ArcNews

Esri | Spring 2018 | Vol. 40, No. 2

Briefly Noted

Generate Intelligent Map-Based Information, Instantly
Esri has acquired ClearTerra technology from Esri partner ClearShark, LLC, making it easier to map information contained in emails, briefings, and reports. With this technology, ArcGIS platform users can extract the geographic coordinates from unstructured textual data without having to spend hours reading, copying, pasting, and running spreadsheet formulas.

SAP, Esri Streamline IT Architecture
The SAP HANA platform is now a supported Esri enterprise geodatabase, which allows organizations to integrate, deliver, and access their spatial data all from one place.

A Complete Utility GIS Platform
The ArcGIS Utility Network Management extension is now available. A comprehensive solution to managing utility networks, the extension allows users to create, manage, and share complete data about a network's entire infrastructural supply chain—from the source to the customer. As an extension of ArcGIS Enterprise, users can manage their infrastructure in a secure environment across the ArcGIS platform.

Esri Contributes Generously to Open Source
Esri encourages its developers to participate in the social coding platform GitHub. A recent *InfoWorld* article ranks Esri in the top 25 of contributing companies, based on the number of employees contributing code. Read the article at p.ctx.ly/r/6w37.

A Data Hub for the Sustainable Development Goals

Research Exercise Connects Data at Regional, National, and Global Levels to Get Results

The United Nations (UN) has undertaken an ambitious challenge to help countries achieve an extensive collection of social and economic development goals by 2030. Known as the Sustainable Development Goals (SDGs), these 17 lofty objectives range from eradicating poverty, ending hunger, and ensuring gender equality to building infrastructure and creating inclusive, sustainable cities while protecting land and conserving water.

The national statistics offices and mapping agencies participating in the pilot program are creating information products, including story maps like this one, to engage with constituents.

What really sets these goals apart from the UN-backed Millennium Development Goals—which drew to a close in 2015, making way for the SDGs—is that, for the first time, the United Nations Statistical Commission coordinated a globally agreed-upon framework for each country to measure its progress in an open, timely, and actionable manner. The purpose is to encourage member states to make data-driven decisions so they can foster positive change at a faster pace.

The UN recognizes the role that location plays in integrating information about society, the economy, and the environment, as well as to simply track each of the SDGs. The organization has been working for years to combine geospatial and statistical information to visualize patterns, address data gaps, and effectively target resources to areas demonstrating the most need in order to improve overall development outcomes. (See "National Statisticians Embracing Location-Based Information" in the Spring 2015 issue of *ArcNews* at arcg.is/2nB3k6p.) Now, the UN Statistics Division (UNSD) is teaming up with Esri on a research exercise to test a data hub that will help targeted member states measure, monitor, and report their progress on achieving the SDGs within a geographic context.

"One of the fundamental philosophies behind the SDGs is that development is not *[done]* by segments and areas," Stefan Schweinfest, director of UNSD, said in a UN Web TV video interview last year. "You cannot just develop the education sector without paying attention to the health sector.

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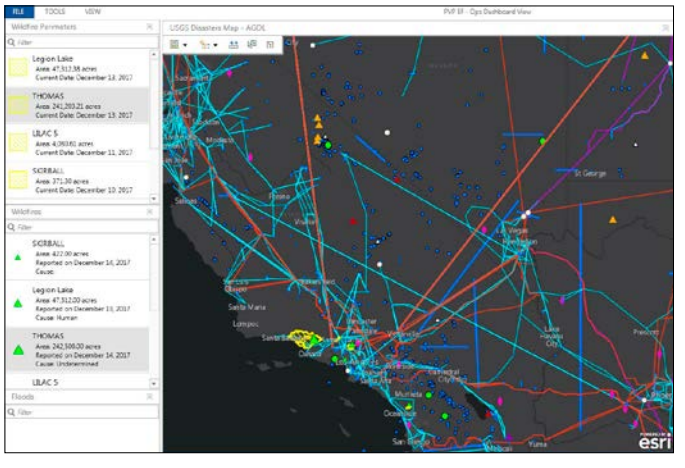
Big Data Keeps the Lights On

Monitoring and Maintaining the US Power Grid Relies on Real-Time Geovisualizations

The North American Grid is an interconnected network that generates and distributes electricity throughout the continental United States and parts of Canada and Mexico.

It evolved in stages. In the 1920s, neighboring generator operators began linking their electricity production capabilities together to share peak load coverage and provide backup power for their respective users. In 1936, the US government ratified the Rural Electrification Act, which provided federal funds to create local generating plants in rural areas that previously had no electrical power. Later, the construction of long-distance transmission lines, coupled with the use of frequency converters to link incompatible generators, allowed the creation of a unified electric system throughout the United States.

Today, the North American Grid consists of a complex network of power plants and transformers that are connected by more than 450,000 miles of high-voltage transmission lines. Although monitoring and maintaining the electrical output of different parts of the grid fall to several different entities, they must work synergistically to keep all the lights on. This requires taking real-time measurements of electricity output and usage and making split-second decisions using this big data—which is why one reliability coordinator, Peak Reliability, is beginning to depend heavily on the ArcGIS platform.



With its new visualization platform, Peak Reliability has real-time fire visualization information—including location, size, and boundary data—that is updated every five minutes.

A Balancing Act

Because electricity is not stored, it is critical to continually monitor and maintain the balance between demand and generation. The North American Grid is overseen by the North American Electric Reliability Corporation, a nonprofit international regulatory authority that is responsible for the reliability and security of North America's bulk power system.

Due to the size and complexity of the grid, it is divided into two primary sections, the Western Interconnection and the Eastern Interconnection, as well as three minor ones, the Québec, Texas, and Alaska Interconnections.

The Western Interconnection covers more than 1.8 million square miles and stretches from Western Canada south to Baja California in Mexico and eastward over the Rocky Mountains to the Great

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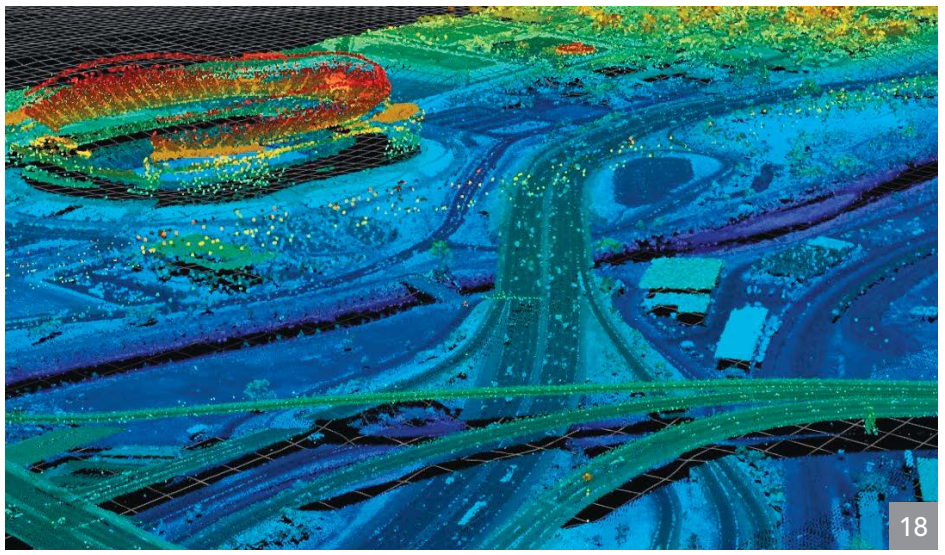
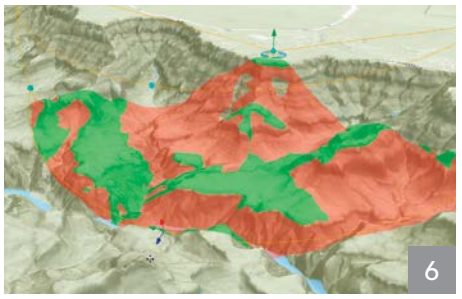


The Open Geospatial Consortium, Inc. (OGC), has defined a process and a set of policies for communities and organizations to submit their widely used, mature specifications to be approved as OGC Community Standards. Find out more about these processes and policies and get to know the three recently adopted OGC Community Standards.



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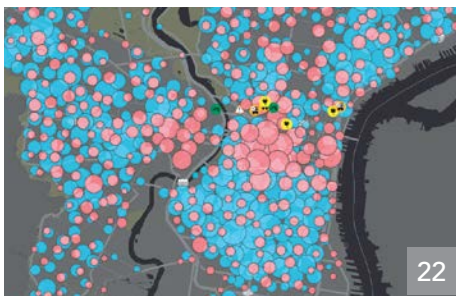

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Cook County Opens Data Hub to Citizens, Civic Activists

On most Tuesday nights in downtown Chicago, a group of "hactivists" gathers to work on making their city a better place to live. They are designers, web developers, academics, journalists, policy wonks, and concerned citizens. At one such Chi Hack Night event, Cook County GIS developer David Treering and senior GIS analyst David Arfa debuted Cook Central, an open data hub built to support Cook County—home to 5.2 million residents.

Treering and Arfa work in the GIS department of the Cook County Bureau of Technology and are part of the team behind the Cook Central hub. The creation of Cook Central was bolstered by strong support from Cook County board president Toni Preckwinkle, who wanted a way for government and citizens to share maps, apps, and data.

"Cook County is committed to transparency and accountability," Preckwinkle said. "We launched the Cook Central hub at Chi Hack Night because we want to provide the site as a foundation for local developers to build useful tools with our data."

While Cook Central serves the civic tech community, Treering said the site also meets two other important objectives: it creates easier data access for partner agencies and local governments, and it is a public landing page for all open spatial data and interactive map apps.

The Cook Central hub features 125 datasets on the environment, transportation, boundaries, land records, places of interest, and more. It provides access to high-resolution aerial imagery of the county. Available interactive mapping apps include the county's property portal, municipal boundary changes, economic and demographic data, a government facility locator, and taxing district information. Visitors can find information on public health, social services, and economic development. Developer resources link to APIs and examples of apps built using Cook County's open data.

Making the Cook Central Hub

At a recent Esri User Conference, the Cook County GIS team saw the pioneering hub work done by the City of Los Angeles and learned about ArcGIS Hub, a two-way engagement platform that connects government and citizens. This inspired the team to transition the county's existing open data site into a hub that provides access to data, apps, and maps and helps put data to work on policy initiatives that impact the public.

For Cook County, hub implementation was straightforward. Using the default styles and design from ArcGIS, the team produced a clean, modern interface. It used Esri's online ArcGIS documentation as a guide for customization. The team translated its existing process for maintaining data in ArcGIS Online into Cook Central maintenance without any extra overhead.

Cook County built individual landing pages for each open data category, such as Boundaries and Districts, Transportation, and Places of Interest. These themed pages each feature a popular dataset or highlight an app that uses data from the category, providing greater context for the datasets than simply browsing by tags.

Serving Data and Apps

Many municipal governments in Cook County do not have the capacity to collect and maintain their own GIS data. They had to request critical information—such as planimetrics, property boundaries, and current imagery—from the Cook County GIS department. Now, Cook Central provides a self-serve solution to access current and historical data. This is significantly reducing the amount of time the GIS team would otherwise have to spend on fulfilling data requests.

Most of the mapping apps currently available on Cook Central—including those for viewing highway construction projects, finding good fishing lakes, or exploring social services—were created by the county's GIS department using the open-source Configurable Map Viewer template and ArcGIS Server map services.

The apps are used by internal county offices and departments in their daily workflows, providing services and resources to Cook County residents and businesses. Citizens can also access and use the apps to be better informed about services and activities dealing with property, business, transportation, taxation, recreation, and more.

"Cook County GIS applications created for the public can be difficult to find on their own," said Arfa. "Cook Central provides not only a window to our open spatial data but *[also]* a portal to explore our many useful applications."

Hub Focuses on Health

A current effort of Cook County is to improve residents' health outcomes by providing them, as well as service agencies, with informational resources and data services. Cook Central spotlights the Cook County Medical Examiner's office, for example, to bring greater public attention to gun violence and opioid deaths since 2014. The Cook County GIS team used Web AppBuilder for ArcGIS to create point and hot spot maps that display medical examiner case records. The maps are featured on the Cook Central hub, identifying the location and number of such deaths to underscore the need for preventative public services.

"It is expected that having a place online to inform and begin conversations about important policy initiatives will increase community engagement and improve how Cook County delivers services for residents and businesses," Treering said.

Information Is Free

While Cook Central is already freeing up information for local governments and agencies, it is also expected to satisfy area journalists and researchers. Typically, when someone needs data from a county agency, such as the medical examiner's office, that person has to file a Freedom of Information Act (FOIA) request. But Cook Central gives the public access to many important datasets, which should reduce FOIA requests, save county staff time, and increase transparency.

With ArcGIS as the platform for Cook Central, there is a direct link to the county's ArcGIS Online content. Instead of having to upload static shapefiles, as was done with the original Cook County open data site, Cook Central points directly to county services based on data replicated from the county's production database. Cook Central also makes it easier for the county to share imagery services without needing to extract raster tiles and send them to people upon request.

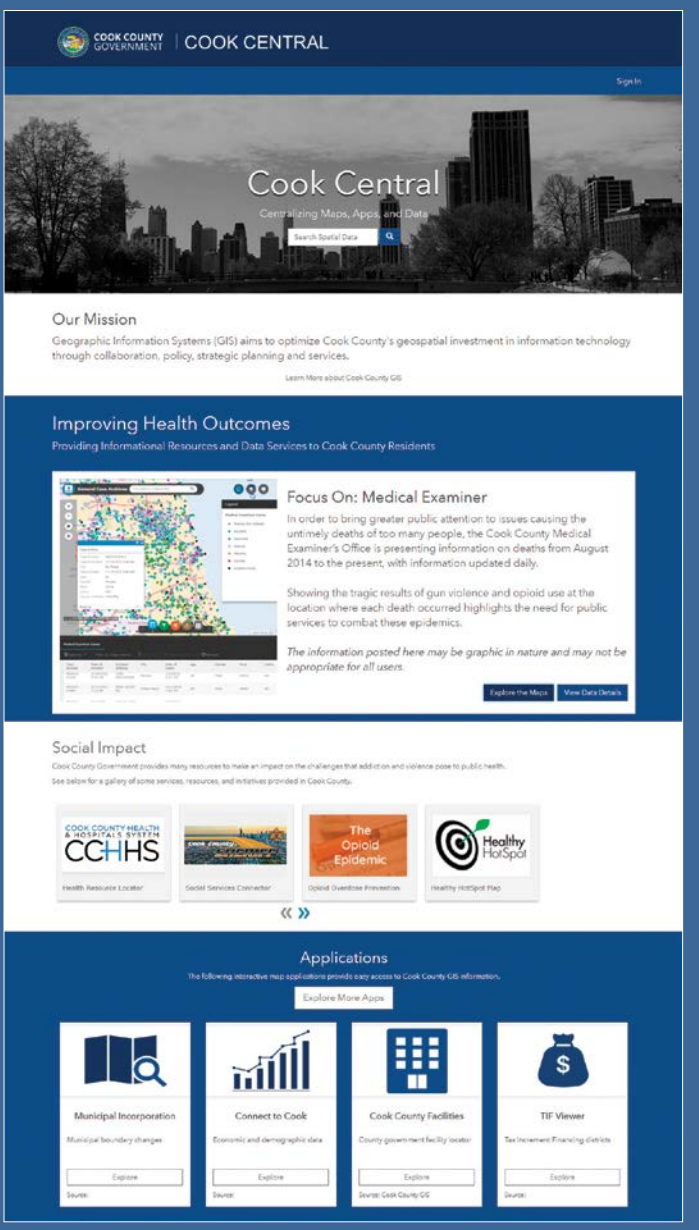
"Cook Central showcases our applications and data in a more seamless way so people can browse everything in one spot," said Arfa. "Users of Cook Central have the most up-to-date data available, immediately."

Explore Cook Central and all that the engagement platform has to offer at cookcountyil.gov/CookCentral.

← The Cook County Bureau of Technology unveiled Cook Central, its open data hub, at a Chi Hack Night event in downtown Chicago, where every Tuesday, "hactivists" gather to work on making their city a better place to live. (© Jeremy Atherton, 2006.)

About Cook County's GIS Department

Housed within the Bureau of Technology, Cook County's GIS department supports and promotes GIS initiatives throughout the county's many departments and agencies. The GIS department is responsible for developing, maintaining, and providing access to the county's authoritative spatial datasets for the 13 offices of elected officials, 135 county municipalities, and 5.2 million residents. This enterprise service department provides custom app development and mapping services to the county clerk, assessor's office, forest preserve district, public health department, homeland security and emergency management agencies, animal control, department of highways and transportation, building and zoning, and more, to improve operational efficiencies and enhance decision-making on important policy initiatives.



← Cook Central serves as a public landing page for all the county's open spatial data and interactive mapping apps and makes it easier for partner agencies and local governments to access data.

A Data Hub for the Sustainable Development Goals

continued from cover

If kids are sick, they will not go to school, even if you have the best schools in the world. We have to *[address dependencies like these]* with integrated data systems, where we can also relate the various information systems to each other."

That is exactly what the new web mapping and data management platform—called the Federated Information System for the SDGs, or SDG Hub—will do.

Organizing Data Around Initiatives

The SDGs are based on the 2030 Agenda for Sustainable Development, which addresses the significant development obstacles that come with trying to wipe out poverty, tackle injustice, and deal with planet-wide environmental damage. The ambitious and transformative agenda encourages member states to measure and monitor progress using good policy, science, technology, and data.

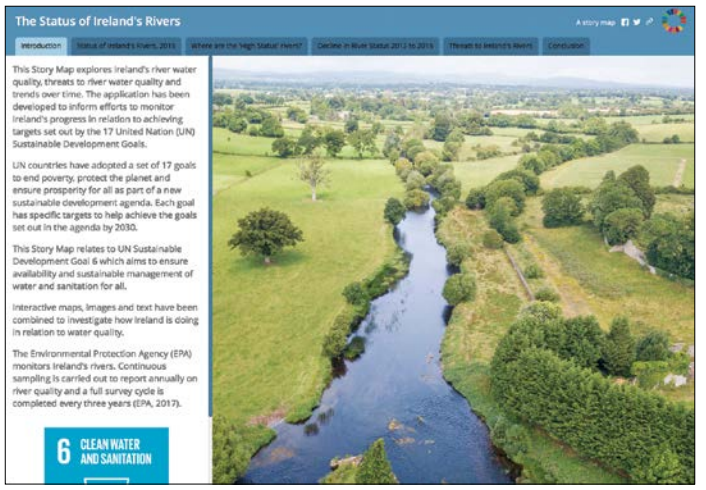
In particular, the 2030 Agenda demands that member states undertake new data acquisition and integration approaches and focus on high-quality, timely, reliable, and disaggregated data. It also calls out geospatial information and earth observations as key methods for tracking progress and informing people about this global policy mandate.

Each SDG is composed of specific, action-oriented targets. The 2030 Agenda identifies and defines a total of 169 targets. The targets, in turn, have their own indicators that demonstrate progression. Currently, these global indicators are tallied at 232. Individual countries then set their own national and regional indicators that reflect their unique challenges and priorities. Countries also develop their own initiatives to frame their actions and track the efficacy of their approaches.

Organizing data and tools around initiatives makes it easier for national statistics offices (NSOs) to align SDG-related data—such as the proportion of the population living in consistent poverty—with relevant goals when publishing data resources. Thus, NSOs can provide context for their open data, giving anyone who uses these resources the knowledge and awareness they need to apply them in ways that address real problems. For example, a government agency or nonprofit organization can further explore a problem like poverty by looking at a country's unemployment rate and occupational skills to determine if there is untapped capacity in one region to match available jobs in another. Likewise, an agency or organization can explore data about the overall health of local waterways alongside the location of industrial areas or other known water polluters to pinpoint sources of water contamination.

Location as a Framework

What makes data exploration like this feasible is having all the information in one place, which is what Esri and UNSD are doing in their joint research exercise. For the project, several member states are leveraging their existing data systems and deploying an ArcGIS Hub in conjunction with ArcGIS Enterprise to help their NSOs integrate SDG-related data into their own work. The exercise also seeks to have NSOs align their data and systems with other in-country SDG stakeholders, including national mapping agencies, health ministries, natural resource and environmental agencies, and private-sector statistical data producers.



The United Nations Statistics Division (UNSD) is working with a pilot group, which includes Ireland, to define the requirements for a Federated Information System for the SDGs.

The flexible deployment options of ArcGIS Hub and ArcGIS Enterprise—with ready-to-use apps, maps, and data—expedite how quickly NSOs can contextualize their data with location. Using location information as the overarching framework, NSOs can visualize and analyze data at the national and global levels in a consistent manner—even when there are differences in format, scale, or metadata among datasets.

Furthermore, rooting datasets in a location platform allows member states' various departments and agencies working on the SDGs to

- Integrate data from different systems using the common denominator of location.
- Share data-driven maps, apps, templates, and analytical tools.
- Apply maps and spatial reasoning to explore data in intuitive ways so they can gain a deeper understanding of the complexities and dependencies inherent in the SDGs.
- Parse problems at different scales to test and discover which actions have the greatest impact.

ArcGIS Hub and ArcGIS Enterprise facilitate the free flow of disaggregated data, integrate data in a consistent manner, provide spatial context for the data to promote understanding and engagement, protect sensitive data through security and privacy controls, and deliver information products and tools that help people apply the data to policy priorities. Most importantly, ArcGIS links data together at the global, national, and subnational levels and has the capacity to unite efforts among multiple countries. Additionally, by enabling interaction and collaboration among multiple self-contained Web GIS deployments, ArcGIS Hub and ArcGIS Enterprise scale Web GIS to achieve a system of systems, where data is offered as a service rather than a finished product.

Pilot Project Makes Strides

Starting in May 2017, UNSD launched this research exercise with a pilot group of NSOs and mapping agencies from Brazil, Colombia, Ireland, Kenya, Mexico, Morocco, Palestine, the Philippines, South Africa, Senegal, Tanzania, and the United Kingdom. They helped define the requirements for the SDG Hub.

Now, each of these offices is applying a services-oriented architecture, known as a system of systems approach, to data sharing. It allows users to engage with data as a service, changing the traditional approach to statistical data production and dissemination. In the past, NSOs tended to aggregate data and records, putting them through a series of transformations and validations before making them available to end users. The SDG Hub removes this time-consuming step of aggregating data, allowing NSOs to instead connect to data from each data producer. This makes the data itself the primary source of information (rather than an aggregation of it) and speeds up its integration using the common denominator of location.

The NSOs and mapping agencies participating in the pilot program are deploying their individual SDG Hubs in three phases. In the first phase, the focus is to align national priorities with the SDGs and identify specific steps to take to achieve the goals. In the second phase, the emphasis is on capacity building, wherein each office takes full advantage of enterprise GIS and leverages the data sharing and spatial analysis capabilities of the SDG Hub. In the third phase, the pilot group expands on the outcomes of previous phases and concentrates on designing and creating information products—including story maps and other apps—to encourage constituent engagement and communicate progress in achieving the SDGs.

Several members of the pilot group already have their SDG Hubs up and running and are currently working on building capabilities and tools to engage stakeholders from the public and private sectors, both domestically and internationally.

"Palestine is fortunate to be part of the SDG Hub experience, since we have just finalized our third Population, Housing and Establishments Census using GIS for the first time in data collection," said Ola Awad-Shakhshir, president of the Palestinian Central Bureau of Statistics and council member of the International Statistical Institute. "The hub will enable Palestine to tell geographically linked stories *[and]* allow researchers to measure the change in trends and perform deep data analysis to assist national evidence-based policy development."

Stefan Schweinfest, director of UNSD, discussed the Federated Information System for the SDGs, also known as the SDG Hub, at the Geospatial World Forum.

Location plays a huge role in integrating information about society, the economy, and the environment, and it is key to tracking progress in attaining each of the SDGs.

> "One of the fundamental philosophies behind the SDGs is that development is not *[done]* by segments and areas. You cannot just develop the education sector without paying attention to the health sector."
>
> **Stefan Schweinfest**
> Director of UNSD

Helping People with Visual Impairments Get Around Graz, Austria

With a New GIS-Based Web App, Persons Who Are Partially Sighted or Blind Can More Easily Preplan City Trips

Graz, in southeastern Austria, is the country's second-largest city, playing host to 300,000 residents, 40,000 students, and an increasing number of local and international tourists. It has been designated a UNESCO City of Design, and its historic city center, which contains architectural wonders that span epochs, is a UNESCO World Heritage Site. The streets and sidewalks are always bustling with sightseers, commuters, restaurant-goers, shoppers, and leisure seekers.

With lots of foot, bike, and motor vehicle traffic, Graz needed to ensure that pedestrians with visual impairments could navigate the city with ease. So a group in the Department of Geography and Regional Science at the University of Graz—which, in addition to being an educational institution, researches and advocates for urban sustainability—set out to design an app that could help with this. It ended up with ways2see, a pretrip planning GIS web app with an app-to-screen reader for the visually impaired—all built with Web AppBuilder for ArcGIS.

Getting Started and Collecting Data

Although Graz is a modern city and is even seen by some as an up-and-coming tech and startup hub, the city had not really laid the groundwork to build such an app. For example, there was no geospatial dataset for the sidewalks that accompany Graz's 1,100 miles of streets. As a result, the team had to collect a considerable amount of data before it could even start developing a solution.

To kick off the project, the team at the University of Graz—four graduate students led by associate professor Dr. Susanne Zimmermann-Janschitz and supported by research associate Sebastian Drexel—partnered with Esri's official distributor in Austria, SynerGIS Informationssysteme GmbH. It secured funding from the Austrian Research Promotion Agency (FFG) and recruited the Odilien Institute Graz, which trains and cares for people with visual impairments or blindness, to carry out end-user needs assessments on the app.

With all the logistics worked out, the team from the Department of Geography and Regional Science first conducted interviews, workshops, and surveys with partially sighted or blind people in Graz and around Austria, as well as mobility trainers. Based on the results, the team determined that the sidewalks dataset would need to identify navigational aids that those with visual impairments typically use as guides, such as walls or fences. It would also have to include lampposts, mailboxes, and the like, which can serve as both landmarks for and impairments to navigation. Additionally, the app would need to let users know where crosswalks are located and notify them of challenges along the route, such as intersections, narrow passageways, and bicycle traffic.

After determining the specific needs of users with visual impairments or blindness, the university project team began to catalog the required geospatial data. The team generated sidewalks using open government data from sources including post offices, the chamber of commerce, the local medical association, the City of Graz, and OpenStreetMap. Team members then enhanced what the government had by including additional sidewalk information—such as availability and surface conditions—they collected and mapped out in the field using Collector for ArcGIS.

Building the App

Once all the sidewalk data was recorded and uploaded to ArcGIS Desktop and ArcGIS Server, the team evaluated which technology it would use to build the app. Because developing ways2see was already going to involve a great deal of customization to make it work with keyboard-only navigation and screen readers (which convey via speech what's displayed on a screen), nobody wanted to have to build the app from scratch. So the team selected Web AppBuilder for ArcGIS as its development tool.

Web AppBuilder for ArcGIS comes with workflows and widgets that can be customized and extended as needed. It also offers built-in support for developing for multiple operating systems and devices. All this would make it easier to optimize the ways2see user experience so it could accommodate a wide range of users—from people who prefer to find their way using acoustics or tactile guides to those who try to bypass intersections whenever possible.

With the details included in its sidewalk dataset—such as where there are fences, mailboxes, and crosswalks—the app can take different user types into consideration. For example, some people who are partially sighted or blind prefer to find their way using acoustics or tactile guides, and some try to bypass intersections whenever possible.

"The overall idea behind ways2see is to create a GIS for all people, whether or not they *[have]* disabilities," said Zimmermann-Janschitz.

And that is what the entire team did, engaging in an intensive back-and-forth process of development and testing. Zimmermann-Janschitz, Drexel, and the graduate students made it so that ArcGIS Network Analyst could read features, other than street names, that are located along lines, such as where the curb is or if there is a hedge or a house. SynerGIS generated a framework, as well as widgets, that could be navigated via keyboard and are accessible to screen readers. And members of the Odilien Institute, along with several mobility and orientation trainers, have comprehensively tested the app to improve the product step-by-step.

Success with Users

The ways2see app is available at https://barrierefrei.uni-graz.at/ways2see, and users are starting to employ it to preplan trips around Graz. Early feedback has generally been very positive and is helping the development team identify missing functionalities, fix problems, and improve the app for different operating systems.

Using the ArcGIS platform—and, specifically, Web AppBuilder for ArcGIS—it took the University of Graz team, along with its partners, three years to collect and record all the sidewalk data it needed and develop a workable app that can help people with visual impairments or blindness navigate a busy city. It is a framework that can be easily adopted by other cities using their own local datasets.

"If you want to do something for people with disabilities, success is defined…not in terms of money or business, but by helping *[people]* gain more independence and individuality through inclusion," said Zimmermann-Janschitz.

With a functioning version of ways2see and plenty of positive feedback on how it works, it appears that this team is driving toward just that kind of success.

Graz, Austria

A Big Release with Far-Reaching Effects

The January 2018 ArcGIS release was substantial. Esri software came away with a great deal of fresh functionality, and several apps are now more agile and user-friendly. Here is a closer look at what's been improved.

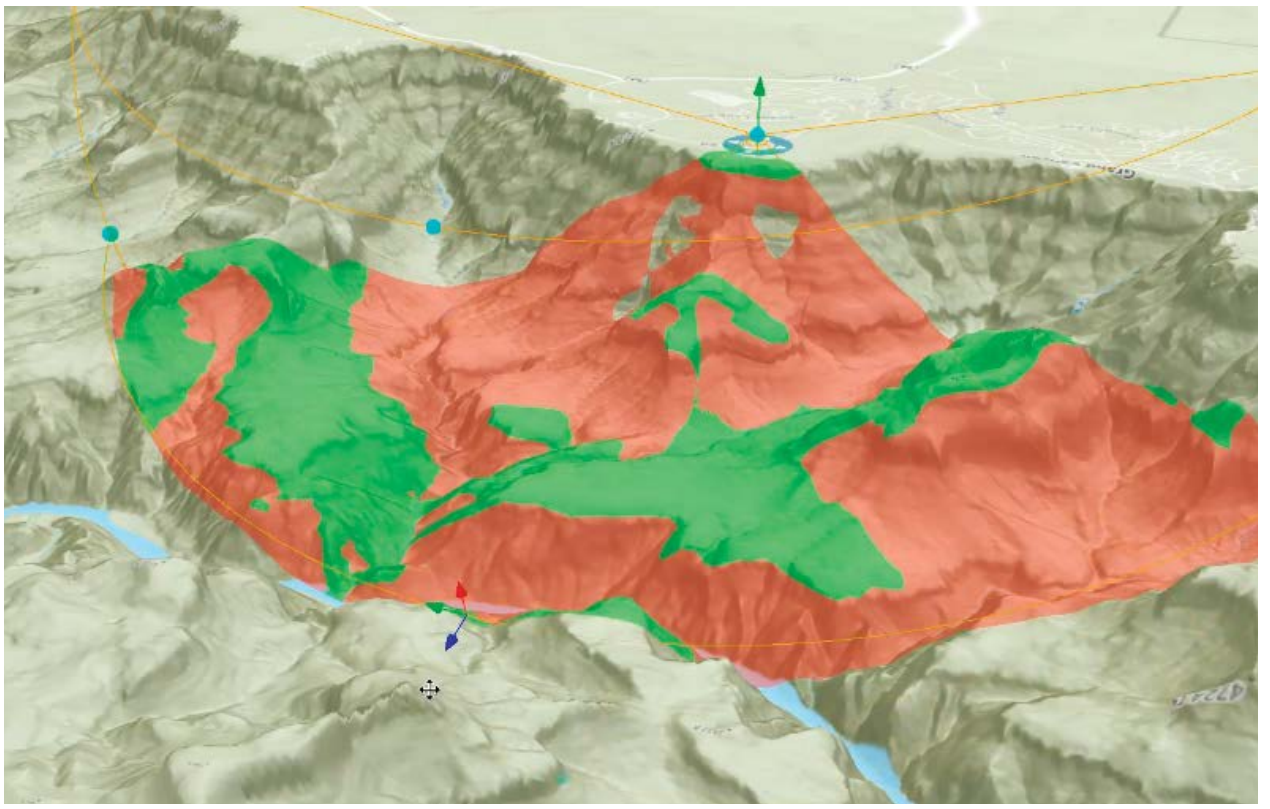
ArcGIS Pro

ArcGIS Pro 2.1

The January 2018 release of ArcGIS Pro, Esri's flagship 64-bit desktop GIS app, includes user-requested functionality, the latest innovations in working with 2D and 3D data, advanced analytics, and enhanced support across the ArcGIS platform.

