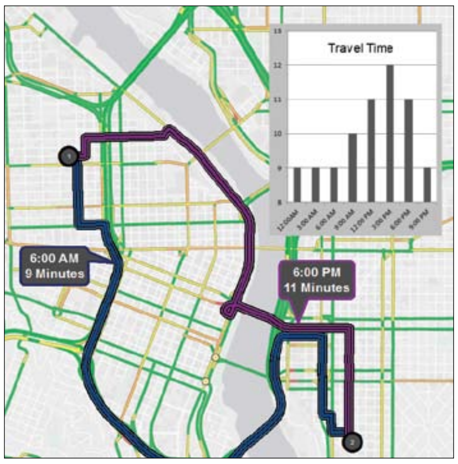
Learn more about ArcGIS Online. Sign up for a free 30-day trial and invite up to five named users to participate in the trial. You get 200 service credits and Esri Maps for Office as part of your trial. When your trial is over, you can purchase a subscription and continue to use all the features and services in the same ArcGIS Online subscription account. To sign up for the trial, go to **esri.com/agoleval**.



The new World Topographic Map design provides a muted background that makes your operational data stand out. **Inset:** Prague, Czech Republic.

Developer Initiative Lowers Barriers to Creating and Sharing Great Applications

Developers interested in incorporating mapping and spatial analysis into their applications will see many exciting changes happening in 2013. Esri has undertaken a multifaceted initiative that will include API improvements, a better application management experience, documentation, improved ways for developers and partners to make applications available to end users, and a one-stop website with all the resources developers need to get started. Esri will roll out these innovations over the first half of 2013.



With the ArcGIS Online Directions Service, developers can add routing to web and mobile applications that generates optimal routes to a specific location or calculates areas accessible within a given amount of time.

At the Esri International Developer Summit, Esri's new **developers.arcgis.com** website is being announced. This website provides code samples across development environments (such as JavaScript, Android, iOS, REST, Windows Phone, and others), along with documentation and a means of registering and monitoring applications.

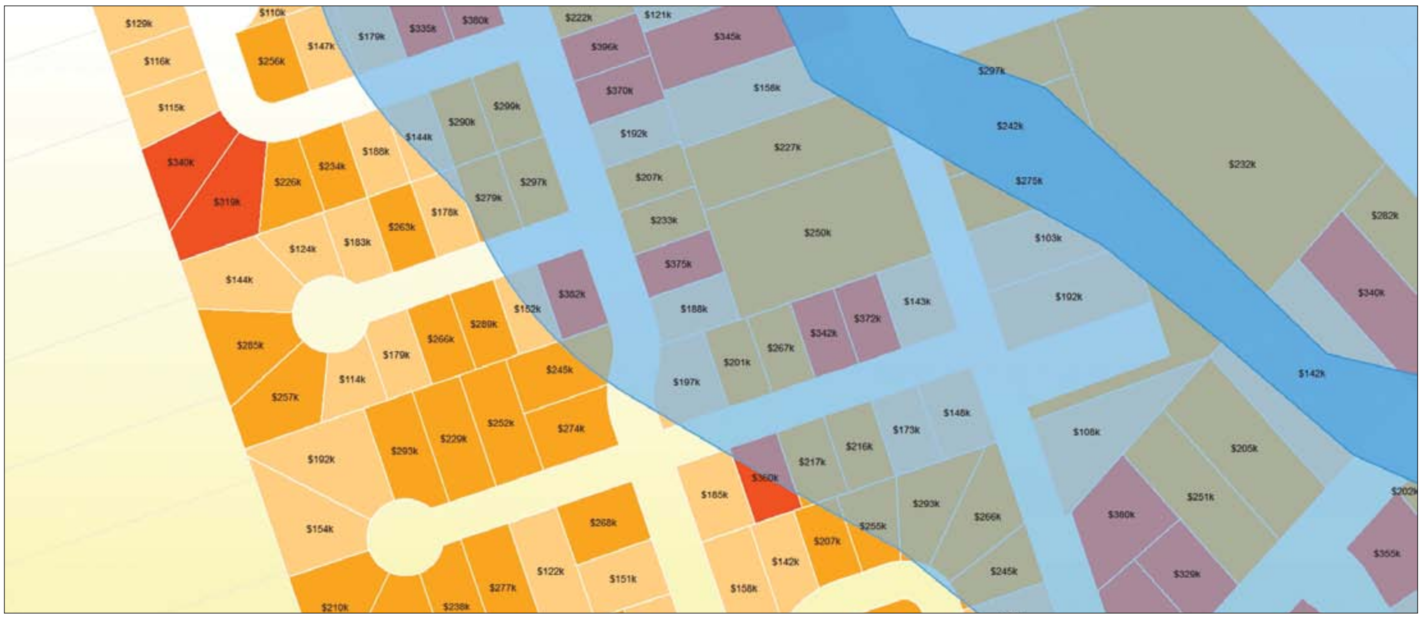
To serve the needs of organizations that focus exclusively on application development, Esri is introducing a new pricing and licensing model.

Various plans are available so developers can choose the number of credits they want based on their anticipated volume for a given month. Developers can then use their ArcGIS Online subscription to leverage features, such as geocoding and place search, directions and routing, ready-to-use basemaps, and data query in the cloud. Along with this new developer licensing of ArcGIS Online, Esri is offering a 90-day developer trial of ArcGIS Online. This trial is available from the **developers.arcgis.com** website.

Later this year, Esri will provide an easy way for developers to showcase their applications to end users. This will be a website where developers can list their applications as being available for sale. Developers will be able to log in to the site and manage their listings and monitor usage. More details about this marketplace will be coming soon.

In the second quarter of 2013, developers can also look forward to having even more tools available to them, including having GeoTrigger technology available as part of their ArcGIS Online subscription. Geotriggers enable developers to build geofences into their applications that can be triggered based on time of day, speed, or position.

To get started building great web and mobile applications that incorporate mapping and spatial analysis, visit **developers.arcgis.com**.



Developers can incorporate spatial analysis into their applications using ArcGIS APIs, along with ArcGIS Online.

ArcGIS Data Reviewer for Server Now Available

Highlights

- ArcGIS for Server extension supports data quality control workflows.
- New ArcGIS extension engages a broad audience of users and stakeholders in the quality control process.
- ArcGIS Data Reviewer increases transparency by publishing data quality metrics.

Data quality plays an important role in any organization that has adopted and is using GIS technology. When data meets agreed-on standards for quality, its positive impacts are realized in multiple ways. For executive leadership, good data quality means minimizing risk in decision making by avoiding the use of faulty or incomplete information. This, in turn, keeps the organization's reputation intact among its customers and stakeholders. For GIS managers, good data quality means decreased operational costs because the time spent fixing poor-quality data is now directed toward higher-value tasks, such as modeling and analysis. Most important, for data consumers, quality data means that they can finally realize the efficiencies and benefits of leveraging good data in their daily work.

Since its release in 1999, many organizations have implemented and managed their quality control processes with ArcGIS Data Reviewer for Desktop. This extension serves as an efficient replacement to traditional QC processes that are executed manually or through custom-built applications. With the ArcGIS 10.1 release, Esri has extended the QC capabilities to additional application platforms (web, mobile) through the new ArcGIS Data Reviewer for Server extension.

ArcGIS Data Reviewer for Server enables opportunities for expanding collaboration throughout the data quality process by providing the following:

- Web services to support the identification of data errors through automated and visual QC methods
- Ways to easily incorporate data quality feedback as an additional function to new or existing web applications
- Capabilities to track and measure data quality in new ways and across multiple reporting platforms

Below are some ways these new capabilities allow QC workflows to be deployed in a more flexible manner by leveraging multiple platforms.

Automated Quality Control

ArcGIS Data Reviewer provides the ability to implement data quality business rules as a series of configurable data validation checks. With the 10.1 release of ArcGIS for Server, organizations can validate their data via web services using those same business rules. These services offload and automate the time-consuming task of data validation to an organization's intranet or cloud-hosted server infrastructure.

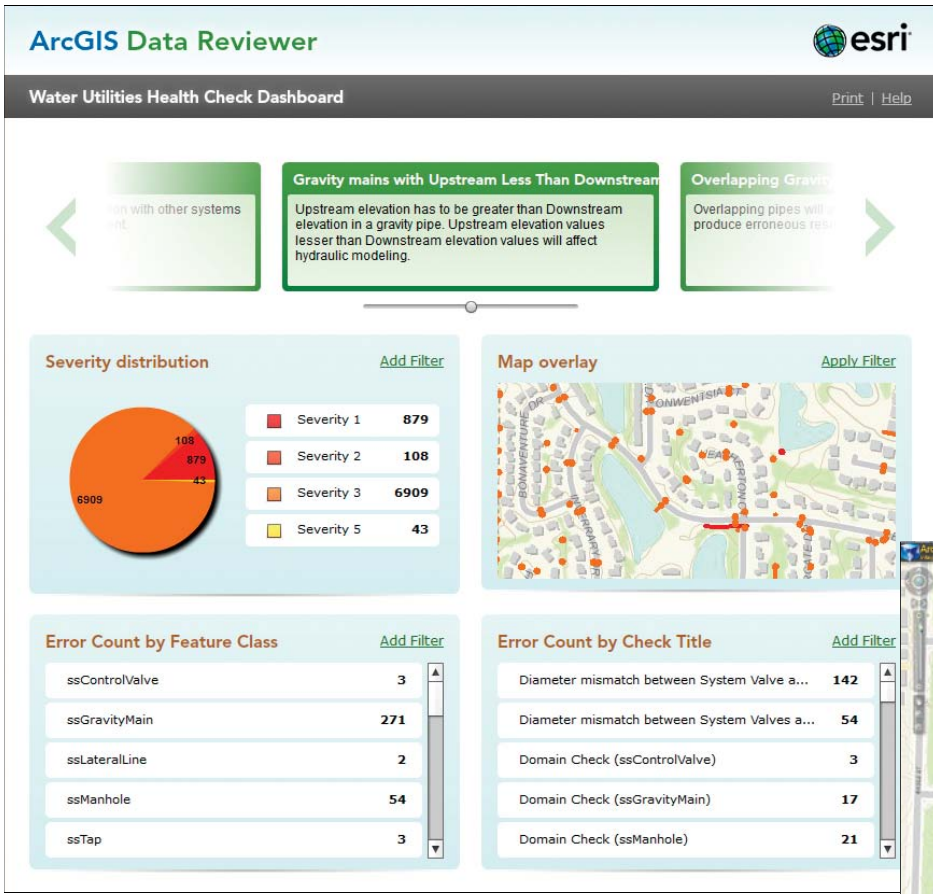
Also, the web services can be scheduled to validate data every time the organization carries out its routine data maintenance operations. Errors detected during these scheduled validations are automatically stored in a central location, which serves as a guide to what needs to be fixed. Using ArcGIS Data Reviewer for Desktop, users can easily navigate to these errors, correct them, and update the correction status to ensure no error was missed.

Error results can be summarized using the preconfigured reporting tools or visualized through a web client using ArcGIS Data Reviewer for Server reporting services so managers can gain insight into the health of the organization's data.

Visual Quality Control

Another key capability of ArcGIS Data Reviewer is the ability to collect and manage error results obtained through nonautomated processes, such as visual review. With ArcGIS Data Reviewer for Server, feedback from a broad community of subject matter experts, stakeholders, and consumers of data can be incorporated as part of the QC process. Web application developers can easily include this feedback as a function of an existing (or new) web application, without the burden of implementing the entire QC workflow from scratch.

For example, ArcGIS Viewer for Flex can leverage the Report Feature widget (available from ArcGIS Resources) to enable a simple error reporting workflow for customer-facing web mapping applications. When customers discover an error, they can easily submit a report identifying its source and location. This report gets logged as part of the ArcGIS Data Reviewer error life cycle management process, where it can be reviewed and corrected.



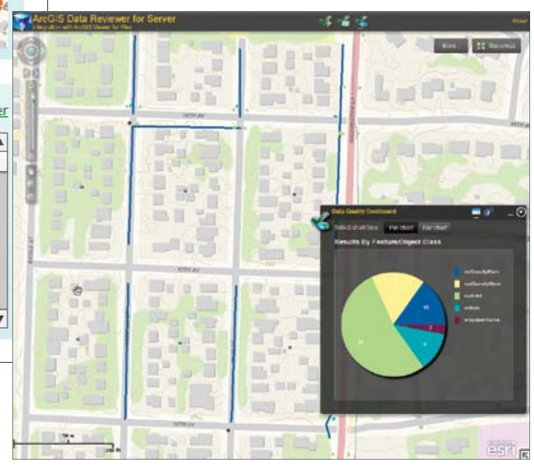
Dashboard reporting helps in communicating data quality issues detected during the Water Utilities Health Check sessions conducted during the 2012 Esri International User Conference.

Data Quality Reporting

Data quality reports help identify and communicate the extent to which data meets established standards of quality. Data producers can evaluate how well a dataset meets the criteria set forth in their production specification, while data consumers can evaluate whether a data product is suitable for its intended application. With ArcGIS Data Reviewer for Server, users can publish reports of error results detected using the automated or visual QC capabilities described above and monitor the health of data. These reporting capabilities can be integrated as a component of an organization's overall business performance management system or as a stand-alone dashboard for reporting data quality.

By communicating data quality, stakeholders can track data compliance through time and are alerted when data does not meet the agreed-on standards.

For more information, visit esri.com/datareviewer.



Data quality reporting services provide transparency to customers.

For Additional Information About Esri Products

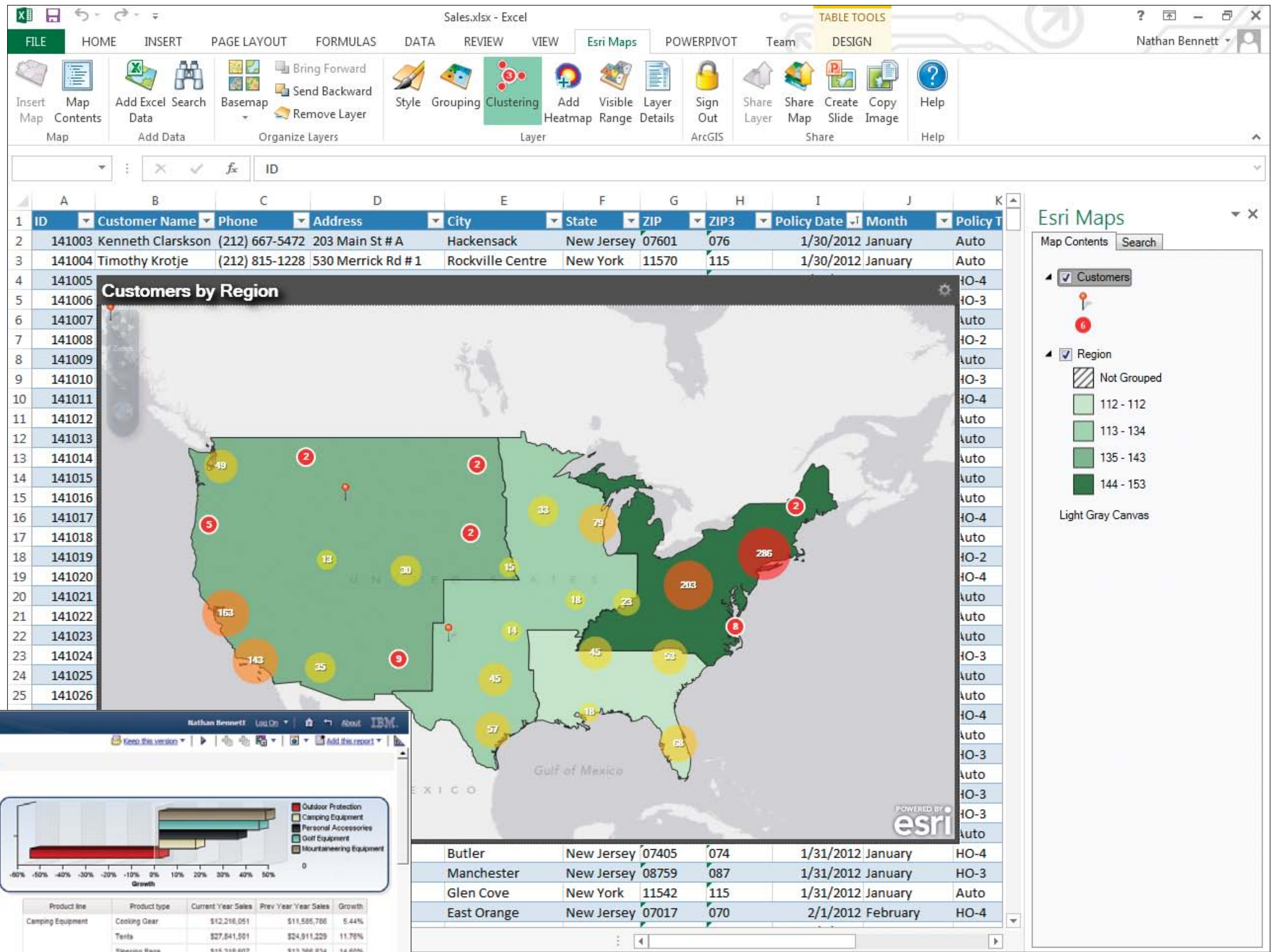
esri.com/products

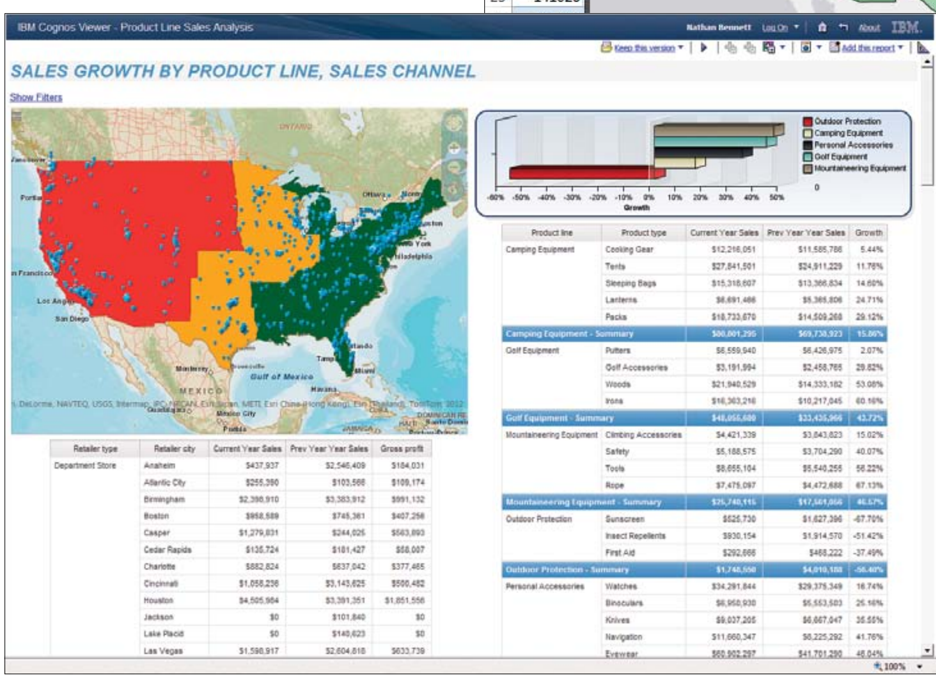
Inside the United States, please call Esri at 1-800-447-9778.

Contact your local office:
esri.com/locations

Contact your local Esri Partner:
esri.com/partners

Many Organizations Need Location Analytics





Both images: Create geographic frameworks, models, and data and share them throughout your organization.

If you're reading *ArcNews,* chances are you have some kind of GIS practice within your organization. And chances are, you believe that geography can serve as the underlying platform, or common intersection, of all business systems and information. However, how do you know if new departments, or new colleagues who are not GIS professionals, would benefit from location analytics?

You Can Share Your Tools and the Value of Your GIS

Esri Location Analytics helps you share your work and the value of ArcGIS with whole new groups throughout your organization. GIS professionals are in a unique position to help these new groups. They are already using the ArcGIS platform to create useful frameworks, data, and map layers that let non-GIS professionals, knowledge workers, and anyone in the organization start to use location and geography to drive their business.

They Can Continue to Use the Tools They Know

Esri Location Analytics seamlessly plugs into your organization's existing enterprise business systems through complementary and nondisruptive technology. Your colleagues benefit from enhanced insight into business data without leaving the business system or information workflow they are used to.

With location analytics, your users can see and analyze location-enabled data in new ways—obtaining new information; adding new context for exploring business information; uncovering patterns and trends; and enabling decision making with additional, critical information, resulting in actionable intelligence.

Where Can Location Analytics Help Within Your Organization?

Look for these indicators:

- ***Desire to see the big picture***—If your colleagues talk about a lack of getting the whole picture from the applications they use every day, something is missing . . . geography. Location analytics helps see patterns in data that charts and graphs can't reveal.
- ***Desire to fully understand customers/constituents and market/jurisdiction***—The feeling of not truly knowing customers or the market keeps your coworkers up at night. Location analytics can bring a wealth of demographic, lifestyle, and business data to your own data. Seeing it on a map brings it into context.

Add the Location Component to Data That Has Yet to Be Leveraged

Location analytics adds a completely new way for users to query their data by using a map to drive the analysis. For example, an insurance adjuster, within a business intelligence dashboard, can ask for the value of all insurance policies that lie in the expected path of a hurricane.

For more information, visit **esri.com/locationanalyst**.

Blending Business Intelligence with Mapping and GIS

ArcGIS Platform Now Supports "MicroStrategy"

For decades, Esri has been bringing ArcGIS to users, departments, and systems within organizations. Business intelligence (BI) is ripe for a geographic perspective, and Esri is releasing its latest offering for the BI space—Esri Maps for MicroStrategy.

This nondisruptive solution plugs into the MicroStrategy dashboard design and viewing workflows, enabling users to analyze BI data in a geographic context.

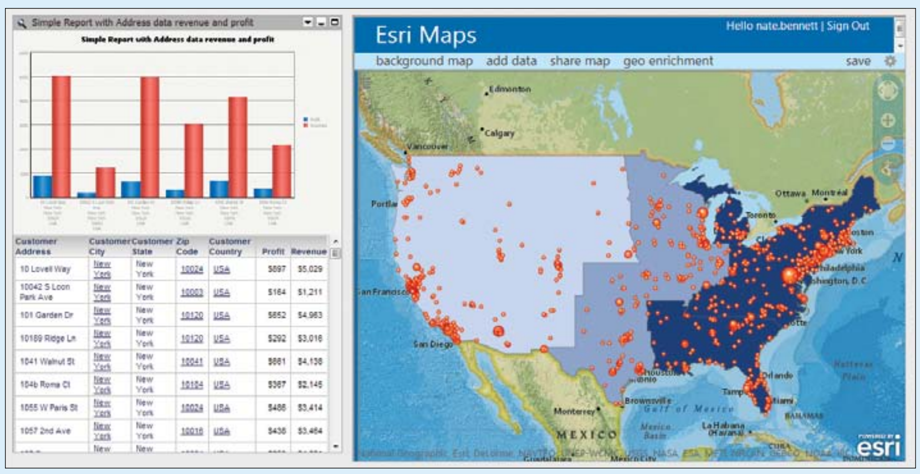
Business analysts will be able to create, integrate, customize, and distribute interactive Esri maps within reports and dashboards.

The Power of Location Analytics

Every BI application has a spatial context. By linking business results with maps, BI users have a new perspective to identify patterns and correlations based on geography. With Esri Maps for MicroStrategy, users can bridge the gap between business metrics and location.

Designed for MicroStrategy

Esri Maps for MicroStrategy is designed for the MicroStrategy user and does not require previous GIS experience. This zero-coding solution lets users employ simple mouse gestures to build and explore map-enabled reports and dashboards.



MicroStrategy users now have access to the ArcGIS platform with Esri Maps for MicroStrategy.

Built for the Enterprise

Esri Maps for MicroStrategy integrates ArcGIS with the MicroStrategy architecture, leveraging in-place security, deployment capabilities, and scalability. The result is a truly enterprise location analytics solution.

To learn more about Esri Maps for MicroStrategy, visit **esri.com/mstrmaps**.

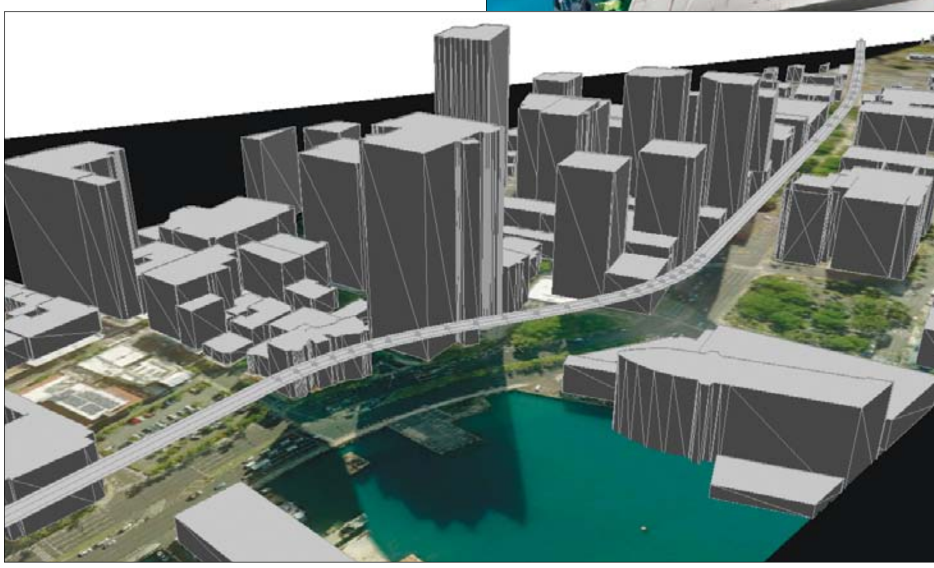
3D Modeling Shows Off Elevated Rail System Landscape

Honolulu Uses Geodesign to Build Case for Rail Corridor

Highlights

- Three core models were needed for the rail corridor geodesign process—walkability, urban growth, and densification.
- Esri CityEngine was used to improve the model by creating 3D geometry and applying textures.
- Through imaging and 3D software, holograms provided unique views for stakeholders and the public.

The City of Honolulu, shown here in CityEngine, shows the elevation levels of the downtown corridor, as well as the proposed transit-oriented development, giving citizens and planners a dynamic view of potential changes to the city.



Preparing this model for hologram printing and display is as simple as adding textures, saving the project, and loading the model into ArcGIS for use with the Zebra Imaging plug-in.

Being on island time conveys the aura that everything is as peaceful and slow traveling as an islander in paradise. In Honolulu, the islanders can boast they do travel slowly through their paradise, but maybe not so peacefully on their roadways, since Honolulu has claimed the top spot as the worst US city for traffic. Compounding the problem, citizens have moved to suburban areas in search of affordable housing, creating urban sprawl, which increases traffic demand when traveling to urban centers for work.

For Honolulu, the effects of urban sprawl go beyond increased traffic demand and have negative impacts, such as environmental pollution, natural habitat reduction, loss of agricultural land, and even decline in human health and well-being. In an effort to help alleviate some of the traffic pressure on its roadways, the City and County of Honolulu have approved and begun construction of an elevated rail system connecting East Kapolei to Ala Moana Center. Not only will the new railway change the way citizens and tourists will travel through Honolulu, but the planning and development surrounding the rail corridor will be redefined through what is known as transit-oriented development (TOD).

Planners look to TOD as a common solution to accommodate future population growth, control urban sprawl, and decrease traffic demands on communities through the use of dense, mixed-use housing placed near transit. This creates mass-transit and walkable access to retail and amenities. This paradigm shift to TOD planned communities with medium- to high-rise development and a new feature in the landscape, the elevated rail system, can and has been met with opposition by some community members. Part of the planners' role is to persuade the citizens of the benefits of TOD for their community through a collaborative planning process where they share information and ideas about the development. The planners must tell the story of the future of the community from both sides of the coin. To do so, planners and consultants are using more sophisticated visualization tools, which can be very effective at shifting the attitudes about new and different development in this island paradise.

To tell the story of TOD, the City and County of Honolulu turned to GIS as a primary tool within the process. The city GIS department embraced and applied the concept of geodesign—that is, incorporating geographic knowledge into design—to more effectively analyze, compare, and visualize different scenarios of TOD for the key communities affected by the new development. To build the case for TOD, the GIS team needed to support the planners' goals to share with the public who would have safe access to rail; how changes to the zoning would visually redefine their community; and how the TOD would positively affect the community and region, preventing future urban sprawl.

The team identified three core models that would be needed for the TOD geodesign process: walkability, urban growth, and densification models. As with any new GIS project undertaking, the GIS department first determined data resources needed to support the analysis and whether these datasets were available or needed to be developed. Most of the core data, such as roads, zoning, and buildings, was available in the rich geodatabase that Honolulu has been developing for years. Since visualization is a key component of geodesign and a powerful tool for persuasive planning support, a 3D model of the physical environment would be needed for the transit corridor. Honolulu had a good start to the city model with 3D geometries for the downtown area, including key landmark buildings with textures.

