ArcNews

Briefly Noted

New Broadband Solution Aims to Close Digital Divide
The Federal Communications Commission (FCC) estimates that 35 percent of Americans lack access to reliable internet service, which can impact their job and educational opportunities and health-care options. To help state and local governments better understand broadband coverage in their communities, Esri released a new ArcGIS Solutions collection called Broadband Outreach. It delivers a set of capabilities that enable government staff to inventory broadband resources and take action to close this digital divide. Find out more at go.esri.com/new-broadband-solutions.

Most Current ACS Data Is Ready to Use
The latest American Community Survey (ACS) data from the US Census Bureau is available in ArcGIS Living Atlas of the World. It contains five-year estimates for 2016–2020 on income, housing, internet access, education, disability, and health insurance. Federal agencies, local governments, businesses, and nonprofits typically use the data for planning and resource allocation. It can be accessed from ArcGIS Pro and ArcGIS Online and incorporated into Esri's configurable mobile apps and dashboards.

Esri Releases Updated Global Land-Cover Map
In partnership with Impact Observatory and Microsoft, Esri released a globally consistent 2017–2021 global land-use and land-cover map of the world based on the most up-to-date 10-meter Sentinel-2 satellite data. This digital rendering of Earth's surfaces illustrates five years of change across the planet and offers detailed information about how land is being used. The map can be accessed through ArcGIS Living Atlas.

Extending Renewable Energy Resources While Protecting Wildlife

By Eric Aldrich, The Nature Conservancy

Tackling the immense challenge of climate change will require enormous investments in renewable energy sources, such as wind and solar power. But building out utility-scale wind parks and solar farms requires land—and a lot of it. A recent study from Princeton University estimated that for the United States to reach net-zero greenhouse gas emissions by 2050, it will require 228,000 square miles of land. That's an area larger than the states of Colorado and New Mexico combined!

So where can all these wind and solar facilities go? And how can they be installed without harming wildlife habitats and other treasured places?

Geospatial science and Esri technology provide a good place to start. The Nature Conservancy (TNC) has created a mapping tool with ArcGIS Pro called Site Renewables Right. The online resource, available at nature.org/siterenewablesright, is designed to help companies and communities identify the
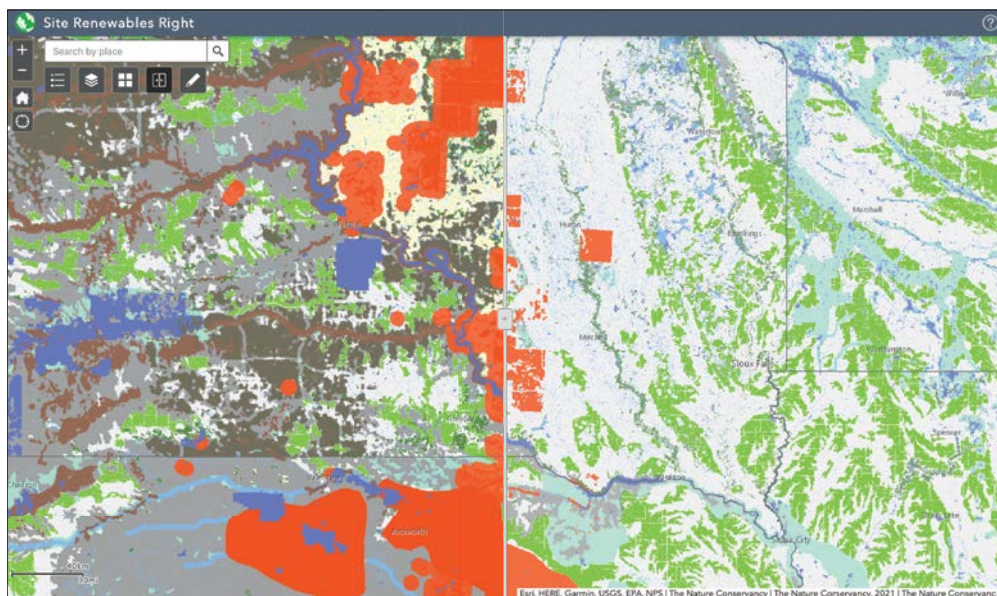
↑ Viewers can see, on the right, where utility-scale wind parks could go without significantly impacting wildlife and, on the left, how those sites avoid key wildlife habitats, such as whooping crane stopover sites (in orange) and protected and managed lands (in purple).

Developers Make GIS—and DevSummit—Come to Life

↑ Developers were excited to participate in the 2022 Esri Developer Summit (DevSummit).

"It's nice to be back, isn't it?" Esri president Jack Dangermond asked the audience when he opened the 2022 Esri Developer Summit (DevSummit), held in Palm Springs, California, for the first time in two years.

"There is a lot of energy in this room," echoed Esri product manager for developer technology David Cardella, who served as emcee for most of the Plenary Session.

More than 1,000 attendees from dozens of countries took part in the 17th DevSummit, gathering March 8–11, 2022, at the Palm Springs Convention Center. Extra health and safety precautions were put in place due to the ongoing COVID-19 pandemic, and the event offered several virtual components.

But it was evident from the outset that the most thrilling part of DevSummit was having developers and Esri staff members together again in the same room.

"This is a time where you can get together and meet each other and inspire each other," said Dangermond, minutes before Cardella expressed Esri's appreciation for the developer community.

"You engage us. You provide us with feedback so we can improve our products. You push our technologies to the limit. And you challenge us to do more and to do better," Cardella said. "We've got hundreds of Esri staff from the development teams and the product teams who are eager to interact with all of you."

Discover the Tacare Approach to Holistic Conservation

Dr. Jane Goodall is renowned, of course, for her work studying and protecting chimpanzees. But she has also spent decades empowering communities that live on the edge of human settlement to safeguard their natural resources—or risk losing them forever.

Local Voices, Local Choices: The Tacare Approach to Community-Led Conservation, a forthcoming book from Esri Press by the
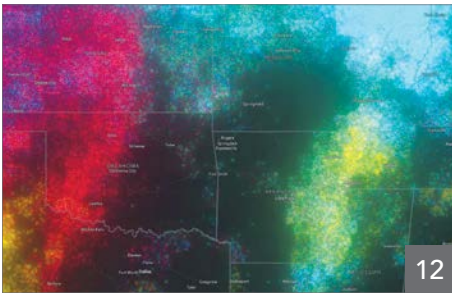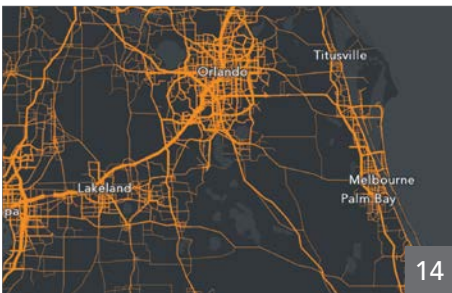
ArcNews

Have you ever wanted one easy place to document your adventures with beautiful photos, compelling videos, and intriguing maps? That's what StoryMaps offers! Esri's first direct-to-consumer product is a powerful, personal storytelling tool that lets everyone capture and share their life's experiences. And right now, it's available to try for free.

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How to Create a GIS Strategic Plan

By Robert Hawks, City of Cayce, South Carolina

Robert Hawks

In 2017, I was hired at the City of Cayce, South Carolina, to provide professional GIS support to the utilities department. At the time, Cayce—which has a population of about 14,000 people—had very little in the way of mature geotechnical capabilities. From virtually my first day on the job, I made it my mission to build a fundamental GIS architecture not just for utilities but also for the entire city. Along the way, I found that strategic planning was critical.

For some context: When I embarked on this journey, strategic planning as a management methodology was not something I had ever really focused on. I understood that I needed to do some manner of planning, but my methods were ad hoc. It wasn't until I started putting together regular, year-end reports that I discovered how important it was to create a strategic plan.

About two years after I started working at Cayce, I realized that to advance our geospatial capabilities, I would need to justify additional expenditures and investments in GIS resources. My initial approach to this was to create a series of annual return on investment (ROI) reports. At the end of each year, I would present to management what I had accomplished, how much value and cost savings my activities had generated, and how much the city had paid for all this. To be prudent, I made limited requests for additional resources. I found, however, that my managers often didn't understand why I needed the items I was requesting, nor did they comprehend how it would benefit them going forward.

To better explain all this to the city's leadership, I developed a reporting system that I began presenting to my managers each year. It is composed of the following three elements:

- **GIS presentations:** By putting together periodic presentations to showcase the city's GIS work, I have been able to educate stakeholders on the benefits that these activities are providing to Cayce. This also allows me to inform people about new technology and advances in GIS.
- **An ROI analysis:** The ROI analysis that I put together at the end of every year gives my direct managers quantitative evidence of what they've gained from GIS versus what it has cost. This not only justifies the city's geospatial activities, but it also provides rationale for additional funding and resources.
- **A strategic plan:** By conducting an annual review of Cayce's GIS strategic plan with my managers, I can show them how their investments in geospatial technology will be spent. This also gives them the opportunity to weigh in on the process.

GIS Five-Year Strategic Plan as of 2021

This is a brief summary of items that will be approached during each of the indicated fiscal years. Details are not provided on this summary but are available in the write-up of this strategic plan.

FY2022
- Completing Comprehensive Inventory of GIS Features (**Inventory**)
- Completion of Backflow Devices Collection Project (**Inventory**)
- Completion of Water Service Meters Collection Project (**Inventory**)
- Rollout of As-Built Web Map (**Development**)
- Train Field Crew and Locators in GIS Collections (**Infrastructure**)

FY2023
- ArcGIS Online Backflow Testing Program (**Development**)
- Complete ArcGIS StoryMaps Story for Arts District (**Development**)
- Complete Move to ArcGIS Pro Environment (**Infrastructure**)
- Complete Scanning of All Remaining Record Drawings (**Inventory**)
- Convert All GIS Features to Living Features in ArcGIS Online (**Inventory**)
- Easement Documents Digitization Project (**Inventory**)
- Establish a GIS Department/Promotion (**Infrastructure**)

FY2024
- Complete Elder Valve Collections (**Inventory**)
- Complete Public Safety CAD NG911 Compliance Project (**Development**)
- Establish a Cayce ArcGIS Hub Website (**Development**)
- Hire/Promote Additional GIS Personnel (**Infrastructure**)
- Rebuild All Water Billing Routing and Cycles (**Analysis**)
- Tying Edmunds and ArcGIS Online Together (**Infrastructure**)

FY2025
- Assess and Commence Citywide Spatial Analysis Projects (**Analysis**)
- Assess GIS Enterprise Environment (**Infrastructure**)
- Complete Wrap-Up of All Utilities GIS Inventory (**Inventory**)
- Work on replacing Motorola PremierOne CAD System (**Infrastructure**)

FY2026
- Begin GIS-based Emergency Management Integration (**Analysis**)
- Begin Move to ArcGIS Enterprise (**Infrastructure**)
- Ensure Full Integration between AMA/AMI System and ArcGIS Online (**Infrastructure**)
- Ensure Full Integration between Edmunds and ArcGIS Online (**Infrastructure**)

Notes:
Inventory: This means a project to bring more assets into our GIS architecture. This is the *least* sophisticated type of project.
Infrastructure: This is a project to increase our overall GIS architecture and capability.
Development: This is a product that is meant to be provided for our city or staff to use.
Analysis: This is a project to use the GIS data we have in an exploratory manner to enhance our overall operations. This is the *most* sophisticated type of project.

↑ The GIS strategic plan for the City of Cayce, South Carolina, is a bulleted list that describes GIS-based goals for the next five years.

Taken together, these three elements have been incredibly effective at the City of Cayce. In five years, we have gone from having one to two GIS users at the city and paying just a few hundred dollars annually for geospatial technology to having dozens of users across the organization and spending more than $100,000 per year on GIS-related activities.

Strategic planning was the last element I incorporated into this system. It has proven critical. Using our strategic plan, I have been able to construct a project-to-project workflow over the past few years. Each time we complete one of our planned projects, it gets added to the annual reports we prepare and becomes an immediately recognizable example of how GIS enhances operations at the city.

Our strategic plans are remarkably simple. I wonder if this is something that many people don't realize—that a strategic plan doesn't have to be an extensive, flashy product that takes a lot of time and effort to develop. Cayce's GIS strategic plan boils down to a single page of bulleted text that describes what we would like to do. The plan is easy to read, comprehend, and update.

When I created our first strategic plan, I simply brainstormed a list of endeavors I wanted the city to pursue—some in the immediate term, some in the near future, and others further down the road. I then refined these ideas, concepts, and projects into a list of bullet points organized by priority. From there, I thought about the level of effort and resources each undertaking would require and sorted the items into what I felt could be accomplished over the course of a single year. After creating a series of lists going out five years, the leftover endeavors fell to the bottom of the page as wish list projects. I then wrote up detailed descriptions of each bullet point. The resultant documents became the city's first GIS strategic plan.

For Cayce's purposes, I have tended to focus near-term goals on less sophisticated and more fundamental projects, such as building out the city's GIS infrastructure and managing geospatial inventory. I leave more advanced and exploratory projects—such as conducting major spatial analyses, expanding into new departments and fields, and advancing geospatial technology—for the longer term.

Something else that has been very useful is recognizing that iteration is important. I review and update our GIS strategic plan every year. I don't regard any project as set in stone. While the plan is a good guidepost for me to understand how to develop and enhance Cayce's GIS capabilities, I also want it to be flexible enough to take into account software and technological changes, system discoveries, and new developments within the city.

Taking the time to produce a GIS strategic plan provides great benefits to any organization. At Cayce, our strategic plan has become an effective road map for advancing the city's geospatial architecture, technology, and undertakings. While we change and update it frequently, it still provides useful guidance. This plan has instilled confidence in my managers that I am moving in the right direction. When combined with giving periodic presentations about the work we do and the ROI analyses we put together at the end of each year, our strategic plan has become a very effective way to gain support for GIS at the city and garner recognition for what we do with the technology.

I would go so far as to say that putting together a GIS strategic plan is necessary for all mature enterprises. This ensures that the GIS they use can not only meet the challenges within their own organizations, but that it can also stand up to the demands that often crop up in this rapidly changing, technological field.

About the Author

Robert Hawks is the GIS manager for the City of Cayce, South Carolina. He has a master's degree in geographic information science from Kent State University and a bachelor's degree in human geography from the University of South Carolina.

Esri's Field Maps App Is Helping Meet the Needs of the Modern Mobile Workforce

For any organization that conducts field operations—whether the business is centered on field workflows or this happens as part of a larger enterprise—there are two fundamental requirements. Team members need to be able to leverage data and insights in a timely manner, and those carrying out field operations must have access to the tools and information they need to perform their jobs.

ArcGIS Field Maps does both. And since its release a little more than 18 months ago, the all-in-one app has gained key capabilities to better meet the needs of field teams. Organizations can use it to plan operations and coordinate their workforces, provide situational awareness to mobile teams, collect and edit business data, ensure people's safety and meet regulations through location sharing, and synchronize office and field operations in near real time.

Recent updates to Field Maps boost organizational efficiency, empower mobile workers with new field capabilities, and support further integration with wider business systems and technologies.

Field Workflows Get More Efficient

While mobile operations range in scale—from conducting a single ecological survey to doing asset inspections across whole cities, states, and even nations—they all have one demand in common: efficiency. Building efficiency into mobile operations doesn't stop once workflows are digitized, either.

In Field Maps, being able to capture and edit data in the field accounts for a large proportion of user workflows. That's why recent updates have focused on improving how users build forms. Now, it's possible to group related fields together and display fields conditionally, based on user inputs, so that mobile workers only see the fields and data required to do the work at hand.

Field Maps also incorporates calculated expressions, which enable mobile workers to automatically calculate and populate data in a form. Not only does this allow for rapid data capture, but it also minimizes data entry errors. Data is always valid, as these calculations are run every time a feature is created or edited. This reduces the time needed to do quality assurance on the data back at the office. Moreover, the data can be made operational within the larger organization in near real time.

Field Maps gives organizations the ability to deploy quickly as well, getting mobile workers what they need to get the job done. Organizations that use a mobile device management (MDM) system can automate a variety of user settings on managed devices, including how often mobile workers' locations are synced with the app. The March 2022 release of Field Maps also made it possible to provide predetermined settings for high-accuracy workflows, so mobile teams no longer have to spend time configuring complex settings before using Global Navigation Satellite System (GNSS) devices.

Simple, Intuitive Design Empowers Mobile Workers

Members of a mobile workforce are often experts in their industries but not in GIS. For this reason, Field Maps has been designed to be intuitive and simple to use. And as mobile operations evolve, so do the capabilities of Field Maps—especially in the areas of location sharing, mapping utility networks, and indoor use.

Location Sharing

Keeping workers safe, following regulations, and synchronizing field-based and office work are primary reasons that organizations require mobile employees and contractors to share their locations. This capability is an integral part of Field Maps, and it works whether users are in a connected environment or in remote areas where coverage isn't readily available.
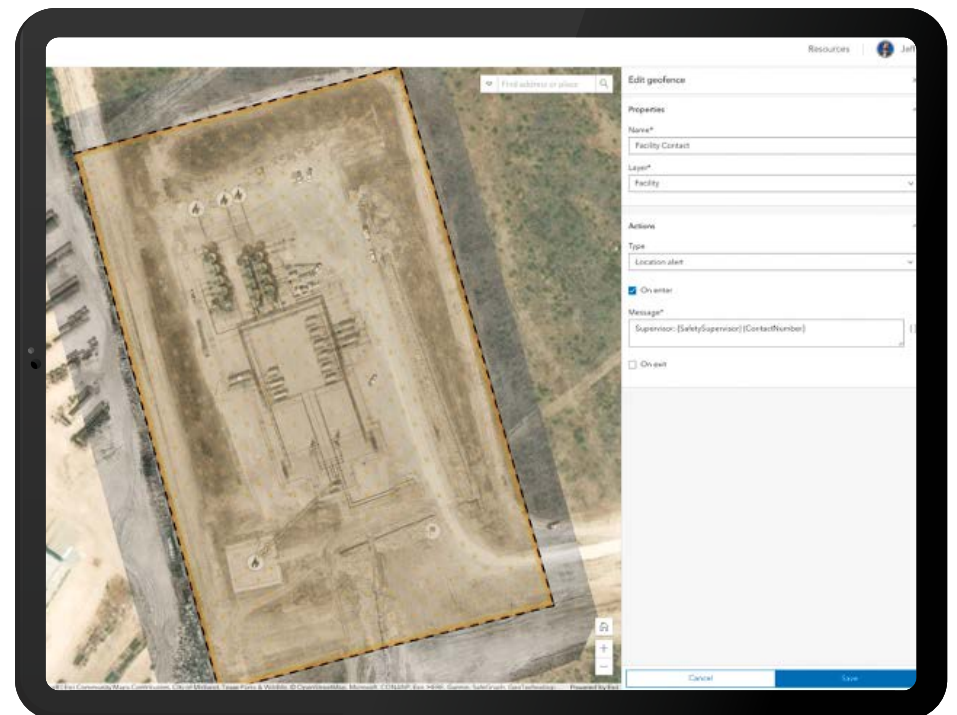
↑ When a mobile worker enters or exits a geofence while using a map, ArcGIS Field Maps can perform an action, like displaying a message or turning location sharing on or off.

New geofencing capabilities, powered by geotriggers, enhance the location-sharing experience. When mobile workers enter or exit a geofence, the app can perform an action, like displaying a message or turning location sharing on or off. The purpose could be to notify mobile workers when they enter an ecologically sensitive area or inform engineers of parcel easements when they are conducting asset inspections.

In addition, geofences can determine the areas where users share their locations. This ensures that mobile workers stop sharing their locations once they've completed their tasks.

Utility Networks

Accessing digital utility records has traditionally been limited to desktop environments. But now that Field Maps supports ArcGIS Utility Network, comprehensive data about utility assets and networks can be accessed in the field from mobile devices. This enables engineers, for example, to query a digital twin of utility assets as they view easements and encroachments—all on the same map, all while on-site completing their tasks.

With Field Maps, users can also now view assets that aren't normally visible on a map—like fuses that are contained inside a transformer bank—as well as how assets are connected to one another within a network. Additionally, field engineers are able to perform traces using Field Maps, which allows them to more easily respond to incidents, such as when employees of a water utility need to identify which valves to close to isolate a water main break.

Indoor Mobile GIS

Increasingly, people want to be able to use mobile GIS inside buildings. This growing demand is encouraged by the wider availability of building information modeling (BIM) data and indoor positioning systems (IPS).

Field Maps is keeping pace with this demand. The app can leverage the ArcGIS Indoors model and is floor aware, meaning mobile workers can view indoor maps and filter information by floor. It is also possible for users to create floor-aware data and see their indoor location using IPS beacons, which is useful for conducting indoor asset inventories or fire safety inspections.

Linear Referencing

When inspecting assets along roads, railways, and utility lines, mobile workers often need to describe where the infrastructure is located by taking measurements from a fixed point using a linear referencing system. Now, Field Maps can find the measurement nearest to a mobile worker's location or search for locations anywhere along a line. Found measurements like this can be captured by mobile workers when collecting information. They can also be used as

→ Mobile workers can use Field Maps to view indoor maps of buildings and filter information by floor.
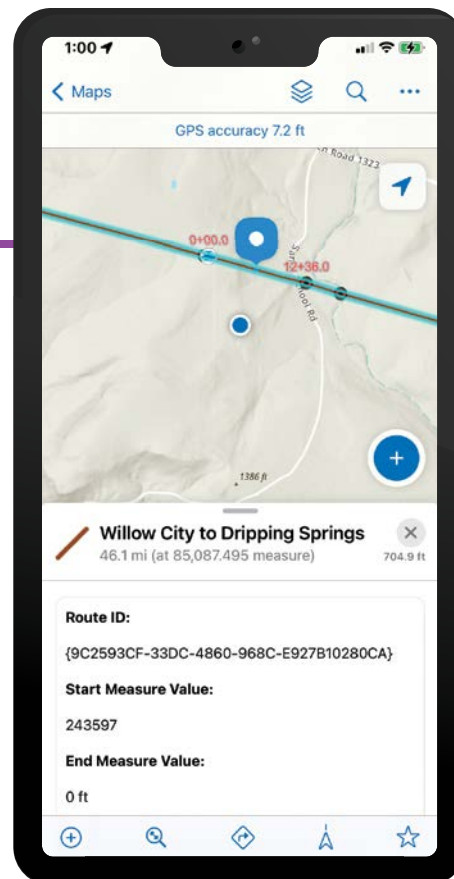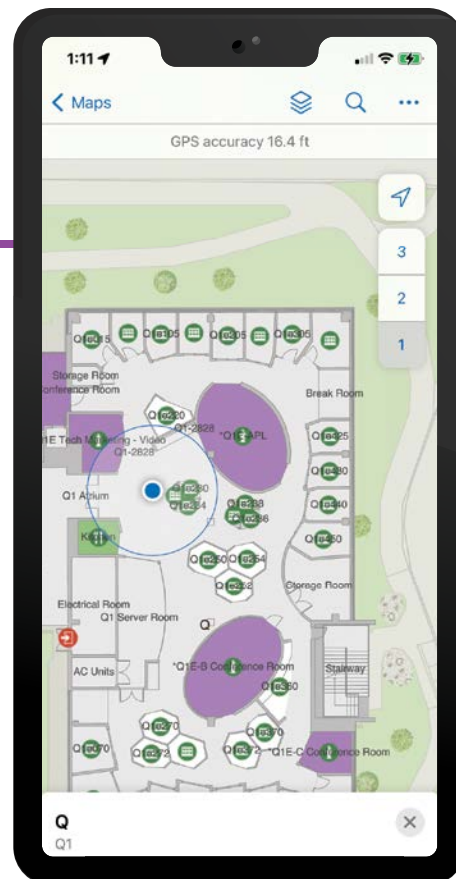
← In the app, mobile workers can now understand where they're located relative to specific assets and take measurements along a route.

destinations for driving directions or navigated to by using a compass.

Integration Capabilities Generate Smoother Workflows

Part of the appeal of using Field Maps is that it is agile and can be integrated with other technology—namely, high-accuracy devices and within wider business systems.

First, Field Maps works seamlessly with third-party devices, enabling mobile workers to more easily and expeditiously capture data and conduct other field-based duties. Field Maps allows users to leverage high-accuracy GPS and GNSS devices, as well as laser range finders, for projects that require submeter accuracy. The app was also recently integrated with InfraMarker from Esri partner Berntsen, which means mobile workers

can scan a radio-frequency identification (RFID) tag on an asset and have Field Maps locate that asset automatically on a map.

Second, Field Maps can be integrated into wider business systems to streamline and automate workflows, including how maps are prepared and how they're made available to mobile workers. ArcGIS API for Python enables organizations to use Field Maps to deploy maps and manage and analyze the data that's collected in the app. Field Maps can also leverage webhooks, which are used to send notifications via email or text messages, post to social media, automatically write records to spreadsheets, and update enterprise databases. Additionally, App Links enable users to launch Field Maps from other applications with preset information, so they can get to work immediately.

The Future of ArcGIS Field Maps

The Field Maps team at Esri is focused on meeting the ever-evolving needs of the modern mobile workforce. This includes developing new and updated capabilities to make workflows more efficient, empower mobile workers, and enable deeper integration with other apps and devices.

To stay up-to-date on new developments with the app, go to esri.com/fieldmaps.
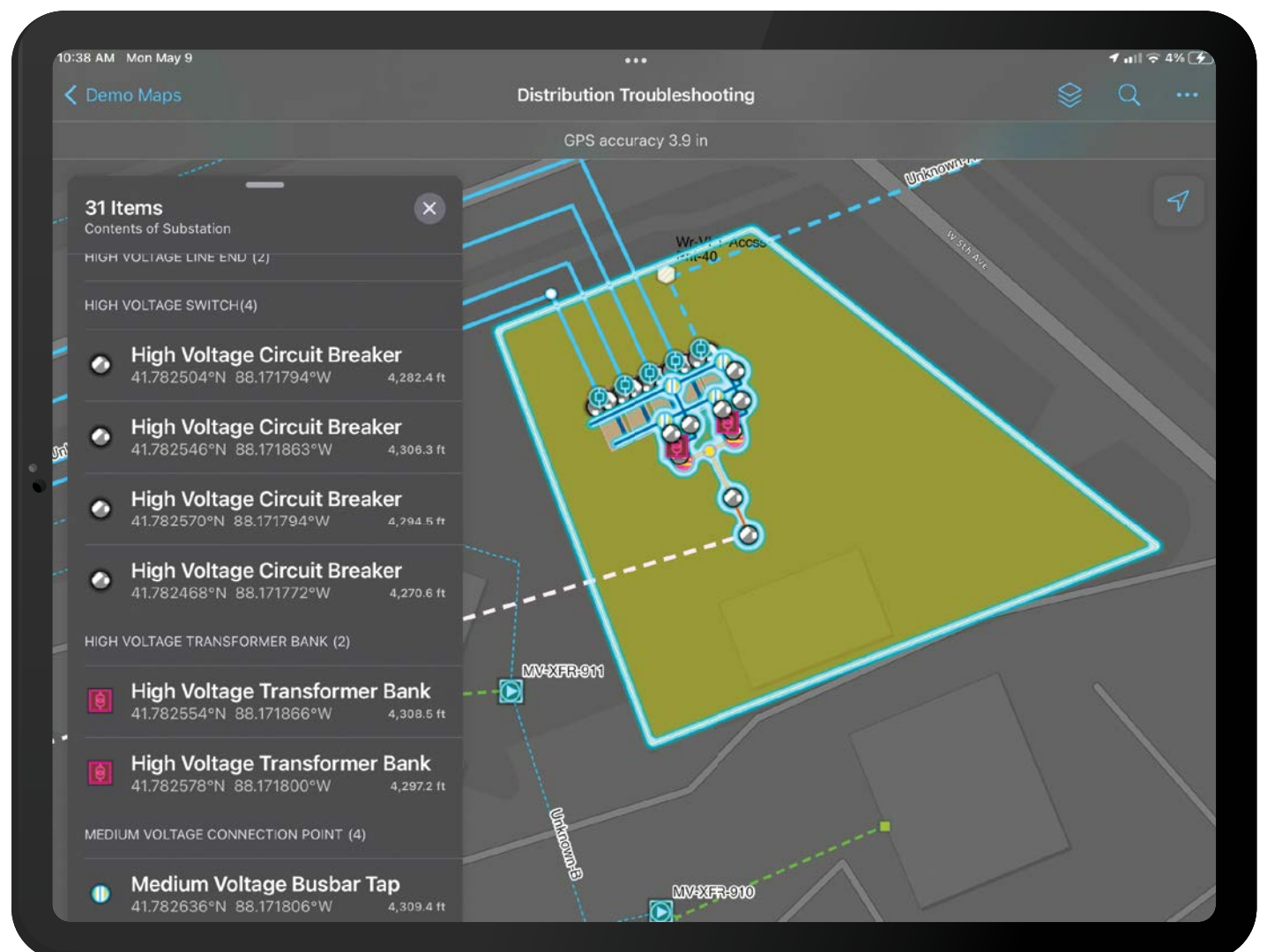
↑ Field Maps now supports ArcGIS Utility Network, meaning mobile workers can access data about utility assets when they're out in the field.

