## Briefly Noted

#### Celebrate GIS Day Virtually!

GIS Day falls on November 18 this year. It's the perfect time to share your passion for GIS and teach and inspire others with geospatial technology—no matter where you're located. Find an event or register your own at gisday.com.

#### Generate High-Res 3D and Imagery Content with SURE

Having acquired nFrames, a technology company that developed SURE, the industry-leading imagery and lidar 3D surface reconstruction software, Esri can offer its users the ability to seamlessly capture and analyze 3D data from aerial, drone, and ground-based sensors in an automated. end-to-end process. This enhances Esri's ability to create extremely high-quality 3D data from imagery, which is critical for users in the municipal; planning; and architecture, engineering, and construction (AEC) industries.

### Esri and UN-Habitat Partner for More Sustainable Cities

UN-Habitat, the United Nations (UN) program that supports socially and environmentally sustainable urban spaces, will use Esri software to develop cloudbased geospatial technology that can help areas with scarce resources build inclusive, safe, and resilient cities and communities. Through this partnership, UN-Habitat will leverage geospatial tools and open data capabilities from the ArcGIS platform to improve urban infrastructure and service delivery in regions where development is needed.

## Preparing for the Next Crisis...Now

Most organizations have been in crisis response mode for the majority of 2020. The coronavirus disease 2019 (COVID-19) pandemic continues to stress resources, requiring organizations to balance public health with economic vitality as businesses reopen and people start returning to the workplace. At the same time, desert locusts are devastating parts of Africa and the Middle East; wildfires in the western United States have taken a toll on communities and the environment; a very active Atlantic hurricane season has wreaked havoc on parts of the Gulf Coast; and a catastrophic explosion severely hampered Beirut, Lebanon.

It's probably safe to say that everyone is familiar with crisis response this year. But even in this time of global calamity, organizations can still prepare for what may come next. This could make the difference between repeating past mistakes and getting through the next crisis more smoothly.



↑ There is a life cycle to any crisis or disaster. Following the response phase is an opportunity to build resilience.

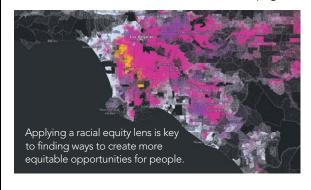
Those who work in public safety know that there is a life cycle, or flow, to any crisis or disaster. While an effective response is critical to delivering much-needed resources to a community, saving lives and property, and ensuring that businesses and residents are stabilized, that's just one phase of the cycle. Beyond that is the opportunity to make lasting change—and build resilience.

continued on page 6

## GIS—Visualizing Racial Equity

Race and place come together in various ways that generate different outcomes for different people. Too often, this results in racial inequity and social injustice. And none of this happens solely at one moment in time. These outcomes are a consequence of decades, generations, and centuries of policies, practices, assumptions, and actions.

Understanding entrenched inequities and injustices is complex, and figuring out what to do is a daunting endeavor. But GIS is technology that, at its fundamental level, breaks down complexities and reveals patterns over space and time, which can go a long way toward guiding action. To help users leverage the full power of location intelligence to address issues that revolve around race, Esri has launched a new racial equity initiative. continued on page 16



## The Geospatial Community Comes Together Virtually

Despite a global pandemic, Esri brought the 2020 Esri User Conference (Esri UC) to the people. More than 88,000 registrants from around the world watched the first virtual Esri UC online, tuning in from home offices; meeting rooms; and, in at least one case, a camper in the woods.

Speaking live from Esri headquarters, Esri president Jack Dangermond opened the conference by thanking attendees for the remarkable work they do with GIS.

"This is a challenging time," Dangermond said. "We have not just one issue—COVID-19—but [multiple issues]," such as the coronavirus disease 2019 (COVID-19) pandemic's impact on people's health, jobs, and the economy; racial disparities and inequities; climate change; and political polarization.

But the GIS community is working on these issues and more. "You are thinking about and implementing solutions," Dangermond said.

The theme of this year's conference, GIS— Interconnecting Our World, is about using geographic science to better understand complex issues and solve problems. It also underscores a network of intertwined trends, including the increasing ease of use of GIS apps, the growing real-time aspect of the technology, the increasing number of geospatial hubs to promote community engagement, and the growth of interconnected GIS systems that create geospatial infrastructure.

Dangermond emphasized the need to use geographic science to tackle problems that also are interconnected: environmental degradation, social instability, climate change, natural disasters, and loss continued on page 14



↑ GIS organizes geographic knowledge and provides a process and framework for applying it widely.

### **ArcNews**

Esri | Fall 2020 | Vol. 42, No. 4



Kuwait has been on the cutting edge of geospatial technology for decades. Now, the country's Public Authority for Civil Information (PACI) is blazing trails in machine learning. Using geospatial artificial intelligence, or GeoAI, PACI extracts roads and building footprints from satellite imagery—a feat for a fast-developing state with a flat, desert landscape.



**Executive Editor** 

Monica Pratt

Managing Editor Citabria Stevens

. . . . .

**Graphic Designer** Takeshi Kanemura

**Illustrator** Derick Mendoza

Manage Your ArcNews Subscription To subscribe, unsubscribe, or make changes to your Esri publications, please go to esri.com/

Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit esri.com/distributors.

Article Submission Guidelines

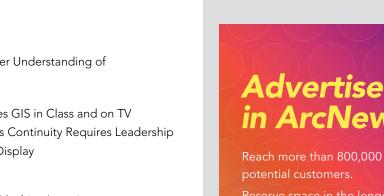
Before writing an article, read and follow the publication guidelines at esri.com/ansubmission

#### ArcNews

Esri 380 New York Street Redlands, CA 92373-8100 USA arcnews\_editor@esri.com Tel.: 909-793-2853, ext. 1-2730 Website: esri.com/arcnews

manage-subscriptions

ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA. ArcNews is written for the Esri user community as well as others interested in mapping and geographic information system (GIS) technology. It contains material of interest to planners, foresters, scientists, cartographers, geographers, engineers, business professionals, and others who use spatial information.





#### **Table of Contents**

#### **NEWS**

- 1 Preparing for the Next Crisis...Now
- 1 GIS—Visualizing Racial Equity
- 1 The Geospatial Community Comes Together Virtually
- Briefly Noted
- 12 The Africa GeoPortal Brings Together a Whole Continent of GIS Users



- 3 ArcGIS Field Maps: Three Field Apps in One
- 7 Create Captivating Geospatial Experiences
- 8 An Easier Way to Interpret and Exploit Imagery
- 9 Map Viewer Beta in ArcGIS Online: Intelligent Defaults, Instant Visualization

#### YOUR WORK

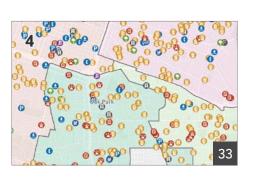
- 4 GIS-Based Contact Tracing Initiative in Pennsylvania Sets US Precedent
- 10 Machine Learning Becomes Part of the Fabric of Kuwait
- 20 Web Map Brings Together Wildlife Conservation and Green Energy Development
- 22 Citizen Science App Helps Mitigate Threats to the Environment
- 25 University Incorporates 3D GIS into Curriculum
- 28 Oklahoma Crowdsources Damage Assessments to Kick-Start Disaster Recovery
- 32 GIS Enables Tourist Destination to Operate Efficiently While Empowering Others
- 33 Sacramento's Revamped 311 System Uses Groundbreaking Location Analytics
- 34 Cloud-Based GIS Streamlines Neighborhood Revitalization Efforts

#### **GIS PEOPLE**

- 17 People and Places, Not Points and Lines
- Better Data and Visualization Foster Deeper Understanding of Black California
- 24 Open Science Is Good Science
- 26 In Unique Circumstances, Educator Teaches GIS in Class and on TV
- 27 In a Changing World, Maintaining Business Continuity Requires Leadership
- 35 Cartographic Creativity and Ingenuity on Display

#### **COLLABORATIONS**

- 29 Utility Upgrades Water Infrastructure with Machine Learning
- 30 With Help from Esri Partners, Users Enhance Their GIS
- 36 Esri Press
- 38 New Training and Certification Offerings



Reach more than 800,000 potential customers.

Reserve space in the longest-running GIS magazine.

ads@esri.com

## ArcGIS Field Maps:

#### Three Field Apps in One

ArcGIS technology has advanced over the past decade to more fully meet the needs and requirements of organizations that perform field operations. Whether those mobile activities lie at the center of a company's business model or are ancillary to an organization's goals, the results of their execution can significantly influence outcomes.

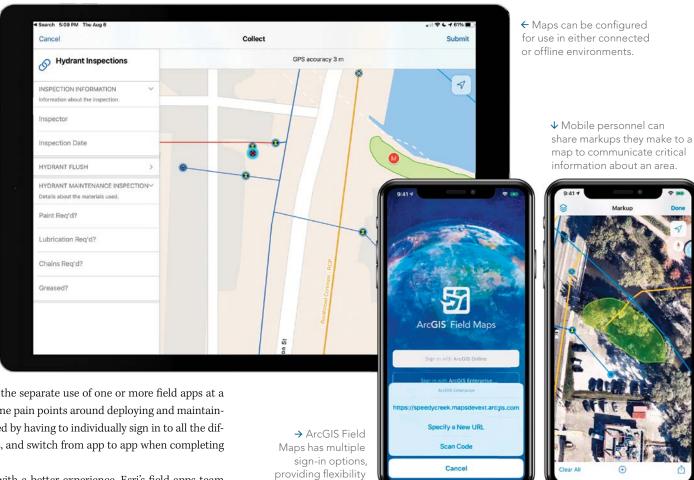
In the last five years, Esri's field operations offerings have evolved, too. They've progressed from initially focusing on map viewing and data collection to encompassing optimized routing, work management, and location tracking. Now, the way users employ these mobile apps is evolving too.

While having a flexible framework that allowed the separate use of one or more field apps at a time was valuable, customers have experienced some pain points around deploying and maintaining multiple apps. Mobile users were also challenged by having to individually sign in to all the different apps, deploy offline maps on a per-app basis, and switch from app to app when completing workflows that required using more than one.

To resolve these issues and provide app users with a better experience, Esri's field apps team created a single app that incorporates the full range of field operations capabilities: planning and managing work, navigation, data capture, and monitoring projects and personnel.

The new ArcGIS Field Maps app, introduced to customers in the early adopter beta program in July and now available to everyone, brings together the functionality of ArcGIS Collector, ArcGIS Explorer, and ArcGIS Tracker to give users the ability to collect data, view maps, and track locations all within a single mobile app.





and ease of access

Field Maps has two components, a mobile app and a web app. The mobile app is powered by maps created with ArcGIS and configured using the Field Maps web app. The web app streamlines map configuration and deployment by bringing together the experiences throughout ArcGIS that support offline capabilities—including configuring feature templates, form capabilities for data capture, and editing in the field—in one place.

In addition, with Field Maps, a single map can support all field workflows, meaning it's no longer necessary to have separate maps for data collection, map exploration and markup, navigation, and work management. This minimizes device storage consumption that often results in reduced app performance.

Mobile personnel who use Field Maps benefit from map-centric workflows that make it easy to explore a map of a work area, search within the map to find assets or places of interest, and record location tracks. Data that they edit or capture feeds directly into the organization's ArcGIS system, where it's available for others to use in near real time. Field Maps works seamlessly in disconnected environments, too. It retains collected data on the mobile device until connectivity is available, and then it syncs with the organization's ArcGIS platform.

For GIS administrators who manage an organization's mobile devices, having all these field apps available via one app makes it easier to assign apps to mobile personnel. There's only one app to manage and update—Field Maps—rather than having to do all this work separately in Collector, Explorer, and Tracker. In future releases, Field Maps will also include the work management capabilities of ArcGIS Workforce and the navigation functionalities of ArcGIS Navigator.

Existing customers that currently use Collector and Explorer either as stand-alone apps or through the Field Worker user type license get the same data collection and map viewing capabilities with Field Maps. Those that also use Tracker experience the same location tracking capabilities they currently have. And all the capabilities that have previously required the use of three separate apps are now available within the Field Maps app.

For users who are only now getting ready to digitally transform their mobile operations, Field Maps is the best place to start. It's where all future development and new capabilities will be delivered.

The use cases for Field Maps vary widely. For organizations that manage significant infrastructure, such as utilities or pipeline owners, Field Maps provides a streamlined experience for inspection and maintenance workflows. An inspector, for example, can use Field Maps to find assets that need service; follow a built-in inspection form to document any findings; and if necessary, confirm through location tracks that the correct asset was inspected.

Home health workers, as another example, can use Field Maps and its smart form capabilities to complete built-in health surveys for their patients. They can also employ app-based location tracks to show supervisors that they've covered their areas of responsibility.

With Field Maps, decision-makers can stay aware of how work is progressing and where their crews are by viewing location tracks. If an associate in the field doesn't report in when expected, managers can see that person's last known location, making it easier to provide help if needed.

For anyone involved in field operations—from GIS administrators to crews and supervisors—it's game changing to be able to deploy, use, and manage all the robust GIS capabilities that are so critical to field activities from one app.

To learn more about ArcGIS Field Maps and get started with it, go to esri.com/fieldmaps.

esri.com/arcnews ArcNews Fall 2020

## GIS-Based Contact Tracing Initiative in Pennsylvania Sets US Precedent

By Stephen Goldsmith, Harvard Kennedy School

When Vicky Kistler, Allentown, Pennsylvania's director of health, and Matt Leibert, the city's chief information officer, traveled together to an Esri conference in Philadelphia in 2003, they had big hopes for what GIS could provide for the city, imagining that one day they might have an advanced platform that could help them visualize and track the spread of disease in real time. Little did they know, a global pandemic 17 years later would give them the chance to adopt this capability.

Today, Allentown has taken the lead on a fourcity, GIS-based community contact tracing initiative alongside Bethlehem, York City, and Wilkes-Barre that is poised to set the foundation for one of the United States' more promising responses to the coronavirus disease 2019 (COVID-19) pandemic.

#### The Limitations of an App-Based Model

When the pandemic first hit, many local governments turned to app-based solutions for contact

tracing and exposure notification to try and keep up with the spread of the virus. Unfortunately, cities often found themselves in situations where this app-based model failed to garner momentum, resulting in adoption rates below those required to be effective. So state and local governments working to build up their contact tracing workforces relied, in large part, on traditional manual processes.

As the pandemic has dragged on, transmission has advanced to community spread,

where those who get infected are unable to pinpoint how they contracted the virus. This makes identifying and tracking contacts much more difficult. In turn, it's necessary to adopt a location-focused approach.

But the problem is far more complicated than downloading apps and building up the workforce, according to Matt Leger, policy research analyst for the Innovations in Government Program at Harvard Kennedy School, who also serves as director of strategy at CONTRACE Public Health Corps, a social enterprise that provides COVID-19 contact tracing workforce and advisory solutions to the public and private sectors. Tracing programs face significant operational constraints aggravated by often outdated back end IT infrastructure that slows responses, he said.

Combining person-to-person tracing with upgraded IT infrastructure and GIS tools, however, can help overcome these limitations.

#### Layers of Benefits to Using GIS

That is exactly the approach Allentown has taken. As Kistler and Leibert explained, using community contact tracing tools from Esri produces multiple layers of benefits.

In the first place, these tools gave Allentown a running start, since it was already using the ArcGIS platform. Allentown invested in IT solutions, including broadening its GIS capacity, several years ago—even in a period of resource scarcity—in hopes that the investment would increase productivity.

This foresight continues to produce benefits for both routine and extraordinary service demands. Although the GIS capacity differs among the four cities participating in the community contact tracing initiative, the fact that they all had access to ArcGIS tools

← The City of Allentown's dashboard for the coronavirus disease 2019 (COVID-19) pandemic protects people's privacy while providing a clear visualization of what's going on.





### **Built to Thrive and Survive**

All Day, Every Day High-Performance Rugged Devices

Next-generation rugged phones and tablets from the market share leader in rugged mobile computing.

#### Versatile. Rugged. Reliable.

To learn more visit zebra.com/government.

877 208-7756 | Contact.us@zebra.com

ZEBRA and the stylized Zebra head are trademarks of Zebra Technologies Corp., registered in many jurisdictions worldwide





provided the foundation for standardization and collaboration

These tools also helped Allentown replace cumbersome, paper-based processes with digital technology and semiautomated workflows. Leibert and his team conducted a workflow analysis of the COVID-19 case investigation and contact tracing processes to identify duplicative actions. They quickly realized that the city needed far more advanced capabilities to be able to do contact tracing effectively.

Officials identified nine manual steps that had to be taken between receiving data from the National Electronic Disease Surveillance System (NEDSS) and sending the data back to the Pennsylvania Department of Health—a very laborintensive effort filled with risks of human error. And this was just for case investigation; it did not include the steps needed for contact tracing.

Joseph Yashur, community health specialist for the City of Bethlehem, agreed that new capabilities were needed to be able to do successful contact tracing. He noted that tasks that previously took hours to complete, including performing quality assurance on the data, are done much more efficiently using Esri tools such as ArcGIS Survey123.

#### Myriad Advantages for the Community

For the four Pennsylvania cities participating in this initiative, the now automated and spatially oriented workflows that connect case investigation and contact tracing will produce substantial advantages as community contact tracing accelerates. Examples of the many manual steps that have been automated include verifying addresses and notifying contact tracing staff when there is a rapid reassignment of cases. This will significantly improve efficiency.

But as Joe McMahon, former managing director for Allentown's mayor, Ray O'Connell, pointed out, "It's not just a matter of efficiency; it's a matter of accuracy." And the original contact tracing platform provided to the City of Allentown by the state's department of health was not equipped for the level of detail needed to do contact tracing at scale, which would have affected accuracy.

"You know the old saying—if you enter it once, it's less likely that there will be transferred errors throughout multiple systems," McMahon added.

Yet the spatial nature of contact tracing furthers the ability of city leaders to inform the public and enact strategic, place-based interventions. So accuracy is key.

With the GIS-based contact tracing tools Allentown, Bethlehem, York City, and Wilkes-Barre have put in place, officials can protect people's privacy while also providing dashboards and map narratives of COVID-19 cases in a fashion that clearly visualizes what is going on. This, in turn, helps improve community safety.

Geographic analysis can also assist by making connections among the locations of the disease, affected individuals, and nearby available resources. In fact, Allentown intends to integrate an automated notification system to help communicate information to high-risk neighborhoods and to people who have tested negative or been exposed to someone who has tested positive.

#### Looking Ahead to Future Public Health Uses

Another benefit of having a cloud-based platform is the opportunity to share innovations and discoveries with other public health departments. As Kistler emphasized, she hopes that, as the other cities in her collaborative join in using the technology, "they may have ideas we haven't thought of that could enhance our capabilities even further."

"We're all borrowing from one another. It's information sharing that we're looking at doing," said Kristen Wenrich, Bethlehem's director of health. And that's something she takes pride in. "I'm anticipating that we'll hold regular meetings, since we're all speaking in the same language of GIS," she added.

In addition, having a GIS-based foundation allows multiple agencies to gain even broader insight into public health. Both Bethlehem and Allentown public health leaders hope that the layered data will help cities pay more attention to the social determinants of health and how neighborhoods are affected by a multitude of factors. Officials are currently considering how to apply GIS technology to trace sexually transmitted diseases (STDs), tuberculosis, whooping cough, and other illnesses. And the four cities in the collaborative are optimistic that, by crossing health data with geographic data, they can join together to apply for research grants and respond to the causes of health disparities.

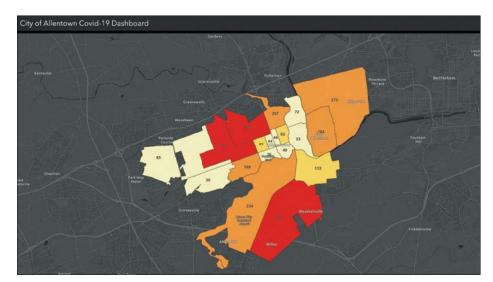
According to Wenrich, Bethlehem plans to have officials—when they become more comfortable with the power of spatial analysis—use these new capabilities for other disease prevention activities.

"When you see mapped clusters, you can also see potential action that can be taken," she said.

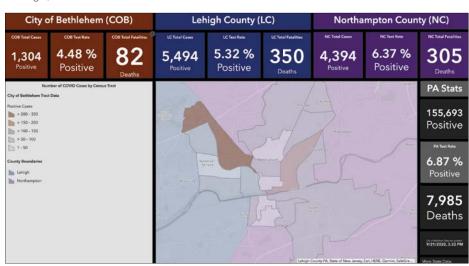
For example, these capabilities helped Bethlehem improve outreach efforts to Spanish-speaking communities after the public health department saw the disproportionate impact of COVID-19 in certain Hispanic neighborhoods. Now, Wenrich is contemplating applying this technology more broadly—for food inspections, public health nuisance complaints, STDs, and highway safety initiatives, for example.

The officials also hope that the increased efficiencies they've experienced will allow the state's public health department to make better decisions about other important tasks, such as mass flu shot and COVID-19 vaccine distribution, when the latter becomes available.

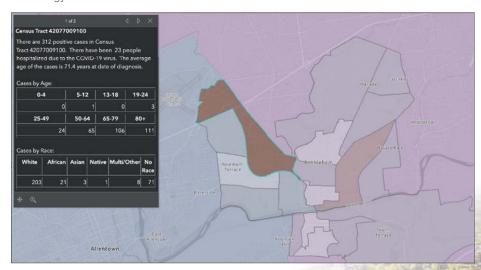
Often, according to McMahon, the public doesn't understand the need for technology investments. But, he said, "the transition to this platform [is] an investment that will have massive returns for not just public health but [also] city government overall."



↑ The spatial nature of contact tracing helps city leaders keep the public informed and carry out strategic, location-based interventions.



↑ Officials from the City of Bethlehem like that cities and counties are sharing data and borrowing technology ideas from one another.



↑ Geographic analysis can help city officials make connections among the locations of COVID-19 cases, affected individuals, and available resources.

#### About the Author

Stephen Goldsmith is the Derek Bok Professor of the Practice of Urban Policy and director of the Innovations in American Government Program at Harvard Kennedy School. He also directs Data-Smart City Solutions, a project that highlights local government efforts to use new technologies that connect big data analytics with community input to reshape the relationship between government and citizens.



esri.com/arcnews

ArcNews Fall 2020 5

#### Preparing for the Next Crisis...Now

Once a community emerges from the immediate response to a disaster—natural or otherwise—recovery efforts begin. This is when governments start doing impact assessments and businesses seek to establish continuity.

In this phase of the crisis management life cycle, GIS aids in evaluating damage and documenting impacts to infrastructure and the environment. It also helps organizations quickly report the results of these assessments to state and federal agencies so communities can access the recovery funds they need to get relief and start the rebuilding process.

The recovery phase is also a time for organizations to pinpoint and log any lessons learned from the response phase. This exercise should encompass both the good and the bad to foster an evolution in thinking and inspire new solutions that can be used in the next response.

One of the key lessons learned from COVID-19 is the need for greater collaboration among all levels of government and across sectors. The City of Bozeman, Montana, for example, has taken this idea and used ArcGIS Hub to develop a hub site that shows real-time COVID-19 indicators for its immediate tri-county area. The website, available at ow.ly/72cQ50BrVFO, provides access to critical resources that can help the community reopen and return to work. These resources include lists of where residents can buy certain types of masks at local stores and links to flyers

and brochures that all kinds of businesses—from schools and childcare facilities to hotels and restaurants—can print to ensure that they are in compliance with current public health regulations. The comprehensive hub site also provides greater transparency on the current status of COVID-19 cases, businesses, and community resources across multiple counties.

During an ongoing crisis and even afterward, lessons learned serve as a foundation for better preparedness-that is, they give organizations greater situational awareness of the risks and vulnerabilities that were exposed during the emergency. Paired with GIS, these lessons learned can spark concrete action. For example, mapping the location of known hazards like floodplains or faults; critical infrastructure, such as schools and office buildings; and population or employee characteristics, including demographics and health, racial, and economic equity data, can help identify locations and populations that are more vulnerable to the effects of an emergency. For these locations, organizations can plan how to better mitigate a disaster's potential impacts. Communities, for example, can make proper adjustments to building codes or buy and redevelop land located in flood-prone areas to implement flood mitigation. Efforts like these can prevent an emergency from turning into a disaster.

The City of West Palm Beach, Florida, has taken an inclusive approach to determining

community-wide risk and vulnerability due to climate change, focusing, in part, on sea level rise. By employing a community-focused process that uses maps and data to communicate the risks and potential outcomes of sea level rise, as well as GIS to analyze existing threats and hazards, the city has been able to establish mitigation priorities that reflect the community's shared vision for long-term resilience to climate change. This includes setting goals for planting 10,000 trees in West Palm Beach by 2025 and achieving net-zero greenhouse gas emissions by 2050.