However, the model was not complete and needed to be enhanced in areas, since more than 3,000 buildings were without textures and some were mere footprints. The team used Esri CityEngine to improve the model by creating 3D geometry and applying textures based on a custom set of rules. Honolulu wanted to simulate the true look and feel of the city and accomplished this by collecting photos of real facades that were used to create a custom set of textures. These textures were applied based on the rules, instantly painting the remaining buildings. Rules were further applied to create 3D geometries by converting simple building footprints into complex structures with textures. The last component was the addition of the proposed evaluated rail, which was added from the existing engineering drawings, completing the 3D urban model of Honolulu.

The next step in the geodesign process was to analyze the effectiveness of a TOD and create alternative scenarios used by the planners to convey the benefits of TOD for a given community and the region. Utilizing the ArcGIS 3D Analyst and ArcGIS Spatial Analyst extensions and ModelBuilder, the GIS team developed reusable walkability, urban growth, and densification models in which data was run against changing variables to create different scenarios. A key factor of TOD is to provide the acceptable and safe walking or biking distance to a transit stop. The walkability model used Spatial Analyst geoprocessing tools to determine the travel distance from residences or work to a transit station.

From this analysis, stakeholders or citizens could determine the viability of transit for their use. Since the acceptance of TOD in a community must be more convincing than just ridership, the planners must convince members of the public that TOD will benefit Honolulu's future whether they utilize the rail or not. The GIS team supported the planners by creating scenarios based on the projected future with TOD and without. The TOD plans for each station were run against the urban growth and densification models using Spatial Analyst and 3D Analyst to perform the analysis.

Using CityEngine, the rules for creating 3D geometries and texture were applied to the resultant analysis, and new models were generated representing proposed build-out of the future with TOD. The 3D model showed urban growth concentration around stations with low- to medium-density buildings and ample undeveloped land. The same models were run against the existing zoning with no TOD, resulting in a sea of houses, showing a stark comparison of Honolulu's landscape in the future as urban sprawl. An incentive of geodesign for planners is to equip them with analytic outcomes that could be used to persuade the stakeholders and public that TOD will have a positive impact on the community. Honolulu approached the community engagement with unique visualization technologies, which included 3D holograms and simple web views of TOD scenarios. The GIS team worked with Zebra Imaging, a leading 3D visualization company and Esri Partner (Austin, Texas), to create visually captivating, true 3D views of the analysis in 3D holographic images.

Through Zebra Imaging software, ArcGIS 3D Analyst, and Esri CityEngine, the holograms were sourced directly from the exports of 3D GIS data models representing TOD and rendered to capture thousands of unique 3D views. The 3D views of the GIS were used to create a holographic grating that is recorded on film with lasers. When illuminated with an appropriate light source, what looks to be a flat piece of plastic reveals a 3D, full-parallax, color image reflected above the film's surface.

For more information, contact Ken Schmidt, GIS manager (kschmidt@honolulu.gov).

Subsurface Utility Data Modeled in 3D

Underground Visualization of Utilities at Green Square Complex in Raleigh, North Carolina

Highlights

- ArcGIS was used to create the underground 3D environment.
- Once utility pipe horizontal and vertical elevation values were determined, the Green Square Complex 3D Utility Inventory was rendered.
- With advanced utility mapping using GIS and 3D GIS modeling, facility managers developed a utility inventory atlas.

The Green Square Complex in Raleigh, North Carolina.

The Green Square Complex—located in the heart of Raleigh, North Carolina's capital city—is a two-block, multiuse sustainable development project that is now home to North Carolina's state environmental offices and the new Nature Research Center. The complex includes two beautifully designed "green" buildings that integrate the gold standard of sustainable design strategies, costing less to operate and maintain by incorporating energy- and water-efficiency techniques. The Green Square Complex was built in conjunction with the Department of the Environment and Natural Resources (DENR) and the North Carolina Museum of Natural Sciences to enable those organizations to lead by example in promoting stewardship and the Leadership in Energy and Environmental Design (LEED) Gold Standard.

The new DENR office is a five-story building and connects via a one-level bridge over McDowell Street to the remaining DENR offices in the adjacent block. The second building in the Green Square Complex is the Nature Research Center, which will connect to the existing North Carolina Museum of Natural Sciences on the opposite side of the complex via a two-story bridge over Salisbury Street. The research center was built for scientists to conduct their research while visitors from the neighboring museum observe science in action. Its most unique design feature is a 50-foot globe of the earth called The Daily Planet.

Project Evolution

In spring 2008, planning for the construction of the new buildings and a parking garage on the Green Square Complex began. The civil and structural engineers needed critical depth information regarding the location of the existing above- and belowground utility infrastructure in the roadway around the block. Following a review of engineering firms, the project engineers contracted with Esri Partner McKim & Creed's Subsurface Utility Engineering (SUE) team (Raleigh, North Carolina) to provide the detailed underground utility mapping. By using SUE-quality level A locating services (the highest level of accuracy), which uses nondestructive pneumatic vacuum excavation to expose subsurface utilities, data regarding the precise vertical and horizontal pipe diameter and type of utility was collected for accurate planning for the construction of the project. While the standard delivery method for this sort of information is typically a CAD or MicroStation drawing file, with so much exact data and information collected, the team created a GIS geodatabase to house the information.

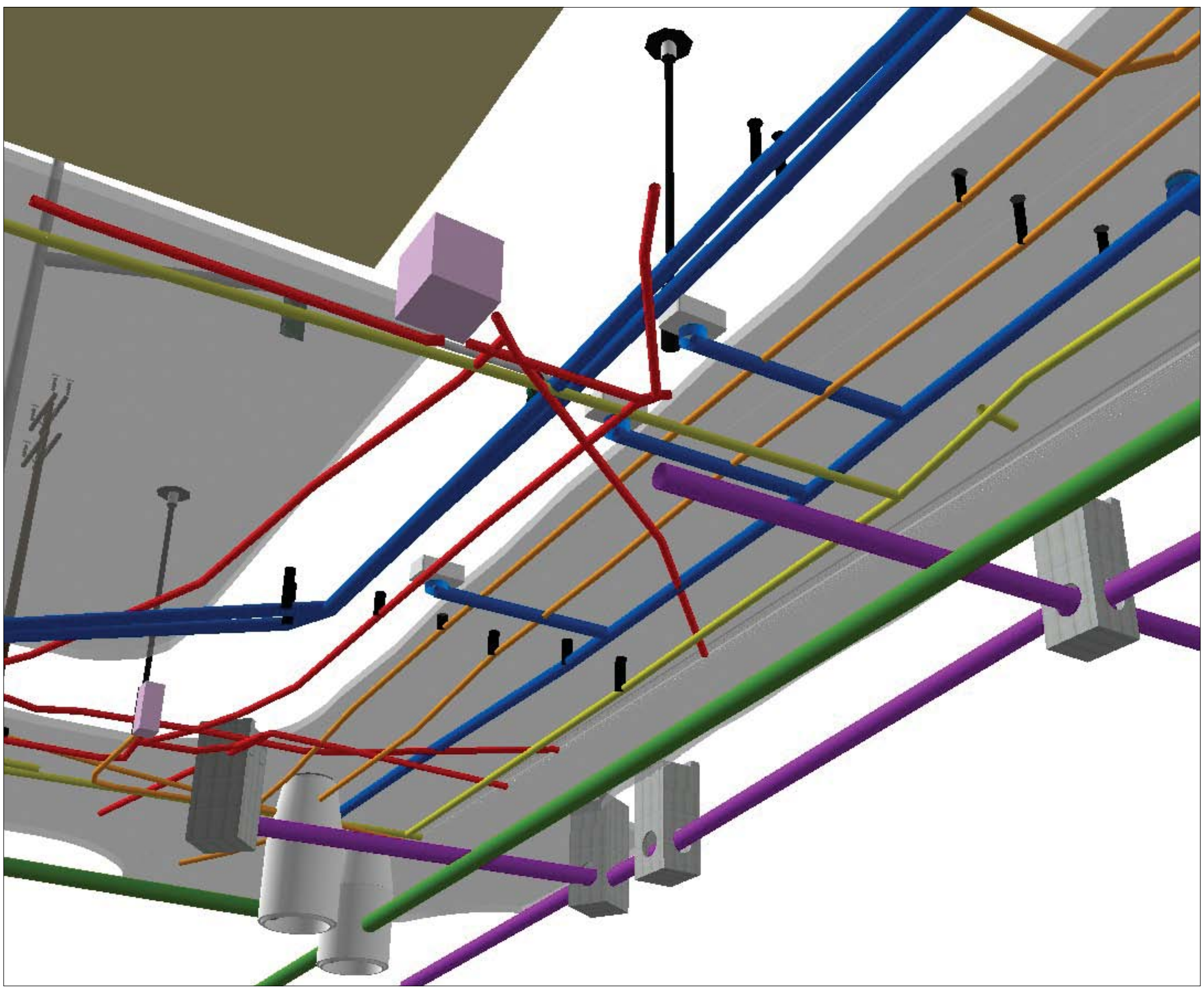
Advanced Utility Mapping

To protect the foundation of the existing Old Education Building (built in 1938) located on the Green Square Complex block required the stabilization of the soil in a pit dug around the perimeter where the two new buildings needed to be constructed. A technique called *soil nailing* or *pinning* was employed to shore the soil slope and prevent landslides by inserting steel reinforcement bars into the soil and anchoring them to the soil strata in a pit roughly 40–50 feet deep. The construction process starts by drilling holes for the steel bar and grouting the nails into the soil to create a composite mass. Precise SUE data was used for determining the drilling location so the nails would not be bored into the utilities. Since the SUE team collected 139 test hole locations (pneumatic vacuum excavated) on the utilities, a true-to-life, three-dimensional model was created of the under- and aboveground features around the Green Square Complex to assist in determining the nail locations.

Using ArcGIS (ArcScene with the 3D Analyst extension) to create the 3D environment, a triangular irregular network was generated from the survey contours to establish the ground surface elevation. The building corners were surveyed and the footprints extruded as a multipatch feature class. An existing 3D building model (downloaded from the Trimble 3D Warehouse) on the Green Square Complex block was imported to replace one of the existing buildings. The utility pipe geometry was given the correct elevation values based on the test hole data. Once all the data was spatially correct horizontally and vertically, the Green Square Complex 3D Utility Inventory was ready for rendering. Many of the point features are imported from the file model components, such as the sanitary sewer manhole covers, the concrete underground storm water drains, and the power and telephone utility poles. The pipes are 3D simple line tube symbols color coded per specific utility system (blue for water, red for electric, green for sewer, orange for telephone/fiber optics, yellow for gas, and purple for storm water).

When the existing pipes were removed and/or new ones added during the Green Square Complex construction phase, the information was captured for easy updates to the utility inventory atlas that the city maintains, thereby taking the SUE data to a higher level.

For more information, contact Julie Willett, GISP, McKim & Creed (tel.: 919-233-8031, e-mail: jwillett@mckimcreed.com), or W. Sean Patterson, SUE, McKim & Creed (tel.: 919-233-8031, e-mail: spatterson@mckimcreed.com).



Underground utilities beneath McDowell Street in downtown Raleigh, North Carolina.

The City of Québec Models a Bright Future with 3D GIS

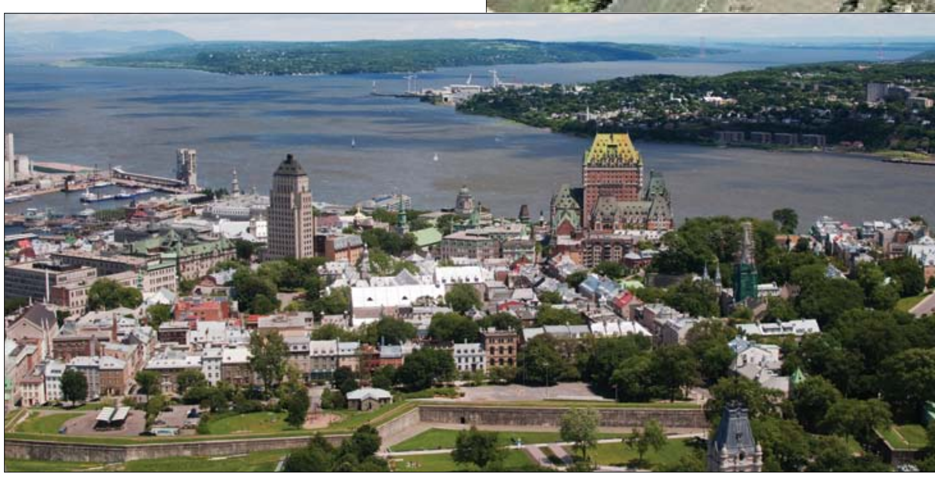
Highlights

- Using ArcGIS 3D Analyst, 3D elements from internal and external sources were integrated for a proposed tramway project.
- Visualization in 3D during public consultations informed neighborhood residents of impacts.
- Being able to rotate 3D models helps to gain buy-in from stakeholders.

Modeling in 3D provides the city with an indispensable communication tool because it allows anyone to realistically view the impact of proposed construction.

The City of Québec is the second largest municipal in the province of Québec, Canada, and continues to grow; its population jumped a remarkable 5.2 percent between 2006 and 2011. The city is also unusually dense, with a population density of 1,137.7 people per square kilometer as compared to an average of 5.8 for the province as a whole.

Accordingly, city planners are tasked with a complex balancing act that involves developing infrastructure to support continued growth, protecting historical architecture, and promoting a healthy environment. In response, the City of Québec leveraged 3D technology to develop a complete and accurate view of its urban ecosystem. The city uses 3D tools to model risk, assess the impact of proposed new construction, and intelligently plan and design infrastructure that benefits both residents and the surrounding environment.



The City of Québec.

Planning a City in 3D

In 1994, the City of Québec created the basis of a 3D city model using 2D footprints and photogrammetry. Fifteen years later, the city recognized a need for something more. Steeve Guillemette, the city's information systems manager, explains, "Only the GIS technician could access and manipulate our data models. This made it difficult for city planners, architects, and other stakeholders to retrieve and use the data they needed to complete their work."

To extend access to vital information, in 2010 the city consolidated all its data into a central ArcGIS for Server geodatabase. It leveraged ArcGIS 3D Analyst so that it could analyze 3D models in multiple ways. Through ArcGIS Explorer, the models were then made available to urban planners, environmental engineers, and building management staff online.

These models are frequently consulted to measure the impact of proposed construction on existing city assets. For example, shadow analysis enables city planners to measure the impact of proposed buildings on public swimming pools. If it is determined that a new building will cast a shadow that may negatively impact a public pool, the proposed development is relocated. To ensure safety, 3D models of proposed city buildings are also combined with a digital elevation model to measure the impact of new construction on flood risk, particularly within the city's flood-prone areas.

Line-of-sight analysis is another key advantage of 3D modeling and is leveraged to ensure that proposed new developments will not impede the view of the famous Saint Lawrence River.

Says Guillemette, "3D models provide a perspective that is simply not possible with 2D. You can assess the visual impact of a proposed building from any angle, whether from the street, your house, or the waterfront."

Similarly, 3D models are used to maintain visual harmony between new construction and heritage properties. For example, throughout certain areas of the city, buildings can only be a few stories high, and all buildings within the city are subject to energy efficiency standards. When a building is found to contravene regulations, measures are taken to bolster compliance while preserving the building's unique character.

Gaining Buy-in Through Effective Communication

Modeling in 3D provides the city with an indispensable communication tool because it allows almost anyone to realistically view the impact of proposed construction from multiple angles and viewpoints. A history of 3D buildings can also be referenced to demonstrate powerful before-and-after scenarios.

ArcGIS 3D modeling has proved especially useful for the city's highly publicized $1.5 billion tramway project. The proposed tramway, currently in its preliminary stage, would connect the suburbs to the downtown core, hospitals, and shopping centers, serving as a hub for the city's public transportation. It would also encourage residential development in the city's core. Using ArcGIS 3D Analyst, the city was able to integrate 3D elements from internal sources, as well as external suppliers, for the entire 27-kilometer network. As a result, system benefits could be clearly demonstrated to both potential investors and the public.

A 3D model was also developed to inform the construction of a new recreational arena. Through 3D visualization, building managers were able to develop a comprehensive plan outlining a two-phase approach to construction: the first would focus on the development of an ice rink, and the second would center on building a new soccer field. During public consultations, 3D visualization was used to inform nearby residents of the arena's impact on surrounding neighborhoods.

"Unlike a picture, 3D models can be rotated to show impact from any perspective," says Guillemette. "This helps to gain buy-in from a diverse range of stakeholders, including city council; potential investors; and most importantly, our residents."

Building Communities of the Future

An exciting initiative currently unfolding in Québec is the introduction of Green Neighborhoods. A Green Neighborhood is designed according to sustainable development principles to reduce its overall ecological footprint. It attempts to connect urban sustainability principles with microlevel community planning for the betterment of residents and the environment. The concept has already proved successful in Montréal and several US cities, where this approach to urban design has been shown to reduce greenhouse gas emissions by 20–40 percent.

Green Neighborhoods are characterized by a number of features that can include sustainable, energy-saving infrastructure developed using ecological materials; vast green spaces and waterways; the installation of green roofs; minimal distance between homes, shops, and office space; and ecological modes of transportation.

ArcGIS 3D Analyst is used to map attributes onto buildings to analyze the impact and efficacy of green initiatives. The city can also determine the overall impact of Green Neighborhoods not only on surrounding communities but also on the city at large.

"We used to have visibility only into how a proposed project would affect the area directly surrounding it, whereas now, we can view the citywide impact of our initiatives," says Guillemette. "GIS affords the ability to assess relationships between buildings and the wider landscape, which is critical to the success of all our projects."

In the near future, the city plans to extend 3D modeling to its underground infrastructure. It will also model its water plant, sewers, and hydrants to optimize the sustainability of water/wastewater management throughout the municipality.

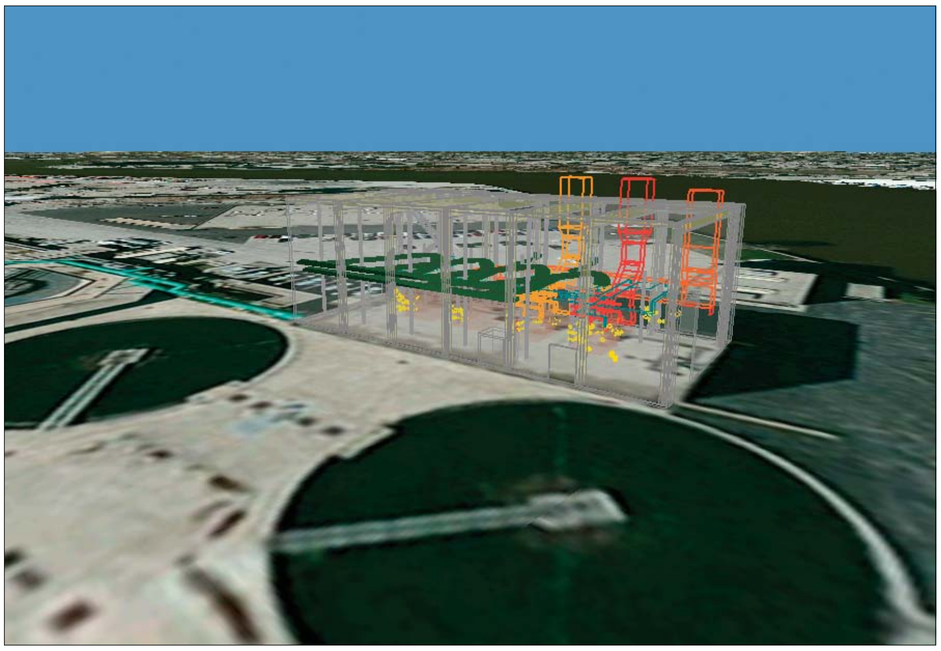
For more information, contact Steeve Guillemette, information systems manager, City of Québec (e-mail: steeve.guillemette@ville.quebec.qc.ca).

Lidar, Building Information Modeling, and GIS Converge

Bringing Business Efficiencies to Milwaukee Metropolitan Sewerage District

Highlights

- Integrating lidar and BIM data with enterprise GIS helped provide 3D design and construction methods.
- Viewing an intelligent 3D model provides insights that result in valuable questions and proposals.
- Extending BIM and lidar into the ArcGIS environment benefits from the integration points between the technologies.



Interactive viewing of the 3D geodatabase in the ArcGIS Engine application, including dynamic symbolization of features.

Milwaukee, Wisconsin, is the 26th largest city in the United States; its regional wastewater system is among the largest, most sophisticated, and well run in the country. The Milwaukee Metropolitan Sewerage District (MMSD) provides wastewater services for 28 municipalities comprising about one million people. The district's 411-square-mile planning area includes all cities and villages except the City of South Milwaukee. Serving these municipalities requires MMSD to develop spatial inventories and applications that meet internal and external needs for planning and design. Like any large facility, many of these efforts began organically within single departments to answer a specific need for one project.

To ease the consolidation of facilities data information, MMSD called on HNTB of Kansas City, Missouri, a national infrastructure firm and Esri Silver Partner, to conduct a practical research project that pilots a data management approach for lidar and building information modeling (BIM) data. The project specifically studied the practical business applications integrating 3D design and construction data from an aeration system rehabilitation project into MMSD's enterprise GIS environment.

Put the Money Where the Return on Investment Is

As part of this research and development project, return-on-investment estimates were generated for distinct use cases, focusing on integrating lidar and BIM technology with GIS to greatly improve access and retrieval of as-built conditions for MMSD employees and their consultants. A number of different application development platforms and existing software solutions were considered for the project. Each software package was evaluated based on criteria defined by MMSD. ArcGIS Engine was selected as the platform that met all these requirements. ArcGIS Engine is a collection of GIS components and developer resources that can be embedded into other applications, allowing dynamic mapping and GIS capabilities in many different environments.

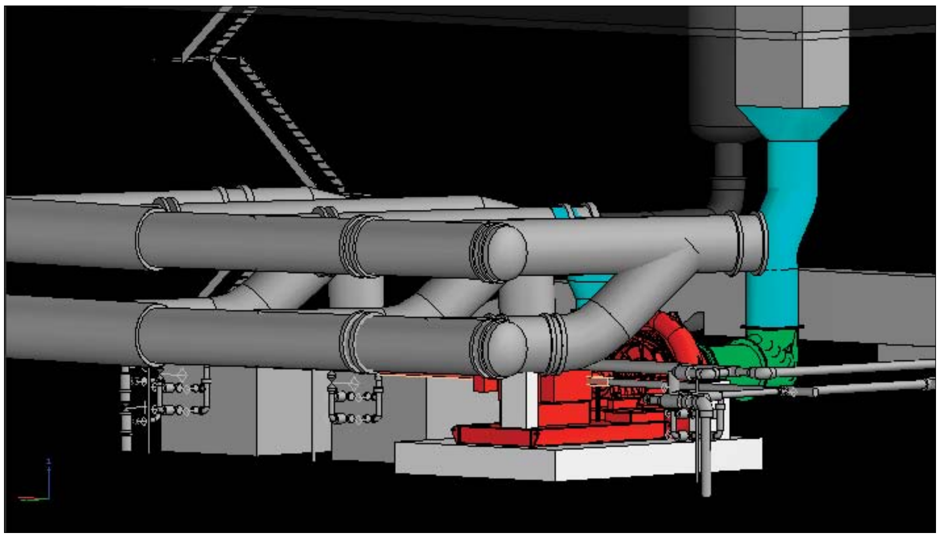
An Expandable Enterprise System

MMSD was already a user of Esri technology, having adopted ArcGIS for Desktop software in 2003 for department-specific solutions. In 2009, MMSD consulted with HNTB to help facilitate the move into an enterprise environment using ArcGIS for Server. This was a multiphase implementation that included the development of a business data model. The data model focused on existing data inventory and application user needs at the time, including improving mapping and organizational efficiencies, as well as bringing added value to MMSD business operations. In 2011, MMSD completed the project, developing several applications that addressed specific areas to map related data to the district's infrastructure resources and to service areas.

"Historically, information regarding water quality, water quality improvements, and physical features of water were located in separate departments at MMSD," says Jeff Siegel, GISP, associate vice president and technology solutions center director, HNTB. "Consolidation of this information took time, money, and executive sponsorship to change priorities. Now, all staff can access and output this information from their desktops without the help or sponsorship of other staff. The staff has the information it needs to make better and faster decisions, which was another of our guiding objectives."

For this pilot project, among the many criteria MMSD had, data and document access was again selected as a high priority. "In this scenario, a 3D model was created and integrated into GIS," says Siegel.

Again, the objective was for users to view and select features on their own. In this case, the 3D model would be displayed within an environment they are familiar with—the ArcGIS environment. Using this model, staff can access related data in external databases, including documents relevant to the 3D model feature the user selected.



The application employs dynamic linkages from the geodatabase to the building information model (BIM) for viewing greater 3D design detail.

Modern Technology Studies a Historic Facility

The study area included Jones Island Water Reclamation Facility, one of two wastewater treatment facilities within the district's service area. Jones Island is located on the shores of Lake Michigan in Milwaukee. On average, the Jones Island facility collects and treats a maximum daily flow of 300 million gallons of wastewater, returning clean, clear water to Lake Michigan.

As part of the Milwaukee Metropolitan Sewerage District 2020 Facilities Plan, HNTB was tasked with developing design improvements for the Jones Island Water Reclamation Facility aeration system. The project will lead to a reduction of electrical energy usage through gains in aeration system blower and diffuser efficiencies, as well as enhancements to controlling air distribution to aeration basins and channels.

To gather accurate and precise as-built conditions of the aeration system, HNTB engineers decided to collect internal facility data to derive a BIM from static lidar point clouds. This approach quickly brought dependable and accurate existing conditions information to the designers in an interactive 3D design environment.

"Because static lidar scanning is a direct line-of-sight method of data collection, the entire interior of a facility required enough scans for every single feature to be captured," says Siegel. "The estimated number of scans required increases based on the number of floors and the complexity of the building."

A typical static lidar scan takes about 10 to 15 minutes. So a crew of two has the ability to scan anywhere from four to six locations—typically a room or hallway—in just one hour. For this project, more than 100 scans were collected in one day to gather point clouds of the entire facility.

The decision to use BIM to manage the design process allowed many different disciplines to collaborate at different phases of the facility design project. BIM is defined as a process using a combination of technologies and resources to capture, manage, analyze, and display a digital representation of physical and functional characteristics of a facility.

Realistic 3D Models for Everyday Use

Integrating lidar and BIM data with MMSD's enterprise GIS was thought to offer many benefits to the agency. "In our opinion, this was the most well-organized way to package up and deliver all our 3D design and construction methods to our client," says Siegel.

By extending BIM and lidar into the ArcGIS environment, the district can benefit from the data and integration points between the technologies, realizing significant operational efficiencies. Asset and facilities management is one area where improvements to maintenance management and document management systems can happen. The ability to manage data and keep a record of work orders and maintenance activity is invaluable to managers.

Another area where the district is expected to realize efficiencies is in plant and facilities operations. "There are a number of ways a 3D, geographically based representation of the facilities will help our customer," says Siegel. "From safety and training to creating documentation and just having an operational database, GIS makes it easy to manage and use the collected information and model the facility dynamically in so many ways."

Facility planning is another area where this approach can offer some real payback. From modeling proposed upgrades to capital improvements, the ease of sharing this information in an easily understandable format is a big win. "Since this is a historical landmark for the area, there are many complexities in maintaining the 3D model to the data management standards that MMSD expects," says Siegel. "Viewing a 3D model that is intelligent—meaning we can see more information about the facility picture we are displaying—makes it so much more efficient to answer questions, propose new scenarios, and move the projects along at a quicker pace."