Developers Make GIS—and DevSummit—Come to Life

While geospatial technologies have a rich history and developers have been helping to advance them for decades, Dangermond noted that this field is really just getting started.

"It's a field that's going to address basically all the major challenges and all the major problems that we are facing as a society," he said. "This is where developers really come in, because it's your creativity, your craft, your work, and your understanding of what is needed and wanted that really make it come alive."

Over the last few years, Esri has completely rearchitected its developer technology.

"We've done this to stay modern and current, yes," Cardella said. "But we've also done it so we can provide sophisticated capabilities that you can then use and implement in your solutions."

The ensuing plenary presentations, which took place over three days, were divided into three overarching themes: building applications, the ArcGIS system, and extending ArcGIS and spatial analytics. More than 50 Esri developers and product experts showcased the recent enhancements that have been made to ArcGIS developer technology. By the end, what emerged was a picture of a comprehensive developer experience that gives developers the tools they need to create stunning, innovative, and engaging geospatial products.

Improvements to Web and Native App Development

In a whirlwind of demonstrations that rounded out day one of the Plenary Session, DevSummit attendees were introduced to the latest enhancements in Esri's web and native app development systems.

Product manager Jianxia Song showed how ArcGIS Experience Builder makes it easy to build custom web apps without writing a single line of code. Members of the ArcGIS API for JavaScript team then presented an array of updates that enable web apps to produce impressive visualizations much more quickly. In addition to being able to render big data faster and at more detailed scales than before, JavaScript API now supports client-side queries, which makes it less taxing on the server for apps to go viral.

To help developers produce stylish and consistent-looking mapping apps, Esri released its Calcite Design System last year—and continues to make improvements to it, as Julie Powell, principal product manager for JavaScript API and Calcite, explained to the audience. It is the same design system that Esri developers use, and it has a rich library of user interface components, such as buttons, icons, and theme colors.

"*[You]* can create clean, consistent, and modern user experiences with minimal effort," Powell said.

For building high-performance native mapping apps, ArcGIS Runtime SDKs have what developers need.

"Whether you're building apps for the office or apps for the field, apps for consumers or apps for the enterprise, ArcGIS Runtime can put the right map in the right app on the right device," said Divesh Goyal, product lead for the ArcGIS Runtime SDK for .NET team.

Over the past year, the ArcGIS Runtime team has added support for multiscale maps so they show the right details at the right time. Display filters have been added to allow users to explore maps while focusing on the right data. The team has improved the performance of scene layers and labeling in 3D. And it is now possible to render vector tiles in 3D.

One new development that takes location-based native apps to the next level, according to Goyal, is geotriggers.

"Geotriggers allow you, as developers, to automate workflows in your apps based on the user's location," he said.

Geotriggers can be used to open forms for users to fill out when they arrive at certain locations or to turn layers on and off. And all this works offline.

The first day's Plenary Session ended with impressive demonstrations from early adopters of ArcGIS Maps SDK for game engines, which brings scenes to life in augmented and virtual reality. This capability is becoming more in demand in industries that range from defense and public safety to natural resources.

A Tour of the ArcGIS System

For day two of the Plenary Session, Dr. Sud Menon, Esri's director of software product development, guided the audience through a comprehensive overview of the ArcGIS system.

"ArcGIS is advancing rapidly in all its capabilities, integrating and leveraging many innovations from the larger worlds of computing and science," he said.

Menon noted that Esri's goal is to have ArcGIS support a multitude of communities, from the GIS and mapping communities to developers and data scientists.

ArcGIS Platform, Esri's platform as a service (PaaS) offering, is specifically geared toward developers who want to embed mapping and location services in their apps.

"Those services are the foundation of things like basemaps, geocoding, geoenrichment, and routing, all the way up to spatial analysis and the hosting of your own data," Menon explained. "And it comes with a very simple and clean consumption-based business model."

A host of product engineers, product managers, and software developers then showed attendees new capabilities in Map Viewer and ArcGIS Arcade, improvements to products such as ArcGIS Insights and ArcGIS Image for ArcGIS Online, new offerings including ArcGIS Knowledge and ArcGIS Velocity, and new ways to access cloud-based data and do spatial analysis.

For people who would like to perform spatial analysis without having to load their data into a SQL-based data warehouse, ArcGIS GeoAnalytics On Demand Engine offers a solution. Leveraging the Apache Spark unified analytics engine, it is a stand-alone spatial analytics system for processing massive volumes of data, and it works with all kinds of files. It relies on a consumption-based model and is expected to be out of beta this summer.

The integration of ArcGIS Utility Network with ArcGIS Field Maps was also a big topic of the day. Brent Pierce,

product engineering lead for Field Maps, used an example from the Dubai Electricity and Water Authority to show how mobile workers can access key detailed utility network data in the field. (For more on this, see "Esri's Field Maps App Is Helping Meet the Needs of the Modern Mobile Workforce" on page 4.)

How to Extend ArcGIS and Expand Spatial Analytics

The third and final day of the Plenary Session got into the details of how developers can extend ArcGIS technology and expand its spatial analytics capabilities.

Esri's chief technology officer (CTO), Jim McKinney, noted that there are two ways for developers to extend ArcGIS Pro: with Python and with ArcGIS Runtime SDK for .NET. Developers can use these to build ArcGIS Pro add-ins, like new tools and customized workflows; create custom configurations; integrate proprietary datasets with ArcGIS Pro; and develop stand-alone apps on top of the ArcGIS Pro geodatabase.

ArcGIS is also an enterprise-ready automation platform, as Jay Theodore, Esri's CTO of ArcGIS Enterprise and artificial intelligence (AI), explained.

"Over the last year, we've added a lot of functionality in terms of GIS workflow automation," he said, specifying that developers can automate workflows, operations, and collaborations. "You can automate all these things through the API, but you can also do it through low-code and no-code options."

At the core of the ArcGIS system is spatial data science, as Dr. Lauren Bennett, program manager for spatial analysis and data science at Esri, made clear.

"It's not about algorithms for algorithms' sake and technology for technology's sake," she said. "It's really about applying that geographic approach to solve the complex challenges that our organizations, our communities, and the world face."

Esri is advancing spatial data science in a number of ways, she said, including via spatiotemporal statistics, multidimensional raster analysis, and geospatial AI. For example, new tools in ArcGIS can predict the presence of events without having absence data and detect change points across time. These tools can help forecast where wildfires might happen and dig deeper into how the pandemic has affected small business startups.

At the end of almost every presentation, the product engineers featured in this last section of the Plenary Session concluded with fitting parting words: "We can't wait to see what you do with all this."
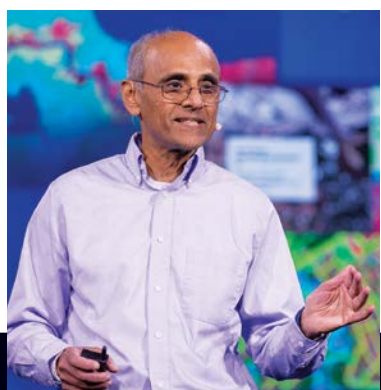
↑ Sud Menon took DevSummit Plenary Session attendees on a comprehensive tour of the ArcGIS system.

↑ Jianxia Song demonstrated how easy it is to use ArcGIS Experience Builder to build custom web apps.

↑ ArcGIS Runtime SDKs can put the right map in the right app on the right device, according to Divesh Goyal.

↑ Lauren Bennett demonstrated how Esri is helping to advance spatial data science.

↑ More than 1,000 people attended DevSummit at the Palm Springs Convention Center.

Extending Renewable Energy Resources While Protecting Wildlife

↑ Tallgrass prairies, like Bluestem Prairie in Minnesota, host hundreds of species of native plants and wildlife. (Photo courtesy of Richard Hamilton Smith, TNC.)

↑ Site Renewables Right estimates that there are at least 120,000 square miles in the central United States that can support low-conflict renewable energy development, shown in green.

most promising places in the central United States to develop renewable energy while preserving wildlife and habitats.

Site Renewables Right combines more than 100 geospatial layers of wildlife habitat and land-use data to show areas where renewable energy development is most likely to avoid important natural areas, permitting delays, and cost overruns. The map spans 19 central US states, from Ohio to Montana. Because of the growing need for this kind of data, TNC is looking to expand the mapping tool so it covers the entire country.

"To tackle climate change, we need to transition to renewable energy—and fast," said Nathan Cummins, director of renewable energy programs for TNC's Great Plains Division. "Site Renewables Right finds there is huge opportunity to do this at a large scale across the central United States without [having] significant impacts [on] habitat and wildlife. Like any type of development, solar and wind facilities can harm wildlife and habitat if not sited properly. Site Renewables Right provides a way for companies and communities to assess those [effects]. It encourages the right conversations to avoid project delays and impacts to the very same wildlife and natural areas we are trying to protect from climate change."

Siting Renewable Energy Developments in Low-Impact Areas

To reduce the effects of climate change and decarbonize the US electricity grid, renewable energy development is essential. And the transition is coming quickly. Changing market conditions, improved technology, and ramped-up state and federal actions are all galvanizing the move to alternative energy sources at an unprecedented scale. New solar development alone is expected to generate almost half of all the electricity produced by renewable energy sources in the United States by 2040.

Not surprisingly, energy development is one of the largest drivers of land-use change in North America. But poorly sited renewable energy projects can seve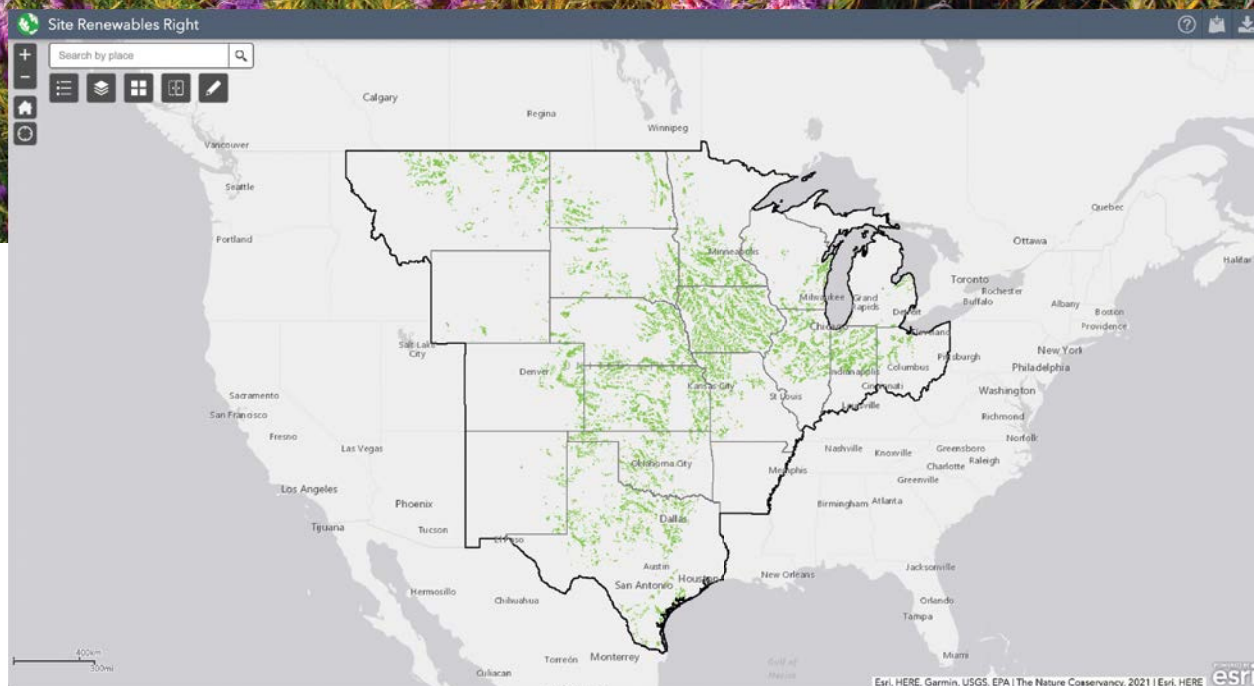rely harm wildlife and high-priority habitats. Renewable energy projects that are sited in areas with significant wildlife and habitat can lead to conflict, costly overruns, and delays. One study from TNC and consulting firm ECONorthwest found that permitting was three times faster and costs were 7 to 14 percent lower when solar projects were sited in areas of low biodiversity, compared to highly biodiverse sites.

In the temperate grasslands of the Great Plains, when wind and solar facilities are put in intact native prairies, like the Sandhills region of Nebraska, they can pose serious concern for the sandhill and whooping cranes and other grassland birds. This is because the projects can fragment their habitats and cause the birds to stay away from otherwise suitable environments.

The Site Renewables Right map was originally launched in 2020 as Site Wind Right. That map aimed to show places in the central United States—America's "wind belt"—where new, utility-scale wind energy projects are most likely to avoid critical natural areas. Now, Site Renewables Right incorporates data to also identify

areas where solar development, which is rapidly expanding in this region, can occur while keeping wildlife habitats intact. The updated map also reflects new science on wind.

One of the first challenges in creating the online map was assembling and organizing a significant number of data layers from a variety of state, federal, and industry sources. ArcMap was key to organizing the data when developing Site Wind Right a few years ago, and ArcGIS Pro was vital for incorporating the solar and updated wind data for Site Renewables Right. Using these core technologies plus ModelBuilder, the team determined where large-scale wind and solar projects could be established across the central United States and then removed areas designated as wildlife hot spots and habitats. Once the analysis was finished, the team used ArcGIS Web AppBuilder to create Site Renewables Right as an easy-to-use online tool that people of all GIS skill levels can explore.

The Site Renewables Right map is designed to serve as an important source of information for early screening of potential wind and solar energy sites. It follows state and federal guidelines for renewable energy development but is not intended to

serve as a substitute for those guidelines. The map shouldn't be the only source of site screening, and it doesn't replace the need to consult with state, federal, and tribal governments or conduct detailed, site-level analyses.

Appealing to a Wide Range of Users

Site Renewables Right estimates that at least 120,000 square miles—an area nearly the size of New Mexico—hold the potential for low-conflict renewable energy development in the central United States. The analysis demonstrates that these areas could support roughly 1,000 gigawatts of wind capacity, which is nearly 10 times what the United States currently generates in wind energy. It also indicates that the potential for low-impact solar development is significantly greater than that for wind. Solar has a much higher average power density and smaller projected land-use requirements than wind, suggesting that solar build-outs in the central United States would be less geographically constrained.

Among those who will find Site Renewables Right useful in planning renewable energy projects are utilities, large energy-consuming companies, utility regulators, energy buyers, and wind and solar developers. Moreover, demand is growing among corporate power purchasers for renewable energy that maximizes climate contributions and minimizes biodiversity impacts.

One such energy buyer that seeks these standards is multinational beverage and food corporation PepsiCo.

"The Nature Conservancy's Site Renewables Right map is an excellent example of data capture that helps organizations make informed business decisions when evaluating renewable energy projects," said Roberta Barbieri, vice president of global water and environmental solutions at PepsiCo. "Projects that are properly sited and developed support a sustainable and equitable clean energy transition—a critical lever in achieving our net-zero-by-2040 goal and broader pep+ (PepsiCo Positive) ambitions."

Energy companies like Xcel Energy are also embracing Site Renewables Right's analysis to help them achieve their climate targets.

↓ Site Renewables Right can help wind and solar energy developers avoid sensitive habitats—like those of the whooping crane, one of the rarest birds in North America. (Photo courtesy of Kendal Larson, TNC.)

"Renewable energy plays a critical role in Xcel Energy's vision to deliver at least 80 percent emissions reduction by 2030, and we're responsibly developing wind and solar resources to protect the environment," said Jeff West, senior director of environmental services at Xcel Energy. "We're committed to working with organizations such as The Nature Conservancy and its Site Renewables Right initiative that researches and supports protecting wildlife and other natural resources as we provide a clean energy future for our customers."

Researchers are interested in using the Site Renewables Right tool as well.

"The Nature Conservancy is a recognized and trusted advocate for natural resources and biodiversity," said Brian Ross, vice president for renewable energy at the Great Plains Institute. "The Site Renewables Right map enables multibenefit solutions for the critical renewable energy investment needed to address the climate crisis. Site Renewables Right demonstrates that developers, communities, and natural resource advocates can work in partnership to create a new energy future."

Ranchers, farmers, and other landowners can also use Site Renewables Right to inform their engagement around renewable energy.

"I am a strong supporter of Site Renewables Right," said Ford Drummond, an Oklahoma-based rancher and TNC board member. "It will help us be better stewards of the land by protecting wildlife and the wide-open spaces of the Great Plains while also advancing opportunities for a cleaner energy future."

For inquiries about Site Renewables Right or to partner with TNC, email SiteRenewablesRight@nature.org.

Key wildlife areas - solar
- Whooping crane stopover sites
- Threatened / endangered species
- Water / wetlands
- Protected / managed lands
- Intact natural habitats
- Other areas of biodiversity significance
- Climate resilient lands
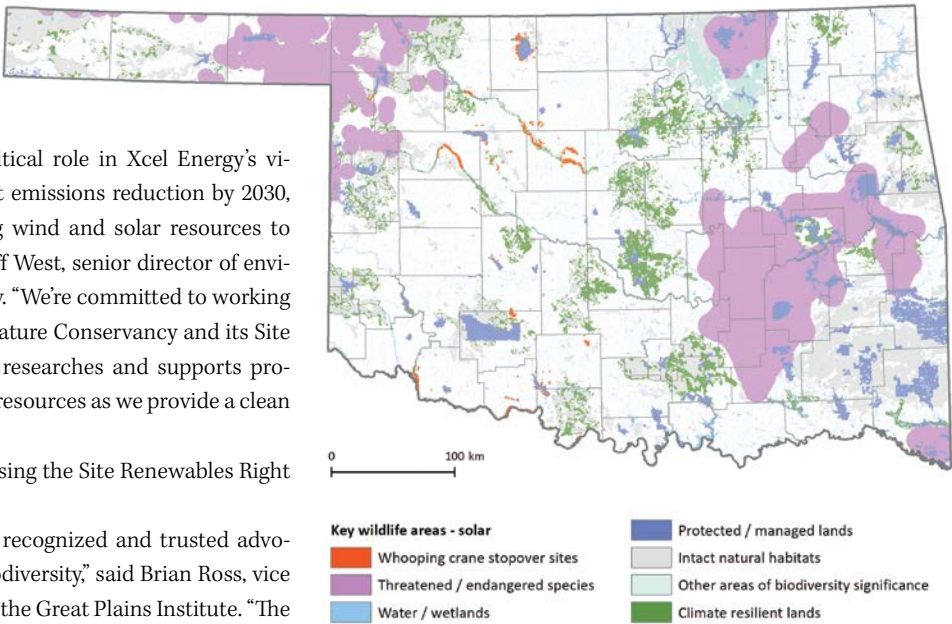
↑ The areas in green show where solar farms could be developed without impacting key wildlife habitats.

About the Author

Eric Aldrich is the marketing manager for TNC's United States conservation strategies. Based in New Hampshire, Aldrich has written about conservation topics—including renewable energy, climate change, fire ecology, wildlife, fisheries, and rivers—for more than 30 years. He can be reached via email at ealdrich@tnc.org.

↑ Greater prairie chickens are one example of a ground-nesting bird whose habitat could be threatened by poorly sited renewable energy developments. (Photo courtesy of Harvey Payne, TNC.)

Scientific Currents

By Dawn Wright
Chief Scientist, Esri

An Important Meeting of the Minds

#ScienceSymposium
#esriUC

2016
Dr. Margaret Leinen
Scripps Institution of Oceanography
University of California, San Diego

2017
Dr. Jon Foley
California Academy of Sciences
(now Project Drawdown)

2018
Dr. Camilo Mora
Department of Geography and Environment
University of Hawaiʻi at Mānoa

2019
Dr. Olga Wilhelmi, Jennifer Boehnert
National Center for Atmospheric Research

2020
Dr. Katharine Hayhoe
Texas Tech University
(now The Nature Conservancy)

2021
Dr. Healy Hamilton
NatureServe

2022
Dr. Adrian Gardner
SmarTech Nexus

Keynote speakers have ranged from renowned climate scientists to pioneering science communicators.

Esri has always embraced its mandate to help solve the world's biggest problems by using GIS software and services—an endeavor that fosters sustainability and resilience along the way. Succeeding in this requires a very broad view of science, one that recognizes the value and rigor of both the physical and social sciences, as well as the digital humanities. It also entails engaging in reliable, verifiable methods of scientific investigation and sharing the results broadly, all with the aim of increasing people's understanding of the world.

Some years ago, it became evident that a subset of attendees at the Esri User Conference (Esri UC) could benefit from discussions that went beyond traditional geography and GIS and delved into disciplines such as agriculture science, climate science, conservation biology, ecology, forestry, geology, health sciences, hydrology, ocean science, and various social sciences. The idea emerged that it might be beneficial to put on a special, science-focused event at the Esri UC, and the Esri Science Symposium was born.

Founded by yours truly in 2015—with critical input and support from University of California, Santa Barbara, professor emeritus of geography Michael Goodchild—the Esri Science Symposium affirms Esri's commitment to supporting scientists who are expanding fundamental understanding in many scientific fields by developing innovative GIS tools. The aim of the gathering is to engage with Esri UC attendees who are interested in science and enlighten them on how the pressing issues of today—such as climate change and sustainability—intersect with visualization, geodesign, and the growth of geospatial technology. The symposium also salutes the work of product and solution engineers and industry managers at Esri who are actively involved in scientific research and organizations and publish papers in scientific journals and books.
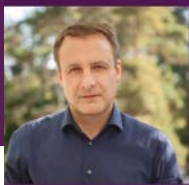
One of the symposium's biggest benefits is the networking and community building that happens among scientists. Before, this typically occurred throughout the week of the Esri UC at disparate paper sessions and special interest group meetings, in demonstration theaters, and at technical workshops. Now, the 1,000 or so Esri UC participants—among tens of thousands of attendees—who are academic or government scientists have a home of their own, of sorts, within the larger conference. And the popularity of the symposium keeps growing. In 2015, organizers expected around

30 people to attend a special science reception at the Esri UC, yet more than 300 showed up! In 2016, when a formal registration system was established for the inaugural Esri Science Symposium, that number swelled to 650 attendees.

For that first symposium, Dr. Margaret Leinen, director of the Scripps Institution of Oceanography at the University of California, San Diego, delivered the keynote speech. She talked eloquently about what it takes to understand and protect the planet and people. She discussed the use of innovative data arrays and statistical modeling to better comprehend the impacts of climate change around the globe and the regional interconnectivity of changes in sea surface temperatures, drought, and increase in fire events throughout Southern California.

The following year, Dr. Jonathan Foley—who was then the executive director of the California Academy of Sciences and is now executive director of the climate change solution nonprofit Project Drawdown—challenged the audience to improve the world's condition by communicating scientific ideas in ways that focus on hope instead of fear, solutions rather than problems, and stories over straight data. And in 2018, Dr. Camilo Mora of the Department of Geography and Environment at the University of Hawaiʻi at Mānoa delivered a compelling keynote about what he consistently sees as some of the most important climate change issues, including the dangers of deadly heat waves.

The original approach for all three of these symposia was to have a prominent, geospatially informed scientist (rather than someone who specializes in GIS) speak about a broad societal issue and then have a panel of GIScience experts respond to the keynote, sharing how GIS could help solve the problem. Some panelists also discussed how to implement the keynote speaker's vision for the future from an information technology, informatics, and/or GIS perspective. A brief Q&A session ensued, followed by a networking reception with drinks and delicious appetizers to close out the day.

But the event is always evolving. Adjustments from 2018 to the present have included removing the reaction panel from the program to yield more time for audience participation and networking, and the deliberate decision to invite more women scientists to give the keynote presentation. Starting in 2019 with the publication of the first of three *GIS for Science* books from Esri Press, every Science Symposium attendee has received a free, advance copy of that year's volume in ebook form before its public release in the fall. In fact, the prerelease of these special books—which highlight how scientists use GIS to understand the way Earth works, how

humans have changed Earth's appearance and function, and how different ways of looking at Earth through observation and measurement are vital—has been timed each year to match the opening of the Esri Science Symposium. Even though the book series ended with volume 3 last year, symposium attendees will continue to receive a complimentary copy of that book.

Turnout at this 2.5-hour Esri UC session has grown to nearly 800 in-person attendees (to match the capacity of the San Diego Convention Center ballroom in which it is held) and as many as 3,000 online participants during the pandemic years of 2020 and 2021. Feedback about the Esri Science Symposium has been consistently and overwhelmingly positive. This is thanks to the quality of the keynote speeches and the value participants garner from their interactions with one another, given that this is a unique event—not a paper session, not a technical workshop, not a special interest group meeting, and not a typical Esri UC party.

The 2022 Esri Science Symposium will take a marked turn toward the social sciences. Dr. Adrian Gardner, founder and CEO of SmarTech Nexus, a data-driven community engagement nonprofit, will speak about the work his organization does on social determinants of public health and food security, as well as the access urban residents have and don't have to health services, such as vaccination centers—all with an eye toward racial equity. More specifically, he will discuss how location intelligence and faith-based organizations are essential components for improving service delivery in hard-to-reach, underserved, and at-risk communities.

This year's event will take place on Tuesday, July 12, from 4:00 p.m. to 6:30 p.m. (Pacific time), in Ballroom 20 D of the San Diego Convention Center. Everyone who is registered for the Esri UC is eligible to attend the symposium in person, and badges will be scanned at the door. The event will not be livestreamed virtually. For more details, visit esri.com/events/science-symposium.

Please, won't you come join us?

Curious about past Esri Science Symposium presentations? Check out the following:

- For a synopsis of the 2019 Esri Science Symposium, in which Dr. Olga Wilhelmi and Jennifer Boehnert from the National Center for Atmospheric Research (NCAR) discussed climate risks, go to esriurl.com/symposium19.
- For a recap of the 2020 Esri Science Symposium, in which atmospheric scientist Dr. Katharine Hayhoe illustrated how to better communicate information about climate change, visit esriurl.com/symposium2020.
- To watch a recording of the 2021 Esri Science Symposium, with Dr. Healy Hamilton, chief scientist of NatureServe, talking about biodiversity, go to esriurl.com/healyuc. A full recap of the event is available at esriurl.com/symposium2021, and an additional Q&A can be found at esriurl.com/symposium2021qa.

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.

ADVANCING ETHICS IN MAPMAKING

Maps are generally seen as reliable information sources. Why? Because most maps that are recognized as authoritative adhere to standards and quality control guidelines.

As mapping software has evolved to produce higher-quality maps at lower costs, geographic data has become more commonly available. Much of it is free and accessible in formats that are ready to be mapped. In some respects, this means that it is easier to make authoritative maps that adhere to standards and promote accountability. But it also means that there is an opportunity for untrained, ignorant, or even malevolent mapmakers to use low-cost or free mapping software and free data to create inaccurate or intentionally misleading maplike products.

To the undiscerning eye, unreliable maps may look just like authoritative maps. This opens the door for maps to be used to spread misinformation. The onus is on the professional mapmaking community to ensure the integrity of maps and their underlying data. Which is why ethics in mapmaking and cartography is an important conversation to be having right now.

THE MAPMAKER'S MANTRA

At the 2021 Esri User Conference (Esri UC), which was held virtually, there was a panel discussion about maps and storytelling. The participants were Esri president Jack Dangermond, journalist and contributing writer to *The Atlantic* James Fallows, and former president and CEO of the National Geographic Society Gary Knell. In their free-ranging conversation, the three speakers talked about the increasing reach of GIS and the implications of that. They also broached how to ensure the appropriate use of GIS tools, given the growth in dissemination of false information.

As the global market leader in GIS, Esri has an obligation to take a stand on how maps get made and used in the modern world. Additionally, the company seeks to contribute to a broader discussion about the ethical use of GIS in all endeavors in which ArcGIS technology is used—not just mapmaking.

This led Esri research cartographer Dr. Aileen Buckley, Esri storytelling program manager Allen Carroll, and Esri director of product engineering Clint Brown to craft The Mapmaker's Mantra, a set of guiding principles for ethical mapmaking. Available on *ArcGIS Blog* at links.esri.com/mapmakers-mantra, it is a short list of simple instructions for making maps that are accurate, justifiable, and thorough.

The mantra consists of the following principles:

- **Be honest and accurate:** Communicate information in the most precise and understandable way possible. Strive for veracity and verifiability.
- **Be transparent and accountable:** Take responsibility for your work and be open about your sources and decisions. Neither speed nor format takes the place of accountability.
- **Minimize harm and seek to provide value:** Treat sources, subjects, colleagues, and members of the public with respect. Promote equity, inclusion, and empathy. Make useful maps that increase understanding.
- **Be humble and courageous:** Disclose when you get something wrong, and gently point out others' errors. Admit when you don't know something, and considerately let others know when their knowledge or skills are lacking.

And this is just a start. The Mapmaker's Mantra is Esri's first attempt at describing what ethical mapmaking looks like.

FURTHER ACTION FROM THE WIDER GIS COMMUNITY

Over the long term, Esri seeks to foster additional discussion about what ethics in mapmaking looks like and encourage concomitant action from other prominent groups in the GIS community.

The International Cartographic Association (ICA), for example, is well positioned to take a leadership role on this topic, offering broad perspectives from cartographers all over the world and encouraging wider adoption of these tenets. The ICA's current president, Tim Trainor, will be presenting a session at this year's Esri UC that centers on ethics in cartography. He also plans to take this work forward through his professional contacts, other organizations he is involved in, and current and future writing projects.

Several activities that aim to advance a code of ethics in cartography have already taken place or are planned for the near future. At its annual meeting in February, the American Association of Geographers (AAG) hosted a panel to facilitate discussion of the topic among members of many national and international cartographic societies, including the ICA, the International Map Industry Association (IMIA), the Cartography and Geographic Information Society, the North American Cartographic Information Society, and the British Cartographic Society. Additional organizations expressed interest in participating in the conversation, but the session was only open to those registered for the meeting.

More discussion is scheduled to take place at several upcoming events as well, including at the IMIA Mapping Leaders Forum in Denver, Colorado, in June; EuroCarto 2022 in Vienna, Austria, in September; and AutoCarto 2022 at Esri in Redlands, California, in November. The goal at the IMIA forum is to develop a statement on ethics in the mapping industry, and the ensuing events will further the conversation. The ultimate objective is to have cartographic societies collectively draft a code of ethics for mapmaking—one that is inclusive of various perspectives and ensures widespread adoption.

TAKE THE NEXT STEPS AT THE ESRI UC

Defining the ethics of mapping reaches beyond developing a code of ethics, however. It is indeed a very broad and complex topic.

Considering this, two sessions that cover the subject will be offered at the Esri UC on Wednesday, July 13. One will be a discussion of the fundamentals of ethical mapmaking, and the other will explore one of those elements in depth: the practice of making maps.

The first session, called Elements of Ethical Cartography: Refining a Mapmaker's Mantra, will be held from 1:00 p.m. to 2:00 p.m. (Pacific time) in Room 3 of the San Diego Convention Center. In it, an in-person panel—consisting of Carroll, Buckley, Trainor, and Esri's Mark Cygan—will present the details of The Mapmaker's Mantra and go into the motivations that led to its creation. Most of the session will be an open discussion about the mantra, with the goal of moving toward a consensus on what the essential elements of ethical mapmaking are.

The second session, The Ethics of Making Maps, will be held in the same room from 2:30 p.m. to 3:30 p.m. (Pacific time). It will feature Esri's Charlie Fitzpatrick, Dr. Joseph Kerski, Dr. Kenneth Field, and Lisa Berry as panelists, who will go over some tenets of mapmaking that attendees can apply to their work to make more honest and authoritative maps. The speakers will demonstrate how mapmakers imbue their work with different messages and share resources to help participants better understand ethics in mapping.

These sessions aim to be informative and enlightening, and anyone who is attending the Esri UC in person is encouraged to take part.

Now's the Time to Upgrade to ArcGIS Enterprise 10.9.1

ArcGIS Enterprise, Esri's industry-leading mapping and analytics software, works within an organization's infrastructure and in the cloud. It is adaptable and integrates with existing business systems, providing unparalleled security and reliability.

Part of the flexibility that ArcGIS Enterprise offers is that administrators have control over their organization's system and can make changes and perform upgrades on their own terms. That being said, now is the time to upgrade to ArcGIS Enterprise 10.9.1.

This long-term support release is the last release of ArcGIS Enterprise that will support the publishing and consumption of services from ArcMap. The release contains migration tooling to help users prepare for this and other changes that will come later this summer with the release of ArcGIS Enterprise 11.0.

ArcGIS Enterprise 10.9.1 is full of enhancements and new functionality across many areas. Read on to find out more about why upgrading to this release now is of value.

Start Migrating Map Services to ArcGIS Pro

All users who have ever published services from ArcMap need to start migrating those services to the ArcGIS Pro service runtime. ArcGIS Enterprise 10.9.1 is the last release that will include both the ArcMap and ArcGIS Pro service runtimes. It has specific migration tooling that users can employ to migrate compatible services from the ArcMap service runtime to the ArcGIS Pro service runtime.

ArcGIS Enterprise 10.9.1 is the last release that will include the classic Esri Story Maps templates, ArcGIS Dashboards Classic, and Presentation for Map Viewer Classic. It is also the last release to contain Microsoft .NET Framework support for .NET-based server object extensions (SOEs) and server object interceptors (SOIs), as future support will be based on .NET 6. So it is important to upgrade to ArcGIS Enterprise 10.9.1 to get help with these transitions.

Some services, like geoprocessing and geocoding services, will still have to be migrated manually, meaning they will need to be republished from ArcGIS Pro. To learn how to do this and how these changes will affect an ArcGIS Enterprise organization, check out Esri's recent technical paper on this by visiting go.esri.com/arcmap-migration or scanning the QR Code above.

Easier Access to Upgrades That Expedite Work

Users will appreciate that in ArcGIS Enterprise 10.9.1, it is easier to visualize big datasets because they can now consume data from cloud data warehouses. This means that upgrading and maintaining the software takes less time than it did before because of faster-running installer and patching technology.

ArcGIS Enterprise 10.9.1 also includes upgrades to Map Viewer that are available by default, so they don't require separate installations or additional configuration. These include the ability to apply certain effects to layers in a map—such as the invert effect, which reverses all the colors in a basemap, and the bloom effect, which makes specific colors stand out.

A New, Cloud-Native Deployment Option

ArcGIS Enterprise on Kubernetes is Esri's new cloud-native deployment option for ArcGIS Enterprise that's optimized for scalability and resilience. It is orchestrated using Kubernetes, an open-source system for automating the deployment and management of containerized apps across various hosts. ArcGIS Enterprise on Kubernetes is offered in addition to the current ArcGIS Enterprise deployment methods of Windows and Linux.

The new autoscaling capabilities for ArcGIS Enterprise on Kubernetes, which will come out in the next release, are incredibly powerful. They allow administrators to configure and deploy production systems that respond to unexpected performance demands with minimal intervention and overhead. For IT administrators—who often need to maintain complex systems and ensure that they run smoothly—autoscaling can help monitor their systems and scale resources when needed.

↑ ArcGIS Enterprise 10.9.1 can consume data from cloud data warehouses, making it easier to visualize big data, like sea surface temperatures.
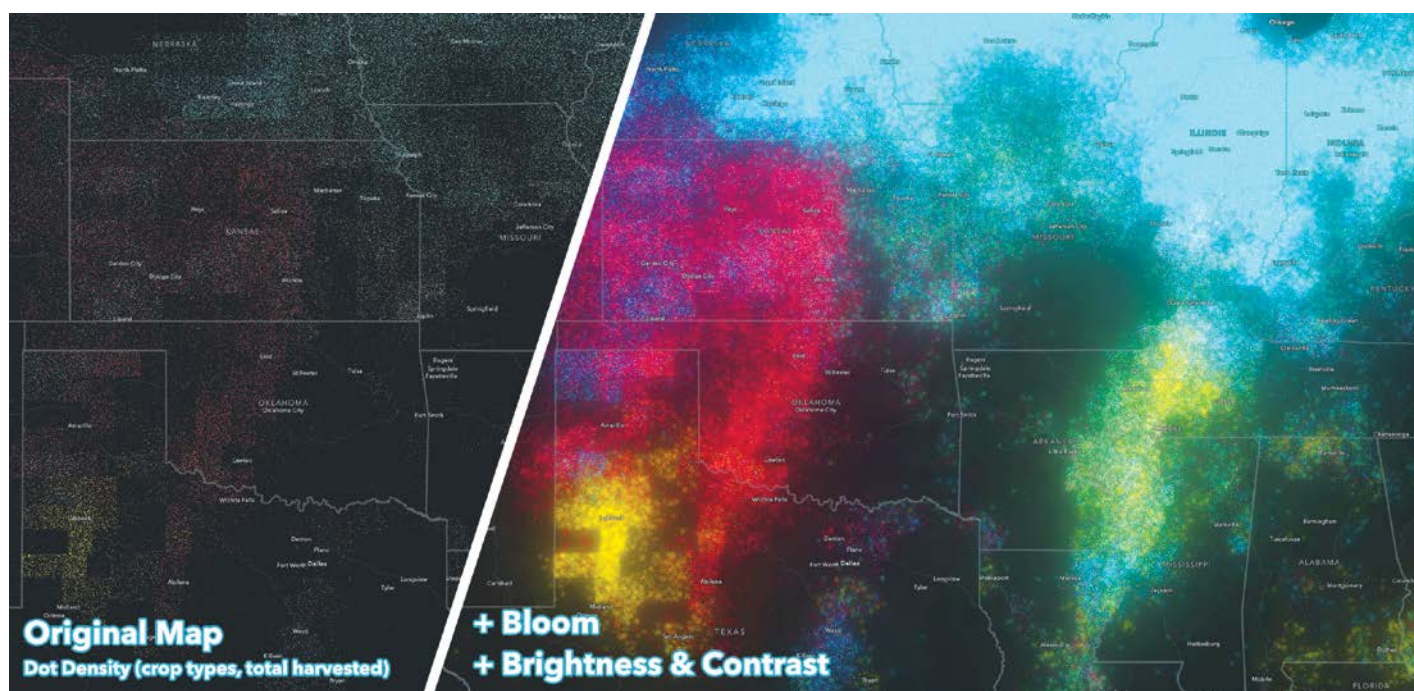
↑ Upgrades to Map Viewer—such as the bloom effect, which adds a neon-like glow to colors on a map—are now available by default.

To learn more about ArcGIS Enterprise 10.9.1 and other features and capabilities expected to release with ArcGIS Enterprise 11.0, reach out to your Esri representative or read more detailed blog posts at esri.com/arcgis-blog/arcgis-enterprise.

PUT CALIFORNIA ON THE GIS MAP. ACCURATELY AND CONTINUOUSLY.

INTRODUCING PARCELQUEST GATEWAY, THE ALL-NEW PARCEL STREAMING SERVICE FOR ESRI USERS.

Uploading last month's California property data into your GIS environment is sooooo last year. With ParcelQuest Gateway, now you have automatic access to real-time data that's up-to-date and straight from the source—all 58 county assessors. Our comprehensive California data is kept current within 24 hours of most assessors' internal property tax systems. We'll repeat that for those of you in the back: within 24 hours!

PARCELQUEST GATEWAY MAKES YOUR JOB SO MUCH EASIER.

- Continuously updated parcel boundaries, owner names, addresses and characteristics
- We get our data straight from county assessors—all 58 of them
- PQ Gateway is kept current within 24 hours of most assessors' internal property tax systems
- Automatic integration into ArcGIS
- We have GIS mappers on staff, ensuring boundaries are current and accurate
- No more waiting for the purchase of updates
- No more downloading, formatting, standardizing, cleaning or re-integrating parcel data—ever
- Did we mention sweet, sweet data for 13 million California parcels?

PARCELQUEST GATEWAY | esri Partner Network Bronze

READY TO GET STARTED WITH PQ GATEWAY?
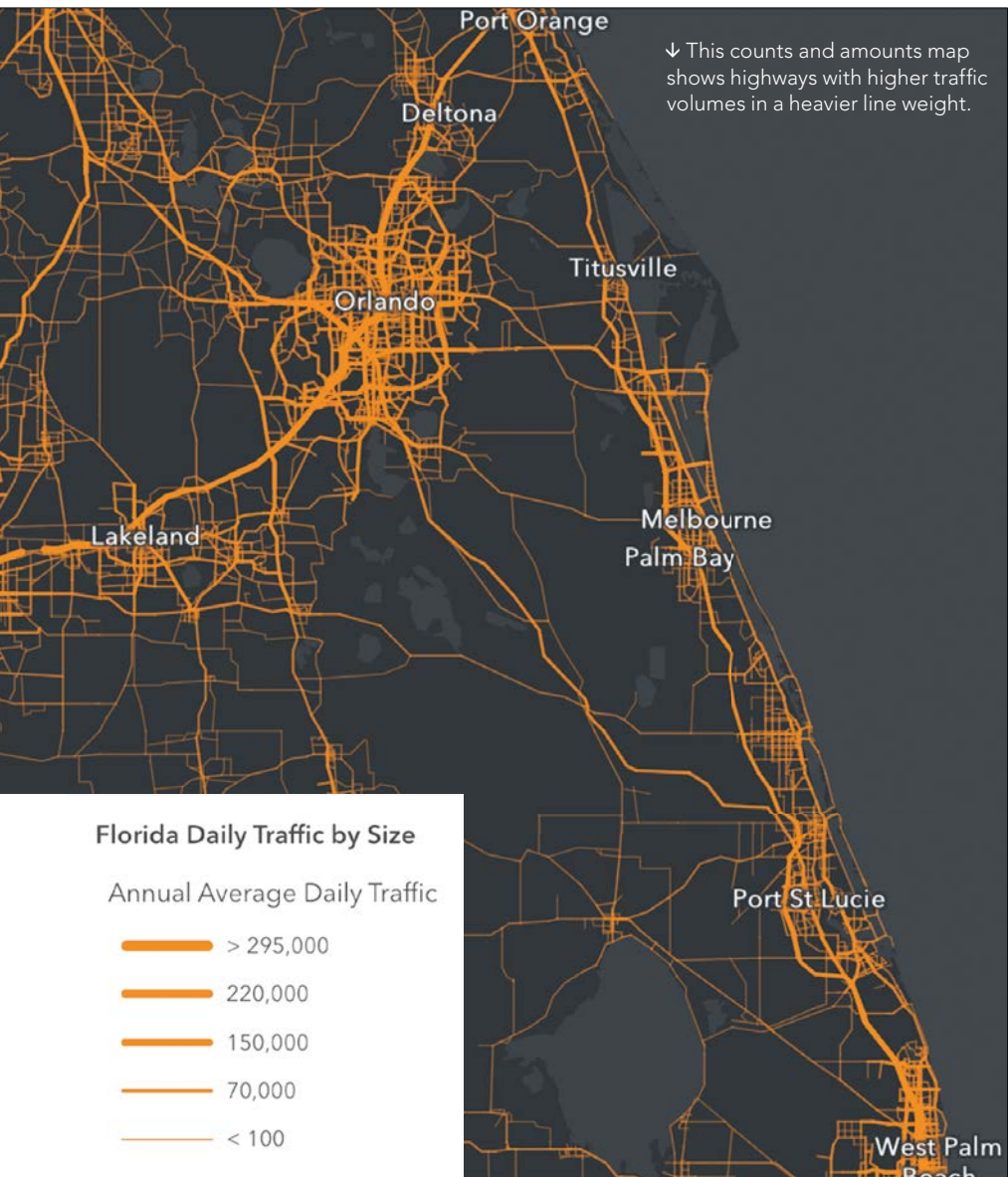Call us for a custom quote at **1-888-217-8999.**

Smart Mapping Can Make Compelling Thematic Maps in Minutes

In Map Viewer in ArcGIS Online and ArcGIS Enterprise, smart mapping helps users build beautiful, informative maps with just a few clicks. It unifies Esri's advanced mapping technology with streamlined workflows to enable seasoned mapmakers and mapmaking novices alike to explore their data and uncover insightful patterns.

Smart mapping takes the guesswork out of mapmaking by suggesting map styles that go best with the data users are working with. It allows them to employ default options quickly and still customize the shapes, symbols, colors, sizes, transparency, rotation, and outlines used in the map. To help the map tell the same story at every scale, smart mapping gives users the option to adjust symbol sizes automatically as the map zooms in and out, enabling certain map styles to work at multiple scales.

Recent enhancements to ArcGIS Online and ArcGIS Enterprise have made smart mapping a more powerful tool for quick and thorough mapmaking. Here's how to get started using it, and an overview of many of the sophisticated things it can do.

↓ This counts and amounts map shows highways with higher traffic volumes in a heavier line weight.

Florida Daily Traffic by Size

Annual Average Daily Traffic

— > 295,000
— 220,000
— 150,000
— 70,000
— < 100

Begin with One Question, Then Ask Three More

Some of the best maps answer some of the world's toughest questions. And that's how the mapmakers got started: with a question.

To get under way with smart mapping, just ask a question. Questions that begin with, Where does…? can be answered with a smart mapping style that reveals the locations of things on a map. The map will either unveil a pattern that looks interesting as is, or it will entice you to ask, What else?

Whether the resultant map is or isn't revelatory, it's time to ask more questions. Try starting with, How much/how many…? What is the most common…? How has this changed over time…? and What is the relationship between…? Asking more questions after visualizing your data can lead to deeper insight.

So after creating a map that answers your first question, explore your data further by asking three more. You'll be surprised at the new information your existing data can show you.
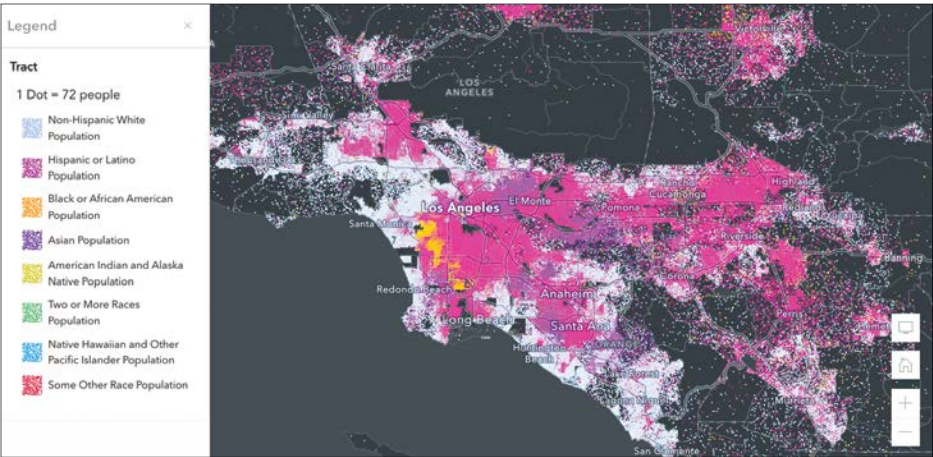
↑ A dot density map is useful for showing population distribution by race and ethnicity.

Now, Get Started with Smart Mapping

In Map Viewer, once you've added a data layer to your map and chosen the attributes you want to show, choose the Styles option from the menu bar on the right to start working with smart mapping. Keep in mind that smart mapping styles work best when you select a basemap that has neutral colors but still shows important details.

Now that the basics are out of the way, explore the different smart mapping styles and see how you can apply them.

Single Symbol

Where are the electric vehicle charging stations? or Where do we have gaps in our electric vehicle charging station offerings? are the kinds of questions that the Single Symbol style can help answer. This creates a simple map because it just shows the locations of things.

This style can be used for points, lines, and polygons. For example, a map consisting of points can represent the locations of certain items, such as restaurants. And a map consisting of lines can represent features like highways and roads.

Types

Types is a smart mapping style in which each color or symbol on a map represents a different category for a chosen attribute.

A question that can be answered using Types is something like, Where are the wind turbines in the United States grouped according to manufacturer? With the Types style, users can apply unique symbols to show categorical data, though it doesn't work for counts or numeric measurements.

Users can customize line colors to specify which category each feature belongs to. They can also use symbols to represent different categories.

Be sure to experiment with various colors, shapes, sizes, and outlines to enhance your map of categorical data.

Counts and Amounts

Say your question is, Which highways in Florida experience the most traffic each day? Counts and Amounts is a good style to use to answer this.

It's easier to discern patterns in numeric data on maps when distinct colors and sizes are used to represent different values. With smart mapping, users can distinguish features using graduated colors to reflect various amounts. They can also represent numeric data or ranked categories using different sizes.

Alternatively, users can assign specific colors to numeric ranges. This technique also works with averages, means, medians, rates, ratios, percentages, and other normalized data. Not only does smart mapping make it easy to represent distinct counts and amounts, but it also helps show how big or small the differences are.

Color and Size

Map Viewer makes it simple to vary a feature's color or size based on only one numeric attribute. But with smart mapping, you can go one step further by using both color and size to represent one or two numeric attributes.

This style helps answer questions like, Which areas have high poverty rates? and Which areas have the highest number of people living in poverty? For this, colors can be used to represent poverty rates, while the size of the symbol can show the number of people living in poverty.
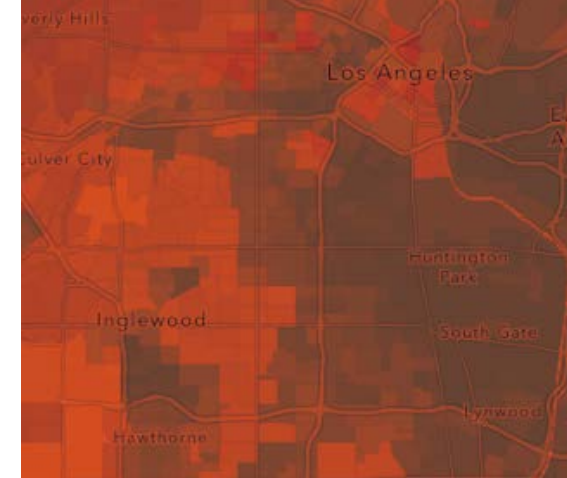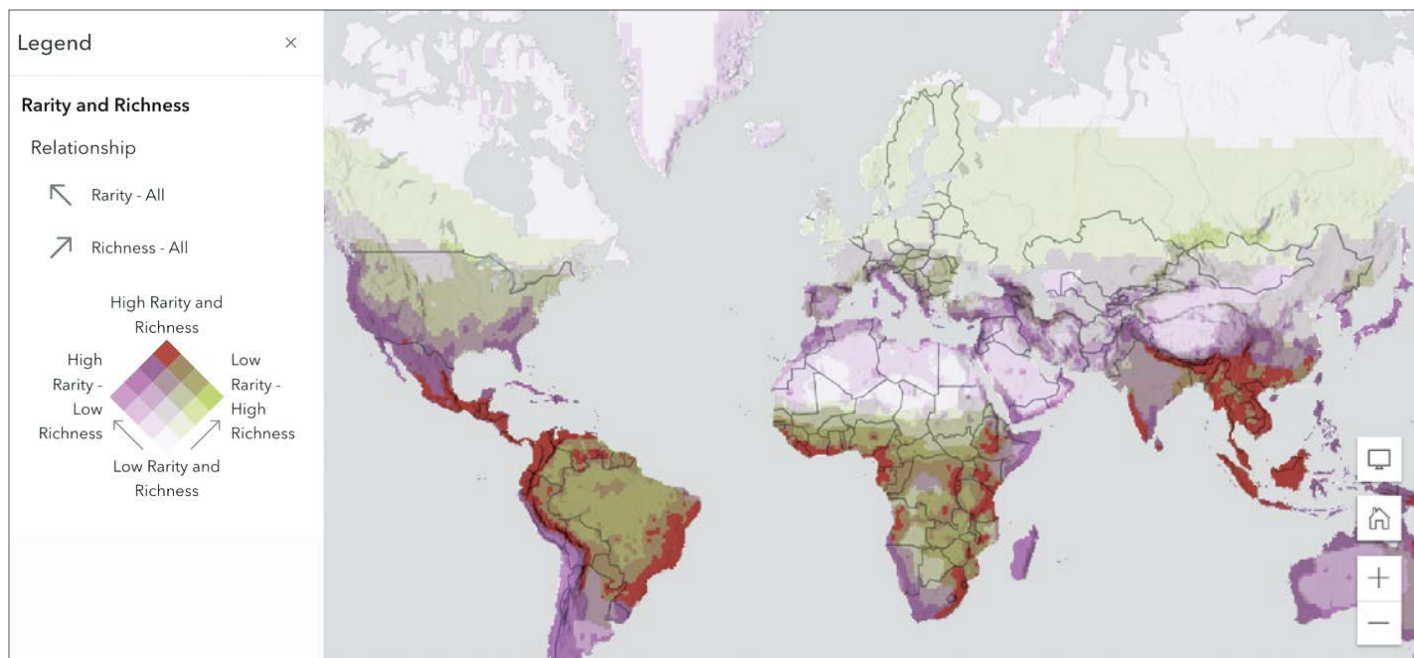
← To show where the relationship among the attributes is most or least pronounced—like where high species rarity and low species richness occurs—use the Relationship style.

Compare A to B

This is the smart mapping style to choose when you want to compare two attributes as a percentage, a simple ratio, or an overall percentage. A good question for this style is, Which areas have high and low population growth relative to overall population change?

Even if you don't have a percentage or ratio as an attribute field, you can still use Compare A to B as long as the numerator and denominator are somewhere in your data. This means that you can compare two numbers and represent their relationships as a percentage or a simple ratio. This would be useful for comparing populations based on political affiliation, homeownership, or veteran status.

Predominance

With the Predominance smart mapping style, users can analyze multiple columns of related data to see which has the highest value for each feature. This style can help answer the question, What are the most common races and ethnicities in the Los Angeles, California, area?

To use the Predominance style, select between 2 and 10 numeric attributes to compare within the smart mapping window. Don't hesitate to get creative with various size and color options. You can also try using a sequential color ramp to map a topic with sequence or order, such as income ranges. It's helpful to play around with different shapes, too, such as triangles, squares, or diamonds.

Users can even build a predominance map using a custom ArcGIS Arcade expression.

Relationship

If you want to answer a question such as, What areas have high rarity of species and low richness of species?, try the Relationship style. It allows users to visualize patterns that are normally hidden among numeric attributes in point, line, or polygon feature data.

This kind of map shows where the relationship among the attributes is most or least pronounced. It combines map patterns to explore where they overlap or diverge and uses two individual color ramps to show a mixture of the patterns. Users can also add a third variable into a relationship map to create a relationship and size map.

Clustering

When mapping several points, it is common for those points to overlap. This can prevent your map from conveying the story it is meant to tell. While there are other workarounds, such as making a heat map or doing statistical analysis, these approaches often require restructuring the data.

The Clustering style groups points together dynamically so the map is easier to read at different scales. When viewers zoom out, more points are aggregated into fewer groups, and when they zoom in, more cluster groups appear. Clusters are proportionally sized according to the number of features within each cluster. The bigger the symbol, the more features it contains.

Try Clustering the next time you want to answer a question like, Where are the highest and lowest concentrations of public schools in my city?

Heat Map

Like Clustering, the Heat Map smart mapping style helps resolve overlapping points. It can help answer the question, In which areas of New Zealand are you most likely to see great white sharks?

Heat maps analyze the features in a layer and display the relative density of the points as a smooth, varying set of colors. For example, cool colors, like blues and greens, might represent a low density of points, while hot colors, such as oranges and reds, could indicate a high density of points.

Heat Map is a good style to use to show event-based data where points are likely to coincide, such as the number of traffic violations given out in a specific area of town.

Dot Density

Instead of filling an entire polygon with a thematic color, the Dot Density style represents counts in data using dots. This allows users to visualize the distribution of one numeric attribute or compare multiple numeric attributes with differently colored dots. One question that can be answered using Dot Density is, How is the population distributed by race across Los Angeles?
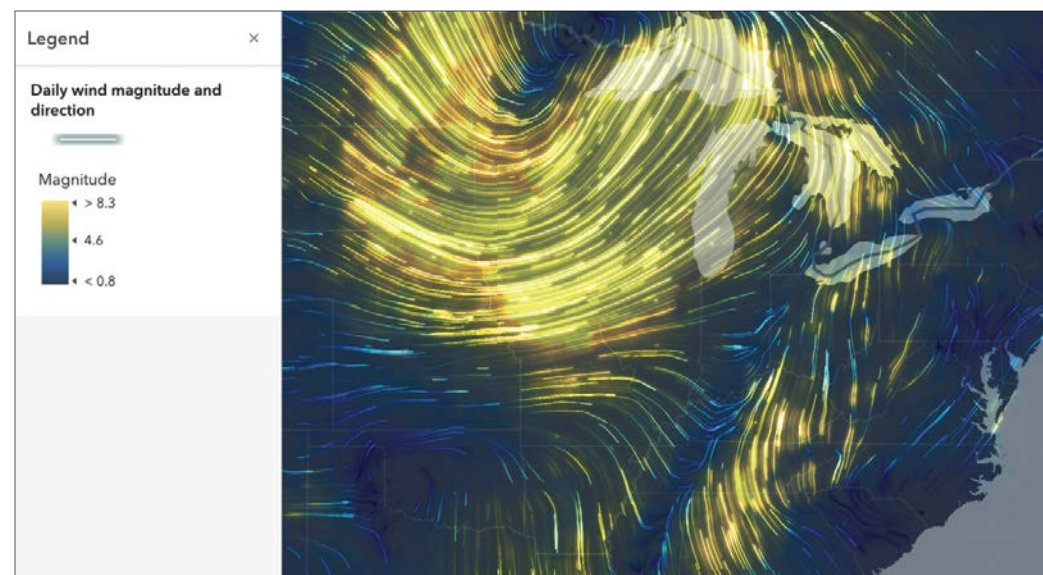
This technique can be used to map any type of numeric or quantitative data and is commonly employed to map demographic and socioeconomic patterns. With Dot Density, you can evenly represent counts regardless of the size of the polygons in that layer as compared to using size. For example, each dot could represent a household or person, with the dot color symbolizing race.

Continuous Timeline and Age

Two styles—Continuous Timeline and Age—help users visualize date and time attributes.

A Continuous Timeline can convey when something happened using color or size to represent the dates associated with each feature on the map. With this style, users can view the data sequentially, from old to new or before and after a key date. Some questions this style helps answer include, What buildings were rebuilt after the Rotterdam Blitz in World War II? and Which emergency calls took more than 10 minutes to respond to versus which ones took less than 5 minutes?

The Age mapping style can be used to show the age of features on a map. As with Continuous Timeline, age can be expressed via color or size.

Flow

Flow is among the newest smart mapping styles. It now appears as an option if you have tile imagery layers or dynamic imagery layers that contain data on magnitude and direction.

This style is great to use in meteorology, climatology, hydrology, and oceanography to animate wind speeds and directions or ocean currents. It can help answer a question like, What is the direction and magnitude of wind in the Midwest?

If you would like to explore this style but don't have the right kind of data (UV or MagDir), use the HYCOM - Ocean Current Vectors dataset in ArcGIS Living Atlas of the World.

↑ Flow is a great style to use to animate wind speeds and directions or ocean currents.

Create Thematic Maps in Minutes

It has always been possible to make these maps in ArcGIS Online and ArcGIS Enterprise, but it has previously required extensive customization and planning. Now, anyone can create insightful thematic maps in minutes rather than days, weeks, or months.

To learn more about the different smart mapping styles, check out the ArcGIS StoryMaps collection Smart Mapping Styles in Map Viewer at links.esri.com/smart-mapping.

Participatory Mapping Enhances Coordination of USAID Projects in Nepal

The United States Agency for International Development (USAID), formed in 1961, administers international aid and promotes social and economic development on behalf of the US government in countries all over the world. For years, the agency has worked in Nepal through the USAID/Nepal Field Mission. The purpose of this field mission is to design and execute development programs in sectors prioritized by the government of Nepal. These sectors include emergency response, economic growth, health, democracy and governance, education, agriculture, the environment, and disaster risk mitigation.

Given the hundreds of activities in various locations that USAID/Nepal supports, leaders have instituted a geographic approach to implementing, monitoring, and analyzing the outcomes of projects. It is a participatory mapping system, and—because of how easy the technology is to deploy and customize—it relies heavily on ArcGIS Online.

Geospatial Technology Guides Development Activities

In countries where USAID operates, the agency creates development programs based on a Country Development Cooperation Strategy (CDCS). The CDCS—which is prepared using a rigorous analytical process that aligns US resources with the host country's priorities—outlines goals and objectives that the host country aims to achieve over a five-year period.

"USAID/Nepal is one of the first field missions to adapt geospatial technology to its CDCS development cycle," said Indra Sharan KC, senior GIS adviser and geospatial analyst at USAID/Nepal.

The field mission has been using Esri technology since 2001 to better target humanitarian and development assistance via geospatial analysis, data visualization, and enhanced communication. It started by providing geospatial services to the entire USAID program in Nepal, which includes partners that oversee specific projects. Now, however, GIS at USAID/Nepal is a decentralized, participatory system that revolves around activity mapping—a standardized way of geospatially tracking all that goes into implementing USAID projects in the country, from strategic objectives to detailed results.

This is all part of USAID's Collaborating, Learning, and Adapting (CLA) framework, the central approach for how USAID works with partners and stakeholders in host countries on common development issues. The idea is to collaborate and learn from one another's shared knowledge and then use those lessons to improve development outcomes. Because all USAID/Nepal's projects are tailored to specific locations, it is a strategy that makes geospatial data an essential part of the decision-making process.

Connected Through ArcGIS Online

USAID's field mission in Nepal is a data-driven organization that employs geospatially referenced, multisectoral data from various organizations both within and outside the country. Data includes climate and weather information, poverty and income statistics, health and nutrition indicators, population and sociodemographic characteristics, topography and terrain, land-use and land-cover changes detected by remotely sensed imagery, human settlement and migration dynamics, conservation and development information, and economic activity indicators. The data also, of course, includes the locations of all the development activities that partners of the USAID/Nepal Field Mission are carrying out.

"We have an ongoing need for high-quality, disaggregated data that's collected rapidly, frequently, and accurately," said Sharan. And the technology that the field mission uses to gather and analyze this data needs to be "developed with limited human resources because we have a small staff," he continued. "So we standardized on the ArcGIS system because it requires minimum customization, allowing us to focus more on program goals."

The field mission and its implementation partners have worked with ArcMap and now use ArcGIS Pro. But ArcGIS Online is the backbone of the system.

"We are connected through our ArcGIS Online organizational account," said Sharan. "Partners using ArcGIS Online can replicate the common standards, data models, and apps and share the hosted feature services and geographic data that we provide."

USAID/Nepal staff and partners also use ArcGIS Survey123 and other mobile data collection apps built with ArcGIS technology to gather data on project infrastructure. In emergency situations, such as after an earthquake, this data collection often happens in near real time. Additionally, to store important datasets, staff and partners have access to ArcGIS Enterprise on Amazon Web Services via the USAID GeoCenter, which provides geospatial support to USAID programs throughout the world.

A Gold Mine of Insight for Decision-Making

The USAID/Nepal Field Mission works with more than 50 partners that conduct hundreds of activities at thousands of locations, according to Sharan.

"Documenting these locations with related project or intervention information is at the core of USAID/Nepal's work," he said. "Knowing and managing this data for the entire USAID/Nepal portfolio reveals a gold mine of insight for decision-making."

To keep track of all the USAID projects being implemented around Nepal, Sharan and his team developed activity mapping as part of the workflow process. This allows staff and partners to record information about their projects geographically, using a standard spatial referencing framework in ArcGIS.

"Maintaining all the related attributes for these activities using a standard activity data model—from the field data collected to strategic objectives—is the activity mapping workflow," Sharan explained.

Users at USAID/Nepal employ the Activity Data Organization Tool to input data about their activities into a geodatabase. Based on the level of detail and information required at various times over the course of a project, one of three data models is applied: macro, hybrid, or micro.

The Activity Mapping Tool allows users to crowdsource and map macro data, which tracks strategic USAID project information at the national and regional levels. Users employ
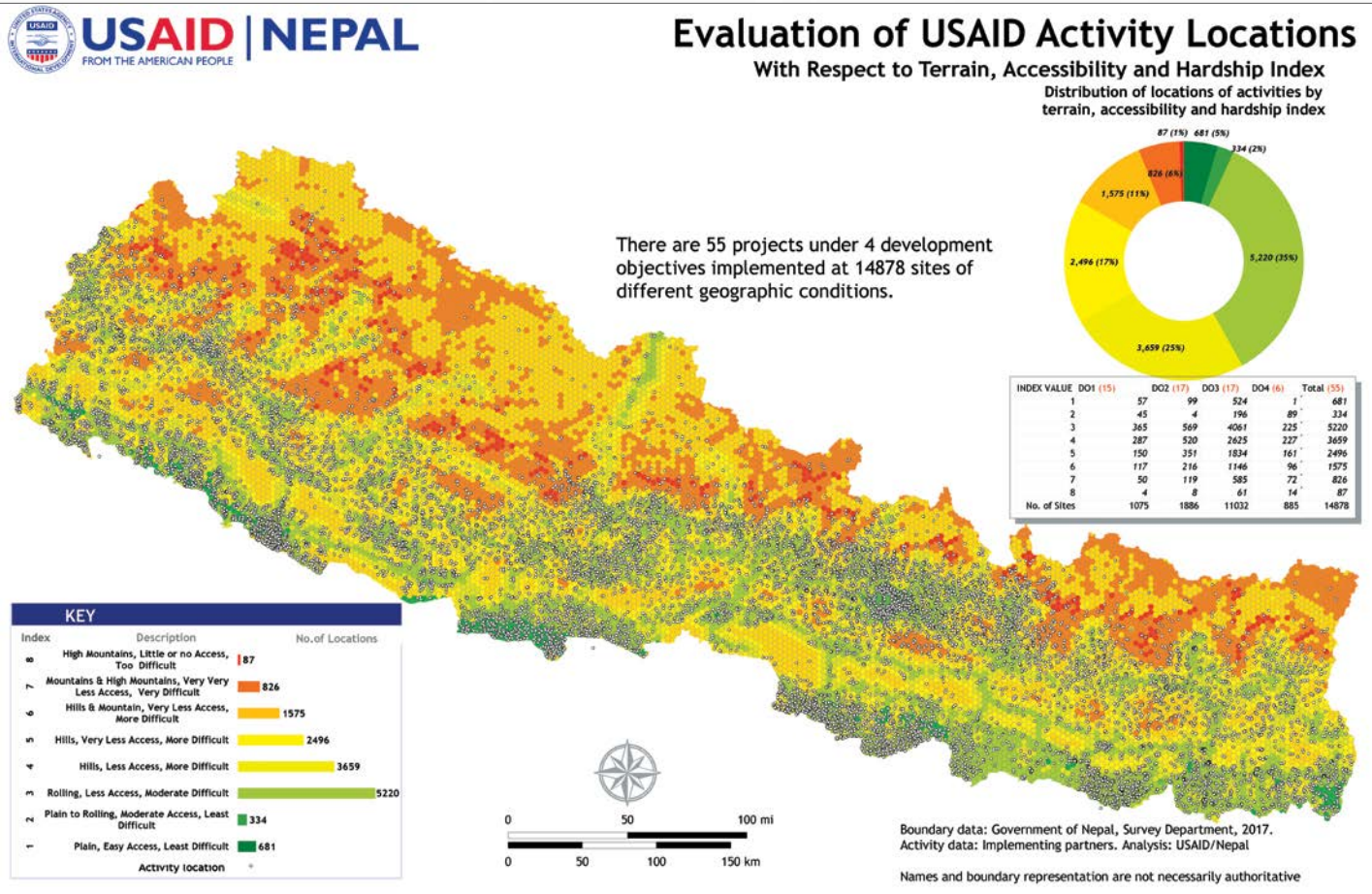
↑ Geographic conditions, such as terrain, accessibility, and demographics, are important to consider when planning development activities in Nepal's complex social and physical environments.

Note: One dot on the map is one activity location. There are 14104 dots (activity locations) on this map representing 56 different activities.

Projects are implemented in 3837 VDCs/Municipalities (out of 3912) in all 75 Districts.

USAID Nepal's Geospatial Lab designed this map from data as of August 1, 2016 received from Implementing Partners.
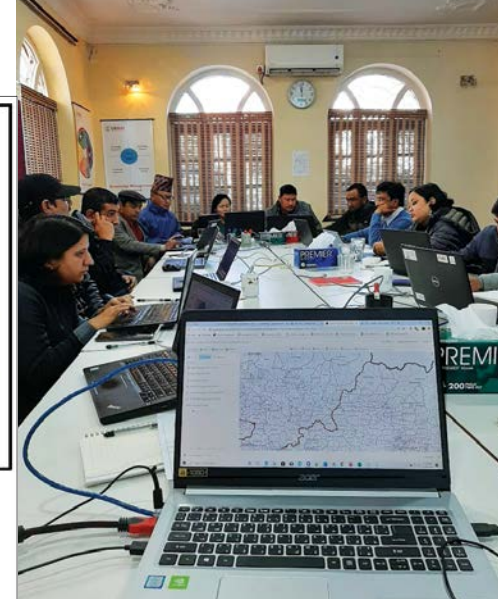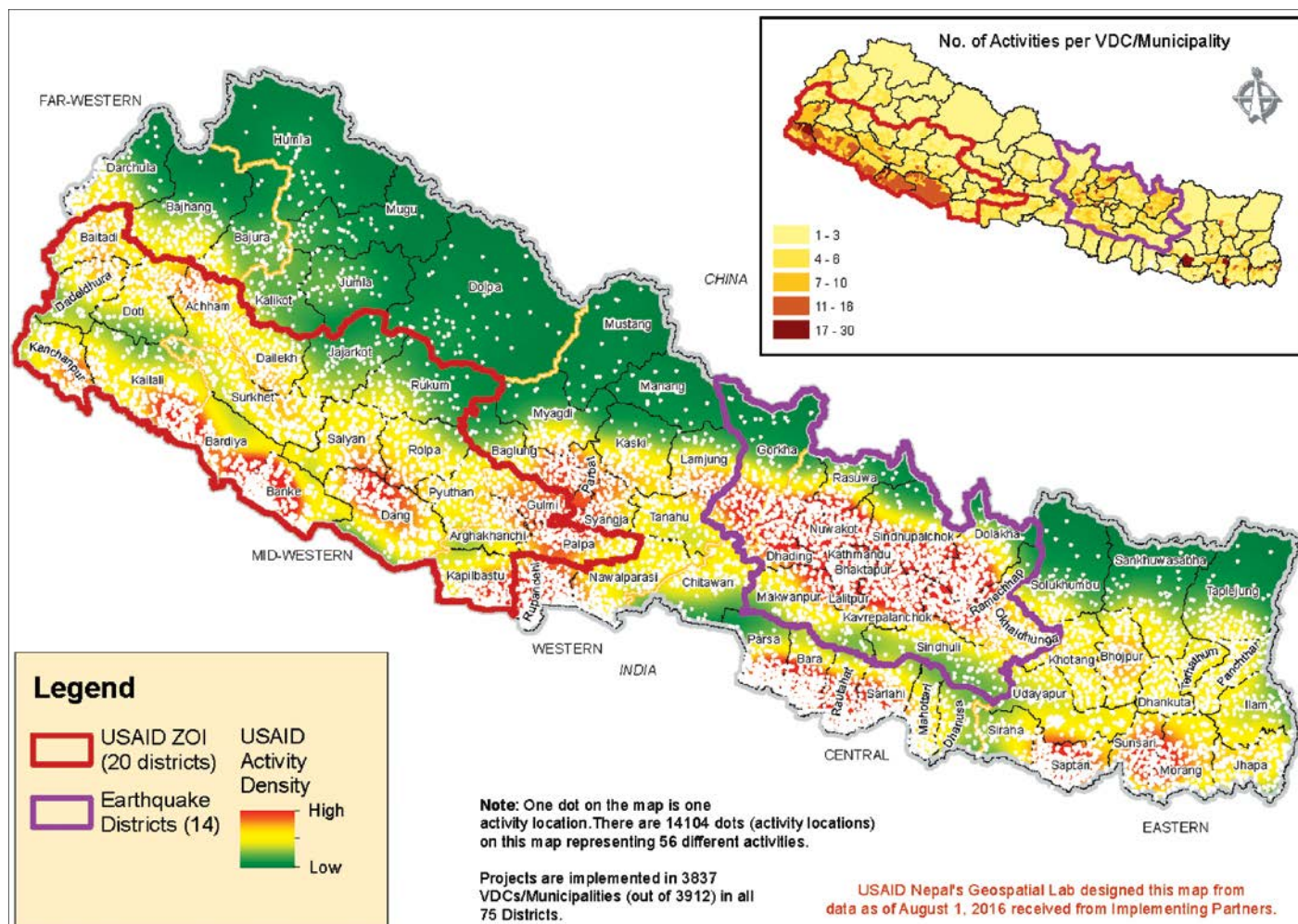
↑ Staff members from the United States Agency for International Development (USAID)/Nepal Field Mission trained partners in how to use the ArcGIS system to map and document their activities.

← A heat map of all the development activities associated with USAID/Nepal shows a high concentration of projects in areas that have been affected by earthquakes.

the same tool to crowdsource and map project information in a hybrid format that shows data about USAID/Nepal projects at a relatively more detailed scale. Finally, the Intervention Mapping Tool is used to capture disaggregated, micro-level data on projects and their results.

"USAID/Nepal staff held several half-day sessions with the partners to teach them how to use the system to map and document activity locations," said Sharan.

After experimenting with these methods for years, all USAID/Nepal implementing partners have been using the ArcGIS technology-based system to map their activities since January 2019.

Plans to Expand the System

Conducting participatory mapping on a standardized system using ArcGIS technology has been very valuable to the USAID/Nepal Field Mission. It provides timely, high-quality data; eliminates duplication; and improves overall operational efficiency.

"The activity maps have been strong tools in humanitarian assistance, geographic evaluation and targeting, adaptive management, policy analysis and strategic planning, and results-based management," said Sharan. "The 3D capabilities of the ArcGIS system create realistic geographic context and visualizations of the intervention sites throughout the country. The visualizations are provided to decision-makers, including the USAID/Nepal program managers located in Kathmandu. This helps them better understand the activities at the sites for subsequent projects and reporting."

Sharan and his team are currently exploring using ArcGIS Hub to develop an open data site that they can use to share data with citizens and partners.

"Our system is now being scaled up to provide access for development partners and local governments throughout the country with whom USAID operations interact," said Sharan. "It will be as a monitoring and mapping platform for enhanced coordination and better development outcomes."

He hopes that USAID/Nepal's work in GIS can serve as a model for other USAID missions all over the world.

Her Land, Her Power: How Geospatial Tech Secures Women's Land Rights

By Amy Coughenour Betancourt, Cadasta

> Editor's Note: This article was originally published as a guest blog post by the United Kingdom's Geospatial Commission. It has been lightly edited for clarity and style.

It is estimated that 70 percent of land in the developing world is undocumented. This makes one billion people vulnerable to eviction and, more specifically, affects a staggering one in five women globally, according to nongovernmental research organization Prindex.

Land rights are the foundation of stability and prosperity. Landownership insecurity—the fear of losing your home or the land on which you live and farm—is often linked to a lack of legally recognized landownership documents to prove or defend land claims.

Even when accounting for legal and cultural differences across countries, women are disproportionately disadvantaged when it comes to land access and property rights.

We know from evidence that when women do have secure landownership, the entire household benefits. Women increase their decision-making power, agricultural productivity, income, health and education spending, and investments in climate-resilient land practices. Conversely, landownership insecurity limits women's economic and social status and makes them and their families more vulnerable to poverty, eviction, conflict, land grabs, hunger, and climate change.

The Sustainable Development Goals (SDGs)—namely, SDG 1, to end poverty, and SDG 5, to achieve gender equality—call for reforms to give women equal rights to economic resources. These include access to ownership and control over land and other forms of property, as well as financial services, inheritances, and natural resources.

Esri partner Cadasta is a nonprofit global technology and services organization that enables vulnerable communities to affordably and easily document, map, and secure inclusive land and resource rights. By creating an accessible digital record of land, property, and resource rights and building local capacity, Cadasta helps empower individuals, communities, organizations, governments, and businesses with the information they need to make data-driven decisions and put vulnerable communities and their needs on the map.

Of the 5.8 million people registered on Cadasta's platform—who live in 3,566 communities across 44 countries on 20.6 million hectares of land—53 percent are women and girls. Registering women and girls for the platform is done through community and government engagement to change mindsets and practices, which complements the introduction of geospatial tools to achieve gender parity in the data.

Another essential tool for strengthening women's land rights is ensuring that women's names are on formal land documents. From the outset, Cadasta has helped its partners develop clear, localized gender inclusion strategies to close the gap between the law and the implementation of women's rights.

In Her Name: Ampol Satyavathi's Story

Getting her name on a land title was a life-changing experience for Ampol Satyavathi, a local vendor in a small fishing village near Konark, on the Bay of Bengal in the Puri district of the state of Odisha, India.

For 38 years, she lived in this informal community with no secure title to her home or land. Through a partnership with Tata Trusts and the state government's Jaga Mission—dubbed the "world's largest slumland settlement program" and winner of a World Habitat Award—Satyavathi's dream of owning her own place became a reality.

"I now have the document that proves that this is my home and my business," she said. "I feel more secure and am hopeful that this will help my business grow."

Facilitated by the use of geospatial technology and digital survey tools, all members of the community have received land rights documents. Additionally, the area has been upgraded with improved roads, markets, water and sanitation services, and lighting.

For Satyavathi and her community, geospatial technology, participatory community mapping exercises, and the resultant land rights have made a huge difference—all the more for children.

"The young people were the ones who proposed the road extension, the play area for the children, and the fish storage area," Satyavathi said.

In addition to securing Satyavathi's land, the collection and use of geospatial data have empowered people to set a course for the future of the whole community.

Mapping from the Ground Up

Considering women's rights and participation every step of the way, Cadasta provides the technology and geospatial tools that help document women's use of, and claims to, land. Making geospatial technology accessible allows the visualization and understanding of data in new ways, which further enables them to make decisions that will improve their lives.

The technology and geospatial mapping tools and workflows that Cadasta provides—including digital survey data collection—support full community engagement and empowerment. Cadasta's tools are taught to partners who then train community mappers and data collectors, including women and young people. Women data collectors help break down gender barriers during interviews with other women and model the power of women's digital literacy for the rest of the community.

Leveraging geospatial technology as a tool to lead efforts around gender equality, climate change action, land tenure, and the creation of more sustainable communities brings wider benefits. Cadasta demonstrates the art of the possible—what real-world progress looks like on the ground. The organization reflects to global stakeholders what local partners can do to lead their own development with enterprise-level technology, technical support, and targeted investments.

One way that governments, multilateral organizations, businesses, and philanthropists can lift women up through land rights is by providing them with access to enabling technology, including geospatial technology. This has the power to transform people's economic, social, and environmental situations around the globe—all for the better.