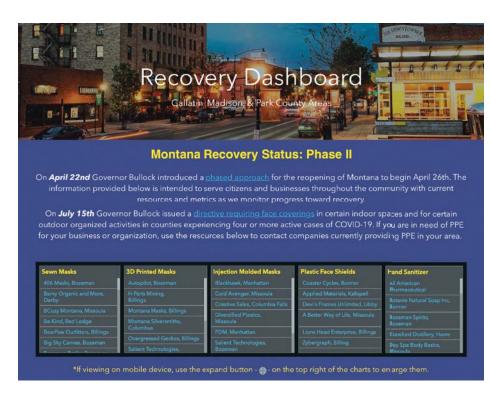
Finally, to ensure readiness for the next crisis, there is a need to bring all this together. Organizations should take the lessons learned, the increased awareness of vulnerabilities, and the new tools or programs that have been put in place to mitigate risk to train and prepare their staff, partners, and the rest of their communities for the next crisis, which could happen at any time.

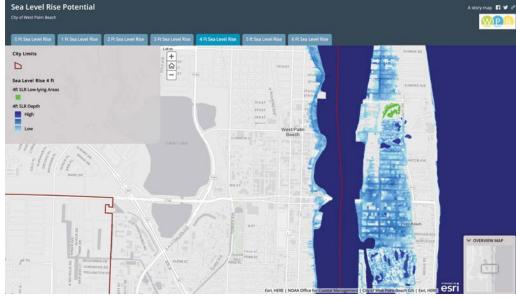
With each new emergency, the crisis management life cycle continues, on and on, providing

organizations with new lessons learned and fresh opportunities to strengthen their resilience. Amid the global crises that have happened so far in 2020, there are great examples of how organizations have used location intelligence to gain a better understanding of the current situation in real time, model the potential impacts of these hazards on their communities, site and allocate additional resources as effectively as possible, and communicate with and engage the whole community using maps and apps that provide much-needed context and insight.

Building resilience across our global, interconnected society requires each of us to act now. Embrace the crisis management life cycle framework and shift the focus from response to preparedness and readiness. Develop a better understanding of the risks and vulnerabilities that are specific to you and your organization and how they correlate with those of your partners and neighbors. Then, build solutions for a more resilient future—no matter what crisis comes next.

For more than 25 years, Esri's Disaster Response Program (DRP) has been helping governments, businesses, and nonprofits respond to crises of all types and sizes. Based on this real-world experience, Esri has developed a set of ArcGIS solutions that can help any organization respond to any kind of emergency. For more information on the DRP and how these solutions work, go to ow.ly/R5Mq50ByxMH.





← The City of Bozeman, Montana, created a hub site that provides access to critical ↑ The City of West Palm Beach, Florida, has employed a community-focused approach to communicating the risks and potential outcomes of sea level rise due to climate change.





↑ Bozeman's comprehensive hub site shows local business and tourism indicators, the status of federal emergency relief funding, snapshots of development projects in the area, and more.

## Create Captivating Geospatial Experiences

ArcGIS Experience Builder, Esri's newest app builder, empowers users to quickly transform their data into compelling web apps without writing a single line of code. It offers an interconnected environment by taking information, which can be seen in both 2D and 3D, and dynamically integrating it with a range of ArcGIS apps, including web apps, dashboards, map narratives, and surveys.

With Experience Builder, users have the option to focus their apps on one type of content, like a map, or combine and link various types of content, such as text and images, to create a single destination where their audience can view everything. Users can get started with a template or create an experience from scratch, and from there, building an app is easy. Users just choose, drag, position, and configure widgets—including maps, images, text, and tools—and add triggers and actions to make the widgets work together, either within a single page or across multiple pages. If additional customization is needed, developers in an organization can use ArcGIS Experience Builder (Developer Edition) to create their own widgets, templates, and themes.

Experience Builder works seamlessly in ArcGIS Online and ArcGIS Enterprise. This means that any apps created in Experience Builder can leverage all of an organization's existing content. Experience Builder users can share custom templates with others in their organization and choose how their apps are shared—whether privately within a group or as a landing page for their organization's website. Furthermore, apps created with Experience Builder are responsive and mobile friendly, so they look great on any device.

One example of an Experience Builder app, showcased in the Plenary Session of the 2020 Esri User Conference (Esri UC), is an emergency management app that Miami-Dade County could use to inform residents about severe weather and emergency management operations. Users can filter the entire app and the data it shows by panning the map and selecting specific municipalities within the county. This interactive experience lets app users see weather warnings and analyze their effects on different areas of the map.

The integrated 2D/3D feature in Experience Builder, which allows users to switch between 2D and 3D, really shines through in the emergency management app when examining how floods could affect Miami's coastline. In the 2D view, users can see various weather events and warnings; whereas in the 3D view, they can discern how buildings might be impacted by a three-foot storm surge.

The Miami-Dade County app is packed with additional information as well, including details about emergency shelter availability and school closures. It incorporates dynamic media and text, too—including videos and Twitter feeds—which create a rich, informed narrative. And it features links to updates that come directly from Miami-Dade County's website, which makes the app a one-stop shop for authoritative information.



↑ Users can easily create an app in ArcGIS Experience Builder by choosing a theme, adding widgets, and connecting to data.



↑ In the Miami-Dade County severe weather app, switching on the 3D view allows users to see the heights of buildings along the coastline and how they could be affected by a three-foot storm surge.

Experience Builder is built on the powerful ArcGIS API 4.x for JavaScript, so users can create more compelling apps than ever before. As an app's requirements expand, adding new features to the experience is easy. From within the builder, users can add new widgets or pages, edit existing pages, connect to additional data sources, and adjust the app's theme.

To start building dynamic and powerful web apps that run on any device and bring together the apps you're already using in one, unified location, get started with ArcGIS Experience Builder at go.esri.com/experiencebuilder.



#### COLLECT

Built-in laser measurement routines allow you to collect more data than ever before.

#### **FEATURES**

Integrate with Eos Arrow Series™ GNSS reciever systems and devices.

#### **SAFELY**

Position yourself to capture remote asset locations from a single location.

Seamlessly integrates with Esri® ArcGIS® Collector

for iOS!

Go2.LaserTech.com/GNSSMapping

esri.com/arcnews ArcNews Fall 2020 **7** 

## An Easier Way to Interpret and Exploit Imagery

#### Web-Based App ArcGIS Excalibur Unites GIS and Imagery

Both geospatial analysis and imagery have evolved over the years. From the famous Lewis and Clark expedition of the western United States from 1804 to 1806 to the establishment of the National Imagery and Mapping Agency, now known as the National Geospatial-Intelligence Agency (NGA), in 1996, important projects and operations—at the international level down to the local level—have hinged on bringing together geospatial data, maps, charts, and imagery.

Although GIS and imagery have always had a symbiotic relationship, only recently have these technologies been combined in a single experience.

ArcGIS Excalibur transforms the way analysts search, discover, and work with imagery—all in a web app. Excalibur modernizes and enhances image-based workflows by unifying traditional, separate geospatial and imagery-based views into a single field of vision: the imagery exploitation canvas. This intuitive user experience has the power to improve daily decision-making

across industries, from airlines that need to view flight patterns to farmers who need to monitor crop life cycles.

Regardless of what it's used for, Excalibur provides a way to quickly access imagery, conduct efficient exploitation, and share results.

#### **Greater Access to Imagery**

Excalibur has an integrated imagery search and discovery experience that provides one-click access to web-enabled image services and Web Map Services (WMS). Analysts can filter and refine images by date, cloud cover, predicted National Imagery Interpretability Rating Scale (NIIRS), obliquity, or name. The results of an image search can then be added to the queue for further analysis. Analysts also have the option to input a WMS URL for faster access to the imagery exploitation canvas.

#### **Efficient Imagery Exploitation**

With Excalibur, users can incorporate geospatial layers into their visual imagery analyses.

This integrated approach allows analysts to extract observations or create markups from oblique imagery while maintaining their geospatial reference information.

In the imagery exploitation canvas, users can work with a focused image in its native perspective or in a split screen so they can also view it simultaneously in a map. Additionally, users can examine and employ tools that work directly with the imagery service they use. These tools include features that enhance imagery display, exploit imagery through markups and measurements, and export a user's current view for use in presentations.

Excalibur also introduces what's called an imagery project—a dynamic way for users to organize all the resources required for an image-based task in a single location. Projects can include imagery and geospatial reference layers, in addition to a set of tools that simplify image-based workflows. This can help analysts streamline structured observation

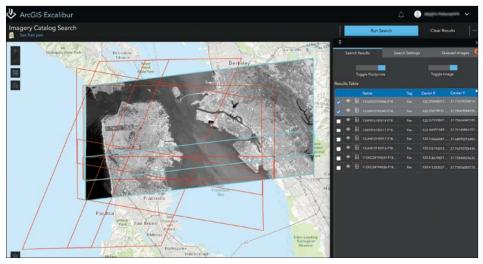
management (SOM), imagery comparisons, and other imagery workflows.

#### **Easily Share Results**

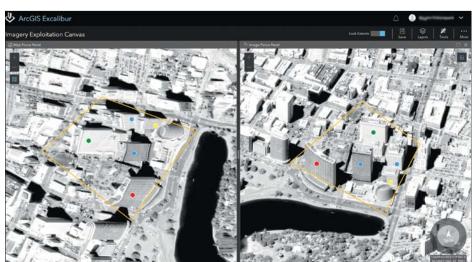
Given that Excalibur is built to work right inside ArcGIS Enterprise, users can easily exploit imagery, export areas of interest, and share observations with stakeholders. For example, users can add their observations to feature services that others can access through web pages on any device. Users can also bring other ArcGIS apps and solutions into play to create products such as image observation reports, dashboards, interactive briefing materials, and dynamic analysis layers.

#### **Get Started**

To learn more about Excalibur and add it to your organization's ArcGIS Enterprise deployment, get in touch with an Esri representative at go.esri.com/arcnews/excalibur. Also, get the latest news about Excalibur at go.esri.com/arcnews/excalibur-blogs.



↑ With ArcGIS Excalibur, users can locate and access imagery in seconds



↑ Markup tools help users integrate geospatial layers in their visual imagery analysis.



### Map Viewer Beta in ArcGIS Online: Intelligent Defaults, Instant Visualization

Map Viewer beta in ArcGIS Online opens the door to the next generation of mapping. Its intelligent defaults help users quickly create maps, and its instant visualization of settings and data filters encourage exploration. Map Viewer beta is available to all ArcGIS Online and ArcGIS Enterprise 10.8 users.

Many of the features included in Map Viewer beta—such as layer groups, cluster labeling, improved symbology, and layer blending—have been requested by users. Read on to see what each feature entails.

#### **Grouping Layers**

Users can organize the layers in their maps and apps into groups using the layer groups functionality. With layer groups, it's easy to turn groups of layers on and off and quickly reorder them. Users can also employ layer groups to show more

levels of geography for a single dataset. This makes it easier to look at topics like how commuter habits align and differ at the state, county, and tract level.

## Labeling Options for Clusters lemma of having overlapping

points by grouping points together and providing one symbol for all of them. With Map Viewer beta, users can add clarity to their clusters by including a label that appears on each symbol. The label can show the number of points in the cluster or the average value of the clustered points. Users can customize the font, size, placement, offset, and halo of their labels. They can also set the minimum and maximum size for the clusters.

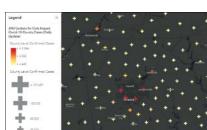


 Map Viewer beta offers flexible options for labeling point clusters.

#### Improved Symbology

Map Viewer beta has new vector point  $symbols\,as\,well.\,Because\,they\,are\,Scalable$ 

Vector Graphics (SVG), the integrity of the shapes is preserved when scaling, which makes a cleaner, better-looking map. Users can also change the colors to fit their map. These new vector point symbols come from 2D web styles published in ArcGIS Pro 2.6. This means users can also publish their own web styles in ArcGIS Pro and display them in Map Viewer beta.



point symbols in Map Viewer beta preserve the integrity of each symbol's shape when scaling

#### Sophisticated Layer Blending

In Map Viewer beta, there are more than 30 blend methods,

which take two or more layers and blend the pixels that each layer normally draws. This gives users control over what shows through each layer and how colors and textures between layers appear. While this may sound like layer transparency, it's not. Blend methods give users the power to enhance their maps without obscuring them. The interface in Map Viewer beta encourages users to explore with blending, too. It's a property setting, meaning that the layers remain independent. To return to the layers' original state, all users have to do is turn blending off.



← In Map Viewer beta, blend methods give users control over what shows through when two layers are combined.

Some users have raised questions about how to approach the new Map Viewer beta when they're used to the classic Map Viewer. Here are some answers to those inquiries.

Do I need to convert maps built in Map Viewer classic to Map Viewer beta?

No conversion is necessary. Maps created in Map Viewer classic are supported in Map Viewer beta. Users can simply open a map from Map Viewer classic in Map Viewer beta and save it. When saving, users have the choice to Save this map (overwrite the existing map) or Save as a new map (create a second map). Saving as a new map enables users to verify that their updated map performs as expected before using it in a production workflow.

When will this new Map Viewer replace the classic Map Viewer?

Both viewers will coexist until the new Map Viewer supports all the functionality available in the classic version. Additionally, Esri will share the replacement date far in advance to give users time to prepare for the change.

How can I find out which apps support the capabilities introduced in Map Viewer beta?

Most capabilities are supported across the platform. However, some capabilities introduced in Map Viewer beta—including vector symbols, layer groups, and advanced labeling—are enabled by ArcGIS API 4.x for JavaScript. Thus, web maps authored in Map Viewer beta are best paired with apps that are also built using ArcGIS API 4.x for JavaScript. Apps built using ArcGIS API 3.x for JavaScript can still display maps created with Map Viewer beta, but it's possible that not all their capabilities will be supported. Over time, more apps will be updated to use version 4.x.



## MACHINE LEARNING BECOMES PART OF THE FABRIC OF KUWAIT

For decades, Kuwait has been on the cutting edge of geospatial technology. An early adopter of GIS among countries in the Gulf Cooperation Council (GCC), the government of Kuwait started using GIS in the late 1990s for planning purposes. As the technology evolved and a range of government agencies began implementing GIS, Kuwait's Public Authority for Civil Information (PACI) emerged as a standout user and is now blazing trails in machine learning.

PACI provides civil identification to commercial and residential establishments across the country and to the people of Kuwait. Because of this, PACI keeps authoritative records of every address, business, and individual in Kuwait.

"All these components are linked together with a unique identifier called a PACI number," explained Maher Abdel Karim, GIS project manager at PACI. "Each parcel or building or unit inside a building is uniquely identified through that [number] all over Kuwait, and there is no duplication."

Having to keep track of all this data meant that PACI realized early on the importance of incorporating GIS workflows into its business processes. It has also enabled PACI to consistently innovate with GIS.

"We embarked on an enterprise-wide GIS project in 2011, where we converted all our CAD-based papers and digital records into GIS and

built a complete enterprise GIS by integrating this with our legacy systems," said Karim.

That helped PACI create a comprehensive basemap for the entire country. After that, the organization decided to simplify how people could search for addresses and businesses across the country, so it developed a mobile app called Kuwait Finder. The app provides the public with distinctly local information about all the businesses in Kuwait.

"Five years ago, this was a revolutionary application, and we at Esri assisted in developing a supporting, state-of-the-art, back end infrastructure," said Mansour Raad, Esri's global chief technologist.

"Kuwait Finder provides people with a hyperlocal search engine plus navigation and certain local features, like supermarkets, health centers, or the date and location of a public figure's funeral proceedings so people can go give their condolences," said Karim. "It's a really popular app in Kuwait—the number two app on both Android and iOS."

But in a fast-growing country with unique geographic features, keeping the basemap that supports Kuwait Finder (along with many other projects) current proved to be a constant, complicated, and time-consuming job. What's more, for Karim and his team to provide Kuwait

Finder as a service, like they wanted to, they had to find a better way to update the basemap.

"So over two years ago, Maher goes, 'What if we use machine learning for that?" recalled Raad, whose work revolves around advanced geospatial analytics. "At the time, nothing was done using geospatial artificial intelligence, or GeoAI. But he and I developed a way to use satellite imagery to do road and building footprint extraction. This was a huge time-saver and very groundbreaking."

"The things that PACI is doing are just really transformational for Kuwait as a whole," said Linda Peters, global business development manager for official statistics at Esri. "Doing this deep learning, PACI is taking a process that used to take five analysts more than a year to complete and running it in less than a week."

### UNIQUE CONDITIONS REQUIRE INVENTIVE SOLUTIONS

Geographically, Kuwait is quite distinctive, which has given rise to unique-looking infrastructure in and around Kuwait City, where everyone lives. The country's largely flat and sandy desert landscape gives way to a warm coastline on its eastern edge and small patches of agricultural land in the southeast. Rapid development has been a mainstay of life in Kuwait for decades. In a bid to become a regional and

international financial and trade hub by 2035, new construction has soared in recent years.

"Because Kuwait is a burgeoning country, every time you go somewhere, a road will change or a new one will appear that wasn't there a few months ago," said Raad. "Keeping up with this is difficult."

Which is why Karim wanted to use machine learning to extract road data and building footprints from satellite imagery. But aside from the fact that GeoAI was nascent technology at that time, Kuwait faced other issues as well.

"In the United States, you can find high-accuracy satellite imagery and aerial and drone photos. You'll find a lot of green areas or gardens or structures, and there will be added contrast on the imagery, which can help you distinguish between buildings and the surrounding land-scape," said Karim. "In Kuwait, due to its desert landform, the contrast in the satellite imagery is very weak. So it's difficult to distinguish between the building and the street."

Additionally, the shapes of Kuwait's houses vary a lot, which is not the case in many other countries. And even the shapes of parking lots and streets aren't standard.

"Another problem was the absence of synchronization between satellite imagery and vector data," said Karim. "This vector data is needed for ground truthing that PACI can feed into a model to help it learn what various features look like."

PACI had to start from scratch, creating new ground truth data that includes building footprints, street polygons, and parking lots. These features were used to train the model to detect what to pull from satellite imagery. From there, the team at PACI had to test various models and manually check the GIS features they were producing.

"When we started evaluating the output of the models, we found that it was totally different from what we were looking for," said Karim.

In short, the models didn't reflect what Kuwait actually looks like. So the team had to innovate again.

"Since we were already creating the ground truths for buildings and streets and parking lots, we built a model that can provide us with these three feature types," said Karim.

Then came more training and testing. PACI took a 600-square-kilometer area (about 230 square miles) of satellite imagery of Kuwait and had the model infer where buildings and streets are to provide the prediction raster.

"We ended up taking what Kuwait City looks like, what the desert looks like, what the agricultural areas look like, what the region by the gulf looks like, and we taught the machine those things by explicitly labeling everything." Raad explained. "Maher and his team spent a lot of time labeling the data, which is very important in machine learning, and it paid dividends."

← Kuwait's Public Authority for Civil Information (PACI) created new ground truth data for building footprints, street polygons, and parking lots all over Kuwait to train the model.



"After postprocessing, we got around 111,000 building footprints and around 78,000 street segments, and this took around one and a half hours," said Karim.

The team then checked the model's output building by building. By Karim's estimate, it took just over 48 hours total to do quality control on the data, which reached 97 percent accuracy.

"Before, this would have taken us 119 days, so we are comparing a week to 119 days," said Karim. "You can imagine the productivity increase by applying machine learning and deep learning models to automate the GIS workflow for basemap updates."

#### FORGING AHEAD WITH NEW IDEAS

While the project has come a long way in two years, it is still a work in progress.

"We are still trying to automate as much as we can from this process in order to reach the point that we minimize manual efforts and manual processes," said Karim. "We are trying to enhance our models and our workflows to achieve this."

At the same time, Karim and his team are already working on adapting machine learning to new projects—namely, to 3D, street-level imagery.

PACI currently has its own street-level imagery of the whole country and serves it to the public via Kuwait Finder. As with the basemap, this street-level imagery needs to be updated regularly. So what Karim is working on now is how to extract features from this street-level imagery to enrich PACI's GIS layers.

"In order to use deep learning to do this, we decided to create a new training dataset based



 $\uparrow$  PACI used training data (in red) to teach a model to detect what to pull from satellite imagery.

 $\uparrow$  The shapes of houses, parking lots, and streets in Kuwait vary a lot, as can be seen in these sample inferred building footprints from the trained model

on the imagery that was captured in Kuwait," said Karim. "We currently have around 41 different classes, like cars, buses, people, manholes, traffic signs, stop signs, and traffic lights. So we are combining these 41 classes...and converting them back to GIS."

"All this is really avant-garde," said Raad. "Maher is very forward thinking about what he needs to do."

And he has a great team behind him, whose members believe in extending the benefits of GIS not only across government agencies but throughout Kuwait as well.

"PACI has one of the best GIS teams that works on a range of different projects—not only keeping data updated but also providing lidar surveys; doing machine learning; updating applications, like the mobile apps and Kuwait Finder; creating different information products; and supporting other government agencies," said Raad. "PACI has been bold enough to embrace the latest developments and cutting-edge technologies, which has helped the country in general understand how effectively GIS technology can be implemented."



 $\uparrow$  PACI took new satellite images and inferred buildings and streets from them to update its GIS.



esri.com/arcnews ArcNews Fall 2020 11

## The Africa GeoPortal

## Brings Together a Whole Continent of GIS Users

GIS users who live in or work on topics related to Africa now have a robust community geospatial platform for the whole continent: the Africa GeoPortal.

"The unique thing about it is it brings together geospatial data, geospatial tools, and learning about GIS," said Matthew Pennells, the Africa manager for Esri. "All this is free for single users to access if they're working in Africa or on African-based geospatial challenges. It's also designed to be helpful regardless of how much experience in geospatial or GIS technology a user has."

#### A Novel Way to Connect Africa's Geospatial Community

Before the Africa GeoPortal launched in early 2019, there wasn't anything that really connected the geospatial community in Africa, despite there being a lot of common challenges, according to Pennells.

"How agricultural problems are solved in Kenya and Ghana is similar, yet how agricultural problems are solved within Ghana and the United States is very different," said Pennells. "So there's value in having this as a continental platform."

◆ Before the Africa GeoPortal, there wasn't any resource that really connected the geospatial community in Africa. The Africa GeoPortal is powered by Esri technology. It comes with content from ArcGIS Living Atlas of the World that's specially curated so it relates directly to Africa. Users also get access to ArcGIS Online; apps and analytical tools such as ArcGIS Collector, ArcGIS Survey123, ArcGIS StoryMaps, and ArcGIS Insights; and a large selection of Esri's e-Learning materials.

But the unparalleled value of the Africa GeoPortal comes in the form of communitycontributed data.

"People bring in data they might collect at a local or national or continental level, especially if they need a place to store it," said Pennells. "We also have governments adding data—so statistical agencies and such that want to expand access to their open data. And then we have broader partners in the geospatial industry, such as the Earth observation initiative Digital Earth Africa."

#### **Users Expand on One Another's Work**

The idea behind the Africa GeoPortal is to get this community of diverse users to inspire one another and build on each other's work.

"If someone is collecting data on health center locations in Kenya and creates a map to show people where the newest one is, we want other people to see that and take it further, maybe by doing that in Ghana," said Pennells. "So it's a combination of people contributing data and Esri giving them space to share their data and inspire other users."

Once users sign up for a complimentary account, they can create data, store it, make maps, and build solutions. For data scientists, the platform has a range of notebook tools. And if users want to learn more about any of this, the Africa GeoPortal points them to specific e-Learning materials—many of which use data, examples, and scenarios from throughout the continent—that they can use to build their skills.

Now, if someone wants to take that data on health facilities in Kenya and build an app around it, the person no longer has to become an app developer to do that. Both the data and tools needed are available on the Africa GeoPortal. All that user needs to do is find and download the data, locate the appropriate geospatial tools—such as Survey123 or Collector—to use to fill in any missing data, and then bring that information into a simple app that's easy to share.

"We want to remove the barriers to entry for working with geospatial data that currently exist throughout much of Africa and make it so that people can direct their energy toward building local solutions that help solve local problems," said Pennells.

#### **Important Themes Are Front and Center**

On the home page, the Africa GeoPortal highlights big themes that affect most, if not all, of the continent.

Resources for responding to the coronavirus disease 2019 (COVID-19) pandemic, for example, have been front and center for most of 2020. Navigating to the subpage, users find official dashboards containing COVID-19 data for African Union member states, as well as for individual countries ranging from Morocco to South Africa. There are also reliable data and tools from independent users, such as a well-trafficked dashboard from a user in Ghana.

"This guy had the opportunity to bring the data together how he wanted to present it, highlighting the geographic areas more local to him," said Pennells. "His dashboard has received a good number of hits."

Another subsection of the home page spotlights data about the desert locust crisis afflicting the Horn of Africa. It points users primarily to an open data hub built by the United Nations' Food and Agriculture Organization (FAO), as





COVID-19 Resources for Africa are now available

Africa COVID-19 Response

#### Desert Locust Crisis

The Horn of Africa is facing the worst desert locust crisis in over 25 years, and the most serious in 70 years for Kenya. The current situation - an upsurge with the potential to become a regional plague - represents an unprecedented threat to food security and livelihoods in the region and could lead to further suffering, displacement and potential conflict.



well as other datasets on locust swarms, control operations, hot spots, and more.

"What we really want to see for these subtopics is for people to go on and build localized solutions—whether that be local to their geographic problem or local to their particular thematic area—that are based on the authoritative data assembled on the Africa GeoPortal," said Pennells.

### Where Everyone Can Find What They're Looking For

The site is further broken down into country and organizational pages, where data, examples, and stories are more tightly arranged around specific needs and objectives. Anything from these pages is accessible on the wider Africa GeoPortal, and users within the more streamlined geoportals can still access everything that's on the Africa GeoPortal.

"These pages allow people to focus on some datasets, but they don't restrict them from using any of the other content," said Pennells.

The National Office of Technical Studies and Development (known by its French acronym *BNETD*) maintains a country-level geoportal for the Ivory Coast to make its open data more accessible.

"Right now, we are just publishing data for everyone," said Fernand Balé, director of the Geographic and Digital Information Centre (known as CIGN) at BNETD. "But we are building a network of users in every field—in social, economic, and government fields."

BNETD started contributing data to the Africa GeoPortal about a year ago. But sharing data is just the first step in what it seeks to do.

"We want to build apps in order to help our government and decision-makers make good decisions," said Balé. "In our vision, people could share very smart datasets—accurate data—in order to plan infrastructure or access to education and health centers, to achieve more in the private sector, and so on. We want to build a very powerful geodatabase for our users. We want to show how geographic tools can help improve government programs and people's lives."

But first, users need access to accurate data—and a lot of it—which, according to Balé, can be hard to come by right now.

"It's very difficult to have access to maps [and] satellite imagery in Africa," he said. "My big-picture [vision for our use of the Africa GeoPortal] is to be a reference—the place where everyone, every government organization, can find what they are looking for to improve their work, to improve people's lives, to fight poverty, to fight climate change, and so on."

### More Widely Accessible Earth Observation Data

Another organization working to disseminate important geospatial data via the Africa GeoPortal is Digital Earth Africa, which aspires

to make free and open satellite data of the entire continent available in analysis-ready formats.

"Esri is the GIS package that is most abundantly used, especially in Africa," said Aditya Agrawal, senior program adviser for Digital Earth Africa. "Being able to have our data available within the Africa GeoPortal enables that data to be accessible by more users."

The team at Digital Earth Africa also cares about how its data is being used, which is something it can see through the Africa GeoPortal.

"How's it influencing policy and decision-making? What's the impact being generated by the data?" Agrawal queried. "Being able to understand how [geoportal] users are using the data and what outcomes and stories come out of that is going to be the most important part for us and our community."

One area that Digital Earth Africa is currently focused on is food security. It has tailored some of its satellite imagery so users can visualize land-use change over time.

"We're developing a crop mask for the continent to make...changes in agricultural areas easier to understand at national and local levels," said Agrawal. "All the data can be explored via a map viewer, and eventually, we will develop an ecosystem approach where you can access fit-for-purpose apps."

The organization has also used the Africa GeoPortal to release water-related Earth observation data.

"Often, villagers have to go to the nearest water body to fill up their pots with drinkable water. Sometimes they have to walk far distances to find that, and once they get there, they don't know if there will be water," said Agrawal. "The idea behind [this imagery and an associated app] is to make this process easier for people living in these villages so they can get the water they need."

As more people and organizations join the Africa GeoPortal, Agrawal and his colleagues will be curious to see how they use Digital Earth Africa's data.

"It'll be interesting to see the stories they put on their own pages," said Agrawal.

### Users Evolve the Geoportal in Amazing Ways

In its less than two years of existence, the Africa GeoPortal has already morphed into something Esri's Africa team didn't expect.

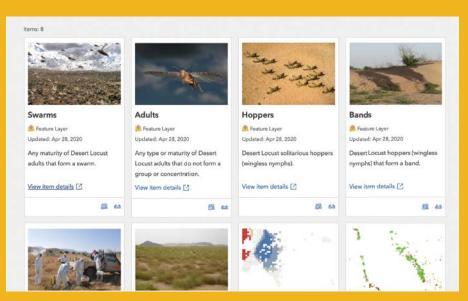
"It went from being africageoportal.com to now having all these other parts of the family, such as the country and organizational pages," said Pennells. "We saw someone use it to make a StoryMaps story about their education and how they got into GIS, and that's proved very popular. We weren't expecting that, but we love to see it."

Esri is committed to supporting users throughout Africa in as many ways as it can.

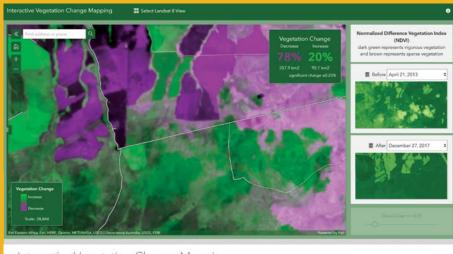
"We are continually amazed at where people are taking the Africa GeoPortal as a tool and as a community platform," Pennells added.



↑ Community members have also contributed reliable data and tools to the COVID-19 subpage.



↑ Datasets on the desert locust crisis include information about swarms of the insects, various control operations, and hot spots.



Interactive Vegetation Change Mapping

Mapping changes in land use through time is a key capability of Digital Earth Africa. This interactive application allows you to investigate changes in vegetation through time using Landsat 8 imagery from Digital Earth Africa. This is available in the Africa Living Atlas of the Africa GeoPortal by selecting available before and after dates for locations in Africa. The application allows selection from a range of dates, computes a vegetation index for those dates and the difference in vegetation index. The results displayed shows increasing vegetation as green and decreasing vegetation as magenta. Summary statistics show the total area and percentage of change within the area of the map display.

↑ Digital Earth Africa makes satellite data of the entire continent available in analysis-ready formats. To reach more users, it's accessible from the Africa GeoPortal.

To get started on the Africa GeoPortal, go to africageoportal.com. Email any questions to africageoportal@esri.com.

esri.com/arcnews ArcNews Fall 2020 1



#### The Geospatial Community Comes Together Virtually

of nature. Overcoming these issues will require better understanding, communication, and collaboration, along with the best science, technology, problem solving, and design thinking, he said.

"Geography, our science; GIS, the technology; and you, the geospatial community, will be essential in creating...a geospatially literate society [to work on these issues]," Dangermond said.

#### A New Experience

To ensure that all members of this vibrant GIS community could get the most out of the conference, Esri created the 2020 Esri UC virtual platform, which registered attendees used to access the Plenary Session livestream, technical sessions, special interest group (SIG) meetings, the virtual Expo, the Map Gallery, and a networking app.

Although users expressed disappointment at not being able to be together in San Diego, California, this year, a number of people found the silver lining in getting to attend the event virtually.

Posting to Twitter from Awka, Nigeria, Chidimma Umeogu said, "Attending *[the]* #EsriUC...has always been a dream." A PhD student and assistant lecturer at Nnamdi Azikiwe University and cofounder of African Women in GIS, Umeogu said in an interview that although she has always wanted to attend the Esri UC, it would be "a Herculean task."

"Its being made virtual this year due to the pandemic granted us from low-income countries the opportunity to participate, network, and have a virtual experience of what the [Esri] UC is all about," she said. "The experience made me feel more connected to the GIS industry and to all the key players."

Brandi LeRoy, a high school geography, history, and GIS teacher from Bangor, Maine, said that while she prefers the in-person event, she was glad to get to join in this year.

"It's always good to hear from Jack and see what's new with ArcGIS technology," she said. "It's really helpful to see how people use GIS in other fields, since that's part of what I want to show my students—how far-reaching the technology is."

Dangermond shared many examples of this far-reaching technology during the Plenary Session. He featured impressive maps from users and called attention to work being done with census data.

"[Some of the] maps show this issue that's on all our minds today—social equity—[along with] racial and ethnic disparities for things like COVID-19...and access to healthy food," he said.

Users have produced a profusion of maps and dashboards related to COVID-19, such as those showing numbers of cases and deaths, information about hospital admissions and patient status, and social distancing-based sidewalk analyses. Dangermond, along with Esri's chief medical officer Este Geraghty and director of public safety and disaster response Ryan Lanclos, highlighted some from around the world.

"Your work on COVID-19 has been incredible," Dangermond said. "It is saving lives, transitioning economies, and making the world safer"

To help people and organizations continue to use geospatial technology to confront the pandemic and its effects, Esri released three new GIS capabilities: time series forecasting, space planners in ArcGIS Indoors, and community contact tracing. Learn more about them at ow.ly/hrN850AMUYW.

#### **User-Focused Advances in ArcGIS**

At Esri, teams continually add new capabilities to ArcGIS, often based on user feedback.

"Our main purpose...is to build tools that help you do your work better," said Dangermond.

He highlighted advances in ArcGIS, including the integration of ArcGIS Notebooks, Esri's implementation of Juypter Notebook, into ArcGIS Pro and ArcGIS Online. He also noted that, in addition to ArcGIS Drone2Map, the new cloud-based Site Scan for ArcGIS—for drone flight planning, image processing, and analysis—is now available.

The Plenary Session featured a number of demonstrations from Esri employees, starting with Map Viewer beta in ArcGIS Online.

"This is the next generation of online mapping that will help you explore your data quickly and create stunning maps that can be shared across the ArcGIS platform," said senior solution engineer Madeline Schueren.

Ivonne Seler, 3D program manager and product owner of scene layers, demonstrated 3D voxel layers in ArcGIS Pro. Voxels offer a stunning new way to understand complex, multi-dimensional data.

"You can slice through the voxel volume to discover information hidden inside," she said.

Diving into ArcGIS Utility Network, technical consultant Deilson da Silva demonstrated how telecommunications companies can use new nonspatial object capabilities to model complex networks without duplicating geometries. Performing an upstream trace from a new customer location, da Silva was able to see all the equipment needed to add service to that location.

Finally, solution engineer Kenyon Huber-Wilker showed the audience how to use LocateXT, an extension for ArcGIS Pro and ArcGIS Enterprise that extracts locations, text, and dates from unstructured documents. Taking 546 Mayan archaeological documents, which included Microsoft Word files, emails, and PDFs, Huber-Wilker loaded them in ArcGIS Pro, extracted the locations and attributes of Mayan sites, and added them to a map. LocateXT can also now extract dates in foreign languages and convert them to standard date-time formats.

#### **Analytics Takes Center Stage**

The Plenary Session featured other advanced tools from across the platform as well, including new raster analysis tools that let users detect, analyze, and predict change over space and time.

Looking at eastern Massachusetts, imagery product engineer Julia Lenhardt used the new continuous change detection tool to analyze a stack of 286 Landsat images in a single image cube to see how land cover there has changed over the past 18 years. Imagery product manager Vinay Viswambharan then showed viewers how to use two new multidimensional raster tools—one that analyzes trends and one that does predictive analysis—by looking at sea surface temperature data over the last 35 years. Using an image cube that contains more than 2,000 slices of data, Viswambharan extracted trend information over time from every pixel within the cube. On a global map, the resultant red spots showed where temperature trends are increasing. He also used the Prediction tool to analyze sea surface temperature trends out to 2030.

"This...enables you to perform predictive analysis on large-scale raster data," he said, adding that processing is done on the fly.

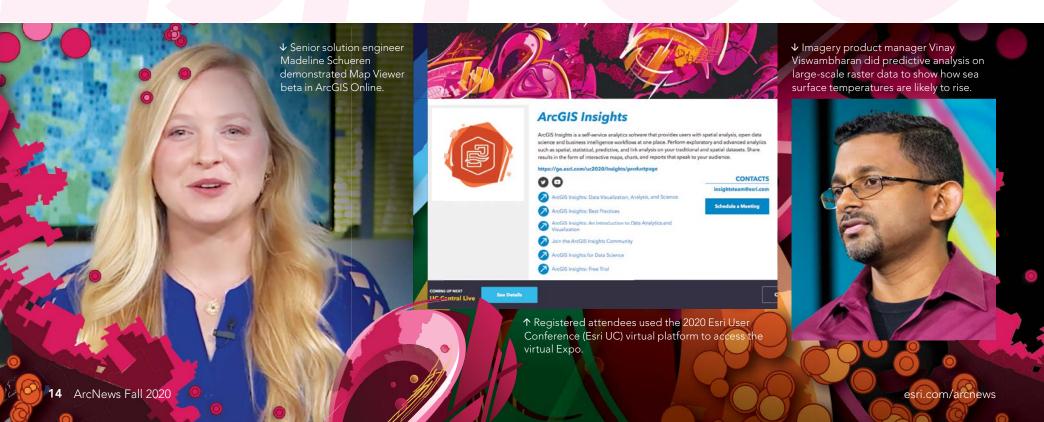
Suzanne Foss, product manager for ArcGIS Velocity, demonstrated how the California Department of Toxic Substances Control (DTSC) is exploring using Velocity to closely monitor how hazardous waste travels through communities. Tracking devices on trucks paired with Esri's cloud-based Internet of Things (IoT) technology would allow DTSC to do geofencing, incident detection, and pattern analysis in real time, near real time, or over time—without writing code.

Shannon Kalisky, lead product manager for analytics and data science, then showed how Esri is making it easier for users to get started with deep learning models and frameworks. With 15 deep learning models now included in ArcGIS API for Python, "all you have to do is pick a model that fits your problem and start training," she said.

She took viewers to a map of Jamaica Bay, New York, and used deep learning to detect boats in the water. Kalisky brought in ground truth data to teach the model what to look for, used the built-in learning rate finder to identify an optimal learning rate, and let the model train itself. It did exactly what she wanted it to do: identify all the boats in the bay and leave out any on land.

"Now, when we get updated imagery in the area, all we need to do is rerun our model, and we'll get an updated feature class of boats in the bay," she said.

Employing the same deep learning process and model with a different workflow, Kalisky then detected the hundreds of ships that sank there during Superstorm Sandy in 2012. She even used the features generated by the model to update nautical charts.





↑ A deep learning model detected all the boats in Jamaica Bay, New York—both on and under the water and helped update the area's nautical charts.

↑ ArcGIS Living Atlas—Indicators of the Planet displays recent data on the health and safety of the planet.

#### A Global GIS

While GIS goes a long way in trying to solve the world's big problems, being successful will require more sharing of information.

"Your collective work is starting to emerge as a kind of global GIS," Dangermond said.

But now is the time to share information more widely. "We need to leverage this information for greater things," he added.

That process began several years ago when Esri started collaborating with organizations including Microsoft, the United Nations (UN), the National Geographic Society, and the E.O. Wilson Biodiversity Foundation.

"This consortium envisions creating and [sharing] a new class of digital experiences for different communities," Dangermond said.

The group is dedicated to producing digital experiences that are easier to work with than traditional GIS technology has been, according to Dangermond. "It's not as if we are not making progress in that domain," he said. "But we need to make a dramatic jump if we are going to transform the world with the kind of holism that so many of you appreciate."

One example of an engaging digital experience that Esri built is ArcGIS Living Atlas—Indicators of the Planet. The app, created using cards in ArcGIS Experience Builder, displays recent data on the planet's health and safety. People can click on points on the interactive maps to see, for instance, the latest air quality and deforestation information from around the world.

Esri technology evangelist Bern Szukalski demonstrated the app for the Plenary Session audience.

"It's a new addition to [ArcGIS Living Atlas of the World], and it's a destination where anyone can go to look at these key global indicators and see [their] current status and conditions," Szukalski said.

Each card focuses on a particular topic and is powered by ArcGIS Living Atlas content, which means it is curated, authoritative, and updated continually. The template can be customized for any organization's topics, too.

"The individual cards package a lot of information together in a shareable and embeddable way," Szukalski said. "If you  $[work\ for]$  a

city or state, a federal agency, a conservation organization, or a university research center, you are going to use applications like this...to create sites to inform others, drive policy, and make better decisions."

#### Stories About a Changing Planet

Educators and young people are great at sharing information—and, according to Vicki Phillips, executive vice president and chief education officer of the National Geographic Society, they are also critical to finding solutions to the planet's most pressing problems.

Speaking at the Plenary Session about the National Geographic Society's new education strategy, Phillips said the organization plans to use GIS to tell stories about how the planet is changing.

"Our goal is to cultivate empathy for the earth among 100 million young people...and lift the voices of 5 million young leaders," she said.

The National Geographic Society's education program will equip 2.5 million educators with what Phillips called "game-changing content and tools"—science, social studies, and geography content delivered anywhere, anytime, and on any device. In partnership with Esri, the National Geographic Society will educate millions about geography and how to use it to solve problems.

MapMaker Interactive (mapmaker.nationalgeographic.org), which the National Geographic Society has collaborated on with Esri, is a free app that does just that. Additionally, the team has developed several other no-cost resources for classroom and home-learning environments, including 20 activities for addressing and understanding climate change, ArcGIS Online SkillBuilder activities, ArcGIS StoryMaps stories, and access to the beta site Teach with GIS (learn. arcgis.com/en/educators). These will be hosted on both the National Geographic Society's Education Resource Library and Esri websites.

"[The tools] are going to allow educators to help young people have the knowledge and skills they need to act with urgency and be the architects of change," Phillips said.

#### A Network for Sustainable Development

Another group that's well equipped to help build solutions to address the world's problems is GIS users.

In talking with economist Jeffrey Sachs, president of the UN Sustainable Development Solutions Network (SDSN) and director of the Center for Sustainable Development at Columbia University, Dangermond highlighted how the business community—and GIS professionals and geographers, specifically—have the expertise and tools needed to make the UN Sustainable Development Goals (SDGs) come alive.

"We need a big change of direction on the planet," Sachs said. "We are enmeshed in an unprecedentedly complex challenge of *[having]* eight billion interconnected people...every one of *[whom]* wants and deserves and needs safe water and a nutritious diet each day and a healthful environment—and they're not getting that."

These and other global issues are what the SDGs aim to tackle. To support that work, Sachs developed the SDSN, which brings together thought leaders, scientists, universities, and now the business community to create practical solutions.

The newly launched SDGs Today website (SDGsToday.org), built as a partnership between the SDSN and Esri, supports this by aggregating relevant real-time data from around the world. Cards, like the ones Szukalski demonstrated, allow site visitors to drill down into complex topics, such as food insecurity, and see what could be contributing to them in certain areas.

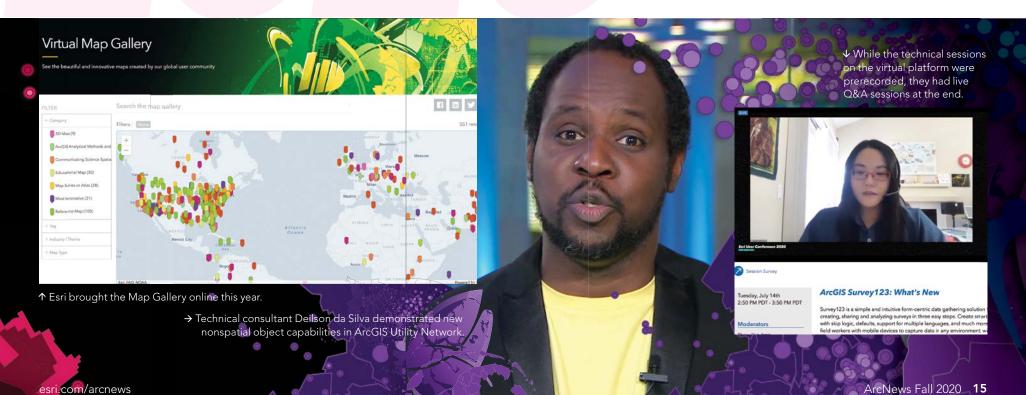
Sachs is hoping that the GIS community will submit data to the SDGs Today website and expand the number of topics it covers.

"I want people to look at these goals and the targets that go along with them and ask...how can I contribute to the solution?" said Sachs.

Dangermond agreed to keep contributing and urged attendees to do the same.

"At this great time of change, you...have so much to offer," he told viewers. "If we're going to create a sustainable future in the world...we've got to double down on this in virtually everything we do"

To watch all the Plenary Session videos from the 2020 Esri UC, go to ow.ly/XLNL50AMWhs.



#### **GIS**—Visualizing Racial Equity

"We have users in every sector that have expressed interest in using GIS to tackle racial equity and social justice—and that's not to mention our users who have already been doing this work," said Clinton Johnson, a solution architect at Esri and the racial equity team lead. "Though our efforts in this space really started about two years ago, formalizing this racial equity initiative demonstrates that Esri is stepping into those conversations more intentionally, building solutions and providing resources to help users in the United States and around the world take on long-persisting racial disparities."

"Similar to how GIS is synonymous with environmentalism and conservation and how the technology is critical to that movement, we want GIS to be synonymous with social justice," said Margot Bordne, an account manager at Esri who is part of the racial equity team. "There are so many examples of this already. Many of our users, from governments to nonprofits, are doing pioneering work when it comes to addressing systemic racism and the myriad problems that stem from that. So we're listening to their needs, learning, and working with them to make sure everything we do is grounded in best practices for racial equity."

Much of the initiative has so far focused on looking at the range of tools Esri already has available and developing a racial equity workflow that fuses well-established best practices with GIS and location intelligence.

"The four major elements of the workflow are to automate and spatially enhance community engagement, map and analyze inequities, operationalize racial equity best practices, and manage the performance of racial justice initiatives to achieve more equitable outcomes," said Johnson. "And this cycle revolves around engaging with various stakeholders, from those who experience inequities to community organizations, partners, and leaders who are rallying together and helping to address these challenges."

Esri's core technology, such as ArcGIS Pro and ArcGIS Online, is key to visualizing racial disparities. Organizations can use their own data or curated datasets that Esri is making easily accessible through its Racial Equity GIS Hub (esriurl.com/RacialEquityHub). When combined with other apps and extensions, such as ArcGIS Insights, ArcGIS Hub, ArcGIS Dashboards, and ArcGIS StoryMaps, users can explore practical ways to create more equitable opportunities and services for people.

"If you're trying to figure out where to place a new hospital or grocery store, you can use Esri tools to apply a racial equity lens to the site selection process," Johnson explained. "This can help you ask questions like, Will this create benefits for communities of color or more barriers?"

Using ArcGIS Survey123, for example, an organization can better understand the needs of the community it serves. With ArcGIS Hub, it can more easily engage with both internal and external stakeholders. ArcGIS Mission and other workforce enablement tools from Esri can help the organization automate and track teams that are gathering information or taking action out in the community. ArcGIS Dashboards enables the organization to show, very clearly, where inequities are and how it is actually working to enact change in those places. And ArcGIS StoryMaps is a great way for the organization to formulate and share narratives that revolve around racial equity and social justice.

Esri has been adding other capabilities to its technology as well. The Racial Equity Community Outreach solution leverages ArcGIS Online, Hub, Survey123, and Dashboards to help government agencies communicate their progress on defined racial equity initiatives. The solution makes it easy to set up a hub site to promote racial equity programs, build surveys to collect information about community sentiments, and create a dashboard that shows workforce diversity metrics. The new Police Transparency solution is geared toward helping law enforcement agencies rebuild the trust of the communities they serve and increase transparency. It includes a crime stats dashBoard and a public crime map; use-of-force dashboards that can be broken down into categories such as race and ethnicity, neighborhood, or officer; a police interaction survey; and a community safety and policing satisfaction form.

Additionally, Esri is making learn lessons available on the Racial Equity GIS Hub to help users build GIS skills aimed specifically at strengthening racial equity and social justice.

"These learn lessons can help people get familiar with different workflows and racial equity topics that GIS can have an impact on," said Bordne.

Several lessons are rooted in health topics, such as mapping breast cancer cases by ethnicity and showing which US counties need to improve newborns' health outcomes. Forthcoming learn lessons will likely explore activism, police reform, the digital divide, and food access.