Lessons Learned

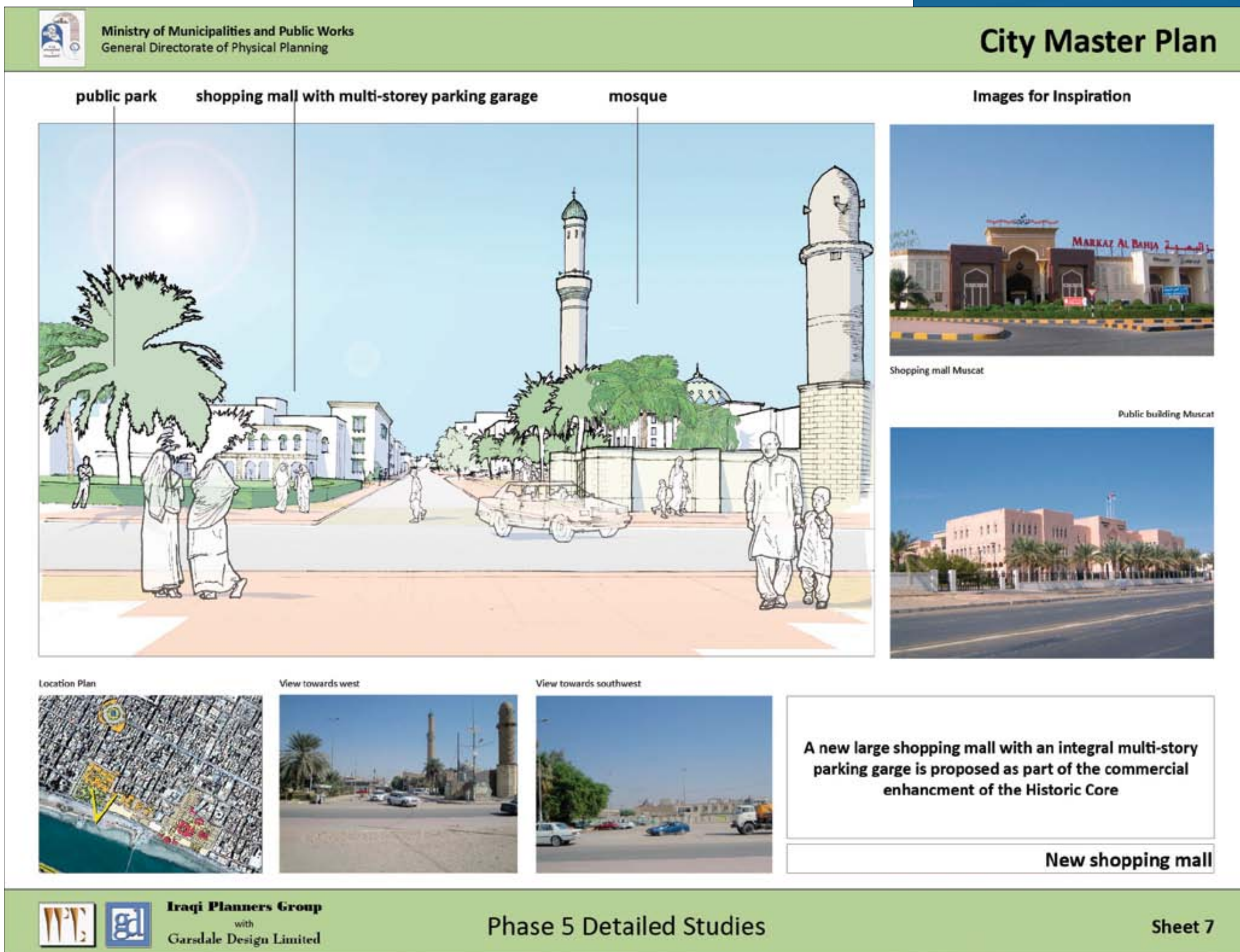
The most critical factor preventing more robust integration between BIM and GIS is the native incompatibility of the two data formats. A critical data integration fracture between BIM and GIS is the importance of defining spatial coordinates of the BIM file at the beginning of the project. "The purpose of this is to allow us and our client to accurately locate a building within a site and to give it a physical location context at larger scales that can be overlaid with aerial imagery and topographic and other layers from an enterprise geodatabase," says Siegel.

For more information, contact Don Nehmer, Capital Program business manager, MMSD (e-mail: dnehmer@mmsd.com), or Jeff Siegel, associate vice president and technology solutions center director, HNTB Companies (e-mail: jsiegel@hntb.com). For information on using GIS for facilities, visit **esri.com/facilities**.

CityEngine Creates New Solutions for Historic Cities

Highlights

- Employing Python scripting allowed staff to go back and forth between conventional mapping and 3D modeling.
- CityEngine goes beyond standard visualization into actual creation of data based on specific urban planning standards.
- Using CityEngine, 3D models from previous jobs were imported and their preexisting 3D assets and rule files put to use.



This Nasiriyah display sheet for detailed study presents a proposal for a large shopping mall.

Iraq has had a rough ride in recent times, and many of its cities are showing the scars of years of neglect and warfare. A lack of investment in basic infrastructure, combined with a brain drain of professionals, has left many Iraqi cities in a very poor state of repair and with limited plans for the future. But with the fall of the previous regime have come opportunities to revive and repair these aging and often historic cities.

In 2007, the Iraqi Ministry of Municipalities and Public Works (MMPW) awarded a British firm, Garsdale Design Limited (GDL), and its Iraqi Planners Group (IPG) the contract to develop a master plan for the city of Nasiriyah in southern Iraq. The project was to deliver urban planning for the new dwellings, infrastructure, sewerage, water, and electric systems needed over the next 30 years. Nasiriyah is the capital of Dhi Qar province in Iraq. Almost 500,000 people call this city their home, located 225 miles southeast of Baghdad on the Euphrates River and close to the ancient city of Ur.

Garsdale Design is a planning, architecture, and heritage consultancy based in Cumbria in the United Kingdom. It has extensive experience in the Middle East, and many of its projects have entailed urban design and city master planning in the Gulf Arab states.

"Master planning any city is a complex task," says Elliot Hartley, director of Garsdale Design, "but Iraq's cities face huge additional challenges from lack of investment in infrastructure to training of planning departments." Hartley manages and analyzes the spatial data that is required for planning projects like the Nasiriyah City Master Plan.

Magical Modeling

The staff at GDL focused on planning a contemporary community in Nasiriyah with an integrated public transport network that still reflects the culture and history of the almost 150-year-old city. The goal is to help the city grow sustainably over the next 30 years.

Over time, GDL had experience with various time-consuming spatial packages that did not meet its needs. Pursuing a better solution, GDL and IPG concluded that ArcGIS with Esri CityEngine met and exceeded the needs of MMPW. On production of some of the 3D modeling, GDL staff found that they were able to remodel iteratively in response to new data or late requests. This created results that Hartley describes as "almost magical."

"When presented with this reality, we thought, what if the project team could change detailed plans with ease, taking into account new data instantly and avoiding the laborious redrawing of layouts?" says Hartley. "This is the

The stages of any workflow are important, but it is the visualization of the small details that can have dramatic impact, such as the placement of palm trees.

promise of the 'instant city' and what we can achieve with GIS."

Creating a Responsive Model

The GDL team quickly realized that CityEngine could be part of the master planning process and not just a visualization tool.

"Unfortunately, we can't just jump into a new workflow in the middle of a project. This could have unacceptable impacts for us and our clients," says Hartley. However, the company quickly learned that using CityEngine on elements of master planning projects helped to visualize where the pieces best fit.

The first task performed with the 3D modeling software was building a new neighborhood with basic block models. Data from previous phases of the project was used to visualize elements of the master plan quickly in realistic 3D visualizations in just a matter of hours.

"This would have taken many hours, if not days, to produce in-house using other 3D modeling packages," says Hartley.

Mining Its Stock of 3D Models

Over the years, GDL has built up a stock of 3D models used for previous jobs that provide inspiration for current work. Using CityEngine, these models were imported and their preexisting 3D assets and rule files put to use, with a few quick adaptations. For example, staff employed a rule file that tests the size of a plot and places an appropriately sized building model accordingly. A specific set of vegetation models that included native trees was also used, with one tweak—existing tree rules were replaced with a new definition. Streets were then modeled with these trees—palm trees—and the trees were randomly inserted on lots to give a more natural look to the model.

Employing Python scripting allowed staff members to go back and forth between the ArcGIS environment for conventional mapping and CityEngine for 3D modeling. For example, a street centerline was created in ArcGIS and then brought into CityEngine, where curbs, central medians, streetlamps, and trees were added in accordance with the rule file. The result was then exported back to ArcGIS for analysis and mapping. This data was then used to create plots and place building types according to the underlying land use in CityEngine, then brought back into ArcGIS for further analysis.

"This goes beyond standard visualization and into actual creation of data based on our specific urban planning standards," says Hartley. "The ability to dynamically add attributes to plots with rules allows for a more responsive model."

When the Future Means Change

Underlying data, such as relief or geology, can also be used. For example, a raster with a red color can be used to restrict development in particular areas, and elevations can be used to restrict building heights or types.

Staff used the modeling rules they need for each individual project, no matter how general or detailed, so different issues can be modeled at either micro or macro scales.

"Sometimes we have started with a relatively simple rule file for land uses," says Hartley, "but have then combined it with a previous dwelling rule file that links to yet another one to locate small elements, such as water tanks and satellite dishes."

Intelligent modeling in this manner is starting to generate questions, such as the following, and quickly provide answers:

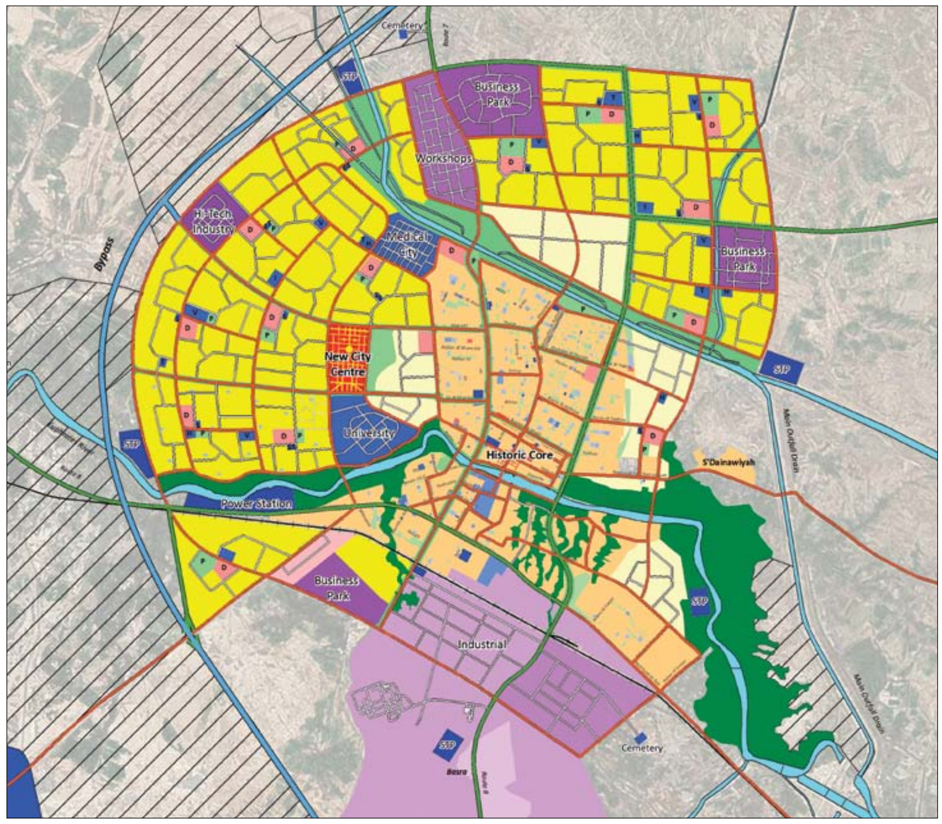
- What size of plot is needed within a particular land block?
- Can building height be varied to recognize the underlying geology?
- How can lots smaller than a certain size be shown as playgrounds within a residential area?
- What lane and sidewalk width is required for the different grades of roads?
- How wide should the central median be for higher-order roads?
- Can streetlamps be modeled differently to suit the various grades of road?
- Can buildings be modeled at different heights depending on how close they are to a center or transport node?

"In the future, we are going to be able to create a city plan that changes very quickly as new data arrives from the client," says Hartley. "This is a game changer for firms like ours, as last-minute client requests at a late stage are inevitable."

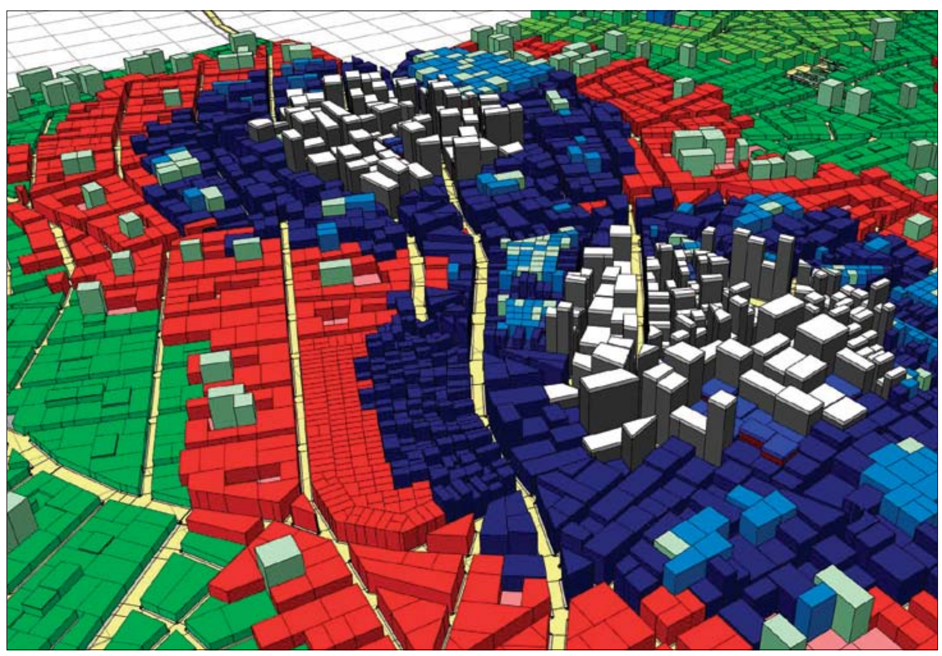
A Living Model

When Garsdale Design staff started working with CityEngine, the primary appeal was the software's ability to work with GIS data and export it into a variety of 3D modeling and rendering packages to provide the materials required by the client. "But once we started to explore the potential of the software, we saw that it could be more useful as an urban planning tool," says Hartley. "In fact, it has also shown us an exciting new direction for planning cities in the future. We can start to use these sophisticated 3D visualizations in a variety of media, including printed reports, websites, video, and full interactive walk-throughs. Our clients want to see how their cities would look when their plans are implemented."

For more information, contact Elliot Hartley, director of Garsdale Design Limited (e-mail: elliot.hartley@garsdaledesign.co.uk).



This is a typical Nasiriyah City Master Plan sheet.



This is a simple demonstration of a density-based concept.

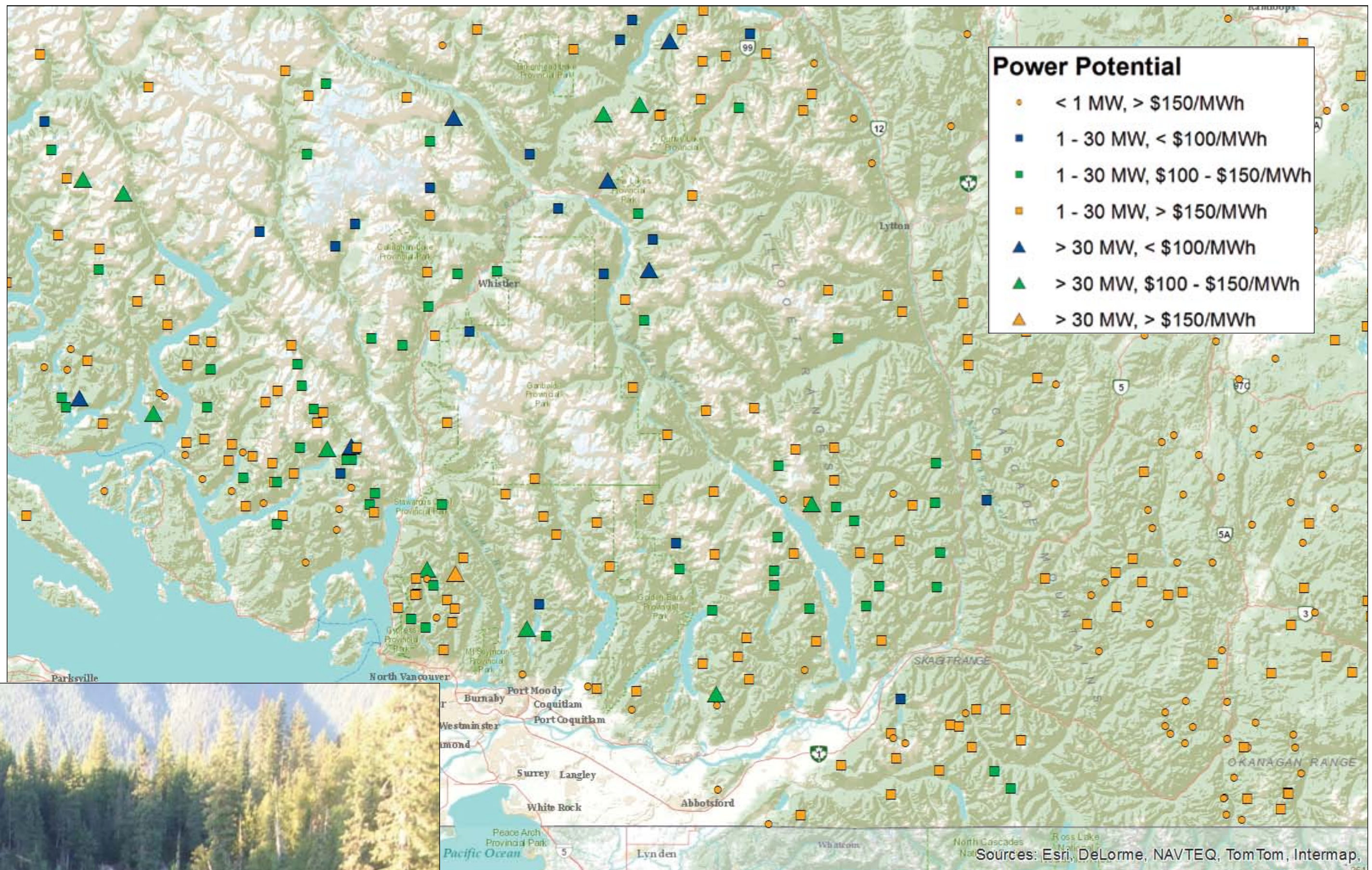
Unlocking British Columbia's Hydropower Potential

GIS Assessment Tool Uncovers Optimal Sites for Renewable Energy Production

Highlights

- With ArcGIS, KWL collected data on more than 10 million potential sites in hours rather than years.
- Through the GIS-based Rapid Hydropower Assessment Tool, KWL identified more than 8,000 potential run-of-river power sites.
- GIS was used to create cost estimates for access roads and power lines, as well as identify the least expensive routes to hydropower sources.

It's predicted that the province of British Columbia (BC), Canada, will require an additional 30,000 gigawatt-hours of electricity within the next 20 to 25 years. To meet this projection, BC Hydro retained consulting firm Kerr Wood Leidal Associates Ltd. (KWL) to conduct a hydroelectrical analysis and identify optimal sites for run-of-river power development.



Sample of Rapid Hydropower Assessment Tool (RHAT) model results indicating potential run-of-river hydropower in southwestern British Columbia, Canada.

Because stream flows vary from month to month, many variables must be considered to accurately target reliable sites. These include surface runoff; seasonal changes in streamflow; and terrain characteristics such as slope, elevation drop, and proximity of sites to existing power lines and access roads.

Traditionally, data would be collected and analyzed by inspectors using paper and topographic maps. However, manual data collection over large areas can take years to complete and can be ineffective for locating sites in remote areas. As such, KWL needed to develop an automated process to identify potential sites for run-of-river power development both quickly and cost-effectively.

In response, the firm used the ArcGIS Spatial Analyst extension to build a Rapid Hydropower Assessment Tool (RHAT) that automates the process of site selection. Using algorithms, the tool can estimate a site's potential power output by combining factors such as a stream's flow and the elevation differential between the water intake and the turbine in the powerhouse. Power potential information was gathered for more than 10 million sites in BC and saved as a vector data layer in ArcGIS for Desktop.

Once these sites were identified, data was screened for parameters suitable for run-of-river power development. Areas considered "no-go zones," such as parks or salmon streams, were removed, and an optimization process was applied to further narrow results based on energy output relative to infrastructure required.

"Through GIS, we were able to collect data on more than 10 million potential sites in a matter of hours—a process that traditionally would have taken years," says Ryan Taylor, GIS administrator, KWL. "We were also able to target locations that were off the beaten path and would have never been discovered."

Regional hydrology analysis was also carried out to develop an estimate of energy production by region. This involved statistically analyzing hydrological data from Water Survey of Canada and distributing resultant statistics to the remaining project locations. Using conventional cost estimating, data modeling, and ArcGIS, KWL then developed estimated production costs for each site.

Unit energy costs were also predicted by combining the estimated energy production with annual and operating expenditures. Also considered were social and environmental factors, such as the number of jobs that could be created and the geographic size of the area that would be affected by each potential project.

Through the GIS-based Rapid Hydropower Assessment Tool, KWL identified more than 8,000 sites in the province that could be developed as run-of-river power projects. It also predicted how power output could fluctuate throughout the year based on regional variability factors that might create changes in streamflows.

To ensure project viability, GIS was used to create cost estimates for access roads and power lines and identify the least expensive routes to hydropower sources. Cluster analysis was used to reveal sites that could potentially share road networks and transmission lines while identifying remote areas that would benefit from the construction of new infrastructure.

These sites have a potential installed capacity of more than 12,000 megawatts and could generate nearly 50,000 gigawatt-hours of energy per year. By calculating unit energy costs, KWL was also able to highlight projects that would be the most cost-effective to pursue and discovered 121 potential sites within BC where energy production would cost less than $100 per megawatt-hour.

Given the success of the project, KWL will use the Rapid Hydropower Assessment Tool to help other communities, including First Nations groups, develop renewable energy projects and transition away from reliance on diesel generators.

For more information, contact Ryan Taylor, GIS administrator, Kerr Wood Leidal Associates Ltd. (e-mail: rtaylor@kwl.ca).

Creating a 3D Hydrostratigraphy Model of the Gulf Coast Aquifer in Texas

By Daniel M. Lupton and Gil Strassberg

Highlights

- Cross sections and two-dimensional sketching were done within ArcGIS using Arc Hydro Groundwater tools.
- The Arc Hydro Groundwater Subsurface Analyst toolset transformed cross sections into 3D.
- With improved drilling records and geophysical logs, cross sections can easily be resketched in ArcGIS.

Understanding the structure, extent, depth, and distribution of subsurface materials is important for many disciplines, including geology, mining, oil and gas, and hydrogeology. With the advances in 3D capabilities, GIS-based packages have been developed to integrate GIS into the world of 3D subsurface modeling and visualization.

The creation of a subsurface model of the northern part of the Gulf Coast Aquifer in Texas was the primary objective of a project completed by Esri Partner Intera Inc. (Austin, Texas) in association with Esri Partner Aquaveo LLC (Provo, Utah). The purpose of the project was to provide stratigraphic surfaces and sand thickness maps of the geologic formations that compose the Gulf Coast Aquifer. The project is part of a long-term plan (sponsored by the Texas Water Development Board) to update groundwater availability models that are used for water resources planning and management for Texas. To develop a groundwater model simulating the flow of water within the subsurface, one has to first understand the hydrogeology of the system and estimate the physical properties of underlying aquifer layers and confining units. Thus, a detailed and accurate description of the subsurface is essential for developing accurate models.

By its nature, creation of a 3D realistic subsurface model is complex and requires integration of many datasets (usually from different sources), such as digital elevation models, borehole records, geologic maps, and hydrography. Common data products in the process of creating a 3D subsurface model include borehole logs, 2D cross sections, 3D fence diagrams, surfaces representing terrain or top/bottom elevations of units, and 3D volume elements. The use of GIS datasets in their native format and integration of all the information into a single geodatabase streamlined the process of building the 3D subsurface model and later updating and maintaining the model as new information is obtained.

The Subsurface Analyst toolset, available as part of the Arc Hydro Groundwater tools, was used to integrate the necessary information, create cross sections in ArcGIS for Desktop, transform the cross sections into 3D features, and build a 3D subsurface model.

For this study, the Gulf Coast Aquifer has been subdivided on the basis of chronostratigraphic correlation to yield subaquifer layers. The aquifer system is composed of four units—from shallowest to deepest, the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining System, and the Jasper Aquifer. Each of the units was further subdivided into subunits, resulting in a set of 10 hydrogeologic units. The basic workflow started with identification of aquifer layer boundaries along boreholes, based on drilling and geophysical logs, and then systematic correlation of layers throughout the study area.

To support the correlation, a grid of cross sections was created covering the model domain. For each cross section, a set of panels was sketched based on borehole logs, the digital elevation model, and geologic maps, together with the best geologic knowledge of the area. The creation of the cross sections and the sketching process was all done within ArcGIS using the Subsurface Analyst cross section tools. Each cross section is created in a separate data frame setup using the Cross Section wizard, and different types of information are projected onto the cross section.

The sketched 2D cross sections are the base for developing a 3D subsurface model. Although not part of the original project, a workflow was developed to support the creation of a 3D subsurface model from the sketched cross sections. The workflow includes the following steps:

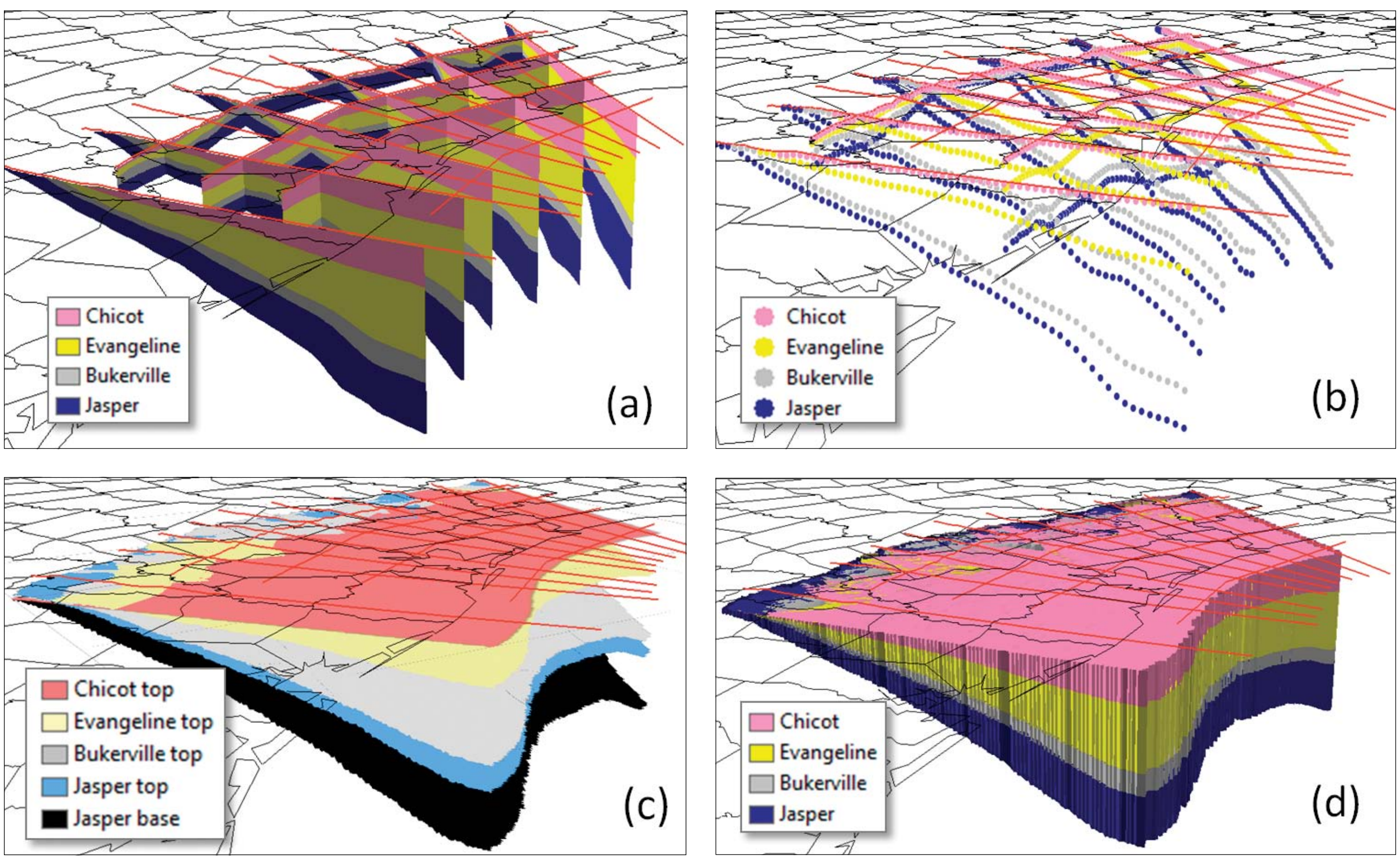
- The sketched 2D cross section panels were converted into GeoSections (3D multipatch features) that enable viewing hydrogeologic layers as a 3D fence diagram.
- The 3D GeoSections were sampled to create a set of new 3D points, where each point represents the top or base of a hydrogeologic unit.
- Raster surfaces were interpolated from the points using ArcGIS Spatial Analyst interpolation tools. Each raster represents the top or bottom of a hydrogeologic unit.
- GeoVolume (3D multipatch features) features were created by "filling" between the raster surfaces to display hydrogeologic units as 3D volume elements.

This project is an excellent example of how GIS-based workflows can support the development of subsurface models. The ability to integrate a wide array of spatial datasets into a single geodatabase, automate parts of the data processing, and visualize the results in real spatial context proved invaluable for the project.

About the Authors

Daniel M. Lupton is a hydrogeologist with Intera Inc., Austin, Texas, and Gil Strassberg is a senior product engineer for Aquaveo LLC, Provo, Utah.

