ArcNews

Bavaria Gains Insight into Managing Its Roads

Roads connect people to job opportunities and travel destinations. They support commerce, communication, public safety, and many other industries.

Government officials around the world are looking for better ways to plan, build, operate, and maintain the transportation infrastructure that citizens rely on every day. In Germany, the Bavarian State Building Administration needed a stronger system to optimize its road infrastructure. So it chose to use Insights for ArcGIS as a data visualization tool, since the app is quick to implement and easy to use and makes sharing analysis simple.

Software for the Future
The Bavarian State Building Administration—part of the Bavarian Ministry of the Interior, for Building and Transport, which oversees issues that range from public administration, police, and internal security to public buildings, highways, roads, and bridges—needed a strategic management tool for roads that would enable data analysis, support decision-making, and drive accountability. The solution needed to serve the Bavarian State Building Administration well into the future, so the ideal software had to meet four essential criteria.

First, it had to provide a comprehensive view of key performance indicators that measure a variety of spatial, demographic, economic, and governmental policy outcomes. This would be used to highlight regional disparities and measure progress over time.

Second, the tool had to facilitate easy collaboration among federal and state government officials. They

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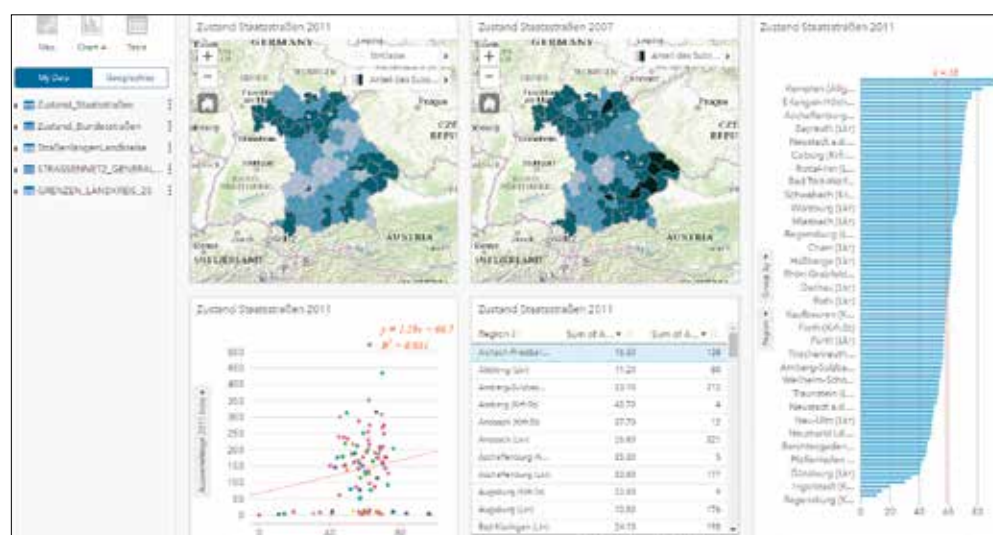
↑ Insights for ArcGIS provides a comprehensive view of key performance indicators that are used to highlight regional disparities in road infrastructure and measure progress over time.

## The Building Blocks of a Smart, Data-Driven Community

In Geodesign, Ask Questions, Analyze and Visualize Data, and Tell Stories

Where and how should a community grow? Where should the city build sidewalks and trails to lower the risk of accidents and encourage walking? What areas should be preserved as green infrastructure? How far do residents have to walk or drive to reach a public park?

These are the questions urban planners around the world face every day. And the answers are out there, thanks to the increasing availability of open and proprietary data and the growing use of geodesign technologies, such as GIS, that make sense of the data.

Smart community planning is powered by the ability to analyze and visualize data on maps, including in high-resolution 3D city models. This smart, data-driven approach to planning was one of the major topics discussed at the 2017 Geodesign Summit.

"Data is everywhere and can be collected from everywhere, including from individuals walking around with cell phones," said summit moderator Stephen Goldsmith, speaking to more than 220 planning directors, urban planners, architects, engineers,

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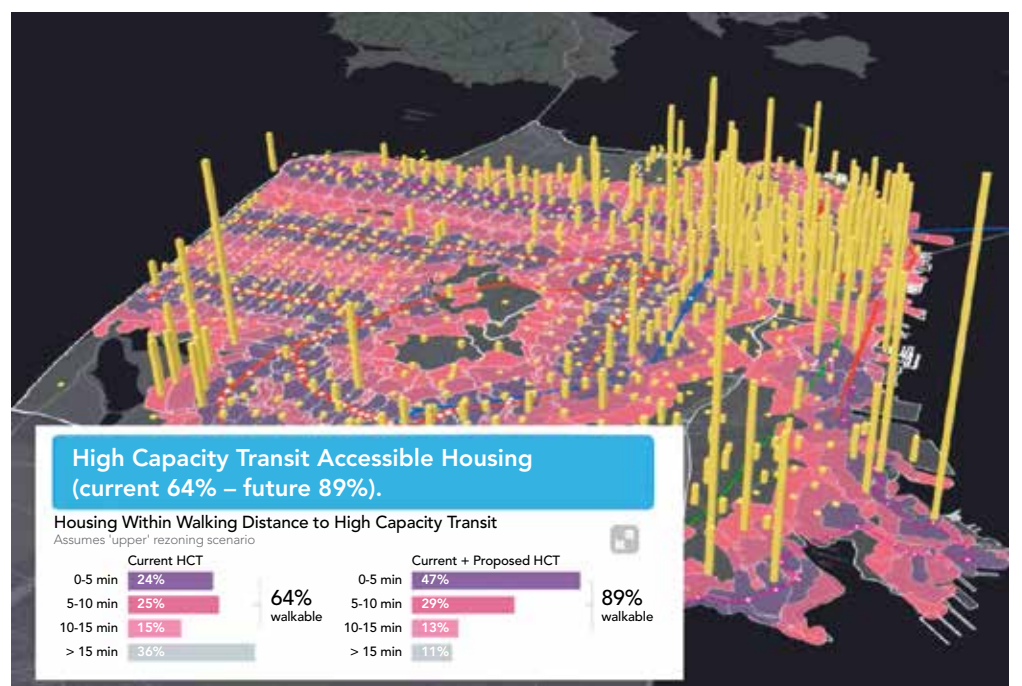
↑ The San Francisco Planning Department used 3D GIS tools to analyze and visualize data on how accessible the city's transit is to housing and jobs.
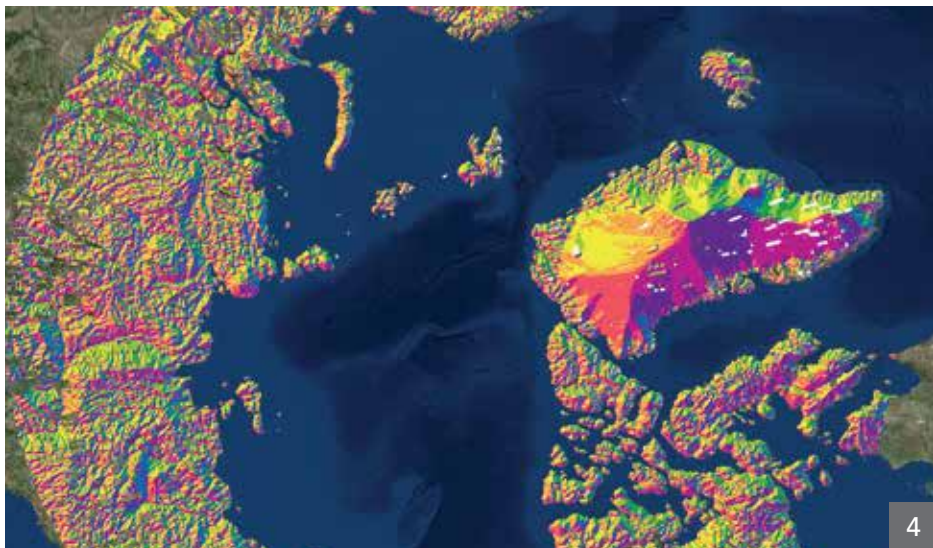
To make its computing resources instantly available across the enterprise, the National Geospatial-Intelligence Agency (NGA) is migrating to a cloud-native environment. Deputy Director Susan (Sue) Gordon spoke about the importance of GIS at NGA and her plans for future innovation.

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Ireland's Next Great Innovation, All Mapped Out

Ordnance Survey Ireland (OSi) is in the midst of a groundbreaking cartographic automation project that's transforming its product offerings and service capabilities. In partnership with Esri Ireland, OSi has developed the multiresolution data store (MRDS), an advanced cartographic solution based on the ArcGIS platform that enables OSi to automatically generate and update map products and services quickly, with minimal human intervention.

This is an ambitious process-transformation project, and it's improving OSi's ability to respond to customer needs, save on operational costs, and provide the authoritative location framework that is essential to meeting Ireland's social, economic, legislative, security, business, and administrative requirements.

Modernizing Data Management

As the Irish national mapping agency, OSi's mission is to create, maintain, and provide the

↓ When OSi captures new data and loads it into PRIME2, all that information will instantly—and automatically—filter down through all the organization's map projects and end up on maps like this one.

country's definitive mapping and geospatial information services to support citizens, businesses, and government. OSi's work is essential to developing Ireland's infrastructure. And in the wake of the 2008–2011 economic downturn—one of the worst Ireland has ever experienced—OSi had to meet its customers' growing needs and help drive economic recovery, all while experiencing a 30 percent reduction in staff.

To make this happen, OSi needed to modernize how it managed its authoritative data so it could more quickly provide users with an increasing variety of information products at many different scales and resolutions. It was taking employees considerable time to manually update OSi's maps and services, and many of the organization's map-making processes got unnecessarily duplicated because of repeat data sources.

What OSi needed to do was replace its tile-based cartographic data (which had limited attribution) with a seamless database of real-world objects with rich attribution. The organization had recently consolidated all its digital mapping data, across all scales, into a single database called PRIME2. The next step was to create a framework of GIS-based processes that

will automatically refresh OSi's map products and services when new data becomes available. This—the MRDS—is OSi's next great innovation.

Breakthroughs in Technology and Processes

At just over 190 years old, OSi is no stranger to innovation. It created the first original land survey of the entire Irish island in 1846, making Ireland the first country in the world to be mapped at the detailed scale of six inches to one mile. Later in the nineteenth century, pioneering employees at OSi developed groundbreaking survey methods and equipment, such as bimetallic parallel bars, that brought previously inconceivable levels of accuracy to the land surveying process. OSi maintains an active interest in new technology and process advances—particularly those that improve the currency and quality of its maps.

To generate many different products from PRIME2, such as large- and small-scale maps and interactive web services, OSi worked with Esri Ireland to develop the technological platform and process models. The first 18 months of the project consisted of a knowledge transfer from Esri staff, including Esri Ireland, to OSi's product generation team. Now the team is in the product phase of the project, using ArcGIS Desktop and the Esri Production Mapping extension to create the sophisticated process models that can do things like add symbols and resolve conflicts on their own. Critical products and services are expected to be delivered later this year.

Automating Map Updates

Although a few other national survey organizations, such as the Netherlands' Cadastre, Land Registry and Mapping Agency, have introduced similar automated processes, OSi is the first organization to start with large-scale topographic data at 1:1,000 scale to derive all its products at multiple scales. These include 1:1,000 large-scale urban maps with precise building and road outlines; 1:5,000-scale rural maps, which

have less detail; and the smallest-scale maps—up to 1:250,000—which highlight important landmarks and main roads.

This project exponentially increases the amount of data being generalized via automatic processing, which is remarkable.

"It is the most important advance in cartographic product automation in Ireland since the introduction of digital maps over 30 years ago," said Colin Bray, OSi's chief executive officer.

The MRDS will greatly benefit the hundreds of government, public sector, and commercial organizations that rely on OSi mapping, as well as the thousands of people who use OSi's printed maps and road atlases.

Primarily, and most significantly, the project will empower OSi to provide better-quality maps. When the organization captures new data and loads it into PRIME2, all that information will instantly—and automatically—filter down through all its map projects. This will, in turn, help OSi's diverse array of users accurately integrate multiple data sources into their analyses so they can make well-informed decisions. Since the Irish government's reform program centers on better decision-making, this is critical for stimulating the Irish economy and supporting other key national priorities.

When the MRDS project is complete, it will take OSi much less time to get its map products to market. At present, updating the organization's online map viewer—accessible at map.geohive.ie/mapviewer.html—involves numerous manual steps, so it is only updated every six months. Upon completion of the MRDS project, however, OSi will be able to update its web services—including MapGenie—much more frequently, which will benefit its commercial customers in particular.

Similarly, OSi currently only refreshes its 1:50,000-scale leisure map series once every five years by updating about 50 of its 250 tiles each year. With new automated processes, though, OSi will be in a position to update these paper maps more regularly, printing off small runs at more frequent intervals. This way, citizens and businesses will be able to get ahold of up-to-date maps more easily.

Automating its map updates is also expected to save OSi money. The organization will see savings year-on-year partly by reducing IT hardware costs and partly by coping with a natural reduction in staff due to retirements. OSi expects to get a full return on investment in its cartographic automation system within two years.

Meeting the Needs of Today and Tomorrow

The MRSD project is another major milestone in OSi's long history of innovation in the mapping world. Not only will this adaptive GIS infrastructure be able to meet the country's wide-ranging needs today—delivering high-quality mapping products quickly and cost-effectively—but it also has the potential to meet the unanticipated requirements of Ireland's government, businesses, and citizens in the future. Additionally, it puts OSi in a stronger position to keep innovating.

Esri staff taught OSi's product generation team about automated product generation.

At the NGA, GIS Underpins Virtually Everything

Because the National Geospatial-Intelligence Agency (NGA) provides geospatial intelligence services to a wide spectrum of users including US policy makers, the armed forces, intelligence agencies, and first responders, it needed greater data interoperability. But, as with many mature organizations, NGA's data and applications weren't designed for the demands of immediate accessibility. So the agency is migrating to a cloud-native environment to make its computing resources instantly available across the enterprise.

"Getting our data into the cloud environment, where it is easily accessible and useful, is incredibly important to us," said Susan (Sue) Gordon, deputy director of NGA. "We needed to get our data in a place that would protect it, make it application agnostic, and allow it to be quickly retrieved—and the cloud is perfectly designed for that. From this point forward, we will develop everything in the cloud."

Gordon is known as NGA's innovation advocate and, among other initiatives, has introduced new programs to further NGA's relationships with vendors, including the Commercial Initiative to Buy Operationally Responsive GEOINT, or CIBORG. This is a partnership with the General Services Administration to facilitate purchases of commercial GEOINT capabilities and services.

Gordon became the agency's deputy director in 2015 after more than 25 years of service with the Central Intelligence Agency (CIA), where she served concurrently as the director of the CIA's Information Operations Center and the CIA director's senior adviser on cyber. She recently spoke with Esri about the importance of GIS at NGA and her plans for future innovation at the agency.

What are the advantages of migrating NGA to a cloud-native enterprise?

Our move to the cloud has three primary benefits. What started us on this path was the prospect for interoperability and more shared data. There are lots of components to this, but basically, we wanted our data to be more widely available among the intelligence community and combat support entities. Developing everything in the cloud allows for that.

Secondly, we will take our existing data, put it into the cloud, and redesign the apps that use that data so that they both operate seamlessly in our cloud environment. Adapting our legacy systems to the cloud environment is the most challenging and forward-thinking thing we're doing.

The third part of our cloud migration strategy is to make data more available on all classifications—not just top secret, where the intelligence community typically operates, but also at the secret and unclassified levels, where our combat support partners and customers work. We're expanding its use for humanitarian relief and other civilian operations as well.

What role does GIS play in providing GEOINT services to the intelligence community?

GEOINT services give users the means to employ NGA data, and GIS is typically the foundation for those services. It is the toolkit that allows people to use data in a customized way within a common framework. Historically, there was such a tight coupling between an app and its data that using the data was restricted to that specific app. Now with GEOINT services, the two have been separated so the data can be used in any app in which it is needed.

What is interesting about our commitment to GEOINT services is that we are learning more about what it means to be a service provider and how to respond to our users so they get the greatest benefit from our data and apps. One of our really great approaches is the use of ArcGIS as a geospatial framework, since it is in common use in the industry, allowing our users to quickly access our data and apps.

← Sue Gordon.
(Photo courtesy of Erica Knight, National Geospatial-Intelligence Agency.)

NGA uses what's called the IC GIS Portal to collaborate and share data across the intelligence community. What are some of the successes of this initiative, and do you anticipate its use to grow?

The IC GIS Portal, which is our first GEOINT service and provides easy access to NGA data, is now about two years old. Within that time, we've grown from zero users to almost 60,000 users worldwide.

Based on ArcGIS, the IC GIS Portal is a platform for analytics, collaboration, and data sharing that is used throughout the intelligence community—right down to the war fighter. So imagine you are in a deployed location, and you want to present the operating picture that you see using all the data that multiple sources have made available to you. When you use the IC GIS Portal, you have a framework that you know will support the inclusion of multiple data types and allow them to interact to produce both the visualizations and the analytics you need.

Right now, the IC GIS Portal is on our top secret network, but we have plans to drive it to the other networks. That will really expand its use.
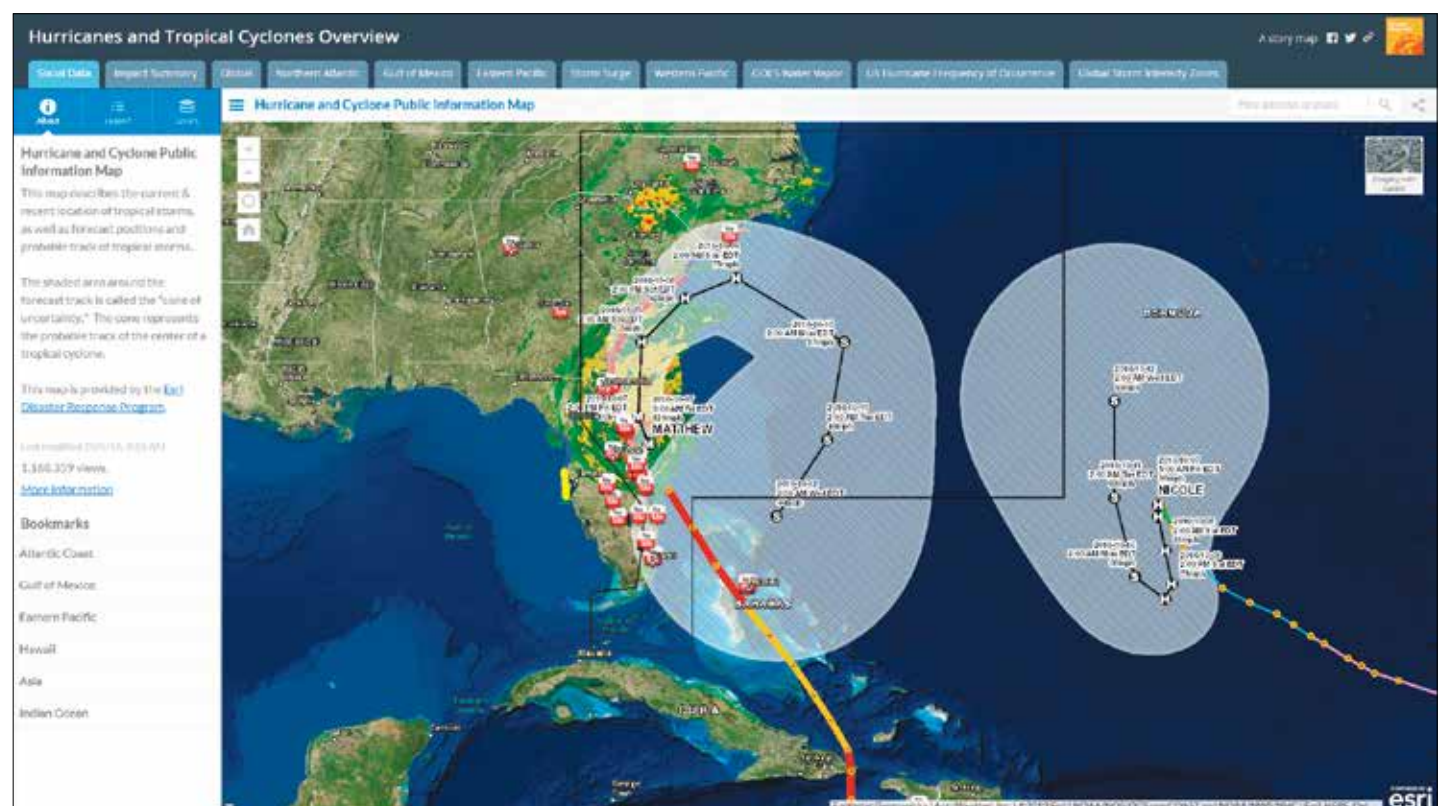
One of NGA's core missions is to provide mapping and charting products for the intelligence community. How is NGA modernizing the process to manage, produce, and share GEOINT?

As mentioned, the cloud environment provides NGA with three strategic capabilities: interoperability, legacy system integration, and the comprehensive provision of geospatial services to the intelligence community.

Because navigational data is key to the successful outcome of many of our missions, we maintain a vast collection of aeronautical, nautical, and terrestrial data that is continually updated. Storing this data in the cloud provides easier access, enabling it to better serve as an asset to the intelligence community.

Our worldwide foundation data includes topographic features, elevation, precise point positioning, and geodetic information. This data rarely changes and can also be easily accessed from the cloud to support activities such as intelligence analysis, operational planning, modeling and simulation, command and control, and joint intelligence operations.

We are in the process of modernizing our foundational GEOINT to substantially improve the quality of its content and management. The backbone is an enterprise GIS platform that captures, stores, manipulates, analyzes, manages, and presents all types of geospatial information. We are implementing a centralized database that collects data from multiple sources and updates it in near real time. Again, our focus is on determining how we can make our data more commonly available to the greatest number of users in the intelligence community in the most efficient way.

→ For Hurricane Matthew in 2016, ArcGIS Online was used to create new views instantly whenever new data was provided.

How is NGA leveraging the growth and availability of commercial and unclassified data to improve its capabilities in intelligence analysis?

Today, the amount of openly available geospatial content, images, and geospatially enabled data is absolutely staggering, and many of our analysts need data produced outside the intelligence community.

We are committed to providing that data by establishing partnerships to identify, evaluate, and use all sorts of data—from commercial, airborne, and handheld imagery to social media products and related services. To do this, NGA is looking into acquisition methodologies and business relationships with other producers to take advantage of everything that is available to us.

For example, NGA recently partnered with the National Reconnaissance Office (NRO) to form what we call a Commercial GEOINT Activity (CGA). Our intent is to form a clearinghouse where we can make our needs known and companies can proffer their services and products. We will then evaluate the effectiveness of offered capabilities in relation to our needs. This will allow NGA and NRO to perform a service for both government organizations and companies that want to do business with us.

The CGA is only a few months old now, but it will be valuable for understanding how all the available geospatial data and services can meet our needs.

Recently, NGA made efforts to improve its transparency to the public and increase its support of disaster relief efforts and other activities using unclassified data. How would you describe NGA's success in the use of ArcGIS Online in support of Hurricane Matthew and the Arctic Support Data?

Among my favorite stories is our use of ArcGIS Online in support of humanitarian relief efforts that developed as a result of our partnership with Esri.

This platform allows real-time interaction with both emergency responders and data providers that is truly stunning. Previously, situation updates required the collection and processing of geospatial data and from that, we created a new view of the area of interest for analysis and response.

With the use of ArcGIS Online for Hurricane Matthew, whenever new data was provided, new views were created instantly and then widely distributed to those involved in the emergency response and recovery efforts.

The ArcticDEM was a collaborative project that included NGA, the National Science Foundation, the University of Minnesota, Cornell University, Ohio State University, and Esri to automatically produce high-resolution, high-quality, digital elevation models (DEMs) of the Arctic using optical stereo imagery. Surprisingly, the Arctic is relatively undermapped—not underexplored, but undermapped—because of its remoteness.

NGA collects a lot of big data from a range of sources and in a variety of formats. What is NGA doing to better integrate and manage this data, and how can GIS best serve as the integrating platform?

NGA director Robert Cardillo talks about creating coherence from chaos. That's really what this is about. How do we take the vast amount of data that exists and structure it in a way that lets us better analyze and understand the situations that confront us?

GIS is so important to integrating this data because it all needs to be maintained in a common format and displayed within a common framework. That's the approach we're taking with data: It looks noisy; yet we can turn it into something that is widely understood, and then we can act on that data together.

You are well-known as an agent of change in the intelligence community. What is your secret to implementing innovative solutions in such a large government organization like NGA?

I believe that I am supposed to get things done, and to do that, I sometimes have to find new ways to operate. I also believe that current systems exist for a reason. So I first take into account what those systems are accomplishing before showing people how that can be achieved in a better, different way.

The government wants to be perceived as deliberate, so its actions need to be constant and repeatable and it has to be transparent and fair. No government agency can take the same chances that private industry does. So when I do things differently, I must show that my new methods are still accountable.

