

Briefly Noted

Saint Louis University Partnership to Create Solutions for Security Issues

A new partnership between Esri and Saint Louis University (SLU) will advance geospatial research and innovation in the university's Geospatial Institute (GeoSLU). The institute encourages students and staff from various fields to explore how GIS can provide insight into issues such as climate change, access to food and clean water, and economic stability. The partnership will also focus on creating national security solutions for critical customers like the National Geospatial-Intelligence Agency (NGA).

OSI Integrates Utility Network into Its Solution

Open Systems International, Inc. (OSI), a leading supplier of automation solutions for electric, oil and gas, transportation, and water utilities, will now leverage the ArcGIS Utility Network data model in its platform. "We are very excited about our partnership with Esri, as it will enable us to provide the best technical solutions to our joint customers," said OSI president and CEO Bahman Hoveida.

Property Assessors Gain More Access to GIS Capabilities

Under a new partnership with Esri, all new members of the International Association of Assessing Officers (IAAO) have access to ArcGIS. This will give them the ability to visualize and share Esri's property assessment data using modern, map-based technology. Details of the program are available at go.esri.com/esri-iaao-grant.

Esri Launches New Company in Myanmar

This new team will support a growing user community across government and in the nongovernmental organization (NGO) sector. See page 3 for more details.

Dashboards Give Geographic Perspective to Coronavirus

As the new coronavirus (COVID-19) began to spread in the first few months of 2020—initially in Wuhan, China, and then quickly to other countries around the world—the health-care community rushed to understand how the disease was advancing. This potentially lifesaving information was changing fast, so many Esri users, including local and global authorities, built maps and dashboards to display data about the virus.

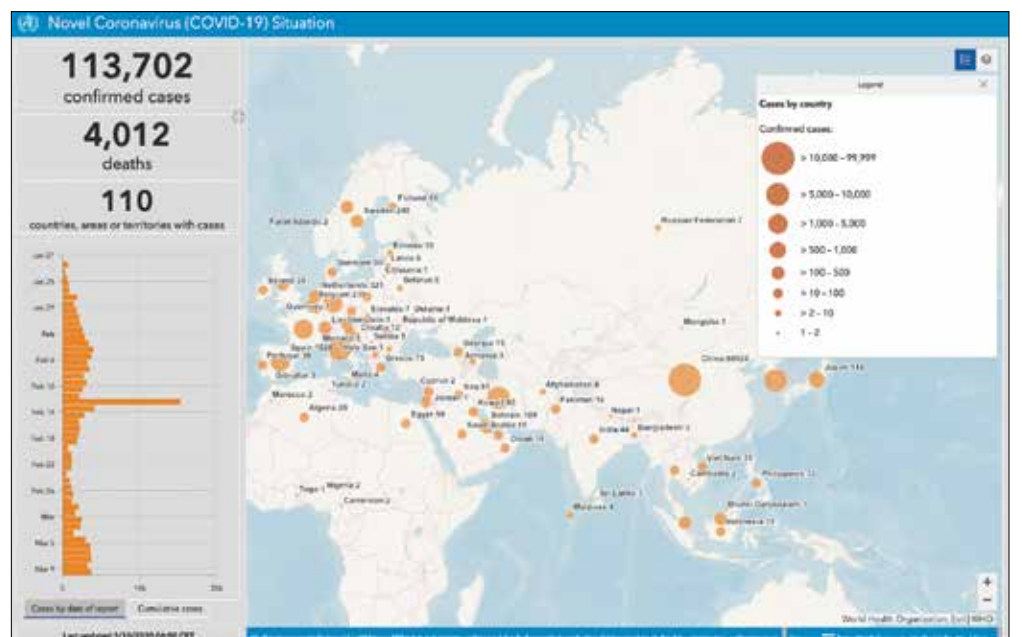
At Johns Hopkins University in Baltimore, Maryland, a team consolidated data from authoritative sources, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), in a dashboard that shows where the disease is cropping up around the world. The dashboard—which has an interactive map that displays the number of confirmed infections, fatalities, and recoveries in each location—went viral.

Other organizations have been using GIS to address similar needs. WHO, which maintains a near real-time dashboard of all global health-related events, has created a derivative dashboard that tracks confirmed cases of COVID-19. GIS specialists from Esri China produced a dashboard that also includes suspected but unconfirmed reports of the disease, complete with links to related news stories

about those cases. Another interactive dashboard tracks confirmed coronavirus cases in Hong Kong down to the building level. And the International Civil Aviation Organization put together an animated dashboard that displays how typical air traffic compares to where cases of COVID-19 are

occurring. It's a strong visual of how quickly the virus can spread in our hypermobile world.

All this data taken together is giving the best possible picture of where—and how—the new coronavirus is spreading in near real time. This geographic perspective is invaluable for trying to manage the disease.



↑ This World Health Organization (WHO) dashboard shows all confirmed cases of COVID-19 as of March 10, 2020.

How GNSS Data Is Helping a National Park Clear Snow from Unmarked Alpine Roads

By Timothy Smith, National Park Service



↑ Lassen Volcanic National Park (LAVO) gets snow as early as September and as late as March. (Photo courtesy of the National Park Service.)

A three-story building is about 40 feet high. That's how much snow can fall and cover Route 89, the main highway that runs through Lassen Volcanic National Park (LAVO) in Northern California. The park, which lies about 50 miles east of Redding near the northern edge of the Sacramento Valley, gets snow as early as September and as late as March.

"It's a whole different world up here in wintertime," said LAVO roads and trails supervisor Mark Welch.

When spring comes, a field crew has to find—and clear—Route 89. The highway includes 13 miles of road above the tree line, the altitude above which trees stop growing. Up there, few clues indicate where Route 89 lies beneath the snow.

"A lot of our work relies on having faith in our GPS and GIS," said Welch.

The consequences of not finding the road range in severity. Best case scenario, if crew members are a few inches off, they might have to move
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Real-Time GIS Apps Quicken Response to Earthquake in Albania

At 3:54 a.m. on November 26, 2019, a 6.4-magnitude earthquake jolted people awake across central Albania. It was the most powerful earthquake to hit the southeastern European country since 1979—and its deadliest. Fifty-one people died, and approximately 2,000 were injured.

The destruction was extensive, especially in Durrës, the town closest to the epicenter. About 900 buildings in the coastal city were damaged, and many, including the seven-story Vila Palma hotel, collapsed.

"We were in a panic situation," said GIS specialist Glen Olli, who works for Esri's official distributor in southeastern Europe, GDi. His office, in Albania's capital of Tirana, is located about 25 miles from Durrës. "It was a workday, so as soon as we got to the office [later that morning], we grabbed our laptops and went outside to be safe. Then we started developing apps."

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The Bureau of Land Management, has a national office, 12 state offices, and hundreds of field offices. Its business needs are as diverse as the geography of the United States. That's why the organization is applying a people-first change management approach to introducing new technology.



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Esri Myanmar Launches with Focus on Sustainable Development

Esri's newest international distributor, Esri Myanmar, opened for business on February 20, 2020, in Yangon, the country's largest city.

To commemorate the launch, the company hosted an event in Myanmar's capital, Nay Pyi Taw, to communicate the importance of GIS to leaders in government, business, and nongovernmental organizations. More than 100 participants attended. Many were senior government officials from various departments.

Esri Myanmar's goal is to help users work on initiatives that improve people's quality of life across Myanmar. It already supports many key national government initiatives, such as OneMap, an open-access geoportal with user-friendly data about land use and natural resources. Esri will also invest in and grow local training, technical support, and professional service capabilities.

Together with the local user community, the team at Esri Myanmar will center its work



↑ The whole Esri Myanmar team, plus Brett Dixon (second from left) and Zoe Zhang (third from right), both from Esri and based in Singapore.



↑ Esri Myanmar general manager Wuttiboon Fa-amnuaypol, presenting at the launch event.

on helping this emerging nation achieve the Sustainable Development Goals (SDGs), the ambitious targets set by the United Nations (UN) to end poverty, protect the planet, and ensure that all people have peaceful and prosperous lives by 2030.

"There are many challenges in Myanmar where GIS can play a significant role in providing a deeper understanding of issues, leading to better-informed decision-making and greater transparency," said Brett Dixon, Esri's general manager for the Asia Pacific region. "Many of Myanmar's major cities, such as Yangon, have

the same challenges that other developing cities around the globe face, including a rapidly growing population, lagging access to clean water and sanitation, and heavy traffic. GIS plays an important role in finding solutions to those issues."

"In addition, GIS can help address the divide between rural and urban populations," said Zoe Zhang, one of Esri's business development managers. "As in other countries, this is a specific focus for the citizens of Myanmar and international aid organizations that work there."

Dixon and Zhang, who are both based in Singapore, attended the launch event and gave

presentations about Esri's vision of a connected world through GIS. Esri will provide not only local support for ArcGIS technology but also serve as a nesting ground for GIS expertise in diverse and far-flung regions of the world.

One major priority for both Esri and Esri Myanmar is to cultivate this expertise in Myanmar by instituting GIS education programs at many of Myanmar's universities. The aim is to create a community of highly skilled, highly employable GIS professionals across the country.

"A vibrant GIS community is an important step for nation building and, in Myanmar, will help give rise to a brighter future," said Dixon.

Esri Myanmar's general manager, Wuttiboon Fa-amnuaypol, echoed this sentiment.

"The founding of Esri Myanmar is an important step in continuing to build Myanmar's GIS community and that community's ability to openly contribute to Myanmar's society and ongoing transition," he said, referring to the once-closed country's nine-year endeavor to institute political reforms and engage with the rest of the world.

The Esri Myanmar team also includes business development lead Myoza Woo and expert solution engineers, as well as support staff. They are working with customers on projects in a number of sectors, including land surveying, emergency response, urban planning, and heritage protection. The company is also partnering with international agencies to aid in infrastructure development and humanitarian efforts. Fa-amnuaypol already has plans to open a second office in Nay Pyi Taw soon.



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Esri Technology Gets Faster, Easier, and More Robust

The latest release of ArcGIS technology, which includes ArcGIS Pro 2.5 and ArcGIS Enterprise 10.8, offers powerful new features in mapping, visualization, analytics, and more.

ArcGIS Pro

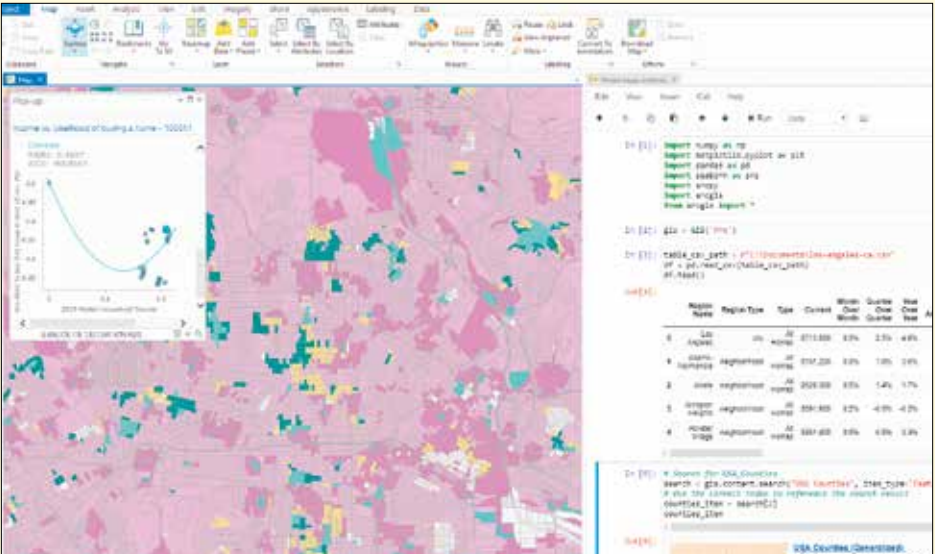
ArcGIS Pro 2.5 brings users new tools and capabilities to optimize their workflows. More than 60 of these enhancements came straight from user requests, and many are ArcMap equivalencies.

When it comes to mapping and visualization, ArcGIS Pro 2.5 has updated color management settings to ensure that colors render consistently across devices. It also has an overprint capability for symbol layers to prevent registration errors in printing, and now maps can be exported to the Adobe Illustrator Exchange (AIX) file format so users can add graphics and finish their maps in Adobe Illustrator. There are also a few new map projections.

For analysis, this latest update integrates Python notebooks into ArcGIS Pro to improve data science workflows, and users can now schedule analytical tools to run later or in a recurring pattern. There are new workflows for business analytics tasks, such as site evaluation and target marketing, and users will notice better performance in ArcGIS Pro 2.5, especially when working on large projects.

ArcGIS Pro 2.5 helps users better manage their data as well. Users can now automate metadata workflows. With geodatabase replication workflows, they can create and manage data replicas and sync changes using traditional versioning. Building information modeling (BIM) file workspaces can now be turned into geodatabase feature datasets. The map authoring experience for ArcGIS Indoors Web has been simplified, too.

Updates have been made to the following ArcGIS Pro extensions as well.



↑ To improve data science workflows, Python notebooks have been integrated into ArcGIS Pro.

ArcGIS Image Analyst

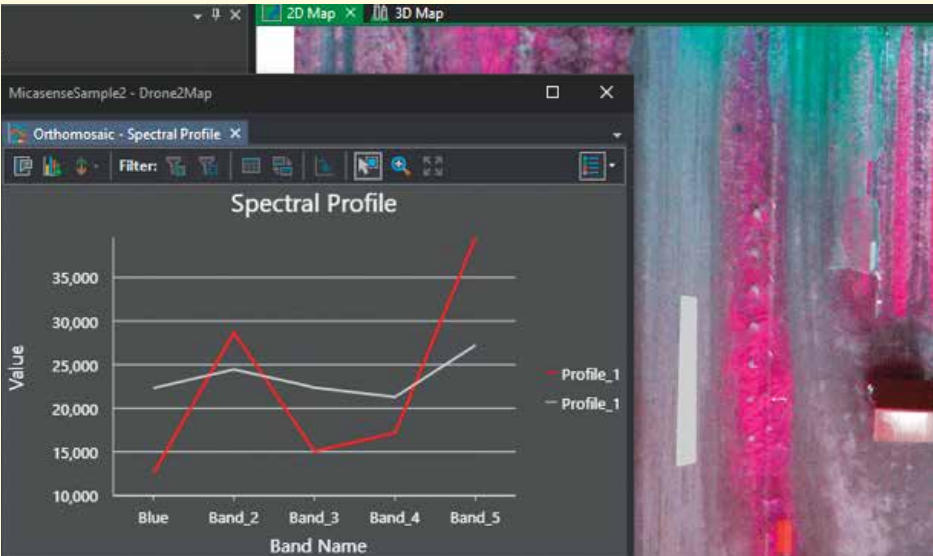
The most recent release of ArcGIS Image Analyst includes more comprehensive support for image analysis with expanded deep learning, new raster functions, and improved full-motion video (FMV). Users can now natively train deep learning models using geoprocessing tools in ArcGIS Pro. Image Analyst has 10 new raster functions that enable analysts to design and run targeted workflows for distance modeling, hydrologic modeling, and multidimensional analysis. It's also easier to manage and use FMV with embedded geospatial metadata, and the video player now has enhanced streaming.

ArcGIS for Maritime

The new maritime ribbon in ArcGIS Pro 2.5 contains new tools that make it easier for maritime users to create and edit complex features. The S-100 Attribute Editor simplifies how users edit complex attributes, too. The Association Manager makes it easier to create and manage relationships among multiple feature and information types. And the Display Scale control further simplifies editing by enabling users to set minimum and maximum scales for newly created features.

Drone2Map for ArcGIS

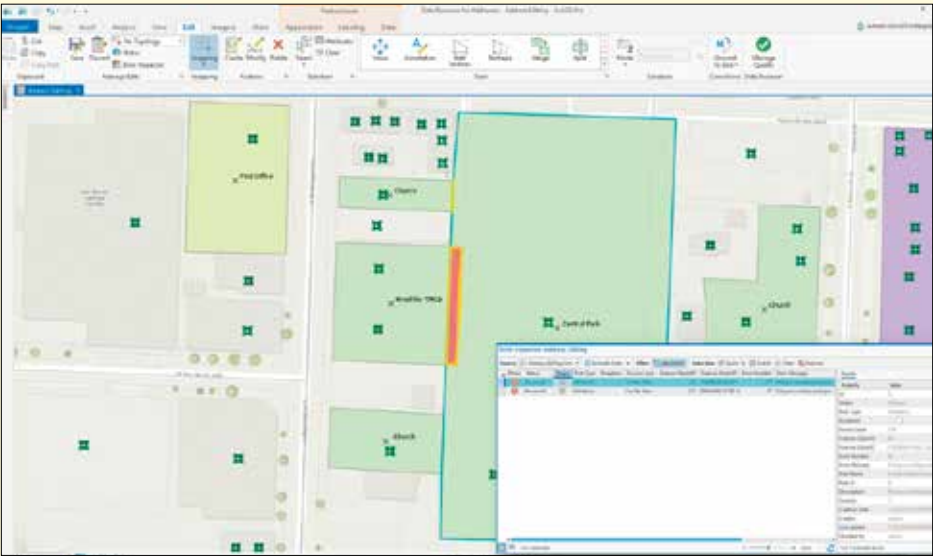
New features in Drone2Map for ArcGIS include improvements to elevation models that allow users to publish their own custom surfaces, such as bare ground digital terrain models (DTM) or top surface digital surface models (DSM), in ArcGIS Online or ArcGIS Enterprise. Users can add their own elevation surfaces to ensure that all 3D views incorporate the most authoritative elevation surface information. The camera model editor has also been improved. It now allows users to edit and store camera models in the database, ensuring that the same parameters are kept throughout processing.



↑ Drone2Map for ArcGIS has new features.

ArcGIS Data Reviewer

ArcGIS Data Reviewer has new capabilities for automating quality control workflows. Users can configure several automated validation checks, which are used to identify features that don't meet data quality requirements, as attribute rules. These checks include those that assess a feature's integrity, attribution, or spatial relationship with other features. By leveraging validation services in ArcGIS Server 10.8, features that fail validation can be reviewed and corrected using ArcGIS Pro 2.5 or through custom web apps.



↑ Users can now configure several automated validation checks as attribute rules.

Esri Production Mapping and Esri Defense Mapping

For the Esri Production Mapping and Esri Defense Mapping extensions, the latest release of ArcGIS Pro introduces new production workflows to help with data editing, quality control, and cartography. New tools have been added to the Workflow toolset, and the Data Management toolset has a new Extract Data By Feature tool, which helps users take data from a particular area of interest.

ArcGIS Living Atlas of the World

ArcGIS Living Atlas of the World now includes 78 new data layers that cover 89 different American Community Survey (ACS) tables from the newest 2014–2018 ACS demographic estimates. These layers are ready to use and cover topics such as housing, population, employment, income, race, age, insurance status, education, veteran status, and internet connectivity.

ArcGIS Enterprise

ArcGIS Enterprise 10.8 introduces several features and capabilities to help users make the most of their GIS infrastructure. These include updates to ArcGIS Enterprise Sites; new administrative settings in the Enterprise portal; more options for publishing data; and new apps, such as ArcGIS Mission.

A read-only setting for ArcGIS Enterprise now allows administrators to do system maintenance and upgrades while preserving data. Administrators can configure an information banner for the header and footer of the Enterprise portal to display important information to users. An access notice can now prompt users to accept terms and notices before they do anything on the site. The new ArcGIS Vector Tile Style Editor helps customize the look and feel of vector tiles, and hosted feature layers now render faster and take less time to publish when users have a lot of hosted layers. New webhooks also trigger events when someone's user type or role changes.

Many groups, including administrative groups, have new enhancements, such as being able to hide the list of group members on the Members tab and restrict members from leaving a group. There are also two new user type extensions available in ArcGIS Enterprise: the Utility Network Service user type extension and the Parcel Fabric Service user type extension.

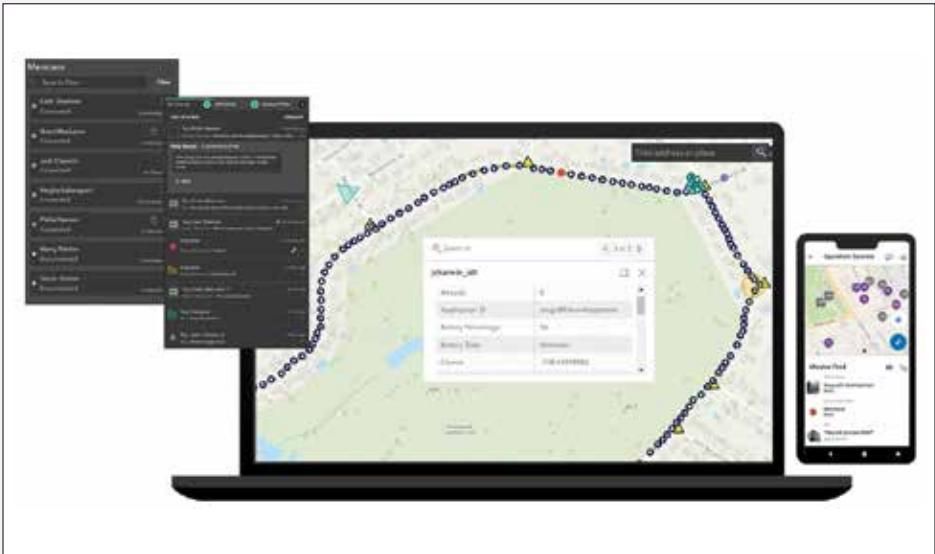
It's worth noting that ArcGIS Enterprise 10.8 is a short-term support release. ArcGIS Enterprise 10.8.1, planned for release later in 2020, will be a long-term support release for users who want several years of support and updates.



↑ ArcGIS Enterprise 10.8 includes new updates to ArcGIS Enterprise Sites.

ArcGIS Mission

This situational awareness and mission-management software solution, released with ArcGIS Enterprise 10.8, provides organizations with a comprehensive understanding of operating environments. Team members can track, monitor, and coordinate movements via location sharing and peer-to-peer communication. ArcGIS Mission also gives supervisors the ability to assign teams, designate maps, and share documents for mission operations.



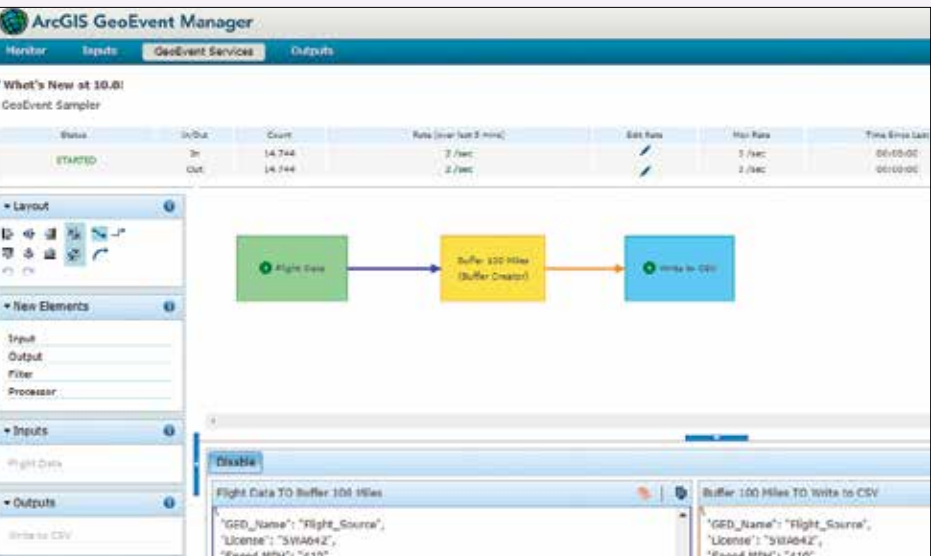
↑ ArcGIS Mission makes it possible to track, monitor, and coordinate the movements of team members.

ArcGIS Notebook Server

In ArcGIS Enterprise 10.8, ArcGIS Notebook Server—a complete data science platform—offers notable developments, enhancements, tools, and bug fixes. The new ArcGIS Notebook Server Manager can be used to manage common administrative tasks. In the notebook editor, users can collapse sections of ArcGIS Notebooks, enabling easier navigation. And the new Execute Notebook operation in the ArcGIS Notebook Server Administrator directory lets users automatically execute all the code cells in a notebook at once.

ArcGIS GeoEvent Server

For ArcGIS GeoEvent Server, recent updates focus on usability and functionality. Users can now create and add new input and output connectors and edit their properties directly in the service designer for ArcGIS GeoEvent Manager. The service designer also gives users the ability to edit key GeoEvent Server settings, such as GeoEvent Definitions, GeoFences, and Data Stores. GeoEvent Sampler, a utility embedded in the service designer, lets users sample and view geoevents as either delimited text or prettified JSON. Also, input and output connectors are now in a stopped state by default, giving users more control over when to start data inputs and processing.



↑ Recent updates to ArcGIS GeoEvent Server focus on usability and functionality.

ArcGIS GeoAnalytics Server

Users of ArcGIS GeoAnalytics Server have more analytics capabilities and broader flexibility for storing big data. With the new Find Dwell Locations tool, users can analyze where people, vehicles, or assets remained still for a certain amount of time. The Find Point Clusters tool lets users discover clusters of points based on their spatiotemporal distribution. In addition to being able to write analysis results to big data file shares like the Hadoop Distributed File System (HDFS), Amazon Simple Storage Service (Amazon S3), and Microsoft Azure Data Lake, users can now also write them to Microsoft Azure Blob containers.

ArcGIS Image Server

The ArcGIS Image Server 10.8 release includes broader support for data formats and sensor types, improved image hosting and analysis capabilities, and enhanced deep learning capabilities. These updates help users leverage more data formats, such as images taken by Sentinel-3 and Sentinel-5 observation satellites. Improved image hosting allows organizations to host more complex image data. And users can take advantage of building footprints and color correction processing that was previously only available with ArcGIS Pro. At 10.8, deep learning tools now support image space, allowing users to apply deep learning to oblique imagery.

ArcGIS for INSPIRE

In the latest release of ArcGIS for INSPIRE, Esri added the biogeographic regions data theme and the Elevation Vector Elements application schema for the elevation data theme. ArcGIS for INSPIRE Geoportal Server also now supports creating and updating metadata according to INSPIRE Metadata Technical Guidance 2.0.

ArcGIS Apps

When it comes to ArcGIS apps, there are a lot of new things to get excited about, including a new app and updates that improve user experience and enhance workflows.

ArcGIS Experience Builder

ArcGIS Experience Builder helps users transform their data into compelling web apps and web pages without having to write a single line of code. In the app, users can customize layouts and design elements, choose the tools they need to interact with 2D and 3D content, and build responsive apps that run on any device.

ArcGIS Insights

In ArcGIS Insights, Esri’s app for advanced analytics, workbooks have a cleaner, simpler user interface with more screen real estate. On desktop deployments, users now get unlimited data-only connections (as long as there’s one primary ArcGIS Online or ArcGIS Enterprise connection) and can connect to a single ArcGIS Online account and multiple ArcGIS Enterprise accounts. Insights also now supports coded value domains and subtypes. With a new one-click Export Data option, it’s easier than ever to share analytical datasets with other people or apps. It’s also now easier to add, remove, and reorder fields with improved summary tables.



↑ In ArcGIS Insights, workbooks have a cleaner, simpler user interface.

Collector for ArcGIS

Collector for ArcGIS now has one of the most often-requested capabilities: feature snapping. Available currently for iOS and soon Android, this allows users to snap to existing point features or vertices (for both lines and polygons) when using the map to create a new feature or update the location of an existing one. Bulk form updating is another enhancement that allows users to update a form entry for multiple assets or observations at the same time. When using maps offline, users can now create irregular offline areas (polygons) so they only carry the map areas they need. Additionally, users can sign in with a bar code or QR Code that enables quick access to the organization’s Enterprise portal.

ArcGIS QuickCapture

The ArcGIS QuickCapture designer has several new features to help users more easily create projects. App designers can configure dialog boxes that fieldworkers use to enter extra information in the app, without losing the fluid, big-button experience. It’s also now possible to configure buttons that make it either required or optional for fieldworkers to include a photo. Additionally, a new continuous mode allows users to capture feature data in a continuous stream, as they move around, rather than point by point.

Explorer for ArcGIS

In addition to being available in iOS and Android, Explorer for ArcGIS is now available in Microsoft Windows. This new version gives users more ways to take maps offline, the ability to use raster imagery directly within mobile map packages, refresh layers more often to boost situational awareness, and keep data secure with public key infrastructure (PKI) authentication.

ArcGIS StoryMaps

ArcGIS StoryMaps has surpassed the functionality of classic story map templates. In addition, users can now convert their story maps into printable PDFs and share them with a group. There’s also a new user type, Storyteller, for anyone in an organization who only wants to build stories using ArcGIS StoryMaps.

