ArcNews

Esri | Fall 2022 | Vol. 44, No. 4

Briefly Noted

Nonprofit Organizations Receive Free Geospatial Software

To support and advance the missions of small nonprofit organizations that may see GIS as being out of reach, Esri launched the Esri Small Nonprofit Organization Grant Initiative, which will provide 150 grantees with access to GIS training and software. "We are proud to assist small nonprofit organizations that are new to GIS while helping them understand the unique perspective and new insight that location brings to data," said Esri director of government markets Christopher Thomas. Nonprofit organizations working in the areas of civic and humanitarian efforts, economic advancement, conservation, food insecurity, and civil rights can leverage GIS through this initiative. The deadline for grant applications is January 31, 2023. For more information, visit esri.com/nonprofitgrant.

Inspire Others to Learn About GIS

Spread enthusiasm for GIS, mapping, and all things related to geospatial technology by celebrating GIS Day on November 16. Enthusiastic GIS practitioners can host a GIS demonstration at work, give a talk at a school about the importance of geospatial technology, bake GIS-themed treats, and more. Anyone who hosts a GIS Day event can register it on gisday.com, and the activity will be discoverable on the GIS Day events map. Registered hosts will receive five ArcGIS for Personal Use annual subscription licenses to distribute as they please, and event attendees will receive a free, one-year Premium subscription to StoryMaps, a new, powerful personal storytelling tool from Esri. Find out more at gisday.com.

Where People, Ideas, Data, and Maps Come Together

↑ People who attended the Esri User Conference (Esri UC) in July were happy to be together once again.

As one colorful poster in the San Diego Convention Center noted, "It has been 2 years, 11 months, and 29 days since we've been together," referring to members of the geospatial community who attend the Esri User Conference (Esri UC). "We are happy you are here."

Indeed, it seemed that everyone who attended the Esri UC in person in San Diego, California, July 11–15, was happy to be there.

"I attended virtually the last two years and was excited to go in person," said Katie Wheatley, senior GIS analyst for EA Engineering, Science, and Technology, Inc., PBC. "To be able to further my education in the profession, see what others are doing with the software and technology, and meet new people has been more beneficial than I imagined it would be."

For Dr. Nadine Sherif, regional marketing manager for Esri in the Middle East, Africa, and central Asia, this year's Esri UC offered an extraordinary atmosphere.

continued on page 4

White House Releases New Climate Data Portal

As Americans grapple with extreme heat and drought, longer and more intense hurricane and wildfire seasons, increased flooding, and more severe winter storms, it is important that people come together to help solve complex problems related to the planet's changing climate.

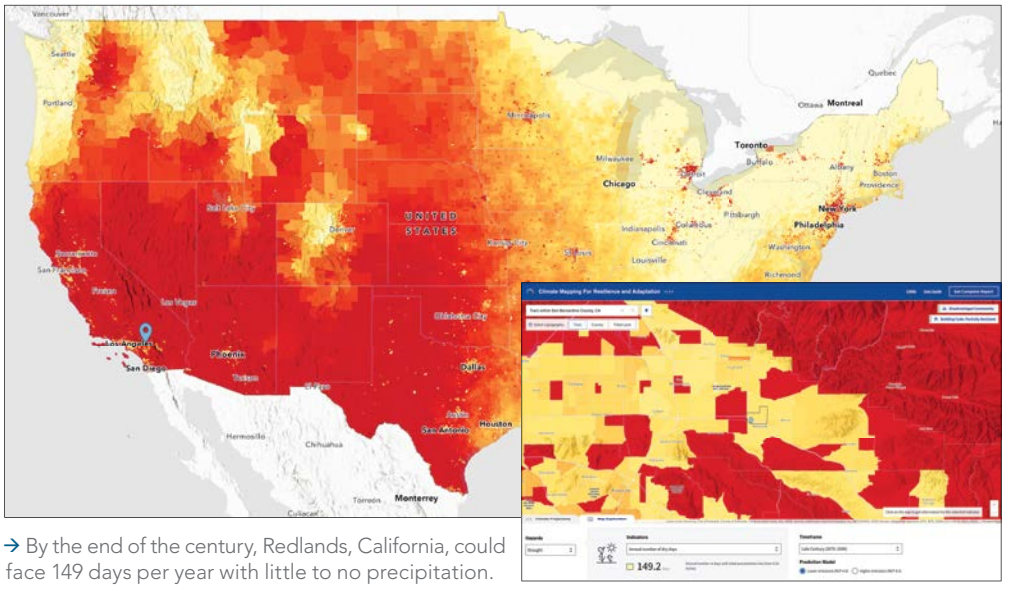
To foster this kind of cooperation, the White House debuted the Climate Mapping for Resilience and Adaptation (CMRA) portal in September. A collaboration between the administration and Esri, the portal can help cities, counties, states, tribal communities, and territories make better decisions about where and how to take action.

Central to the portal is the Current Hazards dashboard that monitors the climate-related hazards that affect communities each day. Site visitors can see where there are extreme heat advisories, active wildfires, coastal flooding warnings, and more.

The CMRA Assessment Tool lets users dive deeper to explore ongoing and projected climate conditions in locations across the United States based on whether greenhouse gas emissions are lowered by a lot or a little. In Redlands, California, for example, where Esri is headquartered, it is forecasted that temperatures could reach at least 105 degrees 22–42 days per year by the end of the century, compared with 12–13 days per year now. This indicates that extended periods of extreme heat is something that government officials in the area should prepare for. They can use the CMRA to learn which resilience-building actions to prioritize and find programs that offer compatible funding.

The CMRA provides links to federal funding resources, federal climate policies, and proven solutions from other communities. For instance, the linked U.S. Climate Resilience Toolkit offers videos and stories about what communities around the United States are doing to tackle their own climate-related challenges. The portal also displays a curated collection of open data related to extreme heat, drought, wildfires, flooding, coastal inundation, and more. Users can combine this data with their own geospatial data or incorporate it into their assessment tools to configure new maps and apps that address local needs.

This portal brings together critical climate data in one place and makes it easy to visualize on maps, in charts, and in reports. Anyone can access the data, from city planners and resilience officers to tribal leaders and residents. To start exploring the CMRA, go to resilience.climate.gov.



→ By the end of the century, Redlands, California, could face 149 days per year with little to no precipitation.

ArcNews

Esri | Fall 2022 | Vol. 44, No. 4

To help scientists better understand what's happening to the ocean and, in turn, how this affects the rest of the world, Esri's chief scientist, Dr. Dawn Wright, traveled to the deepest point on Earth: Challenger Deep, located in the Pacific Ocean. When the data and maps from this groundbreaking journey are ready, they will be widely shared with the public, including with Esri users.

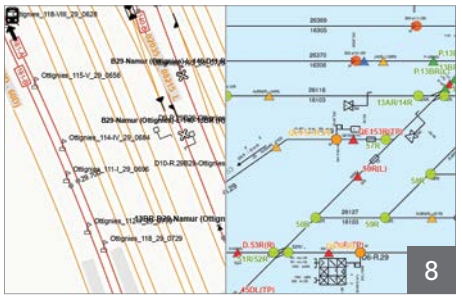
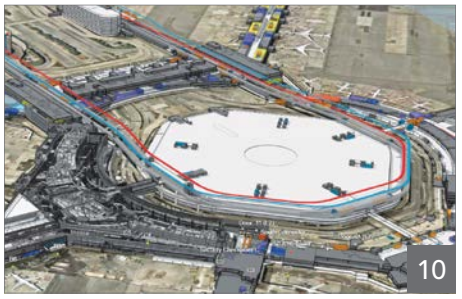
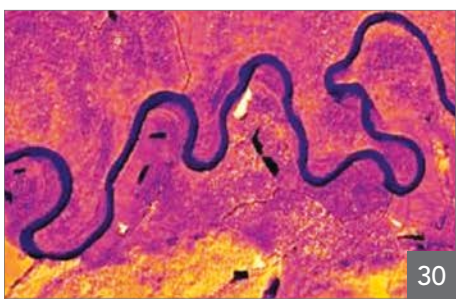


Table of Contents





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Bringing Spatial Analysis of Big Data to the Cloud

Because of its size, big data can be difficult to store and complex to process using traditional data processing software. Rather than migrating big data to specialized computing environments, organizations typically store and analyze this data in managed clouds.

ArcGIS GeoAnalytics Engine brings the power of Esri's spatial analytics capabilities to where organizations' cloud-based big data lives: in data lakes, data warehouses, and databases. Supported cloud environments include Microsoft Azure Synapse Analytics, Amazon EMR, and Google Cloud Dataproc.

Data scientists and GIS analysts access GeoAnalytics Engine directly from within Apache Spark, the large-scale data processing engine that's designed for big data analysis. This makes performing spatial analysis on big data faster and more efficient while going well beyond the basics.

Conducting Analysis Where Data Is Stored

In the past, data had to be moved to where analytics was accessible, usually in specialized analysis environments. But migrating massive data is cost prohibitive and time-consuming and creates data silos.

This is primarily why data scientists adopted Spark—an open-source analytics engine used to process large amounts of data—as their big data environment of choice. It employs cluster computing to increase big data processing speeds while hosting various libraries of analytic functions that are delivered directly to data where it is stored.

GeoAnalytics Engine is native to Spark, so it leverages Spark's computing power while rapidly processing massive volumes of spatial data. Without GeoAnalytics Engine, processing big datasets can take hours or even days. But benchmark testing done by Esri shows that the performance of GeoAnalytics Engine is 10 to 100 times faster than other open-source spatial analysis options.

Processing 16 Billion Records in Five Minutes

Government agencies and commercial organizations often work with tens of billions of records to gain actionable intelligence from data. Cellular network coverage data, for example, is huge and can reveal a wealth of information if the right spatial analytics is applied to it.

Real-world uses of anonymized cell coverage data include determining where mobile networks have satisfactory or unsatisfactory coverage and finding out how many people lingered at a specific site for a particular amount of time. Cell Analytics, from Esri partner Ookla, collects big data on how cell networks around the world are performing each day. Taking a dataset of about 16 billion depersonalized records from Cell Analytics (the cellular coverage dataset from Speedtest), a team of data scientists at Esri used the Find Hot Spots and Find Dwell Locations tools in GeoAnalytics Engine to identify patterns of cell signal strength and human presence and mobility. It took the team less than five minutes to extract, transform, load, and analyze 16 billion records. The team was then able to quickly build interactive dashboards, web and mobile apps, map-based stories, and analytical models to share actionable information with stakeholders.

In this scenario, if the data scientists had used traditional spatial analysis packages, they would have needed to geospatially index the data, which takes a significant amount of time. GeoAnalytics Engine enables users to skip that step and employ geospatial data immediately, streamlining the process of getting from raw data to actionable results.

This means that data analysis can begin right away. Users are able to focus on supporting the mission at hand rather than losing valuable time on moving and preparing data. And once generated, analysis results are easy to communicate so that stakeholders can act.

Seeing the Full Picture

GeoAnalytics Engine enables users to create comprehensive analyses of specific situations. It has a library of more than 120 functions and analysis tools—ranging from simple transformation and spatial aggregation tools to advanced statistical algorithms that aren't available in open-source packages—in a standard big data analysis workflow. Thus, data scientists and GIS analysts no longer have to patch together spatial analysis packages to get the full picture of a situation.

To conduct a full-picture analysis with GeoAnalytics Engine, data scientists at Esri obtained public information from the City of New York's open data website to see where noise complaints occur in high numbers. City officials could use the results of an analysis like this to identify where more noise-tampering resources need to be deployed.

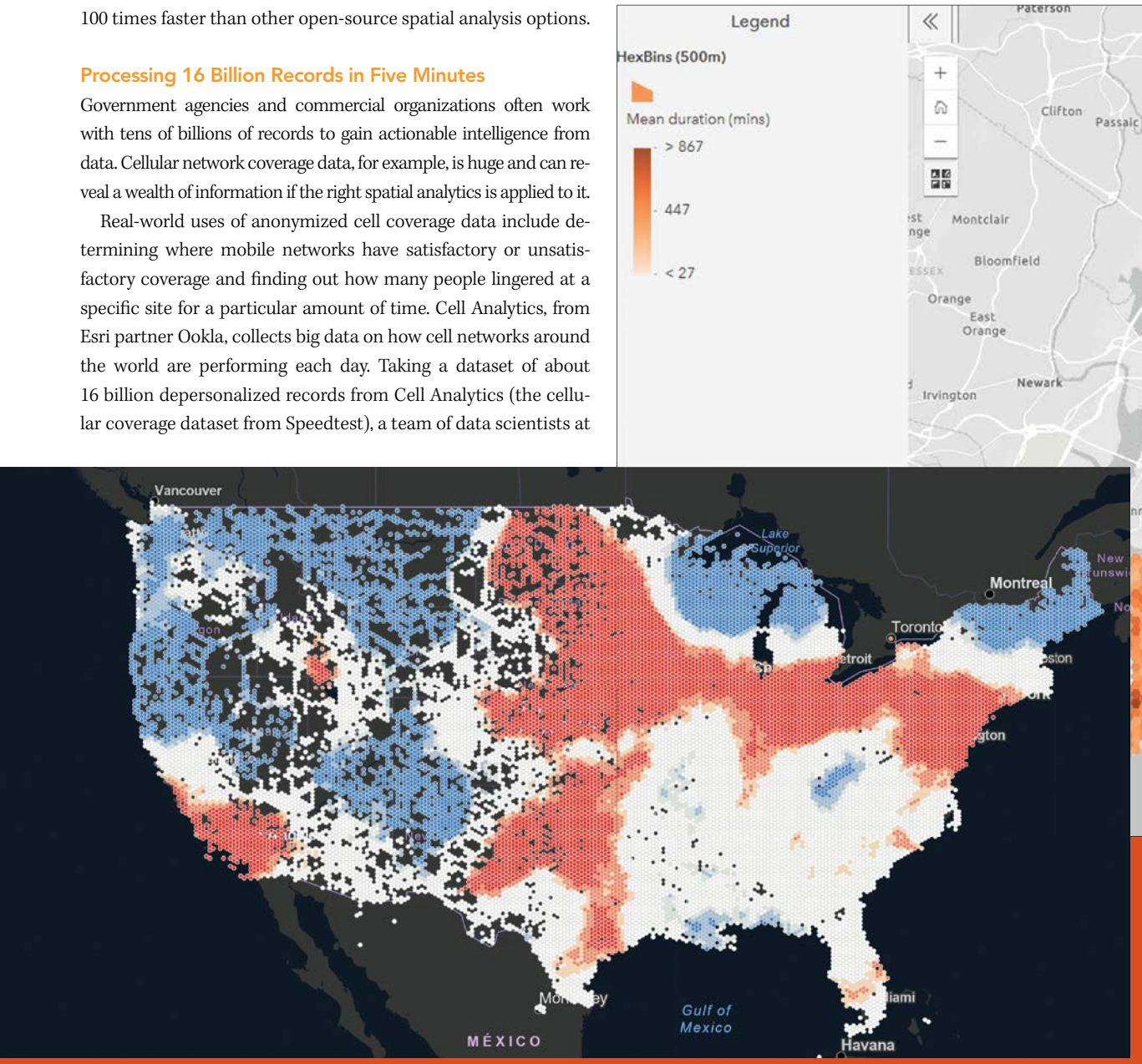
In New York, residents can call or send a message to the city's 311 customer service center to make noise complaints (and access other nonemergency city services). The Esri team obtained 27 million noise complaint records for a 10-year period to perform the analysis.

If team members had relied on traditional analytics to try to answer their primary question, they could have used the 311 data to determine whether noise complaints had increased, decreased, or stayed the same, but it would have been much more difficult to find out where and when the complaints had occurred and how long it had taken to respond to them. That's where spatial analysis comes in. Using GeoAnalytics Engine to process the data, the team generated a hexbin map to show clusters of 311 noise complaints along with their corresponding response times. Darker bins on the map reveal areas where it took longer for city officials to respond to noise complaints, suggesting less efficient 311 service.

Continuing to Evolve Big Data Spatial Analytics

As organizations obtain ever-larger volumes of spatial data that need to be processed and analyzed, the capabilities of GeoAnalytics Engine will only continue to grow. Future releases will focus on adding tools and functions, advancing how data comes into and is shared out of GeoAnalytics Engine, and enhancing visualization capabilities.

For more information and to get started with ArcGIS GeoAnalytics Engine, visit go.esri.com/geoanalytics-an.



↑ A hexbin map shows clusters of 311 calls and response times. The darker bins suggest areas where 311 call assistance was less efficient. (Data courtesy of the City of New York.)

← Using the Find Hot Spots analysis tool in ArcGIS GeoAnalytics Engine, data scientists processed 16 billion cell phone records to establish patterns of cell signal strength across the United States. (Cell Analytics data reproduced, analyzed, and published with prior consent from Ookla.)

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Where People, Ideas, Data, and Maps Come Together

"Seeing all the Esri customers, distributors, and partners in the same place was just phenomenal," said Sherif, who traveled from Berlin, Germany, to be at the conference. "I was really delighted to meet people face-to-face again."

Esri president Jack Dangermond was overcome with emotion when he welcomed the nearly 15,000 in-person attendees and more than 16,000 virtual participants to the Plenary Session.

"It's so wonderful to be with you," he said. "I'm a little overwhelmed by it all, being together for the first time in three years!"

While attendees come from all over the world, speak different languages, and work in various disciplines, Dangermond pointed out that everyone at the Esri UC approaches problem-solving from a common angle: geographically. In today's complex and interdependent world, that is key.

"The world that we are living in is changing rapidly, increasingly dominated by the human footprint," Dangermond said, noting how this is creating many challenges, from pollution and wildfires to social conflict, food shortages, and a steep decline in biodiversity.

But by bringing people, ideas, and data together—by Mapping Common Ground, the theme of this year's Esri UC—Dangermond believes that geospatial professionals can create understanding and find solutions. And the speed at which geospatial technology is advancing means that GIS professionals will have profound effects on the way civilization evolves, according to Dangermond.

Esri staff gave presentations on these advances throughout the Plenary Session. Audience members got to see new products such as ArcGIS Knowledge, which employs graph analytics to map relationships among datasets, and ArcGIS GeoAnalytics Engine, which brings GIS software to where big data is stored. (See "Bringing Spatial Analysis of Big Data to the Cloud" on page 3 for more information on GeoAnalytics Engine.) And attendees greeted many updates to ArcGIS Pro—including dynamic feature clustering and new animated symbols—with enthusiasm.

The highlight of the Plenary Session was the user presentations. They showed how innovative the GIS community can be when grappling with challenging problems. Taken together, the presentations demonstrate the widespread impacts that maps and the geospatial community have on people, places, animals, and ecosystems.

"What you do and how you do it matters. No one else understands things like you do or is equipped to provide the solutions you can," Dangermond told the audience. "You are being called upon at this most critical point in human civilization to provide the language, methods, and infrastructure for helping the world find common ground. History will judge all of us based on our success."

3D GIS Helps Fast-Growing City Expand Sustainably

Over the next eight years, more than 40,000 people are expected to move to Sioux Falls, South Dakota. The city wants to ensure that this growth happens sustainably, so its civic analytics team has been experimenting with cutting-edge GIS, like using reality capture technology with 3D GIS.

After developing a 3D mesh of Sioux Falls, the civic analytics team created a 3D parcel finder for residents to use. This is particularly helpful for visualizing condo parcels.

"In 3D, we can see each condo parcel's shape and location and quickly identify its parcel information," said Lauri Sohl, civic analytics manager for the City of Sioux Falls.

To plan the future of Sioux Falls, the civic analytics team is employing ArcGIS Urban. It lets city officials view new development plans in context as web scenes. According to Christopher Anderson, a civic analytics specialist for Sioux Falls, this allows the city to identify "poor street connectivity or zoning transitions and…see how the proposals fit in around existing housing and facilities."

Austin Brynjulson, another civic analytics specialist for the city, illustrated how the team is working with the fire department to enhance public safety by using the 3D mesh for preincident planning.

"They were immediately drawn to the detail of the building rooftops, pointing out all the dangerous features," Brynjulson said about the firefighters. So the civic analytics team built an app that shows the overall risk of rooftops.

The City of Sioux Falls also employs its 3D mesh during winter storms to keep residents abreast of road plowing operations.

"*[Our]* application tracks the fleet that plows, sands, and salts the streets," said Sohl. "We can use data extraction to help predict icing risk by calculating solar radiation, shadow accumulation, slope, and aspect to create an icing model. This helps us prioritize the high-risk areas for our plows to target."

By being endlessly curious and eager to experiment, the civic analytics team at the City of Sioux Falls has earned the trust of colleagues, residents, and city leaders.

"This team is making it easy and efficient to use data as we tackle the challenges and opportunities of a growing city *[and]* create a better future for our residents," said Sioux Falls mayor Paul TenHaken in a video message.

DOT Builds Common Ground with Hub Technology

The Massachusetts Department of Transportation (MassDOT) manages 36 regional airports, 18 transit stations, more than 300 miles of transit lines, 37,500 lane miles of roadway, and pedestrian and bike paths that traverse more than 14,000 miles of the state.

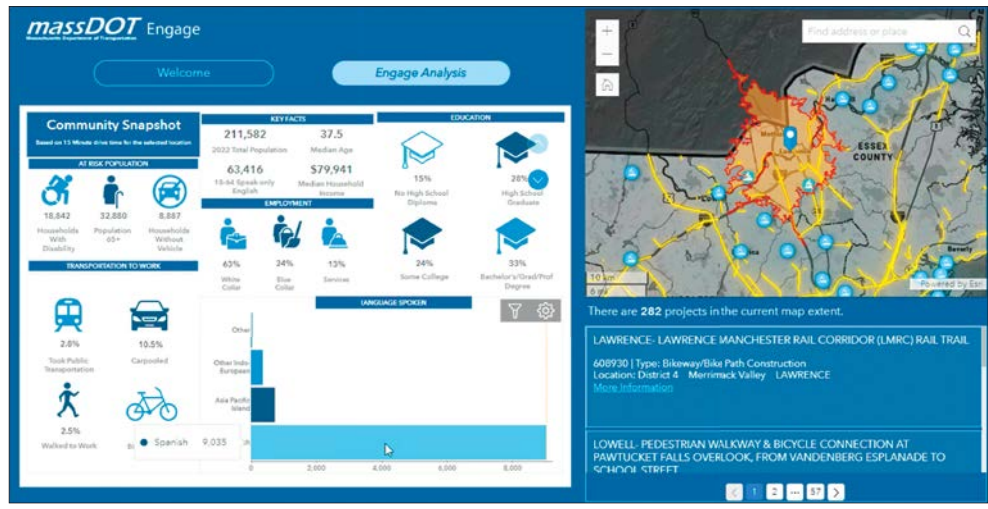
"For us, GeoDOT—our ArcGIS Online organization—is the foundation of what we do," said José Simo, MassDOT's GIS outreach coordinator. "It's where we provide access to data *[and]* dashboards and build focused solutions for our users."

GeoDOT Local is a site, created with ArcGIS Hub, that MassDOT's GIS team built to boost collaboration with municipal partners.

"It brings together datasets, viewers, and easy-to-use tools designed for cities and towns," explained Carl Hughes, GIS lead developer for MassDOT.

For example, municipalities can use the Road Inventory Submission Application (RISA) within GeoDOT Local to update the data on roads in their jurisdictions, and MassDOT automatically sees the proposed changes in its database. Municipal employees can also use the Massachusetts Project Intake Tool, or MaPIT, to launch projects digitally.

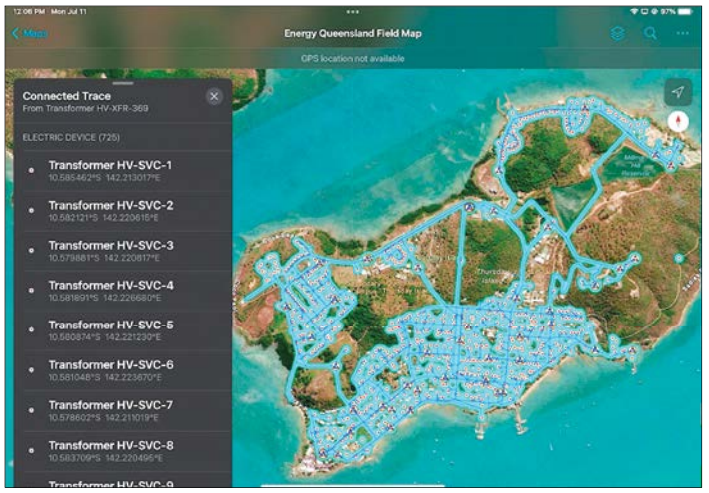
"Previously, municipalities initiated projects using paper forms and manual processes. This often resulted in the need for resubmissions for the same projects," said Hughes, noting that this wasted staff time and taxpayer dollars. "With MaPIT, project initiation has gone from months to days."



→ GeoDOT Local enables the Massachusetts Department of Transportation (MassDOT) to better collaborate with municipal partners.

↑ To help Sioux Falls, South Dakota, grow sustainably, the city's civic analytics team uses cutting-edge GIS.

↑ The Sioux Falls civic analytics team includes, from left to right, Lauri Sohl, Christopher Anderson, and Austin Brynjulson.



↑ Energy Queensland used ArcGIS Utility Network to modernize its electrical and communications network.

↑ Shannon Connolly illustrated how Energy Queensland's digital transformation helps the electric utility better meet its customers' needs.

MaPIT leverages ArcGIS Web AppBuilder; ArcGIS Enterprise; ArcGIS Roads and Highways, which hosts MassDOT's linear referencing system; and the department's internal reference system for projects. Municipal users are led through the steps to map their project's location and verify funding eligibility. MaPIT then sends the proposal for additional screenings and sign-offs.

To ensure that MassDOT is distributing project funds equitably, a dashboard within GeoDOT Local provides a geographic view of infrastructure investments based on how many roadway miles cities and towns own and where people live and work. A related tool called Engage enables MassDOT to understand each community's unique characteristics and ensure compliance with civil rights codes and environmental justice responsibilities. Engage has data on local populations, including what languages they speak, and contact information for community influencers to encourage public involvement.

"The positive response to our GeoDOT Local collaboration strategy has been really exciting," said Hughes. "Over 85 percent of municipalities are now participating, and the equitable distribution of infrastructure funding has improved dramatically."

Electric Utility Modernizes Operations with ArcGIS

Energy Queensland in Australia maintains 153,000 substations and nearly 130,000 miles of connecting power lines while serving more than 5.2 million customers and supporting over 3,500 mobile workers. To keep the lights on for such a vast operation, efficiency is key. That is why the electricity provider has undertaken a digital transformation that allows it to operate more quickly and comprehensively.

"We took our legacy GIS data and, using *[the]* ArcGIS Utility Network model, modernized our electrical and communications network," said Shannon Connolly, GIS delivery executive for Energy Queensland.

In practice, this means that the grid can be viewed at any scale, from the whole distribution network to individual meters. The data can also be viewed in 3D, allowing users to locate and edit assets quickly and easily.

In addition, Utility Network enables staff at Energy Queensland to trace the grid from energy sources, such as solar farms, to customer service points. This is particularly useful for field crews who need to know where to go when responding to outages and maintenance requests. Now, they can see this information in real time with ArcGIS Field Maps.

GIS also helps Energy Queensland better trace communities' vulnerabilities to natural disasters, such as bushfires, cyclones, and severe flooding. Energy Queensland can de-energize, inspect, and reenergize specific points on the network as needed during an emergency—a capability that is becoming ever more important with the yearly uptick in climate-related disasters.

"ArcGIS Utility Network is underpinning our ability to achieve a sustainable and resilient future," Connolly said.

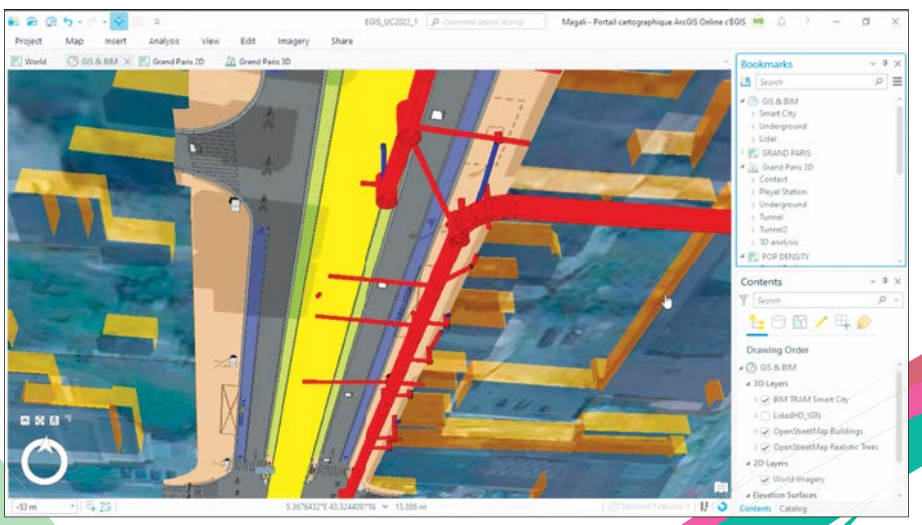
BIM Integration Helps Engineers Aim for Carbon Neutrality

Egis, a French engineering group, conducts infrastructure projects all over the world. One of the company's goals is to contribute to achieving worldwide carbon neutrality by 2050.

"*[We can]* do this by designing intelligent cities, smart buildings, resilient infrastructure, and low-carbon solutions," said Vincent Keller, head of the rail digital engineering department at Egis.

One of Egis's biggest projects is constructing the Grand Paris Express rapid transit lines, part of a larger effort to revitalize the rail system in Paris, France. The plan is to build nearly 125 miles

continued on page 6



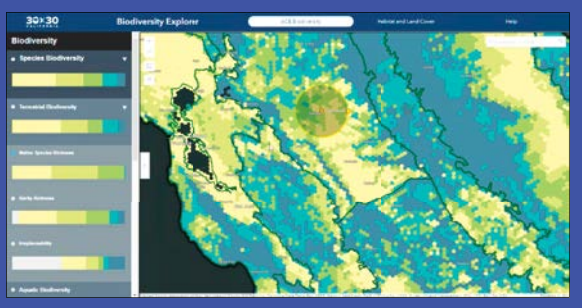
→ The team at Egis can visually track where construction projects conflict with existing utilities and buildings.

Geospatial Collaboration Is Key to Fighting Climate Change

Climate change was a big topic at this year's Esri User Conference (Esri UC). Special guests and keynote speakers underscored the valuable work that GIS practitioners can do to ameliorate the effects of a changing climate and spur humans to modify their behavior.

David J. Hayes, special assistant to the president for climate policy at the White House, introduced a new climate resilience portal that Esri and the federal government have built. In line with the goals in US president Joe Biden's climate agenda, the portal will enable federal agencies to more easily develop and share information about climate change. (For more information on this, see "White House Releases New Climate Data Portal" on page 1.)

Wade Crowfoot, secretary of the California Natural Resources Agency, updated attendees on California's effort to conserve 30 percent of its land and coastal waters by 2030. He and Dr. Nathaniel Roth, chief scientific and data adviser for the California Department of Conservation, demonstrated CA Nature, an online GIS site that synthesizes data about biodiversity, climate change, public access to recreation, and more. Users of CA Nature can explore each of these topics using maps and charts and see where there are additional opportunities for conservation.



↑ CA Nature shows areas of California that have been preserved and are primed for additional conservation.

Two presenters from the National Geographic Society—Dr. Jill Tiefenthaler, its chief executive officer, and Ronan Donovan, a National Geographic Explorer—reinforced the importance of map-based storytelling to create common understanding. Tiefenthaler announced National Geographic's new Global Storytelling Institute, which can help geospatial practitioners more effectively communicate geography-based stories. And Donovan showed the audience how he employs geospatial analysis to find out where conflicts between humans and wolves are common—and, thus, where coexistence is possible.

To round out the special presentations, keynote speaker Deanne Criswell, administrator of the Federal Emergency Management Agency (FEMA), focused on how analyzing data from past disasters and performing predictive modeling are vital to preparing for a future with more natural hazards. FEMA's National Risk Index, a geographic database, does this by examining communities' risk of and social vulnerability to experiencing disasters. Users can employ the tool to evaluate their own communities' risks, and it can help emergency managers better focus their resources. This is important because, as Criswell emphasized, emergency preparedness and response are collaborative endeavors.

↑ Keynote speaker Deanne Criswell advised the audience on how to prepare for future natural hazards.

"Connect and grow with each other," she implored the audience. "Keep innovating and creating so we can save the most lives, protect the most property, and create sustainable communities for generations to come."

continued from p. 5

Where People, Ideas, Data, and Maps Come Together

of underground metro lines between 2024 and 2030, including 68 new stations and 7 new depots. More than 10,000 workers are already involved in the project.

"With ArcGIS, we've been able to centralize all the data about existing utilities and buildings," said Thomas Lesage, Egis's digital transformation officer.

This allows Egis to use building information modeling (BIM) to visually track possible conflicts, such as whether the construction of a new station would require decommissioning existing services.

To collect data about each construction site, 70 on-site Egis collaborators take geolocated pictures each day and upload them to Field Maps. Clients can view this and other real-time data with ArcGIS Dashboards to track construction progress.

"In this case, the GIS platform becomes the single source of truth that provides potentially all the relevant views and dashboards to make decisions in a short time," said Keller.

The Egis team is also improving workflows by integrating BIM data with ArcGIS and using the Industry Foundation Classes (IFC) data standard with ArcGIS GeoBIM in particular. This helps Egis ensure data continuity not only between construction sites and clients but also between BIM models and GIS, boosting efficiency and increasing transparency with stakeholders.

"The project will change the lives of many people," concluded Keller. "We believe the processes we've presented will also change the lives of many project managers."

GIS Creates Space for Particle Physics

The European Organization for Nuclear Research (known by its French acronym, CERN), a particle physics research institute in Geneva, Switzerland, is most famous for its Large Hadron Collider (LHC), which sits more than 320 feet below ground and tests the properties of accelerated particles. But CERN houses many other projects as well—along with the scientists who work on them—at 18 sites on 540 acres of land. The complex includes 700 individual buildings that accommodate more than 15,000 workers.

"In a way, CERN is a small city," noted Youri Robert, team referee for topography and geomatics at CERN. "And the underground infrastructure is just as huge."

The geomatic engineering team at CERN is dedicated to making sure this small city runs smoothly, giving people not just a place to work but also space to carry out their projects effectively.

To overhaul what was previously a time-consuming process of organizing floor plans, team members used GIS to build basemaps of the facility and computer-aided design (CAD) files to create indoor layouts. They then converted the indoor CAD plans to a geodatabase format. This provided an easy-to-read display of all the departments in CERN that was also linked to the organization's human resources database. The team even implemented an integrated reservation tool for employees to use to book rooms and work spaces on campus.

The plan eventually went beyond simply mapping space for people to work. The geomatic engineering team ended up integrating data from the team in charge of aligning the 1,600 magnets of the LHC, and this now allows the alignment team to work even when the LHC tunnel is closed.

"Seeing the benefits for asset maintenance, more and more teams requested a layer in the system," said Nicolas Guilhauden, geomatics engineer at CERN.

Over time, the team mapped more than 300,000 assets on the CERN campus with GIS software. And it is currently in the process of integrating ArcGIS Indoors to replace previously used custom tools.

"With Indoors, we are enabling both administrative and technical teams to manage their assets in a common system," said Guilhauden. "This collaboration at CERN will allow us to face new challenges ahead, like the Future Circular Collider, an ambitious project *[aimed at]* discovering a new universe of particles."

A Geospatial Approach to Conservation

Listening to and working with communities on conservation is at the core of how the Jane Goodall Institute (JGI) helps people meet their own needs while preserving the natural world around them.

"If we don't help people find ways of living other than destroying their environment, we can't save chimps' forests or anything else," said Dr. Jane Goodall in a prerecorded video played for the Plenary Session audience. She was outlining JGI's method for holistic conservation—the subject of a new book from Esri Press. (For more on *Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation*, see page 36.) "It just makes all the difference…working with the people *[and]* listening to what they say."

By bringing technology like GIS into communities, JGI enables people to monitor and address the health of their forests. With this approach, "places that were utterly destroyed can once again support the natural world," said Goodall.

↑ Bringing GIS to communities helps people monitor and address the health of their forests, according to three presenters from the Jane Goodall Institute (JGI).

Three presenters took the stage on behalf of JGI to demonstrate Goodall's vision: Japhet Jonas Mwanang'ombe, national coordinator of Roots & Shoots Tanzania; Dr. Lilian Pintea, JGI's vice president of conservation science; and Merlin van Lawick, communications associate for JGI.

Mwanang'ombe detailed how, by using JGI's Tacare approach to conservation, one community replaced an invasive eucalyptus species that was stressing the water supply with native plants.

"My goal is to make sure we try to recover what we have lost," said Mwanang'ombe. "Mapping is helping us to document not only what scenarios exist today but also the future of what we want to have."

JGI also uses satellite imagery to help communities fight deforestation. The bird's-eye view allows community members to connect the emotional reality of deforestation to the tangible work they need to do to restore the land to health.

"Mapping common ground allowed us to develop a common language *[and]* a common understanding, and it helped develop trust between us as true partners in conservation," said Pintea.

It's important that this work continue far into the future, noted van Lawick, who is Goodall's grandson. He also said that young people need to have a platform to care for their environment and each other.

"Sharing common ground," he emphasized, "is one of the only hopes that we have for our generations to create a sustainable future."

↑ The European Organization for Nuclear Research (CERN) has vast infrastructure underground.

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Belgian Rail Company Reenvisions Worker Safety

With nearly 9,000 kilometers (about 5,500 miles) of railroad track packed into 30,000 square kilometers (about 19,000 square miles) of land, Belgium's national railway is one of Europe's busiest. For government agency Infrabel, which manages all of Belgium's railway infrastructure—including train tracks, power stations, and underground cables—safety is a major concern.

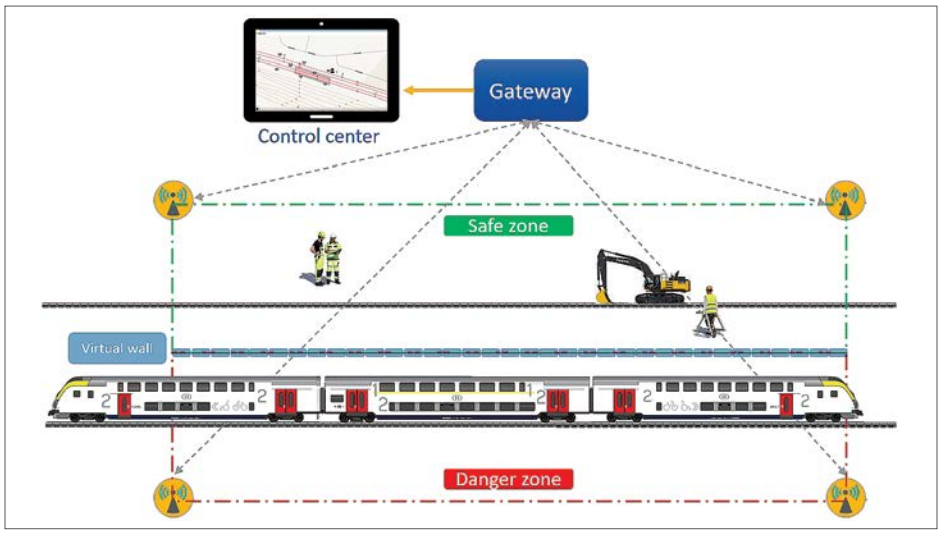
"Infrabel provides the backbone for everyone in Belgium to travel by train throughout the country," said Damien Paque, team leader of geoservices and solutions at Infrabel. "The first and biggest priority for us is to be able to provide more safety to our workers in the field."

Crew members in rail yards sometimes work within five meters of active tracks, so precision and accuracy are vital for Infrabel. That's why Paque and his team have spent the last few years developing an innovative deployment of geospatial technology. The system consists of a robust GIS and several apps that combine advanced technologies such as Global Navigation Satellite System (GNSS) devices, local positioning, and geofencing. One app in particular tracks mobile crew members in real time down to the decimeter, or subfoot, level—a groundbreaking way to improve safety.

"What they've done is brilliant," said Terry Bills, Esri's transportation industry manager. "Infrabel is developing a solution to the number-one challenge railroad companies worldwide face, which is protecting workers."

A Single Source of Up-to-Date Infrastructure Data

The first step in creating a safer work environment is having accurate data on infrastructure. That's where Infrabel's GIS journey began.



↑ Using geofencing in ArcGIS Pro, Infrabel's technology team creates a virtual fence around a mobile crew's work space and divides it into safe zones and danger zones.

Previously, the agency's infrastructure data was recorded in a variety of formats. In 2018, Infrabel adopted ArcGIS technology to consolidate and improve infrastructure records. Paque and his team built tools to digitize as-built records, georeference computer-aided design (CAD) drawings, and survey the entire rail network to validate asset locations. Those tools also allowed them to georeference photos taken by cameras placed on trains and incorporate high-precision aerial drone imagery of Belgium's rail system.

The result of all this is InfraGIS, a single source of accurate and up-to-date geospatial data for all the rail infrastructure that Infrabel oversees.

"The goal is to have good management of this data, so we have built a repository where we can have this information," Paque explained.

The data in InfraGIS is made available to approximately 10,000 Infrabel employees through an app called InfraGIS Viewer. Built within ArcGIS Enterprise and using ArcGIS API for JavaScript, InfraGIS Viewer consists of three synchronized viewers. Geographic Viewer offers a map view of railway infrastructure and is used for asset and workforce management. Schematic Viewer provides a dynamic, schematic representation of the rail network and assets and is often used in planning and train traffic management. RailView shows a photographic view of infrastructure, which office-based employees can use to get a glimpse of what's happening in the field.

Data is synchronized among the three viewers. For example, when a user pans or zooms in Geographic Viewer, the view is reflected immediately within both Schematic Viewer and RailView.

InfraGIS Viewer is now the most-used cartographic app at Infrabel. It plays a primary role in managing worker safety, and its success enabled the agency's technology team to develop two ambitious geospatial mobile apps: !nfraSPAD and Virtual Fencing.

Alerting Train Conductors of Danger Ahead

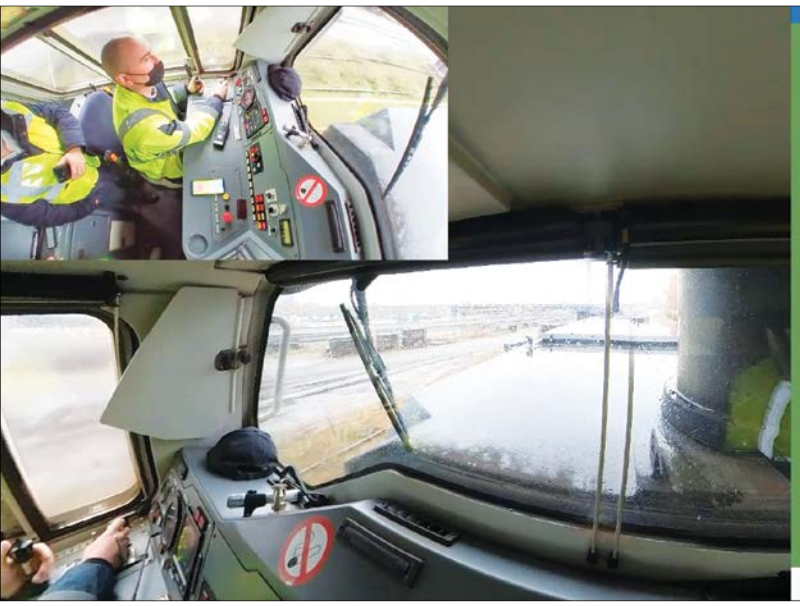
When maintenance crews work in the rail yard, numerous logistics must be coordinated to provide them with a safe work site. This often includes taking segments of track out of service to ensure that trains don't operate where crews are.

"You don't want the two—trains and work crews—to mix," said Bills.

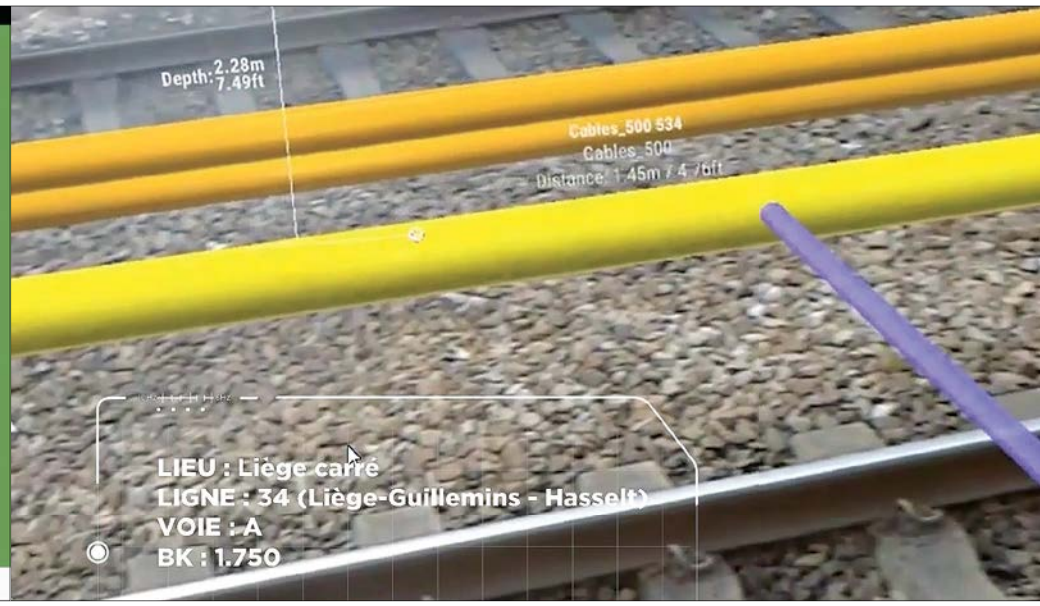
A red signal is what tells train conductors where not to go. If a train does cross a red signal, it is known as a signal passed at danger, or SPAD.

To reduce potential hazards from SPADs, Infrabel created !nfraSPAD, a critical alert app developed with ArcGIS API for JavaScript that informs train conductors (and subcontractors) and their supervisors when they are approaching a red signal.

When !nfraSPAD detects a red signal ahead, it immediately sets up three default geofences, or buffer zones, 150 meters from the signal, 80 meters from the signal, and 50 meters from the signal. When the train passes through each buffer, the app sends progressively louder and more jarring warnings to a location tracking device, such as a smartphone or tablet, that every train conductor and supervisor at Infrabel carries. For example, a yellow, moderately loud and vibrating alarm that goes off at 150 meters from the signal will turn into a red, much louder, more intensely vibrating alarm at 50 meters. This maximizes the likelihood that the train



↑ The !nfraSPAD app creates buffers around red signals to alert train conductors when they are getting close to one.



↑ To help mobile crews better understand where underground cables are, Infrabel plans to implement augmented reality (AR) technology.

conductor will know to proceed with caution and be prepared to slow down or stop.

The conductors' tracking devices are accurate to about 10 meters, which is standard for most smartphones and tablets.

Tracking Mobile Crews Precisely, in Real Time

For mobile crews and their supervisors, the Virtual Fencing app, which is under development, will be even more precise. It will alert mobile crews and their supervisors if a worker enters a high-danger area in the rail yard, like a section with live track. Because the virtual fences that the app relies on are based on GNSS and ultra-wideband (UWB) positioning technology, these alerts will be accurate to within 10 centimeters.

To yield this level of reliability, Infrabel is effectively creating its own high-accuracy, location-tracking mesh network. For places along the rail network where there is no GNSS connectivity, such as in tunnels, Paque and his team are installing UWB positioning beacons every 100–200 meters. The team is surveying the beacons using Arrow Gold GNSS receivers from Esri partner Eos Positioning Systems. These receivers use differential corrections from local real-time kinematic (RTK) networks to record centimeter-accurate coordinates in the geodatabase.

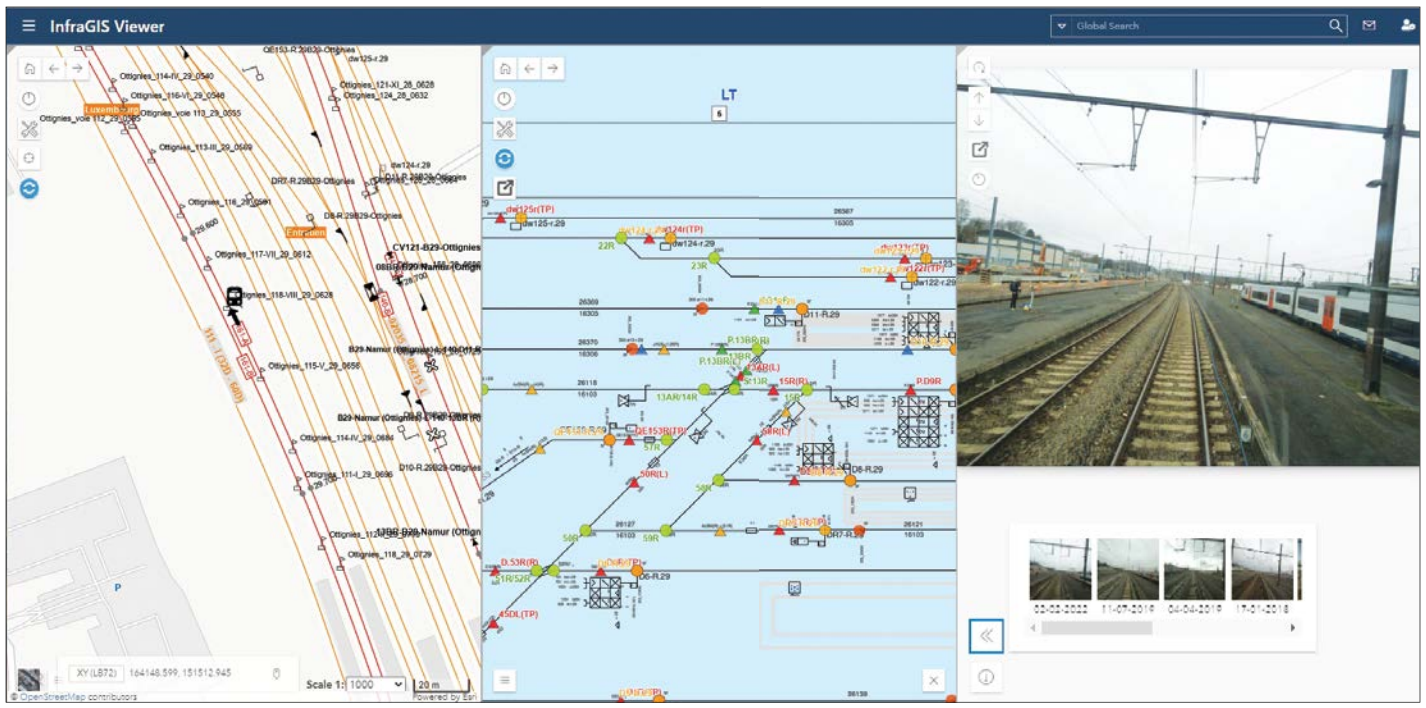
"With this level of accuracy from the Arrow Gold, we can get a precision of a few centimeters for the location of each beacon," said Infrabel technical GIS manager Jérôme Duckers.

The net effect of the beacons being so precisely located is that, together, they can track human movement throughout the area to within 10 centimeters of where the person actually is.

All Infrabel mobile workers will carry lightweight positioning tags in the pockets of their smart, high-visibility vests when they work in the field. The tags, which are approved for use in live-rail environments, will track each worker's movement throughout the beacon network.

In addition, Infrabel's technology team will use geofencing in ArcGIS Pro to create a virtual wall around the crew's work space and divide the area into safe zones and danger zones.

"There is a safe zone, in which the maintenance workers can keep working on their track, and a danger zone that they should not enter," Paque said.



↑ InfraGIS Viewer's three synchronized viewers show, from left to right, a map view of railway infrastructure, a schematic view of the rail network, and a photographic view of what's happening on the ground.

The moment any workers cross into a danger zone, they and their supervisors will receive alerts. The supervisor's tablet will flash and make noise, and the crew member's high-visibility vest will vibrate, flash, and sound an alarm.

"When this happens, the supervisor and worker will both know that the worker needs to move back to the safe zone immediately," said Paque.

This high-precision, scalable location-tracking technology could have widespread implications for the railroad industry. Knowing—in real time—the exact location of all mobile workers in the rail yard and being able to send them alerts when they need to get out of danger enable rail operators to keep their workers safe in a whole new way.

Routing Workers and Emergency Crews More Safely

Minimizing the time spent in a live rail environment is another way railway companies can improve safety. To do that, Infrabel developed an additional mobile app called Access to Railway. The agency makes it available to staff members and emergency services so that they all have more efficient access to assets.

Built using ArcGIS Runtime SDK for .NET, Access to Railway contains a list of all the rail network's points of access, such as stations and crossings. When maintenance workers are called in to repair a switch or emergency personnel need to respond to an accident, they can launch Access to Railway on a tablet and see the safest and most efficient way to get there. Directions in the app include how to get from where they are to the Infrabel facility containing the equipment they need, from the facility to the parking location closest to the asset, and from the parking location to the nearest rail yard access point (which is typically outside the public road network).

While many third-party apps could optimize either a driving route or a route within an asset network, Access to Railway does both. This ensures that mobile crews; emergency service personnel; and soon, Infrabel subcontractors spend the least amount of time navigating to, from, and within the yard.

Visualizing Nonvisible Assets with Augmented Reality

Looking ahead, Paque and his team want to help crews stay safe when working near nonvisible underground cables by using augmented reality (AR) to visualize the cables' locations.

"When you can see the cables underground, you can avoid accidents when working in the field," Paque said. "With this AR help, the goal is to show those cables to the workers, superimposed on their actual view of the work site."

Before deploying the AR visualization, however, Paque and Duckers need to enhance the data Infrabel has on its underground cable network.

"The location data from the previously digitized CAD drawings has proven, overall, to be not accurate enough for an AR application," said Paque. "We are looking into ways to improve the quality of this data so that, ultimately, we can use AR technology on our construction sites."

Once the data is ready, Paque and his team would like to implement an AR app that projects buried infrastructure assets via a HoloLens device. When connected to an Arrow Gold GNSS receiver, the app can precisely orient crew members to their position relative to buried assets.

According to Bills, Infrabel is taking a lead in the rail industry when it comes to addressing safety challenges.

"The ability to know and understand the location of all your assets with extremely high accuracy is critical to safety in the rail industry worldwide," he said. "What Infrabel has done is highly innovative. Along with some of the work that other railway organizations in the region are doing, it charts a path for others to follow."

Standardized Location Data Transforms San Francisco Airport Operations

San Francisco International Airport (SFO) is the 17th-busiest airport in the United States and the 40th-busiest airport in the world by passenger count. Its facilities include 4 terminals; 6 parking garages; 11 AirTrain stations; 1 Bay Area Rapid Transit (BART) station; support buildings; and dozens of shuttle, bus, and transportation network company stops. Within the airport's 17 million square feet of interior space, there are more than 15,000 defined locations for shopping, dining, maintenance, storage, and more.

Over the years, a variety of maps of the airport complex have been created for use by staff members, airline operators, retail tenants, and passengers. But these maps were produced using different sources, so they were often inconsistent with one another and out-of-date because of the continual development that takes place at SFO.

This became particularly apparent when SFO began its most recent capital improvement program. The undertaking, which will cost more than $7 billion, consists of hundreds of projects to upgrade buildings, taxiways, utilities, and security by 2026. It reflects the previously developed SFO Master Plan, which was based on data and maps kept in various files and formats.

To standardize map production, the GIS team within SFO's Planning, Design, and Construction Division employed ArcGIS technology to develop three data models: one for subsurface utilities, one for exteriors, and one for interior spaces. Now, the hundreds of contractors and subcontractors working on capital improvement projects at SFO use data from the three models every day to streamline processes and update the airport so that its facilities meet the current and future needs of staff members, customers, and passengers.

More Ways to View and Work with Building Data

SFO has used ArcGIS technology for more than 14 years. During that time, the GIS team has deployed more than 50 apps and integrations to support operations, business and finance, planning, design and construction, emergency services, security, and retail trade.

For design and construction projects, teams use building information modeling (BIM) data processed in Autodesk's Revit software and computer-aided design (CAD) data processed in Autodesk's AutoCAD and Civil 3D software. They capture data with GIS and use ArcGIS Enterprise extensively for map production and staging.

Prior to 2017, all interior data at SFO was maintained in CAD and BIM datasets on local networks. This limited who could use the data and what they could use it for.

"We have found that BIM and CAD programs can present some pretty big obstacles to widespread use due to licensing, training, and the necessity of robust computers to run the programs," explained Hanson Guy Michael, GIS analyst for the Planning, Design, and Construction Division at SFO.

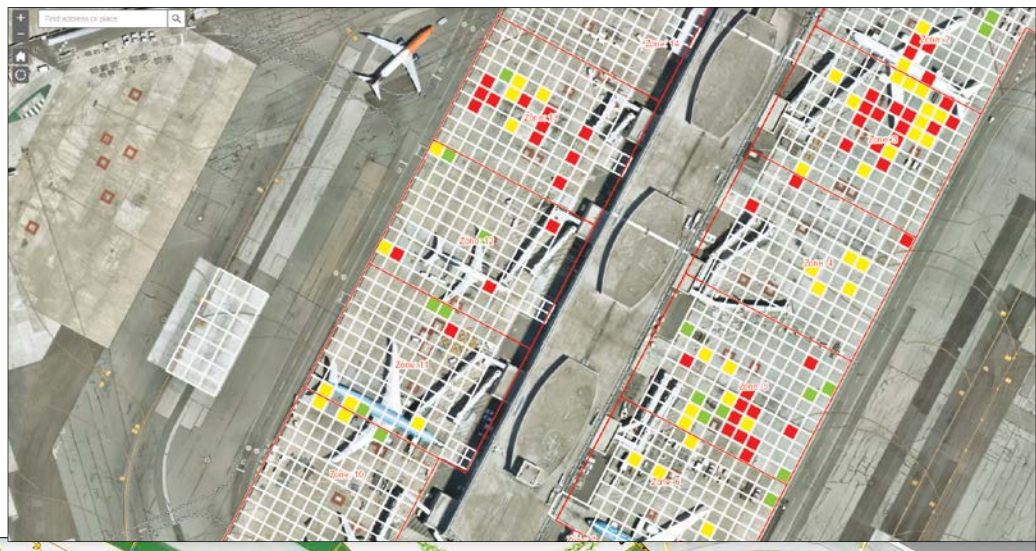
To ensure that all potential users of the data have access to it and can work with it, the GIS team decided to standardize the data on ArcGIS.

"ArcGIS provides us with broad access that serves all of our users' needs," Michael said. "Non-technical staff can examine *[ArcGIS]* StoryMaps or view data through their browsers via a web application or ArcGIS Online. Others may want the data in GeoJSON, KML *[Keyhole Markup Language]*, or PDF formats—or to be able to consume data from an API, which we can easily generate from ArcGIS."

To develop the SFO Interior Data Model, GIS analysts within the Planning, Design, and Construction Division converted thousands of CAD files to the ArcGIS format using Esri partner Safe Software's FME data integration platform.

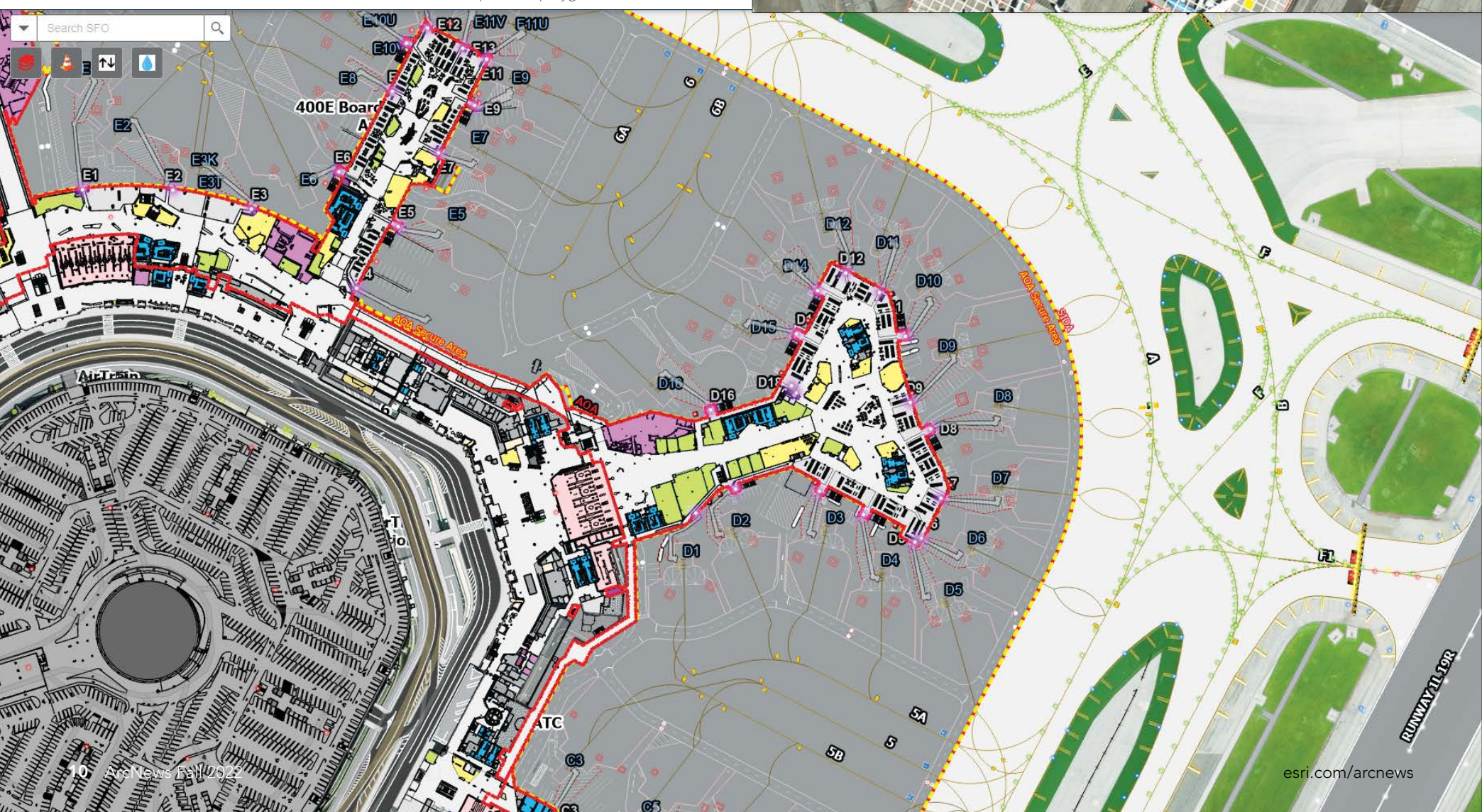
"Our interior data model represents rooms or other spaces as polygons," said Agie Gilmore, another GIS analyst with SFO's Planning, Design, and Construction Division. "Attributes include the space number, lease type, square footage, and other information provided by *[SFO's]* Aviation Management group."

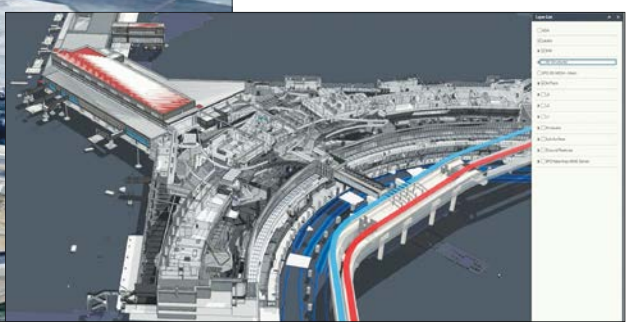
Now, staff members use ArcGIS Pro and ArcGIS Field Maps, along with apps built with ArcGIS Web AppBuilder and ArcGIS Experience Builder, to inspect floor plans and update the business information associated with particular spaces, such as the tenant, the listing for the tenant's doing business as (DBA) name, and the lease number. While working in the field, users can employ native and browser-based apps to open specific rooms and see their attributes, such as what type of lease a tenant has and how many months are left on the lease. And when new data is synchronized with



→ The data needed to monitor airfield pavement conditions is in San Francisco International Airport's (SFO) enterprise GIS database.

↓ SFO's interior data model represents rooms or other spaces as polygons.



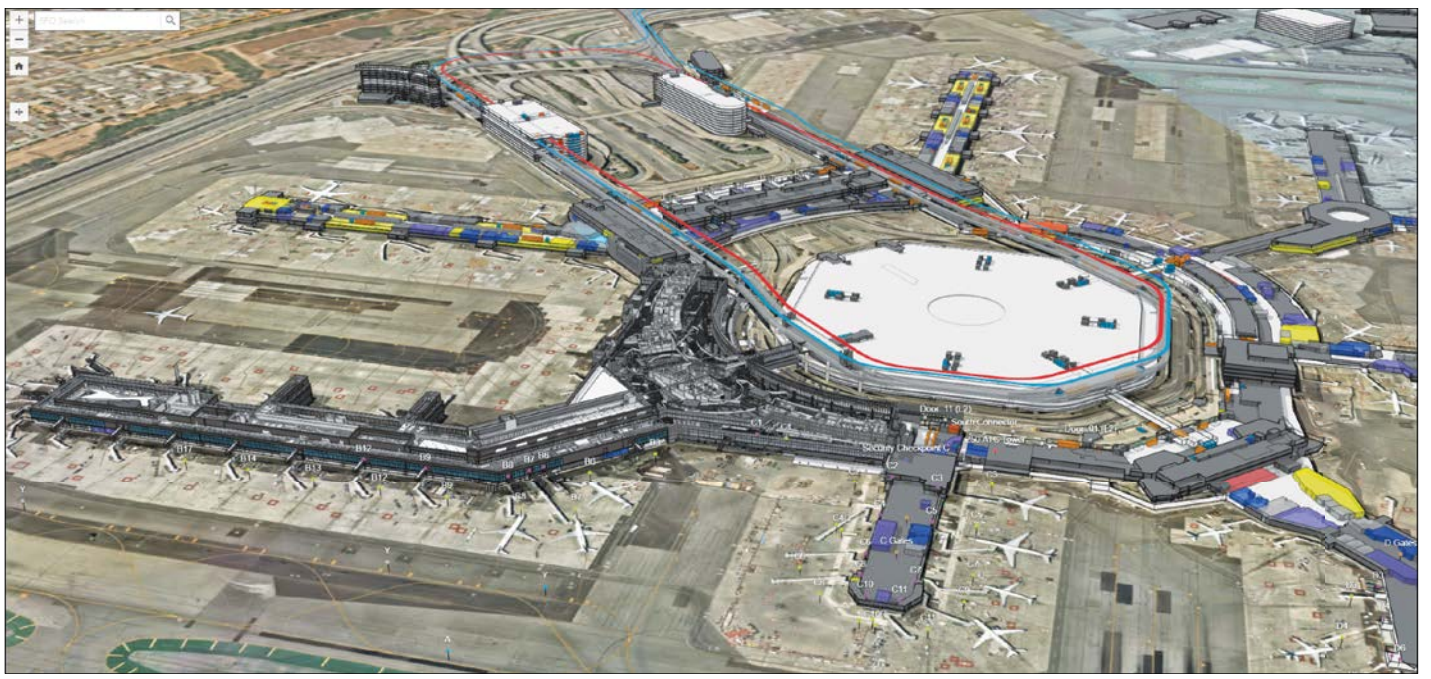


←↓ The GIS team within SFO's Planning, Design, and Construction Division is currently building a 3D model of the airport campus.

the server, staff members can do analysis on it to find out things like how much retail space is being used in each terminal.

"ArcGIS Pro and ArcGIS Online have really allowed us to work in an enterprise environment," said Gilmore. "SFO space planning analysts, who traditionally relied on CAD to manage floor plans and spaces, have transitioned parts of their standard workflows to ArcGIS Pro and ArcGIS Online in order to manage the thousands of leased spaces and hundreds of tenants, using GIS."

So when staff members need to investigate a hazardous materials spill, view laser strike events (when lasers are pointed at aircraft) over time, or monitor airfield pavement conditions, the necessary location data is available because it is maintained in SFO's enterprise GIS database. The three data models—subsurface, exterior, and interior—give staff a holistic picture of the airport. They can query the data in a web browser, since it is all maintained in ArcGIS. And some of the data can be subsequently converted for use by the public to help visitors navigate airport facilities using their mobile devices.



← For design and construction projects, teams at SFO use building information modeling (BIM) data and computer-aided design (CAD) data.

Future Improvements to the Airport Experience

In looking ahead, Michael, Gilmore, and the rest of the GIS team are working on integrating smart monitoring with SFO's GIS to allow staff members to react dynamically to changes at the airport. This would help with big events, like responding to a natural hazard, and more minor occurrences, such as when an escalator breaks down.

The team is also employing 3D modeling and BIM data conversion to build a 3D model of the airport campus. This includes using ArcGIS Pro web scenes and textured mesh, employing 3D GIS objects as a BIM model in the building scene layer package, and modeling airfield signs in 3D with ArcGIS Aviation Airports.

"In the future, we would like to make use of the Internet of Things *[IoT]* to provide smart monitoring for our interior space," said Michael. "This would *[help]* us improve energy efficiency, air quality, and noise reduction. It would also help us to quickly reroute our passengers intelligently and dynamically if necessary, depending on what is happening in a particular location of the airport."

By improving the quality of SFO's location intelligence, the GIS team is improving the airport experience for everyone who passes through, whether to work or to travel.

New Ways to Access Big Data in the Cloud

As organizations require ever more storage for their data, data storage technologies need to adapt to provide adequate data retention and processing. Cloud data warehouses do this, making data such as point-of-sale information, telemetry data from sensors, and sales leads generated by websites easier to access and process. For Esri users, ArcGIS Pro 2.9 (and later) and ArcGIS Enterprise 10.9.1 (and later) offer support for connecting to cloud data warehouses and publishing that data.

The Advantages of Cloud Data Warehouses

Anyone who works with constant streams of data—whether cataloging sales transactions for a grocery store chain or tracking data produced by delivery truck fleets—needs a data storage solution that can keep up with enormous intakes of structured data.

Traditional databases may run into challenges when serving this data to a wide audience. If the data is stored on premises, an existing deployment would likely need to be scaled up, which comes with considerable cost. If a dataset is used as a source for an app that's available worldwide, making the data accessible at that scale becomes a significant challenge.

Cloud data warehouses offer several advantages over other forms of structured data storage, including the following:

- Lower total cost of ownership: Cloud data warehouses reside on infrastructure that is maintained by a data center. This off-loads the costs of setting up and maintaining the hardware and networking requirements.
- Improved speed and performance: As opposed to traditional structured data solutions, cloud data warehouses are systematically engineered with data access in mind. Multiple servers are implemented for optimal load balancing, which results in greater efficiency when retrieving data.
- Better data access and integration: A common benefit of working in the cloud is the ability to make services and data available across multiple regions. This is an important capability of cloud data warehouses because they service the data constantly around the globe.
- Scalability and elasticity: Consistent with other cloud-based services, cloud data warehouses can scale indefinitely to meet users' needs.

How to Access Data Stored in a Cloud Data Warehouse

The ability to connect to and use data from cloud data warehouses was implemented in ArcGIS Pro 2.9 and ArcGIS Enterprise 10.9.1 on Windows, Linux, and Kubernetes. The software supports connections to three cloud data warehouses: Google BigQuery, Snowflake, and Amazon Redshift.

Adding this data to ArcGIS Pro is like adding data from any other database. One of the main challenges of working with cloud data warehouses, however, is access. There is a cost associated with accessing data stored in cloud data warehouses, which is something developers need to keep in mind when building web maps or apps that rely on this data.

To balance cost and access, data publishers can publish data from cloud data warehouses to ArcGIS Enterprise as map services. There are three ways to do this, based on how frequently users need to retrieve the data stored in cloud data warehouses:

- Accessing data directly: Retrieving data stored within a cloud data warehouse is a great way for data publishers to experiment with how structured and semistructured data may behave with other workflows. When they publish a map image layer, it references the data warehouse directly, querying data as needed to fulfill requests. Due to the costs associated with retrieving the data, this workflow should only be considered for smaller datasets or when the most up-to-date data is required.
- Accessing data via a snapshot: When publishing data in a cloud data warehouse as a snapshot, the data that's stored in the cloud data warehouse is copied to ArcGIS Data Store. When a map image layer needs to retrieve the data, it references a location on ArcGIS Data Store rather than in the cloud data warehouse. This configuration allows organizations to avoid the costs associated with accessing the data directly in the cloud data warehouse. Bear in mind, however, that updates made at the cloud data warehouse level are not automatically applied to the snapshot. To ensure that updates carry through, data publishers need to conduct on-demand updates within the ArcGIS Enterprise portal.
- Accessing data via a materialized view: This method of accessing data in a cloud data warehouse supports query layers within ArcGIS Pro. In a materialized view, requests to retrieve data are still made directly to the cloud data warehouse but not against the data itself. Instead, the requests are made to an appropriate cached query in the cloud data warehouse. This is a middle-of-the-road option for data publishers who need the most up-to-date data on a clearly defined subset of the total dataset. Apps that require faster query performance, as opposed to faster drawing performance, should employ materialized views over snapshots.

Keeping Up with the Evolution of Big Data

As much of the world moves toward wider adoption of Internet of Things (IoT) technology and Web 3.0, the amount of data being produced will only continue to scale up. Cloud data warehouses are a widely adopted standard for users who work with an immense amount of structured data.

ArcGIS Pro 2.9 (and later) and ArcGIS Enterprise 10.9.1 (and later) offer several ways to access data in cloud data warehouses, allowing users to more easily—and cost-effectively—explore, visualize, and share large volumes of structured data. To learn more about how Esri supports connecting to cloud data warehouses, read the following blog posts on *ArcGIS Blog*:

- "Introducing Cloud Data Warehouse Support," available at go.esri.com/cloud-data
- "New in ArcGIS Enterprise 10.9.1: Cloud Data Warehouse Support," available at go.esri.com/data-warehouse

When structured data from different sources is stored in a cloud data warehouse, users of ArcGIS Pro 2.9 (and later) and ArcGIS Enterprise 10.9.1 (and later) can publish this data as map image layers.

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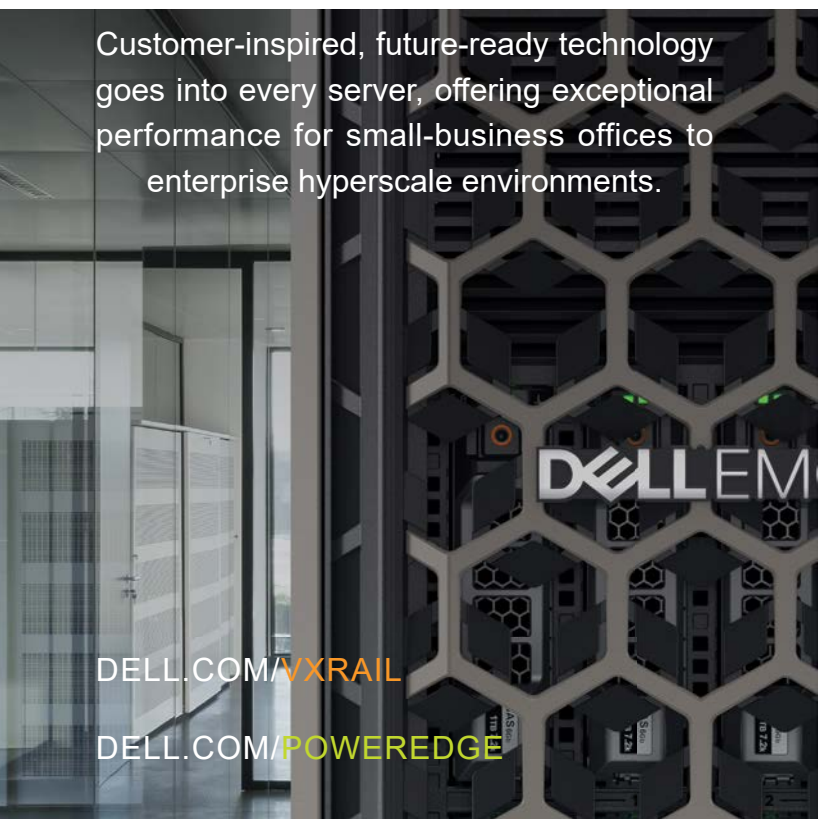

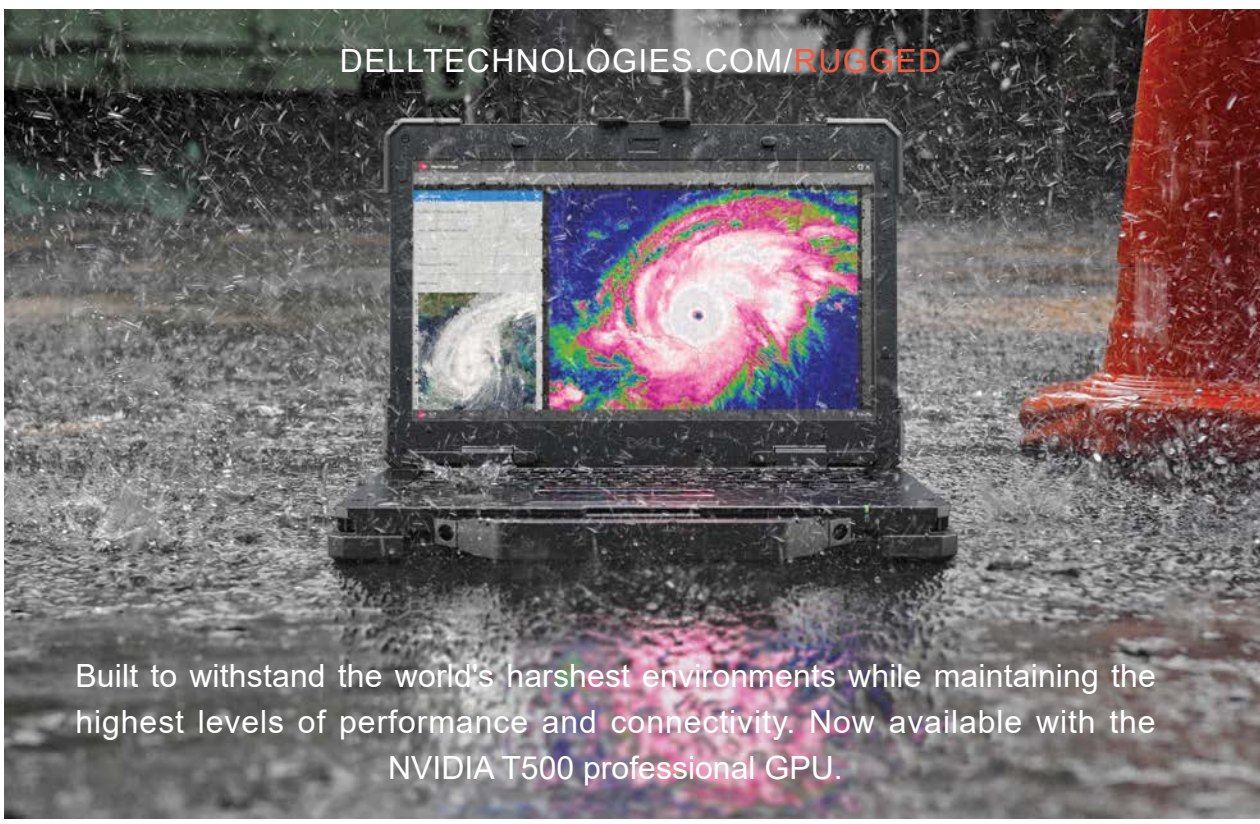

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[1]Based on IDC Quarterly Workstation Tracker, CY2021 (units)

ArcGIS Online Extensions Get New Features

ArcGIS Online has several powerful extensions that help users supercharge their cloud-based mapping and analysis workflows and boost productivity. These extensions seamlessly integrate with ArcGIS Online, making it easier to do things like work with real-time data and imagery and engage with community members.

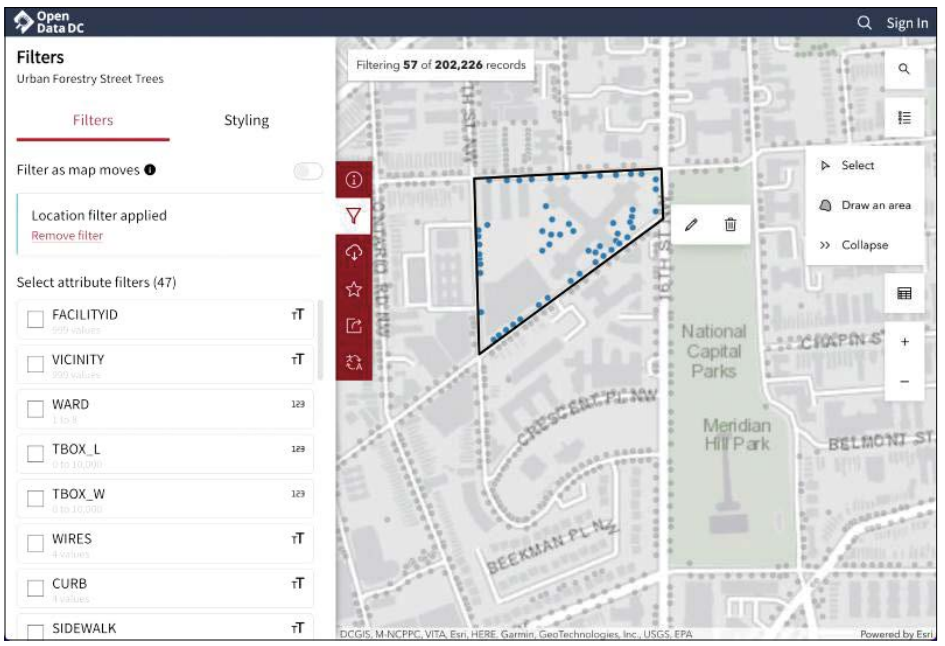
Recent updates to ArcGIS Online included new features for five of these extensions. Read on to find out more about how to incorporate these new capabilities into your work.

Make Insightful Decisions Based on Real-Time Data

ArcGIS Velocity is a cloud-native real-time and big data software as a service (SaaS) solution that allows organizations to ingest, visualize, analyze, and act on data from sensors and asset trackers. It also enables organizations to process high volumes of historical data to gain insight into patterns and trends and discover anomalies.

In 2022, ArcGIS Velocity users gained access to more feeds and analytics. Users with ArcGIS Velocity Standard subscriptions can now run up to 10 feeds and analytics, and users with ArcGIS Velocity Advanced subscriptions can run up to 15 feeds and analytics. Several improvements have also been made to keep users better informed of subscription management needs. For example, the feed data rate notifications that users receive now clarify the specific feeds that are exceeding maximum data rates.

Several enhancements have been made to the feeds, outputs, and analytics in Velocity as well. Users can develop integrations for real-time data providers that aren't supported out of the box by leveraging the gRPC feed type, a high-performance, open-source remote procedure call that pushes real-time data into ArcGIS via a hosted endpoint. Dynamic geofencing, which was also recently released, helps support users that need to find relationships, perform spatial enrichment, and make decisions based on the spatial proximity between two real-time feeds. Tools that support these capabilities include Detect Incidents, Filter by Geometry, Calculate Distance, and Join Features.



↑ Two new buttons in ArcGIS Hub—Select and Draw an area—allow site visitors to filter data by point or polygon, draw buffers around points and polygons, and use the new polyline draw tool.

Engage Community Members with ArcGIS Hub

With ArcGIS Hub, organizations can leverage the data and technology they already have in ArcGIS Online to work with internal and external stakeholders on particular projects and wider initiatives.

Improvements have been made to certain types of gallery cards, which Hub users employ to display datasets, related apps, and additional sites and pages. Map and iframe cards can now be shared in addition to app cards. Within these cards' settings, there are two new options: Enable Sharing, which can be toggled on or off, and Button Always Visible, which keeps a button visible when toggled on. When the Enable Sharing button is toggled off, the Share button only appears when hub site visitors hover over the item. And when visitors click the Share button, they're able to copy a link (to share with others) that goes directly to that card on the hub site.

While site owners and creators have already been able to expose catalog and collection metadata in standardized and interoperable formats, such as DCAT-US 1.1 and DCAT-AP 2.0.1, Hub now supports RSS 2.0 feeds. This enables site visitors to more easily see daily changes to a site's content. Site creators and owners can also now set domain redirects when editing or changing their site's primary domain. This ensures that community members can access hub sites without any discrepancies when the primary domain address has been altered or changed.

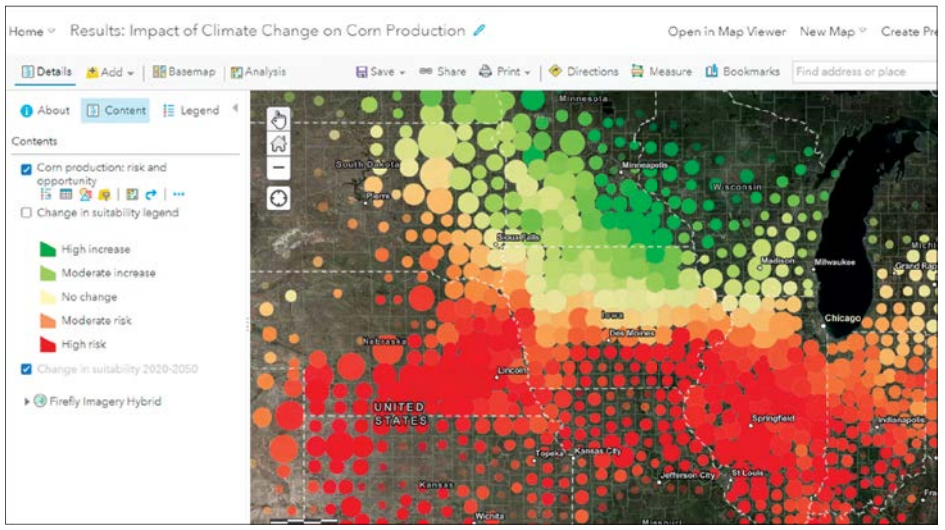
Lastly, there are several new ways for users to explore and interact with data when viewing a dataset on a map. Two new buttons on the right side of the screen are Select and Draw an area. These allow site visitors to filter data by point or polygon; draw buffers around points and polygons; and use the new polyline draw tool, which lets users draw a line on the map, select to filter by area, and set a buffer size using various units.

Simplify How Stakeholders Work with Imagery

Imagery and raster data enable decision-makers to see what's happening on the ground and immediately understand change. But imagery data takes up a lot of space and comes in a variety of formats, so people often find it difficult to work with for the following reasons:

- It's time-consuming and expensive to procure the imagery and set up the infrastructure.
- It's hard to manage and normalize imagery for use in analytical workflows.
- It's difficult to stay on a budget as data volumes increase.

ArcGIS Online, however, offers an easier and more seamless way for organizations to use imagery. The ArcGIS Image for ArcGIS Online extension allows organizations to host, analyze, and stream imagery and raster collections without leaving ArcGIS Online.



↑ ArcGIS Image for ArcGIS Online lets users host, analyze, and stream imagery and raster data collections in ArcGIS Online.

Once the imagery is in an organization's system of record, users and stakeholders have direct access to the data and can use it to do the following:

- Run image and raster analyses at scales that range from the specific site to the entire globe.
- Detect change, inspect assets, monitor vegetation, trace water flows and plan routes and networks.
- Share data and analysis results with internal and external stakeholders as interactive apps, dashboards, and reports.

ArcGIS Image Online is a premium user type extension that adds image hosting, analysis, and streaming capabilities to the Creator and GIS Professional user types. While storage and analysis consume credits, this approach can also put unused credits to work, saving organizations the cost of standing up and maintaining their own infrastructure.

To find out how one small company, Esri partner Skytec, incorporated ArcGIS Image Online into its business operations, see "SaaS Imagery Solution Helps Conservation Startup Detect Change Faster" on page 30. For more information about the extension, go to go.esri.com/simplify-imagery.

Try New and Improved ArcGIS Solutions

ArcGIS Solutions consists of industry-specific configurations of ArcGIS that align with users' business needs and are quick to set up and deploy. They leverage users' authoritative data and are designed to improve operations, provide new insight, and enhance services across industries that range from utilities and telecommunications to government and public safety.

In July, the new Fire Accreditation Analysis solution was released. It can be used to complete spatial analysis workflows and generate fire maps that conform with requirements set forth by the Commission on Fire Accreditation International (CFAI). The July release also included enhancements to existing solutions across the industries that ArcGIS Solutions supports, including 3D Basemaps, Crime Analysis, and Tree Management.

To explore all ArcGIS Solutions configurations and read about their capabilities, head to go.esri.com/solutionsgallery. Then sign in to ArcGIS Online to deploy them.

More Options for Designing and Presenting 2D and 3D Plans

ArcGIS Urban gives planners the ability to model 2D and 3D maps of their community's zoning codes, land-use codes, and physical structures to provide context for new development projects. When these models are shared beyond the planning department, they give stakeholders and the public the ability to preview proposed changes to their community and provide feedback on them.

Now, planners have more styling options when applying zoning and overlays to 2D maps, including custom colors and outline styles. Planners can also bring back buildings previously deleted from the maps, undo the merging of two parcels, and change a zone back to its previous type.

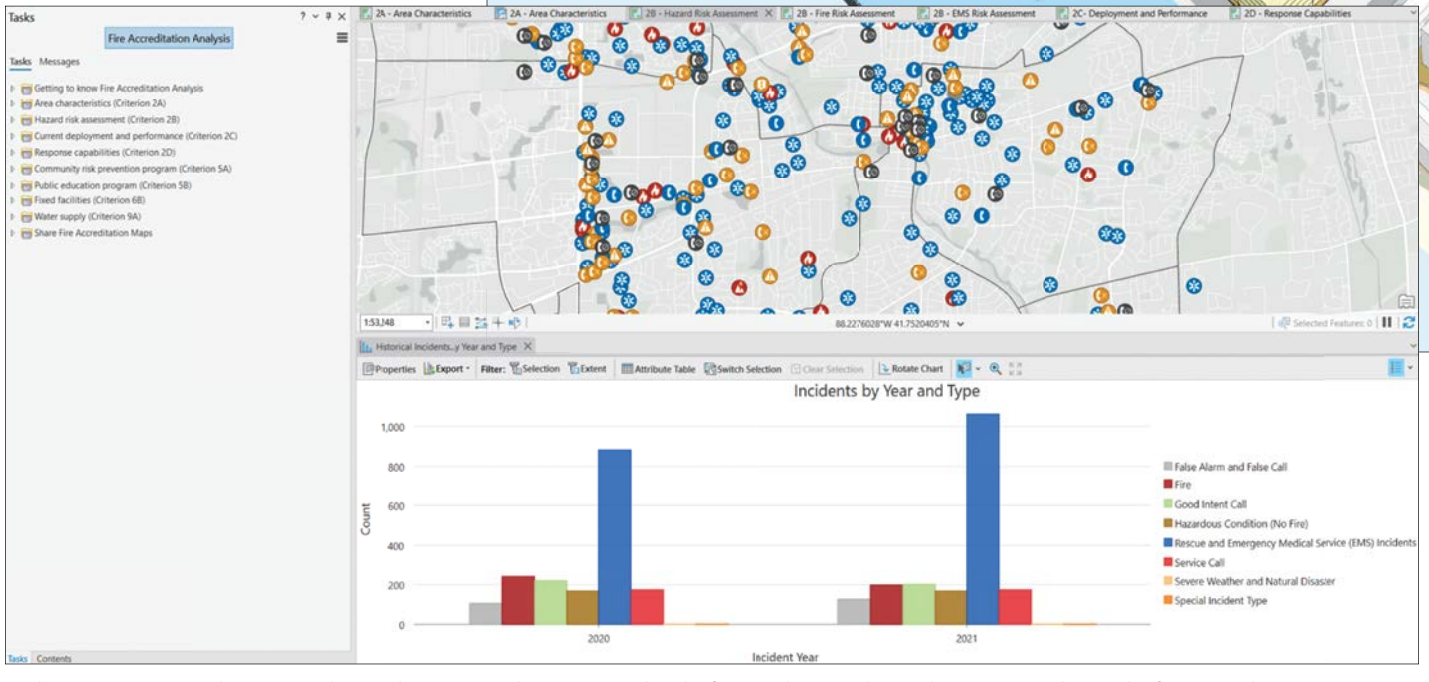
In planning for community development, planners often use site suitability analyses to find optimal locations for future housing, schools, and open space. But compiling these analyses can be costly and time-consuming. The ArcGIS Urban suitability tool offers an alternative to compiling disparate documents and spreadsheets. Instead, ArcGIS Urban generates on-the-fly calculations based on existing and proposed zoning conditions. Recent updates to this tool make it easier to compare various options, giving users the ability to copy and run multiple analyses of the same suitability model.

When plans and projects are ready to be reviewed by external stakeholders, planners have new ways to create presentations of their urban models. With the new viewpoints functionality, they can capture the most important perspectives in a design and create a predefined sequence to guide viewers from one viewpoint to the next.

Planners can also export their urban models directly as web scenes for use on external websites, in ArcGIS StoryMaps stories, and in presentations. Details about a specific project or plan—including a thumbnail image, links to external web content, and project start and end dates—are now accessible alongside the project's dashboard and comments section. This gives the public a single touchpoint for viewing plan and project information and providing feedback.

Lastly, planners and GIS teams can use the new ArcGIS Urban API to write and read aggregated data from their urban model's system of record. This allows them to extend the functionalities of ArcGIS Urban. To learn more about the ArcGIS Urban API, visit go.esri.com/urban-api.

↓ Updates to ArcGIS Urban give planners more styling options for their 2D and 3D maps.



↑ The new Fire Accreditation Analysis solution provides structured tasks for conducting the analyses required to make fire accreditation maps.

ArcGIS Online extensions give users powerful capabilities to boost productivity and perform sophisticated mapping and analysis workflows in the cloud. Extensions must be purchased with licensing for at least one foundational user type—GIS Professional or Creator—or can be added to an existing organizational account. To stay up-to-date on the latest ArcGIS Online news, sign up to receive the newsletter at go.esri.com/arcgisonlinenewsletter.

To Mark 50 Years, United Arab Emirates Maps Growth and Quality of Life

The United Arab Emirates (UAE) has grown at an extraordinary rate in the years since it was formed in 1971. Not only has the UAE diversified its economy beyond oil, which required careful planning and great discipline, but its seven emirates—particularly Abu Dhabi and Dubai, where the bulk of the country's population lives—have seen dramatic urban growth. Abu Dhabi, for instance, is now a modern city with gleaming office towers, a complex multimodal transportation network, utility-scale renewable energy, and an education system that ranks in the top 20 in the world.

In advance of the 50th anniversary of the country's founding, the UAE's Federal Competitiveness and Statistics Centre (FCSC) mapped the country and its people, using GIS to quantify how far the nation has come.

FCSC adopted GIS to modernize workflows and visualize the statistical indicators it gathers for sectors such as health, education, the environment, and the economy. GIS data feeds the UAE's 1Map, a collection of map layers housed in a hub site, created using ArcGIS Hub, that includes roads, facilities, and demographics. The information in 1Map, available at 1map-fcsa.hub.arcgis.com, allows residents to see how the UAE is faring and enables government ministries to evaluate the country's strengths and weaknesses so that they can better target investments.

"We launched our GeoStat geostatistical initiative four years ago," said Marwa Elkabbany, the GIS expert with FCSC. "We started by collecting detailed facilities datasets from ministries, like health and education facilities, and geoenabling statistics to map more than 70 national indicators."

Setting Goals and Meeting Objectives

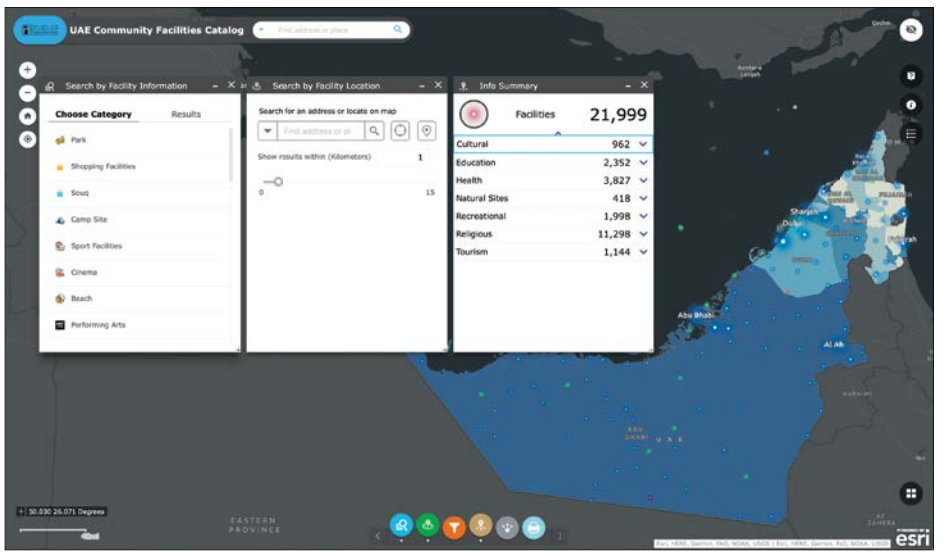
The discovery of oil in the 1950s fueled growth in the UAE, displacing pearling, fishing, and agriculture as key industries. Two decades ago, almost all the country's economy was oil based. Now, oil makes up less than 30 percent of the UAE's gross domestic product (GDP). A series of plans have guided national investments away from oil dependency.

His Highness Sheikh Mohamed bin Zayed Al Nahyan, the third president of the UAE, spoke in 2015 about this effort and the steady focus toward a future without oil.

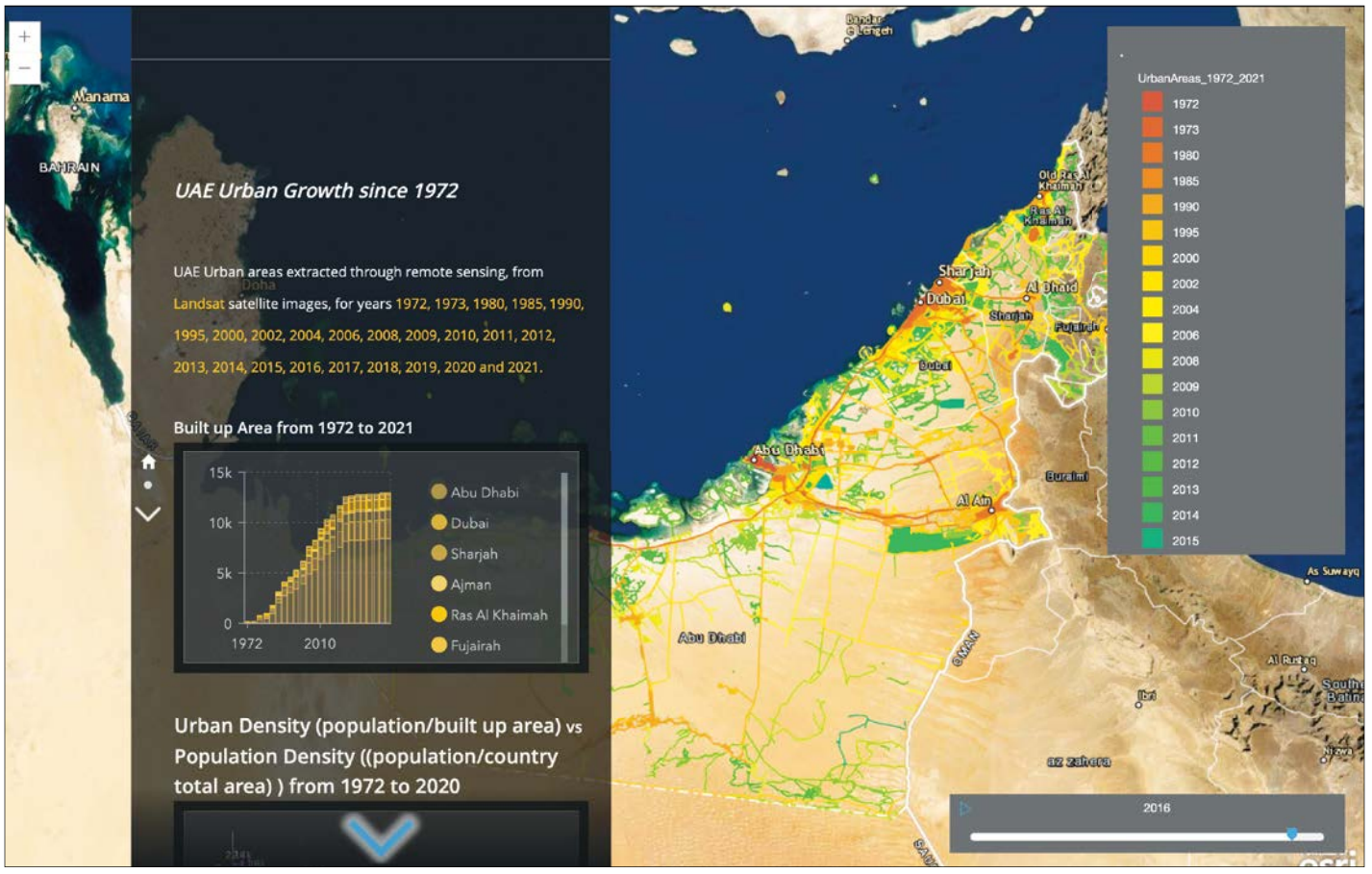
"In 50 years, when we might have the last barrel of oil, the question is, When it is shipped abroad, will we be sad?" he asked. "If we are investing today in the right sectors, I can tell you, we will celebrate."

The UAE has diversified with investments in infrastructure, hospitality and tourism, and technology. There are three sovereign wealth funds in the UAE that invest on behalf of the government, including the Abu Dhabi Investment Authority, which has assets of nearly US$700 billion. Many of the investments aim to improve quality of life—for example, by making the UAE a destination for world-class health care.

↑ The United Arab Emirates (UAE) carefully tracked the diversification of the country's economy away from oil dominance.



↑ The UAE Community Facilities Catalog allows anyone to search for health, education, recreational, religious, and cultural sites across the country.



→ Urban areas in the UAE have grown tremendously since the country's founding.

In pursuit of this goal, statistics have driven societal advancements. First, the UAE needed to know about the health of its people. Then, it needed to compile details on health-care facilities.

"We started the National Facilities Catalog by collecting the health facilities datasets along with the indicators, such as how many are publicly owned, how many beds they have, and the number of medical staff and physicians," Elkabbany said. "We mapped it to feed our geostatistical platform. Then we overlaid facilities with our population and administrative maps to understand and evaluate their geographic distribution."

Building a Modern Map

FCSC has been mandated by the Ministry of Cabinet Affairs to collect data from federal government entities—including location data where applicable—in a seamless manner while establishing best practices regarding data quality and standards. The 1Map name and branding by FCSC support the country's data integration goal, which aligns with the capabilities of modern GIS to tackle challenges across sectors.

The FCSC team has come a long way in four years. It started by developing national foundational administrative maps for districts and subdistricts while defining national urban areas. The process included setting national standards and harmonizing data to produce an up-to-date, authoritative geodatabase.

The FCSC GIS team has been working with federal and local partners to implement a national, collaborative geographic information portal that collects geospatial data from partners. FCSC then processes the data to harmonize and standardize it and uses it to create various apps and sites that serve the community and governmental partners through the one-stop 1Map portal.

The creation of a national digital data ecosystem is a key priority for the UAE government. FCSC has been working on a variety of projects as the lead federal entity for this effort. One such project is the Data Maturity Index, which aims to help agencies manage and administer their data in accordance with international standards and best practices to ensure data accessibility, flow, governance, and quality. Another example is the Emirates Data Network project, which supports the exchange of federal administrative data.

At FCSC, the move to GIS started slowly with licenses for ArcGIS Pro and ArcGIS Online. But the organization soon expanded to ArcGIS Enterprise to enable integration among each ministry's ArcGIS system through portal-to-portal collaboration. The UAE's 1Map provides the foundational maps that each ministry builds on with its own data. Then all the ministries share their maps through ArcGIS Enterprise, which allows them to maintain authority and security over the data they create.

The 1Map datasets include population distribution; land use and housing; public facilities such as hospitals, schools, and cultural and religious destinations; and preserved natural areas and parks. This data is then further broken down. For example, with population data, added demographic details—such as gender, citizenship, and age—become available at different geographic scales. Maps show each of these indicators, as well as population density, across the country.

Much of the 1Map data is sensitive and restricted. So while some datasets are public, others are only available to certain ministries or approved researchers.

The data is displayed in dashboards built with ArcGIS Dashboards to show progress on issues, some of which are specific to a ministry's objectives, while others apply to the whole nation. For instance, a public-facing dashboard gathers total international non-oil trade for the country. Narrative maps, built with ArcGIS StoryMaps, are used to better communicate with the public. One ArcGIS StoryMaps story employs satellite imagery of Earth at night to illustrate urban growth in the country. Data is organized using ArcGIS Hub, which helps show progress. And experts perform further analysis on the data to inform leaders, check on the progress of existing policies, and craft new policies that focus on moving the country forward.

Measuring to Plan, Act, and Understand

Competitiveness on quality-of-life issues is central to the way FCSC operates. For instance, an initial calculation by international organizations about rural access to roads showed that just 76 percent of people living in rural areas had access to an all-season road within two kilometers.

"The roads in UAE are amazing, so it didn't make sense that rural areas lacked road coverage," Elkabbany said, relating how the World Economic Forum report in 2019 ranked the UAE seventh in the world for quality of road infrastructure, and the *Legatum Prosperity Index* ranked the UAE first in the world for satisfaction with roads and highways.

"We looked at the dataset the international organization used to understand it. Then we consolidated rural and urban boundaries from local municipalities, built a national population grid reflecting local statistics for population estimates, and overlaid all this data with the roads network according to the World Bank methodology," Elkabanny said. "Now when we run this indicator, it shows 99.54 percent of rural-area residents have access to a road within two kilometers."

This was one of the many examples of how maps help verify the accuracy of data and how data helps verify the accuracy of maps.

As in many nations, official statistics for the UAE have long been maintained in spreadsheets. But there is a growing move to put these measurements on a map, thanks to the United Nations Sustainable Development Goals (SDGs) that were adopted in 2017. The SDGs recognize intertwining issues, such as how alleviating poverty goes hand in hand with improving health and education and spurring economic growth. Putting indicators on a map provides a crucial view that helps address inequalities and pinpoint where the impacts of climate change need to be limited.

When the COVID-19 pandemic hit, FCSC had just launched maps of health facilities and population distribution. That data became critical for identifying areas of risk and helping leaders understand the importance of maps and geostatistics for crisis management.

"Government stakeholders are endorsing the use of GIS and geospatial intelligence capabilities across different sectors, with growing demand for map-driven meetings where geospatial dashboards are used as a decision-support tool," Elkabbany said.

Lately, FCSC has been using satellite imagery and machine learning to fill in data gaps. The team has collected all building footprints across the country and used smart meter data about electricity and gas consumption to derive population estimates for where people live and work. FCSC continually looks at nontraditional data sources, such as employing anonymized phone location data to understand the movement patterns of people. This helps compare facilities and opportunities across different geographic areas, which is a great input for planning purposes.

"We have to be ready. We must prepare our data," Elkabbany said. "We need to measure prosperity and competitiveness to ensure that high quality-of-life standards are maintained and elevated."

Measurements of Happiness

By 2071, the centennial of the United Arab Emirates' (UAE) founding, the country aims to be "the best country in the world," as stated in the government's UAE Centennial 2071 plan.

Building on the Federal Competitiveness and Statistics Centre's (FCSC) success in mapping the country's accomplishments so far, progress in the next 50 years will center on four pillars: a future-focused government, excellence in education, a diversified knowledge economy, and a happy and cohesive society. The plan is based on a speech by the late Zayed bin Sultan Al Nahyan, founding father of the UAE, who said the ultimate aim of the union is to achieve happiness in society.

A national program for happiness and well-being has been established to help UAE residents find purpose, live healthy lives, build relationships, and fulfill their potential. Measuring the goals is done through surveys, and maps and dashboards shed more light on each indicator.

By Dawn Wright
Chief Scientist, Esri

An Inspiring Journey to Map the Deepest Part of the Ocean

On a warming planet, understanding the ocean is more critical than ever. Not only does the ocean cover almost three-quarters of the surface of the earth, it also absorbs 90 percent of the world's excess heat and 25 percent of its carbon dioxide. This means that the ocean is buying humans and other species valuable time. But how much, and at what cost, is unknown.

Like the rest of the planet, the ocean is in peril. Climate change, overfishing, and ocean acidification are jeopardizing the health of marine ecosystems. Loss of biodiversity and the destruction of coral reefs threaten the ocean's ability to provide food and sustainable livelihoods to millions of people.

To understand what's happening to the ocean and, in turn, how this affects the rest of the earth, humans need comprehensive maps of the ocean. Yet there are more detailed maps of the surface of Mars than there are of Earth's ocean floor. To date, only 23.4 percent of the ocean floor has been mapped to modern standards, and we need to get to 100 percent to more fully use and protect the ocean's resources and uncover clues about what climate change might do to the rest of the planet.

Part of the reason for this disparity stems from differences in technology. To map other planets, scientists use electromagnetic energy, which easily travels through Earth's atmosphere and space but not through water. Because Earth is a water planet, and given how well acoustic (sound) energy travels through water—think about the calls of marine mammals—this is the best type of energy to use to map the ocean floor. Gathering data from acoustic instrumentation, however, takes much longer than it does with satellite or airborne remote sensing technology.

There are two ways that acoustic instrumentation is deployed: either at the surface of the ocean, in large arrays from the bottoms of ships and surface drones; or closer to the ocean floor, in portable arrays from deep-diving drones and submersibles. There are also two ways that acoustic energy is used: to measure the travel time of sound pulses to and from the ocean floor, which returns depths (bathymetry), or to measure the intensity of those sound pulses as they return, which yields backscatter imagery of the seafloor (akin to a hillshade or an aerial photograph). The instruments deployed at the surface of the ocean can already provide very good maps of the ocean floor. But maps of certain places still need more intricate detail—hence the higher-resolution mapping from deep-diving drones and submersibles.

On July 12, 2022, I took part in an expedition with ocean research company Caladan Oceanic to dive with its founder, undersea explorer Victor Vescovo, to the deepest point on Earth: Challenger Deep, located in the Pacific Ocean's Mariana Trench near Guam. With Vescovo piloting the *Limiting Factor* submersible, the two of us descended 10,919 meters below the ocean's surface to the Western Pool of Challenger Deep. For our dive, the submersible was outfitted with a first-of-its-kind portable acoustic instrument for mapping the backscatter of the ocean floor. Normally, these types of portable instruments implode at 6,000 meters due to the intense pressures of the deep ocean, but our instrument was customized to operate at the greatest depths of the ocean—that is, full ocean depth. We just needed to prove it. So as mission specialist, my primary duties during the dive were to operate this instrument and, together with Vescovo, conduct the first high-resolution backscatter survey of this part of Challenger Deep.

During our ten-and-a-half-hour dive—with two-and-a-half hours of visual observation and successful acoustic surveying on the bottom of the ocean—Vescovo and I saw stunning evidence of where two tectonic plates collided; several deep-water marine species, including some striking anemones and amphipods; and, if you can believe it, a beer bottle. We must do better!

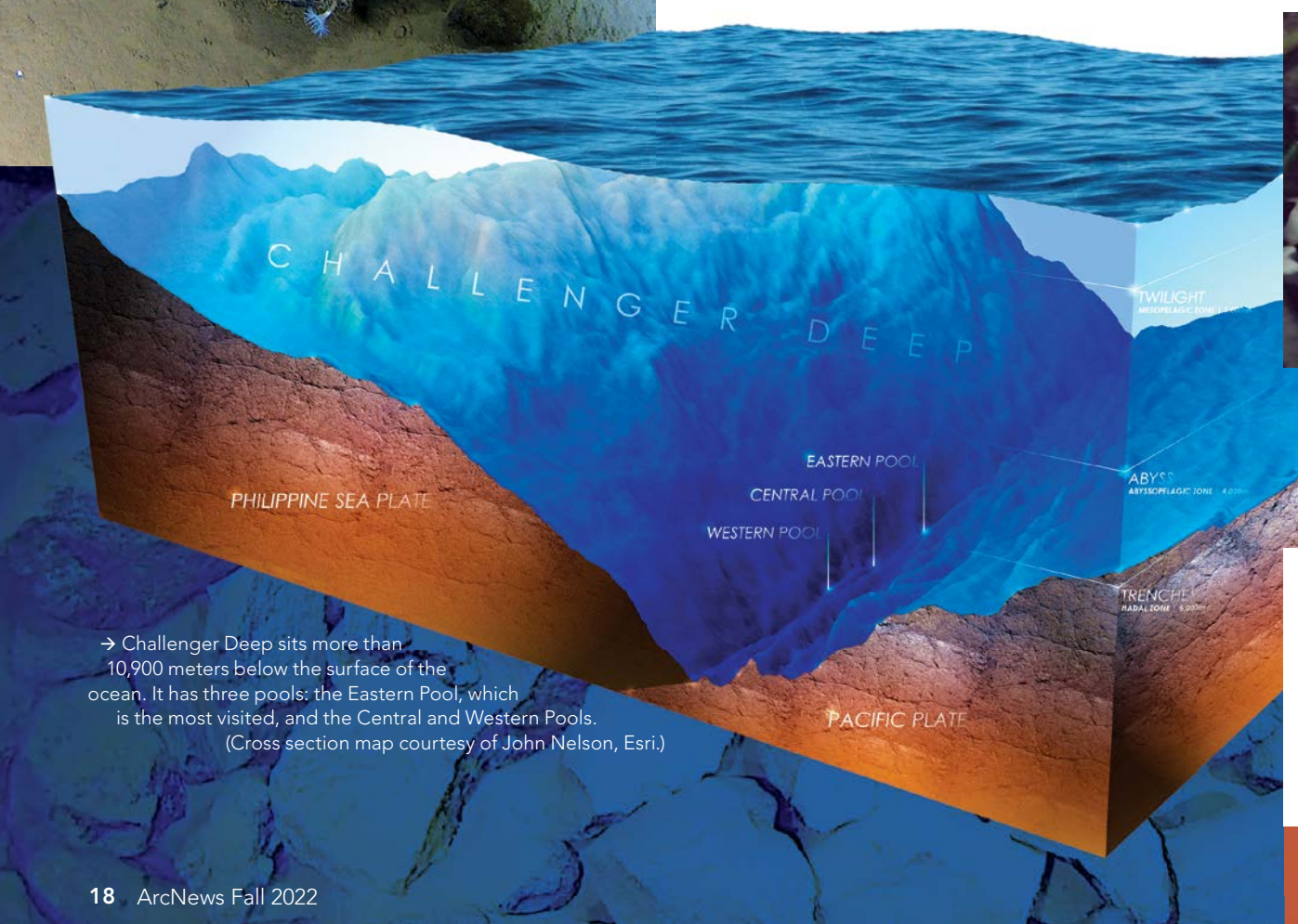
In all, we collected nearly four terabytes of data that maritime scientists at Esri are currently processing using ArcGIS Pro and ArcGIS Image for ArcGIS Online. Among the many products we hope to release are the first high-resolution acoustic images of a portion of Challenger Deep's Western Pool, which will add to our knowledge of the geomorphology there and inform the design of future deep-diving portable acoustic instruments. When the data and maps are ready, they will be shared through ArcGIS Living Atlas of the World; through a series of ArcGIS StoryMaps stories; and with Seabed 2030, a joint project of the Nippon Foundation and the General Bathymetric Chart of the Oceans (GEBCO) that seeks to get 100 percent of the ocean floor mapped to modern standards by the end of the decade.

Many firsts were achieved during this dive to the deep ocean floor, including this one: I became the first person of African descent (of any gender) to visit Challenger Deep. I hope that like many of my own heroes did for me—including oceanographer Dr. Evan Forde, who in 1979 became the first Black person to complete a research dive in a submersible, and Dr. Mae Jemison, who in 1992 became the first African American woman to go to outer space—this adventure will inspire young people, especially young Black people and early career academics and scientists, to live out their own dreams. Science, the oceans, and the earth will be the better for it.

Find out more about my dive to Challenger Deep by exploring the following resources:

- See photos from the dive and get an idea of how I prepared for it at **links.esri.com/challenger-deep**. More resources will be added to this hub site as they become available.
- Learn why it's important to map the ocean floor at **links.esri.com/why-map**.
- Read about other expeditions that Caladan Oceanic has undertaken to help increase understanding of the ocean at **links.esri.com/caladan**.
- Discover how GIS is used in marine science at **links.esri.com/ocean-science**.

↓ These striking anemones are among the few species that can live in the extreme conditions of Challenger Deep. (Photo courtesy of Caladan Oceanic.)



→ Challenger Deep sits more than 10,900 meters below the surface of the ocean. It has three pools: the Eastern Pool, which is the most visited, and the Central and Western Pools. (Cross section map courtesy of John Nelson, Esri.)

↑ Victor Vescovo (right) piloted the *Limiting Factor* while Dr. Dawn Wright (left) served as mission specialist. (Photo courtesy of Caladan Oceanic.)

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, she is an elected member of the National Academy of Sciences and has authored and contributed to some of the most definitive literature on marine GIS.

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A Global Approach to Preventing Plastic from Reaching the Ocean

Like many coastal areas around the world today, the beaches in Chennai, India, attract large amounts of plastic debris. For teenage surfer and local resident Karan Chakravarthy, the presence of plastic at his favorite surf spots was distressing. So he decided to do something about it.

Chakravarthy joined other volunteers to collect trash with a nonprofit called Namma Beach, Namma Chennai (which translates to "Our Beach, Our Chennai"). In 2021, the organization removed 176,000 pounds of plastic waste from Chennai's beaches. But Chakravarthy felt that more could be done.

He contacted his grandfather, Mandyam Venkatesh, who lives in San Diego, California, and obtained a $5,000 grant from Venkatesh's Sunrise Rotary Club to further support Namma Beach, Namma Chennai. Through his grandfather's Rotary connections, Chakravarthy also met Carl Nettleton, the founder of OpenOceans Global, a San Diego-based organization that employs geospatial technology and citizen science to help stop the flow of plastic to the world's oceans.

Nettleton set up Chakravarthy with an ArcGIS Survey123 form that he used to record information about beaches in Chennai that are consistently littered with plastic. The data was then uploaded to the OpenOceans Global geospatial portal. Now, on the organization's web-based *Ocean Plastic Map*, a red bull's-eye symbol sits on India's southeastern coast, and a pop-up displays information about the plastic waste found on Chennai's beaches, including where it likely comes from and what is being done to clean it up.

Nettleton hopes that citizen scientists all over the world will do what Chakravarthy has done and record data for OpenOceans Global about beaches that are consistently fouled by plastic trash. In particular, he would like GIS practitioners to take the lead.

How Plastic Waste Gets to the Ocean

Eleven million metric tons of plastic reach the ocean each year, and that number could triple by 2040 if large-scale solutions aren't developed quickly, according to research by The Pew Charitable Trusts and sustainability consultancy SYSTEMIQ.

"The common perception is that most ocean plastic is in the Great Pacific Garbage Patch, which is estimated to be twice the size of Texas," Nettleton said, referring to the largest of five garbage patches in the world's oceans.

However, according to a recent Florida State University study published in *Frontiers in Marine Science*, from 2010 to 2019, about 75 percent of mismanaged plastic waste turned up on beaches.

"Plastic ends up on shorelines because the majority of ocean plastic comes from land, and most of that comes from rivers," Nettleton said.

OpenOceans Global seeks to identify how plastic flows into the ocean and accumulates on those shorelines. According to a study funded by the nonprofit The Ocean Cleanup and published in *Science Advances*, about 80 percent of plastic that traverses rivers and ends up in oceans comes from more than 1,000 rivers—many of which are in Asia, Latin America, and Africa. Researchers found that small urban rivers in places with poor trash management practices convey the most plastic pollution to the ocean. But this doesn't mean that the trash necessarily originates there. Many countries with upper-income economies—such as the United States, Japan, and France—outpace the rest of the world in plastic consumption and then ship more than a million tons of recyclable plastic overseas each year, often to places with trash management issues.

"We think there are ways to stop plastic waste from reaching the ocean if we know where it comes from geographically," said Nettleton. "Even though the United States and other developed nations produce most of the plastic, the Florida State study found that 55 percent of ocean plastic reaches the ocean from five countries: China, the Philippines, India, Brazil, and Indonesia. If the Philippines sends almost 16 percent of the world's plastic to the ocean via its rivers, as this study discovered, the world could focus on developing solutions for this one country and bring global resources behind it to get the Philippines as close to a zero ocean plastic contribution as possible. We could see which solutions work best there—whether it's implementing river intervention technologies to stop the plastic from reaching the ocean, developing new products to replace plastic, or implementing new processes for trash management—and then replicate those models in other high-plastic polluting countries."

A Global View of Where Plastic Pollution Originates

To get started with this ambitious project, the team at OpenOceans Global employed ArcGIS Online and ArcGIS Living Atlas of the World to develop a map that focuses on where plastic litters the world's coastlines.

"You can click on the map and see the rivers of the world, major ocean currents, and a highly detailed point-in-time snapshot of ocean currents," said Nettleton. "These tools help people better understand how plastic debris travels."

Map users can activate layers that show the top 20 rivers that contribute plastic to the ocean and where plastic collects in ocean gyres.

→ Karan Chakravarthy used ArcGIS Survey123 to record data about beaches in Chennai, India, that are consistently littered with plastic. (Photo courtesy of Karan Chakravarthy.)

They can also see the survey data that citizen scientists contribute about plastic pollution on their local beaches.

Using Survey123 on their mobile devices or desktop computers, citizen scientists enter the beach or coastal area's name, pinpoint its exact location on a map, upload an image that shows the waste accumulation, provide a description of the issue, predict where the trash is likely coming from, and record what is being done to solve the problem. They also enter their contact details and information about organizations they work with.

After an entry is submitted, a temporary red dot symbol automatically appears on the OpenOceans Global web map. A team at the organization then verifies the information and, if it all checks out, turns the red dot into a red bull's eye, indicating that the coastal area is pervasively fouled by plastic.

"The way plastic has been approached is as a local problem—you know, 'my beach has plastic on it, so I'd better not use plastic straws or plastic bags anymore,'" said Nettleton. "Well, that's important. But there isn't yet a global view of where that plastic comes from."

The more entries that are contributed via OpenOceans Global's Survey123 form, the clearer this global picture will be. And once OpenOceans Global has enough data points, the team will be able to distinguish the sources of plastic pollution on specific beaches—whether from rivers, stormwater systems, or inadequate local trash management—and develop new symbology on the map to reflect that.

"Knowing where the plastic originates helps identify solutions to prevent plastic from reaching the ocean," said Nettleton. "For instance, placing barriers in small, local rivers can capture trash before it gets to the ocean. Theoretically, that will reduce the amount of plastic that ends up on beaches, and at a certain point, those beaches won't be pervasively fouled by plastic anymore."

Tracing Plastic Through the Open Ocean

For plastic pollution that arrives onshore via the open ocean, it is more challenging to identify the source. In the Galápagos Islands, whose once-pristine coastlines now gather plastic waste, an international research initiative called Plastic Pollution Free Galápagos employs a sophisticated forensic process to analyze plastic debris and determine its source. The initiative's research suggests that more than 60 percent of plastic that ends up in the Galápagos Islands stems from mainland South America (mainly southern Ecuador and northern Peru), with about 30 percent coming from nearby fishing vessels and less than 10 percent from local towns.

But not every coastal area has access to forensics data. So the team at OpenOceans Global worked with Jingyi Huang—who, at the time, was a student working toward a master's degree at the University of Redlands and is now an enterprise analyst at Esri—to create a mapping app that traces plastic on coastlines back to its likely source.

The app employs Ocean Surface Current Analysis Real-time (OSCAR) data, which shows surface-level ocean currents, along with ocean current data from the National Oceanic and Atmospheric Administration (NOAA) and satellite data from the National Aeronautics and Space Administration (NASA). App users can click on an area of the ocean immediately adjacent to where coastal plastic was found, and the app will create a route to its likely source. In the case of plastic waste in the Galápagos Islands, the OpenOceans Global tracing app aligns with Plastic Pollution Free Galápagos's forensics research.

Before the app is included with OpenOceans Global's publicly available web map, however, the tracing tool needs to incorporate wind and wave variables, since these affect how plastic is moves through the ocean. Huang plans to merge that data with the app's existing ocean current data.

Carl Nettleton believes that geospatial practitioners—especially Esri users—would make ideal citizen scientists for the OpenOceans Global project.

"They work in a unique mix of science and technology and tend to really care about the environment," he said. "There are Esri users in almost every country around the globe, and many of them live near or travel to coastlines that have been pervasively fouled by plastic. We are asking Esri users to play an essential role in populating the *Ocean Plastic Map*."

To get started, go to openoceans.org/trash-survey and fill in the form to identify plastic-plagued coastlines. The form can be used on smartphones, tablets, and desktop and laptop computers.

Citizen Scientists Are Key to Finding Solutions

In the future, Nettleton hopes that OpenOceans Global can use aerial imagery and artificial intelligence to identify where plastic is accumulating on shorelines.

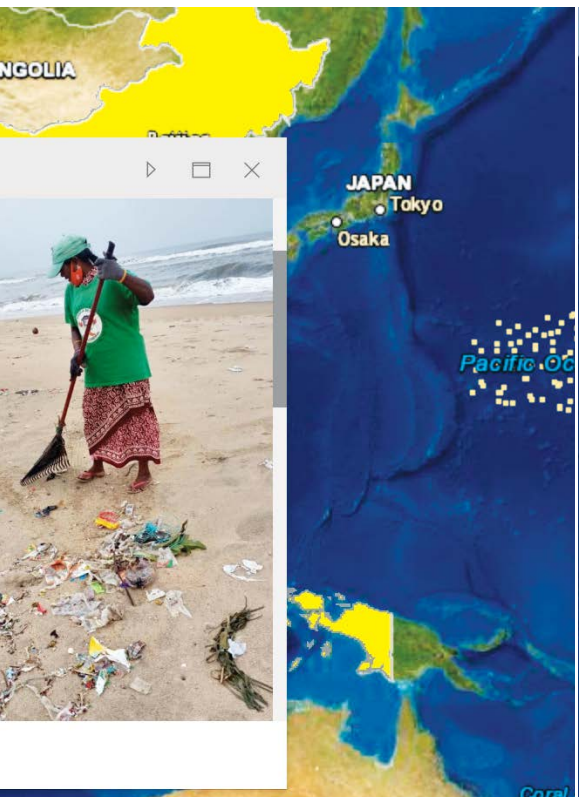
"But as of now, the most effective and comprehensive way to collect this data is with citizen scientists using our Survey123 mapping tool," said Nettleton. "Citizen scientists are critical to our success."

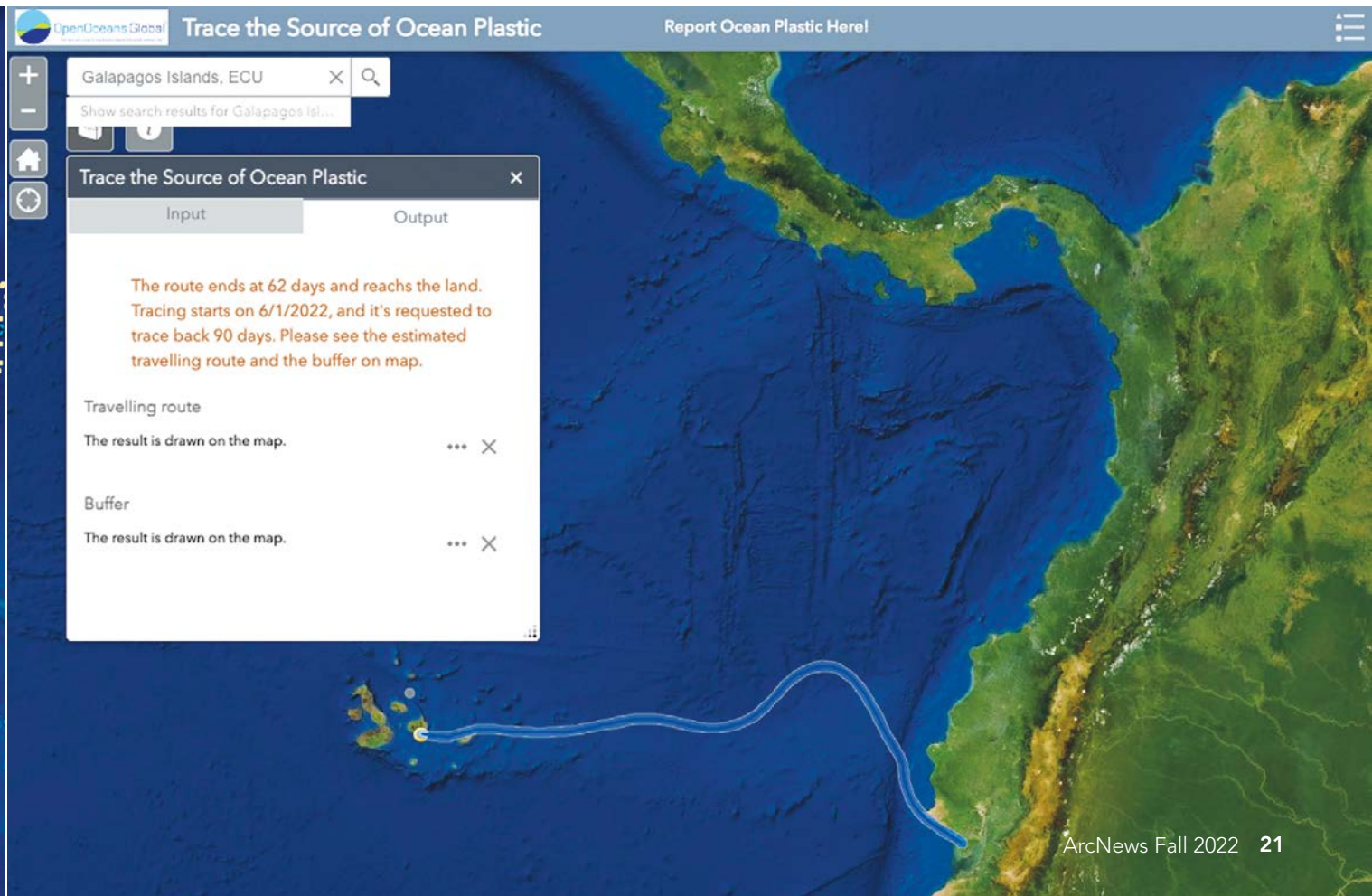
He hopes that people who participate in data gathering will also form a community through OpenOceans Global where they can exchange ideas about how to keep their beaches free from plastic pollution.

"As solutions are put in place and shorelines are no longer fouled by plastic, we will turn the icons on our map green to show that the problem has been fixed," said Nettleton. "That's the ultimate goal."

↓ Volunteers cleared 176,000 pounds of plastic waste from the beaches in Chennai, India, in 2021.

↓ A tracing app tracks plastic that ends up on coastlines back to its likely source.





Coastal City Amplifies GIS to Better Manage Water Quality Assets

By Shawnetta Grandberry, City of Carlsbad

The Clean Water Act requires municipalities across the United States to implement programs that address water quality and prevent water pollution, especially in urban areas. That's because dense residential and commercial development is dominated by impervious surfaces, which allow pollutants to flow unabated to waterways.

To protect water quality in urban areas, municipalities must install post-construction best management practices (BMPs). These are engineered structures—such as bioretention basins, vortex separators, filtration systems, and vegetated swales—that capture pollutants and prevent them from entering waterways.

In Carlsbad, California, to keep up with the maintenance needs of post-construction BMPs, the city developed a comprehensive, ArcGIS technology-based solution that streamlines data management and improves asset inspection processes. Most importantly, the system empowers the local community to help preserve Carlsbad's water quality and protect the environment.

The Need for More Effective Data Management

Carlsbad is a unique coastal community located in north San Diego County. With more than 115,000 residents, the city encompasses 39 square miles and includes 7 miles of coastline, three lagoons, and four creeks situated in a hydrologic area that receives runoff from five nearby cities. When it comes to water quality protection, Carlsbad has earned a reputation as one of the most environmentally sustainable cities in San Diego County.

Effective data management is key to helping Carlsbad stay on top of its environmental responsibilities—especially when it comes to maintaining post-construction BMPs. Many BMPs are privately owned, so performing maintenance on them is a responsibility shared by the city and the community. The community agrees to keep its structures in good condition, while the city verifies proper maintenance and compliance by regularly inspecting the BMPs.

But the City of Carlsbad didn't always have systems in place to make data management for post-construction BMPs easy. Under its old data management system, information was kept in different parts of the organization with no real way to integrate it or view data as a cohesive unit. Program management for post-construction BMPs was paper based, cumbersome, time-consuming, and costly. The city used six software systems and numerous workflows, which made it complicated to review engineered structures from hundreds of projects. Currently, the city provides oversight for 1,770 privately owned post-construction BMPs divided among 300 owners.

For over 25 years, the City of Carlsbad has leveraged ArcGIS technology—including ArcGIS Enterprise, ArcGIS Pro, and ArcGIS Online—as its system of record. GIS has been used to engage internal and external stakeholders and give staff members insight into the city's infrastructure, utility management, land development, and many other data services. In 2020, Carlsbad's GIS administrator—along with a public works business systems specialist, an engineering technician, and the city's post-construction BMP program manager—began brainstorming for better ways to use GIS to manage the city's BMP assets.

Without assistance from outside vendors or contractors, this small project team developed the Automation, Compliance, Tracking, Inspection and Owner Notification (ACTION) System, a comprehensive suite of apps and tools that organizes large datasets and synthesizes them into meaningful, reliable, and actionable information.

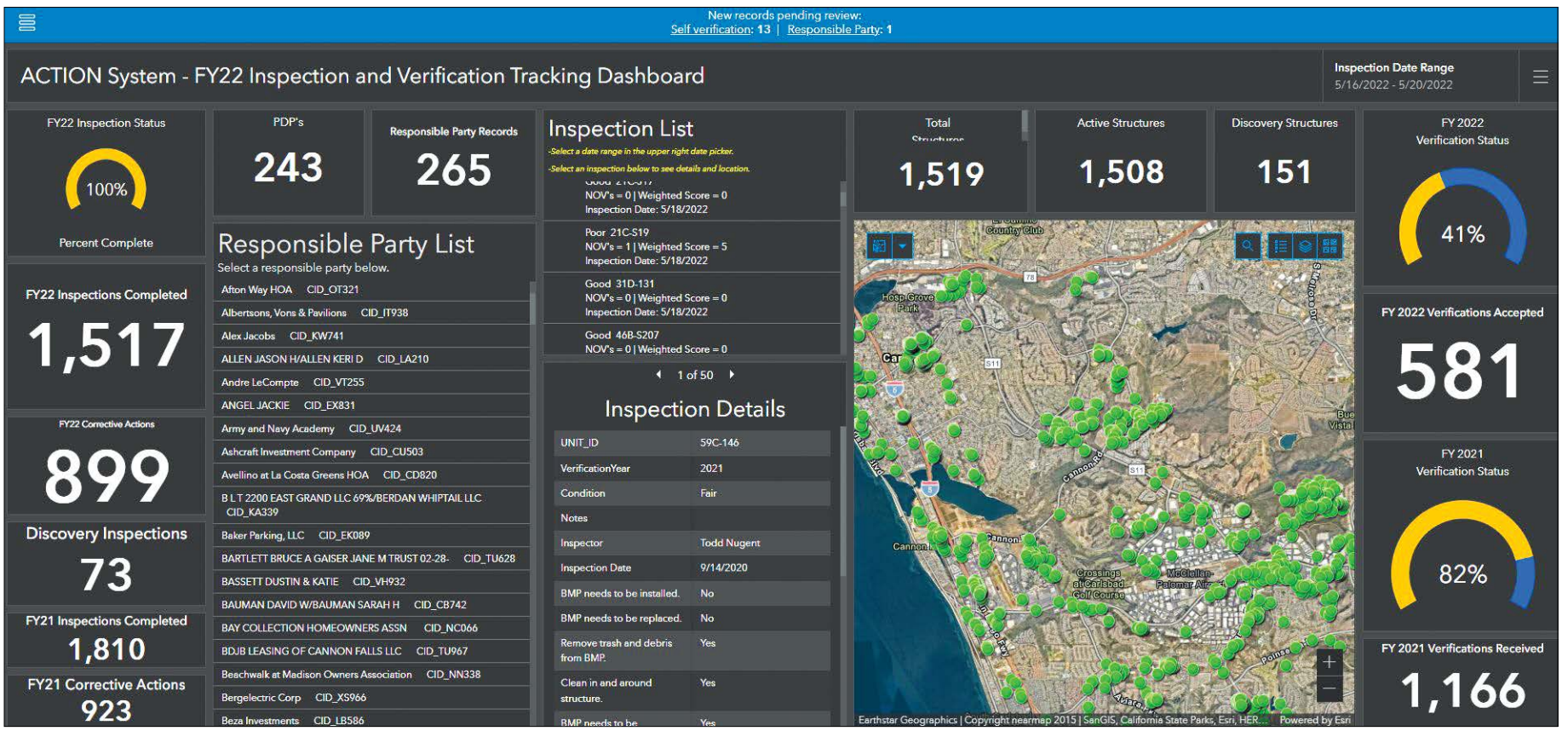
A Big-Picture Solution That Streamlines the Details

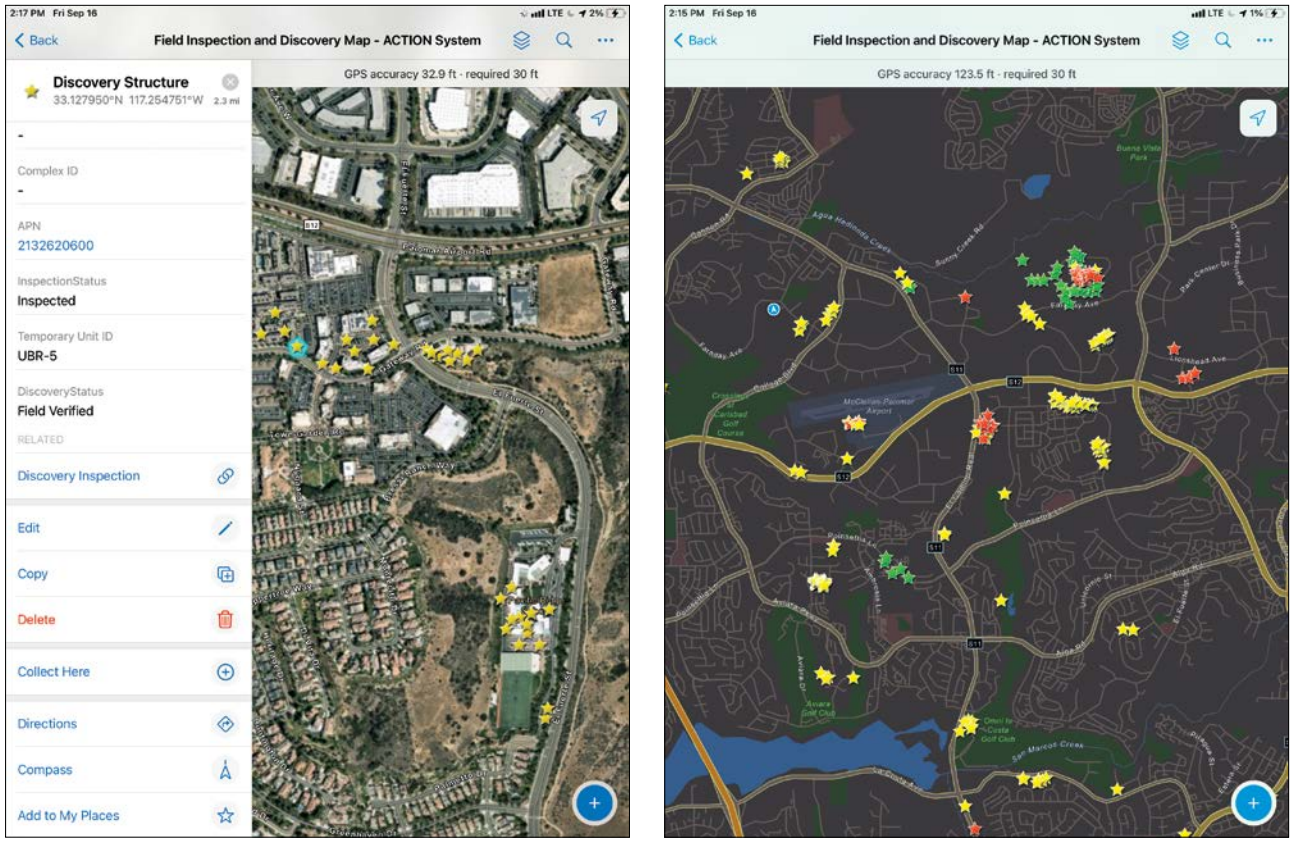
All members of the project team used their subject matter expertise and experience to develop the ACTION System. The GIS administrator and the business systems specialist modeled the database schema; wrote Python scripts; configured apps; and enabled reporting, analysis, and mapping capabilities. The engineering technician assisted with GIS integration and data entry processes. And the program manager led the project team to ensure that the ACTION System met the compliance and public engagement requirements of the municipal stormwater regulations.

ArcGIS technology serves as the backbone for Carlsbad's ACTION System. It not only streamlines data management and smooths out the details—from conducting asset inspections to engaging with the community—but it also provides the city with a big-picture perspective of how well Carlsbad is complying with the Clean Water Act and other environmental initiatives.

For data modeling, the project team used ArcGIS Pro to develop the ACTION System's database schema. The team started by modeling relationships among structures, inspections, responsible parties, and maintenance records by creating complex IDs for each BMP owner or operator. The GIS datasets were then filtered to identify and extract post-construction BMP assets, which provided the basis for the custom schema. Additional tables were created to manage inspection data and accept user inputs. These were then linked back to the assets through a series of database relationships. With all this in place, city staff can use ArcGIS Pro to create unique maps for post-construction BMP owners and operators that show each structure's location, priority, and condition. The maps can be exported as PDFs and sent via email to each responsible party.

↓ A dashboard provides the City of Carlsbad with an overall view of program compliance.





↑ When assessing the condition of post-construction best management practices (BMPs), inspectors use ArcGIS Field Maps.

The city also provides responsible parties with links to their unique complex IDs, which connect to an app built with ArcGIS Dashboards and ArcGIS Survey123. The links take the responsible parties to personalized self-verification portals, where they can view interactive maps of their BMPs, document the condition of the structures, update contact information, and upload photos and maintenance records. When new data is ready for the city to review and approve, Carlsbad's program manager receives a notification and can then leverage apps built with ArcGIS Experience Builder, Dashboards, and Survey123 to assess everything and quickly identify compliance issues.

When the city carries out BMP inspections, the ACTION System employs spatial statistics and cluster analysis to find hot spots of potential concern. This indicates where staff members should focus their resources and outreach initiatives. And when inspectors go out to assess the condition of post-construction BMPs, they now use ArcGIS Field Maps to capture photos and fill in easy-to-use forms. The app also allows them to work offline when necessary and sync their data to the system later.

During inspections, the program manager uses interactive dashboards to monitor progress and gain an overall view of program compliance. The program manager also manages data without assistance from the city's GIS department, thanks to an app built with ArcGIS Web AppBuilder that makes it easy to review, edit, and validate data from a desktop computer.

One of the most important parts of the ACTION System is sharing information with the public, which fosters transparency, increases engagement, creates a sense of community ownership over BMPs, and goes a long way toward changing people's behavior. This is now done through an ArcGIS StoryMaps story called the "City of Carlsbad's TCBMP Program." The visually engaging narrative encourages the community—especially owners and operators of post-construction BMPs—to actively participate in protecting the quality of Carlsbad's water.

Returns on Investment Run the Gamut

The City of Carlsbad's innovative ACTION System is a completely digital, GIS-based asset management platform that was designed and implemented entirely by leveraging existing staff and technological resources. The system allows city staff members to visualize Carlsbad's post-construction BMPs as an integrated network while measuring program effectiveness.

Since its launch in 2021, the ACTION System has produced numerous returns on investment, including the following:

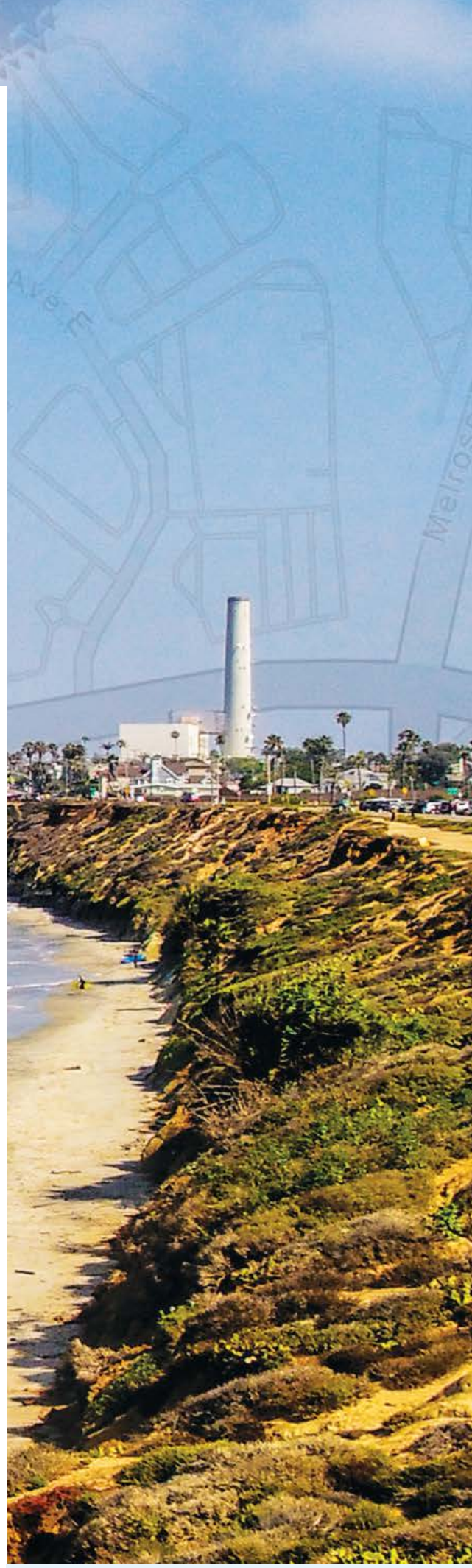
- Post-construction BMP program costs have been reduced by 44 percent.
- Program staff have cut down the time it takes to manage BMPs by 40 percent.
- Because owners and operators can now submit BMP maintenance verification records via the ACTION System, it now takes them 75 percent less time to submit maintenance verifications, and there's been a 24 percent increase in submittals.
- Field staff have decreased the amount of time it takes to inspect BMPs by 34 percent.
- The program has reduced paper use by 73 percent, resulting in an overall program cost savings of 57 percent.

Additionally, the city saved an estimated $100,000–$350,000 by creating its own system that employed already-existing technology rather than hiring contractors or outside vendors to do the work.

Key Ways to Shift Program Strategies

Post-construction BMPs are valuable because they help increase awareness about water quality issues and inspire municipalities to partner with the public to prevent pollution from reaching waterways. By improving how the City of Carlsbad encourages BMP compliance, the ACTION System has generated a measurable shift in the processes, norms, and relationships that are critical to managing these important environmental assets.

When municipalities shift their program strategies to see environmental asset management as a community resource and regard public engagement as a catalyst for change, they can implement policies that better leverage technology, encourage collaboration, and foster sustainability. Municipal governments can no longer just provide public services. They now need offer sound solutions, progressive policies, and professional expertise to make sustainable environmental asset management realistic and attainable.



About the Author

Shawnetta Grandberry is a senior program manager for the City of Carlsbad's Construction Management and Inspection Department. She has more than 30 years of experience as an environmental professional in stormwater compliance and public policy development. Grandberry has a master's degree in public administration from San Diego State University and is a Certified Professional in StormWater Quality (CPSWQ).

A Self-Learner Becomes an Influential GIS Lecturer

For a relatively recent self-taught GIS practitioner, Dr. Charlotte Smith has had quite an impact on the GIS education community.

A faculty lecturer at the University of California (UC), Berkeley, and visiting professor at the Instituto Tecnológico y de Estudios Superiores de Occidente (ITESO) in Guadalajara, Mexico, Smith teaches GIS courses that incorporate her background in public health and environmental health sciences in a truly integrated way.

"It's a thrill to see students come to understand the power of including location in statistical analyses, visualizing data, and telling stories," Smith said. "They're learning GIS techniques, but in the end, it's all about what they can do with the technology and how they can use the information for advocacy and making the changes they want to see."

Smith hasn't always been an educator, and her forays into GIS began only about seven years ago. But she started writing GIS curricula almost as soon as she finished her first set of Learn Lessons from Esri Training and quickly immersed herself in the GIS education community.

"What drew me in and keeps me in the world of spatial analysis is the community aspect," she said. "GIS is very much about community, and this community can really keep you motivated."

Smith describes her career as being like one of Dutch graphic artist M. C. Escher's famous lithographs, "with the steps going in all directions and people going up and down at the same time," she said.

She majored in microbiology at the University of Michigan and stayed on as a research scientist in the Department of Microbiology and Immunology. From there, she went to Columbia University to do similar work as a molecular biologist.

Then, it seems, her insatiable curiosity and limitless desire to learn took over when she got the idea to get more involved in community health work. Smith became interested in health promotion in local community settings, so she decided to get a master's degree in community health from Brooklyn College. She believes that getting more education and acquiring credentials is the best way to make a career change.

Smith finished her degree, but she never ended up fully working in that field because, by happenstance, a new interest came into the picture.

"During my master's degree, I got an internship at the New York City Water Department, which turned into a job, which turned into a career in the drinking water sector," she said. "This is why I tell students, never say no to an opportunity. You don't know what you'll make of it or what it will turn into."

Smith found the work fascinating, especially when it came to evaluating water quality.

"People turn on the tap, and they think that's it; it's fine," she said. "But we can see now with Flint, Michigan, and the recent water crisis in Jackson, Mississippi, that clean water should not be taken for granted. If it were easy, those problems would have been solved in a few hours. It takes technical know-how, political will, financing, regulations, and operator training to ensure good quality drinking water."

Smith spent six years at the New York City Water Department before becoming director of water quality for a French company that owned and operated 35 drinking water utilities in the United States as well as others around the world. In this phase of her career, she focused on solving water quality problems and developing regulatory compliance programs. When the American subsidiary was sold, she had the choice to either join the purchasing company or not.

"I chose not," she said. "And when you choose 'not,' you have an opportunity to do something new and better."

That's when she founded Charlotte Smith & Associates, Inc., a consulting firm that helps utilities all over the world improve water quality. For almost 30 years, she has conducted evaluations of water systems and trained water distribution system operators to find and solve water quality problems, among many other jobs.

In the middle of all this, Smith decided to go back to school to pursue her PhD. She'd heard that *Legionella*, the bacteria that causes Legionnaires' disease, lives inside protozoa and avoids digestion and, thus, destruction.

"I thought that was one of the most interesting things I'd ever heard in my entire life, and I wondered what else does that," said Smith. "Well, nobody was going to pay Charlotte Smith & Associates to find out."

So she obtained a Science to Achieve Results (STAR) research grant from the Environmental Protection Agency (EPA) and entered a PhD program at UC Berkeley to answer this question. She studied two bacteria—*H. pylori*, which causes stomach cancer, and *E. coli*, which causes diarrheal disease—to see if they can survive digestion in protozoa.

"The answer is no for *H. pylori* and yes for *E. coli*," said Smith. "I was happy because I had my answer."

According to Smith, that's how a doctoral dissertation should play out.

"You should have an obsession with a question," she said. "If you have that, then go back to school, take some time, answer the question, and move on with your life."

Smith did move on with her life. After she answered her question, she took on an entirely new role in academia, teaching the courses Environmental Health Sciences and Drinking Water and Health at UC Berkeley in the School of Public Health. She kept running Charlotte Smith & Associates (and still does). Additionally, this new stage of her life gave her time to explore a technology she'd gotten curious about: GIS.

"I just did a whole bunch of Esri's Learn Lessons," she said. "They're amazing. They're perfect for independent study because almost every step has an image, so you know that you're on the right track."

Through the Learn Lessons, Smith developed an appreciation of GIS in public health and environmental health sciences.

"GIS helps us understand the full picture," she said. "As I got more and more into mapmaking and spatial analysis, I created four GIS courses. I eventually dropped the courses I was teaching, and now it's all GIS all the time. I've become a GIS zealot."

Her students have used GIS to map the locations of drinking fountains throughout Berkeley to help the city promote the consumption of water rather than sugary beverages. The students have employed ArcGIS Survey123 to gather data about campus restrooms to help ensure that the university has accessible and gender-inclusive bathrooms. They've used Survey123 to collect quantitative and qualitative data on access to safe drinking water in Guadalajara and in rural communities on Lake Chapala, Mexico. Smith teaches her students how to use Esri technology, such as ArcGIS Online, ArcGIS Dashboards, and ArcGIS StoryMaps, as well as how to conduct geospatial analysis.

"I'm amazed at what these students can create in such a short amount of time," Smith said, referring to her eight-week and semester-long courses.

While Smith has been teaching GIS to undergraduate and graduate students for about five years, she had never taken a formal university course in GIS until last year. Ever the lifelong learner, she enrolled in Johns Hopkins University's Master of Applied Science in Spatial Analysis for Public Health program.

"Because I had never taken a GIS course, I had no role models for the pedagogy," she said. "The way I've been teaching GIS is based on the way I've taught other courses. But I questioned whether that's the best way to teach GIS."

Learning from the Johns Hopkins faculty and students, Smith says she's not only becoming a better professor by participating in the program, but she's also learning to approach projects in different ways.

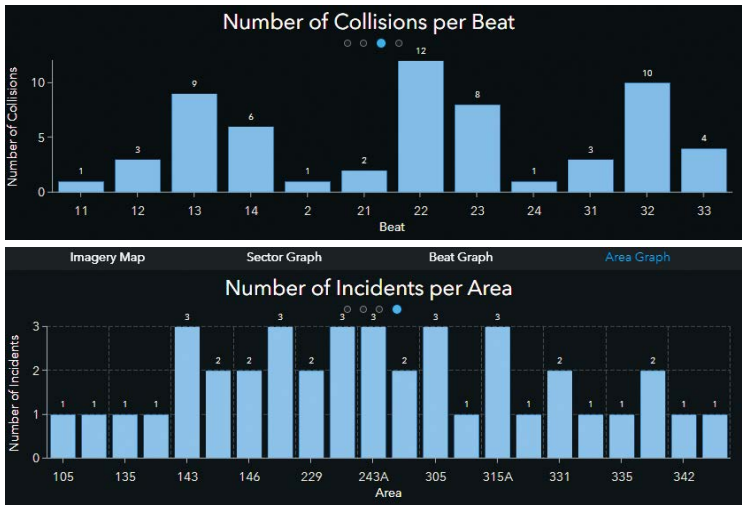
"The GIS community is full of people who are willing to share, communicate, and support one another," said Smith. "As a person with a neurodegenerative disease and limited mobility, being part of the GIS community sustains me."

Charlotte Smith

Dr. Charlotte Smith is an associate editor for the Centers for Disease Control and Prevention's (CDC) *Preventing Chronic Disease* journal. One of the sections she focuses on is "GIS Snapshots," which consists of 1,000-word articles about public health projects that involve spatial exploration or analysis. Smith and her colleagues invite people to submit articles for publication. For additional information, visit cdc.gov/pcd/issues/gis_toc.htm.

GIS Hero

Intern Develops GIS Dashboard for Alameda Police Department



↑ Graphs on the Alameda Police Department (APD) dashboard show the number of collisions and traffic stops per beat or police reporting area.

Over the summer, David Ho, a newly minted high school graduate from Alameda, California, was hired for a five-week summer internship with the City of Alameda's Information Technology (IT) Department. The goal of the internship program, which is sponsored by the city's Community Development Department, is to connect with young talent to advance city objectives while introducing students to the critical functions of operating a city.

When Ho came on board, Alameda was taking its first steps toward implementing a smart city plan. The plan includes unifying data collection with maps to help the city improve decision-making to secure better outcomes.

"We felt confident that David could master Esri tools to help us with GIS projects that other departments needed," said Carolyn T. Hogg, the City of Alameda's IT director. "As it turned out, the Alameda Police Department *[APD]* had a burning need for a GIS-powered dashboard that David Ho delivered."

In Alameda, which is home to 80,000 residents, APD reports to hundreds of traffic stop and collision incidents each month. It is paramount that APD have steady access to vehicle incident data so that officers can make decisions quickly and respond to problems appropriately. Being able to locate hot spots with high traffic stop and/or collision rates is helpful.

Previously, to do this, APD had been using data in an ArcGIS Online web map. But police staff were printing PDFs of the map when they conducted monthly reviews, which meant that the department wasn't using GIS at its full potential.

"After meeting with police leadership, IT and APD agreed that a GIS dashboard would be a better way to present the data," said Zachary Baron, GIS analyst for the City of Alameda and Ho's internship supervisor. "So David got to work."

APD documents traffic stops and collisions through its computer-aided dispatch (CAD) software. The police department's records supervisor exports incident report data from the CAD system into Microsoft Excel. The reports include latitude and longitude fields, allowing the data to be converted into a point feature class using the Display XY Data button in ArcGIS Pro. The records supervisor then uses the Append tool to upload the new data points to the existing ArcGIS Online hosted feature layer.

Police department staff wanted to see traffic stops and collisions overlaid on police sector, beat, and reporting area polygons. So Ho added two more existing layers: high-incident roads and high-incident intersections.

ArcGIS Online offers many methods for creating maps, apps, and dashboards. After testing out different templates, Ho decided to use ArcGIS Experience Builder to construct a customized experience from a blank template.

The GIS team at Alameda's IT department had a list of criteria for the dashboard. The dashboard needed to be easy to use and have a gentle learning curve. It needed to display data in a clear and concise manner. It needed to be versatile so that it could be refined later. And it needed to be organized and uncluttered.

To make navigation of the dashboard easy, Ho split each part of the dashboard into sections that display different information. The map is integral to powering the dashboard, since the map and its data are linked to dynamic content in the widgets. When selecting and filtering data, the map reflects the changes in real time, giving users clarity when sorting incidents.

Ho made it so that sections visually separate different parts of the dashboard while retaining the changes made to them, even when the sections are hidden. This allows users to sort traffic stops and collisions into their own sections, each with their own lists, filters, and graphs. Users can feature data from one section without interfering with the other. Additionally, users can filter traffic stops and collisions at the same time, and both will show on the map in real time. This versatility vastly improves APD's data organization.

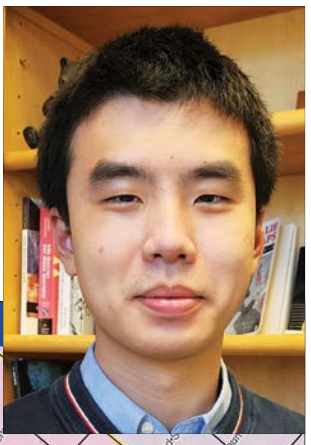
In the end, the dashboard that Ho built met—and then exceeded—the criteria the IT department had set for it. Ho added a separate small map that employs satellite imagery of the city and moves dynamically alongside the other map to increase visibility and clarity when users navigate the dashboard. He also made it possible for users to elect to show other sections in place of the secondary map if needed. These sections include graphs that sort incidents by police sector, beat, and reporting area. The graphs, like the map, change dynamically based on what users select and filter.

APD's new dashboard proves the importance and relevance of GIS within the city.

"We are all fortunate to have a summer intern help our city's *[GIS]* team by gathering traffic data that includes traffic collisions and traffic stops," said APD police chief Nishant Joshi. "From this map, we visually saw the problematic areas and concentrated on traffic stops in places more prone to traffic collisions, resulting in a reduction of collisions."

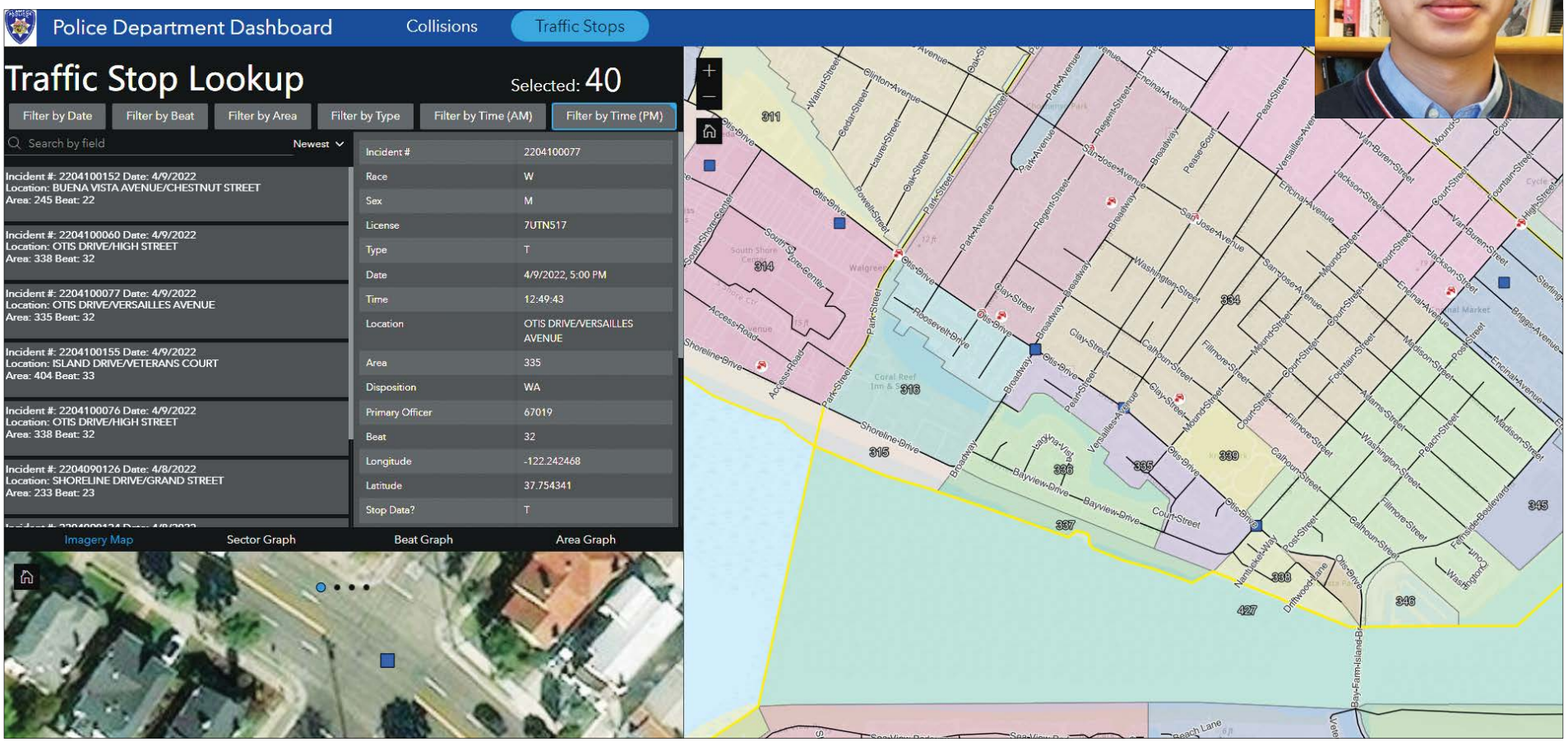
Hogg reiterated her commitment to applying GIS to helping solve problems in other city departments.

"While the demands and requests from city staff get more complex over time, technology always needs to stretch our capacity to meet these requirements," she said. "With the help of ArcGIS, the City of Alameda plans to expand GIS into other departments to increase productivity *[and improve]* decision-making and organization. In addition to implementing GIS citywide, we are also excited about future plans to introduce GIS to students in the Alameda Unified School District."



→ As a summer intern, David Ho built an interactive dashboard of traffic stops and collisions for the APD.

↓ When users select and filter data on the dashboard, the map reflects these changes in real time.



Cloud-Based Imagery Software Helps Manage Abandoned Mines

By Shane Zentner, Brierley Associates

In Wyoming, the Abandoned Mine Land (AML) program oversees the reclamation of lands with unused mines on them and works to restore those areas to safety. For abandoned mines that are at risk of collapsing, AML can conduct grouting operations. This is when holes are drilled into old mines and filled with a cement-like mixture to reduce the likelihood that the roofs of the mines will cave in. But these operations can cause ground movement in the areas where they're being done. What's more, subsidence—or the gradual sinking of land—can happen when mine roofs fail, leading to sinkholes that form near infrastructure and towns.

To help monitor ground movement and subsidence of old mines in Wyoming's Carbon and Converse Counties, AML works with the aerial mapping program at Esri partner Brierley Associates. Site Scan for ArcGIS plays a critical role in processing imagery of these areas, so project managers, engineers, geologists, GIS analysts, and other staff members at AML can use aerial mapping and oblique imagery to manage their projects.

Strained Storage Capacity Leads to a Cloud-Based Solution

Bierley's GIS team needed an efficient way to upload imagery to a cloud-based solution so it could process, analyze, view, and share imagery products with AML engineering staff. Normally, the GIS team used ArcGIS Drone2Map for image processing. However, the amount of imagery that Brierley was collecting for AML strained the storage capacity of Brierley's servers. So the team needed a better way to manage the imagery being collected and processed.

When Site Scan became an option for Brierley in October 2021, the company's GIS team uploaded several years' worth of AML's imagery to the cloud-based software. Processing the imagery was quick, and the team was able to produce 2D and 3D products that it could share with anyone who was granted viewing privileges by the administrator. This allowed staff at AML to view and track a project's status on a weekly basis using high-resolution, high-accuracy image products.

Some of the products derived from the aerial imagery of mines in Carbon and Converse Counties include orthomosaics, digital terrain models, digital surface models, contours, volumetric calculations, cut-and-fill operations, hillshades, and 3D mesh scenes. All of these—which employ ground control points to ensure accuracy—help leaders at AML plan projects and make decisions.

Having the ability to share these products with anyone who has access to them, as well as directly with various ArcGIS Online accounts (and other cloud-based platforms), has enabled Brierley's aerial mapping program to present its products to a much wider audience than before.

The Benefits of Using Site Scan for ArcGIS

While there are many advantages to using Site Scan, the main benefits for Brierley have been threefold. First, the software has ample storage capacity for imagery and imagery products. Second, using Site Scan allows the GIS team to easily share imagery products. And third, Site Scan incorporates volumetric calculations into analysis, which is required by AML's engineering and geology staff members so that they can assess potential subsidence features and make critical decisions about current and future projects.

From the client's perspective, the products generated by Site Scan enable staff members at AML to easily manage and track the daily progress of various projects without having to leave their offices. This saves them the time it takes to drive out to project sites and conduct field visits.

Because Site Scan makes high-resolution imagery easily accessible from within the product or ArcGIS Online, it is Brierley's goal to use up-to-date aerial imagery orthomosaics for every map and figure it provides to AML. This will ensure better data quality for analysis and presentation purposes.

A Small GIS Shop Gets Transformed

Site Scan has enabled Brierley's small GIS shop to morph into a full-fledged photogrammetric mapping department that offers oblique imagery and aerial and thermal imagery mapping. Being able to store, process, analyze, and share aerial mapping products in the cloud has been pivotal for the Brierley GIS team and the project managers who have been working with AML.

Thanks to Site Scan, the team at Brierley can now create products for various clients that demand high-resolution imagery and give them access those products anywhere, anytime.

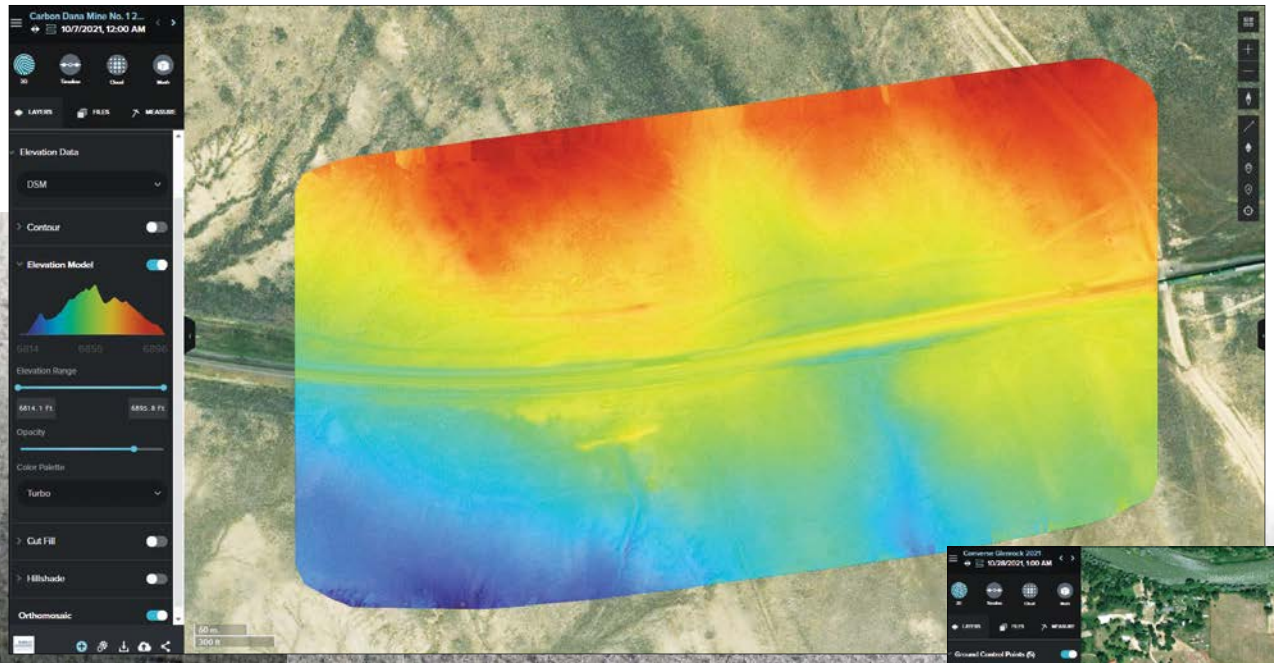
"Site Scan has been a game changer for our mapping program," said David Hibbard, project geologist at Brierley Associates. "*[It]* has allowed me to visualize the activities at a project site and to analyze progress on a regular basis."

"Site Scan for ArcGIS in a one-stop shop for all of Brierley's aerial mapping products," added Cory Ott, senior GIS analyst at Brierley Associates. "The ease of storing, processing, and sharing aerial imagery products has provided the GIS team with more services offered to our clients and engineers."

For more information about Brierley Associates' use of Site Scan for ArcGIS, email Brierley remote sensing specialist Shane Zentner at szentner@brierleyassociates.com.

About the Author

Shane Zentner, GISP, is a remote sensing specialist at Brierley Associates. He has more than 20 years of experience in the mapping sciences, including with photogrammetric 3D mapping, image processing, surveying, and GIS. Zentner is a Federal Aviation Administration (FAA) Part 107-licensed unmanned aerial systems (UAS) pilot.



← Digital surface models derived from the aerial imagery stored and processed in Site Scan for ArcGIS help leaders at the Abandoned Mine Land (AML) program plan projects.

↓ Orthomosaics employ ground control points—known points used for georeferencing—to ensure accuracy.

→ When the roofs of abandoned mines fail, it can lead to the formation of sinkholes.

GIS FOR A BETTER WORLD

PROTECTING AQUATIC HABITATS IN THE GULF OF MEXICO

"To help protect reef and coral communities in the Flower Garden Banks National Marine Sanctuary, I developed a dashboard using ArcGIS® Dashboards that accessed a National Oceanic and Atmospheric Administration (NOAA) data server to display related live oceanographic conditions (currents, wave height, wind, sea temperature, and salinity) to assist in maritime transportation for the health and safety of sanctuary monitoring programs."

J. Keaton Thompson
MS GIS '22
B.S. Environmental Science, Spanish, Spatial Studies Minor '21

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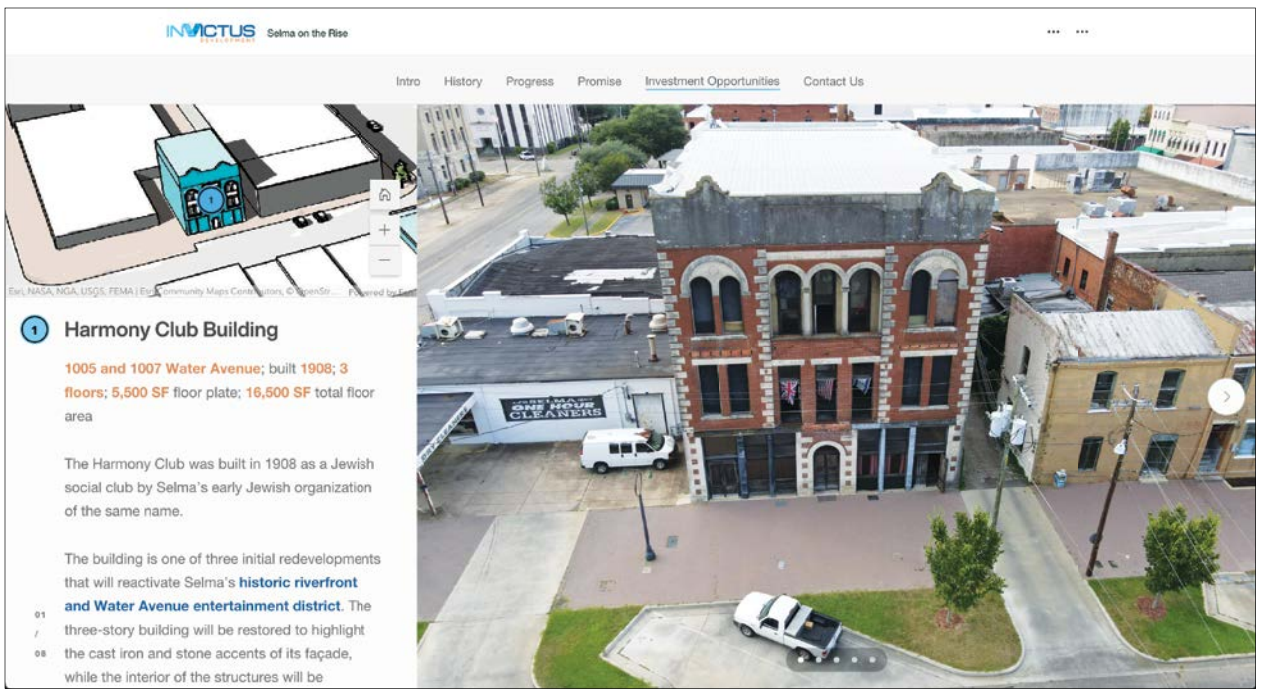
For Big Projects, Turn to Esri Partners

When organizations need to tell important geospatial stories, standardize disjointed processes, or implement extensive new systems, Esri partners have the expertise and tools to make those jobs easier. Find out how Esri partners Datastory, Arup, and UDC contributed geospatial solutions to help rehabilitate a struggling downtown; bring along the electric vehicle revolution; and modernize two utilities' geospatial infrastructures, laying the groundwork for other utilities to follow suit.

Telling the Compelling Story of a Historic City with Modern Promise

In 2019, InVictus Development—a development firm that builds affordable, multifamily housing and rehabilitates historic commercial properties—completed 56 affordable housing units in northern Selma, Alabama. Throughout the development process, InVictus cofounders Paula Rhodes and Rick Cavalieri visited the city frequently, and while they knew Selma as a city of profound historical significance, they were surprised by its untapped potential. Many of downtown Selma's iconic structures—with scenic views of the Alabama River and the Civil Rights Movement landmark the Edmund Pettus Bridge—were buckling due to years of neglect.

In collaboration with members of the Selma community who were pioneering redevelopment, Rhodes and Cavalieri further invested in Selma's future by purchasing and optioning several downtown buildings. Their vision was to renovate the buildings in a way that reflects their historical significance while modernizing them to attract retail and residential customers to the downtown district. Because traditional investment metrics would not favor investing in Selma, the challenge InVictus faced was how to tell potential investors a compelling experiential story about Selma that was grounded in data-driven evidence.



↑ InVictus Development's vision is to renovate buildings in a way that reflects their historical significance while attracting retail customers and residents to the downtown district.

InVictus turned to **Datastory** (datastoryli.com) to help highlight the history, progress, promise, and opportunities available in Selma for real estate investors and current and future residents. Working with stakeholders, the team at Datastory leveraged ArcGIS StoryMaps to shine a light on what makes Selma forward-thinking and unique and invite viewers to learn about specific opportunities to invest in and engage with the community. The resultant ArcGIS StoryMaps narrative, which leverages an array of data from Esri and public government sources, is filled with stunning data visualizations. Creative analytic outputs include measurements of tourism that are derived from human movement data compiled by another Esri partner, SafeGraph, and a visualization of people's live-work patterns gleaned from US Census Bureau data.

The powerful presentation encourages people to connect with InVictus and join the community of Selma to help lead it into the future. To explore the story, go to opportunityselma.com.

Improving Site Selection Methods for EV Charging Stations

One of the key barriers to achieving widespread electric vehicle (EV) adoption in the United States is that there is no nationwide network of charging stations. To scale up EV infrastructure quickly and cost-effectively, special attention needs to be paid to where curbside public charging stations are built.

Currently, many site selection methods are ad hoc and done on a case-by-case basis. To give decision-makers access to consistent site selection methods, pertinent geospatial data needs to be available in a centralized, online location.

Taking on this challenge, global built environment consulting firm **Arup** (arup.com) collaborated with Los Angeles Cleantech Incubator (LACI) and three leading energy utility companies to assess the curbside EV charging infrastructure landscape in Southern California. From these findings, Arup developed a geospatial site suitability platform called Charge4All that offers a unique approach to assessing the suitability of potential EV charging station sites.

Charge4All leverages ArcGIS Pro, ModelBuilder, ArcPy, and ArcGIS Online and features color-coded maps that display a breadth of geospatial data—including needs in dense areas with multiunit dwellings—to determine locations that are suitable to host EV charging stations. By zooming in on GIS-developed smart maps, decision-makers can see details down to the curb to determine a potential site's proximity to existing electrical infrastructure and different types of roads.

The goal of Charge4All is to help elected officials, utilities, and community leaders choose the most effective and equitable locations in which to install EV charging stations. The level of detail available on the platform, which can include street-level views, enables users to prioritize certain sites before conducting in-person inspections, saving organizations time and money.

After launching Charge4All in Southern California, Arup is now partnering with officials in other cities across the United States to help them explore how to expand EV charging infrastructure within their communities.

← Charge4All employs a breadth of geospatial data to determine the most suitable sites for electric vehicle (EV) charging stations.

Standardizing Gas Utilities on a Common GIS

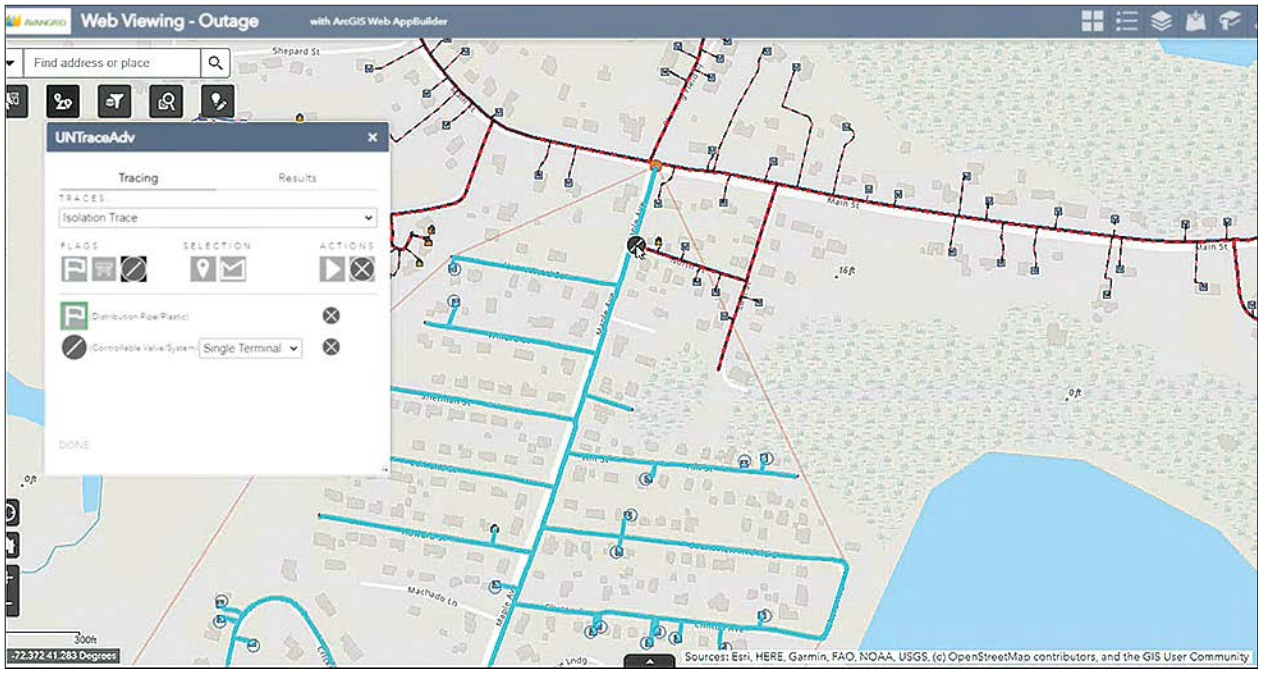
Energy company AVANGRID, which operates in 24 US states, has two primary lines of business: Avangrid Renewables and Avangrid Networks. Avangrid Networks is composed of eight electric and gas companies in the northeastern United States. Until recently, two of these companies—Southern Connecticut Gas (SCG) and the Berkshire Gas Company (BGC)—were not using GIS to spatially manage their assets and networks.

To better align SCG and BGC with their cosubsidiaries, AVANGRID chose **UDC** (udcus.com) to help transition them to GIS from computer-aided design (CAD) mapping systems and lay the foundation for implementing ArcGIS Utility Network. One of AVANGRID's goals for the project was to define a common GIS Utility and Pipeline Data Model so that it could eventually use that to standardize all Avangrid Networks gas companies.

Focusing on data conversion and app development, UDC worked with SCG and BGC to leverage their existing geospatial technology investments—including ArcGIS technology and ArcFM software from Esri partner Schneider Electric—to create a complete distribution-level GIS with spatial locations for gas utility assets. Schneider Electric provided product support for its Session Manager extension (which allows users to run through approval processes prior to posting to a geodatabase), consulted on tracing features, assisted with setting up the environments, and helped create workflows.

While implementing the utilities' GIS infrastructure, UDC also digitized and converted their gas data, mapped legacy data sources in Utility Network, and developed integrations and web and mobile apps. These simultaneous efforts enabled SCG and BGC to continue with normal business operations while seamlessly transitioning to a comprehensive GIS.

SCG went live with its GIS production environment in September, and BGC is scheduled to follow soon. The two utilities will now use GIS to support gas operations, emergency planning, outage management, asset replacements, new business expansion, and more. Traces implemented using the new network management system will aid with leak surveys, outage management, and network analysis within the companies' Synergi Gas engineering software from Esri partner DNV. Because of the configured network traces, staff members at both utilities can more effectively manage risks and outages without having to build as many models or conduct a lot of analyses.



↑ An isolation trace app enables staff members at Southern Connecticut Gas (SCG) and the Berkshire Gas Company (BGC) to identify which customers and critical facilities will be affected by an outage so that they can create temporary gas shutoff points to reduce the impacts of the outage.

The initial implementation of Utility Network at SCG and BGC is intended to be the template for all other Avangrid Networks subsidiaries as the product is rolled out across the enterprise. UDC is assisting Avangrid Networks in training users on the new web and mobile apps, ArcFM, ArcGIS Pro, and specialized add-ins that enhance utility workflows.

"This implementation is important to AVANGRID because it lays the foundation for our future," said George Porto, IT GIS applications manager at AVANGRID. "It was a unique opportunity for us to learn about *[ArcGIS Utility Network]*, and we are confident that it will help us be successful when we migrate our other electric and gas companies in the not-too-distant future."

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

SaaS Imagery Solution Helps Conservation Startup Detect Change Faster

To help care for and protect natural resources, including land, water, and wildlife, Esri partner Skytec (skytecllc.com) employs unmanned aerial systems (UAS), remote sensing, and GIS technology. In 2019, around the same time the small startup graduated from the Esri Startup program, Skytec developed Ranger, an app for detecting whether high-priority areas are undergoing significant change, such as shrinking or disappearing.

Skytec uses drones and near-daily satellite imagery from Esri partner Planet Labs to remotely monitor subscribers' property. Clients include land trusts that maintain natural resources, organizations that work in forest agriculture, and pulp and paper industries. The Ranger app, built with ArcGIS Web AppBuilder, is optimized for use on desktop computers and tablets and is already monitoring more than 500,000 acres of land across the United States.

"As we become more wired *[and]* more connected—*[and with]* more people on the planet—things are changing fast," said Andy Carroll, chief technology officer at Skytec. "Rather than being reactive all the time, we can catch things early."

To better manage and store imagery, Skytec wanted a new, cloud-based solution that was simple to deploy and could scale to meet clients' growing needs. So the small team of environmental scientists began using ArcGIS Image for ArcGIS Online, a software as a service (SaaS) product that has helped Skytec improve its change detection analysis, provide custom client deliverables, and streamline processes.

Improving Complex Imagery Management Processes

Prior to implementing ArcGIS Image Online, managing and analyzing imagery was cumbersome for Skytec team members. First, they used ArcGIS Pro to mosaic the individual tiles downloaded from Planet Labs' satellites. Then, they created a tile package from the imagery and uploaded it to make a tiled service.

Processing imagery required a lot of resources as well. After satellite imagery was collected to perform change detection, the team primarily used a desktop computer to produce different types of models, indexes, and scripts. Skytec didn't have an enterprise server or cloud resources available to help with storage and processing, so the team needed a solution that could better manage assets—and could scale to allow the company to bring products to market quickly.

While Skytec initially wanted a full ArcGIS Enterprise deployment—and is still working to make that happen—ArcGIS Image Online allows the team to host, analyze, and stream imagery and raster collections in the cloud and power the Ranger app in ArcGIS Online. According to Carroll, ArcGIS Image Online was a good solution for Skytec because it could handle the volume that subscribers needed right out of the gate.

To get started using ArcGIS Image Online, Skytec team members tested their raster data in the SaaS offering over several weeks. They leveraged on-the-fly image processing algorithms, also known as raster functions, to create custom raster chains to visualize change. This enabled data analysts to serve out meaningful representations of change over any given area at any given time—which is what Skytec clients are looking for.

Imagery That's Ready to Visualize and Analyze

Within five or six weeks of deciding to implement ArcGIS Image Online, it was running live at Skytec.

Customers have the option to have their land monitored monthly, quarterly, or at custom intervals. The new method for managing and processing the imagery involves receiving image quads from Planet Labs as tiled GeoTIFFs. These multispectral images are then uploaded as imagery layers to ArcGIS Online for visualization and analysis.

The upload process enables Skytec to automatically create a single tiled imagery layer that's ready for clients to visualize and the Skytec team to analyze. Users can go into the Ranger app, zoom in on the imagery layer, and see current or previous images throughout the lifetime of their subscription.

Skytec creates and serves out both tiled and dynamic imagery layers. Tiled imagery layers are fast to create, while dynamic imagery layers enable on-the-fly processing using multiple processing templates, all within the Ranger app.

"It's neat that a single layer can be used in production and to generate derivative products at the same time," said Carroll. "You can't do that with a tile service."

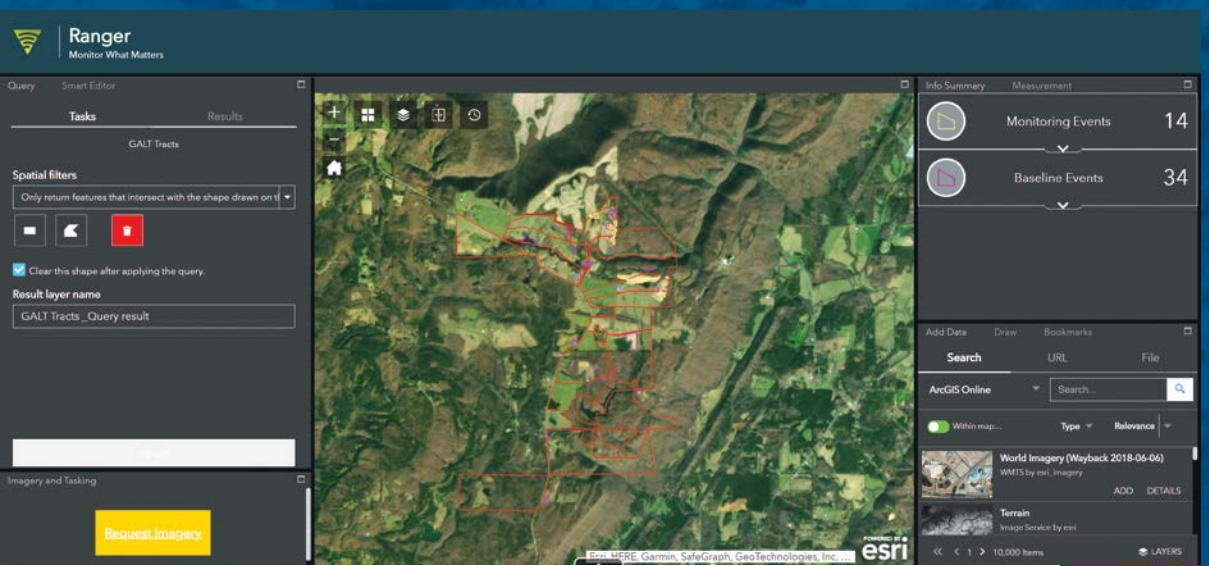
Quick Deliverables Make a Difference

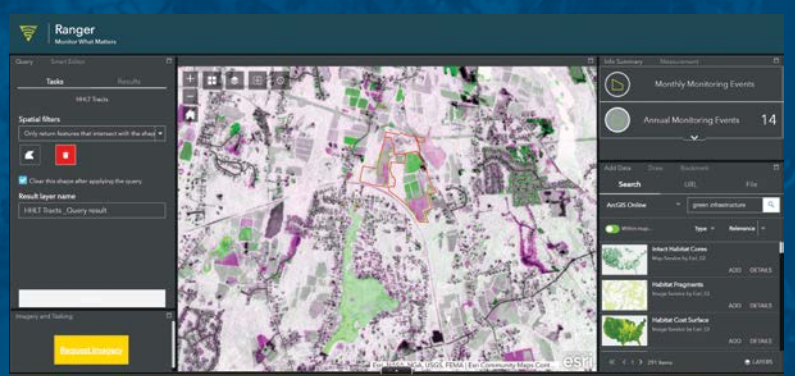
Skytec has been using ArcGIS Image Online for a little more than a year and has already seen an array of benefits, including a seamless onboarding experience that enables the company to go to market quickly. Onboarding people, from clients to data analysts, is simpler because ArcGIS Image Online is user-friendly and easy to learn.

"It takes less time out of the day to get people up to speed internally and externally," said Andrew Mindermann, senior data analyst at Skytec. "That's been a huge time-saver."

ArcGIS Image Online has streamlined overall processes as well, including automating and speeding up the derivative product process.

↑ Processing drone imagery with ArcGIS Image for ArcGIS Online is easier and less time-consuming for the Skytec team.





←↓ The team at Skytec uses change detection visualization models, now hosted in ArcGIS Image for ArcGIS Online, to track changes made to conservation easements.

"The on-the-fly processing capabilities available in ArcGIS allow us to avoid redundant storage," said Mindermann. "We're streamlining it and really making the most out of all the products that we generate. We're trying to reduce any type of doubled effort or unnecessary storage, not only for us but *[also]* for our clients. And it benefits the performance as well."

ArcGIS Image Online has significantly improved change detection for clients. For example, Skytec onboarded a new client recently that immediately saw two potential violations of conservation easements (boundary encroachments and harvesting) during their one-hour phone call.

"Those are the experiences we are beginning to have with all our clients," said Carroll. "We're detecting things on the landscape that *[may have gone]* undetected and saving people from driving out to a site in person. That's been pretty rewarding."

Now, as soon as products from Planet Labs are uploaded to ArcGIS Image Online, it takes 15 minutes for the Skytec team to generate derivative products. Visualization models, for example, are made within the cloud and can be chained together and automated, saving time. And clients receive deliverables much faster. For a recent request, Skytec uploaded imagery for a client into the Ranger app 24–48 hours after tasking a satellite.

"Being able to act quickly is key to detecting change at this level," said Mindermann. "It's knocking out a lot of time *[and]* increasing efficiency."

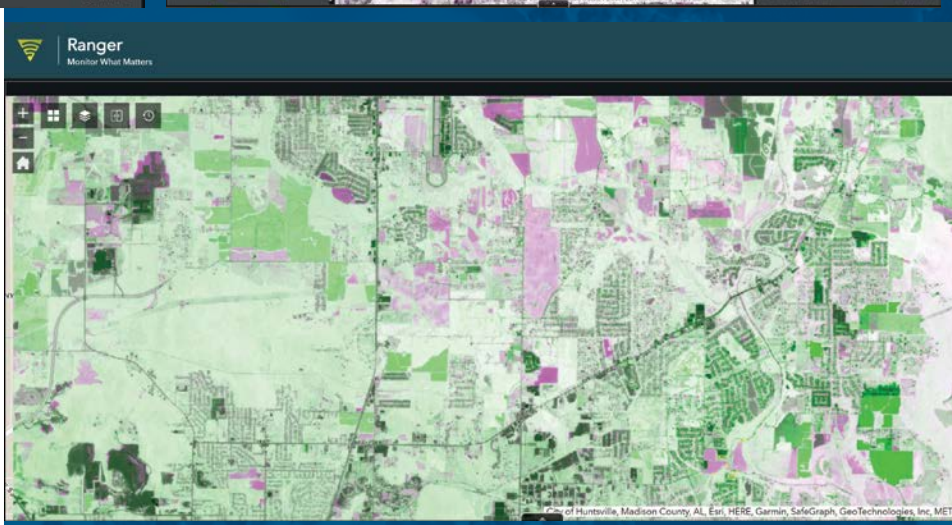
The ability to customize with ArcGIS Image Online has been very helpful, too. For example, if Skytec team members need to change the indexes they're using, they can do that directly in a browser instead of creating and uploading functions using a desktop computer on the local network. The security and reliability of ArcGIS Image Online allow team members to focus on the science of their work rather than on the infrastructure. Previously, processing imagery tied down an entire computer. Now, ArcGIS Image Online off-loads that and lets the team continue working while the processing is running in the cloud.

"I don't have to worry about the back end, the database, the structure, *[or]* the security of the servers," said Carroll.

In delivering the product through ArcGIS Online, Skytec has essentially opened a gateway between two different ArcGIS Online organizations. And it's secured by the user, who can easily control access to the data via built-in security features.

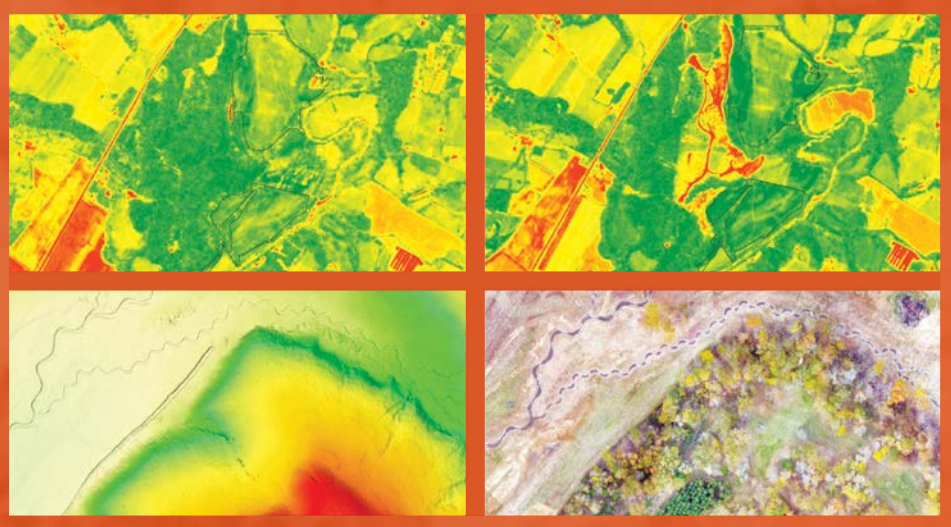
According to Mindermann, ArcGIS Image Online has been a game changer, equipping Skytec with the same capabilities as larger organizations.

"*[ArcGIS Image Online]* gives us the ability to compete with what typically might be a whole team of data scientists that are handing off different components of models or multiday processing," added Carroll.



↑ With its Ranger app, Skytec is detecting changes to landscapes that may have otherwise gone unnoticed.

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**.



↑ Skytec creates satellite-derived change detection models and drone-based lidar and imagery products.

From the Meridian

By Dr. Katina Michael
Arizona State University

As Maps Transform, So Must the Ethics of Mapmaking

Maps are one of the most magical inventions in human history. The *Babylonian Map of the World*, or *Imago Mundi*—a clay tablet that displays a labeled disk of what was thought at the time to have been the whole world—is said to have been created in the sixth century BCE. There is also evidence to suggest that maps were etched on cave walls more than 5,000 years ago.

Maps are products and reflections of their times. A map from 100 years ago is radically different from one created today, due to social, economic, and technological developments. Maps made 100 years from now will be more intricate, in many ways, than the ones currently produced, thanks to advancements in technology.

The potential for mapping—and what a map can be—is enormous. But with this potential comes great responsibility.

How Time Changes Maps

What is transforming mapping? The altered role of time may be among the most profound factors. Albert Einstein's 20th-century revelation that time is inseparable from space is written into 21st-century maps. Time-lapse maps now allow people to hurtle through whole days, weeks, and years and pinpoint single moments in time to a particular place.

The shift from producing static maps of fixed locations to creating time-infused locational guidance is related to the development of other technology that merges time and space in the physical, social, and cyber worlds—most notably, what is being positioned as the metaverse. In the future, maps may be a continual feed of location-based video preserved in 3D—and overlaid with semantic layers that indicate place, tell stories, and connect to social networks—to create an augmented reality.

The layers that are part of the digital cartographer's toolkit have also prompted a sea change in people's sense of both scale and time. For example, when working with layers in GIS, it is possible to model simultaneity at various scales and levels of detail. Like Matryoshka dolls nesting within one another, layered maps enable viewers to go from the macroscale to the microscale with a transparency that reveals the universe, world, society, community, and people as intertwined within a transdisciplinary system. In considering different views of the same map, people can experience the subject matter's interdependencies in ways that no classic map could allow.

The data itself is changing, too. Machine vision and embedded camera technology now make it possible to determine the location of photographs in real or near real time. So a photo of the Eiffel Tower can automatically be pinpointed to its precise location in Paris, France. Additionally, the things that can be mapped are changing. A profusion of satellites is allowing humans to explore outer space and scan even the most remote areas of Earth at the ground level. But beyond the streets and even the ocean floor, what might come next? Perhaps it will be the monitoring of human activity en masse—aggregating people's movements and personal interactions from minute to minute. This would give map viewers an incredible sense of a town or city's pulse, for instance.

It seems that every inch of the world has been mapped. Indeed, even DNA has been mapped to create the human genome. So what's next? Perhaps it will be charting the estimated 100 billion neurons—plus the trillions of connections called *synapses*—that make up the brain, that most complex network of networks. These biometrics—the measures of distinct physical characteristics and behavioral traits—make each being unique. Mapping this metaphysics could reveal a great deal about human beings.

The Maps of the Future

One reason for making such granular maps of humans is because it's possible. Another, more contestable, reason is because it reveals who humans are, where we came from, and what might befall us.

Within 200 or 300 years, maps will likely be video recordings of every step ever traversed by singular units, kept in a Web of Things and People. The hope for this would be that greater knowledge of human activity provokes sustainability and longevity for the species. Together with geospatial artificial intelligence (GeoAI), technologies that enable people to literally and remotely see what someone else is doing—like a wearable camera that allows others to experience a person's point of view in real time—will be increasingly used to control, provide convenience, and give care.

Applications of mapping technology that seek to control people are the most controversial. They yield information for law enforcement (even preemptive policing), surveillance, and investigative purposes. Presently, there are niche companies that harvest billions of open-source images to provide vehicle detection. And this same technology can already be used for biometric matching.

Map-based technology that provides convenience is proliferating, particularly with the Internet of Things. These kinds of apps allow people to connect with one another and their assets through location-based services and real-time data sharing. Thanks to today's innovative distribution and order fulfillment processes, for example, people can closely monitor the routes that their products and services take—down to the minute and the Global Positioning System (GPS) point.

Apps geared toward care, such as AI-based safety maps, will likely be able to determine the condition of people just by the way they walk or via the emotions detected on their faces. People living with dementia, for instance, may be monitored so that caregivers receive alerts when their patient's well-being or personal security is at risk.

Taken together, all this will give rise to "überveillance," an above-and-beyond type of surveillance that relies on technology that is not merely always on—it's actually embedded in humans. The implications of this potential future of mapping deserve careful consideration and warrant guidance.

A Geoethical Framework

In June 2022, the American Association of Geographers (AAG); the Center for Spatial Studies at the University of California, Santa Barbara; and Esri convened the Summit on Locational Information and the Public Interest to examine the issues that arise when shifting to human-centered location data. This resulted in the publishing of a report that builds a framework for how geographers, GIScientists, social scientists, computer scientists, legal professionals, labor experts and activists, lawmakers, and members of the public can collaborate to deal with the challenges that come with the evolution of mapping. Suggestions include the following:

- Develop a research agenda that embraces key ethical issues, such as data ownership and use; privacy and anonymity; trust and risk perception; multicultural and multivalent analysis; data sharing and infrastructure; and codesigning for inclusivity.
- Produce educational materials and training goals for those studying the ethics of location information.
- Create a path to move from discussing ethical principles to forming globally applicable and enforceable regulations.
- Increase dialogue with nontraditional and indirect GIS stakeholders and expand collaboration among members of the academic, public, and private sectors regarding the use of location information throughout the life cycle of technologies—especially as it relates to privacy and other values-based dimensions.

Geographers and geospatial practitioners were once preoccupied with points, lines, and polygons. While these fundamental layers will always be relevant to geographic information systems, the ability to map more—from the floor spaces of homes to the internal dimensions of the human heart—in more advanced ways, calls for integrity. The maps of the future should be reflections not only of the greatest scope of technology but also of the most consistent and serious respect for human (and beyond-human) life, dignity, and privacy.

Download the report on locational information and the public interest at links.esri.com/aag-report.

From the Meridian is a regular column from AAG. Find out more at aag.org.

About the Author

Dr. Katina Michael is a professor at Arizona State University (ASU) and a senior global futures scientist in the Julie Ann Wrigley Global Futures Laboratory.
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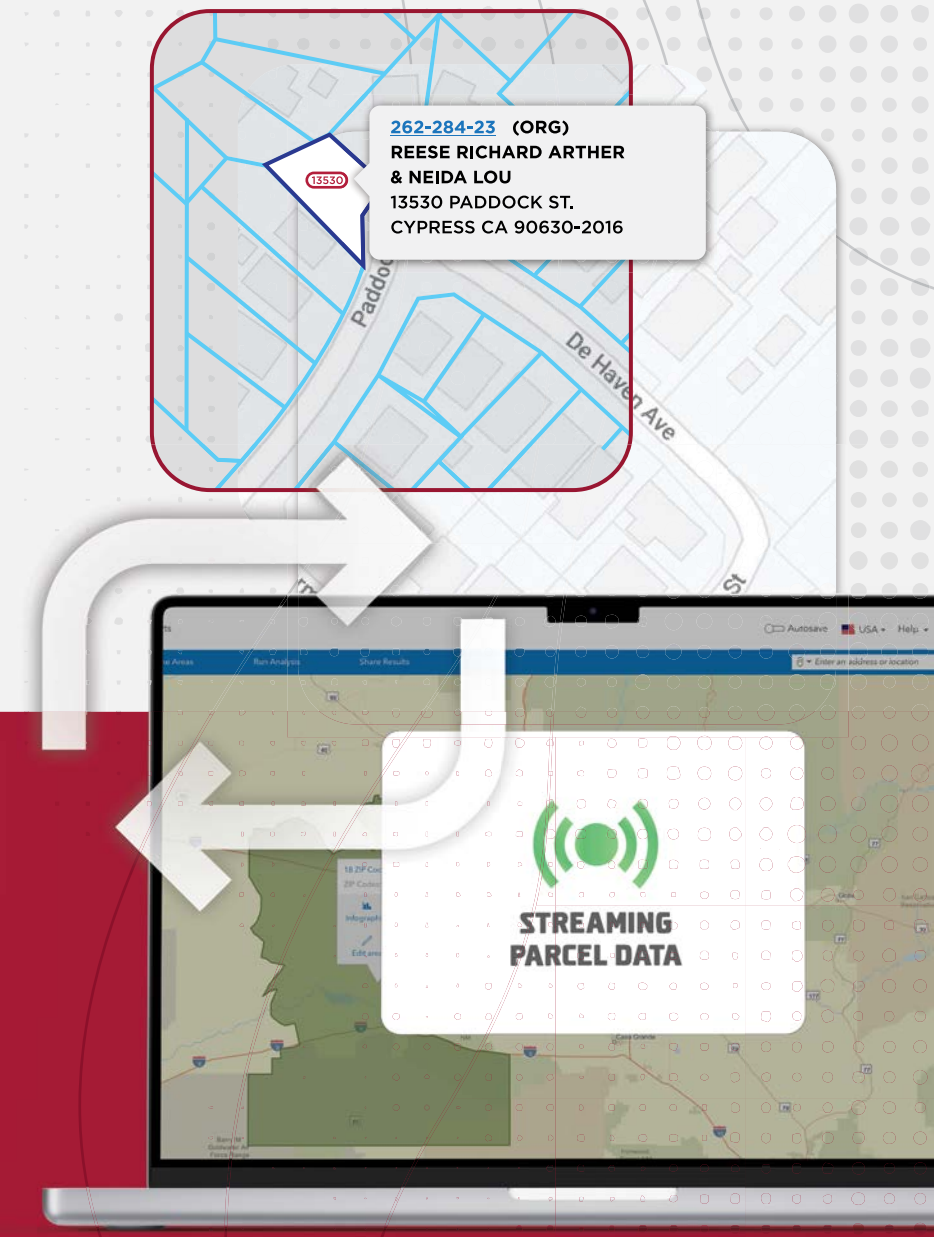

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THE IMPORTANCE OF A GOOD ELEVATOR PITCH

By Tripp Corbin, SAM, LLC

The adage is true: you never get a second chance to make a first impression.

When people ask GIS practitioners what they do, many respond with, "I'm a GIS professional," or "I'm a GIS technician," or "I'm a GIS analyst." Then the inevitable question follows: What is GIS? Often, GIS practitioners stammer "um" and "ah" a few times before saying something like, "I make maps" or "GIS is like Google Maps on steroids."

What kind of first impression does this make? These answers don't give people a true idea of what GIS practitioners do or why GIS is important, and they marginalize what GIS practitioners can accomplish. This is why it's important to have a good elevator pitch.

The Essence of an Elevator Pitch

Elevator pitches are short, one- to three-minute speeches that people use to describe what they do and why it's important to the person or group they're talking to. The idea is that two people are riding in an elevator together, and one person only has the time between when they get on and the other person gets off to get their point across.

An elevator pitch has three main goals. First, speakers need to establish their credibility. Second, they need to make the other person curious. Third, they need to ensure that the other person will want to talk to them again. Depending on who is on the receiving end of the speech, there can be additional, more minor goals. If the other person is a potential client, for example, speakers might want to highlight their capabilities or experience. But be careful not to overload an elevator pitch with too much detail. Remember, it needs to be short!

So how can you accomplish the three main goals of a good elevator pitch? Here are some ideas.

How to Establish Credibility

People normally establish credibility by introducing themselves. In an elevator pitch, state your name, job title, and the organization you work for. Don't assume that other people know who you are, even if they work at the same company or agency as you.

Next, name some clients you've worked for. This is especially useful if the people you're talking to have knowledge of or connections to someone you mention. That association can provide them with a frame of reference for your work. It allows them to relate to what you're saying and, later, check up on what you tell them. This can also start you down the path to your second goal—generating curiosity.

For someone I don't know, my elevator pitch would sound something like this: "Hello, I'm Tripp Corbin, a business development manager for Surveying And Mapping, LLC, also known as SAM. We've provided GIS services to clients very similar to your organization, like Newton County Water and Sewerage Authority, Burlington Municipal Waterworks, and the Kansas City Board of Public Utilities."

If I were talking to someone who's part of my organization, I'd say something more along the lines of this: "Hello, my name is Tripp Corbin, and I'm the GIS coordinator for the city. I oversee the city's enterprise GIS, which supports several departments, including the planning, emergency management, and public works departments. My team does field data collection, spatial data analysis, mapmaking, and web app development for those departments."

As you can see from these examples, I identify who I am and what I do, no matter whom I'm speaking to.

How to Make People Curious

The next step is to make the people you're talking to curious. Hopefully, you've already piqued your audience's interest by talking about some of your past clients. If so, people often follow that up with questions such as, What did you do for them? or What problem did you solve? If you don't get asked these questions, however, don't fret. Just ask people what issues they're having or what might interest them. Generally, people like to be engaged. It makes them feel like they're part of the conversation and aren't in the middle of a sales pitch. You can then use what they tell you to explain how you could help solve their problem.

As you do this, be sure to include the possible results or benefits people can attain by working with you. It doesn't have to be specific, like, "We could save you $1,000 or 200 hours." In an elevator pitch, it can be more general.

For example, you might say something such as, "For one of our clients, we performed an underground utility inventory that was integrated with their work order and Call Before You Dig systems. This helped reduce the number of lines that got cut, plus those repair costs. I understand that you've been having problems with your distribution lines getting cut. I'm sure we could achieve similar results for you."

That last part is the hook that will make people want to talk to you again—the third goal of an elevator pitch. You're showing them that you know how to solve a problem that's similar to one they're experiencing.

How to Get People to Talk to You Again

Of course, to talk with people again, you'll need to get their contact information. Thus, your final task is to ask people what the best way is to get in touch with them so that you can set up a meeting. Ensure that you get their name, title, and an email address or phone number. Once you have people's contact information, tell them when they can expect to hear from you. This is extremely important. Not only does it display professionalism and a commitment to follow through, but it also sets the stage for building trust.

The people you speak to may request your contact information, too. By all means, give it to them. But try not to let them do this in lieu of you obtaining their contact information. While they may have the best of intentions to get back to you, people often get sidetracked. You want to get their contact information so that you can keep yourself on their to-do list.

A Sample Elevator Pitch

Putting all this together, a good elevator pitch might sound something like this:

"Hello, I'm Tripp Corbin, business development manager for Surveying And Mapping, LLC—also known as SAM. We provide GIS, aerial, and surveying services. SAM recently helped Newton County Water and Sewerage Authority when its distribution lines were being cut. We inventoried the utility's assets, loaded the data into its GIS databases, and integrated all that with Newton's Call Before You Dig systems. This reduced the total number of accidental line cuts by 30 percent and decreased repair costs. I understand that you're having a similar issue with all the construction going on in your area. I'm sure we could help you solve your problem as well. I'd enjoy talking with you about this in more detail. What's the best way to reach you to schedule a time to chat? Can I get your email address or phone number? Thank you! I'll get in touch with you next week to set up a meeting. I look forward to talking with you again soon."

Remember, you'll need more than one elevator pitch to use with different audiences. So take the time to develop a few, and then practice them!

To learn more about how to create a good elevator pitch, consider attending the Urban and Regional Information Systems Association's (URISA) GIS Leadership Academy, which is put on a couple of times a year. More details can be found at urisa.org.

About the Author

Tripp Corbin, GISP, is the aerial and GIS business development manager at Esri partner SAM, LLC. He has more than 25 years of experience in GIS and is a past president of URISA.

Managing GIS

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

URISA Fostering Excellence in GIS www.URISA.org

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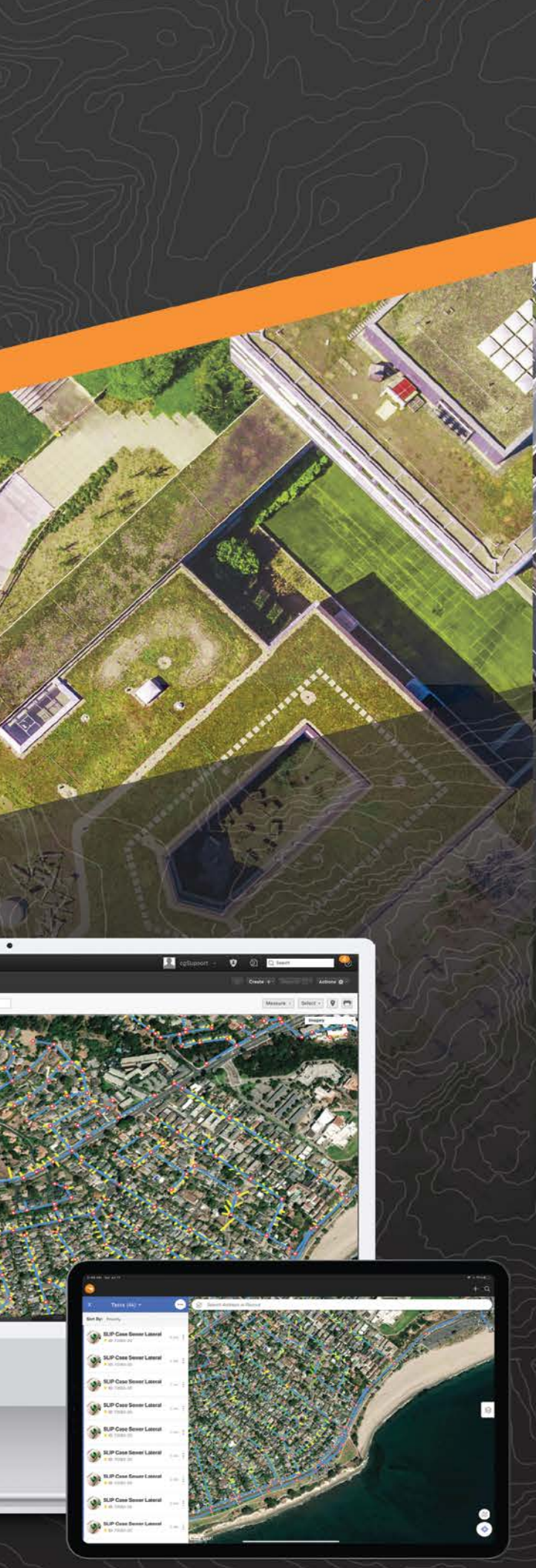

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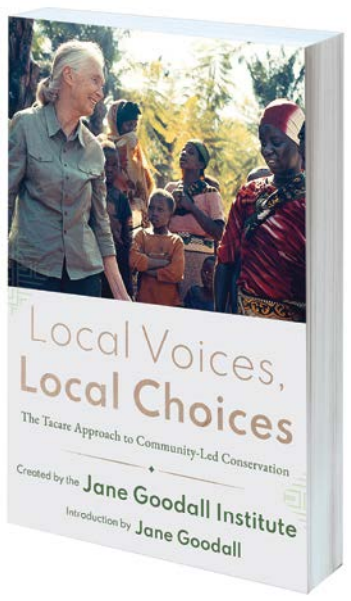
Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation

By The Jane Goodall Institute; Introduction by Jane Goodall

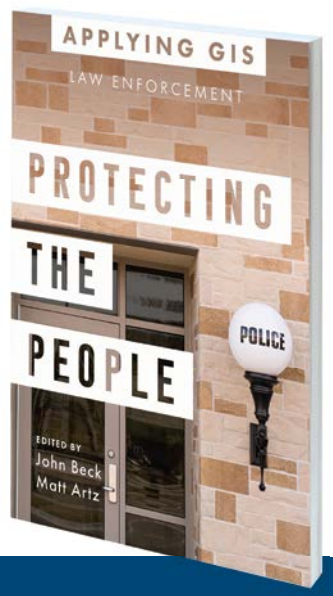
Just as Jane Goodall's work with chimpanzees has been transformative, so have her efforts to empower communities living on the edge of human settlement to protect their natural resources or risk losing them forever. *Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation* details the Jane Goodall Institute's holistic method for conservation, which puts local communities in charge of preserving the natural world around them. Working with science and technology and with support from conservationists, local residents learn to balance their needs with the surrounding ecosystems. Written for conservationists, fans of Goodall, and anyone interested in environmental issues, *Local Voices, Local Choices* is a vibrant expression of Goodall's hope that the Tacare approach will be widely adopted. August 2022, 280 pp. Ebook ISBN: 9781589486478 and hardback ISBN: 9781589486461.



Protecting the People: GIS for Law Enforcement

Edited by John Beck and Matt Artz

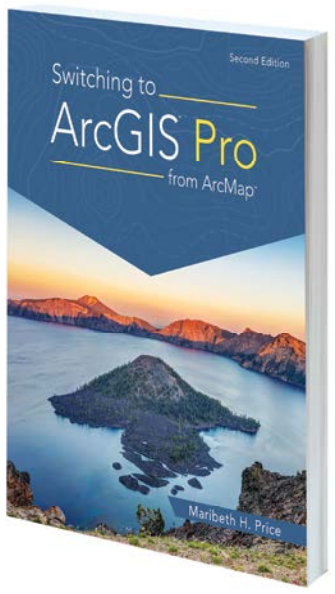
Protecting the People: GIS for Law Enforcement is a collection of real-life stories about how law enforcement agencies have used GIS to improve crime analysis, streamline operations, practice open policing, and enhance field mobility. Through these accounts, the book illustrates how police departments and law enforcement organizations employ GIS to drive decision-making in everyday operations. August/November 2022, 114 pp. Ebook ISBN: 9781589487307 and paperback ISBN: 9781589487291.



Switching to ArcGIS Pro from ArcMap, Second Edition

By Maribeth H. Price

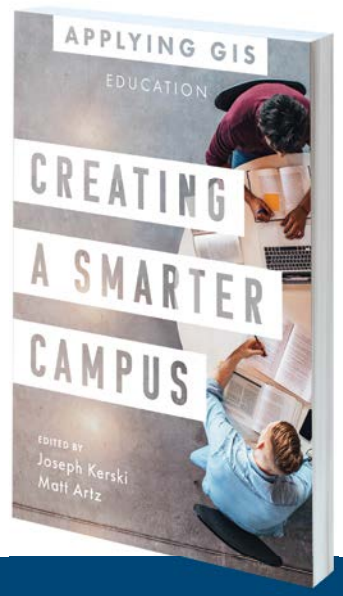
Switching to ArcGIS Pro from ArcMap, Second Edition, is the concise yet comprehensive source for getting existing ArcMap users up and running with ArcGIS Pro. Updated and tested for ArcGIS Pro 2.9, the book introduces readers to the ribbons, panes, and project-based structure of ArcGIS Pro. In 10 chapters, readers cover the most common and important workflows required to learn the ArcGIS Pro user interface while concentrating on one project for Crater Lake, Oregon. Author Maribeth H. Price's more than 20 years of experience writing GIS textbooks shines through as she takes the frustration out of switching to a new desktop GIS software. July/August 2022, 168 pp. Ebook ISBN: 9781589487321 and paperback ISBN: 9781589487314.



Creating a Smarter Campus: GIS for Education

Edited by Joseph Kerski and Matt Artz

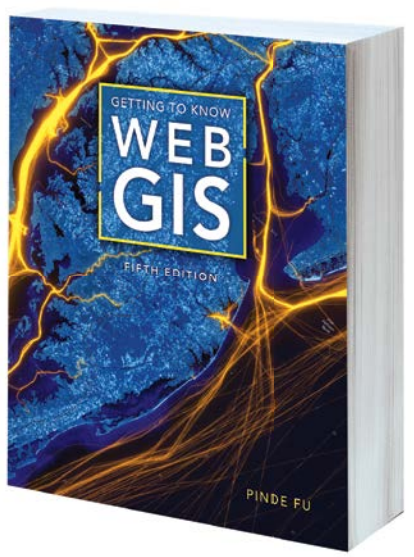
GIS has a wide range of uses in the educational sphere. It provides educators with novel ways to teach problem-solving to tech-savvy learners. Researchers can employ GIS for data visualization and integration. IT professionals can use it to improve their cloud-based platform offerings. And administrators can wield the technology to visualize and manage everything from campus facilities to expansion opportunities. *Creating a Smarter Campus: GIS for Education* shows how educational institutions are actively integrating spatial reasoning and GIS technology into teaching, research, and management. August/December 2022, 170 pp. Ebook ISBN: 9781589487383 and paperback ISBN: 9781589487376.



Getting to Know Web GIS, Fifth Edition

By Pinde Fu

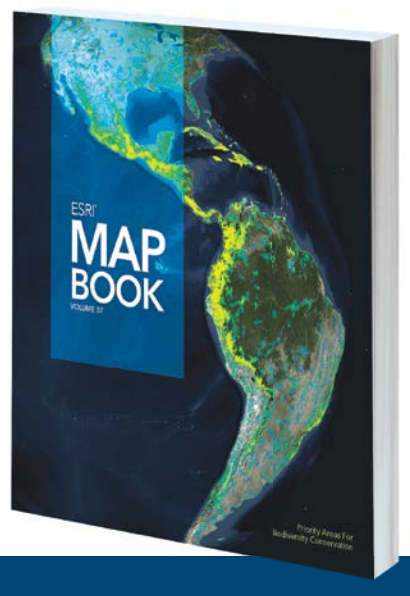
As the capabilities of Web GIS continue to expand, *Getting to Know Web GIS*, Fifth Edition, keeps readers up-to-date on the scientific concepts and big-picture ideas behind cloud computing, along with the real-world applications of and tutorials for using the most current ArcGIS software and apps in the cloud. This edition covers the latest releases of ArcGIS Online, ArcGIS Pro, ArcGIS StoryMaps, and ArcGIS mobile apps. It gives readers hands-on experience with ArcGIS Experience Builder, ArcGIS Field Maps, ArcGIS Instant Apps, ArcGIS Image for ArcGIS Online, ArcGIS Velocity, and ArcGIS Mission. Author Pinde Fu also goes over the latest advancements in artificial intelligence (AI), virtual reality (VR), and spatial data science tools. This edition enables readers to work with 3D web scenes, analyze data using deep learning packages, program a triggered notification using a visual interface, and more. July 2022, 500 pp. Ebook ISBN: 9781589487284.



Esri Map Book, Volume 37

By Esri

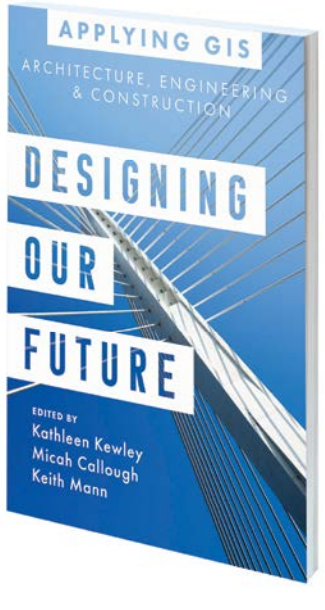
Every year, Esri selects works from mapmakers around the world for the *Esri Map Book* to demonstrate how GIS helps governments, businesses, and residents solve problems and better understand the world. Volume 37 continues this tradition, showcasing maps and apps that use ArcGIS technology to evaluate the sustainability of resources, determine efficient transportation routes, mitigate the effects of natural disasters, and much more. Each map or app includes a description of its purpose and how it was produced. August 2022, 196 pp. Paperback ISBN: 9781589487109.



Designing Our Future: GIS for Architecture, Engineering, and Construction

Edited by Kathleen Kewley, Micah Callough, and Keith Mann

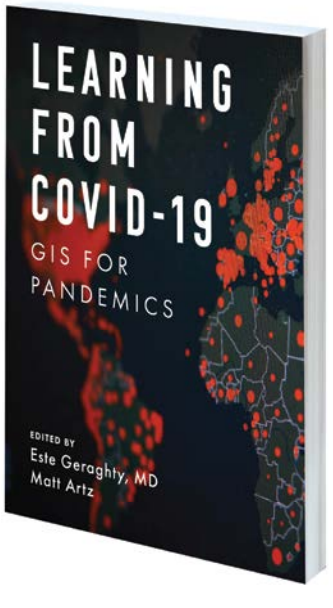
Location intelligence is changing how land development and large infrastructure projects take shape. Whether building a new residential complex or planning a high-speed rail system, taking a geographic approach generates better, more sustainable designs. *Designing Our Future: GIS for Architecture, Engineering, and Construction* shows how architects, engineers, and construction professionals implement GIS to improve workflows; bring context to large projects; and increase collaboration among governments, contractors, partners, and the public. July/October 2022, 120 pp. Ebook ISBN: 9781589487246 and paperback ISBN: 9781589487239.



Learning from COVID-19: GIS for Pandemics

Edited by Este Geraghty and Matt Artz

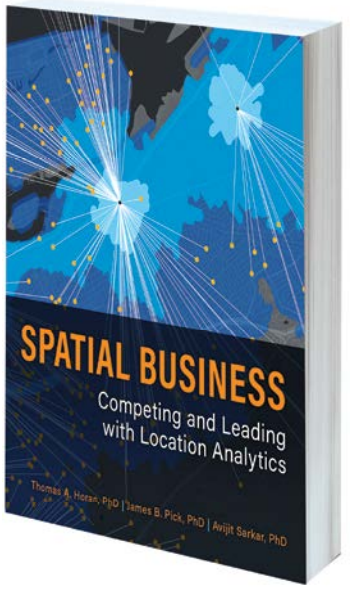
With the health community examining the worldwide response to the COVID-19 pandemic, it is time to think about how to raise the bar for responding to the next public health emergency. Now is the time to revisit health preparedness strategies and plans, review what worked to see how that can be done again, and put lessons learned into practice. *Learning from COVID-19: GIS for Pandemics* gives true examples of how spatial thinking became invaluable for both local and full-scale outbreaks of COVID-19. Answering the question of "where" was paramount, and when civic leaders and public health agencies used GIS to do real-time disease surveillance, it transformed overwhelming amounts of data into valuable location intelligence. June/August 2022, 204 pp. Ebook ISBN: 9781589487123 and paperback ISBN: 9781589487116.



Spatial Business: Competing and Leading with Location Analytics

By Thomas A. Horan, James B. Pick, and Avijit Sarkar

In today's global economy, business leaders need to know where to source materials, where to operate, and where to grow their customer bases. *Spatial Business: Competing and Leading with Location Analytics* shows how real organizations have designed, deployed, and managed GIS solutions to improve decision-making and add value in both strategic and operational ways. Written by experts in spatial business, the book provides managers, professionals, and students with a road map for realizing the potential of geospatial data across the entire business value chain. August/December 2022, 300 pp. Ebook ISBN: 9781589485341 and paperback ISBN: 9781589485334.



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

Training

Take an Instructor-Led Course

Taught by experienced instructors with subject matter expertise, the following new courses from Esri support professionals who want to apply the latest ArcGIS capabilities for indoor mapping and imagery analysis:

- **Introduction to ArcGIS Indoors:** Learn how to create and maintain a complete system for indoor mapping and data management. Get hands-on practice with workflows used to support indoor navigation via web maps and apps, and work with indoor data to streamline work space planning and facilities management. Learn more and register at go.esri.com/arcgis-indoors-class.
- **Image Analysis for Defense and Intelligence:** This course teaches geospatial intelligence and imagery professionals how to accurately visualize and analyze a variety of imagery data in the context of realistic scenarios. Gain experience with ArcGIS Pro imagery tools, and discover techniques to create information that supports mission planning and tactical operations. Learn more and register at go.esri.com/imagery-defense-course. A version of this course is also available for GIS professionals and imagery analysts in the private sector and civilian government agencies. View details for this class at go.esri.com/imagery-class.

For organizations that want to simplify their teams' access to these courses and other training options, they can take advantage of the Esri Training Pass. It allows administrators to purchase training days in advance and redeem them as needed for classes and other training opportunities. Find out more about the Training Pass at go.esri.com/esri-training-pass.

New at Esri Academy: Knowledge Assessments

There is now an easier way for people to test their knowledge in Esri Academy. The My Assessments page provides learners with direct access to all the assessments they can take, along with results from any previous assessments they've completed.

There are three types of assessments. "Are you ready" assessments allow users to measure their knowledge of ArcGIS against the prerequisites for specific instructor-led courses. If it turns out that a learner could benefit from reviewing some concepts prior to taking the class, the assessment recommends additional resources. Anyone can take (and retake) "Are you ready" assessments and use the targeted resource recommendations to improve their skills.

When learners are registered for an instructor-led class, they will see two additional assessment options: preclass and postclass. These are based on the course's learning objectives and are useful for measuring the specific outcomes gained from taking classes. People who take these assessments always have access to their preclass and postclass assessment results via the My Assessments page.

To find out more about these assessments and get started with them, visit go.esri.com/my-assessments and sign in using your ArcGIS account.

Add a MOOC to Your 2023 Training Calendar

So far this year, 98 percent of individuals who have completed a massive open online course (MOOC) through Esri said they would take another one. Participants find the relaxed environment a fun way to build their GIS technology skills. To experience this, check out one of the following courses:

- **Going Places with Spatial Analysis, February 1–March 15:** Appropriate for GIS novices and experienced practitioners alike, this MOOC reveals how performing spatial data analysis leads to deeper understanding. Over six weeks, participants explore the fundamentals of spatial analysis and use tools in ArcGIS Online to complete increasingly complex analyses. Find out more and register at go.esri.com/going-places-mooc.
- **Cartography., February 22–April 5:** This popular course is great for anyone who enjoys making maps. Experts share their knowledge of ArcGIS map design tools while discussing cartographic techniques and tips to help participants maximize the impact of their maps. The lively video conversations are entertaining, while the exercises allow attendees to hone their mapmaking skills. Sign up at go.esri.com/carto-course.

Certification

The Esri Technical Certification Program supports professionals and students who want to validate their experience with ArcGIS Pro, ArcGIS Enterprise, ArcGIS Online, and other ArcGIS technologies. Available exams now include the following:

- **ArcGIS Pro Associate:** This exam is for people who have two or more years of experience using ArcGIS Pro. It measures the skills and knowledge needed to accurately manage, map, analyze, manipulate, and share geospatial data. Find out more at go.esri.com/arcgis-pro-associate.
- **ArcGIS Utility Network:** This specialty exam is for those who have industry-specific asset management experience and work with ArcGIS in a multiuser environment. People who take it should have a strong understanding of services-based architecture, the ArcGIS Utility Network information model, and network management workflows. Get additional exam details at go.esri.com/utility-network-certification.

If certification is something you're interested in, explore the latest Esri technical certification exams at esri.com/training/certification. To find out what it takes to prepare for an exam, watch *Preparing for an Esri Technical Certification* at go.esri.com/cert-prep-video. Additionally, view certification success stories at go.esri.com/certification-success and join the Esri Technical Certification groups on LinkedIn and Esri Community.

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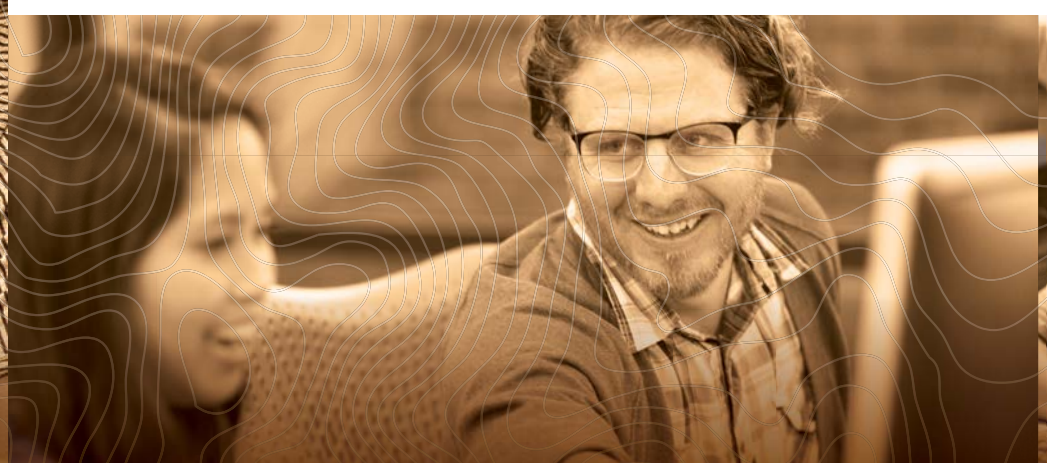

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