ArcGIS Pro 2.1 empowers users to do more with tables, 3D, modeling, analytics, and imagery. Users can now add interactive tables to layouts, including Microsoft Excel spreadsheets and attribute tables from map layers. This release also supports enhanced 3D work with the new 3D editing grid that allows users to precisely snap to, edit, and work with data. Additionally, branches can be added to ModelBuilder using a set of nine logical tools that support the creation of If-Then-Else branching logic in models.

ArcGIS Pro has two new extensions as well. The addition of ArcGIS Business Analyst for ArcGIS Pro brings the first wave of licensed Business Analyst tools to the desktop GIS app, providing users with easy access to marketing analytics, including customer and competitor analyses and site evaluation. And the ArcGIS Image Analyst extension allows users to visualize and analyze imagery—including stereo mapping and advanced image segmentation—in ArcGIS Pro.



It's now possible to do quick interactive 3D analysis in ArcGIS Pro with new 3D exploratory analysis tools, such as this Viewshed tool.

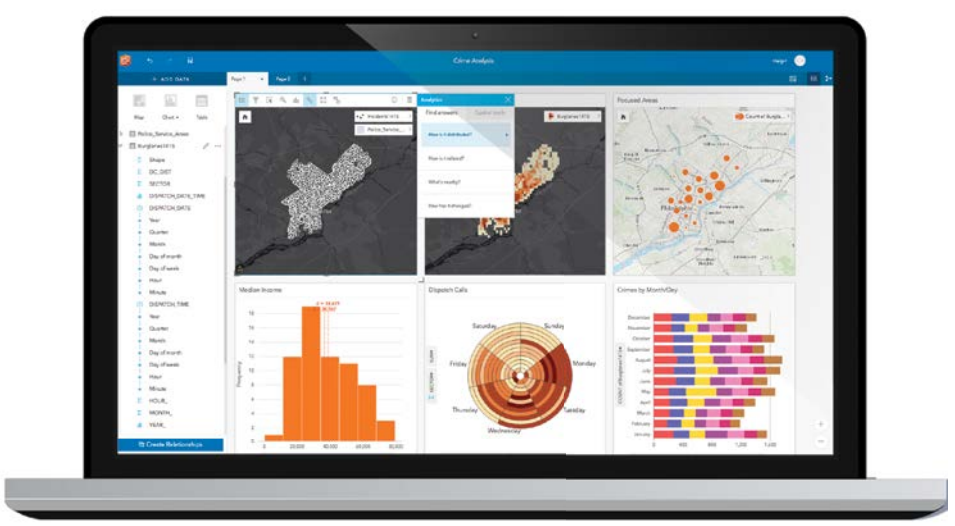
ArcGIS Online

Insights for ArcGIS

Insights for ArcGIS, the web-based data analytics workbench that allows users to analyze spatial and nonspatial data with simple drag-and-drop functionality, is now available in ArcGIS Online. Users can enjoy the same capabilities that Insights for ArcGIS offers in ArcGIS Enterprise: interactive analysis, the automatic creation of analysis models, and guided spatial workflows. The only difference is, ArcGIS Online does not connect directly to enterprise databases.

With Insights for ArcGIS, users can interact with data in new ways using cards, which provide live snapshots of analysis. For example, a user can make a data selection on one card and see that selection automatically filter the other linked cards. This allows users to slice and dice their data and quickly reveal relationships. Insights for ArcGIS has more than 17 data visualization types as well that can be applied to data. Users can visualize large datasets via binned maps, a map type that makes it easier to display and view large or clustered datasets. For charting many variables, Insights for ArcGIS supports bar and column charts created with two string fields that can be visualized as stacked charts.

New users can get a free trial to ArcGIS Online and Insights for ArcGIS at arcg.is/2qYbj2G. ArcGIS Online users can sign up for a free trial of Insights for ArcGIS in the ArcGIS Marketplace.



Insights for ArcGIS, which allows users to explore both spatial and nonspatial data, is available through ArcGIS Online.

Operations Dashboard for ArcGIS

Operations Dashboard for ArcGIS is now a configurable web app included with ArcGIS subscriptions. Delivering clear, concise, and intuitive views of meaningful data, it is available for both ArcGIS Online and ArcGIS Enterprise via the app launcher.

With Operations Dashboard, members of an organization can create, browse, and manage dashboards within their content or from the dashboard home page. They can also share dashboards with other members of the organization and the public.

Dashboards inform by consolidating and arranging information in a single screen—using charts, gauges, indicators, maps, and other graphic elements—so it can be visualized at a glance. Organizations often employ dashboards to make decisions in real time, using them to monitor events, assets, services, people, and more. Dashboards can also be interactive, wherein visual elements are configured to communicate with one another, providing viewers with more context and better understanding.

Operations dashboard features smart mapping, including heat map renderers, vector basemaps, stream layers, labels, and custom pop-ups. Arcade expressions can be used to enhance map labels and symbology. The app offers attractive and intuitive defaults and is highly configurable, enabling users to create compelling information products.

For those using the desktop-based Operations Dashboard, operation views are still supported but won't be updated. Esri encourages users to move to the new browser-based version.

Operations Dashboard for ArcGIS is now a configurable web app included with ArcGIS Online.

ArcGIS Enterprise

ArcGIS Enterprise 10.6

Each release of ArcGIS Enterprise expands on the software's key areas—mapping, analytics, data management, and Web GIS. Highlights from the ArcGIS Enterprise 10.6 release include updates to analytics, mapping, collaboration, the cloud, and licensing.

For custom analytics in ArcGIS Enterprise 10.6, users throughout the entire organization can now easily access custom web tools for modeling, aggregation, and routing. Point clustering makes decluttering web maps simple with an out-of-the-box renderer that shows general trends plus exact data points. For distributed collaboration, this release enables users to securely share content to other Web GIS portals—between two or more ArcGIS Enterprise portals and even to ArcGIS Online. Also, users can now generate and serve map and image service caches from cloud stores such as Amazon S3 and Microsoft Azure Storage.

In terms of licensing, all ArcGIS Enterprise Standard and Advanced customers are now eligible to add viewers (Level 1 named users) at no additional cost. Administrators can provide viewer-level access to everyone in the organization who needs to see secured layers, maps, apps, and services within ArcGIS Enterprise. To maintain the performance of an ArcGIS Enterprise deployment, users may need to add ArcGIS Server capacity (cores) to the deployment if a large number of viewers are added.

ArcGIS GeoEvent Server

ArcGIS GeoEvent Server is a server licensing role of ArcGIS Enterprise that enables the real-time GIS capabilities of enterprise GIS. The 10.6 release of ArcGIS GeoEvent Server provides new functionality, enhancements, and bug fixes in several key areas.

Some of the new features include support for multiple-machine sites and the ability to start and stop all inputs, outputs, and GeoEvent Services. This release also includes enhanced on-the-fly aggregation to support polygon, polyline, and multipoint features in the spatiotemporal big data store. Data retention purge rules have been improved as well, giving users the ability to specify WHERE clauses in the spatiotemporal big data store.

This release of ArcGIS GeoEvent Server has also added developer support for on-the-fly space-time volume aggregation in the spatiotemporal big data store. Plus, new documentation on string functions is available in the Field Calculator Processor, GeoEvent Server REST API, and GeoEvent Server SDK, as well as for monitoring log files and system requirements.

ArcGIS Monitor

Introducing ArcGIS Monitor—a tool uniquely tailored to monitor the health of an ArcGIS Enterprise implementation throughout its life cycle. It provides awareness of system usage and performance, helping users get the most from their GIS and IT investments.

ArcGIS Monitor helps users reduce costs with more effective system operation. It allows an organization to oversee databases, networks, and GIS software with alerts and notifications to detect and resolve problems or potential problems. Additionally, ArcGIS Monitor users can deliver system updates to staff and management by using reports and metrics.

A New Platform, an Updated App

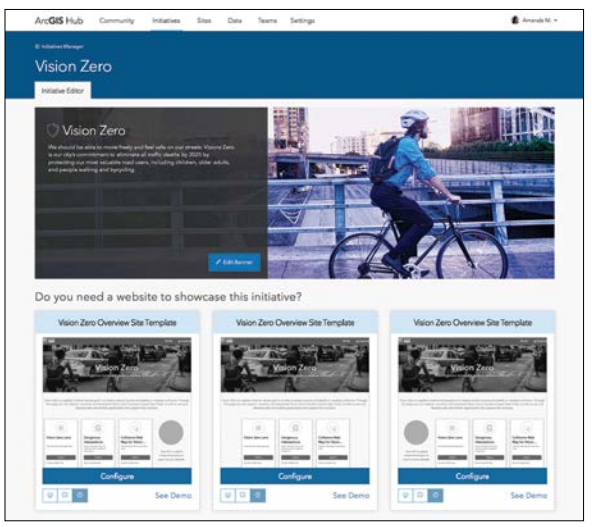
ArcGIS Hub

ArcGIS Hub is now available to everyone, not just early adopters. A new two-way engagement platform, ArcGIS Hub enables government agencies to leverage existing and open data by linking it directly to community priorities. It employs innovative communication tools to foster collaboration, empowering governments to connect both internal departments and external stakeholders with issues and initiatives.

ArcGIS Hub comes with the tools communities need to track the progress and outcomes of their initiatives. It engages developers and citizens, giving them the ability to apply data to the task of making communities more efficient, livable, smart, and sustainable.

Drone2Map for ArcGIS

The latest release of Drone2Map for ArcGIS, which comprises new functionality, enhancements, and bug fixes, was significantly influenced by feedback from users. Some of the most requested features include licensing support for Integrated Windows Authentication (IWA) and Security Assertion Markup Language (SAML) secured portals, improved performance for creating projects and adding source imagery, and the ability to log out and exit the app on shared workstations. Users can also enjoy an even better experience working with images created by Drone2Map for ArcGIS, such as 3D point clouds that make it easy to analyze built-up and natural features.



ArcGIS Hub, a new two-way engagement platform for government agencies and citizens, is available for general use.

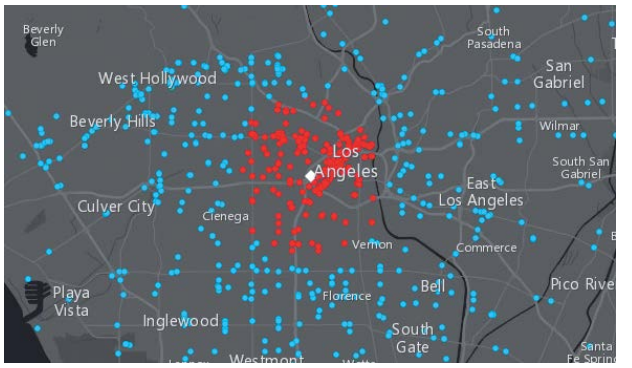
Users now get an even better experience working with images created by Drone2Map for ArcGIS, such as 3D point clouds.

APIs and SDKs

ArcGIS API for JavaScript

ArcGIS API for JavaScript is designed to maximize productivity when building beautiful, engaging web mapping apps. The API combines modern web technology with powerful geospatial capabilities to enable users to create high-performing apps and smarter data visualizations. The latest API versions (4.6 and 3.23) include new features, such as a new directions widget, a 3D measurement widget, and a layer refresh interval.

The 4.x series of ArcGIS API for JavaScript is Esri's next generation JavaScript API that integrates 2D and 3D into a single, easy-to-use, powerful API. Version 4.6 lets users build full-featured 3D apps powered by web scenes that can include rich information layers such as terrain, basemaps, imagery, features, integrated mesh layers, and 3D objects.



ArcGIS API for JavaScript combines modern web technology with powerful geospatial capabilities so users can create high-performing apps and smart data visualizations, such as this one that shows where city buses enter the downtown Los Angeles area.

ArcGIS API for Python

ArcGIS API for Python is a powerful Python library for working with maps and geospatial data. It provides simple and efficient tools for sophisticated vector and raster analysis, geocoding, mapmaking, routing, and directions, as well as for organizing and managing a GIS with users, groups, and information items.

In addition to working with user data, the library has access to ready-to-use maps and curated geographic data from Esri and other authoritative sources. It also integrates well with the scientific Python ecosystem and includes rich support for Pandas and Jupyter Notebook.

ArcGIS API for Python in Jupyter Notebooks is great for conducting exploratory data analysis. Users can quickly visualize spatial patterns with smart mapping, as well as the attribute data in tabular form. The latest 1.3 release packs some serious enhancements for GIS administration, content management, and performing spatial analysis.

ArcGIS Runtime SDKs

ArcGIS Runtime SDKs for Android, .NET, iOS, macOS, Java, and Qt help users build and deploy native apps for a variety of popular platforms and devices. Users can add powerful spatial capabilities to native apps and empower app users to do all things GIS—even when offline.

The 100.2 release, also known as ArcGIS Runtime Update 2, is the second major update to 100.0.0. It brings Esri closer to functional equivalency with 10.2.x versions of Runtime. And 100.2 bridges most of the functional gaps between ArcGIS Engine and Runtime, allowing users to plan their migration to the ArcGIS Runtime platform.

With this release, users experience new layers and data sources, additional analysis tools, 2D and 3D rendering improvements, better handling of standard and custom geographic transformations, workflow productivity enhancements, bug fixes, and more.

For a complete guide to the January 2018 ArcGIS release, visit **arcg.is/2roUcXK**.

Get More Acquainted with New User-Focused Features in ArcGIS Online

Esri continually updates ArcGIS Online to make it simpler and more impactful to use. With so many releases coming out in a given year, though, it can be difficult to keep up with all the improvements.

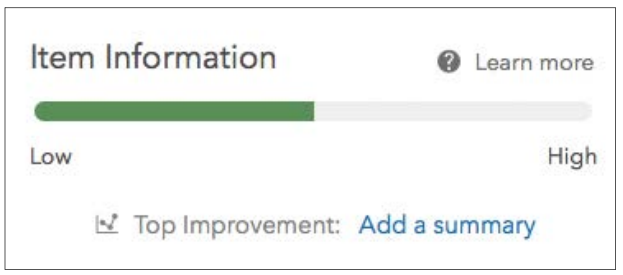
To help users gain more familiarity with some of the recent updates to ArcGIS Online, here is an in-depth look at a few new features that help users' content shine, make working in 3D faster, provide quick access to apps, and expand the ways in which files can be added.

Create, Designate, and Find Quality Content

Content consumers often judge the quality of an item by the information on its item page. That is why it's important to provide thorough item information.

To help with this, ArcGIS Online now includes an item information status bar that tells item owners and administrators how to improve their item information to ensure that others can find, understand, and use their items. For example, the item information status bar might suggest writing a longer summary or description, adding tags, or including terms of use. As the item owner adds information, the status bar moves from Low to High. Content with quality item information appears in search results when users search for terms that are listed in the item's title, summary, description, and tags.

ArcGIS Online also has two new content status settings—Authoritative and Deprecated—to help users discover quality content. When an item is marked as authoritative, ArcGIS Online recommends its use. When an item is marked as deprecated, it means that it isn't as reliable or is out of date. Items assigned one of these indicators contain a corresponding badge on their item pages to make them clearly distinguishable. So when users search within the organization with filters, look at organization content on the content page, or add layers from the organization in Map Viewer, they can easily see authoritative content. Anything marked as deprecated is demoted in search results.



The item information status bar tells item owners and administrators what they need to do to ensure that others can easily find, understand, and use their items.

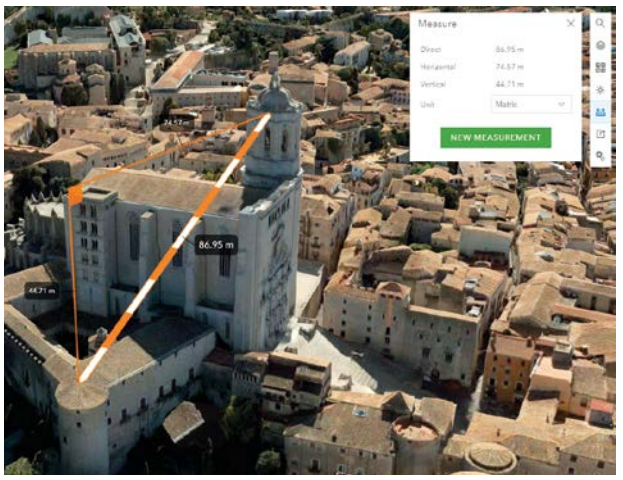
Two new content status settings, Authoritative and Deprecated, help ArcGIS Online users discover quality content.

An Even More Dynamic Scene Viewer

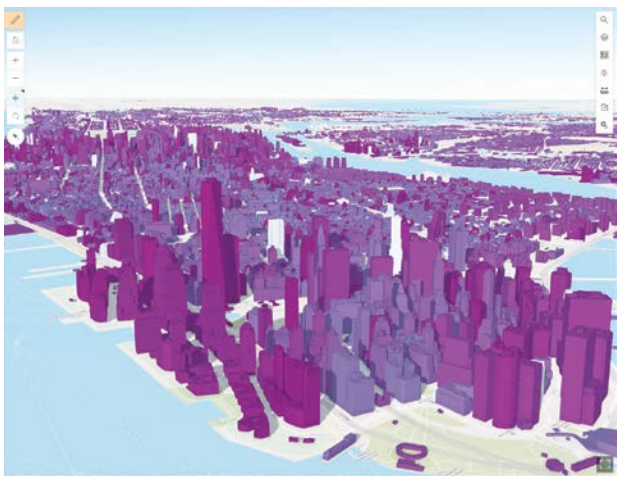
A new measurement tool in Scene Viewer allows users to dynamically calculate distances in 3D—all while gliding right over features, terrain, buildings, or point clouds. Clicking and moving the pointer diagonally measures both horizontal and vertical distances in one action. Users can employ a variety of units and leverage laser lines to guide their measurements.

Scene layers have undergone two significant improvements. First, 3D objects and integrated mesh scene layers load up to 50 percent faster. Second, scene layers now display front-to-back when loading, so users can see what's most important to them from the outset without having to wait for other pieces of the scene to randomly load.

Additionally, users can now place their own 3D models, such as fire hydrants or airplanes, into their scenes. Once these 3D symbols are added, they are available in the Scene Viewer point symbol gallery, alongside Esri's default 3D symbols. Users can also share custom 3D symbols created in ArcGIS Pro 2.1 to their ArcGIS Online organizations (and ArcGIS Enterprise 10.6).



The new measurement tool in Scene Viewer allows users to dynamically calculate distances in 3D while gliding over features, terrain, buildings, or point clouds.



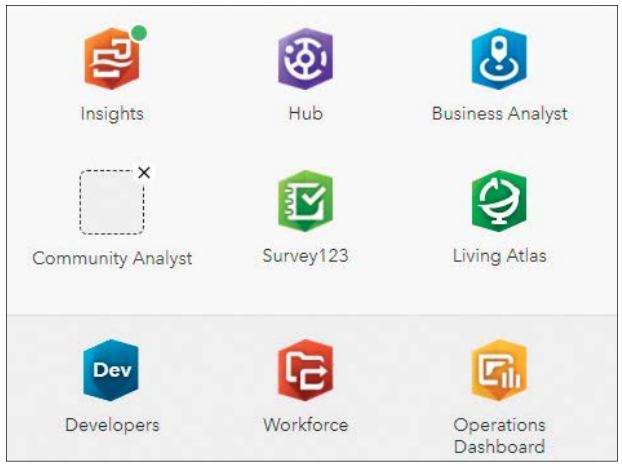
Scene layers now load front-to-back so users can see the most important parts of the scene from the outset.

The App Launcher Can Be Customized!

The app launcher is a convenient way for users to open the apps available to them in ArcGIS Online—and now it can be personalized. Drag-and-drop functionality allows users to change the order of apps to display frequently used ones up top and hide others at the bottom.

There are new status indicators for apps within the app launcher as well. Apps that are newly available to a user are marked with a green dot, and apps that are no longer available are displayed as an empty gray box. The status indicators disappear once users interact with the new apps, and users just delete the gray boxes to make room for usable apps.

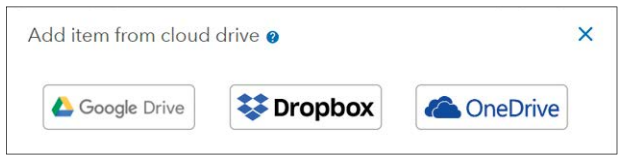
Administrators can place their organizations' frequently used apps into the app launcher via the Organization page. Not only does this add the apps to every organization member's app launcher, but it also approves them for use in ArcGIS Online on behalf of all members so they don't have to do that every time they launch the apps using Single Sign-On.



Users can customize the app launcher through drag-and-drop functionality.

Add and Update Content from the Cloud

Users can now add and publish CSV, Microsoft Excel, and Google Sheets files from cloud drives as ArcGIS Online layers. The workflow is the same as when adding and publishing files from the computer. In My Content, users click Add Item and select From cloud drive, which brings up a window with the option to get a file from Google Drive, Dropbox, or Microsoft OneDrive. After signing in to one of these accounts, users select a file and then fill out the new item's title, summary, description, location information, and tags in ArcGIS Online. Thus, a new layer is born, yet the source file used to create it remains in the cloud drive.



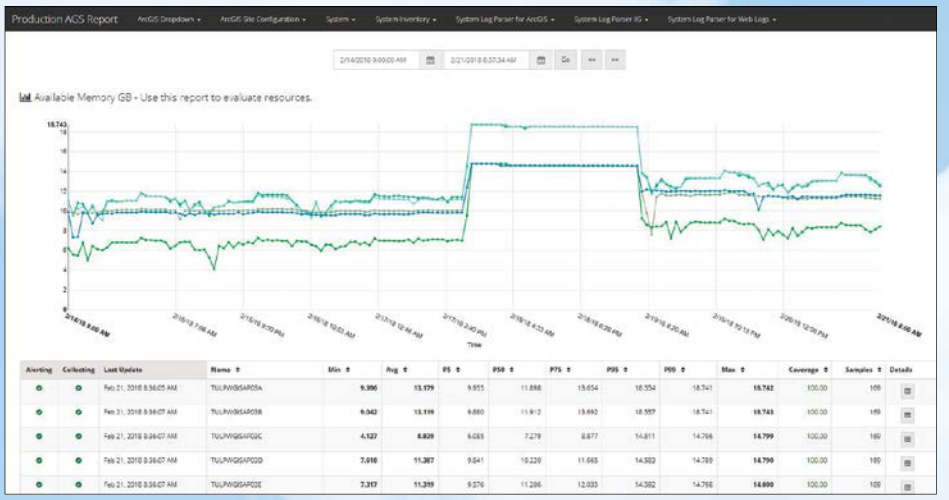
Users can add and publish CSV, Microsoft Excel, and Google Sheets files from Google Drive, Dropbox, and Microsoft OneDrive.

Want Even More Information?

Esri regularly publishes detailed blogs with additional information about all the new features in ArcGIS Online. Visit **go.esri.com/arcnewsblogs** for more.

Monitoring and Managing GIS Resources, Proactively

With Offices Spread Across the United States, Williams Uses ArcGIS Monitor to Keep Tabs on Its ArcGIS Implementations



With ArcGIS Monitor, Williams can monitor the memory it has available. That way, the company only has to purchase extra memory if there is a demonstrated need for it.

Williams, an energy infrastructure company, owns and operates the midstream gathering and processing assets, as well as the interstate natural gas pipelines, that connect many of North America's hydrocarbon resources to markets that use natural gas and liquefied natural gas. The company, headquartered in Tulsa, Oklahoma, has major offices throughout the United States—from Utah and Texas to Pennsylvania. To manage such a vast network of infrastructure from distant locations, Williams relies heavily on GIS.

The GIS environment at Williams includes an average of 120 ArcGIS Desktop users on Citrix. It also supports 63 development, quality assurance (QA), and production servers. The company's clustered ArcGIS Server environment hosts more than 300 services and 164 maps. And a federated ArcGIS portal runs 238 services, 199 maps, and 30 feature services—and accommodates 1,800 users.

With so many employees depending on GIS maps and services, troubleshooting implementation issues has always been difficult.

"Anytime a web map or map service wasn't working correctly, we would have to research what's causing the issue," said Steve McCarthy, a systems architect at Williams. "We'd start by looking at the web app *[and]* then *[might have]* had to dig into the code to figure out what's not working right. This could take several hours or days."

Determining the causes of problems like these—whether they were broken links, bad indexes, or underpowered services—took McCarthy and his team away from more proactive projects, such as creating new apps and fine-tuning the ones they already had. They needed to be able to easily monitor resource utilization and status, service usage, and performance in their GIS environment so they could identify potential problems ahead of time. That is why Williams implemented ArcGIS Monitor, a tool uniquely tailored to monitor the health of ArcGIS implementations.

ArcGIS Monitor remotely monitors enterprise GIS and IT infrastructure, providing GIS managers and teams with insightful information about system usage and performance. It swiftly detects existing and potential problems in databases, networks, and GIS services, allowing GIS teams to rapidly resolve any infrastructural and operational issues that appear or are on the horizon. ArcGIS Monitor also enables staff to view actionable reports and quantifiable metrics to improve communication among GIS and IT staff, business owners, and senior management.

"ArcGIS Monitor gives us reports that are very helpful," said McCarthy. "It lets us see where there is heavy traffic. The Excel reports show me where I might have issues such as a broken link…by *[the]* hour or over a period of time."

Since implementing ArcGIS Monitor, Williams has reduced the amount of time its staff spends on troubleshooting and making repairs to its enterprise systems.

"In the past, it took between 4 and 40 hours to troubleshoot issues that we can troubleshoot in under an hour now," said McCarthy.

The company has also saved money on resource purchases—of extra servers, storage, memory, or CPUs, for example—since it now only has to acquire them if there is a demonstrated need. According to McCarthy, this has amounted to a $50,000–$100,000 savings per year in purchases of new hardware resources. Having concrete evidence of need also helps team members justify why they require more resources when they request them.

McCarthy can fine-tune the ArcGIS Server environment at Williams to cater to high-demand map and geoprocessing services. He uses feedback from ArcGIS Monitor to increase or decrease resources, such as the number of instances he has running, based on whether activity is heavy or light. He also receives alerts from ArcGIS Monitor when the server hits 75 percent capacity so he can proactively adjust resources or services to prevent problems. (Users can set alerts to any desired size or percentage of capacity for system metrics.) ArcGIS Monitor also delivers hourly reports on all systems, which the team at Williams often publishes and makes available to developers and users who need status, usage, or performance metrics.

"We've gone from responding to issues to proactive, high-performance tuning," said McCarthy. "Now, we don't go buy extra resources unless we can justify it. In the past, we would only be able to assume we *[needed]* more memory or more servers. ArcGIS Monitor helps build confidence in our GIS because we have very little downtime."

For more information on how Williams uses ArcGIS Monitor, contact McCarthy at steven.mccarthy@williams.com or 918-573-6384.

"In the past, it took between 4 and 40 hours to troubleshoot issues that we can troubleshoot in under an hour now."

Steve McCarthy, Systems Architect at Williams

Visualizing Park Access Around the United States

By Emmalee Dolfi and Gabriel Patterson-King, The Trust for Public Land

ParkServe is a new interactive platform from The Trust for Public Land (TPL) that park planners, city officials, and park advocates can use to map and analyze parks nationwide. When all the data is available via the platform later this spring, ParkServe will include green space information from nearly 14,000 cities and towns in the United States, covering where more than 80 percent of the country's population lives. The web-based platform, which currently contains approximately 130,000 local and urban parks, enables users to locate the nearest park, determine the percentage of residents in a city or town that live within a 10-minute walk of a park, and identify neighborhoods that are most in need of new parks.

Built on the ArcGIS platform, ParkServe expands on the success of TPL's widely acclaimed ParkScore Index, which ranks park systems in the United States' 100 largest cities. Like ParkScore, ParkServe is a free, publicly accessible, web-based system that includes data and analytics on park systems across the nation. Users can access an extraordinary amount of parks data that was previously available only to well-funded municipal parks researchers.

To develop ParkServe, TPL's GIS team had to collect and verify park data, build the 10-minute-walk park accessibility tool, and model the TPL's plans for sharing the data. Here's how the small team did that, with ArcGIS underpinning the entire process.

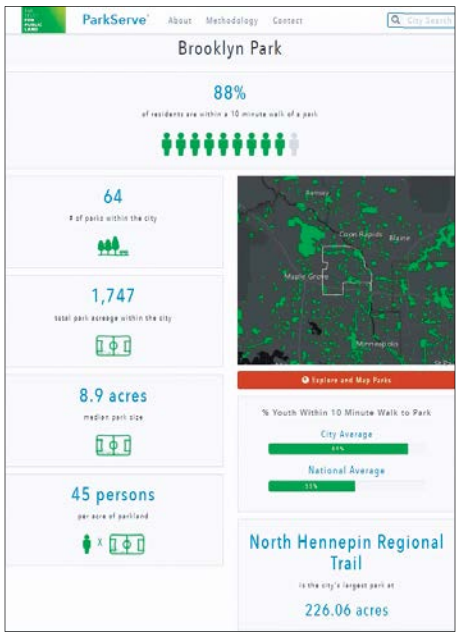
Building a Standardized Dataset

The ParkServe platform provides a stand-alone, standardized database that can easily be incorporated into existing databases of federal, state, and local parks and protected lands. Creating the data involved working with thousands of local partners in a multistep process to ensure that the most accurate and up-to-date data is included.