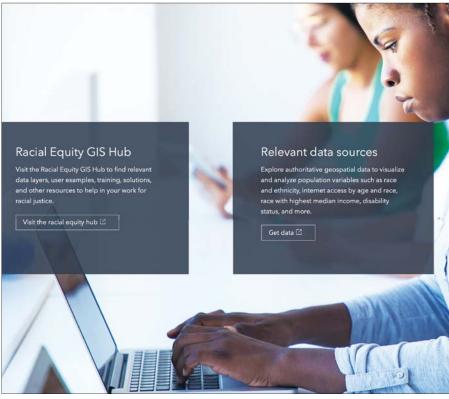
Esri's racial equity team is also looking to develop solutions that help organizations build a pipeline of new job candidates by connecting them with institutions that serve underrepresented populations, including historically Black colleges and universities (HBCUs); tribal colleges and universities (TCUs), and women's colleges. And because businesses that are owned by Black, Indigenous, and People of Color (BIPOC) face additional challenges from systemic and structural racism that can make it difficult to thrive, Esri plans to eventually release some tools to help promote and support BIPOC-owned ventures.

While in most cases, racial inequities are weaved into long-standing systems and structures, there are moments when people's awareness of these social injustices peaks and public outcry demands swift action.

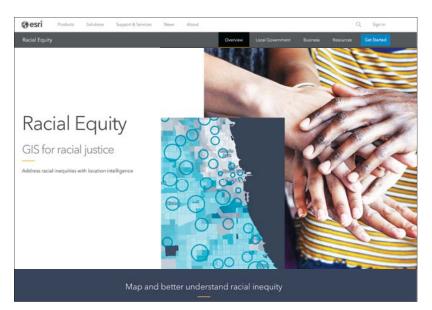
"In these moments, we want our users to be able to act without having to figure out all the logistics," said Johnson. "So we are tapping into a mechanism that we already have available—the Esri Disaster Response Program (DRP)—to support customers when they need to respond to a situation quickly."

That is not to say that racial inequity is separate from other disasters, such as the coronavirus disease 2019 (COVID-19) pandemic, hurricanes, or wildfires, because crises like those repeatedly underscore the disparities that communities of color often face. It's just another example of how applying a racial equity lens to a geographically based emergency can help organizations respond more effectively.

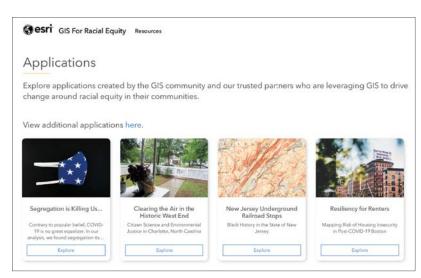
"This work that we're doing is important in a different way than anything else we've ever focused on at Esri," said Johnson. "We are responding to a disaster, really, and it's one that's entwined with so many other issues, from climate change and public health to education and the workplace. Racial equity and social justice are central to so much of what we do, so we want to provide solutions to help Esri customers around the world who are stepping in and taking action."



 $\boldsymbol{\upphi}$  Available resources include Esri's Racial Equity GIS Hub and authoritative data sources.



 $\uparrow$  Esri's racial equity initiative aims to help users leverage the full power of location intelligence to address issues that revolve around race.



 $\uparrow$  Many Esri users are doing pioneering work to tackle systemic racism and the myriad problems that stem from it.

For more information on how GIS and location intelligence can help address racial inequity and social injustice, visit esri.com/racial-equity.

#### From the Meridian

**American Association of Geographers** 

By Dr. Aretina Hamilton

Associate Director, Interlochen Center for the Arts



## People and Places, **Not Points and Lines**

One month after George Floyd was killed while in police custody in Minneapolis, Minnesota, street artists in Atlanta, Georgia, painted an unsanctioned Black Lives Matter mural on the east side of the BeltLine, a popular walking trail created on the bed of a former railroad line.

As of press time, the artwork remains untouched, as it is seen as a catalyst for conversations on race. Yet this mural runs alongside the Old Fourth Ward and Eastside, among Atlanta's most historic—and historically Black—areas, which are now the site of rapid gentrification.

Just a few feet from this powerful work of public art, thousands of Black individuals and families were and are being displaced by revitalization efforts whose looming condos and new amenities will create pristine, planned communities in the heart of Atlanta—communities that will be mostly affluent and predominantly white.

Whose lives ultimately matter on Atlanta's east side?

#### **Present-Day Colonialism**

As professionals who address spatial dynamics through geography, GIS, planning, and more, we like to believe that colonialism and imperialism took place long ago in distant lands. But we reproduce colonialism through research, policies, and teaching—and we need to recognize that. By colonialism, I mean not only the practices of dominating and replacing existing populations in spaces and places but also the mental patterns and elements of professional training that lead us to accept, normalize, and promote those practices.

Certainly, we often also use analysis to critically interrogate the world we live in. Yet our data and numbers can themselves prevent us from interrogating our own blind spots. We use quantitative, and sometimes qualitative, research to justify our claims regarding space while ignoring what occurs—who does what to whom—in that space.

Who constitutes the "we" of our profession also matters. Without robust racial representation, we cannot have a geospatial workforce

esri.com/arcnews

that is experienced and prepared enough to engage with the critical questions of cities, towns, and rural communities. (See "Earth Science Has a Whiteness Problem" at ow.ly/92uX50AW0mm for more on this.)

I challenge us to consider the impacts of our work on the everyday spatialization of public space. How has data science, as a tool, impacted not only the future of cities but also the current battles over racial violence and racial injustice?

#### **Communities Have Realities**

Four years ago, while living in Atlanta, I occasionally attended city hall and planning commission meetings to remain connected to conversations surrounding urban design, development, and policy. I once sat in a room of planners and graduate students who were discussing the future of Atlanta. Even though the theme of the conversation was What Is Your Atlanta, the Atlanta in that room was not representative of the city.

It was a predominantly white, well-heeled, elitist, and closed space. Participants in the group cited data and examples of crime prevention that rested on environmental design and the blending of public and private spaces. They completely ignored the role that race-based policies have played in shaping the city.

While this discussion was intended to cultivate entrepreneurial innovation around urbanization. the nearly uniform social, political, and economic standing of those in the room ignored the history and lives of the people who are impacted by their policies. Furthermore, the event was advertised among networks of acquaintances and occurred at a time and place that fostered an inequitable and exclusionary decision-making process. As a result, the gatekeepers and power brokers engineered communities that they visualized more as properties on a Monopoly board than as real people.

In addition, experts, armed with long-range data that insulates them from immediate consequences, often ignore economic realities. Take, for example, the well-known scholar who spoke at Atlanta's planning commission about the development impacts of the BeltLine. He had recently accepted a joint position in real estate and urban planning at the university where he taught, and I was struck by the convergence of commerce and planning in academia contained in that title.

As I scanned the audience that day, I noticed a repeat of the previous meeting: I was surrounded by the same people, just in a larger venue. After the professor's lengthy talk and bold predictions, we entered the O&A period, where local residents posed questions about rising housing costs, gentrification, and the unsustainable population bubble that choked Atlanta. I recall one interaction most vividly: a white, middle-aged man described the extreme gentrification that was occurring in the neighborhood he grew up in, Cabbagetown. He stated that it was becoming difficult to afford his mortgage and property taxes.

The professor dismissed this man's concerns. Eventually people would grow tired of the city, he insisted, and the cost of homes would decline. The professor's reliance on a long-term scenario-so popular in planning practice and so prized in data analysis—failed to even consider what would happen to people in the meantime.

As so-called public forums, these meetings illustrate the extent to which a powerful few make decisions behind closed doors. This power frequently goes unseen and unchecked.

#### **Race-Conscious Geospatial Practice**

When geographers and planners of color hold the opportunity to frame and use the powerful, exploratory tools of geoscience, outstanding work is possible-work that creates a path for responsible and effective decision-making in matters of community planning, public health, economic development, business creation, housing and homeownership, and much more. Once we commit ourselves to a more diverse and representative geospatial practice, we will

be committing to a future of thriving, healthy, equitable neighborhoods, towns, and cities.

Just one example of the depth and dimension of data frameworks that are made possible by racially just geospatial practice is the Texas Freedom Colonies Project (ow.ly/T31L50AW0mZ). In mapping the presence of more than 550 (and counting) historic Black settlements in Texas, Dr. Andrea Roberts's participatory atlas reflects the full history and status of these places. Using ArcGIS technology, residents and descendants of these communities can submit qualitative and quantitative evidence of settlement, from deeds and documents to personal recollections and family trees. So far, Roberts, an assistant professor at Texas A&M University, has verified and mapped 357 communities and made place-names and crowd-sourced information available for 200 more.

The processes for confirming and documenting these irreplaceable places are an act of community revitalization and preservation. Mapping these once-rural communities-many of which are in the path of exurban development and have been subjected to devastating environmental pollution—improves their chance for survival. The Texas Freedom Colonies Atlas includes lavers for the state's current transportation projects. 2010 Census data, and Hurricane Harvey disaster areas, making it a critical resource for addressing current planning problems as well. (Read more about Roberts's work at ow.ly/BxB950AW0nq.)

#### **Transforming Our Profession**

Recently, as I have watched the news and lamented my own position as a Black woman, planner, and geographer, I've been paralyzed by intellectual fatigue.

With the coronavirus disease 2019 (COVID-19) pandemic, we can no longer pretend that everything is business as usual. Our cities today are an amalgamation of not only redlining, historic zoning codes, and Federal Housing Administration (FHA) policies but also of color-blind data science that is used to justify the demolition of com-

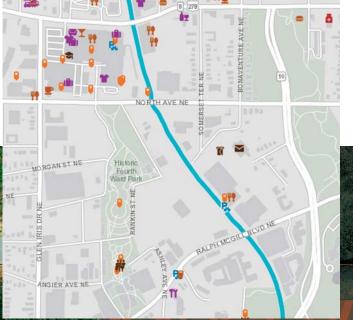
As I look at images of the BeltLine in Atlanta, I am reminded of the decisions made by faceless planners who mapped boundaries that excluded and displaced people—people whose lives didn't matter to those planners. We must transform our profession's practices in ways that incorporate community-based participatory action, research, qualitative data, and socially conscious policies while bursting the pipelines that skew our field white and male.

Our communities are more than dots and lines. They are people and places.

#### About the Author

Dr. Aretina Rochelle Hamilton is a cultural geographer whose areas of specialization include Black geographies, Black queer cartographies, and racialized space and trauma. She received her doctoral degree in geography from the University of Kentucky. Hamilton was recently appointed the inaugural associate director of diversity, equity, and inclusion at the Interlochen Center for the Arts in Michigan. Follow her on Twitter @BlackGeographer.





◆ Street artists painted a Black Lives Matter mural on the BeltLine's Eastside Trail—a quickly gentrifying area where Black residents are being displaced.

## Better Data and Visualization Foster Deeper Understanding of Black California

By Dr. Paulette Brown-Hinds, Voice Media Ventures



Dr. Paulette Brown-Hinds

Communities need quality information to thrive. They also need a way to analyze and understand the world around them, especially information and data that impact their daily lives.

As publisher of the *Black Voice News*, a 48-year-old
weekly newspaper based in

Southern California, I launched Mapping Black California (MBC) in 2017 to better understand, report on, and visualize data on Black Californians. The initiative combines the advocacy journalism legacy of the Black press and the data visualization capabilities of geospatial technology to enhance community news and storytelling.

My interest in GIS started after my staff at *Black Voice News* used Esri's ArcGIS technology to map the Black Voice Foundation's Footsteps to Freedom Underground Railroad study tour, a trip for educators to teach them about 19th-century freedom seekers and cultivate learning through empathy. The map was simple: it traced the route of our eight-day trip from Kentucky to Canada and included photos, site descriptions, and historical information. A few months later, the same team created a map narrative for a California Coastal Commission grant documenting the history of the segregated beaches that used to dot California's coastline.

When I later met Esri president Jack Dangermond, I mentioned my growing interest in geojournalism. Since *Black Voice News* is a community newspaper, I thought our work needed to maintain a focus on our immediate community. But my idea expanded after

◆ Mapping Black California (MBC) built a hard-to-count map to more effectively target difficult-to-count Black populations in California with relevant messaging. Dangermond invited me to the Esri campus in Redlands, California, to witness one of his favorite events: annual presentations made by high school students who have used ArcGIS technology to better understand complex problems in their communities and explore possible solutions. I left the campus inspired. That inspiration led to the Mapping Black California idea.

Structured within a community mapping framework, MBC promotes the value of GIS and encourages community collaboration around data and information by bringing together community media, community-based organizations, and educational institutions. The team at MBC-led by project manager Candice Mays, who has a background in the humanities and education; digital cartographer and designer Chuck Bibbs; and writer/editor Stephanie Williams-was joined in 2019 by archivist and information management consultant Bergis Jules, communications strategist Marla Matime, and researcher Dr. Anthony Jerry. The goal by that time was to expand MBC's work as part of the State of California's historic 2020 Census and media communications effort.

As a team, we saw this work as an opportunity to truly turn our community mapping project into a hub of census information and data. In February 2020, we launched the MBC Census Lab with 400 community-based organizations and 32 media partners that worked collectively on census reporting and community engagement with the goal of getting a complete count.

As part of this effort, our team built a hard-to-count map to more effectively target Black populations in California that are difficult to count with relevant messaging that would inform and educate them about the census and motivate them to participate. Following the lead of the California Census Office's interactive Hard-to-Count map, which takes into

account indicators that historically correlate with undercounts and are associated with new barriers to enumeration, our map is based on multiple demographic, housing, and socioeconomic variables that show where it's typically difficult to enumerate the Black population. Of California's 8,057 census tracts, those with higher hard-to-count scores are areas that posed significant challenges to the 2020 enumeration, while tracts with lower scores were potentially easier to count.

Armed with the hard-to-count data, we led community meetings and held focus groups to assess Black Californians' gaps in knowledge about the census and discuss what would drive them to participate. We then used this information to create culturally relevant messages for our Black media partners to share with local communities.

Together with Esri, we held a four-hour training on ArcGIS Online and a one-hour ArcGIS StoryMaps workshop for other Black community news publishers in California. MBC and Esri also jointly hosted a briefing from the national Mapping the Count initiative-a broadbased coalition of racial equity organizations, including the National Association for the Advancement of Colored People (NAACP) and the National Urban League—for Black journalists and publishers to further support our shared goal of getting a complete count of all communities of color. The briefing exposed media outlets to the GIS tools the coalition used to identify; reach; and, ultimately, count the hardest-to-count populations across the country. In addition, MBC facilitated a partnership between the Mapping the Count coalition and Esri, leading to the donation of more than 1,300 free ArcGIS Online licenses to grassroots organizations around the United States that were working to get a full census count.

Another important aspect of our community mapping project is working with strategic community-based organizations that are dedicated to educating and training the next generation of community leaders and strategic thinkers by introducing them to geospatial technology. For example the team at the C3 Initiative, led by founder Kevin Carrington, has incorporated geospatial technology into its comic book-themed coding camps, which have introduced GIS to approximately 300 Black youth. And then there is Ignite Leadership Academy, where middle and high school-aged girls are introduced to GIS as a tool they can use to learn about the environment, business, civics, and history, as well as to tell their own stories. The academy's founder, Shirley Coates, works with GeoMentors who dedicate 10 weeks of their time to teach the technology to young women of color.

One of our goals for the future is to continue introducing GIS technology to Black media and, through the community mapping framework, engage and empower the Black community around important data that significantly impacts their lives. We also want to assist our publishing partners with revenue strategies that underwrite the vital journalism they produce.

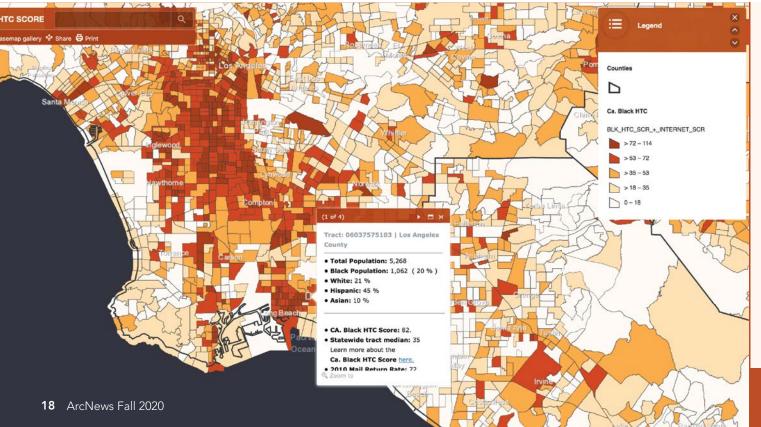
And, as we all know, maps need data. But a huge challenge has been having access to data that's disaggregated by race. In many cases, we are learning, California is data blind. One of our next projects at MBC is to build a data hub that complements our mapping work and community news reporting efforts. This hub will be a data access and content discovery platform and will allow us to create more maps much quicker.

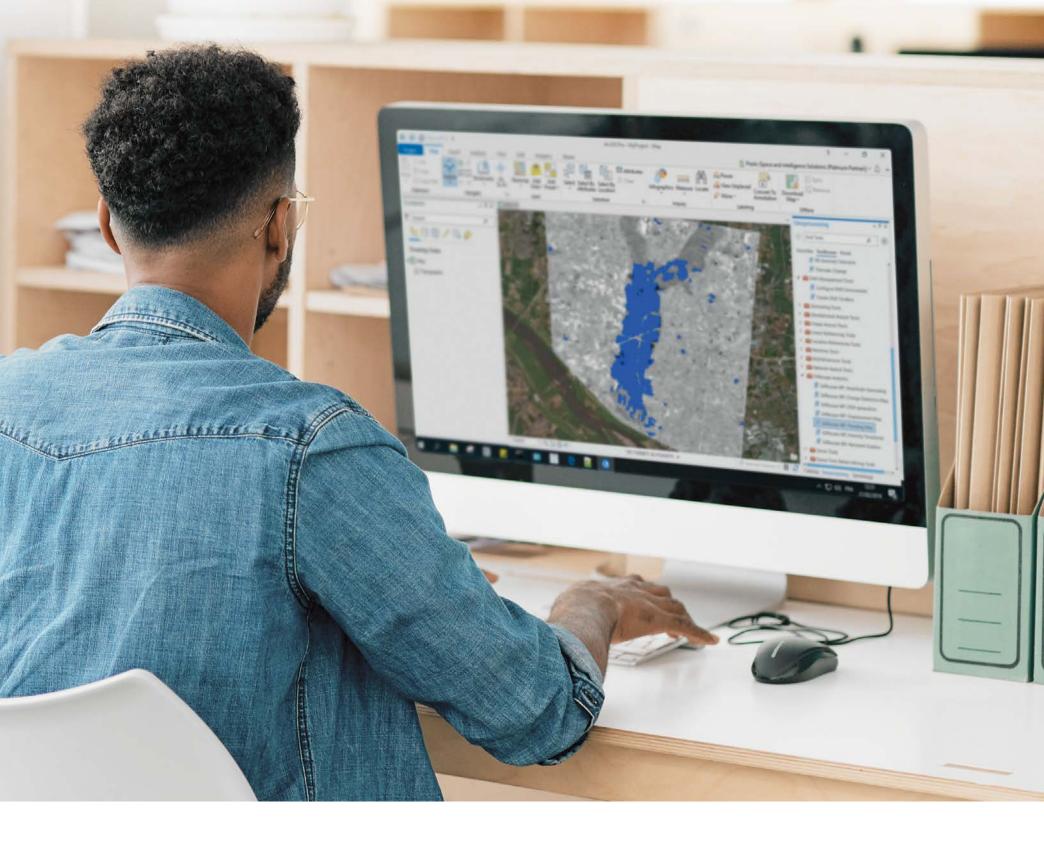
As the community media sector, we are tasked with providing crucial, accountable, and independent information to our communities. And as a community mapping initiative, MBC exemplifies how spatial data and location intelligence can serve as the basis for the types of understanding that precede action.

We believe that community leaders can use this information and data to increase their knowledge about specific issues; journalists can use it to shape social and cultural views and inform the public; and students and scholars in academic institutions can employ it to support learning, teaching, and research projects.

#### About the Author

Dr. Paulette Brown-Hinds has over 30 years of experience working in community media. She has served as an advocate for California's ethnic and local media through her firm, Voice Media Ventures, and her position on the boards of several news media organizations, including CalMatters; the California Press Foundation; and the California News Publishers Association, where she served as president of the board in 2019, becoming the first African-American elected to lead the organization in its 130-year history. As the founder of Mapping Black California, she sees GIS as an important analytical and storytelling tool for information sharing and community building across America's most populous state. Email her at paulette@ voicemediaventures.com or follow her on Twitter @mygoldenstate.





# EASILY PROCESS AND ANALYZE SAR DATA

Get the benefit of SAR analytics across the ArcGIS® platform

L3HARRIS™ FAST. FORWARD.

## Web Map **Brings Together** Wildlife Conservation and Green Energy Development

By Eric Aldrich, The Nature Conservancy

😵 Site Wind Right 

Site Wind Right, from The Nature Conservancy (TNC), evaluates more than 100 datasets from 17 states and shows that 76 million acres in the United States' wind belt could be developed for wind energy without affecting key wildlife habitats. (Map courtesy of TNC.)

Background photo courtesy of Richard Hamilton Smith.

The Midwest is known as the wind belt of the United States, and for good reason: nearly 80 percent of the country's current and planned wind energy capacity exists in the Great Plains, an area that extends east of the Rocky Mountains and runs from northern Montana to southern Texas. And wind energy is showing tremendous potential as a clean, renewable energy source that can help reduce greenhouse gas emissions.

Much wind energy development is occurring—and is expected to increase—in the wind belt. But as wind energy developers plan new sites, they all face this question: How can new wind turbines be sited in places that are optimal for wind resources and transmission yet aren't likely to impact wildlife or encounter costly delays from regulatory or legal challenges?

Wind projects sited in the wrong place can threaten some of the best wildlife habitat. The Nature Conservancy (TNC) estimates that renewable energy development could adversely affect as much as 76 million acres of land in the United States—an area about the size of Arizona.

But a new Esri technology-based resource, developed by TNC, can help focus renewable energy in the right places—windy areas that pose a relatively low risk to wildlife and their habitats. Called Site Wind Right (ow.ly/JoBe50Bbcov), this interactive online map is available for wind developers, power purchasers, utilities, companies, state agencies, and municipalities to use to help reduce conflict between wind energy and conservation.

TNC developed Site Wind Right for 17 states in the Midwest, pulling from more than 100 datasets on wildlife habitat and land use to help highlight areas with the lowest potential for environmental friction. The results of this analysis, done by TNC scientists, are both enlightening and encouraging.

"We were thrilled to discover we could generate more than 1,000 gigawatts of wind power in the central [United States], solely from new projects sited away from important wildlife areas," said Mike Fuhr, state director of TNC in Oklahoma. "That's a lot of potential

> energy, comparable to total US electric generation from all sources today. While advancements in transmission and storage would be needed to fully realize this wind energy potential, it proves we can have both clean power and the land and wildlife we love. It's a win-win."

#### **Great Potential for Wind** in the Great Plains

What eventually became the Site Wind Right analysis started evolving in 2011 as two things were happening. First, wind energy facilities were beginning to spring up across the Great Plains. Second, the TNC and other scientists were putting together studies that demonstrated considerable potential for wind and solar energy development in the western and central United States.

The Great Plains is a vast area that's home to the United States' largest and most intact temperate grasslands, which are among the most altered and least protected habitats in the world. The

last expanse of this once-extensive ecosystem is found in the Greater Flint Hills region of Kansas and Oklahoma. Poorly sited wind turbines in places like the Flint Hills pose a serious threat to the wildlife that depend on this endangered and beautiful place. That includes bison, bald eagles, and the once-common greater prairie chicken.

But as studies from the time were demonstrating, the Great Plains could provide clean, renewable electricity that doesn't compromise wildlife habitat and other natural resources.

"Those studies showed very positive results that we can meet or exceed renewable energy goals by using sites that were previously disturbed or had relatively low conservation value," said Chris Hise, associate director of conservation for TNC in Oklahoma.

Ultimately, TNC scientists created a resource that energy planners could use early in the siting process to avoid impacting wildlife and delaying their projects. TNC is among many organizations that want properly sited wind, solar, and other renewable energy projects to succeed so we can all meet the challenges posed by climate change.

With support from partner organizations and other TNC scientists, Hise and his team gathered a large collection of data—on wildlife, habitats, land-use restrictions, and areas of biodiversity significance, for example—and organized it in ArcGIS Desktop using ArcCatalog. With ArcMap and ModelBuilder, the TNC team then assembled multiple spatial data layers of wildlife habitats and potential engineering and land-use constraints. Finally, using ArcGIS Web AppBuilder, the team created an online resource that could share this data in what became the Site Wind Right interactive map.

One of the biggest surprises for Hise and his team was the impressive amount of lowimpact areas across the central United States that popped up in the analysis approximately 90 million acres. Planners in the early stages of establishing a wind energy operation can now look at site-specific details, explore Site Wind Right, consult with appropriate state wildlife agencies, and use the Wind Energy Guidelines developed by the US Fish and Wildlife Service to find spots that work best for everyone.

Although transmission and storage technology do need to improve, the low-impact sites in the Midwest are very well distributed.

"If we plan carefully, there's plenty of space to go big on wind energy in this part of the country," said Hise.

#### Broadening the Reach of Wildlife-Minded Green Energy Projects

Site Wind Right has the potential to reduce the risks of wind deployment delays and cost overruns by helping developers locate sites that are less likely to face regulatory or legal challenges. This has spurred the endorsement of Evergy, an energy provider in Kansas and Missouri that became an early user of the analysis.

"Site Wind Right is an invaluable resource that helps us avoid unnecessary impacts to the wildlife and iconic landscapes of the Great Plains while also allowing us to provide clean, low-carbon energy for our customers," said Evergy CEO Terry Bassham.

The mapping analysis has also invited accolades from another early reviewer, the Association of Fish & Wildlife Agencies, which conferred its Climate Adaptation Leadership Award for Natural Resources on Site Wind Right. Additionally, the web map has received endorsements from several conservation groups, including the National Wildlife Federation and the Natural Resources Defense Council.

"We need more resources like this to speed up our move away from burning fossil fuels," said Katie Umekubo, a senior attorney at the National Resources Defense Council. "Well-sited wind energy allows us to meet our climate goals, advances conservation, and ensures that we avoid irreversible environmental impacts."

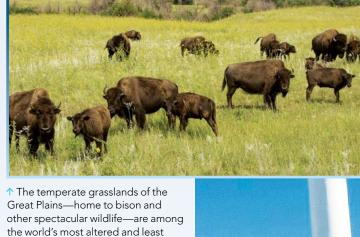
Currently, TNC is looking to broaden the reach of Site Wind Right within communities, companies, and government agencies so they can all apply this wildlife-minded strategy quickly and get the blades turning on clean and homegrown energy in the Great Plains.

"The Nature Conservancy supports the rapid acceleration of renewable energy development in the United States to help reduce carbon pollution," said Fuhr. "We are looking forward to providing Site Wind Right to the people making important decisions about our nation's clean energy future."

For more information about Site Wind Right—including the interactive map, GIS datasets, the methodology, and FAQ—visit nature.org/sitewindright.



↑ The once-vast greater prairie chicken population has fared poorly as its grassland habitats have been converted to other uses. (Photo courtesy of Harvey Payne, TNC.)



About the Author

Chris Helzer, TNC.)

protected habitats. (Photo courtesy of

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

# CITIZEN SCIENCE APP HELPS MITIGATE THREATS TO THE ENVIRONMENT

Each year on April 22, people around the world celebrate Earth Day, an important tradition that began in 1970 when 20 million people gathered across the United States to protest the effects of more than a century and a half of industrial development. Earth Day began as an environmental movement to preserve the planet for future generations, and as the world continues to face significant challenges, including climate change, deforestation, and loss of species, people are thinking up new ways to make a positive impact.

In honor of the 50th anniversary of Earth Day, a diverse collective of organizations—spearheaded by the United States Department of State, Earth Day Network, and the Wilson Center—organized in support of a new initiative to help clean up the planet. The group set out to create a mobile app that the public could employ to collect billions of data points that can be used in both new and ongoing citizen science projects.

Esri partner GeoMarvel, an Alexandria, Virginia-based geospatial software development company that specializes in GIS-focused cloud infrastructure, data analysis, and mobile app development, was tasked with designing the app and implementing its associated citizen science cloud. Using ArcGIS AppStudio, GeoMarvel was able to configure and scale cross-platform software and create mobile data collection widgets that it deployed directly to the app. Now, hundreds of thousands of users around the world can use it to easily collect and submit data, view global submissions, access educational materials, and take action.

#### **Building a Mobile App Unconventionally**

Dr. Anne Bowser, director of innovation at the Wilson Center, an independent research firm, enlisted GeoMarvel to design the new citizen science mobile app. According to Jon Nordling, CEO of GeoMarvel, the overall mission of the app is to collect massive amounts of citizen data to gain a better understanding of key environmental issues, such as plastics pollution, air quality, insect populations, and food supplies.

From the outset, the GeoMarvel team faced a unique challenge: the app concepts it received from other partners in the project lacked implementation architecture, and because the data was going to be sourced from citizen scientists all over the world, the geospatial aspect of it was paramount. Additionally, because new research questions—and, thus, widgets—would be continually added to the app, GeoMarvel needed to be able to scale quickly and effectively while incorporating geospatial components that citizens could use to gather accurate location data.

The conventional methods used to build mobile apps are time-consuming and involve numerous steps. As Nordling pointed out, adding a new component to an app usually entails updating specific code, adding new assets, increasing the version, building a new file, and going through an app store review process for each change made.

GeoMarvel needed a solution that would streamline app development and provide an easier way to introduce new features for data collection. So the team chose AppStudio to build the new Earth Challenge 2020 (EC 2020) app.

"Making citizen science into an application isn't easy—not from the design, concept, or build," said Nordling. "Using [AppStudio] has been a great decision. The feedback has been extremely positive."

#### **Making App Development Easy**

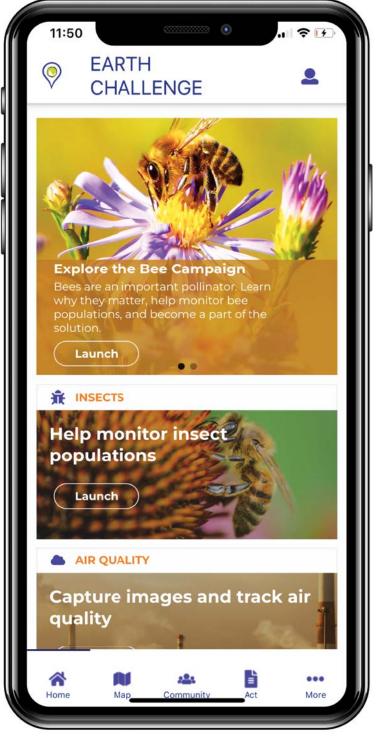
AppStudio is a low-code platform that allows users to create geoenabled cross-platform native apps. According to Nordling, AppStudio allowed the GeoMarvel team to get EC 2020 to market quickly, enabling citizen scientists to begin data collection fast. In addition, being able to deploy the app via ArcGIS AppStudio Player, which allows developers to view their AppStudio apps on real devices without doing a full build and deployment cycle, made it easier to get EC 2020 on both the iOS and Android platforms.

"From a mobile application development standpoint, the underlying inner workings of AppStudio Player were the real reason that we chose AppStudio," said Nordling. "AppStudio gave us the ability to create geoenabled collection widgets without having to go through repetitive technical hurdles to get there."

The GeoMarvel team initially created two widgets within the app—one focusing on plastics pollution, and the other on air quality. Kevin Cheriyan, an application developer for GeoMarvel, said the online resources for AppStudio were very helpful in constructing EC 2020, especially the documentation and the ready-to-use templates in the AppStudio template gallery.

"We were able to utilize [the templates] to our advantage and see how other robust applications were using recommended code," said Cheriyan. "We also had to be familiar with the documentation on Esri's ArcGIS framework sections and general AppStudio tutorials. Along with the templates, I think they really helped us take the app to the next level."

→ In honor of
Earth Day, a
diverse collective
of organizations
set out to create a
mobile app that the
public could use
to collect billions
of environmentally
focused data points.



### Empowering More Citizen Scientists with Targeted Functionality

The way the app works is simple. Users select the research question they want to participate in, such as "What is the extent of plastics pollution?" and submit relevant data, like photos of plastic trash along with information about the types of plastic they found. As users participate, they unlock different features and functionality in the app. There are also educational materials, lesson plans, and geoenabled petitions that users can access to learn about local, environmentally focused legislation.

Since the initial deployment of EC 2020, the GeoMarvel team has used AppStudio to easily add new features, functionality, and research questions. This is empowering organizations around the world to introduce citizen science to a new generation of users.

And when it comes time to release or upgrade a widget, Nordling and his team can get the update directly to users without having to release an entirely new build to the app stores.

"[With] AppStudio...we [can] control releases through group share settings in ArcGIS Online and say, 'We're ready to deploy [the] Air Quality [widget] now. Let's go ahead and share that [publicly] in AppStudio Player," said Nordling. Then,

anyone with the EC 2020 app automatically gets the new widget.

This also helps GeoMarvel issue rapid fixes for bugs. "We now have an application that allows us to dynamically create and deploy *[new widgets and updates]* to users at any time," said Corey Norris, business operations manager for GeoMarvel. "That's really powerful."

Additionally, AppStudio gave the team the ability to quickly test new features and easily discard them if needed.

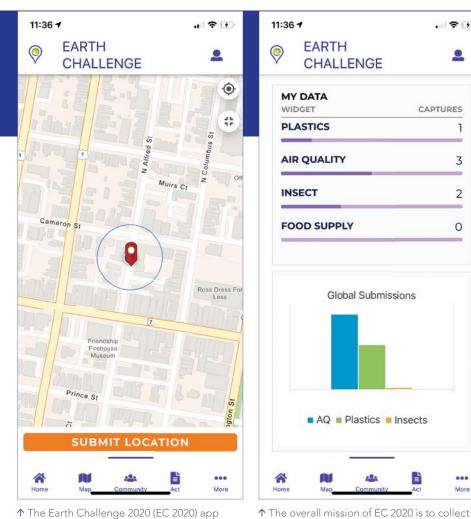
"Speed was very helpful with this," said Harman Hassan, an application developer for GeoMarvel. "We would be able to build out different features and tools and quickly test to see whether we liked them or not. If we did like [something], we kept it. If not, we removed it."

Then the team would go back and add more on top of what was already built.

"We would work all day, put out a release, and then test on Android and iOS," said Hassan. "This capability was my favorite part of using AppStudio."

Nordling echoes that sentiment, stating that the group loved having the ability to write some quick code and then throw it away if warranted.

"We didn't feel bad about doing that because there wasn't any technical debt that we were



11:36 4

**EARTH** 

MY DATA

PLASTICS

INSECT

**AIR QUALITY** 

FOOD SUPPLY

Global Submissions

AQ Plastics Insects

massive amounts of data to gain a better

understanding of key environmental issues.

CHALLENGE

↑ The Earth Challenge 2020 (EC 2020) app sources data from citizen scientists all over the world, so the geospatial aspect of it is vital.

[incurring]," said Nordling. "And our turnaround

things without having to impact every little piece

of the application. The functionality is targeted."

App users have complimented the user experi-

Being Part of a Bigger Cause

"When my nontechnical friends have used for new features is better because we can redo the app, they would be able to easily take a photo of the sky, submit their data, see their point on the map, and click it to immediately see their image pop up. They have an interactive map on their mobile device that's simplified," he said. "I think that helps encourage people to go out ence on EC 2020, and that's an added benefit of there. You're not just collecting data, sending it

data come in from people around the world, which reinforces the fact that you're part of this bigger cause."

↑ To use the app, users select the research

submit relevant data.

question they want to participate in and then

11:36 4

CAPTURES

3

2

0

EARTH

CHALLENGE

**SELECT A CATEGORY** 

Honeybees

**Bumblebees** 

Large Carpenter bee

CONFIRM LOCATION

Nordling said the team has received lots of positive feedback since launching EC 2020, and there are plans to introduce future research questions that focus on issues like water quality. Ultimately, he said, the goal of this initiative is to collect data to understand the planet better, so the project

HOW YOU CAN HELP **AVOID USING PESTICIDES AND** HERBICIDES TO HELP BEE **POPULATIONS RECOVER** Use Earth Day Network's insec Avoid buying single use plastics READ PLASTICS

11:36 4

**EARTH** 

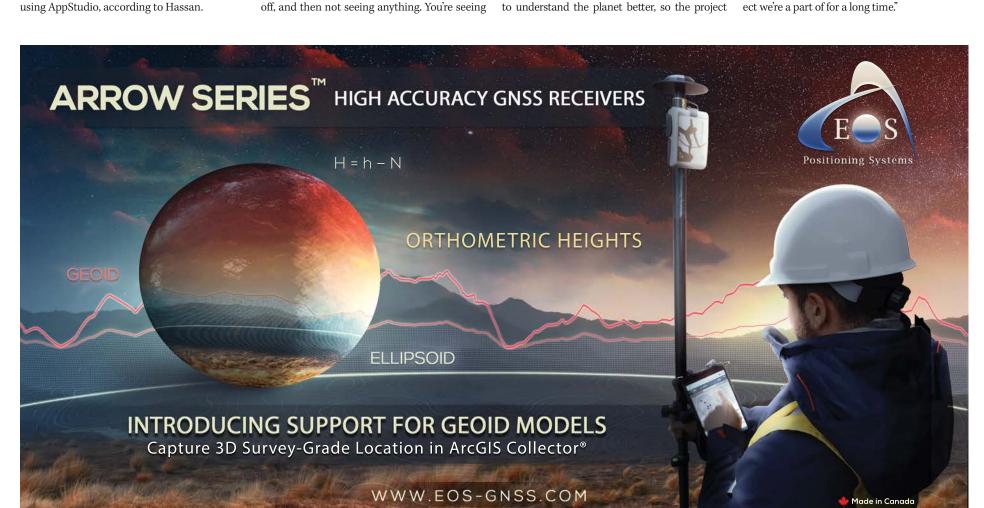
CHALLENGE

↑ EC 2020 also contains educational materials, lesson plans, and geoenabled petitions that users can access.

off, and then not seeing anything. You're seeing

will likely be ongoing because there are always new problems to solve in the world.

"It's not only about building the technology. It's about knowing what's coming and what's possible for the future of this application and initiative," said Nordling. "This is about building an application for users to participate in an ongoing, long-term citizen science effort. I hope it's a project we're a part of for a long time."



## Scientific Currents

By Dr. Dawn Wright Chief Scientist, Esri



## **Open Science Is Good Science**

Modern GIS is an important part of open science—that international movement toward making scientific research as open and accessible as possible so it can foster scientific growth and innovation and also be of practical use to society. But what does open science really mean?

The term, first coined by Canadian engineer and inventor Steve Mann in 1998, strongly implies open data, open source, open workflows, more open and transparent peer reviews (of research, data, and software), open educational resources, and—perhaps most importantly—open access.

Open access to what, though? Certainly to scientific publications, research data, lab and field samples, source code, and a treasure trove of apps for mobile devices or web browsers. And open access for whom? For other scientists in a given field, researchers in all disciplines, governments, industry sectors, schools, nonprofit organizations, and anyone else who is interested.

In short, open science is seen by many as a way to reassert science as a global public good.

If we assume, and even insist, that open science is good science, what is the best approach to doing it? How do we open our data and services to make them FAIR—findable, accessible, interoperable, and reusable?

There is now literally a rainbow of open science practices to choose from (see ow.ly/jVgq50Bmefr) that address everything from data search, analysis, and writing to publication, outreach, and assessment. But our research and communication tools are constantly changing. And many of our online labs are still a chaotic, unsearchable mess that don't receive the same care and maintenance that brick-and-mortar laboratories do.

In his 2011 book *Reinventing Discovery: The New Era of Networked Science*, Michael Nielsen writes: "All that's needed for open science to succeed is for the sharing of scientific knowledge in new media *[and for that]* to carry the same kind of cachet that papers do today." Almost a decade later, the cachet of new media is actually increasing, with innovations that better democratize data, maps, apps, scientific storytelling, and more. I am, of course, talking about next generation geospatial content management systems that scientists can and should employ.

ArcGIS Hub, for one, is an easy-to-configure, cloud-based portal and community engagement platform that helps organizations work more effectively with their communities. It's useful for scientists, too, in keeping their own communities, networks, and desired audiences informed of—and involved with—their scientific work.

Hub achieves this by organizing not just data but also tools and even people by way of information-driven initiatives. An initiative allows people to bundle content around a particular project, topic, or goal. Every initiative has a website, a core team, and the ability to send messages and content to specific audiences, including the public. Core team members can also create templates of their initiatives that include the relevant sites, apps, and pages so others within the organization or community can configure standardized content as their own.

Hopefully the power of this approach is readily apparent, especially by way of the following science exemplars.

From the nonprofit science world, there is NatureServe's Map of Biodiversity Importance (ow.ly/40vx50Bmeib), which provides a spatial modeling infrastructure with data from more than 1,000 botanists and zoologists within NatureServe's network. A series



↑ GIS can play an important role in open science.

→ NatureServe's Map of Biodiversity Importance hub site puts data and analytics in the hands of scientists so they can take action on saving places that matter for sustaining biodiversity.

of compelling ArcGIS StoryMaps stories and select layers from ArcGIS Living Atlas of the World reveals, in unprecedented detail, the geographic distribution of over 2,000 at-risk species. All this information is stacked in a way that identifies the places that matter most for sustaining biodiversity in the United States.

Similarly, Conservation International has been working with Esri on a series of hub sites to support the Ocean Health Index (OHI), the first program to comprehensively assess ocean health globally and aid governments in setting appropriate ocean management priorities and policies. The first hub site, now under construction at ohipoc-conservation.opendata.arcgis.com, is focused on the Philippines. This hub site provides not only data and map narratives but also gateways to ArcGIS Dashboards, ArcGIS Survey123, and developer APIs that are especially helpful for those who want to customize workflows and apps using OHI's open data science tools (available at ohi-science.org). The aim is to streamline data management, target setting, and communication within that single hub site to make it easier for scientists, managers, nonprofits, governmental agencies, and citizens to access this data and collaborate.

Speaking of citizens, one of the richest resources for professional and citizen scientists alike is the Earth Challenge 2020 hub site at earthchallenge2020.earthday.org. A collaboration among the Wilson Center, the Earth Day Network, and the United States Department of State, the resources within the hub site are guided by research initiatives aimed at raising global awareness around plastics pollution, differences in air quality, changing insect populations, and more. Within each initiative, citizen scientists can use an app to collect and integrate billions of applicable data points. [For more information about the app, see page 22.] They can also see their data come alive in an interactive web map or dashboard; view a range of map narratives on prior efforts; and work with a sequence of educational materials either before, during, or after data collection. This more fully engages participants in the scientific method.

Another hub site that's extremely rich in content and variety is the Agricultural Collaborative Research Outcomes System (AgCROS) site, put together by the United States Department of Agriculture's (USDA) Agricultural Research Service. This hub site, available at agcros-usdaars.opendata.arcgis.com, makes it easier for staff members across the agency to share the complex data relationships that emerge from the hundreds of scientific measurements and experiments they conduct. It's also intended to make it easier for the USDA to align with other agencies, such as the Environmental Protection Agency (EPA), the United States Geological Survey (USGS), and the National Oceanic and Atmospheric Administration (NOAA); universities; industry partners; and other stakeholders.

In addition, ArcGIS Hub is an excellent framework for quickly sharing workshops or conference proceedings, as demonstrated by the National Geospatial Technology Center of Excellence. For



its GeoEd'20 conference, the organization compiled a hub site at geoed20-kctcs.hub.arcgis.com that features maps and pie charts of attendee data, as well as recordings of the sessions. This, to me, signifies conference proceedings of the future, as we continue to virtualize our scientific meetings by necessity.

On the university front, I have two favorite hub sites. The first is the California State University, Los Angeles's Community Data Initiative (communitydata-lahub.hub.arcgis.com), which gives students an opportunity to use open data from the City of Los Angeles to help local nonprofits tackle real-world problems. The second is the University of Michigan's Matthaei Botanical Gardens and Nichols Arboretum hub site (mbgna-umich. opendata.arcgis.com), which features maps, apps, and other data about the surrounding area's plants, soils, and geology.

A final favorite is the Pacific Ocean Data Portal (portal-test-escap.hub.arcgis.com), being developed by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). It aims to comprehensively monitor the sustainability of the Pacific Ocean by openly compiling assessments of regional-scale environmental and economic statistics. [For more information on this, see "The Power of Shared Information for the Pacific Ocean," from the winter 2020 issue of ArcNews, at ow.ly/KU3i50BmekT, along with a video from the 2019 Esri Ocean and Atmospheric GIS Forum at ow.ly/O4yL50Bmen7.]

May the examples above serve as inspiration to those seeking to ensure that geospatial science remains—and becomes more—open so it can foster unencumbered scientific methods, workflows, interpretation, and explanation and lead to greater insight about our complex, interconnected world. Open science is good science.

#### About the Author

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

## University Incorporates 3D GIS into Curriculum

#### Coursework Ends Up Being Distance Learning-Friendly

West Chester University of Pennsylvania (WCU), the largest institution in the Pennsylvania State System of Higher Education, is home to the awardwinning West Chester University Geography and Planning department. The department's cuttingedge GIS program is known for its GIS-based community mapping and engagement projects and for successfully placing alumni in jobs at GIS companies around the United States.

Recently, WCU created two new planning degrees: a bachelor of science degree in urban and environmental planning and a master's degree in urban and regional planning. These courses of study are designed to introduce future GIS professionals to the spatial analysis concepts and techniques they will need to mold the future of land-use planning, resource conservation, community growth, and more. Incidentally, some of the classes in the programs are also uniquely suited to distance learning.

#### Keeping Pace with Advances in GIS

The WCU Geography and Planning GIS program draws extensively from the GIS technology available across the Esri platform—from standard ArcGIS and ArcGIS Online curriculum to ArcGIS CityEngine and beyond.

Five years ago, WCU started using CityEngine in its urban and regional planning master's

degree program. That inspired the Geography and Planning department to use a virtual reality (VR) model to visualize campus streets and buildings and, eventually, led a cohort of students to build a 3D model of the campus. From there, WCU expanded the VR platform and began using 3D modeling as an urban planning and design tool.

Students in the program first learn basic and advanced GIS skills and then apply them in studio classes, which center on real-world projects done with community partners, or research courses. For example, one group of students helped the

City of Málaga, Spain, with community planning by creating 3D models and cloudbased GIS maps and using ArcGIS Hub to build a hub site.

As GIS technol-

ogy has expanded and deepened in response to user needs, the program has introduced newer, more sophisticated tools to keep pace with advancements in the field, particularly in the areas of 3D mapping and modeling, mixed reality technologies, and digital publishing of mapping results. While students already received a solid foundation in the use of 2D ArcGIS Pro, WCU needed to craft a path that would advance them to the point that they could develop and publish 3D-based products for planning projects.

#### Incorporating New Technology and Teaching

Designing an enhanced curriculum to address this need came with several challenges. WCU had to adapt new software and tools within the



↑ Students and faculty from West Chester University's Department of Geography and Planning met with Esri staff to get help with introducing ArcGIS Urban into their Geodesign for Smart Cities course.

existing program and then provide students with guidance, resources, and opportunities to learn and apply the new software.

After thoroughly examining its GIS pedagogy, the WCU Geography and Planning GIS program incorporated 3D modeling in ArcGIS Pro and integrated SketchUp modeling software, AutoCAD drawings, CityEngine, and the Unity 3D development platform. To help students publish the results of their projects and share them with partners throughout the West Chester community, the program also included web-based platforms such as ArcGIS Hub initiatives and the West Chester University Urban Forestry GIS open data site.

In addition, the WCU Geography and Planning GIS program introduced a new course, Geodesign for Smart Cities, to bridge the gap between traditional 2D GIS classes and the critical need for 3D GIS learning. WCU worked closely with the Esri education outreach team and the solution engineers for ArcGIS Urban to launch the course, which focuses on teaching GIS rather than teaching with GIS. It covers a wide range of software, including ArcGIS Pro, SketchUp, CityEngine, 3D web scenes, ArcGIS StoryMaps, ArcGIS Urban, and Hub initiatives. Geodesign for Smart Cities blends the need to incorporate cutting-edge GIS modeling technologies and techniques with applied, studio-based, community-oriented projects. The urban model students develop in the class then serves as a foundation for further planning and design studio courses.

#### Adapting Curriculum to a Pandemic

The Geodesign for Smart Cities course was scheduled to launch in the spring 2020 semester, but another obstacle arose with the arrival

of the coronavirus disease 2019 (COVID-19) pandemic: all WCU classes had to move online.

Although WCU offers students ArcGIS Online accounts, uses a virtual desktop environment, and provides Esri software and license support, it was still difficult to maintain an effective program during the transition to virtual curriculum. Not all students were able to access ArcGIS Pro or CityEngine remotely or install software on their home computers, and many students owned noncompatible devices. Additionally, the in-person studio courses that are an integral part of the WCU Geography and Planning GIS program are required for the bachelor of science degree accreditation.

It turned out, however, that the underpinnings of the new Geodesign for Smart Cities course held the key to moving students to a virtual format. Besides helping them bridge the gap between 2D and 3D GIS classes, the fact that the new course incorporates ArcGIS Urban and ArcGIS Hub—both of which run in a web browser—enabled students to continue learning remotely with significantly less disruption for those who had difficulty accessing other GIS tools from home.

#### Enhancing Education in Challenging Times

During the summer session, students taking WCU's Economic Development Planning course used ArcGIS Urban to develop city plans based on the West Chester borough urban model. Students analyzed indicators and planned space use and capacity, and members of the ArcGIS Urban team at Esri discussed with them how to use and operate an urban model. This model has also been used throughout the year by WCU students who have volunteered to create web maps, map narratives, and 3D web scenes to assist local COVID-19 response, support small businesses, and model business continuity and recovery.

In the fall session, the planning and design studio started using an urban model to develop plan scenarios and projects for the east end of West Chester borough. This historical neighborhood is currently experiencing a shift from light industrial warehouses to new residential developments and business redevelopment projects, so students are exploring social, economic, and infrastructure development opportunities in the area.

"With the Geography and Planning department's GIS program, West Chester University was able to combine what it was doing in the business course with ArcGIS Community Analyst, ArcGIS Business Analyst, and 3D modeling and tools," said Keera Morrish, solution engineer for smart city solutions at Esri. "The platform brought the different parts of the program together, and it's amazing what they are doing with it now. Our hope is that other universities might be able to take this as a model of what they can do with their own planning and design programs, especially during a time of distance learning."

Learn more about using ArcGIS Urban resources in higher education at go.esri.com/urban-highered.



esri.com/arcnews ArcNews Fall 2020 **25** 

## In Unique Circumstances, **Educator Teaches GIS in Class and on TV**

When the coronavirus disease 2019 (COVID-19) pandemic caused science teacher Ryan Miller and all his students at Washington-Liberty High School in Arlington, Virginia, to start at-home schooling in mid-March, the enterprising educator had an idea.

"I'm the fill-in meteorologist at [ABC7 affiliate] WJLA-TV, so when that weekend hit, I emailed my boss at the TV station and said, 'Hey, do you want me to do a few lessons on things students can do at home to keep learning while they're away from school?" Miller recalled. "She said, 'Yes, go ahead!"

Miller's first few segments were 2 minutes long and covered the theme of change, since so many variables were up in the air at the time. Within days, he was doing 30-minute segments, which got such great reviews that the station asked him the very next week if he wanted his own show.

"I said, 'Sure!' So we created Outside the Classroom," he said. It's an hour-long show that covers science and often incorporates GIS into lessons. While it's geared somewhat toward teenagers, the station's ratings data shows that kids in all age groups tune in.

"We'll do some GIS on the show where we talk about, If it rains an inch over an acre of land, how much rain is that in gallons? or What's the volume of water that fell? and we can map that out," Miller said. "I set up an interactive map through ArcGIS Online that I use on the show, and I'll say, 'Hey, if you want, go to this website and search for this map and use your device with a very simple app I built to upload the weather conditions where you are. We can map it out and talk about that."

During the spring, the show aired five days a week in the mornings, but it moved to three days a week over the summer a schedule that Miller kept until the show moved to afternoons when the school year picked back up in September. He said the show doesn't require a lot of extra work on his part because he really sees it as an extension of his teaching.

"I teach environmental science and a GIS mapping class, so the show is just like having another class," he said, pointing out that this is his 19th year teaching and his 13th or 14th year of covering these two subjects. "Also, it's done from home, so it's not like I have to, you know, go anywhere."

Miller was always interested in geography as a kid, thanks to the World Book Encyclopedia set his parents had.

"I just remember being fascinated by the maps that accompanied the entries on every US state," he said. "I would go through those maps all the time.

For college, he went to Penn State University, where he studied agronomy with a specialty in turfgrass science. While there, he took some weather classes but not enough to major or minor in it.

"When I graduated from Penn State, I was trying to work on golf courses and athletic fields, but for some reason, I lost my interest in it," he said. "I met somebody who was in a program at Virginia Tech doing a math- and science-focused teaching degree, so I did that program."

He fell in love with teaching and, 18 months later, was placed in a school system to begin his career as an educator.

"I've been at the same school ever since, and I haven't looked back," he said.

But Miller has certainly pursued other interests on the side.

"By dumb, random luck, I started working at a TV station, helping out with the weather," he recalled. "So I went back and did the graduate program in broadcast meteorology at the US Department of Agriculture's Graduate School."

And when he was earning his education specialist degree at George Washington University, he was able to use credits from his broadcast meteorology degree to fulfill some requirements.

"So it all kind of blended well together," Miller said.

That synchronicity persisted. Shortly after starting his teaching career, one of Miller's earth science students asked him a question about the weather, but Miller didn't know the answer.

"I emailed, on a whim, the chief meteorologist of the ABC station in Washington, DC, and asked him the student's question," he recalled. "Lo and behold, he said, 'Hey, you know, I have such an affinity for teachers. Do you want to come in and we can talk about it?' And I was like, 'Sure'. So I went in and hit it off with the gentleman...and I just started spending time volunteering and helping them out in the weather center every once in a while, if there were storms. I had enough of a background in it to be helpful."

Soon, Miller started producing weather segments, which entailed making the forecast and putting together the graphics. Eventually, when an on-air personality left the station, Miller was asked if he'd like to do the weather on television.

"I said, 'Well, I've never done it, but yes," he said. "I would go down to the station between the 6:00~p.m. news and the 11:00~p.m. news and just practice in front of the green screen, doing the weather for hours. Finally, I felt comfortable, and they were like, 'You're on."

In many ways, Miller thinks of doing the weather and being a teacher as one and the same.

"When you're doing the weather, your job is to communicate science and data and turn it into useful information for your audience," he said. "There's no difference between that, in my mind, and teaching."

A number of his students have certainly found his classes to be very useful, especially those who, after taking his GIS class, have gone on to become GIS professionals.

"I have quite a few of those, actually," he said.

James Fendley, who took Miller's GIS class during his senior year at Washington-Liberty High School, is one such student. He majored in geography at the University of Mary Washington and, after graduating this spring, landed a job as a business intelligence developer at JSTech Consulting. He's also pursuing his  $\,$ master's degree in geospatial analysis.

"In high school, I wasn't the best student, but Mr. Miller made his GIS class fun and productive," said Fendley. "I learned so much about GIS that when I went to college, it was the only subject I felt comfortable doing and learning. He gave me confidence and made me feel like I was good at GIS."

Part of what makes Miller's GIS class unique is that students get to do real projects for real businesses.

"There are so many GIS professionals in the Washington, DC, area, and I knew that a lot of them had one or two projects on the back burner that they just didn't have time to do," said Miller. "So I started going around to a lot of them and saying, 'Hey, I've got 20, 18-year-olds with a fair amount of GIS knowledge. Do you want them to try and take on some of this work?' A lot of folks in the area, luckily, were able to give us meaningful projects."

What's more, seniors like Fendley who take Miller's GIS class get to participate in the Geospatial Semester, a joint program with James Madison University that allows them to earn college credit for it.

"The program keeps kids invested in the process of learning during their senior year," said Miller. "It's pretty cool teaching a college class at the high school level, giving the kids that take it an opportunity to learn skills and tools that a lot of their peers don't know."

Helping students build this kind of knowledge, which they can then use to help others, is what most inspires and motivates Miller. And now that GIS, as he sees it, is synonymous with tackling climate change, the spread of disease, misinformation, and more, he thinks it's an essential technology for people to know.

"It's very necessary and useful in so many ways," he said.

esri.com/arcn



## In a Changing World, Maintaining Business Continuity Requires Leadership

By Thomas Fisher, Cuyahoga County, Ohio



↑ Thomas Fishe

of Ohio's first three confirmed cases of coronavirus disease 2019 (COVID-19), and not two weeks later, the state recorded its first death from the virus. That set off a chain of events that quickly changed how society in Ohio—let alone the rest of the world—functions, and it altered the way I would lead as manager of Cuyahoga County, Ohio's

On March 9, 2020, the public became aware

GIS department.

On March 13, the county ordered all equipped, nonessential employees to work from home. Nonessential county employees without proper equipment were permitted to take up to two weeks of paid leave starting March 16. On March 18, the Cuyahoga County executive ordered all county buildings closed to the public. And on March 22, following the lead of several other states, Ohio governor Mike DeWine issued a statewide stay-at-home order.

As a leader, I knew I needed to communicate to my staff how fluid the situation was and that I empathized with their feelings of uncertainty. I gave them reassurance that we would get through this together. And then I had to quickly adapt to managing a team of GIS professionals working from home, spread across northeastern Ohio.

Many companies and organizations had not prepared for business continuity in the event of a pandemic. Many did not have plans for decentralizing staff to stop the spread of a highly contagious virus. The new work-from-home reality was a culture shift. It took some getting used to and trial and error. The added stress of living through a global pandemic and the uncertainty of what each new day would bring did not make this transition any easier. So at Cuyahoga County, we took it one day at a time, made incremental progress, and have so far gotten through it and even begun to thrive in this new paradigm.

To ensure a successful transition to working from home, I made sure that my staff had the hardware, software, and equipment they needed to be effective. I coordinated with my IT department to obtain a computer system and virtual private network (VPN) connection for each of my team members so we could access our GIS licensing, infrastructure, and data. I also made sure everyone on the team had credentials and could work within the security parameters set forth by the county's chief security officer.

I then set out to establish effective rules for communicating. In a typical office environment, I got to see my employees every day. I was able to check in with them to see how their weekends went, if they needed my assistance, and how they were progressing on work assignments. Communication in the office was personal and seamless. But working in different locations? That did not afford them nor me that comfort, so we had to come up with a communication plan. What platforms were we going to use? What expectations would we have for communication? How frequently were we going to meet?

For our instant communication needs, we decided to use our Slack account. To stay organized, we set up specific channels for segmenting our communication by topic. Channels proved extremely helpful when the whole team attended the 2020 Esri User Conference. Slack allowed us to have one-on-one chat channels for personal communication, too. Setting up a video conferencing platform was not as straightforward, however. In the beginning, we only had Cisco Webex, so we used that. As time went on, we gained access to Microsoft Teams, Zoom, and Slack video conferencing. We have test-driven each video app, but none of them meet all our needs, so we remain flexible while using Teams for most of our meetings.

In evaluating what everyone's expectations were for communication, I knew that I did not want to micromanage my staff. We have built trust working together in the office, and I always want to empower my team members to act professionally. I understand that, when working from home, staff need flexibility to walk the

dog, greet the plumber, or care for children. All I expect is that everyone knows each team member's schedule and availability. We post our schedules in our Time and Attendance channel on Slack, and we keep notes of our hours and work completed.

In terms of meeting frequency, I felt that having predictable video conferences would help my employees feel like they were still part of a team and working toward a shared vision. We continued to hold a staff meeting and a strategic planning session once a week. We also introduced Breakfast with CEGIS (Cuyahoga Enterprise GIS), a two-hour meeting that takes place once a week wherein a team member educates the rest of the group on county GIS processes, procedures, or best practices. By sharing knowledge like this, we are no longer dependent on one person in a crisis; we have more business continuity.

Once I made sure everyone had the tools they needed to work from home and we had a communication plan in place, I followed five basic principles to manage my team effectively.

- Encourage setting parameters, such as a dedicated work space, and seeking work-life balance. I have a desk in my basement, where I set up my workstation. I now call this my office. My wife and two sons know that when I am in the basement, I am at work. I recommend establishing a dedicated space for work only—even if it is a desk in the corner of the living room or bedroom. This helps separate work life from home life, which, I have found, is the key to finding clarity of purpose while working from home.
- Have 360 degrees of accountability. Understanding what everyone is working on and setting goals and deadlines helps my team be productive and stay on task. Just because I cannot see my team members doing the work does not mean they are not being productive. One of the special things about working in GIS is that it allows us to see progress in many ways, whether it is in data maintenance or the steady creation of a map or app. I trust my team's professionalism, which is essential for accountability.
- Invite flexible work schedules. For my team, work hours are normally between 7:00 a.m. and 6:00 p.m., Monday through Friday. But working from home has changed that. It has allowed my team to experiment with nontypical schedules, such as working four 10-hour days in a week or trying out four 9-hour days with a half-day Friday. This works because my

team members and I communicate our plans with each other, especially any variations in our schedules.

- Listen to team members and open sincere lines of communication. Feeling socially isolated is legitimate when working from home. So when I talk to my staff, I check on their well-being. I need to know that they are having human contact, whether virtually or in person, while following social distancing regulations. My team also finds time to chat about non-work-related issues on Slack, and I often welcome tangents during video calls to add a sense of normalcy to work. As a manager, I also make myself available for one-on-one conversations, which is key to team building.
- Celebrate successes. Giving credit where credit is due is important. My team members deserve a tremendous amount of approbation for their flexibility and adaptability in transitioning from a traditional and institutional office environment to working from home. During these uncertain times, they have stayed positive and kept pressing forward. Without great employees, I would not have a highly successful GIS department. In this spirit, I would like to recognize senior analyst Dan Giersz, GIS analyst Jordan Abbott, GIS analyst Joe Milan, GIS technician Matt McGuire, and GIS technician Justin Haynes for continuing to provide excellent service to the residents of Cuyahoga County during this unprecedented time.

#### About the Author

Thomas Fisher is the enterprise geospatial technologies administrator for Cuyahoga County, Ohio. He has more than 25 years of experience in public and private sector GIS and currently serves on the board of directors for the Urban and Regional Information Systems Association (URISA).

#### Managing GIS

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





### Oklahoma Crowdsources Damage Assessments to Kick-Start Disaster Recovery In May 2019, record rainfall 27 counties in Oklahoma. (Photo courtesy of the Civil Air Patrol.)

When record-setting rainfall caused historic flooding in the spring of 2019, 27 counties across Oklahoma were declared official disaster areas. Approximately 2,200 homes were damaged as the devastating storm produced water levels that caused reservoirs, lakes, and rivers to overflow.

The Oklahoma Department of Emergency Management (OEM) immediately activated its disaster response and recovery protocol, kick-starting a workflow that begins with recording damage information and concludes with federal assistance being allocated to survivors.

For this disaster, OEM took an innovative approach to this workflow. It crowdsourced damage assessments by having those who were affected by the floods spend less than five minutes completing a simple, web-based form using ArcGIS Survey123.

Now, this mobile GIS solution serves as the centerpiece of a new workflow that's enabling OEM to speed up the recovery of impacted communities after a major disaster.

#### A Fast, Scalable Damage Assessment Workflow

When a disaster strikes, OEM oversees a number of critical functions through the State Emergency Operations Center in support of local emergency management officials. The OEM team provides guidance to survivors that need to report any damage to their property, as well as resources to help them file for eligible assistance from the Federal Emergency Management Agency (FEMA). The office also coordinates the delivery of those federal resources to declared disaster areas.

When floodwaters began to overwhelm the state last spring, OEM looked to quickly configure and deploy a fast and scalable damage assessment data workflow. After the team determined the information that needed to be collected, it stood up the Online Damage Reporting survey using Survey123. The information gathered from the survey's web form would be integral to helping local

and state emergency managers better understand the location and extent of flood damage to homes, businesses, and agriculture.

Once completed and ready for launch, OEM promoted its new online damage survey, located on a dedicated state government website-damage.ok.gov-through traditional media channels and social media platforms. OEM also included the survey information in its emergency situation updates, which ensured that it was amplified in most local newscasts.

"We did send it to all of our legislators and other stakeholders, so it was being shared very widely throughout the event," said Keli Cain, OEM's public information manager. "And of course, since it was a program that was being used statewide in every county that was impacted, it got a lot of play for sure. There was a lot of interest in it."

#### Keeping Emergency Managers on the Same Page

After configuring the surveys, the OEM team turned its focus to the second component of the new damage assessment workflow: managing the data that would stream in from those completed surveys. The team chose to use ArcGIS Dashboards for this because of its rapid data aggregation and simple visualizations.

"We have dashboards already that show, basically live, the situation across the data. This made it very easy to integrate this dataset," said Zach Stanford, the state coordinator for crisis information and disaster intelligence at OEM. "As you see how many incidents you have working, you can also see how many damage assessments or damage reports are pending review. So you can kind of see that workflow as one."

After the floods, OEM featured the dashboards on displays in the State Emergency Operations Center to easily communicate the current situation. Local emergency managers were also able to access the dashboards, keeping everyone on the same page throughout both the event and the recovery.

#### **Getting Vital Resources to Survivors**

Oklahoma residents who were affected by the disaster embraced OEM's mobile-friendly surveys and new crowdsourcing strategy. For the 2019 floods, the office received approximately 2,600 submissions.

The digital assessment allows survivors to share their unique damage information, upload photos, and pinpoint the location of their property on an interactive map—all using a smartphone or tablet. The ease of using Survey123 enabled OEM to streamline getting preliminary damage assessments (PDAs) to FEMA and the Small Business Administration (SBA). This ultimately resulted in FEMA approving a major disaster declaration for the area and SBA supporting a related low-interest disaster loan program.

"I think the survey gives survivors a step that they can take. It gives them an action that they can do themselves [to try] to receive assistance," said Stanford. "Rather than being passive and just having to wait for a PDA to happen or a declaration to be approved, they can actually do something on their own behalf to show what the need is in their communities...something that they can do to try to affect their own outcome and recovery."

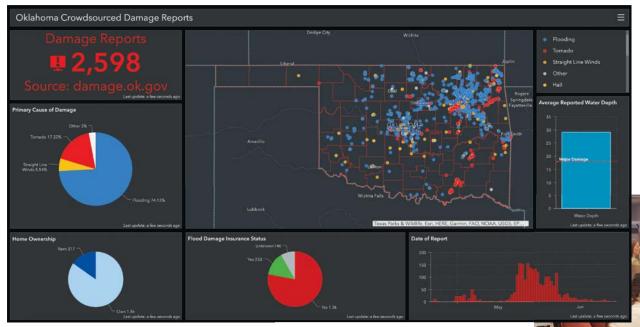
Emergency managers have also benefited from OEM's new standardized best practices for conducting damage assessments. This digital transformation, powered by ArcGIS technology, has completely eliminated the paper-based inefficiencies of not too long ago. Emergency managers no longer have to make educated guesses about what information they need to collect and then travel to every site to manually record their observations.

Instead, OEM now gives local emergency managers access to the dashboards that contain damage assessment data, allowing them to quickly view and analyze the damage assessment forms submitted by impacted residents. From there, emergency managers are able to quickly determine whether further inspection or analysis is required before submitting the full assessment to FEMA for evaluation.

#### How to Reduce the Next Disaster's Impact

Currently, OEM is looking ahead and exploring how it can use GIS technology beyond disaster response and recovery.

For example, the office is coming up with ways to offer an open dataset of historical damage assessment reports to researchers and the academic community. The idea is that people in these fields could perform risk analyses and gain a better understanding of how different disasters affect people or infrastructure. This kind of historical context would provide OEM and its partners with new insights into mitigation strategies that drive better preparedness. And it could certainly help reduce the impacts of the next disaster.



↑ The Oklahoma Department of Emergency Management (OEM) team used ArcGIS Dashboards to display crowdsourced damage reports.

→ The OEM featured dashboards on displays at the State Emergency Operations Center throughout disaster and recovery efforts. (Photo courtesy of the Oklahoma Department of Emergency Management.)

## Utility Upgrades Water Infrastructure with Machine Learning

Technology from Startup VODA.ai Reduces Water Loss Due to Pipe Failures

Safe, reliable water infrastructure is essential to any country's public health and basic sanitation needs. Yet across the United States, water pipes that have been in use for 50, 100, or even 150 years are common, and the hazards of this aging infrastructure are many. Frustrated customers experience more service disruptions and higher water bills, while water utilities deal with higher repair costs and increased nonrevenue water (NRW) loss from broken pipes.

Utilities the world over are challenged by NRW loss. Separate studies by the World Bank and the American Water Works Association (AWWA) estimate global NRW loss to be 20–40 percent. And that loss occurs after utilities have already incurred the expenses of sourcing, treating, and distributing water. Additional consequences of deteriorating water infrastructure include damaged property and roads following a main burst and repair, as well as increased greenhouse gas emissions due to the electricity and fossil fuels consumed during the sourcing, treating, and distribution of water.

For water utilities, it isn't enough to wait for the breaks to occur. Proactively replacing water main pipes is the best way to reduce NRW loss from pipe failures.

Longtime Esri user Nob Hill Water Association in Yakima, Washington, elected to prevent this loss by proactively replacing old water mains. But this wasn't going to be easy. The utility would need a system for selecting the right pipes to replace at the right time, which would include factors such as pipe age, failure history, and manufacture material. Overall, the utility needed a way to make better-informed decisions about these pipe replacements while maintaining service to its customers, avoiding water loss, and staying within budget.

To address these challenges, Nob Hill Water combined its already existing ArcGIS technology with daVinci, a powerful machine learning engine from Esri startup partner VODA.ai (voda.ai). Using ArcGIS Desktop, Nob Hill Water gains insight into terrain, infrastructure, and risk via contextual tools that help visualize and analyze data. When joined with VODA.ai's machine learning-powered virtual condition assessments, the resultant functionality allows the utility to accurately target those assets most in need of attention before costly damage occurs.

"Every utility has more miles of main line that should be replaced than there is money in the budget," said Zella West, manager at Nob Hill Water. "We are using this program to direct our valve exercising program to the mains that are predicted to fail so that if they do fail, the damage can be kept to a minimum."

VODA.ai's machine learning features rank each water main segment by the likelihood of failure, as well as the consequences of that failure. This then guides its priorities and fieldwork planning. Factors that the system analyzes include pipe data, weather, soil type, seismic activity, and traffic and satellite data—all of which reveal the water mains most likely to fail next. On the flip side, daVinci also establishes the pipes that have remaining useful life, which helps the utility avoid replacing healthy pipes prematurely.

"VODA.ai's artificial intelligence platform finds patterns of pipe strengths and weaknesses for all of our water mains. It even predicts which pipes are likely to fail within the next 12 months," said West. "Asset management decisions based on the age of pipes or their failure history are generally less than half as accurate as VODA.ai's machine learning assessments, so this helps us make smarter decisions on pipes to replace or leave alone."

Once in the field to perform repairs or maintenance, utility engineers use CarryMap, an app from Esri partner Data East that's compatible with ArcGIS Desktop, to view pipes, valves, and hydrants on a map. Using daVinci's ranking of pipe segments by risk, engineers can look for visible leaks on vulnerable pipes and make repairs if needed. The map view on the app also makes it easier to find and test nearby valves and figure out which customers are served by which pipes.

Having mobile access to ArcGIS maps, along with the insights created by VODA.ai's machine learning analysis of high-risk pipes, has made the utility's engineers so much more efficient that the board at Nob Hill Water approved the largest capital budget to date for the repair and replacement of water mains. What's more, leaders at Nob Hill Water now make smarter decisions on the basis of machine learning-enabled virtual condition assessment.



↑ Nob Hill Water Association elected to replace water mains along Scenic Drive in Yakima, Washington, due to their high likelihood of failure.

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









esri.com/arcnews ArcNews Fall 2020 **29** 

## With Help from Esri Partners, Users Enhance Their GIS

A consumer goods company wants to keep better tabs on key business metrics; a water utility needs to move to the cloud; a city makes a new, future-oriented master plan—and Esri partners help implement the GIS for it all. Read on to find out about these stories and more.



#### Implementing ArcGIS Utility Network

Norwegian utility Lyse is planning to go live with ArcGIS Utility Network for its electricity distribution grid by the end of 2020. To help Lyse successfully migrate to Utility Network, the company enlisted **Similix** (similix.dk), which has developed a complete solution for this.

Lyse is a longtime Esri user that employs a geometric network in ArcGIS Enterprise. One of the reasons Lyse became an early adopter of Utility Network in Europe is that the company wanted to employ the extension's new services-based architecture, rich data model, and data integrity rules. Additionally, Lyse is one of the founders of Europe's Utility Network Community (UNC), which helps organizations collaborate around Utility Network. Thus, Lyse has aided in developing a data model for European-style operated grids, which is the foundation for its own Utility Network implementation and that of several other utilities in Europe and Asia. This asset package, which has a data model, rules, symbols, and sample data, is available from UNC and can be downloaded for free.

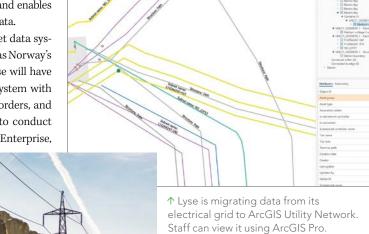
Lyse's implementation of Utility Network is phased. It starts with a full migration from its geometric network to Utility Network and then transitions to a delta integration, wherein the two systems run in parallel for a time while Lyse approaches change management one business process, integration, and app at a time. Similix is supporting all this with standard software from its Utility Network Migration Suite, which has an intuitive, drag-and-drop interface; allows users

to define rules for enriching their data during the migration process; supports going live in phases for the delta integration; and enables utilities to run migration iterations based on their own data.

For Lyse, Utility Network will serve as a master asset data system and also provide asset data to other systems, such as Norway's transmission system operator. By the end of 2020, Lyse will have also integrated a new enterprise resource planning system with Utility Network to manage asset maintenance, work orders, and project information. This will allow Lyse employees to conduct spatial analytics and visualization through ArcGIS Enterprise, both on the web and via mobile devices.

Each phase of the project provides Lyse with new web map-based information products as well that can monitor specific types of assets or voltage, for example. This ensures that everyone at the company can benefit from Utility Network data.

"The Utility Network technology [combined] with an open common data model—UNC—will drive our business forward," said Sigve Hamran, GIS manager at Lyse. "It will be the central platform for designing and managing the life-span of the electrical grid, including new distributed energy sources and smart devices."



← A longtime Esri user, Lyse is implementing Utility Network for its electricity distribution grid.

# Take the Next Step! Earn Your Master's in GIS Management



Salisbury University's M.S. in GISM — now in its 13th year — is designed specifically for the working GIS professional who seeks the management credentials needed for career advancement.

#### **Specialized Program**

- Combines management and technical proficiency
- Customized for those in government, business and non-profits
- Earn education credits toward GISP® certification

#### Convenient and Accessible: 100% online

- Earn degree full time in 13 months or part time in 2 years
- Complete coursework on your schedule
- Begin classes summer, fall or spring
- Open to international students
- Flexible scheduling for U.S. military, including those serving overseas

### GRE Waived for 2020-21 Enrollment

More information contact: Dr. Stuart Hamilton sehamilton@salisbury.edu

#### **Value-Added Education**

- Degree frequently leads to substantial salary increases
- Third-party billing options make employer payment easy
- Flat tuition rate, regardless of location

APPLY NOW



www.salisbury.edu/msgism

#### Seeing Operations Unfold in Geographic Context

The consumer goods market is highly competitive. To stay relevant, companies need to continually innovate and use technology to better understand their businesses.

3M is a leader in this field, offering products that range from health-care technology to office supplies, and even it is not exempt from these market rules. Recently, its hardware store sales and marketing team for Central America and the Caribbean was looking for new ways to use technology to improve key business metrics, such as distributors' points of sale (POS) coverage, how deeply its more than 30 product categories have penetrated the market, and how productive the team is across seven countries.

The company chose **Intelligis Technologies** (intelligisgroup. com), a recognized leader in producing commercial GIS apps in Latin America, to implement a real-time solution that managers now use to see 3M's operations unfold in geographic context. This way, 3M can help its distributors identify opportunities to improve their business performance.

Intelligis implemented ArcGIS Survey123 to allow a mobile force of more than 40 trade marketing specialists to report conditions at POS sites and immediately take action where

needed. For example, if a distributor is low on or out of a certain product, the trade marketing specialist can submit a purchase order right then and there through Survey123. Intelligis also used ArcGIS Web AppBuilder to create an app that, among other things, allows users to download all this field information in CSV format. Additionally, the solution employs ArcGIS Dashboards to show indicators such as the number of POS visits each trade marketing specialist makes, that person's coverage area, and each distributor's market share.

"This tool allows me to know, in real time, exactly in what POS [sites] my products are not present and to take action immediately in order to increase sales, penetration, coverage, and overall productivity," said

Juan Carlos Espinosa, regional manager of the hardware store channel at 3M in Central America and the Caribbean.

Eighteen months after the solution was implemented, 3M presented it as a success story to its business leaders in the region. The company is planning to roll it out to the rest of Latin America.



#### Getting Help Moving to the Cloud

Connecticut Water Company (CWC) is a regulated water utility that services many water systems across Connecticut and Maine. Its GIS team, which is distributed throughout New England, was experiencing lagging desktop performance and unpredictable outages that affected its ArcGIS software and apps. The team's GIS needs were also heavily straining IT staff and resources, who needed to focus on customer-facing issues.

So CWC brought in **ROK Technologies** (roktech.net) to develop a cloud-based GIS plan that could meet its needs. The three-step plan consisted of the following:

- Relocate CWC's entire enterprise GIS infrastructure to the cloud using ArcGIS Enterprise, ArcGIS Web Adaptor, ArcGIS License Manager, and an SQL database.
- Move the GIS team to Amazon Web Services (AWS)
   WorkSpaces to effectively run programs—such as ArcMap,
   ArcGIS Pro, and Bentley Systems' OpenFlows WaterGEMS—
   without interruption.
- Ensure that CWC's GIS needs are continually supported and properly maintained via ROK's managed services.

Once CWC's GIS was moved to the cloud, the company's GIS editors immediately experienced superior performance.

"It was an instant fix for us," said Daniel Goodrich, senior GIS analyst at CWC. "Performance-wise, the cloud was better. We started working the way we had always imagined we should be able to work, without all the little hiccups."

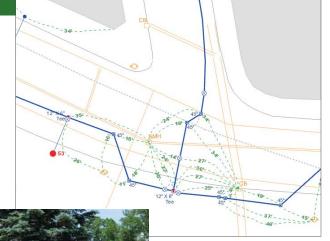
Overnight, CWC was able to deploy fast, reliable, and secure web maps to its mobile crews and office staff. Moreover, the solution offered excellent performance from any location, a reliable platform from which to serve GIS apps, and a way to reduce GIS demands on the company's internal network and IT staff.

"With ROK's managed services, we now have a team of IT experts who specialize in GIS," said Goodrich.

Today, CWC not only provides better GIS information to staff throughout the company, but it also better serves its customers. And what is Goodrich's advice for other organizations considering a move to the cloud?

"Go to the cloud right away, especially with a managed solution like [that from] ROK," he said. "They handle all the stuff we don't want to."

This allows CWC's GIS team to focus on what it does best—GIS.



↑ Connecticut Water Company (CWC) now deploys fast, reliable, and secure web maps to both its mobile crews and office staff.

← CWC is a regulated water utility that services water systems across Connecticut and Maine.

#### **Becoming a City Ready for the Future**

Cities around the world are embracing a smart community philosophy and integrating technology across governmental functions to better address economic, social, and environmental responsibilities. The City of Orlando, Florida, is doing this via its Future-Ready City Master Plan, which leverages innovation and collaboration to enhance services and investments across seven functional pillars: connectivity, energy, health and safety, placemaking, mobility, water, and materials.

As the primary consultant for the Future-Ready plan, **VHB** (vhb.com) has helped Orlando create a unified vision by working with the city to assess past investments, identify challenges to overcome, discuss future needs, and set priorities. This stepwise process was key to building consensus and defining a path forward.

One foundational element in particular was critical: engaging with stakeholders, including residents, the business community, educational partners, utility providers, nonprofits, and other local governments. The team at VHB also gathered input via internal city stakeholder discussions, roundtables on each pillar of the project, public workshops, and online surveys.

While the City of Orlando currently uses ArcGIS technology, including ArcGIS Desktop, ArcGIS Enterprise, and ArcGIS Online, the Future-Ready plan creates the opportunity for the city to expand its use of GIS and leverage the full potential of data to improve its operational and business results.

The Future-Ready City Master Plan is a living document and will be refined as technology and innovation progress and the world changes. While stakeholder engagement occurred prior to the coronavirus disease 2019 (COVID-19) pandemic, a midproject review revealed that the identified pillars and priorities were increasingly relevant to solving emerging challenges. Now, the team at VHB is preparing conceptual plans and business models to

implement relevant actions and help the city achieve its vision of becoming the premier future-ready city, a global destination, and a place where everyone can thrive.



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

esri.com/arcnews ArcNews Fall 2020 **31** 

## GIS Enables Tourist Destination to Operate Efficiently While Empowering Others

By Jennifer D. Stone, Sullivan County, New York

Sullivan County, New York, known as the gateway to the Catskill Mountains, is a 90-minute drive northwest of New York City. Rich in cultural, historical, and recreational landmarks, the area has been an on-again, off-again tourist destination for city dwellers for 200 years.

In the 1980s and 1990s, the tourism industry there suffered, and Sullivan County has since struggled to bounce back from the 2008 recession. But now, with New Yorkers' renewed interest in vacationing close to home, the county's population of 76,330 people rapidly swells to more than three times that amount during the summer months.

Frequently cash-strapped and underresourced, the county government wanted to find a way to help its staff balance tourism needs with the realities of country living. That solution turned out to be GIS, which Sullivan County now uses to empower not only local government employees but also the public.

#### GIS Proves Its Value Early On

Sullivan County's Real Property Tax Services Agency, in which the Sullivan County GIS program began, has long understood the value of GIS.

In 2006, staff members in Real Property converted the county's tax maps from Mylar and paper maps to ArcGIS Desktop. The power of this new digital system was immediately apparent: technicians were able to do in minutes what previously would have taken hours, from plotting parcels to identifying data errors. Additionally, having quality basemap data improved efficiency and empowered this small office to develop more sustainable, financially feasible solutions to a range of issues.

For example, in 2011, when Sullivan County had to lay off a number of employees, Real Property absorbed two additional responsibilities: maintaining 911 addressing and administering the county's GIS. With half the staff and at least twice the amount of work, Real Property sought to use existing resources to accommodate the additional workload and an expanded customer base.

First, the team focused on building custom tools to digitize paper-based tasks and streamline manual duties. Employing ModelBuilder, Real Property staff members automated a number of tasks, such as populating databases and exporting shapefiles. This allowed them to spend more time on data development for other departments, as well as a new initiative: implementing Web GIS.

A few years later, Real Property's budding GIS program was able to use the county's existing ArcGIS Online account to develop and release its first online GIS app, the Address Verification App (AVA). AVA, which helps community members and local business owners verify that they're using the correct 911 address, taught the county an invaluable lesson—that empowering the public can, in turn, empower local government.

Sullivan County realized its return on investment on this app immediately. The number of on-site customers and requests for address



← Public safety and fire officials use the Sullivan County Outages, Weather, and Traffic (SCOWT) dashboard daily to monitor incidents in real time.

verification letters dwindled as use of AVA took off, averaging more than 15 views per day during the first year and increasing ever since. Currently, that amounts to 30 customers, phone calls, questions, and/or letters per day—or nearly 8,000 per year—that overwhelmed staff members no longer have to handle.

AVA's success showed that Sullivan County residents were ready to embrace building a smarter community, one that views existing problems through a map-based lens. With growing support from the public and other county departments, it was time to build a new, mapcentric approach for another old-school process.

#### Summer Plans Inspire a Digital Overhaul

Prior to 2018, emergency management in Sullivan County was technologically limited.

"Monitoring of the news and the public safety radio frequencies, along with relying on first responders in the field to provide situational awareness, was the primary means of monitoring [an event]," said Rick Sauer, Sullivan County's commissioner of public safety. "There was no written plan for EOC [emergency oberations center] activations."

But at that time, Sullivan County was anticipating the 50th anniversary of the Woodstock music festival, which took place there in 1969. To mark the occasion, the county planned a series of live concerts at the Bethel Woods Center for the Arts from August 15 to 18, 2019. But there were four other major events happening in the county at the same time: a two-day music and arts festival, the Grahamsville Little World's Fair, a Boy Scouts camp-out, and family day at local campgrounds.

In preparation for a massive influx of visitors, staff members from Sullivan County's EOC began exploring how they could improve their incident monitoring and response capabilities, along with their situational awareness. Sauer worked with the 911 Center; the Bureau of Fire; the Bureau of Emergency Medical Services; the director of communications; the GIS program; and a number of federal, state, and local officials to establish a new EOC plan that took advantage of the county's

technological resources. GIS ended up being a critical component of the multitiered solution.

Sullivan County's GIS program first used ArcGIS Pro to deploy ArcGIS Solutions for Emergency Management, a suite of ready-made configurations for ArcGIS that focus on preparedness, response, recovery, and mitigation. Using these solutions, the team created four apps for EOC staff members: Operations Response, which helps users identify and map emergency facilities; Situational Awareness, which lets users map event and incident perimeters and identify affected populations; Logistics Planning, which helps users outline emergency logistics; and the Emergency Resources Reporter, which allows users to streamline field data collection via an offline map with sync capabilities and an online reporter. All components of the solution are now collectively known as the Emergency Operations Suite.

Being able to easily deploy these resources enabled the county to more effectively map and monitor all its public safety assets and resources. It also helped the team quickly provide maps and updates and identify any additional critical information.

"All these efforts provided for a successful 50th Woodstock Anniversary weekend by increasing situational awareness [by] leaps and bounds, having the right people in the room at the right time, and assisting decision-makers," said Sauer.

What's more, restructuring the EOC to use the Emergency Operations Suite—along with live-feed camera systems, cell phone technology, drones, and social media—throughout that weekend has allowed Sauer and his team to more effectively monitor and coordinate other public safety and emergency management incidents that affect Sullivan County's residents and visitors.

#### A Sustainable GIS Platform Emerges

One of the biggest improvements Sullivan County has seen with implementing GIS for emergency management is being able to use a GIS-based dashboard, called the Sullivan County Outages, Weather, and Traffic (SCOWT) dashboard, to monitor multiple data sources on one screen.

"This is used on a daily basis by the commissioner of public safety and the fire coordinator to monitor traffic, electrical outages, and weather alerts," said Sauer. "We have taken advantage of this technology to share needed information [with] the public through our public information officer."

Staff members from the GIS program created SCOWT using ArcGIS Online, along with a number of Esri-provided resources and collaborations, including the Waze Live Alerts Layer, available on ArcGIS Marketplace. Through its Waze for Cities partnership, Sullivan County obtains near real-time traffic incident and road closure data at no cost—a huge benefit for a county that's regularly low on funding. Taking advantage of Waze's crowdsourced data allows the Sullivan County EOC to monitor the Waze traffic incident reports that drivers submit every day.

Other resources provided by Esri include streaming feature services for weather, flooding, and traffic. Combining these with embedded outage maps from local utility companies in the SCOWT dashboard allows public safety organizations to take advantage of mapcentric monitoring capabilities.

Moving forward, these GIS resources—along with a multiuser geodatabase environment; a new enterprise GIS implementation; and additional support from the Sullivan County IT Department, where the GIS program is now housed—will enable Sullivan County to continue empowering its staff and the public with an efficient, financially responsible, and sustainable GIS platform for years to come.

#### About the Author

Jennifer D. Stone is the GIS coordinator for Sullivan County, New York. Largely self-taught via conferences, workshops, and online courses, she has 15 years of experience in GIS. For more information, contact her at jennifer.stone@co.sullivan.ny.us or 845-807-0224.

## Sacramento's Revamped 311 System Uses Groundbreaking Location Analytics

For many Americans, including Californians, the city of Sacramento is primarily the location of California's statehouse. For Sacramento's residents, it is a thriving city in its own right—by some metrics, the fourth most ethnically diverse city in the United States.

What the city's varied communities have in common is a high engagement with Sacramento's 311 service. In any year, the service logs around 500,000 different interactions—or one for every Sacramento resident.

Since Sacramento launched the 311 service in 2008, the city has maintained an ambitious conception of what the program should achieve. While most large- or medium-sized cities maintain a 311 program, many of them are structured as adjunct city agencies that perform a kind of ombudsman role. In Sacramento, however, 311 is conceived of as a civic connective tissue, a digital hub that links many city departments.

"It's the front door to Sacramento," said Maria MacGunigal, the city's chief information officer (CIO), "the highest touch point for all the interactions the city has with the community."

#### A Uniquely Expansive 311

In 2013, soon after MacGunigal accepted the job of Sacramento's CIO, 311 was placed under her purview.

"That isn't typical for a city's IT department, but the 311 system was struggling under heavy demand," she said. Much of the challenge involved the ambitious scope of Sacramento's 311 program, which for many years has used GIS to route requests.

"We've always had a back end ArcGIS Server that supported geocoding and some overlay values," said Dara O'Beirne, the city's GIS developer. "Whenever someone submits a ticket and enters an address into the interface, it validates against our internal geocoder to ensure that it actually is a valid address within the city of Sacramento. Then it conducts an overlay and pulls attribute information from 35 different layers, such as the correct council district or police beat."

A report of a stray dog, for example, would automatically note the relevant animal care district and notify animal care officers in the area. The ticket also generates automatic updates on the problem for the public and any agencies involved.

"Right now, that's occurring from Salesforce, through our firewall, and into the ArcGIS Server," O'Beirne explained.

"Most cities don't have that kind of back end integration through all those business lines," MacGunigal added. "It doesn't have nearly as much of an impact on the community if we're just taking notes and handing off the requests."

#### **Broadening the Scope**

When MacGunigal was tasked with overhauling Sacramento's 311, she wanted to broaden the program's scope even further so it would eventually become "a foundation upon which we can build all other portal access to the public," she said. That meant retaining the system's GIS-enabled back end while also using GIS to improve the real-time interface. With the new setup, 311 users interact with maps, via Salesforce, that are built using ArcGIS API for JavaScript.

Consider that stray dog. The first person to report it will see the ticket displayed on the map. If someone else sees the dog and logs on to 311 a few seconds later, that person will see the same ticket and realize there's no need to report it.

"Managing multiple reports [of the same issue or incident] was one of the challenges we were trying to overcome with this integration between Salesforce and ArcGIS Online," O'Beirne said. "As soon as someone submits the ticket, it goes to ArcGIS Online so it'll be reflected on the map. The next person can see the same incident at the same location. If they click on it, they open the ticket in Salesforce to find out more information."

People can even "follow" the ticket to receive notifications when updated information is added to the ticket.

"It's a more encompassing experience for the user," O'Beirne said. The system also helps city agencies better serve their constituents. "We now have data from GIS maps and layers, and we take the Salesforce data and start building dashboards around it," said Ivan Castellanos, Sacramento's 311 manager. "There's even more value

in the data now because it can be used to help various city departments drive their strategies and make data-driven decisions."

#### The Final Challenge

"From my perspective, one of the most important aspects of this implementation is not that any one of the components of the GIS integration is brand new, but that they're as comprehensive as they are across all the different levels of integration with the map or with the geography," MacGunigal said. "For example, the idea that you would try to geographically understand if something had already existed or it had already been reported has been around for a long time, but we just used to do it mathematically. We didn't actually use GIS. We used an approximation of what might be in proximity, but it became so burdensome in the system that we actually removed it at one point. So the concept was there, but the full implementation wasn't quite there until now."

"I think at the beginning of the project it was difficult because it was a completely unknown endeavor," O'Beirne said. "There weren't that many people out there who had already done this. There were one or two other cities, but not to the level that we were trying to implement."

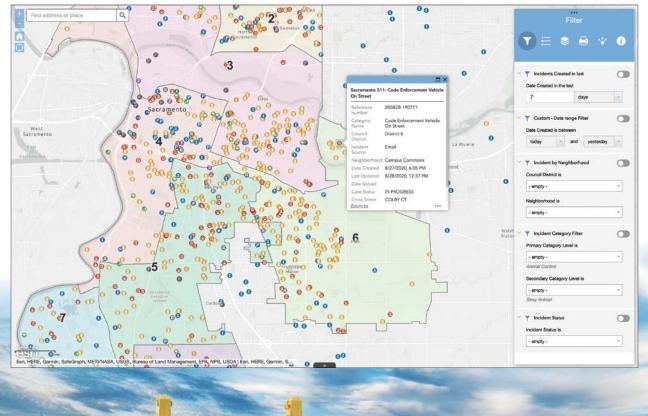
The final challenge was unexpected. When California's governor, Gavin Newsom, issued the state's first stay-at-home order in response to the coronavirus disease 2019 (COVID-19) crisis, MacGunigal's team was nearing the end of several months of planning for the 311 transition. After all the work they'd put in, was the effort to push the project over the finish line while the team was scattered worth jeopardizing it?

MacGunigal chose to power through. The new 311 debuted on April 15, a mere month behind schedule. All feedback suggested that any hiccups, inevitable in this kind of launch, were minor.

The new technology worked so well that the team was able to surmount an unforeseen hurdle. Operators trained to answer calls in the 311 call center were among city employees who had been sent home. In addition to launching the new system remotely, the team also had to figure out how to make the 311 call center function remotely, a daunting task made simpler by the cloud-based architecture of Salesforce and ArcGIS Online.

"It's not unheard of in the private sector to have call centers that have a lot of distributed locations, whether that's at people's homes or just multiple locations for call taking, but we're one of the first public agencies to have a mostly remote call center," MacGunigal said. "Everyone was remote—the development team, the GIS team, the infrastructure team—and we pulled it off without a hitch. So that was pretty awesome."

← Users of Sacramento's new 311 system can now see incident tickets on a public-facing map.



## Cloud-Based GIS Streamlines Neighborhood Revitalization Efforts

By Brita Austin, Allworld Project Management

In Memphis, Tennessee, the Community Redevelopment Agency (CRA) works with local organizations, residents, and businesses to address blight and provide affordable housing. Using the Tax Increment Financing (TIF) tool, the CRA identifies underdeveloped areas that are ripe for improvement and calculates how much funding the projects can obtain based on future expected tax revenue. Projects that the CRA works on include single-family rehabilitation, which provides up to \$30,000 in home improvement funds to homeowners in need of assistance, and targeted infrastructure improvement in high-crime areas, which focuses on lowering crime by removing weeds, cleaning up graffiti, and fixing broken streetlights.

For several years, the CRA has used GIS on a limited basis to map parcels, analyze appraisal changes, and communicate with the public—essentially, to do quick analysis and data visualization. But recently, one of its big projects, the Uptown TIF District, required a more robust GIS implementation.

The 100-block revitalization effort of this north Memphis neighborhood focuses on several important community anchors, including the downtown Memphis area; St. Jude Children's Research Hospital; the Memphis medical district; and a number of community centers, historic businesses, schools, and parks. The idea is to use the \$95 million allocated to the project by TIF over the next 10 years to strengthen these anchors so they have the greatest impact on the community, resulting in a neighborhood revival that gives residents a sense of collective pride, makes them feel safe, and attracts additional investment.

To accomplish this, the CRA needed to streamline its data management, mapping analysis, and visualization capabilities. So it turned to Esri partner Allworld Project Management, a Memphisbased professional services firm, to assemble a powerful suite of cloud-based ArcGIS technology.

For the Uptown TIF District project, the CRA had a very specific vision:

- 1. Promote the area as a great place for residents of various income levels and ages to live
- 2. Protect already-existing single-family homes from dilapidation and gentrification
- Preserve and create vibrant community anchors that strengthen residents' connections to one another and make it easier to get to nearby downtown

To prioritize and manage the projects that would be key to this revitalization effort—including handling Crime Prevention Through Environmental Design (CPTED) data and tracking blight removal, housing rehabilitation, and infrastructure improvements—Allworld configured a series of GIS solutions. Most of them were built in ArcGIS Online and included apps configured using ArcGIS Web AppBuilder, ArcGIS Survey123 forms, a custom configuration of ArcGIS Collector, and dashboards built with ArcGIS Dashboards.

For example, CRA staff members are able to use the Community Redevelopment Manager app, created with Web AppBuilder, to record new data about ongoing projects, such as their status and cost, and edit existing entries. It also enables staff to perform quick, exploratory, and inferential analysis on where to implement changes and invest funds. Using a new business analysis widget

linked to Esri Tapestry Segmentation data, the app allows staff members to dig into background and up-to-date information about specific neighborhoods. And Allworld built another, similar app for the Uptown Advisory Committee—which is made up of community members—to show much of the same content, just without the editing capabilities available to CRA staff.

The ease of use of ArcGIS Online, coupled with web-based apps, makes it easy for other stake-holders, in addition to the CRA, to communicate and visualize data as well. For instance, city officials employ the Community Redevelopment Manager web app to collect data on infrastructure projects, such as sidewalk, alleyway, and camera installations, so they can keep track of who is doing what project, how much it's costing, its status, and more. City officials also use the Block Wellness app to monitor the removal of environmental factors, like weeds, graffiti, and broken streetlights, that contribute to crime.

The same feature services that Allworld used to create the Community Redevelopment Manager app were also used to build a Survey123 app that the CRA can employ in the field to keep tabs on project inspections. Another option (though the CRA didn't choose this) would have been to use ArcGIS Workforce coupled with Collector or Survey123—or even Collector by itself—to manage field crews and conduct project inspections. The versatility of employing a feature service paired with ArcGIS apps is extremely helpful when trying to meet end-users' various data collection, management, editing, visualization, and communication needs.

To help key stakeholders with decision-making, Allworld used ArcGIS Dashboards to assemble multiple dashboards that provide a quick, focused understanding of real-time project data. The dashboards, which feature simple visual formats such as maps and charts, include macro views of project statuses and costs, as well as descriptive data—from who owns the land to what kinds of improvements are needed.

Because ArcGIS Online is secure and makes it easy to duplicate apps, the team at Allworld was able to build one set of internal solutions that it employed to manage the project, while the CRA and the Uptown Advisory Committee rely on their own set of solutions to carry out redevelopment operations. Given that all these solutions were tied to the same datasets via cloud-based storage in ArcGIS Online, everyone was working from the same data. This has saved the CRA time in determining which areas in the Uptown TIF District to target for revitalization, which, ultimately, has helped everyone involved streamline funding.

#### About the Author

Brita Austin is a GIS specialist for Allworld Project Management. She has a bachelor's degree in geography, with a focus on the environment and climate, and a master's degree in geoscience, with a focus in GIScience, both from Western Kentucky University.



#### The Relevance of Cartography

A Cartographer's Perspective

By Tim Trainor

President, International Cartographic Association



## Cartographic Creativity and Ingenuity on Display

The best way to learn about mapping is to spend as much time as possible looking at maps. All map lovers have dedicated many hours to developing and refining their interests while gazing at maps. Some maps are simple and require little effort to understand. Others—with more detail or that include addi $tional\ information, such as\ textual\ descriptions\ or\ graphs-necessitate\ more\ careful\ study.$ 

Maps invite people to be inquisitive and indulge their curiosity. For some, map exploration begins with a place they're familiar with. Others search for a theme to explore, while still others seek to discover patterns of activity. Map viewers see beyond the points, lines, areas, colors, textures, sizes, and other cartographic variables. (In fact, if the building blocks of the map are visible first, the cartographer may need a bit more training in communicating the intent of the map.)

In times when travel is simpler than it is now, there are two excellent venues for map displays. The first is the biennial International Cartographic Conference (ICC), which includes the International Cartographic Exhibition as one of its highlights. The second is the Map Gallery at the Esri User Conference (Esri UC). Anyone who has had the good fortune of attending the Esri UC begins the week in the Sails Pavilion of the San Diego Convention Center marveling at an assortment of creative cartography—as Esri UC attendees were able to do virtually this year.

The ICC's exhibition is a competition among national and affiliate members of the International Cartographic Association (ICA) in which contestants submit map products to reflect their country or organization. There are seven general categories: maps, charts, atlases, digital cartographic products, digital services, educational cartographic products, and an "other" category that includes unique products like globes and tactile maps. The Barbara Petchenik Competition, which accompanies the program, is a map drawing contest for children aimed at encouraging kids to make creative renditions of the world in graphic form. Seeing how children from around the world depict a common theme always draws the attention and curiosity of adults.

Esri's Map Gallery is also presented via themes and categories, many of which are similar to those in the ICA competition. The themes are usually based on changing trends. Recently, the Map Gallery has incorporated new categories as well, such as Communicating Science Spatially, Most Innovative, and Story Maps.

Of course, map displays are offered in many different venues beyond the ICA and Esri UC. But these fine works to international audiences. Similar to exploring an art gallery, map exhibits draw attention in different ways. Visitors wander through the displays—some looking for specific themes, others more interested in which country or

two events are well-known competitions where organizations and cartographers can show off their

organization produced the work. People always seek out the high-quality National Geographic maps at map exhibits, not unlike the art admirer setting out to see the *Mona Lisa* at the Louvre.

In the end, each map or cartographic product stands on its own merit. What is it that draws a visitor to explore that particular map? Is it the title—either one that's familiar to the visitor or something that provokes the viewer's attention? Is the map type a source of interest—a topographic map, perhaps, that calls to the outdoor nature in each of us, or a map image of Mars that shows geographic characteristics largely unknown to humans? Or maybe it's a port chart displaying the mooring of boats and ships that we long to experience. A thematic map might catch our interest, with lines and arrows swirling about or different-sized, graduated pinwheels showing comparative values between one location and another. A different enticement might be the innocence of a child's work that conjures what is important to them without the encumbrance of formal training.

Maps have a way of reaching out to us, whether it's through cartographic design or some other factor. Color is an attention-getter, often bringing us forward for a closer look. Map symbols, both familiar and unfamiliar, beckon our visual senses and interests. We might be attracted to locations we recognize. Or sometimes it's the combination of art and map or that old-world appearance, most common in historical maps, that draws us closer.

Every viewer of a map is a judge. When many maps are brought together in an array of themes as part of a map exhibition, viewers make choices about what to see. Depending on their level of interest, they might study their selection in detail, moving closer to the map to probe its content along with its design, or move on quickly.

Each map is made for an audience, someone other than the map creator. Recognizing the creativity, artistic design, and scholarship displayed in a map is important for giving credit to the map author's skills, talent, and accomplishments, as well as the original sources of the map's content.

In the map competitions presented by both the ICA and Esri, committees of expert cartographers

judge the submissions based on criteria such as theme and map design. The winning mapmakers are recognized based not only on the judges' artistic and technical specifications but also, for some categories, on preferences indicated by the public.

The excerpts to the left (which have been lightly edited for clarity) are some judges' observations made during a recent map exhibition. They show how map readers can  $learn\,about\,cartography\,as\,they\,explore\,maps\,in\,a\,display.$ 

As the judges describe, there is an incredible amount of variety, creativity, scholarship, and fun in maps and apps. And map exhibitions manifest the art, science, and technology of cartography in a panoply of forms, dimensions, and perspectives.

In a map gallery, viewers can learn many cartographic principles just by observing the creativity and ingenuity of the visualizations on display. So the next opportunity you get, make it a point to wander through a map display to enjoy very different views of your world.

↑ Adults are usually intrigued by how children from around the world depict a common theme in

This map is packed with information. The text is almost encyclopedic, yet one's first impression is how effectively the color and shading of map areas are presented.

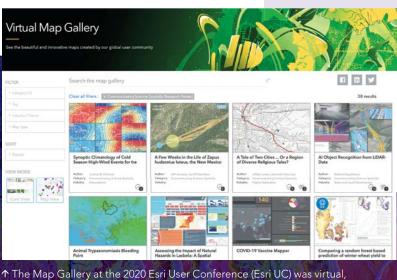
Scrolling through this project reveals different media—text, graphs, charts, and diagrams—that effectively complement the main map and each other. No easy feat.

The app is notable for its use of historical maps; well-designed interactivity; and tight, unflinching storytelling.

It's a well-curated virtual globe with a particularly useful slider to modify vertical exaggeration.

This perfectly crafted app tells you everything you'd ever want to know about polygonal boundaries. Starting at the parcel level, the successive maps step the viewer out from the local to the global, with dozens of stops in between.

There is a dark, moody feel to this map that is well suited to its subject—the many old cemeteries and burial grounds found in this national park. The basemap's shaded relief and color tones are blended with a smoky feel at the map edges, and the text provides both location and a story narrative. Every name on the map is an invitation to explore the story of a forgotten community, an isolated family, or a mysterious individual—a fine artistic touch that humanizes the map and connects us to those who passed long ago.



featuring such categories as Communicating Science Spatially, Most

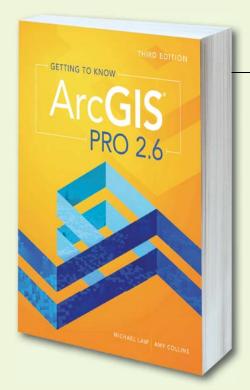
Innovative, and Story Maps.

↑ This ArcGIS StoryMaps story, which shows how the history of landownership, valuation, and development in Richmond Virginia, destroyed many Black communities, won first place in the Educational Map category at the 2020 Esri UC.

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



#### Getting to Know ArcGIS Pro 2.6, Third Edition

By Michael Law and Amy Collins

Continuing the tradition of the best-selling Getting to Know series, *Getting to Know ArcGIS Pro 2.6*, Third Edition, teaches new and existing GIS users how to solve problems using ArcGIS Pro. Introducing the software's basic tools and capabilities via practical project workflows, the book helps readers learn how to analyze and present geospatial data in both 2D and 3D environments. Using figures to show each step, authors Michael Law and Amy Collins demystify complicated processes such as developing a geoprocessing model, using Python to write a script tool, and creating space-time cubes. Ideal for students, self-learners, and seasoned professionals looking to learn about new GIS technology, *Getting to Know ArcGIS Pro 2.6* is a broad textbook and desk reference designed to leave users feeling confident when using ArcGIS Pro on their own. August/October 2020, 420 pp. E-book ISBN: 9781589486362 and paperback ISBN: 9781589486355.

#### GIS Tutorial for ArcGIS Pro 2.6

By Wilpen Gorr and Kristen Kurland

Updated for use with ArcGIS Pro 2.6, GIS Tutorial for ArcGIS Pro 2.6 is the introductory workbook for learning about GIS using ArcGIS Pro. Designed for use in classrooms or for self-learners, it is an easy-to-follow guide that employs proven teaching methods to show readers how to make maps, create and analyze spatial data, and manage operational systems. Step-by-step exercises use ArcGIS Pro, along with ArcGIS Online, ArcGIS StoryMaps, ArcGIS Dashboards, and ArcGIS Collector, to work with real-world data. "Your Turn" sections help readers reinforce what they've learned. Free, downloadable video lectures and lecture slides that cover the whole book are also available. July/September 2020, 448 pp. E-book ISBN: 9781589486263 and paperback ISBN: 9781589485891.

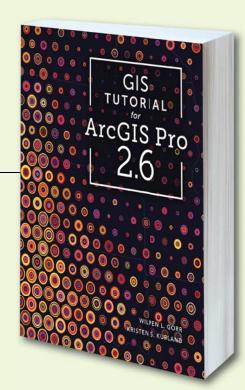


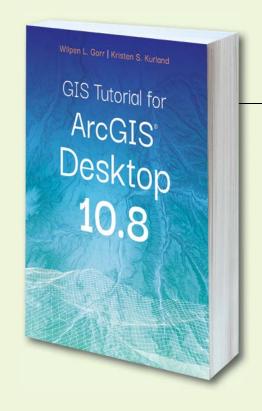
By Wilpen Gorr and Kristen Kurland

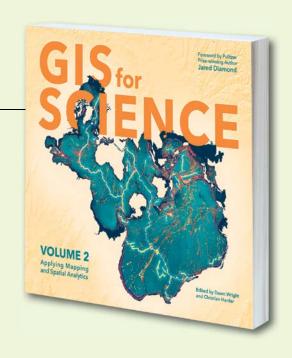
GIS Tutorial for ArcGIS Desktop 10.8, updated for use with ArcGIS Desktop 10.8.1, is a classic textbook for learning how to gather, manage, and analyze data using map visualizations and location intelligence in ArcGIS Desktop. The book, which incorporates well-established instructional techniques, introduces readers to the tools and functionality of ArcMap and ArcCatalog. Readers get to use and make maps, work with spatial data, and analyze that data by doing proximity and site suitability analyses. They also get hands-on experience with the ArcGIS 3D Analyst, ArcGIS Spatial Analyst, and ArcGIS Network Analyst extensions for ArcGIS Desktop. Detailed exercises, "Your Turn" sections, and homework assignments make GIS Tutorial for ArcGIS Desktop 10.8 ideal for the classroom or self-learners. September/December 2020, 448 pp. E-book ISBN: 9781589486157 and paperback ISBN: 9781589486140.

#### GIS for Science, Volume 2: Applying Mapping and Spatial Analytics Edited by Dawn Wright and Christian Harder

GIS for Science, Volume 2: Applying Mapping and Spatial Analytics—coedited by Esri chief scientist Dawn Wright and Esri technology writer and information designer Christian Harder, with a foreword by Pulitzer Prize winner Jared Diamond—showcases rigorous scientific research projects that employ GIS. The book's contributors represent a cross section of scientists who employ data gathered from satellites, aircraft, ships, drones, and other remotesensing and on-site technologies. This collated data is brought to life by GIS and the broader realm of spatial data science to study issues including epidemiology; sustainable precision agriculture; geologic processes that occur below the surface of the earth; disaster response, recovery, and resilience; and air quality monitoring. The stories in the book also show, in very practical terms, how ArcGIS software and the ArcGIS Online cloud-based system work as a comprehensive geospatial platform to support research, collaboration, spatial analysis, and science communication across many settings and communities. A supplementary website, gisforscience.com, includes data along with additional maps, videos, web apps, workflows, and snippets of computer code for readers who want to learn more. October/December 2020, 250 pp. E-book ISBN: 9781589485884 and paperback ISBN: 9781589485877.











By Andy Mitchell and Lauren Scott Griffin

The second edition of The Esri Guide to GIS Analysis, Volume 2: Spatial Measurements and  $\mathit{Statistics}$  builds on volume 1 by taking users beyond visualizing patterns in maps to teaching them how to quantify patterns in a significant way. The book guides readers through some of the most common spatial statistics tasks, including measuring distributions, identifying patterns and clusters, and analyzing relationships. It also shows how spatial statistical tools can be applied in a range of disciplines, from public health to habitat conservation. With this educational aid, users can move their work past mapping and visualization to more quantitative statistical assessment. November 2020/January 2021, 250 pp. E-book ISBN: 9781589486096 and paperback ISBN: 9781589486089.

#### Understanding Crime: Analyzing the Geography of Crime By Spencer Chainey

Understanding Crime: Analyzing the Geography of Crime is the first book to fully explain how to truly analyze the geography of crime. With comprehensive content that includes both new and old techniques, the book shows readers how to examine the spatial and temporal patterns of crime, analyze crime with other spatial data, and evaluate the impact of geographically targeted interventions. Topics covered in the book include the following:

- Hot spot analysis using microplace crime concentration and cluster analysis techniques
- Temporal analysis, including methods of examining the stability of crime patterns
- · Analyses of troublesome places, repeat and near-repeat victimization, and persistent and emerging crime patterns
- The dispersion of crime concentration over time

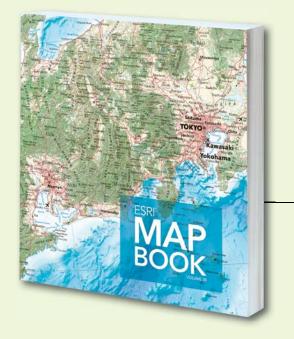
Whether readers are new to analyzing the geographic patterns of crime or are experienced pros, they will benefit from learning the techniques presented in *Understanding* Crime. November 2020/January 2021, 500 pp. E-book ISBN: 9781589485853 and paperback ISBN: 9781589485846.

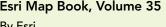
### Esri Map Book, Volume 35

Every year, works from mapmakers around the world are selected for the Esri Map Book to  $demonstrate\ how\ GIS\ technology\ helps\ governments,\ businesses,\ and\ individuals.\ \textit{Esri\ Map}$ Book, Volume 35, continues this tradition, showcasing maps and apps that employ ArcGIS technology to evaluate the sustainability of resources, determine efficient transportation routes, mitigate the effects of natural disasters, and more. Each map or app includes a de-

For more information on all Esri Press publications, visit esri.com/esripress.

UNDERSTANDING





scription of how it was produced. August 2020, 168 pp. Paperback ISBN: 9781589485860.

## **STEAM**

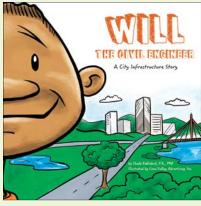
#### STEAM at Work! Children's Book Series

The STEAM at Work! series, for grades 1–5, opens children up to new ideas for channeling their passions, particularly into science, technology, engineering, art, and math (STEAM) careers. Each book demonstrates different environmental and social issues, which the characters use their skills to solve, encouraging critical and creative thinking about the world. Just like the characters in the series, readers will be inspired to make a positive impact on their communities now and in the future. Following on the first book, Lindsey the GIS Professional, meet three of Lindsey's friends.



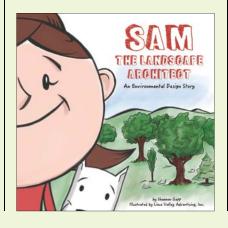
#### Will the Civil Engineer By Chadd Kahlsdorf

Will's dad is a civil engineer who uses math and science to make the world a better place. Follow along as Will learns that everything that gets built requires an engineer and how he can be one, too! September 2020, 24 pp. Paperback ISBN: 9781589486430.



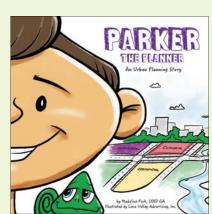
#### Sam the Landscape Architect By Shannon Gapp

Sam loves to design things. She plans to be a landscape architect one day so she can help make the world green. See how she uses her imagination to create parks and gardens that improve her community. October 2020, 24 pp. Paperback ISBN: 9781589486423.



#### Parker the Planner By Madeline Peck

Parker's city is a mess. It's full of traffic and has no sidewalks or parks. But Parker has a plan! He'll build his own city—with parks, zoos, transportation, and environmental benefits-and show kids how they can help create change. October 2020, 24 pp. Paperback ISBN: 9781589486416.





#### Esri Corporate Headquarters

Esri Technical Suppor esri.com/support

Esri Desktop Order Center and Software Information Tel.: **1-800-447-9778** (USA only)

Esri Products esri.com/products

Esri Store

ArcGIS for Developers

Customer Care Portal

Esri US Regional Offices esri.com/about-esri/usa

Esri Distributors
esri.com/distributors



38 ArcNews Fall 2020

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

### **Training**

#### **New Instructor-Led Courses**

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT+ certification. Courses are currently offered online, in real time (in multiple time zones), and as private training events.

Whether you need to apply the latest ArcGIS tools to make maps and perform spatial analysis or come up with an efficient geospatial data management strategy, the following courses can help:

- Creating Maps and Visualizations with ArcGIS  $\,$ 

Visualizing and mapping data is a core function practiced by almost all GIS professionals. This course covers the latest ArcGIS Pro techniques so learners can create and share a variety of professional-quality information products, including print maps, web maps, 3D scenes, animations, and charts.

Spatial Analysis with ArcGIS Pro

Participants in this course learn essential concepts and a standard workflow that they can apply to identify patterns, make predictions, and answer the questions that matter to their organizations. Exercises allow learners to work with a variety of analysis tools in ArcGIS Pro, ArcGIS 3D Analyst, ArcGIS Spatial Analyst, and ArcGIS Geostatistical Analyst.

• Managing Geospatial Data in ArcGIS

This course explores the geodatabase, the native data storage format for ArcGIS software. Attendees develop the skills they need to configure unique geodatabase features that ensure data accuracy over time and a thorough understanding of file and enterprise geodatabase capabilities.

#### **Experience an Esri MOOC**

Massive open online courses (MOOCs) are free, convenient, and a great way to keep up-to-date with fast-changing technologies. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage with learners from around the world. Everyone who completes the course content receives a certificate of completion. View all Esri MOOCs at esri.com/mooc.

The popular **Cartography**. MOOC returns for six weeks starting February 3. With guidance from expert Esri cartographers, participants learn how to use ArcGIS Pro to create beautiful maps that are tailored to specific audiences, purposes, and media. They also discover practical techniques that can take an average map to extraordinary cartographic heights. Learn more and register at go.esri.com/carto-course.

### **Certification**

#### **New Specialty Exam**

The ArcGIS Utility Network specialty exam validates proficiency with ArcGIS Utility Network software. Individuals interested in earning this specialty certificate should have experience with services-based architecture and asset management in a multiuser environment, as well as a strong understanding of the Utility Network information model and network management workflows. View exam details at go.esri.com/utility-network-certification. Are you wondering whether a specialty exam is right for you? Check out this brief Q&A:

What is the difference between a core exam and a specialty exam?

In the Esri Technical Certification Program, core exams test a broad range of knowledge related to multiple ArcGIS Desktop and ArcGIS Enterprise product capabilities and how practitioners use ArcGIS software to complete defined tasks that they might encounter in the real world. Exams take about two hours and typically include 80 questions. Specialty exams, on the other hand, focus on one ArcGIS app or related technology. They take about one hour to complete and typically include 40 questions.

• Why is earning a core certification required to take a specialty exam?

Achieving a high-stakes certification is an accomplishment that speaks volumes about an individual's professional credibility. Being able to knowledgeably apply individual ArcGIS components and related technology requires solid familiarity with ArcGIS products and strong practical experience—both of which are validated by Esri's core certification exams. Achieving a core certification and one or more specialty certifications provides Esri-certified individuals with the most value and inspires the highest confidence in them.

To explore the latest Esri Technical Certification exams, visit esri.com/training/certification. Also join the Esri Technical Certification groups on LinkedIn and GeoNet to connect with other professionals and discuss all things certification. Looking for inspiration for your GIS journey? View all certification success stories at go.esri.com/certification-success.

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





## HARNESS THE POWER OF WHERE

# ONLINE GRADUATE SPATIAL PROGRAMS

The University of Redlands is a private, nonprofit university located in Redlands, California—close neighbors and partners with geospatial leader, Esri.

All Redlands academic programs enable access to Esri technology, training, people, events, and internships, including classes taught by Esri employees.

## **Geographic Information Systems (GIS) Certificate**

Advance your career in a GIS-related field with an introductory graduate certificate that teaches you how to manage a spatial database, extract useful information from remotely sensed data, use Python to extend GIS, and develop a web GIS application. Access to extensive Esri resources complements your GIS education with diverse cutting-edge applications and technologies.

#### **Online + On campus**

4 courses

11-13 credits\*

32 weeks

\* Credits can be applied to MGIS and MSGIS degree programs.

## **Business Location Analytics Certificate**

Master the business of "where" with a graduate certificate that focuses on using GIS to achieve business success.\* Learn how leading organizations deploy location analytics to gain customer insights, expand the business, manage risk, and design effective spatial business strategies. Develop technical skills in location analytics and spatial storytelling that can improve business decision-making and positively impact society.

#### **Online only**

3 courses

10 credits

20 weeks

\* Pending WSCUC approval.

## MBA – Location Analytics Concentration

Use the power of location intelligence to lead 21st century businesses and organizations. The MBA with a location analytics concentration equips you to unlock the potential of spatial data, solve real-world problems, and gain a competitive advantage in today's business world.

#### **Online + On campus**

9-12 courses

36-48 credits

**18-24 months** 

Learn more spatial.redlands.edu



#### Add a Subscription, Change Your Address, or Unsubscribe

Subscribe, unsubscribe, or update information at esri.com/manage-subscriptions. Outside the United States, contact your local distributor.

To request other publication services, see page 2.

Copyright © 2020 Esri. All rights reserved. Printed in the United States of America.

The information contained in this document is the exclusive property of Esri or its licensors. This work is protected under United States copyright law and other international copyright treaties and conventions. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, except as expressly permitted in writing by Esri. All requests should be sent to Attention: Director, Contracts and Legal Department, Esri, 380 New York Street, Redlands, CA 92373-8100 USA.

The information contained in this document is subject to change without notice

The information contained in this document is subject to change without notice.

@esri.com, 3D Analyst, ACORN, Address Coder, ADF, AML, ArcAtlas, ArcCAD, ArcCatalog, ArcCOGO, ArcData, ArcDoc, ArcEdit, ArcEditor, ArcEurope, ArcExplorer, ArcExpress, ArcGIS, aregis.com, ArcGlobe, ArcGrid, ArcIMs, ARC/INFO, ArcInfo, ArcInfo Librarian, ArcLessons, ArcLocation, ArcLogistics, ArcMap, ArcNetwork, ArcNews, ArcObjects, ArcOpen, ArcPad, ArcPlot, ArcPless, ArcPy, ArcQuest, ArcReader, ArcScan, ArcScene, ArcSchool, ArcScripts, ArcSDE, ArcSdl, ArcSketch, ArcStorm, ArcSurvey, ArcTIN, ArcToolbox, ArcTools, ArcUSA, ArcUSA, ArcWeb, ArcWeb, ArcWord, ArcXML, Atlas GIS, AtlasWare, Avenue, BAO, Business Analyst, Business Analyst Online, BusinessMAP, CityEngine, Community, Community Analyst, CommunityInfo, Community Maps, Company, Esri—The GIS Comp

Other companies and products or services mentioned herein may be trademarks, service marks, or registered marks of their respective mark owners.



Presorted Standard **US** Postage Paid

176036

