ArcNews

Esri | Fall 2017 | Vol. 39, No. 4

Briefly Noted

Celebrating GIS Around the World
GIS Day is Wednesday, November 15. Plan an event, register it, and get promotional resources at gisday.com, or head there to find an event near you.

ArcGIS Online Now More Flexible, Affordable
An ArcGIS Online subscription no longer requires a minimum number of named users, making it more flexible and affordable for smaller organizations to use. Now, users can subscribe to it for however many named users they need. There must be at least one Level 2 named user, however, to manage the subscription.

ArcGIS 10.5 Excels in OGC Compliance
The ArcGIS 10.5 platform has received more than 30 compliance certificates from the Open Geospatial Consortium, Inc. (OGC). These certificates of compliance, which cover a variety of OGC implementation standards, allow users to work more collaboratively both inside and outside their organizations while minimizing the risks of sharing data. Learn more about Esri's commitment to open technology at go.esri.com/OpenSoftware2017.

DigitalGlobe's Imagery+Analytics in ArcGIS Enterprise
DigitalGlobe chose ArcGIS Enterprise 10.5 to deliver its new subscription service for high-resolution imagery and analytics. The service, called Imagery+Analytics, leverages ArcGIS Image Server to let users search, access, and analyze vast amounts of high-resolution DigitalGlobe imagery within their own Esri environments.

ArcGIS Hub: A Catalyst for Creating Smart Communities

New Framework for Government-Resident Collaboration Goes Beyond Open Data

↑ ArcGIS Hub initiatives are focused, policy-driven goals that stem from executive and strategic objectives.

No one cares about a neighborhood as much as the people who live in it. Our communities are where we spend our daily lives—going to work and school, walking our dogs, raising our children, making what often amounts to the largest financial decision of our lives, and sleeping every evening. Neighborhoods are part of an urban tapestry, working together to build diverse, resilient, and livable regions.

Residents and citizens want to actively engage with government to understand policies, share their local knowledge, and improve their communities. There is a tremendous opportunity to use modern technology, combined with the collective knowledge of governments and researchers, to improve constituent engagement.

Esri has worked with communities around the world to figure out what encourages effective governments to work closely with residents, and vice versa. All facets of policy making, people, processes, and technology need to be in balance and aligned to make engagement efforts honest, supported, and successful. So while innovative technology can dramatically improve citizens' access to government and the overall success of such partnerships, it needs to be deployed in a way that supports shared outcomes. That is where ArcGIS Hub comes into play.

continued on page 6

The Science of Where in Action

Users Showcased Incredible GIS Work at the 2017 Esri User Conference

Taylor Shellfish Farms of Shelton, Washington, takes The Science of Where to Puget Sound to sustainably produce Manila clams, Pacific and Shigoku oysters, mussels, and geoduck.

In Canada, Shock Trauma Air Rescue Service (STARS) uses The Science of Where to transport critically ill and injured patients via helicopter.

The Chesapeake Conservancy in Annapolis, Maryland, puts The Science of Where to work to prioritize conservation efforts in the Chesapeake Bay.

And The Science of Where gives Oakland County, Michigan, the ability to share information about topics as diverse as economic development, delinquent taxes, and opioid addiction.

To accomplish all this, The Science of Where must be versatile, agile, and powerful. But what is this science? And from where does it derive its capabilities?

The answers to these questions came at the 2017 Esri User Conference (Esri UC), the largest annual gathering of GIS users in the world. This year's event, held in July in San Diego, California, drew almost 18,000 people from the United States, Canada, the United Arab Emirates, Japan, Germany, Ecuador, and dozens of other countries.

"For this conference, we have a theme called The Science of Where," said Esri president Jack Dangermond as he welcomed the crowd at a packed Plenary Session in the San Diego Convention Center. But the phrase is more than a mantra. Behind the words is a system of understanding driven by science, technology, and people.

"It's the science of geography and the technology of GIS," Dangermond said. "The Science of Where is a framework for applying science to almost everything."

As a "metascience," according to Dangermond, GIS is underpinned by geography, data science, modeling, analytics, visualization, and computer science.

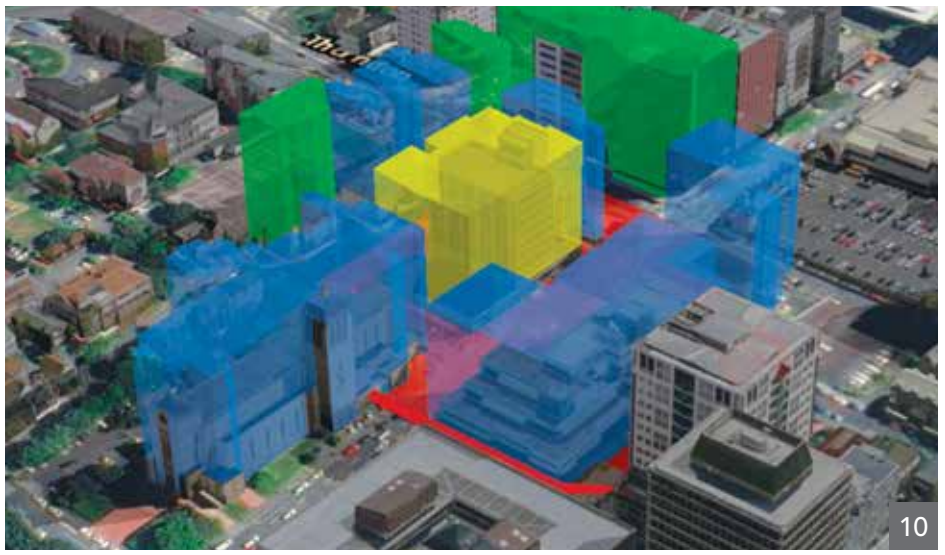
"At its heart, *[GIS]* is a system of insight where we can do spatial analytics, look at relationships, and approach problem-solving in a holistic way," he said.

continued on page 14

↑ Canada's Shock Trauma Air Rescue Service employs The Science of Where to transport critically ill and injured patients via helicopter to hospitals that can treat them. (Photo courtesy of STARS/Mark Mennie.)

ArcNews

Esri | Fall 2017 | Vol. 39, No. 4



Using 3D GIS, the Wellington City Council's Emergency Operations Centre was able to react rapidly to the 7.8-magnitude Kaikoura earthquake that struck parts of New Zealand on November 14, 2016.

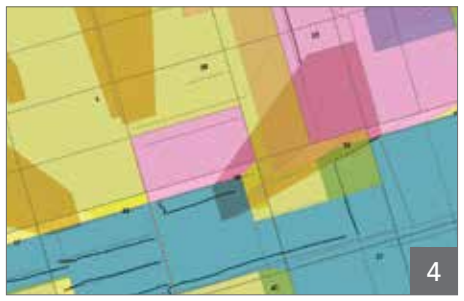


Table of Contents

NEWS

1 The Science of Where in Action
1 Briefly Noted
16 Esri Young Scholars Find the Drive to Do More
37 Coursebooks Go Digital at Esri Training

ESRI TECHNOLOGY

1 ArcGIS Hub: A Catalyst for Creating Smart Communities
3 Unique Innovations Make ArcGIS Pro 2.0 the Most Advanced Desktop GIS Available
24 ArcGIS Online Keeps Blazing Trails

YOUR WORK

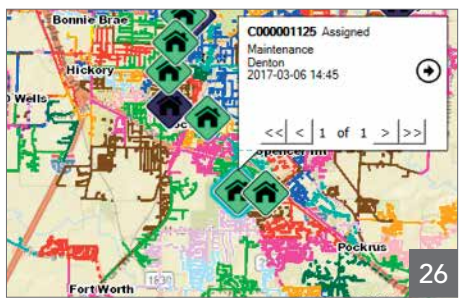
4 3D GIS Simplifies Management of Oil and Gas Leases in West Texas
5 Pinpointing Revenue Loss with Simple Data Visualization
9 Enterprise GIS Helps the Federal Government Compile, Share Housing Data
10 3D Geospatial Data Puts Earthquake Damage into Context
20 Following Ice Storm, City Fixes Tree Hazards in Real Time
22 GIS Field Apps Keep Public Works Department Running Smoothly
29 Web-Based Apps Help Agricultural Producers, Consumers Digest Information
30 Restoring a Watershed, One Bag of Litter at a Time
32 Mobile Technology Keeps Election Day on Track in LA County
33 Automating Inspection Reports with Mobile GIS

GIS PEOPLE

8 Using GIS to Revolutionize Development, from Egypt to the Rest of Africa
12 Preparing for Next Generation 911 Now
17 Helping Youth Form Scientific Habits of Mind
18 New GIS Coding Initiative Engages Girls, Women
34 Can Cartographers *Do* Maps?
35 Esri T-shirt Heroes Take On the World

COLLABORATIONS

7 Open Data Powers Economic Growth in South Bend, Indiana
26 Esri Partners Share Data for Better Results
28 With Street-Level Imagery, Property Reappraisals Go Virtual
35 Esri Press
36 New Training and Certification Offerings
38 Career Opportunities



Executive Editor
Monica Pratt

Editor
Citabria Stevens

Graphic Designer
Takeshi Kanemura

Manage Your *ArcNews* Subscription

To subscribe, unsubscribe, or make changes to your Esri publications, please go to **esri.com/updates**.

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

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.

Unique Innovations Make

ArcGIS Pro 2.0

the Most Advanced Desktop GIS Available

With its professional 2D and 3D mapping capabilities and intuitive user interface, ArcGIS Pro 2.0—the latest version of Esri's next generation, 64-bit desktop GIS software—is technologically ahead of everything else on the market. It delivers new innovations not available in any other desktop GIS and advances visualization, analytics, image processing, and data management. ArcGIS Pro 2.0 is more tightly integrated with the rest of the ArcGIS platform as well. Now is a great time to upgrade.

Highly Requested Workflows

Esri asked ArcGIS Pro users to report their favorite workflows to its engineers, so in ArcGIS 2.0, those workflows are easier and more powerful. Now, users can perform more complete workflows, such as map creation and data management, solely in ArcGIS Pro instead of having to use ArcMap or ArcCatalog.

Other workflow improvements include the ability to create more effective and meaningful maps with grids, which make it simpler to find locations on a map, and annotation, which lets users label features not represented in a feature class (such as a sea in a larger body of water or mountain ranges in imagery). Favorites, an added feature, helps users get started with new ArcGIS Pro projects more quickly by maintaining a collection of their frequently used folder, database, and server connections. Users can also modify topology properties directly in ArcGIS Pro and use the enhanced Traverse tool to improve COGO (coordinate geometry) workflows. Additionally, the Catalog pane now includes widely requested context menu options for importing and exporting data. With this, users can import a feature class simply by right-clicking a geodatabase or feature dataset in the Catalog pane and selecting Import. Conversely, users can export a geodatabase, feature dataset, feature class, table, or shapefile by right-clicking in the Catalog pane and selecting Export.

Unique Innovations

Unlike in other desktop GIS programs, users of ArcGIS Pro 2.0 can now easily explore 3D landscapes with new 3D navigation controls and then sync the views of 3D and 2D maps. For example, if a city planner is creating a 2D map of road closures for a construction project and wants to factor in information that's stored in a 3D dataset (like building and tree heights or underground features), he or she can combine the 3D dataset with the 2D map to present a more comprehensive outlook on how the construction will affect roads and businesses.

3D drawing has also been improved. It now includes feature drawing by camera distance, which allows users to customize the symbology of 3D features based on how far they are from the camera. For instance, features 50 yards away from it can be green, while features 100 yards away can be yellow, and those 200 yards away can be red. Users can also modify individual features this way, making the nearside of a feature one color and the far side another. 3D visualizations are now even more spectacular as well. Esri has enhanced the lighting of 3D objects in ArcGIS Pro by adjusting the position of the point light sources used to simulate the sun when using the Noon at camera position setting.

Additional enhancements include geoprocessing tools only available in ArcGIS Pro, like the Fill Missing Values tool, which replaces null values with estimated ones to minimize the impact of those missing values on subsequent analysis. And embeddable dynamic charts bring a whole new level of understanding to maps by allowing users to interact with charts and see the results instantaneously on the map. Also, a new tool called Create Space Time Cube From Defined Locations lets users generate space-time cubes where attributes change over time but the geography does not, like with environmental monitoring stations.

ArcGIS Platform Integration

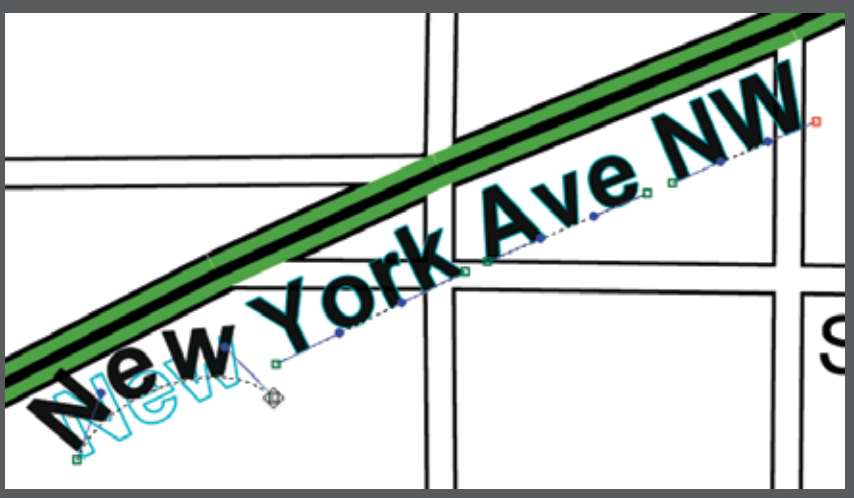
ArcGIS Pro 2.0 works better with the rest of the ArcGIS platform, including ArcGIS Online, ArcGIS Enterprise, and Esri's vast library of ready-to-use apps. To boost efficiency, ArcGIS Pro 2.0 allows users to continue working in ArcGIS Pro while packaging operations are completed in the background.

Cross-platform workflows are now easier and more powerful as well. This version includes enhancements for editing and interacting with the geodatabase in the updated ArcGIS Pro SDK. Users are also able to consume native Open Geospatial Consortium, Inc. (OGC), Web Feature Services (WFS) directly in ArcGIS Pro and sync with feature layers that reference data registered in Portal for ArcGIS 10.5.1. Additionally, vertical coordinate systems are included when sharing web scenes and web scene layers.

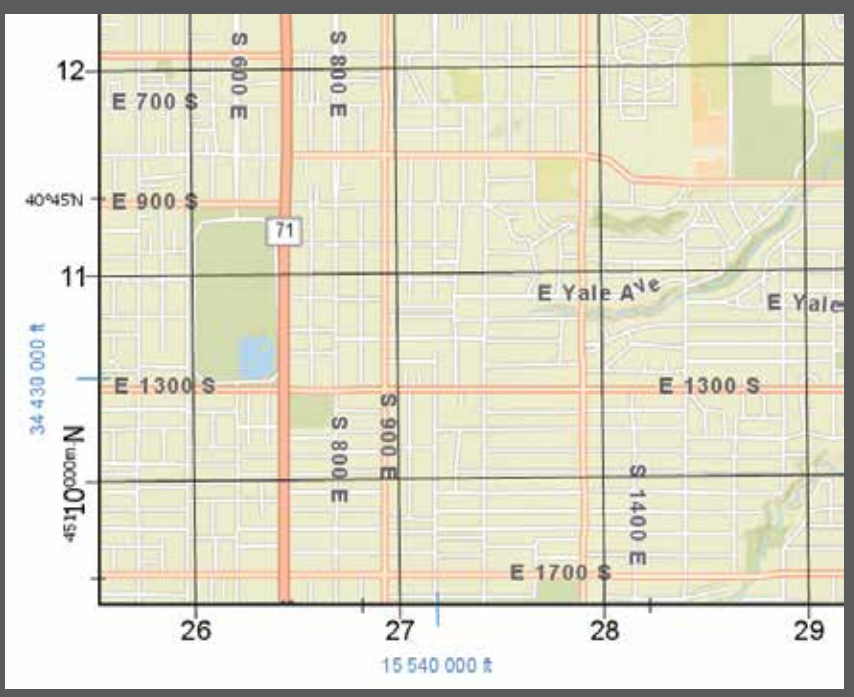
Download ArcGIS Pro 2.0

Head to My Esri at my.esri.com to download ArcGIS Pro 2.0 and upgrade to the most advanced desktop GIS on the market.

↑ With embeddable dynamic charts in ArcGIS Pro, users can interact with their charts and see the results instantaneously on the map.



↑ Annotation lets users label features not represented in a feature class, as well as adjust those labels to fit with the map's design.



↑ ArcGIS Pro 2.0 now supports grids, which make it easier to find locations on a map.

3D GIS Simplifies Management of Oil and Gas Leases in West Texas

With ArcGIS Pro, Analysts Can Easily View Extent of Leased Land Plus Depth of Mineral Deposits

University Lands manages the surface and mineral interests of 2.1 million acres of land across 19 counties in west Texas. Its revenue goes to the Permanent University Fund (PUF), one of the largest university endowments in the United States, that benefits operational and capital improvements for both the University of Texas and Texas A&M University systems.

Since 1923, oil and gas production have been key sources of income for the PUF. University Lands leases its land to companies for oil and gas development and retains royalty interest in production. To ensure that companies' drilling operations were staying inside the boundaries of their leases and that University Lands was receiving accurate royalty payments, analysts from the land and regulatory departments needed to be able to quickly identify oil and gas wells traversing through leases and view perforations (oil and gas extraction points) along that trajectory.

This required having a 3D view of the leased land, including the depths of mineral deposits and the horizontal wells (laterals) being used to extract oil and gas. Since analysts at University Lands were already familiar with using ArcGIS for portions of their work, the organization's GIS team decided that ArcGIS Pro would be the best solution for integrating their workflows entirely.

Viewing 3D Data on 2D Maps

Prior to implementing ArcGIS Pro, land and regulatory analysts at University Lands had to juggle information housed in various repositories. For each well, land analysts would use ArcReader to determine where the well was—and if it was located where it was supposed to be. Then they would scour horizontal directional drilling reports to get the maximum depth of the well and figure out if its owner was drilling in the correct range for its lease. Regulatory analysts would use the measuring tool in ArcReader to determine the locations of perforations so they could validate which lease a company was obtaining its production from.

With ArcGIS Pro, however, analysts in both departments could view 3D data on their 2D maps without having to open another application. The program's ribbon interface is contextual, giving users the tools they need when they need them. And ArcGIS Pro has seamless panning, zooming, and labeling, which enables the University Lands analysts to visually inspect the leases and laterals faster than they could have before.

To implement ArcGIS Pro, University Lands GIS analysts Ray Jimenez and Ben Kennady converted the lateral data from CSV files into layers that can be viewed in 3D scenes. They used Python scripting along with ArcPy, a Python site package, to display the leases and laterals in 3D in ArcGIS Pro. The scripts allowed the land and regulation analysts, who were only moderately familiar with GIS, to incorporate a focused view of data into their current workflows. Finally, the subsurface data was displayed in an ArcGIS Pro scene so that analysts could examine the leases and well laterals in a 3D environment, using just one program.

The Benefits of Retaining IT Infrastructure

Now, analysts from University Lands' land department can better assess whether companies are operating within their leased land agreements, and the organization's regulatory and accounting departments can ensure that companies are reporting their production figures accurately.

"ArcGIS Pro easily integrated into our existing enterprise GIS system and gave us the 3D view we needed while saving us the cost of purchasing a new software solution," said Jimenez.

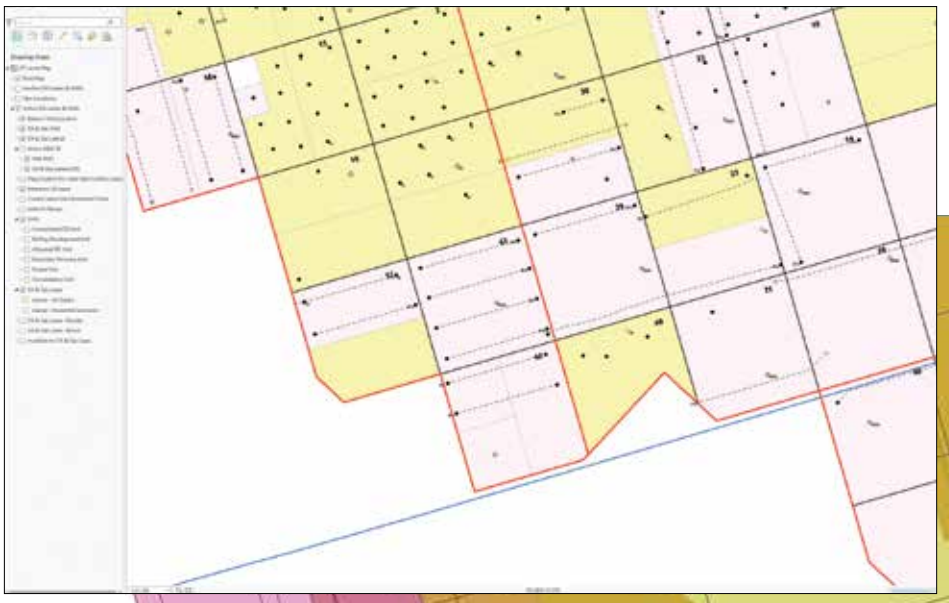
Implementing ArcGIS Pro allowed University Lands to maintain the IT infrastructure it was already using while enhancing some of its most important workflows. The GIS team only had to train users on how to look at and narrow the focus of the data in ArcGIS Pro, since the interface was different from what they had used before, rather than teaching them a whole new suite of technology. And sticking with the ArcGIS platform is making subsequent development of the tools pretty simple.

"We have future plans to include more 3D data, like oil and gas formations, so users can view wells in the target formation," said Jimenez. "That would expand our *[ArcGIS]* Pro use to our geology department."

The GIS team is also looking to include a tool in ArcGIS Pro that breaks up laterals where they intersect with lease lines so University Lands can measure the length of the lateral in each lease.

"This will make regulatory analyst jobs even easier so they don't have to measure out the lateral themselves," added Jimenez.

For more information on how University Lands implemented ArcGIS Pro, email Jimenez at gis@utsystem.edu.



← Analysts use ArcGIS Pro mostly to view wells, laterals, and leases. This map shows them in 2D.

→ This map shows the wells, laterals, and leases in 3D, making it easier to see the depths of the mineral deposits and the horizontal wells (laterals) being used to extract oil and gas.

Pinpointing Revenue Loss with Simple Data Visualization

Utility in Alabama Zeroes In on Clusters of Dead Meters Using Insights for ArcGIS

Opelika Utilities in Opelika, Alabama, serves nearly 20,000 customers. Its mission is to determine the current and future water needs of Opelika's citizens and industries while ensuring that its water sources, facilities, and staff continually provide pure and plentiful water.

With a view to improve its operational efficiency, Opelika Utilities began taking a closer look at where it was losing revenue and how it could increase earnings more effectively. While many utilities are concerned about water loss due to leaky infrastructure, this is not a major issue for Opelika Utilities, since its infrastructure-based water loss is well below industry standards. Instead, Opelika Utilities' primary concern was dead meters—meters that are either broken or not reporting accurate usage. The utility had no way of knowing how vast its dead meter problem was, though, until it assembled all its data in Insights for ArcGIS and visualized some unexpected patterns.

Transitioning from Manual to Automated to Easy

For years, Opelika Utilities had employed a manual process to identify potential dead meters and extremely high and low monthly meter readings, which often indicate leaks or meters that aren't tracking water being used. Once a month, an office-based team member would spend a day reviewing the meter reports, painstakingly combing through 14,000 daily readings in Microsoft Excel, line by line. Unsurprisingly, a significant amount of information likely got overlooked. Opelika Utilities needed an easier—and automated—way to review its meter readings, analyze them, and generate work orders so that nonoperating meters could be attended to.

In 2016, Opelika Utilities teamed up with Esri partner GISinc to connect its billing system to the Cityworks solution (which it was already using) and GIS. To collect, filter, and aggregate data, the team used Python scripts along with ArcPy, a Python site package, to develop a mostly automated way to comb through meter reports and find discrepancies in readings. With this scripting process, Opelika Utilities was able to simplify its meter inspection and work order processes, leading to an increased annual revenue of about $100,000. But the scripting process was demanding on the hosted servers, and maintaining and modifying the scripts took a lot of time and effort.

By April 2017, Opelika Utilities was ready to make dead meters easier to identify. Armed with hundreds of thousands of records on service connections, meter usage, work order history, and more, Opelika Utilities and GISinc put all this data into Insights for ArcGIS.

Discerning Patterns in Dead Meters

This web-based data analytics workbench made it simple to visualize the results, which were eye-opening—so much so that Opelika Utilities' general manager, Dan Hilyer, almost fell on the floor. Out of 14,000 meters, more than 3,000 (between 20 and 25 percent) were dead. This translated into an estimated $25,000-per-month loss in revenue, or $300,000 per year.

"It's information that no manager wants to hear, but information that we need to know," said Hilyer.

This was a much higher loss than Opelika Utilities had expected. The company's capital projects manager, Alan Lee, knew there had to be a larger problem. Thankfully, with Insights for ArcGIS, Opelika Utilities could do further analysis to discern patterns in dead meters and identify specific manufacturers, model numbers, and when meters were installed. It turned out that most of the issues were occurring in meters from a single manufacturer that were being installed in new developments. The good news was, all the problematic meters were still under warranty. So replacing the majority of the dead meters would cost Opelika Utilities nothing in equipment.

"Insights for ArcGIS gives *[the]* end user the power to filter data and see results without the requirement of being a computer programmer or Python scripter," said Lee. "Once the data is connected, it's all plug and play—a very powerful software."

As Opelika Utilities continues to replace the dead meters, some of its next steps include working with GISinc to enhance the results by integrating them with Operations Dashboard for ArcGIS to show progress, Collector for ArcGIS to assist with field collection, and Cityworks to automate the work order process even more. Additionally, Opelika Utilities is identifying the next big question it wants to ask and analyze data for using Insights for ArcGIS.

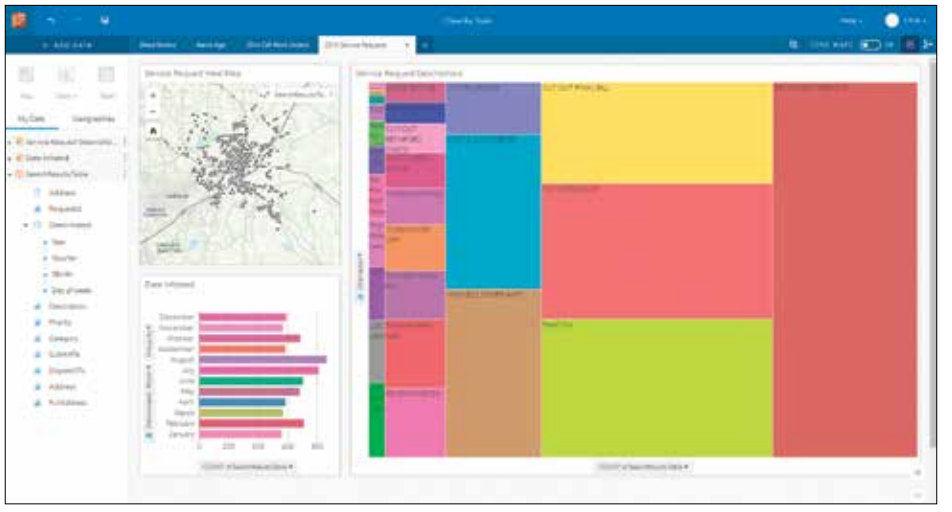
"*[This illustrates]* what can happen when you combine powerful technology from Esri with the desire to improve operational efficiency and a vision of location-enabled business," said Kevin Stewart, director of state and local sales at GISinc.

Identifying and Curbing Revenue Loss

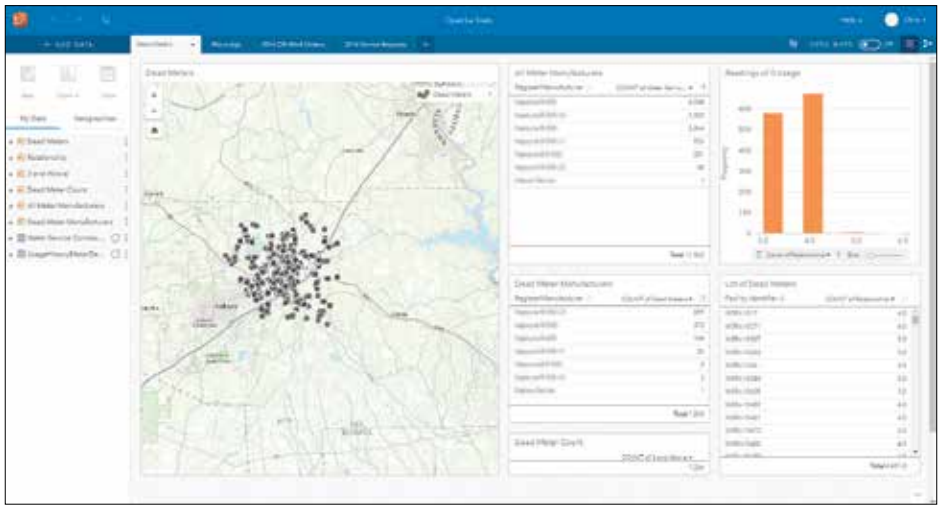
At some point, every meter will stop working due to manufacturer defect, age, or damage and require maintenance or replacement. The power of being able to connect meter usage with billing and service requests can help utilities identify the extent of their equipment problems. And with Insights for ArcGIS, the process can be replicated repeatedly, meaning that utilities can use the technology to identify and curb all issues causing revenue loss.

