ArcNews

Single Source of Truth Guides Market Expansion

A fourth-generation family-run business with a legacy of creating durable high-quality workwear, Carhartt is a large multinational organization with wholesale and direct-to-consumer distribution lines. It operates in the United States, Mexico, and Europe.

As the company set its sights on expansion into new markets and sales channels, it needed to develop a single source of truth for data that would help create a cross-functional, unified strategy to support intelligent decision-making at every level. Carhartt selected ArcGIS Business Analyst for this job.

Fragmented and disconnected data impeded the development of an omnichannel approach to marketing. Omnichannel marketing uses coordinated communication channels to improve customer experiences and improve relationships with customers. ArcGIS Business Analyst unlocked a common and complete operating picture for Carhartt by combining demographic, business, lifestyle, spending, and census data with map-based analytics for market planning, omnichannel expansion, and customer segmentation.
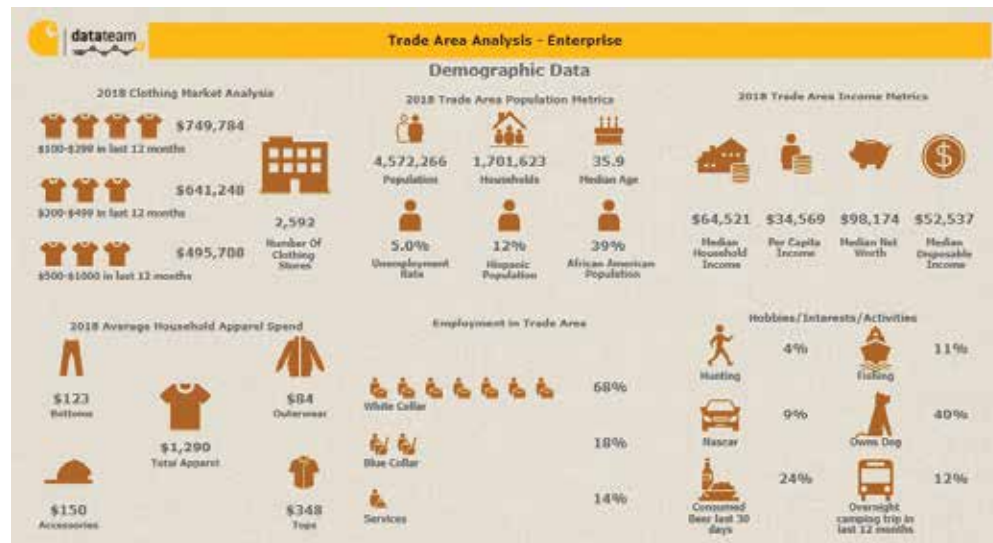
Founded in 1889, the company's business and technological environments have evolved over the years. It has been making strategic use of GIS and its robust datasets over the last decade to support sales, marketing strategy, and operations.

Balancing Multiple Sales Channels

Since the very beginning, Carhartt's highest priority has been its commitment to customers. Ensuring that its customers always have easy access to the exact products they need has been a critical underpinning of expansion efforts.

However, customer satisfaction is not the only consideration. Carhartt understood early on that the best way to ensure access to its products was to expand the company's reach by fostering relationships with a network of distributors and resellers that includes small mom-and-pop retailers as well as wholesale giants. In addition to its own brick-and-mortar stores, Carhart has recently added e-commerce channels.

← By gaining a better understanding of customer demographics, spending patterns, and other characteristics, the company can better make the critical connection between supply and demand and make intentional decisions about where products should go.

ArcGIS Platform Gives Developers Direct Access to Location Services

ArcGIS Platform is made up of three high-level elements:
- An excellent developer experience
- A comprehensive set of industry-leading location services
- A simple, transparent business model

ArcGIS Platform provides a new option for developers to access powerful ArcGIS location services and high-quality geospatial content through this location platform-as-a-service (PaaS). The underlying services that power ArcGIS are directly available to developers building mapping and location-based applications. ArcGIS Platform complements the rest of the ArcGIS system—ArcGIS Online, ArcGIS Pro, and ArcGIS Enterprise.

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ArcNews

With the Mekong Infrastructure Tracker, the Stimson Center provides a broad understanding of infrastructure projects across Southeast Asia with tools that allows stakeholders to communicate and compare development scenarios and evaluate the benefits and impacts of each project.

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Expansion at this scale demands an intimate understanding of how growth in one channel might affect adjacent ones. Expansion plans must be assessed to ensure they don't cannibalize valued members of Carhartt's network, especially smaller retailers that have been stocking Carhartt products since the company's earliest years.

Carhartt addressed these challenges by harnessing big data and GIS to create a unified expansion strategy. Disconnected priorities and hearsay data skewed by biases were replaced by a single source of truth that supports every channel and partnership, allowing the company's safe and confident expansion.

Consolidating Data

Carhartt assembled a data team to consolidate and interrogate data from multiple sources, creating a single source that would guide the company's expansion while controlling for customer needs and partner relations.

With ArcGIS Business Analyst, Carhartt was able to view its sales data against Esri's authoritative data—demographics, psychographics, and spending habits—to understand the performance and potential of any market. Traditional data reporting formats, such as complex spreadsheets and static PDFs, have been replaced with intuitive, map-based visualizations and interactive infographic reports that help business leaders at all levels make decisions. They can now answer questions they might never have thought to ask before.

With ArcGIS Business Analyst, the team can now view performance metrics for all sales channels in a single interactive map view that includes Carhartt's 33 brick-and-mortar locations, its retail distribution partners (big and small), and its e-commerce transactions. Now, when considering a new prospect, Carhartt can see existing channels and performance in any given area at a glance.

"Plotting the big guys and the little guys together in a map really tells so many different stories," said Steve Brennan, vice president of data strategy and analytics at Carhartt. When pursuing a stronger relationship with a large wholesaler in a given area, the company can generate a visual and interactive risk assessment that uses authoritative data rather than hearsay.

Carhartt's expansion needed to account for all distribution partnerships. A deeper analysis of its sales data helped it understand whether increased revenue in one channel represented a legitimate shift in buyer habits or was simply moving dollars from one channel to another. Isolated reports of increased revenue in one channel that once appeared promising now tell a very different story: the full picture shows that a nearby channel would pay the price.

Data Analysis Unifies Cross-Functional Strategy

Mapping its rich data to form one clear, descriptive picture was a game changer for Carhartt. Steve Sapardanis, manager of sales and business analytics at Carhartt, emphasized that the powerful visualization tools in ArcGIS Business Analyst were central to this revelation. "You can just literally see the numbers and the color coding that says it's up, it's down, it's plus, it's minus, with very little words. You let the visual describe itself. That was a way that we have never looked at data and performance at Carhartt," he said.

The Carhartt team is also using ArcGIS Business Analyst to deepen its understanding of customer needs. By using the drive-time analysis tool to analyze market potential within a given geographic radius, then overlaying demographics and household spending habits from Esri Tapestry Segmentation, the team can refine market assessments.

By combining Tapestry data with Carhartt's point of sale (POS) data in ArcGIS Business Analyst, the team can segment customers to help meet demand where it is, down to the most granular level of the product mix. This allows more intentional decisions about where products should go based on demographics, spending patterns, and even which types of Carhartt-centered hobbies—such as fishing or hunting—are popular in an area. The company can better make the critical connection between supply and demand.

Carhartt shares this data with its wholesalers and distributors to help these accounts recapture sales from competitors. The data team uses Tapestry data to rigorously interrogate and corroborate its own first-party consumer data about a given market, ensuring maximum accuracy of analyses. Detailed and visual reports prove whether there is demand for specific products in specific markets.

When considering how to penetrate previously underexplored markets, this repeatable workflow can be used on a larger scale. Historical sales data can be visualized alongside other factors.

"When you can have a picture that shows proximity and shows potential oversaturation—that's made a world of difference," Brennan explained. Dwayne Newsome, manager of data engineering, explained that ArcGIS Business Analyst gives the company a visual overview of the entire country, so it can hone in on prospects whose potential may have been overlooked and create robust visual reports for how to enter these markets. ArcGIS Business Analyst can pull that big picture into focus so that the analytical view of a market's potential or performance is holistic and detailed rather than relying on reductive guesswork.

Thinking Bigger

Since adopting ArcGIS Business Analyst and a more rigorous approach to data, Carhartt has seen a demonstrable, positive shift toward more intelligent decision-making at all levels, from sales managers to executives. Working from a single source of truth has helped bring all the channels together under one unified strategy with accurate, authoritative data as the central, common point.

"It helped make a clearer picture, because retail has its leadership, wholesale has its leadership, e-commerce has its leadership. Having one set of data, and especially the visualizations, helps them make better decisions at a macro level," Newsome said.

Data presented in maps, interactive web apps, and infographics created with ArcGIS Business Analyst have become a staple in leadership discussions more than ever before in Carhartt's history and the data team has led the way. As Brennan explained, "We're the team that comes together and facilitates that true cross-functional discussion to say, here's what the market looks like, and here is what the data is saying is the best way to leverage that market, or to maximize that market."

ArcGIS Business Analyst enabled a successful expansion strategy that empowers physical and e-commerce partners and their retail businesses to deliver the products customers want—where they want them and how they want them.

But Carhartt also wants to go bigger. Newsome and Eric Isaak, business intelligence architect at Carhartt, envision a future in which they can use ArcGIS to create interactive web apps tailored to the needs of internal stakeholders, empowering entire sales teams to take the power of GIS and data into their own hands.

With custom-designed web apps to streamline workflows for each user, Carhartt envisions a future where it can empower stakeholders at any GIS experience level to run their own analyses, closing the gap between curiosity and answers across the company. In the meantime, Newsome and Isaak can offer the sales team drillable web-based reports with live-updating infographics in place of unruly Microsoft Excel spreadsheets and static PDFs.

Sapardanis hopes to develop workflows to allow sales teams to capture the layout and merchandizing of all their accounts' stores. "Imagine if they could just walk in with their phone, and click—it comes back to us, and now we can put it in the mapping tool. That's where I want us to go, and I think that's exactly where we're headed." Newsome and Isaak think this data could even interface directly with Carhartt's sales platform, seamlessly integrating with GIS.

Meanwhile, the data team is currently exploring predictive modeling by creating a tool capable of identifying trends and projecting future development. This is a grassroots effort inspired by the team's desire to ask deeper questions and explore what is possible using its tools and data. For Carhartt, the excitement is palpable and the possibilities are endless.
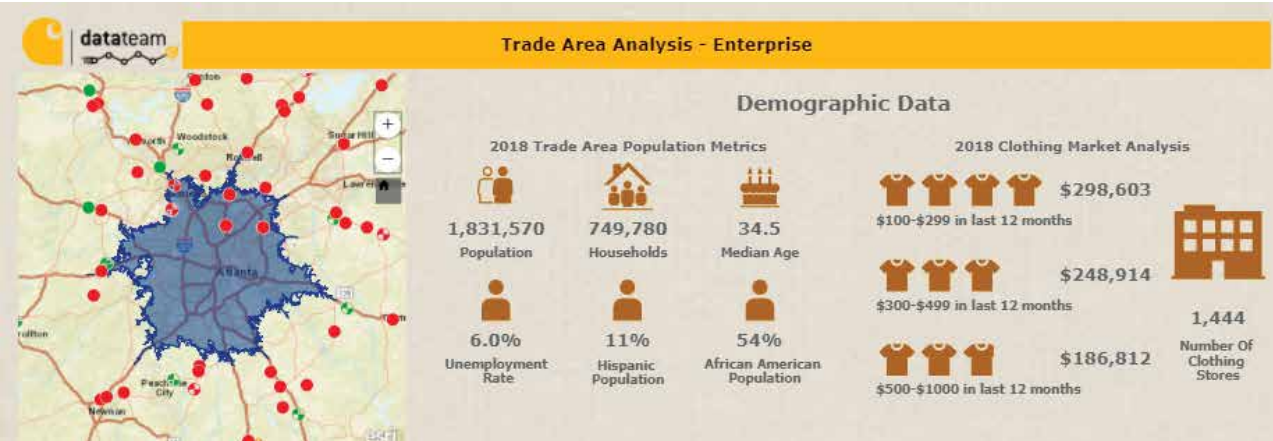
↑ The Carhartt team uses ArcGIS Business Analyst to deepen its understanding of customer needs. By using the drive-time analysis tool, then overlaying demographics and household spending habits, the team can refine market assessments.

← With the Market Attack platform's Sales Analytics Decision Augmentation application, Carhartt envisions a future that empowers stakeholders at any GIS experience level to run their own analyses, closing the gap between curiosity and answers across the company.

Mekong Infrastructure Tracker Provides a Regional Perspective on Sustainability and Development

Rapid growth in the number of dams along the Mekong River is transforming Southeast Asia's energy, food, transportation, security, and ecological networks. The Mekong River, which starts on the Tibetan Plateau in China, flows through Myanmar, Laos, Thailand, Cambodia, and Vietnam before emptying into the South China Sea.

Eleven hydropower dams now span the river's mainstream before it leaves China, with hundreds more dams planned or under construction in the other countries that contain parts of this vital watershed. This development has been rapid, and the consequences to people and the environment are still largely unknown.

Scientists at the Stimson Center, a think tank focused on enhancing international peace, have been monitoring the impact of hydroelectric power projects on regional stability and the food and water security nexus.

"Our core message is that nonhydropower renewable energy, like solar and wind, can replace hydropower with far less disruption," said Brian Eyler, director, Southeast Asia Program at the Stimson Center. "Our static map of Mekong mainstream dams is very popular for use in the media and for research presentations, but we realized that a static map didn't show the full picture."

With support from the US Agency for International Development (USAID) and The Asia Foundation, a nonprofit international development organization, through the five-year USAID Mekong Safeguards program, Eyler and his team set out to create the Mekong Infrastructure Tracker (https://www.stimson.org/2020/mekong-infrastructure-tracker-tool/). It is a database of visual presentations, spatial analyses, and shared expertise. The dashboard was created using GIS, with help from Esri partner Blue Raster. The Mekong Infrastructure Tracker provides a single source of truth that allows stakeholders to communicate and compare development scenarios.

"In addition to tracking dams, we had the idea to track solar projects after seeing a big uptick in the region in 2018," Eyler said. "Our partners at USAID asked us if we'd track all infrastructure in Cambodia, Laos, Myanmar, Thailand, and Vietnam. It didn't take much consideration to jump at this opportunity because infrastructure is a hot issue in the Mekong region."

The tracker catalogs projects for power generation and industrial development as well as road, rail, and waterway transportation. It also includes tools to analyze and quantify the impacts of infrastructure projects.

Construction on the existing dams has already displaced thousands of people, immediately impacting some. River people, who subsist on fishing and riverbank agriculture, are feeling effects of the ecological damage to the ecosystems. In the village of Baan Huay Luek in northern Thailand, for example, villagers speak about how the dams have switched the rules of nature, with dry seasons no longer dry and wet seasons no longer wet.

Mapping Mekong Infrastructure Development

The Mekong River has been deemed Southeast Asia's most important waterway, as it is central to the lives and livelihoods of millions of people and serves as a food source. The Mekong watershed is known as the "rice bowl" of Asia, and 20 percent of the world's freshwater fish catch comes from its waters.

To date, governments and activists interested in Mekong watershed development have had to contend with the lack of information about or awareness of existing or planned projects.

"This information is usually something that private sector organizations collect and then distribute only to their clients," said Regan Kwan, research associate at the Stimson Center and manager of the Mekong Infrastructure Tracker project. "Through GIS, we make the data available so that anyone can visualize it, analyze it, and contribute to it."

The Xayaburi Dam is a hydroelectric dam on the Mekong River in northern Laos.

↑ The Mekong Infrastructure Tracker database presents a comprehensive source of information on energy, transportation, and water infrastructure in the Mekong countries.

↑ The Mekong Infrastructure Tracker Dashboard visualizes and provides data on energy projects including biomass, coal, gas, geothermal, hydro, mixed fossil fuel, nuclear, oil, solar, waste, and wind.

The Stimson Center works with a wide range of stakeholders on this and other projects, with an eye on community engagement and capacity building. The Mekong Infrastructure Tracker has drawn interest and participation from national development banks, government agencies, ministries, international nongovernmental organizations, local grassroots organizations, the private sector, academic researchers, and individuals.

"Our Stimson team is relatively small, and we're collecting thousands of data points," Kwan said. "We're bound to make some mistakes, skip things, or not see everything others are seeing. It's great to have others use our data, share their viewpoints, and fill in gaps."

In addition to serving as a single, accurate data source, the Mekong Infrastructure Tracker helps guide foreign policy and assess investment opportunities.

"Having all this information transparently and freely available gives those looking to achieve a more sustainable future a resource to ask questions anytime they want," Eyler said. "No one has provided this depth of information before."

Learning About Energy and Environment in the Mekong Region

The Stimson Center avoids advocacy, instead allowing partners to draw their own conclusions from the data. One such partner—EarthRights International, based at the Mitharsuu Center in Chiang Mai, Thailand—trains young activists on development issues, environmental impacts, and human rights law and policy. During a seven-month program called the EarthRights School, students take classes and learn to conduct research.

"We've been encouraging our students to use the Mekong Infrastructure Tracker to map out various projects in their home countries in order to support their advocacy," said William "BJ" Schulte, Mekong policy and legal adviser, EarthRights International. "We value the tracker as a strong tool that can support networks of activists and community leaders to address the regional energy strategy in the Mekong region, as we see a growing reliance on fossil fuels, especially coal."

One of the reasons fossil fuels are gaining interest in Cambodia, for example, is that existing dams haven't produced as much energy as predicted, largely due to an ongoing drought. Coal causes grave concern because it releases the most greenhouse gas of any fuel, and the hazardous waste by-product coal ash is hard to safely store.

"One of our alumni alerted us to a coal-fired power plant that's going to be sited within *[Preah Monivong]* Bokor National Park," Schulte said. "We're working with local activists to understand the local impacts."
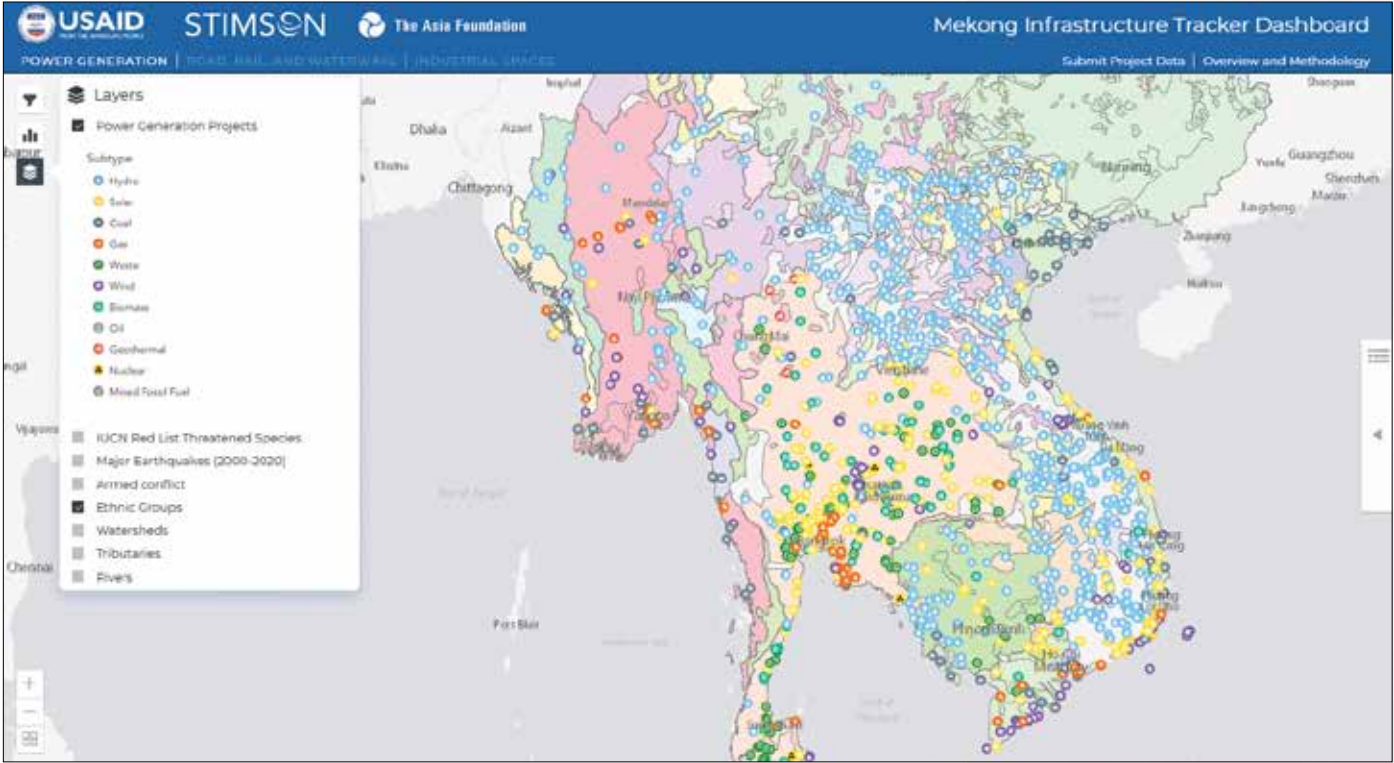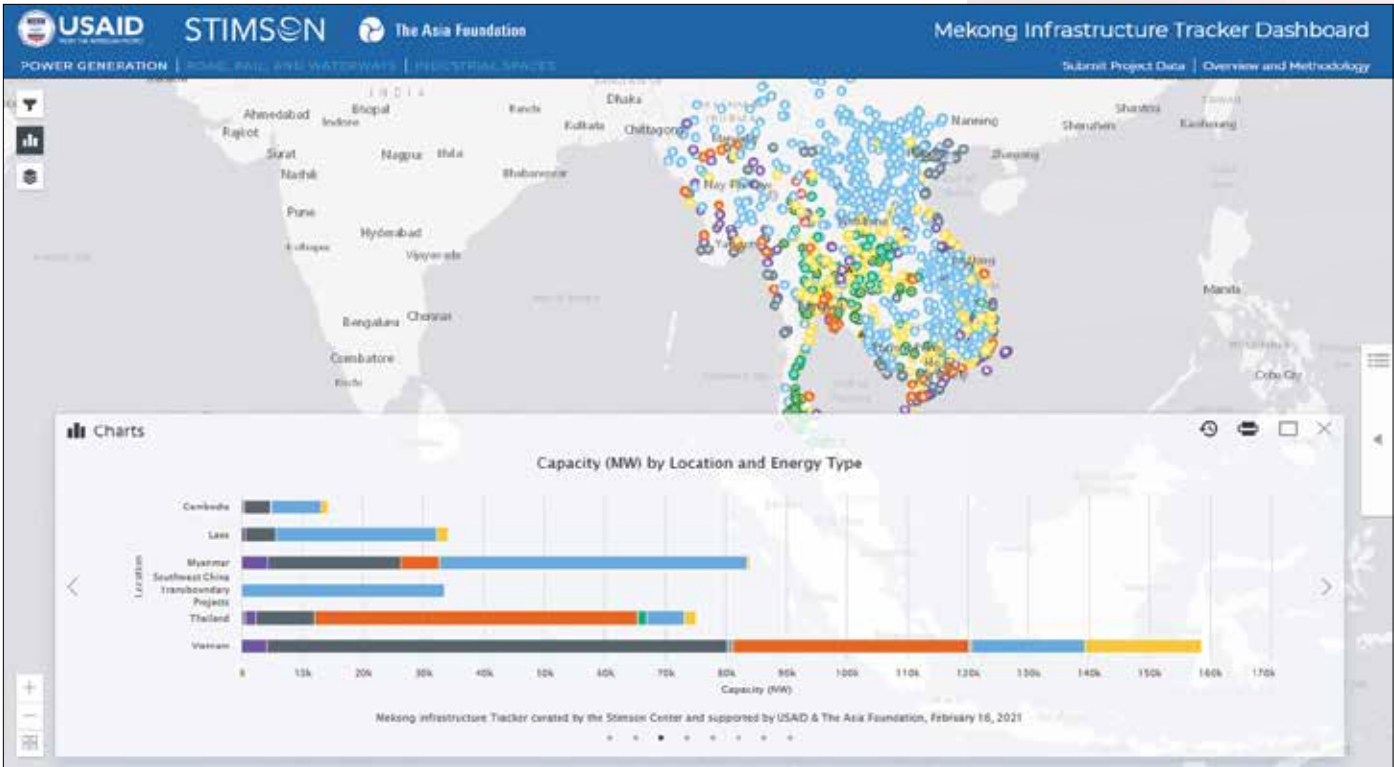
EarthRights International has participated in adding data from communities to the Mekong Infrastructure Tracker to raise awareness about such projects.

"The tracker gives us the ability to draw out where all the projects are and see how they impact each other," said Naing Htoo, Mekong program director at EarthRights International. "We use it to see the regional perspective, including the financiers behind the projects, which include a lot of cross-boundary investment."

Gaining Geopolitical Awareness

Many government leaders are seeing the Mekong Infrastructure Tracker data and getting a greater regional perspective.

"At first, we had some anxiety about presenting our data to governments in the region, because satellite imagery and other forms of remote-sensing data are often seen with suspicion," Eyler said. "We found that data which shows the speed of change in the region and the ease of visualizing and analyzing the data appeases concerns. It was the first time they could see what's happening in other countries."

China's ambitious Belt and Road Initiative, a massive infrastructure project that is planned to stretch from East Asia to Europe, plays a major role in much of this development. The Mekong Infrastructure Tracker promotes awareness of this and other development programs.

"The data can be used to assess the geopolitics, seeing areas where China or other external investors from Japan, Korea, or the United States are more heavily invested," Eyler said. "You can see how many projects are planned and how many are moving forward. Knowing the gaps is really useful information."

With more infrastructure projects being planned, and with the rising risks due to climate

Mekong Infrastructure Tracker Provides a Regional Perspective on Sustainability and Development

change, EarthRights International workers are also seeing more negative impacts on indigenous people.

"Due to their locations, many of the large infrastructure projects disproportionately impact ethnic minorities and indigenous peoples," Schulte said. "When they try to raise their voices, they are increasingly attacked or imprisoned, or even disappear. A lot of the fossil fuel projects are backed by powerful people with significant financial interests."

Operationalizing Data Gathering and Shared Insights

The transparency of the Mekong Infrastructure Tracker—along with the elements of citizen science that allow anyone to contribute—is encouraging widespread participation from a diverse array of people. The Stimson Center takes a data-accurate and research-agnostic approach to the platform to engage participants and encourage dialogue. Administrators are driven to gather complete data and present the truth.

"If anyone using our geodatabase realizes it differs from what they know about an infrastructure project, and they have sources to back it up, we provide an ArcGIS Survey123 form to fill in missing information," Kwan said. "We review it, and if it checks out, we make the update."

The Mekong Infrastructure Tracker has a Facebook group that participants use to drop links to news reports about infrastructure projects. If the news signals a new project, then it's added to the database. Any information about changing timelines or project details is noted. In addition, hackathons are held to fill in data gaps and correct inaccuracies.

The dashboard focuses on five main datasets for energy, transportation, and water infrastructure projects and has data about the surrounding environment and people, including ethnic groups. Data on energy projects—including biomass, coal, gas, geothermal, hydro, mixed fossil fuel, nuclear, oil, solar, waste, and wind—is curated along with transportation details on upgrades to canals, urban and high-speed railways, and national roads. The site also covers industrial development at airports, railway stations, and sea or inland ports, as well as special economic zones that provide investment incentives.

"We work to ensure the data is accurate and complete," Eyler said. "The vision is to continue to provide a mix of technical and simple-to-use tools to analyze the data and improve decision-making in the region."

The Mekong Infrastructure Tracker database provides robust environmental and social impact indicator layers that allow anyone to see and study the risks and benefits of various development scenarios.

"A long-term goal is to create a scenario planning application which gives users a chance to generate their own investment scenarios and assess costs and benefits across a variety of indicators," Eyler said. "Users could compare scenarios and even take their scenarios to other policy makers and planners to talk through multiple development pathways and choose the most optimal for their own locality or for the region at large."

Learn more about how location intelligence guides sustainable development at https://bit.ly/3qusbYO.

The Mekong watershed is known as the "rice bowl" of Asia, and 20 percent of the world's freshwater fish catch comes from its waters.

ArcGIS Platform Gives Developers Direct Access to Location Services

Together, these elements provide an intuitive experience for accessing and using ArcGIS Platform.

Outstanding Developer Experience

ArcGIS Platform provides a premium developer experience that comes with the robust ArcGIS API for JavaScript and a set of APIs for mobile and desktop development. Developers using ArcGIS Platform can also leverage open-source mapping libraries, including Mapbox GL JS, Leaflet, and OpenLayers. ArcGIS Platform supports industry-standard authentication using API keys.

The ArcGIS Developers website (developers.arcgis.com) provides resources and tools to help developers be successful with ArcGIS Platform. These resources include a developer guide describing productive workflows, extensive SDK documentation, more than 100 tutorials with a live sandbox that lets developers code and instantly see results, and a dashboard that gives detailed service usage and statistics. On the ArcGIS Developers website, a free account can be quickly and easily created to get started using these tools and resources.

A Collection of Location Services

ArcGIS Platform gives developers access to a comprehensive set of industry-leading location services: basemaps; data hosting; data visualization; geocoding and search; routing and directions; maps and data; and spatial analysis.

↓ ArcGIS Platform furnishes an excellent developer experience; a comprehensive set of industry-leading location services; and a simple, transparent business model.

Esri delivers billions of basemap views around the world every day and ArcGIS Platform makes this rich resource available to developers.

Content can be hosted on ArcGIS Platform. This content can include services based on data as well as features; vector and image tiles; GeoJSON; spreadsheets; shapefiles; and text files stored in the ArcGIS Platform, which is secure, scalable, and performat. Note that developers retain ownership of any hosted data and telemetry data is not collected by Esri from users of apps and solutions developed using ArcGIS Platform.

All the tools for making beautiful maps in 2D or 3D—at scales from hyperlocal to global—and insightful visualizations are provided. The power of Smart Mapping is available to assist in creating intelligent maps by using just a few lines of code.

The geocoding service is powered by industry-leading reference data that comes from multiple authoritative sources that include commercial data providers, government agencies, and a network of Esri partners from around the world.

Services provide routing and turn-by-turn directions for single vehicles or for multiple vehicles to multiple destinations. The routing service has global coverage and generates localized directions. The route solver also takes into consideration current traffic conditions and dozens of restriction types.

Through ArcGIS Platform, developers have access to an extensive data library that includes demographic and statistical data (such as income, spending, market segmentation, and psychographic data), real-time live feeds, and high-resolution imagery from multiple commercial and community providers that can be used directly in apps or joined with proprietary data sources.

ArcGIS Platform provides hundreds of spatial analytics tools and operators—from geometric processing to attribute and spatial queries—and supports interactive analytical operations on 2D and 3D data. These spatial analytics tools can be used in two ways: on the client side by leveraging the power of devices and on the server side. Developers can also work with the big data, real-time analytics, advanced spatial tools, machine learning, and deep learning capabilities provided by the ArcGIS system.

These services can be used in many different deployment patterns for the web, mobile devices, desktops, and even system-to-system integration.

Consumption-Based Pricing

ArcGIS Platform is offered through a new business model that provides frictionless access and consumption-based pricing, so developers pay just for what they use. Getting started is as simple as signing up for an account at the ArcGIS Developers website (developers.arcgis.com) to receive the free tier, which includes two million map tiles a month and thousands of other service requests, which can be used to search, geocode, and host data.

"With the release of ArcGIS Platform, developers now have access to professional-grade content and capabilities they can readily plug into their apps, allowing them to stay on budget while delivering enormous value by reducing time to market," said David Cardella, Esri product manager for developer technologies.

ArcGIS Platform | A Location Platform as a Service

Location Services
Content and Capabilities

Developer Experience
Mapping APIs
Open-Source Mapping Libraries
Developer Resources

Business Model
Consumption Based Pricing

An Intuitive Developer Experience for Accessing and Using ArcGIS Platform

Rwanda Improves Land Management Processes with GIS Technology
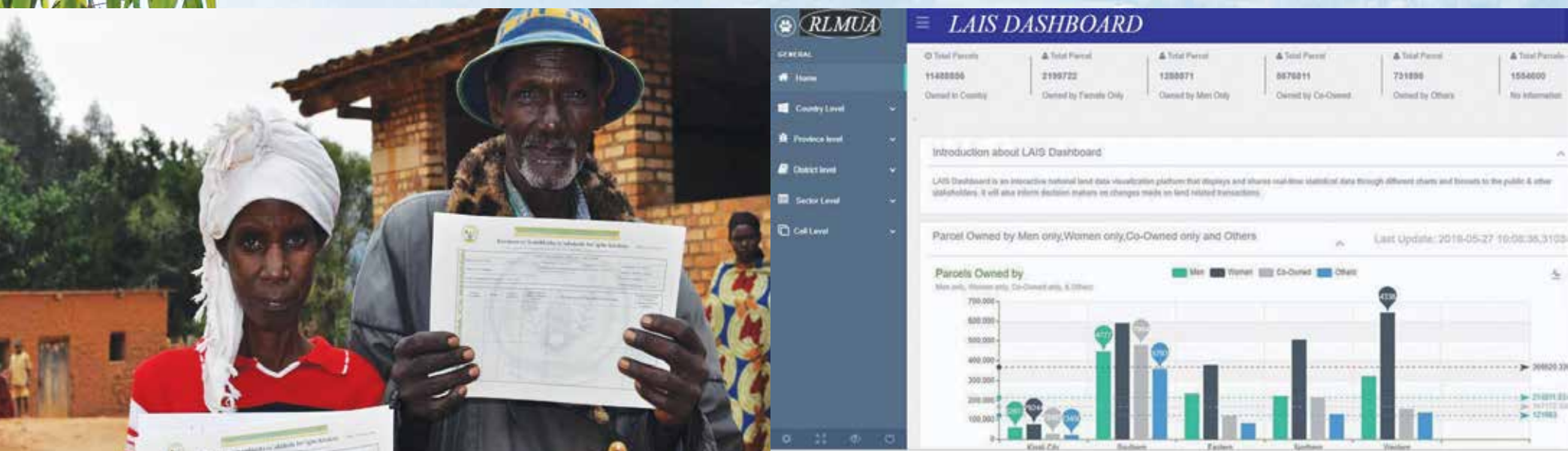
↑ Land Administration Information System (LAIS) improves the current process of titling and certification of land throughout the country.

↑ LAIS version 4.0 integrates interactive national land data visualization that shares real-time statistics on land use through a dashboard.

The latest release of the Land Administration Information System (LAIS) by the Rwanda Land Management and Use Authority's (RLMUA) is transforming the way the country manages, develops, and maps its land.

Begun in 2008, Rwanda's land registration reform has fostered incremental improvements in the Rwanda land administration processes. The first version of LAIS helped support the initial collection and management of large amounts of land administration and legal data for the development of land-use plans at the national and district levels.

In collaboration with Kadaster International, RLMUA used the Esri ArcGIS to develop and deploy LAIS version 4.0, which is improving the current process of titling and certification of land throughout the country.

Meeting the Challenge of Land Governance

The land authority is responsible for implementing the National Land Tenure Reform Program, as provided by the National Land Policy and the law governing the land in Rwanda.

Over the last two decades, Rwanda has invested considerably in land administration. Most recently, the successful deployment of LAIS version 4.0 in 2019 and the adoption of Esri's Land Administration Modernization Program (LAMP) have provided the country with advanced GIS technology and support to meet the evolving challenge of comprehensive land governance.

Esri's LAMP is a grant program that allows resource-constrained countries and their cadastral agencies access to the Esri enterprise platform, supporting the upgrade to LAIS version 4.0 and mapping work.

"RLMUA got multiple benefits from implementing LAMP, such as providing better and [speedier] service delivery to the population, more consistent data; eliminated errors in land titles; and [provided] a better protection of the land titles [and] web map services, among others," said Espérance Mukamana, director general and chief registrar of land titles, RLMUA.

The new system overcame technical challenges encountered in the previous LAIS versions by combining previously separated textual and GIS components into one system and better aligning with the current IT system's security procedures. The new system also ensures alignment with the ISO 19152:2012 Land Administration Domain Model (LADM), which supports standardization and integration of land data.

LAIS version 4.0 now provides users with web access to up-to-date spatial data through mapping services, which can be shared seamlessly. It also integrates interactive national land data visualizations that share real-time statistics on land use through charts available on a central dashboard.

Additionally, the new system is enhancing transparency and providing users with the spatial tools and data they need to perform land-use analysis for their own land and, collectively, to better plan for the sustainable development of the country.

A Lighthouse for Africa

RLMUA has gained remarkable experience and results by using GIS for land management services, according to Mukamana, who says the technology has "led to a better understanding and implementation of the land management system and helped RLMUA achieve its targets efficiently."

LAIS version 4.0 places Rwanda among the few countries on the continent with the level of advanced geospatial technology that can operationalize land administration and use capabilities while also enabling real-time monitoring of land rights and use for potential investments in the country. The entire system has proved to be a vital tool that informs decision-makers on any changes made to land-related transactions.

"This project represents a lighthouse for Africa," said Sohail Elabd, Esri Global Business Development general manager, Middle East and Africa region. "Many governments are looking at ways to increase revenue through registration of land. Esri technology, provisioned through the LAMP, provides a set of out-of-the-box tools to do so. We are excited to be working with RLMUA to make this happen."

↑ RLMUA used ArcGIS to develop and deploy LAIS version 4.0.

App Helps to More Effectively Manage Crocodiles and Public Safety

↑ Saltwater crocodiles, the largest crocodile species in the world, may cause serious and even fatal injuries.

↑ Gareck Packer, director and solutions manager at GP One Consulting, has been a personal champion of ArcGIS AppStudio ever since he developed an app for an Esri challenge he entered and won.

From sparkling blue oceans to scenic islands and rain forests, the northern Australian state of Queensland has an array of natural habitats that are home to plants, mammals, and reptiles that are found nowhere else in the world.

One animal native to this region is the saltwater crocodile, the largest crocodile species in the world. Also known as estuarine crocodiles, or "salties," these deadly predators may cause serious and even fatal injuries.

The government in Queensland needed to find a new way to help keep its residents safe. The Queensland Government Department of Environment and Science is responsible for national park management and wildlife conservation. Its personnel handle overall crocodile management and educate the public on how to remain safe around crocodiles. These responsibilities can include deciding whether to leave a crocodile where it was sighted or remove it from the area.

Initially, the department set up a toll-free number for people to report crocodile sightings. This telephone system is part of the QWildlife platform, a series of solutions for wildlife management. However, the telephone system had some shortcomings.

According to Lindsay Delzoppo, director of northern wildlife operations in the Queensland Government Department of Environment and Science, "We just found that the 'phone us and press a button' system didn't cut it in today's market. Younger people wouldn't use it because it's just too old-fashioned and frustrating to use."

In addition, the system generated a series of emails routing reports to decision-making personnel and the field staff managing sightings. Each part of the workflow could potentially be managed by a different person. This caused delays and provided no feedback to people who reported crocodile sightings.

A New Solution

The Queensland government approached GP One Consulting, following its successful bid to develop a new solution for reporting crocodile sightings, improving the safety of tourists and residents, and streamlining decision-making related to those reports. Queensland's Deputy Premier Steven Miles, former Queensland environment minister, specifically requested that GP One Consulting create an app that would work on smartphones and tablets.

Located in Townsville, Queensland, in the heart of "croc country," GP One Consulting is a software development services business that focuses on delivering targeted spatial web and native mobile applications. Gareck Packer, director and solutions manager at GP One Consulting, and his team began searching for the best software for developing this app. Packer and his team opted for ArcGIS AppStudio, an Esri solution they have been using for several years. Packer has been a personal champion of AppStudio ever since he developed an app for an Esri challenge in 2015, which he subsequently won.

With ArcGIS AppStudio, users can build geoenabled cross-platform native apps from a single code base. The team chose this low-code platform because it offers significant benefits both in production and in making apps easily available on multiple platforms. In tandem with AppStudio, the team also managed content using ArcGIS Survey123, a formcentric solution to create and distribute surveys and forms.

"As a business, we've been using AppStudio for quite some time, and we chose it because we could get something out very quickly. The app also leverages Survey123 so it fit in terms of a best practice, cross-platform solution," said Packer. "The Survey123 template that was provided by Esri allowed us to put a lot out without us doing too much initial development or too much customization. Esri provided the templates for us to hit the ground running."

As customizations of the original template were minimal, app development was rapid. Educational content was included, and the user interface changed to reduce the number of clicks and improve the overall user experience.

The GP One Consulting team involved rangers in the app's development. "The rangers drove the design process, and they got to see exactly what was happening during the development process," said Packer. "It's been a massive success because the guys on the ground that will be using the system were taken on the full journey. The approach worked extremely well."

The app, available on iOS and Android, is linked to ArcGIS Enterprise. When the public logs a crocodile sighting using the app, built with AppStudio, the data is pushed to ArcGIS Enterprise, where park rangers can leverage a range of web-based toolsets to manage and monitor each sighting.

Using AppStudio let the GP One Consulting team deliver an efficient app quickly and easily make it available to the public. "We don't have to have a different developer for different platforms. We can just do it once and distribute it to many platforms," said Packer. "As a developer, we love it. I think all of us…just get it."

Reporting, Educating, Managing

The QWildlife app lets the public input crocodile sightings and educates them on how to behave in crocodile-infested areas. The app gives details on reported crocodile sightings from the last 30 days through an embedded map. Users can see exactly where crocodiles have been reported and where there are problem crocodiles being targeted for removal.

When a sighting is submitted, on-duty rangers, or field operators, receive text messages and emails. These notifications prompt rangers to access the system, fill out what is required, and pass on the report so that the workflow moves from sighting to decision so preventative actions aren't delayed.

Once a sighting has been passed on, that sighting will pop up on the map. Users can check the status of sightings they've submitted. They can also subscribe to notifications to be alerted when a crocodile is sighted in their area.

↑ Once a sighting has been passed on, that sighting will pop up on the map on the app, and users can check the status of sightings they've submitted.

According to Packer, the app is not just about public safety. Conserving crocodiles and other wildlife is fundamental to the department's mission. By informing people how to behave around wildlife, it is less likely that drastic action will be necessary to mediate interactions with wildlife.

Engaging the Public

After six months in use, both the public and the rangers were pleased with the QWildlife iOS and Android apps. Delzoppo said sightings are reported and received by rangers quickly with the new digital system. Through the app, users are informed on how the department is dealing with the animal. Delzoppo added, "People are very pleased that we recognized their sighting and are dealing with it."

"We haven't done the math yet, but I'm sure that the efficiency and the cost saving will be there in terms of us being able to deal with an increasing number of sighting reports more efficiently and effectively," said Delzoppo.

Although the phone system can still be accessed, the new app makes reporting and other capabilities accessible to a much larger demographic.

The new QWildlife app is helping the Queensland government appeal to a younger generation of users and expand their reach, an unexpected but welcome result of using new technology. "We're not just an old fuddy-duddy organization using 1980s
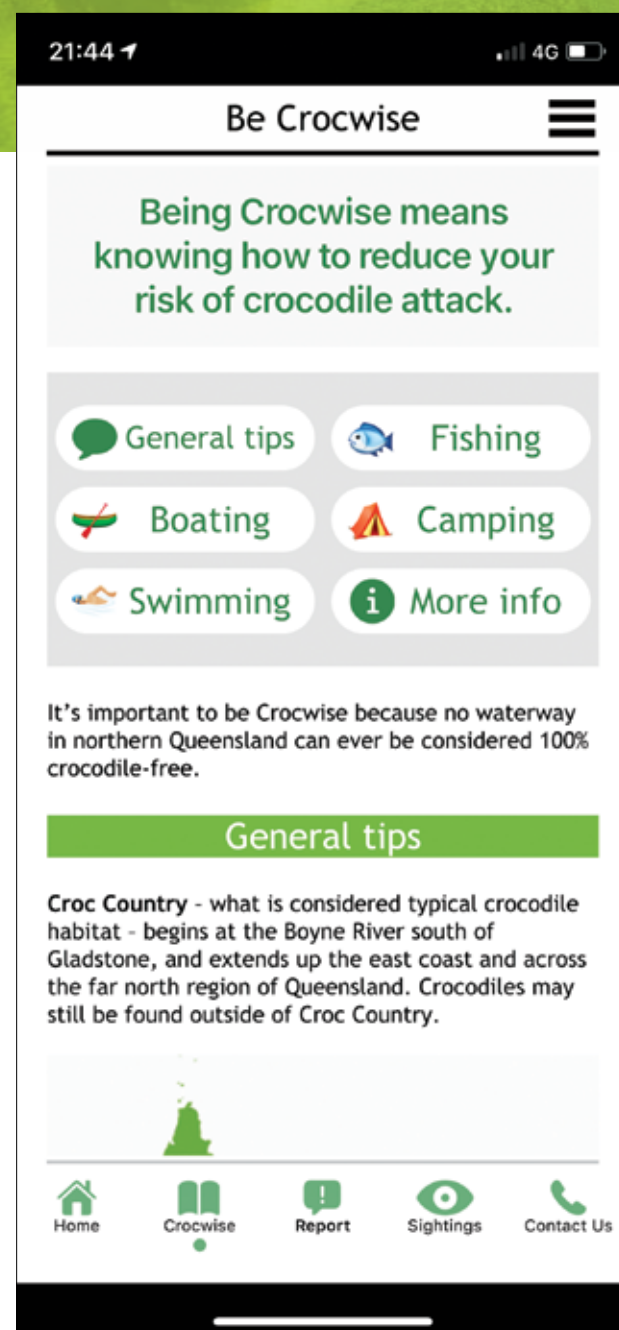
↑ The QWildlife app not only lets the public input crocodile sightings, but it also educates them on how to behave in crocodile-infested areas.

technology. *[The app helps us show]* that we're with the times," Delzoppo said.

"The app is an engagement piece for those people that are proactively being part of that reporting," said Packer. "Users can get something back in return. And they feel good about themselves and may be more willing to engage later."

Expanding App Uses

While users are pleased with the app, the feedback from partner organizations of the department has been equally positive. Delzoppo explained that 40 local governments in Queensland can directly benefit from this solution. His team can let the counselors in each local government know what's happening in their parks and keep their constituents better informed.

Surf Life Saving Queensland is another partner organization and a key client of the department. Surf Life Saving manages swimming on Australian beaches. The fast reporting with the app has allowed the department to alert Surf Life Saving in advance if there has been a crocodile sighting in the area to help keep swimmers safe in the water.

Delzoppo said the department has big plans for the QWildlife app and will use it to manage sightings of other interesting wildlife—such as koalas and cassowaries, a native exotic bird—to help conserve them. "We're starting with crocodiles, but we'll be dealing with a whole range of different wildlife in Queensland," he said.

Empowering Others with GIS

In a career as an extension specialist with the University of Tennessee (UT) Extension that spanned more than 37 years, Tim Prather helped the state's farmers benefit from a variety of extension programs. With GIS, Prather found a powerful tool for making agriculture more sustainable, both environmentally and economically. Through his work as a GeoMentor and volunteer with the 4-H program, he also found a way to make a positive difference in the lives of youth.

Tim Prather

GIS Hero
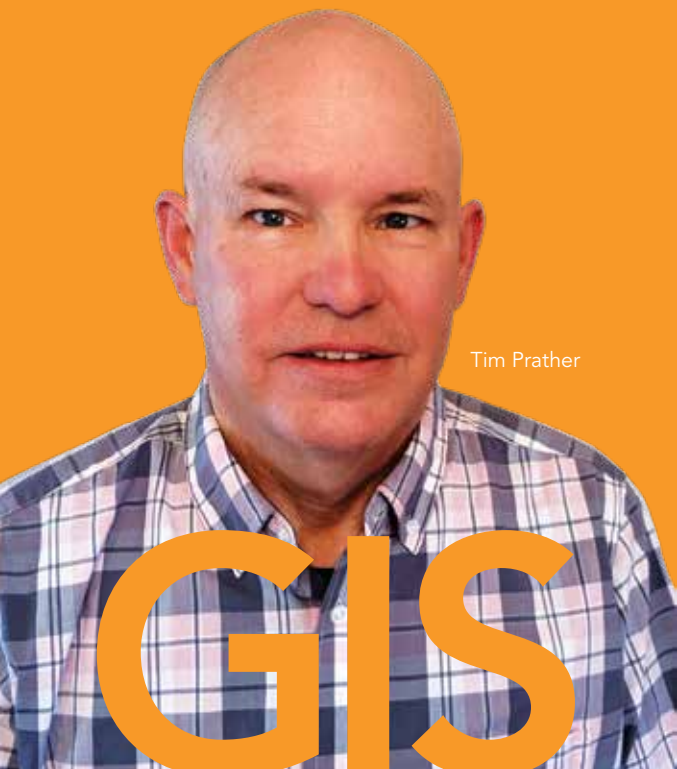
Growing up in Good Hope, Georgia, Prather was introduced to agriculture and plenty of outdoor activity. When he wasn't reading *Popular Mechanics* and *National Geographic*, he was living a country boy's life, working in his dad's pecan orchard, hunting, fishing, camping, raising steers, and helping out on his grandfather's 400-acre farm.

"I grew up in farm heritage and spent a lot of my summers over at my granddaddy's farm. It was probably my favorite place to go," Prather said. "In the summertime, I'd ride my bike the 15 miles over there and spend the weekend working with his cows, chickens; plowing the soybeans; or mowing the pastures—whatever there was to do."

While Prather will be the first to say he isn't a farmer, his family's farming heritage played a critical role in forming his interest in agriculture and mechanics. When it came time to pursue college, enrolling in the agricultural engineering program at the University of Georgia—just 20 miles down the road—was a natural fit. The program empowered Prather to combine interests in the various engineering disciplines to solve food production problems. After graduating with his master's degree, Prather joined the University of Tennessee Extension in 1983 as the farm safety specialist and safety coordinator, setting the foundation for a fulfilling 37-year career helping farmers, community members, and students better their lives with technology.

A Career Helping Others

Extension programs, such as the one at UT, came to fruition as a result of the Land-Grant College Act of 1862, or the Morrill Act. This act granted each state 30,000 acres for each of its congressional seats to sell to finance new schools or establish schools of agriculture and mechanic programs at existing universities and colleges, both private and state funded.

Beginning in 1914, land-grant universities were given funding for the Cooperative Extension System (CES). CES, which is administered by the United States Department of Agriculture (USDA), furnishes services through county governments that provide research-based education programs to community farmers. Extension programs include the National AgrAbility Project, 4-H, beginning farmer programs, and safety education. At some point in his career, Prather would work with all these programs.

As a farm safety specialist and coordinator, Prather offered safety workshops to farmers throughout Tennessee. In 1994, he worked to secure grant funding from the USDA for an AgrAbility Project. This program assists farmers, farmworkers, and their family members with disabilities to live more independent, productive, and profitable lives.

Prather has seen the program's positive impact firsthand. He recalled a young farmer who was paralyzed after an all-terrain vehicle (ATV) accident on his farm. To continue farming, he needed a lift to help him get off and on his tractor or in and out of his truck without assistance. Through the program, Prather's team was able to secure the funding for the lift.

"It can take a long time to accomplish these, but when you finally manage to help a young man regain his independence and improve his ability to contribute to the farm operations after an accident like this, it can be life changing," Prather said. "I am very proud of our team of UT, Tennessee State University, and nonprofits, and that Tennessee AgrAbility was able to operate continuously since 1994."

Prather's career evolved to include solar energy education and precision agriculture. After he was introduced to GIS technology, Prather created maps of soil samplings and crop yields and other factors that measure profitability. He used GIS as a tool to make farming more economically and environmentally sustainable.

→ During the 2017 Esri User Conference Plenary Session, Tennessee 4-H GIS members Austin Ramsey, Amanda Huggins, and Elizabeth Sutphin presented data from the National 4-H GIS/GPS Leadership Team's research project on obesity in the United States.

"I learned about GIS midcareer when I took a class in my department. We were using ArcView *[GIS]* 3 at the time, and I remember it was exciting to create a map with the data I had collected with GPS or from a farmer's combine yield monitor," Prather said.

As someone who wanted to "open his eyes" to the power of spatial thinking, Prather attended his first Esri User Conference (Esri UC) in 2007 where he said he was "blown away" by the future capabilities of GIS and the enthusiasm of Esri founder and president Jack Dangermond.

The conference also introduced Prather to the National 4-H GIS/GPS Leadership Team and started him on a 14-year journey as a GIS volunteer and mentor. The team consists of 20 to 40 teens and adults from participating states who work together on projects and community mapping programs. Each year, 4-H students attend Esri UC to present their maps and research and participate in a service-learning project in San Diego, California.

Giving Back as a GIS Volunteer

Whether he was reviewing Esri UC Map Gallery submissions, teaching students how to build a map, or showing them how to collect data with ArcGIS Survey123, Prather has helped students understand the power of GIS. As a 4-H leader, Prather served as a chaperone to Esri UC and planned the annual student service-learning project in San Diego that is held in conjunction with Esri UC. Some of his favorite service-learning projects were collecting data on invasive plants at the Tijuana Estuary, an intertidal coastal wetland in San Diego County, and mapping signage and illegal hiking trails at the Cabrillo National Monument, located west of the city of San Diego. Prather is committed to sharing his knowledge and time to help students understand the power of GIS and grow as individuals.

"I was just one of several people trying to open their eyes to the power of spatial thinking and give them the tools to present their findings," Prather said. "I was always excited by the creative projects our members would come up with

and how much they grew by doing them. And to see their excitement for GIS during Esri conferences."

One of Prather's fondest and proudest memories is of his Tennessee 4-H GIS team presenting the results of a National 4-H GIS/GPS Leadership Team research project during the Plenary Session at the 2017 Esri UC. Working with an Esri educator, Prather's team took project data on obesity rates across the US that had been collected in spreadsheets and analyzed and mapped it using ArcGIS Pro. The team's analysis explored obesity rates in relation to other health conditions.

While Prather enjoys the students' GIS achievements, watching them mature, gain confidence, and develop has made the greatest impact on him. Prather recalls a young person who had a difficult upbringing. She was shy, nervous, and lacking in confidence when she joined 4-H in high school. In her four years with the program, she flourished, becoming a poised and confident young woman. Her project won second place at the state 4-H project judging and earned her a trip to the National Safety Council Conference & Expo in Las Vegas.

"I still think about her because she is such a great example of what 4-H, nurturing teachers, and leaders can do for our youth," Prather said. "I think the skills and confidence that young people gain from the 4-H opportunities prepare them to be the next generation of leaders, and I am glad to have been a part of it."

If there is anything that Prather hopes others in the GIS community can learn from his story, it is the importance of giving back to the next generation of leaders.

"I want to encourage others to become a GeoMentor in their community, whether through K–12 schools, 4-H, Scouts, Big Brothers Big Sisters *[of America]*, or any other youth organization. No matter their expertise or background, they can help open doors for students by showing them what made GIS exciting to work with in the first place. In doing so, you never know how you are making a difference that can change someone's life," Prather said.

For more information about the use of GIS in 4-H clubs and the support available from Esri, visit https://4hclub-k12.hub.arcgis.com.

A Single Platform Delivers Up-to-Date Information on a Massive Urban Renewal Project

In 2014, the French government launched Nouveau Programme National de Renouvellement Urbain (NPNRU), its national program for urban renewal. The goal of this ambitious 10-year program is rehabilitating neglected urban areas throughout the country.

Occupation by the Axis powers during World War II and bombing by Allied forces caused extensive damage throughout the area. During the reconstruction efforts that began shortly after the war, large residential tower blocks and commercial buildings were quickly erected. While utilitarian in design, these buildings provided much-needed infrastructure.

Two districts, Monplaisir and Belle-Beille, were selected for NPNRU funding for a massive urban rehabilitation project. These districts are located in the Angers Loire Métropole (ALM), the metropolitan authority surrounding the city of Angers. ALM encompasses 29 municipalities and is near the confluence of the Mayenne, Sarthe, and Loire Rivers in western France.

ALM launched a project management (PM) task to manage the more than 700 rehabilitation subprojects being undertaken in these two districts that would be running in parallel or cascade. The project's goal is to renovate residential and public facilities that have not been modernized since the rapid construction
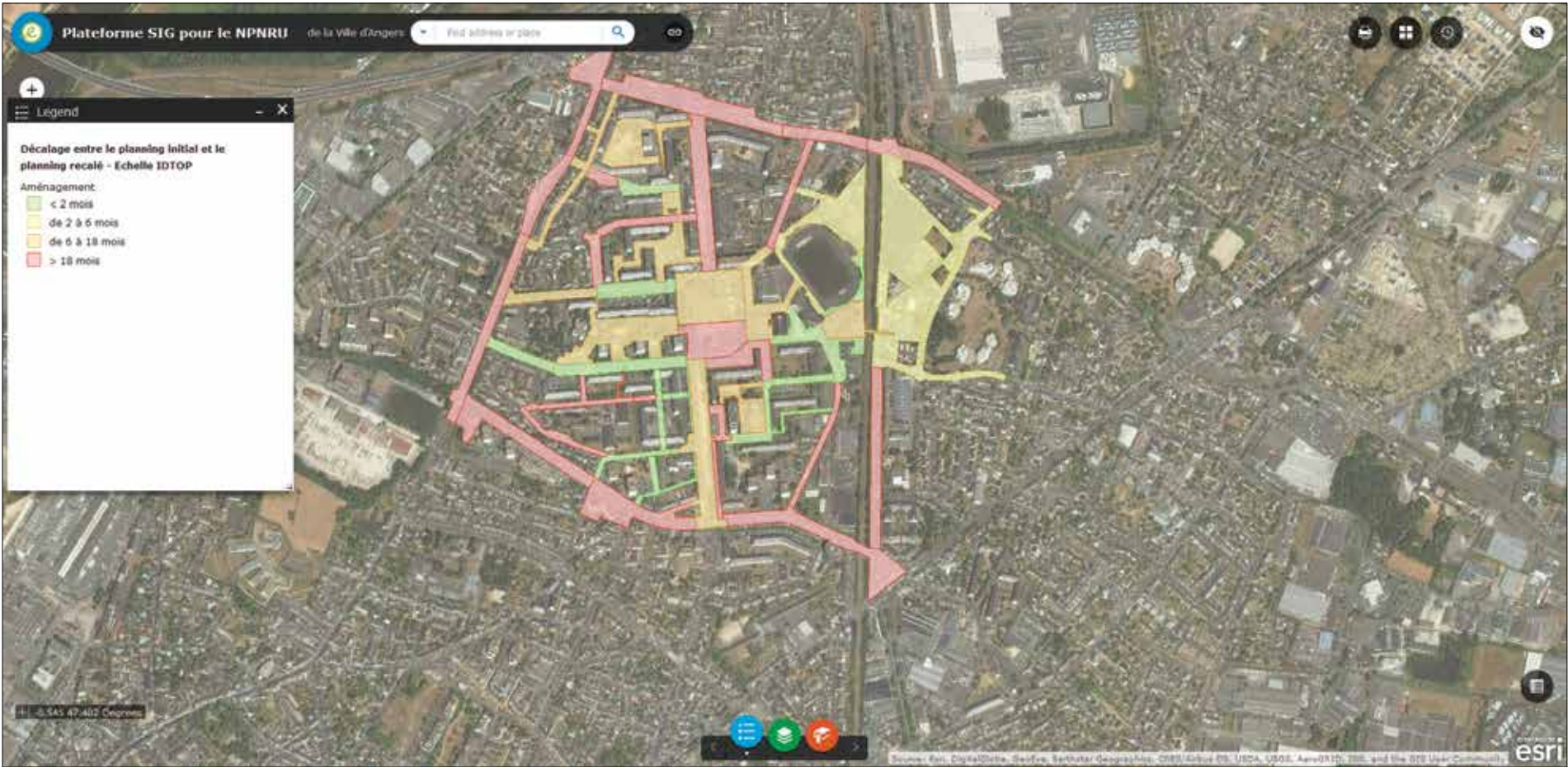
↑ This map of the project area shows the shift between the initial schedule project and ongoing work.

efforts after World War II. Costing 400 million euros (approximately US$450 million), this project will provide a mix of services and facilities in residential areas and bring businesses and residents closer to improve the residents' quality of life.

The scale of this renovation is ambitious. The project requires coordinating 13 participating organizations. In the Monplaisir district, 368 buildings will be demolished and 1,470 housing units and public spaces, such as parks, will be built in their place. In Belle-Beille, 623 buildings are to be demolished and 1,318 housing units and public spaces will be built.

A key requirement of the contract was the implementation of a project monitoring system that integrated complex planning, budgetary, and GIS functionality. Additionally, the system had to be easily accessible for both city officials and the many subcontractors working on the project.

In 2018, the Egis Group, a civil engineering company based in France, won the contract for managing the project, which must be completed in 2024. "The time frame is extremely tight because those people living in the old buildings must first be relocated, then the existing buildings will be demolished, and finally the reconstruction of the new buildings can begin," said Frédéric Jehan, head of GIS development for Egis.

"There is a vast amount of construction data that is continually being collected, reviewed, and updated for this project," said Jehan. "Because of the need to make it widely available 24/7, we have implemented a common data environment for the system."

The relational database used is PostgreSQL, and project and planning information is stored in Microsoft Project (MS Project). The Web GIS front end employs the portal in ArcGIS Enterprise and is used to visualize the project status. Egis is a system integrator that implements software solutions adapted to the working environments of its clients. The company tailors implementations to meet the specific data management, analysis, and presentation needs of its clients' management teams.

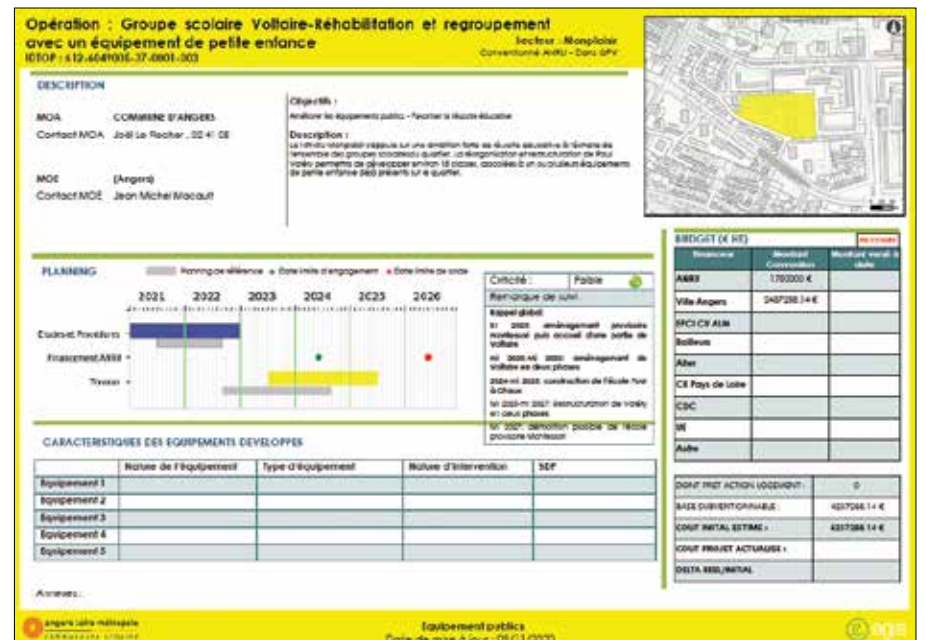MS Project was integrated into the system because it is commonly used for project management and planning. Because MS Project lacks mapping capabilities, it could not display geospatial data that would show subproject locations. A Gantt chart, included in MS Project, is the traditional planning tool used to illustrate a project schedule, but can't show spatial overlaps that indicate possible subproject conflicts that are visible on a map.

"So, the information depicted on the map allows us to modify the Gantt chart accordingly," said Jehan. "The mapping component is a huge differentiator for us. The data from MS Project is sent to our geospatial database. This allows us to implement a time-sequenced GIS so we can visually compare the original plan in MS Project with updates as the project develops. Then we know which subprojects are ahead of schedule and which ones are delayed. By specifying each subproject on a map, we can click on them to get all of the details related to that project."

A Python script was developed to transfer the data in MS Project to the geospatial database. Whenever a modification is made in MS Project, the script automatically saves a copy of it in a text file. Once a day, the script collects those files and integrates them into the GIS database, using unique IDs and nomenclature to adhere to the proper IT structure. The entire process is automatic.

"From the GIS database, project status reports with maps are automatically generated each month for the city administration to review," said Jehan. "The reports indicate the progress that was made on each subproject during the previous month. They include the data from MS Project, such as the budget, when a particular subproject was started, the company that is working on it, and a variety of construction details."

Previously, this report was generated annually because it was a slow, manual process. Now, most required tasks for the project are automated through the project monitoring system.

"Centralizing the database in the system has been revolutionary for us. In the past, we had to use different software on different platforms to get the latest information on a project. Now, on a single platform, up-to-date project information is readily available and easily accessible," said Jehan

"In addition, there is great concern in France about reducing the carbon footprint, so that there is less impact on the environment. One way to do this is to reduce the amount of data that is stored, because server storage consumes energy. By centralizing the database, we have reduced the necessity to maintain the same data on separate systems."

Thanks to this first, one-of-a-kind Web GIS approach, the client has identified clear benefits in implementing a collaborative Web GIS that brings multiple participants in a large-scale project under one common platform. It allows the various stakeholders to realize the advantages of having data with a high-quality data that is shared between all parties in a transparent way.

"Our management is very pleased with the outcome of the project monitoring system in Angers," concluded Jehan, "particularly since we have won six additional projects based on the concept of the Angers platform."

Improving Trash Monitoring with Drone Imagery, Artificial Intelligence, and Mapping

One of California's premier aquatic and ecosystem science institutes, the San Francisco Estuary Institute (SFEI), worked with partners in the state to develop an automated workflow for validating current trash monitoring methods used by California cities and municipalities.

Improving waste management offers many environmental benefits and is one of the most significant ways to help preserve the planet. Federal and statewide regulations, guidelines, and initiatives actively encourage local agencies to begin reducing the amount of trash and pollutants entering the local environment and waterways.

In 2015, the California State Water Resources Control Board adopted amendments to the Water Quality Control Plan for Ocean Waters of California to Control Trash and Part 1 Trash Provision of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries (ISWEBE Plan). The amendments were designed to provide statewide consistency for the water board's regulatory approach to protecting aquatic life and public health and reducing environmental issues associated with trash in state waters.

City governments and agencies must create ways to monitor trash to measure whether they are reaching the net zero trash generation rate goal. As difficult as this goal is to achieve, progress toward this goal is even harder to measure. Under current regulations, local governments must actively monitor garbage in public areas to ensure that trash-reducing measures are effective.

To validate the current trash monitoring methods in use by California cities and municipalities, SFEI was brought in. The institute's more than 60 scientists, technologists, and designers strive to improve environmental planning, management, and policy development.

According to Tony Hale, PhD, director of the environmental informatics program at SFEI, "Our organization is designed to produce visionary science that can empower communities to be better stewards over their natural resources. We measure the quality of our work by the decisions that they help to inform."

To reduce financial costs to municipalities and improve efficiency in the field, the SFEI team set out to implement a new solution to cover survey areas and monitor trash. They used drones to gather imagery from the air and deployed cloud-based drone mapping software to streamline collection and analysis and share results with partnering agencies.

Standardizing Trash Monitoring

With every organization and jurisdiction left to establish its own assessment method, it was difficult to determine whether the trash situation in local communities was improving or worsening and how it compared to other communities, according to Hale.

The California Ocean Protection Council (OPC) approached SFEI and the Southern California Coastal Water Research Project (SCCWRP) to partner with them to evaluate different trash monitoring methods currently in use across the state and assess their level of accuracy and precision. Under the California Natural Resources Agency, OPC coordinates activities of ocean-related state agencies to improve the effectiveness of state efforts to protect ocean resources. SCCWRP is an aquatic sciences research institute in Southern California.

This collaboration between SFEI, OPC, and SCCWRP sought to develop a trash monitoring playbook that would identify which methods are best suited for monitoring trash and informing local decision-making. Beyond merely monitoring current practices, SFEI and SCCWRP wanted to explore new methods and leverage new technology because other methods previously considered had been inefficient or cost prohibitive, noted Hale. SFEI was specifically interested in developing a novel method using drones and machine learning to create a cost-effective approach to trash surveys.

The traditional method of monitoring trash was time-consuming and could be costly. It involved sending a five-person crew into the field and manually counting each piece of trash. This process could take five hours or more, depending on the site.

Implementing technology without proper planning could also result in significant expense. Manually flying a drone to capture imagery, then downloading the imagery to a local computer to assemble might produce useful results, but it could also incur outsize costs.

According to Pete Kauhanen, GIS manager at SFEI, "If you're getting your own drone and sensor, trying to integrate it yourself, and then getting your own mission planner, and then the software to process the imagery, and then worrying about where to store all the different images and files…there are a lot of pain points and points where the system can break down. All that can really lead to higher costs and inefficiencies."

Focusing on Results

SFEI wanted to use drones to fly over survey areas and capture high-quality imagery. Survey areas included public rights-of-way in creeks and rivers and excluded private property. The group also set out to develop a machine learning algorithm to automatically detect trash in the drone-captured imagery.

According to Hale, SFEI wanted to concentrate on the actual products the drones would deliver—imagery, maps, and data—rather than planning, storage, and the mechanics of obtaining those products.

"If it can all just be more or less automatic and handled by another service, then…we could concentrate our attention on what we thought was most critical, which are the maps that the drones generate, the imagery that we could derive from that, and the insights that we could get

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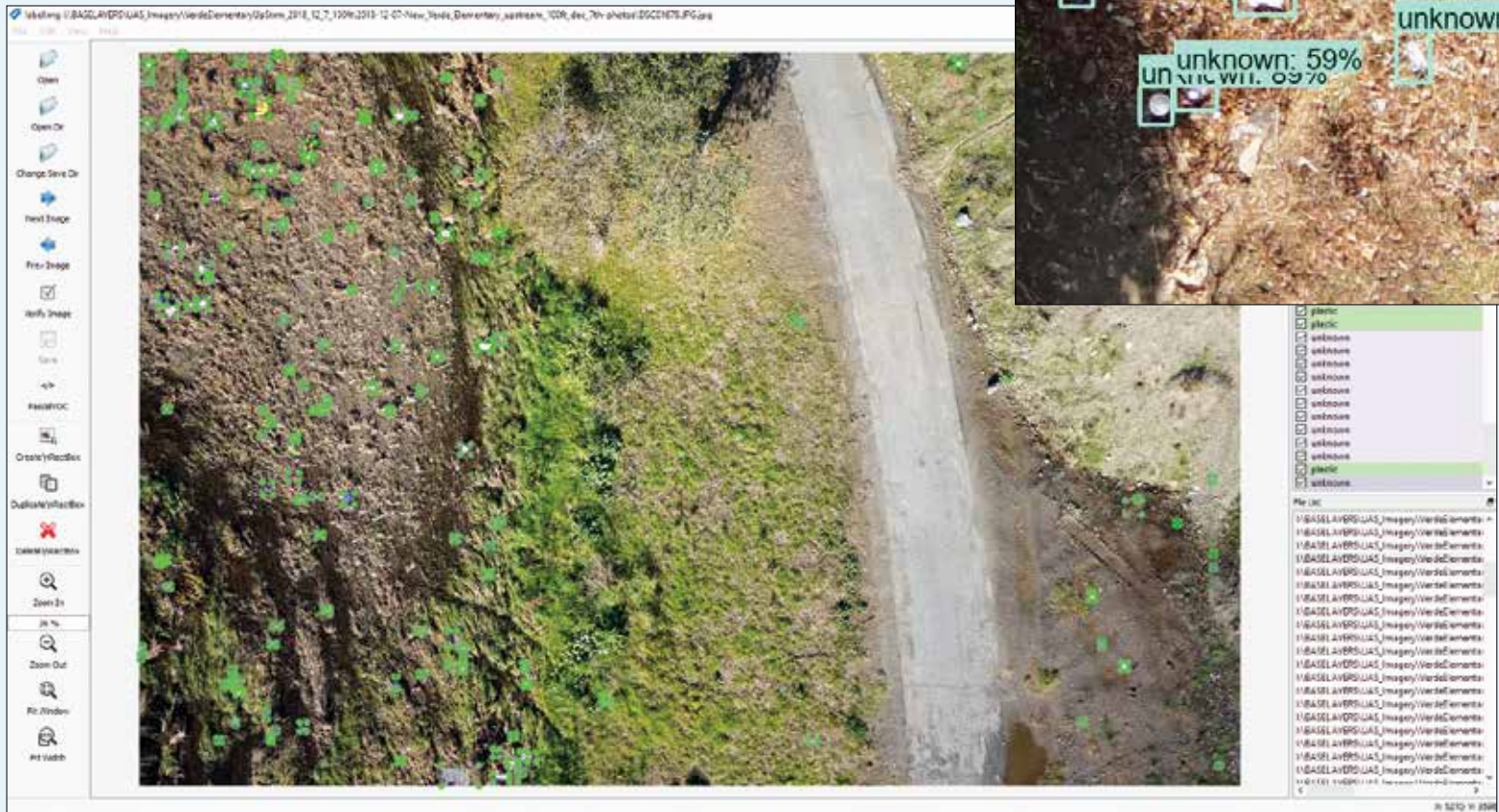
↑ The trash items detected by SFEI's machine learning-based trash detection algorithm are indicated.

← Captured imagery was annotated to provide training data for SFEI's machine learning-based trash detection algorithm.

as far as identifying the trash in the imagery," said Hale.

The SFEI team chose Site Scan for ArcGIS to help streamline drone flights. Site Scan for ArcGIS is cloud-based drone mapping software designed to transform imagery collection, processing, and analysis.

When he first began exploring Site Scan, Kauhanen was trying to see how he could use it for environmental issues SFEI works on, like wetland ecology. He eventually realized Site Scan would be a great fit for the trash monitoring project because of its ability to manage drone assets

and process imagery. SFEI wanted to be lean and not have a lot of overhead to worry about. Kauhanen is the only drone pilot at SFEI, so it made a lot of sense to allow Site Scan to handle the processes. The product support provided would handle any issues.

SFEI created a website, cd3 Contaminant Data Display & Download (https://cd3.sfei.org/), that leverages the sampling SFEI did as well as work done by the Bay Area Stormwater Management Agencies Association (BASMAA) and the Southern California Stormwater Monitoring Coalition (SMC).

BASMAA is a consortium of nine San Francisco Bay Area municipal stormwater programs and SMC serves a similar collaborative purpose for Southern California public agencies. This website offers a view of all the different sites where trash monitoring was conducted.

When a site displayed on the website is selected, the source of the data is shown as well as the trash level (low or high), the sample date, and whether the site was a targeted (i.e., selected for its likely high trash load) or a probabilistic

Improving Trash Monitoring with Drone Imagery, Artificial Intelligence, and Mapping

site (i.e., selected according to randomized sampling design). All data is downloadable. Users can easily explore the map. The map's symbology indicates the methods SFEI used.

Monitoring More Places, More Frequently

From more automated workflows to increased drone flights in the field, the use of Site Scan has enhanced processes for SFEI. Kauhanen explained that it only takes 10 to 15 minutes and just one or two people to complete a flight. This will let municipalities conduct their own sampling and monitoring in the future.

"This approach using Site Scan allows us to go and monitor many more places and to go out much more frequently so you can get a much better synoptic view of what's happening in an environment," said Kauhanen. Instead of visiting a site twice in a season, it is now feasible to visit that site between 10 and 15 times during the same period.

Currently, cities monitor trash by going out to a handful of sites twice a year (at most). This makes it difficult to get an accurate assessment of how much garbage is being generated by a city. Monitoring trash manually in certain locations is completely impractical.

According to Hale, Site Scan allows SFEI to cover a broader geographic range and capture the total view of a survey area. "Not only is it now more efficient—meaning it takes less time—but you're also able to potentially cover a much broader geography than you could otherwise," said Hale.

With Site Scan, SFEI can develop a more automated workflow with an integrated solution. Kauhanen said Site Scan was a great option because the software integrates information about the vehicle and sensor into the mission planning, processing, and storage processes, simplifying operations in the field and building an efficient system for data management.

"We're definitely benefiting…from being able to do volumetric calculations on the fly or being able to now add markers for pieces of trash and being able to export that. Those are all features that are really helpful [to have] in one place. We're not having to have 5 or 10 different pieces of software to do the work we're trying to do," said Kauhanen.

"It's great that I can go out, basically draw the polygon on the iPad, and hit go. It already lays out the flight plan for [the drone] and…then I can just hit upload to the server. The whole process is automated in a way…where I know it all works together."

Kauhanen also likes how easy it is to share results with other agencies. With just a hyperlink to a map or summary report, others can view the most current data. "Just sharing a link is really useful versus having to download the imagery and then try and send it as an attachment, which wouldn't work because it's too big of a file size," said Kauhanen. "So, it saves us a lot of time and headaches in terms of being able to use drones as a solution for any of these projects."
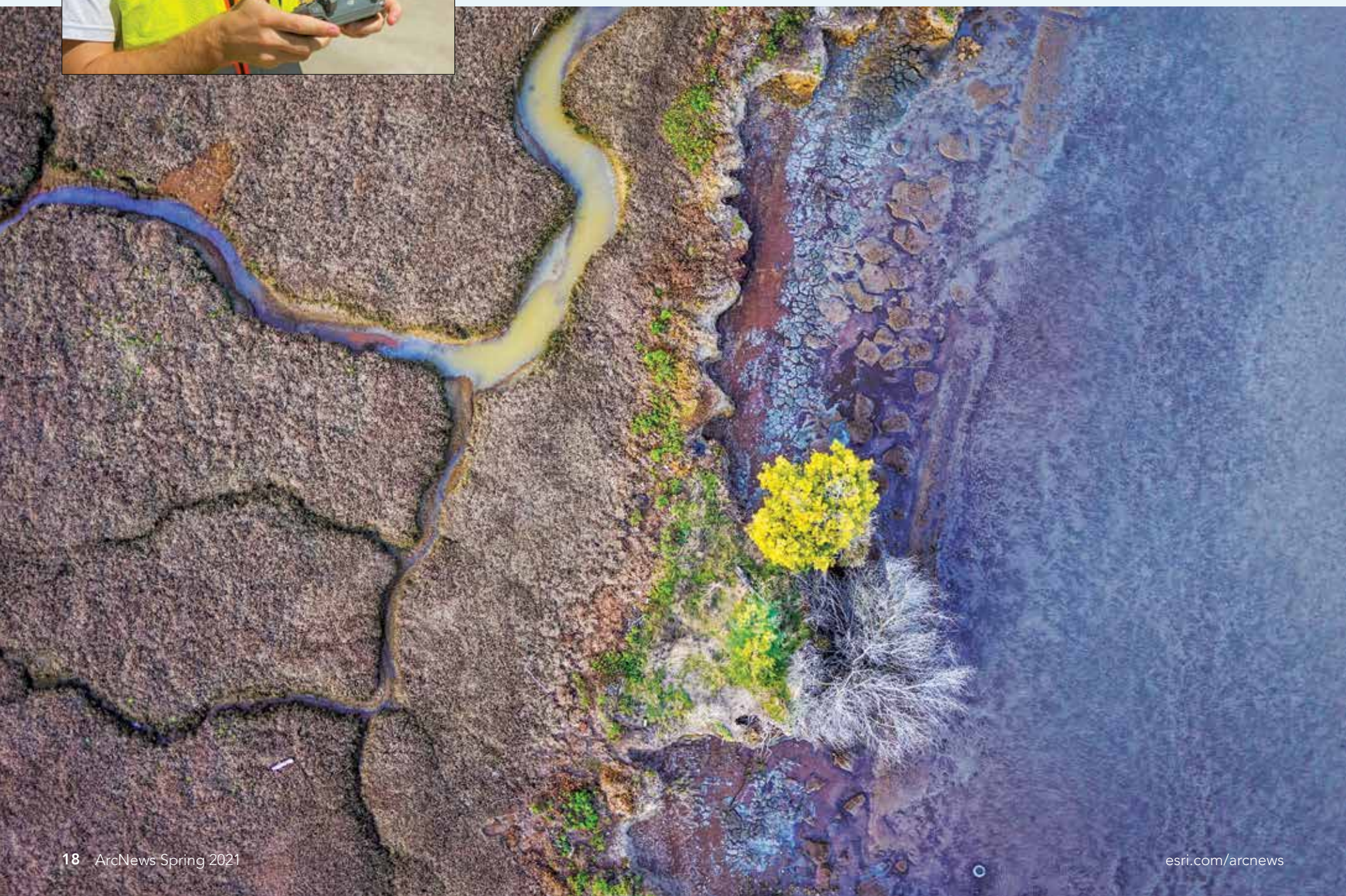
After presenting the results of the trash monitoring project with Site Scan, groups like the Northern California Recycling Association have shown interest in the tool. Hale said people are interested in the ways it can be used for an array of purposes.

"We're doing more with less. We're able to have fewer people involved but are being just as effective as if you had someone who programmed it themselves," said Hale. "We are excited about what we can do in the future."

← Pete Kauhanen, GIS manager and UAS pilot at SFEI, gathers UAS training data for trash detection algorithm development. (Photo courtesy of SFEI)

↓ This UAS photo at a tidal marsh edge was taken by Pete Kauhanen during an Site Scan for ArcGIS survey.

DEVELOPING SPATIAL THINKING IS CRITICAL

By Michael Gould

In 2020, the United Kingdom's Geospatial Commission identified the ways in which location data—where people and objects are in relation to a particular geographic location—can impact virtually every aspect of daily life, from infrastructure to the environment. Without GIS, that data is like paint without a canvas.

The US Department of Labor has identified geotechnology as one of the three most economically powerful emerging fields. Since then, the number of companies, organizations, and nonprofit groups using GIS has doubled—and policy makers worldwide have affirmed the critical role location data plays in economic transformation.

A Decline in Spatial Awareness

But even as the use of GIS has increased, technology has also exerted a countervailing influence on geospatial literacy. A generation that has grown up with easy access to GPS-based tools is missing an overall spatial awareness. Mounting evidence has shown that young people, lacking facility with traditional paper maps, have trouble navigating without technological assistance.

"There was recently a program on Belgian TV that showed people getting basic training to go into the military," said Luc Zwartjes, an assistant professor of geography at Ghent University in Belgium. "They had to do a lot of tests, including reading a topographical map. Only one of the candidates was able to do it."

Renowned geographer Peirce F. Lewis described geography as "the only subject that asks you to look at the world and try to make sense of it." A slight exaggeration, yes, but geography is indeed the discipline that probes the relationship between the physical world and the lived experience.

For geographers, the possibilities of studying the world have exploded, as GIS technology has grown in both popularity and capability. The use of GIS is vast in both the public and private sectors, as more of the world's information—80 percent, by some estimates—has a geographic component.

Deeper Implications for Education and Business

The implications of map illiteracy cut to the core of being human. Even our inner worlds are shaped by the concept of spatial relativity. As cognitive psychologist Barbara Tversky, a professor of psychology and education at Columbia University, and professor emerita of psychology at Stanford University, has argued that, "Spatial thinking—acting in the world with the things in the world—is the foundation of thought."

Tversky has focused a good deal of her research on maps for their remarkable capability to wordlessly convey real spaces. She cites decades of research to show how well-crafted maps (along with diagrams, graphs, and visualizations) are the most effective language to convey a broad range of complex concepts.

Zwartjes defines geospatial thinking as a specialized form of spatial thinking that manifests itself in the ability to "interpret and explain information at different geographic scales connected to Earth." For millennia, that skill was linked most closely to the ability to read a paper map.

Lacking geospatial skills and being immersed in map apps that require no critical thinking, people lose the ability—and, perhaps even more important, the motivation—to pursue geospatial thinking as one's life calling. Too few take courses in geographic

information science in higher education. Zwartjes has found that even for those who do, academic programs mostly focus on informatics, without giving students solid instruction on the scientific basis of spatial thinking.

Karl Donert, former president of the European Association of Geographers, has led efforts to persuade the European Union to address the problem. "We spent over 10 years trying to get GIS and the geotechnology market recognized as an area where jobs weren't being filled because kids weren't being trained," he said. "We phoned and emailed high-level politicians and policy makers at the European Commission. Despite agreeing, they never issued a policy statement affirming the need to focus on geotechnology education."

The Birth of GI Learner

A few years ago, Zwartjes and Donert decided that one way to encourage geospatial thinking in education was to make it easier for teachers to include geospatial concepts in their curricula. After careful study, they created GI Learner, a six-year program designed to help teachers instill geospatial thinking and GIS awareness, beginning in the seventh grade and continuing through high school.

"GI Learner is not a single course about spatial thinking or GIS. It's about applying the benefits of spatial thinking and GIS to courses like geography, history, and so on," said Zwartjes. To create GI Learner, Zwartjes and Donert identified 10 core competencies related to geospatial thinking, such as the abilities to "visually communicate geospatial thinking" and "critically read and interpret cartographic and other visualizations in different media."

Each competency is divided into three levels. Most of the competency subjects are designed to be introduced in the early years of the program, with levels gradually added through the years. Zwartjes and Donert provide exercises and activities teachers can use in the classroom.

"For instance," Zwartjes said, "you say you're able to read a map. But level C asks if you can critically read a map. If you look at the map, is the information correct? Who made it? Is it a kind of political statement or is it pure data?"

One Program, Many Approaches

Because the way geography is taught varies so widely across different European countries, Zwartjes and Donert designed GI Learner for maximum flexibility.

"We created lessons in a way that gives teachers a lot of options," Zwartjes said. "So if they're talking about globalization in their school, we have a package of two to four lessons that teachers can use to replace their own lessons. They don't need to make a new course, and they can start with what they already produced."

As GI Learner has been deployed in five schools in five countries (Austria, Belgium, Romania, Spain, and the United Kingdom), the EU officials Donert tried to reach for so many years have started to take notice. The European Commission Directorate-General for Education, Youth, Sport, and Culture has selected the project as a "success story," a distinction given to projects that have had a great impact, contributed to policy making, and produced innovative results with a creative approach.

"Two things have made the program really encouraging to the European Commission," Donert said. "One is that it covers six years of study, and the other is that it's applicable across the curricula in all countries." A new consortium is now working on a follow-up project, GI Pedagogy, that helps train teachers on GIS instruction, using materials such as GI Learner.

"I'm rather confident that over the next five years, GI Learner will be—I'm not going to say 'booming'; that would be the wrong word," Zwartjes explained. "But it will certainly have more influence, and teachers will get used to working with it. At the same time, it will give students more flexibility to use it in more subjects and more situations."

My Map, My Story

GIS provides new ways of looking at the world. But the technology—and maps in general—also opens up new vistas in storytelling. In addition to deploying GI Learner, geographers Luc Zwartjes and Karl Donert have developed the My Story Map project, which teaches young adults how to use GIS to develop their own personal narratives.

"It's aimed at youngsters who have dropped out of school or have problems at home," Zwartjes said. "I've been training groups of them, and sometimes it gives me the shivers. I'm used to working with high-level students because of the university and so on, but some of these students, I can't even imagine what they've gone through." For some students who have participated in the program, particularly recent immigrants, the maps provide an ideal medium for telling their life story.

Unlike GI Learner, the My Story Map project doesn't aim to broaden the scope of geospatial thought. "To be honest, the emphasis really isn't on spatial thinking," Zwartjes said. "It's more about giving these youngsters a way to develop 21st century skills. They've had negative experiences, so let's try to turn those into something positive. They do everything themselves—using the tool, making the map, adding data. They make the story their own."

About the Author

Michael Gould is global education manager at Esri, working with Esri's 85 offices around the world on a variety of capacity development projects. He has been a professor of GIS at Universitat Jaume I in Spain since 1997.

Virginia High School Helps More Students Expand Their Analytical Capabilities

An innovative program that lets Virginia high school students earn university credit for geospatial classes has been expanded to include a broader range of students.

The Geospatial Semester (GSS) is an innovative dual enrollment program between high schools in Virginia and the Integrated Science and Technology department at James Madison University (JMU) that started 13 years ago. Juniors and seniors are dual enrollment students who take GIS classes at their high school and earn credit from the university.

Students learn how to find data, create maps, and apply mapping analysis tools to solve real-world problems. The Geospatial Semester in Virginia is financially self-supporting (and has been for more than a decade).

Students from Loudoun County Public Schools (LCPS) participate in GSS. Loudoun County, located in the Commonwealth of Virginia, is part of the Washington (DC) metropolitan area. LCPS obtained an education license for Esri software more than 15 years ago. Today there are geospatial science classes taught in 11 of the county's 17 high schools.

Michael Wagner is the lead GIS teacher in the LCPS Science Office. "I developed the original GIS course with my colleague at Heritage High School, Jon Pruess," said Wagner. "We ran a pilot course for three years and then started to roll it out to the other schools in the county." In addition to teaching earth and geospatial science classes, Wagner oversees all geospatial science classes in the county and manages the district's relationship with JMU and GSS.

At the beginning of the 2019–2020 school year, Taryn Langmead, earth science and geospatial science teacher at Loudoun Valley High School, teamed up with Dan Loper, special education teacher at the school, to teach a GIS class that combined exceptional learners with the dual enrollment students.

"Basically, we decided to introduce geospatial science in the Basic Skills class for our exceptional learners that range from grade nine to returning graduates," said Langmead. The class was developed as a cooperative effort between the principal at Loudoun Valley High, the special education department chair, Loper, and Langmead. Support for class instruction was provided by teaching assistants, Edwina Payne and Carrie Crum, as well as student helper Elsa Higbie.

"Foremost in our minds is how our exceptional learners have just as much right to knowledge as their typically

Loudoun Valley High School Safety Features Collected Using QuickCapture
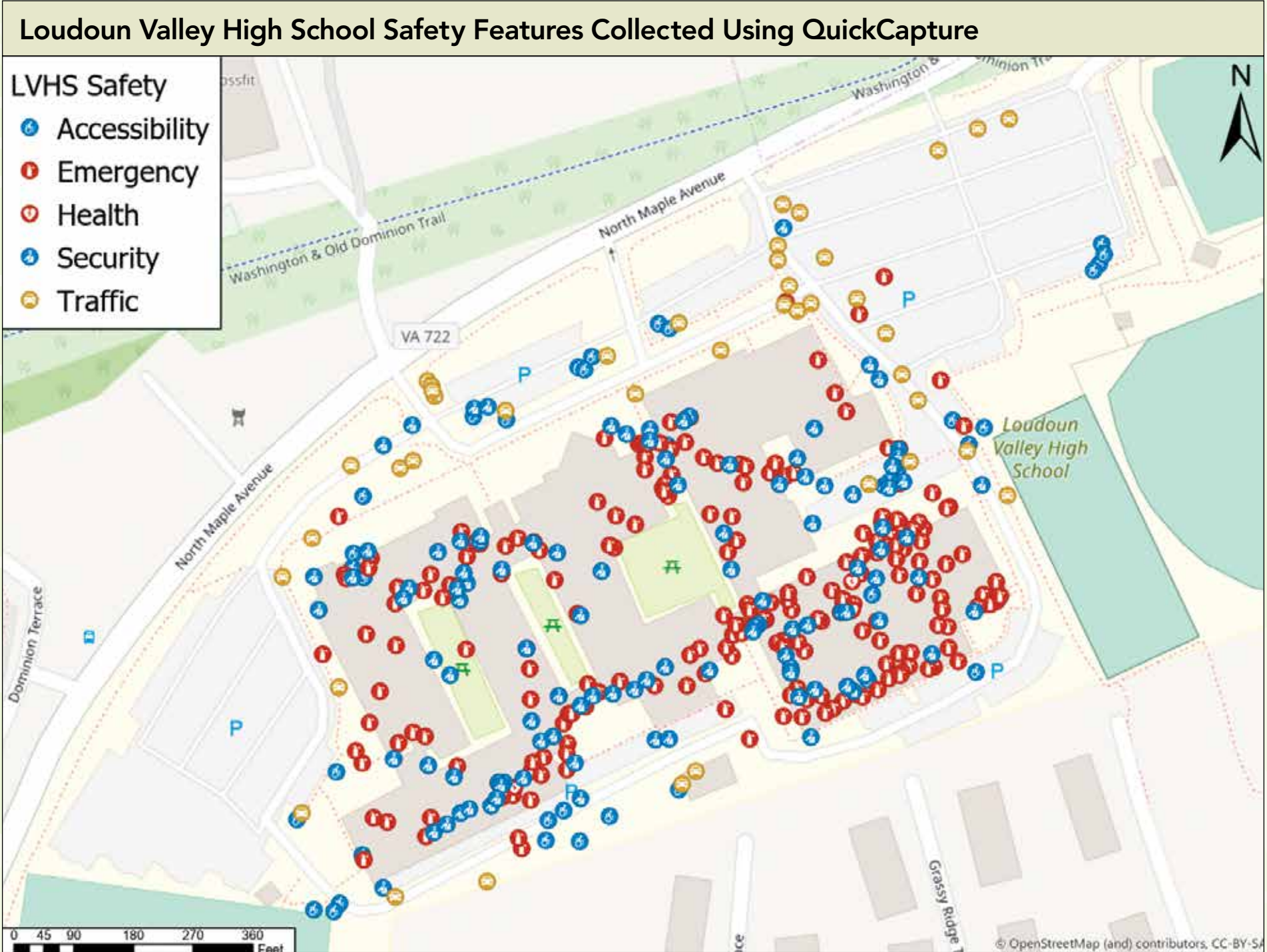
↑ This map created by students shows the safety features located on the Loudoun Valley High School campus. Students collected the data for this map using ArcGIS QuickCapture.
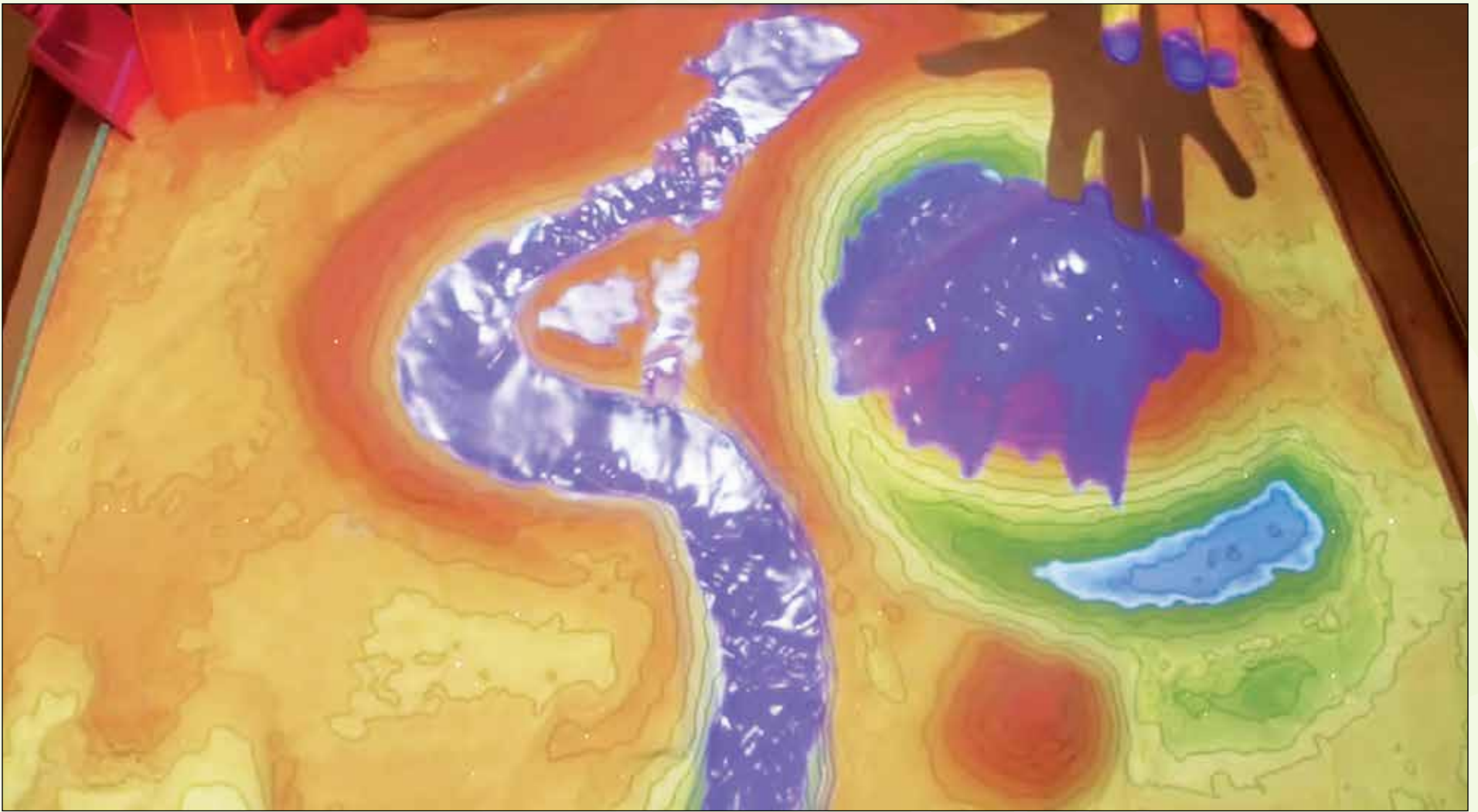
↑ Teachers at Loudain High School built an augmented reality sandbox to teach earth science concepts in an engaging way using directions provided by University of California, Davis (UC Davis) at https://bit.ly/3bkcUUc.

developing peers," said Loper. "Next, we considered differentiation. Our exceptional learners have diverse needs as individuals, sometimes changing on a day-to-day basis. We introduced the GIS concepts with those considerations in mind. These experiences may open doors for our students that might not have otherwise been available to them. In addition, the content may become an inspirational platform for our students to develop a love of the field and eventually find GIS employment."

"Dan had previously used GIS, so we were well equipped to scaffold GIS concepts to help the exceptional learners understand the expected outcomes for the class," said Langmead.

To make the course accessible to all students, the use of descriptive teaching and learning techniques were adopted. Flash cards were used with some of the students to help them better understand GIS concepts and terminology. In addition, the course was referred to as Geography Science rather than Geospatial Science, and data was called number knowledge.

Lessons combine different approaches to learning content. For example, some lessons are computer based. Students use ArcGIS Online to complete them. In other lessons, students make models of the landforms they are studying.

Participation in projects varies to accommodate authentic inclusion and provide as much lesson detail and curriculum as possible. Projects can have many levels. For some projects, dual enrollment students create maps and surveys using ArcGIS QuickCapture. Then these students work collaboratively with exceptional learners to gather data around the school campus. Exceptional learners loved it when the dual enrollment students worked with them on different projects.

Langmead built an augmented reality sandbox using information from the University of California, Davis (UC Davis). An augmented reality sandbox combines sand with 3D visualization applications that were created through National Science Foundation-funded research at

UC Davis. Molding the sand manually brings a simulated landscape to life. The visual perception of the sand is augmented in real time with a colored elevation map that has topographic contour lines and simulated water.

Loper and Langmead tried to place towns in the augmented reality sandbox as part of classroom lessons. Unfortunately, the COVID-19 pandemic curtailed their sandbox modeling activities, but the two teachers were able to continue using ArcGIS Online for data and visualization.

Exceptional learners provided perspectives that Loper and Langmead hadn't previously considered. They also had the opportunity to give the dual enrollment students feedback on their midterm projects, which those students appreciated.

The teachers generally felt that taking the class helped the exceptional learners improve their communication skills because they could better explain how they perceive the world. At the beginning of the school year, some exceptional learners were asked to provide details about a particular map feature, such as a mountain or a beach. Initially, students didn't know how to describe those features. As the school year progressed, however, these same students were making observations and analyzing what they were seeing on the map and connecting that with other experiences or information they had learned.

"The students were enthusiastically engaged and often stepped up to challenges that were outside of their comfort zones. Some students would do really well with one task and then help out their classmates with the same task. Other times they would struggle, but there was always perseverance and encouragement fostered between all of the students," said Langmead.

"I think that the cognitive abilities among the students have most certainly improved at varying levels," said Loper. "This is evidenced by the demeanor in which they approach the class, the looks on their faces as they are getting to know various GIS concepts and tools, and the

utter exuberance of some students as they embark on their GIS learning."

Wagner believes the spatial thinking skills they develop will benefit these students long after high school and might help them in getting a job that uses GIS.

"I would love to figure out a way that ArcGIS Online and some of the tools that come with it could be available to these students after high school," said Wagner. "I have worked with some of our job coaches on integrating the ArcGIS Workforce app for students who are involved in community-based instruction. Though we are in the early stages of this project, I believe it is a tool that can allow students to be more independent as they navigate daily tasks."

↑ A student works on making a 3D relief of world topography after studying different maps and representations of the world using ArcGIS Online.

Stories for Change
ArcGIS StoryMaps Contest Winners

The winners chosen from more than 300 entries in the 2020 ArcGIS StoryMaps Competition for the Sustainable Development Goals have been announced. Storytellers from more than 47 countries worldwide used ArcGIS StoryMaps to communicate solutions to global challenges through GIS and storytelling.

The contest, sponsored by Esri and the United Nations (UN) Sustainable Development Solutions Network (SDSN), encouraged entrants to use innovative storytelling techniques, mapping best practices, and media to create stories focused on achieving the 17 Sustainable Development Goals (SDGs) adopted by all United National member states. These goals recognize that improving the lives of the world's people must include safeguarding the environment while developing strategies for improving health, education, and economic conditions.

The contest affirms the need for geospatial data and GIS tools to produce the geographic knowledge to understand these challenges, support the development of effective strategies, and communicate with decision makers and the public both.

The top three stories in the student and professional categories were selected from the 20 finalists by the guest judges. The four guest judges were Jeffrey Sachs, economist and president of SDSN; Hindou Oumarou Ibrahim, UN SDG advocate and environmental activist; Alex Tait, who leads geopolitical and cartographic direction at the National Geographic Society; and Dawn Wright, chief scientist at Esri. Each judge has spent years contributing to the science, policy, and educational efforts to support sustainable local and global communities.

"The submissions were incredibly high quality and covered really important topics. I was very impressed both by the student and the professional categories, in the topics that were picked and the statistical and human stories that supported the SDGs," said Tait.

Student Track Winners

The competition received student submissions from 74 schools in 22 countries and 18 US states. The first-place winner resulted from the collaboration of Melissa Kaslowski at Columbia University, Zeynep Abes at University of California Los Angeles, and Eda Kazancioglu at Emerson College. "Hidden Realities: Femicides in Turkey" (https://bit.ly/2NIwocS) addressed SDG 5, Gender Equality. It is a compelling story not only because of its excellent organization and effective use of infographics, but also because it put the faces of women on those numbers.

Ainayya Rahma, Allessandro Aryo Setyaki, and Martin Reynaldi Simanjuntak, students at Universitas Negeri Semarang in Indonesia, took second place with "iBanker Kendal Regency" (https://arcg.is/1SWqP5). They told the story of how flood and drought impact agricultural production in Kendal Regency in Central Java Province in Indonesia.

Kellie Ward at the University of Tennessee, Knoxville, won third place for "What you CAN'T see in the Tennessee River" (https://arcg.is/05qnmz). The story examines threats from industrial chemicals, raw sewage, microplastics, agricultural pollution, and urban and household pollution. The Tennessee River is a water source for recreation, power generation, drinking water, and biodiversity. The story makes effective use of infographics, animated charts, artwork, and videos as well as maps.

Professional Track Winners

More than 150 government agencies, nonprofits and NGOs, educational institutions, and private entities vied in the professional track. First place in this track went to "Segregation is Killing Us," (https://bit.ly/2M6cAQk) an entry by Zarith Pineda, Victoria Vuono, Cecilia Gonzalez-Rubio, and Yi Zhang of Territorial Empathy, a nonprofit design collective. This story uses a variety of maps, charts, video, and analysis to demonstrate how the effects of COVID-19 have beem exacerbated by racial segregation in New York City. It looks at how the long-term impacts of segregation are causing a public health crisis in the city.

Author Corine Porter of the Dena Kayeh Institute in Canada won second place in this category. Her story, "Dene K'éh Kusān," (https://bit.ly/2MdH4jC) makes the case for preserving the Kaska Ancestral Territory in northern British Columbia as an Indigenous Protected and Conserved Area through maps, stunning photos, and analysis of the priceless natural resources this area contains.

"Keeping up with the Kuchis" (https://arcg.is/0T8ba5), the third-place winner, was submitted by Alcis Holdings Ltd., an Esri partner that provides geospatial services to its clients and beneficiaries. This story follows the nomadic Kuchis as they travel across Afghanistan looking for pasture and water to raise their animals. It provides a 3D, interactive experience that connects current mapping efforts with an assortment of SDGs.

Congratulations go to winners, finalists, and all entrants in the 2020 ArcGIS StoryMaps Competition for the SDGs. See the winning stories on the 2020 ArcGIS StoryMaps Competition for the Sustainable Development Goals pages (https://bit.ly/3blZ2Jg) and on SDGs Today, a global hub site for real-time SDGs (https://sdgstoday.org/storymaps).


↑ "Hidden Realities: Femicides in Turkey" won the first place in the student work category.

↑ The second-place winner in the student work category, *iBanker Kendal Regency*, tells the story of how flood and drought impact agricultural production in Kendal Regency in Central Java Province in Indonesia.
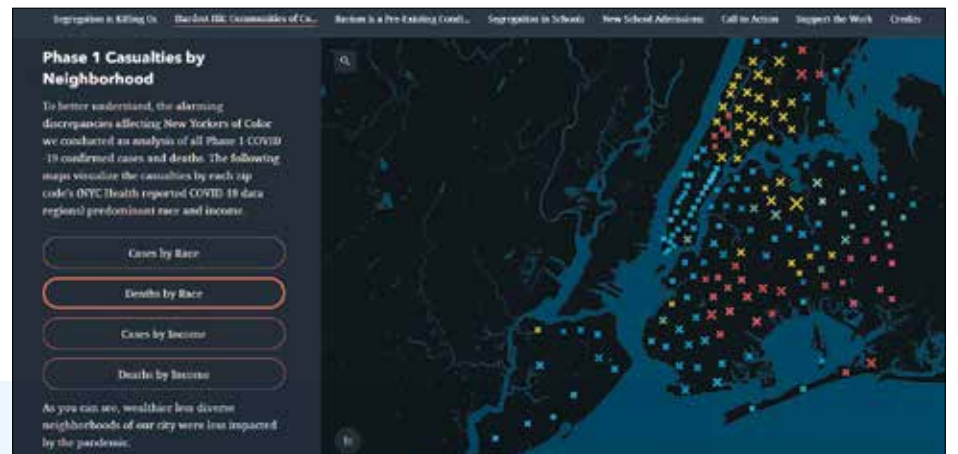
↑ First-place winner in the professional track, "Segregation is Killing Us," demonstrates how the effects of COVID-19 have been exacerbated by racial segregation in New York City.
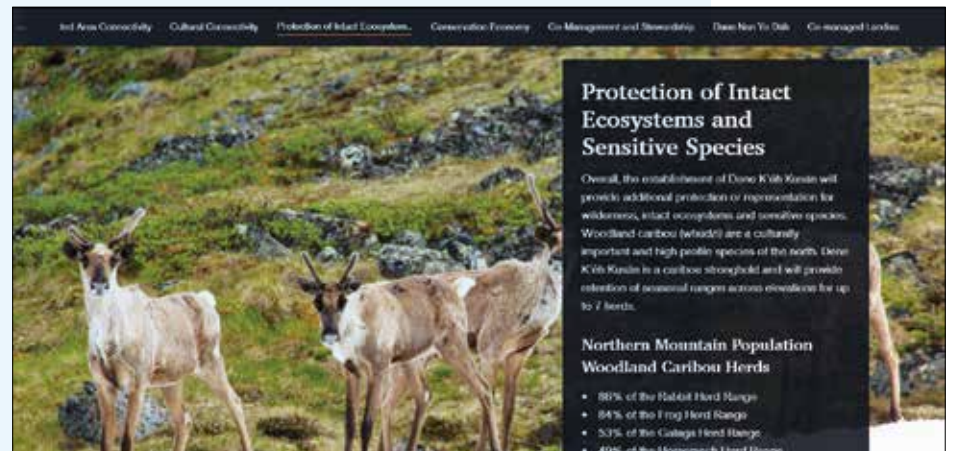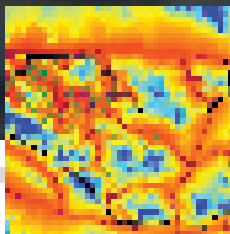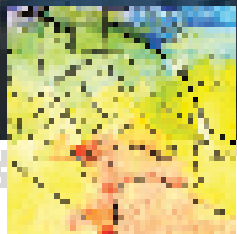

↑ Second-place winner in the professional track, "Dene K'éh Kusān" (https://bit.ly/2MdH4jC) makes the case for preserving the Kaska Ancestral Territory in northern British Columbia as an Indigenous Protected and Conserved Area.

One App Speeds and Simplifies Mobile Work

↑ ArcGIS Field Maps, gives mobile workers a single app that can perform multiple critical field activities, even in remote locations.

↑ Use external GPS to place point, line, and area features with high accuracy.

A new mobile app, ArcGIS Field Maps, gives mobile workers a single app that can perform multiple critical field activities, even in remote locations where internet connectivity is spotty or unavailable. With ArcGIS Field Maps, fieldworkers have secure 24/7 access to an organization's most current information via Android and iOS mobile devices.

ArcGIS Field Maps combines the functionality of ArcGIS Explorer, ArcGIS Collector, and ArcGIS Tracker into a single app that speeds the tasks of mobile workers and simplifies the work of the people who manage them.

Field Maps replaces paper maps used by mobile workers in numerous industries—utilities, public safety, natural resources, transportation, health care, commercial, and government and can be configured to meet the specific needs of the worker and workflows in these industries.

Nonorganizational workers, such as contractors, can access the maps and asset data needed to fulfill their roles while maintaining the security of the organization's system. Field Maps supports HTTPS to encrypt data in transit.

By centralizing map viewing, map markup, high-accuracy data collection, forms editing, and worker activity tracking into one app, ArcGIS Field Maps eliminates the duplication of offline content to provision multiple field apps. Because maps are only downloaded once, Field Maps saves space on mobile devices.

Mobile workers sign in once and have access to all maps and data needed for all operations. An organization deploys one app and its mobile workers need to learn only one app for all their tasks.

Working from the same current data simultaneously saves time, reduces error, and boosts the overall efficiency of field staff. Collaboration between staff in the field is easier with peer-to-peer email. Updates made in the field in ArcGIS are shared back to the office so that decisions can be based on the most accurate and up-to-date information.

ArcGIS Field Maps supports viewing maps rich in cartographic detail and lets users search by location, address, and feature. All associated layers can be viewed on the map, layers toggled

off and on, and the basemap changed. Workers have access to a map's bookmarks and legend. Maps that are compatible with ArcGIS Indoors and contain Facilities and Levels layers can be viewed using ArcGIS Field Maps.

Map markup using freehand sketching, placing markers, and adding notes and labels makes the correction and annotation of maps more easily accomplished. Because markup is saved to the device, it can be reused with other maps and shared with others.

Because ArcGIS Field Maps provides highly accurate placement of point, line, and area features using external GPS, updates maintain and improve an organization's data quality. The app supports snapping and editing multiple features simultaneously. Assets can be added using a feature template, speeding the collection process.

Robust smart form editing ensures valid and rapid input of inspection data. Forms management has been simplified. These forms support recently used form values and make use of conditional visibility so that workers see only the required fields they need to accomplish tasks.

Tracking capabilities supply real-time location awareness of field personnel, so managers know where mobile workers are and can quickly adapt to changing circumstances. All tracks can be displayed on a map and specific time frames can be selected. Location time stamp, altitude, course, speed, accuracy, and device information (i.e., battery state) can all be shown for each track.

Tracking provides verification of when, where, and by whom work was done. To access the location tracking capabilities in Field Maps, location tracking must be enabled for the manager and an add-on ArcGIS Tracker license assigned to each ArcGIS account that will be tracked.

With ArcGIS Field Maps, everyone can see and work from the same data simultaneously, saving time, reducing errors, supporting field workflows, and enhancing overall efficiency by bringing modern digital workflows to field activities. Later releases will combine capabilities from ArcGIS Workforce and ArcGIS Navigator.

ArcGIS Field Maps is available for download from the Apple App Store and Google Play. To learn more, visit esri.com/fieldmaps.

A Faster Way to Maintain Data Quality

The agency responsible for maintaining the infrastructure for water, wastewater, and reclaimed water management in a rapidly growing Florida county needed a workflow that helped it more quickly and accurately incorporate utility drawings for new subdivisions into its GIS.

Clay County Utility Authority (CCUA), based in Middleburg, Florida, serves 54,000 customers and maintains 1,500 miles of utility infrastructure. From hydrant safety to asset repair and replacement, data is central to the utility's daily operations. Consequently, CCUA operators needed an efficient quality assurance (QA) and quality control (QC) processes to produce reliable data about its infrastructure.

Rapidly growing Clay County expects 12,000 new homes to be built within the next decade. These homes will require the creation and attribution of new assets for new subdivisions on a weekly—sometimes daily—basis. The GIS team at CCUA needed to keep up with this increasing workload while also ensuring the data integrity of its GIS.

GIS data supports numerous projects for new subdivisions, so it's critical that data is of the highest quality. In 2016, CCUA migrated to the ArcGIS Local Government Information Model (LGIM) for water utilities. LGIM is a database schema provided by Esri for use by local governments that supports data management for the maps and apps deployed across CCUA.

When preparing to migrate to LGIM, CCUA configured a comprehensive set of data checks using ArcGIS Data Reviewer, an extension for ArcGIS Pro, ArcGIS Enterprise, and ArcMap that provides automation and improves data quality management.

After implementing LGIM, these checks needed to be reconfigured to work with the new schema. Until the checks could adjusted, quality control was conducted visually by one person who manually checked each feature in the field. With well over 300,000 features across all three utility types, this process not only was resource intensive but also left a lot of room for human error.

The county's rapid growth meant that CCUA's GIS department needed to prioritize reconfiguring ArcGIS Data Reviewer for data QA and QC processes to work with the LGIM. Daniel Johns, GIS manager, tasked Sarah Grimsley, GIS analyst II, with reconfiguring ArcGIS Data Reviewer and improving the efficiency

and performance of QA/QC processes.

To reconfigure the data checks using ArcGIS Data Reviewer, Grimsley first referenced old checks and the sample water utility checks from Esri's Data Reviewer for Water Utilities template. Then she categorized the checks by type (geometry, attributes, and point/line valency) for each utility type. Each utility now had data checks that were in accordance with the new schema, so the data met the business requirements for CCUA's GIS applications.

It took just two weeks for Grimsley to reconfigure the checks, even though she had no previous experience using ArcGIS Data Reviewer. Grimsley could create a check for any scenario in the utility system. She appreciated the tool's flexibility and can see how it could be used in other areas such as asset management.

The CCUA GIS team has seen significant improvement in the speed of its QA/QC processes since implementing ArcGIS Data Reviewer for the LGIM data schema. In addition to organizing the checks by type, the number of checks required for validation was dramatically reduced due to the updated schema.

For example, domain codes for valves, mains, laterals, and casings are always one diameter. Fittings, however, can be different sizes on either end, resulting in 325 domain codes. With several hundred fitting sizes, hundreds of data checks were initially configured for each size. In the LGIM schema, Grimsley configured this check using the Table Check and applying an SQL expression within the check configuration according to fitting sizes against the equivalent pipe diameter.

This significantly reduced the number of domain-related checks. Similar improvements were experienced with the valency and geometry checks. Depending on the utility, these checks now take only 20 to 30 minutes.

"ArcGIS Data Reviewer allows us to do our job better. Using this application, we're able to quickly and efficiently turn around new projects and get them into our GIS production system," said Grimsley.

Technicians are responsible for conducting their own checks and making their own edits. With ArcGIS Data Reviewer, Grimsley can now review the results of their QC work to see what was fixed. This allows her to track the edits completed by technicians and verify them to ensure that errors are caught, which ultimately

improves data quality. Grimsley is also using ArcGIS Data Reviewer to go back and run the checks on older areas to address any outstanding issues.

"The way things are set up now, we're pretty much catching everything. We're also using [ArcGIS Data Reviewer] to capture errors related to the assets that are surrounding that job," said Johns. "So getting this application back up and running against the LGIM schema was very vital."

The response from other departments at CCUA has been positive. "We haven't advertised the use of ArcGIS Data Reviewer, so a lot of our colleagues are just operating under the impression that we're able to get work out a lot quicker and with less error," said Johns. "We no longer have to deal with the slow turnaround linked to our previous processes and can now provide data to our field staff much faster."

Grimsley added, "I've been told by multiple people within the organization that they are impressed with how fast we are pumping out work after getting the batch checks running. With ArcGIS Data Reviewer being so quick and efficient, we can have required edits accessible in the GIS, all within minutes."

Grimsley continues to add new checks to improve QA/QC within the utility and for the rest of the organization. She and Johns look forward to ArcGIS Data Reviewer continuing to streamline their QA/QC processes.
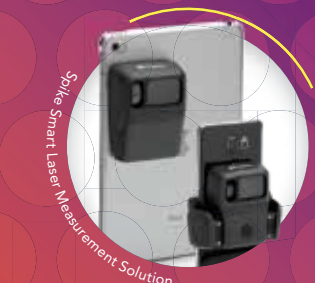
"ArcGIS Data Reviewer enables employees to operate more efficiently and reduce the amount of time it's taking them to do their work," said Johns. "I can see this playing an important role as we continue to grow."
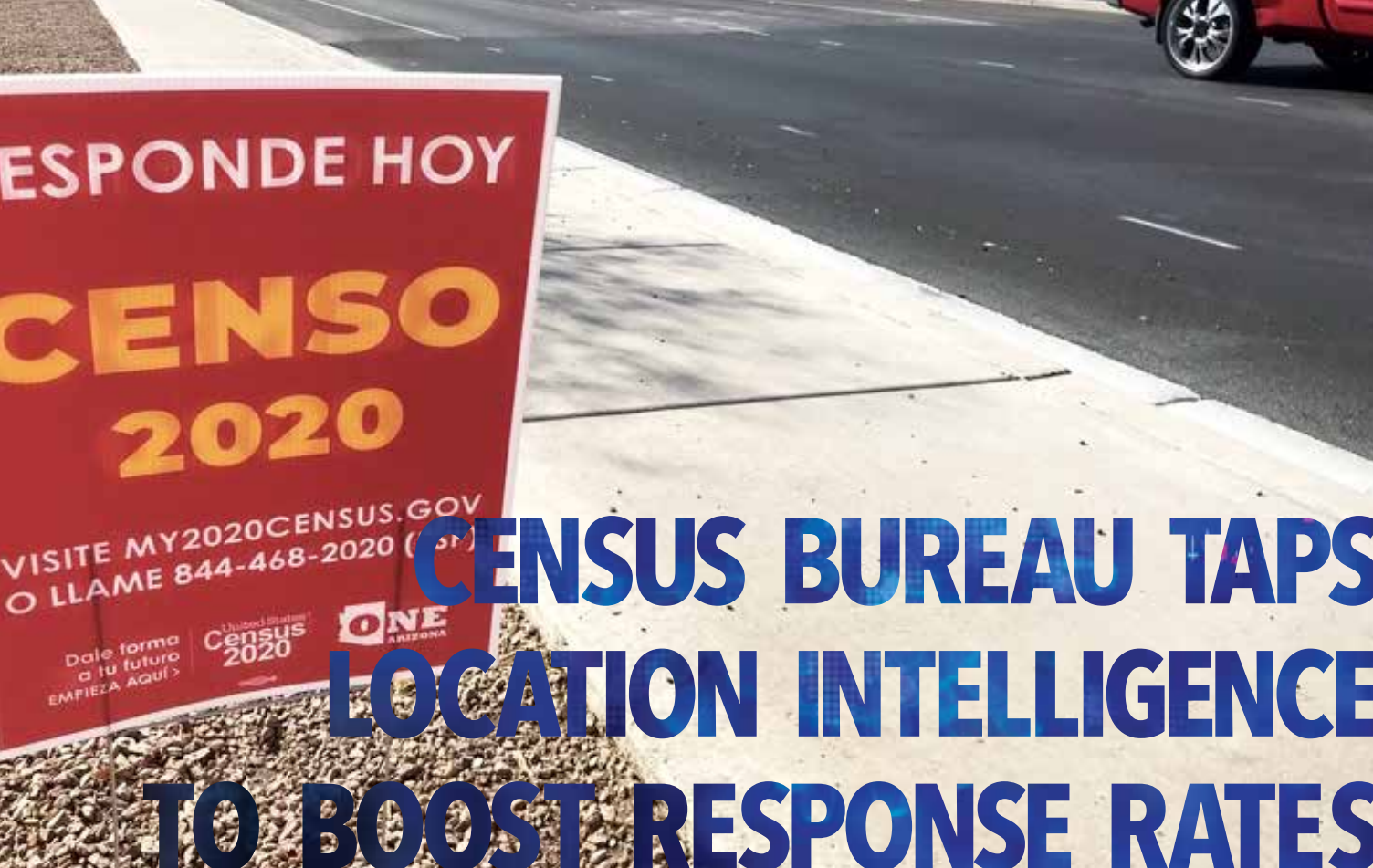
CENSUS BUREAU TAPS LOCATION INTELLIGENCE TO BOOST RESPONSE RATES

The US Census Bureau faced unimaginable challenges with its 2020 population count, given the public health measures brought on by the COVID-19 pandemic. The typical household visits were curtailed for a time until infection spikes settled and accommodations were made. This situation caused the Census Bureau to increase its paid media investment and adapt with targeted appeals to nonresponders.

"In the middle of this, we had to decide whether our enumerators should wear masks," said Nancy Bates, senior researcher for Survey Methodology at the US Census Bureau. "We conducted a survey asking, 'If an enumerator comes to your door wearing a mask, would you be more likely to respond, less likely, or wouldn't it make a difference?' We found that when combined, the majority said they would prefer a mask or it wouldn't make a difference."

This is indicative of the analytical approach the Census Bureau took to assess every task, set standards, and fine-tune processes to increase efficiency. For the first time, digital submissions were allowed via the internet and the Census Bureau used location intelligence and lifestyle segmentation data to guide its outreach.

COMBATING COMPLACENCY

The US Constitution mandates a count of every person in every state and territory every 10 years. The results become a key metric for federal funds distribution. The data influences the makeup of election districts and describes the US population at every geographic level.

Despite the importance of the data, the Census Bureau experiences low response rates from certain populations throughout the

country, which can have a significant impact on government and commercial services people receive. The Census Bureau combats this complacency by placing ads tailored to local interests, which are determined by using location analytics. It's part of a quest that marketing professionals understand all too well: reaching an elusive audience.

Starting in 2020, as part of its digital transformation, the Census Bureau studied how to improve its reach. Census Bureau staff conducted an advertising test in Savannah, Georgia, in 2015. They evaluated whether online forms improved response rates and assessed the best mix of ads and ad channels for targeting hard-to-reach residents. The results of the test were detailed in a research report, "Viewing Participation in the US Census through the Lens of Lifestyle Segments."

The primary focus was on gaining insight into the makeup, location, and behavior of hard-to-survey populations to improve response rates among those groups. To begin that analysis, bureau staff turned to a technique popularized by marketing executives—lifestyle segmentation data powered by a GIS.

SEGMENTING THE AUDIENCE

First, Census Bureau officials used location intelligence to derive a low response score, a metric that guided further analysis of areas determined to be the hardest to count. Then those areas were mapped and overlaid with data of each area's lifestyle segments. Each segment within Esri's Tapestry Segmentation has distinct socioeconomic and demographic profiles that also reveal psychographic constructs, including participation in faith-based organizations and attitudes on arts

and culture—important variables when marketing to these groups. *[Psychographics is the use of demographic characteristics to predict the attitudes and tastes of specific segments of a population to make marketing more effective and targeted.]*

Once nonresponders were analyzed and correlated to lifestyle segmentation groups, Census Bureau staff could perform deeper analysis to find outreach opportunities, just as a corporate marketing team might.

Using the location intelligence generated by GIS, the Census Bureau correlated areas of historically low census response with the locations of various population segments to identify people who most needed outreach. Although the six population segments with the lowest participation rates covered a range of lifestyles and socioeconomic conditions, they shared some characteristics—they were renters; single-person households; and people with high mobility, low education, low income, and limited fluency in English.

Dorms to Diplomas (22.7 percent response rate): With a median age of 21.5, these youngsters live in neighborhoods with a mix of dorms and on-campus/off-campus housing that caters to young renters.

City Lights (31.3 percent response rate): This group earns an above-average income but lags the nation in net worth. Its median age is 38.8.

Young and Restless (41.5 percent response rate): This is a highly mobile group with a median age of just under 30, populated with people who are beginning careers and changing addresses frequently.
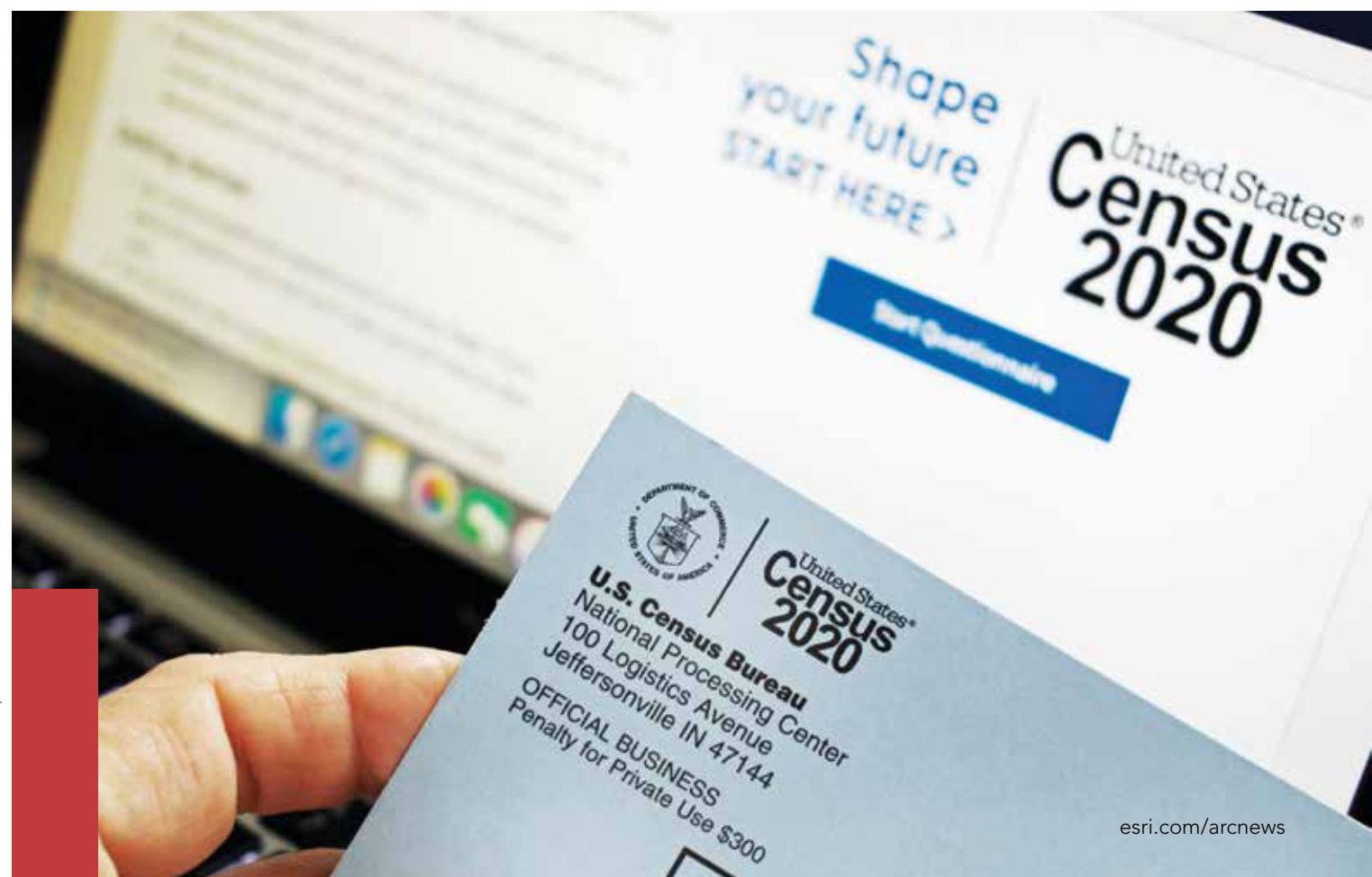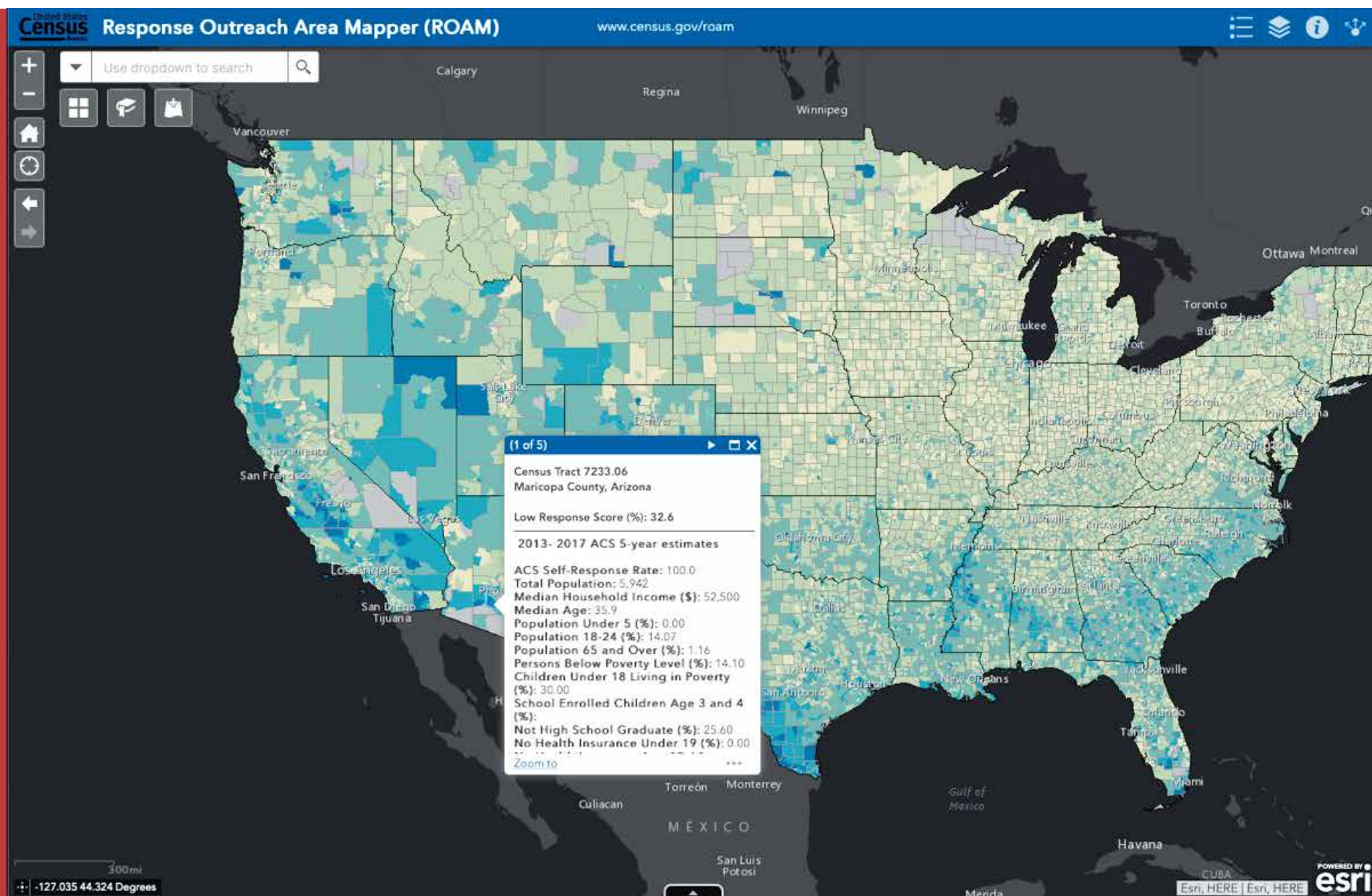
↑ The Response Outreach Area Mapper (ROAM) application was developed to make it easier to identify hard-to-survey areas and to provide a socioeconomic and demographic characteristic profile of these areas.

Modest Income Homes (44.8 percent response rate): The labor force participation rate for this group is just 50 percent, with an income of less than half the US median. Most households rely heavily on public transportation.

Metro Fusion (45.6 percent response rate): Single-parent and single-person households account for more than half of this group, with a median age of 28.8 and median household income of $33,000.

City Commons (46.5 percent response rate): Nearly one-quarter of the people in this group receive public assistance or social security benefits. They typically live in large cities and rent apartments in mid-rise buildings.

Once Census Bureau staff had correlated nonresponders to these lifestyle segments (or LifeMode) groups, they could perform deeper GIS analysis to find outreach opportunities. Its report states the following:

Within LifeMode groups, drilling down to individual segments provides an even more nuanced and granular understanding that can be used in developing messages and to tailoring their delivery.

MARKETING THROUGH SMARTER OUTREACH

Armed with insight into the profiles of each segment, the bureau customized its outreach efforts for difficult-to-track-down audiences during the 2020 Census.

"We met weekly with VMLY&R *[the agency that secured the Integrated Communications Contract for the 2020 Census campaign in August 2016]* to discuss the memo they prepared that showed exactly where segments were under- or over-reporting in terms of self-response," Bates said. "We then drew on mitigation plans to get self-response rates to where we wanted them to be."

Deeper knowledge of lifestyle segmentation groups helped Census Bureau staff detect patterns in how people respond to marketing and how they might prefer to complete the census form. Direct mail, including flyers and cards touting the web address of the online census form, drove most of the web traffic during the Savannah test in 2015. As expected, there were anomalies. Among people of the Modest Income Homes segment, for instance, traditional television and radio advertisements drove a

disproportionately high percentage of web responses.

Two segments, City Commons and Modest Income Homes, were the least likely to select the web for submitting their responses, averaging 54 percent. In contrast, the Young and Restless segment was about average with 70 percent choosing the web as the mode of response. Dorms to Diplomas, which had the lowest participation rate, had the fifth-highest web response rate at 77 percent—in line with attitudinal characteristics of this younger, tech-savvy segment.

An enormous volume of political advertising and the emergence of the COVID-19 pandemic and its public health and economic fallout caused the Census Bureau to move quickly to adapt to market dynamics and increase its paid media investment. Lessons learned from the Savannah test helped staff do this effectively.

Census Bureau workers used digital marketing to reach more people more frequently than was possible in 2010. A heavier digital imprint boosted participation among low-responding segments through search-engine-based digital

ads and Facebook posts. In the Savannah test, seniors responded at the highest rate to search engine ads (more than 80 percent), and singles responded the most to Facebook ads (more than 30 percent). These proclivities helped guide targeted ads.

"Some of the segments are really small, such as Student and Military Communities that make up just 2 percent of the US population," Bates said. "But knowing where those communities are helps us target their interests."

A metrics-driven marketing strategy helped improve 2020 Census response even under the year's extraordinary circumstances. The Census Bureau's digital transformation—including the application of GIS to gain location intelligence on population segments with typically low response rates—empowered census staff to craft outreach based on lifestyle segmentation data. Ultimately, this modern approach supported a successful 2020 Census count even during a pandemic.

Learn more about using Esri Tapestry Segmentation and psychographics to gain insights into America's changing population by visiting https://bit.ly/2ZkYsG8.

From the Meridian
By Michelle Kinzer
Government Relations Manager, American Association of Geographers

A Geographer's Place in Redistricting

Once an obscure bureaucratic process, redistricting has made its way to the forefront of American political consciousness. After 10 years with our current legislative maps, the time has finally come to draw new districts in 2021.

While it may feel as though we've always aspired to principles of equitable and consistent redistricting—perhaps more in theory than in practice—the push for regularly and fairly drawn maps is relatively recent. It wasn't until the 1962 US Supreme Court decision *Baker v. Carr* that "one person, one vote" became part of the reapportionment lexicon. Without that landmark decision, the State of Tennessee may never have been forced to break its decades-long streak of forgoing regular congressional district reapportionment, thus setting precedent and standards for years to come.

Over the last decade, we've witnessed a handful of high-profile gerrymandering battles play out in the courts, which has made the once overlooked maps feel especially like high stakes. We saw the Pennsylvania Supreme Court strike down its own congressional district map in January 2018, declaring that it "clearly, plainly and palpably violates the Constitution of the Commonwealth of Pennsylvania," leading to the adoption of a new statewide map later that year. In June 2019, the US Supreme Court ruled on a pair of cases from Maryland and North Carolina, declaring—much to the dismay of fair-map advocates—that partisan redistricting was inherently political and thereby not reviewable by federal courts.

These judicial victories and defeats show that partisan gerrymandering is no longer revisited just once a decade. The shared consensus that has emerged between bipartisan lawmakers, officials, and the general public is that districts drawn in favor of one party are fundamentally unfair and unacceptable.

States alone have the power to redraw legislative districts using decennial census data, and all major recent changes to district maps have been in response to lawsuits. The power held by government institutions to both create and resolve the gerrymandering problem is clear, but the power of individuals to influence and encourage fair mapping remains murky.

Constituents can exercise their power at the ballot box, voting for statewide reform initiatives and electing state leaders committed to fair redistricting practices, such as those endorsed by the National Democratic Redistricting Committee in the last election cycle. Choosing fair-map-friendly politicians doesn't give constituents total control, but it at least prioritizes the issue and reflects voter expectations before a politician's first day in office.

However, the November 2020 election saw almost no change in the makeup of state legislatures. Few of the new candidates who pledged commitment to fair maps were voted in, and power dynamics remain largely unchanged in the state houses prepared to draw districts in 2021.

At the same time, a handful of measures that passed in recent election years seek to bring more impartiality and transparency to redistricting. Just last fall, Virginians chose to ratify a constitutional amendment establishing a bipartisan commission of citizens and elected officials to draw the state's 2021 maps. Old Dominion joins a growing list of states that have established redistricting commissions in recent years, though with varying degrees of "independence."

In Virginia, for instance, the commission's maps must ultimately be approved by the general assembly, or else be redrawn by the state's supreme court. Virginia and other states, such as Colorado, Michigan, Arizona, and California, have made progress toward transparency.

But the vast majority of states will practice the same type of redistricting that has become so notorious, characterized by closed-door meetings, little collaboration, and the state's incumbent majority party having the final word. The preponderance of these status quo states makes it easy to feel like the bulk of redistricting outcomes are preordained.

Opportunities for public review and participation are unique to the state in which you reside. Wading through the procedures of legislative hearings or open comment periods on proposed maps can be time-consuming and discouraging. With the multitude of issues competing for our attention, it may seem difficult to justify why anyone should feel compelled to take up this fight for a seat at the table.

But when it comes to the fight for fair redistricting, there is no one better equipped than a geographer. Understanding the composition of communities based on shared geographic factors is a deeply powerful perspective to offer. When deployed for the good of equity and access, that perspective is essential to drawing an honest map.

Of course, every local stakeholder should offer input as new districts are drawn. But when creating maps that will comprehensively impact a community's resource allocation and representation, the contributions of a geospatial thinker cannot be overstated. Having someone in the room who appreciates spatial interconnectedness and understands GIS can level the playing field with final decision-makers.

The geographer can serve as an interpreter for local interests while speaking for underrepresented communities in the process. Even a simple understanding of geographic population density is an asset. For years, our elected officials have utilized such geographic principles for political gain. It's up to geographers to not only share our expertise but also demonstrate our vigilance to state officials.

The call for geographers is an inclusive one. An academic geographer with expertise in gerrymandering may already feel well suited for this cause. But this community must expand and embrace anyone with a geospatial background and the drive to put it to use. The community's geographer in the room can be an expert, whether a mathematician who can quantify compactness from thousands of geospatial renderings or an amateur as an undergrad who just completed an introductory GIS course. What matters is not the level of skill you bring, but your tenacity to show up and hold officials accountable.

If you're unsure where to start, consider an AAG guide, *4 ways YOU can make an impact on gerrymandering and redistricting (https://bit.ly/3qoVUBW)*. Official redistricting websites for states, such as California and Colorado, are informative and up-to-date, although many other state websites are less than helpful.

However, there are dozens of nonprofit organizations that have done the investigative legwork for you. Through its People Powered Fair Maps program, the League of Women Voters website has a Civic Engagement and Education focus area that includes community competency building in all 50 states. The National Conference of State Legislatures provides information for state lawmakers and constituents alike. GeoCivics at the University of Colorado hosts a suite of redistricting resources, with a great emphasis on teacher and student activities. And organizations like Fair Maps Arizona, Draw the Lines in Pennsylvania, and People Not Politicians in Oregon are strong outlets for state-specific advocacy activities. These partner organizations provide more than just updates. They can serve as centralized hubs for thought leaders in your state and illuminate ways to get involved. Simply joining an email list for upcoming events is a great way to get started.

It's worth acknowledging that there is no such thing as a perfectly drawn district map, as some criteria will always be prioritized over others. But with the opportunity to elect new state leadership behind us, public participation throughout 2021 is the best and most logical next step toward more just outcomes. By activating our collective power as a community and pressing to have a geographer in the room in every state, we can set new expectations this year and show why geospatial thinkers are indispensable.

Just as it is vital to participate and hold government officials accountable, we have seen the dangerous and extreme result of a populace that feels kept in the dark on matters of process. In January we saw extremists, spurred on by false claims, question the legitimacy of our government and stoop to violent riots in our nation's capitol in an attempt to exercise influence.

Soliciting public input is inherently slow and messy, but the deliberate and steady timeline creates invaluable buy-in. It shines light into the often boring and uneventful bureaucratic processes that build the fabric of our major decision-making institutions. A commitment from those institutions to keep redistricting unequivocally transparent, and a commitment from citizens to peacefully bear witness to those mundane yet immensely consequential meetings build a shared understanding that there is nothing to hide.

The time for 2021 redistricting has come, and our officials are in place. Regardless of last fall's statewide election outcomes, the substantive work is just getting started. This is hardly the time for us to tune out. If you've ever cared about gerrymandering and wanted to exercise your power as a geographer to make a difference, this is your challenge to accept.

About the Author

Michelle Kinzer is the government relations manager for the American Association of Geographers (AAG). She serves as the association's public policy advocate and engages with lawmakers on behalf of its members to advance the interests of the broader geography community. Kinzer is a graduate of Virginia Polytechnic Institute and State University (Virginia Tech), where she earned her bachelor's degree in urban planning.

Scientific Currents

By Dawn Wright
Chief Scientist, Esri

The Face of Our Earth

Esri and the Group on Earth Observations

Although we are well into 2021, we continue to deal with the specter of last year. The highest global temperatures on record were experienced in 2020, according to "Climate crisis: 2020 was joint hottest year ever recorded," a 2021 article in *The Guardian*. Only 2016 was as hot, but that year included a significant El Niño warming event. Even with human activity in 2020 slowed by a global pandemic, data providers, such as the European Union's Copernicus Climate Change Service, showed how drastically the face of the Earth continued to change as a result, putting the future of billions of people at great risk.

The clear danger—present and future—of climate change is still with us. One of the best ways that we can cope on a global scale is by continuous, near real-time mapping and monitoring of the entire face of the Earth. The Group on Earth Observations (GEO) is one of the most comprehensive collaboratives doing just that. This mini "United Nations" of governments and organizations, which includes Esri, is building the Global Earth Observation System of Systems (GEOSS) *[see https://www.earthobservations.org/geoss.php]*.

In 2003, an initial group of 33 countries, including what was then the G8 convened at the Johannesburg Summit on Sustainable Development. *[G8 or the Group of Eight was an intergovernmental political forum.]* These government ministers (who were ***not*** scientists) recognized a growing and critical need for improved, near simultaneous observation of the entire planet, and developed a plan for a more coordinated Earth observing system.

GEO was established in February 2005 as a result of this summit. It has now grown to a membership of 100 governments working in concert with 100 participating member organizations. The GEO Secretariat (which will be led by Yana Gevorgyan, beginning in July 2021) plays a leading role in coordinating and supporting a series of work plans for implementing GEOSS. These work plans build on national, regional, and global observation systems of airborne, space-based, and shipboard instruments, along with a growing network of environmental sensors on land and in freshwater lakes and streams.

Not surprisingly, GEO is also deeply involved in the United Nations 2030 Agenda for Sustainable Development, the Paris Climate Agreement, and the Sendai Framework for Disaster Risk Reduction. As such, it seeks to address eight societal benefit areas where Earth observations can provide viable solutions to the planet's challenges: biodiversity and ecosystems, disasters, energy and mineral resources, food security, public health, infrastructure and transportation, urban development, and water resources.

For the past several years Esri has been involved in a variety of GEO projects, including an effort since 2014 to broker various forms of Earth observation data and services between ArcGIS Online and the GEOSS Portal. This essentially gives ArcGIS Online subscribers the ability to share their data with the broader GEOSS community, and also discover and access the data services published to the GEOSS Portal by others.

Also, in 2014 GEO called for the development of a standardized, robust, and practical global ecosystems classification for all of Earth's terrestrial, marine, and freshwater ecosystems. This incredibly ambitious mapping task became a key program within GEO Biodiversity Observation Network (GEO BON) and GEO Global Ecosystems Community Activity (GEO ECO). Roger Sayre of the US Geological Survey served as a US delegate to GEO. Under his leadership a terrestrial world ecosystems map, Global Ecological Land Units (ELUs), was developed at the unprecedented resolution of 250 meters as well as the Ecological Marine Units (EMUs), which provides baseline 3D mapped ecosystems of the ocean. Both were produced in close collaboration with Esri and a number of other partners. The work to fulfill GEO's global ecosystems mapping vision continues with an Ecological Coastal Units project, which is underway, and will be followed by an Ecological Freshwater Units project. *[For more information on these projects, see the To Learn More section at the end of this article.]*

Under the skillful coordination of Pat Cummens, Esri director of government strategy and policy solutions, Esri has risen to the status of a GEO Associate. This is a fairly new category that enables for-profit companies and national associations of commercial firms to participate in a non-governing but highly collaborative capacity within GEO. As a result, Esri is increasing its participation in GEO. Nearly 30 Esri staff members are taking part in many GEO programs.

At the highest level of GEO, Esri staff actively participate in GEO BON, a GEO Flagship programs, and 6 of the 19 GEO Initiatives, including the GEO Global Water Sustainability (GEOGloWS) and Oceans and Society: Blue Planet (GEO Blue Planet) initiatives.
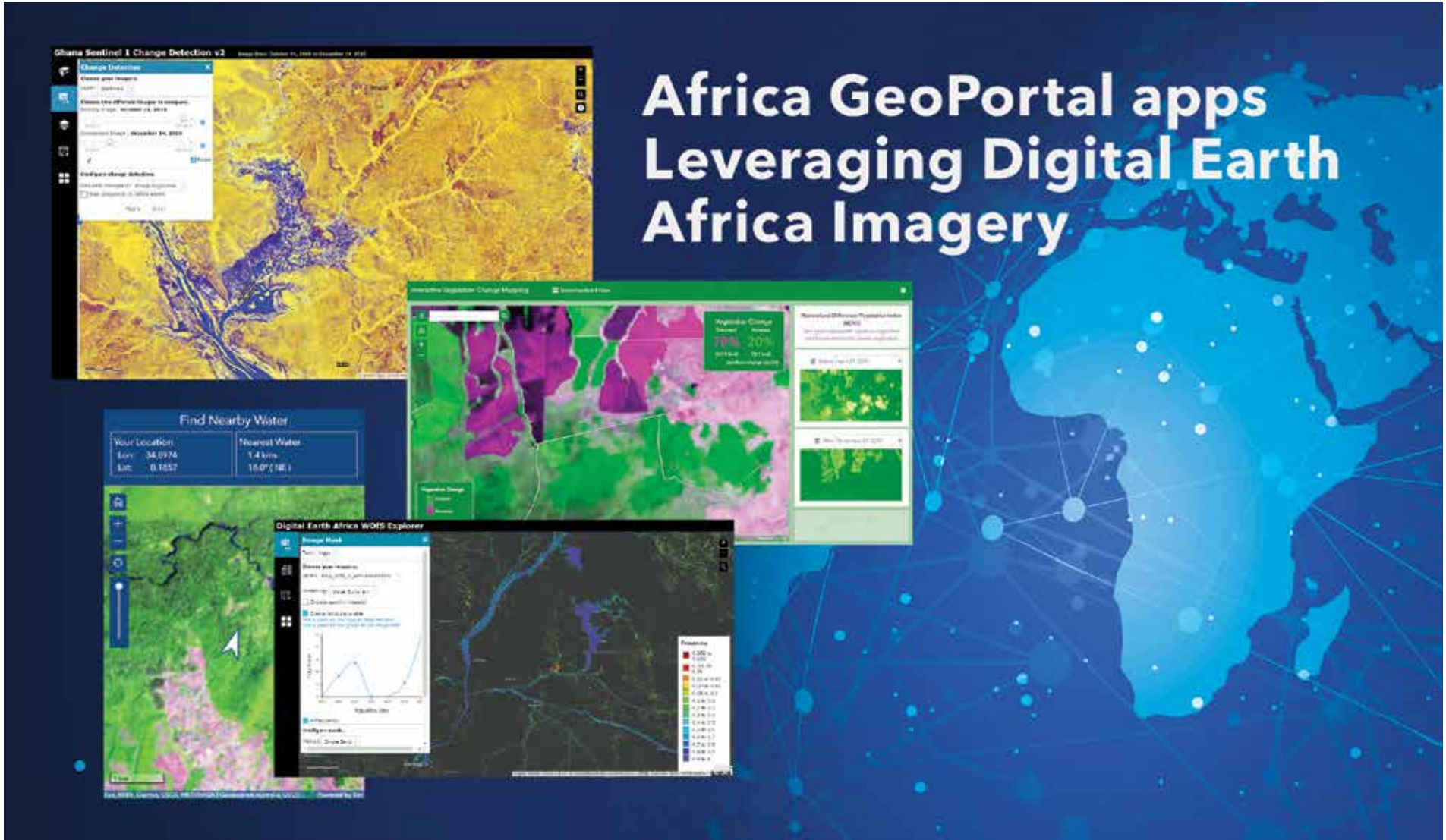
For example, since 2015, under the auspices of GEOGloWS, Steve Kopp has led Esri's involvement in a collaboration with Brigham Young University, the European Center for Medium Range Weather Forecasting (ECMWF), and others in a quest to provide global streamflow forecasts. This global stream flow service is wrapped in a web map featuring updated hydrologic modeling and cartography.

GEO Blue Planet is the coastal and ocean arm of GEO, connecting ocean and coastal information with society. This initiative delivers usable data and information services to support informed decision-making geared toward reaching United Nations Sustainable Development Goal 14 (SDG 14). This SDG is aimed, in part, at reducing the impacts of ocean pollution, particularly from land-based activities such as agricultural runoff.

Not all countries have the capacity to map and monitor this kind of nutrient pollution within their coastal waters. To address this capability gap, GEO Blue Planet partnered with a team from Esri and the United Nations Environment Programme. Together, they developed a new statistical approach and GIS workflow that enable countries to report on the eutrophication in their coastal waters using country-level data combined with satellite observations. *[Eutrophication is the excess nutrient loading of coastal environments from anthropogenic sources, which results in excessive growth of plants, algae, and phytoplankton.]* The 2020 GEO SDGs Awards Program recognized this collaboration with a Special Category award for its novelty of results and products, which are now available at chlorophyll-esrioceans.hub.arcgis.com.

In its work with 34 GEO Community Activities, Esri is working with Geoscience Australia and others to integrate the Digital Earth Africa imagery (digitalearthafrica.org) into the Africa GeoPortal (africageoportal.com), and develop tailored applications and training materials specific to Africa. The Africa GeoPortal with Digital Earth Africa imagery is an open mapping community for data sharing, transparency, and cooperation across Africa. It enables countries to

Global Earth Observation System of Systems (GEOSS), the global, coordinated, comprehensive, and sustained system of observing systems created by Group on Earth Observations (GEO), includes eight societal benefit areas.

↑ The Africa GeoPortal enables users to access data from across the continent, along with tools for mapping, analytics, sharing, and collaboration and a suite of templates and field applications.

work together on investment opportunities and challenges. In the spirit of technical sustainability, Esri is committed to keeping the platform running as long as it is needed, including as a portal of portals that references and hosts geospatial data, regardless of its source.

To this end, Esri is also involved in AMERIGEO, which is a regional collaborative group for GEO members in the Americas. Esri also co-sponsors the Microsoft-GEO BON grant initiative known as Essential Biodiversity Variables on the Cloud. And finally, Esri staff are serving on several GEO

Working Groups that deal with topics ranging from capacity development to climate change to disaster risk reduction.

As the danger of climate change looms, governments and their partners continue to monitor the face of the Earth. GEO will be relentless in fulfilling its credo to provide global, coordinated, comprehensive, and sustained Earth observation for better and faster decision-making that will stimulate innovation and growth, tearing down digital divides along the way. Esri is proud to be part of this effort.

To Learn More

Global Ecological Land Units (ELUs)	https://www.gisforscience.com/chapter1/v1/ and https://bit.ly/3qXnpDk
Ecological Marine Units	https://bit.ly/3qW5Hju
Ecological Coastal Units	https://www.gisforscience.com/chapter2/
GEOGLoWS	https://bit.ly/2MbhfjX
Microsoft-GEO BON Grant Initiative	https://bit.ly/3r111ZL

About the Author

As chief scientist of Esri, Dr. Dawn Wright aids in strengthening the scientific foundation for Esri software and services while also representing Esri to the scientific community. A specialist in marine geology, Wright has authored and contributed to some of the most definitive literature on marine GIS.

The Relevance of Cartography
A Cartographer's Perspective

By Tim Trainor
President, International Cartographic Association

Experience the World of Maps and Mapping at the International Cartographic Conference

This year, the International Cartographic Association will convene both virtually and in person at the 30th International Cartographic Conference (ICC) in Florence, Italy. The timing for the conference has been adjusted to December 14–18, 2021. We are all anxious to experience more normal times as we work together in looking back at the COVID-19 pandemic through our rearview mirrors. The ICC brings together colleagues from government, academia, and the private sector to share new research and developments in cartography and GIScience, exchange experiences from our daily work and map hobbies, and reconnect with friends and make new connections.

Program offerings at the ICC include keynote addresses from leaders in the cartographic field, presentations on a variety of relevant cartographic and GIScience topics, the International Cartographic Exhibition, a Technical Exhibition, social events, tours of Florence and the surrounding region, and more. Keynote addresses each day will excite us about what is possible as we venture into a new era making our way out of the pandemic. Speakers will examine how cartography and GIScience contributed to pandemic solutions and may look at ways of strengthening programs and processes that yield stronger defenses against future pandemics. The daily keynotes provide ideas for future agendas in cartography and GIScience—from the classroom to the workplace.

The list of conference topics indicates the extensive nature of the cartographic field. Many themes reflect the focus of the 28 ICA Commissions as well as other relevant topics of interest. Examples of topical themes include artificial intelligence in mapping, atlases, cartography for early warning and crisis management, cartography, privacy and ethics, education, geoinformation management, geospatial data, infrastructure and standards, geovisualization, location-based services, mapping and sustainable development, military mapping, marine cartography, participatory mapping, and the transformation of national mapping agencies.

Information about participating in the 30th ICC is available on the conference website at https://www.icc2021.net/. For those who simply want to attend and personally experience the many facets of a cartographic conference in a wonderful venue, you are encouraged to sample every aspect, even if only for a brief time. You can hear an interesting talk or have a conversation with the author of a poster on a topic that grabs your attention. You can absorb the creativity demonstrated by the countries and companies that produced impressive visual displays of data and other interesting artifacts. You can visit with vendors to learn more about what they do and their plans. You can also take a tour of Florence to take in the rich history of the Renaissance or simply enjoy a walk through a working city to observe the daily routines and hear a romance language combined with other sounds of Florence.

For those who want to be part of the conference's scientific program, there are two submission options: a full paper or an abstract. The details of the submission, review, and selection process are available at https://www.icc2021.net/submission-guidelines/.

The deadline for submitting a full paper was March 19, 2021. Authors of papers that are accepted by the Scientific Program Committee will receive guidance regarding possible publication.

The deadline for abstracts is May 28, 2021. If an abstract is accepted, authors are invited to give either an oral or a poster presentation at the conference. The type of presentation will be decided by the Program Committee.

The International Cartographic Exhibition is a large venue for display of the best recent works from countries around the world and from the ICA's affiliate members, including companies and organizations. Examples of cartographic products include maps, charts, atlases, and digital online cartographic displays and services. Other categories of maps and geospatial data are also part of the exhibition including spatial data infrastructures, educational maps, globes, and tactile map products. Most of these products are eligible for competitions in various categories that are judged by an expert panel of judges and members of the public who view the exhibition.

The Barbara Petchenik Competition *[an international map drawing competition for children]* is another treat at the International Cartographic Exhibition. The cartographic work of children from each participating country is on full display during the ICC. The theme for this year's competition is A Map of My Future World. Given all that we have been through this last year, it is possible that we might see some of the most creative maps ever in this year's competition. One of several awards for the best map given in the Barbara Petchenik Competition will be decided by public voting .

The ICC 2021 in Florence provides unique business opportunities for sponsors and exhibitors from the private sector. Companies and organizations can promote their products, services, and contributions to cartography and the geospatial industry. Leaders from companies and organizations have an opportunity to observe frontline research efforts to leverage developments that may yield new business opportunities. In addition, engaging with researchers at the ICC affords an opportunity for company and organization developers to discuss challenges they face in pursuing new products, services, and capabilities. Companies wanting to expand in a global market gain exposure to a global community of experts in a reassuring environment.

For attendees who have an interest in the work of the ICA Commissions, each commission will meet during the ICC and many will schedule special programs and workshops prior to or immediately following the ICC, either in Florence or in a nearby location. See specific ICA commission websites for further details (https://icaci.org/commissions/).

Decades ago, the ICA had a conference in a European city that was referred to as the Florence of the North. This time we can be together in the city of Florence to experience the rich history, art, and connections to our cartographic heritage. Florence, as the Renaissance capital, is the right place at the right time. The city leaders of Florence are in full support of the ICC. The ministers of tourism from Florence and the greater region of Tuscany welcome everyone to the city and region. The conference organizers in Florence have worked very closely with the ICA Executive Committee and the ICA Commission chairs to guarantee an exciting and provocative conference experience. As we make our way out of the current pandemic, plan to attend the 30th International Cartographic Conference in Florence, Italy, and contribute to the rebirth of our professional lives, our future business ventures, and our collective healing after more than a year of uncertainty.

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 is a member of the US Federal Geographic Data Committee's National Geospatial Advisory Committee, has served as cochair for the UN Committee of Experts on Global Geospatial Information Management, and was the senior agency official for geospatial information for the US Department of Commerce.
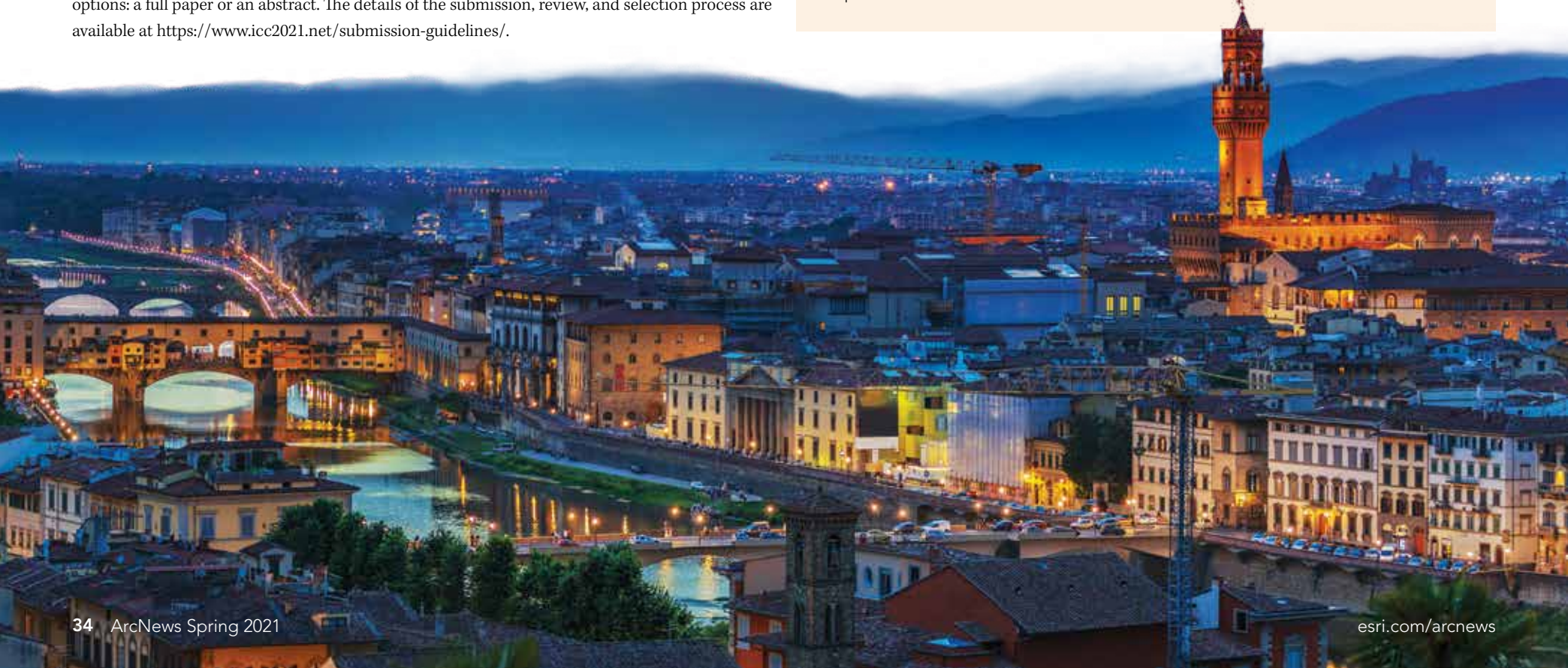
Esri Press

Protecting the Places We Love:
Conservation Strategies for Entrusted Lands and Parks
By Breece Robertson

Bold conservation goals require strategic action to achieve better results. In *Protecting the Places We Love: Conservation Strategies for Entrusted Lands and Parks*, veteran conservationist and geospatial designer Breece Robertson uses her experience, real-world examples, and myriad resources to demonstrate how to act now and collaborate to achieve better results from your conservation efforts. Designed for professionals and advocates at small- to medium-sized land trusts, conservation organizations, and park agencies, *Protecting the Places We Love* includes tips and tricks, methods, and examples from land protection organizations all over the globe. May 2021. Print: paperback, 280 pp. ISBN 9781589486164; e-book: ISBN 9781589486171.
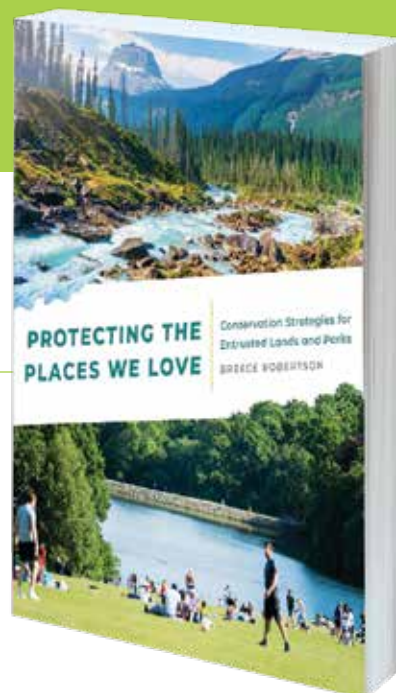
Dealing with Disasters:
GIS for Emergency Management
Edited by Ryan Lanclos and Matt Artz

Discover a modern approach to understanding threats and hazards that are more complex, costly, and devastating than ever before. *Dealing with Disasters: GIS for Emergency Management* explores a collection of real-life case studies about emergency management agencies that successfully used GIS for real and potential hazards. The chapters are organized into sections that deal with the three primary areas of disaster management: preparedness, response, and recovery. Each section includes How to Get Started that provides ideas, strategies, tools, and actions to help readers jump-start their own use of GIS for emergency management. An index helps readers quickly locate topics, and online resources are provided. April 2021. Print: paperback, 150 pp. ISBN 9781589486393; e-book: ISBN 9781589486409.

Delivering Water and Power:
GIS for Utilities
Edited by Pat Hohl and Keith Mann

Delivering Water and Power: GIS for Utilities is a collection of case studies that demonstrate how utilities have modernized workflows, created actionable data, reduced costs, and prepared for new challenges by using GIS. By applying location intelligence, utilities have developed a deeper understanding of network maintenance and performance within a real-world context, which has increased operational flexibility and improved worker safety and customer satisfaction. March 2021. Print: paperback, 150 pp. ISBN 9781589486751; e-book: ISBN 9781589486768.
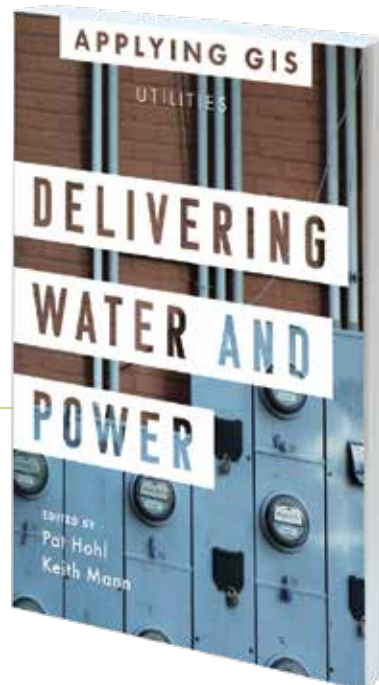
Modern Policing Using ArcGIS Pro
#### By Eric L. Piza and Jonas H. Baughman

Crime mapping and spatial analysis play a key role in a variety of day-to-day police functions, and with ArcGIS Pro, crime analysts now can enhance the efficiency of workflows and the quality of crime mapping products they produce. *Modern Policing Using ArcGIS Pro* is an easy-to-use, hands-on guide for crime analysts of any skill level. Using ArcGIS Pro for problem analysis, crime analysts can create crime prevention strategies, measure program outputs to gauge program implementation, and conduct evaluations to determine whether crime control strategies are having the desired impact. *Modern Policing Using ArcGIS Pro* is essential for crime analysts looking to bring value to their agencies' operations using GIS for analyzing crime. April 2021. Print: paperback, 340 pp. ISBN 9781589485976; e-book: ISBN 9781589485983.
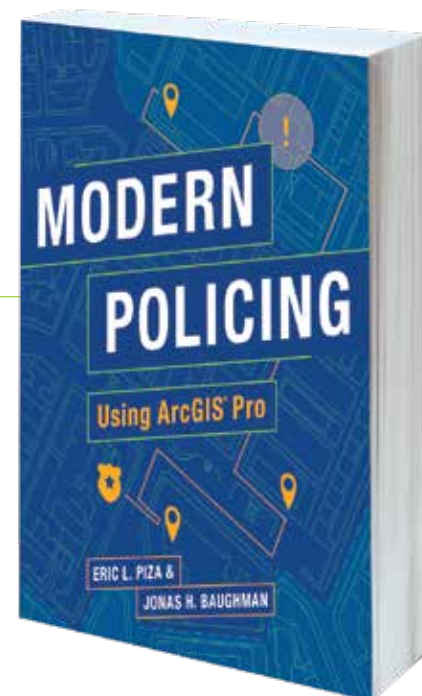
The Playground Problem
By Lauren Scott Griffin and Fred Folger

Written by GIS expert Lauren Scott Griffin and illustrated by Fred Folger, *The Playground Problem* is a hybrid graphic novel/activity book that explores how to overcome problems and find the perfect solution. Large pages brightly illustrate the adventure as readers learn about maps and use basic spatial thinking, including introductory mapping, zeroing in on distance, direction, basic spatial analysis, and other skills. Research shows that encouraging spatial reasoning skills at an early age accelerates the development of science, technology, engineering, and mathematics (STEM) skills. This book's audience is children aged 6 to 10 years. May 2021. Print: paperback, 40pp. ISBN 9781589485686.
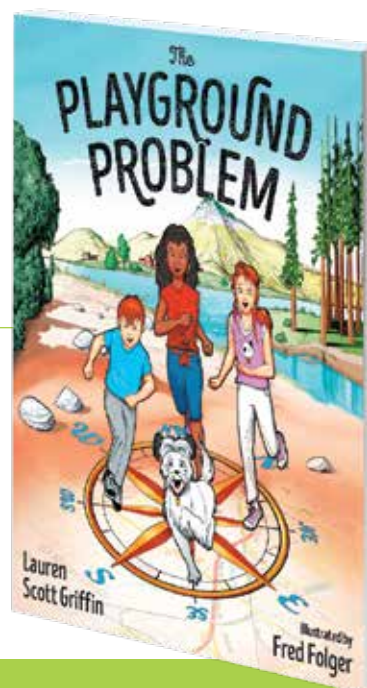
For more information on all Esri Press publications, visit **esri.com/esripress**.

Helping Schools Navigate the Pandemic

The COVID-19 pandemic has disrupted every aspect of American life. During this pandemic, school superintendents face unique challenges. Not only must they ensure the best educational outcomes for students, they must also protect the health of students, teachers, and communities.

"In addition to making the usual safety, operational, and educational decisions, superintendents are now expected to assess the current landscape in order to make critical choices regarding public health," said Neil English, the superintendent of Riverview School District in Pennsylvania. "Navigating the health crisis is unchartered territory, and school leaders are tirelessly managing the confluence of local, state, and federal mandates; CDC *[Centers for Disease Control and Prevention]* guidelines; and local health metrics to assess risk and make informed decisions regarding the health and safety of the students and their families."

Like other school districts in the United States, Riverview was flying blind. However, Esri partner Epistemix (epistemix. com) helped the district make better-informed policy decisions. Epistemix used its epidemiological simulation platform to model the local, specific health impacts of the response and opening strategies under consideration.

Using a statistically accurate digital twin of the US population that individually represents every student, teacher, and resident within the district and surrounding areas, Epistemix calibrated the COVID-19 model to the evolving epidemic with realistic social dynamics, using ArcPy geoprocessing tools. The results were imported into a hosted layer in ArcGIS Online with additional data from ArcGIS Living Atlas of the World. The results were presented to the district using ArcGIS. A dashboard gives English and the school board the information needed to lead the district through this pandemic, including specific estimates for student, teacher,
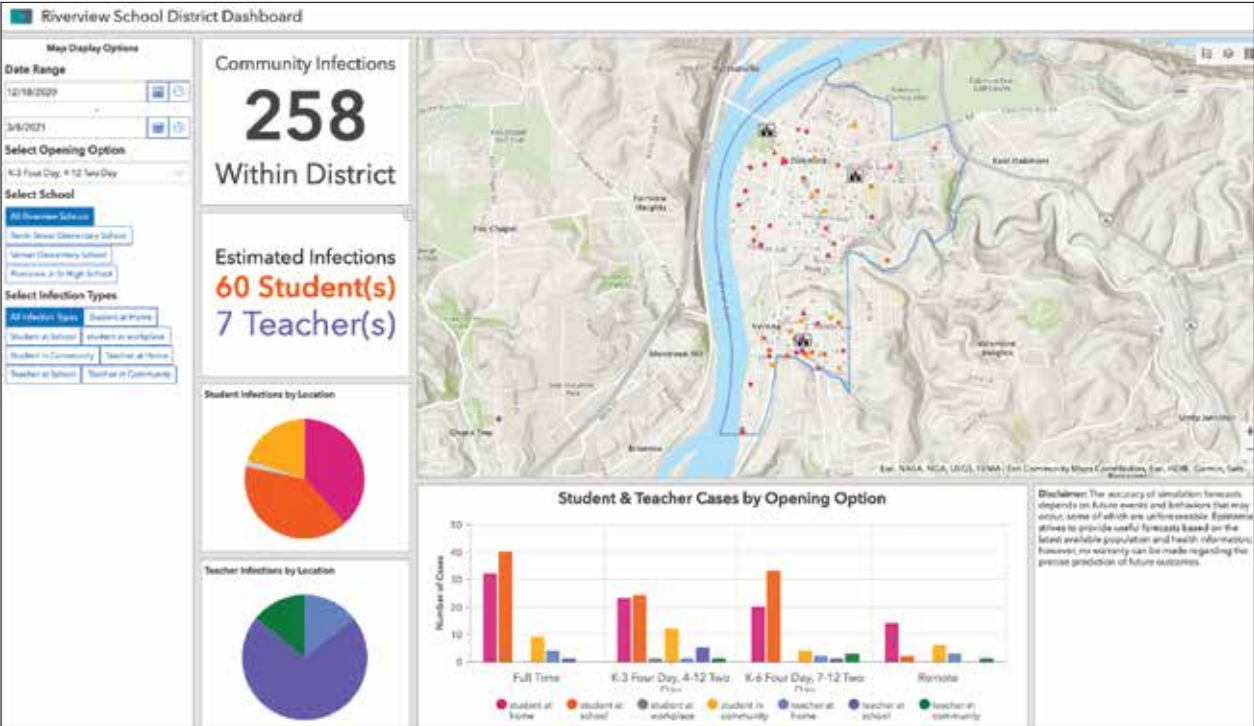
↑ Epistemix calibrated the COVID-19 model with realistic social dynamics, imported the results into a hosted layer in ArcGIS Online, and presented them to the district.

and community infection rates for four different opening strategies with breakdowns for individual schools within the district.

Riverview isn't flying blind anymore. "Epistemix helps to lead the way by providing much-needed projection and modeling data that can help superintendents make more informed decisions," said English. "And more informed decisions are a valuable commodity in the wake of COVID-19."

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

Esri Partners Deliver Solutions That Improve Decisions and Operations

Esri partners have developed solutions and services that use GIS to help nonprofits improve the supply of clean water; national agencies more rapidly respond to disasters; and help governments streamline operations, saving time and money.

Understanding the Need for Clean Water

Water4Life Global (W4LG) is a nonprofit based in San Diego, California, that works in Guatemala distributing water filter technology products to villages in need. In Guatemala, it is estimated that 1 out of 20 children will die before they reach kindergarten, and this is mainly due to lack of safe drinking water.

To assist W4LG in its efforts, Bay Park Data Solutions, an Esri partner, developed a custom questionnaire using ArcGIS Survey123 that enabled W4LG to better understand the clean water access needs in each village and track relevant information about each family including a photo for follow-up and marketing purposes. The data collected in rural villages was then uploaded to ArcGIS Online so that US stakeholders could track the project in real time via an online dashboard. ArcGIS StoryMaps stories supported the team's marketing and fund-raising efforts.

Using Esri's platform and technologies Bay Park Data Solutions built GIS solutions for W4LG that provide visual information to make better, more informed decisions, improve transparency with donors and stakeholders, and empower W4LG to tell its story visually to increase fund-raising efforts. Water4Life Global has distributed nearly 2,000 water filters over the past two years and plans to distribute an additional 1,500 filters in 2021.

Bay Park Data Solutions (www.bayparkdatasolutions.com) understands how important monitoring, evaluating, and tracking outcomes is for a nonprofit. These measurements help a nonprofit's donors and stakeholders understand its progress each year.

↑ Bay Park Data Solutions, an Esri partner, focuses on providing GIS solutions to nonprofits around the globe.

Cloud-Hosted Location Intelligence Accelerates Recovery

According to the National Oceanic and Atmospheric Administration, 2020 set a new annual record with 22 disaster events in the United States. Each event exceeded $1 billion in losses. Postdisaster, the Federal Emergency Management Agency (FEMA) deploys field staff to affected areas to assess damages and justify the flow of federal funding to aid recovery for survivors. FEMA's mobile damage assessment and survivor interaction tools must be scalable, secure, and easy to use—and in some cases, available 24/7 for weeks at a time while data is collected.

FEMA partnered with Ardent Management Consulting (ArdentMC, www.ardentmc.com) to architect and maintain a secure and accredited ArcGIS Enterprise deployment in AWS GovCloud (US). ArdentMC is an Esri partner, holding the Esri Release Ready and Esri Cloud Services specialties. The company is also an AWS Advanced Consulting Partner and has AWS Public Safety and Disaster Response Competency. This unique combination of Esri cloud solution engineering competencies supports public safety and disaster response.

The secure ArcGIS Enterprise environment created by ArdentMC supports FEMA's Disaster Survivor Assistance (DSA) and Preliminary Damage Assessment (PDA) missions through Esri mobile solutions. These field tools, when coupled with analytics solutions built using ArcGIS Dashboards, ensure the success of FEMA's mission. Using this environment, FEMA was able to provide the following support in 2020:

- A total of 111,895 disaster survivor interaction surveys occurred.
- A total of 21,814 community interactions were completed, with 8,509 organizations willing to distribute information. This resulted in disaster-related information being potentially available to 8 million individuals.
- In eight states and Puerto Rico, 1,101 PDAs were completed.

Using secure, cloud-hosted tools built on ArcGIS Enterprise, FEMA can now more efficiently collect information on survivor needs, community services, and environmental hazards impacting communities postdisaster.

↑ ArdentMC supports FEMA's Disaster Survivor Assistance (DSA) and Preliminary Damage Assessment (PDA) missions that assist communities after natural disasters.

Digital Assessor Maps Improve Efficiency and Accuracy

In 2015, San Mateo County's Office of the Assessor-County Clerk-Recorder and Elections (ACRE) created a strategic plan to foster a GIS environment focused on reducing redundant efforts, creating more accurate information, and increasing citizen engagement and transparency.

ACRE is the largest consolidated department in the State of California. It combines the constitutional office of the assessor with other constitutionally mandated functions of the clerk-recorder and elections to serve 770,000 residents in 20 cities and 70 jurisdictions. ACRE has a reputation for investing in GIS and technology to find ways to gain efficiency and reduce waste.

With that vision in mind, San Mateo County contacted Bruce Harris & Associates (BHA, www.bruceharris.com), a company specializing in GIS mapping and providing GIS solutions to local government agencies. In 2017, San Mateo County hired BHA to remap the county's 230,000 parcels, replacing a 20-year-old legacy GIS. Working with the county, BHA consolidated multiple databases and redrew parcels from source materials to eliminate redundancies and greatly improve accuracy. Parcels were delivered in the ArcGIS Parcel Fabric data model on time and within budget.

ACRE can now digitally produce all assessor maps, eliminating the time-consuming hand-drawing process previously used and providing an immediate return on investment (ROI). With this foundation in place, ACRE is now completely aligned to take advantage of ArcGIS as well as the portal infrastructure put in place by the Information Systems Department (ISD).

The county has already used this technology to support response to recent fires and assist work-from-home efforts to ensure business continuity during the COVID-19 pandemic. The county's strategic plan can now be accomplished using Esri's applications for local government. ACRE's investment in GIS and its trust in BHA resulted in a successful project that will continue providing benefits to the county for years to come.

↑ San Mateo County hired Bruce Harris & Associates to remap the county's 230,000 parcels, replacing a 20-year-old legacy GIS.

Esri partners represent a rich ecosystem of organizations around the world that work together to amplify The Science of Where by extending ArcGIS and implementing it in distinct ways to solve specific problems. Search for and discover partners, solutions, and services that meet your needs at **esri.com/partners**.

New **Training** and **Certification** Offerings

Training

Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have achieved Esri Technical Certifications and CompTIA CTT+ certification. Instructor-led courses will help you discover essential concepts, ArcGIS best practices, and Esri-recommended workflows and build skills you can apply right away to enhance your projects.

To maximize the value from instructor-led training, Esri is providing preclass and postclass assessments for most classes. Both assessments are online and completely optional. Pre-class assessments are available to registered class attendees three business days before the class start date. Assessments take 5 to 10 minutes to complete and use multichoice questions to measure knowledge related to the course learning objectives. Postclass assessments, available on the last day of class and for seven days afterward, help measure what has been learned in the class.
Attendees can use these assessment reports to gain insight into their knowledge of course topics before the class, then measure their knowledge after the class. Assessments can help attendees more confidently apply newly acquired knowledge. Read more about assessments in "New Year, New Learning Tools" (https://bit.ly/3iDqy8m).

If you or your team members are just getting started with ArcGIS, are enabling non-GIS teams with maps and apps, or transitioning established GIS workflows to ArcGIS Pro, one of these courses can help.

Introduction to GIS Using ArcGIS
This course is for individuals with no GIS background who need to acquire a foundation in GIS concepts to get started with ArcGIS software.

ArcGIS Pro: Essential Workflows
This course is for those with some GIS knowledge who need a broad introduction to ArcGIS Pro capabilities. Attendees learn how to map, edit, analyze, and share geospatial data and resources.

Migrating from ArcMap to ArcGIS Pro
This course prepares experienced ArcMap users to transition to ArcGIS Pro and be productive right away. Learn essential concepts and get the hands-on practice needed to confidently perform common workflows related to mapping, editing, analyzing, and sharing geospatial data.

Upcoming Esri MOOCs

Massive open online courses (MOOCs) are a free and convenient way to stay current with fast-changing technologies. Participants get access to ArcGIS software. Each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums that encourage engagement with classmates from around the world. Everyone who completes the course receives a certificate of completion. View all Esri MOOCs at esri.com/mooc. The following MOOCs are opening soon.

Do-It-Yourself Geo Apps
March 31–April 28
You don't need programming skills to create and share useful apps that feature geospatial capabilities. Join this four-week course and build skills to make apps for crowdsourcing data, communicating through stories, and sharing data on dashboards. Access to a suite of ArcGIS apps is included. Learn more and register at go.esri.com/learn-geo-apps.

The Location Advantage
April 14–May 26
To date, more than 25,000 individuals have joined this MOOC to learn how organizations can achieve a competitive advantage using location analytics. This six-week course explores the application of data and ArcGIS Business Analyst Web App to better understand markets, customers, risk, and growth potential. View course details and sign up at go.esri.com/location-course.

Certification

The certification team is updating core desktop and enterprise exams, which are planned to be released later this year. To explore current Esri Technical Certification exams, visit esri.com/training/certification. Join the Esri Technical Certification groups on LinkedIn and the Esri Community to get the latest certification news, connect with other professionals, and discuss all things certification. Looking for inspiration for your GIS professional development journey? View certification success stories at go.esri.com/certification-success.

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

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