ArcGIS Hub

ArcGIS Hub is now in the app switcher and no longer requires an administrator to enable an organization’s open data. This means that any ArcGIS Online member who has a Creator user type and a Publisher role can quickly get started building sites and pages with ArcGIS Hub Basic. Users can now add 3D web scenes to sites and pages using the map card to show things like proposed developments and underground utilities. There are also easier ways for administrators to configure their hub’s sign-in experience. And users can add a trusted logo, a community support contact, and/or custom terms and conditions to their sign-in pages. Additionally, the Supporting Teams feature is a new way to collaborate privately with target groups in ArcGIS Hub.

Navigator for ArcGIS

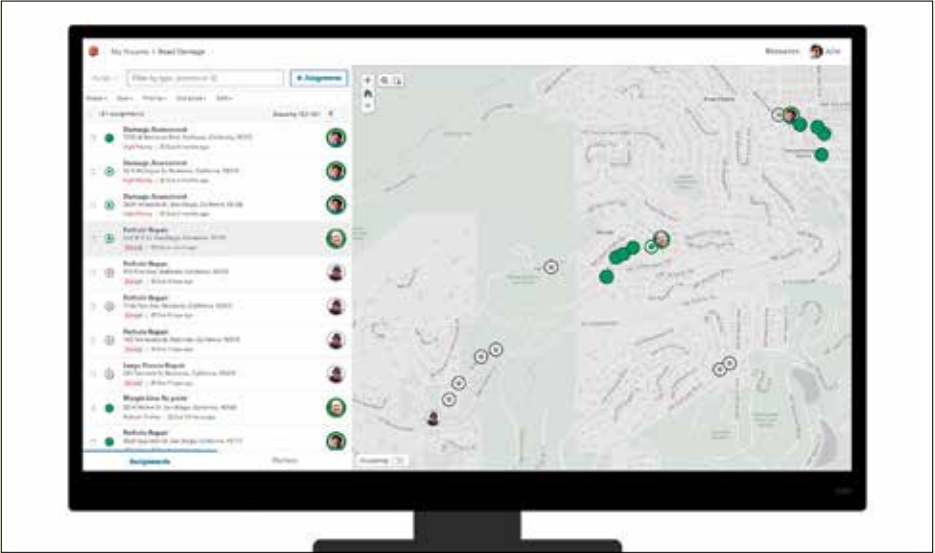
Recent updates to Navigator for ArcGIS focus on drivers. Dispatchers can now share route layers directly with drivers in the app, which ensures that routes don’t get compromised if drivers lose connectivity. Drivers can pause multistop routes without canceling their trips entirely. They can also fully interact with features and assets on maps and see complete attribute information, including media and attachments.

Tracker for ArcGIS

In Tracker for ArcGIS, the Track Viewer web app is now embedded in ArcGIS Enterprise. Once an administrator enables location tracking in the enterprise organization, users who are authorized to track views—typically managers and supervisors—can access Track Viewer through the app switcher.

Workforce for ArcGIS

The most recent release of Workforce for ArcGIS focuses on the web app. Users, who are generally supervisors, can now install it with ArcGIS Enterprise instead of having to do a separate installation.



↑ Supervisors can now install the Workforce for ArcGIS web app with ArcGIS Enterprise.

Esri Redistricting

The Esri Redistricting web app has several new features for the 2020 Census cycle. These include improved workflows for creating redistricting plans, a new streamlined Themes function that allows for demographic overlays, and support for dual monitors and pop-out windows. Esri Redistricting also now lets users create plans for multiple counties at once, as well as for smaller areas within a county, state, or region.

ArcGIS Excalibur

The latest release of ArcGIS Excalibur, a premium web app that simplifies image exploration, includes broader support for image services, more viewing and editing options within projects, and an improved read-only user experience in the portal. Two new tools, Swipe and Flicker, also make it easier for users to engage in comparison or change-detection workflows.

ArcGIS Earth

ArcGIS Earth, a free, lightweight, easy-to-use app for immersive 3D experiences, now lets users edit KML, including ground overlays, screen overlays, and network links. Users can take content entirely offline with mobile scene packages. ArcGIS Earth also supports a new workflow that uses QR Codes to quickly share data from the desktop app to ArcGIS Earth on a mobile device.

Real-Time Tracking Improves Offshore Patrols in Argentina

Coast Guard Uses ArcGIS Enterprise to Monitor Illegal Activity on Country's Ocean, Rivers

The Argentine Coast Guard, Prefectura Naval Argentina, oversees almost 1.4 million square nautical miles (1.8 million square miles) of water within Argentina's exclusive economic zone (EEZ), which extends 200 nautical miles from the coast and covers more than 2,300 miles of inland waterways. On the open ocean, where Argentina's EEZ adjoins international waters, illegal fishing is often a problem. Moreover, portions of the country's aqueous areas traverse lush subtropical forests, making them prime routes for drug smuggling and human trafficking.

The coast guard deploys ships, helicopters, and observer planes to protect the EEZ against illicit activities. But as recently as five years ago, Prefectura Naval faced an uphill battle in monitoring marine poaching and trafficking.

"We had very little information about the use of our seas," said Ernesto Miguel Klocker, director of informatics and communications for Prefectura Naval.

To collect more data about Argentina's waterways and streamline how it monitors marine activity, Prefectura Naval began working with Aeroterra S.A., Esri's official distributor in Argentina, to implement a real-time tracking system. Called Guardacostas, it consists primarily of ArcGIS Enterprise and ArcGIS GeoEvent Server, with analysis capabilities provided by ArcGIS GeoAnalytics Server and ArcGIS Insights.

Now, the Argentine Coast Guard can track and analyze patrols digitally, in real time, which has improved decision-making.

A Slow, Time-Consuming Process

Prior to implementing ArcGIS technology, the coast guard enforced maritime law by constantly patrolling waterways and investigating specific ships to get an idea of their background, including

what they transport and if they've ever been involved in illegal activities before. It was especially important for the coast guard to monitor the porous 2,800-mile border of the EEZ, where boats would frequently attempt to sneak into the zone to poach fish or conduct other illegal activities.

The only way for the coast guard to get evidence of illicit incidents, however, was for a patrol vessel to visually confirm that a ship was doing something illegal, track it down, and then secure it. The process was limited by the number of ships Prefectura Naval had patrolling the EEZ, as well as their 25-mile radar range.

What's more, Prefectura Naval stored the data it did have on ships in multiple isolated systems, so members of the coast guard could only see bits and pieces of information at one time. Getting a complete picture of a specific vessel required working with different systems and having an analyst create a background report on the ship that, if warranted, the coast guard could use to charge the vessel with a crime.

Whether dealing with illegal fishing in the Atlantic Ocean or smuggling on other major waterways like the Paraná River or the La Plata estuary, accurately identifying and tracking illegal activity was a slow, time-consuming process.

Big Data Made Manageable

Vessels involved in illegal activity don't typically transmit their positions via the automatic identification system (AIS), an onboard transponder that broadcasts ship locations. The real-time system that Prefectura Naval and Aeroterra

S.A. developed uses ArcGIS GeoEvent Server to monitor every significant vessel in the world and alerts the coast guard immediately when a boat encroaches on Argentine waters. By setting parameters and using signal processing and radar images, Prefectura Naval's mission control can track a ship's position both inside and outside the EEZ in real time, as well as detect ships that are not transmitting their positions.

Using GeoEvent Server, Prefectura Naval ingests and manages AIS data feeds, filters that data to find events of interest (e.g., a ship that enters a defined area, or a geofence), and configures alerts to send to mission control. ArcGIS GeoAnalytics Server conducts deep analysis on the huge amounts of data collected and, paired with ArcGIS Insights, allows mission control to see trends and patterns. The entire process is automated, so Prefectura Naval no longer has to rely solely on visual ship sightings to apprehend vessels that are engaging in illicit activities.

The Guardacostas system also enables Prefectura Naval to consolidate the data it used to house in various systems and combine it with geographic information, creating a common operating picture of what's happening in the EEZ. This allows coast guard members to track more vessels with more data than ever before, resulting in keen situational awareness.

Light-Years Ahead

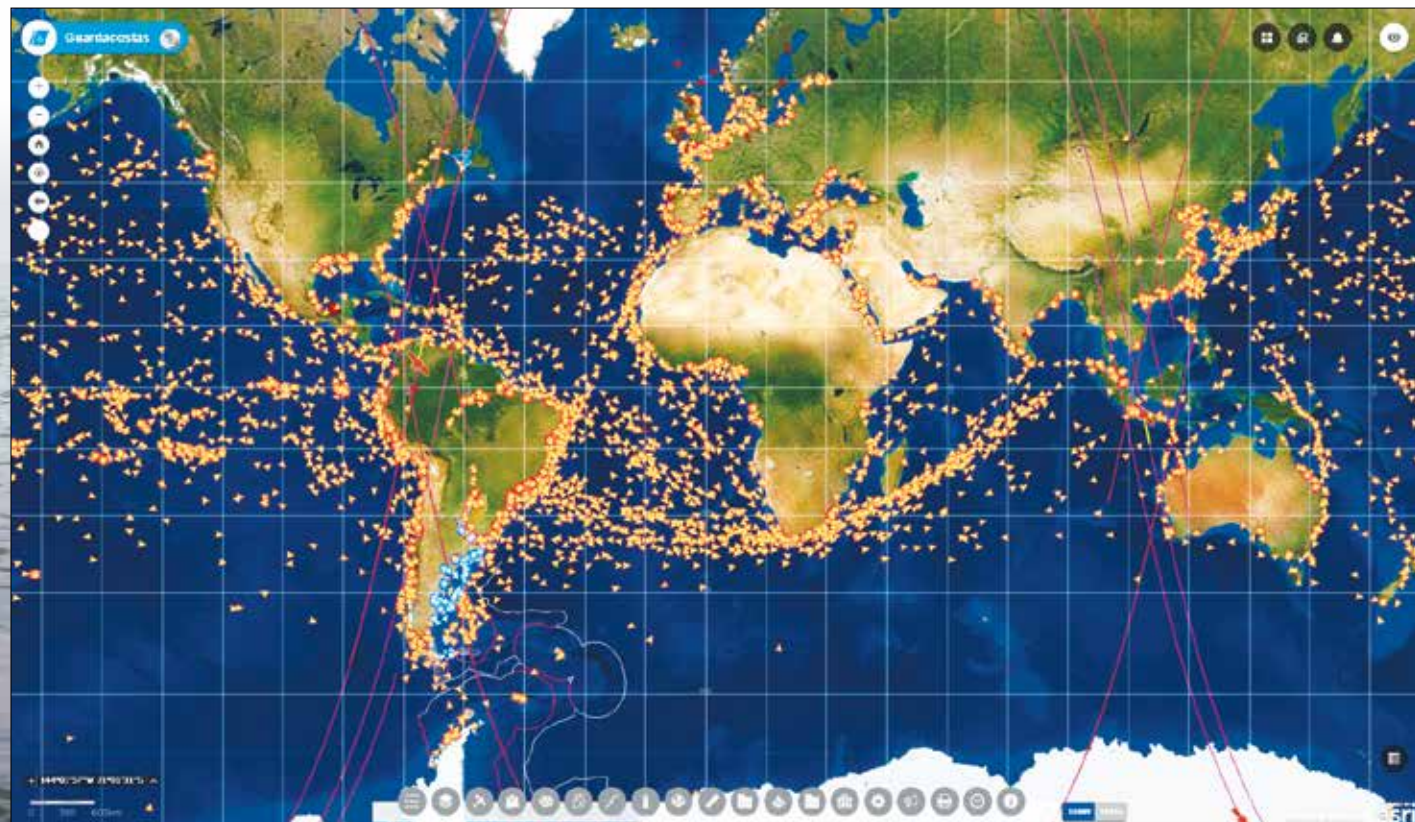
Having started with just 3 million records taken from about 20 AIS data feeds, Prefectura Naval's database has grown to more than

17 billion records coming in from 50 feeds. ArcGIS GeoEvent Server now allows the coast guard to process 1,000 records per second and analyze them in real time. Compared to the manual, visual-based system it used before, this is light-years ahead.

The success of Guardacostas has encouraged the Ministry of Security, which the coast guard is part of, to adopt it more widely. Prefectura Naval is helping to roll out Esri technology in other groups, such as the federal police, airport security, and the national guard. These other agencies now use ArcGIS Enterprise and GeoEvent Server as well to track their own assets through mobile devices, radios, and other equipment with location sensors.

Prefectura Naval is also using ArcGIS Enterprise Sites to share different views of its data with other security forces. This is helping additional departments in the Ministry of Security get a better understanding of Prefectura Naval's data, and some are even using it to improve their own deployments of field personnel.

From a technical standpoint, it was very challenging for Prefectura Naval to gather all the information it had available in different systems and use it effectively to combat illicit dealings in the EEZ. Since implementing the ArcGIS platform, however, the coast guard has turned this into a real-time operation, where information is received, processed, displayed, and archived instantly. Now, all that data is readily available and can be used to conduct better analysis and, ultimately, improve security.



↑ Guardacostas uses ArcGIS GeoEvent Server to monitor every significant vessel in the world.

Smart Policing Gets a Boost from Enterprise GIS

St. Petersburg, Florida, Modernizes and Improves Policing Methods with ArcGIS Technology

For years, the police department in St. Petersburg, Florida, relied on paper and spreadsheets to fight crime.

“Everything was text based,” said Frank Ullven, a systems analyst on the St. Petersburg Police Department’s Information and Technology Services (ITS) team. “We didn’t have any maps. It was all street names and addresses.”

Ullven remembers how police officers in the Gulf Coast community had to read addresses in columns to figure out where incidents were occurring. Matching a crime to an address was difficult without visual representation, especially when new streets were added to the community or street names got changed.

“Officers don’t have to memorize all that, like this used to be 2nd Street South, but now it’s University Way South,” said Ullven.

The police department’s ITS team, which includes a GIS specialist, a systems analyst, and a data specialist, along with a team of five analysts in the Intelligence-Led Policing (ILP) unit, set out to fix this. Together, the group administers the ArcGIS platform and creates the maps and dashboards used by more than 575 officers, detectives, and supervisors at the St. Petersburg Police Department. More specifically, the ITS unit manages the police department’s ArcGIS Enterprise portal, while the ILP unit is a data-driven center that provides support to tactical, strategic, and operational initiatives.

According to Dr. Richard Ferner, Jr., the ILP unit supervisor, several department stakeholders, including the chief of police and command staff, were overwhelmed by the sheer volume of text-based information available about crime. The police department did implement older types of geospatial technology, but they lacked the flexibility needed to support custom, user-friendly visualizations.

“Those solutions did not promote robust and relevant visualizations,” said Ferner. “Users had little incentive to utilize those tools when deliberating on a course of action, such as proactive patrol assignments or developing leads in identifying suspects.” This made it difficult for staff and supervisors to gain the meaningful insight they need to make decisions and do their jobs effectively.

Five years ago, the arrival of a new police chief, Anthony Holloway, marked the St. Petersburg Police Department’s transition to a data-driven organization. Holloway advocated adopting a management model called CompStat, or computer statistics, a policing method that uses timely and accurate information to combat crime efficiently and improve police accountability.

At the time, the ITS team realized it needed to move away from a static environment and deliver content in an interactive manner.

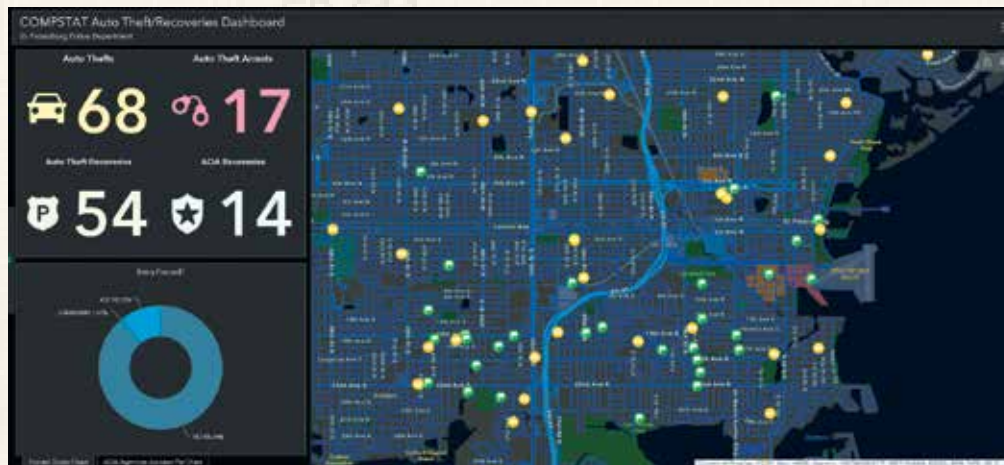
“The minute I heard Esri developed an enterprise solution that could allow the user community to interact with the content we publish, I knew, unequivocally, that was the solution we needed,” said Ferner.

In 2016, the department implemented ArcGIS Enterprise 10.5 and ArcGIS Pro and has kept pace with each upgrade, steadily adding products such as ArcGIS Insights and ArcGIS Dashboards.

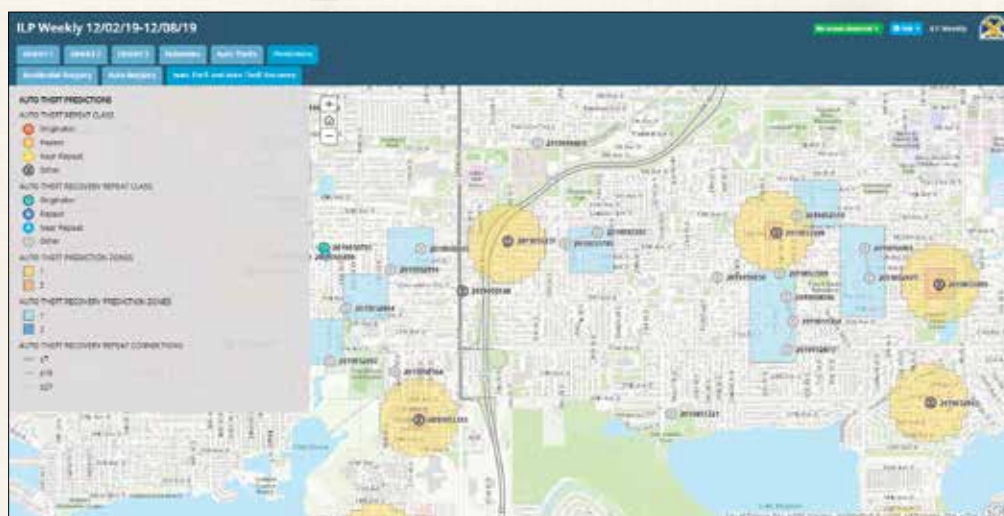
ArcGIS Enterprise was key in supporting the department’s need for a secure, behind-the-firewall enterprise platform that powered data management and analysis, especially in the context of law enforcement data.

“There’s a level of comfort in knowing that it’s our data on our in-house system and that it’s not located somewhere that we don’t have control over who sees it or what’s being accessed,” said Ullven.

Before implementing ArcGIS Enterprise, analysts at the St. Petersburg Police Department created static content that was distributed through email and posted to a file sharing system and Microsoft SharePoint. Disparate tables, charts, and graphs did not tell the whole story, and there was no way to customize dashboards to visualize data and come up with a common operating picture.



← The police chief advocates a policing method called CompStat, which uses timely and accurate information to combat crime effectively and improve police accountability.



← With the ArcGIS platform, analysts can create dashboards and story maps that focus on what each unit needs to know.

Since moving to the ArcGIS platform, however, analysts have been able to create dashboards and story maps that focus specifically on what each unit needs to know. That way, people don’t get overwhelmed with irrelevant information.

“Now that we’ve evolved onto the Esri platform, we can carve out highly nuanced, relevant data that matters and answers questions,” said Ferner. “It helps the staff and supervisors carve out a strategy and set of tactics for immediate application.”

These days, data is refreshed 45 minutes before each shift, which allows watch commanders to detect emerging crime trends and evaluate initiatives on the go. Analysts use the Crime Analysis configuration in ArcGIS Pro along with ArcGIS Insights to analyze data and then share interactive content via story maps and dashboards made with ArcGIS Enterprise.

“Canvassing a neighborhood no longer requires a six-foot-long paper map and tons of hard-to-decipher markings,” said Kevin Christy, the ITS team’s GIS specialist.

Instead, an app created using Web AppBuilder for ArcGIS made the process more targeted and efficient by allowing detectives to live track the addresses they visit. And Survey123 for ArcGIS enhanced the department’s Eagle Eye program, a public camera registration website, by making it easier to geocode addresses and maintain an up-to-date camera locator app.

In one example, the command team was looking for information about parking meters being destroyed in downtown St. Petersburg. Analysts pulled crime data for areas around parking meters, used ArcGIS Pro to predict a crime risk area, and published this data on a map within ArcGIS Enterprise. Staff were then able to use the prediction to plan operations.

The data to make the prediction was acquired from the records management system, where detailed accounts of crime around each parking meter location were documented. Analysts then geocoded each parking meter location in ArcGIS Pro and

subsequently published the content as a hosted feature layer in ArcGIS Enterprise.

Armed with this analysis, police officers patrolled the risk area identified in the prediction and encountered the suspects, who were arrested as they prepared to commit more crimes. Prior to implementing this vast array of ArcGIS technology, doing this kind of analysis and making such a prediction were not possible.

Now, more officers are requesting specific dashboards from the ILP and ITS units. They want to see what ArcGIS technology can do, and when they get a tour of it, their eyes light up, according to Christy.

“I see their wheels turning,” he said. “The big thing is tailoring it for exactly what the end user wants. Whether it’s ‘I want these metrics in my dashboards’ or ‘I want these colors’ or ‘I want an app that does x, y, z,’ it’s all about giving them what they want. If they don’t get exactly what they want, they’re less likely to use it.”

Ferner also noted that having a growing number of younger police officers has contributed to a critical mass of users in the department.

“One of our biggest challenges was the cultural dynamic in giving them access to these products and assigning accountability to the metrics,” he said. “The workforce here is also becoming younger, and we’ve discovered that they are more adept with using different technologies. Even if we had a product 10 years ago that is as sophisticated as this one is today, I don’t think the staff then would have been so accepting of these technologies.”

The move from static maps and data that officers couldn’t fully engage with to a more interactive mapping platform has transformed the department.

“Esri allows officers to have a customized product that really presents them with geospatial data that prompts questions,” said Christy. “They can look at the data, they can ask questions, and now they are getting more insights than they had in the past. It’s really helping to drive better policing.”

Dashboards Get an Upgrade

ArcGIS Dashboards Beta Lets Users Try Out New Features

Each month, Esri users create thousands of dashboards using ArcGIS Dashboards (formerly known as Operations Dashboard for ArcGIS). Informative and dynamic, they serve multiple purposes, from managing performance and monitoring progress to doing impact assessments and sharing information. They're built for a variety of audiences, too, including operations staff, line-of-business managers, and C-suite executives.

To help users achieve these objectives and more, the ArcGIS Dashboards team is always working to improve the product. The new ArcGIS Dashboards beta, available in ArcGIS Online, is the latest version of Esri's dashboard authoring technology. Built on ArcGIS API 4.x for JavaScript, it enables dashboard authors to take advantage of multiple enhancements that have been introduced across the ArcGIS platform.

With ArcGIS Dashboards beta, users get to test-drive several new features, highlighted below, and provide feedback to the team. All ArcGIS Online users have access to ArcGIS Dashboards beta through the app launcher. Just look for the familiar ArcGIS Dashboards icon labeled **BETA**. Also, once this version of ArcGIS Dashboards comes out of beta, it will be available in ArcGIS Enterprise.

Improved Usability and Performance

The ArcGIS Dashboards team has made a number of user experience improvements, many of which are exposed through dashboard configuration options. These include new and improved summary statistics for percentile and count, as well as support for Hex, RGB, and HSL formats for color input. Options such as these enable authors to customize their dashboards to create the information products they want and need, supporting diverse audiences and adhering to organizational branding.

The beta version has also been built to take advantage of the latest mapping innovations available in the ArcGIS platform. These include overall improved map performance and the ability to draw more features on a map. The best way to see this in action is to create a map with the new Map Viewer beta and employ its new mapping capabilities, such as the dot density mapping style and/or improved pop-ups, and bring that map into a dashboard. The capabilities carry over, and the map looks great and renders fast.



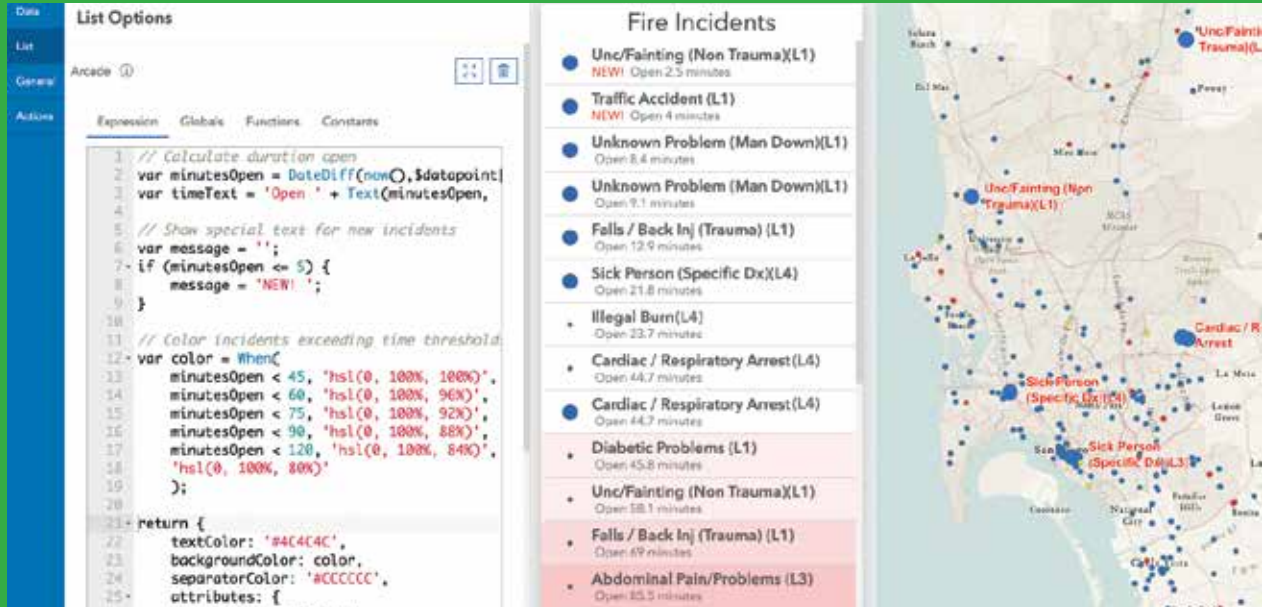
↑ This dashboard makes use of a dot density map, created with Map Viewer beta, that shows the veteran population across the United States.

Support for ArcGIS Arcade

ArcGIS Arcade is a portable, lightweight, and secure expression language written for use in the ArcGIS platform. It can perform mathematical calculations, manipulate text, and evaluate logical statements. Dashboard authors have been asking for the ability to leverage Arcade features, so the ArcGIS Dashboards team has added support for Arcade to the beta version in two ways.

First, just as other mapping enhancements carry over to the beta version, ArcGIS Dashboards beta now fully leverages all map authoring customizations made using Arcade. This enables users to take advantage of custom attribute expressions they've already written within their maps, whether in layer styles, labels, or pop-ups.

Second, the beta version has an interface that lets users compose Arcade expressions directly in ArcGIS Dashboards for both list and indicator elements. This allows users to customize how data points are rendered. Within these elements, Arcade can be used for conditional formatting, value conversions, and more. For example, users can employ Arcade to alter list items so special text appears when specific event conditions occur or to change the background color based on a reference value.



New Data Sources

Historically, dashboards supported a variety of different data sources, depending on the element and behavior. The map element supported the widest range of sources, but those sources could only be shown on a map, meaning they could not be used as the data source for other dashboard elements. In ArcGIS Dashboards beta, dashboard authors now have the flexibility to use the layers that were added to a map as the data source for other dashboard elements, such as lists, indicators, gauges, or charts.

Try It Out

To try ArcGIS Dashboards beta and provide feedback to the team, sign in to your ArcGIS Online account or get a free trial at go.esri.com/freetrial. Documentation, FAQs, and a discussion forum for ArcGIS Dashboards beta are available on GeoNet.

The ArcGIS Dashboards team is continuing to work on other features and will make them available for beta testing as they become stable.

← In this dashboard, ArcGIS Arcade expressions alter how items appear in the list. The **NEW!** label appears when incidents have been opened within the last five minutes, and the background colors change when incidents exceed specific time thresholds.

Real-Time GIS Apps Quicken Response to Earthquake in Albania

“In Albania, the emergency services and other authorities were not prepared for such an event,” said Shpati Jupe, managing director of GDi Tirana. It was an all-hands-on-deck moment, with agencies across Albania and experts from around the world pitching in.

Jupe and Olli got in contact with staff at the City of Durrës to see how they could be of service. The internet was still up and running, so with support from the Esri Disaster Response Program (DRP), the small team in Tirana used ArcGIS Online to develop seven critical apps that helped citizens, city staff, and other decision-makers find emergency facilities, record damages to buildings, and figure out which areas of town needed the most immediate attention.