For more information, email Lee from Opelika Utilities at alee@owwb.com or Stewart of GISinc at kevin.stewart@gisinc.com.

To see how to put Insights for ArcGIS to work in any organization, watch a collection of demonstrations at go.esri.com/Insights-Fall17.



↑ With Insights for ArcGIS, Opelika Utilities was able to identify extremely high and low monthly meter readings, which could indicate dead meters.



↑ Insights for ArcGIS helped the utility see that most of the problems were occurring in meters from a single manufacturer.

ArcGIS Hub: A Catalyst for Creating Smart Communities

continued from cover

It Starts with a Goal

Open data is a global movement to share authoritative information that is public and reusable to drive economic development, improve government efficiency, and increase stakeholder engagement. ArcGIS Open Data enables any organization to quickly and freely share its data—both geospatial and tabular—in common, open formats with a simple user experience on officially branded websites. More than 8,000 government, nonprofit, and commercial organizations use ArcGIS Open Data to provide open information to their constituents and customers.

In working with many government staff members, research groups, and communities on ArcGIS Open Data, Esri learned both the benefits and shortcomings of open data policies. Governments often ask which pieces of data they should release first and how they can know that their open data is actually being used to improve livelihoods or businesses. And while citizens, researchers, and businesses want up-to-date, authoritative information to improve their awareness and decision-making, they often don't know which data will be the most useful until they know what data their governments can make available.

By itself, open data is a great set of principles, but the concept often lacks focused goals or expected outcomes. Open data is much more effective when it is driven by strategic priorities and empowered to measure outcomes for improving engagement on specific, constituent-centered benefits.

In July, Esri introduced ArcGIS Hub, a new two-way engagement platform that truly connects government and citizens. ArcGIS Hub includes tools for managing open data and introduces a new framework designed to prioritize initiatives, organize data and teams, measure the progress of key performance indicators, and empower the community to understand complex relationships with explorative analytics and infographic reports. ArcGIS Hub goes beyond open data. It is a catalyst for creating smart communities.

Initiatives Provide Structured Engagement

ArcGIS Hub initiatives are a new concept and capability of ArcGIS. They are focused, policy-driven goals that come straight out of executive and strategic objectives. Vision Zero, for example, is a global initiative to prevent traffic-related deaths and life-altering injuries. The goal—to have zero traffic-related deaths—is clearly identifiable as an important and measurable metric. Everyone has a vested interest in accomplishing this target, and as a result, groups are motivated and focused on how they can work together to achieve this outcome.

The platform recommends specific tools and apps to use to help citizens engage with particular initiatives. Esri Story Maps apps, for example, inform the public about the current state of affairs related to an initiative and what the government is doing to achieve associated goals. Surveys gather initiative-related information and feedback from the public and internal stakeholders. And dashboards with analytics measure progress toward accomplishing the initiative's objectives. These tools are brought together for the public to view and use in dynamic and mobile-responsive ArcGIS Hub initiative web pages, which allow users to learn about an initiative's goal, interact with data and maps, and provide input. They also recommend ways to engage with the government.

Initiatives in ArcGIS Hub help governments prioritize the data they need to power tools, apps, and analyses that optimize policies and actions and generate better outcomes. The Vision Zero ArcGIS Hub initiative, for example, uses common collision report data indicators and street infrastructure data that most cities have. With ArcGIS Hub, cities can provide this data in a simple user experience that makes it easy to configure maps, apps, surveys, and dashboards with compelling cartography and eye-catching charts. Cities can build surveys for garnering public input on unsafe road conditions or build an app that allows users to view the most dangerous intersections in a city. This ability to unlock the informative power of data enables everyone—from staff members in the transportation and planning departments to educators, law enforcement officers, and business executives—to work from the same data and gain new perspectives.

In addition to aiming data and apps at a specific goal, ArcGIS Hub initiatives can help governments better coordinate their own work and invite other organizations, such as civic advocacy groups, to cohost events, gather new data, perform analysis, and collaborate with tech developers to devise creative solutions to issues. Discussion and feedback from the community are captured through ArcGIS Hub conversations, which are forums to track public feedback, government responses, and ArcGIS Hub initiative team actions to ensure that everyone is working together toward the initiative's goal.

ArcGIS Hub includes a growing gallery of initiative templates for prominent issues, such as Vision Zero, addressing the opioid crisis, and preventing vector-borne disease outbreaks. Organizations can also create their own custom ArcGIS Hub initiatives that identify and standardize new processes and goals. These initiatives can be repeatedly launched within an organization (at each school in a school district, for example) or shared with other ArcGIS Hub municipalities so that hubs around the world can adopt and adapt them for their own needs.

Become a Smart Community

If a government is going to be "of the people, by the people, for the people," as US president Abraham Lincoln famously expressed during the Gettysburg Address, then open government—with open data—is one way to precipitate that. ArcGIS Hub extends enterprise GIS beyond government circles, providing organizations, businesses, and citizens with equitable access to data, analysis, and opportunities for cooperation.

The road to successful community collaboration begins with sharing data and implementing open data best practices. Then, find the executive leadership that will prioritize community-centered initiatives and seek out the advocacy groups that are ready and willing to collaborate. Finally, connect with Esri at esri.com/hub to learn how to create a smarter, more engaged community with ArcGIS Hub.

For Vision Zero, a global initiative to prevent traffic-related deaths, cities can build surveys to find out about unsafe road conditions or build an app that lets users view the most dangerous intersections in a city.

Open Data Powers Economic Growth in South Bend, Indiana

ArcGIS Hub Early Adopter City Aims for Vitality, Transparency, and Engagement

With a population of just over 100,000 residents, South Bend, Indiana, is best known for the University of Notre Dame; its young mayor Pete Buttigieg; and as the one-time headquarters of the Studebaker Corporation, a now defunct American automaker.

Although the city has faced challenges familiar to other areas in what is known as the Rust Belt, where manufacturing used to dominate, South Bend is now thriving because of recently successful economic development and revitalization projects.

The South Bend city government focuses on providing residents with high-quality services at the greatest value to taxpayers. And residents have widespread confidence that the city successfully manages the fundamentals. Staff members work to gather input from citizens while providing clear and transparent indications of how the government uses public resources. For this transparency effort, South Bend uses ArcGIS Open Data to share plans, decisions, and projects with community members. And soon, the city will transition to ArcGIS Hub.

One of South Bend's major projects, the Vacant and Abandoned Properties initiative, set aside 1,000 days in which to either rehabilitate or demolish 1,000 abandoned houses throughout the city. In partnership with the City of South Bend, the Urban Enterprise Association of South Bend Inc. offered the Vacant to Value (V2V) Repair Grant Program, which provided matching grant funds of up to $10,000 to repair vacant and abandoned properties located within the City of South Bend. South Bend took action on 1,122 vacant or abandoned properties by its deadline, with a repair rate of nearly 40 percent.

ArcGIS Open Data was so valuable in communicating initiative results that the City of South Bend is currently transitioning to ArcGIS Hub as an early adopter. With ArcGIS Hub, South Bend will be able to further its community engagement efforts by providing a central location where citizens can rally around initiatives and access relevant open data.

Following the Vacant and Abandoned Properties initiative, South Bend is working to engage the public on what should be done with vacant parcels. René Casiano, director of applications for the City of South Bend's department of innovation and technology, performed suitability analysis to determine how vacant lots could be better used to drive growth and stability in neighborhoods. His analysis included county parcels, code enforcement violations, permitting, lidar, topology, and property value information.

Land parcels could become pocket parks or gardens. Neighbors could be allowed to purchase the land. Or they could support the local environment by becoming a rain retention parcel to help maintain creek levels, a tree nursery to anchor soil, or a small monitoring station for environmental studies or smart city tech hubs. Through ArcGIS Hub, South Bend residents will be able to visualize proposed ideas and provide live feedback.

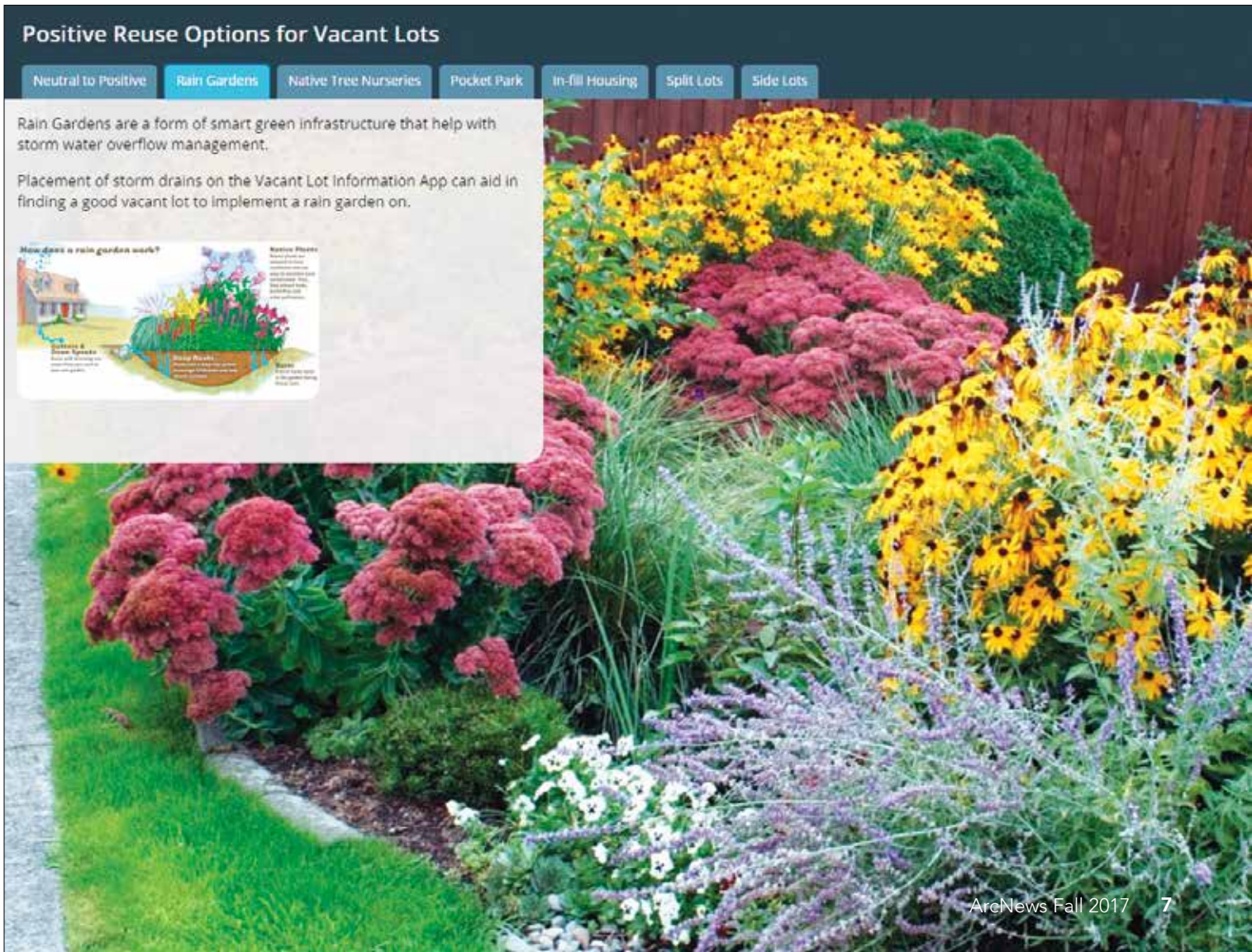
"We used the analysis at neighborhood meetings to work with residents and see which best-use land options they would like to see in their neighborhood," Casiano explained. "The community part of this is key. While we might think that physical characteristics lend the land to one use, the neighborhood members might need a completely different use. Since they live there, it is very important to get their input."

↑ South Bend residents will be able to use ArcGIS Hub to visualize proposed ideas and provide live feedback.

Casiano sees ArcGIS Hub as a way for citizens to become greater stakeholders in their future. "ArcGIS Hub and ArcGIS Open Data strengthen the city's transparency efforts by enabling everybody to participate in data-driven discussions about public policy," Casiano said. "The community section of ArcGIS Hub offers a digital platform for residents and the city staff members to discuss our public policy, either through open data or other initiative information."

By helping users put open data into the context of top priorities, ArcGIS Hub enables governments and communities to work together on policy initiatives that tackle pressing issues. Current ArcGIS Open Data users will still have access to the same open data functionality and capabilities they had before but will now manage those capabilities through ArcGIS Hub.

To learn more about ArcGIS Hub and find out how to get started with it, visit esri.com/hub.



→ ArcGIS Open Data was so valuable in communicating the results of its Vacant and Abandoned Properties initiative that the City of South Bend is transitioning to ArcGIS Hub as an early adopter.

Using GIS to Revolutionize Development, from Egypt to the Rest of Africa

GIS Hero

↑ The Geospatial Platform for Food and Nutrition Security

For Menghestab Haile, GIS is about transforming development.

"GIS will accelerate development—if we can manage to make it understandable for decision-makers," he said.

To him, leaders are the key to precipitating progress. "If you really want to make a difference in a country or on a continent, you really need to have the decision-makers on board," he added.

But across Africa, where Haile has focused his career, many governments don't have the information they need to make informed decisions.

"So you *[have to]* link the right information with the right decision-makers at the right levels and with the right amount of detail," he said. "For me, that is what GIS does."

As the country director and representative for the World Food Programme's (WFP) Egypt Country Office, he is in a prime position to link leaders to GIS. And that is exactly what he is doing.

Working in partnership with Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS)—which collects, processes, analyzes, and disseminates all statistical data in Egypt—and Esri Northeast Africa (Esri NeA), Haile is leading the development of a Geospatial Platform for Food and Nutrition Security. But this is just where his vision begins.

"It's not only a project," said Haile's colleague Alaa Zohery, a senior information manager associate of GIS at WFP and one of the engineers who helped build the platform. "It is an innovation. It is something really new."

Much of WFP's work in Egypt revolves around promoting good nutrition, and a lot of its projects focus on capacity building. Egypt's government has strong technical capabilities, but Haile noticed that ministries and other organizations were apprehensive about sharing their data—including CAPMAS, which has the largest amount of and most authoritative data in Egypt.

"Their biggest challenge was fear of losing control of their data," said Haile. So he enlisted Esri NeA to show CAPMAS how it could share its data while still protecting it.

"Through that partnership, we basically built the confidence of the government that we were not exposing their data and *[that]* they were in control of it," he said.

Now, CAPMAS is central to Haile's goal of getting information into the hands of decision-makers, starting with data on food security. The statistical organization currently houses its public-facing data on the geospatial platform, which officially launched in November 2016. And by the end of this year, Egypt will have released its first-ever paperless census on the portal. This means that anyone—scientists, statisticians, researchers, and government staff members—can access data from CAPMAS and the census and use it.

"Census data usually takes two years to analyze before it is shared," said Haile. "Now, it takes two months."

"The ultimate objective is to empower whole segments of society by disseminating the statistics and information and by improving this sort of dissemination using very attractive and very informative tools, such as GIS tools," explained one of Haile's key partners in this venture, Dr. Mohamed Ramadan, the research and development adviser to the president of CAPMAS.

Now that the data and technology are in place for the geospatial platform, allowing anyone to analyze the drivers of food and nutritional insecurity, the next phase of the project is to get more government ministries involved in data sharing.

"We have proved that we have the technology," said Haile. "Now, we will create other portals for other ministries."

Each portal will address the needs of the individual ministry. But by following a similar setup as the Geospatial Platform for Food and Nutrition Security, the team will ensure that the various portals are compatible. This will make it easier for the different ministries to work toward common goals, such as achieving the Sustainable Development Goals (the United Nations' current agenda for eradicating poverty and safeguarding the planet).

And that gets to the heart of the project: to foster government-to-government linkages across Egypt and, eventually, share this model with other countries around Africa.

"I am demonstrating what can be done at a country level, which can be upscaled to other countries," said Haile.

"From the first time *[we talked]*, it was *[Haile's]* point of view that we should share our experience with other countries, especially other African countries," said Ramadan. "And we expressed our 100 percent readiness for that."

Haile and his colleagues at WFP and CAPMAS have already hosted a delegation from Ethiopia that wanted to see how the paperless census was going to work. He has also targeted other countries—including Nigeria, Cameroon, Mali, Malawi, and Botswana—as the next batch of African countries that could revolutionize development by connecting their data to location and getting it in front of decision-makers.

"My view is, if we work together, then we can work with the decision-makers at the biggest level—at the African Union level," said Haile.

→ Menghestab Haile

With his technical expertise in GIS and experience living and working in other African countries, it seems that Haile has been building up to this all of his professional life.

Originally from Ethiopia, he studied physics as an undergraduate and received his PhD in climate science from the University of Reading in the United Kingdom. While there, he was trying, as he put it, to figure out how to be useful in Africa.

"In most places *[in Africa]*, you don't have observation on the ground," Haile said, because of geography, poverty, lack of infrastructure, conflict, and the like. So he decided to integrate satellite data with model-generated meteorological data and weather forecasts to make climate studies in Africa more feasible.

"I found that to integrate the satellite data with the model data, you needed GIS capabilities," he recalled.

Following graduation, he worked at the university as a research fellow before returning to Ethiopia to use GIS to help the government modernize its early warning system, which monitors the climate, weather, and a country's food situation to predict drought and ward off famine. From there, he went to Kenya to help the Intergovernmental Authority on Development's (IGAD) member states strengthen their remote-sensing applications for food security early warning and environmental monitoring systems.

Haile then made his move over to WFP, where he became the head of its Vulnerability, Analysis, and Mapping (VAM) unit in Sudan, helping the government build its technical capacity to monitor food security. Then he went to WFP's headquarters in Rome, where he led the GIS and remote sensing section of the VAM unit.

From there, Haile went back to Ethiopia as the deputy director of WFP's Africa Office in Addis Ababa, where he focused on policy analysis, resource management, and again on capacity building.

"It is here that I really saw the weaknesses that governments have," he recalled. "Basically, you have decision-makers that…don't have the information that is required to make informed decisions."

When Haile got to WFP's Egypt office, where he spent two years as the deputy country director before becoming the country director, he was finally in a position to connect data directly to the leaders who need it.

"Now, I am a decision-maker and have the resources to say what we will focus on, while at the same time, I have the technical understanding to actually demonstrate how policy decision-making and technical capabilities can work together to help leaders deliver on their objectives," he said.

Haile is trying to get governments to see that GIS is not a luxury.

"I want to make sure that GIS and data and remote sensing are all part of *[government]* budgets," he said, because he believes it is critical for governments to understand geography so they can fully comprehend what is affecting people in their countries and regions.

"But a lot of leaders don't know that," he lamented, before adding: "Here in Egypt, I am proving how important it is. All the ministers I talk to now want me to work with them."

And Egypt wants to contribute its knowledge and know-how from the Geospatial Platform for Food and Nutrition Security project to the rest of the African continent. Which is certainly a win for Haile.

"This is much bigger than me or than Egypt," he said. "In the end, we are talking about development transformation."

Enterprise GIS Helps
the Federal Government Compile, Share Housing Data

The US Department of Housing and Urban Development (HUD) has a mission to build durable, inclusive communities and provide quality homes for low-income families and individuals. In pursuit of these objectives, HUD collaborates with communities across the United States to establish job-generating economic development projects.

To meet high demand for information about these projects and make its data easily accessible, HUD works with Esri partner VSolvit to develop and maintain an enterprise GIS (eGIS). Building on the data it houses in ArcGIS Server, HUD can easily manage this data, generate intelligent maps, and create interactive web apps and dashboards.

Members of Congress often request reports from HUD to see how the department's money flows through their districts and to check up on local HUD projects. Recently, HUD launched the Community Assessment Reporting Tool (CART) to answer the frequently asked question, How is HUD investing in my community? Using any device, representatives' staff members can simply go to CART, type the name of a location into the GIS web app, and see the housing funds allotted to that community, the dollars spent on rental assistance, information on mortgage insurance programs and other insurance-related data, community development blocks, poverty levels, and more.

From Hours, Days, or Weeks to Now

Before HUD launched CART, the department's staff spent many tedious hours manually creating reports. If a member of Congress asked to see entitlements in his or her district, a HUD field analyst would begin the process by asking local communities' planning and development offices for data on area HUD investments. Then, the analyst would pull up two additional data layers—one that showed the area of the entitlement jurisdiction and another that showed the congressional district—on a map to see where the two intersected. The analyst would populate that area with the entitlement data and, finally, send the map to the requester. This process usually took hours or days—and sometimes even weeks.

Now, CART does all the work. Built with ArcGIS API for JavaScript, it automatically compiles the agency's program investments at five geographic levels: city, county, state, metropolitan statistical area (MSA), and congressional district. Drawing on the most recent data, the CART web app displays the information in a dashboard with a map, a chart, and a table. Users can jump from tab to tab to view the different ways HUD invests in a community.

And CART isn't only a tool for congressional staff. It is public facing as well, accessible via HUD's eGIS Storefront at https://egis.hud.gov, a portal that makes the agency's authoritative datasets available and easy to find and that also houses all the department's external and internal apps.

Citizens can use CART to see how much funding is available for projects in their neighborhoods, find out the occupancy of a specific public housing project, discover which HUD funds are available to their communities, and look up HUD investments based on congressional district. With access to this information, citizens can better engage with their representatives on matters that concern them and their neighborhoods.

What's more, CART is available to each of HUD's 18 program offices and 64 field and regional offices. This enables staff at any location to access HUD's eGIS information and answer questions for stakeholders on behalf of the agency.

Consistent Data, Future Development

CART takes data from different sources, people, and agencies, such as the US Census Bureau, the American Community Survey, nongovernmental organizations, federal employees, and contractors. It also draws data from HUD's internal systems, such as the Inventory Management System, the Tenant Rental Assistance Certification System, and the Homelessness Data Exchange. Data providers update their contributed data quarterly, annually, or simply as needed.

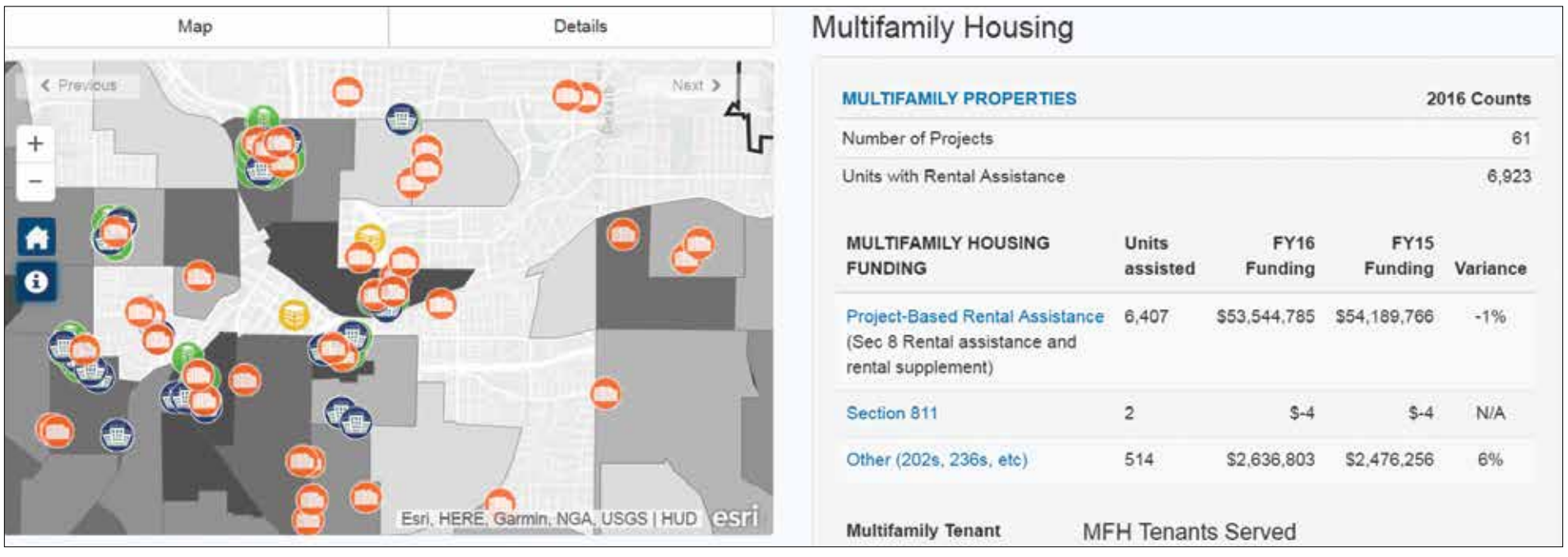
The eGIS program team conditions this varying administrative data by geocoding it with time and space features. To ensure that map outputs and reports are consistent, all data must comply with HUD's standards. These requirements ensure that the data in CART is accessible and compatible with other data so that users can generate accurate analyses.

To make CART even more useful, the team is exploring new avenues for the app, such as how to summarize and visualize HUD program data for other geographic levels. Adding American Indian and Alaska Native jurisdictions, for example, would help people understand how HUD is investing in tribal communities.

Additionally, in giving demonstrations of CART to congressional staff, HUD employees have had the opportunity to think more broadly about how other enterprise-wide GIS apps could benefit the agency and its constituents. One possibility is disaster support. After a natural disaster such as a flood, various agencies and people want to know what HUD investments are in the affected area and which assets were damaged. Disaster recovery managers, for example, could use the analysis capabilities of eGIS to answer these basic questions, inform decision-makers about the situation, and help victims get back on their feet.

Satisfying Stakeholders and Meeting Citizens' Needs

With CART, HUD can deliver better intelligence to all stakeholders and manage its funding more efficiently. HUD is now meeting Congress's need for information in an easy-to-understand format that is useful for allocating housing allowances, evaluating community needs, and communicating with citizens.



↑ The Community Assessment Reporting Tool (CART), from the US Department of Housing and Urban Development (HUD), answers the question, How is HUD investing in my community?

3D Geospatial Data Puts Earthquake Damage into Context

New Zealand's Wellington City Council Relied on the ArcGIS Platform to Quickly Collect Data, Make Decisions

Just after midnight on November 14, 2016, residents on both the south and north islands of New Zealand were awakened by a 7.8 magnitude earthquake. The Kaikoura earthquake was one of the most complex earthquakes ever recorded, with 21 fault lines rupturing over about 110 miles (180 kilometers).

New Zealand's capital of Wellington experienced considerable damage. Windows shattered in high-rise buildings, and plaster and masonry fell onto the streets. In the immediate aftermath of the earthquake, the Wellington City Council was under pressure to cordon off the city.

To evaluate the damage and react to a rapidly changing environment, the council had to mobilize fast. Building assessments had to be done under extreme conditions—in high winds and torrential rains—and quick decisions had to be made to get transportation, infrastructure, and the city's port operating normally again. The mayor, councillors, and senior government officials needed to be briefed with comprehensive, real-time information so they could make sound decisions and communicate effectively with the public to avoid loss of lives.