At NGA, we go a bit against the grain because of the GEOINT space in which we operate. But although we are a little bit revolutionary and certainly have an entrepreneurial spirit, we also trust our long-time partners, such as Esri, because we share a common vison about the impact GIS can have in so many areas—from national security to humanitarian relief.


↑ The Arctic is relatively undermapped because of its remoteness.

↓ The ArcticDEM was a collaborative project to automatically produce high-resolution, high-quality, digital elevation models (DEMs) of the Arctic using optical stereo imagery.

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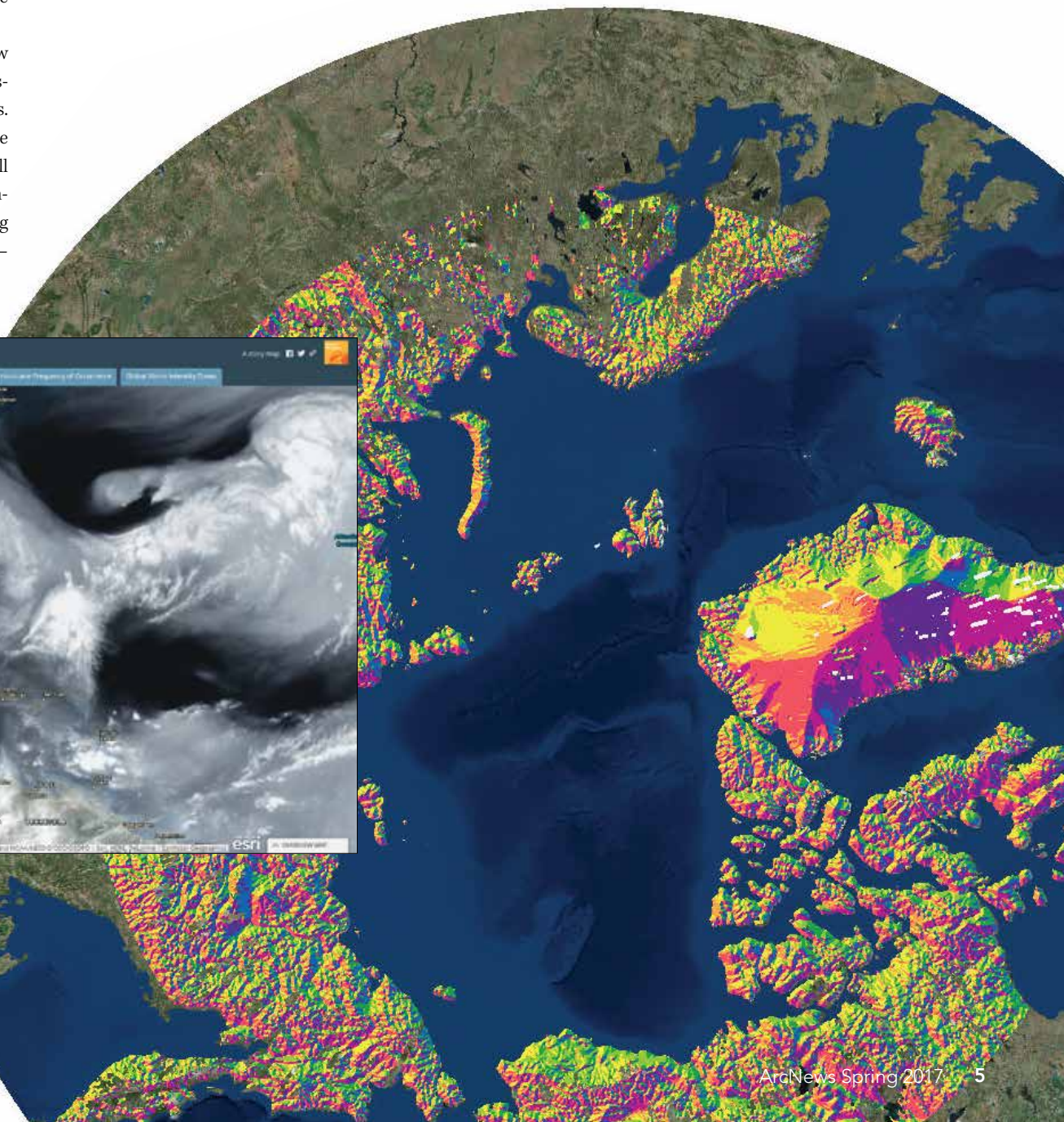
Getting Insights Quickly

Insights for ArcGIS Is Now Offered as a Managed Service

Exploring spatial and nonspatial data quickly with Insights for ArcGIS is even easier now that the app can be deployed as a managed service.

Backed by Esri Managed Cloud Services (EMCS), which provides users with world-class hosting and management support, Insights as a managed service gets users up and running fast. EMCS gives organizations peace of mind that their deployments are secure, since the systems are managed by cloud and GIS experts. It also allows users to focus on what's important—discovering, sharing, and acting on the awareness they gain from visualizing their data.

Insights is a shortcut to thinking spatially. Through dimensional modeling, Insights intelligently determines which visualizations best suit the data. From there, Insights can provide guided workflows to help users quickly answer spatial questions—even ones they wouldn't have thought to ask. This is ideal for users who need to get spatial analysis going fast, as well as for GIS analysts who want to save time by using common workflows to find answers fast before heading to ArcGIS Pro to do further analysis.

Insights leverages the power of ArcGIS Enterprise, a key component of the ArcGIS platform. ArcGIS Enterprise equips organizations with a complete GIS that runs behind a firewall, in an organization's own infrastructure, on-premises, and in the cloud. Together, ArcGIS Enterprise and Insights allow users to explore data—and more of it—in new ways. They can tap into ArcGIS GeoAnalytics Server to evaluate large amounts of historic data, as well as use ArcGIS GeoEvent Server to analyze rapidly changing information in real time—both of which provide a holistic view of any situation.

Getting this kind of digital intelligence is easier when back-end operations are less demanding. That is why, once Insights is operational in the cloud, EMCS stays connected to the organization—providing regular updates on usage, operational assistance, and early warnings about storage capacity and outage events. As users' needs and goals change and Insights progresses, EMCS helps organizations evolve and optimize their Insights environments so they continue to obtain the results they're looking for.

Get up and running with a turnkey system of Insights for ArcGIS at go.esri.com/Insights-as-a-Service. Learn more about Esri Managed Cloud Services at go.esri.com/InsightsEMCS.

Bavaria Gains Insight into Managing Its Roads

would need a flexible, task-based workflow that would allow them to connect to available data, perform analyses, and publish their results—all while factoring in guidelines for government action.

Third, the tool had to be a web-based solution. Users would need to be able to publish and share analytic discoveries online to support quick and accurate decision-making.

Fourth, the ideal solution had to work with the Bavarian State Building Administration's existing information platform, BAYSIS, which is hosted on Microsoft SQL Server. BAYSIS contains an expansive amount of data on Germany's transregional road network and all road-related technical information, and it supplies this data to users both inside and outside the administration. The core Microsoft SQL Server database is augmented by a number of additional databases and apps as well, and all these information tools are brought together under one system: the digital version of Bavaria's road network.

Connecting Data and Users

To find a solution that met these criteria, the Bavarian State Building Administration conducted an in-depth market study of potential vendors. The organization assessed both single-user and web-based solutions, as well as various product offerings from Esri. After much research and evaluation against the key criteria, the administration decided that Insights for ArcGIS best met its needs.

"Insights for ArcGIS supports the process for both management and government decision-making in a way that optimally serves both a citizen- and business-oriented infrastructure deployment," said Roland Degelmann, head of unit infrastructure planning for the Supreme Building Authority in the Bavarian Ministry of the Interior, for Building and Transport.

In selecting Insights, Degelmann said the team liked how the app allows users to connect to many data sources (such as Microsoft Excel spreadsheets), geodatabases, enterprise databases (such as SQL and SAP HANA), demographic data from Esri, and publicly accessible statistical material. The modern user interface and drag-and-drop functionality enable Bavaria's transportation authorities to perform spatial analysis in just a few clicks. The team can then share analysis results or the analysis model with others.

Up and Running Quickly

Once it was decided to use Insights, the Bavarian State Building Administration deployed the app quickly. Although the people working on the project did not have special expertise in GIS, they found Insights easy to use and were able to get up and running fast. Soon, they could see and analyze data for decision-making and share their analyses and visualizations online.

The Bavarian State Building Administration sees Insights as an analysis platform for the future—especially because of its ability to apply statistical methods and run analytic processes on the fly, or dynamically. The app is flexible enough for Degelmann to feel confident that he can use it to tackle yet unknown challenges and issues. And because Insights is scalable, Degelmann plans to use it to calculate and analyze key performance indicators in a larger, statewide context.

"In the future, Insights for ArcGIS will be an essential basis of the management process of the Bavarian Authority of Road Infrastructure," Degelmann said. "The consistent application of such tools will result in significant time and cost savings and efficiency gains."
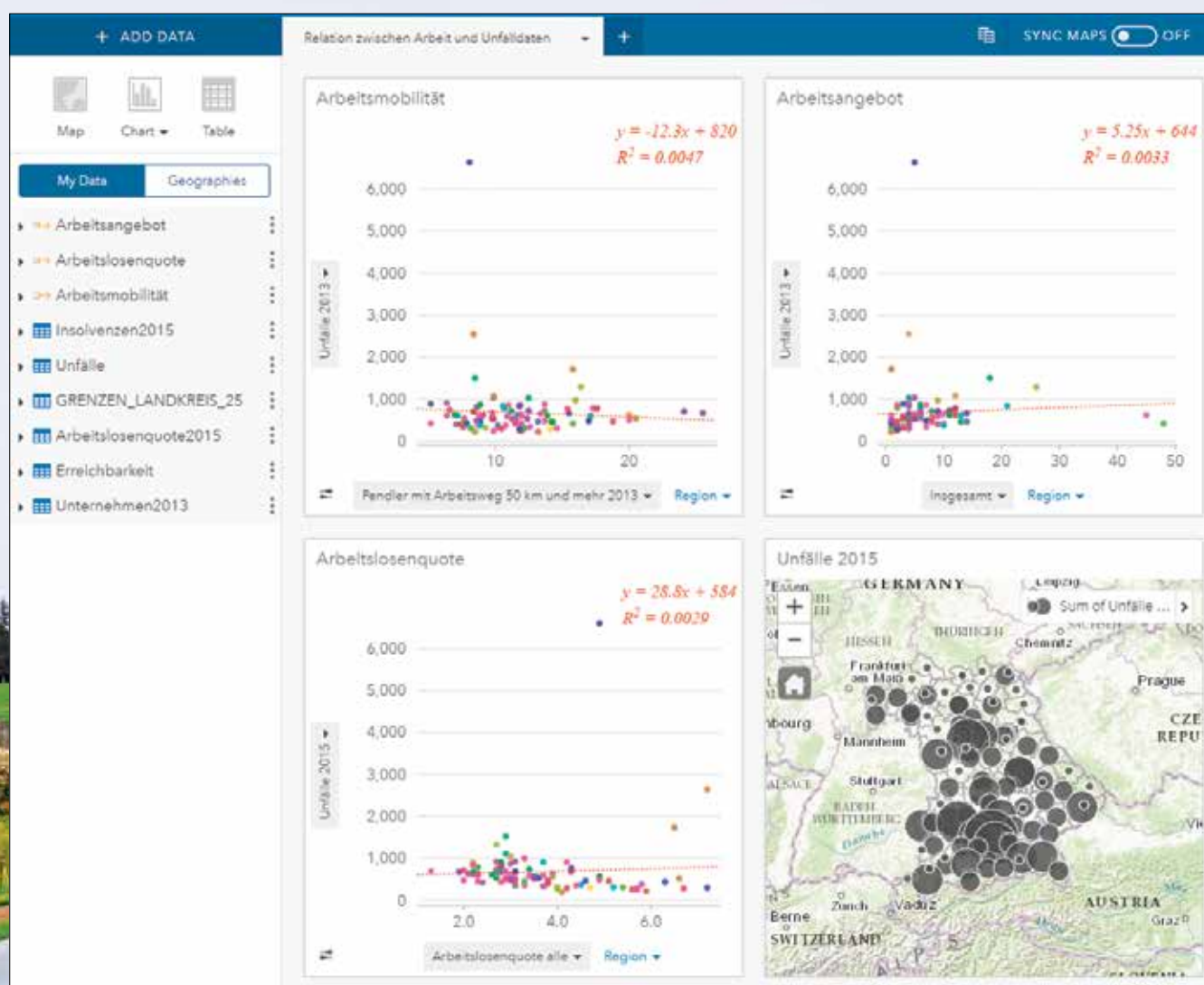
↑ Insights for ArcGIS allows users to apply statistical methods to analyze relationships, such as the correlation between the frequency of accidents and the distance people drive from their residences to their workplaces.

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Building a Complete GIS Database of Protected Areas

USGS Leads Inventory of Lands in the Public Interest

By Lisa Johnson and Mason Croft, United States Geological Survey and Boise State University, and Larry Orman, GreenInfo Network

By 2020, it will be feasible to find GIS data for any park or other protected area in the United States. In fact, it's almost possible now.

The Protected Areas Database of the United States (PAD-US) is the official GIS inventory of public parks and other protected areas in all US states and territories. It contains 3 billion land and marine acres managed by more than 15,000 agencies and nongovernmental organizations (NGOs) in over 150,000 separate parks and protected areas.

Developed and managed by the US Geological Survey's (USGS) Core Science Analytics, Synthesis, and Libraries, the most recent data—published as version 1.4 in May 2016—has close-to-complete data for federal and state agencies. PAD-US also has nonsensitive easement data from the National Conservation Easement Database and information on marine protected areas from the National Oceanic and Atmospheric Administration (NOAA). What's left to finish are the regional and local levels, where detailed data is only available for about 15 states.

A just-released action plan for USGS lays out what's needed to complete PAD-US by 2020, and scheduled updates to the dataset for this year and 2018 are key steps along the way. For the first time, planners, conservationists, and many others can now look forward to having parks and protected areas all mapped out in the next three years.

Using PAD-US

The data in PAD-US (available at gapanalysis.usgs.gov/padus) can be used to meet a wide range of needs. For example, app developers who are working on park finder apps, like Recreation.gov, or ParkRx apps, which allow doctors to prescribe park use to patients with chronic diseases, can use PAD-US to build their web apps. The National Wildfire Coordinating Group can use the database to effectively manage fire response. Communities and nonprofits can use it to define conservation priorities for habitats and species. And it provides a framework for tracking federal and state Land and Water Conservation Fund investments.

Regional and county planners can also use PAD-US to better assess park needs in their areas, and local and state governments can use the maps and data to calculate parks' economic benefits when coming up with tourism-based economic development ideas and to better guide visitors to local parkland. Additionally, land planners can employ PAD-US to site the best locations for energy and transmission facilities.

The PAD-US database is particularly useful to anyone who needs regional data as well, including counties; intrastate, multistate, and national organizations; research bodies; and planning and policy groups. The data is also available as an ArcGIS web map, making it easy for Esri users to find it and apply it to their work.

→ The Protected Areas Database of the United States (PAD-US) categorizes fee and private lands, designation areas, easements, and marine protected areas.

↓ PAD-US contains 3 billion land and water acres managed by more than 15,000 agencies and NGOs in over 150,000 separate parks and protected areas in the United States and its territories.

What's Under the Hood?

PAD-US is a complex dataset developed by integrating scores of data flows from land-owning and management agencies, as well as NGOs. At its core, PAD-US defines the boundaries of public parks and protected areas owned and managed by governments and nonprofits, including terrestrial and marine areas.

To get federal, state, and NGO data into PAD-US, USGS works with federal agencies and data stewards—such as state governments, universities, and nonprofits—to aggregate data for state and local parks and protected areas. With more than 30,000 state, regional, local, and NGO land managers, state aggregators create a distributed yet viable system for gathering the data.

The PAD-US development team manages all the data in ArcGIS in a file geodatabase.

Geodatabase domains help PAD-US data managers standardize attributes. Having multiple feature class representations supports data development and managing overlapping designations.

PAD-US web mapping services, which provide users with ready-made interpretations of the data, are available through USGS and shared via ArcGIS Server 10.3 and later, including ArcGIS Enterprise. The USGS PAD-US Viewer (maps.usgs.gov/padus) and the web map at protectedlands.net/map are examples of how these map services can be used to aid interpretation, with the data broken up into Manager Type, Manager Name, Protection Status, and Public Access, for example.

| Easement over **fee** land | Easement over **private** land | **Designation** (roadless area, wilderness, etc) | **Marine-protected area** | **Fee-owned** land (national forest, etc) | **Fee-owned** land (city parks) |

Protected Areas Database of the U.S. (PAD-US) - Land Management

Glacier National Park, Montana

Coordination and Collaboration

PAD-US is first and foremost a product of collaboration and coordination, particularly at the federal, state, and NGO levels.

How PAD-US is Built

State stewards develop statewide data for fee-owned lands

NATIONAL NGOS

FEDERAL AGENCIES

INTEGRATION

USGS SAP integrates all and publishes products

NCED
Data sharing, coordination: National Conservation Easement Database

US and global data products published

World Database on Protected Areas (WCMC)

CEC North American Protected Areas Database

↑ PAD-US is a complex dataset developed by integrating scores of data flows from land-owning and management agencies, as well as NGOs.

PAD-US contains detailed information about public parks and other protected areas in the United States, including this urban park in Atlanta, Georgia.

For the past five years, USGS has cochaired (along with the US Census Bureau and the Bureau of Ocean Energy Management) the Federal Lands Working Group (FLWG), an innovative partnership of 15 federal agencies that are defining data translation protocols for sharing all federal-level land management data directly into PAD-US. This has been a huge task. Tremendous progress was made for PAD-US 1.4, and momentum is building.

The state-level data stewards—which include one or two governmental agencies, universities, and non-profits per state, depending on each state's situation—manage state and local data for PAD-US updates. Stewards range from departments of natural resources and natural heritage programs to universities like Colorado State University and non-profits such as the GreenInfo Network. (A complete list of partners, plus more information about them, can be found at protectedlands.net/partners.)

Nongovernmental organizations also play key roles in PAD-US. The Nature Conservancy, for example, has helped develop inventories in many eastern states. The National Conservation Easement Database, which is led by the Trust for Public Land and Ducks Unlimited, secures easement data from land trusts and agencies. And the National Recreation and Parks Association promotes PAD-US-compatible data standards and tools for its thousands of agency members.

Coming Soon

Thanks to the considerable efforts of these data stewards and USGS, PAD-US version 2.0 will be released before the end of 2017. In addition to having extensive data updates for many state and federal lands, the second version of the geodatabase will have a new structure with separate feature classes for fee ownerships (e.g., national forest or state park), designation areas (such as wilderness, wild and scenic rivers, areas of critical environmental concern, and some state wildlife areas), easements, and marine protected areas. This structure will resolve a long-standing challenge with PAD-US in which fee-owned lands and designated areas have been in a single feature class with many overlaps, requiring extra data manipulation to conduct analysis.

The new PAD-US structure will also help USGS publish tailored PAD-US data editions (for conservation, land planning, recreation, and more) out of the core dataset. Additionally, federal agencies are seeking to reduce the overlaps and slivers between agency datasets, which will boost the analytical capabilities of PAD-US.

Later in 2018, the Trust for Public Land is scheduled to release its ParkServe GIS dataset, which will cover parks in all urban areas of the United States. This data will add tremendous coverage, bringing the full database much closer to realization. Work is also moving forward on many other technical improvements to PAD-US. These include resolving boundary gaps and overlaps, filling in data for some attributes, and improving the status ranks for biodiversity conservation.

By 2020, it is likely that PAD-US will be a complete inventory of public lands in the United States, incorporating all known sites and descriptive information. This will make continued maintenance by USGS and its state steward data partners much easier.

Join the Effort

Users are an indispensable part of the future of PAD-US. Here's how to get the most out of the dataset:

- **Use it.** Try it out! If you haven't used PAD-US before, download the dataset, view it in custom map apps (maps.usgs.gov/padus and protectedlands.net/map), or access more than 23 PAD-US-specific web mapping services at gapanalysis.usgs.gov/padus.
- **Support it.** PAD-US is a national resource. Support making it the best dataset it can be. Collaborate with local, state, federal, and NGO data stewards to help them integrate the highest-quality geospatial data.
- **Adopt it.** If you are a parks data steward at any level, consider adopting the PAD-US data standards into your local data format. Get more information at gapanalysis.usgs.gov/padus/data/standards.
- **Comment on it.** Tell USGS about your experience with PAD-US. What works? What doesn't work? What else would you like to see in the database (and can you help make that happen)? Get in touch with the PAD-US team at gapanalysis.usgs.gov/padus/contacts.

PAD-US is already an incredible resource, and the vision of having a complete inventory of US parks and protected areas is within reach. Join the effort to help make it a reality.

To find out more about the vision for PAD-US, download the full 2020 action plan report and an eight-page summary at protectedlands.net/vision. This report was prepared for USGS by Boise State University in Idaho and the California-based nonprofit GreenInfo Network, with support from the National Park Service and the Centers for Disease Control and Prevention.

About the Authors

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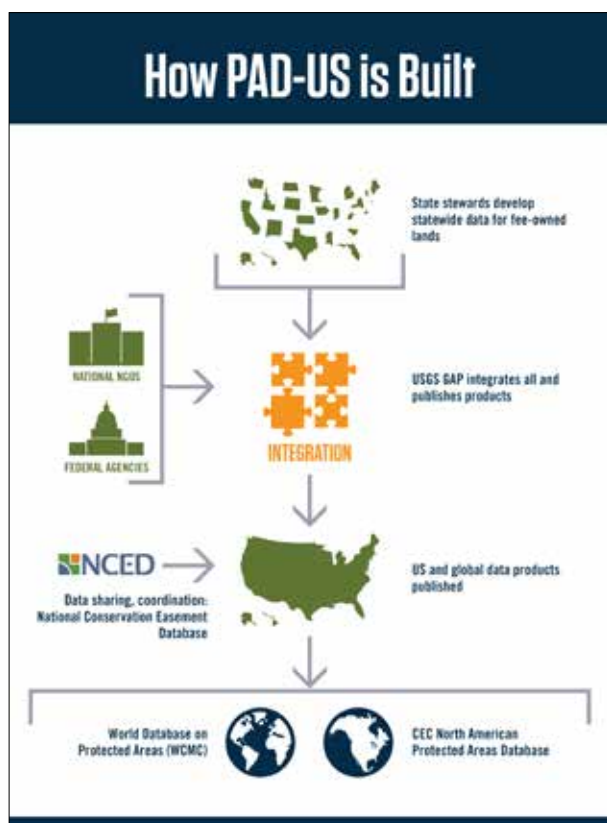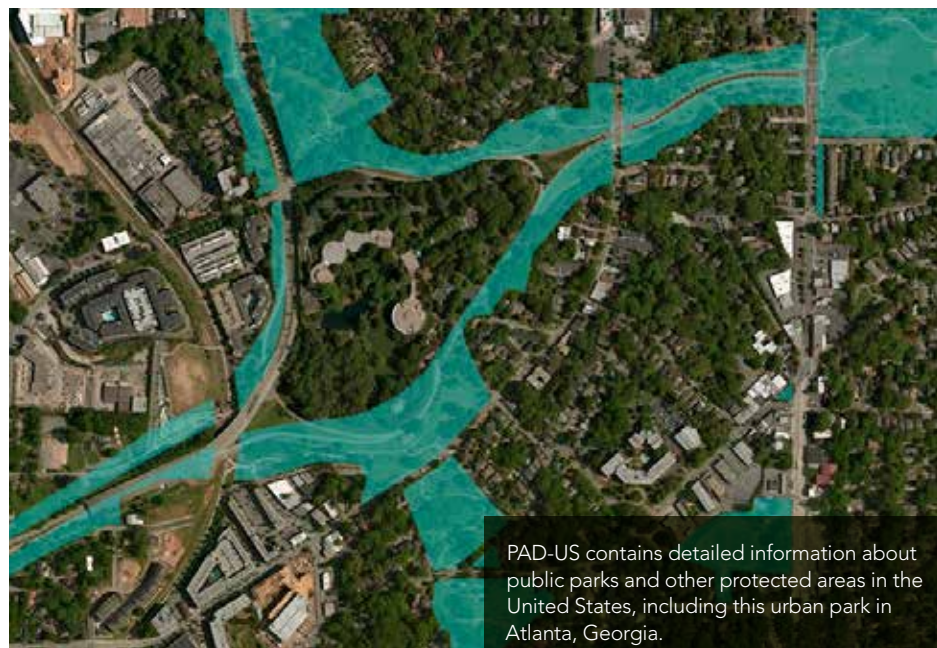
High-Resolution Land-Cover Data Helps Restore Chesapeake Bay Watershed

By Margaret Markham, Chesapeake Conservancy

The Chesapeake Bay watershed spans 64,000 square miles across six US states and the District of Columbia. To manage the environment in this vast area, having accurate land-use and land-cover information is imperative. Existing datasets, such as the National Land Cover Database (NLCD), have been extremely useful in identifying priority zones throughout the watershed that are in need of conservation and restoration. This data, however, often lacks the resolution required to examine, track, and identify fine-scale trends or make parcel-scale decisions that focus on restoration efforts.

Recognizing the importance of having datasets that can achieve these goals, some counties

↓ Compared to the National Land Cover Database (bottom), the Chesapeake Conservancy's high-resolution land-cover dataset (top) can break down dense urban development in places like Washington, DC, into details—such as buildings, roads, and street trees—that are valuable for planning restoration projects.

and municipalities commissioned small-scale initiatives to produce high-resolution land-cover information for areas under their jurisdiction. While this information has aided local decision-making, the land-cover classification categories differ across boundaries, as do data accuracy and resolution. The data wasn't widely available either, which made it difficult to use high-resolution land-cover data for larger policy making and restoration endeavors.

To bridge the gap between local and regional efforts, the Chesapeake Conservancy, a nonprofit organization based in Annapolis, Maryland, proposed a project to create consistent high-resolution land-cover data for all 206 counties that comprise the Chesapeake Bay watershed area. Using ArcGIS, the conservancy and its partners developed a dataset that makes it easier to pinpoint high-priority restoration and conservation areas. The Chesapeake Conservancy is also collaborating with the Chesapeake Bay Program (CBP) and the US National Park Service to use the dataset to implement environmental projects in the area.

Data Discrepancies Hamper Progress

In 2010, the Environmental Protection Agency put the Chesapeake Bay on a pollution diet to restore the health of the watershed's rivers, streams, and creeks. Called a Total Maximum Daily Load (TMDL), the diet's goal is to decrease by 20 percent or more the amounts of nitrogen, phosphorus, and sediment in the water by 2025. The TMDL has directly affected state- and county-wide policies and regulations throughout the watershed and stimulated a number of new pollution reduction initiatives at local levels.

To model, track, and manage statewide progress toward reaching these water goals, CBP—a regional partnership that helps lead, direct, and manage restoration efforts in the Chesapeake Bay—relies heavily on land-use and land-cover data. Before 2015, CBP calculated its watershed-wide pollution numbers using the 30-meter resolution NLCD. But there were still discrepancies between the NLCD and the higher-resolution datasets being employed by local planners.

"This resulted in inconsistencies when comparing local evaluations with CBP's modeling, which made planning, implementation, and reporting very difficult," said Jeff Allenby, the Chesapeake Conservancy's director of conservation technology.

CBP partners recognized that having a high-resolution land-cover dataset of the entire watershed would not only improve their ability to quantify the effects of existing and in-progress restoration efforts but also would have very real implications on planning new restoration projects. Thus, in 2015, CBP commissioned the Chesapeake Conservancy to upgrade the land-cover data for the entire watershed. Working with the University of Vermont's Spatial Analysis Laboratory and Esri partner WorldView Solutions, the conservancy created a one-meter-resolution dataset for the Chesapeake Bay watershed and all the counties that intersect its boundaries.

"Our project covers more than 100,000 square miles—beyond the boundary of the Chesapeake watershed—to give the border counties complete pictures of their landscapes," said project manager Cassandra Pallai. "This makes the CBP dataset one of the largest high-resolution land-cover datasets in the [United States]."

Building a Consistent Dataset

To execute the update, the Chesapeake Conservancy developed a multistep image classification workflow using ArcMap, ArcGIS Pro, and the image processing software ENVI from Esri partner Harris Corporation.

"Since the conservancy had to make the classification technique adaptable to diverse landscapes, we opted for a rule-based methodology," explained Colin Stief, an app designer at the Chesapeake Conservancy who helped create the protocol. "Trees, for example, were categorized as tall, green, and as having a high vegetative index."

The project analysts broke the multistate region into areas composed of 8–12 mosaicked National Agriculture Imagery Program (NAIP) images, each the size of a United States Geological Survey (USGS) digital orthophoto quadrangle, or quarter quad. The NAIP images, collected between 2013 and 2014, were one meter resolution and had four spectral bands: red, green, blue, and near infrared.

Where lidar was available, staff used ArcGIS Desktop to create mosaics of digital elevation models (DEMs) and LAS datasets of lidar-derived point clouds. Then, using the mosaicked imagery's footprint as a processing extent, analysts implemented an iterative process in ModelBuilder to create complementary digital surface models (DSMs) of landscape height. This height information and a Normalized Difference Vegetation Index (NDVI) layer were appended onto the four-band NAIP mosaics as fifth and sixth bands.

Other data used in the project included the most up-to-date high-resolution, leaf-off imagery (with pixel sizes between 15 centimeters and one meter). When available, the conservancy also incorporated county, state, and federal planimetric (2D) datasets to enhance the classifications of road, structure, and impervious features.

Relying on proprietary rule sets, analysts used ENVI to segment the tiles of the aerial imagery and organize them into five to seven classes. Once the data was categorized to analysts' satisfaction, they exported the results in both raster and shapefile formats. The analysts then used ArcGIS Desktop to manually correct the polygon versions of the classifications. Using an object-based methodology for accuracy assessment that was designed for high-resolution land-cover data, they also analyzed each county individually in ArcGIS Pro and made additional corrections in ArcMap.

From there, local experts in each watershed county reviewed the completed datasets to further ensure their accuracy.

"This was incredibly important for improving county staffs' confidence in the TMDL pollution models," said Pallai. "It was the first time that most of them had [contributed] to CBP's pollution calculation process."

The final watershed-wide dataset ended up being about 90 percent accurate. Once everything was finished, the conservancy and CBP used available county parcel, zoning, and land-use information to classify the land-cover data into land-use data, the tabular form of which will be incorporated into the TMDL water quality evaluations.
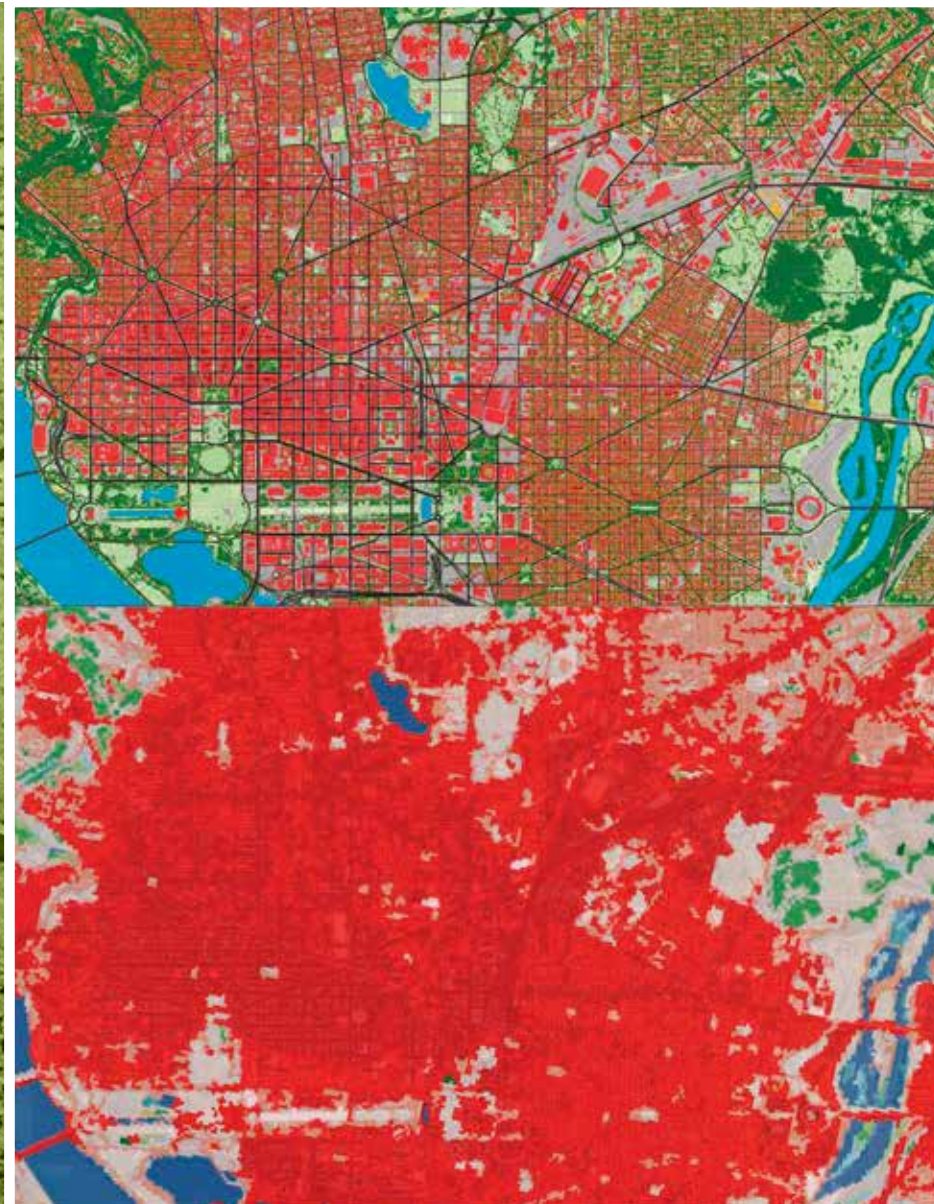
Restoration Projects Get a Boost

Given that water quality regulations such as the TMDL underlie most of the restoration work done in the Chesapeake Bay watershed, this new dataset has quickly become essential. It gives CBP, the conservancy, and the watershed's environmental stakeholders the technological power to make effective decisions about where to target their restoration efforts.

For example, in 2016, the Chesapeake Conservancy partnered with Pennsylvania's York County Stormwater Consortium to incorporate the land-cover data into a customized, web-based tool that streamlines and standardizes the data, calculations, and formatting for the storm water project reports that the county's 44 municipalities submit. Now, the consortium can identify, compare, and prioritize the most cost-efficient projects to help York County achieve its water quality goals.

Additionally, at George Washington's Mount Vernon estate, along the Captain John Smith Chesapeake National Historic Trail, the Chesapeake Conservancy is helping protect the natural vista by conducting a viewshed analysis. With the conservancy's higher-resolution data, users can estimate a more accurate viewshed by including a precise representation of on-the-ground features like trees and buildings. The conservancy also built a web app that allows anyone to calculate the visual impact of new development or tree loss by selecting specific parcels and drawing in hypothetical buildings of various heights.

To supplement the land-cover data, the Chesapeake Conservancy has developed a methodology as well that identifies flow paths in areas where surface water tends to concentrate. Using the new land-cover and flow path data in the ArcGIS platform, the conservancy is able to identify natural buffers by distinguishing trees, wetlands, or shrubs within 35 feet of a stream or river.

"From there, we can analyze which buffer gaps would be higher-priority restoration projects by...quantifying the area *[of land]* that is draining into each gap," said David Saavedra, a new member of the conservancy's GIS team. "Gaps with drainage areas containing a large percentage of impervious or agricultural surface areas could become a high priority for restoration because they contribute more pollution than those dominated by forest or wetlands."

"It is really exciting to be at the forefront of a product that will fuel a revolution in the way the landscape is modeled and managed," added Allenby. "This land-cover product is groundbreaking in many ways."

To download the data and view webinars on use cases, visit chesapeakeconservancy.org. For more information, email Allenby at jallenby@chesapeakeconservancy.org.

→ ENVI's rule-based classification workflow breaks imagery into segments, such as the one outlined in blue, so that analysts can easily categorize different areas.

The Building Blocks of a Smart, Data-Driven Community

GIS professionals, and academics. The group met for a series of workshops and presentations at the end of January at Esri headquarters in Redlands, California.

"*[With]* this massive amount of data, we need context," continued Goldsmith, a professor at Harvard University's Kennedy School of Government and the former mayor of Indianapolis, Indiana. "GIS is an organizing context for data."

Esri president Jack Dangermond, who had just returned from a trip to India, where he inaugurated a GIS Innovation Hub in Hyderabad, said that that country is embracing the idea of data-driven smart cities faster than in some areas of the United States. He said that digital technology is everywhere in India, from "tiny rural villages to growing metropolises."

Every person who walks around with a mobile phone is a potential sensor or collector of real-time data that, once analyzed and visualized, can be used to make decisions and improve how a community functions.

Real-time data collection using sensors and the Internet of Things (IoT)—coupled with advanced spatial analytics and visualization of big data, or "smart GIS"—will help drive problem solving, Dangermond said. And there are big problems to solve, including climate change, loss of nature, and loss of biodiversity.

"These are problems we are going to face for the rest of our lives, *[so]* we need to collaborate and work together," said Dangermond. "GIS and geodesign represent a framework and process for creating a smarter world."

Smart Urban Planning

Creating a smarter world starts with smart planning. That's where geodesign comes in.

Geodesign combines the art of design with the science of geography in the planning process. Stakeholders provide input, and geodesign practitioners then use creative design techniques, rigorous methodologies, spatial analysis, and mapping to find the most suitable sites for housing developments, parks, office space, transit, and renewable energy projects.

All government organizations, from small municipalities to major cities, face vexing planning issues that often revolve around questions of where and how to grow while still maintaining the unique character of the community. To study those issues, some cities, such as San Francisco, California, and Boulder, Colorado, are beginning to use 3D geodesign technologies.

Scott T. Edmondson, a strategic sustainability planner-economist for the San Francisco Planning Department, said that as the City of San Francisco studies how to grow, it is beginning to use 3D GIS technology. He showed the summit audience how city planning staff and an Esri team used 3D GIS tools to analyze and visualize data on height control of buildings, housing and jobs capacity, housing and jobs growth, and transit access to housing and jobs.

Edmondson said that the city typically employs tools such as 2D maps, Microsoft Excel

Scott T. Edmondson, a strategic sustainability planner-economist for the San Francisco Planning Department, said that as the City of San Francisco studies how to grow, it is beginning to use 3D GIS technology.

tables, and charts to communicate planning scenarios. However, the 3D tools and techniques used for the demonstration project provided a "better visual explanation" of the data, he said. "People get it quickly."

In Boulder, Colorado, work is under way to update the Boulder Valley Comprehensive Plan, a long-range planning guide for the community, which has 107,000 people and 100,000 jobs. The city's comprehensive planning manager, Lesli Kunkle Ellis, told the audience that the city is expected to grow rapidly in the next four to five years. While job growth is strong, however, the availability of affordable housing lags.

To study and communicate data and issues related to land use, the City of Boulder has used a range of Esri technology, including Esri CityEngine 3D modeling software and Esri Story Maps apps. The maps show, for example, what percentage of land in the Boulder area is currently residential (72 percent); commercial and mixed use (8 percent); parks, open space, and mountain parks (14 percent); publicly owned (5 percent); and other (1 percent). The Boulder Valley Comprehensive Plan Story Maps (arcg.is/1RiTUap) include 3D maps of subcommunities with layers that, when turned on, show wetland areas, bike lanes and pedestrian trails, sidewalks, transit routes, parks and open space, zoning districts, and capital improvement projects.

Ellis said Boulder residents are very interested and engaged in the planning process. To give the public the opportunity to explore the land-use data, the city put the story maps on its website.

"The story maps are a fantastic tool," said Ellis. The city would like to create more.

Kenton County, Kentucky, also uses GIS maps to research issues and communicate with the public. Trisha Brush, GIS director, and Emi Randall, director of planning for Kenton County's Planning and Development Services (PDS), told summit attendees about LINK-GIS,

"If a picture is worth a thousand words, a map is worth a million," said Kenton County's Trisha Brush.

an information portal that lets people explore a wide selection of online maps.

Brush and Randall also talked about Northern Kentucky Map Lab (NKYmapLAB), a PDS initiative in which data is analyzed to produce story maps that inform and solicit feedback from the public and elected officials about various issues—some of which are connected to Direction 2030, the county's long-range plan.

PDS has created story maps on topics such as walkability and sidewalk connectivity, traffic congestion, the urban tree canopy, solar potential, and a plan to widen a state highway in northern Kentucky.

"If a picture is worth a thousand words, a map is worth a million," Brush said.

Brush and Randall's presentation also included the PLAN4Health in Kenton County story map (arcg.is/1W2zznE), which shows the results of an analysis done to identify food deserts—areas of a community that lack easy access to healthy foods, such as fruits and vegetables. The American Planning Association (APA) funded the project to conduct the analysis and supports a program to educate people about nutritious foods and bring more healthy foods into corner grocery stores.
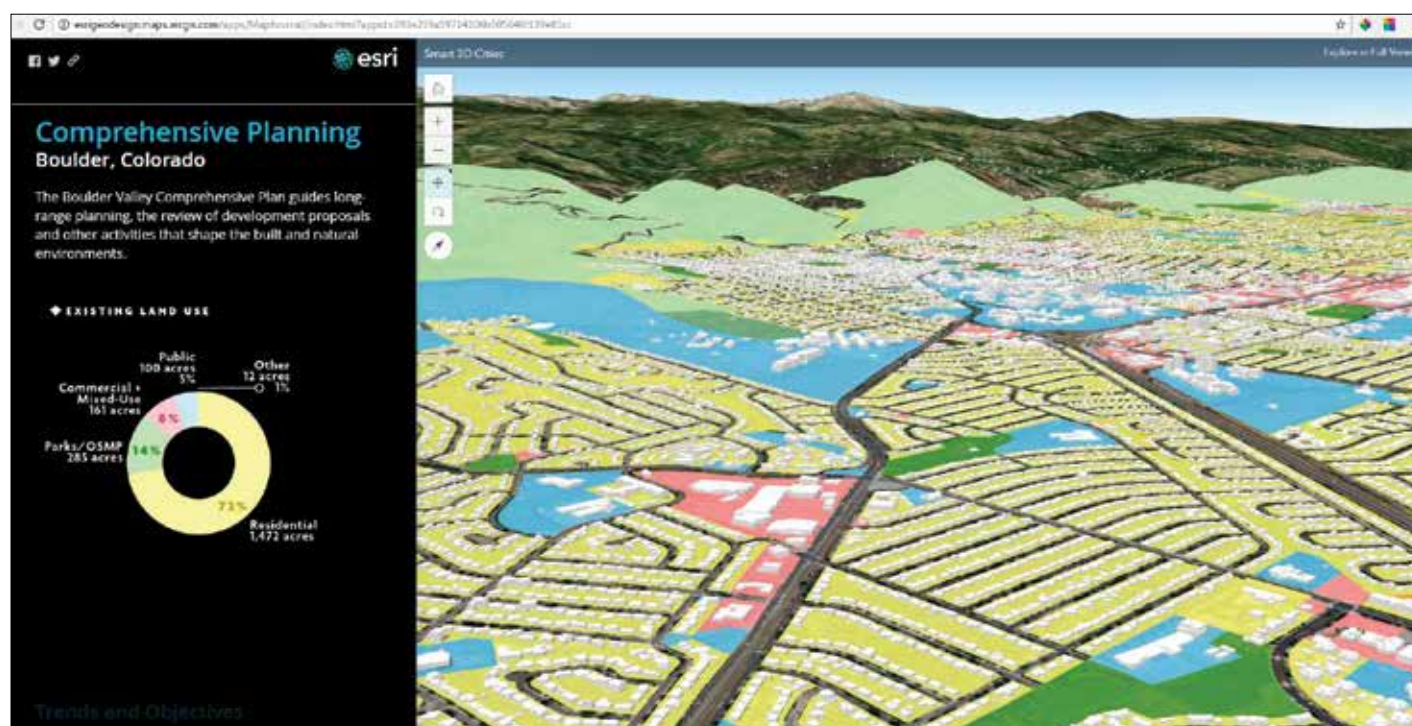
↑ Boulder, Colorado, has used a range of Esri technology, including Esri CityEngine 3D modeling software and Esri Story Maps apps, to study and communicate updates to its long-range community planning guide.

↑ The PLAN4Health in Kenton County story map shows the results of an analysis done to identify food deserts—areas of a community that lack easy access to healthy foods.

What's New in ArcGIS Online

One program participant was Kimmy's Korner, a neighborhood corner grocery store in Covington, Kentucky.

"The owner, Mark, wanted to help kids eat healthier," Randall said.

With the help of new refrigeration equipment, he added apples, oranges, yogurt, fresh vegetables, and sweet potatoes to his shelves.

Learning Technology, Planning Communities, Telling Stories

The Kenton County PLAN4Health project, along with its story map, serves as a good example of what James M. Drinan, APA's executive director, calls "Place-making as Storytelling," the title of his Geodesign Summit talk.

Urban planners need expertise in both design technology—including geodesign—and storytelling, Drinan said. He believes that planners need to educate themselves about the latest technology available to gather and communicate stories about a place, which is important in the design process.

"Technology is not just a tool but a compelling requirement that planners must master," he said. "Otherwise, we risk irrelevancy. We risk being left behind."

While data is important in planning, so are stories, according to Drinan. Planners need to gather people's perspectives, or stories, about issues to create plans for the community's well-being, he said.

"As planners, we need to listen to the stories that people tell [us]," Drinan advised. "I want to start by understanding everyone's perspective. I need to ask questions and get information from them."

Stories carry weight and can be used to better explain a plan than data alone, said Drinan. For example, a story can illustrate how straightening a road and adding lighting to an area will keep bike-riding children safer.

"Storytelling humanizes the data," continued Drinan.

That's why he thinks that using technology such as Esri Story Maps apps is so helpful. Drinan pointed to the PLAN4Health in Kenton County story map as an example. The story map includes

- Interactive maps of neighborhoods that are within easy walking distance of or have mass transit service to grocery stores.
- Profiles of some of the stores that participate in the Covington Healthy Store Corner Program.
- Educational information on what types of foods to eat to stay healthy.

"We don't just need to tell stories; we also need to link place-making to the public good," Drinan said.

And to improve people's lives in this digital age, planners need to embrace new technologies.

"If we don't take advantage of new technology, we risk losing our audience," he concluded.

With the March update, ArcGIS Online continues to deliver faster and more extensive capabilities, apps focused on personalized solutions, and easier administration tools to strengthen collaboration.

Expanded Operational Capabilities

The scene viewer now offers users the ability to scale geometry by emphasizing height and keeping the other axes constant. When entering a uniform size for all the 3D objects in a point layer, users can select which real-world units—such as meters or feet—to use to size their 3D objects. They can also choose the color of a style symbol such as a car, a house, or an airplane. There are new labeling options as well that allow users to position and adjust labels. They can also select point cloud scene layer points and zoom to and rotate around them. The scene viewer supports touch navigation with touch-enabled computer screens as well.

Route analysis now has better directions, which include the ability to specify line barriers. Users can deploy these barriers to represent temporary route restrictions, such as street closures during a large event or construction project.

A Planet of Content

The World Imagery basemap has been updated with 2016 National Agriculture Imagery Program (NAIP) aerial imagery for several states in the United States, DigitalGlobe satellite imagery for numerous countries in Europe and Asia, and detailed imagery for many metropolitan areas around the world.

Other map updates include detailed demographic data for Japan; traffic count data for the United States; and the latest Michael Bauer Research (MBR) demographic data for more than 35 countries, including Austria, Brazil, Greece, Ireland, Portugal, and Turkey.

Apps Become More Personal

To help organizations apply consistent branding (colors and logos) to their information products, ArcGIS Online administrators can now deploy a shared theme for configurable apps and ArcGIS Open Data sites created by members of their organization. Authors of Esri Story Map Journal, Story Map Series, and Story Map Shortlist (in beta) apps can let readers find addresses, places, and features by implementing a search bar. Story Map Cascade, which has enhanced image galleries and 3D performance, is also available in all supported languages. The Time Aware configurable app template, which allows users to visualize time-enabled layers with a time slider, now supports including future dates in sets (for live weather forecasts, for example). As part of Esri's effort to design web products that align with Web Content Accessibility Guidelines 2.0, users can also interact with the time slider via the keyboard.

With Crowdsource Reporter—used to collect citizen information on issues and events—users can reorder the details, attachments, and location sections of the submission form. They can also load the app onto mobile devices and see a map view of existing reports instead of a list view. The update to GeoPlanner for ArcGIS

enables users to visualize data in 3D so they can better evaluate specific scenarios. This 3D mode allows users to publish features, model shadows, view perspectives by date and time, and evaluate a scenario's potential impact by looking at key performance indicators.

Esri's Apps for the Field and Apps for the Office continue to become more powerful as well. For Android users, Collector for ArcGIS is now better integrated with Navigator for ArcGIS and Workforce for ArcGIS. Fieldworkers with Android devices can use Workforce for ArcGIS on their mobile phones and tablets as well. And Workforce dispatchers can disable clustering, identify workers more easily, and see which crew members are closest to a particular assignment.

Users of Survey123 for ArcGIS can now build surveys on top of existing hosted feature services, as well as log in from social media accounts, including Facebook and Google. Survey results can also be shared with stakeholders via the Survey123 website.

ArcGIS Maps for Office, which gives Microsoft Excel spreadsheet users the ability to visualize tabular data, is now faster with an integrated Chromium-based browser. It also supports vector basemaps that look even better on high-resolution screens. And users can select items on a map and export the corresponding rows of data to a new Excel workbook or worksheet.

Enhancements to the ArcGIS Business Analyst Web App include more powerful suitability analysis with competitive layers and better support for site attributes, improved infographics with support for adding location pictures and attributes and using proprietary data, and updates for 32 countries in Western and Eastern Europe.

Taking Care of Administrative Business

ArcGIS Online administrators can now more easily control the content a user can access. New privileges allow administrators to decide who should have view-only access to organization members, content shared within the organization, and groups shared with the organization. This way, some members can only view the content shared with them through groups they belong to.

Users who have multiple accounts for ArcGIS Online and Esri websites can now link them and switch between accounts, connecting all their Esri customer information—from My Esri, e-Learning courses, and GeoNet, for example. The option to switch accounts is currently available from an organization's ArcGIS website, the ArcGIS Online website (for public accounts), and Esri websites.

To learn more about the March updates to ArcGIS Online, visit the ArcGIS Online What's New page and check out the ArcGIS Online blog at blogs. esri.com/esri/arcgis/category/arcgis-online.

Gaining a Deeper Understanding of Retail Spaces and Customers

The Shopping Center Group, a commercial real estate company with offices in 12 states, offers a wide range of advisory services—including property management, construction supervision, and tenant representation—to retail tenants, landlords, and developers. But the Shopping Center Group does more than ink sales and lease deals. The company provides clients with in-depth analyses of trade areas to "better understand the consumer, trends, market drivers and the competitive retail landscape," as it says on its website.

Information drives its operations. And GIS powers that information, as well as its analyses.

"What we do from a real estate standpoint is very visual," said Gregg Katz, director of innovation and technology at the Shopping Center Group. "We consider GIS and research to be the heartbeat of the organization. It allows *[all our service lines]* to tell a story."

Spreading GIS Across the Organization

The Shopping Center Group operates 22 offices mostly on the East Coast—from New York to Florida and Mississippi to Kentucky—and it recently opened an office in Santa Barbara, California, with the intent of growing its West Coast operations. As a retail-only real estate platform, the company has four primary service lines: working with tenants to find locations and optimize markets; leasing space for landlords; managing retail properties; and selling investment-grade retail premises, such as large grocery store-anchored centers or shopping centers.

Conducting the extensive analysis required to evaluate a trade area (the geographic region from which a shopping center gets most of its customers) calls for maps, which the Shopping Center Group has always relied on.

"Back in the old days, so to speak, we were putting dots on maps—the old AAA *[American Automobile Association]* maps," recalled Katz. "You would go get them and put dots on the maps and hope you were as accurate as you could be. Now, we have *[digital maps]* with information about population density, the employment base, and the entertainment venues. We can pop those up and get a full perspective."

In each state the company covers, it has every retail trade area mapped out. And because the Shopping Center Group believes in having boots on the ground to gain local market knowledge, it spreads its GIS across the organization.

"People in each office use ArcGIS Desktop, Esri Business Analyst, and ArcGIS Online," said Katz.

Out of the Shopping Center Group's 215 team members, 28 are mappers.

"We have one mapper to every four brokers," Katz said. "For a company our size and larger, that is unheard of. We are a production and mapping machine in terms of what we do for our retailers and clients."
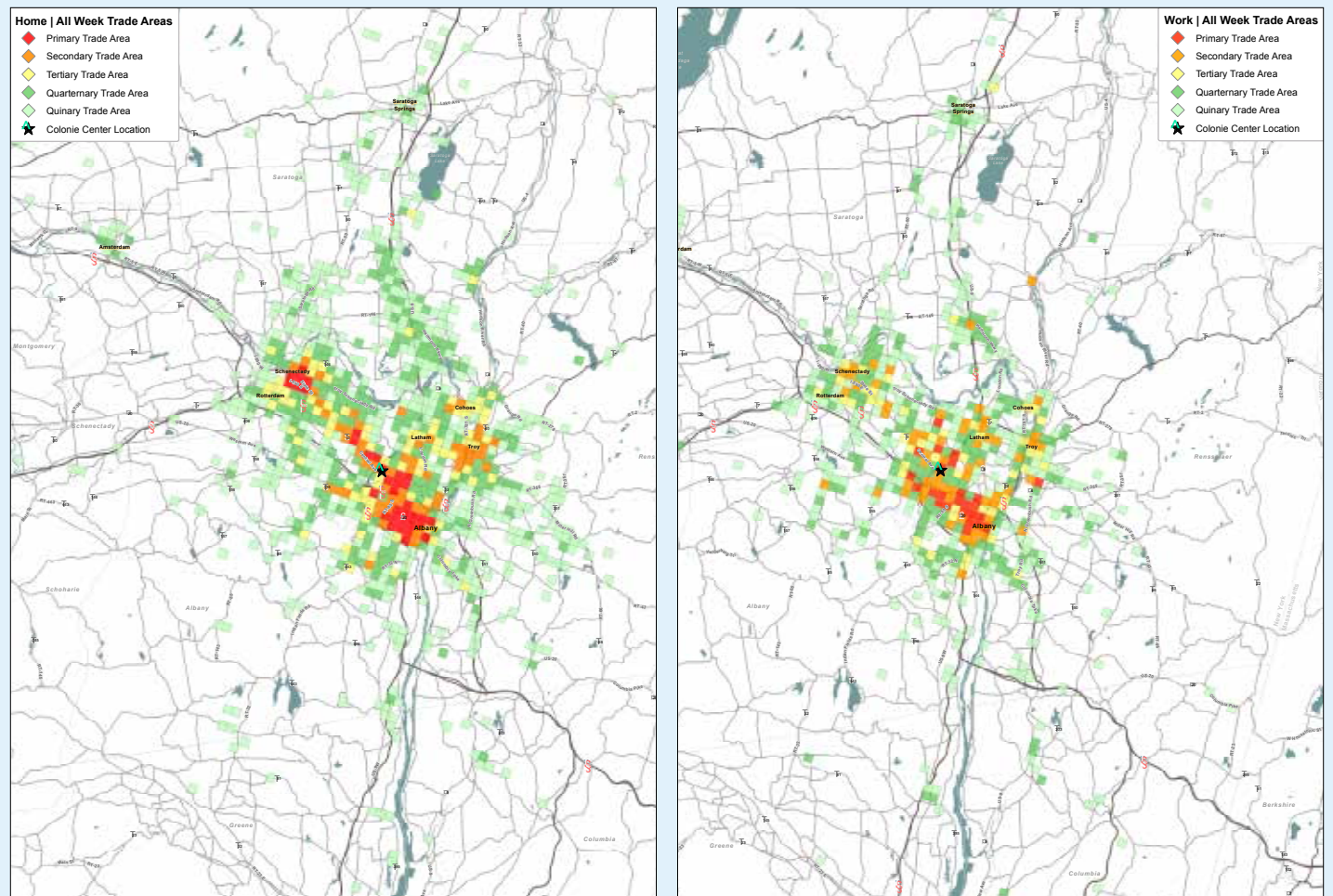
↑ Using two GPS datasets, the Shopping Center Group highlighted the differences between the home locations of people who frequent Colonie Center in Albany, New York, and the work locations of those who patronize the same shopping center. The company can then use Esri Business Analyst Online to uncover slight variations in the demographics and psychographics of Colonie Center guests.

Sharing Market Intelligence

The Shopping Center Group uses ArcGIS Online, mainly, to share information internally and with its clients.

"If we want to look at apparel retailers, we turn on apparel; if we want to look at restaurants, we can turn on restaurants," described Katz. "We can show each client different things. The web platform is giving us flexibility. So if we get on the phone with *[a grocery store chain]* and they want to look at the grocers in the area or the drivers of population, we can give them an initial cursory view."

The company has also created apps that provide team members with market intelligence—such as what's happening in a specific trade area or information on other retailers—that they can share with clients.

"Apps give us a clue as to where density is for residential, office, and industrial *[areas]* and the location of tourism hot spots," said Katz. "Custom reports can be called up on iPads and iPhones, and we are in the process of allowing our people to edit our proprietary database on the fly. So if we are out in the field and we see something is missing in the database or something is closed or there is a vacancy we didn't know about, we can instantly update the database."

Being able to show this to customers has certainly influenced their business decisions.

"We have had several cases where we have had retailers turn down a location," said Katz.

"When that happens, we ask why. Sometimes they say it was related to demographic criteria or a concern about cannibalization to an existing store. There have been numerous occasions where we've been able to go back and analytically show that those concerns were unfounded and then gotten deals approved that were previously rejected."

Making this data easily available to clients is one of the reasons the Shopping Center Group is beginning to use Esri Story Maps apps as well. For one project, the company built a story map to show a developer all the current, planned, and under-construction developments in a certain district to give the builder a firm understanding of what was happening in the trade area. The Shopping Center Group updates the story map as needed as well, to allow the current landscape to be better understood.

Deciphering Customer Patterns

The Shopping Center Group is currently looking into analyzing and visualizing psychographic data, too.

"It used to be straight demographics, but demographics don't tell the whole story," said Katz. "If *[two people]* both make $50,000 a year, how *[one person spends]* it and how *[the other spends]* it are going to be very different."

The company is also starting to focus more on GPS data to show the movement of people. It wants to understand where people live, where they go to work, and how they move throughout the day so it can make more informed decisions on finding optimal store locations.

"That allows us to better understand something we have been unable to in the past: *[people's]* travel patterns," said Katz. "Each retailer and landlord is going to ask for something slightly different. So it was really important for us, when we ended up picking a platform four years ago, that we *[got]* one that had necessary data—such as demographic, psychographic, spending statistics, and a wide variety of other information—as well as the ability to integrate datasets from third parties. We needed to meet all the different needs of these retailers."

As Katz pointed out, it is understanding the customers—who they are, what they like, where they go, and why they buy things—that distinguishes the Shopping Center Group's business. And that is enhanced by knowing how these customers move through the trade area.

"For the first time, instead of *[only]* understanding where consumers live, we're able to see how they move and what that movement does for a trade area and what that movement does for a location decision," said Katz.

For more information on how the Shopping Center Group uses GIS, watch Katz's presentation to the 2016 Esri Business Summit at http://p.ctx.ly/r/3fgz.

Helicopter Simulation Made Realistic with 3D Modeling Software
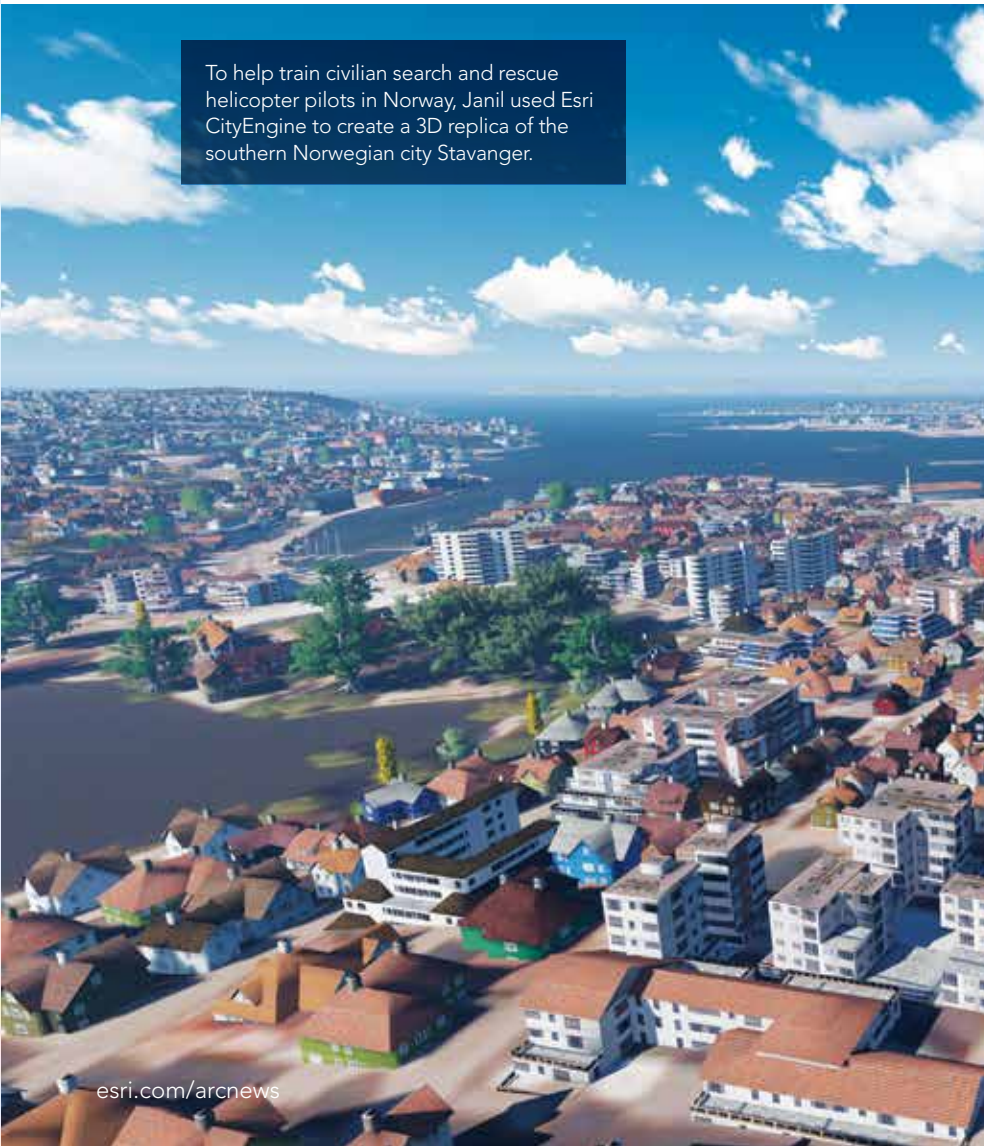
To help train civilian search and rescue helicopter pilots in Norway, Janil used Esri CityEngine to create a 3D replica of the southern Norwegian city Stavanger.

Before they can take to the skies, helicopter pilots in training must practice with a flight and tactical simulator—a machine that uses computer-generated images to mimic the view and experience of flying an aircraft. The more realistic the simulation, the better.

Romain Janil, a 3D artist based in Paris, France, works with industrial aviation companies to make flight simulation as realistic as possible. He uses Esri CityEngine 3D modeling software to populate terrain databases with buildings and other landscape elements in a pilot's field of view.

"Helicopter simulations need to take place in over hundreds of thousands of square kilometers, or over densely populated areas like major cities, or sometimes both," said Janil. "I started to use CityEngine to add reality to the landscape for rescue and civilian helicopter simulation. It's the best tool to generate thousands of clean, geotypical 3D buildings with nicely resolved texture maps—even when there is no input data."

Janil said he developed a particular workflow that enables him to imagine and create a distinguishable and efficient terrain model.

"First, I immerse myself in the city I have to model," he explained. "I study architecture types and find the best way to make the buildings look recognizable. Then, I imagine the way to merge all these types to make the database. It's tempting to add more details, but we have to keep it simple so all of that data can be processed in real time."

Through the course of developing his workflow, Janil said he's been amazed by CityEngine technology.

"CityEngine is a powerful tool that's very simple to use," he said. "I like the simplicity of CityEngine CGA language. There is a high level of abstraction. You can deploy generation that is multithreaded and multiprocessed."

Before he started using CityEngine, Janil did modeling by hand. Now, for each project he balances the more time-consuming work of hand modeling with work that can be done procedurally. CityEngine allows him to maintain high levels of both realism and simplicity. This saves Janil a considerable amount of time, especially for projects that involve a big city with hundreds of buildings and curious topology, as well as fields of view of up to 50 kilometers.

"Imagine doing Tianjin *[in China]*—a city of 12 million inhabitants—by hand. It's almost impossible," Janil said. "With CityEngine, you can create the field of skyscrapers and all the landscape with a great amount of detail. You can write simple rules or make them more complex. Then you can deploy all this intelligence on very large areas."

For more information, email Janil at romain@romainjanil.com. To learn more about CityEngine, visit esri.com/software/cityengine.

Esri Partners
Help Users Make the Maps That Run Their Towns

To plan, visualize, and build smart communities, local governments are tapping Esri partners around the world to help them implement enterprise GIS and use innovative apps to solve complex problems. With such focused solutions, cities and towns are making data more widely available to employees and citizens—on any device—which is generating operational efficiency, reducing costs, and improving returns on investment.

3D Modeling to Preserve That New England Feel

The Cape Cod Commission (CCC), a regional planning agency that supports communities in Cape Cod, Massachusetts, is tasked with protecting the features that make the cape special and give it its quintessential New England feel—including the area's natural vistas and historic architecture. To balance protecting the environment with the demands of the local economy, CCC uses GIS to measure and model development changes across the peninsula.

Last summer, CCC contracted Bergmann Associates (bergmannpc.com) to implement 3D geodesign tools for its planning team. Because CCC already had extensive ArcGIS infrastructure, it was important that the new tools leverage its existing GIS investments and staff skills. Working with an Esri partner meant that CCC's new 3D capabilities could take full advantage of the organization's geodatabase and planning datasets.

Bergmann employed Esri CityEngine to build a 3D basemap that includes more than 260,000 3D models, covering every structure on the cape. While Bergmann expected the basemap modeling to be the most challenging part of the implementation, project manager Eric Brady said they found otherwise.

"Using CityEngine CGA scripting language, it turned out to be one of the easiest," he remarked.

Bergmann also helped CCC configure 3D capabilities by using an ArcGIS Pro add-in called Bergmann Impact 3D. With Impact 3D, stakeholders can see how new properties will affect the existing environment. The add-in helps users model and compare development scenarios to evaluate the potential effects on the natural and built environments, traffic and parking, employment, and other variables. Planners can even modify scenarios on the fly during live meetings with collaborators and developers.

CCC's new 3D tools have made it easier to develop plans and share them with stakeholders early in the planning process. As its deputy director Kristy Senatori pointed out, Esri's 3D framework allows CCC to work with development partners and constituents to "ensure plans meet the needs of a diverse audience of stakeholders."

The organization has applied the tools to three development plans: East Hyannis, Capetown Plaza, and Mashpee Commons.

Connecting Enterprise GIS Internally and Externally

With a population of more than 80,000, Brooklyn Park is the sixth-largest city in Minnesota and the fourth-largest in the Twin Cities metropolitan area. Until 2012, the city's relatively small GIS department struggled to keep its data, maps, and apps up-to-date.

"Our legacy system made it very difficult and time-consuming to maintain and update [apps]," said the city's GIS coordinator John Nerge. "It was time to modernize our approach."

In 2013, Brooklyn Park implemented Geocortex Essentials, an ArcGIS solution from Latitude Geographics (geocortex.com). With this, the city developed internal and public-facing GIS apps that make important information easier to access.

The main internal app, CityView, connects staff to all the city's major data sources. With a single search, users can find property information; land management and permitting information; police records; and data stored natively in the city's enterprise GIS, which contains more than 70 maps and image layers. CityView includes workflows for printing maps and mailing labels, and several map layers contain links to related documents, such as plat drawings and utility as-built drawings. CityView provides seven department-focused apps as well.

Brooklyn Park also developed two public-facing apps. The Neighborhood Info app lets residents, businesses, and real estate agents view more than 50 variables—from utility and school district information to elected officials and nearby parks—for any given property. And the Adopt a Hydrant app, part of the city's crowdsourcing campaign, encourages residents to take responsibility for specific fire hydrants and shovel them out of the snow following winter storms. (For more about Adopt a Hydrant, see http://p.ctx.ly/r/3p8i.)

Brooklyn Park's internal apps have significantly streamlined business operations and made it easier for staff to access data and GIS resources outside their departments. The public-facing apps have also seen strong usage across the community. In 2016, Neighborhood Info was used 1,700 times, and residents adopted 76 fire hydrants through Adopt a Hydrant.

Working with ArcGIS Online and Geocortex Essentials has turned the city's attention to designing simple, powerful web GIS apps.

"By maintaining a focus on building easy-to-use apps, we've seen [a] great uptake in the use of our internal and public-facing applications," said Nerge.

↑ With Bergmann Associates' assistance, the Cape Cod Commission (CCC) was able to use ArcGIS Online to compare existing and proposed development side by side.
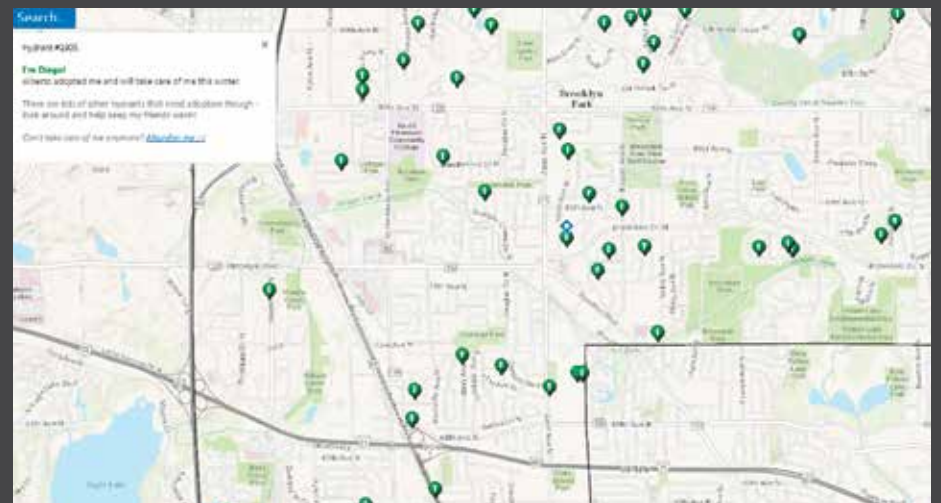
↑ Adopt a Hydrant, part of Brooklyn Park's crowdsourcing campaign, aims to get residents to voluntarily shovel out their fire hydrants after it snows.

A Holistic Plan for Downtown Revitalization

Fostering and sustaining a vibrant downtown is critical to any planning commission's vision for having an economically healthy community. That's why the town of Bennington, Vermont, worked with private and public partners—including Stone Environmental (stone-env.com)—to create the Bennington Downtown Area-Wide Plan.

As a historical manufacturing center, Bennington faces major redevelopment challenges. Shifts in industrial and commercial activity throughout the twentieth century have left numerous vacant and underutilized properties. Many of these sites are classified as brownfields, meaning they require environmental remediation. To successfully address these challenges, Bennington needed a holistic plan for revitalizing its downtown area.

Using ArcGIS, Stone helped the town perform an environmental and infrastructure assessment. Information related to the appraisal—including data about historical land use, natural resources, infrastructure, and brownfield sites—was collected, stored, and managed in a geodatabase. Stakeholders can now use ArcGIS Online to quickly retrieve this information for any parcel in the downtown area.

The final downtown plan includes the results of the environmental assessment, a set of conceptual visions for the downtown area, and a detailed implementation strategy. ArcGIS maps bring the development scenarios to life, which is especially helpful for prospective partners as they evaluate property development opportunities.

To help communicate the plan effectively to stakeholders, Stone also built an interactive story map. It recounts Bennington's economic history, summarizes the plan's recommendations, and illustrates the proposed development scenarios. The town presented the story map at a public meeting to gain community buy-in for the plan.

To date, the development plan has helped spur Bennington's Putnam Block redevelopment project, which will create a mixed-use space with offices, residences, retail stores, and restaurants. Bennington anticipates engaging in other, similar public-private partnerships soon as well.
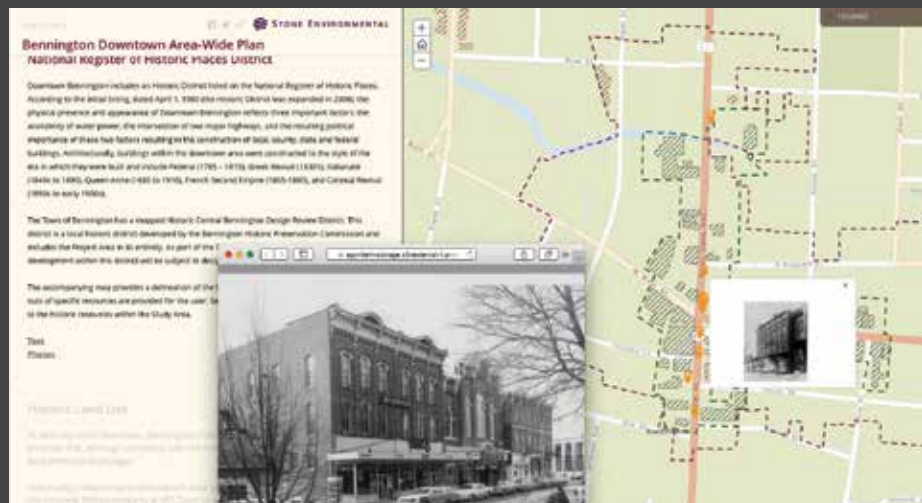
Workflow Upgrades Improve ROIs in GIS

The City of Fayetteville, North Carolina, is constantly under pressure to provide more and better services to its constituents—without increasing staff, of course. To accomplish this, the city needed more streamlined workflows for delivering quality spatial information.

Working with Timmons Group (timmons.com/gis), the city implemented an enterprise GIS using ArcGIS Online. Timmons helped the city document its needs and develop a road map that leverages its existing technology investments. The resultant system lets staff and decision-makers access accurate, up-to-date geospatial data at any time. Employees use Collector for ArcGIS to gather data and edit information about city assets in the field. Many of the city's apps are also now integrated with ArcGIS Online, including apps from Esri partners Cityworks, RouteSmart Technologies, and SunGard Public Sector.

These apps have improved city workflows and substantially increased Fayetteville's return on investment in technology. The city estimates that implementing ArcGIS—along with apps like RouteSmart, which helps the city optimize daily trash pickup schedules—has saved tens of thousands of dollars. Fayetteville also estimates that employing Survey123 for ArcGIS for code enforcement may cut operational costs by 40 percent. In addition, the city has reportedly saved another $75,000 by implementing ArcGIS Open Data instead of a stand-alone open data solution.

The City of Fayetteville's public-facing GIS—complete with best practices for search engine optimization (SEO) that were implemented by Timmons—makes it easy for citizens to interact with open data and engage with the city. Fayetteville is also using ArcGIS Workflow Manager and ArcGIS Data Reviewer to improve the quality of its essential spatial data, such as storm water and zoning data. This lets the city deliver more accurate and authoritative information to its citizens.

↑ With help from Stone Environmental, Bennington, Vermont, built a story map that summarizes the town's economic history and proposed development scenarios.

↑ To provide more and better services to its citizens, Fayetteville, North Carolina, worked with Timmons Group to implement an enterprise-wide GIS architecture, complete with 3D capabilities.

Esri's 2,300 global partners provide customer-focused, geoenabled solutions that span dozens of industries. Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content. To search and discover partners, solutions, and services that meet your needs, visit esri.com/partners.

With Real-Time GIS,
One Startup Keeps Employees Safe

The Esri Startup Program helps emerging businesses add location analytics to their services and solutions. Taking advantage of this support, these startups build revolutionary technologies for many industries, including public safety.

One such startup is **Antris** (antris.com), which enables companies and organizations to track personnel—not just for improved efficiency, but also to ensure safety for remote workers in industries such as oil and gas, forestry, utilities, and social services.

Consider a social services organization that sends fieldworkers and volunteers on house

calls. How can that organization verify that everyone is safe?

Big Brothers and Big Sisters of London and Area (BBBSOLA) is one such nonprofit organization that services the city of London and Middlesex County in southwestern Ontario, Canada. BBBSOLA develops and implements a wide range of mentoring programs through its community-based, school-based, one-to-one, and group programs. Today, BBBSOLA has more than 800 volunteers who cover 1,150 square miles of the community.

Although the organization is composed mainly of volunteers, there are typically 10 staff members

who are responsible for tasks that include home and school visits and recreational outings. Such assignments often present travel or personal safety risks. These employees also have to tabulate the mileage and costs of their travel, as well as report on and analyze their activities to determine the organization's reach within the community.

BBBSOLA used to do all this manually, using thumbtack mapping and buddy systems to monitor out-of-office activities, staff safety, and reporting. But this was time-consuming, inefficient, and often inaccurate. So the organization looked to automate these duties to enhance productivity, improve reporting and data accuracy, and save on costs.

Seeking to quickly phase safety monitoring into staff members' daily work routines, BBBSOLA engagement specialists and coordinators implemented AntrisPRO, a cloud-based app from Antris that employs the ArcGIS platform to enable BBBSOLA to map fieldworkers in real time.

When engaging with new volunteers during home visits, employees can use the app on their mobile devices to confirm that they have arrived and departed safely. It also lets employees do reporting from the field, and the app sends automated notifications to supervisors when workers may be at risk.

Unlike other fieldworker safety solutions that require investment in special devices, AntrisPRO leverages ArcGIS API for JavaScript to communicate with commonly used mobile devices, including iOS and Android smartphones, laptop and tablet computers, satellite phones, and GPS messengers. Because it is a cloud-based solution, AntrisPRO integrates with ArcGIS Online

to ensure that basemaps are always accurate and up-to-date. Users can also share their own ArcGIS Online content with the app.

Additionally, AntrisPRO automatically provides a detailed report of the total mileage each user travels, which is essential for reporting. BBBSOLA is now able to use the app to assess how to improve time management by putting together snapshots of staff time in the community, how frequently they're there, and where they need to enhance their work. AntrisPRO also captures data for how often each trip is traveled, generating a heat map of BBBSOLA's overall reach within the community.

AntrisPRO allows BBBSOLA to save on both costs and time. The organization doesn't need to hire an additional person to be available for employee check-ins and ensure safe arrivals and departures, which saves the nonprofit almost $1,000 per month. Documenting employees' mileage used to take two to three hours to complete, but now that this is an automated process, employees can use those hours to do other work. And using the heat map lets BBBSOLA quickly and easily see how to better manage personnel and resources.

With AntrisPRO, BBBSOLA now has a reliable, GIS-based solution that ensures everyone's safety while also making data easier to collate, share, and evaluate.
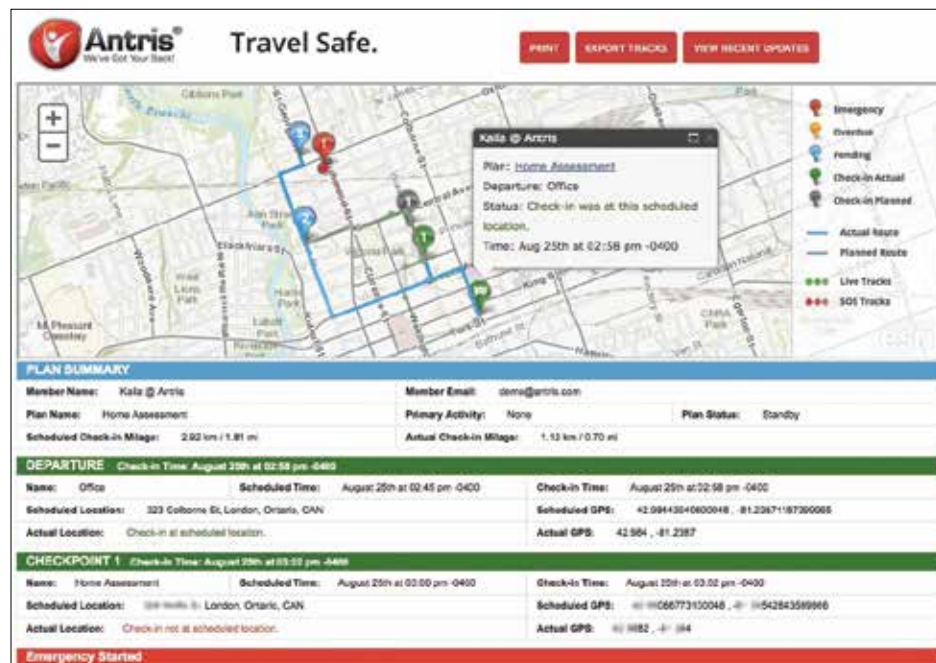
↑ When something goes wrong, Big Brothers and Big Sisters of London and Area (BBBSOLA) can share a summary report with emergency contacts.

Get Started with the Esri Startup Program

Companies founded less than three years ago that build software or platform-as-a-service products and generate less than $1 million annually may be eligible to participate in the Esri Startup Program. This three-year program provides qualified businesses with free ArcGIS platform technology to integrate spatial functionality into their products. Learn more about the Esri Startup Program at developers.arcgis.com/startups.

Maps, Facts, and Opinions

These days, we are repeatedly confronted with opinions that are not based on true facts. This is not necessarily new, but it is disturbing. What worries me most is that the expression, "science is just another opinion," is gaining popularity. It allows people to ignore evidence and well-founded arguments.

So, what about maps? Are maps based on facts? Do maps make authoritative statements beyond a doubt?

Mark Monmonier's book, *How to Lie with Maps*, is not very helpful here, since it can be interpreted as a crash course on how to misuse maps. Monmonier encourages readers to have "a healthy skepticism of maps" and to look at them with wary eyes. Rightfully so? Yes, and no.

As a cartographer, I do know that there are limitations. Sometimes cartographers do not (yet) know everything about a particular area or topic, so we interpolate and extrapolate the data to create a clear map. This was the case, for instance, with early explorers' maps of coastlines. It also happens with today's weather maps, which interpolate weather patterns based on measurements—including wind and rain—taken at weather stations. And on soil maps, lines may demarcate different soil types, but there is seldom an abrupt change between clay and sand; rather, there is usually a transition zone.

Sometimes, before data is displayed on a map, it is processed in several ways according to different formulas, which can result in varied patterns for the same set of data. A simple example of this is a population density map for all the municipalities in a country. The data can be broken up based on different classification methods, such as equal interval, which divides data into equal-sized subranges, or standard deviation, which emphasizes values above and below the average. It can also be divided using different numbers of classes—splitting a hundred observations into two classes versus four classes, for example.

In all these situations, we cartographers do not consider these representations to be lies, since the results are created using reliable and renowned methods. We do realize, however, that different outcomes exist. As I have written in a previous column (http://p.ctx.ly/r/3j7e), even a topographic map, which might seem neutral enough, can impose different perspectives on the landscape, depending on the map reader's background. A geologist, for example, uses a map to find fault lines, while a trail runner uses the same map to plan out running routes. Again, cartographers do not consider different uses of the same map to be wrong. It actually corroborates the universality of maps.

Still, I always warn my students to be alert and to try to find out why maps look the way they do. Perhaps the reasoning for why a map was designed a certain way can be reconstructed.

On the other hand, Monmonier certainly did not write his book in a vacuum; there are problems with how some maps display their information. Sometimes it is due to ignorance (using software defaults can contribute to this), whereas sometimes a mapmaker manipulates the data on purpose. During wartime, for example, a cartographer may mark dangerous areas in green and safe zones in red to throw off the enemy, since red is usually associated with risk, while green tends to symbolize safety. Or a cartographer may deliberately misplace objects on a map to mislead an adversary. If you are aware of these intentional deceptions, however, you can try to deal with them.

Worse is when a cartographer tries to justify his or her methods, but the map falls into the hands of conspiracy theorists. Then, the case is lost. I ended up in a situation like this recently. During an interview on CNN, in which I was asked to comment on the use of the Mercator projection, I did my job—if naïvely—by explaining what it is (a cylindrical map projection with severe distortions at the poles), why it had been created (for navigation), when it shouldn't be used (as a wall map in a classroom), and why it is used by map servers all around the globe (because its perpendicular longitude and latitude lines make it easy to convert these into map tiles). It was a very factual explanation, in my opinion. But during the interview, I was positioned opposite a more activist interpretation that says the Mercator projection downplays Africa. I tried, even more naïvely, to convey my point: *No, Africa is actually quite okay*, I said. *It is the polar regions that are in trouble*. And, damage done. Although CNN created some very nice interactive graphics that compared the different projections, the segment resulted in headlines appearing on conspiracy websites—which I do not frequent, by the way—that claimed, "ICA Admits Western Cartographers Deliberately Shrunk Africa," and, "Africa Map Fakery Admitted by Int'l Cartographer's *[sic]* Assn."

Of course, this is not the first time people have viewed maps as dark instruments being used by untrustworthy governments. But in my opinion, the conspiracy websites walked away with my facts and gave them an interpretation I would not have dreamed of. Even though my colleagues' reactions were heartening—"Ahh, they've discovered Mercator again; it happens every decade"—I did not feel happy.

Scientists always start from the back in discussions like these. That is because we see nuances and make qualifying statements—"Yes, but…" or, "No, because…." It seems that not only do people want black-and-white answers, but they also want to give them a special twist.

Even so, it is worth making maps based on facts. Applying the appropriate cartographic methods that allow any (sensible) user to understand a place or situation will always give people more context and open up true facts for further use.

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.

Taking GIS to the Field and Back

As an operations manager in the city's public works department, Ben used to spend most of his time shuffling papers among three towering piles on his desk. One was for projects that were about to start, one was for in-progress operations, and one was for completed tasks. He also assigned and monitored the department's field crews, though he never really knew where they were or what they were doing until they reported back to him at the end of each day. This made it difficult to communicate progress on projects to other city departments.

Natalie is part of the field crew at the public works department. She spends most of her time inspecting and servicing various city assets. Each morning, she used to go to the office to get her work assignments from Ben before heading out into the field. She always carried an overflowing clipboard that held all the pieces of paper she needed, as well as a badly worn map book so she could find the city assets that had to be inspected or repaired. At the end of each day, Natalie's final task was to drive back to the office to hand her completed work assignments to Ben, who would add them to his third pile.

Nick, the city's GIS manager, worked hard using ArcGIS Pro to create a system of record for the city that included street networks and the precise locations of assets, such as fire hydrants and park infrastructure. Under the city manager's directive to get more value out of existing technology, Nick embarked on a new initiative to improve efficiency and accuracy at the public works department by employing ArcGIS field apps, which work directly and seamlessly with ArcGIS Pro.

Understanding Ben and Natalie's pain points, as well as their concerns about learning new technology, Nick helped them get up and running. Both Ben and Natalie quickly became adept at using their new GIS apps. Before long, neither of them could imagine returning to their cumbersome, paper-based processes.

Now, employees in the back office and the field are all using the same authoritative data. The city has more timely access to information, it can better monitor field activities and respond to changing conditions, and it has increased productivity as well.

Here's How It Works:

Coordinating Field Assignments

Using **Workforce for ArcGIS** in a web browser, Ben first creates work projects and then assigns Natalie her field jobs for the day. Natalie receives her assignments via the Workforce app on her mobile device. As she makes headway in her assignments, she communicates her status to Ben via the app. Ben can see where she is in real time and monitor her progress to determine whether she will complete her tasks in time or whether he needs to reassign her outstanding duties to someone else.

Collecting Asset Data

At Natalie's first field assignment, she uses **Collector for ArcGIS** to capture a new asset—a recently built slide in the community park's playground. Not only can she create new GIS features in Collector, but she can also update existing features—if she sees a light pole with a broken bulb, for example—directly on her mobile device, even if she's disconnected from the Internet. Collector's map-centered interface allows her to find asset locations on a map and click on them to see and edit their data on an easy-to-use screen. This enables Natalie to record highly accurate information. Once she's finished with her data collection, the updates can be seen immediately back in the office.

Surveying Amenities

Natalie's next job for the day requires taking a survey of amenities—such as the number of parking spaces and picnic tables—in the park. She employs **Survey123 for ArcGIS**, whose formcentric workflow makes it easy to collect data, then share and analyze the results. Natalie opens an already-built community park survey via the Survey123 mobile app and walks around the park, selecting answers for each question from a drop-down menu. The survey is smart, so it hides or displays additional questions based on the answers Natalie enters. Every time Natalie completes a survey, the results get reported in real time back to the office, where Ben and others can see them instantly. The public works department wastes no time putting in an order to repaint the faded handicapped parking spots and fix the picnic table.

Navigating Here, Then There

To get from one job to another, Natalie uses **Navigator for ArcGIS** on her mobile device. The app works both online and offline to help Natalie find the most efficient route to her next assignment. It takes into consideration which vehicle she is driving and even navigates off the commercial street network. And because it is integrated with other ArcGIS field apps, Natalie moves seamlessly between Navigator, Workforce, and the other apps in her arsenal.

Monitoring Real-Time Progress

From the office, Ben monitors Natalie and the other fieldworkers in real time using **Operations Dashboard for ArcGIS**—the same tool the city manager uses to keep an eye on day-to-day activities, as well as to monitor big events. This allows Ben to see not only public works activity but also what is going on with other departments—such as parks and recreation, police, and fire—so he can respond quickly if something unexpected occurs in a location where his field crews are working. Operations Dashboard splits everything up into focused dashboards with maps, charts, and graphs, making it easy for managers and executives to understand an entire situation and make critical decisions quickly.

A Taste of GIS

Local Agencies in Clarkston, Michigan, Use Workforce for ArcGIS to Coordinate Fall Festival in Real Time

By Mark Brown, Independence Fire Department, and Doreen Groth, Independence Township

Road closures and traffic detours are usually a major cause for complaint. This is not the case, however, during the Taste of Clarkston, an annual fall festival in Clarkston, Michigan, that showcases local restaurants and caterers and brings in crowds from the entire Township of Independence.

Entering its twentieth year, the event fills downtown Clarkston with thousands of people who stroll on historic Main Street using prepurchased "taste" tickets to enjoy samples of food from more than 50 restaurants. The Taste of Clarkston grows every year, now drawing more than 4,000 people to enjoy the city's thriving culinary community, along with live music, local exhibitors, and children's activities. It is a boon for local businesses as well, which stay open late to take advantage of the additional foot traffic.

Planning the event requires sharp coordination. To put together a smooth, safe, and entertaining day, the two local governments of Clarkston and Independence work with the Clarkston Area Chamber of Commerce and the Oakland County Sheriff's Office. To make this easier, event coordinators recently switched from a paper-based system to a web-based GIS process. And that has made a big difference.

Smart Event Planning, Seasoned with a Location-Based Approach

Before 2016, all the planning for the Taste of Clarkston was done using hand-drawn maps, written instructions, and spreadsheets. As planning proceeded and changes were inevitably made, figuring out which version of the information was most current and getting that distributed across departments was a huge problem.

But at the 2016 Esri User Conference, members of Independence Township's Geospatial Information and Solution Office (GISO) were introduced to Workforce for ArcGIS. They immediately saw the app's potential to assist in planning the next Taste of Clarkston event, which at the time, was only a few months away.

The biggest hurdle the GISO had to overcome was that it only had four named users available in its ArcGIS Online organizational account. But at another Esri workshop, a member of Esri's Disaster Response Program mentioned that communities could gain additional temporary users for planned events by going through the Disaster Response Program. So GISO submitted a request and received 30 extra named users for the Taste of Clarkston event. This allowed the GISO to create ArcGIS accounts for all the workers and volunteers who needed one.

The first step in the planning process was to digitize the event's vendor and exhibit locations, as well as the event assets. These included the command post, emergency medical services, generators, electrical connections, road barricades, volunteer posts, and music stages.

Using Events Site Map (a configuration of Web AppBuilder for ArcGIS in the ArcGIS for Local Government solution), along with input from the primary event coordinators, the GISO digitized the source information, adding additional data—such as vendor tent sizes and available electrical connections—to the attribute table where necessary. The GISO then published feature services related to the event that served as the basis for several map products.

A Smooth Setup, Spiced with a Mobile Strategy

To help coordinate the event, the GISO created a Workforce project, which is the ArcGIS Online item type used to provide a common view to everyone involved in a task or event. The GISO incorporated building outlines, parking lot locations, and aerial imagery into the map to provide additional points of reference.

Members of the GISO then met with the event's coordinators to determine what Workforce assignment types would be critical during each phase of the festival. The newly created ArcGIS Online users were added as mobile workers as well.

↑ Throughout the festival, crews used Collector for ArcGIS to verify and update the event feature service.

During event planning meetings, a member of the GISO introduced crews and volunteers to the mobile app. Using their smartphones, they learned how to accept and complete assignments, as well as how to use the app to gain better insight into the big picture.

For the first time, crew members working the Taste of Clarkston received assignments based on their real-time locations. They got a detailed description of each task, its priority, and a deadline, all of which increased their situational awareness. Fieldworkers and volunteers also used the app to report their availability and the status of their assignments to the command post. Workforce helped crews move resources to where they were needed most. And once everything looked ready, the field crew used Collector for ArcGIS to verify the setup and update the data with any last-minute changes.

This integrated mobile strategy—with people simply using their mobile phones—boosted efficiency and cut operational costs. The most up-to-date data was always available across all the map products being used for the event. This allowed the GISO to be proactive instead of reactive—so trash got picked up more quickly, shuttles arrived on time, and fire hazards were

↑ Being able to consolidate data and share information in real time via Workforce for ArcGIS made the 2016 Taste of Clarkston run smoothly.

↑ Independence Township's Geospatial Information and Solution Office created a web-based map app for the public that highlighted the event's sponsors and showcased participating restaurants and local businesses.

investigated promptly. What's more, all the setup data was saved and is easily accessible, which will help with planning the festival in future years.

Safe Hosting, Flavored with Operational Efficiency

Safety and security at the Taste of Clarkston was everyone's number-one priority. The command post, which was set up just off Main Street the morning of the event, included a tent and several tables, with electricity provided by a nearby generator. A member of the GISO opened the Workforce project for the Taste of Clarkston on a ruggedized PC and placed a large second monitor in a central location within the command post. Emergency medical services were located near the command post as well so the paramedics could view the live event map.

As vendors made their final preparations, the fire department used the Workforce mobile app to conduct fire safety inspections, while sheriff's deputies used it to maintain situational awareness. Additionally, all the public safety personnel used a common radio channel for communicating about incidents. While most emergencies during the event were minor, using Workforce allowed public safety crews to be better prepared and reduce their response times when situations arose.

An Entertaining Event, Layered with Audience Engagement

To further capitalize on its new GIS resources, the GISO also used Web AppBuilder for ArcGIS to create a web-based map app for the public. To increase awareness of the new app, called Taste of Clarkston 2016, links were posted on social media and the township's website. As festivalgoers arrived at the Taste of Clarkston, they could either choose to get a traditional paper map of the event's layout or scan a QR Code to access the app on their smartphones.

The app not only showcased the participating restaurants and local businesses, but it also highlighted the event's sponsors in a novel way (by adding their logos to the web app's splash page). App users could see their location on the screen and easily navigate to vendor booths. Additionally, by tapping on booth features on the map, users could bring up a description of each vendor along with its menu items. App-using customers were thus more informed and could make their choices about what to taste before getting in line.

It is community tradition as well for event goers to vote for their favorite items at the Taste of Clarkston. To streamline this, the GISO is now looking at how to use Survey123 for ArcGIS for the vote during this year's festival.

A Pleasant Piquancy, Laced with Innovative Technology

After cleanup, when all the roads were open again, event coordinators declared the 2016 Taste of Clarkston a success. The festival provided residents, township employees, and visitors with a collective experience celebrating what makes the community special.

The event's planners and volunteers were enthusiastic about employing new technology in innovative ways. By consolidating data and using the ArcGIS platform's dynamic tools to share information in real time—from the planning stages through teardown—coordinators ensured that the Taste of Clarkston was an entertaining, safe, and smooth event for everyone.

About the Authors

Mark Brown is a staff lieutenant and GIS specialist for the Independence Fire Department. Doreen Groth is Independence Township's GIS manager. Brown and Groth are both members of Independence Township's IT Oversight Committee. For more information, contact Independence Township's Geospatial Information and Solution Office (GISO) at giso@indtwp.com or 248-625-8222.

↓ The Taste of Clarkston draws more than 4,000 people from the surrounding area to sample food from more than 50 restaurants.

Dynamic Apps Help Florida City Share More GIS Data

By Richard Littlefield, Olivia DeSimone, and Kyle Crawford, City of Altamonte Springs, Florida
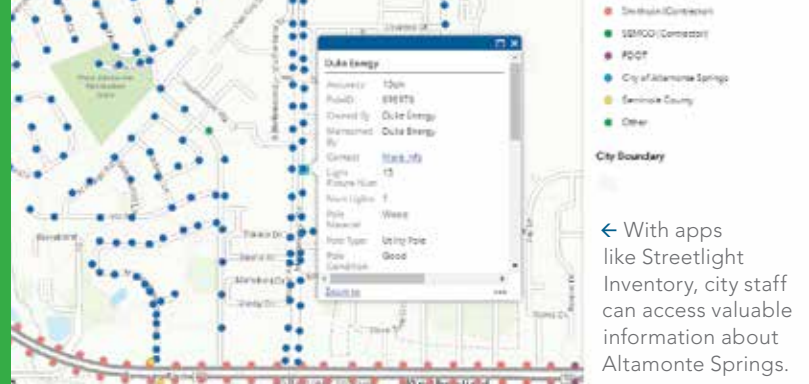
← With apps like Streetlight Inventory, city staff can access valuable information about Altamonte Springs.

In this rapidly evolving world of technology, the innovative City of Altamonte Springs, Florida, faced a challenge: the software it used to deliver its authoritative spatial data to employees via web apps was quickly becoming outdated. Altamonte Springs needed to find a solution, fast.

The city's existing GIS apps were originally built using ArcGIS Viewer for Flex. But Adobe stopped supporting Flex. So Altamonte Springs looked at several potential, non-GIS replacements, but they all had drawbacks, including high costs, increased maintenance, and short-term viability.

The city decided instead to leverage its existing ArcGIS Online organizational account and convert its Flex apps to ones built with Web AppBuilder for ArcGIS. With the switch, the City of Altamonte Springs got greater flexibility and functionality in its apps.

More Efficient Workflows and Better Access

Changing to Web AppBuilder for ArcGIS—which lets users build native, cross-platform apps without doing any coding—has made it easier for the city to deliver its data to internal users.

With its new apps, the city's GIS division has been able to create more efficient workflows. The department no longer has to worry about updating software on individual computers because Web AppBuilder for ArcGIS is software-as-a-service (SaaS) technology, meaning Esri pushes out updates automatically. When ArcGIS Online gets upgraded, the GIS department automatically has new features at its disposal. Updating the apps themselves has become easier, too, since they are less customized and don't require any code changes to get the new capabilities to take effect.

Other city employees have experienced the benefits of using ArcGIS Online and Web AppBuilder for ArcGIS as well. The old Flex apps were hosted on the city's intranet, so they could only be used on computers that were hooked in to the internal network, not out in the field. The new Web AppBuilder for ArcGIS apps, however, are hosted in ArcGIS Online and can be accessed anywhere, as long as there is an Internet connection. Since the apps are built using JavaScript and HTML5, staff can use them on their smartphones, tablets, and computers. The apps are dynamic and resize automatically to fit different screens. And with just the click of a button or the tap of a screen, city employees—from fieldworkers trying to resolve a broken pipe emergency to decision-makers attending remote meetings—can readily access GIS data.

The apps are also currently kept in one central location. Whereas before, specific apps were built for certain people or departments—and only those users had the links to the apps—now, all the city's apps are housed in ArcGIS Online and appear on the gallery page. Early on in the transition process, it was decided to gear the ArcGIS gallery and home pages toward internal users. So even though the pages are public, the internal apps—which are secured via ArcGIS Server (now called ArcGIS Enterprise)—can only be accessed by people with city credentials.

The home page serves as a landing page for maps and apps, displaying some of the city's most-used apps, such as the public works, growth management, and address apps. It also provides links to more in-depth overviews of GIS, its history, and the field's development, as well as a video that shows users how to create custom maps in ArcGIS Online.

The City of Altamonte Springs' GIS division maintains the gallery and home pages and controls which apps are displayed. This makes it easy for the department to add new apps and remove old ones as needed.

The Public Finds What It's Looking For

The City of Altamonte Springs also employs Web AppBuilder for ArcGIS to create web apps for public use. These apps and other downloadable GIS information can be found in separate gallery pages linked from the city's website. This way, residents and visitors alike can find what they're looking for—from zoning maps to interactive apps that deal with current and future land-use issues.

Two recently published apps, for example, offer members of the public a more interactive way to learn about the City of Altamonte Springs. Park Locator helps users find nearby recreation centers and lists their available amenities and activities, while My Government Services provides information about local resources, such as elected officials, community centers, transportation options, and police and fire stations.

Quick Acceptance and Adoption

By now, the City of Altamonte Springs has converted all its web apps to Web AppBuilder for ArcGIS. And both internal and external users have quickly accepted and adopted the new GIS apps.

The Web AppBuilder for ArcGIS apps have an improved user experience compared to the city's old, Flex-based apps, and the gallery, which displays thumbnails, is easier to use. Additionally, city employees now have access to an array of apps that many of them didn't know existed.

As a result of this successful app conversion, the GIS division is helping city employees understand how the technology can be integrated to improve their existing workflows. This, in turn, lets the city provide more resources that benefit employees and the community.

For more information on Altamonte Springs' new web apps, visit altamonte.org or email Richard Littlefield at rlittlefield@altamonte.org.

About the Authors

Richard Littlefield is the GIS manager at the City of Altamonte Springs, Florida. Olivia DeSimone and Kyle Crawford are GIS analysts at the city.

Web App Unifies Field, Office Work at Czech Utility

Country's Natural Gas Provider Remodels GIS Workflows to Give Spatial Data to All

After spending almost all of the '90s digitizing paper maps and turning its analog information into spatial data, Pražská Plynárenská (PP), the Czech Republic's natural gas provider, introduced the ArcGIS platform to its operations in 2006. At the time, an app with a number of industry-specific tools was designed for use both on a desktop and online. By 2015, however, PP needed to upgrade its GIS technology.

"The former GIS was dependent on third-party extensions that provided industry-specific tools," said Vaclav Wiesner, who was a business analyst at ISE, PP's IT company, during the project. "There was also a need to adjust the whole system for the Esri standard data model. Another requirement was to upgrade [the] current web client and to create a mobile one."

While most of PP's data is only accessible internally, some of it needs to be shared with other companies, such as maintenance businesses or surveyors. To make its data and GIS available to a wider range of its own employees, as well as associated organizations, PP launched NOKOGI (a Czech acronym for New GIS Concept), a project to remodel its GIS workflows.

Designing Now to Customize Later

The concept of the NOKOGI project was to employ standard ArcGIS technology to really open up the system.

"A large analysis of current tools, third-party extensions, and customized tools had shown that most of the functionality [could] be provided by standard or cleverly extended ArcGIS tools," explained Wiesner.

Developers weren't bound by the former technology, and they focused on replacing overcomplicated functions with much simpler ones. Using Web AppBuilder for ArcGIS, they created one app that contained various web maps of the utility network, and with AppStudio for ArcGIS, they built a corresponding mobile app. PP determined that, from there, the company's GIS administrators could use these app builders to customize and adjust the tools—as well as build new apps and update old ones—since neither requires any coding.

With its underlying HTML5 technology, the PP app can be used in web browsers on various devices. This cultivates a unified user experience among office employees and fieldworkers.

Planning a Workflow for All

Since employees throughout the company perform different jobs, designing the workflow for an enterprise GIS requires determining which workers do which jobs and what tools they need to get those jobs done.

Although desktop apps are very powerful and have all the tools necessary for administering and visualizing spatial data, only the GIS specialists at PP—who prepare, manage, and edit geospatial data—really need such complex software. Most employees at the company only require a light and simply designed web app, which is what the NOKOGI development team created.

The web app is powerful and easy to operate. It has become one of the most important and used GIS tools in the company. The app is connected to the company's data via ArcGIS Server. And the content in the app is controlled by web maps that are tailored to various utility management tasks, such as dispatch, maintenance, and business development.

Extending Accessibility

One of the web app's principal features is its broad availability. There's no need to install a desktop version because employees throughout PP can access the app on any computer or device that is connected to the portal. Its interface is responsive, too, so it adjusts as it loads.

NOKOGI developers took advantage of the range of standard and custom widgets available in Web AppBuilder for ArcGIS. They applied the Geocoder widget (which is now the Search widget) to let PP use its own geocoding service. With this, the organization can import data from the Czech Republic's Registry of Territorial Identification, Addresses, and Real Estate, which contains information about buildings and, more importantly, their addresses. Another widget can access real estate data from the State Administration of Land Surveying and Cadastre.

The app also contains a widget for drawing and taking notes directly on a map, making it easy to highlight certain areas or add short descriptions. Users can save these compositions and print or share them with others.

Tracing is another critical tool for certain departments at PP, such as the dispatch center, which often needs to find a route to the closest valves or locate customers affected by an outage. This wasn't easy to do in the old system, but the new app's tracing widget allows users to launch a number of tracing tasks directly from the web app. Additionally, smart presets enable users to start up a tracing task repeatedly and change just one or two parameters to evaluate various scenarios when planning maintenance, for example.

Integrating GIS into Other Systems

Perhaps one of the biggest achievements for the NOKOGI project was integrating PP's GIS into its other information systems, namely, PTIS (a Czech acronym for the Operational-Technical Information System), which the company uses to develop, build, and manage its entire network of gas lines. Now, GIS is one of the main data sources for PTIS.

The connection between the company's GIS and PTIS is synergistic, meaning a lot of their systems work together and are interactive. A graphic representation feature, for instance, lets users draw and update custom features on a map that are linked to various projects and operational events in PTIS. This makes it easier to highlight any areas affected by an incident in PTIS or roughly locate a PTIS item on the map. Thus, users can create representations of planned projects or visualize service issues like outages.

Preparing for Disasters

In the utility industry, demands on the reliability and accessibility of an IT system are very high. When disasters such as floods or blackouts occur, having up-to-date data about the network is imperative. That is the only way a utility company can know what parts of the network have been affected, who lacks service, which nearby areas are in danger of experiencing outages, and which facilities are at risk of being impacted.

When PP workers are on the go, they can usually access the web app on their mobile devices using a browser and a VPN. However, for times when the Internet isn't working or cell service is down, NOKOGI developers used an ArcGIS Runtime SDK to create a special offline solution that keeps PP's data current both on employees' desktop computers and their mobile devices. This solution also includes tools that keep offline copies of network data up-to-date and accurate, so the app doesn't have to download the whole database each time something gets updated.

An Engaging User Experience

Developers finished building the app last year, and so far, PP employees really like it—especially the user experience and its integration with other enterprise systems. They report that it is more user-friendly and intuitive than the systems they were using before. Staff enjoy having a large map window and access to widgets, and they like being able to change basemaps with one click or tap. They also find full-text search a big help and, perhaps most importantly, appreciate being able to work while on the go or offline under treacherous conditions.

↓ Pražská Plynárenská (PP) employees can use the new GIS to do advanced network analysis, such as tracing.

The NOKOGI project was completed by ISE, Arcdata Praha (Esri's official distributor in the Czech Republic), and Czech IT company d-PROG.

Introducing Utility Network for ArcGIS

The Next Generation of Network Management for Utility, Pipeline, and Telecommunications Companies

↓ As part of the ArcGIS platform, the Utility Network will be available on any device, anytime, anywhere.

In *The Sixth Wave*, a book about the next (sixth) innovation boom, authors James Bradfield Moody and Bianca Nogrady argue that we are moving toward a starkly different society—a sort of new wave that will be driven by limited resources. To thrive, we must recycle, eliminate waste, and be more efficient.

Who will be affected by this new wave? Utility, pipeline, and telecommunications companies.

They currently deal with lower emissions requirements, millions of new sensors, rooftop solar panels, aging and obsolete assets, limited funding, conservation, real-time pricing, smart meters, smart grids, lower revenue, big data, reduced skill sets, and smaller workforces—all responses to limited resources.

The common thread in these challenges is the network's relationship to location. Where are customers, sensors, meters, workers, and waste? That's where GIS comes in.

A New Wave of GIS Network Management

Utility, pipeline, and telecommunications companies have used GIS to manage network asset data for decades. After all, knowing asset locations, their conditions, and their relationship to one another is fundamental to managing them. But the GIS data was often kept from the people who needed it most: fieldworkers, executives, managers, service technicians, and accountants.

In this new world of limited resources and increasingly complex networks, companies need a new wave of GIS-based network management with more functionality, added flexibility, and better access. That is why Esri is building the Utility Network in the ArcGIS platform.

The Utility Network lets users create, manage, and share electric, water, wastewater, gas, district heating, and telecommunications asset data. The beta release of the Utility Network comes with base data models for electric, gas, and water networks. The technology is capable of supporting other networks—such as district heating, telecommunications, and wastewater—but, for now, users need to build their own data models or rely on partners. Esri will provide base data models in some of these areas in later releases.

The Utility Network is fast. It can handle billions of data elements with ease. Moreover, as part of the ArcGIS platform, the Utility Network will be available on any device, anytime, anywhere. Workers will be able to edit and trace the path of the network data in the field. The technology can handle modern data needs and makes it easy to share information securely with those who need it.

Here's what else the Utility Network offers:
- Flexibility: Users can edit the network data seamlessly via web services.
- Asset connectivity: Users can mine the behavior of networks. For example, the technology can simulate the connection of a pipe to a valve or a transformer to an electrical conductor. This can be done automatically by placing the network elements at the same location or by specifying which objects are connected to each other.

- Containment: Users can place objects or devices within structures, such as buildings or cabinets. For example, the Utility Network can show the internal electrical connections of a substation inside the substation building or the internal gas piping configuration within a gas meter station building.
- Attachment: Users can model network element attachments, such as how a transformer or telephone cable is affixed to a pole.
- Quality: The technology leverages built-in, industry-standard rules that guard against users making data entry mistakes. Editors would not be allowed to connect a high-voltage cable to a low-voltage one, for example.
- Modeling: Users can specify where sources of electricity, gas, or water are located to facilitate network simulation. They can also model devices that have many connection points, such as complex switches and valves.

Esri is building the Utility Network to give utility, pipeline, and telecommunications customers what they have been asking for, which includes
- Increased productivity: Users have access to shortcuts, templates, and streamlined workflows within the software.
- Tracing: The technology contains extensive, out-of-the-box tracing tools.
- Visualization: The Utility Network supports 3D.
- Schematics: It has an assortment of built-in network diagrams and one-line tools (schematic representations of electric, water, and gas networks).
- Workflows: The Utility Network helps users with editing, giving them guidance at every step of the process. The technology continues to support the concept of long transactions as well, which enable users to create future changes to the network model that go into effect after a certain time.

Using the Utility Network

The Utility Network operates directly in ArcGIS Pro. (There are currently no plans to offer it in ArcMap.) Whereas formerly, ArcGIS Pro users could only view geometric networks (which model utility networks), this new software now allows users to edit networks. It also offers tools to extract data from existing data sources, such as Esri's geometric network, and transforms the data so it automatically conforms to the Utility Network's industry-standard data models. Users can then extend these base data models to fit other types of devices, rules, and configurations either by customizing them or employing partner solutions.

The best way to prepare for using the Utility Network is to follow these simple steps:
1. Upgrade to the current release of ArcGIS, including ArcGIS Desktop 10.2.1.
2. Get familiar with ArcGIS Pro, which is part of ArcGIS Desktop.
3. Create groups and organizations in ArcGIS Online or ArcGIS Enterprise so the data modeled in the Utility Network is available to a range of users on any device.
4. Download industry-specific solutions at solutions.arcgis.com, as these work seamlessly with the Utility Network.
5. Convert customized ArcMap apps into simple apps using tools such as Web AppBuilder for ArcGIS and AppStudio for ArcGIS, as well as templates from solutions.arcgis.com. Doing this before migrating to the Utility Network will ensure a smooth transition to the ArcGIS platform and the Utility Network.

The Next, Smarter Wave of Utilities

The Utility Network's release comes as forward-thinking organizations reenvision how they use GIS. These companies are building information systems that engage users with modern functionality, allowing their employees to have access to data anytime, anywhere, on any device.

This new vision of getting information to anyone at any time enables people and organizations to make better use of limited resources. Companies that employ the Utility Network will manage their assets more efficiently and with enviable flexibility. It is the next, smarter wave of utility management.

To learn more about utility network management and receive information about the Utility Network, visit esri.com/utility-network.

Real Time Revolutionizes USDA's Crop Insurance Verification Program

To help farmers recover from the combined effects of the Great Depression during the 1930s and the simultaneous prolonged drought that struck the United States' Great Plains region, US Congress created the Federal Crop Insurance Corporation (FCIC) in 1938. Wholly owned by the US government and managed by the US Department of Agriculture's (USDA) Risk Management Agency (RMA), the program helps the agriculture industry remain economically stable by supporting and regulating crop insurance.

"The agency reinsures private Approved Insurance Providers who actually administer the crop insurance policies for the individual farmers," explained Justin Koppa, a geographer with the RMA. "The RMA also oversees the entire crop insurance program through the FCIC, and last year we insured 282 million acres of crops and $102 billion worth of insurance liability."

In the past, confirming a farmer's acreage for crop insurance was often a protracted process. But in 2015, the RMA developed an ArcGIS software-based application, called the Resource Land Unit (RLU) application, that provides farmers with immediate verification of their acreage when applying for crop insurance. What used to take months now takes minutes.

A Lengthy, Manual Process

Here's how applying for crop insurance used to work: First, a farmer would submit details about the acreage that needed to be insured to the local Farm Service Agency (FSA) using hand-drawn sketches over existing maps or aerial photography. The agency added that new information to its GIS database, and then the farmer would complete an application for crop insurance with his or her agent. The crop insurance agent would use the Common Land Unit (CLU) database provided by the USDA to complete the application.

From there, the RMA would send a response back to the Approved Insurance Provider indicating either that it would underwrite the insurance policy or that more information was needed to process the application. The whole procedure was time-consuming for the RMA because the CLU database includes more than 37 million polygons that are continually updated, so some of the information is out-of-date while, in other cases, the existing data had been incorrectly entered.

A CLU is the smallest area of land with unvarying land cover and land management practices and a permanent contiguous boundary, which can include fences, rivers, tree/forest lines, roads, and other similar features. To include a CLU in the USDA database, the CLU is digitized using the existing orthophotography of the area from the National Agriculture Imagery Program (NAIP). CLUs are stored in an ArcSDE enterprise geodatabase for documentation and verification purposes.

While farming may seem like a fairly static operation, with the same crops planted on the same acreage year after year, it is actually very dynamic, according to Abdul Syed, a senior geospatial developer with Planned Systems International and a consultant on the development of the RLU application.

"Because farmers plant different crops in different seasons on the same field—depending on agricultural prices, weather conditions, and other variables—the CLU database is constantly being updated by the FSA, particularly because there are many gaps in the database," said Syed. "For example, not all agricultural products are insured by the FCIC program. One year, a farmer may plant a crop that is insured. Another year, he may plant a different crop that we don't currently insure. Or, during a very wet season, a farmer may not be able to cultivate a field that was in production the year before. So all of this needs to be reflected in the CLU database. There are also attribution errors in it. This is why the RLU application is so important. It provides farmers with an immediate validation of their acreage for crop insurance purposes."

A Real-Time, Automated Application

RMA developed the RLU application to translate Geo JavaScript Object Notation (GeoJSON) files—an open-source format in common use by the agriculture industry—into an ArcGIS format so they can be submitted by Approved Insurance Providers directly to the RMA for immediate crop insurance verification.

"The RLU application uses the acreage measurements recorded by the farmer's precision *[agriculture]* equipment," said Syed. "This data is sent by the farmer directly to the crop insurer, who submits it to the RMA. The RLU application can also use data provided by the GPS coordinates of a field or the field boundaries digitized from NAIP orthoimagery. RMA then validates the acreage as a Resource Land Unit. With RLUs, the boundaries aren't permanently fixed, as they are with CLUs, so you can easily specify revised field boundaries when necessary, and RMA will validate it as an RLU. This gives RMA the most current spatial data available for crop insurance purposes."

"The process we use for the RLU file conversion is fairly straightforward," added Koppa. "The GeoJSON record is first converted into the ArcJSON format. Then, the ArcJSON file is converted into an ArcSDE feature class. This is the file we use for our series of acreage validations. The first validation is to make sure that all the attributes are correct—that the attributes have the required values in them. In addition, we make sure that the geometry is valid and doesn't have any gaps. If our validations determine that the record is clean, we assign it a unique ID. We return a JSON file with the unique ID that the *[Approved Insurance Provider]* can link back to the RLU geometry and utilize immediately for obtaining a crop insurance policy. ArcGIS Server maintains our geodatabase so that we can perform the real-time validation the farmer needs for insurance and crop reporting purposes."

The RLU application now gives Approved Insurance Providers and local farmers access to real-time feedback and real-time validation when applying for crop insurance.

"The RLU application is really revolutionary," said Koppa. "Up until now, data management, data remediation, data validation, and data feedback were all taking a lot more time and a lot more resources—a lot more human interaction."

With this new application, however, an Approved Insurance Provider can set up an automated system to submit the GeoJSON file, and the RLU application can process it automatically at any time of day.

"*[This]* is really benefiting the farmers, the insurance providers, and the RMA," concluded Koppa.
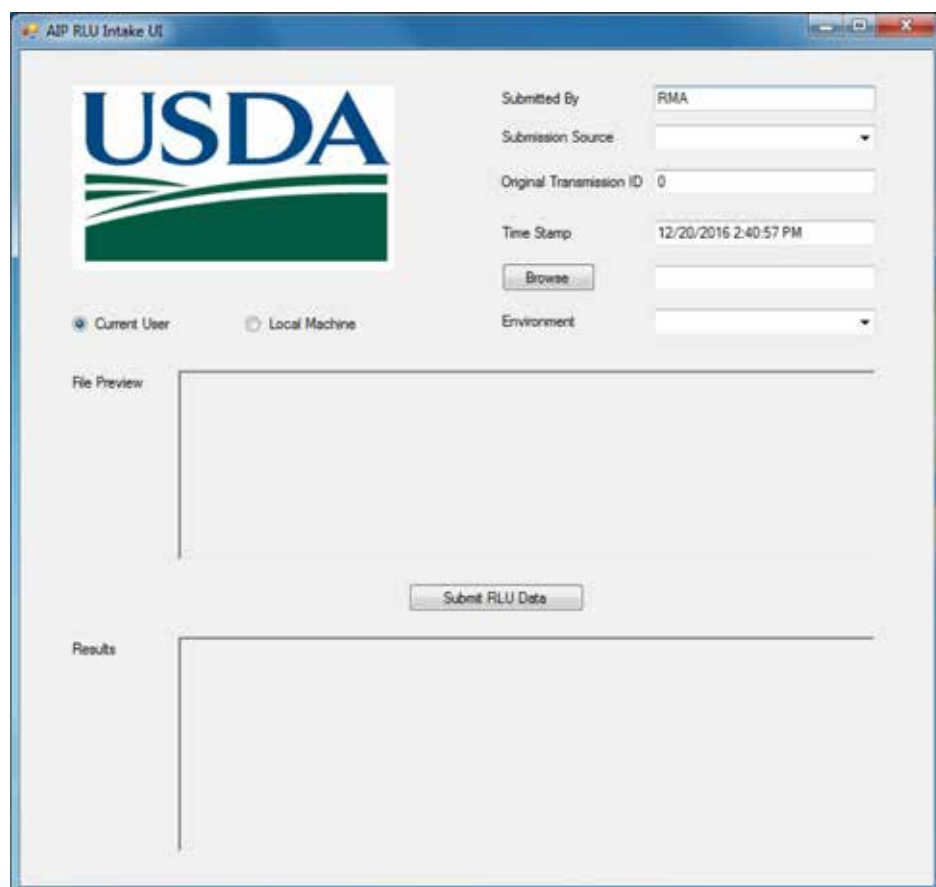
↑ The Resource Land Unit (RLU) application validates farmers' acreage immediately, so it now only takes minutes to apply for crop insurance instead of hours.

Comparing Distant River Systems to Assess the Effects of Climate Change

Advanced Spatial Analysis Tools Expedite Study of Disparate Waterways in United States, Mongolia

By Nicholas Kotlinski, Kansas Biological Survey

In the spring of 2016, a group of researchers from the United States and Mongolia loaded into a van and set out to ply the banks of the Bear River, a mountain stream that flows across the borders of Utah, Idaho, and Wyoming. They were hunting for unique hydrologic and geomorphic sites that could establish a context for studying the flora and fauna of the river and its tributaries as part of a larger comparative study of American and Mongolian waterways.

The river systems in the two nations could not be more different. In the United States, growing population centers, agriculture, and dams all affect river biota and structural health. Mongolian waterways, on the other hand, have far fewer impoundments and are largely undisturbed, since a sizable portion of the population is nomadic. Despite such a low rate of anthropogenic disturbance, however, Mongolia appears to be experiencing amplified effects of global warming compared to North America.

This is why these researchers, along with a handful of graduate students and technicians, are studying rivers in the United States and Mongolia. Examining the differences between the two countries' river systems may help scientists make predictions about them and the greater effects of climate change. But the Mongolian government is planning to build hydroelectric dams in the coming years, so studies of the country's rivers need to be carried out quickly—which is why the team is using ArcGIS to rapidly categorize and select research sites from afar without having to visit every river system first.

Studying Large-scale Ecological Systems

The Macroecological Riverine Synthesis project, or MACRO, is a five-year undertaking in which the group is researching 18 temperate steppe rivers between the two countries to gain a better understanding of how current rapid environmental change might alter natural ecosystem processes. Aided by a $4.2 million grant from the National Science Foundation, the study takes a macrosystem-level look at rivers, examining ecological processes that occur at the large, ecosystem-wide scale.

Working within what's called the Riverine Ecosystem Synthesis (RES) framework, researchers are categorizing rivers in both nations into hydrogeomorphic segments. These segments, known as Functional Process Zones (FPZs), are large patches of aquatic habitat—from less than a mile to sometimes over 60 miles long—nested between watersheds and river reach levels.

FPZs of the same type have similar characteristics, such as geologic histories, discharge patterns, sediment regimes, and channel forms. It is thought that geographically separate yet comparable river systems have more in common ecologically than adjacent but dissimilar patches of habitat, so FPZs are an important way to frame large-scale research questions and come up with water management programs. This study, however, is one of the first of its kind.

The RESonate Toolbox

To determine the distribution of FPZs in these two faraway countries and select field sites to study in more detail, the Aquatic Ecology Laboratory of the Kansas Biological Survey (located at the University of Kansas) developed a set of Python-based GIS tools that help researchers characterize riverine landscapes in the lab before beginning fieldwork. When used in conjunction with other modeling procedures, these tools—called RESonate—can assess the character of large river networks quickly and inexpensively.

RESonate automatically extracts 11 hydrogeomorphic variables from geospatial data layers and datasets derived from modeling procedures. Currently, all the output variables are provided by four principal data layers: digital elevation models, generalized geology, long-term precipitation, and a floodplain polygon layer.

To generate these input layers for RESonate, GIS technicians rely on tools found in the ArcGIS Spatial Analyst and ArcGIS 3D Analyst extensions and the Arc Hydro data model. For example, for rivers in the western United States' Great Basin (including the Bear, Carson, and Humboldt Rivers), researchers used Spatial Analyst and Arc Hydro to create a synthetic, or custom, river network, as well as the hydrologic inputs—such as flow direction and flow accumulation rasters—for the FLDPLN tool, a 2D cellular flood model that estimates the extent of floodplains in a river system. Researchers also employed a high-flow accumulation threshold in Arc Hydro to generate a valley ridgetop layer, composed of many small micro-watersheds that correspond to high points in the valley topography. They looked at satellite and aerial imagery as well to assess each river segment's planform (the appearance of the river's channel), bankfull width (the size of the channel needed to convey heavier amounts of water), and valley sinuosity (curvature). All this helps researchers garner information about a river system and its surroundings.

Users can also modify the code that underlies the existing RESonate toolbox. If they want to add variables such as soil and land-cover information, they can employ ArcPy, a Python site package from Esri, to modify existing functions or add new tools that accommodate project needs.

Once the layer inputs are ready, the data extraction process begins. A GIS technician selects the first tool in the RESonate toolbox, which creates a file geodatabase and master table in a directory specified by the user. RESonate then generates sample points from the river's mouth to its most upstream end at user-defined intervals, as well as along each tributary branch in the study area. RESonate then gives each sample point a unique identifier that indicates the name of the river and the point's distance from the mouth. After RESonate divides each stream network into these uniform sample segments (which provide an adequate representation of the river character in large watersheds), it uses the Surface Spot tool—built using 3D Analyst—to extract precipitation, elevation, slope, and geologic values from the raster and vector layers at each sample point.

Throughout the data extraction process, RESonate continually updates the geodatabase and master table with hydrogeomorphic values. Once the final data table is generated, GIS analysts can load it into statistical software, such as R, and—using hierarchical clustering techniques—group together segments with similar characteristics. Researchers can then categorize these areas into FPZs.

Forging a Common Knowledge Base

MACRO researchers used analyses from RESonate to pick analogous river study sites in the Great Basin and Mongolia.

"Without the information provided by the RESonate tool, we would be literally wandering in the woods without a good plan for ecological site selection in our rivers," said James Thorp, a lead investigator on the MACRO project. "This model allows us to plan research studies on systems where most of us have never visited and to do so in a scientifically valid and systematic fashion."

The US sites in the Great Basin were recently sampled—with researchers studying macroinvertebrates, fish, hydrology metrics, and more. Sampling in Mongolia is scheduled to begin this summer.

In addition to using RESonate for the MACRO project, developers hope that natural resource managers will be able to employ the tool to pick sites for research and restoration projects among large river systems and for conservation and management needs in smaller river segments. Governments and nonprofit organizations distribute most of the necessary primary data sources (such as climate, elevation, and hydrology datasets) for free, and this would help forge a common knowledge base among GIS analysts, geoscience researchers, ecologists, and environmental scientists, making it easier to communicate hydrologic issues to natural resource managers and policy makers. Developers are also now updating RESonate's toolbox with additional geoprocessing scripts to help open it up to users with only basic knowledge of GIS.

↓ RESonate allows users to analyze multiple data layers at once for river networks that cover thousands of square miles.

About the Author

Nicholas Kotlinski is an assistant researcher and GIS technician at the Kansas Biological Survey's Aquatic Ecology Laboratory. For more information about the MACRO project, email him at kotlinic@ku.edu.

↓ Research vehicles must ford rivers to reach some remote sampling sites in Mongolia. (Photo courtesy of Alain Maasri.)
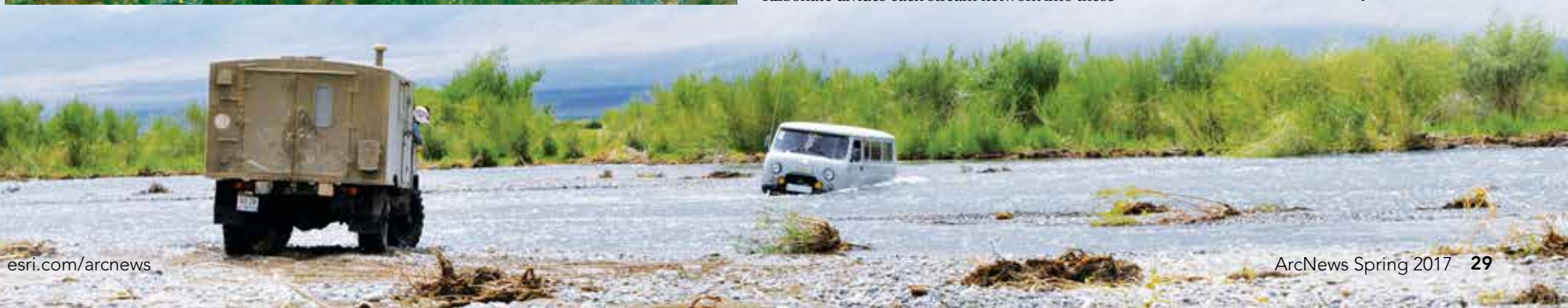
GIS Translates Complex Issues into Simple Visuals

To Better Report Nuclear Decommissioning Activity, Italian Company Sogin Turned to ArcGIS

Sogin, the state-owned company responsible for decommissioning nuclear plants and managing radioactive waste in Italy, is strongly committed to transparency. It is currently involved in decommissioning eight nuclear sites around Italy: the four nuclear power plants in Caorso, Trino, Latina, and Gariglioano; the EUREX plant in Saluggia; the IPU and OPEC plants in Casaccia; the ITREC plant in Rotondella; and the nuclear fuel manufacturing plant in Bosco Marengo. To ensure that these areas are free from radiological substances and waste produced by medical, research, and industrial activities requires the most advanced technology with the highest security standards.

Recently, Sogin's decommissioning activities have intensified. The company has begun construction on CEMEX in Saluggia, which will process the radioactive waste left over from EUREX. There have also been key developments at the ICPF cementation plant in Rotondella, which immobilizes radioactive waste from the old ITREC plant. Additionally, the chimney at the Gariglioano plant has been demolished.

To promote awareness of the work Sogin is doing at these nuclear sites, strengthen its relationships with stakeholders, and bolster dialog with local representatives, the company implemented communication plans that are in accordance with Italy's environmental compatibility laws. In addition to publishing information online about the decommissioning projects and holding press conferences, Sogin developed RE.MO. (which stands for *Rete di Monitoraggio*, or Monitoring Network), a portal that allows the public to keep track of the company's work.

The biggest challenge of this project was creating a portal that could supply up-to-date environmental data in an intuitive layout using simple language. With help from Esri Italia, Sogin built a custom ArcGIS Online web app that displays the latest information about Sogin's decommissioning activities, as well as the environmental monitoring the company does in and around each nuclear site.

The fully responsive app—which supplies stakeholders with all the maps and data in Sogin's geographic database—has been up and running since January 2016. It can be accessed on any device, connecting users immediately to the information they need.

RE.MO. has one main graphic interface that gives users access to information about each nuclear site. The commands are linked together by queries that modify the content without changing the website view. So each time a user clicks on something, the layout stays the same and just the information changes. Throughout the app, there are links that users can click if they want more information. This way, RE.MO. meets the needs of Sogin's various stakeholders without being overwhelming.

In RE.MO., each nuclear site contains four sections that are regularly updated:

***Stato Avanzamento Lavori* (Activity Status):** This section describes the nature and duration of decommissioning operations at each nuclear site, along with information about their licensing procedures. Using a time slider at the top of the map, users can examine the evolution of operations at each site in six-month increments and evaluate overall progress. This information is updated every six months.

***Monitoraggio Convenzionale* (Conventional Environmental Monitoring):** This section contains the results of the periodic surveys Sogin carries out to quantify any effects that project activities have on a nuclear site's surroundings, such as the atmosphere, surface and groundwater, vegetation, flora and fauna, landscape, and noise. In the map, users can click on icons that depict various monitoring sites to open pop-ups that contain summaries of the environmental analyses. These pop-ups highlight any anomalies that have been discovered and include links to the reports Sogin regularly provides to nuclear control authorities. Information for this part of the app is updated either every six months or every year, depending on the site.

***Monitoraggio Radiologico* (Radiological Environmental Monitoring):** This section has the results of the radiometric analyses conducted on environmental and food matrices in locations near nuclear sites around Italy. For this, Sogin monitors the atmosphere, surface and groundwater, terrain and grass, sediment, and fallout, as well as fruits, vegetables, meat, milk and dairy, and fish. As with the previous section, users can click on icons in the map to display more information about each monitoring site, and the pop-ups contain links to the longer reports that Sogin produces for control authorities at regular intervals. The updates to this section are added on a yearly basis.

***Monitoraggio Cantieri In Corso* (Monitoring of Functioning Sites):** This section allows users to view site areas of great significance from an environmental point of view—that is, those that could have immediately perceptible effects on people and the environment. This monitoring focuses on air, noise levels, and landscapes. To guarantee congruence between communicating environmental data and the actual evolution of activities on-site, this data is published approximately every 20 days.

By implementing RE.MO., Sogin has achieved its objective of increasing transparency around the activities it carries out at Italy's nuclear sites. This has strengthened its relationships with institutions and the public. What's more, RE.MO's intuitive user experience enables Sogin to communicate what's happening with extremely complex operations in simple ways that are accessible to all.

> Sogin shared its experience of making RE.MO. at the 2016 Esri Italia User Conference, where the company received the 2016 *Tecnologie per l'Ambiente* (Environmental Technologies) award.

↓ In the Activity Status section, users can employ a time slider at the top of the map to examine the evolution of operations at each site in six-month increments and evaluate overall progress.
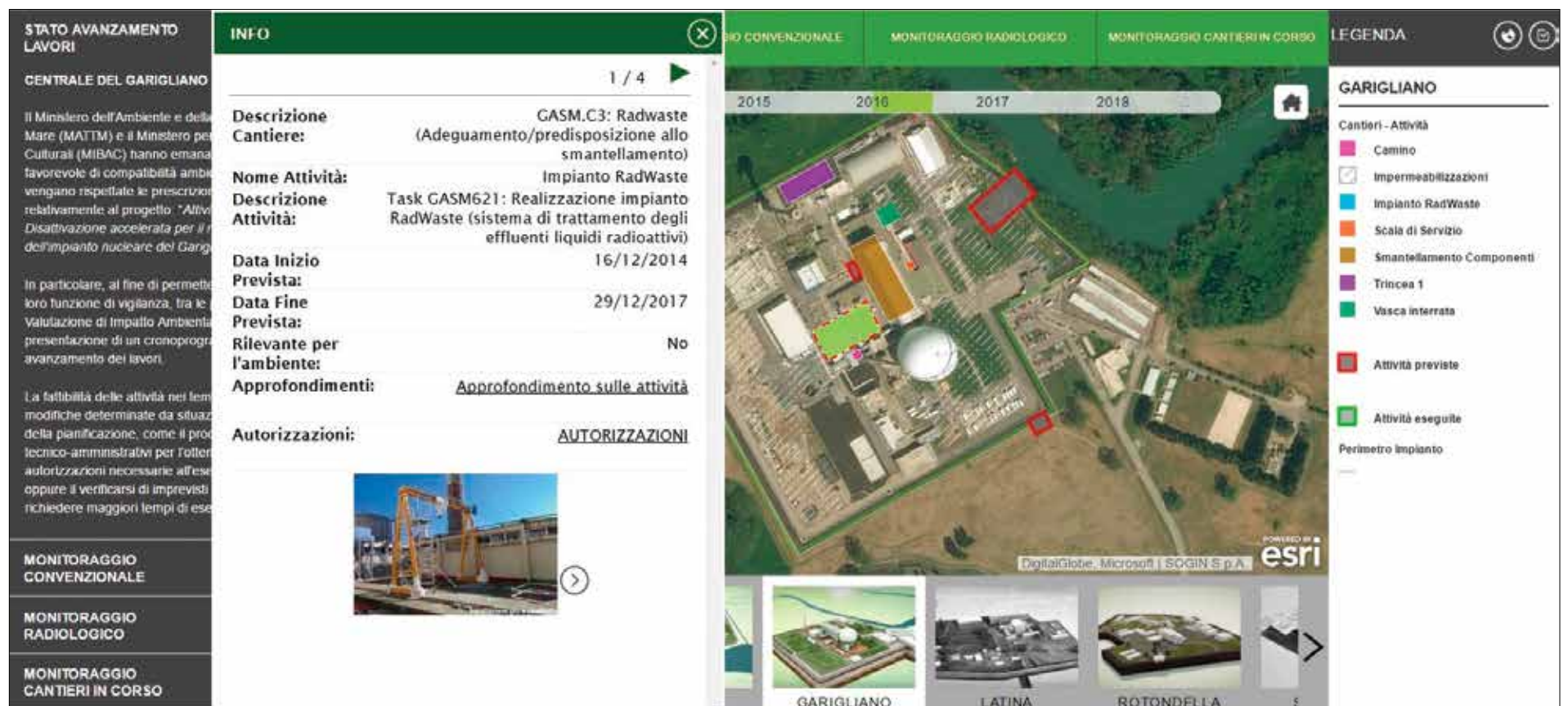
Atlanta Regional Commission Sets an Open Data Example

New City of Tucker Shares Information with Citizens, Saves Time for Employees

← The Atlanta Regional Commission's Open Data site is driven by live map services that integrate easily with web mapping platforms and can be downloaded in a variety of formats.

Just outside of Atlanta, Georgia, lies the one-year-old City of Tucker. Home to 33,000 people, the community had been unincorporated for 124 years.

At the city's onset, Tucker developed an open data site that would give citizens direct access to information, saving clerks the time it takes to process data requests. The city worked with the Atlanta Regional Commission (ARC) to be included in a broader open data initiative taking place across the region.

The ARC is the planning and intergovernmental coordination agency for a 10-county area. It works to bring together the region's collective resources through professional planning initiatives, information sharing, and community collaboration. The ARC handles a significant amount of GIS data and uses ArcGIS Open Data to share it with local governments, planning partners, consultants, and the public.

At one of the ARC's quarterly GIS meetings, Chris Rice, the GIS analyst for the City of Tucker, learned about ArcGIS Open Data. He later attended a workshop hosted by the ARC that showed him how to set up an open data site for his city.

"For Tucker, we realized an open data site would make work more efficient in terms of time for the citizens, the city clerks, and the GIS professionals," Rice said. "It also keeps every city within the ARC consistent in how we manage and share data."

Rice said the City of Tucker chose ArcGIS Open Data because it is easy to use and plugs right into the city's other web services. It took him one week, working on the open data site for a couple of hours each day, to set up the City of Tucker Open Data site. The site—which received hundreds of hits the day it went live—hosts data related to boundaries, planning, zoning, code enforcement, and business licensing.

"I've already saved more time than it took me to build our Open Data site," said Rice. "Anytime someone asks the mayor or city manager for data—for example, a developer who needs zoning information to redevelop a certain part of the city—our officials can simply share a link to that information on our Open Data site. If anything changes, the site will update automatically."

The City of Tucker Open Data site helps citizens figure out whether their address falls within the boundaries of the new city. It also assists people who are interested in applying for a business license.

Ryan Barrett, senior GIS analyst with ARC, is excited to see member jurisdictions join the platform.

"Open data is a core principle in the pursuit of easier data accessibility, collaboration, and innovation," he said. "The ARC Open Data site makes it so easy to dynamically engage with our data in a variety of formats like never before. As an early adopter, we realized what a catalyst this could be in our effort *[to build]* regional open data."

The ARC's Open Data site publishes information ranging from short-term transportation projects to long-range population and employment forecasts. Analytics on the site shows about 1,000 unique users per month. Since its launch in February 2015, the site has seen more than 18,000 unique visitors, 172,000 page views, and nearly 19,000 GIS downloads.

"So many people can find what they need on our site because it's easy to use, and the responsive design works on any smartphone or computer," Barrett said. "Given the ease of use of the
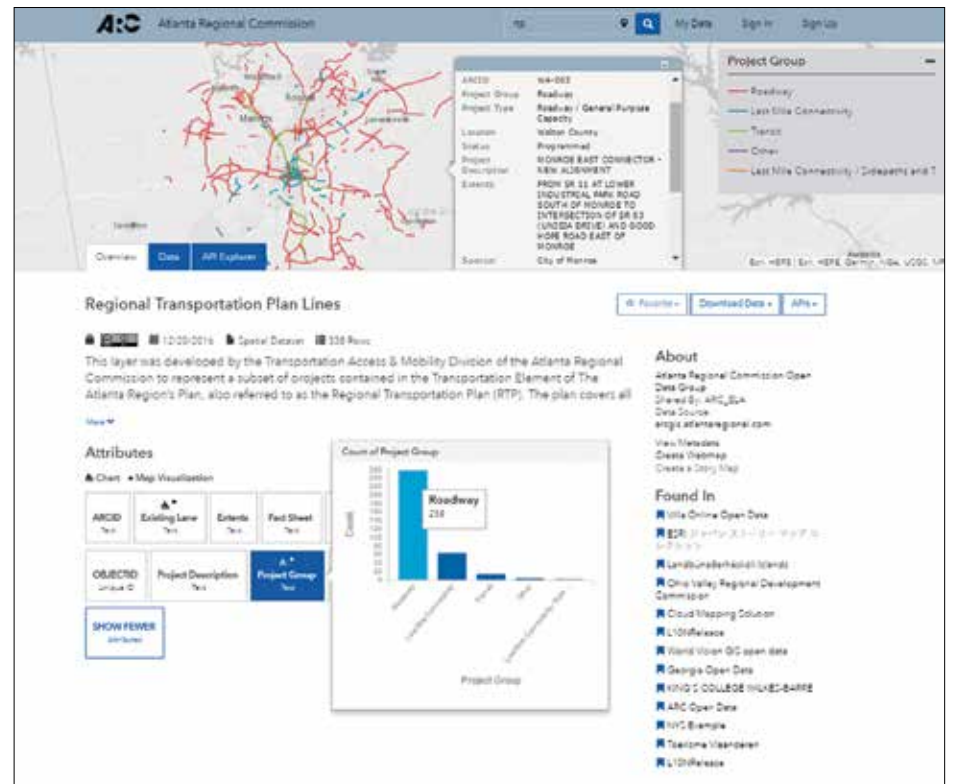
↑ Users can search by keyword or category, then interact with the Overview, Data, and API Explorer tabs to learn more.

site and streamlined workflows, we've realized time and money savings."

To view the City of Tucker's Open Data site, head to tuckerga.gov and click or tap the Open Data tab. In addition, visit arcopendata.com to explore data, web maps, and apps published by ARC and other jurisdictions across the region.

It's Enterprise GIS, and It Started with a Basemap

The University of Maryland's Web Mapping Platform Grows Alongside Its Users

The University of Maryland (UMD) began its expansive enterprise GIS initiative with a simple basemap of its flagship campus in College Park, Maryland.

When Taylor Keen was appointed campus GIS coordinator at UMD in 2010, the campus was just beginning to move away from using CAD with a nonstandard local coordinate system for its facilities mapping needs.

"Our first major enterprise GIS project was creating a GIS-format campus basemap from the existing CAD data and available aerial imagery," said Keen. "It was initially a simple polygon basemap with just a few attributes, but it demonstrated the information retrieval and analysis capabilities of GIS to Facilities Management and allowed us to begin examining other potential uses of GIS on campus."

After completing the basemap, Keen led a small team to develop the prototype of a campus web map that, a few years later, became the basis of the award-winning UMD Interactive Campus Web Map (maps.umd.edu/map). Optimized for both desktop and mobile use, the web map provides a comprehensive set of tools to explore the university's sprawling 1,340-acre semiurban campus that includes more than 250 buildings, 20 miles of roadways, 66 miles of sidewalks, and nearly 15,000 inventoried botanical assets.

Users can search for campus features and view related information about buildings, parking lots, and amenities in pop-ups. In addition, they can automatically determine the optimum route between facilities. Esri World Elevation Services and Google Street View are also incorporated into the map for pedestrian pathway navigation. One of the web map's most popular functions is its ability to access metro train and bus arrival time information and display current bus locations through its live tracking capability.

Cooperation Is the Key to Success

UMD has had an Esri academic site license since 1997, and in 2010, the emerging campus GIS team determined that a number of departments in the university's administrative services could benefit from implementing GIS technology. Centralized university mapping resources would allow spatial information to be shared across departments, provide the opportunity to develop collaborative mapping and information products, and reduce redundancies in projects and data management—ultimately increasing operational intelligence and ensuring access to the best possible information being maintained on campus.

↑ The award-winning UMD Interactive Campus Web Map is optimized for use on both desktop browsers and mobile devices.

Thus, to advance GIS at UMD, Keen helped establish the multidepartment Campus GIS Steering Committee, which developed an enterprise GIS implementation plan and presented it to the university's administration in 2013.

"This included a strategic plan for engaging the campus community through a formal needs assessment and several task forces for campus outreach, technical planning, and data administration," said Keen. "It also included our recommendations for an enterprise GIS implementation including systems, applications, and staffing configurations—both in light of current resources but also planning for future growth."

To accommodate as many different institutional perspectives as possible and increase the implementation plan's potential for success, the steering committee and its various task forces were composed of stakeholders from several different departments. They included Facilities Planning, Facilities Management IT Services, Campus IT, Transportation Services, Public Safety, Administration and Finance, Conference and Visitor Services, and the academic departments of Geographical Sciences and Computer Science.

"System sustainability was also addressed in the plan and included upkeep and data governance agreements for those departments contributing data to the system," said Keen.

↑ Students use the campus web map to determine the optimum routes between facilities.

UMD's enterprise GIS and web mapping platform has been online and in use since the release of the campus web map in November 2013 and has proved very successful.

"It continues to grow along with our user base," said Keen.

Esri's Local Government Information Model (LGIM) was implemented as well to ensure standardization in the data management processes and workflows.

"A university is a small community with similar assets," said Keen. "We have shops, restaurants, medical and sports facilities, administrative offices, grounds maintenance and public safety departments, and so on. With this comes the same concerns and goals as a traditional municipality—safety, connectivity, and stability. So, adopting the LGIM schema was a logical move for us."

Several campus divisions currently use the enterprise GIS and are contributing to maintaining its data. The Public Safety Department utilizes the campus basemaps for its dispatching system and has helped keep up various inventories—including emergency telephones and street signs—with Collector for ArcGIS. The Department of Transportation Services maintains a number of inventories as well, including parking lots, metered parking spaces, and campus bike racks. Many of its inventories are also featured in the public campus web map. Additionally, the Department of Dining Services has contributed layers to the web map and features a version of the map—with its services embedded in it—on the dining locations website.

Looking to the Future

Cloud-based services are an area the university wants to examine to reduce costs and administrative overhead in managing the servers and services.

"We are planning to investigate the use of Amazon cloud hosting during the next year in a test deployment of Portal for ArcGIS," said Keen. "I think we will eventually move most if not all of our on-premises ArcGIS Server and web app server infrastructure to the cloud. We

think there are a lot of benefits in moving to a highly available clustered and federated infrastructure instead of the disconnected, siloed architectures we're using on-premises now."

Keen is also planning to explore other ways of applying GIS at UMD.

"Interior space GIS and BIM-GIS interoperability are areas that interest me for future exploration," said Keen, referring to building information modeling, which is used for facilities management. "We'd really like to get to a point where we have detailed 3D interior space models with a range of interior space-referenced asset inventories. There's also even the potential to view building and utilities information in augmented reality mashups once these datasets are georeferenced."

The university still maintains building floor plans and master utility datasets in CAD format, but it is developing transformation tools to move them between both the GIS and CAD environments. Keen's group will be investigating the ArcGIS for AutoCAD plug-in to see if it can be used to simplify these workflows. This would allow the university's CAD users to work with enterprise GIS datasets in the AutoCAD environments they are familiar with.

"In the immediate future, we'd like to start using Portal for ArcGIS to better enable our user base and investigate vector tile basemaps and 3D web scenes authored in ArcGIS Pro," said Keen. "We also plan to update the campus map to use the recently released ArcGIS API 4.x for JavaScript to take advantage of its new features and functions once everything we need from the 3.x library is supported. Another major update to the campus map that we're really excited about in 2017 will be support for ad hoc dynamic pedestrian routing. Integrating our enterprise GIS with other university business systems and programs—such as work order management, the campus calendar and scheduling systems, and master planning and asset reporting—is also very important to us."

And now, according to Keen, UMD has an established enterprise system in place that can support real advancement in these areas.

The University of Maryland

Crossing Borders

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

Discovering GIS as a Career Choice

One of the pleasures of my job as executive director of the American Association of Geographers (AAG) is getting to work with young people seeking their way in life. Sometimes that means participating in their explorations of considering a career in geography or GIS. As seasoned professionals, we often forget how passionate and creative young people are in the search for meaning in their work and lives.

Nina Feldman, a student intern at the AAG, recently recounted, during a speech she delivered at the Library of Congress, her journey of discovery that led her to study GIS. I was so impressed by this touching account of her career search that I would like to share a version of it. I hope her words resonate with other young people considering a career path in geography or GIS.

This is what Feldman had to say:

For me, GIS was a discovery process, not a clear-cut choice. GIS in its basic definition is "a computer-based system that collects, analyzes, and distributes spatial data and information." However, to me, it is much more than that. It is a collection of data that represents people's lives, experiences, and significance.

I have always been a collector. Throughout my life, I'm sure I've had about 15 different collections. At age four, I started with rocks. At age nine, I advanced to Pokémon cards. At 14, it was Russian nesting dolls, with their exquisite patterns and colors. And finally, today, at age 20, it's maps. Maps of places I've been, maps of places I want to go, maps that friends have given me from their adventures, and maps that I drew myself.

As I watched my wall of maps grow along with my desire to learn, I had a feeling this wasn't just a phase.

It started after the first day in my Introduction to GIS and Cartography class. I called my mom, all bubbly and thrilled, saying, "Mom! I just got out of my GIS class, and it was so much fun! We got to make our own maps about population changes in Vietnam. And we did it all on one computer program!" She excitedly responded, "Aw, honey, that's so great! I'm so happy for you!" There was a pause. "What is GIS?"

Since that day, I've answered that question many times. But no matter how I phrased it, I always got an unsure nod with a confused face. Only a few months' prior, I would have been dazed and befuddled by those three letters as well.

When people ask what is so great about GIS, it's difficult for me to clearly explain because I'm still learning about it myself. And that in itself creates a sense of discovery. With advancements in technology and the development of new ideas, the opportunities for GIS seem boundless. This is why I love it. Watching this progress unfold keeps me captivated in this emerging field.

I came to realize that what I thought was just a simple mapmaking program is so much more. It's a process that takes complex information and simplifies it to make sense of a chaotic world. GIS is an awe-inspiring tool that can help solve real-world problems.

In addition to my coursework, my work experiences have solidified my interest in geography and GIS. I was lucky to have the opportunity to work as an intern with Doug Richardson at the American Association of Geographers and John Hessler at the Library of Congress last summer. Between the two positions, there was never a dull moment.

I remember my first day walking into the Library, when John brought me to where I'd be working. It was a big room with a computer, a few chairs, and a table stretching around the entire room with piles and piles of papers, books, binders, and notes. On the opposite wall were stacks of boxes, some taller than me. At first, I was a bit stumped. What was I supposed to be doing here? But then John explained to me that in these were the personal archives of Roger Tomlinson, the "father" of GIS, and I would be able to comb through and organize them. I've never been more excited to see a room full of boxes.

For the rest of the summer, I was flipping through seminars, organizing case studies, piling up binders, and labeling over 100 boxes. I couldn't have been happier. Because even though I wasn't working with computers handling data or spatially analyzing satellite images, I was able to grow my passion, knowledge, and appreciation of GIS by organizing the past of its founder.

In my hours of filing and labeling I had time to think about my own future and potential careers. I found myself thinking about how my dad made up his mind on becoming a physical therapist. He said that in medical school, he would walk around the hospital in Brooklyn, passing by all types of doctors, but physical therapists were the only ones that always had smiles on their faces.

I want my job to be like that. I want everyone to be happy and smiling. And even in times of stress or sadness, they would never once think about quitting their jobs.

I've heard so many incredible stories over the years from professors and supervisors—from living for months in the jungle as a cartographer to working with permafrost in the Arctic. From the inescapable heat to the bitter cold, these people have gladly dedicated their lives and work to "collect, analyze, and distribute spatial data" in the most amazing ways.

Every day, more people are thinking of ways to use GIS to solve problems around the world. Throughout college, all the people I met—from professors to interns, cartographers to map enthusiasts—have all had that same passion: a passion that drove them to discover something new, to see the world through a different lens.

In the end, why did I choose GIS as my career? Ultimately, it came down to a feeling. I knew I was meant for this field as I sat in the computer lab for hours, perfecting a map, having the time of my life. All I need is a pair of headphones and a window of ArcMap, and I feel whole.

I know that I still have much to learn and discover. But one thing I know for sure is that I can't wait to add some more memories and maps to my collection.

Nina Feldman

For more information about careers in geography and GIS, contact Doug Richardson at drichardson@aag.org.

The Plodding of Yore Instructs the Plotting of Today

How a One-Man Bicycle Survey of Pittsburgh's Stairways Inspired Further Work with GIS

By Bob Regan, University of Pittsburgh

↑ Pittsburgh, Pennsylvania, has more than 700 sets of public steps—a result of the city's topography and rich cultural history.

← Esri helped the City of Pittsburgh produce an interactive web map of the steps.

Pittsburgh, Pennsylvania, is physiographically challenged. Its location at the confluence of three rivers, combined with the land's undulating terrain, offers unique challenges for getting around.

I moved to Pittsburgh in the 1990s, and during my early-morning bicycle rides, I noticed many distinctive public stairways. It turned out, Pittsburgh has hundreds of streets—complete with street signs and often houses—that are composed entirely of steps. These "paper streets" appear as valid thoroughfares on maps and are actually municipal rights-of-way, meaning they are supposed to accommodate traffic, utilities, drainage, and other similar public functions. There are also streets in Pittsburgh that are uncomfortably steep for walking, so they have steps for sidewalks. This is all much to the consternation of unsuspecting motorists and bicyclists.

These "paper streets" and sidewalk steps are a result of the city's topography and rich cultural history. Pittsburgh has more municipal inclines than any other city in the United States and more city steps and bridges than any other city in the world. So in addition to providing functional modes of transportation (though ones that commuters on wheels certainly have to plan for), the stairways are dramatic and picturesque cultural features that I thought should be recorded, publicized, and preserved.

GIS proved to be ideally suited to study, document, and share the history of these (and more) local urban assets in Pittsburgh. The technology's cartographic and spatial relational database capabilities not only provide relevant insight and information, but they are also integral for effectively communicating concepts, conclusions, and results.

GIS has come a long way since 1999, with 3D modeling, real-time analytics, and big data capabilities. But even before it was the robust technology that instantly connects whole industries, governments, and organizations to their data and the world, GIS helped bridge paper-based information with a place's physical surroundings. This generated widespread interest and helped set in motion additional endeavors to better understand the history and space of particular localities.

Here is the story of how this worked in Pittsburgh.

A Neighborhood-by-Neighborhood Survey—by Bicycle

The City of Pittsburgh had a database containing information on 112 sets of public steps. City staff knew there were many more, they just didn't know their locations. So I decided to do a survey of Pittsburgh and locate all the sets of steps myself.

Fortunately, the city was using GIS at the time, so I obtained data layers of the streets, rights-of-way, neighborhood boundaries, and more. I then conducted the survey manually, traversing all the city streets by bicycle, noting the locations of stairways (at both the top and the bottom), and walking the steps to count how many were in each set and record step width and type. To qualify as a set of city steps, the steps had to be in a street right-of-way or an undeveloped city right-of-way. There was no need for any sophisticated location equipment, since I could digitize the location of the steps off the relevant data layer.

During the four-month-long survey, I traversed more than 1,800 miles of streets throughout Pittsburgh, enlisting the help of a friend and professional photographer to visually document the steps. At the end of each day, I transcribed the data by hand onto a form and transferred the transcribed notes to hard-copy maps. Each set of steps was assigned a unique identification number.

I then entered the data into a digital database. The information included each stairway's unique identification number, the identification number from the city database (if applicable), the location of the steps, the street name (if applicable), the "to" street (the top of the steps), the "from" street (the bottom of the steps), the type and width of the steps, the number of steps, which neighborhood the staircase was in, the date the data was recorded, and any comments. I also used heads-up digitizing, in which I manually traced a mouse over features displayed on the screen, to put the locations of the steps and their unique identification numbers into a steps data layer in ArcGIS.

Periodically over the course of the survey—usually during periods of inclement weather—I would perform quality control checks on the data. I compared database printouts with my transcribed notes and the city's database; I selected and plotted all the steps in a neighborhood and compared that plot with hard-copy maps; and I carried out internal checks on the data in the database. Each quality control check took about 40 minutes per set of steps, meaning this alone took 735 hours in total.

In all, the survey located and identified 712 sets of steps, 332 of which are legal "paper streets." At the time, there were a total of 44,500 steps in Pittsburgh. Each step had a rise of .54 feet, resulting in a total rise of 24,030 vertical feet (or 4.5 miles). The number of steps in a set ranged from 1 to 378. And there are five stairways with more than 300 steps in them.

Updating and Reupdating the Data

Following the project, a friend introduced me and my data to a publisher, who encouraged me to produce a manuscript. The resultant book, *The Steps of Pittsburgh: Portrait of a City*, was published in 2004. The book generated a great deal of national and international press and ultimately became the publisher's best-selling book. It sold out and is now out of print.
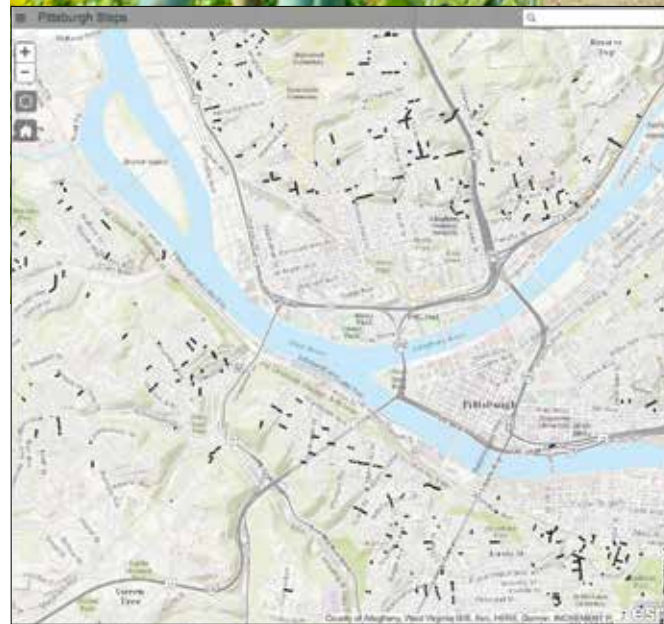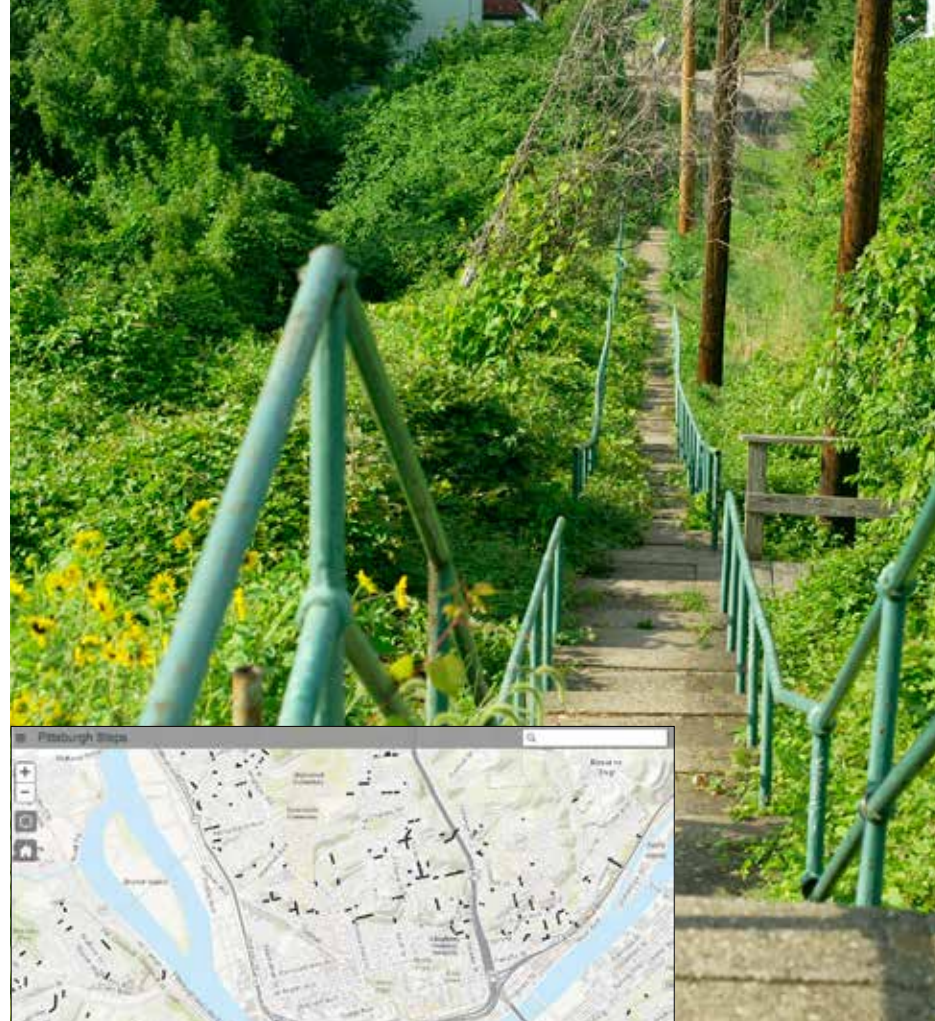
But 10 years later, the *Wall Street Journal* wrote a front-page story about Pittsburgh's steps and my sold-out book, which attracted the attention of publisher Rowman and Littlefield. The publisher asked that I produce a revised and updated version of the book. Since 2004, some interested *step-o-philes* and I had located an additional 27 sets of steps around the city, so this new data (along with other materials) was included in the subsequent book, *Pittsburgh Steps*, which was published in 2015.

I gave the steps data layer to the City of Pittsburgh after taking the first survey and again after updating it. Esri assisted the city with producing an interactive web map of the steps, available at gis.pittsburghpa.gov/steps. Because the project garnered so much interest, the City of Pittsburgh began a program in June 2015 with city employees and volunteers to do a comprehensive survey of city steps—this time using the updated, automated GIS technology of today that makes spatial documentation and spatial awareness ever more accessible. The city is now saving some of the more dilapidated steps rather than removing them, which will preserve and further publicize some of Pittsburgh's most distinctive cultural features.

Inspiring Similar Projects

I have repeated this feat several times over, using GIS to locate and record extensive information about Pittsburgh's 447 bridges; the locations of all the city's present and historic inclines, trolley routes, and sports stadiums; and its 411 churches (in addition to doing similar projects in several other cities around the United States). The results of these research endeavors are published in three additional books: *Bridges of Pittsburgh*, *Quintessentially Pittsburgh*, and *The Churches of Pittsburgh*.

In each situation, I have provided my original data layers to the relevant agencies to complement their extant data. With complete datasets of the public assets they oversee, all these agencies need to do is maintain the data, just like the City of Pittsburgh is doing with its ongoing public staircase surveys.

About the Author

Bob Regan, retired from the University of Pittsburgh, now serves as an adjunct professor teaching classes in GIS and database design. His professional career includes senior-level positions in the federal government, at major corporations, and at universities. In addition to teaching, he spends his time writing books and articles, as well as riding his bicycle. He lives in Pittsburgh, where he pretends to be a native.

At the Helm of Making Communities Smarter

↑ Cory Fleming

Throughout Cory Fleming's career, her focus has been on community. Unsurprisingly, GIS has become central to her mission.

As a senior technical specialist and the director of the 311/CRM program at the International City/County Management Association (ICMA), Fleming advises government managers all over the world on data technologies and helps them implement centralized customer relationship management (CRM) systems, including 311 centers.

"311 centers tend to be hotbeds of innovation in local government," said Fleming. "They have this wealth of data that can answer all sorts of questions."

When a city has a 311 system in place, residents can dial those three numbers to report nonemergency problems.

"It's a one-stop shop for citizens trying to connect with their local government," said Fleming.

In turn, local governments aggregate and map the calls to explore where most of them come from and review the top reasons community members make these calls. With that, governments can work smarter—taking a closer look at how their services are functioning from neighborhood to neighborhood or figuring out how to best redevelop certain parts of town.

Although 311 systems have been around for more than 20 years, not all governments were implementing the technology in the early 2000s. Through a five-year study that Fleming led, the ICMA found out why: the systems were cost prohibitive and too complex to set up. But governments did want them—especially since nonemergency phone calls can bog down 911 circuits. So Fleming and the ICMA set out to provide local government managers with information about how to set up 311 systems and how to use the data from these systems to better run their cities.

"With a lot of these programs, whether you're talking about a CRM system or an enterprise resource management system, all of them have GIS woven in," said Fleming. "Everything you do at local government has a location attribute to it."

She also provides simple and streamlined educational content—from books to blog posts—for the ICMA's 11,000 members worldwide so they can better understand what's happening in the realm of technology and make more informed technological purchases.

It is in this context that Fleming really became engaged in GIS—though she had crossed paths with it and mapping before.

At Iowa State University, Fleming started out studying civil engineering before switching to community and regional planning.

"I love the concept of being able to map out a community and make it better," she said. "That's what got me started on the community and regional planning."

After a post-college stint working in community development for the State of Iowa, Fleming moved to Washington, DC, where she became a program manager for the International START Secretariat, a scientific capacity building program that sets up regional groups of scientists to work on environmental change research in their communities. The idea is that these local experts can inform their governments about sustainable environmental practices instead of having the information come from foreign scientists.

"In that position, I was able to see how useful GIS was from a policy perspective," she said.

One START project that left a lasting impression on Fleming was working with a US-based scientist who was helping peers in Africa map out a new road. They wanted to maintain the local forest, but the road had to meet certain criteria. The team came up with three different options that satisfied all the criteria and then scrutinized the roads to see which one would be the least disruptive. They then made their recommendations to the local government.

"That was incredibly powerful to me to watch the reactions to that kind of information," recalled Fleming. "You can really help people understand quickly and clearly when you have a map."

While working full-time at START—where she broadened her scope of what it means to be part of a community—Fleming also earned a master's degree in environmental studies from Johns Hopkins University.

"The whole issue of sustainability and how we make the planet a better place drew me to environmental science," she said. "Science is how you defend policy decisions. The better your science, the better your ability is to produce meaningful results through policy."

In other words, Fleming was interested in data-driven decision-making—the foundation of GIS.

After completing graduate school, Fleming worked at the Urban Institute, a social and economic policy research center, before making the jump to the ICMA. Her first big project there was editing *The GIS Guide for Local Government Officials*, published by Esri Press in 2005. That was her real foray into GIS.

"Now, my primary responsibility is making sure that our members understand GIS and what it can do for them and their local governments," explained Fleming.

She said it has been fascinating to learn how local governments are using GIS to improve efficiency. In Minneapolis, Minnesota, for example, setting up a 311/CRM system helped the city respond more quickly to citizen requests. It had code enforcers assigned to four quadrants throughout the city. But one quadrant was always behind in answering service calls, and nobody understood why. When city staff started looking at the data using GIS, they realized that that quadrant was receiving 33 percent of the service requests while another one was only getting 16 percent. So the city moved the boundaries, and suddenly all quadrants were up to speed.

"They were able to distribute resources on a more equitable basis," said Fleming.

Making cities and towns better places for people to live is important to Fleming, and she sees GIS as a way to do that.

"She has insight into what cities and counties care about and then has a great understanding of how to take technology and turn it into something they really care about, whether that's cross-jurisdictional collaboration or public safety," said Esri's national government marketing specialist Noel Loughrin, who works with Fleming often.

Fleming, who now lives outside Portland, Maine, is at the helm of making communities better and smarter.

"The thing about Maine that I love is there are all these little gems of places you can go hiking, biking, and kayaking, and I want to preserve those for the next generation," she said. "I think GIS can help do that."

Making Room for Innovation with GIS Strategic Planning

By Ashley Hitt, Connected Nation

With 2017 already a quarter of the way over, has your organization started planning for 2018 yet?

Strong organizations—especially ones that use an ever-evolving technology such as GIS—continually plan for future developments and updates to their current product offerings. Furthermore, strategic planning like this is essential to making sure a GIS department has a single vision, where products and innovation come together to produce a sustainable future.

Developing a GIS-specific strategic plan ensures that departmental and corporate leadership are on the same page when it comes to identifying how GIS empowers internal staff, as well as clients and external stakeholders. When making a strategic plan for GIS, staff skills, other technologies, and internal and external processes and communication all need to be taken into consideration so they can be optimized. But current resources and staff skill levels shouldn't restrict a strategy. Instead, improvements and desired outcomes should be built directly into the strategic plan. This demonstrates to senior leadership how the department will accomplish its goals.

Below is a step-by-step guide to developing a GIS-specific strategic plan, based on lessons learned recently at Connected Nation, an organization that helps communities and states plan broadband service.

1. Perform a Self-Assessment

The first step to preparing a GIS strategic plan is to conduct a self-assessment. Ask questions such as, Where are we now? Where do we want to be? and What resources are going to help us get there? The purpose is to acknowledge weaknesses in the GIS department and around the organization and turn them into opportunities.

A great resource that can serve as a guide for performing self-assessments is the GIS Capability Maturity Model from the Urban and Regional Information Systems Association's (URISA) GIS Management Institute. This evaluation tool can help organizations identify areas of improvement in enterprise GIS management and implement changes to make their work more effective and gain better returns on investment.

2. Read, Read, Read

After completing the self-assessment, look for ideas about how to innovate, make enhancements to current product offerings, and become more efficient with GIS. Seeking out and reading articles, case studies, and professional newsletters about GIS is an excellent way to discover how others have tackled similar issues. How have other organizations transformed comparable challenges into solutions? Which solution trends are appearing in print more frequently, and how could they alleviate specific pain points?

3. Incorporate the Organization's Mission

All organizations—whether they are nonprofits, government agencies, or private firms—have an overarching foundation that connects what they do with how they do it and, most importantly, why they do it. Figure out why your organization exists and incorporate that mission into the GIS strategic plan. This is an effective way to ensure that, as the GIS department plans for innovation and sustainability, there's collaboration across the organization—at the corporate, departmental, and individual levels—to establish meaningful goals and objectives.

If an organization doesn't currently have a visible, deliberate vision that is widely understood by all staff, however, then the GIS strategic planning exercise can serve as a motivator to senior leadership to establish one.

4. Set Goals at Various Levels

Setting goals at multiple levels within the organization increases accountability and lets each staff member know how his or her contributions fit into a project, program, or core competency. It also provides an opportunity to address individual skill gaps and resource needs while contributing to overarching departmental and corporate objectives.

Set an individual goal to increase training in a specific area. Set a departmental goal to migrate or upgrade an essential system or process. Set a corporate goal to release a new product that helps stakeholders make more informed decisions.

Some questions to consider when setting interconnected goals include the following:

- What motivates the organization's work?
- Why do stakeholders seek out the organization's products and expertise?
- Which processes and products align with the organization's vision?
- Do planned innovations on the GIS team fit the organization's present and future strategies?

5. Don't Innovate in a Vacuum

Don't take on the entire strategic planning process solo. Work with and seek feedback from GIS analysts, as well as non-GIS staff and senior leadership. To do this effectively, consider some of the following feedback questions:

- Do staff outside the GIS department know everything that the team does and is capable of doing?
- Which products do non-GIS staff and their clients or stakeholders use most?
- How do staff members throughout the organization use GIS products?
- What tools and functionality do non-GIS staff wish their GIS products had?
- What frustrates non-GIS staff when they use current products?
- What questions are people trying to answer when using GIS tools?

Pending initial feedback, it is also beneficial to have technical meetings with select clients and stakeholders who frequently use the GIS department's products. It is ideal to keep the number of meeting attendees small, but do include project managers and main points of contact, in addition to one or two GIS staff members who work on a project that these stakeholders are involved in. This gives the stakeholders and internal staff an opportunity to feel more connected to the strategic plan and have a vested interest in its success.

6. Revisit and Reassess

Once the strategic plan is created, don't just print it out and let it sit on a shelf in the office. It should be treated as a living document—one that the GIS department revisits often to ensure that its goals are still attainable and relevant. Consider it a road map that provides short- and long-term objectives, forecasts the resources that will be needed, and improves accountability with the department.

Consistently revisiting and updating the plan also shows senior leadership that the continuous evolution of GIS—by frequently improving and enhancing GIS products—is vital to the organization's success. This allows the GIS team to identify current and potential risks and mitigate them before they become impediments to the organization's success.

Empowering as Many People as Possible

Devising GIS innovations through strategic planning doesn't have to be a long, drawn-out process each time. Once the GIS manager establishes a cycle of research, planning, and feedback, the GIS department will be able to effectively collaborate with everyone in the organization to ensure that the products and processes put in place directly contribute to the overarching vision and empower as many people—internally and externally—as possible.

About the Author

Ashley Hitt, GISP, is the director of GIS services for Connected Nation (connectednation.org), a national leader in broadband expansion programs. She uses GIS to develop strategies for providing data visualization solutions that impact broadband Internet policy, economic development, and the digital divide. Hitt is a recent URISA board member (2013–2016) and was selected as URISA's Young GIS Professional of the Year in 2011.

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

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By Esri

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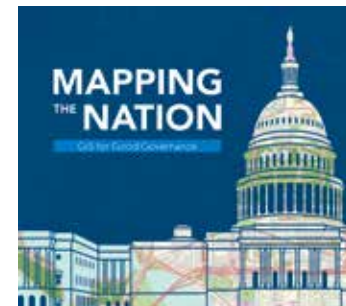
Children Map the World:
Commemorating the International Map Year, Volume 4
Edited by José Jesús Reyes Nuñez, Carla Cristina R. G. de Sena, Necla Uluğtekin, and Pilar Sánchez-Ortiz Rodríguez

Children Map the World: Commemorating the International Map Year, Volume 4, showcases 50 maps created by children aged 5 to 15 for the 2015 International Cartographic Association's map design competition, held in Brazil. The drawings convey powerful messages and emotions that reflect the contest's theme, "My Place in Today's World." The second part of this volume includes a special atlas of 50 additional maps selected from previous competitions and dedicated to the International Map Year. Children, parents, teachers, and map enthusiasts will delight in the work of these imaginative young cartographers, whose representations of the world and life in it exhibit their many perspectives on the state of our planet, from optimism to pessimism, grandeur to lightheartedness, and beauty to sobering—and sometimes frightening—truths. April 2017, 140 pp. Paperback ISBN: 9781589484788.

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