TPL contacted each city, town, and community included in ParkServe via phone and email to request their parks data. If no GIS-based park data was provided, the ParkServe team created data for the area based on available resources, such as park information from municipal websites, GIS data from counties and states, and satellite imagery (from Esri's *World Imagery* basemap, for example). GIS analysts and interns compiled and loaded the data into a standardized schema based on the US Geological Survey's (USGS) Protected Areas Database of the United States (PAD-US) standards. To ensure consistency within the database, GIS analysts and project managers streamlined the compilation and loading process with Python scripts that used the ArcPy site package.

After TPL's GIS team loaded the initial data into the standardized parks database and verified it, each community was given the opportunity to review the data and verify it for accuracy. To facilitate the review process, TPL created ParkReviewer, a web app that partners from municipal and local parks could use to confirm that all the publicly accessible parks in that community had been mapped correctly.

Most smaller jurisdictions did not have GIS experts on staff, so it was imperative that ParkReviewer be intuitive and easy to navigate for someone who might not be familiar with GIS tools and apps. TPL built ParkReviewer on an Esri technology stack that included ArcGIS Enterprise, ArcGIS API for JavaScript, and the ArcGIS enterprise geodatabase, ensuring that users who were inexperienced with GIS could view and edit the database in a spreadsheet format, see informational pop-ups when they hovered over icons, and read detailed methodology documentation. The GIS team then used a versioned geodatabase to track the edits that communities made with ParkReviewer.



Statistics for the city of Brooklyn Park, Minnesota, were generated by a Python script that used the ArcPy site package.

Upon completion of the verification process, TPL staff reviewed all edits using ArcGIS Data Reviewer to compare versions of the database and ensure that it still included everything they intended it to cover. The team then reconciled acceptable edits and posted them to the base version of ParkServe.

Visualizing Who Lives Close to a Park

One of TPL's core visions is that all US residents live within a 10-minute walk of a high-quality park or green space. A major component of ParkServe is being able to do proximity analysis using demographics to measure how equitable access to green spaces actually is.

Using the ArcGIS Network Analyst extension in StreetMap Premium for ArcGIS as the base road network, GIS analysts and interns created

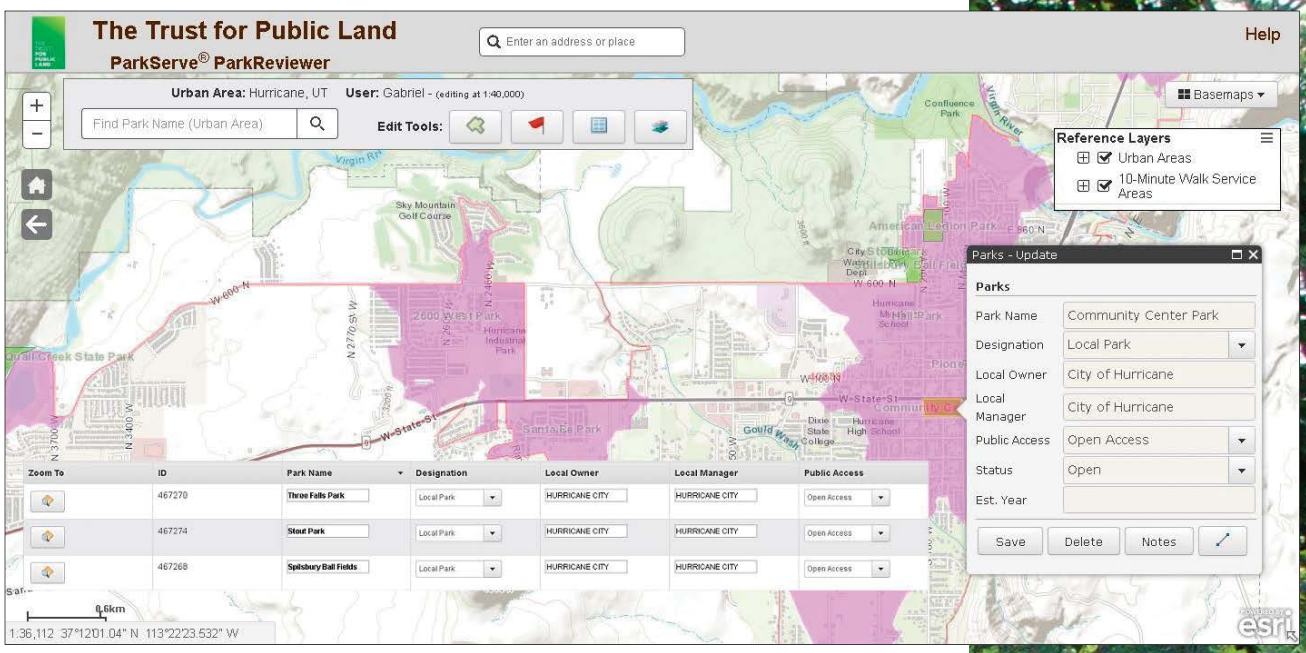
10-minute-walk service areas for each park. These service areas were used to visualize and analyze the populations living within a 10-minute walk of every green space. The team then generated park access statistics not only for each park but also for every one of the 14,000 ParkServe communities and the encompassing US Census-defined Urban Areas in each community.

Analysts and interns further analyzed park access statistics in several demographic categories—including race and ethnicity, age, and household income—since those categories offer a lens into the equitability of park access. The additional outputs created included a park need layer that uses a weighted overlay of several demographic statistics to highlight where parks are needed most for each community and urban area, as well as an optimized points layer that highlights potential park locations that would serve the most people and therefore have the biggest impact on improving a community's park accessibility.

Accessing ParkServe Data

TPL plans to share the ParkServe data widely and make it easily accessible in a variety of formats. This summer, GIS users will be able to download the data at multiple geographic scales and access it through public REST end points from the ParkServe website. ParkServe data will also be included in the PAD-US dataset from USGS.

Additionally, the ParkServe website enables non-GIS users to view park information for communities across the United States; understand detailed information about park needs; generate park access reports; and even sketch new parks, complete with demographic profiles of who would live around them and what the potential impacts would be.



Using the ParkReviewer tool, users could add missing parks to the database, edit the attribute information, and suggest new boundaries for existing parks.

Incorporating Feedback and Making Changes

Going forward, TPL's priority is to incorporate user feedback into ParkServe as quickly as possible.

Despite the thorough quality control and verification processes that were performed during data creation and aggregation, TPL will need to continually make edits and updates on things like parks' geometry and attributes, the 10-minute-walk service areas, and the park access statistics. For example, TPL might eventually need to add new parks; change the boundaries of existing parks; denote parks that are no longer part of a parks system; or edit a park's nonspatial attributes, such as who owns or manages it.

Soon, users will be able to propose edits—such as the location of a missing park—directly in the ParkServe web platform. And in future phases, GIS users will be able to directly upload their GIS datasets into the standardized ParkServe database.

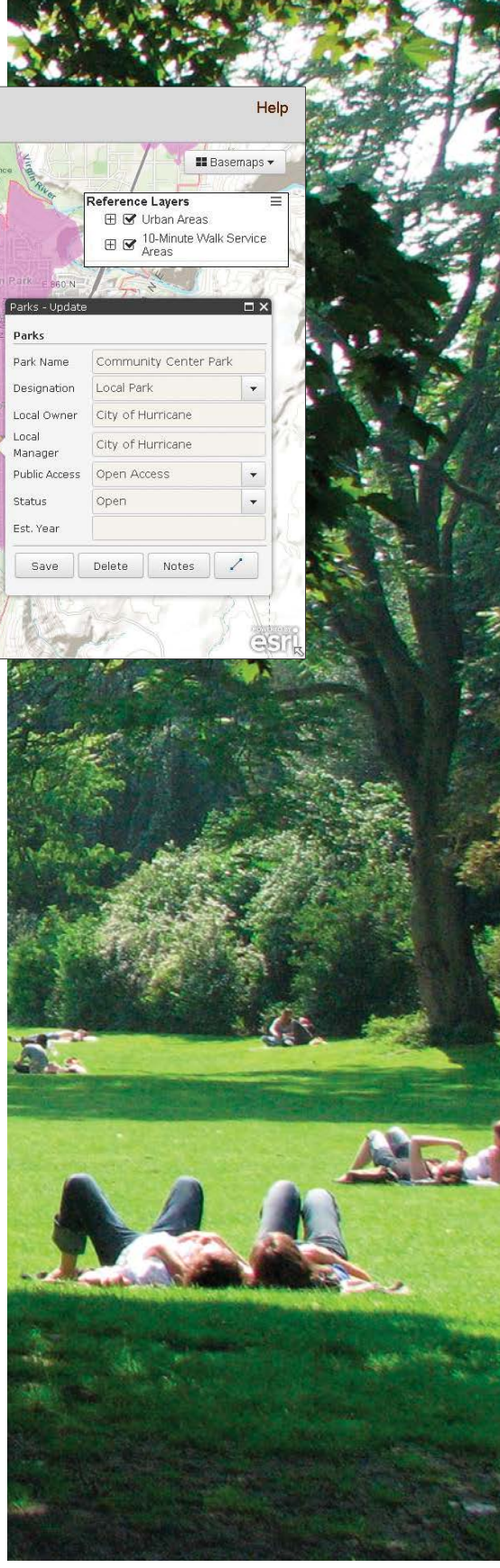
In addition to refining its accuracy, TPL plans to add more detail to the data. Beginning this summer, TPL's GIS team will add data on park amenities and park quality. For this effort to work, the team will take multiple approaches, from gathering and creating the data manually to putting crowdsourcing and other community-generated data-gathering techniques into practice.

By enriching the ParkServe database with this kind of information, TPL, its partners, and communities will be able to answer questions such as Where is the closest park with a swimming pool or basketball court? Doctors will be able to use the database to write ParkRx prescriptions, which are intended to help patients with chronic diseases get out into nature and be more physically active. And park advocates will have new resources to show community officials that demonstrate which neighborhoods in their communities are desperate for playgrounds and walking trails, as well as which nearby parks are in need of care.

To view the ParkServe platform, visit parkserve.org. TPL welcomes feedback from all users via the Contact page (for now) or by contacting Emmalee Dolfi at emmalee.dolfi@tpl.org.

About the Authors

Emmalee Dolfi is the GIS senior project manager for ParkServe at TPL, and Gabriel Patterson-King is a GIS analyst for the organization.



Geodesign Steps Up to Shape the Future

Technology and People Need to Work in Sync to Create Resilient Communities

It's crunch time for geodesign.

That was Esri president Jack Dangermond's overarching message as he opened the Geodesign Summit, held in January at Esri in Redlands, California. In keeping with the event's theme, Resilient by Design, Dangermond drove home the point that our planet is on the precipice of change that, if left unaddressed, will negatively affect biodiversity, the environment, our infrastructure, and people's health and well-being.

The world's population is on track to spike by more than 2 billion people over the next 30 years, placing more stress on the planet and its resources. That's why, according to Dangermond, it is imperative that design professionals work toward creating more resilient, livable communities using geodesign techniques and technologies. Geodesign uses stakeholder input, creative design techniques, rigorous methodologies, and spatial analysis and mapping to find the most suitable, environmentally friendly, and sustainable options for how to use space.

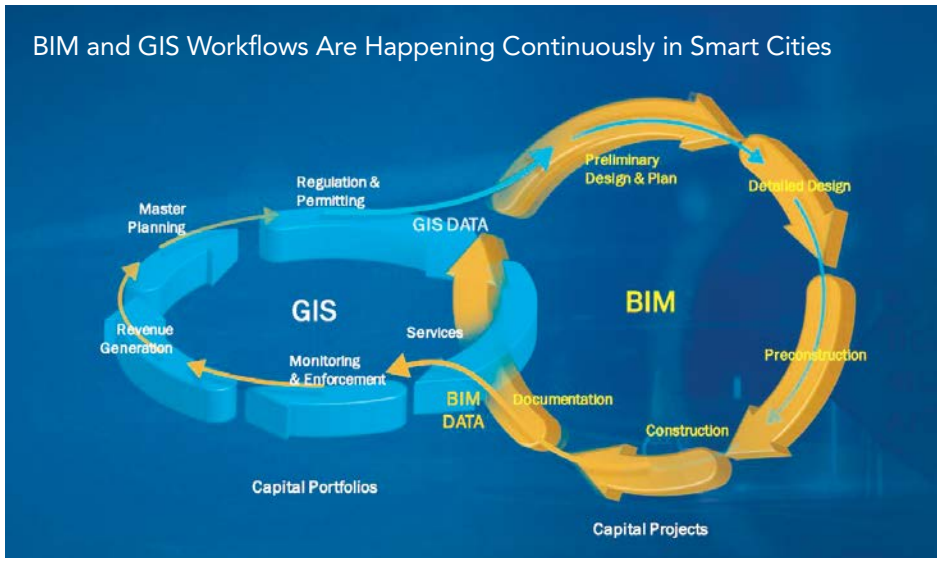
"Things are not going in the right direction on so many levels," Dangermond told more than 175 summit attendees, a group that included urban planners, landscape architects, and GIS professionals. "We need to not only do better design, we *[also]* need to integrate our best knowledge and science into it."

One of those sciences is The Science of Where, which Dangermond defines as the science of geography and the technology of GIS. The summit's focus, he said, was to learn and share ideas about how to apply The Science of Where to geodesign, ultimately leading to better design decisions.

"We aren't *[just]* talking about the better design of a road or a bridge or even a city," Dangermond said. "It's about the better design of all that we do. If we do it right, we can transform how our cities operate."

Though the challenges appear daunting, Dangermond said he sees reasons for being optimistic.

"We can make a huge impact on the way it turns out because human ingenuity will kick in, and we will create a sustainable future," he said.



When GIS and building information modeling (BIM) software work well together, architecture, engineering, and construction (AEC) professionals can create better designs—especially in 3D.

BIM and GIS, Working Together

Human ingenuity has already led to the era of digital transformation that's currently changing how organizations—including those that use GIS technology—do business. Cloud computing, big data, the Internet of Things (IoT), artificial intelligence (AI), machine learning, and Web GIS are in the mix, along with a strategic vision on how to bring everything together to achieve a mission.

"Integrating geodesign into everything we build requires well-thought-out technologies that work and help people," Dangermond said.

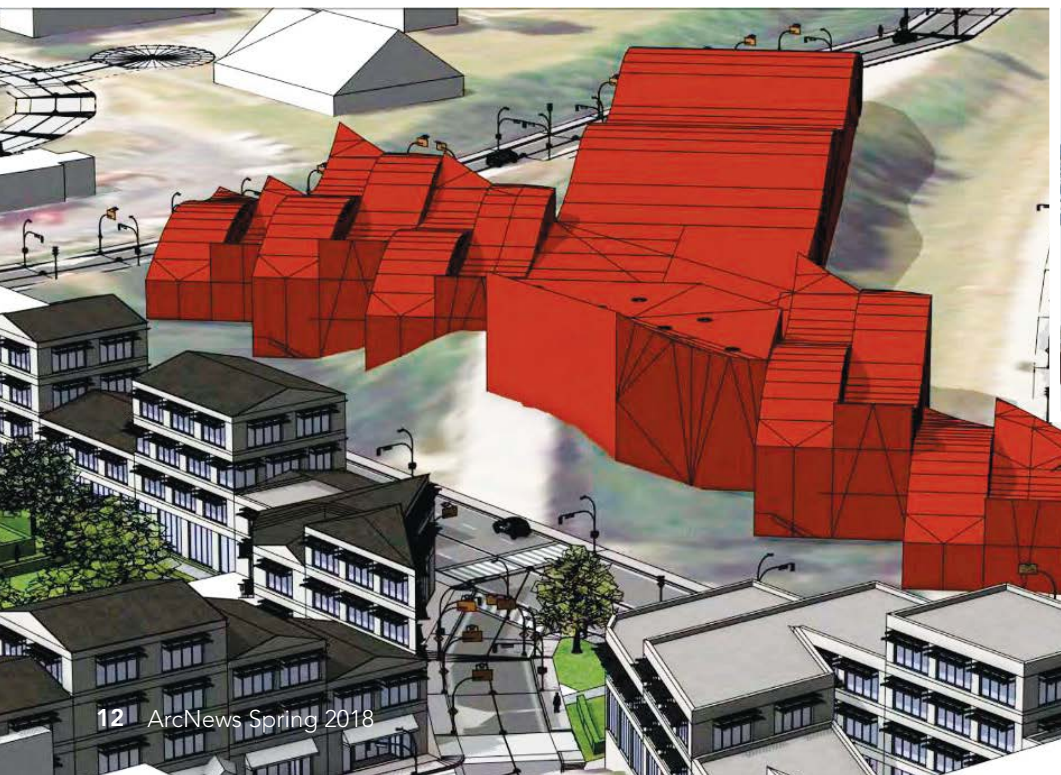
What would be helpful in the architecture, engineering, and construction (AEC) industry would be to bring GIS and building information modeling (BIM) software—often each an island unto itself—much closer together.

That's why buzz is building over plans to integrate BIM and GIS data and workflows. Late last year, Esri and Autodesk announced a strategic partnership to better connect the BIM and GIS platforms, with the aim of giving AEC professionals the ability to create better, more efficient, and sustainable designs, especially in 3D. Autodesk develops software for the AEC community, such as Revit and AutoCAD Civil 3D, which are used by architects and engineers to design real-world assets according to BIM patterns and practices.

"Based on feedback from users and partners, we know there's a tremendous demand for GIS and BIM interoperability," said Chris Andrews, the product manager for 3D at Esri.

The hope is that the collaboration will help the AEC community improve design and construction by using more precise geographic knowledge or context, resulting in a greater understanding of how designs would impact the environment. The Autodesk and Esri initiative will also focus on ways to gain more information from BIM data for use in GIS-based operations and maintenance workflows.

In his Geodesign Summit presentation, Andrews explained some of the benefits of bringing GIS and BIM together. For example, a new building or bridge that's being planned could be viewed and analyzed in its proper geographic context to assess the impact on traffic in the area. The location of trees could be viewed to see how they fit in with the design of a road. And BIM models of a building, bridge, or tunnel could be viewed and analyzed in the correct geospatial location.



BIM gives AEC professionals detailed information about assets (left), while GIS provides them with information about assets in the context of the built and natural environment (right).

One of Christine Wacta's students at Savannah College of Art and Design used Esri CityEngine to create a 3D model of a jazz history museum and train station for Savannah. (Image courtesy of professor Christine Wacta/Savannah College of Art and Design.)

There's tremendous demand to have GIS and BIM be interoperable, said Esri's Chris Andrews.

The integration of BIM and GIS is going to be a marathon, not a sprint, according to Autodesk's Theo Agelopoulos.

Christine Wacta, a PhD candidate in geospatial information science and a professor of architecture, believes that GIS and BIM have to work hand in hand.

Breece Robertson, director of planning and GIS for The Trust for Public Land, spoke of the conservation organization's efforts to create green infrastructure.

Currently, BIM users can work with GIS data, and GIS users can work with BIM data—but the process was described by Autodesk's Theo Agelopoulos as "painful." He says that will change.

"A majority of our customers are architects, engineers, and contractors, and they are designing buildings and infrastructure such as roads, airports, dams, and plants. The assets they are building have geospatial context—they exist somewhere in the real world," said Agelopoulos, director of infrastructure strategy and marketing at Autodesk. "Creating a more seamless connection between BIM and GIS would allow those customers to do a better job designing and building."

Initiatives such as integrating BIM and GIS will "produce a better context model earlier on in the design process to enable a smarter and more optimized design," he said. "We want to better consume Esri's data to provide that project insight to help engineers do more *[and]* better with less."

The AEC industry needs to be patient, however, because the integration will take time and be incremental—though there are plans to integrate ArcGIS Online into Autodesk's InfraWorks software later this year.

"It's going to be a marathon, not a sprint," Agelopoulos said. "But we will eliminate the existing barriers between BIM and GIS and improve the user experience for our mutual customers."

One person who looks forward to a connection between BIM and GIS workflows is Christine Wacta, a professor of architecture at Savannah College of Art and Design in Savannah, Georgia, and a PhD candidate in geospatial information science. Wacta said her PhD studies focus on BIM and GIS.

"BIM and GIS have to work hand in hand," Wacta said, following a presentation she gave at the Geodesign Summit. "Those two tools should be together because they are not competing."

Wacta said she advocates using GIS in her architecture classes and has taught her students to use Esri CityEngine to create 3D models from 2D GIS data. Her students have used both Esri and Autodesk software in their architecture courses. For instance, one student used Esri CityEngine to create a 3D model of a jazz history museum and train station for Savannah. The model shows the development in the context of the surrounding urban landscape, including the terrain and nearby buildings and infrastructure. In Revit software for BIM, the student then created interior and exterior designs of the museum and train station.

Models created with Esri CityEngine give architects and urban planners a realistic view of their projects, helping them see where a building that is proposed might cast shadows, reflect heat, or even block views for nearby residents. This type of information is useful in design, according to Wacta.

"When you start saying 'BIM and GIS,' it's like *[talking about]* bananas and plantains," she said. "It's not the same thing."

Having GIS data available in software for BIM would help in site analysis, Wacta said.

"In architecture, we do all the things that GIS does. We do site analysis, but we do it with our ears and our eyes and our feelings," she said. "GIS makes you work smart and not hard. With BIM, we work too hard. I send the students to go trace buildings when the building footprints are already *[available]*. It's *[often on]* the city's website, and it's free. Why don't we make the students' lives easier so they can spend more time on design rather than busywork?"

Geodesign That Improves Urban Planning—and People's Lives

The summit delved into many aspects of geodesign and supporting technology and content.

Geodesign benefits from communities having access to data and apps that they can use to develop green infrastructure plans. Esri's Hugh Keegan showed the audience the Green Infrastructure web page that Esri maintains (esri.com/greeninfrastructure). There, people can find maps, apps, and other resources that will guide them through creating a green infrastructure plan.

Eric Wittner, from Esri, gave a presentation about the impact that virtual reality (VR) and augmented reality (AR) will soon have on planning and geodesign. He talked about how urban planners will be able to view proposed buildings by using the ArcGIS 360 VR application with a VR headset. ArcGIS 360 VR is an Esri Labs project that, Wittner said, will become a product offering in the future.

Esri's Rob Stauder demonstrated GeoPlanner for ArcGIS, while Aziz Bakkoury, a GIS specialist in the Department of City Planning for the City of Los Angeles, talked about how GeoPlanner is being used in the re:code LA initiative, a revision to the city's zoning code.

Julian Herren, a University of Southern California (USC) student who is majoring in geodesign, talked about his work on SunSmart, a collaborative project between the school's Spatial Sciences Institute and the Keck School of Medicine at USC. The project aims to reduce harmful sun exposure among elementary school students in Los Angeles. Herren and other students have used technology such as GeoPlanner for ArcGIS and ArcGIS Pro to find out where, on one elementary school campus, students get the most and least exposure to ultraviolet light and to determine the best places for locating the sunshades and benches that he helped design.

Herren said he hopes to combine his bachelor's degree in geodesign with a master's degree in architecture.

"At the end of the day, what I want to do is to improve the lives of other people," he said.

Making people's lives better is also a goal for The Trust for Public Land (TPL).

"Our mission is *[conserving]* land for people," said Breece Robertson, the director of planning and GIS for the national conservation organization. "We create parks and protect lands for healthy communities for generations to come."

One of TPL's programs is Climate-Smart Cities, which aims to create green infrastructure to help reduce the impact of climate change. A project linked to the program is Green Alleys, based in Los Angeles, which, according to TPL, has 900 miles of alleys. Using a decision support tool that employs ArcGIS technology—plus community input and other factors—TPL identifies areas that would benefit from green alleys. Many factors go into choosing which alleys could be good candidates for these green spaces, including social vulnerability and environmental equity.

Not only are the alleys cleaned and spruced up with greenery, but the impervious surfaces are removed and replaced with pavement that reflects light and is more permeable. This helps to keep the alleys cooler and reduce water runoff into storm drains.

One of the Green Alleys pilot projects was in the Avalon neighborhood of Los Angeles.

"This area needed connectors for walking and biking and commuting," Robertson said. "But mostly, we were thinking about green alleys as a way to activate social cohesion in these neighborhoods to give people a place to gather *[and]* places they could safely walk to the store. I think some of them have park benches along the way."

Green alleys can serve as a type of park, said Fred Gifford, TPL's GIS director.

"These areas are all built up. There are not a lot of options except for tearing down houses to put in parks," he said. "Alleys are one underutilized piece *[of property]*."

If designers from across the professional spectrum can continue to incorporate geodesign into urban planning and AEC—as so many organizations and students are already doing—then our communities will only become more resilient.

Green alleys can serve as a type of park in areas that are all built up. (Image courtesy of The Trust for Public Land.)

Where Geodesign and Conservation Converge

By Michael F. Goodchild, University of California, Santa Barbara

I like to think of geodesign as a perfect marriage of art and science. In geodesign, a GIS platform is used to support both the creative act of design and the scientific process of predicting impacts and evaluating outcomes.

We often think of geodesign as a form of landscape architecture, a way of improving the planning process by designing neighborhood-scale developments that balance environmental impacts, economic costs, and quality of life. But geodesign can also be applied to the planning and conservation of land and marine environments.

Recently, the cause of geodesign for landscape conservation received an enormous boost when Esri founders Jack and Laura Dangermond donated $165 million to The Nature Conservancy (TNC) to form the Jack and Laura Dangermond Preserve at Point Conception, roughly 25,000 acres of pristine coastal California.

Bypassed by the main coastal highway, Point Conception may be best known to those who have had the pleasure of riding Amtrak's Coast Starlight train north of Santa Barbara, or to the generations of hikers who have risked high tides and trespass laws to visit the lighthouse. It was much in the news in the 1970s and 1980s when a terminal for liquefied natural gas was proposed and eventually defeated by popular protests fueled by phrases such as "Keep Conception Immaculate." The area is also famous for a naval disaster that occurred in 1923, when seven US destroyers ran aground on rocks a few miles north of Point Conception.

The preserve—whose physical beauty is brilliantly captured in a TNC video at p.ctx.ly/r/6l7q—occupies a unique location on the Pacific Coast of North America. It is where the predominantly north-south coast suddenly turns and runs east-west, and where the cold California Current finally relents, allowing warmer water to dominate around the Channel Islands and to the south.

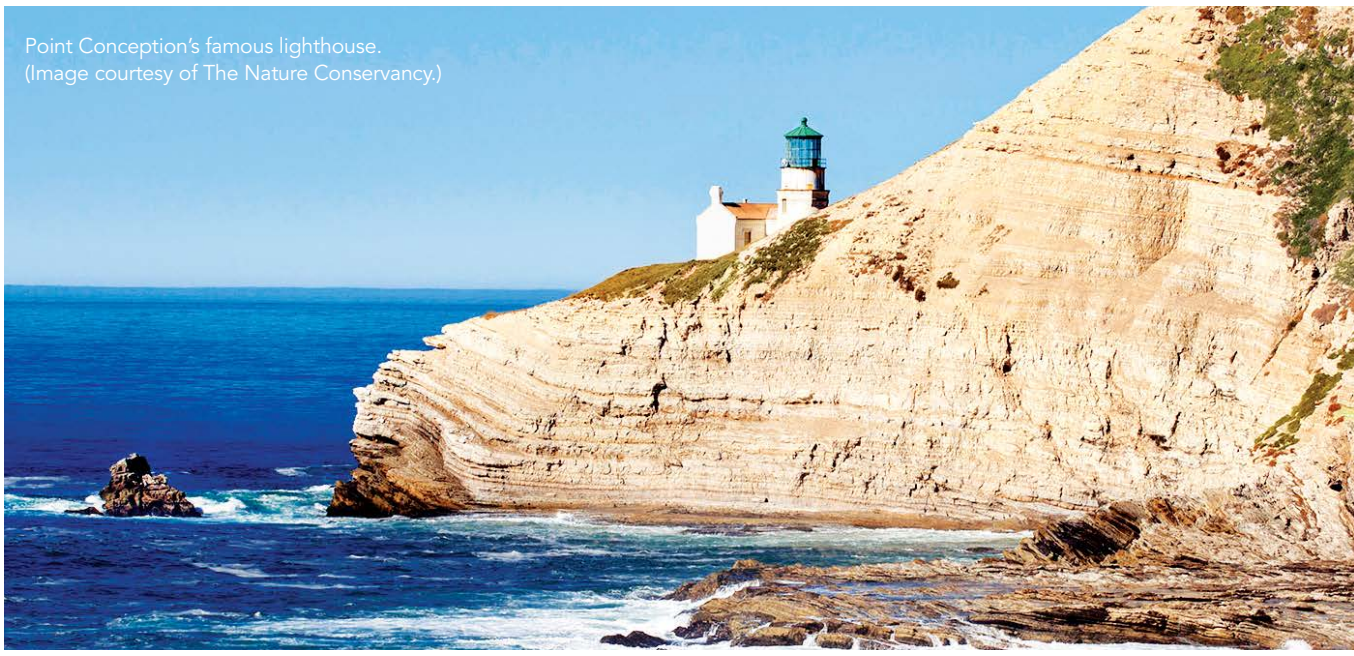
In an article that appeared recently in *The Atlantic* (accessible at theatln.tc/2kHlZgy), Dr. Henry Yang, chancellor of the University of California, Santa Barbara (UCSB), notes, "This is a conservation project of historic significance. The area is recognized globally for its rich biological diversity and ecological significance. As a transition zone from warmer southern species to cooler northern species both on land and in the coastal ocean, it provides a unique place to study and learn how climate affects the ecosystem." The preserve is also a very significant place in Native American culture and rich in archaeological interest.

Managing a preserve of this size and importance will demand the best that creativity, science, and geodesign have to offer. Yet this opportunity could not have come at a better time. We can now image the earth at finer spatial resolution and more often than ever before, using a vast range of satellite, airborne, and ground-based sensors. We have access to aerial photographs of the area dating back decades. And the geodesign tools that are now available in the Esri platform are powerful and readily understood.

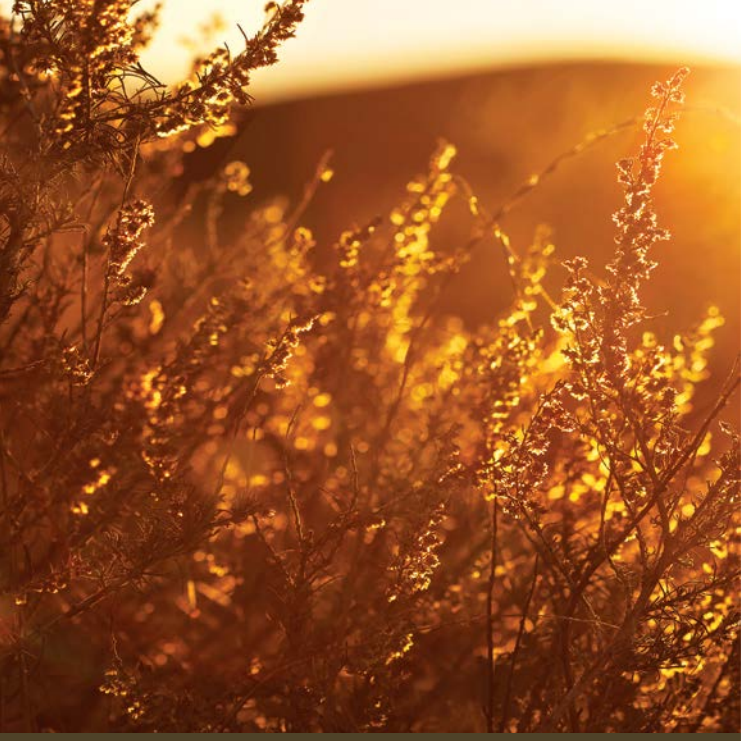
Against this richness, however, are the reality of global climate change and the stresses that we have recently seen in an extended California drought, such as massive late-season wildfires and the catastrophic flooding in neighboring Montecito. The offshore area is rich in oil deposits, and although there has been little new activity in recent years, announcements from Washington, DC, suggest that drilling, production, and their associated environmental hazards may well revisit the area in the future.

The prodigious responsibility of managing the preserve will fall to TNC. In addition to the gift, the Dangermonds will fund an endowed chair in conservation studies at UCSB. The chair will lead a research team that will conduct studies in the preserve in collaboration with TNC and Esri. Among the research questions that will likely dominate their studies are the following:

- What range of habitats exists in the preserve, and which of those habitats is most endangered?
- What have been the effects of climate change to date, and what effects can be predicted in the future?
- What has been the nature of human disturbance in the preserve, and how can its effects be mitigated and reversed?
- What interactions exist between the offshore, coast, and landscape segments of the preserve?
- What areas of archaeological interest exist in the preserve?



Point Conception's famous lighthouse.
(Image courtesy of The Nature Conservancy.)



At Point Conception, California's predominantly north-south coast suddenly juts east-west, and the cold California Current gives in to warmer waters. (Images courtesy of The Nature Conservancy.)

- What role can the preserve play in national and international networks of conservation areas and ecological research sites? In what ways is it unique?

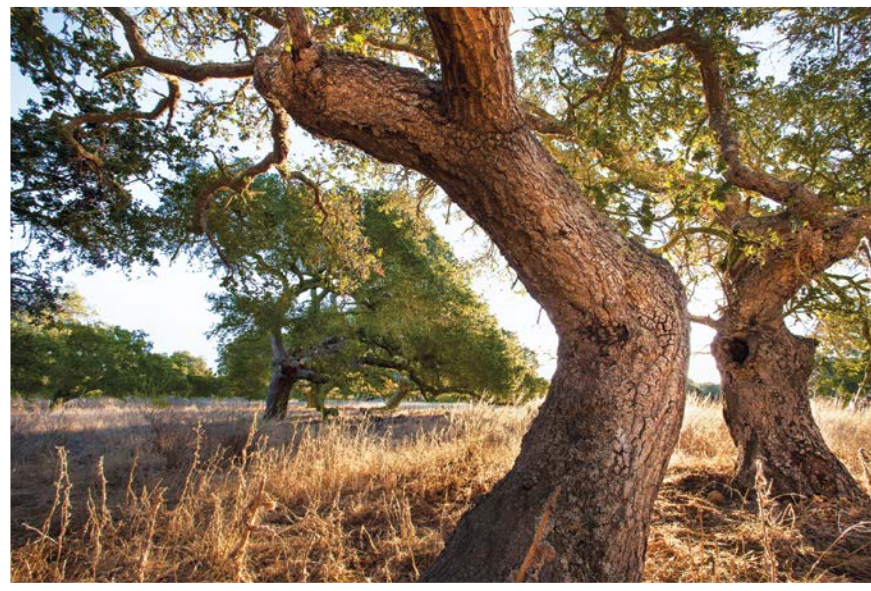
As James Fallows, the author of *The Atlantic* article, makes clear, the Dangermonds intend the gift—and the publicity associated with it—to be an example of what other leaders in the tech industry can achieve through actions to conserve the earth's resources. Not only that, but the Dangermonds want to set an example for anyone who has the means to do so to donate to nature.

"We want to inspire more people to give major contributions toward conservation," said Jack Dangermond. "Conservation isn't just being nice to animals or plants, it's investing in the continued life support systems of humans and all other species on the planet. We need more people to step up to protect our last great places."

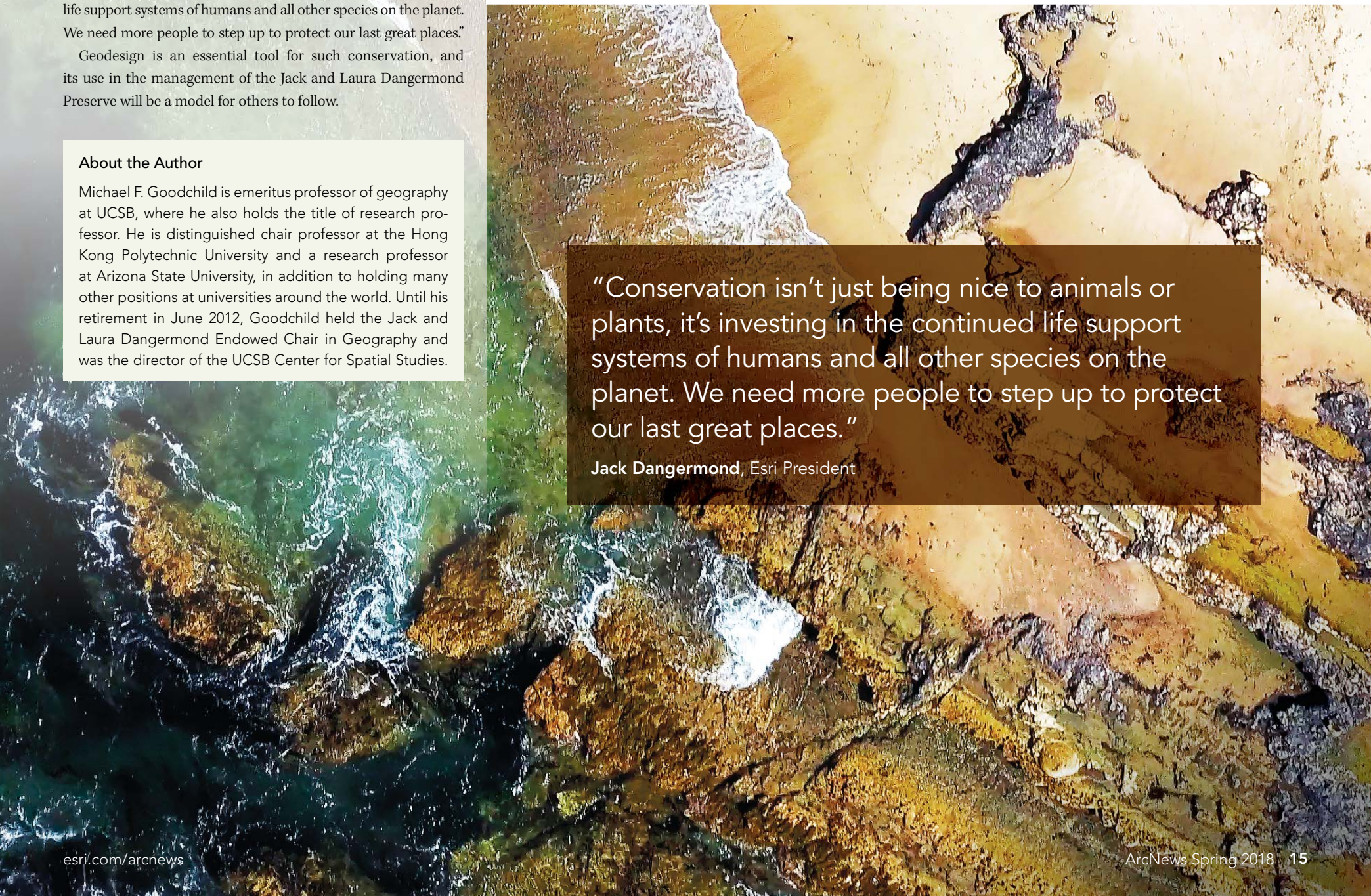
Geodesign is an essential tool for such conservation, and its use in the management of the Jack and Laura Dangermond Preserve will be a model for others to follow.

About the Author

Michael F. Goodchild is emeritus professor of geography at UCSB, where he also holds the title of research professor. He is distinguished chair professor at the Hong Kong Polytechnic University and a research professor at Arizona State University, in addition to holding many other positions at universities around the world. Until his retirement in June 2012, Goodchild held the Jack and Laura Dangermond Endowed Chair in Geography and was the director of the UCSB Center for Spatial Studies.



The site of the new Jack and Laura Dangermond Preserve is biologically diverse and ecologically significant. (Images courtesy of The Nature Conservancy.)



"Conservation isn't just being nice to animals or plants, it's investing in the continued life support systems of humans and all other species on the planet. We need more people to step up to protect our last great places."

Jack Dangermond, Esri President

Big Data Keeps the Lights On

continued from cover

Plains to serve more than 80 million customers. It is characterized by long transmission lines connecting remote generation facilities to load centers. The Western Interconnection is managed by the Western Electricity Coordinating Council (WECC).

Serving the electricity coordinating councils are companies known as reliability coordinators that continually monitor the interconnection's Bulk Electric System (the production resources, transmission lines, interconnections, and all related equipment) to ensure that it remains dependable. Peak Reliability, headquartered in Vancouver, Washington, is the primary reliability coordinator for the Western Interconnection.

"Peak determines the reliability operating limits for transmission operators, balancing authorities, and transmission service providers *[working]* in the Western Interconnection," said Dayna Aronson, an enterprise solutions architect for Peak Reliability. "This means that if a company owns and operates transmission facilities, it is required to operate those facilities according to the reliability limits that Peak sets."

These limits are based on the detailed studies WECC conducts on transmission line capabilities and the network models that Peak continually reviews as it monitors the entire Western Interconnection in real time.

"Since we archive all the real-time data related to the transmission lines throughout the Western Interconnection, we can determine what will happen to any one of the lines if it exceeds our load recommendations, by examining historical data," said Aronson.

Big Data Runs the Show

While individual power companies model their own transmission networks and the points of interconnection with adjacent power companies, Peak Reliability is the only company in the Western Interconnection that models the entire network. Peak receives network models from all the power companies within the interconnection and then assembles more extensive models using its Energy Management System (EMS), which monitors and optimizes the performance of the transmission system in real time.

"We receive the SCADA *[supervisory control and data acquisition]* measurements via the Inter-Control Center Communications Protocol (ICCP) from all the individual balancing authorities and transmission operators in the Western Interconnection into our EMS and PI System," explained Aronson, referring at the end to one component of Esri partner OSIsoft's suite of software.

Peak has about 440,000 tags (specific electrical load measurements taken at distinct times) in the system, and more than 160,000 of them are SCADA points, or pieces of information—like an open or closed breaker—that are read by a device on the power system.

"We get input from *[these]* every 10 seconds," said Aronson. "So the EMS PI archives increase about 5 gigabytes per day."

In addition, Peak has deployed a synchrophasor network in the Western Interconnection. The phasor measurement unit devices in this network take electrical measurements that make Peak more aware of conditions throughout the grid and help the company respond quickly to anything unusual so it can reduce potential power outages.

"Through this network, we are collecting another 4,000 measurements that are updated 30 times per second, and the phasor archive grows about 64 gigabytes daily," said Aronson. "In addition, there are another 150,000 elements in our PI Asset Framework that provides data that we are continually monitoring and then archiving."

All the data generated by these real-time measurements and the 8,000 substations that Peak monitors gets fed into the company's control room. There, operators continually review more than 13,000 displays of primarily tabular data to look for system anomalies that could lead to interruptions in the grid. On top of these numerous displays, Peak had compatibility issues among several of the systems it had developed or purchased over the years.

Because of the scale of its operations and the need to provide a method for its operators to more easily spot and resolve problems, Peak set out to develop a system based on technologies from Esri and OSIsoft that would allow it to both monitor and visualize its sensor data.

"We began the development of the Peak Visualization Platform (PVP) in late 2015, and it took us about a year and a half to complete," said Aronson. "The PI Integrator for Esri ArcGIS was implemented to connect OSIsoft's PI System with the ArcGIS platform to allow the visualization of SCADA and other sensor data within a geospatial context."

Using its network model and overlaying it with sensor and other grid data, Peak Reliability is employing Operations Dashboard for ArcGIS to visually monitor the grid.

"Essentially, we use the ICCP Protocol to transmit this data to both our EMS and our PI Data Archive application," said Aronson. "*[ArcGIS]* GeoEvent Server then pulls that information from the PI archives and hands it off to ArcGIS for mapping purposes, which is how we are getting the real-time sensor data to drive the visualization of the maps in Operations Dashboard. This provides critical situational awareness for our operators when they have to make rapid decisions."

Learning Lessons in a Fire

As the PVP system was under development, the Blue Cut Fire erupted in Southern California's San Bernardino County in August 2016. A 500-kV transmission line was short-circuited as a result of the fire, which was anticipated by Peak's control room operators. However, beyond that, they really didn't know what to expect.

"They began to call the fire captains out in the field because they needed answers to critical questions about the fire to minimize the risk to the electrical grid," recalled Aronson. "Some of the questions included: Where was the exact location of the fire? What direction was it moving? What transmission facilities were at risk and should be placed out of service over the coming hours?"

It took more than an hour for the operators to get a response from the field. And once they received the information, the analytics available to them could not provide the necessary geographic context. As a result, 175,000 homes and businesses in the Los Angeles area were at risk of suffering an electricity outage.

Though an outage was actually avoided by re-dispatching power generation to bypass the damaged facilities, that re-dispatch was less than optimal due to the lack of situational awareness. As a result, the local power company paid more money for the power that was redirected to Los Angeles consumers because of the tariffs involved in using electricity from outside the balancing authority.

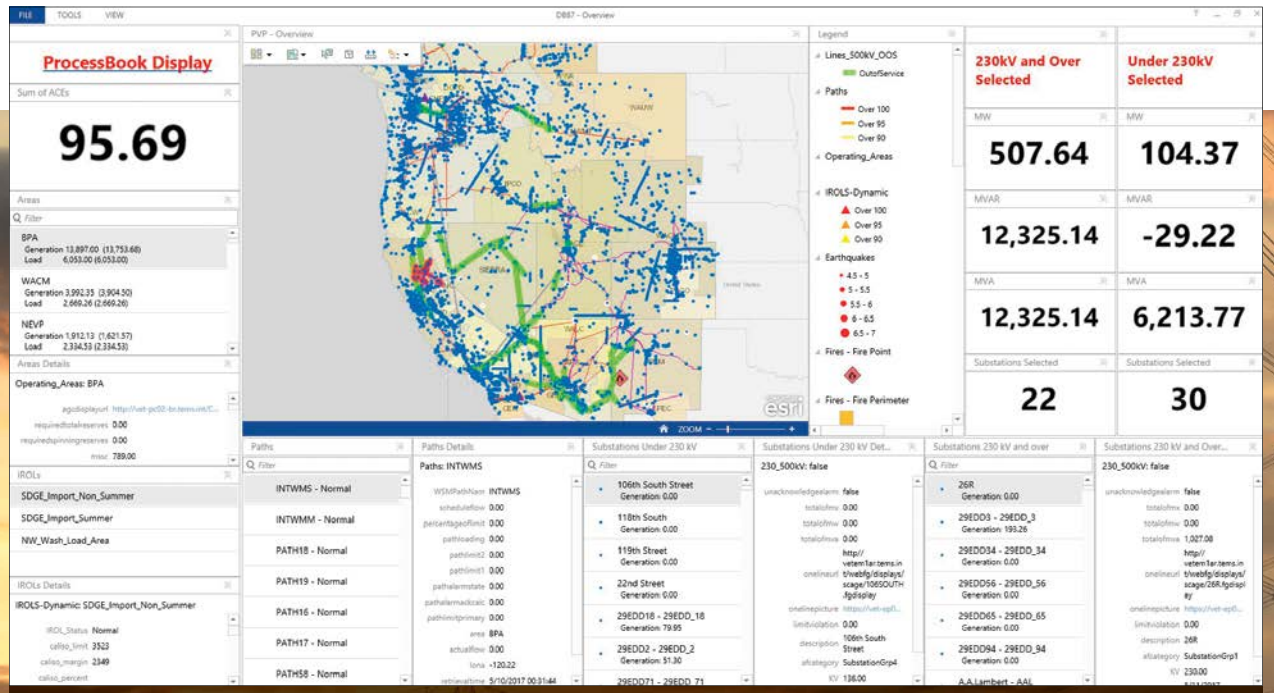
"Now with our PVP, we have real-time fire visualization—including location, size, and boundary data—that is updated every five minutes from the US Geological Survey," said Aronson. "We can also pull down other information from the Internet that can affect electrical transmission, such as weather forecasts, impending storms, *[and]* natural disasters."

Future Visualization Capabilities

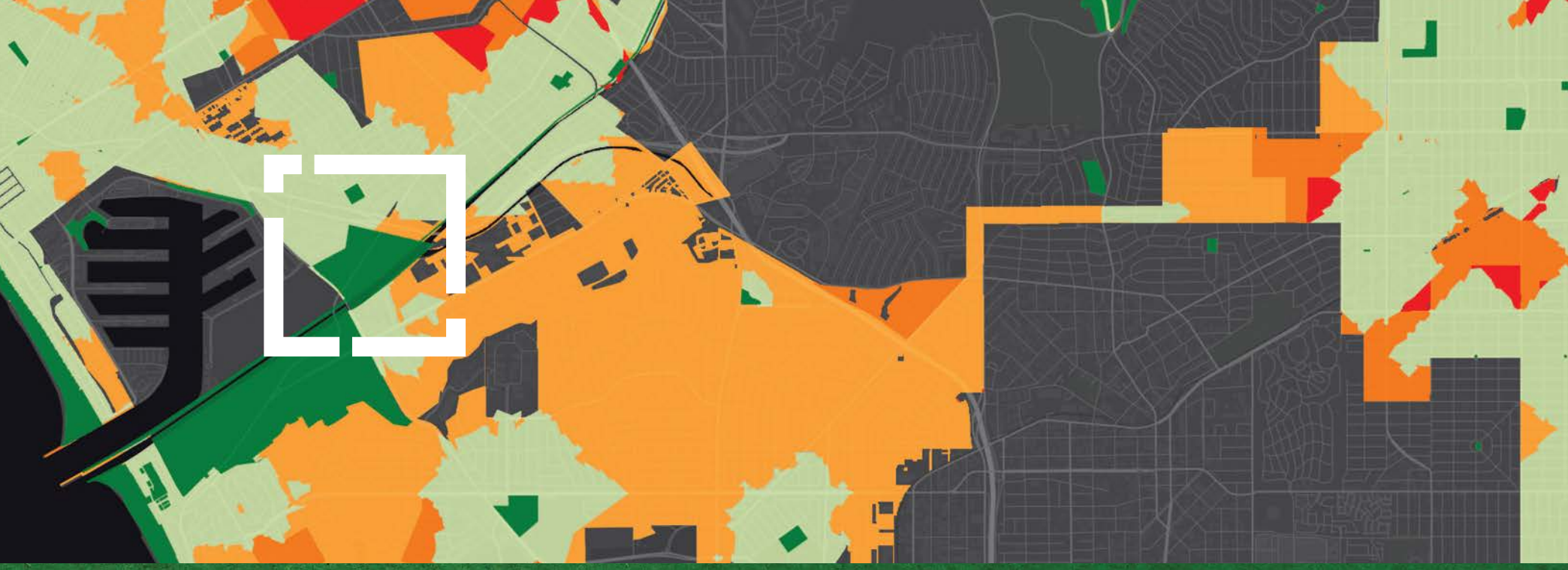
"We have only just begun to explore the potential of the Peak Visualization System," said Aronson. "Originally, we defined about 30 use cases and have so far delivered roughly a third of them for the platform."

One thing Peak is interested in including in the system is a geospatial context for its Real Time Contingency Analysis (RTCA) displays, which provide a five-minutes-ahead, what-if scenario analysis of possible grid conditions.

"The RTCA application simulates more than 8,000 contingencies, which it prioritizes based on their potential negative impact on the operation of the grid," explained Aronson. "We are going to georeference the RTCA results and superimpose them over the topology of the network to give the control room operators the locational intelligence needed to make quick and well-considered decisions in the event of a facility failure, negative contingency, or other event that threatens the reliability of the grid."



← In the Peak Visualization Platform (PVP), each blue dot is a substation, and information about the selected substations (highlighted in red) appears in the widgets. When a line on the map is highlighted in green, it indicates that the line is out of service.



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OGC Wants Your Mature, Community-Developed Standards

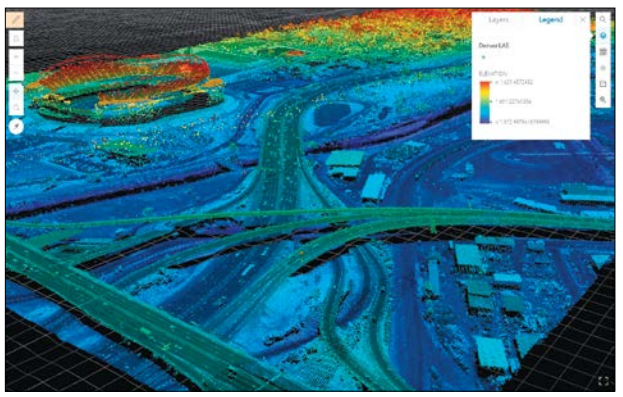
Find Out What an OGC Community Standard Is and How to Submit One

By Carl Reed, Carl Reed and Associates

Many commonly used GIS data sharing specifications were not developed inside a standards organization. Some were developed by a community of experts that needed to share geospatial data across jurisdictional and/or political boundaries, often on a global basis. Other specifications were developed by commercial entities to meet customer requirements.

There are scores of community-developed and community-maintained specifications, such as GeoTIFF, GeoJSON, GeoSciML, and GeoRSS. And then there are the commercially developed ones, including the Esri shapefile and Google KML formats. Such specifications are often termed *de facto* standards, meaning they are used so widely that they are considered standard for a given app, though they have no official status.

Over time, a variety of market and procurement forces—such as demands for stability, formal endorsement, branding, openness, and transparency—may cause a community or company to consider taking the specification to a formal standards organization, such as the Open Geospatial Consortium, Inc. (OGC). But submitting a community specification can raise concerns. Some groups get nervous about losing control over the development of the specification, some are concerned about having two different versions of it, and some wonder how revision will happen going forward.



LAS is a community-developed specification for point cloud file formats. (Data courtesy of Merrick & Company, © 2011.)

To properly address these concerns, members of OGC explored how to define a process, along with a set of related policies, for accommodating the submission of widely used, mature specifications developed independently from OGC. A key goal was to establish a lightweight approach by which non-OGC groups, as well as OGC member organizations, could feel comfortable submitting external specifications into the formal OGC standards approval process. The primary requirements for this approach were

- Assuring submitters that OGC would not alter the content of a specification (unless it discovered errors), would not take over the development and maintenance of that specification, and would not annex anyone's intellectual property.
- Fulfilling government requirements that de facto standards get vetted and branded by a formal standards development organization, such as OGC.
- Ensuring that OGC standards could refer to externally developed de facto standards as normative.
- Furnishing a stable, unchanging version of a de facto standard.

In 2015, members of OGC formally approved new policies and procedures for community organizations and private companies to submit their de facto standards to potentially become what are now called OGC Community Standards. When a specification becomes an OGC Community Standard, OGC has reviewed, voted on, and approved it as an official OGC standard.

Existing OGC Community Standards

Since Community Standards were established, a number of organizations have submitted their de facto standards to be reviewed, edited, approved, and published as official OGC Community Standards. These include Esri's I3S, the American Society for Photogrammetry and Remote Sensing's (ASPRS) LAS, and the GeoRSS file formats. In addition, Cesium's 3D Tiles specification has been approved as a new work activity for consideration as a Community Standard. OGC is looking at other submissions as well.

OGC considers Community Standards to be normative, meaning they become part of the OGC Standards Baseline—the list of OGC standards that can be used in interfaces, app schemas, best practices documents, and more. A normative standard specifies how to comply with the requirements, or rules, defined in the standard. Many organizations mandate the use of normative standards in procurements.

The key feature for a Community Standard is that there is strong evidence of implementation—and the organization submitting the standard to OGC needs to provide information on how widespread its use is via a justification document. Members of OGC then review the justification document and vote on whether to accept the candidate Community Standard as an OGC work activity.

A Community Standard is a snapshot of a mature specification. The group that submits the specification retains control over how it evolves. Furthermore, the external version and the OGC version of the document can remain identical so that, no matter which version a user accesses, the documentation will be the same. Finally, the specification's originator either shares intellectual property rights with OGC or grants unlimited free use of it to all implementers.

Having a lightweight approval process is extremely important to OGC. Many groups worry about the time and resource commitments required to go through a traditional standards development process. Yet formal reviews, comment periods, and voting remain critical to developing relevant Community Standards. To that effect, some normal OGC procedures aren't required to establish a Community Standard, such as forming a Standards Working Group, complying with the OGC Modular Specification process, and requiring compliance tests. Finally, OGC cannot change the normative content of a Community Standard.

Bentley Systems' ContextCapture produces content directly in I3S, which Esri's desktop clients, such as ArcGIS Earth, can access as either services or local files. (Data courtesy of Institut Cartogràfic i Geològic de Catalunya.)

The net result of all this is that moving a Community Standard through the OGC process takes considerably less time than for a traditional OGC standard—that is, approximately 6–9 months compared to 18–24 months or more, respectively.

The Benefits of Submitting Mature Standards

Now that several specifications have been through the Community Standards process, OGC has identified a number of benefits to the process:

- The formal review process pinpointed a variety of spelling and grammatical errors in each submitted specification. These were corrected, which improved the quality of the documents.
- In the case of GeoRSS, errors were identified and documented. These were corrected, generating an even more robust standard.
- In the case of I3S, OGC document editors and Esri were able to align it much more closely with the current OGC/ISO Standards Baseline, especially in terms of coordinate reference systems. This is an important consideration for organizations that specify OGC and ISO standards in procurement language.

To date, the OGC Community Standards process has been a success. Given that this is a relatively new process, it will certainly undergo minor refinements as OGC learns from recent and future submissions.

But the benefits are clear. OGC Community Standards allow proven, widely used technology to be adopted as OGC standards, which enables them to be treated as full-fledged, member-approved OGC standards. Not only does this advance community- and organization-developed specifications, but it also helps modernize the OGC's Standards Baseline.

Community Standards provide huge—and synergistic—advantages to the entire GIS community. OGC can leverage the expertise of a very large technology community to broaden its suite of standards while staying consistent with a range of technology and market trends. In return, GIS users and the procurement community can feel secure that they have access to stable, fully vetted, and freely available standards not controlled by a single vested interest.

About the Author

Carl Reed is a geospatial technology professional. He holds a PhD in geography from The State University of New York at Buffalo, where he specialized in GIS technology development and systems engineering and design. Reed has more than 40 years of experience in GIS software development, architecture, and standards. He generated the original idea and initial policies and procedures for the OGC Community Standards process.

Take a closer look at the three recently adopted OGC Community Standards: I3S, LAS, and GeoRSS.

I3S

Innovative technologies are making it possible to assemble highly accurate digital representations of the real world. New data types and collection methods generate large datasets that users want to employ in distributed mobile and web apps.

For this rapidly developing market, the data being collected is often 3D. In 2015, to coincide with its release of new platform technologies that work well with 3D GIS, Esri produced a new specification for storing, packaging, and streaming large quantities of geospatial 3D content—Indexed 3D Scene (I3S) layers.

Esri released the I3S specification publicly to have its partners and users help drive innovation. The company wanted to encourage interoperability and give users confidence that their data would always be open and accessible.

With I3S, layers define the types of data that make up a single dataset. Currently, the public I3S specification includes 3D object, 3D point, and integrated mesh data types. 3D objects are typically used for assets such as buildings, 3D points are used for simpler features such as trees and signs, and integrated meshes combine textures and triangles into large layers that are often derived from reality capture methodologies. Additionally, a new point cloud I3S layer type will be added to the specification this year.

I3S is a key interoperability tool for growing 3D capabilities across the ArcGIS platform. ArcGIS Earth, the WebGL Scene Viewer in ArcGIS Online and ArcGIS Enterprise, and ArcGIS Pro all consume I3S layers and can combine them with other spatial data types, such as KML files, GeoREST services, and WMS layers. ArcGIS Online, ArcGIS Enterprise, and ArcGIS Pro can publish and create I3S content as well.

I3S has been widely adopted, with notable companies such as Vricon and Bentley Systems now producing content directly in I3S. A Czech startup, Melown Technologies, has even created a data production pipeline, a server, and a web client that work with I3S, demonstrating that I3S can be implemented without the use of any Esri technology.

In response to requests from partners and users, Esri began working with OGC and industry partners in 2016 to submit I3S into an appropriate OGC standards process. It was decided to submit the I3S specification for consideration as a Community Standard to reflect how I3S originated within the industry, was experiencing increased adoption, and had a community-based change management process.

By August 2017, I3S was approved as an OGC Community Standard. Called the OGC Indexed 3D Scene Layer (I3S) and Scene Layer Package Format Specification, the approved standard includes not only the structure of I3S content but also a packaging mechanism that allows I3S to be used as local packages on clients that are disconnected from the Internet.

I3S has become a standard technology across ArcGIS. Users can create I3S content from ArcGIS Pro, ArcGIS Enterprise, and ArcGIS Online. ArcGIS web clients, including Scene Viewer, Web AppBuilder for ArcGIS, and Esri Story Maps apps, allow anyone to use I3S to share interactive 3D maps as streamed services. Esri desktop clients, such as ArcGIS Pro and ArcGIS Earth, can access I3S content as either services or local files. And I3S content can be used as analytical content within 3D scenes using interactive tools for viewshed, line-of-sight, and 3D measurement analyses.

The public I3S standard is available on the OGC website at bit.ly/OGC_I3S. Find out more information about I3S on the Esri Developers site at bit.ly/I3S_Esri_Developers and on the *ArcGIS Blog* at bit.ly/I3SIntroBlog2. Learn more about the different layer types in I3S and get downloadable examples at bit.ly/I3SStoryMap.

LAS

LAS is a community-developed specification for point cloud file formats. The LAS format is primarily used for transmitting laser point cloud data (lidar), but it can also be used for any general 2D or 3D point-oriented encoding.

The LAS specification defines a relatively compact binary encoding of point location and point attribute data. Rather than store attributes in referenced records, LAS's lightweight attribute data is stored in the same record as the point data, keeping everything in a single data file.

LAS is based on work done by EnerQuest Systems in the late 1990s and then released into the public domain. In the early 2000s, a small community of companies teamed up and developed a draft for LAS version 1.0. About a year after this industry group defined the initial specification, ASPRS agreed to take over ownership and expanded the community of contributors. ASPRS released version 1.0 in 2003.

The initial version of LAS 1.4, released in 2011, is the version the community agreed to submit into the OGC Community Standards process. OGC membership endorsed LAS 1.4 as an official OGC Community Standard in October 2017. As part of the evidence of implementation, OGC Point Cloud Working Group asked the OGC membership who was using LAS. Almost 80 percent of the more than 180 respondents reported that they used it.

Support for LAS (versions 1.0 through 1.4) is included in both ArcMap and ArcGIS Pro. These apps enable users to view point clouds directly along with all other geospatial data in both 2D and 3D. Users can filter the points based on return and classification codes, which describe the surface or objects—such as treetops and vegetation—being detected by the sensor system. Profile views are also available, and users can edit the coding of the point if they wish. The point clouds can also be used as input for a range of analysis tasks or to create different surfaces.

ArcGIS provides an extensive set of editing, rendering, and analytical tools for LAS-related workflows. And in the near future, I3S will support point clouds, enabling highly efficient scene rendering of lidar point cloud data provided in the LAS format.

Get more information about how ArcGIS supports LAS files at bit.ly/2FSx3zw.

GeoRSS

GeoRSS was designed as a lightweight, community-driven way to extend existing Really Simple Syndication (RSS) feeds with geographic information. As such, GeoRSS is a simple model and encoding method for geoenabling, or tagging, RSS feeds with location data.

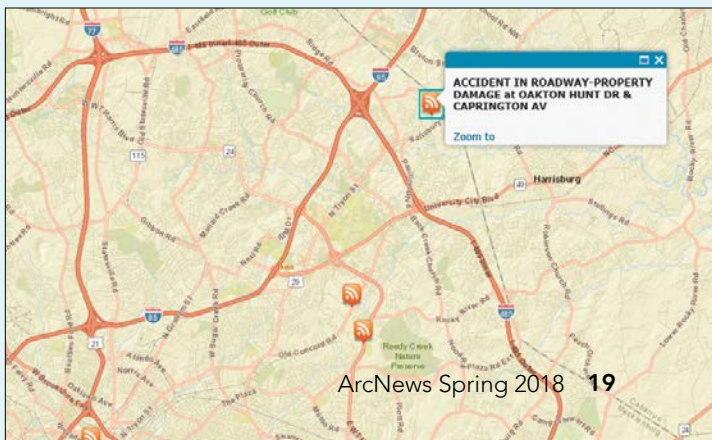
One big advantage of using GeoRSS feeds is that they make incident and emergency communication, Internet searches, geotagging, and map information aggregation more focused, encompassing, and powerful. Rather than get RSS feeds for a particular city or ZIP code, GeoRSS enables users to perform Internet searches by applying myriad geographic criteria. For instance, a homeowner can search all the earthquake-related incidents within 20 miles of his home and get the results delivered to his mobile phone, or a businesswoman with an hour-long commute can get an RSS feed of all the traffic accidents along her daily route. RSS feeds that contain location information power all sorts of apps.

OGC members and their associates began discussing how to geoenable RSS feeds as early as 2003. A small group began collaborating to design and implement GeoRSS in 2005. The initial version of the community-built GeoRSS specification became publicly available in early 2006. Aside from some minor modifications that were made early on, the GeoRSS specification has remained unchanged for the last 10 years. And since its release, GeoRSS has been implemented in hundreds of operational apps from national mapping agencies, multinational institutions, private companies, nonprofit organizations, and more.

GeoRSS was approved as an official OGC Community Standard in 2017. Currently, there are two GeoRSS serializations: GeoRSS Simple and GeoRSS GML. GeoRSS Simple is lightweight but also limits extensibility, while GeoRSS GML is a formal Geography Markup Language (GML) profile that supports a greater range of features than GeoRSS Simple—most notably, coordinate reference systems other than the World Geodetic System 1984 (WGS84) latitude-longitude. Although GeoRSS is designed for use with Atom 1.0, RSS 2.0, and RSS 1.0 web feeds, it can be used just as easily in other languages or encodings, such as JavaScript.

ArcGIS Online has provided full GeoRSS support since 2013, and Map Viewer implements encoding for both GeoRSS Simple and GeoRSS GML.

For more information on how ArcGIS Online supports GeoRSS, visit bit.ly/2r6jEiA.



GeoRSS spatially enables RSS feeds within ArcGIS Online. (Data courtesy of the City of Charlotte and the North Carolina Department of Transportation.)

A Smarter, Safer Way to Walk to School

By Ryan Eckdale-Dudley, Alex Sukupcak, and Kyle Engelking, Symbiont; and David Simpson, City of Wauwatosa

Every child should be able to get to school safely, whether he or she walks, bikes, takes the bus, or gets dropped off by a parent. That's what the National Center for Safe Routes to School—part of the University of North Carolina's Highway Safety Research Center—works to ensure. It sees this as the first step to making entire communities safe for pedestrians and cyclists.

The City of Wauwatosa, Wisconsin, recently sought to improve its own Safe Routes to School program. The city was awash in location data about where students lived, where their schools were, and where there were crossing guards—but it didn't have a way to use this data to benefit students and parents. So senior management decided to leverage all this existing data, plus newly collected data on infrastructure and environmental factors, to create an interactive web-based app that could help parents identify safe, walkable routes to school near their homes. Wauwatosa also hoped it could use the app to make better-informed decisions about potential infrastructure improvements.

The city partnered with Symbiont Science, Engineering and Construction, Inc., and got started.

Identifying What's Safe, and Where

Before the team could begin building the app, it had to identify the environmental factors and infrastructural features that make a route safe and walkable for students—like having well-placed crosswalks and sidewalks and adequate traffic signage. So Symbiont mapped all this out to determine where the city needed additional marked crossings.

To collect this data quickly and easily, Symbiont used Collector for ArcGIS. It took about an hour for the GIS team to assemble a data schema in ArcGIS Desktop and publish a web map to use to denote where street crossings were located and how safe or unsafe they were.

The Symbiont GIS team then took Collector out into the field to document all of Wauwatosa's street crossings and their characteristics. Since most of the city's street crossings are uncontrolled intersections that lack both paint and pedestrian signs, the team assigned default values in Collector to prefill the attributes of a crosswalk data point—noting whether it was painted or not, if it was a controlled or uncontrolled intersection, and whether pedestrian signs were present.

When a team member encountered a crosswalk, he or she would add a point with the prefilled attributes to the map. If that crosswalk did have additional attributes—such as a stop sign, a traffic light, pedestrian crossing signs, or crosswalk markings—the team member would add these elements to the data point using a simple drop-down menu.

It took the City of Wauwatosa just over 40 hours of fieldwork to have a complete database of its 2,130 street crossing assets.

Creating New Safe Routes

Once this data was collected, the city assigned each crosswalk an overall safety score based on its individual attributes. Controlled intersections with traffic lights and stop signs received higher safety scores, while crossings at uncontrolled intersections or in high-traffic areas received lower ones.

Symbiont GIS staff then looked at the distribution of student residences to determine where safer walking routes were needed. The team used the ArcGIS Online World Geocoding Service to map the location of each student residence in relation to his or her school. Using heat maps, the team showed areas throughout Wauwatosa that had a high density of student residences within one mile of a particular school. These were ideal areas for new safe routes to originate.

After assembling the required datasets on crosswalks, student resident locations, and traffic volume, the GIS team used ArcGIS Desktop to generate suggested safer routes by connecting existing sidewalks with the safest crosswalks (according to their scores). Symbiont's team then published these proposed safe routes to ArcGIS Online as feature services so they could be incorporated into both an internal app and a public-facing one.

Making a Helpful Tool for All

To build the apps, Symbiont's GIS staff first brought the published layers together in a web map using Web AppBuilder for ArcGIS. With its what-you-see-is-what-you-get interface, Web AppBuilder for ArcGIS made it easy for the team to quickly build a powerful and intuitive web app—without writing any code. Modifiable themes, such as the Dashboard theme, allowed the team lots of flexibility in designing the look and feel of the app. And Symbiont was able to configure widgets that make it possible to do more than simply view routes. For example, with the Safe Routes Near Me widget, parents and students can quickly search for the safe route nearest their home and receive directions for how to get to it.

To further enhance the city's vision of creating a helpful tool for parents, Symbiont added operational layers to the suggested safe routes. The Walk Time in Minutes layer, for instance, shows parents how long it will take their kids to walk to or from school based on where they get dropped off or picked up. With features like this, the app became even more valuable and user-friendly.

In addition to the public-facing app, the Symbiont team built a private, internal viewer for city officials. Data incorporated exclusively into the internal viewer includes student distributions; crossing guard locations; and crosswalk sites, along with their scores.

Wauwatosa has used the data to strategically relocate crossing guards to more appropriate intersections. The viewer also allows city officials and planners to identify areas that need infrastructure enhancements and pinpoint issues that they couldn't see before, such as the relationship between where crossing guards were placed and student residents are located.

"Utilizing this GIS application to make decisions related to placement of crossing guards has *[proved]* to be an invaluable tool," said David Simpson, the director of public works for the City of Wauwatosa. "I feel that we can be better stewards of the taxpayers' investments into this community by having this tool available to us as we make capital improvement decisions."

To ensure that all kids in Wauwatosa, Wisconsin, can walk to school safely, the city used GIS to update its Safe Routes to School program. (Photo by Brady Pemper.)

Implementing a Data-Driven Solution

After Symbiont finished building the public-facing app, the City of Wauwatosa unveiled it in a pilot program at Wilson Elementary School in July and August 2017. City officials met with school administrators and parent organizations to educate the community about the app.

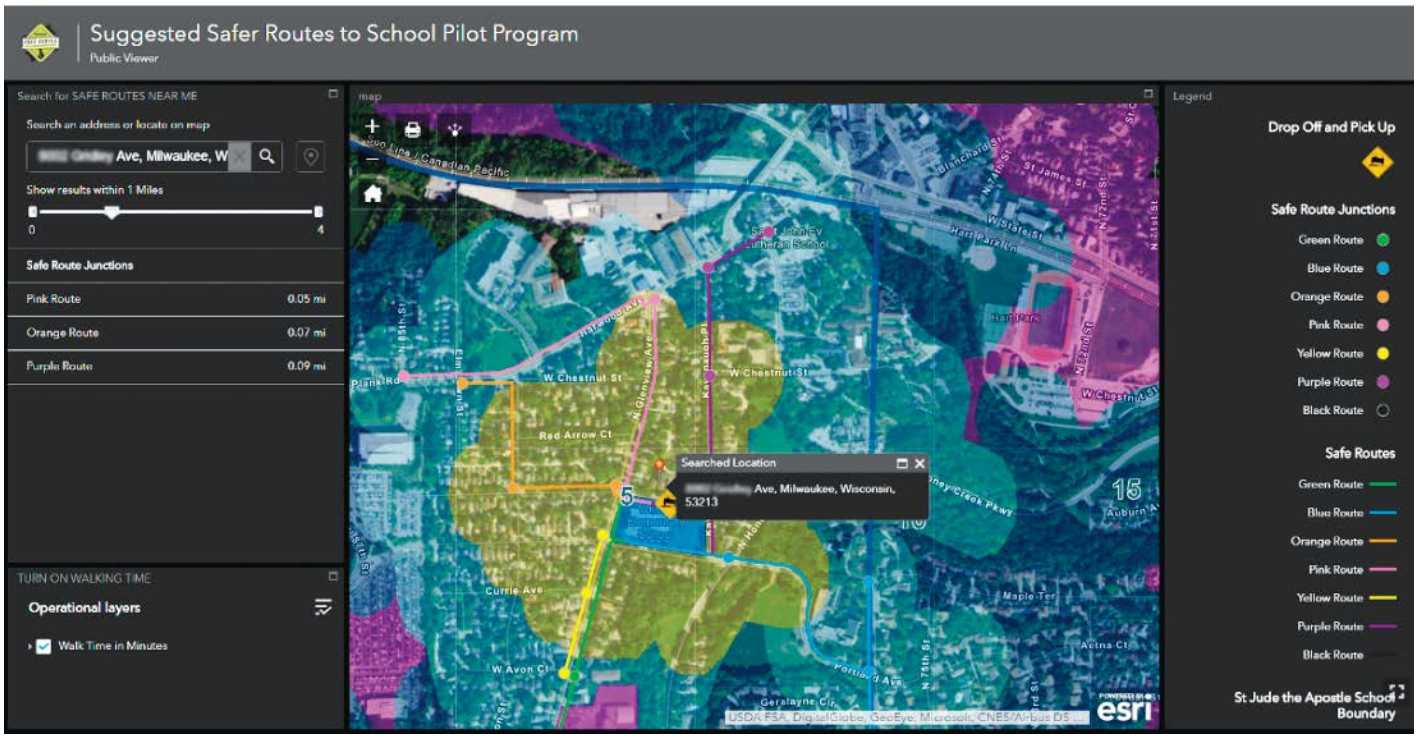
For Wilson Elementary, the city's GIS identified seven safe walking routes that parents could use to take their children to school. During the pilot program, the public was able to use all the app's features, including the Safe Routes Near Me widget and the Walk Time in Minutes layer.

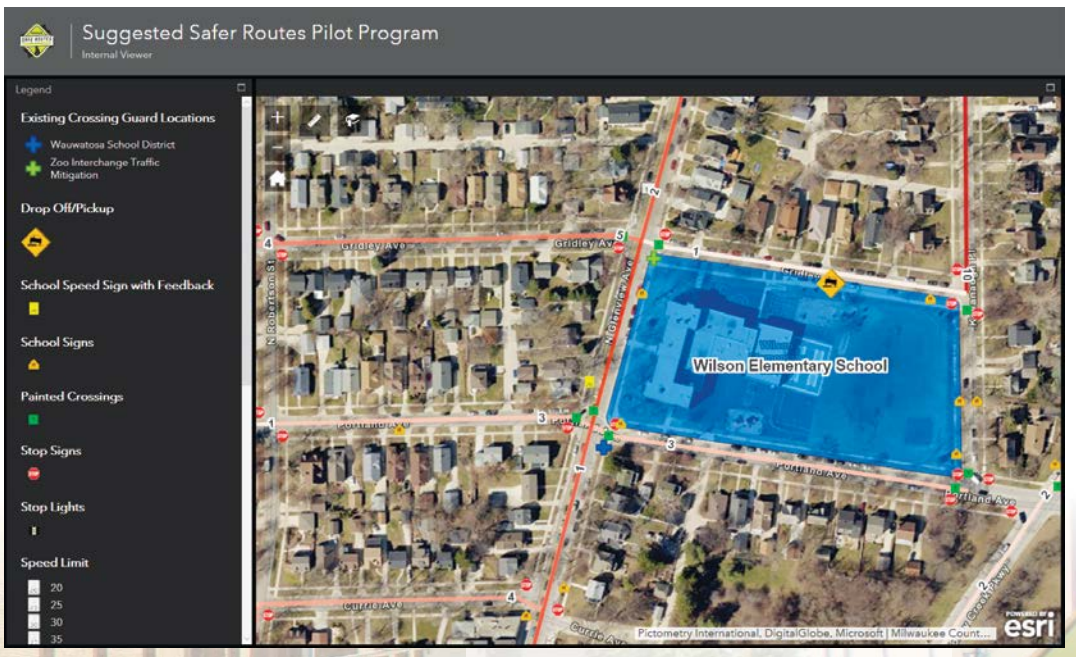
Feedback from parents and school administrators who participated in the pilot program was positive and encouraging. And the Symbiont team intends to continue gathering comments on specific safe routes using an Esri Story Map Crowdsource app that is currently in development.

Based on the success of the Safe Routes to School pilot program, policy makers for the City of Wauwatosa have adopted this data-driven solution to enhance its entire Safe Routes to School program. The district-wide app is expected to launch in time for the 2018–2019 school year.

"This GIS application will likely become the center of the city's Safe Routes to School program," added Simpson. "Communications to parents and students will be dramatically improved by having *[it]* available."

Using GIS to identify and communicate safer walking routes enabled the City of Wauwatosa to ensure that more local kids have safe passage to school. By embracing a data-driven approach and leveraging Esri's GIS tools, Wauwatosa residents and city officials alike have realized the importance of place and gained a better understanding of The Science of Where.





The Safe Routes Near Me widget allows parents to quickly search for safe walking routes near them, and the Walk Time in Minutes layer shows how long it will take to get to or from school.

The internal viewer lets city officials and planners make better-informed decisions about infrastructure improvements.

About the Authors

Ryan Eckdale-Dudley, Alex Sukupcak, and Kyle Engelking are GIS consultants at Symbiont, which specializes in providing innovative, Esri-based solutions to its clients. David Simpson is the director of public works at the City of Wauwatosa, where he champions the use of GIS technology to improve workflows and operations.

For more details, go to symbiontonline.com, email Eckdale-Dudley at ryan.dudley@symbiontonline.com, or contact Simpson at dsimpson@wauwatosa.net.

With GIS, Esri Partners Connect Users and Data in Powerful Ways

Whether organizing data on the challenges of eradicating communicable diseases or helping utilities and police departments implement enterprise-wide GIS solutions, Esri partners are engaging communities, increasing efficiencies, and giving more people access to geospatial information.

Here is how four Esri partners are working with—and extending—The Science of Where.

Tracking Challenges to Eliminating Malaria

Progress in curtailing malaria has stalled, with the World Health Organization (WHO) reporting a global increase in burden in 2016 for the first time since 2000. Further increases are likely, according to the World Malaria Report released in late November 2017.

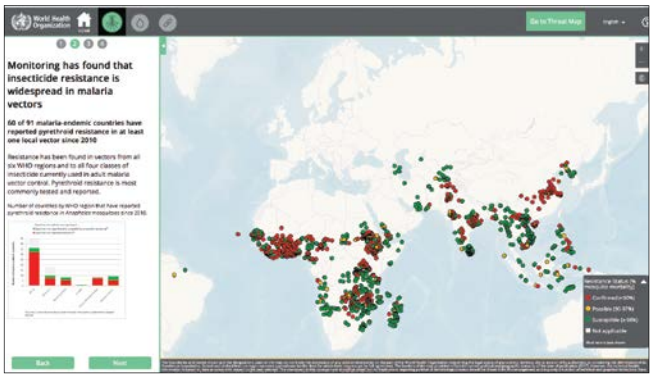
The WHO Global Malaria Programme recognized the need for an interactive mapping tool to identify biological threats that may undermine the prevention, diagnosis, and treatment of malaria. Working with **Blue Raster** (blueraster.com), WHO staff members in Geneva outlined their vision for a powerful display and filtering system that could connect users to authoritative databases on malaria vectors and parasites.

With that guidance—plus data, basemaps, and additional subject matter expertise—from WHO, Blue Raster created the Malaria Threats Map, which shows

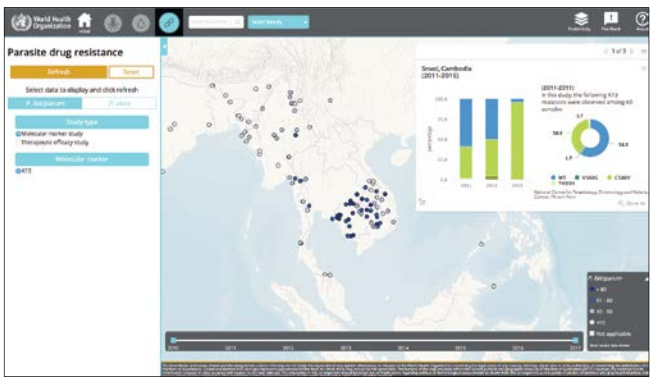
- Vector insecticide resistance: where some malaria-carrying mosquitoes can survive exposure to the insecticides that are supposed to kill them.
- Parasite gene deletions: areas in which rapid diagnostic tests for malaria tend to produce false negative results—and cause people to not get treated—because malaria parasites are missing the genes that these tests usually target.
- Parasite drug resistance: where malaria parasites are resistant to the antimalarial drugs used to treat patients.

The app provides a visual overview of recent data and gives users the option to display it by geographic area and year, as well as by vector/parasite species, insecticide/drug, study type, and indicator. With all the data stored in ArcGIS Server—and ArcGIS API for JavaScript powerfully rendering it—the story map-like app introduces data via curated narratives, displaying detailed information to users and allowing them to filter through thousands of historic outcomes.

The Malaria Threats Map is the sole consolidated source for linked spatial and analytical data on these three trends, and it is available in English, French, and Spanish. With the development phase of the project completed in 2017, there are plans to implement Phase II—adding more data indicators and functionality—in 2018.



A story map-like app, the Malaria Threats Map introduces data via curated narratives, allowing users to filter through detailed data and thousands of historic outcomes.



The app lets users filter data by geographic area and year, vector/parasite species, insecticide/drug, study type, and indicator.

"Blue Raster is honored to work on this global health initiative, bringing the power of GIS to counter a growing malaria threat," said Blue Raster principal and cofounder Stephen Ansari.

Read more about the app on the WHO website at who.int/malaria/news/2017/malaria-threats-map.

Gaining Situational Awareness in Real Time

With a population of 1.5 million and growing, one of the top priorities for the City of Philadelphia is keeping citizens safe. To monitor what's happening, secure events, and coordinate emergency responses throughout the United States' sixth-largest city, officials in Philadelphia rely on access to consolidated, real-time data.

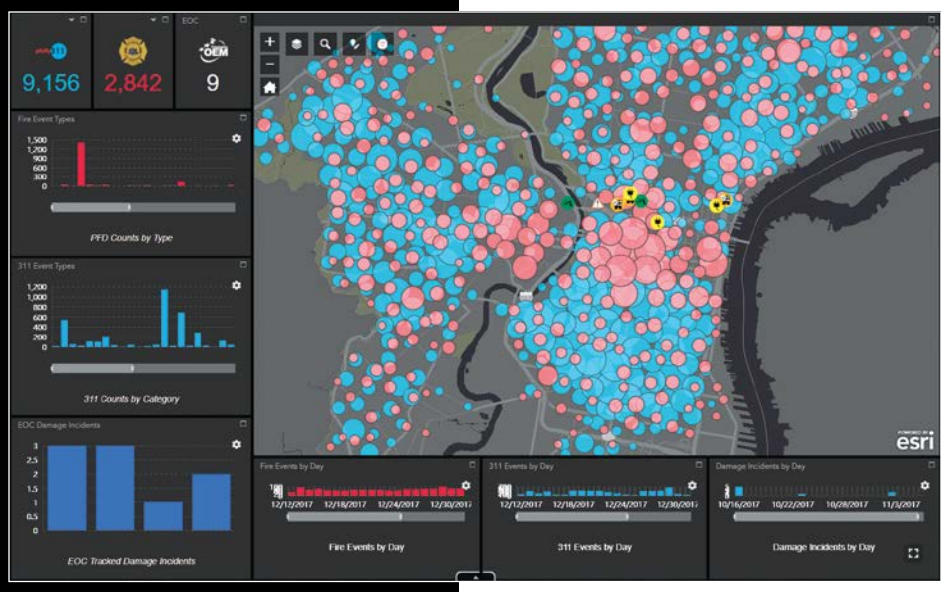
The Philadelphia Office of Emergency Management (OEM) collaborated with geographIT, a division of **EBA Engineering, Inc.** (ebaengineering.com), to build a real-time situational awareness platform. Leveraging ArcGIS Online, ArcGIS Server, and ArcGIS GeoEvent Server, the platform—known internally as City View—has a custom-built native mobile tracking app to help locate OEM staff during deployments. The platform also includes an incident management widget, developed with Web AppBuilder for ArcGIS (Developer Edition), that staff members at the emergency operations center (EOC) use to coordinate and monitor responses to both planned events and emergencies. The widget supports creating and updating incident information, communication between OEM and public safety staff, and assigning and tracking the resources deployed to an incident. It streamlines information gathering and incident monitoring, which saves the OEM time when it matters most.

This robust situational awareness platform, complete with interactive web maps and apps, ensures that Philadelphia's emergency response teams out in the field can view the same real-time information as their colleagues in the EOC. The OEM uses this system 24 hours a day, 7 days a week, 365 days a year to plan, monitor, and manage emergency responses on desktop computers, tablets, and smartphones.

"This solution provides a helpful tool that the OEM uses daily to monitor public safety and security concerns throughout the city," said Daniel Bradley, director of emergency management for the City of Philadelphia. "It is also an essential tool for planning and coordinating public safety response to large-scale, high-profile events like the 2017 National Football League Draft held in Philadelphia last spring."

With the system processing millions of data points each day, officials can see constant streams of real-time information that help them monitor and respond to any situation, whether it's a severe weather event or a parade.

In recognition of this innovative emergency management solution, Esri awarded the City of Philadelphia OEM a Special Achievement in GIS (SAG) Award at the 2017 Esri User Conference.



Damage Tracker, one of the Philadelphia Office of Emergency Management's many apps, performs spatial analysis on real-time data that has been enriched by ArcGIS GeoEvent Server to identify areas that have been impacted by damage-causing events, such as fires.

THE SCIENCE OF WHERE™

Keeping Citizens Safe in Fayetteville, North Carolina

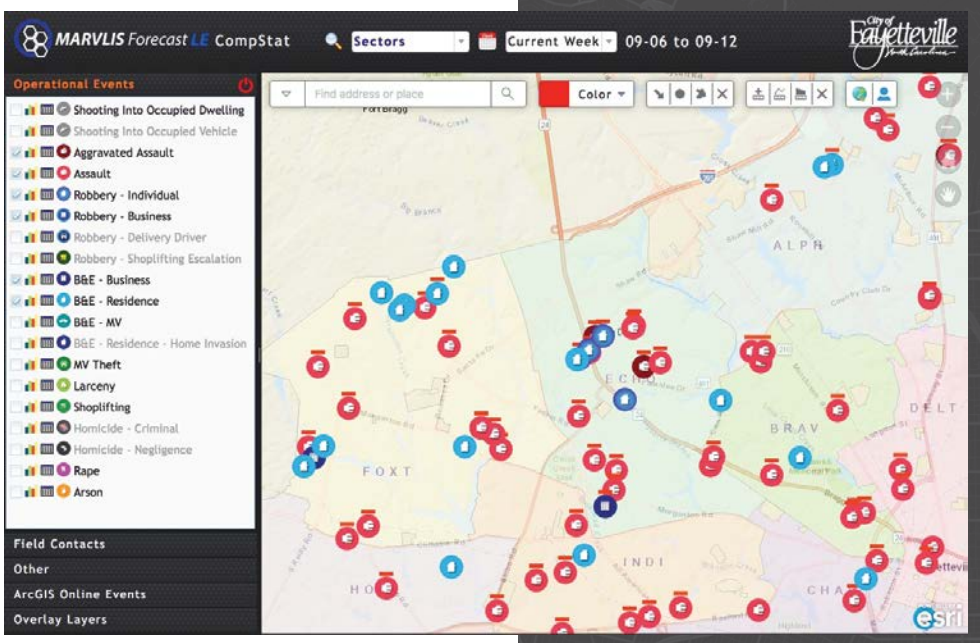
The Fayetteville Police Department understands the benefits of using data-driven solutions to track incidents and enact crime reduction and prevention models for the more than 200,000 citizens in its jurisdiction. But as more facets of police work required accurate and timely data and analytics—from investigations and shift meetings to neighborhood watch programs and public relations initiatives—the burden on the team responsible for data management surged. By 2015, just supporting the administration of weekly departmental CompStat (COMPare STATistics) meetings required 18 hours or more per week from analysts.

Because of its long-standing relationship with the Fayetteville Police Department, the team at **Bradshaw Consulting Services** (bcs-gis.com) understood the challenges the department was facing and how it wanted to improve intelligent data sharing across teams. To meet these needs, Bradshaw Consulting Services (BCS) presented the police department with an opportunity to move to an enterprise system and implement BCS's MARVLIS Forecast LE solution.

With MARVLIS Forecast LE leveraged on ArcGIS Server via an enterprise agreement, the Fayetteville Police Department can now share data and analytics through portals, dashboards, and widgets. It can also customize and configure these so they meet the specific needs of various staff members, from analysts and command staff to officers in the field. This ensures that critical operations data is freely available throughout the department.

The MARVLIS Forecast LE solution also updates and maintains data sources from various independent databases, such as CAD and record management systems. These data sources supply the various modules of the system, such as the CompStat dashboard, with real-time data like traffic and weather reports.

Since putting MARVLIS Forecast LE and ArcGIS Server into action, the Fayetteville Police Department has experienced an 86 percent reduction in the time it spends curating data and working out internal processes. This gives police officers more time to perform crime analysis and support crime prevention activities—especially since they can now use a series of simple dashboards to complete these assignments. This system has also made it easier for the department to share information through its ArcGIS Open Data site.



← With MARVLIS Forecast LE leveraged on ArcGIS Server, the Fayetteville Police Department can now share data and analytics through portals, dashboards, and widgets.

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Jump-Starting an Enterprise GIS Implementation

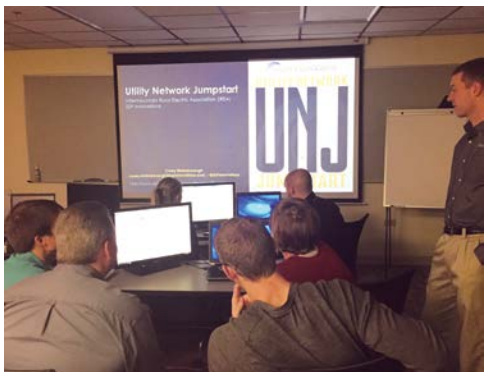
As one of the largest electric utility distribution cooperatives in the United States, Intermountain Rural Electric Association (IREA) in Colorado is responsible for keeping the lights on for more than 150,000 customers over a 5,000-square-mile area. Given the diverse and often extreme weather conditions that characterize this western US state, it is crucial that IREA can continually monitor its vast service area, analyze what's happening, and act fast as weather changes occur.

To increase access to mission-critical data across teams—both in the office and out in the field—and streamline internal processes, the IREA GIS team connected with **SSP Innovations** (sspinnovations.com) and learned about its Jumpstart for the ArcGIS Utility Network Management extension. With Jumpstart, IREA got help implementing the extension, as well as ArcGIS Pro, along with on-site consulting from SSP Innovations service experts.

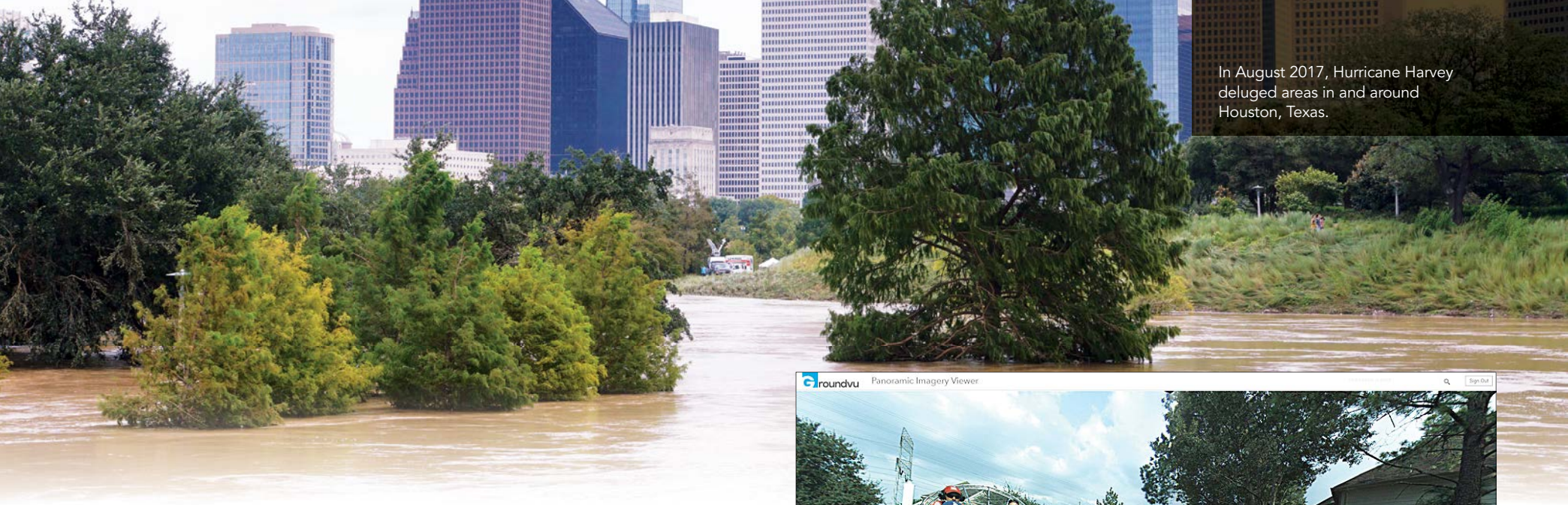
Shortly after beginning Jumpstart, IREA recognized that integrating the ArcGIS Utility Network Management extension with its existing business systems offers greater insight and visibility for field crews; new models for managing network data; and the ability to build network diagrams and 3D connectivity, validate that connectivity, and conduct traces in all map presentations. Beyond showing the utility network data model, the Jumpstart lectures discussed the feature and object classes behind the model and offered clear explanations about why the data model was designed the way it was.

The IREA GIS team gained a clear understanding of how Esri visualizes and manages its data within the ArcGIS Utility Network Management extension and how to incorporate the solution into its workflows.

"The most important results attained from our Jumpstart experience *[are that we understand]* the new data model and the opportunity to provide feedback on the transformation of Utility Network," said IREA director of GIS Duane Holt. "Working with SSP on Jumpstart allowed IREA to gain this understanding in the most efficient and effective manner possible."



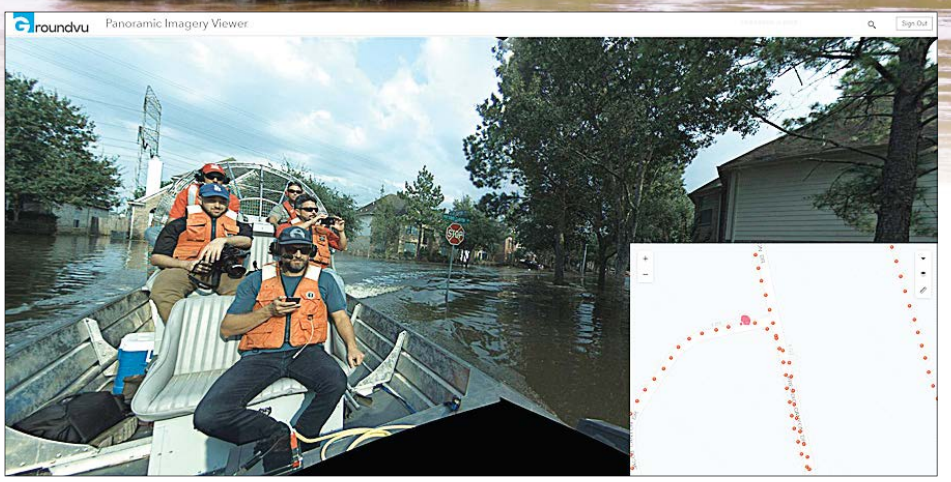
↙ ← With SSP Innovations' Jumpstart for the ArcGIS Utility Network Management extension, Intermountain Rural Electric Association (IREA) got help with implementation, as well as on-site consulting, from service experts.



In August 2017, Hurricane Harvey deluged areas in and around Houston, Texas.

Grounding Disaster Relief in Reality

Esri Startup Partner GroundVu Gives Texas County a True, 360-Degree View of Hurricane Harvey Flooding



The GroundVu team rode in an airboat to capture imagery in a flooded neighborhood near Houston.

Last August, torrential rains triggered by Hurricane Harvey swamped Fort Bend County, Texas, southwest of Houston, forcing some residents to flee their homes for higher ground.

While the skies soon cleared, the flooding in certain areas persisted for days, preventing some people from returning to their houses. Frustrated and frightened, community members demanded to know the status of their properties. Were their homes or yards still flooded? Were the waters receding?

For people who lived in the Canyon Gate at Cinco Ranch subdivision in Katy, Texas, the answers came via an online app called the Panoramic Imagery Viewer, created by **GroundVu** (ground.vu). The app, built using Esri's ArcGIS API for JavaScript, provided 360-degree, panoramic imagery of every home and yard along the streets of the subdivision. Users could view the images by clicking on a location in an ArcGIS Online web map that was embedded in the app.

Loaded with thousands of images taken by a panoramic camera from the streets in front of the homes, Panoramic Imagery Viewer—available at p.ctx.ly/r/6ji5—gave both county officials and neighborhood residents a timely and up-close look at their properties, revealing which ones remained flooded and to what extent.

"It's a ground-level view of what's going on," said Myles Sutherland, chief executive officer and geographer at GroundVu, a startup based in Santa Monica, California.

Having little or no visibility of the level of flooding and damage in residential and business areas, staff at Fort Bend County turned to outside expertise for data and maps that would help in disaster recovery efforts and provide residents with answers to their questions. The Fort Bend County Office of Emergency Management reached out to Texas A&M University, which runs the Center for Robot-Assisted Search and Rescue (CRASAR) engineering experiment station.

CRASAR activated Roboticists Without Borders (RWB), a group of volunteer experts trained in disaster response. Members of the group came from companies and universities and brought with them a fleet of drones to capture the much-needed imagery. GroundVu was among those organizations answering the call. While other volunteers were flying drones to obtain aerial imagery of the flooded areas, the startup offered a different type of situational awareness: 360-degree panoramic images captured on the ground using its custom-made, vehicle-based pod mobile mapping system.

Reporting to the emergency operations center, Sutherland worked directly with the US Army Corps of Engineers and the Army National Guard. The team requisitioned an airboat that could skim the top of flooded streets with little chance of colliding with submerged objects. Team members attached the company's mobile mapping system, with a built-in GPS, to the prow and hoisted the airboat onto a trailer bed. Using the highway as a boat ramp, they launched their skiff into the waters.

The GroundVu crew motored through the flooded streets of Canyon Gate at Cinco Ranch, capturing 360-degree panoramic images at one-meter intervals. The photographs show floodwaters lapping against fences and houses and sloshing up against the cars and trucks that were parked in driveways. The crew went out a second time in an Army National Guard high-water vehicle and captured more images, which were provided to Fort Bend County.

"GroundVu responded to the county's request for ground-level images incredibly fast," said Michael Wainright, GIS director at Fort Bend County. "As GroundVu continued to map a number of neighborhoods, the ground-level images provided a perfect complement to our drone images."

The GroundVu app, which was hosted on GitHub, was built using ArcGIS API for JavaScript and the ArcGIS REST API. The images and maps are consumed from Fort Bend County's ArcGIS Online organization.

To upload and store the imagery and map data and create feature layers for the map, GroundVu's Sutherland received access to a Fort Bend County ArcGIS Online organizational account. He said he used the ArcGIS REST API to process the images, run scripts, and automate the task of uploading about 10,000 images. When field crews collected new data, the software updated the database and the image viewer displayed new images.

Fort Bend County provided a link to the Panoramic Imagery Viewer on its website. Residents of Canyon Gate at Cinco Ranch were then able to use the map in the app to see the flooding situation around their homes. By clicking the orange dot of a residential location on a street map, homeowners could view a panoramic image of their homes' exteriors and pan to see the condition of adjacent homes. The app verified whether homes were flooded and at what level.

The *Houston Chronicle* embedded the app in a news story about the flooding in Canyon Gate at Cinco Ranch. And the county judge—who oversees the county government—used the imagery to decide when people could return to their homes, Sutherland said.

Drone imagery of the flooding was posted on YouTube, but the drones flying over the area had to contend with dangerous power lines, as well as clouds and trees that blocked the view. The GroundVu team captured its images without these obstacles, providing greater insight into the evolving situation on the ground. Moreover, the GIS component of the solution added geographic and spatial context to the imagery data so it could be mapped.

"While drone video provides a good overview of an emergency situation, GroundVu's 360-degree images provided us with an address-level view of the front of people's houses and allowed us to estimate the amount of water in each home," Wainright noted. "We were able to use the 360-degree view to verify the extent of the flooding through an online map interface."

Private and public access to the content was managed by the county so it could use the imagery and maps for its own purposes via an internal web app before making select content available to residents.

Shortly after the flooding subsided, Sutherland returned to Fort Bend County to once again put GroundVu's mobile mapping system to work—this time, to assist with the county's debris and damage assessment efforts. Residents had cleared their homes of ruined carpet, furniture, and other household items, piling the debris in their front yards to be cleared away by garbage collection crews.

GroundVu's image collection and app viewer helped the county quickly review the debris piles and allowed the company overseeing debris collection to assign the correct number of workers and trucks to the area. This saved valuable time and resources during disaster cleanup operations.

The GroundVu team will continue to work with CRASAR on disaster response, as well as with the Esri Disaster Response Program, to provide comprehensive sets of image products via its vehicle-based and aerial imagery collection pods.

In the aftermath of future disasters, the use of planes, drones, and ground-based panoramic imagery will enable first responders and recovery teams to receive rapid insight into the situations they face.

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**.

Location Intelligence Ensures Tornado Warnings Work When It Matters Most

With Survey123 for ArcGIS and Lucity, Tuscaloosa County Inspects Sirens in Real Time

By Raj Patil, Lucity

If a natural disaster were to strike in Tuscaloosa, Alabama, the Tuscaloosa County Emergency Management Agency (TCEMA) would provide leadership, planning, education, and resources to protect lives, property, and the environment. The multijurisdictional organization—jointly funded by the City of Tuscaloosa, the City of Northport, and Tuscaloosa County—serves all jurisdictions and stakeholders in the county, which is Alabama's second largest by land area. TCEMA also coordinates state and federal resources when any are needed in a disaster management situation.

As part of its disaster preparedness and planning operations, TCEMA maintains outdoor warning sirens located throughout the county. These sirens are used to alert the public about tornadoes, which are relatively common in the southeastern United States. As early warning tools, they are also critical to managing disaster response activities, including mobilizing first responders, coordinating storm shelter needs, and facilitating timely evacuations.

TCEMA needed a way to track not only the siren assets but also its fleet and equipment. Which is why the agency opted to gain location intelligence using the ArcGIS platform along with Esri partner Lucity's enterprise asset management system.

Tracking Siren Inspections in the Field

With its tornado siren data strewn across spreadsheets, shapefiles, SDE files, map books, and other paper records, TCEMA was finding it challenging to track the various activities related to doing siren inventories; conducting inspections; performing maintenance; and putting together reports for the Federal Emergency Management Agency (FEMA), since many of the sirens were purchased with federal grant funding. Monitoring these activities was inefficient, time-consuming, and costly—and most importantly, it affected the agency's ability to maintain up-to-date information about the sirens to adequately forewarn citizens of potential danger.

To fix this, TCEMA began by making it easier to document inspection and maintenance data. Starting in January 2017, TCEMA identified and validated information about all its sirens in the field. Then, the Tuscaloosa County Public Works (TCPW) department, as a collaborative partner, imported the existing siren shapefile features into its enterprise geodatabase. Finally, Jeannette Byrd, a mapper and GIS analyst at TCPW, set up a web feature service to publish this data to the field via ArcGIS Online. Within approximately three months, TCEMA had a functioning field solution.

Now, using an easily configured Survey123 for ArcGIS app that TCEMA built, authorized users from TCEMA and TCPW can visualize and interact with the siren features in real time. They can record the required attributes for a siren inspection—such as whether or not the siren is functioning and if there is vegetation that could interfere with its operation—and simultaneously view and correct each siren's mapped location. With the siren data now housed in Lucity's enterprise asset management software, the GIS features are linked to their related maintenance work orders.

"TCEMA is now able to leverage the Esri platform within and outside the office," said Byrd. "It was simple for us to import the old shapefile of siren locations to our enterprise geodatabase and create the Survey123 application. The app allows the EMA specialists to concurrently record a siren inspection and check the existing mapped location of that siren. The easy picklist format of Survey123 ensures the integrity of the data and a smooth data import into our Lucity asset management system. Tracking work orders in Lucity allows us to document maintenance and, therefore, *[reduce]* costs."

In addition to optimizing how TCEMA tracks siren inspection and condition data in the field, this real-time process enables the agency to complete its inspection and maintenance reports more quickly and accurately. By giving authorized employees shared access to and visibility of important public service information in the ArcGIS platform—at any time, and from anywhere—TCEMA was able to achieve higher levels of productivity.

"For a project such as this, cost is always a factor," said TCEMA director Rob Robertson. "The agencies were able to leverage existing Esri and Lucity deployments. Both platforms are flexible, making it easy to adapt our technology investment and increase the *[return on investment]* of stakeholders' tax dollars."

The data in TCEMA's ArcGIS platform is also shared with Lucity, the agency's system of record for work and maintenance activities. This means the data only has to be updated once before authorized users can have transparent access to the siren data published and shared through ArcGIS. That way, TCEMA and TCPW can easily track and follow up on the work activities that are required to

- Perform routine maintenance on outdoor warning sirens.
- Ensure that sirens are in proper working condition.
- Maintain regulatory compliance regarding safety and operational readiness.
- Achieve the desired level of disaster preparedness.

"As the outdoor warning sirens age, maintaining these assets becomes more critical," pointed out Robertson. "Having them accurately mapped and tracked means better siren performance and more efficient use of agency funds."

Optimizing Field Visits Even More

By leveraging the mobile and web capabilities of the integrated ArcGIS platform, TCEMA has achieved significant efficiencies in managing its outdoor disaster warning systems. Using focused, mobile apps together with the spatial, interrogative, and analytical functions of ArcGIS Online has made it easier for field operations staff to check, fix, and report on critical assets, as well as to coordinate response activities during disaster events.

"The Esri and Lucity platforms are flexible enough to allow us to inspect, maintain, and track county assets not only during routine workflows but also during emergency situations," said Robertson. "Our agencies work together under the Tuscaloosa County umbrella, and now we have a unified system to document and analyze our cooperative efforts."

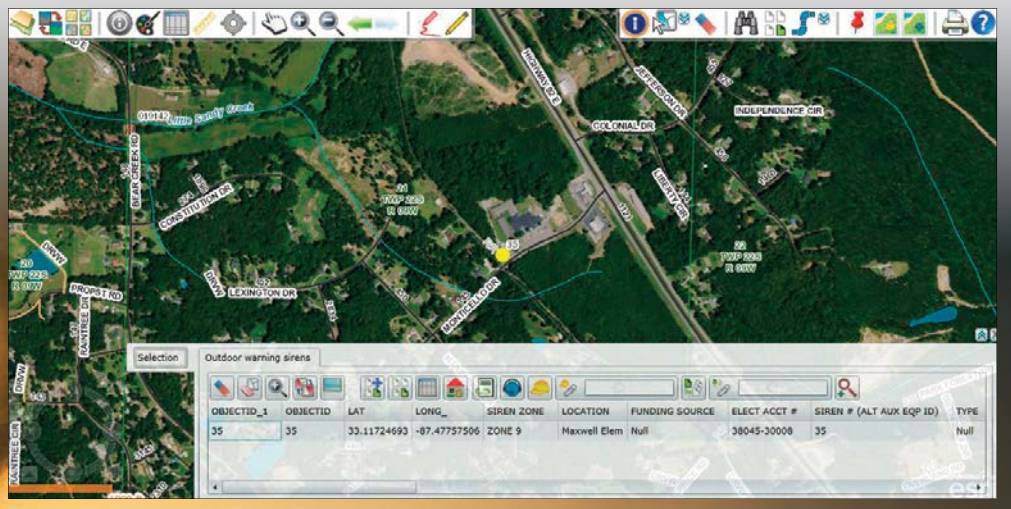
As part of its ongoing endeavor to further optimize field visits, the agency is looking to use Navigator for ArcGIS, which is also integrated with the Lucity work management platform, to help siren inspectors and maintenance workers travel more efficiently to each siren's location when needed. This is expected to strengthen TCEMA's operational foundation and boost workforce productivity, helping the small agency meet its goals more effectively.

"Tuscaloosa County has many remote, rural areas," pointed out Tyler Deierhoi, a GIS and emergency management specialist with TCPW. "Navigation capabilities enable inspection activities to be made efficiently, often when TCEMA staff may be in the area for other types of work. This enables us to not only save on employee hours, but also on fuel costs related to travel."

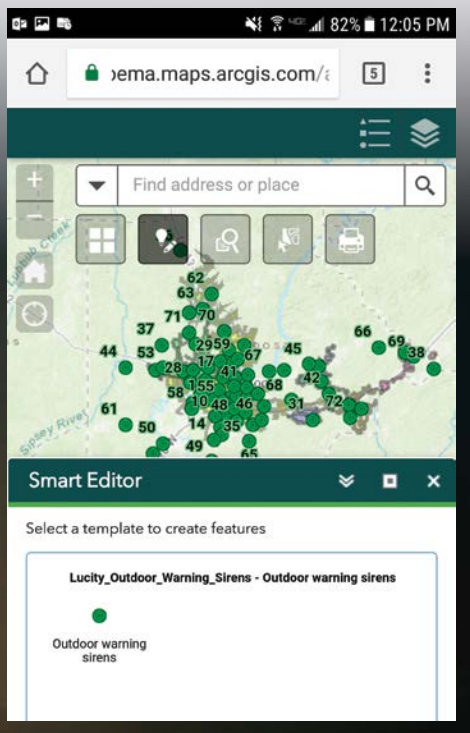
Deierhoi, along with his colleagues, looks forward to continuing to expand the county's use of GIS and enterprise asset management technology to support additional improvements in emergency management and response across Tuscaloosa County.

About the Author

Raj Patil is the director of strategic partnerships, marketing, and international business at Lucity.



↘ Siren data is now housed in Lucity's enterprise asset management software, which links the GIS features to their related maintenance work orders and cost estimates.



↘ Using Survey123 for ArcGIS, EMA specialists can check a siren's location on the agency's existing map at the same time that they conduct a siren inspection.

Navigating to Hundreds of Thousands of Inspections with Ease

Electrical Inspectors in Washington State Now Use Navigator for ArcGIS to Get from Place to Place

The Washington State Department of Labor and Industries (L&I) is responsible for ensuring and maintaining the safety, health, and security of workers all over Washington. The department assists employers in meeting health and safety standards and inspects workplaces when notified of hazards or potential dangers. With 19 offices throughout the state, the department employs approximately 2,800 people—including safety inspectors, claims specialists, nurses, researchers, accountants, labor experts, and support staff.

Anytime a resident or business in Washington installs electrical equipment or makes an upgrade to an electrical system, the local municipality or L&I must inspect it. The department's 200 inspectors perform nearly 200,000 electrical inspections each year.

In an ongoing effort to develop more efficient inspection workflows, L&I decided to have its electrical inspectors create their own customized travel routes. Navigator for ArcGIS became the centerpiece of this project because of its ability to route multiple stops and recalculate a route if something changes.

"By making it easier and faster for our inspectors to drive from site to site, they will be able to more easily complete their daily inspections," said Winston McKenna, a GIS product administrator for L&I. "We wanted to have a workflow and applications we could consistently count on being up-to-date and using the latest information for routing and geocoding."

Creating Customized Routes

McKenna and his team developed an ArcGIS platform-based solution that incorporates geocoding, routing, and custom basemaps. Now, when someone submits an application for inspection through the department's website, the application is added to a SQL database and the address is geocoded. Electrical supervisors can then see the geocoded addresses displayed on their workstations, which they use to assign inspection locations to each inspector.

Once the inspectors see their assignments pop up on their laptops, they can create an optimized route for their day using a custom app that employs the ArcGIS Network Analyst extension and StreetMap Premium for ArcGIS, both in ArcGIS Enterprise. When their routes are planned, the inspectors save them as web links and then connect their department-issued iPhones to the planned route using Navigator.

"Information in StreetMap Premium is well-organized, well-maintained, and consistent from release to release," said McKenna. "Updating the geocoding and routing service is a breeze, and there is minimal interruption."

Inspectors use Navigator on their iPhones to receive audible, turn-by-turn directions as they drive to each inspection stop. A custom L&I basemap enables managers and inspectors to add, maintain, and update any information along inspectors' routes—such as rural or forest roads, fuel stations, department offices, and regional boundaries.

The team also created a map package that allows inspectors to use Navigator while offline in places with limited or no connectivity.

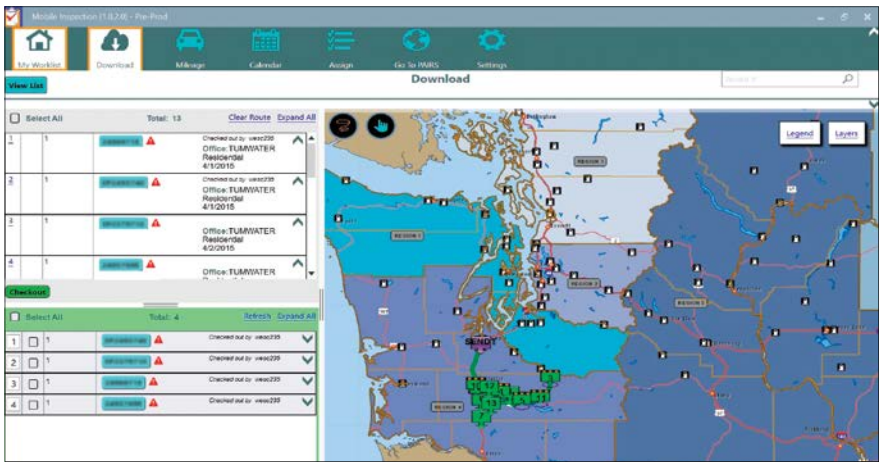
"It's the easiest, most time-efficient, and most process-efficient way to create customized routes," said McKenna. "We can adjust the settings to reflect the environment across the state—for example, routes that involve taking a ferry or areas that are closed for parts of the year due to weather."

More Dynamic Workflows

With Navigator now part of its daily operations, the department has a consistent view of its authoritative data on a navigation map that its users can customize and configure. It is easy to create and share efficient route plans, and L&I has facilitated clearer communication between managers in the office and inspectors in the field. What's more, the department saves time and money because inspectors now drive fewer miles by sequencing stops in the most logical order and taking the surest route to their inspections.

"Navigator reduces unnecessary stops and will readjust the order to minimize the time and distance from location to location," said McKenna, who indicated that inspectors are showing a 1–3 percent increase in the number of inspections they complete. "Our inspectors now have a dynamic navigation and visualization tool *[that]* allows them to adjust to changes in their workday responsibilities. If someone needs to cancel or delay their inspection, the inspector can make the change in Navigator for ArcGIS, and the app will account for that."

For more information on how the Washington State Department of Labor and Industries implemented Navigator into its daily workflows, email McKenna at winston.mckenna@lni.wa.gov.



The Washington State Department of Labor and Industries' (L&I) Mobile Inspection app displays downloaded or searched inspection locations (green), as well as the inspector's starting point (purple).

It's GoTime for Massachusetts Commuters

Using AppStudio for ArcGIS, VHB Delivered Real-Time Traffic App On Time and On Budget

One of the objectives for the Massachusetts Department of Transportation (MassDOT) is to create a cleaner, more efficient, and sustainable transportation system. To aid in achieving that goal, MassDOT developed the Real-Time Traffic Management (RTTM) system, which consists of 137 digital signs that display live travel times to 300 destinations and are placed on more than 700 miles of highway throughout the state. The department estimates that 2.2 million motorists view these signs each day.

While the RTTM system provides valuable real-time information to commuters during their travels on the state's roadways, MassDOT recognized that this information could also be used for pretrip planning. So the department decided to deploy a modern, publicly accessible, and stable mobile companion app: GoTime. And it needed to make it available quickly.

Given its long history of executing successful projects with MassDOT, Esri partner VHB was tapped for the job. A transportation planning and engineering company with 23 offices stretched out along the entire East Coast of the United States, VHB has been a designated Esri ArcGIS Online specialty partner since 2015. The company's applied technology (AT) team focuses on developing geospatial web, desktop, and mobile solutions. Thus, designing, developing, and deploying a native iOS and Android app fast was a challenge that VHB was ready to tackle.

VHB quickly identified the critical project constraints, which were a short time-to-market window coupled with a native code requirement for both iOS and Android. Having flagged up these key driving factors, VHB reached out to Esri to explore whether AppStudio for ArcGIS would work to build GoTime. With assistance from Esri, VHB identified the unique opportunity that using AppStudio for ArcGIS would provide, since it could achieve the goals of the project while mitigating the pressure of turning around an app quickly.

The central advantage of using AppStudio for ArcGIS is that it is built on the Qt framework, providing developers with the ability to write just one code base and then publish to multiple native solutions—in this case, iOS and Android. The singular code base model allowed VHB's AT team to quickly and cost-effectively complete iterative and collaborative design while still delivering a seamless user experience across multiple devices.

"AppStudio was selected primarily because, with that tight time frame, we decided there was no way we were going to be able to build two separate code bases natively—one for iOS and one for Android," said Larry Spraker, an applied technology manager at VHB.

Another benefit of AppStudio for ArcGIS is that testing is integrated, so VHB was able to use iOS simulators and Android emulators to test its app without having to do it on multiple phones and tablets. Moreover, AppStudio for ArcGIS can create app installation files both locally and in the cloud, yielding even more efficiencies for VHB's development team.

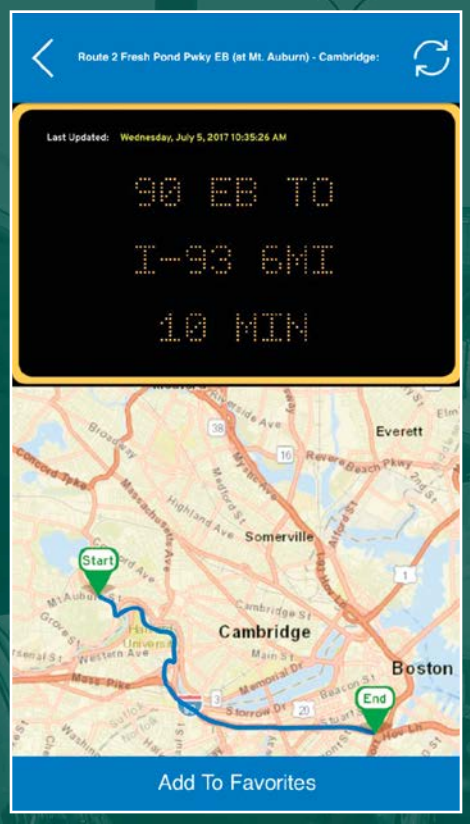
Even after the app was released, the AppStudio for ArcGIS development environment continued to be advantageous because it allowed resource managers flexibility in assigning tasks. Since all developers on the team were skilled in the Qt framework, one developer could make an enhancement to the app that would manifest in both native code bases. This prevented tying up multiple developers for enhancements and upgrades.

It took the VHB AT team just five weeks to conceptualize, develop, and launch the GoTime mobile app in the App Store and Google Play. Since going live in early 2017, more than 9,000 users across Massachusetts have installed the free GoTime mobile app on their iOS and Android devices.

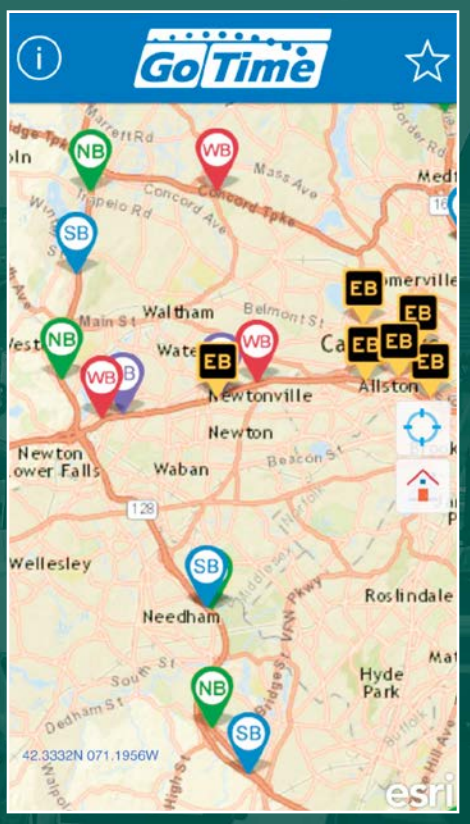
Using the app, drivers in Massachusetts can now quickly identify congested travel corridors and adjust their commutes accordingly. On a smartphone or tablet, a user can see the travel times shown on both permanent and temporary electronic highway signs. Map symbols labeled with *NB*, *SB*, *EB*, and *WB* denote which side of the highway each sign is on. When the user taps one of these symbols, the screen displays what is being shown on the highway signs. From there, the user can tap an arrow to see a map of his or her travel route from start to finish.

With the ability to make better-informed travel decisions, drivers can improve their daily commutes and save time, gas, and money. These positive results directly align with MassDOT's objective to create a more efficient transportation system. And with AppStudio for ArcGIS, VHB achieved its goal of successfully executing yet another on-time, on-budget project—this time, a native deployment of a geoenabled mobile app.

Driving in Massachusetts anytime soon? Download GoTime at massdotgotime.com.

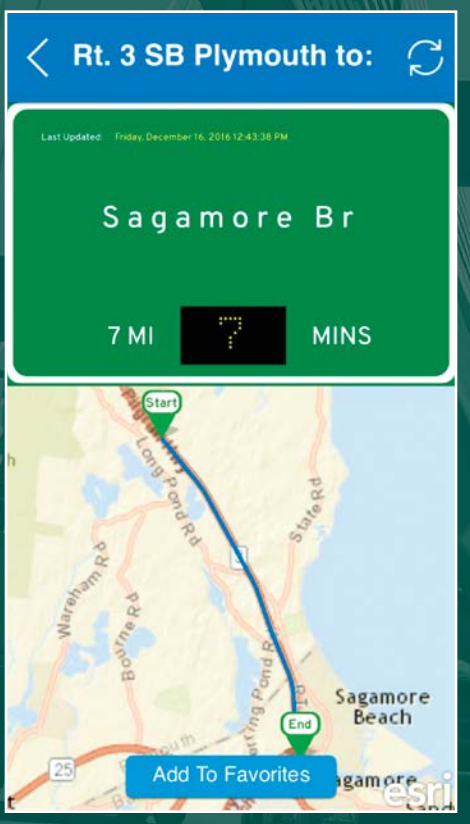


← The GoTime app displays the travel times shown on both permanent and temporary electronic highway signs.



← The *NB*, *SB*, *EB*, and *WB* symbols denote which side of the highway the specific sign is on.

← Users can tap on the arrow of the display panel to see a map of the travel route.



← Users can see their selected route from start to finish. They can also add signs to their Favorites list.

Crossing Borders

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

Rebuilding US Infrastructure Requires GIS and Geospatial Data

A new study by the National Geospatial Advisory Committee (NGAC) warns that the United States' rapidly aging infrastructure is already creating safety hazards, diminishing quality of life, heightening vulnerability to natural disasters, and impairing economic growth. Infrastructure renewal is a national imperative for the United States, and it requires cooperative and coordinated action by the private sector and all levels of government.

The NGAC study, entitled *Geospatial Information: The Key to Smart Infrastructure Investments*, highlights the crucial role that geospatial technologies play in supporting infrastructure planning and development. It also gives recommendations on how to maximize returns on infrastructure investment.

As a member of NGAC, I feel that this report merits the attention of the entire geospatial community. That is why I am dedicating this column to summarizing its findings and recommendations.

Informing Infrastructure Renewal Effectively

As the United States begins to reprioritize the rebuilding of its infrastructure, the governments and companies involved will need accurate and reliable spatial data of all types to ensure that scarce dollars are spent in the most efficient and effective ways possible. Knowing where infrastructure is located, how different pieces relate to one another, and where the critical dependencies lie are required first steps for making good financial decisions.

Geospatial information and technologies make it easier to discern and understand the precise location of every facet of infrastructure, from what's underground to what's overhead. Fortunately, tremendous advances in geospatial technologies—many of which have been driven by the commercial sector, including Esri—have made these tools far more powerful, accessible, and usable. Employing technologies such as intelligent, real-time GIS and GPS maps to prioritize, plan, and execute new infrastructure projects can help optimize public and private infrastructure investments and avoid inefficiency and waste.

Maps created using GIS, GPS, and aerial imagery can be generated and updated rapidly. Additionally, they typically contain detailed information not only about current and planned infrastructure improvements but also about the contexts surrounding them. For example, if a local government wants to visualize all the pothole locations in its downtown area, it can use GIS to see them all mapped out—and then add useful data layers, such as traffic flow and pavement type, to pinpoint what's causing them and try to figure out how to stave them off in the future. These maps can be shared digitally across sectors to improve project planning and operations. And that is just one example of the many geospatial technologies that can effectively inform infrastructure renewal.

To get the myriad elements of new national infrastructure programs to coalesce, investments need to be smart, timely, data driven, and efficient. They must also account for society's current and future needs in a sustainable way. Significantly, the planning and design processes will generate new jobs and continued innovation in the GIS and geospatial technology sectors.

Creating and Maintaining Geospatial Databases and Models

If governments and companies use geospatial technology to thoughtfully coordinate infrastructure planning for mass transit, public spaces, and low-impact development, then the United States will be able to economically cultivate smart, resilient communities with improved qualities of life.

Geospatial technologies can be used to effectively manage infrastructure assets over their entire life cycle—from design and construction to operation and maintenance. They can engage local communities from the get-go. They make 3D infrastructure modeling possible, which enables investors and operators to visualize projects during the planning process and better understand their costs and benefits. They can identify and resolve conflicts quickly and holistically.

Geospatial technologies are essential to managing infrastructure assets such as storm water drains, gas pipelines, tunnels, bridges, the electrical grid, and broadband. The sophisticated geospatial analyses they facilitate, integrating space and time management, help infrastructure planners and operators cope with highly complex projects. Thus, creating and maintaining large-scale geospatial databases and models is important to intergovernmental coordination and should be supported by national research funding agencies.

Building the Infrastructure of the Future

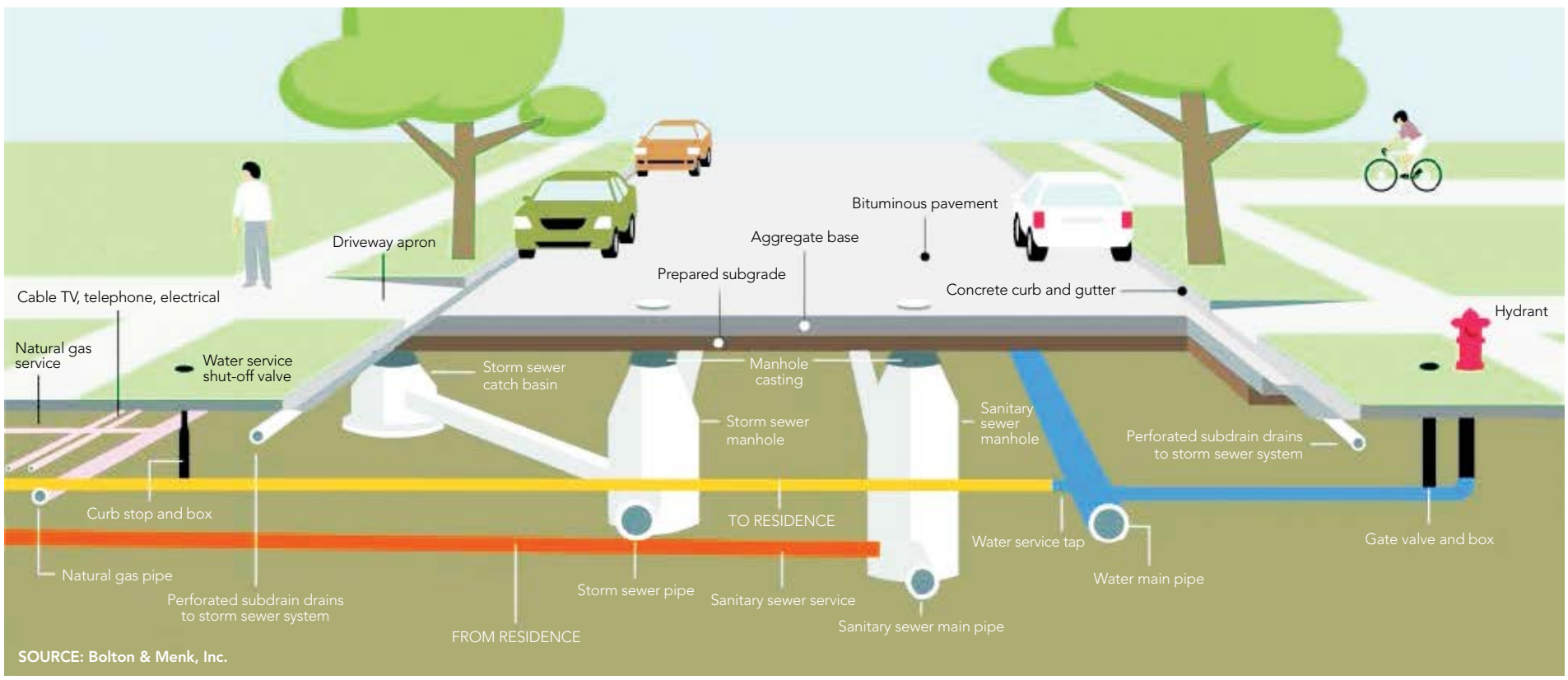
The NGAC report emphasizes that all levels of government, as well as private entities, have a role to play in using geospatial technologies to enhance the efficiency of infrastructure renewal. Governmental roles entail

- Supporting foundational data, such as remotely sensed imagery, address data, and other National Geospatial Data Assets.
- Promoting data sharing standards to reduce duplicate efforts and enhance data sharing.
- Using geospatial data and tools, including the Federal Geographic Data Committee's GeoPlatform (geoplatform.gov), to plan, manage, track, and communicate the results of a national infrastructure initiative.
- Ensuring that infrastructure grant funds can be used for geospatial data, systems, and services. Such grants for geospatial technologies are as important as investments in steel and concrete.
- Modernizing the national governance of geospatial data and programs to reduce duplication and enhance efficiency.

The Esri community is also extremely well positioned to help build the United States' smart infrastructure of the future. To achieve this goal, the entire GIS community—including GIS educators, engineers, geographers, planners, surveyors, GIScientists, researchers, and technicians—will need to work together. That is the only way this country will be able to ensure that the next generation has safe, smart infrastructure.

To read the full NGAC report and see a list of NGAC subcommittee members who contributed to it, visit **aag.org/infrastructure**.

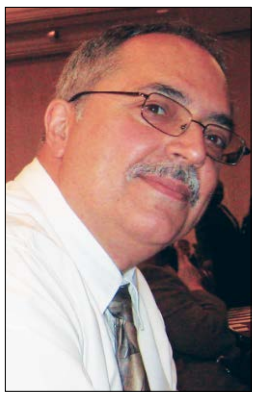
Contact Doug Richardson at **drichardson@aag.org**.



Cities throughout the United States rely on multiple pieces of interrelated infrastructure to function, from underground pipes and catch basins to aboveground pavement, gutters, and hydrants. Smart cities use geospatial technology to manage and improve their infrastructure. (Image courtesy of the National Geospatial Advisory Committee.)

In a City So Big, No Detail Too Small

GIS Hero



Rudy Lopez

No piece of geography is too insignificant for Rudy Lopez. Nor is any person, project, problem, or city department, it seems.

The former director of geographic systems for the New York City Department of City Planning, who retired in December, didn't ever let a known error go unfixed and strove to let no detail go unnoticed. Which is no small feat in a city with 8.5 million residents and 6,000 miles of streets.

"He cares about the geographic anomalies," said Michele McInnes, senior adviser of IT strategic planning and administration at City Planning.

"We have a lot of very difficult geography in New York City," said Thomas Costa, the manager of geographic research for City Planning. This includes a large number of duplicate and hyphenated addresses; stand-alone places, like the Empire State Building, that don't require an address number; complexes with multiple nonaddressed places inside—such as Lincoln Center, which contains the Metropolitan Opera House; and an abundance of streets known by multiple names.

"Rudy's perspective is, I know it's only one street, but so what? It's just as important as every other street," added Costa.

Here's why: If a man having a heart attack calls 911 from a new housing development and the dispatched emergency responders can't find him because they don't have that address, he could die. Or if that new supermarket's opening gets delayed because of a discrepancy in the building's address and it loses its funding, then the elderly woman down the street has to walk a dozen blocks instead of two to get her groceries.

"That was a big thing for me: the satisfaction that I was, in my own way, without any big fanfare, making a difference—that I was helping people," said Lopez.

Born and raised in New York, Lopez dropped out of high school at 17 years old and joined the United States Air Force, where he got his GED. After being stationed in Wyoming, Lopez returned to the Bronx to attend Lehman College on the GI Bill. He started off as a math major, but then he took a required geography class.

"It was geography of the New York metropolitan area, *[…]* and I thought, this is really interesting, finding out why all these people live here and why New York became what it is," said Lopez.

He ended up taking another geography class, and before he knew it, he was halfway through the requirements to get a degree in geography. So he went for it, minoring in math instead.

Lopez figured he would teach—maybe social studies in a junior high or high school environment.

"But as I was ready to graduate, New York City was in a slight fiscal crisis, and they were not hiring any teachers. So what was I going to do with this degree?" he recalled. "One of the up-and-coming fields was city planning. So I thought, maybe I could use my geography skills in this."

He ended up getting funded by the Comprehensive Employment and Training Act (CETA), a federal job training program that paid him minimum wage to work full time in public service for six months, to see what urban planning was about.

"They were able to place me at New York City Planning," Lopez said. "This was in 1980, just after the April 1980 Census, and the department had a population group that was in the process of reviewing the initial results of the census here in New York. They needed some geographers."

The department was trying to make sure that everyone in the city had been counted in the census, and in the correct location. Under the tutelage of more experienced colleagues, Lopez learned to analyze the census data—all without using GIS.

"There was no GIS in my department," he said. "The GIS was really us making hand-colored maps of all the different datasets." Lopez reviewed the data on printouts and mapped it.

"As we were mapping the data, we would see, *This doesn't make sense. There's no way that this particular block can only have three people when the city just built 100 units of housing and they're occupied*," he said. "It was sort of like trying to put puzzle pieces in the right place. That's what really turned me on to this field."

Although Lopez's federal funding dried up, City Planning kept him on. And he began working on geocoding.

"We had some very crude geocoding tools that were developed in the 1970s," he recalled. "The IT director said…it would be good for the city if we could develop a geocoding tool that's maintained by one agency but used by other agencies in the city."

Little did Lopez know that this would become part of his legacy.

He was pulled into the project to look at the US Census Bureau's Dual Independent Map Encoding (DIME) files, correct the geometry, and ensure that data from other city agencies matched those files.

Shortly after the project started, the State of New York audited the New York City Department of Education over student transportation subsidies. The audit found that the subsidies, distributed by the state, weren't getting allocated fairly. Students who lived in the same building and went to the same school weren't receiving the same transportation reimbursements. Part of the problem was that the Department of Education was using paper maps and rulers to determine the allocations.

The department had to figure out how to distribute these subsidies fairly. Lopez and his team ended up using the DIME file to do routing and determine which addresses, in relation to certain schools, were eligible for transportation subsidies. It took a year, but City Planning figured out how to calculate the shortest distance between each address and school, and subsequent subsidy allocations were based on these measurements.

Other city agencies soon got wind of this GIS thing and started requesting help. The Department of Transportation needed assistance geocoding its asset locations. The Department of Finance benefited from a 10-year project that Lopez led to digitize all one million tax lots in New York City. Under Lopez's direction, City Planning digitized the New York City Board of Elections' 5,000 or so electoral districts.

"I went from doing maps in pen and ink to doing this digitizing thing," said Lopez. "The technology was interesting. *[…]* I sort of got caught up in the field."

His first 5 years at City Planning turned into 7. Then 15. Then 20. Finally, he'd had a full, 37-year career at the department.

In that time, Lopez extended his passion for GIS by bringing hundreds of geography and GIS students through his department as interns. Many of them got jobs at other city agencies or now run their own GIS shops.

"One of the things I really enjoyed was the interactions with young people," he said. "It was sort of like I was doing teaching again."

Lopez was also the driving force behind Geosupport, a highly customized geocoding system that allows users to process their inputs (addresses, intersections, tax lot identifiers, and more) and retrieve an array of related information from geographic files that City Planning maintains. And he was at the helm of modifying the city's centerline files so they represented roadbeds in both single and double lines. These centerline files were so well put together, in fact, that the city chose City Planning's map to be the primary map of New York City.

"That was a big win for City Planning in the GIS world of New York City," said Costa. "Rudy was responsible for making sure we got that win."

He was also instrumental in getting the city's emergency services to use one system instead of maintaining their own maps.

"It took a while, but we were able to convince the agencies that it was best to use one system that could feed all the dispatching systems," Lopez recalled.

Now, Lopez's former department focuses more on maintaining the city's geographic datasets rather than mapping them, since city agencies, educational institutions, and even the public have become savvier with the technology.

Which means that Lopez has essentially united New York City's departments and agencies via GIS. That's no small feat.

The Bronx, New York

Real-Time Field Measurements Result in Staggering ROI

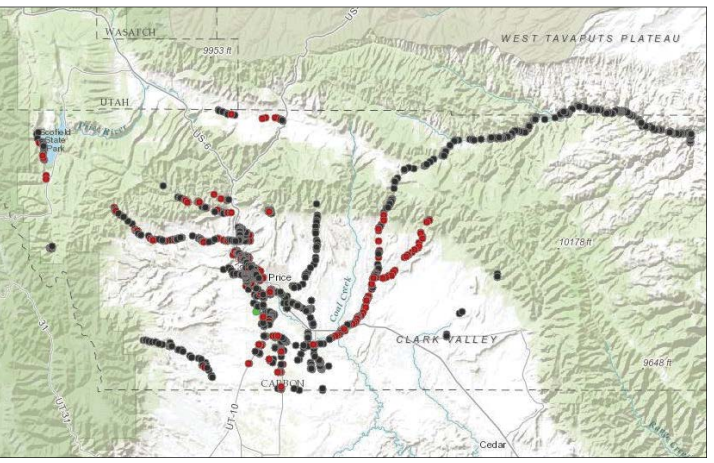
By Vanessa Bagnato, ikeGPS

All local governments need to collect measurements in the field quickly, accurately, and safely. But oftentimes this gets hampered by lengthy and inaccurate methodologies, expensive equipment that requires specialized training, or fragmented workflows that hamper cross-departmental collaboration.

The GIS and roads departments in Carbon County, Utah, recently experienced huge improvements in their field data collection processes when they implemented Collector for ArcGIS with Spike, a mobile GIS and laser measurement solution from Esri partner ikeGPS.

That Aha Moment

Daniel Campbell, the road supervisor for Carbon County's road department, understands the importance of GIS data. In the 17 years he's been with the road department, Campbell has completed numerous projects more efficiently and effectively by collaborating with the county's GIS team.



Using ArcGIS Online back at the office, members of Carbon County's road department can see which signs need to be repaired, removed, or replaced.

One of the road team's responsibilities is completing an annual signage inventory. This entails visiting every street sign in the county to check and record its condition. In the past, it used to take Campbell and his team six months to conduct an inventory of 1,500 signs—and it cost the county approximately $50,000 each year.

To make this more efficient and cost-effective, Campbell turned to Mellissa Lasslo, a GIS specialist who has been with Carbon County's GIS department for about a decade. Lasslo learned about ArcGIS in college and has been using it ever since.

"One of the greatest advantages of using Esri's software is that…any GIS shop in the world knows how to use it, so anybody can pick up my work where I've left off," said Lasslo.

On a mission to capture asset dimensions and photographic records in her GIS data, Lasslo came across Spike, a device that attaches to smartphones and tablets and allows users to take measurements right from their photos. She first heard about Spike while attending a presentation at the 2016 Utah Geographic Information Council Conference, and she was so impressed by its ability to ensure accurate and even real-time measurements that she asked the speaker if she could borrow his Spike.

It just so happened that while Lasslo was testing out Spike, Carbon County experienced flooding. So Lasslo and Campbell were able to test Spike during a time-sensitive disaster, and they were impressed by the results.

They used Spike's built-in laser range finder and Bluetooth—which work directly with each mobile device's camera, compass, and GPS—to measure the depths and widths of road losses and erosion. Moreover, Carbon County was trying to get support from the Federal Emergency Management Agency (FEMA) for flood recovery. Having the measurements readily available, together with a photographic record, made it easier to calculate the amount of material that would be needed for repairs, as well as estimate costs and bid out each project. The county was also able to give its engineering team insight into how flood recovery and damage repair would work best.

Although Carbon County did not receive flood recovery funding from FEMA, having all this information at hand helped Campbell and Lasslo determine that their departments needed their own Spike devices and that they wanted them to work in conjunction with ArcGIS.

"Knowing that Spike had a GPS capability and was collecting the GPS location of the road damages with each photo, we were pushed to find a way to connect Spike with Collector," said Lasslo.

"Our experience with the flood was the first time we could see what Spike could do for us, and we had the aha moment of using this for the signage inventory project," added Campbell.

Going from Time-Consuming to Efficient

Due to high costs and time constraints, Campbell and his team were already behind on the annual sign data collection project.

Normally, field teams were required to collect each sign's GPS coordinates and take its measurements, write them down, and transfer them to a Microsoft Excel spreadsheet on a computer that was plugged into a field generator. They also had to take a photo of the sign and, back at the office, match it with the coordinating sign in the spreadsheet. Finally, they had to embed the photo in that same spreadsheet and add their field notes. Campbell's team was using multiple instruments—a GPS device, tape measure, ladder, laptop, generator, and camera—to complete what is essentially one task. And none of this was connected to ArcGIS.

"The road and GIS departments were…doing their own programs with signage, and neither department was collaborating with one another," explained Campbell. "Data was not updated frequently, and some signs were collected multiple times. This became my pet project, and I went straight to GIS for help."

Once Campbell and Lasslo started using Collector and Spike to complete the signage inventory, the whole process was turned on its head—and the two departments have never looked back. Now, Campbell sends just two team members out into the field to collect sign data. Here's how it works.

One person drives, and the other does the measurement work. When the driver pulls up to a sign, the passenger opens both Collector and Spike. The passenger first marks the location of the sign with Collector and then, with the Spike laser device attached to his or her iPhone or Android smartphone, takes a photo of the sign. From the Spike mobile app, the passenger uploads the photo to the Spike Cloud so that any additional measurements can be taken later back at the office. The passenger also creates

a feature in Collector, attaches the Spike photo, and adds notes about the condition of the sign, as well as the measurements taken using Spike. All this data is pushed to ArcGIS Online.

If a sign is found to be broken in the initial inventory and is later repaired, the field team can easily go out again to collect a new photo of the sign. The passenger just attaches this Spike photo to the feature in Collector, making it easier for the road maintenance department or attorneys to access the comprehensive photographic history and documentation of a sign.

"If we do have an accident and somebody says there is an issue with road signage, attorneys can have the full history in ArcGIS to make the case," said Campbell. "We can prove we keep these signs in good order. For example, we could show a damaged sign and then show the picture of it replaced and on what date."

With Collector, Campbell's team can work offline as well, which is helpful since the road team needs to cache maps of the entire county while conducting the inventory. Luckily, Collector can store basemaps as layers on each device via a tile package, so the road department's fieldworkers can be disconnected from both the Internet and the internal network and still have access to maps of Carbon County, complete with road names.

Spike attaches to smartphones and tablets, allowing users to take measurements straight from their viewfinders or photos.

Using Spike in conjunction with Collector for ArcGIS, Carbon County's two-person inventory team can take sign measurements in real time out in the field.

An Astounding ROI

After successfully implementing Collector with Spike, Campbell's road team was able to collect data on 322 signs per day, which amounts to 1,610 per week. What once cost $50,000 now costs $5,000. That amounts to a staggering 568 percent return on investment (ROI) for Carbon County's most recent sign inventory.

According to Lasslo, implementing Collector and Spike together has significantly impacted how the GIS and road departments capture field data.

"With this new process combining Collector for ArcGIS with Spike, we have been able to collect, measure, and store our data more efficiently," said Lasslo. "We have saved time and money. Now we can have multiple people collecting and editing data at the same time, and when Campbell's team is within range of service, be able to immediately see points added to the map in ArcGIS Online as they are collected."

Carbon County's new and improved sign program has been so successful that other counties want to adopt it and integrate their ArcGIS platforms with Spike. What's more, Carbon County's road department is using its joint Collector-Spike solution for so many other projects—from measuring the lengths and depths of trenches and drainage ditches to calculating the widths of road surfaces, sidewalks, and vegetation encroachments on rights-of-way. The solution is also proving useful for when Campbell has to order oversized equipment from the Utah Department of Transportation (which is often), since he and his team can use Collector and Spike to measure and plan out precise routes so they can get accurate permits.

For more information about how Carbon County's GIS and road departments implemented Collector and Spike, email Lasslo at mellissa.lasslo@carbon.utah.gov or Campbell at daniel.campbell@carbon.utah.gov. For more information on Spike, contact ikeGPS senior vice president of sales, James Pardue, at james.pardue@ikegps.com.

About the Author

Vanessa Bagnato is the vice president of product marketing and partner success at ikeGPS.

Fixing the Fissures in Georgia's Geologic Knowledge

Lacking a legislative mandate that would afford reliable funding, the Georgia Geologic Survey was abolished in 2004 after serving the state for 168 years. Because state geologic surveys provide scientific, economic, and educational functions, they are generally considered a fundamental element of state government. Recently, samples collected by a state geologic survey were used to verify mineral deposits for commercial mining operations, while work by the survey in another state precipitated an investigation into a natural gas seepage through fractured bedrock that resulted in a series of dangerous explosions.

When the Georgia Geologic Survey was abolished, its extensive collection of minerals, core samples, fossils, geologic maps, historical documents, and ongoing research was widely dispersed throughout the state. Some of the materials were relocated to museums, schools, and storage facilities. However, a significant portion was either lost or discarded due to a lack of space.

"The loss of Georgia's Geologic Survey has created a real gap in the knowledge about the geology of our state," said Katayoun Mobasher, an associate professor of geology at the University of North Georgia's Institute for Environmental & Spatial Analysis.

To try to narrow this gap, Mobasher began digitizing both old and new information about the state's geology in a geodatabase. But she felt that she could do more to share this information widely and fill the increasing fissures of knowledge among geologists, geoscientists, and geology educators and students.

"I wanted to create a multimedia publication," said Mobasher. "I found that the Esri Story Maps format works really well."

And so, the interactive *Geology of Georgia* field guide, accessible at arcg.is/DmfGG, was born.

A Digital Field Guide

Having gaping holes in knowledge about geology—and lacking a central organization through which this information flows—affects economic and social development, as well as education.

"Geology is dynamic," said Mobasher. "The processes that took place in the past to form our geology are still happening today, which provides us with important insight into our geologic, and potentially economic, future—particularly for those natural resources that are exploited commercially, such as crude oil, natural gas, and a variety of minerals. In addition, because state geologic surveys regularly publish information that can be used by geoscience researchers and educators, there was a lack of current information available that I could use in my geology classes"—especially for trips to the field, which are an important component of all geology classes.

The 2013 publication of *Roadside Geology of Georgia*, by Dr. Pamela Gore and Dr. William Witherspoon, was welcomed by the geologic community, since it provided much-needed updates about Georgia's geology. But it was only available in print.

"The book does provide excellent material that I have used in my classes," said Mobasher. "But as a GIS professional, I began thinking about the advantages of merging the information contained in the book and developing a field guide that could be published digitally."

Mobasher wanted her students to be able to use their smartphones and tablets to access the guide in the field. She thought a field guide could also include links to additional information about each location. And she wanted to be able to make updates more quickly and foster greater collaboration.

In 2014, Mobasher began developing a geodatabase by field verifying and digitizing the site information contained in the *Roadside Geology of Georgia*, as well as other field information about Georgia outcrops. She also examined the voluminous geologic reports, papers, and data related to the state's geology. Her plan was to use this geodatabase to produce her digital field guide.

"At present, the geodatabase contains more than 300 field-verified collection points with descriptions of the sites and other geologic information," said Mobasher. "Sixteen of those are among the most significant geologic locations in Georgia, and I have enhanced their descriptions with a range of other information, which has been included in the initial release of the guide. Often, there are professional controversies about the age or composition of a particular outcrop, and I think *[it]* is important to include the information that led to the final conclusion in the field guide, as it provides needed perspective."

Because Mobasher uses various ArcGIS software products to collect and maintain the geodatabase, she first attempted to produce a field guide with ArcGIS Online. But it didn't provide the visual context she was looking for. So she turned to Esri Story Maps apps.

"I began *[with a prototype of]* the layout and included photos of the geologic outcrops and rock samples, petrographic thin section images, geologic sketches, and related videos," she said. "The *Geology of Georgia* field guide was the result of this publishing effort, and it was released during the summer of 2017."

Getting Help from the Community

Development of the *Geology of Georgia* field guide is an ongoing process. As researchers complete information about geologic sites around Georgia, Mobasher adds it to the guide. And because the guide is interactive, it provides directions on how to get to each site through Survey123 for ArcGIS or Collector for ArcGIS.

Both professional and amateur geologists use the guide, as do geology students in both undergraduate and graduate classes. To help everyone get the most out of the field guide and further collective knowledge about Georgia's geology, Mobasher has written challenging questions and included references from other geologists concerning the outcrops to promote speculation and analysis about them based on existing evidence.

But building a geologic geodatabase for the entire state of Georgia is a complex and time-consuming project. To maintain its momentum, Mobasher is enlisting the help of the geologic community.

"Contributors to the database include students in geology courses that use the exercises as part of their final projects, research assistants, current and retired geologists, and geology department faculty members," she said. "Contributors can download the Collector for ArcGIS app and/or Survey123 to their smartphones or tablets and then go out into the field to collect geologic data. I have designed a template-based form so that the data can be easily entered into the database. I am actually maintaining two databases for this project—one for my students, which I check very carefully for accuracy, and one for professional geologists."

Infusing the New with the Old

One important aspect of the project is preserving the handwritten notes and sketches of retired geologists and geoscientists.

"Their personal collections of geologic data provide a unique contribution to rebuilding the Georgia geodatabase in a digital format," said Mobasher. "This is a special part of the project for me. I retype some of the information I receive, while other notes and drawings are scanned for use in the field guide."

Because the geology of Georgia is complex, there are sometimes different interpretations of outcrop formations.

"The information provided by the more experienced geologists stimulates thought and dialog among the new generation of geologists," said Mobasher. "The availability of the previous observations by experienced geologists in the easily understandable story map format helps motivate discussion and new hypotheses."

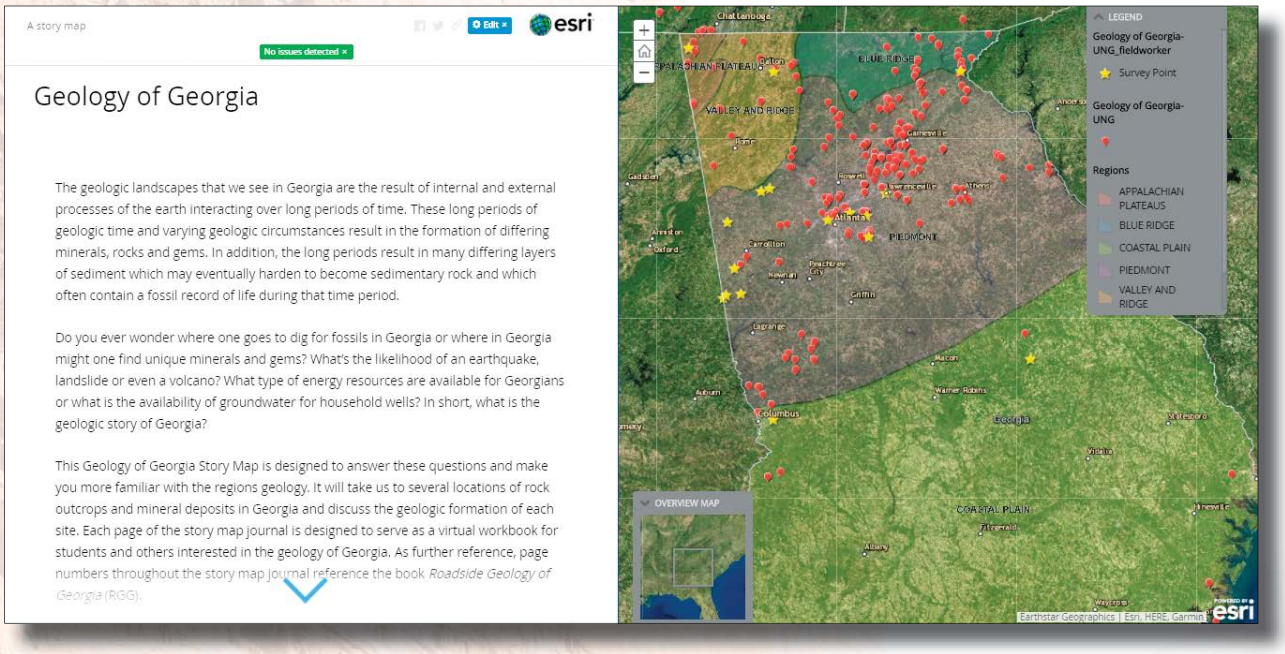
Witherspoon, who is president of the Georgia Geological Society, and Dr. Timothy LaTour, professor emeritus at Georgia State University, are two of several geologists who have given Mobasher invaluable material. When LaTour gave her all his personal geology field notes, he said, "This new era of technology provides great opportunities in making geologic information available to many more people with the potentiality of producing new discoveries."

Implementing Advanced Technologies

It is sometimes difficult to examine outcrops closely in nature, even with binoculars. So Mobasher is implementing another new technology in the field guide: Gigapan, a special camera technology designed by NASA that takes tremendously high-resolution panoramic photos of a specific area.

"You set your perimeters for the photographic series of an outcrop and the photos are taken automatically," explained Mobasher. "Then they are seamlessly stitched together with the provided software to create high-resolution panoramic views. You can zoom in and examine things in great detail. *[...]* Geological details are revealed in the photos that you can't see in any other manner."

The Gigapan imagery, as well as the other photos, videos, sketches, and field notes Mobasher includes in the *Geology of Georgia* field guide, enables those students with physical limitations to participate fully in her classes by allowing them to take virtual field trips.



The *Geology of Georgia* field guide supports dynamic content and provides users with experiences that require no additional learning curve.

Mobasher also plans to soon begin taking georeferenced images of the outcrops using ground control points with Drone2Map for ArcGIS. The data will be converted to 3D imagery for publication in the field guide.

Applying Geology to New Disciplines

The field of geology is evolving, and Mobasher is designing the *Geology of Georgia* field guide to keep pace with that.

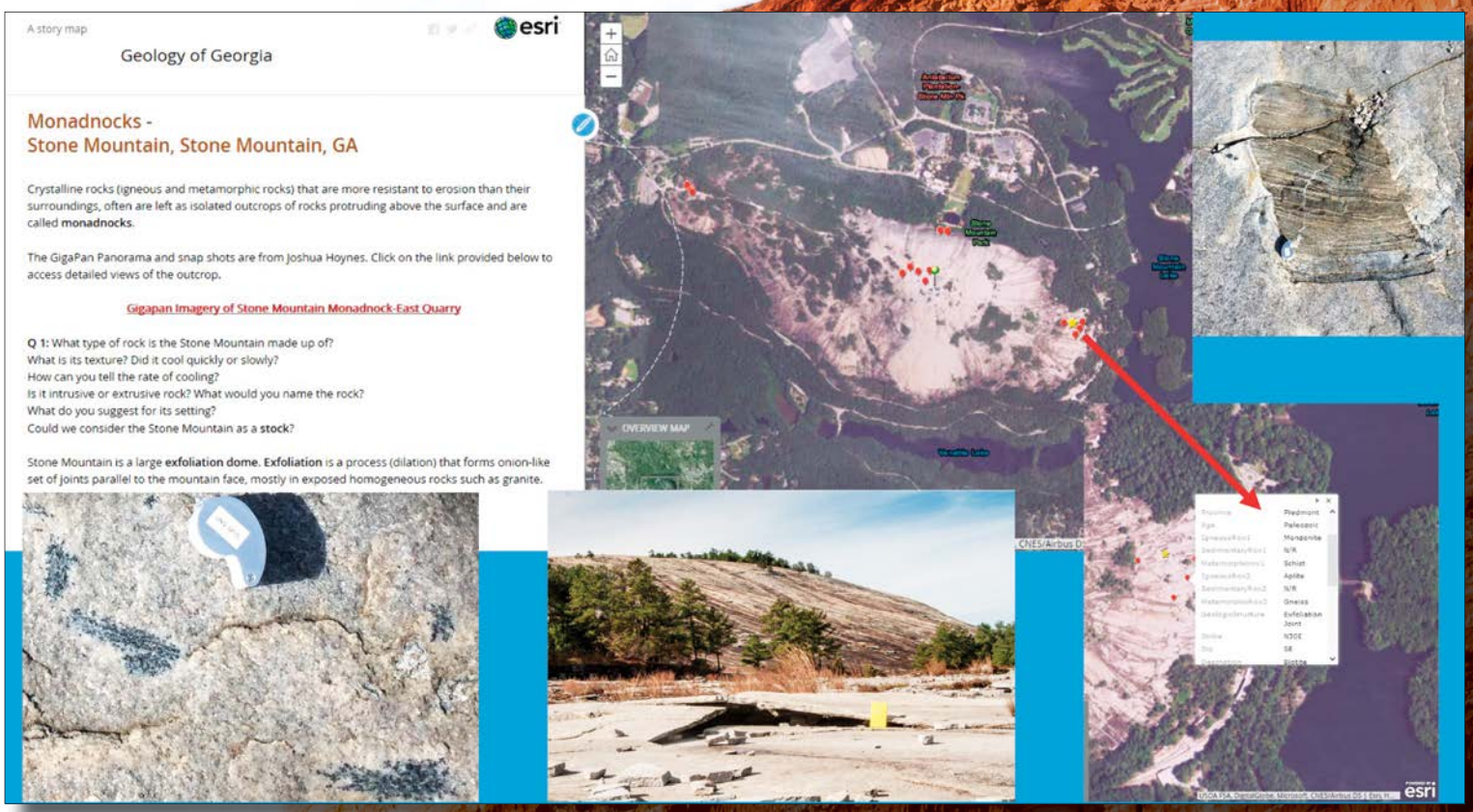
"There is an emerging scientific field called medical geology that examines the relationship between natural geologic factors and their effect on health. Basically, you look at different diseases and try to determine if there is a statistically significant cluster of people suffering from a disease in a particular location," she explained. "I am working with a colleague, Captain Joseph Hughart, a senior environmental health officer in the US Public Health Service Commissioned Corps and a geology instructor at the university, and plan to create a geologic story map of Georgia that features a health layer."

Using a handheld X-ray fluorescence spectrometer, Hughart and Mobasher are going to perform chemical analyses of rocks, minerals, and soils in targeted locations to determine if their composition includes radioactive elements, such as uranium or potassium.

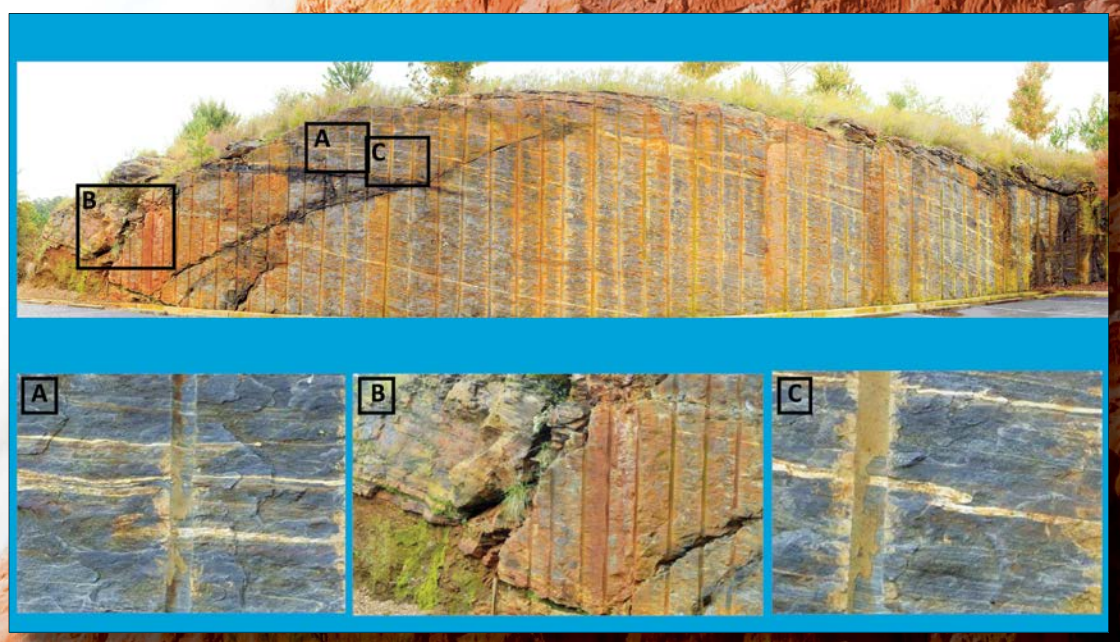
"We want to ascertain if there is a link between the geology of certain areas and the health of the inhabitants," Mobasher said. She will then make a story map of their findings.

"I think that the story map format can make some scientific information clearer, which promotes collaboration and understanding," she concluded.

The *Geology of Georgia* field guide is made possible by the continuing support of the University of North Georgia through both its Institute for Environmental & Spatial Analysis and its Presidential Award program.



↙ Presented as a story map, the *Geology of Georgia* field guide equips users with the tools they need to visualize rock samples and access detailed information about geologic sites quickly.



↙ Gigapan photography of this rock outcrop in Duluth, Georgia, allows users to see all its faults, folds, and veins.

The Relevance of Cartography

A Cartographer's Perspective

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

Don't Shrug Off the Atlas

Although an atlas might seem like a relic to some, atlases are still very much alive—both digitally and in print. Indeed, for most cartographers, an atlas is the ultimate mapping product, the showcase of our discipline. Putting one together requires creativity, an aptitude for organizing data effectively, and production management expertise.

An atlas is an intentionally combined collection of maps structured to reach a certain objective. One such structure is the order of the maps. For instance, an atlas might first have various maps of the United States followed by maps of the Americas and then maps of the world. The objective of this atlas might be to inform American children of their local and regional environments but in a global context. Fusing the structure with an objective like this shapes the atlas's narrative. An atlas might even be considered a story map *avant la lettre*.

Atlases exist in many forms. There is *The Times Atlas of the World*, published by the *Times* (London), which contains reference maps, tables, charts, and now satellite imagery that, together, show not only the earth's geography but also how humans interact with it. There is the notable *National Geographic Atlas of the World* as well, which contains maps and infographics that convey subjects such as migration, climate change, advances in communications, economic trends, and more. Other types of atlases are historical, telling the story of a country's past, for example, or are intended to buttress geography curriculum for schoolchildren. Many atlases are thematic, relating to topics such as geology, the environment, census data, and even wine.

A special category is the national atlas. These are often monumental works made to represent the identity and glory of a country. Finland, for example, published its first national atlas in 1899 while still part of the Russian Empire. The purpose of the atlas was to exhibit the aspiring nation's essence and accomplishments. Ultimately, this national atlas contributed to Finland's gaining its independence in 1917.

Menno-Jan Kraak with the world's biggest atlas at the National Library of New Zealand in Wellington.

Like many cartographers, I collect atlases. During my travels, I always try to bring one home. School atlases are especially interesting to me because of the distinctive thematic maps they feature to tell the story of a country's geography—maps showing the effects of mountain landscapes in Switzerland, for instance, or canals and polders in the Netherlands. The selection of regional and global maps in these atlases can really inform the reader how that specific country looks at the rest of the world.

Although the digital revolution has changed the world of atlases forever, as a collector, I still prefer paper atlases. Why? Well, I can still easily read my physical atlases from 1910. But the first digital atlas I ever purchased—the *Atlas of Arizona*—is no longer accessible to me. It was issued on a floppy disk, and I no longer have any computers in my house that can read a floppy disk. URLs for online atlases don't live forever, either. So for my personal collection of atlases, I will stick to paper editions.

That doesn't mean that digital atlases are in any way futile, though. The big advantage of current-day online atlases is that they can be updated relatively easily. For instance, the census data in an online atlas could be refreshed on a monthly basis (or in any other time frame, depending on how often new data is available). That said, updating an atlas is slightly more complex than just changing the spreadsheet that houses the data. The values might increase or decrease so much so that the map requires a new legend. But the maps included in atlases are designed in such a way that readers can compare different topics in a meaningful way, and map scales and legends are affected by this. By updating some maps and not others, then, this central function of an atlas—comparison—might be destroyed.

It is no surprise that the International Cartographic Association (ICA) has a Commission on Atlases. One of its tasks is to address questions like these—whether to choose a paper or digital format, when to refresh information and when to keep it the same for comparisons' sake, and how to structure an atlas so it achieves its objectives. The commission also hosts activities on updating the concept of the atlas and putting together a manual for how to plan, design, and produce a digital atlas.

To get in touch with the commission and stay informed about recent developments around atlases, visit atlas.icaci.org. Because, as leaders in the cartographic community, we don't want these perfect armchair-travel companions to go flat or become stale. Rather, we want them to stay informative and innovative no matter how the process of making maps—and atlases—changes.

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 University of Technology. 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.

What Have You Accomplished?

Résumé Advice from a Hiring Manager

By Chris Akin, Dunaway Associates and GIS Resumes

At some point, everyone looks for a job, whether straight out of college or partway through a career, voluntarily or involuntarily. In standard hiring practices, all job applicants have to submit a résumé—through a human resources department, a colleague, or even a friend.

This résumé is a job candidate's one shot at making a first impression. The right one can land someone a job interview. The wrong one can put anyone straight into the "no" pile.

So what makes a strong résumé? For starters, résumés need to highlight accomplishments, not previous responsibilities. To ensure that your résumé actually does this, here are some tips I have compiled after sifting through countless résumés over the years.

It's About Accomplishments, Not Responsibilities

Aside from general errors and avoidable typos (I had someone misspell *SQL* once), most people are making one glaring mistake on their résumés: they aren't telling hiring managers what they have actually accomplished in their careers.

Accomplishments are different from responsibilities. Responsibilities are the tasks and activities that someone was hired to do; anyone hired for that position could list out their job responsibilities. Accomplishments, however, are the results of effectively carrying out those responsibilities; only people who execute a job well could put accomplishments down on their résumés.

The most straightforward way to present accomplishments is by having a series of bullet points underneath each job subheading that highlight what you achieved. This shows hiring managers that you have done most, if not all, the tasks required to perform well in the role they are hiring for.

How to Change Course

There's a simple way to turn a responsibilities-oriented résumé into an accomplishments-oriented one. It requires a simple, two-step process.

First, underneath one of your previous job titles, write a brief, one-to-two-sentence paragraph that explains what you were hired to do. Second, in a subsequent set of bullet points, list out what you actually achieved in relation to these responsibilities. Then do that for every single job on your résumé.

To illustrate how this works, here's an example. In their current positions, Sandra and Bob both work on data conversion projects. Sadly, Bob is often behind schedule, has to continually fix errors, and never tries to figure out how to improve the process. Sandra, on the other hand, always converts her files quickly and accurately. She figured out how to automate the conversion process and improved production procedures. In fact, Bob started using Sandra's script for his conversions.

Both Sandra and Bob could write the following bullet points on their résumés:

- Converted CAD and PDF files
- Proficient in ArcMap and Python

Those are responsibilities, though. Both Sandra and Bob are asked to convert files in their day-to-day jobs and can do at least some work in ArcMap and Python. And using a word like "proficient" when trying to illustrate skill sets doesn't demonstrate actual knowledge or aptitude.

If Sandra were to list what she's actually accomplished in both capacities, she would set herself apart from Bob. Here's how:

- Increased data conversions 17% by developing custom Python script using ArcPy and ArcMap 10.5
- Converted 1,000 CAD and PDF files with no data errors by implementing a comprehensive QA/QC process
- Increased project profitability $10,000 by streamlining production process and coordination
- Reduced project delivery time frame by engaging client regarding data delivery issues

Bullet points like these go above and beyond the bare minimum and show Sandra's accomplishments. They highlight not only what she does at her current job but also the results she's achieved by doing good work.

Hiring managers want to see how candidates have added value to their organizations so they can assess whether applicants can do the same in the role they're hiring for. Saying, "Used ArcGIS Online" is okay, but putting, "Made 20 apps using ArcGIS Online," is a bit more telling. And writing, "Increased public awareness of municipal permitting applications by building 20 ArcGIS Online apps" is even better.

Verb, Result, Action

To write powerful accomplishment bullet points, they need to be put into a verb-result-action format.

First, start with a powerful verb such as *Improved*, *Increased*, *Reduced*, *Delivered*, *Developed*, or *Implemented*. Avoid less definitive verbs like *Supported*, *Assisted*, *Helped*, *Learned*, *Tackled*, and *Pursued*. These undescriptive verbs are vague and leave too much room for interpretation. When I see that someone *supported* a project, for instance, I wonder if he engaged clients and drove the process forward or just answered phones all day. I can't know for sure, so I may assume the worst—otherwise, the candidate would have told me if he had actually done more.

Next, note what resulted from the action. What was the great outcome? Whenever possible, use metrics to add more weight. Here are a few questions to ask to get started on this:

- Why did I do the project?
- What was the final product?
- Was there an efficiency or financial gain?
- Did I reduce cost or turnaround time?

Answering those questions should elicit verb-result phrasing like the following:

- Increased production capacity 20%...
- Developed 40 maps and apps monthly...
- Reduced delivery time by 90%...
- Implemented a $50,000 project on time and under budget...

Finally, the action portion of a bullet point addresses how the result was accomplished—i.e., which software, technology, skills, and other tools you used to get those outcomes. Some samples include the following:

- ...by implementing ArcGIS Enterprise
- ...using .NET, HTML5, and custom web services
- ...through researching available technology and making informed recommendations
- ...using Microsoft Project Gantt charts

It helps to transition between the result and action part of each bullet point with the words *using*, *through*, or *by*.

The One-Page Conundrum

Job applicants should load up their résumés with as many accomplishments as possible. But doing that can make layout challenging, especially because every résumé—yes, even ones that chronicle 20-year careers—should fit on one page.

Large headings, lots of white space, and long sentences all eat up valuable space on a résumé. Adjust the margins, shrink the fonts, and reduce line spacing to make more room for accomplishments. Keep contact information to two lines. The longer you've been out of school, the shorter your education section can be. As you get further along in your career, one line per degree should suffice. Until then, treat your education as you would a job entry, complete with accomplishment-oriented bullet points.

Finally, make sure no bullet point exceeds one line. Being concise ensures that each statement packs power. More importantly, this gives you more room to add additional accomplishments. If you end up with more bullet points than you can fit onto one page, great! Pick and choose from your long list of accomplishments and tailor each résumé you send out to the job you're applying for. Then save all the extra bullet points for a job application where they're a better fit.

Start Now

Hiring managers must make quick decisions on job applicants' capabilities, and all they have to base those decisions on is the information each candidate gives them. Having powerful, effective accomplishments on your résumé will help yours stand out when applying for your next job.

Putting together a good résumé takes time and a lot of hard work. If you start updating yours now, it will ideally be ready long before you need it. And if you commit to refining your accomplishment bullet points every three to four months, you will always have your entire career well documented.

So dust off that old résumé and start compiling a new and improved one today!

About the Author

Chris Akin, GISP, is the GIS manager at Dunaway Associates and the owner of GIS Resumes, a firm that offers GIS job applicants with help crafting résumés and cover letters. Akin has almost two decades of experience in developing and managing geospatial projects, strategies, and processes and is dedicated to helping GIS professionals achieve their career goals. He is a former member of the board of directors of the Urban and Regional Information Systems Association (URISA), the former president of the New England URISA chapter, and the current president of URISA Texas. Follow Akin on LinkedIn at linkedin.com/in/chrisakin and on Twitter as @ChrisAkin98.

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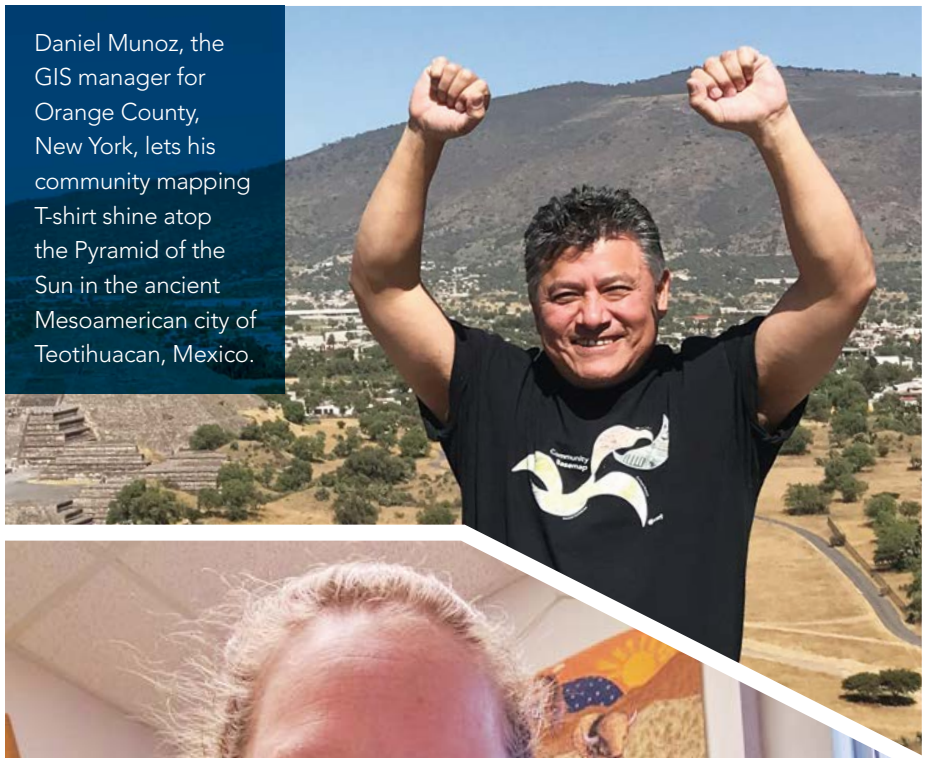

Daniel Munoz, the GIS manager for Orange County, New York, lets his community mapping T-shirt shine atop the Pyramid of the Sun in the ancient Mesoamerican city of Teotihuacan, Mexico.

In Binghamton, New York, 4-H program coordinator Kelly Adams gives her GIS superpowers a bit of a break to give Rizzo, the office therapy pup, a quick snuggle.

Making her way across all 50 US states, geography student Sophia promotes spatial awareness for all!

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.

To learn how to share an organization's GIS content or how to create and edit data and do spatial analysis with ArcGIS Pro, take a look at the following new courses:

- **Sharing GIS Content Using ArcGIS**
  Learn best practices for sharing authoritative GIS content as high-performing feature layers, web maps, package files, and other resources—and find out how to make them easily accessible on an ArcGIS portal. This course also covers how to devise a content-sharing strategy that supports collaboration and making data-driven decisions across the enterprise.
- **Creating and Editing Data with ArcGIS Pro**
  Get hands-on practice maintaining geographic data using ArcGIS Pro. Course participants learn key data-editing workflows and work with a suite of tools used to create and edit 2D and 3D data. The course covers rules and workflows that help ensure data accuracy and integrity over time.
- **Spatial Analysis with ArcGIS Pro**
  Need to complete spatial analysis projects using ArcGIS Pro? Participants in this course learn how to apply a standard analysis workflow that generates reliable results and supports informed decision-making. Course exercises have learners use ArcGIS Pro tools to perform a variety of analysis—from basic proximity and overlay analyses to more advanced weighted suitability and predictive analyses.

E-Learning Spotlight: MOOCs

Esri's massive open online courses (MOOCs) are free online courses that combine video lectures, discussions, and hands-on exercises for a fun and convenient learning experience. Adult learners and working professionals use MOOCs to build new skills and stay up-to-date with technology.

The following two MOOCs are on offer from April 18 through May 29. Students complete two to three hours of study per week. Esri provides participants with access to the ArcGIS software used in course exercises.

- **Cartography.**
  This brand-new MOOC teaches participants fundamental cartographic concepts and techniques so they can author beautiful information products using ArcGIS Pro. It features coaching from experienced cartographers, including Esri's Kenneth Field, and practical, hands-on exercises. And yes, the period in the title is deliberate.
- **The Location Advantage**
  A popular MOOC already, The Location Advantage explores how location information can help businesses question, analyze, interpret, and visualize data to arrive at more informed decisions. Working with ArcGIS Online and Business Analyst Online, participants apply geospatial tools to market planning, site analysis, marketing, and supply-chain and risk management.

Certification

There's a new way for Esri-certified individuals to share their achievement. Anyone who holds a version 10.3 or higher Esri technical certification is now awarded a digital badge through the Acclaim platform. These digital Acclaim badges can be shared easily with online networks, in email signatures, and on résumés. They feature metadata that allows others to immediately verify Esri certification information. Additionally, Acclaim provides certified individuals insight into employers that are looking for the skills and qualifications measured by the exam.

To explore the latest Esri Technical Certification exams, visit esri.com/training/certification. Also join the Esri Technical Certification group on LinkedIn to connect with other professionals and discuss all things certification.

Go to esri.com/training for more information. Find courses at esri.com/training/catalog/search. Keep up with Esri training news by subscribing to the newsletter (go.esri.com/preferences), visiting the *Esri Training Matters* blog (esri.com/trainingblog), connecting with the Esri Training Community on GeoNet (go.esri.com/training-community), and following @EsriTraining on Twitter.

Esri Press

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Mapping the Nation: Solving Challenges from Local to Global

By Esri

Mapping the Nation: Solving Challenges from Local to Global is a collection of maps that illustrate how geographic understanding fosters good governance in the United States and around the world. The book contains examples of how legislators and government agencies use GIS to solve problems and inspire action, emphasizing how the technology advances collaboration across all levels of government and can help decision-makers quickly discern and meet their constituents' needs.
April 2018, 92 pp. Paperback ISBN: 9781589484979.

Getting to Know Web GIS, Third Edition

By Pinde Fu

Pairing the fundamental principles of Web GIS with step-by-step exercises, *Getting to Know Web GIS*, Third Edition, teaches readers the most current and comprehensive ways to share resources online and build Web GIS apps quickly and easily. Rather than focus on individual products, the book approaches Web GIS as a holistic platform. Readers can start by building web apps without writing a single line of code and then move on to developing more advanced skills using a variety of server-side and client-facing Web GIS technology. Each chapter has readers complete an app-based project using multiple products. And this edition includes new chapters and sections that cover image services, big data and raster analysis, virtual and augmented reality, artificial intelligence, ArcGIS Arcade, vector tiling, and portal collaboration, as well as Survey123 for ArcGIS, Operations Dashboard for ArcGIS, and ArcGIS API for Python. With downloadable teaching slides and exercise data, *Getting to Know Web GIS* is a practical manual for use in classroom labs and as on-the-job training.
April 2018, 410 pp. E-book ISBN: 9781589485228 and paperback ISBN: 9781589485211.

Esri ArcGIS Desktop Associate Certification Study Guide for 10.5

By Brittney White

For candidates taking the ArcGIS Desktop Associate exam, the *Esri ArcGIS Desktop Associate Certification Study Guide for 10.5* is tailored to meet their preparation needs. The study guide covers general exam concepts and key testing objectives and helps candidates identify gaps in their skill sets by offering a comprehensive review of the GIS skills and knowledge measured in the exam. The study guide does not teach to the exam but rather helps readers refresh their knowledge. It also contains additional material for self-study and points to existing resources whenever applicable.
April 2018, 150 pp. E-book ISBN: 9781589485150 and paperback ISBN: 9781589485143.

GIS Tutorial for Crime Analysis, Second Edition

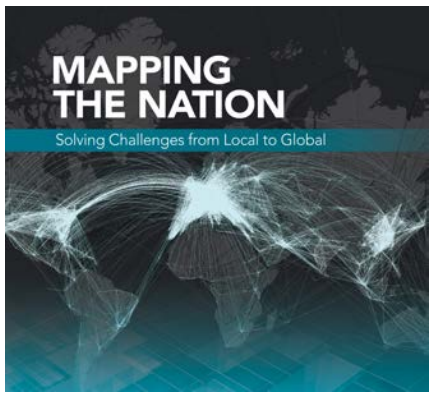
By Wilpen L. Gorr, Kristen S. Kurland, and Zan M. Dodson

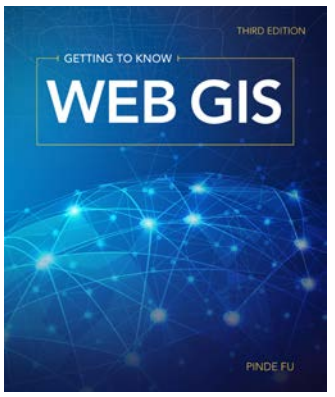
A workbook for crime analysts and students of criminology, *GIS Tutorial for Crime Analysis*, Second Edition, details innovative analytical methods that can be incorporated into any police department's standard practices. In contrast to GIS workbooks that teach skills for one-time projects, this book enables readers to build and use a crime mapping and analysis system that meets all the spatial information needs of a police department. It combines introductions to GIS and crime analysis methods with step-by-step tutorials and independent assignments to help readers learn how to prepare and maintain data, build map templates, query and analyze maps, automate map production, and do predictive modeling. The second edition has updated tutorials, a new chapter on building and evaluating predictive models using ModelBuilder and ArcGIS hot spot analysis tools, and a capstone project on hot spot modeling. It also includes a 180-day trial version of ArcGIS Desktop plus tutorial data. Instructor resources are available upon request.
May 2018, 270 pp. E-book ISBN: 9781589485174 and paperback ISBN: 9781589485167.

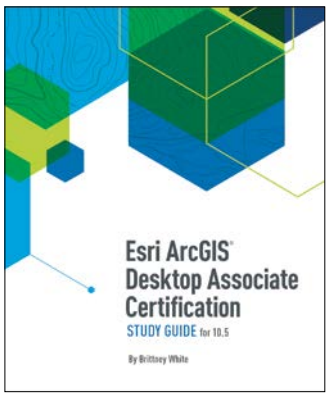
Cartography.

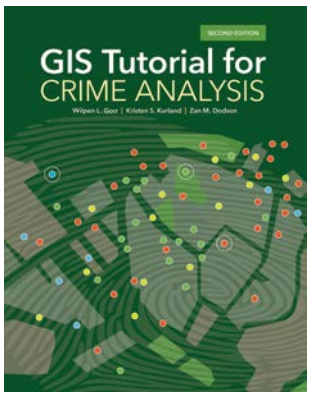
By Kenneth Field

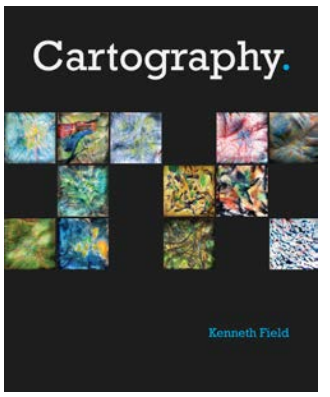
With lavish illustrations, *Cartography.*, by Kenneth Field, is an inspiring and creative companion to have on the nonlinear journey of making great maps. This sage compendium for contemporary mapmakers distills the essence of cartography into useful topics, organized in a way that makes it easy to find specific ideas or methods. Unlike books focused on deep scholarly discourse of cartographic theory, *Cartography.* furnishes sound, visually compelling information that translates into practical tools for modern mapmaking. At the intersection of science and art, this book serves as a guide for designing an accurate and effective map.
June 2018, 556 pp. Paperback ISBN: 9781589484399 and hardcover ISBN: 9781589485020.











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Business Development

SAP Alliance Development Manager and SAP Account Executive: Work with teams from across Esri and SAP, plus their global networks of partners and users, to increase awareness, adoption, and sales of Esri technology and services.

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Presales and Solution Engineering

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GIS Commercial and Transportation Logistics Specialist: Research and report on financial, technological, and other factors that affect the logistics market and collaborate with key internal stakeholders to help define, execute, and measure Esri's logistics marketing plan.

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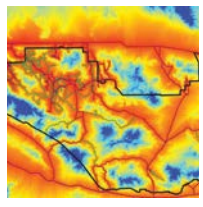

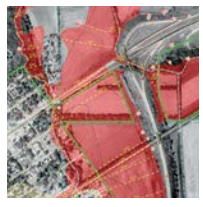

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