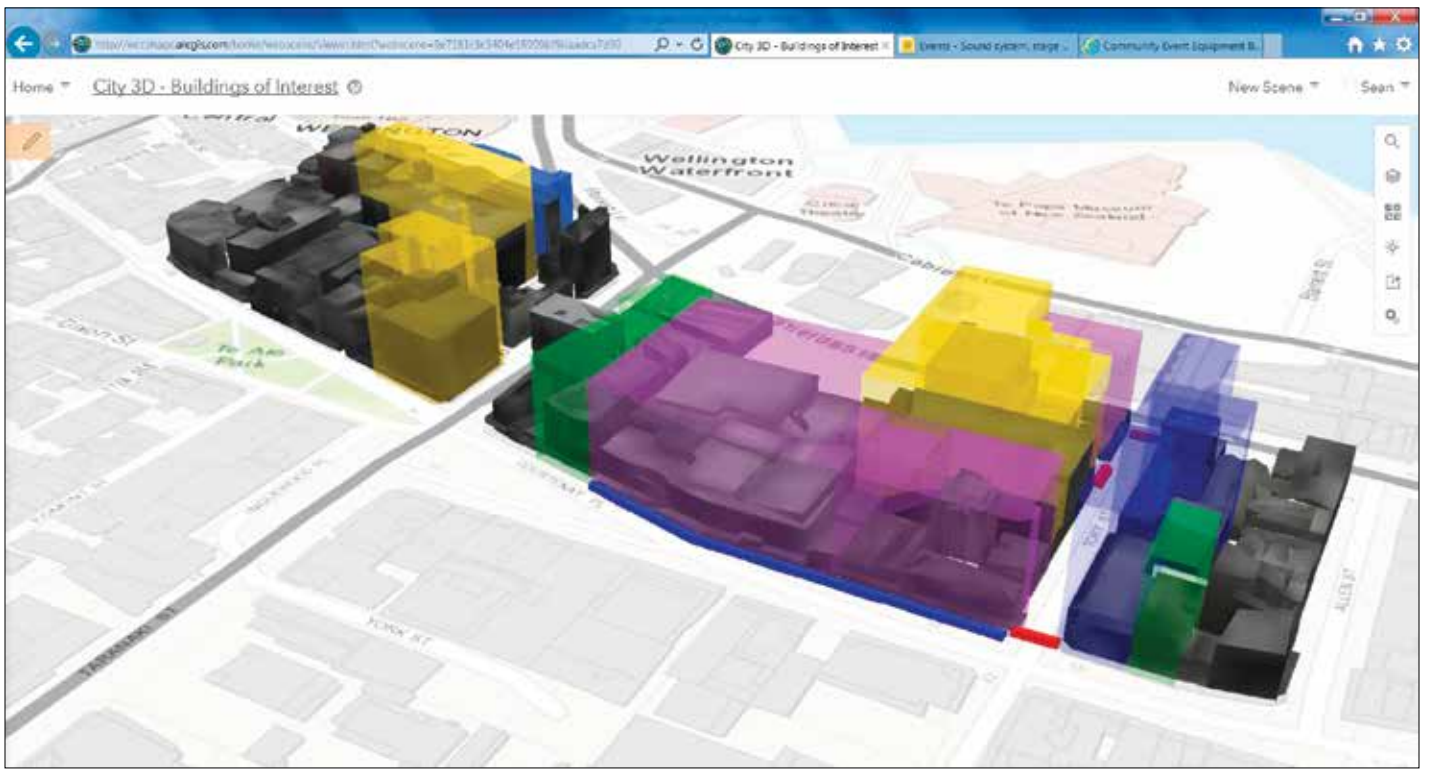
Geospatial data became an important unifier, and the ArcGIS platform allowed emergency crews on the ground to swiftly gather information and easily share it with officials who were briefing city leaders and the media. This helped the Wellington City Council figure out what was happening throughout the city and make key decisions on whether or not to evacuate citizens, close streets, and demolish buildings.

Understanding the Earthquake's Effects

Following the earthquake, the Wellington City Council's Emergency Operations Centre (EOC) was responsible for sharing current information with special council teams, government agencies, and other organizations. To evaluate what was happening around the city and analyze, communicate, and act on these updates, the EOC used 3D building and terrain data in conjunction with geospatial tools supplied by Eagle Technology, Esri's official distributor in New Zealand.

"Geospatial *[technology]* was our means of understanding our city, what was happening to it, and the effects that the earthquake and our responses were having," said Sean Audain, the innovation officer for Wellington City Council.

To rapidly collect the first wave of information from the field, the Wellington City Council's



↑ Using web scenes in ArcGIS Online, the Emergency Operations Centre (EOC) put safety zones into context so decision-makers could see which other areas needed to be blocked off and which parts of the city could remain open.

→ The EOC used Esri Story Maps apps to share information with the public and keep everyone informed about tsunami evacuation zones, road closures, and more.

local hosts (city workers who help tourists and homeless people and assist with events) used Survey123 for ArcGIS to record damage throughout the city and requests for assistance from citizens. Additionally, building inspectors used Collector for ArcGIS to record their building assessments, documenting the damage and indicating whether buildings had internal and/or external safety concerns. Working with the people collecting this field data, as well as local utilities and other asset owners, the council's GIS analysts produced 3D visualizations of the data to showcase a realistic view of the destruction's extent throughout Wellington and the potential problems that lay ahead for residents, infrastructure, and the economy.

At the EOC's headquarters, GIS analysts used web maps and web scenes in ArcGIS Online to create a common operating picture that could both be tailored to individual teams and feed into the entire emergency operation. They also created Esri Story Maps apps to communicate with a range of agencies—including New Zealand's central government, the regional emergency management office, the fire department, and urban search and rescue—that were also working to mitigate the earthquake's damage.

With all this data displayed in real time, 3D scenes became vital for calculating safety zones—cordoned-off areas around unstable and collapsing buildings. It also allowed the EOC to put these zones into context so decision-makers could view the surrounding streets to see what else needed to be blocked off and which areas could remain open for public use. When possible, the EOC used configurable story maps to share its information with the public to keep everyone abreast of tsunami evacuation zones, road closures, affected transportation services, the locations of emergency water supplies, and more.

Progressing from Response to Recovery

With real-time access to more accurate information, the Wellington City Council could be proactive rather than responsive in managing the aftermath of the Kaikoura earthquake.

"By having a stable, durable way of storing, analyzing, and communicating data, we…managed to transition smoothly from response to recovery," said Audain.

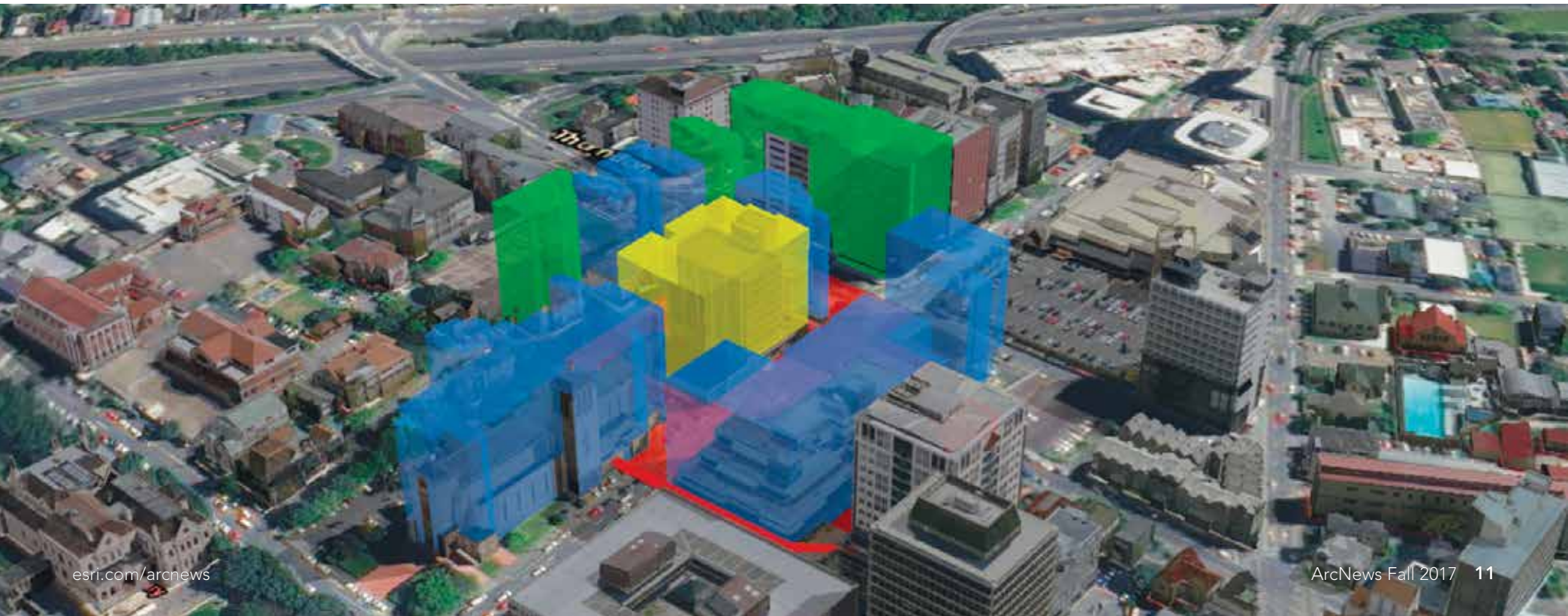
As aftershocks rolled through, Audain and his team overlayed the incoming earthquake damage data onto bedrock and soils maps to visualize how vulnerable certain areas and populations were to additional destruction, since soft soils shake more than hard rock. With that information, they and the city's emergency controllers were able to brief government ministers, the mayor, and councillors on how to deal with the earthquake's immediate aftermath, as well as make well-informed plans for recovery. Thus, even though the environment in Wellington was changing rapidly, senior city council officials had the confidence to make tough decisions quickly.

Ultimately, the Wellington City Council decided that cordoning off and closing the city's entire central business district was not necessary. This prevented a potentially enormous disruption to daily life in Wellington. Had such a critical part of the city been cordoned off, Wellington would have suffered overwhelming logistical issues and damaging economic deficits, and the community likely would have lost an important feeling of ownership in dealing with the aftermath of the earthquake. Instead, thanks to geospatial information and the ArcGIS platform, the city took a more focused approach to managing this emergency: city building inspectors evaluated over 1,600 multilevel commercial and residential structures, infrastructure teams cordoned off individual streets, welfare teams only evacuated residents in affected areas, and contractors swiftly demolished severely damaged buildings.

"When bad things happen to good people, quick and accurate information is gold for those people, for decision-makers, and for the media," said Mike Mendonca, chief resilience officer for the Wellington City Council. "In the longer term, geospatial *[data]* can also help tell the story that supports determining the future of our city."

For more information on the Wellington City Council's immediate and extended response to the Kaikoura earthquake, contact Audain at sean.audain@wcc.govt.nz.

↓ The Wellington City Council was under pressure to cordon off the city's entire business district, but using the ArcGIS platform allowed councillors to take a more focused approach to managing the earthquake's aftermath.



Preparing for Next Generation 911 Now

By Jeff Ledbetter, Michael Baker International, and Kathrine Cargo, Orleans Parish Communication District

Sometimes when change comes, it is difficult and confusing.

In 2011, an extension was added to US Highway 90 Alternate on the east side of Houston, Texas. A few days after it opened, an 83-year-old grandmother accidentally entered the extension going eastbound on the westbound side of the highway, with cars coming straight at her at 65 miles per hour.

A Good Samaritan on the eastbound side of the highway saw what was happening and called 911 from his cell phone. He assumed that emergency responders would be able to see his location instantly. But the 911 dispatcher couldn't find him because the map she was using didn't have the new highway extension on it. The incident ended in a fiery, head-on collision that caused the grandmother to lose her life. First responders eventually located the site of the crash by overriding the system.

The reason the 911 dispatcher was unable to pinpoint the caller was because the new highway extension hadn't been added to the GIS data being used, nor had its existence been communicated with the Houston Emergency Center or the Greater Harris County 911 Emergency Network. As a result, the computer-aided dispatch (CAD) software for the 911 center had no indication that a highway extension was even there.

Next Generation 911 (NG911) aims to upgrade emergency response systems so they can keep up with ever-evolving mobile communication and technology. For NG911 to work, features such as street centerlines and address points must be maintained at a higher level of precision than ever before. This should both excite and terrify GIS professionals who work in local and regional government. On one hand, it cements how mission critical a GIS database really is. On the other hand, amplifying existing data to this level and maintaining its accuracy is a huge undertaking.

Currently, NG911 standards are still being finalized. While that is taking place, it is imperative that GIS professionals in local and regional government explore what their role will be in this transition to NG911 and embark on creating a street centerline and addressing database that can service every internal and external partner in an enterprise GIS.

Finally Embracing GIS in 911

The technology used to accurately locate 911 callers has not kept pace with advances in the digital technology that delivers calls for service, such as smartphones, tablets, home security systems, and health-related wearables. Although the current Enhanced 911 (E911) system has evolved since it was established more than 40 years ago, it was designed at a time when the only 911 calls received were from phones in static locations transmitting via twisted-pair copper wire. E911 was the industry's answer to locating analog calls from wireless phones using GPS and cell tower triangulation. It could figure out where a caller was because the phones, or the cell tower's connection to the wired phone network, never moved.

With the advent of smartphones and their accompanying apps, people now expect that the 911 system will instantaneously know their location and be accessible in ways that go beyond voice communication (via text message, for example). But this is not the case.

Today, if someone calls 911 from anything but a landline, it can take a dispatcher 45–90 seconds to locate the caller within approximately 150 feet. In a worst-case scenario, the dispatcher can find the location of the wireless tower that is transmitting the call—though this is not always the tower closest to the caller. What's more, the Federal Communications Commission (FCC) only requires that 40 percent of all wireless 911 calls be accompanied by a dispatchable location (a verified street address that includes unit information when necessary) with about 150-foot accuracy. The FCC seeks to increase this to 80 percent of wireless calls by 2021.

With NG911, however, 911 communication will transmit across Internet Protocol (IP)-based networks. This will enable all IP-based devices—those smartphones, security systems, and wearable medical devices—to initiate a call to 911. Call centers will also be able to receive additional information from callers, such as photos and videos, to augment emergency response. And devices will be able to send their own coordinates to NG911 during an emergency call. This is where the world of spatial possibilities really opens up.

NG911 fully embraces GIS technology, bringing it into the center of the 911 system. In any 911 call, there are two GIS-based core services at play: the emergency call routing function, which dictates where to send the call for service, and the location validation function, which determines whether an address is valid for routing and dispatch. For these NG911 core services to function properly, an authoritative, GIS-based collection of features—such as street centerlines, address points, call center jurisdiction boundaries, and the operating areas for emergency service providers (e.g., police, fire, and paramedics)—must exist. And these features have to be meticulously maintained so they remain accurate and up-to-date.

A collection of features this detailed and timely will be the gold standard of location data. Not only will it benefit NG911 and other public safety systems, but it will also strengthen every enterprise system that deals with location. And what local or regional government enterprise doesn't deal with location? Almost every department—from the planning and public health divisions to the revenue and county assessor's offices—tracks location data on paper forms or in spreadsheets, flat databases, and GIS databases. Now, GIS professionals have the opportunity to build a street centerline and addressing database that can serve all their colleagues in local and regional government and beyond.

Get Started with Data Sharing

Making this transition begins with bringing the data out of hiding. Many government enterprises operate independently of one another, quashing interdepartmental communication and data sharing. But for NG911 to work, GIS professionals need to build crosswalks that connect data silos to one another. The GIS authority, addressing authority, and 911 authority all need to have access to each other's data. Unsurprisingly, this will have many intangible benefits for the entire enterprise, such as increased cooperation and efficiency.

To start the data sharing process, GIS professionals should first visit their government's public safety, 911 communications, and/or addressing departments. People in these offices will be familiar with NG911 concepts, but they may not fully appreciate what it means to have an authoritative, GIS-based collection of geographic data. It's even more likely that they won't understand how much effort it will take to develop and maintain these precise records.

Given that each emergency call center is liable for coordinating the creation and maintenance of its authoritative data, it is up to the GIS professional to provide GIS subject matter expertise while letting the public safety, 911, and addressing authorities know exactly what is needed to acquire and preserve such accurate GIS data.

Obtaining Better Access to Lifesaving Services

NG911 may not have been able to prevent a tragedy like the one in Houston, but it is a system designed to get the public better access to lifesaving services through as many channels as possible. And for GIS professionals, it is an opportunity to increase the meaningful contributions they make to their communities through GIS.

Head to ng911now.org to read about the NG911 NOW Coalition's goal to have sustainable and standardized IP-based 911 capabilities in every 911 system and call center in the United States by 2020. Learn more about NG911 standards and first steps toward upgrading at nena.org/?page=GIS_NG911_PSAP.

Next Generation 911 upgrades emergency response systems so they can keep up with technology.

About the Authors

Jeff Ledbetter, GISP, PMP, is a senior project manager for Esri partner Michael Baker International, where he leads public safety and NG911 GIS projects. Ledbetter has been working in GIS since 1998 and began applying the technology to public safety in 2009. He is a member of the URISA NG911 Task Force, which supports GIS professionals in developing NG911 systems. For more information, email him at jeff.ledbetter@mbakerintl.com.

Kathrine Cargo, GISP, is the GIS/mapping coordinator for the Orleans Parish Communication District in New Orleans, Louisiana. She is the chair of the URISA NG911 Task Force and is a member of the National Emergency Number Association's (NENA) GIS Data Stewardship Work Group. For more information, contact Cargo at kcargo@911nola.org.

HARRIS®

TECHNOLOGY TO CONNECT,
INFORM AND PROTECT™

TRANSITION YOUR IMAGE ANALYTICS TO THE CLOUD

Harness the processing power of the cloud to quickly get from data to decisions. ENVI® products work seamlessly with the ArcGIS® Platform. When everyone from your organization can access and share geospatial analytics and products, they make quicker, more informed decisions regardless of geographic location.

harrisgeospatial.com/cloudanalytics

The Science of Where in Action

continued from cover

Dangermond underscored the importance of people to The Science of Where, all working together to use GIS to confront problems such as pollution, loss of nature, climate change, food shortages, social conflict, and natural disasters. Keynote speaker Dr. Geoffrey West, a renowned theoretical physicist, encouraged the audience to think about how we sustainably organize society, given that clusters of people—cities—put intense pressure on the world's resources while they also facilitate innovation.

"We are going to have to do everything we possibly can to better understand and…collaborate to address *[these issues]*," Dangermond said—just like the city of Dubai is with its Smart Dubai program. As HE Dr. Aisha Bint Butti Bin Bishr, director general of the Smart Dubai Office, and her colleagues demonstrated, GIS—and the cooperation that it cultivates—is a key element of making the emirate safer; more seamless; and, ultimately, the happiest city on earth.

The challenges may be great, but Dangermond is an optimist. "Can we make a difference with our work and turn *[things]* around?" he asked. "My view is, *Yes*, we can!"

The Science of Where to Sustainably Farm Shellfish

Location has always been critical to Taylor Shellfish Farms, which grows shellfish sustainably on 12,000 acres of leased or owned tide land and owns and operates three oyster bars in Seattle. Yet this fifth-generation, family-owned business has only been employing Esri technology for one year. The Taylor family and employees now use GIS to map their 30 farming sites, analyze farming conditions, identify the best growing areas for different shellfish species, and conduct surveys to meet environmental requirements.

"When I started at Taylor, we were using hand-drawn maps, and I knew there had to be a better way," said Erin Ewald, assistant director of regulatory and environmental compliance for the business. "So *[we]* are modernizing our company through GIS."

Taylor Shellfish Farms didn't start small. Since September 2016, the company has adopted ArcGIS Online; ArcGIS Pro; Esri Story Maps; Drone2Map for ArcGIS; and multiple mobile apps including Explorer for ArcGIS, Survey123 for ArcGIS, Collector for ArcGIS, and Workforce for ArcGIS.

"Our company is growing in both size and geographic reach, and these mobile apps are leading the way in our digital transformation," said Ewald. "We're now able to take our real-time business, operations, and environmental data onto the farms with us."

"In Samish Bay, the tide can recede over a mile to expose large, sandy tidal flats rich with nutrients. We grow oysters, clams, and geoduck here," said Nyle Taylor, the farm's project coordinator, who stressed that the word *geo*-duck is actually pronounced "gooey duck." In this bay and others, farm managers can view a map of farming areas on their smartphones and add information to it—using a sketching tool, for example, to suggest areas where the farm might expand.

"This ability to take a wealth of GIS data into the field…helps us understand the environment we're working in," Ewald said. "As we combine this new understanding with generations of experience in a suitability analysis, we use this data to identify optimal growing areas for our different shellfish species."

With Survey123, Ewald can quickly configure digital surveys that workers use to collect environmental and other data for regulatory agencies. And Taylor Shellfish Farms now also maps out where to plant shellfish using drone-captured imagery processed with Drone2Map.

"Laying out farm beds prior to using Drone2Map was a boots-on-the ground approach," Taylor said. "Drone imagery revolutionizes how we do it. Using a digital terrain model, it's easy to see the natural drainages in the beach. We can build our beds around these to avoid our seed being washed away."

The Science of Where—and How—to Save Lives

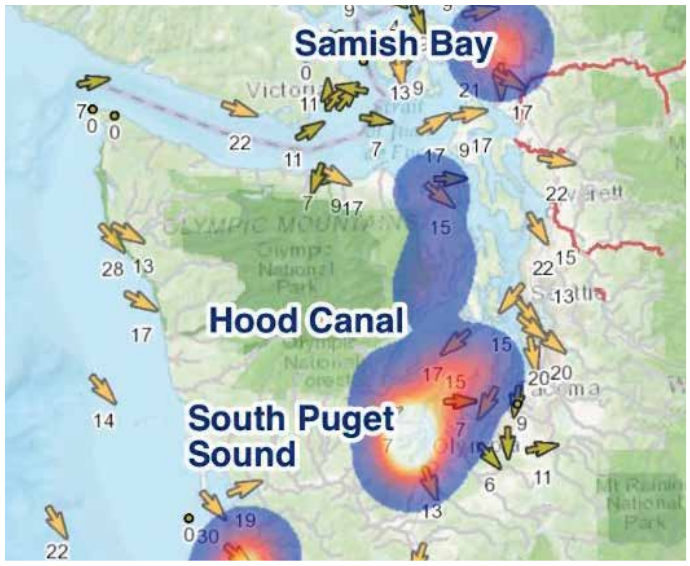
At Shock Trauma Air Rescue Service, planning for dynamic situations is how the Canadian nonprofit provides emergency medical care and transport to seriously ill and injured people. With The Science of Where, STARS can better manage its response to these emergencies.

Operating mainly in remote areas of Alberta, British Columbia, Saskatchewan, and Manitoba, STARS helicopters are dispatched to medical emergencies such as heart attacks; strokes; and traffic, recreational, or industrial accidents. Much of the critical work goes on at the organization's Emergency Link Center (ELC), a 24-hour medical communications and dispatch center. That's where Kevin Hatch and Paul Wiles work, building technology that speeds up response times.

For example, STARS is using GIS to automate the standard operating procedures (SOPs) it follows to determine whether a helicopter needs to be sent to an incident. "We use a dynamic set of SOPs to tell our dispatchers precisely what they need to know so they can make that decision," Hatch, a telecommunication specialist for STARS, told the audience.

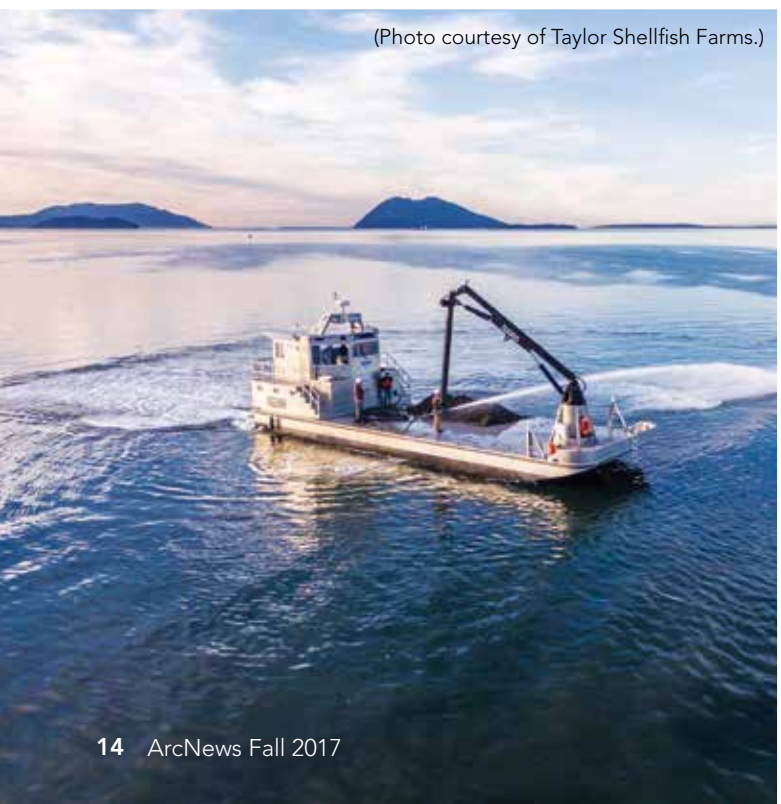
The ELC uses ArcGIS GeoEvent Server to provide dynamic SOPs as each incident unfolds, from what procedures to follow before deciding to send a helicopter to what to do as the mission evolves. A model created with ArcGIS GeoEvent

↓ Although Taylor Shellfish Farms has only been using Esri technology for a year, it has implemented a suite of software and apps to lead its digital transformation.

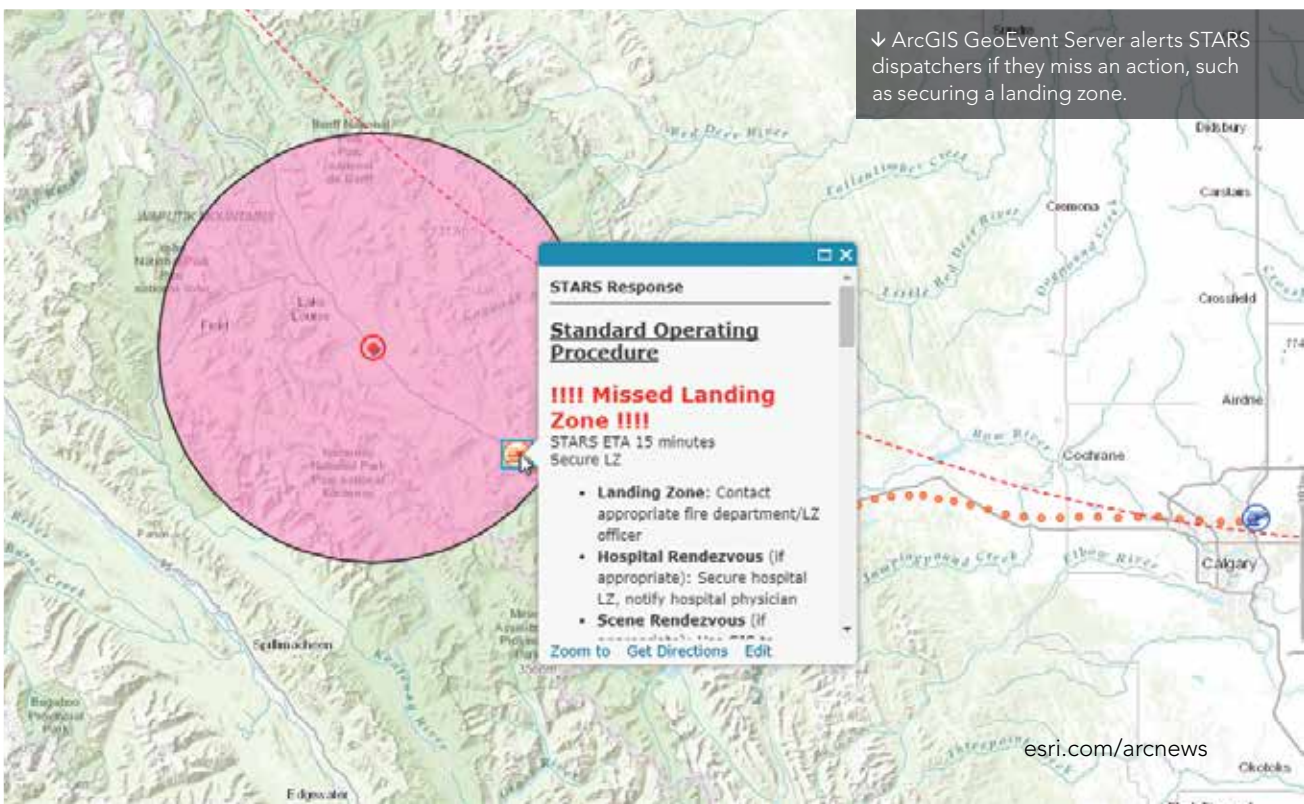


(Photo courtesy of Taylor Shellfish Farms.)

Kevin Hatch of Canada's Shock Trauma Air Rescue Service (STARS) helped build GIS technology that speeds up response times.