> Cadasta employs the following Esri technology in its organization and on the ground with partners and community members:
> - ArcGIS Online
> - ArcGIS Survey123
> - ArcGIS Field Maps
> - ArcGIS Dashboards
> - ArcGIS Hub
> - ArcGIS Experience Builder

About the Author

Amy Coughenour Betancourt is the chief executive officer of Cadasta, an award-winning nonprofit organization that develops and promotes the use of simple digital tools and technology to help partners share critical land and resource rights information. Betancourt has a wealth of experience working in resilience, food security, and rural development. She currently serves on the board of InterAction, an alliance of international nongovernmental organizations working in humanitarian assistance and development. She is also on the executive board of the Washington Capital Region chapter of How Women Lead, a national organization of top executive women focusing on leadership, philanthropy, and investment.
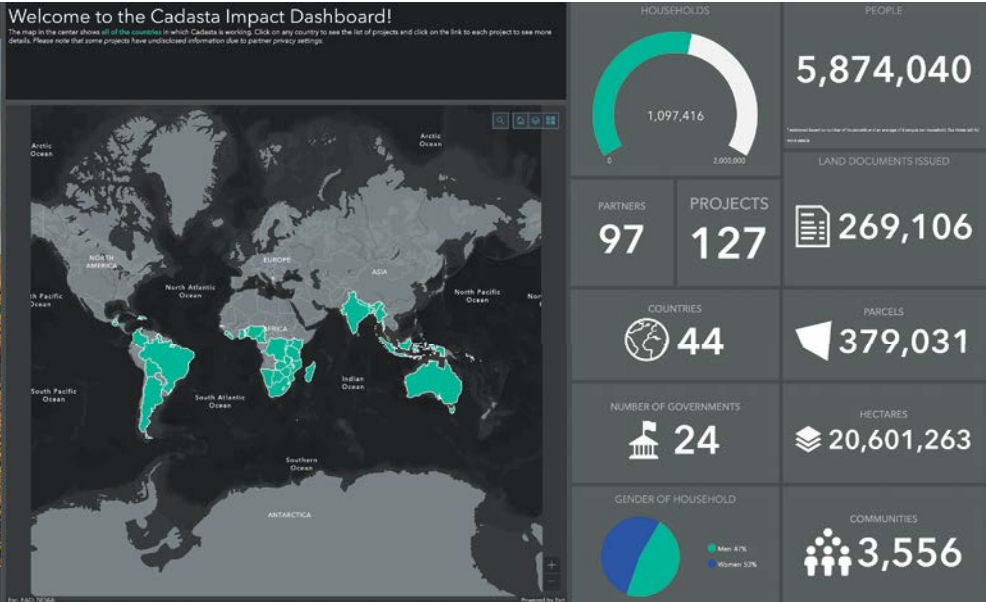
↑ Cadasta has helped issue nearly 270,000 land documents to local community members.

↑ Cadasta has worked with Aso Manos Negra, an organization in Colombia that's dedicated to promoting the economic sustainability and environment of the Afro-Colombian community. (Photo courtesy of Cadasta.)

Tell Your Personal Stories with the New StoryMaps App

Every moment and every memory is connected to a specific location. And now, everyone can capture and share their life's experiences using Esri's first direct-to-consumer product, StoryMaps.

A powerful, personal storytelling tool, StoryMaps brings the geographic approach to content creators. It offers one place for users with varied digital skills to build custom narratives; incorporate photos, videos, and interactive maps; and choose how widely to share their stories.

This is a novel way for anyone to create a travel journal, a résumé or portfolio, an event recap, a virtual tour, a recipe log, an ancestral journey, and so much more. And it's free to try.

To explore some inventive uses of StoryMaps and get an idea of how it is different from ArcGIS StoryMaps (Esri's storytelling offering for GIS professionals), let's take a look at how to create three different types of StoryMaps narratives with distinct purposes and audiences.

A Powerful, Personal Pilgrimage

The last two years have changed the way many people do things, including getting out into the world. Maybe you started a daily jogging routine or did some special hikes that you want to keep track of and remember—but only for yourself.

A personal story, kept private, can do just that. Weaving visual elements together with narrative text, StoryMaps stories generate immersive experiences that transport viewers back to each adventure, spectacular view, and special moment.

Once you enter the story builder, give your story a title, write an (optional) introduction, and start adding content. You can create your own map of each run or hike, picking from a number of basemaps to personalize your journey. You can also add images, videos, and audio files—and embed links to interactive content, such as activities recorded on the

Relive app. (The team is working on enabling uploads from wearable devices and other activity tracking apps, too.)

As you build your story, integrate text into the experience. Perhaps you had a profound or amusing thought as you gazed out over the horizon, and you want to remember where that occurred to you. Or maybe you wrote a poem when you got home that encapsulated the whole experience. You can incorporate this as simple text or even create a timeline that adds more detail.

Once your story is ready to publish, choose the Just me option to ensure that only you can relive your now-documented experience.

Fun with Food for Friends and Family

It's fun to cook new foods or spruce up an old recipe and then brag about the results! Wouldn't it be nice to have a place to compile all your favorite recipes, from Grandma's meatballs to that vegan pesto you made from kitchen scraps; keep track of details, like where the dish originates or which shops had the hard-to-find ingredients; and post pictures of the final product?

A collection in StoryMaps is a great way to do this. It offers one place to gather stories, PDFs, images, videos, and more that you can share with people via a link.

Let's say you want to put together a collection that consists of family recipes, your own kitchen concoctions, and lessons gleaned from cooking classes you've taken. It's simple with StoryMaps.

First, build individual stories for each of your recipes. For Grandma's scrumptious meatballs, you can start with introductory text about how you remember eating them as a child and include a photo of nine-year-old you with sauce all over your face. You might want to add a map that shows Grandma's house or where she learned to make the dish. Then write out the full recipe, complete with snapshots of your own adventures in cooking the family specialty.

Once you have a story for each family recipe, add all of them to your collection. Repeat the process for your own kitchen concoctions. And then—say you have tip sheets from the cooking classes you've taken—you can upload those as PDFs, include some photos or videos from the classes, and make that the last part of your collection.

When you're ready to publish your collection, choose the Anyone with link option to share it with only the people you want to see it. This enables family and friends to access your collection anytime, yet it won't appear on your profile page or in search results—so Grandma's meatball recipe stays a family secret.

Restaurant Recommendations for Restrictive Diets

Traveling is fun, exciting, and oftentimes challenging—especially if you have dietary restrictions. Finding bakeries with gluten-free fare or restaurants with more than one vegetarian option can require a lot of time and research. But once you unearth that special spot that has rich, wheat-free cupcakes; spicy vegan tacos; or juicy, meatless burgers, you want to shout it from the rooftops.

Let's say that, after a trip to Austin, Texas, you want to map out all the special-diet-friendly restaurants, bakeries, and coffee shops you patronized to help others easily find sustenance to fit their needs. Creating a map tour in StoryMaps is a great option for this.

To get started, launch a new story and, after customizing the introductory elements, add an immersive map tour. You can build your tour from scratch or start by uploading photos. There are two layouts to choose from: a guided tour, which takes viewers from one point to the next in the order you specify, or an explorer tour, which lets them decide where to go next.

When building an explorer tour from scratch, all you have to do is open a blank map and locate each restaurant, bakery, or coffee shop. This automatically populates the main map in your story. Add a title and description for each business and, if you want, include photos and videos from your experiences there. Do this for each eatery you want to highlight, and either include all your food finds in one map tour or split them up into separate stories based on dietary restriction or restaurant category. Then you can include those in a collection.

When you're finished and ready to publish your story or collection, choose the Everyone option. This makes it available on your author profile page, enables it to pop up in search results, and allows you (or anyone else) to share it on social media. Additionally, people on the go can take your restaurant recommendations with them by downloading the StoryMaps mobile app and finding your map tour there. StoryMaps is available in both the Apple App Store and Google Play.

There are so many more options for building stories in StoryMaps, and anyone can sign up for an account.

New StoryMaps users have access to Premium subscription features with enhanced storytelling capabilities for the first 30 days. After that, they can purchase a $10 monthly or $100 yearly Premium subscription or downgrade to the free, basic storytelling option.

For more information about StoryMaps and to get started using it, go to storymaps.com.

Working Together to Create Beautiful Science

Imaginative Professor Brings the Power of Community to GIS

↑ Tim Hawthorne
(Photo courtesy of
Kaitlyn Bower.)

When the GeoBus pulls up to a school, the driver turns off the diesel engine, flips a switch, and the former city bus—now expertly painted with geography scenes and equipped with workstations rather than seats—becomes a solar-powered geospatial learning lab.

"From there, an entire class of students works in small groups of three or four through a variety of learning stations, spending 20–30 minutes on each activity. And what they're doing is they're being introduced to different geospatial technologies," said Dr. Timothy Hawthorne, associate professor of GIS in the sociology department at the University of Central Florida (UCF) and the founder of the GeoBus.

There's a 55-inch touch screen whiteboard that students use to visualize geospatial data in ArcGIS Online. They put on virtual reality goggles to take simulated trips around the world. There's an augmented reality sandbox where students learn about topography, elevation, and contours. Three-dimensional, printed landscape models show the kids different terrains, from low-lying valleys to mountains and deserts. Laminated topographic maps from the United States Geological Survey and National Geographic familiarize them with basic wayfinding. Students also work with coding robots, learn to fly mini drones, and gather data on renewable and nonrenewable energy resources around their campuses using ArcGIS data collection apps and Bluetooth GPS receivers.

"It's all about getting them excited about the technology and working as a team," said Hawthorne, who, as a community-based researcher and public scholar, seeks to make GIS more inclusive of and engaging to a wider audience beyond the university setting. "The kids also get to meet UCF students, staff, and faculty so we can show them that there's a possible major for them here and a host of career paths."

Hawthorne thought of building a mobile GIS education lab almost 10 years ago, when he was an assistant professor of geography at Georgia State University and the state coordinator and director of research at the Georgia Geographic Alliance.

"Every state had one of these organizations at the time, and the idea was to connect K–12 educators and the broader education community with each other to build geospatial and geography learning opportunities," he explained. "We did a lot of outreach where I would pack up my Prius or a colleague's car and we would take everything we could to a school and set up shop for an afternoon. And I just thought, there has to be a better way—something bigger we can do."

That's when Hawthorne got the idea for a "geobus." He couldn't find anything like that in the United States, but he did find Columbia University's BioBus, a mobile science lab that serves young people in New York City. So he connected with the team there and met with others in the mobile lab community to get ideas for how to build his bus. All this came together around the time he moved to UCF, however, so momentum waned for a while.

In the interim, Hawthorne—true to form, it turns out—worked on a lot of other, concomitant projects.

"He's a big-idea guy, and he always follows through with those big ideas," said Dr. Lain Graham, a senior solution engineer for the national government sciences team at Esri.

Hawthorne was Graham's instructor when, as a graduate student at Georgia State, she took his study-abroad GIS course in Belize. He also advised her in her PhD studies at UCF. And now, Graham helps Hawthorne lead the undergraduate version of that research trip to the Central American country.

"It takes a big team to execute those ideas, and Tim recognizes that," she continued. "He's a very strong, collaborative leader, and he elevates people by enhancing their passions and augmenting those with additional skills."

"I seek out projects where I might be strong in one thing and somebody else is strong in something else, and we come together to create really beautiful science," Hawthorne affirmed.

Outside the classroom, Hawthorne does this through Citizen Science GIS, the research organization he founded that serves as an umbrella for various projects—many of which operate on grants from the National Science Foundation. These include, among other ventures, the GeoBus; the research trips to Belize; a program with the Smithsonian Institution that's using drones to map eelgrass in the Pacific Northwest; and a project to help a water utility in Orlando, Florida, map its infrastructure.

For all these projects, Hawthorne makes sure "the work is authentically grounded in community," he said, and that local residents and stakeholders are an integral part of the research process.

"Tim has changed the narrative in this respect and has challenged some of the more traditional approaches to doing GIS to make them more inclusive," said Graham. "He involves local knowledge in data collection and provides space to include unstructured, qualitative data in the research. The importance of diversity and inclusion is something that Tim is very aware of and uncompromising on."

In Belize, for example, Hawthorne and his teams have worked with local fishermen, tour guides, and boat captains to map coastal and reef environments. Community members' knowledge is prioritized in the research, and their stories are augmented with quantitative data that researchers gather with drones and data collection apps.

"Tim is very careful to let us researchers know what our roles and responsibilities are on these projects," explained Graham. "We are not the experts on the issues. We are there to collect data."

Hawthorne wants his students and research teams to recognize how the data they're gathering impacts communities and how those communities are part of the data.

"Data is incomplete when you talk about a community but you don't actually work with that community. That leads to more inequality. That leads to lack of access and representation," said Hawthorne. "What our work is really about is bringing those

voices in and ensuring that the data is representative of those communities and that their stories are being put at the same level as some of the other, more authoritative data sources that you might normally find in GIS."

When Hawthorne goes to Belize, he asks community members for permission to work in the area, whether they want to join the data collection team, and what questions the research team should be asking. When he works with kids on the GeoBus, he gives them the tools they need to do bona fide citizen science, like finding gaps in renewable energy sources on campus so they can encourage their teachers, principals, and school districts to make improvements.

"I would give this all up if I didn't feel that it was moving other people's lives forward," Hawthorne said in a nod to one of his own mentors, Dr. John Krygier, professor of environment and sustainability at Ohio Wesleyan University.

Krygier's class on the power of maps—which Hawthorne only took because it fit into his golf practice schedule—was the young college student's introduction to geography.

"It completely blew me away," Hawthorne recalled. "I learned how expansive geography was, and John—who is still a mentor and good friend of mine—was that professor who got me energized about the subject."

Hawthorne took another class with Krygier and ended up with a funded summer research project mapping recreational trails in Delaware County, Ohio.

"I not only learned GIS, but I also learned how to do interviews with community members," he said. "That was foundational for me because it showed that it wasn't just about the technology; it was about engaging people with the technology and connecting people with society. All that came from John Krygier."

Hawthorne, who is currently a 2022 National Geographic Explorer, said that, above all, he wants to be a good mentor.

"Anytime I can provide someone with the opportunity to work on something that they're excited about, that really drives me," he said.

And that drove him to finish the GeoBus project earlier this year. After procuring a bus and getting UCF students to help spruce it up, Hawthorne's GeoBus dream became a reality in February. With the $30,000 grant that he received from being a National Geographic Explorer, Hawthorne and his team of "GeoBus drivers of change" hope that, by making two to three visits per week to schools around Florida, they can reach 10,000 K–12 students this year.

"Let's build the next generation of people in science!" Hawthorne exclaimed.

→ The GeoBus is an old city bus that has been revamped as a solar-powered geospatial learning lab.
(Photo courtesy of Tyler Copeland.)

GIS Hero

MAPS AND DATA HELP SUNRISE LA TELL COMPELLING CLIMATE STORIES

↑ Sunrise Movement activists encourage people to stay focused on climate change.

Founded in 2017, the Sunrise Movement is a youth activist group in the United States that seeks to stop climate change while generating good, green jobs. The movement began when young people at universities along the East Coast started forming so-called hubs where they could meet others who shared their goals of developing healthy communities; preserving the planet; and creating high-paying, environmentally friendly jobs. Today, the Sunrise Movement is a nationwide organization with more than 400 hubs and 20,000 members.

Using strategies from the 1960s civil rights movement, including staging sit-ins and engaging in acts of civil disobedience, Sunrise activists encourage their elected officials and the public at large to stay focused on climate change. They champion many of the policies advocated in the Green New Deal, including getting the United States to net-zero greenhouse gas emissions, investing in green infrastructure, helping communities build resilience in the face of climate change, and promoting equity and social justice. The activists want to elevate these goals to be the defining issues of today's political agenda.

Sunrise Movement LA is one of the movement's many hubs that now exist. Formed in 2018, it promotes environmental advocacy; fair housing practices; racial equity; and economic and social justice in and around the Los Angeles, California, area.

"These issues are all intimately tied to the way the climate crisis affects those living in major cities," said Justin Chow, GIS team project leader for Sunrise LA. "The transition to a low-carbon future is connected to workers' rights, land use, and how people are treated."

Sunrise LA, which gains a lot of momentum from in-person events, started using Esri technology in mid-2020 in response to the COVID-19 pandemic.

"Prior to that, we had significant momentum from monthly youth climate strikes held at the end of 2019, including one led by Greta Thunberg," said Chow, referring to the teenage environmental activist from Sweden who rose to prominence for going on strike from school every Friday to protest inaction on climate change. "Organizers estimate that that strike was attended by about 3,000 people. However, by March 2020, like the rest of the city, Sunrise LA was hit hard by COVID-19. Local, in-person actions that had fueled our momentum were immediately halted, and the organization scrambled to figure out how to proceed."

GIS team leaders chose to use ArcGIS Online as one way to help members continue their efforts remotely. In particular, ArcGIS StoryMaps helped Sunrise LA tell its story with maps and combine data with strong messaging to encourage more people to get involved.

"ArcGIS StoryMaps can support communicating our climate crisis message and its associated issues in a very personal, compelling, and visual way," said Chow. "Technically speaking, ArcGIS Online saved our team lots of time with its huge library of data already uploaded or readily connectable."

One ArcGIS StoryMaps narrative that the team has created is called *The Rise of a Movement: How Far We've Come*. It showcases the group's most significant actions since its founding.

"Relatively nontechnical team members could understand ArcGIS StoryMaps and be trained in little time," said Chow. "Even for experienced users, the tool felt powerful enough to do almost everything we wanted."

The main part of the story is a map that illustrates Sunrise LA's strong commitment and connection to Los Angeles by showing where it has organized various actions throughout the city. A timeline details the numerous strikes, marches, banner drops, and trainings that Sunrise LA has put together. A choropleth map also shows how many people in different parts of Los Angeles receive Sunrise LA's newsletter, giving viewers an idea of the reach the local movement has. The goal of this story is to inspire more people living in the area to join the movement.

Another ArcGIS StoryMaps narrative that the team developed is called *Neighborhood Wells*, and it tells the stories of people who live near urban oil and gas wells in Los Angeles. The city is home to 26 oil and gas fields and more than 5,000 active wells, making it the largest urban area for oil and gas extraction in the United States. Some well sites share walls with residential units, and numerous inactive wells still pose health risks to neighbors.

To get baseline data for this narrative, Chow and his team tapped into well map data from the California Department of Conservation's Geologic Energy Management Division (CalGEM).

"This made the experience more 'plug and play' and let us focus on the value add of telling people's personal stories," said Chow.

Video interviews conducted with people who have been adversely affected by well sites are embedded in the story. There is also a feature that allows viewers to search for wells in the Los Angeles area by ZIP code.

Activist Nalleli Cobo is featured in the *Neighborhood Wells* story. She grew up 30 feet from a drill site in South Central Los Angeles, near the University of Southern California. A sign posted at the drill

site, which is shown in Cobo's video, reads, "Warning, this facility contains one or more chemicals known to the State of California to cause cancer, birth defects, and reproductive harm."

"What started with headaches and stomach pains led up to body spasms so severe I couldn't walk," Cobo says in the video. "I [developed] a reproductive kind of cancer. People don't develop that kind of cancer at the age of 19."

Cobo says in the video that she believes her physical ailments were a direct result of her exposure to toxic chemicals released during drilling. Ultimately, through actions taken by Cobo and others, the oil company was ordered to cap its 21 wells on the site because of numerous violations.
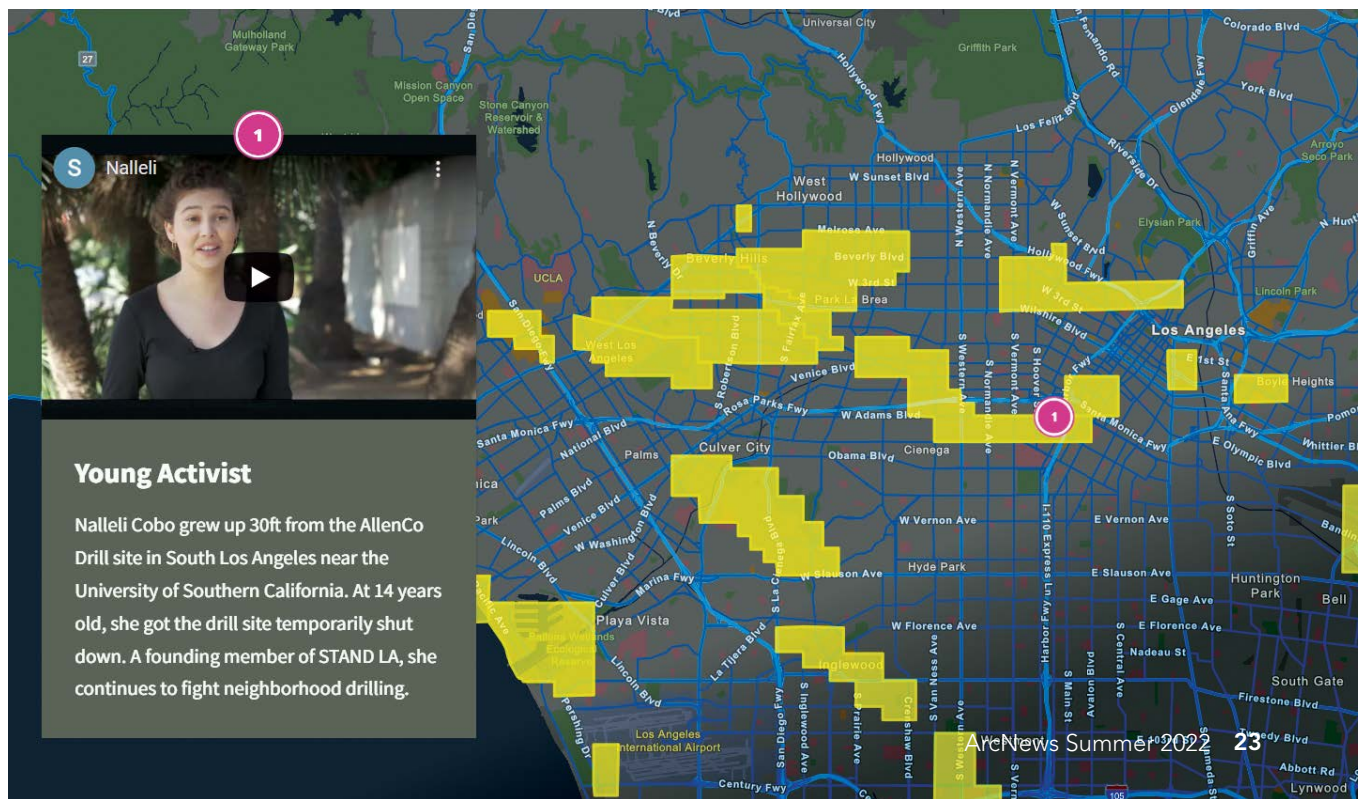
While marginalized communities have faced the greatest challenges from oil and gas drilling in Los Angeles, other local communities have also felt the effects. For example, there are 19 recently capped oil wells on the campus of Beverly Hills High School. One of the well pumps used to burn off excess gases burst into flames in August 2019, spewing toxic smoke onto campus and into the community.

"The climate crisis has metastasized to such a colossal scale that we in the US need to mobilize on a national level," said Chow.

He cited findings from Harvard Kennedy School political scientist Erica Chenoweth's studies that found that it takes around 3.5 percent of the population actively participating in a cause to bring about serious political change.

"That requires 11 million people here in the United States to convince government to take bold action on the order of President Franklin Roosevelt's New Deal," said Chow. "This is a tough road that requires an immense grassroots-level effort, but it is critical to our collective future"—which is what Sunrise LA's ArcGIS StoryMaps narratives powerfully show.

↓ *Neighborhood Wells* tells the stories of people who live near urban oil and gas wells in Los Angeles, California.

Young Activist

Nalleli Cobo grew up 30ft from the AllenCo Drill site in South Los Angeles near the University of Southern California. At 14 years old, she got the drill site temporarily shut down. A founding member of STAND LA, she continues to fight neighborhood drilling.

CONNECTING ONLINE IS CONNECTING GEOGRAPHERS

Last year, I called the COVID-19 pandemic "the crisis of our lifetime"—one that trained "a merciless lens on the social and racial fissures that already made life difficult for so many people." (See "Pulling Together When a Pandemic Pulls Our Lives Apart," from the winter 2021 issue of *ArcNews*, at links.esri.com/meridian-winter21.) This is even truer today, as the pandemic's impact aggravates newer, equally urgent crises around the world. These stressful events reinforce how vital it is for people to connect, especially when we're not in the same room or even on the same continent.

Since COVID-19 transformed our lives at home, at work, and in school, the American Association of Geographers (AAG) has engaged in a broad, online service and community-building experiment for geographers and geospatial scientists. We have offered more than 100 varied learning events online—through our website—to graduate students, young geographers, aspiring leaders, and colleagues in the discipline. I'd like to share what we have learned while creating and scaling up these educational offerings for geographers around the globe.

THE BIG SHOCK OF 2020

In March 2020, staff members at AAG were in the final weeks of preparing for the organization's annual meeting. Suddenly, we all went home. Housebound alone or with partners, roommates, children, and/or pets, we embarked on a new kind of office life. Our members worked and taught on-screen—often without adequate child- or other family care—while experiencing illness among ourselves and loved ones. Soon, many were burned out. This crisis was particularly acute for the medical geographers and GIS specialists who were producing a record number of COVID-19 dashboards, as well as for professors and instructors.

COVID-19 created especially challenging circumstances for students and people just starting out in their careers. In a policy brief released in July 2021, the Organisation for Economic Co-operation and Development (OECD) noted impacts from rising youth unemployment rates in virtually all OECD countries, including increased depression and anxiety (rates were 30–80 percent higher among young people than the general population in three OECD countries, including the United States). Additionally, the OECD reported declines in access to education and increased housing insecurity for young people worldwide.

At AAG, we were also worried about geography students being cut off from campus resources, facing technological barriers at home, and not being able to complete their research projects. This shock reverberated across the sciences. A study conducted by the National Opinion Research Center (NORC) at the University of Chicago found that 67 percent of science, technology, engineering, and mathematics (STEM) research at 208 of the leading graduate science programs had to be put on hold or discontinued due to the pandemic.

These stressors fell disproportionately on women; people experiencing poverty; and members of Black, Indigenous, (and) People of Color (BIPOC) communities. According to "Geographies of the COVID-19 pandemic," a paper published in mid-2020 in *Dialogues in Human Geography*, "There is an emerging consensus that low-income communities, the working class, women, people of color, and Indigenous people are being more significantly impacted by the pandemic in relation to health, working arrangements, and social and economic hardship."

In the summer of 2020, AAG convened an all-volunteer COVID-19 Rapid Response Task Force to develop diverse remedies to support our international community of thousands of geographers and spatial scientists—many of whom are graduate students and early career geographers. These remedies often focused on issues in the discipline that were present before the pandemic, including the need for racial equity, training and networking opportunities for geography department leaders, and career help. AAG and Esri partnered on one such program, Bridging the Digital Divide, to meet the equipment and technical needs of undergraduate geography students at minority-serving institutions (MSIs). Since the program's inception, AAG has distributed more than $580,000 in funds—including member contributions and $50,000 from Esri—to 23 MSIs in the United States.

AAG also created dozens of online webinars in 2020 and 2021 to help members hone their research skills, support academic department leaders, train students in new quantitative and qualitative research methods, explore critical issues related to geography practice and geodata, and provide educational and mentoring support. These webinars—which have attracted approximately 6,000 attendees so far and are continuing throughout 2022—appeal to geographers at every stage of their careers.

WHILE FACILITATING ONLINE LEARNING, WE LEARNED TOO

Did I mention that all this intense activity was carried out as AAG shifted its annual meeting from in-person to virtual, three years in a row? While AAG staff members moved thousands of sessions, keynote presentations, and networking and mentoring events online—each time in a matter of weeks—we were thinking through the profound changes coming to our field via the increase in online-based professional development. Here are just a few lessons we've learned.

Face-to-Face Connection Is Beneficial—Even On-Screen

During AAG's webinar series to introduce graduate students to various research methods and helpful applications, facilitators knew that it was equally important to engender peer-to-peer connection and offer mentoring opportunities. To create this sort of supportive atmosphere, the series included writing workshops and discussions focused on confronting mental health needs in the academy. Moderators were creative in their icebreaker exercises and use of networking tools, activating everything from informal polls and in-the-moment mapping to carefully managed virtual breakout rooms that encouraged small-group and one-on-one conversation.

↓ The American Association of Geographers (AAG) creates a supportive atmosphere by fostering face-to-face connections, especially during virtual events.
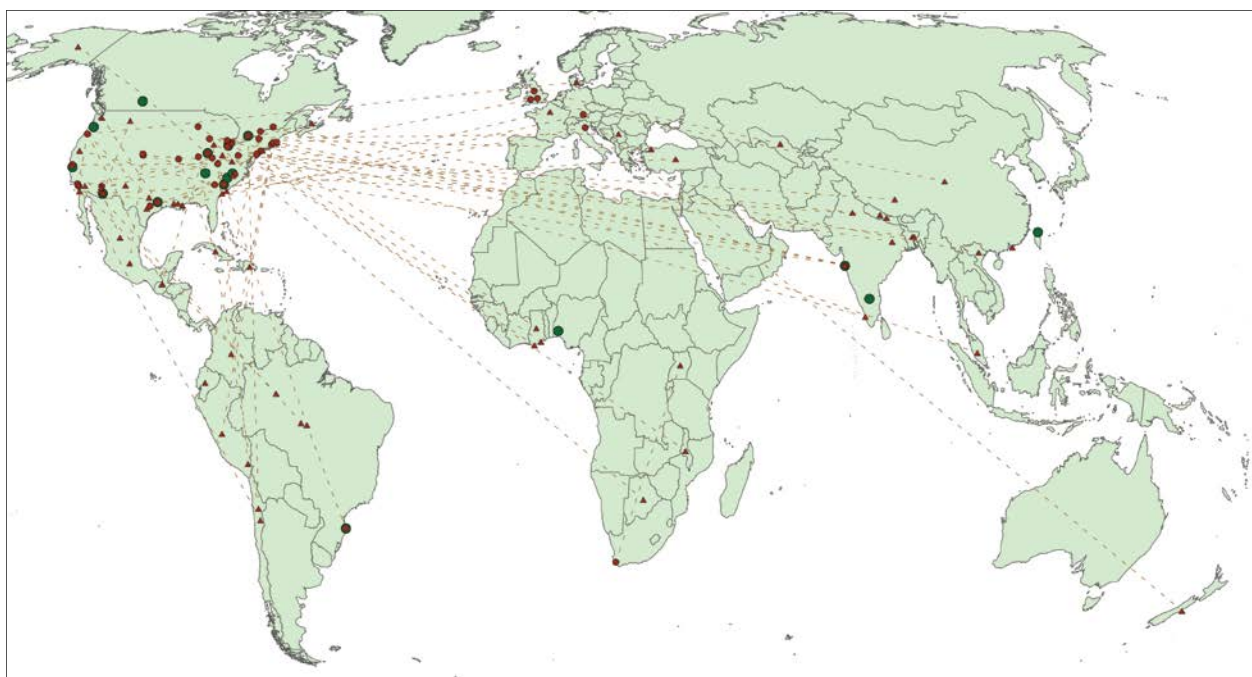
Taking the Whole Person into Consideration Is Vital

An all-remote learning program reinforces the importance of being aware that each participant is a whole person. When planning AAG webinars, we now ask ourselves questions such as the following:

- What do attendees need beyond facts and content?
- How can our learning offerings and modalities embrace differences; cross time zones; accommodate people of varying abilities; and acknowledge participants' caregiving and other teaching or learning commitments while empowering them with new skills, perspectives, and contacts?
- How can our programs impact people's careers, whether they work in academia, research, or teaching or have jobs outside that realm?

Erasing Distance Is Valuable in So Many Ways

Since 2020, AAG's learning opportunities have convened participants from dozens of US states and at least half a dozen other countries. We are finding that these learning opportunities are a powerful way to attract newcomers and reduce or address some of the most significant barriers to learning—namely, cost and distance. One of the most important insights we've gained is how teaching and learning can travel long distances and attain global scale with the blink of a cursor.

WHERE DO WE GO NEXT?

After more than two years of hosting digital events and get-togethers, here is where AAG now plans to take its online learning opportunities:

- **Continue to focus on professional development:** This spring, AAG wrapped up its second series of Professional Development Webinars, which have two tracks: one for people early in their careers and one for those who lead departments. We will offer the next series of webinars in the fall.
- **Maintain support for graduate students and early career geographers:** AAG's summer series for geography graduate students and new geographers offers more than 40 courses that cover topics ranging from how to conduct a literature review and do research to how to navigate the job market both inside and outside academia. In courses, forums, seminars, and graduate-led working groups, participants can learn about everything from how to work with data analytics and create mutual care networks to various visual methods of analysis and theoretical research frameworks. Some forums and seminars are still open for registration.

- **Extend the emphasis on advocacy and contemporary issues:** AAG convenes virtual meetings on a range of issues that are relevant to geographers, including geoethics, innovation in GIS, and the role geographers play in redistricting in the United States. These events pop up throughout the year and are open to geographers and professionals from other disciplines, whether they are AAG members or not.

One participant in an AAG workshop said, "It made me feel part of a community that is willing to exchange and share ideas and knowledge. We need more workshops like this, even beyond the pandemic!"

At AAG, we are glad to continue this work of fostering connections, aiding with professional development, and building a strong and lasting community for geographers and geospatial professionals. We hope you will join us, take part in one of our events, and explore the potential of "place" to be a collaborative and transformative meeting point, wherever you're located.

Find out more about upcoming AAG events at aag.org/all-events.

↑ About 250 AAG members participated in a series of webinars for graduate students in 2021. This map shows the locations of 102 of those participants' universities; whether they were doing local research (green circles) or nonlocal research (red circles); and, if they were doing nonlocal research, where that research was taking place (red triangles). (Data and map design provided by Julaiti Nilupaer, AAG.)

From the Meridian is a regular column from AAG, a nonprofit scientific and educational society whose members, from nearly 100 countries, share interests in the theory, methods, and practice of geography. Find out about AAG's programs and membership at aag.org.

About the Author

Dr. Gary Langham is the executive director of AAG. Previously, he was vice president and chief scientist at the National Audubon Society. In 2000, Langham founded the Neotropical Grassland Conservancy to foster grassland research with grants and equipment. He completed a National Science Foundation bioinformatics postdoc at the University of California, Berkeley, and received his PhD in ecology and evolutionary biology from Cornell University.

Portuguese Wine Producer Digitally Transforms Operations with GIS

Symington Family Estates has been producing wine in Portugal's famed Douro region for five generations. The family business—which specializes in port but also produces other highly regarded wines—owns 26 *quintas*, or estates, that total nearly 2,300 hectares (5,500 acres) of land. More than 1,000 hectares (2,500 acres) of that is vineyards.

In 2010, Symington sought to improve its technical capabilities for land-use and crop management to make them more efficient. At the time, many of the company's records and procedures were still documented on paper and stored in filing cabinets. Digital records resided on individual computers or in siloed servers. But the company's viticultural, enological, and IT teams were familiar with the capabilities of GIS, so they contacted Esri Portugal for a consultation. Symington ended up implementing a comprehensive ArcGIS Enterprise solution that continues to underpin its cultivation and wine-making processes today.

"This was the foundation for the digital transformation of operations at Symington Family Estates," said Rui Roda, business manager at Esri partner whereness, a spin-off of Esri Portugal that took the project over in 2018. "From the beginning, there was a strong perception that a GIS-based solution could facilitate everyday field operations and that centralized, shared information would make a major contribution to the farm managers' knowledge and their ability to exchange ideas with one another."

To fulfill known and anticipated needs over the years, staff at Symington have regularly proposed and requested new GIS apps. For example, when the enology department, which oversees wine making, needed a way to register and monitor wine production processes, staff members adopted ArcGIS Survey123. The form-based app made it easy for them to record structured data about all the events that occur during and after the fermentation process.

The company also uses imagery to monitor things like soil moisture in its vineyards. To make all relevant imagery accessible to people in various departments, whereness developed a single point of access for Symington in ArcGIS Enterprise. This comprehensive solution is composed of several apps and modules, including ones for land and crop management, keeping track of seasonal activity, monitoring plant conditions, and recording Normalized Difference Vegetation Index (NDVI) measurements.

"The system has secure access—named users—and the applications are accessed through a single sign-on," said Roda. "ArcGIS Enterprise aggregates all the web applications—for land use, harvesting, phenology *[the study of cyclical biological events in relation to the climate]*, activities, etc.—that were created with ArcGIS Web AppBuilder templates and customized with JavaScript widgets."

Staff members at Symington also use Survey123 for mobile data collection out in the vineyards. The app's ability to maintain data integrity when recovering from data connection failures is critical. Many of the farms in Douro are in deep valleys at river level, so 3G and 4G mobile network signals are not always stable enough for data transmission.

The GIS workflow at Symington parallels that of the annual cultivation and production of wine. It begins with the new season in December or January of each year. Initially, parcel geometry and grape varieties are confirmed and updated in the GIS if necessary. All field activities, from pruning to fertilization, are recorded.
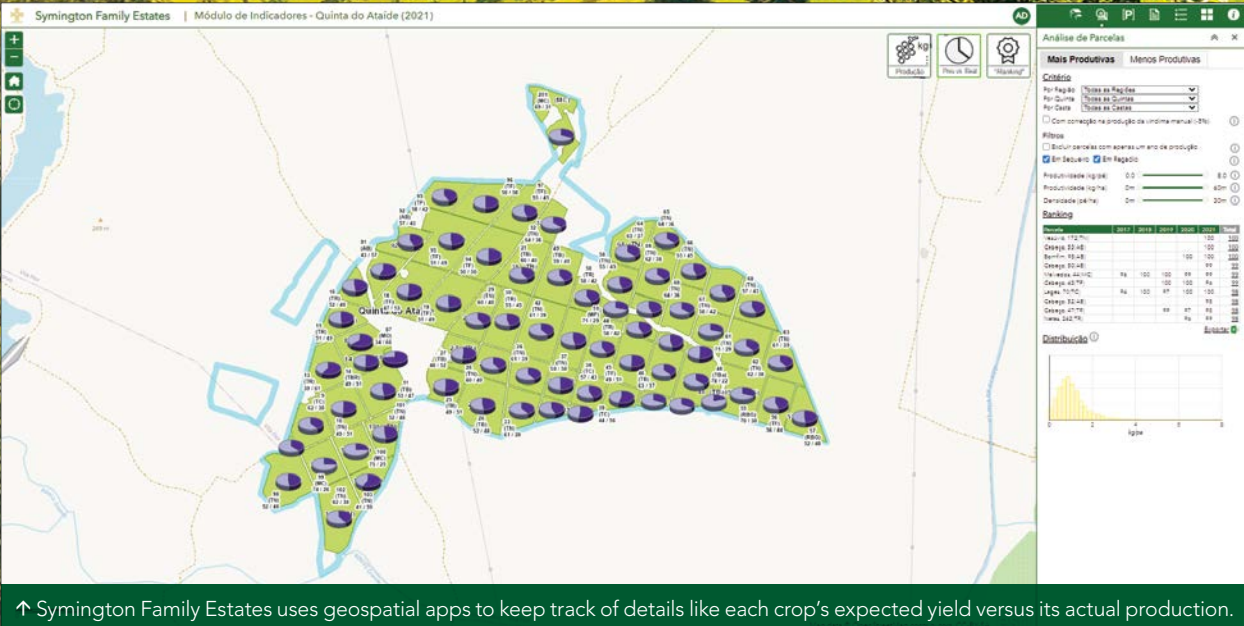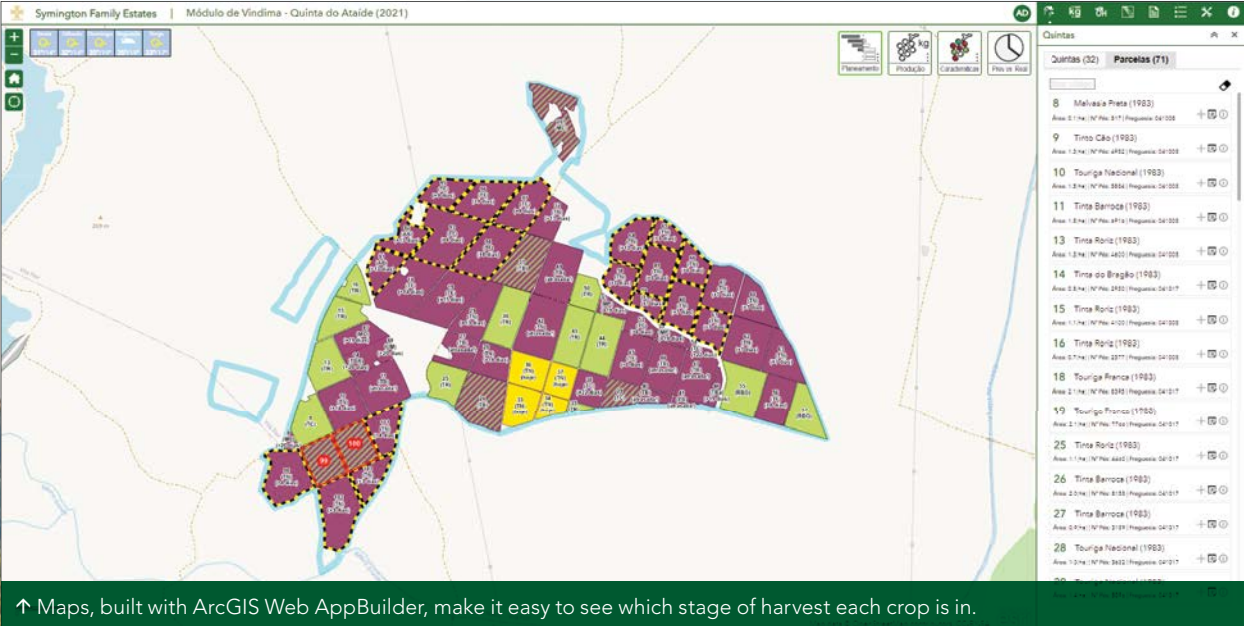
From March through June, the condition of the vines is carefully evaluated and documented three separate times. By the end of July, managers submit their crop plans and production estimates—both of which are based on GIS analyses of previous crops. These reports go to the head of viticulture and the production director, as well as the heads of port wine enology and Douro DOC (*Denominação de Origem Controlada*, or controlled denomination of origin, which guarantees the quality of wines from this region).

Production data is submitted to the system when harvesting begins, typically in the first week of September. Harvesting continues for two months, during which the production status of each parcel is individually monitored and recorded.

By the end of October, the harvest is complete, and all the final production reports are generated in ArcGIS Enterprise to give to management.

"Anyone looking at our GIS system would not imagine that there are 12 years of hard work in its development, because everything seems so simple and logical," said Pedro Leal da Costa, head of viticulture at Symington Family Estates. "It takes a few seconds to obtain a planning map for a particular vintage or a production map for all farms. It's easy to understand from images what we have harvested and still need to harvest. And the system is intuitive when recording events inside a cellar—for example, recommending the necessary follow-up to monitor port wine fermentation."

The next steps for Symington include looking into adding a hydric soils report to the data stack and evaluating the benefits of viticultural zoning. The winemakers are also interested in integrating ArcGIS Enterprise with other systems, such as enterprise resource planning platform SAP S/4HANA Cloud.

↑ Maps, built with ArcGIS Web AppBuilder, make it easy to see which stage of harvest each crop is in.

↑ Symington Family Estates uses geospatial apps to keep track of details like each crop's expected yield versus its actual production.

↑ It is now easy for staff members to keep tabs on the status of the harvest.

Street Sweepers, GIS Help North Las Vegas Determine Roadway Improvement Costs

By Dale Daffern and Dan Herrman, City of North Las Vegas

For most cities, keeping paved roadways in good condition is the single largest maintenance function they perform. This includes sweeping streets; patching pavement; applying life-extending overlays to streets and highways; and road striping to ensure that drivers, pedestrians, and others know the rules of the road.

Having a complete inventory of public roadway surfaces and pavement conditions is the first big step any city needs to take when looking to understand what kinds of road-based maintenance and improvements to undertake. Knowing the number of paved lane miles and the condition of the paved roadway network is critical for determining future maintenance costs and prioritizing funding.

Over the last several years, the City of North Las Vegas, Nevada, has used ArcGIS technology to map its entire 102-square-mile area and create the various infrastructure layers needed to develop a geodatabase of off-site improvement projects (i.e., construction projects to repair and enhance infrastructure used for public travel). The aim was to build a roadway network schema that the city could employ to determine where pavement replacement needed to occur and how much it would cost. Now, this data is being used for longer-term planning on other roadway projects throughout North Las Vegas.

Putting Hodgepodge Data into a Single GIS Layer

As in many cities in the United States, North Las Vegas consists of private roads and public streets and highways that are maintained by different authorities. Moreover, the city is continually growing. From 2015 to 2020, it added 20.6 centerline miles to its road network, increasing its roadway profile by 3 percent over that five-year period. Thus, conducting a roadway inventory and converting it into useful data wasn't a straightforward process and required frequent updates.

The inventory that the City of North Las Vegas carried out includes 640 centerline miles of public paved streets and 176 centerline miles of private paved roads. Since the city only maintains public roads, mapping and evaluating the public roadway network and associated road conditions in a single GIS layer was a major component of assembling the geodatabase.

To map the roadways, the city's GIS analysts relied on parcel and centerline data compiled and maintained by the county. Relevant parcel information was obtained from plat maps, and each parcel was assigned a value to denote whether it was a public or private roadway. Analysts then used ArcGIS Desktop to query the public roadway parcels and join them to the street centerline data in the roadway layer.

While developing this layer, analysts discovered that the region has a long history of changing approved roadway widths and realigning streets. They also learned that there was limited data available on roadway conditions. Most historical information was maintained on hanging paper maps, in Mylar plans stored in slide drawers, and on various spreadsheets used throughout the city's public works department. This hodgepodge data made it difficult to develop a roadway network schema.

To assist with all this, the city's GIS analysts obtained raster aerial imagery of North Las Vegas from Esri partner Nearmap and stitched the images together in one seamless image database (SID) file using GeoExpress from Esri partner LizardTech (now Extensis). Analysts also reviewed scaled civil design drawings and evaluated historical pavement records to determine roadway dimensions and pavement thickness—something that had never been entered into the city's GIS. This allowed the analysts to incorporate the condition and thickness of pavement sections as attributes in the roadway network layer.
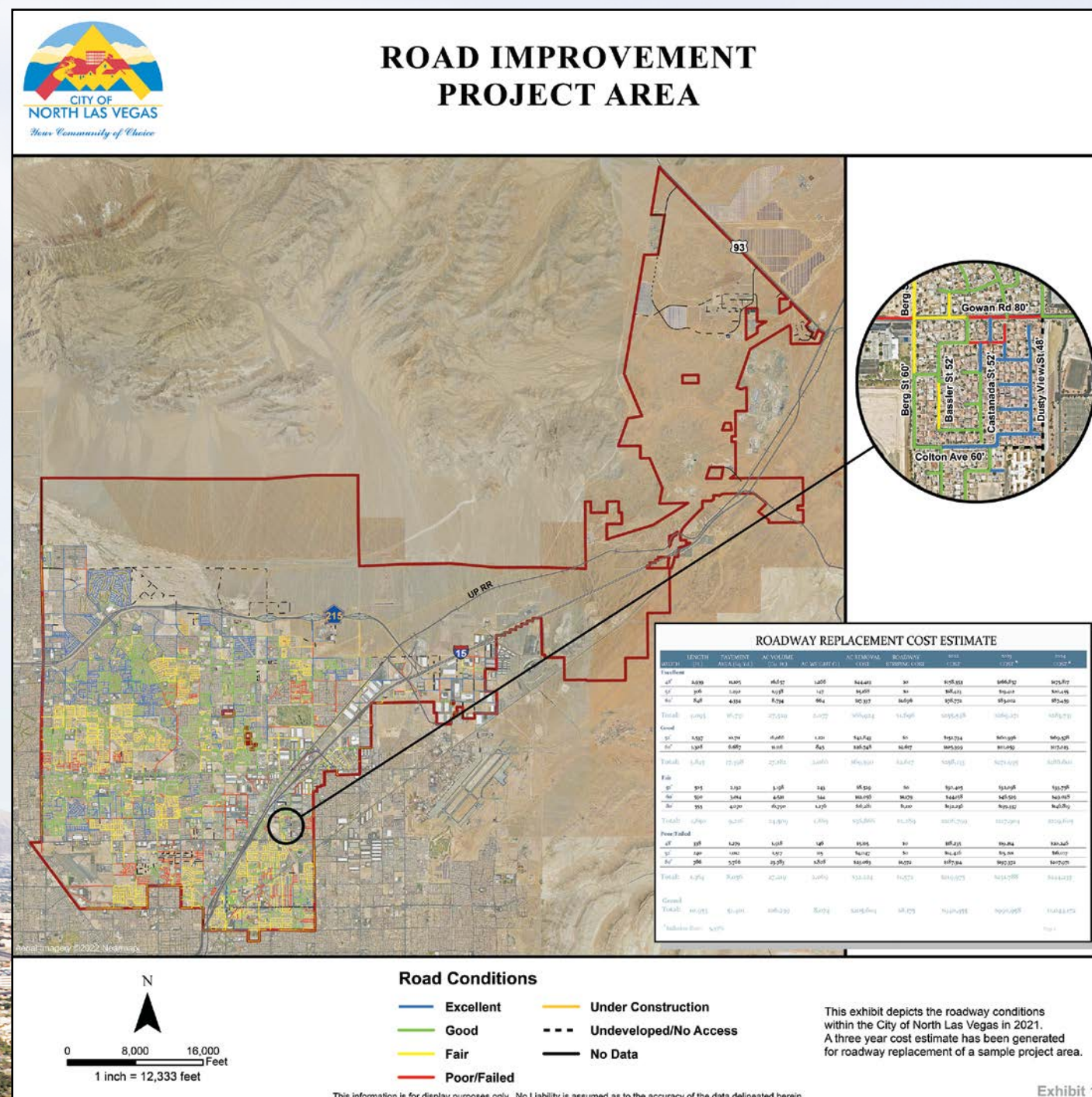
Street Sweeper Operators Become Data Collectors

The next step was to determine the condition of roadway pavement throughout the city. And the team had an interesting idea: to have street sweepers collect data on road surface conditions.

For street sweeping, North Las Vegas is divided into 16 zones that are cleaned on various days of the week. Each street sweeper is equipped with software that records its location in real time. The idea was to have street sweeper operators use a four-button panel installed in the cab to record pavement conditions as they went over each section of street on their routes. The four-tier visual rating system worked as follows:

- Button 1: Poor/Failed roadway condition
- Button 2: Fair roadway condition
- Button 3: Good roadway condition
- Button 4: Excellent roadway condition

Each time an operator pressed one of these buttons, a ping within the city's fleet management system provided the location of the sweeper and assigned the corresponding pavement condition to the section of road being driven. When the roadway condition changed, the operator pressed a new button to record another geolocation and register the new roadway condition going forward.

The city's street sweeper operators generated 30,000 data points on roadway conditions throughout North Las Vegas. These were downloaded as a shapefile in ArcGIS Desktop and

ROAD IMPROVEMENT PROJECT AREA

Road Conditions

- Excellent
- Good
- Fair
- Poor/Failed
- Under Construction
- Undeveloped/No Access
- No Data

This exhibit depicts the roadway conditions within the City of North Las Vegas in 2021. A three year cost estimate has been generated for roadway replacement of a sample project area.

1 inch = 12,333 feet

This information is for display purposes only. No Liability is assumed as to the accuracy of the data delineated herein.

Exhibit 1

← The City of North Las Vegas inventoried 640 centerline miles of public paved streets and assigned them road condition ratings.

Road Selection and Cost Estimator Model

and determine funding for other roadway projects. The new network can also help the city forecast where new roads will be needed, how much it will cost to maintain those future roadways, and how to optimize their life cycle costs.

Looking ahead, in addition to upgrading to ArcGIS Pro, the City of North Las Vegas is actively exploring how to use deep learning in ArcGIS API for Python to automate the city's annual road surface condition data gathering operation. The team also plans to share this road condition data more widely via ArcGIS Online and dashboards built with ArcGIS Dashboards. This way, members of the community would be able to monitor the city's efforts to maintain safe roadways and potentially contribute to identifying roadway hazards that require immediate attention.

For more information about this project, email City of North Las Vegas public works director Dale Daffern at daffernd@cityofnorthlasvegas.com.

combined into a single layer. GIS analysts then spatially joined the shapefile to the street centerline network to obtain a roadway condition for each street. In areas where a street sweeper operator recorded different conditions for each side of the same road, that section of roadway was assigned a single, worst-case condition. Although there were some inconsistencies in the data—such as when a driver identified a pothole on a relatively good street, generating a poor condition rating on an otherwise adequate stretch of tarmac—the results were sufficiently reliable.

Modeling Future Cost Scenarios

Once the roadway network layer was built, the next step was to figure out what road maintenance and improvement work would cost.

GIS analysts outfitted the roadway network with a typical pavement life cycle cost algorithm and input that into ModelBuilder. The algorithm determines what it would cost to replace sections of pavement based on their condition, dimensions, and thickness—and it even includes an annual escalation factor for increased material prices and labor rates. Having all this in ModelBuilder brought geoprocessing tools and Python scripting together to manage all the data associated with the project, automate and document workflows, and automatically generate maps and reports.

One unique feature of the network model is its ability to outline an individual roadway or residential subdivision and determine the cost to repair or replace it. The algorithm can also

evaluate the city's entire paved roadway network—or any portion of it—and determine the 20-year pavement replacement costs. And with ModelBuilder, staff members throughout the city can run these cost analyses quickly, accurately, and consistently—even if they have little or no GIS experience.

Continually Improving Roads and Technology

Of course, roadway maintenance and improvement are never-ending. Although the data gathered through this project needs some additional vetting and the network still requires refinement, the City of North Las Vegas has already used the information to outline a new five-year Capital Roadway Improvement Plan

About the Authors

Dale Daffern is the director of public works for the City of North Las Vegas. A licensed professional civil engineer in Nevada, Daffern is also the city engineer. Dan Herrman is a GIS analyst of public works for the City of North Las Vegas. He has more than 10 years of experience with GIS applications.

TO INCREASE GEOSPATIAL ADOPTION ACROSS THE ENTERPRISE, BUILD YOUR GIS BRAND

By Greg Babinski, GIS Management Consulting Services, LLC

When I think of the term *enterprise GIS*, I often think of the USS *Enterprise* from the popular American television series *Star Trek*. Many of the things GIS managers focus on are like stoking the matter-antimatter reactors with dilithium crystals to power the *Enterprise*. For GIS managers, maintaining data, filling in metadata, updating software, and customizing apps keep an organization's enterprise GIS running smoothly.

But GIS managers have a responsibility to ensure that the key decision-makers up on the bridge and all the stakeholders who work within the enterprise know the value of GIS. Of course, GIS managers understand the benefits of the technology, whether they work for a local, state, provincial, or federal government agency; a nonprofit; or a private company. But elected officials, public works managers, company directors, warehouse supervisors, and budget analysts don't necessarily get it.

If key decision-makers don't know how GIS supports their business functions, then they need to be educated. That's a job for GIS managers.

CORE COMPETENCIES FOR PROMOTING GIS

Like any geospatial operation, promoting GIS requires a structured project management approach. The Geospatial Management Competency Model (GMCM) from the United States Department of Labor outlines specific competencies that are useful to employ when promoting GIS. These competencies include communication, relationship management, business development, and political skills.

Here are six ideas for how to apply some of these competencies:

- **Build a GIS brand.** Well-known brands elicit feelings and expectations in current and potential customers. And that branding starts internally—in this case, within the GIS team. This isn't about building general awareness of what GIS can do; the team already knows that.

  Give the GIS team a name, and let the team members help choose it. On organizational charts, display the team name prominently—Enterprise GIS, Enterprise GIS Services, Enterprise GIS Center, or maybe something else. This helps evoke pride within the GIS team and institutes a sense of value in those who use GIS services. Design a logo and add it to maps, web pages, projects, and presentations.

- **Generate pride in the brand.** This is especially important to do within the GIS team. Attending GIS user group meetings and putting on annual GIS Day events are great ways to spotlight geospatial professionals' work. Encourage team members to participate in professional associations and conferences, and motivate them to pursue their GIS professional (GISP) and other certifications.

  Brand awareness is achieved when team members and current and potential customers have a strong, positive, value-focused reaction whenever they hear a name like Enterprise GIS Services.

- **Communicate effectively.** Clear communication is critical for GIS marketing and business development. Effective GIS managers need to be able to tailor their communications to various audiences. The jargon and acronyms used in team meetings have no place in communication with potential customers.

  GIS managers can help construct appropriate and consistent messaging by developing a standard GIS value proposition presentation and slide deck. They can then train their team members to give the presentation and respond to customer questions in compelling and effective ways. This slide deck should become the core of any marketing presentation.

  From that, GIS managers should develop an elevator pitch for GIS—a 90-second description of what the GIS department does. Team members can then give that pitch to colleagues they run into in the parking lot; hallway; or, perhaps, the elevator.

- **Establish effective relationships.** This increases the visibility of GIS and promotes greater adoption of the technology. The goal of these relationships is to get more business units to adopt GIS tools and apps. For a business unit that is new to GIS, buy-in needs to happen at three levels: with the doers, with the supervisors or managers, and with the ultimate decision-makers.

  Say the water utility at a city government would benefit from using GIS-based mobile data collection apps. The GIS manager will need to have relationships with a few of the people who gather and work with field data to gain an understanding of their work processes and show them how mobile GIS apps can make their jobs easier. The GIS manager will also need to have relationships with these employees' bosses—the people in the enterprise who own the mobile data collection process. Finally, the GIS manager will need to have a relationship with the department director or the person who controls the budget. Here is where GIS brand awareness is very important. With positive GIS brand awareness throughout the enterprise, department directors and C-level leaders should already know that GIS delivers significant benefits.

  Don't forget to develop effective relationships with others who are not prospective GIS users as well, including the IT, budget, finance, operations, and human resources managers. It's also important to get to know GIS managers in neighboring jurisdictions and fellow attendees at conferences or training classes. They can all advocate for GIS managers and help boost the GIS team's brand.

- **Develop political skills.** For GIS managers who work at public agencies, it can be tough to develop relationships with elected officials. But there are ways to do this. Make it a habit to look at council meeting agendas and minutes. Maybe attend some meetings to learn what the key issues and hot-button topics are for individual council members.

Perhaps at one meeting, council members were bombarded by residents complaining about potholes. That might open an opportunity to suggest a GIS-based pothole solution to the city's maintenance supervisor the following morning. This will be especially helpful if the city council demands immediate action on the issue.

- **Become proficient in business development.** GIS managers need to gain an understanding of the business development process and how to apply it on an ongoing basis. At private companies, nothing happens without marketing and business development. In fact, all the ideas above fall into the category of GIS marketing and business development.

The key to success in marketing and business development is to start with a simple plan. First, spell out the value of GIS in simple terms. This is the core of any GIS communications strategy. Next, outline target markets. Start with the company organizational chart and create a simple matrix that distinguishes different work units. Identify the units that are currently using GIS solutions, then pin down the ones that are prime candidates for new, GIS-based products, services, and apps. Finally, think about how to market GIS to those work units.

Some ideas might fit into the GIS team's annual workflow, such as hosting a GIS Day event or giving GIS product demonstrations. Other ideas include creating a quarterly GIS newsletter or turning project closeout reports into compelling, mission-accomplished-with-GIS stories. Also, try to get on the agenda for management team meetings, especially those for work units that could benefit from investing in GIS. A more ambitious strategy would be to implement an internal customer relationship management (CRM) tool. This can help members of the GIS team share their interactions with current and potential customers to build comprehensive, dynamic relationships.

ADDITIONAL RESOURCES FOR GIS MANAGERS

There are many great resources available to help GIS managers develop their brand and marketing competencies. Those include the following:

- Read The Path to GIS Success from Esri, available at links. esri.com/gis-success.
- Seek guidance from the Society for Marketing Professional Services, which can be found at smps.org.
- Join the Geographic Information Systems Professional Service Marketers group on LinkedIn at linkedin.com/groups/13587718.
- Consider attending the Urban and Regional Information Systems Association's (URISA) GIS Leadership Academy. Find out more information at links.esri.com/urisa-gis-leadership.
- Study the Geospatial Management Competency Model at links.esri.com/gmcm.

Effective marketing and business development can help enterprise GIS "boldly go where no *[GIS]* has gone before!"

Managing GIS

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

URISA
Fostering Excellence in GIS
www.URISA.org

About the Author

Greg Babinski, GISP, is a GIS management consultant and founder of GIS Management Consulting Services, LLC. From 1998 to 2021, he served as GIS manager, GIS finance manager, and GIS marketing and business development manager for the King County GIS Center in Seattle, Washington. Previously, he was a GIS mapping supervisor for the East Bay Municipal Utility District in Oakland, California. For more information, email Babinski at greg@gismcs.com.

In New MOOC, Participants Explore Intersection of GIS, CAD, and BIM

After years of separation—that is, using separate systems and disconnected workflows—many GIS and architecture, engineering, and construction (AEC) professionals are now integrating GIS capabilities, computer-aided design (CAD) data, and building information models (BIM) into holistic workflows that provide detailed understanding of a project's design, assets, and geographic environment. They use this understanding to inform decision-making and enhance the entire AEC project life cycle, from planning and design to construction and ongoing operations.

To help people keep pace with this growing interconnectedness, Esri is releasing a new massive open online course (MOOC) called Transform AEC Projects with GIS and BIM. Running September 14 through October 12, the course will give participants firsthand experience with integrating CAD, BIM, and GIS data to help reduce costs, streamline workflows, and increase sustainability throughout a project's life span.

Applying Geographic Context to Construction Projects

GIS data has been used for a long time in the planning and operation of buildings, bridges, airports, and other infrastructure projects—and CAD and BIM data is key for the design and construction of those structures. Bringing all this data together offers many benefits.

"Understanding the geographic context of a project allows architects and planners to optimize the design based on site topography and nearby natural and built features," said Rafael Lucero, practice lead for AEC and indoor GIS at Esri. "The

cost of making design changes after materials have been ordered or construction has started is significant. And the larger the project, the higher the cost. One seemingly minor change can have a ripple effect, requiring larger changes that could dramatically increase the total project cost."

ArcGIS Pro analysis tools are valuable in the design phase of a project to calculate viewsheds, shadow patterns, and the potential impact of a new structure on nearby environmental features, such as wildlife corridors and public green spaces. These location-based insights enable architects and engineers to adjust the design prior to construction if needed.

"Using ArcGIS Pro, architects and engineers can overlay CAD, BIM, and GIS data on a map and output highly realistic project visualizations," Lucero explained. "These visualizations can be shared to an accessible, cloud-based location during the design phase. This allows stakeholder feedback to be efficiently collected, evaluated, and incorporated into the design."

During construction, drone-captured imagery is frequently used to monitor jobsite progress. Using Site Scan for ArcGIS and ArcGIS Drone2Map, AEC project managers can visualize each stage of construction and quickly share updates using a dashboard. In Esri's new MOOC, attendees will learn how to create a 3D mesh using Drone2Map and ArcGIS Pro, upload the mesh to ArcGIS Online, and use dashboards to share project updates.

A Weekly Sampler of Modern AEC Workflows

Since Esri launched its MOOC program in 2014, more than 150,000 participants from around

the world have taken courses on imagery, cartography, spatial data science, and other topics of interest to GIS professionals and lifelong learners of all persuasions.

Transform AEC Projects with GIS and BIM is the eighth MOOC that Esri has developed and offered at no cost to people around the world. Each week, attendees will get access to one or more videos featuring Esri experts, complete a step-by-step exercise using provided ArcGIS software, and visit discussion forums to ask questions and interact with other participants and Esri staff. While attendees are welcome to complete all the course content at their own

pace, those who wish to earn a certificate of completion should plan to start each section during its opening week to stay on track.

This course is most relevant to practicing or aspiring architects, landscape architects, civil engineers, planners, construction professionals, GIS professionals, and others who work on private or public sector construction and infrastructure projects. That said, anyone who enjoys exploring GIS technology topics is invited to attend. Familiarity with GIS and ArcGIS Pro will be helpful but is not required.

To view the complete course details and register, visit go.esri.com/aec-mooc.
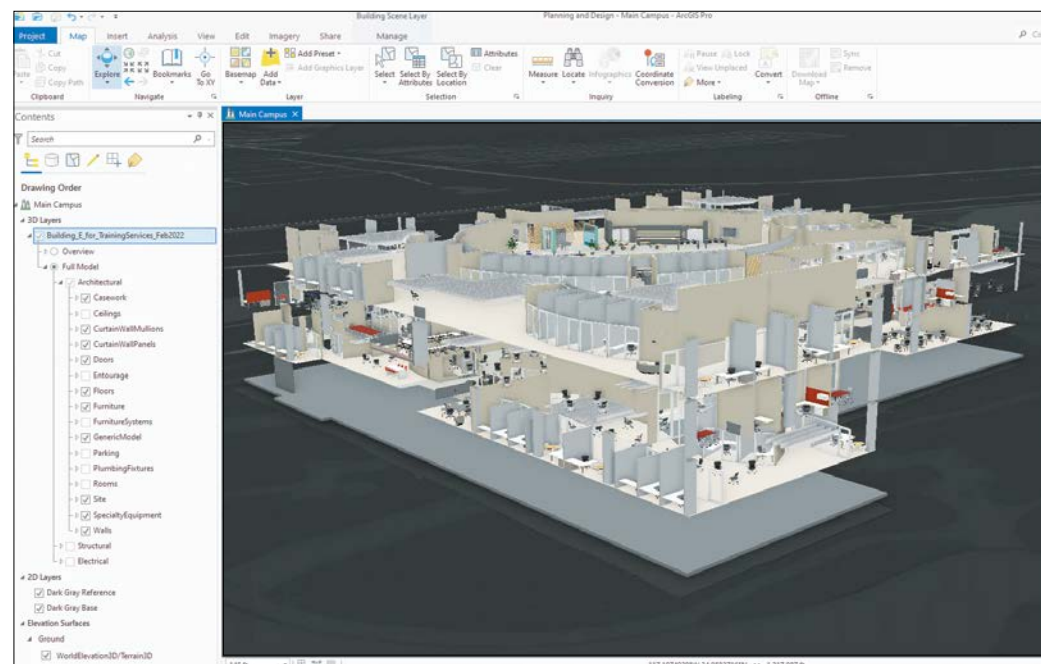
↑ In ArcGIS Pro, a building information model (BIM) is georeferenced so it displays correctly in its real-world location and can be used as an input for geoprocessing tools.

Startup Makes Preconstruction Data Collection Faster, More Accurate

↑ Using Ecobot, natural resources consultants can collect data in the field using the mobile app and then edit their projects and do quality control on the data from a desktop computer.

In the United States, before any construction project begins—especially large, infrastructure-scale projects such as those funded by the recently passed $1.2 trillion Infrastructure Investment and Jobs Act—developers must complete several state and federal environmental impact assessments.

These government-mandated assessments provide critical data about the natural environment that surrounds a project. Civil engineering and construction firms leverage this data to develop resilient assets that mitigate disturbances to the natural environment and avoid costly future complications caused by ecological conditions.

To help environmental scientists efficiently collect accurate preconstruction data, Ecobot (ecobot.com)—an Esri partner that recently graduated from the Esri Startup program—developed a platform for completing these assessments. It works seamlessly with ArcGIS Field Maps and ArcGIS Pro.

One area of focus for Ecobot is helping developers determine the locations of wetlands. When completing preconstruction environmental impact assessments, natural resources consultants must submit the findings of wetland delineations to federal regulators. The results of their findings influence how that land can be developed.

The Ecobot platform, which consists of a mobile app and a desktop app, mirrors industry-standard procedures for this kind of data collection. It automates the calculations used to determine the presence of wetlands and populates government regulatory forms for submission. It also makes the geospatial data available to export directly to ArcGIS Pro.

When consultants at Environmental Science and Engineering (ESE) Partners were contracted to delineate wetlands on a proposed 3,000-acre solar farm in Texas, the company had just two weeks—instead of the several months it would normally take—to complete the project. With only two wetland scientists available at the time, ESE Partners employed the Ecobot app alongside ArcGIS technology to expeditiously find and record hundreds of isolated wetlands and other water elements.

To determine whether an area contains wetlands, environmental consultants collect soil, vegetation, and hydrology data at various points around the site. Prior to the availability of mobile technology like Ecobot and Field Maps, this process required consultants to print out an aerial image of the site and bring that with them so they could approximate their locations while manually collecting data. After that, a professional surveyor would come in to record the data point locations at a higher level of accuracy. This step added at least a day to the project timeline and could cost tens of thousands of additional dollars, depending on the size of the project.

Jeremy Schewe, chief scientist and cofounder of Ecobot, used to work this way. In his nearly two decades of experience doing field research, it typically took him two days to assess a 90-acre plot of land, and then an extra day for the surveying work to be completed. And none of that includes the precursory research and data compilation that had to be done, nor does it include the time it took to transfer the data to government forms and perform quality assurance.

Using Ecobot in conjunction with Field Maps, Schewe can now complete all the work for evaluating a 90-acre plot of land in one day.

"I'm able to work twice as fast, with greater confidence in the accuracy of the decisions being made that impact land use," he said.

This is what Nevin Durish, a senior biologist at ESE Partners, experienced when using Ecobot and ArcGIS technology during the Texas solar farm project.

"In the field, we were able to complete 31 wetland sample points during a single day because of Ecobot," he said. "*[That's]* more than twice our usual productivity."

Integrating Ecobot with ArcGIS technology was a no-brainer for Schewe and his cofounder, Ecobot CEO Lee Lance. Schewe said that he and most of his peers in the industry were already accustomed to working with ArcGIS technology to create the detailed, layered maps they used for preliminary research and to compile their final reports.

"Esri is the number one geospatial software provider in the industry. It's critical that Ecobot and ArcGIS work together," said Schewe. "Before beginning fieldwork, we can export shapefiles from ArcGIS Pro to Field Maps and then view the map during data collection. I can see all the critical geospatial information when I'm out there and where I am in respect to that. Once I'm finished logging data in Ecobot, I can export a shapefile from Ecobot directly onto the basemap that was created in ArcGIS Pro."

Ecobot is also compatible with Global Navigation Satellite System (GNSS) devices, such as those from Esri partners Trimble and Eos Positioning Systems, Inc.
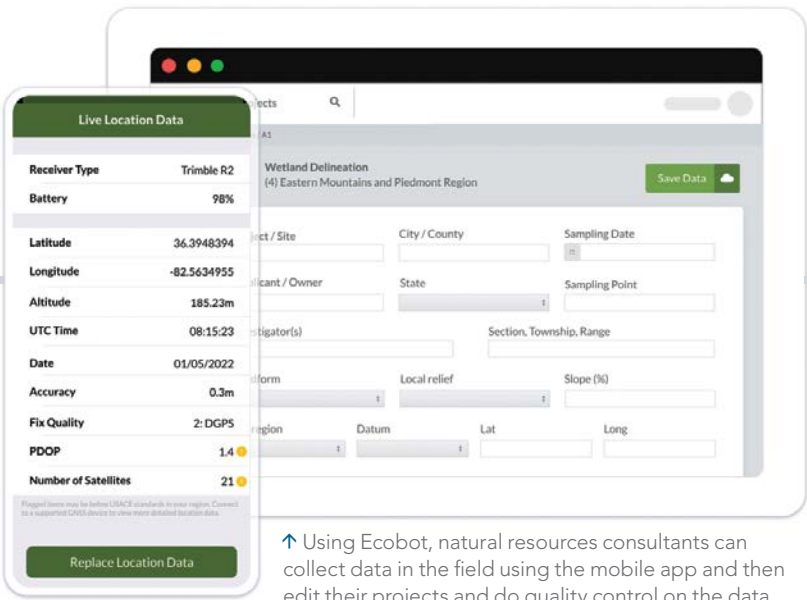
Teams from some of the largest environmental and engineering firms in the United States have started using Ecobot in their mobile operations.

Kelley Samuels, senior ecologist at multinational engineering firm and Esri partner AECOM, said that Ecobot is "invaluable for new construction, especially large-scale projects."

Sarah Soard, environmental project and technical services manager for natural and cultural resources at consulting firm and Esri partner Burns & McDonnell, said that having the real-time calculations that Ecobot provides is valuable "because they eliminate human errors or delays."

Darin Welch, associate vice president for geospatial and virtual engagement solutions at infrastructure solutions firm and Esri partner HNTB, learned about Ecobot at Esri's 2019 Geodesign Summit. His company is heavily invested in digital twins, and he sees value in integrating natural environment data, which Ecobot can provide.

Since launching in 2018, Ecobot has grown to serve more than 1,360 customers that have generated over 60,000 field reports for more than 6,500 assessment projects. With a recent venture capital investment of $2.81 million, Ecobot is now in a position to widen the scope of its app, incorporate workflows for additional environmental permits, and add project management tools to the platform.

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.
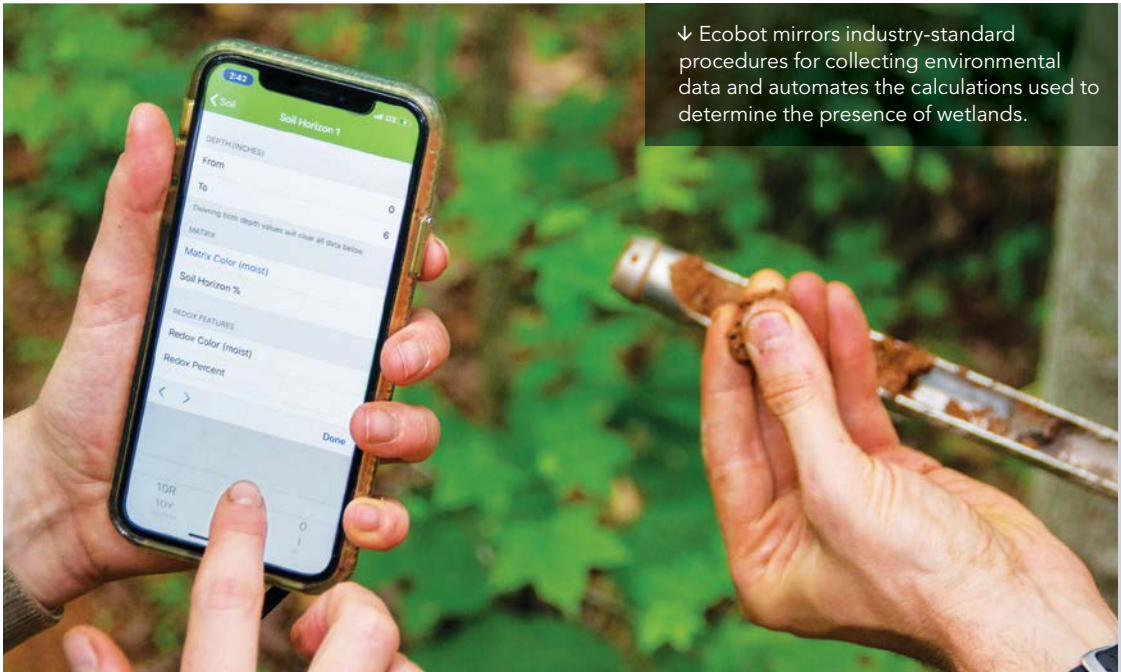
↓ Ecobot mirrors industry-standard procedures for collecting environmental data and automates the calculations used to determine the presence of wetlands.

↓ Users report that, with Ecobot, they can do their work twice as fast as they could before.

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 an ArcGIS® dashboard accessing 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

↓
See you at the Esri® User Conference in San Diego!

July 11 → Academic Fair

July 11-14 → Map Gallery & Special Displays

July 12-14 → Expo

Speakers and events at www.redlands.edu/uc22

Located in Redlands, California—close neighbors and partners with geospatial leader, Esri—we offer academic programs that enable access to Esri technology, training, people, events, and internships, including classes taught by Esri employees.

UNIVERSITY OF Redlands

spatial.redlands.edu

GEOGRAPHIC INFORMATION SCIENCE

Master of Science in GIS (MS GIS)
Enabling professionals with enhanced skills of geo-analytics, problem solving, project management, and effective communication for solving real-world problems with GIS.
On campus | 10–21 months

Master of GIS (MGIS)
Designed for professionals seeking to enhance their theoretical knowledge of GIS and skills of geo-analytics, project management, and effective communication using GIS.
On campus | 8 months

SCHOOL OF BUSINESS & SOCIETY

MBA – Location Analytics Concentration
Enables professionals to use the power of location intelligence to improve decision-making, organizational performance, and corporate social responsibility.
Online + on campus | 18-24 months

Business Location Analytics Certificate
Learn how organizations deploy location analytics to gain customer insights, expand business, manage risk, and design effective sustainable business strategies.
Online | 20 weeks

Esri Partners Awarded for Outstanding Work

At the 2022 Esri Partner Conference, held in March in Palm Springs, California, Esri acknowledged 26 partners that are doing remarkable work with ArcGIS technology by presenting them with awards in 11 categories. Read on to find out more about the innovative solutions, services, and content these partners offer.

Demonstrating Highly Aligned Solutions

Khatib & Alami | khatibalami.com
To help clients across multiple industries and environments improve their business processes, save time, cut costs, and make informed decisions, Khatib & Alami uses ArcGIS technology to integrate location intelligence with e-government services, ArcGIS GeoBIM, geospatial artificial intelligence (GeoAI), augmented reality (AR), virtual reality (VR), and more.

GP One Consulting | gpone.com.au
GP One Consulting brings advanced, practical programming skills to its clients' spatial data challenges. The QWildlife crocodile sightings platform, developed for the Queensland Government in Australia, leverages ArcGIS Enterprise, ArcGIS AppStudio, and ArcGIS Survey123 to improve job tasking, increase public safety, and better protect crocodiles.

GEO Jobe | geo-jobe.com
The ABC's of GIS from GEO Jobe is a powerful combination of solutions that ArcGIS administrators can use to improve their workflows and increase productivity. Nearly 9,000 organizations worldwide use these apps. As the scale of an organization's offerings increases, so does the power of the ABC's of GIS.
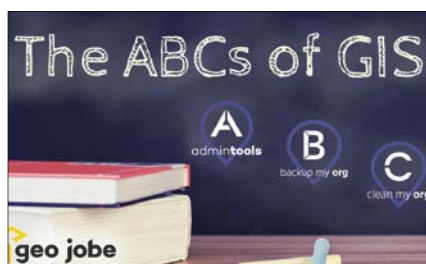
Delivering Creative Content to ArcGIS Users

Beans.ai | beans.ai
Geospatial data as a service provider Beans.ai creates highly accurate subaddress-level geocodes for multiunit dwellings and complexes. The startup's proprietary location data helps customers in the transportation, logistics, delivery, public safety, and emergency response realms solve what's known as the last-mile problem so they get to the correct destination.

IHS Markit | ihsmarkit.com
IHS Markit provides expertise and solutions to help organizations expeditiously visualize and analyze critical and ever-changing information about global commodities. The company leverages the power of cloud data warehouses to deliver spatially enabled data models directly to ArcGIS Pro and ArcGIS Insights.
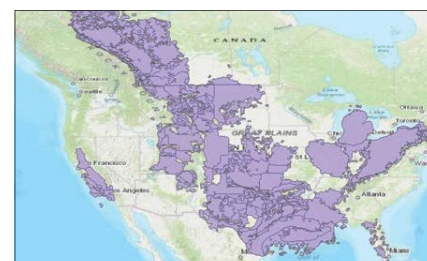
Nexiga | nexiga.com
A full-service provider of GIS and geocoding solutions, Nexiga offers high-quality, geospatial market data down to the household level. Subjects covered include pedestrian frequency, building information, and broadband availability—all of which enable customers to glean cross-industry insight so they can design sophisticated marketing and sales strategies.

Showing Substantial Opportunities for Growth with Esri

Antea Group | anteagroup.nl
Antea Group combines multidisciplinary perspectives and technical expertise to deliver solutions for a better future. Using Antea World, a solution based on ArcGIS Enterprise, Antea employees can explore datasets and apps. Eventually, this will become a digital twin of the Netherlands that integrates with all the company's products.

Berntsen International | inframarker.com
Radio-frequency identification (RFID) is a rapidly growing technology. Berntsen International's InfraMarker app for Survey123 and ArcGIS Field Maps connects RFID-marked field assets with the associated asset data in ArcGIS. This results in faster and more accurate workflows in both the field and the office.

Innovate!, Inc. | innovateteam.com
To help clients optimize their investments in Esri technology, Innovate! does everything from modernizing legacy systems to building scalable enterprise solutions. For the Arbor Day Foundation, [...] to [...] namic [...] ment.
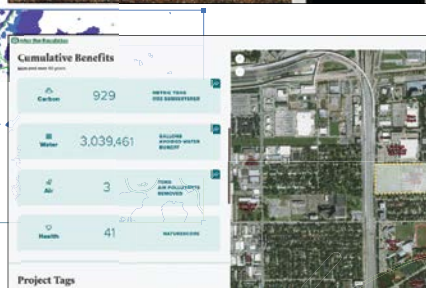
Evolving Customers and Solutions to the Web GIS Pattern with SaaS

**DVG Interactive** | dvginteractive.com
DVG builds enterprise GIS solutions to help customers solve mission-critical business problems across industries, from law enforcement and public safety to health and transportation. The company's GIS experts make use of Esri's full stack of technology for web, desktop, and mobile and specialize in rapid, cloud-based deployments.
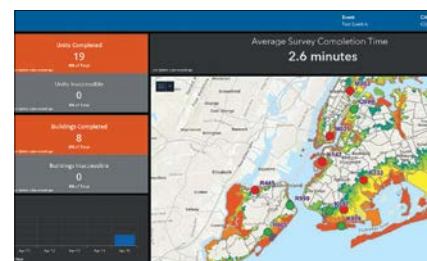

Dawood Engineering | dawood.net
Dawood provides project management tools that geospatially enable asset management and utility workflows. When Southern Company Gas required an optimal land management solution for a pipeline project in Illinois, Dawood developed a custom portal using the AEC Project Delivery subscription service, ArcGIS Dashboards, Survey123, and ArcGIS StoryMaps.
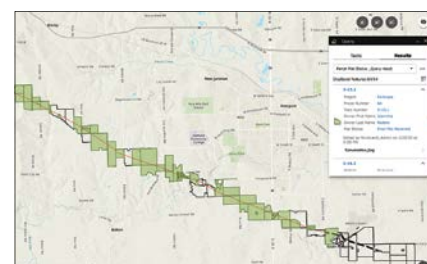
VertiGIS | vertigisstudio.com
VertiGIS works across industries to help organizations that deploy Esri technology accomplish even more and go beyond the out-of-the-box capabilities of ArcGIS software. Using VertiGIS Studio, ArcGIS users can build powerful, purpose-driven apps at a fraction of the cost and development time that are normally required.
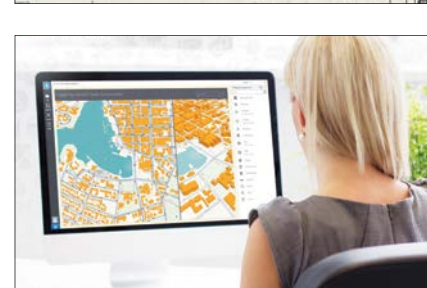
Delivering Analytics and Insight to Users

Airspace Link | airspacelink.com
Drone operators have described AirHub, from Airspace Link, as smart maps for drones. Because roads in the air don't exist yet, AirHub leverages the ArcGIS system, authoritative local data, Federal Aviation Administration (FAA) regulations, and third-party datasets to build compliant and efficient flight routes.
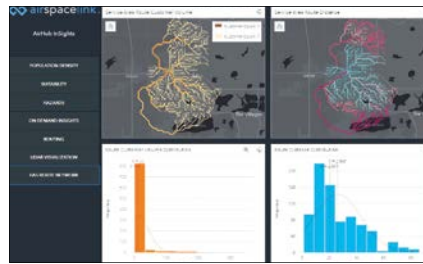
Environmental Science Services, Inc. (Es²) | es2-inc.com
In partnership with the Mississippi River Traffic Information Service, Es² and the Plaquemines Port Harbor and Terminal District ingested raw automatic identification system (AIS) vessel traffic feeds into ArcGIS GeoEvent Server. Geofences around the port's facilities allow staff to monitor vessel movement and track tariff-eligible events.
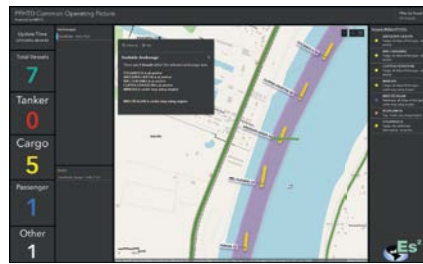
Outstanding Presence on ArcGIS Marketplace

North Point Geographic Solutions (NPGS) | northpointgis.com
NPGS, which supports state and local governments and the forestry industry, specializes in developing unique, GIS-integrated web apps that help users streamline workflows and increase efficiency. For example, NPGS worked with Bayfield County, Wisconsin, to build SmartPermit, a paperless, GIS-based land-use and permit process.

Wejo | wejo.com
Wejo provides feature layers of its Journey Intelligence and Traffic Intelligence data for use with ArcGIS Pro and ArcGIS Online. As a result, real estate, construction, retail, and government organizations have access to millions of connected vehicle data points sourced directly from offices of emergency management.

Compelling Use of Esri Technology to Make an Impact

Alcis | alcis.org
By accessing unique data, harnessing emerging technologies, and continually innovating, Alcis helps its clients in the international development realm use GIS to better understand complex situations, make sound decisions, and generate advantageous outcomes for people in some of the world's most fragile and war-torn environments.

The FaithX Project | faithx.net
FaithX's groundbreaking work employs geospatial data (supplied via MapDash from another Esri partner, Datastory) and ArcGIS StoryMaps narratives to help congregations identify the effects of systemic racism on their surrounding communities so they can mitigate those impacts and better engage with the people they serve.
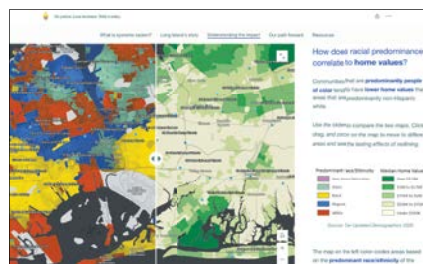
Collaborating Innovatively with Esri and Partners

Bay Park Data Solutions | bayparkdatasolutions.com
Harnessing the power of spatial analytics and data integration, Bay Park helps nonprofit organizations gain actionable insight into fundraising activities, donor retention initiatives, marketing objectives, and development outcomes. The Bay Park team builds these custom solutions primarily using ArcGIS Online, Survey123, ArcGIS Experience Builder, and Dashboards.

GeoComm | geocomm.com
GeoComm, which provides its Public Safety Location Intelligence service, works with local, regional, state, and military agencies in 49 US states. Through extensive collaboration with Esri, GeoComm ensures that its indoor maps empower public safety agencies to improve situational awareness during emergencies and reduce response times.

## Helping Customers Meet the Sustainable Development Goals

ARC-GREENLAB | arc-greenlab.de
German company ARC-GREENLAB provides surveying, GIS, and building information modeling (BIM) services and software to government and commercial customers. To help digital construction firm VIA IMC and its parent company Eurovia reduce CO_2 emissions during road construction, ARC-GREENLAB developed AVUS.ONLINE, a digital twin based on ArcGIS technology.
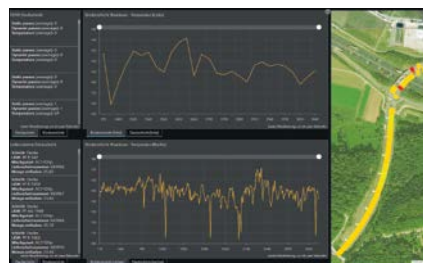
Cadasta | cadasta.org
Using Survey123, Field Maps, ArcGIS Online, and ArcGIS Living Atlas of the World, Cadasta helps local residents and government staff members map and document land rights and build their technical capacity so they can create a more secure and sustainable future for their communities.
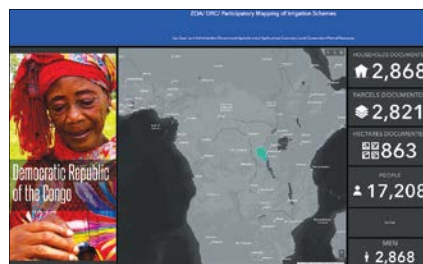
Ensuring Customer Success with ArcGIS

CyberTech Systems and Software | cybertech.com
CyberTech staff members are experts at implementing ArcGIS Enterprise. Their depth and breadth of knowledge, along with the company's extensive resources, ensure project success regardless of scope. Specializing in cloud transformation, they deliver large and complex geoenabled business solutions that fully integrate with critical enterprise systems.

**geoConvergence** | geoconvergence.com
Since 2004, geoConvergence has specialized in implementing, integrating, and extending core Esri technology. The award-winning Small Business Administration (SBA) 8(a)-certified organization provides best-in-class solutions to commercial and government customers. geoConvergence has earned four specialties from Esri, including ArcGIS System Ready, ArcGIS Indoors, and Federal Small Business.
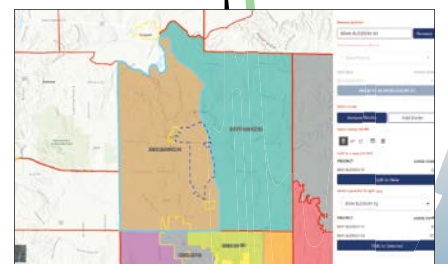
## Influencing the Adoption of Esri Technology at a Strategic Level

Cityworks | cityworks.com
Cityworks, a Trimble Company, provides Web GIS-centric asset management and permitting solutions powered by ArcGIS technology to help organizations streamline asset management and community development. Cityworks combines ArcGIS geodatabase technology with business apps to better coordinate workflows, schedule resources, and prioritize public works activities.
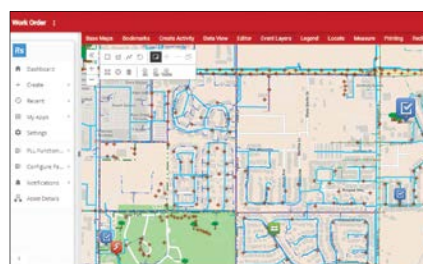
SSP Innovations | sspinnovations.com
SSP Innovations delivers ArcGIS Pro solutions to electric and gas utilities, telecommunications providers, and pipeline operators around the world. Solutions are designed to help customers meet their unique business challenges through a combination of deep technology expertise and comprehensive familiarity with industry best practices.
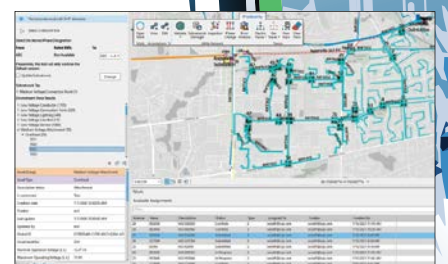
Esri partners represent the rich ecosystem of organizations around the world that work together to amplify The Science of Where by extending the ArcGIS system and implementing it in distinct ways to solve specific problems. Search for and discover partners that meet your needs at esri.com/partners.

Cartographic Engagements in a Postvirtual World

Three International Cartographic Association (ICA) commissions met April 20–22 in Madrid, Spain, at the headquarters of the country's National Geographic Institute for a conference centered on the theme Atlases in Time. Members of the ICA commissions on atlases, toponymy, and map design met in person, with a few participants contributing through an online format. In addition to the ICA and Spain's National Geographic Institute, the Spanish Society of Cartography, Photogrammetry and Remote Sensing was well represented at the event.

The conference took the form of a plenary session, with presentations given by members of all three commissions. The topics were intermingled to reflect how they all contribute to the conference's theme. The keynote speech was an excellent talk on the history of the idea of a national atlas. There were also several special presentations about the National Atlas of Spain to mark the Spanish National Geographic Institute's 150th anniversary.

Joint commission events like this offer participants different experiences, lessons, and revelations that often energize their postconference professional interests. One presentation informed attendees about the impacts that climate change is having on map content. For instance, a hiker might see a glacier labeled on a map but then look out onto a body of water instead of a mass of ice. Transformative changes occurring in different parts of the world can affect map labels and their placement and possibly data classifications.

Another talk spotlighted an educational institution that is designing an atlas to show the influence of its program across space and time. Questions put forward included, How should the institution show information about all its graduates? How should it indicate where they went after finishing the program? and How should it demonstrate the larger impacts that training and support had on the places graduates returned to?

There was also a presentation on the relationship between toponymy and atlases. It focused on how important and complicated it is to transcribe place-names in different languages and scripts. The talk also covered how, when people from the same place say or spell a name differently, that can make this even more challenging.

Another presentation introduced new ways of thinking about the positive role cartography can play in urging the social acceptance of facts. As more data gets created, people's belief in that data is variable and uncertain. But the visual nature of maps and their ability to depict spatial relationships means that cartography can be an effective tool for encouraging discovery and generating understanding.

Atlases—being collections of maps that tell a story—tend to provoke inquiry, which can help people accept information, facts, and science. As viewers page through an atlas, they actively participate in the stories the maps tell when the scale, symbolization, or entire visualization changes according to the amounts and types of data being presented. This allows map viewers to see cause and effect and note how the same data can produce variable results based on factors such as map design and the presence or absence of certain content.

Atlases don't treat viewers as simply observers; atlases immerse viewers in a topic and allow them to engage with the content, possibly contribute to it, and look at things from different perspectives. When viewers invest time in examining and manipulating maps, they become vested in the process. They can pursue what-if scenarios and modify cause-and-effect relationships to find out more about a topic. Ideally, this leads to participation; engagement; learning; and, ultimately, increased understanding.

If the concept of a collaborative atlas existed (and I am not sure what this would look like)—or even if viewers could interact with sources that modify the content—then people could share new ideas or different perspectives and, in turn, strengthen their social engagements. Interacting with others who have different views on a particular topic and partaking in healthy debate using an atlas as the mode of communication could have a positive impact on the exchange of ideas. This is an example of how cartography can contribute to the greater good of society.

Looking to the near future, there are two cartographic events happening in 2022 that will bring cartographers and GIScience professionals together. The first is EuroCarto 2022 in Vienna, Austria, and the second is AutoCarto 2022, taking place in Redlands, California.

EuroCarto, which is being sponsored by seven cartographic societies, will meet September 19–21 at the Vienna University of Technology. Various ICA commissions will put on preconference workshops, and a three-day program of presentations and poster sessions will follow. Speakers and participants have been encouraged to cover many topics to offer a diverse program. There will be a special focus on research topics that advance the discipline, including cartography for disaster management, geospatial artificial intelligence (GeoAI) and machine learning, volunteered geographic information (VGI), crowdsourcing and citizen science, and visualization of statistical data. Examples of familiar cartographic topics that will be highlighted at EuroCarto include atlas cartography, geospatial analysis and analytics, map use, spatial data infrastructures, and map design and thematic cartography.

In contrast to the diversity of topics being offered at EuroCarto, the AutoCarto conference is centered on a theme of great current interest, Ethics in Mapping: Integrity, Inclusion, and Empathy. This event, being held November 2–4 at the Esri campus, is sponsored by the Cartography and Geographic Information Society (CaGIS) and serves as the 24th International Research Symposium on Cartography and GIScience. The conversation will revolve around the responsibilities cartographers and mapmakers have for ensuring that a map's content and design do no harm. The hope is that, in discussing a variety of topics related to this theme, participants can help clarify ethical issues of interest and work toward developing guidance on them for the cartographic and GIScience communities. (See "Advancing Ethics in Mapmaking" on page 11 for more information on this endeavor.) Examples of topics that will be covered at AutoCarto include accuracy and uncertainty in data, models, and maps; geotracking and social responsibility; the use and misuse of geographic information in social media; digital inequities; and privacy issues related to imagery.

Several organizations are offering various workshops at AutoCarto on a range of cartographic topics as well. For example, one will examine the earth's surface as a living structure that, at scales ranging from the entire globe to wall ornaments hanging up in interior spaces, makes maps and mapping possible. Another workshop will encourage dialogue on the future of education in cartography and GIS. Still another will focus on how to select and do future research on map projections, given that they are foundational to cartography. A hands-on workshop will show participants how to build ArcGIS StoryMaps and craft wide-reaching narratives about racial equity and diversity. And a joint workshop being put on by two journal publications will share useful information with potential authors and reviewers.

Plans are also under way for the 31st International Cartographic Conference (ICC) and the 19th General Assembly, being held in Cape Town, South Africa, August 14–18, 2023. The conference theme is Smart Cartography for Sustainable Development. As with all ICCs, it will be an international event that affords a special opportunity for staff of national mapping and geospatial organizations and members of professional societies across Africa to participate in an ICC on the African continent. The local organizing committee is already arranging the program, and more information on the conference will be available soon.

About the Author

Tim Trainor is a part-time consultant to the United Nations (UN) and is the former chief geospatial scientist for the US Census Bureau. He is a member of the US Federal Geographic Data Committee's National Geospatial Advisory Committee, has served as cochair for the UN Committee of Experts on Global Geospatial Information Management, and was the senior agency official for geospatial information for the US Department of Commerce.

Esri Press

Discover the Tacare Approach to Holistic Conservation

Jane Goodall Institute (JGI), details JGI's holistic method for conservation. As Goodall explains in the introduction, the Tacare approach, which stands for "take care," puts local communities in charge of preserving the natural world around them. Working with science and technology and with support from conservationists, local residents in central and western Africa who participate in Tacare projects grow to understand the impact they have on the environment and find ways to balance their communities' 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 vision and her hope that the Tacare method will be understood and adopted wherever there is a need for genuine, community-driven conservation. The 280-page book takes readers through the history of Tacare before turning to the stories of several local people who lead conservation initiatives, including poachers-turned-advocates for sustainable land management and villagers who work to preserve traditional ecological practices. How JGI staff and partners use geospatial technology to support these programs is a subtheme of the book.

Local Voices, Local Choices will be available in August both in hardback (ISBN: 9781589486461) and as an ebook (ISBN: 9781589486478).
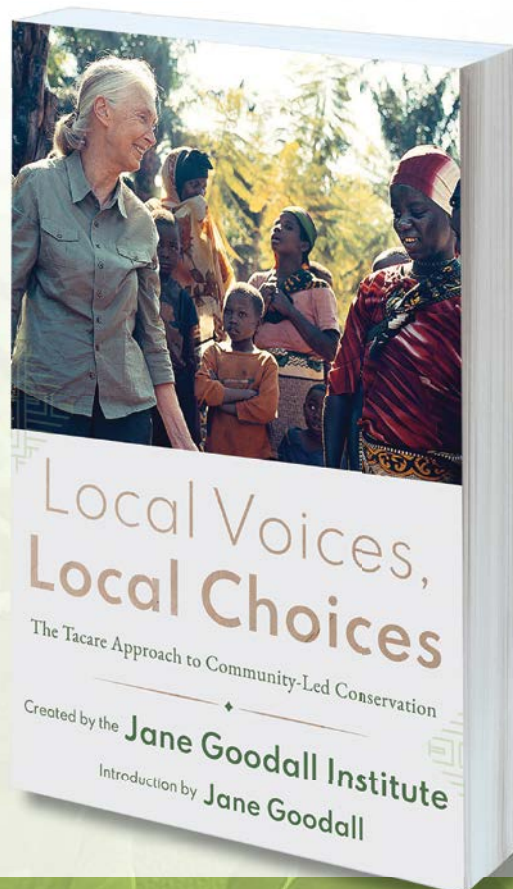
Getting to Know Web GIS, Fifth Edition
By Pinde Fu

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.
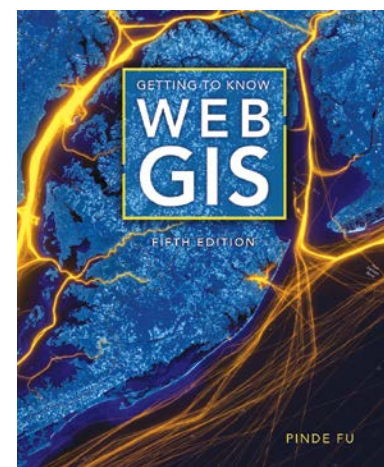
Valuing Place and Purpose: GIS for Land Administration
Edited by Brent Jones and Keith Mann

Location intelligence is changing the way people protect and maintain land. The stories in *Valuing Place and Purpose: GIS for Land Administration* show how various communities, government agencies, nonprofits, and other organizations are implementing GIS in four key areas: to visualize parcels and property; manage land use; strengthen climate and conservation efforts; and address land rights, equity, and social justice. The book includes a special section to help readers use web apps, online maps, dashboards, and other GIS solutions to better represent the value of land and property and more efficiently manage, edit, and share land parcel data. March/May 2022, 120 pp. Ebook ISBN: 9781589487079 and paperback ISBN: 9781589487062.
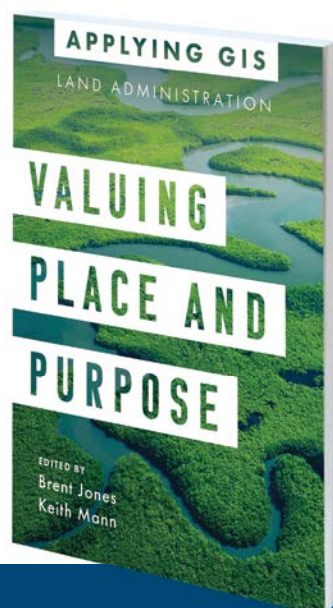
Measuring Up: The Business Case for GIS, Volume 3
Edited by Cory Fleming, Christopher Thomas, and Shannon Valdizon

After community-altering events, such as an economic downturn or a pandemic, how do government organizations maintain the quality of their day-to-day operations while solving big problems? Many turn to GIS. *Measuring Up: The Business Case for GIS*, Volume 3, presents real-world stories of how organizations utilize GIS to save time and money, increase accuracy, improve productivity, and manage resources. This collection operates as a model for how to work through considerable challenges and employ GIS not just as a tool but also as an integral part of the solution. February/May 2022, 200 pp. Ebook ISBN: 9781589486256 and paperback ISBN: 9781589486249.
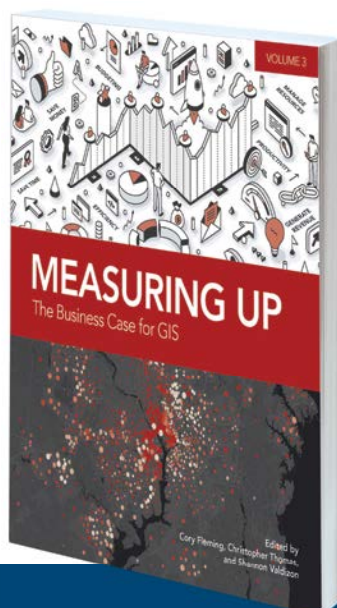
Learning from COVID-19: GIS for Pandemics
Edited by Este Geraghty and Matt Artz

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 real 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. September/October 2022, 175 pp. Ebook ISBN: 9781589487123 and paperback ISBN: 9781589487116.
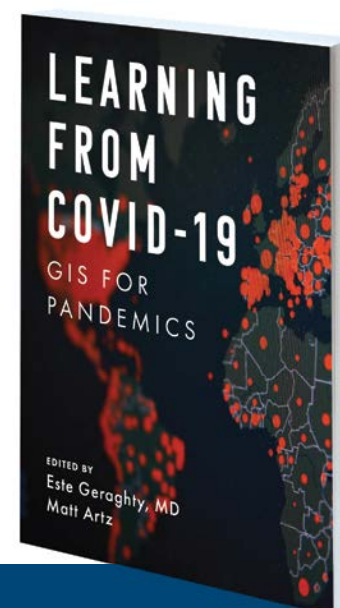
New **Training** and **Certification** Offerings

Training

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Covering topics that range from learning how to manage technology changes to building organizational resilience, Esri's newest instructor-led courses enable participants to acquire knowledge and skills that are directly applicable to their work. Instructor-led courses are taught in person and online—in real time—in multiple US time zones. All Esri courses incorporate proven principles for adult education.

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- **Building Organizational Agility and Enabling Change in a Geospatial World:** This highly interactive course immerses participants in new ways of thinking about implementing change. Attendees learn techniques to develop an agile mindset, overcome reflexive resistance to change, and take action to accelerate the implementation of geospatial apps. Find additional course details at go.esri.com/agility-course.
- **Creating Organizational and Geospatial Resiliency:** Using the Adaptive Mindset for Resiliency assessment from social intelligence company TRACOM, this course helps participants boost resilience and performance in complex environments. It covers strategies for confronting reactive responses to change and developing a resilience road map for ArcGIS modernization efforts. View course details at go.esri.com/resiliency-course.

e-Learning for the Enterprise

Current Esri maintenance subscriptions include unlimited e-Learning access. The following e-Learning solutions are also available:

- **Esri Academy LMS Integration:** Organizations can leverage their own enterprise learning management systems (LMS) to provide employees with access to the latest Esri Academy web courses, videos, and training seminars. By purchasing an annual subscription, organizations enable learners to link directly to live Esri Academy resources from within their LMS, and managers can track learner progress. Learn more at go.esri.com/e-learn.
- **Custom e-Learning:** When staff members with little or no GIS experience need to access and use the content available through an organization's ArcGIS Enterprise portal, Esri can help expedite the learning process with tailor-made e-Learning materials. Esri experts make videos that guide learners through the organization's actual portal environment and highlight its capabilities and content. They also design self-paced, interactive web courses that teach key portal concepts using examples and images provided by the organization. Web courses include hands-on exercises that incorporate the organization's GIS resources, as well as quizzes and tests that reinforce knowledge. Custom e-Learning is hosted on Esri Academy and can only be accessed by an organization's learners.

To get started in determining your organization's e-Learning needs, email GIStraining@esri.com.

Take a MOOC to Discover What's Possible with ArcGIS

Massive open online courses (MOOCs) are free and convenient and offer a great way to build in-demand skills and stay up-to-date with Esri technology. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage with learners from around the world. Take a look at the following upcoming courses:

- **Transform AEC Projects with GIS and BIM, September 14–October 12:** This course is for GIS and architecture, engineering, and construction (AEC) professionals and anyone else seeking to improve decision-making processes for infrastructure projects. Participants work with computer-aided design (CAD) data and building information models (BIM) and apply powerful GIS visualization and spatial analysis tools to see how location-based insight enhances each phase of the project life cycle. Sign up at go.esri.com/aec-mooc.
- **Spatial Data Science: The New Frontier in Analytics, October 5–November 16:** Explore how spatial data science tools and methods help analysts find hidden patterns in data and improve predictive models. Working with ArcGIS analytical tools, participants learn how to integrate popular open data science packages into their analyses. Course exercises focus on suitability analysis, predictive modeling, space-time pattern mining, and object detection from imagery. Register at go.esri.com/sds-mooc.

Certification

The portfolio of exams offered by the Esri Technical Certification Program allows candidates to validate their experience with ArcGIS Pro, ArcGIS Enterprise, ArcGIS Online, and developer technologies related to ArcGIS. Exams are offered at Pearson VUE testing centers worldwide or can be taken remotely using Pearson's OnVUE option. The following new exams are available for people with significant enterprise database and systems management experience:

- **Enterprise Geodata Management Professional:** This exam is ideal for GIS analysts, data managers, data administrators, IT staff who support GIS, and others who have four or more years of experience configuring, deploying, and supporting enterprise servers and multiuser geodatabases. View exam details at go.esri.com/cert-egmp.
- **Enterprise System Design Professional:** This exam is for people who have advanced skills in configuring, deploying, maintaining, and troubleshooting ArcGIS Enterprise core components and managing updates to services and apps to support enterprise GIS workflows. Find more details at go.esri.com/cert-esdp.

If certification is something you're interested in, explore the latest Esri technical certification exams at esri.com/training/certification. Get some inspiration for your GIS journey by viewing 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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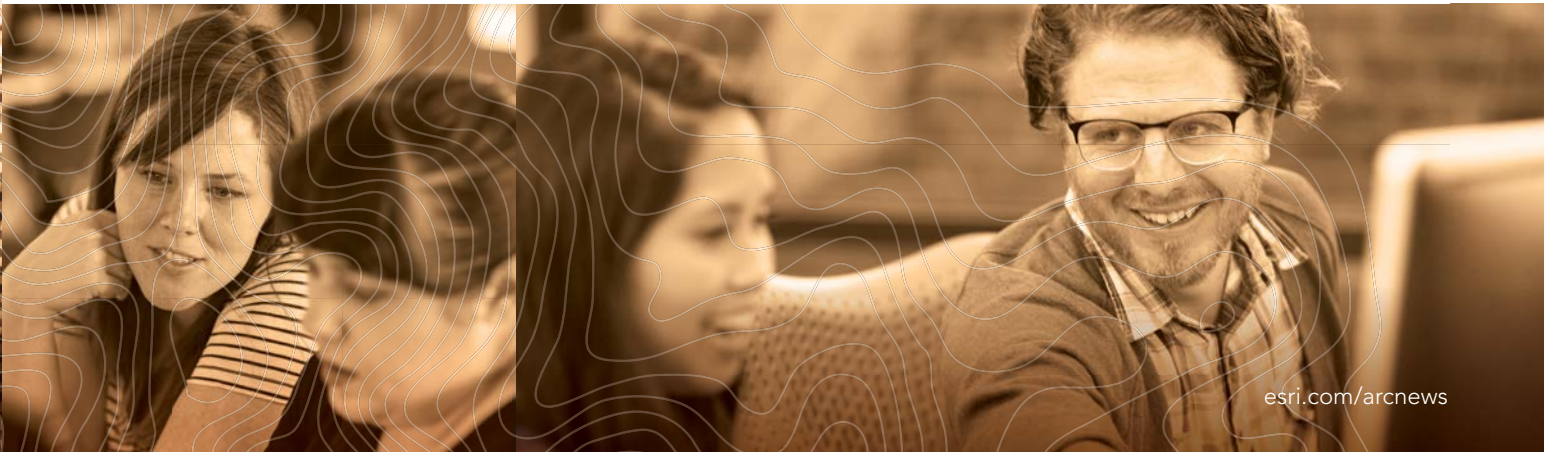
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