“Our solutions were the first ones that were developed and sent, very quickly, to the staff managing the emergency,” said Olli.

In the hours, days, and weeks after the initial earthquake, as powerful and frequent aftershocks continued to rock the region, these location-based apps made all the difference.

Four Apps Help Get Response Effort Off the Ground

The first thing the City of Durrës needed was a map that showed all its emergency facilities.

“Albania’s emergency management capacity at the local level is extremely limited,” explained Andrej Lončarić, managing director of GDi in Croatia. “There was no public website that citizens could reach out to to get this information.”

City staff gave the team point data for its critical buildings, including hospitals, police and fire stations, and first aid centers. Straightaway, Jupe, Olli, and their colleague Enxhi Masha,

GDi Tirana’s product and solutions implementation specialist, built a web app to help citizens and emergency responders locate these facilities and prioritize where to send the wounded.

Next, the team contacted one of their partners, European Space Imaging, based in Munich, Germany, to obtain very high-resolution imagery of Durrës taken early that morning. Using the Esri Story Maps Swipe and Spyglass app template, the team built another web app that let users swipe new imagery onto old imagery to see which buildings had collapsed.

GDi Tirana also put together a Survey123 for ArcGIS form that citizens could use on their smartphones to quickly report damage to buildings. The idea was to get a broad overview of the devastation in Durrës and figure out where the worst damage was, so the form was simple. It asked respondents to record their name; phone number; the geolocation of the building they were reporting on; whether damage was low, medium, or high; any relevant photos; which village and/or administrative unit the building was in; and any additional relevant information.

To ensure that authorities responding to the emergency could see what was happening on the ground and use that information to make decisions, Jupe, Olli, and Masha used ArcGIS Dashboards to build a real-time dashboard that consolidated all the data that citizens were recording with Survey123 into a map, charts, and graphs.

“We developed the dashboard together with the Municipality of Durrës. [Staff] told us what to change and what to add,” said Olli. “We made it available in both English and Albanian so it would be understandable by all the people involved.”

By 9:00 a.m. the morning of the earthquake, Jupe, Olli, and Masha delivered these three apps to the City of Durrës. Staff posted the critical facilities map and the Survey123 form on the city’s website so citizens could easily find them and made all the apps



↑ Government staff members used a second Survey123 app to do additional assessments on damaged buildings.



↑ The Vila Palma hotel in Durrës collapsed. (Photo, taken from a citizen report, courtesy of GDi.)

↓ The 6.4-magnitude earthquake destroyed buildings throughout central Albania, especially in the coastal town of Durrës. (Photo, taken from citizen reports, courtesy of GDi.)



available to other responding authorities, including the City of Tirana, the ministries of defense and the interior, and the national civil protection agency. By noon, all four apps were in full use.

“It was very important to have tools like the ones that we built in the early hours, as the situation was unfolding, to help, in real time, with gathering quality information and creating quality tools,” said Jupe.

A More Detailed Way to Prioritize Needs and Resources

Over the next few days, GDi Tirana focused on refining the data being collected in the field and presenting a more detailed picture to authorities. This involved working not only with the City of Durrës but also with other specialists who descended on the region to help with response efforts.

One of the first groups that deployed to Albania following the earthquake was a team of engineers from the Israeli Home Front Command, the emergency response and civil protection branch of the Israel Defense Forces (IDF). The engineers were tasked with helping Durrës and other communities survey buildings and classify their structural damage.

“They saw immediately that the City [of Durrës] was using the tools that we had built,” said Jupe. “They were happy about that because they also use the ArcGIS platform for their emergency management operations.”

“They introduced us to the concept of sensitivity, or pain, mapping,” said Olli. This is what the IDF uses to prioritize needs and resources. “It’s a combination of different types of data layered on top of one another, and each one is given a certain amount of weight, based on a calculation, which, at the end, provides a more complex overview of the situation,” explained Jupe. “You can combine these different types of data and, through mathematical formulas, better understand what’s going on in the field and prioritize what you need to do.”

Less than two weeks after the initial earthquake struck, on December 8 at 11:00 p.m., the GDi team met with engineers from the Israeli Home Front Command to learn more about the concept of pain mapping, which is part of a system that won the Home Front Command a Special Achievement in GIS (SAG) Award at the 2019 Esri User Conference. The idea was to split up immediate issues into five categories, define whether each need was high or low, and then combine everything to show which areas of Durrës had the highest sensitivity and needed the most immediate attention versus which areas could wait for assistance.

The five categories consisted of the following:

- Citizen sensitivity: The number of damage reports sent in by citizens divided by the total population of that area
- Structural sensitivity: The number of damaged buildings divided by the total number of buildings in an area
- Infrastructure sensitivity: How much of a piece of infrastructure was damaged divided by its total length
- Critical services sensitivity: How many facilities were damaged divided by the total number of facilities in that area
- Patient sensitivity: The number of people in a living unit, within a certain age range, that needed help divided by the total number of people in that unit

Olli and Masha worked all night to build the app and get it ready for use in the field.

“In the morning, we did some quick tweaks with the Israeli guys, and then the chief of the Israeli team showed the app to the prime minister and Albania’s emergency team directly in the field while they were inspecting some damaged buildings,” said Jupe.

The GDi Tirana team also built a second Survey123 app that city and national government staff members used to do further assessments on the damaged buildings that citizens reported. To present this new, more detailed survey data, the team developed another dashboard, in both Albanian and English, with some additional functionalities, including widgets, gauges, pie



charts, and serial charts. Because the engineers from the Home Front Command were using Survey123 for their work, too, they fed their data directly into the dashboard as well. All this gave decision-makers the ability to quickly determine which buildings were livable and which ones weren’t, as well as which regions, villages, neighborhoods, and administrative units needed rapid assistance.

“This was a very efficient and fast way to respond to a disaster situation with the right tools and solutions to help staff in the field be precise, fast, and effective,” said Olli.

Next Time, Albania Will Be Prepared with GIS

Over the next few weeks, the citizen-reporting survey recorded more than 1,800 records, and its accompanying dashboard showed an average of 117 views per day. The second survey ended up with almost as many records, showing an average of 15 views per day.

“This emergency demonstrated all the benefits of having a cloud-based solution,” said Lončarić. “It showed how robust ArcGIS Online is, how well it can scale, and how secure it is.”

“After this very good cooperation, which the City of Durrës has valued so much, it looks like [it is] going to expand [its] GIS

capabilities and use of Esri technology,” Jupe said. “Not only that, but the national government is now pushing for all cities, countrywide, to adopt GIS technologies for emergency management and other city operations, such as maintenance.”

“We are now talking to the Albanian government about getting funding from the United Nations Development Programme (UNDP) so they can equip themselves with the ArcGIS platform,” Lončarić added. “Next time something similar happens, they can be prepared to respond to it themselves—with our support, of course.”



↑ The GDi Tirana team, from left to right, Glen Olli, Shpati Jupe, and Enxhi Masha.

Workforce for ArcGIS Has New Offline Capabilities

Esri's Product Team Lead Explains These Enhancements

Using the power of location, Workforce for ArcGIS helps organizations improve the planning, coordination, and organization associated with fieldwork, making it more streamlined and efficient. Field crews can use the mobile app as a digital to-do list when doing inspections and maintenance or working events, and the app gives managers more insight into what fieldwork entails and how quickly it's getting done.

Here's how it works. GIS analysts use the Workforce web app to create projects that define what type of work needs to be done, and dispatchers use it to generate assignments that they allocate to fieldworkers to complete. Field crews then use the Workforce mobile app to manage their assignments and report progress back to the office. The solution enables supervisors to more effectively monitor and manage projects, while field personnel find that it helps them better organize their daily tasks.

Since its introduction in 2016, Workforce has been adopted by a wide array of organizations. Utilities and pipeline operators use it to inspect and maintain assets, governments and municipalities use it to organize and manage events like parades and elections, engineering firms use it to manage staff and contractors, and public safety organizations use it for emergency response efforts.

Now, Esri is expanding Workforce to support offline capabilities, too. That will allow users in disconnected environments to stay just as organized as everyone else.

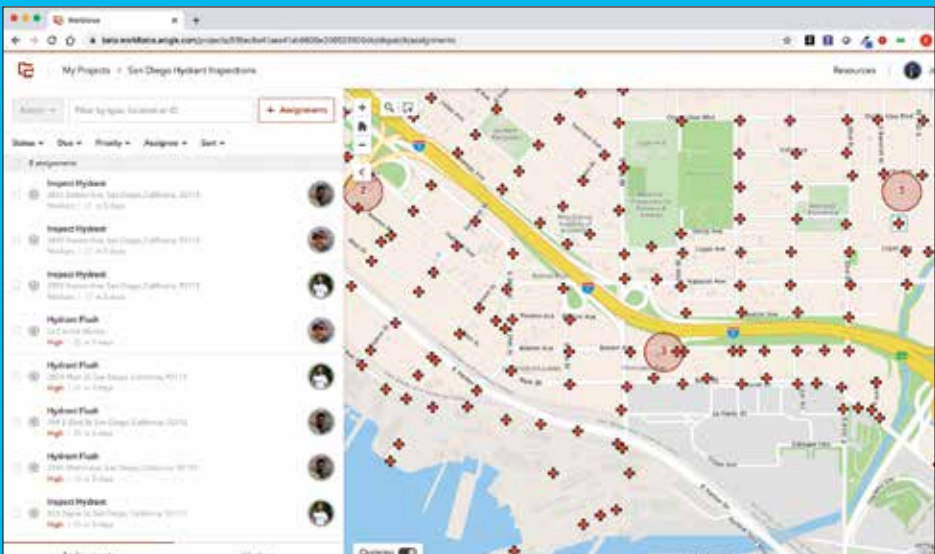
Jeff Shaner, the field apps product lead for Esri's software development team, explains this update.

Q With Workforce supporting offline use, what kinds of problems will that solve for users?

A The app's new offline capabilities will satisfy two critical enhancement requests. First, fieldworkers who use Workforce as their digital to-do list will be able to complete their assignments without disruption, even when they have no internet or cell connectivity. Being able to avoid unnecessary downtime provides a huge boost to productivity. It lets fieldworkers maximize their ability to complete their assignments, as planned by their supervisors.

Second, Workforce will now record an assignment's start and completion date and time, even when it has to be performed in a disconnected environment. This allows managers to more easily monitor and analyze the time it takes to complete different types of fieldwork.

When you think of projects, especially those with multiple phases and different types of tasks, it's challenging for managers to know what's done and not done, how long certain tasks are taking compared to their projections, and how to effectively coordinate dependent tasks. This is where the value of Workforce can really be appreciated. Allowing fieldworkers to complete their tasks, even when they're offline and have to sync the data later, eliminates information gaps. This offline support is invaluable to many of our customers, so we're very pleased to deliver it.



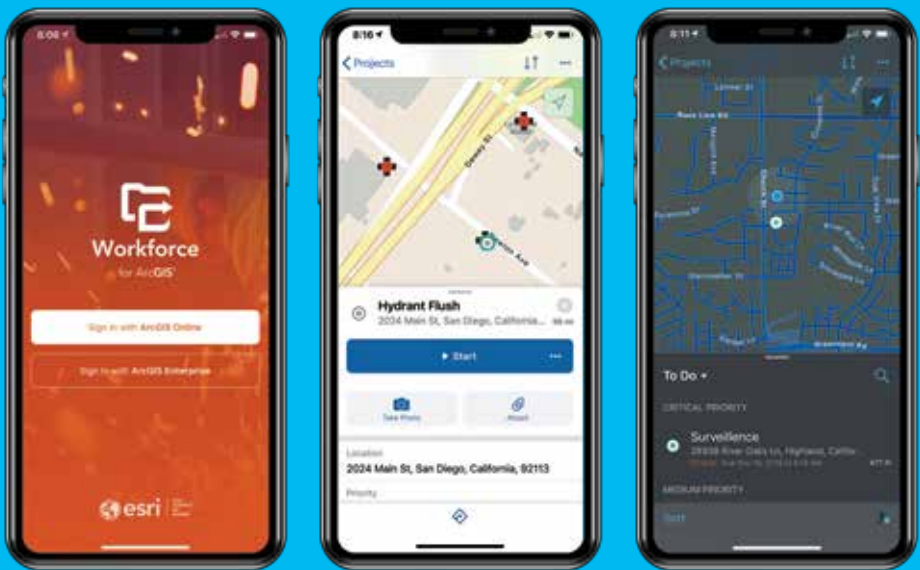
↑ With Workforce, managers can easily monitor fieldwork, even when field crew members are offline.

Q What types of organizations need these offline capabilities?

A I think the significance of the new offline support in Workforce is less based on what type of organization needs it and more about ensuring that fieldworkers are able to complete their assigned work regardless of connectivity.

For example, utilities are required to periodically inspect miles of infrastructure that can be found in both remote locations with no internet connectivity and urban locations with great internet connectivity. Field staff using Workforce to manage daily tasks can now proceed from one assignment to the next and no longer worry about internet connectivity. Completed assignments are stored on users' devices with the date and time accurately accounting for when each assignment started and finished. When connected, Workforce periodically syncs changes so that completed assignments are available to supervisors, and any new assignments are downloaded to fieldworkers' devices.

Workforce is often used to plan and coordinate activities during special events, too, like a festival, marathon, or football game. Event staff and coordinators can manage their tasks using the Workforce app. Most events are held in city parks or stadiums with really good connectivity, but if a lot of people are using their phones, it's quite easy for cell networks to get saturated and become unreliable. By adding offline capabilities to Workforce, staff gain a level of confidence that even if the internet connection is very poor or they lose it altogether, they can still complete their assigned tasks because the app is reliable and continues to work.



↑ Fieldworkers use the Workforce for ArcGIS mobile app to manage their daily assignments.

Q What makes Workforce for ArcGIS unique?

A Workforce is integrated into the ArcGIS platform, and that's unique for field management solutions. Because of this, GIS analysts can put existing map layers in their Workforce projects. They can also display the Workforce assignments and locations of each worker in dashboards and other apps that help operations managers and supervisors monitor the progress and status of field activities. This allows organizations to get even more value from their ArcGIS implementations without having to translate between external work management systems and ArcGIS.

Workforce also integrates easily with the other ArcGIS field operations apps that are used for data collection, navigation, and map viewing. When a GIS analyst creates a Workforce project, it can be configured to launch Collector for ArcGIS, Explorer for ArcGIS, Navigator for ArcGIS, and Survey123 for ArcGIS directly from the fieldworker's assignment. The analyst can even share critical information about the assignment—like the work ID or description—with the fieldworker to streamline data entry with Collector or Survey123. Workforce also integrates with Esri's new location tracking app, Tracker for ArcGIS, which lets fieldworkers see, inside Workforce, where they've been, even if they're in a disconnected environment. Workforce can also open Tracker so fieldworkers can start or stop recording their tracks without having to switch between apps.

Another distinguishing capability of Workforce is that it integrates with non-Esri business systems. Some organizations use external work management systems that often don't have a mobile component that integrates with ArcGIS. Using the Workforce module that's included with ArcGIS API for Python, a GIS analyst can bring work that originates in these external systems into Workforce projects. Several Esri partners employ this API to integrate Workforce with their customers' existing work management systems.

To learn more about Workforce for ArcGIS, go to esri.com/workforce.

A Digital Transformation for Election Support

By Kurt Lebo, Kane County, Illinois

Each Election Day, Kane County, Illinois, sends staff members from its IT department to each polling station to ensure that all election equipment is up and running at full capacity by 6:00 a.m. The county covers approximately 524 square miles, so this is quite an operation.

IT staff members must be at the first polling station by 5:15 a.m. to inspect equipment such as Wi-Fi pucks, printers, and pollbook tablets. They troubleshoot, document, and resolve any issues and make notes about how effective the polling station's setup is. Once they deem a polling station ready for voting, they quickly move on to the next one to do the same thing. Throughout the day, these staff members are also on hand to fix any new issues that pop up until polling stations close at 7:00 p.m. Depending on the type of election—whether it's a big, national election or one with only local measures on the ballot—the county makes varying numbers of IT staff available to support polling stations, each of which is unique and unfamiliar to the crew.

This all used to be cumbersome to plan. The Kane County GIS team would present large paper maps to management, who used them to dole out assignments. Managers often went through several iterations when creating their staff members' routes, and they couldn't systematically share anything.

For the March 2019 local election, however, which required 37 support staff to provide assistance to 121 polling stations, the GIS group

collaborated with the IT development team to implement something different. Using web maps built in ArcGIS Online, managers were not only able to come up with better routes more easily and efficiently, but they were also able to introduce spatial analysis to the process.

Prior to Election Day, the managers did a proximity analysis in ArcGIS Online to plan and optimize everyone's routes according to where they'd be starting out—at home. With this as a baseline, the GIS team built an app using Web AppBuilder for ArcGIS that allowed staff managers to employ the Batch Attribute Editor widget to supplement route information with other factors, such as which polling places had certain problems in the past and who had expertise in what. For the first time, the final staff assignments were tailored toward staff members' location and expertise.

Assigning election support staff to certain polling places in this way was a big time-saver. But the county also needed to get over another big hurdle: dispatching staff to those locations. On previous Election Days, managers didn't have a good understanding of where their staff members were in an area twice the size of Chicago. They also did all dispatching over the phone.

This time, the IT development and GIS teams worked together to come up with an effective solution using Kane County's existing enterprise help desk software from GroupLink. The idea was to both feed information into and receive data

from three Esri field apps: Workforce for ArcGIS, Survey123 for ArcGIS, and Navigator for ArcGIS.

Throughout Election Day, IT staff members deal with two types of support issues: problems with pollbook tablets, which election staff use to check and maintain people's voter registration information, and malfunctioning printers. For the March 2019 election, county staff members (who are not in the IT department but get trained to help on Election Day) entered all requests for IT support into the county's help desk software. From there, everything was automated. Each request that was flagged as election support was passed to ArcGIS GeoEvent Server, which generated a new task in Workforce.

A Workforce task for opening a polling station contained all the data relevant to that polling station, such as its name and location, the name of the election judge assigned to that station, and all IT staff assignments. For Workforce tasks that popped up during the day, all applicable information, including a description of each issue, was passed to the app. With that on hand, staff managers were able to log in to the Workforce web app to assign each new issue to the appropriate staff member based on his or her location, workload, expertise, and availability.

The IT development and GIS teams also integrated Workforce with Survey123 and Navigator. This enabled field support staff to use Workforce to review their assignments, Navigator to get to each polling place, and Survey123 to answer required questions about whether or not each polling place was ready to open.

The final step in processing each issue was to mark it as resolved in Kane County's help desk software. Developers were able to easily access the REST services in Workforce and extract information, such as what time the issue was resolved and any relevant notes, to post to the county's help desk software in near real time.

The improvements these apps made to Kane County's election support system—from assigning staff and dispatching them to polling stations to getting back their data—were so pivotal that GIS is now, and for the foreseeable future, an integral part of Election Day IT support.

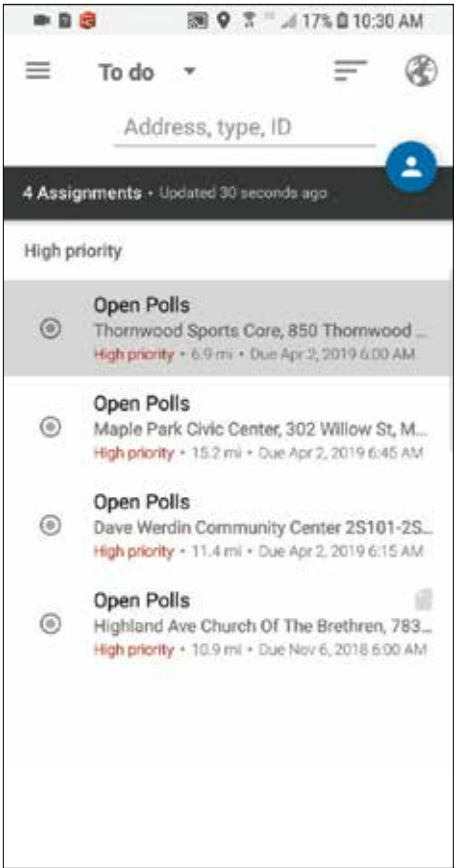
"Elections are not like many other projects. They have a very specific start time that is required by law, without exception," said Kane County deputy chief information officer and chief of staff Charles Lasky. "Before using these products, I spent the whole morning on my cell phone communicating with over 40 different support staff spread over 524 square miles, trying to address high-priority issues with my best guess about who might be closest to the issue without knowing how many items they still had on their plate. Now, we are able to manage the support staff and route staff to high-priority issues in less time, since we know where they are and how many support issues they are currently assigned."

Because Lasky is no longer relying on texts, emails, and phone calls to route staff, explain issues, or determine support staff locations, he is able to answer almost every call that comes in and provide more timely assistance to his staff in the field. He estimates that this implementation has saved him 35 hours of time in organizing Election Day IT support.

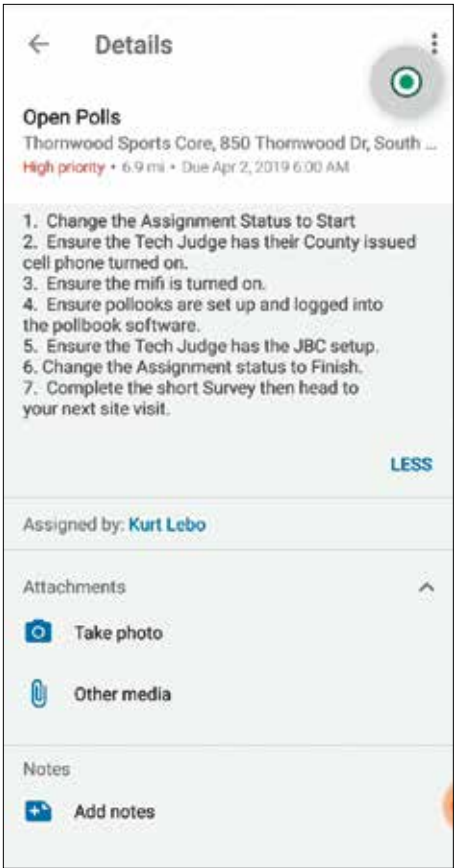
"I would never want to go back to supporting an election without the Esri suite of products," Lasky concluded.

About the Author

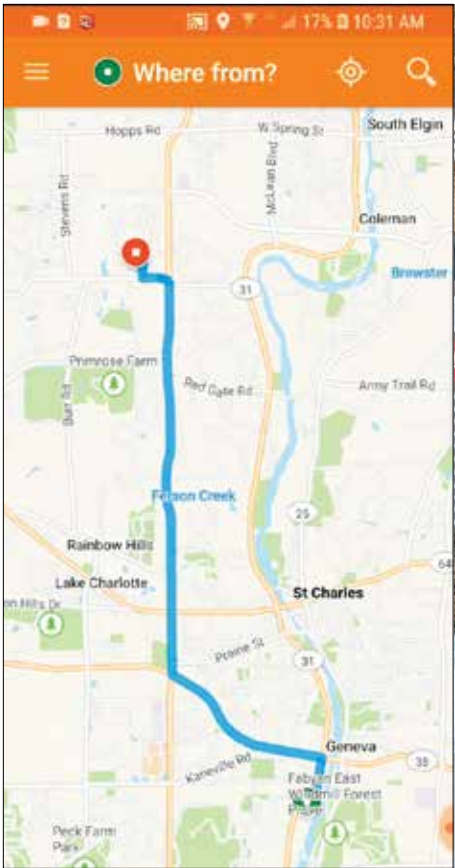
Kurt Lebo, GISP, is a spatial solutions officer for Kane County, Illinois. For more information, email Lebo at lebokurt@co.kane.il.us.



↑ Field staff used Survey123 for ArcGIS to answer questions about each polling place.



↑ A task for opening a polling station contained all the relevant information.



↑ Navigator for ArcGIS got field staff to each polling station.

→ IT support staff were able to review their assignments in Workforce for ArcGIS.

How GNSS Data Is Helping a National Park Clear Snow from Unmarked Alpine Roads

some more snow, adding extra labor and a bit more to fuel costs. Worst case scenario, however, exposes the crew and equipment to life-threatening hazards. Several years ago, one employee was fatally injured when his bulldozer went over the edge of the mountain and the blade hit an obscured boulder.

Most road-clearing mistakes in LAVO do end in inconveniences rather than casualties, but that doesn't make them easy to deal with. Getting back up on the road after veering off takes time and resources.

"When your blade tips over the mountain, it's like riding in a slow avalanche," said Welch. "You've got to have nerves sometimes to do this work!"

To increase accuracy and improve safety, LAVO looked into replacing its legacy Global Navigation Satellite System (GNSS) receivers and use new ones to collect more precise data points along Route 89. The idea was to build a new system to generate a highly accurate map of the road and provide the winter crew with safer and more reliable navigation.

Using Collector for ArcGIS, a rugged Samsung tablet, and Arrow Gold GNSS receivers from Esri partner Eos Positioning Systems, the road's edges were remapped in the spring. This new map was then used at the end of winter to provide precise guidance to bulldozers equipped with plowing blades.

To help the bulldozers navigate, LAVO needed the map data to be accurate to within one foot. This required positional data errors to be corrected immediately. Under normal circumstances, a GNSS base station, which has a fixed location, would provide real-time differential corrections to GNSS field devices via a cellular connection. However, there was no cell coverage in the area where LAVO needed to map and plow the road.

The park was going to have to innovate and do this by other means—using its existing park radio system to transmit not just voice communications but also data.

More Accurate GNSS

In the past, the LAVO plowing crew used older-generation GPS receivers to locate Route 89. The devices were only using a single GNSS constellation, the US GPS constellation.

Newer GNSS receivers can access more satellites in multiple constellations, which improves accuracy, reliability, and

performance. The additional constellations include three other global positioning systems: Russian GLONASS satellites, European Galileo satellites, and Chinese BeiDou satellites.

LAVO chose the Arrow Gold GNSS receiver because, in addition to being able to utilize all four global GNSS constellations, it was compact, easy to use, designed for mapping and navigation apps, and rugged enough to be installed in LAVO's snowplows. To save on cost, the park kept its existing GNSS base station installed at LAVO's Fire Dispatch building.

With this configuration, the park would be able to provide the snowplows with centimeter-level differential corrections via the park's radio system.

A New Way to Share Data

Radios are critical infrastructure at national parks, where cell service is often spotty. They provide a reliable and affordable means of transmitting voice communication and, potentially, data.

Because the radio system at LAVO had been designed for voice transmission only, it had to be modified to also transmit data from the GNSS base station to the Eos receivers in the bulldozers.

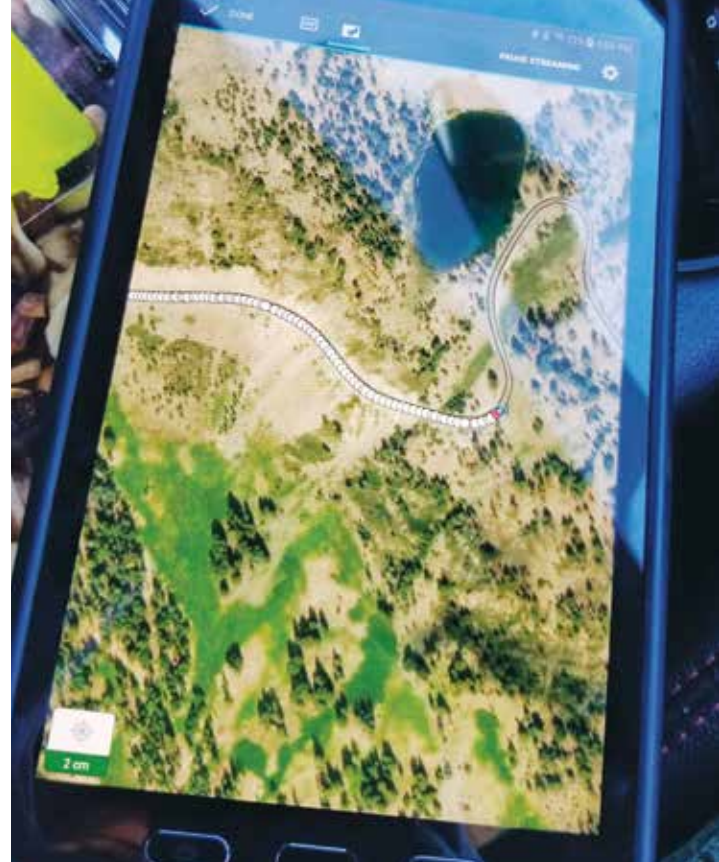
To accomplish this, the Department of the Interior (DOI) and National Park Service (NPS) staff approached Australian radio manufacturer GME, a government-approved contractor that designs P25-compliant data radios. DOI Radio Lab manager Patrick Foster worked with GME for about a year to design and ultimately provide a P25-compliant data radio, the GME CM60-V25D, that transmitted not just voice but also GNSS corrections in the RTCM 3.x open-source format. This was a huge breakthrough.

"Being able to offer differential corrections and pass nonproprietary data through these radios, on an existing park radio system, is really a big deal," Foster said. "It is a lot of data that has to go through a small pipe, unadulterated. This is the kind of work that pushes our government to stay ahead of the curve."

Precise Road Edges

LAVO deployed the new solution in September 2018—just in time to map Route 89 before the first snow.

To set up the system, the legacy GNSS base station, along with one of the new GME radios, was installed at LAVO's Fire

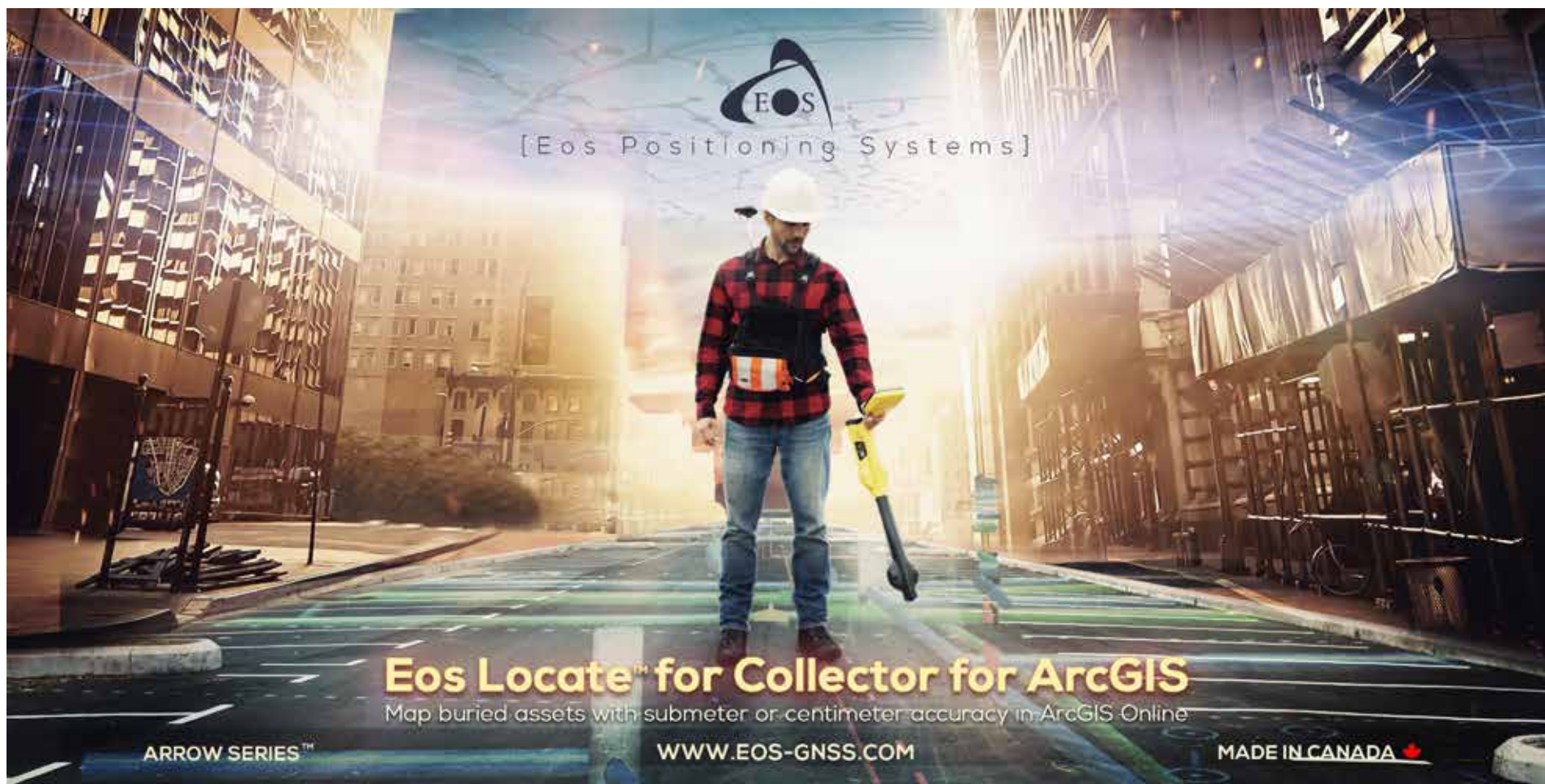


↑ In the spring, a team remapped the road's edges using Collector for ArcGIS.

Dispatch building. This location provided the best unobstructed view of the sky, regular access to power, and the optimal radio broadcast position.

Due to concerns about the amount of data being pushed through the radio system's small data pipe, the GNSS base station was initially configured to transmit corrections for just the GPS satellites at five-second intervals. However, after initial testing, it was determined that this would not provide the required subfoot precision in LAVO's work environment. So the base station was reconfigured to transmit corrections for both the GPS and GLONASS constellations, which would add more available satellites to the roving receivers. In addition, the output interval was set to two seconds to provide correctional information more frequently.

After a second round of testing, the radio system successfully passed the information at the two-second rate and provided corrections at the positional accuracy required to support the park's snowplow operations.





↑ Route 89 includes 13 miles of road above the tree line, which makes it difficult to find the road to plow.



↑ To clear the highway of snow, all the snowplow operator had to do was follow the line on the Collector app.

The next step was to create the map of the road's edges. A team from NPS and DOI installed an Arrow Gold receiver in a vehicle and mounted the antenna to an external range pole attached to the car. The car's side mirror was adjusted to show the bottom of the pole, which enabled the team to ensure that the antenna stayed directly above the highway's painted line while driving along the edge of the road.

To get the data points for the map, the team used Collector for ArcGIS on a rugged Samsung Galaxy Tab Active2 tablet. A three-person crew then drove the car at about 5–10 miles per hour and used the app to map the side of the road as a line feature.

In less than two and a half hours, all 13 miles of highway—or 26 miles of road edge—above the tree line were mapped. The precision along the majority of the route was four centimeters or better. This was much more accurate than in the past and proved to be critical the following spring during snowplow operations.

The True Test

In March 2019, Welch led his team to clear Route 89, which was the true test of the technology.

The operation required that all navigation using Collector on the tablet be done in a disconnected environment, so the road edge data was preloaded into the tablets, which were installed in the first two bulldozers. Paired again with the Arrow Gold GNSS receivers, this newly created navigation system provided the field crew with locations precise to a few centimeters.

The Arrow's external antenna was installed on the center of the bulldozer's roof. The suggested track line for the dozer—a dotted line on the Collector map—was created with an 11-foot offset from the mapped road edges, since the dozer blade is 22 feet wide. To stay on the road, all the operator had to do was drive along the dotted line.

In Collector, the operator could toggle between viewing an aerial base layer, which showed rocks, boulders, and drop-offs, or

a plain white polygon base layer. The white background provided the operator with a very simple map view of the road edges and the suggested dotted track lines that were easy to follow.

"We zoom in pretty close to the line when we're doing the bulldozing," Welch said.

Even though the 2019 winter season was particularly harsh, the results from plowing operations were outstanding. For the first time, there were no incidents of bulldozers going off the road and having to maneuver back up.

"When we were clearing the road...our visibility was zero," Welch said. "We were just staring at the GPS, not even knowing where we were. You had to have faith in the maps."

For the first time, the field crew truly did.

Other Potential Rollouts

Based on this success at Lassen Volcanic National Park, NPS is looking at similar rollouts for other park plowing operations done in dangerous conditions.

Glacier National Park in Montana is considering using the same system to replace an old copper wire system under its roads that has deteriorated and shifted over time. Rocky Mountain National Park in Colorado is looking into using this to take the place of a series of 30-foot-high wooden poles that line Trail Ridge Road, one of the highest paved roads in North America. The poles help crews find the road, but with a navigation system like this one, the park is anticipating being able to remove the poles and restore the natural scenic view of the park.

About the Author

Timothy Smith is the national GNSS position and navigation (PosNav) coordinator for NPS. He has been involved with GPS (GNSS) receivers in the federal government for more than 30 years and has managed the NPS GPS Program since 1994. During his tenure, Smith has taught GPS, worked with vendors to develop innovative uses for the technology, and participated in field projects that range from mapping shipwrecks in the Dry Tortugas to surveying water well heights in Death Valley.

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World Bank Deploys GIS Dashboard to Improve Railway Safety in Croatia

With 189 member countries and offices in more than 130 locations, the World Bank Group is a global partnership that aims to end extreme poverty and promote shared prosperity in economically underdeveloped countries. Composed of five unique institutions, the World Bank has worked with local governments on 12,000 projects that support development and relief and has distributed more than \$45 billion in financial assistance.

The World Bank recently partnered with a group in Croatia to gain insight into the country's rail network, an effort that would lead to improved safety and the more efficient transport of goods. As part of this effort, the two teams inventoried Croatia's railways to better identify sections that were at risk of deterioration and in need of maintenance or that could become commerce choke points. In the inventory, however, some of the data was shown in different systems of measurement, and a lot of the schematic diagrams were rudimentary, which made it difficult to view and manage the data.

To enhance and streamline the railway's existing data management system, the World Bank and the local teams in Croatia joined forces with Esri partner SymGEO. Based in Maryland, the company provides cost-effective GIS mapping solutions and digital community engagement platforms for government, commercial, and nonprofit clients. Over the course of two months, SymGEO worked with staff from the World Bank to develop a high-resolution, unified dataset and create a dashboard solution that improved data management and analysis.



A lot of Croatia's schematic diagrams of its rail systems were rudimentary, which made it difficult to view and manage data.

**Inconsistent, Cumbersome Data
Precipitates Automation**

Croatian rail data used to be stored in a series of spreadsheet files. Depending on what was being queried, the methods of linear referencing (a way of storing geographic locations using relative positions along a measured linear feature) differed. The data included railway information such as network age, speed limits, and transportation volumes.

The different referencing systems made it time-consuming to cross-reference data and get answers to specific questions, such as how many gross tons were transported on networks within a certain time frame. The incompatible linear referencing methods also led to other inconsistencies in the data, such as mismatched railway segments and misnamed stations. It was challenging for the World Bank’s analytical staff to understand which section of the railway particular files were referring to and how that section related to other files in the spreadsheet.

What’s more, this way of storing and managing data made it difficult to identify sections of the Croatian railway that needed upgrades or maintenance. One of the World Bank’s jobs in Croatia was to find railways that might be at risk of structural failure—for example, railways over a certain age that transport a specific amount of cargo per year. Its other job was to pinpoint potential trade bottlenecks due to speed limitations.

World Bank staff members wanted a solution that would allow them to get answers to their questions interactively rather than having to request individual analyses on a per-question

basis. To make this happen, SymGEO developed an automated solution that would streamline data management for Croatian railways, allow staff to answer their own queries on the fly, and enable them to create their own report graphics.

“They approached us with a classic GIS problem: they have attribute data in one format and geospatial data in another. Unfortunately, the two don’t talk,” said Kevin McMaster, principal at SymGEO. “Our job was to facilitate the communication between datasets, leading to greater insight and *[giving them]* the ability to tell a story with their data.”

**Easy-to-Configure App Improves Data
Querying, Summarizing**

To simplify data management and increase accessibility, SymGEO used best-available railway data from OpenStreetMap for the geospatial component of the new feature service and calibrated the network based on the multiple linear referencing systems. The SymGEO team then attached attribute values to the geospatial data on a per-section basis.

Once the data was cleaned, validated, and published, SymGEO used ArcGIS Dashboards to configure a unique dashboard for the World Bank that shows Croatia’s railways. According to McMaster, the World Bank invested in ArcGIS Dashboards because the configurable web app includes tools for data analysis, aggregation, processing, and preparation. For this project, it meant that stakeholders in Croatia’s railways could perform interactive querying in ArcGIS Dashboards and have access to all the attributes originally contained in spreadsheet files but in a more visual format.

“ArcGIS Dashboards was the most cost-effective solution given that it is an easily configurable application as opposed to building custom code from the ground up,” said McMaster. “It is also a very shareable resource.”

To create the Croatian railway dashboard, all the information in the spreadsheets had to be available for the app to query. This included data such as a railway’s segment name, age, speed, transport volume, and rail type. Once the data was set up, configuring ArcGIS Dashboards to read the feature service and summarize the statistics was relatively easy, according to McMaster.

“With ArcGIS Dashboards, you can now click on a particular segment and get the network age, what is the total speed, and what is the transportation volume,” he explained. “The client also has access to multiple years of data.”

After running queries on the railway data, ArcGIS Dashboards can also efficiently summarize it.

“The real power of the application is being able to summarize one attribute based on another, as this wasn’t possible with the multiple spreadsheet files referenced to different systems,” said McMaster. “The fact that now a spatially accurate, attributed railway system was produced as part of this project was an added bonus.”

**Better-Informed Decision-Makers
and Room for Advancement**

For the World Bank and the local teams in Croatia, implementing ArcGIS Dashboards has improved data accessibility and analysis and streamlined processes. Now, decision-makers can easily access information about

Croatia’s railways and gain better insight into them so they can come up with better-informed strategies.

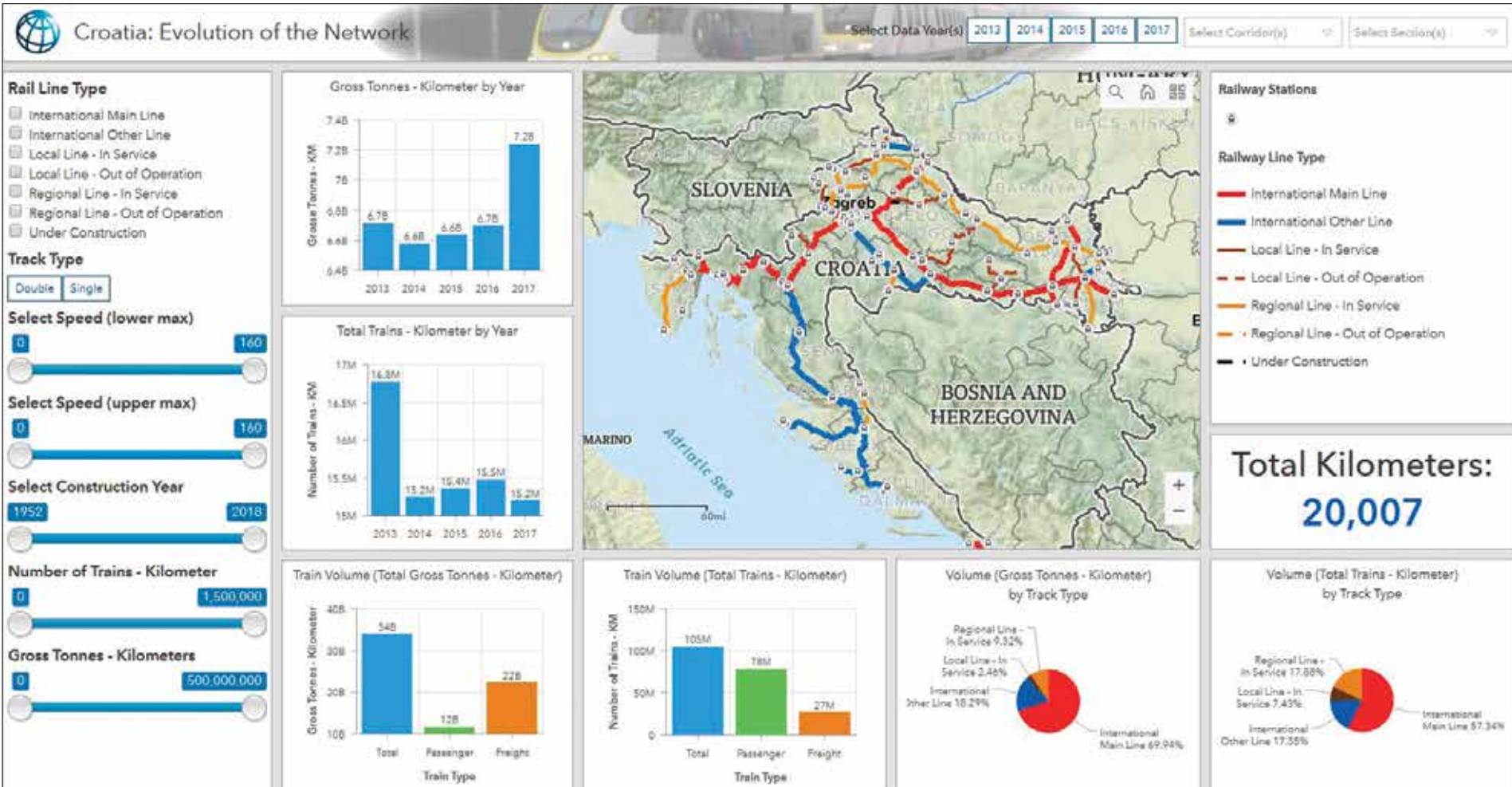
Additionally, the World Bank’s GIS team no longer has to field multiple requests for maps that focus on different aspects of rail infrastructure, and analytical staff can now use ArcGIS Dashboards to query the data interactively. The solution summarizes data on the fly and makes report-ready information available immediately.

ArcGIS Dashboards also gives users the ability to zoom in and out of a map, create report-ready graphics, and focus only on the railway segments of current interest. Overall, this has increased efficiency and enables the World Bank team to get the answers it needs quickly.

“This configurable application is a solution that allows deeper insight into the data than was possible using the individual source datasets,” said McMaster. “The railway feature service data can also be easily expanded to include future years of data.”

With ArcGIS Dashboards, the World Bank now has the robust solution it needs to get an overview of all Croatia’s railway infrastructure and take action based on the best-available data. In the future, McMaster would like to see data from each new year added to the solution so it can be used to answer new questions. He also thinks ArcGIS Dashboards would work really well for similar projects in other countries.

“Now that the data is set up, there is certainly a lot of room for advancement,” said McMaster. “I have found that virtually every project can be complemented by ArcGIS Dashboards.”



↑ With all Croatian railway data available on a dashboard, decision-makers can come up with better-informed strategies to improve safety and more efficiently transport goods.



Photo by BLM Alaska.



Photo by BLM Alaska.



Photo by BLM California.

Photo by Mike Howard, botanist for BLM New Mexico State Office.

A People-First Approach to Implementing Next Generation GIS

Bureau of Land Management Supports Employees
Driving Technology Change



Photo by BLM Alaska.



Photo by BLM.

Photo by BLM Oregon.



Photo by Bob Wick, BLM.

Most organizations recognize the value of digital transformation. Unfortunately, less than a third of those that attempt it succeed, according to consulting firm McKinsey & Company. But the problem is not the technology. The success of digital transformation depends on people. Even if the technology is flawless, if people don't use it, it fails.

Digital transformation initiatives must include strategies that engage people to adopt new technology. That's why, as the Bureau of Land Management (BLM) looks to implement the next generation of location technology, it is first learning what its employees need.

BLM, a bureau within the US Department of the Interior, manages 1 out of every 10 acres of land in the United States and approximately 30 percent of the nation's minerals. These federally managed lands and minerals are found in every state and encompass forests, mountains, rangelands, arctic tundra, and deserts.

Because every piece of BLM's data is connected to a location, it is a heavy user of GIS. Currently, BLM's nearly 6,000 GIS users mostly rely on desktop software to manage data and create maps.

Given the advantages of cloud-based and enterprise GIS—from connecting more data sources to enhancing data collection, accuracy, and analysis—BLM is looking to institute Web GIS. But the bureau wants to do it in a way that's beneficial for all its users, so it is working to get buy-in from them at the outset.

Let Business Needs Drive Change

In the past when BLM headquarters implemented new software, it frequently experienced problems because it didn't consider its workforce's behaviors in adapting to change. The bureau developed and launched several GIS apps without a full appreciation for the scope of work being managed in field offices. This resulted in adoption rates in some offices being very slow or nonexistent once the apps were deployed.

This time around, BLM is applying a change management approach to introducing new technology. The principle at the heart of BLM's GIS modernization initiative is to let business needs drive change.

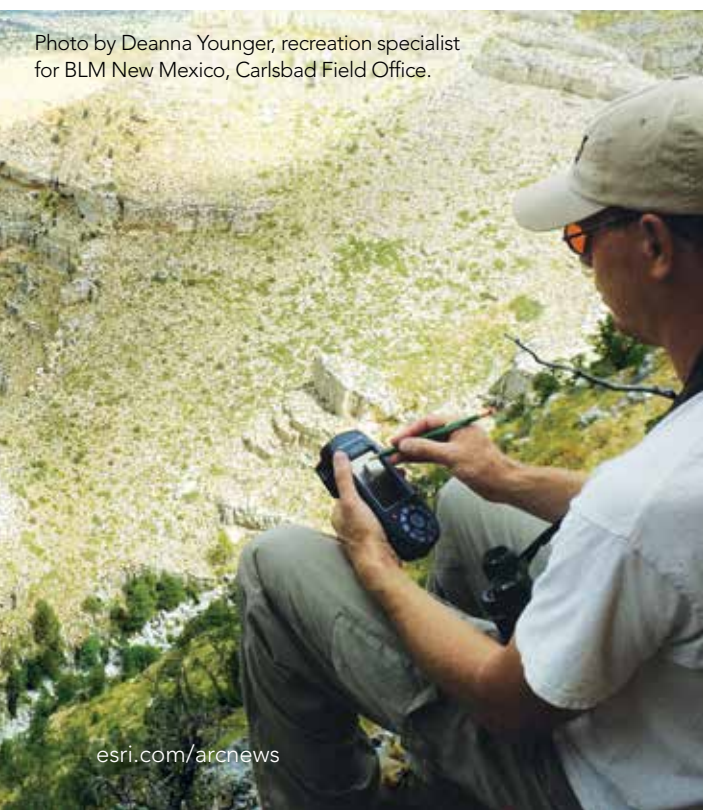
At its national office, 12 state offices, and hundreds of field offices, business needs are as diverse as the nation's geography. So BLM is implementing an engagement strategy to get people at all levels of the organization—from GIS users to land management professionals and resource specialists—to talk about their needs.

BLM headquarters asked state offices across the agency the following questions:

- Who are your users?
- What are their needs?
- What are their workflows?

← With 1 national office, 12 state offices, and hundreds of field offices, the Bureau of Land Management's (BLM) business needs are diverse.

Photo by Deanna Younger, recreation specialist for BLM New Mexico, Carlsbad Field Office.



"While each office has a unique way of doing business," according to BLM geospatial training administrator Peggy Deaton, "the overall needs were the same: a system that is reliable, adaptable, and well supported at all levels of the organization."

Establish Roles for Each Key Part of the Process

A best practice when it comes to change management is to understand and fill key roles.

First, and most critical, is the role of executives. They assign budgets, move the organization forward, and commit resources to support initiatives through completion.

Second is the role of champions, whom the organization enables and empowers to get the work done. These are the project managers and problem solvers.

The third role belongs to technical leaders who oversee system implementation. They select the frameworks that will be used and design the applications that will grow performance across the organization.

Fourth is the people-focused role, which is responsible for enterprise-wide adoption. This may be the most challenging position of them all because its purpose is to integrate the perspectives and needs of developers at one end of the spectrum and users at the other. The people who fill this role end up collaborating with executives, champions, and technical leaders.

For its change management initiative, BLM put together four teams: a data team, a technology team, a business process team, and a people team. The people team, led by Deaton, focuses on engagement, training, staffing, and capacity building. Its job is to prepare the workforce for the change that's coming.

"Change management means thinking about adoption throughout the entire process," Deaton said.

Engage Different Types of Users

The people team wanted to make staff aware of BLM's plan to adopt new technology, but communication within an organization the size of BLM can be difficult. With this in mind, the team set up a discussion site via a private GeoNet group in Esri's cloud service. Now, staff at all levels and from every office can ask questions and talk about the transformation plan.

To engage all BLM employees in the project, the people team also needed to know whom to communicate with, what messages to relay, and how best to build project awareness. Working with the Esri change management group, the team came up with a plan to identify GIS users within BLM and group them into personas. This list allowed the team to tailor communication to specific user types rather than send generalized messages to everyone.

To develop the personas, members of the people team reached out to different BLM field offices and sent surveys that asked who in the office uses GIS and how they employ it. Once they received responses, the team members read them, looked for similarities, and grouped particular user types together. The categories BLM ended up with included GIS consumers who simply view data, people in leadership roles who want reports, and GIS professionals.

Because the information used to define these personas came from field offices rather than BLM headquarters, it was extremely important to understand nuances in the different users—and that was also the point. For example, the user base that works in New Mexico's desert has concerns that are different from the user base that focuses on forests in Oregon.

Get Participation in Development

People who are not technology professionals, such as some BLM scientists, have been hesitant to update their processes. Some are concerned that new technology will make their jobs harder. From experience, BLM knows that it needs to get buy-in from

these users or they will push back, and the implementation of this new Web GIS technology will not be successful.

To get user buy-in, Justin Grossman, the CEO of a design and development agency called meltmedia, suggests three best practices in a post on the Forbes Agency Council's website. First, leadership needs to collaborate with employees in every department to come up with ideas. Second, organizations need to evaluate gaps in their technology. And third, any solutions that get implemented need to be cross-functional.

To this end, BLM's people team invites users to participate in the project's discovery phase, wherein the technology team listens to what users need and then builds apps for field staff to test. Since technology gaps are very apparent to those who will be using the tools every day, staff provide direct feedback to developers, who use it to tweak their apps. This lets users know that their input is valued and shows them that their concerns are being addressed.

"We want to make sure our users know that we are not going to force them to use something that doesn't work for them," said Deaton. "They are participants in the process. We are aware that technology is not one size fits all. This project is very consumer based. We support solutions that work best in individual areas."



↑ The people team at BLM conducts training workshops for field offices, drawing on locally based examples and data to tailor the workshops.

Conduct Tailored Training Workshops

In addition to facilitating dialogue among leaders, developers, and users, the people team at BLM plans training workshops for field offices. Instructors draw on locally based examples and use data collected by individual field offices to tailor the workshops to specific audiences.

With these customized learning plans, participants receive hands-on GIS training using familiar data to map their environments. The result is that at the end of the workshop, people leave with the ability to use the new technology the very next day.

"Today's GIS technology has so many options," Deaton said. "Now, BLM users can make their own maps when and where they need them. They have access to data and the tools to use it. The workforce has greater capacity to do research, make decisions, and share information."

The Benefits of Change Management

Technology companies continually roll out innovative products that elevate work quality and capabilities. This means that, for successful organizations, digital transformation is a never-ending process.

BLM's change management approach will increase the capacity of its workforce to create their own maps and do in-depth analysis. The GIS team, once dedicated to making maps, now has more time to advance technologies that further BLM's mission.

What Is Location Intelligence?

Starting with Data and Points on a Map, a Young Entrepreneur Grows Her Business

Data is more than numbers on a spreadsheet. All data has context. To get a good understanding of what your data means, you need to take into consideration its relevance, relationships, and background.

Location intelligence is the knowledge you gain by examining the world around your data. It's about the insight you acquire by continually asking questions about your data's surroundings. Location intelligence often starts with points on a map, but it doesn't end there. True location intelligence comes from looking at simple but informative maps that summarize more complicated themes, spatial statistics, and analytics.

You can do so much with location intelligence. Just look at Max, a young entrepreneur who's on her own journey toward spatial enlightenment. For seven months, she's been operating a mobile lemonade stand in her town. Max has made some money, but she wants to make more. Let's step into her shoes as she begins to use data to better understand her business.



The What Stage

Research question
What do my sales look like?

Decision-making style
Random

Emotional state
Uncertain

Journey
Max wants to analyze her sales, but she doesn't really know that location can play a role in this. She exports a spreadsheet of her transaction data and creates two charts that show her sales broken down by month and type of lemonade (pink or regular).

Insight gained
She sees that her sales peak in May.

The Where Stage

Research questions
Where did I sell the most lemonade each month?

Where did I sell the most over all seven months?

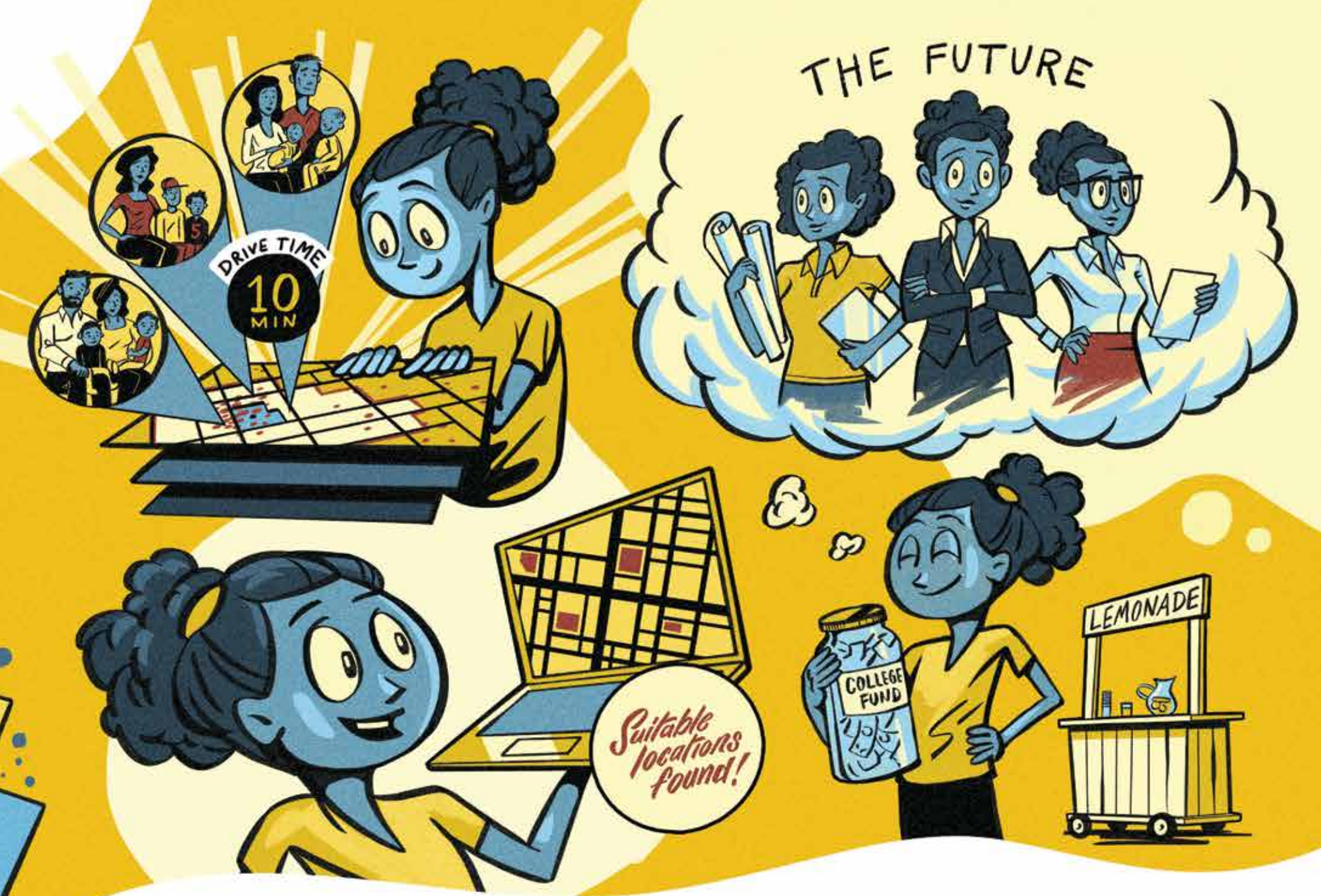
Decision-making style
Intuitive

Emotional state
Curious

Journey
From March through September, Max rode her mobile lemonade stand to parks throughout town. This is the first time she's visualizing her sales as points on a map.

Insight gained
Max notices a large cluster of sales in one corner of her map. She switches the basemap to imagery and sees that there's a housing development and a large park in that area.

Esri, the global market leader in location intelligence, has already helped more than 350,000 organizations solve some of the world's most difficult problems. See how your work already encompasses location intelligence and find out how you can enhance it at go.esri.com/LI-journey.



The Why Stage

Research question

Why are my sales higher here?

Decision-making style

Pattern based, guided by data

Emotional state

Amazed

Journey

Max zooms in to explore the cluster. She wonders why this park, out of all the ones she visits, outperforms the others. Max draws a 10-minute drive-time polygon around the park to get a better understanding of the neighborhood. She enriches that polygon with Esri Tapestry Segmentation data to find out more about the people in this neighborhood, including what they buy and how they spend their time.

Insight gained

The population around this park is made up of Soccer Moms, Urban Villages, and American Dreamers Tapestry segments, which comprise married couples who focus on their children. Max also discovers that the park has four baseball fields and two soccer fields. Through this exploratory analysis, she identifies the characteristics of the neighborhoods and parks she should focus on.

The How Stage

Research question

How can I sell more lemonade?

Decision-making style

Strategic

Emotional state

Empowered

Journey

Max can now identify other locations with similar characteristics and make sales predictions using variables such as day and time. To pinpoint new places to target, she does a similarity search for comparable parks and then runs a weighted suitability analysis on each resultant park that accounts for its size, the number of sports fields it has, and which Tapestry segments make up its surrounding population. To determine the best days of the week and times to sell lemonade, she creates a predictive model.

Insight gained

Max's analytical model reveals that if she sticks to parks with sports fields in neighborhoods made up largely of families with children, she'll sell more lemonade on Tuesdays and Thursdays from 5:00 p.m. to 7:00 p.m. and Saturdays and Sundays from 9:00 a.m. to 3:00 p.m. during baseball and soccer seasons, which run from March through May.

The Endless Possibilities Stage

Research question

What else can I do with location data?

Decision-making style

Data driven

Emotional state

Confident

Journey

Max turns her mobile lemonade stand into a data-driven business. She analyzes all data variables, including location, to the fullest extent. In growing her venture, Max earns enough money to pay for her college tuition.

Insight gained

Fast-forward 10 years, and Max could be

- A security adviser who uses location intelligence to investigate cyber attacks via server logs.
- A local government leader using location intelligence to do site selection for economic development initiatives.
- A real estate developer who uses location intelligence to create new retail concepts and shopping experiences.

TRAILBLAZERS

Cycling Organization Accurately Maps Mountain Bike Trails in Québec, Canada

Cycling is a popular sport and pastime in the Canadian province of Québec, and for good reason.

As Canada's largest province by area, Québec offers a massive trail network with world-class biking trails. Bike-friendly routes go past scenic lakes, rivers, and farms; through forests and quaint towns; up and down hills and mountains; and into the heart of vibrant communities such as Montreal and Québec City. The province's most famous bike network is Route Verte, or Green Route, which comprises more than 5,300 kilometers (about 3,300 miles) of trails.

For cyclists to take full advantage of Québec's trails, they must be mapped and maintained. As a nonprofit organization that promotes bicycling for recreation, health, tourism, and environmental reasons, Vélo Québec took charge of mapping trail networks—including Route Verte—for the province. The mapping initiative, supported in part by Esri technology, aims to

help develop mountain biking trails specifically and promote their use.

"This project is very dear to me," said Francis Tétrault, mountain biking project manager for Vélo Québec and an avid mountain biker for 20 years. "We currently have over 500 kilometers mapped this season in the first installment of our project."

Tétrault has made it his mission to help perpetuate trail networks, as he has seen too many disappear due to poor planning and maintenance and loss of landowner permissions. Ideally, Tétrault and the team at Vélo Québec will map every kilometer of mountain bike trail in the province and add each official new trail to the organization's database.

MORE DETAILED TRAIL DATA

Recently, Tétrault and his team collected accurate data on mountain bike trails by using ArcGIS QuickCapture along with high-accuracy

Global Navigation Satellite System (GNSS) receivers from Esri partner Eos Positioning Systems. The data included points and polylines that show the trail locations from start to finish; the length, directionality, difficulty level, and surface type of each trail; signage; and any obstacles cyclists might face.

ArcGIS QuickCapture, a mobile app designed for rapid field data collection, lets users record data by tapping a large button. The app then transmits the information back to a database in real time.

To improve on the spatial accuracy of this data, Vélo Québec paired QuickCapture with Arrow 100 receivers from Eos. This gave the team submeter location accuracy when collecting data in the field.

Part of Vélo Québec's biking advocacy work includes offering trainings to cyclists and hosting cycling events and trips. To support these efforts—which involve administering risk management, maintaining trails, and amending right-of-way agreements with landowners—the organization needs precise data. The data it collects in the field will also support other goals in the future, such as updating trail maps. (See the organization's interactive online trail map, hosted in ArcGIS Online, at ow.ly/6ZsM50y1o5o. While mountain bike trail data collected for Tétrault's project isn't on the bilingual interactive map, people can view the network of paved trails along Route Verte and use tools to look up routes, create itineraries, and find places to stay such as campgrounds and hotels.)

In many instances, trails in Québec are built on private land. Cycling clubs, which develop the trails, must acquire permission from landowners to build trails on their land. Accurate trail mapping is helpful for obtaining this permission. The maps can show, for example, what portions of a proposed trail might be on a homeowner's land.

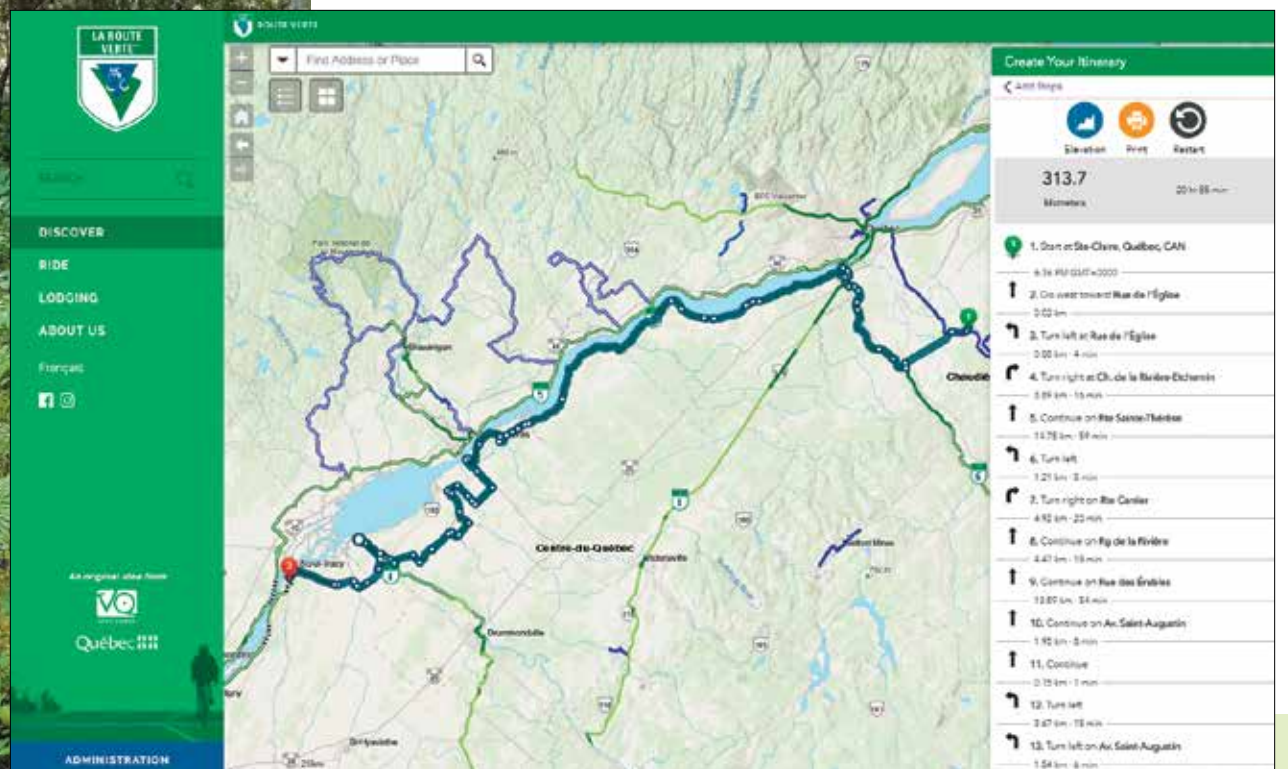
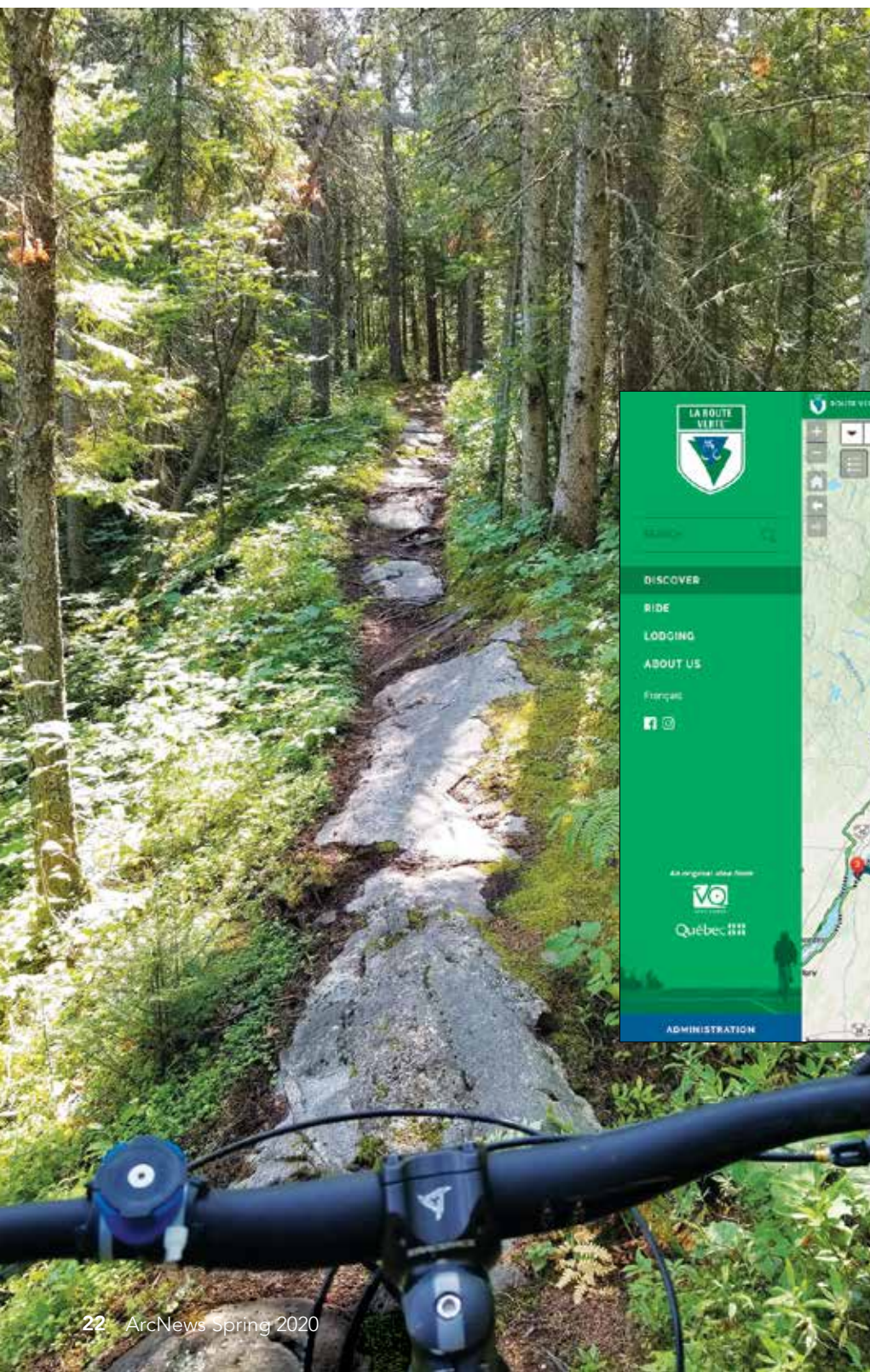
THE RIGHT EQUIPMENT

A network of Vélo Québec staff or volunteers—some of whom are not versed in GIS—create and maintain up-to-date trail data. Because the data-capture process happens out in the field, the technology used must be easy to understand and operate, and any associated training needs to be minimal.

Working remotely in areas without cell coverage and using technology under varying light and temperature conditions can add another layer of challenges. What's more, staff and volunteers capture data while they're riding a bicycle, so having lightweight, compact, durable equipment is critical.

And, of course, this data collection must produce accurate data. Before this initiative, land managers had data that was largely gathered by smartphones (precise to about 14–16 meters) or handheld GPS systems (precise to around 4 meters). The low level of precision impacted data and analysis, so the Vélo Québec team needed a tool to improve accuracy.

"Because of that low level of precision, you could see lines crossing and being



↑ The Route Verte map, available via ArcGIS Online, gives people the ability to plan a cycling trip using the Route Verte network and regional bike path systems.

← Vélo Québec has already mapped all sorts of bike trails, including this advanced, single-track trail near Chicoutimi, Québec.

superimposed *[when collecting trail data]*, especially where tight hairpin turns were concerned, which is a regular occurrence in modern bike trails,” Tétrault explained. “There *[are]* a lot of variables that make the *[tracks]* less precise.”

A BIG-BUTTON EXPERIENCE

Vélo Québec wanted an easy-to-use, highly accurate, and compact field data collection solution, which is why the team selected ArcGIS QuickCapture for this project.

The mobile app’s simple, big-button user experience requires little training and runs on consumer iOS and Android devices, so anyone with either platform can load it on their phone. QuickCapture records and transmits data from the field, while the Arrow 100 receivers improve the spatial accuracy of the captured data.

Due to severe snow conditions in Québec, it wasn’t possible for the team to do its first field tests on bicycles. Instead, Tétrault put the mobile solution and receivers to the test while he went ice-skating on a lake near the Vélo Québec office. Tétrault said the results were remarkable: QuickCapture was easy to use, the receivers were easy to carry, and the data was very accurate. The receivers and QuickCapture app on mobile devices, used simultaneously, were able to precisely map and attribute the tracks on ice.

The next step was to prepare each of the complementary devices for use on mountain bikes in the spring. The team attached a smartphone with the mobile app to a bicycle’s handlebar and mounted the GPS receiver’s antenna on a rider’s helmet. The receiver itself was in a hydration pack worn by the technician. It was configured to stream locations to the app at 2 Hz (two positions sent per second) to improve the granularity of the tracks captured. The receiver was also configured so it could document different kinds of field observations: photos of

the trail, obstacles, bridges, and intersections; the difficulty and category of trails mapped; and polygons captured for trailhead parking lots and buildings.

“The development of this methodology is breaking news for our field and has been very well received,” Tétrault said. “We now have a quality solution for gathering data that wasn’t possible before.”

SIMPLER DATA COLLECTION

QuickCapture has allowed Vélo Québec to simplify how it collects data and improve data processing. The whole operation is now digitized and more streamlined.

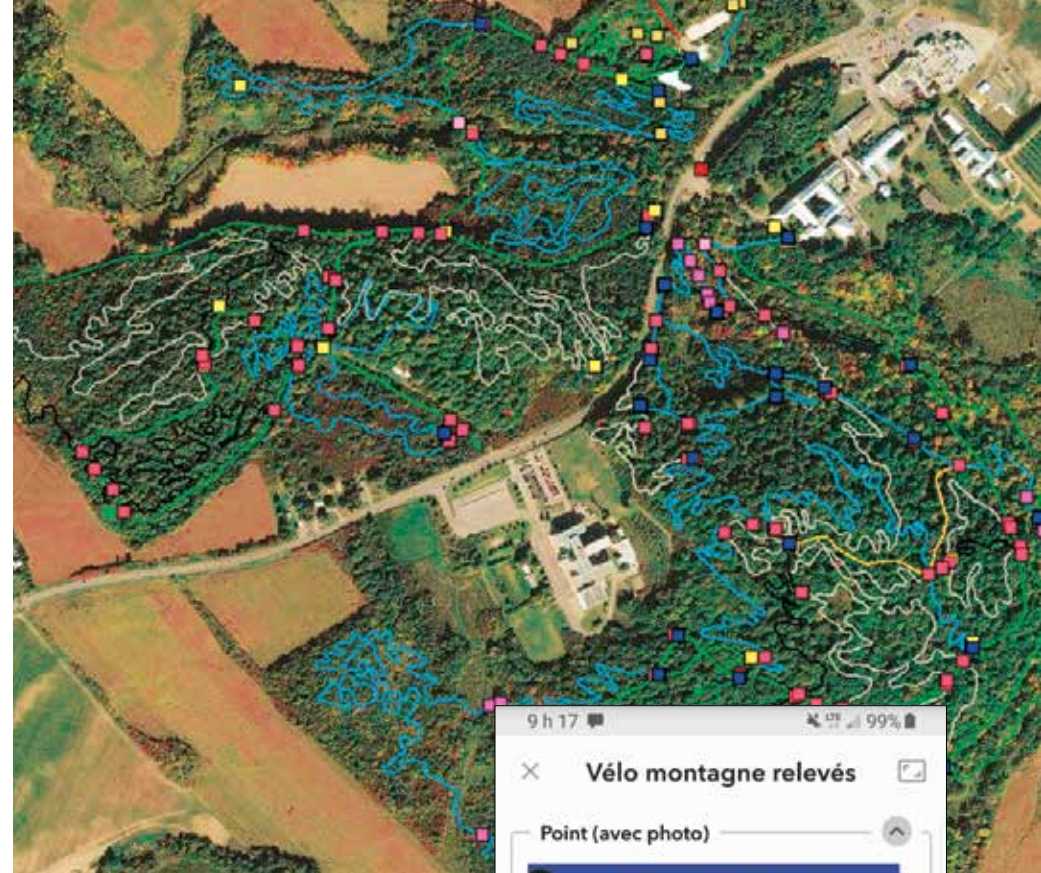
The old method of collecting data on the trails involved using a handheld GPS device to generate waypoints or polylines. Then, data was transcribed in a notebook and later entered into a spreadsheet to populate the attributes related to each point, such as the width or difficulty level of the trail. This old method was cumbersome and opened the door to data entry mistakes that would be hard to track afterward.

Now, the app provides individual buttons for all the types of features recorded on the trails.

“We pick the right trail attributes *[and]* punch the appropriate button in the app, and the track gets recorded as we follow the trail. And it’s the same thing for observations along the trail,” Tétrault said. “It’s incredibly simple. I see this procedure as less of a chore for volunteers than the traditional method of GPS and paper, and the training is much more intuitive.”

The mobile app is also speeding up the capture of data in the field.

“In the short time we’ve been running the app on the ground, we have covered more kilometers in less time than *[we would have]* with our old method,” Tétrault said. “In one 20-week season, we should be able to cover around



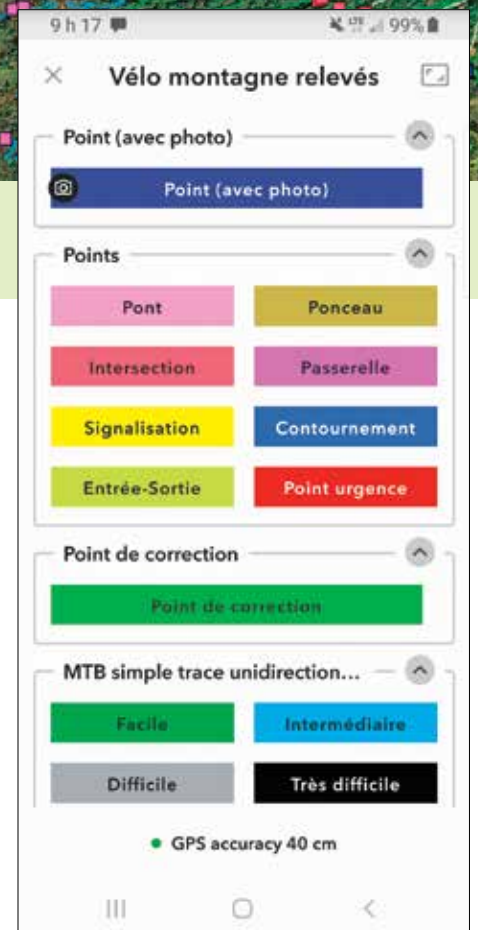
↑ This mapped mountain bike trail network is located in Oka, Québec.

600 kilometers, with an average of 20 kilometers per day. That’s 375 miles for one person, which is a substantial amount.”

Data is now accessible in real time as well, enabling prompt quality assurance and constant monitoring of progress. Technicians in the field can see if a trail has been entered correctly or call in to have office staff check it immediately.

There’s also been considerable improvement in data quality. Tétrault describes the mobile data collection app as a user-friendly solution that is helping Vélo Québec better map and manage trails so that people will have them for generations to come.

“For us, this tool guarantees a uniform quality of the data in the project, which was a big challenge before,” said Tétrault. “I had an idea of the possibilities of GIS before, but this project has opened up a can of ‘wow’ in terms of putting technology in service for a cause.”



↑ The ArcGIS QuickCapture survey includes buttons for bridges, intersections, and signals and information such as trail difficulty.

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In Cities Across America, Esri Partners Improve Efficiency

Cities have a lot of responsibility, from managing public services to engaging with citizens. When they need help with GIS—either improving on existing technology or implementing whole new systems—many of them opt to work with Esri partners. Find out how two cities and one local utility got assistance from Esri partners to upgrade their geospatial technology and streamline their processes.

A SMART WAY TO MANAGE PARKS

Broken Arrow, Oklahoma, has more than 800 acres of land designated for public use, including 38 parks. Families can access a variety of recreational opportunities in green spaces, and the city is working on building a large-scale, 165-acre park to use for events and festivals.

With a growing population and an influx of activities, the City of Broken Arrow needed a comprehensive management solution for its parks and recreation department. City staff members wanted to ensure that they were adequately tracking, analyzing, and using data about parks, their recreational users, and community involvement. They also wanted to more efficiently perform management functions related to parks planning, operations, policy making, social equity, and social economics.

Geographic Technologies Group, or GTG (geotg.com), has been the city's main GIS consulting services provider for more than 10 years, so the parks and recreation department was eager to implement GTG's GreenCityGIS (greencitygis.com), a bespoke GIS-based solution that introduces smart parks technology. GreenCityGIS helps users geoenable park assets, integrate park-use databases, monitor asset repairs and replacements in real time, and measure and analyze both asset

and user data. The solution is composed of three main steps: designing and creating a parks geodatabase, performing an on-site inventory, and developing custom apps.

After GTG built a geodatabase for the City of Broken Arrow, staff from both GTG and the city used Collector for ArcGIS to inventory all park assets, including benches, playground equipment, trees, and light fixtures. They recorded the location of each asset, plus custom attributes such as the manufacturer (if relevant), its current condition, maintenance dates, and photos. Now, with all that data in the geodatabase, staff can make quick, educated, and accurate decisions.

Once all 38 parks were inventoried, GTG developed and deployed four ArcGIS technology-based apps. The first two, built using Web AppBuilder for ArcGIS and ArcGIS Dashboards, are internal apps that allow parks department employees and other city stakeholders to view both historical and real-time data about city parks and their assets, recreational users, facilities, and more. These two apps help streamline decision-making and increase operational efficiency. The other two apps, a park locator and a story map, are public facing and allow users to quickly search for, query, and visualize Broken Arrow's city parks. The idea is to improve community engagement and strengthen people's awareness about parks.

GreenCityGIS and the four GIS-based apps that GTG built have revolutionized how the City of Broken Arrow manages its parks, both internally and externally. With their user-friendly and informative experiences, the solutions have improved communication among city staff members and with citizens—and this should pay dividends for years to come.



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↑ A customizable dashboard enables staff at the City of Broken Arrow to track parks and recreation assets in real time so they can make data-driven decisions.



- The park locator tool allows citizens to search for, query, and filter all city parks.

USING SATELLITE DATA FOR WATER MAIN INSPECTIONS

In Wisconsin, satellite data is helping Green Bay Water Utility (GBWU) do water infrastructure maintenance more quickly and efficiently. But switching from manual surveying methods to using satellite imagery would have been anything but easy if not for the help of **POWER Engineers, Inc.** (powereng.com).

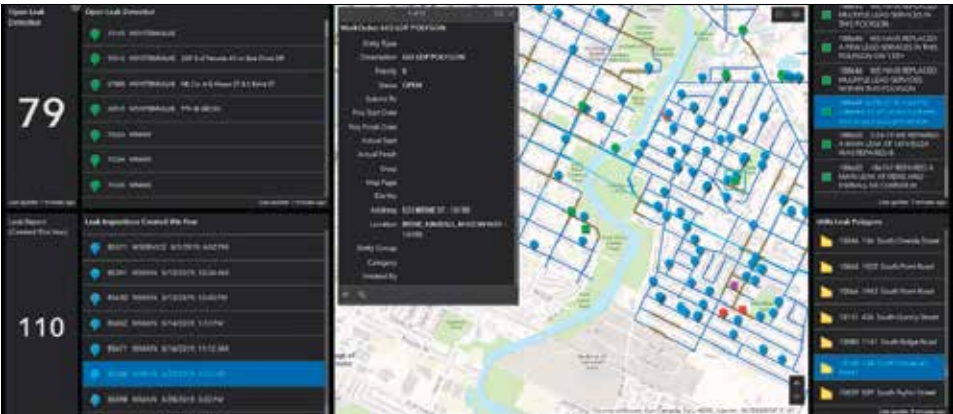
Previously when GBWU needed to survey its underground infrastructure, the 120-year-old utility hired a contractor to use special equipment to listen for leaks in every inch of its distribution system. Because the system was so large, with approximately 450 miles of distribution main, 36,000 service pipes, and 48 miles of supply mains, the contractor could only cover about 20 percent of the utility’s pipes per year. On average, about 1 percent of the area the contractor surveyed ended up having a leak that required further investigation and possible repair.

In March 2019, GBWU started using satellite data provided by **Utilis** (utiliscorp.com) that identifies leaks by detecting treated water in places where it shouldn’t be. This enabled the company to locate four times as many leaks than it could have with its previous ground-surveying method. But this was the first time the utility had received satellite imagery, so to get it to work with its GIS, POWER had to transform the data. In part, this meant projecting the satellite data to match Brown County’s coordinate system.

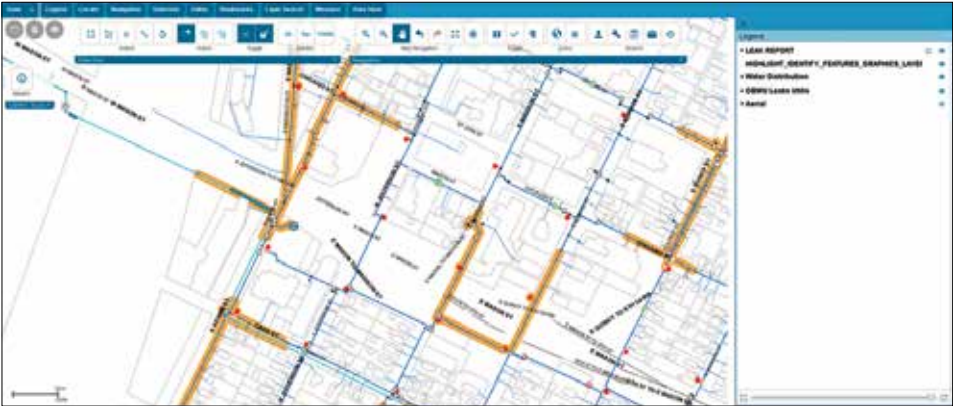
Working with GBWU, POWER also implemented ArcGIS Dashboards to give the utility new ways to monitor its leak data. Additionally, POWER established new procedures in GBWU’s existing asset management system from **Cityworks** (cityworks.com) so the utility could more efficiently identify leaks and make plans to fix them.

Last spring alone, satellite imagery helped GBWU identify 207 points of interest scattered throughout its entire system that showed excess treated water in places that should only contain groundwater, rain, snow, or surface water. These hot spots, as GBWU operations manager Brian Powell refers to them, cover 1,000 feet of water main, or about 11 percent of the system. In the past, it would have taken GBWU at least six months to monitor this much of the system.

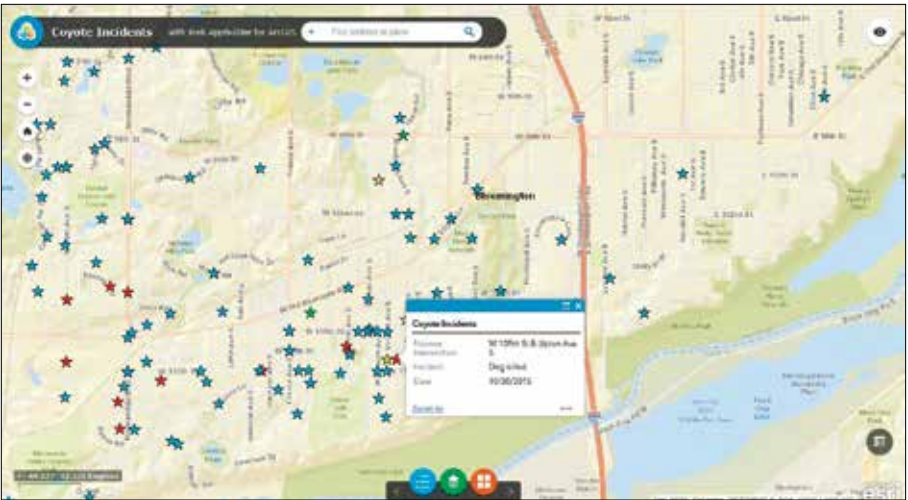
Not only has GBWU’s new maintenance approach detected more leaks, but it has also reduced how often field crews have to go out to do leak detection by 5 percent.



↑ Green Bay Water Utility’s (GBWU) Open Leak Detection and Leak Inspections dashboard displays the current status of leak mitigation.



↑ Satellite data helps GBWU detect potential leaks, shown in light orange. The utility then uses Cityworks AMS to create work orders for leak inspections by selecting the polygons directly on the map.



↑ One of the public-facing apps the City of Bloomington has deployed helps citizens keep track of coyote incidents in the area.



↑ The City of Bloomington’s planning department uses an interactive GIS app to maintain zoning and census-related features and to make maps for both internal and external use.

FULLY EMBRACING ENTERPRISE GIS

The City of Bloomington, Minnesota, home to the Mall of America, has been using GIS for more than 20 years, but the platform it was on didn’t offer the support the city needed to share data and enhance collaboration. In 2016, the city teamed up with **Pro-West & Associates, Inc.** (prowestgis.com), to make a full—and extensive—transition to the ArcGIS platform. The firm offered the spectrum of GIS capabilities the city needed to move from its legacy system to industry-standard Esri technology. Key to the transition was implementing enterprise GIS along with a set of mobile GIS solutions.

The changeover happened in phases. First, the City of Bloomington signed an enterprise agreement (EA) with Esri, which gave the local government uncapped access to certain ArcGIS software and expert assistance as it scaled up its GIS. Then Pro-West designed the system architecture, developed data conversion standards, created a geodatabase, configured ArcGIS Enterprise, implemented ArcGIS Online, ensured data and network security, deployed Portal for ArcGIS, integrated various property and asset management systems, and trained employees on how to use the new tools. With the City of Bloomington’s enterprise GIS implementation fully deployed, Pro-West continues to make recommendations on keeping it up-to-date.

Now, the city has all its data in one central, secure location. Together with Pro-West, it has built more than 20 task-driven solutions for use by city staff and the public. Its ArcGIS organization has more than 250 named users; and staff members from a range of departments, including field crews, are well trained in how to use the GIS apps and tools at their disposal.

The City of Bloomington can now fully embrace the benefits of a modern enterprise GIS. It is well positioned to incorporate new tools and capabilities as emerging GIS technology becomes available, and it can easily scale up to support more data, new users, and any major developments in the Bloomington community.

“Pro-West understood our vision, and it proved this by identifying and delivering the solutions that would allow us to achieve that vision,” said Bob O’Neill, the City of Bloomington’s GIS analyst. “Those solutions have exceeded our expectations and taken us further than we thought we could go. The team is a true partner to the city.”

Esri partners represent a rich ecosystem of organizations around the world that work together to amplify The Science of Where. Their products and services range from configured apps, add-ons, widgets, and custom-built solutions to complete ArcGIS system implementations, content, and hardware. Discover partners, solutions, and services that meet your needs at esri.com/partners.

Startup's Machine Learning Capabilities Improve Road Quality in Houston

Famous for historical landmarks and museums, Houston, Texas, draws more than seven million visitors per year. Leading-edge medical and research facilities, the National Aeronautics and Space Administration's (NASA) Johnson Space Center, and flourishing port and railroad industries have also attracted over two million residents, making Houston the most populous city in Texas.

With a bustling economy and robust tourism, quality roadways are a must. To collect data on current road conditions and maintenance requirements for its 15,000 miles of heavily used roads, the City of Houston was already using street surface assessment vehicles (SSAVs). The SSAVs performed mobile inspections and gathered pavement imagery, which helped Houston prioritize planned road improvement projects to make the best use of available funds.

Although the SSAVs were effective, after several years of use, there was room for improvement. City officials needed more specific data regarding the actual surface area of roads so they could improve road quality ratings and provide accurate information to contractors. They also needed a more effective way to analyze the data generated by the SSAVs. Esri startup partner **Argis Solutions, Inc.** (argis.com), had the answer.

Focusing Improvement Efforts Where It Really Counts

Argis, a Colorado-based company founded in 2016, specializes in technology that combines ArcGIS geospatial data with augmented reality (AR) and machine learning. Members of the Argis development team had helped build and maintain the original SSAVs as part of Idea Integration (the company originally tasked with the SSAV project), and they understood exactly what the City of Houston needed to do next.

"They were looking to fix the roads that impact the largest number of people in order to achieve the best overall improvement in ride quality across the city of Houston," said Argis founder Brady Hustad. "They also wanted to improve the overall efficiency of the funds spent on road improvements."

The startup was subcontracted alongside the International Cybernetics Corporation (providers of the SSAV hardware) by Indigo Beam Consulting, the company managing the project on behalf of the City of Houston. Their task was to convert one SSAV into a ride quality measurement vehicle (RQMV) and make it into a more focused vehicle to enhance road monitoring and maintenance.

Now, once the regular SSAVs have conducted road inspections and collected pavement imagery, the new RQMV gets sent out to evaluate project sites and potential issues both before and after repairs and maintenance work are done. The combined SSAV survey data and RQMV assessments produce an abundance of ArcGIS data, so in addition to needing training on how to use the new van, the city also needed a way to compile and interpret all that data.

A New Approach to Using Data

As the SSAVs and RQMV collect information, the city receives it as a mix of video, images, text-based data, and GPS coordinates. To ingest these inputs and turn them into feature layers in ArcGIS Enterprise, the Argis team designed and created a migration tool, the SSAV web viewer. Each layer focuses on a different aspect of road quality, such as ride quality, pavement assessment, and road width and length. These layers are organized and moved into the city's data servers so city staff can use this information to make road maintenance plans.

"We used Esri tools to provide the advanced analysis and the spatial optimization tools to help the city make better decisions," said Hustad. The SSAV web viewer that Argis built can analyze the condition of individual streets and also rate the overall condition of whole neighborhoods. This way, instead of focusing solely on repairing the worst individual roads, the city can ensure that entire areas receive maintenance at the same time. In turn, this fosters efficiency and generates greater resident satisfaction.

Increased Accuracy and Reduced Labor Costs

The migration tool produced by Argis reduces the number of staff hours needed to analyze the vast amounts of data collected by the SSAVs and the RQMV, saving the City of Houston on labor costs and reducing the potential for human error. Additionally, by applying machine learning, the system will continue to improve as it captures and processes more data. As the RQMV gathers new information, Houston's system enhances the accuracy of its digital model of the roads. This will lead to better road assessments, improved city planning, more accurate repair cost analysis, and a greater return on investment.

Argis's cutting-edge data analysis solution enabled the City of Houston to streamline its processes for evaluating road conditions. With the new RQMV functionality, the city has access to current, intelligent data on ride quality and street maintenance needs. Having the data layers created by the SSAV web viewer solution easily accessible within the city's own GIS helps city leaders make the best decisions on how to spend budgeted funds and support the implementation of further analysis, resulting in better roads for everyone.

"The City of Houston deserves a lot of credit for its willingness to try something different in order to do a better job," said Hustad.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Learn more at developers.arcgis.com/startups.



↑ From left to right, Marc Morin and Chase Fleeman of the International Cybernetics Corporation, which provides the SSAV hardware, and Brady Hustad of Argis Solutions, Inc.



ArcGIS Data Reviewer Helps Bay Area Utility Improve Quality Assurance and Data Integrity

Across the United States, state and local agencies work hard to maintain safe water supplies by treating water to remove contaminants and distributing it via millions of miles of pipelines. The East Bay Municipal Utility District (EBMUD), based in Oakland, California, provides local residents with reliable, high-quality water and wastewater services. The utility's water system serves 1.4 million customers east of San Francisco Bay, and its award-winning wastewater treatment serves 685,000 customers while protecting the bay.

EBMUD's infrastructure includes 4,300 miles of pipeline with fixtures, such as valves, fittings, and pipe junctions, that are mapped and modeled in GIS. The utility's mapping group creates and maintains the water network data in an enterprise geodatabase that relies on a geometric network. Many stakeholders within the district use the GIS data. The water distribution planning group, for example, is building an enterprise hydraulic model that can estimate the pressure and flow at any point in the water distribution system, conduct hydraulic studies to size facilities, recommend facility outages, and identify distribution system improvements and critical locations. The operations and maintenance group also uses GIS data for dispatching to leak investigations, capturing valve exercise data, and creating outage plans for emergency repairs.

For these hydraulic modeling and operational exercises to be successful, EBMUD's water distribution system data must be good. But this is challenging not only because the utility's coverage area is so vast but also because lots of its data had to be converted to GIS from legacy systems. To address this, EBMUD implemented a new set of tools, including ArcGIS Data Reviewer, that make the data review process more efficient and help ensure that the data is of the highest quality.

When Data Quality Is Less Than Ideal

To enable other groups within EBMUD to do hydraulic and pipeline modeling and carry out operational and maintenance exercises, editors in the mapping group export feature classes into a file geodatabase. They then correct any errors found in the local copy of the file geodatabase. In the past, these fixes weren't copied back into the default version of the geodatabase. As a result, editors ended up having to fix the same errors every time they downloaded the latest dataset locally.

Although the geometric network provides basic quality control methods, the quality of EBMUD's GIS data was less than ideal. The geometric network doesn't notify users when a rule is violated, making it difficult to pinpoint errors. Because editors had to manually sort through data to find errors, the quality assurance and quality control (QA/QC) process was time-consuming. And sometimes, users had to make manual corrections to the data to get accurate results for their models and exercises.

"From [doing] exercises on patching leaks to identifying the pipes most likely to fail in the future, GIS data is used for a lot of critical

operations," said Rachel Wong, GISP, GIS software engineer II for EBMUD. "If the GIS data quality is not good enough for a particular job, it can impact their analysis and work."

To remedy these issues, EBMUD began looking for a more comprehensive way to improve quality assurance in its GIS so the mapping group could proactively identify errors, clean up the database, and provide higher-quality data to the rest of the organization.

A Solution That Does Out-of-the-Box Data Checks

When some members of the EBMUD mapping group attended the Esri User Conference a few years ago, they met with a technical consultant from Esri Services to get a Data Health Check. Using ArcGIS Data Reviewer, an extension for ArcGIS Desktop and ArcGIS Enterprise, the consultant ran automated checks against a copy of EBMUD's water network data. This gave them an overall assessment of the quality of EBMUD's data, and they decided to implement the solution.

According to Wong, the mapping group liked ArcGIS Data Reviewer because it provides extensive data validation checks that call attention to integrity, attribute, and relationship errors. If not for these out-of-the-box checks, Wong's team would have had to build complicated models using ArcGIS Desktop geoprocessing tools or by writing custom Python scripts.

ArcGIS Data Reviewer also allowed EBMUD to store and manage data errors in a centralized location—as a Reviewer Table within the utility's geodatabase. Editors use this feature to view data errors, navigate to their location, group errors together by category, and understand their severity to be able to prioritize the data cleanup work.

After EBMUD implemented the extension, the Esri technical consultant conducted an on-site workshop to train the engineering and mapping teams on how to use the solution. He also helped them configure the types of data checks they needed. EBMUD then expanded the configurations internally.

The team started with a list of high-priority data errors to check in the geodatabase. These included disconnected features, such as overshoots or undershoots at pipe intersections and orphan pipes; pipe ends without proper devices on them; overlapping pipes that have coincident geographic locations; and pipe geometry that cuts back in on itself. Wong validated the features in the geodatabase using the configured QC checks and stored the resultant errors for editors to use when correcting features. She also trained editors so they could use the new configurations to find errors on their own.

Identifying Errors More Efficiently

Using ArcGIS Data Reviewer has helped EBMUD improve the quality of its data, and that's had a positive impact on day-to-day operations that involve GIS. The new QC configurations make it easier to edit data efficiently. Editors in the mapping group can now validate their work daily while making map edits, ensuring a

complete QC check before the data gets sent to other groups within EBMUD. Additionally, editors no longer have to sort through the data manually to find and fix issues, since ArcGIS Data Reviewer manages the error life cycle and streamlines the correction process.

Being able to find errors in an automated way has enabled EBMUD's mapping group to focus its efforts on fixing them, according to Wong.

"With ArcGIS Data Reviewer added to our workflow, we now have comprehensive, thorough data quality control audits that validate GIS data and help us identify invalid data more efficiently," said Wong.

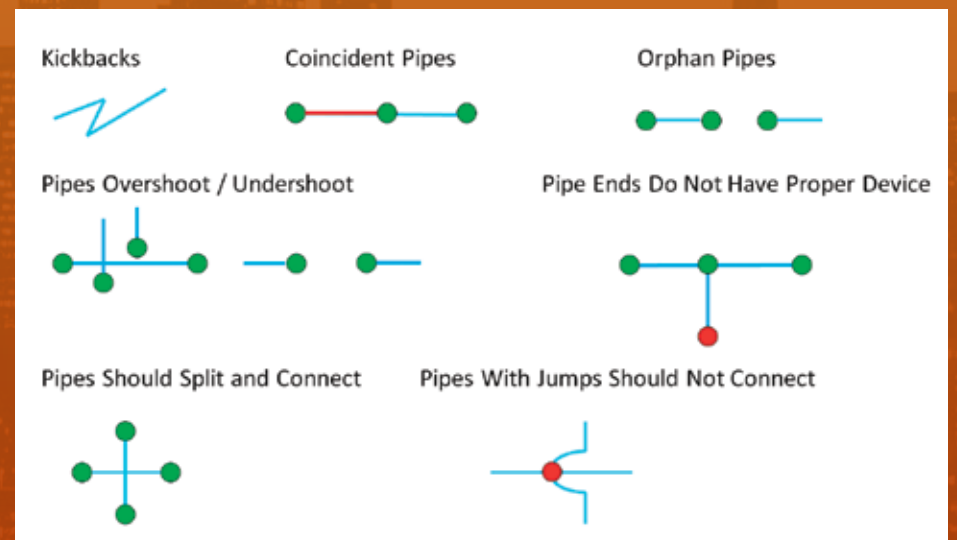
Within six months of implementing the extension, the team was able to correct 80 percent of data errors. That has helped speed up error cleanup as well. Upon rerunning the same checks recently, pipe undershoot/overshoot errors decreased from 2,400 to 400, pipes with errors at crossings plummeted from 490 to 6, and errors showing pipes that don't split properly at the tee dropped from 2,100 to 30.

"We did not have a comprehensive way to identify errors [before]. We could [have used] geoprocessing tools, but the tools could not cover everything," said Wong. "ArcGIS Data Reviewer has really helped us identify errors more efficiently. We can look for the exact type of geometric or attribute error and then go right to the error location in our data."

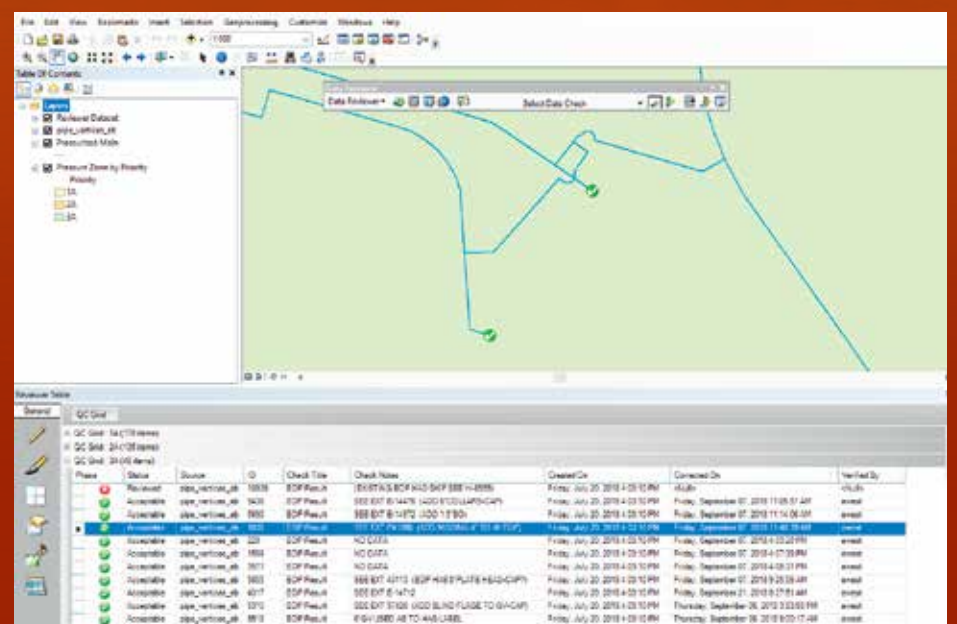
Additionally, because QA/QC results are saved in the geodatabase, there's a certain degree of transparency in error tracking. "We can easily go into the Reviewer Table to see how editors have verified data and view their progress," said Wong.

Other features the mapping group enjoys include the ability to run multiple data checks at once and the QC grid functionality in the Reviewer Table, which links errors to water pressure zone polygons and helps editors assign and prioritize tasks. Focusing on specific pressure zones when cleaning up data reduces the risk of conflicts and, ultimately, increases productivity.

"With ArcGIS Data Reviewer, we've gained efficiency and a cleaner workflow," Wong concluded.



↑ After implementing ArcGIS Data Reviewer, editors started with a list of high-priority data errors to check in the geodatabase, including disconnected features and pipe geometries that cut back in on themselves (kickbacks).



↑ The East Bay Municipal Utility District (EBMUD) stores and manages errors in a Reviewer Table within its geodatabase.

AppStudio for ArcGIS Gives County Leg Up in Finding Illegal Dumping Sites

With a rich history that set the backdrop for the Wild West in the 1800s, San Juan County, New Mexico, has grown into a thriving region with more than 125,000 residents. The burgeoning population means that demands have grown for the local government, which strives to provide residents with the best in services and public safety.

Protecting the environment is one of the local government's top priorities to promote residents' well-being and keep the county's scenic rivers, mountains, mesas, and badlands healthy and flourishing for years to come. One significant issue that was impacting San Juan County's environment was the illegal dumping of trash, which residents expressed concerns about during a public forum on the local recreation industry.

Due to a lack of residential garbage service, residents of the county's rural communities take their trash to local transfer stations, and the county then takes it to a landfill. But illegal dumping was—and still is—widespread.

"AppStudio for ArcGIS is easily my favorite tool to have in my back pocket. It makes me look like a rock star!"

Sherice Snell
GIS Manager
San Juan County, New Mexico

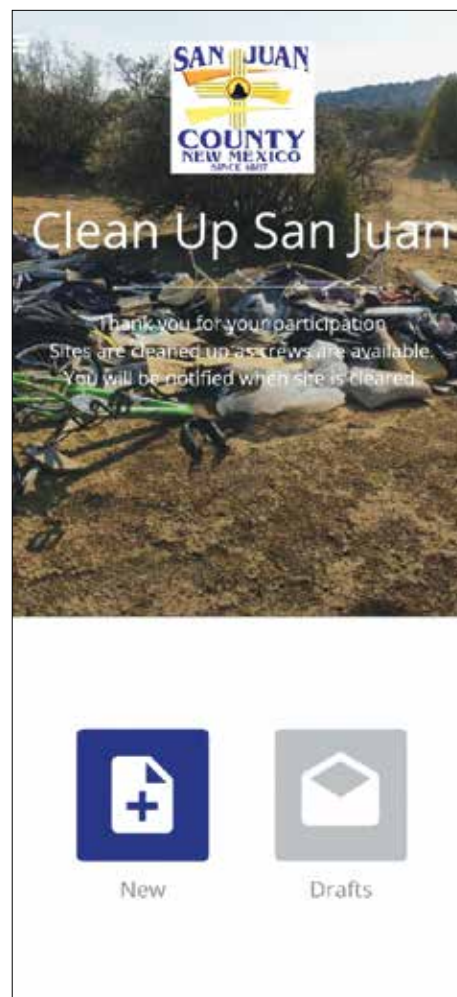
To curb this problem and prevent illegal dumping, the county's GIS team used AppStudio for ArcGIS to create a new app that helps residents more easily report illegal dumping sites. With the accurate location information the app provides, these citizen reports enable the county to engage in targeted cleanup efforts and more swiftly prosecute wrongdoers.

Initial App Left Users Wanting More

In response to the concerns of illegal dumping, Sherice Snell, the GIS manager for San Juan County, developed the Clean Up San Juan app to report illegal dumping sites. The initial Clean Up San Juan app was a crowdsourced story map to help citizens report illegal dumping from their mobile devices. Though popular with residents, it had several notable limitations for users.

Law enforcement officers use the app to investigate incidents of illegal dumping and prosecute offenders. Dumping on public land is a criminal offense in the county, punishable by a \$1,000 fine and/or a maximum of 90 days in jail. As such, the information provided by users is crucial to investigations. According to Snell, the original form didn't fit the needs of officers, who wanted residents to complete different fields than what the story map provided.

Also, the initial app was not easy to access. Users had to bookmark the URL on their devices and try to access it wherever they were. If there was no cell service at an illegal dumping



↑ The new Clean Up San Juan app has helped the county clean up more than 127,000 pounds of trash from illegal dumping sites.

site, the user had to hope he or she remembered where the site was to report it later, according to Snell. This meant that many illegal dumping sites went unreported and, for the ones that were, the location could have been inaccurate, causing setbacks in investigations.


In 2018, Snell set out to revamp the app and tailor it to the needs of both law enforcement and general users.





↑ When submissions are timely and have site details, the county sheriff's office can more easily apprehend violators.

Creating a Native App with Very Little Coding

To increase accessibility and improve reporting, Snell decided to create a new app using AppStudio for ArcGIS. The platform allows users to create native apps with little to no coding and has tools for everything from testing to deployment. Snell chose this solution because she was already an ArcGIS Online user, so she





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↑ With accurate location information coming in from the Clean Up San Juan app, the county is able to engage in targeted cleanup efforts.

↑ For submissions that don't have enough detail for the sheriff's department to do an investigation, the county sends a cleanup crew, which can include (from left to right) Carlos Sanchez, Matt Basinger, and Greg Williams.

knew the tool would seamlessly integrate into her existing platform.

Snell had also previously used the online version of AppStudio and found it simple to use. Employing the desktop version this time around, she retooled the original app and included unique customizations, such as the county's logo.

"I was able to make little changes to make it look more like it belonged to San Juan County, which was great," Snell said.

Snell read the documentation and watched YouTube videos to learn how to better use the solution. She noted that online tutorials were key for helping her get the revamped app into app stores, including Google Play and the App Store.

"I'm not the type of person to download the source code and [create a new app]. I need something easy, and AppStudio for ArcGIS was easy for me to use," said Snell. "Since I'm not a very technical person, this was a huge step for me."

The new Clean Up San Juan app launched in May 2019. Now, once illegal dumping sites are reported by the public, Snell and other staff members evaluate the claim based on the user's

completed form and an uploaded photo or video. They then turn submissions in, complete with details like GPS coordinates, to the sheriff's department for further investigation. For submissions without these details, county staff dispatch cleanup crews to clear the sites.

"AppStudio for ArcGIS is easily my favorite tool to have in my back pocket," said Snell. "It makes me look like a rock star!"

New App Is Easier to Use and More Accurate

With the new Clean Up San Juan app's improved accessibility and reporting, more than 127,000 pounds of trash have been cleaned up from illegal dumping sites across the county. Because users can download the new app from an app store, they no longer have to find the link on the county's website and try to save it for later use.

"AppStudio for ArcGIS really took out a lot of the hoops that people had to jump through to use it," said Snell.

San Juan County officials are receiving positive feedback from residents and county visitors

who have used the app. The app has been downloaded more than 500 times between the Android and iOS platforms, and that number continues to rise.

"It's a great tool for the community, and it's amazing how supportive everyone has been," said Snell. "The community loves it."

The new app is also helpful to local law enforcement and San Juan's public works department, giving them more information to better do their jobs. When submissions have specific site details, the county sheriff's office can more easily investigate claims, which also helps the district attorney build successful cases against alleged violators.


For years, citizen reporters had to call the county to provide the latitude and longitude of a dumping site, and county staff had to enter the coordinates in a mapping program to try and locate it. AppStudio streamlines that process with electronic submissions. When users add a photo or video to their submission, the map automatically retrieves the person's exact location, which improves accuracy for finding sites. Snell also receives submissions in a timely

manner and is better able to direct requests to the appropriate stakeholders.

"AppStudio for ArcGIS is pretty accurate. Depending on where the cell towers are, we're probably 95 percent accurate on [locating sites]. And now our cleanup crews have everything they need on their phone," said Snell. "If they need to contact the person that submitted [the site], and [he or she] entered contact information, they can call [the person] while they're out in the field [to get] more information."


Data about the Clean Up San Juan initiative is also available online in a dashboard that shows which sites are waiting for an evaluation, which ones have been cleaned up, and whether they're on private property or on Navajo Nation land. This has greatly improved transparency, which Snell said has boosted morale.

"For the most part, people are just very appreciative that we are trying to make this place better," said Snell. "AppStudio for ArcGIS is helping us make a difference in the community."




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LASER TECHNOLOGY

Professor Uses GIS to Provide Simple Answers to Complex Questions

Arthur Lembo's wide-reaching and varied career mirrors, in many ways, how GIS has developed as a field.

He started out engrossed in the technical aspects of the discipline and wanted to show the world what the technology itself could do. Over the years, he's realized that the essence of GIS doesn't only lie in its technological intricacies but, rather, also in its ability to provide simple answers to complex questions. Lembo's career has taken him from implementing large-scale, back end GIS projects to getting the technology to answer simple, public-facing questions to, now, preparing future generations to use the technology in innovative ways.

"To me, GIS has finally arrived," he said. "It's about seeing what other people don't see and answering life's challenging questions."

When he was young, Lembo, who's now professor of geography and geoscience at Salisbury University in Maryland, didn't see geography—or GIS, for that matter—as something that could help him answer his own life's questions.

"I was an apathetic kid in high school," he said. "I didn't have an interest in much of anything."

During his freshman year at the State University of New York (SUNY) College at Oneonta, he needed an elective to begin fulfilling the requirements of his business major. A friend told him to take geography because it would be easy. Lembo was pretty sure he'd just have to memorize state capitals.

"After the first lecture, I was hooked," Lembo recalled. "It was the engaging stories the professor told and how the problems geographers were

solving were the problems people were facing on the planet. We looked at weather-related phenomena, economics, and demographics. I just saw that this was a great way to focus on where things were happening and, potentially, understand why those things were occurring."

That same year, Lembo took a course in urban geography, where he got his first taste of GIS.

"I couldn't believe that we were able to use data to visualize what was going on around us," he said. "And remember, this was back in 1983. It was very caveman-like. I was using AUTOMAP 2, a precursor to ARC/INFO, on mainframe computers with line printers, and we used something called a SYMAP ruler to actually put coordinates on a map."

Because he had to work deeply with the technology, stringing together his own commands and digging into the source code, Lembo became captivated by the information technology aspect of GIS. About six months after graduating from Oneonta, riding a wave of inspiration sparked by one of his professors, Paul Baumann, he entered the master's of geography program at SUNY Buffalo. Advised there by the late professor Hugh Calkins, Lembo plunged into learning about what it meant to implement GIS within a computing environment.

"Hugh's mentoring really moved my career more into systems integration than actually doing a lot more geography," Lembo said.

His first job after getting his master's degree was developing GIS at AT&T, and he later moved to Esri partner Bowne Management Systems, now known as the LiRo Group. For 10 years, he

continued to set up enterprise GIS implementations for high-profile organizations—from Nassau County, Long Island, which is home to more than 1.3 million people, to the Long Island Rail Road (LIRR), one of the New York City area's most important commuter rail systems. The work Lembo did for the LIRR helped earn him a Partner of the Year Award from Esri in 1999.

One of the most interesting projects Lembo worked on during his time in the private sector was helping to create the Name Your Own Price hotel service for the travel website Priceline. He said the Priceline staff continually challenged him by asking, "Could my grandma in Topeka, Kansas, use this without asking any questions?"

"We had to think about building tools that anyone could use without having to read a help manual," said Lembo. And that was back in 1998. "All my other clients were beginning to use the internet, and I figured the natural thing to do was to create a GIS on the internet. What the Priceline guys got me to think about was, we don't want a site to do 30 different things; we want a site to do one thing really well."

That changed Lembo's thinking and made him see how powerful spatially enabled apps could be on the internet.

"We were doing all this spatial analysis on the back end that users had no idea about," he said. "As geographers, we're always going to want to understand what's happening behind the scenes. But the general public wants straightforward answers to very important questions, and we're the ones who can give them those answers. They're not interested in coordinate systems. That's the stuff we do. We're taking that and providing results for users to absorb."

That's what made the field of GIS fun to Lembo. But his thinking had also changed in another way: he'd decided that he wanted to reinvest in the community that gave him so much and teach at the university level.

"For me, my life was changed in college, and I wanted to give back to that environment," he said. "I left a successful private sector career to go back and get my PhD so I could help students."

With buy-in from his wife and children, Lembo got his PhD in environmental resource engineering at the SUNY College of Environmental Science and Forestry and started his academic career as a lecturer at Cornell University. While there, he won the SUNY Chancellor's Award for Excellence in Teaching—the highest teaching award in the state—as well as the North American Colleges and Teachers of Agriculture organization's Teaching Award of Merit and the Cornell faculty's Innovation in Teaching Award.

"That was validating," he said, referring to his decision to switch careers. "I applied the lessons I learned in the private sector to the classroom, which I think is important."

After seven years at Cornell, he decided to pursue a tenure-track position and wound up at Salisbury. So two of his children grew up in upstate New York, while his youngest grew up in Maryland—and the whole family benefited from being deeply involved in student life.

"Those college students who spent so much time in our home became role models for my kids," said Lembo. "And for some students—especially international students—we became their home away from home."

As a professor, Lembo's focus has always been on giving students the tools they need to learn GIS and spatial analysis and then helping them apply those skills to their own careers. In his quantitative analysis course, Lembo relies heavily on a textbook he cowrote—*An Introduction to Statistical Problem Solving in Geography*—to acquaint students with geographic research. In his GIS course, he has undergraduate students conduct original academic research.

"Many of them take their research right into graduate school," said Lembo. "A number of them have even been hired on the spot when companies saw the research projects they did for the class."

In 2018, Lembo received the Maryland Board of Regents' Faculty Award for Excellence in Teaching. This was the second time he'd been given a state's highest teaching honor.

"I think it's really cool that there are all these disciplines out there that are known as the standard university disciplines, like English and biology, with great professors in them, yet now we're seeing that the person identified as having a major contribution to academia is a geographer doing GIS," said Lembo. "It's really worthwhile and rewarding, and I'm so thankful that I do what I'm doing now."

As he and his wife transition to life as empty nesters, Lembo is spending more time on hobbies that include golfing, surfing, fishing, and sailing. He's also contemplating where to take his career from here.

"I'm teaching a lot of workshops on the technological aspects of GIS, and I have professionals come up to me afterward to ask a lot of questions," he said. "After college, we don't really have mentors anymore, so part of my transition is shifting my focus to being in those mentor relationships with other professionals."

Drawing inspiration from his family, faith, and friends, it seems that Lembo will continue using GIS to answer people's very important questions.



From the Meridian

By Gary Langham

Executive Director, American Association of Geographers



To Inspire Action on Climate Change, Use Maps

In August, I was honored to become the executive director of the American Association of Geographers (AAG). The AAG works to sustain the pipeline of geographers from grade school to grad school, help geographers find jobs, and strengthen and protect the discipline in both policy and practice.

Geography sits at the confluence of people, place, and the environment and is essential to understanding and exploring the world. For geographers and GIS professionals, AAG serves not only as a bridge to academia but also as a champion for data use and access rights under federal policy and regulations. In addition, it facilitates discussion and progress on forward-looking issues such as ethics, human rights, and climate change.

Prior to coming to AAG, I worked as chief scientist at the National Audubon Society. My team often partnered with Esri on projects ranging from community science to climate change. I have spent much of my professional career working on climate and its impacts on people and nature. Conveying complex ideas in spatial

terms, especially to the public, is the key to explaining—and then solving—many of the world's most pressing problems. But the complexities of climate change can be challenging to convey to policy makers and the public. Fortunately, if a picture is worth a thousand words, a good map must be worth at least 10,000.

To show where climatic suitability exists for specific species, for example, one can combine species occurrence data with climatic variables to build environmental profiles. When these maps are made at the local level, the impacts can be explained in terms that resonate with a general audience. This is important because solving climate change requires governments to take action, since the scale of the problem necessitates spending at government levels. And getting governments to pass worthwhile climate change legislation means that people must vote and call their representatives with this in mind.

Let me tell you a story of how GIS was used to create climate science that inspired artists and the public.

After years of work with many collaborators, Audubon released its *Birds and Climate Change* report in 2014. (A recently updated version is available at audubon.org/climate/survivalbydegrees.) Based on observations of birds over many years, Audubon built models of the relationship between climate variables and birds in North America. These results can be visualized as maps that look a lot like bird range maps for each species. The powerful part comes when future climate models get added to the maps and viewers see how much the range of each species shifts or shrinks. Such a strong visual format translates complexity into dramatic shifts that really get people's attention.

The press coverage for the report was overwhelming, but I was most surprised by the interest from artists and musicians. One example out of New York is now known as the Audubon Mural Project (audubon.org/amp). In northern Manhattan, where famed bird artist John James Audubon resided for a number of years, local artists have converted public spaces into art. Numbering more than 100, the murals depict bird species at risk from climate change, as listed in the report. These murals pop up all over the neighborhood—on the sides of buildings, near subway entrances, and on storefronts. Recently, a similar initiative was launched in Chicago.

Audubon's maps inspired artists, who now inspire the public. The integration of GIS, artists, and activism is a great example of how mapping and geography come together for the common good.

An organization like AAG sits at the confluence of academia, professional GIS, society, and policy makers; and partnering with Esri is a great way to accomplish goals. At AAG, I will focus on strengthening the pipeline of geographers from kindergarten through PhD programs and building up the discipline of geography. What's more, I will ensure that every voice is heard.

AAG has dedicated employees working for its members and in service of geography every day. They have unique and compelling stories to tell as well, so this column will feature voices and perspectives from across AAG.

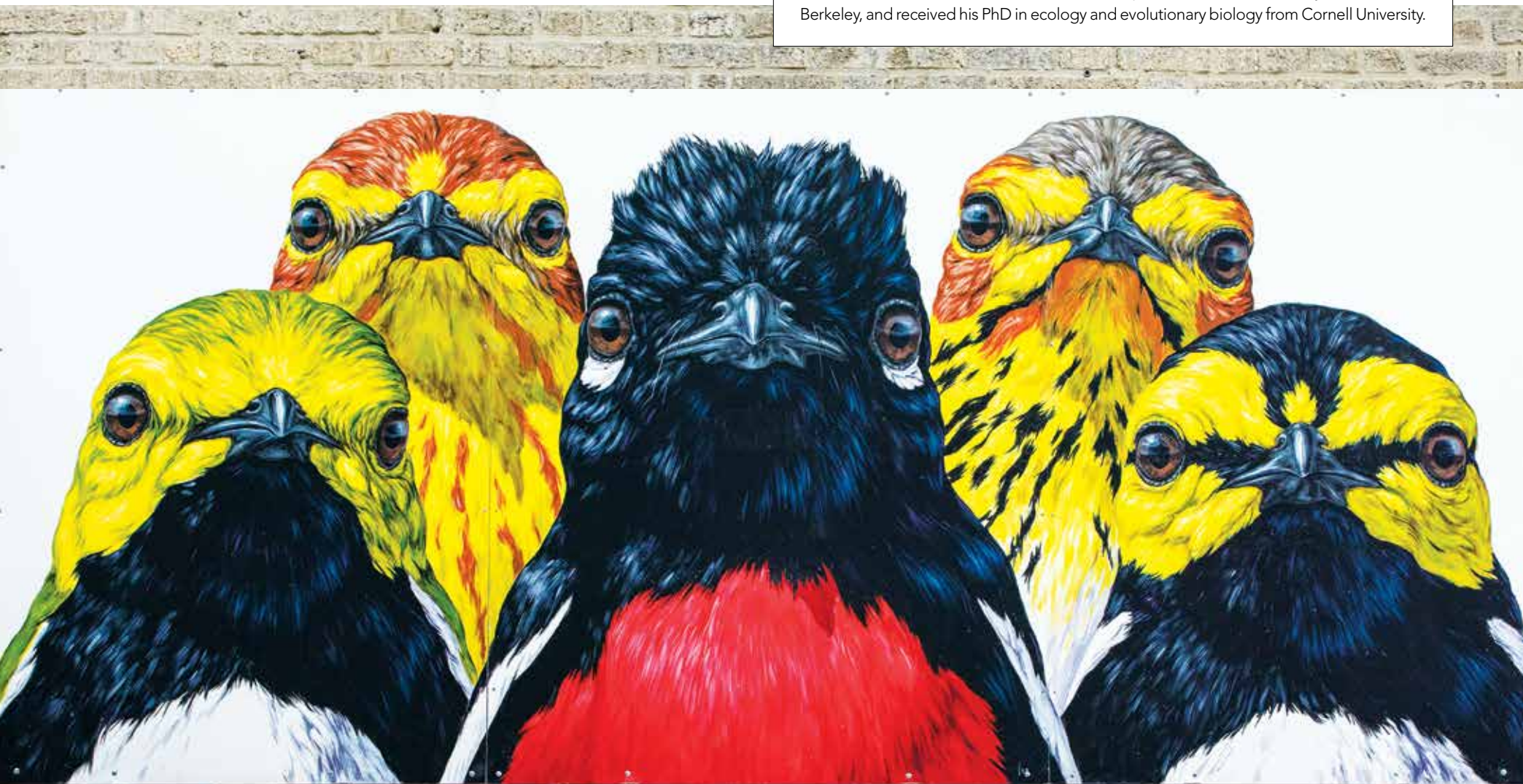
AAG is headquartered in Washington, DC, near Dupont Circle on 16th Street in a historic row house that we call Meridian Place. When Pierre L'Enfant designed Washington, DC, in 1791, 16th Street was known as the Washington Meridian, serving as a prime meridian for the United States. So our work comes From the Meridian—the new title of this column.

Next year marks AAG's 50th anniversary at Meridian Place, and I look forward to restoring the library and showcasing this organization's history. Stop by for a visit if you're in town.

About the Author

Gary Langham, PhD, is the executive director of AAG. As a broadly trained scientist with more than 20 years of experience working on science-based solutions for people and the environment, he has published peer-reviewed papers on a range of topics, including climate change, biogeography, seabirds, evolution, genetics, physiology, animal behavior, and conservation. Formerly, Langham was vice president and chief scientist at the National Audubon Society, where he directed Audubon's wide-reaching scientific initiatives and studies, including the first comprehensive analysis of the effects of future climate changes on 588 North American bird species. In 2000, Langham founded the Neotropical Grassland Conservancy to foster grassland research with grants and equipment. He completed a National Science Foundation bioinformatics postdoc at the University of California, Berkeley, and received his PhD in ecology and evolutionary biology from Cornell University.

↓ In New York City, various artists created public-facing murals that depict bird species at risk from climate change. This mural, by George Boorujy, shows, from left to right, a black-throated green warbler, a palm warbler, a painted redstart, a Cape May warbler, and a golden-cheeked warbler. (Photo by Mike Fernandez, courtesy of the National Audubon Society.)



In Lithuanian Nuclear Accident Simulation, GIS Delivers Success

Built about 30 miles from Lithuania's capital city of Vilnius, the Astravets multireactor nuclear power plant in Belarus is due to begin full operations soon, after eight years of construction. The power plant has been a cause for ongoing regional tension and international concern, particularly for Lithuanian government leaders, who consider Astravets a potential risk for a nuclear radiation leak—one that could easily reach a third of Lithuania's 2.8 million people.

Consequently, Lithuania's national leaders instituted civil protection measures. A wide array of federal agency stakeholders participated in this process, including the Fire and Rescue Department (FRD), which is under the Ministry of the Interior; the Government Emergency Commission; subordinate agencies; and other ministries and municipal organizations. Experts at the FRD and the Ministry of the Interior drafted an associated National Emergency Plan for Nuclear Accidents to prepare for the possibility of a nuclear or radiological incident.

In October 2019, Lithuanian government officials directed FRD staff to lead a four-day, multiagency simulation of a nuclear accident. The team needed to thoroughly evaluate its disaster preparedness, response, and recovery procedures to be sure everyone would be ready in the event of a radioactive threat to the Lithuanian people. The objective of this real-world exercise was to put into practice the skills and capabilities of the agencies that comprise the Lithuanian civil protection system by performing the functions defined in the National Emergency Plan for Nuclear Accidents.

"The exercise would allow us to test and practically measure the implementation of functions foreseen in the national plan," said Edgaras Geda, head of the civil protection board at FRD. "Preparation and planning for the exercise would be beneficial to participating institutions, enabling them to better understand the complex issues related to a potential radioactive accident at the Belarusian NPP. The exercise would also measure interagency cooperation and provide a common understanding of how to carry out the emergency functions."

To perform the emergency simulation effectively, the team needed tools that could help establish a new workflow for the documentation, analysis, and distribution of key operational performance indicators. Esri's local distributor in Lithuania, Hnit-Baltic, introduced FRD to ArcGIS Enterprise, a complete geospatial system that operates behind an organization's firewall or in the cloud, to use for the exercise. The spatial technology included with the platform, such as smart maps, dashboards, and mobile apps, would help stakeholders document, assess, and share safety issues and potential challenges realized during the simulation.

Familiar Technology Creates a Common Operating Picture

FRD was actually already familiar with Esri technology. For more than a decade, the department had used earlier versions of the ArcGIS platform, so staff understood that new ArcGIS technology, supplemented with a customized Radiation Incident Module (RIM), could provide a comprehensive process monitoring solution for the emergency exercises.

"With ArcGIS, we would be able to combine spatial data from different sources and provide a real-time common operating picture of the emergency exercises to all involved institutions, shared

on smart maps," said Geda. "This was very important for us, not only for the decision-making process within the civil protection system but also for our public information sharing efforts."

For the drill, FRD used the following tools in ArcGIS Enterprise to create a common operating picture for all participants:

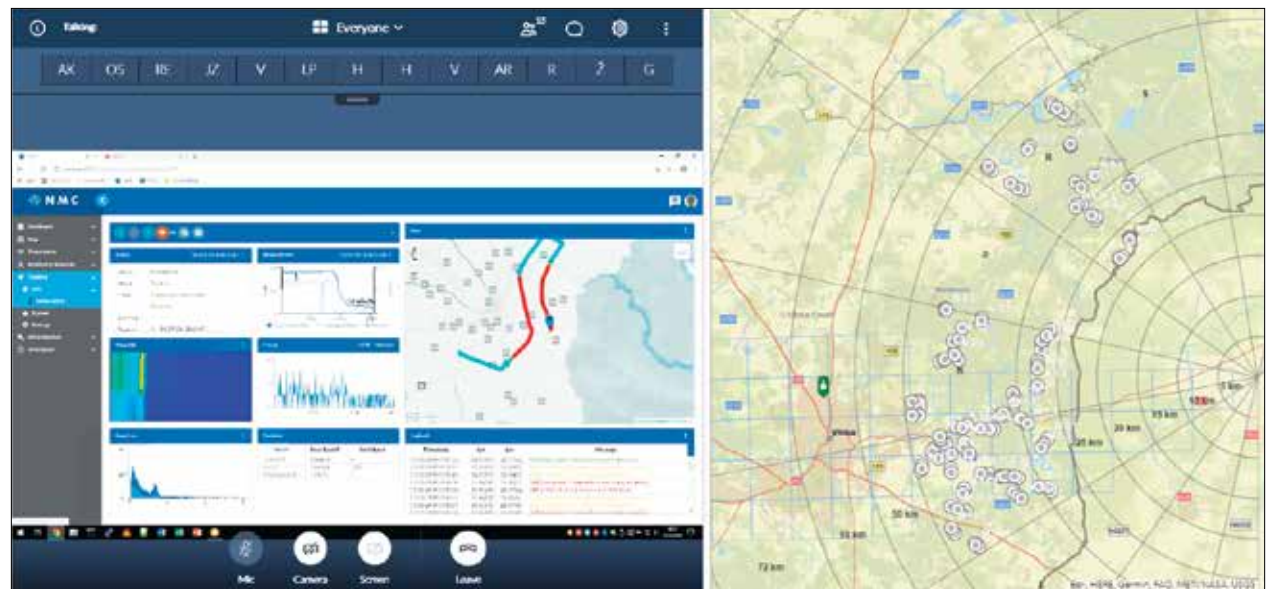
- Interactive smart maps informed citizens located within the affected radius of what was happening.
- Thirteen different operational dashboards displayed the status of alarm systems, who among citizen volunteers had been briefed, the movement of the simulated radiation cloud, the progress of teams collecting data in the field, and more.
- Mobile apps were used to assign tasks to field personnel who, in turn, used them to record data. These included specialized apps for Lithuania's Environmental Protection Agency and the Radiation Protection Centre.
- ArcGIS StoryMaps provided RIM users with detailed exercise information in a visual format.

Up-to-Date, Visual Information Aids Decision-Making

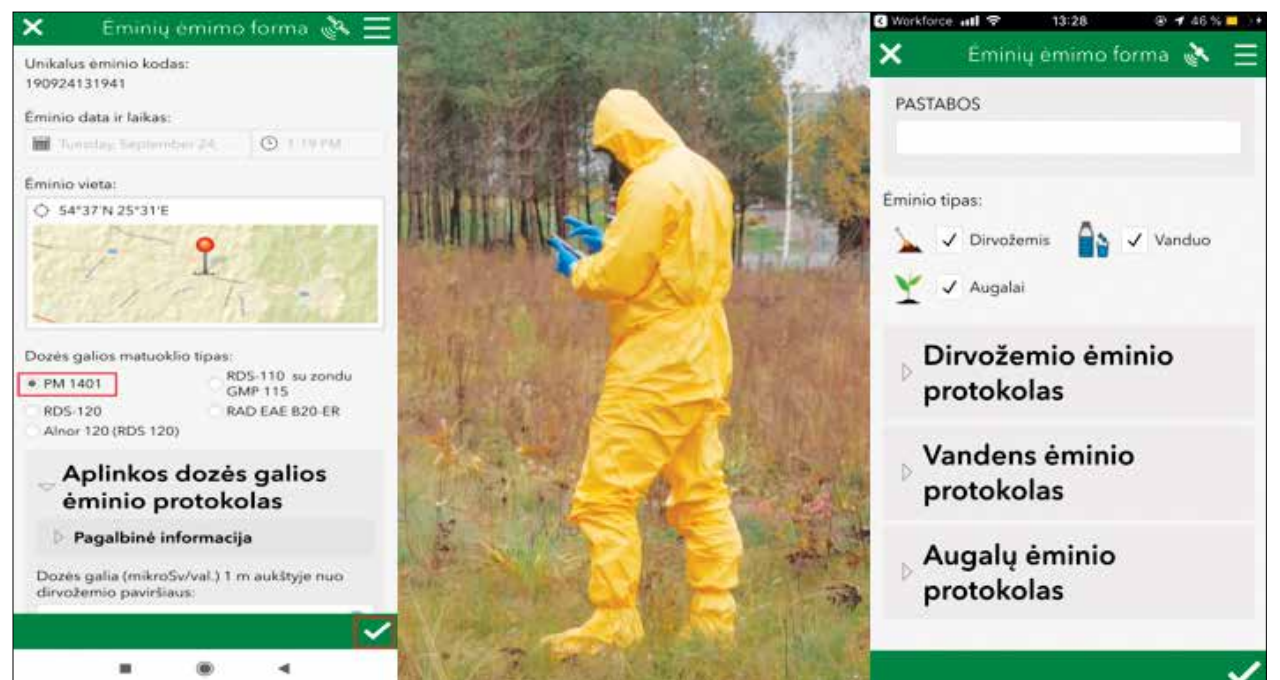
The simulated nuclear emergency exercise was a rousing success. The team achieved its objective: to measure, improve, and put into practice the skills and capabilities agencies would need if there were a radiation leak at the Astravets nuclear power plant.

"The ArcGIS platform proved to be very useful for the emergency drills, as it provided a single, reliable source of data and information for all of our users, at all levels, displayed on maps," said Geda. "As a powerful visualization tool, ArcGIS contributed to improved organization, justification of management decisions, and [the] warning and directing [of] residents through public awareness channels, which helped both government institutions and society."

FRD successfully deployed the local population warning and information system. Sirens alerted volunteers who participated in the drill about mandatory evacuations, while additional warning messages were sent to mobile phones and communicated



↑ Participating agencies used maps and dashboards to display real-time information that helped with decision-making.



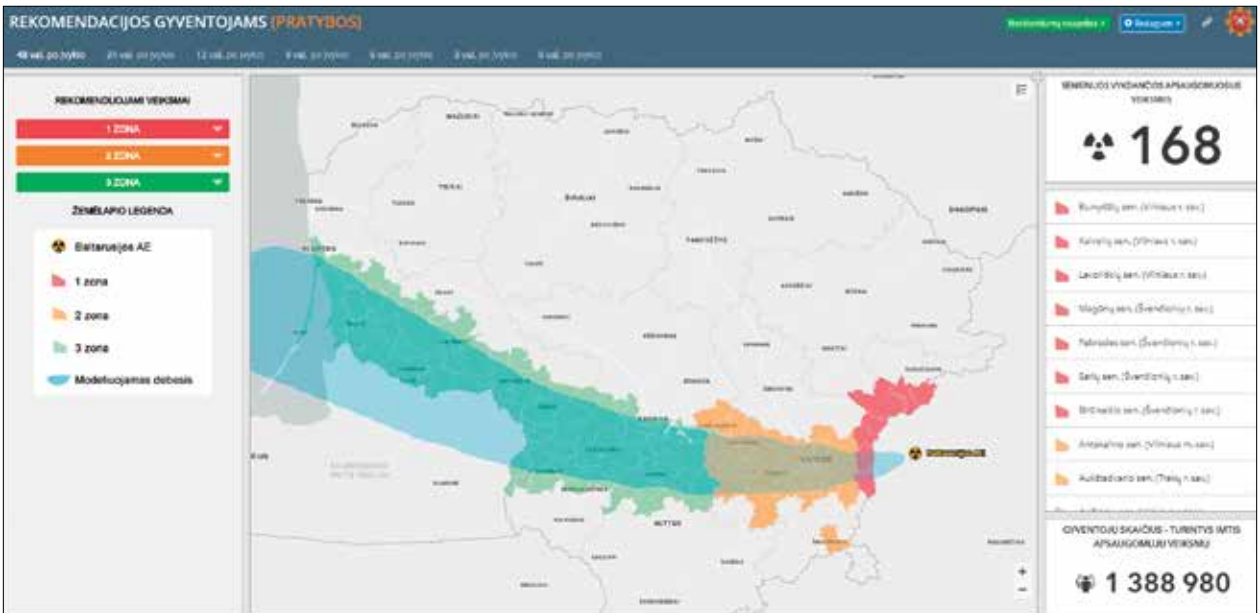
↑ During the drill, the Lithuanian government simplified some emergency processes, including how it gathers real-time field data.



↑ During the drill, citizens in the exposed radiation radius were evacuated, registered by authorities, washed, and given fresh clothes before receiving medical tests. (Photo courtesy of Lithuania's Fire and Rescue Department.)



↑ The exercise, which aimed to provide a common operating picture to everyone involved, measured interagency cooperation.



↑ In the event of a nuclear accident at Astravets in Belarus, the Lithuanian government can predict where people will be affected.

on national television and radio broadcasts. Citizen volunteers within the exposed radius were efficiently evacuated, registered by authorities, washed, and given fresh clothing before being taken to safe locations for medical testing.

Additionally, the team was effective at launching the radiation hazard warning and monitoring information system (RADIS). Staff from FRD and its partner agencies harvested field data from

municipalities via RIM apps, then analyzed and evaluated the results against their emergency exercise goals. Officials also held regular public briefings to provide citizens with the real-time status of simulation activities via an interactive map published to a public emergency website.

“All involved authorities across 19 different operational centers benefited from using the same operational tools from ArcGIS.

This simplified all of our processes, including the gathering and arranging of real-time data displayed on shared operational maps and dashboards,” said Geda. “Up-to-date information helped the FRD make well-informed decisions and in-time recommendations to exercise efficient public warnings.”

Lithuania Proves That It's Ready

International observers from Latvia, Poland, Estonia, and the United Kingdom attended Lithuania's emergency nuclear simulation. Observers expressed an appreciation for the overall process, the arranged tools, and the technical capacities used to perform the simulation. Officials from the Ministry of Interior and other national authorities in Lithuania recognized the FRD for successfully executing the emergency drill.

“The results of the exercises were very satisfying,” said Geda. “All participating institutions gained valuable experience and stronger knowledge of the practical use of ArcGIS during the drills. We saw no issues concerning the processes, workflows, or the integrity of the data, thanks to the assistance provided by Hnit-Baltic representatives.”

Lessons learned from the four-day simulation have enabled the Lithuanian government to maximize its emergency preparedness and response efforts. Should a real nuclear incident occur, the Lithuanian people can rest assured that the FRD and partner agencies have the GIS tools and technology they need to efficiently alert, inform, and evacuate them to safety zones.

The Relevance of Cartography

A Cartographer's Perspective

By Tim Trainor

President, International Cartographic Association

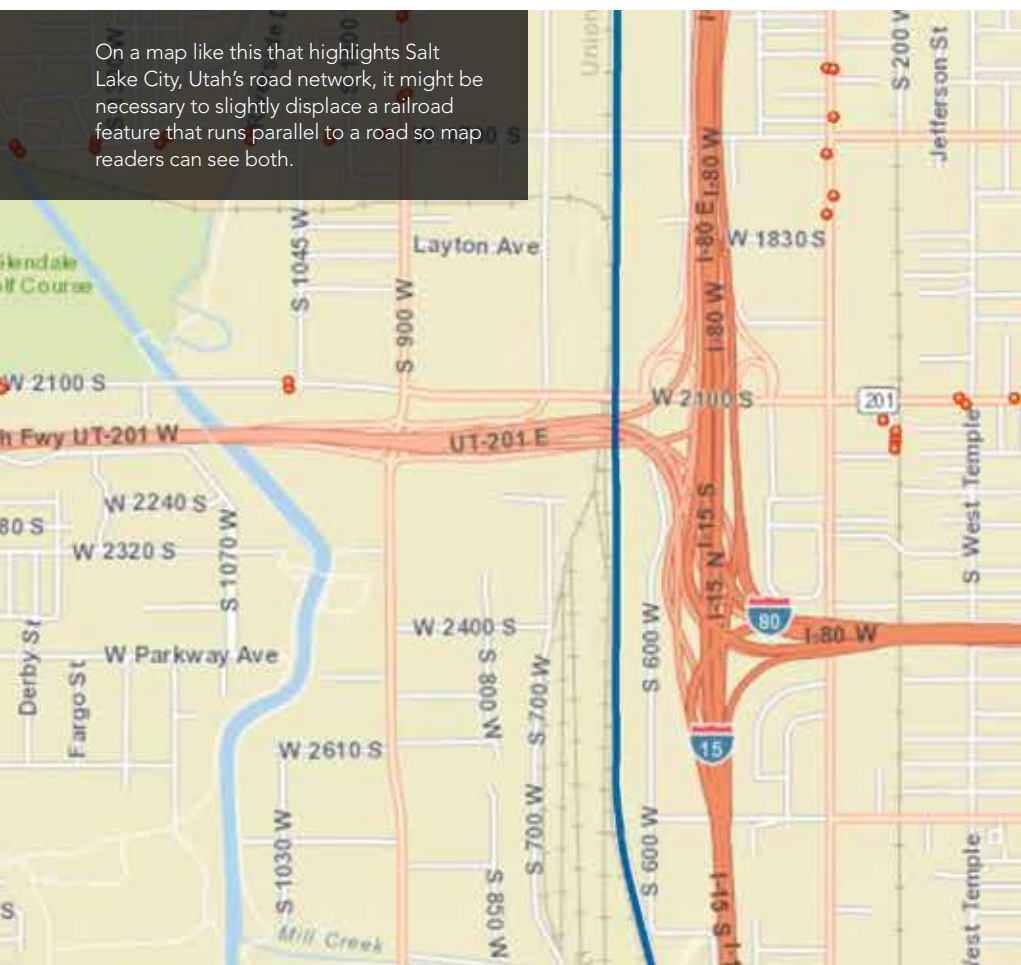


How Cartographers Generalize Data

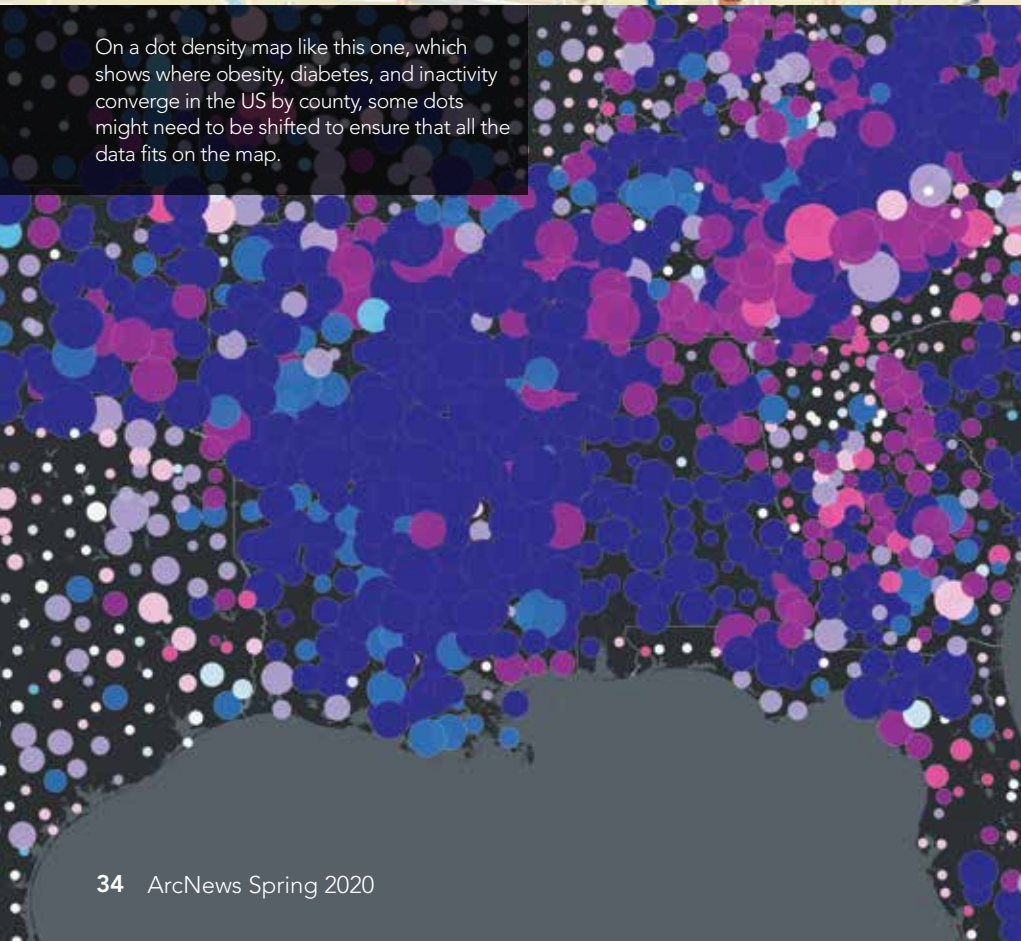
Maps distill diverse and complex data into useful information. But there are limits to what map readers can see and understand. With ever more data available, mapmakers have to make a series of choices to ensure that the maps they produce resonate correctly for many different users.

They have to define the purpose of the map and determine its audience. They need to acquire data that meets that purpose and create a design that effectively communicates the intended

On a map like this that highlights Salt Lake City, Utah's road network, it might be necessary to slightly displace a railroad feature that runs parallel to a road so map readers can see both.



On a dot density map like this one, which shows where obesity, diabetes, and inactivity converge in the US by county, some dots might need to be shifted to ensure that all the data fits on the map.



message(s). They must determine a production method that supports the expected design outcome. And, ultimately, they need to share the finished map with the designated audience.

While this all seems pretty straightforward, mapmakers have to make decisions and navigate complexity at each step of the process. A cartographer's skill, therefore, is called on at every phase.

For this short column, let's focus on how we use data to make a map. By definition, maps are a generalization of more detailed information. Making sense of data and using it in meaningful ways, then, requires generalization techniques. How well these techniques are applied impacts how users understand the resultant maps.

While there isn't a single process for generalizing data, the overarching guideline is that mapmakers need to decide what is important and should be emphasized. When cartographers first encounter data, they usually acquire knowledge about it by doing more research or speaking to specialists. That helps them classify and organize it—a precursor to doing further generalization.

According to *Cartographic Design and Production* by John Keates, cartographers use the concepts of data selection (what is included), simplification (the level of detail), and combination (arranging similar data together) to limit the amount of information that's perceived in graphic form. At some point, applying generalization concepts leads to exaggerating and/or displacing some things. This is unavoidable, and it's okay.

Cartographers use different tools to generalize data, and the processes they choose, along with how they apply them, impact the results. Many times, they test and review some of their choices to see what works best.

If the purpose of a map is to highlight a city's road network, and a railroad runs parallel to one of the main roads, it might be necessary to displace one or both of these features at smaller map scales. Assuming that the railroad is important, since it shows a different transportation feature or could be used as a visible landmark, which of the two features should be moved? Going back to the purpose of the map, if the primary objective is to focus on roads, the cartographer may choose to leave the road in its correct position and move the railroad slightly but far away enough so that users can detect both features while still giving visual preference to the road. This is such a simple example, yet it calls on the mapmaker to make several decisions.

Determining which map production techniques to use is another choice that cartographers have to make when it comes to generalizing data. If the final map is static (e.g., being presented on paper or as a PDF), where the content and scale don't change, then cartographers have more control over which generalization concepts to apply. For other forms of mapping, however—such as electronic maps used for navigation—the content changes, so what is emphasized needs to adapt according to the circumstances. Thus, data generalization becomes much more complex.

For navigating while driving, the road and its label, plus navigation instructions, are probably of greatest initial interest. But when an event such as an accident is added to the map via crowdsourcing, the map view generally needs to change to emphasize where the accident is and how it affects the planned route. What the driver sees on the map display—and hears via auditory cues, if that is part of the navigation platform—should help him or her navigate around the accident without hindering the primary function of driving. So mapmakers have to make difficult decisions about what data to generalize and what to keep on the map and in the driving instructions. Focusing on the map's intended use and purpose helps with figuring this out.

Deciding what kinds of value-based data need to be generalized for a map can also be challenging. Dot density maps typically display qualitative information alongside location (i.e., whether or not something exists in that place). Think of a map that shows population distribution: each dot indicates a set value, as well as that value's location. Cartographers use map scale and other visual factors to determine the value the dots should display (1,000 people or 10,000 people, for example). To accurately represent more people than the value of the dot allows, additional dots must be added to the map. But the location of each dot can't be in the exact same geographic location or it would look like there was only one dot on the map. The mapmaker must displace a few dots to ensure that all the dots fit on the map and reflect the total number of people in each location. Of course, this is only one technique of many that cartographers might consider employing to solve this spatial puzzle. I will also say that caution should be applied so that displaced dots don't appear in areas of low or no population, like in water.

The increasing amounts of geographic data available today, especially with big data and an abundance of crowdsourcing technology and projects, provide seemingly endless opportunities to produce interesting maps. Practicing sound data generalization—by organizing the available data, selecting the most appropriate data to use, simplifying the overall picture the data presents, and combining data that's similar—enables cartographers to help others gain a better understanding of an increasingly complex, data-rich environment.

About the Author

Tim Trainor is a part-time consultant to the United Nations (UN) and is the former chief geospatial scientist for the US Census Bureau. He has extensive experience in cartographic and geospatial topics that include exploring methodological, technical, and substantive issues relating to cartography and the collection, management, and integration of geospatial information. Trainor served as cochair for the UN Committee of Experts on Global Geospatial Information Management and as head of the US delegation to that committee. He was the senior agency official for geospatial information for the US Department of Commerce and was an executive member of the US Federal Geographic Data Committee.

To Rebuild a Harbor Fast, Engineering Firm Turns to New Technology

For more than a decade, the New Orleans Municipal Yacht Harbor in Louisiana was in disrepair. In August 2005, it was ravaged by Hurricane Katrina, which severely damaged three-quarters of its 600 slips. As funding negotiations dragged on, the harbor was hit again by Hurricane Isaac in 2012, which destroyed 20 more slips and left the remainder of the marina with no water or electricity.

The City of New Orleans wanted to completely replace the damaged facility with a harbor of increased resilience and sustainability. The new marina would feature a floating dock system. It would need to be durable enough to survive a larger-category hurricane, have additional facility entry points, and meet updated Americans with Disabilities Act (ADA) access requirements.

In 2016, the city finally got the go-ahead to proceed with a total renovation of the harbor. Moffatt & Nichol, a midsize engineering and infrastructure advisory firm that provides solutions to clients in the marine terminal, transportation, energy, environmental, federal, and urban development markets, was chosen to manage the rebuilding efforts.

Working closely with the Federal Emergency Management Agency (FEMA) and the City of New Orleans, Moffatt & Nichol had a tight timeline to get the project off the ground. It was going to be critical for staff to produce clear, convincing visualizations of the final design to communicate with stakeholders and city officials.

The company needed to be able to present two kinds of visualizations. First were the aesthetic visuals, which would be used to display the differences between the original marina and the proposed new design. Second, it needed technical visuals that designers, engineers, and builders could use for planning.

During projects with less pressing deadlines, Moffatt & Nichol would typically have design staff produce graphics and other information products that the visualization team would then use to create the final models and imagery. But because the timeline for the harbor project was so short, that wasn't possible. Moffatt & Nichol's visualization staff had to gather data, create graphics, build out models, and produce all the final visualization tools, without assistance, in less than two weeks.

With no time to spare, the company's visualization team searched online for ideas on how to accomplish this. One employee—Jeanah Bauer, a visualization specialist at Moffatt & Nichol—discovered the ArcGIS Maps for Adobe Creative Cloud plug-in from Esri. Implementing the plug-in would enable her and her team members to continue working within the Adobe programs they were familiar with while getting the mapping functionality they needed.

"Once I got the plug-in, it had a really easy learning curve," said Bauer. "For the first time, I was able to easily pull satellite images directly into Photoshop, then turn them into layered files with additional relevant data."

Installing the plug-in was fast and easy. Soon, Moffatt & Nichol's visualization staff members were pulling aerial imagery and basemaps into their Adobe software to create the detailed informational map the engineering team needed to move forward.

"In an engineering industry, whether we're engineers, designers, *[or]* visualization or graphics people, anytime we discover new technology that can make us more efficient, everybody is very interested," said Bauer. "We were especially excited to learn how GIS could be incorporated with Photoshop."

To create the large-scale, high-quality visualization results the company needed without aid from additional staff, the team would have originally started by piecing together high-resolution screen capture tiles—a process that could take up to two days per image. Using Maps for Adobe Creative Cloud, the visualization team was able to accomplish the same results in less than an hour.

"Under usual circumstances, I would have had to obtain data like maps and aeries through our GIS department, adding people and time to the project," said Bauer. "I would have also required a second modeler or graphic designer to take on one of the tasks, thereby duplicating some of the work and creating a break in the workflow. To save time, the map graphics would have likely stayed 2D and wouldn't *[have been]* incorporated into the 3D model."

The plug-in enabled Moffatt & Nichol's visualization staff to create detailed, data-rich, layered Photoshop files fast and get these essential planning tools off to the technical team so the rebuilding could begin. Not only did Moffatt & Nichol meet its tight deadline, but the company also did it under budget and without adding more staff.

"I cut my time in half and came in under budget, but most importantly, I kept the City of New Orleans and my project manager happy," said Bauer.

Once created, the Photoshop files could be quickly moved into Autodesk 3ds Max, and any basemap could be altered during planning meetings with architects and engineers. Being able to swiftly manipulate files made project discussions more efficient and ultimately contributed to getting construction started quickly.

Beyond the scope of the harbor project, Moffatt & Nichol also shared its newly created graphics and visualization tools with the founders of Community Sailing New Orleans, Inc., which aims to provide community members, especially disadvantaged children, with access to sailing facilities. The founders were able to use those assets to solicit funds to start building the community sailing center.

"With the use of *[Maps for Adobe Creative Cloud]*, I was able to create graphics for technical meetings *[among]* city officials, engineers, architects, and planners, as well as visualizations for community outreach meetings," said Bauer. "With the addition of ArcGIS to my workflow, I was a one-stop shop for visualization graphics."



↑ Moffatt & Nichol's visualization staff members pulled satellite imagery and basemaps into their Adobe software to create detailed informational maps.



↑ ↓ The New Orleans Municipal Yacht Harbor is finally being rebuilt after it was devastated during Hurricane Katrina.



↓ Most of the harbor's slips were severely damaged (left). Now, the City of New Orleans is replacing the damaged facilities with ones that are more resilient and sustainable (proposed rendering, right).



Tips for Transitioning from Analyst to Leader

By John Nolte, Denver Water

Managing GIS

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



Fostering Excellence in GIS

www.URISA.org

Making the professional transition from technical GIS analyst to GIS manager can be difficult. Even though employees often get promoted to these positions based on experience and competence, many lack the skills they need to become effective leaders.

New managers have to take on many new challenges, including organizing incoming projects, managing budgets, doing performance reviews, and motivating people. This can be difficult when much of the new manager's previous work was technical and, often, routine. Imagine a programmer who is used to writing code all day but now has to navigate the politics and personalities of a dysfunctional team. This is an arduous undertaking for any manager, let alone someone who is new to leadership.

So how does someone smoothly transition from GIS analyst to GIS manager? For anyone who's making this move or even just thinking about it, here are five suggestions for what to do from the outset to be an effective new manager.

Focus on Your Team and Seek Out Mentors

Don't expect to jump in headfirst and change your organization's well-established politics overnight. Instead, focus on your team. Assess its strengths and weaknesses and pay attention to internal communications. For the time being, ignore all external threats from other teams or outside organizations.

Also, look for a mentor. Some organizations offer mentoring programs or leadership connection initiatives, which are great. If your place of work doesn't, though, look for other leaders in your organization whom you respect and ask them what management techniques work for them. Perhaps these more experienced managers could help you navigate your organization's politics. Longtime leaders know where conflict exists and can help you effectively deal with it.

You may be able to find inspiring leaders and potential mentors outside your group or division, so cast your net wide. True leaders aren't always managers either. Sometimes they can be people who motivate and lead from within.

Develop a Leadership Philosophy and Management Style

New managers often take what they've learned from their previous managers and emulate those leadership styles. This can work if your former managers were great leaders, but that's not always the case. What's more, different people have different dispositions, so what may work for your old boss might not work for you. You need to develop your own personal leadership philosophy and determine what kind of leader you are.

By definition, a philosophy acts as a guiding principle for behavior. It's important to align your leadership philosophy with your organization's values and beliefs. Does your organization have a strategic plan or value statements? Use those to help develop your leadership philosophy.

You can look again to other leaders you admire, both inside and outside your organization, to inform your philosophy as well. What do you like about their ideas? It doesn't hurt to analyze leaders you dislike, too, to come up with behaviors to avoid.

It also helps to see how others perceive you. Are you an effective and motivating leader? Does your team respect you? What can you do better to motivate your employees and help them resolve conflicts?

Having a personal leadership philosophy can give you consistency in how you manage people and problems, which is extremely important to new managers. Developing a philosophy may take time, however, and it will certainly evolve as you grow.

Once you've established your leadership philosophy, you can develop and hone your management style. Oftentimes, new managers apply the leadership styles that worked for them when they were employees completing certain projects or dealing with team dynamics, but that doesn't always translate. You're now dealing with a range of employees, some of whom need clear guidance, and others who don't require a lot of direction.

There are scores of leadership styles to pull from. Some of the main types include democratic, which encourages participation; autocratic, which centers on results and efficiency; laissez-faire, which is a hands-off approach; and servant, which focuses on listening and having empathy. Your leadership style will likely change depending on the situation. In times when you need input from your team, you may apply a democratic leadership style, but if you need to resolve conflict, you might be better served by the autocratic style. When trying to build relationships, servant-based leadership might be best.

Figure Out Your Employees' Goals and Personalities

Whether you're managing a new group of employees or have been promoted to manager from within, you need to get to know your team members in a new way. Meet with each of them individually first and then with the team as a whole to establish roles and responsibilities and build short-term strategic initiatives.

If you have worked with these employees before, you may already know how they operate and whether they require more or less direction. If you haven't, you need to gain an understanding of these dynamics, and meetings are a way to do that.

Having individual meetings with your employees helps build rapport with your staff. It is also a great way to learn what motivates them and what projects they're interested in. A previous manager may have established everyone's roles, but people's skills and interests change over time. It's important to understand your employees' personal goals for career development. This also shows that you're interested in them individually and not just in the team's overall success.

There are many tools, such as behavioral and cognitive tests, that help identify people's personalities, but two of the most effective ways to do this are to listen and observe. This can help you draw out some people's strengths and get ideas for how to build better relationships.

It's also vital to separate yourself from any personal relationships you may have already established with individuals on your team. You don't have to suddenly terminate friendships, but be aware that perceived favoritism could lead to conflict. I was once told that trust isn't something you earn but something you lose. Show your team members that they can trust you and your decision-making, and they will respect you as a leader.

Step Back and Learn to Delegate

New managers sometimes find it hard to remove themselves from doing their team's daily work and end up struggling to balance new responsibilities with old job duties. But if you

continue doing the technical work, you may end up suffering from burnout and/or ignoring your team's needs.

It's important to allow your team to grow without your technical expertise. If you were the chief cartographer, it doesn't help the other cartographers on your team if you continually provide feedback on colors and symbology; they need to figure this out for themselves. If you were the expert programmer, pass that skill off to one of your employees who has a passion for writing code. This frees up your time to do what you were promoted to do: manage your team.

Stepping back from the technical, day-to-day work is often one of the most difficult transitions new managers face. Just learn to let it go.

Align Your Team Goals with the Organization's Objectives

Coming up with achievable team goals can be difficult for new managers. Remember, however, that an organization's success relies on the success of individual teams. So align your team's goals with those of your organization. If you don't do this, upper-level management may not see the value in your team's work.

Most organizations have a strategic plan that outlines what they want to achieve and how they intend to do that. Use this as the basis for setting up your team's goals, both short and long term.

Also, look for easy wins—things that will earn your team praise and respect—and focus on those first. These can be individual or team goals and might include getting staff members training or developing standard workflows.

Longer-term goals will most likely be team oriented and are often directed by the organization's objectives. Perhaps your team can achieve a balanced budget or maintain no more than a 5 percent backlog on projects.

It Takes Time

Moving into a managerial position can be tough, but there are tools to make the transition smooth and efficient. It will take time to develop your own leadership philosophy and management style, and getting to know your team is always an ongoing process. In the interim, take advantage of resources at work, such as mentoring networks, and seek out external opportunities, like the Urban and Regional Information Systems Association's (URISA) GIS Leadership Academy. Also, make sure you take the time to listen to your team and adjust to your new position.

About the Author

John Nolte, GISP, is the GIS manager at Denver Water. He has worked in GIS for more than 25 years and has held several managerial positions, from GIS coordinator at the Naval Weapons Station in Charleston, South Carolina, to asset management coordinator at the City of Westminster, Colorado. Nolte is a board member of URISA International and an instructor for the URISA GIS Leadership Academy.

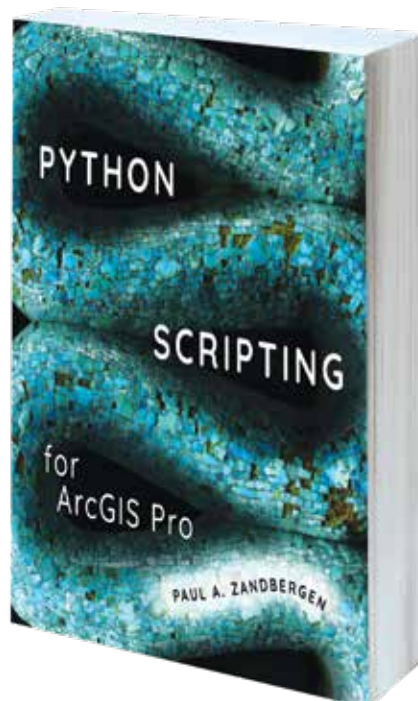
Python Scripting for ArcGIS Pro

By Paul A. Zandbergen

Python Scripting for ArcGIS Pro is the definitive, easy-to-follow guide to writing Python code with spatial data in ArcGIS Pro—and is beneficial whether you're new to programming or not. The book starts with the fundamentals of Python programming and then dives into how to write useful Python scripts that work with spatial data in ArcGIS Pro. Readers learn how to execute the tools in Python, describe data, and manipulate and create data in addition to a number of more specialized tasks. Some of the key topics covered in the book include the following:

- Automating geoprocessing tasks
- Exploring and manipulating spatial and tabular data
- Working with geometries and rasters
- Map scripting
- Debugging and error handling
- Creating functions and classes
- Making and sharing script tools
- ArcPy and ArcGIS API for Python

Helpful points to remember, key terms, and review questions are included at the end of each chapter to reinforce readers' understanding of Python, and corresponding data and exercises are available online. So learn the versatility of Python coding and increase your productivity in ArcGIS Pro with *Python Scripting for ArcGIS Pro*. June 2020, 430 pp. E-book ISBN: 9781589485006 and paperback ISBN: 9781589484993.

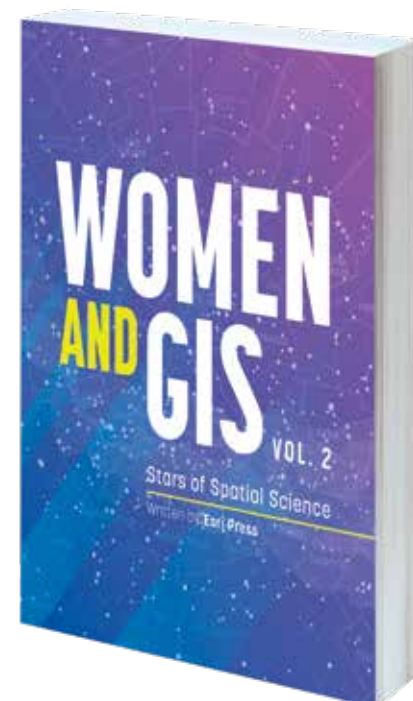


Women and GIS: Stars of Spatial Science, Volume 2

By Esri Press

Foreword by Jane Goodall

In *Women and GIS: Stars of Spatial Science*, Volume 2, readers will find the true and inspiring stories of 30 remarkable women who aimed for the stars and created a better world. As science, technology, education, and mathematics (STEM) continue to advance and shape people's understanding of the world, so, too, do women who take charge and use new research and methodologies to make big changes. The diverse women profiled in the second volume of the *Women and GIS* series have used a combination of maps, analysis, and GIS to overcome obstacles and challenges and become leaders in STEM. From planetary scientists and civil engineers to entrepreneurs and urban planners, the strong, passionate women in this volume will undoubtedly serve as mentors and guides for readers who are in the midst of developing their own life stories and discovering their potential in STEM. April 2020, 250 pp. E-book ISBN: 9781589485952 and paperback ISBN: 9781589485945.



No Ordinary Trip for These Esri T-shirts



Kathryn Scott, who retired from Washington State Parks, and Brian Hall, a GIS coordinator there, went to northern Peru in their well-traveled Esri T-shirts! As volunteers with Earthwatch, they assisted the Marine Institute of Peru with a study of the area's giant manta ray populations and their habitats.



Gwenna F., from Claremont, California, wonders if her mapsicle T-shirt will inspire her dad to let her have a Popsicle after she eats her veggies from the farmers market.

To be featured in ArcNews adventuring in your Esri T-shirt, go to ow.ly/aaSh50yhKNs and send in a photo of yourself wearing your Esri swag, along with a brief description of your trip or activity.

New Training and Certification Offerings

Training

New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT++ certification. Courses are available online, at Esri training centers nationwide, and on-site at customer organizations.

Experienced GIS professionals can learn to apply the latest ArcGIS tools for real-time data and imagery by taking either of the following courses:

- **Get Started with ArcGIS GeoEvent Server**

Enable real-time analytics through your ArcGIS Enterprise deployment. In learning about the architecture and capabilities of ArcGIS GeoEvent Server, attendees discover how to connect to real-time sensors, visualize and analyze a data feed, and send updates and alerts to stakeholders across their organizations.

- **Imagery Analysis in ArcGIS Pro**

This course teaches essential concepts for visualizing and extracting meaningful information from satellite imagery, data collected by unmanned aerial vehicles (UAVs), and other imagery formats. Learners are taught best practices for displaying, processing, and creating derived raster products from imagery and get to explore common applications for imagery, including disaster recovery, damage assessment, and forest canopy assessment.

Cartography and Location Analytics MOOCs

Massive open online courses (MOOCs) are free, convenient, and fun ways to stay up-to-date with GIS topics and fast-changing technologies. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage with learners from around the world. A certificate of completion is awarded to everyone who completes all the course content.

Upcoming Esri MOOCs include the following:

- **Cartography.**, one of Esri's most popular MOOCs, is returning for six weeks starting April 22, 2020. With guidance from expert Esri cartographers, participants learn how to use ArcGIS Pro to create beautiful maps that are tailored to their audience, purpose, and medium. Discover practical techniques that can take an average map to extraordinary cartographic heights. Learn more and register at go.esri.com/carto-course.
- **The Location Advantage**, which helps learners discover the power of location analytics, is being offered May 6–June 17, 2020. To survive and thrive in today's fast-paced, global economy, successful businesses rely on data. Participants in this MOOC learn how to use ArcGIS Business Analyst to help their organizations better understand key market and customer data so they can make better decisions, faster. Learn more and register at go.esri.com/location-course.

Certification

ArcGIS API for JavaScript and ArcGIS API for Python have more in common than just the abbreviation *API*. Both are subjects of new specialty certifications available from Esri.

Specialty certifications help students and professionals validate their knowledge of focused topics related to ArcGIS capabilities and technologies. Individuals who want to earn a specialty certification must have already achieved a core Esri Technical Certification at version 10.3 or higher.

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

Looking for inspiration for your GIS journey? View all certification success stories at go.esri.com/certification-success.

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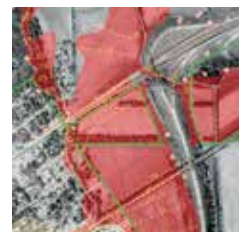
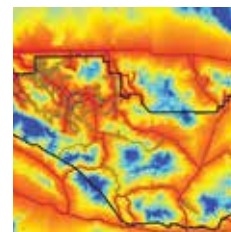
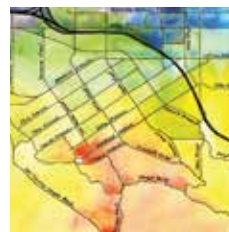
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