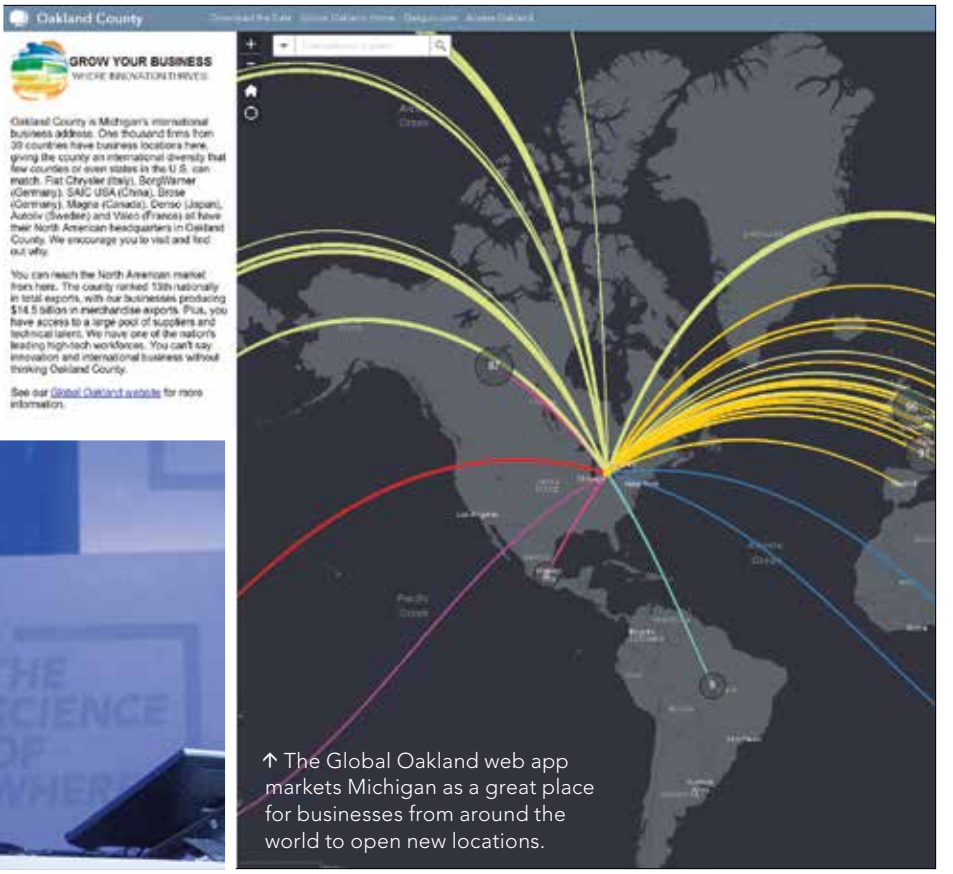
(Photo courtesy of Taylor Shellfish Farms.)



↓ ArcGIS GeoEvent Server alerts STARS dispatchers if they miss an action, such as securing a landing zone.

↑ Jeff Allenby and Cassandra Pallai demonstrated the Chesapeake Conservancy's high-resolution land-cover dataset for the Chesapeake Bay watershed.

→ HE Dr. Aisha Bint Butti Bin Bishr, director general of the Smart Dubai Office, showed the audience how GIS is making Dubai the happiest city on earth.



↑ The Global Oakland web app markets Michigan as a great place for businesses from around the world to open new locations.

Manager generates the dynamic SOPs. "It tells us what we need to know and when we need to know it," said Wiles, a GIS and telephony technologist for STARS. "This improves efficiency, reduces human error, and helps us ensure the best life-saving decisions are made."

To illustrate how dynamic SOPs can help once a mission is under way, Hatch showed the audience a one-car rollover in Banff National Park. STARS decided to send a helicopter to the scene, where two people were trapped in a vehicle and a third person had been ejected.

"Now *[that]* we've assigned a resource, GeoEvent has created a new feature, which uses the AVL *[automatic vehicle location]* of the helicopter," Hatch said. "Using factors such as the status of the aircraft and the base *[from which]* it was dispatched, the SOPs are instructing the dispatcher to perform actions such as giving updates to our pilots and air medical crews." GeoEvent Server will even alert a dispatcher if an action, such as securing a landing zone, is missed.

"When we talk about dynamic SOPs, mapping, spatial analysis, innovation, and engagement, what we are really talking about is improving the tools our team uses to help us make more success stories," Hatch said. "At the end of the day, it's about the patient."

The Science of Where Pollution Gets Cleaned Up

At the Chesapeake Conservancy, it's all about the bay—the Chesapeake Bay. The largest estuary in the United States and the third largest in the world, the Chesapeake Bay stretches 200 miles along the mid-Atlantic coast. The watershed that feeds it occupies more than 64,000 square miles in six states and is home to more than 18 million people.

For a century, the health of the Chesapeake Bay was beset by pollution, population growth, and changes in land use. Over the last four decades, focused efforts have brought the bay back from the brink of destruction.

"But we still have a long way to go," said Jeff Allenby, director of conservation technology for the Chesapeake Conservancy.

Given that so many cities, counties, and states have a stake in restoring the Chesapeake Bay, the conservancy has embraced technology to prioritize restoration projects. While datasets like the National Land Cover Database have informed regional cleanup efforts, smaller entities were using different sets of data. This made it difficult to implement targeted conservation projects.

For 18 months, the conservancy worked for the Chesapeake Bay Program and with partners such as the University of Vermont Spatial Analysis Laboratory and WorldView Solutions Inc. to create an ultra-high-resolution land-cover dataset for the entire watershed. It was released in December 2016.

Almost immediately, the conservancy's partners began asking when it was going to update the data. But this was costly and time-consuming. So, using ArcGIS Pro, the Chesapeake Conservancy employed imagery from the National Agriculture Imagery Program (NAIP) to create a new false-color image of the region and segment it, streamlining the entire land classification workflow into one processing model.

"ArcGIS Pro is reducing the amount of time that it takes us to go from raw imagery to land cover," Allenby told the audience.

To classify more than two terabytes of the most recent NAIP imagery, it would take the conservancy just over 150 hours instead of more than 2,500 hours. Additionally, the conservancy can classify land cover in just one area or, using ArcGIS Image Server in Microsoft Azure, create land-cover classifications for all 206 counties in the watershed. This enables the conservancy and its partners to better understand how development in one place might affect the entire bay.

"Once we know our priorities, we can create customized action maps for our local partners," said Cassandra Pallai, the conservancy's geospatial program manager. "Together, Image Server and the processing capacity of the cloud are enabling us to spend less time making the data that we need to meet our goals and more time on conservation." (Read the full *ArcNews* article about this project at http://p.ctx.ly/r/508g.)

Extending The Science of Where

Oakland County, Michigan, is working with its own municipalities by expanding GIS use beyond the knowledgeable few. The county can build a map or app once, pay for it once, and allow everyone to benefit.

"Through Web GIS, we've grown our distributed GIS model by combining the value of our many collaborative systems of record *[into]* a powerful system of systems, which allows us…to branch out to all our municipalities, businesses, and citizens," said Phil Bertolini, Oakland County's deputy county executive and chief information officer.

He showed the audience the Access Oakland Open Data Portal, which uses maps to promote economic programs and attract new businesses. The Medical Main Street map, for example, underscores Oakland County's thriving health care industry, and Global Oakland markets southeastern Michigan as an advantageous destination for businesses from around the world to open new locations.

"To date, we have more than 400 new businesses located in Oakland County with an economic investment of $3.9 billion," said Bertolini.

The success of these open data initiatives spurred Bertolini to challenge his team to build up a new generation of GIS users in Oakland County.

"What was our approach?" asked Tammi Shepherd, Oakland County's chief of application services. "Grow our tree by finding and inspiring just one user, who would then add hundreds more."

"We found that some branches grow through our cultivation, whereas others sprout almost entirely on their own," said Oakland County IT business analyst Mike Dagle, who, along with Shepherd, took the audience on a tour of how Oakland County transformed its GIS.

The team helped social media managers incorporate colorful maps into their Facebook, Twitter, and blog posts. It created a suite of apps to simplify how the tax administration department stakes notices on the properties of citizens who have not paid their taxes. Shepherd and Dagle and their colleagues helped the equalization division create an internal app that displays all the details about county properties, including parcel acreage, wetlands, and historical imagery. The team then added this app to its suite of standard product offerings, making it available for any municipality in the county to use and customize. GIS is now central to how Oakland County's water resources commissioner's office manages its assets, with the ArcGIS GeoAnalytics Server helping it prioritize and allocate scarce infrastructure resources. And finally, GIS maps and apps assist the county's public health office in administering and offering resources for residents affected by the opioid crisis.

"Two years after challenging my team," said Bertolini, "we have hundreds more users in a distributed GIS model across our county departments and municipalities." (Read the *ArcNews* article about open data at Oakland County at http://p.ctx.ly/r/508h, and see the *ArcNews* article about how one of its municipalities used GIS to manage a community event at http://p.ctx.ly/r/508i.)

Holistic Thinking Made Easier

Hundreds of thousands of other organizations around the world employ GIS and The Science of Where—including the United Parcel Service to optimize delivery routes and the emirate of Abu Dhabi to enhance government operations. The kind of holistic thinking they do is the only way to confront this planet's great challenges and turn things around. And that is precisely the kind of thinking that GIS and The Science of Where make easier.

Esri Young Scholars

Find the Drive to Do More

Esri has a vested interest in developing the next leaders in GIS. That is why every year, it hosts a group of students from around the world at the Esri User Conference who have produced exemplary work in GIS.

This year's group of Esri Young Scholars hailed from 21 countries. Some are well-versed in using GIS, and others only recently encountered the technology. Some are still undergraduates, while others have graduated with their master's degrees, and still others are pursuing PhDs.

All those who were able to make it were excited to attend the 2017 Esri User Conference in San Diego, California, and thrilled to present their work at the Map Gallery.

"The moment my project was displayed at the Map Gallery, that was the greatest moment," said Serin Son, a GIS master's student at Ewha Womans University in Seoul, South Korea, who used GIS to analyze the characteristics of traffic accidents involving females around Seoul to see how to improve driver safety.

The young scholars relished meeting their peers and networking with so many GIS professionals who have done tremendous work in their fields.

"I felt grateful to meet and make friends with my fellow Young Scholars from across the world, all connected by the same passion," said Simon Haumann, a recent graduate of the University of Vienna's master's degree program in cartography and geoinformation, whose project on optimizing the operational range of electronic bikes in routing systems won him this year's prize from Esri Switzerland.

Many of the students were also inspired by the advanced technology they witnessed in demonstrations—some of which they were even able to try out on the expo floor.

"I didn't know what ArcGIS Pro was, but I learned here," said Balca Agacsapan, an environmental engineer pursuing her PhD at Anadolu University in Turkey. The project she submitted to the competition used unmanned aerial vehicles (UAVs) and GIS to evaluate building rooftops at her university for their potential to conduct solar energy via photovoltaic panels. "In my next project, I want to use Drone2Map for ArcGIS," an app she saw demonstrated at the conference.

Alan Pearse, an earth science and statistics major at Australia's Queensland University of Technology, is excited about "the *[ArcGIS]* API for Python…that works with ArcGIS Online and ArcGIS Enterprise," he said. "Just the fact that you can use Jupyter Notebooks and process your Python code on the fly and generate maps and do all your analysis in situ—I thought that was pretty awesome." The project he submitted to the competition involved developing an ArcGIS toolbox that calculates spatially explicit watershed attributes to better analyze the effects that land use has on stream health.

To get to San Diego, the students submitted their projects to the Esri Young Scholars competition through the Esri distributors in their countries.

"Esri advertised at my university for students to present a project for the contest," said Mauricio Grande from José Simeón Cañas Central American University in El Salvador. His project used Drone2Map for ArcGIS to quantify the impact that recent forest fires had on mountainous areas around San Salvador. "You have to work with one teacher from your university, and you have to present a work that is developed with Esri software. So you present your project, a poster, and a technical paper *[to GEOSIS, Esri's official distributor in El Salvador]*, and then you are in the contest."

For Amelie Zehndbauer, who recently graduated with her bachelor's degree in geoinformatics and satellite positioning from the Munich University of Applied Sciences in Germany, the process was a little different.

"I applied with my bachelor's thesis," which assessed the quality and user-friendliness of photogrammetric software, including Drone2Map for ArcGIS, she said. "An employee of Esri Germany helped me with my bachelor's thesis and gave me the hint to apply for the Esri Young Scholars competition."

Emily Acheson, who is currently getting her PhD from the University of British Columbia in Canada, applied with her master's thesis, which she put together at the University of Ottawa. Studying the mosquitoes that carry malarial parasites in Tanzania, she mapped where the mosquitoes were located, as well as where mosquito nets were being used, and compared them to see if mosquito net distribution was matching the distribution of mosquitoes. It was not.

"We looked at indoor residual spraying, too," she said. "We wanted to compare spraying to the nets, and we found that spraying does a good job at targeting mosquitoes."

For someone who said she initially had no background in GIS, she has certainly centered her research on the technology.

"I took one course during undergrad that used ArcGIS, and I fell in love with the technology," she said. "I wanted to find a way to use it in my PhD. I thought it would be a great tool to study disease distribution."

And she is doing just that. Studying a killer fungus in British Columbia called *Cryptococcus gattii*, she is now using GIS to figure out why it is in Canada at all, since it is usually found in tropical places.

Being a GIS novice, yet becoming captivated by the technology, is not unusual among this group.

"I had no clue what GIS was before," said Nael Al Hassanieh, who used GIS for the first time in his final project for his master's degree, which he recently received in aeronautical engineering from the University of Balamand in Lebanon. For it, he and his colleague Michelle Nassar used 3D GIS for Beirut Rafic Hariri International Airport to create Obstacle Limitation Surfaces (OLS), which indicate the volume of airspace around an airport that needs to be free from obstacles, such as buildings, trees, and hills.

"The location of Beirut Airport is kind of sensitive because there are hills *[and buildings]* around it…and the sea from the west side," said Al Hassanieh. "It was kind of a special project because it's the first time this analysis has been done in Lebanon using GIS with high-accuracy maps," which is ultimately why he decided to submit it to the Esri Young Scholars competition.

There are plenty of young scholars who got bitten by the GIS bug early, though.

Sander Varbla, from Estonia's Tallinn University of Technology, started using GIS in high school.

"I was in eleventh grade the first time I realized that something like GIS exists," said Varbla, who is more than halfway through his studies for a joint bachelor's and master's degree in civil engineering with a specialization in geodesy. "We had to do this research project with GIS, and my interest in it grew and grew."

The project he submitted for the Esri Young Scholars competition revolved around improving the accuracy of global navigation satellite system (GNSS)-based bathymetric measurements in the Baltic Sea.

And Patricia Polo, an environmental engineering undergraduate student at the Latin University of Panama, encountered GIS early in her university studies.

"In the university, we do GIS, remote sensing, spatial analysis—all those subjects," said Polo, whose project analyzed noise pollution in different areas of Panama City. She was so inspired by the people she met at the Esri User Conference that she plans to continue using GIS and is even considering getting a master's degree in it.

Above all, the Esri Young Scholars were proud to present their work and energized by who they encountered and what they saw.

"This was just an amazing opportunity for me to showcase my research and see how it's actually solving problems," said Keneilwe Hlahane, a GIS and remote sensing master's student in the oceanography department at the University of Cape Town in South Africa. For her project, she used GIS to monitor eutrophication (when rich nutrients, such as nitrogen and phosphorus, exist in excess in a body of water and alter the ecosystem), which is causing water quality in dams and rivers throughout South Africa to deteriorate. "This goes back to the theme of this year's conference, Applying The Science of Where, which is what I'm doing. I'm applying the science of GIS within water quality resources."

Hlahane, like so many Esri Young Scholars, left the conference with the drive to do even more.

"I've definitely learned a lot of things," she said. "I'm going to try to apply some of the methods that I've seen here to my research to improve it."

For more information about the Esri Young Scholars program, email Michael Gould, Esri's global education manager, at mgould@esri.com.

Editor's note: Some quotations in this article have been lightly edited for clarity.

↑ All the Esri Young Scholars who made the trip to San Diego got a chance to meet Esri president Jack Dangermond.

Helping Youth Form Scientific Habits of Mind

By Engaging with The Science of Where, Future Decision-Makers Strengthen Their Scientific Abilities

By Dixon Butler, Youth Learning as Citizen Environmental Scientists

YLACES presented the Youth Environmental Science (YES) Medal to Esri in 2016 for its sustained contributions to student environmental research and learning. The award includes a $10,000 grant to an organization engaging youth as active citizen environmental scientists, and Esri chose the Jane Goodall Institute's Roots & Shoots program.

Citizens make better decisions when they can think scientifically. Scientific habits of mind start with critical reasoning and include healthy skepticism, the ability to distinguish answerable questions from unanswerable ones, being comfortable examining both quantitative and qualitative information, and the capacity to place things into larger contexts and perceive connections.

Just as the social sciences and humanities are for everyone, so is science. We can all think scientifically, communicate, and relate to one another—even if we aren't Nobel Prize winners, renowned authors, or community leaders. But we need to build these scientific thinking abilities when we are young. Today, that requires demystifying science and its processes.

Learning scientific concepts and reenacting experiments in a lab are important, but they're not enough to awaken kids' scientific propensities. Gathering environmental data and locating it in space and time—using GIS—is the most accessible way for students to do science and, therefore, form scientific habits of mind.

From the age of eight, children have the intellectual capacity to grasp research questions. And a science lab can be anywhere—right outside, even. Having students do environmental citizen science, which requires relatively little (free or low-cost) equipment for close examination and experimentation, offers a way to make student research not only broadly doable but also useful to the wider scientific community, since the data that can be easily collected and examined outdoors is greatly needed for understanding the environment and addressing environmental concerns at different scales.

Youth Learning as Citizen Environmental Scientists (YLACES) is dedicated to helping kids learn scientific habits of mind by doing environmental research in both formal and informal settings. Because such research projects necessitate data analysis, using GIS enables them to conduct far broader and more sophisticated investigations.

There is increasing infrastructure to support these kinds of student activities as well—through the Global Learning and Observations to Benefit the Environment (GLOBE) Program, for example, which helps make it possible for students and citizens all over the world to engage in data collection and the scientific process. And, of course, there is Esri's Schools and Clubs Program, which provides teachers and students with software donations and assistance so they can explore and analyze data using maps.

YLACES has supported schools, teachers, and environmental organizations with instrumentation and training. And since it views scientific ability as universal rather than specialized, the organization is also aiming to change the focus of most science fairs from identifying promising young scientists for special educational activities to providing meaningful feedback on students' research so they can improve their scientific abilities and their projects can contribute to important scientific examinations.

Strengthening the scientific abilities of our future decision-makers will require support from everyone, including the GIS user community. Teachers and youth group leaders need help learning how to use GIS, and young learners need coaching in doing research. Those who are savvy with GIS can advise people in using the technology by getting involved with organizations like SciStarter, which works to connect citizens with citizen science projects. They can also offer to help evaluate student research reports via GLOBE, which operates both virtual and in-person student research symposia to showcase and assess students' environmental research. GIS practitioners can guide teachers in using GIS by becoming GeoMentors or advocate for efforts to build spatial understanding more concretely into science education. They can always make contributions to science education nonprofits as well, including YLACES.

The GIS community, with its deep appreciation of the spatial nature of earth science research, has much to offer this investment in our collective future.

About the Author

Dixon Butler, an atmospheric physicist, is the president of YLACES and an independent consultant focusing on science, environmental, energy, and space policy; STEM education; and congressional appropriations. Previously, he was the director of the Modeling, Data and Information Systems division for the National Aeronautics and Space Administration's (NASA) Mission to Planet Earth and the director of the GLOBE Program (globe.gov). He also spent time as a clerk for the US House of Representatives Committee on Appropriations, where he concentrated on energy and water.

For more information about YLACES (ylaces.org) and how to get involved with youth science education, email Butler at dixon@ylaces.org.

Collecting environmental data and locating it in space and time is the easiest way for kids to form scientific habits of mind.

Crossing Borders

A column by Doug Richardson
Executive Director, American Association of Geographers

New GIS Coding Initiative Engages Girls, Women

Women have come a long way in GIS since Mei-Po Kwan, a professor of geography and GIS at the University of Illinois at Urbana-Champaign, wrote her groundbreaking 2002 article, "Is GIS for Women?" In it, she cites female GIS practitioners' personal experiences in the vocation, quoting one who said that a GIS lab felt like "the domain of the white, middle- to upper-class graduate geography students."

In a more recent study about the profession from 2016, GIS analyst Livia Betancourt Mazur and Hunter College professor Jochen Albrecht sought to find out, with new data, if women are underrepresented in GIS. In surveying almost 500 women in GIS—asking questions such as, Have you ever been the only woman in the room (at meetings, events, etc.)?—the researchers found that while women are not grossly underrepresented in GIS, they are likely underrepresented in certain sectors and positions, especially ones that require managerial or highly technical skills. This suggests that Kwan's question still resonates today.

It is within this context that the American Association of Geographers (AAG) is launching a new initiative called Coding for Girls in GIS and Geography. AAG has developed GIS coding curriculum and is planning a series of workshops on coding for girls and women beginning at the AAG Annual Meeting in New Orleans, Louisiana, in April and continuing throughout 2018 across the United States. AAG is also working with its many international programs to set up similar initiatives around the world, with workshops and webinars already scheduled for Ukraine and throughout Africa, including in Cameroon, Ethiopia, Nigeria, and South Africa.

Many AAG members and staff have strong experience and expertise in computer programming. They have taught introductory and advanced GIS courses at universities or participated in college and high school mentoring programs to support and empower young women who are interested in STEM (science, technology, engineering, and math) fields. In fact, AAG's new Coding for Girls in GIS and Geography initiative is being coordinated by AAG senior researcher Dr. Coline Dony, who has worked for and recently spent the summer with Girls Who Code, a nonprofit that teaches computer science and GIS concepts to high school students.

Dony's personal experience has motivated her to take on this initiative. "I was often the only woman in GIS courses that involved any programming, and I want to change that," she said. "Enrolling for these courses should feel like the right choice for women in geography. This initiative is about boosting women's interest in programming by teaching them how to create web-based geovisualizations and how to automate analyses of new sources of spatial data, such as those from social media."

AAG looks forward to engaging with the broader geography and GIS communities—including other GIS organizations and the extensive GeoMentor network, operated by AAG and Esri—to broaden the reach of Coding for Girls in GIS and Geography and create similar programs for high school students across the United States and around the world.

At AAG, we are convinced that a more diverse geography and GIScience community will enhance our discipline and amplify our ability to understand and improve our world. To make this happen, we need to change the culture of our schools and workplaces to tap the talents of girls and women at an early age and prepare them with the computing and spatial thinking skills required to conduct cutting-edge research and land good jobs. Gaining early access to these skills can help girls and women overcome stereotypes and lead to exciting opportunities around the world. It will also infuse GIS and GIScience with new ideas, perspectives, and talent, which can only propel these fields forward.

For more information on Coding for Girls in GIS and Geography, or to participate in these events, email AAG research associate Jolene Keen at jkeen@aag.org.

Contact Doug Richardson at **drichardson@aag.org**.

Dr. Coline Dony (far left) led a Girls Who Code Summer Immersion Program in Washington, DC, which National Public Radio's lead developer, Joanne Garlow (right), joined as a guest. (Photo courtesy of Coline Dony.)

AAG 2018







April 10-14, 2018 | New Orleans

GIScience & Technology at the AAG Annual Meeting

The American Association of Geographers Annual Meeting is an interdisciplinary forum where thought leaders and experts in GIS and geography intersect to build new partnerships and collaborations.

Meet local and international colleagues. Network and exchange ideas. Discover topical publications. Interact with state-of-the-art technologies.

Don't miss the French Quarter Festival happening during the annual meeting — non-stop music on the streets of New Orleans.

» JOIN US IN NEW ORLEANS

annualmeeting.aag.org

PHOTOS COURTESY NEW ORLEANS CONVENTION AND VISITORS BUREAU; PHOTO OF BRIDGE BY RICHARD NOWITZ

Following Ice Storm, City Fixes Tree Hazards in Real Time

With Custom-Made Web App, Eugene, Oregon, Briskly Coordinates Field Resources

By Brian Richardson, City of Eugene

On the night of December 14, 2016, as an ice storm tore through Eugene, Oregon, the cacophony of fracturing and crashing trees was the call to action for Eric Cariaga, the parks and open space technical specialist for the public works department at the City of Eugene.

"It was apparent early on that this was a dynamic storm," recalled Cariaga, who has worked at the city for 20 years. "I could tell by the sheer number of failing trees that this was going to be a major tree event."

Ultimately, more than 3,500 trees were damaged, making it the most catastrophic ice storm Eugene had experienced in almost 55 years. Calls from the public about downed trees and other storm-related problems began flooding the public works department's phone lines. It was going to require a team of more than 100 staff members from the public works parks and maintenance departments to work together to clean up the mess.

Wanting to maximize efficiency for the 50 field response crews, contractors, and contract managers who were dealing directly with storm cleanup, Cariaga used Web AppBuilder for ArcGIS to create a web-based app—called the 2016 Ice Storm Hazard Tree Response app—that could help emergency management staff in the office map and track the tree hazards. This was then used in conjunction with Collector for ArcGIS to gather data in the field and Operations Dashboard for ArcGIS to keep track of real-time updates.

With chaos unfolding on the streets of Eugene—and 1,700 storm-related work orders needing attention—the calls from the public were recorded in the Maintenance Management System (MMS), a custom-built app that resides in the city's relational database management system, and then published as map services in ArcGIS Online. The information then had to be scrutinized to ensure that it was accurate and not previously reported.

"It was not too difficult taking the real-time information our dispatchers recorded from the public and creating both the desktop application and the Collector map," said Cariaga.

He built several layers showing the work orders, field crews' jurisdictional boundaries, and tree species—which were particularly helpful to know, since deciduous hardwoods are more prone to damage from ice storms than evergreen softwoods. Cariaga implemented the layers into both the tree response app and Collector.

Out in the field, contract managers and specialized tree care professionals, called tree scouts, used Collector to gather data on fallen trees and branches. That information was seamlessly incorporated into ArcGIS Online and distributed immediately to the tree response app and Operations Dashboard. With this wide-reaching GIS, field staff could see updates in real time and managers could keep close tabs on the storm response. Additionally, once field staff cleared a scene, they could use Collector to find the nearest hazard—in real time—that needed to be mitigated.

"This was incredibly valuable for our crews," said Cariaga. "They could not only see the location of downed trees and limbs, *[but]* they *[also]* had a good idea of the damage before they arrived on-scene. In most instances, they knew if they were qualified to respond to a particular call and had the correct tools."

In the office, the real-time updates from the field were displayed in Operations Dashboard. With constantly changing data coming in, the self-updating charts, gauges, and histograms helped contract managers, contractors, and emergency command staff gain a holistic view of the tree hazards all over the city. When field crews updated their work orders in Collector, critical information about each hazard was automatically loaded into Operations Dashboard so everyone could see when a work order had been completed and which resources needed to go where next. Having this information available digitally, on one map, was far better than the old, paper-based system in which field staff picked up work orders at the beginning of each week—making it difficult to update the schedule with new information.

In the hours and days following the ice storm, Eugene's public works staff investigated more than 1,200 calls from the community regarding tree hazards. Branches hung dangerously over streets and in parks, and recording and mitigating the damage was an enormous task.

The highly skilled tree scouts continued to work methodically throughout the city. First, they canvassed priority routes—high-traffic roadways and areas where there was more of a chance that falling trees could damage property or injure the public. They then branched out to other areas of the city, eventually evaluating every street, park, and trail in Eugene. At each spot, they recorded tree-related hazards in Collector. Details included the severity of the hazardous conditions, coordinates, and photos.

With all this data available in ArcGIS Online, Collector, and Operations Dashboard, technical staff in the City of Eugene's parks and open space department were able to document, understand, and analyze the hazards—determining hot spots of storm-related destruction, figuring out which tree species were most susceptible to ice storm damage, calculating the average number of hazards each response team mitigated per day, and more. It also saved Eugene time when working with the Federal Emergency Management Agency (FEMA) to apply for reimbursement for storm cleanup and other related costs.

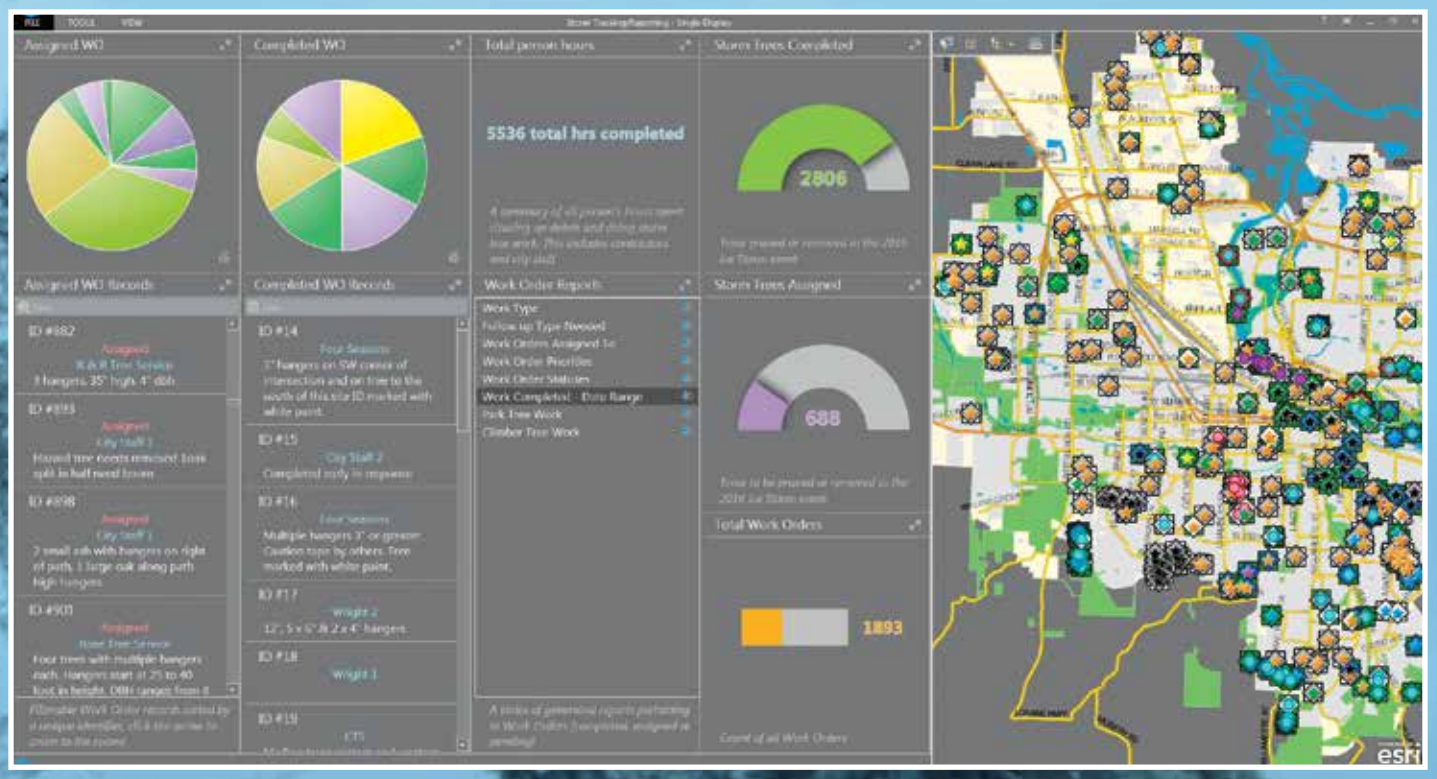
"This storm response was by far the best I've ever seen in my time at the City of Eugene," said Cariaga. "We were able to respond to calls quicker and with increased accuracy and efficiency."