For more information, contact Daniel M. Lupton, Intera Inc. (e-mail: dlupton@intera.com), or Gil Strassberg, Aquaveo LLC (e-mail: gstrassberg@aquaveo.com, web: www.aquaveo.com/archydro).



Workflow for creating a 3D subsurface model from 2D cross sections: (a) cross section panels are converted to GeoSections, forming a 3D fence diagram; (b) GeoSections are sampled and 3D points created representing top/bottom of units; (c) raster surfaces are interpolated from the 3D points; and (d) 3D GeoVolume features are created by "filling" between the surfaces.

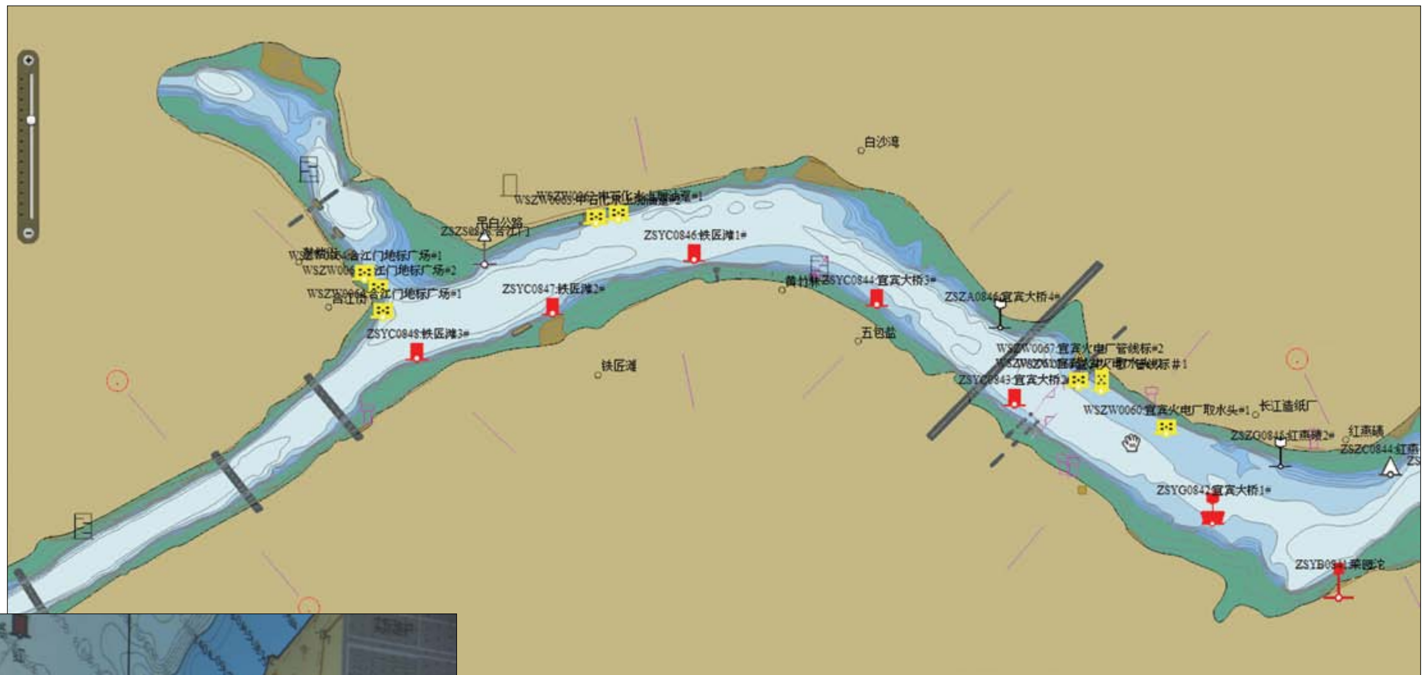
Intelligent Charting for Asia's Longest River

The Changjiang Waterway Bureau Adopts GIS to Improve Navigational Charts

Highlights

- ArcGIS provides electronic mapping capability for more than 3,000 miles of river and 5,300 navigational markers.
- The digital charts can be edited in a multiuser GIS environment and data updated as needed.
- With GIS, disparate data is collected and transformed into China's national data standard.

The Changjiang (or Yangtze) River meanders 3,915 miles through China, from the glaciers in Tibet to the East China Sea. Since opening the river to foreign trade 30 years ago, China's shipping industry on the Changjiang River has grown by leaps and bounds. In 2011, freight volume exceeded 1.6 billion tons, making it one of the largest and busiest transport rivers in the world. Increasingly, electronic navigation devices are being used instead of paper charts to keep up with the rise in vessels on the waterway.



Using ArcGIS, the Changjiang Waterway Bureau charts approximately 5,300 navigating markers, including beacons and buoys, along 3,915 miles of river.

Staff member for the Changjiang Waterway Bureau reviewing nautical charts.

The Changjiang River is managed by the Changjiang Waterway Bureau, part of China's Ministry of Transport. The bureau is responsible for waterway planning, construction, management, conservation, and waterway administration on the river. The bureau's cartographers and chart makers use ArcGIS to create standardized Electronic Navigation Charts (ENCs). These charts are a vector database of the marine environment, comprising the shape of the coast; the river bottom, including depths; and the location of navigational aids along the river. More than 10,000 people work in the bureau, many charting and mapping hundreds of miles of the river and approximately 5,300 navigating markers, such as beacons and buoys, that allow ships to safely sail. Staff members are spread throughout 77 waterway management departments, ensuring that the data is collected as close to the source as possible, increasing its accuracy.

Multiple Data In—Local Authoritative Data Out

Historically, the bureau had been providing navigational reference services in the form of hard-copy charts. However, ships sailing the Changjiang River are increasingly using modern digital information technology, including electronic navigation devices instead of paper charts, and need more current ENC data. Bureau staff chose ArcGIS because it was the only solution available that could handle the large volumes of disparate geographic data used throughout the organization and distribute information quickly as ENCs.

Each local bureau creates and maintains its own data in its own projection using different software. This data, including both topographic and bathymetric data, is shared centrally with the main Changjiang Waterway Bureau in both text and Microsoft Excel data formats. The data is imported into ArcGIS using a customized toolbar that was created for users to transform local coordinates to the standard cartographic and navigational coordinate system. Once in a standard coordinate system, the data is then input into one of two centralized GIS geodatabases for either survey and mapping (terrain data) or ENC (bathymetric data).

The Changjiang Waterway Bureau has developed its own local river ENC chart standard—CJ-57—based on the maritime industry's international S-57 standard. These standards are developed to ensure digital data can be transferred from one system to another without jeopardizing the integrity of the data. Since the GIS data model is based on the industry standard, bureau staff can maintain the local data standard when it is stored in the geodatabase.

Le Xu, the ENC production technical leader, explains that the GIS and its extensible data model, objects, and attributes make meeting Changjiang standard characteristics easy, paving the way for the bureau's ENC production.

No Man Needs to Be an Island

Traditionally, multiple workstations in standalone mode were used by bureau cartographers to edit data and export maps and charts individually. This operational workflow has quite a few shortcomings. Many workstations must be used to store data, and the cartographers cannot interact. From a technical perspective, it is difficult to make each individual map sheet and ENC cell match exactly once they are created.

All the source data editing and modification is now centralized in the bureau's geodatabase and shared over the internal network. The end result is the ability to export seamless maps from a single database. Having a centralized geodatabase has also improved the quality of the data and cartography by reducing the inconsistencies that occurred when the maps and cells were edited individually in silos.

When a cell or sheet is checked out, the editor will get a local copy of the geodatabase, and no other editor can edit or delete this cell. This ensures there are no conflicts in editing. When the cell is checked back in, other editors can check it out for a second edit, allowing consecutive editing of the data. Inconsistencies that occurred when the maps and cells were edited individually have been reduced significantly.

Support of Intelligent, Complex Editing

For complex editing, the bureau uses a more sophisticated workflow. Cartography in general is changing rapidly to accommodate the expectations of users. No longer is a single map produced on a paper sheet—today, maps combine foreground information for analysis, as well as a background map to give spatial context. The bureau does this by combining multiple scales for its maps. Sometimes one export file will include two scales.

GIS makes managing and editing these different scales manageable using scale band technology. The ENC in Nanjing, for example, has both 1:1,000 and 1:2,000 scales in one file. To modify the scale band, the cartographers use ArcGIS, which prompts them to edit areas of interest at the appropriate scale band.

When multiple datasets must be edited at the same time, the map tile or chart cell is first divided into continuous stream segments, or river reaches, in the main geodatabase. Then, each version is divided into different versions: contours and soundings, riverbanks, and other objects. The advantage to this workflow is the ability to modify the data without affecting another editor's edit.

Golden Opportunities on the Golden Waterway

As traffic increases, so does the risk of water accidents and loss of economic opportunities. Ensuring water traffic safety on the Changjiang River is essential to the health of the river and the national economy. Creating one unified nautical information system is helping China increase trade along its "golden waterway."

"By implementing GIS," says Shuo Xu, the ENC production team leader, "the waterway authority has improved the extensibility of the system; achieved the functionality required by the ENCs to achieve multiscale, distributed ENC production; and improved the efficiency and quality of the system."

For more information, contact Wen Peng, director, Changjiang Waterway Bureau Survey Center (e-mail: xmpw1011@163.com). For more information on how ArcGIS is used at nautical organizations around the world, visit **esri.com/nautical**.

Listen to Esri Podcasts

Esri podcasts are a free and easy way to listen to users share their experiences, get news and information from Esri, and learn software tips. To check the availability of new podcasts and subscribe to the podcast feeds, visit **esri.com/podcasts**.

EXELIS

Visual Information Solutions

Add Image Analysis to Your GIS Workflow.
Update Your Geodatabase with Information from Imagery.
Understand More About the World Around You.

Geospatial imagery is a powerful and cost effective way to update your geodatabase with the most current and detailed information about a geographic area. Exelis Visual Information Solutions provides you with a seamless integration of ENVI® image analysis tools and ArcGIS® from Esri® to deliver the power of advanced image analysis directly to the ArcToolbox™

ENVI. Information from Imagery Means a Better GIS.

ENVI

esri Partner Network Platinum

www.exelisvis.com/ENVI-ArcGIS

From Sensor to Sound Decisions

Federal Agencies Use Sonar, Lidar, Optical Imagery to Preserve Seafloor Habitats

Highlights

- Using GIS and image analysis software, the strengths of sonar, lidar, and optical imagery can be exploited together.
- NOAA moved the NPS habitat maps into GIS for more analysis and the creation of applications.
- The lidar and acoustically collected bathymetry were used to calculate a suite of complexity metrics in ArcGIS.

The *Nancy Foster* is one of the most operationally diverse platforms in the NOAA fleet.

Buck Island Reef National Monument, off the US Virgin Island of St. Croix, is one of only a few fully protected marine areas overseen by the US National Park Service (NPS) and is home to a coral reef ecosystem that supports a large variety of native flora and fauna, including several endangered and threatened species, such as hawksbill turtles and brown pelicans. This area has been dubbed one of the finest marine gardens in the Caribbean Sea. Still, the monument is relentlessly impacted by its visitors, boaters, snorkelers, and scuba divers, as well as pollution, climate change, and extreme weather events like hurricanes.

Recently, the US National Oceanic and Atmospheric Administration (NOAA) has assisted NPS to map and extract detailed information about the monument's seafloor habitats. To do this efficiently, NOAA needed to develop a new semiautomated approach that would allow it to process, analyze, and fuse different types of imagery and provide NPS with the fundamental data needed to make informed decisions.

When One Sensor Isn't Enough

After evaluating the area, NOAA determined that traditional marine mapping methods that rely on the manual interpretation of optical imagery derived from satellites couldn't produce a comprehensive habitat map of the monument given its depths, which extend from the coastline of Buck Island to 1,800 meters at its deepest extent.

"We had a very unique problem," says Tim Battista, an oceanographer at NOAA. "There is no one technology or sensor that allowed us to collect the data we needed in the range of depths present at the monument. We had to devise a method that would allow us to both measure seafloor depths, as well as characterize its habitats, across the entire seascape in the monument."

After much testing and innovation, NOAA ultimately devised a new method that fuses four different sonar, lidar, and optical imagery sensors to gather the information needed. NOAA chose to use Esri's ArcGIS with ENVI image analysis software from Esri Platinum Partner Exelis Visual Information Solutions of Boulder, Colorado, to tackle this unique challenge. This combination allows the processing and image analysis of the latest image types, such as radar, lidar, optical, hyperspectral, stereo, thermal, and acoustic. Using GIS and image analysis software, the strengths of these different sensors can be exploited together, which creates a rich context that aids in decision making.

NOAA recorded depth and other characteristics of shallow areas in the monument using multispectral and lidar imagery. This imagery was acquired from planes that flew over the areas needing mapping. Multispectral and lidar mapping can be used for water up to about 30 meters in depth, the point at which light is often unable to penetrate to the seafloor.

At depths of more than 5 meters, NOAA used sonar technology located on board vessels and ships, such as the NOAA ship *Nancy Foster*, to scan the seabed. The *Nancy Foster* emits more than 3,500 pings per second, and receivers on the ship record the time and angle of the echoes returning from the seafloor. Days spent sailing and employing sonar technology yielded bathymetry, or depth information. The intensity of the echo also provided information about the seafloor, such as how hard, soft, rough, or smooth it is, which often indicates discrete habitats, such as coral, sand, and sea grasses.

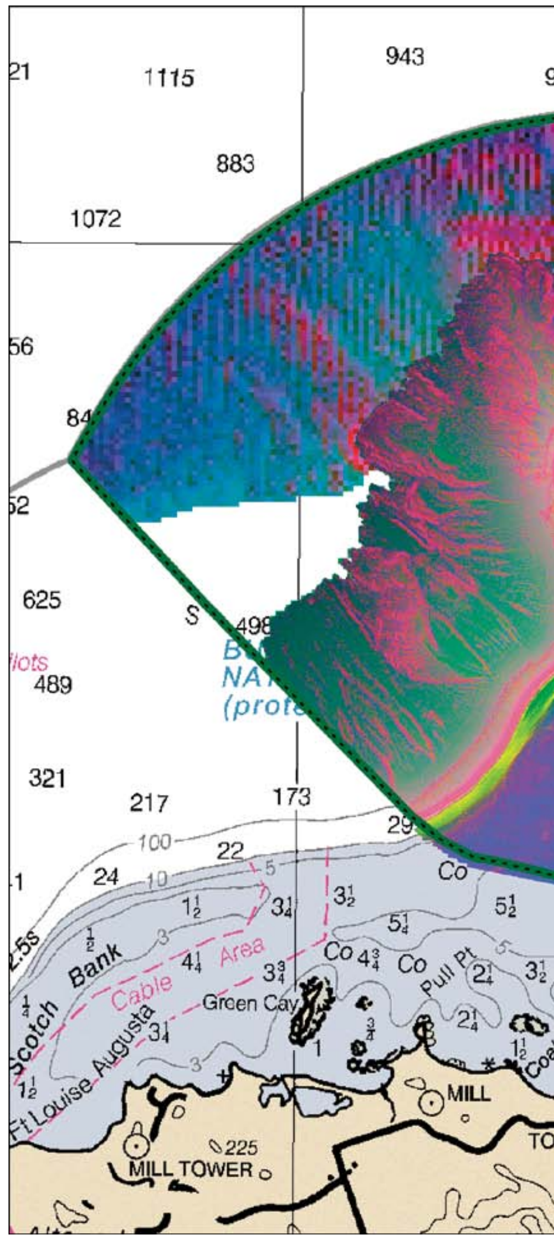
Mapping the Seafloor

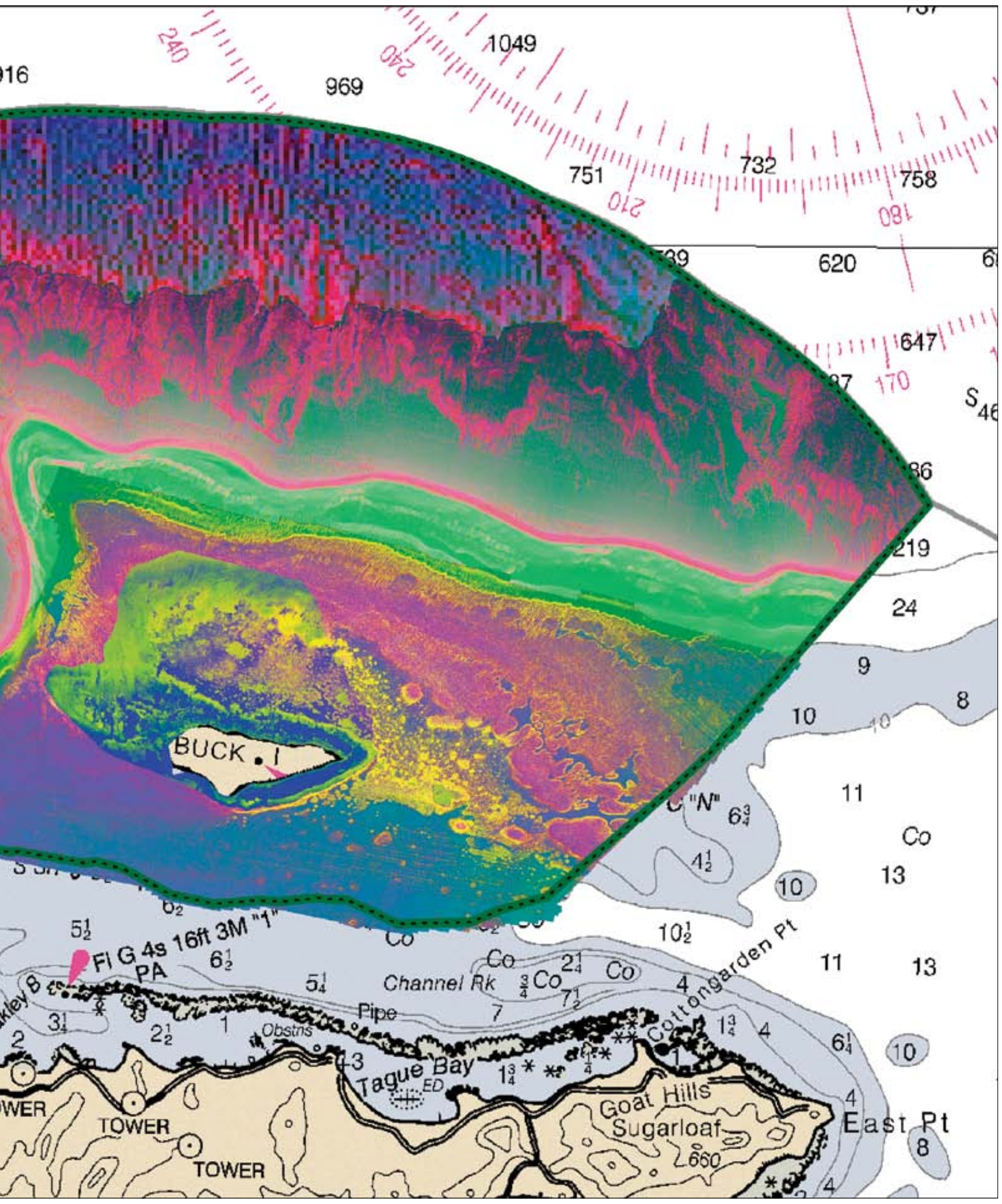
The lidar and acoustically collected bathymetry were also used to calculate a suite of complexity metrics in ArcGIS, such as slope, which emphasize the differences between habitats on the seafloor. As part of its preprocessing work, NOAA used principal component analysis to reduce redundancy in the data and better understand the complexity on the seafloor. This, along with ancillary data, including intensity information, was loaded into ENVI, allowing the researchers to draw distinctions between softer and harder sediments in flatter areas of the seafloor.

Using an automated workflow, NOAA staff segmented the imagery data using the software's extraction tool. Following image segmentation, users classified and assigned attributes to the features in their imagery. NOAA staff classified features by selecting locations with unique acoustic or optical signatures and performed ground validation using still and video cameras operated by divers and remotely operated vehicles. NOAA's classification scheme used to describe these sites takes into consideration what the seafloor is made out of, what is growing on top of it, and the quantity of cover.

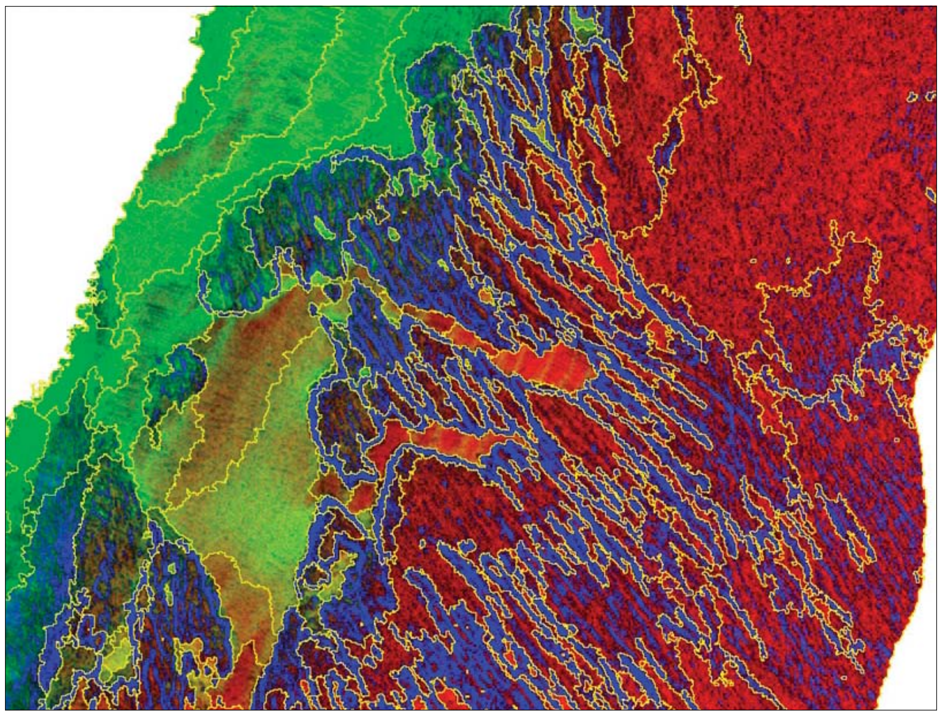
NOAA then took the segments and classified ground validation points using a free add-on tool to ENVI called RuleGen. RuleGen includes a classification and regression tree that was well suited for NOAA's acoustic datasets. Afterward, NOAA staff returned to the field and verified the accuracy of the output—a draft classified habitat map.

"Acoustic data is often very noisy and heterogeneous, which makes classification difficult using traditional pixel-based approaches," says Sam Tormey, marine spatial analyst contracted with NOAA through scientific support provider CSS-Dynamac of Fairfax, Virginia. "We were able to overcome these challenges, so we are no longer classifying a pixel but, rather, an object. We are now able to more objectively and efficiently deal with heterogeneity and make products that meet our partners' needs."





NOAA used ENVI to produce a principal component analysis surface—the foundation for its mapping methodology—from four different acoustic and multispectral datasets spanning the monument's 20,000-acre extent. (Image courtesy of NOAA.)



The feature extraction process identifies unique objects and habitat types on the ocean floor. (Image courtesy of NOAA.)

Effective Analysis for Ecosystem Management Decisions

As a final step, NOAA took the habitat maps and other information derived from the imagery and moved them into ArcGIS for more analysis and the creation of applications. Information extracted from imagery and added to ArcGIS provided a complete picture of a geographic area of interest that includes pertinent, current information. Using ENVI for this step made the process to update ArcGIS with information from geospatial imagery seamless by delivering image analysis tools directly to both desktop and server environments.

Analysis included looking at the structure, biologic cover, and percent cover—key pieces of information that resource managers need to make effective ecosystem management decisions. One application that NOAA develops for some partners is a web-based mapping portal so that partners have the option of displaying each habitat class separately, overlaying ground-truth points, viewing videos and images that were captured, and creating custom maps. These portals are especially useful for partners that may not be familiar with GIS software.

Previously, NOAA staff could only monitor limited areas because the process was very time intensive and depended on the experiences and interpretation skills of the analyst, which aren't highly replicable.

"Our past mapping efforts were conducted by manually digitizing and interpreting optical imagery," says Tormey. "The new methods that were developed allow us to integrate the strengths of multiple acoustic sensors and multispectral and lidar imagery and produce a seamless product across the entire extent of our study areas."

NOAA is now able to process, analyze, and fuse different types of geospatial imagery and integrate information to produce products at a much finer spatial scale, so maps are more reflective of the true features on the ground.

For more information, contact Bryan Costa, CSS, contracted to NOAA (e-mail: bryan.costa@noaa.gov), or Patrick Collins, Exelis Visual Information Solutions (e-mail: patrick.collins@exelisvis.com). For more information on how GIS can help better analyze remotely sensed data and imagery, visit **esri.com/imagery**.

Participatory GIS

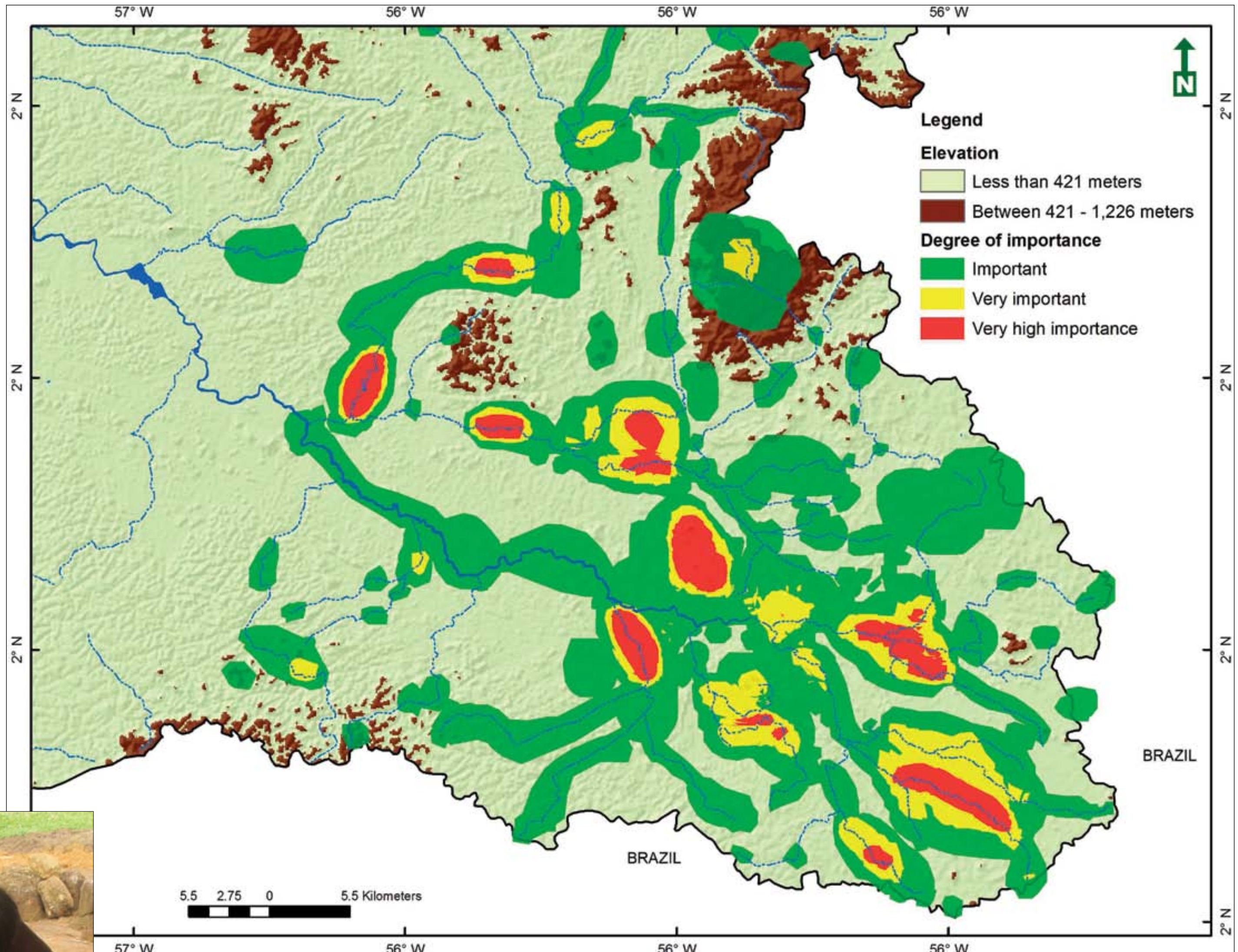
Indigenous Communities in Suriname Identify Key Local Sites

By Sara O. I. Ramirez-Gomez and Christian Martínez

Highlights

- With GIS, indigenous people's spatial knowledge is incorporated into digital maps for conservation planning.
- Villagers drew polygons on georeferenced landscape maps to indicate areas of local importance.
- With ArcGIS, a tool was developed to count overlapping polygons to identify concentrations of important places.

NGO Non-Governmental Organization



Map of the Sipaliwini village's perceived importance of the landscape for subsistence, based on the count of overlapping locations.

The nation of Suriname is tucked up against the Atlantic Ocean in northeastern South America. Southern Suriname is covered with continuous tracts of unspoiled tropical forest, and it is the home of approximately 2,000 Wayana and Trio indigenous peoples. The area is currently remote, and economic development is practically nonexistent, which has helped it remain intact. However, several economic development projects for the area are becoming priorities for the national government, including mining, hydroelectric dams, and road construction. While these investments may benefit Suriname, they also pose a threat to Suriname's ecosystems and local communities' livelihoods, fundamentally in the lack of socioecological information. In the absence of reliable information, the decision-making process will fail to include local people's needs in terms of land and natural resources, bringing further inequity and poverty to vulnerable people in the country.

A village woman drawing polygons on an elevation map.

Conservation International Suriname (CI Suriname) is working with five indigenous communities in southern Suriname to produce maps depicting perceived importance for landscape services. Through this work, the organization is supporting the development of a visual tool for tribal communities to facilitate their interaction with government planners and external institutions in all issues related to their territory.

To foster progress with informed decision making, CI Suriname is undertaking participatory mapping processes that produce spatial information to support a community bottom-up approach in the land-use decision-making process. To do this, the project team looked for a way to combine community mapping with GIS technology to put people's spatial knowledge into digital maps that could be incorporated into conservation planning. As a longtime user of Esri technology, CI Suriname chose ArcGIS to build a tool to effectively count the times that thousands of polygons were overlaid to produce maps showing the frequency of landscape services polygons as surrogates of importance; the more overlays, the more use of the area and thus the more important the landscape for the indigenous people.

To produce these maps, the development of an operational tool was needed to count the number of times that the landscape services polygons were overlaid. This tool combined several ArcGIS tools to effectively map intensity of use. The input data was obtained through social mapping workshops with community participants in five Amerindian villages of South Suriname. During the data collection process, people were prompted to individually indicate, by drawing polygons on a georeferenced landscape map, the areas that they use for four distinct landscape services. The services were distinguished by using different color markers: subsistence (red), income-generation-related services (blue), culture (orange), and life-sustaining services (green). The number of maps produced during the workshops coincided with the number of participants. The polygons in each of these maps were then digitized in ArcGIS, queried by the landscape service they represent, and prepared for the data analysis process. At this stage, thousands of polygons were processed.

Using the ModelBuilder environment in ArcGIS, a tool was developed to count overlapping polygons inside a shapefile, and a new shapefile was created with polygons whose attributes are the number of overlaps identified in that specific spatial unit. The developed tool has a simple user interface: it first asks for an input shapefile, which has all the polygons mapped in the area, and then it asks the name and location of the output shapefile. CI Suriname uses this tool to identify concentrations of important places for provision of landscape services according to the perceptions of local people.

ModelBuilder flexibility lets CI Suriname integrate available tools to create a new user-designed tool able to process a large amount of information and with a user-friendly interface. Identification of the areas important to local people is useful input to develop sustainable action plans and support decision making. Indigenous communities see the importance of the maps to facilitate dialog with outsiders. Some of the villagers highlighted the importance of the maps for tourism, while others highlighted their importance for future generations.

Kapitein Euka, the chief of Sipaliwini village, is a firm advocate of ensuring that the natural environment remains intact so that his village can continue to exist. At a meeting with CI Suriname, with whom villagers have created maps showing the areas and ecosystems they depend on, he said, "It is important for us to be able to show the government what parts of land are necessary for our way of life and are important to us." He added that he thinks the maps are vitally important to this cause, especially if future infrastructural development takes place. "It's good that everyone knows about these maps and is aware of how important this land is to our village."

About the Authors

Sara O. I. Ramirez-Gomez is South Suriname project coordinator for Conservation International Suriname. Christian Martínez is the land-use planning coordinator for Conservation International Ecuador.

For more information, contact Sara O. I. Ramirez-Gomez (e-mail: soi.sararamirez@gmail.com) or Christian Martínez (e-mail: cmartinez@conservation.org).

Seeing the Signs

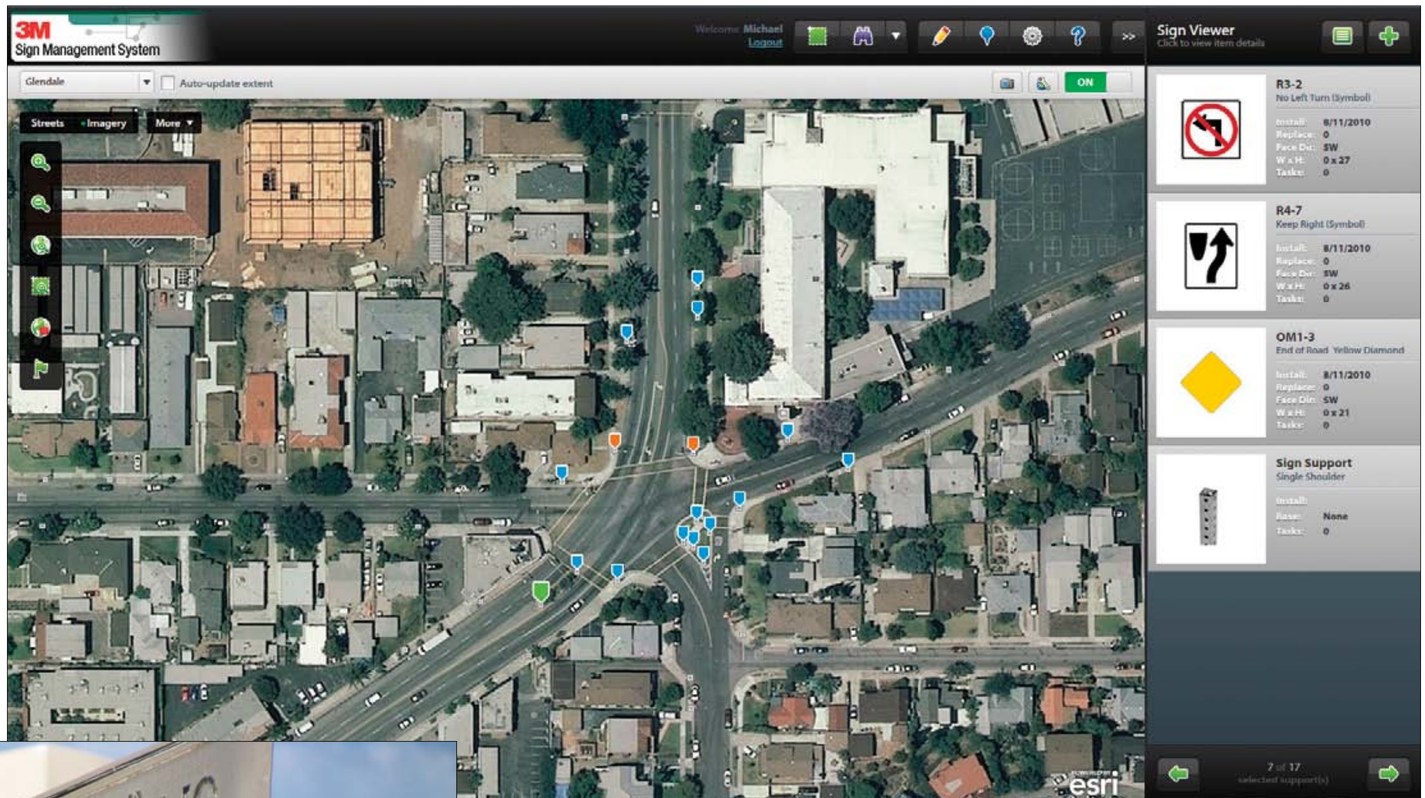
The City of Glendale Partners with 3M to Manage Street Signs More Effectively

Highlights

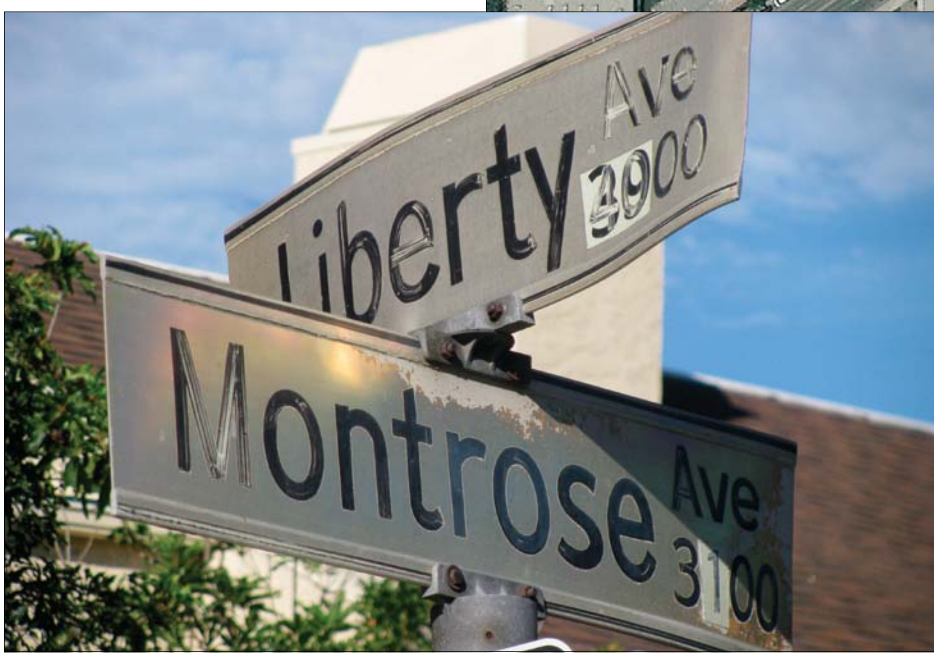
- Glendale's 3M sign management system uses ArcGIS to help organize and display sign information easily.
- 3M staff determined that ArcGIS was better suited to the job than open source products.
- The interface is very graphic in nature, since it uses ArcGIS web map services.

Got signs? The City of Glendale, in Los Angeles County, California, does. In fact, it had 2,000 more street signs than it thought it did. While this surprise may not seem to be a big deal to some, for Glendale City staff, not having an accurate count of their street signs could mean the difference between staying in budget and exceeding it by thousands of dollars.

"Each street sign costs at least $200," says David Lew, parking and traffic supervisor, City of Glendale. "If we need to replace them and end up miscounting by a couple thousand signs, we could be in a pretty big financial hole."



Having a system that manages street signs is helping Glendale maintain assets more efficiently, keep constituents safe, and protect the city against lawsuits and noncompliance.



Glendale city staff manually inventoried their street signs for decades by driving the city streets and recording where signs—including street name and road safety signs—were located. While this system seemed to work well, the introduction of new minimum reflectivity standards, as well as a timetable for city agencies to comply with these new regulations by the Federal Department of Transportation, pushed the city to adopt a more comprehensive solution for road sign management. Glendale staff needed to get a better handle on what their street sign inventory was for replacement and maintenance purposes. The city found itself helping beta test and implement a 3M sign management system that uses ArcGIS to help organize and display sign information more easily for office and field-workers.

When Every Sign Matters

Headquartered in St. Paul, Minnesota, 3M is a $30 billion company creating unique products that make people's lives easier. The company prides itself on its innovation and takes the business of inventing seriously. Finding a solution for inventorying street signs was tackled with the same visionary thinking that has made the company so successful.

The 3M sign management system is used by the sign and traffic department at the City of Glendale, where a staff of nine uses the system for maintenance to accurately budget for and plan sign replacement in the city. 3M coordinated inventory of all the street signs for Glendale, including data capture and asset assessment, and put it into the software solution. City staff were then trained on the management tools they would be using to update and keep the inventory current.

"We really had no idea how many signs we had," says Lew. "We found out that our estimating was only off by 2,000 signs, out of 28,000 that the city maintains, which is pretty good. But when you are talking about being required to replace signs every 5 to 10 years and having accurate data in case of accidents or lawsuits related to signage, every sign is important."

3M has performed hundreds of traffic engineering studies and uses this knowledge to build in predictive modeling for sign management that assesses the sign type, installation data, and other attributes to estimate when the next replacement date for each sign may be. This intelligence makes it easier for Lew's staff to manage the sign inventory. They can query the signs to find those that are deemed critical for maintenance or signs that possibly fall below the federal minimum requirements.

After the signs are found, a work order can be placed in the system and downloaded on a mobile device by a crew member out in the field. The mobile devices used contain GPS receivers, so as a field-worker approaches the sign, he or she can select the sign that appears on the screen, ensure that it is the correct sign that needs to be replaced, pull up and fill out the work order, and then sync the work order back up into the system. "This system works especially well in an emergency situation, such as replacing a sign that has been knocked down," says Lew. "Within a couple of hours, the sign can be fixed and the work order processed."

A Total Solution for Street Sign Management

One of the nice aspects of the system is the fact that the web interface that is used back in the office is the same interface that is seen on the mobile devices. The interface is very graphic in nature, since it uses ArcGIS web map services. These services provide an interactive map for workers to pan and zoom so they understand exactly where the signs are located in the city. This has made training the staff very easy, especially important in California city agencies, where fiscal troubles have meant moving staff to different departments or reducing the work force. "Once the staff is trained on one system or the other, it's a done deal—we don't have to retrain them," says Lew. "This is a huge time- and money saver for the city."

To Serve and Protect

Having a system that manages street signs is helping Glendale more efficiently manage assets, keep constituents safe, and protect the city against lawsuits and noncompliance. As the city continues to grow and more streets are added to accommodate this growth, there is a system in place to maintain those new signs. And no longer will agency workers put up a new sign at an intersection and forget about it. All these signs will be appropriately tracked in a manageable way.

"Signs have a definite life to them," says Lew. "After a few years, they lose their reflectivity. We as a city have to take care of this problem so motorists can see the signs, especially at night."

The Cloud Option

Glendale is maintaining its system at the city, but other cities have the option of a cloud-based system where 3M can host it on its own servers. "This is a nice option for smaller municipalities that may not have the budget of larger cities but still have the responsibility to maintain their street and road safety signs," says Debra Gaborik-Snyder, business development and project manager for 3M's traffic safety systems division.

A cloud solution meant that 3M needed to find a level of service that had little or no interruption and systems that could all talk to each other in a common language. At first, 3M staff looked at open source GIS technology but, working with Esri Partner GIS, Inc., based in Birmingham, Alabama, chose ArcGIS instead.

Says Gaborik-Snyder, "Choosing one platform that is proven and has the kinks worked out will save us and our clients time and money in the end."

For more information, contact David Lew, parking and traffic supervisor, City of Glendale (e-mail: dlew@ci.glendale.ca.us).

Social Media Maps a Volcano's Aftermath

Tracking the Consequences of the Guatemalan Eruption

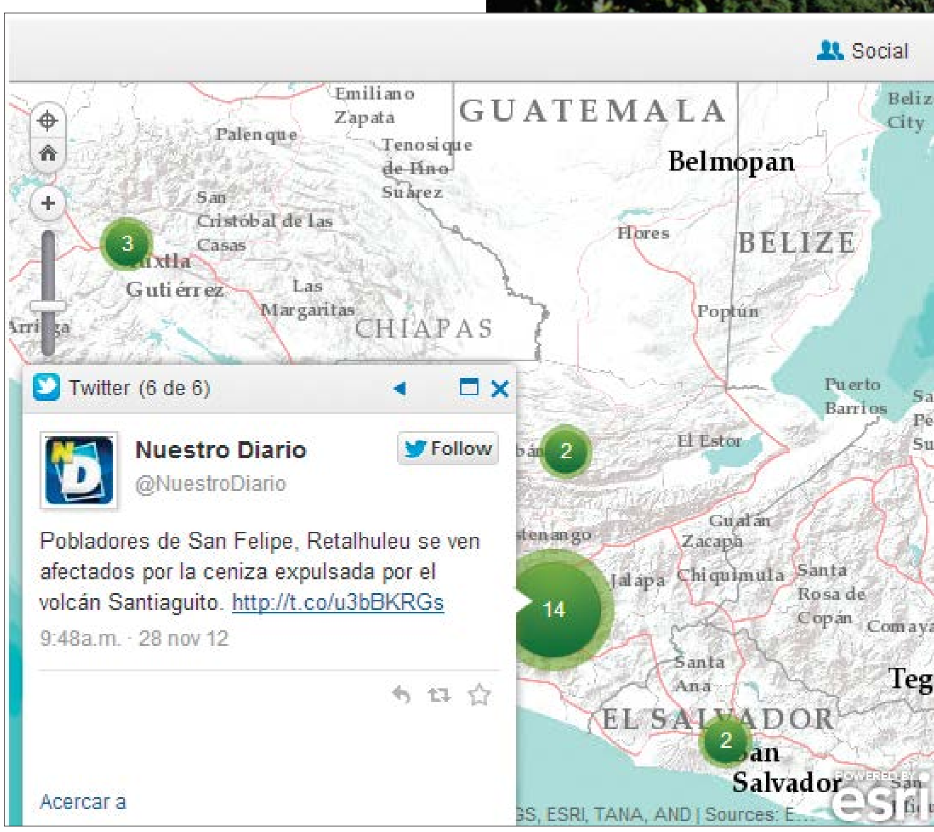
By Javier A. Carranza Tresoldi

NGO Non-Governmental Organization

Highlights

- Terrain basemaps were readily available on ArcGIS Online and were used to display social media information.
- Coordinated emergency efforts benefited from using the social media widget available online at ArcGIS.com.
- GeoCensos tapped into a worldwide community of mapped data and created a readily accessible alert tool.

Guatemalan volcano Santiaguito.



Interactive mapping of the eruption of the volcano Santiaguito using social networks is shown. The Tweet says in Spanish, "People from San Felipe, Retalhuleu affected by ashes expelled by Santiaguito Volcano."

On the afternoon of November 28, 2012, the Guatemalan volcano Santiaguito erupted, launching sand and ash three kilometers into the air. Lava and gas spewed into the surrounding area—some in areas as far as 80 kilometers away. This eruption was considered by the authorities to be a "very strong" one, and the National Meteorology Agency recommended restricting air traffic in the area. Nevertheless, according to the National Coordinating Commission for Disaster Reduction (CONRED), there was no immediate need for evacuation of populations closest to the mountain.

Santiaguito is located in a popular tourist area about 220 kilometers from Guatemala City in the Department of Quetzaltenango. Known as the western highlands of Guatemala, the area sits 2,550 meters above sea level. The volcano is located only 11 kilometers from the city of Quetzaltenango. People in the Quetzaltenango area were already experiencing hardships from an earthquake that shook the region three weeks earlier, killing nearly 50 people and leaving 25,000 homeless.

GeoCensos, a nongovernmental organization comprising international and Latin American experts and researchers, was invited by Washington, DC-based humanitarian organization iMMap to join coordinated efforts in the area to identify damage and emergency response for the Guatemalan government and report them to CONRED. GeoCensos explores topics related to geospatial technology, such as data mining and digital mapping applications, applying recent census results. A large part of the organization's core activity is to produce information updates based on censuses and geographic information trends happening in Spanish-speaking countries. In the case of the volcanic eruption, GeoCensos was looking for applications that could streamline the provision of real-time georeferenced data, such as social networks, to understand what was happening during the event.

Finding the Right Fire Hose to Make Sense of Emergency Data

Staff at GeoCensos decided they needed an easily accessible tool to describe at a glance what was going on live in the affected region. Social media is well on its way to becoming a valued source to understand emergencies, but many times, there is a lot of data being posted quickly. Trying to channel the flow of this "fire hose" of information is the key to applying it. Researchers at GeoCensos were looking for a tool that could help them make sense of all the available near real-time data being posted when the volcano erupted. They understood that the coordinated emergency efforts of all the first responders could benefit from using these tools. The one they chose was the social media widget for Flex developed by Esri and available online at **ArcGIS.com**.

This application was chosen because it helps the user create thematic layers to display information from a variety of social media sources: Tweets from Twitter, images from Flickr, and YouTube videos, along with other data about events happening in the disaster area, such as United States Geological Survey earthquake ShakeMaps and real-time local weather reports. Terrain basemaps readily available on ArcGIS Online were used as the base layer to display the social media information. Using the social media widget and data available from ArcGIS Online, GeoCensos was able to tap into a worldwide community of mapped data and create a readily accessible alert tool.

Emergency networks like CONRED, which was created to prevent disasters or reduce their impact by coordinating relief efforts, also provided data. CONRED is responsible for assessing potential hazards, as well as impending or actual disaster, by reviewing data from the Executive Secretary of CONRED and the National Institute of Seismology, Volcanology, Meteorology, and Hydrology. Once a disaster has been declared, such as the eruption of the volcano, CONRED is responsible for declaring states of alert and coordinating disaster relief efforts.

Assessing the Eruption Through Social Media

Using only the Internet, GeoCensos staff screened live messages and pictures posted by people affected by the volcano through the social media widget. The widget streamed this social media into the appropriate application, including the Common Operational Picture template, also created and provided free by Esri. GeoCensos configured the application to collect georeferenced information from three different social networks in the area of interest with selected thematic restrictions. The restrictions they used were mainly messages that were preconfigured to display from authoritative agencies—such as where to go for assistance—or those related to key search words and the hashtags #santiaguito, #erupción, and #afectados on Twitter.

CONRED closely monitored not only recent seismic activity but also the activity of the volcano and provided this data as updates throughout the event. GeoCensos shared the social media map with CONRED as an informal supplement to incoming earthquake and eruption information for the emergency response activities of the organization. CONRED did not consider it merely a demonstration exercise; the map was used to justify decisions.

Tools like Esri's social media widget can be particularly effective if the general emergency system in a given country aims to alert the public and reduce the impact of disasters. During a time when many budgets are shrinking, involving the community to generate geospatial data can be very helpful. GeoCensos found that introducing these new nodes of emergency information—information from social media—together with census data, especially housing, can save time and effort at moments of crucial importance.

About the Author

Javier A. Carranza Tresoldi is chief editor, GeoCensos, and has an MSc in geoinformation from Twente University.

For more information, contact Javier A. Carranza Tresoldi, GeoCensos (e-mail: javier.carranza@geocensos.com, web: **www.geocensos.com**).

Agents, Models, and Geodesign

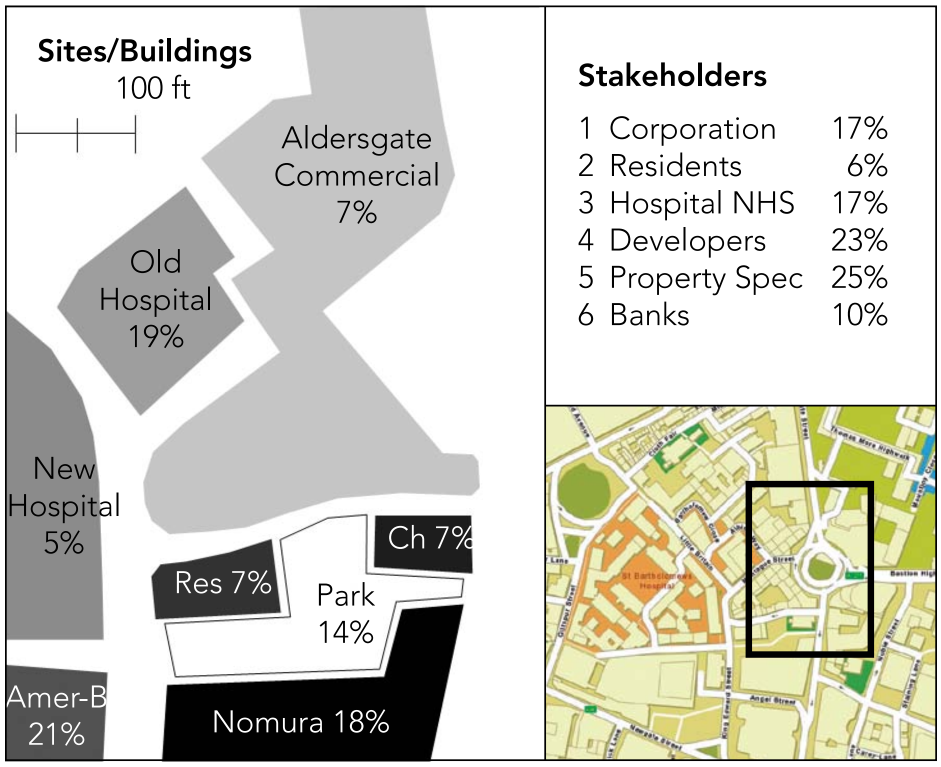
continued from cover

Michael Batty explains how the process of geodesign might be compared to one in which conflicting views about a spatial design can be systematically resolved in moving to a solution by using a simple network model of conflict resolution. Such models assume two sets of agents—designers or stakeholders, as well as land parcels or locations—incorporated with attributes of suitability that the stakeholders use to reach a consensus over the best design. He illustrates the idea with a "toy" problem of the redevelopment potential of eight sites in central London that are influenced by six distinct stakeholders.

computations, now usually being referred to as *agents*. Agents are essentially individual objects that have to be well-defined with strong identities and distinct from the environment in which they sit. These might be likened to the "atoms" that compose our cities, notwithstanding that what goes on inside the atom is hidden from our view. Although in cities agents are often considered to be human beings, it is quite possible to define them in terms of any distinct objects that compose a system. In particular, agents might be streets or buildings, components that make up the weather or vehicles on the highway, the bricks that a house is built from, or the pipes/wires that click together to keep our utilities functioning. Their definition is entirely dependent on the context, and in this sense, agent-based models or modeling (ABM) has emerged as a much more generic tool for simulation than most of the other approaches developed hitherto. Indeed, Esri has introduced a plug-in called Agent Analyst that enables users to build agent models that have a spatial component, which is the map in ArcGIS.

The easiest way to introduce ABM would be to illustrate a model of moving cars on a highway or pedestrians on a street. Agents in this case have mobility, and the focus of simulation would be the dynamics of how they behave and how they cluster and spread out. There are many models of this kind linked to spatial environments that are presented using GIS. But here we will change the focus and develop a model for illustrating how the agents who are actually involved in the design process itself communicate with one another in the effort to reach a collective decision. Our model will be about how designers design rather than how they use their knowledge of cities and their environments to generate decisions. We are thus transferring our focus to the design and decision process itself, and we will show how a model can be built that enables us to articulate the way those involved in design communicate and pool their ideas and opinions about what is the best design.

In fact, the model of how geodesigners or the stakeholders who are involved in the design and decision process communicate with one another is rather simple to explain. Essentially, we assume there is a network of relations between stakeholders, which is a structure based on how close, in terms of ideas about the design problem, they are to one another and how likely they are to communicate. The network connects everyone to everyone else, some directly, but most indirectly. The process works as follows. At each time period, those agents who are connected to other agents send their opinions to those agents to whom they are directly connected across the network. When the agents receive the opinions of those to whom they are directly connected, they make a rational compromise: they change their own opinions to an average of those they receive. They then take these new averaged opinions and communicate these using the same network at the next time step. They then average the averages in the second round. If they keep doing this, the initial differences between the agents will be reduced, and eventually everyone will hold the same opinion. Consensus reigns in the form of a weighted average of all the differing opinions. If the problem is suitably framed, then this consensus can be seen as the design solution.

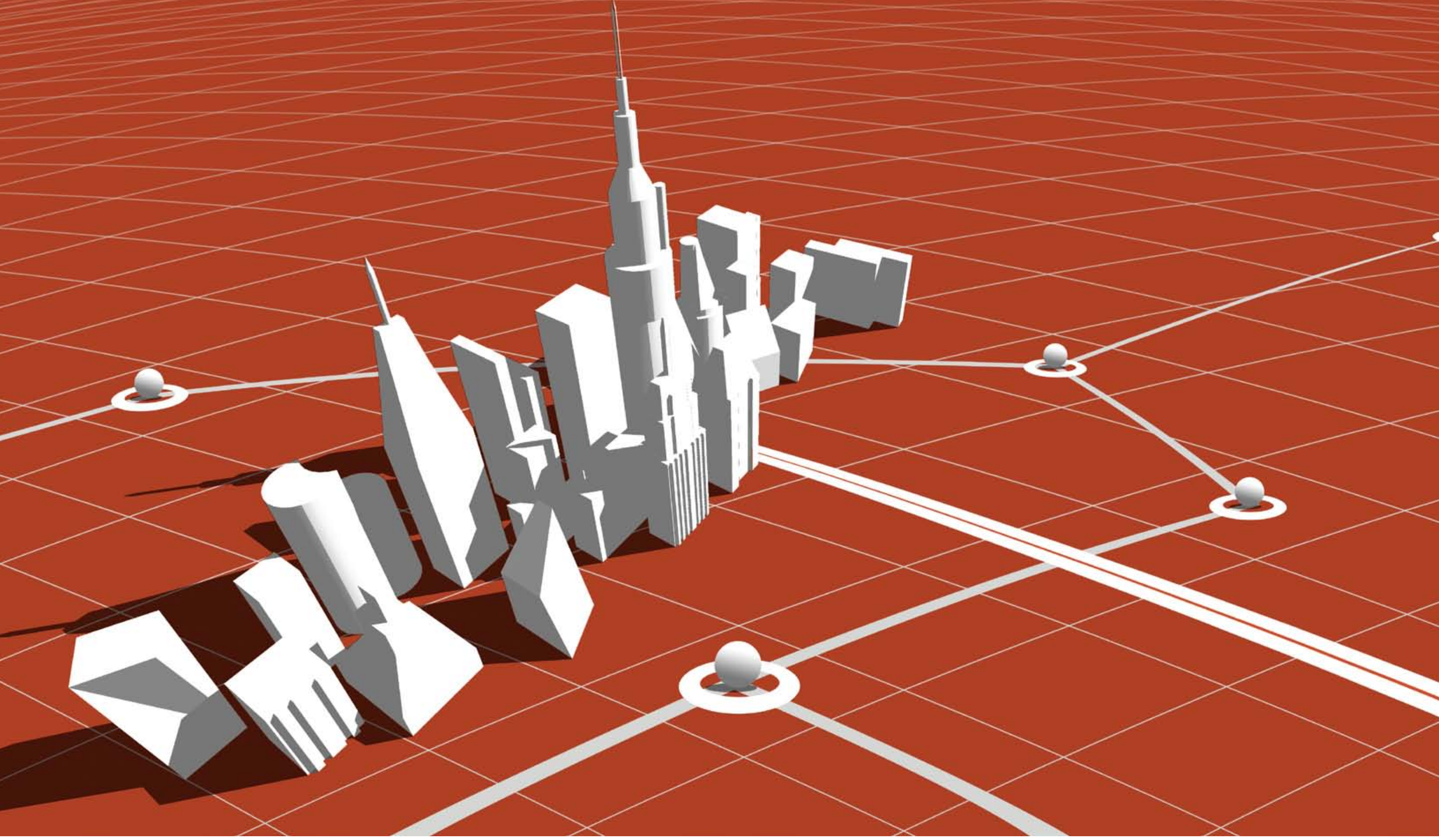


The Sites and the Stakeholders—The location of the area is shown in the inset at the bottom right, while the ultimate importance of each site for redevelopment and the power of the stakeholders in determining this are shown as the percentages in the figure.

Of course, you might object that in any design problem, this kind of consensus could not be ensured. Links in the network might be absent, meaning that some agents never pass their opinions to others. If opinions are passed, the agents may not decide to consider them. There are many ways in which communication may fail or be blocked, distorted, or manipulated. But if a design is to result, then some sort of compromise of conflicting or differing views about the best design must occur. Moreover, this idea of a network could be the basis for the design of a process that would achieve consensus—that is, of designing a network that enables the right kinds of communication to take place from which the best solution is guaranteed. Now this, of course, is an ideal type. This model of agents who are geodesigners in the broadest sense of the word is what we might hope for, but it can be made operational, and it is a point of view that forces us to consider how geodesigners design and converge to an agreed solution.

To illustrate it, let me pose a hypothetical problem that we have studied in London's financial quarter, or the "square mile," where we have identified a typical problem of change and redevelopment of land use and building form that requires the agreement of several key stakeholders. This involves a cluster of buildings composed of residential, commercial, and hospital uses where we show and label the sites in question in the above illustration. This is a toy problem, but it could easily be scaled up to include many building parcels and land uses and many different stakeholders. As in any specific context, the model only comes into its own as a useful way of exploiting geodesign once we do scale up, and thus our toy model simply illustrates the method.

continued on page 26



Agents, Models, and Geodesign continued from page 25

The area for our design is around the original location of the central post office adjacent to St. Paul's Cathedral and the new London Stock Exchange in central London. This is the notional center of the UK postcode districts. Here, Marconi sent the first public wireless signal in 1896, and John and Charles Wesley founded Methodism in 1738 in the street known as Little Britain. The area is composed of eight key sites: the Bank of America/Merrill Lynch and Nomura Bank, which occupy two of the old post office buildings sold off to the private sector in the last 20 years; a residential block built recently; two buildings of St. Bartholomew's hospital, one of these just reconstructed and one ripe for redevelopment; a small Georgian church called St. Botolph's; a large commercial block recently developed; and a pocket park of enormous charm. If you want to look at the problem more graphically, then see the PDF of my slides given when I presented a similar talk at the recent 2013 Geodesign Summit (**www.spatialcomplexity.info/archives/1109**). We can now define six key interest groups—stakeholders—that all have some stake in whether or not these eight sites need to be redeveloped and/or change their use, which would involve some alteration to their building fabrics. The stakeholders are the hospital, in the form of the National Health Service; the residents; the banks; property speculators who continually dwell on high-value sites, such as those in this problem; developers anxious for lucrative redevelopment contracts; and the City Corporation (the municipality), which acts as the basic arbiter of all development in the city. Now each of these agents has a view about whether or not each of the eight buildings should be converted or redeveloped. If we then record these views as being in favor of change (1) or against it (0), then we can assemble a matrix or table where the rows are the stakeholder agents and the columns are the land parcels or sites, a second and different set of agents. We can show this level of interest as in Table 1 below, where each row is the interest (1) or disinterest (0) the relevant stakeholder has in the redevelopment potential of the building parcel.

Now, this matrix or table contains all the salient information about the design problem. This, in fact, is a set of maps. If you look at the table from the vantage point of each stakeholder—across each row—then each is a map of what the stakeholder thinks should be done in each parcel. One could easily imagine each row as constituting a set of grid squares from a 2D map splayed out as a vector rather than a grid or other 2D arrangement of sites. The second problem is defined when we look at each column, which is a set of what each stakeholder's interest is in any particular site.

Now, the problem as we posed it involves each stakeholder taking the map and pooling it with those to whom they are connected in a network. However, we have not yet been at all specific about what the network is, but one way of defining it is from the above matrix. If we pose the question, How related are each of the stakeholders to each other with respect to their maps? then we could relate each row/stakeholder to any other by simply counting the number of common links. We can arrange this as an interaction matrix, and this can act as our communications network, with the strength of the links giving the importance of the communication for the pooling or averaging of maps. To give an idea of this interaction, the network between the stakeholders can be easily derived by counting in the way I have explained as shown in Table 2 on page 27.

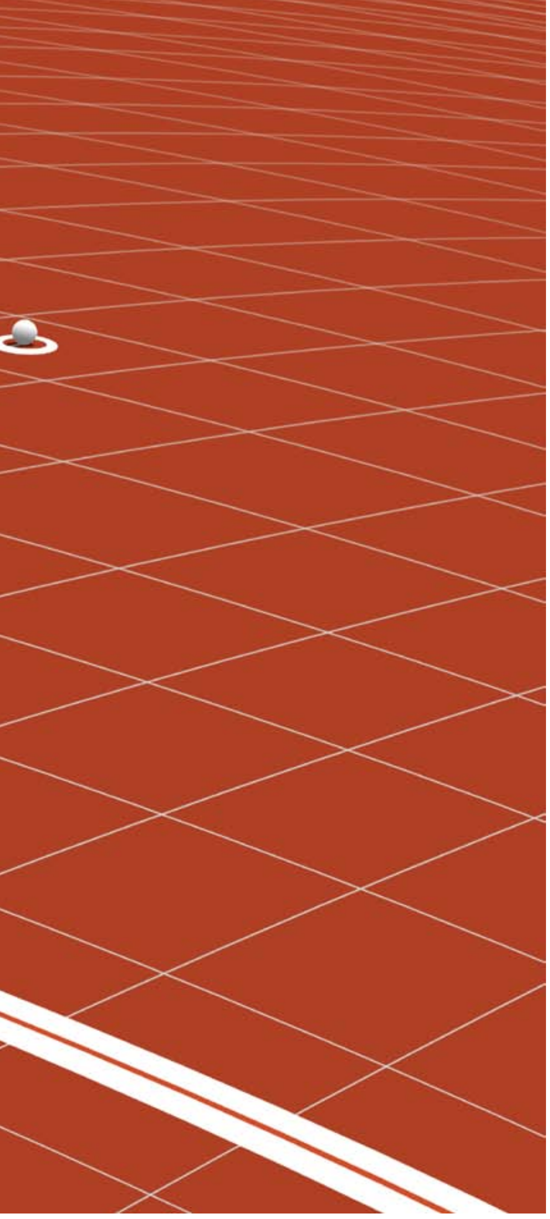
The sums (Σ) of the interactions given at the end of each row must be divided into the entries to get the fractional network weights. Now for the action—for the way the agents interact in moving to a consensus. We can swap each map (row in the initial matrix) for all the other maps linked to each agent in the network mentioned above and then average these maps—the opinions of stakeholders to whom each agent is linked—using the strengths of the links as weights. So for the City Corporation, the new averaged map showing the corporation's new interest in the sites is formed by setting the weights proportionally to the strengths of the connections. So this would be 3/14, 1/14, 3/14, 3/14, 3/14, and 1/14, noting that these weights add to 1 to make the average of the maps of the stakeholders to which the corporation is linked. If we keep on averaging for all stakeholders in this manner, then eventually each map will converge to the same interest that each stakeholder shows in each site, and this would converge to the following values of interest, where we note that we have scaled these degrees of interest in each of the eight sites to add to 100: 7, 7, 18, 7, 14, 21, 5, and 19.

Now, this decision process gives us weights that each stakeholder can apply to produce an average map. But there is another process we might consider as the dual that involves us in averaging each site against each other site in terms of the weight associated with each stakeholder. We count the number of common stakeholders with respect to each pair of sites from the first matrix above, and this gives us another network—a dual network—which is generated as strengths of interaction between the sites. In this sense, the site might also be seen as an agent. If we average on sites with respect to the different views of stakeholders, eventually the same sort of convergence occurs, and we can then find the importance of each site as making up the consensus of the stakeholders. The values we get for each of the stakeholders from the averaging of sites when consensus is reached is as follows, noting again that the values are scaled to add to 100: 17, 6, 17, 23, 25, and 10.

What all this means is as follows: For the first problem—the so-called primal—we work out a probability that each site should be redeveloped for change of use, which is agreed by all stakeholders, and this occurs when they reach a consensus by successfully changing their degree of interest sequentially. For the dual problem, each

Stakeholders	Buildings	Aldersgate Office	St Botolph's Church	Nomura Bank	Residential	Postman's Park	Bank of America	Hospital New Build	Hospital Old Build
City Corporation		0	0	0	0	1	1	0	0
Residents		1	1	1	1	1	1	0	1
Hospital NHS		0	0	1	0	1	1	1	1
Developers		0	0	1	0	0	1	0	1
Property Spec		0	0	0	0	0	0	0	1
Banks		0	0	1	0	0	1	0	1

Table 1.



							Σ
City Corporation	3	1	3	3	3	1	14
Residents	1	1	1	1	1	0	5
Hospital NHS	3	1	3	3	3	1	14
Developers	3	1	3	5	4	2	18
Property Spec	3	1	3	4	7	2	20
Banks	1	0	1	2	2	2	8

Table 2.

stakeholder is given a degree of importance in the problem, which is due to the fact that there is convergence on the value of each site.

Now, I appreciate that this is a huge mouthful of ideas to absorb. I have not produced many graphics here to explain it blow by blow, but the map on page 25 shows the eight sites in question as land parcels and their relative importance and also tables of the stakeholders (on pages 26 and 27) and their relative importance in determining the importance of the sites. What this shows is that the property speculators and developers have much more importance in influencing the outcomes of redevelopment than the residents or even the banks. In terms of the eight sites, the most important with respect to a change of use are, first, the banks that acquired the old post office sites and are now subject to financial problems—hence their current decision to lease out these buildings—and second, the old hospital site. The Georgian church is protected, and there is little enthusiasm to redevelop the newly developed hospital site, the existing Aldersgate offices, and the residential block, all of which have been renovated and/or rebuilt in the last 15 years. The park is intriguing, as there is more than a little interest in changing its use, for it appears the property and development interests are central in this. This is, however, unlikely to happen, as it is one of the most highly protected pieces of green space in the city, with more than a few historic associations.

What we have produced is a model of how we can articulate stakeholders and the sites they are interested in as two different sets of agents that interact within themselves as well as between. The model we have suggested is rather simple, but it does focus on what it might take to engender important changes in how these kinds of problems might be resolved. Of course, the problem can be formalized mathematically, and although the algebra is not difficult, it is needed so that one can work out weights and averages. The real power of this approach, however, is in dealing with big problems where it is not obvious how powerful interests might be or how important sites might be. If we have hundreds of stakeholders and hundreds of sites linked spatially, the sort of networks that might apply can be extremely tricky to explore. Moreover, in such problems, consensus is often difficult to achieve without ensuring that certain communication channels are put in place. This, then, is the process of geodesign. Our argument here is that it is important in advancing this science that links GIS and design to build models not only of the subject matter and focus of the design but of the design process itself: models not only of the product but also of the process.

Most of the software that is being developed for geodesign lies more in the *geo* component of GIS than in the design component. But the process we are suggesting as good geodesign practices is a kind of map algebra, and it could be implemented as a way of combining land coverages within software, such as ArcGIS using the ModelBuilder toolkit. If we think of stakeholder maps as different land coverages, then the process of combination is similar to many overlay map techniques central to land suitability analysis. I am not suggesting that we should use GIS in this way, although it would be easy to add this into such generic software. But I think that formal models of the geodesign process are useful as thought experiments about how one should go about design, and they clearly suggest ways in which stakeholders with very different interests might come to some sort of agreed answer.

Note: A version of this paper was presented at the 2013 Esri Geodesign Summit, held January 24–25, 2013 (**www.geodesignsummit.com**). A PDF of the presentation is available at **www.spatialcomplexity.info archives/1109**.

About the Author
Michael Batty is Bartlett Professor at University College London and chair of the Centre for Advanced Spatial Analysis (CASA).

For more information, contact Michael Batty (e-mail: m.batty@ucl.ac.uk).

Wendy's, Arby's, Culver's

Restaurants Optimize Site Locations

More and more quick-service restaurants and franchise owners are discovering the power of GIS to find the best sites for their restaurants. Owners of successful franchises have relied on GIS technology to discern markets for many years. The technology provides tools that help organize information by using location as the common identifier for data. By understanding where franchises, the competition, and customers are located, franchisors can make informed decisions, improve communication, and share their knowledge with others.

Better Trade Area Assessment

Arby's Restaurant Group, Inc., the second-largest quick-service sandwich chain in the United States, uses Esri Business Analyst to guide business decisions. Arby's, based in Atlanta, Georgia, uses the solution to more accurately assess restaurants and trade areas for projects, such as growing the chain and remodeling or relocating restaurants.

Business Analyst merges Esri's vast demographic and business data with detailed maps and allows organizations like Arby's to perform spatial analysis. Using the solution, Arby's can now update the locations of its restaurants and business development activity on designated market area maps, which describe the activity taking place in individual markets.

Since Business Analyst can be easily deployed across the enterprise as a web-based solution, on desktops, and even from iPhones and iPads, Arby's can make these maps accessible to its staff. Development teams working in the field are able to quickly access the maps and easily discover the information they need through the Arby's intranet.

"Esri Business Analyst has saved our GIS analyst countless hours and has had a positive impact on the business development department," says Dave Conklin, senior vice president, business development, Arby's.

Site Selection and Predictive Modeling

Wendy's, the world's third-largest quick-service hamburger chain, is integrating Esri Business Analyst with the restaurant's corporate IT systems. The web-based business GIS solution will be part of the company's reporting system for new locations, assisting in site selection and market analysis.

"Demographic data and location analytics are critical components when making investment decisions to build new restaurants," says Dennis Hill, vice president, real estate. "With Business Analyst, everything we need—including mapping, analytics, and modeling—can be done on one platform that is scalable across our organization." The Wendy's chain includes more than 6,500 franchise and company-operated restaurants in the United States and 27 countries and US territories worldwide.

Business Analyst replaces a current system in use at Wendy's. Implementation was completed by Esri Partner GIS, Inc., located in Birmingham, Alabama. The new solution includes server GIS applications, Esri demographics data, and customized analytics developed specifically by GIS, Inc., to streamline and enhance the chain's site screening and market assessment process. Staff can easily view sales records, customized demographics, and other business reports on existing restaurants through an intuitive mapping interface. The system also enables Wendy's to perform predictive modeling and assess potential restaurant cannibalization for new and existing sites by simply clicking on the map.

Building a Better Franchise

With almost 500 restaurants that stretch from Wisconsin's heartland east to South Carolina, into Texas, and west to Utah, Culver's is continually looking at possible new sites. The first Culver's restaurant opened in 1984. Cofounders Craig Culver and his wife, Lea, oversee almost 500 restaurants in 20 states through Culver Franchising System, Inc.

Although the success of Culver's stems a great deal from the delicious food it serves, the company also relies on Business Analyst software and data to ensure the locations its new franchisees are selecting will be successful. Using Business Analyst, new sites can be easily compared and contrasted by analyzing the demographics of existing restaurants, then pinpointing new areas that are similar.

"We chose Esri because they have the best information available for what we need to know," says Dave O'Brien, real estate manager at Culver's. "Using Business Analyst, we are able to easily compare and contrast new sites by analyzing the demographics of our existing restaurants and then pinpointing new areas that are similar."

O'Brien uses a combination of software for an in-depth view of the market at analysts' desks, as well as providing an easy way for anyone in the company to incorporate the information they find into the tools they need to do business. Business Analyst, including the segmentation module, provides in-depth customer analytics.

Business Analyst Online is used for creating boardroom-quality maps and easy-to-understand reports that are used by the franchise partners. "We are a family company, and this is apparent in all our daily efforts," stresses O'Brien. "We want our franchise partners to succeed. Without them—the local owners and operators in their own communities and hometowns—we would not exist."

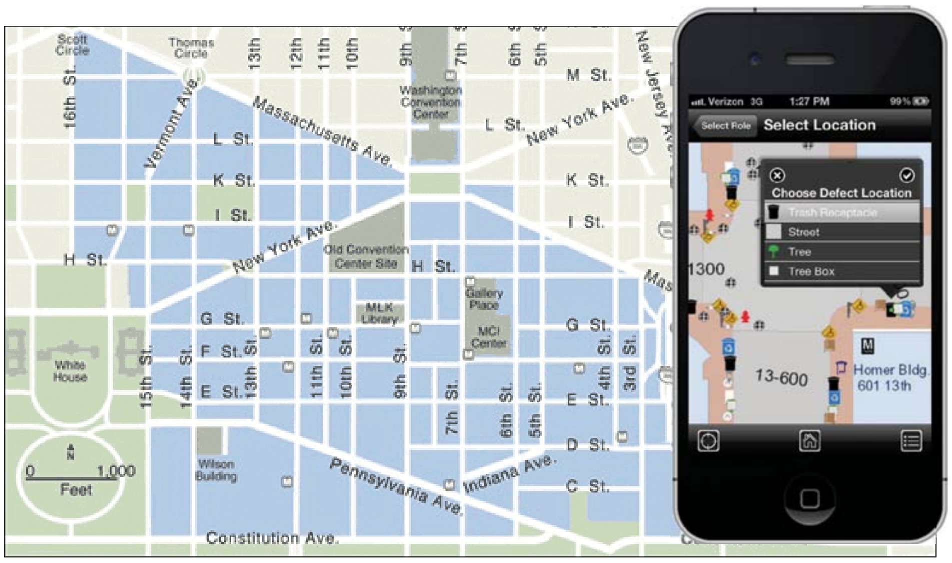
Find out more about how GIS can help businesses grow at esri.com/retail.

Culver's is continually looking at possible sites for new restaurants.

Maintaining a Safe and Healthy Community for the District of Columbia

Highlights

- DowntownDC BID now benefits from an integrated end-to-end solution for spatial data management.
- ArcGIS for Server serves maps and applications.
- GIS streamlines the data collection process, aids quality control, and integrates 311.



The DowntownDC BID Boundary Map, a 138-block area of approximately 520 properties from Massachusetts Avenue on the north to Constitution Avenue on the south and from Louisiana Avenue on the east to 16th Street on the west in Washington, DC. **Inset:** iPhone screen shot, illustrating a condition assessment taken while in the field.

The downtown business district in Washington, DC, is a bustling hub of tourism, business, and residential activity comprising more than 500 commercial buildings and a host of DC landmarks, including museums and cultural institutions, as well as the Gallery Place, Chinatown, Federal Triangle, Franklin Square, McPherson Square, Midtown, and Penn Quarter neighborhoods. Formed by local businesses and funded by property owner tax assessments, the DowntownDC Business Improvement District (DowntownDC BID), which includes the area from Constitution Avenue to Massachusetts Avenue and 16th Street to North Capital Street in northwest DC, is dedicated to the improvement, marketing, beautification, and maintenance of this special district. The primary goal of the organization is to tend to the well-being of the area's public environment, local economy, and community safety to help promote and retain businesses.

To maintain a safe, healthy urban atmosphere, DowntownDC BID continuously monitors and evaluates the condition of the district's facilities and environment with the help of its more than 80 safety, hospitality, and maintenance workers (SAMs). SAMs are responsible for field data collection relative to fixed assets and variable conditions throughout the district, including features such as trash receptacles, benches, fire hydrants, bus shelters, and parks/open space areas.

At the heart of their mission, SAMs track and report the acceptability of these assets as it relates to their condition, but with more than 80 different SAMs keeping detailed, paper-based records of the DowntownDC BID area, challenges naturally arose with respect to maintaining the accuracy, integrity, and timeliness of the data collected. It was clear that to successfully track and maintain the inventory, DowntownDC BID was in need of an asset management solution that would allow the SAMs to efficiently and accurately gather information in the field and provide in-office editors with the ability to verify this data and then rapidly push service requests to the district government's work order management system.

"We realized that the way our organization was reporting conditions on public space was outdated," says David Kamperin, director of public space management for DowntownDC BID. "We needed a solution that would specifically identify fixed assets within the community while providing flexibility to capture variable conditions at the same time."

To address this challenge, DowntownDC BID teamed with Esri Partner JMT Technology Group (of Sparks, Maryland), a leading geospatial and technology solutions provider with a wealth of experience implementing Esri enterprise solutions for field data collection and asset management. JMT Technology Group worked with DowntownDC BID to design, develop, and implement a solution built on ArcGIS technology that streamlines the data collection process, incorporates tools and processes for quality control, and provides integration with the district's 311 work order management system. DowntownDC BID was already using mapping and reporting capabilities from Esri. Says Kamperin, "This solution provided our team with an updated platform based on technology with which we were already familiar." Ultimately, the solution allows DowntownDC BID to more effectively understand, plan, and make improvements within its area.

The DowntownDC BID solution leverages the ArcGIS system, including ArcGIS Runtime SDK for iOS for field data collection, ArcGIS for Desktop to manage and administer the solution, an enterprise geodatabase with PostgreSQL to store the data, and ArcGIS for Server to serve the maps and applications from the Amazon Elastic Compute Cloud. "This implementation provides an integrated end-to-end solution for spatial data management and a platform for future growth," says Tim Abdella, GISP, project manager for JMT Technology Group.

At the heart of the solution is ArcGIS for Server on Amazon Web Services with an enterprise geodatabase implemented in the PostgreSQL RDBMS and built on the ArcGIS for Local Government Information Model. This approach provides a centrally managed environment from which users can access and share data and an opportunity for DowntownDC BID to leverage freely available maps and applications built on the ArcGIS for Local Government Information Model.

To support the field-based asset management requirement, a custom, focused iOS application was developed using ArcGIS Runtime SDK for iOS. This field asset management application consumes cached basemap services and data asset services from DowntownDC BID.

"This provides DowntownDC BID with an intuitive means to inventory new and existing features and report defects found during routine inspections," says Abdella. "The application integrates with the device's built-in functionality to provide the user with the ability to include photos of the field conditions and leverage GPS to quickly define location."

The final component of the solution is an ArcGIS for Desktop add-in developed to support quality control efforts, integration with the district government's 311 system via the open311 API, and reporting functionalities that will allow DowntownDC BID to inform property managers of activities and actions taken at user-defined intervals.

For more information, contact Karyn Le Blanc, director of communications, DowntownDC BID (e-mail: karyn@downtowndc.org, web: www.DowntownDC.org), or Ashley Flamholz, senior marketing coordinator, JMT Technology Group (e-mail: aflamholz@jmttg.com, web: www.jmttg.com).

The Greek Island of Kythera Jumps to the Forefront of Historical Research

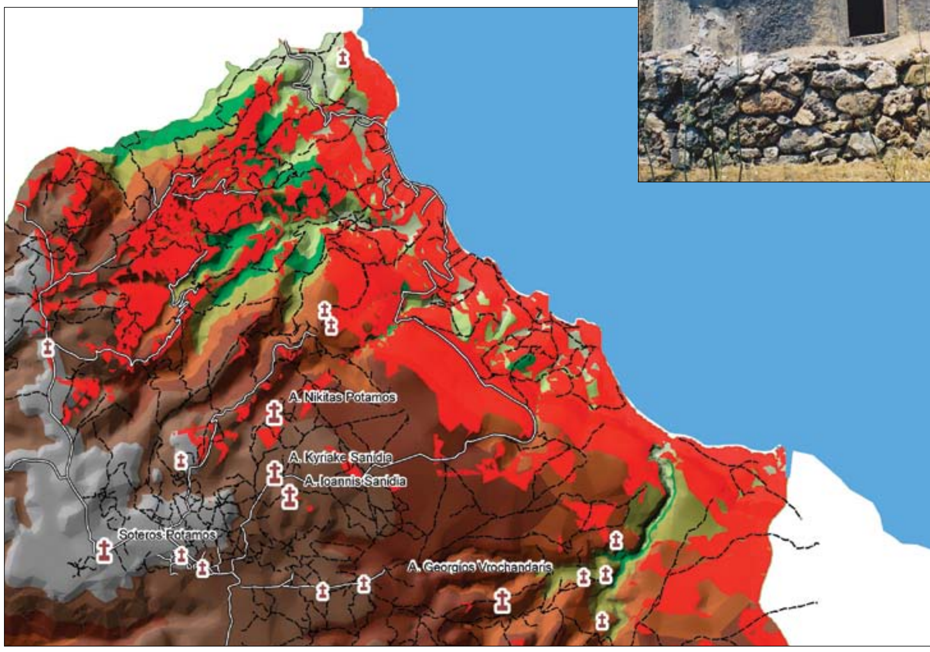
Mapping Citadels and Churches with GIS

By Richard MacNeill

The small churches and chapels across the island have been a consistently significant part of the way of life of Kytheran families.

Highlights

- GIS supports the rediscovery of a forgotten way of life.
- ArcGIS has been successfully integrated into a toolbox for historical research.
- Spatial analysis with GIS reveals historical changes in land use.



The relationship between the location of churches in the landscape and areas visible from the sea (in red) helps researchers assess the reality of the historical threat of coastal raids and the presumed reaction of the local population.

Over the centuries, the island of Kythera, nestled between the southern peninsulas of the Greek Peloponnese, has been subjected to the fortunes of war; occupation; piracy; and, occasionally, the quiet solitude of poverty and isolation. Mass migration to Australia after the Second World War was only one in a series of fundamental changes for the island.

Today, villages of the north of the island lie abandoned, the roofs of the houses fallen and the exposed rooms forests of brambles. The paths that once led to springs by the bright, running streams have been lost, and the springs, mills, and washing troughs that once sustained the communities lie derelict. But something is changing. Some villages show new life as people return to the island. Professor Tim Gregory and Dr. Lita Gregory are two people who have returned. Academics at Ohio State University with close connections to the Kytheran community, they are leading projects designed to bring to light the forgotten history of Kythera.

History is never straightforward. For an island, most of its history being nowhere near the hubs of commerce or empire building, historical records consist of accounts written by the two literate classes: the clergy and the Venetian powers that were overlords of the island after the 13th century. Written history, largely accounts of the lives of the saints and administrative data, is therefore incomplete, inconsistent, and subjective.

How did the history of the island play out for the local communities in the small, scattered towns? How did the vast majority of island inhabitants live? What was their response to the piracy, depopulation, and ruin that characterize written accounts of the island's history? Were these accounts in fact accurate? Spatial analysis supported by geographic and cultural surveys is working to shed light on local history across the island and, by asking these questions, put the "official" accounts to the test.

The work of uncovering a forgotten history involves constant interaction between field surveys, locating and recording features, spatial analysis synthesizing information from these records, and a constant generation and testing of theory. The ability to use a suite of capabilities to compile and refine spatial data, review maps and plans presenting area-based summaries, and explore spatial relationships and distributions is critical.

ArcGIS originally came into the picture with staff of the University of Sydney, Australia, in the beginnings of this work. At this time, ArcGIS

Temporally Discrete Prehistoric Activity Identified

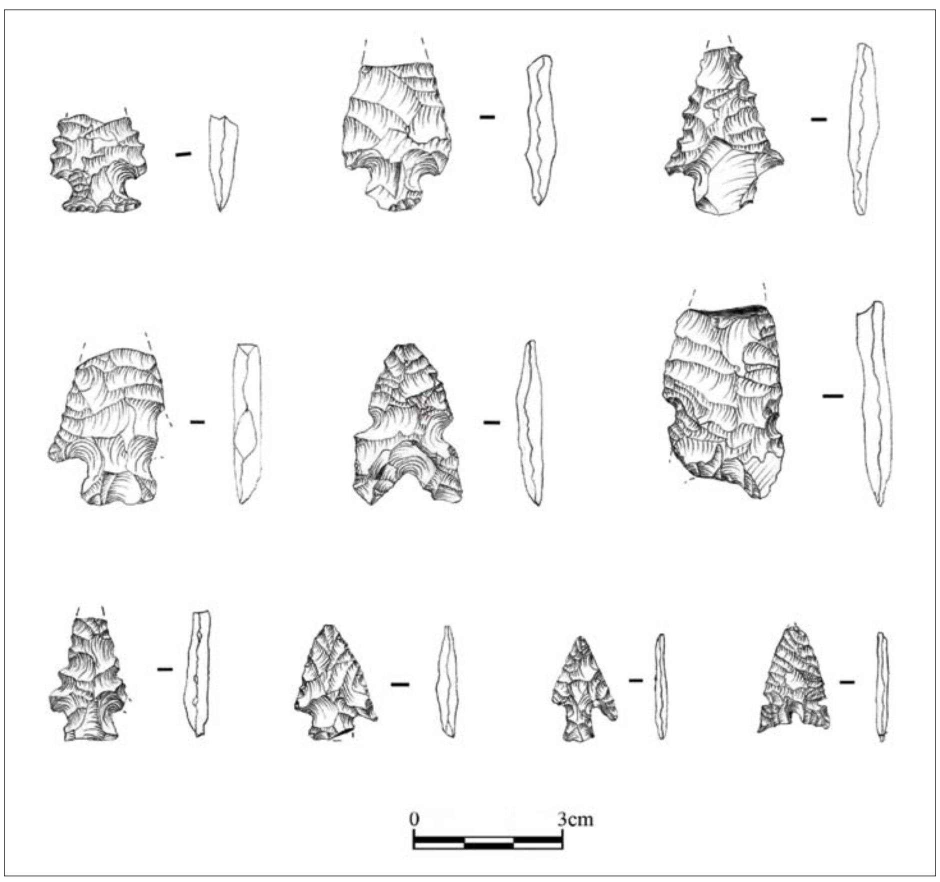
Mitigating Impacts of Transmission Line Upgrades in Western Colorado

By Matthew J. Landt and Seth Frame

Highlights

- Spatial modeling with ArcGIS focused on the distinction of discrete prehistoric activity areas.
- ArcGIS 3D Analyst displays of the activity areas enable an understanding of overlapping occupations.
- GIS improves archaeological understanding in ways not readily available through classical statistical software analyses.

Electric power provider Tri-State Generation and Transmission Association, Inc., is owned by 44 electric cooperatives and serves 200,000 square miles of Colorado, Nebraska, New Mexico, and Wyoming. When Tri-State planned to upgrade the 92-mile, 115-kilovolt Nucla-to-Sunshine Transmission Line in San Miguel and Montrose Counties, Colorado, because of the potential to disturb archaeological deposits associated with numerous prehistoric and historic sites on public land, the United States Department of the Interior Bureau of Land Management (BLM)—Uncompahgre Field Office requested the involvement of archaeologists to mitigate the impacts of construction. Alpine Archaeological Consultants, Inc., was hired to conduct archaeological investigations and monitor construction activities during the transmission line rebuild.



Projectile points recovered during the study of site 5MN8324. (Drawn by Jenn Mueller.)

Western Colorado has been occupied for at least the last 10,000 years, and numerous sites represent the overlap of many temporally different occupations. Traditional archaeological mitigation in western Colorado has attempted to focus on single occupations by excavating prehistoric and historic structures or fire pits, which generally allows the identification of plant and animal processing events, as well as the definition of stone tool workshop or activity areas.

One prehistoric site along the Nucla-to-Sunshine Transmission Line, site 5MN8324, was inappropriate for such excavations because of a lack of suitable subsurface deposits. At that site, archaeological investigations focused on the mapping of surface artifacts in an effort to define intrasite activity area clusters and any association those clusters may have had with temporally discrete prehistoric occupations.

Fieldwork at the 2.45-hectare (6-acre) site began with Alpine carefully flagging individual artifacts for detailed site mapping. The dense pinyon-juniper woodland prevented the line-of-sight requirements of using a total station for site mapping, so an electronic map was created with a survey-grade Trimble 2008 GeoXH device attached to a vertical rod with a circular bubble level. Utilizing multiple base stations, 97 percent of the map data was corrected within a +15 cm margin of error. In this way, 1,550 artifacts were point plotted and described. Artifacts in the mapping protocol include 1,454 pieces of flaked stone debris, 92 flaked stone tools, 3 fragments of ground stone tools, and 1 stone tool cut-marked bone fragment.

was emerging as the system of choice, under the aegis of Dr. Ian Johnson (Archaeological Computing Laboratory, University of Sydney), replacing an initial reliance on a legacy GIS. Staff currently make use of an Esri university site license provided to Ohio State University.

ArcGIS contributes in each of these areas. It provides the resources to compile digital spatial data by georeferencing scanned maps and field plans. Its basic editing and coordinate geometry capabilities allow users to integrate recorded measurements. Heads-up digitizing capabilities enable users to efficiently digitize map- and plan-based topographic and architectural features. Large-scale elevation data resulting from this work forms the source for fine-detail triangulated irregular network models and derived surfaces generated using the ArcGIS 3D Analyst extension. The ArcGIS Spatial Analyst extension explores spatial relationships and distributions making use of these results. Moreover, the ability to efficiently and rapidly integrate the processes of compiling, representing, and analyzing spatial data allows researchers to work interactively with spatial information sources that complement textual and oral sources.

Researchers have used spatial systems to support fieldwork in Kythera since 1999, when staff from the University of Sydney and Ohio State University joined to form a team under the Australian Paliochora-Kythera Archaeological Survey (APKAS) project. Over the years, this work has developed into a series of community-based projects, working in close cooperation with the Kytheran community to reveal more of the island's past and preserve knowledge of a way of life that existed on the island until the end of the Second World War.

The baseline in the hierarchy of spatial systems is an extensive topographic dataset providing details of roads, paths, terraces, and other public infrastructure. This work, commenced by staff at the University of Sydney, is continually being extended as the geographic scope of the project increases.

This level of data forms the basis for cultural datasets comprising features and attributes associated with social and cultural activity from the earliest records to the present day. These datasets include the location and characteristics of churches and the results of diachronic (spanning historical eras) archaeological field surveys.

These two levels of data combine to form the base for spatial analysis designed to prompt, support, and test theories about social and cultural change and practice across the history of Kythera.

An example of this work is the use of the locations and characteristics of 58 churches spanning nine centuries to test historical accounts by determining changes in their distribution over time.

In the absence of reliable and consistent records, churches and their location in the landscape can provide insights into the locations of local settlements and the routes by which people moved, traded, and communicated.

Tradition and written sources tell us that two significant events influenced life on Kythera during the period that these churches were built and used. After the Fourth Crusade in 1250, Kythera came under the rule of Venetian interests. Less well known but more dramatically documented was the sack of the citadel of Paliochora, then capital of the island, by the Turkish admiral Barbarossa in 1537.

The mass of records resulting from the Venetian occupation of the island, largely official census records and correspondence, indicate the start of a colonial exploitation of resources that was to continue into the last century. The sack of Paliochora, characteristically for Kythera, is said to have resulted in massive ruin and long-lasting depopulation.

The study involves two analyses. The first uses a deceptively simple nearest-neighbor tool to determine the degree of clustering within the locations of churches by comparing the average distance between points with a hypothetical random dataset. The reporting coefficients provided by the tool and the ability to vary the algorithm allowed the information resulting from this analysis to be interpreted in the light of the terrain. This analysis was applied across combinations of three periods defined by the above events.

The second analysis reconstructed likely routes of communication by applying the least cost path analysis tool to link a randomly distributed set of points across the study area to two alternate centers associated with the flux of power in the island: Potamos, a market town reflecting the dominating Venetian influence, and Paliochora, the old Byzantine capital of the island.

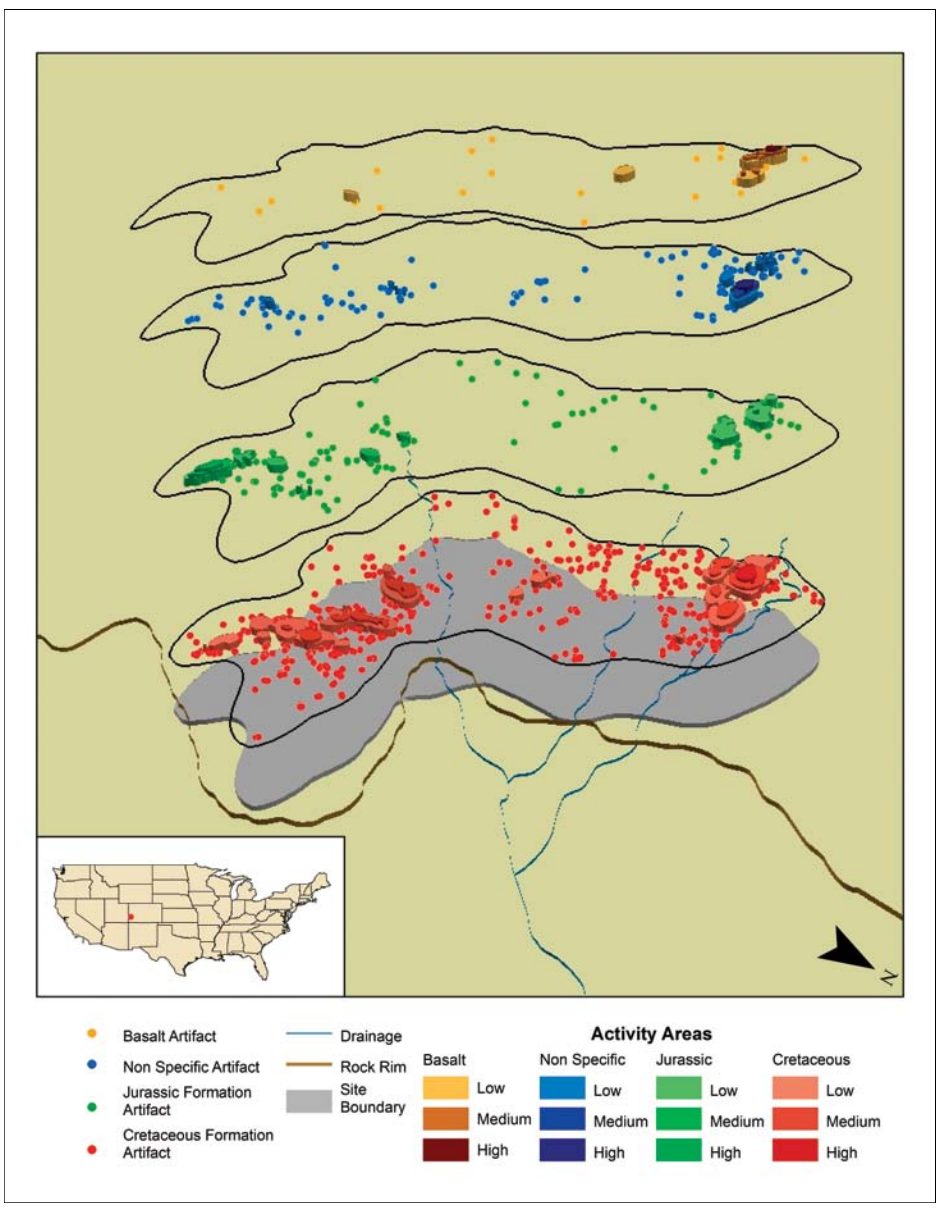
The results of these analyses are not conclusive and indeed can never be so. However, the spatial analysis shows a trend toward greater clustering of churches in the years following the 16th century. While suggesting general changes in land use and settlement perhaps at odds with accounts of depopulation, these results prompt further research into the Venetian archives for information on corresponding changes in population and local economic conditions. The real significance of these results is the role they play within the processes of historical research.

This work is long term and tightly integrated with the Kytheran community. Its objectives will expand as more geographic and cultural surveys take place across specific areas of the island. The results of this work prompt and support new ways of looking at the past that involve a finer focus and a deeper understanding as information is gleaned from the character and distribution of features. Already, the results of spatial analysis are prompting new ways of looking at the past on the island of Kythera.

About the Author

Richard MacNeill is a senior staff member of the APKAS project and has participated in work on Kythera since 2003. He has maintained spatial systems and provided GIS analysis and data management for a variety of cultural heritage and ecological organizations and agencies.

For more information, contact Richard MacNeill (e-mail: macneill55@gmail.com) or visit **kythera.osu.edu**.



3D modeling allows archaeologists to visualize the degree of overlap between discrete stone tool material activity areas.

ArcGIS 10 Desktop with the Spatial Analyst extension was then used to define discrete activity areas, which were graphically displayed with the ArcGIS 3D Analyst extension.

Discrete groups of artifacts were created with ArcGIS Spatial Analyst by building nearest-neighbor isopleth gradients. The gradients were based primarily on the geologic source of the stone and secondarily by each artifact's proximity to similar materials. The artifacts were sorted into different geologic groups (e.g., Jurassic-age stone versus Cretaceous-age stone) based on visual descriptions of the stone material for each artifact. Within each geologic group, finer distinctions allowed for further subdivision into distinct geologic nodules (e.g., tan Cretaceous-age stone versus white Cretaceous-age stone). All the stone artifacts were grouped into one of 11 geologic nodule types.

Once each artifact was assigned to a geologic nodule type, ArcGIS was used to create a nearest-neighbor isopleth based on a 50 m^2 (i.e., 4 m radius) activity area. Or rather, the number of neighboring artifacts of the same material within 4 m of a single artifact was used to create an amplitude value for that artifact. The amplitude points for all 1,550 artifacts were then turned into a raster with six contour intervals (using the Jenks optimization method). The contour intervals were then displayed as an isopleth map. The higher amplitude clusters are likely representative of activity areas with high archaeologically interpretable value. In essence, by defining groups of artifacts that likely came from the same geologic source, archaeologists can better define and understand prehistoric stone tool use in western Colorado.

Understanding prehistoric use of an area is easier if the spatial clusters are shown to be temporally discrete, which archaeologists frequently accomplish with temporally defined projectile point forms. During the mapping protocol, temporally diagnostic arrow points and atlatl/dart points were found. Those projectile points indicate that the site was occupied between 2000–1200 BC and AD 450–1400. Spatial analyses of the density groups with reference to the projectile points indicate that in only one case were projectile points from two different temporal periods included in the same artifact group. In that case, however, there were subtle spatial differences within the group to separate the two. As such, the cluster analysis performed with ArcGIS Spatial Analyst enabled the spatial and temporal division of artifacts into discrete prehistoric activity areas.

With Spatial Analyst, the hierarchical clustering of artifact groups allows the analyst to focus on areas of likely activity and spend less time dealing with distant or fringe pieces within the analytical dataset. By removing the lowest contour values, which are mostly background noise from thousands of years of occupation, spatial analysis allows archaeologists to concentrate on artifact groups that are more readily interpretable as the product of focused human activity.

About the Authors

Both authors are employed by Alpine Archaeological Consultants, Inc., in Montrose, Colorado, where Matthew J. Landt is a principal investigator and Seth Frame is a GIS specialist.

For more information, contact Matthew J. Landt (e-mail: matt_landt@alpinearchaeology.com; tel.: 970-249-6761, extension 23) or Seth Frame (e-mail: seth_frame@alpinearchaeology.com).

ArcGIS the Platform—On Display at the 2013 Esri International User Conference

You Are GIS . . . You Come Together to Redefine the New Spirit of GIS

The Esri International User Conference (Esri UC) is where you can spend five days experiencing more than 900 GIS success stories, best practices, and real-world projects from more than 15,000 of the brightest minds in GIS that all have one thing in common—they are all Esri software users just like you.

This year promises to be even more informative and dynamic as presenters concentrate on mobile devices, 3D technology, cloud-based computing, GIS workflows, data management, and new ArcGIS features that improve the efficiency and deployment of your solutions across all devices.

Discovering ArcGIS the Platform

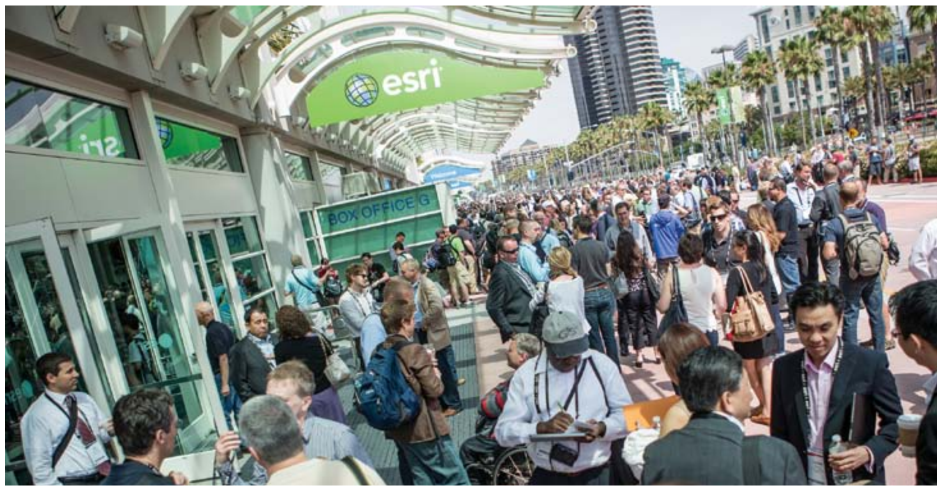
The 2013 Esri UC creates the opportunity to work face-to-face with nearly 1,000 Esri staff on the latest features released in ArcGIS and ArcGIS Online, providing user sessions, tech workshops, demo theaters, and displays to discover the latest techniques to open geospatial capabilities to any of your organization's users by any application on any device anywhere, anytime. Come ready to learn the following fundamental features of the ArcGIS platform:

- Ready to use
  - Self-service mapping
  - Applications across all devices and browsers
  - Content
  - Services (routing, address, geoprocessing, analysis, etc.)
- Strong developer access and tools
- Platform for easily hosting and sharing applications and content
- Dynamically scalable and redundant (cloud infrastructure)
- Open and accessible using standards
- Supports all geospatial data types, including real-time server networks
- Provides an ecosystem of applications, content, and communities for users and partners
- Provides simple access to GIS using a software as a service (SaaS) model
- Integrates with ArcGIS desktops
- Integrated with business intelligence tools (Microsoft Office, SharePoint, etc.)

The Esri UC is more than a collection of sessions, exhibits, and Lightning Talks—it is our yearly opportunity to gather together to inspire, share, and collaborate on the latest GIS technologies available to create a better world through the power of geography. From the opening presentation on the main stage to the smallest session room, you'll be inspired by the innovative ways GIS is helping address important issues around the world.

You can't get this comprehensive combination of firsthand information anywhere else. Make sure you're taking full advantage of Esri technology by joining us in San Diego, California, this summer, July 8–12.

Learn more and register at esri.com/uc.



Save the Date
GIS Day 2013

When: Wednesday, November 20, 2013.

What: GIS Day is a grassroots celebration for everyone to learn and discover the many ways GIS can help people make better decisions.

Where: Worldwide—nearly 1,000 registered events in 2012 in schools, universities, community centers, and offices.

gisday.com

Interesting ArcGIS Services

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

Cultural Heritage of Norway
www.kulturminnesok.no
Kulturminnesøk is a web portal that provides an overview of the protected heritage sites in Norway.

School District Demographic System
nces.ed.gov/surveys/sdds/ed/index.asp
This site provides access to demographics, social characteristics, and economics of children and school districts from the National Center for Education Statistics of the US Department of Education.

Economic Development Site Selector
www.lambtongis.ca/siteselector
The County of Lambton, Ontario, Canada, designed a custom Flex economic development site with demographic charting, printing, and advanced printing to PDF capability.

Texas Beach Watch
www.texasbeachwatch.com
Funded by the US Environmental Protection Agency and administered by the Texas General Land Office, Texas Beach Watch enables agencies and the public to monitor water quality at Texas' recreational beaches.

SpatiaLABS Enhance College Coursework for Instructors and Students

Installed from a DVD, SpatiaLABS from Esri Press are designed to supplement college coursework with computer lab activities that enhance spatial reasoning and analysis skills in students. Across an entire campus, educators decrease the time spent preparing materials for their course with this packaged solution. Additionally, students are offered a platform to see real-world applications of the concepts and skills they are studying in their art and science classes through the use of mapping technology and visualization tools, including Esri's ArcGIS software.

Esri Press SpatiaLABS DVD.

SpatiaLABS Supplement Arts and Sciences Courses
More than 60 labs are available and examine issues, such as dwindling resources, environmental equity, and global politics, allowing students to feel a sense of personal responsibility and empowerment to make a difference. Each lab activity functions independently, but some labs are organized into course sets, such as the following:

General Interest Topics
- Determining Areas Accessible to Search and Rescue Teams in the Ouachita National Forest
- The Global Oil Market: A Spatial Perspective of this Complex Phenomenon

Forestry Topics
- Determining Insect Vulnerability
- Calculating Watershed Impacts

Business Topics
- Demographic and Lifestyle Segmentation
- Sales Territory Design

Students Better Understand Our World
SpatiaLABS teach students how to approach a spatial problem using analysis and visualization rather than teaching the mechanics of geospatial tools. Whereas books deliver concepts, SpatiaLABS provide a framework for analyzing those concepts against real-world issues.

Getting Started
There is an annual license fee for SpatiaLABS. Within SpatiaLABS, each lab is classified by level. Level 1 labs are for students with little or no exposure to GIS. Level 2 labs require some basic GIS skills. Level 3 labs are advanced activities written more like guidelines, providing students with what they need to do, but little, if any, instruction on how. Most labs require students to have had some exposure to GIS.

To learn more about SpatiaLABS, visit **esri.com/spatialabs** or call Esri at 1-800-447-9778.

New Training and Certification Offerings from Esri

Training

Keeping Up with Change
The real world is dynamic—communities expand, natural disasters strike, and economies grow (or falter). As change occurs, organizations must ensure their geospatial data assets remain accurate and up-to-date. After all, data is the building block of every GIS map and application, and analysis results are only as reliable as the data they are based on. The courses below teach ArcGIS 10.1 best practices to efficiently maintain geospatial data.

- **Editing Data with ArcGIS for Desktop—**Instructor-led course
- **Editing and Maintaining Parcels Using ArcGIS—**Instructor-led course

ArcGIS Customization and Development
Developers around the globe are building compelling desktop, web, and mobile applications that feature ArcGIS maps, data, and services. Developers and GIS professionals alike see the value of using Python scripts to automate and share ArcGIS workflows. For ArcGIS 10.1, the courses below are available.

Desktop Development
- **Building Desktop Applications Using ArcGIS Runtime SDK for Java—**Instructor-led
- **Building Desktop Applications Using ArcGIS Runtime SDK for WPF—**Instructor-led
- **Programming ArcGIS for Desktop Using Add-ins—**Instructor-led course
- **Introduction to ArcGIS Runtime SDK for WPF—**Free training seminar

Application Development
- **Building Web Applications Using ArcGIS API for Flex, JavaScript, or Silverlight—**Instructor-led courses
- **Introduction to ArcGIS for Server REST API—**Web course
- **Using HTML5 with ArcGIS—**Free training seminar

Python Scripting
- **Introduction to Geoprocessing Scripts Using Python—**Instructor-led course
- **Python for Everyone (for ArcGIS 10.1)—**Web course
- **Creating Desktop Add-ins Using Python (for ArcGIS 10.1)—**Free training seminar
- **Creating Python Toolboxes Using ArcGIS 10.1—**Free training seminar

You can view the complete Esri course catalog at **esri.com/coursecatalog**.

Certification

10.1 Exam Plans
Our release plan for version 10.1 certification exams is set, and execution is well under way. There are six version 10.1 exams in beta right now, and they should all be available by April 2013. Here's the current schedule:

Web Application Developer Associate (10.1)	Released February 2013
Enterprise Geodatabase Management Associate (10.1)	Released February 2013
Enterprise System Design Associate (10.1)	March/April 2013
ArcGIS Desktop Developer Associate (10.1)	March/April 2013
Enterprise Geodatabase Management Professional (10.1)	April 2013
Enterprise Administration Associate (10.1)	April 2013

Follow Esri training on Twitter at **twitter.com/Esritraining** to receive the latest news and announcements when the exams are released.

Why Certify?
The best way to answer this question is to talk to someone who passed an exam. We asked Stefanie Obmann, the first person to achieve an ArcGIS Desktop Associate 10.1 certification since the exam was released, for her thoughts on the question, and this is what she shared. She decided to earn the ArcGIS Desktop Associate certification because, in her words, "Thinking I know is different than 'knowing I know.' I wanted to be tested and test myself." With the exam behind her now, she says, "I feel more confident in giving advice since I was able to answer the exam questions and will be able to answer many more questions by our users now."

See which exam your skills align with, and get other exam details and resources, at **esri.com/certification**.

For More Information

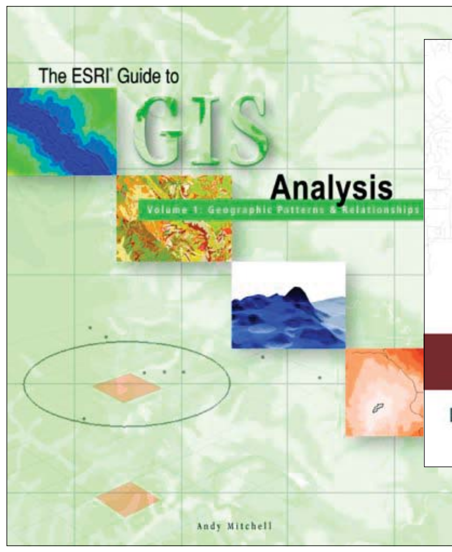
Training website:	**esri.com/training**
Find a course:	**esri.com/coursecatalog**
Training Matters blog:	**esri.com/trainingblog**
Training on Twitter:	**twitter.com/Esritraining**
Subscribe to the training newsletter:	**esri.com/trainingnews**
Esri Press books:	**esri.com/esripress**
Esri Technical Certification website:	**esri.com/certification**
Esri Technical Certification exam registration site:	**pearsonvue.com/esri**
Esri Technical Certification prep resources:	**esri.com/skillsreview**

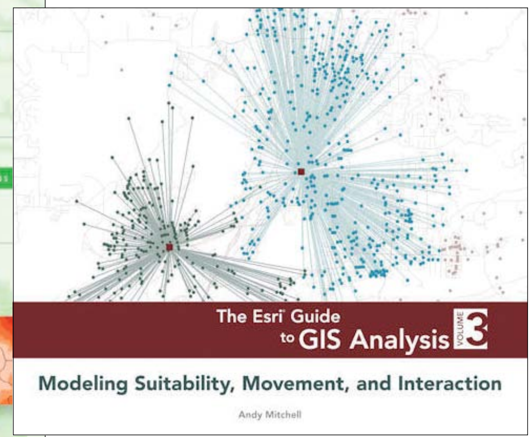
NATIONAL GEOGRAPHIC™

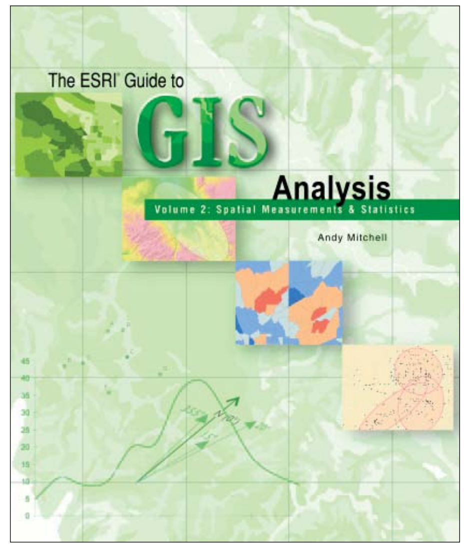
"Geo Learning"

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

Using GIS to Explain Geographic Reasoning







I began the winding path that has become a career, as a researcher in artificial intelligence. I was drawn to artificial intelligence by one of its central tenets: you can understand how the human mind works by trying to reproduce its behaviors in the form of a computer program.

I was musing about that recently as I found myself using what GIS software does while trying to explain to someone what I mean by "geographic reasoning." As I've written before in this space, one of my biggest challenges as an advocate for improved geography education is explaining what geography is really about.

Since most people tend to associate geography with factual knowledge, I want to be able to broaden their understanding of geography by explaining geographic reasoning to them. However, I've struggled to find descriptions of geographic reasoning that are helpful when talking to people who haven't studied geography.

What I've found are two kinds of descriptions of geographic reasoning. One characterizes geographic reasoning using terms and examples that only other geographers can understand. The other is frustratingly circular: geographic reasoning is what geographers do to understand the world; geographic reasoning consists of asking geographic questions, gathering and analyzing geographic information, and constructing geographic explanations; geographic reasoning is the process of constructing explanations and predictions about place and location.

There is no shortage of examples of geographic reasoning. John Snow's discovery of the source of the 1854 cholera outbreak in London immediately comes to mind. However, it's hard to see what the underlying reasoning is in individual examples.

However, as I was leafing through Andy Mitchell's *Esri Guide to GIS Analysis* at the User Conference this summer, I had a flash of insight. The table of contents of that wonderful three-volume guide to GIS can be read as an overview of geographic reasoning. Consider the following:

- Measuring geographic distributions
- Identifying patterns
- Identifying clusters
- Analyzing geographic relationships

This list happens to be the main chapters in the second volume of Mitchell's series, but to me it reads like a clear list of the core components of geographic reasoning. I assume that Mitchell did not sit down to identify the conceptual categories of geographic reasoning. Presumably, he set out to create a well-organized overview of what you can do with sophisticated GIS software. However, the outcome here is the same as the one that many researchers in artificial intelligence seek.

Over the course of the last 50 years, GIS software developers set out to create a set of productivity-enhancing tools to support geographic reasoning. Over time, they increasingly externalized geographic reasoning in the software, so that when a modern instructor sets out to teach someone how to use GIS, what they are essentially doing is providing an overview of geographic reasoning.

The hidden benefit of GIS, therefore, is that GIS software has come to embody geographic reasoning to the point where the best way to explain to someone what geographic reasoning consists of may be to demonstrate to them what you can do with GIS.

Want to introduce younger children to geographic reasoning? How about using the following as a progression?

1. Mapping where things are
2. Mapping the most and least
3. Mapping density
4. Finding what's inside
5. Finding what's nearby
6. Mapping change

Ready to teach advanced students about sophisticated forms of geographic reasoning? What about these?

1. Finding suitable locations
2. Rating suitable locations
3. Modeling paths
4. Modeling flow
5. Modeling interaction

It will come as no surprise that I lifted the first list from the table of contents of volume 1 and the second from volume 3 of Mitchell's series.

So the next time someone asks me what's valuable about geography education, I won't turn to John Snow and the 19th century. I will tell them about identifying patterns and clusters or modeling paths and flow.

Follow Daniel Edelson on Twitter: @NatGeoEdelson.

The Data Miner's Quest: Drilling for and Refining GIS Data as the GIS Manager

By Alicia Gayle, GIS Manager, National Works Agency, Jamaica

Oil is valuable, but if unrefined, it cannot really be used. So must data be broken down and analyzed for it to have significance. From the GIS perspective, we believe that for geospatial data, it will be the value-added products, developed using customized methods, that will create new insights in any organization that embraces GIS. By looking at geospatial data that is created and maintained in relation to the critical workflows of your organization, you are providing everyone with a simple principle by which decisions can be vetted. Finding a cultural changing perception is generally hard, but its concept is so valuable and powerful that it will drive real change within an organization.

Drilling for Data

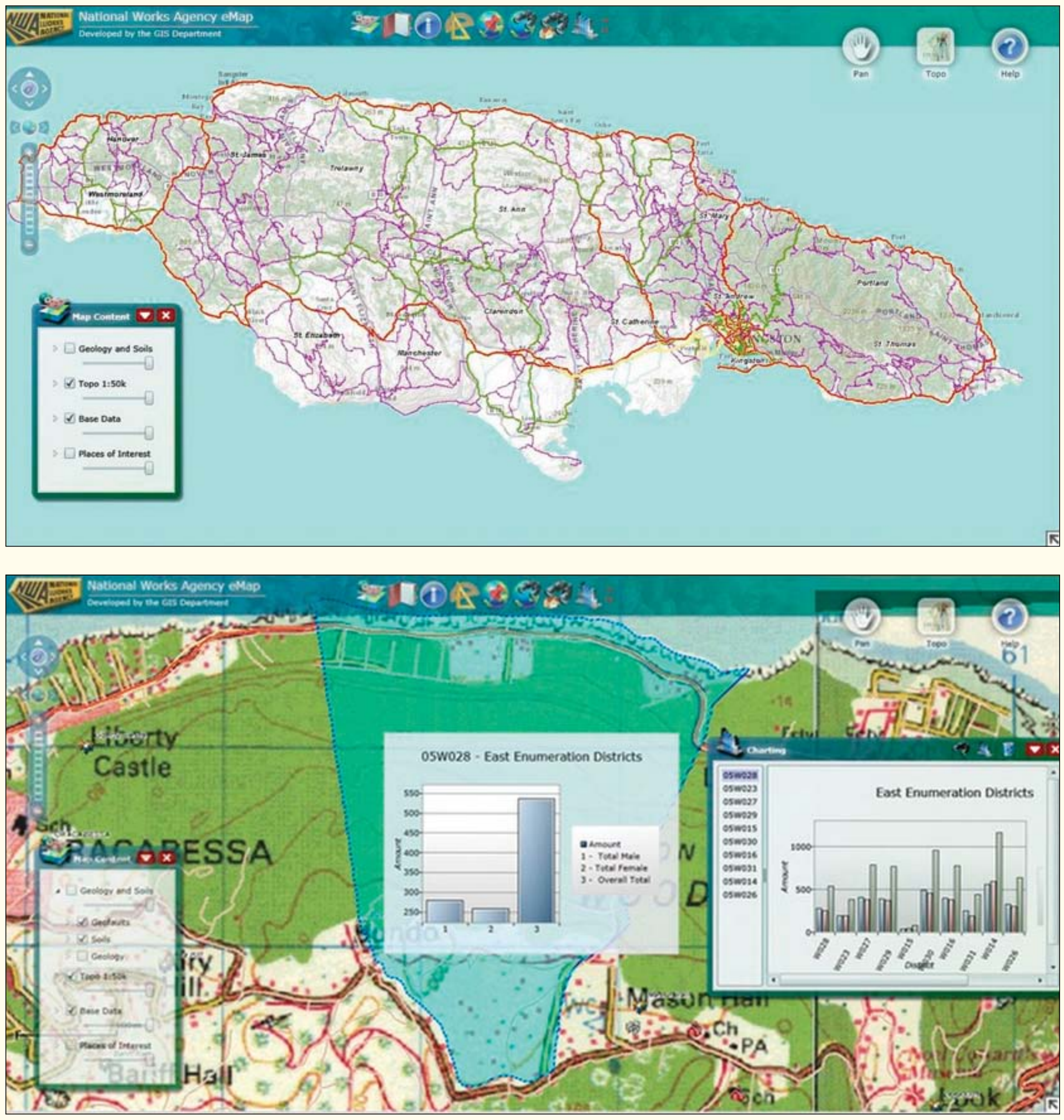
GIS data and products are often time-consuming to create. Additionally, with the fast-growing use of some popular geovisualization tools available on the web, many individuals are resorting to faster ways to create data through estimation and approximation. Yet in examining its value to an organization, it is easier to prioritize the use of these geovisualization tools and achieve a good balance between "guesstimation" and accuracy with the use of GPS technology. As such, at the National Works Agency of Jamaica (NWA), a critical workflow of the GIS department is to use GPS technology for mapping features, such as bridges and roads, and responding to other periodic requests from technical staff. We therefore prepare our technical staff through GPS training to collect their relevant data. Additionally, training sessions are available on request and may be carried out if an upcoming project requires new road features to be mapped. GIS personnel will also accompany internal clients to work sites and project areas. This approach not only facilitates quick access to mapped datasets but will also encourage on-site training and exposure to in-house techniques and processes by all personnel involved. All datasets are downloaded and stored to the GIS server at NWA's head office. Therefore, collected datasets can be considered as crude, needing refinement into products and services to meet the requirements and issues of the organization.

With the influx of smartphones, collecting geospatial data is not only easier through mobility but also less time-consuming. In fact, technical officers at NWA have been encouraged to download free GPS mapping software for their BlackBerry phones to further assist in logging project area features. The beauty of this process is that the free software creates files that are compatible with our in-house GIS applications. An obvious combination with great possibilities!

Refining Data

After finding or creating geospatial data, the GIS department defines how to use our data to best help/fix our customers' challenges and satisfy the project planning requirements of NWA. As data providers, adopting this kind of service thinking will allow us not to be superseded by more accessible web-based applications (Benson Reason, director, live|work). Therefore, at NWA, we can categorically highlight the following processes that are undertaken to develop our geospatial data into value-added services:

Customization—In some cases, where our customers are accustomed to only viewing base data as published hard-copy maps from other government agencies, the service opportunity is to help them customize their use. This means enabling them to transform existing information into their data with dynamic tools. As we customize, clients get better results from their information, and we develop a deeper understanding of their requirements, which helps to further refine the service. The GIS department developed an online web-based map service called NWAEMAP. NWAEMAP simply enables customers to view, search, and create custom maps using base data files published through the intranet-based application. It is unique in the way that it enables users to easily adjust their search terms and refine their maps dynamically before printing. This simple customization empowers the users to get exactly what they want, extremely quickly. It also allows them to explore the range of data available. As the customers use the service, they build value through the repeated exchange of information.



National Works Agency of Jamaica eMaps.

Enrichment—Our technical clients have their own information that aids greatly in their workflows. This may be their GPS mapped features, such as bridges, breakaways, and roadways. The approach, in this case, is to augment that information with additional data to make our clients more effective in their job. As such, this kind of service is often about aiding decision making or enabling customers to use more customized tools for increased productivity. In doing this, our data is core to NWA's business processes and fits directly into several departments' workflows, since pertinent and well-presented data enables critical business decisions to be made more quickly and with less risk.

Enabling—On the flip side, we also cater to users who are not geospatially technical. Their objectives require a customized solution that is based on our existing in-house platforms. Such applications create value-added services using existing data in a more cohesive and intelligent manner, therefore enabling them to collectively examine and analyze this information. NWA GIS-LAMS satisfies these users' needs. This online GIS web application has taken accessible geospatial land parcel data online to create a service that provides GIS functionalities to nontechnical users. For NWA GIS-LAMS users, we realized that we needed to take geospatial data and refine it further by not only improving access to the information but also helping customers employ it for ordinary uses.

Conclusion

Geospatial data requires customization for better application. The most important approach is to determine the objectives of clients and provide them with services that help in their workflows. Therefore, value-added products will be provided/created for ubiquitous use throughout the organization.

About the Author

Alicia Gayle is the GIS manager at the National Works Agency of Jamaica. She's a graduate of the University of Liecester, where she pursued an MSc in GIS. Her current projects at the National Works Agency range from road works prioritization models to land acquisition data management and spatial analysis.

For more information, contact Alicia Gayle, GIS manager, National Works Agency, Kingston, Jamaica (e-mail: aliciagayle@nwa.gov.jm).

Reference

Reason, Benson. Director, live|work. "Data Is the New Oil, Part 1: Business Information." www.livework.co.uk/articles/data-is-the-new-oil-part-1-business-information.

"Crossing Borders"

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

Getting a Job in Geography and GIS

Employees with geographic and geospatial skills are in high demand to help solve real-world problems and enhance organizations' efficiency and effectiveness. The latest estimates from the US Bureau of Labor Statistics classify GIS and remote sensing (RS) as "new and emerging" fields, in part because of their importance to the "green" jobs sectors. Job openings for GIS and RS scientists, technicians, and technologists are projected to grow between three and nine percent between 2010 and 2020, while median salaries for these positions continue to rise. The job category of "geographer" is poised for even more dramatic growth, with job openings projected to increase nearly 30 percent by 2020.

A recent report by the Georgetown Center on Education and the Workforce revealed that geographers are highly dispersed across sectors and industries within the US work force. Therefore, a comprehensive search for geography-related jobs should span resources across the business, government, nonprofit, and educational sectors. The AAG's Jobs in Geography and GIS Center (www.aag.org/careers) is an excellent starting point. This online jobs listing allows you to search for current job openings by sector (e.g., private, public, academic, nongovernmental organizations [NGOs], etc.), by state or international location, and by topical specialties.

Other leading industry resources for careers in geospatial technology and GIS include Esri (esri.com/careers), *Directions* (www.directionsmag.com/careers), GISLounge.com, GISjobs.com, and the GIS Jobs Clearinghouse (gjc.com). Because the public sector continues to be a major employer of geographers, USAJobs.gov is a helpful place to go for federal government employment. Idealist.org is a central repository for volunteer and employment opportunities in the nonprofit and NGO sectors. Links to all these career resources can be found on the AAG careers website.

Research conducted for the AAG's National Science Foundation-funded EDGE program, which is geared to better preparing graduate students for nonacademic jobs in geography and GIS, indicates that employers today are particularly seeking employees who can apply broad, interdisciplinary perspectives and diverse expertise to the specific needs of their unique organizations and industries. More companies and industries are now using location-based data and spatial analysis to support business operations as wide-ranging as health care delivery, retail sales, environmental management, transportation planning, economic development, and more.

While the employment outlook for geography and GIS careers is relatively strong, competition for openings is high. In a tight job market, many students and professionals are considering strategies to boost their credentials and enhance their portfolio of skills. In addition to opening up new career paths, further education can also lead to increased earning potential. A directory of state-by-state listings of online courses, certificates, and degrees offered in geography and GIS is posted at www.aag.org/education. An important credential for GIS careers is professional certification. Information on becoming a certified GIS Professional (GISP) is available from the GIS Certification Institute (www.gisci.org), the leading GIS certification organization in the United States.

Volunteering and internships with potential employers also provide excellent work-based learning and professional development opportunities. Many employers recruit from their intern and volunteer pools, so these short-term experiences can often lead to longer-term or permanent employment. AAG has developed guidelines on how to get the most out of your internship and also lists internship and mentoring opportunities at its Jobs Center.

The Association of American Geographers offers a broad selection of resources to help current and aspiring geography and GIS professionals make the most of the many available employment opportunities. The Jobs & Careers area of the AAG website features a range of educational and informational materials to support career exploration, including profiles of geographers working in a variety of fields, salary data and employment trends for more than 90 geography and GIS-related subfields, tip sheets and resumé advice, and much more. Also available is the new book, *Practicing Geography*, which provides a wealth of information on geography and GIS careers in business, government, and non-profit organizations. To access this regularly updated information, visit www.aag.org/careers.

The AAG's Annual Meetings (April 9–13 in Los Angeles this year) also feature a robust offering of current job listings, careers panel discussions, drop-in career mentoring services, and professional guidance and networking opportunities for prospective employees at all career stages. Good luck with your next job search!

Doug Richardson (e-mail: drichardson@aag.org)
(with contributions by Joy Adams and Jean McKendry)

Online-Only Articles

More *ArcNews*

The Spring 2013 issue of *ArcNews Online* (esri.com/arcnews) presents the following special online-only articles:

- Fostering New Pathways to GIS
- RacerGISOnline: Applying ArcGIS Online to Business Courses and Beyond!
- Wall Street Network Leverages Cloud Knowledge Management to Provide New Business Insight

URISA's GIS-Pro 2013 in New England

Following a very successful 50th annual conference in Portland, Oregon, the Urban and Regional Information Systems Association (URISA) begins its next 50 years in New England with GIS-Pro 2013, taking place September 16–19 in Providence, Rhode Island. Students, young professionals, midcareer managers, and GIS luminaries will go beyond basic technology and applications and contemplate issues related to policy, information, and technology management. GIS-Pro offers a multidisciplinary approach, with participation from all levels and agencies of government, academia, consultants, developers, and technology providers, so attendees receive the benefit of a variety of viewpoints and experiences.

In addition to active local chapters and GIS groups in the region, New England is the home of high-profile university and college programs, offers easy transportation options (a 50-minute drive from Boston and a three-hour drive from New York City), and boasts a commuter rail center a couple of blocks from the conference.

Last year's conference featured keynote addresses from professor Michael Goodchild, Microsoft's Johannes Kebeck, and Esri's Jack Dangermond. Who will be featured this year? Visit www.gis-pro.org for updates!

Esri Partner Offerings

Esri maintains relationships with more than 1,600 partners around the globe that provide solutions and service-based solutions to our customers. In this issue, we would like to recognize those organizations that have been Esri Partners for more than 20 years. For a complete list of Esri Partners and offerings, visit the Esri website at esri.com/partners.

Forestry

F4Tech
www.thinkf4.com
SilvAssist and Real-Time Inventory
SilvAssist and Real-Time Inventory (RTI), working in tandem, enable foresters to efficiently collect, manage, report, and analyze forest inventory data through the ArcGIS interface. RTI is a patented technology that allows foresters to easily navigate to spatially located field locations (plots) to collect critical forest data for management purposes. SilvAssist is a toolbar for ArcGIS that permits forest managers to spatially manage this data. SilvAssist features include plot allocation, reporting and analytics, events management, growth and yield export to Forest Vegetation Simulator, and numerous data management utilities.

Water/Wastewater Management

GIS Solutions, Inc.
www.gis-solutions.com
Water Management Solutions
GIS Solutions, Inc., provides server and mobile applications for ArcGIS that encourage end-user adoption of GIS data and spatial analyses and help tailor enterprise GIS to the specific business practices and workflows for utilities and water management. GIS Solutions provides services aimed at broad system integration activities. GIS Solutions designs, develops, and deploys integrations with IBM Maximo, Microsoft SharePoint, FileNet, multimedia (photo, video, audio, etc.), and hydraulic modeling.

Land Surveying

Topographic
www.topographic.com
LandScape
LandScape is Topographic's online mapping and project management system designed specifically for the oil and gas industry. LandScape provides clients (and their many agents) with easy, real-time access to project status maps and legal plats related to the well, unit, and pipeline surveys they hire Topographic to perform. The system can be set up to include only current versions of a document or all historical revisions and has virtually replaced outdated and cumbersome methods of file sharing, like FTP sites and massive e-mails. In addition to the standard tools available in most online mapping systems, Topographic's team of developers has built many additional features specifically tailored to client workflows.

Government/Utilities and Communication/Natural Resources

The CEDRA Corporation
www.cedra.com
CEDRA-AGsuite Software
CEDRA-AGsuite is a package comprising CEDRA-AVcad, CEDRA-AVcogo, CEDRA-AVparcel, CEDRA-AVland, CEDRA-AVsand, CEDRA-AVwater, CEDRA-DataEditor, and CEDRA-DxfExport, based on ArcGIS software, with which the user can work with CAD; COGO; deed transcription; parcel mapping, surveying, and contouring; traverse adjustment; cross-section and profile stripping/plotting; stakeout, roadway design, and earthwork calculations; site development; plan and profile drawing assembly; sanitary, storm, and combined sewer modeling; water distribution modeling; data editing/maintenance; and DXF export functionality.

Subscribe to Esri Publications

To **subscribe** to Esri publications, visit esri.com/subscribe.
To **unsubscribe** from Esri publications, visit esri.com/unsubscribe.
To **update your mailing address**, visit esri.com/coa
or use any of these e-mail, phone, or fax options.
Outside the United States, contact your international distributor to subscribe, unsubscribe, or change your address.
For a directory of distributors, visit esri.com/distributors.
Requests for back issues, missed issues, and other circulation services may also be sent via requests@esri.com; 909-793-2853, extension 1-2778; or faxed to 909-798-0560.

North Carolina and Nevada—Esri Shirts Fit in Everywhere!

Steve Gochenaur, GISP, GIS analyst, Lancaster County GIS, Lancaster, Pennsylvania, is wearing his oldie-but-goodie Esri T-shirt at the lighthouse in Ocracoke, North Carolina. His family vacations on the Outer Banks every year.

Kitty Hurley, GIS and all-hazards assessment coordinator, Hennepin County Emergency Management, Medina, Minnesota, poses with her GIS apparel in front of Caesars Palace, Las Vegas Strip, Las Vegas, Nevada.

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. Upload digital photos at *ArcNews Online* or send them via e-mail (tmiller@esri.com). Digital images are preferred, but prints or slides can be sent to *ArcNews* T-shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews Online* at **esri.com/arcnews**.

Steve Gochenaur

Kitty Hurley

Esri Corporate Headquarters

380 New York Street
Redlands, CA 92373-8100 USA
Tel.: 909-793-2853
E-mail: info@esri.com
Web: esri.com

Esri Technical Support
Tel.: 888-377-4575
E-mail: support@esri.com
Web: esri.com/support

Online Discussion Forums
Web: esri.com/forums
Esri-L: esri-l@esri.com
ARCVIEW-L:
arcview-l@esri.com

FTP: ftp.esri.com

Esri Desktop Order Center and Software Information
Tel.: 1-800-447-9778
(USA only)

Esri Customer Service
Toll Free
Tel.: 888-377-4575
E-mail: service@esri.com
Web: esri.com/customerservice

Esri Store
Web: esri.com/store

Esri Developer Network
Web: edn.esri.com

Esri US Regional Offices

Boston
Danvers, MA
Tel.: 978-777-4543

California
Redlands, CA
Tel.: 909-793-2853, ext. 1-1906

Charlotte
Charlotte, NC
Tel.: 704-541-9810

Denver
Broomfield, CO
Tel.: 303-449-7779

Minneapolis
St. Paul, MN
Tel.: 651-454-0600

Olympia
Olympia, WA
Tel.: 360-754-4727

Philadelphia
Chesterbrook, PA
Tel.: 610-644-3374

San Antonio
San Antonio, TX
Tel.: 210-499-1044

St. Louis
St. Charles, MO
Tel.: 636-949-6620

Federal Office
Washington, DC
Vienna, VA
Tel.: 703-506-9515

For additional information about Esri US regional offices, visit esri.com/usa.

Esri Distributors Worldwide

Esri Australia Pty. Ltd.
Brisbane
Tel.: 617-3218-4100
E-mail: connect@esriaustralia.com.au
Web: www.esriaustralia.com.au

Esri BeLux N.V.
Wemmel, Belgium
Tel.: 32-2-460-7480
E-mail: info@esribelux.com
Web: www.esribelux.com

Esri Bulgaria Ltd.
Sofia
Tel.: 359-2-964-0850
E-mail: info@esribulgaria.com
Web: www.esribulgaria.com

Esri Canada Limited
Toronto, Ontario
Tel.: 416-441-6035
E-mail: info@esri.ca
Web: www.esri.ca

Esri Chile S.A.
Santiago
Tel.: 56-2-481-9000
E-mail: info@esri.cl
Web: www.esri.cl

Esri China Information Technology Co. Limited
Beijing
Tel.: 86-10-5763-2288
E-mail: info@esrichina.com.cn
Web: www.esrichina.com.cn

Esri China (Hong Kong) Limited
Hong Kong
Tel.: 852-2730-6883
E-mail: info@esrichina.hk
Web: www.esrichina.hk

Esri Eastern Africa Limited
Nairobi, Kenya
Tel.: 254-20-271-3630
E-mail: sales@esriea.co.ke
Web: www.esriea.co.ke

Esri Finland Oy
Espoo
Tel.: 358-207-435-435
E-mail: info@esri.fi
Web: www.esri.fi

Esri France S.A.
Meudon
Tel.: 33-1-46-23-6060
E-mail: info@esrifrance.fr
Web: www.esrifrance.fr

Esri Deutschland GmbH
Kranzberg
Tel.: 49-89-207005-1200
E-mail: info@esri.de
Web: www.esri.de

NIIT GIS Limited (Esri India)
New Delhi
Tel.: 91-11-4057-0700
E-mail: info@esriindia.com
Web: www.esriindia.com

Esri Italia Sp.A.
Rome
Tel.: 39-06-406-961
E-mail: info@esriitalia.it
Web: www.esriitalia.it

Esri Japan Corporation
Tokyo
Tel.: 81-3-3222-3941
E-mail: esri_general@esrij.com
Web: www.esrij.com

Esri Korea, Inc.
Seoul
Tel.: 82-2-2086-1900
E-mail: info@esrikr.com
Web: www.esrikr.com

Esri Lebanon sal
Beirut
Tel.: 961-1-844944
E-mail: info@esrilebanon.com
Web: www.esrilebanon.com

Esri Muscat Co LLC
Muscat, Oman
Tel.: 968-24693723
E-mail: info@esrimuscat.com
Web: www.esrimuscat.com

Esri Nederland B.V.
Rotterdam
Tel.: 31-10-217-0700
E-mail: gisinfo@esri.nl
Web: www.esri.nl

Esri Northeast Africa
Cairo, Egypt
Tel.: 202-2271-9350
E-mail: info@esrinea.com
Web: www.esrinea.com

Esri Polska sp. z o.o.
Warsaw
Tel.: 48-22-390-4700
E-mail: esri@esri.pl
Web: www.esri.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.
Lisbon
Tel.: 351-2-1-781-6640
E-mail: market@esri-portugal.pt
Web: www.esri-portugal.pt

Esri Romania S.R.L.
Bucharest
Tel.: 40-21-231-1422
E-mail: esri@esriro.ro
Web: www.esriro.ro

Limited Liability Company Esri CIS
Moscow, Russia
Tel.: 7-495-988-3481
E-mail: yulia@esri-cis.ru
Web: www.esri-cis.ru

Esri Saudi Arabia Ltd
Riyadh, Saudi Arabia
Tel.: 966-1-416-2600
E-mail: info@esrisaudiarabia.com
Web: www.esrisaudiarabia.com

Esri South Africa (Pty) Ltd.
Midrand
Tel.: 27-11-238-6300
E-mail: info@esri-southafrica.com
Web: www.esri-southafrica.com

Esri Southern Africa
Ebene, Mauritius
Tel.: 27-11-238-6300
E-mail: info@esri-southernafrica.com
Web: www.esri-southernafrica.com

Esri South Asia Pte. Ltd.
Singapore
Tel.: 65-6742-8622
E-mail: connect@esrisingapore.com.sg
Web: www.esrisa.com

Esri España Geosistemas S.A.
Madrid
Tel.: 34-91-559-4375
E-mail: informacion@esri.es
Web: www.esri.es

Esri Sverige AB
Gävle, Sweden
Tel.: 46-771-984800
E-mail: info@esri.se
Web: www.esri.se

Esri (Thailand) Co. Ltd.
Bangkok
Tel.: 66-2-678-0707
E-mail: krairop.l@cdg.co.th
Web: www.esrith.com

Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.
Ankara, Turkey
Tel.: 90-312-233-5050
E-mail: mtankut@esriturkey.com.tr
Web: www.esriturkey.com.tr

Esri (UK) Ltd.
Aylesbury
Tel.: 44-1296-745-500
E-mail: info@esriuk.com
Web: www.esriuk.com

Esri Ukraine Ltd.
Kiev
Tel.: 380-44-502-4121
E-mail: info@esri.ua
Web: www.esri.ua

Grupo Esri de Venezuela, C.A.
Caracas
Tel.: 58-212-285-9394
E-mail: esriven@esriven.com
Web: www.esriven.com

Esri has more than 80 distributors in other countries around the world. For more information, contact Esri (tel.: 909-793-2853, ext. 1-1235; fax: 909-307-3070) or visit esri.com/distributors.

Career Opportunities at Esri

Esri is actively recruiting smart people with all levels of experience who get the job done. These positions represent openings at our headquarters in Redlands, California, as well as our regional offices, and offer you a great opportunity to work with the best in our profession. We provide exceptional benefits, competitive salaries, profit sharing, a collaborative team environment, and much more. Join Esri and make a difference.

Software Development and ArcGIS Product Development

Software Developer, Server Framework—Design and build the next generation of ArcGIS for Server software for enterprise and cloud for millions of users worldwide.

Front-End Data Engineer, Washington, DC—An exceptional engineer with a desire to deliver high-performance, front-end solutions is needed to develop visually stunning applications and mashups.

User Experience Designer—Apply your passion for elegant design and keen eye for aesthetics to bring Esri mapping and location analytics to the world of business analytics.

Raster Product Engineer–Resource Specialist—Evangelize and support ArcGIS imagery functionality by creating useful and relevant resources that communicate to and educate ArcGIS users.

GIS Services

Solutions Architect—Consult with Esri customers and partners to support the design, development, and implementation of enterprise GIS solutions.

Applications Developer, Washington, DC—Help us integrate our products with your creative applications, services, and data expertise within our clients' environments.

Educational Services and Technical Support

Course Developer, Server—Work with the latest Esri software and subject matter experts to assess, design, develop, maintain, revise, and validate instructor-led and web-based training materials.

Support Analysts (Redlands, California, and Charlotte, North Carolina)—Provide high-quality support to end users of Esri software to solve technical problems quickly and effectively.

Sales

Account Executive, Location Analytics—Leverage your sales know-how and love of data analytics to develop and present integrated business intelligence and GIS solutions to organizations.

Partner Development Manager, Commercial—Identify and develop relationships with new high-potential partners in the retail, insurance, financial services, transportation, and manufacturing-related industries.

Account Manager, Federal Sciences and Health, Washington, DC—Work directly with federal agencies to facilitate analysis and decision making through the application of GIS technology.

Presales and Solution Engineering

Technical Marketing Engineer, Location Analytics—Be involved in a new initiative where you'll communicate and promote Esri's location analytics solutions to the business analytics community.

Solution Architect, Commercial (location open)—Work closely with sales and technical marketing resources to define and develop sales and client-oriented documentation and solutions.

Marketing

Product Marketing Manager—Bring strategic vision, marketing discipline, and business leadership to Esri in this senior-level position responsible for helping technology buyers make purchasing decisions.

Multimedia Editor (Mapping and Data)—Develop creative content for the media and fill mapping and data requests from media organizations around the world.

Industry Solutions Specialist, Water/Wastewater—Use your years of industry experience to help manage marketing efforts related to products and services within this sector of the local government market.

esri.com/careers

Subscription Additions and Address Changes or Deletions

E-mail: requests@esri.com

Fax: 909-798-0560

Subscribe on the web: **esri.com/subscribe**

Subscribe outside the US: Contact your local distributor.

Unsubscribe on the web: **esri.com/unsubscribe**

Update information on the web: **esri.com/coa**

To request other publication services: See page 36.

PRINTED WITH SOY INK

133901

esri
380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri