ArcNews

Esri | Summer 2016 | Vol. 38, No. 3

Briefly Noted

ECP Lead Receives Distinguished Award
The United States Chapter of the International Association for Landscape Ecology awarded the director of Esri's Conservation Program (ECP), Charles Convis, with the 2016 Distinguished Landscape Practitioner Award. The award is presented to individuals who have applied the principles of landscape ecology to real-world problems in outstanding ways over the years. As director of ECP for almost three decades, Convis has used GIS to empower countless organizations to conserve species, landscapes, and ecosystems. Learn more about ECP at conservationgis.org.

Partnership Increases Regional Collaboration
Esri has partnered with the National Association of Regional Councils (NARC) to deliver GIS training to the organization's members. They will benefit from hands-on workshops and webinars; free app templates for fields such as transportation, the environment, planning, and economic development; a best practices resource center; and a new web portal with information on the public policies advocated by NARC leadership. Learn more at narc.org/Esri.

Planners Earn Credit for Esri Events
The American Planning Association (APA) now allows credentialed American Institute of Certified Planners (AICP) members to earn Certification Maintenance credits for attending Esri conferences and participating in workshops, webinars, Esri classes, and massive open online courses (MOOCs).

Returning to America's Green Planning Roots

Esri Green Infrastructure Tools Will Help People, Government, and Planners Design a Better Future

By Jack Dangermond

More than a century ago, landscape architect Frederick Law Olmsted looked out over Yosemite Valley in California and saw a place worth saving. From that point on, he advocated a revolutionary concept that would benefit generations to come.

Olmsted, who codesigned New York City's Central Park in 1858, proposed the idea of creating a system of parks and greenways that protect and integrate the most valuable landscapes in the country. He envisioned communities working together to identify, preserve, and connect open spaces before planning development. His idea caught the attention of the California state legislature, which led to US president Abraham Lincoln signing an unprecedented law in 1864 that set aside land for public use. Fifty-two years later, congress established the National Park Service, which celebrates its 100th anniversary this year.

Turning Belief into Action

Olmsted and the conservation advocates who followed him, including naturalist John Muir and US president Theodore Roosevelt, were guided by the belief that all people should be able to enjoy beautiful green spaces—a belief that we at Esri deeply share. It's a notion that ignited the country's early conservation movement and one that I believe can come alive again today.

The idea of developing green infrastructure—before gray, man-made infrastructure—spread throughout the country and eventually the world.

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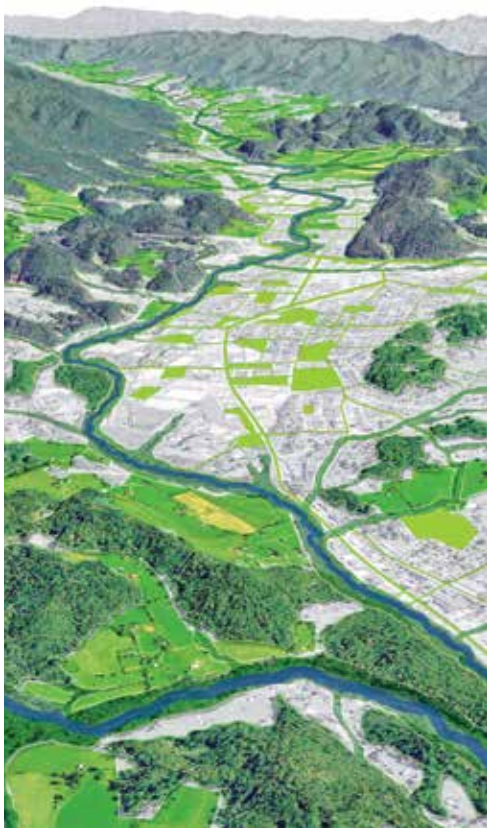

↑ Green infrastructure is a strategically planned and managed network of open spaces, watersheds, wildlife habitats, parks, and other areas. (Image courtesy of Zach Hill, Ecosystem Services.)

Geodesign Restores Chimpanzee Habitats in Tanzania

The Jane Goodall Institute Implements GIS in Local Contexts to Help Communities Regenerate Woodlands

By Dr. Lilian Pintea, the Jane Goodall Institute

Dr. Jane Goodall has been conducting pioneering research on chimpanzees in Tanzania for more than 55 years. The Jane Goodall Institute (JGI) continues Dr. Goodall's research to this day, collecting data on chimpanzee behavior in Gombe National Park via the Gombe Stream Research Center. JGI's research partners—including Duke University, the University of Minnesota, Arizona State University, Franklin & Marshall College, and George Washington University—digitize, manage, and analyze the information to advance our knowledge of chimpanzees, basic science, and conservation.

The Jane Goodall Institute (JGI) protects wild chimpanzees in and around Gombe National Park in Tanzania. (Image courtesy of JGI.)

Almost 25 years ago, however, Dr. Goodall wondered how the Gombe chimpanzees would survive. While flying in a small plane over Gombe, she saw the almost total loss of forest and woodlands around the park.

"There's no way we can even attempt to save these precious Gombe chimpanzees unless we could improve the lives of the people living around that last little oasis of forest," she recalled recently in an interview with National Public Radio (NPR).

Since then, JGI has been working with individual farmers, local communities, and governments—along with science and geospatial technology partners—to learn how to design more sustainable landscapes. GIS initially allowed JGI to put people, chimpanzees, and habitat data on the same map. Now, new technologies and very high-resolution imagery—integrated with ArcGIS—are enabling JGI to closely monitor geodesign processes and apply appropriate methodologies to local contexts.

With all these efforts combined, many of the woodlands outside Gombe are coming back. And local communities themselves are managing the forest's natural regeneration.

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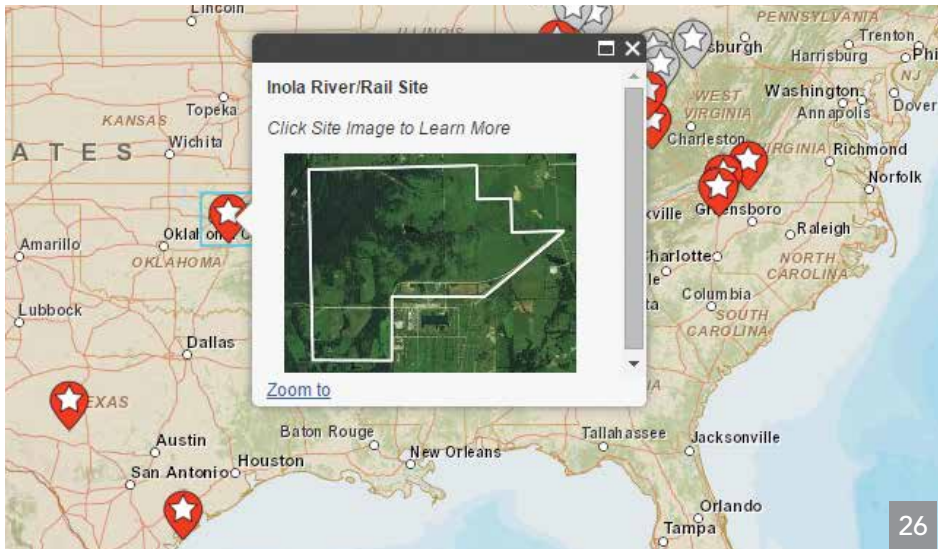

American Electric Power uses the ArcGIS platform to work closely with local communities and state agencies to support business expansion and community development in its service territory.

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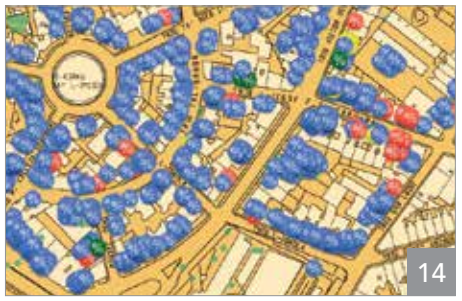

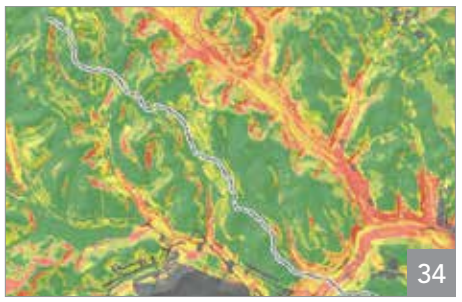

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ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA. *ArcNews* is written for the Esri user community as well as others interested in mapping and geographic information system (GIS) technology.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

Esri's Real-Time Analytics Keep Pace with Internet of Things

Get Ready for the New Real-Time Managed Services

This year, Esri will unveil the next generation of Real-Time GIS. It will enable users to ingest, analyze, and store millions of sensor events per second at scale; rapidly visualize, replay, and explore observations that are in the billions of features; and quickly perform batch analytics on this profusion of information.

Available through Esri Managed Services, this new Real-Time GIS can keep pace with the meteoric rise of the Internet of Things (IoT) and handle any organization's big data needs.

Connecting with Real-Time Data Streams

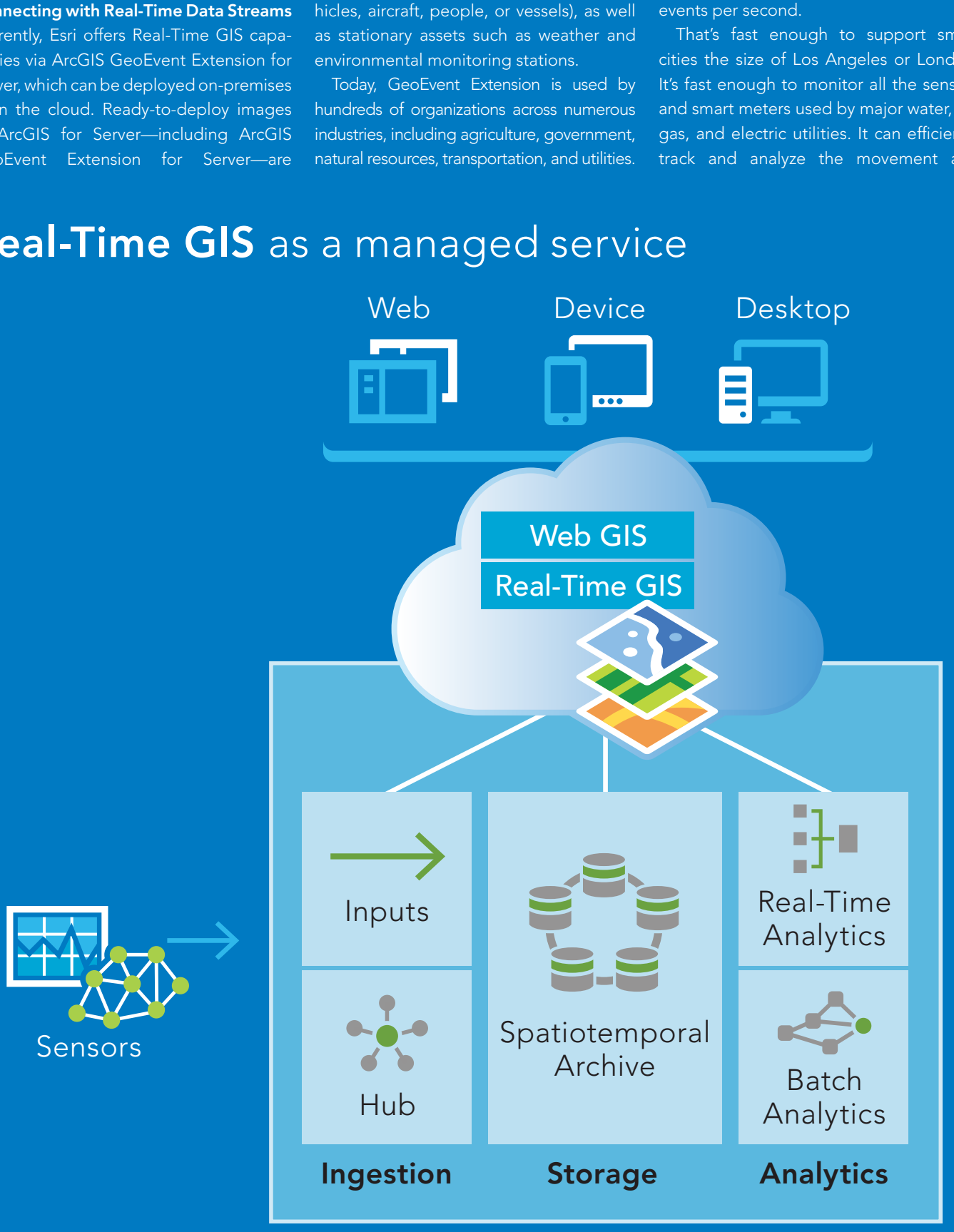
Currently, Esri offers Real-Time GIS capabilities via ArcGIS GeoEvent Extension for Server, which can be deployed on-premises or in the cloud. Ready-to-deploy images of ArcGIS for Server—including ArcGIS GeoEvent Extension for Server—are available in the Microsoft Azure and Amazon Web Services marketplaces.

Users employ GeoEvent Extension to connect with real-time data streams, including mobile devices, sensors, in-vehicle GPS devices, and social media providers. It accommodates multiple streams of data flowing continuously through user-defined filters and processing steps that allow clients to focus on only the most important aspects of their operations. It is used to track dynamic assets that are constantly changing location (such as vehicles, aircraft, people, or vessels), as well as stationary assets such as weather and environmental monitoring stations.

Today, GeoEvent Extension is used by hundreds of organizations across numerous industries, including agriculture, government, natural resources, transportation, and utilities.

But with the number of connected devices—and the data created from them—increasing exponentially, big data and the IoT are escalating data scope dramatically, requiring higher and higher data ingestion rates and faster analytics. Whereas on-premises Real-Time GIS can process thousands of events per second (fast enough for many organizations that manage small fleets of vehicles or sensor networks), the new Real-Time GIS service will reliably ingest, process, analyze, and store tens of thousands to several million events per second.

That's fast enough to support smart cities the size of Los Angeles or London. It's fast enough to monitor all the sensors and smart meters used by major water, oil, gas, and electric utilities. It can efficiently track and analyze the movement and disposition of large fleets of trucks, ships, and aircraft, which are essentially moving sensor warehouses.



Supporting the IoT's Vast Quantities of Data

This new managed service for Real-Time GIS has a distributed computing architecture designed to support the volumes of data produced by the emerging constellation of connected devices and sensor technologies that compose the IoT.

The technology will be offered through Esri Managed Services, which provides ready-to-use instances of ArcGIS running in the cloud that can be easily scaled, depending on an organization's requirements. Users will be able to choose their cloud provider (initially, it will be between Microsoft Azure and Amazon Web Services) and select the geographic region for the cloud deployment.

Real-Time GIS as a managed service leverages multiple aspects of the ArcGIS platform, including web GIS, the Spatiotemporal Big Data Store (which archives real-time observational data), and real-time and batch analytic capabilities. End users will be able to interact with archived data using standard ArcGIS clients, such as ArcMap and ArcGIS Pro in ArcGIS for Desktop and web maps. Rather than try to visualize millions of points on a map, the data can be aggregated on the fly—dynamically, during a transaction—for more effective visualization. The Real-Time GIS cloud service will also work with the new Spatiotemporal Big Data Store, which means that millions—or even billions—of observations can be batch analyzed and then visualized and replayed to provide insight into an organization's daily operations.

Taking Advantage of Real-Time GIS

When the new Real-Time GIS cloud service becomes available later this year, ArcGIS users will be able to acquire and process millions of sensor events per second, as well as explore and analyze extremely large datasets. Since users will be able to specify the region used by their cloud provider, organizations will be able to run continuous real-time processes on their nearby data for faster, more secure access.

As Adam Mollenkopf, the Real-Time GIS capability team lead at Esri, recently said, "If you're not factoring real-time geospatial analytics and mapping into your GIS strategy, you're leaving an immense gap in your ability to truly understand what's going on, why it's happening, and how you should respond."

The new Real-Time GIS managed cloud service makes it possible to close this gap.

As Technology Evolves, So Does ArcGIS

The 2016 Developer Summit Highlighted Esri's Latest Innovations

↑ Attendees of the 2016 Esri Developer Summit learned how to work with smart mapping and real-time GIS, build apps using APIs and SDKs, and use drone imagery with ArcGIS.

Drones, imagery, video, sensors, real-time data, mobile 3D, big data, the cloud, the Internet of Things (IoT)—all these are impacting how geospatial data is collected, analyzed, visualized, and shared.

"Our world is changing," said Esri software development director Sud Menon during the opening of the 2016 Esri Developer Summit (DevSummit). "And ArcGIS is changing too"—to embrace this new reality.

The focus of DevSummit—which drew more than 1,700 people to Palm Springs, California, in early March—was how ArcGIS is evolving in this rapidly innovating landscape. Amid technical sessions on app development, there were talks on real-time GIS and analytics, 3D web GIS, live data deployment, wearables, the IoT, and drones.

"The platform, from my experience and my 50 years in doing this kind of work—there's never been anything like it," proclaimed Esri president Jack Dangermond. "The opportunity to be able to extend and expand and be creative with the kind of tools that are coming down the pathway—and are already here—is unparalleled."

Menon also emphasized how the ArcGIS platform is a system that developers can build on. He highlighted several Esri initiatives that will drive the new age of intelligent mapping, including

- Future updates to ArcGIS Online that will give users the ability to host vector tiles, create configurable 3D apps, and perform advanced analytics.
- Field, office, and public apps that work together—like Navigator for ArcGIS, Collector for ArcGIS, and Survey123 for ArcGIS, which all provide real- or near real-time information that can be monitored on Operations Dashboard for ArcGIS.
- Drone2Map for ArcGIS, which turns still imagery from drones into 2D and 3D imagery products that can be used for visualization and analysis in ArcGIS.
- 3D mapping across the platform, which is powered by an information model that uses web scenes and 3D layers.
- Substantial enhancements to the real-time infrastructure in ArcGIS 10.4, including faster data ingestion and storage rates.
- A new Spatiotemporal Big Data Store that supports archiving observations that come in at high velocity.

In the months ahead, Esri will bring together big data, standard data, business data, and GIS data to help organizations leverage their information, observations, and assets in new ways that help them gain enhanced insight.

"We are doing this in both the user experience as well as in the functionality," Menon said. "In the latter, we are really looking at working with big data, harvesting the power of distributed computing. And we refer to that initiative as *geoanalytics*."

To help users analyze their data more easily, Esri is devising a whole new application experience.

↓ Software development director Sud Menon highlighted several Esri initiatives that are driving the new age of intelligent mapping.

Gaining New Insight from Data

Data alone does not provide meaning, but a thorough analysis of it does.

"We all know data is important," said Art Haddad, chief technology officer of location analytics for Esri. "But it's not as important as the answers it provides or the stories that it tells."

Insights for ArcGIS, slated for release later this year, introduces new, easy ways to interact with data, explore it, and analyze the results. Users will be able to drag and drop data (including enterprise data) onto digital cards that display the information as maps, charts, and tables—or all three. They can then analyze their data right on those cards.

Esri product engineer Linda Beale demonstrated Insights workflows using crime statistics from a major American city. As her cursor touched various data points on a timeline that charted the number of residential burglaries in an area over a two-year period, a map next to the chart displayed the burglary locations as points. Beale then switched to a heat map of the burglary locations.

"Now we can explore those *[crime]* patterns changing over time across the city," she said.

She created more cards—maps, charts, and tables—as she dove deeper into her analysis.

"Analysis is very much a part of Insights," Beale said. "The data format determines the kind of on-the-fly analysis that can be done, either through drag and drop or by using the action button."

Kacey Johnson Pham, GIS manager for Los Angeles-based International Medical Corps, was amazed by Insights when Beale gave her a one-on-one demonstration of it later.

"I was really impressed with the advances in charts and graphs that Esri has made," said Johnson Pham, who also volunteers at the La Brea Tar Pits and Museum in Los Angeles, where fossil excavations have taken place since the early 1900s. "The interactive charts and maps in Insights are fast, visually appealing, and easy to use."

Developing with ArcGIS

Among the many presentations at DevSummit aimed at making things easier for app developers was a preview of the next generation of ArcGIS Runtime SDKs, which are used to build native apps. Of particular interest was the Quartz release.

"With Quartz…we are releasing a significant set of functionality for you as developers," announced Euan Cameron, chief technology officer for the Runtime group at Esri.

The new functionality includes improved APIs so developers can build better apps and devise more fitting methods for constructing cross-platform native applications. It also contains support for content stored in the cloud or locally on devices, performing analysis locally or through geoprocessing services, and 3D visualization and analysis on Runtime supported devices.

Cameron also demonstrated ArcGIS API 4.0 for JavaScript, which supports the creation of apps (that run on any device) that give users 2D and 3D mapping visualization capabilities.

"It's the JavaScript API reimagined," Cameron said, adding that Esri developers have created a simpler, more consistent API design. "If you are a 2D map developer or you're a 3D scene developer, we are making it easier for you to integrate it with other JavaScript frameworks as well."

ArcGIS API 4.0 for JavaScript will also be mobile first.

"What does that mean?" Cameron asked. "It means the design of the widgets works great on mobile devices, as well as the traditional desktop browsers."

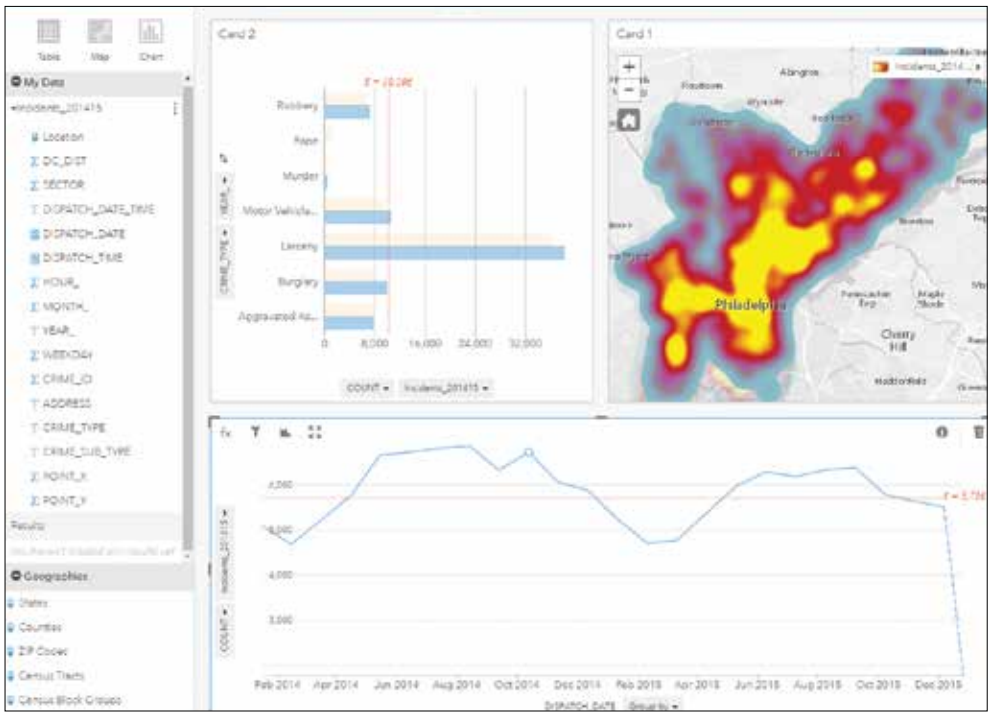
Attendees also got an overview of the updated ArcGIS for Developers website from David Cardella, Esri product manager for developer technologies. The site—which Cardella calls "the one place that you will go regardless of how you are developing with the platform"—contains information on building apps using the JavaScript API, Runtime SDKs, and configurable apps and app builders. It also includes information on extending the ArcGIS platform and accessing content and services such as basemaps, traffic maps, open data, the geocoding service, and the Living Atlas of the World.

Writing Programs That Work Well

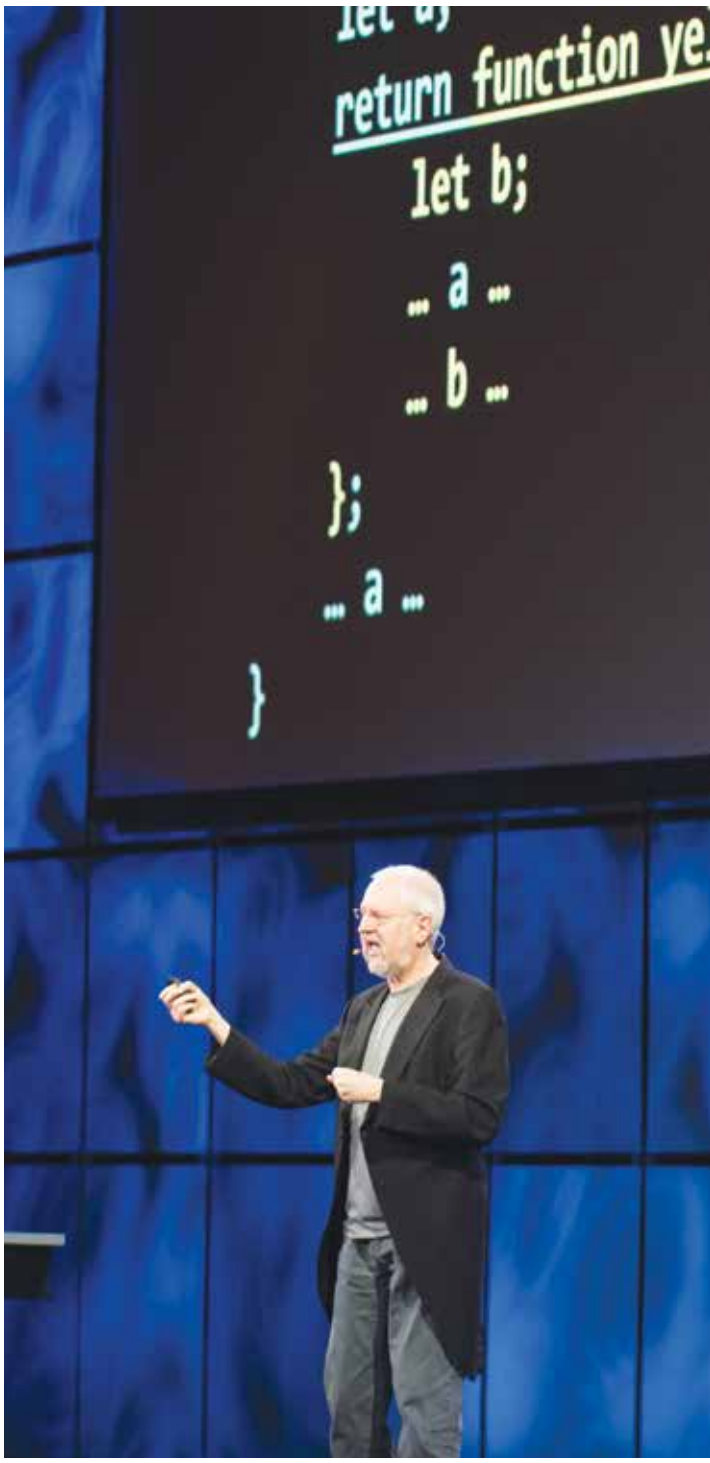
Since programming is a crucial part of an app developer's job, DevSummit attendees also received advice from the event's keynote speaker, computer programmer Douglas Crockford. Author of *JavaScript: The Good Parts*, Crockford has been instrumental in the ongoing development of the JavaScript programming language.

He advised the app developers to heed a line from the book *Wind, Sand, and Stars*, by French aviator and writer Antoine de Saint-Exupéry: "It seems that perfection is attained not when there is nothing more to add, but when there is nothing more to remove."

"Just a brilliant sentence," lauded Crockford. "He was talking about the design of airplanes, but it really seems to apply to everything. *[…]* And it applies especially, I think, to software because we have requirements in software that programs need to be perfect. Because if a program is not perfect, then the computer has a license to do the worst possible thing at the worst possible time."



← With Insights for ArcGIS, users can drag and drop data onto digital cards that display the information as maps, charts, and tables.



→ Keynote speaker Douglas Crockford advised app developers to edit their programs down to just the essentials.

To make apps perfect then, developers need to slenderize them rather than build them up—just as programming languages should be edited down to just the essentials, or the "good parts."

"If a feature of a programming language is sometimes useful and sometimes dangerous, and if there is a better option, then always use the better option," he cautioned. "We are not paid to use every feature of the language. We are paid to write programs that work well and are free of error."

Real Uses for Real Time

Over the course of the summit, attendees listened to dozens of presentations. They learned about how to work with smart mapping and real-time GIS, build apps using APIs and SDKs, extend and automate ArcGIS, create 3D scenes and share them as 3D web apps, and use imagery from drones with ArcGIS.

Johnson Pham said real-time GIS was of particular importance for her work with International Medical Corps, a nonprofit that provides medical assistance to people impacted by war, diseases, and natural disasters.

"There is a lot of interest…in real, live data," she said. "It is important to my job because we need up-to-the-minute data on disasters like earthquakes and tsunamis, as well as conflict areas where the security of our staff and beneficiaries *[is]* at risk."

Additionally, as a volunteer at the tar pits, Johnson Pham has created a web app of fossil discoveries, including saber-toothed cat skeletons. She hopes to someday build an app for an interactive exhibit at the museum—and she thinks that live data could play a role.

"At the La Brea Tar Pits, the emphasis is that discoveries are made daily," said Johnson Pham. "What better way is there to show that to museum visitors than to have a live interactive app featured in the museum with an updated count of new fossils discovered and new, exciting paleontological discoveries made each day?"

Johnson Pham was not the only one teeming with ideas. After spending four days soaking up information and inspiration, DevSummit attendees were abuzz with new ways to develop with GIS and new projects to take on once they got home.

Returning to America's Green Planning Roots

continued from cover

Today, this concept serves as a reference for many environmental planning efforts. Europe and Australia are using green infrastructure as a framework for smart growth. They're realizing the cultural and economic benefits of conserving natural resources and connecting people with nature.

But the United States has forgotten the concept. As a result, we are witnessing the negative effects of haphazard development and conservation. Critical resources, such as water, clean air, agricultural land, and landscape identity, are jeopardized. Cities and towns are left vulnerable to the impacts of a changing planet, with people, wildlife, and the economy bearing the brunt of rampant development. We have more work to do.

Smart Conservation for Smarter Development

At the 2016 Esri Federal GIS conference in Washington, DC, we announced a new partnership with the National Geographic Society to create a greener infrastructure for America. Esri committed to working with the National Geographic Society on its Great American Landscape Project. Together, we're developing information products that will provide a snapshot of green spaces across America for the public to explore.

In addition, Esri is developing geospatial tools and guidance for the people who face difficult planning decisions while dealing with the onslaught of twenty-first-century challenges, such as climate change, population growth, and water safety control.

We envision a national green infrastructure map to help communities take action in their own backyards. The mapping app will include a collection of different layers and datasets—from transportation and terrain to water and vegetation—to help all levels of government, nongovernmental organizations, nonprofits, and the public guide conservation and development efforts. While creating such a map is not new, it's the incredible innovations in GIS technology that can help us shape a pathway of openness for our children and grandchildren.

By applying a green infrastructure framework to planning development, local communities can grow without adversely affecting the environment. Cities and towns can see what's at stake—inside and outside their borders—and take action to preserve valuable landscapes, including cultural, scenic, ecological, and agricultural ones.

With a series of web maps that inform them at a national and regional scale, decision-makers, planners, and the public can collaborate to collect local data. By mapping key local assets, communities can understand how these landscapes are connected and how they can be connected. With green infrastructure as a starting point, communities as a whole can plan strategic development that is consistent with natural patterns.

We look forward to sharing these tools with you soon as a resource and an inspiration for planning your community's green infrastructure.

For more information on Esri's partnership with the National Geographic Society, watch the 2016 Esri Federal GIS Conference video at arcg.is/1WaP6WT.

> "It is a scientific fact that the occasional contemplation of natural scenes of an impressive character…is favorable to the health and vigor of men and especially to the health and vigor of their intellect."
>
> Frederick L. Olmsted

↓ By visualizing key landscape assets together on a green infrastructure map, local decision-makers prioritize ways to build ecological connections at all scales, such as greenbelts that connect town centers. (Image courtesy of Zach Hill, Ecosystem Services.)

What's New in ArcGIS Online

Esri is constantly improving ArcGIS Online. The latest release includes updates to item detail pages, the map viewer, the scene viewer, and account administration.

Improved Item Detail Pages

With an enhanced layout, better workflows, and more streamlined performance, users can explore items more in depth. An interactive attribute table integrates related records and attachments so that users can more easily navigate data and view all aspects of a field together—including field values, summary statistics, and settings. Content creators and administrators can change an item's settings, such as feature layer styles and pop-ups, in the item details page as well. And item owners now receive notifications when new comments are posted. They can also delete comments about items they own.

A Smarter Map Viewer

The map viewer contains new smart mapping styles to help users better understand their data as it relates to time. The Continuous Timeline (Color) and Continuous Timeline (Size) styles let users view data sequentially, from old to new or before and after a key date. A health care organization could, for example, use this to evaluate how the rate of measles immunizations changes in the weeks before and after instituting a pro-immunization campaign.

Scene Viewer Innovations

In global scenes, users can now employ tile layers that have a geographic coordinate system (GCS) World Geodetic System 1984 (WGS84) projection. The scene viewer also supports a new type of scene layer called integrated mesh that can represent concave or overhanging vertical features such as cliffs and building walls. Users can create these and share them in ArcGIS Online using Drone2Map for ArcGIS. It is now possible to configure ground properties and elevation layers using the new Ground setting, and users can enable realistic atmospheres in their scenes with the new High-Quality setting. It's easier to change how sunlight and shadows affect scenes, and there is a new option in the environment settings that automatically replicates the sun's position in a scene for a given day or even an entire year. Users can now create 3D web apps directly from the scene viewer as well.

Espousing More Open Standards

As part of Esri's commitment to supporting standards, interoperability, and Open Geospatial Consortium, Inc. (OGC), services, the following improvements have been made:

- Pop-up windows can be enabled on OGC Web Map Service (WMS) layers.
- Custom request parameters can be used with OGC WMS layers.
- OGC Web Feature Service (WFS) layers can be added to maps as items.
- Third-party OGC Web Map Tile Services (WMTS) can be included as items too.

Better Administration of ArcGIS Online

Administrators can now manage service credit budgets as part of the invitation process for automatic and preestablished accounts, as well as set a default service credit allocation for new users. They can also enable enterprise logins to give users access to Esri web resources such as support, training, forums, and downloads. Organizations can configure custom groups with layers they want to use to perform analysis in the map viewer. And, with the new Esri shopping cart in ArcGIS Marketplace, administrators can designate which apps users can buy.

More Versatile ArcGIS Apps

Collector for ArcGIS now includes support for high-accuracy GPS data collection using external Global Navigation Satellite System (GNSS) receivers. And Survey123 for ArcGIS, Workforce for ArcGIS, and Drone2Map for ArcGIS have all graduated from beta.

Improved ArcGIS Content

The Living Atlas of the World now has detailed boundary layers for several dozen countries—all of which are available for display and analysis in the map viewer and other ArcGIS apps. The beta versions of Esri vector maps have also been improved with data for several areas and layers. And Esri has updated numerous basemaps, including *Light Gray Canvas* and *Dark Gray Canvas*, the *World Street Map*, and the *World Topographic Map*. *World Imagery* now includes the National Agriculture Imagery Program's (NAIP) one-meter imagery from 2015 for 22 additional US states. A new imagery map is also available in the GCS WGS84 projection, which supports 3D display in apps such as ArcGIS Earth. Esri's demographic maps for the United States have been updated with the latest 2016 estimates and 2021 forecast data, and demographic maps for several countries have been upgraded with more recent data as well.

For a comprehensive look at the latest release of ArcGIS Online, visit the ArcGIS Online blog at blogs.esri.com/esri/arcgis/category/arcgis-online.

Create Animations with ArcGIS Pro

Motion brings GIS content to life and allows viewers to connect with the story being told. Animations inspire exploration, drive interaction, and prompt focus.

Creating animations in ArcGIS Pro is simple. They are a combination of keyframes and transitions, and producing them requires no additional training.

Use animations to ride along with a twisting and turning roller coaster, navigate the topography of Mount Vesuvius, or visualize data patterns over both space and time using a 3D space-time cube.

For more information on using animations in ArcGIS Pro, visit pro.arcgis.com.

Geodesign Restores Chimpanzee Habitats in Tanzania

continued from cover

A History of Helping Local Communities Restore Woodlands

To halt the rapid deterioration of natural resources, JGI began working with the local communities around Gombe in 1994 through the Lake Tanganyika Catchment Reforestation and Education (TACARE) project. TACARE sought the local community's support from the beginning by incorporating clean water, agriculture, health, social infrastructure, and community development elements into its conservation programs.

In 2000, JGI began utilizing geospatial technologies to put everything—people, chimpanzees, and habitats—on one map. The organization and its partners integrated more than 400,000 Gombe chimpanzee observations into a geodatabase using Esri's ArcInfo software. At the same time, analysis of Landsat multispectral scanner (MSS), Landsat Enhanced Thematic Mapper Plus (ETM+), and SPOT satellite images confirmed that while forest cover improved inside Gombe between 1972 and 2003, more than 64 percent of forests and woodlands in core chimpanzee range outside the park had been lost.

JGI's community-centered approach entered a new era in 2002 when the first one-meter, high-resolution IKONOS imagery of the larger Gombe ecosystem became available. For the first time, JGI staff and partners could look at one image and see trees that chimpanzees use alongside the farms and other lands that are key to people's livelihoods. This enabled everyone—from villagers and government decision-makers to scientists and conservation practitioners—to gain a common understanding of the landscape, agree on what its major threats are, and work together to save Gombe and the surrounding forests.

In 2005, JGI started incorporating geodesign and conservation action planning (CAP) into its Gombe conservation initiatives. These complementary methodologies bring together people, indigenous understanding, scientific expertise, data, and technology to develop better conservation strategies that are informed by a landscape's physical, biological, social, political, and economic fabric.

For instance, one of JGI's strategies is to advocate that local communities plant trees and set up nurseries to source their firewood and timber. But geospatial data analyzed using the CAP process revealed that much of the deforestation that threatened chimpanzee habitats outside Gombe was happening because local communities were clearing these woodlands to make land available for farming and scattered housing—not to collect firewood. Thus, while planting trees and establishing nurseries could support people's livelihoods, these actions did not remove the most direct threats to the forested areas used by chimpanzees, nor did they address the conservation issue entirely.

So JGI facilitated the development of participatory village land-use plans and community-managed village forest reserves. The aim was to assure land tenure and define appropriate land uses that would both satisfy local residents' rural development goals and protect chimpanzee habitats outside Gombe.

Evaluating Results with Geodesign

Conservation organizations need to continually measure their results to keep their world views in check and be able to adapt and fine-tune their strategies. This also helps them maintain focus on their main conservation objectives, which in JGI's case is protecting wild chimpanzees and their habitats. The geodesign process leverages geospatial technologies to directly integrate evaluation into landscape design workflows.

Recently, Esri partner DigitalGlobe acquired very high-resolution imagery of what is now known as the Greater Gombe Ecosystem—the area that covers Gombe and adjacent village lands. With Esri's help, JGI integrated this and other imagery provided by satellite and unmanned aerial vehicle (UAV) sensors with the ArcGIS platform to support its geodesign process for the area.

Using 2005 and 2014 DigitalGlobe satellite data in ArcGIS Online, for example, JGI staff can visualize—and share with the world—that Kigalye Village has successfully implemented a land-use plan in its village forest reserve that minimizes farming, logging, and fires and allows Miombo woodlands (which are the most extensive habitats available to Tanzania's chimpanzees) to regenerate naturally.

JGI staff can also use the geodesign evaluation tools in GeoPlanner for ArcGIS to clearly show the results of its analysis to decision-makers. For example, Landsat MSS and historical aerial photos show that, in 1972, the area now represented by the Kigalye Village Forest Reserve had 370 hectares of woodlands (70 percent of its total area), while in 2005—when the village reserve was created—its woodlands had decreased to 156 hectares, just 42 percent of the forested area recorded in 1972. The imagery also shows that by 2014, community efforts had increased these woodlands to 302 hectares, or about 82 percent of the forested area documented in 1972.

This integration of imagery with the ArcGIS platform—and especially GeoPlanner—makes it easy for decision-makers to see the impact of village-specific land-use plans. It also helps measure the success of conservation initiatives, starting at the village level and going up to the scale of the whole landscape.

Cultivating Local Leaders' Decision-Making Capacity

To empower local communities to be stewards of their environment and active participants in chimpanzee conservation, JGI galvanized local communities to implement land-use plans for their village forest reserves.

Equipped with Android smartphones and tablets that contain Open Data Kit (ODK), an open-source mobile app, village forest monitors regularly survey their forest reserves and collect data on how many kilometers they patrol, which

↑ Using DigitalGlobe satellite data from 2005 (left) and 2014 (right), JGI staff can see that Kigalye Village has implemented a land-use plan that allows Miombo woodlands to regenerate naturally.

Image courtesy of JGI.

↑ With the Community Forest Monitoring Dashboard, decision-makers can see how thoroughly the Kigalye Forest Reserve is being patrolled and how frequently illegal activities take place.

types of wildlife they see, any chimpanzee presence they observe, and illegal human activities they witness that are threats to wildlife or forests.

JGI started out using ODK in 2009 in 12 villages and has since expanded this work to 52 villages. With the amount of community-generated data continually increasing, it has become difficult to make it accessible to local decision-makers—including village, district, and regional governments—so they can use the results to inform local conservation decisions. So in collaboration with Esri partner Blue Raster, JGI developed the Community Forest Monitoring Dashboard, which leverages ArcGIS Online and ArcGIS for Server to publish this data as maps and interactive charts that are accessible online—even with poor Internet connectivity.

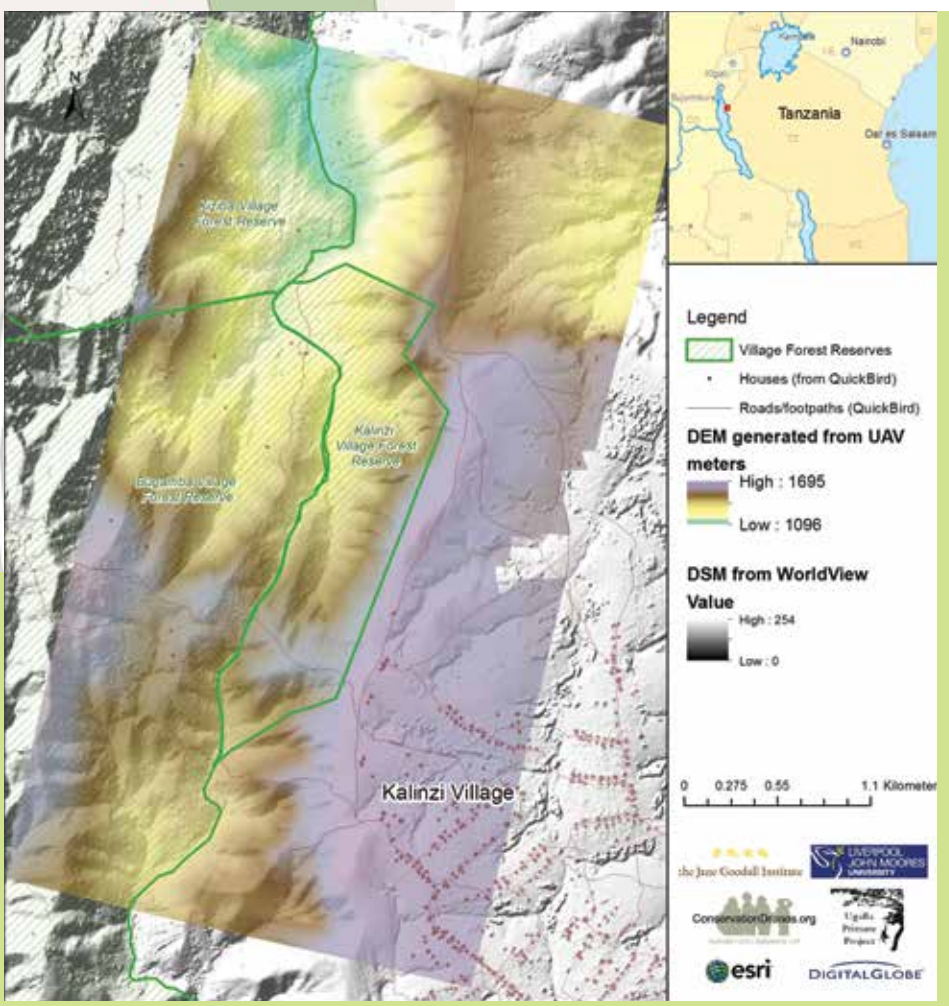
The custom data harvesting system transfers the data recorded in ODK to ArcGIS Online, enhancing it with the rich cartography, spatial analysis and data visualization tools, and amplified security that come with the ArcGIS platform. As a client-side app that was built using the React isomorphic JavaScript framework, which allows both the server and front-facing sides of the app to share the same code, the system can perform in low-bandwidth environments under challenging conditions. The combination of technologies also enables this system to be augmented with capabilities such as administering alerts and processing outside data sources. It is compatible with other Esri tools as well, such as Esri Story Map apps and AppStudio for ArcGIS.

JGI, Blue Raster, local and regional government officials, and other partners launched the Community Forest Monitoring Dashboard in Kigoma, Tanzania, in January 2016. With the dashboard, local decision-makers can now use community data to evaluate the implementation of village land-use plans. Zooming in to Kigalye Village, for example, decision-makers can see not only how thoroughly the Kigalye Forest Reserve is being patrolled but also how often wildlife is encountered and how frequently illegal activities take place. Local leaders can also print maps and browse photos recorded by village forest monitors to get a more detailed impression of activity in the area.

Using UAVs to Capture Village-Scale Imagery

Looking to the future, emerging UAV technologies have the potential to be powerful, locally available tools that JGI staff in Kigoma and communities around Gombe could use to acquire village-scale imagery to evaluate village land-use plans and measure conservation successes. In collaboration with nonprofit Conservation Drones, Liverpool John Moores University, the Ugalla Primate Project, and the local communities, JGI has been assessing the feasibility of using UAVs to complement village forest monitoring efforts and survey chimpanzee nests in western Tanzania.

In June 2015, with support from NASA and the US Fish and Wildlife Service, Conservation Drones trained JGI staff in Kigoma in the use of UAVs. In just two days, with participation from the local communities, JGI successfully acquired very high-resolution imagery of three village forest reserves in rugged terrain along the East African Rift Valley escarpment that lies to the northeast of Gombe. JGI is now working with Esri to use Drone2Map for ArcGIS to streamline the creation of high-resolution imagery products from drone-captured still images. While this will further support the geodesign effort across the ArcGIS platform, the app also shows great promise for improving the automatic classification of tree species.



↑ Using UAVs supplied by Conservation Drones, JGI acquired very high-resolution imagery of three village forest reserves along the East African Rift Valley escarpment to the northeast of Gombe.

The Future of Thriving Conservation Efforts

The technological developments that have taken place since JGI began working with the local communities around Gombe to conserve forests and woodlands are very exciting. GIS, with a focus on geodesign, has already helped plan, implement, and evaluate community conservation efforts in the Greater Gombe Ecosystem—and will continue to do so.

"This is one of the first geodesign projects we've seen progress from conceptualization to implementation," said Shannon McElvaney, global industry manager for community development at Esri. "What makes this project extremely special is the dynamic use of geodesign as a tool for adaptive management—to monitor progress and change plans as needed—to ensure that the collective goals of the communities involved were met."

As long as conservation professionals persist in applying these tools and methodologies within the local context, according to the geodesign framework, conservation efforts will keep thriving in and around Gombe, and even around the world.

↑ JGI is working with Esri to use Drone2Map for ArcGIS to create high-resolution imagery products, which show great promise for improving the automatic classification of tree species.

About the Author

Dr. Lilian Pintea has spent more than 20 years applying remote sensing and GIS to the task of protecting chimpanzees and their vanishing habitats in Africa. As vice president of conservation science at the Jane Goodall Institute, he shapes the organization's agenda for applied research to innovate and discover new solutions to maximize the impact of all JGI programs in protecting the environment—especially chimpanzees and their habitats. For more information, email Dr. Pintea at lpintea@janegoodall.org.

Special thanks go to Esri staff members Gerald Kinn, Kurt Schwoppe, Jim Michel, Greg Pleiss, Robert Stauder, Joseph Peters, and Mark Romero for helping the Jane Goodall Institute leverage the ArcGIS platform to help protect chimpanzees and their habitats.

Raleigh Cleans Up with AppStudio for ArcGIS

By Audrey Robinson, City of Raleigh

Raleigh, North Carolina, is one of the fastest growing areas in the country. Between 2000 and 2014, the city's population increased by 59 percent. Downtown Raleigh has experienced dramatic growth in new residents and businesses as well. The downtown's retail base has increased by over 35 percent in the last four years, and events, festivals, museums, and attractions bring more than 3.5 million visitors to the downtown area each year.

By all indicators, Raleigh is flourishing. But this level of growth presents challenges.

Last fall, residents and business owners raised concerns about litter and cleanliness in downtown. Although multiple groups—including the Downtown Raleigh Alliance's (DRA) Clean Ambassadors and staff from the departments of Parks, Recreation and Cultural Resources and Solid Waste Services—contribute to keeping downtown clean, the demand was outweighing available services. So the City of Raleigh turned to its robust GIS—and used AppStudio for ArcGIS for the first time—to figure out what to do.

A Tool to Gather Location-Based Litter Data

Raleigh's Office of Sustainability and DRA worked with their service partners to form a task force and create a plan of action for tackling the city's litter problem.

Task force members first needed to understand the litter issue. They had to gather information and assess the magnitude, types, and locations of litter before they could make any recommendations.

But the timeline for completing the study was short. Because it was autumn and temperatures were beginning to drop, the schedule for events and activities taking place downtown was slowing down. A litter audit had to be completed quickly to provide the task force with any meaningful information.

An eight-member team from the Parks, Recreation and Cultural Resources and Solid Waste Services departments was looking for a tool to gather location-based information about the density and types of litter in downtown. The City of Raleigh's sustainability manager, Megan Anderson, contacted Raleigh's GIS team to get help.

"They have always been willing to take advantage of new tools and have an innovative approach to problem solving," said Anderson.

GIS and web app integration developer Justin Greco believed he could deliver a mobile application on a tight schedule using AppStudio for ArcGIS. He had learned about the app, in beta at the time, during the 2015 Esri User Conference.

"It was what first came to my mind when this project was brought to our team," he said.

Because of the project's short time frame, Greco said a custom-developed app was out of the question. AppStudio for ArcGIS, however, would allow him to configure a mobile app without spending time on coding or development cycles.

"The main advantage of AppStudio is how fast it was to set up," he continued. "I was able to have a prototype in under an hour."

He leveraged the city's existing maps and added a hosted feature layer to enable field staff to collect data and store it in ArcGIS. Working with members of the task force, it took Greco less than three weeks to build the mobile app, make minor adjustments, and install it onto eight smartphones.

Collecting Litter Data

The litter audit took place in October 2015.

The eight city staff members doing the audit received less than 15 minutes of training on the user-friendly mobile app, called Litter Reporter, just before they went out for the first time. Following the Clean Ambassadors' cleaning routes, the auditors walked downtown six times a day at specific intervals over a period of three days to collect litter data. When they spotted litter, they photographed it; geotagged the location; and used the app's quick-select menu to categorize it as paper, cigarette butts, containers, bottles, cans, food, or cardboard, for example.

The GIS team then used ArcGIS Online to create visualizations of the litter audit data that could be displayed in Operations Dashboard for ArcGIS. Heat maps provided a clear picture of litter density and the types of litter found most frequently downtown (which were cigarette butts, followed by litter associated with food consumption). The task force used the reports to determine where litter is an issue and developed recommendations and plans for reducing litter in these areas.

The Parks, Recreation and Cultural Resources department presented the Raleigh City Council with a detailed report of the task force's findings, along with budget planning options for addressing litter control and cleanliness in downtown Raleigh.

Growing Cities as Smart Cities

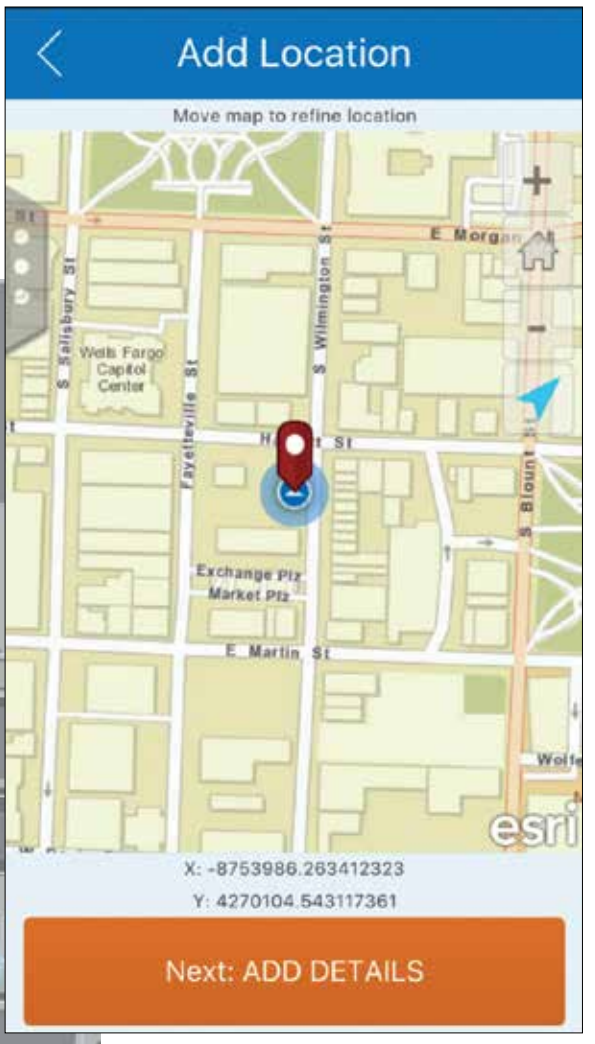
The department continues to use Litter Reporter every quarter to monitor trends and figure out how to efficiently manage litter downtown. Supplemental audits follow the same methodology, routes, and times as the first audit to ensure that the city is monitoring accurate trends.

"In general, there is a lot of information and buzz around smart cities and how cities are utilizing technology," said Anderson. "The litter application is an example of how quickly the tools can be deployed to help cities gather data and make informed, smart decisions about how they deliver service. The process is an excellent model for understanding challenges faced by growing cities."

ArcGIS—and especially AppStudio for ArcGIS—allowed the GIS team to collaborate deftly with the task force, providing its members with the tools they needed to gather data quickly and create actionable reports. Staff at the City of Raleigh will continue to use data and reports from the litter audit app to work cross-departmentally with DRA to evaluate options for increased levels of service downtown.

For more information, contact the City of Raleigh's web and GIS manager, Jim Alberque, at James.Alberque@raleighnc.gov or 919-996-2520.

↓ This heat map, which displays litter data collected using Litter Reporter, resulted in two additional solar-powered trash compacting units being placed at the corner of Hargett and Wilmington streets, where high densities of litter were recorded.



↑ The Litter Reporter app allows users to photograph litter, geotag its location, and select its type.

Detecting Large Landslides in Italy Before They Happen

Esri Italia Uses GNSS with GIS to Discover Anomalous Movements in the Mountains

One of Italy's most charming regions is Le Marche, which sits on the Adriatic Sea south of Bologna. In its Monti Sibillini National Park, the Lake Fiastra reservoir is a popular tourist destination where visitors enjoy swimming and participating in fishing competitions.

Since 1940, however, evidence of deep-seated gravitational slope deformation has been observed in the surrounding Apennine Mountains. These movements, which are caused by active faults and the area's tectonic setting, occur over larger areas compared to landslides. They are the source of the many trenches and deep-ground creeps (gradual, downward movements of soil) that endanger hikers.

To monitor these ground deformations, Italy's National Institute of Geophysics and Volcanology is experimenting with an innovative solution. Developed by Esri Italia, it uses GIS and single-frequency, lightweight Global Navigation Satellite System (GNSS) sensors to detect possible anomalous movements in the mountains and identify potential areas of impact.

Extending GNSS

Using GNSS to measure slow ground displacements is a well-established practice. However, the typical available solutions are based on expensive, bulky, and energy-demanding geodetic-class GPS receivers because, until recently, these were the only ones able to meet the accuracy and precision requirements demanded by high-end apps. This factor alone limited the use of GNSS monitoring systems.

Recently, though, developments in signal analysis and advances in technology have brought to market compact, single-frequency receivers that have extended applications in the field compared to what they were originally intended for. The simultaneous miniaturization of the devices and advances in wireless data transmission technology have given way to solutions that reliably manage and transmit data, even in areas that require simple infrastructure.

Moreover, the development of new navigation satellite systems around the world, such as Europe's Galileo and China's BeiDou, will soon ensure that measurements can be repeated, even for low-end, compact sensors—a fundamental element for monitoring slow, nonlinear drifts that are potential precursors of structural terrain failure.

Collecting Land Movement Data

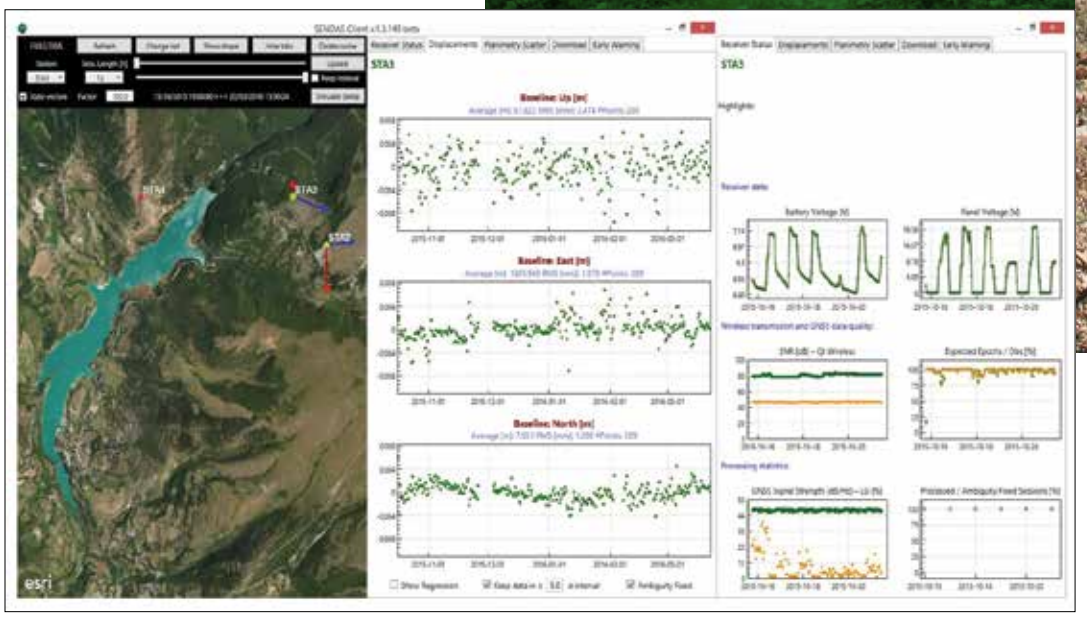
In late 2015, after Esri Italia carried out two years of research and development in collaboration with SpaceEXE, an Italian startup that specializes in designing microelectronic devices, a new and innovative solution for monitoring ground deformations was released: the SurfacE Network Deformation Monitoring System, or SENDAS.

This system collects GNSS data via local receivers, which transmit the information to a local gateway. A modem then sends the data in real time to a cloud server, where it is processed for a variety of uses.

SENDAS sensors are composed of a single-frequency GNSS receiver (that works with both GPS and Galileo) and an antenna, a power supply based on a photovoltaic panel, and an 868 Megahertz (MHz) wireless interface that transmits GNSS and telemetry data. The sensors form a mesh network, which is capable of delivering the data to a gateway node equipped with a General Packet Radio Service (GPRS) modem. This mesh topology provides a reliable infrastructure in case individual nodes malfunction.

Data is transmitted, stored, and processed regularly on one of the National Institute of Geophysics and Volcanology's servers using NDA, a software entirely developed by Esri Italia. The software works best with single-frequency receivers that form local area networks with baseline lengths (the distance between a base station and a rover) of up to 10 kilometers.

Esri Italia deployed four SENDAS sensors around Lake Fiastra during its collaboration with Italy's National Institute of Geophysics and Volcanology.



← The dashboard lets end users see near real-time information on sensors' battery charges, solar panel voltage, and the quality of the wireless interface being used to transmit and process data.

To monitor small shifts in land, the server automatically updates historic displacements of each point with millimeter-level repeatability, or precision, and lets users select update periods of one to 24 hours. For a half-day measurement session, the system can typically detect displacements of just a few millimeters.

Planning for Displacements

Using a dashboard, end users at the National Institute of Geophysics and Volcanology or with the National Institute of Oceanography and Experimental Geophysics can check the field sensors' telemetry, as well as other information, such as the efficiency of wireless data transmission and the GNSS data quality. If there are malfunctions in the system, or if the land's deformation rate exceeds a preset threshold, the dashboard sends warning emails to those at the institute who are responsible for preventing potentially catastrophic events.

Esri Italia also built an app using ArcGIS Runtime SDK 10.2.6 for the Microsoft .NET Framework that allows users to overlay shapes onto the area being monitored in an effort to detect trends in transpiring deformations. The app allows users to model the potential effects of deep-seated gravitational slope deformations.

Users can plot current ground strain vectors on a geomorphological map to identify and prioritize possible environmental and man-made threats. They can also intersect potential areas of impact with at-risk elements, such as buildings, roads, power lines, and vulnerable populations. Users can categorize the level of danger the hazard presents based on the demographic and infrastructural factors of at-risk areas. And they can use the app to develop effective hazard response plans, such as evacuation routes and containment strategies.

Preserving Italy's Geography

Around Lake Fiastra, "SENDAS is used by *[the National Institute of Geophysics and Volcanology]* to *[monitor]* movements induced by a deep-seated gravitational slope deformation causing sinkholes in the ground, often tens of meters deep," said Massimiliano Chersich, the Esri Italia GNSS solutions manager.

Esri Italia has deployed four SENDAS sensors around the lake to constantly keep track of very small land shifts. This allows the institute to react before any sinkholes form—closing trails or roads to protect the national park's visitors.

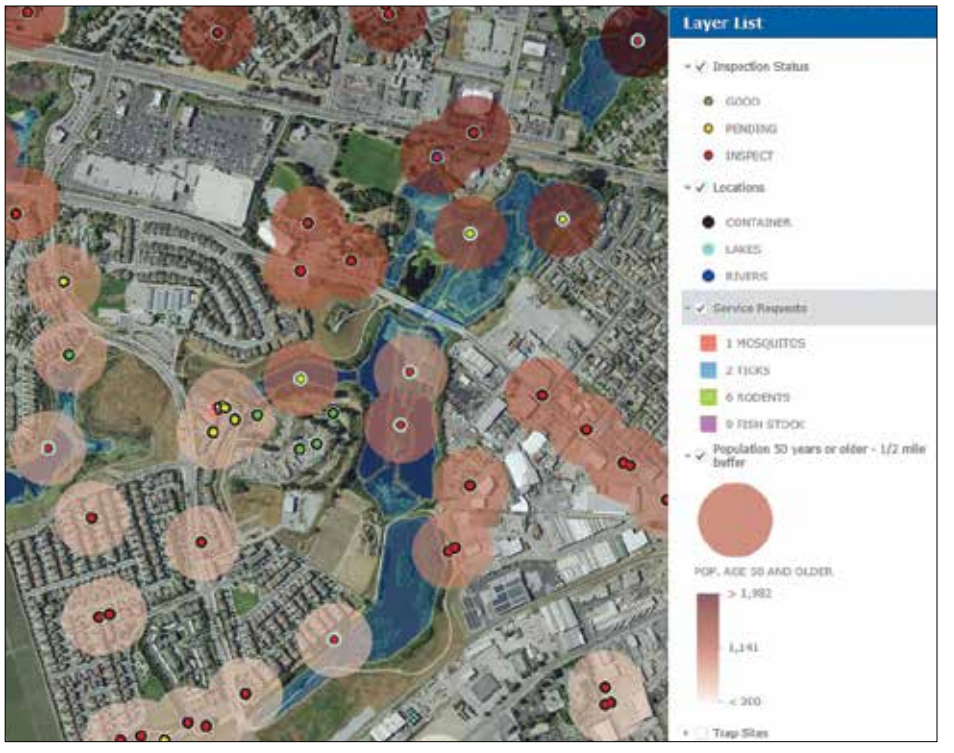
SENDAS is also being used in other localities around Italy. In February, for example, it helped local authorities in the small northern Italian town of Cazzaso close a road that leads to a neighboring village to keep citizens safe from a known landslide that was showing elevated movement.

With this unique tool, the National Institute of Geophysics and Volcanology is improving the effectiveness of initiatives dedicated to protecting the population and infrastructure from unpreventable movements in land. In turn, that is helping preserve the unique geography—and conserve the land—that has contributed to making Italy so famous.

ArcGIS Platform

Curtails Mosquitos in Coastal California

By Bryan Kriete and Matt Price, Santa Cruz County



↑ Santa Cruz County's Mosquito Abatement and Vector Control district now distributes site inspection status information via its Operations Map app.

Mosquitoes are one of the deadliest animals in the world. They are responsible for killing several million people each year, according to the World Health Organization. As vectors of parasites, bacteria, and viruses, they transmit hundreds of millions of cases of malaria, dengue, yellow fever, West Nile virus, Zika virus, and other diseases from one human or animal host to another.

Across the United States, vector control districts employ skilled and dedicated staff members to help reduce the mosquito population. They conduct site inspections; place traps; treat breeding sites with mosquitocide; and, if necessary, fog (spraying pesticides throughout an area) adult populations.

Santa Cruz County's Mosquito Abatement and Vector Control (MAVC) started using GIS almost 20 years ago to identify probable breeding sites. Since then, MAVC has progressively implemented more of the ArcGIS platform to keep its operations effective and innovative. Now, staff members are continually informed of the status of population control projects and can better focus their mosquito abatement work.

Reining In Mosquito Populations

A mosquito undergoes four life cycle stages: egg, larva, pupa, and adult. Females deposit their eggs in moist soil or places with standing water, such as ponds, septic systems, wetlands, ditches, storm water catch basins, and various containers. Once they reach adulthood, mosquitoes can fly three or more miles—depending on the species—making it difficult to get a handle on them. Controlling mosquitoes when they are larvae is the most effective way to reduce populations before they disperse.

California began employing mosquito controls in the early twentieth century to restrict salt marsh mosquitoes around San Francisco Bay and combat malaria in the state's Central Valley. By the 1990s, almost every county in California had formed a vector control district.

Santa Cruz County, located approximately 60 miles south of San Francisco, is composed of pristine beaches and wetlands, lush redwood forests, and rich farmland. More than 14 species of mosquitoes call Santa Cruz County home, and the resources required to control the populations are significant.

In 1998—five years after it was formed—MAVC began employing GIS to locate potential mosquito breeding sites based on ground conditions and proximity to bodies of water. The district developed GIS layers to show where standing water was located to help identify the breeding sites. The size of each breeding area was either calculated using aerial imagery or estimated at the time of treatment. This helped determine how much mosquitocide to administer and where.

The field data—which included the type and amount of mosquitocide applied, the application date, the area treated, and the current condition of the site—was entered into a Microsoft Access treatment database. To date, more than 2,500 potential breeding sites have been mapped and are inspected every other week or each month.

Automating Inspection Statuses

In 2004, to stay ahead of mosquitoes moving into adulthood, MAVC had the Santa Cruz County GIS team develop the Mosquito Button, a geoprocessing script for ArcMap that was used to automatically determine the inspection status of potential breeding sites.

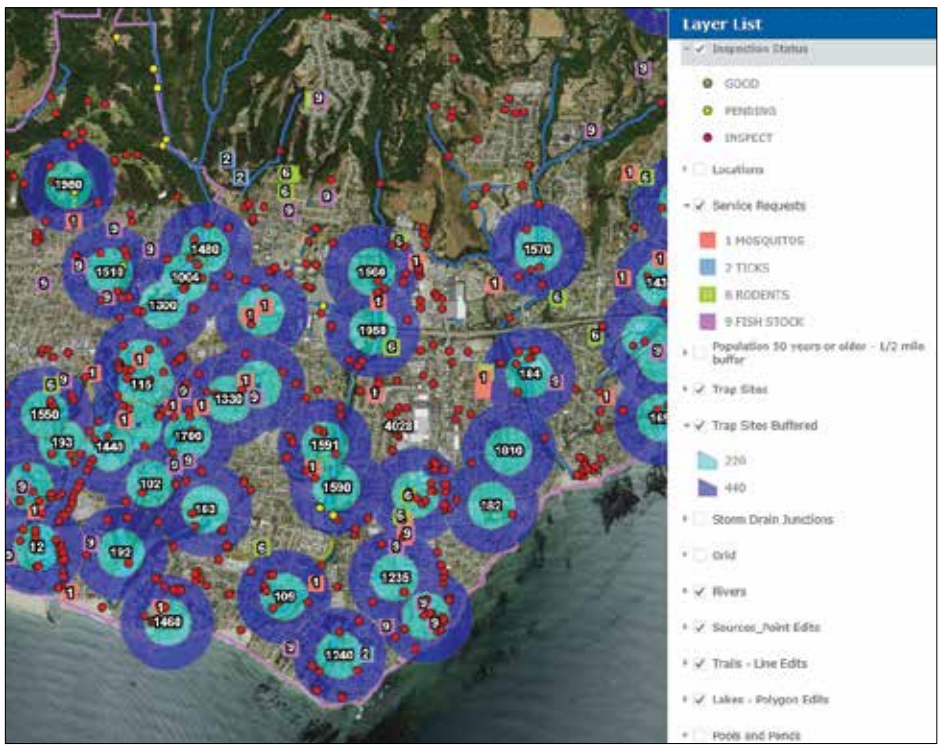
"Mosquito problems can accrue quickly, and our department needed some way to visually see when we've been to a mosquito source," said MAVC vector control specialist Ray Travers. "The Mosquito Button provided a quick and easy way for staff to look at the inspection status of possible mosquito breeding sites."

Pressing the button initiated a query of the treatment database to find the last treatment date and the effective life of the mosquitocide that was used. The inspection sites then appeared color-coded in ArcGIS for Desktop, with red meaning a site needed inspection or treatment, yellow indicating that a site was coming up for inspection within ten days, and green meaning no action was required.

The quick, visual reference provided by the Mosquito Button helped staff members plan their daily work activities by letting them see where inspections and treatments needed to take place within their assigned areas. But because the department had minimal resources and integrating the Microsoft Access-based treatment database with ArcMap was challenging, staff members saved copies of the GIS data locally, on their computers. This led to fragmented GIS datasets and made it difficult to get a countywide picture of mosquito populations.

Consolidating Breeding Site Information

In 2014, MAVC staff moved the treatment data to Microsoft's SQL Server, which allowed the GIS data to be taken off people's desktops and put into ArcGIS Online. MAVC also replaced the Mosquito Button with a SQL-stored procedure that runs nightly to calculate site inspection statuses. This data is published as a REST service in ArcGIS for Server and shared with a Vector Control group in ArcGIS Online. It is distributed via the MAVC Operations Map app, which was developed with Web AppBuilder for ArcGIS.



↑ Staff use ArcGIS Online to view demographic information, together with mosquito treatment and trapping locations, so they can prioritize their resources.

The status data for every mosquito-breeding site in Santa Clara County is now available to all users anywhere, anytime—on their desktops and their mobile devices. The MAVC Operations Map app also contains tools that allow users to edit data, conduct spatial analysis, and measure distances and areas.

Beyond basic mapping functions, the ArcGIS Online platform provides MAVC with tools to identify and protect segments of the population that are most vulnerable to disease, such as children and the elderly. MAVC field staff use ArcGIS Online to create buffers around treatment and trapping locations. They then assign demographic information, such as total population and median age, to the buffers.

Seeing all this information together allows staff members to prioritize their time and resources by giving them a better understanding of where vulnerable segments of the population are located. The buffers also help them identify potential breeding sites. For example, if high numbers of a target mosquito species are found in a trap, there's a chance a potential breeding site has been missed or that the treatment has failed. From there, staff could create a quarter-mile buffer around the trap and select the sites within the buffer that may need to be revisited for inspection or treated again.

Additionally, MAVC began leveraging Collector for ArcGIS toward the end of 2015 to map new breeding sites and trapping locations, as well as update known breeding sites with exact measurements. Now, instead of recording data in the office after they conduct site visits, staff members capture information in real time. They use Collector to measure the area of a site during an inspection or at the time of treatment so a precise amount of mosquitocide can be applied. Field staff also use it to map the trails that lead to particular breeding sites so that, on return visits, they can take the best route and avoid nettlesome conditions such as poison oak.

MAVC is also in the process of implementing Navigator for ArcGIS to develop safe and efficient routes for getting to residential mosquito breeding sites. The district treats more than 1,600 storm water catch basins in the county several times a year, and planning the best routes to get to all of them can be time consuming—especially when a staff member has to visit 70–80 in one day. In some cases, MAVC employs seasonal workers to treat the catch basins, which can add to the complexity if they are not familiar with the area. Using Navigator will reduce everyone's travel times, resulting in savings on gas and decreased vehicle wear and tear.

Capitalizing on ArcGIS Online

The department is looking to implement Operations Dashboard for ArcGIS, Esri Story Map apps, time-enabled layers, and ArcGIS for Open Data as well.

"This is just the beginning," said Travers. "We intend to capitalize on all the features of ArcGIS Online…allowing us to be most effective at our jobs while keeping the public and our colleagues abreast of our actions and the actions of the mosquito."

For more information, email Bryan Kriete, vector control technician for Santa Cruz County, at Bryan.Kriete@santacruzcounty.us.

Malta's Water Flows Smoothly with Enterprise GIS

On the European archipelago of Malta, located in the Mediterranean Sea south of Sicily, the Water Services Corporation (WSC) is the public entity in charge of drinking water and wastewater.

Ensuring that water continues to flow on the country's three inhabited islands—regardless of population growth, increased tourism, and other seasonal demands—requires substantial infrastructure, sophisticated technology, and steadfast organization. That is why WSC has adopted an enterprise-wide geospatial strategy, steeped in ArcGIS, to make location data central to decision-making.

A Comprehensive Enterprise GIS

Since WSC migrated its GIS over to Esri software five years ago, the organization has built up a comprehensive enterprise GIS. It has geolocated all the islands' water meters, valves, taps, and pipes for both drinking water and wastewater. The corporation has also recorded the slope angles and elevations needed to design and maintain efficient and well-functioning systems.

WSC's enterprise GIS allows a large number of employees throughout the organization to use, manage, and share geospatial data. They can create, modify, and visualize GIS data, as well as analyze and disseminate it. Incorporating GIS at nearly every level of the organization allows strategic operators at WSC to see, question, analyze, and interpret data so they can better understand relationships, patterns, and trends in Malta's water systems.

To fully benefit from GIS and maximize its return on investment, WSC came up with a long-term strategic plan for implementing the technology. This involved placing GIS at the core of each existing and new solution and making the technology the bridge between all systems.

"Esri has made the sharing and accessibility of GIS data layers and analysis limitless," said Ian Galea, a GIS technologist at WSC.

Now, nearly the entire utility is GIS centric.

Sustaining a Customer-Focused Business

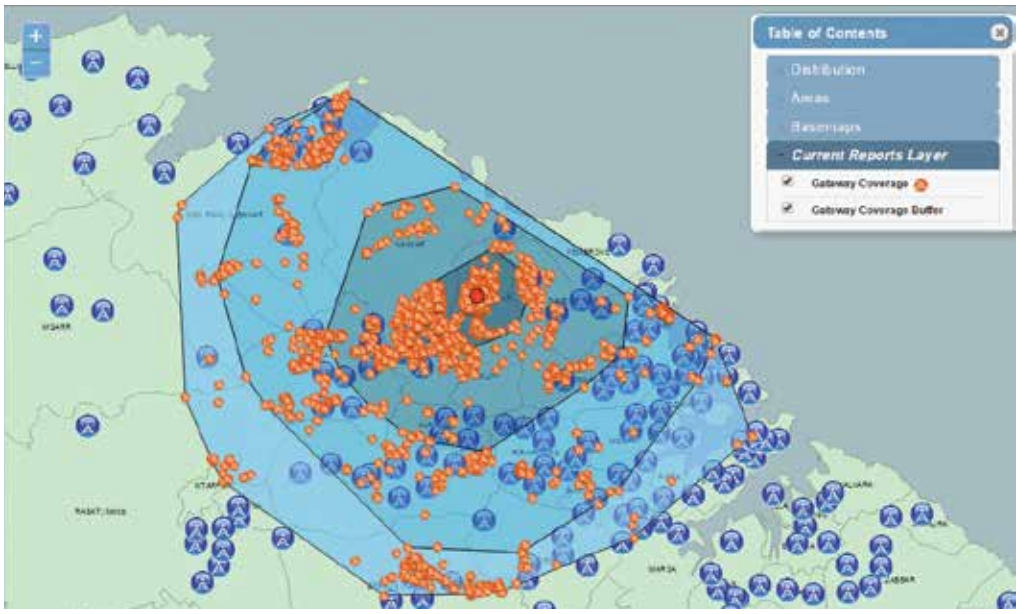
Keeping WSC's 420,000 water and wastewater customers happy is paramount. To that end, the corporation has integrated ArcGIS with its SAP enterprise resource planning (ERP) system to better administer key business functions, including asset and supply chain management, accounting, and finance.

"Although ERP solutions are excellent products, they have the tendency to generate loads of data (most of which can be spatially related), which makes it *[nearly]* impossible to analyze using conventional methods," said Brian Borg, executive director of strategic information at WSC. "Integrating GIS with such solutions not only facilitates the analysis process, but it *[also]* gives the data other dimensions and perspectives on how to analyze it."

With the ArcGIS-SAP integration, WSC's customer care department can pinpoint customer reports on a map, including those for low water pressure, leaks, and service outages. Department staff enter the information into SAP ERP through an in-house-developed GIS app called AquaDot CRM (customer relationship management). This sends an automatic, georeferenced notification of the problem to the relevant region's WSC officer in charge, enabling him or her to quickly see where the problem is on a map.

With GIS, searching for streets and verifying specific locations is much easier as well—especially when customer reports come in over the phone. Call center personnel can use orthographic map projections and street-level views to confirm a reported location by giving visual

↑ With GIS, customer care staff can pinpoint customer reports—such as low water pressure, leaks, and service outages—on a map.



→ The reception area for every smart meter transmitter is periodically analyzed to make improvements in coverage.

↑ The AquaDot AMM solution shows WSC which gateways serve specific consumer meters over time.

cues to the customer. This ensures that reports and repairs get dealt with smoothly.

Managing Smart Meters

Smart meters, which automatically send customers' water usage information back to the supplier, are now a mainstay of WSC's water infrastructure. To effectively monitor and manage the smart meter system, WSC's software engineering team created the AquaDot AMM (automated meter management) solution, a web-based tool that was developed using ArcGIS API for JavaScript. The solution has become WSC's principal monitoring tool at the operational level, keeping track of everything from the parts that make up the smart meters themselves to the areas serviced by their radio-frequency (RF) networks.

"The AquaDot AMM solution gives me all the structured live information I need to *[make]* informed decisions," said Stephan Riolo, the executive director of network infrastructure at WSC. "Getting the same information by tapping raw data from SAP ERP and *[the]* MDM *[mobile device management]* data warehouse is close to impossible."

Using feature layers and geometry services from ArcGIS for Server, WSC can keep track of smart meter system components—namely, the RF receiver gateways and meter module transmitters. Employing the visual aids in AquaDot AMM, users at WSC can rapidly identify the location of a particular RF receiver gateway (which captures hourly meter data) when its alarm goes off, which could indicate a low battery, for example. They can also quickly locate meter transmitter issues, such as cut wires, so the corporation can issue repairs straightaway.

WSC uses the solution to monitor the radio reception between smart meter transmitters and receivers as well. The reception area for every transmitter is generated on demand and is periodically analyzed using the appropriate geometry services (which help apps buffer, calculate areas and lengths, and do map projections). This analysis flags any negative variations in transmission, which can indicate antenna problems that need to be fixed. Examining stored reception areas with GIS can also identify overlapping reception zones, which reflect redundant antennae. Since antennae are costly to maintain, this helps WSC promptly remove the nonessential ones.

Additionally, the AquaDot AMM solution shows WSC what gateways serve specific consumer meters over time so the organization can ensure that all consumer meters are being reached and that hourly data on water use is being received and processed. Users can select a particular antenna as well to visually analyze which meters have been serviced within a specified period of time. This ensures that all smart water meters are recording data on water usage for supply and billing purposes, as well as data integrity reasons. AquaDot AMM also helps administer transmitter installations and maintenance, aiding personnel in locating meters that need transmitters to be installed or inspected.

Maintaining the Sewage Pipe Network

Another central function for WSC is maintaining and extending the country's sewage pipe network. To manage projects like these throughout their life cycles, the corporation developed the AquaDot Projects system.

At the outset of any planned project, the regional network infrastructure department geocodes all the assets that will be used or affected—mainly pipes and other fittings. Any attributes related to these assets, such as pipe diameters and material types, are also stored with every geocoded feature.

In the year that WSC has been using this project management system, it has become easier to identify concentrations of sewage pipe projects. Using heat maps, project planners can see areas that will likely need pipe replacements soon and evaluate areas that may require network expansions. Moreover, using tools in ArcGIS for Desktop to calculate pipe lengths and identify new service points in and around project locations has made the planning process much more efficient.

Using GIS at the Managerial Level

To help management keep track of these numerous and varied projects, WSC also developed AquaDot Insight, a business intelligence solution that uses data gathered by various solutions, such as SAP, to produce high-level reports and key performance indicators. With user-friendly, GIS-based dashboards (developed in-house), managers can evaluate trends and make quick, effective decisions.

One dashboard, for example, provides managers with a visual display of how many consumer transmitters have been installed in every locality in Malta. Another dashboard shows heat maps of customer notifications by type or service-level agreement. These help departmental and top-level managers at WSC monitor the status of installed meter transmitter modules by location.

Implementing a Successful Enterprise GIS

WSC has infused all of its key business functions with GIS. This required the corporation to take the time to understand its GIS needs, select the right technology, and establish implementation milestones to measure progress. By maneuvering so carefully, WSC has optimized its operations, reduced risks, and advanced decision-making—all of which contribute to delivering its customers the best service possible.

Malta's Water Services Corporation won a Special Achievement in GIS Award from Esri in 2016 for its effective implementation of an enterprise GIS solution.

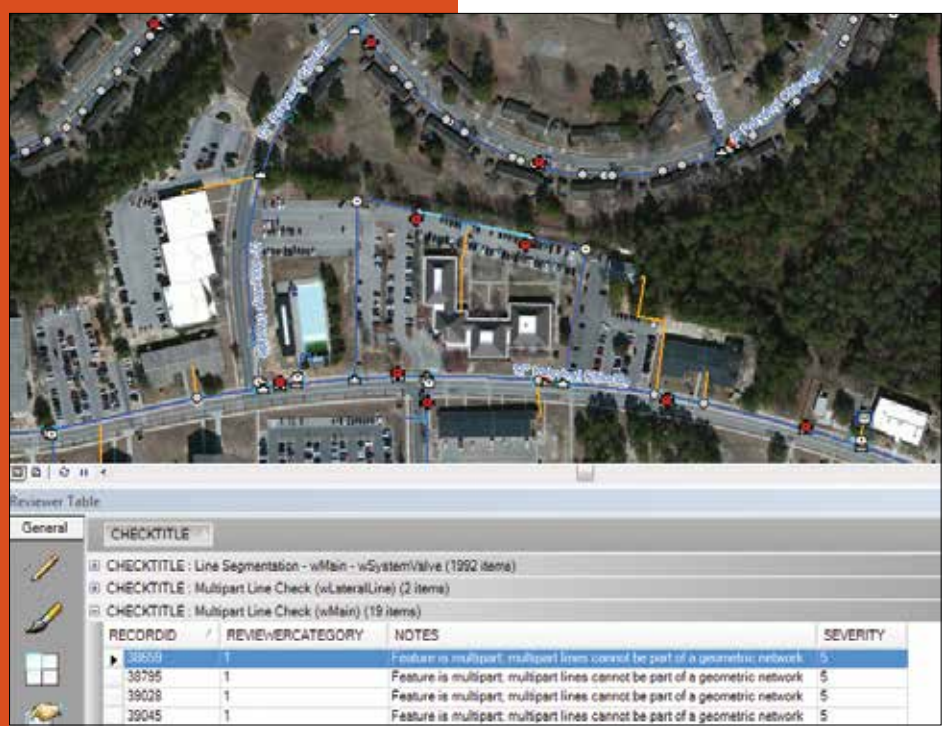
Managing Utilities at US Military Bases with ArcGIS

When US military bases started outsourcing their water and wastewater utilities to the private sector, American States Utility Services (ASUS), a subsidiary of American States Water, began building a business that now services eight installations from Maryland to Texas.

To provide excellent service to the military personnel who live and work on each base, ASUS aims to increase both client satisfaction and operating efficiency. This requires having an accurate inventory of utility assets on each base.

With help from Esri partners Timmons Group and Cityworks, ASUS implemented the ArcGIS Data Reviewer extension—alongside other mainstays of the ArcGIS platform, such as Collector for ArcGIS—to improve and ensure operational integrity and efficiency in the utilities it manages for the US military.

↓ Old North Utility Services uses ArcGIS Data Reviewer as the starting point for correcting errors in its asset inventories and generating accurate reports on data quality.



Incongruous Data

When the US Department of Defense (DoD) puts a military base's utility system up for bid, it issues a 50-year contract to the successful bidder and turns over responsibility for the base's utility operations, management, and capital improvements. These awards are based on a master asset inventory that the military maintains. At times, however, these records can be out of date—as Amanda Owens, operations support manager for ASUS, realized when she was going through the data her company inherited from the military.

"Our data was not congruent," she said. "The information was just not there. And when GIS data was available, it had a lot of floating assets and *[lots]* of assets going in the wrong direction."

Getting the data wrong could have had a significant impact on the inventory and, ultimately, the ability to provide first-rate service to the client.

To get a more accurate view of the assets that ASUS owns and maintains, the company contracted with Timmons to implement the asset management solution from Cityworks.

"In a matter of a year, with essentially three or four GIS technicians, we have managed to update eight major geodatabases and roll Cityworks out at the same time," said Owens, praising Timmons for its support.

Data Validation

But the GIS implementation did not stop there. ASUS also hired Timmons to train its GIS staff on using ArcGIS Data Reviewer, an extension from Esri that provides quality control and assurance. In no time, they were implementing data validation on their own.

Helen Johnson, a GIS technician at Old North Utility Services, the ASUS subsidiary operating at Fort Bragg in North Carolina, said Data Reviewer turned out to be "exactly the tool I hoped it would be."

She uses it extensively to find anomalies in her utility data, such as duplicate assets, mains and laterals that cross (even though they shouldn't be connected), and pipes that don't terminate where they should.

"When you look at it, you say, it's only a foot or two here and a foot there. But when you've got 20,000-plus segments of water mains and laterals, it adds up," said Johnson. "Finding those little inconsistencies and being able to fix them in the long run means a more accurate inventory and a better relationship *[with]* the government."

Asset Replacement Records

Old North also uses GIS to keep track of asset replacements.

One of the stipulations of the DoD contract is that the civilian operators have to replace all utility assets—every valve, pump, and pipe—at least once during the life of the contract.

At Fort Bragg, every time Old North replaces a piece of pipe, it records and tracks that activity and retires the old pipe to indicate its compliance with the contract requirements. Until recently, the company documented these activities in the spreadsheet it inherited from the military. But now, the company handles it using ArcGIS for Desktop.

"We know we need to replace all this within 50 years," said Owens. "But we want to do so in a manner that has the most beneficial impact on our customer. That way, the government is getting the most value for its buck."

Better Serving Customers

Most encouraging to Owens and Johnson is the impact their efforts have had on their customers: military personnel stationed at the bases.

"In the municipal world, the average person walks up to their faucet every day and has no idea where the water comes from or how it got there," said Owens. "They just want it to be clean and to be able to use it. That's the same thing we're doing here for our military."

Before ASUS took over Old North, the utility averaged 500,000 to 750,000 gallons of sewage overflow each year. In recent years, however, Old North has averaged three or fewer overflows with a loss of less than 1,000 gallons per year, according to Owens.

Using GIS "certainly has improved operations for them," she said.

Distinguished Service

Implementing GIS—particularly the ArcGIS Data Reviewer extension—verifies that ASUS is spending DoD funding prudently. It also ensures ASUS customers—the men and women serving in the United States military—the highest-quality customer service, complete with responsive and capable operations support.

For more information, email Amanda Owens at amanda.owens@asusinc.com. To learn more about Timmons Group, email Courtney Moore at courtney.moore@timmons.com. And for more information about ArcGIS Data Reviewer, email Dewey Marino at dmarino@esri.com.

Visionary Inspires Kids and Adults with GIS

He describes GIS not as a tool but as a philosophy, a way of life.

"I can't tell you exactly what it is, but it's not a software anymore," said Forrest Lamb, a general engineer for the facilities branch of the Marine Forces Reserve and a true GIS evangelist. "I can't see the world without GIS."

As someone whose life, as he put it, keeps drifting along to GIS, Lamb has run the gamut of experiences with the technology—from using it in the US Air Force and for facilities management to educating both kids and teachers about how it works.

At some point, he said, he realized that promulgating the virtues of GIS was his place of significance in the world.

"I'm going to immerse myself in this and give my life over to it," he recalled thinking when he had his epiphany about GIS being his life's work. "It's fun for me, so I can't see me not having GIS."

GIS—Right Up His Alley

Lamb first encountered GIS in the 1980s when he was a civil engineer in the US Air Force at what was then Norton Air Force Base in San Bernardino, California. He and his colleagues were tasked with using Esri's ARC/INFO for national defense planning—looking for locations where they could base strategic missiles and big weapons systems.

"For a young captain, that was an amazing project!" he recalled.

And the technology was right up his alley.

"GIS is visual, and I'm a visual person," he said.

Visualizing information on a landscape, as GIS let Lamb do, is akin to viewing the earth's terrain from the air. So it's no surprise that, as a child in Little Rock, Arkansas, he wanted to be a pilot when he grew up.

Upon graduating from high school, he received a prestigious appointment to the US Air Force Academy—though he ended up transferring to Tuskegee University in Alabama, where his father and uncles had gone and his soon-to-be wife went as well. Lamb considered studying aeronautical engineering, but after noticing dwindling career opportunities in the field, he settled on mechanical engineering.

Once he received his bachelor's degree, Lamb was commissioned for active duty in the air force—not as a pilot, however (because of astigmatism), but rather as a mechanical engineer.

He was stationed first at Little Rock Air Force Base and then spent a year in South Korea before being transferred to Southern California, where he spent seven years.

Lamb started picking up GIS toward the end of his stint at Norton. From there, he went to Barksdale Air Force Base in Louisiana, where—after completing a master's degree in aerospace science at Embry-Riddle Aeronautical University—he got progressively more involved with GIS.

When Lamb's job in the air force was closed, he took a civilian position with the government as a community planner for the 2nd Civil Engineer Squadron (also at Barksdale) and joined the US Air Force Reserve. He continued working with GIS.

By 1995, Lamb was base civil engineer for the 926th Mission Support Group at the Naval Air Station Joint Reserve Base in New Orleans, Louisiana, where he directed all aspects of facility management. It was here that he got his first GIS.

"That's when I got my hand on the steering wheel," he said.

He and his colleagues used GIS to conduct battle studies and do land-use analyses for various bases. He eventually found himself doing less engineering and more planning. So he decided to shift his focus to GIS.

"This is a no-brainer," he recalled thinking.

Lamb transferred to the Marine Forces Reserve in 2006, where he introduced GIS. Currently, he and his team build GIS databases for reserve centers to help with facility planning.

Lamb is credited with setting up 180 GIS sites around the United States. And he shows no signs of slowing down.

A GeoMentor in Every Respect

"I want *GIS* to become a household word," said Lamb.

Since shifting his focus to GIS, Lamb has become quite a force in the GIS education world—especially as a GeoMentor.

"GIS cuts across so many different areas," he said. "It's a life skill."

Inspired by his mother, who invested a lot in education, Lamb focuses much of his indefatigable energy on teaching kids—and their teachers—about the technology.

"If it can be a game changer for me just in this local setting, it could be a global game changer," he exclaimed.

Because GIS is so visceral and has so many moving parts, Lamb believes that it really resonates with kids. He thinks that if they could get their hands on the technology, they would be so interested in it and enthralled by what it can do that they wouldn't have time to get into trouble.

He has shared Esri's Tapestry lifestyle data—which categorizes US neighborhoods based on demographic and socioeconomic attributes—with kids to exhibit how retailers, for example, can use GIS to influence what people buy. And the kids show lots of interest, he said.

But the mentoring doesn't stop with GIS.

"He has a real passion for students who don't think that they actually have a future—not even in GIS, but just a future," reflected Joseph Kerski, an education manager at Esri who has worked with Lamb in various education and GeoMentoring capacities over the years.

Lamb prides himself on opening kids' eyes to what exists in the world outside their bubble—which he said is especially important in post-Hurricane Katrina New Orleans, where Lamb noticed lots of kids who didn't have any vision for the future. He tells a story about a time when he asked a little girl—who showed up unexpectedly at Lamb's church one night after Katrina—what she could do with her life if money and time and responsibilities didn't matter. The girl, named Destiny, told him she liked to shop. He responded that those people are called buyers. She beamed.

"My work is cut out for me, and I've got it right here," said Lamb.

Aside from one-on-one mentoring, Lamb has helped scores of kids in Louisiana's schools learn GIS by hosting GIS days; setting up GIS workstations at his daughter's school; being on the steering committee for the Louisiana Geographic Education Alliance; and being on the board of Communities in Schools of Greater New Orleans, which brings community resources into public schools to try to keep students enrolled. He has also instructed teachers in GIS through Esri's Teachers Teaching Teachers GIS (T3G) Institute.

"There are some people who understand why GIS in education matters," said Kerski. "But Forrest, he's a GIS analyst. He knows what he's talking about on a technical level too."

And Lamb wants as many people as possible to know and understand GIS.

"He is always wanting to make this whole idea—of getting people to make smarter decisions with GIS—bigger, more impactful," said Kerski. "He's definitely never content with the status quo for GIS."

"He just thinks that if we can get people to engage GIS, then vast numbers of problems will simply melt away as people understand how to look at and think about and cope with complex issues," said Charlie Fitzpatrick, schools program manager at Esri. "For Forrest, GIS is quite simply *the way* to organize information."

Continuing to Inspire

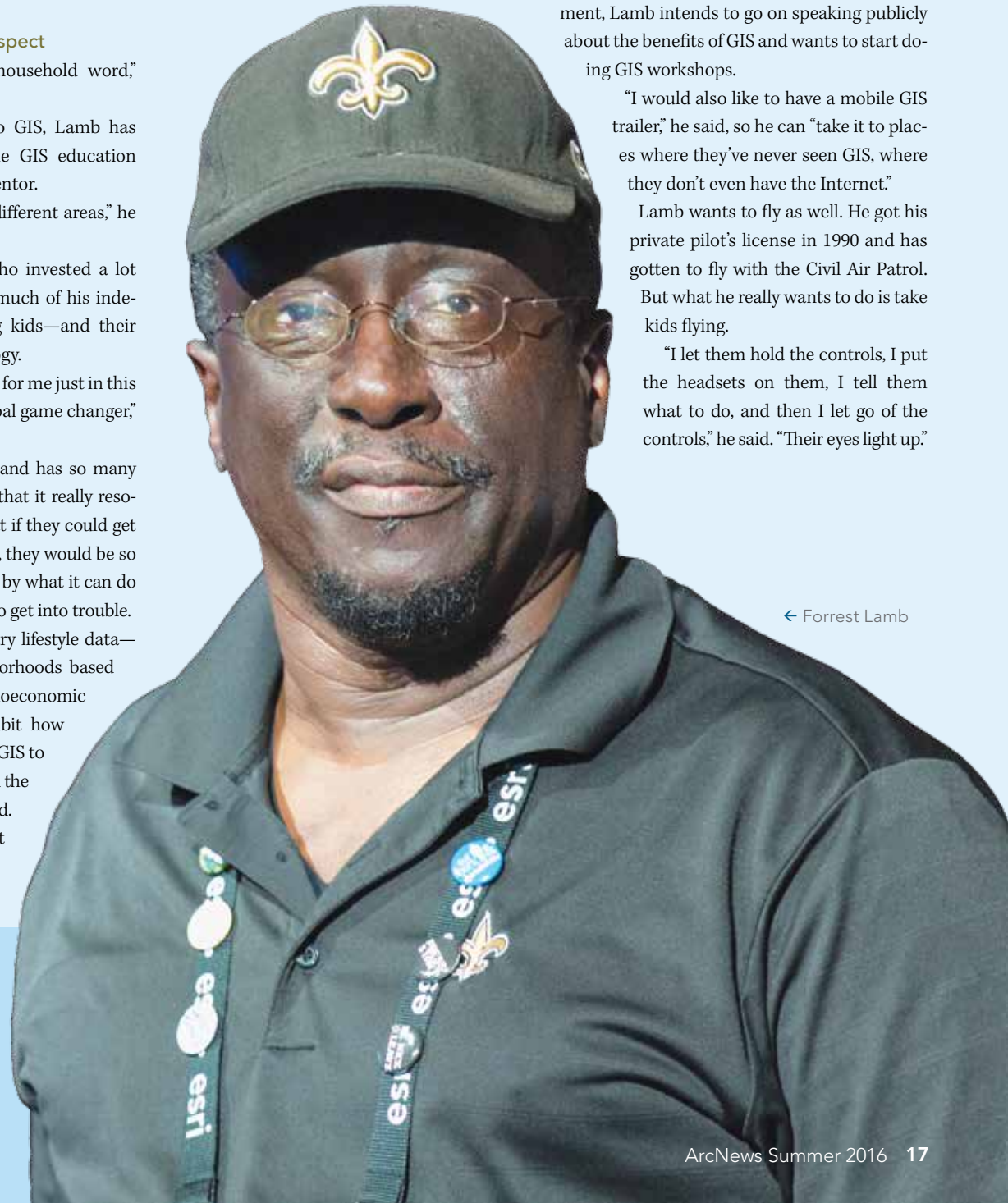
Lamb, who retired from the Air Force Reserve as a Lieutenant Colonel, still works for the Marine Forces Reserve. But he has myriad plans for when he fully retires.

Continuing to employ his infectious excitement, Lamb intends to go on speaking publicly about the benefits of GIS and wants to start doing GIS workshops.

"I would also like to have a mobile GIS trailer," he said, so he can "take it to places where they've never seen GIS, where they don't even have the Internet."

Lamb wants to fly as well. He got his private pilot's license in 1990 and has gotten to fly with the Civil Air Patrol. But what he really wants to do is take kids flying.

"I let them hold the controls, I put the headsets on them, I tell them what to do, and then I let go of the controls," he said. "Their eyes light up."



← Forrest Lamb

GIS Hero

Crossing Borders

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

GeoMentor Program Exceeds 1,000 Volunteers

Since the American Association of Geographers (AAG) and Esri began conducting outreach in April 2015 to encourage people to become GeoMentors, the program has attracted more than 1,000 participants.

These GeoMentors, who assist K–12 schools across the United States with incorporating GIS into their classroom curriculum, possess a wide range of skills and hail from various career levels. For example, nearly 30 percent of GeoMentors have a master's degree in a discipline related to GIS or geography, while approximately 20 percent of volunteers do not have a certificate or degree in GIS or geography at all. (Neither is required to be a GeoMentor.) They also come from a broad range of fields. Volunteers include

- A biologist with the National Park Service who uses ArcGIS regularly.
- An Advanced Placement Human Geography teacher who is integrating ArcGIS Online into lessons.
- A GIS software architect and developer for a major corporation.
- A graduate student in an applied geography and geospatial program.
- An urban planner employed by the real estate department of a local government.
- A certified health educator who has a certificate in GIS.

This range of expertise reflects the interdisciplinary nature of GIS. And having GeoMentors from such distinct backgrounds reflects just how widely geospatial technology can be applied to different classroom subjects and used by students with varying skill levels.

In concert with the GeoMentor program, which is part of Esri's commitment to the Obama administration's ConnectED initiative, Esri has also spurred the development of materials for K–12 curriculum that facilitate using GIS in classrooms. These GeoInquiries (available at edcommunity.esri.com) are short activities for teaching map-based concepts, and there are now three sets of them. Tied directly to lessons that appear in commonly used textbooks, these 15-minute online GIS exercises serve as a great way to introduce geospatial technology to the classroom. Currently, there are GeoInquiries available for middle school earth science and high school US history and human geography courses. GeoMentors use these resources, among others, as a starting point to illustrate the possibilities for using GIS with different subjects in the classroom.

With help from GeoMentors, educators are learning how geospatial technology can enrich their teaching and provide students with new skills and career opportunities. Debi Siler, an educator from Virginia, explained how two GeoMentors have helped her get GIS going in her classroom:

"They are great and *[were]* helpful when I told them I needed help using ArcGIS in my AP *[Human Geography]* and AP World History classes," Siler expressed in a testimonial. "Thank you so much for providing this service for educators like me who want to use ArcGIS more in *[our]* classes but aren't very familiar with how it works."

The AAG constantly receives reports about GeoMentor-facilitated activities and collaborations throughout the country. These undertakings range in grade level and length of time and address various GIS skills and topics. GeoMentors engage in singular events, such as making a career presentation to a class; they also participate in ongoing partnerships like working with a teacher throughout the school year.

One GeoMentor visited a middle school in Riverside, California, to demonstrate how 3D GIS and ArcGIS Online can be used to model earthquakes in an attempt to mitigate architectural damage. Another GeoMentor was asked to give a presentation on teaching with maps and GIS at the Kansas Association of Middle Level Education. And another GeoMentor reached out to her daughter's fourth-grade teacher and inadvertently provoked the educator to change her entire lesson plan so it incorporated GIS.

↑ GeoMentors assist K–12 schools across the United States with incorporating GIS into their classroom curriculum.

The program also has a growing collection of GeoMentor case studies (accessible at geomentors.net/review/case_studies) in which volunteers offer in-depth reports of their activities and experiences as GeoMentors. These case studies highlight how collaborations between GeoMentors and educators are rewarding experiences for everyone involved.

Being a GeoMentor can remind you of why you got into this field in the first place and what you enjoy about geography and GIS. It's also validation of how much you know and what knowledge you have to offer to others.

As Chuck Powell, a GeoMentor in Arizona, related, "Working as a GeoMentor has been an amazing experience. The kids just love using the technology and love solving problems. It's the same reason I love GIS."

And Diana Babshoff, a GeoMentor in California, said her experience made her feel more encouraged in her day-to-day work.

"It reminded me of how fun GIS can be and how it can be applied to almost everything you do daily," she said.

Everyone with some GIS experience or knowledge has something to offer K–12 classrooms, so consider joining our community.

For more information about the GeoMentor program, visit geomentors.net. To volunteer, sign up online at geomentors.net/participate. Additionally, follow @AAGGeoMentors on Twitter and check out the GeoMentor program on Facebook at facebook.com/AAGGeoMentors. The GeoMentor staff can also be reached at geomentors@aag.org.

Doug Richardson and Candice Luebbering from the American Association of Geographers coauthored this column.

Contact Richardson at **drichardson@aag.org**.

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Arctic Risk Map Details Environmental Vulnerability

Energy consumption is projected to increase 56 percent by 2040, and fossil fuels are expected to provide almost 80 percent of the world's energy during that time, according to the US Energy Information Administration.

With ice melt in the Arctic opening up navigable waters for longer periods each year, the region offers increasing opportunities for business ventures in the oil and gas industries and shipping. The Arctic has substantial hydrocarbon reserves. Traversing its waters would also yield faster shipping routes. But the area is subject to harsh and unpredictable weather and has a unique ecosystem. So any development there must be analyzed for risks and vulnerabilities while safeguarding life, property, and the environment.

That is why Norway-based DNV GL—a leading certification society and technical adviser for the maritime, oil, and gas industries—has developed *The Arctic Risk Map* (maps.dnvgl.com/arcticriskmap) to help businesses assess the viability of offshore or marine activities in the region.

"We created *The Arctic Risk Map* to provide an unbiased picture of the Arctic," said DNV GL principal environmental risk specialist Øivin Aarnes, who developed the map. He described the map as "an open platform to be able to communicate risks in the industry and collaborate on development."

Built on Esri technology, the web-based app presents an array of complex information in an accessible format.

Restrictions in the Arctic

The map details the potential limitations of future Arctic activities, such as development and transport.

Data in *The Arctic Risk Map* includes the seasonal distribution of ice, meteorological and oceanographic conditions, sea ice concentrations, biological assets, shipping traffic, and oil and gas resources. This scientific data comes from numerous predictive climate and oceanographic models from organizations such as the National Oceanic and Atmospheric Administration (NOAA), the European Union's COPERNICUS program, and the Computational and Information Systems Laboratory (CISL) of the National Center for Atmospheric Research (NCAR).

DNV GL hosts the data in ArcGIS for Server as map layers and services. The risk map, then, is the freely available portal through which people can access all the information in one place.

"We wanted *[the portal]* to be open so anyone could go in there and try to answer the questions they had themselves," said Aarnes.

By integrating this information with GIS, *The Arctic Risk Map* identifies the drivers of risk—low temperatures, storms, snow, ice, darkness, ocean depth, wildlife, and remote places with no search-and-rescue facilities—and makes it easy for people to visualize how these vary in different areas and seasons. Users can explore the entire Arctic or select a particular region, such as the Kara Sea, the Laptev Sea, or the Barents Sea. The app also includes a time slider that lets viewers observe what changes occur from January through December.

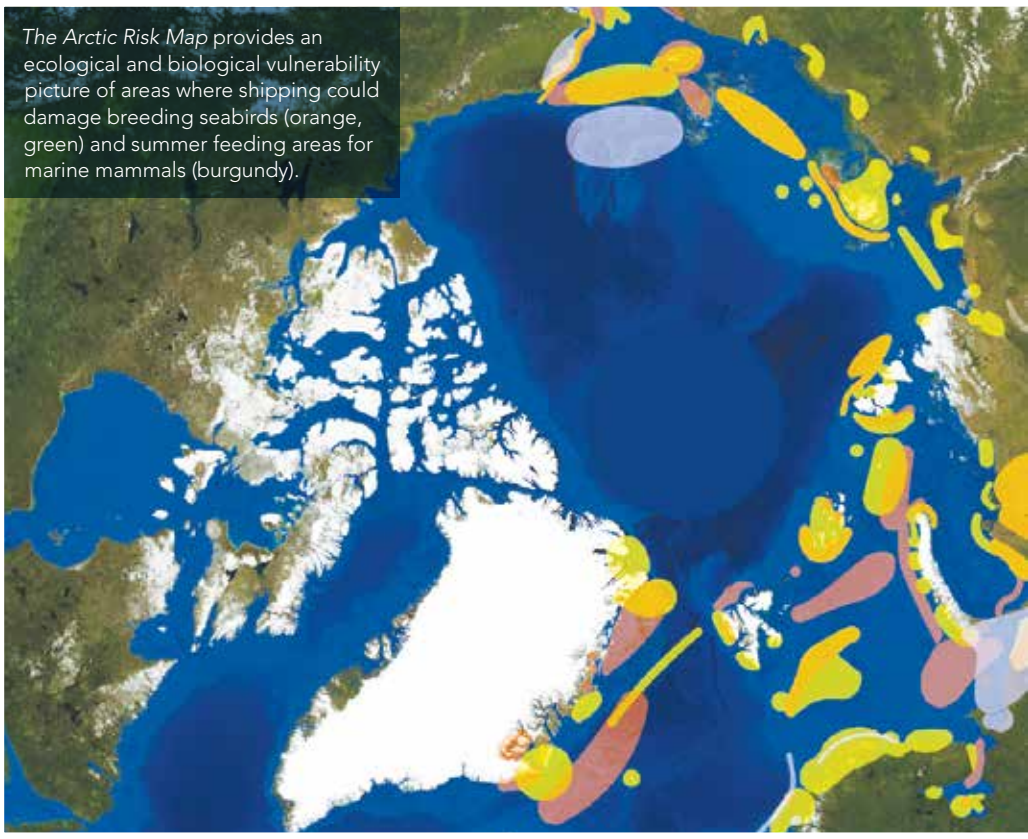
"We've taken one year in the Arctic…to see how conditions change over the year, month by month," described Aarnes. "For instance, we made a map showing where marine icing, or *[superstructure]* icing, toward ships is more likely probable than in other regions. Icing on ships is due to low temperatures, freezing and strong winds, and rough seas. So we needed to join data on low temperatures and strong winds over different seasons."

Users can also combine the map's data layers with their organization's own data to make even more precise decisions about risk. This allows petroleum companies to minimize the impacts of their industrial activities, for example, and enables conservation organizations to evaluate ecologically sensitive areas.

Gauging Safety and Operability

Sea ice covers large parts of the Arctic Ocean during wintertime and retreats to the center of

The Arctic offers increasing opportunities for business ventures in oil, gas, and shipping, but the area, which has a unique ecosystem, is subject to harsh and unpredictable weather.



The Arctic Risk Map provides an ecological and biological vulnerability picture of areas where shipping could damage breeding seabirds (orange, green) and summer feeding areas for marine mammals (burgundy).

the Arctic during summertime, unveiling channels and coastlines to open water. *The Arctic Risk Map* makes it easy for businesses to see seasonal and spatial variations of ice throughout the year and assess safety and operability in the region.

This information helps energy companies schedule exploration and production by providing a basis for deciding when and where it is feasible to work in the Arctic. The map also features data on extreme temperatures, which is especially important to engineers as they design oil rigs and other structural assets to withstand the region's harsh climate.

In addition, the map service shows areas that should be avoided, which not only helps reduce environmental risks from oil spills but also helps shipping companies analyze traffic separation schemes, plan traffic lanes, and set up separation zones. This reduces the likelihood of shipping collisions in areas where the repercussions would be considerable.

An Environmental Vulnerability Index

As shorelines and channels acquire less ice, Arctic animals become more vulnerable to various ventures that encroach on their territories. Walrus, polar bears, seals, belugas, and narwhals are all Arctic dwellers—along with many other species that are threatened or on the verge of becoming threatened because of changes to their environment.

The Arctic Risk Map includes data on where fish, mammals, and seabirds breed, feed, live, and migrate. The map is broken into 17 Large Marine Ecosystems (LMEs), a decades-old concept that the Arctic Council adopted to encourage an ecosystem-based approach to management in the region. *The Arctic Risk Map*'s environmental vulnerability index combines wildlife data with a map of the LMEs to let users see how external factors, such as oil spills, would affect these species and their habitats. It also shows where shipping lanes and wildlife habitats increasingly overlap.

Mapping these sensitive areas provides a geospatial guideline for planning hydrocarbon development and routing marine transit. But, as Aarnes pointed out, the data on marine species—especially the mammals and birds—needs to get more specific.

"The Large Marine Ecosystems are kind of *[a]* recognized and acknowledged way of separating regions in the Arctic," said Aarnes. But he feels that dividing the Arctic into smaller subsections would yield greater detail.

With more comprehensive information about species' migratory patterns, food preferences, and habitat changes due to shrinking ice levels, businesses such as tourism, fisheries, hydrocarbon development, and shipping will be less likely to come into conflict with the Arctic's ecosystems.

"We wanted to also stimulate a discussion on how we can better manage the Arctic," said Aarnes.

And that appears to be happening, with working groups such as the Conservation of Arctic Flora and Fauna interested in getting more environmental data into *The Arctic Risk Map*.

Preserving a Unique Ecosystem

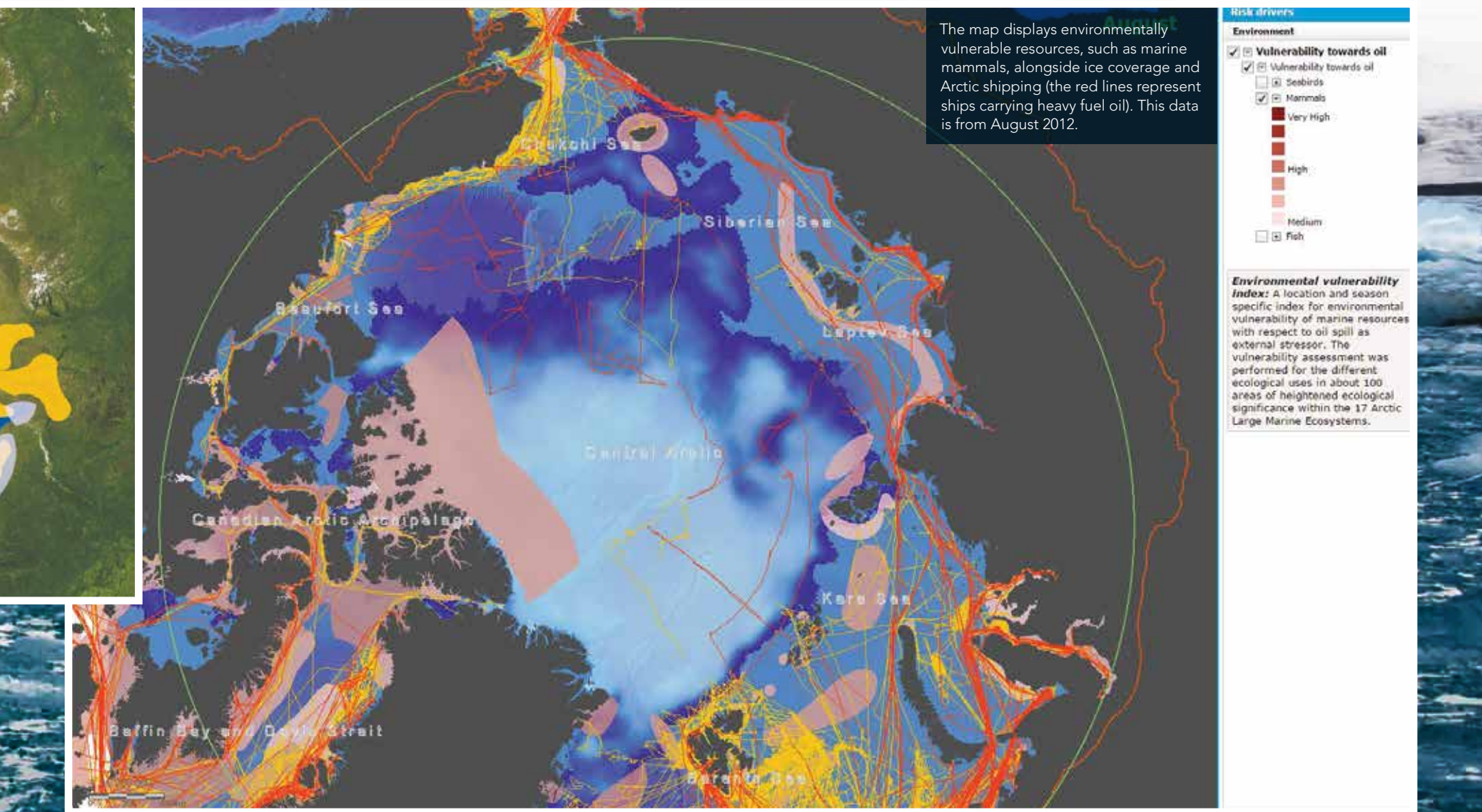
The Arctic is not a uniform environment. Environmental risk changes from place to place and season to season based on weather and climatic conditions, shifting wildlife habitats, and human activity.

With its aggregated spatial and seasonal indices, *The Arctic Risk Map* helps organizations operating in the Arctic plan activities, schedule events, and engineer structures in ways that improve safety and reduce environmental risk in this unique ecosystem.

DNV GL also wants to open up the data behind the map—including all the scientific information and the rasters—to anyone via ArcGIS Online.

"We wanted to raise some awareness with this map," said Aarnes. "We're looking into now porting these services into ArcGIS Online so we can open up the data for others, for the public to use."

And with that, the conversation will only expand.



The map displays environmentally vulnerable resources, such as marine mammals, alongside ice coverage and Arctic shipping (the red lines represent ships carrying heavy fuel oil). This data is from August 2012.

Chilling with ArcGIS Online

Web Maps Steer Senior Citizens to Cool Zones During Summer

By Izabela Miller, Salt Lake County

The extensive interactive mapping platform offered by Salt Lake County, Utah, lets users find anything—from township services and county council representatives to historic temples and community gardens.

But the *Salt Lake County Cool Zones* map, launched in July 2015 for Salt Lake County (SLCo) Aging and Adult Services, might also save lives.

Locating Close Cool Zones

Summers in Salt Lake County can be roasting. Temperatures often soar above 100 degrees Fahrenheit during the day, causing some people to wilt when they venture outdoors.

Excessive heat can be extremely dangerous to senior citizens and disabled persons—especially those whose houses or apartments lack air conditioning. To reduce the instances of heat-related illnesses, such as heat exhaustion and heat stroke, SLCo Aging and Adult Services launched the Cool Zone Program to open air-conditioned libraries, senior centers, recreation centers, and indoor ice skating facilities (called ice centers) to senior citizens and people with disabilities. There are currently more than 30 Cool Zones in Salt Lake County.

To help people find the Cool Zones closest to their homes, the SLCo Aging and Adult Services agency asked the Salt Lake County Surveyor's Office to create a user-friendly, interactive map of Cool Zone locations.

The Surveyor's Office decided to use the Local Perspective configurable app, available in ArcGIS Online, to create the web mapping app. The Local Perspective template—one of dozens of configurable apps that Esri offers in ArcGIS Online—gives users the ability to find the mapped Cool Zones closest to them by either placing a point on the map to mark where they live or typing their street address into a search box. The app then displays the Cool Zones within a buffered distance of the location the user selects.

For example, if the user enters an address on Hollywood Avenue in Salt Lake City and chooses a three-mile radius around that location, six Cool Zones will appear as pop-ups on the map as well as in a list along the right side of the page. The app was configured to create a one- to ten-mile radius around a point on the map.

When the user selects one of the Cool Zones—for instance, Fairmount Aquatic Center near Hollywood Avenue—the distance from the user's location will appear (e.g., 0.94 miles), along with the facility's address, telephone number, hours of operation, and other pertinent information such as the current local temperature.

Residents of Salt Lake County can find the Cool Zone interactive map on the Cool Zone Program section of the SLCo Aging and Adult Services' website.

Building the App in Less Than a Day

Emily LaMunyon, a GIS analyst and web developer for the Salt Lake County Surveyor's Office, created the map. She said it took less than a day to build the app.

First, she compiled a list (from a Microsoft Excel spreadsheet) of Cool Zone locations in the area into a GIS layer in ArcGIS for Desktop. The layer included all the important information associated with each place.

Next, she published the layer as a map service using ArcGIS for Server to make the map available on the Internet. She added the map service to ArcGIS Online so she could use it as the Cool Zones layer in the web map.

To complete it, LaMunyon added a custom basemap that SLCo GIS created and configured the pop-ups in the Cool Zones layer so users can see more information when they click on a Cool Zone location in the map. Finally, LaMunyon shared the map in ArcGIS Online using the Local Perspective app.

"This app was a perfect fit because it allows users to enter their address, use the Locate tool, or just simply click on the map and see which Cool Zones are closest to them," said LaMunyon. "It was also simple to configure the text, colors, *[and]* logo and add current weather information."

Guiding People to "Safe Havens"

Before GIS technology existed, the collaborative delivery and coordination of services—which have a direct impact on people's lives—would have been inefficient, time consuming, or impossible, said Salt Lake County surveyor Reid J. Demman.

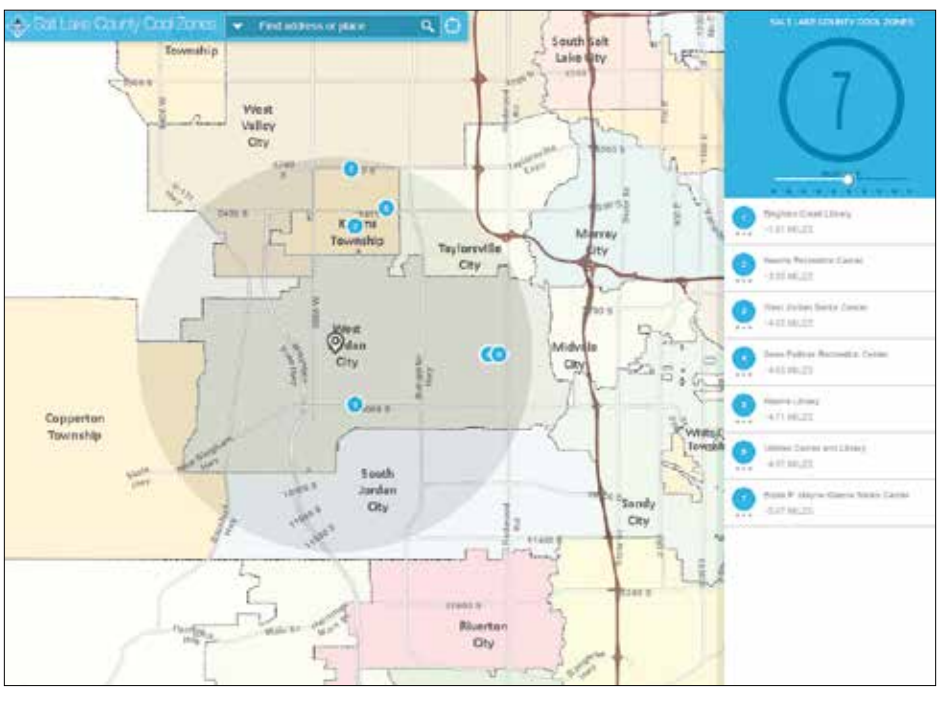
"The Cool Zone map is interactive, simple to use, and allows our at-risk population to locate safe havens from the summer heat," he continued. "This is a great example of the practical application of GIS technology to a real-life human need."

LaMunyon was happy to create the Cool Zone app.

"I like to think the work we do as GIS professionals has a positive impact on the daily lives of people," she said. "I love it when projects come my way that allow my work to be of benefit to the citizens that we serve."

Besides LaMunyon, contributors to this project included Izabela Miller, GIS analyst for Salt Lake County Information Services, and Alex Rudowski, GIS specialist for Salt Lake County Public Works Engineering and Flood Control.

↑ The Local Perspective app was ideal for this project because it lets users enter their address, use the Locate tool, or simply click on the map to see which Cool Zones are closest to them.



↑ After a user enters an address and chooses a one- to ten-mile radius around the location, a number of Cool Zones appear as pop-ups on the map and in a list along the right side of the page.

Using GIS to Form Resilient Public Health Plans

As Negative Health Effects from Climate Change Grow, Sophisticated Technology Will Guide Preparation

By Alex Philp, PhD, Upstream Research, Inc.

The earth's climate is changing, and this will have a tremendous impact on human health. But the relationship between climate change and health is complex.

Ongoing climate change observations and associated prediction models show clear evidence that significant portions of the American population are experiencing various health-related repercussions. Yet the relationship between climate change and human health has not been widely recognized as a major public policy issue, which means that very little practical attention has been paid to the massive public health costs associated with existing and future climate change.

Gaining a better understanding of the interconnections between climate change and human health requires substantial investment in scientific monitoring, risk mitigation, and devising resiliency strategies. One sophisticated technology that can be employed to carry out these daunting tasks is GIS. With its remarkable capacity to distill complicated issues into straightforward, visual representations, GIS will be crucial to guiding interdisciplinary approaches to prepare for the public health impacts of climate change and formulate resilient public health plans.

How Climate Change Affects Health

General scientific consensus clusters most of the effects from climate change into four major categories:

1. Increasing intensity, duration, and frequency of extreme weather events
2. Rising temperatures both with and without elevated precipitation
3. Increasing levels of carbon dioxide
4. Rising sea levels accompanied by an escalation in coastal flooding and erosion

For each of these major climate change categories, a number of specific health effects are already being observed across large tracts of the United States. More disturbingly, many of these climate-health impacts are occurring faster than forecast over the last 20 years and clearly fall outside ranges of historical variability.

Regarding rising temperatures, many American cities and states are experiencing escalating air pollution, which is resulting in increased rates of asthma and cardiovascular disease. When temperatures rise and precipitation doesn't, this leads to intensified desiccation, prolonged extreme drought conditions, and higher levels of particulate matter that is equal to or less than 10 and 2.5 micrometers in diameter (called PM10 and PM2.5, respectively), meaning it can get into the lungs. All these conditions are leading contributors to respiratory illnesses, including emphysema and, potentially, lung cancer.

Meteorologically, rare weather events—often called 500- and 1,000-year storms—are surpassing their event cycles on an annual basis. These changes in extreme weather patterns, combined with increasing annual temperatures and rising sea levels, are causing shifts in vector ecology as well, which affects how diseases are transmitted to human populations. With more instances accruing of malaria, dengue fever, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya virus, West Nile virus, and now Zika, we have not yet figured out how to manage these diffusing diseases.

Rising sea levels plus an increase in significant flooding events are already impairing surface and subsurface water quality. Waterborne illnesses—including cholera, cryptosporidiosis, campylobacter, leptospirosis, and various ailments caused by toxic algae blooms—are on the rise in many regions of the United States.

Changes in water quality also exacerbate the availability of fresh water in places with depleted or difficult-to-access reserves, such as Los Angeles, Houston, Salt Lake City, and Miami. California's Central Valley is currently suffering from its worst drought in more than 1,000 years. Given that this area yields about two-thirds of the United States' fruits and vegetables, the lack of fresh water in the region is having complex effects on food supplies.

Globally, these problems have reached epidemic levels and are only increasing among urban populations. Breakdowns in essential services, such as education and trash collection, go hand-in-hand with environmental degradation and can lead to civil conflict, population migration, and significant mental health challenges.

Although Americans tend to observe these occurrences from afar, there is evidence that these impacts are affecting the United States as well. Populations of extremely low socioeconomic status are already at risk for serious health problems, and climate change is increasing the likelihood that they will get sick.

A public health crisis of epic proportions is looming, and we are largely unprepared.

Using GIS for Public Health Resiliency Planning

The challenge now is to develop innovative, cost-effective tools that allow public and clinical health officials to combine complex climate change modeling with epidemiologic, econometric, and demographic analyses in a way that supports sound policies and sensible decision-making.

GIS is currently being used to combine meteorological, climatological, demographic, and ecological information into various models used for risk assessment, forecasting, and resiliency planning. Instead of wading through exhaustive reports and studies, stakeholders can see—on a map—how increasing temperatures and decreasing precipitation, for example, exacerbate wildland fires and give way to increasing risk from illnesses such as coronary artery disease.

GIS makes spatial correlations clear so that health care organizations can perceive the direct negative impacts of climate change on local and regional areas. With the Zika virus, for example, real-time GIS is being used to model changes in vector ecology for this emerging infectious disease. Maps show how, as temperature, precipitation, and human ecology adjust to a changing climate differently at specific latitudes and longitudes, mosquitoes extend their habitats, making mosquito-borne viruses like Zika more prevalent throughout the world.

Using GIS can also clearly demonstrate the public health costs associated with climate change. A map of Los Angeles that combines demographic, epidemiologic, and econometric data can gauge the prevalence of various diseases in the area—including chronic lung disease, which is estimated to cost $349 million to treat annually in and around Los Angeles. Climate change models of the Los Angeles basin over the next 10 years show that temperatures will likely increase while precipitation decreases, causing elevated levels of PM2.5 in the area. This will exacerbate certain respiratory and cardiovascular diseases, including chronic lung disease. While it is difficult to isolate climate change's precise impact on respiratory diseases (though scientists are trying), it is estimated that the number of asthma cases in the Los Angeles basin will increase by approximately 164,000 between 2016 and 2025, which will place a significant additional burden on health care systems.

Geographers at the Helm of Progress

At a time when federal, state, and private funding for health care in the United States is decreasing, such detailed information on climate-related health changes is sorely needed. And it is geographers who have the ability to quantitatively and qualitatively measure these effects over time.

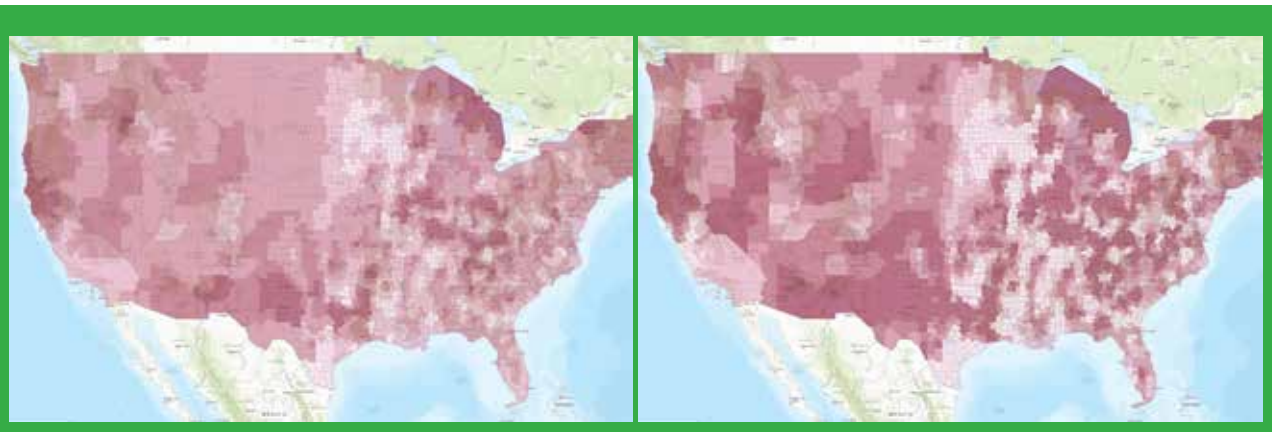
With GIS, it is possible to understand the impacts of climate on human health, forecast specific ramifications, and develop algorithms that leverage the earth's finite resources to come up with feasible resiliency plans.

In the next 10 years, the impacts of climate change on human health will become increasingly pronounced and acute. Preparing proactively now—using GIS as a guide—will result in substantial cost savings, drastic reductions in disease, and decreased human suffering.

It is crucial that geographers get started now.

About the Author

Alex Philp, PhD, is the founder and chief science officer of Upstream Research, Inc., an emerging Esri partner that focuses on using advanced analytics to prevent disease in human populations.



↑ The Navigator Transformation app, developed by Upstream Research, Inc., shows current (left) and future (right) rates of adult asthma for every county in the United States. Various climate change-related phenomena, such as increases in PM2.5 and PM10, will contribute to future spikes in asthma.

↓ In the Los Angeles basin over the next decade, temperature increases and decreases in rain will exacerbate certain respiratory and cardiovascular diseases and add a huge burden to the US health care system.

Bringing Science Stories to Life with GIS

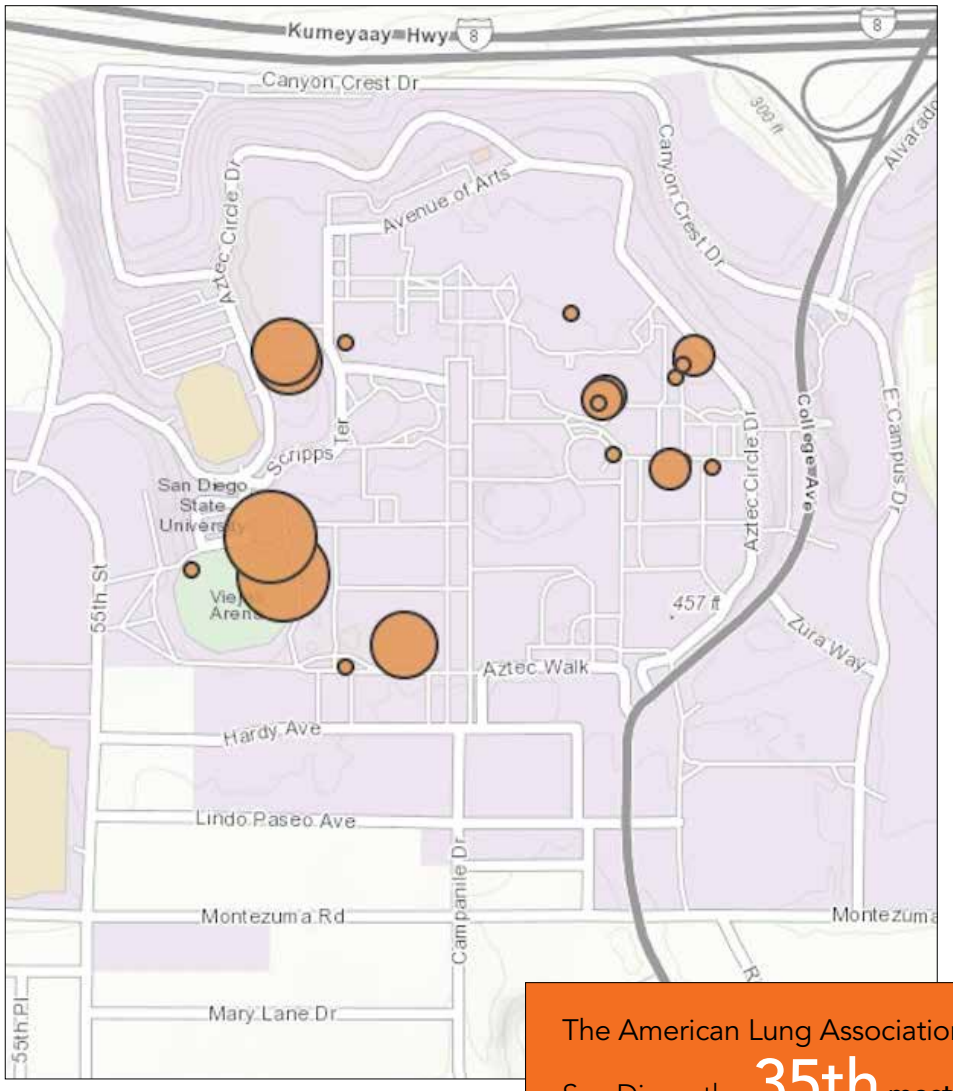
Geology, Journalism Students Collaborate to Learn About Environmental Science, Storytelling

By Amy Schmitz Weiss and Kevin Robinson, San Diego State University

Science and journalism have a lot in common. Both fields require practitioners to ask questions, explore data, analyze information, and then act on the knowledge gained—usually by preparing a final report, whether it is a scientific paper or a news article.

At California's San Diego State University (SDSU), students from the journalism and geology departments recently collaborated on a 15-week live news and science experiment to explore the air quality in four San Diego neighborhoods: Barrio Logan, Logan Heights, Chollas Creek, and Bankers Hill. Funded by a grant from the Online News Association, students built sensor kits (based on open-source technology) that measured particulate matter and different gases—such as liquefied petroleum gas, isobutane, methane, and smoke—in the air. They then used Esri software to map and analyze the information collected by the sensors. In the end, the students produced nine news stories and two videos for inewsource.org, an independent, data-driven online news organization based in San Diego.

The framework for the course was grounded in the geographic inquiry process espoused by Esri, which encourages students to ask questions, explore and analyze data, and then take action on their findings. By engaging in this process, students not only advanced their scientific and journalistic skills, but they also learned how GIS can be a comprehensive yet simple tool for scientists, journalists, and the public to use to discover details and share stories about the environment.



↑ While learning how to use their sensor packages on campus, students quickly discovered how much easier it was to visualize data on maps than on spreadsheets.

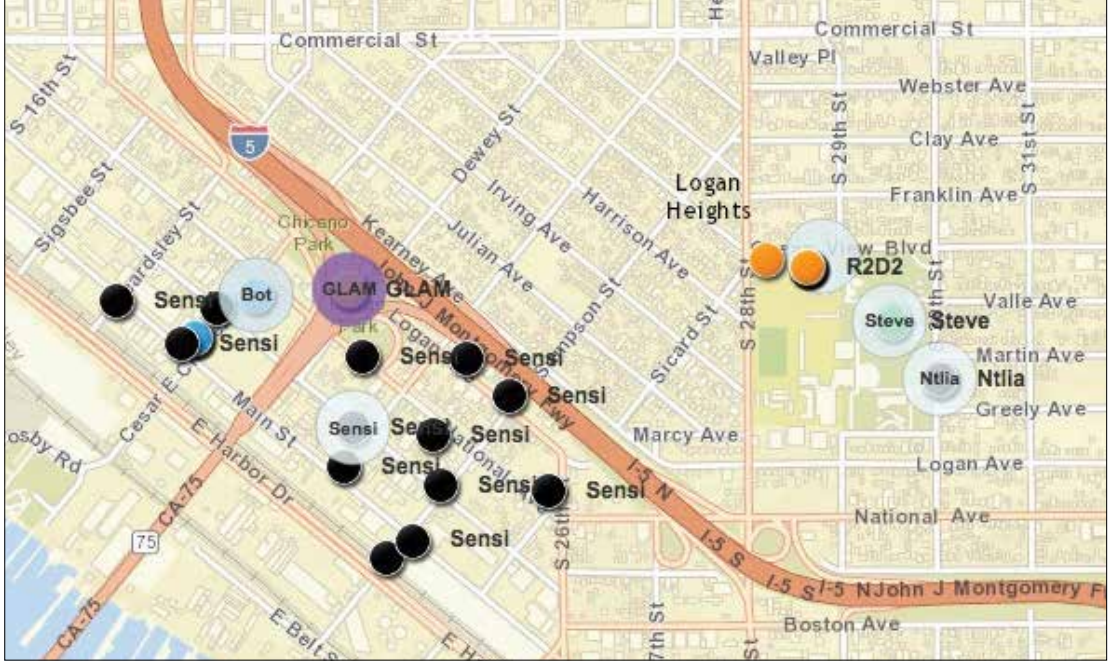
What Is in the Air?

Bound by mountains on most sides and beset by dry air, with quintessential Southern California freeway congestion and the state's fourth-largest maritime port, San Diego tends to attract and retain pollution.

The American Lung Association's "State of the Air" report for 2015 ranked San Diego 35th out of 180 cities for the number of days with high levels of ozone pollution, or smog. The report also ranked the San Diego area 39th for the average amount of particle pollution (a medley of extremely small liquid and solid pollutant particles) present during a 24-hour period and 40th for the levels of particle pollution in the air annually. This is actually a significant improvement from 2011, when San Diego ranked 7th for ozone pollution and 15th for short-term particle pollution.

To sustain—and hopefully accelerate—these improvements in air quality, it helps to know what is in the air. From early February to late April 2015, students in SDSU's digital journalism class monitored the air quality in different parts of San Diego with the ultimate objective of better informing the public about the area's pollutants and their effects.

The American Lung Association's State of the Air report rated San Diego the **35th** most ozone-polluted city in 2015, an improvement from the **7th** most ozone-polluted city in 2011.



← Journalism and geology students at San Diego State University used sensors (which they all named something different, from R2D2 and Sensi to Steve) to collect data on air pollution in various San Diego neighborhoods. They then used ArcGIS Online to map the results.

Mapping and Visualizing Pollution

To begin the project, students assembled environmental sensor packages developed by SDSU staff and a sensor consultant using open-source technology. Each kit included sensors that pick up airborne particulate matter and gases. They each also had an Arduino board that read the sensor information every 30 seconds. This small computer then sent the data to an LCD display, which showed details about the presence and concentration of different pollutants in the air. The data collected by each kit was stored in a mini SD card in the Arduino board.

After each of their eight data collection trips (where they went to the same spots on the same day of the week at the same time), students would take their mini SD cards and put the recorded data—along with the longitude and latitude where each recording was taken—into a spreadsheet. These emerging GIS practitioners would then import the tabulated data into ArcGIS Online and map it.

Students quickly learned how much easier it was to visualize their data once they turned their spreadsheets into maps. GIS equipped them with simple tools that allowed them to examine patterns in the environment and trends in various neighborhoods—and then communicate these stories with their maps.

Bringing Stories to Life

GIS not only helped the students find their stories but also made their stories come to life. Many of them presented their accounts as news articles on inewsource.org.

As one student reported, in the neighborhood of Barrio Logan, which is sandwiched between the Interstate 5 freeway and the Port of San Diego, high volumes of particulates were discovered—especially from black carbon, which, according to the article, is the most noxious fine particle. With little wind to blow pollution away and the additional strain of having the San Diego Coronado Bay Bridge overhead in some areas, this neighborhood has one of the worst air quality ratings in all of San Diego.

Students also discovered that Logan Heights, just north of Barrio Logan, is afflicted by similarly low-quality air. Located between two freeways, its residents—especially children—are at high risk of developing and exacerbating respiratory illnesses such as asthma.

Bankers Hill, however, fared pretty well. Students reported on inewsource.org that although the neighborhood sits directly to the east of San Diego International Airport and is also circumscribed by freeways, this hilltop district receives constant wind—enough to break up pollutants. That said, some areas of the neighborhood that are closer to the freeway experience an eddy effect, meaning that the wind recirculates polluted air.

Underlying all these observations were the students' ArcGIS Online maps. Those made the data meaningful and animated the science.

The Sky Is the Limit

The sensor journalism project engendered a truly collaborative environment. It brought together students from different majors, teachers and faculty from various SDSU departments, and journalists from within the community. And GIS served as the foundation for everyone's exploration and research.

With ArcGIS Online, the class was able to easily make maps and work together on such an encompassing project. Students learned how to collect primary-source data, utilize existing GIS databases to understand and investigate the environment, and create maps to tell stories about the world.

The air quality information displayed on the class's final map, which amalgamates all the pollution recordings the students took in their assigned neighborhoods, helps supplement existing air quality data. It guided the students as they did further field investigations, studying wind patterns and conducting interviews. It also helped them hypothesize about and analyze pollution patterns, sources, and impacts in San Diego's neighborhoods.

The SDSU staff involved in this project continues to fine-tune an interdisciplinary curriculum that brings together geology and journalism students to learn how GIS can contribute to scientific investigation and news reporting. What this project has demonstrated is that, through innovative and cooperative efforts—using cutting-edge technology, open-source tools, and an experimental approach—the sky is the limit to how much students can learn.

For more information on the sensor journalism project, email Amy Schmitz Weiss, associate professor of journalism at San Diego State University, at aschmitz@mail.sdsu.com or Kevin Robinson, lecturer in the department of geological scientists at San Diego State University, at rockrobinson@gmail.com.

Making Business Easy with ArcGIS

Utility Uses Map-Based Website to Help Companies Get Head Start on Development

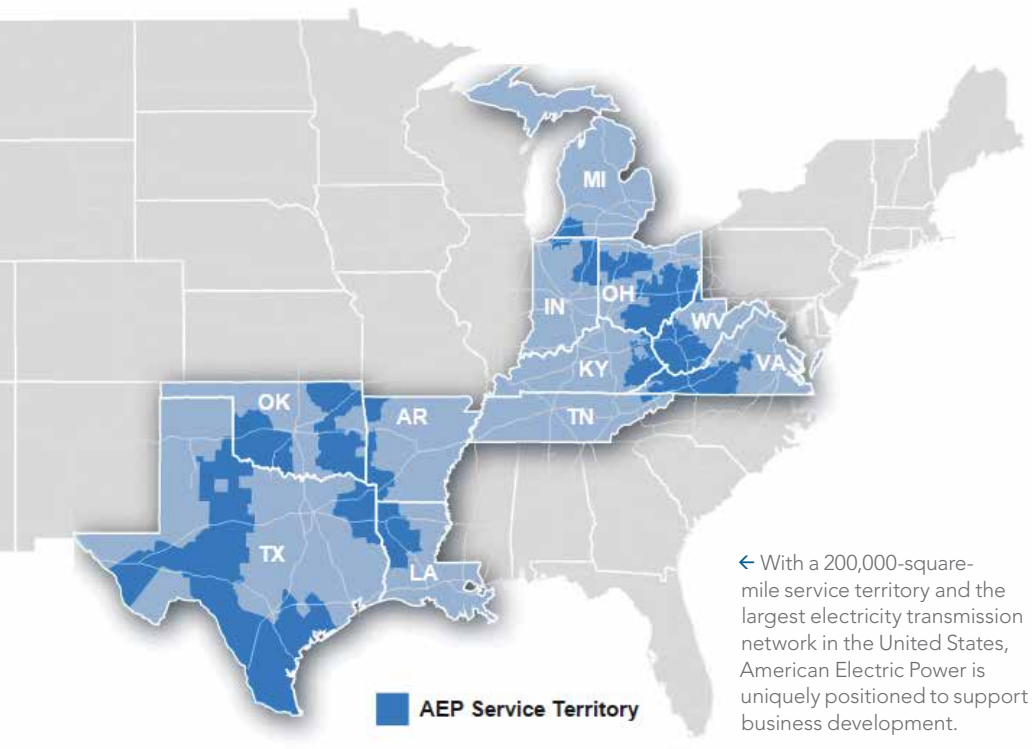
By Robb Watson, American Electric Power

With a service territory spanning 200,000 square miles and the largest electricity transmission network in the United States, American Electric Power (AEP) is uniquely positioned to support business expansion and community development in its service region.

AEP's economic development team works closely with local communities and state agencies to promote economic growth. In 2015, the team generated 170 business attraction and retention projects that created 22,500 jobs throughout its service territory.

Promoting economic development across a large and diverse footprint requires efficiently integrating multiple systems to provide interested parties with timely and accurate information in a variety of formats. With this in mind, AEP recently redesigned aeped.com, a highly focused economic development website that furnishes data to site selectors and companies looking to potentially expand in the electric utility's 11-state service territory.

The website—which was built using the ArcGIS platform—showcases featured properties, contains information and analysis on various states' characteristics, and provides data on business feasibility for key industries.



← With a 200,000-square-mile service territory and the largest electricity transmission network in the United States, American Electric Power is uniquely positioned to support business development.

The Central Role of Maps

AEP provides electricity to parts of 11 states: Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia, and West Virginia. Throughout its seven operating companies, AEP employs economic development managers who are supported by a centralized economic and development group.

Within this group, the operations team handles a range of marketing, research, and GIS requests. Each request requires individual attention, though many similarities among them do exist.

That is why AEP's economic development website (a collaboration between AEP's corporate communications department and Adept Marketing) contains general data on frequently requested items and provides several interactive features for customized, self-service research. Unsurprisingly, maps play a central role.

"Geography is fundamental in economic development," said Mark James, AEP's vice president of economic and business development. "Economic developers *[primarily]* sell location, and our new website makes it easy to see why AEP and our service territory is the best choice for their next expansion project."

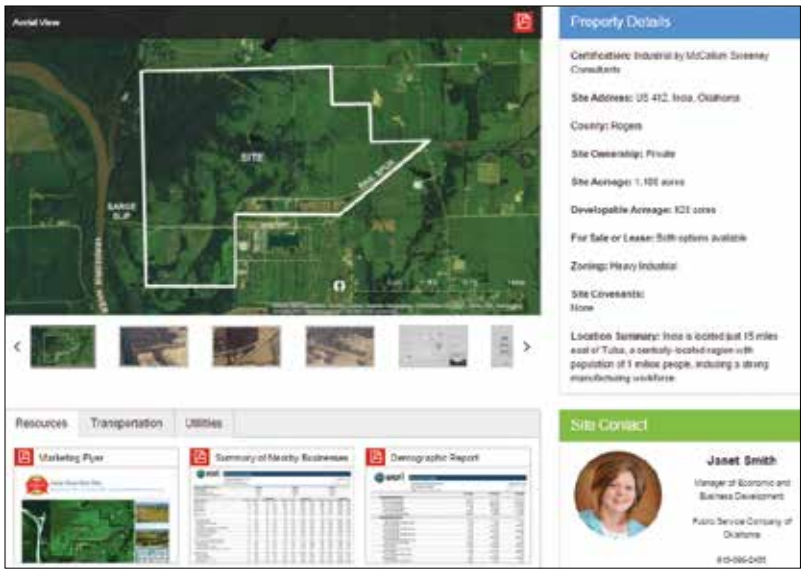
For the aeped.com redesign, AEP's economic development team exploited several Esri tools. ArcGIS for Desktop was used principally to create the thematic and analytical maps that display a wide range of data. The team employed Esri Business Analyst Online extensively to construct drive-time polygons for potential development sites, as well as to report business and demographic data for various geographies. The WordPress plug-in for ArcGIS Online was used to integrate several ArcGIS hosted web maps into the website. And the team employed the Pictometry extension for ArcGIS for Desktop to incorporate oblique imagery (aerial photos taken at about a 45-degree angle) where appropriate.

Unveiling Certified Sites

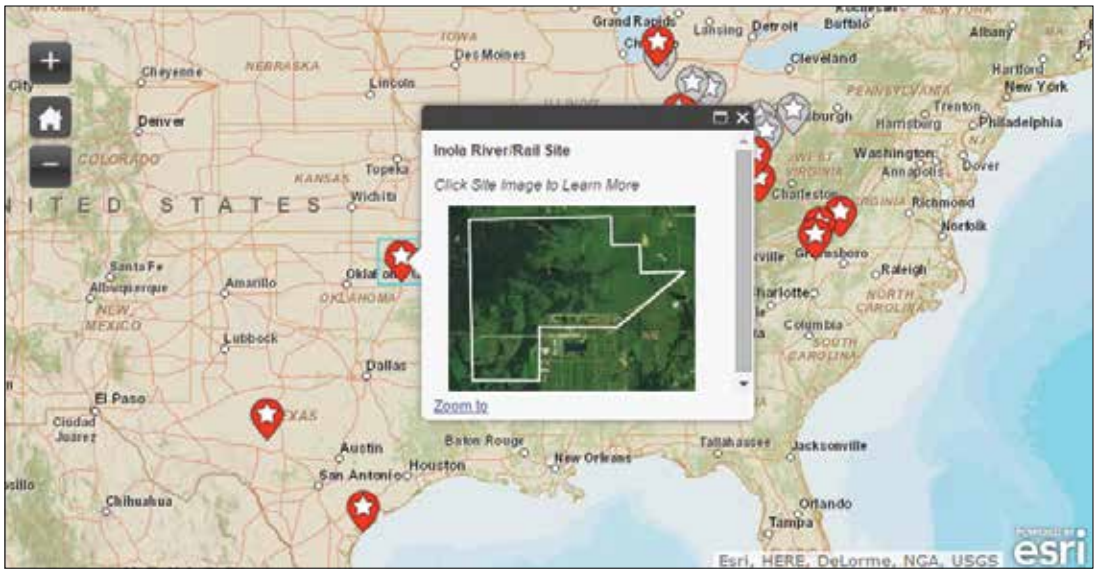
To help businesses speed up their location search, AEP offers development sites that are precertified by independent consultants for use as industrial zones, data hubs, and food centers.

"These sites have a competitive advantage because the designation meets certain readiness that ensures shortened start-up time frames," said Roland Peña, director of economic development for the City of San Angelo, Texas. "Simultaneously, companies are conducting regional analysis, and aeped.com's infographics, maps, and data are helpful for influencing the deadline-driven process of site selection by providing up-to-date business location and facts."

Certified sites are displayed on individual pages that each feature a map gallery. The maps on these pages (which are generated using ArcGIS for Desktop) include an aerial view of each site that identifies its key features, a local proximity map that shows how many people live within a specific radius relative to the site, and a one-day truck drive map that displays 200-, 400-, and 600-mile buffers—approximately how far a truck could drive in a day, depending on various factors—around the selected area. Each map gallery also features a drive-time analysis, completed using Business Analyst Online, to show the available workforce within 20-, 40-, and



↑ American Electric Power offers development sites, such as this one in Inola, Oklahoma, that are precertified for use as industrial zones.



↑ American Electric Power created an interactive map of its certified sites by using the WordPress plug-in for ArcGIS Online.

60-minute drive times, as well as bird's-eye view images (where available) made with the Pictometry extension for ArcGIS for Desktop. The maps and, in many cases, their accompanying analyses are available for download in PDF.

Accessing State-Level Development Data

AEP's economic development website details the advantages of doing business in each of the company's 11 states. It addresses infrastructure, business climate, workforce, and electric service.

As with the certified site pages, the state pages feature a map gallery composed of maps created in ArcGIS for Desktop. For each state, there is a transportation map; an AEP service territory map; an AEP certified sites map; and a proximity to markets map, which utilizes US Census data and information available in Business Analyst Online to calculate the percentage of the US population within a 600-mile radius of the state.

The state map galleries also include thematic maps, such as education levels and workforce characteristics throughout each state, as well as census and labor information. Additionally, users can employ an interactive map to select a county served by AEP and download its market profile, demographic and income information, and business summary reports (from Business Analyst Online).

Focusing on Target Industries

Based on the assets in its service territory, AEP focuses its business recruitment program on several key industries: manufacturing (automotive, plastics, and food and beverage processing in particular), data centers, and shale oil and gas.

For each target industry, the AEP economic development website includes detailed analyses of the fields' workforce, transportation, existing industries, and business costs. The information is presented in a map gallery that integrates data from the US Census Bureau, the US Bureau of Labor Statistics, and the National Transportation Atlas Database, among other sources.

A tab on the page allows users to switch from the static map gallery to an interactive certified sites map. AEP created this responsive map using the WordPress plug-in for ArcGIS Online. The pop-up for each AEP certified site—which includes the site's name and an aerial photo—allows users to either zoom in to the site on the map or open the particular certified site page in a new tab.

Additional Geographic Resources

Maps are used in other locations throughout aeped.com as well. The website's blog includes a maps section that allows users to share individual maps and geographic information. Additionally, a service territory locator tool enables visitors to enter an address or geographic coordinates to determine whether their location is served by AEP. Should the visitor want to learn more, he or she could use this tool to send an email to the appropriate AEP contact, who would then connect with the interested party.

Future Development Plans

As more visitors use aeped.com, the AEP economic and business development team plans to use analytics from the website to improve its content and functionality. Given how important location information and maps are to economic development, the team also intends to seek new ways to integrate geographic data into the website and create tools that meet its audience's needs.

For more information about the website, visit aeped.com or email Robb Watson at rcwatson1@aep.com.

About the Author

Robb Watson, GISP, is an economic and business development analyst with American Electric Power. He holds a master's degree in city and regional planning from Ohio State University and a bachelor's degree in geography from Miami University.

Managing for the Best

By Scott Weisman, Tallahassee-Leon County GIS

To achieve true success, managers must not only manage; they must also lead.

These two concepts are different. As Warren Bennis, creator of the modern field of leadership studies, has said, "Managers are people who do things right and leaders are people who do the right thing." When management and leadership are employed in concert, great things can happen.

I lead an incredibly talented and dedicated GIS team at Tallahassee-Leon County GIS (TLCGIS), an interlocal GIS agency formed in 1990 to serve the City of Tallahassee, the Leon County Board of County Commissioners, and the Leon County Property Appraiser's Office. TLCGIS's missions include promoting resource sharing, reducing redundancy in data collection and maintenance, encouraging solutions based on enterprise information management, and enhancing decision-making for public officials.

In my 17 years at TLCGIS, I have learned and practiced what makes a good manager. I have also built leadership skills that grow with each new opportunity.

Through this training and practice, what has stuck with me above all is this: managers need to manage for the best among us, not the worst. Here are some ways to do that.

Invest in Work Relationships

Many of us spend as much time—or more—with our work families as we do with our home families. So why not invest in work relationships?

A few days per week, I walk around and talk to my team members about what they are working on and what's going on in their lives. This is an effective way to build trust and respect within a group. Getting to know my team members has enabled me to believe in them, encourage them, and give them more opportunities to advance their skills.

Recently, for example, my team gained a new member to work on large, complicated utility databases. His previous experience did not include this kind of work, so he required new skills. After discussing with him what he needed, we agreed that he would get training on data replication with Esri software and database administration for Oracle. I promptly pulled together the training, and after he completed it, he tackled the project brilliantly. From the beginning, I knew he could accomplish great things in this position, and he has exceeded expectations.

Construct a Productive Environment

Environment matters, so create one that the team can thrive in.

Workspaces can set the mood for inspiration and creativity or boredom and lackluster work. Consider meeting spaces. These areas are meant to stimulate teamwork and inventiveness. They need to be places where people want to go. There should be comfortable seating, warm lighting, and nicely painted walls.

At TLCGIS, we updated our meeting spaces the first chance we got. In addition to improving the furniture and aesthetics of each area, we made sure we had the right technology, such as a large-screen monitor and ample computing power for presentations and demonstrations. Now, we can hold daylong brainstorming sessions in our conference room and actually make progress.

Recognize a Job Well Done

When managers demonstrate that they care for their teams—by recognizing team members for their efforts, for example—employees are more willing to give 100 percent. Besides, everyone wants to be treated with respect!

When commending folks, remember that small things mean a lot. I use little tokens that say, "Great Job!" or "You Are Truly Appreciated!" When I hand one out, I include a handwritten note that recognizes the person's specific accomplishment and why it is valued.

Once, when a TLCGIS customer was having performance issues with a complex GIS database, one team member researched the problem, sought advice, performed multiple rounds of testing, and finally found a solution. The customer was grateful, and the employee's tenacity stood out. I recognized her achievement soon after she completed the project, and that helped her maintain confidence when the next challenge popped up (which was within that same week).

Generate Some Fanfare

TLCGIS is a very busy GIS shop. We do a lot of great things without much fanfare. That is why I like to hold a year-in-review meeting where I take the team offsite, provide breakfast, and present a slideshow (built using Esri Story Map apps) to the team and other department managers. I keep a list going all year of everyone's accomplishments. And I ask every team member to participate by providing content for the story map, helping to assemble it, or presenting their work.

This informs the team of what everyone has been doing all year and sends the message that what each person does matters. Additionally, by inviting other managers and administrators, I ensure that we broadcast accomplishments that would otherwise go unnoticed in such a busy public sector organization.

Keep Up with Technology

I often hear people in the GIS industry say, "We are so busy putting out fires that we never get a chance to check out the latest things." But discovering and experimenting with the latest technology is the only way to progress and get a grasp on change. That is why research and development needs to be thought of as an investment.

At TLCGIS, we carve out time to do research and development. I schedule regular sessions where team members with certain areas of interest watch videos or webinars on specific topics. I also have team members do deeper dives on issues or products that we're interested in. That way, fewer people set aside time to do the research, and they bring their findings back to the bigger group for further discussion.

We use videos from Esri User Conferences to learn about new topics and tools that enhance our knowledge. We also use them to jump-start projects, like sharing our data on ArcGIS Open Data, which we are gearing up to do.

Staying on top of Esri software updates and releases allows us to fix issues quickly and get exposed to new features and capabilities. That makes all the difference when generating GIS solutions that work for everyone.

Communicate Clearly

For most people, communicating clearly is a lifelong challenge. But it cannot be neglected.

At TLCGIS, the organizations we support are all stakeholders in the interlocal GIS program. To minimize confusion and make sure we come up with solutions that work for each—and all—of our customers, we need to maintain open communication about our projects and tasks.

One way we communicate effectively with our city partners is by using cloud-based systems to collaborate. While these do not eliminate the need for brainstorming and planning discussions, services such as Smartsheets (which lets multiple users access smart spreadsheets and keep them updated) allow us all to easily track tasks and see the status of requests.

Face time is still important too (and, no, I'm not talking about the iPhone app). Scheduling in-person meetings with teams and customers during a project ensures that everyone is in sync. These meetings should be productive but not dull, so start with some nonwork conversation—especially if challenging topics are on the agenda.

Manage *and* Lead

While many of these concepts seem obvious, putting them into practice is the tough part. That is where managers become true leaders.

Think about your organization and how you can implement some of these tips. As long as you manage for the best among us, you will have the momentum your team needs to build success.

About the Author

Scott Weisman is the GIS program coordinator for Tallahassee-Leon County GIS. A 2009 graduate of URISA's leadership academy, he holds a master's degree in geographic information science and is a Florida certified public manager. He can be reached at weismans@leoncountyfl.gov.

Managing GIS

A column from members of the Urban and Regional Information Systems Association

URISA

Fostering Excellence in GIS

www.URISA.org

ArcGIS Keeps Past Alive in Municipal Cemetery

By Ross Brewer, City of Marietta, Georgia

→ The editors tasked with recording data in the cemetery used Collector for ArcGIS, which allowed them to zoom in on high-resolution imagery to get accurate grave marker placements.

A city steeped in history has a responsibility to tell its stories.

The City of Marietta, Georgia—a pre-Civil War suburb of Atlanta and home to almost 60,000 people—recently fulfilled its storytelling responsibility by choosing to improve its grave marker data and highlight the lives of those buried in its local cemetery. To collect the data, improve it, and share it with the public, the city turned to its GIS department.

With 4,500 grave markers to improve and plenty to highlight, Marietta's GIS staff faced a formidable challenge: Finding ways to add recent burials, increase grave marker location accuracy, and attach photos to an existing grave marker layer—all without access to wireless Internet or cellular connections.

Nothing Set in Stone

To more accurately locate grave markers and be able to attach photos to them, the GIS staff first tried geotagging, which entails attaching coordinates to digital images. Because mobile devices with geotagging capabilities were readily available, the staff wasted no time in testing geotagging on a few grave markers.

Unfortunately, the tests elicited two deal-breaking complications. First, the accuracy of the resultant coordinates was not high enough to differentiate between each grave marker. Second, the staff could only assign coordinates to the images when the devices had access to wireless Internet or a cellular signal. Since wireless Internet did not exist at the cemetery and acquiring a cellular data plan exceeded the project's scope, the staff buried the option of geotagging.

A Solution Appears

Just like the original sculptors of the cemetery's ornate grave markers, Marietta GIS needed to use all available tools to improve the accuracy of its grave marker data. Rather than stone, chisels, brick, and mortar, however, the staff assembled tablets, Collector for ArcGIS, off-site wireless Internet, and an ArcGIS Online organizational account. It was not until this inventory was gathered that a mobile editing workflow began to materialize.

ArcGIS Online could host the existing grave marker layer along with an aerial image of the cemetery. Before leaving the range of city hall's wireless Internet signal, editors could use Collector to generate an editable, offline map of grave marker points and aerial imagery on each tablet. This enabled editors to add new grave markers to the map, move existing ones to more accurate locations (based on the aerial image), take photos of each grave marker, attach those photos to each grave marker point, and temporarily store all the collected data on each tablet—all without a wireless Internet signal. Additionally, upon returning from the cemetery, editors could use city hall's wireless Internet connection to synchronize their collected data with the city's ArcGIS Online hosted data.

Collection Gets Off the Ground

With a mobile editing workflow in place, the six editors on the team began taking trips to the cemetery right away. While the transition from the bustling, air-conditioned, Internet-connected offices of city hall to the quiet, humid, disconnected grounds of the city cemetery took some rigor, it was only a fraction of the toughness and grit that the buried individuals exhibited over their lifetimes.

Editors trod lightly among their offline cache of grave marker points and aerial imagery. They took photos of each grave marker reverently, keeping the perspectives of surviving family members, historians, and genealogical explorers in mind. Processing about 35 graves per hour, the team made short work of the data collection, and the synchronized data began to fill in on the hosted ArcGIS Online grave marker layer.

Once the majority of the data was collected, it was time to start highlighting some of the special stories from Marietta's past.

Telling a Ghost Story (Map)

Hosting data in ArcGIS Online not only made mobile editing possible but also allowed the staff to easily build a hosted web application that the public could access. Using Esri Story Map apps, the team merged its newly collected data with an existing stack of historical narratives and vintage photographs.

The stories began to take form. And the GIS staff only needed a few hours to create and publish a polished story map.

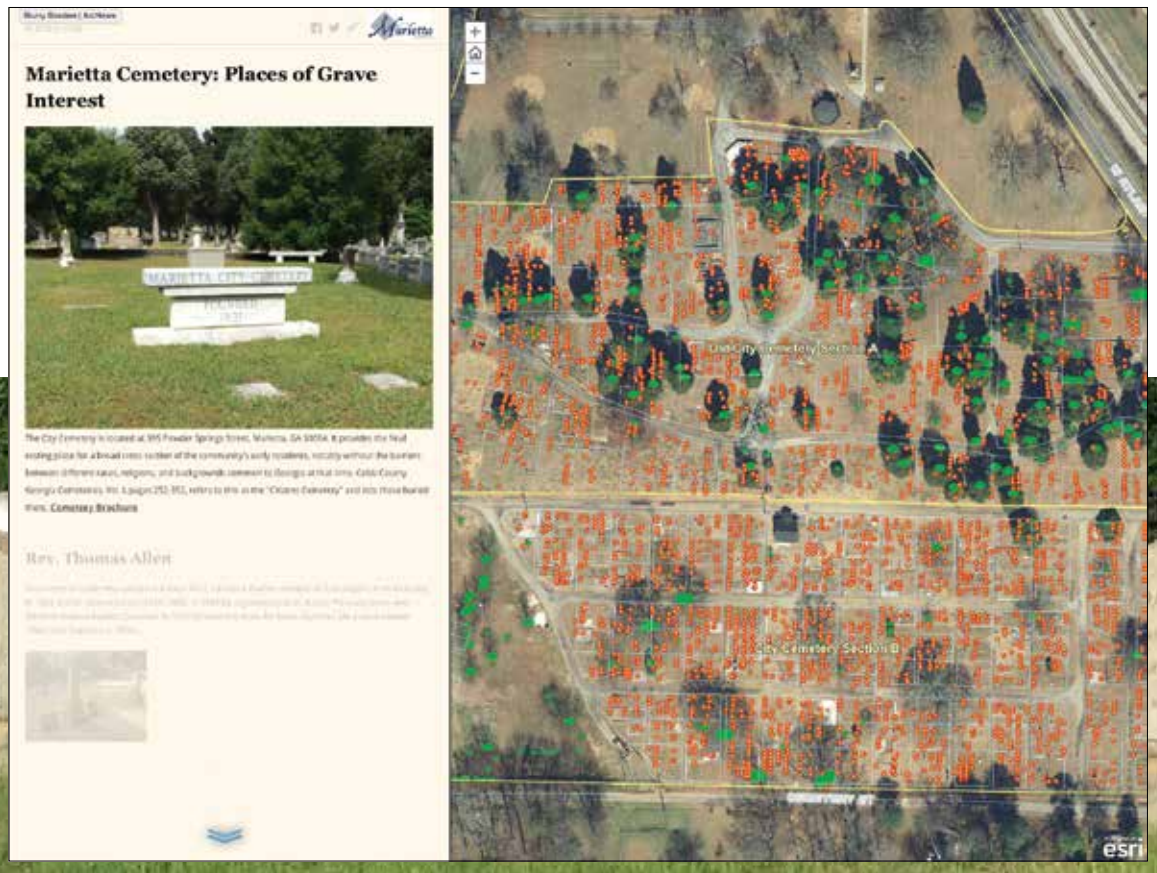
In it, users can learn about Mary Gartrell, whose sister, for 48 years, walked in mourning attire so often from Atlanta to Marietta to visit her grave that the sibling reaped the moniker Lady in Black. People could also now find out that Steadman V. Sanford, the namesake of the University of Georgia's famed football stadium, and Alexander Stephens Clay, the first US senator from the area, are both buried in the Marietta Cemetery. The staff even highlighted extraordinary trees—those quiet witnesses to history—such as the water oak that boasts the cemetery's largest canopy of over 86 feet.

The final story map, called *Marietta Cemetery: Places of Grave Interest* (arcg.is/1JQkEcg), was exactly what the city needed to present the cemetery's fascinating history in an electronic format.

When an End Is Not the End

Since the city of Marietta places great value and respect on the breadth of its surrounding history, the decision to improve and highlight aspects of its cemetery was easy. The challenges arose when determining how best to bring the stories of the past into the modern, technological present. Marietta's GIS team faced these challenges head on and successfully deployed a host of Esri tools—with both online and offline functionality—to achieve its goals.

As those living today make new history, Marietta can build on its revamped technological foundation and continue to accept its responsibility to keep the stories of the past alive.



← To tell the cemetery's stories to the public, the GIS team used Esri Story Map apps to merge its newly collected data with an existing stack of historical narratives and vintage photographs.

About the Author

Ross Brewer, GISP, is a GIS analyst for the city of Marietta and has been in local government GIS for eight years. For more information, email him at RBrewer@mariettaga.gov.

GIS Helps Find Parking in Washington, DC

Department of Transportation Uses ArcGIS and 360-Degree Imagery to Manage Curbside Spaces

By Jennifer Kuntz and Raj Patil, CycloMedia Technology

Parking is hard to find in Washington, DC. The population—which topped 670,000 people in 2015—swells by 79 percent each workday, according to a 2013 study by the US Census Bureau. Not only do residents, commuters, and business owners all compete for the same spaces, but bicyclists, taxicabs, and public transportation need access to curbside areas as well.

When residents and business owners lodge complaints about the shortage of available street parking, their grievances filter down to the Washington, DC, Department of Transportation (DDOT). Managing the intense demand for parking and curbside spaces in this urban core is complex and requires understanding the current parking supply, as well as the prevailing management plan. Knowing the locations of parking meters, restricted parking zones, parking spots, and signs is a critical part of improving the availability of Washington's limited curb space.

Whereas DDOT staff used to have to walk the streets and alleyways in the district to count parking spaces, correct parking meter locations, and inventory street signs, this can now all be done from DDOT's offices. By integrating the ArcGIS platform with high-resolution, highly accurate ground-based imagery, DDOT staff can see what's happening on the ground from their computers.

Desktop Diagnoses

For years, DDOT received complaints from citizens, district council members, and business owners about insufficient parking in various Washington neighborhoods, including Georgetown, Dupont Circle, Kalorama, and Eastern Market. Until recently, DDOT had to react to these complaints without having sufficient data to thoroughly understand the situation.

In late 2014, Benito O. Pérez, DDOT's parking/curbside management and operations planner, began a project to gain adequate information on parking availability. Using ArcGIS Online and imagery from Esri partner CycloMedia Technology, Inc., Pérez developed a workflow to audit curbside parking restrictions and inventory off-street parking.

CycloMedia captured 100-megapixel, 360-degree panoramic views of roadways and alleys at five-meter increments. This georeferenced panoramic imagery—called GeoCycloramas—is high resolution, so staff can see details such as the text on signs and the identification numbers on poles and fixtures. The images from CycloMedia are free from distortions, and every pixel has a known location.

To perform analysis, users can overlay data layers—such as subsurface information or the locations of hydrants, utility poles, or other fixtures—onto GeoCycloramas in ArcGIS Online. Because every pixel has an accurate location, users can make visual references; verify the accuracy of existing datasets; collect new features; and, ultimately, better coordinate fieldwork activities.

"Esri-integrated images from CycloMedia allow us to augment our desktop analysis with a snapshot of reality, which, in turn, streamlines data validation when we do go out in the field," said Pérez.

DDOT staff can now quickly and easily document accurate asset locations, view field conditions, measure assets, and update infrastructure data.

Auditing Parking

For the audit, staff used ArcGIS Online to view GeoCycloramas in the problem areas to inventory all available parking facilities, whether public or private. Having access to alleyways enabled DDOT to document private parking garages and pads that are tucked away behind buildings, in addition to those visible from the road. On the web map in ArcGIS Online, staff recorded the parking spot locations for each block segment in the neighborhoods being reviewed.

From this, DDOT came up with web maps that showed curb uses and parking availability throughout Washington's most crowded areas. What's more, these maps could be shared with stakeholders to give them a clear picture of the parking situation. For Georgetown, for example, DDOT combined the data in the web maps with other information—such as vehicle registrations and the number of residential permits that have been issued—to show the accurate count of parking spaces and the total number of permit holders in that zone. This allowed DDOT to compare local supply with local demand and determine the number of parking spots left for nonresidents.

Inventorying Street Signs

DDOT also handles requests to replace missing or damaged signs, including traffic control signs, parking markers, and street signs. When a request to change or update signage comes in, DDOT has to confirm the conditions in the field before it can accept or deny the request. This also helps determine how to execute the change.

To obtain an accurate inventory of street signs, Pérez enlisted the help of James Graham, a GIS and applications manager in the DDOT office of information technology and innovation, to complete a street sign database using CycloMedia's Street Smart app for ArcGIS, which works in ArcGIS Online.

Users collect data in Street Smart by clicking on a location in a web map to open the nearest GeoCyclorama. They then edit the sign feature class directly on the GeoCyclorama, capturing an x-, y-, and z-coordinate for each feature and entering its attributes.

Viewing GeoCycloramas on their desktops allows staff to gauge a number of factors, including

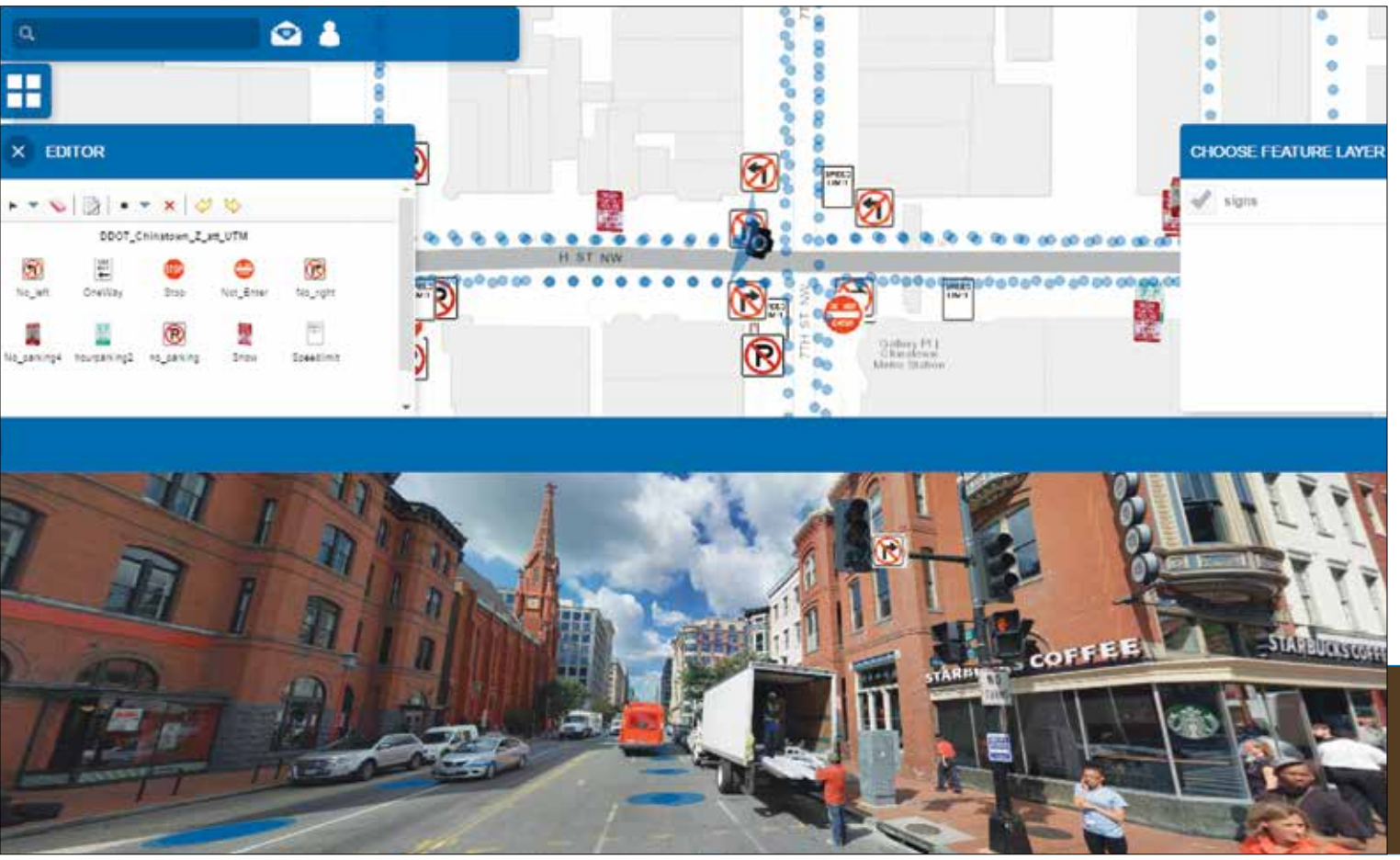
- Seeing whether existing signs have conflicting messages.
- Figuring out the location and type of support structures—such as metal poles, walls, or wooden masts—available for affixing a sign.
- Seeing if there is enough free space in the area to support another sign.
- Evaluating any safety issues caused by current sign placement (a sign allowing curbside parking too close to an intersection, for example).

↓ Each pixel of a GeoCyclorama has a precise location. This enables users to confirm the accuracy of existing datasets and collect new features.

- Determining whether safety issues will arise because of the requested sign change.
- Ensuring that there is an appropriate amount of space between signs or between signs and other infrastructure.

Once staff have performed the necessary inspections and determined that a new sign is needed, they view GeoCycloramas again in Street Smart in ArcGIS Online to find and capture the coordinates for where the new sign should be installed, as well as the location for a new support structure, if needed.

Although the sign inventory is incomplete as of yet, it is already reducing the number of field visits that sign crews need to make and minimizing turnaround time, which help to better manage parking in Washington. Once the inventory is finished, DDOT anticipates that it will be able to eliminate at least 80 field visits per month, according to Graham.



← With CycloMedia's 100-megapixel, 360-degree panoramic views of roadways and alleys, staff at the Washington, DC, Department of Transportation can see street-level details such as text on signs and the identification numbers on poles and other fixtures.

Working More Efficiently

Staff at DDOT have found that using CycloMedia's panoramic imagery in conjunction with ArcGIS Online has considerably enhanced workflows in the field operations division. In the past, sign crews sometimes found that they were sent to the wrong location to do a sign check, or when they were installing new signs, encountered conditions in the field that diverged from what they had anticipated.

"With the *[GeoCyclorama]* data, staff can perform a detailed prework field inspection, letting them know exactly where to go and exactly what to do once they get there," said Graham.

Adding GeoCycloramas to the ArcGIS platform has significantly increased productivity at DDOT and improved outcomes. Staff can now view assets at the street level and edit associated features in ArcGIS geodatabases without having to leave their desks. Being able to clearly see conditions on the street, in combination with GIS datasets, not only reduces the need for field visits but also streamlines GIS workflows by integrating imagery exactly where it is needed.

For more information, email DDOT's GIS and applications manager, James Graham, GISP, at James.Graham2@dc.gov.

The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak
President of the International Cartographic Association

Cartographers Gain Outside Perspective

When countries organize a summit, they typically meet to discuss big problems, such as a refugee crisis, climate change, and reducing trade barriers. So what is a Cartographic Summit?

At the 2013 International Cartographic Conference in Dresden, Germany, during a meeting between the leadership of the International Cartographic Association (ICA) and the event's keynote speaker, Esri president Jack Dangermond, the idea was raised to organize a small, closed gathering among key cartographers and influential professionals who work with maps but who don't have cartographic backgrounds. The purpose would be to discuss the future of the cartographic discipline. And thus, the Cartographic Summit was born.

A small, closed meeting like this might appear to run counter to the inclusive nature of the ICA. And complaints did ensue about the seeming exclusivity of the event. But sometimes small workshops make a bigger difference than large conferences with hundreds of attendees.

Of course, the inevitable question then arose: Who should be included? We preferred to invite people who had stories to tell and opinions to share. But then we encountered the constraints: agendas, locations, finances, differences of interest, and the like.

Despite all this, however, the summit was held in February 2016 at the Esri campus in Redlands, California, with 50 participants. And we were able to bring together an engaging program.

The central themes of the summit were data, media, and design. Data is a prevalent issue right now because, as the big data paradigm illustrates, it is not lack of data but an abundance of it that causes problems. Media is central to contemporary cartographic discussions because maps are used everywhere. And design is always important because maps have stories to tell and they need to do that well. These three topics are also interdependent.

Heeding the objective of bringing in outside perspectives, the keynote speakers at the Cartographic Summit do not label themselves cartographers and have never had any involvement with the ICA. The three of them—Katy Börner, a professor of information science at Indiana University; Gary Gale, the chief technology officer for startup what3words; and Nigel Holmes, a renowned graphic designer—were asked to view maps from their own standpoints.

Talking about maps from a data visualization angle, Börner outlined a generic framework for maps that could allow mapmakers to create alternative visualizations for different users based on user questions and a needs-driven workflow. Gale pointed out how crowdsourcing and social media have contributed not only to an abundance of data but also to a whole new interest in maps—both well-designed ones and those that could use a lot of work. To round it out, Holmes stressed the importance of design in making maps appealing and intelligible. As an example, he placed different-sized (and real) blueberries on top of a rainfall map for the United States to demonstrate one way to creatively scale symbology to quantity.

The keynote speakers were also supported by two Lightning Talks: in keeping with the aims of the summit, one talk was from someone outside the ICA community, and the other was from within it to maintain a certain cartographic perspective.

All these presentations were only a small part of the whole event, though. During breakout sessions—which were a core component of the summit—attendees held lively discussions based on keywords they came up with after hearing each presentation. Examples of discussion topics include "analysis" (from the data presentation), "storytelling" (from the media keynote), "clarity" (from Holmes's talk), and "users" (a common thread in all the speeches). Results from the breakout sessions—where participants were encouraged and felt free to speak up—were reported in joint sessions.

Most of the summit (besides the breakout sessions) was live streamed, and participants live Tweeted it on Twitter—both of which were a first for me, given that I am not very active on social media. This brought a whole new dimension to the event and certainly resulted in some interesting situations.

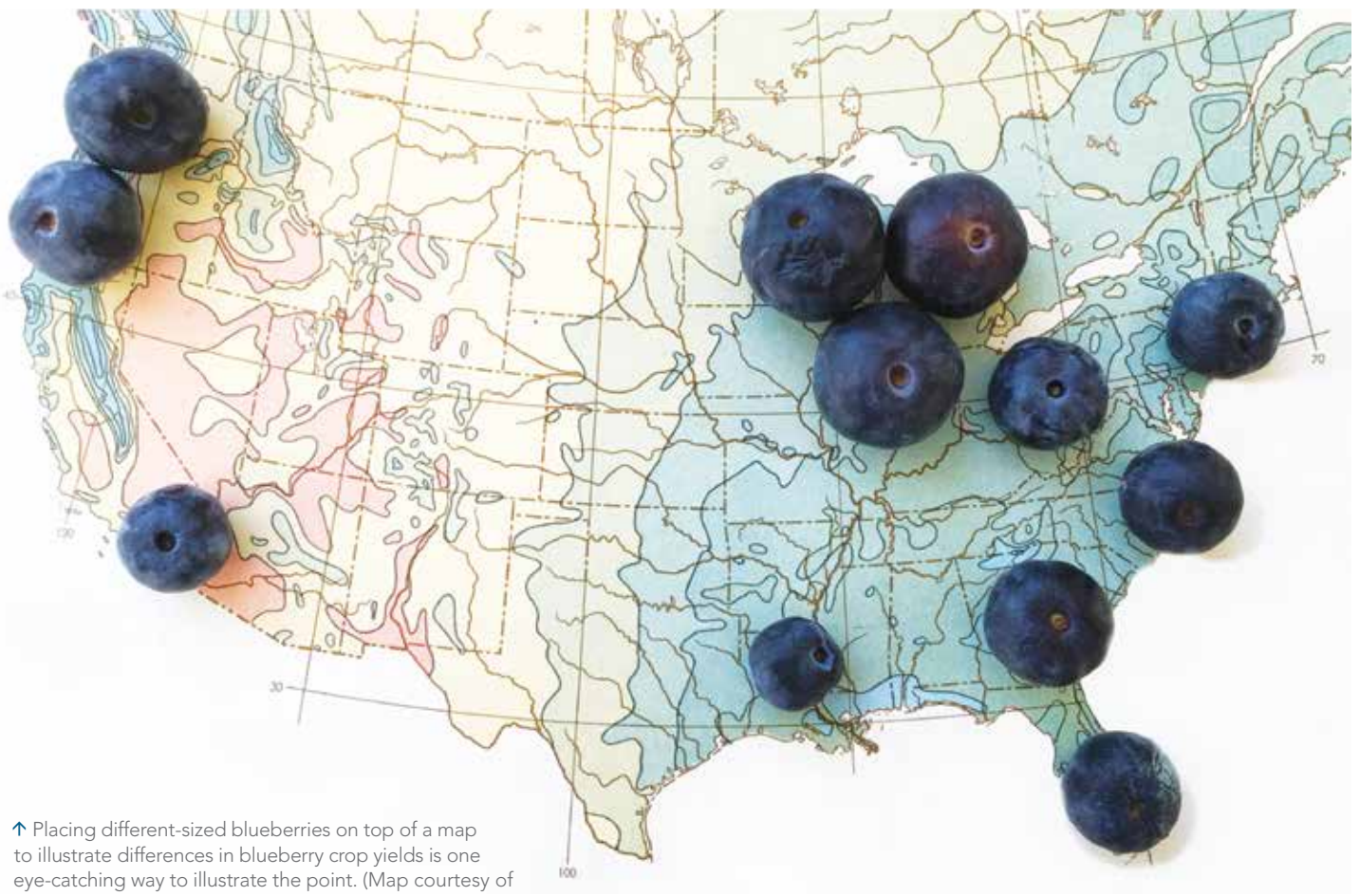
The audience viewing presentations online, for example, could only see the slides and hear a voice. Some context was lost, and some expressions that were heard by online-only viewers started lives of their own on Twitter. It was also more difficult to share research results that hadn't been made completely public yet, as there was the chance that they could go viral without having the correct copyright labels in place. I now realize why politicians are always so vague.

On the other hand, news about the Cartographic Summit spread much faster via its hashtag, #cartosummit, than it would have if I had only written about it in this column.

In the end, one question lingered: Can such an exclusive event really change cartography? Not massively, I would imagine, because the scope of the summit did not cover all aspects of cartography. It was also organized as a onetime occasion—though people have already begun asking me when the next one will take place.

What the gathering did do, however, was open up new avenues for thinking about the subjects that were covered. Additionally, it allowed the cartographic community to bring young and bright visualizers into our world—something that is important for us to keep doing. The noncartographic professionals who attended the summit were also able to see that cartography and cartographers are not as dull as they may have seemed before. And I think we all realized that we—and the ICA's various commissions—need to reach out more to the data, media, and design communities. This is how different groups learn from each other and how we all continue to grow.

For more information on the Cartographic Summit, visit my presidential blog on the ICA website. Video recordings from the summit are available at esri.com/events/cartographic-summit. And do not forget to look at Twitter posts with the hashtag #cartosummit to view some varying opinions on the gathering.



↑ Placing different-sized blueberries on top of a map to illustrate differences in blueberry crop yields is one eye-catching way to illustrate the point. (Map courtesy of Nigel Holmes.)

About the Author

Menno-Jan Kraak is professor of geovisual analytics and cartography at the University of Twente in the Netherlands, where he has been teaching since 1996. He has a degree in cartography from the Faculty of Geographical Sciences at Utrecht University and received his PhD in cartography from Delft Technical University. Kraak has written extensively on cartography and GIS. His book *Cartography: Visualization of Spatial Data*, written with Ferjan Ormeling, has been translated into five languages. He also wrote *Mapping Time: Illustrated by Minard's Map of Napoleon's Russian Campaign of 1812*, published by Esri Press in 2014. Kraak is a member of the editorial boards of several cartography journals, including the *International Journal of Cartography*. He currently serves as president of the International Cartographic Association.

Esri Startups Fuse Communication Media with GIS

Combining location information with communication channels, such as email, Twitter, YouTube, and text messaging, gives organizations an in-depth view of their audience in specific locations and cultivates more intelligent communication. Companies in the Esri Startup Program are innovating in this domain, helping a range of organizations better understand the content and trends that relate to their customers and staff members.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Program participants receive ArcGIS platform technology, training, support, and marketing opportunities to help them succeed. To learn more about the Esri Startup Program, visit developers.arcgis.com/en/startups.

Searching Social Media

Twitter has 310 million active users, Facebook averages more than 1 billion daily active users, and Snapchat's daily user base is reported as at least 100 million. With so many people sharing so much information on social media, it can be difficult to pinpoint a trend to a particular area or discern the larger picture that goes along with a series of posts.

Startup Echosec Systems developed a location-based search platform that allows public safety organizations, security firms, journalists, and intelligence professionals to analyze information on social media and turn it into actionable knowledge.

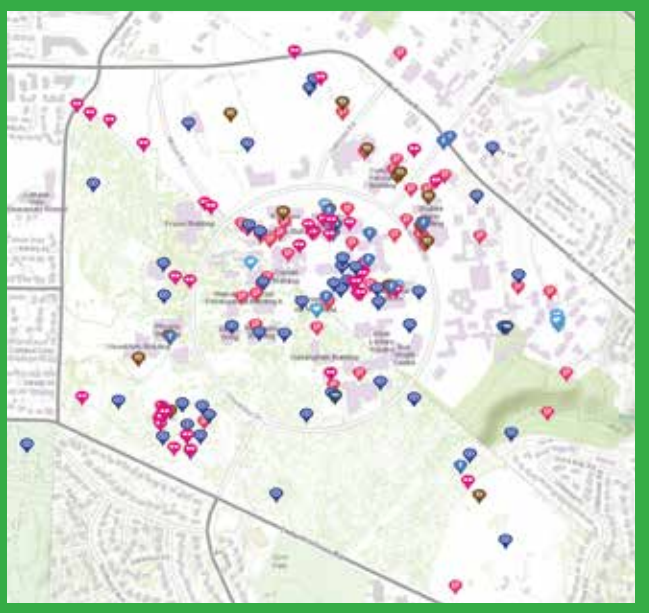
Instead of filtering posts using hashtags or keywords, Echosec leverages location metadata to search social media and other open-source information. It sends API requests directly to social media networks, such as Instagram, Twitter, and YouTube, as well as third-party information repositories. The program queries the data and then displays it on ArcGIS map services and layers available within the application.

Another startup, Snaptrends, processes billions of geotagged posts each month and translates more than 80 languages to help organizations pinpoint the locations of social media content and users.

Snaptrends recently helped one emergency management department in Texas save lives during a flood. After rain deluged the area overnight, residents woke up to find that they were trapped in their houses. They began calling 911—albeit all at the same time—and overwhelmed emergency lines. When residents were unable to call for help, they started posting images and videos of their situations on social media.

Using Snaptrends, the emergency management department was able to see where people needed help and direct its resources to residents who required the most immediate assistance. With the ability to filter social media searches to specific areas, emergency managers—and other organizations—can zero in on what is most important.

Learn more about Echosec at echosec.net and Snaptrends at snaptrends.com.



↑ Echosec leverages location metadata to search social media and other open-source information.

↑ Snaptrends processes billions of geotagged posts and translates more than 80 languages.

↑ Retailers, utility companies, and smart cities can use SmartNotify to analyze their contacts' preferences, circumstances, and locations.

The Right Media at the Right Time

Connecting with people is increasingly complex—especially with the ever-growing list of communication channels (phones, email, texting, social media) and a boom in devices that fuel the Internet of Things (IoT). If an organization uses the wrong medium, its messages get ignored. If it stops listening altogether, it misses out on key information.

Startup SmartNotify helps customers route communication through the right channels at the right time. Rather than mass broadcast generic information, retailers, utility companies, smart cities, and other institutions can analyze their contacts' preferences, circumstances, and locations to reach them intelligently. SmartNotify users can also monitor people's responses to their messages, allowing organizations to be proactive rather than reactive.

The app integrates Esri technology in two ways. First, using ArcGIS Online and ArcGIS API for JavaScript, SmartNotify makes ArcGIS maps, features, and data available to users natively both on the web and as a mobile app. Second, SmartNotify allows customers to feed data from their own ArcGIS accounts into its web and mobile apps.

Some small towns in the French Alps have ingrained SmartNotify into their daily operations. In Vaujany, for example, the town's communication managers can send text messages to residents to notify them of snow conditions so people can adjust their commutes, or call the elderly to inform them that the city's food delivery services might be delayed. They can also get citizens' input on development or environmental issues via social media.

Learn more about SmartNotify at smartnotify.us.

Partners Impress with ArcGIS Platform Solutions

At the Esri Partner Conference, held each March in Palm Springs, California, Esri recognizes partners that have made exceptional strides using the ArcGIS platform. This year's award winners have developed pioneering GIS solutions for solving real-world problems while also demonstrating best practices in business.

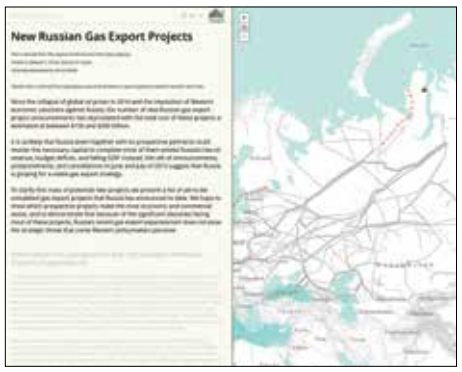
Esri's more than 2,200 global partners provide customer-focused, geoenabled solutions that span dozens of industries. Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content.

Best Use of Story Maps Outside the Enterprise

Exprodat

exprodat.com

In partnership with the Centre for Strategic and International Studies (CSIS), Exprodat created a story map to accompany a report on pipeline projects under construction throughout Russia. The story map, called New Russian Gas Export Projects (arcg.is/1L8g2Po), shows existing and planned oil and gas pipelines in Russia alongside the text of the report and is intended to help readers better understand the detailed information.

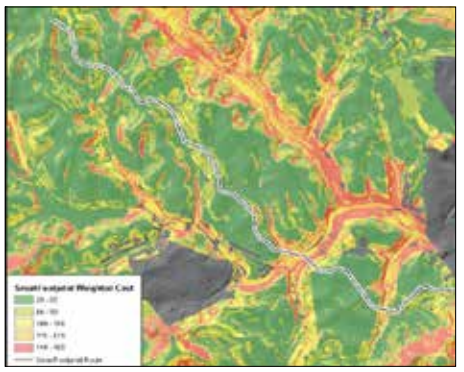


Best Use of Spatial Analysis and Analytics

Earth Analytic

earthanalytic.com

Earth Analytic's SmartFootprint, an extension to the ArcGIS platform, provides scientists with a simulation environment to help them route onshore and offshore pipelines, calculate construction costs, and figure out how to mitigate risks. The solution can also aid with analyzing and optimizing alternative energy projects, public utility construction, conservation, and ranch management.

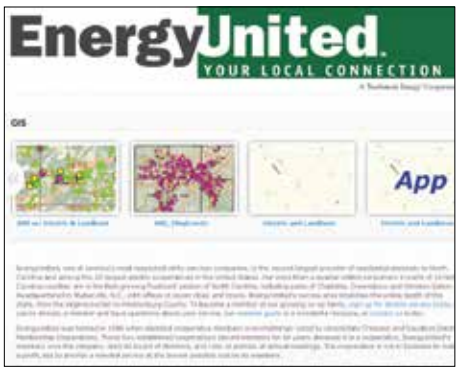


Excellence in Web GIS Expansion

SSP Innovations

sspinnovations.com

To get utility and telecommunication companies, such as Energy United, to quickly realize returns on their GIS investments, SSP Innovations offers jump start services to configure customers' new technology and ensure maximum operational capacity from the get-go. The company deploys custom solutions for managing data, workflows, and assets and advocates extending the use of ArcGIS throughout an entire organization.



ArcGIS Platform Innovation

Argis Solutions

argis.astadia.com

Argis, which specializes in augmented reality (AR), is redefining how people interact with data and the real world. Instead of anchoring its AR to an object like most AR apps do, Argis uses GPS and the ArcGIS platform to anchor its AR to the real world itself. This allows users to layer their data or digital elements on top of a real-world, real-time view of their surroundings and actually see the effects of what they do in a specific location.

Best Use of Story Maps for Partner's Business

Pro-West & Associates

prowestgis.com

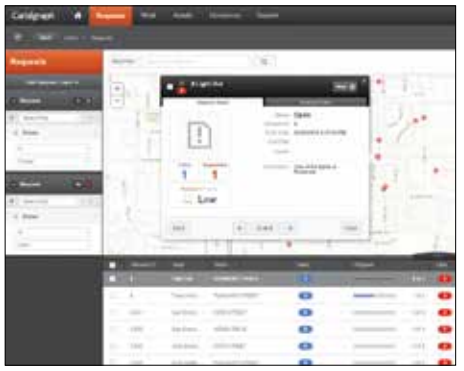
To help customers understand how they can benefit from the array of apps, solutions, and services offered by Pro-West & Associates, the GIS consultant and data management company developed ProGov. The ArcGIS Online based gallery provides easy access to Esri Story Map apps that illustrate the power of the ArcGIS platform for addressing a wide range of needs in federal, state, and local governments, as well as private industry.

Everyone Has an Identity

Cartegraph

cartegraph.com

Cartegraph reengineered its Operations Management System to integrate it completely with the ArcGIS platform. Now, Cartegraph users sign in with unique ArcGIS Identity logins, giving them simultaneous access to Cartegraph's asset management system and the ArcGIS platform's spatial analysis capabilities. With more data and enhanced collaboration at hand, local governments can better manage their enterprise assets.



Exceptional Joint Partner Collaboration

Cityworks

cityworks.com

Meeting the complex needs of customers today requires a broad range of technological and industry expertise, which can be difficult for one organization to obtain and maintain. Cityworks collaborates with Esri partners and distributors to help them give their customers cost-effective asset management solutions based on the ArcGIS platform. This augments the number of organizations that can use intelligent infrastructure management tools and opens up GIS to even more employees at all levels of a company or agency.

ArcGIS Platform: Complete Deployment

Geographic Business Solutions

gbs.kiwi

When the Auckland Council in Auckland, New Zealand, needed to bring data and information from eight local authorities into a single system, it enlisted Geographic Business Solutions (GBS) to build a web viewer that was flexible, scalable, and easy to use. Employing Portal for ArcGIS, ArcGIS for Server, and ArcGIS API for JavaScript, GBS created GeoMaps, which enables internal users to configure and customize the solution while allowing access on a variety of devices.

To search and discover partners, solutions, and services that meet your needs, visit **esri.com/partners**.

In Focus

Auckland Council Deploys the ArcGIS Platform

In 2009, New Zealand's Royal Commission, which reviews significant matters of public concern, recommended that Auckland make some bold changes to the way it was administered. So the government decided to consolidate eight local authorities into one. This was the largest organizational restructuring that New Zealand had ever seen.

The resultant Auckland Council came into existence in November 2010. It is New Zealand's largest local government organization, with more than 10,000 staff members serving 1.5 million people.

Unsurprisingly, there was a great deal of data to amalgamate as well. The Auckland Council tapped Eagle Technology Group, Esri's official distributor in New Zealand, to help manage the four-year-long GIS project. Called the Geospatial Future Mode of Operation (GFMO), it was one of the most substantial geospatial technology ventures ever undertaken in New Zealand.

↑ GeoMaps, a web viewer developed by Geographic Business Solutions, helps internal users configure their geospatial information.

Consolidating Scores of Datasets

"GIS underpins many council services, including—but not limited to—property information, civil defense, resource planning, and building consents," said Auckland Council's geospatial manager Ingrid McClymont. "GIS provides teams within the council *[with]* the tools to do their work and also provides services to the public."

The complexity of consolidating all this information was immense.

"At the outset of the project, although there was one new organization, there were still a multitude of different software platforms, systems, databases, processes, and people required to carry out common activities," said Nathan Heazlewood from Eagle Technology's GIS professional services team, who was also the project manager for GFMO.

Searching for property information in Auckland's central business district, for example, used to require a very different process than conducting a similar search in the rural district of Rodney.

"We also had a mass of inherited data—much of which had been created years or even decades before," continued Heazlewood.

New Zealand's local governments are required to retain any data that has been used for an official purpose in case decisions need to be reviewed later.

"There were literally hundreds of thousands of data items that had to be carefully organized, rationalized, and cataloged—all without losing the ability to trace information back to its original purpose and cross-referenced material," he said.

To rationalize this historic data, GFMO used ArcGIS for Desktop to visualize new data structures for the information. The team then used ArcGIS for Server and Esri partner Safe Software's FME to migrate the data over to the Auckland Council's system.

During this process, a total of 8,470 geographic datasets were reduced to just 2,056—a cutback of 75 percent. Rationalizing the Auckland District Plan (which contains all the bylaws, planning stipulations, and rules that come under the governance of a council) was another feat, requiring that 697 different geographic datasets be replaced with just 25 new ones.

Replacing Legacy Software with ArcGIS

While sorting out the inherited data issues, GFMO also consolidated several legacy software platforms, apps, integrations, and versions into one GIS—the ArcGIS platform. This allows Auckland's GIS to be upgraded, extended, and enhanced more easily than it could be with myriad independent systems.

While this very essential project was challenging, it presented a golden opportunity to review the way things were done before and adopt new best practices.

Given the size of the organization and the magnitude of the operation, the undertaking required assembling the largest geospatial team in the country. The Auckland Council's geospatial team became part of the greater information services (IT) business unit, driving the team to adopt standard IT best practices, which facilitates communication between GIS staff and general IT personnel. This close coordination has also allowed GFMO to contribute to streamlining various aspects of governance and bureaucracy in Auckland.

Geospatial technology is intimately integrated with other software systems at the Auckland Council, which means that a large number of Auckland Council teams now depend on GIS. To ensure that GIS is available to the whole organization with minimal outages, GFMO introduced service-level agreements (SLAs) as a best practice. The geospatial team has also made GIS tools such as Portal for ArcGIS available to other, nongeospatial teams like the city planning and environmental protection departments. This allows these teams to have GIS tools that are easy to use and tailored to their needs—though the geospatial team still manages data integrity.

Realizing the Tangible Benefits of GIS

According to Paul Donald, the Auckland Council program director for the GFMO project, the council can now begin to realize the value of its GIS.

"One tangible benefit is a 25 percent reduction in personnel," he said. "This figure—along with savings through such things as decommissioning older systems and saving space—will save the Auckland ratepayers millions of dollars over the coming years."

He says that there is a growing awareness of geospatial technologies both inside and outside the council.

"Day-to-day council business is conducted using GIS, for example, to manage parks and waste," said Donald. "Ratepayers can access property records online, and land consents will be accessible and easier to transact with GIS."

The council is now starting up a mobile workforce program, which will enable fieldworkers to update information remotely and allow employees in the head office to then access that data.

"This negates the need for many to ever have to drive to the office to file a report," Donald pointed out. "It increases efficiency both in time and in environmental impact."

Zooming out to the bigger picture, GIS has become central to governance in Auckland and the council's direction for the future.

"GIS can create 3D visualization and analysis to reimagine the cityscape and assess the impact of planning decisions," said Donald. "And increasingly, nontechnical decision-makers will be accessing a central geodatabase and integrating geospatial information with their business tools every day."

For more information on this project, including Esri partner Geographic Business Solutions' web viewer contribution, email Eagle Technology's Sarah MacDonald at sarah_macdonald@eagle.co.nz.

Auckland Council's GFMO team was acknowledged by three separate entities in 2015 for the success of its data consolidation project. The New Zealand Association of Local Government Information Managers awarded GFMO the GIS Project of the Year Award, Esri recognized it with a Special Achievement in GIS (SAG) Award at the 2015 Esri User Conference, and New Zealand's Project Management Institute presented GFMO with the Public Sector Project of the Year Award.

Sporting Esri T-shirts

Gwenna F. garners geospatial insight from Map Girl before soccer practice in Claremont, California, to make sure her shots on goal are accurately geolocated.

Retired librarian and longtime Esri user Maureen Miller navigates the topography of North Carolina's woods in her Team Esri jersey, which has been tracked throughout the deserts of California and across Canada too.

Building a Location for Lifelong Learning

Later this summer, Esri Training will release the next-generation e-learning destination for Esri users and geospatial learners. The website, currently in beta, has been completely redesigned to offer a fresh user experience, complete with an open learning model, more flexible courses, and contemporary learning incentives.

The new training website updates the Virtual Campus, which Esri launched in 1997 to extend geospatial literacy by making GIS education more widely available online. Back then, the World Wide Web was still relatively young, the term "e-learning" was just coming into existence, and the e-learning concept was years away from mass adoption. But the idea quickly proved its merit. Virtual Campus courses have been enormously popular with students, GIS professionals, and Esri customers around the world for almost 20 years.

Today, e-learning is ubiquitous. So while the new Esri Training site builds on the Virtual Campus's legacy of providing timely, high-quality content, it also delivers the convenience, versatility, and variety that contemporary learners value.

Focused Learning Anytime, Anywhere

The ArcGIS platform has introduced GIS technology and geoenabled workflows to a whole new ecosystem of users. Now, GIS professionals can create maps and other authoritative resources and share them in an organizational portal where knowledge workers throughout the organization can discover, use, make, and share maps of their own. The result is geoenabled insight and better decision-making across the enterprise.

This also means that employees throughout the workforce must keep their skills up to date. But experienced GIS professionals have different learning requirements than geospatial neophytes.

"Esri training offerings have evolved to reflect that we all have different levels of experience and different learning needs and styles," said Patty McGray, director of customer education for Esri Training Services. "There are new learning trends cropping up on a regular basis, and how we get our information today is very different from 20 years ago, or even 10 years ago."

That is why the new Esri Training site lets users freely move from course to course (no access code needed) and learn continuously anytime, anywhere.

"Virtual Campus began with rather large e-learning courses—some as long as 40 hours," continued McGray. "We're moving away from those large courses and building small, focused, just-in-time pieces of training that better reflect the needs of learners."

This will enable people to develop new skills as required.

Curated, Easy-to-Find Content

For organizations deploying the ArcGIS platform, ensuring that their employees acquire the capabilities they need to work efficiently is important. Esri produces a vast amount of educational content designed to help users of all levels be productive with ArcGIS. And with the new Esri Training website, this content will be easy to find and convenient to consume.

The website will centralize content produced by teams across Esri. In addition to Virtual Campus-style courses, the site's initial release will provide direct access to seminars, videos, massive open online courses (MOOCs), educational classroom activities called GeoInquiries, SpatiaLABS, Learn ArcGIS lessons, instructor-led courses, Esri Press books, and Esri Technical Certification resources. The Esri Training catalog is professionally curated, allowing people to quickly find relevant content and start learning without delay.

McGray pointed out that all material is evaluated, vetted for accuracy and relevance, and organized logically. The site contains great search and filtering tools to help learners find and immediately consume the content that is best for them.

"My personal favorite is that Esri Training will have learning plans," said McGray. "Learning plans will provide a clear starting point and path to developing skills and knowledge on a specific topic. We expect learning plans to be a great tool for individuals and for educators who want to recommend them for their students."

Engaging with Lifelong Learners

Changes in technology will continue to shape how we work. Today's students and working professionals must prepare for the workplace of tomorrow, so making a commitment to lifelong learning is key to possessing the sought-after skills of the future.

Esri Training is designed to be a central location for lifelong learning, where users will be able to explore and have fun as they continually grow their geospatial knowledge and technology skills. As the website evolves over time, elements such as gamification, badging, social communities, and personalization will be considered for future releases.

"Research shows that gamification elements can help with learning and motivation," said McGray. "Personalization will also be important. We want to display content that speaks to you as an individual, such as course recommendations."

While Esri Training is a new experience, its core mission is decades old.

"We are a service organization," stated McGray. "We exist solely to enable our users to be successful."

Visit esri.com/training to learn more about the new Esri Training website.

Public Health Department Opens Data to the People

ArcGIS Open Data helps more than 3,000 organizations around the world share their authoritative data in multiple open formats. The solution, hosted and managed by Esri, comes free with ArcGIS Online. It enables users to set up public-facing websites where members of the community can search for and download open data.

Making Public Health Data, Well, Public

Charged with optimizing citizens' health and well-being, the California Department of Public Health (CDPH) uses ArcGIS Open Data to integrate its open data and share it with other experts and the community.

CDPH's open datasets contain meaningful location information, which the organization can put into ArcGIS Online to develop further. In addition to enabling CDPH GIS professionals to use the data, having the datasets in an open data portal allows geospatial experts and developers worldwide to make good use of it as well.

The department uses its open data to create maps, apps, and websites that better share information with the public. The My Hospital's Infections web map (gis.cdph.ca.gov/HAI/map), for example, shows the rates at which California hospitals have cases of common infections, such as Methicillin-resistant Staphylococcus Aureus (MRSA) and Clostridium difficile infections (CDI). The department also created the Fire Response GIS 2015 site (gis-apps.cdph.ca.gov/responsegis) to share the public health effects of the 2015 California fire season.

CDPH has a long history of distributing public maps and geospatial data using enterprise-level GIS that integrates both proprietary and open-source technology. The department's implementation—which is managed by the application support and development branch of CDPH's information and technology support division—includes ArcGIS for Desktop, ArcGIS Online, Google Maps, JavaScript, Java, and PHP.

Currently, CDPH is expanding its ArcGIS Open Data site to incorporate the collection of open data managed by the California Health and Human Services Agency (CHHS). This includes data from all agency departments, such as the Department of Health Care Services, the Emergency Medical Services Authority, the Office of Statewide Health Planning and Development, and the Department of Social Services. When complete, the CDPH ArcGIS Open Data portal will establish a direct link with CHHS's own open data site.

↑ The California Department of Public Health has a long history of distributing public maps and geospatial data.

To explore CDPH's open data, visit gis-apps.cdph.ca.gov/opendata.

View other websites powered by ArcGIS Open Data at opendata.arcgis.com. Or create your own open data site at esri.com/opendata.

New Training and Certification Offerings

Training

New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT+ certification.

New courses include the following:

- **ArcGIS Pro: Essential Workflows**
  Explore the capabilities of ArcGIS Pro and become comfortable working with this exciting ArcGIS for Desktop app. Participants learn workflows to map, manage, analyze, and share GIS data and resources.
- **Building 3D Cities Using Esri CityEngine**
  Master the efficient, rule-based approach to producing realistic 3D urban landscape models. This course is beneficial to GIS professionals, urban planners, landscape architects, entertainment professionals, and others who need to create 3D models of cities.
- **Deploying Portal for ArcGIS**
  Learn best practices for installing, configuring, and deploying Portal for ArcGIS. This course—which covers techniques for ensuring security and high-availability configurations—helps ArcGIS for Server administrators meet their organizations' needs for private geospatial content sharing.

View the full listing of instructor-led courses at esri.com/il.

Certification

Individuals who achieve Esri Technical Certification will now receive digital badges that verify their accomplishments. The metadata in the badges allows people—including prospective employers—to immediately authenticate someone's Esri certification information. The updated badge design enhances resumés, business cards, and social media profiles.

Digital badges are part of Esri's commitment to provide certified GIS practitioners with modern, engaging products and innovative functionality that support people's professional goals. Those with Esri Technical Certifications can visit esri.com/mycertification to download their badges and view usage guidelines.

- To learn more about Esri Technical Certification exams, visit esri.com/certification.
- To connect with other professionals and discuss all things certification, join the Esri Technical Certification group on LinkedIn.

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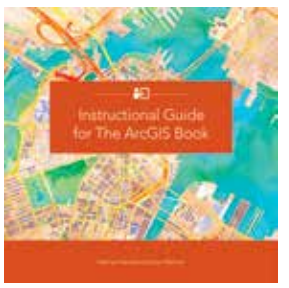
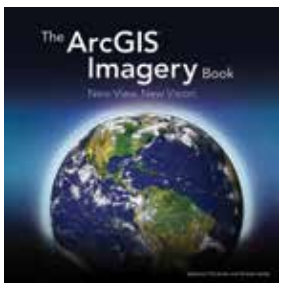


Instructional Guide for The ArcGIS Book

By Kathryn Keranen and Lyn Malone

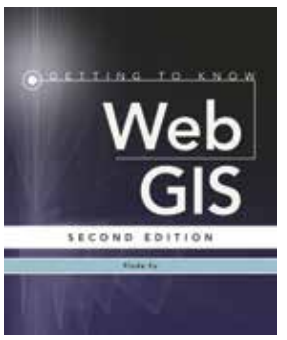
This companion textbook builds on the foundational concepts laid out in *The ArcGIS Book: 10 Big Ideas about Applying Geography to Your World*. The *Instructional Guide for The ArcGIS Book*, which includes downloadable instructor resources, provides the materials that self-learners and teachers need to develop and apply ArcGIS concepts and tools to their work. Aligning with *The ArcGIS Book*'s structure, each chapter contains activities, resources, lessons, and data that illustrate the interaction between various components of ArcGIS Online and demonstrate how to publish GIS apps to the web and mobile devices. The book includes scenario-driven and skills-based lessons (many don't require software downloads) that allow readers to practice using these tools and inspire them to gain a deeper understanding of the power of web GIS. June 2016 (e-book) and July 2016 (print), 120 pp. E-book ISBN: 9781589484719 and paperback ISBN: 9781589484702.



The ArcGIS Imagery Book

Edited by Clint Brown and Christian Harder

Explore how imagery and remote sensing power modern GIS. *The ArcGIS Imagery Book* weaves together fascinating stories about the planet and the current issues that humanity faces. Using the book and its online companion, TheArcGISImageryBook.com (which has links to noteworthy web apps and maps), experienced GIS practitioners can quickly begin putting imagery to better use. Appropriate for people who have never heard of GIS as well, armchair geographers can appreciate the book's wealth of gorgeous, inspiring, and occasionally troubling images. July 2016, 120 pp. Paperback ISBN: 9781589484627.



Getting to Know Web GIS, Second Edition

By Pinde Fu

Featuring detailed, step-by-step exercises, *Getting to Know Web GIS*, Second Edition, shows readers how to share resources online and build web GIS applications quickly and easily. Teaching web GIS as a holistic platform, this workbook covers the Esri suite of web GIS technologies, including ArcGIS Online, Portal for ArcGIS, ArcGIS for Server, web app templates, Web AppBuilder for ArcGIS, ArcGIS API for JavaScript, Collector for ArcGIS, mobile SDKs, and 3D web scenes. The second edition covers Esri's latest upgrades, such as smart mapping, AppStudio for ArcGIS, ArcGIS Pro, and real-time GIS. In each chapter, readers do a project using multiple products. Data for completing the exercises is available for download. June 2016 (e-book) and September 2016 (print), 350 pp. E-book ISBN: 9781589484610 and paperback ISBN: 9781589484634.

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JavaScript Engineer: Help governments and organizations make real-world advances by developing visualization software that enables users to understand data when proximity and location matter.

C++ Software Engineer: Develop software that extends the capacity of the ArcGIS platform. Build C++ software components that help professionals reimagine the design and maintenance of critical infrastructure at city, state, and national levels.

3D Content Product Engineer: Many industries need 3D capabilities, but few know how to get them. This is an opportunity to develop new, easy-to-use workflows that enable users to make more informed decisions and accurate predictions.

Technical Editor—Imagery Workflows: Are you passionate about imagery and image processing? Esri needs your expertise to design, manage, and edit content about new techniques and best practices for imagery to ensure that ArcGIS solutions are simple to use.

Product Management

Product Manager—ArcGIS Earth: Identify and prioritize federal and state government requirements for defining, building, and releasing ArcGIS Earth—a lightweight, simple client application that customers can use to browse maps and share information.

Professional Services and Consulting

Consultants/Project Managers (multiple industries): Work closely with clients to establish solutions that broaden the presence and effectiveness of GIS within their businesses and support the growth of the Esri platform into new domains.

Educational Services and Technical Support

Course Developer—Intel and Defense: Apply your writing and communication skills alongside your military intelligence background and GIS knowledge to assess, design, develop, maintain, revise, and validate training materials.

Support Analysts: Provide users with high-quality technical support by effectively diagnosing and resolving product issues while making a positive impression.

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Account Manager and Account Executive Opportunities for New Grads (San Antonio, TX): Team members will be responsible for establishing new accounts, expanding existing ones, and providing technical sales support.

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Account Executive—Insurance: Work collaboratively with an account team to promote and sell the adoption of the ArcGIS platform within insurance organizations.

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Solution Engineers (multiple locations, industries): Are you a problem solver who is passionate about technology? Work with prospective customers in a range of fields to help shape and deliver strategies on how to effectively use the ArcGIS platform.

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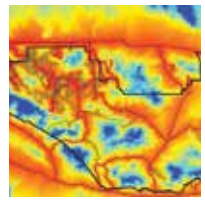


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