While the City of Eugene continues to implement GIS technology in more areas of service—from tracking maintenance activities to maintaining and updating park assets—Cariaga doesn't want to lose sight of the most important portion of the response: the men and women who work out in the field. They spent weeks identifying and clearing tree hazards—removing downed trees and branches from the entire right-of-way street system, which includes all publicly owned streets.

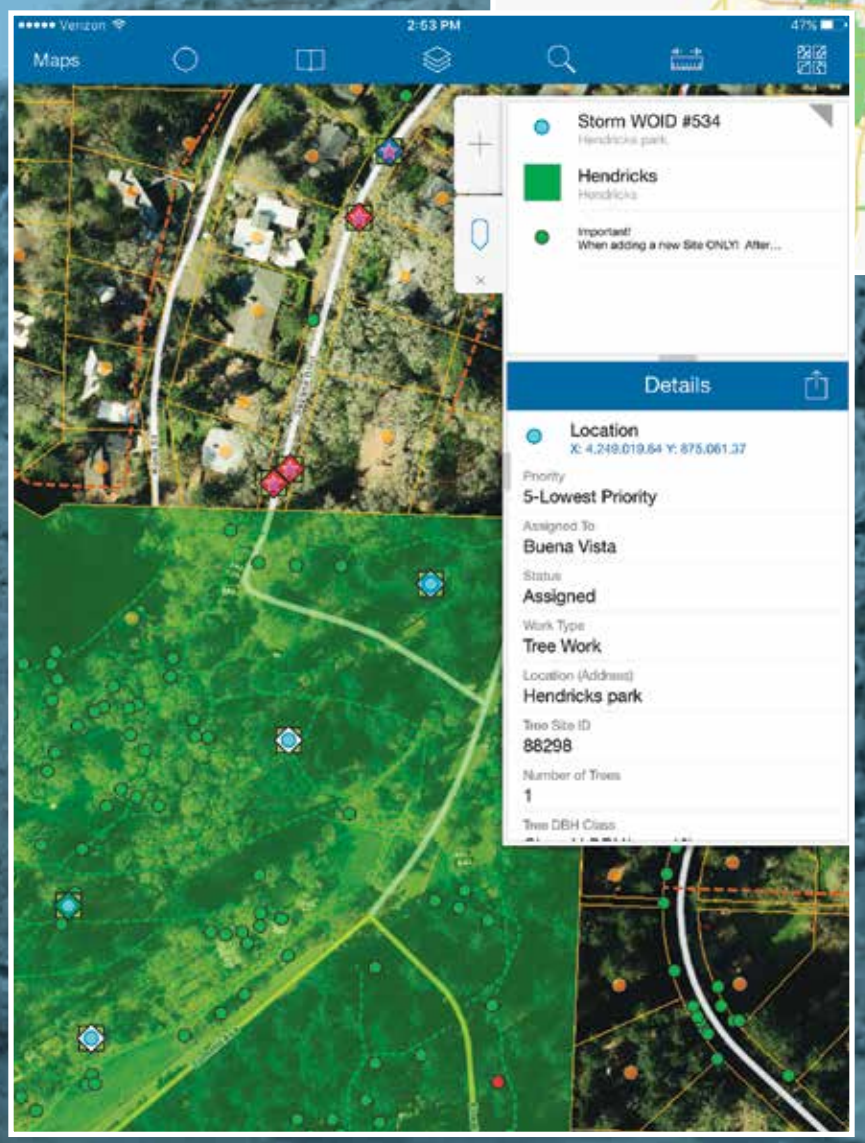
"They truly *[were]* the stars of this recovery process," said Cariaga. "Without our field staff willing to go out in the rain, snow, or freezing temperatures, none of this would be possible."

For more information about this project, contact Brian Richardson, the City of Eugene's public works public affairs manager, at Brian.J.Richardson@ci.eugene.or.us or 541-682-5523.

← On December 14, 2016, a severe ice storm hit Eugene, Oregon, downing trees all over the city.



↑ Using the self-updating charts, gauges, and histograms in Operations Dashboard for ArcGIS, both field and office staff could easily see which resources needed to go where.



↑ Eric Cariaga, the city's parks and open space technical specialist, built a web-based app that could map and track the tree hazards residents called in to the public works department.

← Using the app in Collector for ArcGIS, field crews could see the location of downed trees and limbs and could get a good idea of the damage before they arrived on-scene.

GIS Field Apps Keep Public Works Department Running Smoothly

The City of Nacogdoches, considered the oldest town in Texas, has significantly expanded its GIS program over the last seven years. Smart devices coupled with mobile solutions from Esri—such as Workforce for ArcGIS, Collector for ArcGIS, and Survey123 for ArcGIS—have enabled the city's engineering department/GIS division to get its data out in the field and into the hands of the people who can make the most of it.

The public works department has become one of the city's heaviest users of GIS. Tasked with a range of undertakings, from managing commercial dumpsters to issuing work orders for street, sanitation, and pothole maintenance, the department wanted to move away from sluggish, paper-based processes to app-centered workflows. Building on its already robust use of the ArcGIS platform, the GIS division made this digital transition easily and economically.

Automating Dumpster Pickup Assignments

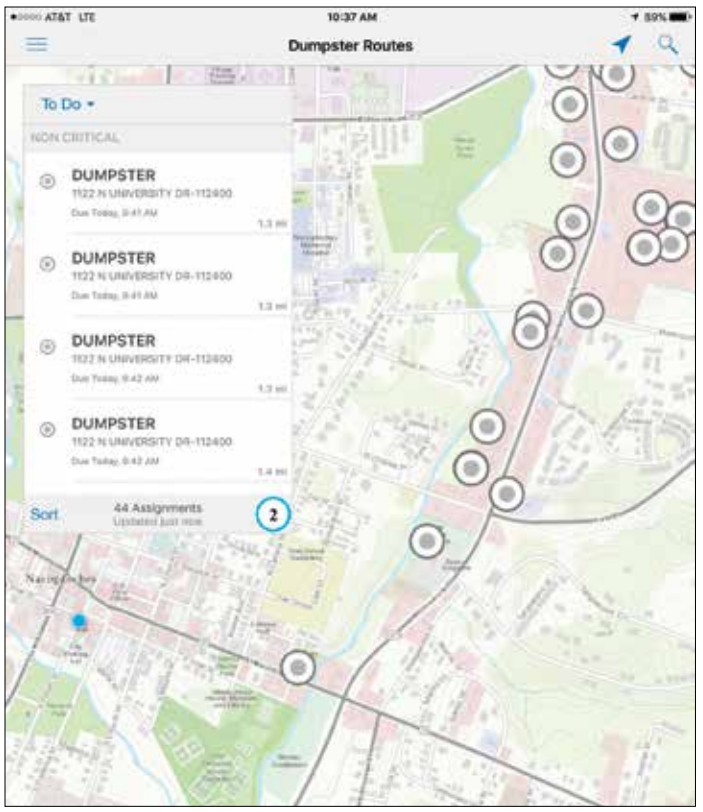
For years, Nacogdoches' public works department used a combination of different software packages, Microsoft Excel files, and handwritten notes to keep track of the dumpster, compactor, and open-top trash can pickups it was responsible for. Unsurprisingly, this muddled system led to inconsistencies between the pickup schedule and billing.

To keep better track of the dumpsters and their collection timetables, public works manager Cary Walker asked the engineering department/GIS division to develop a system that would let the commercial front-load trash truck drivers know when and where dumpsters needed to be picked up each day. Walker also wanted to be able to see the drivers' locations in real time so the department could dispatch them to extra dumpster pickups if they were in the area. To meet both needs, the GIS division chose to use Workforce for ArcGIS.

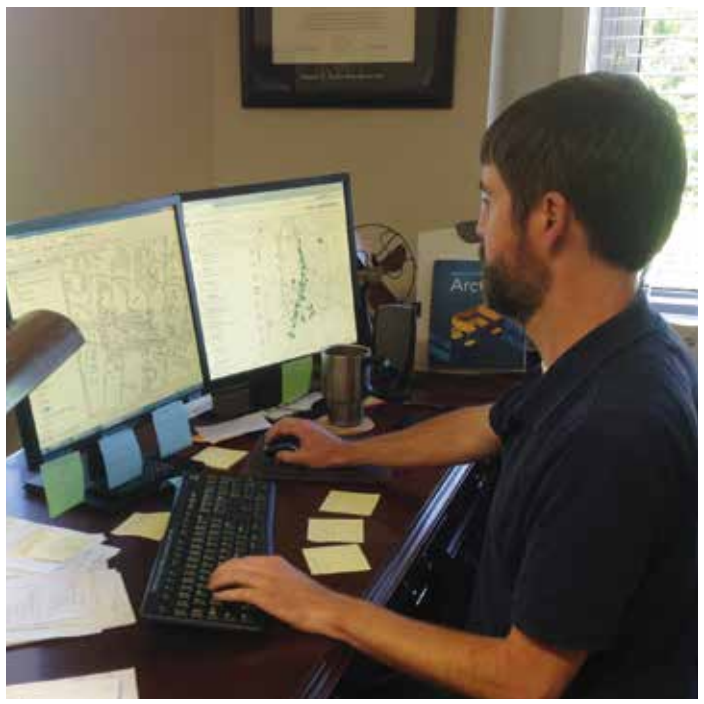
First, the GIS division needed to locate all the dumpsters, compactors, and open tops in Nacogdoches. Jose Olvera, the sanitation supervisor, used paper route sheets (which are just spreadsheets) of the drivers' routes to find every single commercial dumpster and record its GPS coordinates, the collection point's address, the building name, the dumpster's size, the owner's account number, the pickup days, and the order in which it was collected. Although this was the best way to gather all this information, it presented an additional challenge: each route sheet showed the dumpsters that were picked up on a specific day, so if a dumpster was picked up six days a week, the GPS coordinates were recorded six times. With help from the public works department's office assistants, however, the GIS division was able to comb through the database to cross-reference the dumpster locations against billing statements and eliminate duplicate data.

Once the dumpster database was complete, the GIS division automated the process of selecting the dumpsters, compactors, and open tops that had to be picked up on a given day; sequencing the order in which they needed to be collected; and uploading this information to Workforce. It did this by first creating Python scripts to extract each day's routes from the database and put them into a CSV file and then uploaded the assignments to Workforce. Now, the scripts run each night and remove all the completed assignments before uploading the next day's routes. When the commercial front-load drivers report for work the following morning, they turn on their iPads and access Workforce to find out their pickups for the day. In turn, the public works department's office assistants use the app to monitor the drivers as they go about their collection routes.

Immediately after Workforce was implemented, the public works department noticed that drivers were completing their routes faster and that the call volume from citizens with dumpster pickup issues had decreased.



↑ Workforce for ArcGIS automatically selects the dumpsters that need to be picked up on a given day and sequences the order in which they should be collected.



↑ With Workforce, the public works department can keep better track of commercial dumpsters and their collection schedules and monitor drivers' locations in real time.

↓ The GIS division at the City of Nacogdoches gets data into the hands of the people who can make the most of it.

↓ When commercial front-load drivers report for work each morning, they turn on their iPads and access Workforce to get their pickup assignments for the day.

Receiving Work Orders in the Field

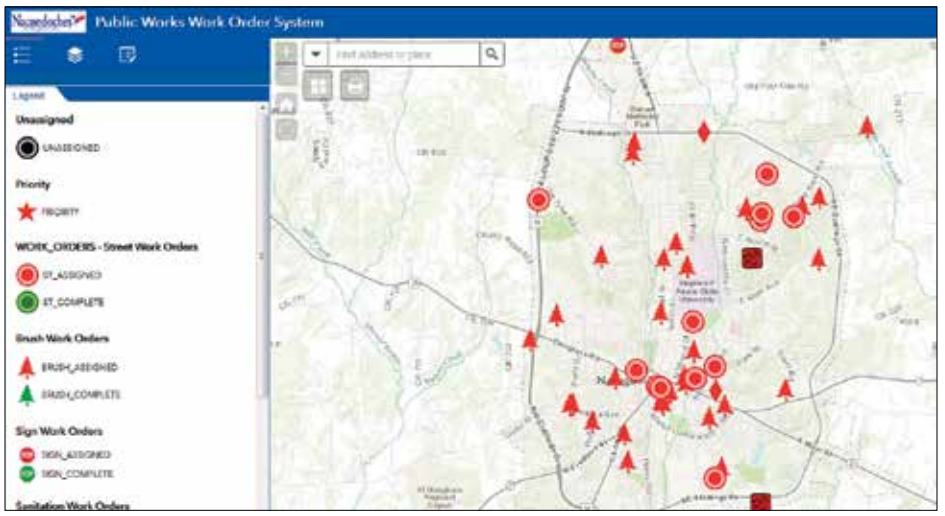
For 25 years, the public works department in Nacogdoches had used paper forms to issue work orders. The process was time-consuming. A paper work order had to be created and delivered to the person who was going to complete it. Then he or she had to bring it back to the office assistants when the work order was finished.

In addition to streamlining this process, Walker wanted to be able to monitor when and where work orders were completed. Specifically, he wanted a customized app that could track requests to fix potholes, trim city-managed bushes and clean up leaves, repair and replace street signs, collect garbage, and fix or change out residential trash containers. Walker wanted each type of work order to have its own symbol so it would be easy to look at a map and instantly know what the work orders were for. He also wanted to maintain an archive of completed work orders for future reference.

The Nacogdoches engineering department/GIS division knew that Collector for ArcGIS would satisfy these requirements. Since maintenance was being done on the city's main enterprise geodatabase, the GIS division began by creating a new enterprise geodatabase that contained dumpster accounts; warnings for dumpster drivers, such as low overhead power lines and trees; and current and archived work orders. The team also shared a map of addresses, streets, city utilities, rights of way, and work orders as a feature service. Using ArcGIS Online, the division then developed an app, called the Public Works Work Order System, that the office assistants could use to assign work orders to field crews. The app also allows other departments within the city to submit work orders.

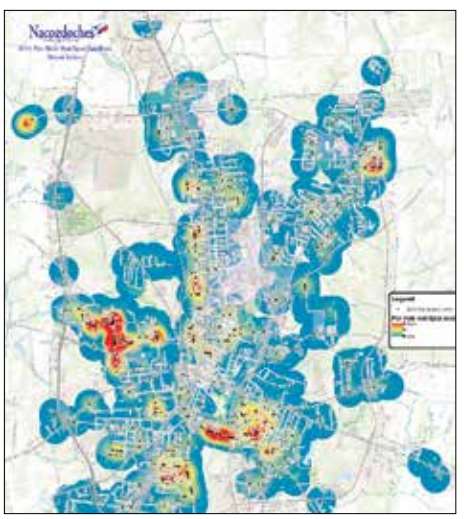
Using Collector on their iPads, crew members out in the field can see when they get assigned a new work order and, if possible, head straight to the issue to fix it. Once a crew member marks a work order as complete, Collector archives it so it is accessible via the Public Works Work Order System app.

Since the public works department integrated Collector with the Public Works Work Order System app a year and a half ago, the City of Nacogdoches has reaped quite a few benefits. Work orders are easier to track, and field crews are more efficient by knowing where their work orders are located and who they will be doing a job with. Additionally, by tracking pothole locations for a full year, the city was able to easily verify which streets needed to be repaired. It is currently tracking storm drain repairs as well to determine which ones will need to be replaced soon.



↑ The public works office assistants use ArcGIS Online to assign work orders to field crews.

↑ With Collector for ArcGIS, crew members out in the field can see when they get assigned a new work order.



↑ After tracking pothole locations for a full year, the City of Nacogdoches easily verified the streets that needed to be repaired.

Keeping Track of Vehicle Maintenance Requests

To complete most of its work, the City of Nacogdoches' public works department relies heavily on 10 trucks: 3 for collecting residential and commercial trash containers, 3 commercial dumpster sanitation trucks, 2 for picking up garbage from open-top dumpsters, 1 yard waste truck, and 1 for collecting brush. To ensure that the department keeps these trucks in good working order, Walker asked the engineering department/GIS division if it could develop a new work order system to track vehicle maintenance requests.

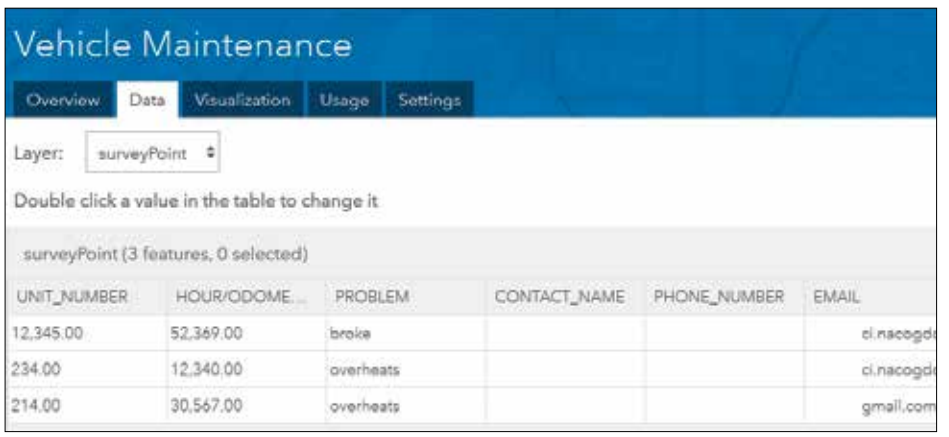
While Walker's request wasn't specifically grounded in geography, the GIS division determined that Survey123 for ArcGIS would work well for this. The team sat down with members of the public works department and vehicle maintenance group to figure out exactly what they wanted to track.

Using Survey123, the GIS division developed a simple survey that contained only fields that city personnel needed to see—such as the vehicle number, the problem, and the person's contact information—to submit a work order to vehicle maintenance. Then, using ArcGIS Online, the team added fields to the survey that only the vehicle maintenance department would be able to see, such as the manufacturer/model, the status of the repair, which parts were used, and how long the repair took. The system also keeps track of who creates a work order, as well as each update to that work order, so it is easy to see when a work order is submitted and when the repair is made.

Now, personnel within the public works department—and throughout the City of Nacogdoches—can submit vehicle maintenance work orders using Survey123. The vehicle maintenance department can easily view and edit these work orders by logging in to ArcGIS Online and looking at the vehicle maintenance feature layer Data tab.

Finally, city staff members no longer have to leave notes on their windshields requesting repairs or wonder why their vehicle is taking so long to fix.

↑ With Survey123 for ArcGIS, the GIS division built a survey that contained only the fields needed to submit a work order for vehicle maintenance.



↑ The team was also able to add fields to the back end of the survey that only the vehicle maintenance department could see and use.

Saving Time and Money

Giving employees in the public works department such wide-ranging access to enterprise GIS—especially via apps they can use in the field—has been a boon for the City of Nacogdoches.

"These applications have saved the city from purchasing outside software packages and have saved time and money on a daily operational basis," said Steve Bartlett, a city engineer.

For more information on how the City of Nacogdoches uses GIS—in the public works department and beyond—contact Tred Riggs, the city's engineering technician supervisor, at riggst@ci.nacogdoches.tx.us or 936-559-2519.

ArcGIS Online Keeps Blazing Trails

A Deeper Look at Recent Improvements to ArcGIS Online

With each new release, ArcGIS Online gains advanced capabilities and fresh content. Thanks to input from users about what they need most from the technology, Esri's team of developers is able to continually infuse ArcGIS Online with improvements that make it easier to use and simpler to navigate.

Dive a bit deeper into some of the more recent improvements to ArcGIS Online and see what this integral part of the ArcGIS platform is capable of.

New Capabilities

Three new features in Scene Viewer bring 3D scenes to the next level.

First, a new elevation mode, called Relative to scene, automatically selects the highest position of all layers to ensure that users can clearly see points that overlap with objects. For example, in a web-based tourist scene that has both a 3D building layer and point layers that mark popular tourist locations, using the Relative to scene elevation mode will place the points on top of the buildings so they show up cleanly.

The second feature is the Callout option, which lifts icons above the buildings they mark and draws a vertical callout line below to help users identify exactly which location an icon refers to. This can be especially helpful for points that are located on the ground between buildings, since they would otherwise be occluded.

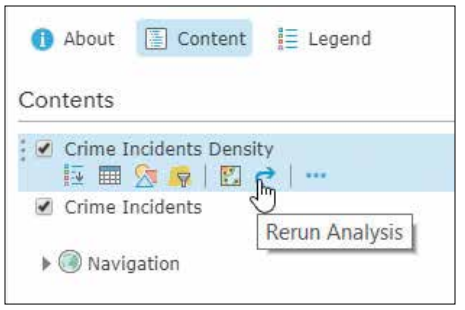
↑ The new Callout option in Scene Viewer lifts icons above the buildings they mark and draws a vertical callout line below.

Third is the new Declutter setting. For scenes that have many overlapping points, it automatically cleans things up by hiding point layers that overlap. For example, a scene of art galleries in New York City would be littered with overlapping points, since there are so many of them and a lot of them are located close together. Using the Declutter setting, however, provides a clean viewing experience, as fewer points are showcased on the full scene. When a user zooms in to a specific area, though, all points become visible.

Smart mapping has new 3D capabilities within Scene Viewer as well. Users can now stylize buildings with colored and gray-scale textures, use the Counts & Amounts style to drive color ramps (showing energy use from high to low, for example, with dark blue indicating high use and light blue signifying low use), and employ the types style to assign a different icon or symbol to each attribute value (a green circle to indicate parks and a purple square to signify commercial buildings, for instance).

Users can also now create hosted feature layer views to generate multiple views of their data—with different styling, sharing, and editing permissions—without having to duplicate their data. It is also possible for users to define what data is visible by creating a view definition based on features or fields.

Map Viewer now makes it easier to run the same (or similar) analysis over and over. It automatically saves analysis input parameters in the results layer, so users can just click the new Rerun Analysis button to update the analysis with the most recent data. The button also works to keep live data feeds current. Just update the input layer before clicking it, and everything stays up-to-date. Additionally, users can employ the Rerun Analysis function to share the steps of an analysis along with the result. When others receive the dataset, they can use the Rerun Analysis button to open the tool pane, view the parameters used to create the result, and rerun the analysis themselves.



↑ The new Rerun Analysis button makes it easier to run the same analysis more than once.

The Esri World Geocoding Service, which has exceptional coverage, accuracy, and flexibility, now supports address-level geocoding in 135 countries. In addition, the reference data for most countries has been updated, and new, authoritative address data sources were added for Australia (from PSMA Australia's Geocoded National Address File, or G-NAF) and Austria (from BEV, the Federal Office of Metrology and Surveying).

Now, even poorly formatted addresses can yield the correct match. For example, the Esri World Geocoding Service can decipher most misspellings, as well as extra, non-location-based information (such as a homeowner's name) and identify the appropriate coordinates.

→ With Counts & Amounts, users can drive color ramps that show energy use from high (dark blue) to low (light blue).

→ The dark and desaturated Firefly basemap ensures that the data presented on top of it pops.

Distributed Collaboration

Working together just got a whole lot easier. As part of an early adopter program, users can now share content between their ArcGIS Online organizations and ArcGIS Enterprise 10.5.1 portals. These new distributed collaboration capabilities in ArcGIS Online allow organizations working in both online and on-premises systems to establish a trusted environment with defined rules for sharing maps, layers, and files. The data stays in sync using item and data replication.

↑ Early adopters can now share content between their ArcGIS Online organizations and ArcGIS Enterprise 10.5.1.

Improved Navigation

To help users who have multiple accounts for ArcGIS Online and Esri websites, Esri introduced Switch Accounts, which links them. Now, it is easier to toggle among ArcGIS Online accounts and Esri websites, including My Esri, Technical Support, and GeoNet. ArcGIS Online accounts that use the same login (a social or enterprise login, for example) are automatically linked with Switch Accounts, whereas ArcGIS Online accounts with different logins allow users to link their accounts from the Switch Accounts panel. With this, users can stay signed in, choose to sign out of the current account, or opt to sign out of every linked account—all in one place. The contents and privileges associated with each account remain independent and separate, completely unaffected by the linking.

Users can also launch web apps directly from ArcGIS Online by clicking the Apps button on the right-hand side of the header on the home page. Once an app is selected, it will open in a new browser tab. Additionally, when users sign out of ArcGIS Online in one tab, they automatically get signed out of ArcGIS instances open in other tabs.

More Content

Even with the profusion of feature layers, apps, and basemaps already available in ArcGIS Online, Esri keeps adding more.

The Living Atlas of the World contains two new basemaps: *World Imagery (Firefly)* and *World Imagery (Clarity)*. Currently in beta, these are both alternative views of the *World Imagery* basemap.

The Firefly basemap is dark and desaturated to ensure that the data presented on top of it pops. It is best paired with a single, glowing thematic layer to easily capture a viewer's interest on a focused topic, such as weather phenomena, which benefits from the drama and spatial context of imagery but is sometimes better represented by reduced-color imagery.

The Clarity basemap is intended to be used when it is more important to get a clear view of a place than to present the most recent imagery of that location (the latter being the default for *World Imagery*). For instance, if the most up-to-date imagery of New York City has a cloud over Times Square, but a user really needs to show the streets that make up Times Square, he or she could employ the Clarity basemap to get a slightly older version of the imagery that doesn't contain the clouds.

The *World Imagery* basemap has a wealth of new content as well. Thanks to Esri's ongoing partnership with DigitalGlobe, developers have been able to update the *World Imagery* basemap with new high-resolution imagery for Afghanistan, Alaska, Austria, Canada, Colombia, Germany, the Netherlands, New Zealand, Spain, Suriname, Turkey, and other places. Several dozen metro areas have also been updated with submeter-resolution imagery. Esri has improved its demographic maps for the United States and a number of other countries as well. For the United States, Esri's demographic maps now feature the latest 2017 current-year estimates and 2022 five-year forecasts based on census and American Community Survey (ACS) data. Esri partner Michael Bauer Research has also released updates for more than 30 countries, including China, India, Japan, Kazakhstan, Israel, and the United Arab Emirates. Additionally, the 2010 US Census demographic data is available for free in the Living Atlas of the World.

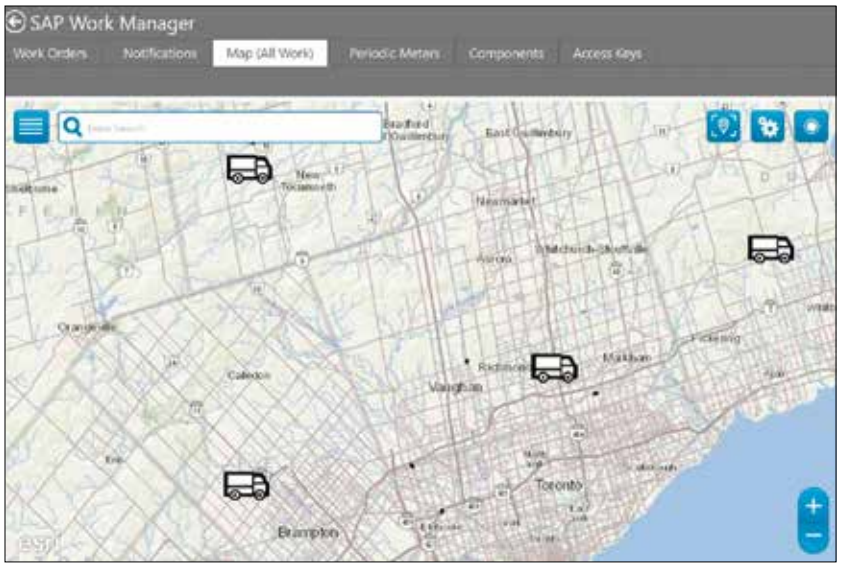
For more information about what's new in ArcGIS Online, visit the ArcGIS Online blog at go.esri.com/blogs. Esri also invites all users to share their product enhancement ideas at go.esri.com/ideas.

ESRI PARTNERS

Share Data for Better Results

Equipped with innovative ideas, industry expertise, and the ArcGIS platform, Esri partners are implementing enterprise GIS that keeps workers safe, increases efficiency, and saves on costs.

Find out how the following four Esri partners are making organizations and communities smarter by giving more people access to a wide range of geospatial information.



↑ With Critigen's Lemur, schedulers can see crew locations in the SAP Work Manager map view and share them with dispatch so dispatch can notify the nearest crew member of an outage or emergency.

↑ Lemur allows users to configure the GIS to cache specific map layers for offline use in the field, as well as update the frequency and extent of coverage.

Move to Mobile Hits the Mark

Hydro One, which has served Ontario, Canada, since the early twentieth century, faces a constant challenge: finding innovative ways to increase the performance of its vast electricity system while reducing costs and keeping safety the number-one priority. As the owner of 97 percent of the transmission network in Ontario, Hydro One needed to move away from antiquated paper-based processes that limited access to information, led to questionable data integrity, and required months to make simple updates. Linemen, for example, could only carry maps of their operational areas in their trucks, meaning that if there was an incident in another jurisdiction, those maps would be useless.

"We needed a new way to connect our offices to the field forces, and vice versa," said Brad Bowness, vice president of distribution at Hydro One.

The solution was to implement Move to Mobile (M2M), which tightly integrates Hydro One's SAP Enterprise Asset Management system and SAP Work Manager (a scheduling software) with Lemur from **Critigen** (critigen.com). Running in the ArcGIS platform, Lemur automates the process of sending updated map data to field crews' tablets.

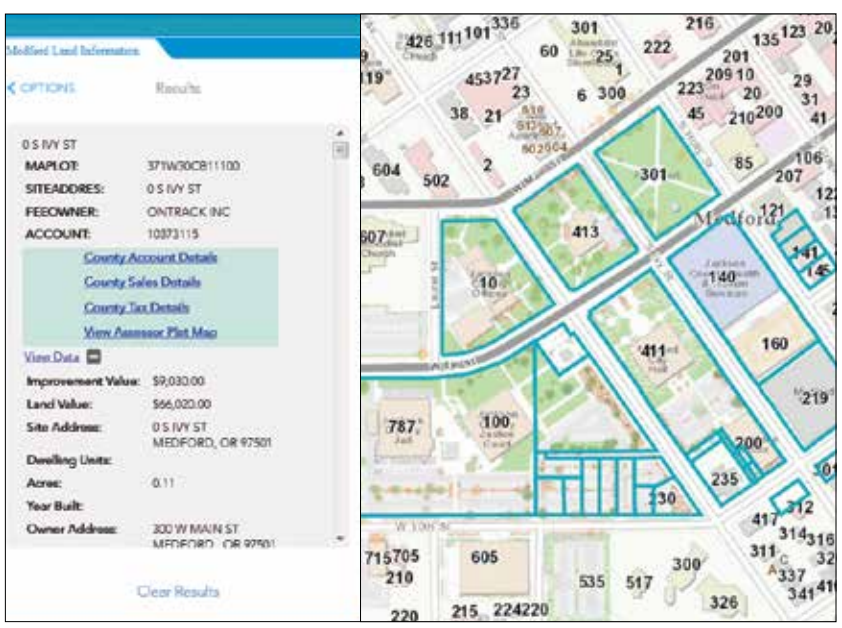
"Critigen helped us put ArcGIS in the field," said Janice Coulson, Hydro One's project team lead on the M2M project. "Field crews receive up-to-date cached map data for their region. If an incident occurs in another region, they can access that region's data to respond."

Getting field data back into the office is easy, too. "As line maintainers complete their work in *[SAP Work Manager]*, our business processes are maintaining that asset information both on the SAP side and in the enterprise GIS," explained Coulson.

With truck locations now visible to schedulers, dispatch can quickly notify the nearest crew member to respond to an outage or emergency. At the same time, crews can submit new issues they encounter while in the field or make the decision to address these problems on the spot. "They've never had that visibility before, and they are taking ownership of the process," said Coulson.

By integrating these best-in-class technologies, Hydro One replaced more than 40 paper forms, modernized its scheduling methods, and gave linemen real-time access to up-to-date SAP data and GIS maps. Moreover, using Lemur to automate the extent and frequency of map cache updates lowered the demand load on Hydro One's server architecture, reduced data entry time from an upper end of 180 days to 4 or 5 days, and greatly improved the integrity of field submissions.

"We have successfully integrated both SAP Work Manager and GIS into one system," said Bowness. "We are already realizing productivity savings as a result of the M2M, and I am confident this will be a powerful tool for Hydro One business operations."



↑ Citizens, businesses, and city staff can use the Medford Land Information (MLI) system to search for information about county parcel taxes, sales, and details, as well as to view parcel maps.

Web GIS for Staff and the Public

With a population of 81,000 that's growing at a steady rate, the City of Medford, Oregon, needed a new way to provide city staff and residents with access to public land information. So the city's GIS team collaborated with **VESTRA Resources, Inc.** (vestra.com), to replace its existing app with one that leverages Web GIS via the ArcGIS platform.

The Medford Land Information (MLI) app is a modern, mostly out-of-the-box solution that empowers decision-making and fosters collaboration within the city, as well as with the public. It contains information about building permits, occupational licenses, planning and zoning, code enforcement, infrastructure, aerial photos of the entire city, and more. The app aggregates data from multiple servers and puts it in one location.

To bridge the gap from the old, unsupported system to the new technology, VESTRA migrated the city's highly customized Microsoft Silverlight app to JavaScript using ArcGIS API for JavaScript and implemented the new MLI app in ArcGIS Online. VESTRA also used Web AppBuilder for ArcGIS to create custom widgets that mirror some of the functionality of the older app, such as advanced querying, reporting capabilities, and the ability to access the city's land information from the IBM iSeries (AS/400) server where it is stored.

Requiring minimal to no training, MLI allows citizens and businesses to easily wield the same public-record information as city staff. Users can find a wealth of information about each parcel in the city, including land value, the year any structures were built, and the zoning and fire districts. They can also use MLI to answer spatial questions such as, Which ward do I live in? and What elementary school serves this area?

Having all this information available to the public has substantially reduced the number of calls the City of Medford receives from citizens, which has helped staff save time, reduce costs, and be more effective overall. Additionally, in allowing Medford's citizens to easily visualize this information on maps, the city is keeping them informed and engaged with their community.

Speeding Up Work and Response Times

Denton Municipal Electric (DME) has been serving the Greater Denton, Texas, area for more than 100 years. To continue to provide effective and efficient utility services, the company needed to replace older technology with new systems that would help improve response times, increase reliability, and ensure crew safety.

"Because DME's systems operations group manages all outages and crews as they respond to incidents, integrating our data systems *[into]* a common platform is becoming very important as we grow," said Trey Price, engineering systems applications supervisor for DME. "Two years ago, we determined our old, archaic system was crashing too often, unable to deliver accurate GIS information to crews, and was a cybersecurity risk."

To improve productivity and data integrity, amalgamate dispatching and work assignments in one system, obtain real-time visibility into field activity, and help crews quickly and safely get to their assignments, DME partnered with **Clevest Solutions, Inc.** (clevest.com), and implemented the Clevest Mobile Workforce Management system, which is fully integrated with the ArcGIS platform.

DME's project required a configurable, utility-wide system for managing work; the ability to create and administer work orders for various citywide calls for service about water and wastewater, locating electric and fiber-optic service lines, and to repair or replace meters and city assets such as poles or streetlights; and new ways to integrate multiple systems used to manage everything from customer information, assets, maintenance, and outages to GIS and 811 (the call-before-you-dig line). The utility also needed a way to handle ticketing for non-customer calls, such as those to report leaks from services DME doesn't handle, both at the office and in the field.

The Clevest Mobile Workforce Management solution lets DME provide mobile service, outage, and locate orders. And all this is integrated with ArcGIS Enterprise and ArcGIS Online, as well as ArcGIS Network Analyst. Office employees use Clevest WorkSpace on their desktop computers, while staff in the field access a mobile app called WorkBook on their smartphones or tablets.

"The real-time map view allows us to instantly filter such items as electric orders, outages, locates, and streetlights," said Price. "If I am in the office, I can see where the crews are, what's been assigned, and what they are working on. If I am a crew member, I can see what is assigned to me and prioritize my work. In addition to accurate GIS information regarding the work location, I can now pull up account information related to that location."

So far, the feedback about M2M has been positive, with office staff and field crews finding the Clevest solution easy to use and informative. Price said that DME's response times are speeding up as well.

"We expect the improved response times and faster power restoration to boost customer satisfaction," said Price. "By unifying our workflow around a paperless system, we are reducing operational costs."

↑ The real-time map view in the Clevest Mobile Workforce Management solution allows employees at Denton Municipal Electric (DME) to instantly filter items such as electric orders, outages, and locates.

← With Clevest Mobile Workforce Management, field staff at DME can access the WorkBook mobile app on their devices.

Collaborating to Curb Homelessness

In 2014, the City of Tacoma, Washington, began working with community partners to address issues related to mental health, substance abuse, and homelessness. After soliciting community feedback, the city partnered with Comprehensive Life Resources (CLR), a nonprofit organization that offers mental health, homeless, housing, and other human services to residents in and around Tacoma.

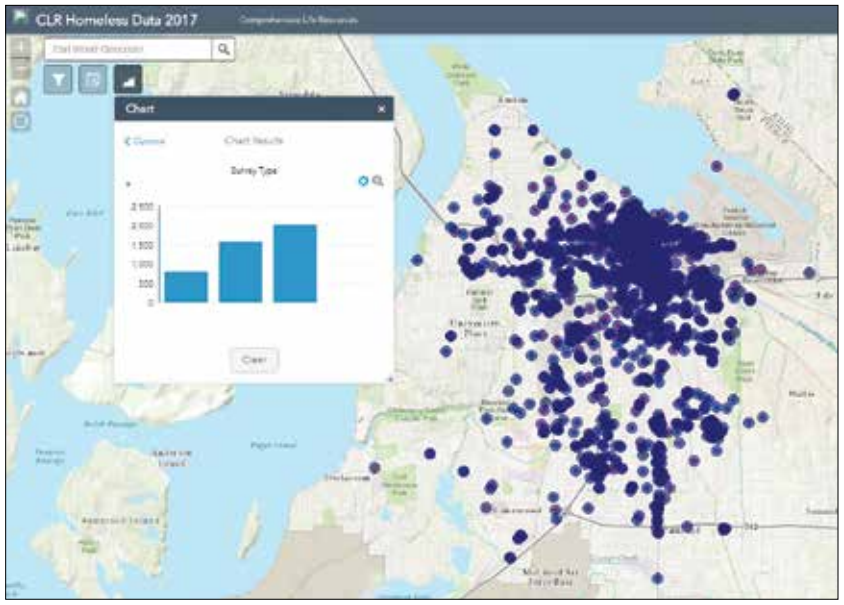
One of CLR's programs, called Positive Interactions, assists local businesses in addressing concerns related to homelessness and blight. Tailored to fit the needs of both businesses and individuals experiencing homelessness, Positive Interactions operates a response line that business owners and community members can call to express their concerns about homeless activity in their areas. CLR field crews then engage directly with the homeless individuals in a way that is sensitive to the traumas they have faced to learn their needs and connect them with services.

To get Positive Interactions started, CLR employees collected field data about businesses and Tacoma's homeless population on paper and then completed fillable forms in Microsoft Word once they got back to the office. It was common to have lapses in time between interacting with homeless individuals and submitting the forms, which often resulted in lost or inaccurate data. CLR also needed to record spatial information, analyze data, track time and resources, and create reports—but it couldn't do any of this easily.

So CLR approached **Frontier Precision** (frontierprecision.com), which suggested that the organization employ Survey123 for ArcGIS on employees' phones and tablets to gather data in the field. Since nobody at the nonprofit had experience with GIS, CLR had Frontier Precision assist in configuring, deploying, and managing the survey and the data.

CLR deployed the digital survey in September 2016, and since then, employees have submitted almost 5,000 surveys. With so much data, CLR can analyze it to find trends and patterns in where homeless activity takes place, how homelessness changes during different seasons, and how demographics factor in. Now, management can better deploy field crews to areas with high levels of homeless individuals. And crew members can view prior surveys to figure out if the homeless individual they are about to visit has been contacted before and follow up with him or her on services that were previously offered.

After Frontier Precision demonstrated how helpful GIS is and how easy it is to use, CLR fully embraced the technology by deploying it across the organization in several different programs. Starting this year, CLR will have a public resources locator that will help members of the community and case workers find housing, financial, and legal services for those in need. Additionally, CLR will employ Survey123 for data collection related to its gang reduction project, its mobile community intervention response team, and for foster care case management.



↑ With almost 5,000 surveys submitted, Comprehensive Life Resources (CLR) can now analyze its homelessness data to find trends and patterns.

← Using Survey123 for ArcGIS, CLR easily arranged to have trash left behind by homeless individuals cleaned up so that local businesses could operate as usual.

With Street-Level Imagery, Property Reappraisals Go Virtual

Esri Startup Partner Mapillary Helps County in Ohio Simulate Site Visits

New businesses that join the Esri Startup Program receive online services, software, content, training, and support so they can incorporate mapping and location analytics into their products. Mapillary, a Swedish startup that wants to map the world using street-level images, has been in the program for three years. In that time, Esri has relayed deep technical knowledge of the ArcGIS platform and helped connect this GIS newcomer with all the right industry touchpoints.

Recently, Mapillary teamed up with Esri partner Bruce Harris & Associates, Inc. (BHA), to help Erie County, Ohio, improve how it conducts recurring property reappraisals on a small island in Lake Erie.

A Digital, Geospatially Integrated Workflow

Like most counties in the United States, Erie County is required to conduct property reappraisals every six years. On Kelleys Island, located about four miles off the mainland in the western basin of Lake Erie, staff members from the county auditor's office were doing property inspections using paper maps and printed property records. Because the appraisals required checking the grade and condition of all county buildings on the island, auditors had to visit every single site.

Even though the island is just over four square miles in size, this workflow took up a lot of time, was too prone to human error, and was difficult to replicate every six years. So Erie County sought to improve how it conducted fair and equitable property assessments. The GIS team at the auditor's office opted to set up a digital, geospatially integrated workflow.

First, the county worked with consulting firm BHA to implement its Paperless Reappraisal System (PRS), a set of apps that uses ArcGIS for Local Government solutions and ArcGIS Online to make the entire reappraisal process—from data collection and review to quality control and workflow management—digital. PRS works directly with Erie County's GIS by linking appraisers to county land records and up-to-date georeferenced information.

Still, the county wanted to be able to simulate the site visits required to check the building grades and conditions. To make that happen, BHA partnered with Mapillary to use its street-level imagery and computer vision capabilities in conjunction with BHA's own PRS Photo Reviewer app. Combining geography, automation, and advanced analysis techniques, Mapillary's imagery platform automatically turns 2D photos into 3D street views by stitching images together at points that match up; recognizing objects in the images; and generating map data such as street signs, road characteristics, and building types. Thus, whereas BHA's app provided useful oblique imagery of Kelleys Island, Mapillary's addition of a street-level angle gave the county the vantage point it needed to fully simulate site visits. This integration was cost-effective and sped up the appraisal workflow.

Giving Field and Office Staff the Same Viewpoint

To carry out the reappraisals, Mapillary personnel and BHA staff, along with Erie County auditor Richard Jeffrey and his staff, equipped a county vehicle with four action cameras (which are small, lightweight, and splash-proof) to capture street-level imagery of the entire island. Photos were taken over a span of eight hours. They were then uploaded to Mapillary, which scrubbed the images to remove faces and license plates, point matched them, and stitched them together to create the street-level viewpoint.

Back at the office, BHA staff verified parcel characteristics such as assessed building grades, property condition, and construction materials. Staff from the county auditor's office viewed all the work via the PRS Photo Reviewer app with Mapillary's integrated photo viewer capabilities.

Using the app with Mapillary allowed Erie County office employees to see the appraisal process through the eyes of field staff. And having a street-level vantage point to verify appraisal data ensured that property assessments were accurate and up-to-date.

"Having this imagery integrated in our apps to use at any time *[is]* invaluable," said Mark Wroblewski, the GIS coordinator for the Erie County Auditor's Office. "The ability to seamlessly collect imagery at any time, without contracts or expenses, *[is]* another return on the investment for Erie County."

Collaboration Leads to Smooth Completion

Leveraging Mapillary's technology, along with software from Esri and BHA, provided Erie County with street-level imagery that met its assessment needs. The resolution and quality of photos—all taken by staff while driving the streets of Kelleys Island—exceeded the county's expectations. The photos effectively supplement the county's workflow for checking the grade and condition of any building. And because the imagery is integrated with PRS using Mapillary's API, county staff can navigate from parcel to parcel smoothly.

With this street-level imagery and its metadata, appraisal managers and county constituents can now see information that Erie County previously had to attain by making site visits to each individual property. Additionally, data entry teams can use the always-available imagery to ensure the quality and consistency of building characteristics.

Overall, the integration saved the county time and money. Thanks to this collaboration between a young startup and a veteran Esri partner, Erie County is on track to meet its sexennial reappraisal mandate.

It took eight hours for this crew to capture photos of the entire island that could be used in Mapillary.

↓ Having a street-level vantage point from which to verify appraisal data ensures that Erie County's property assessments are accurate and up-to-date.

Web-Based Apps Help Agricultural Producers, Consumers Digest Information

Canadian Government's Agriculture Department Develops Self-Serve Map- and App-Building Platform Using ArcGIS Online

The agricultural industry is facing unique agronomic, economic, and environmental challenges and opportunities—from extreme weather events and new invasive species to growing global competition. Consumer expectations are evolving as well. Canadians are demanding more variety and convenience from their food, as well as environmental friendliness and assurances of quality and safety.

Producers are looking for novel products and processes to help them meet the demands of these new markets while also ensuring that their operations are competitive and sustainable. Agriculture and Agri-Food Canada (AAFC), a government organization that aims to drive innovation and ingenuity in Canada's agriculture and food industries, determined that one of the best ways to help the sector develop sustainably is to give as many organizations and people as possible the ability to visualize and effectively leverage the wealth of information—from crop density and soil moisture to farm locations and agri-environmental indicators—that is available to support decision-making in the industry today.

Using ArcGIS Online, AAFC is making that possible. Two years ago, the organization opened up its ArcGIS Online organizational account to almost 180 departmental users. Called UMAP, this AAFC-branded, cloud-based portal enables these users to employ a wide range of agricultural data to create interactive web maps and apps for their colleagues, food producers, and the public.

A Self-Serve Geospatial Destination

When this project started, AAFC had limited resources. So it wanted a solution that would require little in-house development and that would get the department up and running with making its own maps and apps quickly. The solution also needed to meet security requirements and integrate data according to government standards.

As a heavy user of the ArcGIS platform already, AAFC saw that ArcGIS Online met these requirements. Using it would give the team a secure, software-as-a-service (SaaS), cloud-based platform that is hosted and supported by Esri.

"We found the SaaS model very attractive because it meant that we could operate with a small server footprint," said James Ashton, AAFC's geomatics applications manager. In other words, the organization could focus on using the software rather than building it and maintaining the infrastructure.

Now, UMAP is a self-serve geospatial destination that AAFC staff can use to mash up key organizational information layers—such as annual crop inventories and historic yield and production statistics—with interoperable data from other organizations and third parties, like Esri. They can then use this data to create intelligent web maps that can be shared with specific interest groups or departments. Employees can also build on work previously completed by colleagues and share new results across the enterprise.

What's more, employees designated as publishers can host their own, nonsensitive data in the cloud and create their own map services by converting CSV files into shapefiles to web enable them for ArcGIS Online. UMAP administrators monitor credit usage across the organization as well and choose which data to make public or keep private.

"The platform transforms our datasets into ready-to-use web resources that serve as powerful tools to communicate complex information in a very simple way," said Ashton. "It significantly reduces confusion about where to access organizational maps and the need for departments to contact each other for information. This also reduces the number of requests received by our help desk."

The UMAP home page has a customized banner, featured content, and links to training videos—all of which align with branding and objectives.

Disseminating Geospatial Data Efficiently

To make it easier to get data and apps to outside organizations and producers, AAFC also populated a public-facing app gallery with popular web apps.

"The demand for information is always increasing, and we're seeing a much broader range of potential users," said Ashton. "By leveraging a more efficient and cost-effective approach to disseminating geospatial data, we continue to transform ourselves into a knowledge-based department where we *[employ]* geospatial information in our decisions."

Two of the public-facing web apps that AAFC staff recently developed and shared are the Annual Crop Inventory app and the Land Use app. The Annual Crop Inventory app allows users to quickly analyze and visualize field-level cropping patterns (i.e., an overview of what has been planted on farmland before) across Canada. The Land Use app enables users to analyze changes in land use throughout the country between 1990, 2000, and 2010. If a producer is interested in renting farmland, for example, he or she could use these maps to see which crops have been planted in previous years. That way, the producer can make the most effective and environmentally conscious decision about which land to farm and what to cultivate on it.

"A picture is worth a thousand words," said Ashton. "Maps help us visualize the information we collect and that *[the Science and Technology Branch at AAFC]* creates. This, in turn, helps us ask better questions and make better decisions. Imagine how a farmer or policy maker could benefit from simple web-based access to open datasets on changes in land use, such as crop rotations or the environmental impacts of droughts."

AAFC uses Esri templates, such as Compare Maps and specialized Canadian federal government ones, to build the apps quickly and in compliance with accessibility and common government branding requirements. By using ArcGIS Online in conjunction with templates, some apps—like the Spatial Density of Major Crops in Canada app—have taken only an hour to deploy.

In addition, AAFC registers its data, web services, and apps to the Federal Geospatial Platform (an internal government portal) and the public-facing Canadian Government's Open Data Portal. By doing this, it ensures that these portals point back to AAFC's services, giving more people—both internally and externally—access to the organization's data.

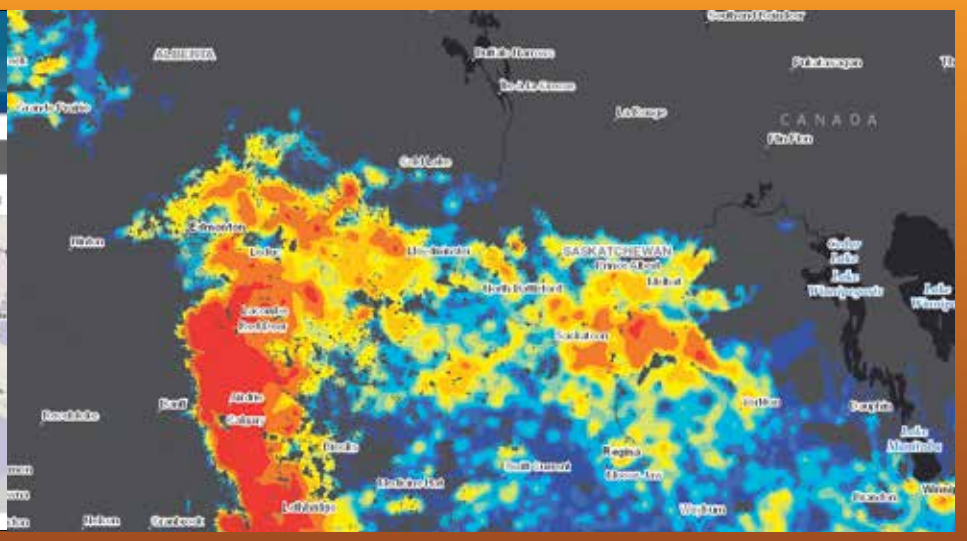
Enabling Better Decision-Making

By using the ArcGIS platform to better inform internal staff, agricultural producers, and the public, AAFC is ensuring that more people can visualize and leverage the myriad information the department receives, meeting both consumer expectations and producer needs.

AAFC's maps and apps are informing policy makers on a global scale, from grain brokers looking for new cereal sources to real estate scouts seeking new investment opportunities. Now, they can all see where specific cropping trends, like monocropping, are occurring and where forest or urban expansion are taking place. Using web maps, the department can share its data broadly and cost-effectively, allowing policy makers to easily collaborate in finding solutions to ongoing challenges.

For more information, contact Gordon Plunkett, the spatial data infrastructure (SDI) director for Esri Canada, at gplunkett@esri.ca or 613-683-6213.

↑ Having rapid visualization of field-level cropping patterns across the Canadian landscape—all in one browser—gives powerful web analytics and visualization to the agriculture industry.



↑ Using one of AAFC's web apps, such as the Spatial Density of Major Crops app, researchers and the public can analyze the density of crops across Canada.

Restoring a Watershed, One Bag of Litter at a Time

Prince George's County Uses Survey123 for ArcGIS to Meet Waste Reduction Targets

Throughout the mid-Atlantic region of the United States, "Save the Bay" bumper stickers and signs adorn cars and store windows. They refer to the Chesapeake Bay—the largest estuary in the country—which stretches 200 miles and receives runoff from a vast watershed that contains about 18 million people. Unsurprisingly, the Chesapeake Bay faces considerable pollution issues.

Prince George's County, located just outside Washington, DC, sits in the bay's smaller Anacostia River watershed—one of the most densely populated watersheds in the Chesapeake Bay drainage basin. With 900,000 people occupying almost 500 square miles of cities, suburbs, and farms, the county is especially concerned about storm water runoff polluting its waterways.

Litter—which often gets washed up in storm drains and transported to local lakes and streams—is one of the most persistent pollutants in the county. Not only an unsightly blemish on the landscape, this garbage carries additional toxins into the bay that affect biota, the chemical makeup of the water, and drainage outlets.

"We were constantly asked the question, Where is this litter coming from?" said Tiaa Rutherford, Prince George's County's litter reduction program manager. "As a county, we could not answer that question."

To keep the local bay tributaries and communities clean and beautiful—and to help protect the 43 fish species and 200 bird species that live in the Anacostia River watershed—the Prince George's County Department of the Environment (DoE) launched a mobile app to track litter. Built with Survey123 for ArcGIS, the app, called PGCLitterTRAK, allows county residents, community organizations, and businesses participating in cleanup activities to use their smartphones to quickly record information about the trash and debris they collect.

"Using Survey123, we developed a simple tool that empowers people doing cleanup work to report back to us on the quantity and location of litter," said Rutherford.

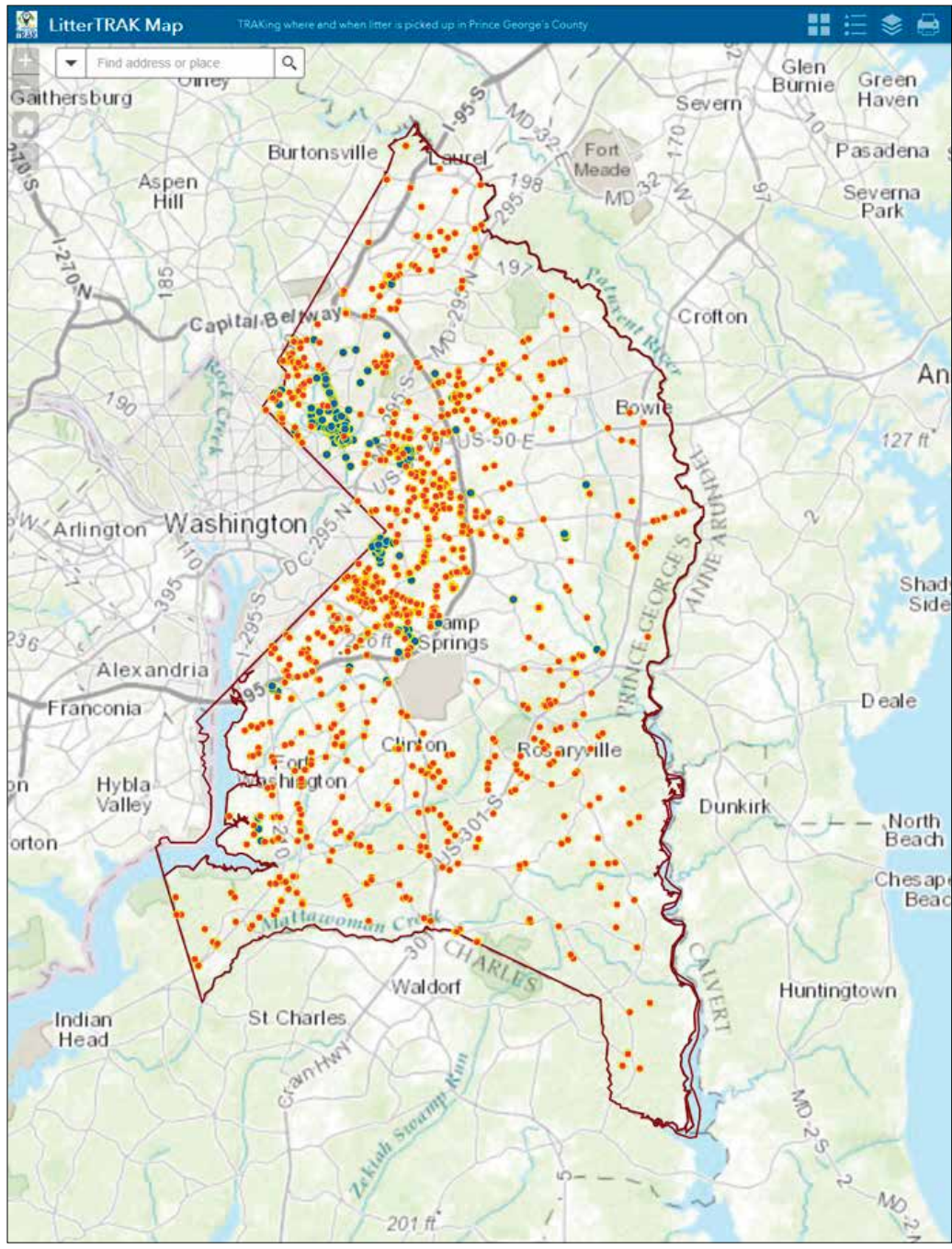
Measuring Litter Pickup Properly

In 2010, several state and federal environmental agencies, as well as local and county government departments, drafted an interjurisdictional trash cleanup blueprint for the Anacostia River. To satisfy federal water quality standards, it mandated that Prince George's County reduce the amount of garbage in the watershed by 170,628 pounds per year.

Prince George's County was already using ArcGIS to show how it was meeting its trash reduction targets. But data collection and documentation were off. Only certain types of refuse picked up in specific watersheds receive trash removal credits from the Environmental Protection Agency. Yet the county could not validate the litter picked up by local organizations and the public, nor could it categorize the array of trash collected by its own garbage trucks.

To more effectively demonstrate how hard the county was working to reduce the amount of litter going into the river, Catherine R. Escarpeta, a senior GIS analyst with DoE, decided to use a resource the county already had: an ArcGIS Online subscription. Employing Survey123, Escarpeta built PGCLitterTRAK, which lets trash collectors record the number of bags of litter gathered, the types of items picked up, and the locations of the garbage—all on-site.

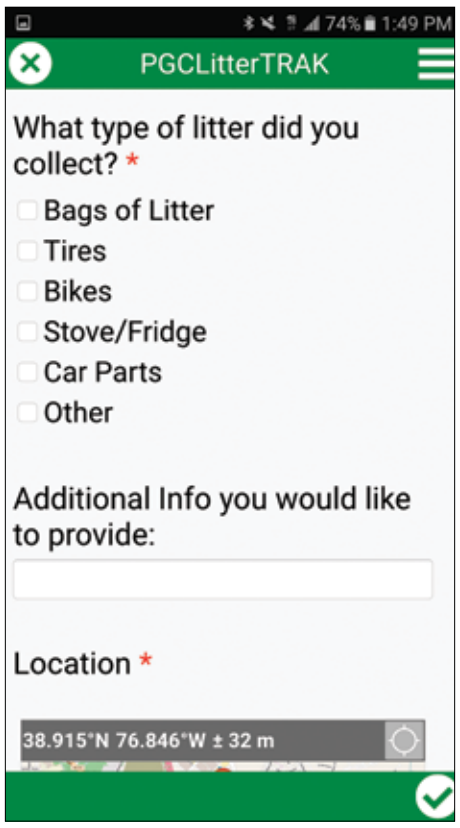
At no extra cost, Survey123 was ideal for this project. Its formcentric design, ability to collect location information in the background, and capacity to upload photos made it easy to use. In addition, Survey123 allowed the county to publish its litter tracking app to Android, iOS, and Windows devices seamlessly, so large numbers of volunteers and employees could use it.



↑ PGCLitterTRAK connects directly to LitterTRAK Map, an internal web-based map that employees at Prince George's County can use to visualize the incoming data and make decisions about where to best allocate resources.

Recording Accurate Data

Above all, Escarpeta wanted to make the app easy to use. She included setup hints—snippets of text, like a sample email address or phone number—that help users answer questions correctly. She also ensured that the county could validate the data by requiring some questions—such as What is your organization?—and giving others drop-down menus so users only have certain, uniform answers to choose from. Additionally, Escarpeta customized the survey so that some fields, especially those required to accurately report litter cleanup to the county, get completed automatically upon submission.



↑ PGCLitterTRAK only asks users about what they are doing at a specific location to ensure that the county receives the correct data.

Escarpeta also wanted to ensure that Prince George's County received the correct data. She focused the app's questions on the quantity and location of litter collected. For example, when filling in the type of garbage being picked up, if a user selects Bags of Litter, the next question will be, How many bags? If the user selects Tires instead, the app will ask, How many tires? Users can upload photographs to further document their cleanup efforts. And hidden fields within the app—such as fiscal year, council and maintenance districts, and watershed data—ensure that the information can be automatically exported to the proper departments within Prince George's County without bogging down users with extraneous details.

"PGCLitterTRAK and Survey123 enhance the user's experience by only asking about what that person is doing at that specific location," said Escarpeta.

The app also functions offline, which is crucial to tracking and reporting litter, since parts of the county have limited wireless connectivity. Additionally, various functions built into users' devices, such as the voice-to-text capability, work within the app.

Guiding Legislation and Allocating Resources

Once users collect data out in the field, PGCLitterTRAK connects directly to LitterTRAK Map, an internal web-based map that Escarpeta built using Web AppBuilder for ArcGIS. With LitterTRAK Map, county employees, such as program managers and crew supervisors, can review and analyze the litter data coming in from throughout Prince George's County. Escarpeta can add layers to the map as well—such as hot spot analyses, council and maintenance districts, and other background information—to enable county employees to better visualize the data.

↑ With PGCLitterTRAK, county workers can track everything they pick up and even upload photos—right from where the refuse is located.

With all this, agencies such as the Department of Public Works and Transportation and the Department of Permitting, Inspections and Enforcement can run reports on the types of cleanup activities they conduct, like roadside litter removal and the disposal of illegally dumped items. These departments can then figure out how to guide legislation and better allocate their resources, determining where to focus outreach efforts to reduce litter, where to place more trash receptacles, and where to position cameras to impede illegal dumping.

Reducing Litter Across the County

Although Prince George's County developed PGCLitterTRAK to target the Anacostia watershed, the app is helping to reduce litter countywide.

"PGCLitterTRAK is making it easier for Prince George's County government to reduce litter in our waterways, streets, and neighborhoods," said Adam Ortiz, the director of DoE. "This user-friendly app gives us the ability to obtain real-time information and see a catalog of trash picked up by our county's 'trash warriors,' who are on the front lines of the battle against litter in Prince George's."

Additionally, program managers throughout the county are examining how to employ Survey123 for tracking other assets and issues, like storm drains in need of "no dumping" imprints, street signs in need of replacing, and residents in need of little nudges to pick up their pet waste.

PGCLitterTRAK is now an indispensable tool for keeping Prince George's County clean, green, and beautiful, according to Ortiz.

"Whether you are cleaning roads, streams, parks, or your neighborhood, PGCLitterTRAK tracks litter reduction achievements and encourages citizens to support the county by volunteering and being good stewards of the environment," he said.

To find out more about Prince George's County's litter reduction program, email Rutherford at trutherford@co.pg.md.us. For more information about PGCLitterTRAK, email Escarpeta (soon to be Catherine Adams) at crescarpeta@co.pg.md.us.

Mobile Technology Keeps Election Day on Track in LA County

With Workforce for ArcGIS, Troubleshooters Get to Polling Places More Quickly

During every election, California's Los Angeles County Registrar-Recorder/County Clerk deploys troubleshooters to ensure that polling places are open and running smoothly. These troubleshooters encounter situations ranging from locked polling place doors and poll workers not showing up on time to people distributing political propaganda too close to a polling place and having to restock ballots and equipment at polling places that are running low.

"We send 50 troubleshooters into the field to take care of our 4,500 polling places during a major election—that's 90 polling places per person," said Elio Salazar, GIS manager for the Los Angeles County Registrar-Recorder/County Clerk. "Whenever there is a problem, we want to be able to send the closest troubleshooter to the polling place as quickly as possible."

To streamline this extensive Election Day work, Los Angeles County started using Workforce for ArcGIS. First rolled out as a pilot in November 2016, Salazar and his team were able to rely on Workforce completely during a special election for California's 34th congressional district, held in June.

Condensing the Troubleshooting Process

Previously, when a problem occurred at a polling place, one of the election workers would call the dispatchers at the county's election operations center to notify them. The dispatchers would then get in touch with one of the troubleshooters, all of whom were driving around Los Angeles County in vans stocked with the supplies they needed to resolve problems.

But the troubleshooters' areas of responsibility are always quite large, since the team covers more than 4,000 square miles every Election Day. And traffic in and around Los Angeles can be ferocious. So sometimes it might be better to send a different troubleshooter to a problem than the one who's in charge of that polling place.

Los Angeles County wanted to condense this process and get troubleshooters to polling places more quickly. Salazar and his GIS team looked at several solutions.

"Many solutions allowed us to track the troubleshooters, but we also needed to be able to see the polling place and who the closest troubleshooter is," said Salazar.

They decided to use Workforce because it not only allowed the department to track the real-time location of troubleshooters using an interactive, web-based map, but it also enabled the county to load its own data into the map.

"Each polling place and troubleshooter *[is]* geotagged, giving the dispatcher the ability to quickly get the nearest troubleshooter to the polling place," said Kenneth Bennett, the information technology manager at the Registrar-Recorder/County Clerk. "This is a great tool for our department to address any Election Day issues."

One Interface for Communicating, Navigating

Now, dispatchers use Workforce to communicate assignments to troubleshooters, and troubleshooters use it to navigate to the polling places and report back to dispatchers on the status of their assignments. And all this is done within the same interface.

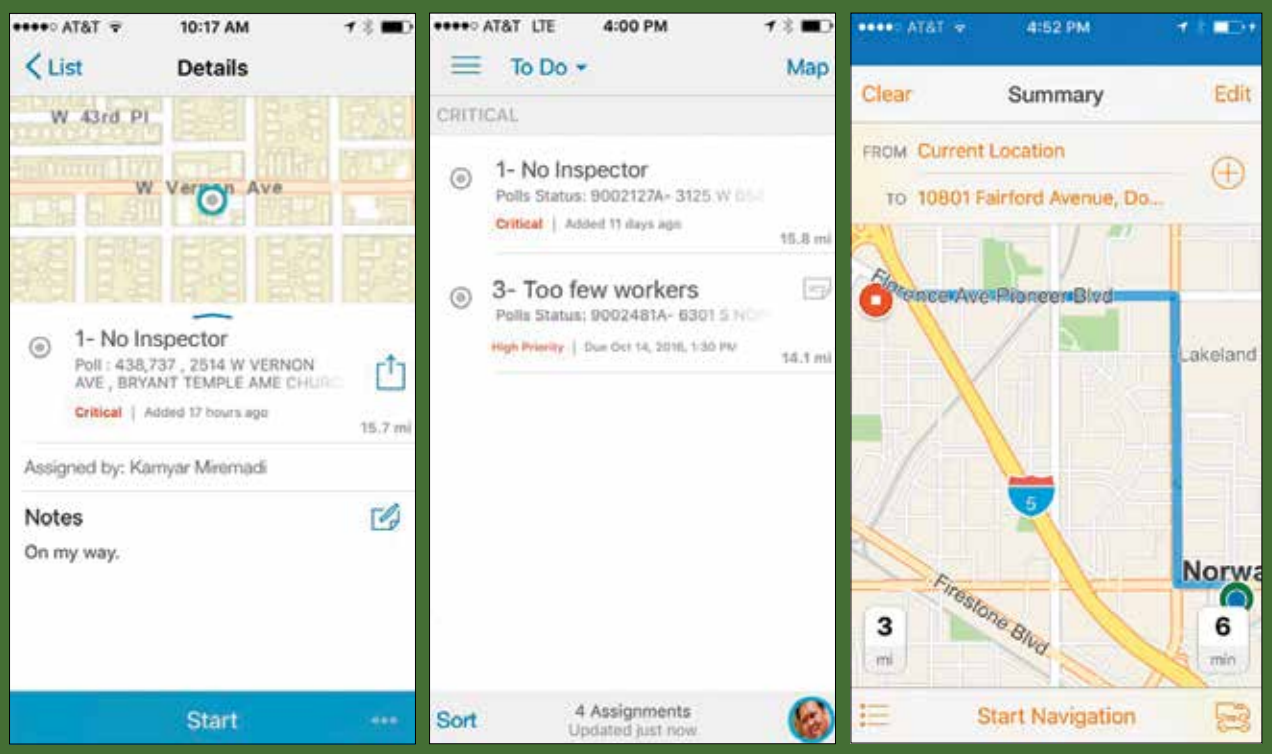
Salazar described the process: "When a call comes in, dispatchers use the map within Workforce to identify the nearest troubleshooter and create an assignment. Workforce sends a work assignment notification to the troubleshooter's smartphone. The troubleshooter uses Workforce to message back to the dispatcher to confirm that they got the assignment and *[that]* they're on their way. Within Workforce, the troubleshooter can navigate to the right location. Once they finish the assignment, they can mark it as complete and let the dispatcher know that it's done."

On Election Day in June, the team created 52 work assignments, including setting up and opening the polls, performing maintenance on audio ballot booths, and sending multilingual assistance to certain polling places. Salazar said that everyone who used Workforce found it easy to operate.

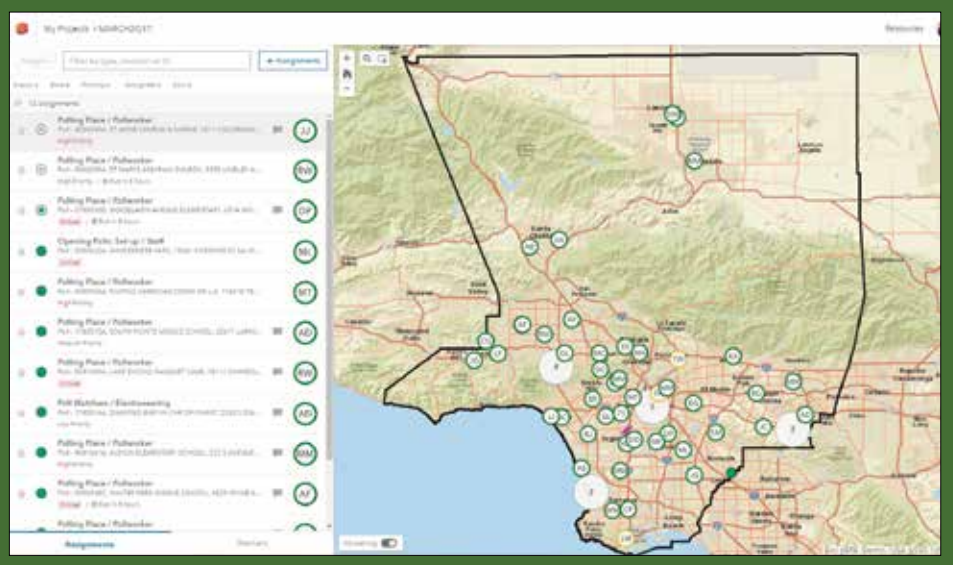
"Before Workforce, the troubleshooters were using paper maps," Salazar said. "We are now saving a lot of driving and getting the troubleshooters where they need to be much faster."

In postelection debriefings, the dispatchers and troubleshooters said they were happy with the app and thought it worked great. Los Angeles County is preparing to use it again for all elections in 2018.

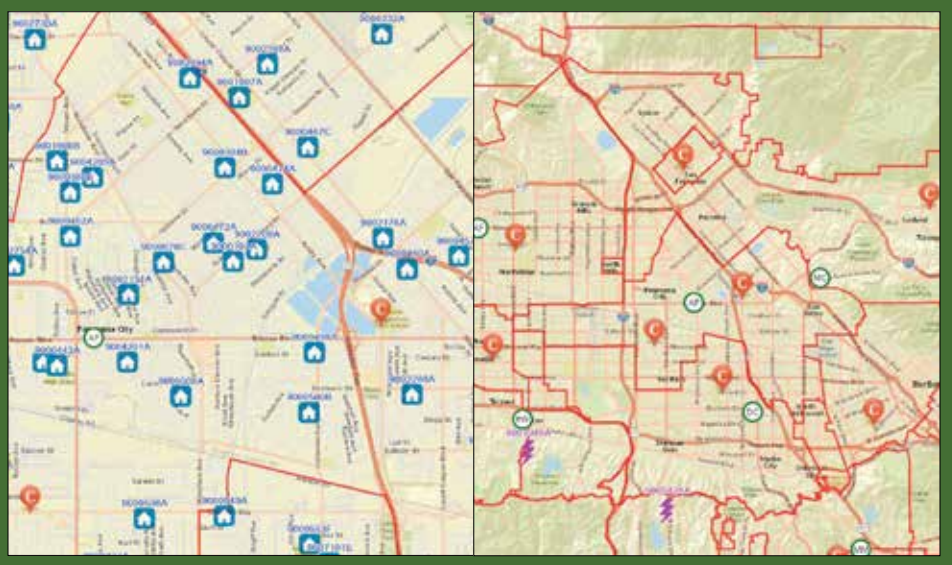
For more information on how the Los Angeles County Registrar-Recorder/County Clerk deployed Workforce, email Salazar at esalazar@rrcc.lacounty.gov.



↑ When a call comes in, dispatchers use Workforce to find the nearest troubleshooter and create an assignment. The app then sends a work assignment notification to the troubleshooter's smartphone.



↑ On Election Day in June, the team created 52 work assignments in Workforce for ArcGIS.



↑ Each troubleshooter is responsible for about 90 polling places over a large area. Taking traffic and the troubleshooter's location into consideration, sometimes it's better to send a troubleshooter from a neighboring jurisdiction to deal with a problem.

Automating Inspection Reports with Mobile GIS

Delaware Cuts Time It Takes to Assess Agricultural Easements by 75 Percent

The Delaware Department of Agriculture (DDA) has a strong history of preserving farmland. For 20 years, Delaware has purchased development rights from landowners in annual rounds, investing $219 million into Delaware's agriculture industry. The success of the agriculture land preservation program is attributed to a competitive bidding process in which easements are purchased at an average 56 percent discount off the appraised value. This allows farmers to make some extra money off their land while continuing to farm it. DDA now holds permanent agricultural easements on 866 farms covering 122,000 acres of Delaware land. Additionally, DDA holds 425 temporary 10-year easements on another 55,000 acres.

Because these easements remain privately owned, DDA monitors them to ensure that landowners continue to comply with development restrictions. The inspections themselves are not complicated, but manually managing the related data and photos was becoming challenging and costly. So DDA enhanced its use of the ArcGIS platform—and implemented Collector for ArcGIS—to streamline inspections and automate reports.

Managing Data and Photos Manually

Prior to 2016, DDA inspectors employed a manual workflow to conduct and report on site visits. They used paper maps to decipher property boundaries; recorded inspection notes on laptops; and used digital cameras to take photos of the properties, being sure to write down each property ID number on a piece of paper and photograph that before every inspection to keep the photos organized.

After inspectors finished a set of hundreds of assessments, they would manually organize the photos by property ID, renaming each photo so it contained the ID and placing all the photos from each property into a folder. Inspectors then put the inspection results, photos, and captions into a report template, which contained a property map that had to be centered and edited to show the photo locations.

This process took hundreds of hours each year. Managing the data and photos manually, as well as creating individual reports for each property, was tedious. Inspectors weren't able to complete their reports until months after the inspections took place, generating a severe time lag.

The workflow was clearly in need of an upgrade, and the staff was asking for improvements.

Designing a Dual-Purpose Geodatabase

Looking for a low-cost upgrade, DDA's GIS coordinator, Jimmy Kroon, determined that he could use Collector for ArcGIS to enable mobile data collection and the Data Driven Pages in ArcGIS Desktop to automate the reports. The enterprise GIS team at Delaware's Department of Technology and Information (DTI) had experience using Collector, so it assisted with designing the database and offered to host it in ArcGIS Server.

To get started, Kroon and DTI's GIS team designed a geodatabase that would support data-driven map documents for individual inspection reports. Then, the team adapted the geodatabase to be the backbone of the operation in Collector. Because the geodatabase structures for Collector and the data-driven map documents were slightly different, the team used ModelBuilder to create a model that transcribes records between them.

To test everything, Kroon first published the solution in ArcGIS Online. This allowed him to make quick modifications to the database schema and map symbology to ensure that the inspection workflow in Collector performed as expected. Once testing was complete, DTI's GIS team published the solution in FirstMap, Delaware's enterprise GIS, and created a secure editing environment.

Inspecting Easements with Collector

It took less than an hour for Kroon to train the inspectors on how to use the new solution. Within a week, DDA inspectors began using Collector to conduct a set of 306 farm inspections.

They reported that the app was easy to use. Having easement boundaries on a mobile map with real-time location details helped them get oriented quickly in the field. They liked being able to capture all inspection data and photos using a single device. And Collector's offline capabilities made rural inspections much easier, since the inspectors didn't have to search for mobile service to upload their data.

Once the inspections were complete, Kroon checked the data for errors, converted it into the reporting schema, and aligned the report template map to the inspection database. ArcGIS Desktop exported every record as an individual PDF file, each named according to the property ID.

Every report contains the inspection data that is stored in the attribute table; photos, which are stored as geodatabase attachments; and photo locations that are stored as related point feature classes. Now, exporting reports takes an hour or two of processing time (depending on the number of reports being generated) rather than weeks of manual effort.

In the first year alone, DDA used Collector to inspect and generate reports for 730 easements throughout the state of Delaware.

Evaluating Return on Investment

One year after implementation, DDA looked back at the process and calculated its return on investment (ROI) for the solution.

Indeed, it took much less time to generate reports. The staff was thrilled about not having to complete these assessments manually. And DDA's funding partners were happy to be getting inspection reports more quickly. Even better, reports were now more thorough because they contained extra data pulled from the program's GIS database and county GIS servers.

During the ROI appraisal, DDA uncovered an unexpected benefit as well. Inspectors revealed that they were completing their site visits about twice as fast using Collector as they did with the old workflow. This was attributed to having data, real-time location, mapping, and photo capture all in one device.

"Just the *[federally funded]* properties would normally take about 20 days to finish at 7.5 hours daily, so 150 hours to complete," said Milton Melendez, a planner in the agriculture land preservation program. "Now, it takes just about 75 hours to finish in about 10 days."

Kroon also gathered information on how long it took, on average, to complete reports using both the old and new workflows, and DTI's enterprise GIS team helped estimate how long it took to create the solution. Additional costs, including purchasing new smartphones and a new cellular service plan with data, were also included in the detailed ROI report.

In the end, DDA reaped very clear benefits from the new workflow. Setting up the solution required a one-time investment of 41 hours, and now DDA saves nearly 500 hours annually—75 percent of the time it used to take—on completing inspections. Generalizing employee costs for everyone involved in the inspections—including their average salary, health care and fringe benefits, and overhead expenses—DDA saved $22,710 in the first year and is slated to save more than $25,000 in each ensuing year.

After reviewing the ROI report, Delaware's deputy secretary of agriculture, Austin Short, concluded, "With all the focus on budget reductions, exercises such as this one are great examples of how DDA is saving money."

For more information about this project, email Kroon, MGIS, at jimmy.kroon@state.de.us.

↑ The map screen in Collector for ArcGIS displays easement boundaries and the inspector's location.

← Photo courtesy of the Delaware Department of Agriculture.

The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak
President of the International Cartographic Association

Can Cartographers *Do* Maps?

Usually, I write about relatively abstract and theoretical topics, such as the challenges of mapping big data (http://p.ctx.ly/r/53dg) or how maps can be instrumental in achieving the Sustainable Development Goals (http://p.ctx.ly/r/53dh). All are no doubt important matters that deserve attention. But sometimes I hear this: "Professor, you can talk about maps, but can you *do* maps?"

Do maps? What does that mean? It turns out, my students want to know if I can use maps. My answer: "Of course."

But they are not talking about comparing two choropleth maps or interpreting a geological map or being able to explain a distinct spatial pattern. They don't want to know if I've mastered map drawing or using exploratory mapping software. No. In fact, they often reference an anecdote that says if you put four cartographers in a car, it will never arrive at its destination because they each think they know how to best read the map.

What my students are asking is if I can do with maps what they were intended for—if I can use them out in the wild. My answer remains the same: "Of course." I am very capable of using maps to navigate around a city or find my way through the countryside.

Every other year, I like to put my map-use skills to the test by participating in an orienteering race. During the biennial International Cartographic Conference (ICC), there is always such an event. This year, with the conference in Washington, DC, the orienteering race was conducted at Fountainhead Regional Park, about 25 miles southwest of the US capital. Here, myself and about 45 other cartographers navigated our way from the start of a preset course to its finish, using only a map and a compass to pick the best route from one control point to another. The winner is the person who makes it to all the control points in order and completes the course in the quickest time possible.

Successful orienteering requires running fast while analyzing the terrain en route and making speedy navigational decisions. It comprises both a physical and mental challenge.

Orienteering maps are like topographic maps but different. The coloring of the land—which, on an orienteering map, indicates the navigability of the terrain—can be especially tricky. On a topographic map, different colors might indicate different land-use categories, with green often designating forestland. On an orienteering map, however, a forest's color can vary from white (meaning easy running) to saturated green (meaning impassable). Also, easy running only refers to the land use, not the heights of the terrain. On both maps, however, blue does indicate water, if that is of any comfort.

Using what my GPS watch recorded, I plotted my race in blue on the map below. Our course was 3.1 kilometers, or just under 2 miles. This length was determined by the straight lines that connect to the big circles, which indicate the 10 control points we had to pass through. The table in the upper left corner of the map gives additional detail on how the control points are hidden—by erosion gullies (symbol 5) and hills (symbol 6), for example. Racers wore electronic devices on their fingers that they had to put into a companion device at every control point, where it marked racers as having been there and registered their times.

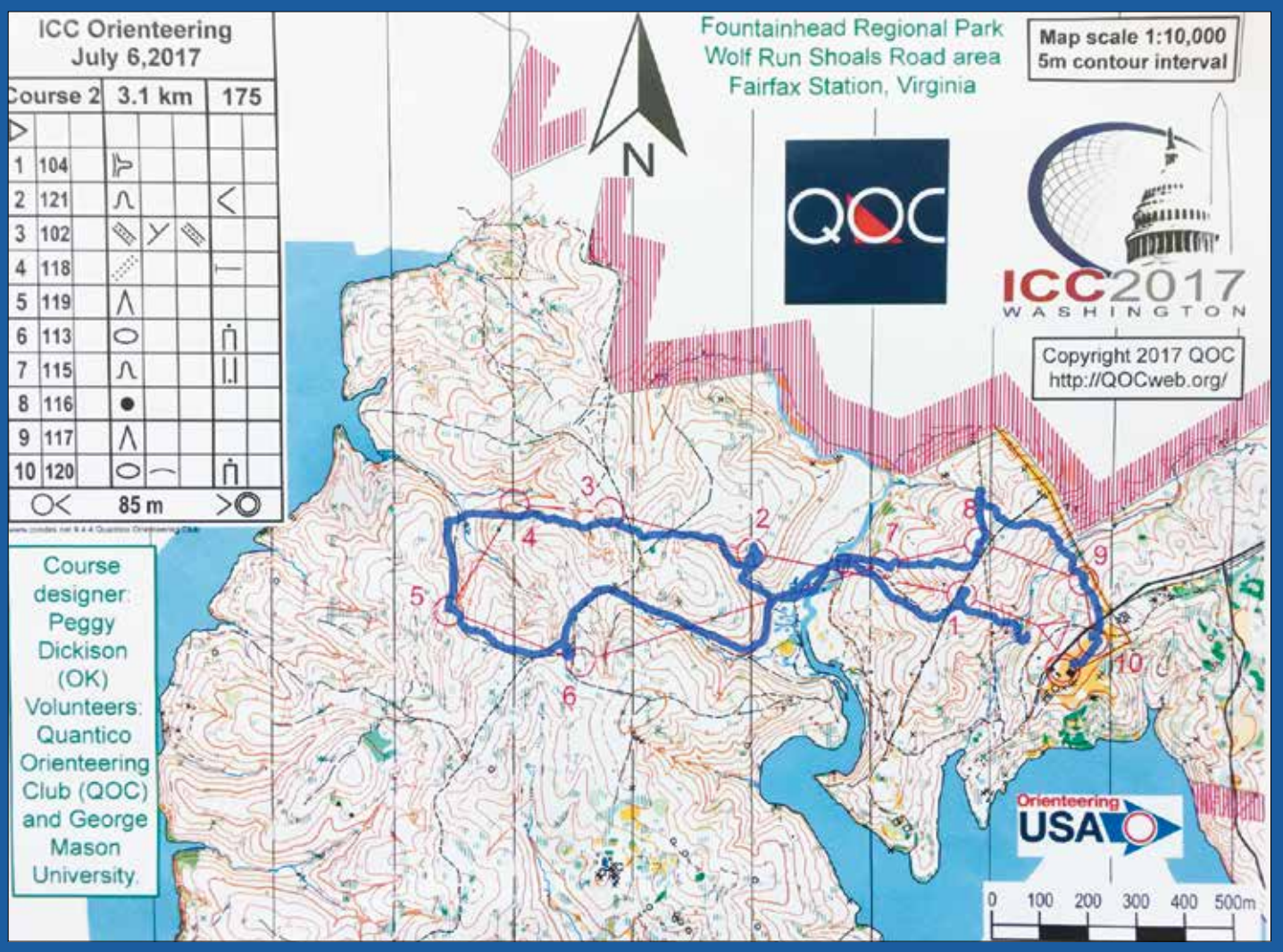
My path was just over 4 kilometers (2.5 miles), so a little longer than the 3.1 kilometers of the designated course. Did I get lost? That is a matter of scale.

Looking at the blue line that indicates my path, there are quite a few squiggly lines around most of the control points. This shows that I was searching for the orange and white flag that held the companion device. Note control point 2 in particular: I was near it for a while, but couldn't quite get there. That cost me time. At point 8, I took off in the wrong direction and realized it only once I crossed a stream that I knew wasn't part of the course. So I went farther than I needed to, which also cost me time. (I should have used the compass earlier.)

And how fast was this race? On the road, a 4-kilometer race would usually take me about 20 minutes. This one took me just over 50 minutes. That all has to do with the terrain, the weather conditions, and the map reading. There were torrential downpours during this orienteering race, making the slopes very muddy and slippery. Sometimes, it was better—and quicker—to follow an actual path and run some extra distance to avoid waterlogged areas, like I did between points 6 and 7. On the way to points 2 and 7, there was only one bridge to use to cross a stream, so again, it was easier to take a longer detour. And just before point 9, a stream that would have been easy to jump during dry weather turned into a small river that was up to my thighs, so I had to wade through it, costing me more time.

Despite arriving at the finish line dirty and completely soaked, this year's ICC orienteering race was great fun. As for the combined physical and mental challenge? My body did indeed suffer, but the race freed my mind.

So here's proof that not only can I talk about maps, but I can also do maps. And since designing and creating maps isn't the same thing as using them, I recommend that all cartographers do maps as well—perhaps by trying orienteering—to get a better idea of what users need.

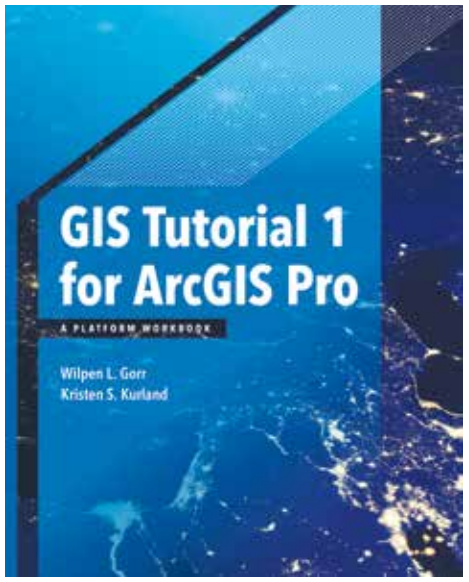


← Using what his GPS watch recorded during the race, Menno-Jan Kraak plotted his path in blue on the orienteering map.

About the Author

Menno-Jan Kraak is professor of geovisual analytics and cartography at the University of Twente in the Netherlands, where he has been teaching since 1996. He has a degree in cartography from the Faculty of Geographical Sciences at Utrecht University and received his PhD in cartography from Delft University of Technology. Kraak has written extensively on cartography and GIS. His book *Cartography: Visualization of Spatial Data*, written with Ferjan Ormeling, has been translated into five languages. He also wrote *Mapping Time: Illustrated by Minard's Map of Napoleon's Russian Campaign of 1812*, published by Esri Press in 2014. Kraak is a member of the editorial boards of several cartography journals, including the *International Journal of Cartography*. He currently serves as president of the International Cartographic Association.

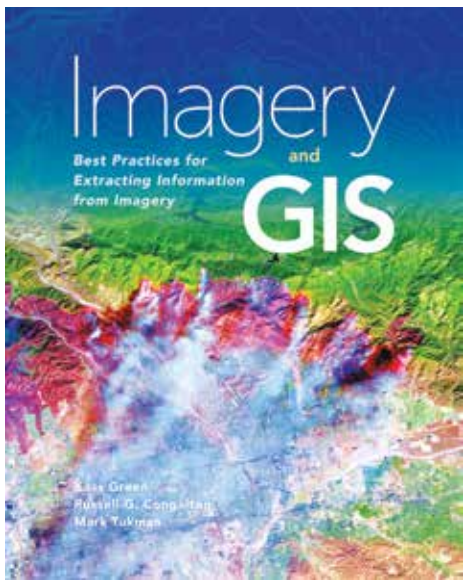
Esri Press



GIS Tutorial 1 for ArcGIS Pro: A Platform Workbook

By Wilpen L. Gorr and Kristen S. Kurland

Looking for an introductory text for learning ArcGIS Pro, the next generation professional desktop GIS? *GIS Tutorial 1 for ArcGIS Pro: A Platform Workbook* is just that resource. With in-depth exercises that incorporate ArcGIS Pro, ArcGIS Online, and other ArcGIS apps, readers learn the latest GIS technology to make maps, create and analyze spatial data, and manage systems. Wilpen L. Gorr and Kristen S. Kurland—authors of the top-selling books *GIS Tutorial 1: Basic Workbook*, *GIS Tutorial for Health*, and *GIS Tutorial for Crime Analysis*—blend proven teaching methods with detailed exercises, Your Turn sections, and expanded homework assignments, making this workbook best suited to learning GIS in a classroom. Resources for instructors are available upon request. Fall 2017. 480 pp. E-book ISBN: 9781589484931, and paperback ISBN: 9781589484665.



Imagery and GIS: Best Practices for Extracting Information from Imagery

By Kass Green, Russell G. Congalton, and Mark Tukman

In *Imagery and GIS: Best Practices for Extracting Information from Imagery*, readers learn how to successfully integrate imagery into maps and GIS projects. Demonstrating how to efficiently manage and serve imagery datasets, the book also shows how GIS can be used to derive value from imagery. The authors draw on a combined total of 85 years of experience in the field to share practical advice and lessons learned from applying these techniques in the real world. With more than 150 full-color illustrations, this reference guide helps practitioners obtain the most value from their imagery. Fall 2017. 448 pp. E-book ISBN: 9781589484894, and paperback ISBN: 9781589484542.

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

Esri T-shirt

Heroes Take On the World

Gisleine Ribas (left) and her colleague Kim Ollivier (right) show off their spatial superpowers at the 2017 Esri Regional User Group Conference in Whangarei, New Zealand.

Four-year-old Pepper channels her inner Map Girl to navigate the soccer field outside San Francisco, California. Perhaps her senior GIS analyst mom is inspiring another mapper in the family?

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.

For fresh approaches to analysis workflows, field data collection, and telling stories with maps, check out the following new courses:

- **ArcGIS Analysis Workflows for Public Safety**
  Learn how to turn public safety data into actionable intelligence. Using ArcGIS Pro, participants explore realistic scenarios and apply a standard analysis workflow to gain deeper insight into how location impacts public safety incidents, trends, and operations.
- **Field Data Collection and Management Using ArcGIS**
  To support efficient operations and real-time decision-making, this course explores workflows that aid in collecting accurate field data. Ideal for GIS and other professionals who manage or support field operations, participants discover best practices for configuring and deploying ArcGIS field apps, including Collector for ArcGIS, Workforce for ArcGIS, Operations Dashboard for ArcGIS, and Survey123 for ArcGIS.
- **Creating Story Maps with ArcGIS**
  For anyone who wants to inform, engage, or inspire an audience, this one-day course teaches attendees how to build Esri Story Maps apps. Taking advantage of this powerful medium, learners integrate web maps with text, photos, videos, and other media to create a rich, interactive experience and one truly powerful communication medium.

View all instructor-led courses at esri.com/training/instructor-led-curriculum.

E-Learning Spotlight: GeoPlanner for ArcGIS Series

The GeoPlanner for ArcGIS web app supports all steps of the planning process—from project creation and data management to design evaluation and real-time feedback integration. This series of four web courses introduces GeoPlanner for ArcGIS and takes participants through a geodesign-based approach to creating, evaluating, and sharing design plans with stakeholders.

Esri customers with a current maintenance subscription have unlimited, organization-wide access to more than 400 e-Learning resources. Explore the entire e-Learning collection at esri.com/training/catalog.

Certification

Obtaining a technical certification is a powerful way for students to differentiate themselves, whether they are continuing in their academic careers or entering the workforce. That is why the Esri Technical Certification Program is partnering with users in higher education so they can align their geospatial curriculum with the ArcGIS Desktop Entry certification. This way, educational institutions can provide a clearer path for students to become certified GIS practitioners. For educational programs that have geospatial curriculum based on the ArcGIS platform, more information can be found at go.esri.com/tech-certification.

Candidates who are ready to schedule an exam appointment may visit the Pearson VUE website (pearsonvue.com/esri) to select their preferred date and location. Pearson VUE operates more than 5,000 test centers worldwide.

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

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/preferences), 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.

Coursebooks Go Digital at Esri Training

Printed Books Shelved in Favor of Digital Versions with Color Maps and Other Features

Esri Training continues its digital transformation with a new initiative: students at Esri training centers will now receive only digital workbooks in their classes.

Digital books replace the printed coursebooks that Esri has supplied over the last 30 years to students who attend traditional instructor-led classes. They offer several benefits over print versions, including the following:

- **Color:** For years, one of the enhancements most frequently requested by students has been to replace black-and-white coursebooks with color books. When working with maps, users want to see them in color, of course! But producing thousands of printed color coursebooks every year is expensive. With digital books, Esri Training can finally provide the materials in color.
- **Productivity tools:** Printed books are wonderful to hold and flip through, but digital books have great features, too. For example, bookmarks allow users to jump directly to lesson pages, and learners can quickly search the content for specific words and phrases. Users can also highlight text and add digital notes. That makes it easy to find important information after the class is over, when participants are trying to remember how to complete an ArcGIS task or workflow back at the office.
- **Up-to-date materials:** In the past, Esri software releases occurred every couple of years. Today, releases happen quarterly. This cycle is great for providing new and improved functionality to Esri's customers, but it makes it very challenging to keep training materials up-to-date. With digital books, Esri will be able to update content much faster.
- **Reduced environmental footprint:** As a company committed to sustainability and smart planning, Esri feels a responsibility to conserve resources wherever possible. Digital books offer yet another way for Esri and its users to preserve the environment.
- **Cost savings:** Recognizing that many organizations have limited training budgets, Esri strives to offer affordable, competitively priced products. Adopting digital coursebooks will produce savings that will help keep the cost of instructor-led training as low as possible.

A Digital Evolution

Digital coursebooks are the latest in a long line of digital moves for Esri Training. In 1997, Esri launched Esri Virtual Campus, one of the first commercial websites devoted to teaching GIS topics and technology online. Web courses were a relatively new phenomenon in the late 1990s but quickly gained a following, especially in the higher education community.

Virtual Campus web courses were so popular that Esri decided to virtualize the in-person seminar experience by launching live training seminars in 2001. These are hour-long, free, online seminars on technical topics. Those also proved to be—and remain—popular.

The instructor-led online classroom was introduced in 2004. Shortly afterward, the Great Recession hit, and many GIS professionals found themselves grounded, unable to travel to attend a training class. For several years, the online classroom was the only viable option for many Esri customers to attend instructor-led training. Today, the online classroom is just as well attended as Esri's traditional classrooms.

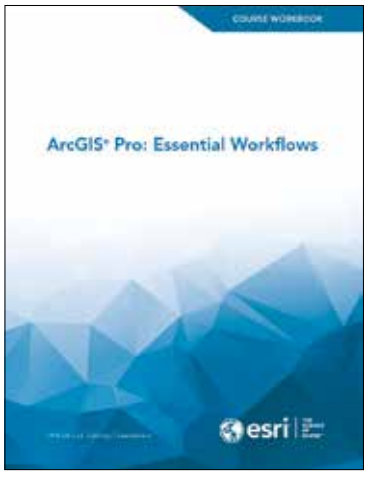
In 2016, Esri Training redesigned its website, doubling the size of the e-Learning collection to include new formats and durations.

So digital is already a huge part of what Esri does. Plus, online classroom students have always received digital coursebooks. Feedback from those attendees has helped Esri understand which digital features are most valuable, both during class and afterward, back at the office.

In Class and Beyond

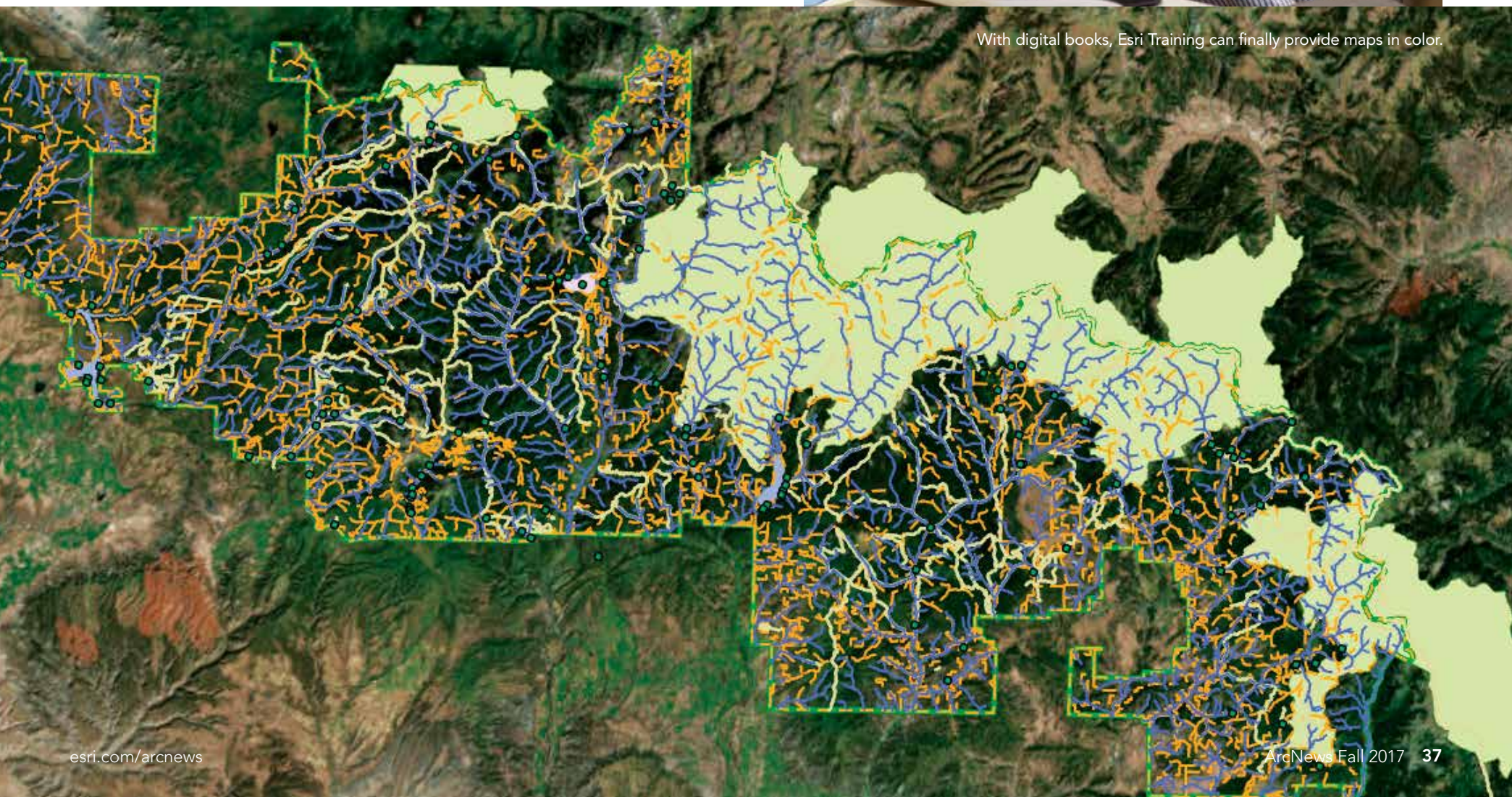
To ensure that students continue to have an excellent classroom experience, Esri is adding a second monitor to each classroom workspace as well. Students will be able to view the digital coursebook on one monitor while following the course presentation and interacting with Esri software on the other monitor.

At the beginning of class, students will download their digital coursebook from the Training website and annotate it as desired throughout the class. At the end of class, students will upload their annotated coursebooks to the Training website. Back at the office, the coursebook can be downloaded to a local drive and easily referenced at any time.



↑ Students taking instructor-led Esri Training courses will now receive only digital workbooks in their classes.

Classrooms will feature dual-monitor workstations for each student.



With digital books, Esri Training can finally provide maps in color.

Esri Corporate Headquarters

esri.com

Esri Technical Support
esri.com/support

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

Esri Products
esri.com/products

Esri Store
esri.com/store

Esri Developer Network
developers.arcgis.com

Customer Care Portal
my.esri.com

Esri US Regional Offices

Boston—Middleton, MA
Tel.: 978-777-4543

Charlotte—Charlotte, NC
Tel.: 704-541-9810

Denver—Broomfield, CO
Tel.: 303-449-7779

Minneapolis—St. Paul, MN
Tel.: 651-454-0600

Olympia—Olympia, WA
Tel.: 360-754-4727

Philadelphia—Chesterbrook, PA
Tel.: 610-644-3374

Redlands—Redlands, CA
Tel.: 909-793-2853, ext. 1-1906

San Antonio—San Antonio, TX
Tel.: 210-499-1044

St. Louis—St. Charles, MO
Tel.: 636-949-6620

Federal Office

Washington, DC—Vienna, VA
Tel.: 703-506-9515

For additional information about Esri US regional offices, visit esri.com/about-esri/usa.

Esri Distributors Worldwide

Esri Australia Pty. Ltd.—Australia
www.esriaustralia.com.au

Esri BeLux N.V.—Belgium
www.esribelux.com

Esri Bulgaria Ltd.—Bulgaria
www.esribulgaria.com

Esri Canada Limited—Canada
www.esri.ca

Esri Chile S.A.—Chile
www.esri.cl

Esri China (Beijing) Holding Co. Ltd.—China
www.esrichina.com.cn

Esri Colombia SAS—Colombia
www.esri.co

Esri Northeast Africa—Egypt
www.esrinea.com

Esri Finland Oy—Finland
www.esri.fi

Esri France S.A.—France
www.esrifrance.fr

Esri Deutschland GmbH—Germany
www.esri.de

Esri China (Hong Kong) Limited—Hong Kong
www.esrichina.hk

NIIT GIS Limited (Esri India)—India
www.esriindia.com

Esri Italia Sp.A.—Italy
www.esriitalia.it

Esri Japan Corporation—Japan
www.esrij.com

Esri Eastern Africa Limited—Kenya
www.esriea.co.ke

Esri Lebanon sal—Lebanon
www.esrilebanon.com

Esri Southern Africa—Mauritius
www.esri-southernafrica.com

Esri Nederland B.V.—The Netherlands
www.esri.nl

Esri Muscat Co LLC—Oman
www.esrimuscat.com

Esri Panama, S.A.—Panama
www.esri.pa

Esri Polska sp. z o.o.—Poland
www.esri.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.—Portugal
www.esri-portugal.pt

Esri Romania S.R.L.—Romania
www.esri.ro

Limited Liability Company ESRI CIS—Russia
www.esri-cis.ru

Esri Saudi Arabia Ltd.—Saudi Arabia
www.esrisaudiarabia.com

Esri South Africa (Pty) Ltd.—South Africa
www.esri-southafrica.com

Esri Korea, Inc.—South Korea
www.esrikr.com

Esri South Asia Pte. Ltd.—Singapore
www.esrisa.com

Esri España Soluciones Geospaciales SL—Spain
www.esri.es

Esri Sverige AB—Sweden
www.esri.se

Esri (Thailand) Co. Ltd.—Thailand
www.esrith.com

Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.—Turkey
www.esriturkey.com.tr

Esri (UK) Ltd.—United Kingdom
www.esriuk.com

Esri Ukraine Ltd.—Ukraine
www.esri.ua

Grupo Esri de Venezuela, C.A.—Venezuela
www.esriven.com

Esri has more than 80 distributors in other countries around the world. For more information, contact Esri (tel.: 909-793-2853, ext. 1-1235; fax: 909-307-3070) or visit **esri.com/distributors**.

Career Opportunities

Esri is hiring smart people with all levels of experience for positions at our headquarters, regional offices, and R&D Centers. Your work will affect the way people live and how organizations solve problems. We offer exceptional benefits, competitive salaries, profit sharing, and a collaborative and stimulating environment. Join us and be part of Esri's mission to make a difference in our world.

Software Development and ArcGIS Product Engineering

3D Software Engineer—ArcGIS Pro Mapping: Work on sophisticated 3D functionality that enhances Esri's existing products, contributes to new technologies, and delivers valuable results to Esri users.

Software Developer—Imagery: Build industry-leading software that allows ArcGIS server and desktop apps to work with rich geospatial imagery and data.

Search and Geocoding Product Engineer: Help design the next generation of geocoding for the ArcGIS platform and ensure that it meets the Esri community's geocoding and geosearch needs.

StreetMap Premium Product Engineer: Contribute to advancing the street data that powers high-quality cartographic maps, accurate geocoding, and optimized routing.

Apps Product Engineer: Look beyond the traditional uses of GIS and create compelling native geospatial apps that work across a variety of platforms.

Cartographer: Help build the Living Atlas of the World. Create stunning new designs and publish cutting-edge online maps and layers that support a broad array of uses.

Product Management

Product Manager—Utility Network: Introduce and evangelize Utility Network—a new feature in ArcGIS Pro for managing utility and telecommunications network data—to Esri users, partners, and internal staff.

Professional Services and Consulting

Technical Consultant—Law Enforcement: Employ your GIS skills and expertise in public safety to help law enforcement agencies around the world implement Esri's enterprise platform.

Educational Services and Technical Support

Instructors—GIS: Teach Esri software courses in traditional or online instructor-led classrooms to help users stay on the front line of GIS technology.

Course Developer: Leverage your GIS experience and work with the latest Esri software and subject matter experts to design, develop, and maintain instructor-led and web-based training materials.

Geodatabase Analyst: Provide high-quality technical support to users and employ Esri tools and other related technologies to resolve technical issues with enterprise GIS servers.

Business Development

Team Lead—Local Government: Lead an account team in promoting the use of ArcGIS in the local government sphere. Strategically participate in all stages of the sales life cycle while providing effective coaching and support to team members.

Account Manager—Electric and Gas: Help organizations in the electric and gas industries leverage geospatial information and technology by articulating the strengths and value propositions of the ArcGIS platform.

Account Manager—Veterans Affairs: Use your wide-ranging knowledge about veterans' affairs to envision, develop, and implement location strategies for related organizations.

Presales and Solution Engineering

Solution Engineers—Multiple Domains: Help customers in one of several different fields adopt the ArcGIS platform by proactively crafting and proposing solutions that clarify how GIS addresses and solves critical business challenges.

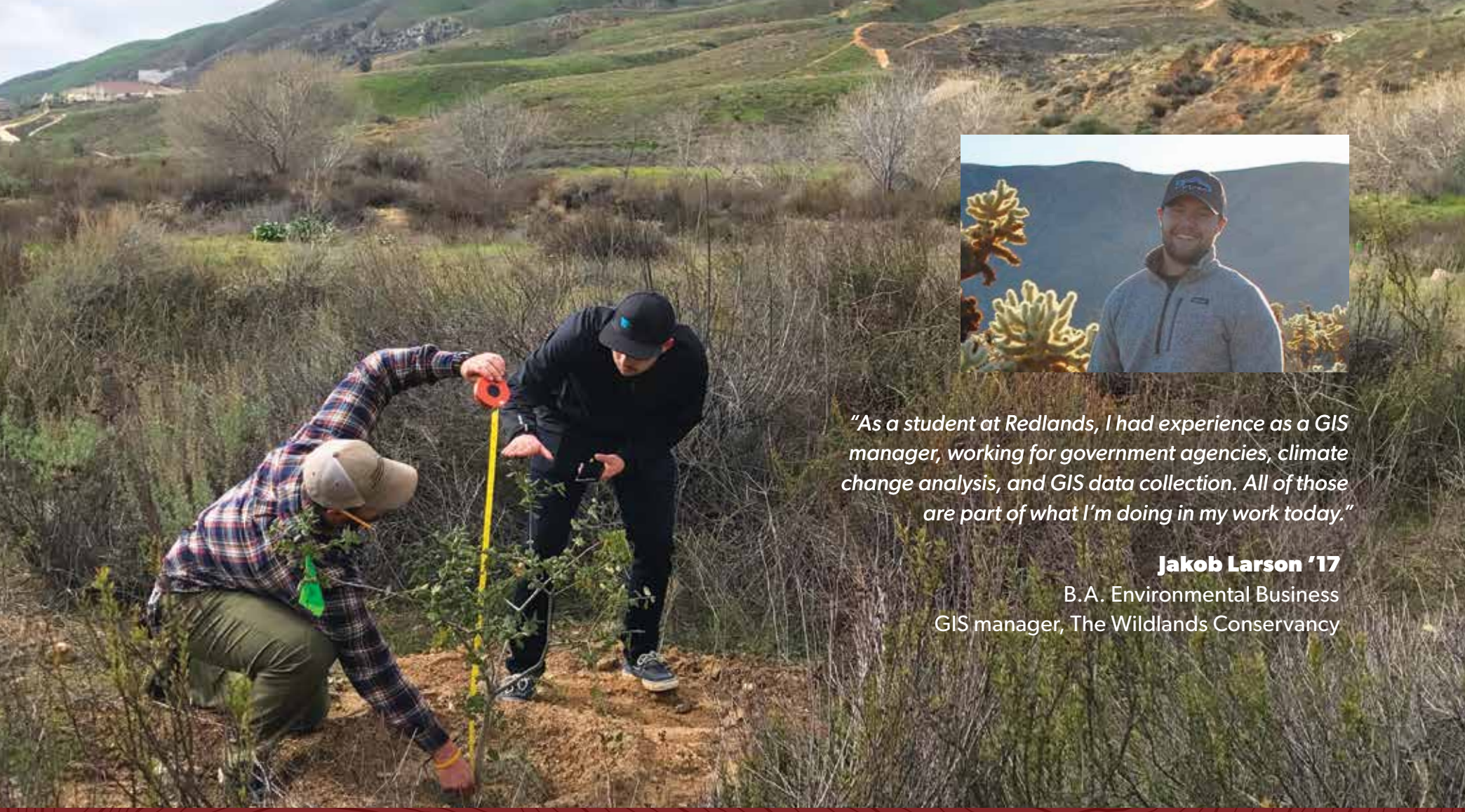
Marketing

Global Marketing Manager: Be Esri's global brand advocate and drive international growth by extending marketing programs through the Esri Global Distributor network.

Industry Managers—Multiple Domains: Develop and oversee the implementation of global go-to-market strategies to drive growth in new and existing markets.

Esri is an equal opportunity employer (EOE). All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

esri.com/careers Follow @EsriCareers on Twitter



"As a student at Redlands, I had experience as a GIS manager, working for government agencies, climate change analysis, and GIS data collection. All of those are part of what I'm doing in my work today."

Jakob Larson '17
B.A. Environmental Business
GIS manager, The Wildlands Conservancy

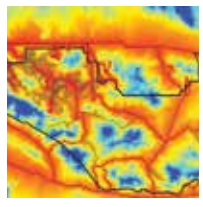
University of Redlands

A Leader in Spatial Studies

Located at the epicenter of geographic information systems (GIS)—Redlands, California, home to the world's leading GIS company, Esri.

We offer:

- Specialized programs that align with geospatial workforce needs—two residential master's in GIS programs, a spatial studies undergraduate minor, and an MBA with a GIS emphasis
- Access to Esri technology, training, people, and events
- Spatial-thinking opportunities infused throughout the University's coursework—in business, natural sciences, environmental sciences, social sciences, humanities, design, and other disciplines—with cutting-edge spatial tools to build skills employers need
- Community service learning projects in which students use GIS and other geospatial technologies to enhance the lives of others



UNIVERSITY OF Redlands

Learn more:

urspatial.redlands.edu
urspatial@redlands.edu

Add a Subscription, Change Your Address, or Unsubscribe

Subscribe, unsubscribe, or update information at **esri.com/updates**.
Outside the United States, contact your local distributor.
To request other publication services, see page 2.

158514

esri
380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri